



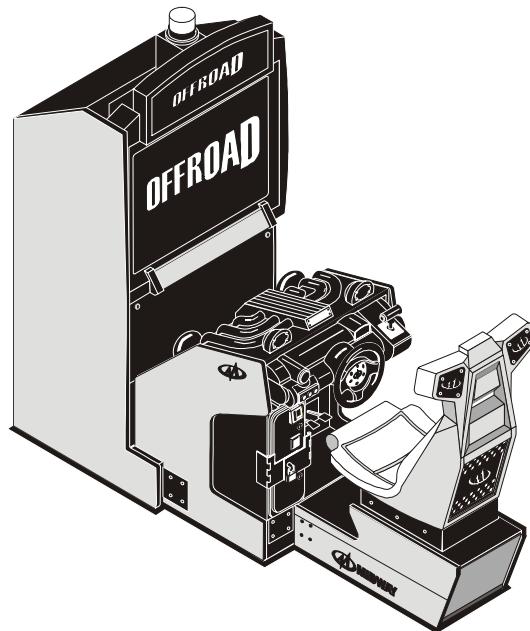
DECEMBER 1999
16-20041-101

<http://www.midway.com>



TM

**Sit-In,
Dedicated
39" Video
Game**



Operation Manual



- Setup
- Operation
- Audits
- Wiring
- Servicing
- Troubleshooting
- Parts

QUICK-START LINKING GUIDE

	NOTICE: Before completing installation, verify that each cabinet has a <i>separate and unique ID</i> . Otherwise the link won't function. For further information, see <i>Linked-Play Adjustments Menu</i> in Chapter Three of this manual.
	NOTICE: To link three or four cabinets, you must use an Ethernet hub.

SET UP THE LINKS

- [] 1. Switch off power to all cabinets. Remove cabinet access doors and linking cables. Check cabinet linking cables. One end of each linking cable must attach to the Arcade Computer's network interface jack.
- [] 2. *To link two cabinets:* If you're only linking two cabinets, use one coupler. You don't need a hub. (You'll find a coupler in a Manila envelope inside the cashbox.)
- [] 3. *To link three or more cabinets:* You need to add a hub to your network. Place the hub near the rear of the cabinets. Connect all linking cables. When you use a hub, *don't* use any couplers.
- [] 4. Turn on cabinet power.

ADJUST GAME OPTIONS

	CAUTION: Don't connect or disconnect cables to the game electronics or hub with the power on. Otherwise, you may damage the electronics and void your warranty.
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- [] 1. Find the diagnostic switches behind each cabinet's coin door. Press and hold each cabinet's TEST MODE button to enter the Menu System.
- [] 2. From each cabinet's Operator Menu, select the Adjustments Menu.
- [] 3. From each cabinet's Adjustments Menu, select the Linked Play Adjustments Menu.
- [] 4. **LINKED PLAY.** At each cabinet, set the LINKED PLAY option to YES.
- [] 5. **UNIT ID.** Each cabinet must have a unique unit ID. Set the option UNIT ID to a separate number for each cabinet.
- [] 6. **EXIT** the menu system.
- [] 7. **RESTART ALL CABINETS.** After the machines reinitialize, they'll operate in Linked Mode.
- [] 8. **TEST THE SYSTEM.** Test the network by playing a Linked Mode game on all linked machines.

DECLARATION OF CONFORMITY

MIDWAY GAMES, INC.

3401 N. CALIFORNIA AVE.
CHICAGO, IL 60618
U.S.A.

WE, HEREBY DECLARE UNDER SOLE RESPONSIBILITY THAT

THE MODEL: "*OFFROAD THUNDER*"39": 230241, 20341, 20441, 20741, 20941, 21041, 21141,
21241, 21341 21441, 21841, 21941, 22041, 22141, 22241, 22341, 27241

**TO WHICH THIS DECLARATION RELATES IS IN CONFORMITY WITH THE
FOLLOWING EUROPEAN PRODUCT SAFETY DIRECTIVES:**

ELECTROMAGNETIC COMPATIBILITY DIRECTIVE
(89/336/EEC AND AMENDMENTS 91/C162/08, 92/31/EEC, 93/68/EEC)

**ELECTRICAL EQUIPMENT DESIGNED FOR USE WITHIN
CERTAIN VOLTAGE LIMITS DIRECTIVE**
(73/336/EEC AND AMENDMENTS 88/C168/02, 92/C210/01,
93/68/EEC, 94/C199/03, 95/C214/02)

AS IS VERIFIED BY COMPLIANCE WITH THE FOLLOWING STANDARDS:

EN55014: 1993	EN61000-4-2: 1995
IEC 801-3: 1984 (EN61000-4-3)	EN61000-4-4: 1995
EN61000-4-5: 1995	EN335-1: 1995
IEC 335-2-82 (DRAFT)	

Date issued: OCTOBER 27, 1999

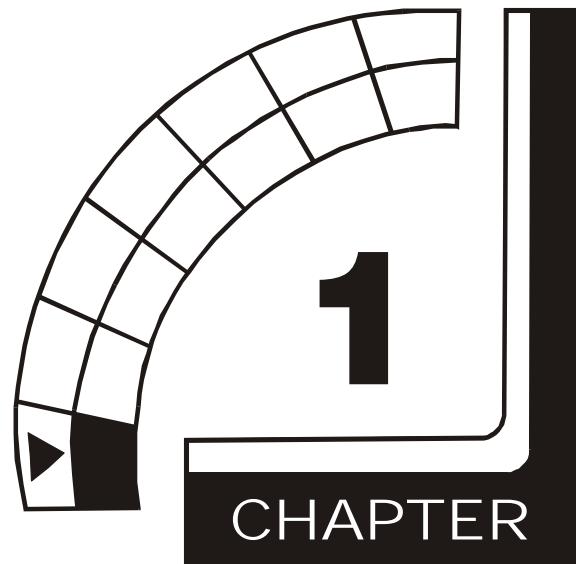


DAN GALARDE

CORPORATE V.P. OF QUALITY

OFFROAD

THUNDER™



SETUP



NOTICE: This manual is subject to change without notice. Midway reserves the right to make improvements in equipment function, design, or components as progress in engineering or manufacturing methods warrant.

Fill out and mail in the Game Information Card. Include the game serial number from the label on the rear of the cabinet. For your records, write the game serial number in the manual. SERIAL NUMBER

SAFETY INSTRUCTIONS

The following safety instructions apply to operators and service personnel. Read these instructions before preparing your game for play. Other safety instructions appear throughout this manual.

DEFINITIONS OF SAFETY TERMS

DANGER: If you fail to avoid this hazard, it *will* cause death or serious injury.

WARNING: If you fail to avoid this hazard, it *could* cause death or serious injury.

CAUTION: If you fail to avoid this hazard, it *may* cause minor or moderate injury. CAUTION also alerts you about unsafe practices.

NOTICE indicates information of special importance.

	WARNING: TRANSPORTING GAMES. This game contains glass and fragile electronic devices. Use appropriate care when transporting this game. Avoid rough handling when moving the cabinet. Don't move this game with the power on.
	WARNING: DISCONNECT POWER. Always turn power OFF and unplug the game before servicing or adjusting. Installing or repairing PC boards with power ON can damage components and void the warranty. Be sure to securely install ground wires.
	WARNING: GROUND GAMES. Avoid electrical shocks! Don't plug in a game until you have inspected and properly grounded it. Only plug this game into a grounded, three-wire outlet. Don't use a "cheater" plug, or cut off the ground pin on the line cord.
	WARNING: HAZARD TO EPILEPTICS. A small portion of the population has a condition which may cause epileptic seizures or momentary loss of consciousness when viewing certain kinds of flashing lights or patterns that are present in our daily environment. These persons experience seizures while watching some television pictures or playing certain video games. People who have not had seizures may nonetheless have an undetected epileptic condition. If anyone in your family has experienced symptoms linked to an epileptic condition (e.g., seizures or loss of awareness), consult your physician before using video games. Parents should observe their children while they play video games. If you or your child experience the following symptoms: dizziness, altered vision, eye or muscle twitching, involuntary movements, loss of awareness, disorientation, or convulsions, <i>discontinue use immediately</i> and consult a physician.
	WARNING: AVOID ELECTRICAL SHOCKS. This video game system does not utilize an isolation transformer. Internal, cabinet AC isn't isolated from the external, AC line.
	WARNING: HANDLE FLUORESCENT TUBE AND CRT WITH CARE. If you drop a fluorescent tube or CRT and it breaks, it will implode! Shattered glass can fly eight feet or more from the implosion.
	CAUTION: CHECK POWER SELECTOR. Set the 110/220VAC selector on the power supply for the correct line voltage. Check the selector setting before switching on the game.

	CAUTION: USE PROPER FUSE. Avoid electrical shock! Replacement fuses must be of the same type as those they replace. Fuse voltage and current ratings must match ratings on the original fuse.
	CAUTION: ATTACH CONNECTORS PROPERLY. Be sure that printed circuit board (PCB) connectors mate properly. If connectors don't slip on easily, don't force them. A reversed connector may damage your game and void the warranty. Connector keys only allow a connector to fit one set of pins on a board.
	CAUTION: TAKE CARE WHEN SHIPPING HARD DISKS. The hard disk drive must be packed in an anti-static bag. When shipping the drive for repair or replacement, pack it in an approved container (P/N 08-8068). Never stack or drop hard disk drives.

PRODUCT SPECIFICATIONS

Operating Requirements

Location	Electrical Power	Temperature	Humidity
Domestic	120VAC @ 60Hz 4.0 Amps	32°F to 100°F (0°C to 38°C)	Not to exceed 95% relative
Foreign	230VAC @ 50Hz 2.0 Amps		
Japan	100VAC @ 50Hz 4.0 Amps		

Cabinet Statistics

Shipping Dimensions		Shipping Dimensions	Shipping Weight
Cabinet Section	Control Section	Universal Pedestal	
Width	58" (147 cm)	Width	22.0" (55.8 cm)
Depth	36" (91 cm)	Depth	36.0" (91.4 cm)
Height	79" (201 cm)	Height	51.0" (130 cm)
			Cabinet, 475 lbs (215 kg) Control Section, 300 lbs (137 kg) Universal Pedestal, 125 lbs (57 kg)

Equipment Characteristics

Video Monitor	Audio System	Currency Acceptors
Medium Resolution RGB 39" (99 cm) CRT	Digital Stereo Sound Two 5.5" (14 cm) and Two 6.5" (16.5 cm) Speakers	1 Coin Mechanism, Coin Counter Dollar Bill Validator Ready Electronic Coin Acceptor Ready

Game Characteristics

Player Variables	Operator Variables	Diagnostics
1 to 4 players per game (with linking) Choice of vehicle and course High Score Recognition	Coinage, Game Options, Difficulty, Force, Volume, Audits, Statistics	Automatic Power-Up Self-Test Manual, Multi-Level Menu System

PRODUCT CONFIGURATION

- **Standalone Units**

Each game is ready to play right out of the box. You can use the game menu system to set player variables in advance. Or you can leave these choices to players.

- **Linked Units**

Linking allows players to compete against each other (on one course). Operator menus are the same as in stand-alone games. Crossover couplers and linking cables to connect two games are factory installed. You can interconnect up to four games. To do this, use the optional Hub Linking Kit.

GAME SETUP



WARNING: The cabinet is top-heavy. Don't use the pedestal seat as a handle or lever. When moving the game, use the two handles on the back of the cabinet.

- [] 1. Remove and set aside items from shipping containers. You'll find casters, levelers, and mounting hardware packed with the pedestal. Inspect the exterior of the cabinet for any signs of damage.
- [] 2. Remove the keys from the steering wheel. Unlock and open the coin, cash box, and rear doors. You'll find electrical cords and spare parts in the cash box.

- [] 3. Unlock and remove the monitor cabinet's rear door. Inspect the cabinet interior for damage. Check major assemblies to assure secure mounting. Assure that nothing blocks fan airflow.
- [] 4. Replace and lock the monitor cabinet's rear door. Locate the casters. Notice that two of the swivel casters have red dots on their bases. These two are special-purpose, high-compliance casters. Tilt the dash cabinet. Install the two casters with red dots at the rear of the dash cabinet. Each caster mounts to a group of threaded studs. Tighten caster-mounting nuts firmly.
- [] 5. Tilt the dash cabinet. Install two swivel casters without dots at the front of the dash cabinet. Each caster mounts to a group of threaded studs. Tighten caster-mounting nuts firmly.
- [] 6. The pedestal uses three casters. Tilt the pedestal. Install a swivel caster on the front studs. Install locking casters on the rear studs. Tighten caster-mounting nuts firmly.
- [] 7. Stand the dash cabinet upright and make certain it is stable. Move the game to its intended location. Level the cabinet. We've designed this game for use only in a fixed position. Assure that final leg leveler adjustments raise the swivel casters off the floor. Distribute weight equally on each cabinet corner. Tighten the leveler nuts.

Location of Pedestal Assembly Mounting Holes

- [] 8. To protect seat pedestal mounting rails during shipment, the factory bolts them inside the dash cabinet. Remove the 1/4-20 hex-head bolts that secure the rails. Slide the rails partway out of the bottom-front cabinet opening. (See the nearby diagram for proper placement.)
- [] 9. Fasten down the rails in this new position. Firmly tighten the rail bolts, but don't torque them down. Slide the seat pedestal onto the rails. Vertically position the rails. Remove the seat pedestal. Tighten the rail bolts with a wrench.



NOTICE: When you mate the cabinets, take care to avoid pinching wires!

- [] 10. Roll the seat pedestal near the dash cabinet. Leave enough space to attach the wiring harness. Mate each seat pedestal cable connector with its cabinet cable connector. Press connectors firmly to seat contacts.
 - [] 11. Align the seat pedestal opening with the rail ends. Slide the seat pedestal forward onto the extended mounting rails. Align holes. Attach the seat pedestal using 1/4-20, tamper-resistant screws and large flat washers. You'll find a T27 wrench with the spare parts. Use it to tighten these screws firmly.
 - [] 12. Fasten the cabinet joining brackets to the monitor cabinet. Align the dash and monitor cabinets. Carefully slide the dash cabinet between the cabinet joining brackets. When the cabinets are flush, attach the cabinet joining brackets to the dash cabinet.
 - [] 13. Attach the wiring harness. Mate each dash cable connector with its monitor cabinet cable connector. Press connectors firmly to seat contacts.
 - [] 14. You can install an extra padlock to secure the rear door. You'll find a hasp in the spare parts bag. Remove the two lock bracket nuts from inside the cabinet, above the rear doorway. Slide the hasp onto the bolts. Now the hasp should protrude from the hole in the cabinet back. Reinstall the nuts.
 - [] 15. Modify the lock plate at the top of the rear door. Remove the bolts and nuts from the lock plate. Rotate the plate so that the slot will be above the door. Reinstall and tighten bolts and nuts.
-
- [] 16. The power cord is with the spare parts. Remove and save four screws from the line cord cover at the cabinet rear. Match the holes on the IEC plug with the prongs in the receptacle. Push the plug firmly to seat the line cord. Hold the cord flat against the cabinet and reinstall the cover plate. (Point the indentation downward, so that the cord exits toward the cabinet bottom.)
 - [] 17. Refer to the cabinet wiring diagram (elsewhere in this manual). Check to see that cable connectors are correctly secured. Inspect for damaged connectors. *Don't force connectors.* Most connectors are keyed to prevent reversed connections. Before you plug the line cord into an A.C. outlet, verify that game electronics are set to correct local A.C. line voltage.

Line Cord Installation

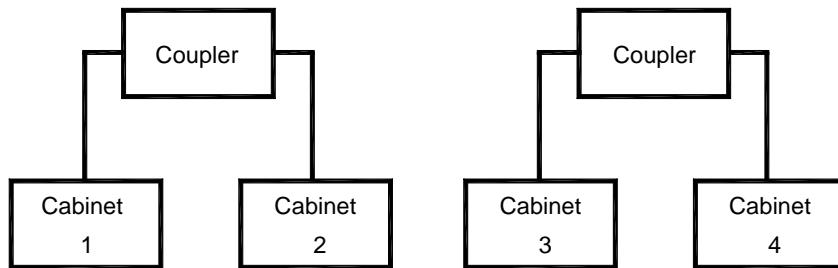
- [] 18. Plug the game into a grounded (3-terminal) AC wall outlet. Switch on the game at the on/off switch. (This switch is on the cabinet roof. Face the cabinet's back. Find the on/off switch to your right.) The game will power up and begin self-diagnostics. If diagnostics find no errors, the game enters its Attract Mode of operation. (Attract Mode includes scenes and sounds from typical races, player's scores, messages, etc.)
- [] 19. Unlock and open the coin door. Locate the control switches. Press TEST MODE to enter the Menu System.
- [] 20. Select "DISK TESTS" at the Diagnostics Menu. Run all the tests in order to verify correct drive operation.
- [] 21. Select "SWITCH TESTS" at the Diagnostics Menu. Check to be sure that all control switches work.
- [] 22. Select "SOUND TESTS" at the Diagnostics Menu. Verify operation of each speaker.
- [] 23. Select "FORCE FEEDBACK TESTS" at the Diagnostics Menu. Verify the presence of steering resistance.
- [] 24. Select "CALIBRATE CONTROLS" at the Main Menu. Set steering and throttle limits for maximum accuracy.
- [] 25. Select "START THE GAME" at the Main Menu. The system should enter Attract Mode. Open the coin door and press the SERVICE CREDITS button to allow game play. Press the START button to begin play. Listen to the audio while playing the game. Note sound irregularities (phase problems, no low frequencies, mono audio from stereo speakers, etc.). If necessary, check the wiring harness for internal shorts or strapped connections.
- [] 26. Change the volume and make adjustments as necessary. Close and lock all open doors. Tighten the leveler nuts. Engage the caster locks.

LINKED OPERATION

Equipment Requirements

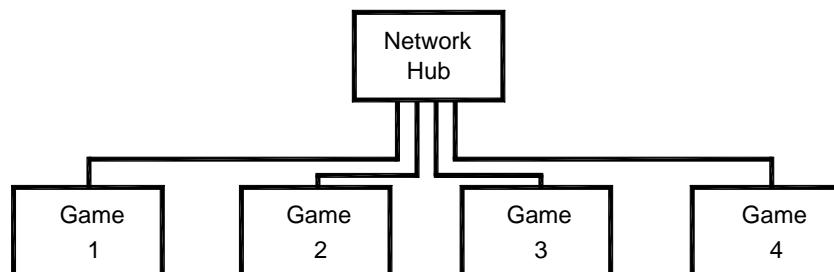
Linked Mode permits players to compete between networked cabinets in real time. The linking program is player selectable, so that each cabinet serves player needs.

To achieve linked operation, you must connect cabinets. The factory installs one linking cable in each cabinet.



Link Two Cabinets with a Coupler

- **TO LINK TWO CABINETS**, use a crossover coupler. All cabinets contain a crossover coupler to connect two cabinets together. Use *only one* coupler between each pair of cabinets. Passive electronics limit the cable length and number of cabinets that you can link. Most operations attach linked cabinets, but you can separate cabinets by up to 25 feet. You can add linked pairs as necessary.



Link Up to Four Cabinets with a Hub

- **TO LINK MORE THAN TWO CABINETS**, use a network hub. The network hub's active circuits allow you to use more and longer cables. Notice that the *hub replaces the coupler* between cabinets. Each hub can connect several cabinets. The hub's active electronics permits use of larger networks. Most operations attach linked cabinets, but you can separate cabinets by up to 300 feet. You can add linked cabinets as necessary.



NOTICE: You can't link more than four Offroad Thunder cabinets.

Networking Pointers

- Protect exposed wiring from player foot traffic, cleaning crews, service personnel, etc. Use approved conduit or wire channels to support cables. Network modular connectors don't include strain relief.
- Keep cables away from heat, moisture and electromagnetic fields. (Avoid neon signs, fluorescent fixtures, two-way radios, cordless telephones, power circuits, speaker wiring, etc.).
- Universal RJ-45 modular plugs aren't numbered or coded. Clearly mark cabinet network connections. Otherwise, someone could confuse them with computer or telephone circuits.
- The factory supplies network cables with the cabinets. These cables will reach the hub in networks of four or fewer cabinets.
- Use only Category 5, twisted pair cable.
- If you want to monitor network activity, you can locate the hub remotely. You can use long cables, if they satisfy these requirements: (1) Cables must not exceed a length of 328 feet or 100 meters. (2) Cables must be Category 3 (or higher), 100 ohm, unshielded, twisted pair, communications-grade wiring. (3) You must not use standard telephone cables.

Network Wiring Setup



NOTICE: Don't use crossover couplers in a hub installation. Otherwise, your network won't operate properly.

- [] 1. Raise the leg levelers. Roll the cabinets to their destination. Lower the leg levelers.
- [] 2. Verify game operation. Make necessary repairs or adjustments before making changes to the cabinets.
- [] 3. Shut down all machines.
- [] 4. Place the hub near the center of the linked cabinet array.
- [] 5. You'll find a linking cable coiled up inside each cabinet. Cut the cable tie. Locate the cable's free end. Uncoil enough cable to reach the hub through the rear box of the cabinet.
- [] 6. Check the other end of the cable. It should attach to an Arcade Computer network jack. You'll find this jack in the middle cabinet box.
- [] 7. Recoil and retie the remainder of the cable. Repeat the cable connection steps at the other cabinets.
- [] 8. Plug the cabinet linking cables into any of the jacks on the hub rear panel.
- [] 9. Plug the hub's AC power adapter into its jack on the hub.
- [] 10. Set the hub front panel switches to the LNK (link) position.
- [] 11. Retract excess cable into the cabinet coils so that the cables don't touch the floor. Retracting the cable keeps it away from cabinet wheels during relocation.
- [] 12. Connect the AC Adapter and line cords to AC power. Turn on each of the cabinets. Examine the screens of all cabinets.



CAUTION: Don't connect or disconnect cables to the game electronics or hub with the power on. Otherwise, you may damage the electronics and void your warranty.

- [] 13. Restart all machines.

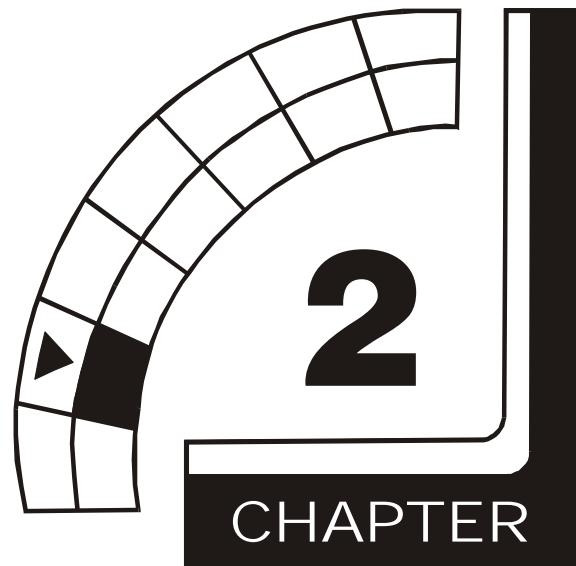
- [] 14. The cabinets will begin the Power-On Self Test. If the test doesn't find any errors, each cabinet enters its Attract Mode automatically.
- [] 15. Start up linked cabinets and ensure that each cabinet's player controls affect the same vehicle on all screens. The CPU and hub LEDS will indicate communication activity between the two cabinets.
- [] 16. Close and lock the coin doors. Reinstall and lock the rear cabinet doors. Lower all leg levelers until wheels lift off of the floor. Then level the cabinets.

Software Setup

- [] 1. **Unlock** the coin doors of all cabinets.
- [] 2. Find the diagnostic switches behind each cabinet's coin door. Press and hold each cabinet's TEST MODE button to enter the Menu System.
- [] 3. From each cabinet's Operator Menu, select the Adjustments Menu.
- [] 4. From each cabinet's Adjustments Menu, select the Linked Play Adjustments Menu.
- [] 5. **LINKED PLAY.** At each cabinet, set the LINKED PLAY option to YES.
- [] 6. **UNIT ID.** Each cabinet must have a unique unit ID. Set the option UNIT ID to a separate number for each cabinet.
- [] 7. **EXIT** the menu system.
- [] 8. **RESTART ALL CABINETS.** After the machines reinitialize, they'll operate in Linked Mode.
- [] 9. **TEST THE SYSTEM.** Test the network by playing a Linked Mode game on all linked machines.

OFFROAD

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OPERATION



NOTICE: The term VGM refers to the video game machine.

GAME OPERATION

STARTING UP

Whenever you turn on the machine or restore power, the system executes boot ROM code. The boot ROM contains self-diagnostic tests. These tests automatically verify and report the condition of the CPU and other hardware. If the hardware fails a test, the system displays an error message.

Having passed power-up tests, the system enters Attract Mode. Attract Mode consists of typical game scenes and sounds, alternating with high scores. Attract Mode continues until game play commences.

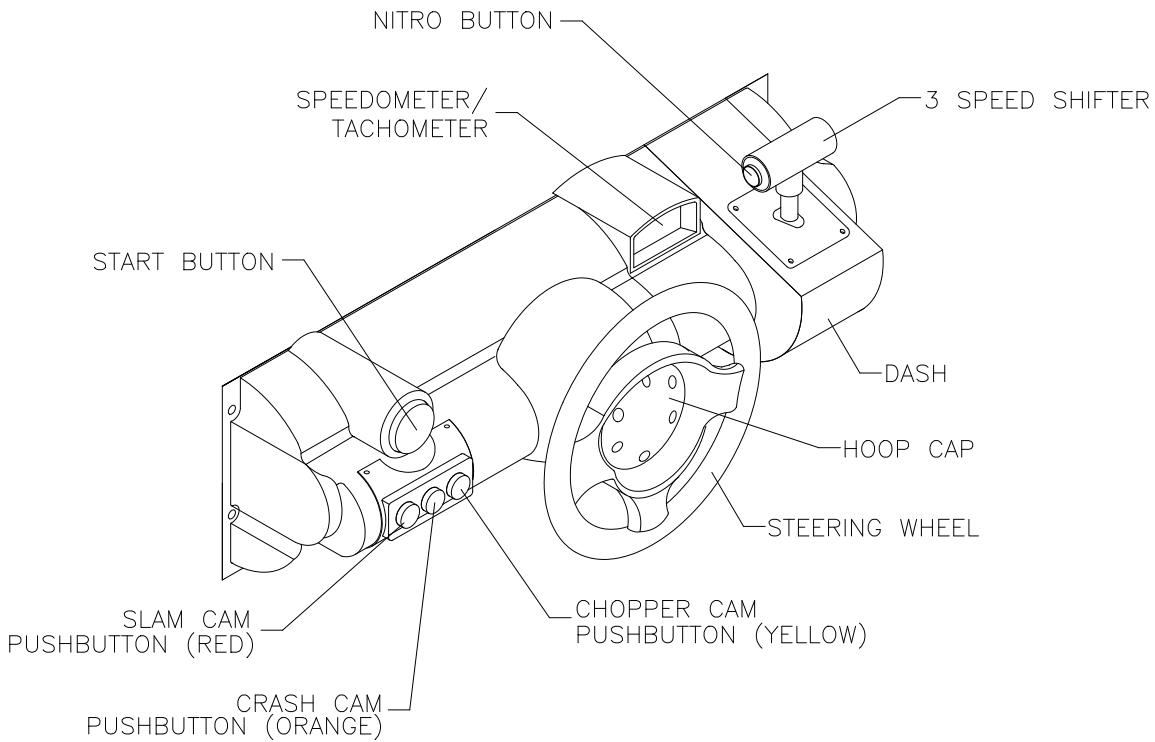
Players insert currency or tokens to start the game. Each player selects a truck and a course. Play begins after a countdown period. The game will progress until players quit or exhaust their playtime. At Game-Over Mode, players may choose to begin again. If players choose not to continue, then the system returns to Attract Mode.

ARCADE COMPUTER

This game uses an Arcade Computer to control its functions. The Arcade Computer is a customized personal computer. Housing the Arcade Computer is a PC-like case. Inside, you'll recognize the motherboard, plug-in cards, modular power supply, disk drives, etc. Despite these familiar features, Midway optimized this computer specifically for this game. The Arcade Computer design permits improved upgradability and service access without sacrificing ruggedness or reliability.

PLAYER CONTROLS

- **ACCELERATOR.** The accelerator pedal controls vehicle speed and acceleration.
- **BRAKE.** The brake pedal stops the vehicle, just like a real brake.
- **GEARSHIFT.** The gearshift lever controls the amount of engine torque that reaches the wheels. The player may choose manual or automatic shift operation. Manual shift operation requires the player to upshift while accelerating and downshift while decelerating. (This shift has no reverse gear.) Players select automatic or manual shift trucks before racing. Manual shift trucks allow skilled drivers more control and faster starts.
- **NITRO BUTTON.** The NITRO button is on the end of the shift lever. If the nitro feature is active, pressing NITRO adds a power burst. (The button illuminates when nitro is available.)
- **START BUTTON.** The START button allows a player to begin or continue play, select courses and trucks, etc.
- **STEERING WHEEL.** The steering wheel aims the vehicle and provides course condition feedback.
- **SLAM CAM.** The red SLAM CAM button displays the cockpit view. The viewpoint is from the driver's seat inside the truck.
- **CRASH CAM.** The orange CRASH CAM button provides a close-up, aerial view of the course. The viewpoint is from above and behind the truck. A truck camera would see this view.
- **CHOPPER CAM.** The yellow CHOPPER CAM button provides a distant aerial view of the course. The viewpoint is from above and behind the truck. A tracking helichopper camera would see this view.



Player Panel Controls

OPERATOR CONTROLS

CABINET CONTROLS

- **DIP Switches** on the MagicBus™ Board set some system variables. These DIP switches are for factory use only. Keep them set at their default value, all off. You can adjust game variables, check bookkeeping totals and perform diagnostics with diagnostic control switches.
- **The Monitor Remote Control Board** allows you to adjust the video display for optimum viewing.
- **The Cabinet POWER Switch** turns off the game, but does not reset game variables.
- **The Computer POWER Switch** turns off the computer. It is on the Arcade Computer. During service procedures, leave this switch ON. Use the main cabinet power switch to control the power.

DIAGNOSTIC CONTROL SWITCHES

- **The SERVICE CREDITS Button** allots credits without changing the game's bookkeeping total. The Menu System occasionally assigns a function to SERVICE CREDITS. Check screen directions for these additional functions.
- **The TEST MODE Button** causes the game to enter the menu system. To access the Menu System, press and hold TEST MODE until the Main Menu appears. Within the menu system, check screen directions for additional TEST MODE functions.
- **VOLUME DOWN and VOLUME UP Buttons** set game sound levels. To make minor volume changes, press either button briefly. To make major changes, press and hold a button. In the menu system, VOLUME UP moves the item highlight bar up the menu. VOLUME DOWN moves the item highlight bar downward.

	<p>NOTICE: The Attract Mode volume level is separate from the Game Mode volume level. For greater profits, raise volume levels to add realism and draw attention to this game.</p>
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Operator Control Switch Locations

GAME FEATURES

GAME RULES

INSTRUCTIONS

Play instructions appear on the left and right sides of the video monitor.

ONE PLAYER

The player inserts currency or tokens to start the game. Next, the player chooses a truck and course and presses the START button. The game displays individual statistics periodically, during and after the race. Additional game information appears on screen as needed.

PLAYER CHOICES

The player can drive any truck on any course. Each truck handles and performs differently. Players learn which trucks are best for a given course and driving style. Press one of the CAM buttons to select more trucks.

CONTROLLING A TRUCK

The steering wheel, brake and accelerator control the truck. As in real trucks, the steering wheel directs the truck. The brake slows or stops the truck, and the accelerator sets speed. A NITRO button on the gearshift provides an extra burst of power. NITRO flashes to indicate nitro availability. Players must collect nitro icons along a course by steering directly under the icons. A gauge meters the amount of stored nitro.

INDICATORS

Across the top of the screen, numeric indicators display truck statistics: A ghost image in the upper-left screen corner indicates shift type, manual or automatic. A meter in the top-left screen corner displays engine RPM. A top-right gauge measures remaining nitro fuel. At the screen's top-center, a digital clock times the current lap in seconds. As appropriate, the screen also flashes CHECKPOINT.

DISPLAYS

The player's vehicle appears at the center of the screen. The numbers floating above some vehicles indicate that other humans control them. (These are linked players.) The Arcade Computer controls trucks without numbers. At the bottom of the screen, another instrument displays relative positions of nearby trucks. The right side of the screen provides race statistics...

- Position per number of trucks (for example, "11th / 12")
- The number of cars ahead of the player ("9 cars ahead")
- A lap timer for each lap ("0:2:00")

GAME ACTION

Action begins after the "three-two-one" countdown. The announcer hollers "Go!" To continue play, the player must drive past each checkpoint within the time limit. To decrease time between checkpoints, players must avoid fixed obstacles and other trucks. Ramps allow players to advance more quickly, collect hovering nitro icons, or avoid obstacles. (Red nitro icons contain more fuel than blue nitro icons.)

Players can change their view of the action by pressing the view buttons. These buttons are on the left side of the control panel. Game sounds include announcer comments, engine noise, and other effects.

SCORING

Players who set a speed record may enter their initials in the High Score Table. After a player completes a certain number of courses, he can choose additional courses. (Adjustments determine the number.)

HEAD-TO-HEAD RACING

Networked cabinets offer players linked, head-to-head racing competition. Each player begins the course-selection process. A join-in message alerts subsequent players to the possibility of a linked race. If players don't begin their selection process before this message disappears, their races don't link. (Unlinked players compete in independent races, as usual.) Players may use the solo feature to decline a link.

If other players begin selection during the join-in message, the cabinets communicate over the network. Each additional cabinet sends out its own packet containing a unique unit ID. In return, each cabinet receives data from active cabinets. A "waiting" message indicates that other players are still selecting race options. Eventually, the last player finishes selecting or the waiting period ends. At this point, all linked players see the start screen simultaneously.

Latecomers can't participate in an ongoing linked race. They can begin an independent race. The link automatically terminates when the game is over. Players can then set up another link.

MAINTENANCE

• Cabinet and Seat

Use plastic-safe, non-abrasive cleaners to avoid damage. Apply cleaner to a clean cloth or sponge. Use this to wipe the seat or cabinet. *Don't apply cleaner directly to the artwork or cabinet!*

• Player Controls

Use plastic-safe non-abrasive cleaners to avoid damage. Apply cleaner to a clean cloth or sponge. Use this to wipe the player controls. *Don't apply the cleaner directly to the controls!*

• Viewing Glass

To clean the glass, you don't need to switch off power to the game. Apply a mild glass cleaner to a clean cloth or sponge. Use this to wipe the viewing glass. *Don't apply the cleaner directly to the glass!* Liquid could drip down into switch or motor circuits and cause erratic game operation.

NOTES

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DIAGNOSTIC, AUDIT & ADJUSTMENT MENU SYSTEM



NOTICE: Information in this manual is subject to change without notice. Midway reserves the right to make improvements in equipment function as progress warrants.

MENU SYSTEM

WHAT IS THE MENU SYSTEM?

The game's Menu System is a series of auditing, game adjustment and diagnostic screens. You can easily access and apply these screens to optimize game performance. For instance...

- Use game audits screens to assess game performance.
- Use adjustment screens to help you to customize game performance. For instance, you can restore factory default game settings. You can also calibrate player controls for accuracy.
- Use diagnostic screens to verify proper equipment operation.

ACTIVATING THE MENU SYSTEM

Open the coin door. Find the TEST MODE switch inside. Press TEST MODE to invoke the Menu System. The game system responds by exiting Game Mode and entering Diagnostic Mode. The system runs a brief self-test, and then displays the Operator Menu. The Operator Menu is the opening screen of the Menu System.

Game audits, adjustments and diagnostics are line items on the Operator Menu. Selecting an item opens its submenu. Every submenu presents various options that you may act upon.



OPERATOR MENU

MENU LAYOUT

Menus differ, but related information tends to occupy the same screen locations.

- The block at the top, center of each screen displays the current menu title.
- Data (menu items, video signals, statistics, reports, etc.) appears in the center of the screen.
- Game-operation information appears at the top-center of the screen, between logos.
- Messages (explanations, control functions, revision levels) display at the bottom of the screen.

MENU NAVIGATION CONTROLS

Highlight a menu line item with the middle two diagnostic buttons inside the coin door. (Press VOLUME UP or VOLUME DOWN.) Select the option with the TEST MODE button. *You can only select one highlighted item at a time.* To return the game to play, first highlight START THE GAME. Then press TEST MODE. (This is the only menu that allows you to exit the Menu System.)

EQUIVALENT MENU NAVIGATION CONTROLS

In most cases, certain player panel buttons duplicate the functions of the diagnostic buttons. You may find menu navigation easier with the player panel buttons. Here are the player panel functions within the Menu System...

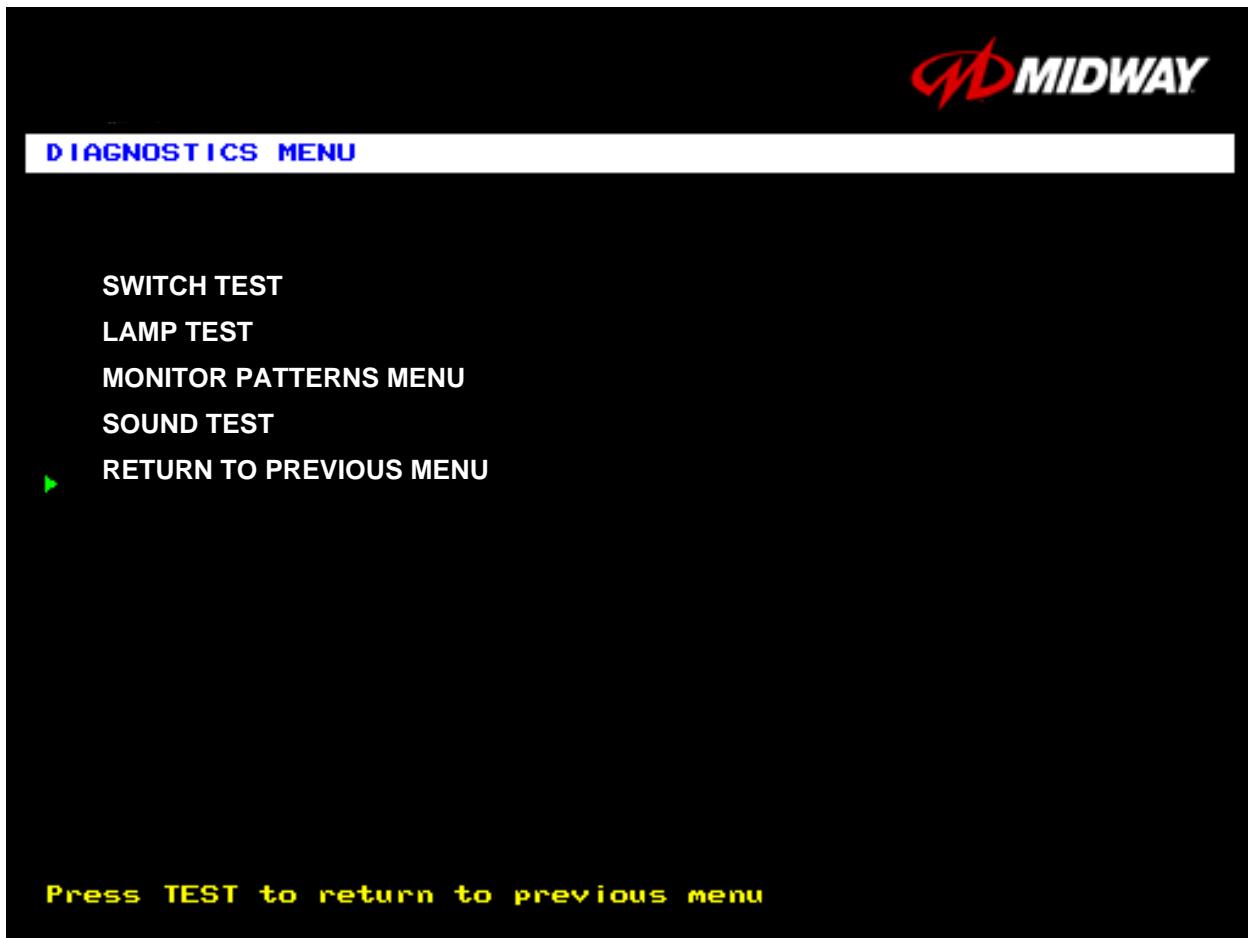
Player Panel Button	Function	Equivalent Diagnostic Switch
NITRO	Select a menu item	(None)
CHOPPER CAM	•Select a menu item •Enter Change Mode	TEST MODE
CRASH CAM	Move down the menu	VOLUME DOWN
SLAM CAM	Move up the menu	VOLUME UP
START	<i>Various functions, including....</i> •To bottom of Operator Menu •Back to Operator Menu •Cancel	SERVICE CREDITS (<i>for some functions</i>)

Operator Menu (continued)
Diagnostics Menu

DIAGNOSTICS

Select DIAGNOSTICS MENU at the Operator Menu. The Diagnostics Menu helps you to verify the electrical and electronic condition of the game.

Highlight a line item with the middle two diagnostic buttons inside the coin door. Select the option with the TEST MODE button.



Operator Menu (continued)

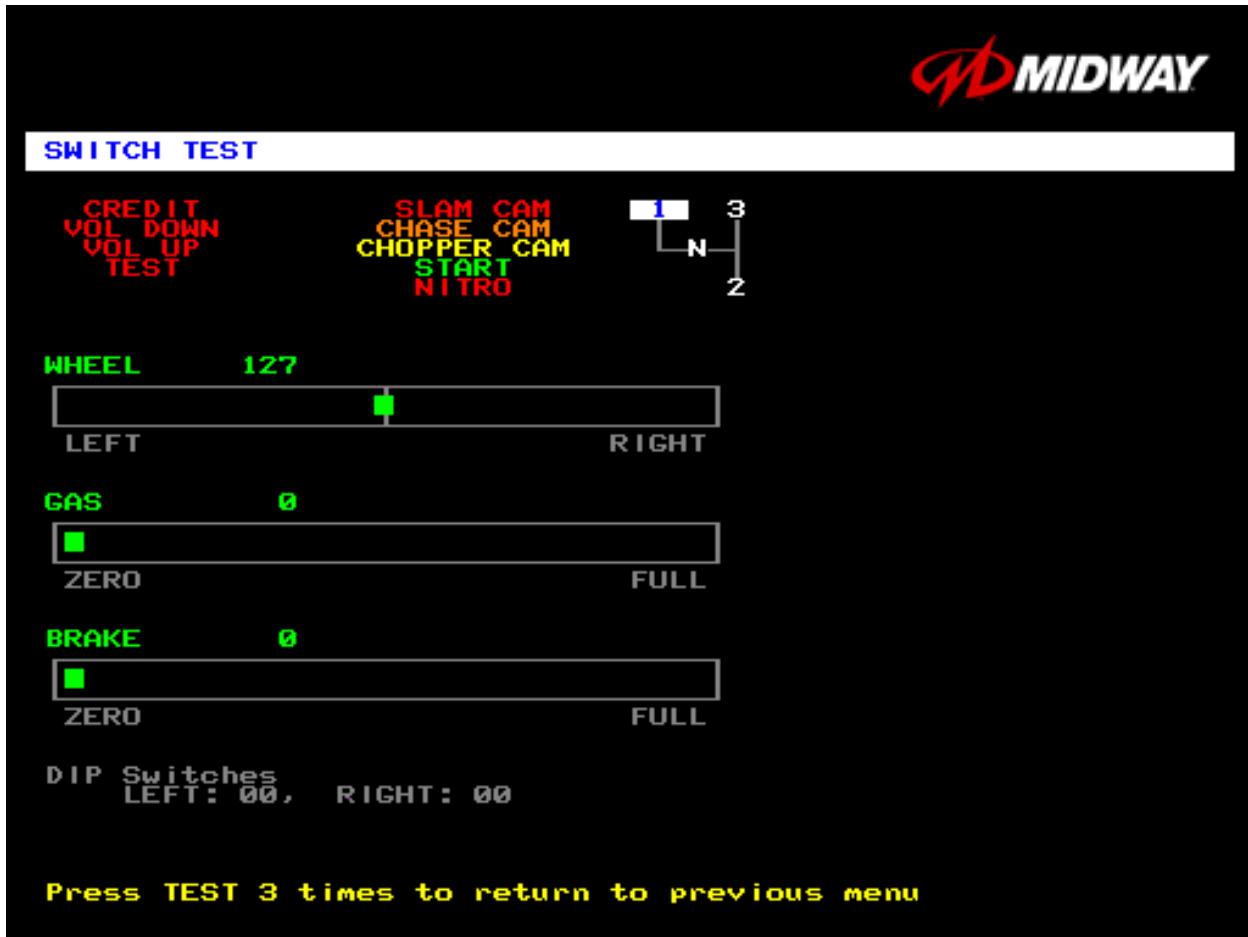
Diagnostics Menu (continued)

Switch Test Menu

SWITCH TEST

Select SWITCH TEST at the Diagnostics Menu. Use the Switch Test to verify crossed wires, intermittent conditions, and stuck switches.

