

16-563-101
April 1989

Black Knight 2000

**Pinball Game Operation
Manual**

**including Game Tables,
Parts Information,
and Reference Diagrams**

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Section 1

Game Operation

&

Test Information

- **Black Knight 2000 (System 11B) ROM Summary**
- **Pinball Game Assembly Instructions**
- **Game Play**
- **Game Status Displays**
- **Game Adjustment Procedure**
- **Game Pricing**
- **Test/Diagnostic Procedures**

Black Knight 2000 (System 11B) ROM Summary

| IC | DESCRIPTION | TYPE | IDENTIFIER | BOARD | PART NUMBER |
|--------------------|-------------|-------|------------|-------|--------------|
| Game ROM 1 | 32K x 8 ROM | 27256 | U27 | CPU | A-5343-563-2 |
| Game ROM 2 | 32K x 8 ROM | 27256 | U26 | CPU | A-5343-563-1 |
| Sound ROM 1 | 32K x 8 ROM | 27256 | U21 | CPU | A-5343-563-4 |
| Sound ROM 2 | 32K x 8 ROM | 27256 | U22 | CPU | A-5343-563-3 |
| Music/Speech ROM 1 | 32K x 8 ROM | 27256 | U4 | Audio | A-5343-563-5 |
| Music/Speech ROM 2 | 32K x 8 ROM | 27256 | U19 | Audio | A-5343-563-6 |

NOTICE

To order a replacement ROM from your authorized WILLIAMS ELECTRONICS GAMES distributor, specify: (1) part number (if available); (2) ROM label color; (3) ROM level (number) on the label; (4) which game the ROM is used in.

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CONNECTOR & COMPONENT IDENTIFICATION

WILLIAMS ELECTRONICS GAMES uses a special technique to identify connectors and . Each plug or jack receives a prefix number (which identifies the circuit board), a letter, and a number. J-designations refer to the male part of a connector. P-designations refer to the female part of a connector. For example, 1J1 designates jack 1 of board 1 (a CPU Board jack); 3P6 designates plug 6 of board 3 (a Power Supply Board plug). Identifying the specific pin number of a connector involves a hyphen, which separates the pin number from the plug or jack designation. For example, 1J1-3 refers to pin 3 of jack 1 on board 1.

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

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

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

Black Knight 2000 CIRCUIT BOARDS

System 11B Circuit Boards for **Black Knight 2000** are in the backbox. They are accessible by unlocking the Backbox lock, removing the Backbox glass, unlatching the Insert Board (with lamps), and swinging it open.

The Master Display Board is mounted on the back of the Speaker/Display Panel, just below the Insert Board. To access the Master Display Board, carefully lift the Speaker/Display Panel out of its bottom guide and lay it forward onto the top of the game cabinet.

Lamp circuit boards are mounted on the Playfield and the Insert Board.

CPU BOARD. The System 11B CPU Board (p/n D-11883-563) must be equipped with the ROMs specified in the **Black Knight 2000** (System 11B) ROM Summary. CPU Board jumpers W1, W2, W4, W5, W7, W8, W11, W14, W16, W17, and W19 must be connected.

AUDIO BOARD. The Audio Board is p/n D-11581-563, including ROMs and microprocessor.

DISPLAY BOARD. The Alphanumeric Display Unit Board is p/n D-12232-1.

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

AUX POWER DRIVER BOARD. The Aux Power Driver Board is D-12247-563.

MASTER INTERCONNECT BOARD. The Master Interconnect Board is D-12313-563.

Figure 1 shows the locations of these circuit boards, as well as other devices especially located to make **Black Knight 2000** a great game.

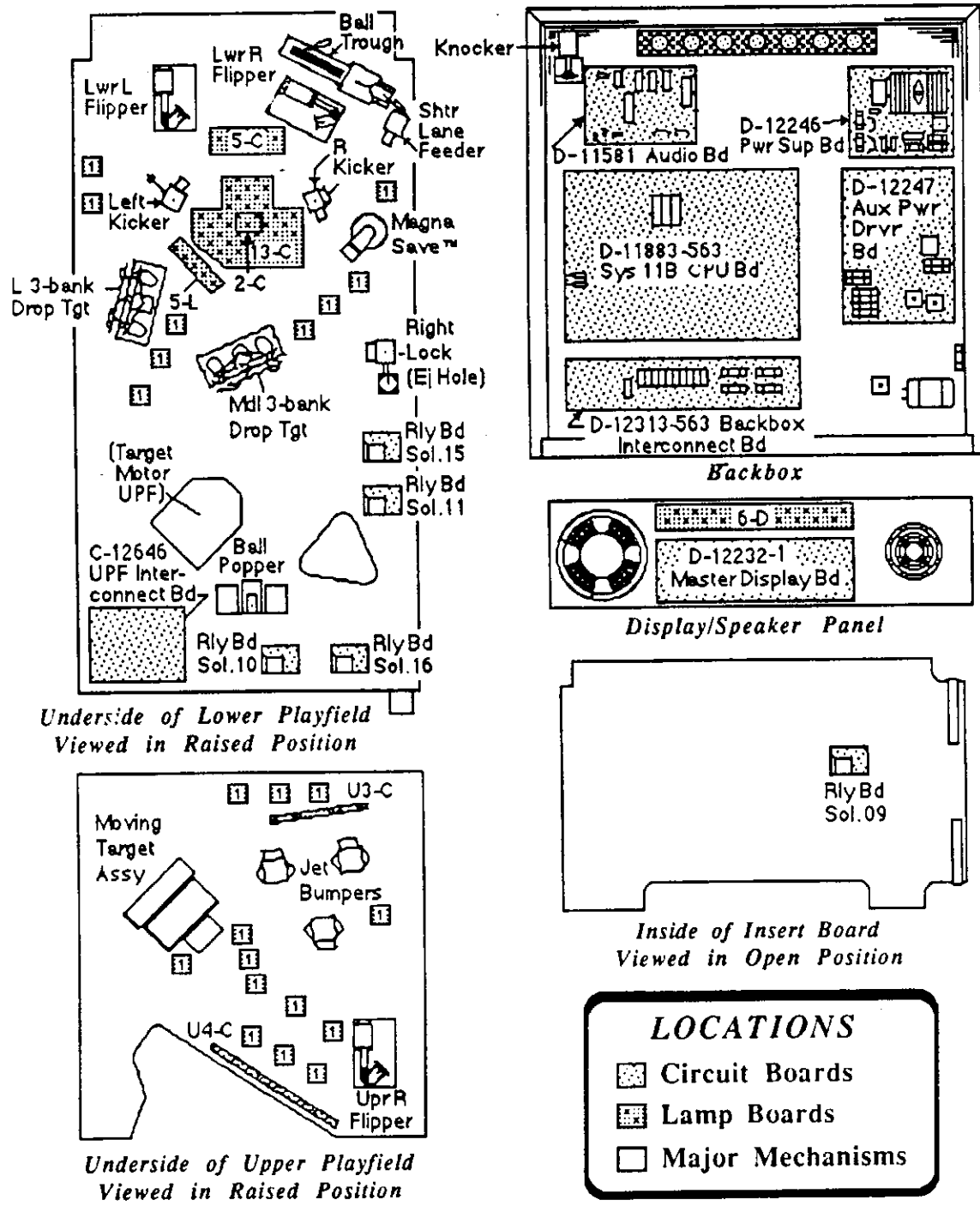


Figure 1. Locations Diagram - Game Circuit Boards and Major Mechanisms

Black Knight 2000 GAME CONTROL LOCATIONS

Figure 2 shows the locations of the following switches, except for the last two (CPU and Sound Diagnostic switches, which are shown in the Backbox portion of Figure 1 on the CPU Board).

The On-Off switch is on the bottom of the cabinet near the right front leg.

The Volume Control is on the left inner wall of the cabinet on the tilt mechanisms board. It is accessible by opening the coin box door.

The Credit switch is a pushbutton to the left of the coin door on the cabinet exterior.

GAME ADJUSTMENT/DIAGNOSTIC SWITCHES. **Black Knight 2000** allows the operator to control all game adjustments, obtain bookkeeping information, and diagnose problems, using only three switches mounted on the inside of the coin door, along with the Credit button beside the coin door.

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

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

Figure 1 shows the locations of the two CPU Board switches (left edge of CPU Board, Backbox View).

The CPU Diagnostic switch (SW 2) is the lower switch (of the two switches mounted on the left edge of the CPU Board) near a large, socketed microprocessor chip. This switch initiates the Memory Chip Test explained in the Test/Diagnostic Procedures.

The Sound Diagnostic switch (SW 1) is the upper switch of the two mounted on the left edge of the CPU Board. This switch initiates the Sound Section Test. Refer to the Test/Diagnostic Procedures.

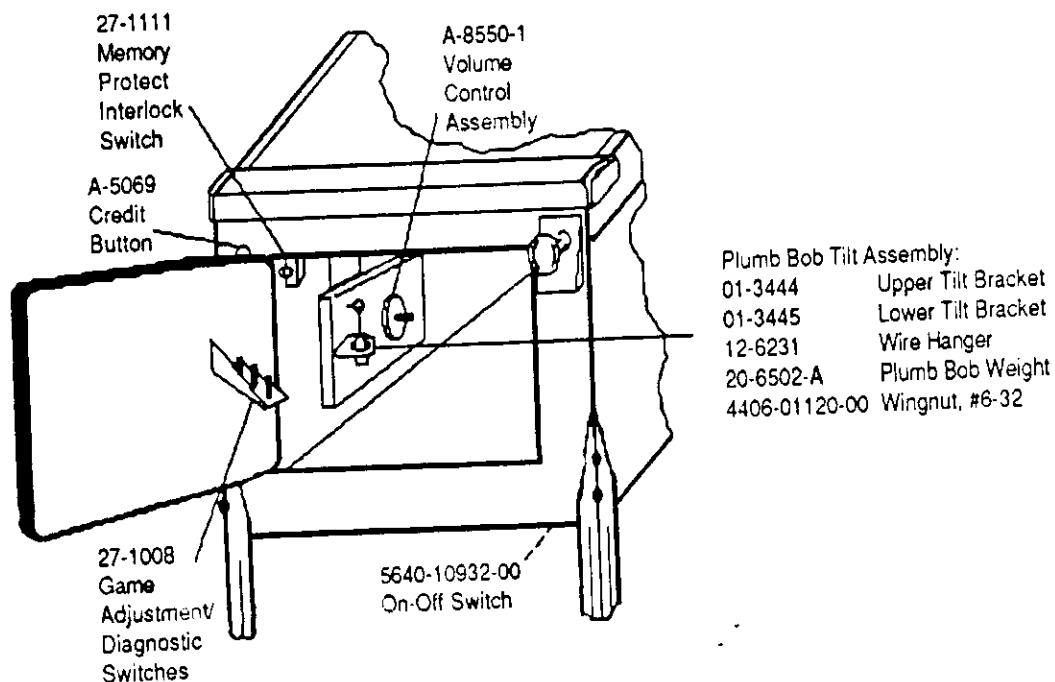


Figure 2. Pinball Game Controls Locations

PINBALL GAME ASSEMBLY INSTRUCTIONS

1. Open the shipping container; remove all cartons, parts, and other items, and set them aside.
2. Place cabinet on a support and attach rear legs (after installing leg levellers), using leg bolts. Leg levellers and leg bolts are both provided among the parts in the cash box.
3. Attach the front legs (after installing leg levellers), using leg bolts. See Figure 3 for details.

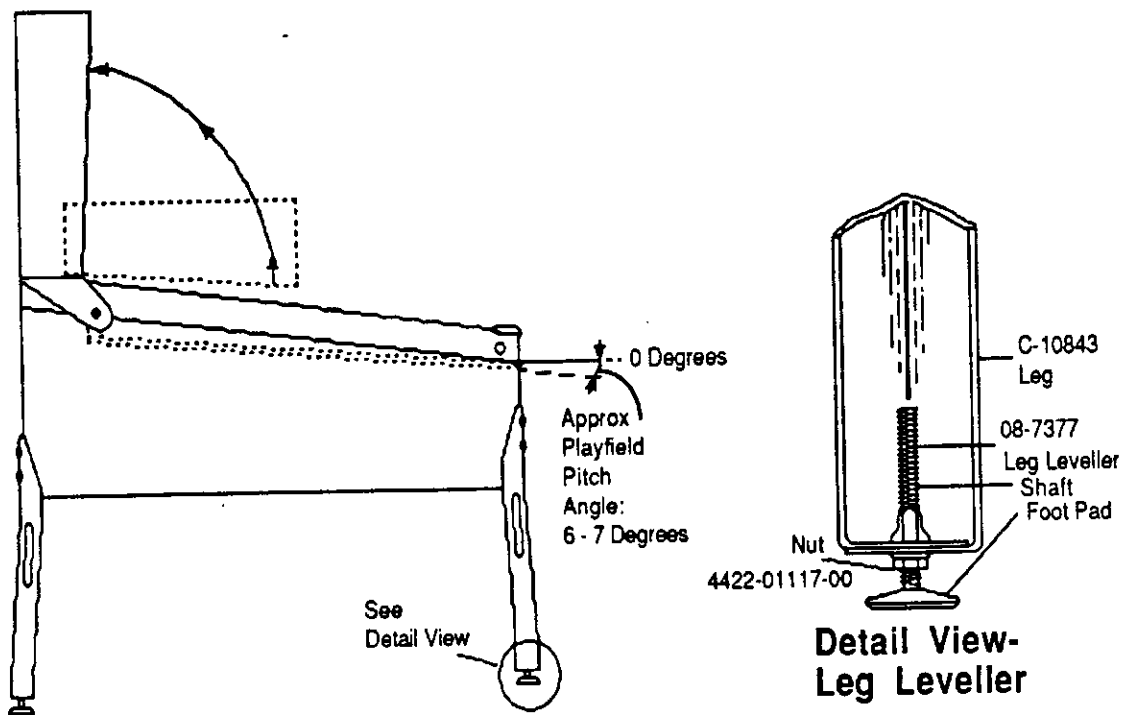


Figure 3. Pinball Assembly, Playfield Pitch Angle, and Leg Leveler Details.

CAUTION

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

4. Raise the hinged backbox upright and stabilize it into position. Unlock the backbox, and remove the backbox glass, storing it carefully to avoid scratches. Remove the shipping block holding the Insert Board. Unlatch the Insert Board and open it, then remove shipping screw securing the Speaker/Display Panel. Lift the Speaker/Display Panel up and lay it forward on the playfield cabinet. This allows access to the bolt holes used for securing the backbox upright. Install the mounting bolts, split lockwashers, and flat washers through the bottom holes of the backbox into the threaded fasteners in the cabinet to secure the backbox. Install the Speaker/Display Panel, close and latch the Insert Board, and install the backbox glass, and lock the backbox.

WARNING

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

5. Extend each leg leveler *slightly* below the leg bottom, so that all four foot pads are extended about the same distance. Remove the cabinet from its support and place it on the floor.
6. Adjust the leg levellers for proper playfield level (side-to-side) *and* playfield pitch angle (incline) of approximately 6 degrees. (Again, it is recommended that these measurements be made **ON** the playfield, not the cabinet nor the playfield cover glass.) Tighten the nut on each leg leveler shaft to maintain this setting, as shown in Figure 3.

PINBALL GAME ASSEMBLY INSTRUCTIONS (Continued)

CAUTION

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

7. Move the game into the desired location; recheck the level and pitch angle of the playfield.
8. Verify that the *required number* of balls are installed in the game. (**Black Knight 2000:** 3 balls.)
9. Clean and re-install the playfield cover glass. Prepare the game for player operation.

GAME OPERATION

WARNING

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

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GAME OPERATION (Continued)

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

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

NOTE

The SYSTEM 11B game program has a great capability to aid the operator and service personnel: At game Turn-On (and also at the beginning of the Test/Diagnostic Procedures), the player score displays now signal with a message. "Press ADVANCE for Report", that the game program has detected a possible problem with the game. Usually, this report indicates that at least one switch has NOT been actuated during ball play for 90 balls (= 30 games). However, the game program compensates the game play requirements affected by each disabled switch to allow 'nearly normal' play. This helps keep **Black Knight 2000** earning good profits! More information is available in the Test/ Diagnostic Procedures text describing the Switch Testing.

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

- A. Recent highest scores*;
- B. A "custom message"
("WILLIAMS PINBALL ... PRESENTS ... BLACK KNIGHT 2000")*;
- C. The score to achieve to obtain a Replay award*;

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

CREDIT POSTING. Insert coin(s). A sound is heard for each coin, and the player score displays show the number of credits purchased. So long as the number of maximum allowable credits* are NOT exceeded by coin purchase or high score, credits are posted correctly. However, after this maximum credits value is reached, posting of additional credits won (not purchased) by the player does *not* occur. ONLY posting of *purchased* credits occurs beyond the maximum credits value.

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

TILT. Actuating the Slam Tilt switch on the coin door inside the cabinet ends the current game; **Black Knight 2000** then proceeds to the Game Over Mode. With the actuation of the playfield tilt switch, or the third closure* of the plumb bob tilt switch, the player loses the remaining play of that ball, but can complete the game.

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

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

* - operator-adjustable feature

Black Knight 2000 GAME STATUS DISPLAYS

Black Knight 2000 provides the game owner/operator with a display of information concerning the game's bookkeeping and game play feature adjustments. Basically, three classes of information now become available in this status display mode: Id (Identification); Au (Audit); Ad (Adjustment). Each of the underscored two-letter abbreviations for these classes appears in the Player 3 score display, while the system microprocessor for the Black Knight 2000 game is displaying the items within each class.

Identification Information--Id

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

| Player 1 | Player 2 | Player 3 | Player 4 |
|--------------|-------------|-------------|-------------|
| BLACK KNIGHT | Id 00 | 568 | L-x* |

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

The game is named in the Player 1 score display. The game's identification number shows in the Player 2 score display and the ROM revision level appears in the Player 4 display. The Player 3 score display shows the status display mode in abbreviated form, *Id*. The Player 3 score display also shows the status display mode item (00) for this particular display.

Pressing ADVANCE once more causes the *Id 01* display to appear. This display describes which of the "Install" options is currently in effect. For example, if the YES option of the INSTALL FACTORY Adjustment Item (Ad 70) was last selected, *FACTORY SETTING* appears on the player score displays. Changing the setting of any other game adjustment item, after selecting the YES option for Ad 70 causes the display to change to *FACTORY ALTERED*. Similarly, if the operator selects the YES option for INSTALL HARD (Ad 65), the display indicates *HARD SETTING*. Changing a game adjustment item later then causes the display to show *HARD ALTERED*.

Audit Information--Au

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

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

The Black Knight 2000 Audit Table lists the 51 items of the Audit Information portion of the Black Knight 2000 Game Status Displays. Presentation of this Audit Information again utilizes the player score displays; however, the Player 1 and 2 displays are combined as a descriptive phrase. The light type below the table's column headings names the respective backbox displays where the information appears. Because the Player 4 display contains information which depends on game play, only a few example entries are shown in the table. The Credits display shows *Au* for all 49 audit items, so its entry is omitted from the tabular listing. Detection of erroneous data affecting any of the counters used in these audit items causes the message, *ERROR*, to be displayed in the Player 3 display, during display of any audit item associated with that particular counter. (The program does not analyze the cause of the error; it merely alerts the operator of the error's existence by the message.)

Black Knight GAME STATUS DISPLAYS (Continued)

Black Knight 2000 Audit Table

| Audit Item (Player 3) | Descriptive Phrases (Player 1 and 2 Displays) | Audit Factor 1 Value (Player 4) |
|--------------------------|---|---------------------------------------|
| AU 01 | LEFT COINS [chute next to coin door hinge] | 432 |
| 02 | CENTER COINS | 0 |
| 03 | RIGHT COINS | 398 |
| 04 | PAID CREDITS | 830 |
| 05 | TOTAL PLAYS | |
| 06 | TOTAL FREE (Total Free Plays) | |
| 07 | PERCENT FREE (% Free Plays) | |
| 08 | REPLAY AWARDS | |
| 09 | PERCENT REPLAY (% Replay Awards) | |
| 10 | SPECIAL AWARDS | |
| 11 | PERCENT SPECIAL (% Special Awards) | |
| 12 | MATCH AWARDS | |
| 13 | HSTD (High Score to Date) CREDITS | |
| 14 | PERCENT HSTD (% HSTD Credits) | |
| 15 | EXTRA BALLS | |
| 16 | PERCENT EX. BALL (% Extra Balls) | |
| 17 | AV. BALL TIME (Average Time in Seconds) | |
| 18 | MINUTES OF PLAY (Minutes of Play) | |
| 19 | BALLS PLAYED | |
| 20 | REPLAY1 AWARDS | |
| 21 | REPLAY2 AWARDS | |
| 22 | REPLAY3 AWARDS | |
| 23 | REPLAY4 AWARDS | |
| 24 | 1 PLAYER GAMES | |
| 25 | 2 PLAYER GAMES | |
| 26 | 3 PLAYER GAMES | |
| 27 | 4 PLAYR. GAMES | |
| 28 | BURN IN CYCLES | |
| 29 | SPELL WAR (# of UPF Lane completions) | |
| 30 | SPELL KNIGHT (# of completions of both 3-bank Dr Targets) | |
| 31 | UPPER RAMP SHOTS (# of Upper Lock shots) | |
| 32 | EX. BALL LIT (# of Extra Ball Opportunities) | |
| 33 | RAMP EX. BALL (# of Ex. Ball awards via Skyway Ramp) | |
| 34 | 2-BALL MULTI-BALLS (# of times for 2-Ball Multi-Ball™ play) | |
| 35 | MILLION VIA WAR (# of Million awards via WAR spelling) | |
| 36 | 3-BALL MULTI-BALL (# of times for 3-Ball Multi-Ball™ play) | |
| 37 | JACKPOTS AWARDED (# of Jackpot awards) | |
| 38 | RANSOMS AWARDED (# of Ransoms awarded) | |
| 39 | H.S.RESET COUNTER | |
| 40 | 0.0-0.4 MIL. SCORE (# of games <500K) | |
| 41 | 0.5-0.9 MIL. SCORE (# of games ≥500K, <1M) | |
| 42 | 1.0-1.9 MIL. SCORE (# of games ≥1M, <2.0M) | |
| 43 | 2.0-2.9 MIL. SCORE (# of games ≥2.0M, <3.0M) | |
| 44 | 3.0-3.9 MIL. SCORE (# of games ≥3.0M, <4.0M) | |
| 45 | 4.0-5.9 MIL. SCORE (# of games ≥4.0M, <6.0M) | |
| 46 | 6.0-7.9 MIL. SCORE (# of games ≥6.0M, <8.0M) | |
| 47 | 8.0-99.9 MIL. SCORE (# of games ≥8.0M, <100.0M) | |
| 48 | FIRST REPLAY IS x,xxx,xxx | |
| 49 | AVG. GAME x.xx MIN (Avg Game in Minutes) | |
| 50 | WHEEL SPINS (# of Bolt Circle lamps via lit SPIN lamp shot) | |
| 51 | LEFT DRAINS (# of drains via Left Outlane) | |
| 52 | KICKBACKS (# of Kickbacks) | |
| 53 | RIGHT DRAINS (# of drains via Left Outlane) | |
| 54 | | |
| 55 | | |

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

Black Knight 2000 GAME STATUS DISPLAYS (Continued)

Black Knight 2000 Game Adjustment Table

| Adjustment Item (Player 3) | Descriptive Phrases (Player 1 and 2 Displays) | Factory Setting (Player 4) |
|-------------------------------|---|-------------------------------|
| Ad 01 | AUTO REPLAY ¹ or FIXED REPLAY ¹ | 10 (%) |
| 02 | REPLAY START (or REPLAY LEVEL 1) ¹ | SCORES |
| 03 | REPLAY LEVELS (or REPLAY LEVEL 2) ¹ | 2,500,000 |
| 04 | (REPLAY LEVEL 3) ¹ | 01 (or OFF) |
| 05 | (REPLAY LEVEL 4) ¹ | (see text) |
| 06 | REPLAY AWARD | (see text) |
| 07 | SPECIAL AWARD | Credit |
| 08 | MATCH FEATURE | Credit |
| 09 | BALLS / GAME | 10 (%) |
| 10 | TILT WARNING | 03 |
| 11 | MAXIMUM EX. BALL | 03 |
| 12 | MAXIMUM CREDITS | 04 |
| 13 | HIGHEST SCORES | 10 |
| 14 | BACKUP HI. SCR.1 | On |
| 15 | BACKUP HI. SCR. 2 | 5,000,000 |
| 16 | BACKUP HI. SCR. 3 | 4,500,000 |
| 17 | BACKUP HI. SCR. 4 | 4,000,000 |
| 18 | HI. SCR.1 CREDITS | 3,500,000 |
| 19 | HI. SCR.2 CREDITS | 01 |
| 20 | HI. SCR.3 CREDITS | 01 |
| 21 | HI. SCR.4 CREDITS | 01 |
| 22 | H. S. RESET EVERY | 3,000 |
| 23 | FREE PLAY | NO |
| 24 | U.S.A. 1 COINAGE (1 COIN 1 PLAY) ^{2,3,6} | |
| 25 | LEFT UNITS | 01 |
| 26 | CENTER UNITS | 04 |
| 27 | RIGHT UNITS | 01 |
| 28 | UNITS/ CREDIT | 01 |
| 29 | UNITS/ BONUS | 00 |
| 30 | MINIMUM UNITS | 00 |
| 31 - 48 | Game-specific Adjustments (detailed in text and the Game Adjustment Setting Comparison Table) | |
| 49 ⁴ | CUSTOM MESSAGE | ON |
| 50 | SW. ALARM KNOCKER | YES |
| 51 - 52 | Coinage Adjustments | |
| 53 - 58 ^{5,6} | Special Pricing Adjustments- See text for Ad 53 - 58 details. | |
| 59 ⁵ | INSTALL ADDABALL | NO |
| 60 ⁵ | INSTALL 5-BALL | NO |
| 61 ⁵ | INSTALL NOVELTY | NO |
| 62 ⁵ | INSTALL EX. EASY | NO |
| 63 ⁵ | INSTALL EASY | NO |
| 64 ⁵ | INSTALL MEDIUM | NO |
| 65 ⁵ | INSTALL HARD | NO |
| 66 ⁵ | INSTALL EX. HARD | NO |
| 67 | AUTO BURN-IN | NO |
| 68 | CLEAR COINS | NO |
| 69 ⁷ | CLEAR AUDITS | NO |
| 70 ⁷ | INSTALL FACTORY | NO |

NOTES:

1. **Automatic Replay** percentage value range is adjustable from 5 to 50%, via the Credit Button. Item 02 permits changing the factory setting value for Replay Start Level (valid for next 500 games played). Item 03 permits setting up to four replay levels, with values as detailed in text describing Item 03. For **Fixed Replay Scores**, set Auto Replay value to 1 less than 5(%) via the Credit Button. Go to items 02, 03, 04, and 05; install their replay level scores. Turn off any replay level by setting 00 as its value.
2. Phrase in parentheses is **Factory Setting**. Phrase appears in player displays. Press Credit Button to change setting of the game pricing of Item 24.
3. To change country OR coinage setting, press Credit button to obtain 16 Standard Settings, followed by a Custom Setting. The Custom Setting activates items 25 through 30. When a Standard Setting is used, items 25 through 30 are set automatically, and cannot be changed.
4. To install Custom Message, press flipper button for alphabet and special characters. Press Credit Button for next message letter or character.
5. Special Preset Adjustment, whose effects are noted in the Game Adjustment text.
6. Refer to **Pricing Table** and text describing these items.
7. Approximates Ad 64, yet includes all factors listed in Factory Setting column, not just Ad 31 through 47 provided by Ad 64.

Black Knight 2000 GAME STATUS DISPLAYS (Continued)

Adjustment Information--Ad

At end of the Audit Information presentation, with the AUTO-UP switch in the Up position, the operator can press the ADVANCE button to proceed to the Adjustment Information portion of the Black Knight 2000 Game Status Displays, as listed in the Black Knight 2000 Game Adjustment Table.

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

The Black Knight 2000 Game Adjustment Table lists the 70 items of the Adjustment Information portion of the Black Knight 2000 Game Status Displays. Presentation of the displays is similar to that for the Audit Information (that is, the player 1 and 2 displays combine as a descriptive phrase; the light type below the column headings names the respective backbox displays where the information appears, etc.). The Player 3 display shows Ad for all 70 adjustment items, so its entry is omitted from the tabular listing.

The Black Knight 2000 Game Adjustment Setting Comparison Table shows the five game 'difficulty' Adjustment Items (ranging from Ad 62 - Extra Easy through Ad 66 - Extra Hard). Installing any one of these 'difficulty' Adjustments causes the values shown for each of the included game play Adjustment Items to be installed as a group, changing the level of play from one difficulty level to another. The owner/operator can use the information provided by the Audit Table items to determine whether the 'difficulty level' for this game in this location needs to change to obtain a higher level of earnings from the game or to provide a greater challenge to the location's players.

Once the 'difficulty level' is changed, a careful review of the Audit Items will reveal whether the change has achieved this higher-earnings goal. Sometimes, one (or more) of the Adjustment Items needs further change to keep the number of plays high, while still keeping the earnings level high. "Fine-tuning" of the game's Adjustment Items is a key feature of Williams Electronic Games products.

