TM-095
1st PRINTING

Operation, Maintenance and Service Manual

Complete with Illustrated Parts Catalog

KEE GAMES
a wholly
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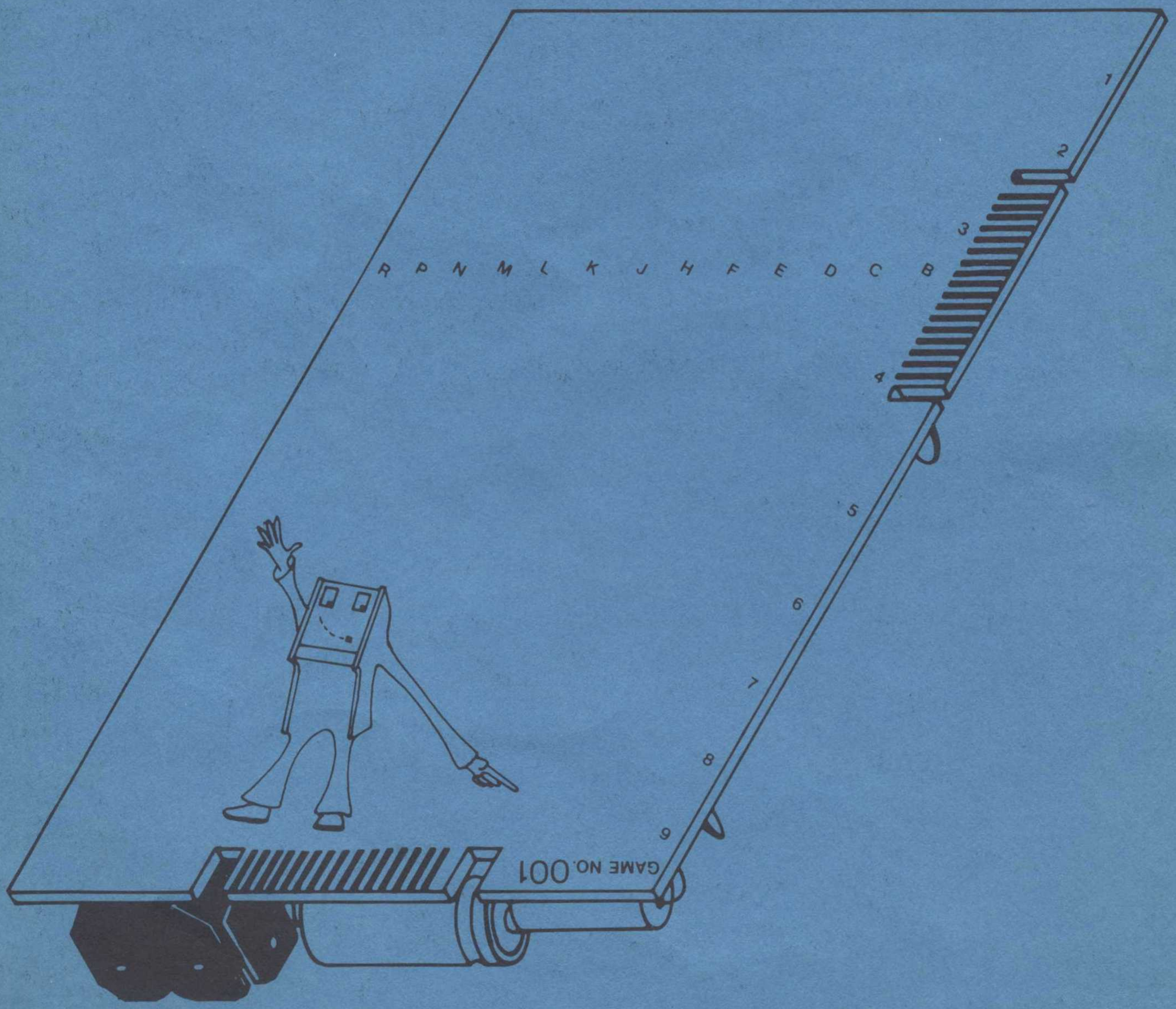
of Atari, Inc.

sprint one™

Woodgrain and Graphics Versions

GAME SERIAL NUMBER LOCATION

Your game's serial number is stamped on the circuit (back) side, bottom right corner, of the printed circuit board—see the illustration below. The *same* number is also stamped on the TV monitor chassis and on the label located on the rear of the game cabinet. Please mention this number whenever calling your distributor for service.



Woodgrain and Graphics Versions

sprint one™

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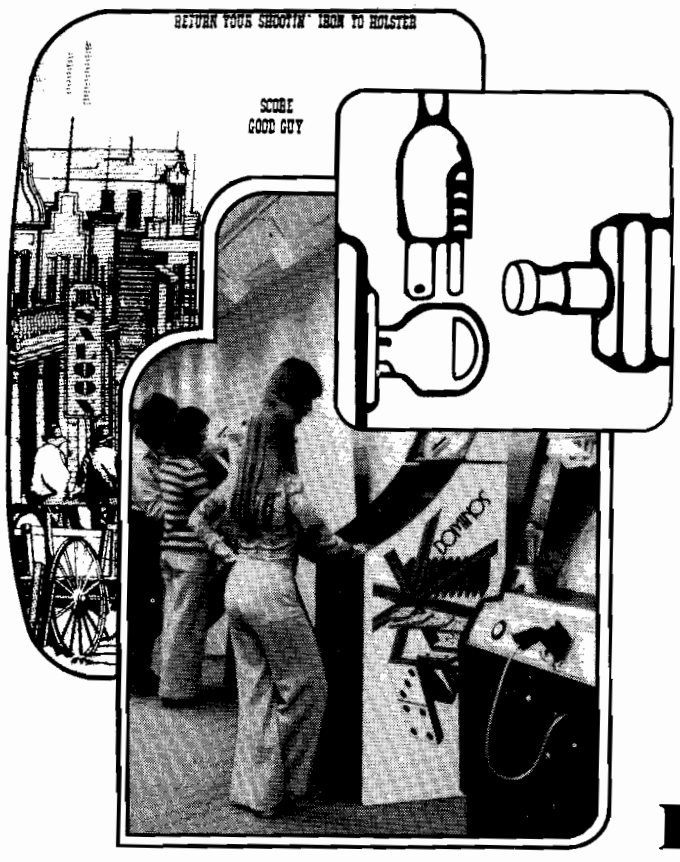


LOCATION SETUP

A. INTRODUCTION

Sprint One™ is a one-player driving game developed by Kee Games. The game is contained in an upright cabinet of either a woodgrain finish or one which is illustrated with brightly colored graphics to further enhance player appeal. A 23-inch TV monitor is mounted in the top front of the cabinet, with the monitor screen tilted back from the vertical. The TV monitor viewing screen is covered with a Plexiglas® panel.

Player-operated controls are mounted directly below the TV monitor viewing screen on the front of the game cabinet. The controls consist of a steering wheel, a four-speed gear shifter, an accelerator foot pedal, and an LED switch labeled START. A speaker mounted above the steering wheel in the upper shelf of the woodgrain cabinet version or above the TV monitor in the upper shelf of the graphics cabinet version provides the game sound.

Two identical coin mechanisms are mounted on the lower front center of the cabinet, below the steering and shifting controls. Either coin mechanism can initiate play. The cash box is located behind a locked access door to the coin mechanisms.

The player's objective is to successfully keep his or her car within the boundaries of the race track and complete as many laps as possible before the end of game time. After the proper coins have been inserted into the coin mechanism, the player must press the START button. This begins the game play and the timer starts counting down from 100. Operating the white car, the player competes with the two black computer-controlled cars. As each cycle is completed, the track automatically changes, becoming progressively more difficult until the twelfth track is reached. A cycle consists of one or two laps, depending on which option has been selected. (See Table 1-1.)

Acceleration is simulated to that of a real car. The car will accelerate slowly if started in anything but first gear. Starting in first gear will enable the car to accelerate normally. Once the car is moving, shifting into progressively higher gears will increase the speed of the car. If the car goes into a turn too rapidly, the car will go into a driver-controllable skid, with the sound of the skid on the game speaker. Whenever the player's car comes in contact with any of the other three cars or with an oil slick, the car goes into a semi-controllable skid. If the player's car makes contact with the track boundary, a crash sound will be heard and the car will stop.

By passing through checkpoint areas on the track, a score is tallied at the top of the TV monitor screen. Ten points are awarded for the completion of each lap. The checkpoint areas, however, are not identified on the displayed track.

The outstanding feature of Sprint One therefore, is that it is a highly competitive game. Players must compete against themselves, as well as against the two computer-controlled cars.

B. GAME INSPECTION

Your new Sprint One game is manufactured by Kee Games with the intent of being ready to play immediately upon removal from the shipping carton. Your cooperation is needed to supply the final touch of quality control. Please follow the procedures below to ensure that your game is in perfect condition.

1. Examine all external parts of the game cabinet for dents, chips, or broken parts.

2. After determining that the game has been received in good condition, unlock and open the rear access door. Carefully inspect the interior and verify that:

   - All plug-in connectors are firmly seated.
   - The fuses are all seated in their holders.
   - No harness wires are disconnected.
   - No loose foreign objects are present, especially metal objects that could cause electrical problems.

Be sure all major assemblies are checked. Check the game printed circuit board (PCB), the transformer, the two coin mechanisms, the speaker, the player controls, and the TV monitor chassis.

C. INSTALLATION REQUIREMENTS

Power Requirements and Line Voltage Selection

Sprint One is shipped for operation at 110 VAC, 60 Hz, single-phase, rated at about 200 watts. However, if your local current is not 110 volts, follow this procedure. You must select one of four connectors at the power supply and plug it into the voltage selection socket. Figure 1-1 shows the four connectors, with one of them plugged in. The plugs are identified by wire color as listed in this figure. Note that there are two basic operating voltages—110VAC, 60 Hz and 220 VAC, 50 Hz, with provisions for low line voltage in each case. To insure proper operation, measure line voltage. If voltage is consistently below 100 V (for 110 VAC lines) or below 210 V (for 220 VAC lines), use the low-voltage connections.

Temperature Range

Location and storage temperatures should not be below 0 degrees Celsius (32 degrees Fahrenheit),

LINE VOLTAGE	VOLTAGE-CHANGING PLUG WIRE COLOR
95 VAC	BLACK
110 VAC	ORANGE (installed at factory)
210 VAC	GREEN
220 VAC	RED

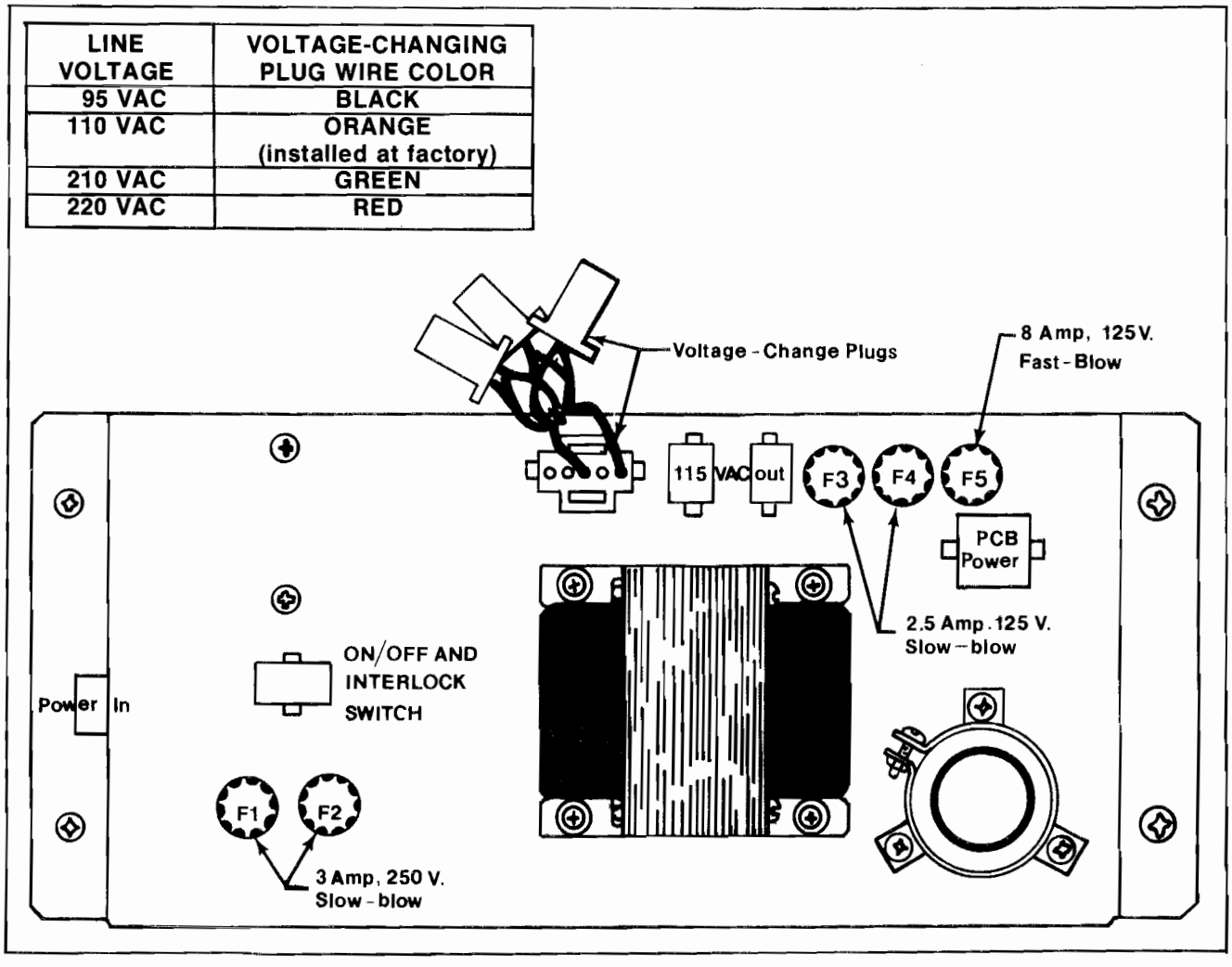


Figure 1-1 Location of Voltage-Changing Plugs on the Power Supply

and no higher than 49 degrees Celsius (120 degrees Fahrenheit).

Humidity Range

Relative humidity for location or storage should be no more than 95%.

Location Space Requirements

The Sprint One game requires a minimum of 152 centimeters (60 inches) of vertical space; a minimum of 64 centimeters (25¼ inches) of width clearance; and 137 centimeters (54 inches) of depth clearance, including 76 centimeters (30 inches) of actual cabinet depth.

Type of Power Cord

Kee Games has added a strain relief power cord to Sprint One. The advantage of this type of power cord is that, if pulled accidentally, the strain relief will hold the cord in place at the cabinet wall. The plastic strain relief "cushions" the impact of the shock and prevents the cord from pulling the wires out of the harness connector.

D. INTERLOCK AND POWER ON/OFF SWITCHES

To minimize the hazard of electrical shock while you are working inside the game cabinet, an interlock switch has been installed at the rear access door. This switch removes all power from the game while the access door is open.

To help you conserve energy, a power on/off switch has been installed on the Sprint One game so that it can be turned off during closed periods. The switch is located above the foot pedal in a recess, as shown in Figure 1-2.

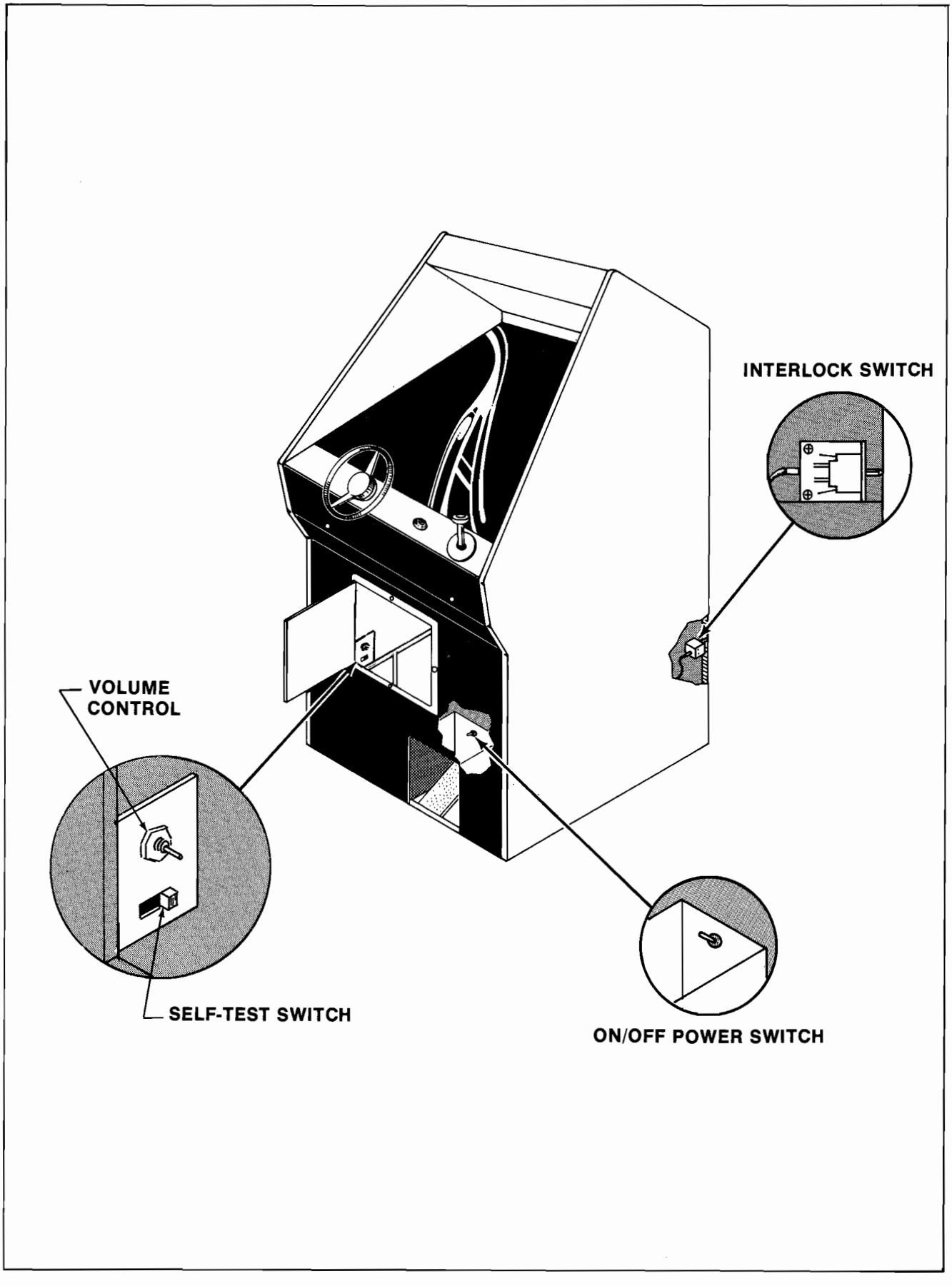


Figure 1-2 Location of On/Off, Interlock, Self-Test Switches, and Volume Control (Woodgrain Cabinet)

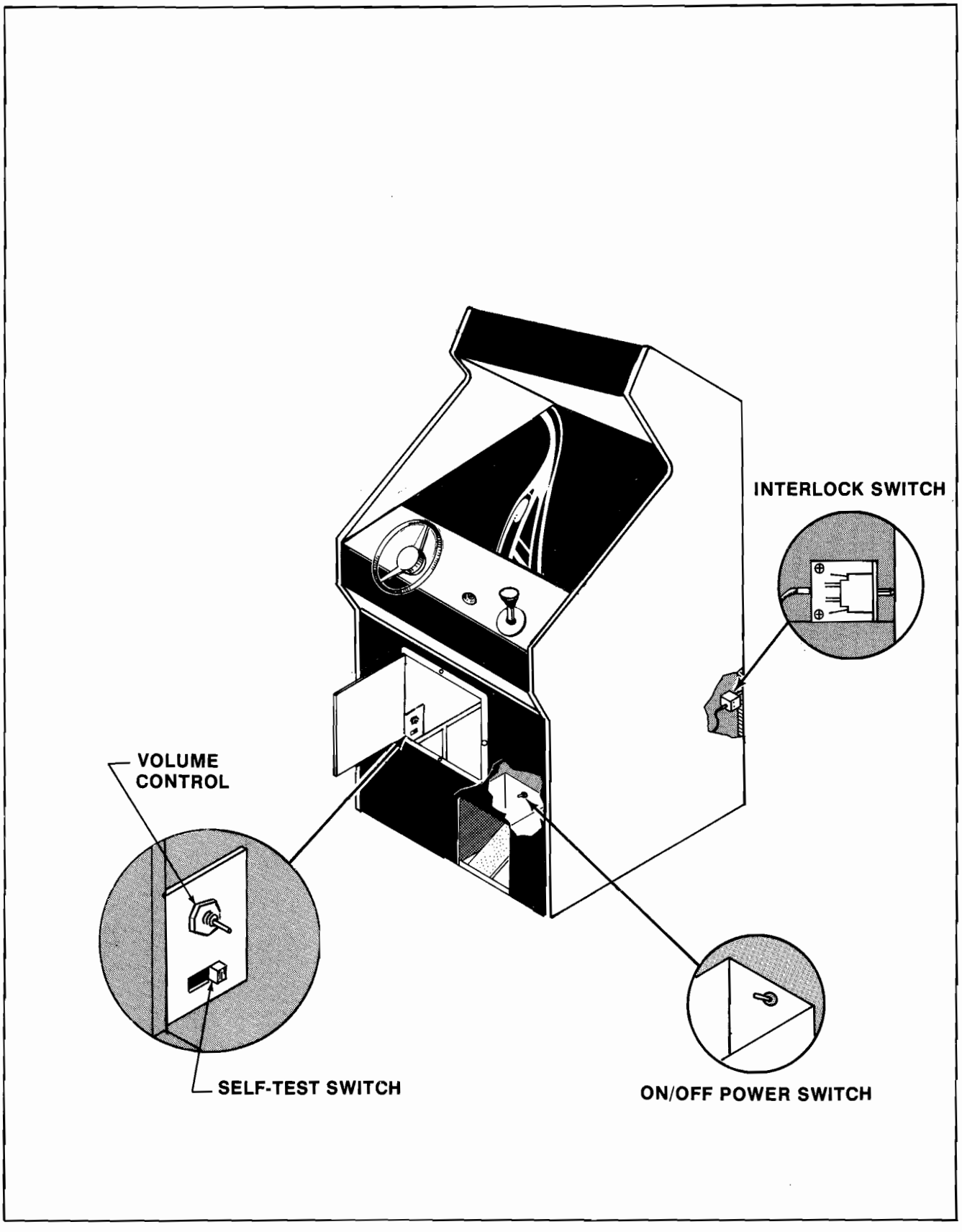


Figure 1-3 Location of On/Off, Interlock, Self-Test Switches and Volume Control (Graphics Cabinet)

Please check for proper operation of the rear access door interlock switch by performing the following steps:

1. Unlock and open the rear access door.

2. Plug the AC power cord into a power source (wall plug).

3. Set the power on/off switch to the on position.

4. Close the rear access door. Within thirty seconds, the TV monitor should display a picture.

5. Slowly open the rear access door until the picture on the TV monitor disappears. The picture should disappear when the rear access door is opened less than one inch from the top.

6. If the results of Step 5 are satisfactory, the interlock switch is operating properly. If the picture does not disappear as described in Step 5, check to see if the switch is broken from its mounting or stuck in the on position.

7. Close and lock the rear access door.

E. OPERATOR OPTIONS

Options of the Sprint One game offer maximum player appeal for each game location. These options are listed in Table 1-1. They are preset for a certain game structure during production. To determine how the switches have been set for your game, compare the TV monitor viewing screen during the attract mode with the information in Table 1-1.

An additional method for determining these switch settings involves the self-test procedure. Set the self-test switch, located inside and to the left of the coin mechanism, to the *on* position. Compare the information on the TV monitor viewing screen during the self-test with the information in Table 1-1.