Operate the switch and watch the screen display. After completing tests, press TEST MODE three times to return to the Diagnostics Menu.



SWITCH TEST SCREEN

BUTTON TESTS check player and Diagnostic switches, such as CREDIT, TEST and SLAM CAM. Activate each button, and the screen indicator changes state. (Gray means off and green means on.) Release the button and the indicator returns to its previous state. A single indication on the screen should exactly duplicate each button change.

THE WHEEL TEST indicates the steering wheel position with a moving bar on a graph. The screen also displays a wheel position number. This number varies between zero (full left) and 255 (full right).

THE GAS TEST indicates the gas pedal position with a moving bar on a graph. The screen also displays a pedal position number. This number varies between zero (full back) and 255 (full forward).

THE BRAKE TEST indicates the brake pedal position with a moving bar on a graph. The screen also displays a pedal position number. This number varies between zero (full back) and 255 (full forward).

Operator Menu (continued)

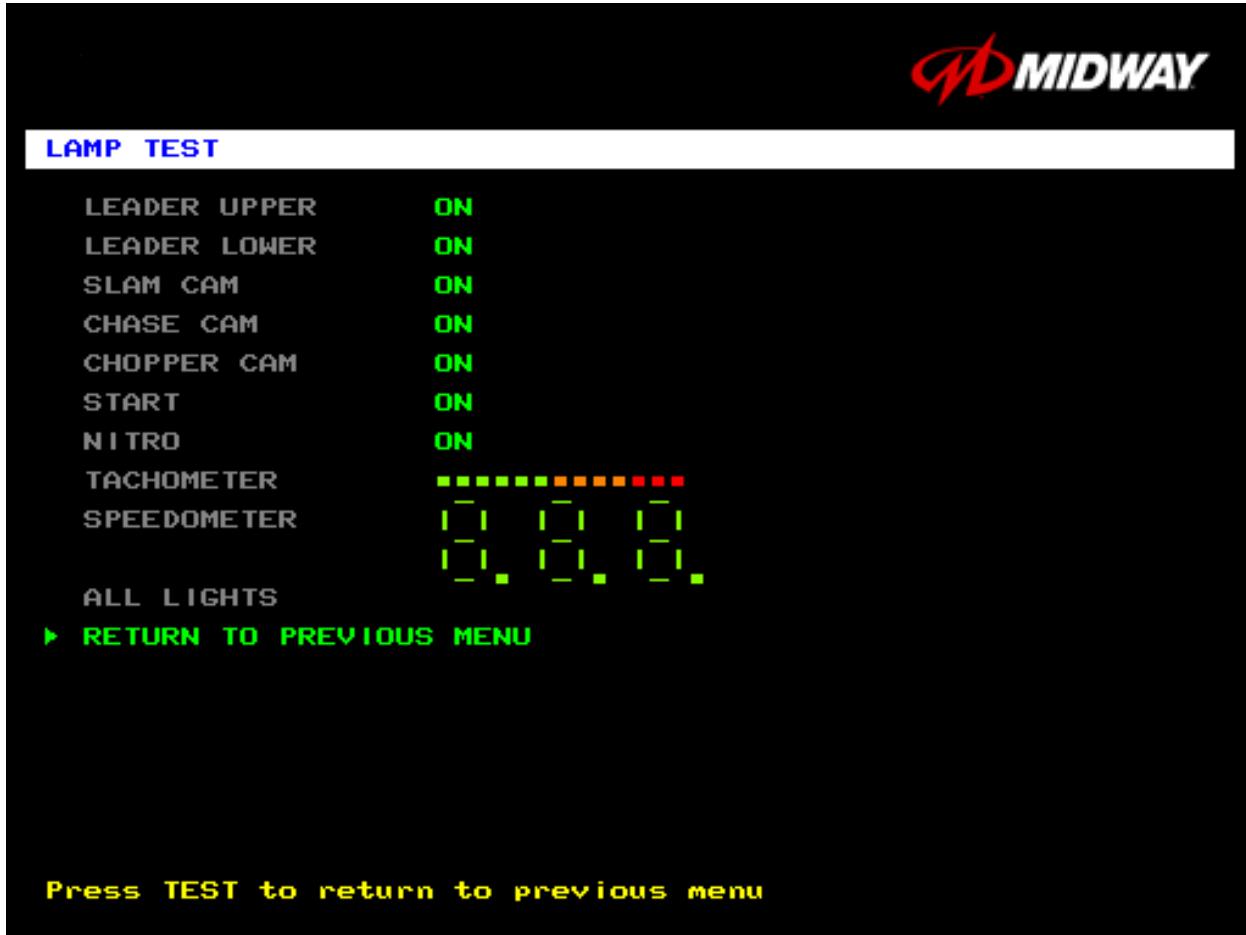
Diagnostics Menu (continued)

Lamp Test Menu

LAMP TEST

Select LAMP TEST at the Diagnostics Menu. The Lamp Test allows you to check operation of game lamps. Use the test to check for burned-out bulbs, faulty lamp wiring, etc.

Highlight a test with the middle two diagnostic buttons inside the coin door. Select the option with the TEST MODE button. Pressing TEST MODE also lights the selected lamp.



LAMP TEST SCREEN

Lamp tests indicate the condition of game lamps. These include lamps in the control panel and overhead linking sign or optional header. (Unless your cabinet has header lights, the Leader Upper and Leader Lower tests have no effect.)

For most tests, select a lamp name from the menu. Press TEST MODE (or CHOPPER CAM) to turn on the selected lamp. Press TEST MODE again to toggle the lamp off. The Tachometer and Speedometer tests operate slightly differently. These tests light one LED for each press of TEST MODE. Press START, SLAM CAM or CRASH CAM to exit. Select ALL LIGHTS to switch on all controlled lamps simultaneously.

After completing tests, select RETURN TO PREVIOUS MENU. This action closes the Lamp Test Menu and reopens the Diagnostics Menu.

Operator Menu (continued)

Diagnostics Menu (continued)

Monitor Patterns Menu

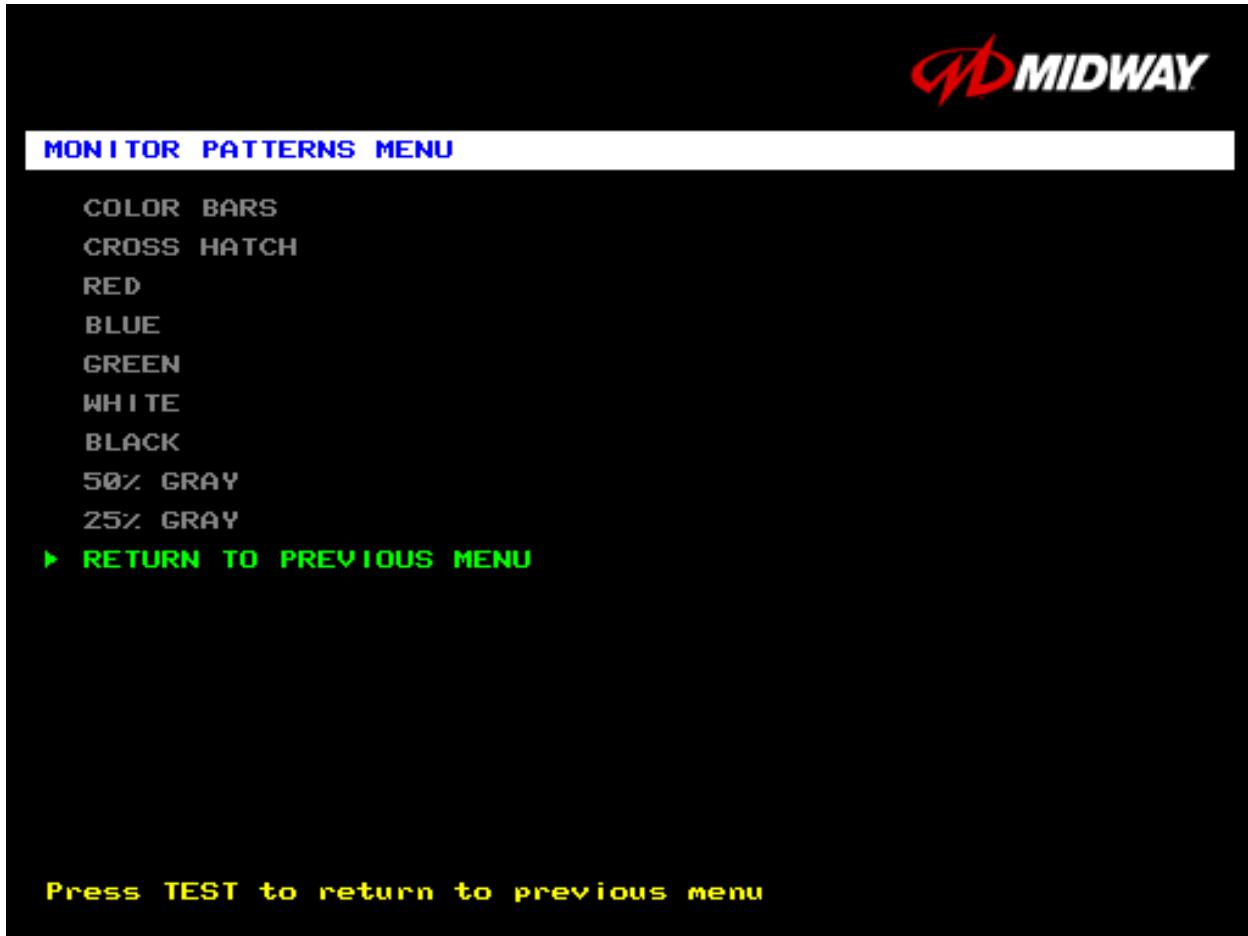
MONITOR PATTERNS TEST

Select MONITOR PATTERNS at the Diagnostics Menu. The Monitor Patterns routine provides test screens to verify monitor performance or make adjustments.

Highlight a test with the middle two diagnostic buttons inside the coin door. Select the option with the TEST MODE button.



NOTICE: Use an industrial-grade degaussing coil before attempting monitor adjustments.



MONITOR PATTERNS MENU

Color Bars paint colored stripes on the screen. Use the color bars to help you to check or adjust monitor brightness and contrast. The color bars also expose defects in horizontal linearity. Each color bar consists of 16 intensity levels. On a properly adjusted monitor, the top 15 of these levels are visible. Each bar should appear sharp, clear, and distinct from bars on either side. Incorrect adjustment can cause missing detail at the top or bottom of a bar. Bent bars indicate horizontal linearity flaws, such as pie crust,

pincushion or barrel distortion. (*Correct color bar colors, left to right: Green, Red, Blue, Black, White, Yellow, Magenta, Cyan.*)

Set controls as follows: 1. Adjust BRIGHTNESS and CONTRAST to minimum. 2. Turn up BRIGHTNESS until the pixels in the black stripe begin to glow (turn dark gray). 3. Bring up the CONTRAST control until you can see 15 bars. Then increase the contrast until you can't distinguish a difference between the top two bars.

Crosshatch Patterns consist of an on-screen grid and a series of dots. Crosshatch Patterns help you to check or adjust several monitor parameters: These parameters include convergence, linearity, active viewing area and dynamic focus. The grid and the dots should be all white in color, with no fringes or parallel images. The lines should be straight and the dots round. For more detail on these adjustments, consult service literature from the monitor manufacturer.

Color Screen tests fill the screen with 100% of the chosen color at normal intensity. The Color Screen tests help you to check or adjust monitor intensity, black level, blanking and color purity. Each screen should be absolutely uniform from top to bottom and side to side. No retrace lines or noise should be visible. Color Screens may not hold their uniformity if the monitor degaussing circuit is defective.

If tests indicate a need for adjustment, use controls on the Monitor Remote Adjustment Board. You can make other adjustments from the back of the monitor.

White, Gray, and Black Screens fill the screen with black, gray or white at various intensities. These monochrome screens help you to check or adjust monitor convergence, purity, contrast and intensity. These screens also simplify black level and color gun control settings. The screens should be uniform with no color tints or distortion. No retrace lines or noise should be visible.

If tests indicate a need for adjustment, use controls on the Monitor Remote Adjustment Board.

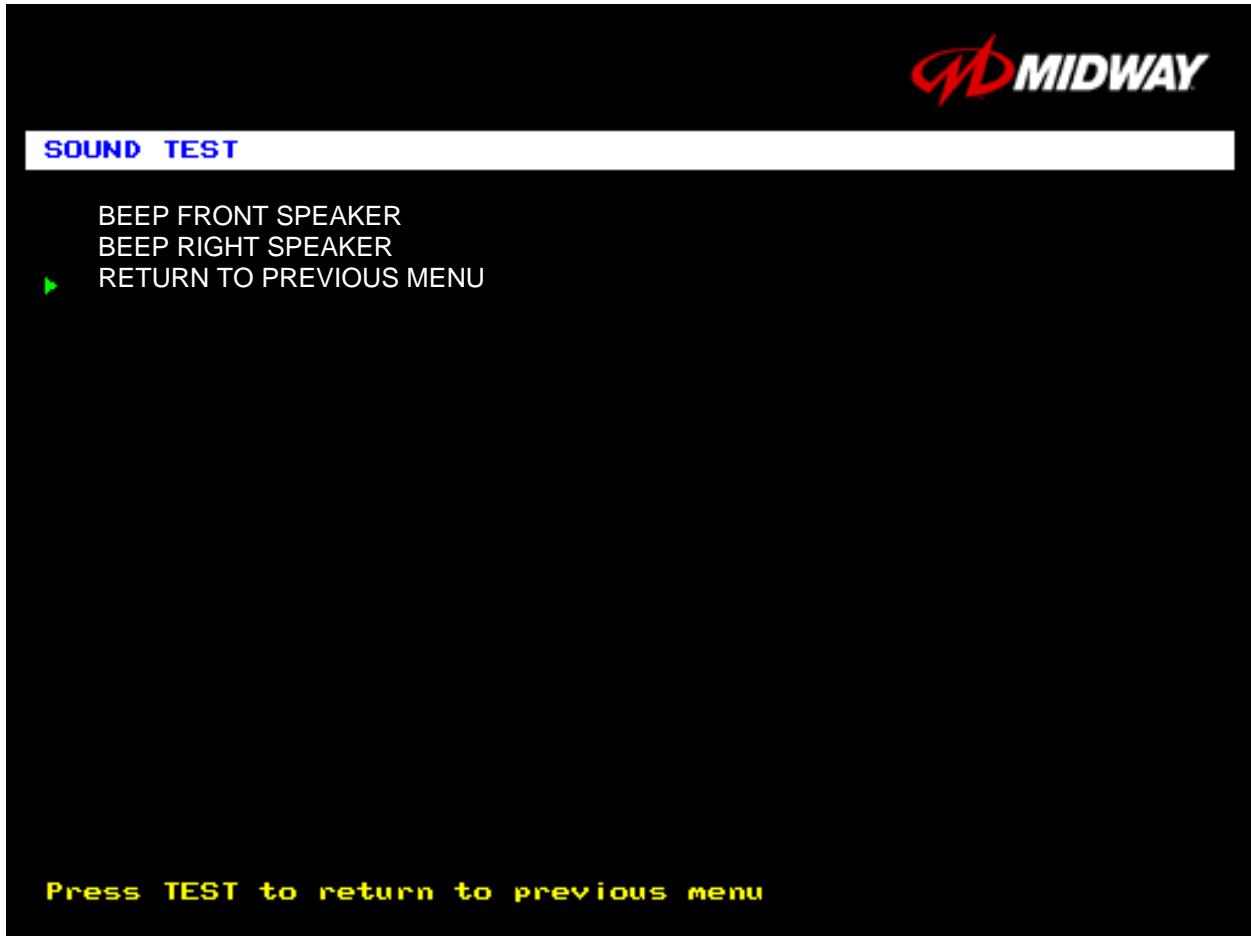
Operator Menu (continued)
Diagnostics Menu (continued)
Sound Test Menu

SOUND TEST

Select SOUND TEST at the Diagnostics Menu. The Sound Test verifies the operation of the sound hardware and speakers. Use the Sound Test to find crossed connections, incorrect phase, rattles, vibration, distortion, etc. The Sound Test screen reports information, but doesn't permit changes.

Increase the master volume level before beginning this test.

Highlight a test with the middle two diagnostic buttons inside the coin door. Select the option with the TEST MODE button. Selecting also activates a sound tone. The tone continues to play until you once again press TEST MODE.



SOUND TEST SCREEN

After choosing a speaker name, listen to the audio tone from that speaker. Only the specified speaker should produce sound. The other speakers should remain silent.

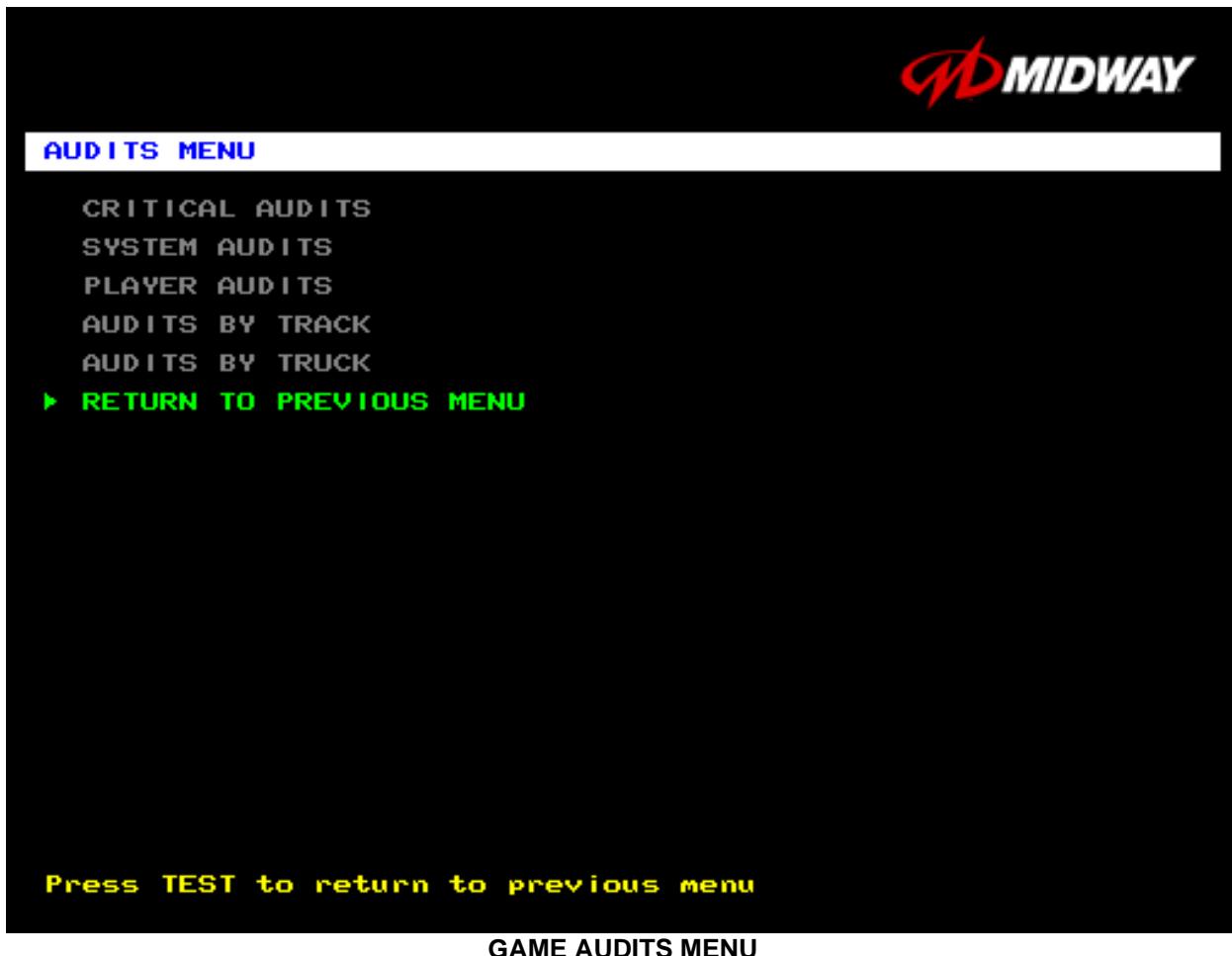
To exit the Sound Test Menu, highlight RETURN TO PREVIOUS MENU. Then press TEST MODE.

Operator Menu (continued)
Audits Menu

AUDITS MENU

Select AUDITS MENU at the Operator Menu. The Audits Menu permits you to review game play statistics. Additional menus provide detailed reports for each player position on game starts, ends, cabinet abuse, fault conditions, etc.

Highlight a line item with the middle two diagnostic buttons inside the coin door. Select the option with the TEST MODE button.



GAME AUDITS MENU

Use the auditing information to help you to keep records of the game's popularity and earnings. You may also analyze favorite tracks, most frequently used vehicles, and other statistics. These screens report information, but don't permit changes.

Examine and record all game audit values before doing service or making repairs on this game.



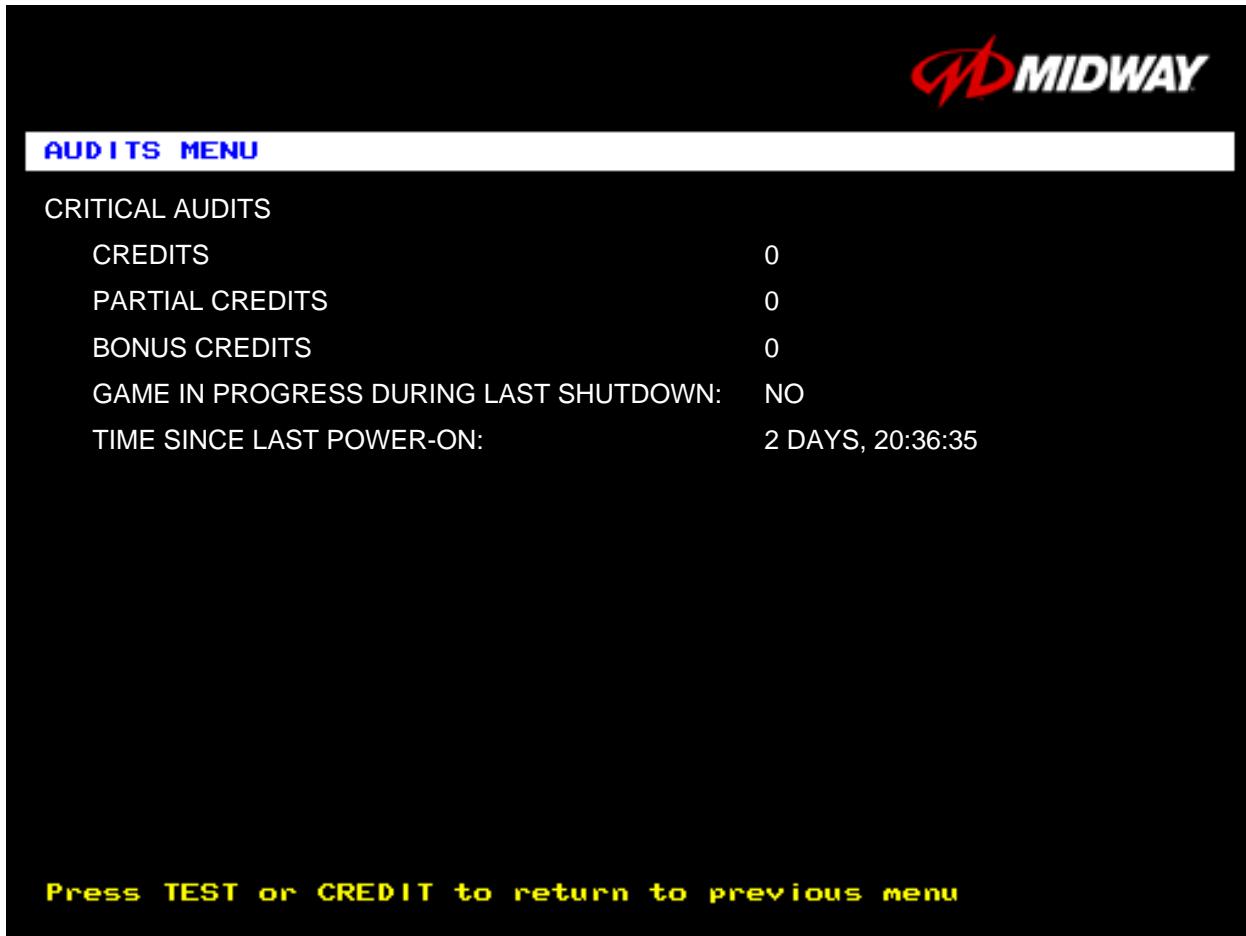
Operator Menu (continued)

Audits Menu (continued)

Critical Audits Menu

CRITICAL AUDITS

Select CRITICAL AUDITS at the Audits Menu. The Critical Audits Menu reports general information about coin counts and game use. This menu reports information, but doesn't permit changes.



CRITICAL AUDITS MENU

CREDITS and **PARTIAL CREDITS** permit you to assess currency collection. The other items present information on game operation.

BONUS CREDITS. A running total of bonus credits that the video game awarded to players.

GAME IN PROGRESS DURING LAST SHUTDOWN. Was the machine in Game-Play Mode when it entered Diagnostic Mode? This function answers the question.

TIME SINCE LAST POWER-ON. This function measures the period between power-ups. The clock starts counting **whenever you switch off the video game machine**.

Operator Menu (continued)
Audits Menu (continued)
System Audits

SYSTEM AUDITS

Select SYSTEM AUDITS at the Audits Menu. The System Audits Menu reports general information about coin counts and game use. Coin Audits is a read-only screen.

To exit, press TEST MODE.



SYSTEM AUDITS MENU

The System Audits Menu reports total quantities of coins, bills or credits collected by each active device. The menu does not calculate the value of the collected currency.

This menu reports information, but does not permit you to make changes. To reset the coin, bill, and credit counters to zero, use the Clear Audits menu.

We recommend that you examine and record audit information before you make changes. Once you've cleared the counters, you can't retrieve the previous data from the system.

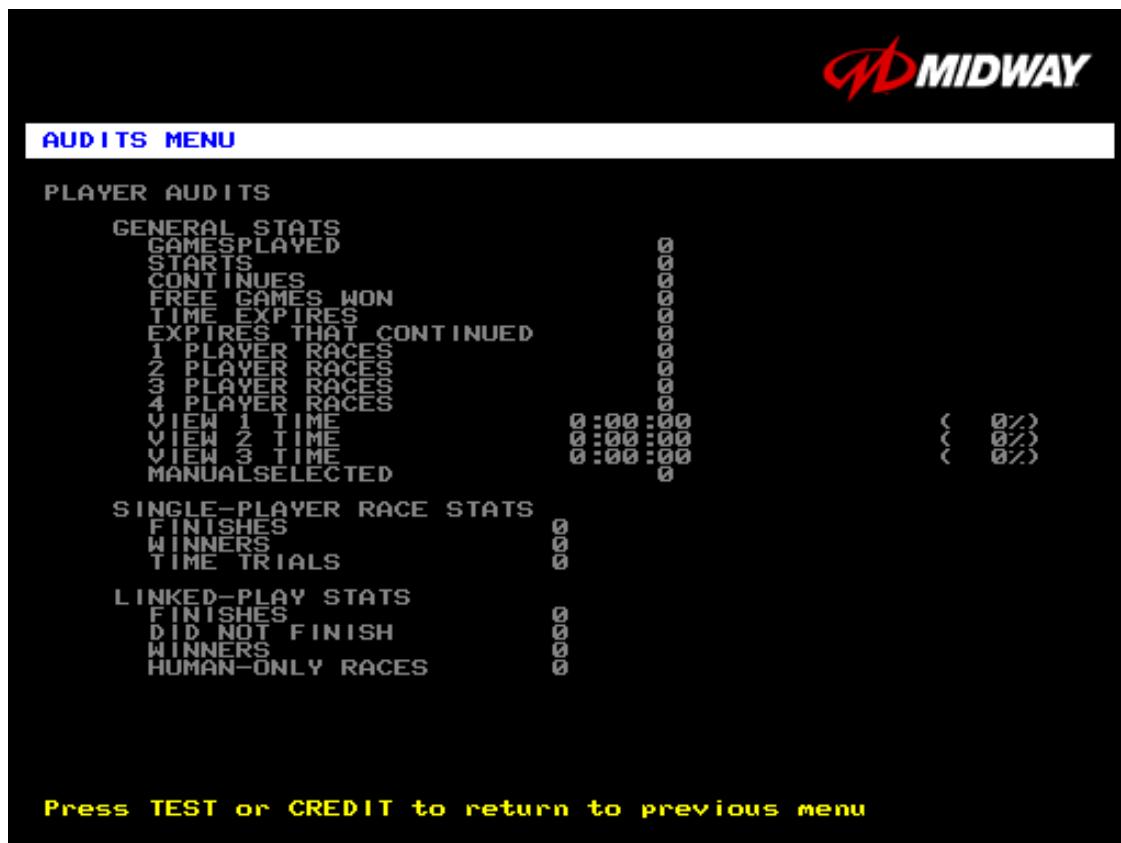
THE COIN COUNT AND BILL COUNT items help you to assess currency collection. The other items present information on game operation.

RESET, LINK, AND SYNC statistics are measures of the game software's ability to recover from conditions that adversely affect game play.

Operator Menu (continued)
Audits Menu (continued)
Player Audits Menu

PLAYER AUDITS

Select PLAYER AUDITS at the Audits Menu. The Player Audits Menu displays additional information about player statistics and ability. This information assists you in understanding game use and profitability. Player Audits is a read-only screen.



PLAYER AUDITS MENU

GAMES PLAYED. Total number of games that players played on this machine.

CONTINUES. Total number of games on this machine that players paid to continue.

FREE GAMES WON remains at zero if you turn off the bonus and award options. Refer to the General Adjustments Menu for the bonus and award options settings.

STARTS. Number of games that players started.

FREE GAMES %. Proportion of games that were free, expressed as a percentage.

TIME EXPIRES. Number of times that time expired before a player completed the game.

DID NOT FINISH. Number of incomplete games.

FINISHES. Number of completed games.

TWO, THREE AND FOUR-PLAYER RACES remain at zero if no other games are linked to this one.

Operator Menu (continued)**Audits Menu (continued)****Track Audits Menu****TRACK AUDITS**

Select TRACK AUDITS at the Audits Menu. The Track Audits Menu includes specific information about player choices and ability. This is a read-only menu.



AUDITS MENU		
TRACK AUDITS		
PAGE 1 OF 16		
Tunnel Vision		
SELECTED	0	
LINKED SELECTED	0	
FINISHES	0	
WINNERS	0	
TOP TEN	0	
LAP TOP TEN	0	
MANUAL	0	
TRUCK	SELECTED	WINNER
Hyena	0	0
Outlaw	0	0
General	0	0
Thrasher	0	0
Silver Streak	0	0
Snake Eyes	0	0
Chieftan	0	0
Bad Omen	0	0
Nitro Ninja	0	0
Wilcat	0	0
Dust Devil	0	0
Stinger	0	0
Use VOL+ or TEST to view next page; CREDIT to return to previous menu		

TYPICAL TRACK AUDITS MENU

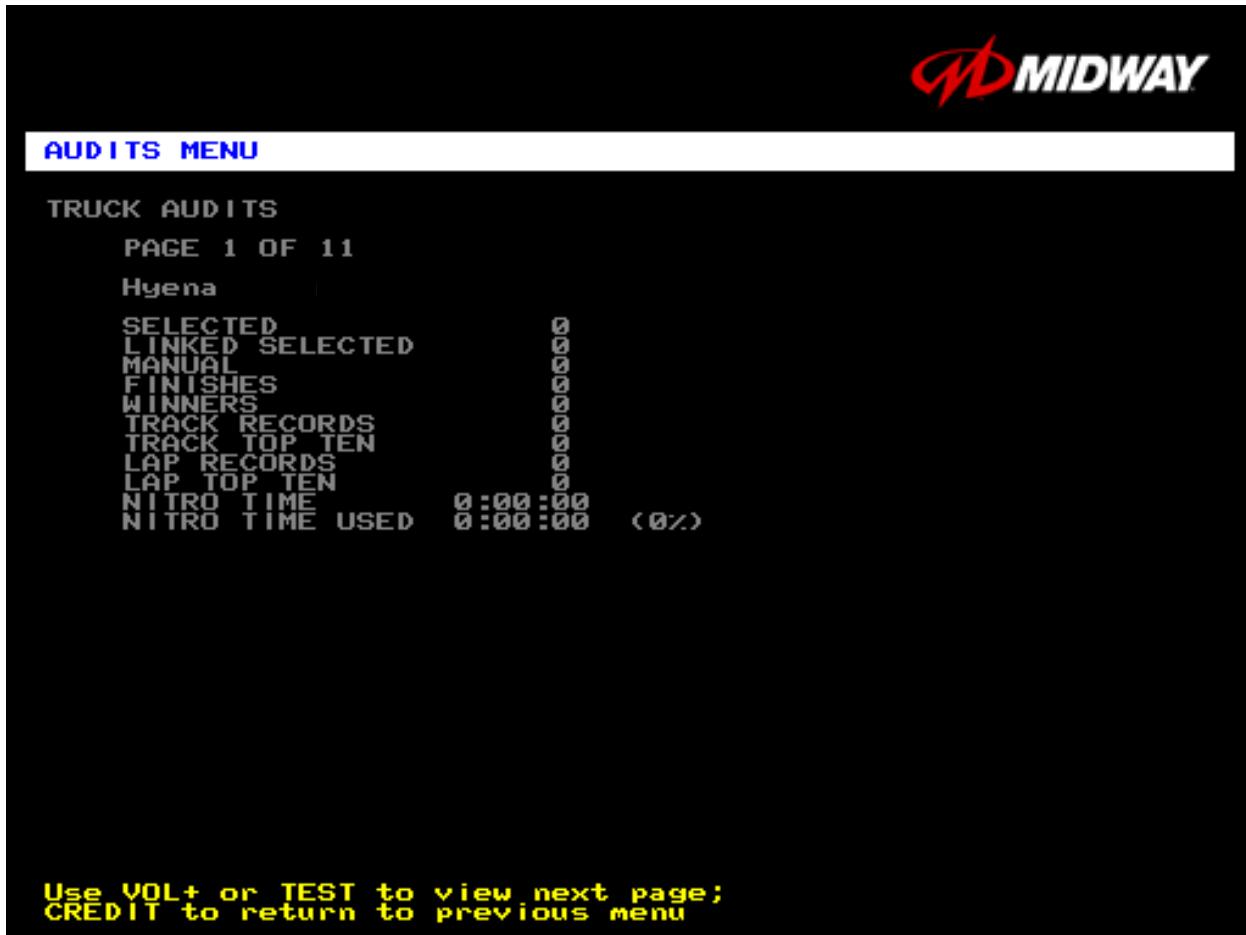
These audits cover several screen pages. The name of the track appears at the top of the page. Press the VOLUME UP or VOLUME DOWN buttons to move through these pages.

Operator Menu (continued)
Audits Menu (continued)
Truck Audits Menu

TRUCK AUDITS

Select TRUCK AUDITS at the Audits Menu. The Truck Audits Menu gives you specific information about player choices and ability. This is a read-only menu.

Menu software includes several pages of audits. The name of the vehicle appears at the top of each menu page. Press the VOLUME UP or VOLUME DOWN buttons to navigate through these pages.



TYPICAL AUDITS BY TRUCK SCREEN

Operator Menu (continued)

Adjustments Menu

ADJUSTMENTS MENU

Select ADJUSTMENTS MENU at the Operator Menu. The Adjustments Menu allows you to set game and player variables. Use these screens to optimize game performance and earnings.

Highlight an option with the middle two diagnostic buttons inside the coin door. Select the option with the TEST MODE button.



Operator Menu (continued)**Adjustments Menu (continued)****General Adjustments Menu****GENERAL ADJUSTMENTS MENU**

Select GENERAL ADJUSTMENTS MENU at the Adjustments Menu. At the General Adjustments Menu, you set the cabinet type, game display and measurement system. General Adjustments Menu options also control the cost and type of play.

Highlight an option with the middle two diagnostic buttons inside the coin door. Press TEST MODE to enter Change Mode. Use the diagnostic switches to change the variable. Then press TEST MODE to save changes and exit the variable.

**GENERAL ADJUSTMENTS MENU**

FREE PLAY determines whether the game accepts money for play, or allows operation without charge. For free play, turn this option on. For paid play, turn this option off (the factory default).

FREE RACE FOR 1ST permits a free game for players who finish in first place. To award a free race to a first-place finisher, turn this option on. To eliminate the free race award, turn this option off. The factory default is on.

FREE RACE FOR 1ST (LINKED). This feature awards a free game to the first place finisher among human players. The feature only operates when a minimum number of players join in. To award a free race to a first-place finisher, turn this option on. To eliminate the free race award, turn this option off. Available settings include 2, 3 or 4 players, or off. The factory default setting is off.

SHOW MILES PER HOUR sets the measurement system for display on game screens. To display speed in kilometers per hour, turn SHOW MILES PER HOUR off. To display speed in miles per hour, turn SHOW MILES PER HOUR on (the factory default).

ADULT MODE. When you enable Adult Mode, the glamorous cheerleaders appear in bikinis. When you disable Adult Mode, the cheerleaders appear in more conservative attire. The default setting is on.

Operator Menu (continued)

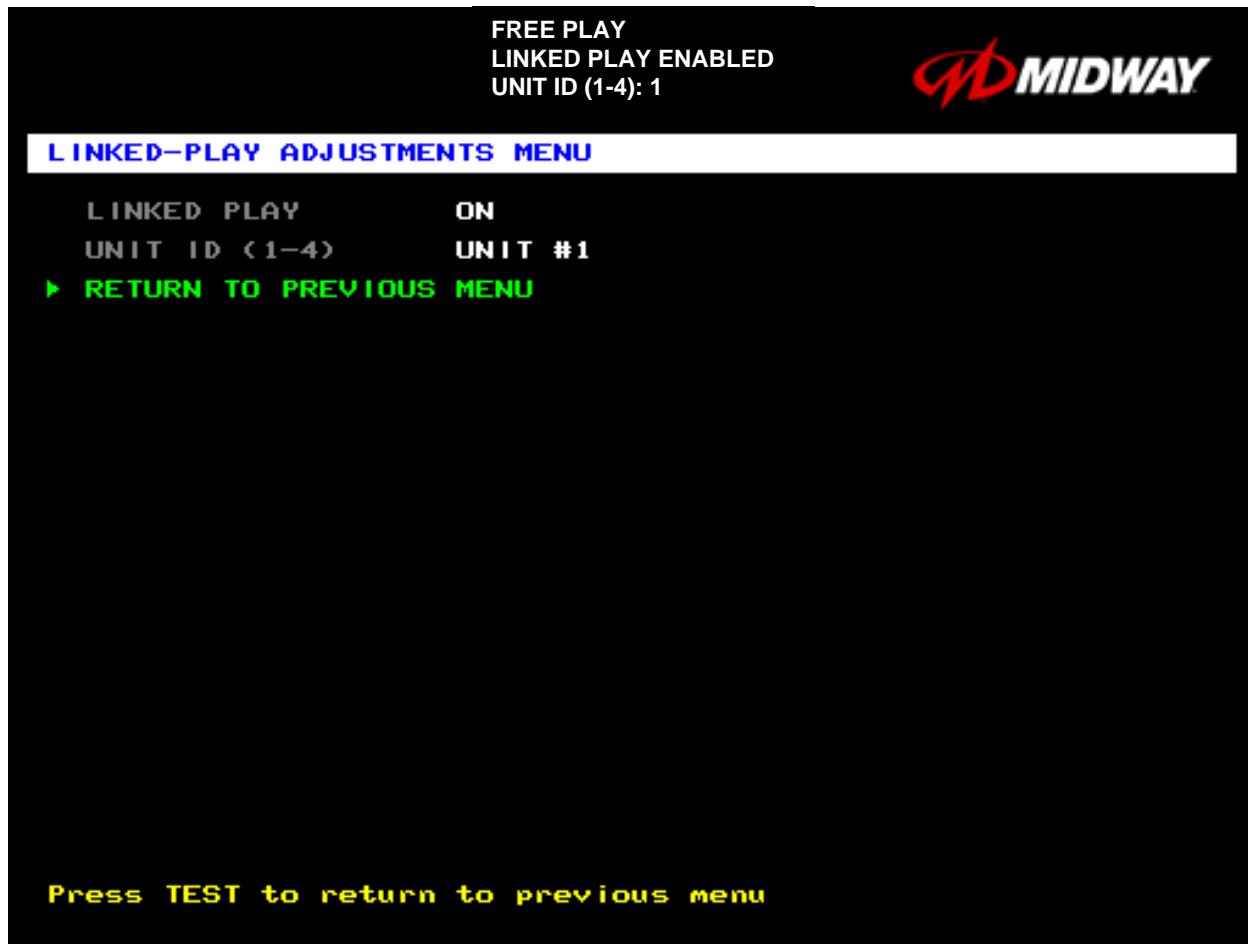
Adjustments Menu (continued)

Linked-Play Adjustments Menu

LINKED PLAY ADJUSTMENTS MENU

Select LINKED PLAY ADJUSTMENTS MENU at the Adjustments Menu. The Linked Play Adjustments Menu allows you to set the game cabinet network identity. After you cable the linked cabinets, use this menu to set up linked play.

Highlight an option with the middle two diagnostic buttons inside the coin door. Press TEST MODE to enter Change Mode. Use the diagnostic switches to change the variable. Then press TEST MODE to save changes and exit the variable.



LINKED-PLAY ADJUSTMENTS MENU

Before proceeding, bring up the Linked Play Adjustments Menu on all linked cabinets.

LINKED PLAY. After you link a cabinet to other games, turn on LINKED PLAY. Now game electronics can communicate with other cabinets. To prohibit linked play, turn off the feature. The factory default is off.

UNIT ID determines the game's address. Each linked game must have a unique number. Never use the same address for two cabinets. Sequence isn't important. The factory default ID is 1.

REINITIALIZE. After selecting the ID, exit the Menu System. Shut down each linked cabinet for one minute. (Leave the computers switched on.) Then restore power to all cabinets. The cabinets should initialize in Linked Mode. Verify linked operation by playing some linked games.

Operator Menu (continued)

Adjustments Menu (continued)

Track Difficulty Adjustments Menu

TRACK DIFFICULTY ADJUSTMENTS MENU

Select TRACK DIFFICULTY ADJUSTMENTS MENU at the Adjustments Menu. From the Track Difficulty Adjustments Menu, you set how much skill players need to complete races.

Highlight an option with the middle two diagnostic buttons inside the coin door. Press TEST MODE to enter Change Mode. Use the diagnostic switches to change the variable. Then press TEST MODE to save changes and exit the variable.



TRACK DIFFICULTY ADJUSTMENTS MENU

LIMIT FREE RACES TO (LFRT) is the award cutoff point. LFRT prevents expert players from monopolizing a cabinet. The range is 1 to 100%. The factory default is 10%.

BONUS START TIME. You can use this feature to award several seconds of extra time to starting players. The factory default is zero seconds.

BONUS CHECKPOINT TIME. Use this feature to award several seconds of extra time as players pass checkpoints. The factory default is zero seconds.

ADJUST TRACK DIFFICULTIES MENU allows you to modify the level of challenge that each track poses.

Operator Menu (continued)**Adjustments Menu (continued)****Track Difficulty Adjustments Menu (continued)****Adjust Track Difficulties Menu****ADJUST TRACK DIFFICULTIES MENU**

Select ADJUST TRACK DIFFICULTIES MENU at the Track Difficulty Adjustments Menu. From the Adjust Track Difficulties Menu, you modify the level of challenge that each track poses. You can also increase or reduce starting and checkpoint bonus time. Difficulty and bonus default values are all zero.

Highlight an option with the middle two diagnostic buttons inside the coin door. Press TEST MODE to enter Change Mode. Use the diagnostic switches to change the variable. Press TEST MODE to save changes and exit the variable. Or press TEST CREDITS to cancel changes and exit the variable.

You'll notice that each option line has three columns of figures to change. The program lets you edit each column in turn. First you modify BASE DIFFICULTY, then START BONUS, and last, CHECKPOINT BONUS.



