Williams® W

JOUST

INSTRUCTION MANUAL
FOR
UPRIGHT GAMES

Including procedures for…

- ## Operation
- ## Auditing
- ## Adjustment
- ## Diagnostics

MANUAL AMENDMENT

MANUAL AFFECTED: 16P-3006-101 and 16P-3006-101 T
Keep This Sheet With Your Instruction Manual

PURPOSE: To Update JOUST ROM Summary

ROM	PART NO.	DESCRIPTION
JOUST 1B	A-5343-09961-A	PROM, 4Kx8, GREEN LABEL
JOUST 2B	A-5343-09962-B	PROM, 4Kx8, GREEN LABEL
JOUST 3B	A-5343-09963-B	PROM, 4Kx8, GREEN LABEL
JOUST 4B	A-5343-09964-B	PROM, 4Kx8, GREEN LABEL
JOUST 5B	A-5343-09965-B	PROM, 4Kx8, GREEN LABEL
JOUST 6B	A-5343-09966-B	PROM, 4Kx8, GREEN LABEL
JOUST 7B	A-5343-10150-B	PROM, 4Kx8, GREEN LABEL
JOUST 8B	A-5343-09968-B	PROM, 4Kx8, GREEN LABEL
JOUST 9B	A-5343-09969-B	PROM, 4Kx8, GREEN LABEL
JOUST 10B	A-5343-10153-B	PROM, 4Kx8, GREEN LABEL
JOUST 11B	A-5343-09971-B	PROM, 4Kx8, GREEN LABEL
JOUST 12B	A-5343-09972-B	PROM, 4Kx8, GREEN LABEL
Decoder ROM 4 (Horizontal)	A-5342-09694	PROM, 512x8
Decoder ROM 6 (Vertical)	A-5342-09821	PROM, 512x8
Video Sound ROM 4	A-5343-09973	ROM, 4Kx8
Special Chip 1	A-5410-09911	Special Chip

NOTES:

• Current JOUST games use green-label ROMs. Earlier games have either yellow or red-label ROMs, which are interchangeable and may be mixed in the same game. DO NOT attempt to mix green-label ROMs with red or yellow-label ROMs.

• Boards with green-label ROMs should include jumpers W1 and W3 only. Boards with red or yellow-label ROMs substitute jumpers W2 and W4.

ROM SUMMARY

ROM	PART NO.	DESCRIPTION
JOUST 1A	A-5343-09961-A	PROM, 4Kx8, YELLOW LABEL
JOUST 2A	A-5343-09962-A	PROM, 4Kx8, YELLOW LABEL
JOUST 3A	A-5343-09963-A	PROM, 4Kx8, YELLOW LABEL
JOUST 4A	A-5343-09964-A	PROM, 4Kx8, YELLOW LABEL
JOUST 5A	A-5343-09965-A	PROM, 4Kx8, YELLOW LABEL
JOUST 6A	A-5343-09966-A	PROM, 4Kx8, YELLOW LABEL
JOUST 7A	A-5343-09967-A	PROM, 4Kx8, YELLOW LABEL
JOUST 8A	A-5343-09968-A	PROM, 4Kx8, YELLOW LABEL
JOUST 9A	A-5343-09969-A	PROM, 4Kx8, YELLOW LABEL
JOUST 10A	A-5343-09970-A	PROM, 4Kx8, YELLOW LABEL
JOUST 11A	A-5343-09971-A	PROM, 4Kx8, YELLOW LABEL
JOUST 12A	A-5343-09972-A	PROM, 4Kx8, YELLOW LABEL
Decoder ROM 4 (Horizontal)	A-5342-09694	PROM, 512x8
Decoder ROM 6 (Vertical)	A-5342-09821	PROM, 512x8
Video Sound ROM 4	A-5343-09973	ROM, 4Kx8
Special Chip 1	A-5410-09911	Special Chip

POWER TURN-ON

CAUTION - This game must be plugged into a properly grounded outlet to prevent shock hazard and to ensure proper game operation. DO NOT use a "cheater" plug to defeat the ground pin on the line cord, and DO NOT cut off the ground pin.

WHEN THE GAME IS FIRST TURNED ON it produces a sound. Simultaneously general illumination should come on and a moment later a scanning "rug pattern"' indicating the RAM test should appear on the screen. Next the rug should become stationary as the ROM test is performed. In a correctly running game the rug pattern will be followed by the message "INITIAL CHECKS INDICATE ALL SYSTEMS GO". If RAM or ROM failure messages come up on the screen instead, refer to Power-Up Tests in TROUBLESHOOTING PROCEDURES.

GAME OPERATION

GAME START - Insert coins; a random sound is produced and credits are displayed on the CRT. With two or more credits displayed, pressing 2-player start initiates a 2-player game where each player gets five***** mounts (turns).

*Adjustable Feature

PLAYER CONTROLS

The Joystick sends the gladiator and his ever stalwart mount (ostrich or stork) boldly to the left or to the right.

The Flap Button causes the hero's mount to spread its robust wings.

