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Black Knight

2000

OPERATIONS MANUAL

including:

- Game Operation
- Parts Information
- Test/Diagnostic Procedures
- Reference Diagrams & Schematics

Black Knight 2000 ROM and Jumper Table

Game	System 11B CPU Rev.	P/N - U15 Game μP	P/N - U27 G. ROM 1	P/N - U26 G. ROM 2	P/N - U21 S. ROM 1	P/N - U22 S. ROM 2	P/N - U24 Sound μP	Jumpers
BIG GUNS	-	5400-09150-00	A-5343-557-2	A-5343-557-1	A-5343-557-4	A-5343-557-3	5400-09150-00	W1, 2, 4, 5, 7, 8, 11, 14, 16, 17, and 19
SPACE STATION	-		A-5343-552-2	A-5343-552-1	A-5343-552-4	A-5343-552-3		W1, 2, 4, 5, 7, 8, 11, 14, 16, 17, and 19
CYCLONE	-		A-5343-564-2	A-5343-564-1	A-5343-564-4	A-5343-564-3		W1, 2, 4, 5, 7, 8, 11, 14, 16, 17, and 19
BANZAI RUN	-		A-5343-566-2	A-5343-566-1	A-5343-566-4	A-5343-566-3		W1, 2, 4, 5, 7, 8, 11, 14, 16, 17, and 19
SWORDS OF FURY	-		A-5343-559-2	A-5343-559-1	A-5343-559-4	A-5343-559-3		W1, 2, 4, 5, 7, 8, 11, 14, 16, 17, and 19
TAXI	-		A-5343-553-2	A-5343-553-1	A-5343-553-4	A-5343-553-3		W1, 2, 4, 5, 7, 8, 11, 14, 16, 17, and 19
JOKERZ	-		A-5343-567-2	A-5343-567-1	A-5343-567-4	A-5343-567-3		W1, 2, 4, 5, 7, 8, 11, 14, 16, 17, and 19
EARTH-SHAKER	-		A-5343-568-2	A-5343-568-1	A-5343-568-4	A-5343-568-3		W1, 2, 4, 5, 7, 8, 11, 14, 16, 17, and 19
Black Knight 2000	-	↓	A-5343-563-2	A-5343-563-1	A-5343-563-4	A-5343-563-3	↓	W1, 2, 4, 5, 7, 8, 11, 14, 16, 17, and 19

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	Bolt 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/Upr 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 Select 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 ("sling")	Special #2	Blu-Red	1P19-4	5J3-6: 5J7-6	Q71	AE-26-1500
19	Right Jet Bumper	Special #3	Blu-Orn	1P19-3	5J3-3: 5J7-3	Q73	AE-23-800
20	Right Kicker ("sling")	Special #4	Blu-Yel	1P19-6	5J3-4: 5J7-5	Q69	AE-26-1500
21	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>	-	Orn-Vio	1P19-1	2J5-5: 2J10-7	-	
-	Lower Right Flipper	-	[Blu-Vio] ²		[2J10-1: 2J8-15]	-	FL11630/50VDC
-	Upper Right Flipper	-	[Blk-Yel]		[2J10-4:2J8-12]	-	FL11630/50VDC
-	<u>Left Flipper</u>	-	Orn-Gry	1P19-2	2J5-4: 2J10-8	-	
-	Lower Left Flipper	-	[Blu-Gry] ²		[2J10-2:2J8-4]	-	FL11630/50VDC

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

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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.

CONNECTOR & COMPONENT IDENTIFICATION

WILLIAMS ELECTRONICS GAMES uses a special technique to identify connectors. 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.

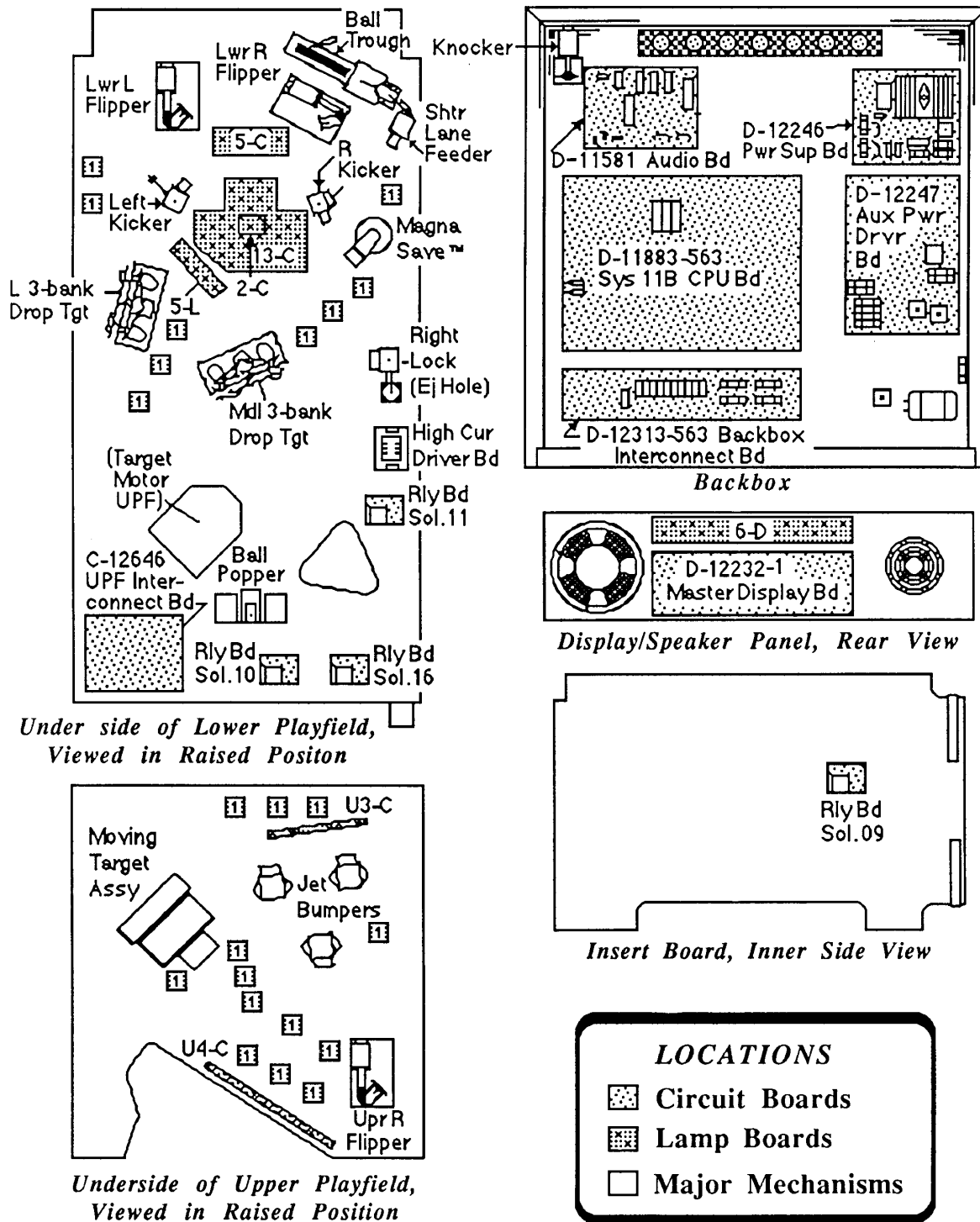


Figure 1. Locations Diagram - Game Circuit Boards and Major Mechanisms

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.

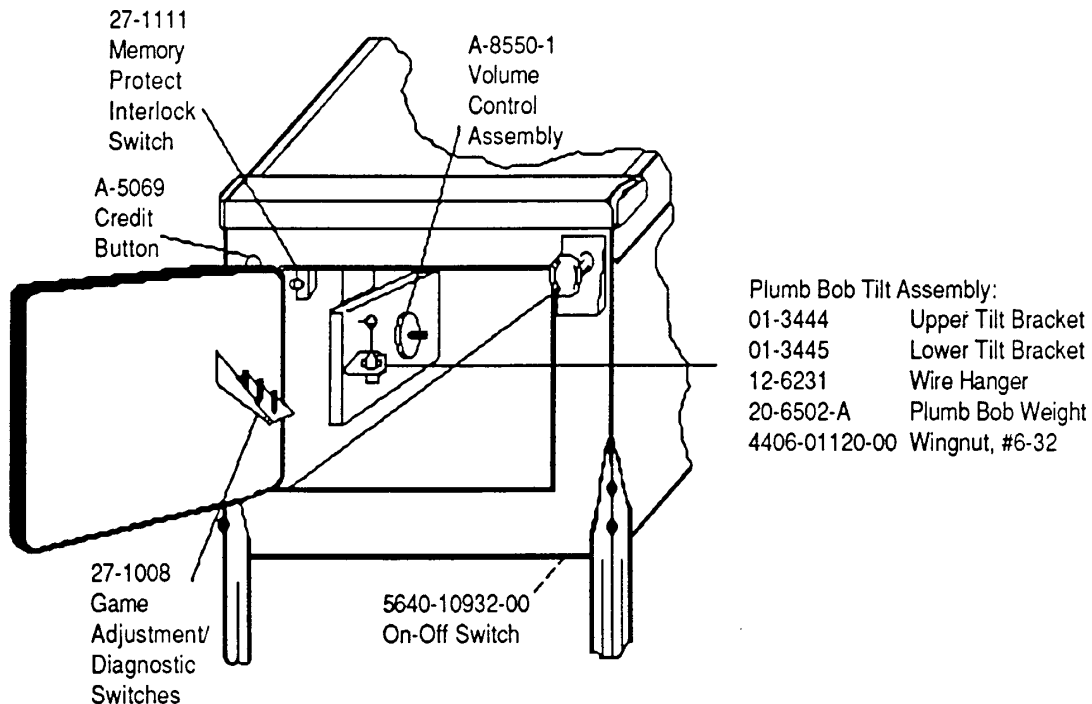


Figure 2. Pinball Game Controls Locations

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.

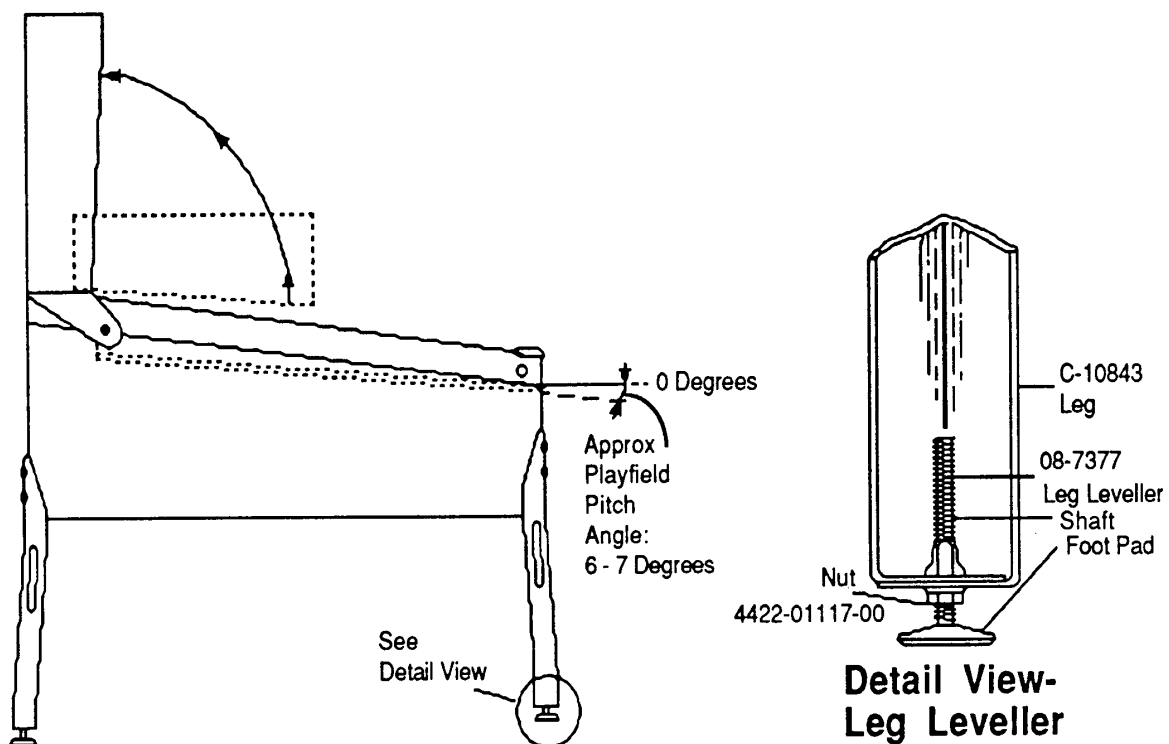


Figure 3. Pinball Assembly, Playfield Pitch Angle, and Leg Leveller Details.

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 leveller *slightly* below the leg bottom, so that all four foot pads are extended about the same distance. Remove the cabinet from its support and place it on the floor.
6. Adjust the leg levellers for proper playfield level (side-to-side) and playfield pitch angle (incline) of approximately 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 leveller 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 (\approx 30 games). However, the game program compensates the game play requirements affected by each disabled switch to allow 'nearly normal' play. This helps keep *JOKERZ* 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 2,500,000
03	REPLAY LEVELS (or REPLAY LEVEL 2) ¹	01 (or OFF)
04	(REPLAY LEVEL 3) ¹	(see text)
05	(REPLAY LEVEL 4) ¹	(see text)
06	REPLAY AWARD	Credit
07	SPECIAL AWARD	Credit
08	MATCH FEATURE	10 (%)
09	BALLS / GAME	03
10	TILT WARNING	03
11	MAXIMUM EX. BALL	04
12	MAXIMUM CREDITS	10
13	HIGHEST SCORES	On
14	BACKUP HI. SCR.1	5,000,000
15	BACKUP HI. SCR. 2	4,500,000
16	BACKUP HI. SCR. 3	4,000,000
17	BACKUP HI. SCR. 4	3,500,000
18	HI. SCR.1 CREDITS	01
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)	
⁴ 49	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	INSTALL FACTORY	NO

NOTES:

- 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.
- Phrase in parentheses is **Factory Setting**. Phrase appears in player displays. Press Credit Button to change setting of the game pricing of Item 24.
- 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.
- To install Custom Message, press flipper button for alphabet and special characters. Press Credit Button for next message letter or character.
- Special Preset Adjustment, whose effects are noted in the Game Adjustment text.
- Refer to **Pricing Table** and text describing these items.
- 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	Hard	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	Hard	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)

0 6 **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).

0 7 **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.

0 8 **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.

0 9 **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.

1 0 **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.

1 1 **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.

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.

15 Backup High Score 2

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

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.

17 Backup High Score 4

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

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:

ABCDEF GHIJK LMNOP QRSTUVW XYZ0123456789 <> ? - / * ' .
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)

5 8 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: 25c) pass through a coin chute.

5 9 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

6 0 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

6 1 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

6 2 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.

6 3 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.

6 4 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.

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 Pricing Table

Country	Coin Chute			Games/Coin	Ad 24 Display	Pricing Functions						W
	Left	Center	Right			25	26	27	28	29	30	
USA and Canada	25¢	-	25¢	1/25¢, 4/\$1 ^{1,2}	U.S.A. 1	01	04	01	01	00	00	x
				1/50¢, 2/75¢, 3/\$1 ²	U.S.A. 2	03	12	03	04	00	00	x
				1/50¢, 2/\$1 ²	U.S.A. 3	01	04	01	02	00	01	x
				1/25¢, 3/50¢, 6/\$1	CUSTOM	01	04	01	01	02	00	x
				1/25¢, 5/\$1	CUSTOM	01	00	01	01	04	00	x
				1/50¢ ; Add'l game: 25¢	CUSTOM	98	00	98	99	00	00	x
Austria	5 Sch	10 Sch	10 Sch	1/2x5 Sch, 3/2x10 Sch ²	AUSTRIA	01	02	02	02	04	01	x
	5 Sch	-	10 Sch	2/5 Sch, 5/10 Schilling	CUSTOM	02	00	05	01	00	00	x
	1 Sch	5 Sch	10 Sch	2/5x1 Sch, 2/5 Sch, 5/10 Sch	CUSTOM	02	10	25	05	00	00	x
Australia	20¢	-	\$1	1/3x20¢, 2/\$1 ²	AUSTRAL.	02	00	10	05	00	00	x
United Kingdom	10 P	50 P	1£	1/2x10 P, 3/50 P, 7/1£ ²	U.K.	03	15	30	05	30	00	x
	10 P	50 P	20 P	1/10 P, 5/50 P, 2/20 Pence	CUSTOM	01	05	02	01	00	00	x
Switzerland	1 F	2 F	5 F	1/1 F, 3/2 F, 7/5 Franc ²	SWISS	03	00	06	02	00	00	x
	1 F	-	2 F	1/1 F, 3/2 F	CUSTOM	01	03	07	01	00	00	x
Belgium	20 F	20 F	20 F	3/20 Franc ²	BELGIUM	03	03	03	01	00	00	x
	5 F	-	20 F	1/2x5 F, 2/20 Franc ²	CUSTOM	01	01	04	02	00	01	x
	5 F	20 F	20 F	1/2x5 F, 2/20 F, 2/20 F	CUSTOM	01	04	04	02	00	01	x
	5 F	5 F	20 F	1/2X5 F, 1/2X5 F, 2/20 F	CUSTOM	01	01	04	02	00	01	x

GAME PRICING (Continued)
Black Knight Pricing Table (Continued)

Country	Coin Chute			Games/Coin	Ad 24 Display	Pricing Functions						W
	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 DMark ^{2,3}	GERMAN1	06	12	30	05	30	00	x
				1/1 DM, 2/2 DM, 6/5 DM ^{1,2}	GERMAN2	06	12	30	05	00	00	x
				1/1 DM, 3/2 DM, 9/5 DM	CUSTOM	09	18	45	05	00	00	x
				1/2x1 DM, 1/2 DM, 3/5 DM	CUSTOM	03	06	15	05	00	00	x
				2/1 DM, 5/2 DM, 14/5 DM	CUSTOM	13	26	65	05	65	00	x
Netherlands	1 Hfl	2.5 Hfl	2.5 Hfl	1/1 Hfl, 3/2.5 Holland Florin ²	NETHERL.	06	15	15	05	00	00	x
	25¢	-	1 G	1/25¢, 5/1 Guilder	CUSTOM	01	00	05	01	00	00	x
	1G	-	1 G	1/1 Guilder ²	HOLLAND	01	00	01	01	00	00	x
Sweden	5 Kr	5 Kr	5 Kr	1/5 Krona ²	SWEDEN	01	01	01	01	00	01	x
	1 Kr	-	1 Kr	1/2x1 Krona	CUSTOM	01	04	01	02	00	01	x
France	1 F	5 F	10 F	1/3x1 F, 2/5 F, 5/10 Franc ^{1,2}	FRANCE	02	10	20	05	20	00	x
	1F	5F	10F	1/2x1F,3/5F,7/10 Franc ^{1,2}	CUSTOM	03	15	30	05	30	00	x
	5 F	10 F	10 F	1/5 F, 3/10 F, 7/2x10 Franc	CUSTOM	03	15	30	10	60	15	x
	5 F	10 F	10 F	2/5 F, 4/10 F, 9/2x10 Franc	CUSTOM	02	10	20	05	40	10	x
	5 F	10 F	10 F	2/5 F, 5/10 F, 11/2x10 Franc	CUSTOM	01	05	10	02	20	05	x
Italy	500 L	500L	500 L	1/500 Lire ²	ITALY	01	01	01	01	00	00	x
Spain	25 P	-	100P	1/25 P, 5/100 Peseta ²	SPAIN	05	00	20	04	00	00	x
	25 P	-	100P	1/25 P, 4/100 Peseta	CUSTOM	01	00	04	01	00	00	x
	25 P	-	100P	1/2x25 P, 2/100 Peseta	CUSTOM	01	00	04	02	00	00	x
	25 P	-	100P	1/2x25 P, 3/100 Peseta	CUSTOM	03	00	12	04	00	06	x
Japan	100 ¥	-	100 ¥	1/100 Yen ²	JAPAN	01	00	01	01	00	00	x
	-	100 ¥	-	2/100 ¥	CUSTOM	01	04	01	02	00	01	x
Antilles, Netherl.	25¢	-	1 G	1/25¢, 4/1 Guilder ²	ANTILLES	01	01	04	01	00	00	x
Chile	Token	-	Token	1/1 Token ²	CHILE	01	04	01	01	00	00	x
Denmark	1 Kr	5 Kr	10 Kr	1/2x1 Kr, 3/5 Kr, 7/10 Krone ²	DENMARK	03	15	30	05	30	00	x
Finland	1 Mka	-	5 Mka	1/2x1 Mka, 3/5 Markka ²	FINLAND	03	00	15	05	00	00	x
New Zealand	20¢	-	20¢	1/3x20¢ ²	N. Z.	01	00	01	03	00	01	x
Norway	1 Kr	-	1 Kr	1/2x1 Kr, 3/5x1 Krone ²	NORWAY	01	00	01	02	05	00	x
Argentina	10¢	10¢	10¢	1/1 Token ²	ARG.	01	01	01	01	00	00	x
Greece	10D	20D	50D	1/2x10D, 1/20D, 3/50Drachma ²	GREECE	03	06	15	05	00	00	x

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 Ball 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 CHANCE (R Outlane) 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 Outlane) 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 Outlane) 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.

1. (From Lamp Test) Using AUTO-UP, press ADVANCE. Observe that the Player 1 and 2 displays show the message, COIL TEST, the Player 3 display shows 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.

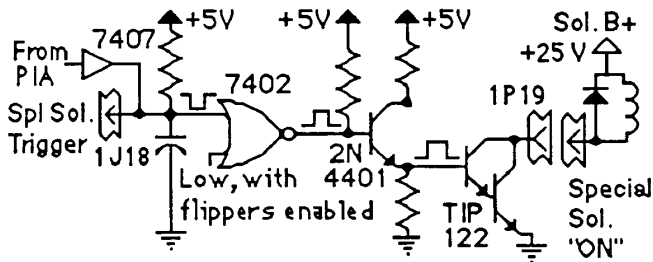
Black Knight 2000 Solenoid Table

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	Bolt 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/UpR 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 Select 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 ("sling")	Special #2	Blu-Red	1P19-4	5J3-6: 5J7-6	Q71	AE-26-1500
19	Right Jet Bumper	Special #3	Blu-Orn	1P19-3	5J3-3: 5J7-3	Q73	AE-23-800
20	Right Kicker ("sling")	Special #4	Blu-Yel	1P19-6	5J3-4: 5J7-5	Q69	AE-26-1500
21	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>	-	Orn-Vio	1P19-1	2J5-5: 2J10-7	-	
-	Lower Right Flipper	-	[Blu-Vio] ²		[2J10-1: 2J8-15]	-	FL11630/50VDC
-	Upper Right Flipper	-	[Blk-Yel]		[2J10-4: 2J8-12]	-	FL11630/50VDC
-	<u>Left Flipper</u>	-	Orn-Gry	1P19-2	2J5-4: 2J10-8	-	
-	Lower Left Flipper	-	[Blu-Gry] ²		[2J10-2: 2J8-4]	-	FL11630/50VDC

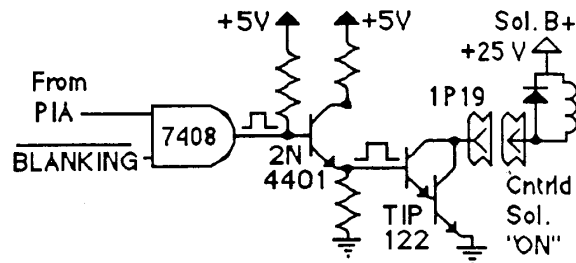
Notes 1. Wire colors, except flipper Orn-Vio and Orn-Gry, are ground connections (to coil terminal with unbanded end of diode). Flipper Orn-Vio and Orn-Gry wires connect from CPU Board to flipper switch. 2. Flipper connections shown in braces are from flipper switch to flipper coil. 3. "A" circuits are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

TEST/DIAGNOSTIC PROCEDURES (Continued)

"On" State Logic - Special Solenoid



"On" State Logic - Controlled Solenoid



"Off" State - Special Solenoid:

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

"Off" State - Controlled Solenoid:

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

NOTE

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

When the game program determines that the Solenoid A/C Select Relay (sol. 12) must be energized, the relay connects 'circuit C power' to eight group C solenoids (01C through 08C). Now, driver transistor Q33 can actuate the 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.

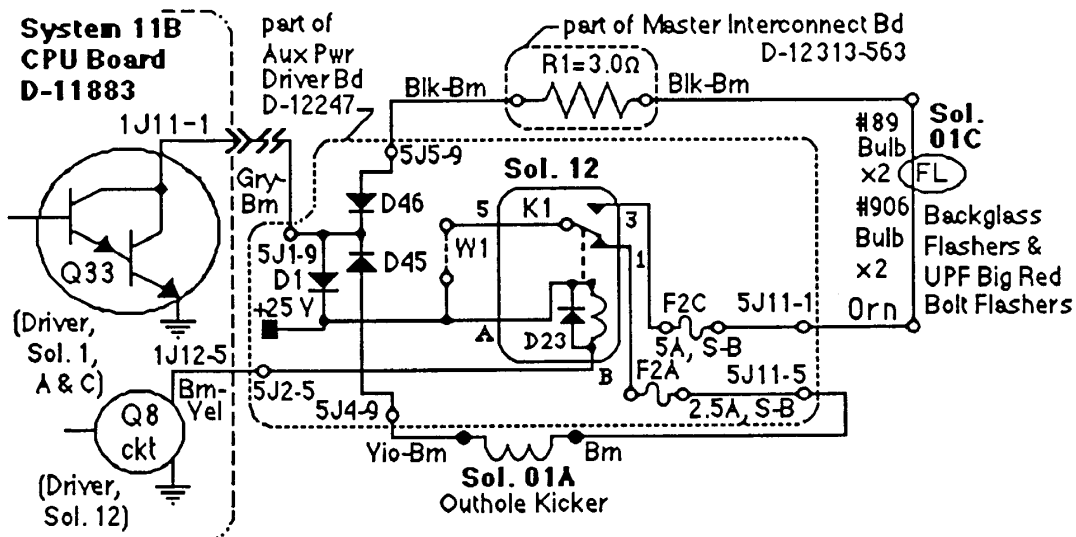


Figure 4. Typical Solenoid A/C Select Relay Circuit, showing the function of Solenoid 12, the Solenoid A/C Select Relay.

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 \ ROW	1 Q45 GRN-BRN 1J8-1	2 Q49 GRN-RED 1J8-2	3 Q44 GRN-ORN 1J8-3	4 Q48 GRN-YEL 1J8-4	5 Q43 GRN-BLK 1J8-5	6 Q47 GRN-BLU 1J8-7	7 Q42 GRN-VIO 1J8-8	8 Q46 GRN-GRY 1J8-9
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.
<p>Notes: 1. This test assumes that the Coin Door is OPEN; it is initiated ONLY by pressing the CPU Diagnostic Switch (SW2).</p> <p>2. Alternatively, its associated connections or connecting devices are causing the IC to appear to have problems.</p>		

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).

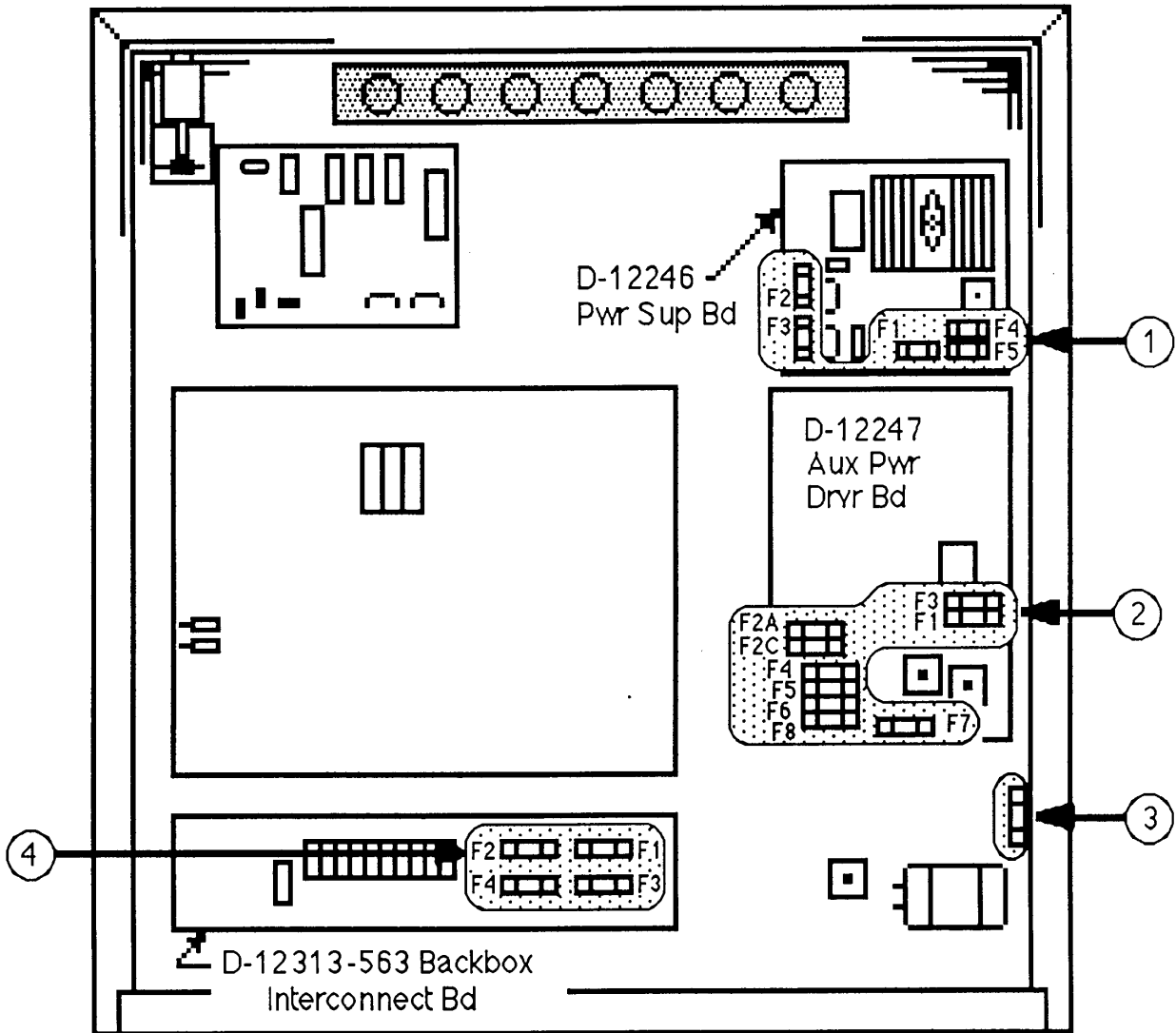
If the previous checks did not isolate the problem, turn the Volume Control for maximum output. Momentarily touch a powered-up AC soldering pencil on the center tap of the Volume Control.

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.

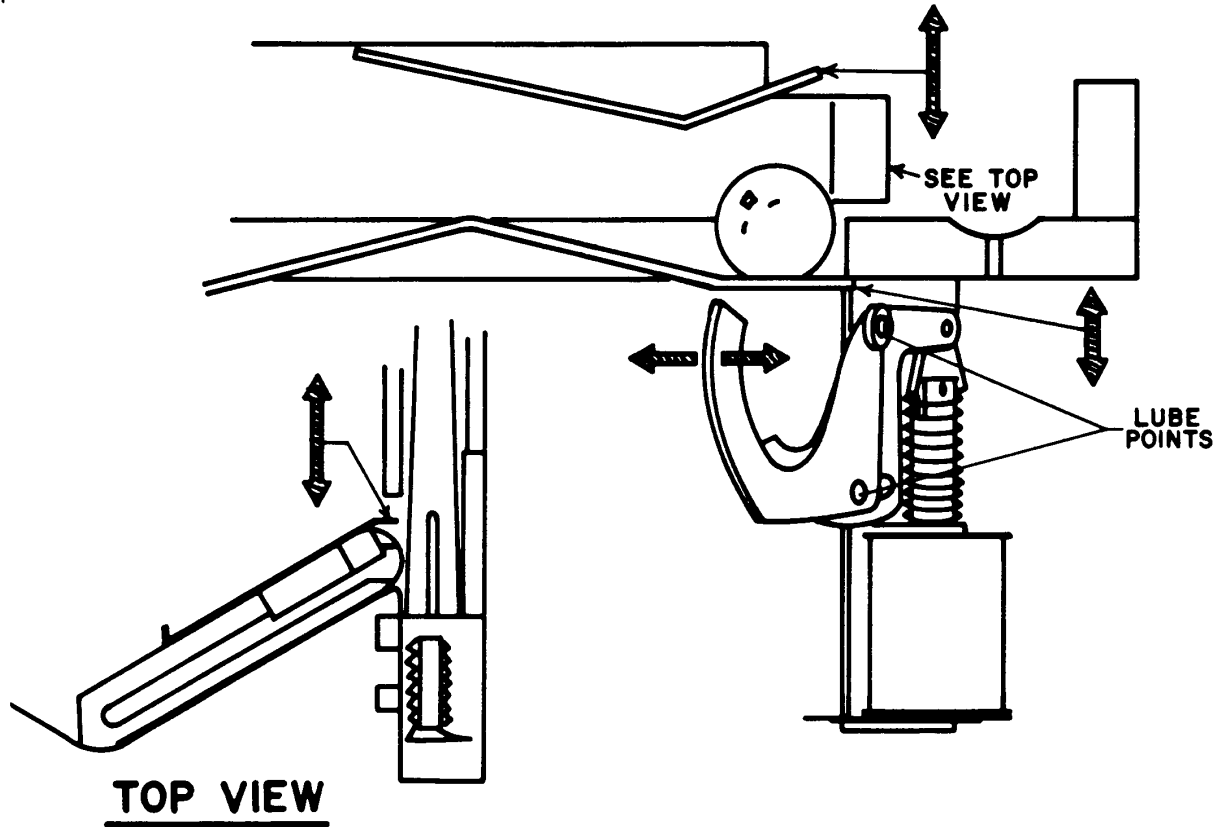


Figure 4. Adjustments and Lubrication Points, Shooter Lane Feeder.