ADJUST TRACK DIFFICULTIES MENU			
TRACK NAME	BASE DIFFICULTY (0-100)	START BONUS (sec.)	CHECKPOINT BONUS (sec.)
Tunnel Vision	0	0	0
Over 'N' Under	0	0	0
Air Time	0	0	0
High Octane	0	0	0
Carnie of Chaos	0	0	0
Cliffhanger	0	0	0
Double Barrel	0	0	0
Alpine Air	0	0	0
Tunnel Vision Mirror	0	0	0
Over 'N' Under Mirror	0	0	0
Airtime Mirror	0	0	0
High Octane Mirror	0	0	0
Carnie of Chaos Mirror	0	0	0
Cliffhanger Mirror	0	0	0
Double Barrel Mirror	0	0	0
Alpine Air Mirror	0	0	0

Press TEST to return to previous menu

ADJUST TRACK DIFFICULTIES MENU

Operator Menu (continued)

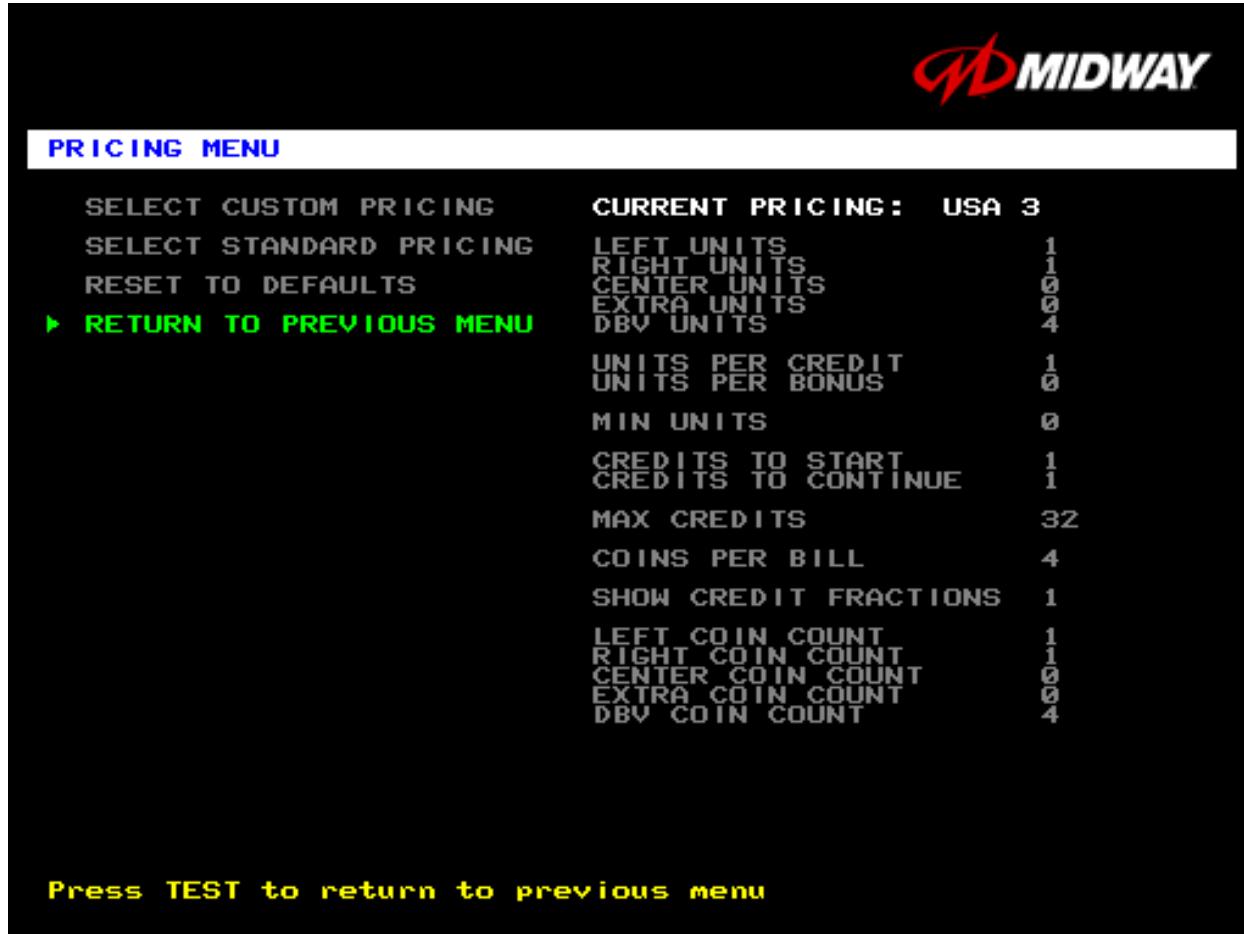
Adjustments Menu (continued)

Pricing Menu

PRICING MENU

Select PRICING MENU at the Adjustments Menu. The Pricing Menu contains options for selecting standard and custom currency combinations. The factory default is USA1.

Highlight an option with the middle two diagnostic buttons inside the coin door. Press TEST MODE to enter Change Mode. Use the diagnostic switches to change the variable. Then press TEST MODE to save changes and exit the variable. Turning on Free Play disables Pricing Menu settings.



PRICING MENU

SELECT CUSTOM PRICING allows you to set coin and credit options manually. Use this option to create your own pricing schemes. This menu permits changes to default values.

SELECT STANDARD PRICING allows you to select from several ready-made price schemes. This menu permits changes to default values.

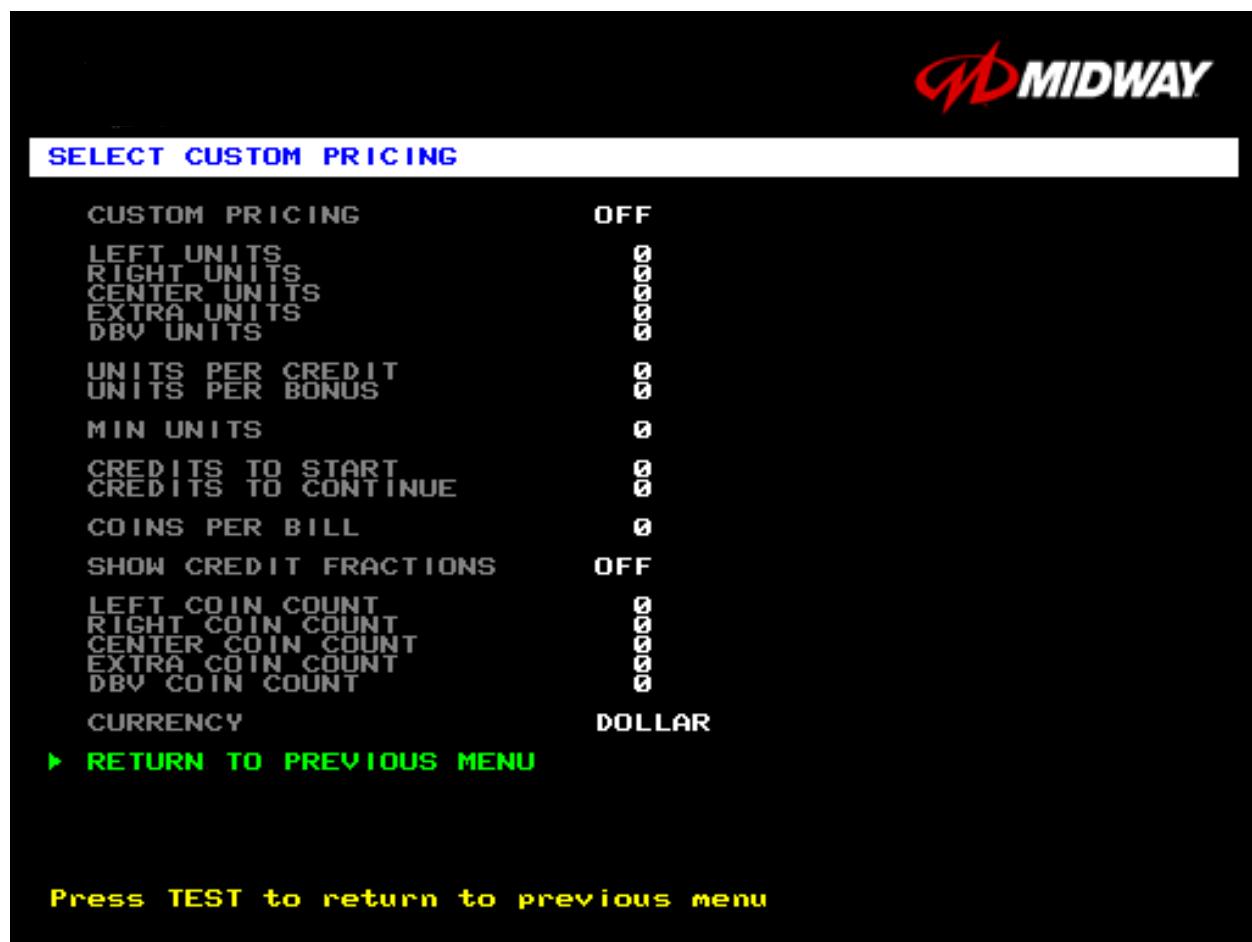
RESET TO DEFAULTS returns the price settings to factory default values. This menu permits changing all current values at once.

Operator Menu (continued)
Adjustments Menu (continued)
Pricing Menu (continued)
Select Custom Pricing Menu

SELECT CUSTOM PRICING MENU

Choose SELECT CUSTOM PRICING at the Pricing Menu. The Select Custom Pricing Menu permits you to program and use your own pricing table. You can save several pricing schemes and chose between them as desired.

Highlight an option with the middle two diagnostic buttons inside the coin door. Press TEST MODE to enter Change Mode. Use the diagnostic switches to change the variable. Then press TEST MODE to save changes and exit the variable.



TYPICAL SELECT CUSTOM PRICING MENU

The Custom Pricing Menu employs the same terms that appear on the Current Pricing Table. See the table below for definitions of these terms.

PRICING MENU TERMS

SCREEN TERM	DISCUSSION
Slot Units; Bill Validator (DBV) Units	Cyber-currency. This adjustment assigns a number of "units" to each coin mechanism or bill acceptor. For instance, if a quarter buys 1 unit, then \$1 buys 4 units. (See <i>Coins per Bill</i> .) You insert a coin into a 1-unit coin acceptor. The system, due to its programming, knows that your coin is worth one unit.
Units per Credit	How many units equal one credit. (Units buy credit, the price of one game.)
Units per Bonus	Units awarded when a player earns a bonus.
Minimum Units	Until this many units accumulate, the system awards no credits.
Credits to Start	Number of games a player must purchase to begin play.
Credits to Continue	Number of games a player must purchase to resume play.
Max Credits	Limits the number of credits that the game will accept.
Coins per Bill	How many coins one bill is worth.

BASIC CUSTOM PRICING. Custom pricing creates an imaginary currency exchange. In this currency exchange, the coins of the realm are "units." Think of units as a type of cyber-currency, useful only within the game software. By inserting coins, you purchase units.

Since units are only negotiable within game software, the system stores your units for you. When the system receives enough units, it buys a game for you. The price of a game is one "credit." You can think of credits as a second form of cyber-currency.

Even though you've now bought one game, you may not be able to begin playing. In many pricing schemes, you must buy two or more credits to begin play. The idea here is something like a minimum order of goods at a store. That is, the operator can "shrink-wrap" two or more games in a package. You can't play unless you buy the entire package.

•1 / 25¢ COIN; 1 CREDIT TO START. In a simple, quarter pricing scheme, the player inserts one coin to buy one unit. The system exchanges that unit for one credit. If CREDITS TO START contains the value one, then play commences. A dollar bill buys four units.

Left Slot Units	Validator Units	Units / Credit	Credits to Start	Coins / Bill
1	4	1	1	4

•1 / 3 X 25¢; 2 CREDITS TO START. Again, assuming quarter slots, here's one way to implement 75¢ pricing... In this scheme, each coin that the player inserts buys one unit. The system exchanges three units for one credit. CREDITS TO START contains the value two. To play, the player must pay for two credits. In this scheme, a dollar buys four units.

Left Slot Units	Validator Units	Units / Credit	Credits to Start	Coins / Bill
1	4	3	2	4

•2 / 1 COIN; 6 CREDITS TO START. Now let's consider a more unusual pricing scheme. Here, the player can buy two units with one coin. The system exchanges each of these units for one credit. Notice that CREDITS TO START contains the value six. To play, the player must insert two more coins to pay for six credits. Also notice that if the player pays with a bill, the system throws in an extra unit.

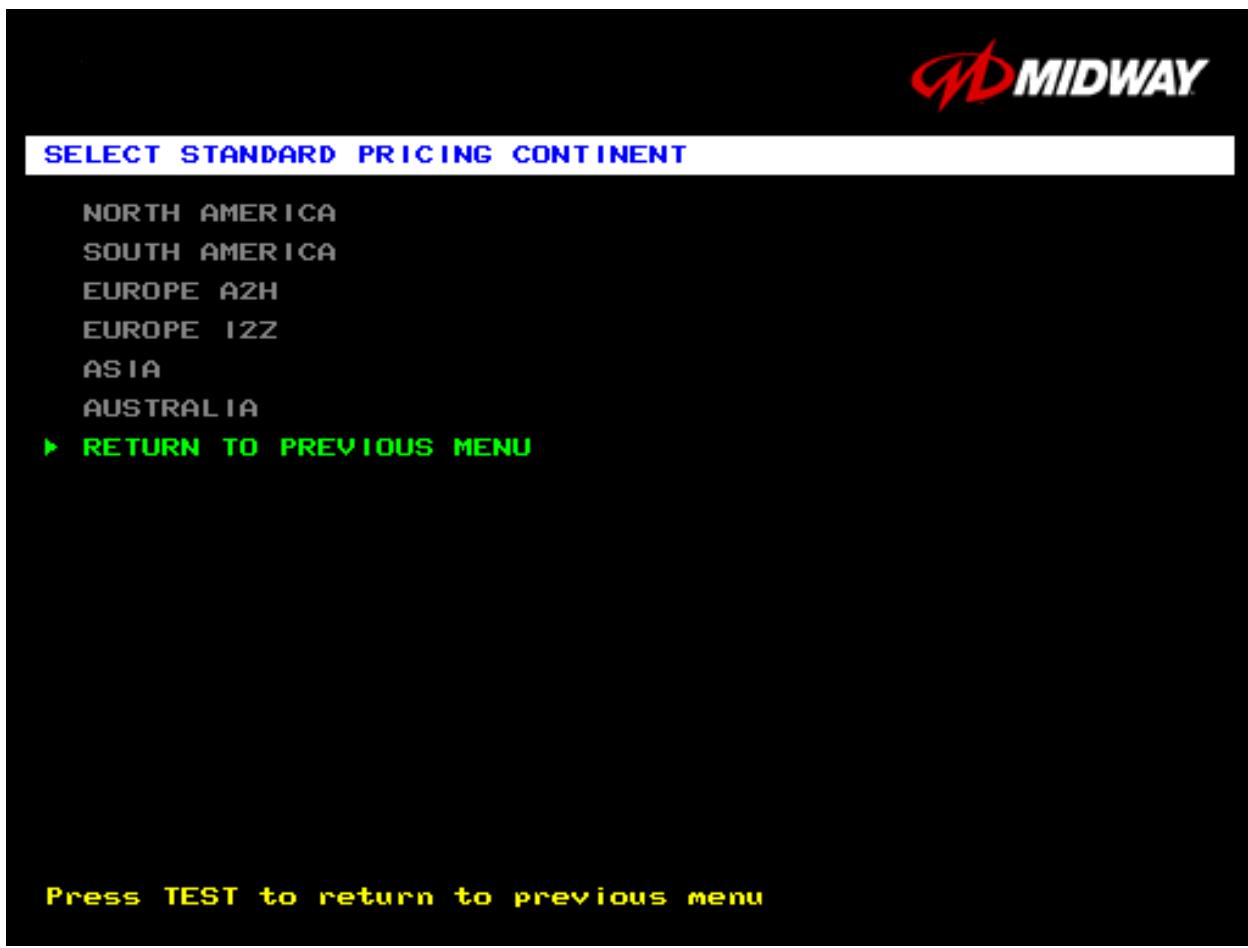
Left Slot Units	Validator Units	Units / Credit	Credits to Start	Coins / Bill
2	9	1	6	4

Operator Menu (continued)
Adjustments Menu (continued)
Pricing Menu (continued)
Select Standard Pricing Continent Menu

SELECT STANDARD PRICING CONTINENT MENU

Choose SELECT STANDARD PRICING at the Pricing Menu. The Select Standard Pricing Continent Menu allows you to choose the continent that you are operating in.

Highlight a line item with the middle two diagnostic buttons inside the coin door. Select the option with the TEST MODE button.



STANDARD PRICING MENU

Operator Menu (continued)

Adjustments Menu (continued)

Pricing Menu (continued)

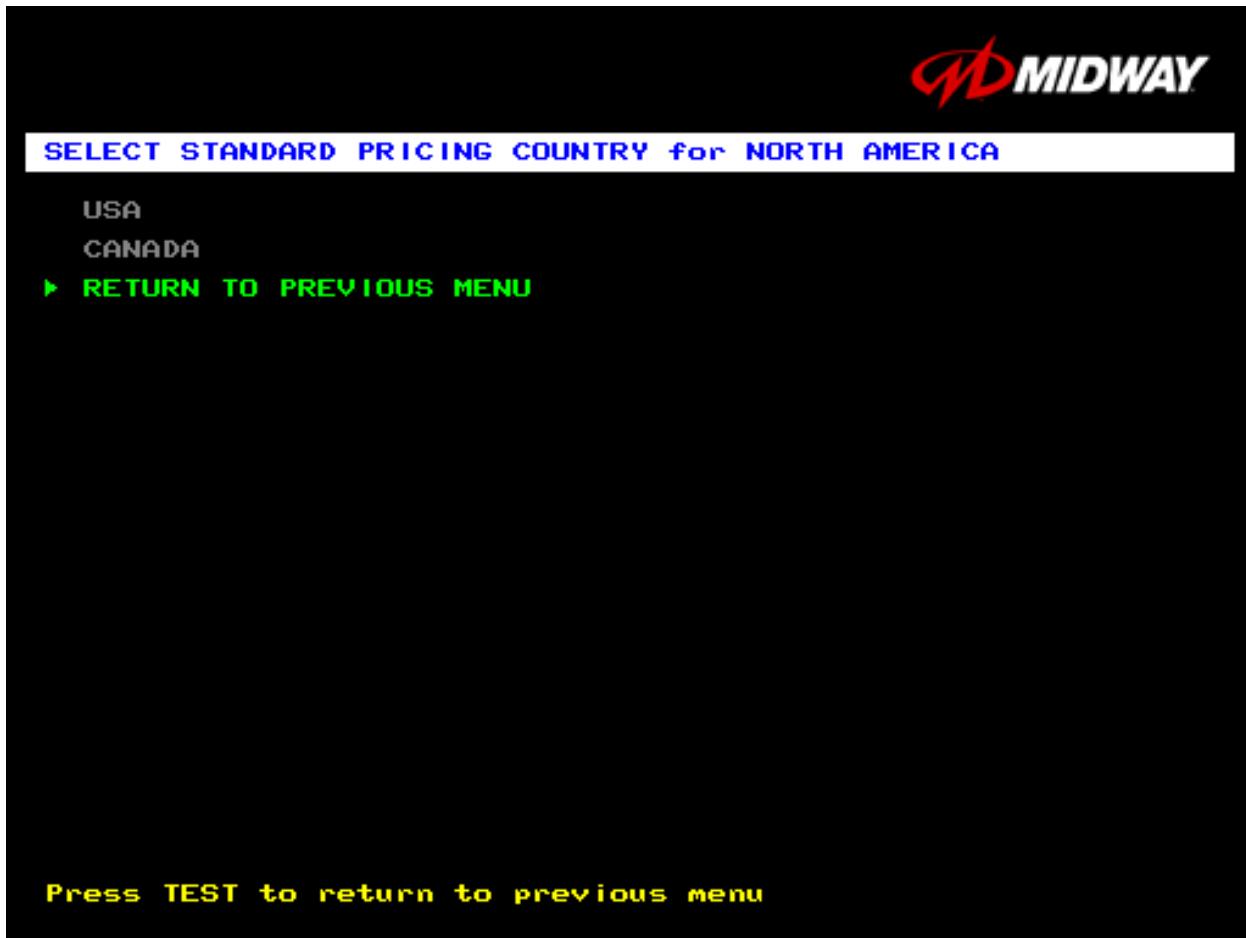
Select Standard Pricing Continent Menu

Select Standard Pricing Country for North America Menu

SELECT STANDARD PRICING COUNTRY FOR NORTH AMERICA MENU

Choose a continent (NORTH AMERICA, for example) at the Select Standard Pricing Continent Menu. The Select Standard Pricing Country for North America Menu contains options for selecting standard currency combinations. You may use standard pricing schemes as-is, or customize them.

Highlight a line item with the middle two diagnostic buttons inside the coin door. Select the option with the TEST MODE button.



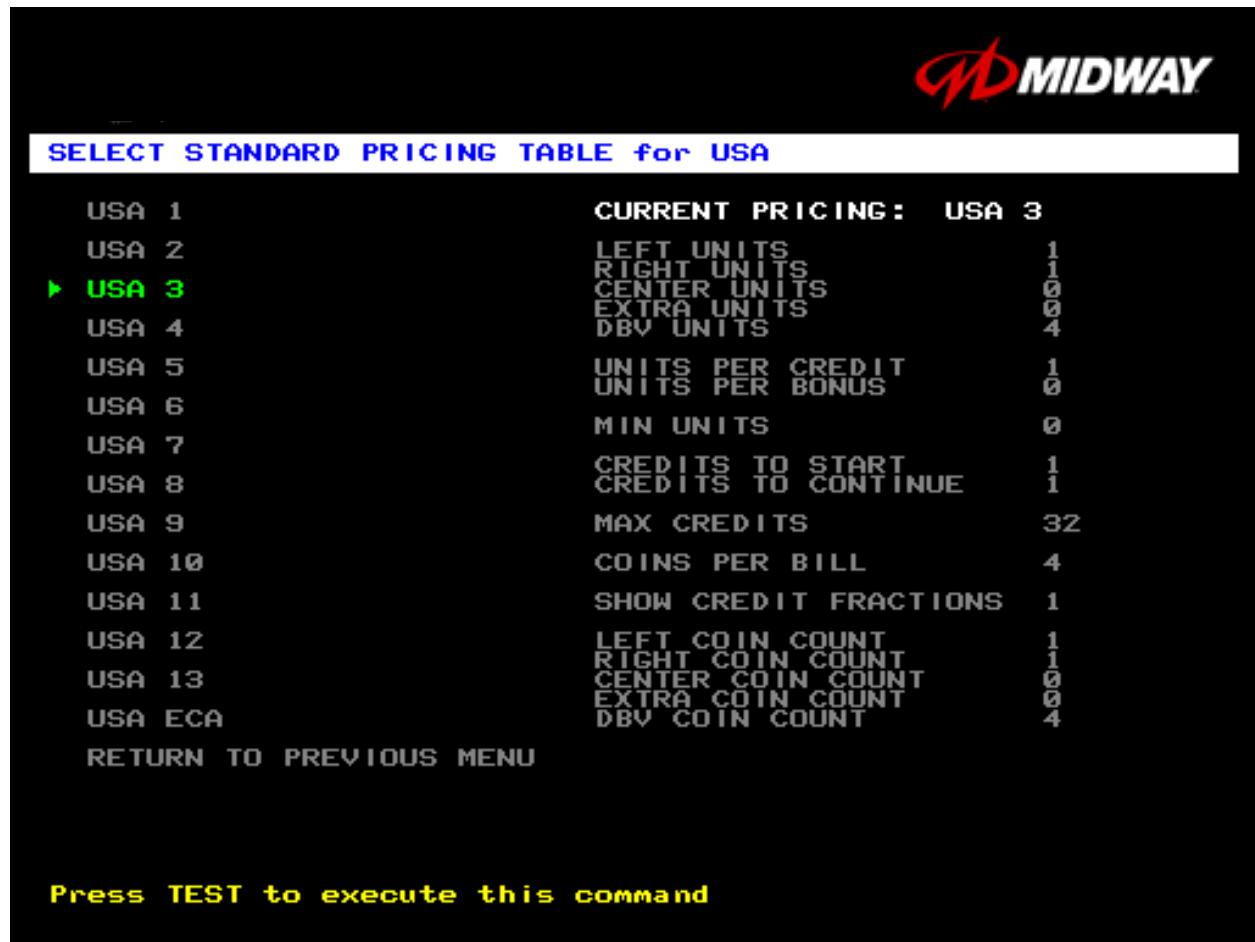
TYPICAL SELECT STANDARD PRICING FOR NORTH AMERICA MENU

Operator Menu (continued)
Adjustments Menu (continued)
Pricing Menu (continued)
Select Standard Pricing Continent Menu (continued)
Select Standard Pricing Country for North America Menu (cont'd)
Select Standard Pricing Table for USA Menu (cont'd)

SELECT STANDARD PRICING MENU

Suppose that you want to set U.S. pricing. Choose USA at the menu entitled Select Standard Pricing Country for North America. This menu contains options for selecting standard U.S. currency combinations.

Highlight an option with the middle two diagnostic buttons inside the coin door. Press TEST MODE to enter Change Mode. Use the diagnostic switches to change the variable. Then press TEST MODE to save changes and exit the variable.



TYPICAL VIEW CURRENT PRICING DISPLAY

STANDARD PRICING TABLE

NAME	START	CONTINUE	CREDITS/COIN	COIN 1	COIN 2	COIN 3	COIN4	BILL
ANTILLES	2	2	1/25¢, 4/1G	.25¢	1G			
AUSTRALIA 1	2	2	1/3X20¢, 2/\$1.00	.20¢	\$1.00			
AUSTRALIA 2	2	2	1/5X20¢, 1/\$1.00	.20¢	\$1.00			
AUSTRIA 1	2	2	1/5Sch, 2/10Sch	5 Sch	10 Sch			
AUSTRIA 2	2	2	1/2X5Sch, 3/2X10Sch	5 Sch	10 Sch			
BELGIUM 1	2	2	1/20BF	20BF	20BF			
BELGIUM 2	2	2	3/20BF	20BF	20BF			
BELGIUM 3	2	2	2/20BF	20BF	20BF			
BELGIUM ECA	2	2	1/20BF	50BF	20BF	5BF		
CANADA 1	2	2	1 / 2 x 25¢, 3 / \$1	25¢	25¢			
CANADA 2	2	2	1 / 2 x 25¢, 3 / \$1	25¢	\$1.00			
CANADA 3	2	2	3 / \$1.00, 6 / \$2.00	\$1.00	\$2.00			
CANADA ECA	2	2	1 / 2 x 25¢, 3 / \$1	25¢	\$1.00	\$2.00		
DENMARK	2	2	3/5DKr, 7/10DKr	5DKr	10DKr			
FINLAND	2	2	1/1Fmk	1Fmk	5Fmk			
FRANCE 1	2	2	2/5Fr, 5/10Fr	5Fr	10Fr			
FRANCE 2	2	1	2/5Fr, 4/10Fr	5Fr	10Fr			
FRANCE 3	2	1	1/5Fr, 3/10Fr	5Fr	10Fr			
FRANCE 4	2	1	1/5Fr, 2/10Fr	5Fr	10Fr			
FRANCE 5	2	1	2/5Fr, 5/10Fr, 11/2 X 10Fr	5Fr	10Fr			
FRANCE 6	2	1	2/5Fr, 4/10Fr, 9/2 X 10Fr	5Fr	10Fr			
FRANCE 7	2	1	1/5Fr, 3/10Fr, 7/2 X 10Fr	5Fr	10Fr			
FRANCE 8	2	1	1/5Fr, 2/10Fr, 5/2 X 10Fr	5Fr	10Fr			
FRANCE 9	2	1	1/3 X 1Fr, 2/5Fr	1Fr	5Fr			
FRANCE 10	2	1	1/2 X 1Fr, 3/5Fr	1Fr	5Fr			
FRANCE 11	2	1	1/3 X 1Fr, 2/5Fr, 5/2 X 5Fr	1Fr	5Fr			
FRANCE 12	2	1	1/2 X 1Fr, 3/5Fr, 7/2 X 5Fr	1Fr	5Fr			
FRANCE ECA 1	1	1	2/5Fr, 5/10Fr	1Fr	5Fr	10Fr	20Fr	
FRANCE ECA 2	1	1	2/5Fr, 4/10Fr	1Fr	5Fr	10Fr	20Fr	
FRANCE ECA 3	1	1	1/5Fr, 3/10Fr	1Fr	5Fr	10Fr	20Fr	
FRANCE ECA 4	1	1	1/5Fr, 2/10Fr	1Fr	5Fr	10Fr	20Fr	
FRANCE ECA 5	1	1	2/5Fr, 5/10Fr, 11/2 X 10Fr	1Fr	5Fr	10Fr	20Fr	
FRANCE ECA 6	1	1	2/5Fr, 4/10Fr, 9/2 X 10Fr	1Fr	5Fr	10Fr	20Fr	
FRANCE ECA 7	1	1	1/5Fr, 3/10Fr, 7/2 X 10Fr	1Fr	5Fr	10Fr	20Fr	
FRANCE ECA 8	1	1	1/5Fr, 2/10Fr, 5/2 X 10Fr	1Fr	5Fr	10Fr	20Fr	
FRANCE ECA 9	1	1	1/3 X 1Fr, 2/5Fr	1Fr	5Fr	10Fr	20Fr	
FRANCE ECA 10	1	1	1/2 X 1Fr, 3/5Fr	1Fr	5Fr	10Fr	20Fr	
FRANCE ECA 11	1	1	1/3 X 1Fr, 2/5Fr, 5/10Fr	1Fr	5Fr	10Fr	20Fr	
FRANCE ECA 12	1	1	1/2 X 1Fr, 3/5Fr, 7/10Fr	1Fr	5Fr	10Fr	20Fr	
FRANCE ECA 13	1	1	1/10Fr, 2/20Fr, 4/30Fr	1Fr	5Fr	10Fr	20Fr	
FREE PLAY	--	--	--	None	None	None	None	None
GERMANY 1	2	2	1/1DM, 6/5DM	1DM	5DM			
GERMANY 2	2	1	1/1DM, 7/5DM	1DM	5DM			
GERMANY 3	2	1	1/1DM, 8/5DM	1DM	5DM			
GERMANY 4	2	1	1/1DM, 5/5DM	1DM	5DM			
GERMANY 5	2	1	1/1DM, 6/5DM	1DM	5DM			
GERMANY ECA 1	2	2	1/1DM, 2/2DM, 6/5DM	1DM	2DM	5DM		
GERMANY ECA 2	2	1	1/1DM, 2/2DM, 6/5DM	1DM	2DM	5DM		
GERMANY ECA 3	1	1	1/1DM, 2/2DM, 6/5DM	1DM	2DM	5DM		
HUNGARY	2	2	1/2X10Ft, 3/2X20Ft	10Ft	20Ft			
ITALY	2	2	1/500Lit	500Lit	500Lit			
JAPAN 1	2	2	1/100Yen	100	100			
JAPAN 2	2	2	2/100Yen	100	100			
NETHERLANDS	2	2	1/1HFI, 3/2.5HFI	1HFI	2.5HFI			
NEW ZEALAND 1	1	1	1/\$1	\$1	\$2			
NEW ZEALAND 2	1	1	2/\$1	\$1	\$2			
NORWAY	2	2	3/5NKr, 6/10NKr	5NKr	10NKr			
SPAIN 1	2	2	1/100Pta, 6/500Pta	100Pta	500Pta			
SPAIN 2	2	2	1/100Pta, 5/500Pta	100Pta	500Pta			
SWEDEN	2	2	1/3X1SKr, 2/5SKr	1SKr	5SKr			
SWITZERLAND 1	2	2	1/1SFr, 6/5SFr	1SFr	5SFr			
SWITZERLAND 2	2	2	1/1SFr, 7/5SFr	1SFr	5SFr			
SWITZERLAND 3	2	2	1/1SFr, 8/5SFr	1SFr	5SFr			

(Table continues on next page)

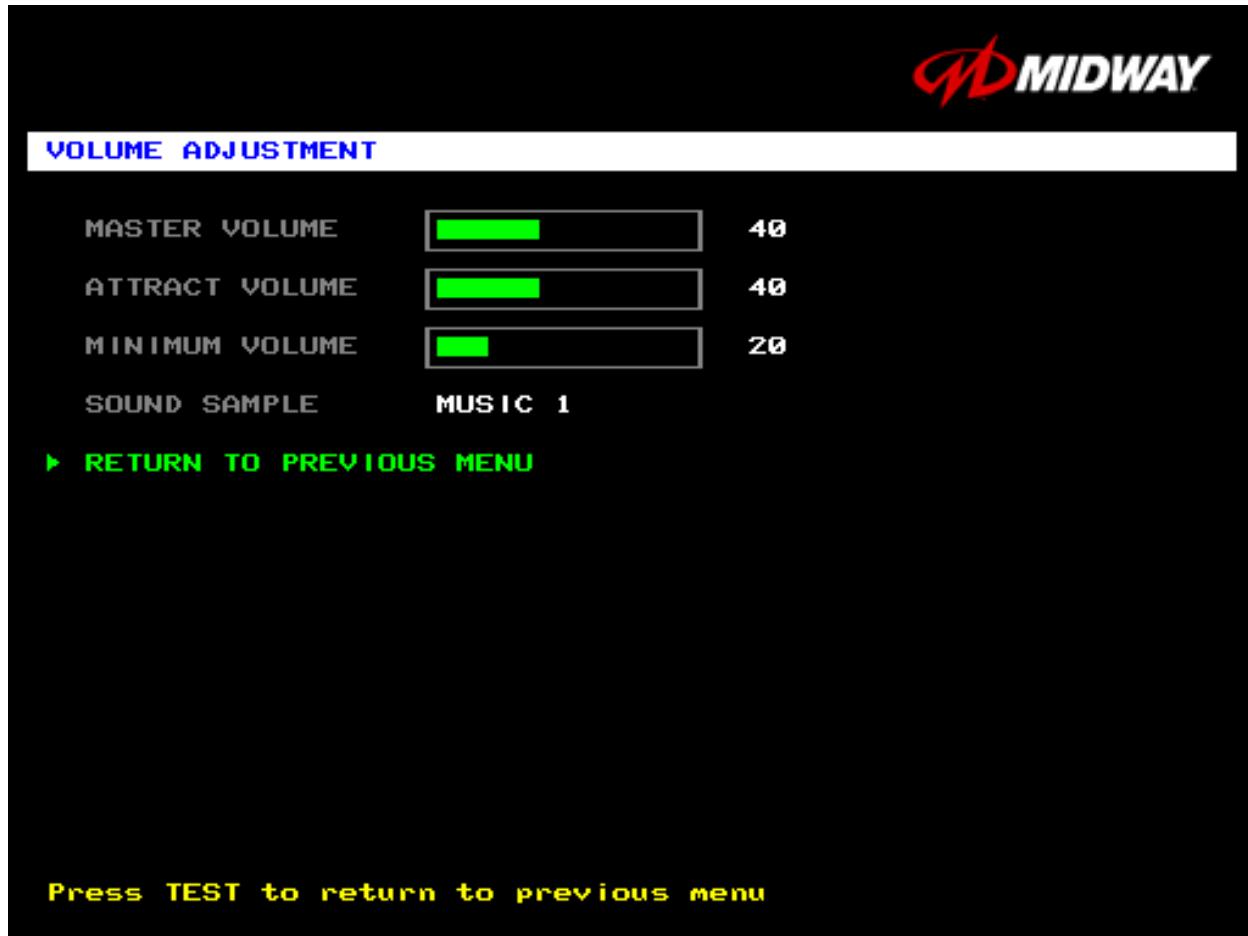
STANDARD PRICING TABLE, *continued*

NAME	START	CONTINUE	CREDITS/COIN	COIN 1	COIN 2	COIN 3	COIN4	BILL
UK ECA 1	1	1	1/50p, 3/£1.00	£1.00	50p	20p	10p	£2.00
UK ECA 2	1	1	1/50p, 2/£1.00	£1.00	50p	20p	10p	£2.00
UK ECA 3	1	1	1/30p, 2/50p, 5/£1.00	£1.00	50p	20p	10p	£2.00
UK 4	1	1	1/50p, 3/£1.00	£1.00	50p			
UK 5	1	1	1/50p, 2/£1.00	£1.00	50p			
UK ECA 6	1	1	1/30p, 2/50p, 4/£1.00	£1.00	50p	20p	10p	£2.00
UK ECA 7	1	1	3/£1.00	£1.00	50p	20p	10p	£2.00
UK ECA 8	1	1	1/50p, 2/£1.00, 4/£2.00	£1.00	50p	20p	10p	£2.00
USA1	2	2	1/25¢	25¢	25¢			\$1.00
USA2	2	1	1/25¢	25¢	25¢			\$1.00
USA3	1	1	1/25¢	25¢	25¢			\$1.00
USA4	1	1	1/50¢, 3/\$1.00	25¢	25¢			\$1.00
USA5	2	1	1/50¢, 4/\$1.00	25¢	25¢			\$1.00
USA6	1	1	1/50¢	25¢	25¢			\$1.00
USA7	1	1	1/50¢, 3/\$1.00	25¢	25¢			\$1.00
USA8	2	2	1/50¢, 4/\$1.00	25¢	25¢			\$1.00
USA9	3	2	1/25¢, 4/\$1.00	25¢	25¢			\$1.00
USA10	3	3	1/25¢, 4/\$1.00	25¢	25¢			\$1.00
USA11	4	2	1/25¢, 4/\$1.00	25¢	25¢			\$1.00
USA12	4	3	1/25¢, 4/\$1.00	25¢	25¢			\$1.00
USA13	4	4	1/25¢, 4/\$1.00	25¢	25¢			\$1.00
USA ECA	3	3	1/25¢, 4/\$1.00	\$1.00	25¢	10¢	05¢	\$1.00

Operator Menu (continued)**Adjustments Menu (continued)****Volume Adjustment Menu****VOLUME ADJUSTMENT MENU**

Select VOLUME ADJUSTMENT at the Adjustments Menu. (You can also access this menu from the Operator Menu.) The Volume Adjustment Menu allows you to adjust relative sound volume levels.

Highlight an option with the middle two diagnostic buttons inside the coin door. Press TEST MODE to enter Change Mode. Use the diagnostic switches to change the variable. Then press TEST MODE to save changes and exit the variable.

**VOLUME ADJUSTMENT MENU**

	NOTICE: The Master Volume setting affects all other volume adjustments. You can still alter Attract sounds in relation to normal game sound. For example, suppose that you set Attract Mode volume to 50%. Then Attract Mode sounds are half as loud as normal game sounds.
	NOTICE: Check the Master Volume setting before testing. Increase Master Volume to fully test speakers. Restore Master Volume to its previous level before returning to Game-Over Mode.

MASTER VOLUME sets the overall volume level during game play. This value simultaneously affects all other sound settings. The range is 1 to 100%. The factory default is 60%.

ATTRACT VOLUME adjusts the Attract Mode sound level only when you turn on Attract Mode. The Attract Mode sound level is independent of game audio levels. The Attract Volume range is 1 to 100%. The factory default is 50%.

MINIMUM VOLUME sets the quietest sound level during game play. The range is 1 to 100%. The factory default is 20%.

To exit the Volume Adjustment Menu, highlight RETURN TO PREVIOUS MENU. Then press TEST MODE.

Operator Menu (continued)

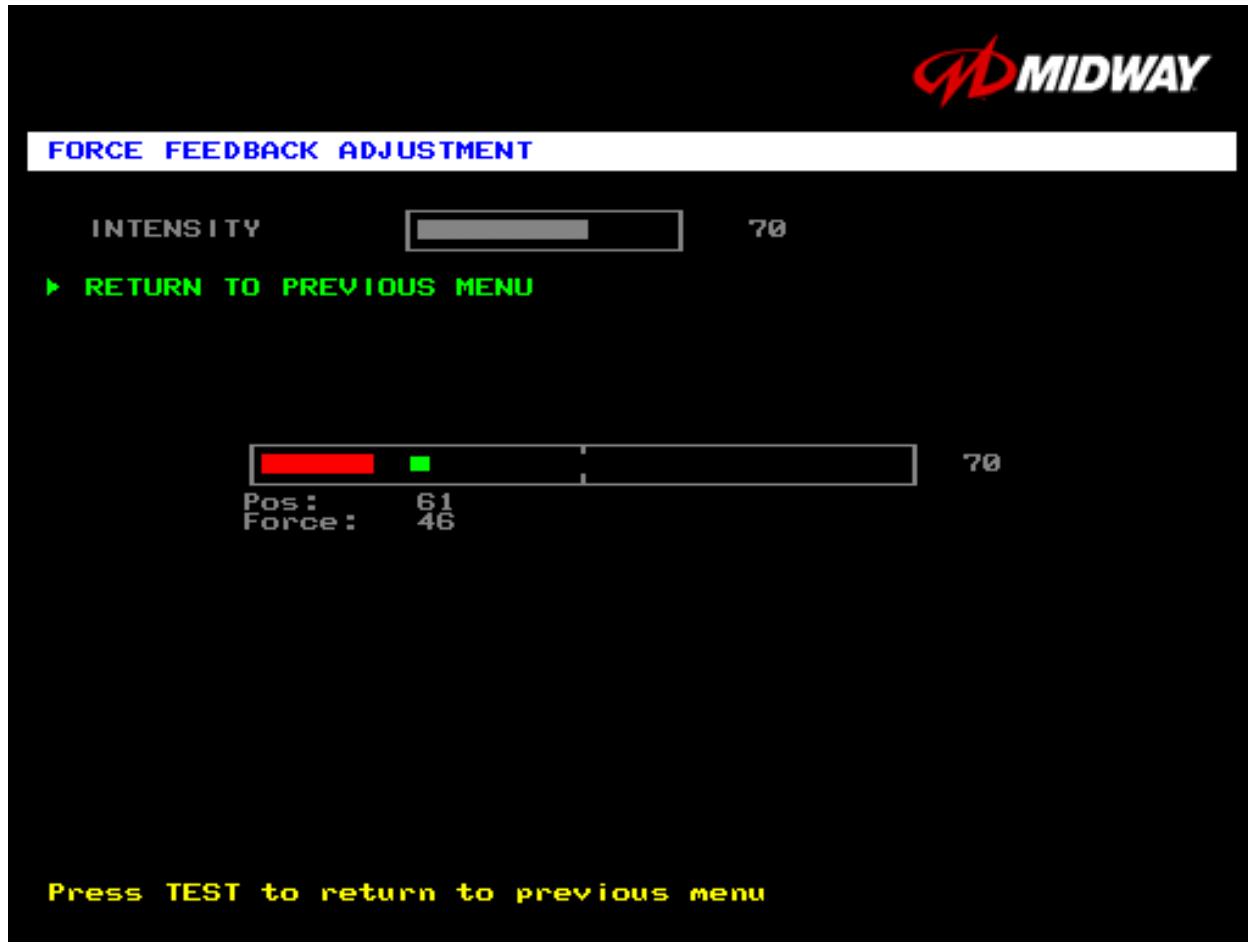
Adjustments Menu (continued)

Force Feedback Adjustment Menu

FORCE FEEDBACK ADJUSTMENT

Select FORCE FEEDBACK ADJUSTMENT MENU at the Adjustments Menu. The Force Feedback Adjustment Menu allows you to alter the intensity of steering wheel feedback.

Highlight an option with the middle two diagnostic buttons inside the coin door. Press TEST MODE to enter Change Mode. Use the diagnostic switches to change the variable. Then press TEST MODE to save changes and exit the variable.



THE INTENSITY ADJUSTMENT ranges from 0% (minimum) to 100% (maximum). The factory default setting is 60%. If players have superior upper body strength, apply greater force. Younger players may be more comfortable with smaller force settings.

THE FORCE FEEDBACK CENTER TEST checks operation of steering wheel motor drive circuits. Select this option and move the steering wheel to any position. As soon as you release the wheel, it must automatically return to its center position. If it doesn't, then the vehicle won't respond properly.