GAME PLAY

AT SOME FAR-DISTANT TIME two fantastic gladiators meet and square off for battle. Each is mounted on a fanciful bird of prey (ostrich or stork) who's wings can carry it from the cliftops to the mouth of the abyss and hopefully back . . . or the bubbling lava below will increase it's toll.

While your mount is a skilled flyer, your opponent is a shrewd gladiator. You must prove you are his better. Stealthily you must pilot your mount above him, and cleverly you must stalk him . . . to strike at the moment he least suspects you! And always remember this rule: **In every Joust, the highest lance wins!**

Of course your opponent will resist your attempts, all the while pursuing his own designs on you. Each gladiator has five***** mounts. Every time you're toppled you must mount a new bird for the next joust. The gladiator who scores the most dismountings is the winner.

YOUR PATH MAY SEEM CLEAR and your work cut out, but just them a flock of vicious Buzzard-Riders will ambush you! Ruthless even as they are dismounted, these wily Buzzard-Riders instantly lay their eggs. You must pick up the eggs or they will soon hatch into even more persistent and antagonistic foes!

Fortunately at 20,000***** points (should you make the grade) you will be awarded another bird to mount against the loyal opposition.

Joust is designed for either one or two players.

HIGH SCORE SIGNATURE

Select letters with the joystick. Push right to move forward through the alphabet; push left to move backward. Then push the FLAP button to lock in the letter.

BOOKKEEPING AND EVALUATION TOTALS

1. In Game-Over Mode, open the cashbox and depress the cashbox advance switch. The advance switch located on the coin door can also be used. The CRT should indicate all bookkeeping and evaluation totals. If so, go to step 3. If the CRT display comes up in the ROM test, perform step 2.
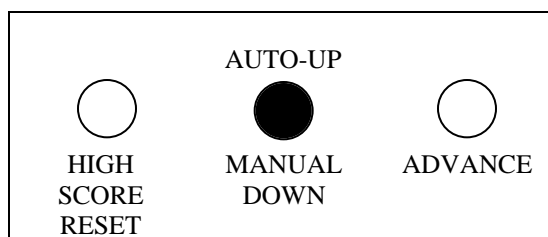

Figure 1. Coin Door Button Switches

2. Continue to depress the cashbox advance switch, stepping the game through test programs for ROMs, RAMs, CMOS RAMs, color RAMs, sounds, switches, and then CRT test patterns, of which there are five. The fifth test pattern, color bars, directly precedes the CRT display of the bookkeeping and evaluation totals.

3. The bookkeeping and evaluation totals appear on the displays as in Figure 2.

* Adjustable feature

2

CLEARING BOOKKEKPING TOTALS

1.   Depress ADVANCE to display Game Adjustments.
2.   Operate PLAYER 1 joystick to position cursor on CLEAR BOOKKEEPING TOTALS.
3.   Push PLAYER 2 Joystick.
4.   Depress ADVANCE.

BOOKKEEPING TOTALS

LEFT SLOT COINS	167
CENTER SLOT COINS	0
RIGHT SLOT COINS	426
PAID CREDITS	593
FREE MEN	221
TOTAL TIME IN MINUTES	1038
TOTAL MEN PLAYED	2000
TOTAL SINGLE PLAYER	101
TOTAL DUAL PLAYER	492
TOTAL CREDITS PLAYED	593
AVERAGE TIME PER CREDIT	1:45

Figure 2. Bookkeeping display

GAME ADJUSTMENTS

In the Game-Over Mode open the coin door with AUTO-UP/MANUAL-DOWN switch set to AUTO-UP, and depress the coin door ADVANCE switch twice to cause a CRT display as shown in Figure 3.

To select and then set functions to the desired values, use the PLAYER 1 joystick (push right to move arrow down, left to move arrow up) then, making sure the coin door is open, use the PLAYER 2 joystick to increase or reduce the value of the selected function.

The number of turns (men) per 1-credit game can be set anywhere from 1 to 99 (5 recommended). Difficulty is factory-programmed at 5 (moderate). It can be custom-programmed (0-9, with 9 conservative) as desired.

Game pricing is selected with standard settings or with custom settings as shown in Tables 1 & 2. Table 1 lists some common pricing schemes and directs the reader to the proper entry in Table 2, which shows what the CRT display should look like to accomplish the desired pricing. Note that free play can be elected by entering the code number 9 at the PRICING SELECTION function (see Tables 1 and 2).