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

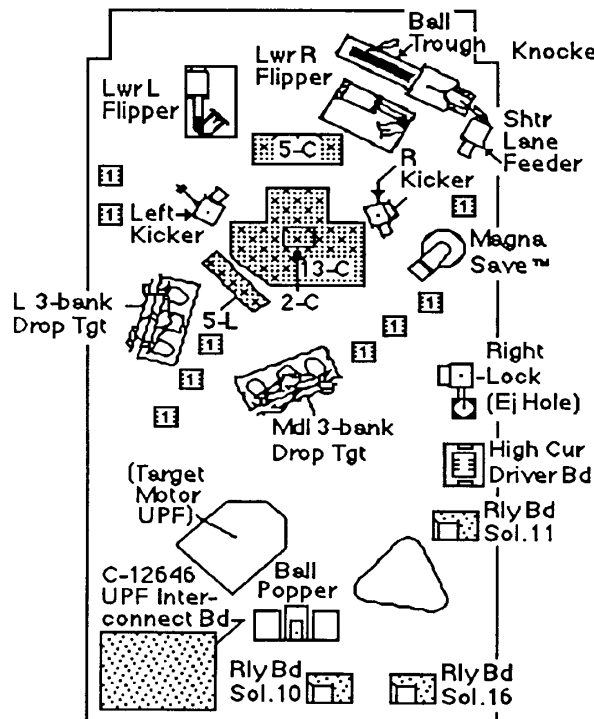
All Major Mechanism Assemblies of ~~Black Knight~~ 2000

Solenoids/Flashers & Rubber Parts

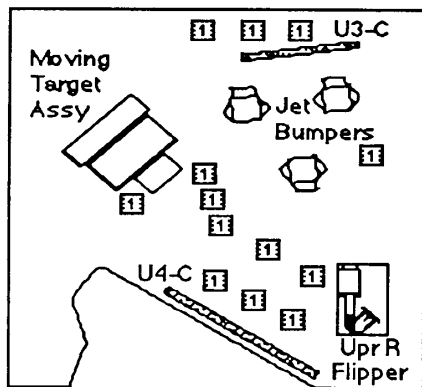
Switches

Lamps

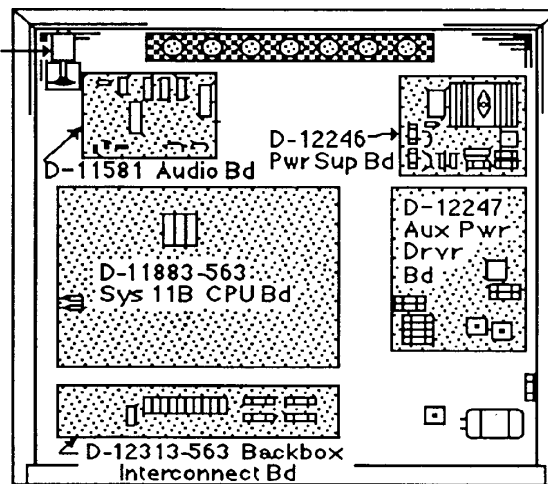
Playfield Parts



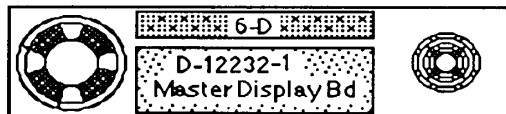
*Under side of Lower Playfield,
Viewed in Raised Position*



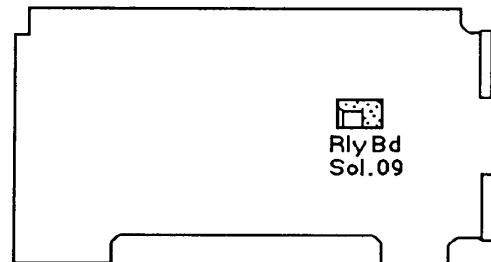
*Underside of Upper Playfield,
Viewed in Raised Position*



Backbox






Display/Speaker Panel, Rear View



Insert Board, Inner Side View

LOCATIONS

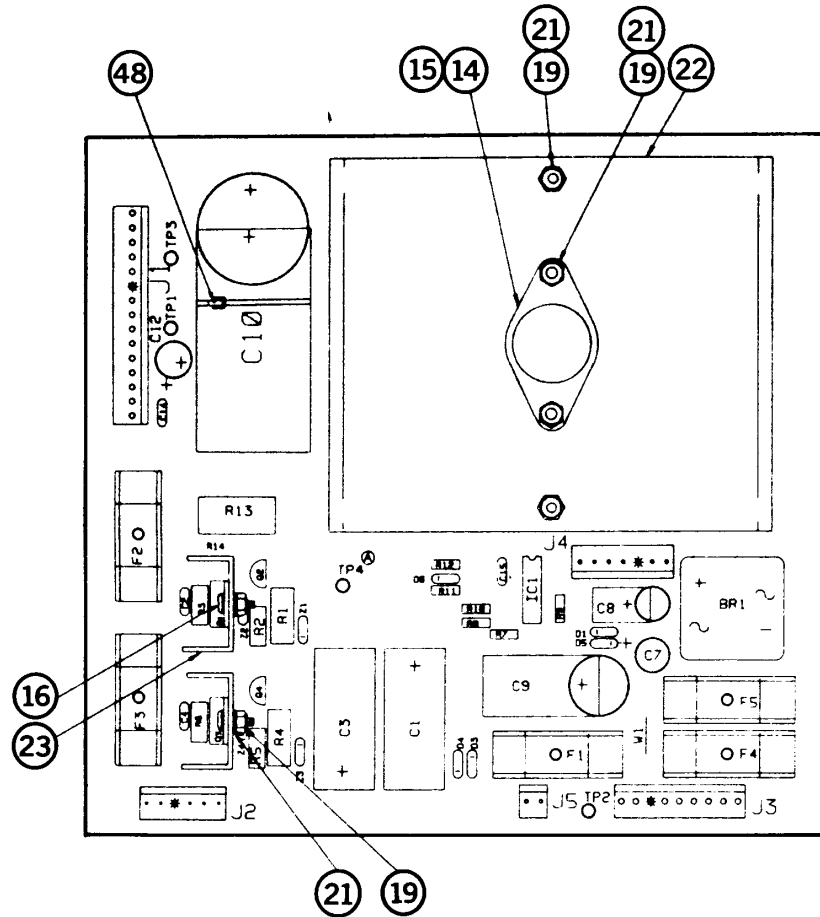
-  Circuit Boards
-  Lamp Boards
-  Major Mechanisms

Locations Diagram - Game Circuit Boards and Major Mechanisms

- | | | | |
|-------------|------------------------------------|-------------|---------------------------------------|
| C-11626-L-3 | Lower Left Flipper | B-10686-2 | Knocker Assembly |
| C-12898 | Lower Right Flipper | D-11581-563 | Audio Board |
| C-9638 | Ball Shooter Lane Feeder | D-12246 | Power Supply Board |
| B-12665 | Left & Right Kicker Arm Assembly | D-11883-563 | System 11B CPU Board |
| A-12831 | Magna Save™ Coil & Bracket | D-12247-563 | Aux Power Driver Board |
| C-12519 | Lamp Board ("5-C") | D-12313-563 | Backbox Interconnect Board |
| D-12503 | Lamp Board ("13-C") | C-12700 | Lamp Board ("6-D") |
| D-12503-1 | Lamp Board ("2-C") | D-12232-1 | Master Display Board |
| D-12520 | Lamp Board ("5-L") | C-11998-1 | Relay Board (Sol. 09 & 10 Gen. Illum) |
| B-12224 | Lamp Board ("1") (22) | | |
| C-11223-1 | 3-Bank Drop Target (Left & Middle) | | |
| C-12559 | 3-Bank Opto Board | | |
| B-9361-R-5 | Eject Hole Arm Assy | | |
| C-12493 | High Current Driver Board | | |
| C-11902-1 | Relay Board (Sol. 11 & 16) | | |
| D-11335-1 | Ball Popper Assembly | | |
| C-12646 | UPF Interconnect Board | | |
| C-11998-1 | Relay Board (Sol. 10) | | |

Upper Playfield Items

- | | |
|-------------|----------------------------|
| C-12464 | Moving Target Assembly |
| B-12465 | Mvg Tgt Motor Assembly |
| B-9414 | Jet Bumper (R, L, Lwr) |
| B-9415-1 | Bumper Coil & Bracket Assy |
| D-12702-R-1 | UPF Right Flipper |

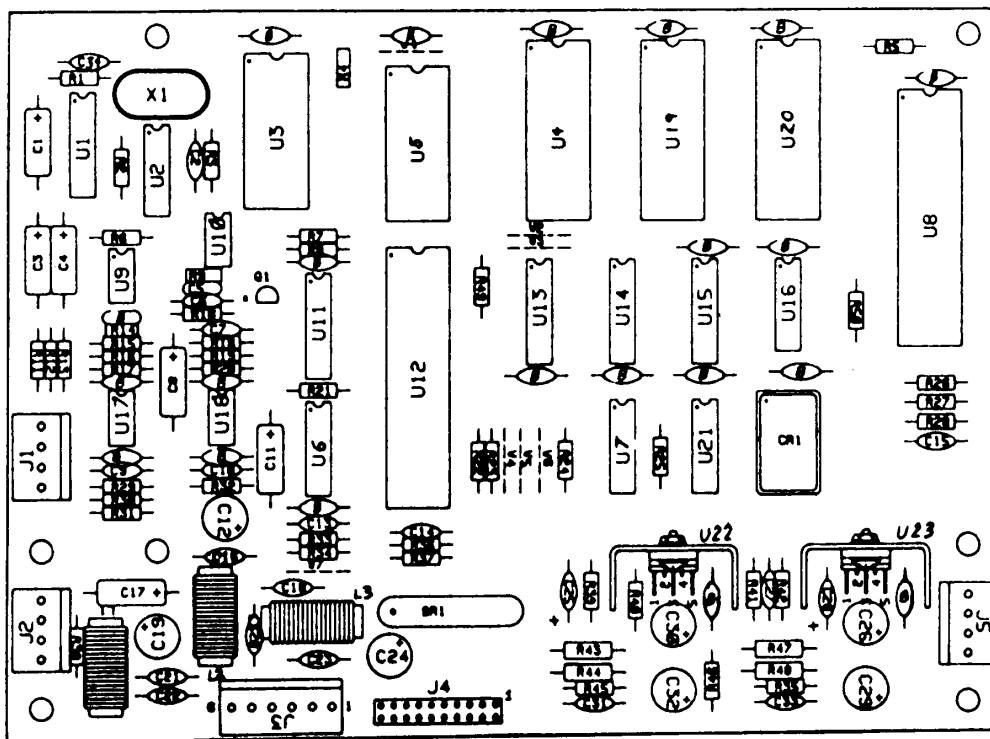


Power Supply p/n D-12246

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, 25v, axial or radial
18	20-9229		Thermal Compound		5040-08893-00		Capacitor, 18,000 mfd, electr, 20v, axial
19	4406-01117-00		Nut, 6-32 Hex.	43	5040-09419-00	C10	Capacitor, 330 mfd, electr, 10v, radial
20	5010-09534-00	W1	Resistor, 0Ω	44	5040-09423-00	C12	Capacitor, 0.1 mfd, 50v, disc
21	4703-00007-00		Lockwasher, #6 Ext.	45	5043-09446-00	C14	Capacitor, 470 pfd
22	5705-12330-00		Heatsink 4"	46	5043-09065-00	C15	Terminal, #1502-1 (Test Post)
23	5705-09199-00		Heatsink 6030B	47	5824-09248-00	TP1-TP4	Tie Wrap, 8" Long
24	5070-09054-00	D1, D3 - D6	Diode, 1N4004	48	03-7947		
25	5075-09059-00	ZR1, ZR3	Zener, 1N5990, 3.9v, 1/2w				

NOTES:

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



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 fd, 20v, \pm 20%
5371-09152-00	U11	IC, D/A Convr, MC1408	5040-10974-00	C12, C19, C24	Capacitor, 100 μ fd, 35v
5430-10322-00	U12	IC, PIA, MC68B21	5040-09776-00	C26, C30	Capacitor, 470 μ fd, 16v; +50, -10%
5340-10139-00	U5	IC, RAM/S 5516-2 2Kx8	5040-12006-00	C29, C32	Capacitor, 1000 μ fd, 16v, 20%
5281-09487-00	U16	IC, Dual D Flipflop, 74LS74	5041-09243-00	C25, C28	Capacitor, 10 μ fd, 10v, \pm 10%
5281-10043-00	U13	IC, 74LS175	5043-08980-00	C5, B (17)*	Capacitor, 0.01 μ fd, 50v, +80, -20%
5281-09235-00	U21	IC, Triple NAND, 74LS10	5043-08996-00	C31, C33	Capacitor, 0.1 μ fd, 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) 4006-01003-06		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, 6 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
5010-09161-00	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.

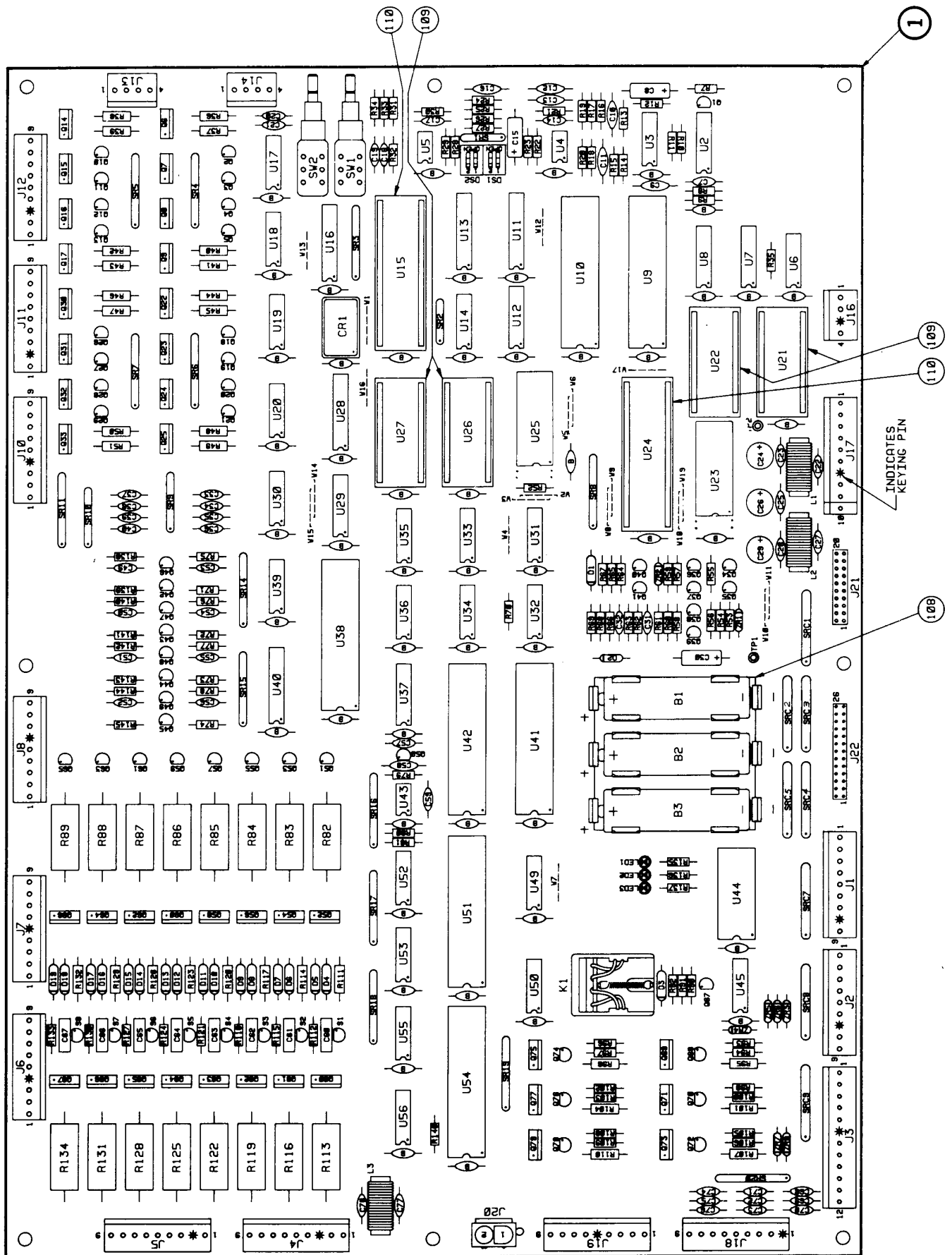
System 11B CPU Board

p/n D-11883-563

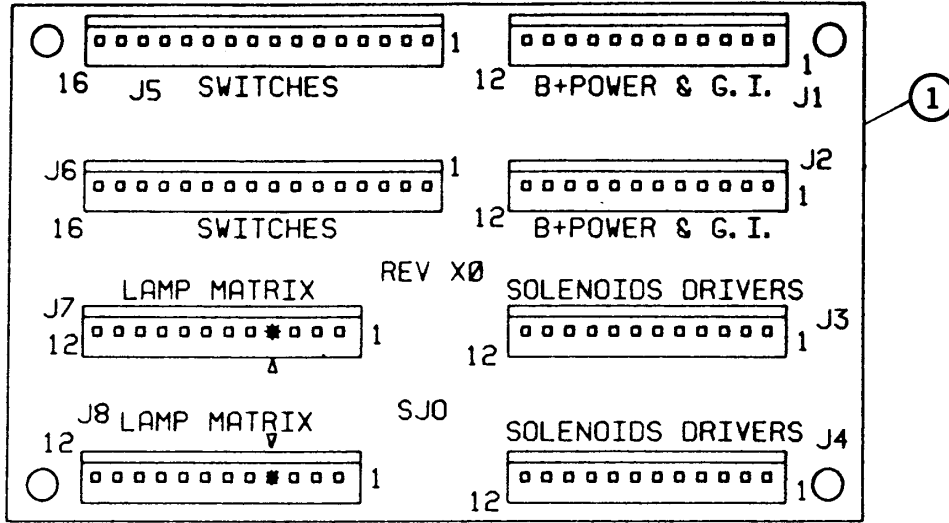
Item	Part No.	Ckt Designator	Description	Item	Part No.	Ckt Designator	Description
1	5764-12206-00		Bare P. C. Board	62	5010-10003-00	R62, R63	Resistor, 390Ω, 5%, 1/4w, C. F.
2	5370-09691-00	U3	IC, CVSD Mod., 55536	63	5010-10171-00	R67	Resistor, 56Ω, 5%, 1/4w, C. F.
3	5370-09321-00	U4, U5	IC, Dual Op Amp, 1458	64	5010-10170-00	R69	Resistor, 47Ω, 5%, 1/4w, C. F.
4	5281-09308-00	U16	IC, Octal Bus Xcvr, 74LS245	65	5010-09160-00	R59, R61, W12, W13	Resistor, 220Ω, 5%, 1/4w, C. F.
5	5430-08972-00	U9, U10, U38, U41, U42, U51, U54	IC, PIA, MC6820/6821	66	5010-09416-00	R33, R34, R71-R78, R135-R137	Resistor, 470Ω, 5%, 1/4w, C. F.
6	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	5281-09246-00	U7, U8, U12	IC, 2-4 Decoder, 74LS139	69	5010-10631-00	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	5310-09236-00	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	SR18	SIP, 9R, 10-pin, 6.8KΩ, .125w/R, 5%
17	5280-09013-00	U3C	IC, Hex Inverter, 7404	78	5019-09362-00	SR3, SR15, SR17, SR19, SR20	SIP, 9R, 10-pin, 4.7KΩ, .125w/R, 5%
18	5281-09499-00	U31, U34	IC, Quad 2-Input NAND, 74LS00	79	5019-09808-00	SR4, SR6, SR11	SIP, 9R, 10-pin, 560Ω, .125w/R, 5%
19	5281-10014-00	U33	IC, Dual 4-Input NAND, 74LS20	80	5019-09785-00	SR16	SIP, 9R, 10-pin, 2.2KΩ, .125w/R, 5%
20	5281-09486-00	U28	IC, Octal D Flip-flop, 74LS374	81	5019-10472-00	SR14	SIP, 9R, 10-pin, 3.3KΩ, .125w/R, 5%
21	5371-09152-00	U2	IC, D/A Converter, MC1408	82	5019-09669-00	SR8	SIP, 9R, 10-pin, 1.0KΩ, .125w/R, 5%
22	5281-09745-00	U37	IC, 3-8 Decoder, 74LS138	83	5019-09780-00	SR9, SR10	SIP, 4R, 8-pin, 1KΩ, 5%
23	5340-09878-00	U23	IC, 2K x 8 Static RAM, 2016	84	5019-09786-00	SR1, SR2	SIP, 5R, 6-pin, 4.7KΩ, .125w/R, 5%
24	Not Used			85	5019-09792-00	SR5, SR7	SIP, 9R, 10-pin, 2.7KΩ, .125w/R, 5%
25	5281-09867-00	U11, U13, U40	IC, Octal Buffer, 74LS244	86	5060-10396-00	SRC1 - SRC5, SRC7 - SRC9	SIP, 8R, 8C, 10-pin, 4.7KΩ & 470pfd
26	5280-09873-00	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(+80,-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	5040-10974-00	C24, C26, C29	Capacitor, 100 μfd, Electr., 25v(+50,-10%), Axial
33	5162-08976-00	Q51, Q53, Q55, Q57, Q59, Q61, Q63, Q65	Transistor, NPN Darl. 2N6427, TO-92	94	Not Used		
34	5191-08978-00	Q52, Q54, Q56, Q58, Q60, Q62, Q64, Q66	Transistor, PNP, TIP42, TO-220	95	5045-09796-00	C60-C67	Capacitor, 0.1 μfd, Polycarbonate Rad., 100v(±10%)
35	5162-09410-00	Q6-Q9, Q14-Q17, Q22-Q25, Q30-Q33, Q69, Q71, Q73, Q75, Q77, Q79, Q80-Q87	Transistor, NPN, TIP122, TO-220	96	5043-09065-00	C33-C40, C68, C69, C76, C10, C12	Capacitor, 470 pfd, 50v(±20%), Axial
36	5160-08938-00	Q2-Q5, Q10-Q13, Q18- Q21, Q26-Q29, Q34- Q38, Q41, Q67, Q68, Q70, Q72, Q74, Q76, Q78	Transistor, NPN, 2N4401, TO-92	97	5040-09545-00	C30	Capacitor, 22 μfd, Electr., 10v(+50,-10%), Axial
37	5160-10269-00	Q1, Q40	Transistor, NPN, 2N3904, TO-92	98	5041-09031-00	C58	Capacitor, 1 μfd, Tant., 25v(±20%), Axial
38	5190-09016-00	Q39, Q50	Transistor, PNP, 2N4403, TO-92	99	5043-09030-00	C16, C57	Capacitor, 0.047 μfd, 50v(±20%), Axial
39	5130-09014-00	S1-S8	SCR, 30v, 0.8A, 2N5060	100	Not Used		
40	5070-06258-00	D3-D19	Diode, 1N4001	101	5043-09492-00	C11	Capacitor, 100 pfd, ceramic, 100v(±20%)
41	5070-08919-00	D2	Diode, 1N4148, 150mA	102	Not Used		
42	5070-09266-00	D1	Diode, 1N5817, 1.0A	103	5048-10992-00	C13	Capacitor, 4700 pfd, ceramic, 50v(±10%)
43	5075-09018-00	ZR1	Diode, Zener, 1N5996A, 6.8v, 0.5w	104	5551-09822-00	L1-L3	Inductor, 4.7 μH, 3A
44	5075-09059-00	ZR2	Diode, Zener, 1N5990, 3.9v, 0.5w	105	5641-09312-00)	SW1, SW2	Switch, Pushbutton, DPDT, 100v, 5A
45	5010-08992-00	R94, R97, R100, R103, R106, R109	Resistor, 560Ω, 5%, 1/4w, C. F.	106	5880-09022-00	B1-B3	Battery, Alkaline, 1.5v, AA
46	5010-09039-00	R56	Resistor, 10Ω, 5%, 1/4w, C. F.	107	20-9491	W18, W19	Bus Wire, Jumper
47	5010-09534-00	W1, W2, W4, W5, W7, W8, W11, W14, W16, W17, W19	Resistor, 0Ω, 5%, 1/4w, C. F.	108	5881-09021-00		Battery Holder, #171
48	5010-08991-00	R31, R32, R35, R52 R55, R68, R92, R146	Resistor, 4.7KΩ, 5%, 1/4w, C. F.	109	5700-10176-00		IC Socket, 28 pin
49	5010-09358-00	R54, R57, R58, R64, R66, R138-R145	Resistor, 1.0KΩ, 5%, 1/4w, C. F.	a)	A-5343-563-1	U26	IC, Game ROM 2, 27128
50	5010-09113-00	R79	Resistor, 33KΩ, 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, 3.3KΩ, 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, R90	Resistor, 10KΩ, 5%, 1/4w, C. F.	d)	A-5343-563-4	U21	IC, Sound ROM 1, 27256
53	5010-09086-00	R81	Resistor, 6.8KΩ, 5%, 1/4w, C. F.	110	5700-08985-00		IC Socket, 40 pin
54	5010-09363-00	R3	Resistor, 5.6KΩ, 5%, 1/4w, C. F.	a)	5400-09150-00	U15	IC, μProcessor, 6802
55	5010-08997-00	R23, R24, R91, R93, R96, R99, R102, R105, R108, R112, R115, R118, R121, R124, R127, R130, R133 R113, R116, R119, R122, R125, R128, R131, R134	Resistor, 2.7KΩ, 5%, 1/4w, C. F.	b)	5400-09150-00	U24	IC, μProcessor, 6802
56	5012-09037-00	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 R82-R89	Resistor, 68Ω, 5%, 1/2w, C. F.	112 - 115	Not Used		
58	5012-10860-00	R82-R89	Resistor, 27Ω, 5%, 2w, C. F.	116	20-9229		Thermal Compound
59	Not Used			117	5580-08994-01	K1	Relay, 4-pole, 40Ω, 6v
60	Not Used			118	5791-10862-09	1J1, 1J2, 1J4-1J8, 1J10-1J12, 1J17-1J19	Connector, 9 pin (Hdr)
61	5010-10987-00	R19	Resistor, 56KΩ, 5%, 1/4w, C. F.	119	5791-10862-04	1J13, 1J14, 1J16	Connector, 4 pin (Hdr)
				120	5791-10862-12	1J3	Connector, 12 pin (Hdr)
				121	Not Used		
				122	5791-10850-00	1J22	Connector, 26 pin Ribbon (Hdr)
				123	5791-09437-00	1J21	Connector, 20 pin Ribbon (Hdr)

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.



SYSTEM 11B CPU BOARD (D-11883)



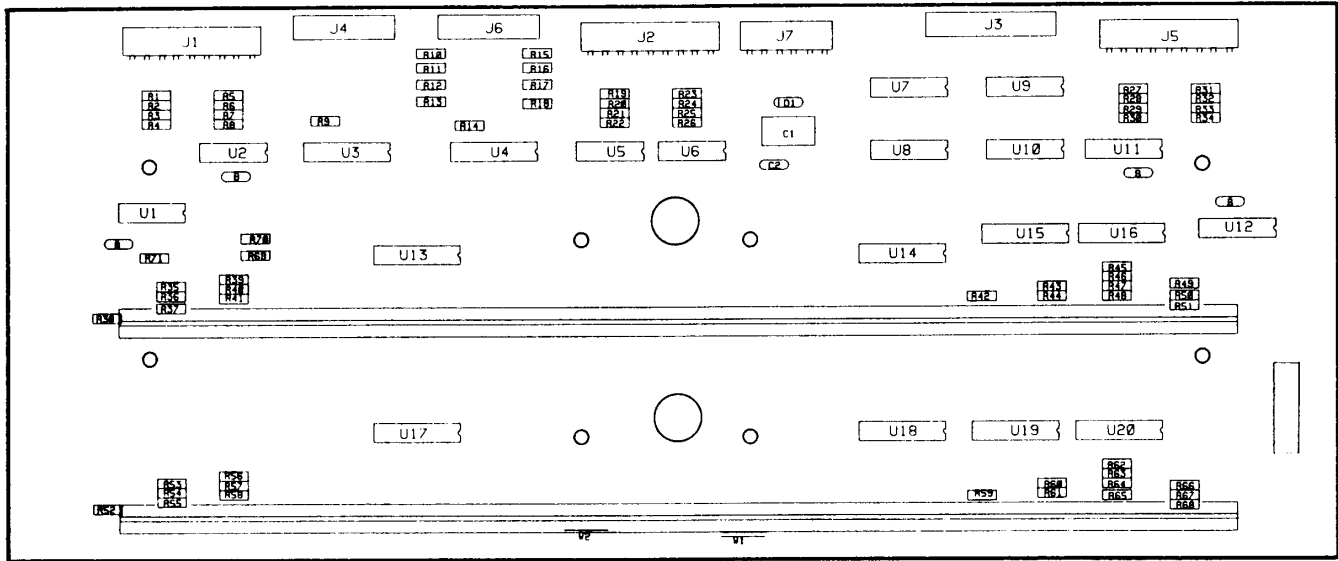
Upper Playfield Interconnect Board p/n C-12646

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

Connector Wiring Information - Upper Playfield Interconnect Board

J1				J2				J3				J4				
Pin	From	Color	To	Color	From	Color	To	Color	From	Color	To	Color	From	Color	To	Color
1		N/C		N/C	2J11-16	BLK/BRN	Sol. 01C	BLK/BRN								
2	5J11-1	ORG	Flashers	ORG	2J11-15	BLK/RED	Sol. 02C	BLK/RED								
3	5J11-11	RED/WHT	J Bmprs	RED/WHT	2J11-9	BLK/VIO	Sol. 15	BLK/VIO								
4	5J12-11	YEL/VIO	50V Sol.	YEL/VIO	2J11-8	BLK/GRY	Sol. 07C	BLK/GRY								
5	5J12-4	BLU/YEL	Flpr	BLU/YEL	-	N/C	-	N/C								
6	Flpr Sw	BLK/YEL	Flpr	BLK/YEL	5J7-7	BLU/BRN	L J Bmpr	BLU/BRN								
7	5J9-4	WHT/BLU	Motor	WHT/BLU	5J7-3	BLU/ORG	R J Bmpr	BLU/ORG								
8	5J9-6	WHT/BLU	Motor	WHT/BLU	5J7-2	BLU/GRN	B J Bmpr	BLU/GRN								
9	2J9-6	YEL	Gnl Illum	YEL	5J4-2	VIO/BLK	Sol. 07A	VIO/BLK								
10	2J9-5	VIO	Gnl Illum	VIO	-	N/C	-	N/C								
11	2J9-7	WHT/YEL	Gnl Illum	WHT/YEL	-	N/C	-	N/C								
12	2J9-1	WHT/VIO	Gnl Illum	WHT/VIO	-	N/C	-	N/C								

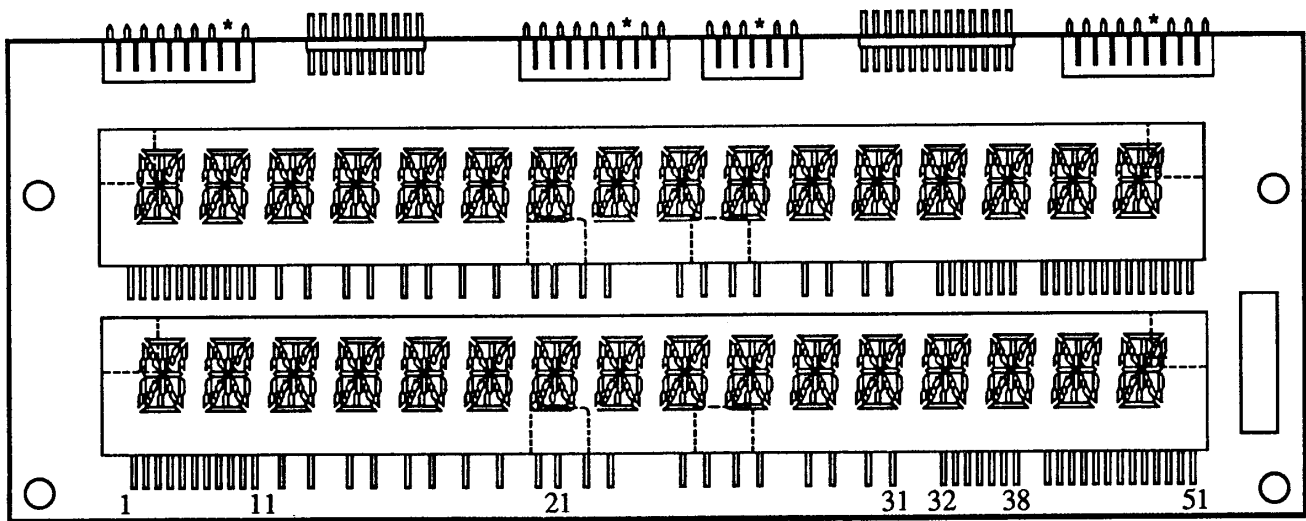
J5				J6				J7				J8				
Pin	From	Color	To	Color	From	Color	To	Color	From	Color	To	Color	From	Color	To	Color
1	1J8-2	GRN/RED	Sw Col 2	GRN/RED	1J7-3	YEL/ORG	Lmp Col 3	YEL/ORG								
2	1J8-3	GRN/ORG	Sw Col 3	GRN/ORG	1J7-4	YEL/BLK	Lmp Col 4	YEL/BLK								
3	1J8-4	GRN/YEL	Sw Col 4	GRN/YEL	1J7-6	YEL/GRN	Lmp Col 5	YEL/GRN								
4	1J8-5	GRN/BLK	Sw Col 5	GRN/BLK	-	N/C	-	N/C								
5	1J10-9	WHT/BRN	Sw Rw 1	WHT/BRN	1J6-1	RED/BRN	Lmp Rw 1	RED/BRN								
6	1J10-8	WHT/RED	Sw Rw 2	WHT/RED	1J6-2	RED/BLK	Lmp Rw 2	RED/BLK								
7	1J10-7	WHT/ORG	Sw Rw 3	WHT/ORG	1J6-3	RED/ORG	Lmp Rw 3	RED/ORG								
8	1J10-6	WHT/YEL	Sw Rw 4	WHT/YEL	1J6-5	RED/YEL	Lmp Rw 4	RED/YEL								
9	1J10-5	WHT/GRN	Sw Rw 5	WHT/GRN	1J6-6	RED/GRN	Lmp Rw 5	RED/GRN								
10	1J10-3	WHT/BLU	Sw Rw 6	WHT/BLU	1J6-7	RED/BLU	Lmp Rw 6	RED/BLU								
11	1J10-2	WHT/VIO	Sw Rw 7	WHT/VIO	1J6-8	RED/VIO	Lmp Rw 7	RED/VIO								
12	1J10-1	WHT/GRY	Sw Rw 8	WHT/GRY	1J6-9	RED/GRY	Lmp Rw 8	RED/GRY								
13	1J18-5	ORG/BRN	SS Sw 1	ORG/BRN												
14	1J18-2	ORG/BLK	SS Sw 3	ORG/BLK												
15	1J18-8	ORG/GRN	SS Sw 5	ORG/GRN												
16	1J14-2	WHT	Sw Gnd	WHT												



Master Display Board

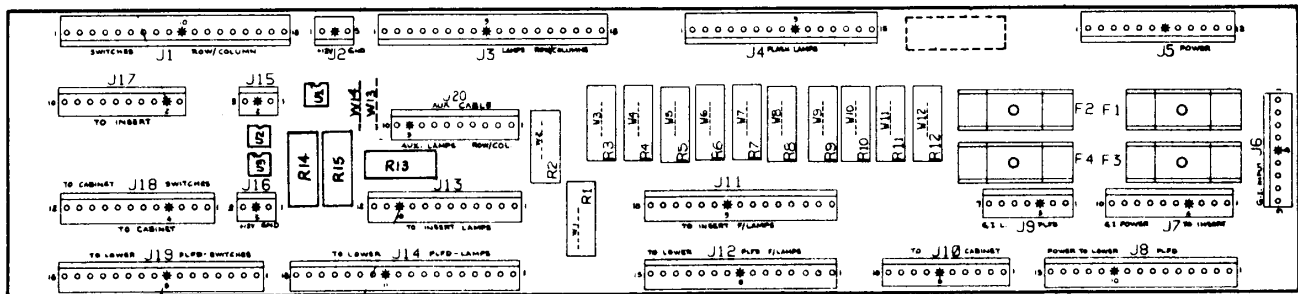
p/n D-12232-1

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,	Resistor, 18KΩ, 1/4w, 5%
5310-09882-00	U1, U2, U5, U6	I.C. 4001		R41, R43, R45, R71	
5310-08975-00	U7 - U12	I.C. 4049	5010-10258-00	R38, R52	Resistor, 1MΩ, 1/4w, 5%
5680-08968-00	U13, U14, U17, U18	I.C. 6184, Anode Driver	5010-10927-00	R36, R39, R40, R42,	Resistor, 8.2KΩ, 1/2w, 5%
5680-08969-00	U15, U16, U19, U20	I.C. 7180, Cathode Driver		R47, R48, R50, R51,	
5040-09343-00	C1	Axial Cap, 10 μfd, 20v, ±20%		R54, R56, R57, R59,	
5043-08980-00	Bypass	Axial Cap, 0.01 μfd, 50v, +80, -20%	5010-08981-00	R64, R65, R67, R68	Resistor, 10KΩ, 1/2w, 5%
5075-09135-00	D1, D2	Zener, 1N4740A, 10v, 1w		R37, R44, R46, R49	
5791-10869-09	J1, J2, J5	9-pin Header, Rt. Angle	03-8088-1	R55, R61, R63, R66	Support
5791-10869-06	J7	6-pin Header, Rt. Angle	16-8850-234		Support, Display
23-6634		Cover, Display			P.C.B. I.D. Label