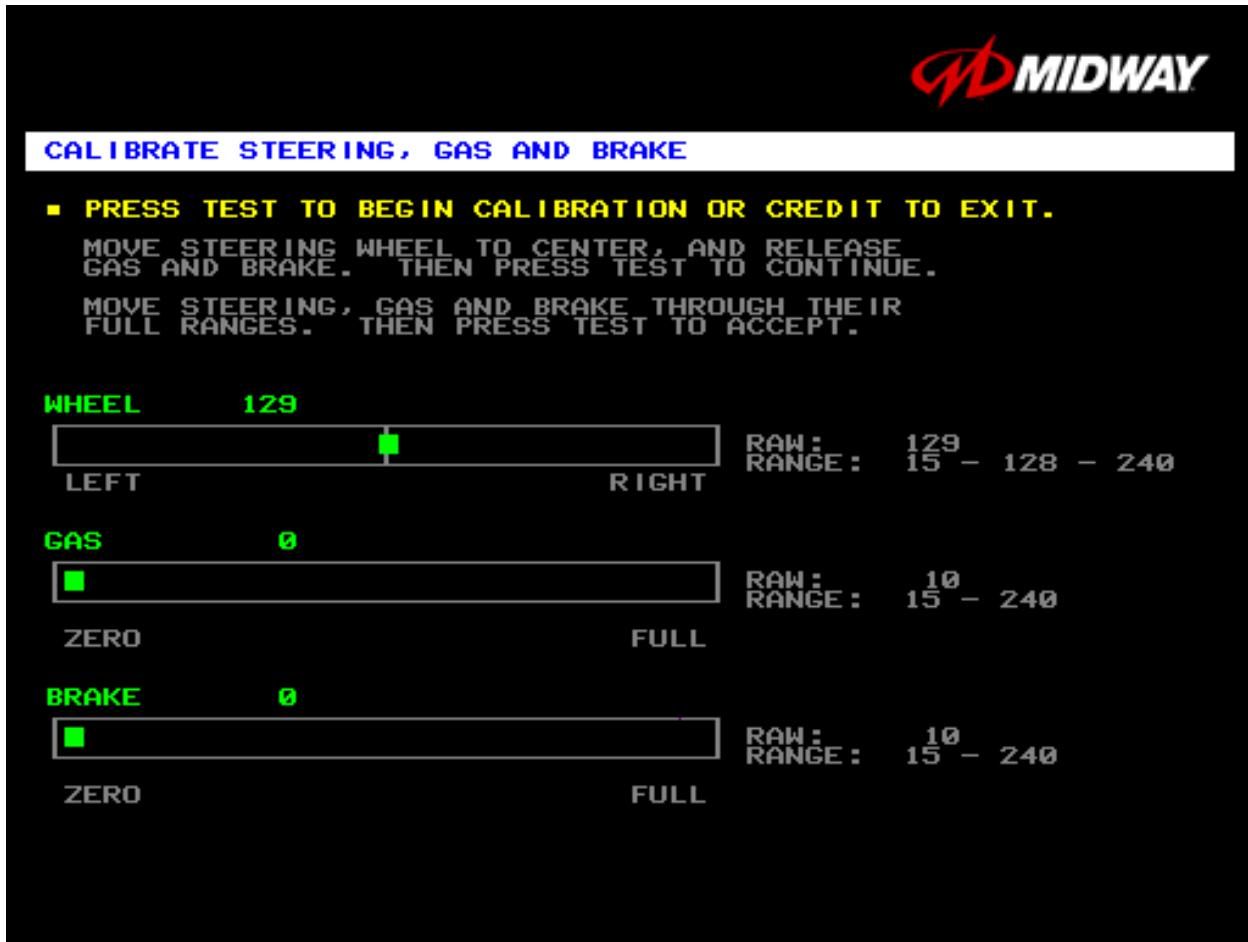
Operator Menu (continued)**Adjustments Menu (continued)****Calibrate Steering, Gas and Brake Menu****CALIBRATE STEERING, GAS AND BRAKE**

Select CALIBRATE STEERING, GAS AND BRAKE at the Adjustments Menu. (You can also access this menu from the Operator Menu.) This option allows you to set steering and throttle mechanisms for optimum control during game play. Poorly calibrated player controls can reduce profits.



NOTICE: Before calibrating player control switches, make needed repairs to the game. If you plan to move the game, move it before calibrating player control switches.

To set up each calibration procedure, follow screen directions. Press TEST MODE to begin the procedure.

**STEERING, GAS AND BRAKE CALIBRATION SCREEN**

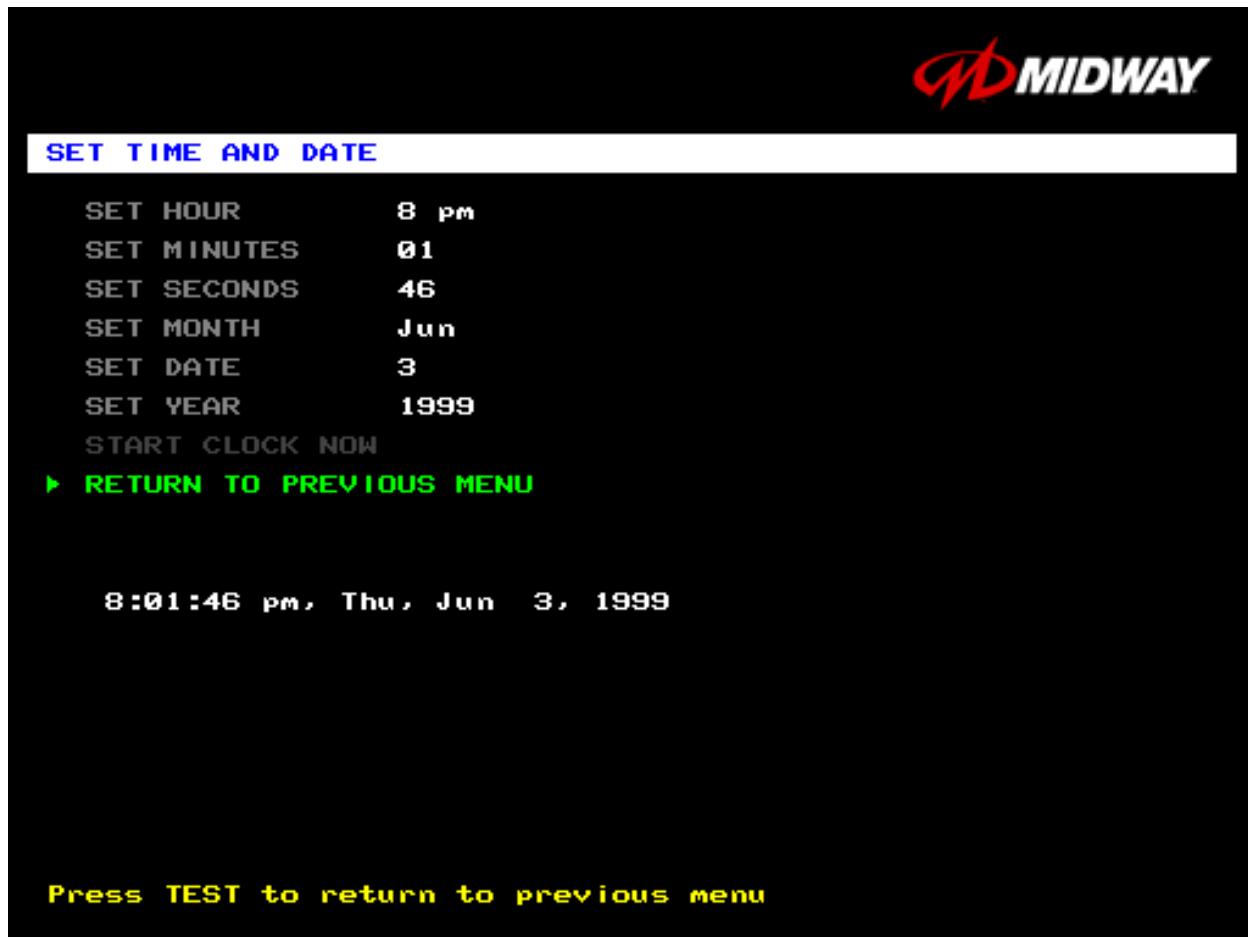
The steering wheel, brake and gas pedal couple to potentiometers. These potentiometers output DC voltages between zero and five volts. Game electronics digitize this analog output into an eight-bit (256-value), numeric stream.

Watch the numbers on the calibration screen. These numbers vary to indicate a control's position within that control's range of motion. For instance, steering straight ahead produces a number halfway between the left and right steering limits. To accurately simulate steering, numbers must change sequentially.

Operator Menu (continued)**Adjustments Menu (continued)****Set Time and Date Menu****SET THE TIME AND DATE**

Select SET TIME AND DATE at the Adjustments Menu. The Set Time and Date Menu provides the current date and time for the game. This screen also allows clock adjustments for time zone changes and seasonal time changes.

Highlight an option with the middle two diagnostic buttons inside the coin door. Press TEST MODE to enter Change Mode. Use the diagnostic switches to change the variable. Then press TEST MODE to save changes and exit the variable.

**SET TIME AND DATE MENU**

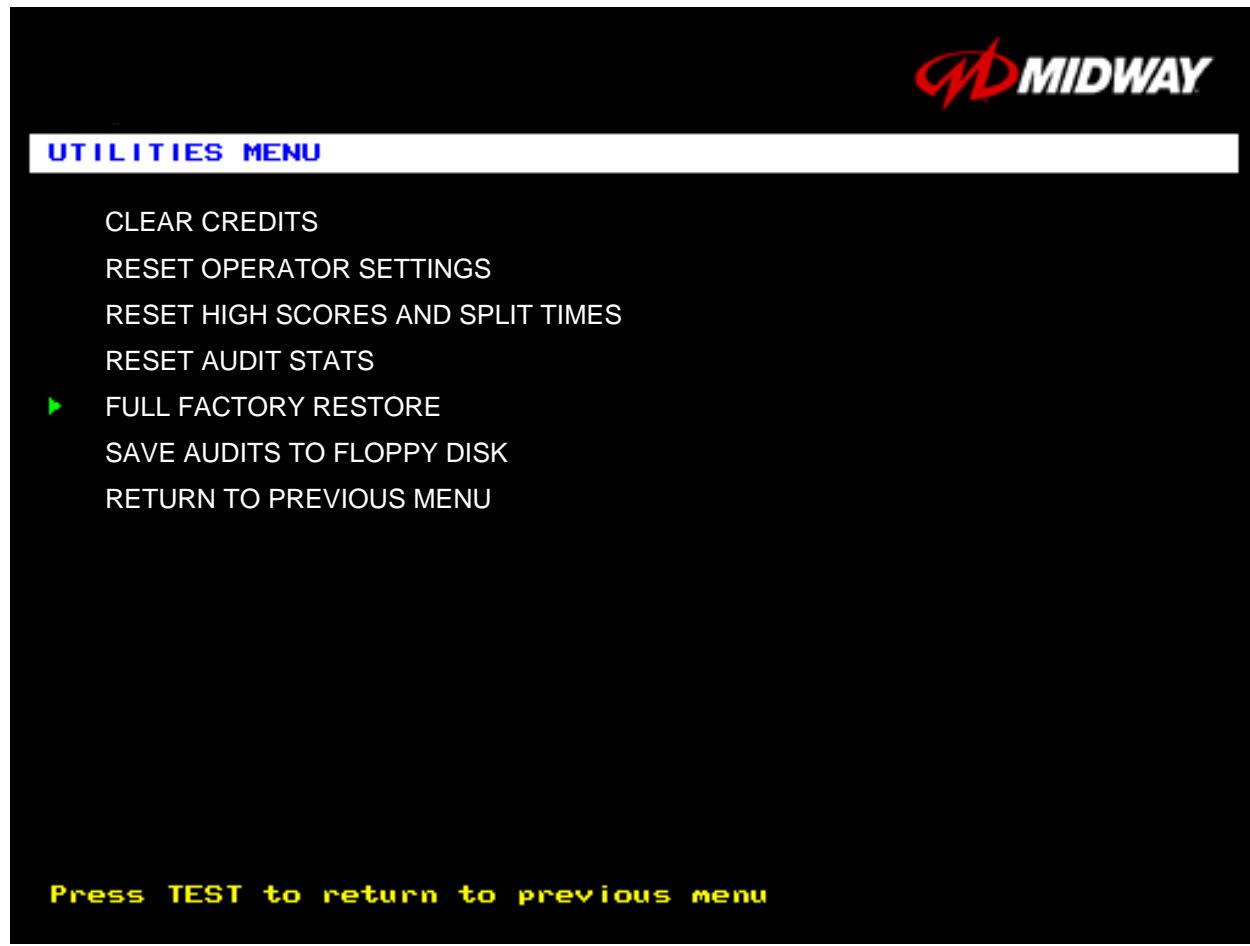
The clock assists in providing accurate game statistics. It doesn't affect game operation. When the circuit board isn't receiving external power, the clock runs until the battery fails.

Operator Menu (continued)
Utilities Menu

UTILITIES MENU

Select UTILITIES MENU at the Operator Menu. The Game Utilities Menu permits you to clear game credits, player statistics, and game audits. Here, you restore game settings to factory defaults or save audit data. A confirmation screen appears before you finalize changes.

Highlight an option with the middle two diagnostic buttons inside the coin door. Press TEST MODE to enter Change Mode. Use the diagnostic switches to change the variable. Then press TEST MODE to save changes and exit the variable.



UTILITIES MENU

CLEAR CREDITS zeros all credit variables.

RESET OPERATOR SETTINGS returns Adjustments Menu variables to factory default values.

RESET HIGH SCORES AND SPLIT TIMES overwrites the player high scores with factory default data.

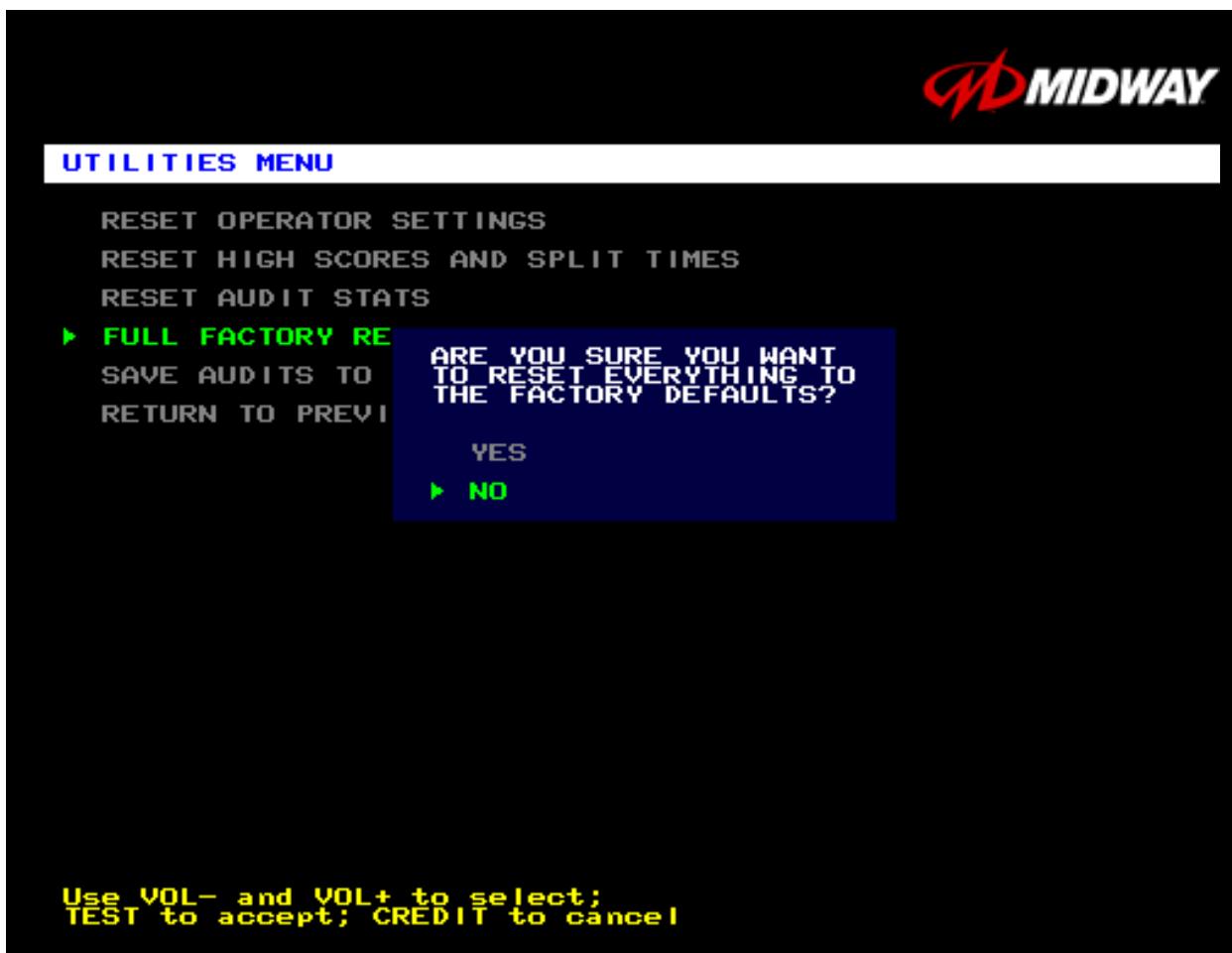
RESET AUDIT STATS zeros track and truck audit values.

FULL FACTORY RESTORE resets all variables above to factory default values. A confirmation screen appears before you finalize changes.

SAVE AUDITS TO FLOPPY DISK allows you to copy game data to a disk. Comparing audit data over time demonstrates the effect of game variable changes on profits. Use a formatted, 1.44MB high-density diskette. The floppy drive is in the CPU cabinet.



NOTICE: Be careful when clearing audit information. Once you clear data, you can't restore it. Use the Save Audits to Floppy Disk option to save data for analysis. To clear audit registers, use the Reset or Full Factory Restore functions.



A CONFIRMATION SCREEN APPEARS BEFORE YOU FINALIZE CHANGES

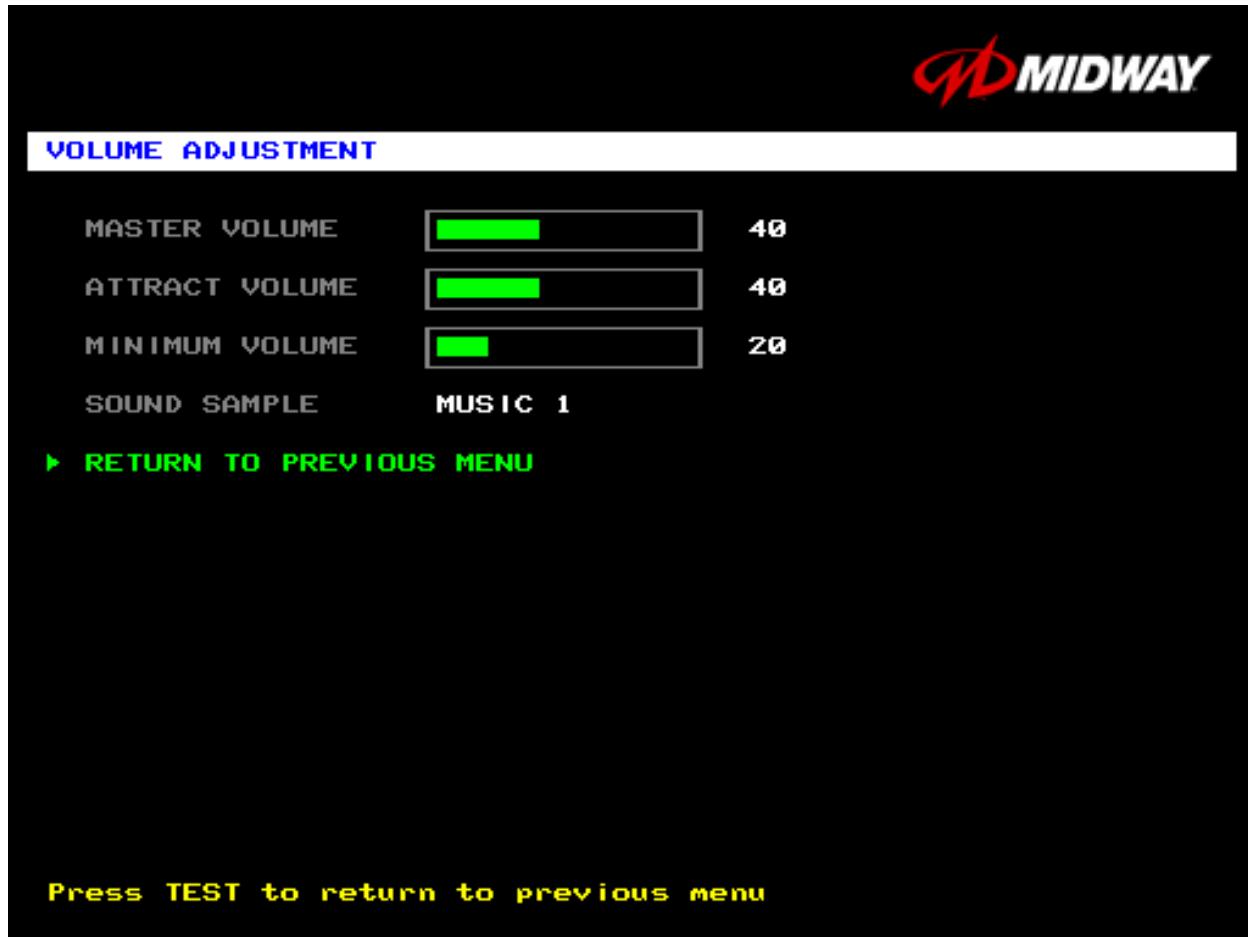
Operator Menu (continued)

Volume Adjustment Menu

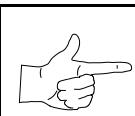
VOLUME ADJUSTMENT MENU

Select VOLUME ADJUSTMENT at the Operator Menu. (You can also access this menu from the Adjustments Menu.) The Volume Adjustment Menu allows you to adjust relative sound loudness levels.

Highlight an option with the middle two diagnostic buttons inside the coin door. Press TEST MODE to enter Change Mode. Use the diagnostic switches to change the variable. Then press TEST MODE to save changes and exit the variable.



VOLUME ADJUSTMENT MENU



NOTICE: The Master Volume setting affects all other volume adjustments. You can still alter Attract sounds in relation to normal game sound. For example, suppose that you set Attract Mode volume to 50%. Then Attract Mode sounds are half as loud as normal game sounds.



NOTICE: Check the Master Volume setting before testing. Increase Master Volume to fully test speakers. Restore Master Volume to its previous level before returning to Game-Over Mode.

MASTER VOLUME sets the overall volume level during game play. This value simultaneously affects all other sound settings. The range is 1 to 100%. The factory default is 60%.

ATTRACT VOLUME adjusts the Attract Mode sound level only when you turn on Attract Mode. The Attract Mode sound level is independent of game audio levels. The Attract Volume range is 1 to 100%. The factory default is 50%.

MINIMUM VOLUME sets the quietest sound level during game play. The range is 1 to 100%. The factory default is 20%.

To exit the Volume Adjustment Menu, highlight RETURN TO PREVIOUS MENU. Then press TEST MODE.

Operator Menu (continued)

Calibrate Steering, Gas and Brake Menu

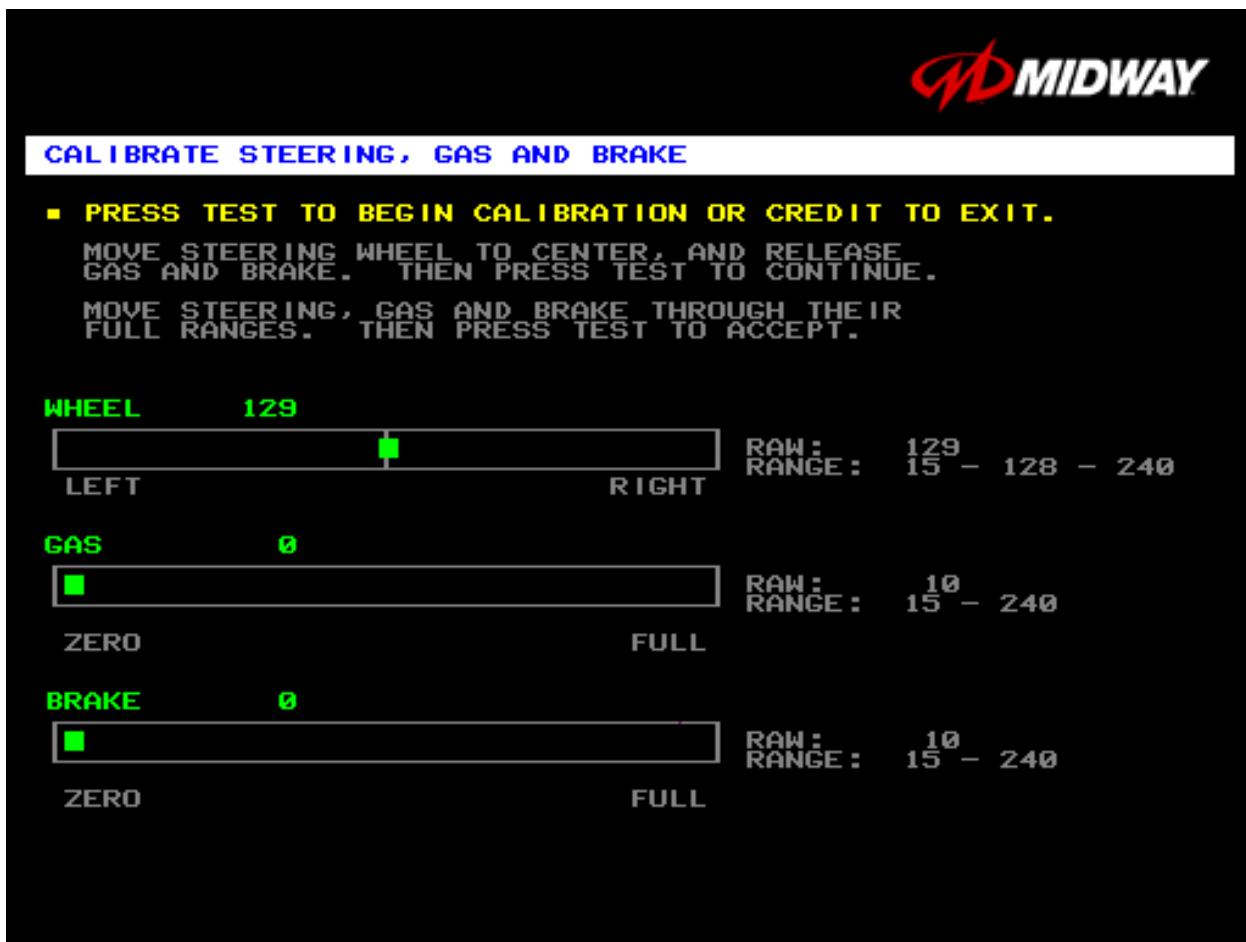
CALIBRATE STEERING, GAS AND BRAKE

Select CALIBRATE STEERING, GAS AND BRAKE at the Operator Menu. (You can also access this menu from the Adjustments Menu.) This option allows you to set steering and throttle mechanisms for optimum control during game play. Poorly calibrated player controls can reduce profits.



NOTICE: Before calibrating player control switches, make needed repairs to the game. If you plan to move the game, move it before calibrating player control switches.

To set up each calibration procedure, follow screen directions. Press TEST MODE to begin the procedure.



STEERING, GAS AND BRAKE CALIBRATION SCREEN

The steering wheel, brake and gas pedal couple to potentiometers. These potentiometers output DC voltages between zero and five volts. Game electronics digitize this analog output into an eight-bit (256-value), numeric stream.

Watch the numbers on the calibration screen. These numbers vary to indicate a control's position within that control's range of motion. For instance, steering straight ahead produces a number halfway between the left and right steering limits. To accurately simulate steering, numbers must change sequentially.

NOTES

OFFROAD

THUNDER™



WIRING & CIRCUIT INFORMATION

	WARNING: Failure to reconnect ground wires or replace metal shields may result in radio frequency interference.
	NOTICE: The term VGM refers to the video game machine.

Harness Connector Prefixes

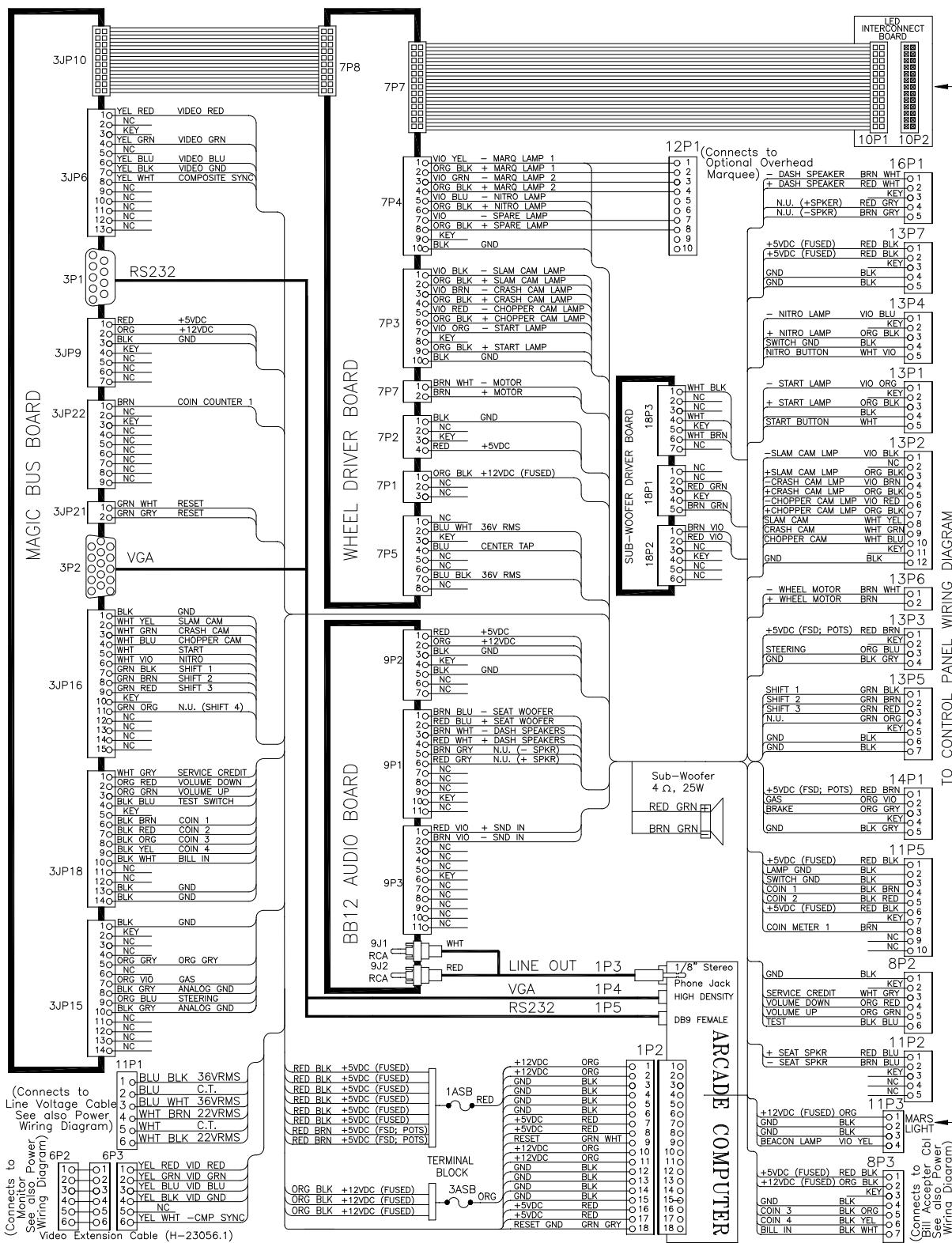
Prefix	Connector Location	Example
1	Arcade Computer	1P1
2	--	--
3	Magic Bus Interface Board	3P1
4	Fluorescent Lamp	4P1
5	Power Supply	5P1
6	Video Monitor	6P1
7	Wheel Driver Board	7P1
8	Coin Door Area	8P1
9	BB12 Audio Board	9P1
10	LED Interconnect Board	10P1
11	Cabinet	11P1
12	Optional Overhead Marquee	12P1
13	Dashboard	13P1
14	Gas Pedal & Brake	14P1
15	Upper Speakers	15P1
16	Seat Speaker	16P1
17	Dash LED Board	17P1
18	Subwoofer Driver Board	18P1



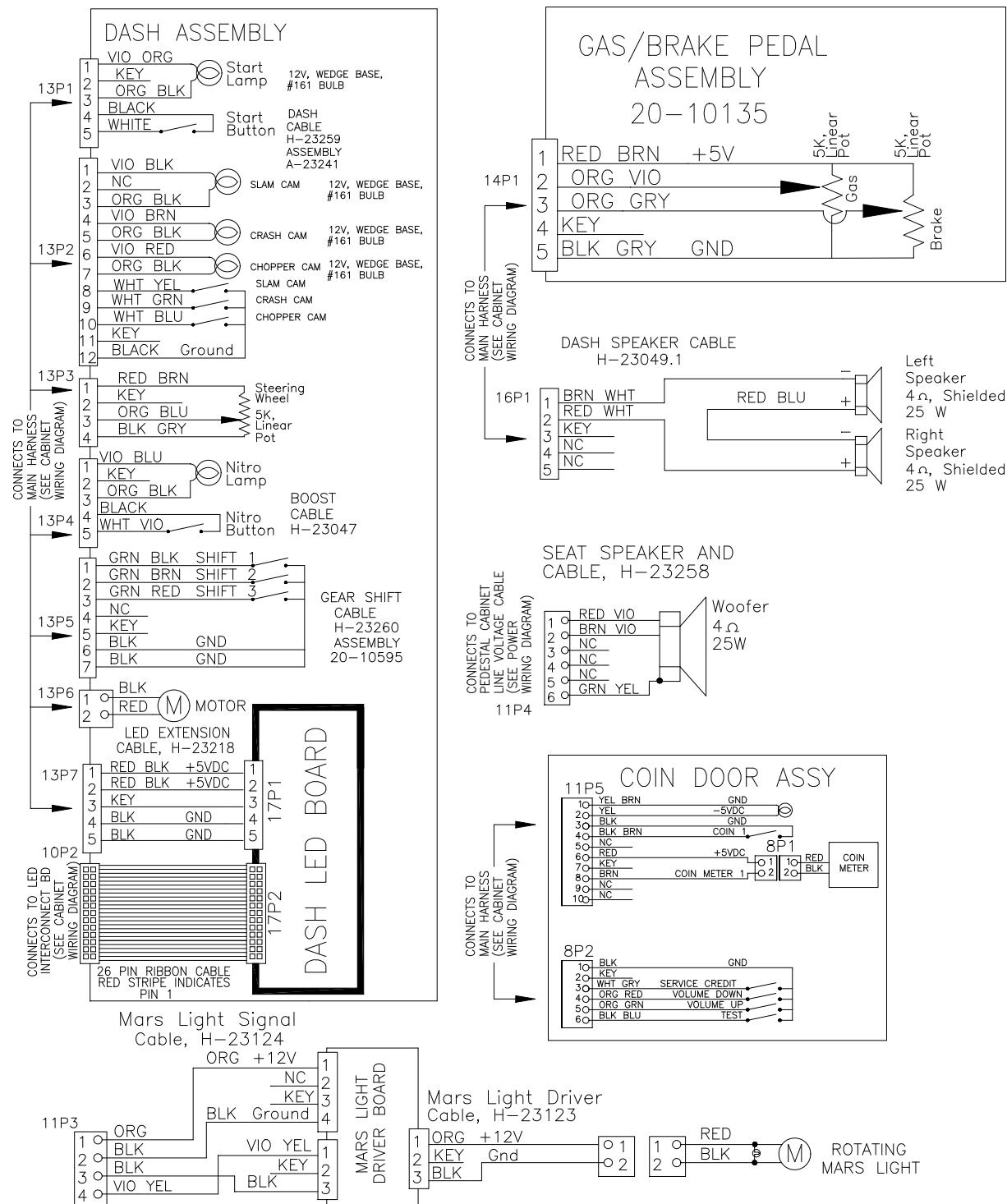
NOTICE: Look for the connector prefix on wiring diagrams. The prefix shows you where you'll find the connector.

Power Wiring Diagram

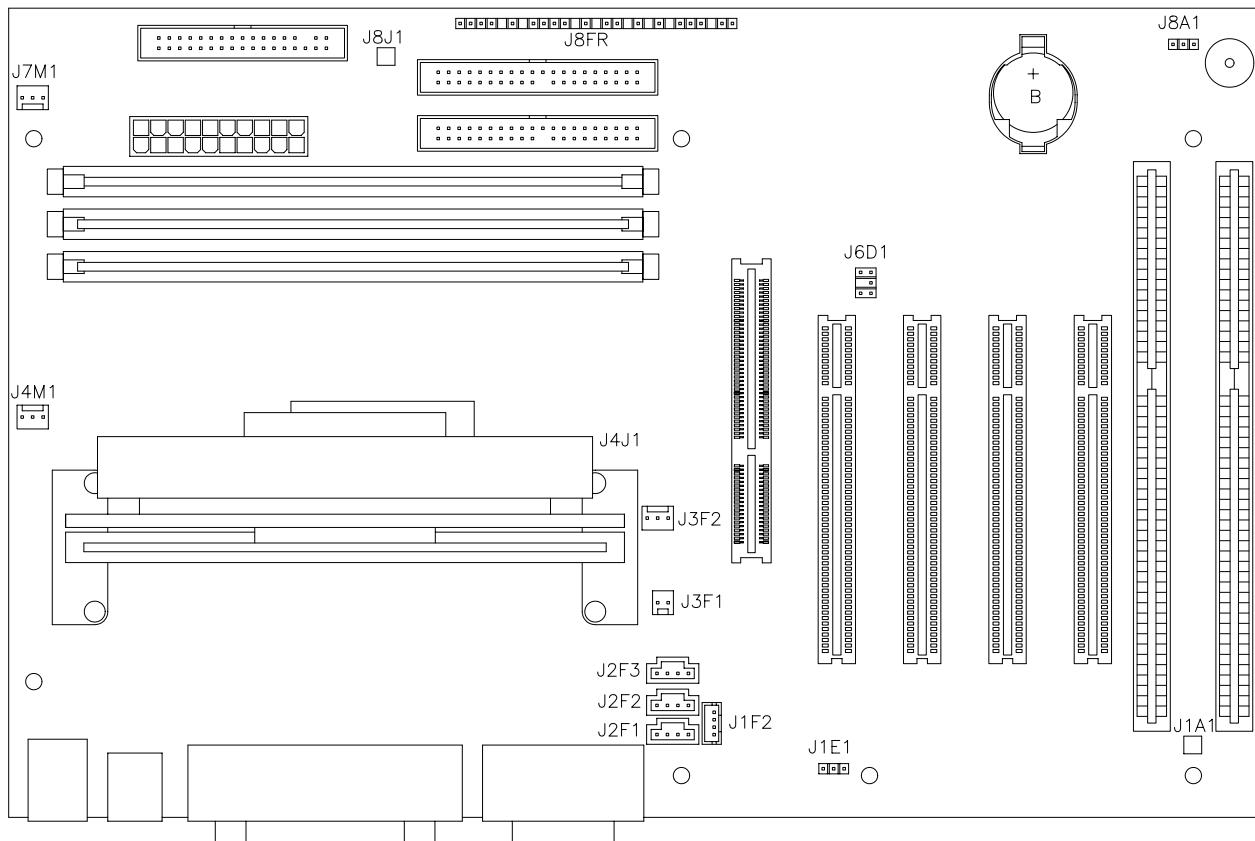
Cabinet Wiring Diagram



Player Panel Wiring Diagram



Computer Motherboard Assembly 20-10554



MOTHERBOARD CONNECTOR AND JUMPER STATUS

(NOTES FOR TABLE ON FOLLOWING PAGE)



NOTICE: The term VGM refers to the video game machine.

NOTES:

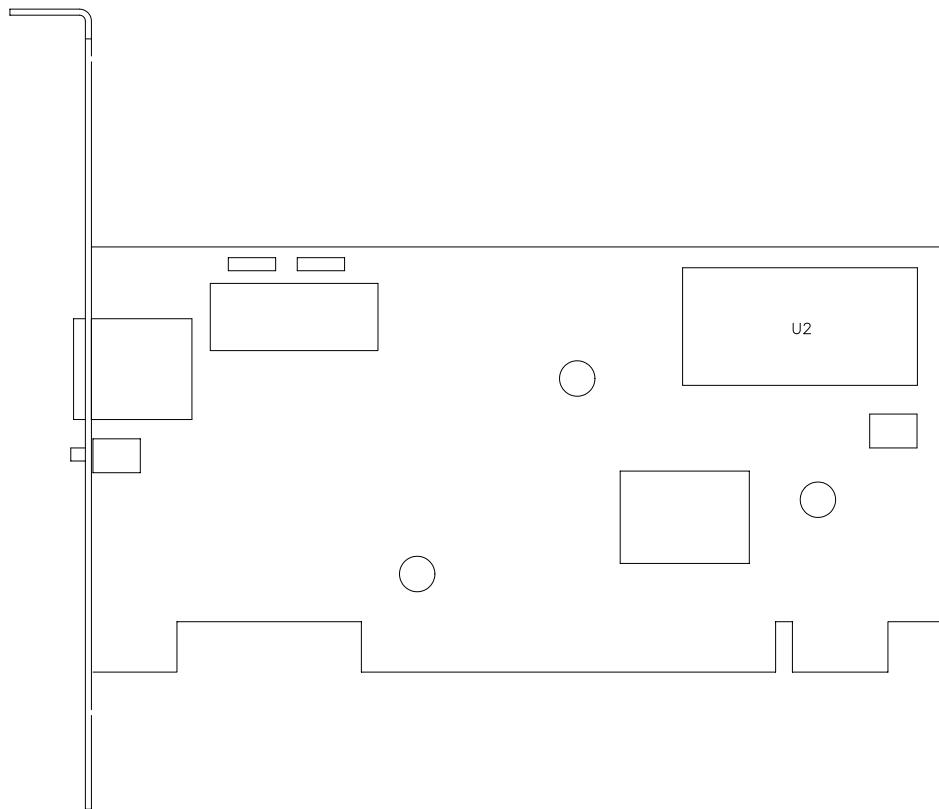
1. VGM doesn't require jumper or telephone connection.
2. VGM doesn't require jumper. VGM uses proprietary network for game linking.
3. VGM doesn't require connections. VGM has no ATAPI devices (CD ROMs).
4. VGM doesn't require jumper. Tamper-detection security feature isn't installed.
5. Connect processor module fan to this jack. Computer may become unreliable if processor overheats.
6. Connect processor module to this jack. 242-pin socket accepts single microprocessor modules.
7. VGM doesn't require connections. Case cooling fans connect directly to power supply.
8. VGM doesn't require connections. VGM doesn't use SCSI devices (Hard Drives).
9. Connect reset cable from Filter Board to this jack. VGM doesn't use front-panel devices.
10. Jumper must be set over pins 1 & 2 for this VGM. VGM won't run with incorrect or missing jumper.

* Replacement Motherboards may not include this jumper. Refer to Parts to order extra shunt jumpers.