Black Knight 2000 Game Adjustment Setting Comparison Table

| American & French Games | | Extra Ad | Easy Ad | Medium Ad | Hard Ad | Extra Ad | Not |
|-------------------------|-----------------------|------------|-----------|--------------|--------------|----------|------------|
| Adj # | Adj Description | Easy 62 | Easy 63 | (Factory) 64 | 65 | Hard 66 | Applicable |
| 31 | Magnet "ON" Timer | 5 | 5 | 5 | 5 | 5 | 5 |
| 32 | Magna Save Start | On | On | On | Off | Off | Off |
| 33 | W-A-R Memory | Yes | Yes | No | No | No | No |
| 34 | Free Spins | 2 | 2 | 1 | 0 | 0 | 0 |
| 35 | Ransom Spot Freq | 50 games | 100 games | 100 games | 300 | 400 | 400 |
| 36 | Multi-Ball Spot Freq | 10 games | 20 games | 20 games | 50 | 100 | 100 |
| 37 | Multi-Ball Difficulty | 0 | 0 | 0 | 1 | 2 | 5 |
| 38 | Percent SPECIAL | 4 | 4 | 4 | 3 | 3 | 2 |
| 39 | Loop Champ Award | Special | Special | Ex. Ball | 500,000 | Nothing | Nothing |
| 40 | Extra Ball Timer | 12 sec | 10 sec | 8 sec | 7 sec | 6 sec | 2 sec |
| 41 | U Turn Timer | 14 sec | 12 sec | 10 sec | 9 sec | 8 sec | 5 sec |
| 42 | Knight Timer | 15 sec | 13 sec | 13 sec | 12 sec | 11 sec | 5 sec |
| 43 | Ransom Timer | 25 sec | 20 sec | 20 sec | 20 sec | 15 sec | 5 sec |
| 44 | Lower Lock Timer | 25 sec | 20 sec | 20 sec | 15 sec | 10 sec | 5 sec |
| 45 | Jackpot Timer | 15 sec | 15 sec | 12 sec | 10 sec | 8 sec | 3 sec |
| 46 | Ransom Bolt Timer | 20 sec | 17 sec | 12 sec | 10 sec | 8 sec | 8 sec |
| 47 | Jackpot Advance | 10,000 | 8,000 | 5,000 | 2,000 | 2,000 | 1,000 |
| Adj # | Adj Description | Not | Extra Ad | Easy Ad | Medium Ad | Hard Ad | Extra Ad |
| German & European Games | | Applicable | Easy 62 | Easy 63 | (Factory) 64 | 65 | Hard 66 |

GAME ADJUSTMENT PROCEDURE

Adjustment Items 01 through 70

The coin door must be open to access the Game Adjustment/Diagnostic switches. All readings and setting changes require operation of these coin door switches. Some setting changes utilize the Credit button; some also use the flipper button(s). *Additional text describing the game adjustment items follows this procedure; the value of the Factory Setting for each Game Adjustment item is in the preceding **Black Knight 2000** Game Adjustment Table.*

1. Use AUTO-UP and press ADVANCE. The Id 00 display initially appears. Press ADVANCE until the Player 3 display indicates **Ad 01**. If the factory setting has not changed, the Player 1 and 2 Score displays indicate AUTO REPLAY, and the Player 4 display shows 10%, indicating a 10% replay percentage. (The game program adjusts itself automatically, as discussed in the following text concerning the 'details' about Adjustment Item 01.)
2. To reach a higher item number (in the Player 3 display), use AUTO-UP and press ADVANCE. To return to a previous item number, use MANUAL-DOWN and press ADVANCE.
3. With the desired Game Adjustment Item number showing in the Player 3 display, increase the setting value (or select another option) shown in the Player 4 display by using AUTO-UP and pressing the Credit button. Repeat this step for each item, until all changes to the factory settings for the Game Adjustment Items have been made. The preceding Game Adjustment Table consolidates the Factory Settings into one grouping.

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

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

4. To proceed rapidly through the entire adjustments series, press *and hold* ADVANCE, until **Ad 70** shows in the Player 3 display. From item 70, you can: (A) return to the Game-Over Mode; or (B) restore factory settings and zero audit (bookkeeping) totals. Perform either of the following, as desired:
 - A. To reach Game-Over Mode, use AUTO-UP and press ADVANCE once. **Black Knight 2000** now goes to the Game-Over Mode.
 - B. To restore the Factory Settings for Game Adjustment Items (as listed in the Game Adjustments Table), zero all audit (bookkeeping) totals, *and* return to Game-Over Mode, use AUTO-UP or MANUAL-DOWN to display Ad 70 in the Player 3 display. Press the Credit button to display the YES option in the Player 4 display. Using AUTO-UP, press ADVANCE once. **Black Knight 2000** now zeroes ALL Audit Item totals and changes ALL Game Adjustment Items back to those originally selected as Factory Settings. It then shows the operator a message ("FACTORY SETTING") that this has occurred. (A problem in the Memory Protection circuit or closing the coin door will cause the message "ADJUST FAILURE" to appear.) Press ADVANCE once more to return to the Game-Over Mode.

GAME ADJUSTMENT PROCEDURE (Continued)

Details of Adjustment Items 01 through 70

01 Auto Replay (or Fixed Replay)

Of the two options, AUTO REPLAY is the percentage of replays automatically awarded per game. The game program aids a pinball's initial installation by causing a comparison of the value of the Replay Level to the value of all players' scores every 50 games for the first 1,000 games. At each comparison, the program increases (or decreases) the Replay Level by an amount necessary to achieve the replay percentage specified either via the factory setting or later operator selection. (After the first 1,000 games, the comparison occurs after every 500 games. The adjustment value is 100K, for this (and each subsequent) comparison.) Use the Credit button to change the percentage within the range of 5 to 25 (%), with the value increasing using AUTO-UP (or decreasing using MANUAL-DOWN). The next Credit button change below 5%, selects the FIXED REPLAY option.

For AUTO REPLAY, Ad 02 provides the Starting Replay Level (Player 1 and 2 displays show REPLAY START). Ad 03 provides the number of replay levels (01, 02, 03, or 04). **Black Knight 2000** then proceeds to Ad 06 automatically.

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

02 Starting Replay Level (or Replay Level 1)

For AUTO REPLAY (refer to Ad 01), the initial Factory Setting is listed in the Game Adjustment Table. The range of settings is 800,000 through 4,000,000 (by increments of 100,000 with AUTO-UP or decrements of 100,000 with MANUAL-DOWN).

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

03 Replay Levels (or Replay Level 2)

For AUTO REPLAY (refer to Ad 01), this is the number of replay levels in a game. The option range is *one, two, three, or four* replay level(s). When the operator chooses two replay levels, **Black Knight 2000** automatically adjusts the second replay level to be twice the value selected for Ad 02, the starting replay level. Choosing three or four replay levels automatically adjusts their replay levels to three times or four times the Ad 02 value.

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

04 (Replay Level 3)

For AUTO REPLAY, this Adjustment Item is not applicable. **Black Knight 2000** automatically bypasses this adjustment.

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

05 (Replay Level 4)

For AUTO REPLAY, this Adjustment Item is not applicable. **Black Knight 2000** automatically bypasses this adjustment.

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

GAME ADJUSTMENT PROCEDURE (Continued)

06 Replay Award

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

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

07 Special Award

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

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

08 Match Award

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

- 1%-50%* - 1% is 'hard'; 50% is 'extremely easy'. During Match action, the game selects a random two-digit number at end of game and compares each player's score for an identical two digits in the rightmost two positions. A matching of the two digits results in the award of a credit.
- Off* - The MATCH display does not operate at completion of the game; no award is given.

09 Balls / Game

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

10 Tilt Warning

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

11 Maximum Extra Ball

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

- 00* - NO extra ball play; displays a message, NO EX. BALL. A score is awarded in lieu of the Extra Ball.
- 1-9 Extra Balls* - 1 through 9 Extra Balls per game.

GAME ADJUSTMENT PROCEDURE (Continued)

1 2 Maximum Credits

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

NOTE

Whenever the number of credits is less than the specified maximum credits, any credits obtained by coin purchase or game awards (High Score, Match, Replay Levels, etc.) will be accumulated even though they exceed the maximum value. Thereafter, no additional credits can be accumulated, until the credit total is reduced below the specified maximum setting.

1 3 Highest Scores

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

- Off* - NO high scores are recorded.
- On* - The four highest scores are stored in memory for use by Game Adjustment 22.
- Auto* - The four highest scores are stored in memory for use in a game program subroutine associated with Game Adjustment 22.

1 4 Backup High Score 1

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

1 5 Backup High Score 2

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

1 6 Backup High Score 3

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

1 7 Backup High Score 4

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

1 8 Credits for Highest Score 1

The operator can select the number of credits to be awarded, by using the Credit button, whenever a player exceeds the previous Highest Score. The range of this setting is 00 through 10. A variation to this award occurs, when the setting of Ad 06 is Coil. (This permits a ticket or token dispenser to provide the award, when applicable.)

1 9 Credits for Highest Score 2

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

2 0 Credits for Highest Score 3

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

GAME ADJUSTMENT PROCEDURE (Continued)

2 1 Credits for Highest Score 4

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

2 2 Automatic High Score Reset

The operator can specify (via Credit button) that the game will provide an automatic reset of the displayed "Highest Scores", and the number of games to be played before the reset occurs. (Audit item 39 displays the games remaining before the reset.) The values provided upon reset are those selected by the operator in Ad 14 through 17, the Backup High Scores. The range of this setting is Off (to disable this adjustment), and 1,000 to 24,750 games (in increments of 250).

2 3 Free Play

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

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

2 4 Coinage Selections

The operator can specify (via the Credit button) any of the 16 Standard Settings for game pricing, each of which exhibits a message identifying the country and the number of coins required and the number of games that the coin requirement purchases. Choosing a Standard Setting permits the game to omit items Ad 25 through 30, which are adjustments allowing for a special custom coinage setting.

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

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

2 5 Left Chute Coin Units

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

2 6 Center Chute Coin Units

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

2 7 Right Chute Coin Units

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

2 8 Units Required for Credit

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

GAME ADJUSTMENT PROCEDURE (Continued)

29 Units Required for Bonus

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

30 Minimum Units Required for any Credits Posted

The operator can specify that NO Credits are to be posted (indicated in the Credits display), until the credit units counter reaches a particular value.

The System 11B game program defines the following 18 Adjustment Items as "game-specific"; that is, they are unique for each game. The Game Designer/Engineer/Programmer team members work together to use these as controlling factors for game play. By varying the setting of these Adjustment Items, it is possible to "fine-tune" a game to suit a particular location, enabling the owner/operator to reap maximum earnings, while still providing the players with sufficient challenge to keep them playing.

GAME ADJUSTMENT PROCEDURE (Continued)

- 3 1 MAGNET "ON" TIMER**
The operator can specify (via the Credit button) the period of Magna-Save coil actuation after the player presses the Magna-Save coil pushbutton. The range of this setting is *2 seconds* (Conservative) through *8 seconds* (Liberal).
- 3 2 MAGNA SAVE START**
The operator can choose (via the Credit button) whether the MAGNA SAVE lamp is lit at game start. The choices are:
ON - (Liberal) The MAGNA SAVE lamp is lighted at game start.
OFF - (Conservative) The MAGNA SAVE lamp is *NOT* lighted at game start.
- 3 3 W - A - R MEMORY**
The operator can choose (via the Credit button) whether the lighted W - A - R lamps carry over from ball to the next. The choices are:
YES - Any lighted W - A - R lamp is stored in memory and recalled for 'next ball' play.
NO - Lighted W - A - R lamps are *NOT* recalled for 'next ball' play.
- 3 4 FREE SPINS**
The operator can choose (via the Credit button) the number of "Free Spins" occurring at game start. "Free Spin" is a condition where the SPIN lamp remains lighted from game start and does *NOT* expire after a timed period. The range of this setting is *0 Free Spins* (Conservative) through *5 Free Spins* (Liberal).
- 3 5 RANSOM SPOT FREQUENCY**
The operator can choose (via the Credit button) the number of games to be played before spotting RANSOM on the wheel. The range of this setting is *50 games* (Liberal) through *4950 games* (Conservative).
- 3 6 MULTI-BALL SPOT FREQUENCY**
The operator can choose (via the Credit button) the number of games to be played before spotting MULTI-BALL on the wheel. The range of this setting is *10 games* (Liberal) through *990 games* (Conservative).
- 3 7 MULTI-BALL DIFFICULTY**
The operator can specify (via the Credit button) the difficulty of achieving Multi-Ball play. The range of this setting is *0* (Very Liberal) through *5* (Very Conservative).
- 3 8 PERCENT SPECIAL**
The operator can choose (via the Credit button) the percentage of SPECIAL lamps to be lighted on the Lightning Wheel (also called the 'Bolt Circle' in the Lamp Matrix). The range of this setting is *0%* (Conservative) through *50%* (Liberal).
- 3 9 LOOP CHAMP AWARD**
The operator can specify (via the Credit button) the award earned by the player who exceeds the record for number of consecutive loops. The range of this adjustment is *Extra Ball*; *500,000*; or *Nothing* (Very Conservative).
- 4 0 EXTRA BALL TIMER**
The operator can specify (via the Credit button) the lighting duration of the Extra Ball lamp. The range of this adjustment is *OFF* (Adjustment Disabled); *2 seconds* (Conservative) through *20 seconds* (Liberal).

GAME ADJUSTMENT PROCEDURE (Continued)

4 1 U TURN TIMER

The operator can specify (via the Credit button) the Time Limit for blinking the 'U TURN lamps after they are enabled. The range of this setting is *3 seconds* (Conservative) through *30 seconds* (Liberal).

4 2 "KNIGHT" TIMER

The operator can select (via the Credit button) the time that must elapse before the two 3-Bank Drop Targets (K-N-I and G-H-T) are reset. The range of this setting is *5 seconds* (Conservative) through *40 seconds* (Liberal).

4 3 RANSOM TIMER

The operator can choose (via the Credit button) the time period for continuous ball serving during the Ransom sequence. The range of this setting is *5 seconds* (Conservative) through *30 seconds* (Liberal).

4 4 LOWER LOCK TIMER

The operator can choose (via the Credit button) the duration of a ball remaining in the Lower Lock during Multi-Ball™ play. The range of this setting is *3 seconds* (Conservative) through *30 seconds* (Liberal).

4 5 JACKPOT TIMER

The operator can choose (via the Credit button) the duration of the lighted JACKPOT lamp, following Multi-Ball™ play. The range of this setting is *3 seconds* (Conservative) through *30 seconds* (Liberal).

4 6 RANSOM BOLT TIMER

The operator can choose (via the Credit button) the duration of the lighted RANSOM bolt. The range of this setting is *3 seconds* (Conservative) through *30 seconds* (Liberal).

4 7 JACKPOT ADVANCE

The operator can choose (via the Credit button) the number of points added to the JACKPOT by every switch hit during Multi-Ball™. The range of this setting is *1,000* (Conservative) through *30,000* (Liberal).

4 8 ATTRACT MODE SOUNDS

The operator can choose (via the Credit button) whether sounds are heard during the Attract Mode. The choices are *On* (Sounds are heard) or *Off* (No sounds).

4 9 Custom Message

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

- 1 - Display a message during the Attract Mode. The Player 4 display shows this choice as ON. The 3-line message provided is:

WILLIAMS PINBALL ... PRESENTS ... BLACK KNIGHT 2000

- 2 - Do NOT display a message during the Attract Mode. (Player 4 shows OFF.)
- 3 - The Player 4 display shows this choice as CHANGE. The operator can enter a special ("custom") message, as follows:
 - A. Press ADVANCE once. The operator can now enter as many as three 14-character lines for display during the Attract Mode.

GAME ADJUSTMENT PROCEDURE (Continued)

49 Custom Message (Continued)

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

ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789<>?-/**
A. B. C. D. E. F. G. H. I. J. K. L. M. N. O. P. Q. R. S. T. U. V. W. X. Y. Z. _

- C. Move to the next character via the Credit button. The game program does not allow entirely blank lines to be displayed.

50 SWITCH ALARM KNOCKER

This Adjustment controls the operation of the Knocker, allowing it to be used to indicate the probable failure of one or more playfield switches. The choices are *On* (the knocker sounds to indicate a switch problem) or *Off* (No knocker actuation).

51 1 COIN BUY IN

The operator can choose (via the Credit button) whether to allow "1 Coin Buy-in" when Game Adjustment Ad24 is set for USA 3 (2 coins-1 play, 50¢ per game player) pricing. This option enables each player, during a timed period at the end of each game, to buy another game for only one coin (25¢), after having purchased the first game for 50¢. That is, after purchasing the first game for 50¢, subsequent games cost 25¢, if purchased within the time limit.

52 - 54 Not Used In USA Games

(NOTE: Refer to the table listing ~~Black Knight~~ 2000 Preset Game Adjustments for German Games for settings of Ad 53 through Ad58.)

55 INSTALL 50¢-5 BALLS

The operator can use this Adjustment Item to modify the current game pricing selection to enable 5-ball game play to begin when the specified number of coins are deposited. In this instance, the player now obtains 1 play (5-ball game) when two 25¢ coins pass through a coin chute.

56 INSTALL 1 COIN

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

57 INSTALL 3/\$1.00

The operator can use this Adjustment Item to modify the current game pricing selection to enable game play to begin after acceptance of the specified number of coins. In this instance, the player now obtains 3 plays when 25¢ coins totalling \$1.00 pass through a coin chute.

SPECIAL PRESET ADJUSTMENTS CAUTION

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

GAME ADJUSTMENT PROCEDURE (Continued)

SPECIAL PRESET ADJUSTMENTS CAUTION (Continued)

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

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

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

NOTE

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

Black Knight 2000 Preset Game Adjustments Table for German Games

| Adj # | Adj Description | German Ad 1 53 | German Ad 2 54 | German Ad 3 55 | German Ad 4 56 | German Ad 5 57 | German Ad 6 58 |
|-------|----------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| 01 | Auto Replay | On | On | On | On | On | On |
| 02 | Replay Start | 3,000,000 | 3,000,000 | 3,000,000 | 3,000,000 | 3,000,000 | 3,000,000 |
| 03 | Replay Level 2 | 02 | 02 | 02 | 02 | 02 | 02 |
| 06 | Replay Award | Credit | Coil | Audit | Credit | Coil | Audit |
| 07 | Special Award | Credit | Ball | Score | Credit | Ball | Score |
| 08 | Match Feature | 10 % | 10 % | 10 % | 10 % | 10 % | 10 % |
| 12 | Max. Credits | 30 | 30 | 30 | 30 | 30 | 30 |
| 14 | Backup High Score 1 | 7,000,000 | 7,000,000 | 00 | 7,000,000 | 7,000,000 | 00 |
| 15 | Backup High Score 2 | 6,500,000 | 6,500,000 | 00 | 6,500,000 | 6,500,000 | 00 |
| 16 | Backup High Score 3 | 6,000,000 | 6,000,000 | 00 | 6,000,000 | 6,000,000 | 00 |
| 17 | Backup High Score 4 | 5,500,000 | 35500,000 | 00 | 5,500,000 | 5,500,000 | 00 |
| 18 | High Score 1 Credits | 03 | 03 | 00 | 03 | 03 | 00 |
| 19 | High Score 2 Credits | 00 | 00 | 00 | 00 | 00 | 00 |
| 20 | High Score 3 Credits | 00 | 00 | 00 | 00 | 00 | 00 |
| 21 | High Score 4 Credits | 00 | 00 | 00 | 00 | 00 | 00 |
| 22 | High Score Reset | 1000 spiele | 1000 spiele | 1000 spiele | 1000 spiele | 1000 spiele | 1000 spiele |
| 24 | Coinage Setting | 6 spiele/5 DM | 6 spiele/5 DM | 6 spiele/5 DM | 7 spiele/5 DM | 7 spiele/5 DM | 7 spiele/5 DM |

GAME ADJUSTMENT PROCEDURE (Continued)

53 through 58 **FOR GERMAN/USA GAMES ONLY:** Install German 1, 2, 3, 4, 5 or 6. The operator can use these Adjustment Items to modify the game pricing selection of Standard Setting named "German 2 or German 1" in the Pricing Table to permit the style of play for the particular price shown in the **Black Knight 2000 Preset Game Adjustments Table for German Games.**

GAME ADJUSTMENT PROCEDURE (Continued)

58 INSTALL 2 COINS

The operator can use this Adjustment Item to modify the current game pricing selection to enable game play to begin after acceptance of the specified number of coins. In this instance, the player now obtains 1 play when 2 coins of the proper denomination (USA: 25¢) pass through a coin chute.

59 Install Add-A-Ball

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

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

60 Install 5 Ball

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

| <u>Ad Name</u> | <u>New Setting</u> | <u>Ad Name</u> | <u>New Setting</u> |
|-----------------|--------------------|-----------------|--------------------|
| 02 Replay Start | 3,500,000 | 09 Balls / Game | 05 |

61 Install Novelty

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

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

62 Install Extra Easy

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

63 Install Easy

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

64 Install Medium

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

AMENDMENTS TO THE *BLACK KNIGHT* OPERATIONS AND PARTS
INFORMATION MANUAL

The Following Amendments Have Been Made to the BLACK KNIGHT Manual.

1. Page 22, Game Adjustment 58

Install 5 Ball, is now, Install 3 Ball 1 Coin

The operator can use this adjustment to modify the current game pricing selection to enable game play to begin after acceptance of the specified number of coins. In this instance, the player now obtains 1 play when 1 coin of the proper denomination (USA: 25¢) pass through a coin chute.

2. Page 22, Game Adjustment 60

Install 2 Coin, is now, Install 3 Ball 2 Coin

The operator can change the game to 3-Ball play, including the changing of certain features to the recommended 3-Ball play difficulty level.

NOTE: Ad 65 (Install HARD) settings are also set when the game is changed to '3-Ball Play'. Individual Adjustments are affected, as follows:

| <u>Ad Name</u> | <u>New Setting</u> | <u>Ad Name</u> | <u>New Setting</u> |
|-----------------|--------------------|----------------|--------------------|
| 02 Replay Start | 3,500,000 | 09 Balls/Game | 05 |

GAME ADJUSTMENT PROCEDURE (Continued)

6 5 Install Hard

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

6 6 Install Extra Hard

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

6 7 Auto Burn-In

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

6 8 Clear Coins

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

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

6 9 Clear Audits

The operator can request the clearing of the non-coinage audits (Au 05 through 38) by selecting (via the Credit button) the YES option, as shown in the player 4 display. This Adjustment zeroes the counters tallying the remaining Audit factors. Please note that this does NOT affect the Automatic Replay Percentaging data nor the automatic High Score Reset counter.

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

7 0 Install Factory

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

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

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

GAME ADJUSTMENT PROCEDURE (Continued)

RESETTING THE HIGH SCORES

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

For **Black Knight 2000**, in fact, three methods of resetting the High Score values are available. The simplest method involves allowing Game Adjustment Item Ad 22 to reset the High Score values automatically after the specified number of plays designated by the operator. The second method requires pressing the High Score Reset switch on the inside of the coin door in the Attract Mode. This action simply erases the previous high score values and replaces them with the Backup High Score values. The third method establishes new values replacing the factory setting values or previous operator setting values; it requires performing the following steps:

1. Using AUTO-UP or MANUAL-DOWN, reach item Ad 14 (and items Ad 15, 16, and 17, if desired). The High Score value of the factory setting (or previous operator-adjusted setting) appears in the Player 1 display. If this value is satisfactory, go to step 4 below.
2. If you wish to increase the High Score value from that displayed in the Player 1 display, use AUTO-UP, and press the Credit button, until the desired value shows in the Player 1 display.
3. If you wish to decrease the High Score value, use MANUAL-DOWN, and press the Credit button, until the desired value shows in the Player 1 display.
4. Using AUTO-UP, press and hold down ADVANCE, until the Player 3 display shows Ad 70. Press ADVANCE once, to return to Game-Over Mode.
5. Press the High Score Reset switch (on coin door), and listen for the sound signifying that the score reset action is complete. Observe player score displays (Player 1, Player 2, etc.) to verify that the new High Score values are displayed.

GAME PRICING

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

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

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

X = Coin Chute Multiplier (Item 25, 26, or 27 in *Pricing Table*);

V = Value of coin;

C = Coin units equivalent to one Credit (Item 28).

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

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

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

Black Knight 2000 Pricing Table

| Country | Coin Chute | | | Games/Coin | Ad 24 Display | Pricing Functions | | | | | | W | B |
|----------------|------------|--------|--------|--------------------------------------|---------------|-------------------|----|----|----|----|----|---|---|
| | Left | Center | Right | | | 25 | 26 | 27 | 28 | 29 | 30 | | |
| USA and Canada | 25c | - | 25c | 1/25c, 4/\$1 ^{1,2} | U.S.A. 1 | 01 | 04 | 01 | 01 | 00 | 00 | + | + |
| | | | | 1/50c, 2/75c, 3/\$1 ² | U.S.A. 2 | 03 | 12 | 03 | 04 | 00 | 00 | + | + |
| | | | | 1/50c, 2/\$1 ² | U.S.A. 3 | 01 | 04 | 01 | 02 | 00 | 01 | + | + |
| | | | | 1/25c, 3/50c, 6/\$1 | CUSTOM | 01 | 04 | 01 | 01 | 02 | 00 | + | + |
| | | | | 1/25c, 5/\$1 | CUSTOM | 01 | 00 | 01 | 01 | 04 | 00 | + | + |
| | | | | 1/50c; Add'l game: 25c | CUSTOM | 98 | 00 | 98 | 99 | 00 | 00 | + | + |
| Austria | 5 Sch | 10 Sch | 10 Sch | 1/2x5 Sch, 3/2x10 Sch ² | AUSTRIA | 01 | 02 | 02 | 02 | 04 | 01 | + | + |
| | | | | 2/5 Sch, 5/10 Schilling | CUSTOM | 02 | 00 | 05 | 01 | 00 | 00 | + | + |
| | | | | 2/5x1 Sch, 2/5 Sch, 5/10 Sch | CUSTOM | 02 | 10 | 25 | 05 | 00 | 00 | + | + |
| Australia | 20c | - | \$1 | 1/3x20c, 2/\$1 ² | AUSTRAL. | 01 | 00 | 06 | 03 | 00 | 01 | + | + |
| United Kingdom | 10 P | 50 P | 1£ | 1/2x10 P, 3/50 P, 7/1£ ² | U.K. | 03 | 15 | 30 | 05 | 30 | 00 | + | + |
| | | | | 1/3x10 P, 2/50 P, 5/1£ ² | U.K. | 02 | 10 | 20 | 05 | 20 | 00 | + | + |
| | | | | 1/10 P, 5/50 P, 2/20 Pence | CUSTOM | 01 | 05 | 02 | 01 | 00 | 00 | + | + |
| Switzerland | 1 F | 2 F | 5 F | 1/1 F, 3/2 F, 7/5 Franc ² | SWISS | 03 | 00 | 06 | 02 | 00 | 00 | + | + |
| | | | | 1/1 F, 3/2 F | CUSTOM | 01 | 03 | 07 | 01 | 00 | 00 | + | + |
| Belgium | 20 F | 20 F | 20 F | 3/20 Franc ² | BELGIUM | 03 | 03 | 03 | 01 | 00 | 00 | + | + |
| | | | | 1/20 F, 3/50 Franc | BELGIUM | 06 | 00 | 15 | 05 | 00 | 00 | + | + |
| | | | | 1/2x5 F, 2/20 Franc | CUSTOM | 01 | 01 | 04 | 02 | 00 | 01 | + | + |
| | | | | 1/2x5 F, 2/20 F, 2/20 F | CUSTOM | 01 | 04 | 04 | 02 | 00 | 01 | + | + |
| | | | | 1/2X5 F, 1/2X5 F, 2/20 F | CUSTOM | 01 | 01 | 04 | 02 | 00 | 01 | + | + |

GAME PRICING (Continued)

Black Knight 2000 Pricing Table (Continued)

| Country | Coin Chute | | | Games/Coin | Ad 24 Display | Pricing Functions | | | | | | W | B |
|--------------------|------------|---------|---------|--|---------------|-------------------|----|----|----|----|----|---|---|
| | Left | Center | Right | | | 25 | 26 | 27 | 28 | 29 | 30 | | |
| West Germany | 1 DM | 2 DM | 5 DM | 1/1 DM, 2/2 DM, 7/5 DM ^{2,3} | GERMAN1 | 06 | 12 | 30 | 05 | 30 | 00 | + | + |
| | | | | 1/1 DM, 2/2 DM, 6/5 DM ^{1,2} | GERMAN2 | 06 | 12 | 30 | 05 | 00 | 00 | + | + |
| | | | | 1/1 DM, 3/2 DM, 9/5 DM | CUSTOM | 09 | 18 | 45 | 05 | 00 | 00 | + | + |
| | | | | 1/2x1 DM, 1/2 DM, 3/5 DM | CUSTOM | 03 | 06 | 15 | 05 | 00 | 00 | + | + |
| Netherlands | | | | 2/1 DM, 5/2 DM, 14/5 DM | CUSTOM | 13 | 26 | 65 | 05 | 65 | 00 | + | + |
| | 1 Hfl | 2.5 Hfl | 2.5 Hfl | 1/1 Hfl, 3/2.5 Holland Florin ² | NETHERL. | 06 | 15 | 15 | 05 | 00 | 00 | + | + |
| | 25¢ | - | 1 G | 1/25¢, 5/1 Guilder | CUSTOM | 01 | 00 | 05 | 01 | 00 | 00 | + | + |
| Sweden | 1G | - | 1 G | 1/1 Guilder ² | HOLLAND | 01 | 00 | 01 | 01 | 00 | 00 | + | + |
| | 5 Kr | 5 Kr | 5 Kr | 1/5 Krona ² | SWEDEN | 01 | 01 | 01 | 01 | 00 | 01 | + | + |
| France | 1 Kr | - | 1 Kr | 1/2x1 Krona | CUSTOM | 01 | 04 | 01 | 02 | 00 | 01 | + | + |
| | 1 F | 5 F | 10 F | 1/3x1 F, 2/5 F, 5/10 Franc ^{1,2} | FRANCE | 02 | 10 | 20 | 05 | 20 | 00 | + | + |
| | 1 F | 5 F | 10 F | 1/2x1 F, 3/5 F, 7/10 Franc ² | FRANCE | 03 | 15 | 30 | 05 | 30 | 00 | + | + |
| | 5 F | 10 F | 10 F | 1/5 F, 3/10 F, 7/2x10 Franc | CUSTOM | 03 | 15 | 30 | 10 | 60 | 15 | + | + |
| | 5 F | 10 F | 10 F | 2/5 F, 4/10 F, 9/2x10 Franc | CUSTOM | 02 | 10 | 20 | 05 | 40 | 10 | + | + |
| Italy | 5 F | 10 F | 10 F | 2/5 F, 5/10 F, 11/2x10 Franc | CUSTOM | 01 | 05 | 10 | 02 | 20 | 05 | + | + |
| | 500 L | 500L | 500 L | 1/500 Lire ² | ITALY | 01 | 01 | 01 | 01 | 00 | 00 | + | + |
| Spain | 200 L | - | 500 L | 1/2x200 L, 3/2x500L Lire ² | ITALY | 06 | 00 | 15 | 10 | 00 | 00 | | + |
| | 25 P | - | 100P | 1/25 P, 5/100 Peseta ² | SPAIN | 01 | 00 | 05 | 01 | 00 | 00 | + | + |
| | 25 P | - | 100P | 1/25 P, 4/100 Peseta | CUSTOM | 01 | 00 | 04 | 01 | 00 | 00 | + | + |
| | 25 P | - | 100P | 1/2x25 P, 2/100 Peseta | CUSTOM | 01 | 00 | 04 | 02 | 00 | 00 | + | + |
| Japan | 25 P | - | 100P | 1/2x25 P, 3/100 Peseta | CUSTOM | 03 | 00 | 12 | 04 | 00 | 06 | + | + |
| | - | 100¥ | - | 2/100 ¥ ² | JAPAN | 01 | 04 | 01 | 02 | 00 | 01 | + | + |
| | 100¥ | - | 100¥ | 1/100 Yen | JAPAN | 01 | 00 | 01 | 01 | 00 | 00 | + | + |
| Antilles, Netherl. | 100¥ | - | 100¥ | 2/100 Yen | CUSTOM | 02 | 00 | 02 | 01 | 00 | 00 | + | + |
| | 25¢ | - | 1 G | 1/25¢, 4/1 Guilder ² | ANTILLES | 01 | 01 | 04 | 01 | 00 | 00 | + | + |
| Chile | Token | - | Token | 1/1 Token ² | CHILE | 01 | 04 | 01 | 01 | 00 | 00 | + | + |
| Denmark | 1 Kr | 5 Kr | 10 Kr | 1/2x1 Kr, 3/5 Kr, 7/10 Krone ² | DENMARK | 01 | 06 | 14 | 02 | 00 | 01 | + | + |
| Finland | 1 Mka | - | 5 Mka | 1/2x1 Mka, 3/5 Markka ² | FINLAND | 01 | 00 | 06 | 02 | 00 | 01 | + | + |
| New Zealand | 20¢ | - | 20¢ | 1/2x20¢ ² | N. Z. | 01 | 04 | 01 | 02 | 00 | 01 | + | + |
| Norway | 1 Kr | - | 1 Kr | 1/2x1 Kr, 3/5x1 Krone ² | NORWAY | 01 | 00 | 01 | 02 | 05 | 00 | + | + |
| Argentina | 10¢ | 10¢ | 10¢ | 1/1 Token ² | ARG. | 01 | 01 | 01 | 01 | 00 | 00 | + | + |
| Greece | 10D | 20D | 50D | 1/2x10D, 1/20D, 3/50Drachma ² | GREECE | 03 | 06 | 15 | 05 | 00 | 00 | + | + |

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

TEST/DIAGNOSTIC PROCEDURES

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

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

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

CAUTION

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

MUSIC TEST.