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 & 16)

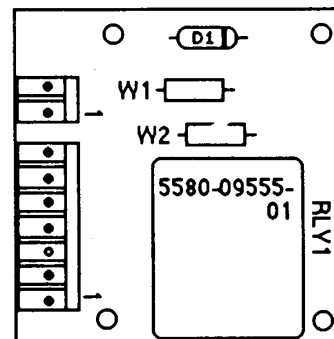
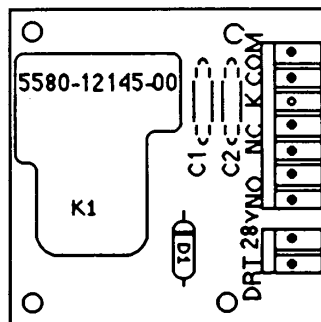
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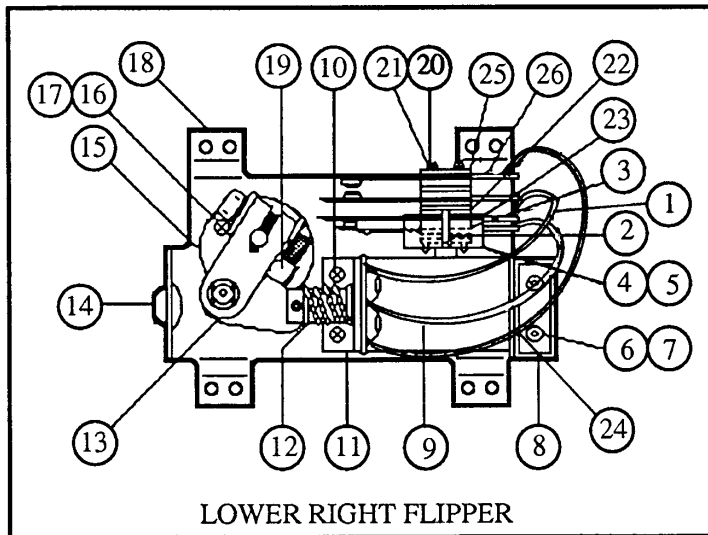
Part No.	Description
5768-12221-00	PC Board
5070-09054-00	Diode, 1N4004, 1.0 A.
5580-12145-00	Relay, 24vdc, 30 A.
5791-12273-02	Header, 2-pin sq post (J1)
5791-12273-07	Header, 7 pin sq post (J2)

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)



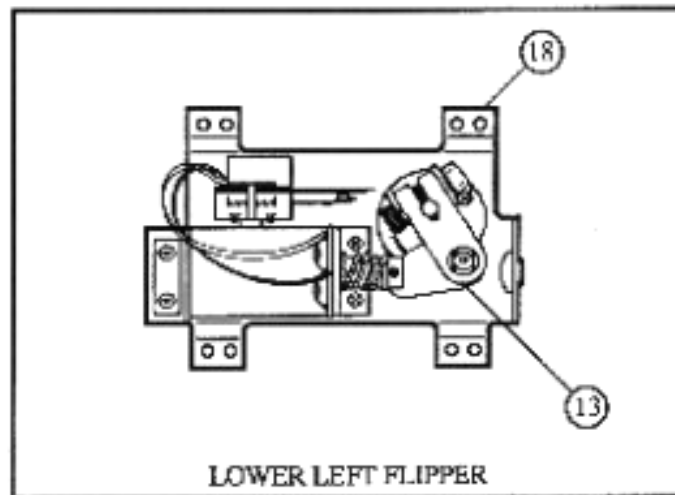


Lower Right Flipper
p/n C-12898

Item	Part No.	Description	Item	Part No.	Description
1	HW-30018-6	Wire, 18 AWG, Blue	19	06-14G	Insulating Blade
2	03-7520-2	Ty-Wrap, Nylon	20	4105-01001-20	Sh. Metal Screw, #5 x 1-1/4
3	20-6516	Speednut, Tinnerman	21	4701-00002-00	Lockwasher, #6 Split
4	5045-12098-00	Capacitor, 2.2 μ Fd, 250V, 20%	22	23-6622	Tape, Double-sided
5	RM-21-06	Sleeve, Vinyl (Cap. leads)	23	03-7811	End of Stroke (EOS) Switch
6	4010-01066-06	Cap Screw, 10-32 x 3/8, SH	24	HW-30018-64	Wire, 18 AWG, Blue/Yellow
7	4701-00004-00	Lockwasher, #10 Split	25	01-3670	Switch Plate-Curve
8	A-12111	Flipper Stop Assembly	26	SW-1A-183	Flipper Switch
9	FL-11630	Flipper Coil (Red), (* - Refer to Note 3)			
10	4006-01017-06	Mach. Screw, 6-32 x 3/8, 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			
17	4406-01117-00	Nut, 6-32 Hex			
18	C-11627-R	Flipper Base Assembly, R.			

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.
- Not Used.
- All moving elements of the assembly must operate freely, with no evidence of binding.
- The large end of the Coil Plunger Spring (item 12) must fit within the four lugs of the Solenoid Bracket.
- For coil replacement, remove the Solenoid Bracket (item 11) to prevent screw damage.
- Use Loctite™ 242 when reattaching screws to the Flipper Stop Assembly, the Solenoid Bracket, and the Flipper Bushing.
- When replacing the Bumper Plug (item 14) to restore proper flipper operation, readjust the flipper paddle and shaft position.
- Solid color blue wire connects to the banded end of each diode, mounted on the connector end of the Flipper Coil (item 9). Trace color wire connects to the unbanded end of the diode.



Lower Left Flipper

p/n C-11626-L-3

(Parts listed replace same items of C-12898)

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
20	4105-01019-10	Sh. Metal Screw, #5 x 5/8
24-26	Not Used	

Upper Right Flipper

p/n D-12702-R-1

(Parts listed replace same items of C-12898)

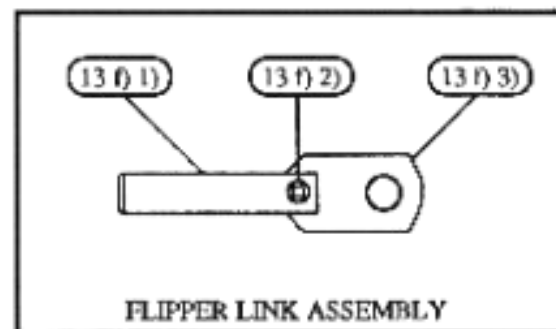
Item	Part No.	Description
19	Not Used	
20	4105-01019-10	Sh. Metal Screw, #5 x 5/8
24-26	Not Used	

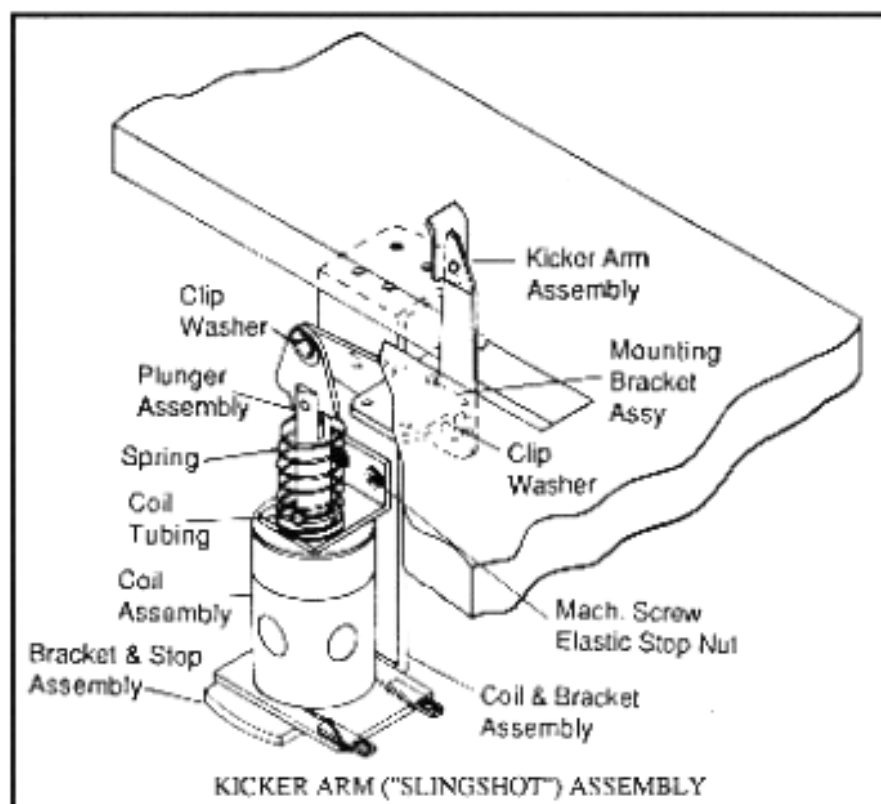
Flipper Link Assembly

p/n B-10686-2

(Drawing Part Numbers Refer to C-12898 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





Kicker Arm ("Slingshot") Assembly

p/n B-12665
(Left & Right Kickers)

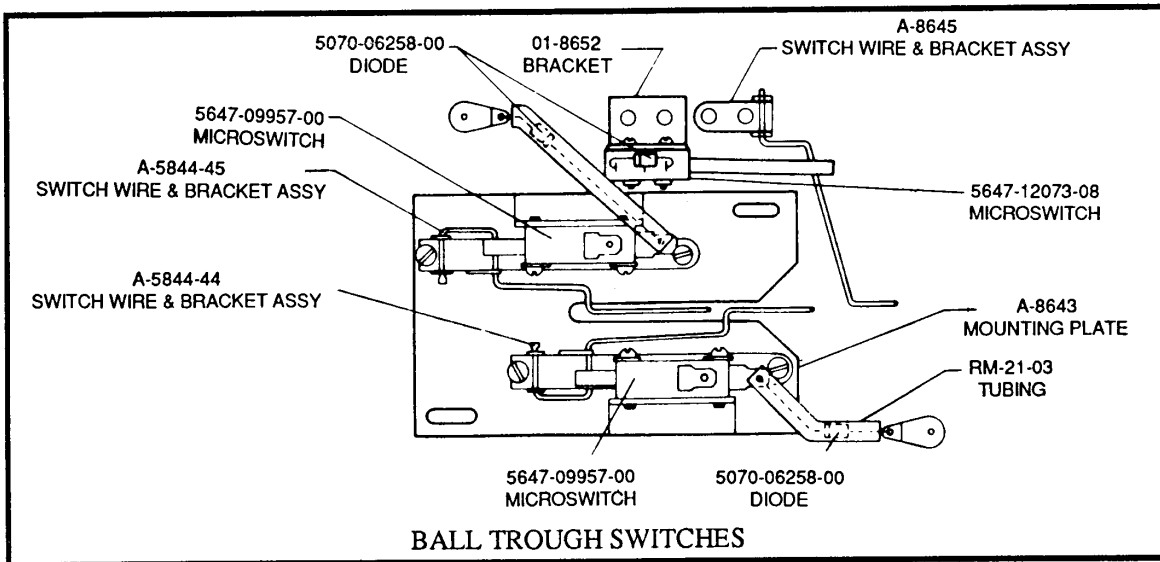
Part No.	Description
12-6227	Clip, Hairpin
A-12664	Kicker Crank Assembly
A-5103	Coil Plunger Assembly
02-2364	Coil Plunger
20-8716-5	Roll Pin, 1/8 x 7/16
03-8085	Armature Link
4700-00030-00	Flat Washer, 17/64 o.d. x 1/2 i.d. x 15 ga.
A-5653	Mounting Bracket Assy

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 Trough Switches

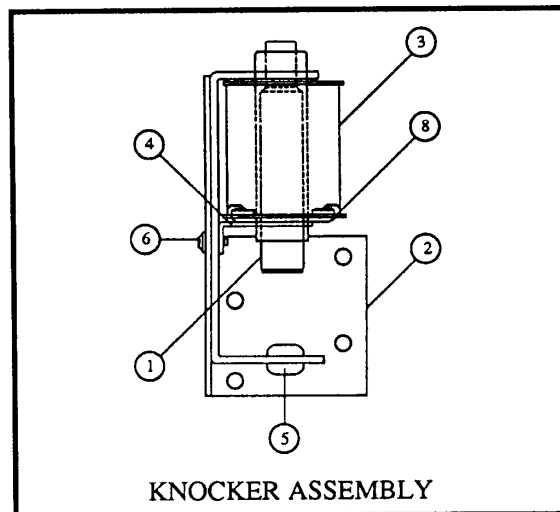
(Viewed from underside of playfield to show locations)

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

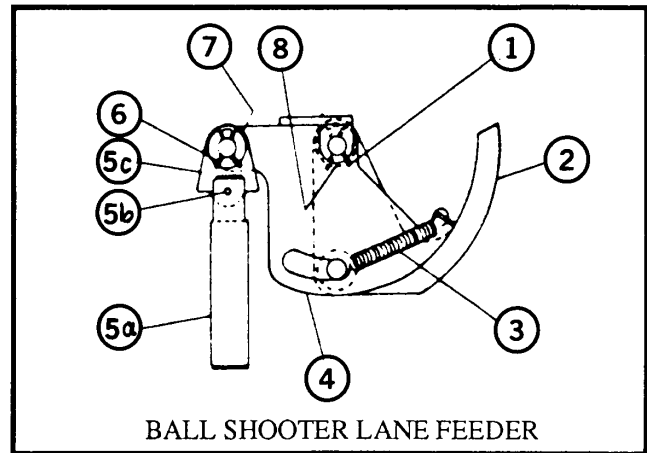
p/n B-10686-1

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



Ball Shooter Lane Feeder C-9638 & Associated Parts

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



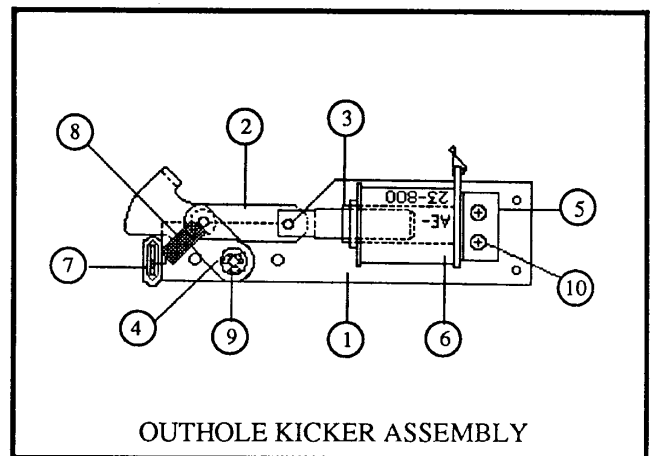
BALL SHOOTER LANE FEEDER

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

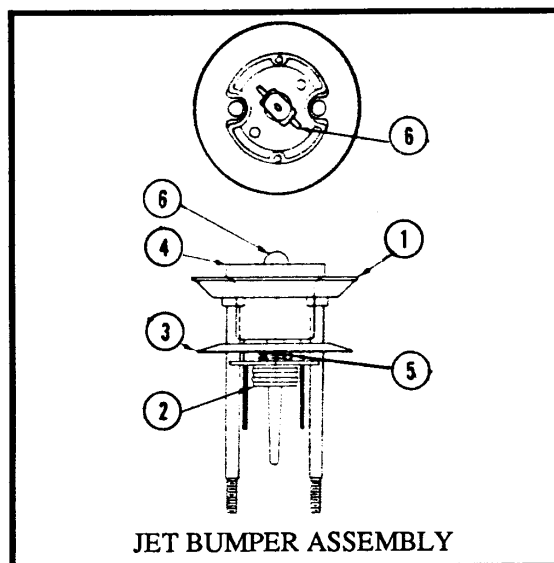
Item	Part No.	Description
1	A-6378	Mounting Plate Assy
2	A-8335	Coil Plunger Assy
	a) 02-2364	Coil Plunger
	b) 20-8716-5	Roll Pin, 1/8 x 7/16
	c) 01-4251	Ball Return Link
3	03-7066	Coil Tubing
4	A-6889	Kicker Lever Assy
5	A-8038	Coil Stop Assy
6	AE-23-800	Coil Assy
7	03-7176-1	Striker Ring
8	10-101-4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



OUTHOLE KICKER ASSEMBLY

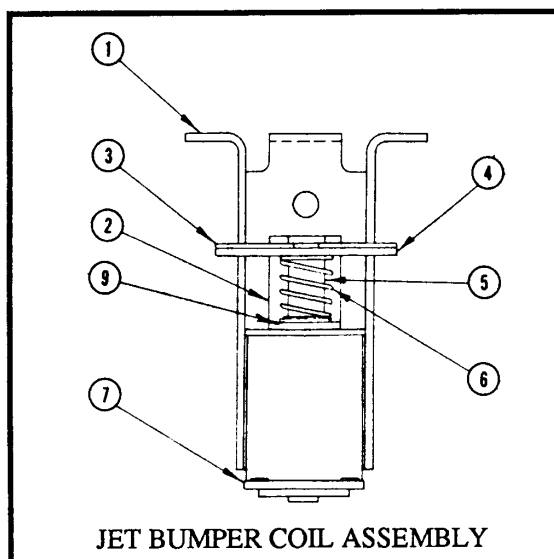
Jet Bumper Assembly p/n B-9414-2

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

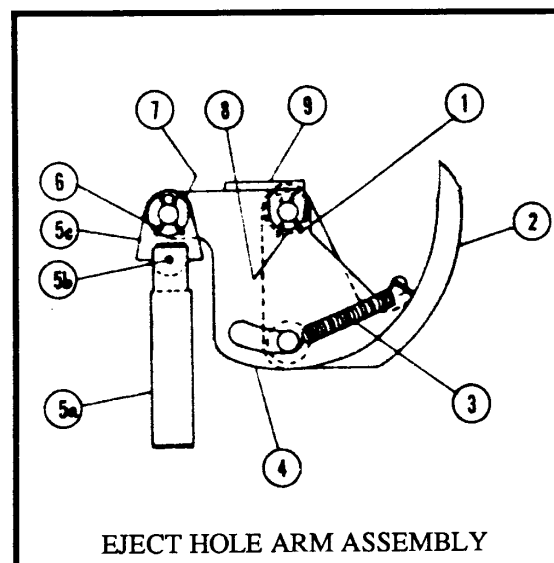


Eject Hole Arm Assembly p/n B-9361-R-5

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-8050-1	Plunger Assembly, 2-1/8
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.

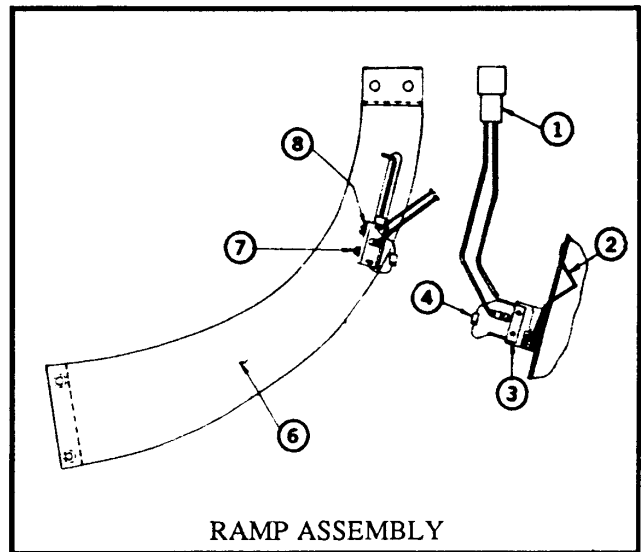
Associated Parts For Eject Hole

B-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



Ramp Assembly p/n B-12636

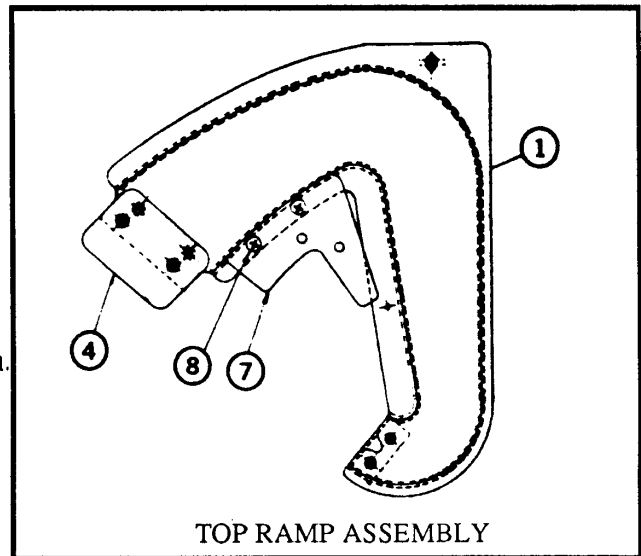
Item	Part No.	Description
1	H-12685	Ramp Switch Cable
2	5647-12073-20	Subminiature Switch
3	01-8240	Nut Plate # 2-56
4	5070-06258-00	Diode, 1N4001, 1.0 A.
5	Not Used	
6	B-12637	Ramp Sub-Assembly
	a) 01-8323	Switch Bracket
	b) 01-9118	Ramp
7	4002-01005-08	Mach. Screw, #2-56 x 1/2
8	4701-00024-00	Lockwasher,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



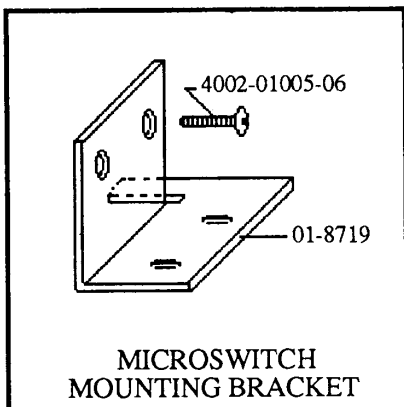
RAMP ASSEMBLY

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 x 21ga.
7	31-1006-563-34	Playfield Plastic
8	4106-01033-08	Sh. Metal Screw, #6 x 1/2



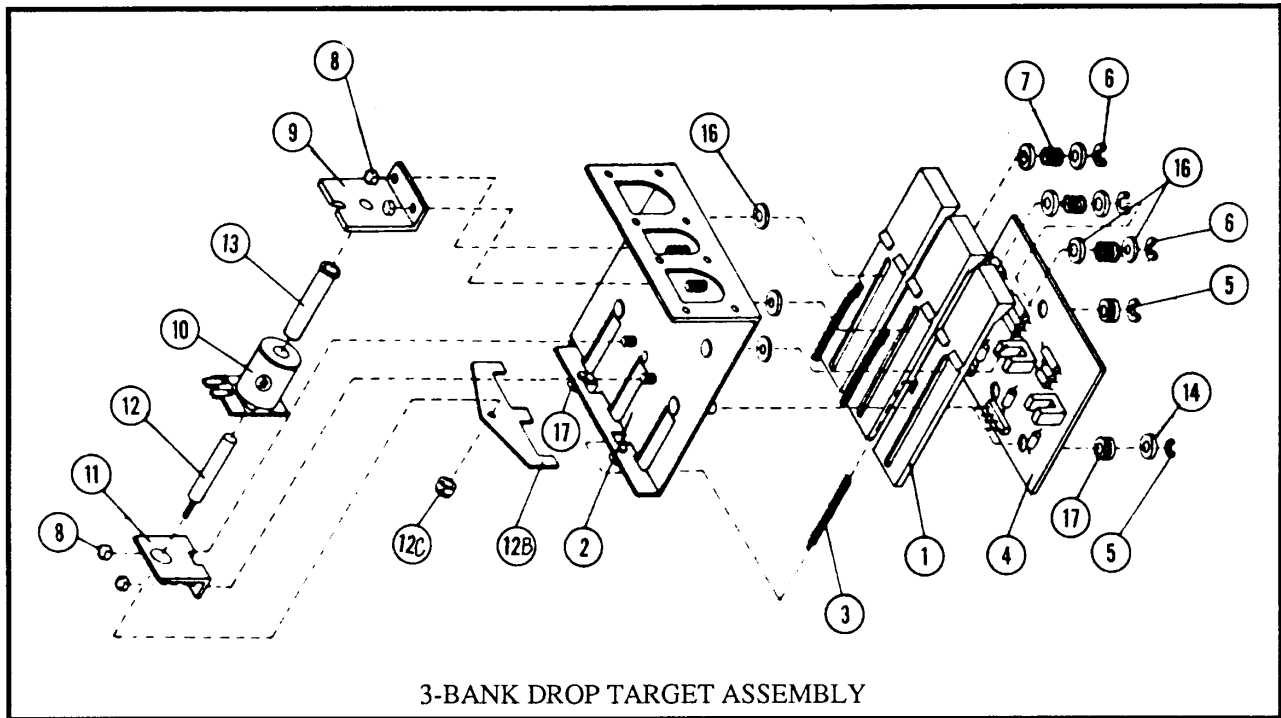
TOP RAMP ASSEMBLY



MICROSWITCH
MOUNTING BRACKET

Microswitch Mounting Bracket

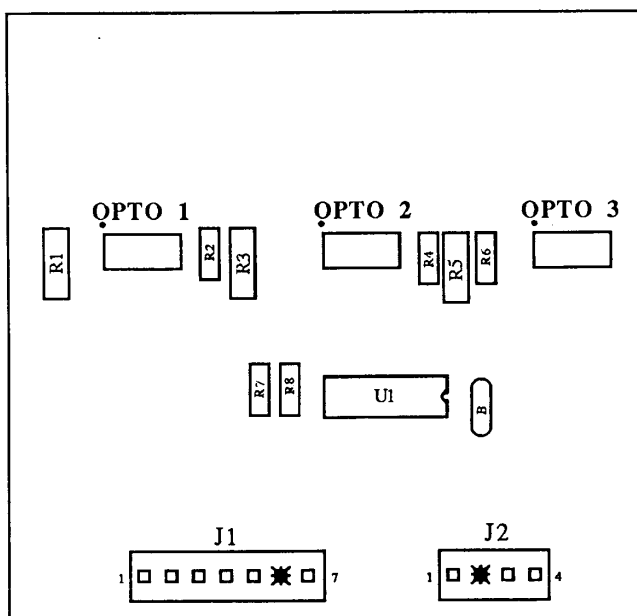
p/n 01-8719



3-Bank Drop Target

p/n C-11223-1

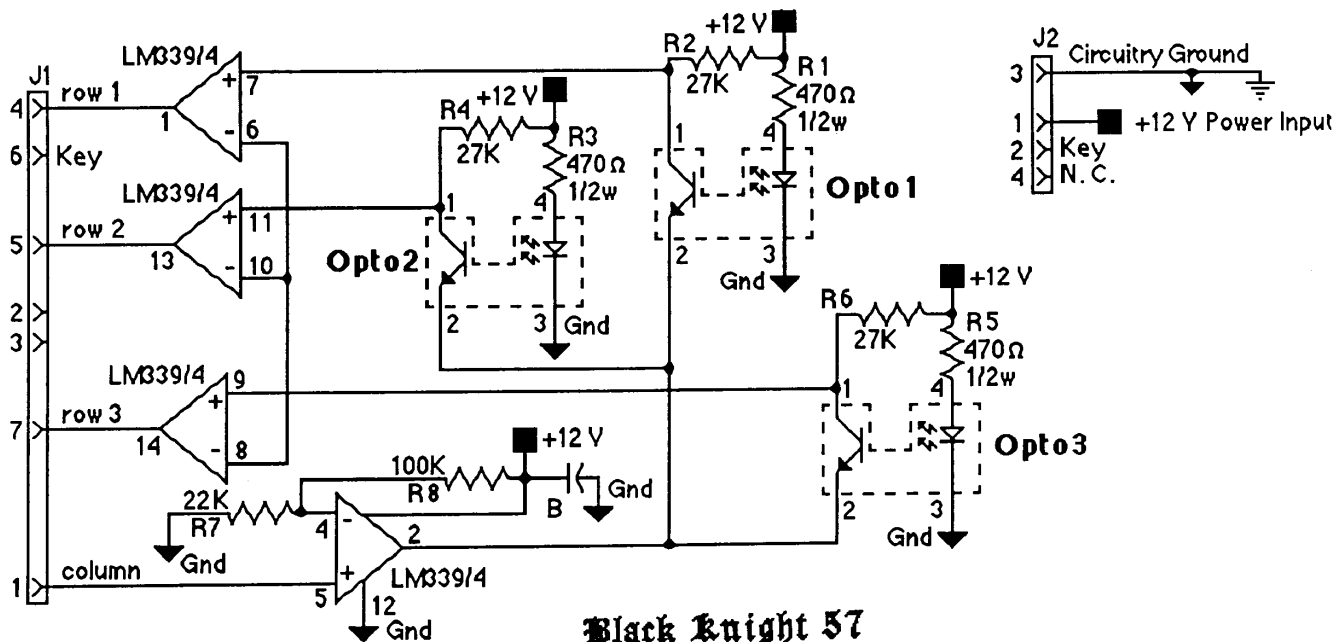
Item	Part No.	Description	Item	Part No.	Description
1	03-8036	Target, Plain	11	01-8413	Bracket Coil Mounting
2	B-11224	3-Bank Tgt Sub-Assy	12	A-11389	Plunger & Reset Plt Assembly
3	10-364	Spring - Extension	A)	02-3972-1	Plunger
4	C-12559	3-Drop Target Opto Assy	B)	01-8408	Reset Plate, 3-Bank
5	20-8712-18	"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

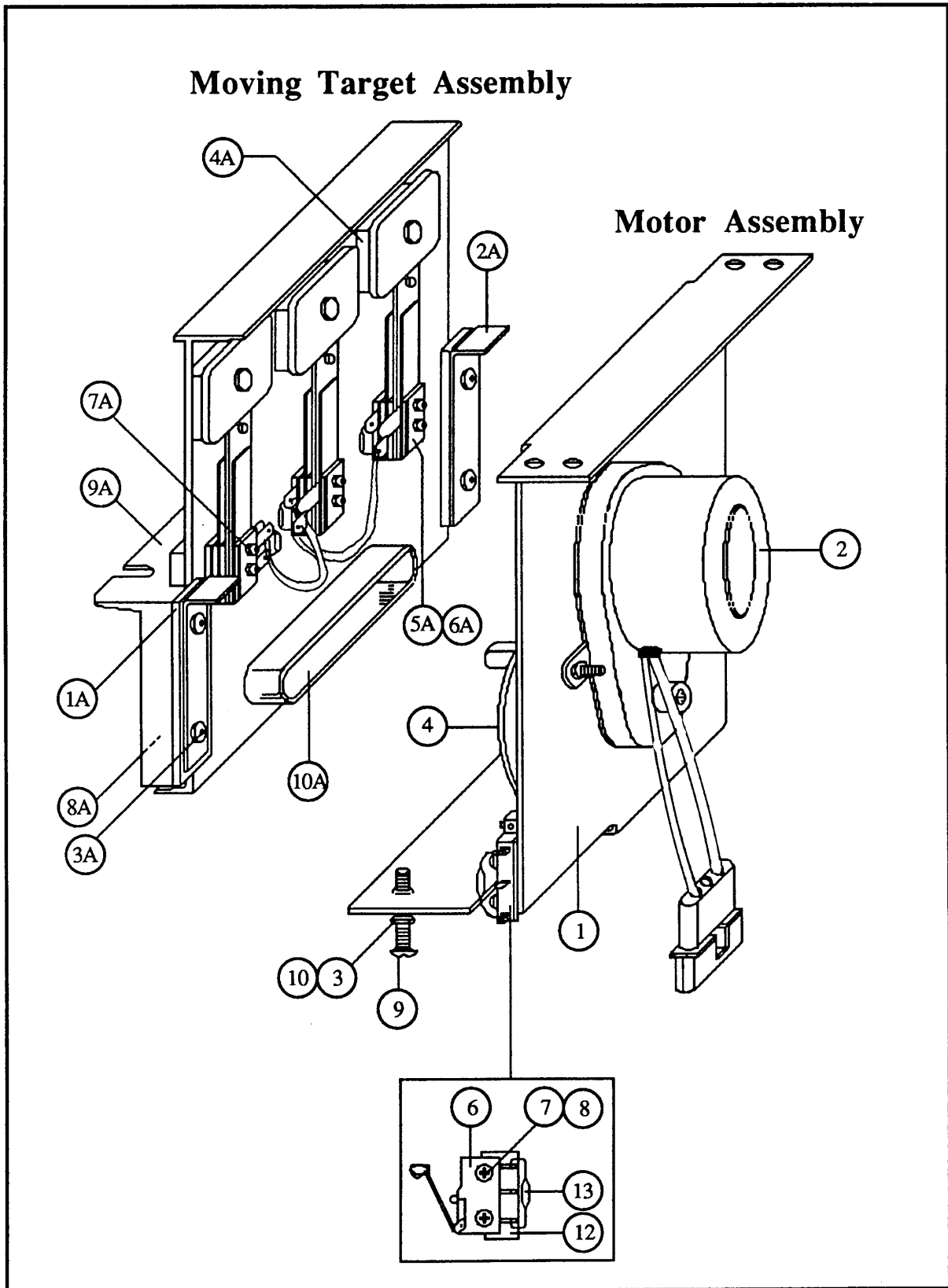
Item	Part No.	Description
1A	03-8028	Retainer Carrier
2A	01-8494	Support Bracket
3A	4106-01001-10	Sh. Metal Screw, #6 x 5/8
4A	23-6534-9	Edge Protector
5A	B-12725	Targets & Cable Assembly
1)	A-11177-1	Left Target Assembly
2)	A-11315-3	Mid & Rt Target Assembly
6A	01-3670-1	Switch Plate (Flat)
7A	4004-01003-12	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
* 11A	4106-01019-10	Sh. Metal Screw, #6 x 5/8