For standard settings you need change only the PRICING SELECTION. For custom settings, first set PRICING SELECTION to zero and then set the remaining values according to Table 2.

```
             GAME ADJUSTMENT
    EXTRA MAN EVERY                        20000
    MEN FOR 1 CREDIT GAME                  5
    HIGH SCORE TO DATE ALLOWED             YES
    PRICING SELECTION                      3        1/QUARTER 4/DOLLAR
      LEFT SLOT UNITS                      1
      CENTER SLOT UNITS                    4
      RIGHT SLOT UNITS                     1
      UNITS REQUIRED FOR CREDIT            1
      UNITS REQUIRED FOR BONUS CREDIT      0
      MINIMUM UNITS FOR ANY CREDIT         0
    FANCY ATTRACT MODE                     YES
    DIFFICULTY OF PLAY                     5
    LETTERS FOR HIGH SCORE NAME            3
    RESTORE FACTORY SETTINGS               NO
    CLEAR BOOKKEEPING TOTALS               NO
    HIGH SCORE TABLE RESET                 NO
    AUTO CYCLE                             NO
    SET ATTRACT MODE MESSAGE               NO
    SET HIGH SCORE NAME                    NO
        USE 'PLAYER 1 MOVE' TO SELECT ADJUSTMENT
        USE 'PLAYER 2 MOVE' TO CHANGE THE VALUE
              PRESS ADVANCE TO EXIT
```

Figure 3. Game Adjustment

Highest Score Signature
The number of letters allowed the highest scoring player for entering his name can be varied from 3 to 20 and is recommended as 3. If objectionable words are entered as the signature name, you can change the lettered entry leaving the highest score the same. See Setting Highest Score Name.

Restore Factory Settings
1. Position the cursor on RESTORE FACTORY SETTINGS.
2. Push PLAYER 2 joystick to the right.
3. Depress ADVANCE switch twice.

Resetting High Score Table
1. Position the cursor on RESET HIGH SCORE TABLE.
2. Push PLAYER 2 joystick to the right.
3. Depress ADVANCE.

Setting Attract Mode Message
1. Position the cursor on SET ATTRACT MODE MESSAGE.
2. Push PLAYER 2 joystick to the right.
3. Depress ADVANCE.
4. Enter up to two lines of your message following instructions on the screen
5. Depress ADVANCE to terminate process.

NOTE:
To restore the Williams attract mode message, it is necessary to perform steps 1 through 3 and then turn the game OFF then ON.

Setting High Score Name
1. Position the cursor on SET HIGHEST SCORE NAME.
2. Push PLAYER 2 joystick to the right.
3. Depress ADVANCE.
4. Enter new signature; depress ADVANCE to terminate process.

NOTE:
An alternate, simpler method enters the factory highest score signature. In the game over mode, hold HIGH SCORE RESET Depressed. After a few seconds a sound is produced and the factory highest score signature has been activated.

Table 1. Pricing Schemes

COIN DOOR MECHANISM	CREDITS/MONEY	TABLE 2 STANDARD SELECTION/ CUSTOM KEY
Twin Quarter Quarter, Dollar, Quarter	1/25¢, 5/$1	A
	2/50¢, 5/$1	B
	1/25¢, 4/$1	3
	2/50¢, 4/$1	C
	1/50¢, 3/$1, 4/$1.25	D
	1/50¢, 3/$1, 7/$2	E
	1/50¢, 3/$1, 6/$2	1
	1/50¢	5
1DM, 5DM	1/1DM, 6/5DM	2
20-Cent, 50-Cent	1/20¢, 3/50¢	F
1 Franc, 5 Franc	1/2F, 3/5F	4
25 Cent	1/25¢, 4/1G	6
1 Guilder	1/25¢, 5/1G	G
5 Franc	1/5F, 2/10F	7
10 Franc	1/10F	8
1 Franc, 2 Franc	2/1F 5/2F	2
100 Lire, 200 Lire	1/200 Lire	8
Twin Coin	1/1 Coin	3
	1/2 Coins	5
	1/3 Coins, 2 5 Coins	H
1 Unit, 5 Unit	1/2, 3/5	4
	1/1, 5/5	I
	1/3, 2/5	J
FREE PLAY	-	9

Table 2. Pricing Settings

DISPLAY FUNCTIONS	STANDARD SELECTION									CUSTOM KEY									
										A	B	C	D	E	F	G	H	I	J
Pricing Selection	1	2	3	4	5	6	7	8	9	0	0	0	0	0	0	0	0	0	0
Left Slot Units	1	6	1	1	1	1	1	1	1	1	1	1	3	12	6	1	2	1	2
Center Slot Units	4	0	4	16	4	0	0	0	4	4	4	4	12	48	0	0	0	0	0
Right Slot Units	1	1	1	6	1	4	2	2	1	1	1	1	3	12	15	4	2	5	10
Units per Credit	2	1	1	2	2	1	1	2	1	1	1	1	4	14	5	1	5	1	5
Units for Bonus Credit	4	0	0	0	0	0	0	0	0	4	4	0	15	96	0	4	0	0	0
Minimum Units for Credit	0	0	0	0	0	0	0	0	0	0	2	2	0	24	0	0	0	0	0

TROUBLESHOOTING PROCEDURES

Certain types of game malfunctions may inhibit the game's diagnostic or display faculties. Troubleshooting procedures for most of these types of malfunctions as well as malfunctions that permit self-diagnosis are covered below.

Our troubleshooting algorithm begins with **Power-Up** and continues until **Game Over Mode**. All procedures can be performed with minimal test equipment or merely by observing the game itself.