In order to change the toggle positions of the switch assembly and set the desired options, the printed circuit board (PCB) must be removed according to the following procedure:

1. Unplug the game. Unlock and open the rear access door.

2. Locate the radio frequency (RF) shield assembly immediately inside the cabinet on the right. (It is

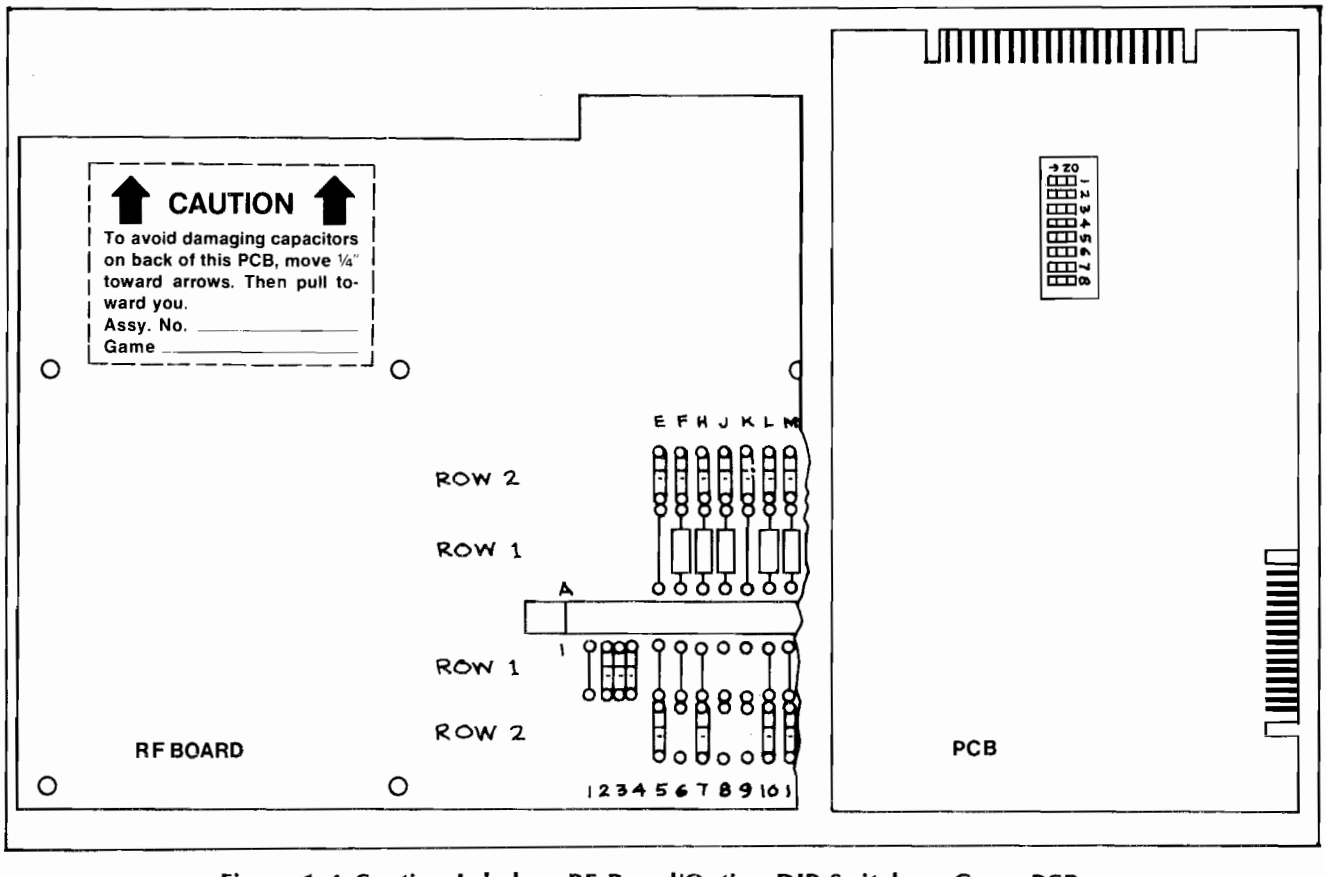


Figure 1-4 Caution Label on RF Board/Option DIP Switch on Game PCB

Table 1-1 Operator Options

Switch Settings								Results	TV Monitor Display During Self-Test
1	2	3	4	5	6	7	8		
ON OFF								Oil slicks added to tracks No oil slicks	Oil
	ON OFF							Cycle to next track every lap Cycle to next track every two laps	Cycle
		ON ON OFF OFF	ON OFF ON OFF					Game cost—25¢ per player Game cost—25¢ for two players Game cost—50¢ per player Game is free (No attract mode)	1 Coin Per Player 2 Players Per Coin 2 Coins Per Player Demo
				ON OFF				Extended play equalling 3/10 of game time (set by toggles 7 and 8), if player obtains enough points to place halfway between Rookie and Pro rating during normal play. Exact point totals for extended play are displayed on the screen during game play. No extended play.	Extended Play
					ON OFF			Not used, any position OK Not used, any position OK	
						ON ON OFF OFF	ON OFF ON OFF	Game time—150 seconds Game time—120 seconds Game time— 90 seconds Game time— 60 seconds	Time 150 Time 120 Time 90 Time 60

an aluminum box with small holes.) On one end of the box is a printed circuit board with an edge connector coming from the edge of the board.

3. Remove the five pan-head Phillips screws from each of the long sides (total of ten screws) of the RF shield assembly.

IMPORTANT

To prevent damage to the capacitors on the rear side of the PCB, move the board about ¼ inch towards the edge connector (same direction as the two arrows on the small white label). Then pull the RF board out toward yourself. Never yank the RF board straight out of the metal box. (See Figure 1-3 for caution label identification.)

4. Carefully remove the PCB from the RF shield assembly.

5. Set the switches for the desired options, as shown in Table 1-1.

6. Reinstall the PCB following Steps 1 through 4 in reverse order. Do not force or bend the printed circuit board. Before reinstalling, always inspect the printed circuit board for damage. Close and lock the rear access door.

7. Plug in the game and verify option functions by playing it.

F. SELF-TEST PROCEDURE

The self-test procedure permits you to check the TV monitor, the character-generating and sync circuits, and the controls. It speeds up troubleshooting by quickly isolating many kinds of component problems. This feature tests about 95% of the game's circuitry. The tests, except for the switches, are done

Table 1-2 Self-Test Procedure

Test Instruction	Results if Test Passes	Results if Test Fails
1 Unlock and open coin door. Set self-test slide switch (located inside and to the left of the coin door), to the "on" position. (RAM Test)	TV monitor "flashes" alphanumerics (A through Z, and 0 through 9) on the screen, while audio "hash" sound comes from speaker. Rotating car appears in the lower right-hand corner of the screen and moves diagonally toward upper left-hand corner. When the car reaches the upper left corner of the screen, RAM test is complete. If RAM testing is satisfactory, self-test feature automatically begins the ROM test (Test 2).	TV monitor display freezes. NOTE TO TECHNICIAN The TV monitor display freezes, with a letter or number showing on the screen. This letter or number corresponds to the alpha-numeric whose particular data code was not written into the RAM correctly.
2 No operator action required. (ROM Test)	Self-test operator sees a visual representation of game structuring in white characters at the top of the screen. No other visual effects appear on the screen.	Black numbers appear in the center of the screen. Refer to Table 3 to to determine the failing ROM locations on the PCB. Match the part number of the game's PCB with the part number in Table 1-3.
3 Set gear shifter in 4th position; then shift into 1st, 2nd, and 3rd positions.	For each position except 4th gear, an audio screech sound occurs.	
Step on accelerator foot pedal.	Audio screech sound occurs each time foot pedal is depressed.	A constant screech sound indicates a stuck switch or a shorted harness. No screech sound indicates a broken switch or an open harness.
Press START button.	Audio screech sound occurs each time START button is pressed.	
Trip right and left coin acceptor wires.	Audio screech sound occurs each time wires are tripped.	
4 No operator action required.	Light-emitting diode for START button activates automatically and stays on.	Light in START button is not activated.

automatically when the self-test switch is turned on. The results of each test are displayed sequentially on the TV monitor until the self-test switch is turned off. High scores will reset to 000 when performing the self-test. We suggest that you run the self-test each time the coin box is emptied.

See Table 1-2 for specific instructions on interpreting the self-test feature.

G. VOLUME CONTROL

If volume is incorrect for your location, open the coin door and adjust the volume control. See Figure 1-2 for location of volume control.

Table 1-3 ROM Locations for ROM Test Failure Indications
(Test 2 of Self-Test)

Failure Indication	0	1	2	3	4		5		6		7	
Location of failing ROM for PCB 6433-01	B1		C1		L0	L1	M0	M1	N0	N1	P0	P1
Location of failing ROM for PCB 6433-02	B1		C1		D1				E1			

During normal use Sprint One™ operates in one of three modes: attract, ready-to-play and play. Connecting the power cord to the proper AC source and activating the on/off switch energizes the game and begins the attract mode. When coins are inserted and clear the coin mechanism, the game goes into the ready-to-play mode. The play mode is then initiated by pressing the START button. The game timer will begin counting down from 100 by one-digit increments. When the game timer reaches zero, the game goes into a "freeze mode" for approximately ten seconds before returning to the attract mode.

2

GAME PLAY

A. ATTRACT MODE

Figure 2-1 illustrates one of the TV monitor displays during the attract mode. The cars are displayed moving around the track. The tracks progressively change from the simplest to the most difficult. There is no sound during the attract mode. As the twelve tracks change, it is normal for some of the cars to "cheat" by going through some of the track boundary lines without crashing. On the TV monitor one or more of the following will be displayed:

1 COIN PER GAME
2 COINS PER GAME
2 GAMES PER COIN
BLACK CARS DRIVE AUTOMATICALLY
GAME OVER

B. READY-TO-PLAY MODE

Figure 2-2 illustrates the TV monitor display during the ready-to-play mode before the START button is pressed. The insertion of the proper coins in the coin mechanism initiates this mode. When the coins clear the coin acceptor the display stops the automatic track changes, the easiest track is displayed, and the cars line up at the starting line.

In the ready-to-play mode the game reacts only to the START button. Pressing the START button places the game in the play mode.

C. PLAY MODE

When the START button is pressed, a motor sound from the speaker begins. The TV monitor display is the same as the ready-to-play mode, except (1) the instruction PUSH START BUTTON disappears from the bottom of the display and (2) the game timer begins counting down from 100 (see Figure 2-3). Point requirements for extended play will also be displayed on the TV monitor screen during the play mode. (See Table 1-1 for specifics on extended play.)

When the play mode is initiated the player controls are activated. As the player advances his or her white car around the track, a score is tallied at the top of the TV monitor viewing screen. Two points are awarded for passing each of the five checkpoint areas on the track. The five checkpoint areas are not identified on the TV monitor display.

When the game timer reaches zero, a "freeze" mode is initiated for approximately ten seconds. The TV monitor display is the same as in the play mode, except (1) all car motion is "frozen," (2) the words GAME OVER flash across the top of the TV monitor display, and (3) driver rating words GRANNY, ROOKIE, or PRO appear at the bottom of the display. After ten seconds the game will go back into the attract mode.

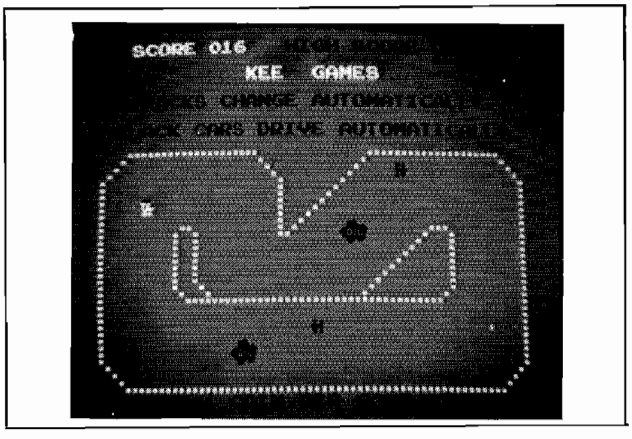


Figure 2-1 Attract Mode

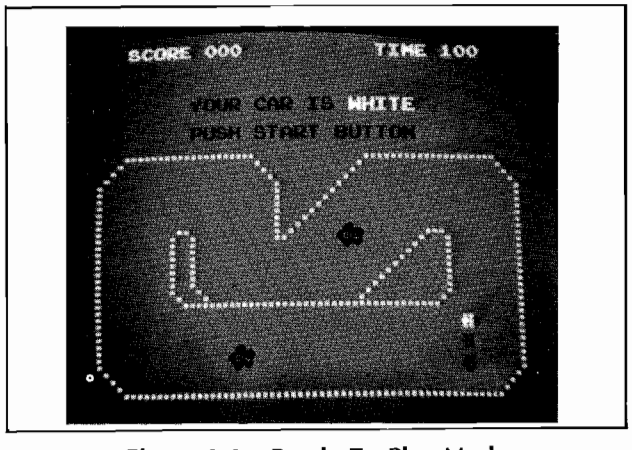


Figure 2-2 Ready-To-Play Mode

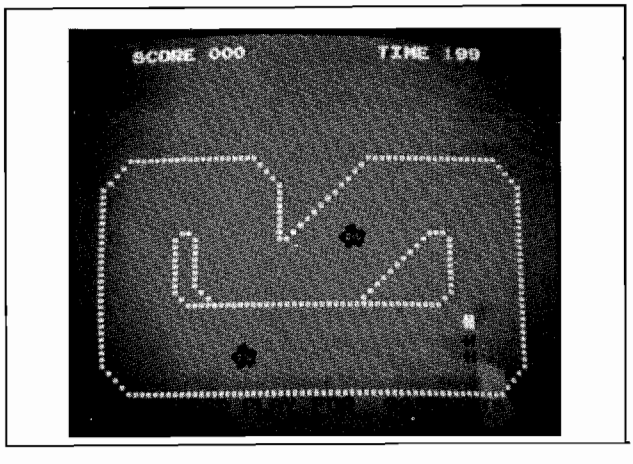
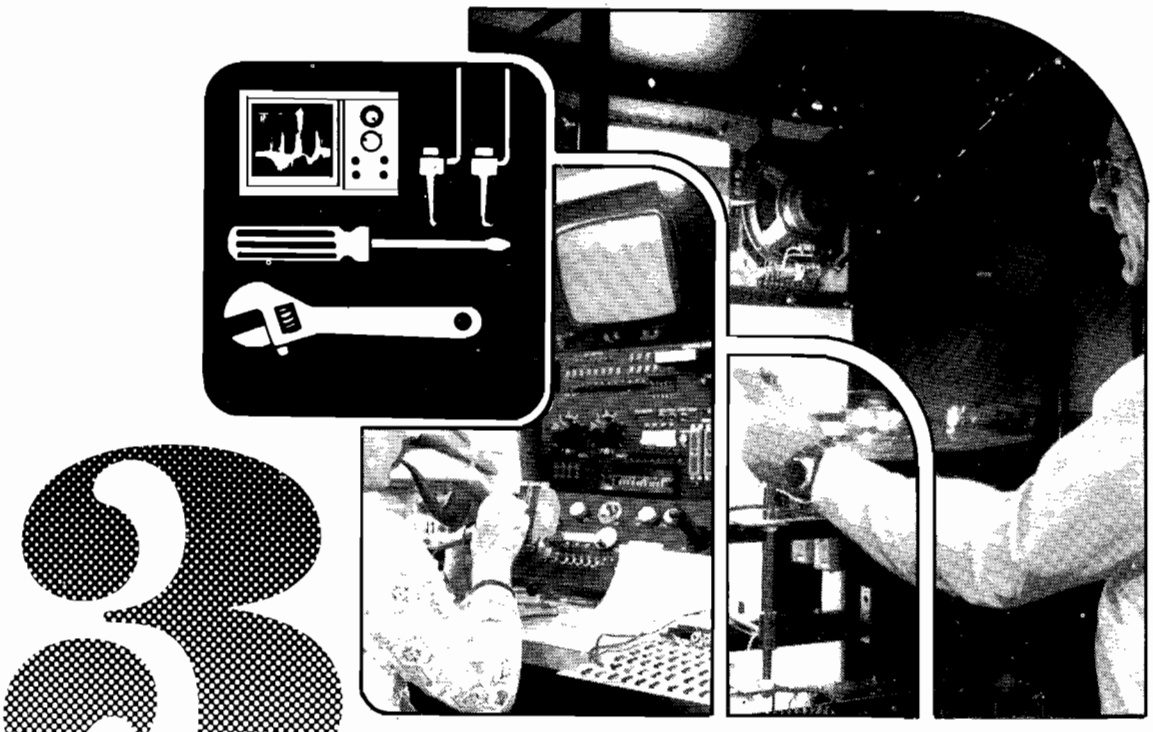


Figure 2-3 Play Mode



3

MAINTENANCE AND ADJUSTMENT

Due to its solid-state electronic circuitry, this Kee Games unit requires very little maintenance and only occasional adjustment. Information given in this chapter and elsewhere in the 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. If reading through this manual does not lead to solving a specific maintenance problem, you can reach Atari's Customer Service Department by telephone Monday through Friday, from 7:30 a.m. to 4 p.m. Pacific Time. From California, Alaska and Hawaii, call (408) 984-1900; from the remaining 47 states call (800) 538-6892 toll-free.

If you are interested in gaining more information on video game technology, especially the electronics, we recommend reading the *Video Game Operator's Handbook*, manual number TM-043. This book is available from Atari, Inc., Attn. Customer Service Department, 2175 Martin Avenue, Santa Clara, CA 95050 for $5 each, or from your distributor.

A. COIN MECHANISM

Components On Coin Door

Figure 3-1 shows the back side of the coin door assembly where the game's two coin mechanisms are mounted. Included is the lock-out coil assembly; the lock-out wires are connected to this assembly but are hidden behind the coin mechanisms. During the attract mode the microcomputer energizes the lock-out coil, causing the lock-out wires to retract far enough to allow genuine coins to reach the coin box. But during the ready-to-play mode when the LED is lit, and during the play mode (and also when AC power to the game has been turned off),the lock-out coil is de-energized, causing the lock-out wires to move out far enough to divert coins over to the return chute.

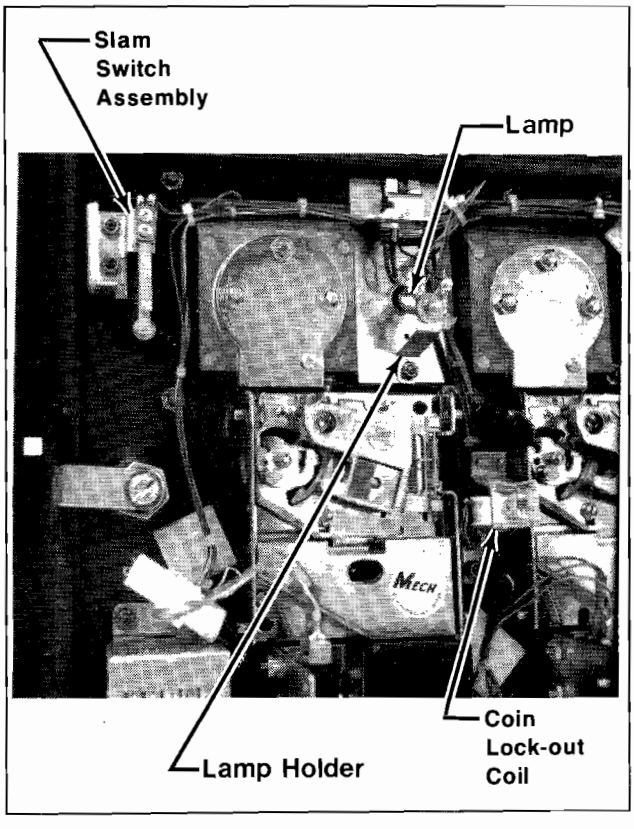


Figure 3-1 Coin Door Assembly

Directly below each coin mechanism is a secondary coin chute and a coin switch with a trip wire extending out to the front edge of the chute. When the trip wire is positioned correctly, a coin passing down the secondary chute and into the coin box will momentarily push the trip wire down and cause the switch contacts to close.

Also shown in the photograph in Figure 3-1 is a slam switch assembly. It has been included to defeat any players who might try to obtain free game plays by violently pounding on the coin door to momentarily close the contacts on the coin switch. The slam switch contacts connect to the microcomputer system, which will ignore coin switch signals whenever the slam switch contacts are closed.

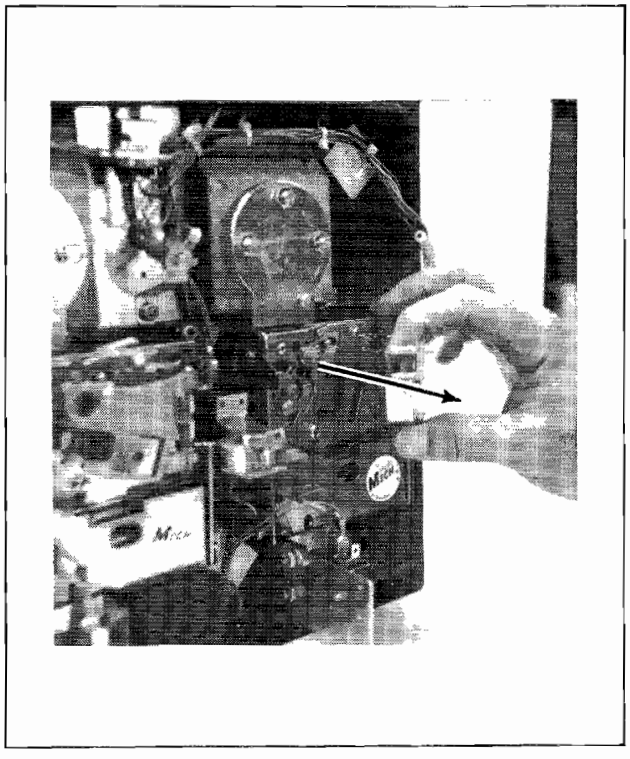


Figure 3-2 Hinging Open the Magnet Gate Assembly

Access to Coin Mechanisms

To remove jammed coins, and for maintenance cleaning, each magnet gate assembly can be hinged open without removing it from the door, as shown in Figure 3-2. Or, if necessary, each coin mechanism can be entirely removed from the door merely by pulling back on a release lever and simultaneously tilting the mechanism back, then lifting it up and out. This is shown in Figure 3-3.

Cleaning of Coin Paths

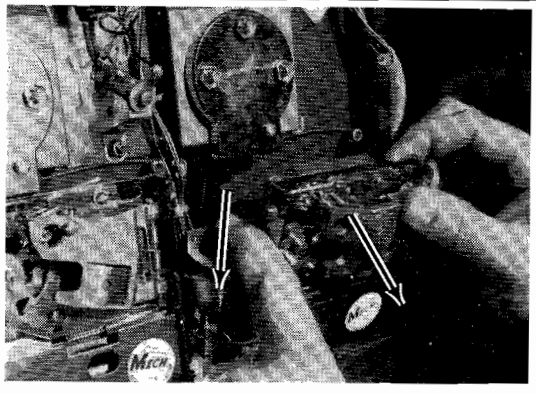
CAUTION

The use of an abrasive (such as steel wool or a wire brush) or a lubrication on a coin mechanism will result in a rapid buildup of residue.

By talking to many operators, we have found that the best method of cleaning a coin mechanism is by using hot or boiling water and a mild detergent. A toothbrush may be used for those stubborn buildups

of residue. After cleaning, flush thoroughly with hot or boiling water, then blow out all water with compressed air.

Figure 3-4 shows the surfaces to clean inside the coin mechanism. These include the inside surface of



(Clean both surfaces where coin enters the mechanism, as well as the magnet)

Figure 3-3 Removal of Coin Mechanism

the mainplate, and the corresponding surface of the gate assembly. There may also be metal particles clinging to the magnet itself. To remove these you can guide the point of a screwdriver or similar tool along the edge of the magnet.

If coins are not traveling as far as the coin mechanisms, you will need to clean the channel beneath the coin slot. To gain access to this channel, use a ⅜-inch wrench and remove all three nuts that secure the cover plate (refer to Figure 3-5. Removing the plate will provide access to the entire channel.

Also clean the inside surfaces of the secondary coin chutes, but when doing this be careful not to damage or bend the trip wires on the coin switches.

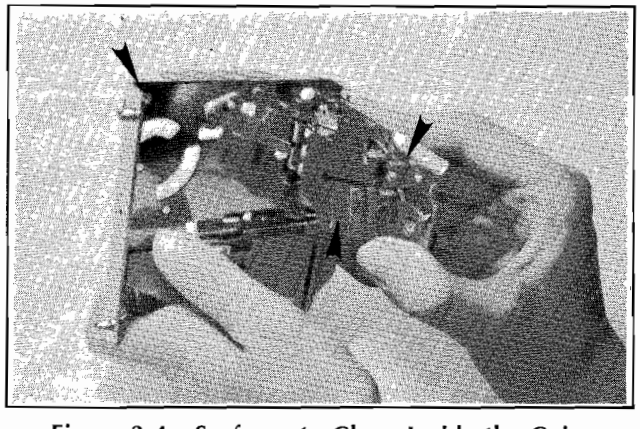


Figure 3-4 Surfaces to Clean Inside the Coin Mechanism

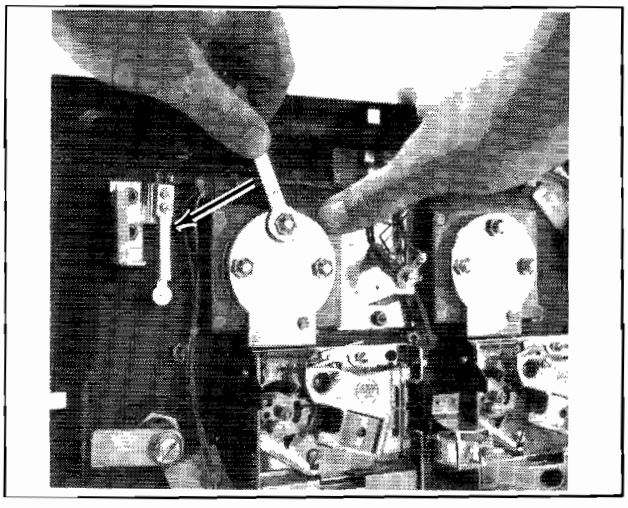


Figure 3-5 Removal of Plate Covering Rear of Coin Slot Slot

Lubrication

Do *not* apply lubrication to the coin mechanisms. The only points that may need lubrication (and only rarely) are the shafts of the scavenger buttons (coin rejection buttons) where they pass through the coin door. Apply only one drop of light machine oil, and be positive that no oil drops down onto a coin mechanism. Figure 3-6 shows this lubrication point. To ensure that no oil accidentally reaches the coin mechanism, remove the latter from the door before applying oil.

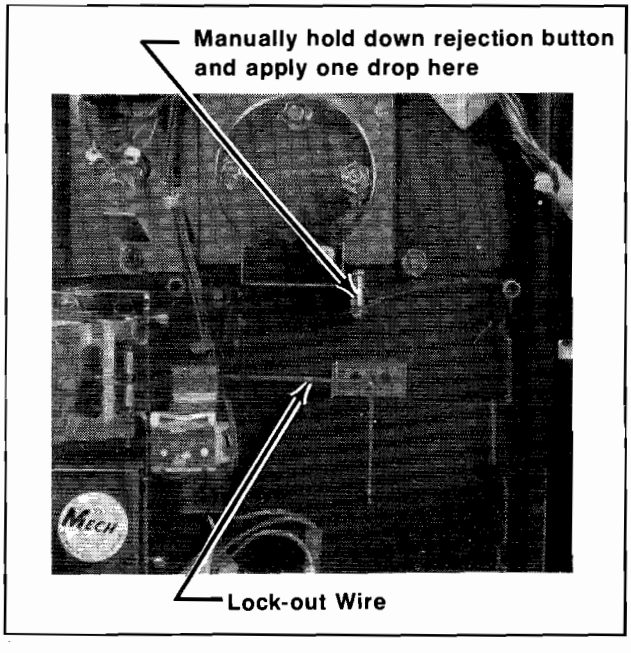


Figure 3-6 Close-Up View of Lubrication Point

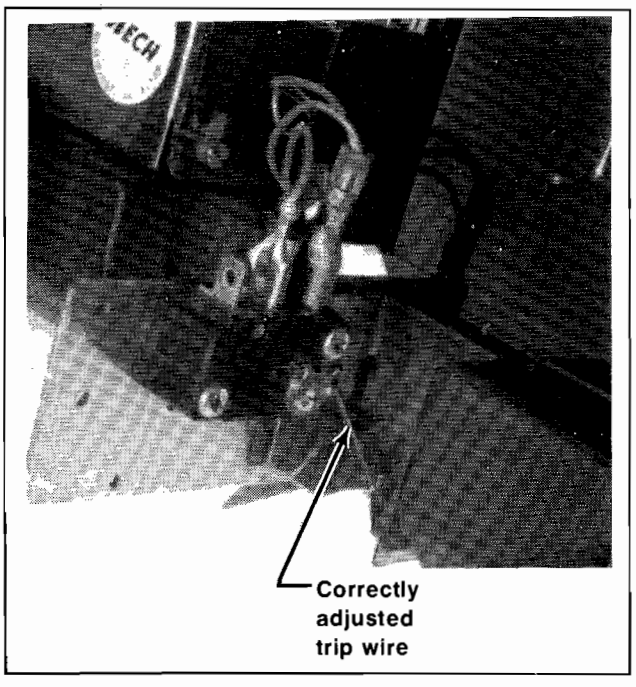


Figure 3-7 Detail View of Coin Switch and Trip Wire

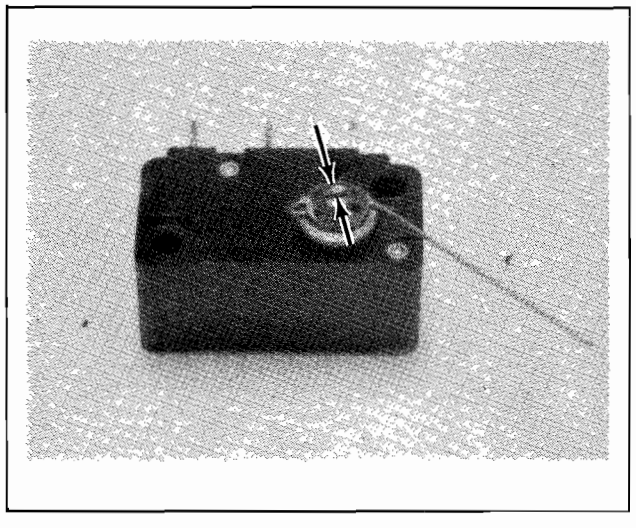


Figure 3-8 Securing the Coin Switch Trip Wire

Adjustment of Coin Switch Trip Wire

In order for a coin switch to operate reliably when a coin travels down the secondary coin chute, the rest position of the switch's trip wire should be as shown in Figure 3-7. Use extreme care when handling or touching these wires.