* Not Shown

Motor Assembly

p/n B-12465

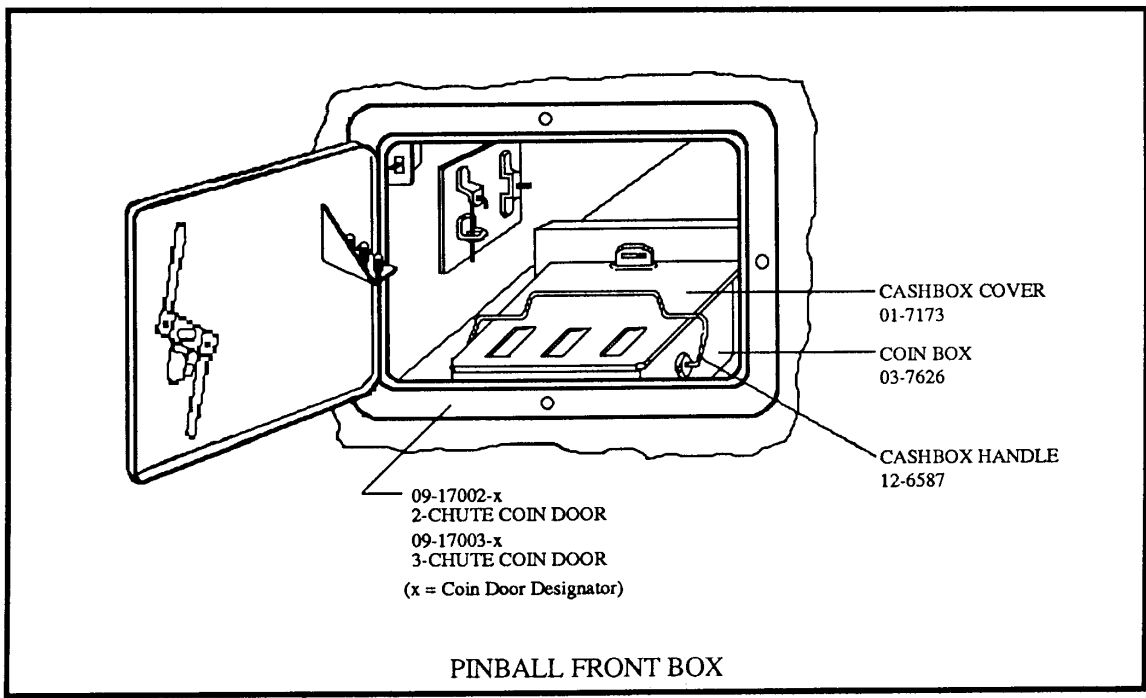
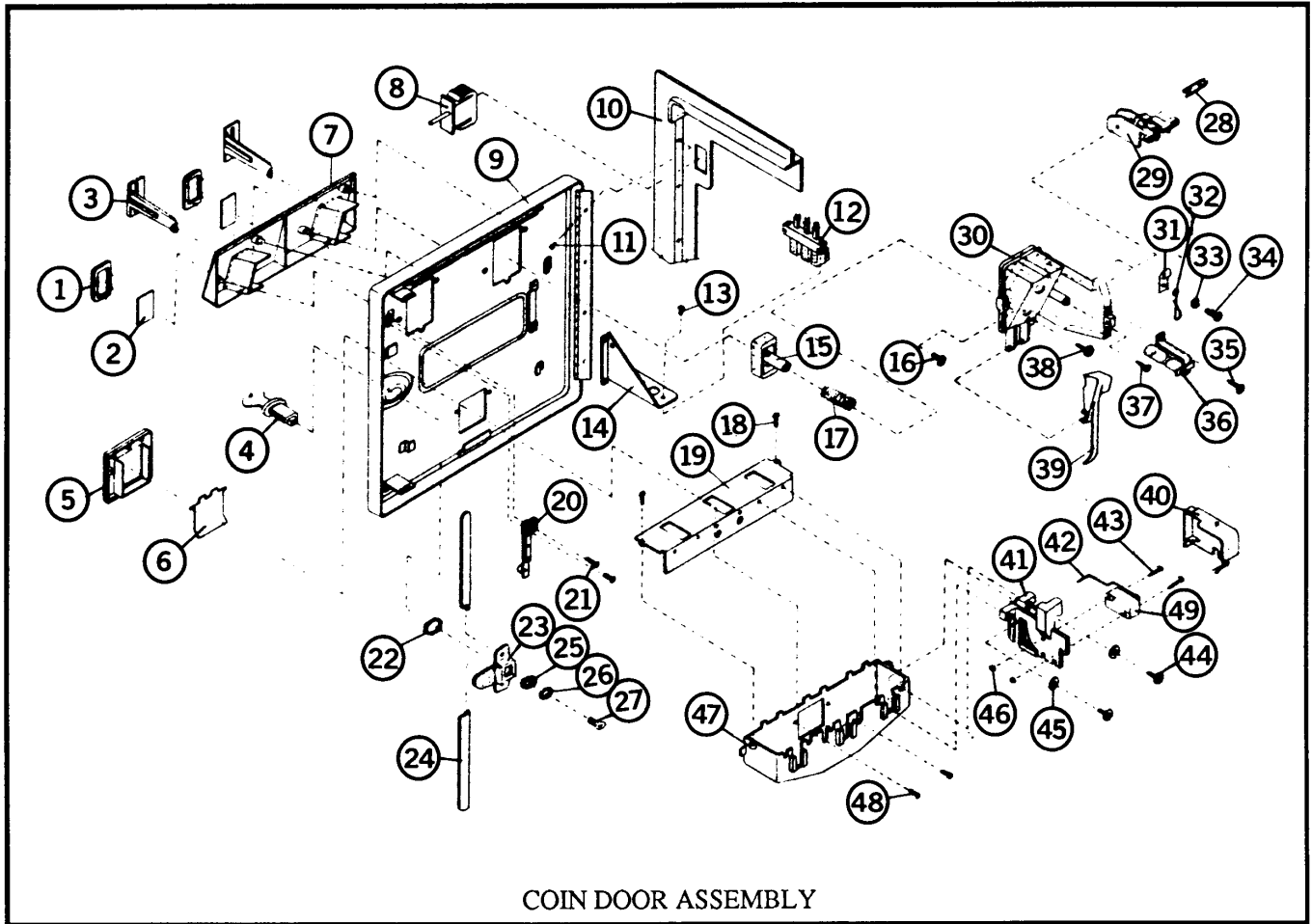
Item	Part No.	Description
1	01-9017	Motor Mounting Bracket
2	B-11571-2	Motor Sub-Assembly
a)	14-7941-3	Motor 11 RPM
b)	5791-09111-00	3P1396 03-09-2032
c)	5820-09080-00	PM1190 02-09-2101
3	4701-00003-00	Lockwasher, #8 Split
4	A-12463	Motor Cam Assembly
a)	02-4262	Operating Post
b)	02-4354	Motor Cam
c)	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.



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

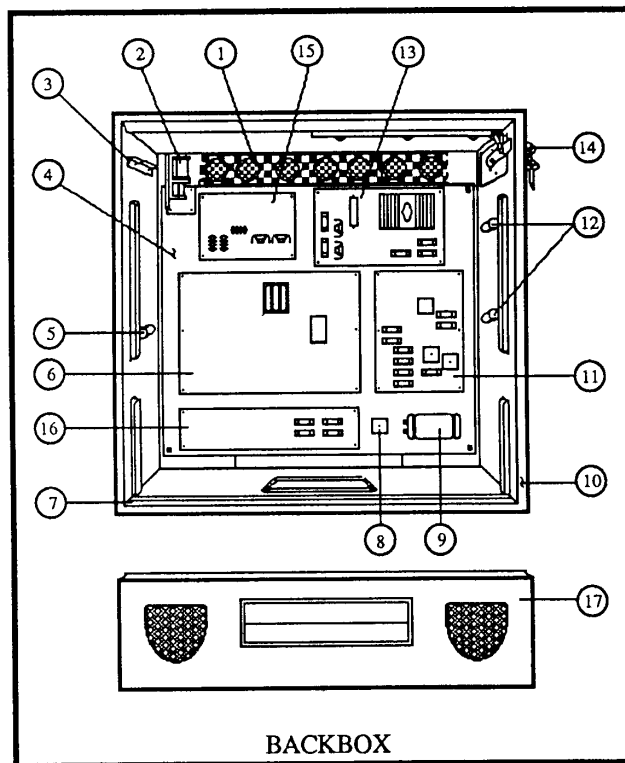


Black Knight 2000 UNIQUE PARTS LIST

Part No.	Description	Part No.	Description
A-10231-1	PCB Mount Socket & Bulb	D-12702-R-1	Flipper Assembly-Right
A-11538-1	Standup Switch & Bracket Assembly	D-12768	Bottom Arch Assembly
A-11539-1	Kicker Switch Assembly-Right		
A-12463	Motor Cam Assembly	H-12190-563	Main Backbox Cable
A-12640	Ball Gate Assembly	H-12192-563	<i>Black Knight</i> Cabinet Cable
A-12664	Crank Assembly	H-12680	Playfield Lamp Cable
A-12670	Kicker Mounting Plate Assembly	H-12681	Playfield Lamp Cable
A-12687	Sub-Mini Switch Assembly	H-12682	Playfield Solenoid Cable
A-12688	Sub-Mini Switch Assembly	H-12683	Upper Playfield Cable
A-12692	Ball Guide Assembly	H-12684	Insert Cable
A-12767	Playfield Holder Bracket Assembly	H-12685	Ramp Switch Cable
A-8447-1	Magna Coil & Bracket Assembly	H-12690	3-Bank Drop Target Switch Cable
		H-12726	Auxiliary Lamp Cable
B-12465	Motor Assembly	01-9122	Ramp Flap
B-12599	Ball Turnround Assembly	01-9145	Ball Deflector
B-12636	Ramp Assembly	01-9151	Ball Guide Baffle
B-12637	Ramp Sub-Assembly	01-9168	Playfield Holder Bracket-Right
B-12639-L	Hinge Bracket Assembly-Left	01-9177	Playfield Support Bracket
B-12639-R	Hinge Bracket Assembly-Right	01-9182	Playfield Prop Arm Ctxh
B-12649	Ball Guide Assembly		
B-12650	Ball Guide Assembly	03-7960-563	Playfield Mylar
B-12657	Ball Guide Assembly	03-8204-9	Light Hood-Double, Tr-Red
B-12658	Ball Guide Assembly	03-8205-9	Light Hood-Single, Tr-Red
B-12659	Ball Guide Assembly		
B-12665	Kicker Assembly-Nylon	10-407	Extension Spring
B-12671	Kicker Assembly		
B-12693	Left Wire Gate Assembly	11-902-A	Wood-Rail, Lower
B-12695	Flipper Ball Guide Assembly	11-902-B	Wood-Rail, Lower
B-12708	Ball Gate & Switch Assembly	11-902-C	Wood-Rail, Lower
B-12720	Ball Gate & Switch Assembly	11-902-D	Wood-Rail, Lower
B-12725	Switch & Cable Assembly	11-902-E	Wood-Rail, Lower
B-12743	Flipper Ball Guide Assembly-Left	11-903-A	Wood-Rail, Upper
		11-903-B	Wood-Rail, Upper
C-12464	Moving Target Assembly	11-903-C	Wood-Rail, Upper
C-12519	Bottom Playfield Lamp Assembly	11-903-D	Wood-Rail, Upper
C-12520	Left Side Playfield Lamp Assembly		
C-12638	3-Switch Mount PCB Assembly	12-6826	Ball Pop Wire Form
C-12646	Upper Playfield Interconnect Board Assy	12-6827	Return Wire Form
C-12652	Ball Guide Assembly	12-6828	Left Wire Cage
C-12653	Ball Guide Assembly	12-6830	Connect Wire Ramp
C-12654	Ball Guide Assembly	12-6831	Exit Wire Ramp
C-12655	Ball Guide Assembly		
C-12656	Ball Guide Assembly	20-9589-24	Slit H/Sleeve 24"
C-12674	Top Ramp Assembly		
C-12700	6-Speaker Lamp Assembly	31-1002A-563	Lower Playfield (Screened)
C-12723	Upper Playfield Top Lamp Assembly	31-1002B-563	Upper Playfield (Screened)
C-12724	Upper Playfield Bottom Lamp Assembly	31-1006-563	Playfield Plastics
D-11581-563	Audio Sound Board Assembly	31-1008-563	Bottom Arch (Screened)
D-11883-563	CPU System 11B Assembly	31-1009-563	Shooter Gage Plate (Screened)
D-12313-563	Master Interconnect Board Assy	31-1422-563	Speaker Grill (Screened)
D-12503	Center Playfield Lamp Assembly	31-1457-563	<i>Black Knight</i> Backglass
D-12660	Ball Guide Assembly	31-1463-563	Drop Target Decal
D-12696	Speaker Display Assembly		

Backbox Parts List

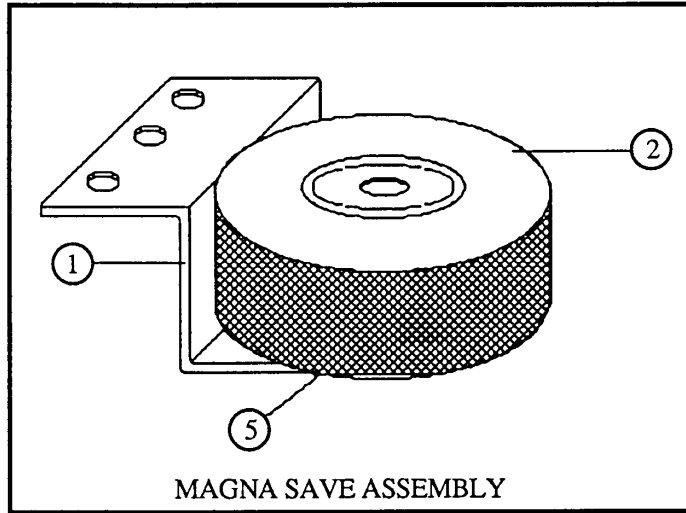
Item	Part No.	Description
1	01-6645	Venting Screen
2	B-10686-1*	Knocker & Bracket Assy
3	A-12497	Upr Insert Bd Hinge Assy
4	D-12184-1	P.C.B Plate Assembly
5	A-12498	Lwr Insert Bd Hinge Assy
6	D-11883-563*	System 11B CPU Board
7	01-8569	Lwr Spkr Panel Bracket
8	5100-09418-00	Bridge Rectifier, 100v,35A
9	5040-09051-00	Capacitor, 30,000 μ Fd, 25v
10	A-11-888-563	<i>Black Knight 2000</i> , 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 4 Ω , 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	<i>Black Knight 2000</i> , 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, <i>Black Knight 2000</i>
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		



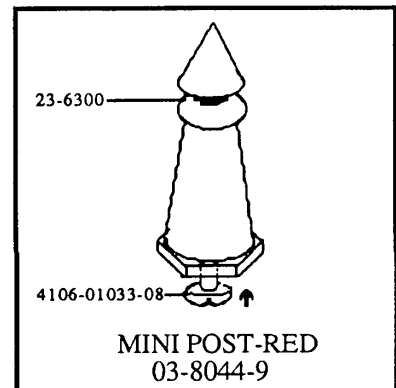
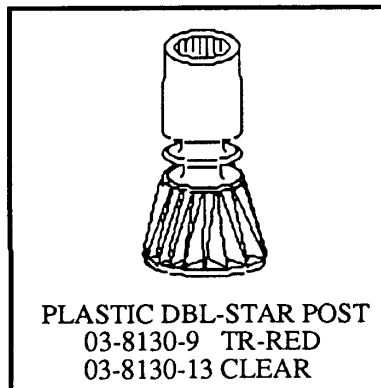
Magna Save Assembly

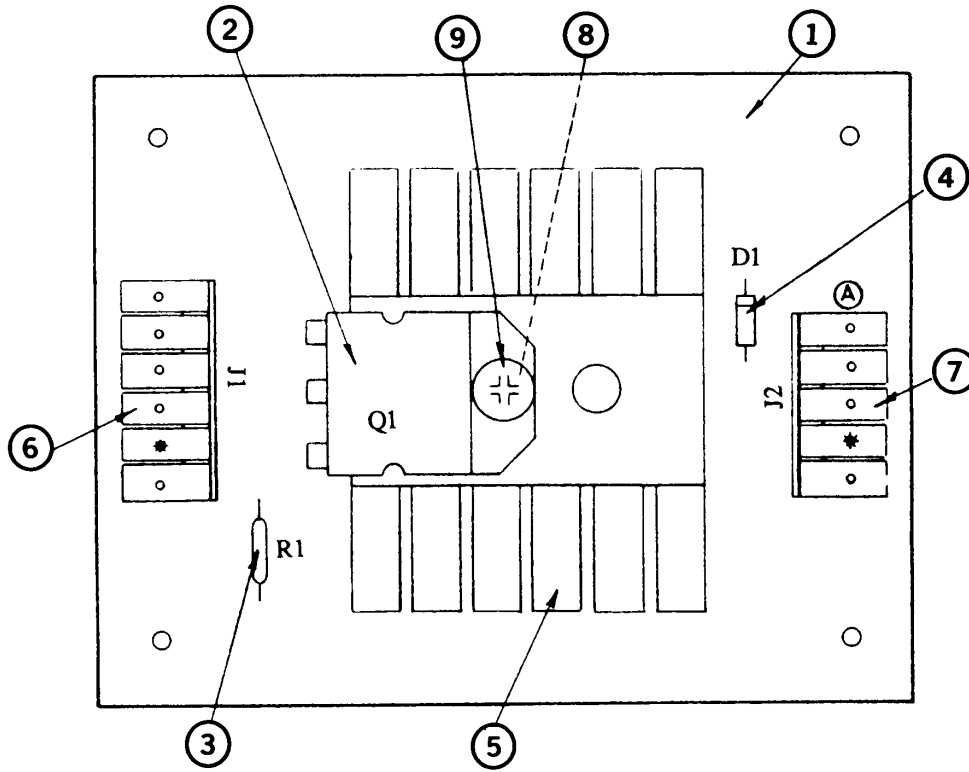
p/n A-12831

Item	Part No.	Description
1	A-12832	Bracket & Pole PC Assy
2	B-20-9608	Coil Magnet & Breaker
3	5791-10770-00	3P1625 03-06-2032
4	5820-09078-00	PM1560 02-06-2101
5	20-9612	Wave Spring Washer

* Not Shown

Plastic Posts

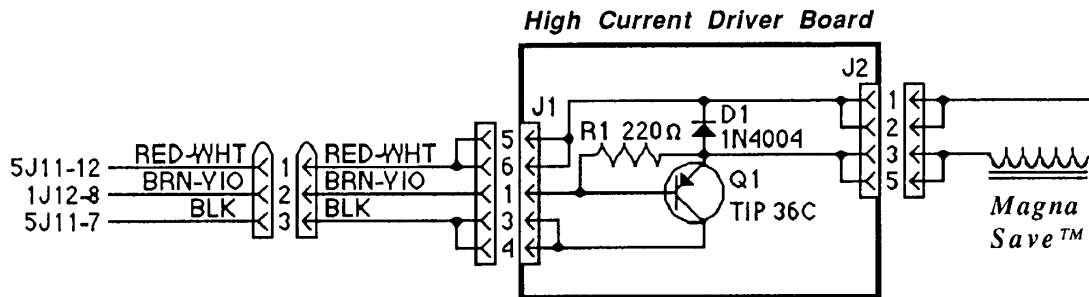




High Current Driver

p/n C-12493

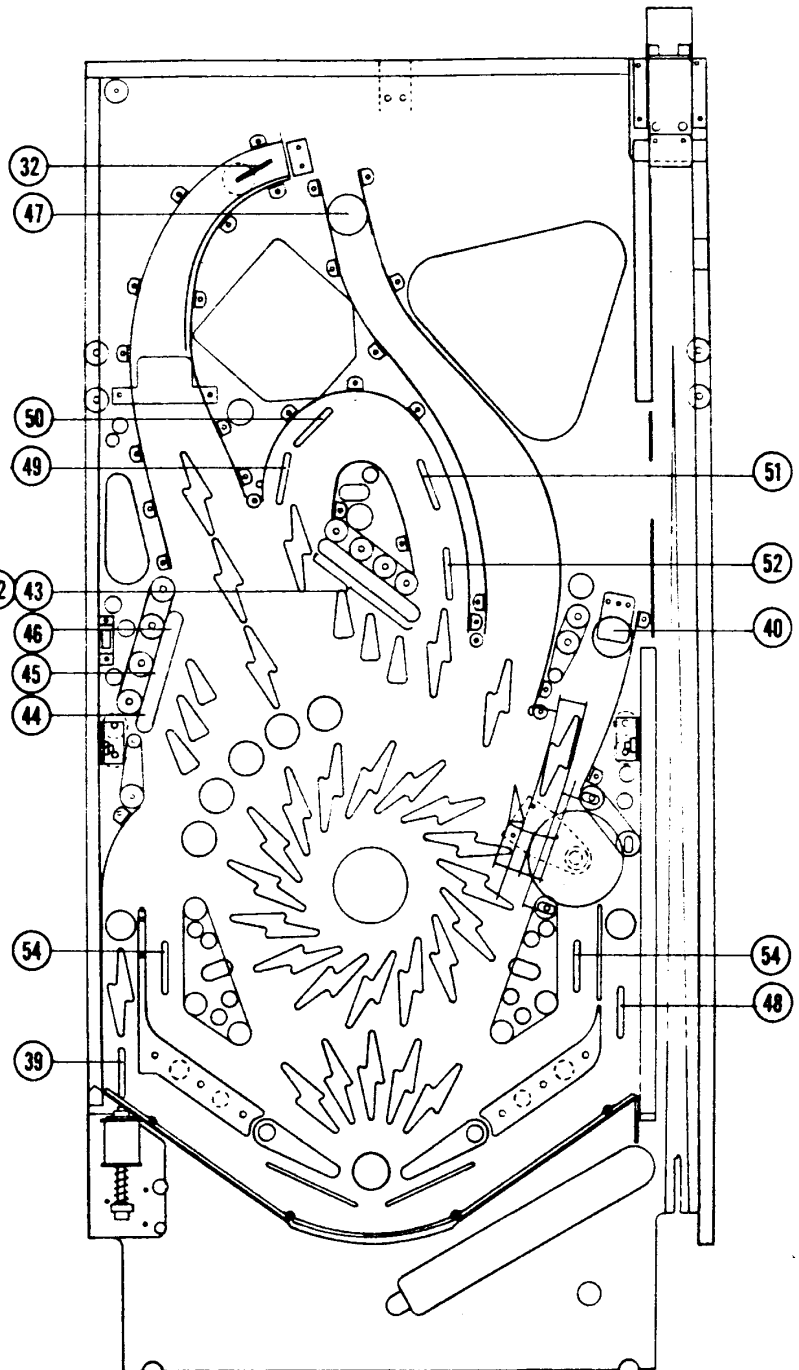
Item	Part No.	Ckt Designator	Description
1	5768-12372-00		High Current Driver P.C.B.
2	5191-12179-00	Q1	Transistor, TIP36C
3	5010-09160-00	R1	Resistor, 220Ω, 1/4w, 5%
4	5070-09054-00	D1	Diode, 1N4004, 1.0A
5	5705-09172-00		Heatsink, 6072B
6	5791-10862-06	J1	Connector, 6-pin Hdr Sq Pin .156
7	5791-10862-05	J2	Connector, 5-pin Hdr Sq Pin .156
8	4406-01128-00		Nut, 6-32 KEPS
9	4006-01017-08		Mach. Screw, 6-32 x 1/2



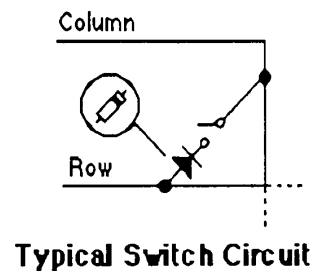
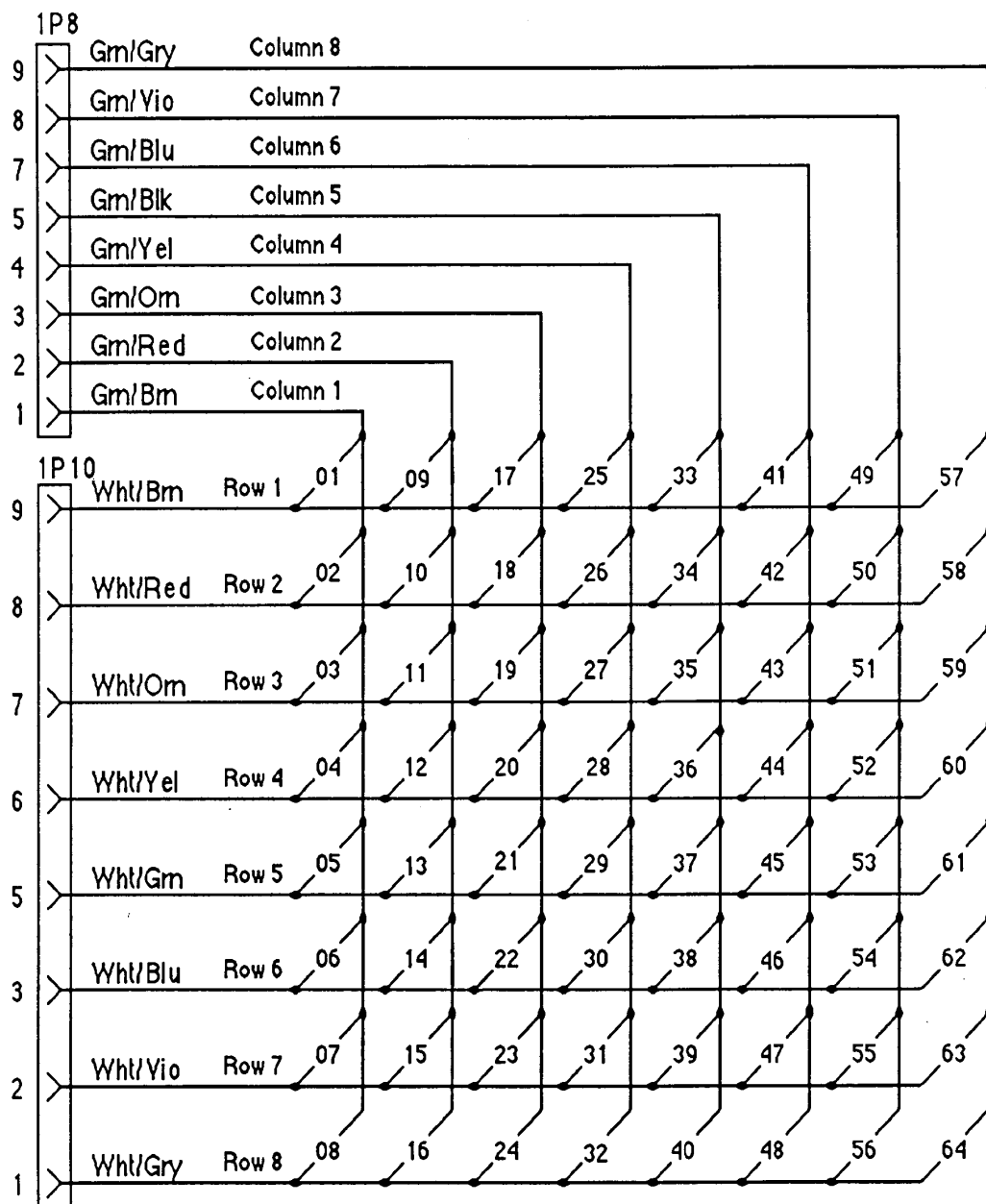
High Current Driver - Magna Save™ Circuit

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 (see later diagram)	
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)



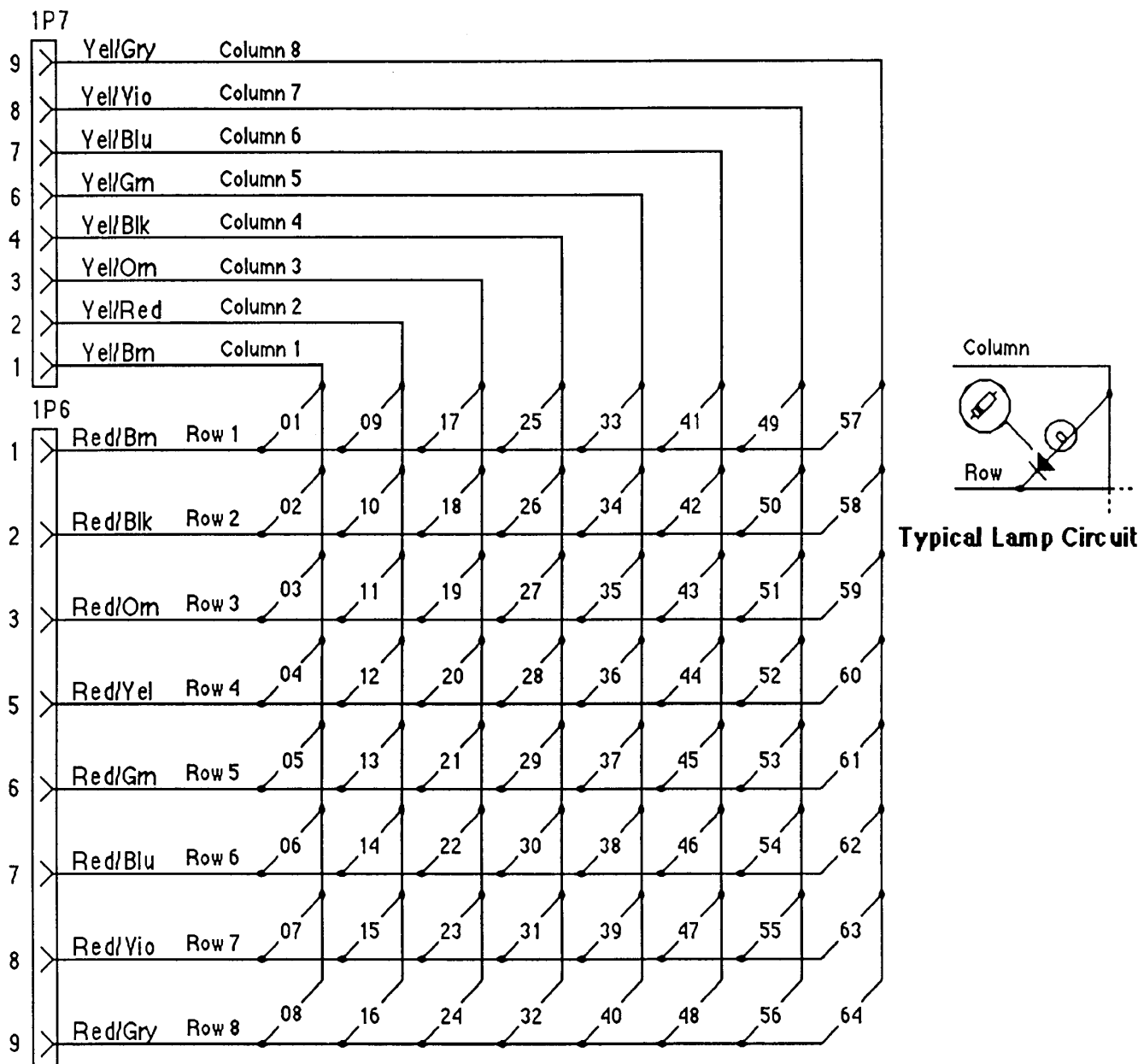
Notes: * P/N is for entire Diagnostic Switch Assembly, including H S Reset Switch; ** Optotransistor on : (1) Backbox Interconnect Bd; (2) 3-bank Drop Target Positioner Bd. *** [Paired Kicker Actuating Sw: A-4834-H; A-11538-1]



Black Knight 2000 Switch-Matrix Table

COLUMN \ ROW	1 Q45 GRN-BRN 1J8-1	2 Q49 GRN-RED 1J8-2	3 Q44 GRN-ORN 1J8-3	4 Q48 GRN-YEL 1J8-4	5 Q43 GRN-BLK 1J8-5	6 Q47 GRN-BLU 1J8-7	7 Q42 GRN-VIO 1J8-8	8 Q46 GRN-GRY 1J8-9
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 AC 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



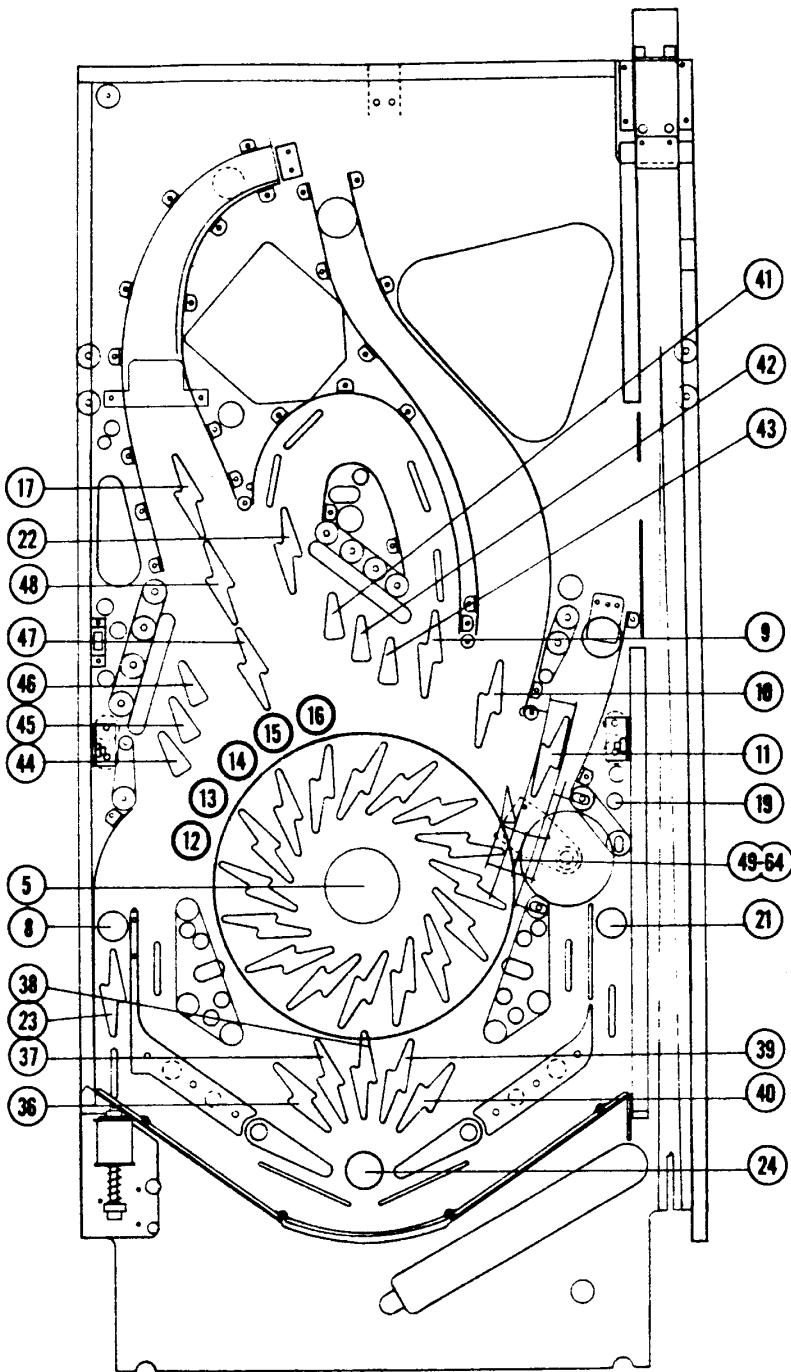
Black Knight 2000 Lamp-Matrix Table

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

Lower Playfield Lamps

Lamp Location/Description



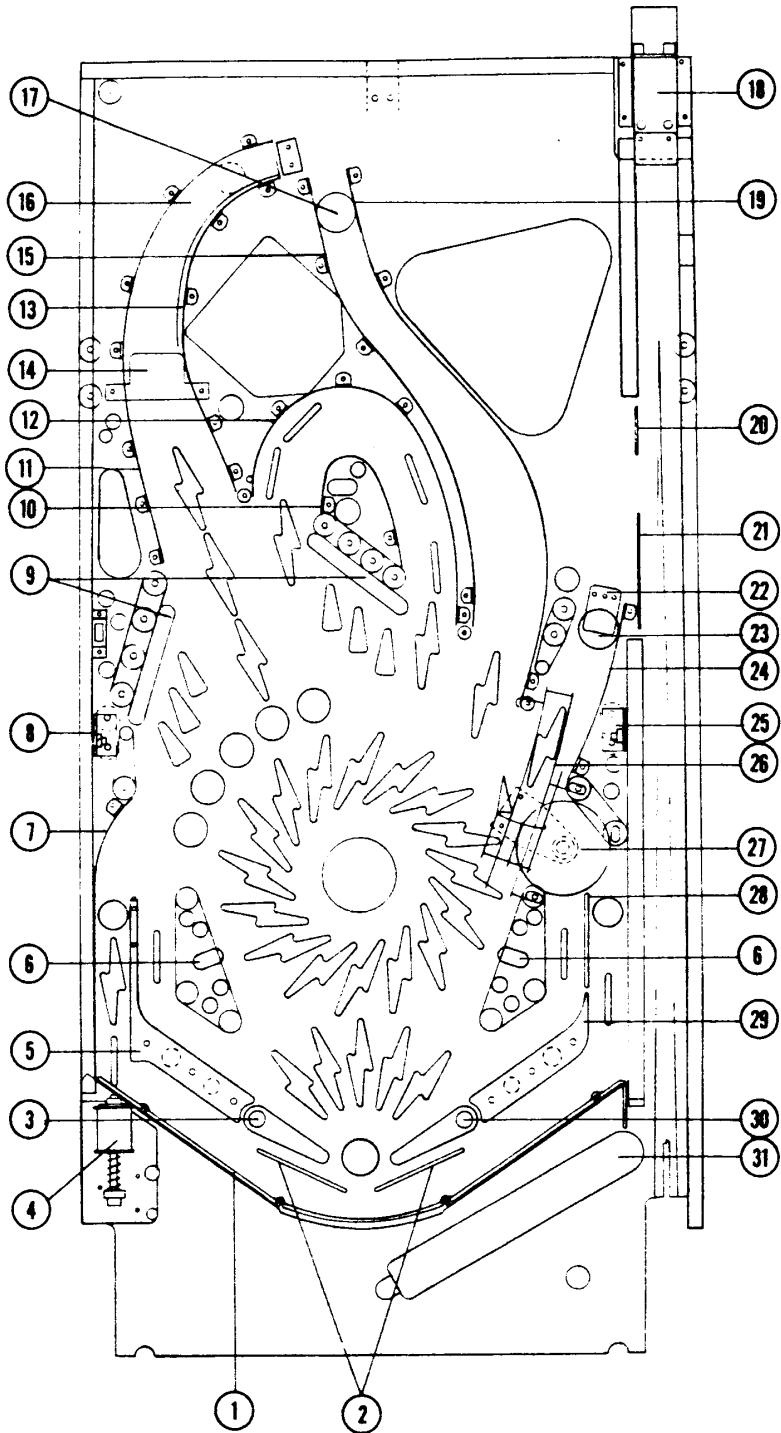
- 5 Center, Bolt Circle
- 8 LAST CHANCE (L Outlane)
- 9 U-TURN Bolt (Right)
- 10 SPIN Bolt
- 11 LOCK Bolt (R Eject Hole)
- 12 B (in "BLACK")
- 13 L (in "BLACK")
- 14 A (in "BLACK")
- 15 C (in "BLACK")
- 16 K (in "BLACK")
- 17 EXTRA BALL Bolt
- 19 MAGNA SAVE™
- 21 LAST CHANCE (R Outlane)
- 22 U-TURN Bolt (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

