Williams ELECTRONICS, INC.

16P-500-103
Game No. 500
December, 1980

Black Knight

INSTRUCTION BOOKLET

This booklet provides game operation, bookkeeping, game adjustment, and diagnostic and self-test procedures for BLACK KNIGHT. For installation information refer to the blue-covered game manual. For detailed information refer to Williams Solid State Flipper maintenance Manual.

SPECIAL CONSIDERATIONS WHEN REPLACING CIRCUIT BOARDS

CPU Board

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

Driver Board

Either earlier model D 7997 or later model D 8341 boards may be used. When earlier boards are used, switch matrix series resistors R196 thru R211 must be zero-ohm or be replaced with wire jumpers. Later D 8341 boards do not use series resistors in the switch matrix.

Sound Board

1. D 8224 required for speech
2. Must be jumpered for white-labeled sound ROM operation and be equipped with Sound ROM 5. (Jumpers W2, W5, W7, W9, W10, W12, and W15 connected; W3, W4, W6, W8, W11, and W13 removed).

Power Supply Board

1. When transformer is mounted in cabinet, D 8345 board (equipped with relay) is required. When transformer is mounted in backbox, earlier D 7999 board is required.
2. F4 (20A SB) for flipper solenoids and magnets must be installed.

Display Boards

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

Optional Speech Module

Requires 5T5001 (IC7), 5T5002 (IC5), 5T5003 (IC6), and 5T5004 (IC4) Speech ROMs.

GAME OPERATION

*Indicates adjustable features.

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

Multi-Ball **and** ***Magna-Save*** **are trademarks of Williams Electronics, Inc.**

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

Game Start - Three balls must be resting on ball ramp, locking mechanism, or ball shooter switches (maximum of one ball in ball shooter trough) before game will start. Push credit button, startup tune played, ball served, credit display reduced by 1, player 1 score flashes 00 until first scoring switch is made, ball in play shows 1. Pushing credit button before ball 2 displayed allows additional players.

Bonus Advance - The bonus is advanced (from 1,000 to 49,000) one time by making left ramp rollover, twice by making left and right inside rollovers or outlanes, three times by completing a bank of drop targets, and five times by making left or right inside rollovers as a result of ***Magna-Save***™ feature. With bonus at maximum and multiplier at 5x, completing a bank of drop targets or making one of the advance switches scores 5,000. Bonus multipliers are advanced from 2X to 5X by making the Turnaround.

Magna-Save **Feature*** - Completing a drop target 3-bank while associated lamp is still flashing scores 10,000, lights a target arrow, and lights a magnet. If the associated lamp goes out before the bank is completed, the bank is reset. With a magnet lamp lit, operating the corresponding ***Magna-Save*** button on the side of the cabinet energizes the magnet for a *few seconds and a ball held stationary by the magnet will tend to go through the inside rollover.

Mystery and Spinner - Making the left inside rollover flashes the right ramp rollunder for a mystery value. Making the rollunder while still flashing awards the mystery value which will be indicated on other player display(s). Making the right inside rollover flashes the spinner.

Multi-Ball™ **Play** - Making a ball in the lock mechanism when a lock arrow is flashing, lights a lock arrow steadily and lights the lower playfield eject hole. Locking three balls in the mechanism or making the eject hole when lit releases the balls from the mechanism. All scoring and mystery values are tripled while three balls are in play and doubled while two balls are in play. Lock arrows do not flash until turnaround is made.*

Extra Ball - A maximum of four * Extra Balls may be accumulated at one time. Spotting three arrows for both top and/or* both bottom banks lights the left ramp rollover for the first possible extra ball. Spotting all 3-bank arrows lights the Turnaround for the second possible Extra Ball. Spotting all 3-bank arrows alternately lights the left ramp rollover and Turnaround for additional Extra Balls. Making left ramp rollover or Turnaround when lit awards an Extra Ball.

Last Chance* - With locked balls on the last ball of the game, the left and right outside rollovers are lit for a "last chance." Making the rollover when lit releases any locked balls (no ***Multi-Ball*** scoring). If Extra Ball(s) is won during "last chance", the rollovers are not relit.

Bonus Ball* - With two or more players, a player with the highest score is awarded a bonus ball*. All three balls are released and play is allowed for 30* seconds with both magnet lamps lit. There is no ***Multi-Ball*** or mystery scoring or playfield Extra Ball feature during the bonus ball. Extra Balls won from Special or high score levels are awarded as additional bonus balls.

