I N F E R N O®

KIT SERVICE MANUAL

ROM SUMMARY

ROM	PART NO.	DESCRIPTION			IC NO.	BOARD	INDICATION
Sound ROM	A-5343-10822	2764	PROM,	8Kx8	IC8	CPU	no sound
INFERNO 2	A-5343-10823	2732	PROM,	4Kx8	IC9	F CPU	209
INFERNO 3	A-5343-10824	2732	PROM,	4Kx8	IC10	CPU	210
INFERNO 4	A-5343-10825	2764	PROM,	8Kx8	IC11	CPU	211
INFERNO 5	A-5343-10826	2764	PROM,	8Kx8	IC12	CPU	212
INFERNO 6	A-5343-10827	2764	PROM,	8Kx8	IC13	CPU	213
INFERNO 7	A-5343-10828	2764	PROM,	8Kx8	IC14	CPU	214
INFERNO 8	A-5343-10829	2764	PROM,	8Kx8	IC15	CPU	215
INFERNO 9	A-5343-10830	2764	PROM,	8Kx8	IC16	CPU	216
INFERNO 10	A-5343-10831	2764	PROM,	8Kx8	IC17	CPU	217
INFERNO 11	A-5343-10832	2764	PROM,	8Kx8	IC18	CPU	218
INFERNO 12	A-5343-10833	2764	PROM,	8Kx8	IC19	CPU	219
Not Used	--	2764	PROM,	8Kx8	IC20	CPU	220
INFERNO 13	A-5343-10834	2764	PROM,	8Kx8	IC21	CPU	221
Not Used	--	2764	PROM,	8Kx8	IC22	CPU	222
INFERNO 14	A-5343-10835	2764	PROM,	8Kx8	IC23	CPU	223
Not Used	--	2764	PROM,	8Kx8	IC24	CPU	224
INFERNO 15	A-5343-10836	2764	PROM,	8Kx8	IC25	CPU	225
Not Used	--	2764	PROM,	8Kx8	IC26	CPU	226
Special Chip 2	A-5410-10083	Special Chip			IC29	CPU	--
Special Chip 2	A-5410-10083	Special Chip			IC30	CPU	--
Clock-ROM 1	A-5282-10295	82S123	ROM,	32x8	IC14	VIDEO	no video
INFERNO 16	A-5343-10837	2764	PROM,	8Kx8	IC41	VIDEO	vert lines
Horiz-sync ROM 1	A-5282-10294	82S129	ROM,	256x4	IC47	VIDEO	--
INFERNO 17	A-5343-10838	2764	PROM,	8Kx8	IC57	VIDEO	vert lines
INFERNO 18	A-5343-10739	2764	ROM,	8Kx8	IC58	VIDEO	vert lines
Decoder-ROM 5A (Horizontal)	A-5282-10292	6349	ROM,	512x8	IC60	VIDEO	--

NOTICE

TO ORDER REPLACEMENT ROMS from your authorized WILLIAMS distributor, specify (1) part number shown above, (2) ROM label color, (3) REV level (number) on the label, and (4) which game the ROM is used in.

CPU-BOARD JUMPERS: W1, W3, W5, W7, W10, W11, W14, W16 and W18. Remove jumper W11 for cocktail games.

Contents

Warnings & Notices
(For Game Kits Only)

WARNING

Parts salvaged from an old game are required to complete your kit. These
salvaged parts MUST operate perfectly, or the converted game cannot perform
properly or safely. ALWAYS repair circuit board malfunctions and cabinet
damage, before conversion is attempted.

CAUTION: POWER SUPPLY

Be sure the power supply from your old game is capable of +5VDC and -5VDC at
5A and +12VDC at 1A. These operating voltages are necessary for your kit.

Your power supply must be F.C.C. approved.

NOTICE: MONITOR

1. This kit is not intended for use with an X-Y monitor. A suitable monitor
    has a horizontally-mounted CRT and raster electronics with inputs for red,
    green, and blue video, as well as positive sync. (These inputs must be
    compatible with TTL (logic) levels.)

2. This game's horizontal sweep lasts 50 microseconds. This time constant
    may not be compatible with a monitor designed to display a 40-microsecond
    video signal. Using this game with a 40-microsecond monitor will probably
    result in horizontal overscan (loss of some of the video display on the
    left and right sides of the screen). Consult your monitor's manufacturer
    on how to convert your monitor, or use a 50-microsecond monitor.

NOTICE

Make sure to clean and lubricate your old coin mechanisms. Servicing them is
crucial to this game's earnings and operation!

NOTICE

Use this checklist to be sure your kit is complete!

F

MAJOR PARTS	P/N	Quantity
[] button assembly	C-9214-10	(2)
[] button holder with switch	20-9457	(2)
[] control-panel overlay	31-1349-3020	(1)
[] CRT-glass decal	31-1351-3020	(2)
[] easel	08-7434	(1)
[] eight-way joystick	20-9319	(4)
[] FCC cage with CPU and video boards	C-10705	(1)
[] harness clip (part of C-10705)	03-7618	(3)
[] instruction card	16-3020-1	(2)
[] marquee decal	31-1350-3020	(1)
[] miscellaneous control-panel decals	31-1356-3020	(1 set)
[] "NEW GAME" decal	31-1354-3020	(1)
[] service manual	16-3020-101	(1)
[] side decal	31-1352-3020	(2)
[] wiring harness (part of C-10705)	H-10706	(1)

NOTICE

Blank control panels for WILLIAMS' games are available through your WILLIAMS
distributor.

RECOMMENDED TOOLS AND SUPPLIES

[] Black, semi-gloss paint
[] Electric drill
[] Electric screwdriver

[] Grease pencil or marker
[] Hex driver set
[] Phillips screwdriver

[] Pliers
[] Razor knife
[] Soldering iron and solder

[] Wire cutters
[] 180-grit sandpaper (sander)

[] A. Cabinet Modifications

[] 1. First, inspect your old cabinet. Remove foreign objects and fill in gouges with quick-hardening wood putty. Sand the cabinet and wipe it clean.

[] 2. Refer to the decal locations diagram. Games with painted cabinets: If this kit's decals don't cover the old graphics, repaint your cabinet with semi-gloss paint. Games with woodgrain sides: Remove the old decals and clean the side panels, so that no old glue residue remains.

[] 3. SIDE DECALS: Pencil a line roughly at the top of the old graphic. Lightly moisten the cabinet with soapy water or glass cleaner. Apply the decal, starting at the top and working downward. After the decal is in place, use a piece of the foam packaging as a squeegee and smooth the decal down. (Use a razor knife or needle to pop air bubbles in the decals.) Allow 12 hours for your decal's adhesive to set.

[] 4. Position the FCC decal near the power cord.

[] 5. Inspect your CRT shield for cigarette burns and scratches. If the CRT shield is badly marred, replace it with new clear (or smoked) acrylic shield. Place one CRT decal on the right and one on the left side. Be careful not to cover the monitor.

[] 6. Put your instruction card in the lower portion of the CRT decal (on either the right or left side of the monitor).

[] B. Marquee Modifications - Overlay

[] 7. We recommend using a new piece of clear acrylic in place of your old marquee. With the new overlay on top of an old marquee, the marquee may not transmit light as well as it did with the old game.

[] 8. Refer to the decal location diagram. Remove the old marquee. Lift the backing from the left edge of the new marquee decal. With the overlay hanging over the edge of the glass, stick down one edge on the new (or old) marquee glass. Check to see that the game name is centered and that it's aligned with the top of the glass.