Three problems can occur with trip wires—they can be too long, too short, or become loosened and fall off.

With a wire that is too long, you may have a problem of catching it on the opening in the cash box as a coin is accepted. You can cut off the end of the wire in small increments, making sure it still extends slightly through the "V" of the coin chute.

If the trip wire is too short (either by wrong adjustment or by being cut off too much), coins may slip by the wire without tripping it, and *no* credits will be given. The solution is to carefully bend and straighten out the wire to lengthen it. If you cannot straighten it sufficiently, contact your distributor to order another trip wire.

If the wire is loose and falls off its mounting stud, it will also cause *no* credits to be given. Secure the wire by crimping together both ends of the brass-colored mounting stud with a pair of pliers (see Figure 3-8). If you should ever need to remove the trip wire, the two halves of the mounting stud can be separated with a small screwdriver.

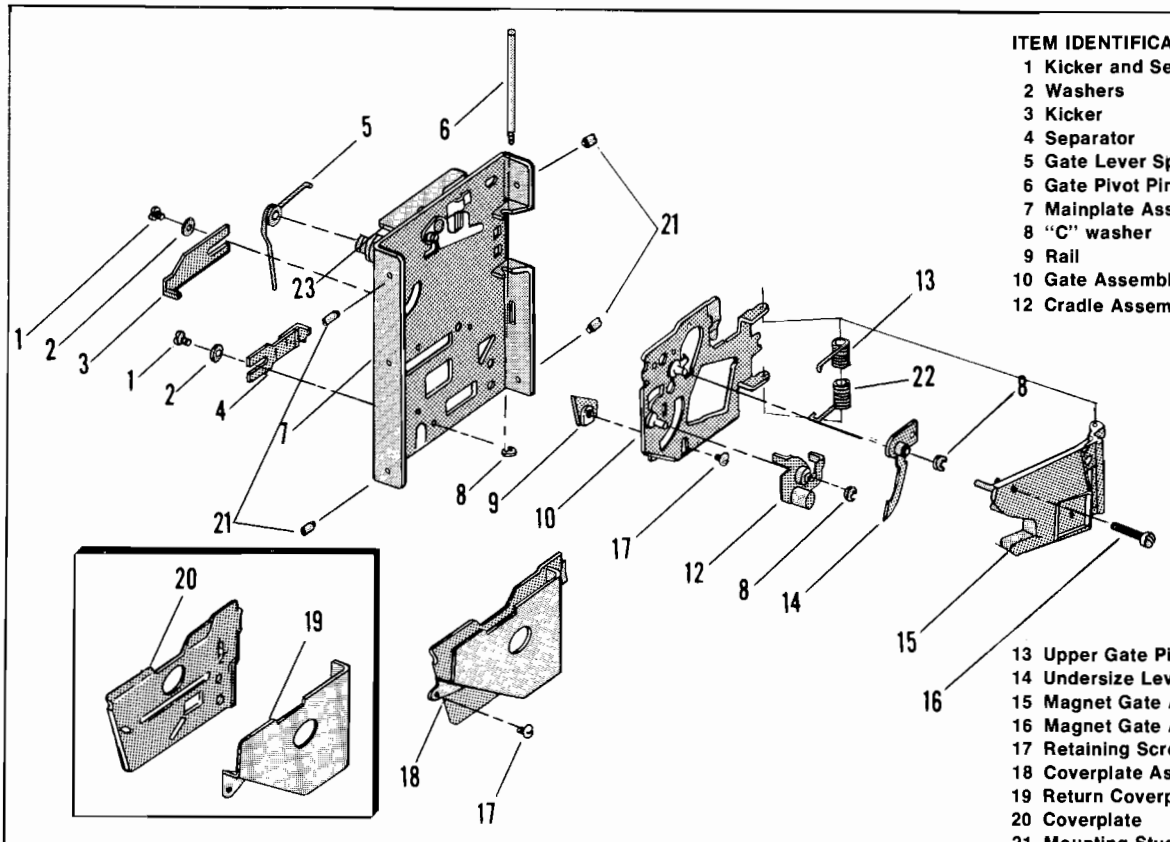
Mechanical Adjustments on Coin Mechanism

Coin mechanisms are adjusted prior to shipment from the factory and normally will retain these adjustments for many months. If, due to wear or other causes, it becomes necessary to make new adjustments, remove the coin mechanism from the coin door. Transfer it to a clean, well lighted area where it can be placed in a vertical position on a level surface (such as a bench top).

Along with a screwdriver you will need several coins, both old and new. Figure 3-9 shows an exploded view of the mechanism and gives procedures for adjusting the kicker, the separator, and the magnet gate. These adjustments should only be done by someone with experience in servicing coin mechanisms and who understands their operation.

General Troubleshooting Hints

The first action item is to search for jammed coins. After these have been removed, examine the coin path for foreign material or loose objects (such as chewing gum, small metallic objects, paper wads, etc.). In cases where game usage is heavy, it may be necessary to clean the entire coin path periodically, in order to prevent buildup of contaminants that can hinder the movement of coins through the mechanisms. Also confirm that the trip wire on each coin switch is intact, and is properly adjusted. If problems persist, check the condition and position of the lock-out wires, and the mechanical adjustment on the coin mechanisms, before suspecting the elec-



Kicker and separator

1. Set the acceptor with the back of the unit facing you in the test position.
2. Loosen the kicker and separator screws (1) and move the kicker (3) and the separator (4) as far to the right as they will go. Lightly tighten the screws.
3. Insert several test coins (both old and new) and note that some are returned by striking the separator.
4. Loosen the separator screw and move the separator a slight amount to the left. Lightly retighten the screw.
5. Insert the test coins again and, if some are still returned, repeat Step 4 until all the coins are accepted.
6. Loosen the kicker screw and move the kicker as far to the left as it will go. Lightly retighten the screw.
7. Insert the test coins and note that some are returned.
8. Loosen the kicker screw and move the kicker a slight amount to the right. Lightly retighten the screw.
9. Insert the test coins again and, if some are still returned, repeat Step 8 until all the coins are accepted.
10. Be sure that both screws are tight after the adjustments have been made.

Magnet gate

1. Set the acceptor with the front of the unit facing you in the test position.
2. Turn the magnet gate adjusting screw (16) out or counterclockwise until none of the coins will fit through.
3. With a coin resting in the acceptor entrance, turn the adjuster in or clockwise until the coin barely passes through the magnet gate.
4. Test this adjustment using several other coins (both old and new) and, if any fail to pass through the magnet gate, repeat Step 3 until all the coins are accepted.
5. Fix the magnet gate adjusting screw in this position with a drop of glue.

Additional Cleaning

1) Remove the transfer cradle (12) and the undersize lever (14).
2) Use a pipe cleaner or similar effective cleaning tool to clean the bushings and pivot pins.
3) Replace the transfer cradle and the undersize lever.
4) To be certain the coin mechanism is completely free of any residue, place the mechanism in boiling water for several minutes. Carefully remove it and let it air-dry completely before reinstalling in the door.

Figure 3-9 Adjustments on Coin Mechanism

tronics. If a coin mechanism rejects genuine coins, try to readjust it. If this is not successful, replace it with a working mechanism.

B. CLEANING

The exteriors of game cabinets and Plexiglas® panels may be cleaned with any non-abrasive household cleanser. If desired, special coin machine cleaners that leave no residue can be obtained from your distributor. Do not dry-wipe the plex panels because any dust can scratch the surface, thereby fogging the plastic.

C. ADJUSTMENTS ON TV MONITOR

CAUTION

For best results be sure game has been turned on for a while before making any TV monitor adjustments.

NOTE

The TV monitor adjustments are accessible through the rear door panel of the game cabinet. These adjustments have to be done while the game is energized. Therefore only persons familiar with safety measures and repair procedures on electrical equipment should perform them.

The TV monitor need be adjusted only when the picture is distorted or if the contrast or brightness seem out of adjustment.

The monitor's adjustments function like those of a conventional commercial television set, except that the volume adjustment has no effect. Instead, the game produces its sound in circuits separate from the TV monitor. Figure 3-10 shows the location of the adjustments on both TV monitors used by Atari. Your game contains a TV monitor manufactured to Kee Games' specifications by either Motorola or TEC.

When making adjustments, follow these general guidelines:

BRITE (Brightness) — Perform this adjustment before the contrast. Adjust so that the white lines covering the screen just barely disappear, when the brightness is turned up.

CONT (Contrast) — Adjust so that the images are as distinct as possible against the grey background without being blurred.

HORIZ HOLD (Horizontal Hold) or HORIZ OSC (Horizontal Oscillator) — Adjust if the picture is slightly off-center horizontally, if the images appear warped, or if the picture is broken up into a series of diagonal lines. Adjust for a stable, centered picture.

VERT HOLD (Vertical Hold) — This needs adjustment only if the picture appears to be rolling up or down the screen. Adjust for a stable, centered picture.

D. TV MONITOR REMOVAL

If the TV monitor proves to be at fault, remove the monitor as shown in Figure 3-11.

E. FLUORESCENT LAMP REMOVAL

If the fluorescent lamp needs replacing, (Graphics version only) then remove the fluorescent lamp as illustrated in Figure 3-12.

F. FUSE REPLACEMENT

Sprint One contains seven fuses, five on the power supply assembly in the lower cabinet and two on the TV monitor assembly in the upper (TV) cabinet. All fuses are easily accessible through the rear access door. Replace fuses only with the same type of fuse as follows:

TEC TM-600/TM-623 Monitors:
3AG 2-amp and 0.5-amp quick-blow, 250 volts

Motorola M5000/M7000 Monitors:
3AG 0.8-amp quick-blow, 250 volts

Power Supply:
Fuses F1 and F2 — 3AG 3-amp slow-blow, 250 volts

Fuses F3 and F4 — 3AG 2.5-amp slow-blow, 125 volts

Fuse F5 — 3AG 8-amp quick-blow, 125 volts

G. STEERING PCB REPLACEMENT

If it becomes necessary to replace the steering PCB, use the following procedure:

1. Unlock the coin door for easy access to the steering PCB.

2. Unplug the 10-pin Molex connector from the steering PCB.

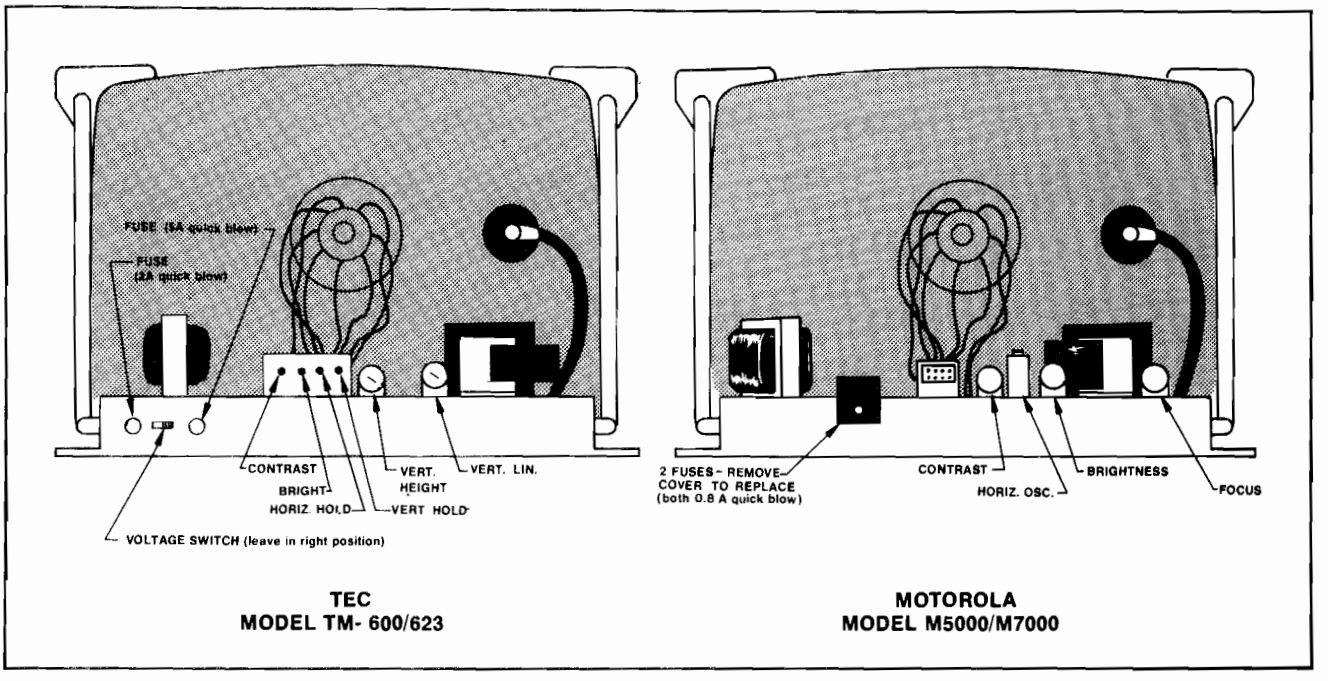


Figure 3-10 Locations of Adjustments on TV Chassis

3. With a 7/16-inch wrench, remove the self-locking hexagonal nut and ¼-inch internal tooth starlock washer fromthe steering wheel axle screw, while a helper holds the steering wheel at the front of the cabinet.

4. Remove the black plastic edge-toothed wheel.

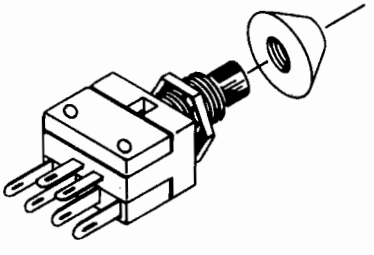
5. Remove the steering PCB by removing two pan-head #2-56 x ½-inch Phillips screws and lifting the board out.

6. Before installing the replacement steering PCB, be sure there is a sufficient amount of silicone lubricant on the inner hole of the black plastic edge-toothed wheel.

7. Install the replacement PCB by completing Steps 1 through 5 in reverse order.

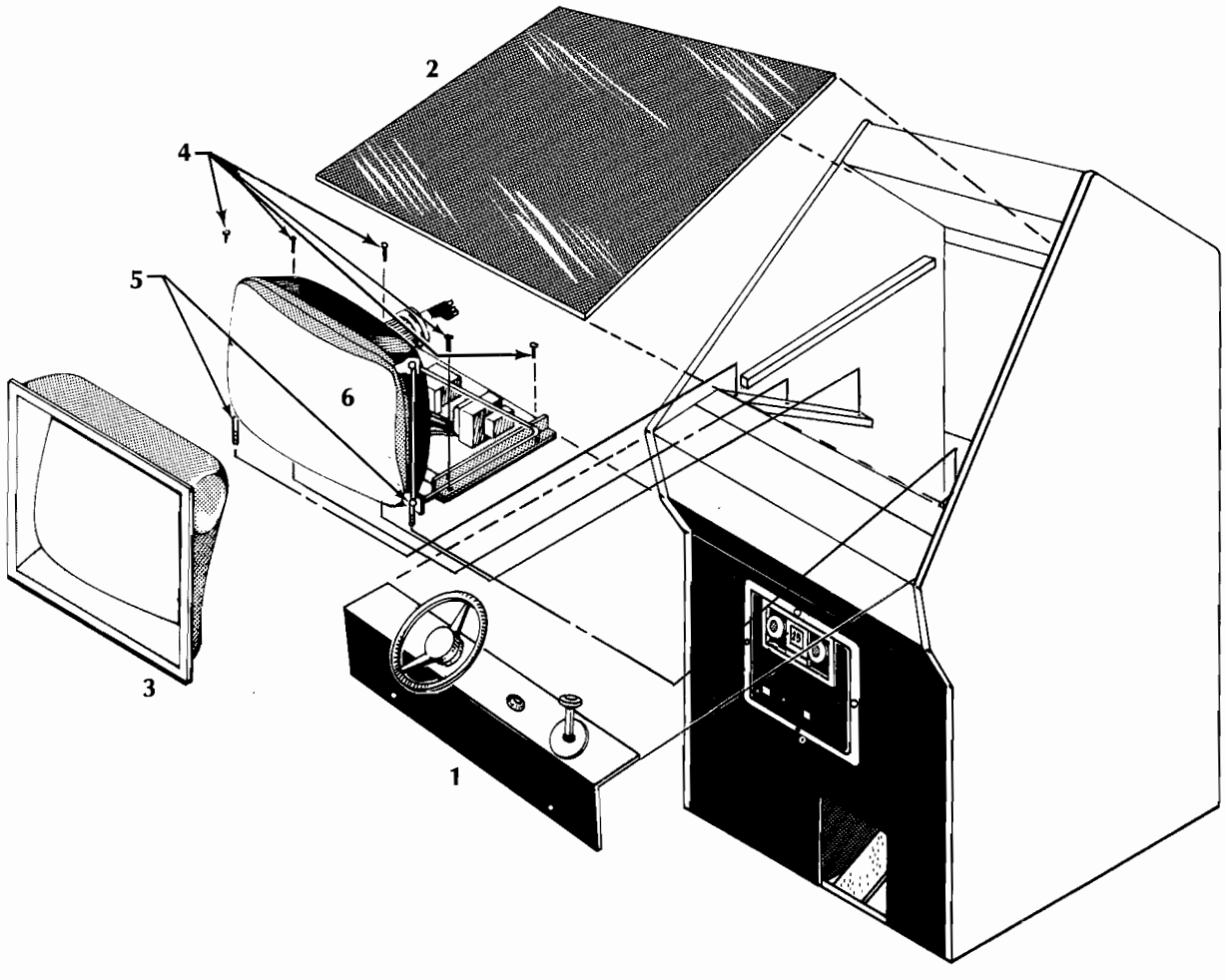
H. LED START SWITCH REPLACEMENT

The start switch on the front panel has a very low failure rate. To test a switch, unlock and open the coin door. Remove the wires from the suspected switch. With a multimeter set on the Rx1 ohmmeter scale, test the contact opening and closing. If the contacts do not operate sharply, replace the switch. To change a switch follow the procedures listed in Figure 3-12.



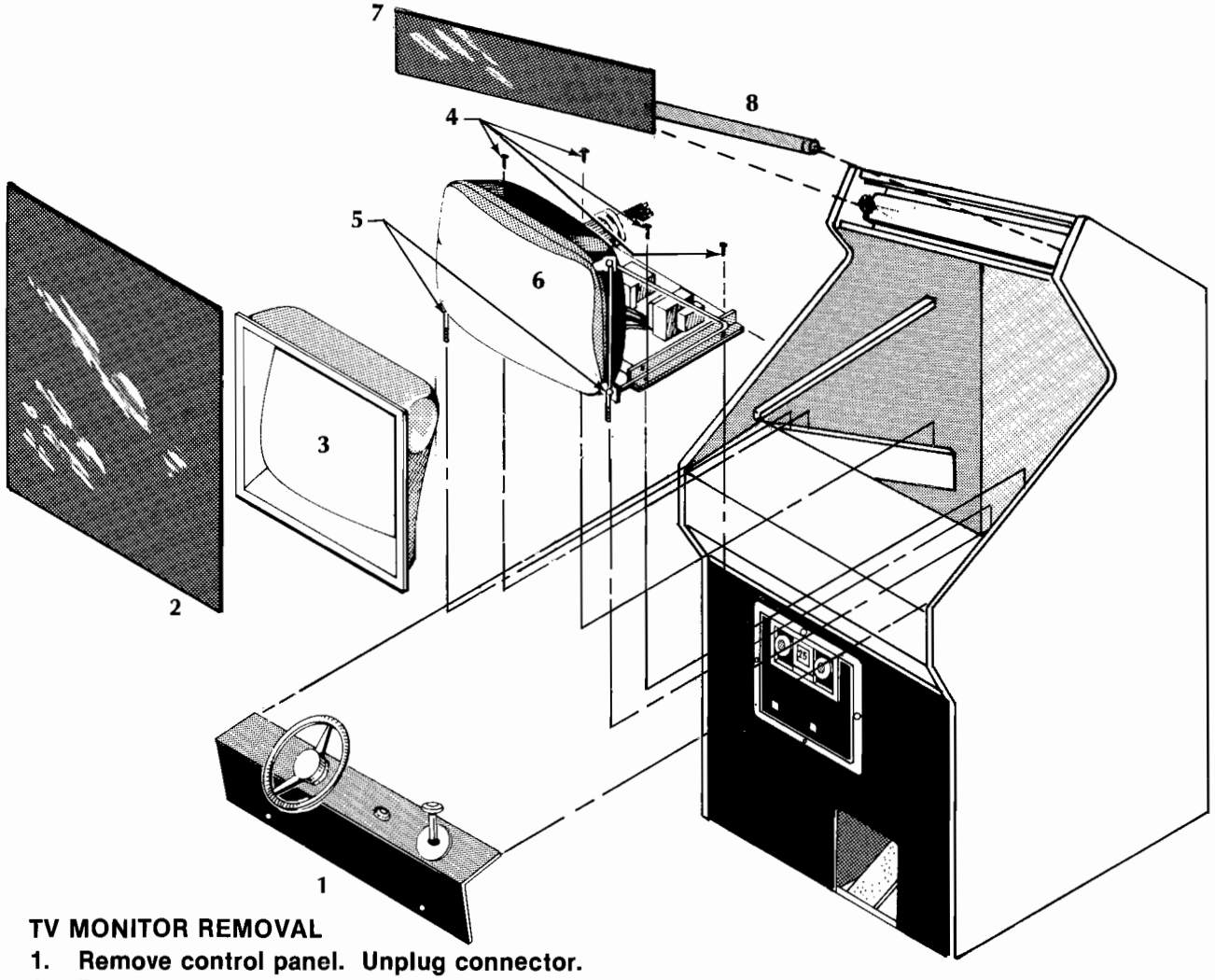
1. Unlock and open the Coin Door.
2. Disconnect control panel cable connector; then remove two carriage bolts.
3. Remove wires from suspected switch.
4. Turn switch counterclockwise while holding cone-shaped nut on outside of game cabinet.
5. Install new switch using reverse procedure.
6. Reconnect harness wires.

Figure 3-13 LED Start Switch Replacement



1. Remove control panel. Unplug connector.
2. Remove playfield Plexiglas shield.
3. Remove cardboard bezel.
4. Unplug TV monitor chassis connector and remove four carriage bolts on TV shelf assembly
5. Remove two eyebolt nuts.
6. Remove TV monitor.

Figure 3-11 TV Monitor Removal



TV MONITOR REMOVAL

1. Remove control panel. Unplug connector.
2. Remove playfield Plexiglas shield
3. Remove cardboard bezel.
4. Unplug TV monitor chassis connector and remove four carriage bolts on TV shelf assembly.
5. Remove two eyebolt nuts.
6. Remove monitor.

FLUORESCENT LAMP REMOVAL

7. Remove attraction Plexiglas shield.
8. Gently rotate fluorescent bulb until it slips out of socket. Remove fluorescent lamp.

Figure 3-12 TV Monitor and Fluorescent Lamp Removal (Graphics)

A. GENERAL INFORMATION

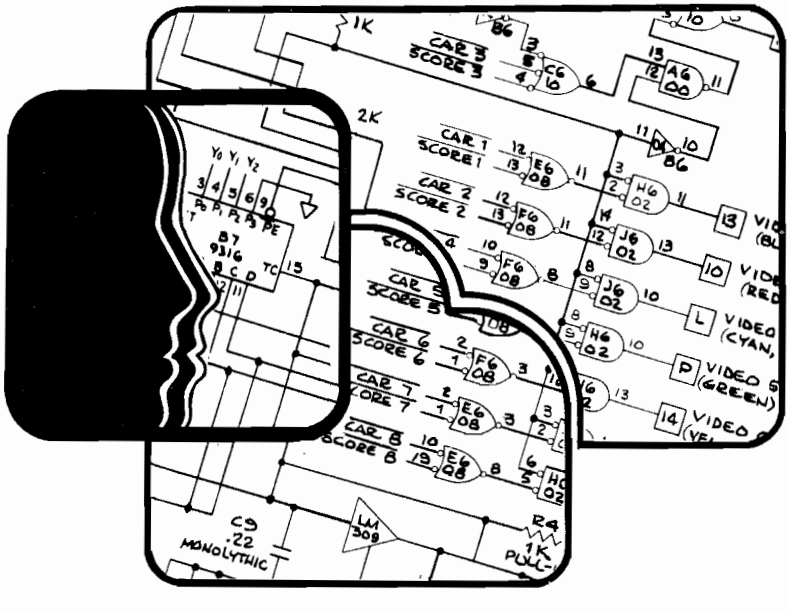
Electronically, the Sprint One game consists of a power supply, a TV monitor, a game printed circuit board (PCB), and a speaker. Mechanically, it consists of a control panel, foot pedal assembly, and a coin door.