Special - Completing all four drop target 3-banks during the bonus ball lights the Turnaround for a possible Special. Making the Turnaround when lit awards a Special.

Memory - 3-bank drop target arrows, locked balls, magnet lamps, and Extra Ball lamps.

Tilt - Ball in play tilted on first closure of ball roll tilt and third* closure of Plumb Bob and playfield tilts. Slam tilt return game to game over.

End of Game - Match Digits* appears in ball in play display, *credit awarded for match. Exceeding high score to date awards *three credits. Match, High Score to Date, and Game Over sounds made as appropriate. A new game cannot be started with more than one ball resting in the ball shooter trough; excess balls must be returned to the playfield and rest on the ball ramp switches.

With Speech Module, the following phrases are produced during game play.

Game start, add players 2, 3, and 4; Random phrase:

Defend thyself, Knight.
I challenge thee to fight me.
You cannot fight and win.
I will slay you, my enemy.
The BLACK KNIGHT will win again.
The BLACK KNIGHT will slay you.
Fight against me, the BLACK KNIGHT.
I will slay thee, Knight.

Achievement	Response
2-ball ***Multi-ball*** Play	Fight against 2 enemies.
3-ball ***Multi-ball*** Play	Fight against 3 enemies.
Magna-Save drain	Laughter.
Win free game	I cannot slay you. You win.
Win Extra Ball	Fight me again, Knight.
**After last regular ball:	
1-player	One enemy cannot fight the BLACK KNIGHT again.
2-,3-, or 4-players	You win the right to fight the BLACK KNIGHT again.
High Score to Date	You win one fight. I challenge thee again.
Match	The BLACK KNIGHT will win again.
Game Over	Will you challenge the BLACK KNIGHT again?

**Produced only if "Bonus Ball" enabled.

BOOKKEEPING AND GAME EVALUATION

(Functions 01-17)

1. Set AUTO-UP/MANUAL-DOWN switch to AUTO-UP and depress ADVANCE pushbutton. Test 04 is indicated in the credits display, Function 00 in Match display, and Game Identification in Player 1 display.
2. Operate the ADVANCE pushbutton to display Functions 01 thru 04 on the Match display (See Table 1) and record the corresponding totals (number of coins and total paid credits) from the Player 1 display. (To review a total that has been advanced past, set switch to MANUAL-DOWN and operate the ADVANCE pushbutton).
3. Operate the ADVANCE pushbutton to display Functions 05, 06, and 07 in the Match display and record the corresponding free credit totals from the Player 1 display.
4. Operate the ADVANCE pushbutton to display Function 08 in the Match display. Total credits is indicated in the Player 1 display, total free credits in the Player 2 display, and percentage of free credits in the Player 4 display.

Table 1. Audit Totals

	DESCRIPTION		
FUNCTION	PLAYER 1	PLAYER 2	PLAYER 4
00	Game Identification (2500 2)	—	—
01	Coins, Left chute	—	—
	(closest to coin door hinge)	—	—
02	Coin, center chute	—	—
03	Coin, right chute	—	—
04	Total Paid Credits	—	—
05	Special Credits	—	—
06	Replay Score Credits	—	—
07	Match Credits	—	—
08	Total Credits	Free Credits	% Free Credits
09	Total Extra Balls	—	—
10	Ball Time in Minutes	—	—
11	Total Balls Played	—	—
12	Current High Score to Date	—	—
13	Backup High Score to Date	High Score to Date Credits Awarded	—
14	Replay 1 Score	Times exceeded	—
15	Replay 2 Score	Times exceeded	—
16	Replay 3 Score	Times exceeded	—
17	Replay 4 Score	Times exceeded	—

5. Operate the ADVANCE pushbutton to display Function 09 thru 12 in the Match display and record the corresponding totals from the Player 1 display.
6. Operate the ADVANCE pushbutton to display Functions 13 thru 17 in the Match display and record the corresponding totals from the **Player 2** display.
7. With switch set to MANUAL-DOWN operate ADVANCE to display Function 50 in the Match Display. From Function 50 you can return to game over or zero audit totals and return to game over. Perform step 8.a. or 8.b. as desired.
8. a. To return to game over, set the switch to AUTO-UP and depress ADVANCE.
   b. **To zero audit totals** and return to game over set switch to AUTO-UP, operate the credit button to display 35 in the Player 1 display, and depress ADVANCE.

GAME ADJUSTMENT PROCEDURE
(Functions 13-41)

Coin door must be open to change settings.