[] 9. Lift the new marquee decal. Spray glass cleaner on the marquee. With one hand, peel the backing a few inches at a time. Rub down the overlay with your other hand. Where each corner of the overlay hangs over the glass, cut a 45-degree diagonal with a razor knife. Bend the marquee overlay behind the glass. Replace the marquee in the game. Your new marquee won't have any edges to be peeled off.

[] 10. If you used your old marquee and its old graphics show through your new marquee decal, disconnect the marquee light.

[] C. Control-Panel Modifications

[] 11. Remove control-panel button switches or joysticks. Clean and sand any
        imperfections on the old vinyl, or remove the old vinyl. (Blank
        control panels for WILLIAMS games are available from your authorized
        WILLIAMS distributor.)

[] 12. Leaving the backing on the new control-panel overlay, use it as a
        template to help you design your control panel.

[] 13. Leave the two player START button-holes where they are. Mark and
        drill holes as needed for the joysticks. (Plug old holes with wood
        blocks, putty, cardboard, or epoxy.) File the new holes smooth.

[] 14. Remove the backing from the control-panel overlay. Carefully place
        the overlay on top of the old control panel. Try not to get any
        bubbles under the vinyl.

[] 15. After the overlay is on securely, use a razor knife to cut holes for
        your joysticks. Place the "1 Player" and "2 Players" decals, as
        shown near the appropriate buttons. Place a joystick-direction decal
        around each joystick opening. Re-install your components on the
        control panel, and tighten them down.

[] 16. If your control panel is too thick for the kit's buttons, remove the
        switches from the buttons and shim them with the spacers (supplied).

[] D. Installing Interboard Wiring

[] 17. Disconnect the old wiring-harness from the CPU board. Using the
        schematic drawings from your old game, carefully note the function of
        each wire. Label the wires as an aid.

[] 18. Carefully remove the circuit boards and the metal circuit board panel
        or cage. Leave the transformer chassis in the game.

[] 19. Leaving several inches of wire at each connector, cut the wires near
        the game's coin door, monitor, player control panel, power supply, and
        speaker. DON'T CUT the other end of these same wires (that is, at the
        CPU-board end).

[] 20. Following the wiring drawings in your kit, splice and solder the
        coin-door (including the diagnostic switches), monitor, player control
        panel, power-supply, and speaker wires to the new CPU-board harness.
        Using electrical tape, be sure to insulate all splices.

[] 21. If your game has series-pass transistors for the power supply on a
        separate heatsink, remount the metal heatsink beside the power-supply
        board.

[] 22. Check and clean the input jack on the power-supply board. Replace any
        burned or damaged pins.

Conversion Instructions (Continued)

[] E. Installing the FCC Cage

[] 23. While installing the FCC cage, DO NOT OPEN IT. Using the screws (supplied), mount the FCC cage on one of the inside walls of the game or on the back door. (If you use the door, make sure the wiring harness reaches your power supply and control panel before screwing down the cage! Check cable length with the door open.)

[] 24. Remove one of the screws holding each of the following: the transformer, the power-supply board, the FCC cage, and the mounting plate. Wrap a ground braid or wire around each screw, and then re-install these screws securely, to obtain a good electrical ground. The FCC cage and the mounting plate MUST be grounded separately.

[] F. Hardware and Software Examination

[] 25. Check for wiring errors and leftover kit parts. Correct any errors and install all parts properly.

[] 26. Turn the game on. Run the game through all its built-in diagnostics.

[] 27. Test the operation of the game by leaving it in Auto-Cycle Mode for at least an hour. Check for error messages.

[] 28. Turn the game off. Zero the program in CMOS by removing one battery and then returning it to the CPU board. Turn the game off and on twice.

[] 29. Play the game several times before releasing it to a location.

[] G. Easel

[] 30. Fold and assemble the kit's easel. Place easel on top of finished game to attract attention and increase earnings.

Game Setup

WHEN THE GAME IS FIRST TURNED ON, its general illumination should light. A moment later, the scanning "rug pattern" (indicating RAM testing) should appear on the screen.

Next follows the ROM test: The CPU board is depicted on the CRT. Each ROM chip is shown, with the test results: Each ROM turns green, if it's good, or red, if it's bad.

IN A CORRECTLY RUNNING GAME, the testing is followed by the message "INITIAL TESTS INDICATE ALL SYSTEMS GO." If failure messages appear on the screen instead, refer to Built-In Test Procedures.

DEMAGNETIZE THE GAME with a television degaussing coil. Besides the CRT, remember to degauss large steel parts (for example, the back-door hinge). Do this as a daily procedure. Otherwise, residual magnetism may cause color impurities that may adversely affect your collections.

STARTING YOUR GAME

INSERT COINS. The game allocates an adjustable number of credits per coin and displays this number on the CRT. Factory settings are one credit per quarter. At factory settings, when two credits are displayed, pressing 2 PLAYERS START button initiates a two-player game. In two-player games, both players are up at the same time.

PLAYER CONTROLS

MOVE in any direction by manipulating the MOVE joystick.
FIRE continuously with the FIRE joystick.

PLAYING THE GAME

LASER AT THE READY, the player defends highlands and lowlands alike from the greedy cyclopes: Dohrt, Zohrt, and Mohrt (respectively worth 500, 700, and 900 points). But, even a direct hit isn't a victory in this game!

DEAD CYCLOPES TELL TALES, and the player must tag their souls before they do! A cyclops' soul is good for points, in an indirect way. Here's the trick... Players use the soul to liberate a nymph. (Nymphs, of course, are trapped in statues by the cyclopes.) Once free, nymphs flit across the screen with such attraction that all the cyclopes freeze in position...making them easy marks for our hero!

MEANWHILE, THE WILY CYCLOPES employ the highest of tech in their stealthy attacks. The player must beware of the crawling tankovs and the hovering boom birds!

WISE PLAYERS learn two tricks: (1) They can always escape the onrushing enemy by stepping onto the launchpad; (2) If they follow the enemy into the lizard's mouth, they enter the netherworld of the dead. There, if they dare, they can achieve even more points by fighting with souls!

BUY-IN FEATURE. If, during a two-player game, only one of the two players uses up all his lives, he can "buy in" (continue) where he left off. Continued games are more challenging than original games. So, continued games tend to involve skilled players at the level they prefer and to increase collections. To buy in, a player inserts his next coin, while "CONTINUE GAME" appears on the screen. Then, he pushes either of the start buttons.

Bookkeeping Totals

BOOKKEEPING TOTALS SHOW YOU AT A GLANCE whether game settings are bringing you a satisfactory return on your investment! Only games from WILLIAMS ELECTRONICS GAMES have this feature. Think of it as a unique way to keep your INFERNO game the leader of the pack when it comes to earnings...location after location, week in and week out!

AUTO-UP

○ ● ○

HIGH   MANUAL· ADVANCE
SCORE DOWN
RESET
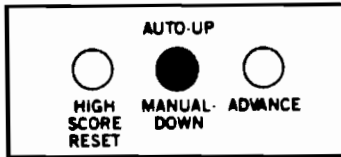
Diagnostic Button Switches

ENTERING BOOKKEEPING MODE. Inside the coin door is a bracket with three push-button diagnostic switches. It makes bookkeeping a snap! Set the AUTO-UP/ MANUAL-DOWN (center) switch to AUTO-UP. Press the ADVANCE switch to display BOOKKEEPING TOTALS on the screen. Now, check the totals. Here's what to look for...