1. In the Music Test, observe that the player 1 and 2 displays show the message, MUSIC TEST. Switching to AUTO-UP, observe that the message now reads MUSIC OFF, and that the player 3 score display shows 00 00. Press the Credit button to select the desired music selection: 01 - 'Main Theme' through 08 - 'Hi. Score Theme' (the selections repeat). Adjust the volume control for proper sound level for the game location.
2. Use the AUTO-UP position.

DISPLAY TEST.

1. To initiate the Display Test, press ADVANCE. Observe that player 1 and 2 displays briefly show the message, DISPLAY TEST, and that the player 3 score display shows 01 (the Display Test identifier).
2. Use AUTO-UP. Observe that all displays begin a display cycle of all 0s through all 9s, one digit at a time. Verify that the proper comma segments light during display of the odd-numbered digits. Next, a special "all segments" character 'walks' from left to right across each player score display.
3. To halt the display cycle, use MANUAL-DOWN. Then, press ADVANCE to step through the sequential digit display, digit by digit, and the subsequent "all segments" characters display test. Use AUTO-UP to resume cycling, and to proceed to the next test.

SOUND TEST.

1. (From Display Test) To initiate the Sound Test, press ADVANCE. Observe that the player 1 and 2 displays show the message, SOUND TEST, and that the player 3 display shows 02 (the Sound Test identifier). The player 3 display shows a series of test steps from 00 through 07. Verify that a different sound is heard each time the number in the display changes.
2. To repeatedly pulse a single sound, use MANUAL-DOWN. Verify that one particular sound repeats. Press ADVANCE to step to the next sound, which repeats until ADVANCE is pressed again. Use AUTO-UP to resume cycling the sounds, and to proceed to the next test.

TEST/DIAGNOSTIC PROCEDURES (Continued)

LAMP TESTS.

1. All Lamps.

(From Sound Test) To initiate the first Lamps Test, press ADVANCE. Observe that the Player 1 and 2 displays show the message, ALL LAMPS, and that the Player 3 display shows 03 (All LampsTest identifier) and that all feature lamps (playfield and backbox) blink on and off. (Note, however, that the General Illumination lamps remain lighted steadily.) To locate the wiring associated with a particular feature lamp, refer to the **Lamp-Matrix Table**. CPU Board connections at jacks 1J6 (columns) and 1J7 (rows) are also listed in the table.

2. Single Lamps.

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

Black Knight 2000 Lamp-Matrix Table

| COLUMN ROW | 1 Q66 YEL-BRN 1J7-1 | 2 Q64 YEL-RED 1J7-2 | 3 Q62 YEL-ORN 1J7-3 | 4 Q60 YEL-BLK 1J7-4 | 5 Q58 YEL-GRN 1J7-6 | 6 Q56 YEL-BLU 1J7-7 | 7 Q54 YEL-VIO 1J7-8 | 8 Q52 YEL-GRY 1J7-9 |
|----------------------------|---------------------------------|-------------------------------|----------------------------------|------------------------------|--------------------------------------|--------------------------------|--------------------------------|--------------------------------|
| Q80 RED- 1 BRN 1J6-1 | R (SP) 1 | U-Turn Bolt (Right) 9 | Extra Bail Bolt 17 | "W" Lane (Top UPF) 25 | Motor Target Bolt 3 (L UPF) 33 | "G" (R) 3-Bank Dr Tgt 41 | EXTRA BALL (Bolt Circle) 49 | SPECIAL (Bolt Circle) 57 |
| Q81 RED- 2 BLK 1J6-2 | A (SP) 2 | Spin Bolt (Ball Popper) 10 | Red Bolt (UPF right) 18 | "I" Lane (Top UPF) 26 | Motor Target Bolt 2 (L UPF) 34 | "H" (R) 3-Bank Dr Tgt 42 | 50,000 (Bolt Circle) 50 | 20,000 (Bolt Circle) 58 |
| Q82 RED- 3 ORN 1J6-3 | N (SP) 3 | Lock Bolt (R Eject) 11 | Magna Save™ 19 | "N" Lane (Top UPF) 27 | Motor Target Bolt 1 (L UPF) 35 | "T" (R) 3-Bank Dr Tgt 43 | MAGNA SAVE (Bolt Circle) 51 | KICKBACK (Bolt Circle) 59 |
| Q83 RED- 4 YE 1J6-5 | S (SP) 4 | B 12 | Blue Bolt (UPF left) 20 | "W" Lane (Btm UPF) 28 | 2X ① (left) 36 | "K" (L) 3-Bank Dr Tgt 44 | 10,000 (Bolt Circle) 52 | 150,000 (Bolt Circle) 60 |
| Q84 RED- 5 GRN 1J6-6 | Bolt Circle Center 5 | L 13 | LAST CHANGE (R Outline) 21 | "A" Lane (Btm UPF) 29 | 3X ② 37 | "N" (L) 3-Bank Dr Tgt 45 | MULTI-BALL (Bolt Circle) 53 | Drawbridge (Bolt Circle) 61 |
| Q85 RED- 6 BLU 1J6-7 | O (SP) 6 | A 14 | U-TURN (Left) 22 | "R" Lane (Btm UPF) 30 | BONUS HOLD ③ 38 | "I" (L) 3-Bank Dr Tgt 46 | 100,000 (Bolt Circle) 54 | 75,000 (Bolt Circle) 62 |
| Q86 RED- 7 VIO 1J6-8 | M (SP) 7 | C 15 | KICKBACK (L Outline) 23 | JACKPOT Bolt 31 | 4X ④ 39 | SKYWAY Bolt 47 | RANSOM (Bolt Circle) 55 | HURRY-UP (Bolt Circle) 63 |
| Q87 RED- 8 GRY 1J6-9 | LAST CHANCE (L Outline) 8 | K 16 | SHOOT AGAIN 24 | ADVANCE RANSOM Bolt 32 | 5X ⑤ (right) 40 | HURRY-UP Bolt 48 | 200,000 (Bolt Circle) 56 | 250,000 (Bolt Circle) 64 |

All Lamps are Lower Playfield, except those marked SP (Speaker Panel) and UPF (Upper Playfield) ② = Item Identifier

TEST/DIAGNOSTIC PROCEDURES (Continued)

SOLENOID TEST.

- (From Lamp Test) Using AUTO-UP, press ADVANCE. Observe that the Player 1 and 2 displays show the message, COIL TEST, the Player 3 display shows 05 (Solenoid Test identifier). Next, the Player 3 display shows a series of test steps from 01 through 22, while the Player 1 and 2 displays show the solenoid/circuit name. During each of these steps, pulsing of the respective solenoid/circuit occurs. The test cycles repeatedly, unless halted via the MANUAL-DOWN switch. Refer to the **Solenoid Table** for solenoid numbers and wiring information. CPU Board connections at 1P11, 1P12, and 1P19 are also listed in the table.

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

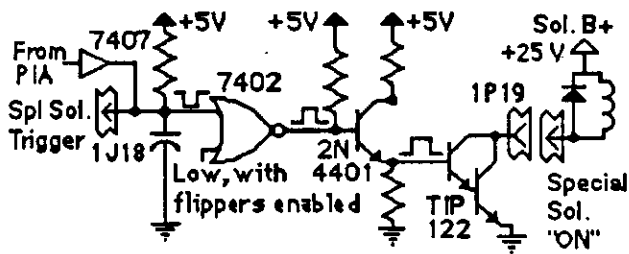
Black Knight 2000 Solenoid Table

| Sol. No. | Function | Solenoid Type | Wire Color | Connections | | Driver Trnstr | Solenoid Part Number Flashlamp Type i = Insert Bd; p = Playfield |
|------------------|-----------------------------------|---------------|------------------------|-------------|-----------------------|---------------|--|
| | | | | CPU Bd | Playfield/ Cabinet | | |
| 01A ³ | Outhole Kicker | Switched | Vio-Brn | 1P11-1 | 5J1-9: 5J4-9 (A) | Q33 | AE-23-800 |
| 01C ³ | UPF Big Red Bolt Flasher | Switched | Blk-Brn | (Gry-Brn) | 5J5-9 (C) | Q33 | #906/#89 flashlamps 2p,2i |
| 02A ³ | Ball Release (Shtr Lane Feeder) | Switched | Vio-Red | 1P11-3 | 5J1-7: 5J4-8 (A) | Q25 | AE-23-800 |
| 02C ³ | UPF Big Blue Bolt Flasher | Switched | Blk-Red | (Gry-Red) | 5J5-8 (C) | Q25 | #906/#89 flashlamps 2p,2i |
| 03A ³ | Left 3-Bank Drop Tgt Reset | Switched | Vio-Orn | 1P11-4 | 5J1-6: 5J4-7 (A) | Q32 | AE-26-1200 |
| 03C ³ | Ball Circle Center Flasher | Switched | Blk-Orn | (Gry-Orn) | 5J5-7 (C) | Q32 | #906/#89 flashlamps 2p,2i |
| 04A ³ | Right 3-Bank Drop Tgt Reset | Switched | Vio-Yel | 1P11-5 | 5J1-5: 5J4-6 (A) | Q24 | AE-26-1200 |
| 04C ³ | Flipper Lane Flasher | Switched | Blk-Yel | (Gry-Yel) | 5J5-5 (C) | Q24 | #906/#89 flashlamps 2p,2i |
| 05A ³ | Not Used | Switched | Vio-Grn | 1P11-6 | 5J1-4: 5J4-5 (A) | Q31 | |
| 05C ³ | Drop Target Flasher | Switched | Blk-Grn | (Gry-Grn) | 5J5-4 (C) | Q31 | #906/#89 flashlamps 1p,2i |
| 06A ³ | Ball Popper | Switched | Vio-Blu | 1P11-7 | 5J1-3: 5J4-4 (A) | Q23 | AE-23-800 |
| 06C ³ | LPF Ramp Flasher | Switched | Blk-Blu | (Gry-Blu) | 5J5-3 (C) | Q23 | #906/#89 flashlamps 2p,2i |
| 07A ³ | UPF Lockup Kickback | Switched | Vio-Blk | 1P11-8 | 5J1-2: 5J4-2 (A) | Q30 | AE-24-900 |
| 07C ³ | Right Eject/Up'r Flipper Flashers | Switched | Blk-Vio | (Gry-Vio) | 5J5-2 (C) | Q30 | #89 flashlamps 1p,2i |
| 08A ³ | Right Eject | Switched | Vio-Gry | 1P11-9 | 5J1-1: 5J4-1 (A) | Q22 | AE-26-1500 |
| 08C ³ | UPF Lockup Kickback Flasher | Switched | Blk-Gry | (Gry-Blk) | 5J5-1 (C) | Q22 | #906/#89 flashlamps 1p,2i |
| 09 | Insert Board Gnl Illum Relay | Controlled | Brn-Blk | 1P12-1 | 5J2-9: 5J6-9: 2J4-3 | Q17 | 5580-09555-01 4a |
| 10 | UPF Gnl Illum Relay | Controlled | Brn-Red | 1P12-2 | 5J2-8: 5J6-8: 2J4-5 | Q9 | 5580-09555-01 4a |
| 11 | LPF Gnl Illum Relay | Controlled | Brn-Orn | 1P12-4 | 5J2-6: 5J6-7: 2J4-6 | Q16 | 5580-12145-01 4b |
| 12 | A/C Seled Relay | Controlled | Brn-Yel | 1P12-5 | 5J2-5 | Q8 | 5580-09555-01 5 |
| 13 | Kickback (L Outlane) | Controlled | Brn-Grn | 1P12-6 | 5J2-4: 5J6-5 | Q15 | AE-23-800 |
| 14 | Knocker | Controlled | Brn-Blu | 1P12-7 | 5J2-4: 5J6-3 | Q7 | AE-23-800 |
| 15 | Magna Save™ Driver | Controlled | Brn-Vio | 1P12-8 | 5J2-2: 5J6-2 | Q14 | C-12493 |
| 16 | Motor Targets (UPF) Relay | Controlled | Brn-Gry | 1P12-9 | 5J2-1: 5J6-1 | Q6 | 5580-12145-01 4b |
| 17 | Left Jet Bumper | Special #1 | Blu-Brn | 1P19-7 | 5J3-7: 5J7-7 | Q75 | AE-23-800 |
| 18 | Left Kicker ("slings") | Special #2 | Blu-Red | 1P19-4 | 5J3-6: 5J7-6 | Q71 | AE-26-1500 |
| 19 | Right Jet Bumper | Special #3 | Blu-Orn | 1P19-3 | 5J3-3: 5J7-3 | Q73 | AE-23-800 |
| 20 | Right Kicker ("slings") | Special #4 | Blu-Yel | 1P19-6 | 5J3-4: 5J7-5 | Q69 | AE-26-1500 |
| 21 | Lower Jet Bumper | Special #5 | Blu-Grn | 1P19-8 | 5J3-2: 5J7-2 | Q77 | AE-23-800 |
| 22 | Not Used | Special #6 | Blu-Blk | 1P19-9 | 5J3-1: 5J7-1 | Q79 | |
| | <u>Right Flipper</u> | | | | | | |
| | Lower Right Flipper | | Orn-Vio | 1P19-1 | 2J5-5: 2J10-7 | | FL11630/50VDC |
| | Upper Right Flipper | | [Blu-Vio] ² | | [2J10-1: 2J8-15] | | FL11630/50VDC |
| | | | [Blk-Yel] | | [2J10-4: 2J8-12] | | |
| | <u>Left Flipper</u> | | | | | | |
| | Lower Left Flipper | | Orn-Gry | 1P19-2 | 2J5-4: 2J10-8 | | FL11630/50VDC |
| | | | [Blu-Gry] ² | | [2J10-2: 2J8-4] | | |

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

TEST/DIAGNOSTIC PROCEDURES (Continued)

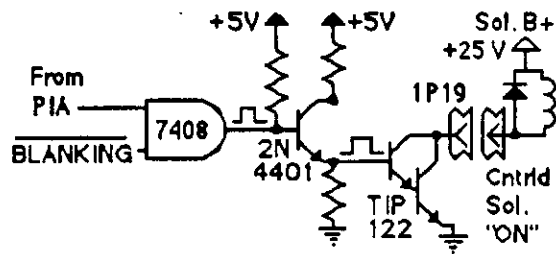
"On" State Logic - Special Solenoid



"Off" State - Special Solenoid:

The Special Switch Trigger Input goes low. Meanwhile, the PIA line remains high. The remaining signals reverse their states.

"On" State Logic - Controlled Solenoid



"Off" State - Controlled Solenoid:

The Enable Input (from the PIA) goes low. Meanwhile, the BLANKING signal remains high. The rest of the signals reverse their states.

NOTE

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

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

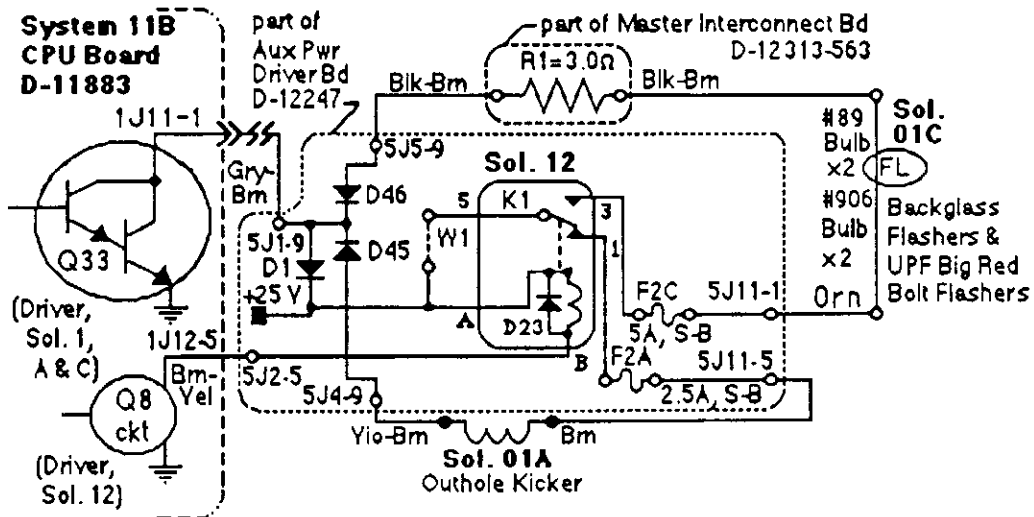


Figure 4. Typical Solenoid A/C Select Relay Circuit, showing the function of Solenoid 12, the Solenoid A/C Select Relay.

TEST/DIAGNOSTIC PROCEDURES (Continued)

SWITCH TESTS.

1. Switch Levels.

(From Solenoid Test) To initiate the Switch Levels Test, press ADVANCE. Observe that the Player 1 and 2 displays show the message, SWITCH LEVELS, and the Player 3 display shows 06 (Switch Levels Test identifier). Normally, the right portion of the Player 3 display remains blank, indicating that no switch is actuated.

If, however, a switch is actuated (possibly stuck closed), the Player 3 display shows that switch's number, while the Player 1 and 2 displays indicate the switch's name. A sound also accompanies the displays. (This is another facet of the **Black Knight 2000** System-11B's switch testing capability.) If more than one switch is closed, a series of displays show each actuated switch's name and number.

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

As soon as the operator opens a closed switch, its name and number are eliminated from the Switch Levels display series. For **Black Knight 2000**, switch numbers can range from 01 through 64. Refer to the **Switch-Matrix Table** for switch numbers and wiring information. CPU Board connections at jacks 1J8 (columns) and 1J10 (rows) are also listed in the table.

Black Knight 2000 Switch-Matrix Table

| COLUMN | 1 Q45 GRN-BRN 1J8-1 | 2 Q49 GRN-RED 1J8-2 | 3 Q44 GRN-ORN 1J8-3 | 4 Q48 GRN-YEL 1J8-4 | 5 Q43 GRN-BLK 1J8-5 | 6 Q47 GRN-BLU 1J8-7 | 7 Q42 GRN-VIO 1J8-8 | 8 Q46 GRN-GRY 1J8-9 |
|--------|--|----------------------------|---------------------------|---------------------------|----------------------------------|-------------------------------------|---------------------------|---------------------------|
| 1 | WHT-BRN 1J10-9 Plumb Bob Tilt 1 | Playfield Tilt 9 | Left Jet Bumper 17 | W Lane 25 | Motor Targets (Upper Tgt) 33 | R 3-Bank Dr Target (left) 41 | U-Turn 49 | Flipper Right 57 |
| 2 | WHT-RED 1J10-8 C Side Power A/C Relay 2 | Outhole 10 | BL Kicker ("sling") 18 | I Lane 26 | Motor Targets (Middle Tgt) 34 | R 3-Bank Dr Target (mid) 42 | U-Turn 50 | Flipper Left 58 |
| 3 | WHT-ORN 1J10-7 Credit Button 3 | Ball Trough #1 (R) 11 | Right Jet Bumper 19 | N Lane 27 | Motor Targets (Lower Tgt) 35 | R 3-Bank Dr Target (right) 43 | U-Turn 51 | Magna Save™ 59 |
| 4 | WHT-YEL 1J10-6 Left Coin Chute 4 | Ball Trough #2 (Mid) 12 | BR Kicker ("sling") 20 | W Lane 28 | UPF Lock Lower Switch 36 | L 3-Bank Dr Target (lwr) 44 | U-Turn 52 | 60 |
| 5 | WHT-GRN 1J10-5 Center Coin Chute 5 | Ball Trough #3 (L) 13 | Lwr Jet Bumper 21 | A Lane 29 | UPF Lock Middle Switch 37 | L 3-Bank Dr Target (mid) 45 | Ball Shooter 53 | 61 |
| 6 | WHT-BLU 1J10-3 Right Coin Chute 6 | 14 | Left UPF Loop End 22 | R Lane 30 | UPF Lock Upper Switch 38 | L 3-Bank Dr Target (upr) 46 | Right Return Lane 54 | 62 |
| 7 | WHT-VIO 1J10-2 Slam Tilt 7 | 15 | Right UPF Loop End 23 | Upper Ramp Entry 31 | Left Outlane 39 | Ball Popper 47 | Left Return Lane 55 | 63 |
| 8 | WHT-GRY 1J10-1 High Score Reset 8 | UP Motor Targets 16 | DOWN Motor Targets 24 | Lower Ramp Exit 32 | Right Eject 40 | Right Outlane 48 | 56 | 64 |

UPF = Upper Playfield BL = Bottom Left BR = Bottom Right ③ = Item Identifier

Row Problems. If a display of two (or more) switch numbers of a row occurs, although only one switch is closed, check for a short circuit between the column wires.

Multiple Switch Number Indications. Check the associated column wire for a short circuit to ground.

Column Problems. If display of two (or more) switch numbers in a column occurs (while only one switch is actuated), check for a short circuit between the row wires.

Use AUTO-UP to proceed to the next test.

TEST/DIAGNOSTIC PROCEDURES (Continued)

SWITCH TESTS (Continued).

2. Switch Edges.

From the Switch Levels Test, press ADVANCE. Observe that the Player 1 and 2 displays show the message, SWITCH EDGES; the Player 3 display shows 07 (Switch Edges Test identifier). The right portion of the Player 3 display is blank, indicating that no switch is actuated.

This test permits the operator to test whether actuating a switch provides the proper signal to the System-11B switch testing program. When actuating a switch, the operator should see the switch's name and number (in the Player 1, 2, and 3 displays, respectively). If no indication appears at the time the switch is actuated, the operator then knows that there is a malfunction associated with that switch.

Using this technique, the operator can test each switch appearing in the **Black Knight 2000** switch problem reporting displays (either at game Turn-On or at the beginning of the Diagnostic Tests) to determine whether the switch can be actuated. If the switch's name and number are displayed while the operator checks its operation, the operator then knows that the reported problem with that switch is NOT currently caused by a switch malfunction. The operator can then seek other causes for the reported problem, being almost certain now that the switch did not fail. *This test is also useful when the operator is adjusting the sensitivity of a particular switch's actuation mechanism.*

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

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

C-SIDE TEST

From the Wheel Test, press ADVANCE. Observe that the Player 1 and 2 displays show the message, C-SIDE TEST, and that the Player 3 displays shows 09 (C-Side Test identifier).

The Player 1 and 2 displays then change to show the 'side' of the circuit being tested, alternating between "SELECTED A-SIDE" and "SELECTED C-SIDE", while the Player 3 display shows 09 and the side being tested. The message "Err" appears whenever the side being tested is not receiving power via the relay and fuse of the Aux Power Driver Board and the resistor and opto transistor of the Backbox Interconnect Board. The "Err" message of this test indicates a component failure (most likely, a blown fuse) in the pulsing circuitry for the coils and flashers.

ENDING THE DIAGNOSTIC TESTS.

To end the Diagnostic Tests, reach the C-Side Test (09 in the Player 3 display), use AUTO-UP and press ADVANCE. The backbox displays should show the **Black Knight 2000** game's Identification Information. Use MANUAL-DOWN, and press ADVANCE to reach Adjustment Item 70 (INSTALL FACTORY). Use AUTO-UP, and press ADVANCE to go to the Attract Mode.

TEST/DIAGNOSTIC PROCEDURES (Continued)

AUTO BURN-IN MODE.

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

1. While in the Game Adjustments, reach Ad 67 and change the Factory Setting of NO to YES, via the Credit button. Set the AUTO-UP/MANUAL-DOWN switch to AUTO-UP.
2. Press ADVANCE to start the Auto Burn-in Mode. This mode repeatedly sequences through the Music Test, the Display Test, the Sound Test, the All Lamps portion of the Lamp Test, and the Solenoid Test.
3. To halt the Auto Burn-in Mode, switch the game Off and then On. **Black Knight 2000** now starts in the Attract Mode. (If a switch problem is now reported by the displays, perform the Switch Tests again to determine the nature of the problem; then, perform necessary repairs.)

SYSTEM-11B MEMORY CHIP TEST.

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

In addition to the displayed message, when a test fails, LED2 ('DIAGNOSTIC') mounted on the CPU Board can be observed to determine the probable cause of the problem. This LED blinks, or flashes, a certain number of times to identify the probable cause, as described in the **CPU LED Indicator Codes Table**. The operator can also start the self-testing routine by pressing the CPU Diagnostic Switch (SW 2) on the edge of the CPU Board.

CPU LED Indicator Codes Table

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

Notes: 1. This test assumes that the Coin Door is OPEN; it is initiated ONLY by pressing the CPU Diagnostic Switch (SW2).
 2. Alternatively, its associated connections or connecting devices are causing the IC to appear to have problems.

TEST/DIAGNOSTIC PROCEDURES (Continued)

SYSTEM-11B SOUND CIRCUITRY TESTS.

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

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

2. General System-11B Sound Test. Press the Sound Diagnostic Switch (SW 1) on left edge of the CPU Board. Listen for the two test sounds, showing that both the CVSD (Continuously Variable Slope Delta) Modulator, which provides the voices for **Black Knight 2000**, and the DAC (Digital-to-Analog Converter) sound circuits are functioning properly.

If no sound is heard, refer to the text entitled "NO SOUND ...". If one "ring" is heard, this indicates a malfunction of the U23 RAM Chip. If either two or four "rings" is heard, this indicates a problem associated with the U21 ROM Chip. If either three or five "rings" is heard, this indicates a problem with the U22 ROM Chip.

NO SOUND DURING THIS TEST (but sound can be heard during the Diagnostic Tests).

Check the sound-select inputs (pins 2 through 9 of U9) to see if they pulse during Sound Test 01. Also, check the -12 V supply voltage on the CPU Board. If this voltage is low (or AC ripple seems too high), perform the following checks:

1. The gray and gray-green transformer secondary wires for 19.4 VAC.
2. The CPU Board filter capacitor C26 for -12 VDC.
3. The filter capacitor C26 for excessive AC ripple (over 0.75VAC).

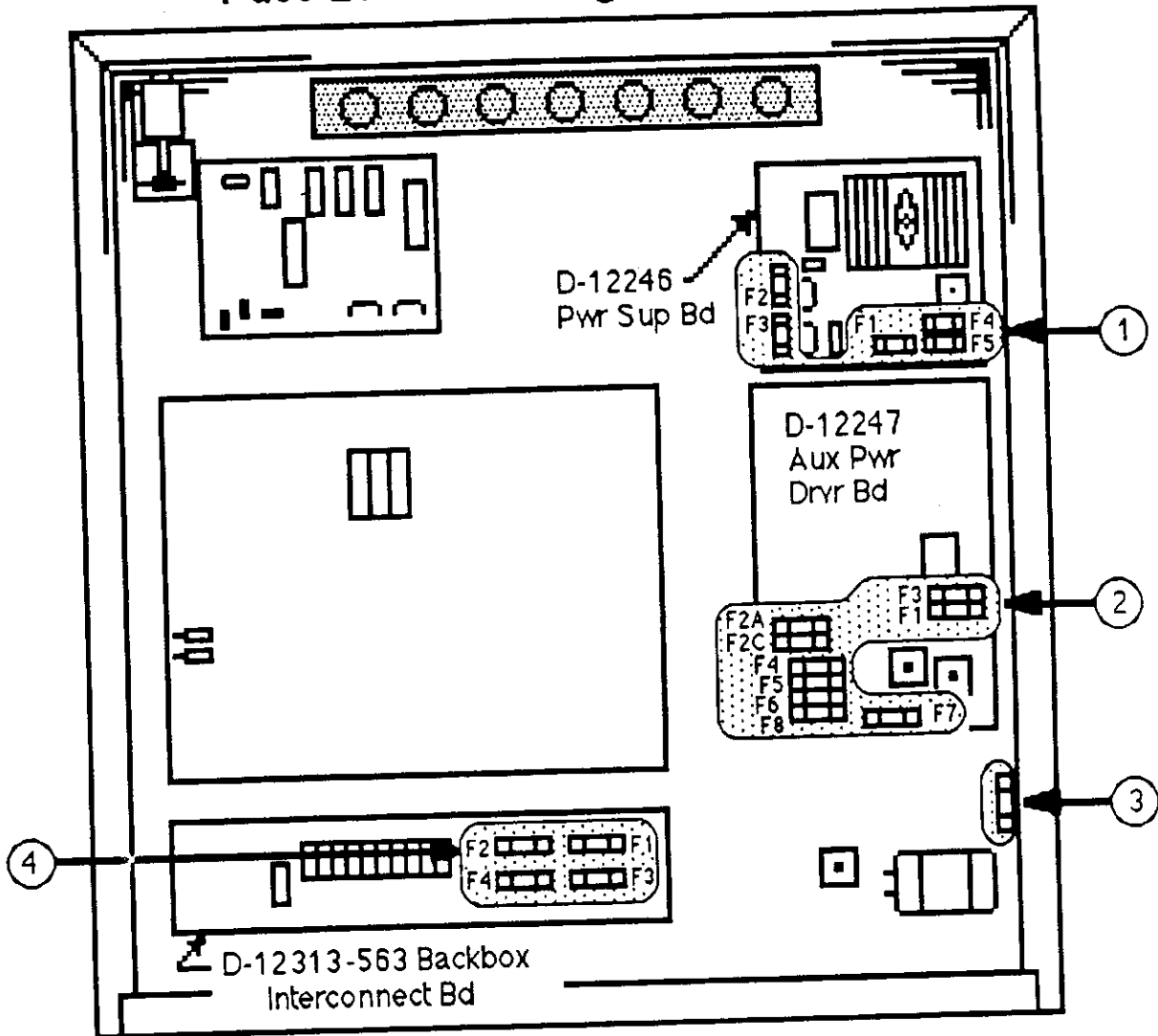
If the previous checks did not isolate the problem, turn the Volume Control for maximum output. Momentarily touch a powered-up AC soldering pencil on the center tap of the Volume Control.