1. Set AUTO-UP/MANUAL-DOWN switch to AUTO-UP and depress ADVANCE pushbutton. Test 04 is indicated in the Credits display, Function 00 in Match display, and game identification in Player 1 display.
2. **To raise** Function number in Match display, operate ADVANCE pushbutton with switch set to AUTO-UP. **To lower** Function number operate ADVANCE with it set to MANUAL-DOWN.
3. With desired Function indicated in Match display, **raise** value in player 1 display by operating credit button with switch set to AUTO-UP; **lower** value by operating credit button with it set to MANUAL-DOWN. Value left in Player 1 display is new setting. For values see Table 2 and (for pricing) Table 3.
4. Repeat sets 2 and 3 until all required adjustments have been made.
5. Operate ADVANCE until Function 50 is indicated in Match display. From Function 50 you can return to game over or **restore factory settings**. Perform step 6 or 7 as desired.
6. To return to game over, depress ADVANCE with switch set to AUTO-UP.
7. To restore factory settings **and** zero audit totals:
   a. Operate Credit button with switch set to AUTO-UP until 45 is indicated in Player 1 Display.
   b. Depress ADVANCE. The game returns to Test 04, Function 00.
   c. Set switch to MANUAL-DOWN and depress ADVANCE to indicate Function 50.
   d. Set switch to AUTO-UP and depress ADVANCE.

RESETTING HIGH SCORE TO DATE
1. Using game adjustment procedure, set Function 13 to the desired reset value.
2. Depress HIGH SCORE RESET pushbutton.

FACTORY AUDIT TOTALS
(Functions 42-49)

The following factory audit functions are assigned:

42 - Total "Last Chance" won
43 - Total times ***Multi-ball*** achieved
44 - Total times "Mystery" score won
45 - Total "Bonus" balls awarded
49 - Number of Auto Cycle Test Passes.

Table 2. Game Adjustments

FUNCTION	DESCRIPTION	NOTES	*FACTORY SETTING
13	Backup High Score to Date [HSTD Credits Awarded]	1	2,500,000
14	Replay 1 Score [Times exceeded]	2	1,000,000
15	Replay 2 Score [Times exceeded]	2	2,000,000
16	Replay 3 Score [Times exceeded]	2	0
17	Replay 4 Score [Times exceeded]	2	0
18	Maximum Credits	3	30
19	Standard and Custom Pricing Control (00-08)	4	01/03
20	Left Coin Slot Multiplier	4	03/09
21	Center Coin Slot Multiplier	4	12/45
22	Right Coin Slot Multiplier	4	03/18
23	Coin Units Required for Credit	4	04/05
24	Coin Units Bonus Point	4	15/45
25	Minimum Coin Units	4	00
26	Match: 00 = Match ON; 01 = Match OFF	—	00
27	Special: 00 = Awards Credit; 01 = Awards Bonus Ball; 02 = Awards Points	—	00
28	Replay Scores: 00 = Awards Credit; 01 = Awards Extra Ball or Bonus Ball	—	00
29	Maximum Plumb Bob Tilts	—	03
30	Number of Balls(03 or 05)	—	03
31	***Magna-Save*** Feature: 03-09 = on time in seconds	5	05
32	Attract Mode Sound; 00 = ON; 01 = OFF	—	00
33	Drop Target Timing: 00-09 = 6-15 seconds	—	03
34	"Bonus Ball" Time: 00 = not allowed; 01-99 = Time in seconds	—	30
35	Bell: 00 = Bell OFF; 01 Bell ON	—	01
36	Extra Ball Difficulty 00 = 1st EB from pair of drop target banks 01 = All EBs from four drop target banks	—	00
37	Multi-Ball Difficulty: 00 = Liberal; 01 = Moderate	—	00
38	Locked Ball lamps: 00 = Memory; 01 = No Memory	—	01
39	Background Sound: 01 = ON; 00 = OFF	—	01
40	High Score Credits	1	03
41	Maximum Extra Balls at one time (00 = No Extra Ball)	—	04

* Second Factory Setting value is with jumper W25 connected.

[ ] Description in brackets shown in Player 2 Display.

1. Function 13 may be set to any multiple of 100,000 points. Setting Function 40 to zero with Function 13 set to any score but zero permits the High Score to Date feature to operate but no credits are awarded.
2. Functions 14-17 (Replay Scores) may be set to any multiple of 100,000 points. Setting a function to zero disables the replay score point.
3. Setting Maximum Credits (Function 18) to zero places the game in a free play mode.
4. With Function 19 set to 00, Functions 20-25 must be set manually. Refer to Table 2 for eight standard pricing schemes (selected by values of 01-08 for Function 19) and custom pricing values.
5. Magnets always enabled during "Bonus Ball".

