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TM-136
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LUNAR LANDERTM

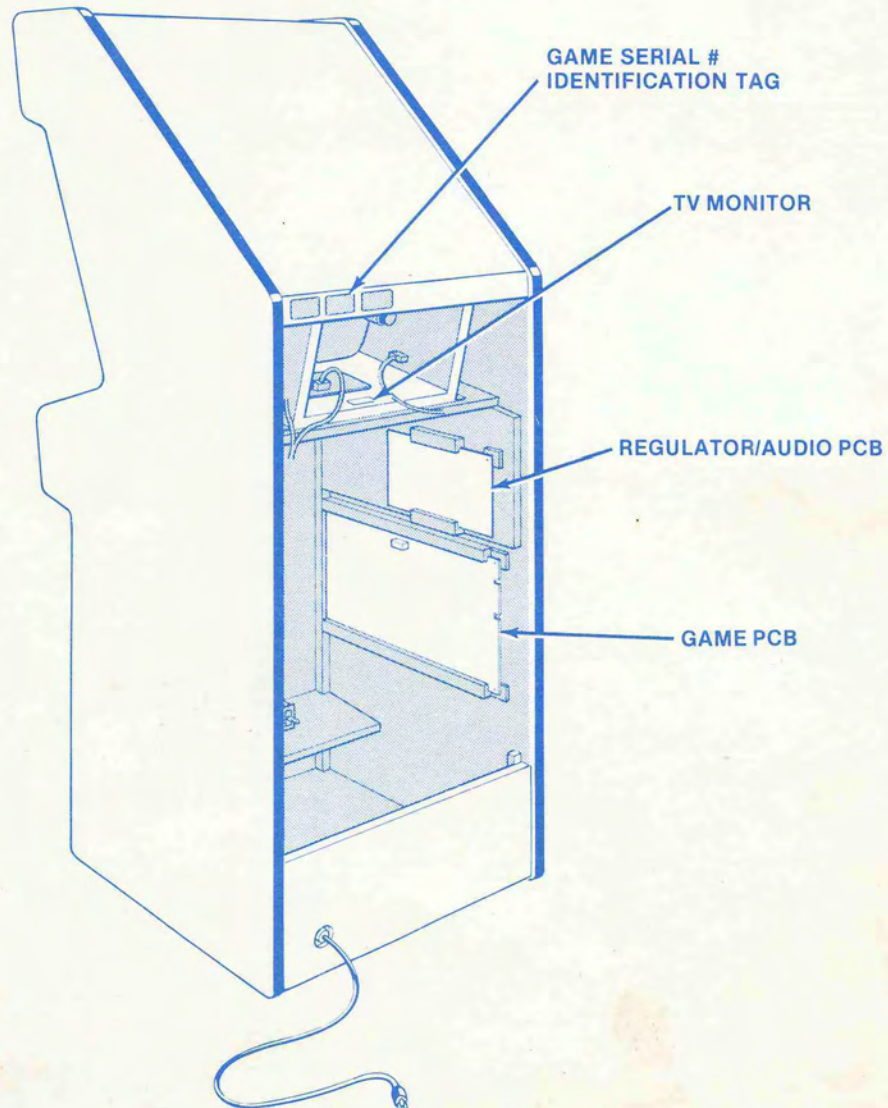
Operation, Maintenance and Service Manual

Complete with Illustrated Parts Catalog



GAME SERIAL NUMBER LOCATION

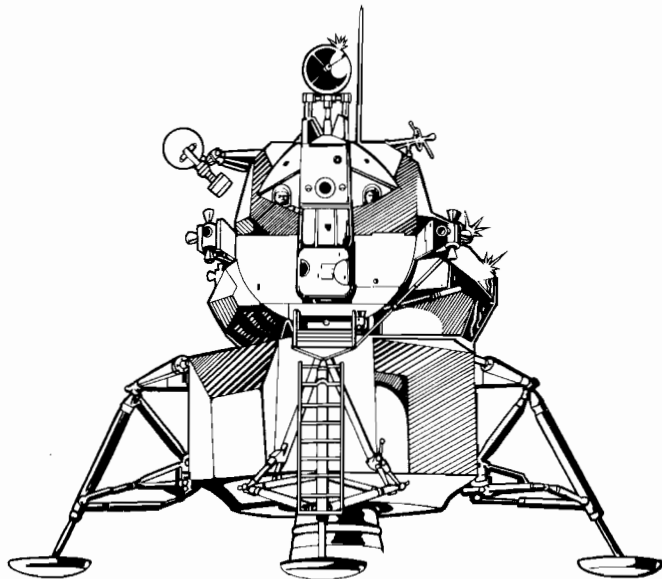
Your game's serial number is located on the outside of the game. The same number is also stamped on the chassis of the TV monitor, game PCB and Regulator/Audio PCB. Please mention this number whenever calling your distributor for service.



LUNAR LANDER™

Operation, Maintenance and Service Manual

Complete with Illustrated Parts Catalog



A Warner Communications Company



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NOTE

If reading through this manual does not lead to solving a certain maintenance problem, call Tele-Help™ at the Atari Customer Service office in your geographical area, as shown in *one* of the two maps below. Order all parts from the California office.

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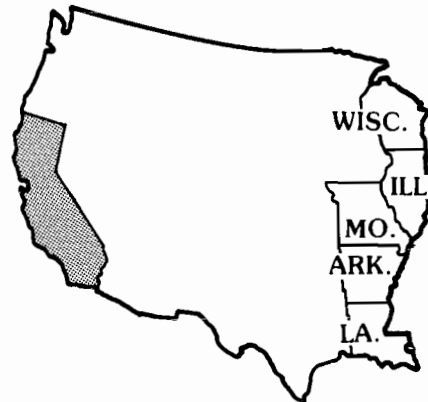
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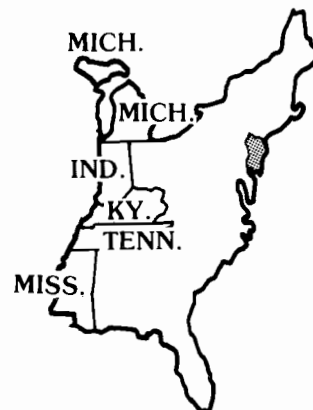
Atari Inc.
New Jersey Customer Service Office
Cottontail Lane, Somerset, NJ 08854
Telex 37-9347
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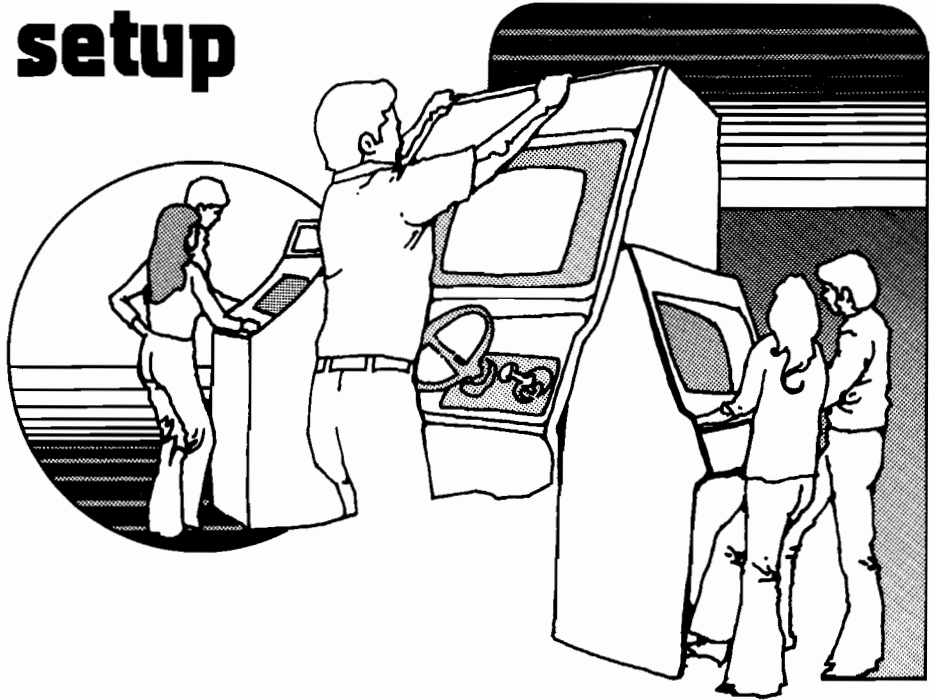
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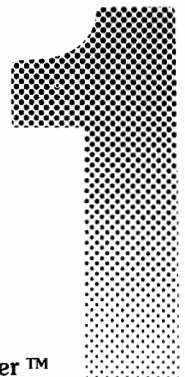
location setup



a. new parts

The Lunar Lander™ game has five new Atari parts. If you have worked on Atari video games in the past, then you should be aware of these important differences. The new parts are:

- *Power Supply Assembly.* It covers a wider voltage range than before, has higher reliability, a smaller overall size, and all fuse numbers and fuse amperages are marked directly on the metal chassis.
- *Game PCB Circuitry and TV Monitor.* Most video games to date have used the raster scan method of display. This



game uses vector generation with X and Y axes to allow greater contrast, a greater number of moving objects on the screen, and lines at any angle can be “drawn” on the screen.

- *Thrust Control.* This new design realistically simulates applying engine thrust.
- *Regulator/Audio PCB.* Most of the heat-producing components have been moved off the game PCB and onto this smaller board, so the parts will not be prone to a higher rate of failure.
- *New Speaker Arrangement.* A larger loudspeaker installed in an enclosed wood compartment provides better bass response for the sound. Throughout this manual and illustrated parts catalog, wherever one of these five new parts is mentioned, you will see this symbol in the page margin:



b. game inspection

This new game is ready to play upon removal from the shipping carton. However, your careful inspection is needed to supply the final touch of quality control. Please follow these steps to help us insure that your new game was delivered to you in good condition.

NOTE

Do not plug the game in yet!

1. Examine the exterior of the game cabinet for dents, chips, or broken parts.
2. Unlock and open the rear access panel of the cabinet and inspect the interior of the game as follows:
 - a. Check that all plug-in connectors (on the game harness) are firmly seated.
 - b. Remove the game printed circuit board (PCB) as follows:
 - Remove the screws at the edge of the PCB closest to you.
 - Unplug the edge connector carefully. DO NOT BEND THE PCB.
 - Slide the PCB out of its slots.
 - c. Verify that all integrated circuits (ICs) are firmly seated in their sockets or soldered in place. You should eliminate any foreign material such as loose bits of wire or solder splashes that could cause unwanted conductive paths.
 - d. Note the location of the game’s serial number—it is on the metallic label in the upper left corner on the back of the cabinet. A serial number (not necessarily the same one) also appears in the corner of the back side of the game PCB that is between the two edge connectors. A drawing of this is on the inside

front cover. Please mention this number whenever you call your distributor for service.

- e. Carefully slide the PCB back into its slot in the game cabinet and secure with the two screws at the board’s edge closest to you.
- f. Plug the edge connector back onto the PCB. DON’T FORCE IT. The connector is keyed so it will only go on in the proper orientation. A reversed edge connector will damage the PCB.

WARNING

To avoid possible unpleasant electrical shock, do not touch internal parts of the video monitor with your hands or metal objects held in your hands. Check the monitor chassis mounting hardware only.

3. Check all major subassemblies such as the power supply, loudspeaker (which contains powerful magnets that will attract small metal items—remove these items), and all player-operated controls and switches. Check that the video monitor is securely mounted; tighten the hex nuts below the monitor shelf as necessary.

c. voltage selection

Table 1 Installation Requirements

Power	110 VAC, 60 Hz (nominal), 175 watts OR 220 VAC, 50 Hz (nominal), 175 watts
Temperature	0 to 38°C (32 to 100°F)
Humidity	Not over 95% relative
Space Required	65 × 79 cm (25½ × 31 in.)
Game Height	184 cm (72½ in.)

Before plugging in your game, make sure that the voltage selection plug on the power supply is correct for your location’s line voltage. Check the wire color on the plug and see if it is correct per the list below.

Line Voltage Range	Voltage Selection Plug Color
90-110 VAC	Violet
105-135 VAC	Yellow
200-240 VAC	Blue
220-260 VAC	Brown

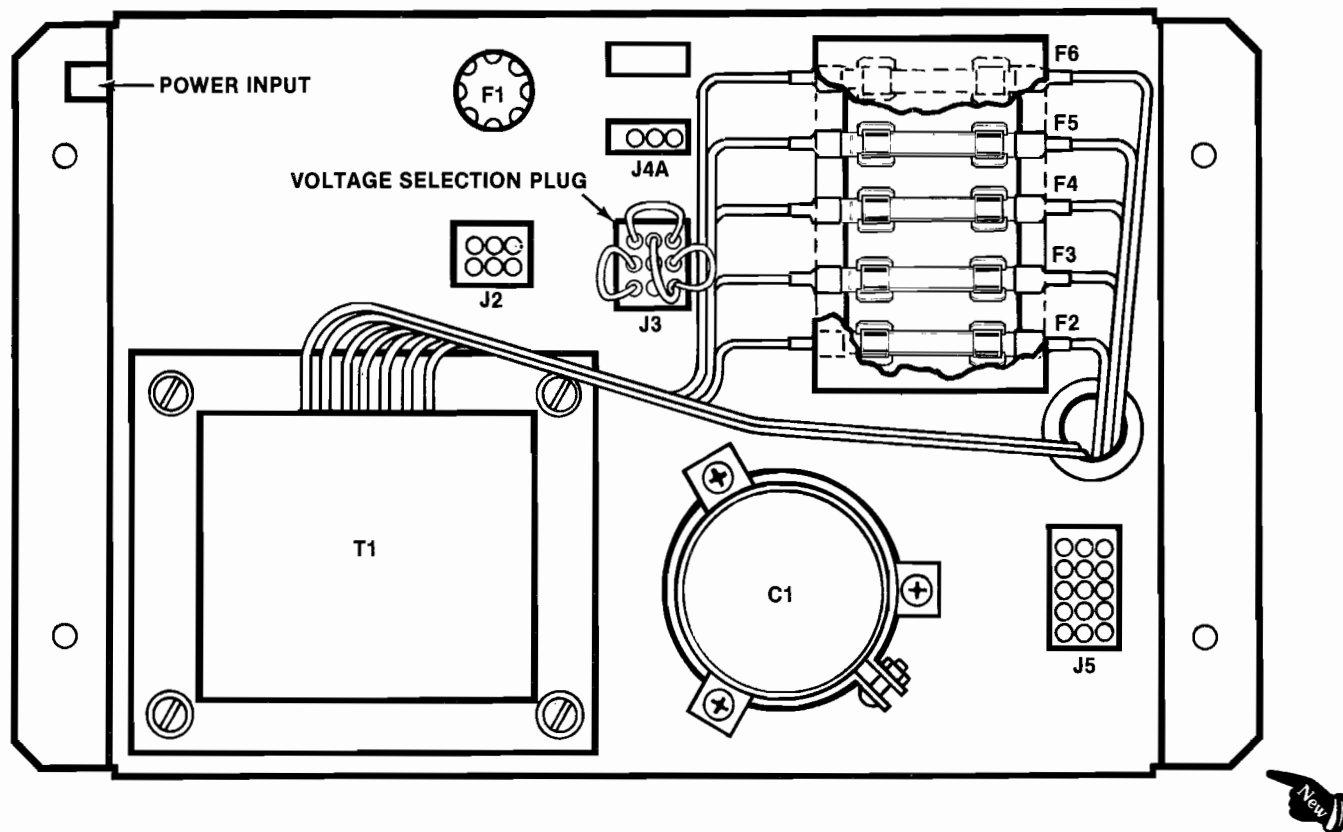
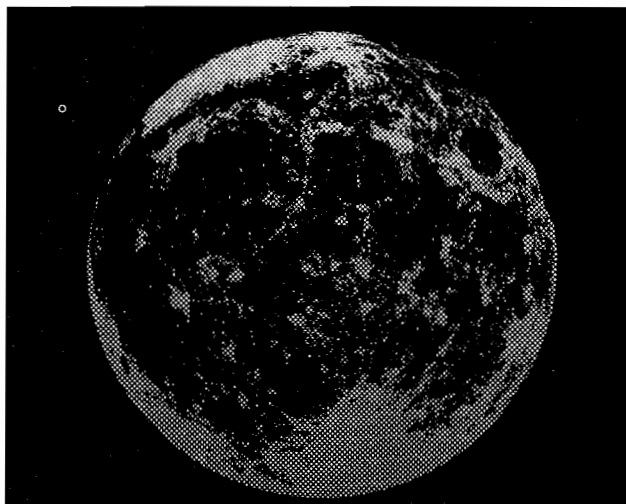


Figure 1 Power Supply

d. interlock and power on/off switch

To minimize the hazard of electrical shock while you are working on the inside of the game cabinet, two interlock



switches have been installed (see Figure 2). One is located behind the rear access panel and one is behind the coin door. These switches remove all the AC line power from the game circuitry when a door is opened.

Check for proper operation of the interlock switches by performing the following steps:

1. Unlock and open the rear access panel and the coin door.
2. Plug the AC line power cord into an AC outlet.
3. Set the on/off switch to its *on* position.
4. Close the rear access panel and coin door. Within approximately 30 seconds after closing the panel and door, the TV monitor should display a picture (the game lighting should light immediately).
5. Slowly open the rear access panel. The TV monitor picture should disappear and the game lighting should go off when the panel is opened to approximately 2.5 cm (1 inch). Close and lock the rear access panel, and repeat this step with the coin door.