BOOKKEEPING TOTALS

LEFT SLOT COINS	432
CENTER SLOT COINS	0
RIGHT SLOT COINS	398
PAID CREDITS	830
FREE MEN	226
TOTAL TIME IN MINUTES	34:28
TOTAL MEN PLAYED	689
TOTAL SINGLE PLAYER	548
TOTAL DUAL PLAYER	141
TOTAL BUY-IN	51
TOTAL CREDITS PLAYED	830
AVERAGE TIME PER GAME	2:00

Monitor Screen showing Bookkeeping Totals Information

AVERAGE TIME PER GAME: 2:00 (TWO MINUTES). Your most important figure on the BOOKKEEPING TOTALS screen is AVERAGE TIME PER GAME. You'll want to pay special attention to this figure every day, for this reason: Thorough field and factory research has shown that two-minute games both satisfy players and also keep the quarters flowing.

If games aren't running around two minutes long, then collections probably aren't at their peak. You'll want to tailor your game to your game-playing public. It's easy. But only WILLIAMS games let you do it!

GAME ADJUSTMENTS

EXTRA LIFE EVERY	50000
MEN FOR 1 CREDIT GAME	5
HIGH SCORE TO DATE ALLOWED	YES
PRICING SELECTION	3
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
DIFFICULTY OF PLAY	5
LETTERS FOR HIGHEST SCORE	3
ALLOW 2-PLAYER BUY-IN	YES
RESTORE FACTORY SETTINGS	NO
CLEAR BOOKKEEPING TOTALS	NO
HIGH SCORE TABLE RESET	NO
AUTO CYCLE	NO
SET ATTRACT MODE MESSAGE	NO
SET HIGHEST SCORE NAME	NO

USE 'MOVE' TO SELECT ADJUSTMENT
USE 'FIRE' TO CHANGE THE VALUE

PRESS ADVANCE TO EXIT

Monitor Screen Showing Game Adjustment Factors with the Factory Settings

Exclusive Game Adjustments

1. Inside the coin door is a bracket with three pushbutton switches.
   Set the AUTO-UP/MANUAL-DOWN (center) switch to AUTO-UP.
2. Press the ADVANCE switch twice. The GAME ADJUSTMENTS screen will
   appear.
3. Use the MOVE joystick to choose an adjustment.
4. Use the FIRE joystick to alter an adjustment.

Now begins the multiple choice section! Choose one or more:

[] EXTRA LIFE EVERY
   For a shorter game, increase the bonus-point figure, or set it to
   zero. For a longer game, reduce it. (50,000 = long/200,000 = short).

[] MEN FOR 1 CREDIT GAME
   For a shorter game, decrease the number of . For a longer game,
   increase the number. (1 = short/20 = long).

[] HIGH SCORE TO DATE ALLOWED
   1. Use MOVE to highlight HIGH SCORE TO DATE ALLOWED.
   2. Move FIRE.
   3. Press ADVANCE, to enter Game-Over Mode.

[] PRICING SELECTION
   Choose your desired game pricing selections from among the standard
   or custom options available in the Pricing Table.

[] DIFFICULTY OF PLAY
   This factor is adjustable over a broad range. Use FIRE to choose the
   appropriate level (0 = easiest or extra liberal, 5 = average, 9 =
   hardest or extra conservative).

[] LETTERS FOR HIGHEST SCORE
   The highest-scoring player can select an adjustable number of letters
   for his initials. You can vary this number from 3 to 20 letters (3
   recommended). If players enter objectionable words, you can change
   the words without deleting the scores. See SET HIGHEST SCORE NAME.

[] ALLOW 2-PLAYER BUY-IN
   1. Use MOVE to highlight ALLOW 2-PLAYER BUY-IN.
   2. Move FIRE.
   3. Press ADVANCE to enter Game-Over Mode.

[] RESTORE FACTORY SETTINGS
   1. Use MOVE to highlight RESTORE FACTORY SETTINGS.
   2. Move FIRE.
   3. Press ADVANCE twice.

[] CLEAR BOOKKEEPING TOTALS
   1. Use MOVE to highlight CLEAR BOOKKEEPING TOTALS.
   2. Move FIRE.
   3. Press ADVANCE to enter Game-Over Mode.

[] HIGH SCORE TABLE RESET
   1. Use MOVE to highlight HIGH SCORE TABLE RESET.
   2. Move FIRE.
   3. Press ADVANCE to enter Game-Over Mode.

[] AUTO CYCLE (This adjustment is actually a series of tests. Refer to
   the later text entitled Diagnostic Mode Tests.)
   1. Use MOVE to highlight AUTO CYCLE.
   2. Move FIRE to display a "YES"
   3. Press ADVANCE to enter Auto-Cycle mode. The coin door must
       remain open for this test.
   4. To exit Auto-Cycle Mode, turn the game off, and then on again.

[ ] SET ATTRACT-MODE MESSAGE
1. Use MOVE to highlight SET ATTRACT MODE MESSAGE.
2. Move FIRE.
3. Press ADVANCE.
4. Enter up to two lines of your message by following instructions on the screen.
5. Press ADVANCE to enter Game-Over Mode.

To restore the factory setting attract-mode message, perform steps 1 through 3; then, turn the game off, and back on again.

[ ] SET HIGHEST SCORE NAME
1. Use MOVE to highlight SET HIGHEST SCORE NAME.
2. Move FIRE.
3. Press ADVANCE.
4. Enter the new signature.
5. Press ADVANCE to enter Game-Over Mode.

A simpler method enters the factory highest-score signature. In the Game-Over Mode, hold down the HIGH SCORE RESET button. After a few seconds, a sound is produced and the factory signature is activated.

Coin-Door Mechanism	Games/Price	Pricing Selection	Left Slot Units	Center Slot Units	Right Slot Units	Units Req'd For Credit	Units Req'd For Bonus Credit	Min. Units For Any Credit
Twin Quarter	*1/25¢, 4/$1	3	1	4	1	1	0	0
or	*1/50¢, 2/$1	5	1	4	1	2	0	0
Quarter,	1/50¢, 2/75¢, 3/4x25¢	0	3	12	3	4	15	0
Dollar,	2/25¢, 8/$1	0	2	8	2	1	0	0
Quarter	1/25¢, 3/50¢, 6/$1	0	1	4	1	1	2	0
	1/25¢, 5/$1	0	1	4	1	1	4	0
(USA & Canada)	*1/50¢, 3/$1	0	1	4	1	2	4	0
1DM, 5DM	2/1DM, 12/5DM	0	12	0	2	2	0	0
(West Germany)	*1/1DM, 6/5DM	2	6	0	1	1	0	0
1F, 5F, 10F (France)	1/3x1F, 2/5F, 5/10F	0	2	10	20	5	20	0
25-Cent,	*1/25¢, 4/1G	6	1	0	4	1	0	0
1 Guilder (Netherlands)	1/25¢, 5/1G	0	1	0	5	1	0	0
5 Franc,	*1/5F, 2/10F	7	1	0	2	1	0	0
10 Franc (Belgium)	*1/10F	8	1	0	2	2	0	0
1F, 2F (Switzerland)	1/1F, 3/2F	0	3	0	6	2	0	0
Twin 100-Yen (Japan)	*2/100Y	5	1	4	1	2	0	0
Twin 100L (Italy)	*1/200 Lire	5	1	4	1	2	0	0
20¢, $1 (Australia)	1/40¢, 3/$1	0	1	0	6	2	0	0
10P, 50P (UK)	1/10P, 5/50P	0	1	5	1	1	0	0
Twin Coin	*1/1 Coin	3	1	4	1	1	0	0
	*1/2 Coins	5	1	4	1	2	0	0
	1/4 Coins	0	1	4	1	4	0	0
	*1/2 Coins, 3/4 Coins	1	1	4	1	2	4	0
	1/3 Coins, 2/5 Coins	0	2	0	2	5	0	0
	*1/2, 3/5	4	1	16	6	2	0	0
1-Unit,	1/1, 5/5	0	1	0	5	1	0	0
5-Unit	1/3, 2/5	0	2	0	10	5	0	0
Any	*Free Play	9	0	0	0	0	0	0

Game Pricing

PRICING SELECTION allows a <u>fast</u> method of setting the game pricing functions. If a number from 1 to 9 is entered into the PRICING SELECTION function, a corresponding standard setting (shown in the Pricing Table) will be entered into the game. <u>The rest of the pricing functions are automatically set for that standard.</u>

FOR CUSTOM SETTINGS, first set PRICING SELECTION to zero. Then, set the remaining values according to the Pricing Table.