CAUTION

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

Hearing a low hum or a 'click' indicates that the power amplifier (U1, TDA2002), the Volume Control, and the speaker are operating satisfactorily, as is the sound circuit cabling. Not hearing a sound requires repeating the test with the Volume Control turned part way down, to determine whether the Volume Control is faulty. Also, check the cable connectors for proper mating, and that no broken wires affect this circuit.

Fuse Locations Diagram & Listing



Note: Under the Upper Playfield near the top center above the Jet Bumpers is a 2.5A., 250V, S-B, fuse (p/n 5731-09128-00) in the Red-White line powering the Jet Bumpers.

Fuse Listing

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

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

MAINTENANCE INFORMATION

Figure 4 shows the two main lubrication points of the Shooter Lane Feeder. The shaded arrows show the directions in which the Shooter Lane Feeder and other parts of its related assemblies can be adjusted for proper operation. Note that the mechanisms of the Eject Hole Arm Assembly is quite similar to the Shooter Lane Feeder; it has the same lubrication requirements and adjustment capabilities as the Shooter Lane Feeder.

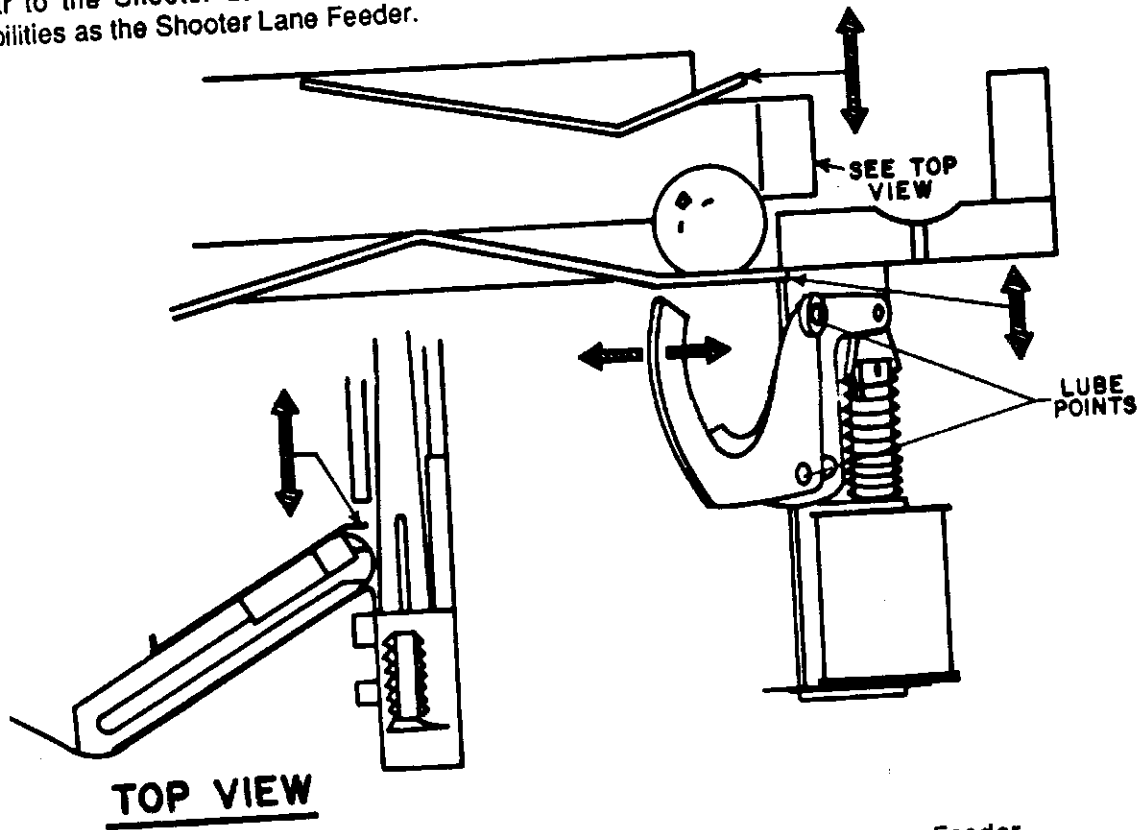


Figure 4. Adjustments and Lubrication Points, Shooter Lane Feeder.

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

Lubrication to ensure proper operation also applies to the target blades of each 3-Bank Drop Target. Regular maintenance is essential to a game's continuing contribution to the operator's earnings.

Section 2

Game Parts Information

- ***Parts Lists & Diagrams***

Locations:

Game Circuit Boards and Major Mechanisms

Power Supply Board (D-12246)

Aux Power Driver Board (D-12247-563)

Backbox Interconnect Board (D-12313-563)

Audio Board (D-11581-563)

System 11-B CPU Board (D-11883-563)

Master Display Board (D-12232-1)

Lamp Boards

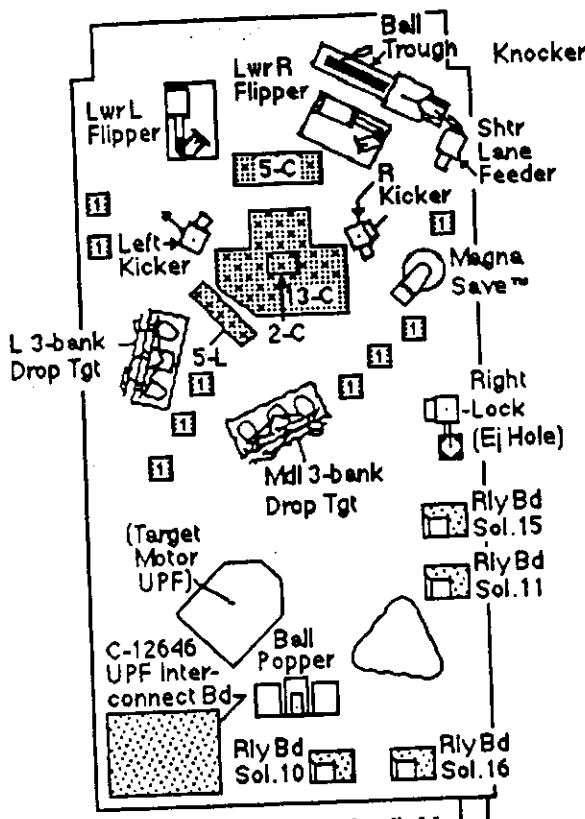
All Major Mechanism Assemblies of Black Knight 2000

Solenoids/Flashers & Rubber Parts

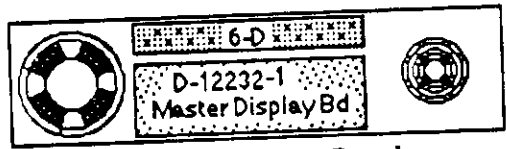
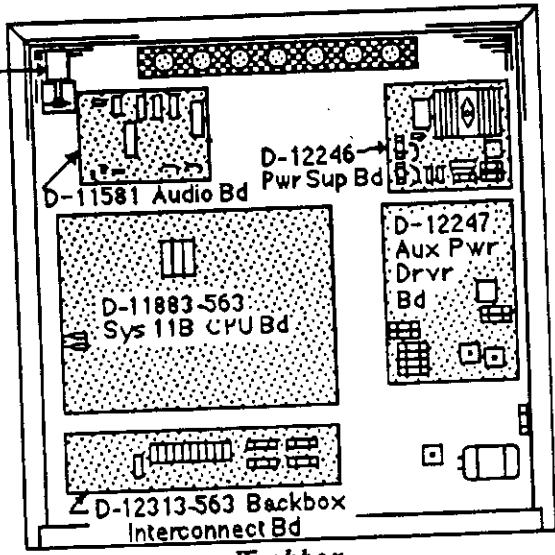
Switches

Lamps

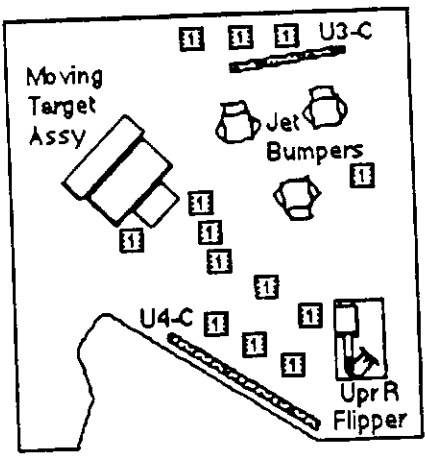
Playfield Parts



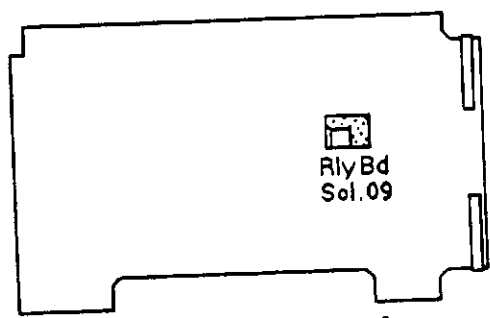
*Underside of Lower Playfield
Viewed in Raised Position*



Display/Speaker Panel






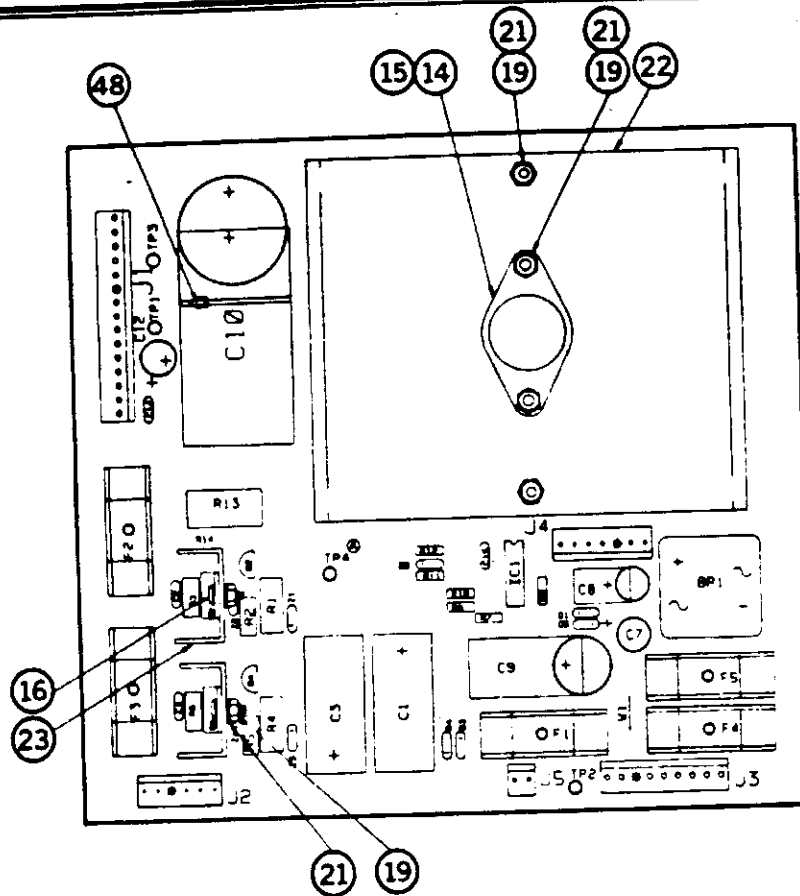
*Underside of Upper Playfield
Viewed in Raised Position*



*Inside of Insert Board
Viewed in Open Position*

LOCATIONS

-  Circuit Boards
-  Lamp Boards
-  Major Mechanisms

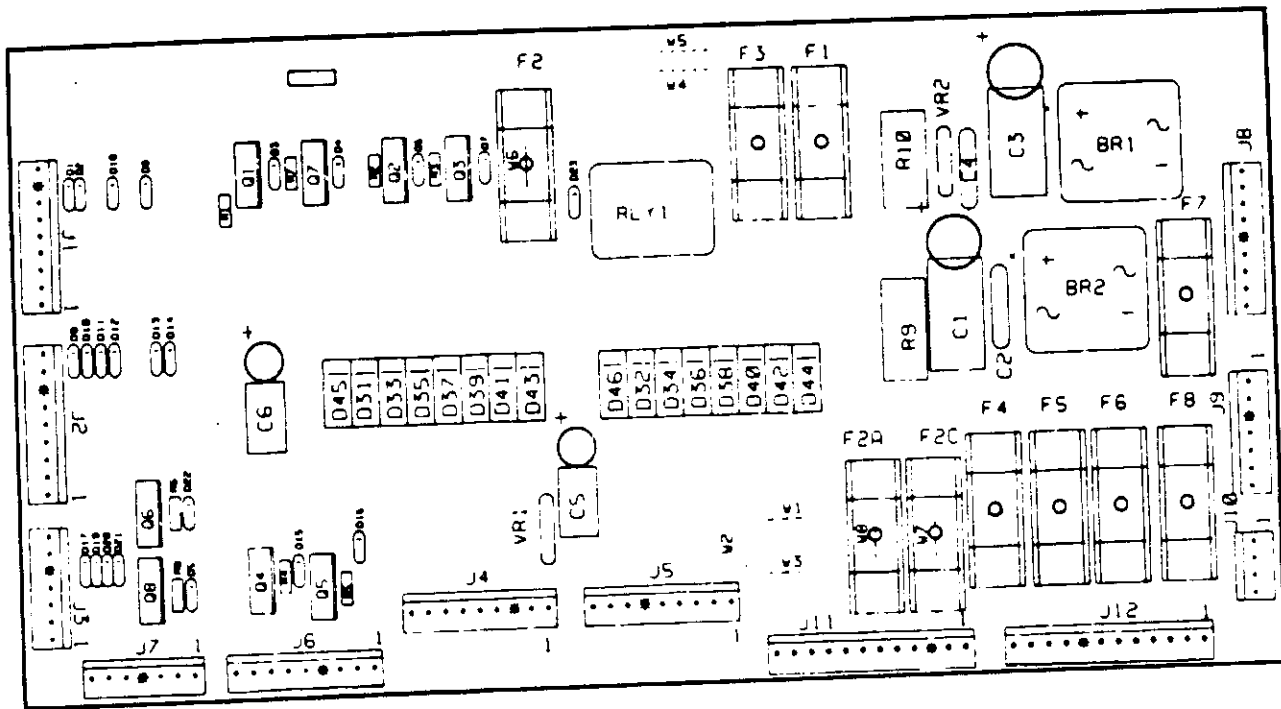


Power Supply
p/n D-12246

| Item | Part No. | Ckt Designator | Description | Item | Part No. | Ckt Designator | Description |
|------|---------------|----------------|------------------------------------|------|---------------|----------------|----------------------------------|
| 1 | 5765-12317-00 | | Power Supply PCB | 26 | 5075-09060-00 | ZR2, ZR4 | Zener, 1N4764, 100v, 1w |
| 2 | 5733-12060-01 | F1-F5 | Fuse Holder | 27 | 5460-09424-00 | IC1 | IC, Volt. Reg., MC1723C5 |
| 3 | 5731-09432-00 | F4, F5 | Fuse, 7A., S-B, 250v | 28 | 5010-09069-00 | R3, R6 | Resistor, 330K, 5%, 1/2w, C.F. |
| 4 | 5731-12328-00 | F1 | Fuse, 3/8A., S-B, 250v | 29 | 5010-10631-00 | R2, R5 | Resistor, 1.2K, 5%, 1/2w |
| 5 | 5730-12327-00 | F2, F3 | Fuse 1/8 A., 250v | 30 | 5010-09536-00 | R1, R4 | Resistor, 39K, 5%, 1w |
| 6 | 5791-10862-15 | J1 | Connector, 15-pin Hdr, Sq Pin .156 | 31 | 5013-09426-00 | R7 | Resistor, 2.15K, 1%, 1/4w, C. F. |
| 7 | 5791-10862-06 | J2 | Connector, 6-pin Hdr, Sq Pin .156 | 32 | 5013-09427-00 | R8 | Resistor, 4.99K, 1%, 1/4w, C. F. |
| 8 | 5791-10862-09 | J3 | Connector, 9-pin Hdr, Sq Pin .156 | 33 | 5010-09541-00 | R9 | Resistor, 2.7K, 2%, 1/4w, C. F. |
| 9 | 5100-09690-00 | BR1 | Bridge Rectifier, 35A., 200V | 34 | 5010-09085-00 | R10 | Resistor, 1.5K, 5%, 1/4w, C. F. |
| 10 | 5164-12154-00 | Q1 | Transistor, MJE15030, NPN | 35 | 5010-09428-00 | R11 | Resistor, 1.5K, 2%, 1/4w, C. F. |
| 11 | 5194-12155-00 | Q3 | Transistor, MJE15031, PNP | 36 | 5010-09508-00 | R12 | Resistor, 270Ω, 2%, 1/4w, C. F37 |
| 12 | 5194-09055-00 | Q2 | Transistor, MPSD52, PNP | 37 | 5012-09429-00 | R13 | Resistor, 0.12Ω, 5%, 5w |
| 13 | 5164-09056-00 | Q4 | Transistor, MPSD02, NPN | 38 | 5040-12324-00 | C1, C3 | Capacitor, 150 mfd, 160v, radial |
| 14 | 5162-09425-00 | Q5 | Transistor, 2N6057, NPN | 39 | 5043-09072-00 | C2, C4 | Capacitor, 0.1 mfd, 500v, disc |
| 15 | 5701-09652-00 | | Thermal Pad T0-3 | 40 | 5040-09421-00 | C7 | Capacitor, 100 mfd, 25v, radial |
| 16 | 4006-01003-06 | | Mach. Screw, 6-32 x 3/8 | 41 | 5040-09422-00 | C8 | Capacitor, 47 mfd, 50v, radial |
| 17 | 4006-01003-08 | | Mach. Screw, 6-32 x 1/2 | 42 | 5040-09420-00 | C9 | Capacitor, 1000 mfd, electr. |
| 18 | 20-9229 | | Thermal Compound | 43 | 5040-08893-00 | C10 | Capacitor, 18,000 mfd, electr. |
| 19 | 4406-01117-00 | | Nut, 6-32 Hex. | | | | 20v, axial |
| 20 | 5010-09534-00 | W1 | Resistor, 0Ω | 44 | 5040-09423-00 | C12 | Capacitor, 330 mfd, electr. |
| 21 | 4703-00007-00 | | Lockwasher, #6 Ext. | | | | 10v, radial |
| 22 | 5705-12330-00 | | Heatsink 4" | 45 | 5043-09446-00 | C14 | Capacitor, 0.1 mfd, 50v, disc |
| 23 | 5705-09199-00 | | Heatsink 6030B | 46 | 5043-09065-00 | C15 | Capacitor, 470 pfd |
| 24 | 5070-09054-00 | D1, D3 - D6 | Diode, 1N4004 | 47 | 5824-09248-00 | TP1-TP4 | Terminal, #1502-1 (Test Post) |
| 25 | 5075-09059-00 | ZR1, ZR3 | Zener, 1N5990, 3.9v, 1/2w | 48 | 03-7947 | | Tie Wrap, 8" Long |

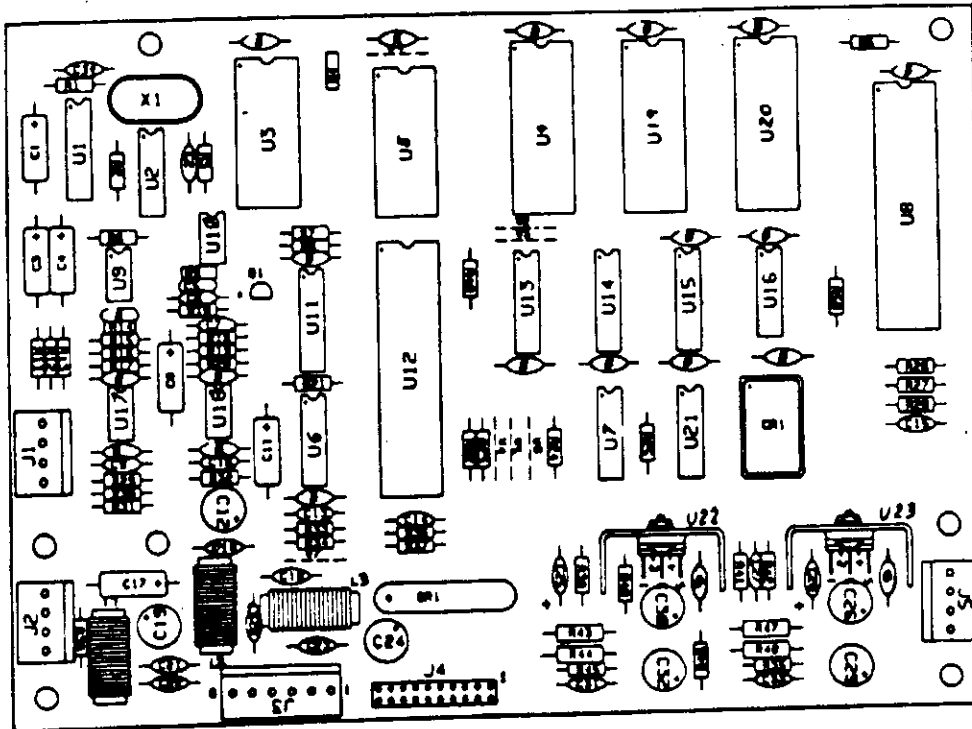
NOTES:

1. Heat sink compound must be applied between transistor and heat sink.
2. Observe index mark on integrated circuit, polarity of capacitors and diodes, and position of transistors.
3. The view of Q5 and its related heat sink and hardware is from the bottom of the heatsink, to clarify installation.



Aux Power Driver Unit Board
p/n D-12247-563

| Part No. | Ckt Designator | Description |
|---------------|---------------------|--|
| 5763-12184-00 | | Bare P.C. Board |
| 5040-09537-00 | C1, C3 | Capacitor, 100 μ fd., 100v, Radial |
| 5040-12181-00 | C5, C6 | Capacitor, 10 μ fd., 100v, Radial |
| 5043-09072-00 | C2, C4 | Capacitor, 0.1 μ fd., 500v |
| 5010-09160-00 | R1 - R8 | Resistor, 220 Ω , 1/4w C.F., 5% |
| 5012-12238-00 | R9 | Resistor, 3.3K Ω , 5w, 10% |
| 5010-09534-00 | W1, W3, W4, W6 | Resistor, 0 Ω , 1/4w |
| 5017-12180-00 | VR1, VR2 | Varistor, 100v |
| 5100-09690-00 | BR1, BR2 | Bridge Rectifier, 35A, 200v |
| 5070-08785-00 | D1 - D23 | Diode, 1N4003 |
| 5070-09045-00 | D31 - D46 | Diode, MR501 |
| 5191-12179-00 | Q1 - Q8 | Transistor, TIP36C |
| 5580-09555-01 | K1 | Relay, DPDT, 13A |
| 5733-12060-01 | | Fuse Holder |
| 5731-08665-00 | F5, F6 | Fuse, 2A, S-B, 250v |
| 5731-09128-00 | F1, F2A | Fuse, 2-1/2A, S-B, 250v |
| 5731-09651-00 | F2C, F3, F4 | Fuse, 5A, S-B, 250v |
| 5731-06314-00 | F7 | Fuse, 4A, S-B, 250v |
| 5731-09432-00 | F8 | Fuse, 7A, S-B, 250v |
| 5791-10862-09 | J1, J2, J4 - J6, J8 | Connector, 9-pin Hdr, Sq Pin |
| 5791-10862-07 | J3, J7, J9 | Connector, 7-pin Hdr, Sq Pin |
| 5791-10862-12 | J11, J12 | Connector, 12-pin Hdr, Sq Pin |
| 5791-10862-04 | J10 | Connector, 4-pin Hdr, Sq Pin |
| 16-8850-252 | | P.C.B. I.D. Label |



Audio Board Assembly p/n D-11581-563

| Part No. | Ckt Designator | Description | Part No. | Ckt Designator | Description |
|------------------|----------------|-----------------------------------|---------------|---|---|
| 5766-12130-00 | | Bare P. C. Board | 5010-08998-00 | R2, R3, R12 | Resistor, 2.2K, 1/4w, 5% |
| 5371-11087-00 | U1 | IC, D/A Conv, YM3012 | 5010-08983-00 | R7-R9 | Resistor, 3.3K, 1/4w, 5% |
| a) 5700-09006-00 | | Socket, IC, 16-pin (U1) | 5010-08991-00 | R1, R4, R5, R11, R26 - R28, R33, R36, R37, R49, R50 | Resistor, 4.7K, 1/4w, 5% |
| 5370-11086-00 | U3 | IC, Sound Processor, YM2151 | 5010-09034-00 | R14 - R17 | Resistor, 10K, 1/4w, 5% |
| a) 5700-09004-00 | | Socket, IC, 24-pin (U3) | 5010-09324-00 | R6, R38 | Resistor, 27K, 1/4w, 5% |
| 5400-10320-00 | U8 | IC, μ Processor, MC68B09E | 5010-09162-00 | R39 | Resistor, 100K, 1/4w, 5% |
| a) 5700-08985-00 | | Socket, IC, 40-pin (U8) | 5010-10258-00 | R40 | Resistor, 1M, 1/4w, 5% |
| A-5343-563-5 | U4 | IC, Audio ROM 1 | 5010-09179-00 | R10 | Resistor, 3.3M, 1/4w, 5% |
| A-5343-563-6 | U19 | IC, Audio ROM 2 | 5010-09534-00 | W9 | Resistor, 0 Ω , 1/4w, 5% |
| a) 5700-10176-00 | | Socket, IC, 28-pin (U4, U19) | 5040-09343-00 | C1, C3, C4, C8 | Capacitor, 10 μ f, 20v, \pm 20% |
| 5371-09152-00 | U11 | IC, D/A Convtr, MC1408 | 5040-10974-00 | C12, C19, C24 | Capacitor, 100 μ f, 35v |
| 5430-10322-00 | U12 | IC, PIA, MC68B21 | 5040-10976-00 | C26, C30 | Capacitor, 470 μ f, 16v, +50, -10% |
| 5340-10139-00 | U5 | IC, RAM/S 5516-2 2Kx8 | 5040-12006-00 | C29, C32 | Capacitor, 1000 μ f, 18v, 20% |
| 5281-09487-00 | U16 | IC, Dual D Flipflop, 74LS74 | 5041-09243-00 | C25, C28 | Capacitor, 10 μ f, 10v, \pm 10% |
| 5281-10043-00 | U13 | IC, 74LS175 | 5043-08980-00 | C5, B (17)* | Capacitor, 0.01 μ f, 50v, +80, -20% |
| 5281-09235-00 | U21 | IC, Triple NAND, 74LS10 | 5043-08996-00 | C31, C33 | Capacitor, 0.1 μ f, 50v, \pm 20% |
| 5370-09321-00 | U9, U10, U17 | IC, Op Amp, MC1458 | 5043-09065-00 | C13 - C15 | Capacitor, 470 pfd, 50v, \pm 20% |
| 5281-09215-00 | U2 | IC, Hex Inv, 74LS04 | 5043-09492-00 | C2, C34 | Capacitor, 100 pfd, 50v, \pm 10% |
| 5281-09246-00 | U14 | IC, 2-4 Dec, 74LS139 | 5043-09844-00 | C6 | Capacitor, 47 pfd, 50v, \pm 20% |
| 5281-09745-00 | U15 | IC, Dual Mux, 74LS138 | 5043-09845-00 | C16, C18, C20 - C23, C27 | Capacitor, 1000 pfd, 50v, \pm 20% |
| 5370-09156-00 | U22, U23 | IC, Audio Amp, TDA2002 | 5520-09020-00 | X1 | Crystal, 3.58 MHz |
| a) 5705-09199-00 | | Heatsink, #6030B | 5521-10931-00 | CR1 | Oscillator, 8 MHz |
| b) 4006-01003-08 | | Mach. Screw, 6-32 x 3/8 | 5551-09822-00 | L1 - L3 | Inductor, 4.7 μ H, 3A |
| c) 4406-01117-00 | | Nut, 6-32 Hex. | 5791-09437-00 | J4 | Connector, 20 pin, (Hdr), Rib. Cbl |
| d) 4703-00007-00 | | Lockwasher, #6 Ext. | 5791-10862-04 | J1, J2, J5 | Connector, 4 pin (Hdr) |
| 5160-10269-00 | Q1 | Transistor, 2N3904, NPN | 5791-10862-06 | J3 | Connector, 8 pin (Hdr) |
| 5060-10396-00 | SP1 | SIP 4.7K & 470pfd, 8R8C | 16-8850-250 | | P.C.B. I.D. Label |
| 5010-09181-00 | R44, R48 | Resistor, 1.0 Ω , 1/2w, 5% | 20-9229 | | Thermal Compound |
| 5010-09181-00 | R35, R45 | Resistor, 2.2 Ω , 1/4w, 5% | | | |
| 5010-09361-00 | R43, R46, R47 | Resistor, 220 Ω , 1/2w, 5% | | | |
| 5010-09358-00 | R41, R42 | Resistor, 1K, 1/4w, 5% | | | |

NOTES:

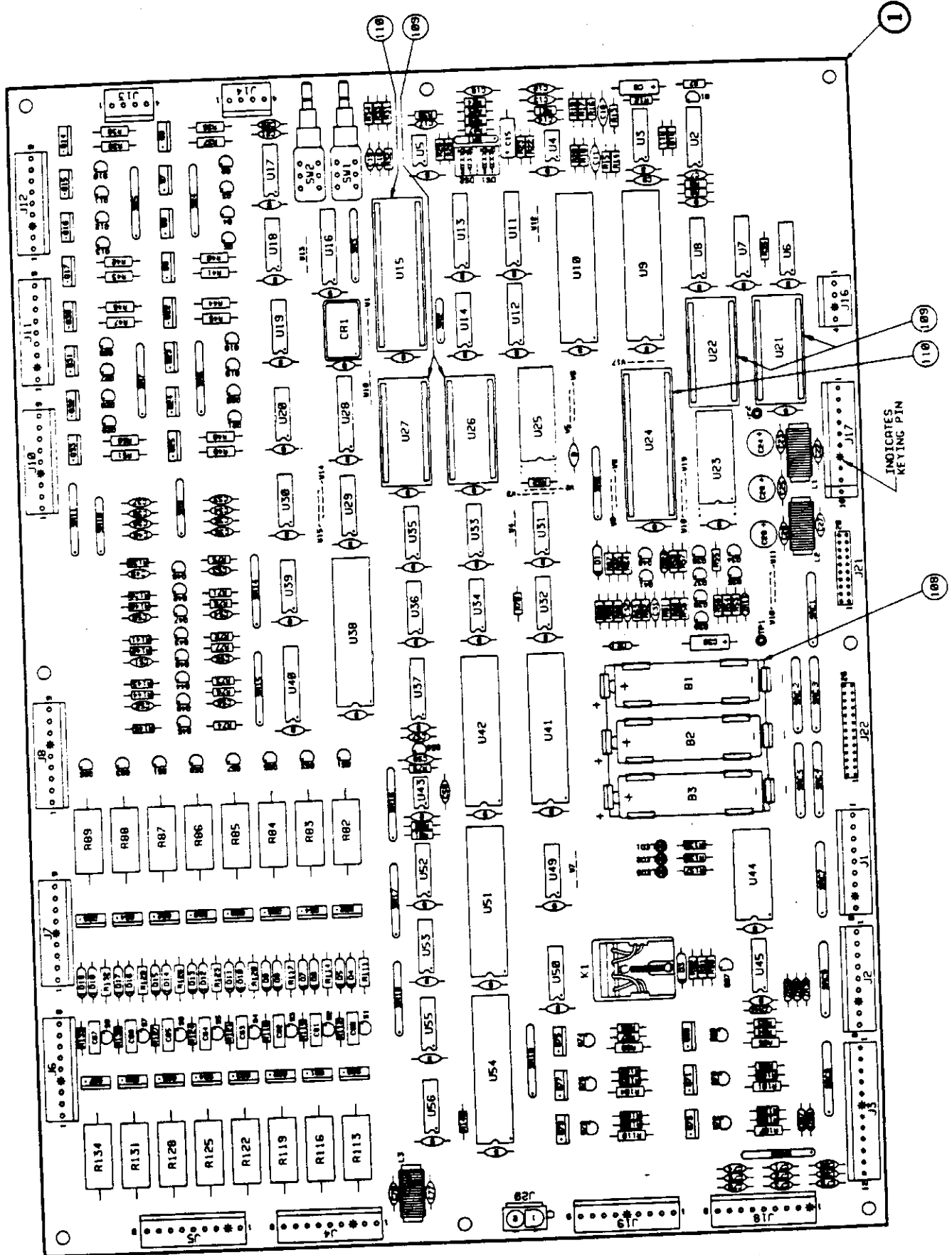
- * 17 capacitors (shown on diagram with "B" symbol) provide +5VDC filtering for ICs.
- All capacitors are ceramic, 50v, axial, unless otherwise noted.
- All resistors are 5%, 1/4w, Carbon Film, unless otherwise noted.