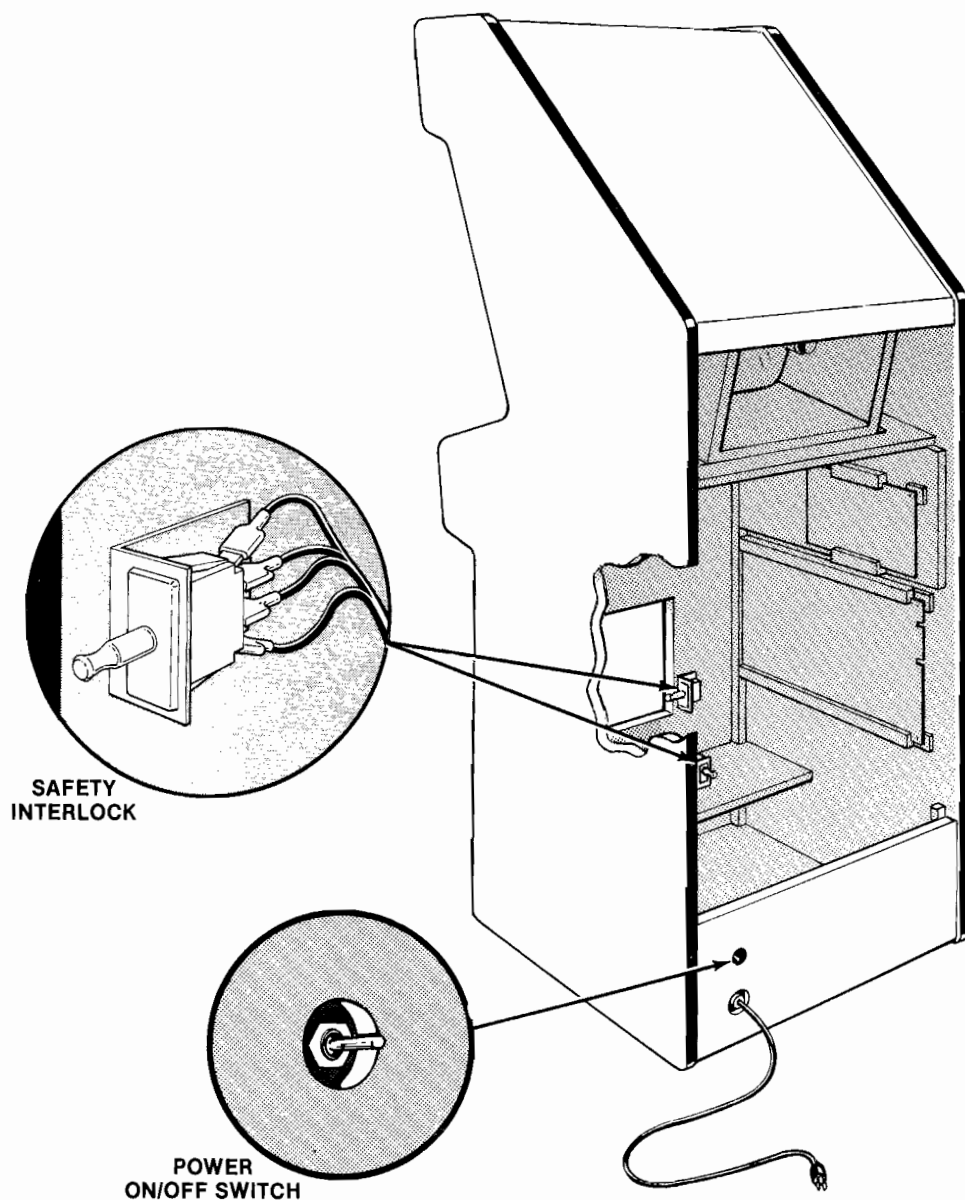


Figure 2 Location of Interlock and Power On/Off Switches

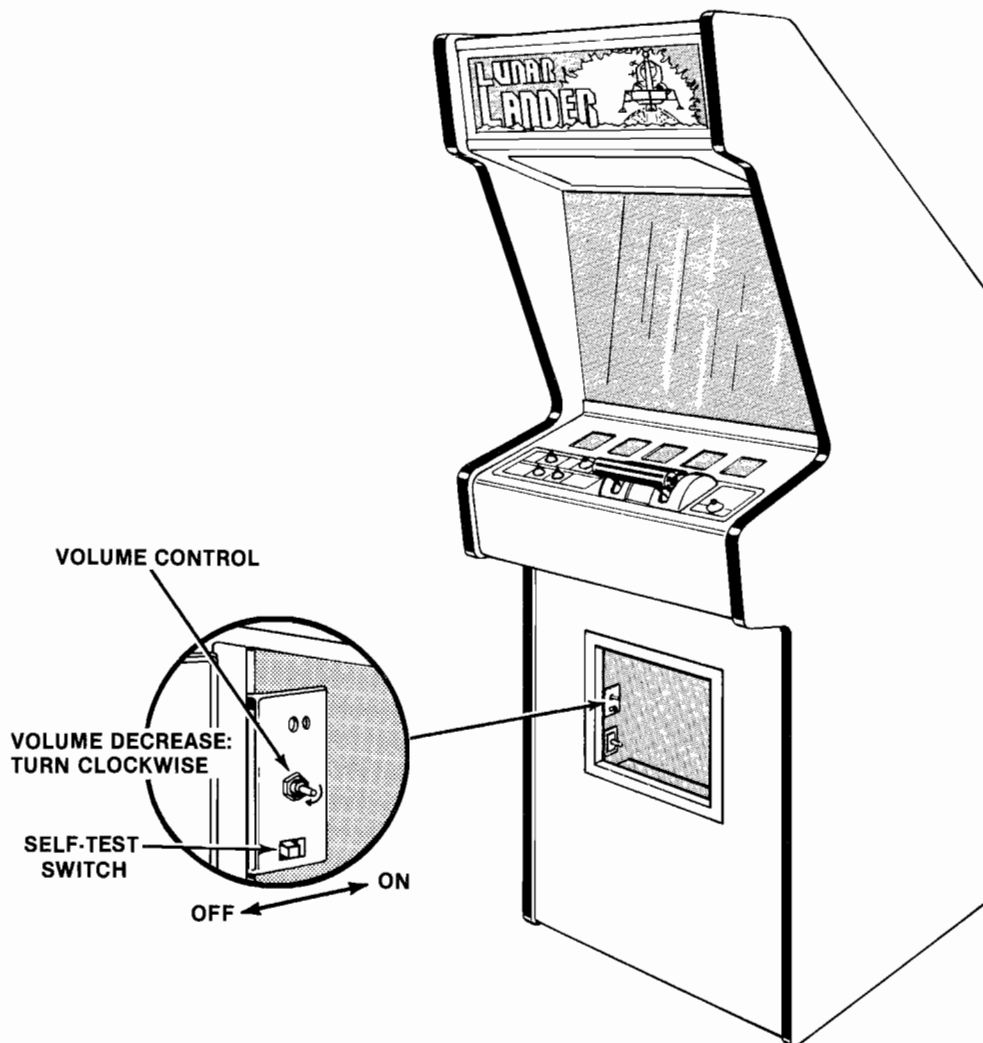
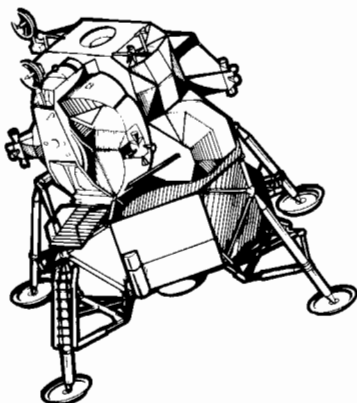


Figure 3 Location of Self-Test Switch and Volume Control



6. If the results of step 5 are satisfactory, the interlock switches are operating properly. If the TV monitor and game lighting don't go off as described, check to see if the corresponding interlock switch is broken from its mounting or stuck in the on position.

e. self-test procedure

This game will test itself and provide data to demonstrate that the game's circuitry and controls are operating properly. The data is provided on the TV monitor and the game speakers: no additional equipment is required.

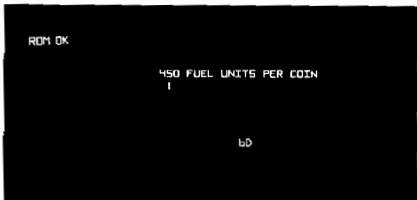
Part of the self-test includes a test of the volume level and a display of the operator-selected game options. Therefore, we suggest you run the self-test anytime you need to adjust the volume or change the options. Besides, this method will eliminate an inaccurate coin count, which would be gotten

by tripping the coin switch wire merely to change the volume level during game play.

To begin the self-test, follow the instructions outlined in Table 2.

Table 2 Self-Test Procedure

Preliminary: With power on, slide self-test switch towards rear of cabinet or on (see illustration). This switch is located on a metal bracket just inside the coin door. Game advances through all tests automatically, except when it fails in Test 1 or 2. In such a case, it will stop wherever it finds a failure. Lunar Lander will not be able to finish the self-test procedure until the defective RAM(s) is replaced.

Name of Test/ Instructions	Result if Test Passes	Result if Test Fails
1. Zero Page RAM Test	Select and Start switches light and stay lit. Screen is blank. Two short medium-high beeps are sounded (3000 Hz).	Screen stays blank and never displays any characters of Test 3. One or both beeps are very high pitch (6000 Hz), meaning bad RAM(s). 1st beep very high = bad RAM at location D2 on game PCB 2nd beep very high = bad RAM at location E2
2. Vector Generator (Screen) RAM Test	Four long medium-high beeps are sounded (3000 Hz).	One or more of the beeps are very high pitch (6000 Hz), meaning a bad vector generator RAM. 1st beep very high = bad RAM at M4 2nd beep very high = bad RAM at R4 3rd beep very high = bad RAM at N4 4th beep very high = bad RAM at P4
3. ROM Test	ROM OK appears in upper left corner of screen. 	☒ is displayed in upper left corner of screen, indicating bad or missing ROM at location N/P3 or PROMs at locations K4 and L4. OR One or more numbers 0 thru 27 will be displayed, indicating a bad ROM or PROM: see <i>Identification of Faulty ROM Chips</i> list on page 8.

Name of Test/ Instructions	Result if Test Passes	Result if Test Fails
4. Option Display	Option settings are displayed in center of screen, as shown in photograph above. The first line shows one of 8 different numbers (see <i>Option Switch Settings</i> list on page 10) or an "X" to indicate free play setting. Message will be in one of four available languages. The second line shows the right coin mechanism factor — it will be 1, 4, 5, or 6.	
5. Thrust Control Test Push thrust control slowly towards rear of game.	The third line shows two characters: they should <i>increase</i> . "Flickering" numbers while control is at rest are unimportant and should be ignored.	Two characters don't change at all, or skip numbers, indicating a dirty potentiometer. <i>Decreasing</i> numbers as you push control means harness wires have been reversed. Thrust control at rest and numbers changing rapidly indicate harness wires are loose.
6. Lamp Audio, and LED Test	Four mission select lamps light sequentially from right to left. (<i>Instructions</i> lamp is always lit.) Engine thrust sound increases with each light from right to left. With <i>Training Mission</i> light on, you'll hear instead the crash sound. Now adjust volume for your location. Between the end and beginning of the four-light sequence, both <i>Select</i> and <i>Start</i> switches go on in unison for a moment.	One or more lights won't go on, indicating a defective light bulb. No engine thrust or crash sound means volume control too low, a defective speaker, loose speaker wires, or a problem in the audio circuitry. One or both of the <i>Select</i> and <i>Start</i> switches do not flash on, indicating bad LED switches or loose harness wires.
7. Switch Test Press each of these switches:	High beep is sounded for each change in switch state, i.e., a push and release should produce two beeps.	No beep indicates a defective switch or loose harness wires.
Slide the self-test switch towards the front of the game or <i>off</i>. Note that using the self-test will cause all the numbers at the top of the screen to reset to zeroes.		

Identification of Faulty ROM Chips

Display During Self-Test	-01 P.C. Boards (PROMs)	Alternate -01 P.C. Boards (PROMs)	-02 P.C. Boards (ROMs)
1 3 0 2		035176-01 K4 035177-01 L4	034599-01 R3
☒		035174-01 K4 035175-01 L4	034598-01 N/P3
9 11 8 10		034600-01 ¹ K4 034601-01 ¹ L4	034597-01 ¹ M3
13 15 12 14	034579-xx F2 034580-xx L2 034587-xx H1 034588-xx M1	034592-xx F2 034596-xx H1	034572-xx F1
17 19 16 18	034577-xx H2 1034578-xx M2 034585-xx J1 034586-xx N1	034591-xx H2 034595-xx J1	034571-xx D/E1
21 23 20 22	034575-xx J2 034576-xx N2 034583-xx K1 034584-xx P1	034590-xx J2 034594-xx K1	034570-xx C1
No display at all	034573-xx K2 ² 034574-xx P2 ² 034581-xx L1 ² 034582-xx R1 ²	034589-xx ² K2 034593-xx ² L1	034569-xx ² B1

¹These chips contain *only* the French, German and Spanish messages. If the game is to be operated in the English language, you do not need to replace them. In fact, they may not even be supplied on a printed circuit board intended for use only in English-speaking areas. Thus in such a case you should ignore the 8 9 10 11 "bad" ROM message.

²ROM or PROMs *must* be in place for self-test to work.

-xx after some of the part numbers above means that the chip can be either an -01 or -02 version. The difference between the two versions is in the operator option switch settings. First note what part numbers and versions are stamped onto the ROMs on your PCB; then refer to page 10 in the manual for the switch settings that correspond to your version.

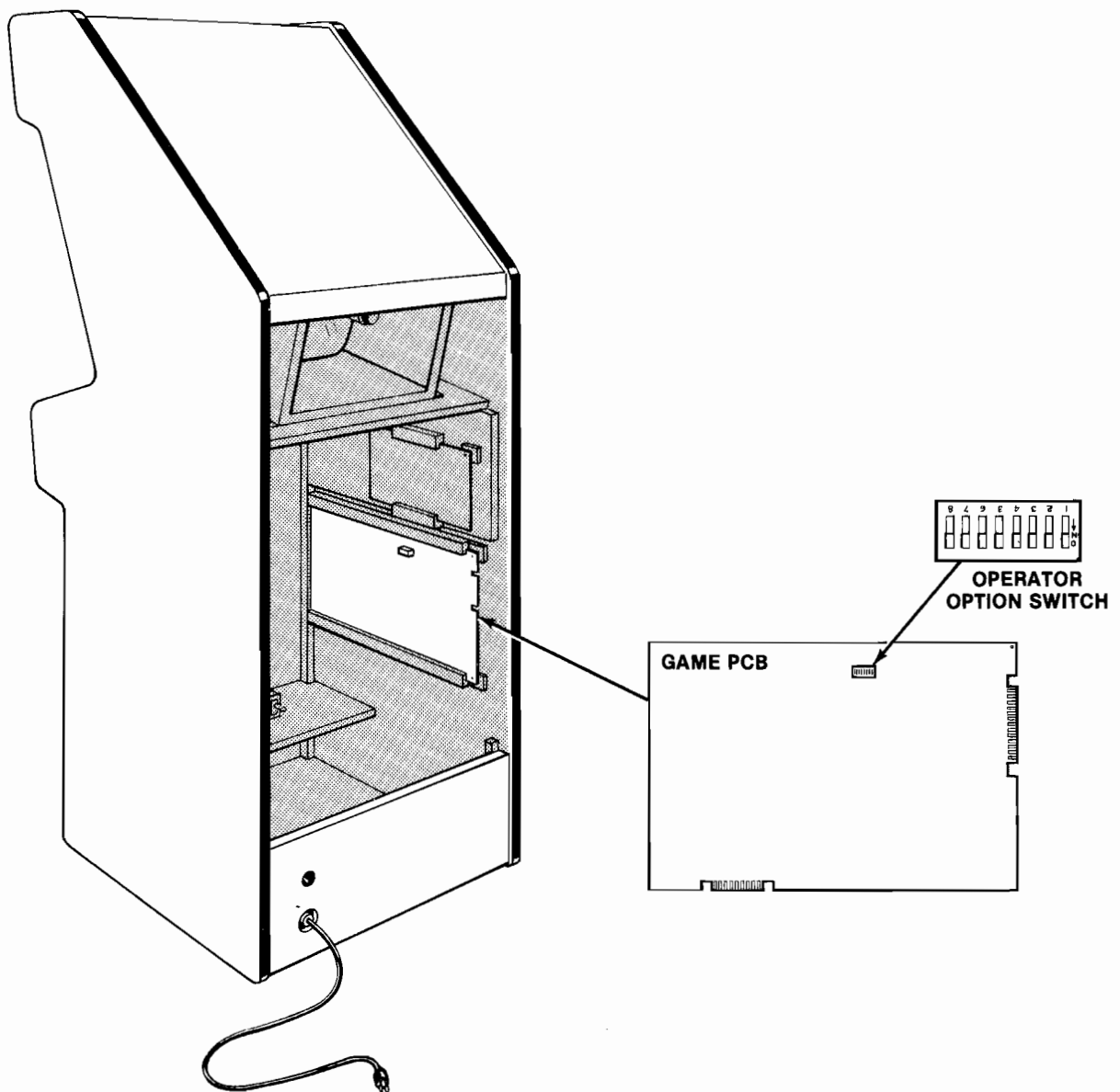


Figure 4 Location of Operator Option Switch

Option Switch Settings

To change the toggle positions of the switch assembly, you need not remove the PCB. The switch, usually colored blue, is easily accessible when the PCB is left mounted in place. Unless you are a qualified technician, *do not turn any of four adjustments knobs near the PCB's edge connector.*

Your game will contain either of two different sets of program ROM/PROM chips. Check your game PCB to see which suffix is stamped after the part numbers on these chips (-01 or -02). Then refer to the appropriate table below to determine your game's option switch settings.

Option Switch Settings with -01 ROMs on Printed Circuit Board

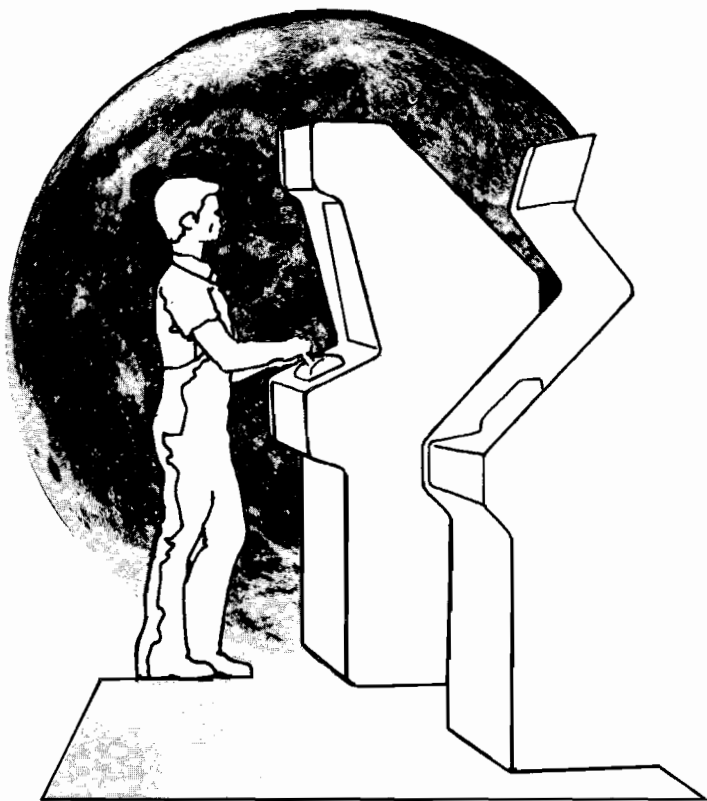
Switch settings of 8-Toggle DIP Switch (located at position P8 on the game PCB)								Results
8	7	6	5	4	3	2	1	
On	On	TOGGLE						450 fuel units per coin
On	Off							600 fuel units per coin
Off	On	UNUSED						750 fuel units per coin \$
Off	Off							900 fuel units per coin
			Off					Free play
			On					Coined play as determined by toggles 7 & 8 \$
				Off	Off			*German instructions on screen
				Off	On			*Spanish instructions on screen
				On	Off			*French instructions on screen
				On	On			English instructions on screen \$
						On	On	Right coin mechanism (as you face the game) registers: 1 credit per coin \$ } (Left coin mechanism <i>always</i> registers 1 credit per coin)
						On	Off	
						Off	On	
						Off	Off	

Option Switch Settings with -02 ROMs on Printed Circuit Board

Switch Settings of 8-Toggle DIP Switch (located at position P8 on the game PCB)								Results
8	7	6	5	4	3	2	1	
On	On		On					450 fuel units per coin
On	Off		On					600 fuel units per coin
Off	On		On					750 fuel units per coin \$
Off	Off		On					900 fuel units per coin
On	On		Off					1100 fuel units per coin
On	Off		Off					1300 fuel units per coin
Off	On		Off					1550 fuel units per coin
Off	Off		Off					1800 fuel units per coin
		Off						Free play
		On						Coined play as determined by toggles 8, 7, and 5 \$
				Off	Off			*German instructions on screen
				Off	On			*Spanish instructions on screen
				On	Off			*French instructions on screen
				On	On			English instructions on screen \$
						On	On	Right coin mechanism (as you face the game) registers: 1 credit per coin \$ } (Left coin mechanism <i>always</i> registers 1 credit per coin)
						On	Off	
						Off	On	
						Off	Off	

***IMPORTANT:** When changing instruction language switches, the six phrases at the top of the screen will remain in the previous language; only the *FUEL UNITS PER COIN* phrase will change immediately. When the lander 'crashes' (in the attract mode) the language will reset completely. In free play, the language will reset when the start button is pressed.

\$ indicates settings made at the factory and/or recommended settings



game play

Lunar Lander™ is a one-player coin-operated electronic game that simulates landing a manned spaceship on the moon. Various video-display phrases indicate score, time elapsed during this landing mission, fuel units consumed, altitude above the moon, and horizontal and vertical speed. The fuel consumption and both speed readings are important for the player to determine how to land the craft. Realistic engine rumble and crash sounds accompany game play. A high beep warns of an almost-depleted fuel supply, whereupon players can add coins to automatically extend the game and “fill up” their fuel tanks. Depending on the quality of the landing or the crash, various messages are displayed on the screen.

The Lunar Lander game has four basic modes of operation: attract, ready-to-play, play and the self-test. The *attract mode* starts after power-up, after the play mode, or after the self-test. It ends when a coin has been inserted into either



Lunar Lander™

coin slot. The *ready-to-play* mode follows the attract mode and begins after a coin has been inserted. It ends with the pressing of the LED start switch.

The *play mode* begins immediately after the ready-to-play mode, when a player presses the start switch. (The game does not automatically start after a certain time has elapsed, i.e., pressing the start switch is the only way Lunar Lander will begin the play mode.) The *self-test* is a special mode used for verifying proper game operation. It begins with the self-test switch set to on, and ends when the switch is set to off.

a. attract mode

The attract mode is specifically programmed to attract potential players by displaying the basic sequence of game play. The lander module flies horizontally across the screen, drifting slowly towards the bottom right corner. At the end it “crashes” into a canyon wall. (The actual slow-motion explosion is not displayed, though, as an incentive for players to try out the game.)