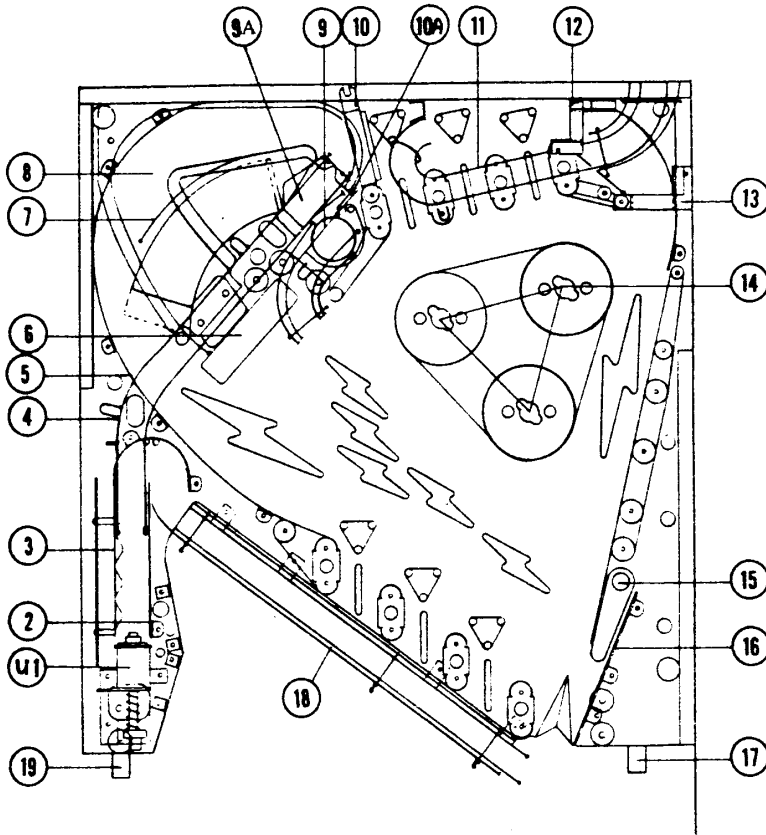
Item	Part No.	Description
1	12-6842	Bottom Arch Fence
2	12-6468	Anti-Rebound Wire
3	C-11626-L-3	Lwr Left Flipper Assy
a)	20-9250-6	Lg Flipper Paddle & Shaft
4	B-11873-1	Left Outlane Kickback
5	B-12743	L Flipper Return Frame
6	B-12665	Kicker Arm ("Sling") Assy
7	B-12651	Ball Guide Assembly
8	B-12639-L	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

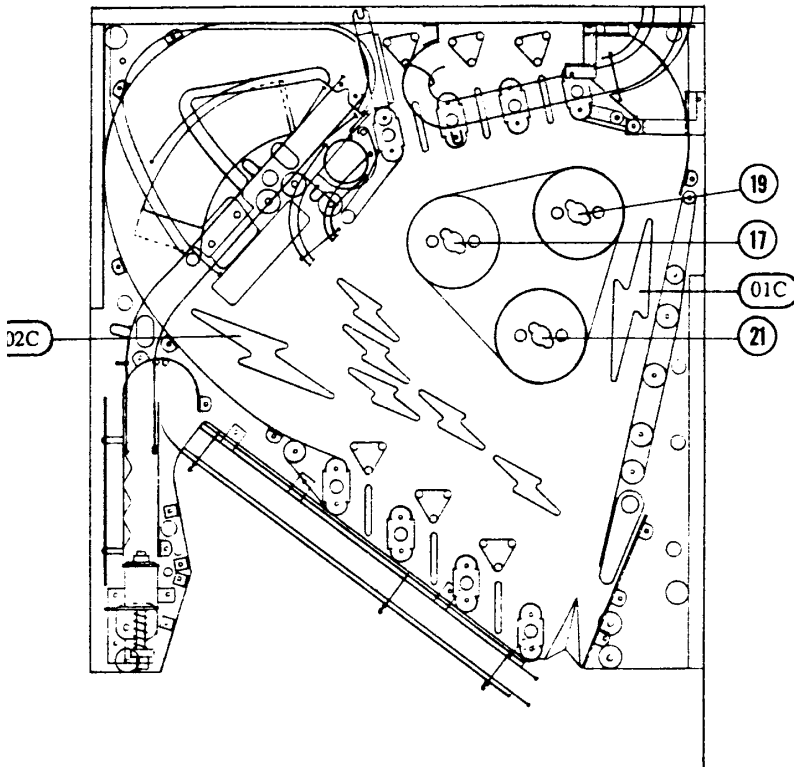


Upper Playfield Parts



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	Target 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-12640	Bail 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
07A	AE-23-800	3-Ball Lock Kickback
08C	#906 Flashlamps	3-Ball Lock Flashers
12	5580-09555-01	Solenoid A/C Select Relay***
17	AE-23-800	Left Jet Bumper
19	AE-23-800	Right Jet Bumper
21	AE-23-800	Lower Jet Bumper

Backbox Solenoids (Not Shown)

09	5580-09555-01	Insert Bd Gnl Illum Relay *
14	AE-23-800	Knocker

* - On Relay Board, C-11998-1, on inside of Insert Bd
 *** - On Aux Power Driver Board, D-12247

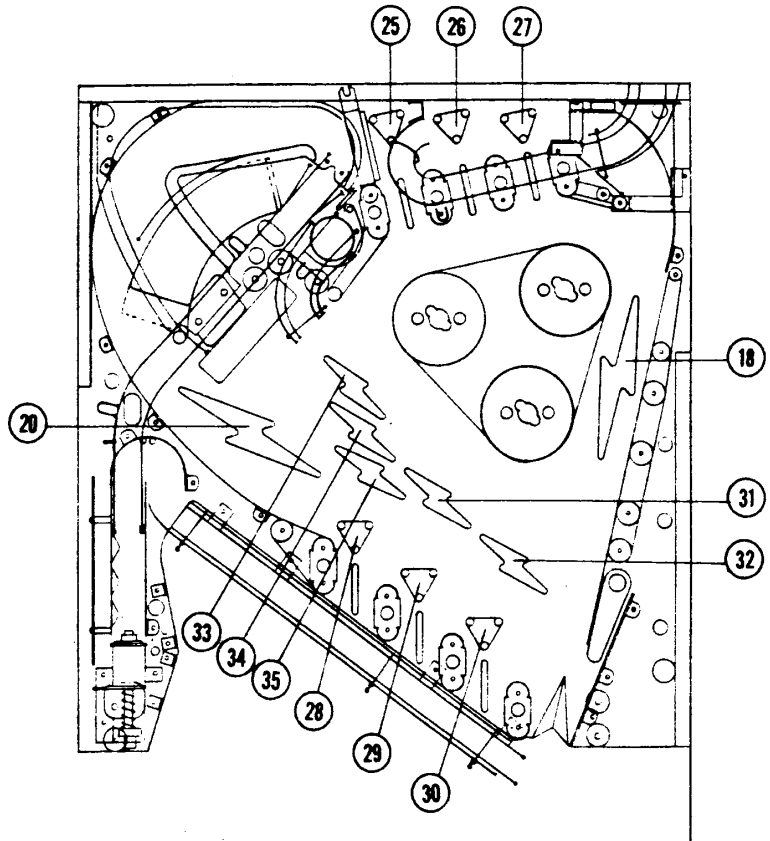
Upper Playfield Lamps

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

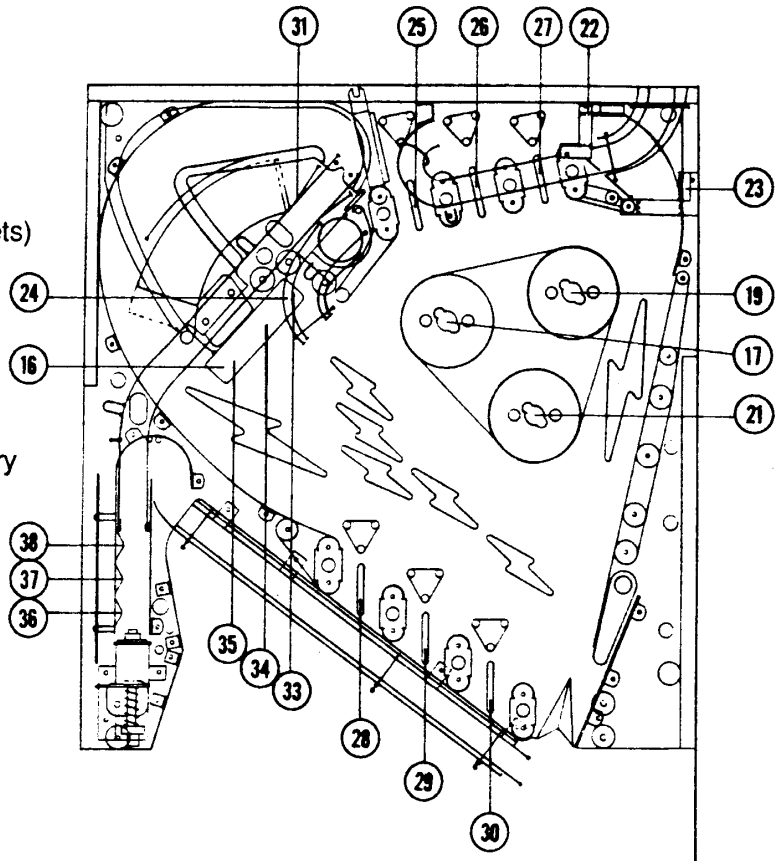
NOTE:

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



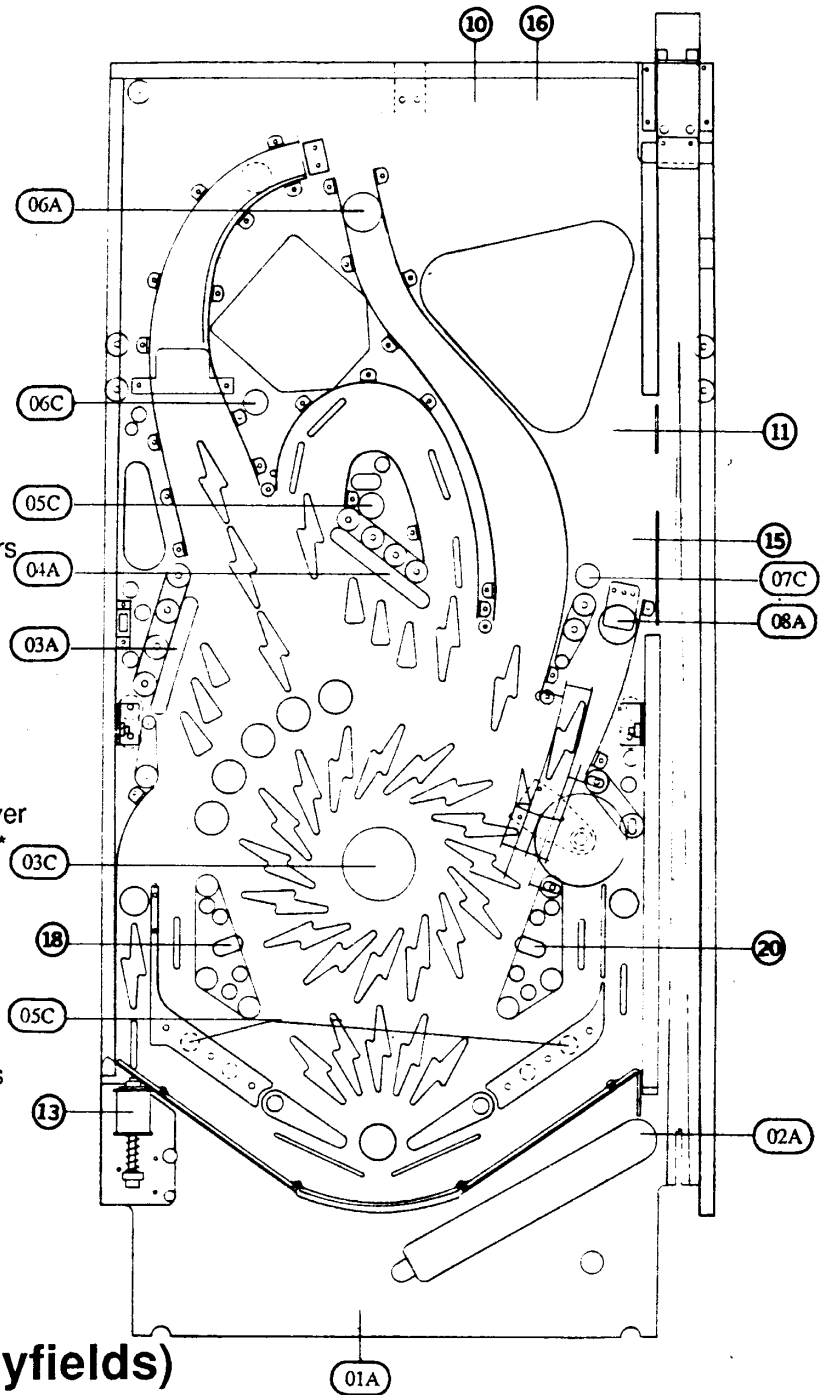
Upper Playfield Switches

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



Lower Playfield Solenoids/Flashers

Item	Part No.	Description
01A	AE-23-800	Outhole Kicker
02A	AE-23-800	Ball Shooter Lane Feeder
03A	AE-26-1200	L 3-Bank Drop Target Reset
03C	#906/89 Flashlamps	Bolt Circle Center Flashers
04A	AE-26-1200	R 3-Bank Drop Target Reset
04C	#906/89 Flashlamps	Flipper Lane Flashers
05A	Not Used	
05C	#906/89 Flashlamps	R Drop Target Flashers
06A	AE-23-800	Ball Popper
06C	#89/906 Flashlamps	Level 1 Ramp Flasher
07C	#89/906 Flashlamps	R Eject & UPF Flipper Flashers
08A	AE-26-1500	Right Eject Hole
10	5580-09555-01	UPF Gen Illumin Relay*
11	5580-12145-01	LPF Gen Illumin Relay**
13	AE-23-800	Kickback (L Outlane)
14	AE-23-800	Knocker/Ticket Dispenser (b)
15	C-12493	Magna Save™ Hi Current Driver
16	5580-12145-01	Moving Targets Motor Relay**
18	AE-26-1500	Left Kicker ("Sling")
20	AE-26-1500	Right Kicker ("Sling")
22	Not Used	
-	FL 11630/50VDC	Lower Left and Right Flippers Upper Right Flipper



* - On Relay Board, C-11998-1, on Playfield underside
 ** - On Relay Board, C-11902-1, on Playfield underside

Rubber Parts (Both Playfields)

Item	Part No.	Description	Qty	Item	Part No.	Description	Qty
A	23-6300	5/16" Ring	5	J	23-6313-1	Grommet	1
B	23-6301	3/4" Ring	1	K	23-6327	Ball Shooter Tip	1
C	23-6302	1" Ring	9	L	23-6519-4	Lg Red Flipper Ring	3
D	23-6303	1-1/4" Ring	1	M	23-6420	Grommet	3
E	23-6304	1-1/2" Ring	3	N	23-6552	Sleeving, Yellow	3
F	23-6305	2" Ring	4	P	23-6556	Sleeving, Black	1
G	23-6306	2-1/2" Ring	2	Q	23-6626	Grommet	6
H	23-6309	4" Ring	1				

Notes...