This chapter provides a technical description of the Sprint One electronic circuitry. For easy reference, the Sprint One PCB is divided into 126 sections. These sections are identified by letters A through R (skipping letters G, I, O, and Q because they may be easily confused with numbers 6, 1, and 0 respectively) for the short side of the PCB, and numbers 1 through 9 for the long side of the PCB.

The following circuitry discussion is divided into two sections; the microcomputer circuitry and the game circuitry. Figure 4-1 is a block diagram of the entire Sprint One PCB.

4

THEORY OF OPERATION



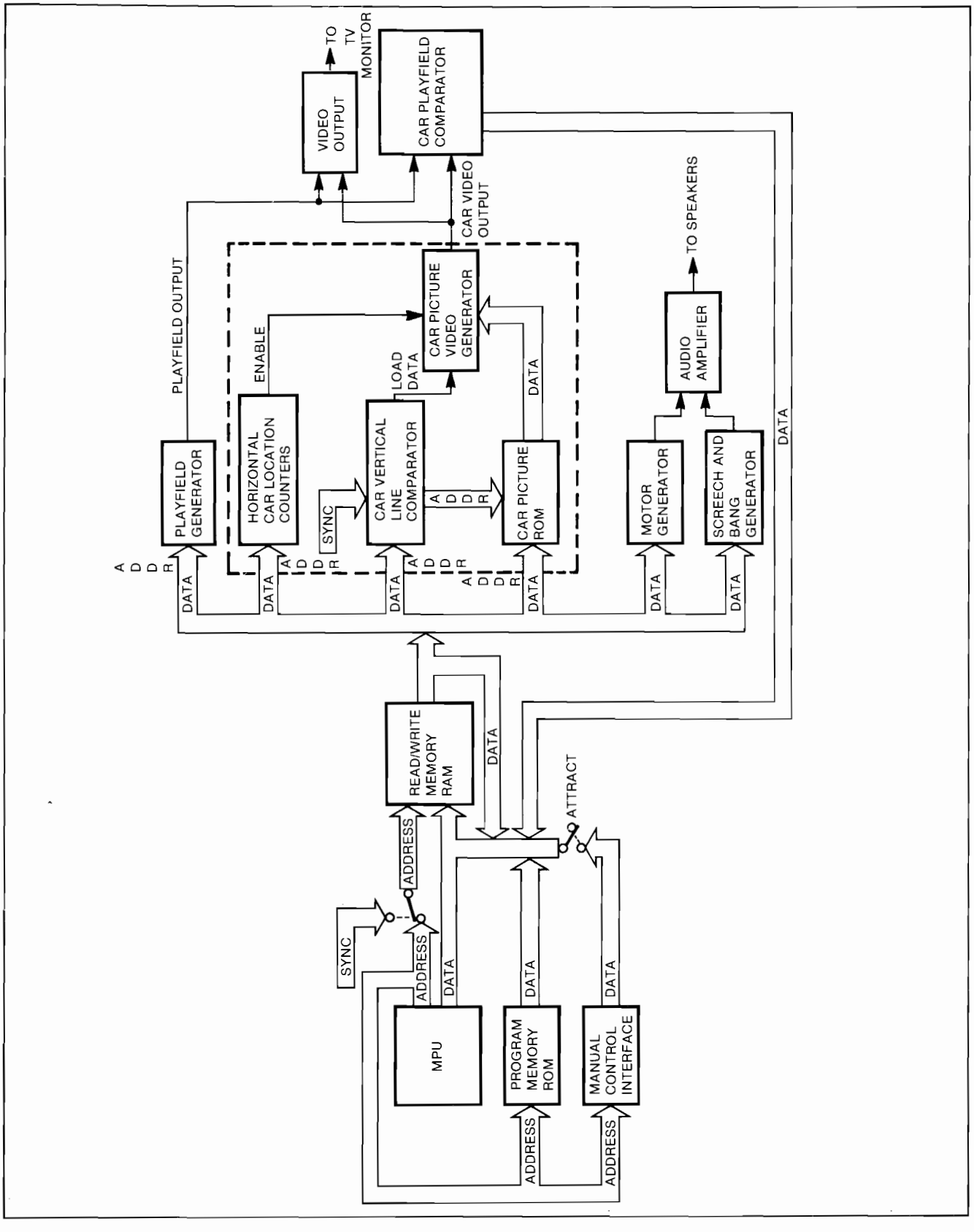


Figure 4-1 Sprint One PCB Block Diagram

B. COMPONENTS OF THE MICROCOMPUTER SYSTEM

The microcomputer system carries out complex tasks of the game by performing a large number of simple tasks. Control of the system is the primary function of the microprocessing unit. The microprocessing unit causes the system to perform the desired operations by addressing the program memory for an instruction. It then reads that instruction and executes the simple task dictated by the instruction. Temporary storage of data necessary for executing future instructions (such as arithmetic operations) is stored into a read/write memory.

Program Memory

Program memory consists of read-only memories (ROMs), permanently programmed by Kee Games to execute the Sprint One game. This memory has the capability of producing 8 bits of data for each of 8,192 unique address locations. In computer terminology this is stated as a memory size of 8k x 8.

The Sprint One game contains one of three combinations of ROM chips to make up the program memory, depending on the dash number configuration of the game PCB. These combinations are listed in Table 4-1 and all combinations are illustrated on schematic sheet 3.

Since the data in the program memory is a permanent physical configuration of the ROM chips, the data is not lost when power is disconnected from the game or when the chip is removed from its socket. Since the program consists of read-only memory, the result of an address input can only be the "reading" of data stored in the manufacturing process. It is not possible to "write" in more data.

Read/Write Memory

Read/write memory consists of random-access memory (RAM) which is composed of eight 1K x 1 2102-1s. Data may be stored in the RAM (called "writing" the RAM), then recalled later (called "reading" the RAM). The memory size of the read/write memory is referred to as 1K x 8.

In order to read from the RAM, R/W (pins 3) input of all random-access memories must be high; to write into the RAM, R/W input must be low.

Data can be stored in the RAM by the MPU for the purpose of performing operations on it, as instructed by the program memory. Since the RAM is a temporary storage area, removing power from the RAM chips will "erase" all stored date.

Microprocessing Unit

The controller of the microcomputer is the microprocessor (MPU). From the MPU, a sixteen-bit address bus addresses program memory, RAM and an address decoder. An eight-bit bi-directional data bus serves a path for transferring data from program memory as well as to and from the RAM and other interfacing devices.

Tri-State Devices

Tri-state devices, such as E5 of schematic sheet 3, are capable of having normal logic output of ones and zeros when disable (pin 1) is low. When disable is high, the output becomes a high impedance. In other words, when disable is high, it is equivalent to completely removing device E5 from the circuit. ROMs and RAMs are also tri-state devices. Each ROM or RAM must be enabled by a certain logic level at its chip-enable input before the device is capable of outputting or inputting data.

C. MICROCOMPUTER SYSTEM

The primary function of the Sprint One microcomputer is to instruct the game circuitry for the proper TV monitor display and audio outputs for corresponding manual inputs.

Table 4-1 ROM Program Memory Chips for Various Sprint One PCB Configurations

PCB Part No.	Sprint One PCB Location											
	B1	C1	D1	E1	L0	L1	M0	M1	N0	N1	P0	P1
6433-01	X	X			X	X	X	X	X	X	X	X
6433-02	X	X	X	X								

Program Memory Enable

With initial power supplied to the Sprint One PCB, the MPU addresses program memory for an instruction by placing a 16-bit code at outputs AB0 through AB15. The address decoder, consisting of ROM E2, one-of-ten decoders D2, F2, and E8, and addressable latch A1, receives the five most significant bits of this address code (address 9 through 13) as an instruction of which part of program memory to access. Outputs of one-of-ten decoder F2 enable only the individual ROMs of program memory required for the desired instruction.

RAM Enable

With the address decoder now addressed for the enabling of the desired program ROM and the ROM addressed for a data instruction, the MPU receives the 8-bit data instruction on the data bus. If this data instruction includes the temporary storage of information, the MPU addresses the RAM and writes data into the memory RAMs. The procedure of writing into RAM is enabled by two signals; chip enable CE (pins 13) and R/W (read/write not, at pins 3) of the RAM must be low. The address decoder ROM (E2) receives an address (A9 through A13), and one-of-ten decoder D2 receives a high write signal from the MPU. The result of these signals is a low $\overline{\text{DISPLAY}}$ at the input of multiplexer K2 for a low chip enable CE at pins 13 of the RAM. The MPU also causes the R/$\overline{\text{W}}$ (pins 3) input to the RAM to be pulsed, via the $\overline{\text{WRITE}}$ signal. When this input is pulled low, MPU data on the data input to the RAM (pins 11) is stored into the RAM location determined by inputs A0 through A9.

Phase 1 and Phase 2.

Phase 1 (Φ1) and phase 2 (Φ2) are outputs of the MPU and are formed by shaping the pulse of horizontal synchronization pulse 4H by D-type flip-flop A7. The 4H input of A7 (pin 13) is fed twice through the flip-flop at a clock rate of 12.096 MHz. The output of the first flip-flop is fed through an OR gate to produce a phase 0 (Φ0) signal, as illustrated in Figure 4-2. The MPU provides an output of Φ2 that is exactly like Φ0, except with a slight delay, and an output Φ1 that is of an opposite phase of Φ2. Phase 2 is fed through AND gate N3, which acts as a buffer.

When Φ1 is positive, the address and data lines of the MPU change and stabilize for the next output. When Φ2 is positive, the MPU addresses memory on the address bus and inputs or outputs data on the data bus. In order to guarantee that the MPU data is written to external devices at the proper time, write enable (WRITE A7, pin 10) is shaped by NAND gate A8 and D-type flip-flop A7 as illustrated in Figure 4-3.

Phase 2 is also used to control the output of RAM address multiplexer K2, J2, and H2. The multiplexer

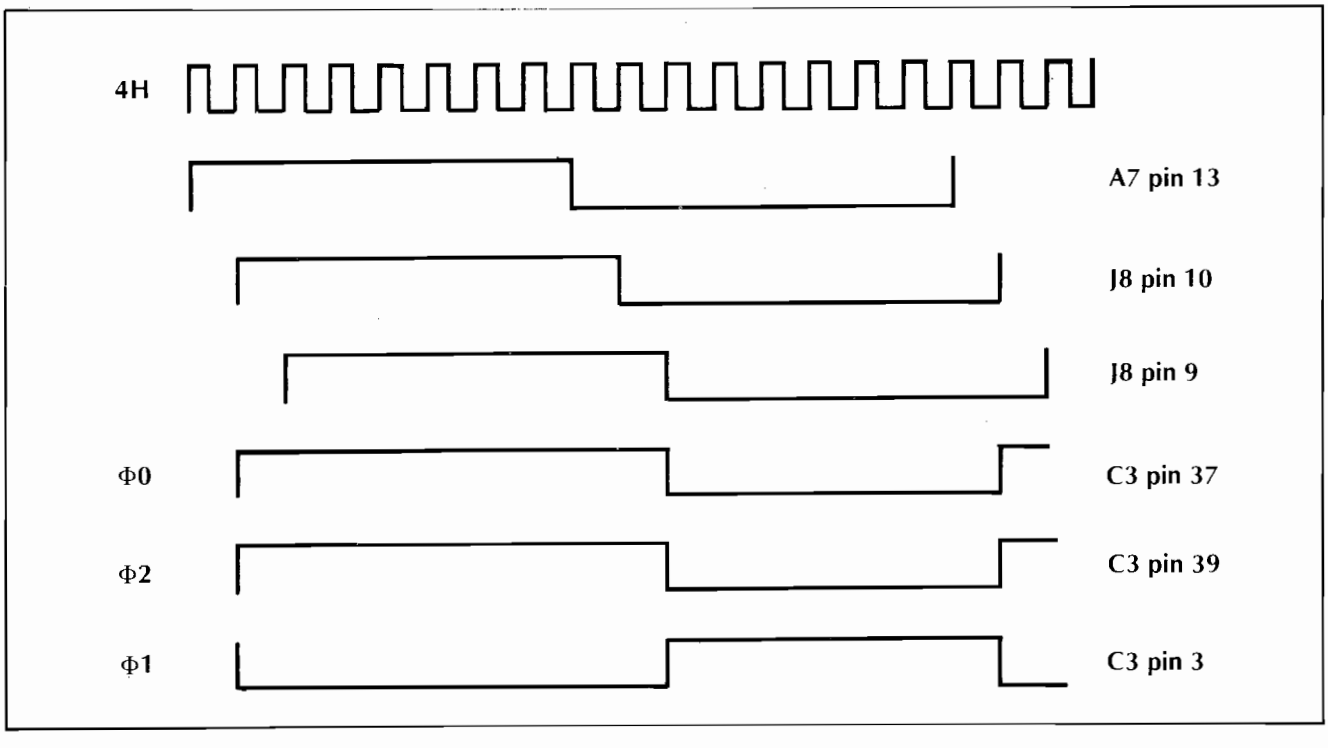


Figure 4-2 Phase 1 and Phase 2 Signal Shaping

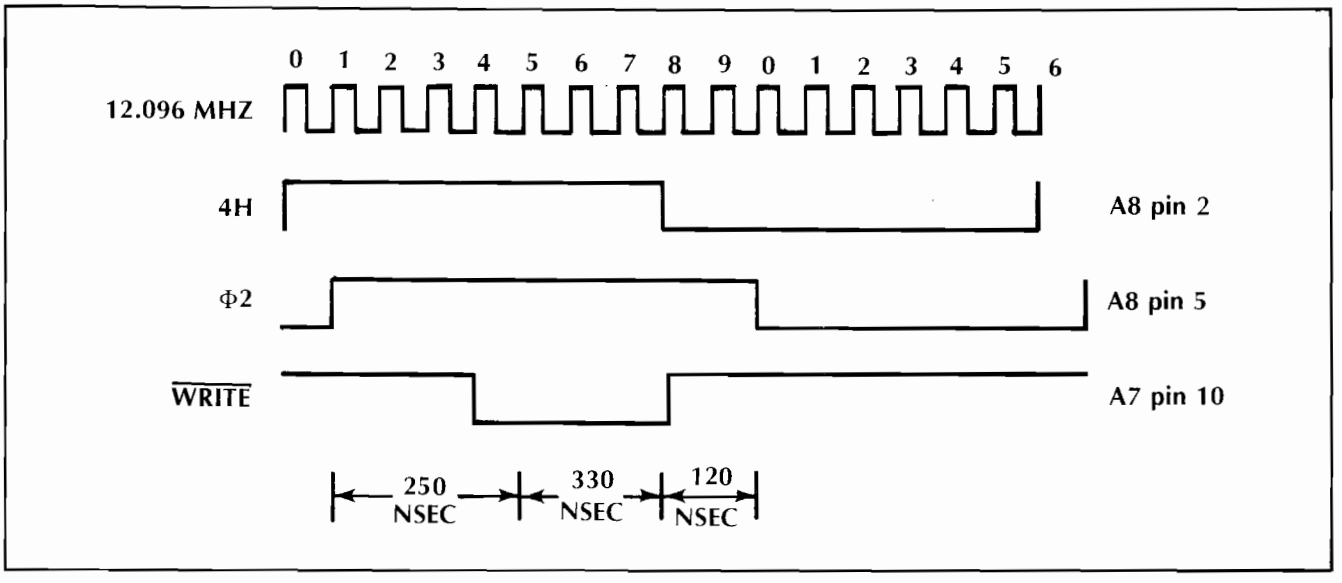


Figure 4-3 RAM Write Enable Signal Shaping

acts as a 12-pole double-throw switch, and is switched at a rate of Φ2. The RAM is addressed by the MPU and data is transferred between the MPU and RAM when Φ2 is high. When Φ2 is low, the RAM is addressed by horizontal and vertical synchronization, and data is read out of the RAM by the game control circuitry.

RAM Output

As mentioned, the RAM serves as a data storage medium for the MPU. This stored data is used for two different purposes. It can be read back by the MPU if the program has need to access that information again. In this case, the RAM output data is fed back onto the MPU data bus via tri-state buffers E5 and K5. This "RAM read" cycle is done when Φ2 is high and the MPU address lines are valid.

The other valid access of RAM data is for video and audio generation. In this case, the game circuitry reads the RAM output data when Φ2 is low, by addressing the RAM with horizontal and vertical line count information. The RAM output data is then latched by hex latch F5 and L5, at the end of each time period when Φ2 was low, so that this data is held stable for use by the peripheral circuitry.

D. MICROCOMPUTER WATCHDOG

Watchdog is an external monitoring system that resets the program memory back to its initial start-up instructions if the program execution deviates from its intended sequence. This is accomplished by a watchdog statement (address code) incorporated in the program memory, resulting in a $\overline{\text{TIMER RESET}}$ pulse at the output of the address decoder. This reset pulse must occur before decade counter C6 and 7 reaches the count of eight. Therefore if the program memory is functioning properly, a TIMER RESET pulse occurs within every eight frames of video.

E. GAME CIRCUITRY COMPONENTS

The game circuitry receives game instructions from the microcomputer and responds with the proper video and audio outputs. The manual player controls of the game provide control information as data input to the microcomputer.

System Clock and Sync Generator

The crystal-controlled clock generates a 12.096-MHz clock frequency that is used to produce all of the operating frequencies of the game.

The horizontal and vertical synchronization signals are used to produce a TV monitor raster made up of 262 horizontal lines at a horizontal frequency of 15,750 Hz (256H). Synchronized with line 224 is a vertical blanking pulse that occurs for the duration of 38 more horizontal scans, resulting in the total number of 262 lines per frame.

Playfield Generator

The playfield generator generates both the playfield and all alphanumeric video for the TV monitor display. This is accomplished by the playfield ROM (consisting of ROMs P4 and R4 for a memory size of 512 x 8), shift register R3, and binary counter R2.

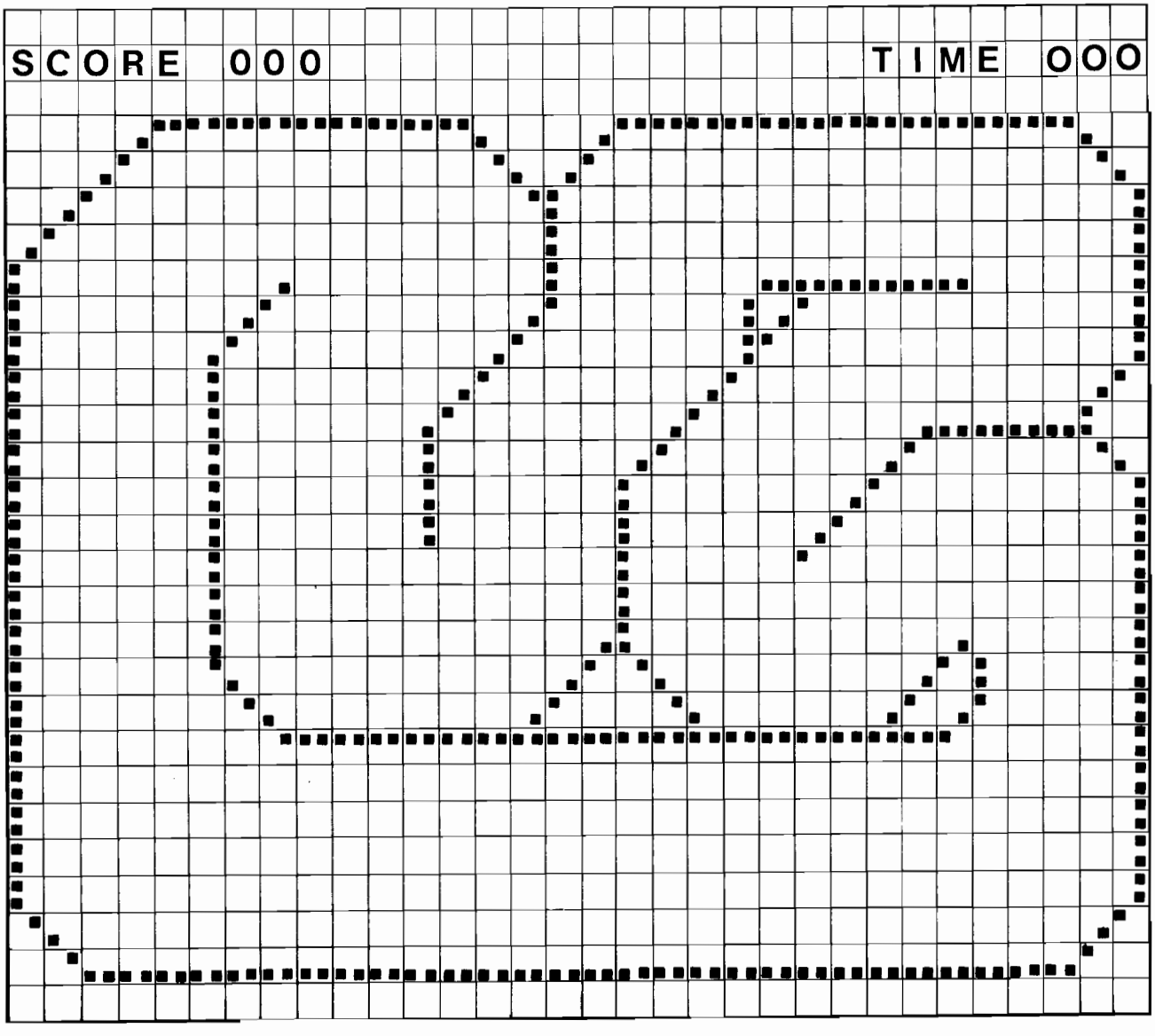


Figure 4-4 TV Monitor Playfield Display

As illustrated in Figure 4-4 the TV monitor display is made up to 32 horizontal by 28 vertical grid sections (each eight lines tall by eight bits wide). For each grid section, the microcomputer RAM stores a btye of data (one byte equals eight bits D0 through D7),

During the Φ2 cycle (Φ2 is high), the RAM is addressed by the MPU, at which time the desired byte of data is transferred from program memory to the RAM. Then, during the Φ1 cycle (Φ2 is low), the horizontal and vertical synchronization signals can access each of these bytes of data as that particular grid is to be displayed. The RAM then outputs six bits of data (DISPLAY 0 through DISPLAY 5) that address any of the 64 different alphanumerics and playfield characters stored in the playfield ROM, and one bit (DISPLAY 7) that determines whether the character is to be displayed as black or white video.

The playfield ROM is programmed by Kee Games to provide eight bits of data for each of 512 addresses (64) characters of eight lines each). The least significant addresses are from vertical synchronization 1V, 2V, and 4V, and the most significant addresses are DISPLAY 0 through DISPLAY 5 from the microcomputer RAM.

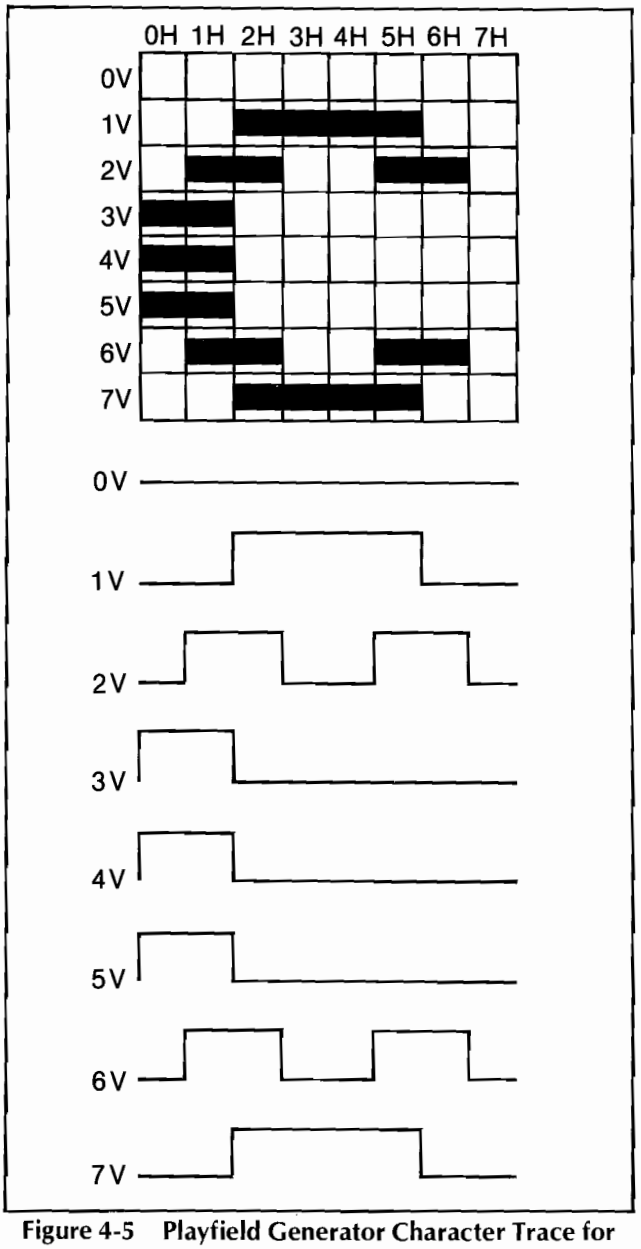


Figure 4-5 Playfield Generator Character Trace for the Letter "C"

The top of Figure 4-5 illustrates the letter "C" as it would be "traced" on the TV monitor display. The RAM would provide one six-bit address to the playfield ROM for the letter, while vertical synchronization 1V, 2V, and 4V would complement the RAM address for each of the horizontal scan lines. The bottom of Figure 4-5 illustrates the output of shift register R3 for each horizontal scan.

Note the letter "C" in the word *SCORE* in Figure 4-4. In order to generate the character in this location, the microcomputer RAM outputs a data code when this part of the display is being scanned. This six-bit code (DISPLAY 0 through DISPLAY 5) contains the playfield ROM address for the letter "C." Vertical synchronization 1V, 2V, and 4V determines which one of the eight lines of the character is being scanned at that time.

Shift register R3 then loads the actual playfield or alphanumeric data from the playfield ROM and shifts it out in serial video (R3 pin 13).

Binary counter R2 latches data DISPLAY 7 from the microcomputer RAM. This results in the selection of white playfield video if DISPLAY 7 is high, or black playfield video if DISPLAY 7 is low. Some alphanumerics and all oil slicks are represented in black video, while all of the racetrack boundary (playfield) is represented in white video.