Motherboard Connector and Jumper Status Table

Designation	Location	Function	Meaning	Setting	Default
J1A1 (Note 1)	Lower Right Near Board Expansion Slot	Wake On Ring	Not Used In This VGM (No Telephone)	Open	■
				1 & 2	
J1E1 (Note 2)	Lower Center Near Board Expansion Slot	Wake On LAN	Not Used In This VGM (No PC LAN)	Open	■
J1F2 (Note 3)	Lower Center Near Board Expansion Slot	CD Audio Input Circuit	Not Used In This VGM (No CD Player)	Open	■
J2F1 (Note 3)	Lower Center Near Board Expansion Slot	CD Data Input Circuit	Not Used In This VGM (No CD Player)	Open	■
J2F2 (Note 1)	Lower Center Near Board Expansion Slot	Telephony Input Circuit	Not Used In This VGM (No Telephone)	Open	■
J2F3 (Note 3)	Lower Center Near Board Expansion Slot	Auxiliary Input Circuit	Not Used In This VGM (No Aux Devices)	Open	■
J3F1 (Note 4)	Middle Center Near CPU And Fan	Chassis Intrusion Circuit	Not Used In This VGM (No Intrusion)	Open	■
				1 & 2	
J3F2 (Note 5)	Middle Center Near CPU And Fan	Processor Fan Circuit	Two Speed Fan For Processor Cooling	Open	
				1, 2, & 3	■
J4J1 (Note 6)	Center Left Module With Fan Assembly	System Micro- Processor	System Micro- Processor	Open	
				Filled	■
J4M1 (Note 7)	Center Left Near CPU Module	Processor Fan Circuit	Controlled Fan For Processor Cooling	Open	■
				1, 2, & 3	
J7M1 (Note 7)	Upper Left Near Power & Floppy Jacks	Case Fan Circuit	Controlled Fan For Hard Disk Drive Cooling	Open	■
				1, 2, & 3	
J8J1 (Note 8)	Upper Left Between Hard & Floppy Jacks	SCSI Drive Indicator	Not Used In This VGM (No SCSI Drives)	Open	■
				1 & 2	
J8FR (Note 9)	Upper Center Near Hard Disk Drive Jacks	Front Panel Devices	Only Reset Pins Are Used In This VGM	Open	
				1 & 2	■
J8A1 (Note 10)	Upper Right Near Battery And Speaker	Configur- ation Select	Starts System Setup Routine or Operation	Open	
				1 & 2	■
				2 & 3	

Network Interface Board Assembly 20-10550



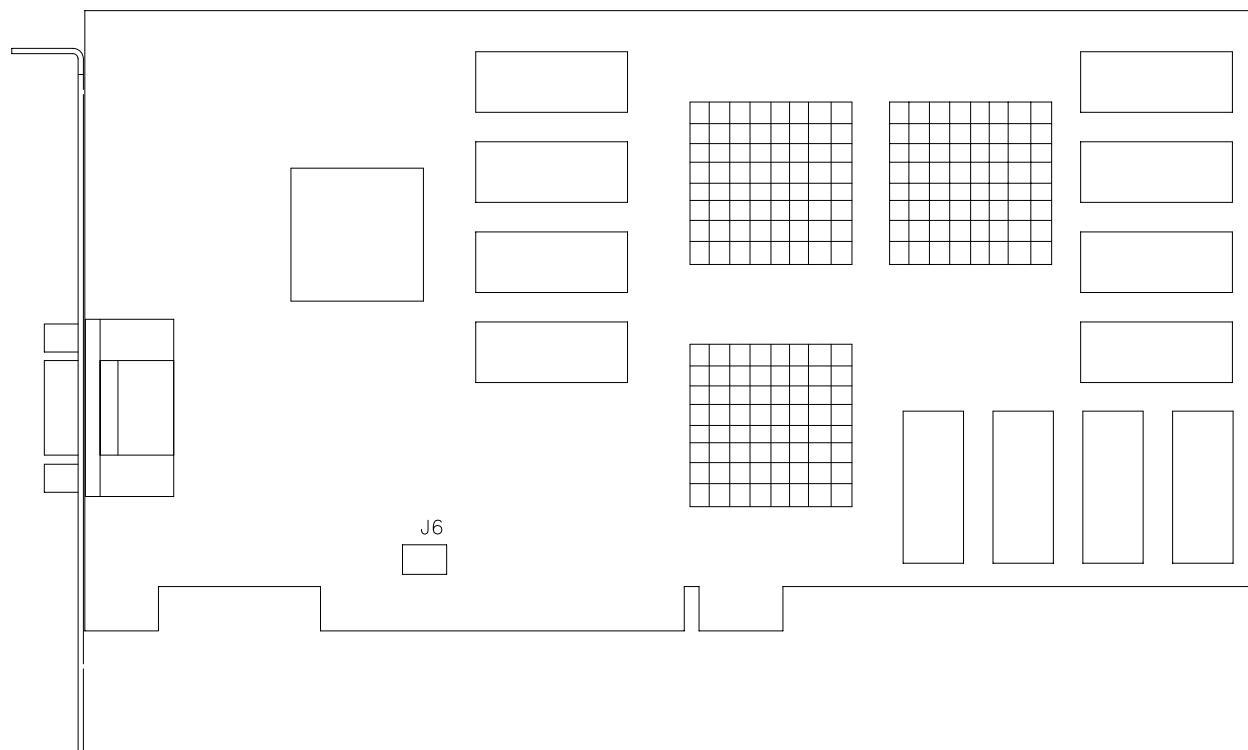
Network Interface LED Indicator Table

Designation	Location	Function	Color	State	Meaning
LED 1 (LNK)	Left Center Under Jack	Link Verify Indicator	Green	Off	Not In Use (No Game Link)
				On	Normal Operation
				Blinking	Link Fault (Note 1)
LED 2 (ACT)	Right Center Under Jack	Activity Indicator	Green	Off	Not In Use (No Data)
				On	Receiving Data (Note 2)
				Blinking	Normal Operation

Notes:

1. Intermittent cable or hub problems may cause blinking. Blinking must be continuous during linked operation.
2. Blinks during data packet exchange. Blinking may appear continuous during heavy network activity.

Video Graphics Board Assembly 20-10551



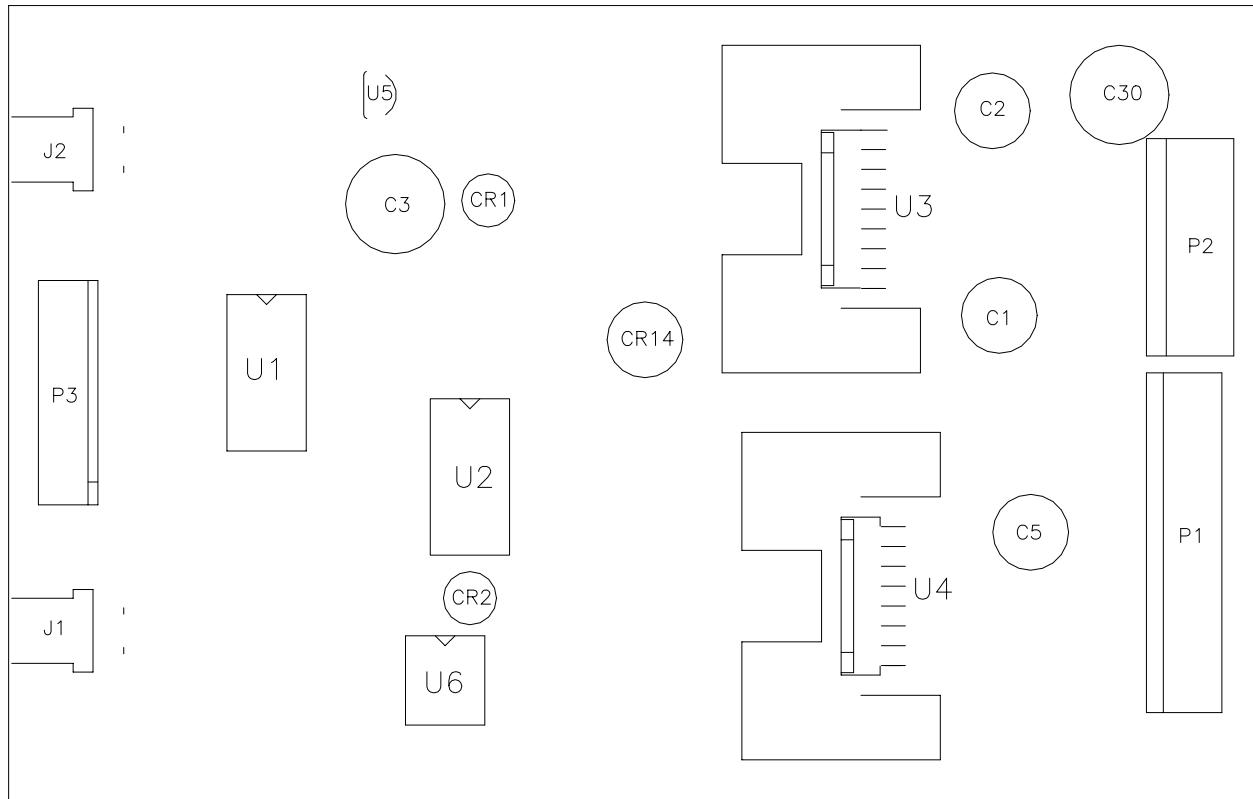
Video Graphics Connector And Jumper Table

Designation	Location	Function	Meaning	Setting	Default
J1 (Note 1)	Left Center (DB-15 on Bracket)	Video Signal Output	Graphic Information To Interface	Open	
				1-15	■
J2-J7 (Note 2)	None	---	Not Used	Open	■
JP2 (Note 2)	None	---	Not Used	Open	■

Notes:

1. Connects to Interface Board through shielded cable. Doesn't connect directly to monitor.
2. Manufacturer option connectors and jumpers. Not required for this VGM.

Audio Amplifier Board Assembly 04-12529.1



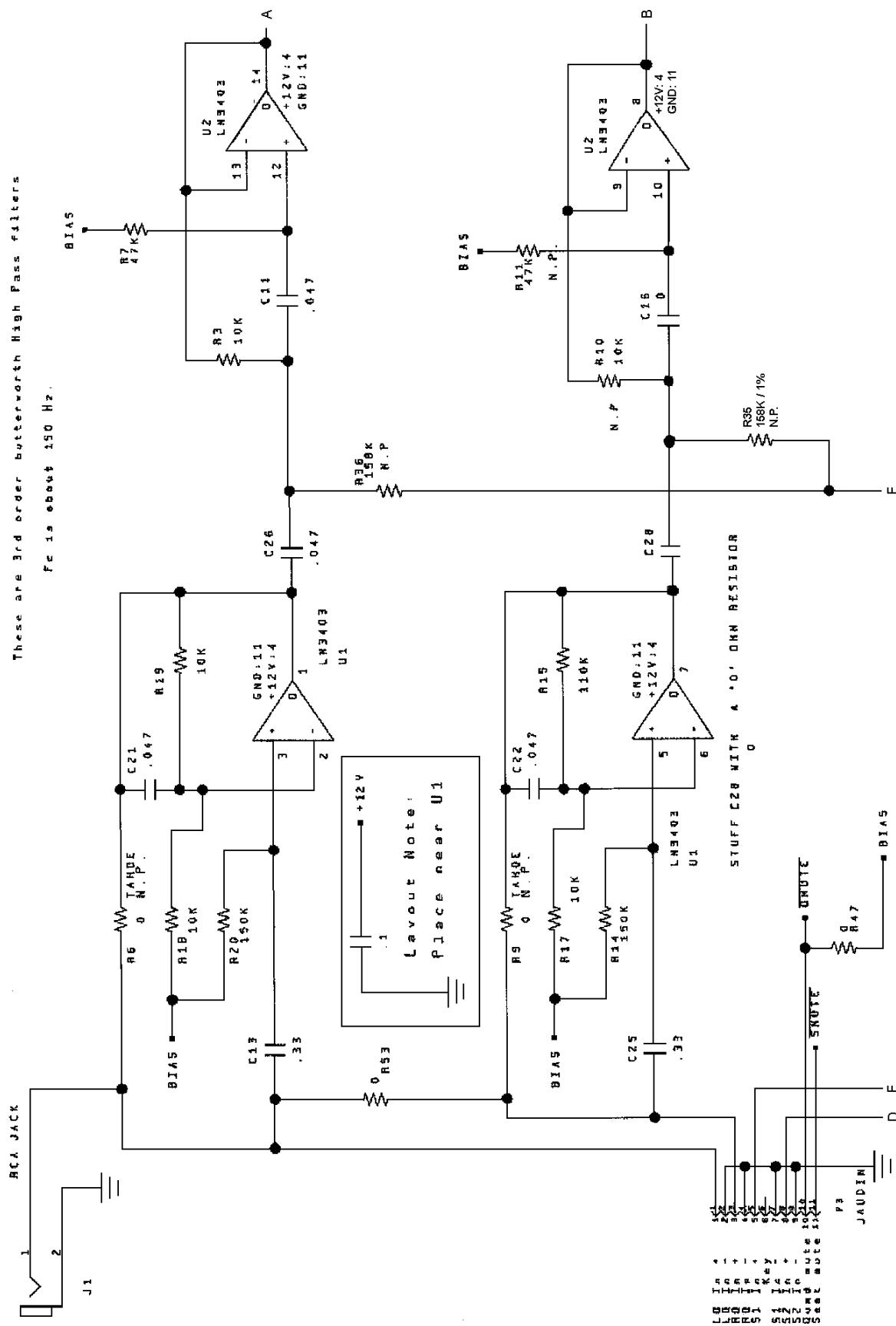
BB12 Audio Amplifier LED Indicator Table

Designation	Location	Function	Color	State	Meaning
LED 1 (CR1)	Upper Center Near C3	Fault Indicator	Red	Off	Normal Operation
				On	Locked Up (Note 1)
				Blinking	Overload (Note 2)
LED 2 (CR2)	Lower Center Near U2 & U6	Fault Indicator	Red	Off	Normal Operation
				On	Locked Up (Note 1)
				Blinking	Overload (Note 2)

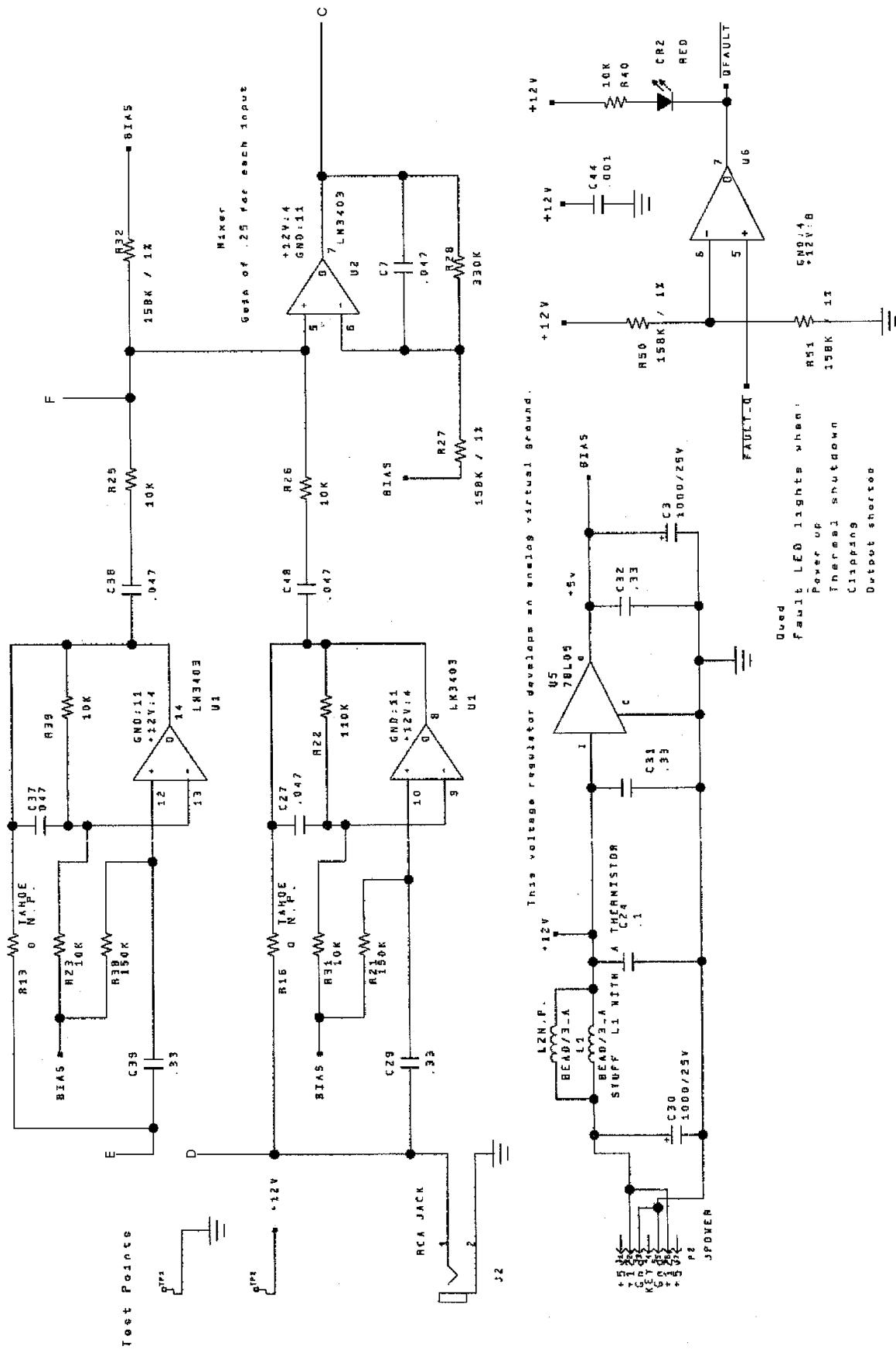
NOTES:

1. Active output protection circuit. Attempt to reset circuit by clearing fault and removing power.
2. Intermittent audio overload or overheating may cause blinking. LED should flash only during startup.

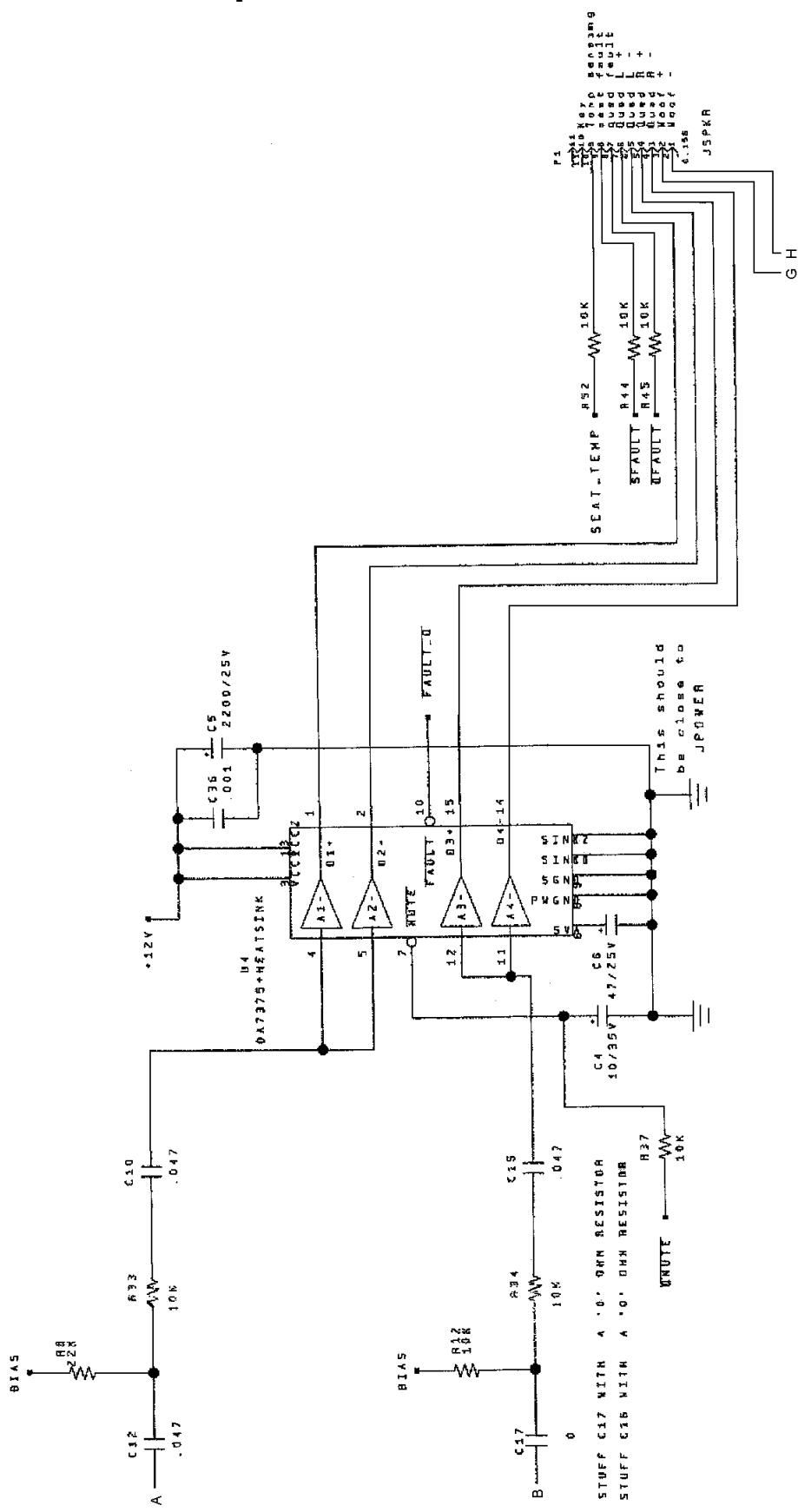
Audio Amplifier Board Schematic, 1/4



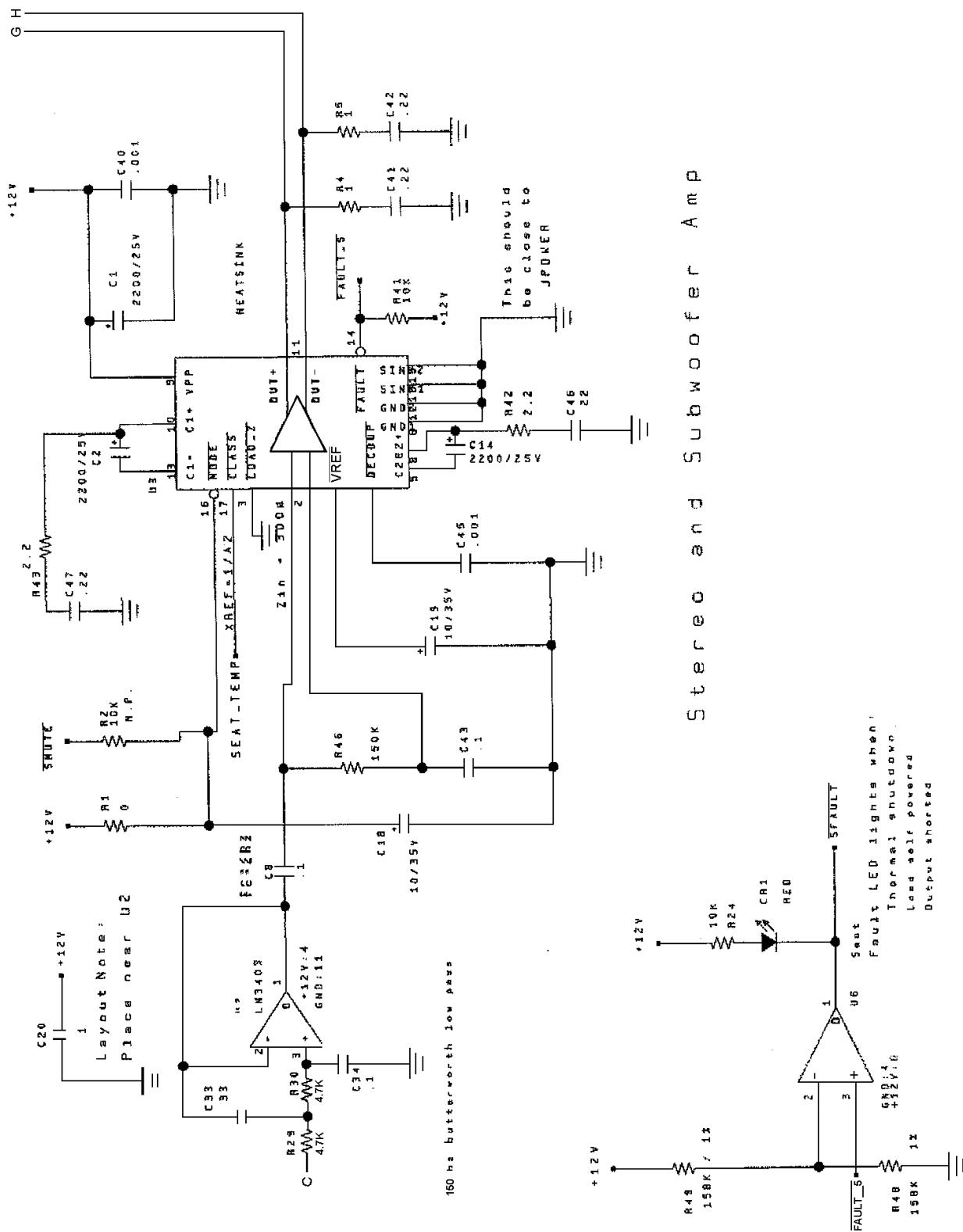
Audio Amplifier Board Schematic, 2/4



Audio Amplifier Board Schematic, 3/4



Audio Amplifier Board Schematic, 4/4



MagicBus™ Interface Board Assembly 04-12697.3

MagicBus™ Interface Board Switches

Designation	Location	Function	Positions	State	Meaning
S1-7	Right Center Near D19 – D26	USB / UART Mode Selector	2	Off*	UART Mode (Offroad VGMs)
				On	USB Mode
S1-8	Right Center Near D19 – D26	Host Watchdog Reset	2	Off*	Watchdog Enabled
				On	Watchdog Disabled

Notes:

1. Bank 1, Switch 7 should be off for *Offroad Thunder*. This switch selects USB or UART mode. USB mode is for factory testing only, and is not supported. Leave this switch in the off position.
2. Bank 1, switches 1 through 6 have no assigned function. Leave these switches off.
3. Bank 2, switch 1 through 8 have no assigned function. Leave these switches off.

MagicBus™ Board LED Indicator Table, 1/2

LED #	Location	Function	Color	State	Meaning
LED 28 +12V Power for Output Lamps	Left Center, Near Fuse F2 & Connector JP12	Indicator	Red	Off	No +12V
				On	+12V Present
				Blinking	Intermittent +12V
LED 27 +5V Power for Analog Inputs	Right, Near DIP Fuse F1	Indicator	Red	Off	No +5V
				On	+5V Present
				Blinking	Intermittent +5V
LED 10 Communication	Right Center, Near DIP Switch S1	Indicator	Red	Off	Not In Use
				On	Communication Error
				Blinking	Normal Operation
LED 9 EEPROM	Right Center, Near DIP Switch S1	Indicator	Red	Off	Not In Use
				On	EEPROM not responding
				Blinking	Normal Operation
LED 8 Security	Right Center, Near DIP Switch S1	Indicator	Red	Off	Not In Use
				On	Security error
				Blinking	Normal Operation
LED 7 MagicBus Reset	Right Center, Near DIP Switch S1	Indicator	Red	Off	Not In Use
				On	MagicBus Reset
				Blinking	Normal Operation
LED 6 MagicBus Program Running	Right Center, Near DIP Switch S1	Indicator	Green	Off	Faulty MagicBus Board
				On	Faulty MagicBus Board
				Blinking	Normal Operation
LED 5 UART / USB Mode	Right Center, Near DIP Switch S1	Indicator	Green	Off	Not In Use
				On	Faulty MagicBus Board
				Blinking	With 4 & 3: UART; Individually: USB

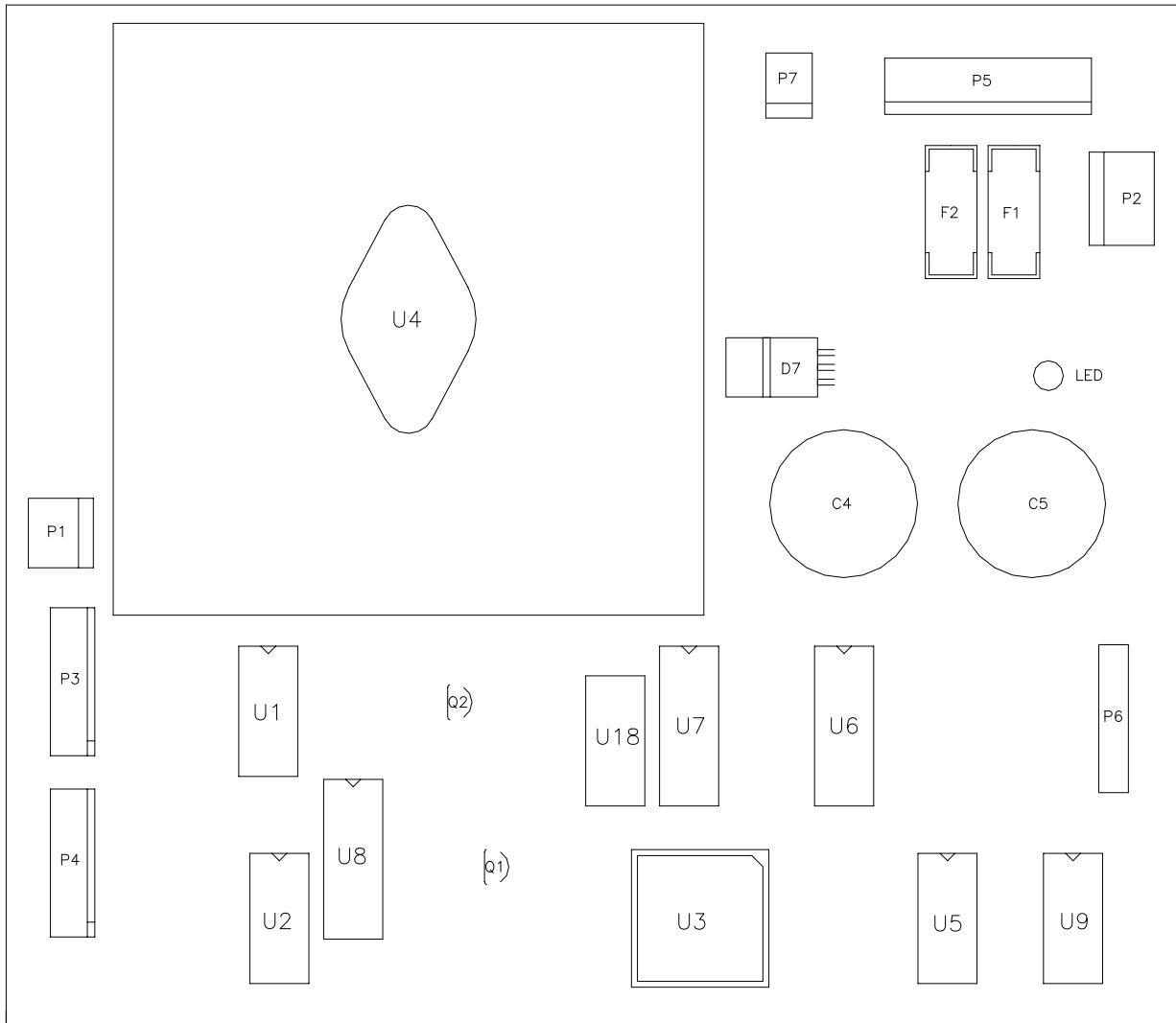
MagicBus™ Board LED Indicator Table, 2/2

LED 4 UART / USB Mode	Right Center, Near DIP Switch S1	Indicator	Green	Off	Not In Use
				On	Faulty MagicBus Board
				Blinking	With 5 & 3: UART; Individually: USB
LED 3 UART / USB Mode	Right Center, Near DIP Switch S1	Indicator	Green	Off	Not In Use
				On	Faulty MagicBus Board
				Blinking	With 5 & 4: UART; Individually: USB
LED 1 Power to MagicBus™ Board	Center, Near Fuse F2	Indicator	Red	Off	No Power
				On	Power Present
				Blinking	Intermittent Power

MagicBus™ Interface Connector & Jumper Table

Jumper	Location	Function	Meaning	Setting	Default
JP 1 (Note 1)	Upper Right Between JP4 and JP2	Blue Video Impedance	High Impedance	Open	■
			Low Impedance	1 & 2	
			High Impedance	2 & 3	
JP 2	Upper Right Between JP1 & JP3	Green Video Impedance	High Impedance	Open	■
			Low Impedance	1 & 2	
			High Impedance	2 & 3	
JP 3 (Note 3)	Upper Right Between JP2 & JP5	Red Video Impedance	High Impedance	Open	■
			Low Impedance	1 & 2	
			High Impedance	2 & 3	
JP 4 (Note 3)	Upper Right Near JP1 & JP2	Video Sync Polarity	Positive Sync	Open	
			Negative Sync	1 & 2	■
			Positive Sync	2 & 3	

Wheel Driver Board Assembly 04-12770.1



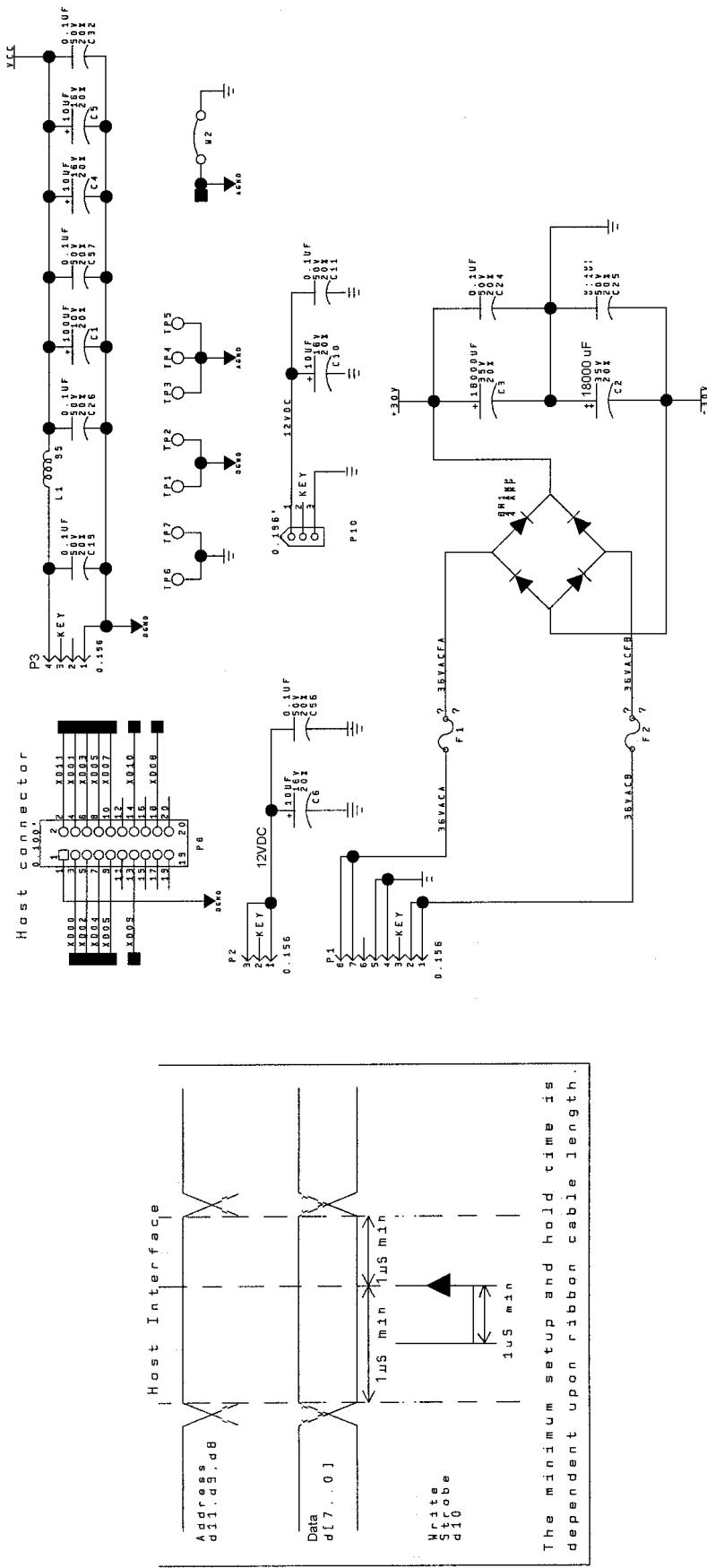
Wheel Driver Board Led Indicator Table

Designation	Location	Function	Color	State	Meaning
LED 1	Right Center, Near C5 & P2	Indicator	Red	Off	Not In Use
				On	Normal Operation
				Blinking	Power Fault (Note 1)

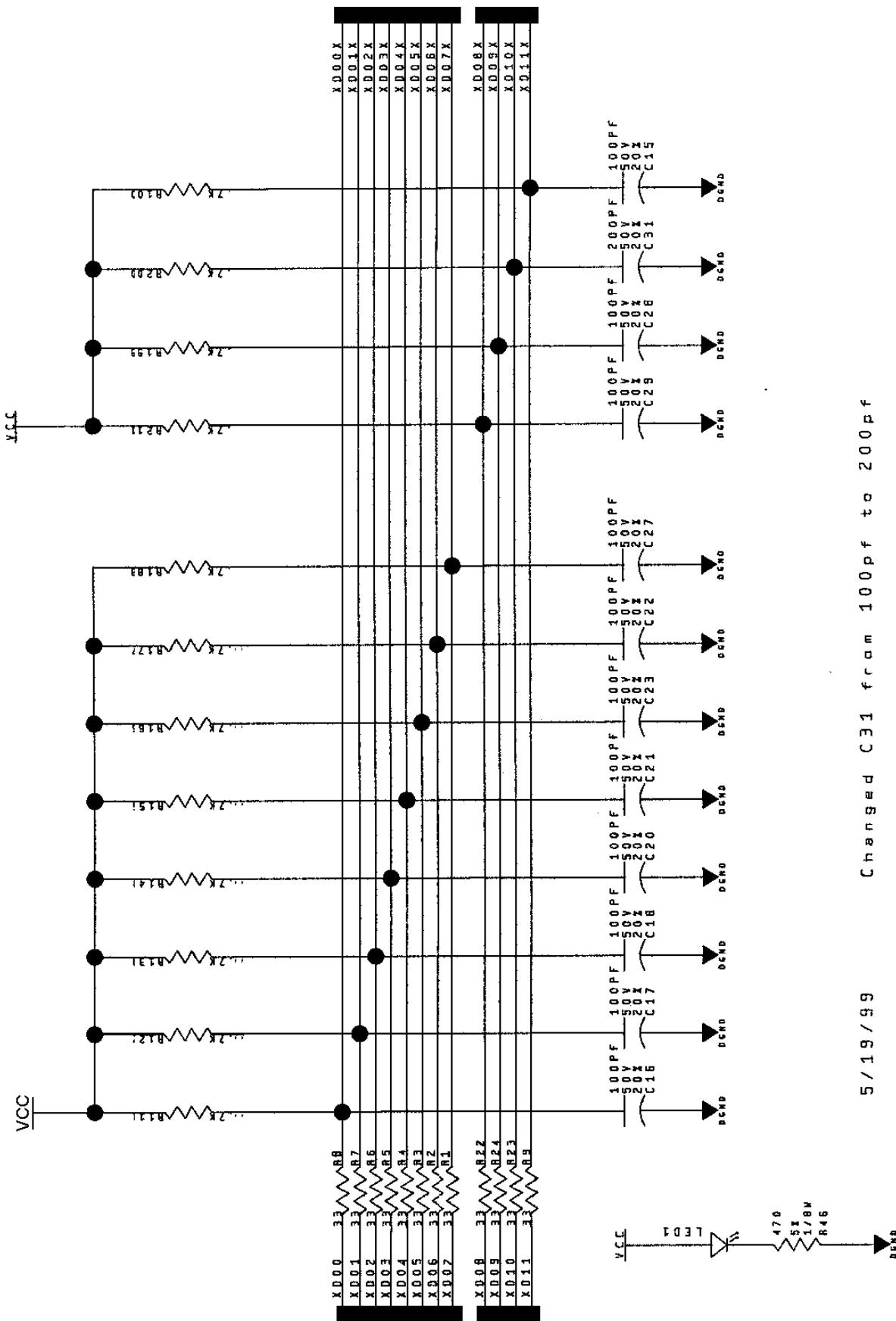
Notes:

1. LED 1 monitors regulated power supply voltage source. Must be on continuously. Flash or blinking indicates intermittent connection, power problem, circuit fault, etc.