The sequence is reset, and a new landscape panorama is displayed. The center of the screen displays the message *INSERT COINS* and *xxx FUEL UNITS PER COIN* in English or one of three foreign languages. The previous game score is displayed after the word *SCORE* for player encouragement.

b. ready-to-play mode

This mode starts when either coin switch is activated by a coin. The messages *SELECT OPTION*, *PUSH START* and *xxx FUEL UNITS* appear on the screen until a player pushes the LED start switch.

c. play mode

Similar to the attract mode, actual game play begins with engine rumble and the lander drifting towards the bottom

right corner of the screen. Horizontal and vertical speeds are constantly displayed, including two arrows to show horizontal and vertical directions of travel. Altitude is measured in distance above the surface of the mountain — not above “sea level”. The screen also shows time in actual seconds, representing time elapsed in the current mission.

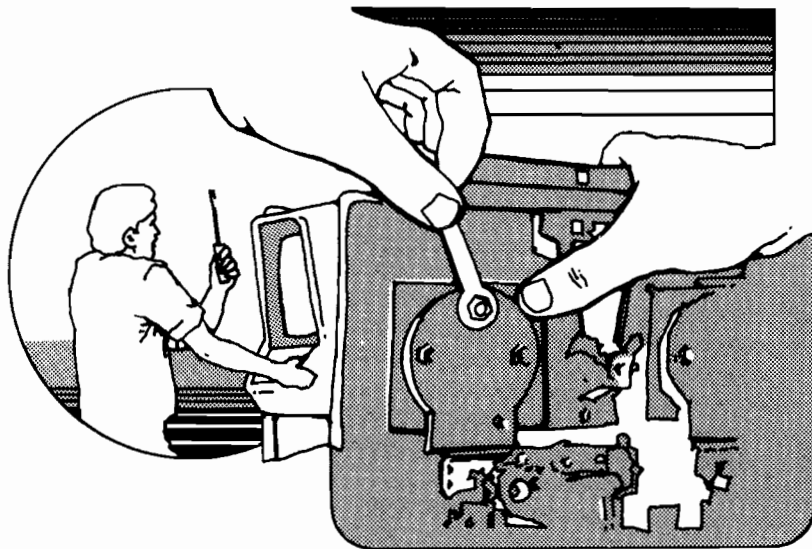
The scoring system gives 50 points for a good landing, plus 50 fuel units as a bonus. A hard landing earns only 15 points, and a crash earns 5 points. A crash happens when the vertical speed exceeds 15 and the horizontal speed exceeds 31. The number displayed after *SCORE* is cumulative of all landings made in the current game. The point scores for a good or hard landing can be greatly increased by landing on an area with a flashing multiplier, for example 2X or 5X. Thus, a good landing on the very narrow 5X site would give that player 250 points.

As already mentioned in Chapter 1, the operator can select from up to eight different settings for fuel units — 450, 600, 750, 900, 1100, 1300, 1550 or 1800 fuel units per coin (free play is also available). As the lander module flies over the landscape, it approaches the mountains and a landing site. At a certain point near the mountains, the game “zooms in” for a close-up view of the landing zone.

If the player realizes the speed is too fast and the landing looks hopeless, he or she can press the *ABORT* button on the control panel. This will give the lander extra thrust and make it fly upwards at top speed. The abort feature does consume 120 to 180 fuel units, though, as a disincentive to overusing it. If the *ABORT* button is pressed too late, however, a crash cannot be avoided.

The four levels of mission difficulty are determined by the player and can be changed at any time during the game or the ready-to-play mode. The differences between the four are printed on the mission select panels and are self-explanatory, except perhaps rotational momentum. This feature causes the lander to tumble around when either *ROTATE* button is pushed. The longer either button is held down, the faster the lander module will spin in that direction. The player gains control of the lander by pressing the other *ROTATE* button for the same amount of time.

maintenance and adjustments



Due to its solid-state circuitry, this Atari unit should require very little maintenance and only occasional adjustment. Information given in this chapter and elsewhere in this manual is intended to cover most servicing situations that may be encountered at the game site. The procedures given are in sufficient detail to be understood by a person with moderate technical background.

a. cleaning

The exterior of the game cabinet and the three acrylic panels may be cleaned with any non-abrasive household cleaner. If desired, special coin machine cleaners that leave no residue can be obtained from your distributor. Do *not* dry-wipe any of the acrylic panels, because any dust can scratch the surface and result in fogging the plastic.

b. fuse replacement

This game contains six fuses—all on the power supply assembly (not including the TV monitor fuses). Replace fuses only with the same type as listed below. See the Electrohome TV monitor manual for the monitor fuse data.



F1, F2, F3	7-amp. 250V 3AG slow-blow glass cartridge-type fuse
F4, F5, F6	3-amp. 250V 3AG slow-blow glass cartridge-type fuse

The metal power supply chassis is marked with all six fuse numbers and their amperages. Figure 16 shows the power supply in detail, including top and bottom views.

c. control panel access

Prior to repairing or replacing any component on the control panel or prior to removing the TV monitor, unplug the game. Then open the coin door.

Reach through the opening and remove all four sets of wing nuts, split lock washers, and flat washers, located on the underside of the control panel (see Figure 5). The two carriage bolts closest to the front of the game will come out of the control panel; at this point in the procedure the rear two bolts are left as installed.

Lift up on the control panel and tilt it towards you. *Be sure that the acrylic TV monitor shield does not fall on you.* The top edge of the control panel acts as a retainer strip for the shield: once the control panel is opened, the shield is free and could slide out under its own power.

1. LED Switch Replacement

The light-emitting diode (LED) switches on the control panel have a very low failure rate. In case a switch should

ever be suspect, first test it per the description that follows. To replace the switch, refer to Figure 5.

1. Remove the wires from the suspected switch.
2. Set multimeter to ohms scale. Set ohms scale to $R \times 1$, then zero the meter.
3. Connect multimeter leads to appropriate LED switch contacts. (See Figure 5 for designation of switch contacts and meter lead placement.)
4. Check contacts (push and release the switch button) for closed and open continuity.
5. If the contacts do not operate sharply or always remain closed or open, then replace the LED switch as outlined in Figure 5.

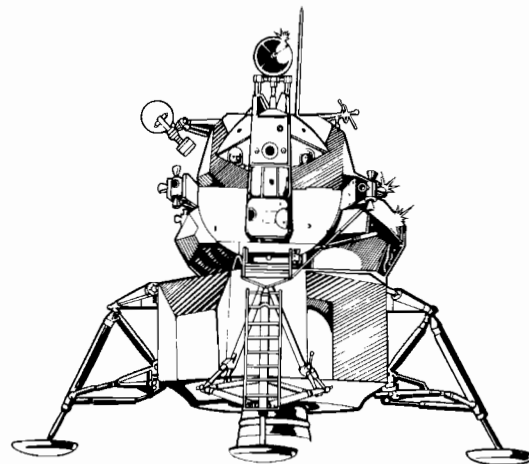
2. Mission Select PCB Lamp Replacement

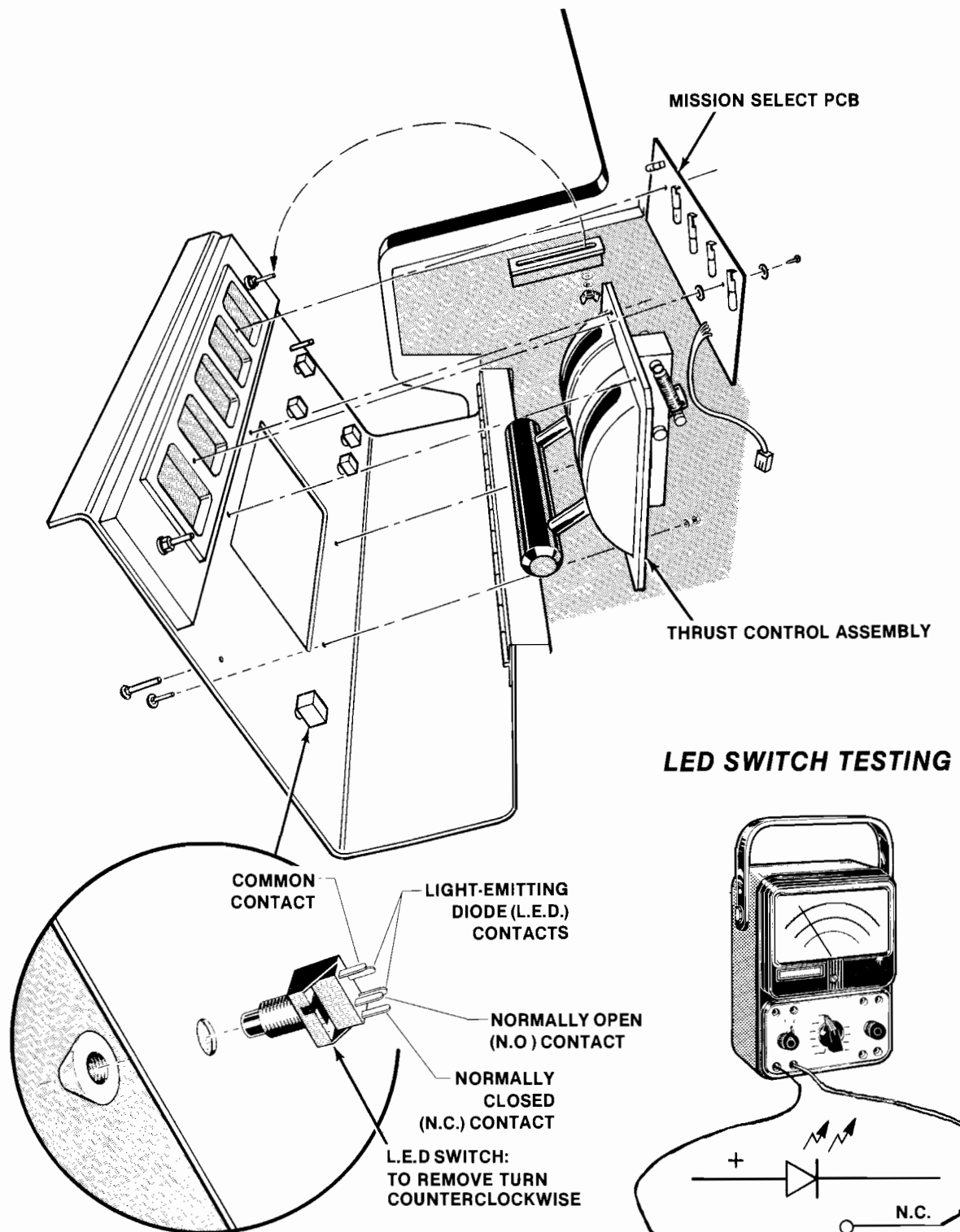
With the control panel open, be sure power is turned off. Unplug the harness connectors closest to this PCB. Carefully remove both cross-recessed screws plus the four fiber washers used to mount the board. Replace any of the burned-out lamps. (See Figure 5.)

To re-install the board, *be sure* the edge with the harness wires faces down towards the floor. Place a fiber washer on either side of the board's mounting hole, insert each screw and fasten the board down onto the wood framework of the control panel. Re-plug the harness connector together again.

3. Thrust Control Maintenance and Repair

To maintain this control, you will only have to lubricate the nylon bearings and the springs approximately every





- Remove all wires from the faulty switch.
- Turn the switch counterclockwise while holding the cone-shaped nut on the outside of the control panel.
- Install a new switch using the reverse procedure.
- Reconnect the harness wires.

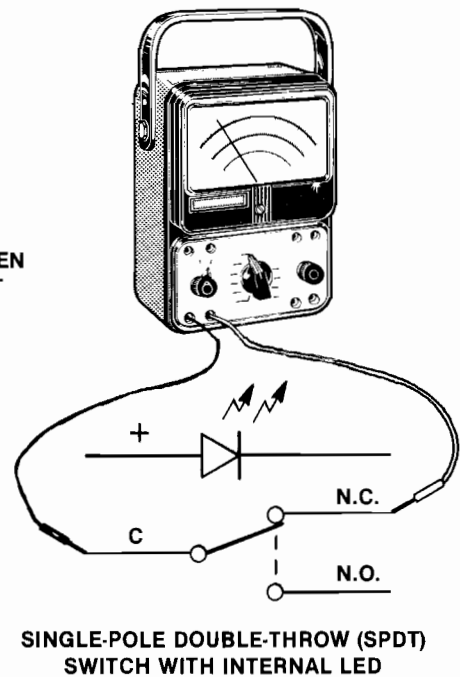


Figure 5 Opening and Removing Parts from the Control Panel

2500 credits or \$625 in income earned. The number of credits can be read off the coin counter, located on the coin door. For the thrust control, use only a small amount of *Dow Silicon Grease Type 14770-79*, Atari part no. 78-1708. Refer to Figure 6 for exactly where to lubricate the thrust control.

Lubricate Springs. Open the control panel and be sure the game's power is turned off. For lubrication you do *not* need to remove the whole thrust control assembly. To lube the springs, remove both by slipping them sideways off the ends of the pins. Then apply a small amount of the Dow silicon grease to the two outer recessed grooves on each pin that holds the springs. (See the heavy arrows in Figure 6.)

Lubricate Nylon Bearings. The large pin that is protected by white nylon bearings must be removed before

you can lubricate it. First remove the two springs, then the Allen-head screw and split lock washer in the center of the handle. While holding the control's handle, carefully pull out the pin that rides on the bearings. Be aware that the flat white washers may fall onto the control panel as you remove this pin. Now apply grease only where the bearings normally ride. Reassemble the handle, pin, screw and washers in reverse order.

Repairs on this control, if any, would probably be replacing a broken spring or potentiometer, or trading/replacing neoprene stops that have become dented. Replacing springs has already been explained above.

Potentiometer Replacement. To determine if the potentiometer is defective, run the self-test (see Table 2). If the numbers displayed on the screen are in erratic sequence as

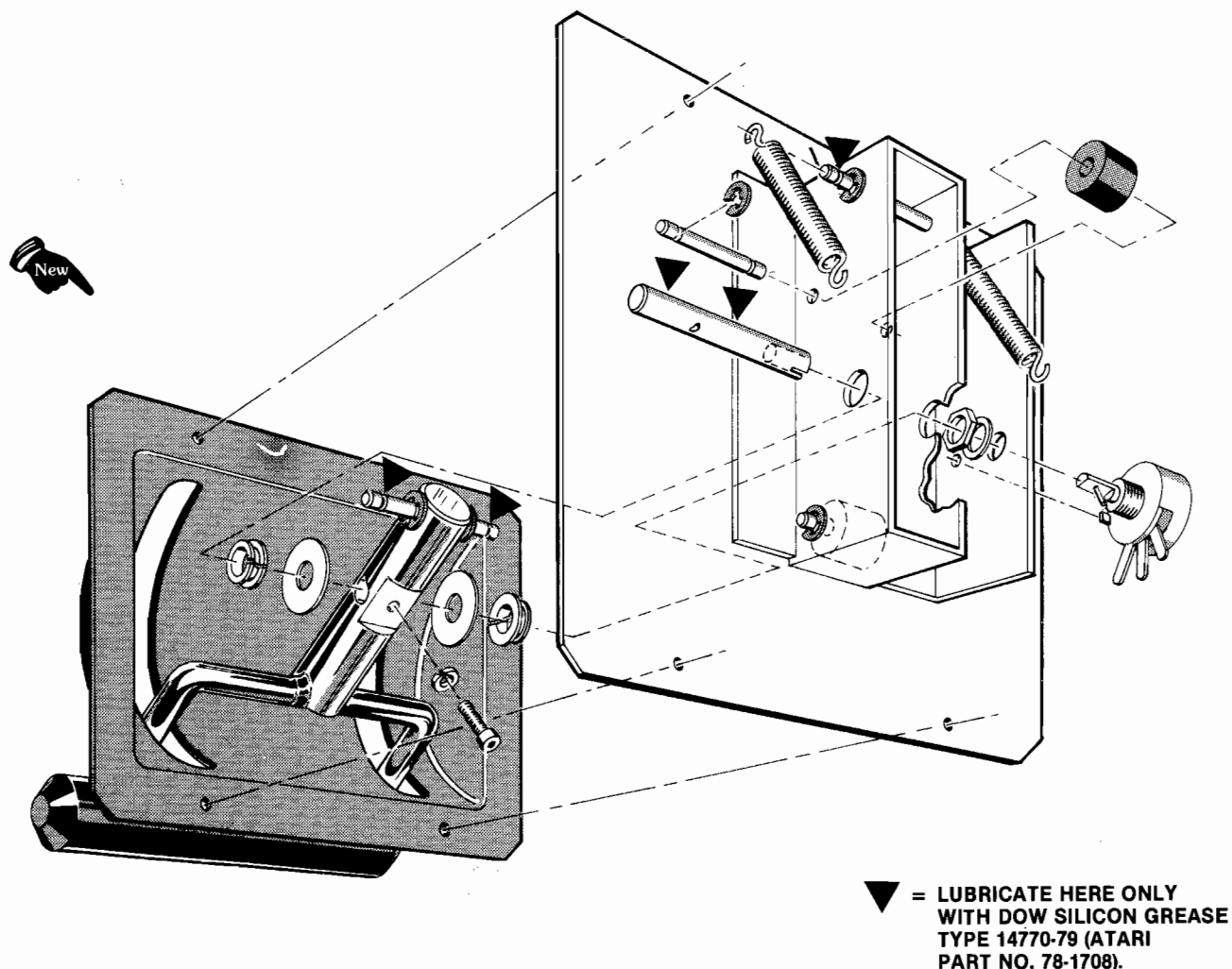


Figure 6 Thrust Control Lubrication and Repair

you move the handle slowly forwards and backwards, then the pot is bad. Simply remove the harness wires on the pot, then remove the hex nut and flat washer that mount the pot on the black metal bracket. Slide the pot out sideways and replace it with a new one. **Note that this potentiometer has been modified to include a tiny pin:** an off-the-shelf pot cannot be used for this game! Replace with Atari part no. A034117-01.

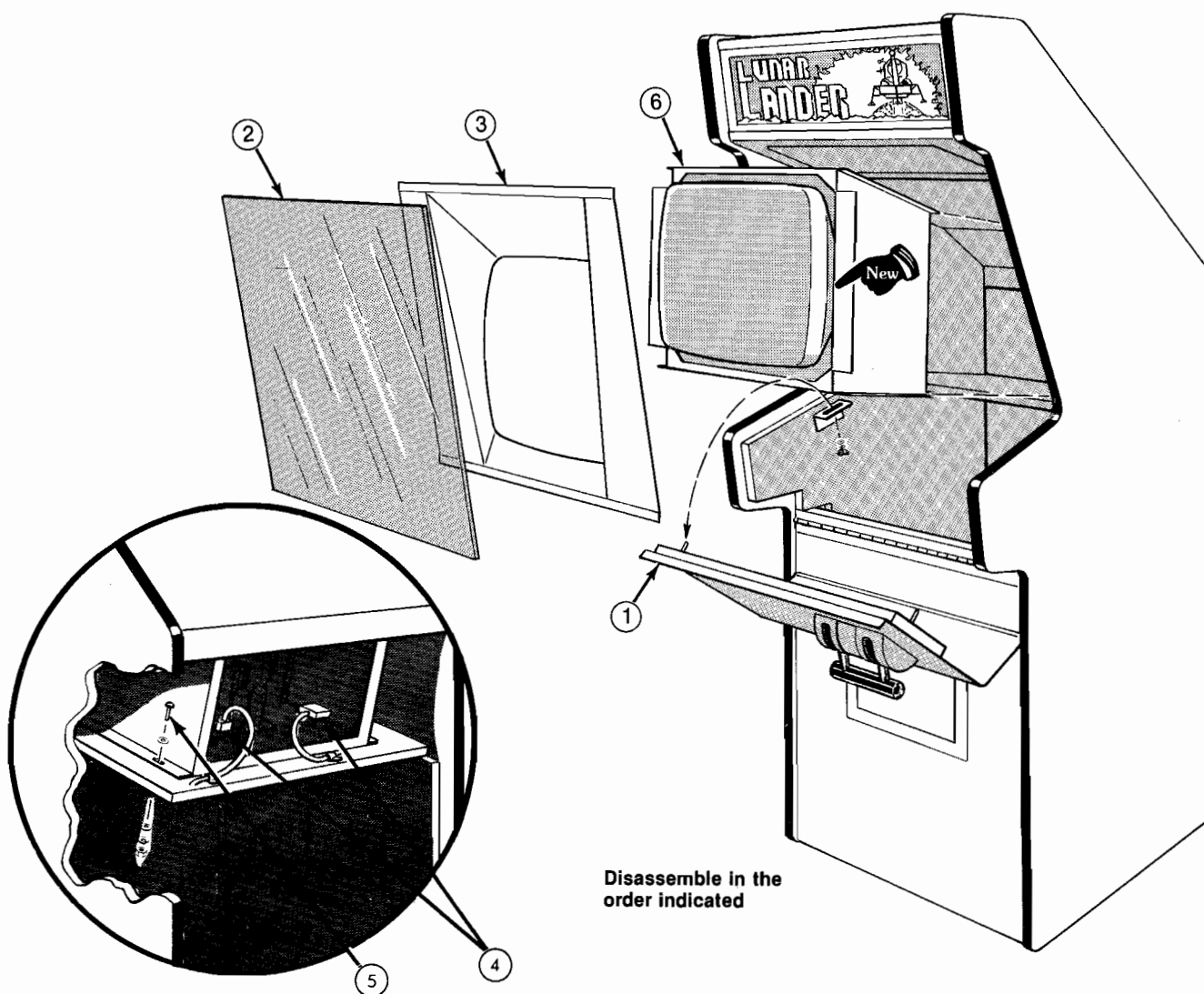
Neoprene Stop Replacement. The neoprene stop most likely to wear is that on which the handle sits when in its rest position. The lifespan of this stop can be increased by trading it with the other stop. To trade or replace the stops, remove the E-rings at the ends of the pins. Pull the pins out sideways and replace the stops.