RECOMMENDED SCORE LEVELS

CREDIT GAMES

3-Ball: *1,000,000; 2,000,000
5-Ball: 2,000,000; 3,000,000

EXTRA BALL

3-Ball: 700,000
5-Ball: 1,000,000

*Factory Setting

Table 3. Standard and Custom Price Settings

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

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

DIAGNOSTIC PROCEDURES

Display Digits Test

1. Set AUTO-UP/ to MANUAL-DOWN switch and depress ADVANCE. Displays should indicate all 0's.
2. Set the switch to AUTO-UP. Displays should sequence from all 0's thru all 9's. Comma segments should come on when odd digits are displayed.
3. To stop cycling, set switch to MANUAL-DOWN. Operate ADVANCE pushbutton to step tests one number at a time. Set switch to AUTO-UP to resume cycling.

Sound Test

1. From Display Digits Test depress ADVANCE with the switch set to AUTO-UP. Test 00 should be indicated in the number of Credits display and the Match display sequences from 00 thru 06. Different sounds should be produced for 00, 01, 02, 03, and 04.
2. To continuously pulse a single sound, set the toggle switch to MANUAL-DOWN. Operate ADVANCE pushbutton to sequence through sounds one at a time. Set toggle switch to AUTO-UP to resume sequencing.

Lamp Test

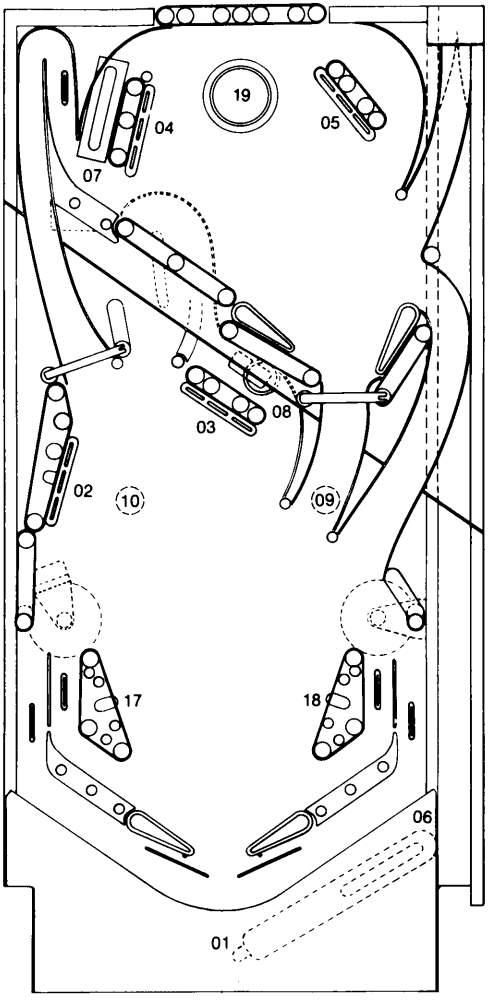
From Sound Test depress ADVANCE with the switch set to AUTO-UP Test 01 should be indicated in the Credits display and all multiplexed lamps should flash.