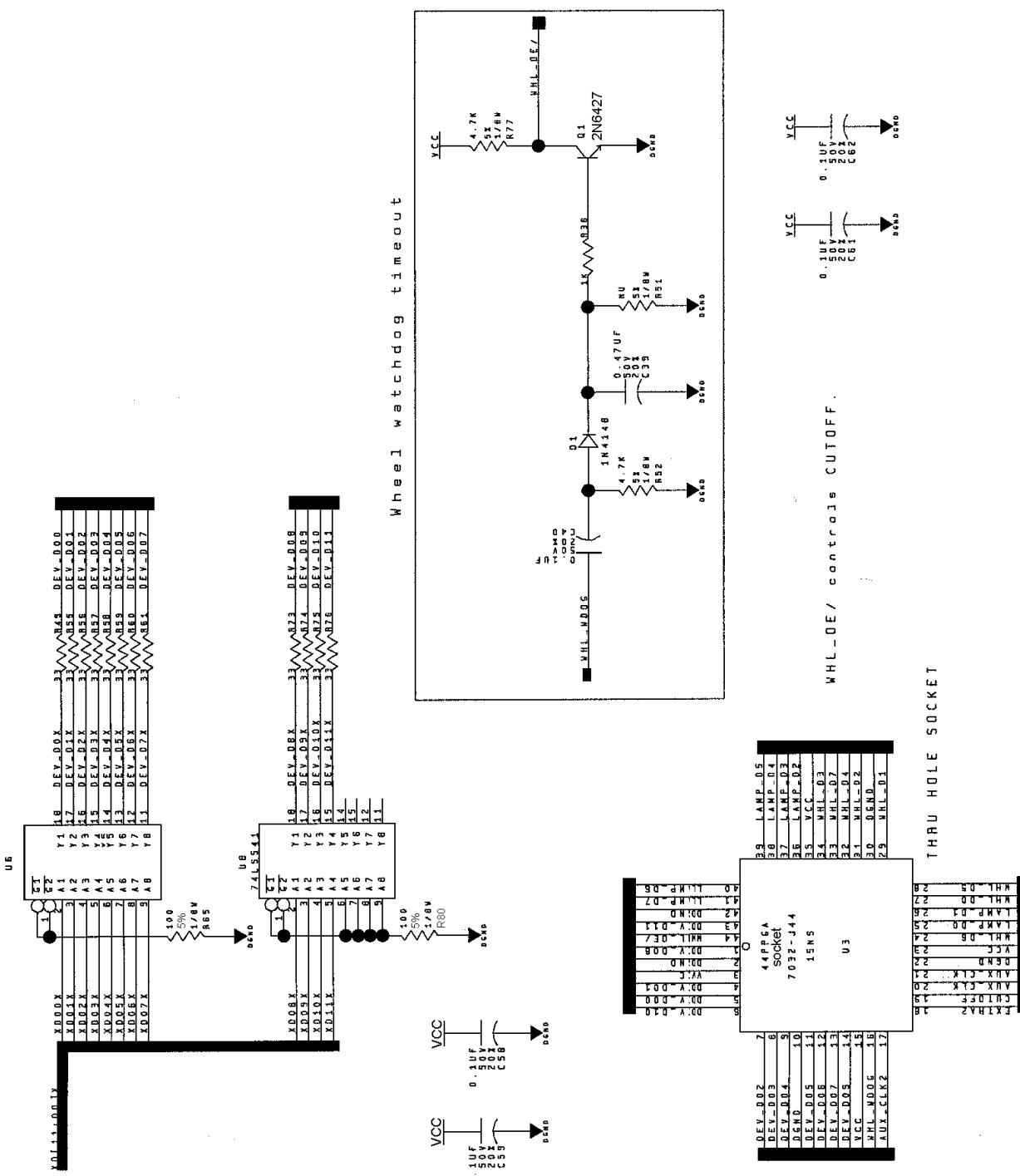
Wheel Driver Board Schematic, 1/8



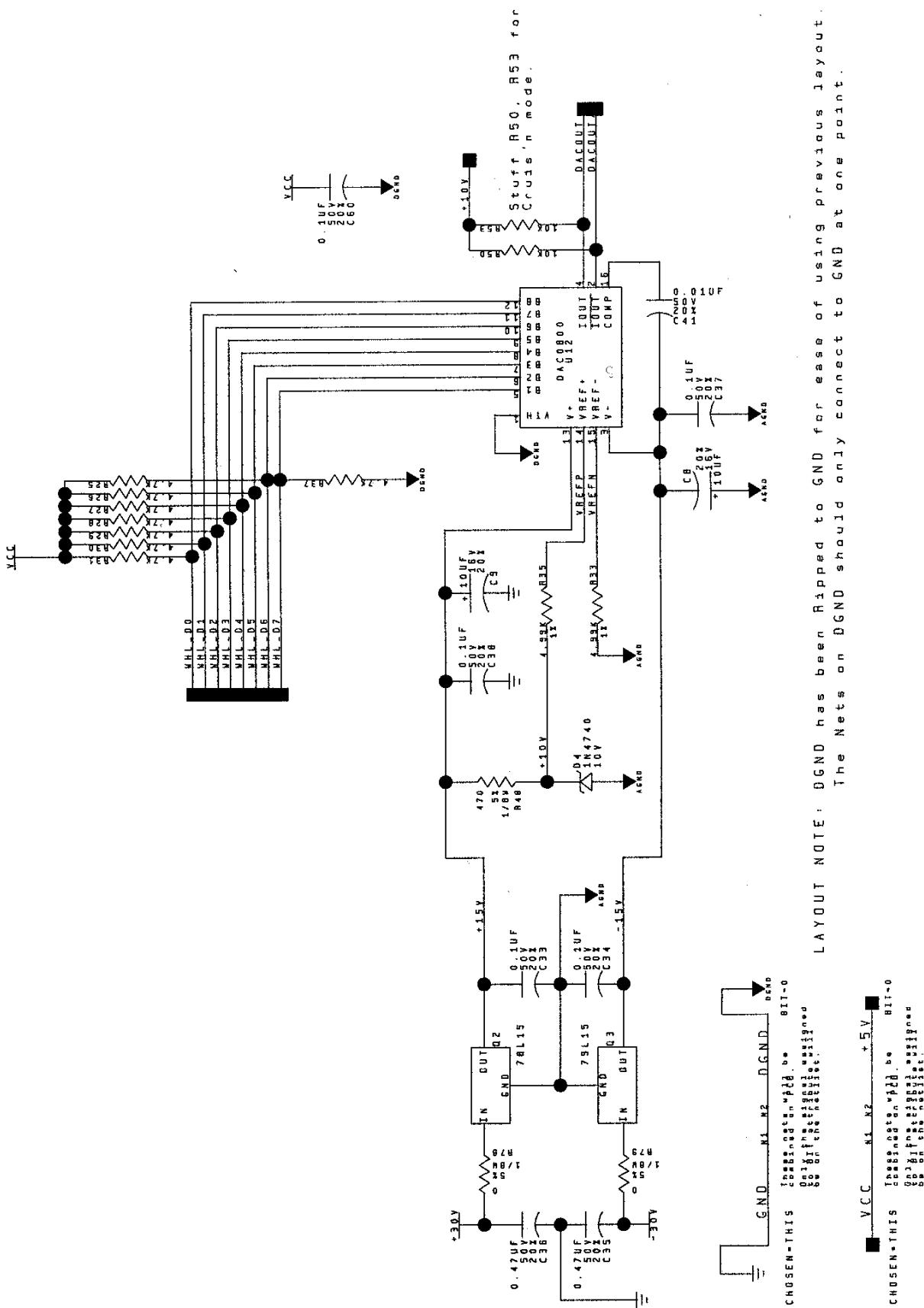
Wheel Driver Board Schematic, 2/8



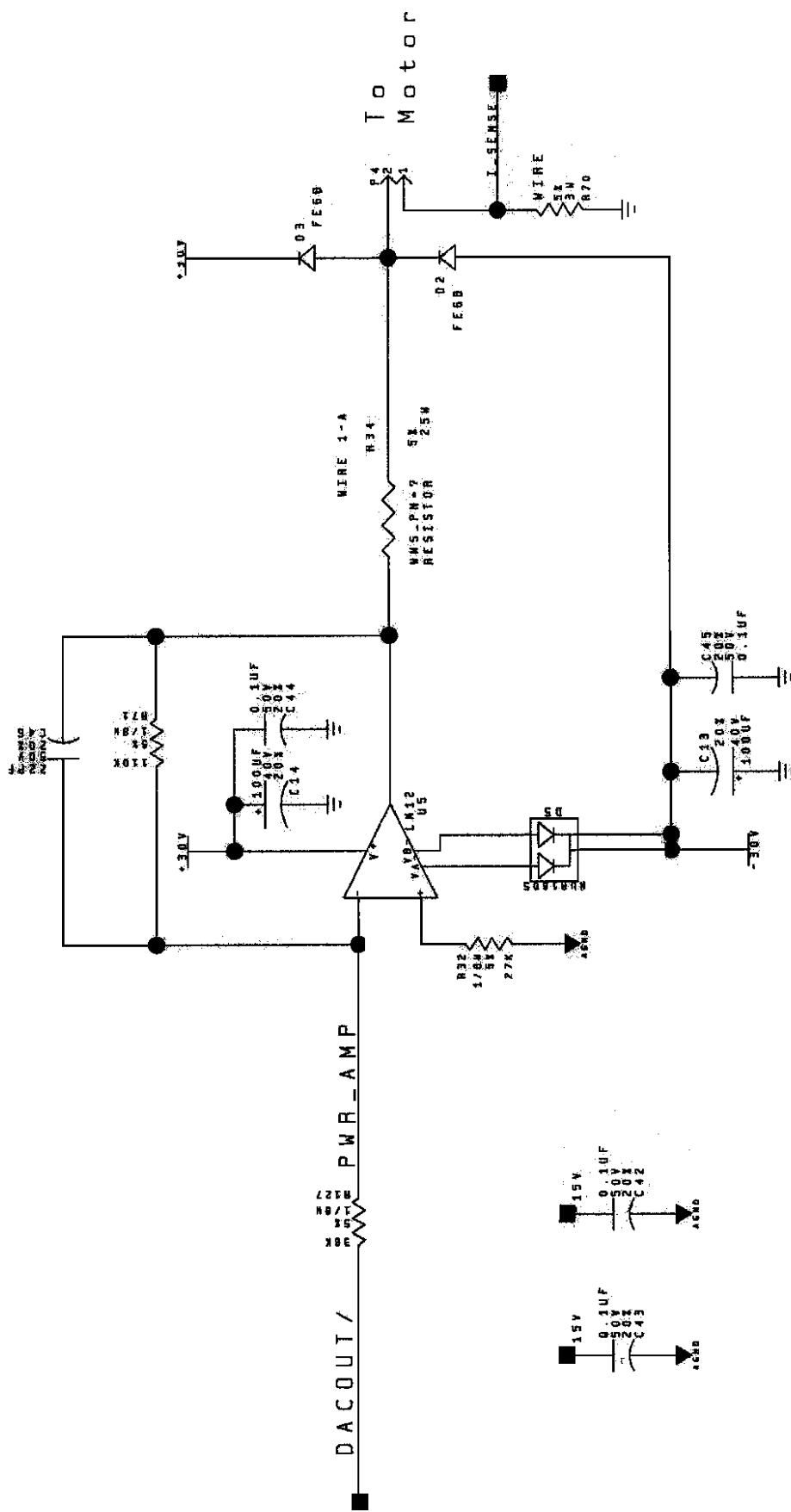
Wheel Driver Board Schematic, 3/8



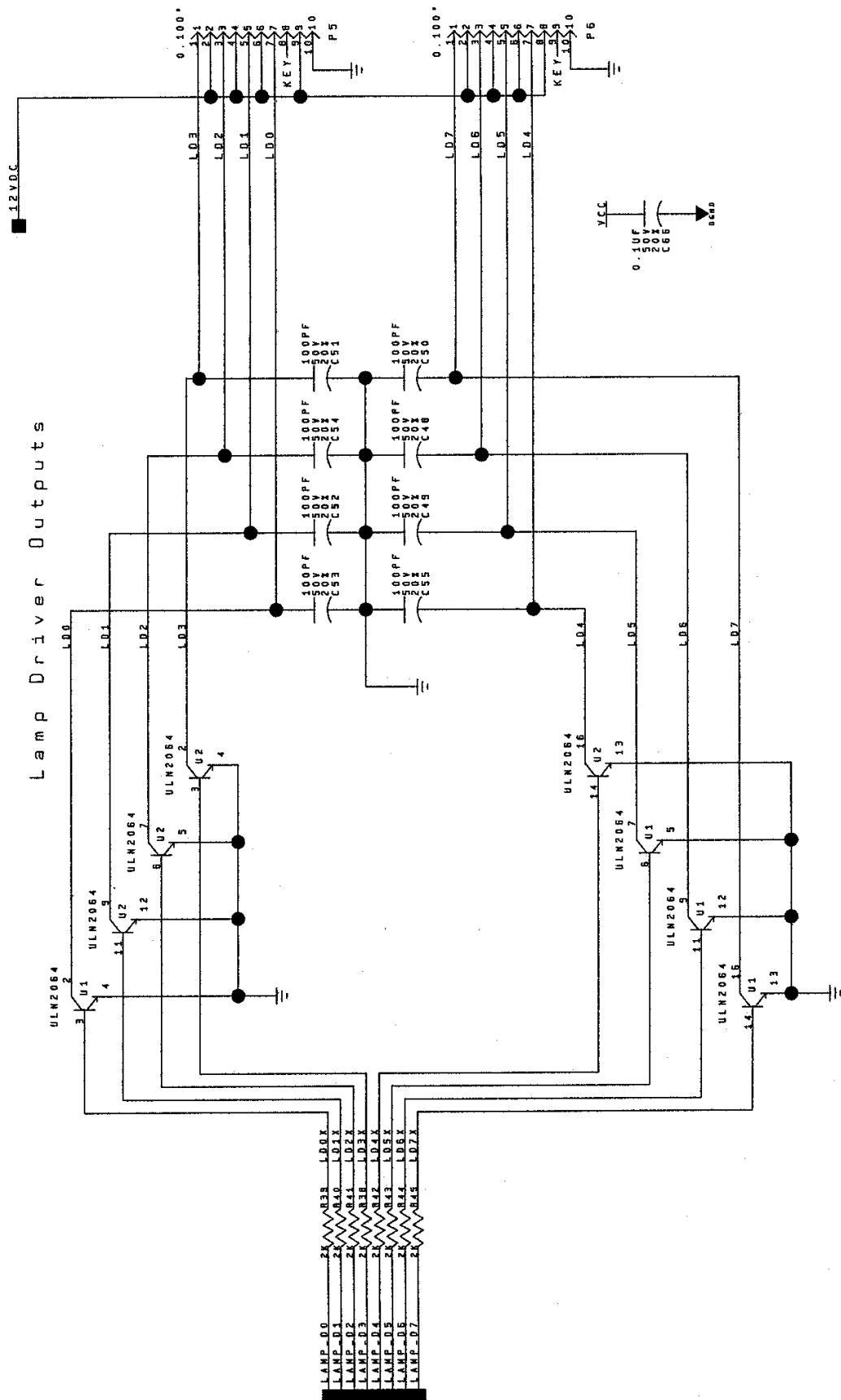
Wheel Driver Board Schematic, 4/8



Wheel Driver Board Schematic, 5/8

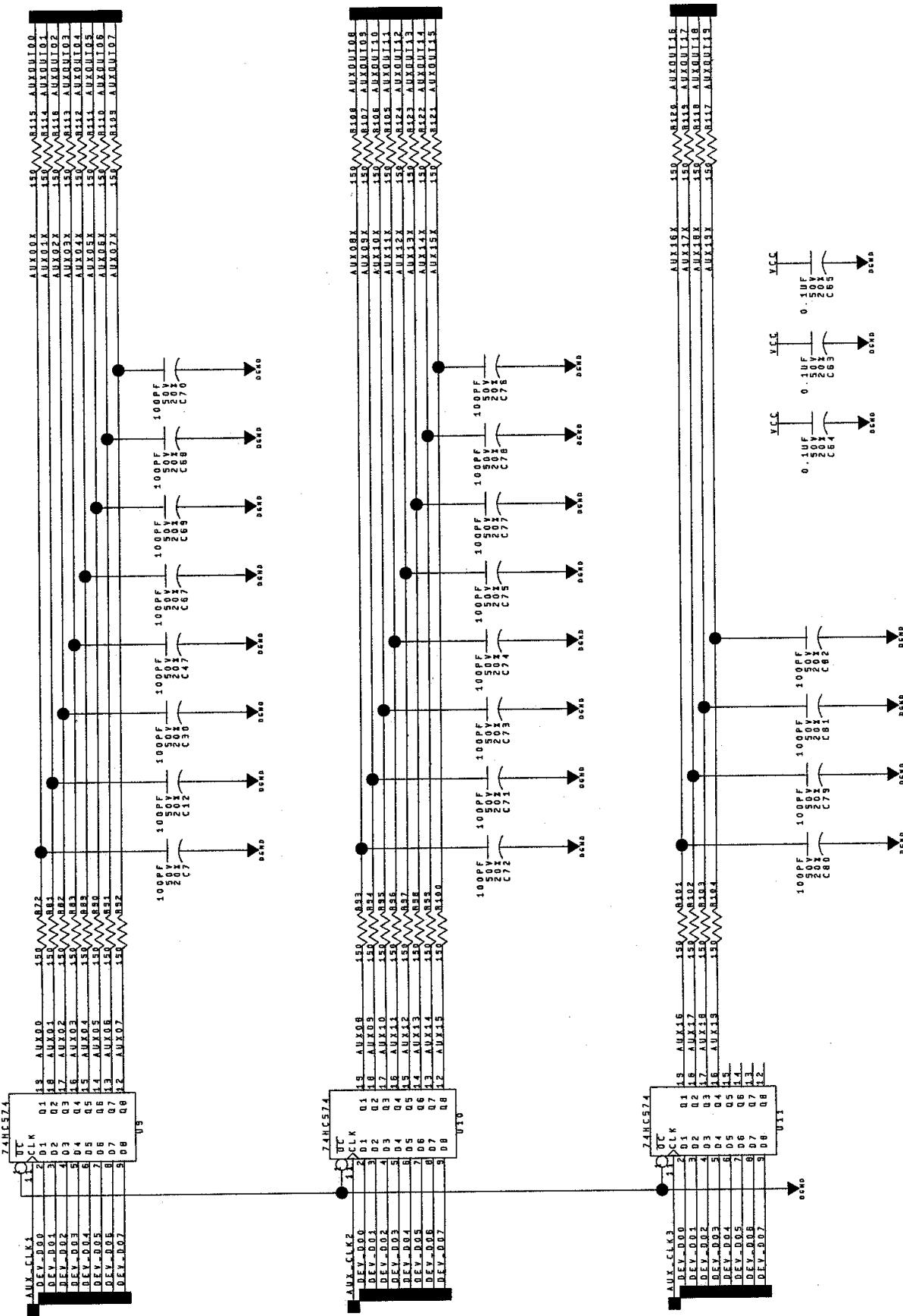


Wheel Driver Board Schematic, 6/8

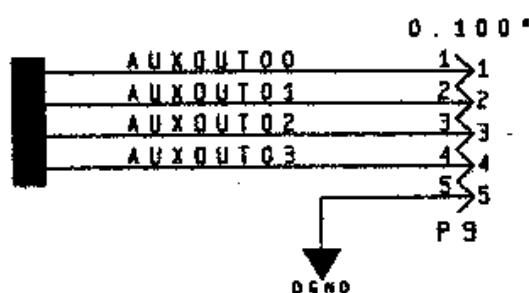
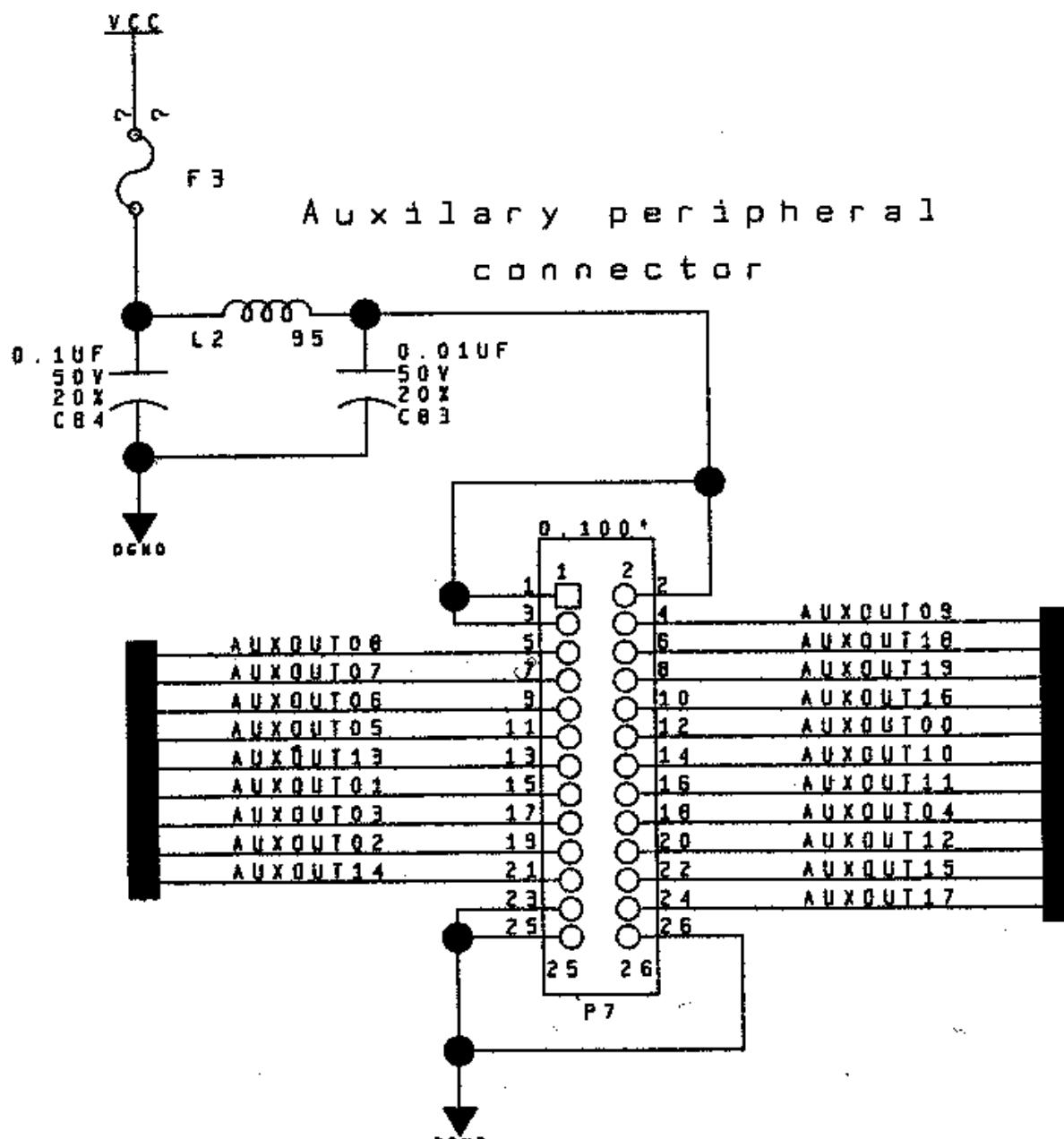


Wheel Driver Board Schematic, 7/8

Auxiliary Latched Outputs



Wheel Driver Board Schematic, 8/8



OFFROAD

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SERVICING

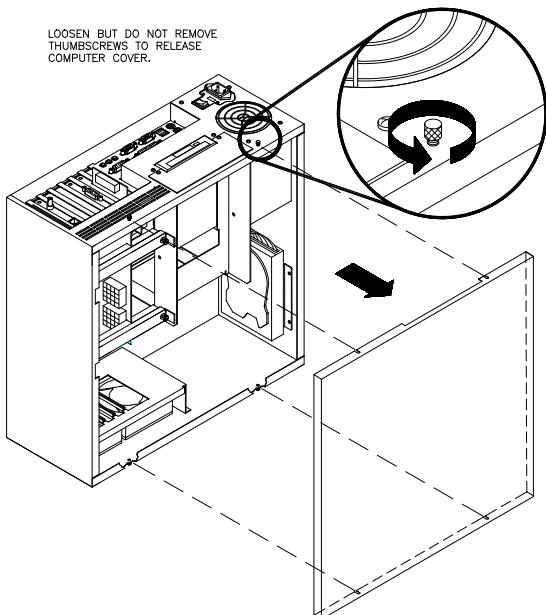
	NOTICE: The term VGM refers to the video game machine.
	NOTICE: Avoid damage to electronics! Turn off VGM power before servicing circuit boards or any electronic assembly. Never "hot plug" circuit boards.
	CAUTION: Static electricity builds up on your body. This static can damage or destroy sensitive circuits. <i>Before</i> touching or handling electronics, discharge static electricity by touching the power supply chassis.

DISASSEMBLY & REASSEMBLY

This chapter includes summarized procedures for disassembling and reassembling VGM components. Only qualified service personnel should repair VGM equipment. The following product guidelines apply to all video game operators and service personnel. Notes, cautions and warnings appear throughout this manual where they apply. Study the Safety pages before beginning service.

- **Arcade Computer**

Switch off power to the VGM. Open and remove the rear door. The Arcade Computer is behind this door. To expose Arcade Computer circuitry, loosen four metal thumbscrews. Don't remove the screws. These screws reside at the top and bottom corners of the case. Slide off the back of the computer. For most computer service, you must also separate the Player Panel Cabinet and Monitor Cabinet.



- **Audio Amplifier Board**

Switch off power to the VGM. Unlock and raise the top door of the Player Panel Cabinet. Note the orientation of the connector and other cables. Extract the harnesses from the board connectors. Remove mounting screws and washers from the Audio Board. Lift the board off its mounting posts. Handle the board by a heatsink. If you aren't reinstalling the board, store it in an anti-static bag and protective container.

- **Battery**

	CAUTION: If you install the battery incorrectly, it may explode! Avoid direct shorts across the terminals or from terminals to ground. These batteries are designed for very long life. Don't attempt to recharge these batteries!
	CAUTION: Avoid an explosion! Replacement batteries must match the originals in size, voltage rating, and composition. Manufacturer recommended equivalent types are acceptable. Store batteries in a safe place until you've completed repairs. Dispose of used batteries according to manufacturer instructions.

A battery on the CPU Board retains data in memory during power disruptions. This battery is a 3-volt, lithium button cell. Switch off power to the VGM. Separate the Player Panel Cabinet and Monitor Cabinet. Unlock and raise the top door of the Player Panel Cabinet. The Arcade Computer is under this door. Remove the back of the Arcade Computer. The battery resides toward the edge of the

motherboard, near the daughter board sockets. Carefully pry up the battery retaining lever. Then grasp the battery edges and remove the device. Set the battery aside.

Note the “+” marking on one side of the replacement battery. When you install a battery, this “+” marking must face the battery retaining lever. After replacing the battery, set the system clock to the correct date and time. Also enter the Menu System and check or update system adjustments as necessary.

- **Coin Counter**

Meter replacement requires vault removal. Switch off power to the VGM. Unlock and open the coin door and cashbox door. Find the meter behind the bottom of the cashbox door. Remove the cashbox.

Remove two mounting screws at the bottom (front) of the vault assembly. Reach through the cash door. You'll find two mounting screws at the back of the vault. Remove these. Access the four remaining vault screws from the inside-back of the cabinet. Remove these four screws. Slide the vault out of the cabinet.

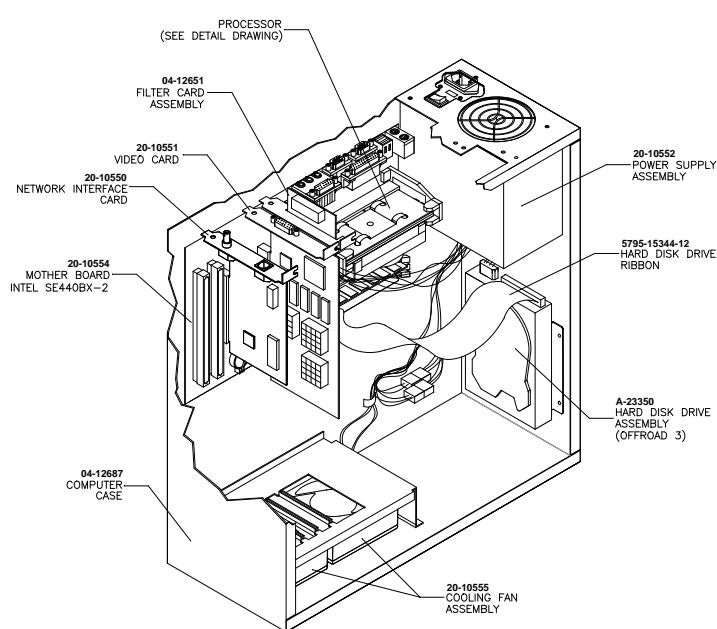
Locate the meter wires under the vault. Disconnect wiring at the connector. Remove two mounting screws from the front of the meter. Remove the meter. Assure that the replacement meter has a diode across its terminals. This diode protects driver circuits from the meter's inductive kick. Install the new meter. Log the new meter count.

- **Coin Mechanism**

Switch off power to the VGM. Unlock the coin door and swing it open. To clean or replace a coin mechanism, unlatch and remove it. After reinstallation, assure that the mechanism seats fully in its bracket. Close and lock the release latch. Then close the door. Enter the Menu System to change the coin mechanism setup. Test known good and bad coins to verify operation.

- **CPU Board**

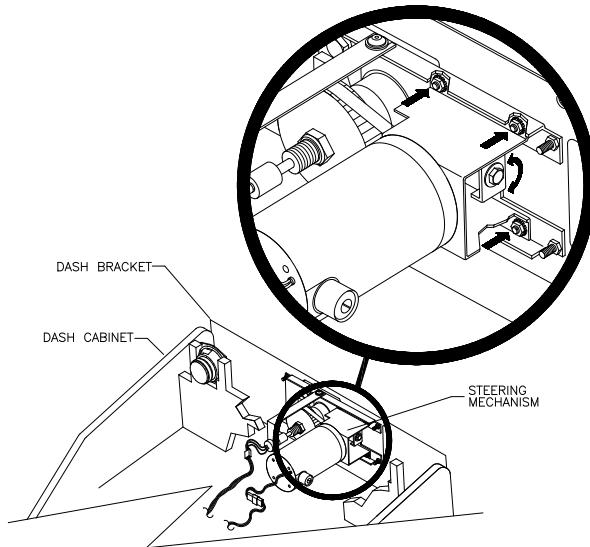
The CPU Board is part of the Arcade Computer. Switch off power to the VGM. Separate the Player Panel Cabinet and Monitor Cabinet. Unlock and raise the top door of the Player Panel Cabinet. The Arcade Computer is under this door. Find the four metal thumbscrews at the top and bottom corners of the computer case. To expose the CPU Board, loosen, but don't remove these screws. Slide off the back of the computer. Disconnect the floppy disk power and data cables at the disk drive. Remove the floppy drive mounting bracket. Lift the bracket and floppy drive out of the cabinet. Set these aside for reassembly. Remove the CPU Board power cables at the CPU Board. Remove the circuit board retention bars. Remove the Video card, Network card, and DC Filter board. Disconnect the hard drive power and data cables at the disk drive. Remove CPU Board mounting screws. Lift the circuit board out of the cabinet and set it aside for reassembly. Use anti-static packaging from new parts to store boards that you won't reinstall.



- **Dashboard and Steering Mechanism**

Switch off power to the VGM. Separate the Player Panel Cabinet and Monitor Cabinet. Unlock and raise the top door of the Player Panel Cabinet. Disconnect the wiring harnesses from the dashboard. Support the steering wheel. Remove one screw from each corner of the instrument cluster. Remove the support. Carefully set the dash assembly on your workbench.

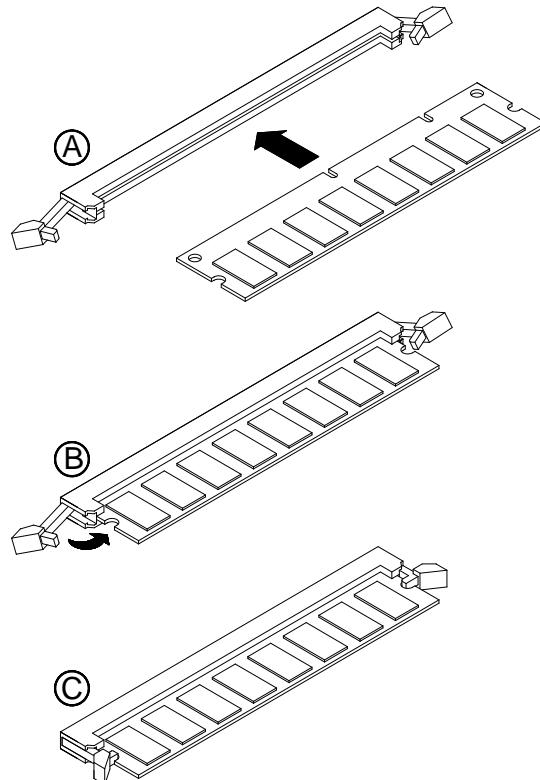
Inspect the motor, pulleys, and belt. If the belt is broken or shows signs of wear, replace it. Locate the two nuts on each side of the motor mounting bracket. Loosen all four bracket nuts. Rotate the tension adjustment bolt as necessary. Tighten this bolt until the belt is taut. Then restore correct tension by loosening the bolt one full turn. Tighten the motor bracket nuts.



- **DIMMs (Dual In-Line Memory Modules)**

DIMM circuits contain the computer read-write memory for this VGM. Switch off power to the VGM. Separate the Player Panel Cabinet and Monitor Cabinet. Unlock and raise the top door of the Player Panel Cabinet. Remove the back of the Arcade Computer. Unplug the ribbon cable from the floppy drive. Leave the other end of the cable attached to the CPU Board. Unscrew and remove the circuit board retention bars. Remove the floppy drive mounting bracket. Remove the floppy drive. Note DIMM positions. Press out on the locking retainer on each side of the DIMM. The DIMM should partially or completely pop out of its socket. Lift the DIMM from its socket. Handle the DIMM only by its edges.

To reinstall memory circuits, orient the DIMM over its socket. Make sure that you've positioned the keying holes and notch properly. Push the DIMM board into its socket, so that the board snaps into place under the locking retainer on each side of the socket. Be sure that the retainers mate tightly with DIMM board notches. *Don't attempt to force a DIMM into its socket.*



- **Dollar Bill Validator**

(Use MARS AE2451-U3E, UL-recognized currency changer)

You can install dollar bill validators in VGMs manufactured with the additional wiring connector. Other currency acceptors will also work with this connector.

Switch off power to the VGM and unplug the AC line cord. Unlock the coin door and swing it open. Read the coin door label for additional information.

Remove nuts, spacers, and the cover plate from the door. before mounting the validator, change switch settings or make adjustments. If the manufacturer supplied an adapter plate, place it over the door cutout. Install spacers on threaded studs. Then align the validator mounting holes with the studs. Seat the validator in the door opening. Install the nuts and tighten them.

Attach the ground wire (green with yellow stripe) lug to the door ground stud. The stud is beside the hinge. Mate the wiring harnesses and press them together to fully seat connectors. Route wires away from the door edges and hinge. Inspect the bill chute for proper alignment. Set the dollar bill validator to produce 50ms output pulse widths, 1 pulse per dollar. This setting avoids counting errors. To remove a validator for service or replacement, reverse these steps.

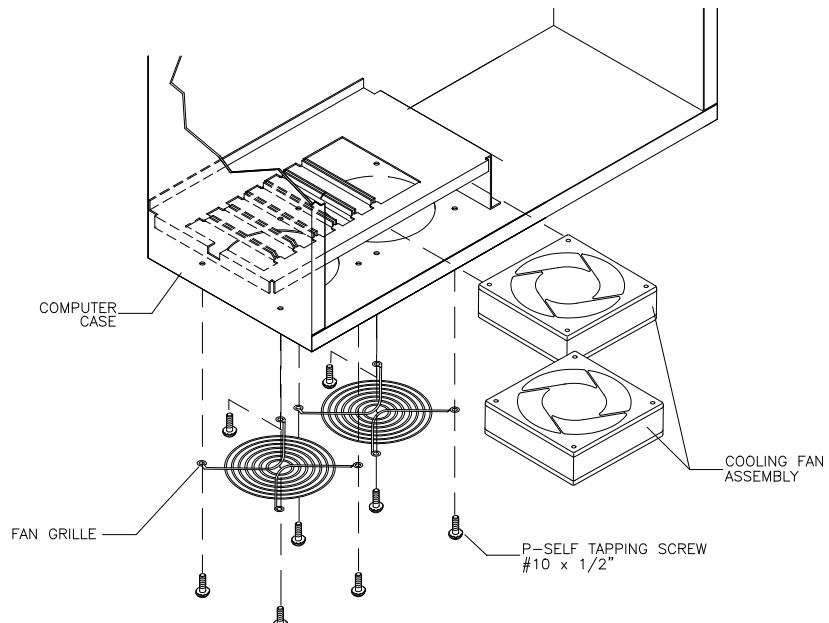
Plug in the line cord and turn on the VGM. From the Menu System, change the mechanism setup and pricing. Then test known good and bad bills to verify proper operation. Close and lock the coin door.

- **Fans**

The Arcade Computer incorporates several fans. Two fans reside at the bottom of the Arcade Computer enclosure. The power supply includes one fan. Inside the microprocessor cartridge is another small fan.

Switch off power to the VGM. Separate the Player Panel Cabinet and Monitor Cabinet. Unlock and raise the top door of the Player Panel Cabinet. Remove the back of the Arcade Computer.

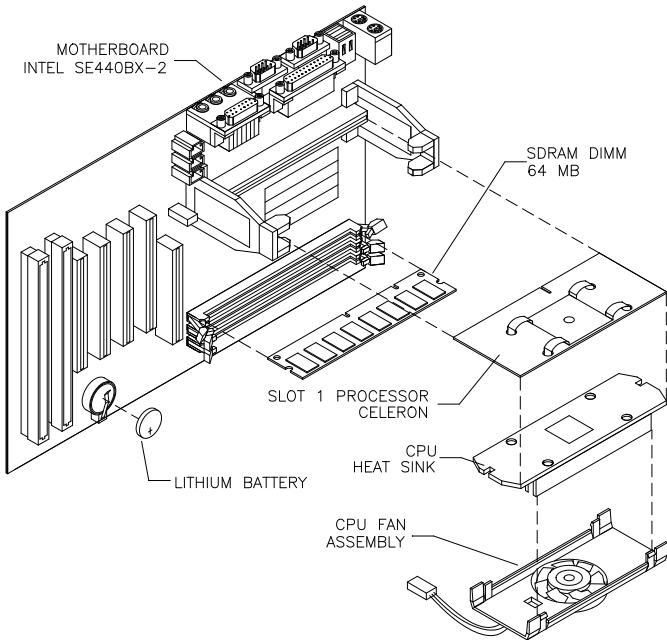
FANS AT THE BOTTOM OF THE ENCLOSURE. Disconnect the fan's power harness. Remove the fan mounting screws. Note the fan orientation. Each fan has an arrow molded into its plastic case to indicate airflow direction. Slide the fan out of its mounting bracket. Be certain to reinstall the fan in the proper direction to assure airflow over circuitry.



POWER SUPPLY FAN. The power supply contains no user-serviceable parts. Never open the power supply.

MICROPROCESSOR FAN.

Unscrew and remove the circuit board retention bars. Remove the floppy drive mounting bracket. Unplug the ribbon cable from the floppy drive. Remove the floppy drive. Disconnect the fan's power harness. Remove the microprocessor cartridge. Squeeze the plastic end tabs on the fan side of the cartridge. While squeezing, carefully pry the fan assembly away from the heatsink. If the fan is bad, replace the entire fan assembly with a new one. Reassemble the cartridge and insert it into the computer. Then reconnect fan power.



- **Floppy Disk Drive**

Switch off power to the VGM. Separate the Player Panel Cabinet and Monitor Cabinet. Unlock and raise the top door of the Player Panel Cabinet. Remove the back of the Arcade Computer. Disconnect the DC power cable from the floppy drive. Unplug the ribbon cable from the floppy drive. Leave the other end of the cable attached to the CPU Board. Unscrew and remove the circuit board retention bars. Remove the drive bracket mounting hardware. Remove the bracket. Remove the drive mounting screws. Lift the drive off the mounting bracket. Save the mounting screws for reuse in future floppy drive installations. When returning a floppy drive to your distributor, pack it in an anti-static bag.

REINSTALLATION. Mount the floppy drive in its bracket. Install the drive mounting screws. Reinstall the bracket and drive in the Arcade Computer enclosure. Connect the drive's ribbon and power cables.

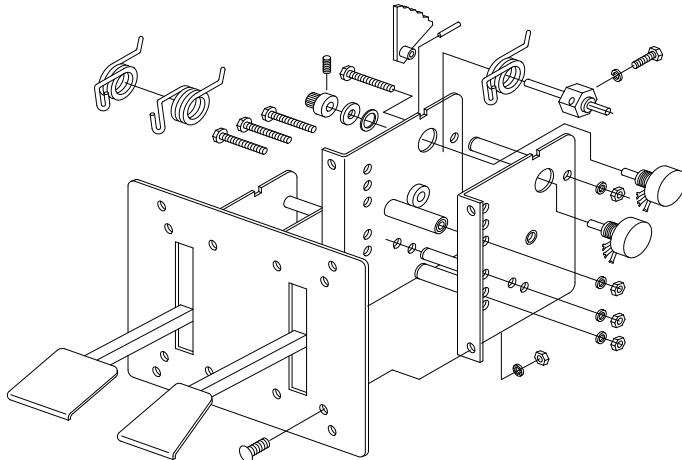
- **Front Housing**

OPENING THE DOOR AND HOUSING. Switch off power to the VGM. Unlock the front cabinet door and swing it open. Release the latches at the corners under the front housing. Gently pull out on the bottom of the formed front housing and swing it towards the control section. Remove the free end of the prop rod from the retainer at the left side of the monitor shelf. Swing the rod up until it rests in the rod bracket on the lower right side of the front housing. Lower the housing until the prop rod supports the housing's weight.

CLOSING THE DOOR AND HOUSING. Snap the rod into the retainer. Close the housing. Engage latches and snap them shut. Close the front cabinet door

- **Pedal Assembly**

Switch off power to the VGM. Unlock and raise the top door of the Player Panel Cabinet. Disconnect the pedal cable from the wiring harness. Disconnect the safety ground from the pedal frame. Adjust the seat to the maximum rear position. Remove four outer mounting screws from the front perimeter of the pedal plate. Pull the pedal toward the seat until it clears the opening. Then lift it up and away from the cabinet.



- **Gear Shift**

Switch off power to the VGM. Unlock and raise the top door of the Player Panel Cabinet. Disconnect the two cables from the back of the shifter. At the front of the shifter, remove shift plate mounting screws. Lift the shifter up and out of the player panel.

- **Hard Disk Drive**

	CAUTION: Hard disk drives are very fragile! Handle them with care. Keep disk drives away from magnets, heat and vibration. Don't move a VGM with the power on.
	CAUTION: Don't stack or drop hard disk drives. Use an anti-static bag and an approved shipping container to return the drive to your distributor.

Switch off power to the VGM. Separate the Player Panel Cabinet and Monitor Cabinet. Unlock and raise the top door of the Player Panel Cabinet. Remove the back of the Arcade Computer. Disconnect the DC power cable from the hard drive. Unplug the ribbon cable from the hard drive. Leave the other end of the cable attached to the CPU Board. Remove the drive mounting screws. (Don't remove the drive-mounting bracket.) Lift the drive out of the cabinet. Save the mounting screws for reuse in future hard drive installations. When returning a hard drive to your distributor, pack it in an anti-static bag. Box the drive in approved shipping container 08-8068.

REINSTALLATION. Before mounting the hard drive in its bracket, install the drive mounting screws. To avoid damage during installation, mount the hard drive in the brackets before connecting cables.

After a driver plays one game, the new drive copies data from other linked VGMs. *Important! The data won't copy if players are actively driving. Files transfer only when all VGMs return to Attract Mode.*

- **MagicBus™ Interface Board**

Switch off power to the VGM. Unlock and raise the top door of the Player Panel Cabinet. Extract the harnesses from the board connectors. Remove mounting screws and washers from the MagicBus Board. Remove the MagicBus Board. Lift the board off its mounting posts. During reinstallation, tighten the screws: Start at the board's center and work toward the outer edge. If you aren't reinstalling the board, store it in an anti-static bag and protective container.

- **Marquee**

Switch off power to the VGM. Open the front, monitor cabinet door. To replace the marquee, you must completely remove the front housing from the monitor cabinet. Then you can access the

marquee, and remove it from the bezel. Take the glass and artwork out of the front housing. Clean the glass before reinstalling it. Install the bracket and tighten screws. Replace the front housing on the monitor cabinet. Tighten mounting screws. Don't use excess force.

- **Mars Light Driver Board**

Switch off power to the VGM. Unlock and remove the rear door of the Monitor Cabinet. Note the orientation of the connector and the other cables. Extract the harnesses from the board connectors. Remove mounting screws and washers from the Mars Light Driver Board. Lift the board off its mounting posts. Handle the board by the edges. If you aren't reinstalling the board, store it in an anti-static bag and protective container.

- **Microprocessor**

This VGM's microprocessor is in a postcard-size cartridge that also includes cache RAM. The cartridge is inside the Arcade Computer, near the DIMM sockets. Switch off power to the VGM. Separate the Player Panel Cabinet and Monitor Cabinet. Unlock and raise the top door of the Player Panel Cabinet. Remove the back of the Arcade Computer. Unplug the ribbon cable from the floppy drive. Leave the other end of the cable attached to the CPU Board. Unscrew and remove the circuit board retention bars. Remove the floppy drive mounting bracket. Remove the floppy drive. Disconnect the microprocessor fan power harness. Spread the locking retainers on each side of the microprocessor cartridge. Pull the cartridge out of its socket. Take care not to touch the copper traces on the socket.

To reinstall a microprocessor cartridge, orient the cartridge over its socket. Make sure that you've positioned the keying notch properly. Push the microprocessor cartridge into its socket, so that the cartridge snaps into place under the locking retainer on each side of the socket. Be sure that the retainers mate tightly with cartridge notches. *Don't attempt to force a cartridge into its socket.* Reconnect the microprocessor fan harness.

- **Monitor**

	WARNING: The video monitor is <i>very heavy</i> , with most of the weight toward the front. Solidly support the monitor as you remove from it from the cabinet.
	WARNING: When operating the monitor outside the cabinet, use an isolation transformer. In normal operation, the monitor doesn't require isolation from AC line voltage.

The monitor is very heavy and difficult to balance. Removing the monitor is a two-person task. Don't attempt to remove it by yourself. Switch off power to the VGM. Open the front cabinet door. Disconnect the fluorescent light assembly connector and all monitor cables. Remove the front housing hinge screws and set the housing aside. Remove the monitor bezel and both barrier panels. Remove the four flange nuts securing the monitor's mounting brackets to its mounting panel. Pull the monitor carefully from the cabinet and set in a safe place. The monitor remote adjustment board is behind the front door with the rest of the electronics. Clean the face of the CRT before reinstalling the barrier panels and the monitor bezel.

The monitor is a medium resolution type. Other monitors may look as if you can use them for replacements. Yet the screens of different monitor types curve differently. Only medium resolution monitors fit correctly against the monitor bezel. Other monitor styles won't seal properly, and also won't synchronize.

- **Network Interface Board**

Switch off power to the VGM. Unlock and raise the top door of the Player Panel Cabinet. Remove the back of the Arcade Computer. Note the orientation of the cables. Loosen the header-mounting screw. Disconnect the network cables from the board header connectors. Remove the circuit board retention bars. Remove the board. As you remove the board, handle it only by its edges. Don't touch the copper traces! If you aren't reinstalling the board, store it in an anti-static bag and protective container.

- **Power Filter Board**

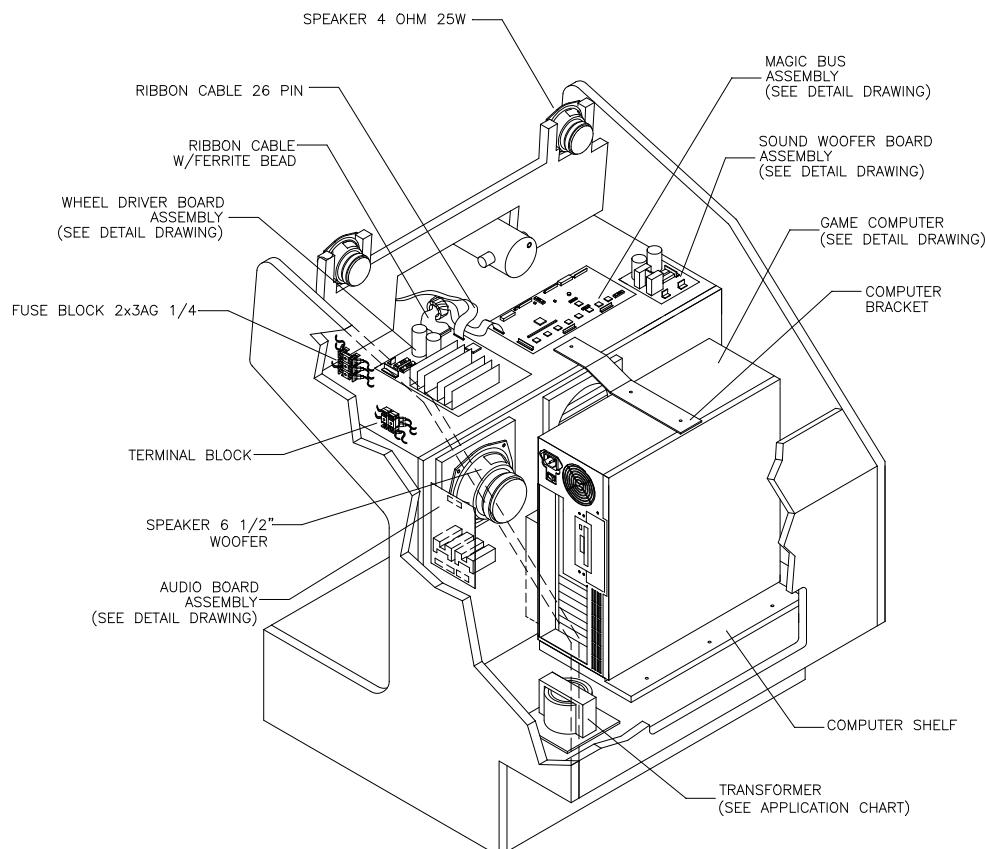
Switch off power to the VGM. Unlock and raise the top door of the Player Panel Cabinet. Remove the back of the Arcade Computer. Loosen the header-mounting screw. Disconnect the cables from the board header connector. Remove the circuit board retention bars. Remove the board. As you remove the board, handle it only by its edges. Don't touch the copper traces! Use anti-static bags and protective containers to store the board if you won't reinstall it.

- **Power Supply**

Switch off power to the VGM. Disconnect the line cord. Unlock and raise the top door of the Player Panel Cabinet. Remove the back of the Arcade Computer. Unplug the IEC AC power cord. Inside the Arcade Computer, disconnect DC power cables. These connect to the hard drive, motherboard and other peripherals. Remove four mounting screws from the outside of the Arcade Computer enclosure. Lift the power supply out of the cabinet. Before reinstalling the power supply, check the line voltage switch setting.

- **Speakers**

This VGM has four speakers. One woofer is behind a grille at the back of the driver's seat. Smaller, full range speakers are behind the front of the Player Panel. Below these full-range speakers is one more woofer. Switch off power to the VGM.