THE GAMES : PRICE RATIO is equivalent to the ratio X : VC, where:
    X = SLOT UNITS
    V = COIN VALUE
    C = UNITS REQUIRED FOR CREDIT

For example, at factory settings with quarter chutes, the ratio is 1 : 25x1, or one game for 25¢.

UNITS REQUIRED FOR BONUS CREDIT is the number of units that must accumulate either by coin or bonus score awarding, before credits entitling the player to a free game is available. The factory setting for this function is 0. <u>This 0 means that the BONUS-CREDIT feature is disabled.</u>

MINIMUM UNITS FOR ANY CREDIT determines the number of games that must be purchased before play may begin. The factory setting for this function is 0. <u>This 0 means that the MINIMUM-UNITS feature is disabled.</u>

POWER-UP TESTS

To ensure player satisfaction, the game automatically proceeds through a series of operational tests to verify proper operation, each time you turn it on. Any problems found during these tests produce messages on the CRT screen to indicate the nature of the problem found.

*   SCREEN RAM TEST. Screen RAMS (dynamic type) are tested in the following manner: A <u>rug pattern</u> scans across the screen. The LED display on the CPU-board signals a bad RAM with an error code between 100 and 199 (e.g., 1-2-1: The code numbers appear one at a time). A code 198 designates RAM 98, and a code 199 designates RAM 99. <u>The rest of the RAMs (chips 100 to 121) are designated by their chip numbers.</u>

    Screen RAMs are located on the video board. If you suspect a RAM error, check all three DC voltages to the RAM indicated: -5 at pin 1; +12 at pin 8; +5 at pin 9. None of these should have more than a few millivolts of AC on it. <u>Never replace a RAM chip, until you prove that these voltages are normal!</u>

*   ADDITIONAL RAM TESTS. <u>Power-Up Tests</u> include separate tests for seven more RAMs. On the video board, the background RAM (U40) and the four color RAMs (U75, U76, U77, and U78) are checked. Two CPU-board RAMs (U54 and U55) are also tested. Details follow...

RAM	DESCRIPTION	IC NO.	BOARD	ERROR CODE
background	TC5516AP or 2016, 2Kx8	40	video	440
color RAM	2148 or 2149, 1kx4	75	video	575
color RAM	2148 or 2149, 1kx4	76	video	576
color RAM	2148 or 2149, 1kx4	77	video	577
color RAM	2148 or 2149, 1kx4	78	video	578
static RAM	6810, 128x8	7	CPU	none
static RAM	6116, 2kx8	54	CPU	654
static RAM	6116, 2kx8	55	CPU	655

* ROM TEST. The CPU-board is depicted on the CRT. Each ROM chip is shown. Each ROM turns green, if it's good, and red, if it's bad, to indicate the test results.

The LED display (on the CPU-board) signals a bad ROM with an error code between 200 and 299 (e.g., 2-1-1: See the table titled ROM Summary for codes). Because diagnostics are stored in ROM, the ROM test's accuracy depends on which chip is bad. After replacing suspected chips, always rerun the diagnostics. (Note: Unlike RAMs, ROMs are NOT interchangeable.)

* CMOS RAM DATA TEST. Checksums are compared. If faults are detected, the program attempts to correct them (for example, by restoring factory settings to substitute for lost data). If it can't, the game won't operate and you'll have to run the CMOS RAM test. Screen indications are explained in the text titled CMOS RAM Test.

Your Game's Diagnostic Mode Features

SET THE AUTO-UP MANUAL-DOWN SWITCH to the MANUAL-DOWN position and press ADVANCE. The game is now in its Diagnostic Mode, and a ROM test is performed. With ROM test results present on the CRT display, set the AUTO-UP/MANUAL-DOWN switch to the AUTO-UP position. Enter subsequent tests by pressing ADVANCE once more for each test. After the last test, Game-Over Mode commences.

AUTO-CYCLE MODE initiates continuous ROM, RAM, and CMOS RAM tests to detect failures that only occur after numerous checksum comparisons. If an error is detected, Auto-Cycle Mode is aborted, and a failure message appears on the CRT.

1. Open the coin door. It must remain open for AUTO CYCLE.
2. Display GAME ADJUSTMENTS.
3. Move down to AUTO CYCLE.
4. Display YES.
5. Press ADVANCE.
6. To enter Game-Over Mode, turn the game off, and then back on.

DIAGNOSTIC MODE TESTS

* RAM AND ROM TESTS...Refer to the earlier text (POWER-UP TESTS) concerning the Screen-RAM Test, Additional RAM Tests, and ROM Test information. In the Diagnostic Mode, these tests are repeated; however, the ROM test is performed first.

* CMOS RAM TEST. The CMOS RAM (U59) is on the CPU board. A chip error is displayed on the CRT and the LED display on the CPU board. If this chip is bad, an error code, 359, appears on the LED display.

    When the CMOS RAM fails the test (or a memory-protect failure occurs), FACTORY SETTINGS RESTORED appears on the CRT. Meanwhile, the LED display indicates 300. In this case, Bookkeeping Totals reset to zero.

    However, the CMOS RAM itself isn't always the cause of such problems. For example, a game without battery power reverts to factory settings. NOTE: Whenever factory settings are restored, your custom settings are lost and must be re-entered.

    If the game always comes on with the display FACTORY SETTINGS RESTORED, troubleshoot the game: With power OFF, check for a minimum of 3.5VDC at pin 18 of the CMOS RAM (chip U59) on your CPU board.

    1. Less than 3.5VDC. Replace the three AA alkaline batteries.
    2. No voltage. Matching polarity, replace diode D2 (type 1N4148) on the CPU Board. Now, recheck the voltage at pin 18 of chip U59.
    3. Voltage is present. Test the memory-protect switch on the coin door and the wiring to the CPU board. Check memory-protect gates 5F, 6D, 6E, 7E, and transistor Q2.

        A. You should have a pulsing signal at pin 10 of U59, when the coin door is open.
        B. You should see a long pulse (inverted reset-pulse) at pin 8 of U59 when you first turn on the game. This pulse holds pin 8 high for about a second.
        C. The long pulse should then be followed by a continuously-pulsing signal.

* SOUND TEST. One by one, sound lines 1 through 6 are pulsed. When a sound line is pulsed, its number appears on the CRT. You should hear a separate sound for each sound line. If a sound is missing, its corresponding line is stuck high or stuck low. If two lines produce the same sound, they're shorted together.

    Use AUTO-UP to cycle through all the sounds. Press MANUAL-DOWN to continuously test one sound line.

    Sound Test Trouble Analysis
    1. NO SOUND: Check the sound-select inputs (pins 2 through 9 of IC 4) on the CPU board for pulsing during the test. Also, check for shorts between sound lines. Repair as necessary.

        NOTE: The SOUND DIAGNOSTIC BUTTON on the CPU board is NOT used in this game. Pressing this switch accidentally causes game sounds to be disabled, until you turn the game off and on again.