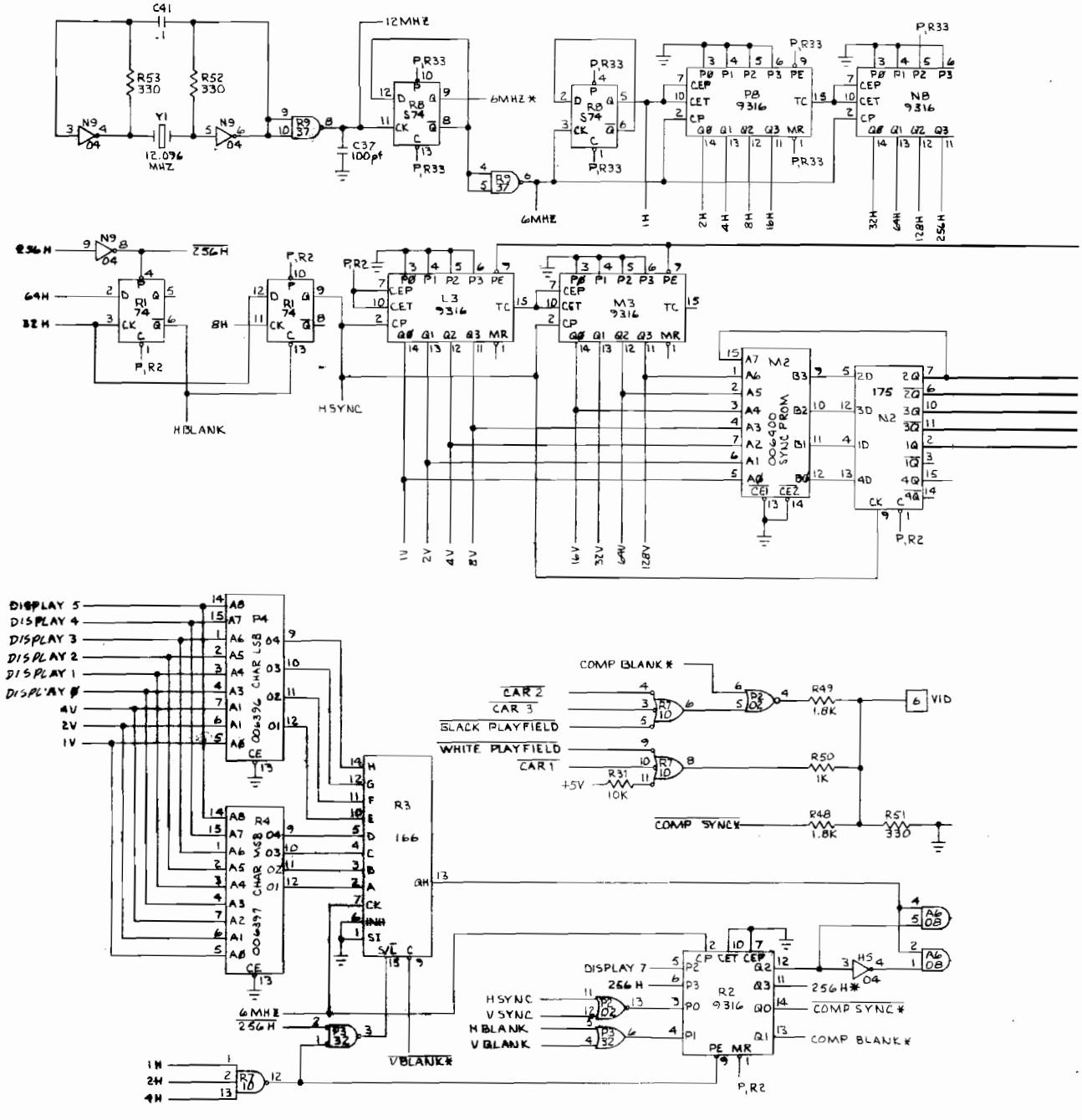
Binary counter R2 is also used to produce the COMP SYNC, COMP BLANK, and a 256H signal that are all delayed one character's width from their original timing. This delay is used to center the playfield on the monitor's horizontal scan.

Motion Generator

The motion generator generates the video for the three cars, which are the only moving objects of the Sprint One game. The picture ROM (consisting of ROMs J6 and K6, for a memory size of 512 x 8) is programmed by Kee Games to provide 16 bits of data for each of the 8 lines of each of the 32 different states of rotation of a car.

The microcomputer RAM provides three words (bytes) of data for the display of each car picture. The first byte determines the vertical location of the car, the second determines the proper rotation picture of the car, and the third determines the horizontal location of the car. The accessing of these bytes of RAM data is done during the horizontal blanking period ($\overline{256H}$).

Vertical position data is received by vertical line comparator M4 and L4. Take, for example, the data code for a car to be displayed beginning on line 120. The RAM byte data code of 01111000 would be loaded into the comparator. When the vertical line comparator reaches the count of 01111000, and 8H, 64H, $\overline{256H}$, and $\Phi 2$ are all high, the conditions are met for a low signal at the output of NAND gate N4 (pin 8). One $\Phi 2$ clock pulse later, a low appears at the Q3 (pin 7) output of latch L5 (clock input for L5 is located on


C41
.1
R53
330
R52
330
Y1
12.096
MHZ
12MHZ
C37
100pf
6MHZ*
6MHZ
1H
2H
4H
8H
16H
32H
64H
128H
256H
256H*
HSYNC
HBLANK
L3
9316
M3
9316
N3
9316
M2
006400
SYNC PROM
N2
175
DISPLAY 5
DISPLAY 4
DISPLAY 3
DISPLAY 2
DISPLAY 1
DISPLAY 0
4V
2V
1V
P4
P5
CHAR LSB
006396
CHAR MSB
006397
R3
166
R4
VBLANK*
DISPLAY 7
HSYNC
VSYNC
HBLANK
VBLANK
R2
9316
COMP BLANK*
COMP SYNC*
CAR 2
CAR 3
BLACK PLAYFIELD
WHITE PLAYFIELD
CAR 1
+5V
R31
10K
R49
1.8K
R50
1K
R48
1.8K
R51
330
VID

NOTES: UNLESS OTHERWISE SPECIFIED
1. RESISTANCE VALUES ARE IN OHMS.
2 CAPACITANCE VALUES ARE IN MICROFARADS.

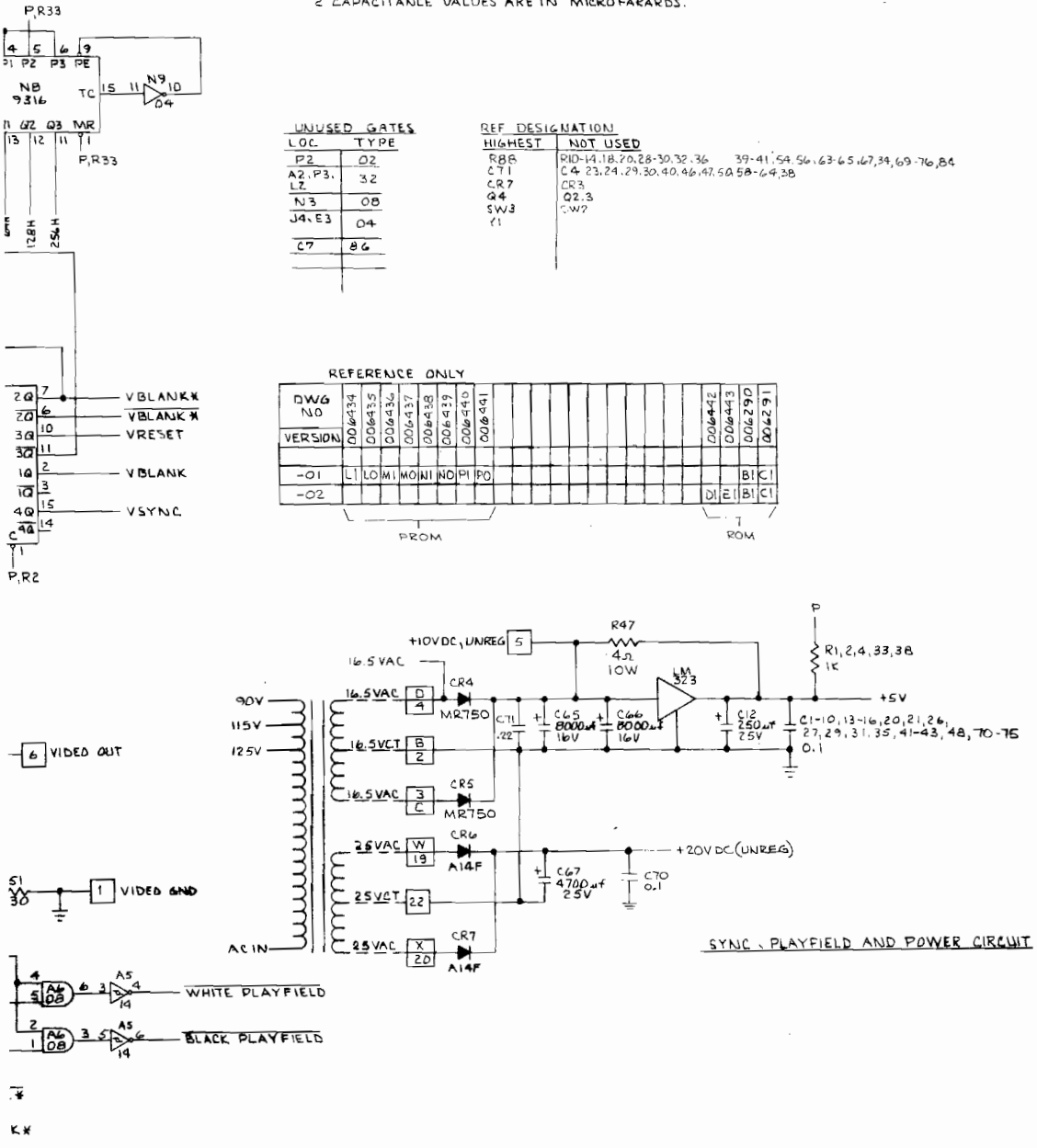
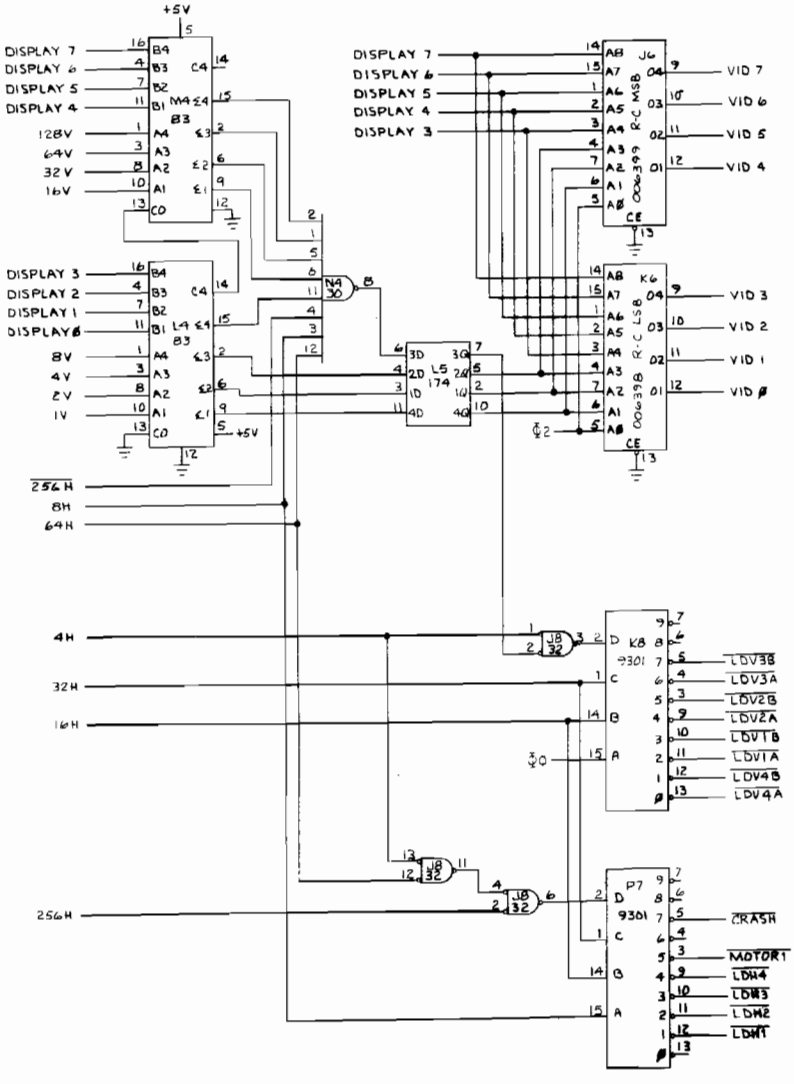


Figure 4-6 Sprint One Schematic Diagram Sheet 1 of 5

006433 C


+5V
DISPLAY 7
DISPLAY 6
DISPLAY 5
DISPLAY 4
128V
64V
32V
16V
M4 B3
DISPLAY 3
DISPLAY 2
DISPLAY 1
DISPLAY 0
8V
4V
2V
1V
L4 B3
N4 30
L5 174
256H
8H
64H
4H
32H
16H
256H
J8 32
K8 9301
P7 9301
LDV3B
LDV3A
LDV2B
LDV2A
LDV1B
LDV1A
LDV4B
LDV4A
CRASH
MOTORT
LDH4
LDH3
LDH2
LDH1
DISPLAY 7
DISPLAY 6
DISPLAY 5
DISPLAY 4
DISPLAY 3
J6 R-C MSB 006399
K6 R-C LSB 006398
VID 7
VID 6
VID 5
VID 4
VID 3
VID 2
VID 1
VID 0
Φ2
Φ0

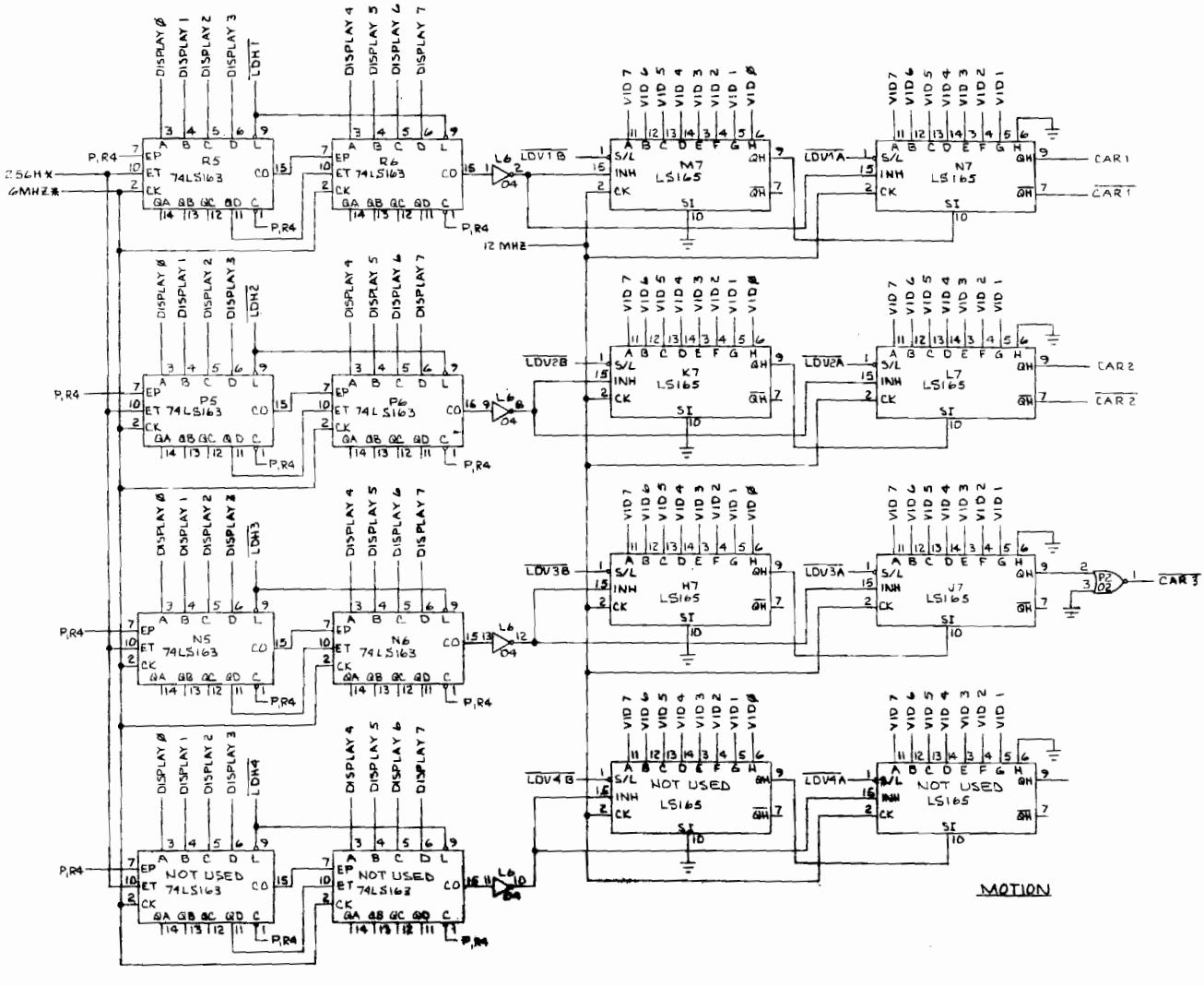
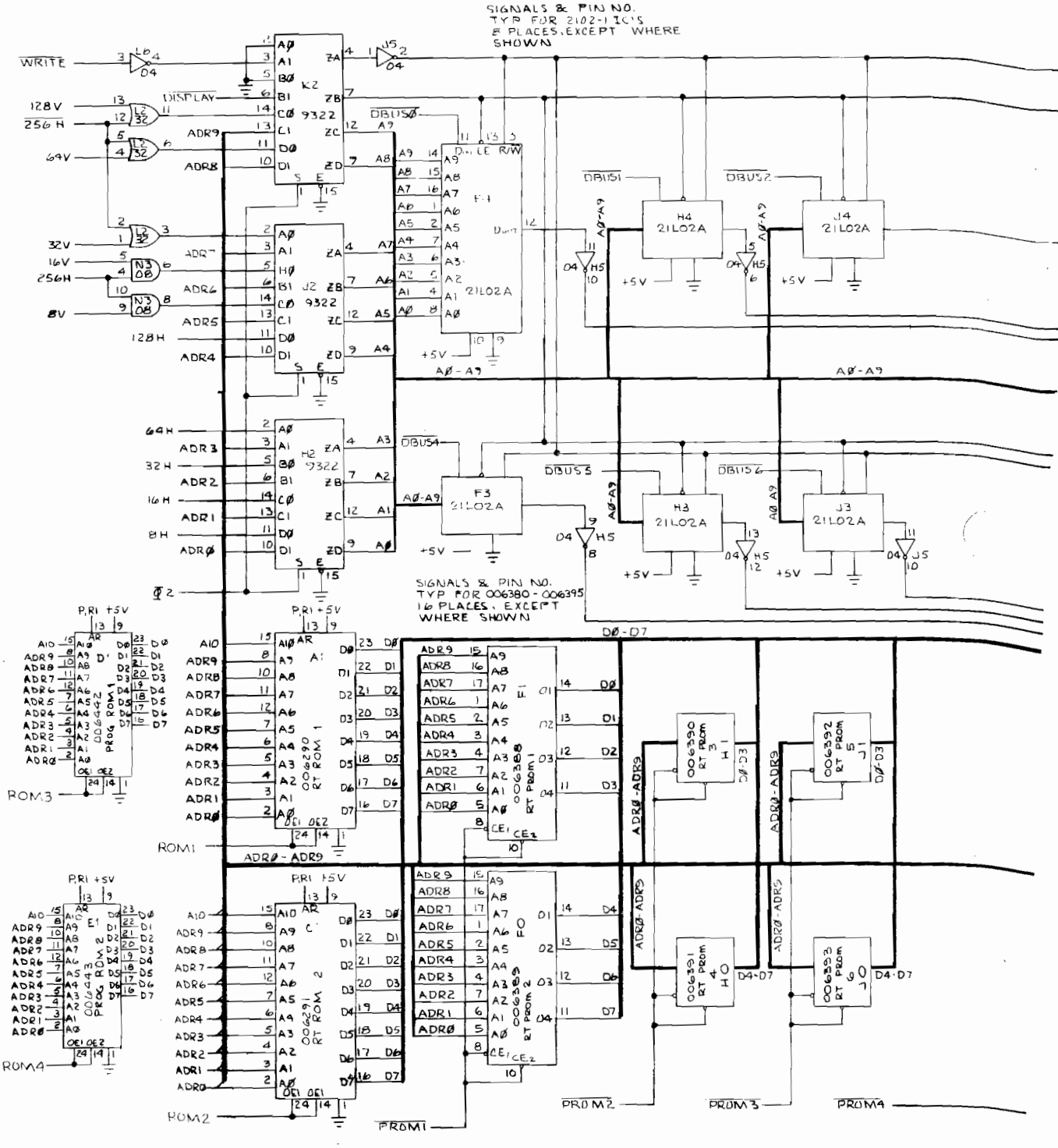


Figure 4-6 Sprint One Schematic Diagram Sheet 2 of 5
006433 C


SIGNALS & PIN NO.
TYP FOR 2102-1 IC'S
8 PLACES, EXCEPT WHERE
SHOWN
WRITE
DISPLAY
128V
256H
64V
32V
16V
8V
128H
64H
32H
16H
8H
ADR9
ADR8
ADR7
ADR6
ADR5
ADR4
ADR3
ADR2
ADR1
ADRØ
K2 9322
J2 9322
H2 9322
DBUSØ
DBUS1
DBUS2
DBUS4
DBUS5
DBUS6
F1 21L02A
F3 21L02A
H4 21L02A
J4 21L02A
H3 21L02A
J3 21L02A
AØ-A9
+5V
SIGNALS & PIN NO.
TYP FOR 006380-006395
16 PLACES, EXCEPT
WHERE SHOWN
DØ-D7
ROM1
ROM2
ROM3
ROM4
PROM1
PROM2
PROM3
PROM4
006390 RT PROM H1
006392 RT PROM J1
006391 RT PROM H0
006393 RT PROM J0
D0-D3
D4-D7

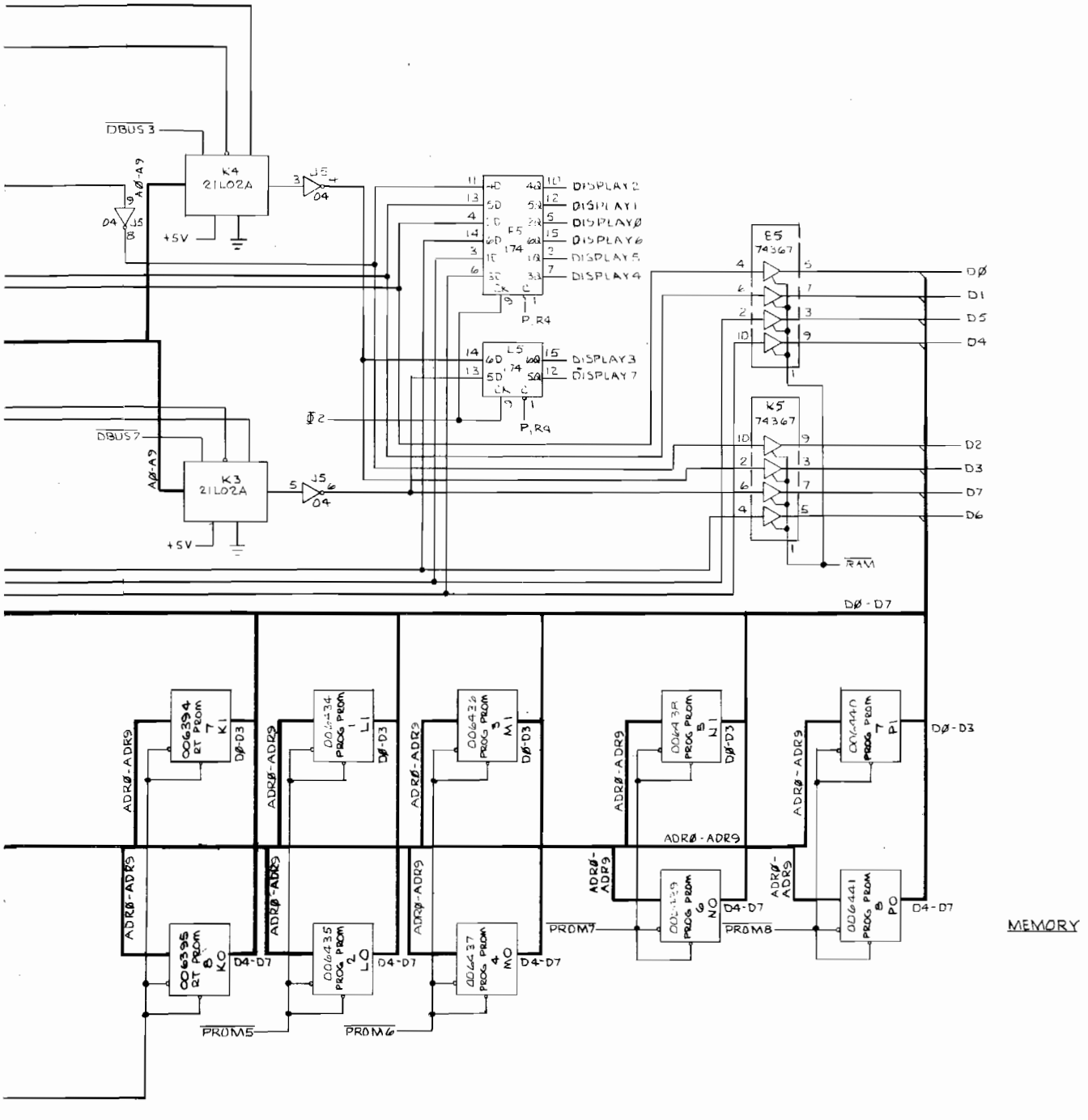
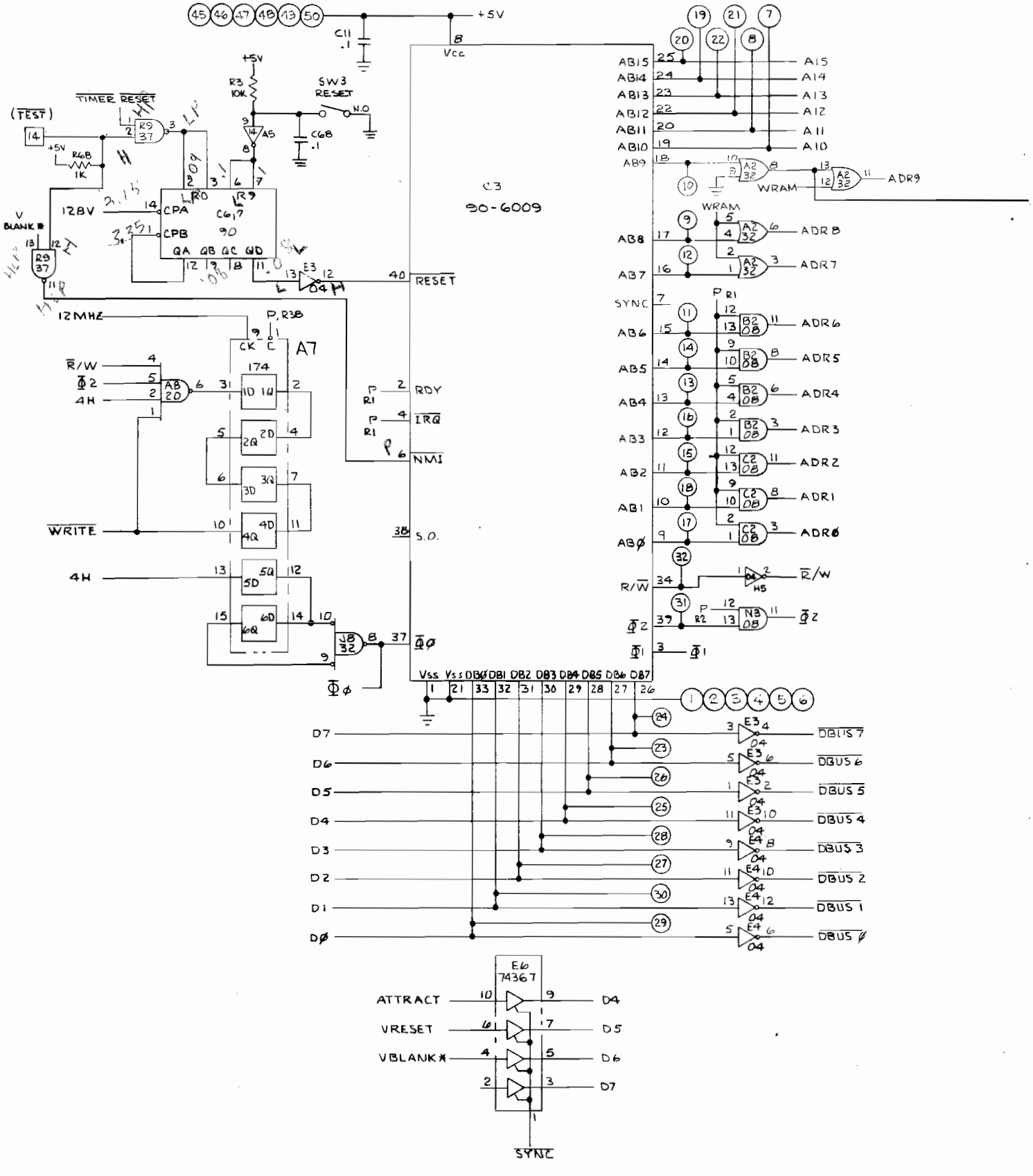