ROW \ COLUMN	1 YEL-BRN 2J5-8	2 YEL-RED 2J5-9	3 YEL-ORN 2J5-6	4 YEL-BLK 2J5-7	5 YEL-GRN 2J5-3	6 YEL-BLU 2J5-5	7 YEL-VIO 2J5-1	8 YEL-GRY 2J5-2
1 RED-BRN 2J7-1	SAME PLAYER SHOOTS AGAIN	RIGHT *MAGNA-SAVE*™ LAMP	BOTTOM LEFT 3-BANK LAMP	BOTTOM LEFT 3-BANK, LOWER ARROW	TOP LEFT 3-BANK LOWER ARROW	LEFT RAMP ROLLUNDER EXTRA BALL WHEN LIT	"2" BONUS	"10" BONUS
2 RED-BLK 2J7-2	BALL IN PLAY	LEFT *MAGNA-SAVE*™ LAMP	BOTTOM RIGHT 3-BANK LAMP	BOTTOM LEFT 3-BANK CENTER ARROW	TOP LEFT 3-BANK CENTER ARROW	LEFT LOCK LAMP	"3" BONUS	"20" BONUS
3 RED-ORN 2J7-3	TILT	LEFT OUTLANE	TOP LEFT 3-BANK LAMP	BOTTOM LEFT 3-BANK UPPER ARROW	TOP LEFT 3-BANK UPPER ARROW	NOT USED	"4" BONUS	"30" BONUS
4 RED-YEL 2J7-4	GAME OVER	RIGHT OUTLANE	TOP RIGHT 3-BANK LAMP	2X SCORING	JET BUMPER	NOT USED	"5" BONUS	"40" BONUS
5 RED-GRN 2J7-5	MATCH	RIGHT SPINNER	CENTER LOCK LAMP	BOTTOM RIGHT 3-BANK, RIGHT ARROW	TOP RIGHT 3-BANK LOWER ARROW	NOT USED	"6" BONUS	2x
6 RED-BLU 2J7-6	HIGH SCORE TO DATE	RAMP ROLLUNDER	TURNAROUND EXTRA BALL WHEN LIT	BOTTOM RIGHT 3-BANK, CENTER ARROW	TOP RIGHT 3-BANK CENTER ARROW	NOT USED	"7" BONUS	3x
7 RED-VIO 2J7-9	CREDITS (PLAY-FIELD)	RIGHT INSIDE ROLLOVER	TURNAROUND SPECIAL	BOTTOM RIGHT 3-BANK, LEFT ARROW	TOP RIGHT 3-BANK UPPER ARROW	SAME PLAYER SHOOTS AGAIN (PLAYFIELD)	"8" BONUS	4x
8 RED-GRY 2J7-8	BONUS BALL TIME	LEFT INSIDE ROLLOVER	LOWER PLAYFIELD EJECT HOLE	3X SCORING	RIGHT LOCK LAMP	"1" BONUS	"9" BONUS	5x

Figure 1. Lamp Matrix

Solenoid Test

1. From Lamp Test depress ADVANCE with the switch set to AUTO-UP. Test 02 should be indicated in the Credits display. Display sequences from 01 thru 25. Corresponding solenoids 01 thru 24 are pulsed. Flipper relay is de-energized with subtest 25.
2. To continuously pulse a single solenoid set switch to MANUAL-DOWN. Operate ADVANCE pushbutton sequence through the solenoids one at a time. Set toggle switch to AUTO-UP to resume sequencing.



Sol. No.	Function
01	Ball Release
02	Lower Left 3-Bank Drop Target Reset
03	Lower Right 3-Bank Drop Target Reset
04	Upper Left 3-Bank Drop Target Reset
05	Upper Right 3-Bank Drop Target Reset
06	Ball Ramp Thrower
07	Multi-Ball Release
08	Lower Eject Hole
09	Right Magnet Relay
10	Left Magnet Relay
*11	Special Relay
12	Not Used
13	Not Used
14	Not Used
15	Bell
16	Coin Lockout
17	Left Kicker
18	Right Kicker
19	Jet Bumper
20	Not Used
21	Not Used
22	Not Used

* Special relay located on Power Supply Board (games with transformer in cabinet) or in backbox (games with transformer in backbox).

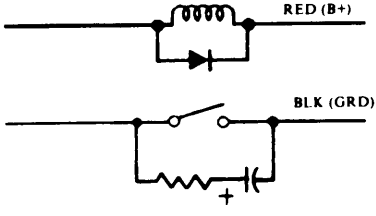
Figure 2. Playfield Solenoid Locations and Solenoid Chart