2. STILL NO SOUND: Turn the volume control fully on. With the game turned
   on, momentarily touch a powered-up AC soldering-pencil on the center tap
   of the volume control. (CAUTION: DO NOT use a soldering iron of over
   40 watts. Cordless (DC) irons will NOT work here.)
   A. If you hear a low hum, the power-amplifier chip (TDA2002A), volume
      control, and speaker are okay.
   B. If you don't hear a hum, try the test again with the volume control
      turned halfway up.

3. GARBLED SOUNDS: One at a time, replace microprocessor (IC 27) and sound
   ROM (IC 8) on the CPU board.

* CROSSHATCH PATTERN. This screen aids the technician in converging the
  monitor.

* COLOR PURITY SCREENS. The solid red, green, and blue screens are intended
  for monitor adjustments and for checking the color RAMs (ICs 75 through 78
  on the video board). If these screens show contaminated colors, degauss
  the monitor, and adjust the purity magnets. If colors are missing, one of
  the color RAMs may be bad.

  A color purity screen with vertical lines through it also signals a color
  RAM error. (Don't confuse the purity screens with the crosshatch pattern
  or color bars. These two patterns are supposed to have vertical lines!)

* COLOR BARS. From the left to right on the CRT, you should see: red, green,
  blue, black, white, yellow, cyan, and magenta. These enable you to make
  monitor adjustments and to check the color RAMs. The bars serve as a color
  and brightness reference, when you adjust the color drives and cutoffs,
  screen, and black-level controls.

  If any color is missing or any wrong colors are displayed, you may have a
  defective color RAM.

* SWITCH TEST. The name of the switch is highlighted on the CRT, when that
  switch is closed. Close each of your game's switches. The names of open
  switches don't appear on the screen. Stuck switches appear constantly.

  A problem in the I-O port circuitry can also mimic a bad switch. Wiring
  cables, buffers, or a PIA may be involved. After first checking the switch
  and then the wiring for the cause of the problem, you then check components
  on the CPU board near PIAs IC5 and IC6. Buffers (ICs 43, 44, 45, and 46)
  are more likely to be at fault than a PIA.

  1. Trace the switch line (on your CPU board schematic), and check the
     appropriate buffer:
     A. Does the buffer have +5V at pin 1?
     B. Press (or ground) the switch in question.
     C. Does a low appear on the input of the buffer, AND a high at the
        buffer output? (Any other signals indicate the buffer to be bad!
  2. Is the PIA's input pin following the signal at the buffer's output?

To exit the Switch Test, you must hold ADVANCE down, until the next screen
appears.

A Word About Troubleshooting

WILLIAMS ELECTRONICS GAMES PROVIDES EXTENSIVE DIAGNOSTICS in its games. These can be a dramatic timesaver in your servicing work. Familiarity with the service literature can also enhance troubleshooting. In the few instances when you can't find the problem using the built-in diagnostics, these hints may help...

1. GIVE YOUR GAME A VISUAL INSPECTION in the suspected area. Bad connections are common in older games. Are the plug-in chips firmly seated in their sockets? Are connectors securely mated?

2. THINK OVER THE SYMPTOMS and then jot them down. Keeping notes defines the details of your problem. Also, keep notes of test results as you perform them; this prevents wasted time going over the same tests.

3. YOUR ANALYSIS SHOULD REVEAL which tools you need: Multimeter (analog or digital), logic probe, oscilloscope, or other diagnostic equipment. Gather your tools.

4. CHECK YOUR VOLTAGES. Check regulated and unregulated DC voltages first, at the output of the power supply. If any DC voltage is missing, check the AC voltage at the fuse (with reference to its return line to the transformer). Use your Power-Wiring Diagram and Interboard-Wiring Diagram to find the fuse's location.

5. SWAP INTERCHANGEABLE BOARDS and chips that relate to your problem.

6. AFTER YOU'VE ISOLATED THE SUSPECTED CIRCUIT, use your logic probe or oscilloscope to locate the problem.

WARNING

FOR SAFETY AND RELIABILITY, WILLIAMS ELECTRONIC GAMES does not recommend or authorize any substitute parts or modifications of WILLIAMS equipment.

USE OF NON-WILLIAMS PARTS and modifications of game circuitry may adversely affect game play, or may cause injuries.

SUBSTITUTE PARTS OR EQUIPMENT MODIFICATIONS may void FCC type-acceptance.

SINCE 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

THREE-WIRE PLUG. 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 power cord, and DO NOT cut off the ground pin.

CAUTION

This kit is intended for use only on coin operated video games manufactured after January 1, 1983, which have been verified for compliance with the requirements in Part 15 of FCC Rules for Class A computing device. Improper connection of this kit or connection to any other coin operated video game not so manufactured or verified for compliance may cause unacceptable interference to radio and TV reception requiring the operator to take whatever steps are necessary to correct the interference. WILLIAMS ELECTRONICS GAMES, INC., takes no responsibility for kits improperly connected and those connected to games for which use is not intended.

NOTICE

INFERNO is a registered trademark of WILLIAMS ELECTRONICS GAMES, INC.

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Main Harness Wiring - Color Code