Thrust Control Removal. If you ever need to remove the entire thrust control assembly from the game, be sure the power is turned off first. Remove the harness wires on the potentiometer. Then remove the four sets of hex nuts, split lock washers and carriage bolts from the thrust control assembly. Lift the control and its black plastic cover out of the control panel. (See Figure 5.)

d. tv monitor replacement



If you should need to service or replace the Electrohome X-Y monitor, you must first remove it from the game cabinet. Follow the instructions below, and refer to Figure 7.



Disassemble in the order indicated

Figure 7 TV Monitor Removal

1. Open the control panel as described in Section C, Control Panel Access. *Be sure the game is unplugged from its wall outlet!*

CAUTION

High voltages may exist in any television unit, even with power disconnected. Use extreme caution and do not touch electrical parts or the TV yoke area with your hands or with metal objects in your hands!

2. Remove the acrylic TV monitor shield by sliding its lower edge out.
3. Working up from the bottom side corners, carefully pry loose the two side flaps of the black cardboard bezel. (A 4-inch strip of double-sided adhesive tape is centered behind both side flaps, flush with each edge.) Remove the bezel.
4. Open the rear access panel and unplug the following two TV monitor harness connectors: each one is a 6-pin connector on the TV's PCBs.
5. Remove the four sets of carriage bolts, flat and split lock washers, and hex nuts that hold down the metal TV chassis.
6. Carefully slide the TV monitor chassis out the front of the game.

e. printed circuit board replacement

You may wish to remove the game printed circuit board (PCB) or the Regulator/Audio PCB for service or inspection. To do this, refer to Figure 8 and proceed as follows:

1. Open the rear access panel.
2. Locate the securing screws and fiber washers that hold down the PCB in its slots, and remove them. (The game PCB has two, the Regulator/Audio PCB has one set of this fastening hardware.)
3. Unplug the edge connector or the three small harness connectors; then carefully slide the PCB straight out of its slots. Be careful not to twist the board, as this may loosen connections or components.
4. Replace or repair as required.
5. Reinstall the PCB, making sure that the connectors are properly plugged in. Note they are keyed to fit on only one way, so if they don't slip on easily, don't force them! *A reversed connector may damage the game.*

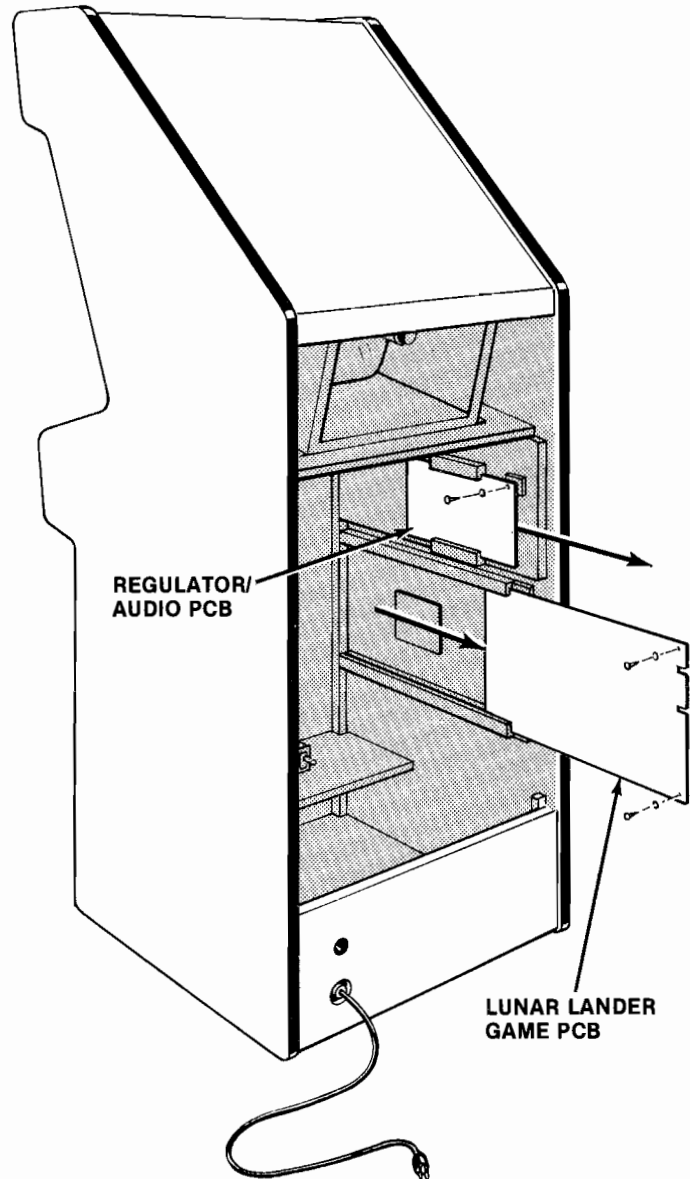


Figure 8 Removing Printed Circuit Boards

6. Replace the securing screws and fiber washers in the PCB.
7. Close and lock the rear access panel.
8. Check that the operation of the game is correct and *perform the self-test*. This is especially important with any game when you replace a PCB. Normally the *only* adjustments on the Lunar Lander game PCB are option switch changes (made on the 8-toggle DIP switch). Unless you are a qualified technician, *do not turn any of the four knobs* near the PCB's edge connector.

f. fluorescent tube replacement

To replace the white fluorescent tube behind the graphics attraction panel, follow this procedure (see Figure 9):

1. Remove the three Allen-head screws at the top of the game. They secure the metal retainer for the silk-screened panel. Remove the retainer completely.
2. Tilt the top of the acrylic panel towards you, then lift it up and out of the bottom retainer.

CAUTION

If you drop a fluorescent tube and it breaks, it will explode! Shattered glass can fly 6 feet or more from the explosion. Use care when replacing any fluorescent tube.

3. Remove the two grey clips from the fluorescent tube. Now turn the tube one quarter turn in either direction. Remove the tube and both orange clips.
4. Replace with a new tube. If you move games a lot from one location to another, you should re-use the orange

and grey clips. They provide extra protection against vibration loosening the tube out of its fixture.

5. Close up the game by following these instructions in reverse order.

g. speaker replacement

Probably the only cause of speaker failure is an electrical short or a ruptured cone, but both of these failures are highly unlikely. If the loudspeaker should ever need to be replaced, removal is very simple.

Remove the six sets of black Allen-head screws and split lock washers that secure the speaker grille. Now remove the four cross-recessed screws that hold down the speaker. Remove the harness "Fast-On" connectors on the speaker and replace this speaker.

Note that Lunar Lander™ has an empty area above the speaker and a smaller hole to the left of the speaker opening. This arrangement improves the audio's bass response: the space enables the engine thrust to have a realistically deep rumble. Therefore, do not cover up the left-hand hole with anything other than the speaker grille.

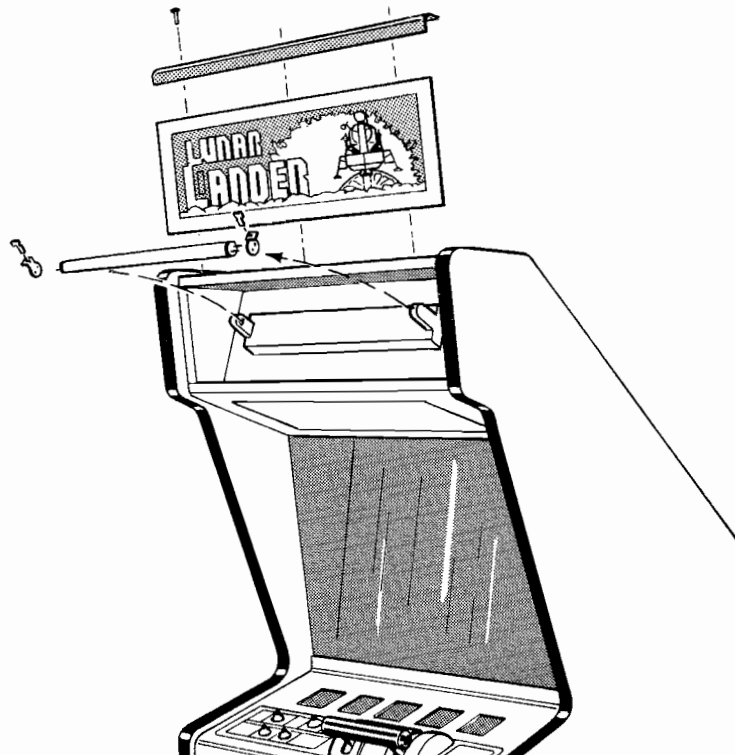
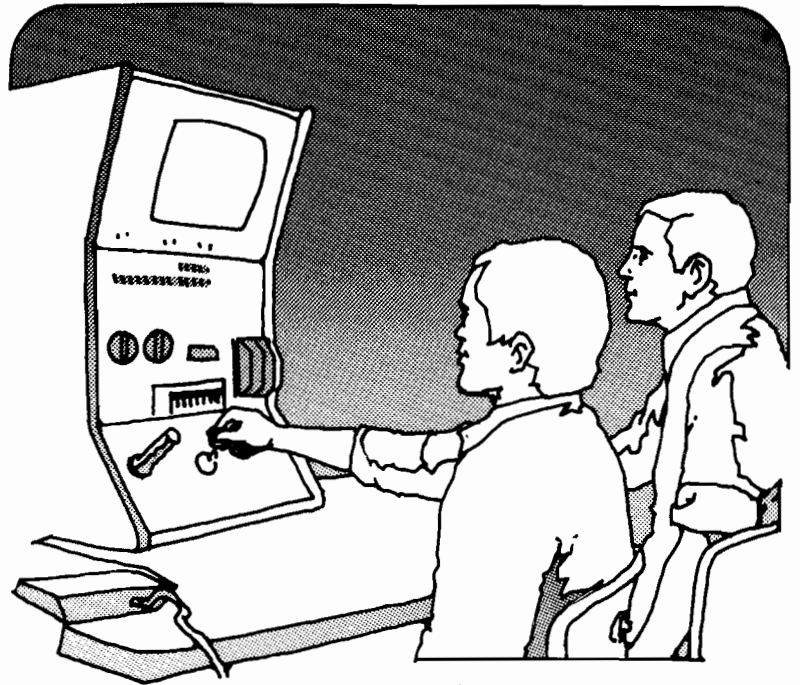
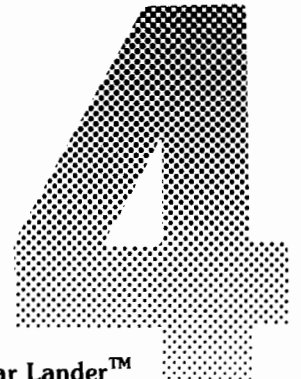


Figure 9 Fluorescent Tube Replacement

details of operation



With this manual you received two large sheets that contain the wiring and schematic diagrams for the Lunar Lander™ game. Sheet 1, Side A, includes an index that shows the arrangement of these diagrams. The diagrams include information that explains the functions of the circuits and defines where the inputs are from and where the outputs go. We hope these larger schematics solve the problems some technicians were experiencing with the smaller diagrams in our previous manuals. By putting them on large sheets, we were able to make them much easier to read, as well as maintaining smoother continuity from one circuit function to another.



Lunar Lander™



a. description of an x-y game

As stated on the front cover of this manual, this is Atari's first X-Y game. What's the difference between an X-Y game and Atari's previous games? To answer this, let's first discuss our previous games.

1. The Raster-Type Game

All previous Atari video games utilized a raster-scan monitor. These games contained a monitor that internally produces signals that scan the beam across the face of the picture tube screen. The beam, as in your home TV, starts at the top left corner of the screen, moves horizontally across to the right of the screen, turns off, moves down a little while returning to the left of the screen, turns on, and again, moves to the right of the screen. This is repeated until the beam reaches the bottom right corner. The beam is then turned off while it is moved all the way back to the top of the screen, then the process is repeated over and over. The result is many horizontal lines (240 lines is typical in our raster games) on the surface of the screen, scanned so fast that the screen appears to be lighted all the time.

In these games, the game PCB electronic circuitry is synchronized with the beam and turns the beam on and off, as required to produce the appropriate game video.

2. The X-Y-Type Game

This type of game utilizes a monitor known as an X-Y monitor. In the X-Y game, the first thing you will notice is that the picture tube beam is not continuously scanned. Therefore, the game PCB does not contain a standard sync circuit. Instead of the beam being internally controlled by the monitor, the game PCB controls the location of the beam at all times. As in the raster-scan monitor, the yoke of the X-Y monitor deflects the beam. The picture of the X-Y game is produced by drawing vectors on the surface of the monitor screen. This is done by the vector generator circuitry of the game PCB. This circuitry locates the beam in steps. There are 1024 steps for the horizontal location of the beam, and 768 steps for the vertical location. Therefore, there are 786,432 resolution bits (768 x 1024) on the surface of the X-Y monitor screen. Since our typical raster-scan game has only 61,440 resolution bits (256 line bits x 240 lines), the X-Y game is capable of developing a picture with much finer detail.

The vector generator draws vectors on the monitor by turning the beam on while deflecting the beam horizontally and/or vertically. An increase of the horizontal deflection current moves the beam to the right. Decreasing this current

moves the beam to the left. Increasing the vertical deflection current moves the beam up. Decreasing this current moves the beam down. Increasing both deflection currents simultaneously at the same rate results in a vector that slopes upward and to the right at a forty-five degree angle. By controlling the amount of horizontal and vertical deflection current, the vector generator is capable of "drawing" a line between any two given points on the monitor screen.

The X axis output of the vector generator is the horizontal axis of the monitor, while the Y axis is the vertical. The Z axis output of the vector generator controls the brightness of the beam. Without the brightness control, a short vector drawn in the same amount of time as a long vector would result in the short vector being brighter than the long vector.

b. game wiring and power distribution

The wiring diagram for the Lunar Lander game is located on Sheet 1, Side A, of the large sheets that came with this manual. Included on this sheet are the schematics for the power supply, Regulator/Audio PCB, Mission Select PCB, and coin door.

Figure 10 of this manual shows the distribution of the power of this game.

c. description of electronic assemblies

The following section describes the electronic assemblies within the Lunar Lander game. Some of these new designs are, X-Y monitor, Regulator/Audio PCB, X-Y game PCB, and Power Supply. For information concerning the X-Y monitor, please refer to the monitor manual that is included with the game.

Figure 11 of this manual shows the distribution of signals of the game.

1. Power Supply

The Power Supply is located on the floor of the game cabinet. This supply was specifically designed to provide the voltages required for both raster and X-Y games. Some of the features of this new supply include: a new transformer with greater power output and additional secondary windings; one unregulated DC voltage output, and various AC voltage outputs; a line filtered AC line input; appropriate



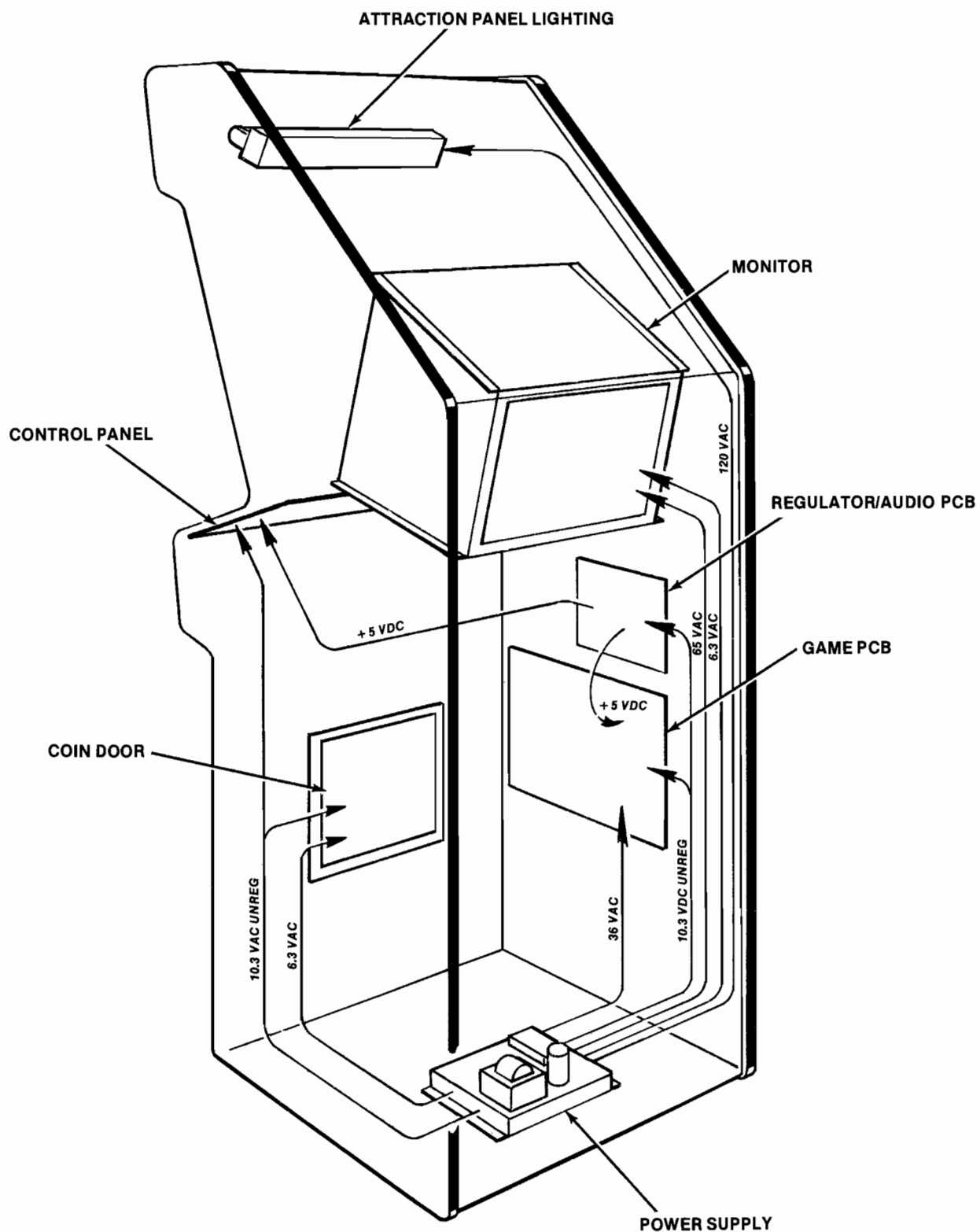


Figure 10 Power Distribution

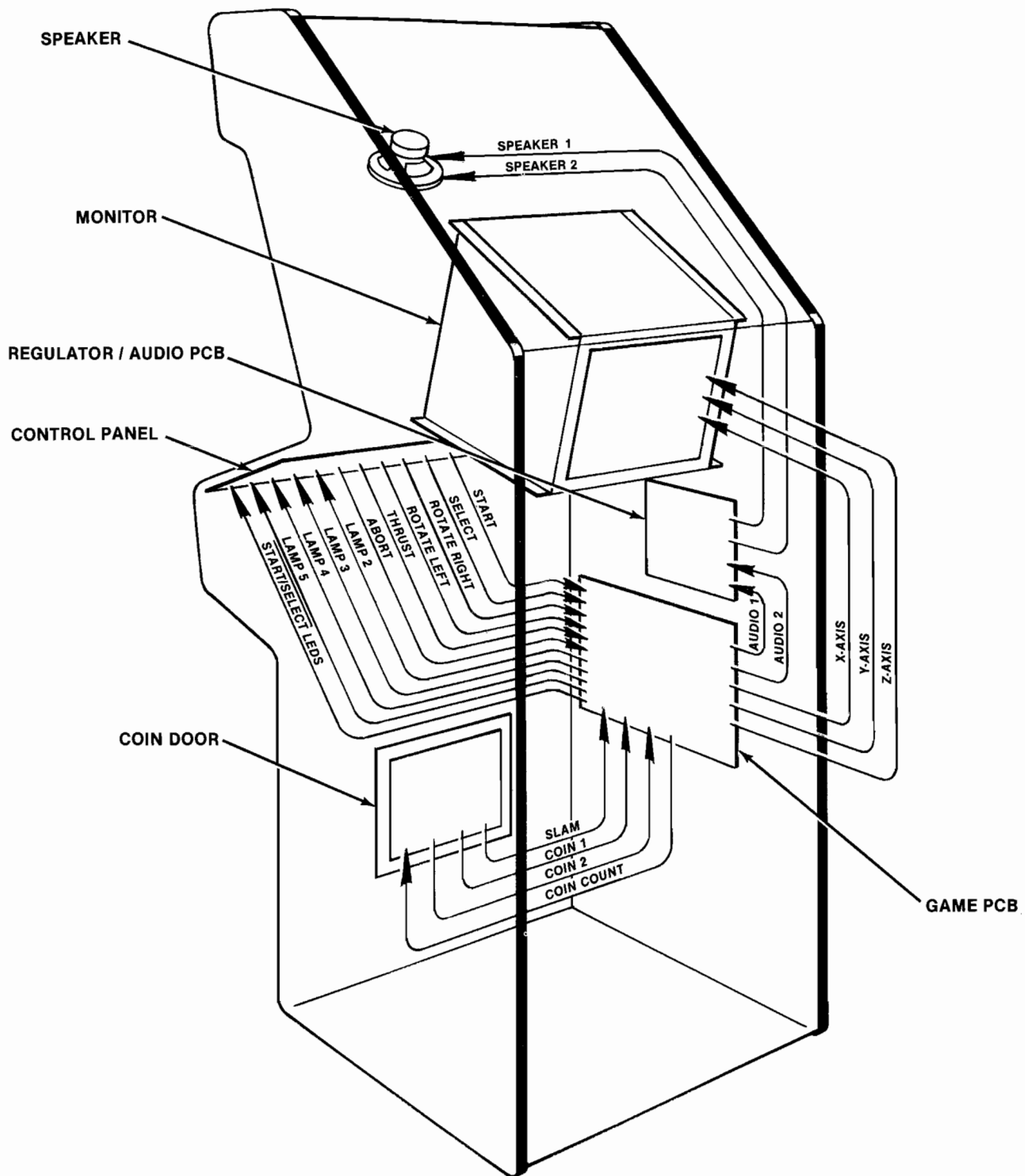


Figure 11 Signal Distribution

voltage selection plugs for four different ranges of AC line voltages; and a bank of fuses located on an easily accessible fuse block, with fuse values plainly labeled beside each fuse. (See Chapter 1, Section C, for location of power supply fuses and instructions for the voltage selection plug.)