POWER-UP TESTS

NO GENERAL ILLUMINATION	NO INITIAL VIDEO (RUG PATTERN)	CHECKING POWER SUPPLY BOARD
(1) Check fuse F2 on power supply board. (2) Check for proper installation of jumpers W1, W2, W3 and/or resistor R27. (Some machines DO NOT have an R27. Refer to your drawing set.) (3) Check 4P1/J I, 4P3/J3, 6P2/J2 and 6P3/J3. (4) If all the above don't turn up the problem check power supply board.	(1) Open back doors (2) Press reset button on CPU Board. (3) Try RAM and ROM tests (see below). (4) If all the above don't turn up the problem, check power supply board.	(1) Swap power supply board with one from known-good game. (2) If game plays, problem is on power supply board. (3) If game doesn't play, check power transformer with voltmeter. (4) If known-good power supply is unavailable for tests above, check +5V, – 5V and + 12V outputs on power supply in game. Each MUST BE within 2% of rated output with less than 0.1% AC hum.

MORE POWER-UP TESTS

TEST	ROM BOARD LEDs RECOGNIZE CONDITION	ROM BOARD LEDs IDENTIFY CHIPS	VIDEO	REMEDY
GENERAL	"0" means all power-up tests passed	-	(1) Scanning rug pattern (2) Stationary rug pattern (3) "INITIAL CHECKS INDICATE ALL SYSTEMS GO" (4) Game-Over Mode	If any video (see left) is missing or error message is displayed, proceed to **Diagnostic Mode** tests.
CMOS (See Appendix A)	"0" means tests passed	-	"HIGH SCORE TABLE RESET" "BOOKKEEPING TOTALS CLEARED" "ADJUSTMENT FAILURE" "RESTORE FACTORY SEITINGS BY OPENING FRONT DOOR OR TABLETOP AND TURNING GAME OFF AND ON"	(1) Open coin door and turn power off and on.
	"0" means tests passed	-	"FACTORY SEITINGS RESTORED"	(2) Press ADVANCE. Game should return to Game-Over Mode.
BATTERY (See Appendix A)	"0" means tests passed	-	"HIGH SCORE TABLE RESET" "BOOKKEEPING TOTALS CLEARED" "ADJUSTMENT FAILURE" "RESTORE FACTORY SEITINGS BY OPENING FRONT DOOR OR TABLETOP AND TURNING GAME OFF AND ON"	(1) Open coin door and turn power off and on. Or press ADVANCE. In either case, game should return to Game-Over Mode. (2) Check AA alkaline cells on CPU Board. (3) If problem persists proceed with CMOS RAM test by putting the game into its **Diagnostic Mode** (see SELF-DIAGNOSTICS).
MEMORY PROTECT INTERLOCK (See Appendix A)	"0" means tests passed	-	"HIGH SCORE TABLE RESET" "BOOKKEEPING TOTALS CLEARED" "ADJUSTMENT FAILURE" "RESTORE FACTORY SEITINGS BY OPENING FRONT DOOR OR TABLETOP AND TURNING GAME OFF AND ON"	(1) Making and breaking coin door interlock switch, check with VOM and replace if faulty. (2) Replace if faulty: Memory protect gates 6E, IC1, Ql, or CMOS RAM 1C.
SPECIAL CHIP	"0" means tests passed	-	(1) Scanning rug pattern. (2) Blank screen instead of "INITIAL TESTS INDICATE: OPERATIONAL" (3) High score table with no scores. (4) Intro blank or program crash.	(1) Turn power off. (2) To find bad chip replace 2 special chips one at a time with known good chips. (3) Turn Machine on after each replacement and run through Power-Up Tests.

+5v DC ADJUSTMENT (R10 & R24)

Before adjusting the voltage output, always check the output at the supply for AC hum. This hum should never rise above 0.005v on the +5v DC supply. If it does, consult your schematic drawing set for proper DC voltages throughout the circuit. Test for these with the DC setting of your multimeter. Make a second check using the AC setting. Pay particular attention to readings at TP5 (top of capacitor C10). If the voltage here is too low (less than +11v DC) or you find excessive ripple (more than 700mv rms), replace the capacitor.

Table 3 Voltage Adjustments to +5v Dc Supply

WHICH RESISTORS SUPPLY HAS . . .	Neither	R10 only	R24 Only	R24 & R10
TO INCREASE VOLTAGE IF UNDER 4.25v DC . . .	Add R24	Remove R10 or add R24	-	Remove R10 or add R24
TO DECREASE VOLTAGE IF OVER 5.25v DC . . .	Add R10	-	Remove R24 or add R10	Remove R24 or add R10

SELF DIAGNOSTICS

If RAM or ROM failure messages are displayed on the CRT after the "rug pattern" proceed with self-diagnostics. Self-diagnostic procedures are controlled by the AUTO-UP/MANUAL-DOWN and ADVANCE switches in the coin door. Set the AUTO-UP/MANUAL-DOWN switch to the MANUAL-DOWN position and depress the ADVANCE pushbutton. The game is now in its **Diagnostic Mode** and a ROM test is performed. With ROM test results present on the CRT display, depressing the ADVANCE pushbutton initiates the RAM test. Further tests (CMOS, sound, switch, color RAM, monitor test patterns) are encountered one after the other as the ADVANCE pushbutton is depressed (once more for each subsequent test).