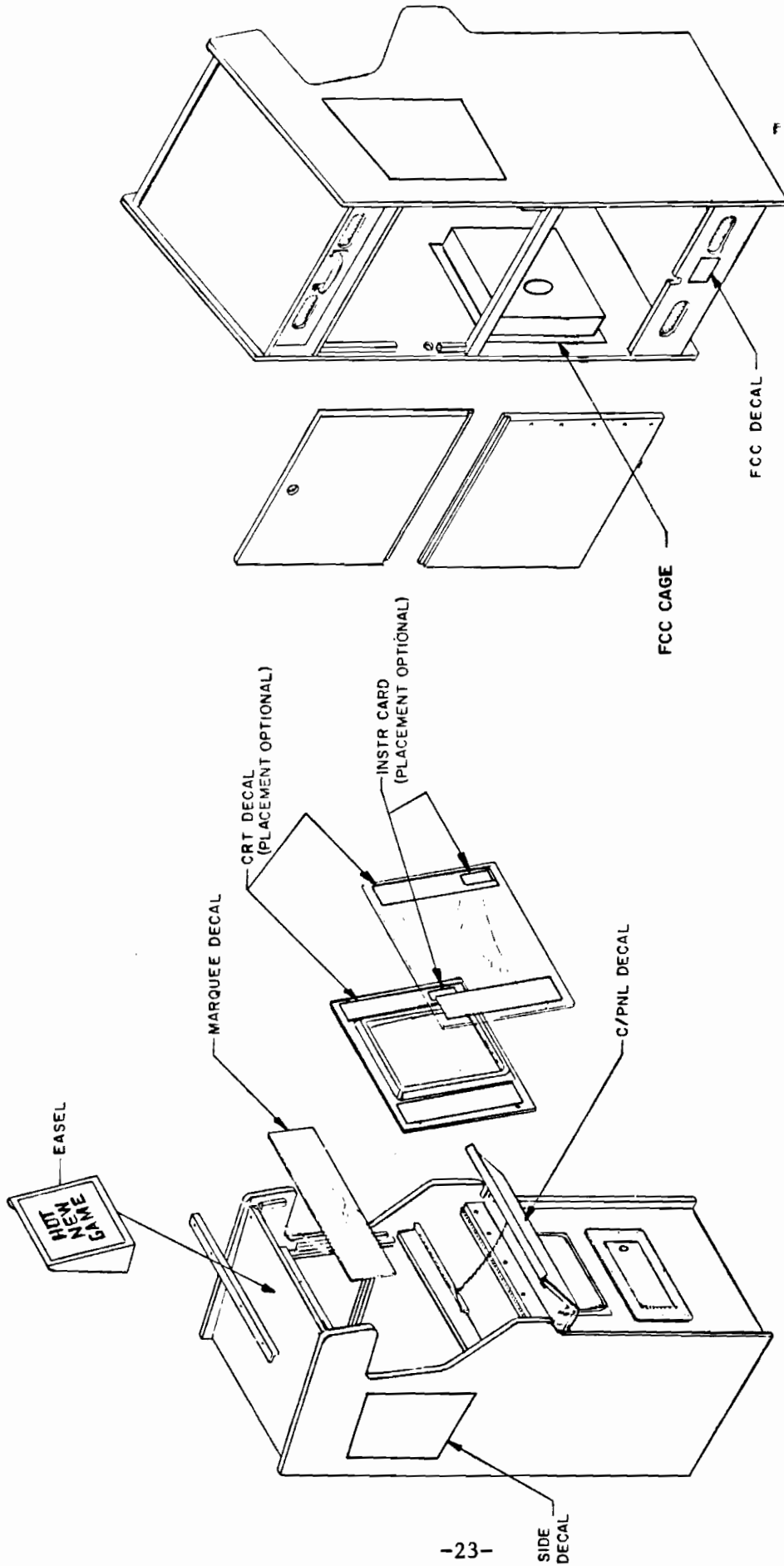| COLOR	FUNCTION
GREEN-BLACK	switch ground
BLACK	ground
GRAY	+5 volts
GRAY-YELLOW	+12 volts regulated
GRAY-WHITE	+12 volts unregulated
ORANGE	-5 volts
RED-BLACK	speaker +
BLACK-RED	speaker -
RED-ORANGE	MEMORY-PROTECT switch*
WHITE-VIOLET	SLAM-TILT switch**
YELLOW-WHITE	RIGHT-COIN switch
WHITE-BLUE	LEFT-COIN switch
WHITE-GRAY	HIGH-SCORE RESET switch
GREEN	ADVANCE switch
BLUE	AUTO-UP/MANUAL-DOWN switch
ORANGE-BLUE	FIRE UP-LEFT P1-joystick switch
ORANGE-YELLOW	FIRE UP-RIGHT P1-joystick switch
ORANGE-WHITE	MOVE DOWN-LEFT P2-joystick switch
RED-GRAY	MOVE DOWN-RIGHT P2-joystick switch
RED-BROWN	MOVE UP-LEFT P2-joystick switch
ORANGE-GRAY	MOVE UP-RIGHT P2-joystick switch
ORANGE-BROWN	MOVE DOWN-LEFT P1-joystick switch
ORANGE	MOVE DOWN-RIGHT P1-joystick switch
ORANGE-RED	MOVE UP-LEFT P1-joystick switch
ORANGE-BLACK	MOVE UP-RIGHT P1-joystick switch
YELLOW-BLUE	2-PLAYER START switch
YELLOW-GREEN	1-PLAYER START switch
RED-WHITE	FIRE DOWN-LEFT P2-joystick switch
RED-GREEN	FIRE DOWN-RIGHT P2-joystick switch
RED-YELLOW	FIRE UP-LEFT P2-joystick switch
RED	FIRE UP-RIGHT P2-joystick switch
ORANGE-GREEN	FIRE DOWN-LEFT P1-joystick switch
ORANGE-VIOLET	FIRE DOWN-RIGHT P1-joystick switch

Shielded Video-Cable Colors

RED	video red
BROWN	video blue
GREEN	video green
BLACK	video-sync vertical
WHITE	video-sync horizontal
SHIELD	video ground