2. Regulator/Audio PCB

The Regulator/Audio PCB is the smaller PCB, located on the left wall (standing in front of the game) of the cabinet. It was designed for two reasons: 1) to remove high-heat-producing components from the game PCB, and 2) to provide better regulation of the +5 VDC logic power for the game PCB. A description of both the regulator and audio sections of the PCB is included on Sheet 1, Side A, of the large sheets included with this manual. The schematic for the audio section is repeated on Side B of the sheet.

3. Control Panel

The control panel on the front of the game includes the Lunar Lander Mission Select PCB, Thrust Control, and four LED pushbutton switches.

The Mission Select PCB contains five #1816 lamps. Lamp 1, the INSTRUCTIONS lamp, is always on, as it is connected between +10.3 VDC and two diodes to ground. The other four lamps are lighted by signals LAMP2 thru LAMP5 from the output of the game PCB. These lamps are connected between +10.3 VDC and the collector of a transistor for each lamp. When the base of a transistor is low, the associated lamp is off. When the base voltage goes high, the lamp lights.

The Thrust Control contains a 5K ohm potentiometer that is connected between +5 VDC and ground. The wiper of the potentiometer is connected to the POTIN input of the game PCB. There is no calibration necessary for this control.

The four pushbuttons on the control panel each have light-emitting diodes (LEDs) inside their buttons. The ROTATE LEFT and ROTATE RIGHT switches are always lighted. The SELECT and START switches are lighted by the START/SELECT output signal from the game PCB. When this signal is high, the LEDs in both the SELECT and START switches are unlighted. When this signal is low, both switches are lighted.

4. Game PCB

The game PCB is the larger PCB located on the left wall of the cabinet. This PCB contains power input regulators, a microcomputer, audio generator circuit, vector generator (actually a second microcomputer), and video output circuit.

a. Power Input and Game Output

The power input circuitry to the game PCB is described on Sheet 1, Side B, of the large sheets included with this manual. Also included on this side of Sheet 1 is the schematic and functional descriptions of the game PCB's mission select output, audio output, and video output.

b. The Microcomputer

The microcomputer of the game PCB consists of a microprocessing unit (MPU), a clock circuit, a power reset and watchdog counter, NMI counter, address decoding circuit, program ROM memory, and program RAM memory. See Sheet 2, Side A of the large sheets for the schematic diagram and functional descriptions of this circuitry. This sheet also includes the schematic diagram and functional descriptions for the player control inputs to the game PCB.

A memory map is included in the address decoding circuit block of the microcomputer schematic. The memory map identifies the addresses that the MPU uses to gain access to its peripheral circuits. The ones and zeroes in the ADDRESS column indicate the address necessary for information to be passed to and from the MPU. A zero indicates that the address line is low, and a 1 indicates the line is high. Blank spaces indicate that it doesn't matter whether the address line is low or high. An A indicates that the address line is used as part of the functional address for that particular peripheral access. In the DATA column, a D indicates that the data line is used to transfer information.

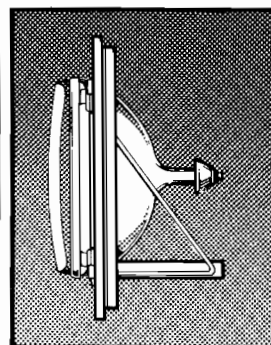
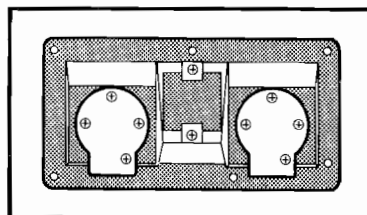
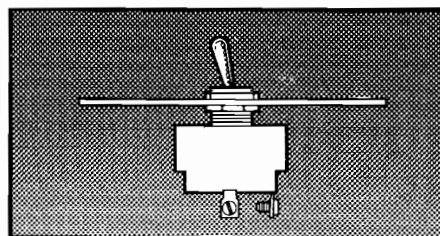
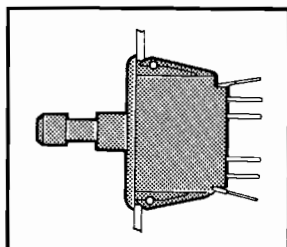
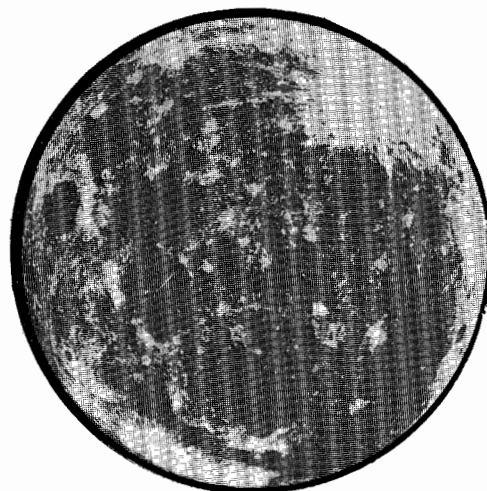
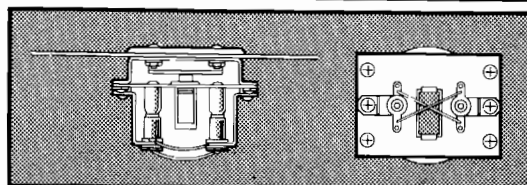
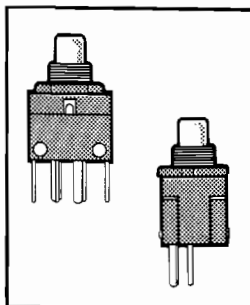


c. The Vector Generator

The inputs and outputs of the vector generator circuitry are defined on Sheet 2, Side B, of the schematic package with this manual. This circuit is in itself a semi-smart microcomputer. It receives instructions from the "game" microcomputer and once instructed what it is to do, it executes the instruction. When it is finished, it tells the microcomputer, via the HALT signal from the SINP1 switch input port, that it is through and is waiting for its next instruction.

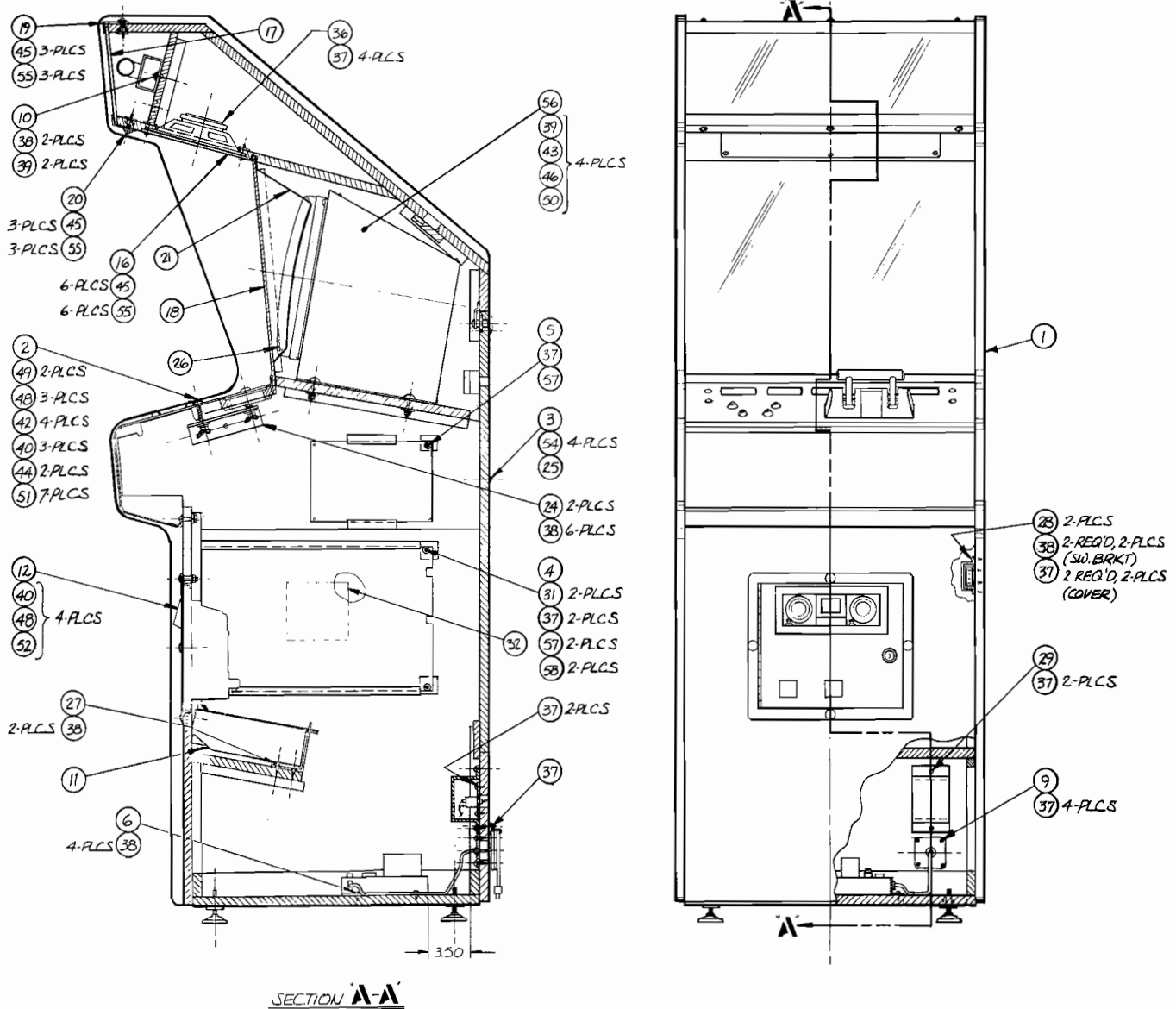
All of the picture data on the monitor screen is stored in the program memory of the vector generator. The vector generator RAM receives information from the game microcomputer that tells it what video should be displayed, i.e., rotation of the lunar lander, amount of lunar lander thrust, messages to be displayed on the monitor, etc. The vector generator then accesses this appropriate video stored in its ROM memory and outputs it to the X-Y monitor display.

illustrated parts catalog



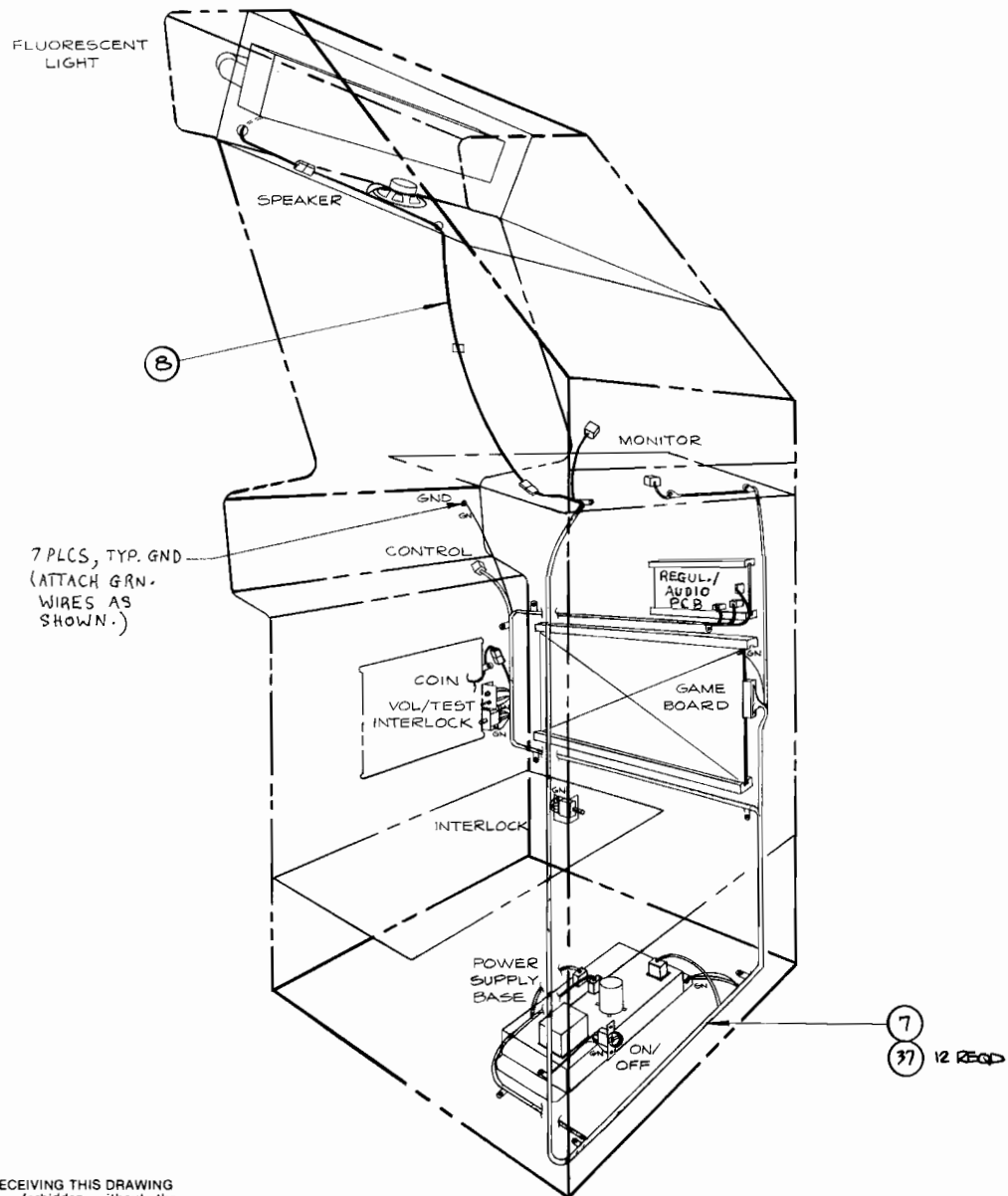
The purpose of this chapter is to provide you with the necessary information for ordering replacement parts for the Lunar Lander™ game.

When ordering parts from your distributor, give the part number, part name, applicable figure number of this catalog, and serial number of your game. This will help to avoid confusion and mistakes in your order. We hope the results will be less downtime and more profit from your game.



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Figure 12 Final Assembly
 A034480-01 C



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Figure 12 Final Assembly, continued
 A034480-01 C

**Figure 12 Final Assembly
Parts List**

Item	Part No.	Qty.	Description
1	A034470-01	1	Cabinet Assembly
2	A034460-01	1	Control Panel Assembly — see Figure 13
3	A034517-01	1	Door Panel Assembly
4	A034230-01*	1	Lunar Lander PCB Assembly (PROM version) — see Figure 15
5	A034485-01	1	Regulator/Audio PCB Assembly — see Figure 20
6	A034561-01	1	X-Y Game Power Supply Assembly — see Figure 16
7	A034626-01	1	Main Harness & Component Assembly
8	A034628-01	1	Light & Speaker Harness Assembly
9	A034841-01	1	Power Cord Assembly
11	A030268-01	1	Coin Box Assembly, consisting of the following 4 items:
11a	030269-01	1	Cash Drawer
11b	030249-01	1	Separator
11c	030247-01	1	Handle
11d	030245-01	1	Lid
12	A009083-16	1	Coin Door Assembly — see Figure 18
13	A034519-01	1	Fluorescent Light and Panel Assembly, consisting of the following two items:
13a	034478-01	1	Wood Panel for Fluorescent Light
13b	A034752-01	1	Fluorescent Light Assembly — see Figure 17
16	034457-01	1	Speaker Grille
17	034513-01	1	Attraction Panel with Graphics
18	034467-01	1	Monitor Shield
19	034515-01	1	Upper Attraction Shield Retainer
20	034516-01	1	Lower Attraction Shield Retainer
21	034518-01	1	Bezel
23	TM-136	1	Lunar Lander Technical Manual w/ Illustrated Parts Catalog
24	001638-01	2	Panel Mounting Bracket
25	005233-01	1	Rear Door Seal
26	006319-04	1	Copyright Decal (1979)
27	006870-01	1	Coin Box Bracket
28	007882-02	2	Interlock Switch Cover
29	007103-01	1	On/Off Switch Cover
31	030868-01	2	Connector Mount

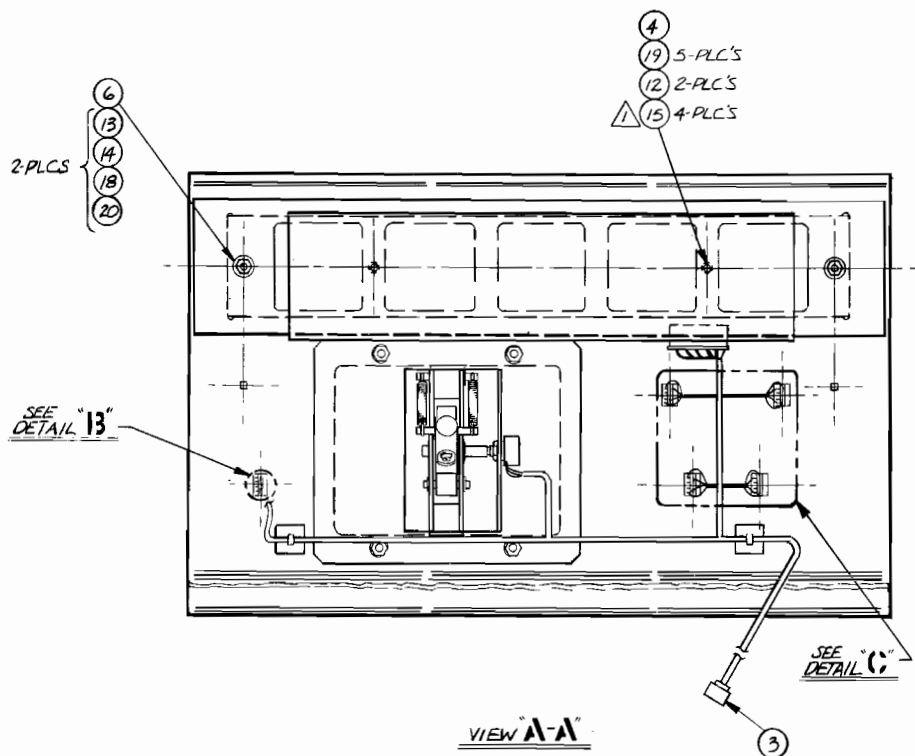
*A034230-02 is an acceptable substitute (ROM version) — see Figure 15