Section 3

Reference Diagrams & Schematics

- **Diagrams and Schematics:**

- Cabinet Wiring**

- 3-Bank Opto Board**

- Power Supply Board**

- System 11B CPU Board**

- Master Display Board**

- Audio Board**

- Aux Power Driver Board**

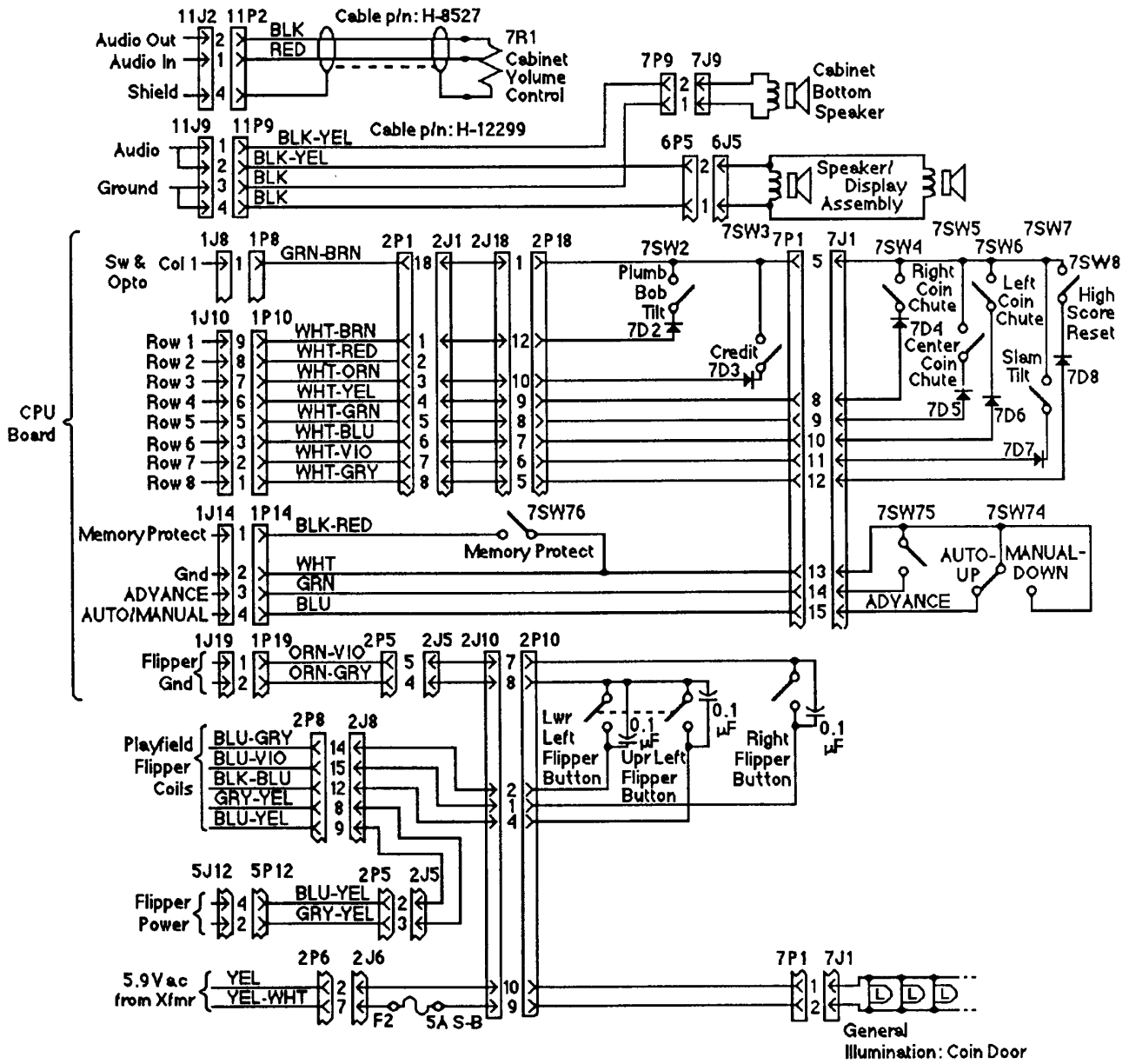
- Backbox Interconnect Board**

- Controlled, Special, & Switched Solenoids**

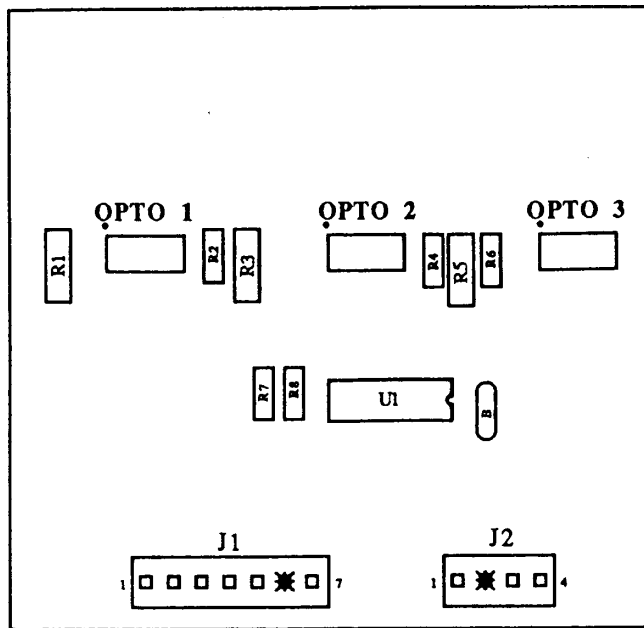
- Power Wiring**

- Game Circuit Boards Interboards Signals**

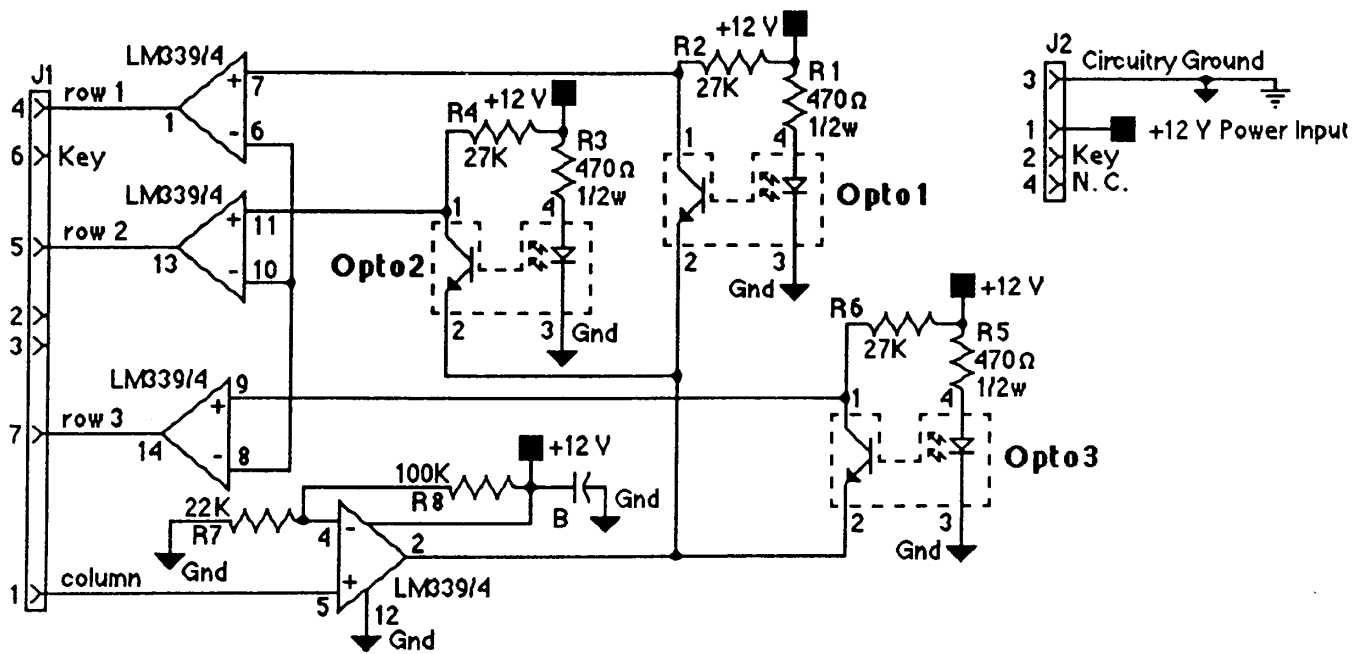
- **Diagnostic Test Flowchart**



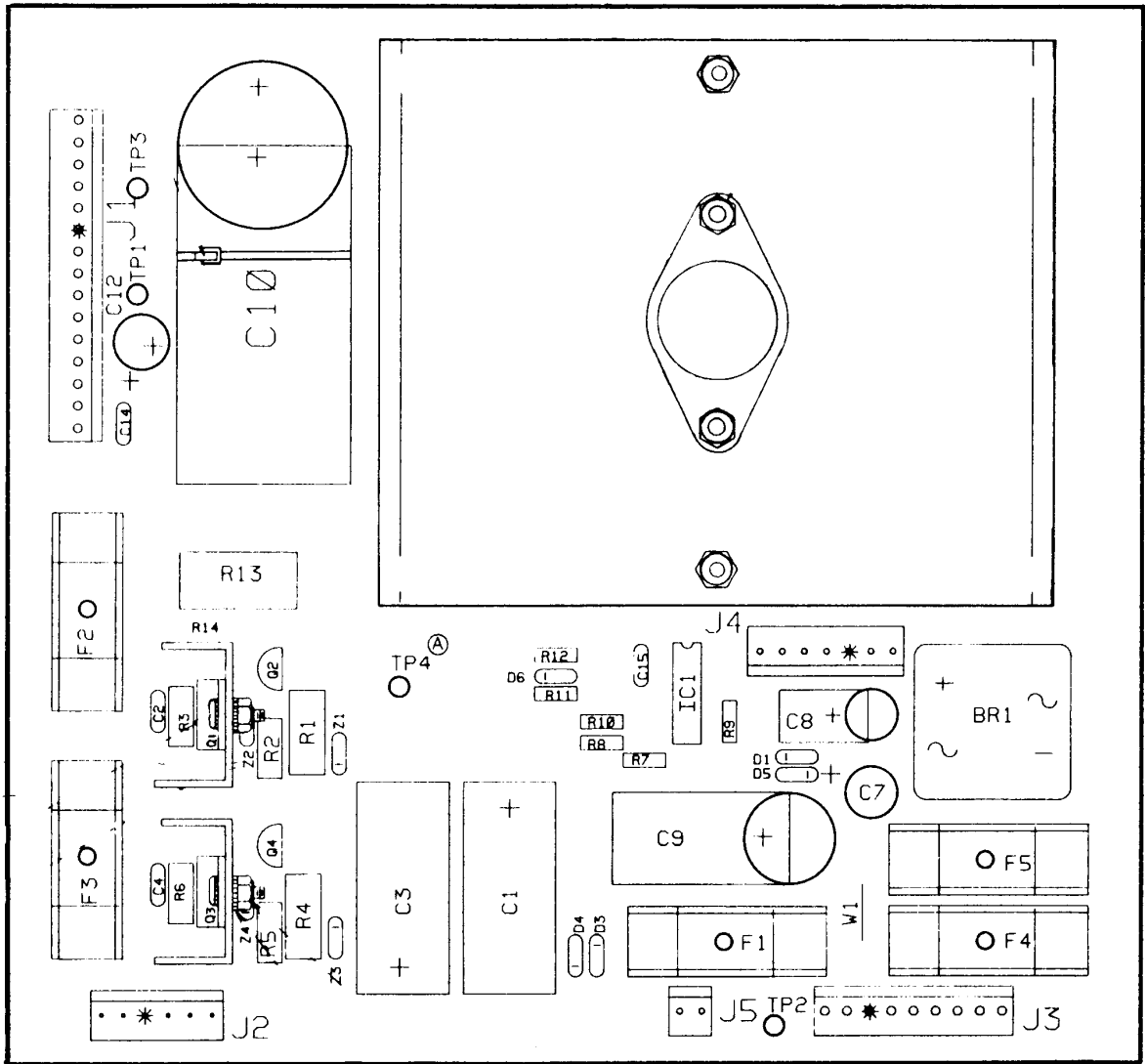
Black Knight CABINET WIRING



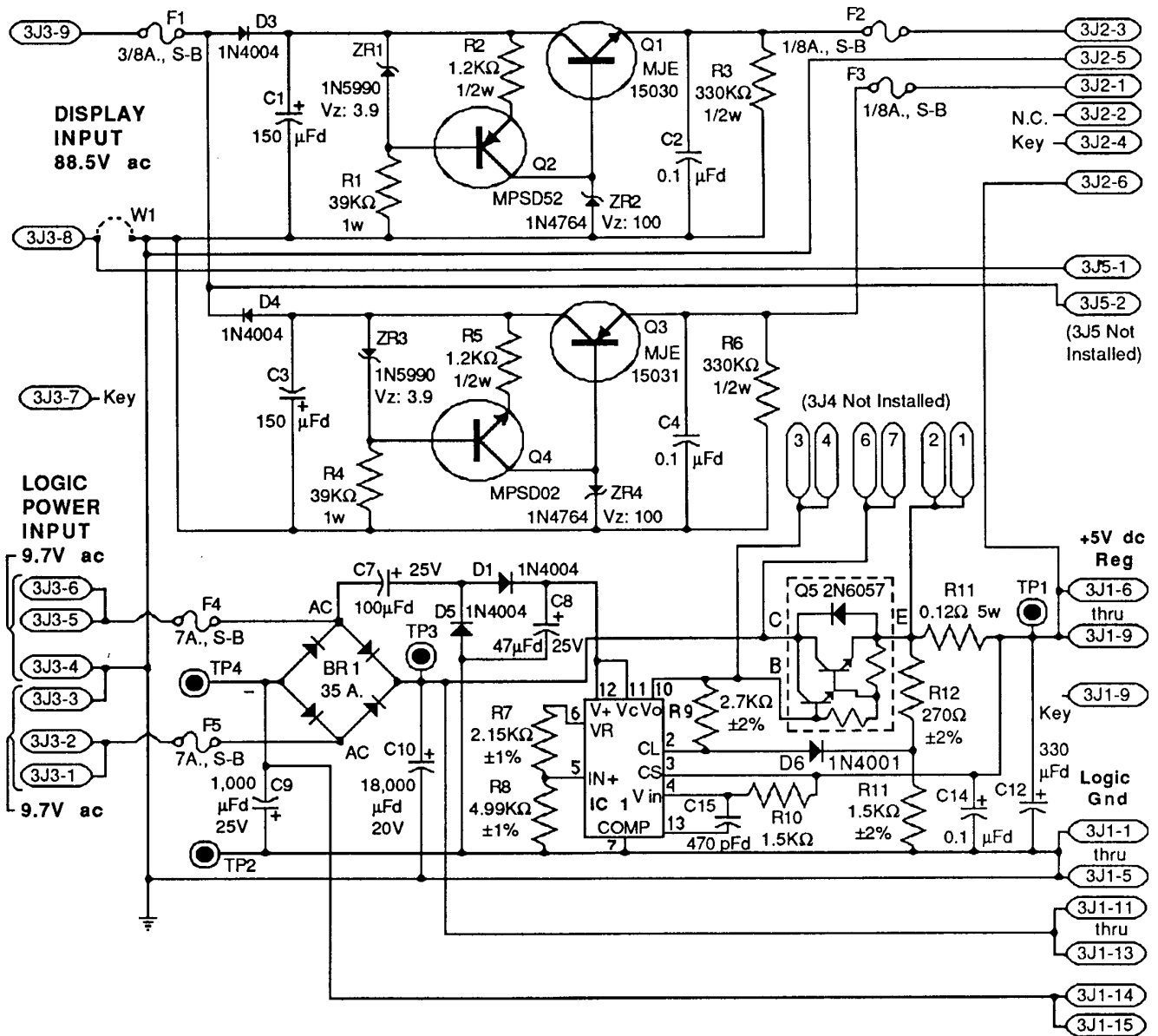
3-BANK DROP TARGET BOARD
p/n C-12559



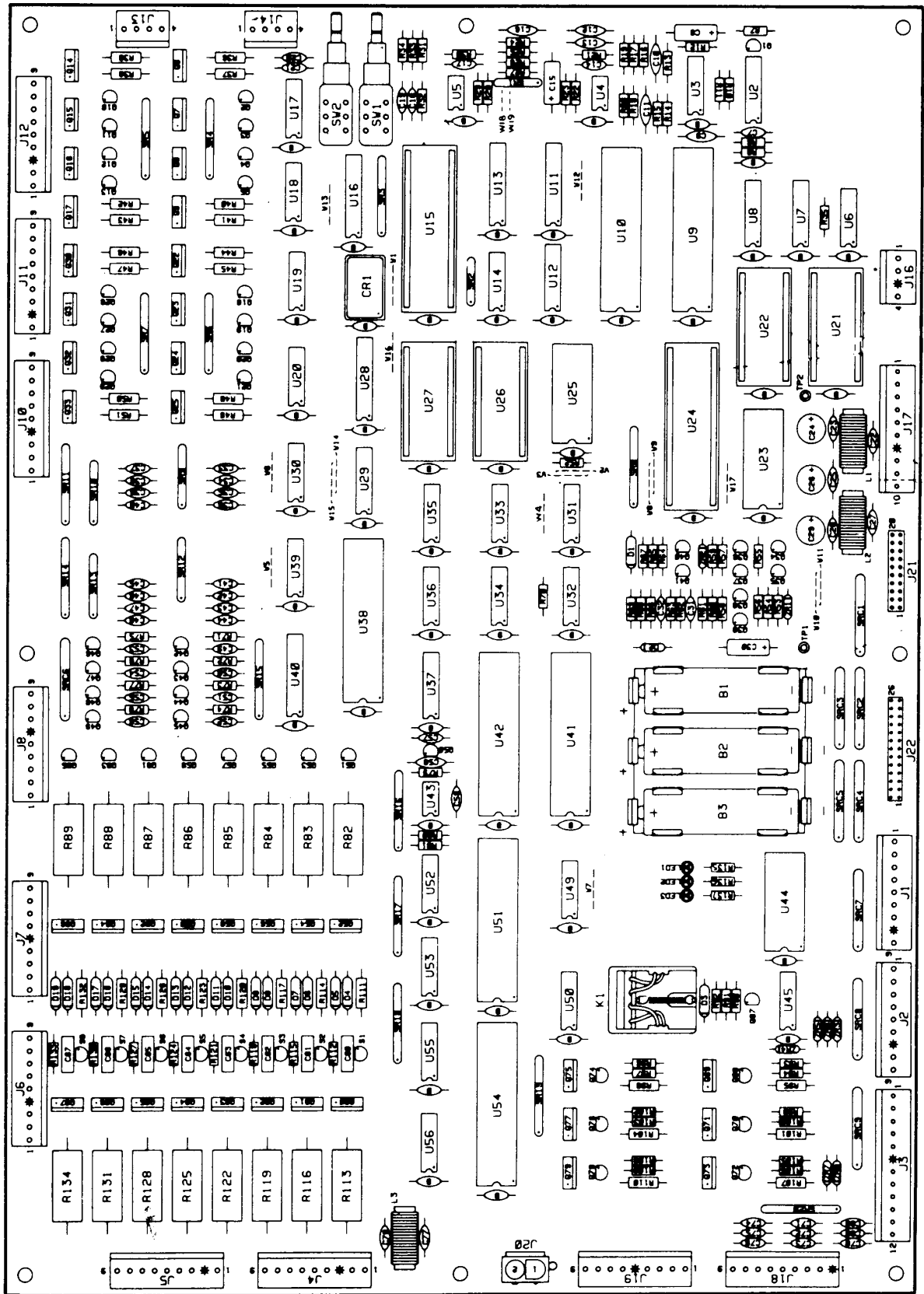
3-BANK DROP TARGET BOARD & SCHEMATIC



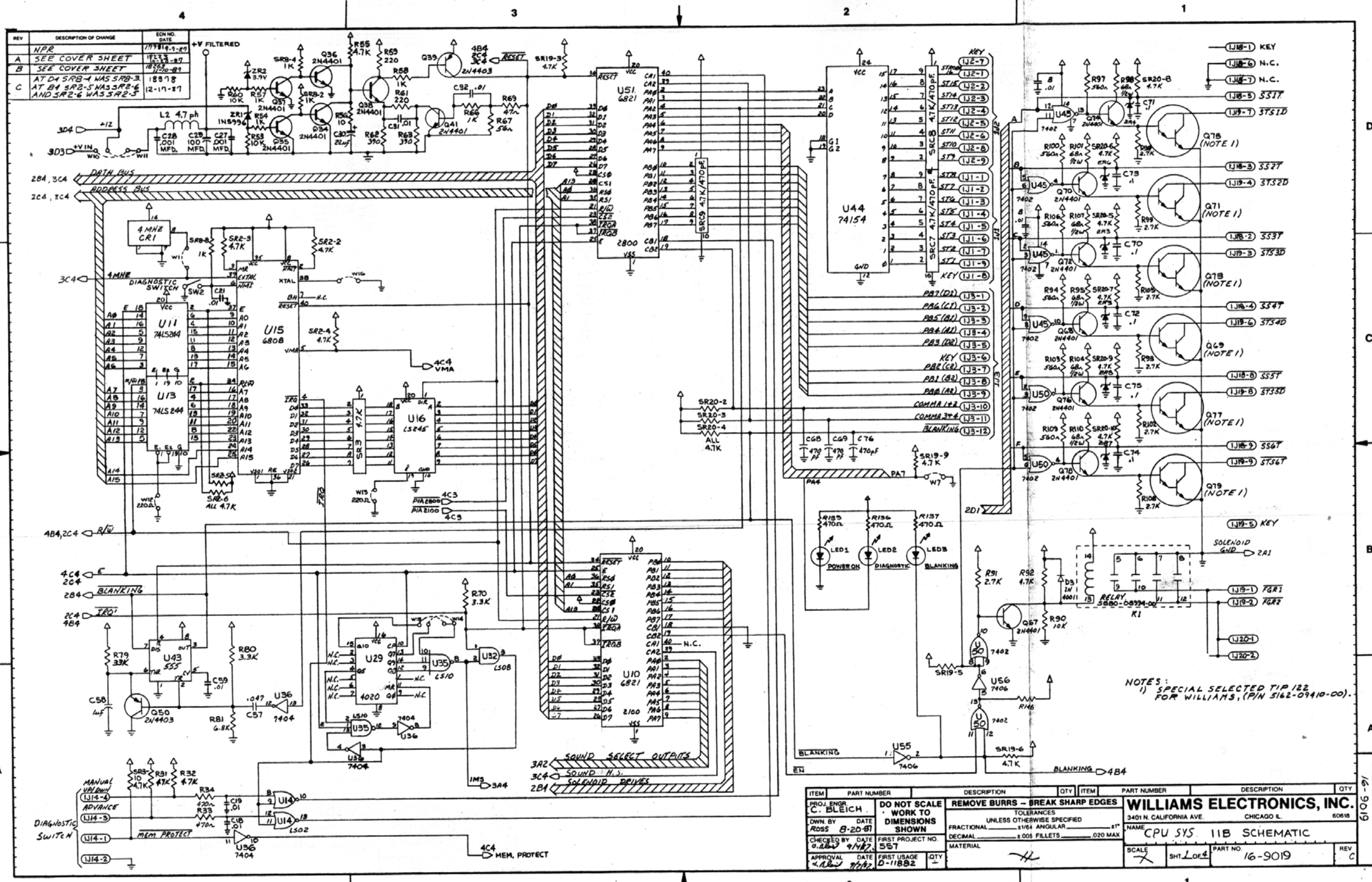
POWER SUPPLY BOARD
 p/n D-12246



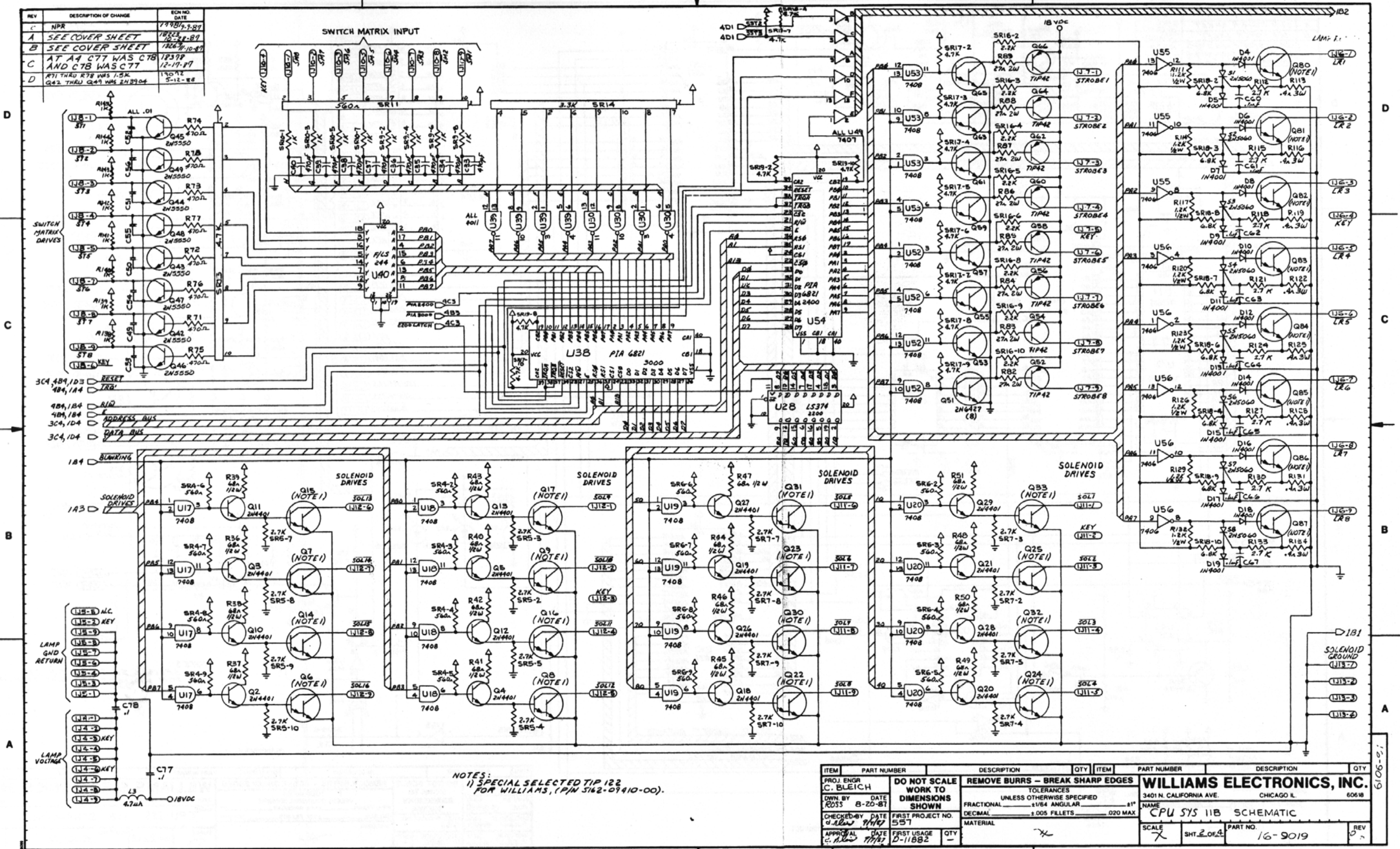
POWER SUPPLY BOARD SCHEMATIC



SYSTEM 11B CPU BOARD
 p/n D-11883



REV	DESCRIPTION OF CHANGE	ECH NO.	DATE
C	NPR	1795	7-27
A	SEE COVER SHEET	1822	8-21-87
B	SEE COVER SHEET	1823	10-17
C	AT A4 C77 WAS C78 AND C78 WAS C77	1837	12-17-87
D	R71 THRU R78 WAS 1.5K Q42 THRU Q49 WAS 2N3904	1857	5-12-88



NOTES:
 1) SPECIAL SELECTED TIP 122 FOR WILLIAMS, (P/N 5162-0910-00).

ITEM	PART NUMBER	DESCRIPTION	QTY	ITEM	PART NUMBER	DESCRIPTION	QTY
PROJ ENGR	C. BLEICH	DO NOT SCALE WORK TO DIMENSIONS SHOWN		REMOVE BURRS - BREAK SHARP EDGES		WILLIAMS ELECTRONICS, INC.	60618
OWN BY	DATE	FRACTIONAL	UNLESS OTHERWISE SPECIFIED	DECIMAL	±.005 FILETS	±.020 MAX	
CHECKED BY	DATE	FIRST PROJECT NO.	557	MATERIAL			
APPROVAL	DATE	FIRST USAGE	12-11-82	QTY			
				SCALE	1/8" = 1"	SHT 2 OF 4	REV 0
				NAME: CPU SYS 11B SCHEMATIC			
				PART NO. 16-9019			

System 11B CPU Schematic (16-9019, Sheet 2 of 4)

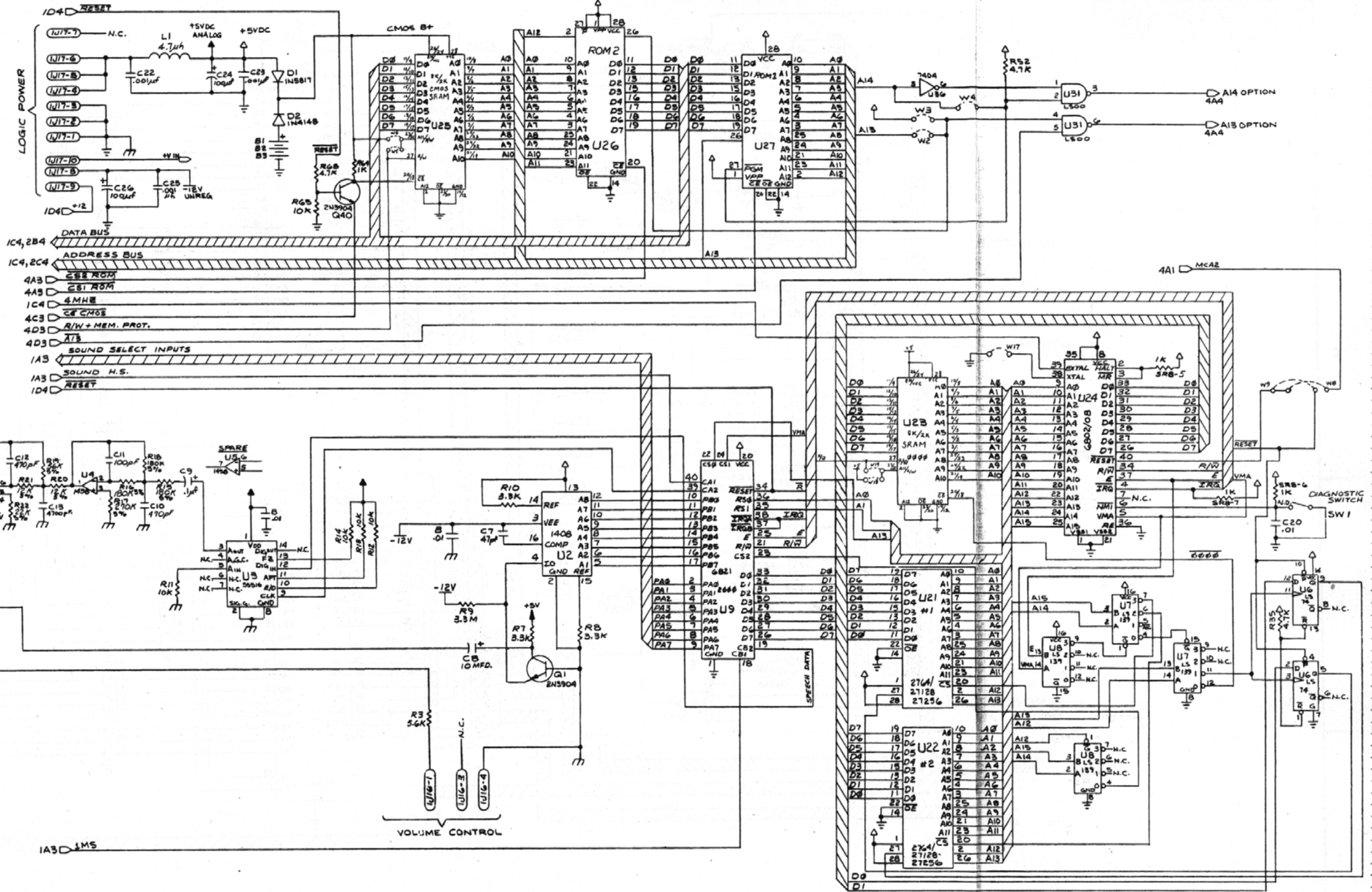
REV	DESCRIPTION OF CHANGE	ECN NO.	DATE
	N. P.R.	17981	9-7-89
A	SEE COVER SHEET	1833	12-31-87
B	SEE COVER SHEET	1833	12-31-87
C	AT C1 SRB-5 WAS SRB-4 DELETE SOUND SECTION & LOCATION A3	18393	12-17-89

D

C

B

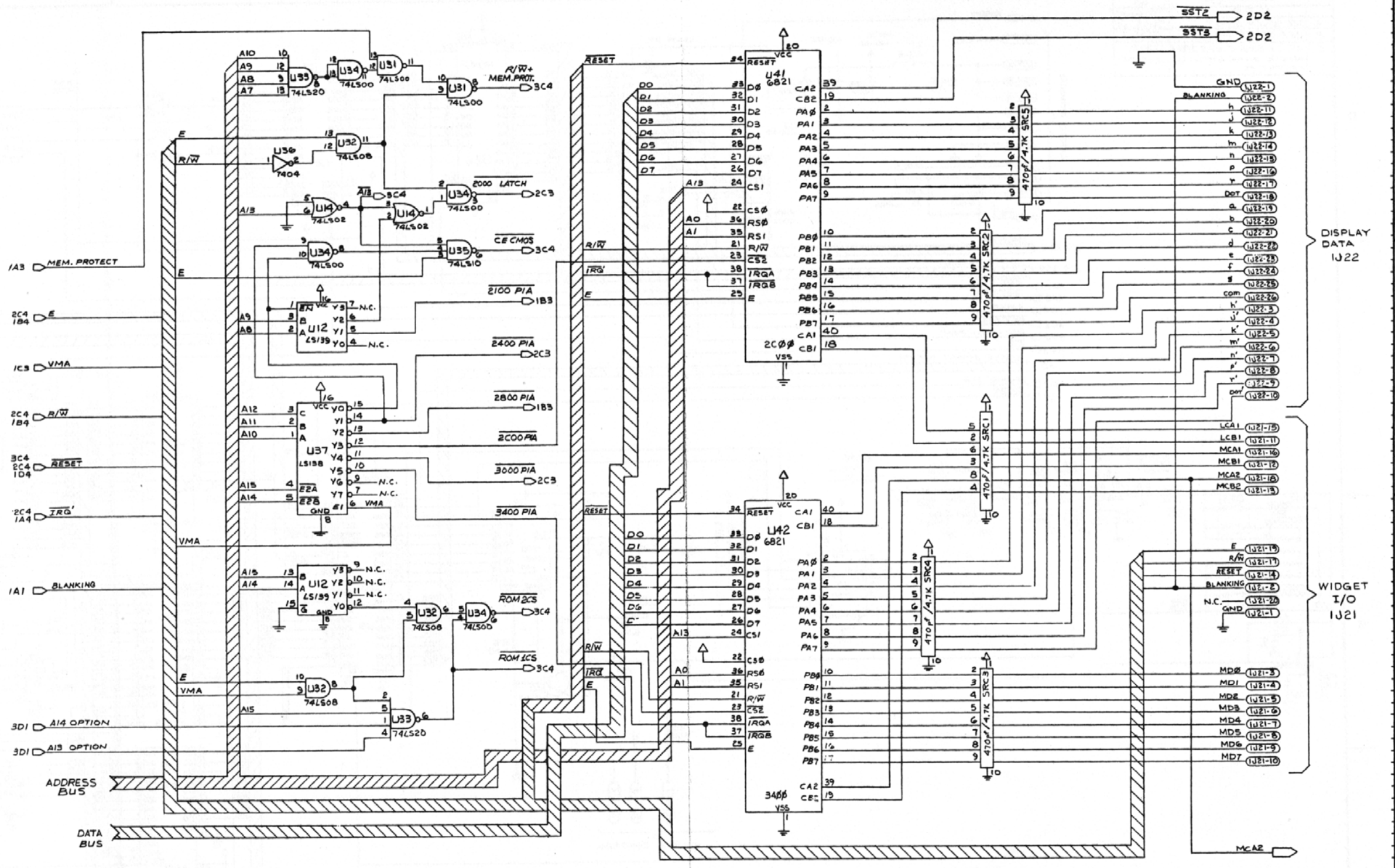
A



ITEM	PART NUMBER	DESCRIPTION	QTY	ITEM	PART NUMBER	DESCRIPTION	QTY
PROJ. ENGR C. BLEICH		DO NOT SCALE WORK TO DIMENSIONS SHOWN		REMOVE BURRS - BREAK SHARP EDGES		WILLIAMS ELECTRONICS, INC.	
OWN BY DATE ROSS 8-20-87		FIRST PROJECT NO. 557		TOLERANCES UNLESS OTHERWISE SPECIFIED		3401 N. CALIFORNIA AVE. CHICAGO IL. 60618	
CHECKED BY DATE C. BLEICH 11/10		FIRST USAGE D-11882		FRACTIONAL .2500 ANGULAR .1°		NAME CPU SYS 11B SCHEMATIC	
APPROVAL DATE C. BLEICH 11/10		QTY		DECIMAL .005 FILLETS .020 MAX		SCALE 1/8" = 1"	
				MATERIAL		SHT. 3 OF 4 PART NO. 16-9019 REV C	

System 11B CPU Schematic (16-9019, Sheet 3 of 4)

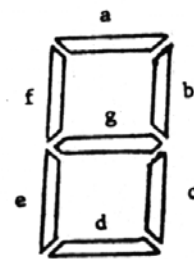
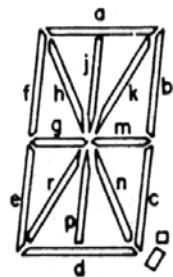
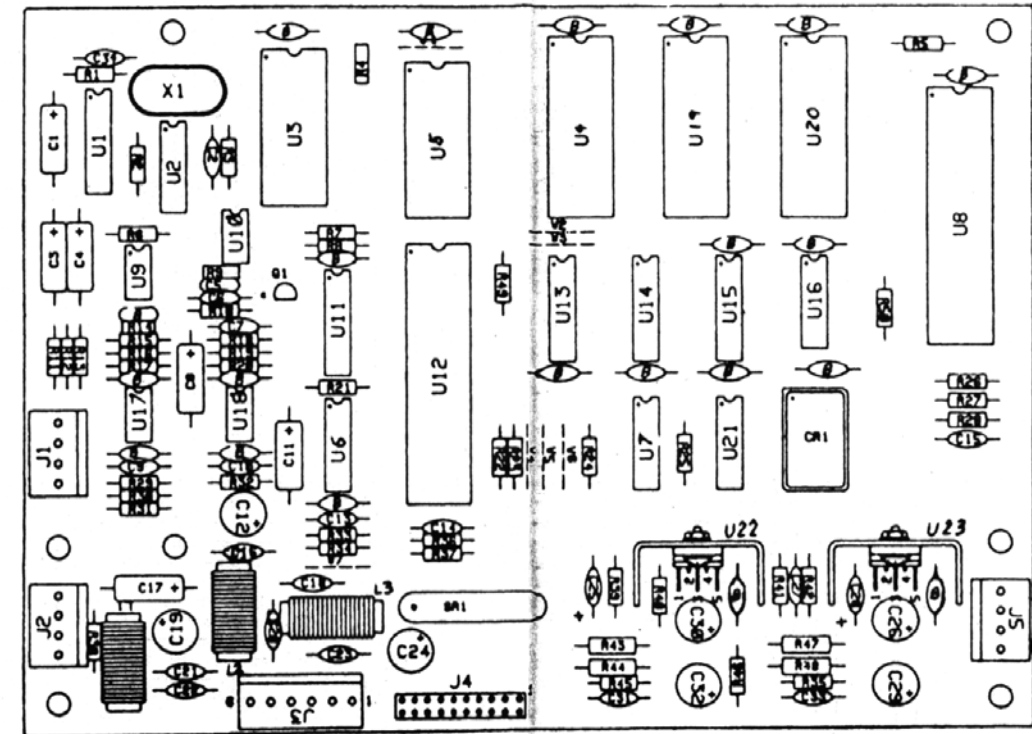
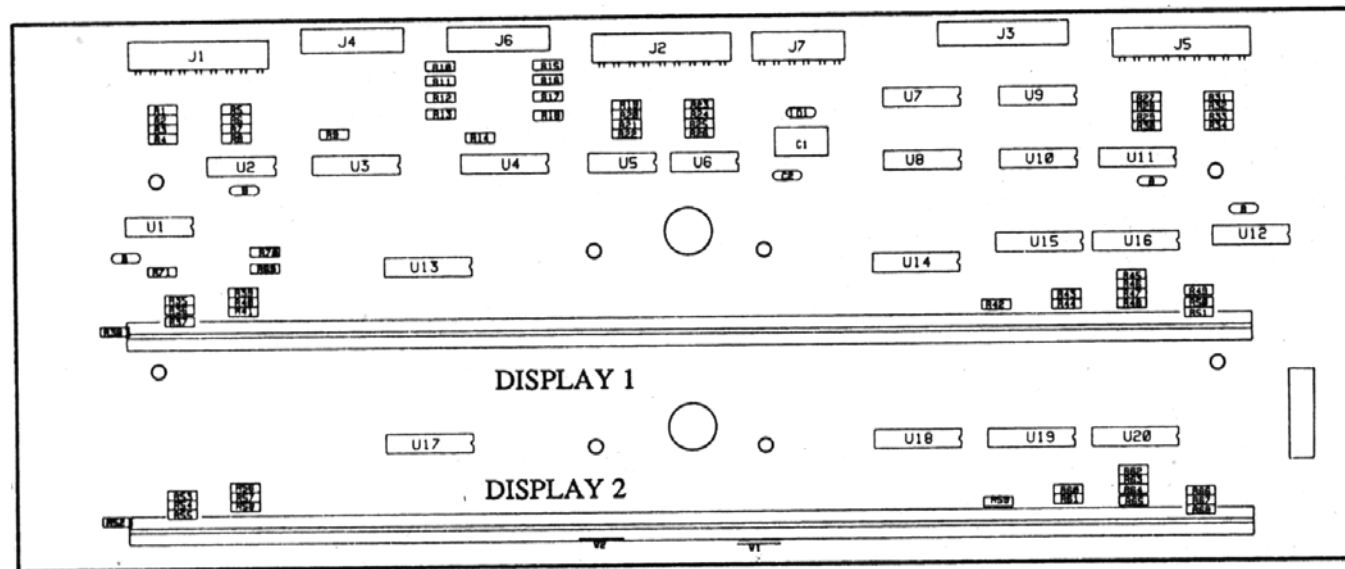
REV	DESCRIPTION OF CHANGE	ECN NO.	DATE
	N. P. R.	1778	7-27-87
A	SEE COVER SHEET	1822	8-27-87
B	SEE COVER SHEET	1824	10-27-87
C	SEE SHEET 1-3	1831	12-15-87



ITEM	PART NUMBER	DESCRIPTION	QTY	ITEM	PART NUMBER	DESCRIPTION	QTY
PROJ. ENGR C. BLEICH		DO NOT SCALE WORK TO DIMENSIONS SHOWN		REMOVE BURRS - BREAK SHARP EDGES		WILLIAMS ELECTRONICS, INC.	
OWN BY ROSS		DATE 8-20-87		TOLERANCES UNLESS OTHERWISE SPECIFIED		3401 N. CALIFORNIA AVE. CHICAGO IL. 60618	
CHECKED BY G. [Signature]		DATE 9/1/87		FRACTIONAL ±1/64 ANGULAR ±1°		NAME CPU SYS 11B SCHEMATIC	
APPROVA [Signature]		DATE 9/1/87		DECIMAL ±.005 FILLETS ±.020 MAX		MATERIAL 11	
FIRST PROJECT NO. 557		FIRST USAGE D-1188Z		SCALE N/S		SHT. 4 of 4	
PART NO. 16-9019		REV C		PART NO. 16-9019		REV C	

System 11B CPU Schematic (16-9019, Sheet 4 of 4)

Black Knight 84

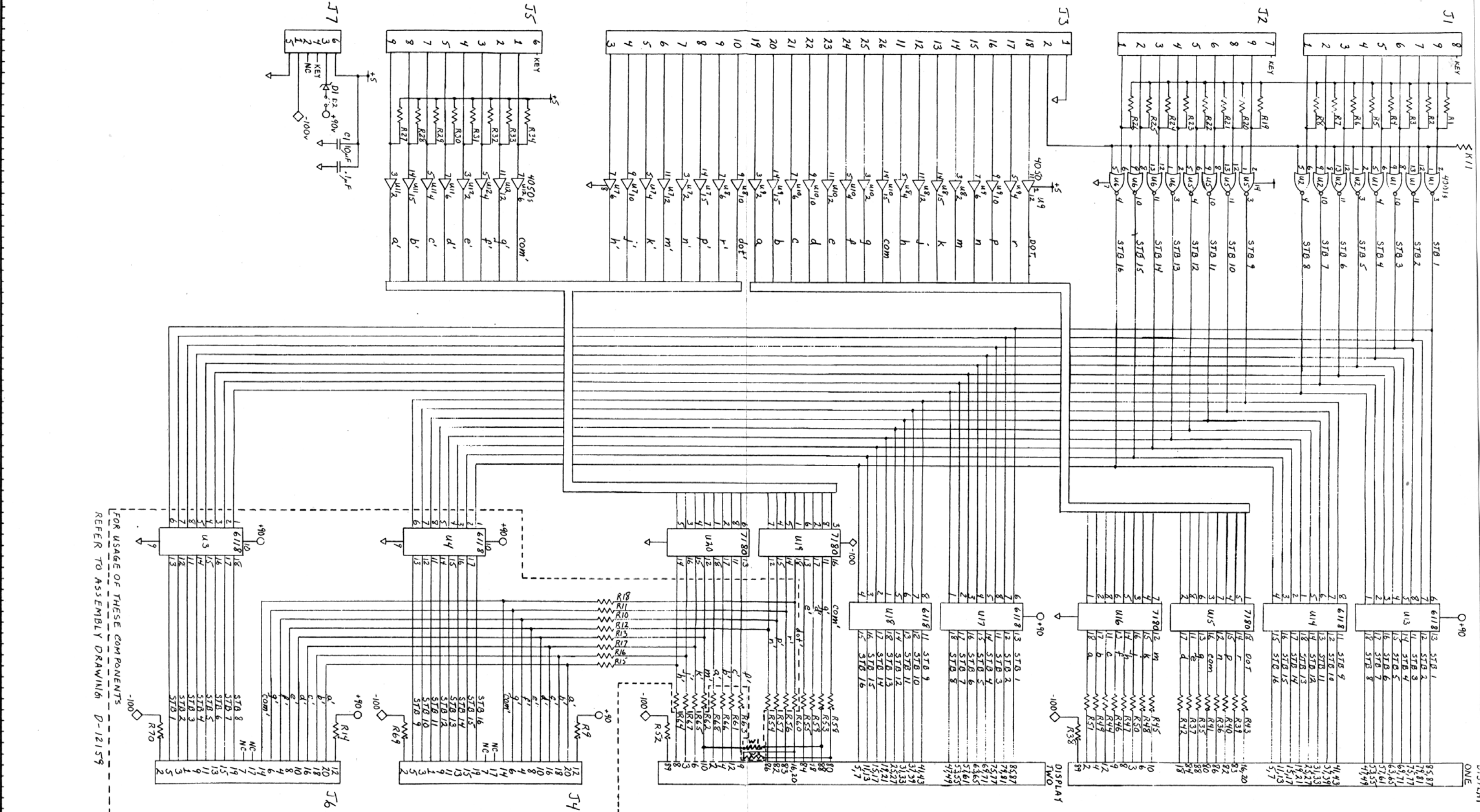


Display Characters Segment Designations

MASTER DISPLAY BOARD
p/n D-12232-1

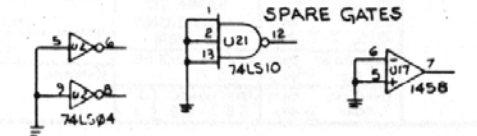
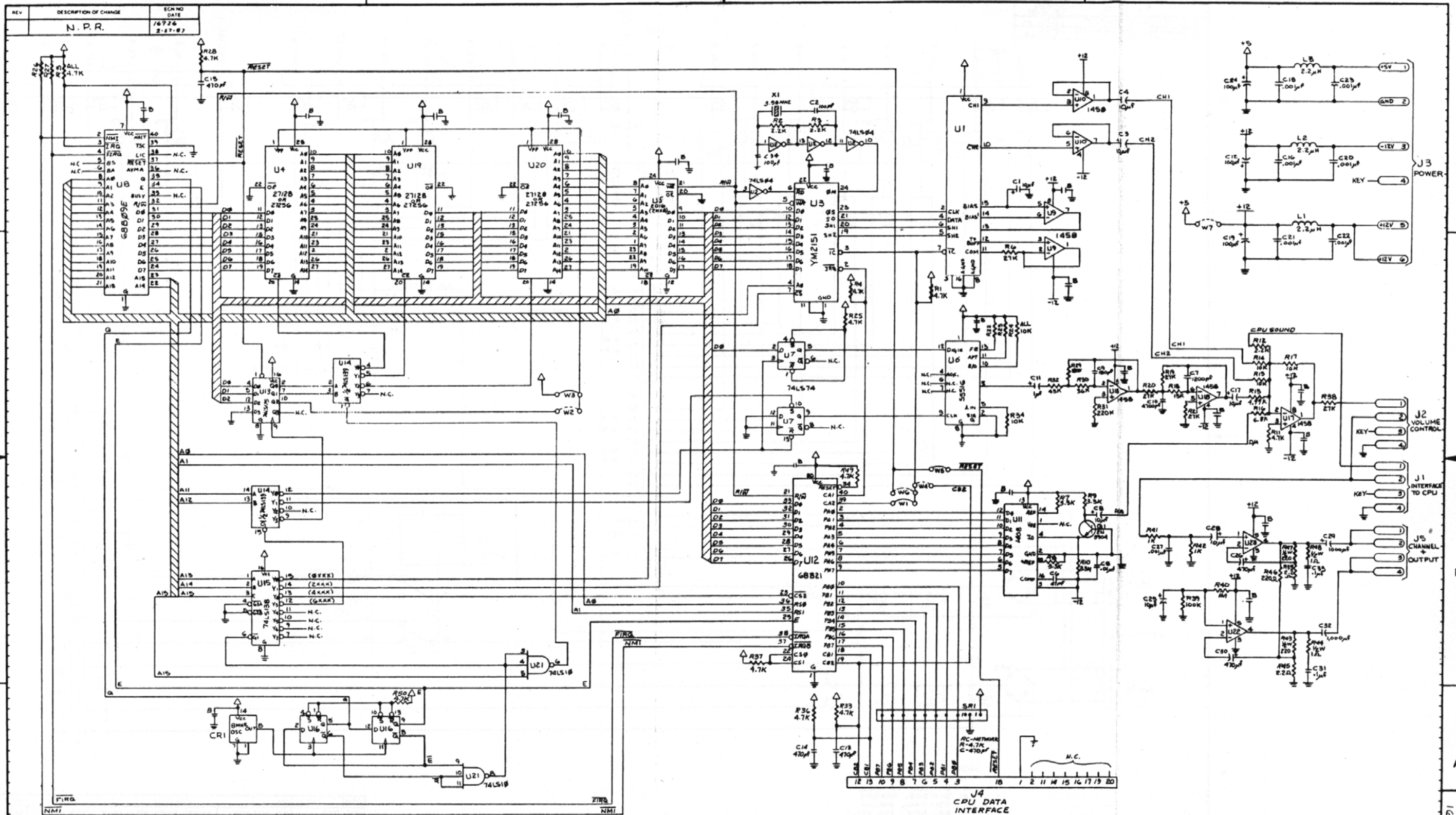
AUDIO BOARD ASSEMBLY
p/n D-11581-568

REV	DESCRIPTION OF CHANGE	ECN NO. DATE
1	NPR	1957 7-21-88



ITEM	PART NUMBER	DESCRIPTION	QTY	ITEM	PART NUMBER	DESCRIPTION
PROJ. ENGR. MARK COLDEBELLA		DO NOT SCALE WORK TO DIMENSIONS SHOWN		REMOVE BURRS - BREAK SHARP EDGES		
DOWN BY DATE M.C. 3/21/88		FIRST PROJECT NO. 553		TOLERANCES UNLESS OTHERWISE SPECIFIED		
CHECKED BY DATE M.C. 7-21-88		FIRST USAGE D-1223-1		FRACTIONAL ±1/64 ANGULAR ±1°		
APPROVAL DATE M.C. 7/21/88		QTY 1		DECIMAL ±.005 FILLETS .020 MAX		
				MATERIAL		
WILLIAMS ELECTRONICS, INC.						
3401 N. CALIFORNIA AVE. CHICAGO, ILL. 60641						
NAME MASTER DISPLAY 88, SCHEMATIC						
SCALE 1/8" = 1" SHT. 1 OF 1 PART NO. 16-9033						

Black Knight 86

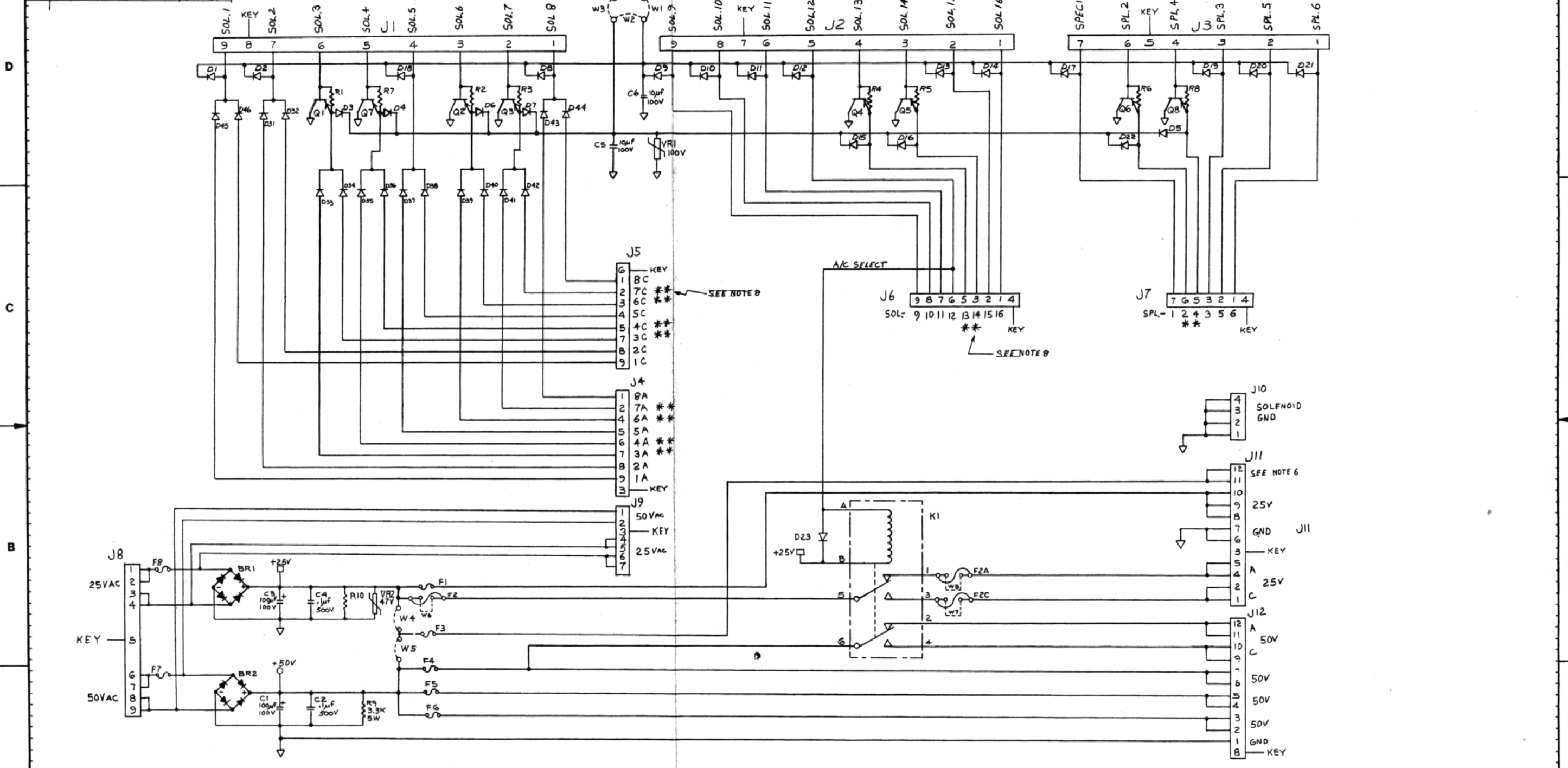


NOTES:
 - ALL CAPACITORS WITH "B" ARE BYPASS AND HAVE A VALUE OF .01μF.
 - LAST USED C31, R40, U23, W7, J5, L3.