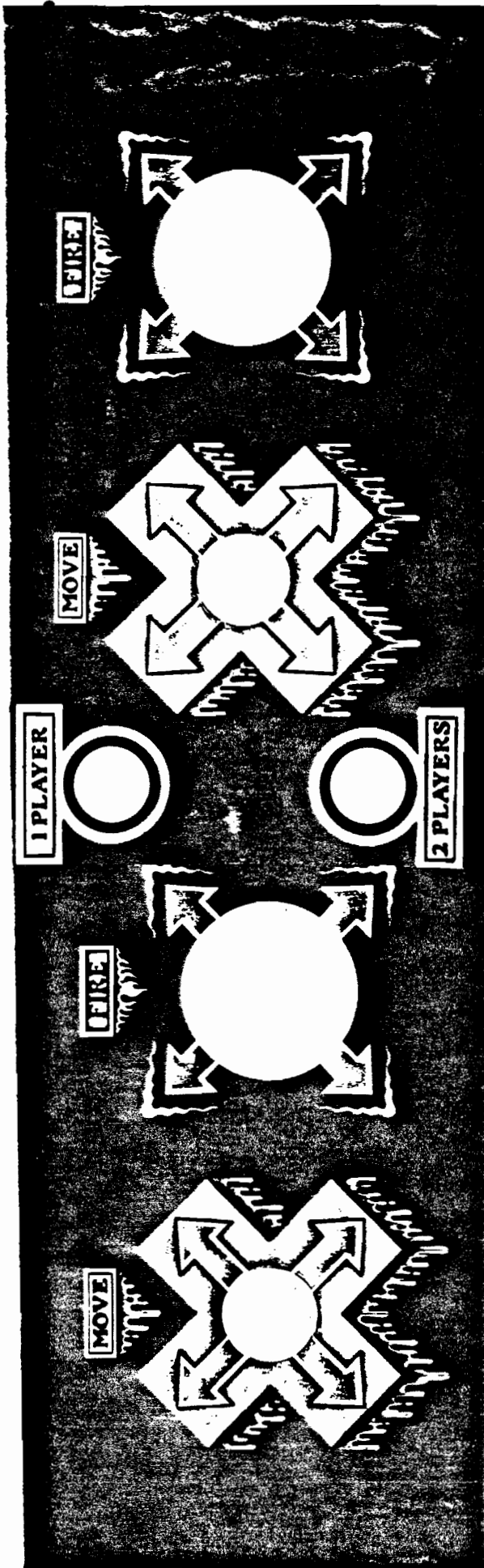Shielded Volume-Cable Colors

RED	positive
BLACK	negative
SHIELD	ground

* If you're converting a non-WILLIAMS game, the MEMORY-PROTECT feature is optional. You can order the MEMORY-PROTECT switch and bracket assembly (P/N A-8630) from your authorized WILLIAMS ELECTRONICS GAMES distributor.
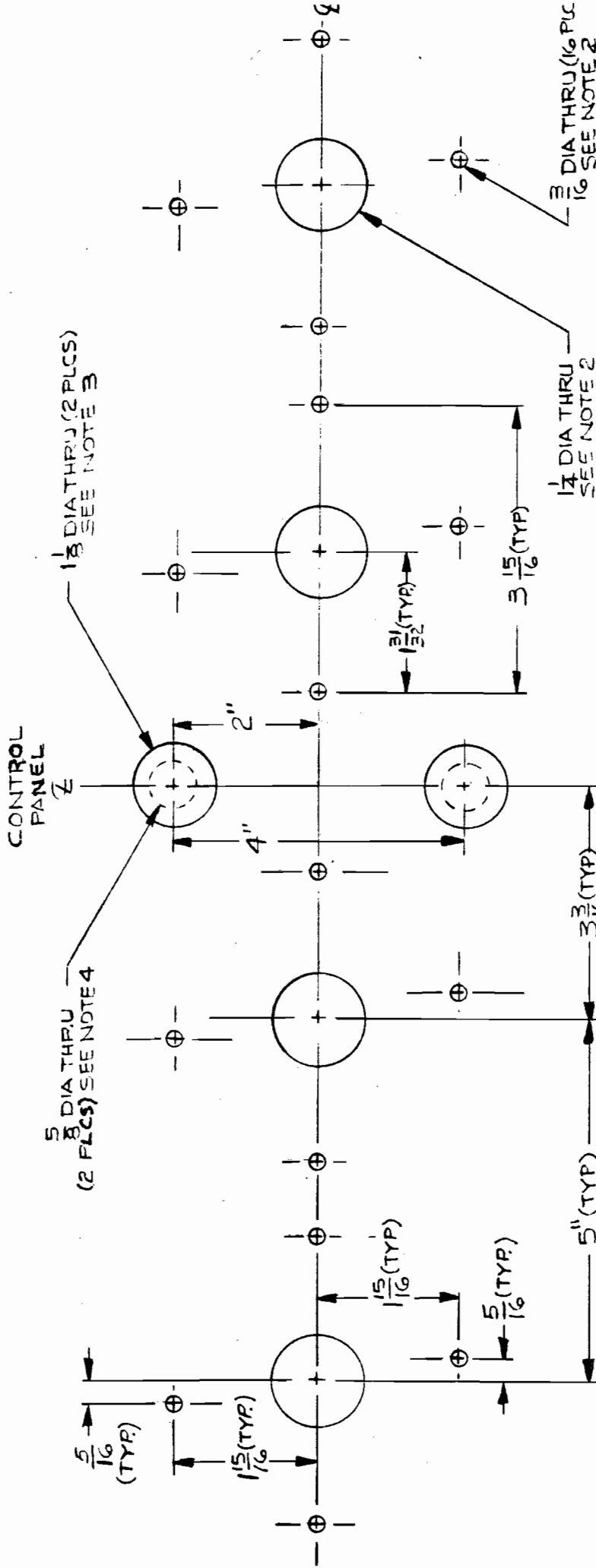
** The kits's SLAM-TILT switch can be wired to the existing SLAM-TILT device in your game's coin door.
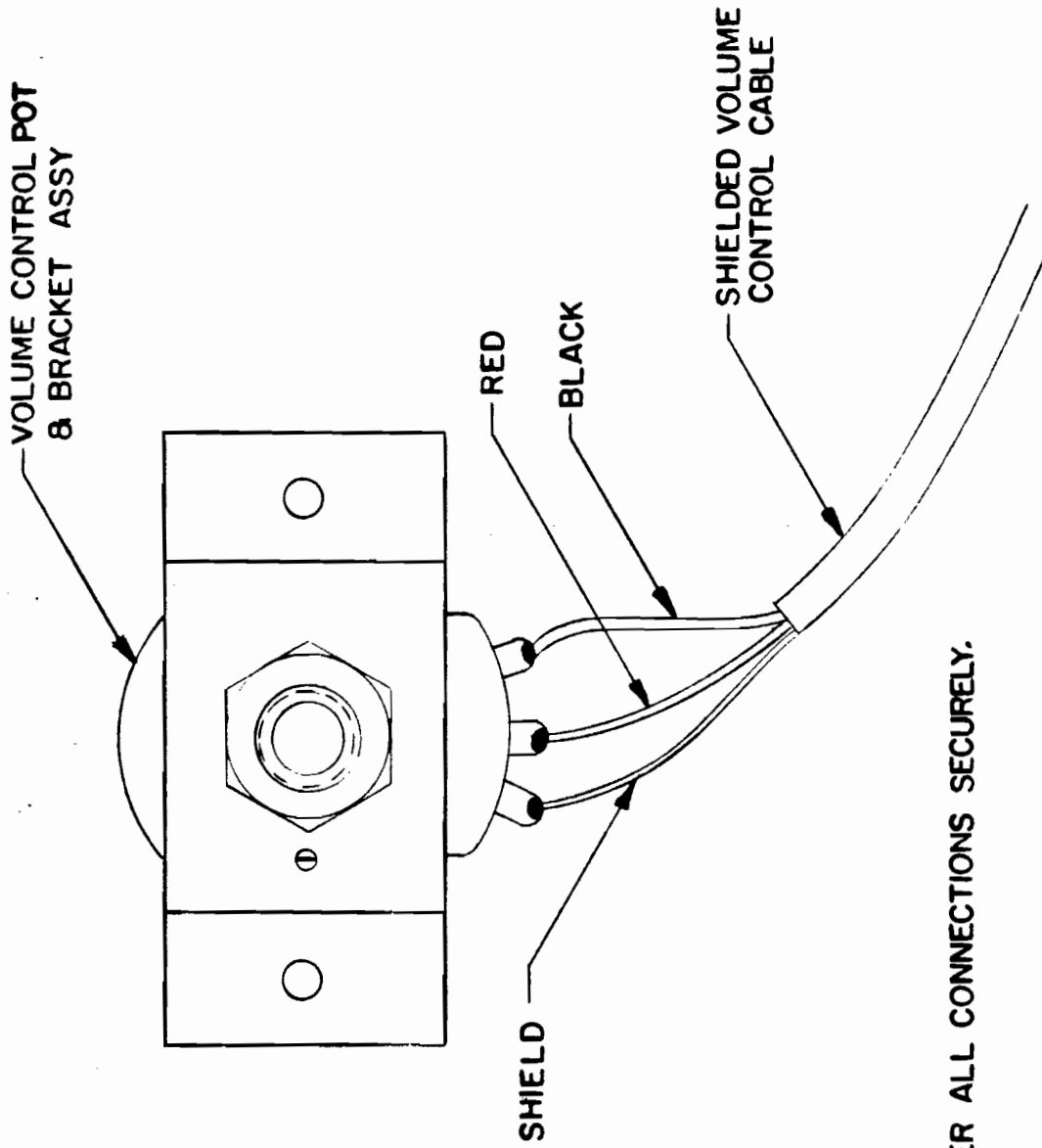
DECAL LOCATIONS

HOT
NEW
GAME

EASEL

MARQUEE DECAL

CRT DECAL
(PLACEMENT OPTIONAL)

INSTR CARD
(PLACEMENT OPTIONAL)

C/PNL DECAL

SIDE
DECAL

FCC CAGE

FCC DECAL

F

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"INFERNO"
CONTROL PANEL DECAL LAYOUT

"INFERNO"
CONTROL PANEL LAYOUT

$\frac{3}{16}$ DIA THRU (16 PLCS)
SEE NOTE 2

$1\frac{1}{4}$ DIA THRU
SEE NOTE 2

$1\frac{1}{8}$ DIA THRU (2 PLCS)
SEE NOTE 3

CONTROL
PANEL
"Z"

2"

4"

$\frac{5}{8}$ DIA THRU
(2 PLCS) SEE NOTE 4

$3\frac{15}{16}$(TYP)

$1\frac{31}{32}$(TYP)

$3\frac{3}{16}$(TYP)

$1\frac{15}{16}$(TYP)

$\frac{5}{16}$(TYP)