MONITOR TEST PATTERNS - For ease in monitor adjustments, the monitor may be slid back and the screen viewed in the CRT mirror provided on the inside-top of the cabinet. Remove the two bolts and carefully slide the monitor back in its shelf; secure the monitor in the extended position by inserting the two bolts though holes in the monitor base and monitor shelf provided at the left side of the monitor.

AUTO CYCLE MODE - From the color bar pattern (or Game Over with the switch set to AUTO-UP) depress ADVANCE two times to display GAME ADJUSTMENTS.

1. Position the cursor on AUTO CYCLE with the MOVE Joystick and push the FIRE joystick up.
2. Depress ADVANCE.
3. The system will now sequence through ROM, RAM, and CMOS RAM tests repeatedly. The coin door must be open during the Auto Cycle test. If an error is detected, the test is terminated and the failure indication is displayed on the CRT.
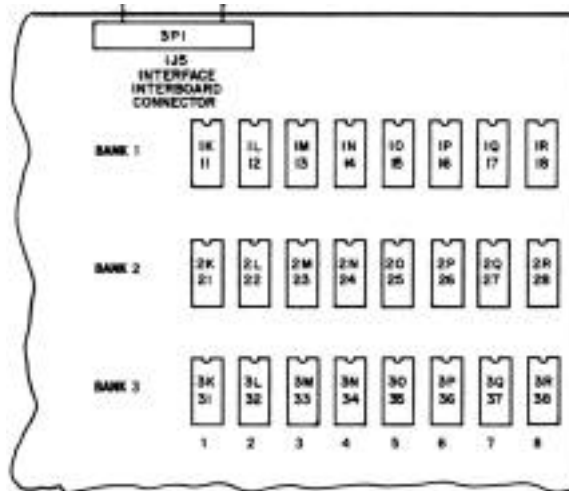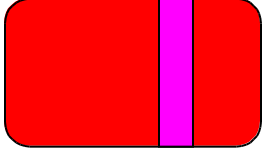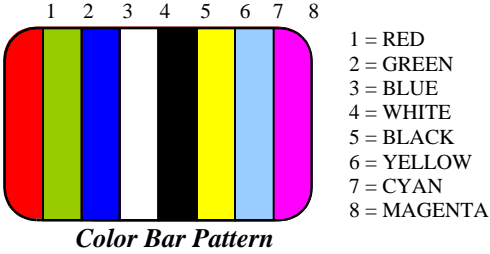4. To terminate the Auto-Cycle test, turn the game OFF and ON.

Figure 4. RAM Location and Numbering on the CPU Board

DIAGNOSTIC MODE RAM AND ROM TESTS				
TEST	**ROM BOARD LEDs RECOGNIZE CONDITION**	**ROM BOARD LEDs IDENTIFY CHIPS**	**VIDEO**	**REMEDY**
ROM	"2" means ROM error.	2-digit ROM chip number	"ROM ERROR" and ROM chip number.	(1) Turn power off. (2) Replace suspected chip.
RAM	"1" means RAM error.	Bank number first, then chip number in bank (see figure 3)	"RAM ERROR" followed by RAM bank number and chip number (Note: with multiple RAM failures this display may not appear)	(1) Check for normal voltages on indicated RAM chip: -5v/pin 1, +12v/pin 8, +5v/pin 9. (2) Turn power off. (3) Replace suspected chip. (4) With multiple RAM failures always check power supply. See POWER-UP TESTS.
CMOS (See Appendix A)	"3" means CMOS RAM error	-	"CMOS RAM ERROR OR WRITE PROTECT FAILURE"	(1) Check pin 22 of CMOS RAM for +3.2VDC minimum. If present, replace CMOS chip 1C. If absent replace AA alkaline cells. (2) With new alkaline cells, check for +3.8VDC. If still absent, replace diodes D9 and D10. (3) Upon power-up and re-entry into diagnostics if CMOS error message persists check CMOS RAM memory protect and address decoding circuits with a logic probe.

Tests 4 and 7 provide sequential subtests. To stop automatic cycling set switch to MANUAL-DOWN. Depress advance in MANUAL-DOWN to step through subtests. LED indications are not made for these tests.