ACCESSING THE SEAT WOOFER. Remove mounting screws and set the speaker grille aside. *Don't use excess force when removing or tightening mounting screws threaded into plastic.* Avoid speaker damage by removing the upper mounting screws first. Replace these top screws last.

ACCESSING A PLAYER PANEL CABINET SPEAKER. Unlock and raise the top door of the Player Panel Cabinet. Remove mounting screws from the rear of the speaker.

SPEAKER REMOVAL. Assure proper polarity by marking each speaker wire ("+" or "Gnd"). Remove the speaker from the enclosure and disconnect the wire lugs.

- **Sub-Woofe Driver Board**

Switch off power to the VGM. Separate the Player Panel Cabinet and Monitor Cabinet. Unlock and raise the top door of the Player Panel Cabinet. Note the orientation of the connector and the other cables. Extract the harnesses from the board connectors. Remove mounting screws and washers from the Sub-Woofe Driver Board. Lift the board off its mounting posts. Handle the board by a heatsink. If you aren't reinstalling the board, store it in an anti-static bag and protective container. The board has two 0.5A, 250-volt fuses. Check these with an ohmmeter. Replace bad fuses only with the identical type.

- **A.C. Power Chassis**

Switch off power to the VGM. Unlock and remove the rear door of the Monitor Cabinet. Note the orientation of the connector and the other cables. Disconnect A.C. Power Chassis harness connectors. Remove mounting hardware from the chassis. Lift the chassis out of the cabinet.

- **Video Board**

Switch off power to the VGM. Separate the Player Panel Cabinet and Monitor Cabinet. Unlock and raise the top door of the Player Panel Cabinet. Remove the back of the Arcade Computer. Loosen the header-mounting screw. Disconnect the video cable from the board header connector. Remove the circuit board retention bars. Remove the board. As you remove the board, handle it only by its edges. Don't touch the copper traces! Use anti-static bags and protective containers to store the board if you won't reinstall it.

- **Viewing Glass**

Switch off power to the game. Open the front cabinet door. To replace the viewing glass, you must completely remove the front housing from the monitor cabinet. Lift the glass out of the front housing. Clean the glass before reinstalling it. Install the bracket and tighten screws. Replace the front housing on the monitor cabinet. Tighten mounting screws. Don't use excess force.



CAUTION: Before you replace the CRT viewing glass, completely remove the front housing assembly from the cabinet. Glass is hazardous to handle with the housing pivoted up on the drop rod.

- **Wheel Driver Board**

Switch off power to the VGM. Separate the Player Panel Cabinet and Monitor Cabinet. Unlock and raise the top door of the Player Panel Cabinet. Note the orientation of the connector and the other cables. Extract the harnesses from the board connectors. Leave the other end of the ribbon cable connected to the MagicBus Board. Remove four mounting screws and washers from the Wheel Driver Board. Lift the board off its mounting posts. Handle the board by the heatsink. If you aren't reinstalling the board, store it in an anti-static bag and protective container.

OFFROAD

THUNDER TM



TROUBLESHOOTING

	NOTICE: The term VGM refers to the video game machine.
	CAUTION: This VGM uses complex electronic components that are <i>very sensitive to static electricity</i> . Observe the following precautions before handling VGM electronics. Failure to do so may void your warranty and could damage electronic assemblies.

- Before servicing electronics, turn off AC power to the VGM. Wait for capacitors to discharge.
- Before touching or handling electronic assemblies, discharge static electricity on your body. To discharge this static, begin by connecting the line cord to a grounded outlet. Don't turn on the VGM! Next, touch the safety ground stud of the power supply chassis.
- Store electronic assemblies in an anti-static area. Use anti-static bags to store or transport VGM circuit boards. Transport the hard drive in its shipping container.
- Don't remove or connect electronic assemblies when cabinet power is on. Otherwise, you'll damage electronic assemblies and void the VGM warranty.
- After you complete maintenance or service, replace ground wires, shields, safety covers, etc. Install and tighten ground and mounting screws.

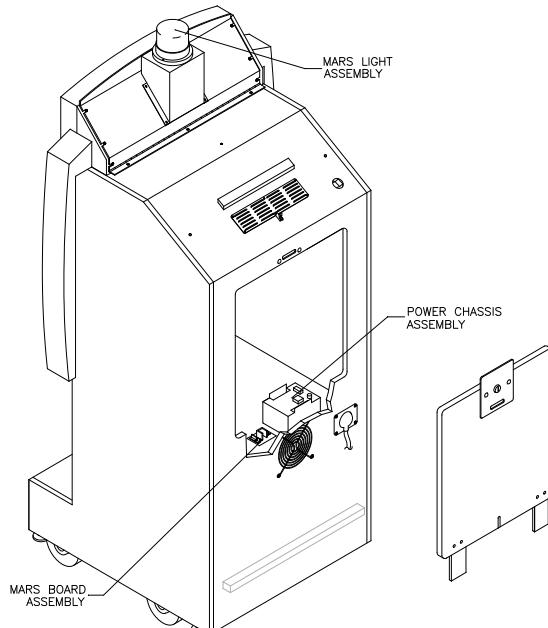
Coin Mechanism and Pricing Troubleshooting Table

SYMPTOM	CAUSE	REQUIRED ACTION
• VGM (<i>video game machine</i>) accepts currency or tokens, but number of credits per coin or bill is incorrect.	Improper settings at Pricing Menu	From Adjustments Menu, choose PRICING MENU. Verify that units and credits are set correctly.
	Faulty wiring	<ol style="list-style-type: none"> Check that cabinet wiring is correct for this VGM. Assure that coin meter and coin switches connect properly to control input wires.
	Incorrect pulse width on bill validators	<ol style="list-style-type: none"> Consult bill validator manufacturer's literature. Adjust pulse width on validator to <i>long</i> setting. Retest validator operation.
• VGM won't accept currency or tokens. • VGM won't start. • Audio and video are present.	Improper currency	<ol style="list-style-type: none"> Unlock and open cash door. Empty cash box. Inspect revenue for counterfeit currency. Check vault. Remove any items that block path from mechanism.
	Faulty coin mechanism	<ol style="list-style-type: none"> Unlock and open coin door. Check each mechanism for proper mounting. Remove mechanism. Clear currency path. Reinstall mechanism and latch it. Enter Menu System by pressing and holding TEST MODE switch inside coin door. From Diagnostics Menu, choose SWITCH TEST. Use tests to confirm operation of coin switches.
	Tilted coin mechanism or VGM	<ol style="list-style-type: none"> Verify that mechanism is level after doors close. Repair or replace coin door if it is bent or damaged. If necessary, adjust cabinet leg levelers to keep mechanisms vertical.
• Coin indicators don't light	Burned-out bulb	<ol style="list-style-type: none"> Burned-out bulbs may appear white or darkened. Check continuity with DVM. Replace burned-out bulb with same type.
	Open fuse circuit	<ol style="list-style-type: none"> Check fuse continuity with DVM. If fuse is blown, replace fuse with same type. If fuse isn't blown, check wiring.

Typical Coin Mechanism Mounting

VGM Startup Troubleshooting Table

SYMPTOM	CAUSE	REQUIRED ACTION
<ul style="list-style-type: none"> • VGM (video game machine) doesn't start. • VGM appears completely non-functional. • No audio • No illumination • No video display 	Power problem	<ol style="list-style-type: none"> 1. Check that VGM power switch is on. 2. Inspect computer to see if fans are turning. <i>If not:</i> Is computer power supply connected to its power cable? Is computer power supply turned on? 3. Plug VGM into AC power outlet. Verify presence of AC line voltage.
	Improper line voltage switch setting	Turn off VGM power. Unplug AC line cord. Check line voltage switch. If necessary, set it to agree with local AC line voltage. Retest VGM.
	Open fuse	<ol style="list-style-type: none"> 1. Turn off VGM power. Examine AC fuse at rear of VGM, on AC cord plug plate. 2. Replace faulty fuses with identically rated parts. 3. Turn on VGM power. If fuse opens again, check AC wiring harness and connectors.
	Faulty wiring	<ol style="list-style-type: none"> 1. Remove line cord. Test line cord, power plug, and IEC connector for breaks or damage. Verify continuity of each wire in cord. Install cord at power chassis. Press connector firmly to seat it. 2. Check computer cord in same manner. 3. Assure that cabinet wiring harness connectors fully seat in corresponding power supply and board connectors. 4. Inspect wiring for breaks or damage.
	Arcade computer problem	Turn off power for one minute and turn VGM on again. Power On Self-Test checks electronics. Screen may report errors. If video circuits don't operate properly, computer produces series of beeps. (See <i>Error Message Troubleshooting Table</i> .)



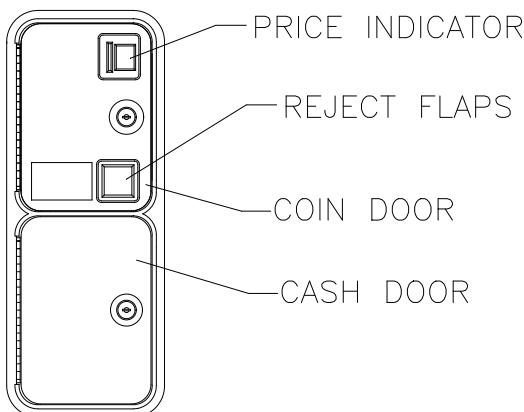
Location of Power Supply and Line Cord

VGM Startup Troubleshooting Table, *continued*

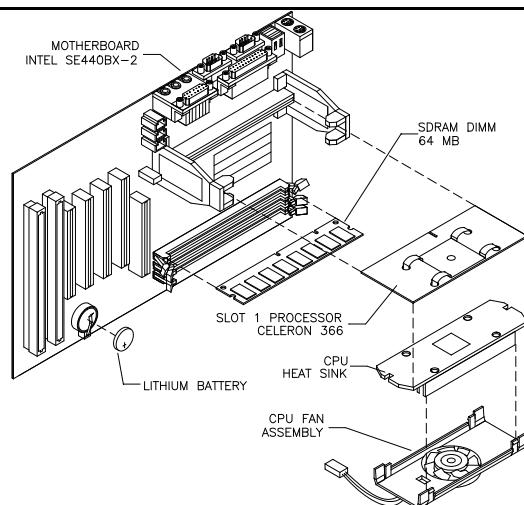
SYMPTOM	CAUSE	REQUIRED ACTION
<ul style="list-style-type: none"> • VGM (<i>video game machine</i>) appears non-functional. • Currency acceptor price indicator is illuminated. 	Power problem	<ol style="list-style-type: none"> 1. Inspect circuit boards under low-light conditions. LEDs glow if processor circuits receive voltage. Fan should be turning. These indications prove presence of DC from power supply. Still, voltages or signals may not be normal. Computer has no internal LEDs. 2. Turn on VGM power. Using 20-volt DC setting on digital voltmeter, measure DC voltages at power connector pins. (Power supply voltage isn't adjustable.) 3. Using 2-volt AC setting on digital voltmeter, measure same DC voltages as above. Any reading here indicates that supply voltages are unstable and may contain ripple or noise.
	Faulty wiring	Turn off VGM power. Assure that wiring harness connectors attach and fully seat onto mating board connectors. Verify that harness connects to computer.
	Improper jumper or DIP switch settings	Verify that circuit board jumpers are set as intended. Check DIP switch settings.
	Faulty circuit boards or arcade computer	<ol style="list-style-type: none"> 1. Run power-up self-test sequence. Note errors or failures during tests. Compare LEDs with LED indicator status charts. Note discrepancies. 2. Turn off computer. Wait for hard disk to stop spinning. Leave VGM power on. Loosen computer case thumbscrews and lift off cover. Turn computer power on. Listen for beeping sounds. Compare beeps with <i>Error Message Troubleshooting Table</i>.



CAUTION: Don't remove or install any connector while power is turned on. Doing so will damage circuit boards or hard disk drive, and void warranty.



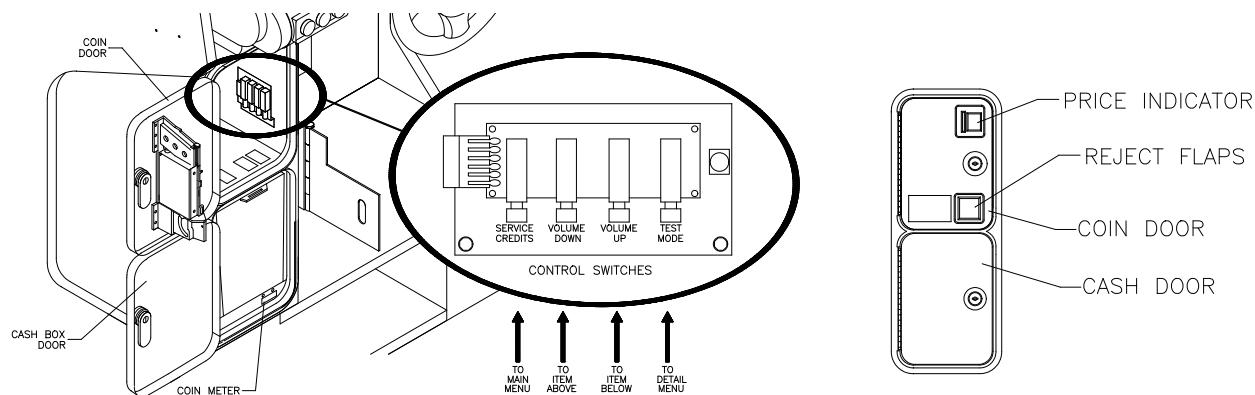
Front View of Coin Door



Interior View of Electronics

VGM Startup Troubleshooting Table, *continued*

SYMPTOM	CAUSE	REQUIRED ACTION
<ul style="list-style-type: none"> • VGM (<i>video game machine</i>) doesn't start. • VGM accepts currency or tokens. • Audio and video are present. 	Faulty coin mechanism	<ol style="list-style-type: none"> 1. Unlock and open coin door. Check each currency acceptor to assure proper mounting. Verify that each release latch is closed and locked. Does mechanism accept and reject currency correctly? Test mechanism with good and bad coins. 2. Inspect to see if external acceptor indicators (Pricing, Flashing Arrows, etc.) are lit. 1. Verify that each acceptor operates properly by placing it in working VGM. Replace bad parts.
	Faulty switches	<ol style="list-style-type: none"> 1. Enter Menu System by pressing and holding TEST MODE switch inside coin door. From Diagnostics Menu, choose SWITCH TEST. Use tests to confirm operation of each switch in VGM. 2. Assure that no loose parts or wires are caught in switch contacts. 3. Check for continuity in each suspect switch connection (Common to Normally Open or Common to Normally Closed). 4. Replace faulty switches (bent levers, broken actuators, etc.).
	Faulty wiring	<ol style="list-style-type: none"> 1. Assure that no wires are caught in hinges, latches or switch contacts. 2. Check wiring continuity from circuit board connectors to acceptors.



Interior View of Coin Door and Cash Door

Audio Troubleshooting Table

SYMPTOM	CAUSE	REQUIRED ACTION
<ul style="list-style-type: none"> • No audio • Video is present • VGM (<i>video game machine</i>) appears to operate normally 	Improper volume setting	Enter Menu System by pressing and holding TEST MODE switch. From Operator (Main) Menu, choose VOLUME MENU. Check that Attract Music is on (enabled). Verify that all volume levels are set well above zero. If necessary, change levels to make VGM audible.
	Faulty wiring	Turn off VGM power. Assure that wiring harness connectors attach and fully seat onto mating board connectors. Verify that harness connects to computer. Check audio cable connectors in same way.
	Faulty or obstructed speaker	Remove grilles and inspect speakers. Free speaker cones, terminals, mounting screws and magnets of loose parts or wires.
	Faulty Audio Board	Verify proper operation of Audio Board by placing it in working VGM.
<ul style="list-style-type: none"> • Constant low hum from all speakers. 	Faulty wiring	<ol style="list-style-type: none"> 1. Check that cabinet wiring is correct for this VGM. 2. Verify that cabinet wiring provides separate wires (not common return) for each speaker. 3. Check connection of all cabinet ground wires.
	Faulty Audio Board	<ol style="list-style-type: none"> 1. Run power-up self-test sequence. Note errors that VGM finds during tests. 2. Verify that BB12 Audio Board operates by placing it in working VGM. 3. If problem persists: Check regulator U5; capacitors C1, C2, C3, C14 and C30. 4. Replace bad parts.
	Faulty power supply	Using 2 Volt AC setting on digital voltmeter, measure voltages at speaker terminals. Any reading indicates unstable supply that may contain ripple or noise.
<ul style="list-style-type: none"> • Audio is distorted, muffled or has missing frequencies. 	Faulty or improper speaker	<ol style="list-style-type: none"> 1. Turn off VGM power. Remove grilles and check speakers. Assure that speakers are full range (100 to 10,000 Hz response) and rated for at least 20 watts. Woofers must be rated for at least 40 watts. 2. Verify proper speaker operation by connecting speaker in question to working VGM.
	Faulty wiring	Multiple-speaker installations: Check for reversed wires at one speaker. Weak low frequencies and thin or hollow sound quality is symptom of incorrectly phased speakers. Sound tests may not detect this condition, but you can hear it during Game Mode.
<ul style="list-style-type: none"> • Dead sound channel 	Faulty speaker	<ol style="list-style-type: none"> 1. From Diagnostics Menu, choose SOUND TEST. Recheck speakers with audio signals provided by test. 2. Verify proper speaker operation by connecting speaker in question to working VGM.
	Faulty circuit board	Run power-up self-test sequence. Note errors that VGM finds during tests. Compare circuit board LEDs with LED indicator status charts. Note discrepancies.
	Faulty wiring	Verify that cabinet wiring is correct. Assure that all speakers connect to audio wires. Audio cable must be fully seated in Computer Line Output Jack. Check for broken or shorted wires.

Error Message Troubleshooting Table

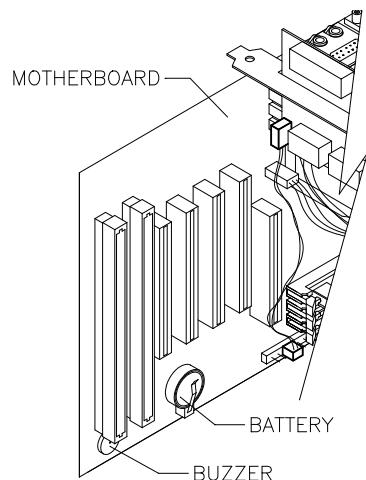
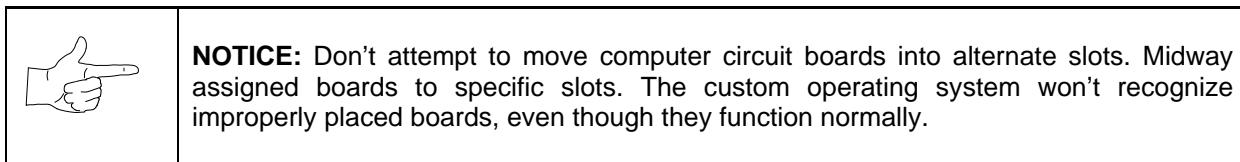
Power-On Self-Test Beep Codes

Audio beeps only. Video may or may not be present. See notes.

MESSAGE	MEANING	REQUIRED ACTION
No beep	No system power	Check power supply and cables
1 continuous beep	Partial system power	Check power supply and cables
1 short beep	Normal start; no errors	Check other VGM components
2 short beeps	Processor problem	Check processor/fan module
3 short beeps	Graphics initialization problem	Check Video Board, cables
4 short beeps	Processor problem	Check processor/fan module
5 short beeps	Insufficient system memory	Check DIMM circuit modules
6 short beeps	Peripheral problem	Check other VGM components

Notes

- The audio buzzer that generates 1 kHz beeps is in the computer, inside the VGM (*video game machine*). If you have difficulty hearing beep codes, remove the rear cabinet door and computer cover.
- Arcade Computer circuit boards resemble those in personal computers. Yet Midway engineers reprogrammed the boards for application in this VGM. *Power-On Self-Test codes are unique to the Arcade Computer in this VGM.*
- Wiring or peripheral circuit problems may not trigger on-screen error messages. You may discover difficulties during Menu System diagnostic or calibration procedures.
- For help with unresolved error messages, call your authorized distributor.



Location of Beeper in Arcade Computer

Link Troubleshooting Table

SYMPTOM	CAUSE	REQUIRED ACTION
<ul style="list-style-type: none"> • Can't connect VGMs (<i>video game machines</i>) together 	Faulty wiring	<ol style="list-style-type: none"> 1. Don't extend linking cables that come with VGM. 2. Install required crossover between VGM cabinets. Each coupler connects two cabinets (one pair). <i>Don't use standard telephone type couplers or wiring to link cabinets.</i> 3. Use only 10Base-T, Ethernet-type, Category 5, twisted-pair wiring for VGM data.
	Improper linking hardware	Use required network hub for your local network. Hub Link Kit permits up to four cabinet connections. Cabinet array completion requires basic kit brackets and spacers.
<ul style="list-style-type: none"> • VGM doesn't recognize other players in linking operation • VGM functions normally by itself 	Improper settings	<ol style="list-style-type: none"> 1. Record any error messages that occur during self-test. 2. From Operator (Main) Menu, choose Adjustments Menu. Then select Linked Play Adjustments Menu. Assure that you've set LINKED PLAY to ON. 3. Be sure that each VGM has unique ID number.
	Power problem	If hub is in use, verify that power is applied. AC adapter wires are thin and easily damaged.
	Faulty wiring <i>(3 or more cabinets)</i>	<ol style="list-style-type: none"> 1. Inspect hub indicator lights. Each active port should have illuminated indicator. If cable connects, and that position has no lit indicator, check for cable continuity from hub to cabinet. 2. Assure that no loose wires catch in hinges, doors, or under cabinet. 3. Verify that linking cable connects to Network Board at each VGM's computer. 4. Verify that each linking cable operates properly by placing it in working VGM.
<ul style="list-style-type: none"> • Some VGMs in group link properly, while others don't 	Improper hub switch setting	<ol style="list-style-type: none"> 1. Assure that switches on hub are set correctly according to Hub Link Kit instructions. (Networked cabinets don't require couplers. Hub has electronic crossover.) 2. Inspect hub indicator lights for link activity. See manufacturer's literature for diagnostics.
	Wrong software version	Verify that all linked cabinets use same software version. Otherwise, linked cabinets won't recognize each other. Contact your distributor.
	Faulty wiring <i>(2 cabinets)</i>	<ol style="list-style-type: none"> 1. Insert crossover connections between coupled cabinets. Standard couplers appear identical to devices supplied with cabinets, but don't include internal crossover. 2. Verify that each linking crossover coupler operates properly by placing it in working link between two cabinets.
	Faulty wiring <i>(3 or more cabinets)</i>	<ol style="list-style-type: none"> 1. You used additional crossover connector and cable to extend VGM or hub link connection. Two crossovers cancel and cause same problem as no link crossover. 2. Connect cables directly to hub. Don't use crossover coupler and hub together in single network. 3. Separate communications wiring from other wiring. Wires that must cross should cross at right angles to limit noise pickup.

Player Control Troubleshooting Table

SYMPTOM	CAUSE	REQUIRED ACTION
<ul style="list-style-type: none"> • Intermittent or completely non-functional player controls • VGM (<i>video game machine</i>) starts normally. 	Faulty switches or lamps	<ol style="list-style-type: none"> 1. Enter Menu System by pressing and holding TEST MODE switch inside coin door. From Diagnostic Menu, choose SWITCH TEST. Run tests to confirm switch operation. 2. Check for loose parts or wires caught in switch contacts. 3. Check continuity at each switch connection (Common to Normally Open or Common to Normally Closed). 4. Verify that control operates properly by placing it in working VGM. 5. Verify that dashboard switch light bulbs are type specified in parts listing. Other types light, but may produce too much heat. Eventually excess heat may cause switches to bind.
	Faulty switch wiring	<ol style="list-style-type: none"> 1. Check for wires caught in door hinges, latches, or switch contacts. 2. Verify that harness connectors are attached and fully seated. 3. Assure that control switches connect properly to control input wires. 4. Check that cabinet wiring is correct for this VGM.
• Steering pulls to one side	Faulty Wheel Driver Board	Find power amp on Wheel Driver Board's large heatsink. Test and replace bad part or board.

How to Adjust Belt Tightness

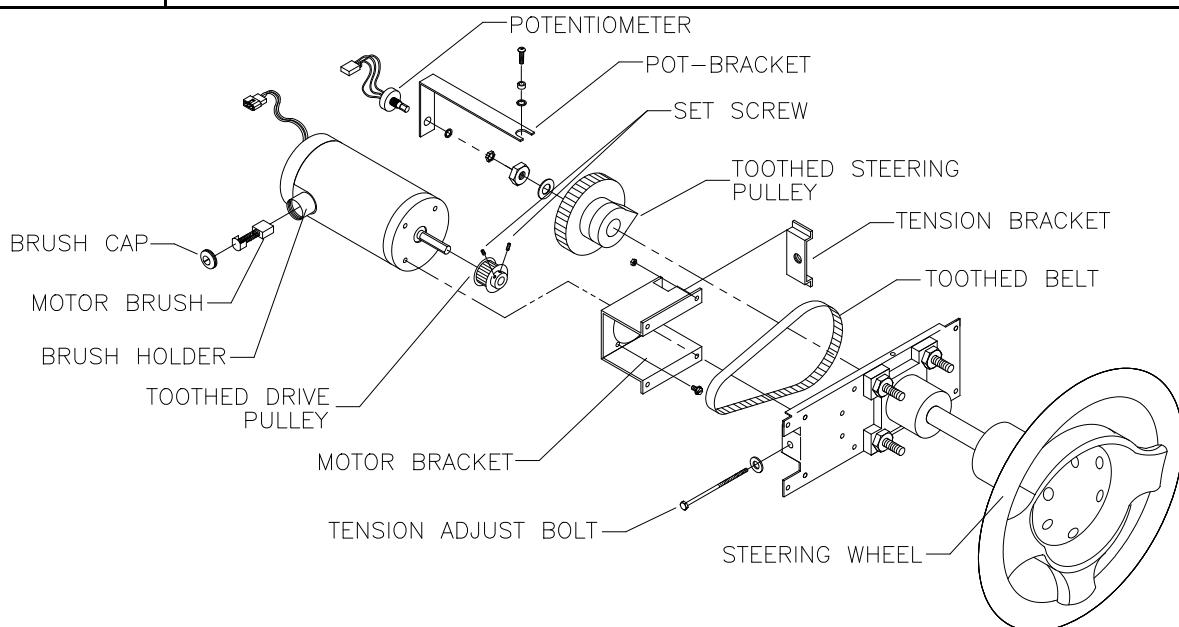
Player Control Troubleshooting Table, *continued*

SYMPTOM	CAUSE	REQUIRED ACTION
<ul style="list-style-type: none"> Sloppy, unpredictable or ineffective steering Video appears on screen VGM (<i>video game machine</i>) starts normally 	<p>Blocked or faulty fan</p> <p>Faulty mechanical parts</p>	<p>With VGM power on, check airflow near each computer fan. Case cooling fans are intake fans. Power supply fan is exhaust fan. Assure that nothing blocks airflow.</p> <p>Turn off VGM power. Open dashboard. Support steering wheel and remove outer mounting screws. Remove metal shield (if your VGM has one) over motor. Inspect for faulty or worn belts, bearings, couplings, gears, etc.</p>
	Faulty Wheel Driver Board	<ol style="list-style-type: none"> Inspect Wheel Driver Board under low-light conditions. LEDs glow if motor driver circuits receive AC power from transformer. (Voltages or signals may or may not be normal.) Examine fuses and cables on Wheel Driver Board. Replace bad fuses. Using digital voltmeter, verify AC voltage between each fuse holder and ground. You should measure approximately 25V. See Wiring Diagram. Using 20 VAC setting on digital voltmeter, measure DC voltage at motor. <i>Don't move steering wheel, drive belt, or motor while making this measurement.</i> Any reading indicates unstable supply that may contain ripple or noise. Verify proper operation of Wheel Driver Board by placing it in working VGM.
	Loose or worn drive belt	<ol style="list-style-type: none"> Turn off VGM power. Open dashboard. Support steering wheel and remove outer mounting screws. Remove metal shield (if your VGM has one) over motor. Inspect for faulty or worn belts, bearings, couplings, gears, etc. If drive belt isn't worn or damaged, check its tightness.
<ul style="list-style-type: none"> No wheel feedback Steering aims vehicle as expected 	<p>Improperly set feedback</p> <p>Faulty circuit</p> <p>Faulty motor</p>	<ol style="list-style-type: none"> From Diagnostics Menu, choose FORCE FEEDBACK ADJUSTMENT. Set feedback to match player requirements. Maximum force may be too extreme for very young or inexperienced customers. <ol style="list-style-type: none"> Examine fuses and cables on Wheel Driver Board. Check cables and wiring between computer, interface, driver and motor. Check resistance of motor series resistors Replace bad parts. <ol style="list-style-type: none"> Turn off VGM power. Open dashboard. Support steering wheel and remove outer mounting screws. Remove metal shield (if your VGM has one) over motor. Unscrew caps. Inspect motor brushes. Replace worn parts.

Player Panel Controls



WARNING: The Wheel Driver Board heatsink, power resistors, and other components may be very hot. The DC Motor in the steering wheel may also be hot.

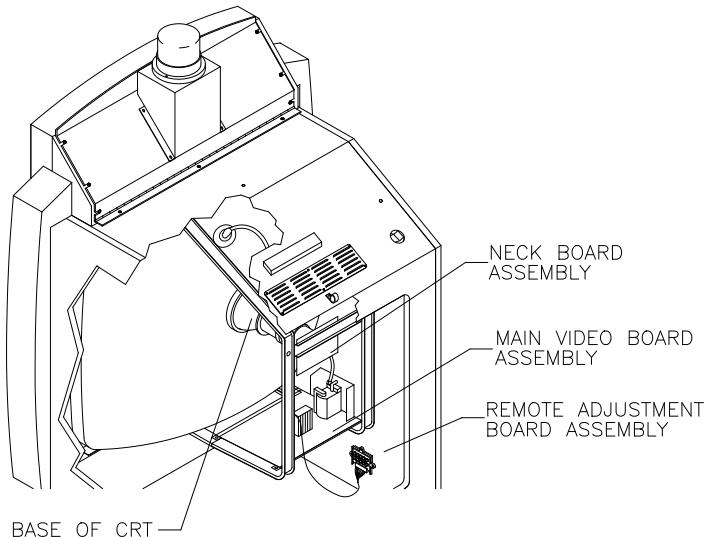


Steering Components

Video Troubleshooting Table

SYMPTOM	CAUSE	REQUIRED ACTION
<ul style="list-style-type: none"> Monitor appears non-functional Audio is present VGM (<i>video game machine</i>) controls operate normally 	Power problem	Verify connection of AC Power to video monitor. Inspect CRT neck in dim light. Glowing filament near CRT base proves that some monitor circuits receive power. Still, voltages or signals may not be normal.
	Faulty wiring	<ol style="list-style-type: none"> Turn off VGM power. Verify that video signal and Remote Adjustment Board connectors seat properly on Video Monitor Board. Assure that video cables connect to circuit boards and computer. Assure that no wires are caught on chassis or mounting brackets.
	Improper monitor adjustments	Check that BRIGHTNESS (intensity) and CONTRAST are set above their minimum levels.
	Faulty monitor circuitry	<ol style="list-style-type: none"> Examine AC line fuse on Video Monitor Board. If fuse is faulty, replace it with identical fuse. If fuse is good: Verify that video monitor operates correctly by placing it in working VGM. If monitor is bad: Check monitor power supply. If power supply is good: Check monitor horizontal output transistor and related circuitry.

	WARNING: HIGH VOLTAGE. VGM (<i>video game machine</i>) monitors generate and store potentially lethal high voltages. Avoid touching any part of the monitor until power has been off for some time. A picture tube can maintain a hazardous charge for up to several days. Only qualified technicians should service monitors. Turn off the power, unplug the VGM and discharge the CRT before attempting service. Even properly discharged tubes can revert to a highly charged state, <i>without reapplication of power</i> .
	WARNING: In normal operation, the monitor doesn't require isolation from AC line voltage. During bench servicing, you may need to operate the monitor outside the cabinet. If you do, <i>isolate the monitor from line voltage with an isolation transformer</i> .



Typical Cutaway Rear View

Video Troubleshooting Table, *continued*

SYMPTOM	CAUSE	REQUIRED ACTION
<ul style="list-style-type: none"> • Game doesn't appear • No audio • Power-up self-test runs 	Floppy disk in drive	Check floppy drive for diskette. If you find disk, eject it. Leave VGM (<i>video game machine</i>) power on. Turn off computer. Wait for hard disk to stop spinning. Turn on computer.
	Faulty wiring	Loosen computer case lid thumbscrews and lift off cover. Assure that hard drive ribbon cable connector is fully seated into mating connector on motherboard. Check hard drive power cable.
	Improper components	<ol style="list-style-type: none"> 1. Verify that hard disk drive is correct for this VGM. Label on drive records manufacturer name, assembly number and program version. 2. Verify that circuit boards are correct for this VGM. Label on each board records manufacturer name, assembly number and hardware version.
	Hard drive problems	<ol style="list-style-type: none"> 1. Turn computer on. Immediately look <i>under</i> hard drive. Hard Drive Activity LED flashes if drive is operating properly. 2. Allow software to load normally. Note and record any error messages that occur during self-test. 3. Remove hard drive and install it in working VGM. If symptom recurs there, hard drive is faulty. Replace it.
<ul style="list-style-type: none"> • Blotches of color appear on screen 	Picture tube aperture mask is magnetized	Remove diskettes from room. Demagnetize monitor with external degaussing coil. Take care not to magnetize neighboring VGMs. Monitor may be on or off for this procedure.
<ul style="list-style-type: none"> • White areas in center of screen appear tinged with color • Object edges have fringe of one or more colors 	Picture tube purity or static convergence is out of alignment	<ol style="list-style-type: none"> 1. Turn on VGM. 2. Press and hold TEST MODE to enter Menu System. At Operator (Main) Menu, select Diagnostic Menu. Then select Monitor Patterns Menu. Run through Crosshatch, Red, Green and Blue screens to find clearest display of problem. 3. Display screen with greatest problem. 4. Display Crosshatch Screen. Locate purity and static convergence ring magnets on back of monitor neck. Watch screen in mirror. Adjust magnets to minimize problem. Follow instructions from monitor manufacturer. 5. Display Crosshatch Screen. Touch up adjustments while watching screen in mirror.

	CAUTION: Don't operate the monitor without its Remote Adjustment Board.
	WARNING: HANDLE FLUORESCENT TUBE AND CRT WITH CARE. If you drop a fluorescent tube or CRT and it breaks, it will implode! Shattered glass can fly eight feet or more from the implosion.

Video Troubleshooting Table, *continued*

SYMPTOM	CAUSE	REQUIRED ACTION
<ul style="list-style-type: none"> White areas at screen edges appear tinged with color Dots at screen edges appear ovoid or cylindrical 	Picture tube dynamic convergence is out of alignment	Have service bureau dynamically reconverge monitor. This procedure requires removing and repositioning yoke. Service bureau must follow instructions from monitor manufacturer.
<ul style="list-style-type: none"> Video tears or rolls, or has black bar down middle of screen 	Faulty wiring	<ol style="list-style-type: none"> Check connectors and cables for wiring continuity. Video cables connect computer to circuit boards, and then to video monitor. Assure connection of all cabinet ground wires, especially at video monitor chassis.
	Faulty monitor circuitry	<ol style="list-style-type: none"> Verify that video monitor operates correctly by connecting it to working VGM. Assure that video monitor is correct type for this VGM. Video monitors with wrong resolution can't lock sync.
	Improper sync signals	<ol style="list-style-type: none"> Check to see if Video Board puts out type of sync that your monitor requires. Verify that jumpers are set correctly for monitor. If necessary, add or remove video sync jumper at MagicBus Board jumper block JP4. With no pins connected (or pins 2 and 3 connected), board outputs positive sync. With pins 1 and 2 connected, board outputs negative sync.
	Electromagnetic fields	Move cabinet far away from machines, appliances, or VGMS (<i>video game machines</i>).
<ul style="list-style-type: none"> Missing colors 	Faulty wiring	Check connectors and cables for wiring continuity from circuit boards to video monitor.
	Faulty monitor color drive circuitry	Verify that video monitor operates correctly by connecting it to working VGM.
<ul style="list-style-type: none"> One color is dimmer or brighter than others Whites appear tinted everywhere on screen 	Maladjusted color bias pots	<ol style="list-style-type: none"> Turn on VGM. Enter Monitor Patterns Menu. Watch Color Bars screen in mirror. Adjust three bias pots for best colors. (Most monitor neck boards include these pots.) Also check White Screen. Touch up controls. If whites still seem tinted, have service bureau rejuvenate picture tube.
<ul style="list-style-type: none"> Picture is dim or faded 	Maladjusted BRIGHTNESS pot or subnormal picture tube emission	<ol style="list-style-type: none"> Watch Color Bars screen. Adjust BRIGHTNESS and CONTRAST pots for greatest number of grays. You'll find these pots on Monitor Remote Control Board, behind coin door. If pots have no effect, have service bureau rejuvenate picture tube.
<ul style="list-style-type: none"> Picture is too narrow 	Maladjusted WIDTH pot	Enter Monitor Patterns Menu. Watch Crosshatch Screen while adjusting WIDTH pot for best picture. You'll find this pot on Monitor Remote Control Board, behind coin door.

Video Troubleshooting Table, *continued*

SYMPTOM	CAUSE	REQUIRED ACTION
• Picture is too short	Maladjusted HEIGHT pot or damaged vertical circuit	1. Enter Monitor Patterns Menu. Watch Crosshatch Screen while adjusting HEIGHT pot for best picture. You'll find this pot on Monitor Remote Control Board, behind coin door. 2. If pot has no effect, service vertical output circuit.
• Picture seems shifted to one side	Maladjusted HORIZONTAL POSITION pot	Enter Monitor Patterns Menu. Watch Crosshatch Screen while adjusting HORIZONTAL POSITION pot for best picture. You'll find this pot on Monitor Remote Control Board, behind coin door.
• Keystone-shaped picture	Shorted turns in yoke	1. Substitute working yoke. 2. Have service bureau converge monitor. 3. Retest monitor.

Software Update Troubleshooting Table

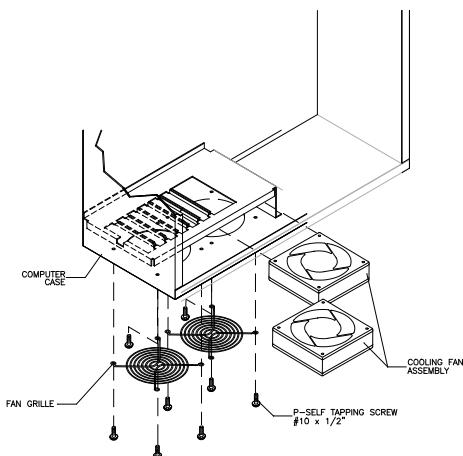
SYMPTOM	CAUSE	REQUIRED ACTION
• Update didn't work • After update procedure, screen reports lower than latest version	You skipped steps or performed them out of sequence.	Return update components to kit, reinstall original parts in cabinet, and try process again.
	You connected linked VGMs to cabinet being updated.	1. Network communication circuits may have prevented full update. Turn off power to all connected cabinets. 2. Perform update on one cabinet at time. If power is off, you need not disconnect linking cables.
	Installation error may have damaged device.	1. Inspect for bent or broken pins. 2. If you have another kit, try it. 3. Ask your distributor to check your floppy disk.



NOTICE: Someday, software updates for your VGM (*video game machine*) might become available. These upgrades may improve your VGM's performance or add new features. Such upgrades tend to appear sometime after factory first releases a VGM. Contact your distributor for information about updates.

Miscellaneous Problem Troubleshooting Table

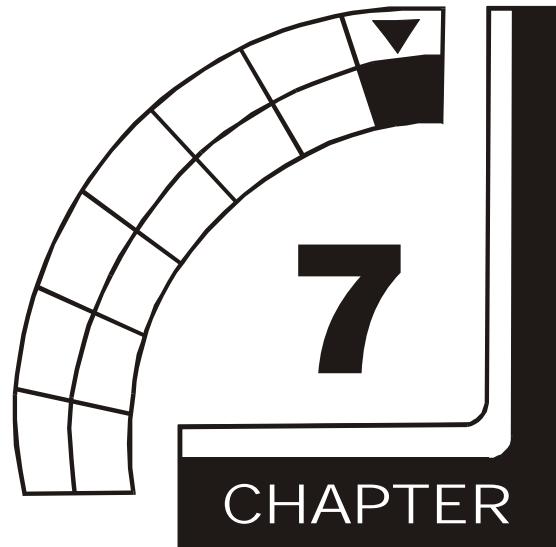
SYMPTOM	CAUSE	REQUIRED ACTION
<ul style="list-style-type: none"> • Marquee lamp is intermittent or non-functional • VGM (<i>video game machine</i>) starts and plays normally 	Faulty fluorescent tube	<ol style="list-style-type: none"> 1. Remove fluorescent tube from its sockets. If you find cracks or darkened ends, install new lamp. Clean tube. 2. Check continuity of both fluorescent tube filaments. 3. Verify that fluorescent tube operates by placing it in working VGM.
	Faulty lamp fixture	Verify that lamp pins make good connection with socket contacts.
	Faulty wiring	Measure fluorescent lamp AC voltages. Check wiring and connector continuity from AC power chassis to lamp assembly.
<ul style="list-style-type: none"> • VGM operates normally • Cabinet becomes warm after several hours of use 	Obstructed fan	<ol style="list-style-type: none"> 1. Check bottom and rear of cabinet for blocked airflow. 2. Move VGM away from sources of heat. 3. Turn off VGM power. Remove dust from vent holes with high-power vacuum cleaner.
	Faulty wiring	Check fan wiring and connectors.
	Faulty fan	Check operation of all fans.
• Error messages appear on screen	Faulty hardware	<ol style="list-style-type: none"> 1. Check any assembly (RAM, ROM, Battery, etc.) identified in error messages. 2. Call your authorized distributor for help with unresolved screen messages.