Figure 12 Final Assembly, continued
Parts List

Item	Part No.	Qty.	Description
32	034536-02	1	Foam Dampener
33	DP-136-01	1	Sheet 1, Lunar Lander Schematic Drawing Package
34	DP-136-02	1	Sheet 2, Lunar Lander Schematic Drawing Package
36	48-001	1	8" High-Fidelity Speaker
37	72-6610S	36	#6 × 5/8" Cross-Recessed Pan-Head Type AB Zinc-Plated Steel Thread-Forming Screw
38	72-6812S	14	#8 × 3/4" Cross-Recessed Pan-Head Type AB Zinc-Plated Steel Thread-Forming Screw
40	75-015S	4	#1/4 Flat Plain SAE-Standard Zinc-Plated Steel Washer
41	75-030S	4	#10 Flat Plain SAE-Standard Zinc-Plated Steel Washer
42	75-035S	4	#1/4 Flat Plain SAE-Standard Zinc-Plated Steel Washer
43	75-040S	4	#10 Zinc-Plated Steel Split Lock Washer
44	75-045S	7	#1/4 Zinc-Plated Steel Split Lock Washer
45	75-050B	12	#10 Black Oxide Steel Internal Tooth Lock Washer
46	75-5120N	4	#10-24 × 1 1/4" Round-Head Square-Neck Nickel-Plated Steel Bolt
47	82-1816S	2	#8 × 1" Cross-Recessed Flat Countersunk-Head Wood Screw
48	75-5520B	7	#1/4-20 × 1 1/4" Round-Head Square-Neck Black Oxide Steel Bolt
49	75-5528B	2	#1/4-20 × 1 3/4" Round-Head Square-Neck Black Oxide Steel Bolt
50	75-911C	4	#10-24 Standard Hex Pattern Corrosion-Resistant Steel Machine Nut
51	75-915C	3	#1/4-20 Standard Hex Pattern Corrosion-Resistant Steel Machine Nut
52	75-990505S	4	#1/4-20 Prevailing-Torque Shallow-Pattern Steel Lock Nut
54	82-1824S	4	#8 × 1 1/2" Cross-Recessed Flat Countersunk-Head Wood Screw
55	82-8016	12	#10-32 × 1" Hex-Socket Button-Head Hardened-Steel Machine Screw
56	92-042	1	19" X-Y Black-and-White Monitor
57	75-07017	3	Fiber Washer with 5/32" Inside Diameter × 3/8" Outside Diameter × 1/8" Thick
58	72-1406S	2	#4-40 × 3/8" Cross-Recessed Pan-Head Type AB Zinc-Plated Steel Thread-Forming Screw
59	99-11006	2	Lamp Socket Clips (set = 2 pieces)
60	70-303	1	18" 15-Watt Cool White Fluorescent Lamp
61	A021084-01	1	90-110 VAC Voltage Selection Plug (Violet Wires)
62	A021084-02	1	105-135 VAC Voltage Selection Plug (Yellow Wires)
63	A021084-04	1	200-240 VAC Voltage Selection Plug (Blue Wires)
64	A021084-05	1	220-260 VAC Voltage Selection Plug (Brown Wires)
65	75-99518	2	#8-32 Nut/Washer Assembly
66	75-935	4	#1/4-20 ANSI Type "A" Light Zinc-Plated Steel Wing Nut





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NOTE

1 ALL FIBER WASHERS
 SHOULD BE ON THE
 INSIDE OF MISSION SELECT
 PCB (4 TOTAL)

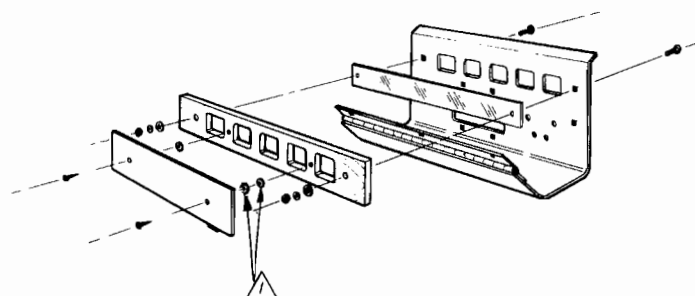
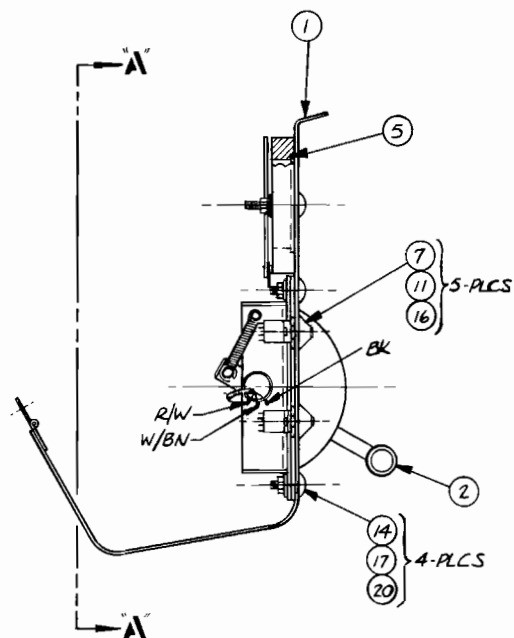
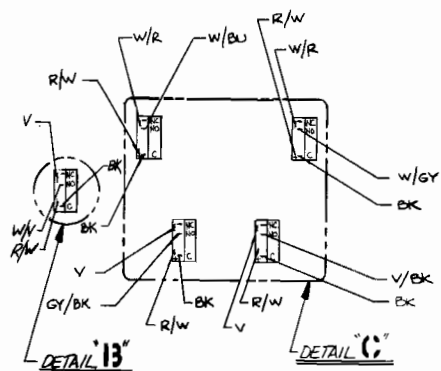


Figure 13 Control Panel Assembly
 A034460-01 C

**Figure 13 Control Panel Assembly
Parts List**

Item	Part No.	Qty.	Description
1	034511-01	1	Metal Control Panel with Graphics
2	A034442-01	1	Thrust Control Assembly — see Figure 14
3	A034627-01	1	Control Panel Harness Assembly
4	A034603-01	1	Mission Select PCB Assembly, consisting of the following five items:
4a	31-1N4001	2	50V Silicon Rectifier 1N4001 Diode (CR1,2)
4b	34-2N6044	4	Darlington NPN Transistor, Type 2N6044 (Q1-4)
4c	79-4312	5	Lamp Socket
4d	79-58281	1	7-Pin Header
4e	81-4302	4	Nylon Snap-In Fastener
5	034512-01	1	Acrylic Mission Select Panel with Graphics
6	034461-01	1	Wood Support for Mission Select PCB Assembly
7	033127-01	5	Black Molded Switch Bushing
11	62-039	5	Pushbutton LED Switch
12	72-6610S	2	#6 × 5/8" Cross-Recessed Pan-Head Type AB Zinc-Plated Steel Thread-Forming Screw
13	75-015S	2	#1/4 Flat Plain SAE-Standard Zinc-Plated Steel Washer
14	75-045	6	#1/4 Corrosion-Resistant Steel Split Lock Washer
15	75-07017	4	Fiber Washer with 5/32" Inside Diameter × 3/8" Outside Diameter × 1/8" Thick
16	75-07054	5	Nylon Flat Washer with .470" Inside Diameter × .968" Outside Diameter × .075" Thick
17	75-5512B	4	#1/4-20 × 3/4" Round-Head Square-Neck Black Oxide Steel Bolt
18	75-5528B	2	#1/4-20 × 1 3/4" Round-Head Square-Neck Black Oxide Steel Bolt
19	70-11-1816	5	#1816 Incandescent Miniature Bayonet-Base Lamp
20	75-915S	6	#1/4-20 Standard Hex-Pattern Cadmium-Plated Steel Nut



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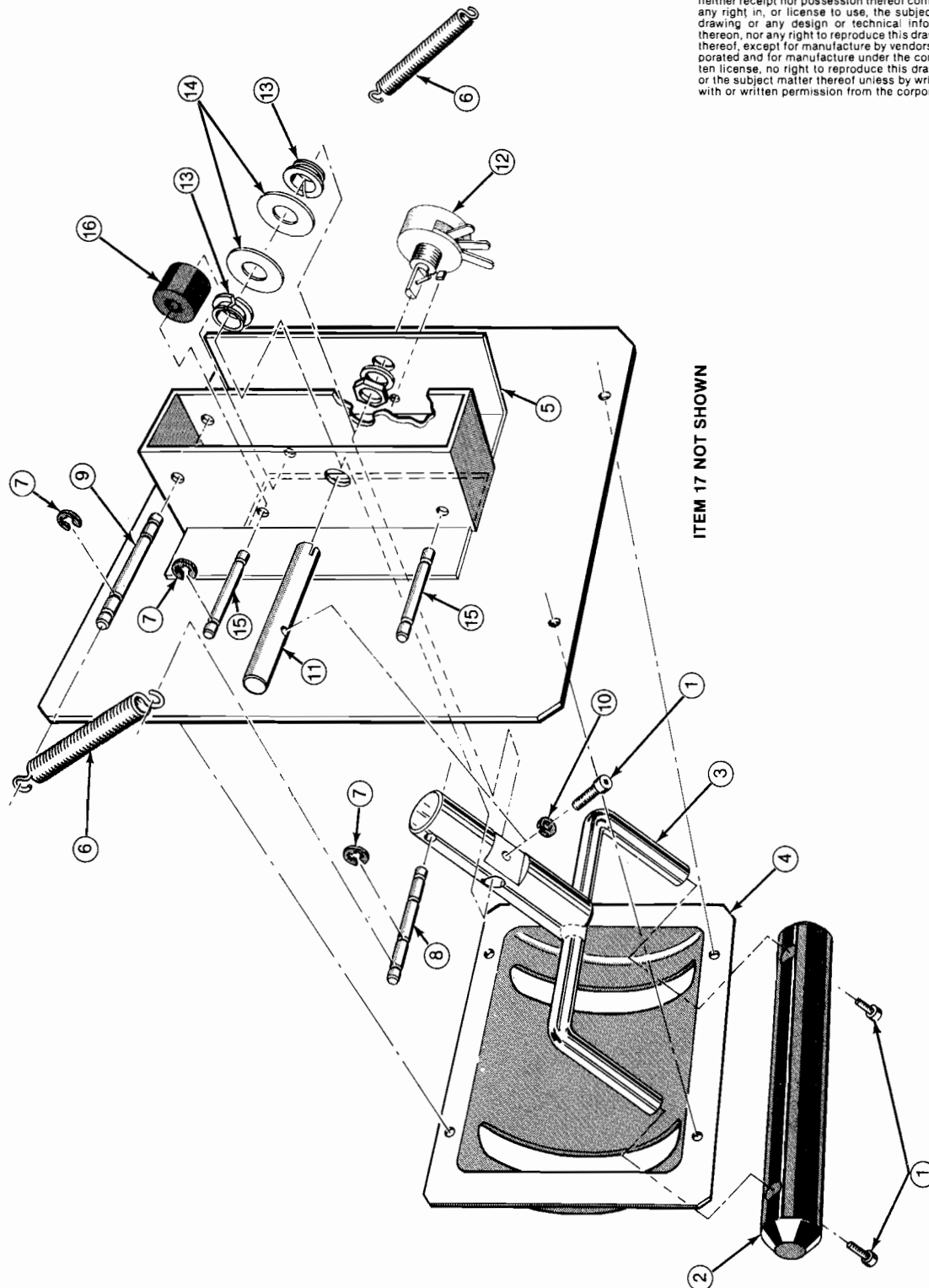


Figure 14 Thrust Control Assembly
 A034442-01 B

**Figure 14 Thrust Control Assembly
Parts List**

Item	Part No.	Qty.	Description
1	72-8812	3	#8-32 × 3/4" Hex Socket-Head Cap Alloy Steel Machine Screw
2	034448-01	1	Handle Bar
3	A034445-01	1	Handle Weldment
4	034443-01	1	Thrust Control Cover
5	A034449-01	1	Bracket Weldment
6	78-3001042	2	Spring
7	73-3001	8	Carbon Spring Steel External Retaining Ring, for 1/4" Diameter Shaft
8	034456-01	1	Spring Pin (in Handle)
9	034455-01	1	Spring Pin (in Bracket)
10	75-048	1	#8 Corrosion-Resistant Steel Split Lock Washer
11	034444-01	1	Pivot Pin
12	A034117-01	1	Variable Resistor (specially modified)
13	76-080602	2	Polymer Bearing
14	75-07060	2	Nylon Washer, with .385" Inside Diameter × 1" Outside Diameter × .031" Thick
15	034454-01	2	Stop Pin
16	034484-01	2	Neoprene Stop
17	78-1708	A/R	Silicon Grease Lubricant, Dow Chemical Part No. 14770-79



NOTE:
PERMANENT MARK '-01' OR '-02'
AFTER A034230 (-01 PROM, -02 ROM)

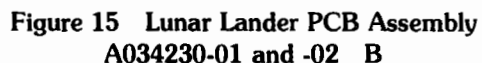


Figure 15 Lunar Lander PCB Assembly, continued
Parts List

Item	Part No.	Qty.	Description	Location
2	10-5270	1	27 Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R50)
3	10-5680	2	68 Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R49, 78)
4	10-5121	1	120 Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R75)
5	10-5151	2	150 Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R70, 71)
6	10-5331	5	330 Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R24, 25, 80-82)
7	10-5391	1	390 Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R72)
8	10-5471	4	470 Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R73, 74, 76, 77)
9	10-5102	7	1K Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R23, 51, 52, 54, 96, 99, 100)
10	10-5122	2	1.2K Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R26, 36)
11	10-5152	2	1.5K Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R21, 53)
13	10-5222	4	2.2K Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R37, 56, 84, 89)
14	10-5392	3	3.9K Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R19, 40, 57)
15	10-5472	1	4.7K Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R38)
16	10-5682	1	6.8K Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R28)
17	10-5822	1	8.2K Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R20)
18	10-5103	37	10K Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	R1-9, 31-34, 39, 41-48, 59-69, 83, 90, 95, 98)
19	10-5153	1	15K Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R18)
20	10-5223	10	22K Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R10-17, 35-55)
21	10-5473	2	47K Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R22, 79)
22	10-5563	4	56K Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R85, 86, 91, 92)
24	10-5274	1	270K Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R27)
25	12-5821	1	820 Ohm, $\pm 5\%$, 1W Carbon Composition Resistor	(R97)
26	19-007	1	10K Ohm 8-Pin Resistor Network. Use with the LS170, not the LS670 (item 78)	
27	19-315103	4	10K Ohm Vertical PCB-Mounting Cermet Trimpot, Bournes Series 3352V-1-10K	(R87, 88, 93, 94)
28	10-5394	2	390K Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R29, R30)
29	21-101104	3	.1 μ f, $\pm 10\%$, Radial-Lead Epoxy-Dipped 100V Mylar Capacitor	(C20, 21, 27)
30	24-250105	6	1.0 μ f Aluminum Electrolytic Fixed Axial-Lead 25V Capacitor	(C26, 28, 50, 70, 72, 73)



Figure 15 Lunar Lander PCB Assembly, continued
Parts List

Item	Part No.	Qty.	Description	Location
31	24-250107	1	100 μ f Aluminum Electrolytic Fixed Axial-Lead 25V Capacitor	(C49)
32	24-250477	2	470 μ f Aluminum Electrolytic Fixed Axial-Lead 25V Capacitor	(C65, 66)
33	27-250104	66	.1 μ f Ceramic-Disc 25V Radial-Lead Capacitor	(C1-14, 16-19, 22-25, 29-36, 38-41, 43, 45-28, 51, 53-56, 58-63, 67, 68, 71, 74-76, 79-83, 86-89, 95)
34	27-250103	2	.01 μ f Ceramic-Disc 25V Radial-Lead Capacitor	(C42, 90)
35	28-101100	2	10 pf Radial-Lead Epoxy-Dipped 100V Mica Capacitor	(C78, C85)
36	28-101101	2	100 pf Radial-Lead Epoxy-Dipped 100V Mica Capacitor	(C44-C92)
37	28-101271	1	270 pf Radial-Lead Epoxy-Dipped 100V Mica Capacitor	(C37)
38	28-101391	1	390 pf Radial-Lead Epoxy-Dipped 100V Mica Capacitor	(C69)
39	29-006	1	1.0 μ f, $\pm$ 10%, 35V Tantalum Capacitor	(C15)
40	21-101473	1	.047 μ f Radial-Lead Epoxy-Dipped 100V Mylar Capacitor	(C91)
41	28-101680	2	68 pf Radial-Lead Epoxy-Dipped 100V Mica Capacitor	(C93, C94)
42	31-1N914	2	75V 1N914 Switching Diode	(CR1, 12)
43	31-1N4001	4	50V 1N4001 Silicon Rectifier Diode	(CR6-9)
44	32-1N756A	2	8.2V, $\pm$ 5%, 1N756A Zener Diode	(CR10, 11)
45	32-1N5235	1	6.8V, $\pm$ 20%, 1N5235 Zener Diode	(CR2)
46	33-2N3906	2	Type 2N3906 PNP Switching and Amplifying Transistor	(Q1, Q5)
47	34-2N6044	1	Type 2N6044 Darlington NPN Transistor	(Q4)
48	28-101221	2	220 pf Radial-Lead Epoxy-Dipped 100V Mica Capacitor	(C77, C84)
49	37-74LS00	3	Type 74LS00 Integrated Circuit	(C6, N6, R9)
50	37-74LS02	1	Type 74LS02 Integrated Circuit	(D6)
51	37-7404	2	Type 7404 Integrated Circuit	(H10, B5)
52	37-74LS04	1	Type 74LS04 Integrated Circuit	(L5)
53	37-74LS08	3	Type 74LS08 Integrated Circuit	(E6, K6, B8)
54	37-74LS10	1	Type 74LS10 Integrated Circuit	(A8)
55	37-74LS14	1	Type 74LS14 Integrated Circuit	(B6)
56	37-74LS20	1	Type 74LS20 Integrated Circuit	(E5)
57	37-74LS32	2	Type 74LS32 Integrated Circuit	(M5, B9)



**Figure 15 Lunar Lander PCB Assembly, continued
Parts List**

Item	Part No.	Qty.	Description	Location
58	37-74LS42	3	Type 74LS42 Integrated Circuit	(L6, E7, E8)
59	37-74LS74	2	Type 74LS74 Integrated Circuit	(D4, A7)
60	37-7497	4	Type 7497 Integrated Circuit	(F8, H8, J8, K8)
61	37-74LS109	1	Type 74LS109 Integrated Circuit	(A9)
62	37-74LS139	2	Type 74LS139 Integrated Circuit	(L3, E4)
63	37-74LS157	5	Type 74LS157 Integrated Circuit	(F3, H3, J3, K3, F6)
64	37-74LS161	1	Type 74LS161 Integrated Circuit	(C5)
65	37-74LS164	3	Type 74LS164 Integrated Circuit	(K9, M6, M7)
66	37-74LS174	3	Type 74LS174 Integrated Circuit	(N5, N11, D8)
67	37-74191	1	Type 74191 Integrated Circuit	(C4)
68	37-74LS191	15	Type 74LS191 Integrated Circuit	(F5, H5, J5, K5, B7, C7, D7, C9, D9, E9, F9, H9, J9, P9, P10)
69	37-74LS244	3	Type 74LS244 Integrated Circuit	(B2, C2, N9)
70	37-74LS245 OR 37-8304B	2 2	Type 74LS245 Integrated Circuit Type AM8304B Integrated Circuit	(E3, R2) (same locations)
72	37-74LS251	1	Type 74LS251 Integrated Circuit	(K10)
73	37-74LS253	1	Type 74LS253 Integrated Circuit	(N8)
74	37-74LS273	4	Type 74LS273 Integrated Circuit	(F7, H7, J7, K7)
75	37-74LS367	3	Type 74LS367 Integrated Circuit	(H6, J6, M10)
76	37-74LS393	2	Type 74LS393 Integrated Circuit	(B4, D5)
77	37-74LS399	6	Type 74LS399 Integrated Circuit	(A10, B10, C10, D10, E10, F10)
78	37-74LS670 OR 37-74LS170	3 3	Type 74LS670 Integrated Circuit Type 74LS170 Integrated Circuit	(F4, H4, J4) (same locations)



Figure 15 Lunar Lander PCB Assembly, continued
Parts List

Item	Part No.	Qty.	Description	Location
80	37-LM324	2	Type LM324 Integrated Circuit	(R7, R11)
81	37-4016B	2	Type 4016B Integrated Circuit	(B12, D12)
82	37-4066	1	Type 4066 Integrated Circuit	(P5)
83	37-1408	1	Type 1408 Integrated Circuit	(N10)
84	37-TL082CP	1	Type TL082CP Integrated Circuit	(A12, C12)
85	37-AD561J	2	Type AD561J Integrated Circuit	(B11, D11)
86	37-7805	1	5V Voltage Regulator	
87	37-7815	1	15V Voltage Regulator	
88	37-7915	1	15V Voltage Regulator	
90	38-MV5053	1	Type MV5053 Light-Emitting Diode	
91	41-3003	11	100 μ H, $\pm 5\%$, Hot-Molded Plastic Fixed R.F. Choke	(L1-4, 6, 7, 9-13)
92	62-001	1	SPST Pushbutton Switch (SW 1)	
93	66-118P1T	1	8-Station Single-Throw, Dual-Inline-Package Bit Switch	(SW2, at location P8)
96	34-2N3904	2	Type 2N3904 NPN Switching Transistor	(Q2, 3)
100	81-4302	4	Nylon Snap-In Fastener	
106	020670-01	16	Test Point	
107	79-42C40	1	40-Contact Medium-Insertion-Force Integrated Circuit Socket	(C3)
109	90-102	1	12.096 MHz, $\pm .005\%$, Crystal	(Y1)
110	90-6013	1	Microprocessor	(C3)
112	90-7019	2	Random-Access Memory	(D2, E2)
113	90-7033	4	Random-Access Memory	(M4, N4, P4, R4)
116	034602-01	1	Programmable Read-Only Memory	(C8)

For remaining memory components and their
part numbers, see next page.