TEST & PROCEDURES	VIDEO		REMEDY OR ADJUSTMENT	
SOUND (Test 4)	"SOUND LINE 1" "SOUND LINE 2" "SOUND LINE 3" "SOUND LINE 4" "SOUND LINE 5" "SOUND LINE 6" (These appear one at a time)		Missing	Check
			1	2P4/lOP3 Pin 3
			2	2P4/10P3 Pin 2
			3	2P4/10P3 Pin 5
			4	2P4/10P3 Pin 4
			5	2P4/10P3 Pin 7
			6	2P4/10P3 Pin 6
			All	Perform **Sound Board Diagnostics** (see below)
SWITCH TEST (Test 5) (1) Set switch to MANUAL-DOWN and clear any stuck switches. (2) CRT should indicate no switches closed. (3) Operate switches and check for display of switch name.	CRT indicates AUTO-UP closed and any stuck switches. **CRT Display for Each Switch . . .**		(1) COIN DOOR SWITCH STUCK: Disconnect 2P3 (2) PLAYER PANEL SWITCH STUCK: Disconnect 3P2 or 3P3 (3) COIN DOOR SWITCH DOES NOT OPERATE: Ground corresponding pin of 2P3. (4) PLAYER PANEL SWITCH DOES NOT OPERATE: Ground corresponding pin of 3P2 or 3P3 **SYMPTOM REMAINS SAME . . .** ROM Board or Interface Board Faulty. **SYMPTOM CLEARS UP . . .** Problem is in switches or wiring	
	Coin Door	Player Panel		
	ADVANCE AUTO-UP HIGH SCORE RESET LEFT COIN CENTRE COIN RIGHT COIN' SLAM SWITCH	1- PLAYER START 2- PLAYER START MOVE 1 FLAP 1 MOVE 2 FLAP 2		

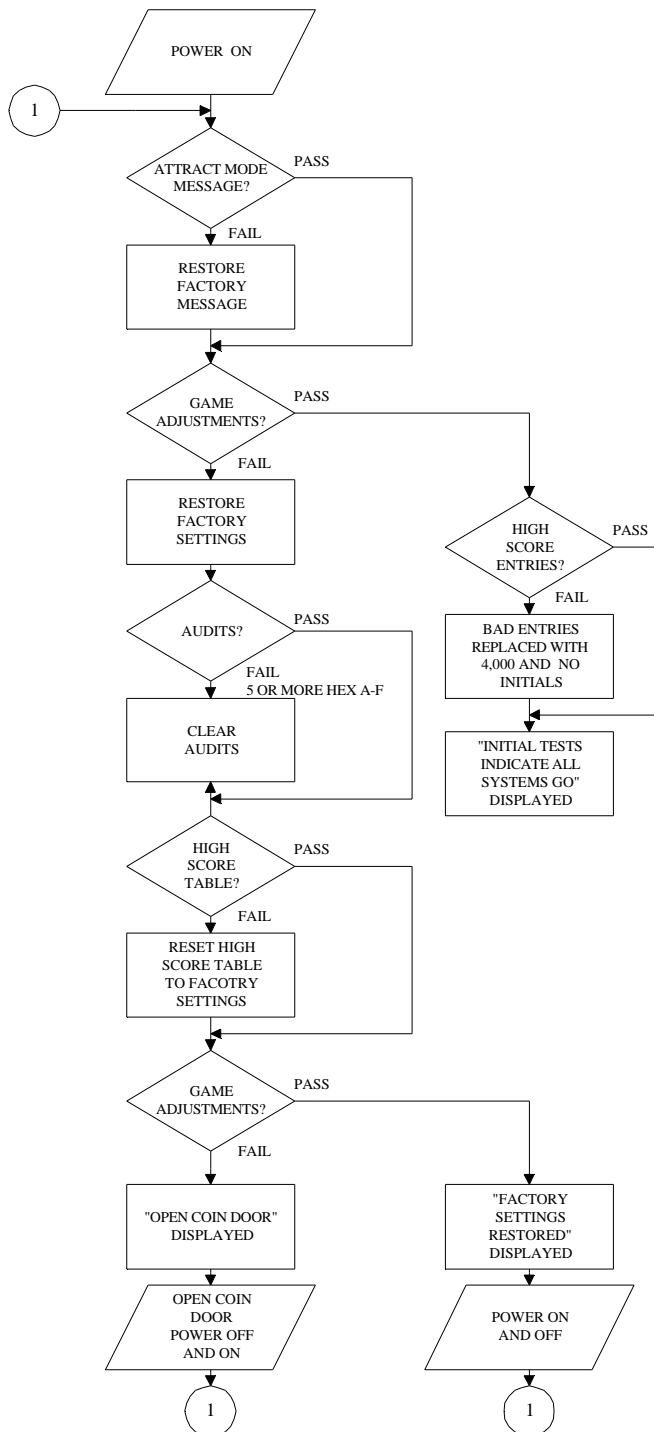| MORE DIAGNOSTIC MODE TESTS			
TEST & PROCEDURES	**VIDEO SEQUENCES**	**REMEDY OR ADJUSTMENT**	
COLOUR RAM TEST (Test 6) Note that a blank sequence or two sequences with the same shade indicate a faulty 1A flip-flop, 1B RAM or 2B RAM or a failure in the color analogue circuit. Check voltages on Q1 (green transistor), Q2 (red transistor) and Q3 (blue transistor). During the eight full screen color tests, the base voltage (center Pin) on each transistor should vary between 3.8v (brightest color) and 4.4v (no color) (1) CRT sequences through 8 colors, 2 seconds each (2) Thick vertical band indicates color RAM fault.		**RAM 1B**	**RAM 2B**
	1 Light red screen 2 Red screen 3 Dark red screen	Too-light or too dark red or gray band	Magenta band
	4 Light green screen 5 Green screen 6 Dark green screen	Yellow band	Cyan band
	7 Light blue screen 8 Blue screen	Magenta band	Too-light or too dark blue or gray band
	4 Light green screen	Green band	Dark green band or gray band
	5 Green screen	Light green band	Dark green band or gray band
	6 Dark green screen	-	Grey band
MONITOR & COLOUR RAM TEST (Test 7) 1 2 3 4 5 6 7 8 1 = RED 2 = GREEN 3 = BLUE 4 = WHITE 5 = BLACK 6 = YELLOW 7 = CYAN 8 = MAGENTA ***Color Bar Pattern***	Cross hatch pattern	Aids you in setting up vertical and horizontal linearity, convergence and focus.	
	Red screen Green screen Blue screen Color Bars	Aids you in optimizing color purity	
	Color Bars • Double-width • Half-width • Transposed • Missing	If color RAM test 6 indicates no faults, symptoms at left suggest a fault in 1A, 1B, 2B or 2C chips.	