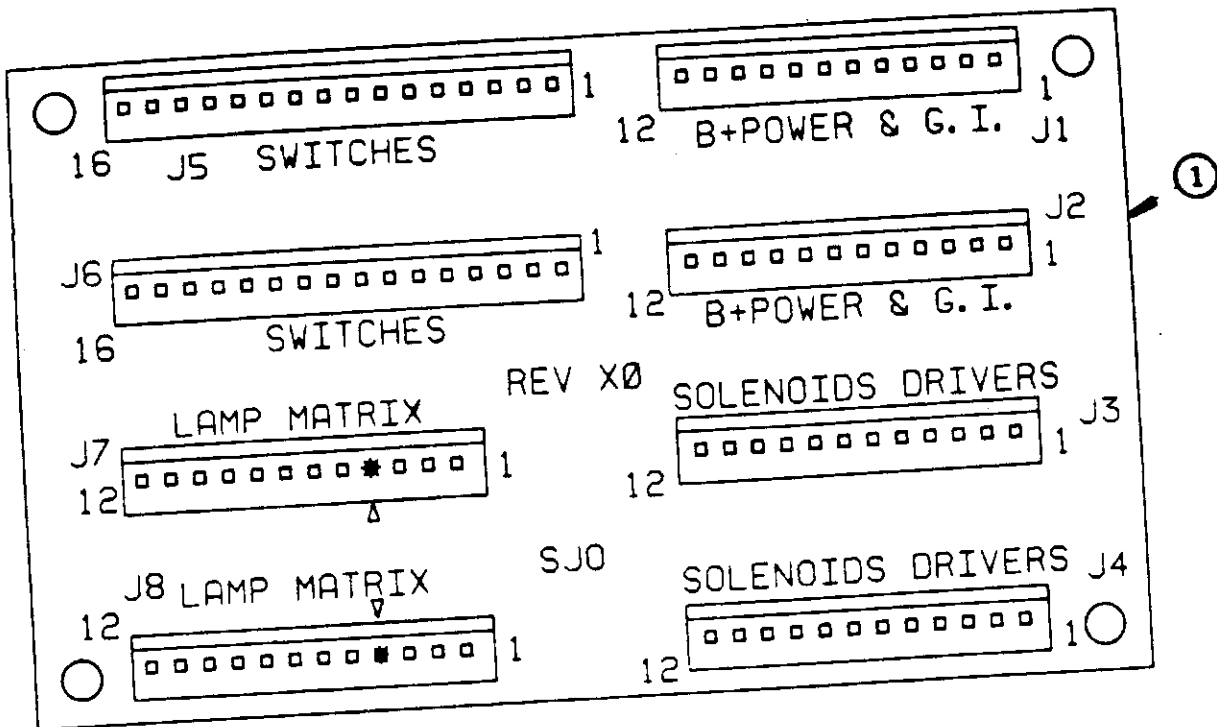
System 11B CPU Board
p/n D-11883-563

| Item | Part No. | Ctd Designator | Description | Item | Part No. | Ctd Designator | Description |
|------|---------------|--|-------------------------------------|-----------|---------------|---|--|
| 1 | 5784-12208-00 | | Bare P. C. Board | 62 | 5010-10003-00 | R62, R63 | Resistor, 380Ω, 5%, 1/4w, C. F. |
| 2 | 5370-09891-00 | U3 | IC, CVSD Mod., 56538 | 63 | 5010-10171-00 | R67 | Resistor, 580Ω, 5%, 1/4w, C. F. |
| 3 | 5370-09321-00 | U4, U5 | IC, Dual Op Amp, 1458 | 64 | 5010-10170-00 | R69 | Resistor, 470Ω, 5%, 1/4w, C. F. |
| 4 | 5281-09308-00 | U16 | IC, Octal Bus Xcvr, 74LS245 | 65 | 5010-09180-00 | R59, R61, W12, W13 | Resistor, 220Ω, 5%, 1/4w, C. F. |
| 5 | 5430-08972-00 | U8, U10, U38, U41, U42, U51, U54 | IC, PIA, MC6820/6821 | 66 | 5010-08418-00 | R33, R34, R71-R78, R135-R137 | Resistor, 470Ω, 5%, 1/4w, C. F. |
| 8 | 5340-10139-00 | U25 | IC, 2K x 8 CMOS Static RAM | 67 | 5010-09179-00 | R9 | Resistor, 3.3MΩ, 5%, 1/4w, C. F. |
| 7 | 5280-09010-00 | U44 | IC, 4-16 Decoder, 74154 | 68 | Not Used | | |
| 8 | 5281-09248-00 | U7, U8, U12 | IC, 2-4 Decoder, 74LS139 | 69 | 5010-10831-00 | R111, R114, R117, R120, R123, R126, R129, R13 | Resistor, 1.2KΩ, 5%, 1/2w, C. F. |
| 9 | 5075-09406-00 | ZR3 - ZR8 | Diode, Zener, 6.2v, 0.5w | 70 | Not Used | | |
| 10 | 5164-10998-00 | Q42 - Q49 | Transistor, NPN, 2N5550, TO-92 | 71 | Not Used | | |
| 11 | 5281-09487-00 | U6 | IC, Dual D Flip-Flop, 74LS74 | 72 | 5010-09120-00 | R17 | Resistor, 270KΩ, 5%, 1/4w, C. F. |
| 12 | 5431-09449-00 | U43 | IC, Timer, MC1455 | 73 | 5010-09333-00 | R15, R16, R18 | Resistor, 180KΩ, 5%, 1/4w, C. F. |
| 13 | 5310-09238-00 | U29 | IC, 14-b Counter, 4020 | 74 | 5010-09324-00 | R29, R30 | Resistor, 27KΩ, 5%, 1/4w, C. F. |
| 14 | 5281-09743-00 | U32 | IC, Quad 2-Input AND, 74LS08 | 75 | 5010-09269-00 | R20, R21 | Resistor, 12KΩ, 5%, 1/4w, C. F. |
| 15 | 5281-09247-00 | U14 | IC, Quad 2-Input NOR, 74LS02 | 76 | 5010-09356-00 | R27, R28 | Resistor, 820Ω, 5%, 1/4w, C. F. |
| 16 | 5281-09235-00 | U35 | IC, Triple 3-Input NAND, 74LS10 | 77 | 5019-09783-00 | SIP, SR | SIP, SR, 10-pin, 8.8KΩ, 125w/R, 5% |
| 17 | 5280-09013-00 | U38 | IC, Hex Inverter, 7404 | 78 | 5019-09362-00 | SR18 | SIP, SR, 10-pin, 4.7KΩ, 125w/R, 5% |
| 18 | 5281-09499-00 | U31, U34 | IC, Quad 2-Input NAND, 74LS00 | 79 | 5019-09808-00 | SR3, SR15, SR17, SR19, SR20 | |
| 19 | 5281-10014-00 | U33 | IC, Dual 4-Input NAND, 74LS20 | 80 | 5019-09785-00 | SR4, SR6, SR11 | SIP, SR, 10-pin, 560Ω, 125w/R, 5% |
| 20 | 5281-09486-00 | U28 | IC, Octal D Flip-Flop, 74LS374 | 81 | 5019-10472-00 | SR16 | SIP, SR, 10-pin, 3.3KΩ, 125w/R, 5% |
| 21 | 5371-09152-00 | U2 | IC, D/A Converter, MC1408 | 82 | 5019-09689-00 | SR8 | SIP, SR, 10-pin, 1.0KΩ, 125w/R, 5% |
| 22 | 5281-09745-00 | U37 | IC, 3-8 Decoder, 74LS138 | 83 | 5019-09780-00 | SR9, SR10 | SIP, SR, 8-pin, 1KΩ, 5% |
| 23 | 5340-09878-00 | U23 | IC, 2K x 8 Static RAM, 2018 | 84 | 5019-09786-00 | SR1, SR2 | SIP, SR, 8-pin, 4.7KΩ, 125w/R, 5% |
| 24 | Not Used | | | 85 | 5019-09782-00 | SR5, SR7 | SIP, SR, 10-pin, 2.7KΩ, 125w/R, 5% |
| 25 | 5281-09887-00 | U11, U13, U40 | IC, Octal Buffer, 74LS244 | 86 | 5080-10396-00 | SRC1 - SRC5, SRC7 - SRC8 | |
| 26 | 5280-08973-00 | U17-U20, U52, U53 | IC, Quad 2-Input AND, 7408 | 87 | 5010-08774-00 | R22 | Resistor, 22KΩ, 5%, 1/4w, C. F. |
| 27 | 5280-08974-00 | U55, U56 | IC, Hex Inverter, 7406 | 88 | 5043-08980-00 | C14, C17-C21, C31, C32, C49-C56, C59, + 54 Bypass, marked B | Capacitor, 0.01 μfd, 50v(±20%), Axial |
| 28 | 5310-09155-00 | U30, U39 | IC, Quad 2-Input NAND, MC14011 | 89 | 5043-09845-00 | C22, C23, C25, C27, C28 | Capacitor, 1K pfd, 50v(±20%), Axial |
| 29 | 5280-08948-00 | U45, U50 | IC, Quad 2-Input NOR, 7402 | 90 | 5043-08996-00 | C9, C70-75, C77, C78 | Capacitor, 0.1 μfd, 50v(±20%), Axial |
| 30 | 5280-09309-00 | U49 | IC, Hex Buffer, 7407 | 91 | 5040-09343-00 | C8, C15 | Capacitor, 10 μfd, Electr., 20v(±20%), Axial |
| 31 | 5671-09019-00 | LED1-LED3 | LED, Red, Display | 92 | 5043-09844-00 | C7 | Capacitor, 47 pfd, 50v(±20%), Axial |
| 32 | 5521-10506-00 | CR1 | Oscillator, 4 MHz | 93 | 5040-10674-00 | C24, C26, C29 | Capacitor, 100 μfd, Electr., 25v(+50, -10%), Axial |
| 33 | 5162-08976-00 | Q51, Q53, Q55, Q57, Q59, Q61, Q63, Q65, Q62, Q64, Q66, Q68, Q69, Q71, Q73, Q75, Q77, Q79, Q80-Q87 | Transistor, NPN Darl, 2N6427, TO-92 | 94 | Not Used | | |
| 34 | 5191-08978-00 | Q52, Q54, Q56, Q58, Q60, Q62, Q64, Q66, Q68-Q9, Q14-Q17, Q22-Q25, Q30-Q33, Q69, Q71, Q73, Q75, Q77, Q79, Q80-Q87 | Transistor, PNP, TIP42, TO-220 | 95 | 5045-09798-00 | C60-C67 | Capacitor, 0.1 μfd, Polycarbonate Rad., 100v(±10%) |
| 35 | 5162-09410-00 | Q2-Q5, Q10-Q13, Q18-Q21, Q26-Q29, Q34-Q38, Q41, Q67, Q68, Q70, Q72, Q74, Q76, Q78 | Transistor, NPN, 2N4401, TO-92 | 96 | 5043-09085-00 | C33-C40, C68, C69, C76, C10, C12 | Capacitor, 470 pfd, 50v(±20%), Axial |
| 36 | 5160-08938-00 | Q1, Q40, Q39, Q50, S1-S8, D3-D19, D2, ZR1, ZR2, R94, R97, R100, R103, R106, R108, R56 | Transistor, NPN, 2N3904, TO-92 | 97 | 5040-09545-00 | C30 | Capacitor, 22 μfd, Electr., 10v(+50, -10%), Axial |
| 37 | 5160-10289-00 | Q39, Q50 | Transistor, PNP, 2N4403, TO-92 | 98 | 5041-09031-00 | C58 | Capacitor, 1 μfd, Tantal., 25v(±20%), Axial |
| 38 | 5190-09016-00 | S1-S8 | SCR, 30v, 0.8A, 2N5080 | 99 | 5043-09030-00 | C16, C57 | Capacitor, 0.047 μfd, 50v(±20%), Axial |
| 39 | 5130-09014-00 | D3-D19 | Diode, 1N4001 | 100 | Not Used | | |
| 40 | 5070-08919-00 | D2 | Diode, 1N5817, 1.0A | 101 | 5043-09492-00 | C11 | Capacitor, 100 pfd, ceramic, 100v(±20%) |
| 41 | 5070-09266-00 | D1 | Diode, Zener, 1N5996A, 6.8v, 0.5w | 102 | Not Used | | |
| 42 | 5075-09018-00 | ZR1 | Diode, Zener, 1N5990, 3.9v, 0.5w | 103 | 5048-10982-00 | C13 | Capacitor, 4700 pfd, ceramic, 50v(±10%) |
| 43 | 5075-09059-00 | ZR2 | Diode, Zener, 1N5990, 3.9v, 0.5w | 104 | 5551-09822-00 | L1-L3 | Inductor, 4.7 μH, 3A |
| 44 | 5075-09059-00 | R94, R97, R100, R103, R106, R108 | Resistor, 580Ω, 5%, 1/4w, C. F. | 105 | 5641-09312-00 | SW1, SW2 | Switch, Pushbutton, DPDT, 100v, 5A |
| 45 | 5010-08992-00 | R56 | Resistor, 10Ω, 5%, 1/4w, C. F. | 106 | 5880-09022-00 | B1-B3 | Battery, Alkaline, 1.5v, AA |
| 46 | 5010-09039-00 | W1, W2, W4, W5, W7, W8, W11, W14, W16, W17, W19 | Resistor, 0Ω, 5%, 1/4w, C. F. | 107 | 20-8491 | W18, W19 | Bus Wire, Jumper |
| 47 | 5010-09534-00 | R31, R32, R35, R52, R55, R68, R92, R148, R54, R57, R58, R64, R66, R138-R145 | Resistor, 4.7KΩ, 5%, 1/4w, C. F. | 108 | 5881-09021-00 | | Battery Holder, #171 |
| 48 | 5010-08991-00 | R56, R68, R92, R148, R54, R57, R58, R64, R66, R138-R145 | Resistor, 1.0KΩ, 5%, 1/4w, C. F. | 109 | 5700-10176-00 | | IC Socket, 28 pin |
| 49 | 5010-09358-00 | R78 | Resistor, 33KΩ, 5%, 1/4w, C. F. | a | A-5343-563-1 | U26 | IC, Game ROM 2, 27128 |
| 50 | 5010-09113-00 | R79 | Resistor, 3.3KΩ, 5%, 1/4w, C. F. | b | A-5343-563-2 | U27 | IC, Game ROM 1, 27256 |
| 51 | 5010-08983-00 | R7, R8, R10, R70, R80 | Resistor, 10KΩ, 5%, 1/4w, C. F. | c | A-5343-563-3 | U22 | IC, Sound ROM 2, 27256 |
| 52 | 5010-09034-00 | R11, R14, R25, R26, R53, R60, R65, R80 | Resistor, 10KΩ, 5%, 1/4w, C. F. | d | A-5343-563-4 | U21 | IC, Sound ROM 1, 27256 |
| 53 | 5010-09086-00 | R81 | Resistor, 8.8KΩ, 5%, 1/4w, C. F. | 110 | 5700-09985-00 | U15 | IC Socket, 40 pin |
| 54 | 5010-09363-00 | R3 | Resistor, 5.6KΩ, 5%, 1/4w, C. F. | a | 5400-09150-00 | U16 | IC, μProcessor, 6802 |
| 55 | 5010-08997-00 | R23, R24, R91, R93, R96, R98, R102, R105, R106, R108, R112, R115, R118, R121, R124, R127, R130, R133 | Resistor, 2.7KΩ, 5%, 1/4w, C. F. | b | 5400-09150-00 | U24 | IC, μProcessor, 6802 |
| 56 | 5012-08037-00 | R113, R116, R119, R122, R125, R128, R131, R134 | Resistor, 0.4Ω, 5%, 3w, Wire-Wnd. | 111 | 5824-09248-00 | TP1, TP2 | Test Point |
| 57 | 5010-08993-00 | R36-R51, R95, R98, R101, R104, R107, R110 | Resistor, 68Ω, 5%, 1/2w, C. F. | 112 - 115 | Not Used | | |
| 58 | 5012-10880-00 | R82-R88 | Resistor, 27Ω, 5%, 2w, C. F. | 116 | 20-8229 | | Thermal Compound |
| 59 | Not Used | | | 117 | 5580-08994-01 | K1 | Relay, 4-pole, 40Ω, 8v |
| 60 | Not Used | | | 118 | 5791-10862-08 | J11, J2, J4-J8, J10-J12, J17-J19 | Connector, 8 pin (Hd) |
| 61 | 5010-10987-00 | R19 | Resistor, 56KΩ, 5%, 1/4w, C. F. | 119 | 5791-10862-04 | J13, J14, J16 | Connector, 4 pin (Hd) |
| | | | | 120 | 5791-10862-12 | J3 | Connector, 12 pin (Hd) |
| | | | | 121 | Not Used | | |
| | | | | 122 | 5791-10850-00 | J22 | Connector, 26 pin Ribbon (Hd) |
| | | | | 123 | 5791-09437-00 | J21 | Connector, 20 pin Ribbon (Hd) |

NOTES:

- For Schematic, refer to drawing #16-9019.
- Items 56 and 58 (resistors) must be mounted 1/8" above PCB surface.
- Standard Jumper: W1, W2, W4, W5, W7, W8, W11, W14, W16, W17, W19.

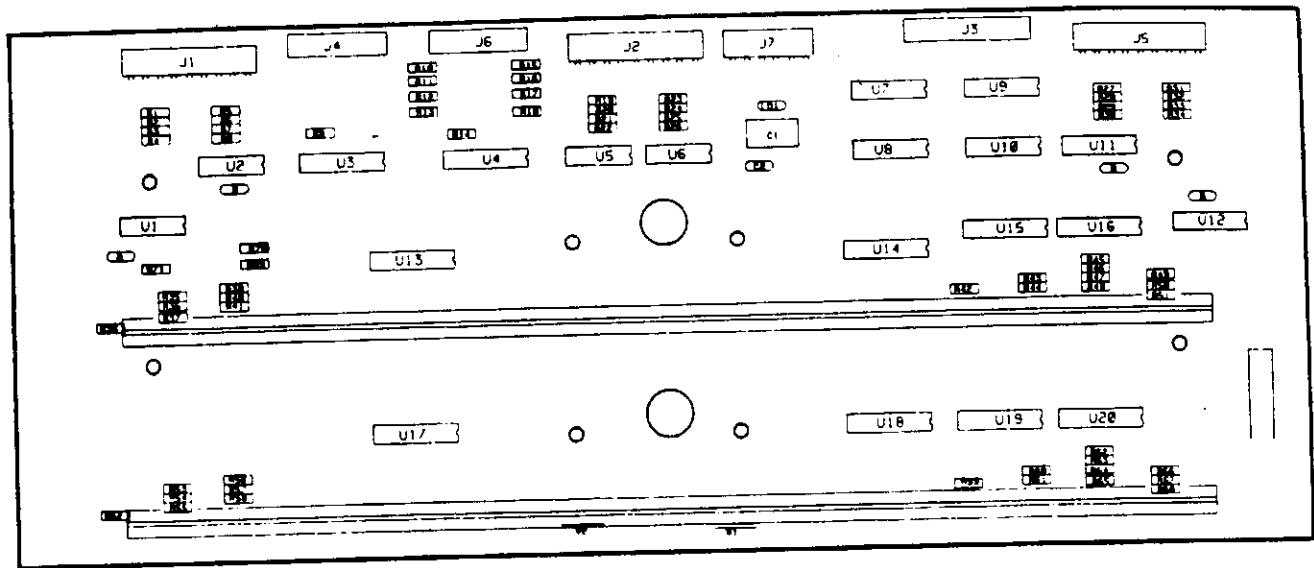




Upper Playfield Interconnect Board

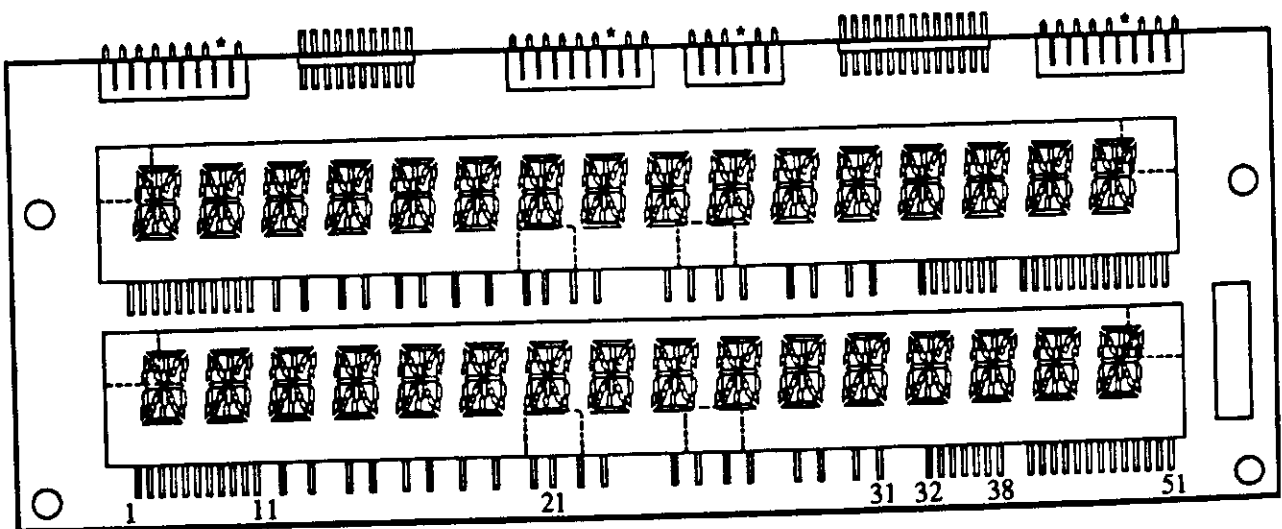
p/n C-12646

| Item | Part No. | Ckt Designator | Description |
|------|---------------|----------------|-----------------------------------|
| 1 | 5768-12398-00 | | Upper Playfield Interconnect PCB |
| 2 | 5791-10862-12 | J1-J4, J7, J8 | Connector, 12-pin Hdr Sq Pin .156 |
| 3 | 5791-10862-16 | J5, J6 | Connector, 16-pin Hdr Sq Pin .156 |

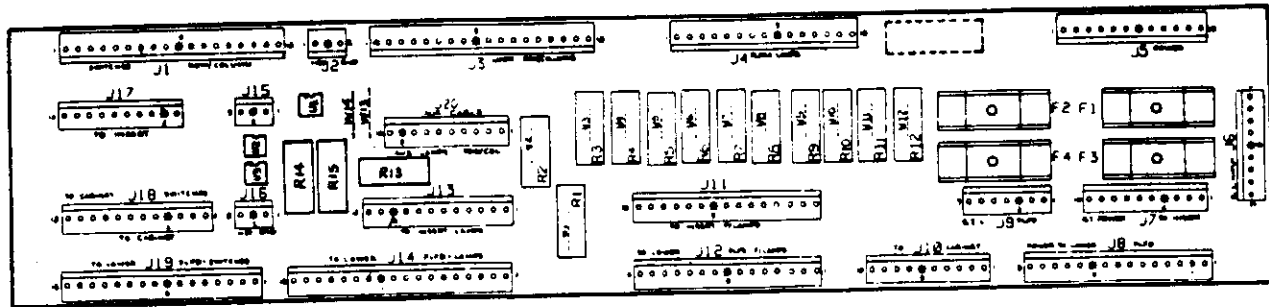


Master Display Board p/n D-12232-1

| Part No. | Ckt Designator | Description | Part No. | Ckt Designator | Description |
|---------------|--------------------|--|---------------|---|------------------------------------|
| 5760-12306-00 | | Bare P.C. Board | 5791-10851-00 | J3 | 26-pin Header, Rt. Angle |
| 5670-12308-00 | DSPL1, DSPL2 | Display, 16-Character, A/N | 5010-08773-00 | R1-R8, R19-R35, R41, R43, R45, R71 | Resistor, 18K Ω , 1/4w, 5% |
| 5310-09882-00 | U1, U2, U5, U8 | I.C. 4001 | 5010-10258-00 | R38, R52 | Resistor, 1M Ω , 1/4w, 5% |
| 5310-08975-00 | U7 - U12 | I.C. 4049 | 5010-10927-00 | R36, R39, R40, R42, R47, R48, R50, R51, R54, R56, R57, R59, R64, R65, R67, R68 | Resistor, 8.2K Ω , 1/2w, 5% |
| 5680-08969-00 | U13, U14, U17, U18 | I.C. 6184, Anode Driver | 5010-08981-00 | R37, R44, R46, R49 R55, R61, R63, R66 | Resistor, 10K Ω , 1/2w, 5% |
| 5680-08969-00 | U15, U16, U19, U20 | I.C. 7180, Cathode Driver | 03-8088-1 | Support | Support, Display |
| 5040-09343-00 | C1 | Axial Cap, 10 μ fd, 20v, \pm 20% | 16-8850-234 | Support | P.C.B. I.D. Label |
| 5043-08980-00 | Bypass | Axial Cap, 0.01 μ fd, 50v, +80, -20% | | | |
| 5075-09135-00 | D1, D2 | Zener, 1N4740A, 10v, 1w | | | |
| 5791-10869-09 | J1, J2, J5 | 9-pin Header, Rt. Angle | | | |
| 5791-10869-06 | J7 | 6-pin Header, Rt. Angle | | | |
| 23-6634 | | Cover, Display | | | |



16-Character Display Glass p/n 5670-12308-00



Backbox Interconnect Board p/n D-12313-563

| Part No. | Ckt Designator | Description |
|---------------|-------------------|-----------------------------------|
| 5768-12332-00 | | Master Interconnect Board |
| 5010-09534-00 | W9-W13 | Resistor, 0Ω |
| 5012-12238-00 | R14, R15 | Resistor, 3.3KΩ, 5w, 10% |
| 5012-12337-00 | R13 | Resistor, 1.5KΩ, 5w, 10% |
| 5012-10023-00 | R5, R8 | Resistor, 4Ω, 5w, 10% |
| 5012-12188-00 | R1-R4, R6, R7 | Resistor, 3Ω, 5w, 10% |
| 5490-10892-00 | U1 - U3 | Opto Isolator 4N25 |
| 5731-09651-00 | F1-F4 | Fuse, 5A.S.B., 250v |
| 5733-12060-01 | | Fuse Holder, F1-F4 |
| 5791-10862-03 | J2, J16 | Connector, 3 pin Hdr Sq Pin .156 |
| 5791-10862-07 | J9 | Connector, 7-pin Hdr Sq Pin .156 |
| 5791-10862-09 | J6 | Connector, 9-pin Hdr Sq Pin .156 |
| 5791-10862-10 | J7, J10, J20 | Connector, 10-pin Hdr Sq Pin .156 |
| 5791-10862-12 | J5, J13, J18 | Connector, 12-pin Hdr Sq Pin .156 |
| 5791-10862-15 | J8 | Connector, 15-pin Hdr Sq Pin .156 |
| 5791-10862-16 | J4, J11, J12, J19 | Connector, 16-pin Hdr Sq Pin .156 |
| 5791-10862-18 | J1, J3, J14 | Connector, 18-pin Hdr Sq Pin .156 |
| 16-8850-243 | | P.C.B. I.D. Label |