ITEM	PART NUMBER	DESCRIPTION	QTY	ITEM	PART NUMBER	DESCRIPTION	QTY	
PROJ ENGR	C. BLEICH	DO NOT SCALE WORK TO DIMENSIONS SHOWN		REMOVE BURRS-BREAK SHARP CORNERS & EDGES		TOLERANCES UNLESS OTHERWISE SPECIFIED		
DWN BY	DATE			DECIMAL	X	0.30	ANGULAR	1/2°
CHECKED BY	DATE	FIRST PROJECT NO	554	MATERIAL	XX	0.03	FRACTIONAL	±1/64
APPROVAL	DATE	FIRST USAGE	D-11581					
WILLIAMS ELECTRONICS, INC.				3401 N. CALIFORNIA AVE CHICAGO IL 60618				
AUDIO SYSTEM SCHEMATIC				SCALE N/S SHT 1 OF 1 PART NO 16-8999 REV -				

Audio Board (D-11581) Schematic

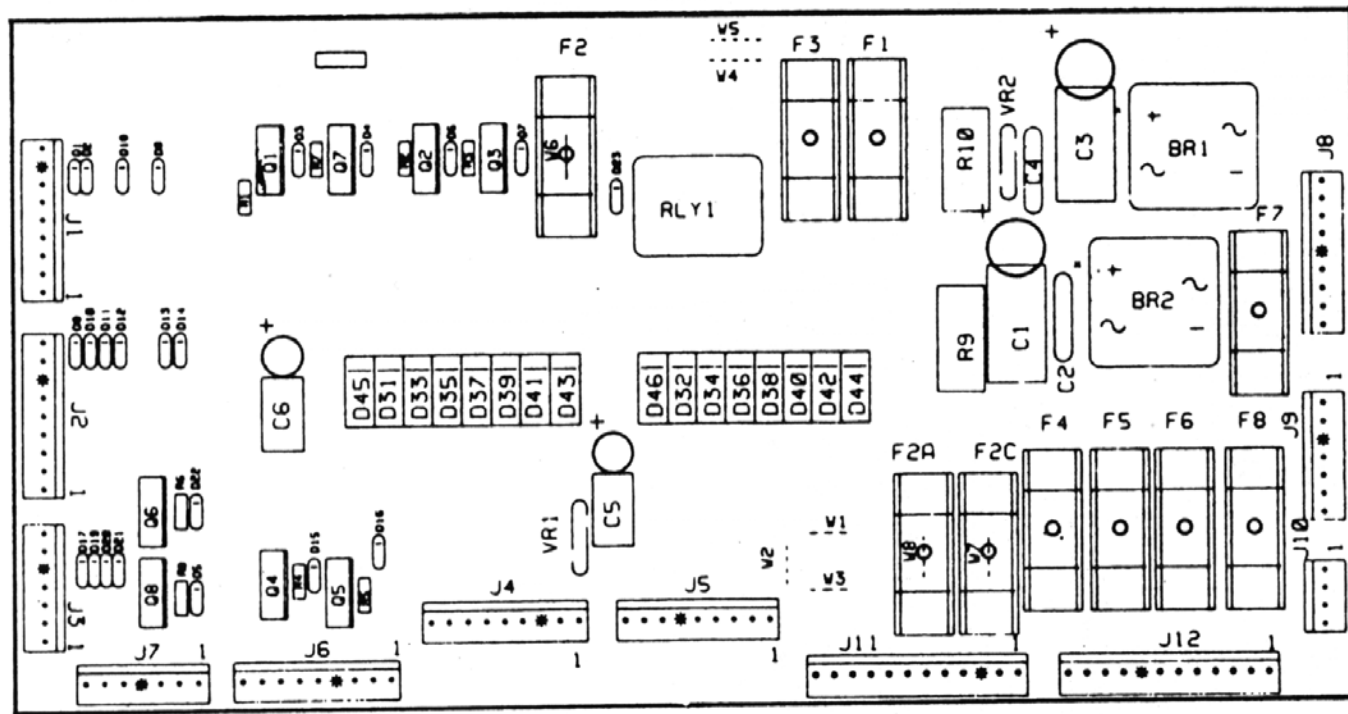
REV	DESCRIPTION OF CHANGE	ECN NO.	DATE
	N.P.R.		1/28/86
A	SEE COVER SHEET		8-19-87
B	ADDED W1, W2, W3, F2A, AND F2C		10-13-87
			11-17-88



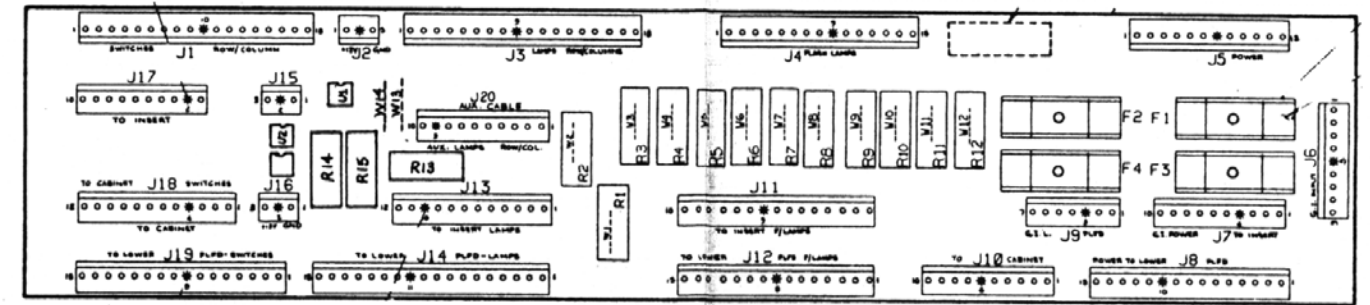
- NOTES:
1. R1-R8, 220Ω 1/4 W
 2. Q1-Q8, TIP-36C
 3. D1-D23, IN4003
 4. D31-D46, MR501
 5. BR1, BR2, 35A 250V
 6. W1, W3, W4 JUMPERS SELECT COMBINATION OF 25V AND 50V COILS; W2, W3, W5 JUMPERS SELECT 50V COILS.
 7. F1-F6, SEE APPROPRIATE ASSEMBLY FOR FUSE VALUES (D-11813-).
 8. *, 50V COILS ONLY; **, 50V COIL OR FLASH LAMP ONLY.
 9. VOLTAGES SPECIFIED UNDER FULL LOAD CONDITIONS.

ITEM	PART NUMBER	DESCRIPTION	QTY	ITEM	PART NUMBER	DESCRIPTION	QTY
PROJ ENGR	K. DEGER	DO NOT SCALE WORK TO DIMENSIONS SHOWN		REMOVE BURRS-BREAK SHARP CORNERS & EDGES		WILLIAMS ELECTRONICS, INC.	
OWN BY	DATE	TOLERANCES UNLESS OTHERWISE SPECIFIED		3401 N. CALIFORNIA AVE. CHICAGO IL 60618		NAME	
CHECKED BY	DATE	DECIMAL	XXX	ANGULAR	±1/2°	SCHEMATIC - AUX. PWR. DR. R.	
APPROVAL	DATE	FIRST PROJECT NO.	557	FRACTIONAL	±1/64	SCALE	N/S
		FIRST USAGE	557-BB	MATERIAL		SHT. OF	16-9015
		QTY	1			PART NO.	REV
							8

Aux Power Driver Board Schematic

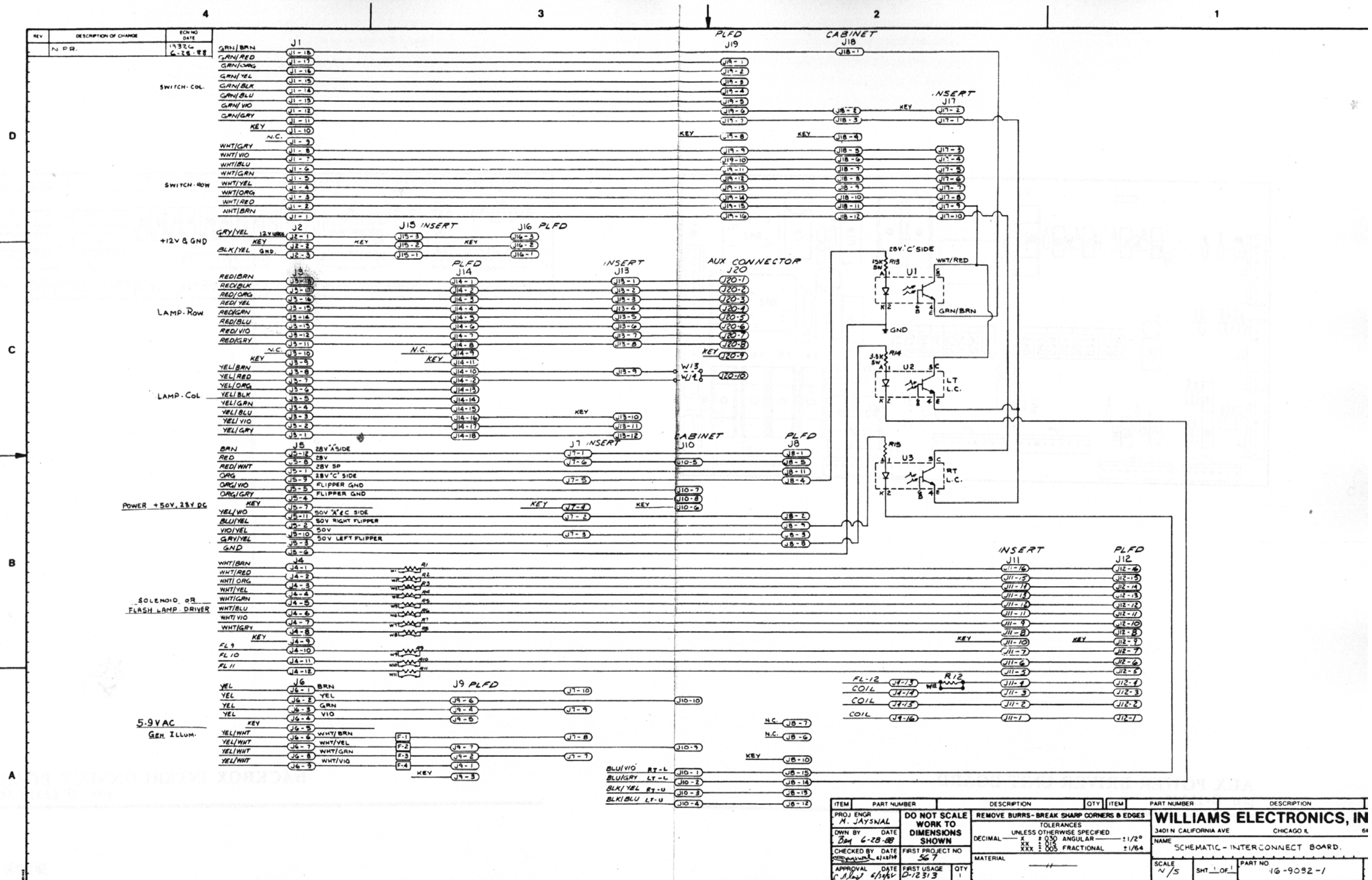


AUX POWER DRIVER UNIT BOARD
p/n D-12247



BACKBOX INTERCONNECT BOARD
p/n D-12313-568

Black Knight:



D

C

B

A

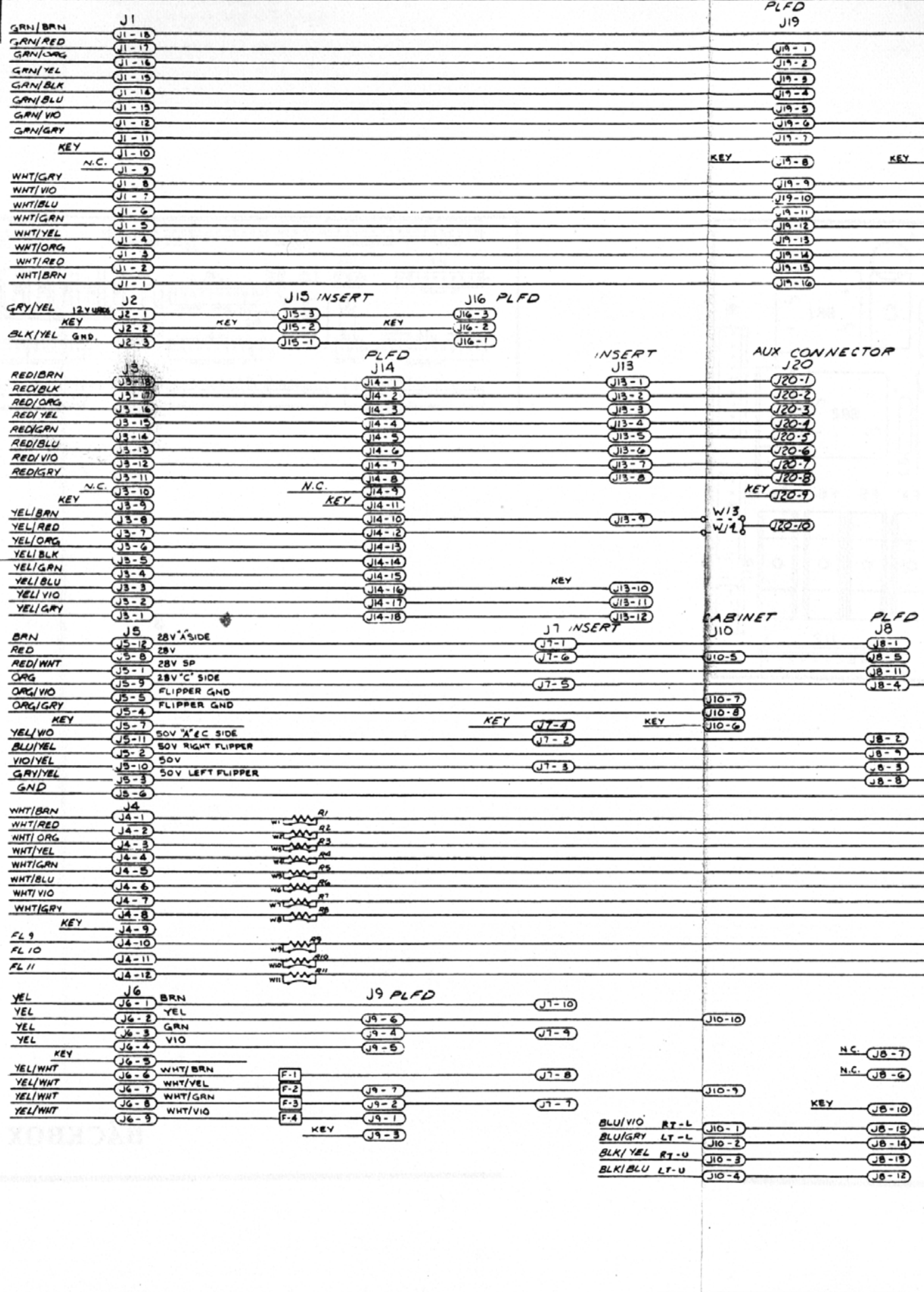
4

3

2

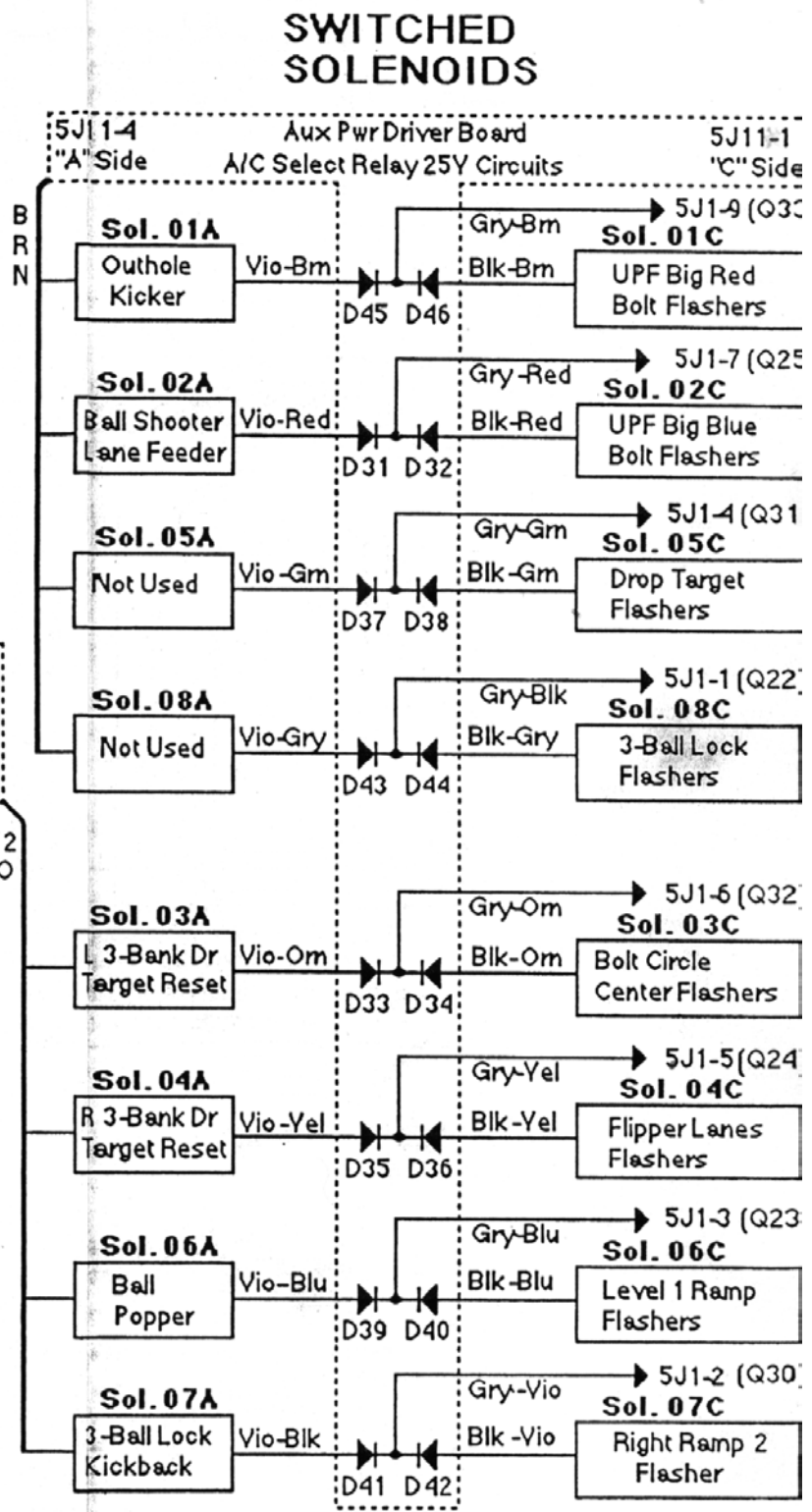
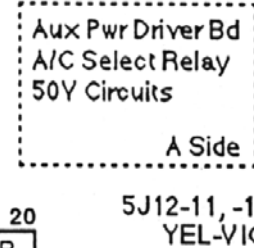
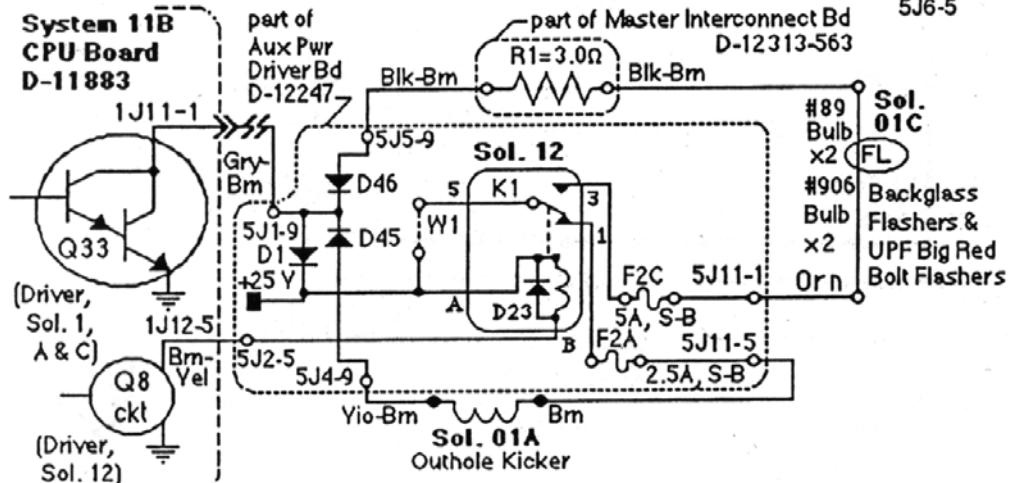
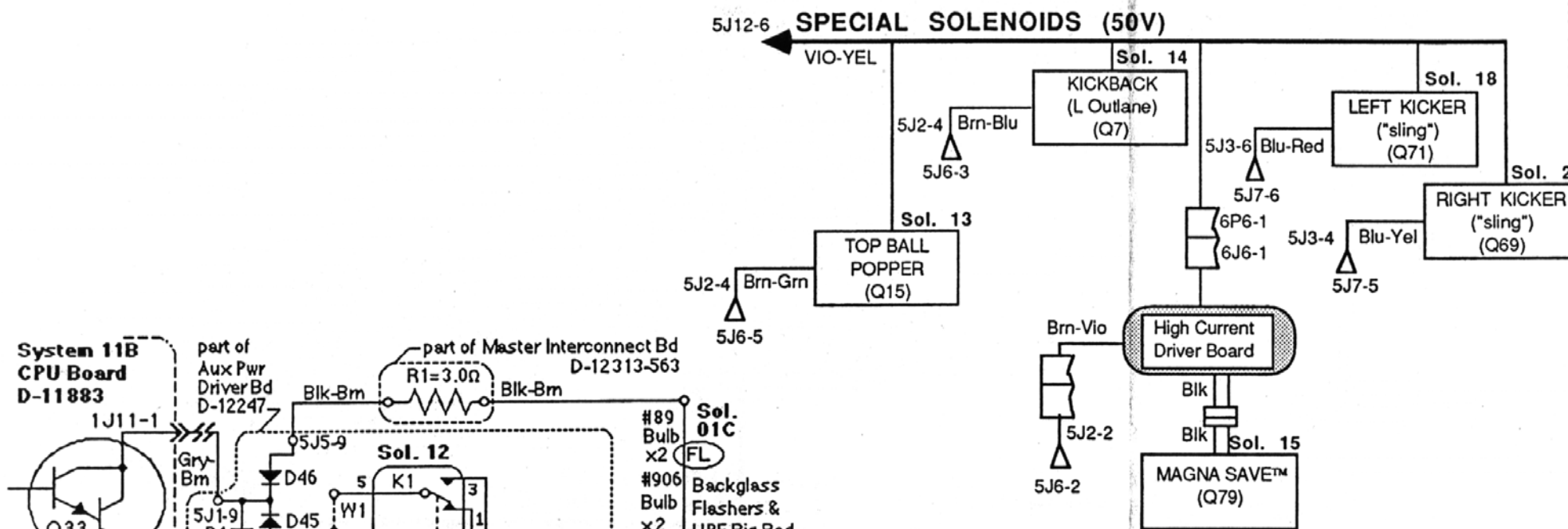
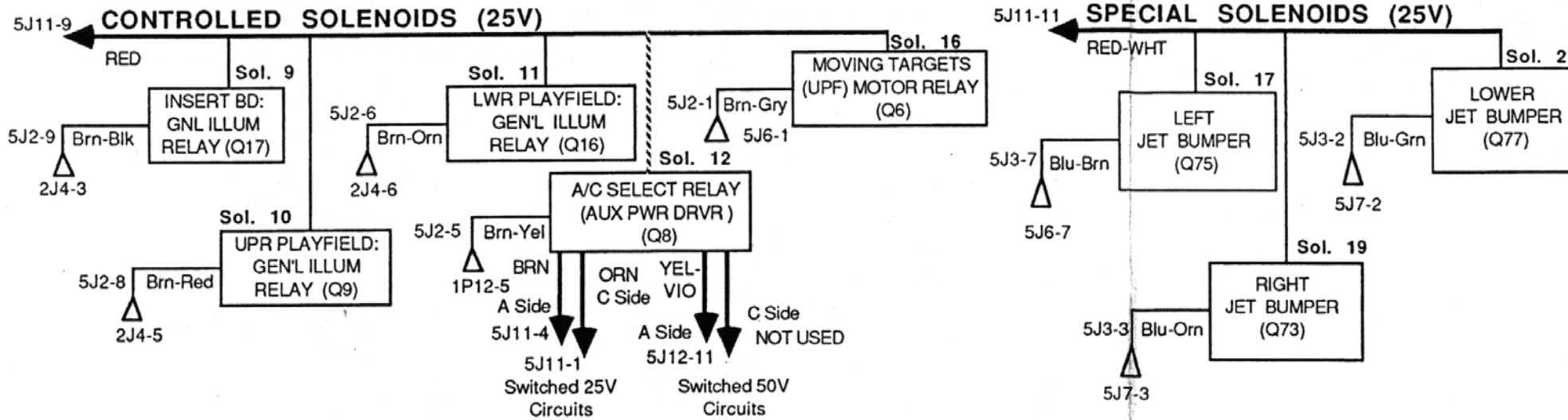
1

REV	DESCRIPTION OF CHANGE	ECH NO DATE
N.P.R.		19326 6-28-68



ITEM	PART NUMBER	DESCRIPTION	QTY	ITEM	PART NUMBER	DESCRIPTION
PROJ ENGR	M. JAYSVAL	DO NOT SCALE WORK TO DIMENSIONS SHOWN		WILLIAMS ELECTRONICS, INC.		
DOWN BY DATE	30th 6-28-68	REMOVE BURRS-BREAK SHARP CORNERS & EDGES		3401 N CALIFORNIA AVE CHICAGO IL 60641		
CHECKED BY DATE	6/28/68	TOLERANCES UNLESS OTHERWISE SPECIFIED		NAME SCHEMATIC-INTERCONNECT BOARD.		
APPROVAL DATE	6/28/68	DECIMAL .X ± 0.30 ANGULAR ± 1/2°		SCALE	N/5	SHT 1 OF 1
		XXX ± .005 FRACTIONAL ± 1/64		PART NO		46-9032-1

Black Knight 90 Backbox Interconnect Board (D-12313-568) Schema



CONTROLLED, SPECIAL, & SWITCHED SOLENOIDS

INTERCONNECT BOARD INTERBOARD SIGNALS

Connector	Wire Color	Signal Designation/Description	Connector	Wire Color	Signal Designation/Description
2J1-1	WHT/BRN	Switch Row 1	2J2-1	GRY/YEL	CPU Power: +12 Vdc Unreg
2J1-2	WHT/RED	Switch Row 2	2J2-2	Key Pin	No Connection
2J1-3	WHT/ORG	Switch Row 3	2J2-3	BLK/YEL	Logic Ground
2J1-4	WHT/YEL	Switch Row 4	2J3-1	YEL/GRY	Lamp Col 8 (Q51/52)
2J1-5	WHT/GRN	Switch Row 5	2J3-2	YEL/VIO	Lamp Col 7 (Q53/54)
2J1-6	WHT/BLU	Switch Row 6	2J3-3	YEL/BLU	Lamp Col 6 (Q55/56)
2J1-7	WHT/VIO	Switch Row 7	2J3-4	YEL/GRN	Lamp Col 5 (Q57/58)
2J1-8	WHT/GRY	Switch Row 8	2J3-5	YEL/BLK	Lamp Col 4 (Q59/60)
2J1-9	Key Pin	No Connection	2J3-6	YEL/ORG	Lamp Col 3 (Q61/62)
2J1-10	---	No Connection	2J3-7	YEL/RED	Lamp Col 2 (Q63/64)
2J1-11	GRN-GRY	Switch Col 8 (Q46)	2J3-8	YEL/BRN	Lamp Col 1 (Q65/66)
2J1-12	GRN-VIO	Switch Col 7 (Q42)	2J3-9	Key Pin	No Connection
2J1-13	GRN-BLU	Switch Col 6 (Q47)	2J3-10	---	No Connection
2J1-14	GRN-BLK	Switch Col 5 (Q43)	2J3-11	RED/GRY	Lamp Row 8 (Q87)
2J1-15	GRN-YEL	Switch Col 4 (Q48)	2J3-12	RED/VIO	Lamp Row 7 (Q86)
2J1-16	GRN-ORG	Switch Col 3 (Q44)	2J3-13	RED/BLU	Lamp Row 6 (Q85)
2J1-17	GRN-RED	Switch Col 2 (Q49)	2J3-14	RED/GRN	Lamp Row 5 (Q84)
2J1-18	GRN-BRN	Switch Col 1 (Q45)	2J3-15	RED/YEL	Lamp Row 4 (Q83)
2J4-1	WHT/BRN	Solenoid 01C	2J3-16	RED/ORG	Lamp Row 3 (Q82)
2J4-2	WHT/RED	Solenoid 02C	2J3-17	RED/BLK	Lamp Row 2 (Q81)
2J4-3	WHT/ORG	Solenoid 03C	2J3-18	RED/BRN	Lamp Row 1 (Q80)
2J4-4	WHT/YEL	Solenoid 04C	2J5-1	RED/WHT	+50 Vdc / Sol. Power
2J4-5	WHT/GRN	Solenoid 05C	2J5-2	BLU/YEL	+50 Vdc / Flippers
2J4-6	WHT/BLU	Solenoid 06C	2J5-3	GRY/YEL	+50 Vdc / Flippers
2J4-7	WHT/VIO	Solenoid 07C	2J5-4	ORG/GRY	Flipper Ground
2J4-8	WHT/GRY	Solenoid 08C	2J5-5	ORG/VIO	Flipper Ground
2J4-9	Key Pin	No Connection	2J5-6	BLK	No Connection
2J4-10	BRN/BLK	Solenoid 15	2J5-7	Key Pin	No Connection
2J4-11	BRN/ORN	Solenoid 16	2J5-8	RED	+25 Vdc / Sol. Power
2J4-12	BRN/RED	Solenoid 9	2J5-9	ORG	+25 Vdc / Sol. Power "C"
2J4-13	BRN/VIO	Solenoid 10	2J5-10	VIO/YEL	+50 Vdc / Sol. Power
2J4-14	BRN/GRY	Solenoid 11	2J5-11	YEL/VIO	+50 Vdc / Sol. Power "A"
2J4-15	---	No Connection	2J5-12	BRN	+25 Vdc / Sol. Power "A"
2J4-16	---	No Connection	2J7-1	---	No Connection
2J6-1	YEL	Transformer: 6V ac	2J7-2	---	No Connection
2J6-2	YEL	Transformer: 6V ac	2J7-3	---	No Connection
2J6-3	YEL	Transformer: 6V ac	2J7-4	Key Pin	No Connection
2J6-4	YEL	Transformer: 6V ac	2J7-5	ORG	+25 Vdc / Sol. Power "C"
2J6-5	Key Pin	No Connection	2J7-6	RED	+25 Vdc / Sol. Power
2J6-6	YEL/WHT	Transformer: 6V ac	2J7-7	WHT/GRN	Solenoid 05C
2J6-7	YEL/WHT	Transformer: 6V ac	2J7-8	WHT/BRN	Solenoid 01
2J6-8	YEL/WHT	Transformer: 6V ac	2J7-9	GRN	Gen Illum Power: 6V ac
2J6-9	YEL/WHT	Transformer: 6V ac	2J7-10	BRN	+25 Vdc / Sol. Power "A"
2J8-1	BRN	+25 Vdc / Sol. Power "A"	2J9-1	WHT/VIO	Gen Illum Power: 6V ac
2J8-2	YEL/VIO	+50 Vdc / Sol. Power "A"	2J9-2	---	No Connection
2J8-3	VIO/YEL	+50 Vdc / Sol. Power	2J9-3	Key Pin	No Connection
2J8-4	ORG	+25 Vdc / Sol. Power "C"	2J9-4	---	No Connection
2J8-5	RED	+25 Vdc / Sol. Power	2J9-5	VIO	Gen Illum Power: 6V ac
2J8-6	---	No Connection	2J9-6	YEL	Transformer: 6V ac
2J8-7	---	No Connection	2J9-7	WHT/YEL	Gen Illum Power: 6V ac
2J8-8	GRY/YEL	+50 Vdc / Flippers	2J11-1	---	No Connection
2J8-9	BLU/YEL	+50 Vdc / Flippers	2J11-2	---	No Connection
2J8-10	Key Pin	No Connection	2J11-3	---	No Connection
2J8-11	RED/WHT	+50 Vdc / Sol. Power	2J11-4	---	No Connection
2J8-12	---	No Connection	2J11-5	BRN/RED	Solenoid 10
2J8-13	---	No Connection	2J11-6	BRN/ORN	Solenoid 11
2J8-14	BLU/GRY	Lwr L Flipper Switch, LPF	2J11-7	BRN/BLK	Solenoid 9
2J8-15	BLU/VIO	Lwr R Flipper Switch, LPF	2J11-8	BLK/GRY	Solenoid 07C
2J10-1	BLU/VIO	Lwr R Flipper Switch, LPF	2J11-9	BLK/VIO	Solenoid 15
2J10-2	BLU/GRY	Lwr L Flipper Switch, LPF	2J11-10	Key Pin	No Connection
2J10-3	---	No Connection	2J11-11	BLK/BLU	Solenoid 06C
2J10-4	---	No Connection	2J11-12	BLK/GRN	Solenoid 05C
2J10-5	RED	No Connection	2J11-13	BLK/YEL	Solenoid 04C
2J10-6	Key Pin	No Connection	2J11-14	BLK/ORG	Solenoid 03C
2J10-7	ORN/VIO	No Connection	2J11-15	BLK/RED	Solenoid 02C
2J10-8	ORN/GRY	No Connection	2J11-16	BLK-BRN	Solenoid 01C
2J10-9	WHT/YEL	Gen Illum Power: 6V ac			
2J10-10	YEL	Transformer: 6V ac			