Figure 4-6 Sprint One Schematic Diagram Sheet 3 of 5
006433 **C**


+5V
C11 .1
Vcc
C3
90-6009
SW3 RESET
N.O
C68 .1
R3 10K
TIMER RESET
(TEST)
R68 1K
12BV
V BLANK*
CPA
CPB
QA QB QC QD
C617
90
12MHz
A7
174
R/W
WRITE
4H
RESET
RDY
IRQ
NMI
S.O.
R/W
WRAM
ADR9
ADR8
ADR7
ADR6
ADR5
ADR4
ADR3
ADR2
ADR1
ADR0
SYNC
AB15
AB14
AB13
AB12
AB11
AB10
AB9
AB8
AB7
AB6
AB5
AB4
AB3
AB2
AB1
AB0
Vss Vss DB0 DB1 DB2 DB3 DB4 DB5 DB6 DB7
D7
D6
D5
D4
D3
D2
D1
D0
DBUS 7
DBUS 6
DBUS 5
DBUS 4
DBUS 3
DBUS 2
DBUS 1
DBUS 0
E6 74367
ATTRACT
VRESET
VBLANK*
SYNC

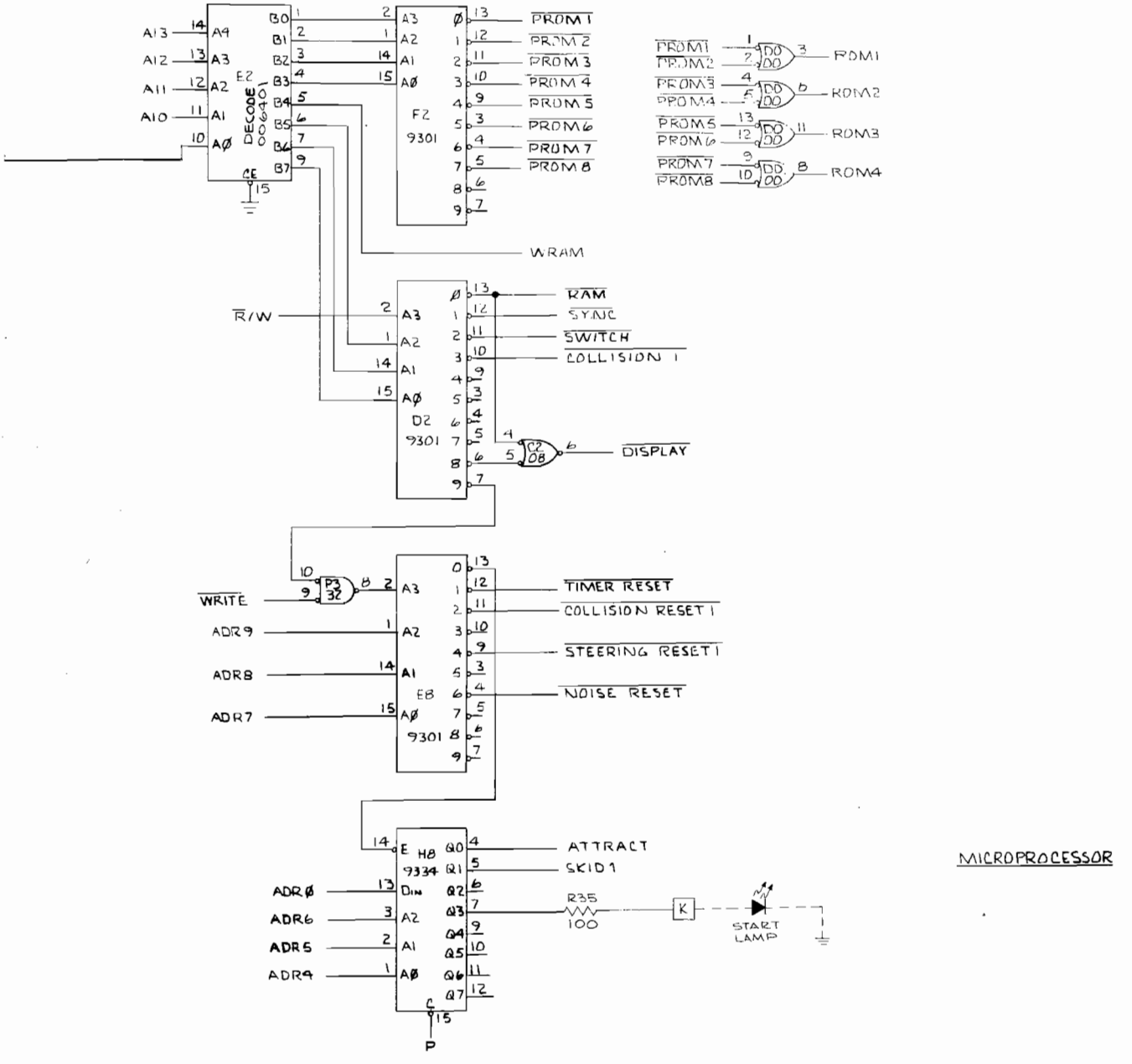
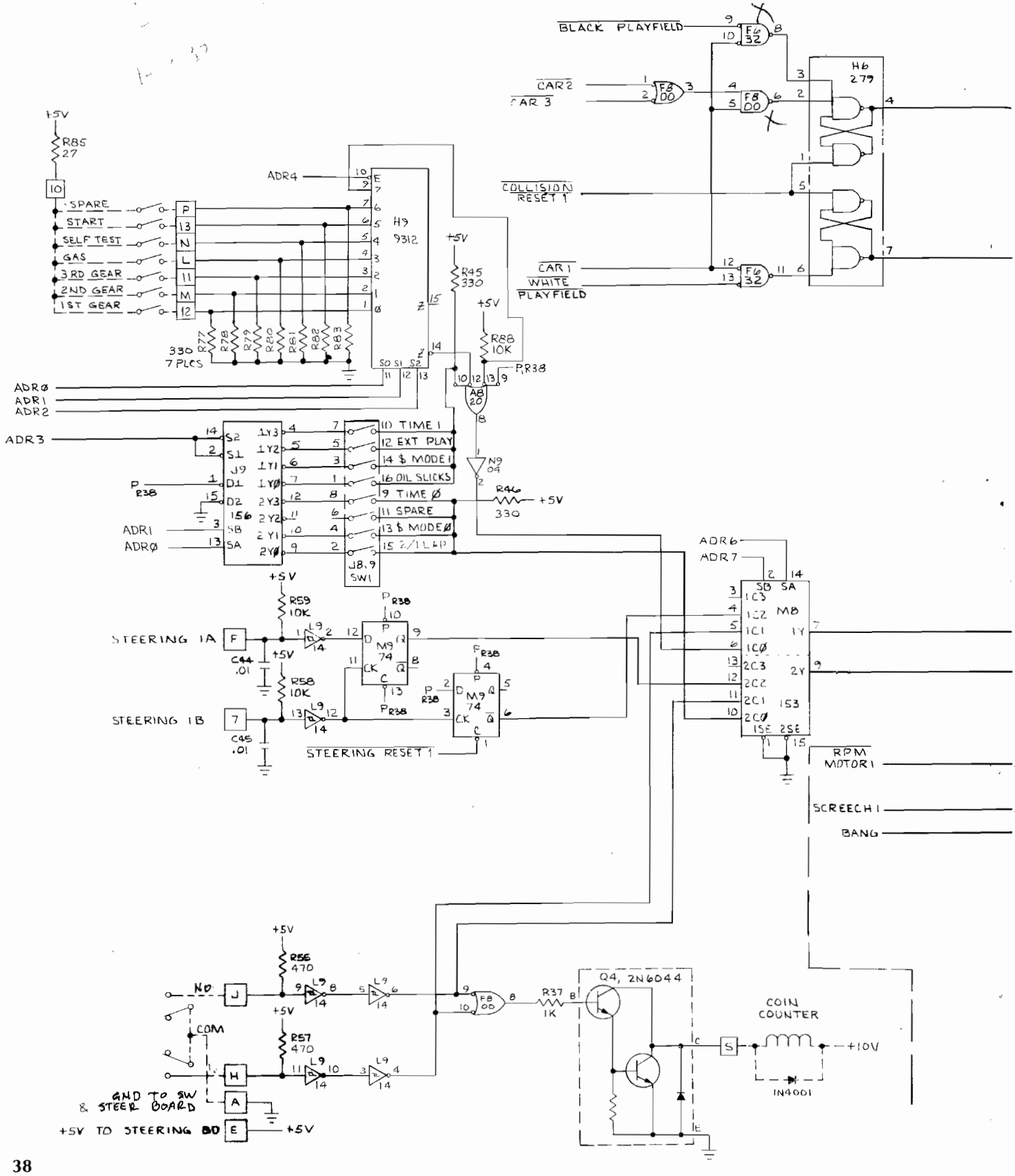


Figure 4-6 Sprint One Schematic Diagram Sheet 4 of 5
006433 C


BLACK PLAYFIELD
CAR 2
CAR 3
H6
279
COLLISION RESET 1
CAR 1
WHITE PLAYFIELD
+5V
R85
27
SPARE
START
SELF TEST
GAS
3 RD GEAR
2ND GEAR
1ST GEAR
ADR4
H9
9312
330
7 PLCS
R45
330
R88
10K
PR38
ADR0
ADR1
ADR2
ADR3
J9
156
J8,9
SW1
10 TIME 1
12 EXT PLAY
14 $ MODE 1
16 OIL SLICKS
9 TIME 0
11 SPARE
13 $ MODE 0
15 2/1 LAP
N9
04
R46
330
ADR1
ADR0
STEERING 1A
STEERING 1B
R59
10K
R58
10K
C44
.01
C45
.01
M9
74
STEERING RESET 1
ADR6
ADR7
M8
153
RPM MOTOR 1
SCREECH 1
BANG
R56
470
R57
470
NO
COM
GND TO SW & STEER BOARD
+5V TO STEERING BD
R37
1K
Q4, 2N6044
COIN COUNTER
+10V
IN4001

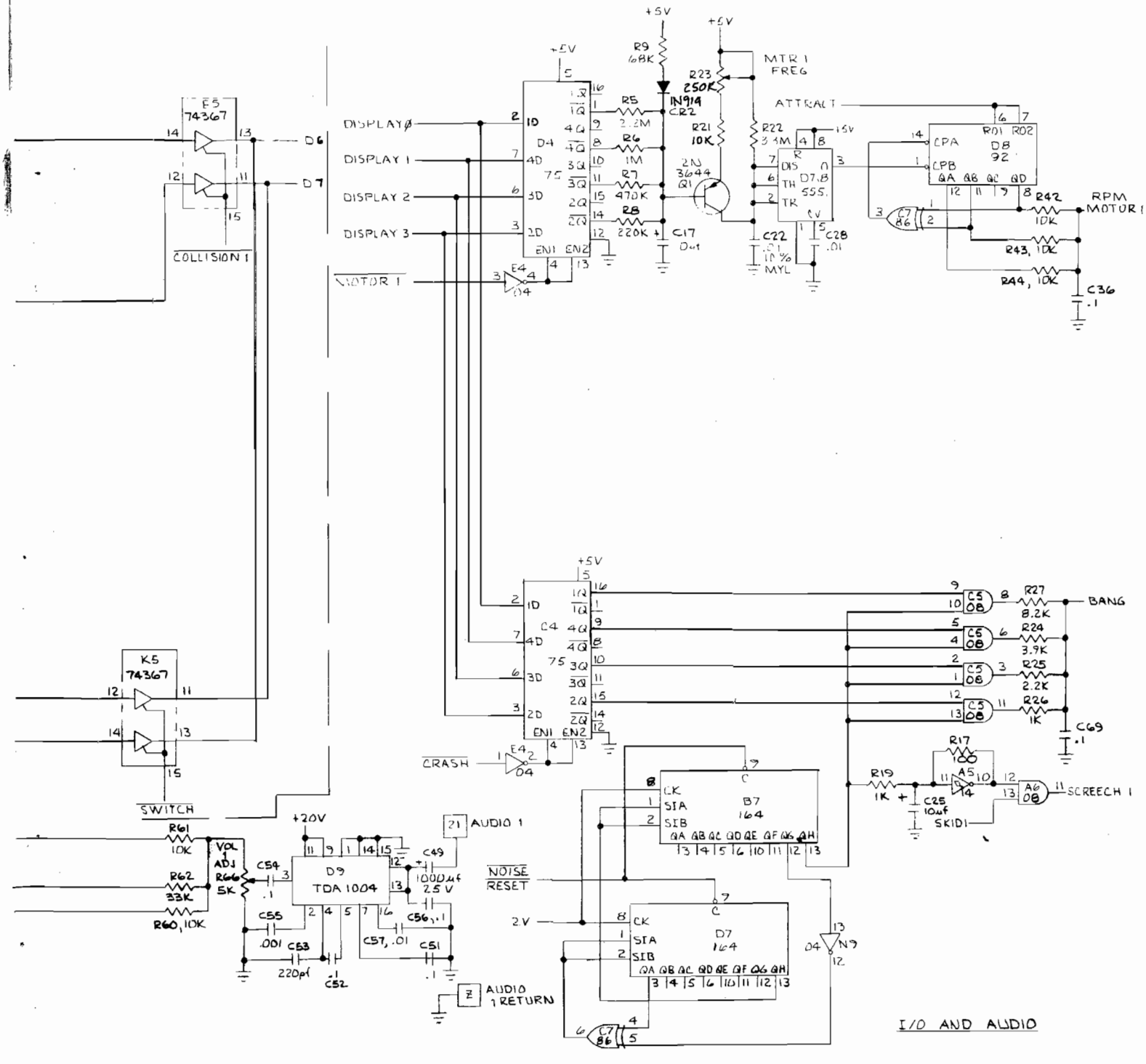


Figure 4-6 Sprint One Schematic Diagram Sheet 5 of 5
006433 **C**

schematic sheet 3). This signal is used to generate the LDV x A and LDV x B load pulses.

The RAM byte data code that controls car rotation is capable of addressing any of 32 different car pictures. The five bits of data code necessary to do this (DISPLAY 3 through DISPLAY 7) are applied directly to the address input of the car picture ROM J6 and K6.

The least significant address lines applied to the car picture ROM (inputs A0, A1, A2 and A3) complement the rotation data code by determining which of the eight lines of the car is being described by the ROM data output, and whether it is the first half (right) or second half (left) of the car to be displayed. When Φ2 is high, the video data output (VID 0 through VID 7) from the car picture ROM is timed with load vertical pulse LDV x B. Load vertical pulse LDV x B enables shift register M7 (K7 or H7) to load the video data from the car picture ROM. This data is for the right half of the car.

When Φ2 is low, the video data output (VID 0 through VID 7) from the car picture ROM is timed with load vertical pulse LDV x A. Load vertical pulse LDV x A enables shift register N7 (L7 or J7) to load the video data from the car picture ROM. This data is for the left half of the car.

In review, the motion generator has received a RAM data code for where the car is to be displayed vertically and a RAM data code for the proper picture of the car. The final instruction needed is for the horizontal placement of the car. The RAM byte that determines this is received by the car horizontal location counter.

The car horizontal location counter R5 and R6 (P5 and P6 or N5 and N6), is loaded each horizontal line by a load horizontal pulse LDHx. The counter is preset to a given count by the RAM data code (DISPLAY 0 through DISPLAY 7) during horizontal blanking. At the end of horizontal blanking, 256H goes high, and the counter is enabled to begin counting up at a clock rate of 6 MHz.

When the horizontal counter reaches its maximum count (all outputs are ones), it generates a "carry out" at pin 15. This carry pulse enables the car video shift registers M7 and M6 (K7 and L7 or H7 and J7) to begin shifting out the appropriate video previously loaded into it. The output of shift register N7 (L7 or J7) is now serial car picture information ready to be displayed as video.

Video Output

The video output circuit receives all video signals and gates them together through summing resistors R48, R49, and R50. Cars 2, 3, and the black video playfield are gated through resistor R49 to produce the black level video. Car 1 and the white playfield are gated through resistor R50 to produce the white level video.

Car/Playfield Comparator

The car/playfield comparator is a network of logic gates that gate together the three video outputs of the motion generator and the two video outputs of the playfield generator. Table 4-2 provides the seven possible conditions that would cause a high to appear on data lines D6 and D7 of the data bus. The microcomputer MPU recognizes an output from the comparator by outputting an address to the Address Decoder for a $\overline{\text{COLLISION 1}}$ or $\overline{\text{COLLISION 2}}$ "read" signal. This causes tri-state devices E5 and E6 to be enabled and allows the output of the car/playfield comparator to be transferred onto the MPU data bus.

Table 4-2 Conditions of Car/Playfield Data Output

Car/Playfield Comparator Conditions	Data Line Output
Car 1 Coincident with Car 2 or 3	D6
Car 1 Coincident with Black Playfield (oil)	D6
Car 1 Coincident with White Playfield (track)	D7

Table 4-3 Operation of Multiplexer M8 with Given Input Address

Address Logic Level ADR6	ADR7	Output 1Y (D7)	2Y (D6)
L	L	1C0	2C0
L	H	1C1	2C1
H	L	1C2	2C2
H	H	1C3	2C3

When the MPU receives the data that a skid (a high on data line D6) or crash (a high on data line D7) condition exists, program memory instructs the MPU to cause the appropriate response to be displayed on the TV monitor display. It then tells the MPU to clear the car/playfield comparator. This is done by the MPU outputting an address that is decoded to cause a low $\overline{\text{COLLISION RESET 1}}$ and/or $\overline{\text{COLLISION RESET 2}}$. The

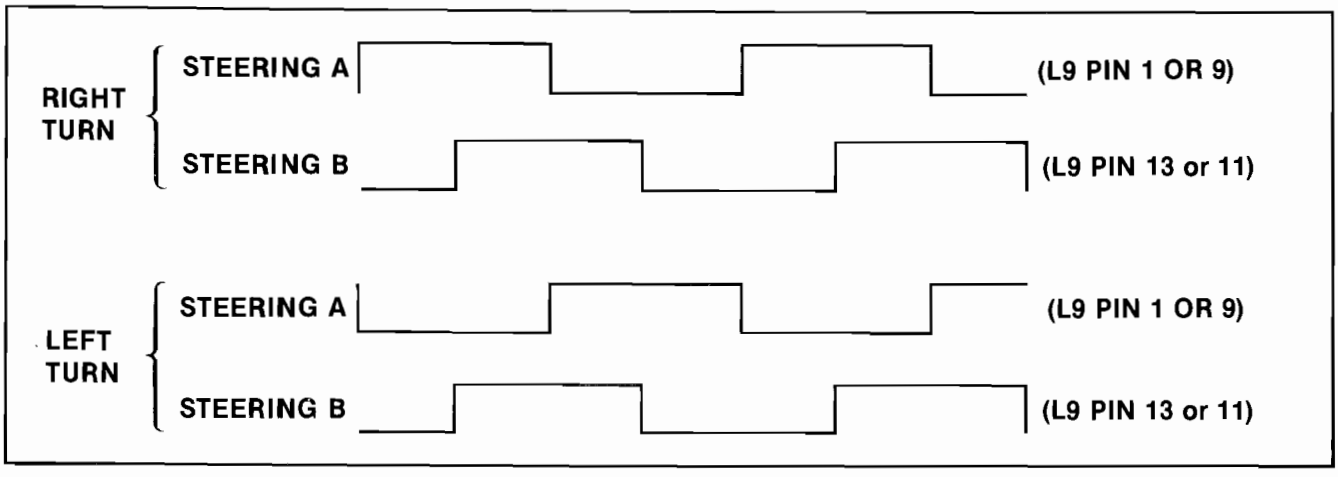


Figure 4-7 Steering Printed Circuit Assembly Output Pulses

Collision Reset signals reset latch H6 of the car/playfield comparator.

Manual Control Interface

The main component of the manual control interface is multiplexer M8. This component acts as a two-pole four-position switch, operated by address lines ADR6 and ADR7 from the microcomputer MPU. Table 4-3 lists the input/output relationship of multiplexer M8 with the given address inputs. Multiplexer M8 interfaces three different sources of information as follows: 1) coin information, 2) steering information, and 3) switch information. All information is received by the microcomputer MPU when the MPU addresses the address decoder for a low $\overline{\text{SWITCH}}$ signal that enables tri-state device K5 for a data output on the D6 and D7 data lines of the MPU.

Coin information is a matter of storing in the microcomputer RAM the number of times a low pulse appears on the data lines, when the appropriate address input of multiplexer M8 is being addressed. The microcomputer MPU only "looks" for coin pulses during the attract mode.

Steering information is "looked" for by the microcomputer MPU during the play mode. The steering printed circuit assembly consists of two light-emitting diodes that are optically aligned with two light-sensitive transistors. A toothed cylinder, turned by the steering wheel, is inseted between the light-emitting diodes and the transistors, and interrupts the light from the diodes. When the steering wheel is turned, two pulses appear at the output of the steering printed circuit assembly that differ in phase.

As illustrated in Figure 4-7 when the wheel is turned to the right, the A output pulse leads the B output pulse. When the wheel is turned to the left the A output pulse lags the B output pulse. The inverse of the two pulses are applied to the D and clock inputs of two D-type flip-flops (see schematic). The microcomputer MPU recognizes that a steering maneuver has been made when a low appears on data line D7. The MPU then "looks" at data line D6 and determines from the logic level (high or low) if "Steering A" input is leading or lagging "Steering B" input. Once the MPU has processed a steering maneuver, the MPU then outputs an address that is decoded by the Address Decoder and results in a low $\overline{\text{STEERING RESET 1}}$ or $\overline{\text{STEERING RESET 2}}$ signal that resets the D-type flip-flop responsible for the steering signal.

Table 4-4 MPU Addresses For Reading Switch Status

MPU Address (in hexidecimal)	Switch Name	MPU Data Line Used to Read Switch
0828	First Gear	D7
0829	Second Gear	D7
082A	Third Gear	D7
082B	Gas Pedal	D7
082C	Self-Test Switch	D7
082D	Start Switch	D7
0830	1- or 2-Lap Option	D6
0830	Oil Slick Option	D7
0831	Coin Option A	D6
0831	Coin Option B	D7
0832	Spare (Unused)	D6
0832	Extended Play Option	D7
0833	Game Time Option A	D6
0833	Game Time Option B	D7

Note: A low signal on the MPU data bit listed at the MPU address specified (in hex) indicates a switch closure.

Switch information is received by multiplexer M8 and inputs 1CO and 2CO. The microcomputer MPU addresses Decoders H9 and J9 to determine if a switch is opened or closed. If closed, a low pulse will result for the given address as listed in Table 4-4.

Motor Generator

The key to the motor generator is the operation of transistor Q1 in conjunction with timer D7,8. Timer D7,8 operates as an oscillator with output frequency dependent upon the resistive charge path of capacitor C22.

Varying the collector-to-emitter resistive value of transistor Q1 varies the combined resistive charge path of capacitor C22 through transistor Q1 and resistors R21 and R23, in parallel with resistor R22. As the combined resistive value decreases, the output frequency of the timer increases. Variable resistor R23 makes it possible for the technician to adjust the frequency for a desirable motor idle sound.

Note: Resistor R22 is placed in parallel with this resistive charge path. Even if there is no current through the transistor, there will still be an alternate current path, so that the frequency of the oscillator will always equal idle frequency at least.

The conductance of transistor Q1 is determined by its available base current. The current is controlled by a digital-to-analog conversion. This conversion is accomplished via latch D4 and resistors R5, R6, R7, R8 and R9. The input to this D/A converter is stored in the MPU RAM, and is accessed at the appropriate time by a "latch pulse" labeled MOTOR 1. Table 4-5 shows the 16 possible voltages that will appear at the base of Q1 in conjunction with the appropriate data codes stored in the MPU RAM (DISPLAY 0 through DISPLAY 3).