Spkr/Display Lamp Bd p/n C-12700

| Part No. | Description |
|---------------|---------------------------|
| 5768-12406-00 | Speaker Lamp PC Board |
| 24-8767 | Twist Lamp Socket |
| 24-8768 | Bulb, #555 (6.3v, .25 A.) |
| 5070-09054-00 | Diode, 1N4004, 1.0 A. |
| 5791-10871-08 | Header, 8-pin sq post |

Lamp Board ("2-C") p/n D-12503-1

| Part No. | Description |
|---------------|--------------------------|
| 5768-12241-00 | PC Board |
| 24-8803 - - | Twist Lamp Socket |
| 24-8802 | Bulb, #906 (13v, .69 A.) |
| 5070-09054-00 | Diode, 1N4004, 1.0 A. |
| 5791-10871-02 | Header, 2-pin sq post |

Lamp Board ("5-C")

p/n C-12519

| Part No. | Description |
|---------------|---------------------------|
| 5768-12380-00 | PC Board |
| 24-8767 | Twist Lamp Socket |
| 24-8768 | Bulb, #555 (6.3v, .25 A.) |
| 5070-09054-00 | Diode, 1N4004, 1.0 A. |
| 5791-10871-07 | Header, 7-pin sq post |

Lamp Board ("13-C")

p/n D-12503

| Part No. | Description |
|---------------|--------------------------|
| 5768-12379-00 | PC Board |
| 24-8767 | Twist Lamp Socket |
| 24-8768 | Bulb, #555 (6.3v, .25A.) |
| 5070-09054-00 | Diode, 1N4004, 1.0 A. |
| 5791-10871-12 | Header, 12-pin sq post |
| 5010-09534-00 | Resistor, 0Ω |

Lamp Board ("1")

p/n B-12224

| Part No. | Description |
|---------------|--------------------------|
| 5768-12312-00 | PC Board |
| 24-8767 | Twist Lamp Socket |
| 24-8768 | Bulb, #555 (6.3v, .25A.) |
| 5070-09054-00 | Diode, 1N4004, 1.0 A. |

Lamp Board ("5-L")

p/n D-12520

| Part No. | Description |
|---------------|--------------------------|
| 5768-12381-00 | PC Board |
| 24-8767 | Twist Lamp Socket |
| 24-8768 | Bulb, #555 (6.3v, .25A.) |
| 5070-09054-00 | Diode, 1N4004, 1.0 A. |
| 5791-10871-07 | Header, 7-pin sq post |

Lamp Board ("U3-C")

p/n C-12723

| Part No. | Description |
|---------------|--------------------------|
| 5768-12419-00 | Upper Playfield PC Board |
| 24-6549 | Light Bulb, #44 |
| 24-8757 | Miniature Socket |
| A-10231-1 | PCB Mtg Socket & Bulb |

Lamp Board ("U4-C")

p/n C-12724

| Part No. | Description |
|---------------|--------------------------|
| 5768-12420-00 | Upper Playfield PC Board |
| 24-6549 | Light Bulb, #44 |
| 24-8757 | Miniature Socket |
| A-10231-1 | PCB Mtg Socket & Bulb |

Relay Board (Sol. 11, 15 & 16)

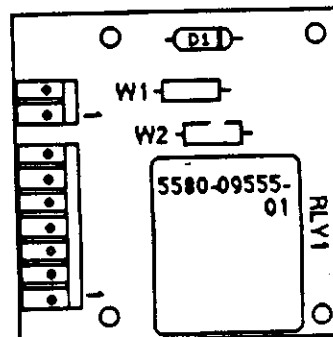
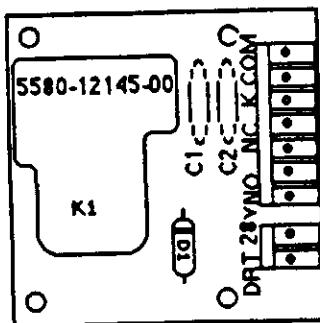
p/n C-11902-1

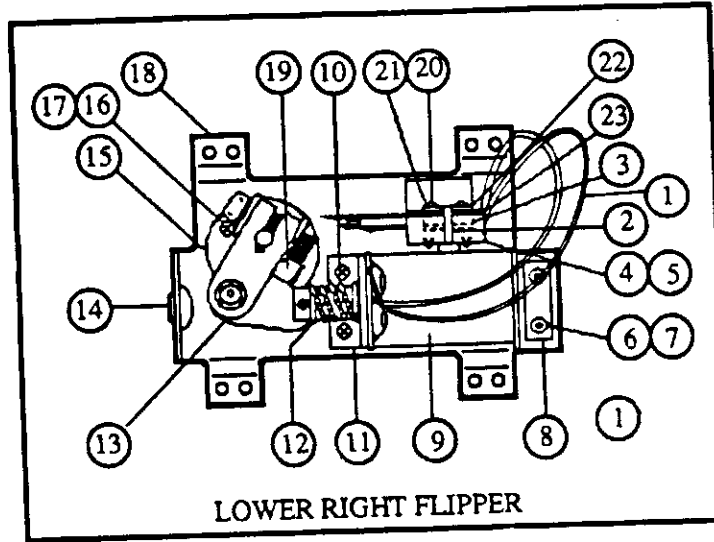
| Part No. | Description |
|---------------|----------------------------|
| 5768-12221-00 | PC Board |
| 5070-09054-00 | Diode, 1N4004, 1.0 A. |
| 5580-12145-00 | Relay, 24vdc, 30 A. |
| 5791-12273-02 | Header, 2-pin sq post (J1) |
| 5791-12273-07 | Header, 7 pin sq post (J2) |

Relay Board (Sol. 9 & 10 Gen. Illum)

p/n C-11998-1

| Part No. | Description |
|---------------|----------------------------|
| 5768-12243-00 | PC Board |
| 5070-09054-00 | Diode, 1N4004, 1.00 A (D1) |
| 5580-09555-01 | Relay, 24vdc, 30A (K1) |
| 5010-09534-00 | Resistor, 0Ω (W1, W2) |
| 5791-12273-02 | Header, 2-pin sq post (J1) |
| 5791-12273-07 | Header, 7-pin sq post (J2) |



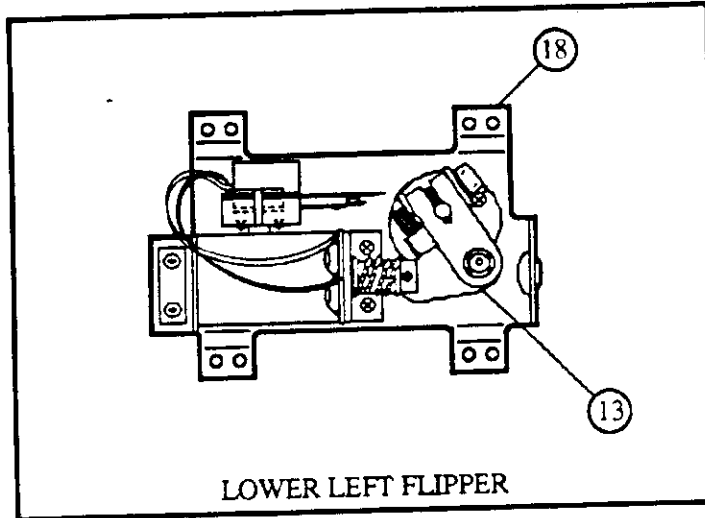


Lower Right Flipper
p/n C-11626-R-3

| Item | Part No. | Description | Item | Part No. | Description |
|------|---------------|---|------|---------------|--------------------------------|
| 1 | HW-30018-6 | Wire, 18 AWG, Blue | 17 | 4406-01117-00 | Nut, 6-32 Hex |
| 2 | 03-7520-2 | Ty-Wrap, Nylon | 18 | C-11627-R | Flipper Base Assembly, R. |
| 3 | 20-6516 | Speednut, Tinnerman | 19 | 06-14G | Insulating Blade |
| 4 | 5045-12098-00 | Capacitor, 2.2 μ Fd, 250V, 20% | 20 | 4105-01019-10 | Sh. Metal Screw, #5 x 5/8 |
| 5 | RM-21-06 | Sleeve, Vinyl (Cap. leads) | 21 | 4701-00002-00 | Lockwasher, #6 Split |
| 6 | 4010-01066-06 | Cap Screw, 10-32 x 3/8, SH | 22 | 23-6622 | Tape, Double-sided |
| 7 | 4701-00004-00 | Lockwasher, #10 Split | 23 | 03-7811 | End of Stroke (EOS) Switch |
| 8 | A-12111 | Flipper Stop Assembly | | | |
| 9 | FL-11630 | Flipper Coil (Red), (* - Refer to Note 3) | | | ** - Also see separate diagram |
| 10 | 4006-01017-04 | Mach. Screw, 6-32 x 1/4, P-RH-S | | | |
| 11 | 01-7695 | Solenoid Bracket | | | |
| 12 | 10-376 | Coil Plunger Spring | | | |
| 13 | B-10655-R | Crank Link Assembly, Right | | | |
| a) | 02-4179 | Link Spacer Bushing | | | |
| b) | 4010-01086-14 | Cap Screw, 10-32 x 7/8, SH | | | |
| c) | 4700-00023-00 | Washer, 5/8 o.d.x13/64 i. d.x16ga. | | | |
| d) | 4701-00004-00 | Lockwasher, #10 Split | | | |
| e) | 4410-01132-00 | Nut, 10-32 ESNA | | | |
| f) | A-10656** | Flipper Link Assembly | | | |
| 1.) | 02-4219 | Coil Plunger | | | |
| 2.) | 20-9370-1 | Spring Pin, 5/32 dia. x 7/16 | | | |
| 3.) | 03-8050-1 | Flipper Link | | | |
| g) | B-10657-R | Flipper Crank Assembly, Right | | | |
| 1.) | 01-8073-R | Flipper Crank, Right | | | |
| 2.) | 17-1037 | Crank Washer | | | |
| 3.) | 4010-01066-18 | Cap Screw, 10-32 x 1-1/8, HCS | | | |
| 4.) | 4410-01127-00 | Nut, 10-32 Hex Hd. | | | |
| 5.) | 4700-00107-00 | Washer, 5/8 o.d.x13/64 i. d.x12ga. | | | |
| 6.) | 4701-00004-00 | Lockwasher, #10 Split | | | |
| 7.) | RM-23-06 | Tubing, H. S. 1/4 DWP | | | |
| 14 | 23-6577 | Bumper Plug | | | |
| 15 | 03-7568 | Flipper Bushing | | | |
| 16 | 4006-01005-06 | Mach. Screw, 6-32 x 3/8, P-PH | | | |

Flipper Assembly Notes:

- Each Flipper Assembly on the Lower Playfield (and the two Lower Flipper Assemblies on the Upper Playfield) is mounted beneath the playfield, in conjunction with the plastic Flipper Paddle and Shaft (20-9250-5) and flipper Rubber (23-6519-4) on the upper side of the playfield. The Upper Flipper Assembly on the Upper Playfield uses a plastic Flipper Paddle and Shaft (C-11927-5) and flipper Rubber (23-6553-4).
- The tip of the EOS Switch must travel 0.0150 (+ .010, - .000) inch, before the contacts fully open, with the flipper in the actuated position. The EOS Switch contacts must have a gap of 0.062 (\pm .015) inch. Adjustment of the EOS Switch must be made at a minimum distance of 0.25 inch from the switch body.
- Flipper Assembly D-12702-R-1 (upper right flipper) uses a Flipper Coil, FL-11630.
- All moving elements of the assembly must operate freely, with no evidence of binding.
- The large end of the Coil Plunger Spring (item 12) must fit within the four lugs of the Solenoid Bracket.
- For coil replacement, remove the Solenoid Bracket (item 11) to prevent screw damage.
- Use LoctiteTM 242 when reattaching screws to the Flipper Stop Assembly, the Solenoid Bracket, and the Flipper Bushing.
- When replacing the Bumper Plug (item 14) to restore proper flipper operation, readjust the flipper paddle and shaft position.
- Solid color blue wire connects to the banded end of each diode, mounted on the connector end of the Flipper Coil (item 9). Trace color wire connects to the unbanded end of the diode.



Lower Left Flipper

p/n C-11626-L-3

(Parts listed replace same Items of C-11626-R-3)

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

Upper Right Flipper

p/n D-12702-R-1

(Parts listed replace same Items of C-11626-R-3)

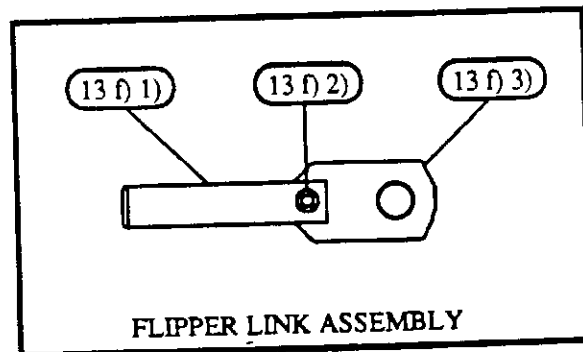
| Item | Part No. | Description |
|------|----------|-------------|
| 19 | Not Used | |

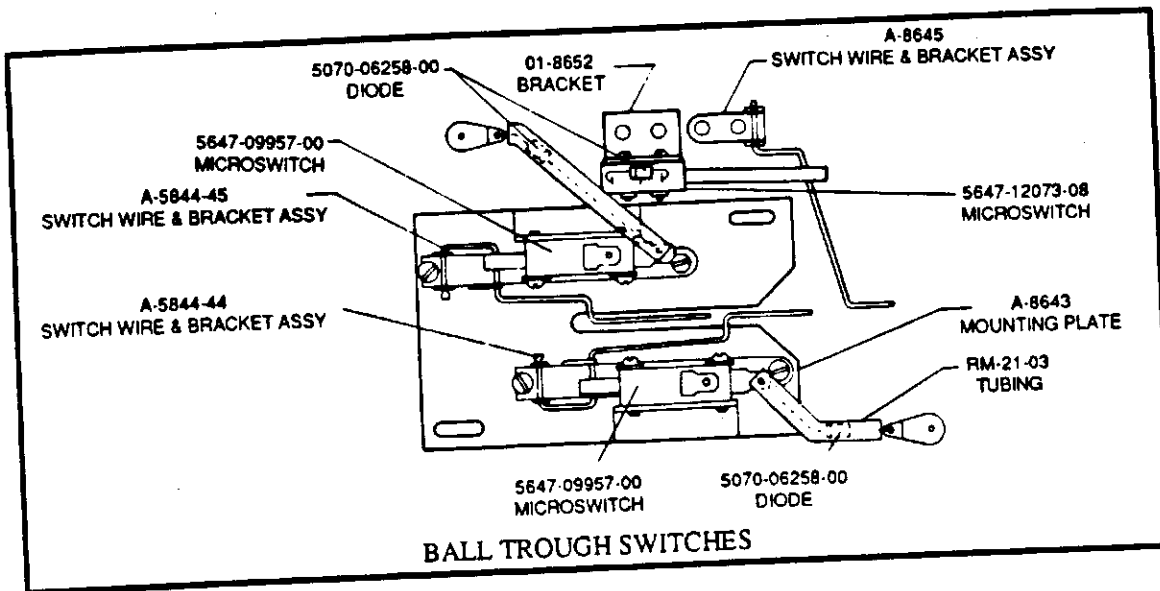
Flipper Link Assembly

p/n B-10686-2

(Drawing Part Number Refer to C-11626-R-3 List)

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



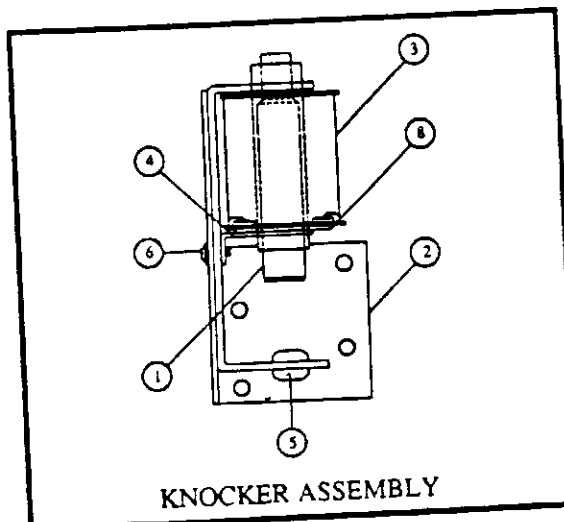


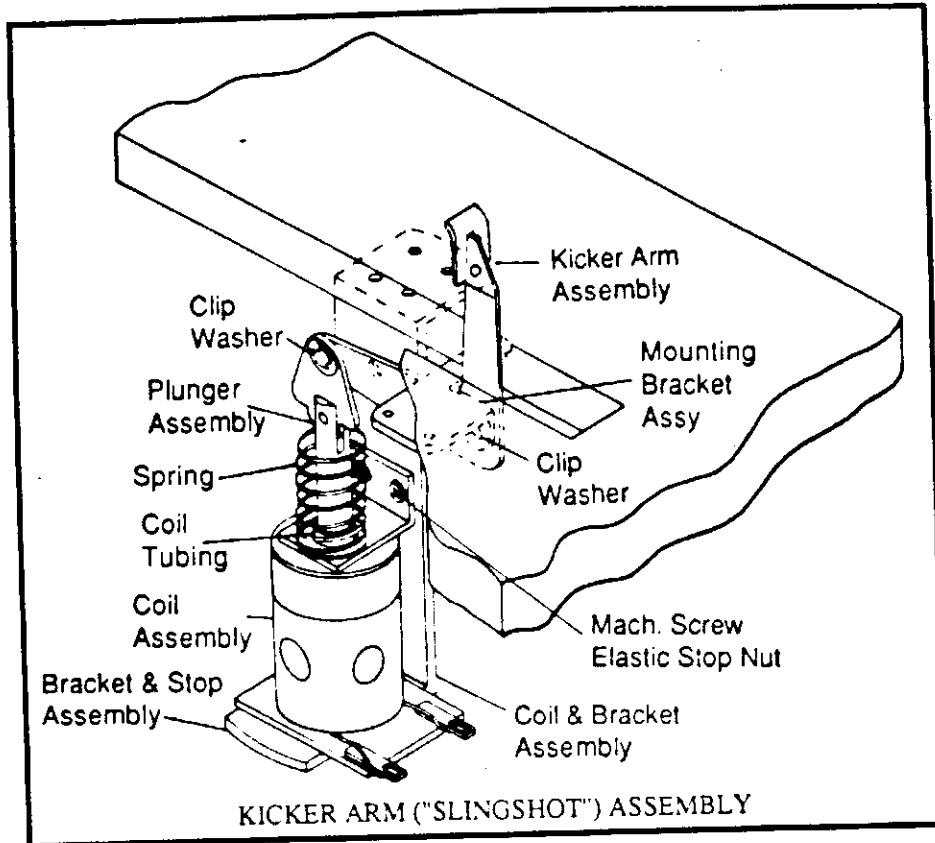
Ball Trough Switches
 (Viewed from underside of playfield to show locations)

| Part No. | Description |
|---------------|-------------------------------|
| B-8925 | Ball Trough Switch Plate Assy |
| A-5844-44 | Switch Wire & Bracket Assy |
| A-5844-45 | Switch Wire & Bracket Assy |
| A-8643 | Bracket & Mounting Plate Assy |
| 5647-09957-00 | µswitch; Cntr & L Ball Trough |
| 4004-01003-10 | Mach. Screw, 4-40 x 5/8 |
| 4005-01005-02 | Mach. Screw, 5-40 x 1/8 |
| 5070-06258-00 | Diode, 1N4001, 1.0A. |
| 5825-06522-00 | Solder Lug-Flat, #6 |
| RM-21-03 | Insulating Tubing, #10 x 1.75 |
| A-11680 | Ball Trough Switch, Right |
| 5647-12073-08 | Submin. Switch |
| 5070-06258-00 | Diode, 1N4001, 1.0A. |
| A-8645 | Switch Wire & Bracket Assy |

Knocker Assembly
 p/n B-10686-1

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





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

| Part No. | Description |
|---------------|---|
| 12-6227 | Clip, Hairpin |
| A-12664 | Kicker Crank Assembly |
| A-5103 | Coil Plunger Assembly |
| 02-2364 | Coil Plunger |
| 20-8716-5 | Roll Pin, 1/8 x 7/16 |
| 03-8085 | Armature Link |
| 4700-00030-00 | Flat Washer, 17/64 o.d. x 1/2 i.d. x 15 ga. |
| A-5653 | Mounting Bracket Assy |

Associated Parts for Right Kicker

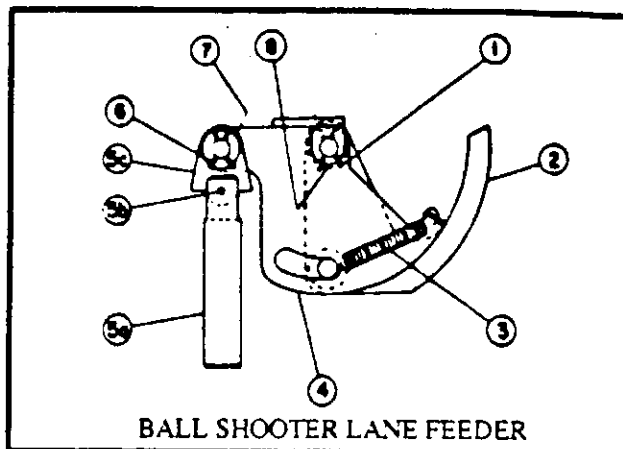
| Part No. | Description |
|---------------|-------------------------|
| B-11203-L-1 | Coil & Bracket Assembly |
| B-7572-1 | Bracket & Stop Assembly |
| 01-8-508-S | Coil Retaining Bracket |
| 4006-01017-06 | Mach. Screw, 6-32 x 3/8 |
| 4406-01119-00 | Nut, 6-32 ESN |
| AE-26-1500 | Coil Assembly |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

Associated Parts for Left Kicker

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

Ball Shooter Lane Feeder p/n C-9638 & Associated Parts

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

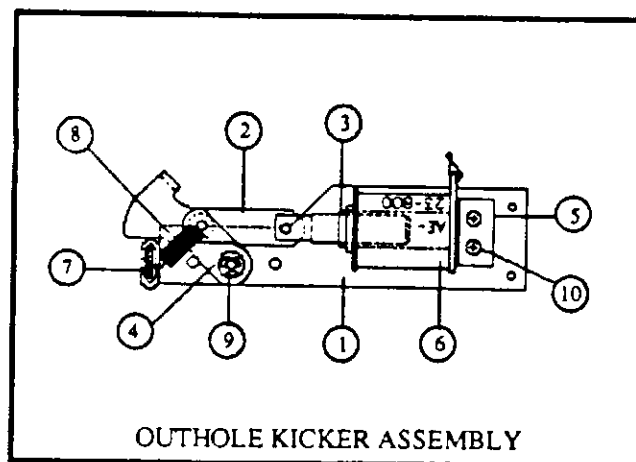


Associated Parts

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

Outhole Kicker Assembly p/n B-8039-2

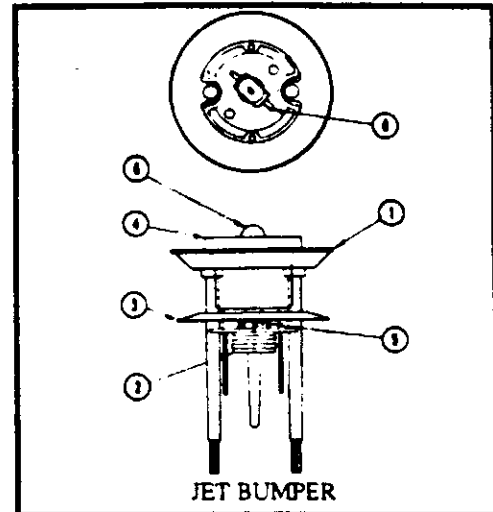
| Item | Part No. | Description |
|------|---------------|--------------------------|
| 1 | A-6378 | Mounting Plate Assembly |
| 2 | A-8335 | Coil Plunger Assembly |
| a) | 02-2364 | Coil Plunger |
| b) | 20-8716-5 | Roll Pin, 1/8 x 7/16 |
| c) | 01-4251 | Ball Return Link |
| 3 | 03-7066 | Coil Tubing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



Jet Bumper Assembly

p/n B-9414-2

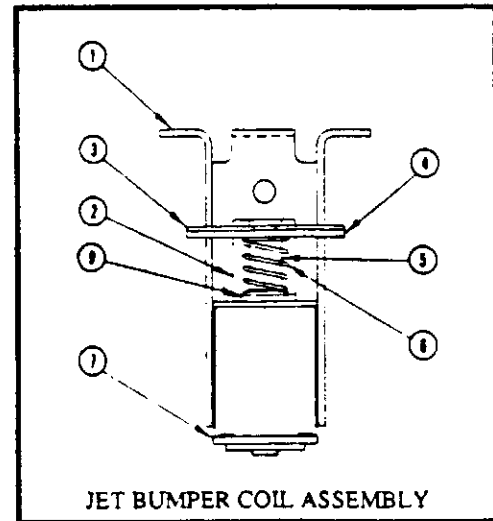
| Item | Part No. | Description |
|------|------------|--------------------|
| 1 | A-4754 | Bumper Ring Assy |
| 2 | 03-6009-A5 | Bumper Base-Wht |
| 3 | 03-6035-6 | Bumper Wafer-Yel |
| 4 | 03-7443-5 | Bumper Body-Wht |
| 5 | 10-7 | Spring-Jet Bumper |
| 6 | A-11199 | Socket & Bulb Assy |



Jet Bumper Coil Assembly

p/n B-9415-1

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



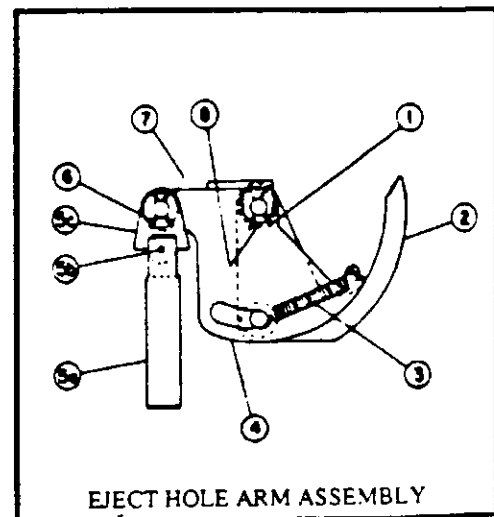
Eject Hole Arm Assembly

p/n B-9361-R-5

| Item | Part No. | Description |
|------|---------------|----------------------------------|
| 1 | A-6949-R | Spring Plate Assy |
| 2 | A-8268 | Mounting Bracket Assy |
| 3 | A-7471-R | Eject Cam Assembly |
| 4 | A-8050 | Plunger Assembly |
| 5 | 10-320 | Eject-Spring (Red) |
| 6 | 12-6227 | Hairpin Clip |
| 7 | 4700-00030-00 | Flat Washer, 17/64 x 1/2 x 15ga. |
| 8 | 4700-00103-00 | Flat Washer, 17/64 x 1/2 x 28ga. |

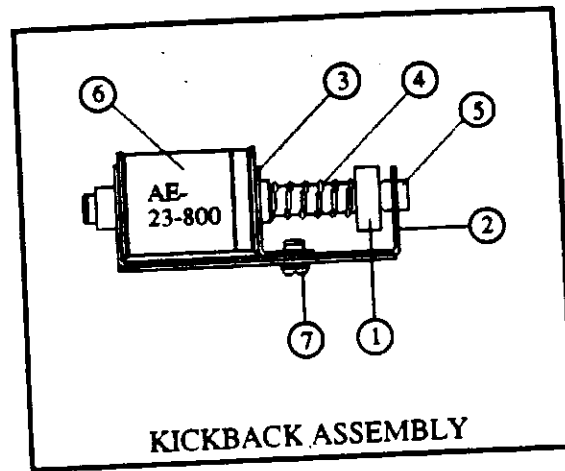
Associated Parts For Eject Hole

| | |
|---------------|-------------------------|
| B-9362-R-1 | Coil & Bracket Assembly |
| B-7572-1 | Bracket & Stop Assembly |
| 01-8-508-S | Coil Retaining Bracket |
| 4006-01017-06 | Mach. Screw, 6-32 x 3/8 |
| 4406-01119-00 | Nut, 6-32 ESN |
| AE-23-800 | Coil Assembly |
| 03-7068 | Coil Tubing |



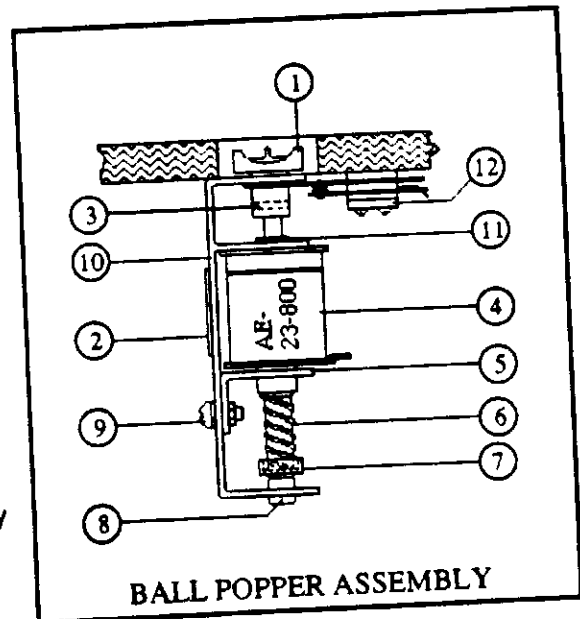
Kickback Assembly p/n B-12671

| Item | Part No. | Description |
|------|---------------|----------------------------|
| 1 | A-6306-2 | Bell Armature |
| 2 | A-12670 | Kicker Mounting Plate Assy |
| 3 | 01-8-508-T | Solenoid Bracket |
| 4 | 10-135 | Solenoid Spring |
| 5 | 23-6420 | Rubber Grommet |
| 6 | AE-23-800 | Coil Assembly |
| 7 | 4008-01017-05 | Mach. Screw, 8-32 x 5/16 |