Table 4. Solenoid Connections

SOL. NO.	FUNCTION	WIRE COLOR	CONNECTIONS	*DRIVER TRANS.	SOLENOID PART NO.
01	Ball Release	GRY-BRN	2P11-4, 8P3-1	Q15 Q7	SA-23-850-DC
02	Lower Left 3-Bank Drop Target Reset	GRY-RED	2P11-5, 8P3-2	Q17 Q8	SA3-23-850-DC
03	Lower Right 3-Bank Drop Target Reset	GRY-ORN	2P11-7, 8P3-3	Q19 Q9	SA3-23-850-DC
04	Upper Left 3-Bank Drop Target Reset	GRY-YEL	2P11-8, 8P3-4	Q21 Q10	SA3-23-750-DC
05	Upper Right 3-Bank Drop Target Reset	GRY-GRN	2P11-9, 8P3-5	Q23 Q11	SA3-23-750-DC
06	Ball Ramp Thrower	GRY-BLU	2P11-3, 8P3-6	Q25 Q14	SG-23-750-DC
07	Multi-Ball Release	GRY-VIO	2P11-2, 8P3-7	Q27 Q15	SG-23-750-DC
08	Lower Eject Hole	GRY-BLK	2P11-1, 8P3-8	Q29 Q16	SG-23-750-DC
*09	Right Magnet Relay	BRN-BLK	2P9-9, 10P3-9	Q31 Q13	SM-35-4000-DC
*10	Left Magnet Relay	BRN-RED	2P9-7, 10P3-10	Q33 Q12	SM-35-4000-DC
11	Special Relay	BRN-ORN	2P9-1, 10P3-11	Q35 Q17	SA-24-750-DC
12	Not Used	BRN-YEL	2P9-2, 10P3-12	Q37 Q18	–
13	Not Used	BRN-GRN	2P9-3, 10P3-13	Q39 Q19	–
14	Not Used	BRN-BLU	2P9-4, 7P1-16	Q41 Q20	–
15	Bell	BRN-VIO	2P9-5, 7P1-17	Q43 Q21	SM29-1000-DC
16	Coin Lockout	BRN-GRY	2P9-6, 7P1-18, 7P2-4	Q45 Q22	SM-35-4000-DC
*17	Left Kicker	BLU-BRN	2P12-7, 8P3-17	Q2 Q1	SG-23-850-DC
*18	Right Kicker	BLU-RED	2P12-4, 8P3-18	Q4 Q5	SG-23-850-DC
*19	Jet Bumper	BLU-ORN	2P12-3, 8P3-19	Q6 Q4	SG-23-850-DC
*20	Not Used	BLU-YEL	2P12-6, 8P3-20	Q8 Q6	–
*21	Not Used	BLU-GRN	2P12-8, 8P3-21	Q10 Q2	–
*22	Not Used	BLU-BLK	2P12-9, 8P3-22	Q12 Q3	–
*	Lower Right Flipper	BLU-VIO	7P1-8,8P3-3	–	SFL-19-400 30-750-DC
	Upper Right Flipper	BLK-YEL	7P1-31, 8P3-5	–	SFL-19-400 30-750-DC
*	Lower Left Flipper	BLU-GRY	7P1-10, 8P3-4	–	SFL-19-400 30-7 50-DC
*	Upper Left Flipper	BLK-GRY	7P1-30, 8P3-9		SFL-19-400 30-750-DC

***NOTES:**

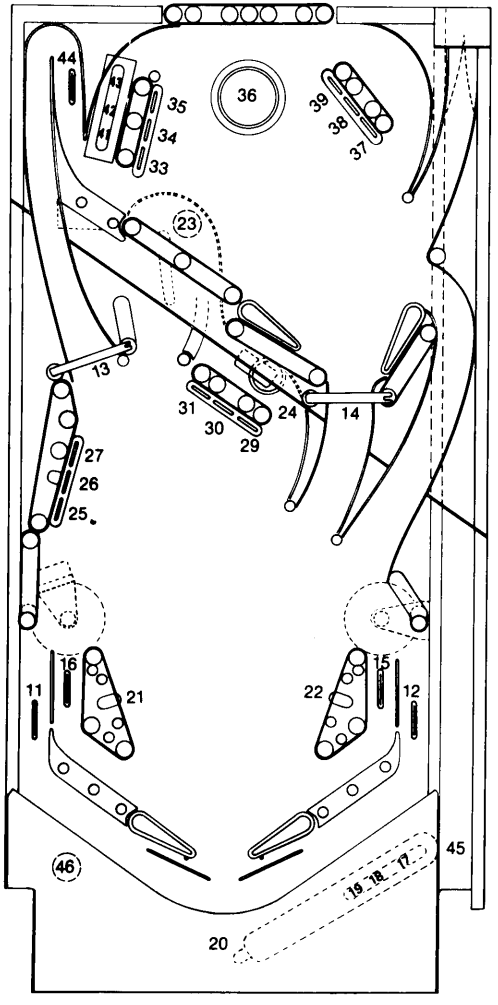
1. First reference no. for D7997 (earlier) Driver Board; 2nd is for D8341 Driver Board.
2. Contacts of solenoids 09 and 10 switch ground to magnets (Part No. 20-8991)
3. Special switch connections for solenoids 17 through 19 are as follows:
   17 — ORN-BRN — 2P13-5, 8P3-5
   18 — ORN-RED — 2P13-3, 8P3-6
   19 — ORN-BLK — 2P13-2, 8P3-7
4. Flipper button connections are as follows:
   Right — ORN-VIO — 2P12-1, 7P1-7
   Left — ORN-GRY — 2P12-2, 7P1-9
5. Typical wiring for solenoids and special switches:



Switch Test

1. From Solenoid Test depress ADVANCE with the switch set to AUTO-UP. Test 03 should be indicated in the Credits display and any stuck switches in the Master display. As stuck switch(es) is displayed a sound is produced. The display continuously cycles through the stuck switches and as they are opened, the number is removed from the sequence. When all switches are open, the Match display is blank and the sounds stop.
2. If all switches in a row are displayed, first verify that all are open and then check for a short to ground on the row wire.

3. Operate switches; a sound is produced and switch number is momentarily indicated in the ball in play display. If two switches in a row are indicated with one switch closed, check for a short between the column wires; for multiple indication check column wire for short to ground. If two switches in a column are indicated with one switch closed, check for short between row wires.
4. If proper indications are obtained in Test 03 but matrix problem is suspected in game play, disconnect lamp connectors 2P5 and 2P7. Recheck in game play. Perform CPU Self-Test if problem remains. If problem is cleared, check for short between lamp matrix and jet bumper mounting brackets.
5. Shorted diodes can cause "rectangle" switch matrix problems as follows: Lower left 3-bank right target down, (switch 27) lower right 3-bank center target down (switch 30) and as ball enters the lockup trough making switch 43, a shorted diode at switch 27 would cause switch 46, Playfield Tilt, to be indicated. Note that the "rectangle" is always completed with an incorrect switch diagonally opposite from the switch with the shorted diode.



Switch No.	Function (Score)
01	Plumb Bob Tilt
02	Ball Roll Tilt
03	Credit Button
04	Right Coin Switch
05	Center Coin Switch
06	Left Coin Switch
07	Slam Tilt
08	High Score Reset
09	Right Magnet Button
10	Left Magnet Button
11	Left Outlane (5,000)
12	Right Outlane (5000)
13	Spinner (100/2,500*)
14	Right Ramp Rollunder (500/Mystery)
15	Right Inside Rollover (2,000/10,000**)
16	Left Inside Rollover (2,000/10,000**)
17	Right Ball Ramp
18	Center Ball Ramp
19	Left Ball Ramp
20	Outhole
21	Left Kicker (10)
22	Right Kicker (10)
23	Turnaround (5,000)
24	Lower Playfield Eject Hole (5,000)
25	Lower Left 3-Bank, Lower Target (1,000)
26	Lower Left 3-Bank, Center Target (1,000)
27	Lower Left 3-Bank, Upper Target (1,000)
28	Not Used
29	Lower Right 3-Bank, Right Target (1,000)
30	Lower Right 3-Bank, Center Target (1,000)
31	Lower Right 3-Bank, Left Target (1,000)
32	Not Used
33	Top Left 3-Bank, Lower Target (1,000)
34	Top Left 3-Bank, Center Target (1,000)
35	Top Left 3-Bank, Upper Target (1,000)
36	Jet Bumper (500)
37	Top Right 3-Bank, Lower Target (1,000)
38	Top Right 3-Bank, Center Target (1,000)
39	Top Right 3-Bank, Upper Target (1,000)
40	Not Used
41	Lockup Trough, Bottom (5,000‡)
42	Lockup Trough, Center (5,000‡)
43	Lockup Trough, Top (5,000‡)
44	Left Ramp Rollover (5,000)
45	Ballshooter Trough
46	Playfield Tilt

Note: Second value is lit or flashing value
*Spinner lit for interval after making right inside rollover
Mystery is 20,000 - 99,000 and lit for interval after making left inside rollover
Inside rollovers light when made after using ***Magna-Save* feature
‡Only one lockup trough switch scores for each locked-up ball