Fan Location and Mounting

OFFROAD

THUNDER™

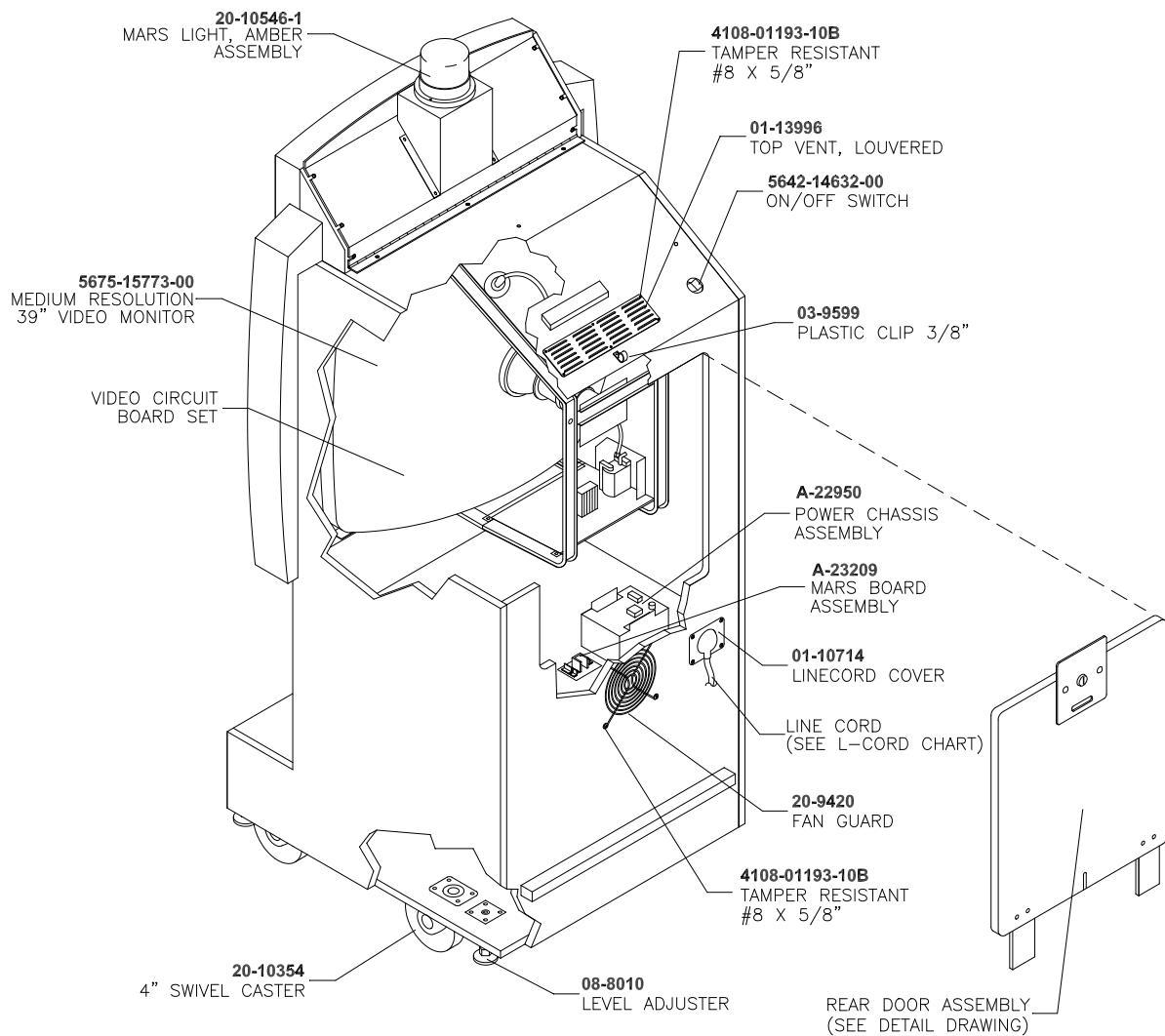


PARTS

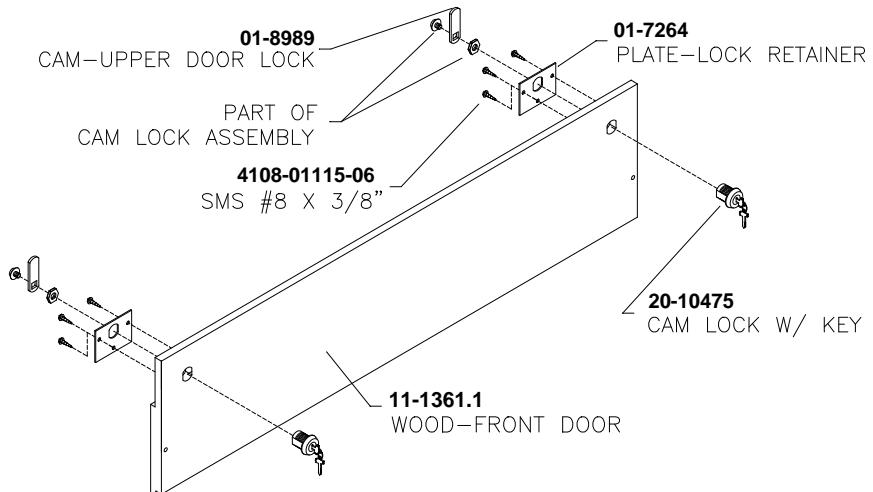
A triangular warning icon containing a large exclamation mark.	<p>WARNING: Use of non-Midway parts or circuit modifications may cause serious injury or equipment damage! Use only Midway authorized parts.</p> <p>For safety and reliability, don't substitute parts or modify Midway products. Substitute parts or modifications may void the game's EMC directive or FCC type acceptance.</p>
A hand icon pointing to the right.	<p>NOTICE: The term VGM refers to the video game machine.</p>

Cabinet Front View

Cabinet Rear View



Front Access Door Assembly A-23055

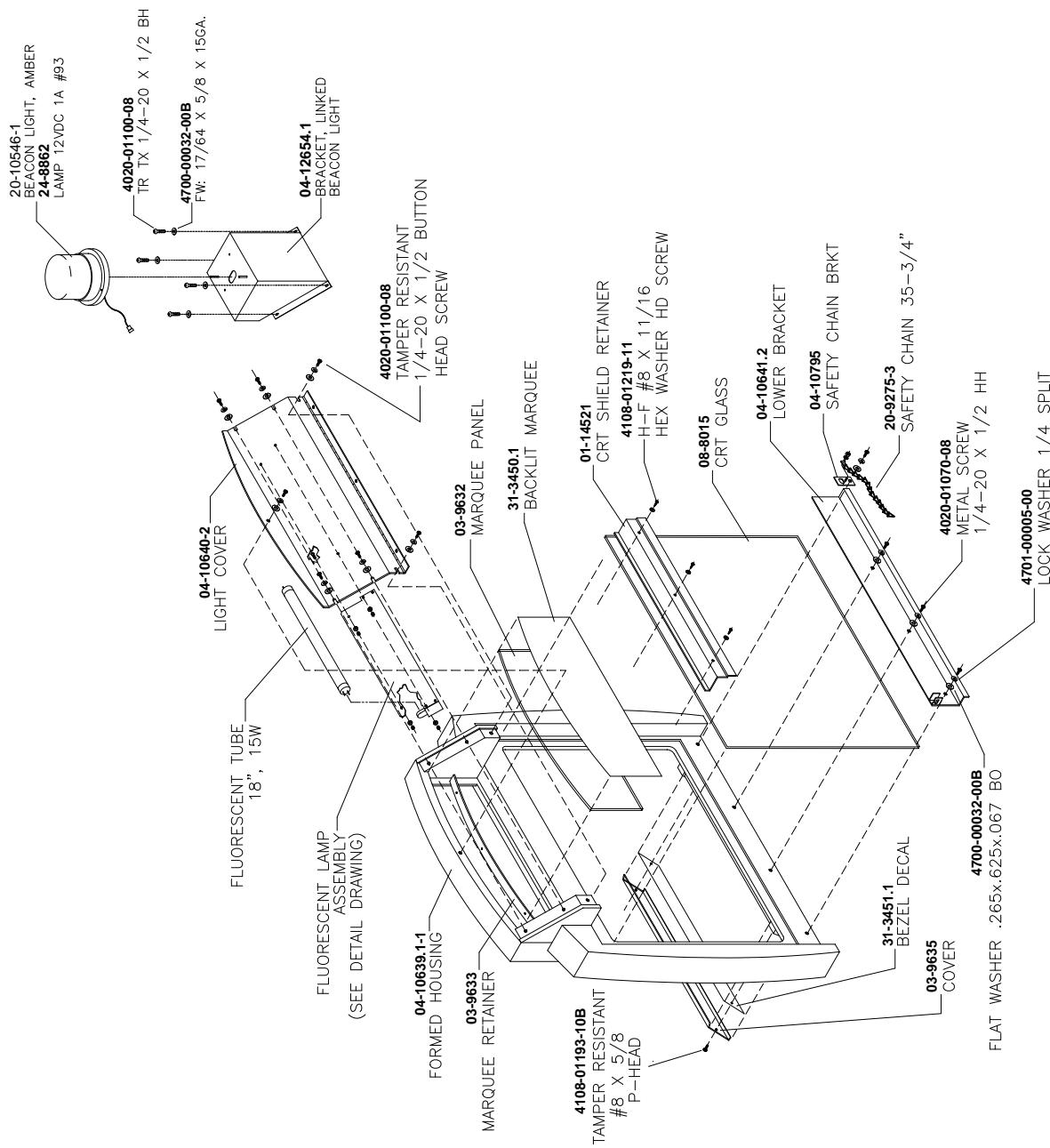


Cabinet Joining Details

Casters and Levelers

Rear Door Assembly A-23058

Monitor Bezel Assembly A-23361



Padlock

Coin Door Assembly

(See Coin Door Application Table for Assembly Number)

Pushbutton Assembly

20-9663-XX

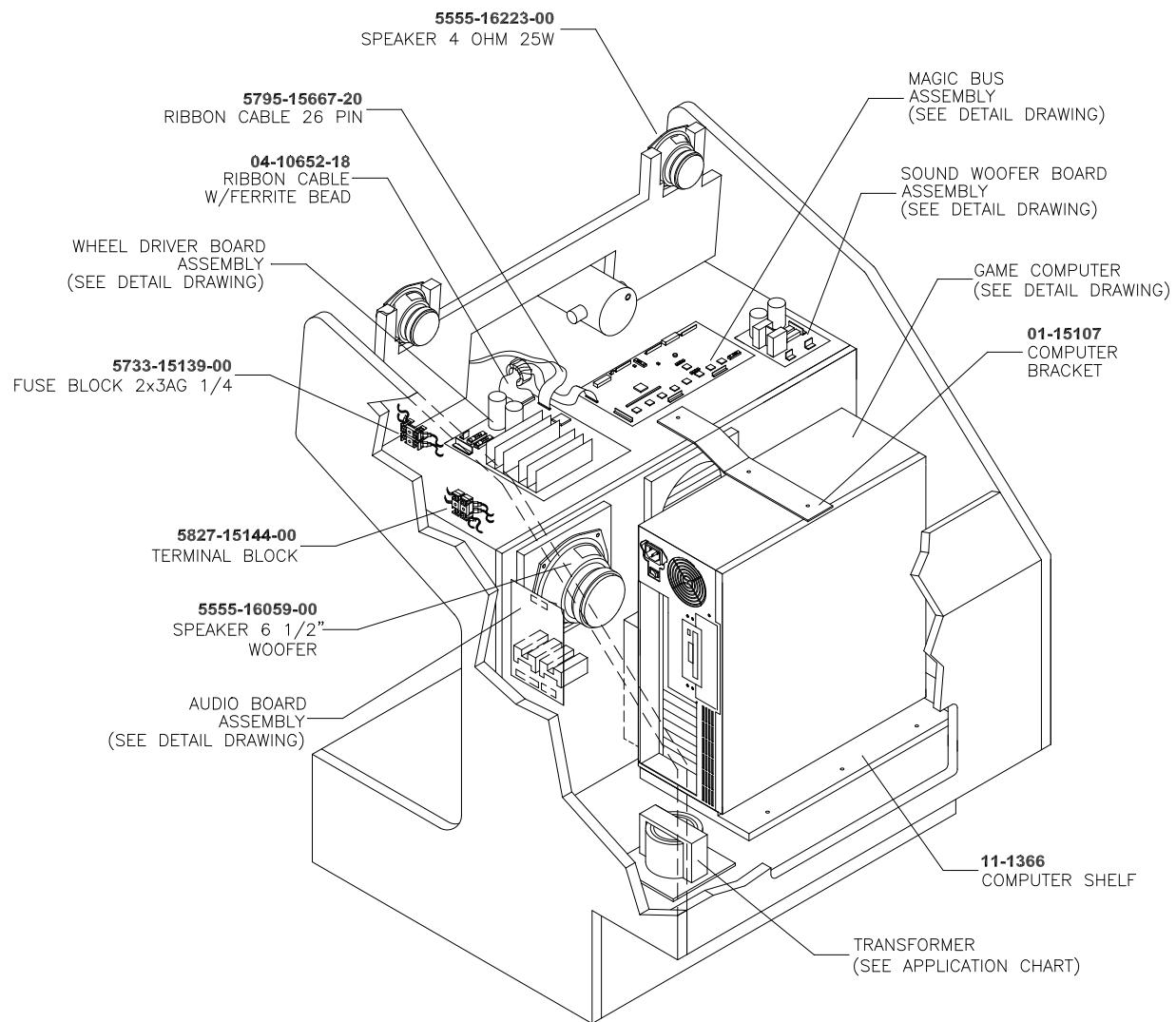
20-10129-5

Dash Assembly A-23365 (*Assembled*)

Dash Assembly A-23365 (*Exploded*)

**Optional Bill Validator
(MARS AE 2451-U3E)**

Dash Cabinet Assembly A-23357

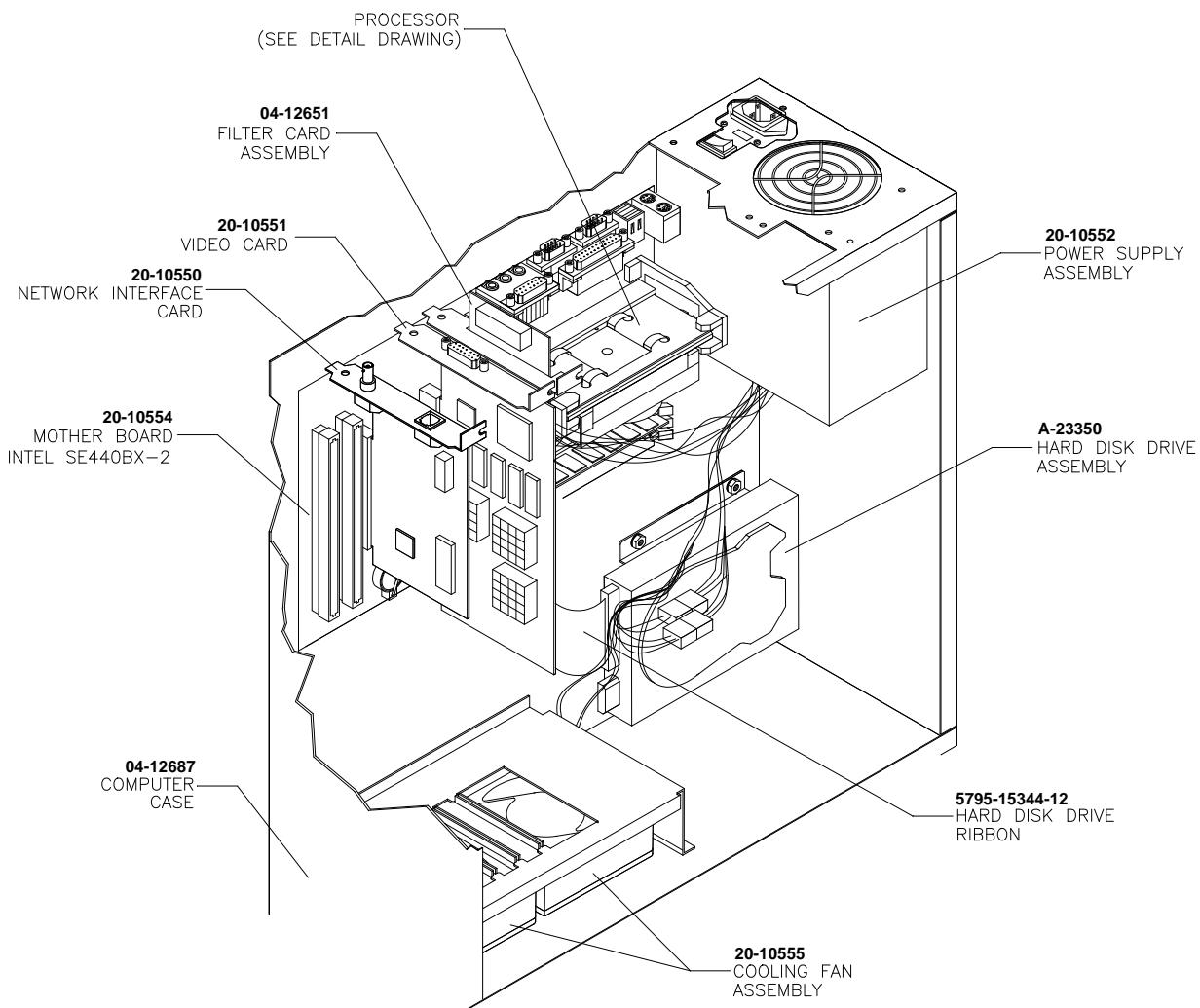


Seat and Pedestal Assembly A-23231

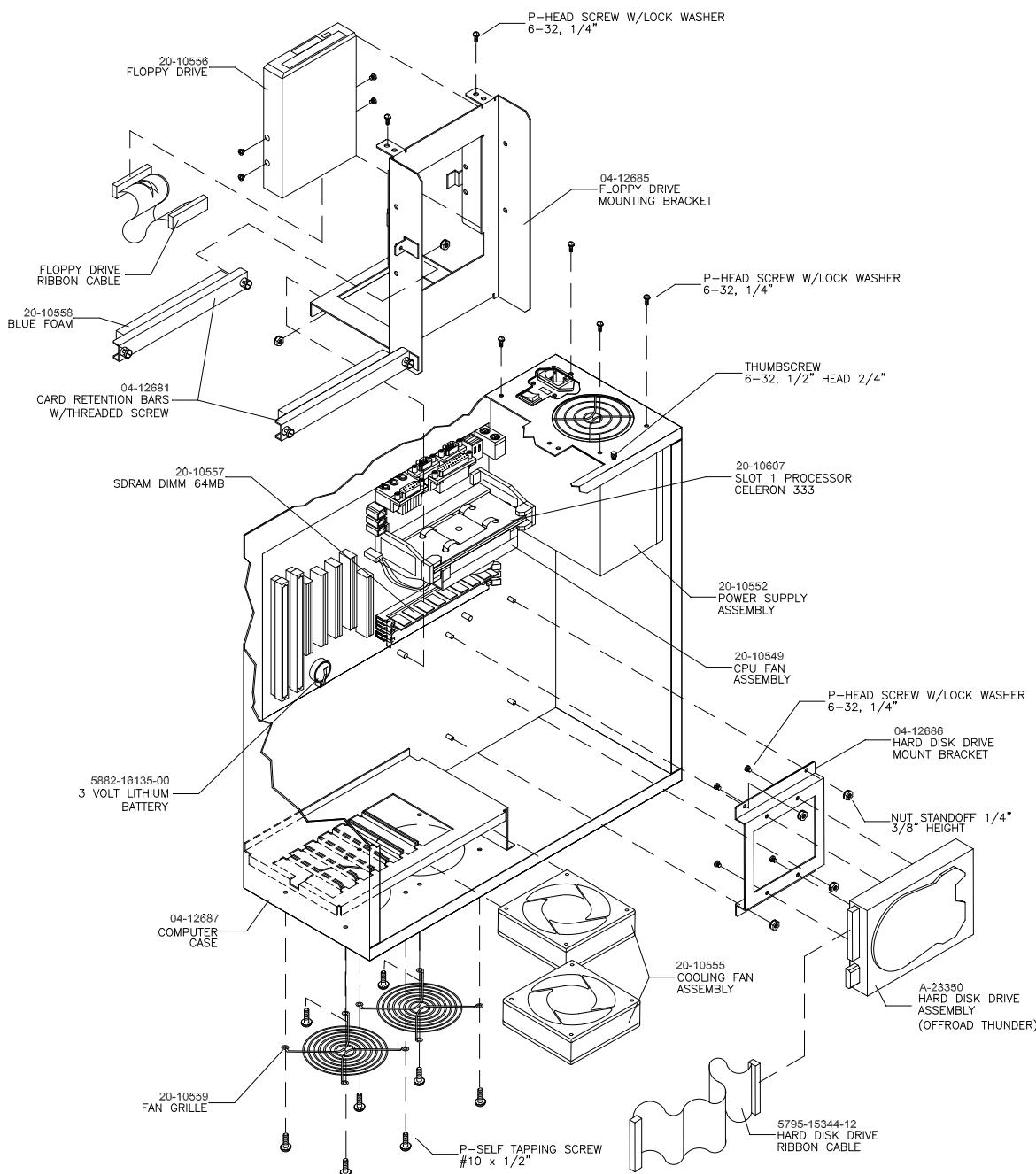
Throttle Assembly 20-10135

Fluorescent Lamp Assembly A-22506

Arcade Computer Assembly 04-12758.3



Arcade Computer Mechanical Components



Arcade Computer Cables

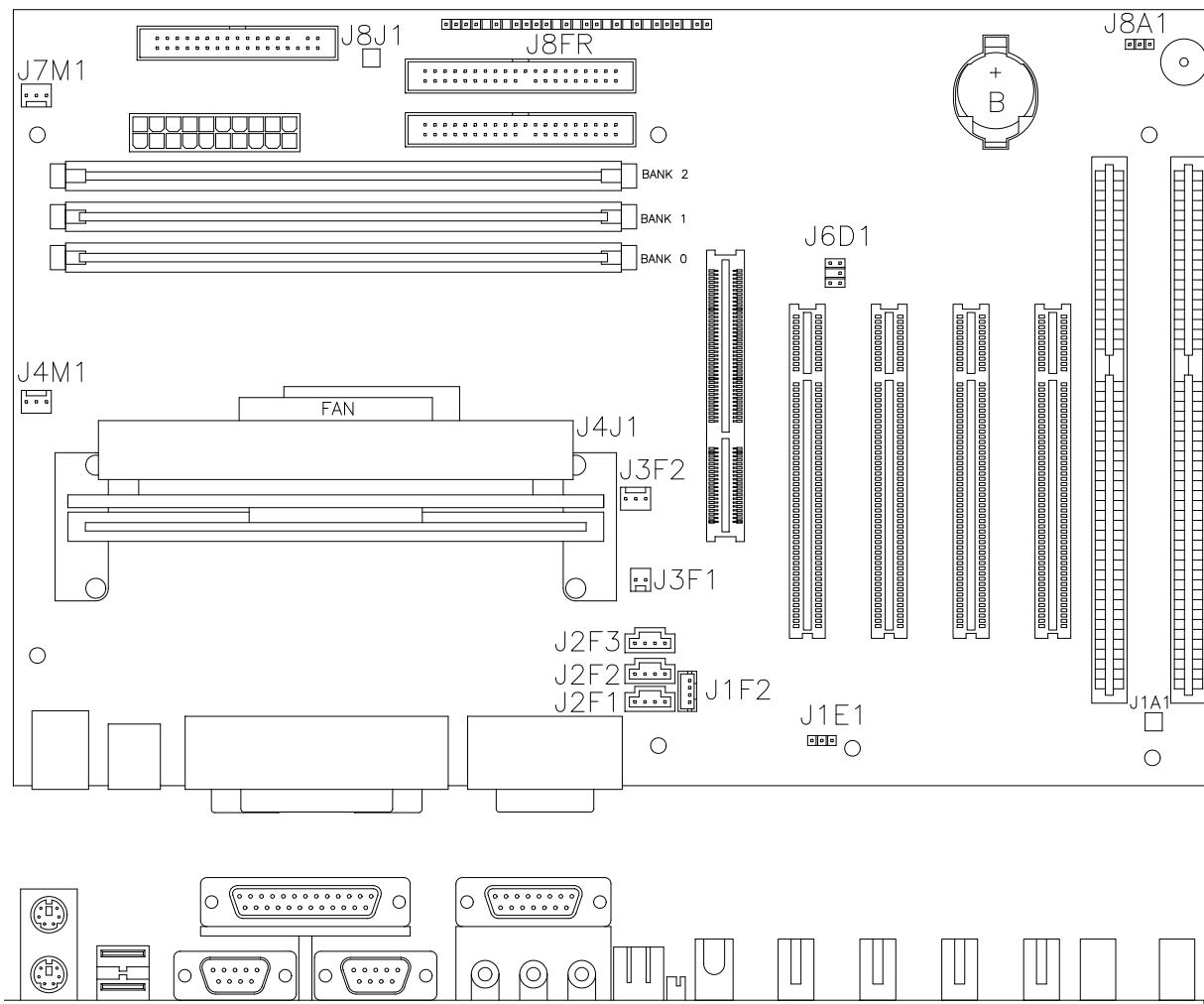


NOTICE: DC power cables are part of the power supply. You can't replace these cables individually.

Arcade Computer Electronic Components

	NOTICE: Many stock computers use a motherboard that resembles this one. Still, a standard motherboard won't function correctly in this video game machine. Operation in this VGM also requires a custom operating system.
	NOTICE: Before attempting to use other than factory authorized parts, ask your distributor for information. Other DIMM and processor modules may be equivalent or superior to those illustrated here. Yet Midway hasn't verified performance with alternate components.
	NOTICE: Celeron and Slot 1 are registered trademarks of Intel.

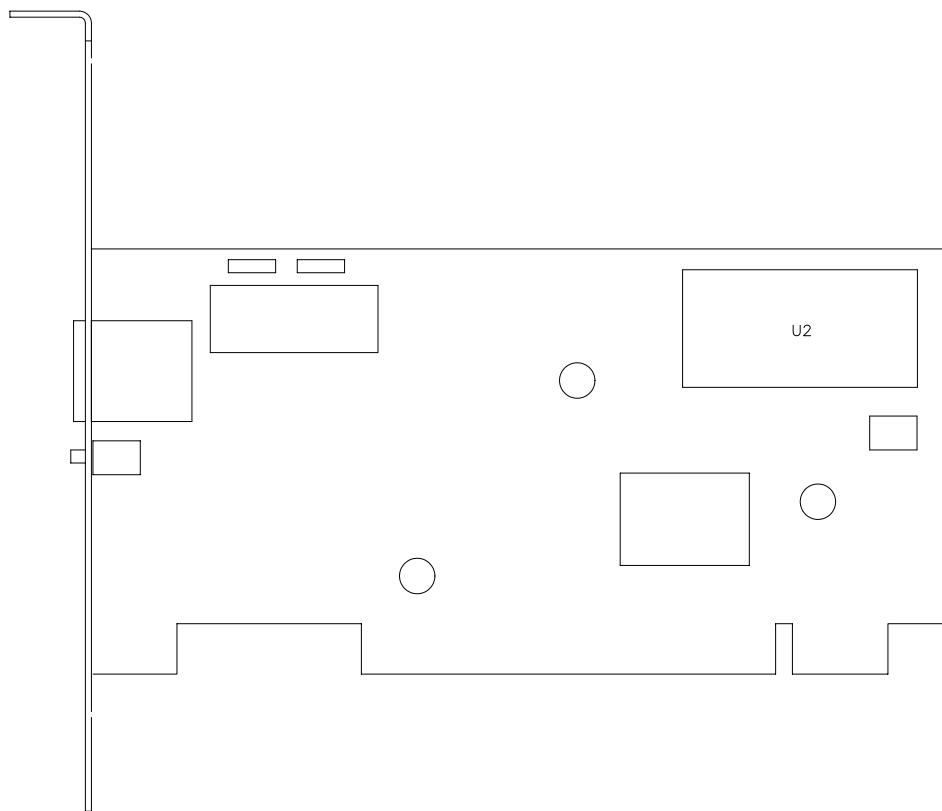
Computer Motherboard Assembly 20-10554



Field Replaceable Parts

Component	Description	Board Location	Part Number
Dual Inline Memory Module	64MB SDRAM DIMM	BANK 0-1-2	20-10557
Memory Backup	3-Volt Lithium Battery	B	5882-16135-00
Processor Assembly	Celeron Processor	J4J1	20-10607
Processor Cooling	Fan with Bracket	FAN	20-10549
Shunt Jumper	BIOS Startup Configuration	J8A1	5882-13046-00

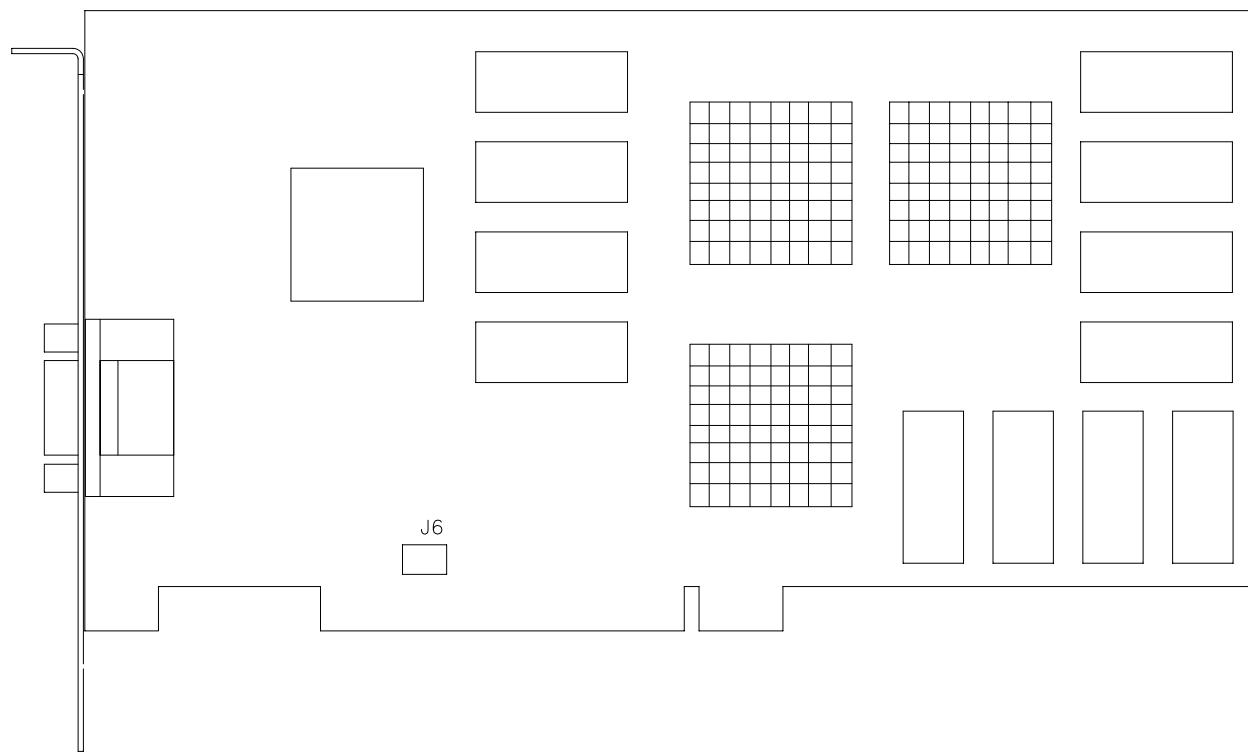
Network Interface Card Assembly 20-10550



Field Replaceable Parts

Component	Description	Board Location	Part Number
Instruction ROM	Not required in this game	U2	--

Video Graphics Card Assembly 20-10551



Field Replaceable Parts

Component	Description	Board Location	Part Number
Graphics Mode Select	Not required in this game	J6	--

Filter Card Assembly 04-12651

Field Replaceable Parts

Component	Description	Board Location	Part Number
EMI Filter	2200 pF Dual Capacitor	F1-F5	5060-15633-00
EMI Filter	Ferrite Bead Inductor	L1-L5	5556-14181-00

BB12 Audio Amp Board Assembly 04-12529.1

Field Replaceable Parts

Component	Description	Board Location	Part Number
Audio Amplifier	LM3403 Quad Amplifier	U1-U2	5370-15163-00
Audio Output	TDA1560Q Power Amplifier	U3	5370-15984-00
Audio Output	TDA7375 Power Amplifier	U4	5370-15833-00
Voltage Regulator	+5VDC, 5% Fixed Regulator	U5	5250-13302-00
None	Not required in this game	U6	--

Sub-Woofer Driver Board Assembly 04-11128-1

Field Replaceable Parts

Component	Description	Board Location	Part Number
Amplifier , Power	IC, TDA 2030AV, 18W	U1	5370-13419-00
Fuse	5 x 20mm, T2,.5A/250V	F1, F2	5731-14532-00
Preamplifier	TL084 Op Amp	U2	5370-12730-00
Regulator, Voltage	78L05, 5VDC	Q1	5250-13302-00
Regulator, Voltage	79L05, -5VDC	Q2	5250-13303-00

MagicBus™ Interface Board Assembly 04-12697.3

Field Replaceable Parts

Component	Description	Board Location	Part Number
Crystal	6 MHz	Y2	5520-16004-00
Diode	1N270	D11-15, D17-25, D28	5070-16229-00
Diode	1N5817, 1A	D2	5070-09266-00
Fuse	5 x 20mm, 2ASB	F1	5735-13853-00
Jumper	2-Pin	JP1, JP2, JP3, JP4	5791-13045-00
Transistor	2N2369 NPN	Q1	5190-15997-00
Transistor	2N3904 NPN	Q5-Q6	5160-14035-00
Transistor	ULN2064 NPN	Q3-Q4	5160-14035-00

Wheel Driver Board Assembly 04-12770.1

Field Replaceable Parts

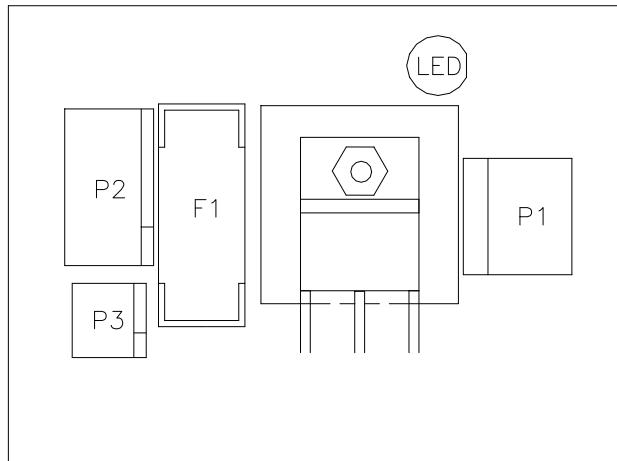
Component	Description	Board Location	Part Number
--	TO-92 Device	Q4	Not Used
Darlington	2N6427 NPN	Q1	5162-08976-00
Diode	Fast FE6B-35nS	D2, D3	5070-16272-00
Driver, Power	LM12 Op Amplifier	U5	5370-14069-00
Fuse	0.63AFB, 250V, 5x20mm	F3	5731-15627-00
Fuse	4ASB, 125V, 5x20mm	F1, F2	5731-14094-00
Pre-Driver	ULN2064B IC	U1, U2	5370-12602-00
Rectifier, Bridge	100V, 6A, SIP	BR1	5100-13945-01
Regulator, Voltage	78L15, 15VDC, TO-92	Q2	5250-15624-00
Regulator, Voltage	79L15, -15VDC, TO-92	Q3	5250-15625-00

Speedometer Board Assembly 04-12759.1

Field Replaceable Parts

Component	Description	Board Location	Part Number
LED	Green, Bright	LED1 - 6	5671-16256-00
LED	Orange, Bright	LED7 - 10	5671-15953-00
LED	Red, Bright	LED11 - 13	5671-15954-00

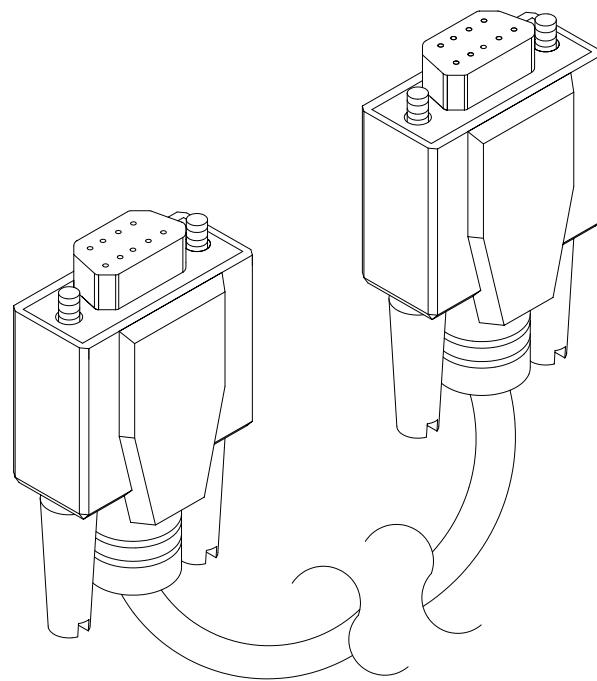
Mars Light Board Assembly A-23209



Field Replaceable Parts

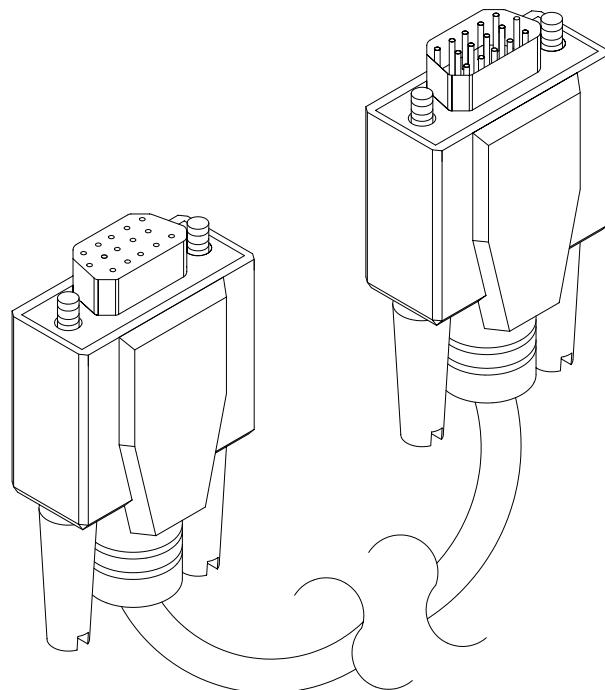
Component	Description	Board Location	Part Number
Fuse	5 x 20mm T2.5A/250V	F1	5731-14532-00
Transistor	TIP36C, PNP	Q1	5191-12179-00

Electronic Cable Assemblies



SERIAL COMMUNICATIONS CABLE (NULL MODEM DB-9F TO DB-9F)

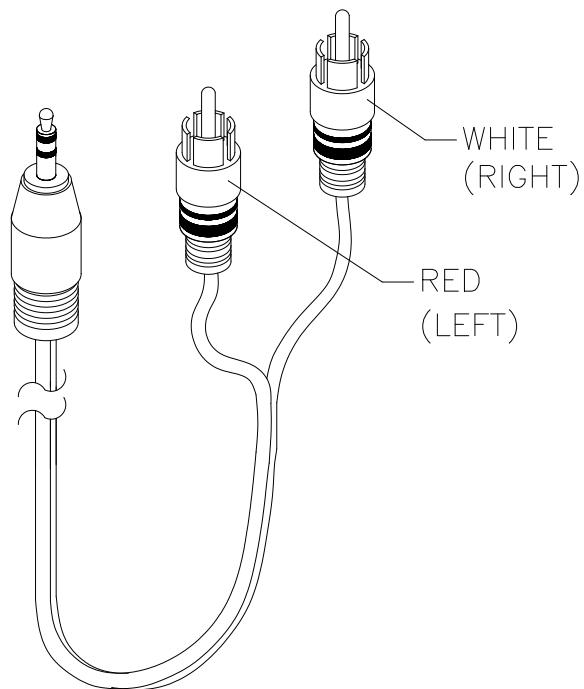
20-10532



VIDEO COMMUNICATIONS CABLE (SHIELDED DB-15F TO DB-15M)

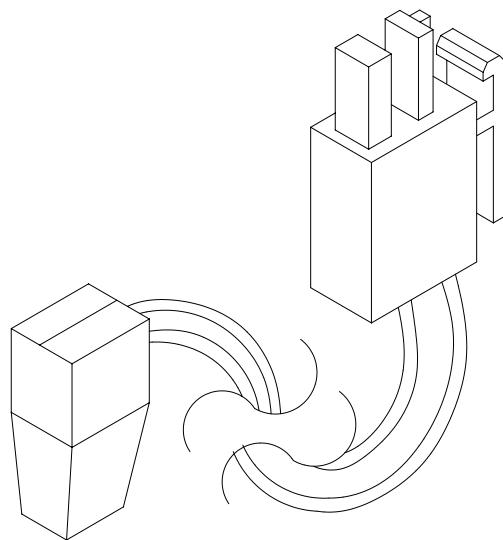
5797-13171-00

Electronic Cable Assemblies



AUDIO AMPLIFIER CABLE (SHIELDED, MINIATURE STEREO PHONE PLUG TO PHONO PLUGS)

04-12578-2

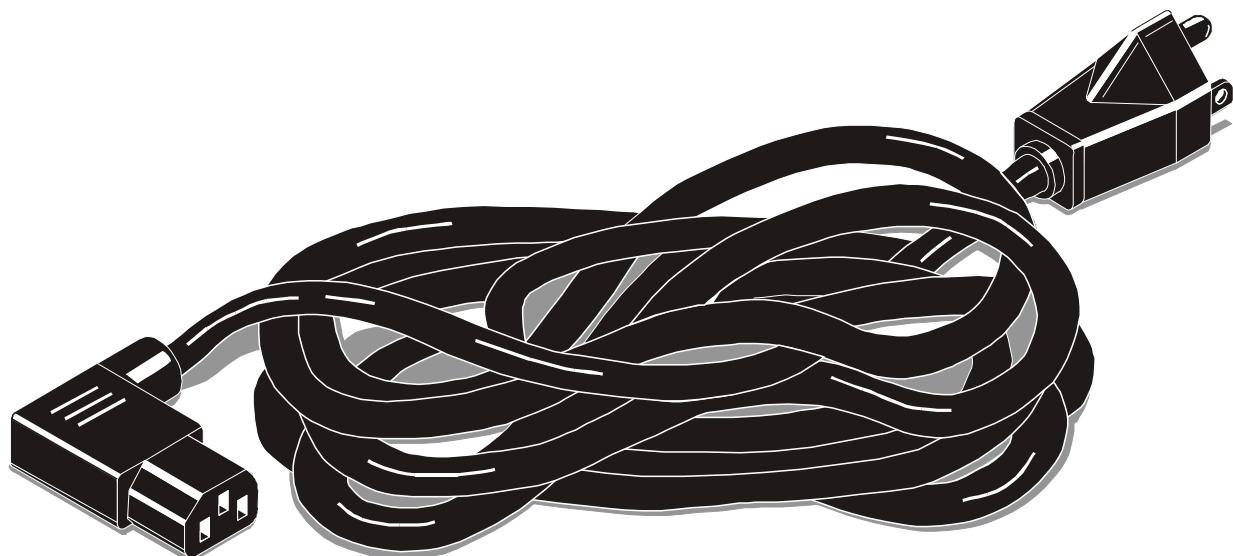


COMPUTER RESET CABLE (2-PIN PLUG TO LOCKING, 2-PIN PLUG)

04-12657

Line Cord Application Table

Part Number	5850-13271-00	5850-15521-00	5850-15521-02	5850-15521-03	5850-15521-06
Country					
France			■		
Germany			■		
Italy		■			
Japan					■
Spain			■		
UK				■	
USA	■				



TYPICAL LINE CORD

Coin Door Application Table

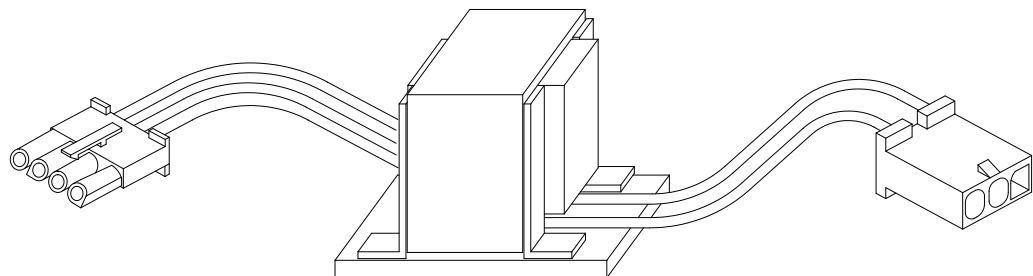
ELECTROMECHANICAL COIN DOOR ASSEMBLIES

Part Number \ Country	09-72000-14	09-72000-15	09-72000-20	09-96011.1	09-96023-33
France				■	
Germany				■	
Italy	■				
Japan		■			
Spain			■		
UK				■	
USA, DBV Ready					■

Transformer Application Table

POWER TRANSFORMER ASSEMBLIES

Part Number \ Line Power	5610-14927-00	5610-14926-01	5610-15275-00
120 VAC 60 HZ	■		
230 VAC 50HZ		■	
100 VAC 50HZ			■



TYPICAL POWER TRANSFORMER ASSEMBLY

WARNINGS & NOTICES

WARNING

- Use of non-Midway parts or circuit modifications may cause serious injury or equipment damage!
- Use only Midway authorized components and parts. Failure to do so will void your warranty and may result in incorrect or unsafe operation. Substitute parts or modifications may void the EMC directive or FCC type acceptance.
- Federal copyright, trademark and patent laws protect this game. Unauthorized modifications may be illegal under Federal law. The modification ban also applies to Midway game logos, designs, publications and assemblies. Moreover, facsimiles of Midway equipment (or any feature thereof) may be illegal under federal law, regardless of whether or not such facsimiles are manufactured with Midway Games Inc. components.

WARNING

Prevent shock hazard and assure proper game operation. Plug this game into a properly grounded outlet. Don't use a cheater plug to defeat the power cord's grounding pin. Don't cut off the ground pin.

WARNING

A small portion of the population has a condition which may cause epileptic seizures or momentary loss of consciousness when viewing certain kinds of flashing lights or patterns that are present in our daily environment. These persons experience seizures while watching some television pictures or playing certain video games. People who have not had seizures may nonetheless have an undetected epileptic condition.

If anyone in your family has experienced symptoms linked to an epileptic condition (e.g., seizures or loss of awareness), consult your physician before using video games.

Parents should observe their children while they play video games. If you or your child experience the following symptoms: dizziness, altered vision, eye or muscle twitching, involuntary movements, loss of awareness, disorientation, or convulsions, *discontinue use immediately* and consult your physician.

NOTICE

This video game machine was tested. It complies with limits for a Class A digital device, under FCC Rules, Part 15. These limits provide reasonable protection against harmful interference when the equipment operates in a commercial environment. This equipment generates, uses and can radiate radio frequency energy. If not installed and used according to the instruction manual, this equipment may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference. If interference occurs, the user must correct it at his own expense.

NOTICE

When Midway Games Inc. ships a game, it complies with FCC regulations. Your FCC label is proof of compliance. Legal repercussions to the owner or distributor may result if the label is missing or damaged. If your game does not contain an FCC compliance label, call Midway Games Inc. immediately.

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3401 N. CALIFORNIA AVE.
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