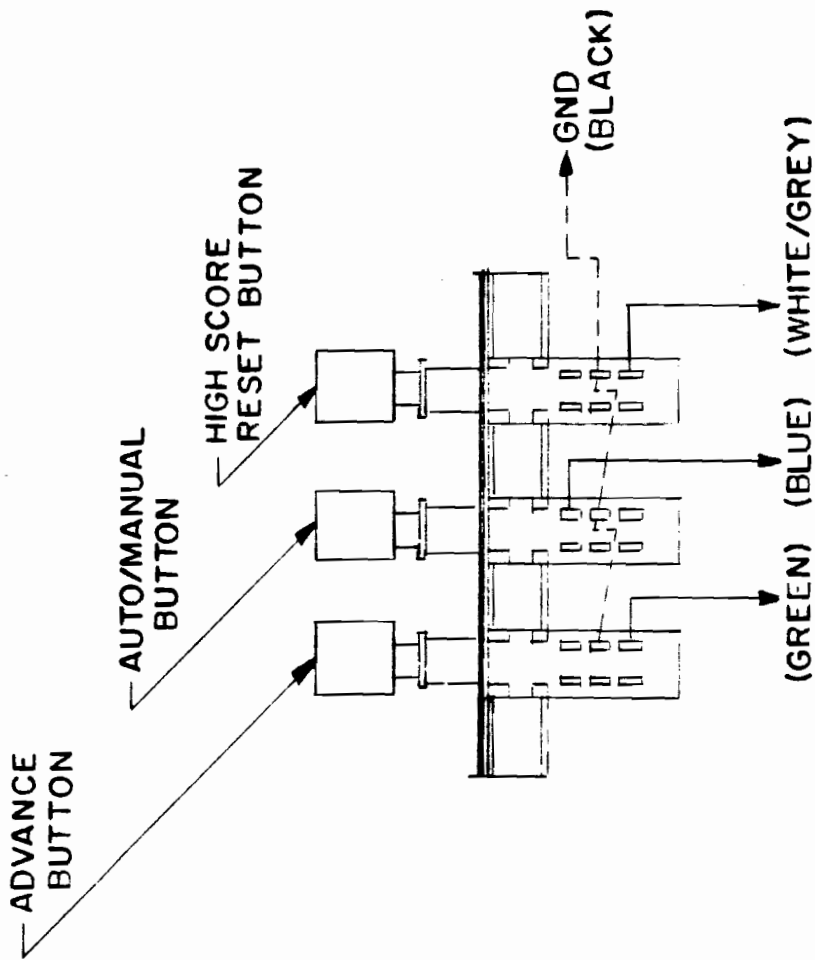5"(TYP)

$\frac{5}{16}$
(TYP.)

$1\frac{15}{16}$(TYP.)

NOTES:

1. DRAWING NOT TO SCALE.

2. JOYSTICKS ARE TO BE MOUNTED AT A 45° ANGLE.

3. THESE DIMENSIONS ARE FOR YOUR REFERENCE AND REFER TO METAL CONTROL CONTROL PANELS.

4. FOR WOOD CONTROL PANELS OR CONTROL PANELS WITH WOOD INSERTS, DRILL $1\frac{1}{8}$ DIA HOLES TO 5/16 DEPTH, THEN DRILL 5/8 DIA HOLES COMPLETELY THROUGH.

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VOLUME CONTROL POT
& BRACKET ASSY

RED

BLACK

SHIELDED VOLUME
CONTROL CABLE

SHIELD

NOTE:
SOLDER ALL CONNECTIONS SECURELY.

"INFERNO"
VOLUME CONTROL WIRING

ADVANCE BUTTON

AUTO/MANUAL BUTTON

HIGH SCORE RESET BUTTON

GND (BLACK)

(WHITE/GREY)

(BLUE)

(GREEN)
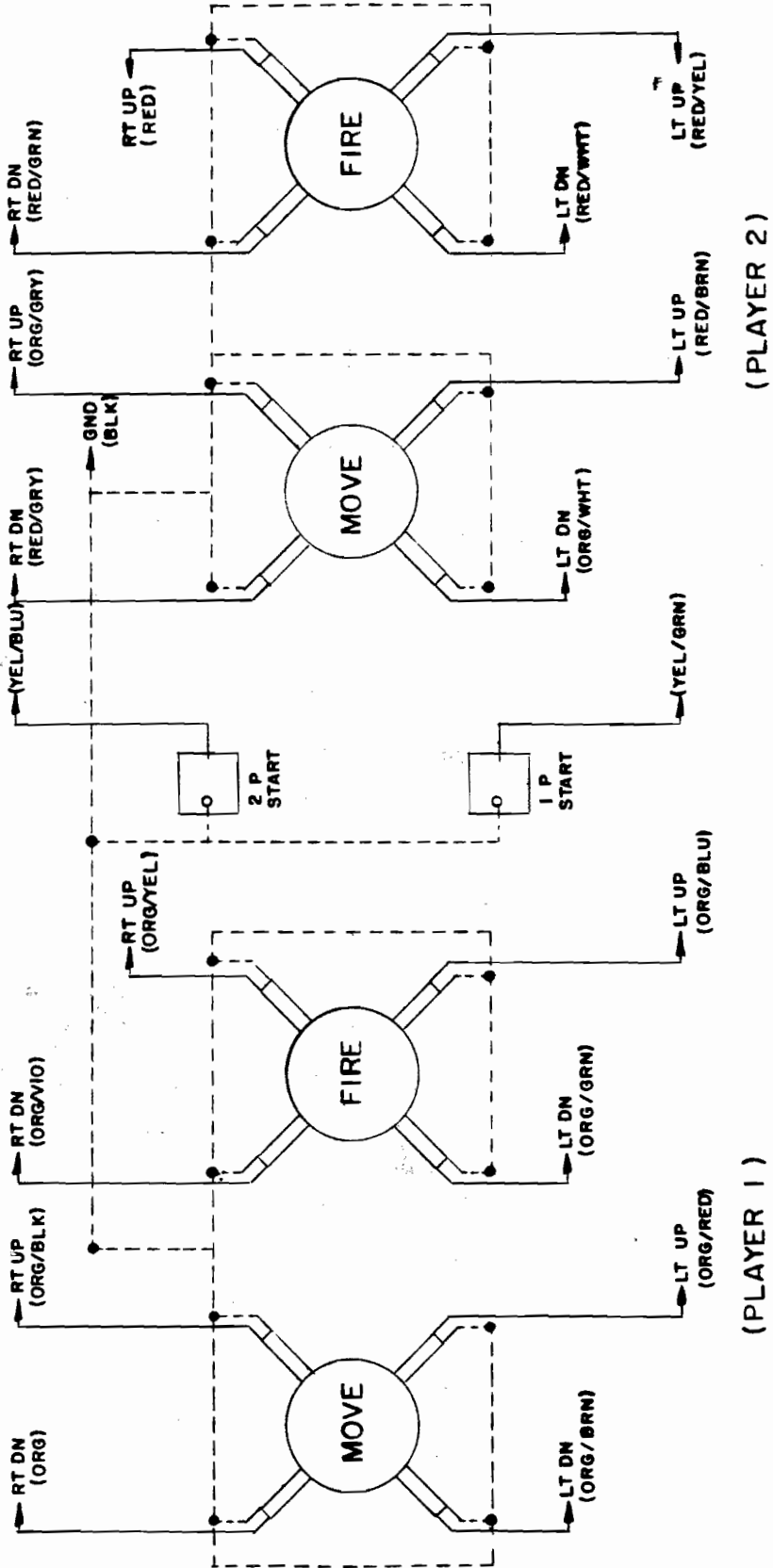
NOTE:

SOLDER ALL CONNECTIONS SECURELY.

INFERNO

DIAGNOSTIC SWITCH WIRING

NOTE:

LAYOUT LOOKING FROM INSIDE
OF CONTROL PANEL.

(PLAYER 2)

(PLAYER 1)

"INFERNO"

CONTROL PANEL WIRING

FIRE

MOVE

FIRE

MOVE

RT UP (RED)
RT DN (RED/GRN)
LT UP (RED/YEL)
LT DN (RED/WHT)
RT UP (ORG/GRY)
LT UP (RED/BRN)
GND (BLK)
RT DN (RED/GRY)
LT DN (ORG/WHT)
(YEL/BLU)
(YEL/GRN)
2 P START
1 P START
RT UP (ORG/YEL)
LT UP (ORG/BLU)
RT DN (ORG/VIO)
LT DN (ORG/GRN)
RT UP (ORG/BLK)
LT UP (ORG/RED)
RT DN (ORG)
LT DN (ORG/BRN)

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