SOUND BOARD DIAGNOSTICS	
SYMPTOM	**TEST AND PROCEDURES**
MISSING SOUNDS NO SOUND	☐ CHECK SOUND SELECT INPUTS (1) Turn power on. (2) Depress DIAGNOSTIC pushbutton on bottom of soundboard. Sounds may be produced now even though absent in diagnostic mode 4. If you hear game sounds proceed with this checkbox. If not go ahead to POWER SUPPLY checkbox below.

	TEST	TOOL	CONDTION AND REMEDY
	Sound board connector 10P3J3-1 to 6	Logic Probe (Game on and in test 4)	• PULSING - Proceed. • LOW - check jacks, foils. • STILL LOW - Perform ROM board checkbox below.
	SR1 DIP resistors R3 to R9	VOM - Reading ohms (game off)	• ALL 4.7K - Proceed. • ANY OPEN - replace SR1.
	C3 to C9	VOM - Reading ohms (game off)	• ALL OK - Proceed. • ANY SHORTED - replace bad.
	IC 5-1 IC 7-14	Logic Probe (Game on and in test 4)	• HIGH - Proceed. • LOW - Replace C19 (IC5) or C21 (IC7). • STILL LOW - Replace bad IC.
	IC5-2, 4, 6, 10, 12, 15 IC7-4, 6	Logic Probe (Game on and in test 4)	• PULSING - Proceed. • LOW - Replace bad chip.
	IC10-18, 19 (PIA)	Logic Probe (Game on and in test 4)	• PULSING - Proceed. • LIFT C20 - Retest. • PULSING NOW - Replace C20. • STILL LOW - Replace IC6, retest.
	IC10-10 to 17	Logic Probe (Game on and in test 4)	• PULSING - Proceed. • SOME LOW Replace IC. • ALL LOW - Lift C31, retest. • PULSING NOW - Replace C31. • STILL LOW - Replace IC

SYMPTOM	TEST AND PROCEDURES
SOUND WHEN *DIAGNOSTIC* PUSHBUTTON PRESSED BUT NOT IN **DIAGNOSTIC MODE** TEST 4	☐ CHECK ROM BOARD OUTPUTS (1) If you hear game sounds, disconnect and reconnect sound board connector 10P3J3. (2) You Should hear one or more game sounds. If so put the game in DIAGNOSTIC MODE Test 4 and proceed with this checkbox. If not go ahead to POWER SUPPLY checkbox below.

	TEST	TOOL	CONDTION AND REMEDY
	ROM board connector 2P4J4-3 to 6	Logic Probe (Game on and in test 4)	• PULSING - Repair cable to sound board. • ANY LOW - Replace jack or foil, proceed.
	0C DIP resistors 2 to 6	VOM - Reading ohms (game off)	• ALL 4.7K - Proceed. • ANY OPEN - replace 0C.
	C26-39	VOM - Reading ohms (game off)	• ALL OK - Proceed. • ANY SHORTED - replace bad.
	IC10-10 to 15 (PIA)	Logic Probe (Game on and in test 4)	• PULSING - Proceed. • SOME LOW Replace IC. • ALL LOW - Lift C23, retest. • PULSING NOW - Replace C23. • STILL LOW - Replace IC