Ball Popper Assembly p/n D-11335-2

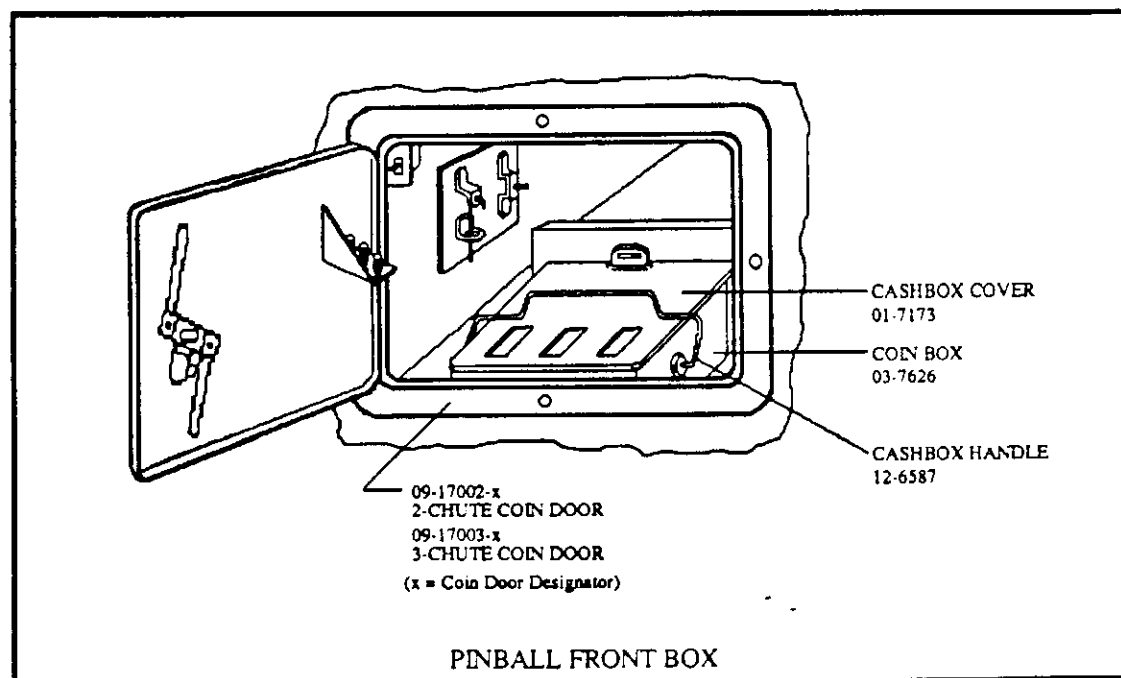
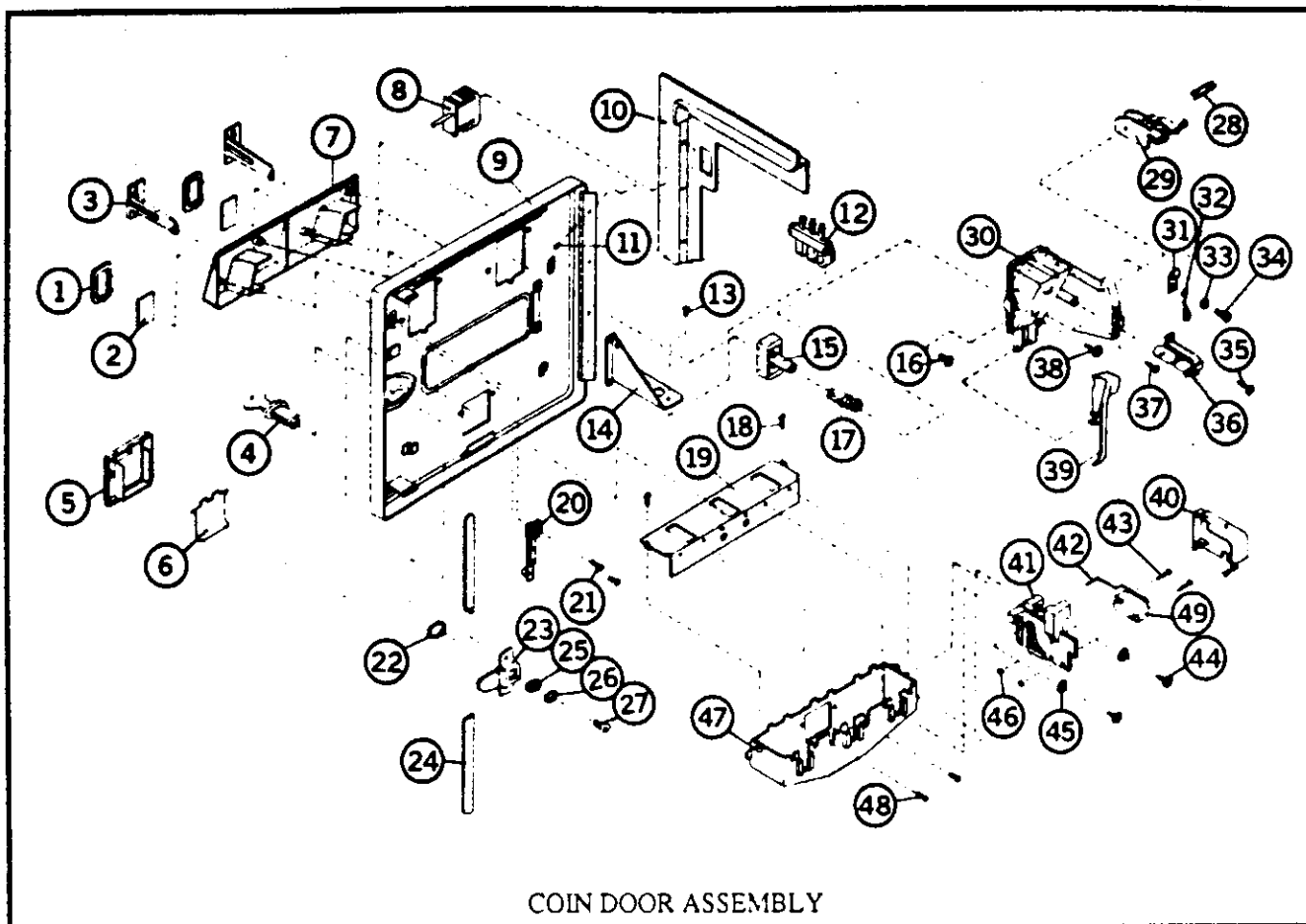
| Item | Part No. | Description |
|------|---------------|------------------------------|
| 1 | 03-8053 | Ball Popper Cap |
| 2 | 16-8850-200 | I.D. Popper Label |
| 3 | 20-9314-7 | Dowel Pin, 3/32" x 1/2" |
| 4 | AE-23-800 | Coil Assembly |
| 5 | A-11721 | Bracket Assembly |
| 6 | 10-135 | Spring Coil Plunger |
| 7 | A-11336 | Armature Assembly |
| 8 | 23-6420 | Rubber Grommet |
| 9 | 4008-01017-05 | Mach. Screw, 8-32 x 5/16 |
| 10 | B-11631 | Ball Popper Bracket Sub-Assy |
| 11 | 03-7067 | Coil Tubing |
| 12 | A-11658 | Switch & Diode Assembly |

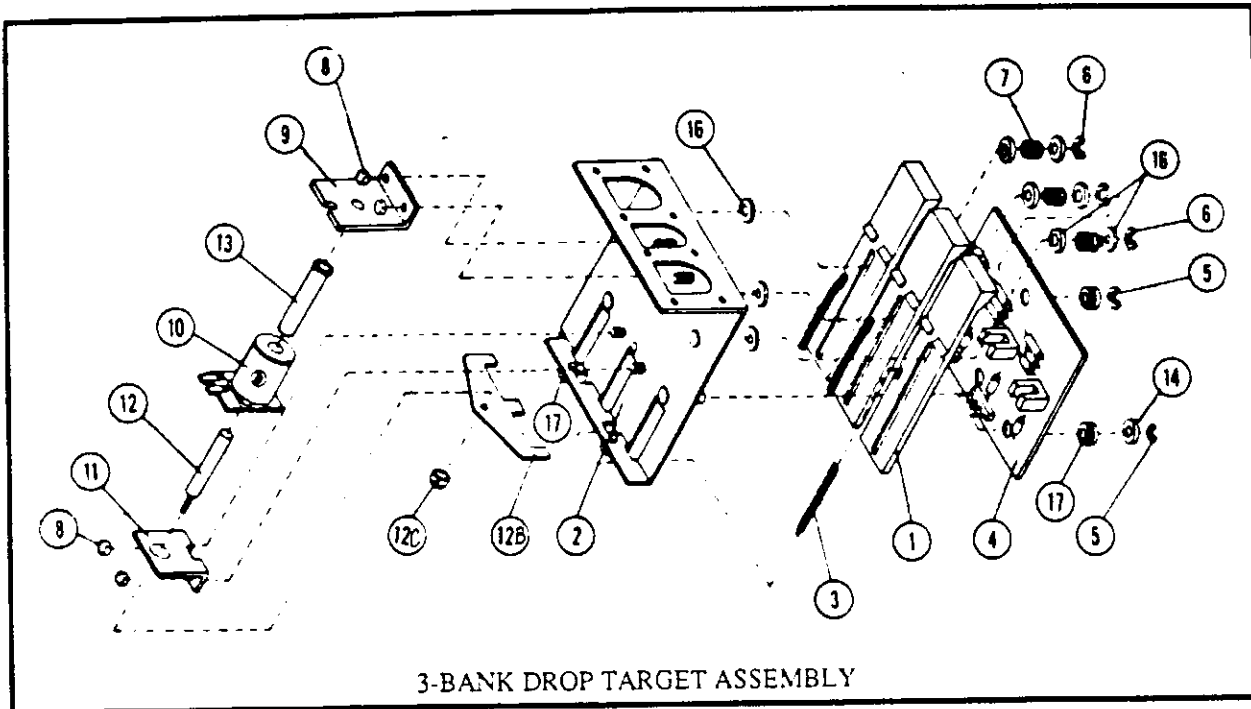


Coin Door Assembly

2-Chute Door, p/n 09-17002-x
 3-Chute Door, p/n 09-17003-x
 ("x" is the country designator)

| Item | Part No. | Description | Quantity |
|------|--------------|------------------------------|----------|
| 1 | 27-1038 | Button Cover | 2 or 3 |
| 2 | 27-1041-1→49 | Price Panel | 2 or 3 |
| 3 | 27-1026-1→15 | Coin Entry Plate | 2 or 3 |
| 4 | 27-1016 | Lock Assembly | 1 |
| 5 | 27-1061 | Coin Return Bezel | 1 |
| 6 | 27-1062 | Coin Return Flap | 1 |
| 7 | 27-1021 | Button Housing - 2-slot | 1 |
| | 27-1022 | Button Housing - 3-slot | 1 |
| 8 | 27-1111 | Interlock Switch | 1 |
| 9 | 27-1006 | Coin Door - 2-slot | 1 |
| | 27-1007 | Coin Door - 3-slot | 1 |
| 10 | 27-1005 | Coin Door Frame | 1 |
| 11 | 27-1003 | M/C Screw, 6-32 x 3/16 | 4 |
| 12 | 27-1008 | Diagnostic Switch | 1 |
| 13 | 27-1101 | M/C Screw, 4-40 x 1/4 | 2 |
| 14 | 27-1102 | Bracket, Diagnostic Switch | 1 |
| 15 | 27-1037 | Button | 2 or 3 |
| 16 | 27-1078 | M/C Screw, 6-32 x 3/8 | 2 or 3 |
| 17 | 27-1039 | Conical Spring | 2 or 3 |
| 18 | 27-1079 | Self-tapping Screw, #6 x 1/4 | 2 |
| 19 | 27-1077 | Coinbox Cover | 1 |
| 20 | 27-1066 | Slam Switch | 1 |
| 21 | 27-1067 | M/C Screw 4-40 x 1/2 | 2 |
| 22 | 27-1017 | Nut (key) | 1 |
| 23 | 27-1012 | Locking Cam | 1 |
| 24 | 27-1011 | Locking Arm | 2 |
| 25 | 27-1020 | Washer | 1 |
| 26 | 27-1018 | Star Washer | 1 |
| 27 | 27-1019 | M/C Screw | 1 |
| 28 | 27-1089 | R-Ring | 1 |
| 29 | 27-1083 | Retainer | 1 |
| 30 | 27-1081 | Coin Inlet Chute | 2 or 3 |
| 31 | 27-1088 | Wire Clamp | 2 or 3 |
| 32 | 27-1025 | Key Hook | 2 or 3 |
| 33 | 27-1086 | Washer, #6 | 2 or 3 |
| 34 | 27-1078 | M/C Screw, 6-32 x 3/8 | 2 or 3 |
| | 27-1078 | M/C Screw, 6-32 x 7/8 | 2 or 3 |
| 35 | 27-1079 | Self-tapping Screw, #6 x 1/4 | 2 or 3 |
| 36 | 27-1084 | Lamp Socket | 2 or 3 |
| | 27-1085 | Lamp | 2 or 3 |
| 37 | 27-1096 | Self-tapping Screw, #5 x 3/8 | 2 or 3 |
| 38 | 27-1087 | M/C Screw, 6-32 x 5/8 | 2 or 3 |
| 39 | 27-1082 | Lever Arm | 2 or 3 |
| 40 | 27-1097 | Switch Cover | 2 or 3 |
| 41 | 27-1091 | Coin Accept Chute | 2 or 3 |
| 42 | 27-1075 | Wire Form | 2 or 3 |
| | 27-1093 | Wire Form | 2 or 3 |
| 43 | 27-1094 | M/C Screw, 6-40 x 7/8 | 2 |
| 44 | 27-1087 | M/C Screw, 6-32 x 5/8 | 2 |
| 45 | 27-1086 | Washer, #6 | 2 |
| 46 | 27-1095 | Nut, 4-40 | 2 |
| 47 | 27-1076 | Coin Return Box | 1 |
| 48 | 27-1078 | M/C Screw, 6-32 x 3/8 | 2 |
| 49 | 27-1092 | Microswitch | 2 or 3 |

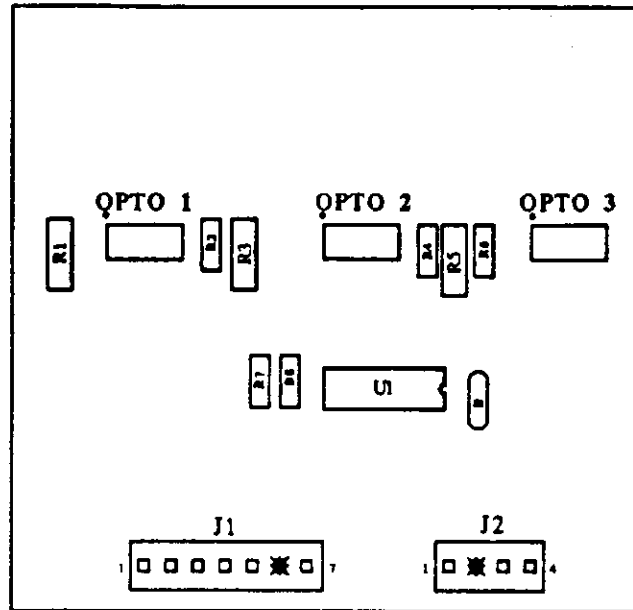




3-Bank Drop Target

p/n C-11223-1

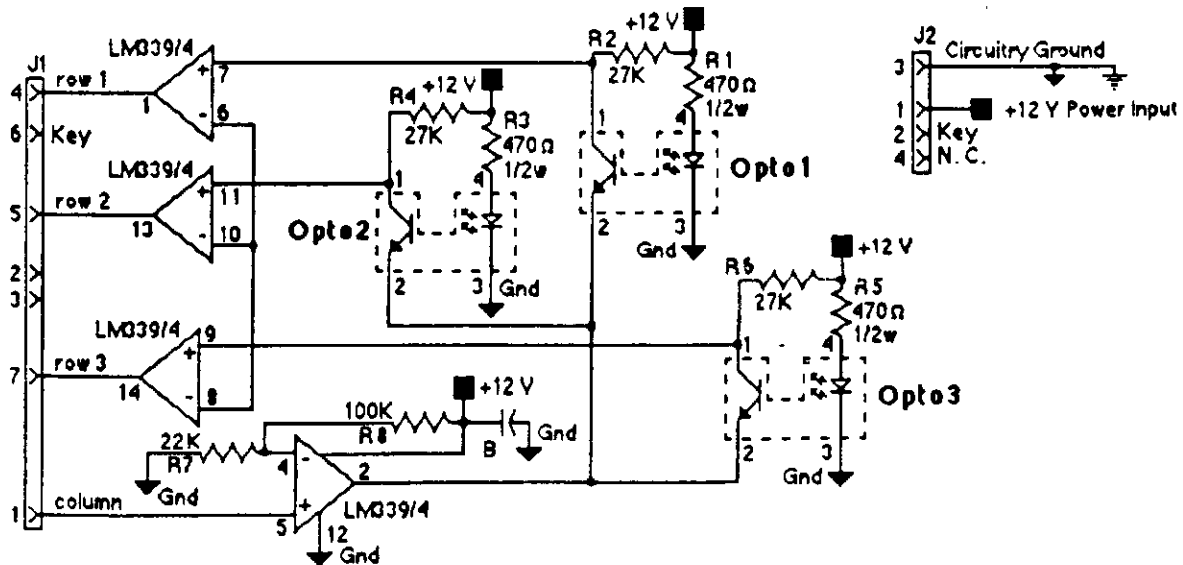
| Item | Part No. | Description | Item | Part No. | Description |
|------|---------------|-------------------------|------|---------------|-----------------------------------|
| 1 | 03-8036 | Target, Plain | 11 | 01-8413 | Bracket Coil Mounting |
| 2 | B-11224 | 3-Bank Tgt Sub-Assy | 12 | A-11389 | Plunger & Reset Plt Assy |
| 3 | 10-364 | Spring - Extension | A) | 02-3972-1 | Plunger |
| 4 | C-12559 | 3-Drop Target Opto Assy | B) | 01-8408 | Reset Plate, 3-Bank |
| 5 | 20-8712-18 | "E" Ring, 3/16" Shaft | C) | 4410-01132-00 | Nut, 10-32 ESN |
| 6 | 20-8712-25 | "E" Ring, 1/4" Shaft | 13 | 03-7066-4 | Coil Tubing |
| 7 | 10-392 | Spring-Compression | 14 | 4700-00016-00 | Flat Washer, 3/16 x 7/16 x 17 ga. |
| 8 | 4408-01119-00 | Nut, 8-32 ESN | 15 | 4008-01016-10 | Mach. Screw, 8-32 x 5/8 |
| 9 | A-11397 | Stop Bracket Assembly | 16 | 4700-00072-00 | Flat Washer, 17/64 x 1/2 x 21 ga. |
| 10 | AE-26-1200 | Coil Assembly | 17 | 23-6626 | Rubber Grommet |

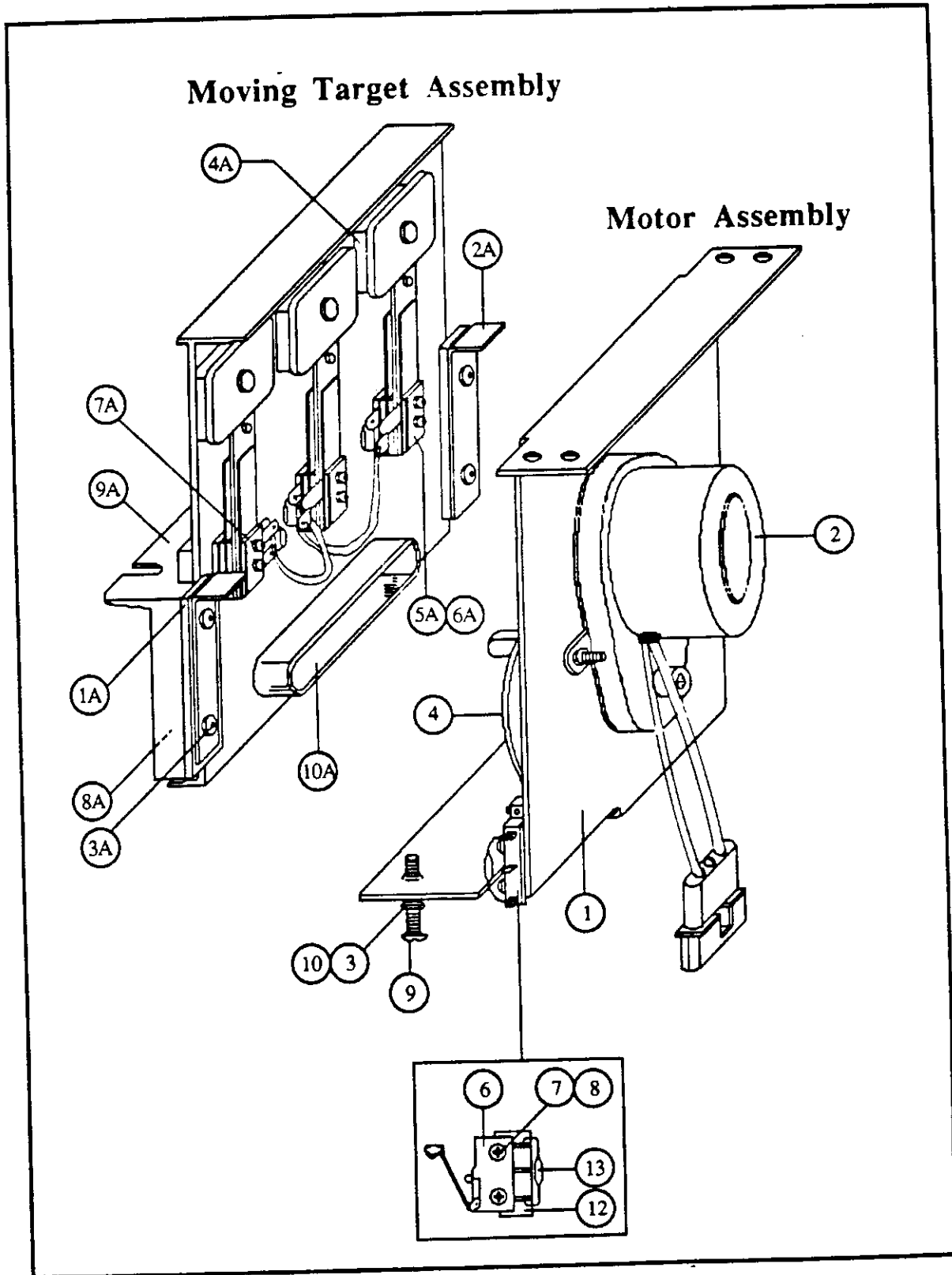


3-Bank Drop Target Opto Board
p/n C-12559

| Part No. | Ckt Designation | Description |
|---------------|-----------------|-----------------------------------|
| 5768-12368-00 | | 3-Bank Opto Board |
| 5490-10159-00 | Opto 1- Opto3 | Opto Interruptor, MDL, S/G |
| 5010-08930-00 | R1, R3, R5 | Resistor, C.F., 470 Ω, 1/2w, 5% |
| 5010-09162-00 | R8 | Resistor, C.F., 100KΩ, 1/4w, 5% |
| 5010-09324-00 | R2, R4, R6 | Resistor, C.F., 27KΩ, 1/4w, 5% |
| 5010-08774-00 | R7 | Resistor, C.F., 22KΩ, 1/4w, 5% |
| 5043-08980-00 | B | Capacitor, .01μfd., +80 -20% |
| 5370-12272-00 | U1 | I.C., Quad. Comp., LM339 |
| 5791-10871-04 | J2 | Connector, 4-pin Hdr, Sq Pin .156 |
| 5791-10871-07 | J1 | Connector, 7-pin Hdr, Sq Pin .156 |

3-Bank Drop Target Opto Board Schematic





Moving Target Assembly

p/n C-12464

| Item | Part No. | Description |
|------|---------------|---------------------------|
| 1A | 03-8028 | Retainer Carrier |
| 2A | 01-8494 | Support Bracket |
| 3A | 4106-01001-10 | Sh. Metal Screw, #6 x 5/8 |
| 4A | 23-6534-9 | Edge Protector |
| 5A | B-12725 | Targets & Cable Assembly |
| 1) | A-11177-1 | Left Target Assembly |
| 2) | A-11315-3 | Mid & Rt Target Assembly |
| 6A | 01-3670-1 | Switch Plate (Flat) |
| 7A | 4004-01003-12 | Mach. Screw, 4-40 x 3/4 |
| 8A | 4404-01119-00 | Nut, 4-40 ESNA |
| 9A | 03-8235 | Target Guide |
| 10A | 03-8236 | Carrier Target |

Motor Assembly

p/n B-12465

| Item | Part No. | Description |
|------|---------------|-----------------------------|
| 1 | 01-9017 | Motor Mounting Bracket |
| 2 | B-11571-2 | Motor Sub-Assembly |
| a) | 14-7941-3 | Motor 11 RPM |
| b) | 5791-09111-00 | 3P1396 03-09-2032 |
| c) | 5820-09080-00 | PM1190 02-09-2101 |
| 3 | 4701-00003-00 | Lockwasher, #8 Split |
| 4 | A-12463 | Motor Cam Assembly |
| a) | 02-4262 | Operating Post |
| b) | 02-4354 | Motor Cam |
| c) | 02-4355 | Switch Actuator Post |
| 5 | 4008-01076-06 | Set Screw, 8-32 x 3/8 |
| 6 | 5647-12073-06 | Snap Action Switch/w Roller |
| 7 | 4002-01005-06 | Mach. Screw, 2-56 x 3/8 |
| 8 | 4701-00024-00 | Lockwasher, #2 Split |
| 9 | 4008-01005-16 | Mach. Screw, 8-32 x 1 |
| 10 | 4408-01117-00 | Nut, 8-32 Hex |
| 11 | 4008-01040-08 | Mach. Screw, 8-32 x 1/2 |
| 12 | 01-8600 | Switch Insulator |
| 13 | 5070-06258-00 | Diode, 1N4001, 1.0 A. |

Ramp Assembly

p/n B-12636

| Item | Part No. | Description |
|------|---------------|--------------------------|
| 1 | H-12685 | Ramp Switch Cable |
| 2 | 5647-12073-20 | Subminiature Switch |
| 3 | 01-8240 | Nut Plate # 2-56 |
| 4 | 5070-06258-00 | Diode, 1N4001, 1.0A |
| 5 | Not Used | |
| 6 | B-12637 | Ramp Sub-Assembly |
| a) | 01-8323 | Switch Bracket |
| b) | 01-9118 | Ramp |
| 7 | 4002-01005-08 | Mach. Screw, #2-56 x 1/2 |
| 8 | 4701-00024-00 | Lockwasher, #2 Split |

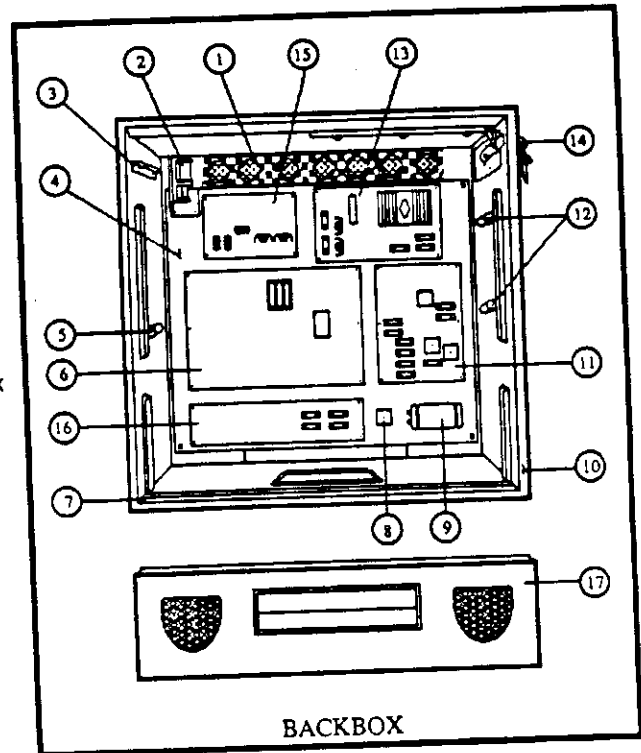
Top Ramp Assembly

p/n C-12674

| Item | Part No. | Description |
|------|----------------|---------------------------|
| 1 | 03-8260 | Top Ramp |
| 2 | 01-8433 | Mounting Bracket |
| 3 | 07-6688-19N | Rivet, 1/8 x 7/32 |
| 4 | 01-9144 | Top Ramp Flap |
| 5 | 07-6688-18N | Rivet, 1/8 x 3/16 |
| 6 | 4700-00003-00 | Flatwasher, 1/8 x 9/32 |
| 7 | 31-1006-563-34 | Playfield Plastic |
| 8 | 4106-01033-08 | Sh. Metal Screw, #6 x 1/2 |

Backbox Parts List

| Item | Part No. | Description |
|------|---------------|------------------------------------|
| 1 | 01-6645 | Venting Screen |
| 2 | B-10686-1* | Knocker & Bracket Assy |
| 3 | A-12497 | Upr Insert Bd Hinge Assy |
| 4 | D-12184-1 | P.C.B Plate Assembly |
| 5 | A-12498 | Lwr Insert Bd Hinge Assy |
| 6 | D-11883-563* | System 11B CPU Board |
| 7 | 01-8569 | Lwr Spkr Panel Bracket |
| 8 | 5100-09418-00 | Bridge Rectifier, 100v,35A |
| 9 | 5040-09051-00 | Capacitor, 30,000 µFd, 25v |
| 10 | A-11-888-563 | BLACK KNIGHT 2000 , Backbox |
| 11 | D-12247-563* | Aux. Pwr Driver Board |
| 12 | 01-9047 | Insert Stop Bracket |
| 13 | D-12246* | Power Supply Assembly |
| 14 | 20-9549 | Cam Lock, 3/4"D x 27/32"L |
| 15 | D-11581-563* | Audio Board Assembly |
| 16 | D-12313-563* | Backbox Interconnect Board |
| 17 | D-12696 | Display/Speaker Panel Assy |
| a) | 31-1420-563 | Cover, Displ/Spkr Panel Assy |
| b) | 31-1422-563 | Speaker Grill |
| c) | D-12232-1* | Master Display PC Board Assy |
| d) | 5555-12015-00 | Speaker 4Ω, 6" Rad., 10w |
| e) | 5555-12068-00 | Speaker 4" Piezo, 50w |
| f) | C-12700 | Lamp Assembly PCB |