To derive a realistic car motor sound, the output of timer D7,8 is divided into three separate frequencies by counter D8, then summed by resistors R42, R43, and R44. A divide-by-three signal at QB (pin 11) output of D8 is applied to summing resistor R42. Outputs QB and QD (pin 8) are also applied to Exclusive OR gate C7 to provide a divide-by-twelve signal at the QA (pin 12) output of D8, which is applied to summing resistor R42.

Bang and Screech Generator

The heart of the bang and screech generator is noise generator B7, D7. Shift registers B7 and D7 are connected in a manner to produce random noise at the QH (pin 13) output of B7.

Bang is the result of data from the microcomputer RAM, which is used to gate varying amounts of random noise through to the audio amplifier via latch C4 and AND gate C5. Noise is gated from noise generator B7, D7 through a digitally-controlled resistive network consisting of R24, R25, R26, and R27. The result is an envelope of sound from full on to full off.

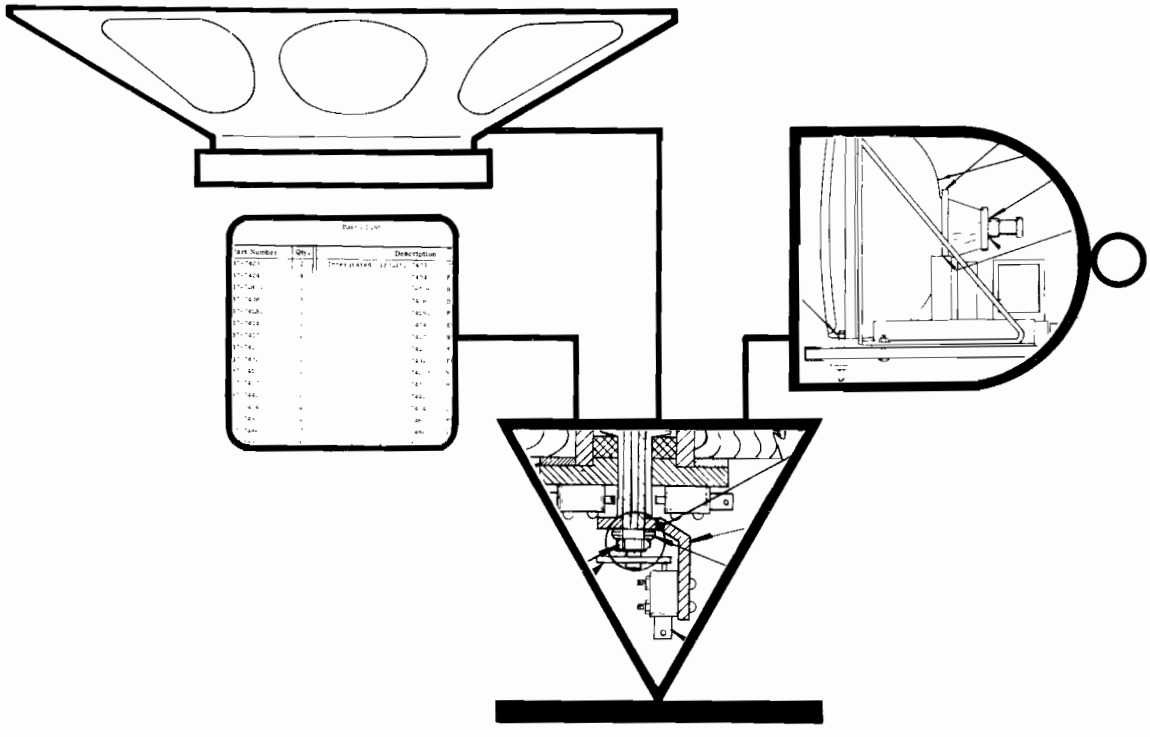
Screech sound is produced by processing the output of the random noise generator with a type of hysteresis feedback loop, via Schmitt-trigger inverter A5 (7414) and 100-ohm resistor R17, and then gating this processed noise with SKID 1.

Audio Output

The summed signals of the motor generator and bang and screech generator are applied to one leg of a 5k-ohm potentiometer. Varying the wiper position of the potentiometer varies the signal input of audio amplifier D9. The output of the audio amplifier is connected to an 8-ohm speaker.

Table 4-5 Approximate Base Voltage of Transistor Q1 or Q2 for Given Address

Address				Base Voltage of Transistor Q1 or Q2
DISPLAY 0	DISPLAY 1	DISPLAY 2	DISPLAY 3	
L	L	L	L	5.00 VDC
H	L	L	L	4.25 VDC
L	H	L	L	4.08 VDC
H	H	L	L	3.95 VDC
L	L	H	L	3.77 VDC
H	L	H	L	3.65 VDC
L	H	H	L	3.52 VDC
H	H	H	L	3.42 VDC
L	L	L	H	3.22 VDC
H	L	L	H	3.13 VDC
L	H	L	H	3.03 VDC
H	H	L	H	2.95 VDC
L	L	H	H	2.84 VDC
H	L	H	H	2.77 VDC
L	H	H	H	2.69 VDC
H	H	H	H	2.62 VDC

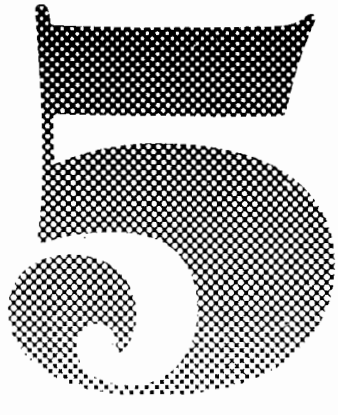


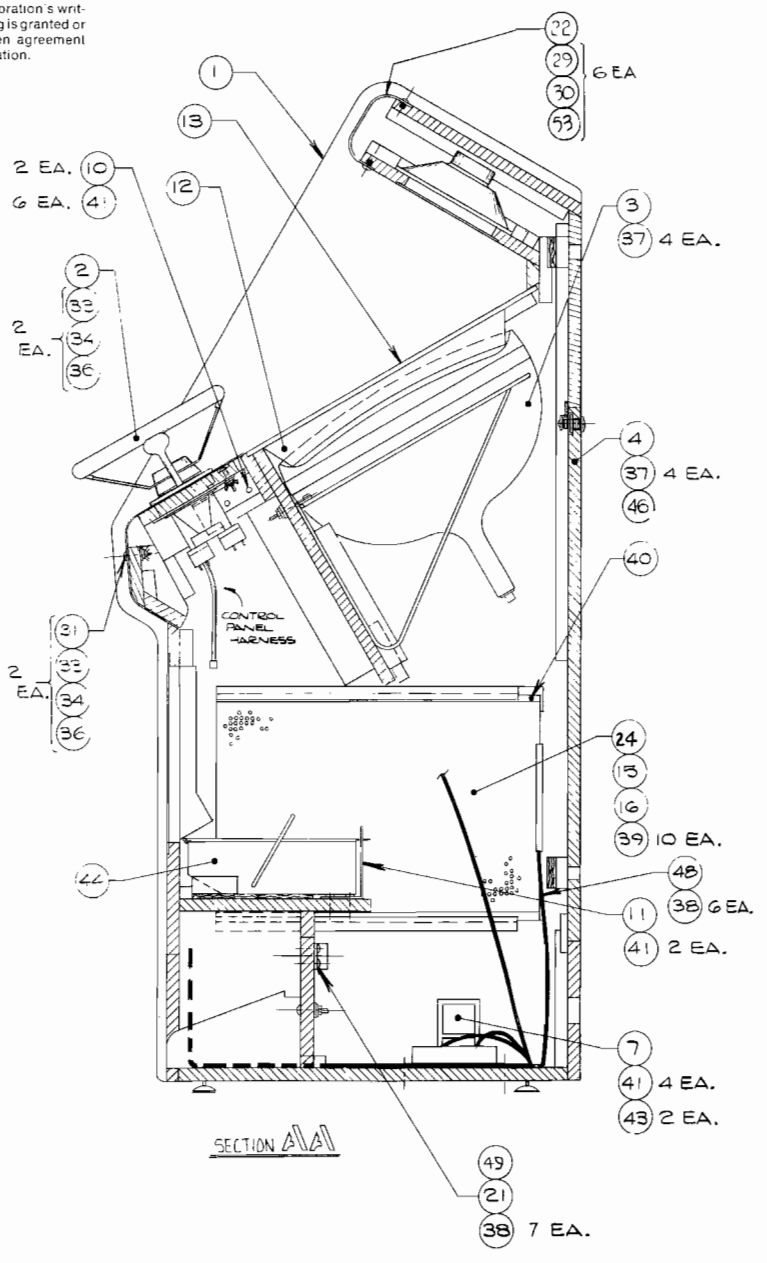
ILLUSTRATED PARTS CATALOG

The purpose of this chapter is to provide you with the necessary information for ordering replacement parts for your Sprint One™ game (woodgrain or graphics version).

When ordering parts from your distributor, give the part number, part name, applicable figure number of this list, and the serial number of your Sprint One 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.

If there are any questions about this catalog, please contact Atari's Customer Service Department by telephone Monday through Friday, from 7:30 a.m. to 4 p.m. Pacific Time. From California, Alaska and Hawaii, call (408) 984-1900, from the remaining 47 states call (800) 538-6892, toll-free.





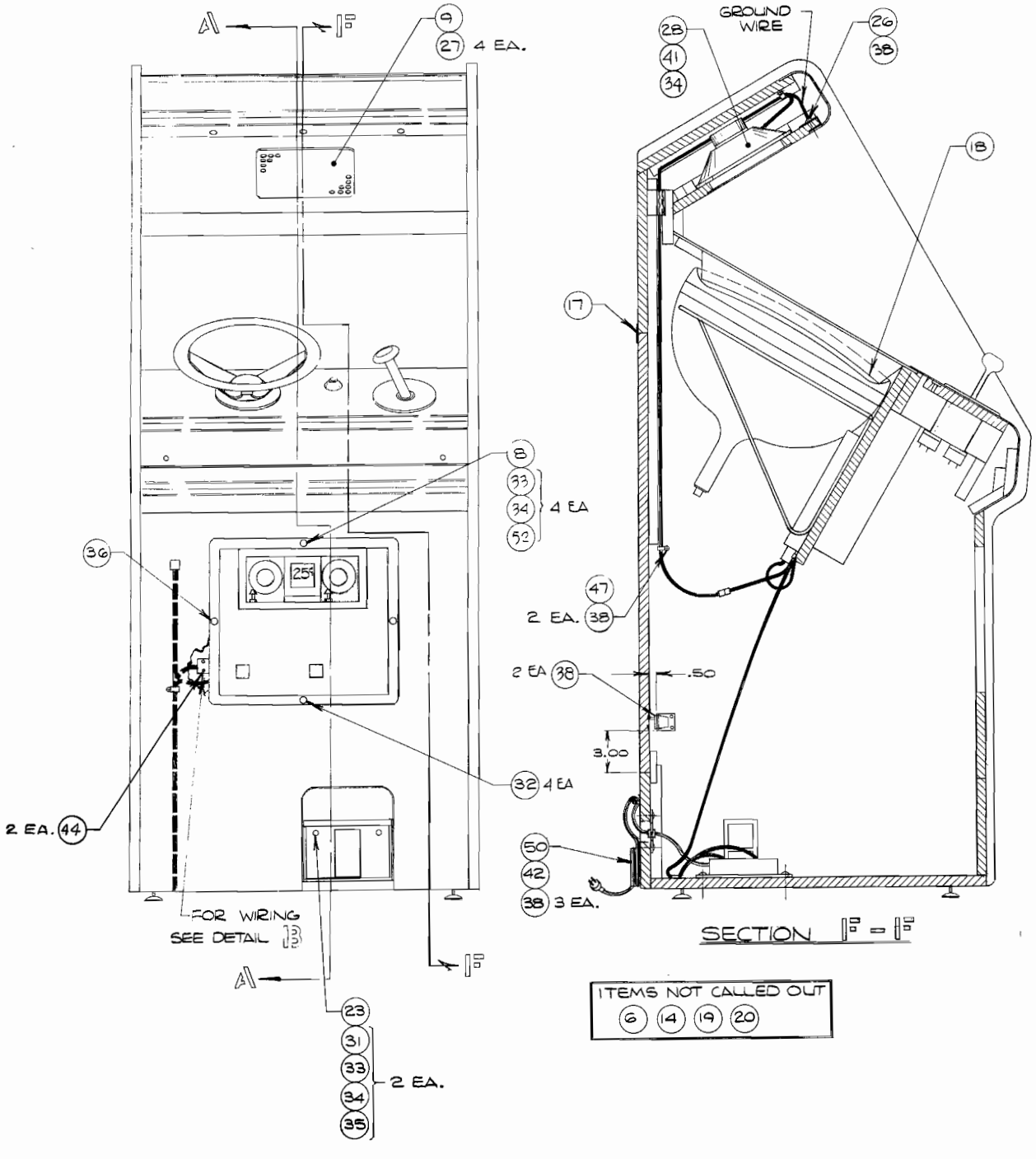


Figure 5-1 Sprint One Final Assembly
A008872-01 C

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Figure 5-1 Sprint One Final Assembly Parts List

Item	Part Number	Qty.	Description
1	A008873-01	1	Cabinet Assembly
2	A008874-01	1	Control Panel Assembly
3	A008875-01	1	T.V. Shelf Assembly
4	A007299-01	1	Rear Door Assembly with Lock
5	A009262-01	1	R.F. Shield Box Assembly
6	A008910-XX	1	Shipping Container Assembly
7	A007258-01	1	Power Supply Base Assembly, Type "C"
8	A009083-01	1	Coin Door Assembly
9	005419-01	1	Speaker Mesh Cover
10	002728-01	2	Brkt. Control Panel
11	006870-01	1	Coin Box Bracket
12	008901-01	1	Bezel, Cardboard
13	008903-01	1	Shield, Plex Cover
14	006311-01	1	Harness, Schematic
15	A006446-01	1	R.F. Shield PCB Assembly
*16	A006443-02	1	P.C.B. Assembly, Sprint I (ROM Version)
17	005233-01	1	Rear Door Seal
18	006319-01	1	Copyright Decal
19	006305-01	1	Printed Poly Bag
20	TM-095	1	Tech. Manual
21	007103-01	1	On/Off Switch Cover
22	008906-01	1	Cover Panel, with Graphics
23	A008845-01	1	Single Foot Pedal Assembly
24	78-24007	4	Cable Tie, Heat Stablized
25	81-702	2	Tip-N-Tell Indicator
26	78-6601216	1	Alum. Foil, 1" Wide x 20" Lg. (Approx.)
27	73-77004	4	Rivets, 3/16" OD x .68 Lg. (.250 - .500 Grip)
28	48-009	1	Speaker, 8"
29	82-8016	6	Screws, Button Hd. Socket Cap. #10-32 x 1.00" Lg.
30	75-99090006	6	Well Nuts, Blind Hole Fastener #10-32
31	75-5524B	4	Carriage Bolts, ¼-20 x 1.50 Lg.
32	75-5516B	4	Carriage Bolts, ¼-20 x 1.00 Lg.
33	75-045	6	Washers, Split-Lock ¼
34	75-015S	11	Washers, Flat ¼
35	75-915S	2	Hex Nuts, ¼-20
36	75-935	4	Wing Nuts, ¼-20
37	82-1824	8	Wood Screws, #8 x 1½ Lg. Ft. Hd. Phil.
38	72-6610	20	Screws, Sm. Pan Hd. Phil. #6 x 5/8 Lg.
39	72-6608	10	Screws, Sm. Pan Hd. Phil. #6 x ½ Lg.

*A substitute for Item 16 is A006433-01

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Figure 5-1 Sprint One Final Assembly Parts List

Item	Part Number	Qty.	DESCRIPTION
40	72-6808	1	Screws, Sm. Pan Hd. Phil. #8 x ½ Lg.
41	72-6812	19	Screws, Sm. Pan Hd. Phil. #8 x 3/4 Lg.
42	78-25001	1	Screw Down Tie-Wrap
43	46-201302	2	Fuses, 3 AMP
44	A007902-01	1	Cash Box Assembly
45	1PC-095	1	Illustrated Parts Catalog
46	ST-095	1	Self Test Chart
47	A009063-01	1	Speaker Harness Assembly
48	A006312-02	1	Main Harness Allembled To Volume Control
49	A009509-01	1	Power Switch & Harness Assembly
50	A033016-01	1	Strain Relief Power Cord Assembly
51			
52	75-990505S	4	¼-20 Nylon Locknuts
53	75-07021	6	#10 Nylon Black Washers
*	A substitute for item 16 is A006443-01, Qty of 1, PCB Assy, Sprint 1 (ROM Version)		

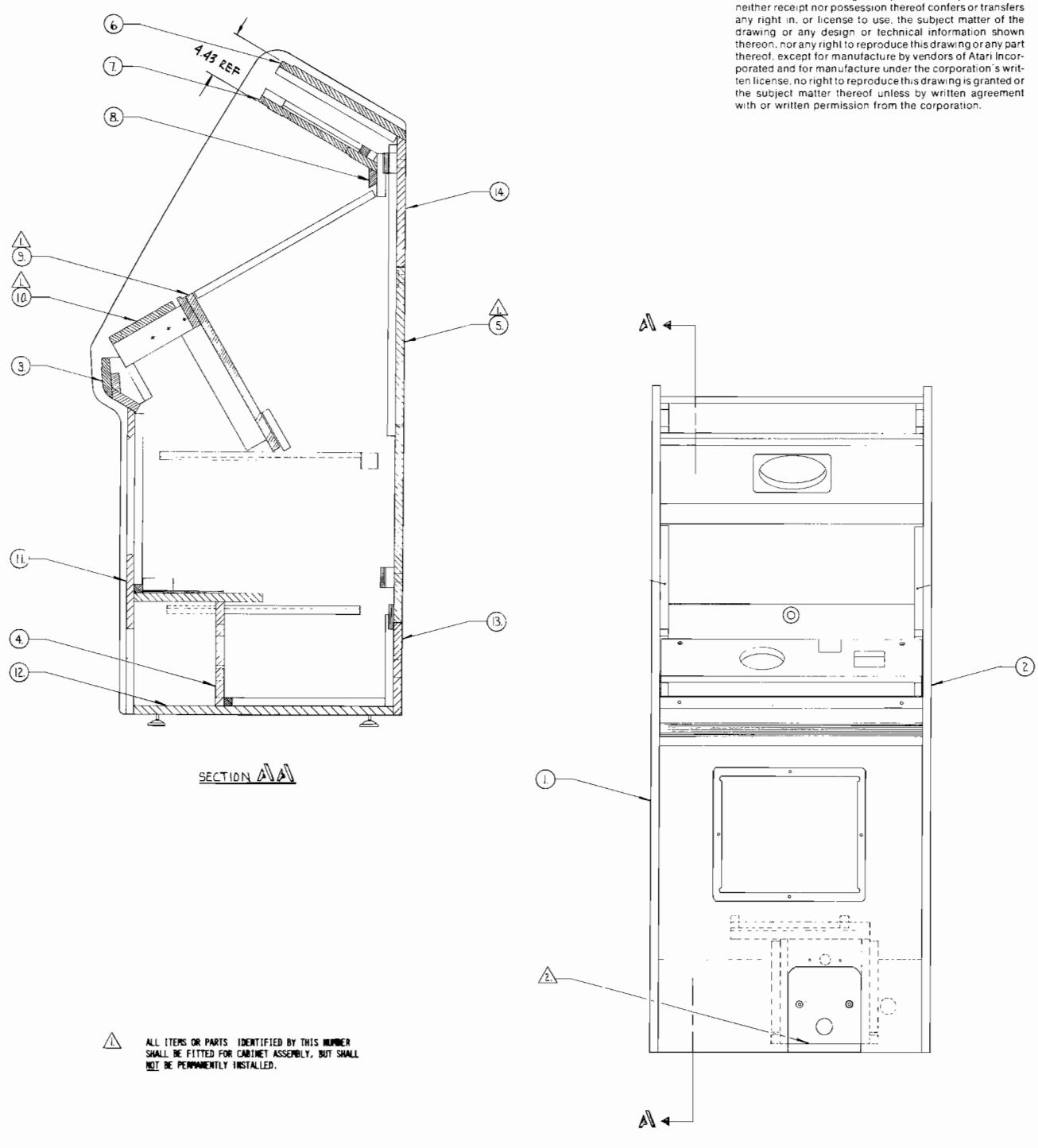

Figure 5-2 Cabinet Assembly
A008873-01 A

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Figure 5-2 Cabinet Assembly Parts List

Item	Part Number	Qty.	Description
1	A008877-01	1	Left Hand Side Panel Cleat Assembly
2	A008877-02	1	Right Hand Side Panel Cleat Assembly
3	A008878-01	1	Lower Control Panel Assembly
4	A008879-01	1	Foot Pedal Box Assembly
5	A007298-01	Ref	Rear Door Assembly
6	008908-01	1	Panel, Top
7	A008876-01	1	Panel, Speaker Mounting Assembly
8	008895-01	1	Panel, Plex Support
9	008897-01	Ref	T.V. Mounting Shelf
10	008898-01	Ref	Panel, Control Support
11	008881-01	1	Panel, Front
12	008896-01	1	Panel, Base
13	008882-01	1	Panel, Lower Rear
14	008883-01	1	Panel, Upper Rear

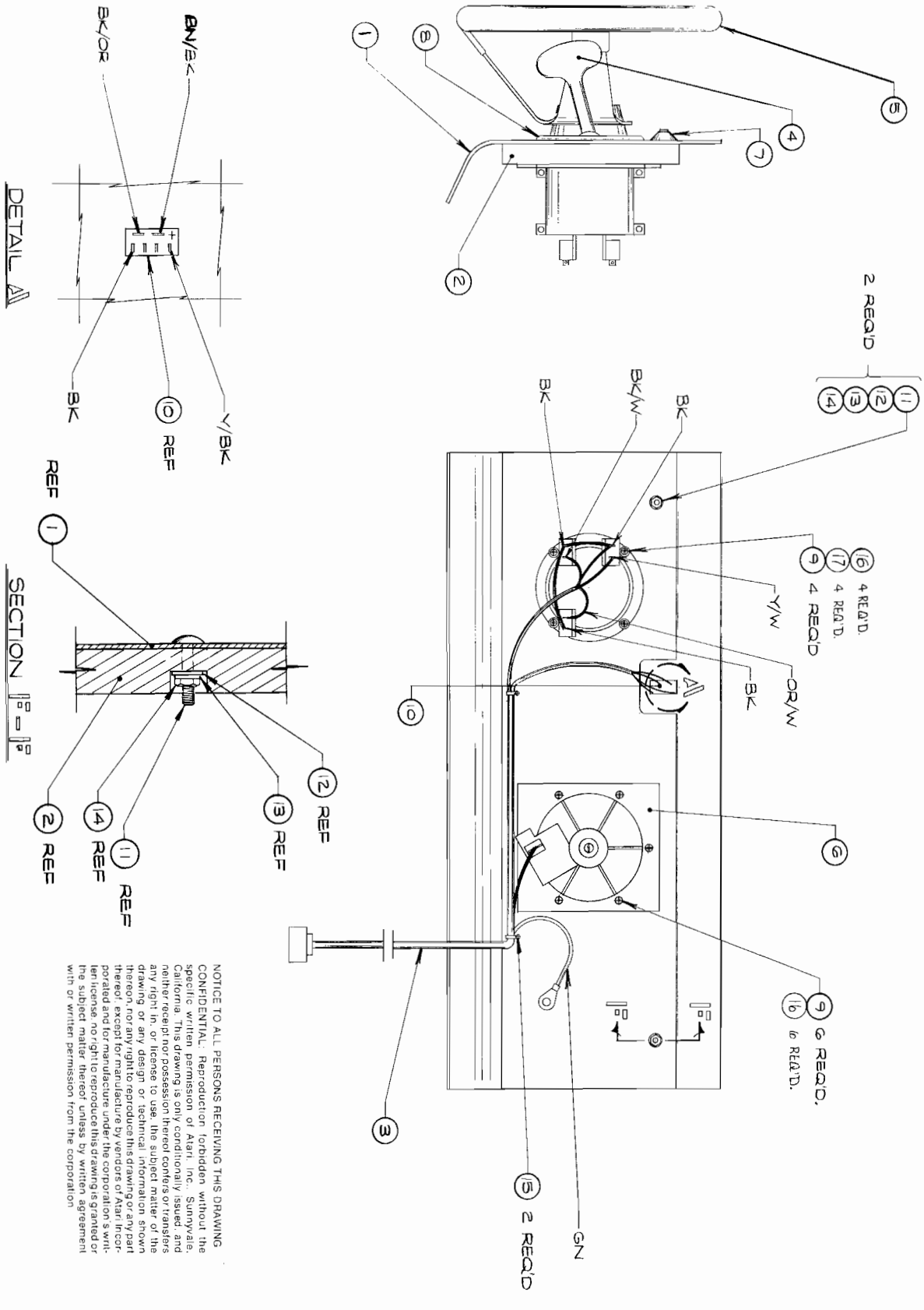

Figure 5-3 Control Panel Assembly
A008874-01 C

Figure 5-3 Control Panel Assembly Parts List

Item	Part Number	Qty.	Description
1	008902-01	1	Control Panel with Graphics
2	008898-01	1	Control Panel with Wood Support
3	A006313-01	1	Assembly, Control Panel Harness
4	A000608-02	1	N-Shift Assembly See Figure 4
5	A000598-02	1	Steering Wheel Assembly See Figure 5
6	000567-01	1	Bow Washer
7	001856-01	1	Bushing Alum.
8	005255-01	1	Shift Bezel
9	85-22F112	10	Screws, #10-24 x 3/4 Lg "F" Type Phil.
10	62-002	1	LED Switch
11	75-5524	2	Carriage Bolt, ¼-20 x 1½ Lg.
12	75-015S	2	Washers, Flat ¼
13	75-045	2	Washers, Split-Lock ¼
14	75-915S	2	Hex Nuts, ¼-20
15	75-6610	2	Screw, Sheet Metal, #6 x 5/8" Lg.
16	75-040	10	#10 Split-Lock Washers
17	75-010S	10	Washer, Flat #10