Figure 15 Lunar Lander PCB Assembly, continued
Parts List

Memory Chip Equivalents

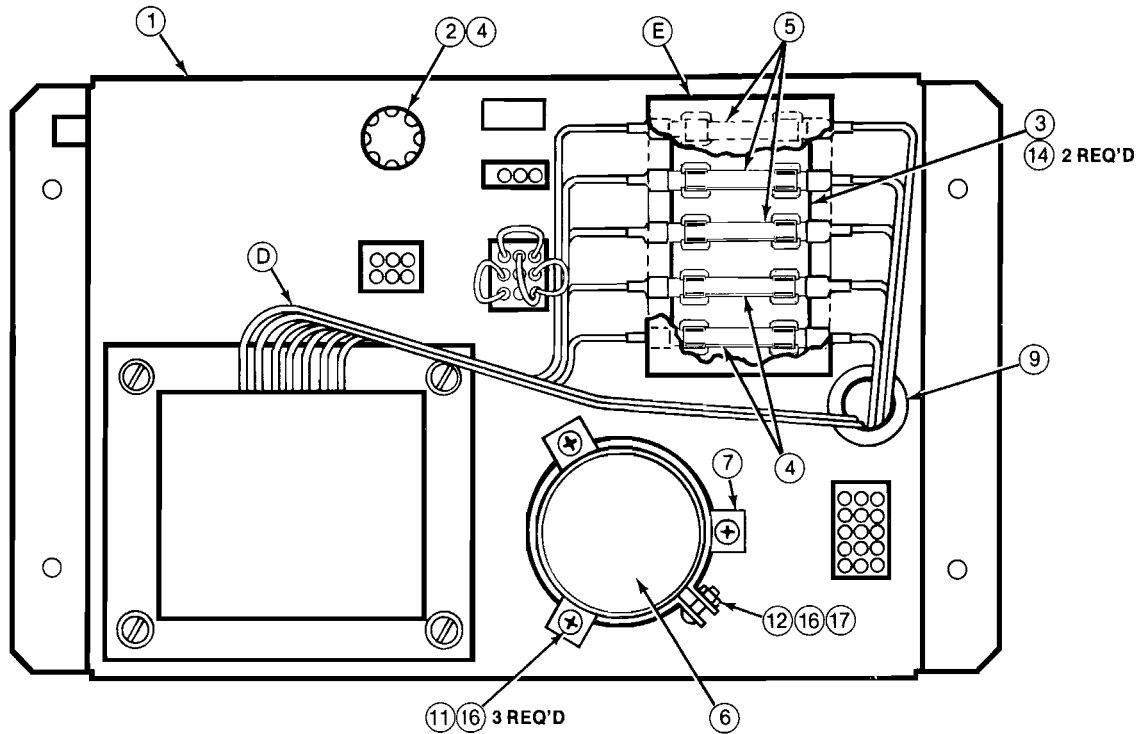
Display During Self-Test	-01 P.C. Boards (PROMs)	Alternate -01 P.C. Boards (PROMs)	-02 P.C. Boards (ROMs)
1 3 0 2		035176-01 K4 035177-01 L4	034599-01 R3
☒		035174-01 K4 035175-01 L4	034598-01 N/P3
9 11 8 10		034600-01 ¹ K4 034601-01 ¹ L4	034597-01 ¹ M3
13 15 12 14	034579-xx F2 034580-xx L2 034587-xx H1 034588-xx M1	034592-xx F2 034596-xx H1	034572-xx F1
17 19 16 18	034577-xx H2 034578-xx M2 034585-xx J1 034586-xx N1	034591-xx H2 034595-xx J1	034571-xx D/E1
21 23 20 22	034575-xx J2 034576-xx N2 034583-xx K1 034584-xx P1	034590-xx J2 034594-xx K1	034570-xx C1
No display at all	034573-xx K2 ² 034574-xx P2 ² 034581-xx L1 ² 034582-xx R1 ²	034589-xx ² K2 034593-xx ² L1	034569-xx ² B1

¹These chips contain *only* the French, German and Spanish messages. If the game is to be operated in the English language, you do not need to replace them. In fact, they may not even be supplied on a printed circuit board intended for use only in English-speaking areas. Thus in such a case you should ignore the 8 9 10 11 "bad" ROM message.

²ROM or PROMs *must* be in place for self-test to work.

-xx after some of the part numbers above means that the chip can be either an -01 or -02 version. The difference between the two versions is in the operator option switch settings. Check your game PCB to see which suffix is stamped after the part numbers on these chips (-01 or -02). Then refer to page 10 in this manual for the switch settings that correspond to your version.

TOP VIEW



NOTE:
THE FOUR AVAILABLE VOLTAGE SELECTION PLUGS ARE LISTED IN
FIGURE 12, FINAL ASSEMBLY.

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BOTTOM VIEW

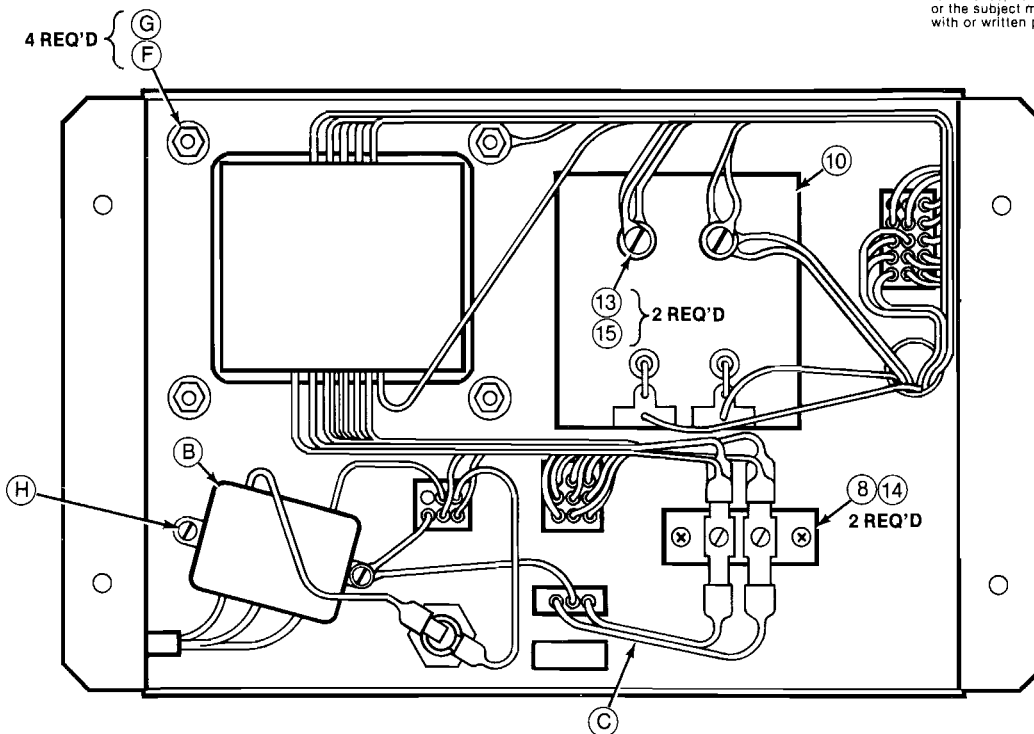
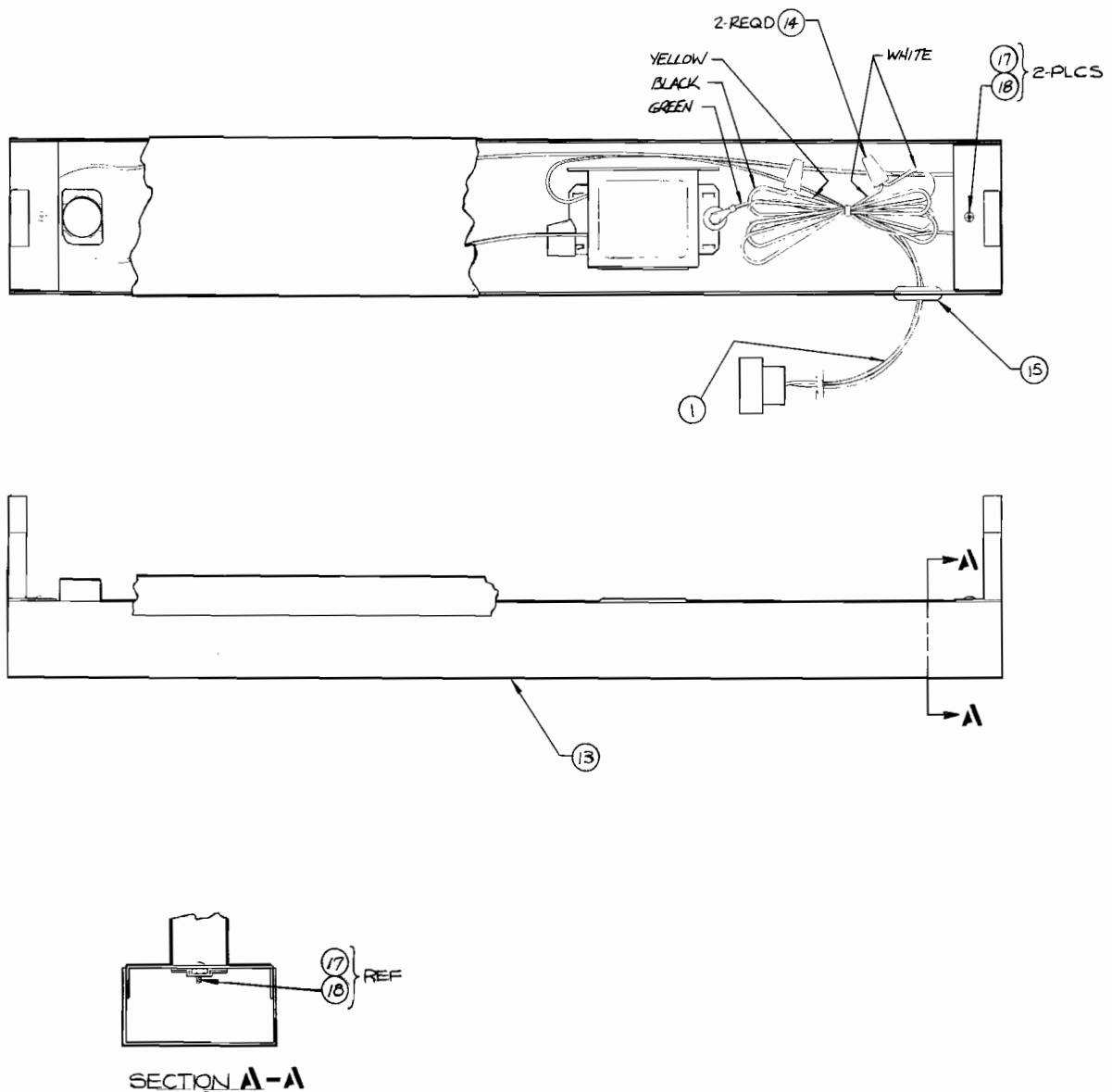


Figure 16 X-Y Game Power Supply Assembly
A034561-01 B

**Figure 16 X-Y Game Power Supply Assembly
Parts List**

Item	Part No.	Qty.	Description
A	A034955-01	1	Power Supply Sub-Assembly, consisting of the following 17 items:
1	034482-01	1	Base for Power Supply Chassis
2	79-4411006	1	Panel-Mounting Non-Indicating 3AG Cartridge-Type Fuse Post
3	79-3206	1	5-Position 3AG Fuse Block with 1/4" Quick-Disconnect Terminals
4	46-2017002	3	7-Amp. 250V 3AG Slow-Blow Glass Cartridge-Type Fuse
5	46-2013002	3	3-Amp. 250V 3AG Slow-Blow Glass Cartridge-Type Fuse
6	29-053	1	26,000 μ f 15V Electrolytic Capacitor
7	78-70501SC	1	2" Diameter Capacitor Mounting Bracket
8	79-15021001	1	2-Circuit Single-Row Terminal Block
9	78-2708	1	Nylon Type 6/6 Hole Bushing with 5/8" Inside Diameter $\times$ 55/64" Outside Diameter $\times$ 1/4" Thick
10	A006555-01	1	Rectifier Printed Circuit Board Assembly
11	72-HA4804S	3	#8-32 $\times$ 1/4" Cross-Recessed Pan-Head Zinc-Plated Steel Thread-Rolling Tri-Fluted "Taptite" Screw
12	72-HA4812S	1	#8-32 $\times$ 3/4" Cross-Recessed Pan-Head Zinc-Plated Steel Thread-Rolling Tri-Fluted "Taptite" Screw
13	72-1008F	2	#10-32 $\times$ 1/2" Cross-Recessed Pan-Head Zinc-Plated Steel Machine Screw
14	72-HA4606S	4	#6-32 $\times$ 3/8" Cross-Recessed Pan-Head Zinc-Plated Steel Thread-Rolling Tri-Fluted "Taptite" Screw
15	75-010S	2	#10 Flat Plain SAE-Standard Zinc-Plated Steel Washer
16	75-018S	4	#8 Flat Plain SAE-Standard Zinc-Plated Steel Washer
17	75-99518	1	#8-32 Nut/Washer Assembly
B	A034630-01	1	RFI Filter Assembly
C	A034629-01	1	A.C. Harness Assembly
D	A034623-02	1	Power Supply Harness Assembly (for X-Y Games)
E	034544-01	1	Fuse Block Cover
F	75-018S	4	#8 Flat Plain SAE-Standard Zinc-Plated Steel Washer
G	75-99518	4	#8-32 Nut/Washer Assembly
H	72-HA4812S	2	#8-32 $\times$ 3/4" Cross-Recessed Pan-Head Zinc-Plated Steel Thread-Rolling Tri-Fluted "Taptite" Screw





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Figure 17 Fluorescent Light Assembly
 A034752-01 A

**Figure 17 Fluorescent Light Assembly
Parts List**

Item	Part No.	Qty.	Description
1	A005493-01	1	18" Fluorescent Light Harness
13	93-113	1	18" Fluorescent Lamp Fixture with Starter
14	79-561816P	2	Spring Connector Wire Nut for 16- to 18-Guage Wires
15	78-2652	2	Rubber Grommet, with 5/8" Inside Diameter × 1 1/8" Outside Diameter × 5/16" Thick, for 7/8" Diameter Sheet-Metal Holes
17	75-916S	2	#6-32 Standard Cadmium-Plated Steel Hex Nut
18	72-1608S	2	#6-32 × 1/2" Cross-Recessed Pan-Head Cadmium-Plated Steel Machine Screw



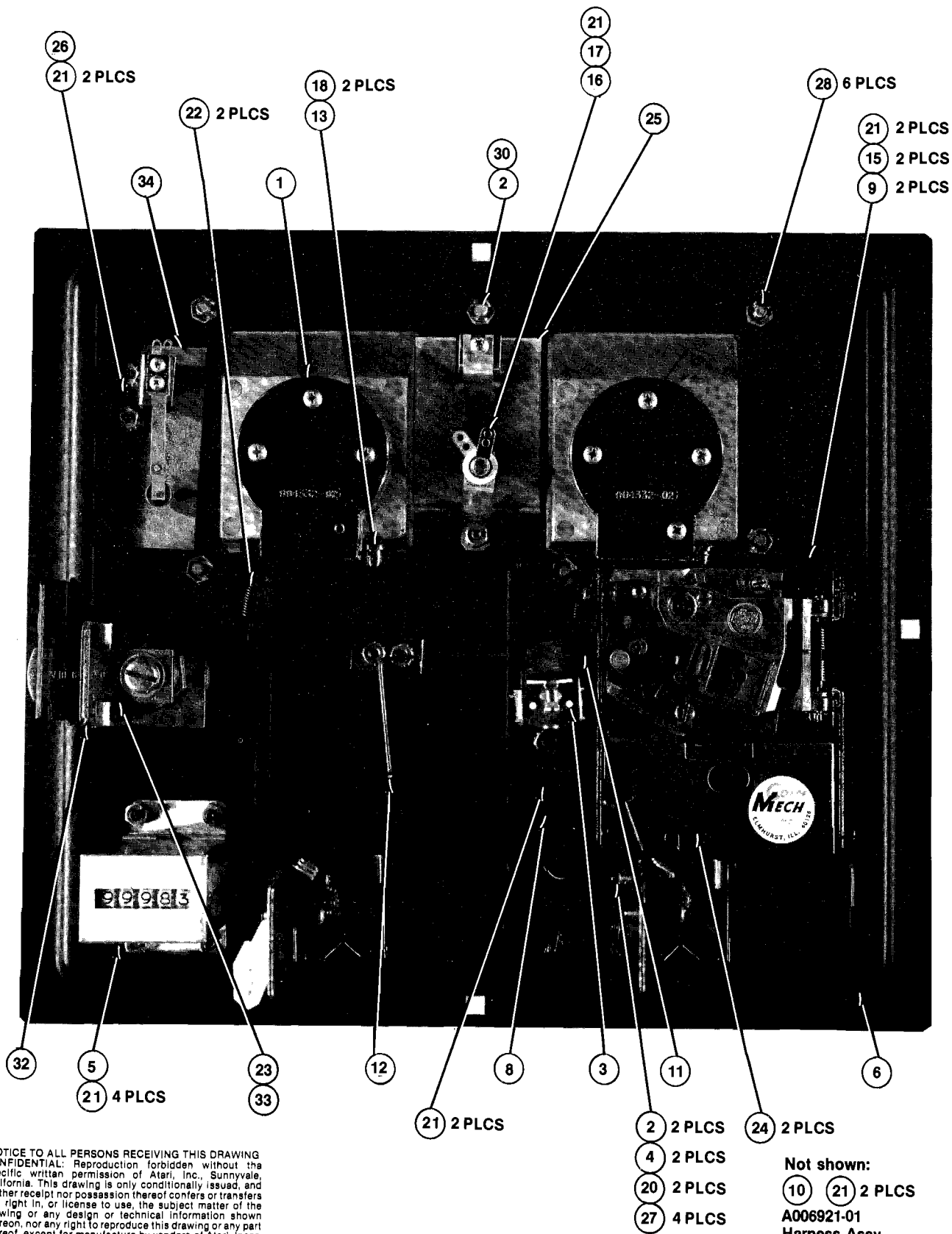


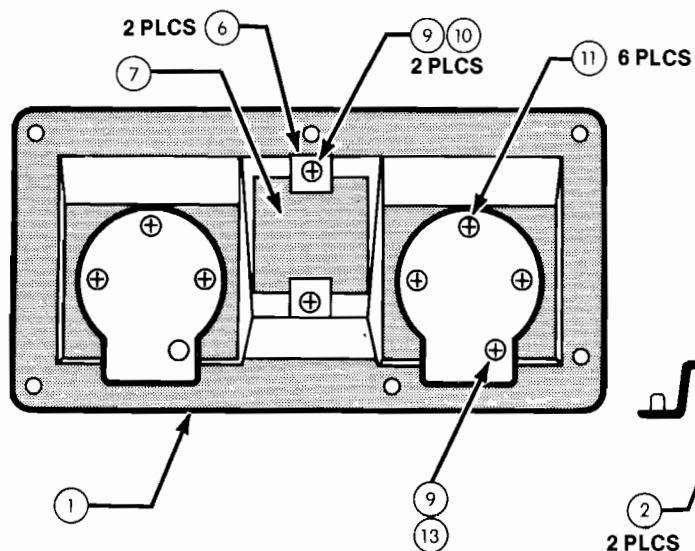
Figure 18 Coin Door Assembly
A006794-16 thru -27 J