Figure 3. Playfield Switch Locations and Switch Chart

ROW \ COLUMN	1 GRN-BRN 2J2-9	2 GRN-RED 2J2-8	3 GRN-ORN 2J2-7	4 GRN-YEL 2J2-6	5 GRN-BLK 2J2-5	6 GRN-BLU 2J2-3	7 GRN-VIO 2J2-2	8 GRN-GRY 2J2-1
1 WHT-BRN 2J3-9	PLUMB BOB TILT 1	RIGHT MAGNET BUTTON 9	RIGHT BALL RAMP 17	LOWER LEFT 3-BANK, LOWER TARGET 25	TOP LEFT 3-BANK LOWER TARGET 33	LOCKUP TROUGH, BOTTOM 41	NOT USED 49	NOT USED 57
2 WHT-RED 2J3-8	BALL ROLL TILT 2	LEFT MAGNET BUTTON 10	CENTER BALL RAMP TARGET 18	LOWER LEFT 3-BANK, CENTER TARGET 26	TOP LEFT 3-BANK CENTER TARGET 34	LOCKUP TROUGH, CENTER 42	NOT USED 50	NOT USED 58
3 WHT-ORN 2J3-7	CREDIT BUTTON 3	LEFT OUTLANE 11	LEFT BALL RAMP 19	LOWER LEFT 3-BANK, UPPER TARGET 27	TOP LEFT 3-BANK UPPER TARGET 35	LOCKUP TROUGH, TOP 43	NOT USED 51	NOT USED 59
4 WHT-YEL 2J3-6	RIGHT COIN SWITCH 4	RIGHT OUTLANE 12	OUTHOLE 20	NOT USED STANDUP 28	JET BUMPER 36	LEFT RAMP ROLLOVER 44	NOT USED 52	NOT USED 60
5 WHT-GRN 2J3-5	CENTER COIN SWITCH 5	LEFT SPINNER 13	LOWER KICKER 3-BANK, LEFT TARGET 21	LOWER RIGHT 3-BANK RIGHT TARGET 29	TOP RIGHT 3-BANK LOWER TARGET 37	BALLSHOOTER TROUGH 45	NOT USED 53	NOT USED 61
6 WHT-BLU 2J3-4	LEFT COIN SWITCH 6	RIGHT RAMP ROLLUNDER 14	RIGHT KICKER 22	LOWER RIGHT 3-BANK, CENTER TARGET 30	TOP RIGHT 3-BANK CENTER TARGET 38	PLAYFIELD TILT 46	NOT USED 54	NOT USED 62
7 WHT-VIO 2J3-3	SLAM TILT 7	RIGHT INSIDE ROLLOVER 15	TURNAROUND 23	LOWER RIGHT 3-BANK, LEFT TARGET 31	TOP RIGHT 3-BANK UPPER TARGET 39	NOT USED 47	NOT USED 55	NOT USED 63
8 WHT-GRY 2J3-1	HIGH SCORE RESET 8	LEFT INSIDE ROLLOVER 16	LOWER PLAYFIELD EJECT HOLE 24	NOT USED STANDUP 32	NOT USED STANDUP 40	NOT USED 48	NOT USED 56	NOT USED 64

Figure 5. Switch Matrix

INITIATING AUTO-CYCLE MODE

1. Set AUTO-UP/MANUAL-DOWN switch to AUTO-UP and depress ADVANCE pushbutton. Test 04 is indicated in Credit display and Function 00 in Match Display.
2. Set switch to MANUAL-DOWN and depress ADVANCE to indicate Function 50 in the Match Display.
3. Set switch to AUTO-UP and operate Credit button to indicate 15 in Player 1 Display.
4. Depress ADVANCE pushbutton to start Auto-Cycle mode. Each cycle of this mode sequences thru the Display Digits Test, Sound Test (00), Lamp Test (01), and Solenoid test (02).
5. To terminate the test and return to game over, turn the game OFF and back ON.

CPU BOARD SELF-TEST

Depress the DIAGNOSTIC pushbutton on the left side of the CPU Board. The following indications are provided for a few seconds and then the game attempts to go to game over:

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

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

SOUND BOARD SELF-TEST

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

Vocabulary	Located in ROM
KNIGHT	5T 5001 (IC7)
BLACK	5T 5001
DEFEND	5T 5001
CHALLENGE	5T 5001
THEE (THE)	5T 5002 (IC5)
WILL	5T 5002
YOU	5T 5002
I	5T 5002
AGAIN	5T 5002 and 5T 5003 (IC6)
SLAY	5T 5003
CANNOT	5T 5003
SELF	5T 5003
ENEMY	5T 5003 and 5T 5004 (IC4)

The IC4 Speech ROM contains laughter and "F" and "R" sounds. The laughter, "F" and "R" sounds, and the following partial or composite words produced in game play are not produced in diagnostics.

WIN	ENEMIES	THREE
ME	THYSELF	AND
TO (TWO)	FIGHT	MY
AGAINST	RIGHT	

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