INTERCONNECT BOARD INTERBOARD SIGNALS

(Continued)

Connector	Wire Color	Signal Designation/Description	Connector	Wire Color	Signal Designation/Description
2J12-1	---	No Connection	2J13-1	RED/BRN	Lamp Row 1 (Q80)
2J12-2	---	No Connection	2J13-2	RED/BLK	Lamp Row 2 (Q81)
2J12-3	BRN/GRY	Solenoid 16	2J13-3	RED/ORG	Lamp Row 3 (Q82)
2J12-4	BRN/VIO	Solenoid 15	2J13-4	RED/YEL	Lamp Row 4 (Q83)
2J12-5	BRN/RED	Solenoid 10	2J13-5	RED/GRN	Lamp Row 5 (Q84)
2J12-6	---	No Connection	2J13-6	RED/BLU	Lamp Row 6 (Q85)
2J12-7	BRN/BLK	Solenoid 9	2J13-7	RED/VIO	Lamp Row 7 (Q86)
2J12-8	BLK/GRY	Solenoid 08C	2J13-8	RED/GRY	Lamp Row 8 (Q87)
2J12-9	Key Pin	No Connection	2J13-9	---	No Connection
2J12-10	BLK/VIO	Solenoid 07C	2J13-10	Key Pin	No Connection
2J12-11	BLK/BLU	Solenoid 06C	2J13-11	---	No Connection
2J12-12	---	No Connection	2J13-12	YEL/GRY	Lamp Col 8 (Q51/52)
2J12-13	BLK/YEL	Solenoid 04C	2J15	Not Applicable	
2J12-14	BLK/ORG	Solenoid 03C	2J16-1	BLK/YEL	Logic Ground
2J12-15	BLK/RED	Solenoid 02C	2J16-2	Key Pin	No Connection
2J12-16	BLK/BRN	Solenoid 01C	2J16-3	GRY/YEL	CPU: Power: +12 Vdc Unreg
2J14-1	RED/BRN	Lamp Row 1 (Q80)	2J17-1	GRN/GRY	Switch Col 8 (Q46)
2J14-2	RED/BLK	Lamp Row 2 (Q81)	2J17-2	Key Pin	No Connection
2J14-3	RED/ORG	Lamp Row 3 (Q82)	2J17-3	---	No Connection
2J14-4	RED/YEL	Lamp Row 4 (Q83)	2J17-4	thru	No Connection
2J14-5	RED/GRN	Lamp Row 5 (Q84)	2J17-7	---	No Connection
2J14-6	RED/BLU	Lamp Row 6 (Q85)	2J17-8	WHT/ORG	Switch Row 3
2J14-7	RED/VIO	Lamp Row 7 (Q86)	2J17-9	---	No Connection
2J14-8	RED/GRY	Lamp Row 8 (Q87)	2J17-10	---	No Connection
2J14-9	---	No Connection	2J18-1	GRN/BRN	Switch Col 1 (Q45)
2J14-10	YEL/BRN	Lamp Col 1 (Q65/66)	2J18-2	---	No Connection
2J14-11	Key Pin	No Connection	2J18-3	---	No Connection
2J14-12	YEL/RED	Lamp Col 2 (Q63/64)	2J18-4	Key Pin	No Connection
2J14-13	YEL/ORG	Lamp Col 3 (Q61/62)	2J18-5	WHT/GRY	Switch Row 8
2J14-14	YEL/BLK	Lamp Col 4 (Q59/60)	2J18-6	WHT/VIO	Switch Row 7
2J14-15	YEL/GRN	Lamp Col 5 (Q57/58)	2J18-7	WHT/BLU	Switch Row 6
2J14-16	YEL/BLU	Lamp Col 6 (Q55/56)	2J18-8	WHT/GRN	Switch Row 5
2J14-17	YEL/VIO	Lamp Col 7 (Q53/54)	2J18-9	WHT/YEL	Switch Row 4
2J14-18	---	No Connection	2J18-10	WHT/ORG	Switch Row 3
2J19-1	GRN/RED	Switch Col 2 (Q49)	2J18-11	---	No Connection
2J19-2	GRN/ORG	Switch Col 3 (Q44)	2J18-12	WHT/BRN	Switch Row 1
2J19-3	GRN/YEL	Switch Col 4 (Q48)	2J20	Not Applicable	
2J19-4	GRN/BLK	Switch Col 5 (Q43)			
2J19-5	GRN/BLU	Switch Col 6 (Q47)			
2J19-6	GRN/VIO	Switch Col 7 (Q42)			
2J19-7	GRN/GRY	Switch Col 8 (Q46)			
2J19-8	Key Pin	No Connection			
2J19-9	WHT/GRY	Switch Row 8			
2J19-10	WHT/VIO	Switch Row 7			
2J19-11	WHT/BLU	Switch Row 6			
2J19-12	WHT/GRN	Switch Row 5			
2J19-13	WHT/YEL	Switch Row 4			
2J19-14	WHT/ORG	Switch Row 3			
2J19-15	WHT/RED	Switch Row 2			
2J19-16	WHT/BRN	Switch Row 1			

AUX POWER DRIVER INTERBOARD SIGNALS

Connector	Wire Color	Signal Designation/Description	Connector	Wire Color	Signal Designation/Descr
5J1-1	GRY/BLK	CPU: Solenoid 8 (Q22) / 1J11-9	5J2-1	BRN/GRY	CPU: Solenoid 16 (Q6) / 1
5J1-2	GRY/VIO	CPU: Solenoid 7 (Q30) / 1J11-8	5J2-2	BRN/VIO	CPU: Solenoid 15 (Q14) /
5J1-3	GRY/BLU	CPU: Solenoid 6 (Q23) / 1J11-7	5J2-3	---	No Connection
5J1-4	GRY/GRN	CPU: Solenoid 5 (Q31) / 1J11-6	5J2-4	---	No Connection
5J1-5	GRY/YEL	CPU: Solenoid 4 (Q24) / 1J11-5	5J2-5	BRN/YEL	CPU: Solenoid 12 (Q15) /
5J1-6	GRY/ORG	CPU: Solenoid 3 (Q32) / 1J11-4	5J2-6	BRN/ORG	CPU: Solenoid 11 (Q16) /
5J1-7	GRY/RED	CPU: Solenoid 2 (Q25) / 1J11-3	5J2-7	Key Pin	No Connection
5J1-8	Key Pin	No Connection	5J2-8	BRN/RED	CPU: Solenoid 10 (Q9) / 1
5J1-9	GRY/BRN	CPU: Solenoid 1 (Q33) / 1J11-1	5J2-9	BRN/BLK	CPU: Solenoid 9 (Q17) / 1
5J3-1	BLU/BLK	CPU: Spl Solnd 6 (Q79) / 1J19-9	5J4-1	VIO/GRY	Solenoid 08A
5J3-2	BLU/GRN	CPU: Spl Solnd 5 (Q77) / 1J19-8	5J4-2	VIO/BLK	Solenoid 07A
5J3-3	BLU/ORN	CPU: Spl Solnd 3 (Q73) / 1J19-3	5J4-3	Key Pin	No Connection
5J3-4	BLU/YEL	CPU: Spl Solnd 4 (Q69) / 1J19-6	5J4-4	VIO/BLU	Solenoid 06A
5J3-5	Key Pin	No Connection	5J4-5	VIO/GRN	Solenoid 05A
5J3-6	BLU/RED	CPU: Spl Solnd 2 (Q71) / 1J19-4	5J4-6	VIO/YEL	Solenoid 04A
5J3-7	BLU/BRN	CPU: Spl Solnd 1 (Q75) / 1J19-7	5J4-7	VIO/ORN	Solenoid 03A
5J5-1	WHT/GRY	Solenoid 08C	5J4-8	VIO/RED	Solenoid 02A
5J5-2	WHT/VIO	Solenoid 07C	5J4-9	VIO/BRN	Solenoid 01A
5J5-3	WHT/BLU	Solenoid 06C	5J6-1	BRN/GRY	Solenoid 16
5J5-4	WHT/GRN	Solenoid 05C	5J6-2	BRN/VIO	Solenoid 15
5J5-5	WHT/YEL	Solenoid 04C	5J6-3	BRN/BLU	Solenoid 14
5J5-6	Key Pin	No Connection	5J6-4	Key Pin	No Connection
5J5-7	WHT/ORN	Solenoid 03C	5J6-5	---	Solenoid 13
5J5-8	WHT/RED	Solenoid 02C	5J6-6	---	Solenoid 12
5J5-9	WHT/BRN	Solenoid 01C	5J6-7	BRN/ORN	Solenoid 11
5J7-1	BLU/BLK	Spl Solnd 6	5J6-8	BRN/RED	Solenoid 10
5J7-2	BLU/GRN	Spl Solnd 5	5J6-9	BRN/BLK	Solenoid 9
5J7-3	BLU/ORN	Spl Solnd 4	5J8-1	WHT/RED	Transformer: 26V ac / 7J2
5J7-4	Key Pin	No Connection	5J8-2	WHT/RED	Transformer: 26V ac / 7J2
5J7-5	BLU/YEL	Spl Solnd 3	5J8-3	WHT/RED	Transformer: 26V ac / 7J2
5J7-6	BLU/RED	Spl Solnd 2	5J8-4	WHT/RED	Transformer: 26V ac / 7J2
5J7-7	BLU/BRN	Spl Solnd 1	5J8-5	Key Pin	No Connection
5J9-1	---	No Connection	5J8-6	BLK/YEL	Transformer: 48V ac / 7J2
5J9-2	---	No Connection	5J8-7	BLK/YEL	Transformer: 48V ac / 7J2
5J9-3	Key Pin	No Connection	5J8-8	BLK/YEL	Transformer: 48V ac / 7J2
5J9-4	WHT/BLU	25 Vac: Ferris Wheel Motor	5J8-9	BLK/YEL	Transformer: 48V ac / 7J2
5J9-5	---	No Connection	5J10-1	BLK	Solnd Gnd / 1J13-1
5J9-6	WHT/BLU	25 Vac: Ferris Wheel Motor	5J10-2	BLK	Solnd Gnd / 1J13-2
5J9-7	---	No Connection	5J10-3	BLK	Solnd Gnd / 1J13-3
5J12-1	---	No Connection	5J10-4	BLK	Solnd Gnd / 1J13-4
5J12-2	GRY/YEL	+50 Vdc / Flippers	5J11-1	ORN	+25 Vdc (C solnd) / Sol. 0
5J12-3	---	No Connection	5J11-2	---	No Connection
5J12-4	BLU/YEL	+50 Vdc / Flippers	5J11-3	Key Pin	No Connection
5J12-5	---	No Connection	5J11-4	BRN	+25 Vdc (A solnd) / Sol. 0-
5J12-6	VIO/YEL	+50 Vdc / Sol. 18 & 20	5J11-5	---	No Connection
5J12-7	---	No Connection	5J11-6	BLK	Solnd Gnd
5J12-8	Key Pin	No Connection	5J11-7	---	No Connection
5J12-9	---	No Connection	5J11-8	---	No Connection
5J12-10	---	No Connection	5J11-9	RED	+25 Vdc / Sol. 9,10,11, &
5J12-11	YEL/VIO	+50 Vdc (A solnd) / Sol. 03A, 04A, &	5J11-10	---	No Connection
5J12-12	---	No Connection	5J11-11	RED/WHT	+50 Vdc / Sol. 17, 19, 21
			5J11-12	---	No Connection

GAME CIRCUIT BOARDS INTERBOARDS SIGNALS

POWER SUPPLY INTERBOARD SIGNALS

Connector	Wire Color	Signal Designation/Description	Connector	Wire Color	Signal Designation/Description
3J1-1	BLK	Ground / 1J17-1	3J2-1	ORG	Display Power: -100V dc / 4J2-1
3J1-2	BLK	Ground / 1J17-2	3J2-2	---	No Connection
3J1-3	BLK	Ground / 1J17-3	3J2-3	BRN	Display Power: +100V dc / 4J2-3
3J1-4	BLK	No Connection	3J2-4	Key Pin	No Connection
3J1-5	BLK/YEL	Logic Ground	3J2-5	BLK	Ground (Display ckt) / 4J2-5
3J1-6	GRY	CPU Pwr: +5V dc Reg / 1J17-4	3J2-6	GRY	Display Power: +5V dc / 4J2-6
3J1-7	GRY	" / 1J17-5			
3J1-8	GRY	" / 1J17-6			
3J1-9	GRY	No Connection	3J3-1	GRY	Transformer: 19.4V ac, 1Ø, C. T.
3J1-10	Key Pin	No Connection	3J3-2	GRY	Transformer: 19.4V ac, 1Ø, C. T.
3J1-11	WHT/GRY	CPU Pwr: +12V dc Unreg / 1J17-9	3J3-3	GRY/WHT	Transformer: 19.4V ac, C. T. com
3J1-12	WHT/GRY	CPU Pwr: +12V dc Unreg / 1J17-9	3J3-4	GRY/WHT	Transformer: 19.4V ac, C. T. com
3J1-13	GRY/YEL	CPU Pwr: +12V dc Unreg	3J3-5	GRY/GRN	Transformer: 19.4V ac, 1Ø, C. T.
3J1-14	BLK/WHT	CPU Pwr: -12V dc Unreg / 1J17-8	3J3-6	GRY/GRN	Transformer: 19.4V ac, 1Ø, C. T.
3J1-15	BLK/WHT	CPU Pwr: -12V dc Unreg / 1J17-8	3J3-7	Key Pin	No Connection
			3J3-8	WHT	Transformer: 88.5V ac
			3J3-9	WHT	Transformer: 88.5V ac

AUDIO BOARD INTERBOARD SIGNALS

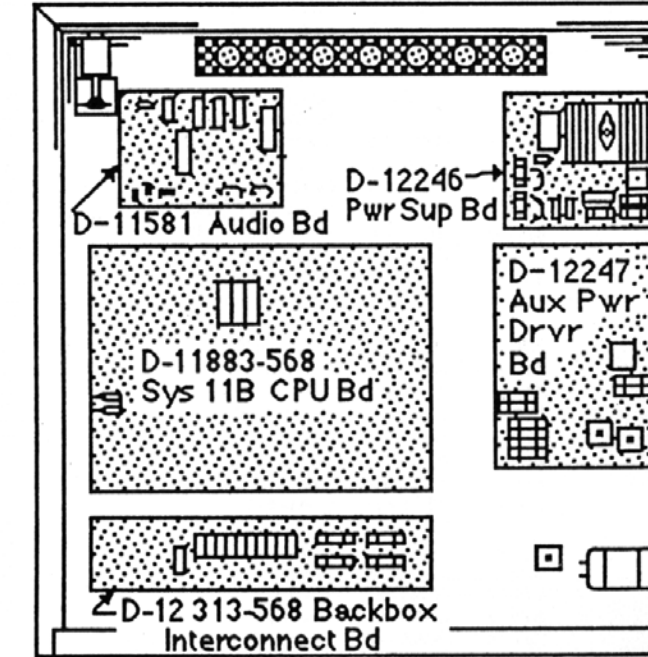
Connector	Wire Color	Signal Designation/Description	Connector	Wire Color	Signal Designation/Description
11J1-1	RED	Sound Input (from CPU) / 1J16-1	11J2-1	RED	Signal Level (to Vol Cntrl)
11J1-2	BLK	Sound Input (from CPU) / 1J16-2	11J2-2	BLK	Signal Level (from Vol Cntrl)
11J1-3	---	No Connection	11J2-3	---	No Connection
11J1-4	WHT	Ground / 1J16-4	11J2-4	shield	Ground
11J3-1	GRY	Power: +5 Vdc / 3J6-7	11J4		Ribbon Cable from CPU 1J21
11J3-2	BLK	Ground / 3J6-11			
11J3-3	BLK-WHT	Power: -12 Vdc Unreg / 3J6-2	11J5-1	BLK-YEL	/ Speaker
11J3-4	Key Pin	No Connection	11J5-2	BLK-YEL	/ Speaker
11J3-5	---	No Connection	11J5-3	BLK	/ Speaker
11J3-6	WHT-GRY	Power: +12 Vdc Unreg / 3J6-6	11J5-4	BLK	/ Speaker

MASTER DISPLAY INTERBOARD SIGNALS

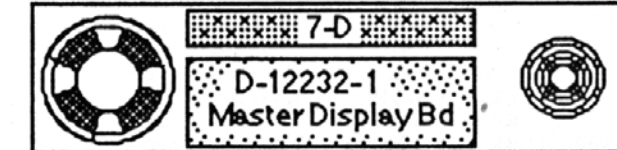
Connector	Wire Color	Signal Designation/Description	Connector	Wire Color	Signal Designation/Description
4J1-1	BRN/GRY	ST-8: Digit Display Strobe / 1J1-1	4J3		Ribbon Cable from CPU 1J22
4J1-2	BRN/VIO	ST-7: Display Digit Strobe / 1J1-2			
4J1-3	BRN/BLU	ST-6: Display Digit Strobe / 1J1-3	4J5-1	BLU/BRN	D1 / Display BCD / 1J3-1
4J1-4	BRN/GRN	ST-5: Display Digit Strobe / 1J1-4	4J5-2	BLU/RED	C1 / Display BCD / 1J3-2
4J1-5	BRN/YEL	ST-4: Display Digit Strobe / 1J1-5	4J5-3	BLU/ORG	B1 / Display BCD / 1J3-3
4J1-6	BRN/ORG	ST-3: Display Digit Strobe / 1J1-6	4J5-4	BLU/YEL	A1 / Display BCD / 1J3-4
4J1-7	BRN/RED	ST-2: Display Digit Strobe / 1J1-7	4J5-5	BLU/GRN	D2 / Display BCD / 1J3-5
4J1-8	Key Pin	No Connection	4J5-6	Key Pin	No Connection
4J1-9	BRN/BLK	ST-1: Display Digit Strobe / 1J1-9	4J5-7	BLU/BLK	C2 / Display BCD / 1J3-7
			4J5-8	BLU/VIO	B2 / Display BCD / 1J3-8
			4J5-9	BLU/GRY	A2 / Display BCD / 1J3-9
4J2-1	VIO/GRY	ST-16: Digit Display Strobe / 1J2-1			
4J2-2	VIO/BLK	ST-15: Display Digit Strobe / 1J2-2	4J7-1	ORG	Display Power: -100V dc / 3J5-3
4J2-3	VIO/BLU	ST-14: Display Digit Strobe / 1J2-3	4J7-2	---	No Connection
4J2-4	VIO/GRN	ST-13: Display Digit Strobe / 1J2-4	4J7-3	BRN	Display Power: +100V dc / 3J5-4
4J2-5	VIO/YEL	ST-12: Display Digit Strobe / 1J2-5	4J7-4	Key Pin	No Connection
4J2-6	VIO/ORG	ST-11: Display Digit Strobe / 1J2-6	4J7-5	BLK	Ground / 3J5-1
4J2-7	Key Pin	No Connection	4J7-6	GRY	Power: +5V dc / 3J5-6
4J2-8	VIO/RED	ST-8: Display Digit Strobe / 1J2-8			
4J2-9	VIO/BRN	ST-9: Display Digit Strobe / 1J2-9			

SYSTEM-11B CPU INTERBOARD SIGNALS

Connector	Wire Color	Signal Designation/Description	Connector	Wire Color	Signal Designation/Description
1J1-1	BRN/GRY	ST-8: Display Digit Strobe / 4J3-1	1J2-1	VIO/GRY	ST-16: Display Digit Strobe / 4J4-1
1J1-2	BRN/VIO	ST-7: Display Digit Strobe / 4J3-2	1J2-2	VIO/BLK	ST-15: Display Digit Strobe / 4J4-2
1J1-3	BRN/BLU	ST-6: Display Digit Strobe / 4J3-3	1J2-3	VIO/BLU	ST-14: Display Digit Strobe / 4J4-3
1J1-4	BRN/GRN	ST-5: Display Digit Strobe / 4J3-4	1J2-4	VIO/GRN	ST-13: Display Digit Strobe / 4J4-4
1J1-5	BRN/YEL	ST-4: Display Digit Strobe / 4J3-5	1J2-5	VIO/YEL	ST-12: Display Digit Strobe / 4J4-5
1J1-6	BRN/ORG	ST-3: Display Digit Strobe / 4J3-6	1J2-6	VIO/ORG	ST-11: Display Digit Strobe / 4J4-6
1J1-7	BRN/RED	ST-2: Display Digit Strobe / 4J3-7	1J2-7	Key Pin	No Connection
1J1-8	Key Pin	No Connection	1J2-8	VIO/RED	ST-10: Display Digit Strobe / 4J4-8
1J1-9	BRN/BLK	ST-1: Display Digit Strobe / 4J3-9	1J2-9	VIO/BRN	ST-9: Display Digit Strobe / 4J4-9
1J3-1	BLU/BRN	D1 / Display BCD / 4J5-1	1J4-1	VIO	Lamp +18V dc Power
1J3-2	BLU/RED	C1 / Display BCD / 4J5-2	1J4-2	VIO	"
1J3-3	BLU/ORG	B1 / Display BCD / 4J5-3	1J4-3	Key Pin	No Connection
1J3-4	BLU/YEL	A1 / Display BCD / 4J5-4	1J4-4	---	No Connection
1J3-5	BLU/GRN	D2 / Display BCD / 4J5-5	1J4-5	---	No Connection
1J3-6	Key Pin	No Connection	1J4-6	---	No Connection
1J3-7	BLU/BLK	C2 / Display BCD / 4J5-7	1J4-7	---	No Connection
1J3-8	BLU/VIO	B2 / Display BCD / 4J5-8	1J4-8	VIO	Lamp +18V dc Power
1J3-9	BLU/GRY	A2 / Display BCD / 4J5-9	1J4-9	VIO	"
1J3-10	---	No Connection			
1J3-11	---	No Connection			
1J3-12	---	No Connection			
1J5-1	---	No Connection	1J6-1	RED/BRN	Lamp Row 1 (Q80)
1J5-2	Key Pin	No Connection	1J6-2	RED/BLK	Lamp Row 2 (Q81)
1J5-3	BLK	Ground (Lamp Ckt)	1J6-3	RED/ORG	Lamp Row 3 (Q82)
1J5-4	BLK	Ground (Lamp Ckt)	1J6-4	Key Pin	No Connection
1J5-5	---	No Connection	1J6-5	RED/YEL	Lamp Row 4 (Q83)
1J5-6	---	No Connection	1J6-6	RED/GRN	Lamp Row 5 (Q84)
1J5-7	---	No Connection	1J6-7	RED/BLU	Lamp Row 6 (Q85)
1J5-8	---	No Connection	1J6-8	RED/VIO	Lamp Row 7 (Q86)
1J5-9	BLK	Ground (Lamp Ckt)	1J6-9	RED/GRY	Lamp Row 8 (Q87)
1J7-1	YEL/BRN	Lamp Col 1 (Q65/66)	1J8-1	GRN-BRN	Switch Col 1 (Q45)
1J7-2	YEL/RED	Lamp Col 2 (Q63/64)	1J8-2	GRN-RED	Switch Col 2 (Q49)
1J7-3	YEL/ORG	Lamp Col 3 (Q61/62)	1J8-3	GRN-ORG	Switch Col 3 (Q44)
1J7-4	YEL/BLK	Lamp Col 4 (Q59/60)	1J8-4	GRN-YEL	Switch Col 4 (Q48)
1J7-5	Key Pin	No Connection	1J8-5	GRN-BLK	Switch Col 5 (Q43)
1J7-6	YEL/GRN	Lamp Col 5 (Q57/58)	1J8-6	Key Pin	No Connection
1J7-7	YEL/BLU	Lamp Col 6 (Q55/56)	1J8-7	GRN-BLU	Switch Col 6 (Q47)
1J7-8	YEL/VIO	Lamp Col 7 (Q53/54)	1J8-8	GRN-VIO	Switch Col 7 (Q42)
1J7-9	YEL/GRY	Lamp Col 8 (Q51/52)	1J8-9	GRN-GRY	Switch Col 8 (Q46)
1J10-1	WHT/GRY	Switch Row	1J9		Not Applicable
1J10-2	WHT/VIO	Switch Row			
1J10-3	WHT/BLU	Switch Row			
1J10-4	Key Pin	No Connection			
1J10-5	WHT/GRN	Switch Row			
1J10-6	WHT/YEL	Switch Row			
1J10-7	WHT/ORG	Switch Row			
1J10-8	WHT/RED	Switch Row			
1J10-9	WHT/BRN	Switch Row			
1J12-1	BRN/BLK	Solenoid 9 (Q17) / 5J2-9	1J13-1	BLK	Solenoid Ground / 5J10-1
1J12-2	BRN/RED	Solenoid 10 (Q9) / 5J2-8	1J13-2	BLK	" / 5J10-2
1J12-3	Key Pin	No Connection	1J13-3	BLK	" / 5J10-3
1J12-4	BRN/ORG	Solenoid 11 (Q16) / 5J2-6	1J13-4	BLK	" / 5J10-4
1J12-5	BRN/YEL	Solenoid 12 (Q8) / 5J2-5			
1J12-6	BRN/GRN	Solenoid 13 (Q15) / Mys. Whl Mtr Cntrl	1J14-1	BLK/RED	Memory Protect / 7J1-4
1J12-7	BRN/BLU	Solenoid 14 (Q7) / Mys. Whl Mtr Cntrl	1J14-2	WHT	Ground / 7J1-3
1J12-8	BRN/VIO	Solenoid 15 (Q14) / 5J2-2	1J14-3	GRN	ADVANCE Switch / 7J1-1
1J12-9	BRN/GRY	Solenoid 16 (Q6) / 5J2-1	1J14-4	BLU	AUTOMANUAL Switch / 7J1-2
1J16-1	FED	Volume Control Input / 11J1-1	1J17-1	BLK	Ground / 3J6-11
1J16-2	---	No Connection	1J17-2	BLK	" / 3J6-12
1J16-3	Key Pin	No Connection	1J17-3	BLK	" / 3J6-13
1J16-4	WHT	Signal Ground - CPU / 11J1-4	1J17-4	GRY	Power: +5V dc / 3J6-7
			1J17-5	GRY	" / 3J6-8
			1J17-6	GRY	" / 3J6-9
			1J17-7	Key Pin	No Connection
			1J17-8	BLK/WHT	Power: -12V dc Unreg / 3J6-2
			1J17-9	WHT/GRY	Power: +12V dc Unreg / 3J6-6
1J18-1	---	No Connection	1J19-1	ORN/VIO	Flipper Ground
1J18-2	ORN/BLK	Spl Solnd Sv 3	1J19-2	ORN/GRY	Flipper Ground
1J18-3	ORN/RED	Spl Solnd Sv 2	1J19-3	BLU/ORN	Spl Solnd 3 (Q73) / 5J3-3
1J18-4	ORN/YEL	Spl Solnd Sv 4	1J19-4	BLU/RED	Spl Solnd 2 (Q71) / 5J3-6
1J18-5	ORN/BRN	Spl Solnd Sv 1	1J19-5	Key Pin	No Connection
1J18-6	Key Pin	No Connection	1J19-6	BLU/YEL	Spl Solnd 4 (Q69) / 5J3-4
1J18-7	WHT	Spl Solnd Sv Ground	1J19-7	BLU/BRN	Spl Solnd 1 (Q75) / 5J3-7
1J18-8	ORN/GRN	Spl Solnd Sv 5	1J19-8	BLU/GRN	Spl Solnd 5 (Q77) / 5J3-2
1J18-9	ORN/BLU	Spl Solnd Sv 6	1J19-9	BLU/BLK	Spl Solnd 6 (Q79) / 5J3-1
1J21		Ribbon Cable to Audio Board 11J1			
1J22		Ribbon Cable to Master Display Board 4J3			

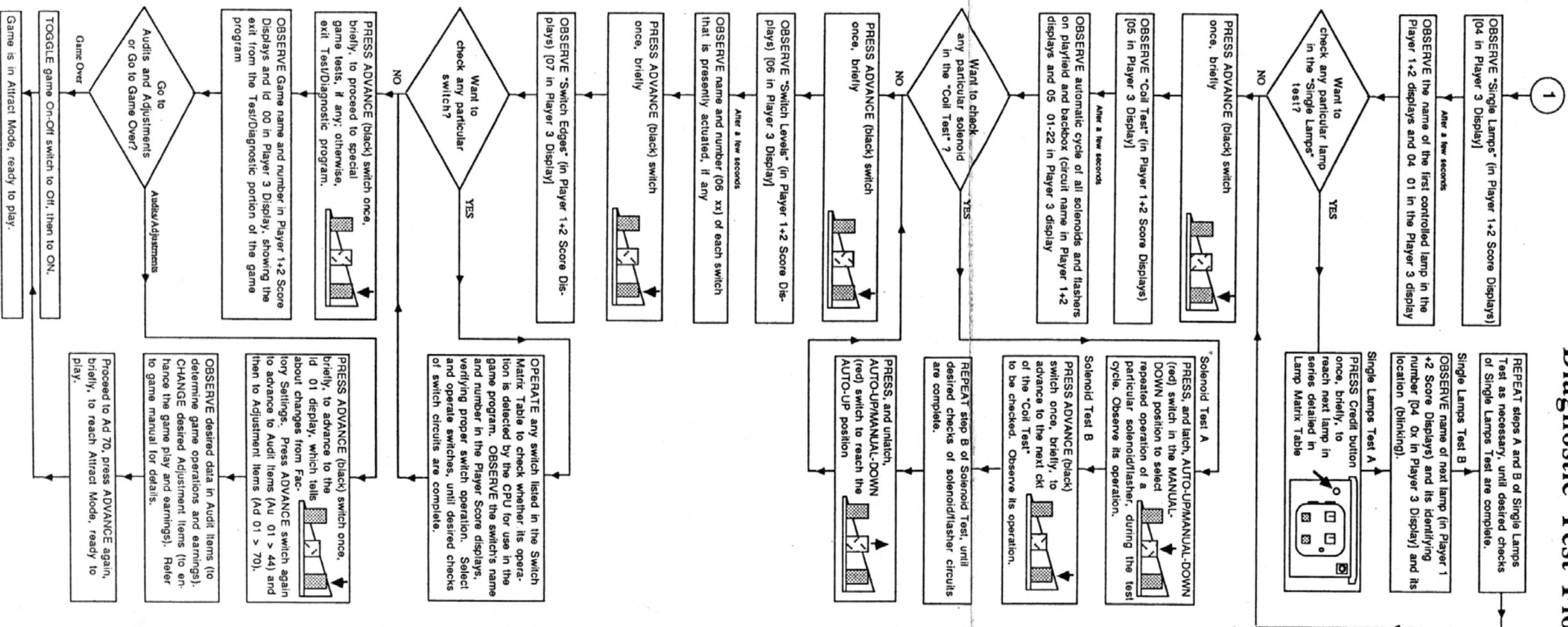


Backbox



Speaker/Display Panel

GAME CIRCUIT BOARDS INTERBOARDS SIGNALS



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

Black Knight 2000 Switch-Matrix Table

COLUMN ROW	1 Q45 GRN-BRN 1J8-1	2 Q49 GRN-RED 1J8-2	3 Q44 GRN-ORN 1J8-3	4 Q48 GRN-YEL 1J8-4	5 Q43 GRN-BLK 1J8-5	6 Q47 GRN-BLU 1J8-7	7 Q42 GRN-VIO 1J8-8	8 Q46 GRN-GRY 1J8-9
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 (1) 49	Flipper Right 57
2 WHT-RED 1J10-8	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 (2) 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 (3) 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 (4) 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 (1) 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 (2) 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

WARNINGS & NOTICES

WARNING

FOR SAFETY AND RELIABILITY, *WILLIAMS ELECTRONICS GAMES* does not recommend or authorize any substitute parts or modifications of *WILLIAMS'* equipment. Use of Non-*WILLIAMS'* parts, or modifications of game circuitry, may adversely affect game play, or may cause injuries.

SUBSTITUTE PART OR EQUIPMENT MODIFICATIONS may void FCC Type Acceptance.

BECAUSE THIS GAME IS PROTECTED by Federal copyright, trademark, and patent laws, unauthorized game conversions may be illegal under Federal law.

THIS 'CONVERSION' PRINCIPLE ALSO APPLIES to unauthorized facsimiles of *WILLIAMS'* equipment, logos, designs, publications, assemblies, and games (or game features not deemed to be in the public domain), whether manufactured with *WILLIAMS'* components or not.

WARNING

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

WARNING

FCC STICKER. Check the back of your **Black Knight 2000** game to verify that an FCC-certification sticker was attached to your game at the factory.

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

Black Knight 2000, Magna Save, and MULTI-BALL are trademarks of *WILLIAMS ELECTRONICS GAMES, INC.*

FOR SERVICE...

CALL your authorized
WILLIAMS' Distributor.

Williams[®] 
ELECTRONICS GAMES, INC.
3401 N. California Avenue
Chicago, IL 60618

WARNING: Transport this game ONLY with hinged backbox down!