**Figure 18 Coin Door Assembly
Parts List**

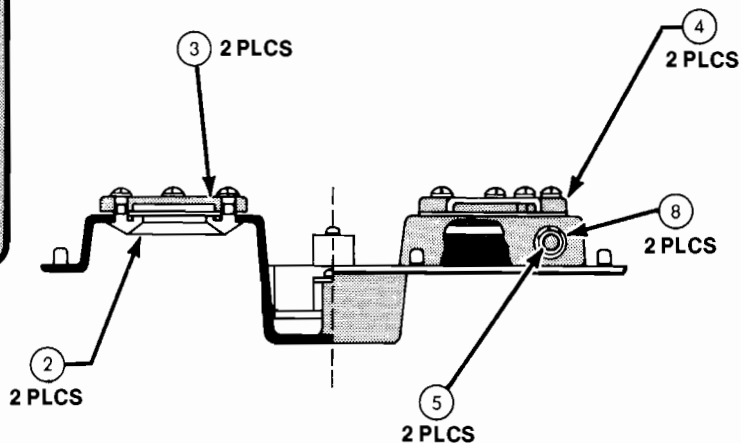
Item	Part No.	Qty.	Description
1	A007637-16 A007637-17 A007637-18 A007637-19 A007637-20 A007637-21 A007637-22 A007637-23 A007637-24 A007637-25 A007637-26 A007637-27	↑ One of these used per coin door ↓	Front Bezel Assy.—Used only on -16 Coin Door Assy. (25¢) Front Bezel Assy.—Used only on -17 Coin Door Assy. (5 Fr) Front Bezel Assy.—Used only on -18 Coin Door Assy. (1 DM) Front Bezel Assy.—Used only on -19 Coin Door Assy. (1 Kr) Front Bezel Assy.—Used only on -20 Coin Door Assy. (100 Y) Front Bezel Assy.—Used only on -21 Coin Door Assy. (10 pence) Front Bezel Assy.—Used only on -22 Coin Door Assy. (20¢ Australian) Front Bezel Assy.—Used only on -23 Coin Door Assy. (1 DM/2 DM) Front Bezel Assy.—Used only on -24 Coin Door Assy. (1 Fr) Front Bezel Assy.—Used only on -25 Coin Door Assy. (1 Baht) Front Bezel Assy.—Used only on -26 Coin Door Assy. (1 DM/5 DM) Front Bezel Assy.—Used only on -27 Coin Door Assy. (100 Lire) <i>For breakdown of Front Bezel Assy., see Figure 19</i>
2	72-HA4608C	3	#6-32 × 1/2" Cross-Recessed Pan-Head Cadmium-Plated Steel Tri-Fluted Thread-Rolling Screw
3	A030362-01	1	Coin Lockout Assembly
4	A030250-01	2	Coin Switch Assembly
5	A002465-01	1	Coin Counter Assembly
6	004320-01	1	Coin Door Weldment
8	004344-01	1	Key Loop
9	004340-01	2	Spring Return (used only on German DM coin doors)
10	004337-01	2	Bracket for Lock-Out Wires
11	004338-01	1	Right-Hand Lock-Out Wire
12	004336-01	1	Left-Hand Lock-Out Wire
13	004326-01	2	Scavenger Button
15	006904-01	2	Spacer (used only on German DM coin doors)
16	030257-01	1	Lamp Socket
17	70-11-47	1	NEMA #47 Incandescent Miniature Bayonet-Base Lamp
18	73-3008	2	Carbon Spring Steel External Retaining Ring, for 1/4" Diameter Shaft
20	72-HA4604C	2	#6-32 × 1/4" Cross-Recessed Pan-Head Cadmium-Plated Steel Tri-Fluted Thread-Rolling Screw
21	75-99516	13*	#6-32 Steel Nut and Spring Washer Assembly *Quantity of 15 is used on the German DM coin doors
22	008629-01	2	Spring
23	71-2118	1	Cam Lock, Hudson #CR73A045S
24	71-1225CU 71-1205FF 71-1201MG 71-1201KS 71-12100YJ 71-1210PE 71-1220CA 71-1202MG 71-1201FF 71-1201BT 71-1205MG 71-12100LI	↑ 2 of any of these used per coin door, as required ↓	Coin Mechanism for American Quarter Coin Mechanism for French 5-Francs Coin Coin Mechanism for German 1-Mark Coin Coin Mechanism for Swedish 1-Krona Coin Coin Mechanism for Japanese 100-Yen Coin Coin Mechanism for English 10-Pence Coin Coin Mechanism for Australian 20-Cent Coin Coin Mechanism for German 2-Mark Coin Coin Mechanism for French 1-Franc Coin Coin Mechanism for Thai 1-Baht Coin Coin Mechanism for German 5-Mark Coin Coin Mechanism for Italian 100-Lire Coin

**Figure 18 Coin Door Assembly, continued
Parts List**

Item	Part No.	Qty.	Description
25	007753-01	1	Anti-Probe Plate
26	A007638-01	1	Slam Switch Assembly
27	75-036S	4	#6 Flat Plain SAE-Standard Zinc-Plated Steel Washer
28	73-3025	6	Carbon Spring Steel External Retaining Ring, for 0.184" Diameter Shaft
30	75-056	1	#6 Internal-Tooth Zinc-Plated Steel Lock Washer
32	033368-01	1	Lock Bracket
33	033369-01	1	Lock Arm
34	033371-01	1	Slam Switch Insulator



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**Figure 19 Front Bezel Assembly
A007637-16 thru -27 G**

**Figure 19 Front Bezel Assembly
Parts List**

Item	Part No.	Qty.	Description
1	004328-02	1	Bezel
2	004330-02	↑ Two of these used per coin door ↓	Ring for American Quarter
	004330-02		Ring for French 5-Franc Coin
	009153-02		Ring for German 1-Deutschmark Coin
	004330-02		Ring for Swedish 1-Krona Coin
	009153-02		Ring for Japanese 100-Yen Coin
	007752-02		Ring for English 10-Pence Coin
	007752-02		Ring for Australian 20¢ Coin
	030677-02		Ring for German 2-Deutschmark Coin
	009153-02		Ring for French 1-Franc Coin
	030677-02		Ring for Thai 1-Baht Coin
	007752-02		Ring for German 5-Deutschmark Coin
	030677-02		Ring for Italian 100-Lire Coin
3	004331-02	2	Coin Shield
4	004332-02	2	Primary Coin Chute
5	004327-01	2	Scavenger Button Bearing
6	004328-01	2	Price Plate Clamp
7	004343-01	↑ One of these used per coin door ↓	Price Plate—25¢
	004343-06		Price Plate—5 FR
	004343-04		Price Plate—1 DM
	004343-03		Price Plate—1 KR
	004343-05		Price Plate—¥ 100
	004343-02		Price Plate—10 P
	004343-07		Price Plate—20¢ Australian
	004343-08		Price Plate—Einwurf 1 DM/2 DM
	004343-09		Price Plate—1 FR
	004343-10		Price Plate—1 Baht
	004343-11		Price Plate—Einwurf 1 DM/5 DM
	004343-12		Price Plate—100 Lire
8	73-3009	2	Carbon Spring Steel External Retaining Ring, for 3/8" Shaft Diameter
9	72-1604S	3	#6-32 x 1/4" Cross-Recessed Pan-Head Cadmium-Plated Steel Machine Screw
10	75-046	2	#6 Corrosion-Resistant Steel Split Lock Washer
11	72-CL606	6	#6-32 x 3/8" Phillips Pan-Head Steel "RoloK" Self-Threading, Thread-Rolling Machine Screw
13	75-056	1	#6 Internal-Tooth Zinc-Plated Steel Lock Washer



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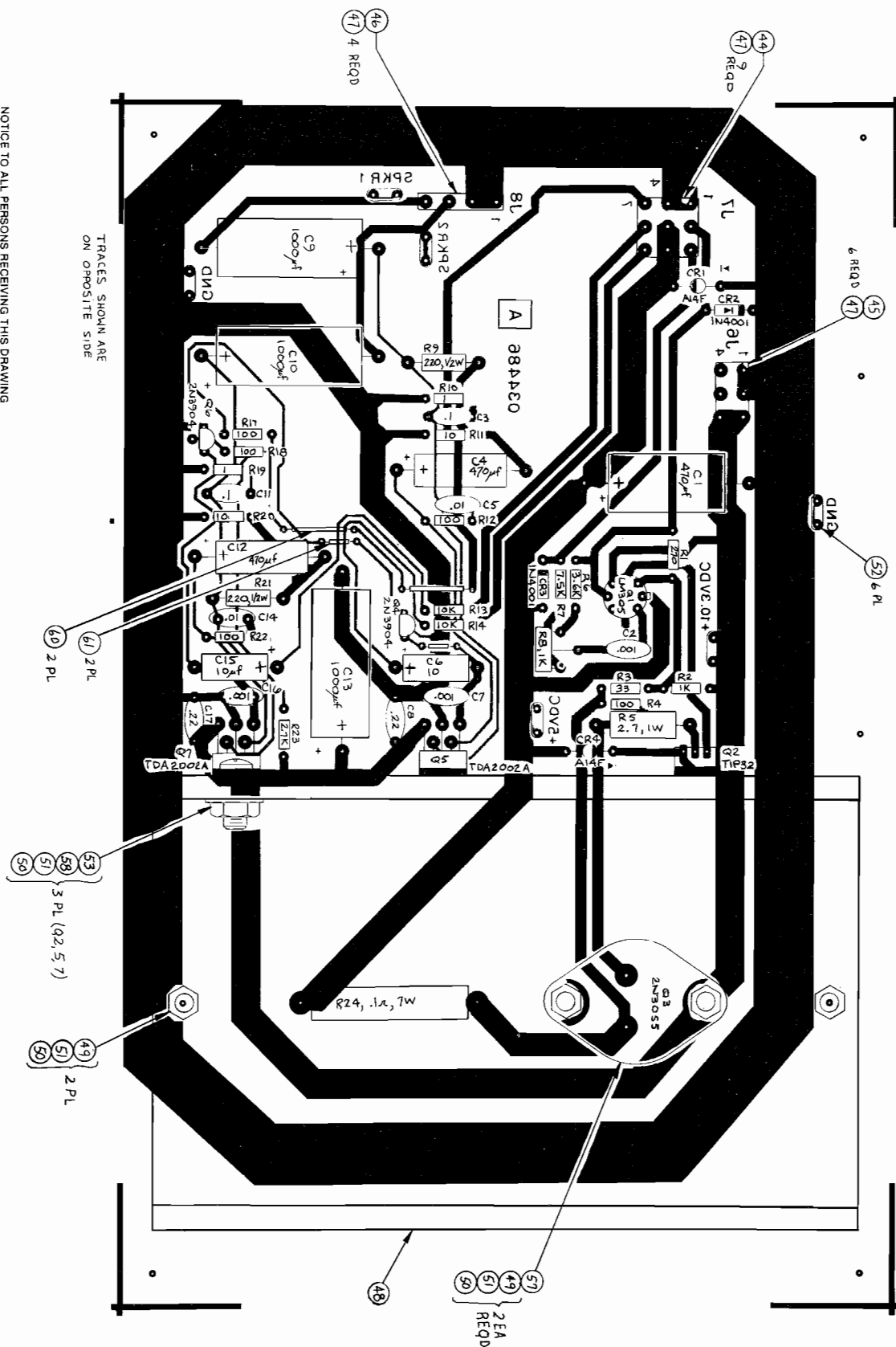


Figure 20 Regulator/Audio PCB Assembly
 A034485-01 D

**Figure 20 Regulator/Audio PCB Assembly
Parts List**

Item	Part No.	Qty.	Description	Ref. Design/ Location
2	10-51P0	2	1 Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R10, 19)
3	10-5100	2	10 Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R11, 20)
4	10-5330	1	33 Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R3)
5	10-5101	5	100 Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R4, 12, 17, 18, 22)
6	10-5271	1	270 Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R1)
7	10-5102	1	1K Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R2)
8	10-5272	1	2.7K Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R23)
9	10-5752	1	7.5K Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R7)
10	10-5103	2	10K Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R13, 14)
11	10-5392	1	3.9K Ohm, $\pm 5\%$, $\frac{1}{4}W$ Carbon Composition Resistor	(R6)
13	11-5221	2	220 Ohm, $\pm 5\%$, $\frac{1}{2}W$ Carbon Composition Resistor	(R9, 21)
15	12-52P7	1	2.7 Ohm, $\pm 5\%$, 1W Carbon Composition Resistor	(R5)
16	19-100P1015	1	.1 Ohm, $\pm 3\%$, 7W Wirewound Resistor	(R24)
17	19-315102	1	1K Ohm Vertical PCB-Mounting Cermet Trimpot, Bournes Series 3352V-1-1K	(R8)
20	24-250106	2	10 μf Aluminum Electrolytic Fixed Axial-Lead 25V Capacitor	(C6, 15)
22	24-250477	3	470 μf Aluminum Electrolytic Fixed Axial-Lead 25V Capacitor	(C1, 4, 12)
23	24-250108	3	100 μf Aluminum Electrolytic Fixed Axial-Lead 25V Capacitor	(C9, 10, 13)
25	27-250103	2	.01 μf Ceramic-Disc 25V Radial-Lead Capacitor	(C5, C14)
26	27-250104	2	.1 μf Ceramic-Disc 25V Radial-Lead Capacitor	(C3, C11)
27	27-250224	2	.22 μf Ceramic-Disc 25V Radial-Lead Capacitor	(C8, 17)
29	27-250102	3	.001 μf Ceramic-Disc 25V Radial-Lead Capacitor	(C2, 7, 16)
31	31-A14F	2	50V 2.5A Miniature Axial-Lead High-Current Rectifier	(CR1, CR4)
32	31-1N4001	2	50V Silicon Rectifier 1N4001 Diode	(CR2-3)
34	33-TIP32	1	PNP Power Transistor, Type TIP32	(Q2)
35	34-2N3055	1	NPN Silicon Transistor, Type 2N3055	(Q3)
36	34-2N3904	2	NPN Silicon Transistor, Type 2N3904	(Q4, 6)
38	37-LM305	1	5V Linear Voltage Regulator	(Q1)
39	37-TDA2002A	2	Type TDA2002A 8W Linear Audio Amplifier Integrated Circuit	(Q5, 7)



Figure 20 Regulator/Audio PCB Assembly, continued
Parts List

Item	Part No.	Qty.	Description	Location
44	79-58308	1	9-Position Connector Receptacle	(J7)
45	79-58306	1	6-Position Connector Receptacle	(J6)
46	79-58305	1	4-Position Connector Receptacle	(J8)
48	034531-01	1	Heat Sink	
49	72-1608C	4	#6-32 × 1/2" Cross-Recessed Pan-Head Corrosion-Resistant Steel Machine Screw	
50	75-99516	4	#6-32 Nut/Washer Assembly	
51	75-056	4	#6 Internal-Tooth Steel Lock Washer	
52	020670-01	6	Test Point	
53	75-F60805	3	#6-32 × 1/2" Binder-Head Nylon Screw	
57	78-16008	1	Thermally Conductive Compound for the 2N3055	
58	78-16014	3	Thermally Conductive Compound for TDA2002A and TIP32	
60	52-003	2	Teflon-Insulated Solder-Plated Solid Copper PCB-Mounting Jumper Wire with .6" Centers	
61	52-004	2	Teflon-Insulated Solder-Plated Solid Copper PCB-Mounting Jumper Wire with .3" Centers	



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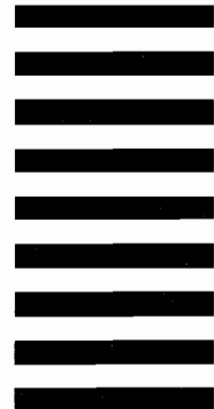


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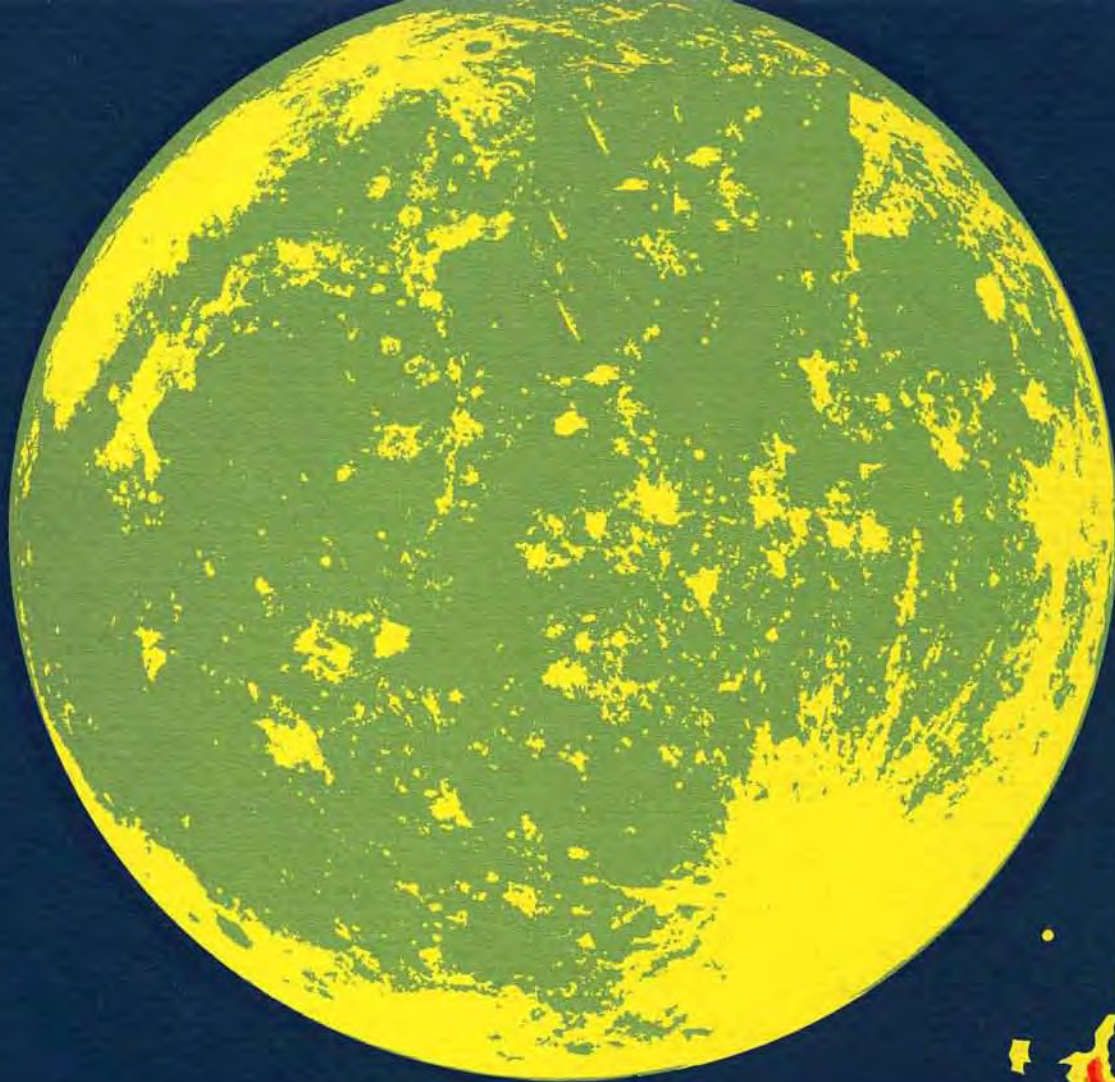
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