SYMPTOM	TEST AND PROCEDURES
NO SOUND	☐ CHECK ON-BOARD POWER SUPPLY (1) With power off test for fuse continuity at F1 and F2. (2) With power on check for +12v unregulated DC at TP1 and pin 5 of IC1. (3) Now check for +5v regulated DC between TP4 and TP3. If voltages are absent or low turn off game and lift one pin of filter capacitors C25, C26 and C27. (4) Check each with ohmmeter for possible short circuits. (5) If capacitors are good and unregulated voltages test okay but you're missing +5v, replace regulator chip IC8.
STILL NO SOUND	☐ CHECK AUDIO (ANALOUGUE) SECTION (1) Turn power on; turn up volume control. Momentarily place powered-up AC soldering pencil on final amplifiers input pin (IC1, pin 1 or 10P4, pin 2) If you hear low hum, audio IC, volume pot and speaker are okay. (2) Repeat test at Q2 emitter. If you hear hum, analogue section is okay. Step (1) will also work if you simply touch amplifiers input pin. *However output level of hum will be much lower than with soldering iron.* DO NOT use a soldering pencil over 40 watts. Cordless models will NOT work here.
MISSING SOUNDS; NO SOUND	☐ CHECK SOUND ROM 12 AND RELATED CIRCUITRY (1) Is jumper W1 connected? IT SHOULD BE on all JOUST games, or sound signals from the D/A converter (IC13) will never arrive at input of impedance-matching transistor Q2. (2) Turn power on. (3) If you have no game sounds but power supply tests show normal voltages and no ripple on +5v, check crystal clock circuit. Using DVM or logic probe, test for pulsing AC across crystal. If clock signal's absent replace crystal and associated capacitors. (4) Turn off power. (5) Swap sound ROM (IC12) and microprocessor chip (IC9) with known-good chips. (6) Power up and test Sound Board after each swap by pushing DIAGNOSTIC button.

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APPENDIX A

CMOS RAM Data Test Protocol

The first sub-test of the CMOS RAM data is that of the ATTRACT MODE MESSAGE checksum. If the test does not pass, the factory ATTRACT MODE MESSAGE is restored. Next, the game adjustments are checked and restored to factory settings if an error is found. If game adjustments are found intact, the high score table is checked for any bad entries. Bad entries are replaced with a score of 4,000 points and no initials. If all entries check, the game returns to the Game Over Mode.

If game adjustments are restored to factory settings, the AUDIT TOTALS are checked. If 5 or more audit digits are other than 0-9 (that is hexadecimal A through F) all audit totals are cleared. This is followed by a check of the high score table and the table is reset to factory settings if errors are found. Finally, game adjustments are rechecked and either OPEN COIN DOOR or FACTORY SETTINGS RESTORED is displayed. With the former, open the coin door and turn the game OFF and ON and then FACTORY SETTINGS RESTORED will be displayed. Return to game over by depressing the ADVANCE pushbutton or by turning the game OFF and ON a second time.

```
                    ┌──────────────┐
                    │   POWER ON   │
                    └──────┬───────┘
      ┌───┐                │
      │ 1 │────────────────┤
      └───┘                ▼
              ◇ ATTRACT MODE ───PASS──┐
              ◇ MESSAGE?              │
                    │ FAIL            │
              ┌──────────┐           │
              │ RESTORE  │           │
              │ FACTORY  │           │
              │ MESSAGE  │           │
              └────┬─────┘           │
                   ◀─────────────────┘
              ◇ GAME ──────PASS───────────────┐
              ◇ ADJUSTMENTS?                  │
                   │ FAIL                     │
              ┌──────────┐                    ▼
              │ RESTORE  │          ◇ HIGH SCORE ──PASS──┐
              │ FACTORY  │          ◇ ENTRIES?           │
              │ SETTINGS │               │ FAIL          │
              └────┬─────┘          ┌──────────┐        │
                   │                │ BAD ENTRIES│       │
              ◇ AUDITS? ──PASS──┐   │ REPLACED  │       │
                   │            │   │ WITH 4,000 │       │
                   │ FAIL       │   │ AND NO     │       │
           5 OR MORE HEX A-F   │   │ INITIALS   │       │
              ┌──────────┐      │   └─────┬──────┘      │
              │  CLEAR   │      │         ◀─────────────┘
              │  AUDITS  │      │   ┌──────────────┐
              └────┬─────┘      │   │"INITIAL TESTS│
                   ◀────────────┘   │INDICATE ALL  │
              ◇ HIGH ──PASS──┐      │SYSTEMS GO"   │
              ◇ SCORE        │      │DISPLAYED     │
              ◇ TABLE?       │      └──────────────┘
                   │ FAIL    │
              ┌──────────┐    │
              │RESET HIGH│    │
              │SCORE TABLE│   │
              │TO FACOTRY │   │
              │SETTINGS   │   │
              └────┬─────┘    │
                   ◀──────────┘
              ◇ GAME ──────PASS──────────┐
              ◇ ADJUSTMENTS?             │
                   │ FAIL                │
              ┌──────────┐       ┌──────────────┐
              │"OPEN COIN│       │"FACTORY      │
              │ DOOR"    │       │SETTINGS      │
              │DISPLAYED │       │RESTORED"     │
              └────┬─────┘       │DISPLAYED     │
                   │             └──────┬───────┘
              ┌──────────┐       ┌──────────────┐
              │OPEN COIN │       │  POWER ON    │
              │DOOR      │       │  AND OFF     │
              │POWER OFF │       └──────┬───────┘
              │AND ON    │              │
              └────┬─────┘            ┌───┐
                 ┌───┐                │ 1 │
                 │ 1 │                └───┘
                 └───┘
```