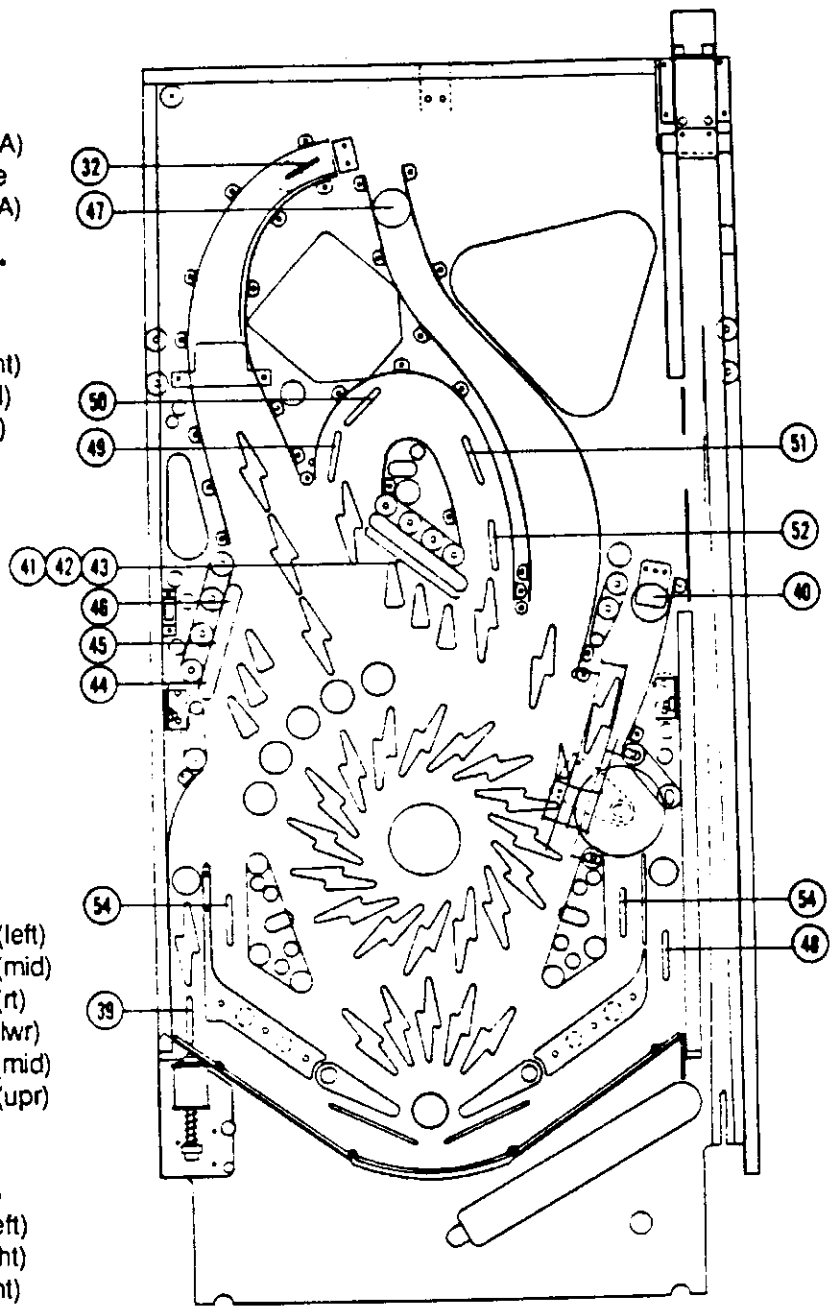
* Refer to Individual Unit's Parts List

Miscellaneous **BLACK KNIGHT 2000** Parts

| | | | |
|--------------|----------------------------|---------------|--|
| A-8552-563 | Backglass Assembly | 563-IN | BLACK KNIGHT 2000 , Insert |
| 31-1357-563 | Backglass | 01-6571 | Hinge Mtg Bracket, Insert Board |
| 03-7960-563 | Playfield Mylar | 01-6655 | Latch-Insert Board |
| 08-7028-T | Glass-Playfield | 01-6652 | Stop Bracket |
| 20-9347 | Toggle Latch | 31-1006-563 | Plastics Set, BLACK KNIGHT 2000 |
| 20-9518 | Backbox Hinge | 31-1008-563 | Bottom Arch (Screened) |
| 31-1002A-563 | Lower Playfield (Screened) | 31-1009-563 | Shooter Plate (Screened) |
| 31-1002B-563 | Upper Playfield (Screened) | 5795-10937-09 | Ribbon Cable, 20-Conductor, 9" |
| 31-1463-563 | Drop Target Decal Set | 5795-10938-27 | Ribbon Cable, 26-Conductor, 27" |
| 31-1470 | Start Button Decal | | |

Lower Playfield Switches

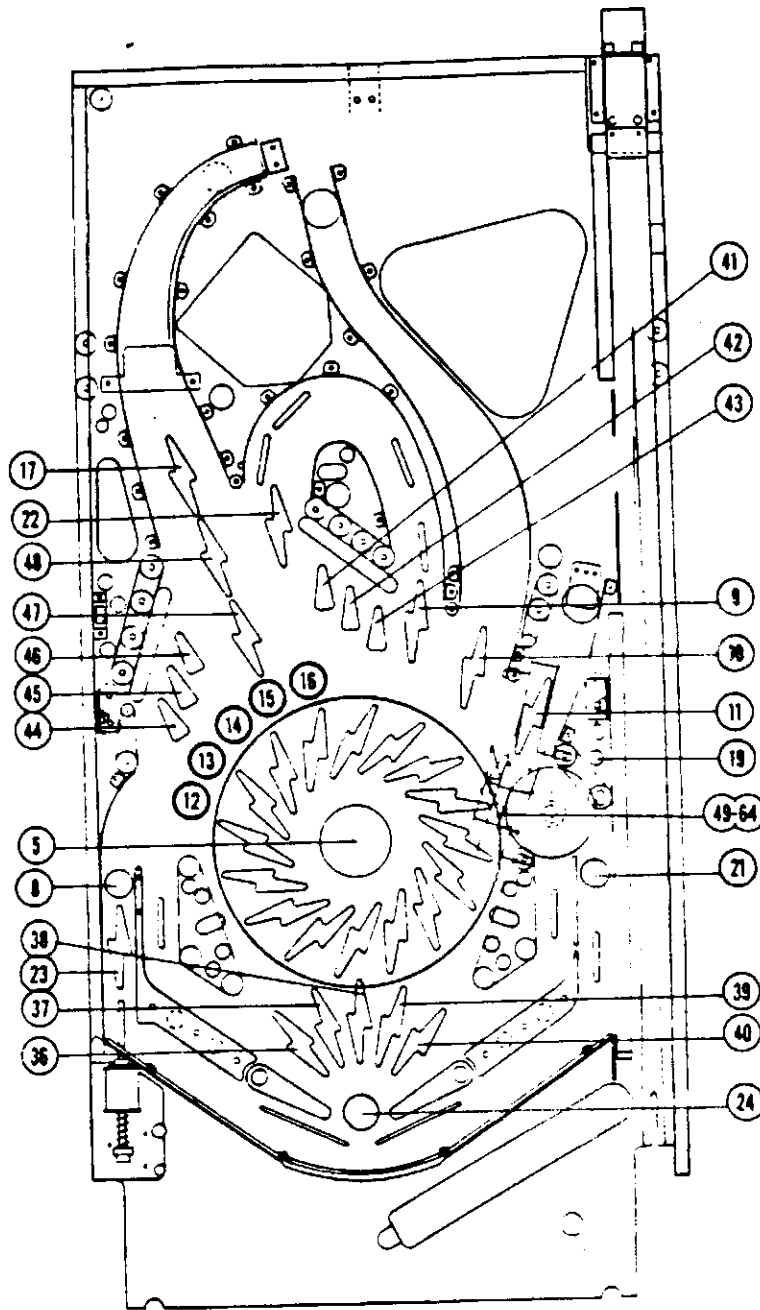
| Item | Part No. | Description |
|---------|-------------------|--------------------------------|
| 1 | p/o D-11920-1 | Plumb Bob Tilt |
| 2 | p/o D-12247 | C-side: A/C Relay |
| 3 | SW-1A-126 | Credit Button |
| 4 | 27-1092 | R Coin Chute (USA) |
| 5 | Not Used (USA) | Center Coin Chute |
| 6 | 27-1092 | L Coin Chute (USA) |
| 7 | 27-1066 | Slam Tilt |
| 8 | 27-1008 | High Score Reset* |
| 9 | B-8306-1 | Playfield Tilt |
| 10 | 5647-12133-12 | Outhole |
| 11 | 5647-12073-08 | Ball Trough 1 (right) |
| 12 | 5647-09957-00 | Ball Trough 2 (mid) |
| 13 | 5647-09957-00 | Ball Trough 3 (left) |
| 14 | Not Used | |
| 15 | Not Used | |
| 16 - 17 | UPF Switches | |
| 18 | | Left Kicker*** |
| 19 | UPF Switch | |
| 20 | | Right Kicker*** |
| 21 - 31 | UPF Switches | |
| 32 | 5647-12073-20 | Lower Ramp Exit |
| 33 - 38 | UPF Switches | |
| 39 | 5647-12073-19 | Left Outlane |
| 40 | 5647-12073-10 | Right Eject Hole |
| 41 | p/o C-11318-1 **2 | R 3-Bank Dr Tgt (left) |
| 42 | p/o C-11318-1 **2 | R 3-Bank Dr Tgt (mid) |
| 43 | p/o C-11318-1 **2 | R 3-Bank Dr Tgt (rt) |
| 44 | p/o C-11318-1 **2 | L 3-Bank Dr Tgt (lwr) |
| 45 | p/o C-11318-1 **2 | L 3-Bank Dr Tgt (mid) |
| 46 | p/o C-11318-1 **2 | L 3-Bank Dr Tgt (upr) |
| 47 | A-11658 | Ball Popper |
| 48 | 5647-12073-19 | Right Outlane |
| 49 | 5647-12073-19 | U Turn 1 (lwr left) |
| 50 | 5647-12073-19 | U Turn 2 (uppr left) |
| 51 | 5647-12073-19 | U Turn 3 (upr right) |
| 52 | 5647-12073-19 | U Turn 4 (lwr right) |
| 53 | 5647-12073-04 | Ball Shooter Lane |
| 54 | 5647-12073-19 | Right Return Lane |
| 55 | 5647-12073-19 | Left Return Lane |
| 56 | Not Used | |
| 57 | p/o D-12313**1 | R Flipper Lane Change |
| 58 | p/o D-12313**1 | L Flipper Lane Change |
| 59 | SW-1A-126 | Magna Save™ Button |
| 60 | Not Used | |
| 61 | Not Used | |
| 62 | Not Used | |
| 63 | Not Used | |
| 64 | Not Used | |
| - | SW-10A-48 | Flipper Button (Cabinet sides) |



Notes: * P/N is for entire Diagnostic Switch Assembly, including H S Reset Switch; ** Optotransistor on : (1) Backbox Interconnect Bd; (2) 3-bank Drop Target Positioner Bd. *** [Paired Kicker Actuating Sw: A-4834-H; B-8734-1]

Lower Playfield Lamps

Lamp Location/Description



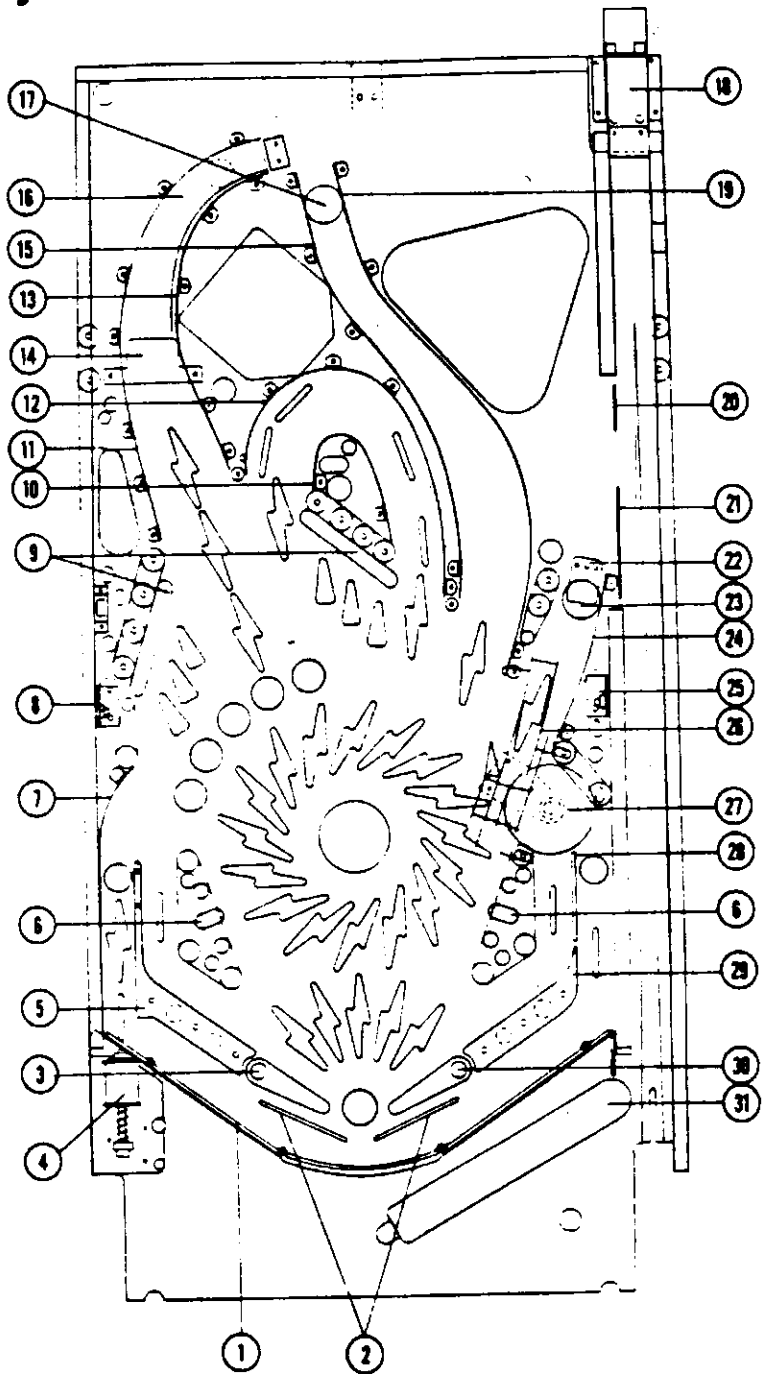
- 5. Center, Bolt Circle
- 8. LAST CHANCE (L Outlane)
- 9. U-TURN Bolt (Right)
- 10. SPIN Bolt
- 11. LOCK Bolt (R Eject Hole)
- 12. B (in "BLACK")
- 13. L (in "BLACK")
- 14. A (in "BLACK")
- 15. C (in "BLACK")
- 16. K (in "BLACK")
- 17. EXTRA BALL Bolt
- 19. MAGNA SAVE™
- 21. LAST CHANCE (R Outlane)
- 22. U-TURN Bolt (Left)
- 23. KICKBACK Bolt (L Outlane)
- 24. SHOOT AGAIN
- 36. 2X (left)
- 37. 3X
- 38. BONUS HOLD
- 39. 4X
- 40. 5X (right)
- 41. G (R 3-b Dr Tgt)
- 42. H (R 3-b Dr Tgt)
- 43. T (R 3-b Dr Tgt)
- 44. K (L 3-b Dr Tgt)
- 45. N (L 3-b Dr Tgt)
- 46. I (L 3-b Dr Tgt)
- 47. SKYWAY Bolt
- 48. HURRY-UP Bolt
- 49. EXTRA BALL (Bolt Circle)
- 50. 50,000 (Bolt Circle)
- 51. MAGNA SAVE (Bolt Circle)
- 52. 10,000 (Bolt Circle)
- 53. MULTI-BALL (Bolt Circle)
- 54. 100,000 (Bolt Circle)
- 55. RANSOM (Bolt Circle)
- 56. 200,000 (Bolt Circle)
- 57. SPECIAL (Bolt Circle)
- 58. 20,000 (Bolt Circle)
- 59. KICKBACK (Bolt Circle)
- 60. 150,000 (Bolt Circle)
- 61. DRAWBRIDGE (Bolt Circle)
- 62. 75,000 (Bolt Circle)
- 63. HURRY-UP (Bolt Circle)
- 64. 250,000 (Bolt Circle)

Lower Playfield Parts

| Item | Part No. | Description |
|------|-------------|----------------------------|
| 1 | 12-6842 | Bottom Arch Fence |
| 2 | 12-6468 | Anti-Rebound Wire |
| 3 | C-11626-L-3 | Lwr Left Flipper Assy |
| a) | 20-9250-6 | Lg Flipper Paddle & Shaft |
| 4 | B-11873-1 | Left Outlane Kickback |
| 5 | B-12743 | L Flipper Return Frame |
| 6 | B-12665 | Kicker Arm ("Sling") Assy |
| 7 | B-12651 | Ball Guide Assembly |
| 8 | B-12639-L | Left UPF Hinge Post |
| 9 | C-11223-1 | 3-Bank Drop Target |
| 10 | B-12650 | Ball Guide Assembly |
| 11 | C-12654 | Ball Guide Assembly |
| 12 | C-12655 | Ball Guide Assembly |
| 13 | C-12652 | Ball Guide Assembly |
| 14 | 01-9122 | Skyway Ramp Entry Plate |
| 15 | C-12653 | Ball Guide Assembly |
| 16 | B-12636 | Skyway Ramp Assembly |
| 17 | D-11335-2 | Ball Popper Assembly |
| 18 | B-12599 | Shooter Lane Turnaround |
| 19 | C-12656 | Ball Guide Assembly |
| 20 | 12-6466-6 | Wireform, 1-1/2" |
| 21 | 12-6466-15 | Wireform, 3-3/4" |
| 22 | 01-9145 | Eject Hole Deflector |
| 23 | B-9361-R | Eject Hole |
| a) | 03-7351-1 | Tr Red Plastic Ball Seat |
| 24 | B-12649 | Ball Guide Assembly |
| 25 | B-12639-R | Right UPF Hinge Post |
| 26 | 12-6827 | Wire Ramp |
| 27 | A-12831 | Magna Save™ |
| 28 | 12-6466-12 | Wireform, 3" |
| 29 | B-12695 | R Flipper Return Frame |
| 30 | C-11626-R-3 | Lwr Right Flipper Assembly |
| a) | 20-9250-6 | Lg Flipper Paddle & Shaft |
| 31 | C-9638 | Ball Shooter Lane Feeder |

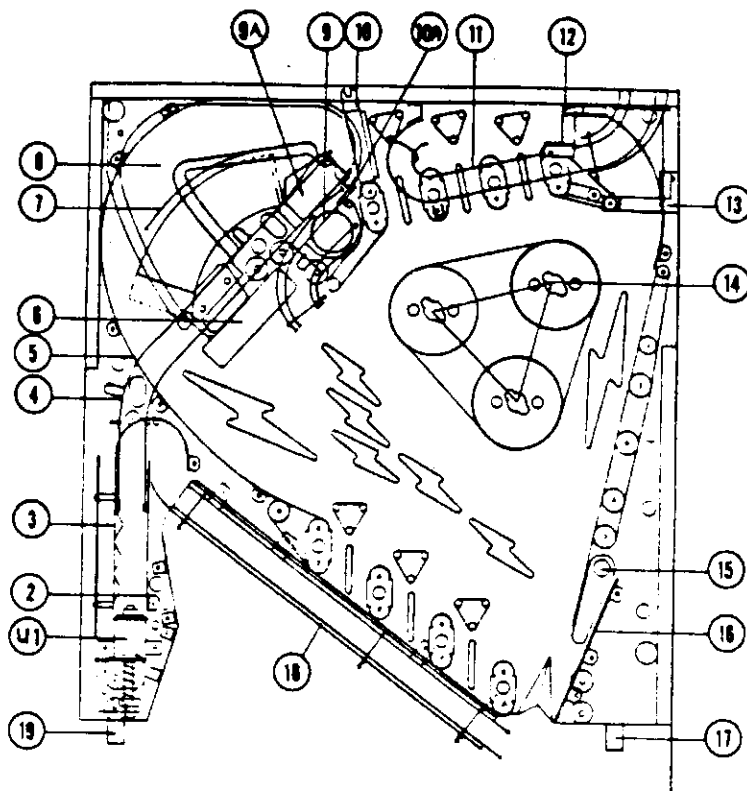
(Ball Trough Parts beneath Bottom Arch)

| | |
|-----------|-------------------------|
| B-8623 | Upr Trough Baffle Assy |
| 01-5575 | Bottom Arch Mtg Bracket |
| C-8235 | Lwr Trough Baffle Assy |
| 12-6542 | Baffle Wire form |
| 01-3569-1 | Ball Trough |



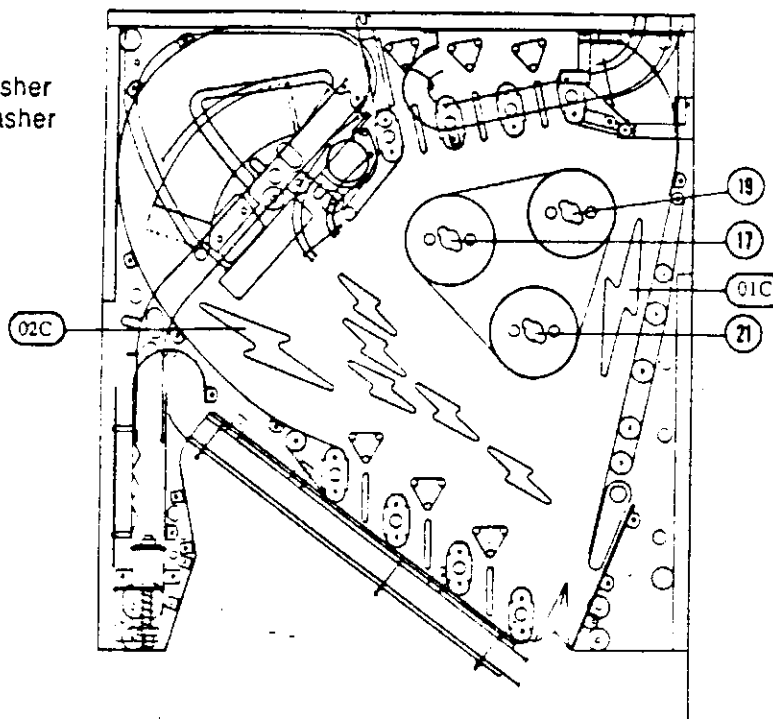
Upper Playfield Parts

| Item | Part No. | Description |
|------|-------------|---------------------------|
| 1 | B-12671 | 3-Ball Lockup Kickback |
| 2 | B-12658 | Ball Guide Assembly |
| 3 | B-12657 | Ball Guide Assembly |
| 4 | B-12693 | 3-Ball Lockup Wire Ramp |
| 5 | D-12660 | Ball Guide Assembly |
| 6 | C-12464 | Motorized Target Assembly |
| a | B-12465 | Motor Assembly |
| 7 | 12-6846 | Wireform |
| 8 | C-12674 | Plastic Ramp Assembly |
| 9 | 12-6826 | Popper Wire Ramp |
| 9A | 01-9151 | Ball Guide Baffle |
| 10 | A-12645 | Ball Gate Assembly |
| a | 12-6833 | Gate Wire |
| 10A | 12-6466-3A | Wireform, 3/4" |
| 11 | 12-6831 | Shooter Exit Wire Ramp |
| 12 | B-12708 | Ball Gate Assembly |
| a) | 12-6741 | Gate Wire |
| 13 | B-12720 | Ball Gate Assembly |
| a) | 12-6841 | Gate Wire |
| 14 | B-9414-2 | Jet Bumper (3) |
| 15 | D-12702-R-1 | UPF R Flipper Assembly |
| 16 | B-12759 | Ball Guide Assembly |
| 17 | 01-9168 | R Hinge Post Bracket |
| 18 | 12-6830 | Wire Ramp |
| 19 | A-12767 | Hinge Post Bracket Assy |



Upper Playfield Solenoids/Flashers

| Item | Part No. | Description |
|------|-----------------|---------------------------|
| 01C | #906 Flashlamps | UPF Big Red Bolt Flasher |
| 02C | #906 Flashlamps | UPF Big Blue Bolt Flasher |
| 17 | AE-23-800 | Left Jet Bumper |
| 19 | AE-23-800 | Right Jet Bumper |
| 21 | AE-23-800 | Lower Jet Bumper |



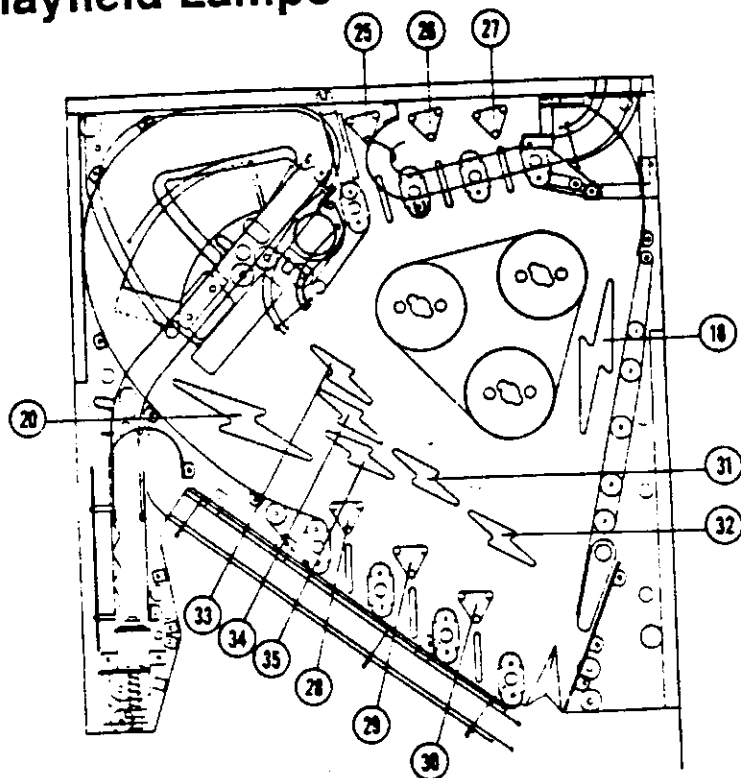
Upper Playfield Lamps

Lamp Location/Description

- 18 Big Red Bolt
- 20 Big Blue Bolt
- 25 W (in "WIN")
- 26 I (in "WIN")
- 27 N (in "WIN")
- 28 W (in "WAR")
- 29 A (in "WAR")
- 30 R (in "WAR")
- 31 JACKPOT Bolt
- 32 ADVANCE RANSOM Bolt
- 33 Motor Target Bolt 3
- 34 Motor Target Bolt 2
- 35 Motor Target Bolt 1

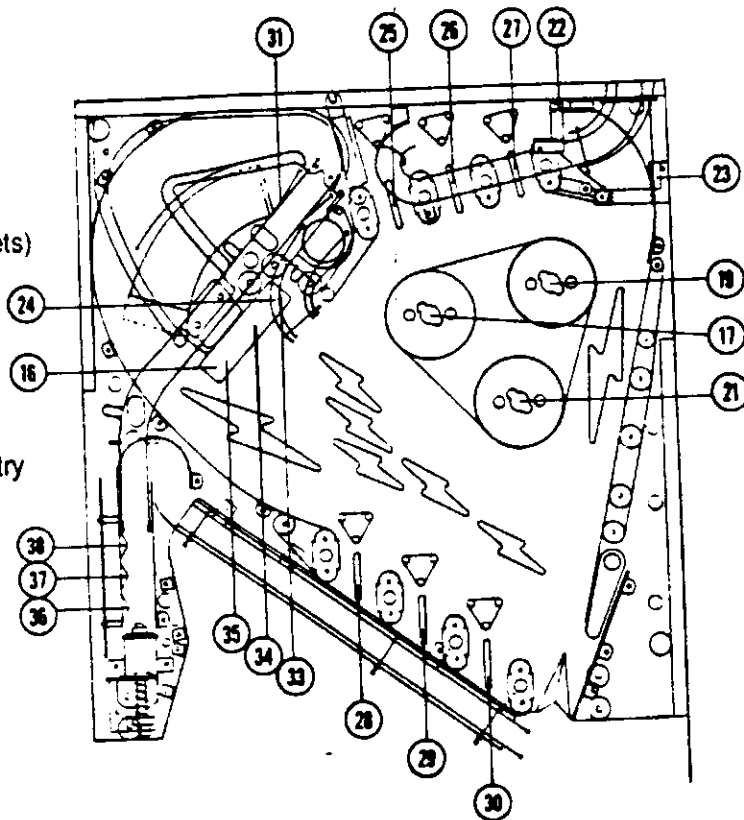
NOTE:

Switches 1 - 4 and 6 - 7 are on the Speaker/Display Panel (R-A-N-S-O-M).



Upper Playfield Switches

- | Item | Part No. | Description |
|------|---------------|----------------------|
| 16 | 5647-12073-06 | UP (Motor Targets) |
| 17 | B-8928 | Left Jet Bumper |
| 18 | B-8928 | Right Jet Bumper |
| 19 | B-8928 | Lower Jet Bumper |
| 22 | 5647-12073-24 | Loop End 1 |
| 23 | 5647-12073-24 | Loop End 2 |
| 24 | 5647-12073-06 | DOWN (Motor Targets) |
| 25 | 5647-12073-18 | W (in "WIN") |
| 26 | 5647-12073-18 | I (in "WIN") |
| 27 | 5647-12073-18 | N (in "WIN") |
| 28 | 5647-12073-18 | W (in "WAR") |
| 29 | 5647-12073-18 | A (in "WAR") |
| 30 | 5647-12073-18 | R (in "WAR") |
| 30 | 5647-12073-01 | UPF Wire Ramp Entry |
| 33 | A-11177-1 | Upper Target |
| 34 | A-11177-1 | Middle Target |
| 35 | A-11315-3 | Lower Target |
| 36 | 5647-12073-22 | Lower Lock |
| 37 | 5647-12073-22 | Middle Lock |
| 38 | 5647-12073-22 | Upper Lock |



WARNINGS & NOTICES

WARNING

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WARNING

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All games that leave *WILLIAMS'* plants have been tested and found to comply with FCC Rules. Because the sticker is proof of this fact, legal repercussions to the owner and distributor of the game may result, if the sticker is missing. If you receive any *WILLIAMS* game, manufactured after December 1982, that has no FCC sticker, call *WILLIAMS'* for advice or write us a note on your Game Registration Card. Be sure that the card bears your game's serial number.

RF Interference Notice

CABLE HARNESS PLACEMENTS and ground strap routing on this game have been designed to keep RF radiation and conduction within levels accepted by the FCC Rules.

TO MAINTAIN THESE LEVELS, reposition harnesses and reconnect ground straps to their original placements, if they become disconnected during maintenance.

Notice

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FOR SERVICE...

CALL your authorized
WILLIAMS' Distributor.

Williams 
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WARNING: Transport this game **ONLY** with hinged backbox down!