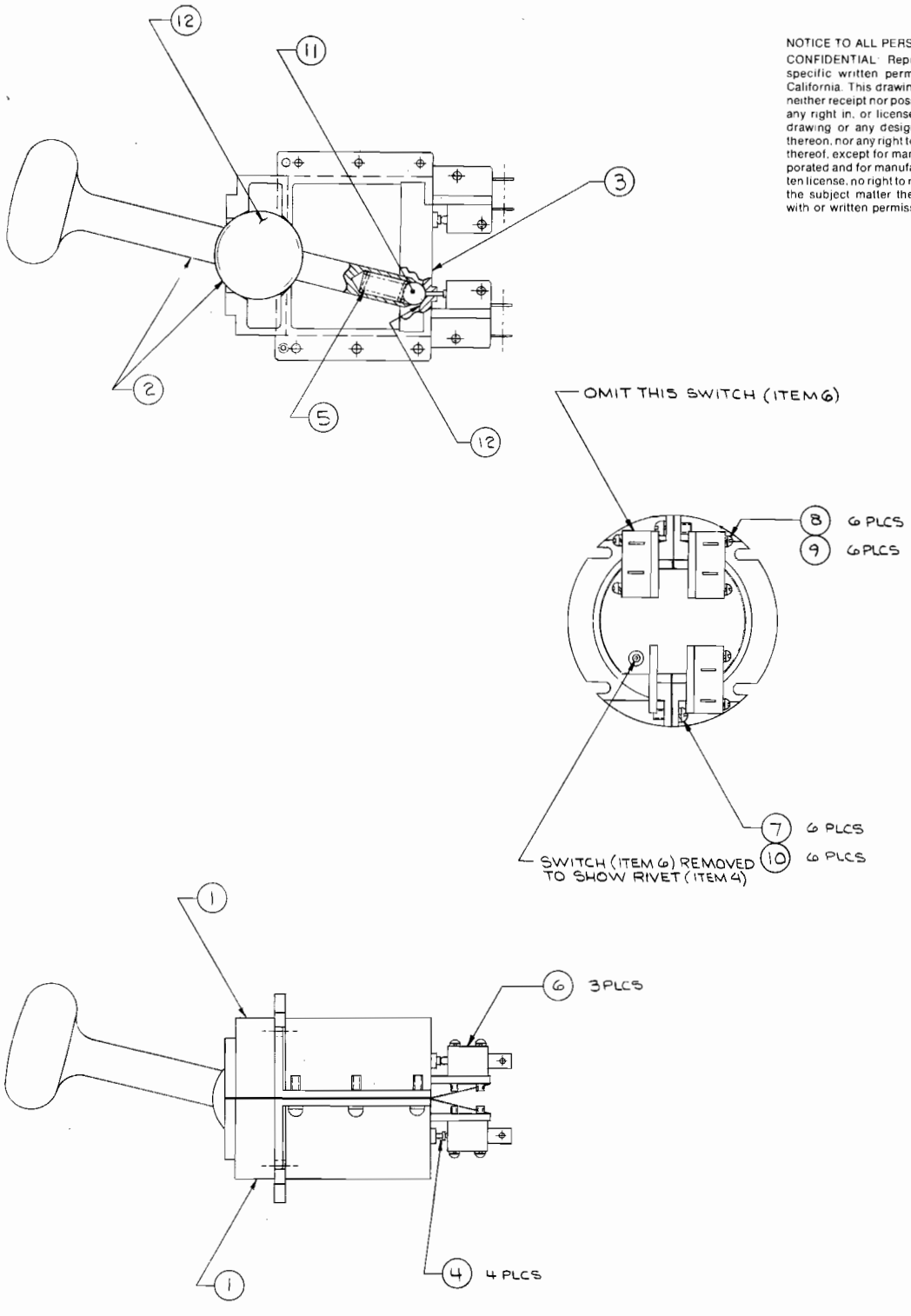

Figure 5-4 N-Shift Assembly
A000608-02 R

Figure 5-4 N-Shift Assembly Parts List

Item	Part Number	Qty.	DESCRIPTION
1	000609-01	2	Shift Housing
2	A000610-01	1	Handle Assy
3	005671-01	1	Shift Detent
4	73-7C0307SH	3	Shift Rivets
5	78-3002003	1	Spring, Assoc. Spring Co. (Co 360-032-100M/W)
6	65-021A	3	Switch, Cherry (E18-00M)
7	75-046	6	Washers, #6 Split-Lock
8	75-044	6	Washers, #4 Split-Lock
9	85-22F412	6	SCR Mach., 4-40 x 3/4 Lg. Pan HD., Self Threading Type "F"
10	85-22F608	6	SCR Mach., 6-32 x ½Lg. Pan HD., Self Threading Type "F"
11	76-11375S	1	Ball, Steel, 3/8 Dia. Bearing Grade
12	78-16002	A/R	Silicone Compound, Dow Corning #5
13	78-33001	1	Clamp, Hose

NOTE: Item #13, 78-33001, Hose Clamp is to be used only with old shift housing P/N 000609 Rev. "D"

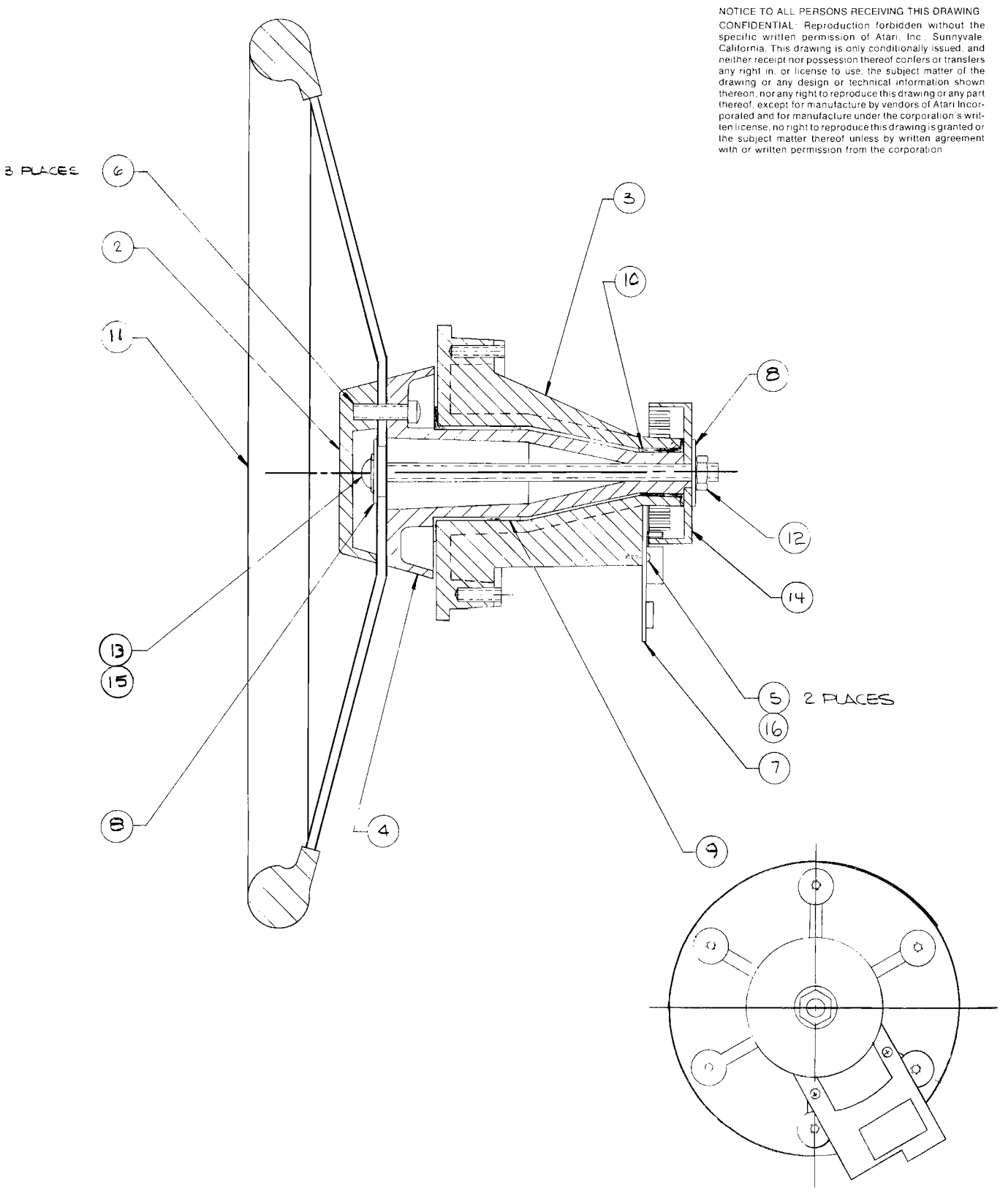

Figure 5-5 Steering Wheel Assembly
A000598-02 R

Figure 5-5 Steering Wheel Assembly Parts List

Item	Part Number	Qty.	DESCRIPTION
1	A000598-02	Ref	Steering Wheel Assembly
2	002133-02	1	Cover, Kee Games Logo
3	000605	1	Housing
4	000606	1	Shaft
5	85-22F206	2	Scr. Sht. Metal, #2-56 X 3/8 'F' Type
6	72-7512	3	Mach Scr, ¼-20 x 3/4 Lg, Fillister Hd Slotted
7	A000607	1	Printed Circuit Assembly See Figure 6
8	75-07002	2	Washer, Fender, ¼
9	76-092020	1	Bearing, Thompson (20L20-FK)
10	76-091010	1	Bearing, Thompson (10L10-FK)
11	78-40104	1	Steering Wheel, 10"
12	75-990505 S	1	Nut, ¼-20, Nylon Lock, Shallow Pattern
13	72-9580	1	Mach Scr, ¼-20 x 5 Lg, Truss Hd, Slotted
14	000616	1	Hub Light
15	75-055	1	Washer, ¼" Int. Tooth, Starlock
16	75-042	2	Washer, Split Lock #2

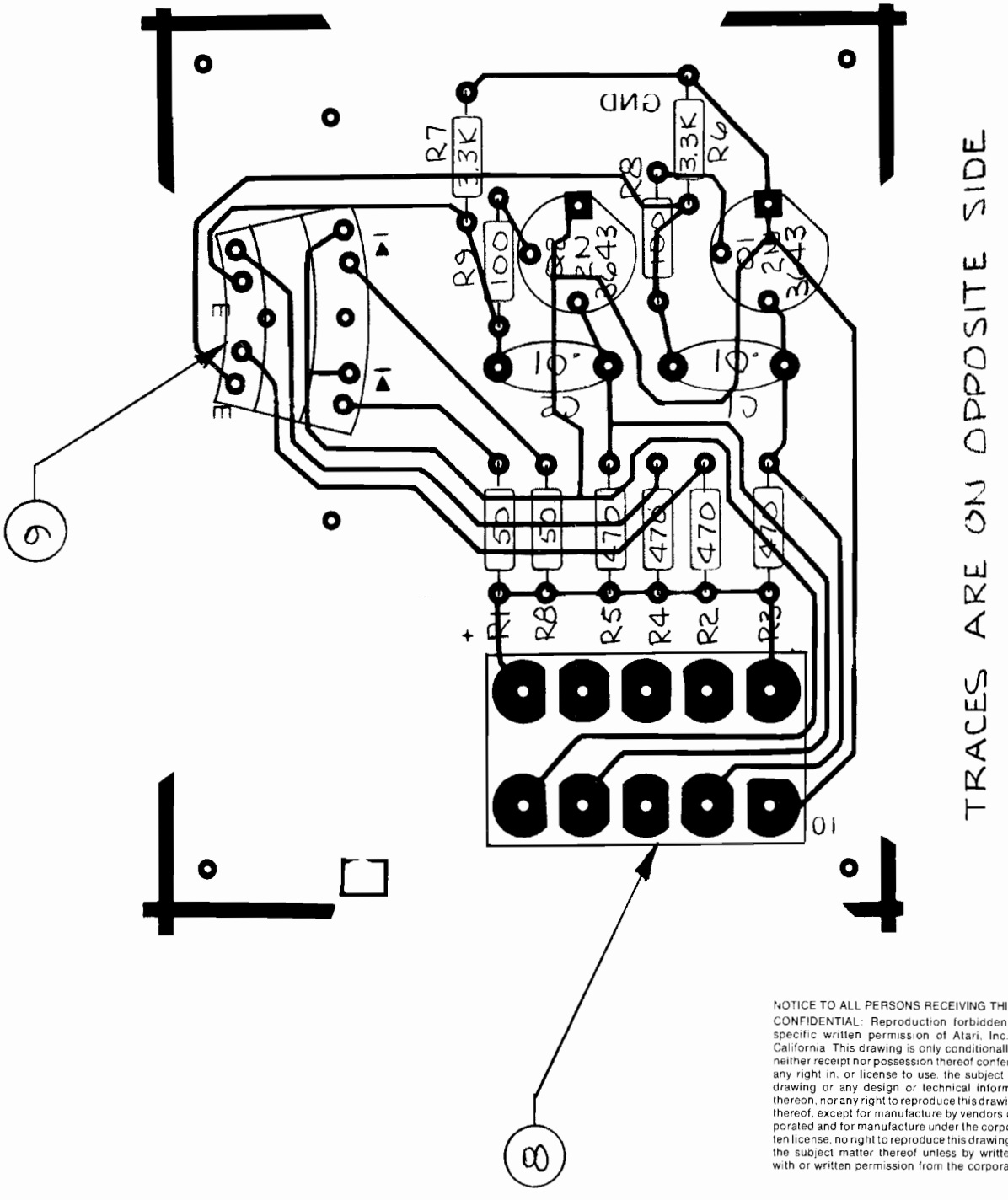

Figure 5-6 Steering Board Assembly
A000607 M

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Figure 5-6 Steering Board Assembly Parts List

Item	Part Number	Qty.	Description
1	009061-01	1	P.C. Board
2	10-5101	2	Res., Carbon Comp., ¼W, 5%, 100 Ohm R 8,9
3	10-5151	2	" " " " " 150 " R 1,8
4	10-5332	2	" " " " " 3.3k " R 6,7
5	10-5471	4	" " " " " 470 " R 2-5
6	27-250103	2	Cap., Cer, Disc., .01 uf, 25V C 1,2
7	34-2N3643	2	Transistor, 2N3643 Q 1,2
8	79-58005	1	Connector, 10 position
9	030369-01	1	Radial Optical Coupler

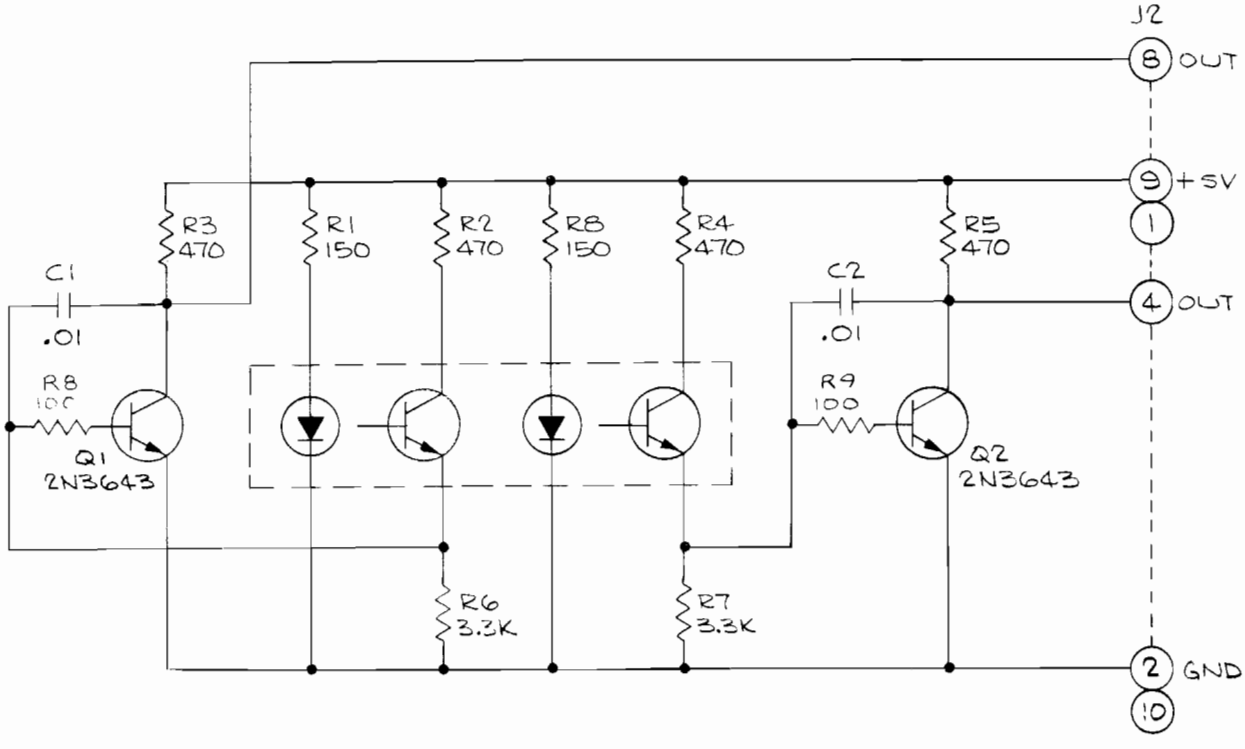

Figure 5-6 Steering Board Schematic Diagram

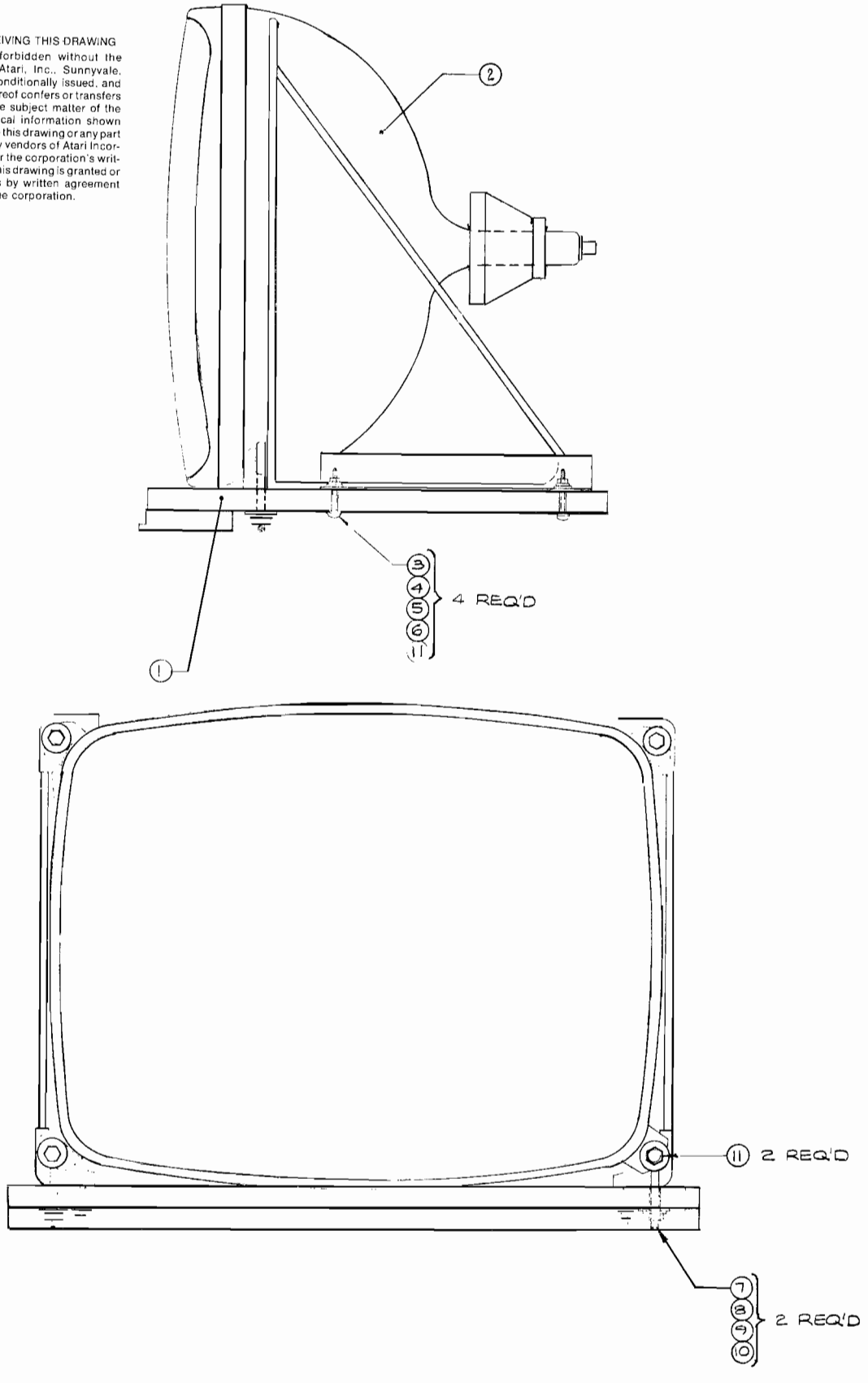

Figure 5-7 TV Shelf Assembly
A008875-01 A

Figure 5-7 TV Shelf Assembly Parts List

Item	Part Number	Qty.	Description
1	008897-01	1	Panel, T.V. Shelf
2	92-032	1	23" T.V. Monitor
3	75-5120	4	Carriage Bolts #10-24 x 1.25 Lg.
4	75-040	4	Lock Washer #10
5	75-911S	4	Hex Nuts, #10-24
6	75-010S	4	Flat Washers, #10
7	82-405	2	Eye Bolts, ¼-20 x 3" Lg.
8	75-07002	2	Flat Washer ¼, Fender
9	75-045	2	Lock Washers, Split ¼
10	75-915S	2	Hex Nuts, ¼-20
11	72-6012	2	Screws, Sm. #10 x 3/4" Lg.
12	75-015S	4	Flat Washer, #¼

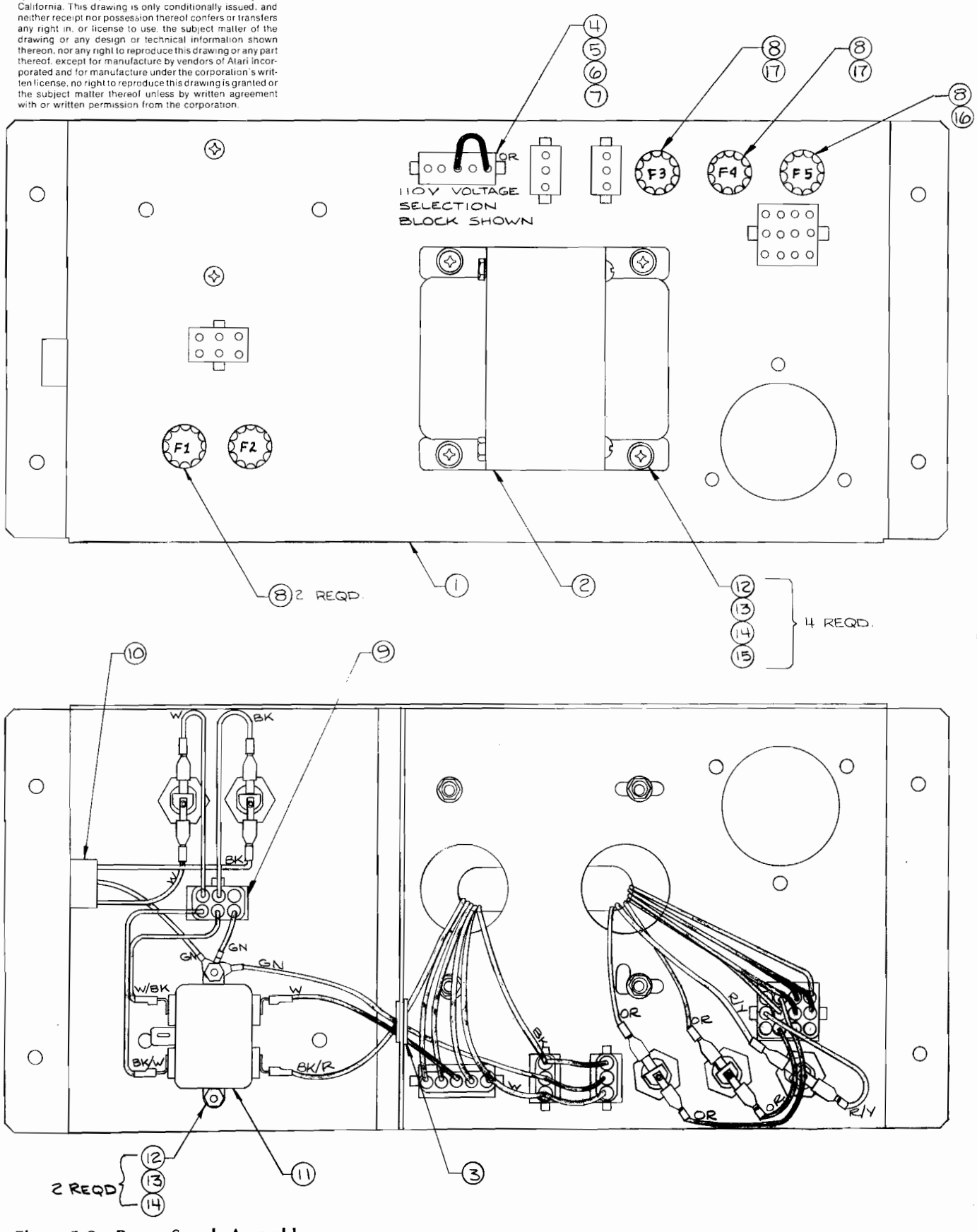

Figure 5-8 Power Supply Assembly
A007258-01 G

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Figure 5-8 Power Supply Assembly Parts List

Item	Part Number	Qty.	Description
1	A009266-01	1	Power Supply Base Weldment
2	A006886-02	1	Transformer Termination Assembly "Type C"
3	78-2708	1	Grommet, Plastic
4	A006958-01	A/R	Volt Sel Block, 95V
5	A006958-02	"	Volt Sel Block, 110V
6	A006958-03	"	Volt Sel Block, 205V
7	A006958-04	"	Volt Sel Block, 220V
8	79-4411004	5	Fuse Holder, Panel Mounting
9	A007192-01	1	Power Switch Termination Assembly
10	A007444-01	1	Power In Harness
11	41-2003	1	Filter, Power Line, 5 AMP
12	75-048	6	Washer, Split Lock, #8
13	75-918S	6	Nut, Mach., Hex, Steel #8
14	72-1810S	6	Screw, Pan Hd., Steel #8-32 x 5/8" Lg.
15	75-018S	8	Washer, Flat, Steel #8
16	46-203801	1	Fuse, 8 AMP, 125V, 3 AG Fast Acting
17	46-201251	2	Fuse, 2½ AMP, 125V, Slow Acting

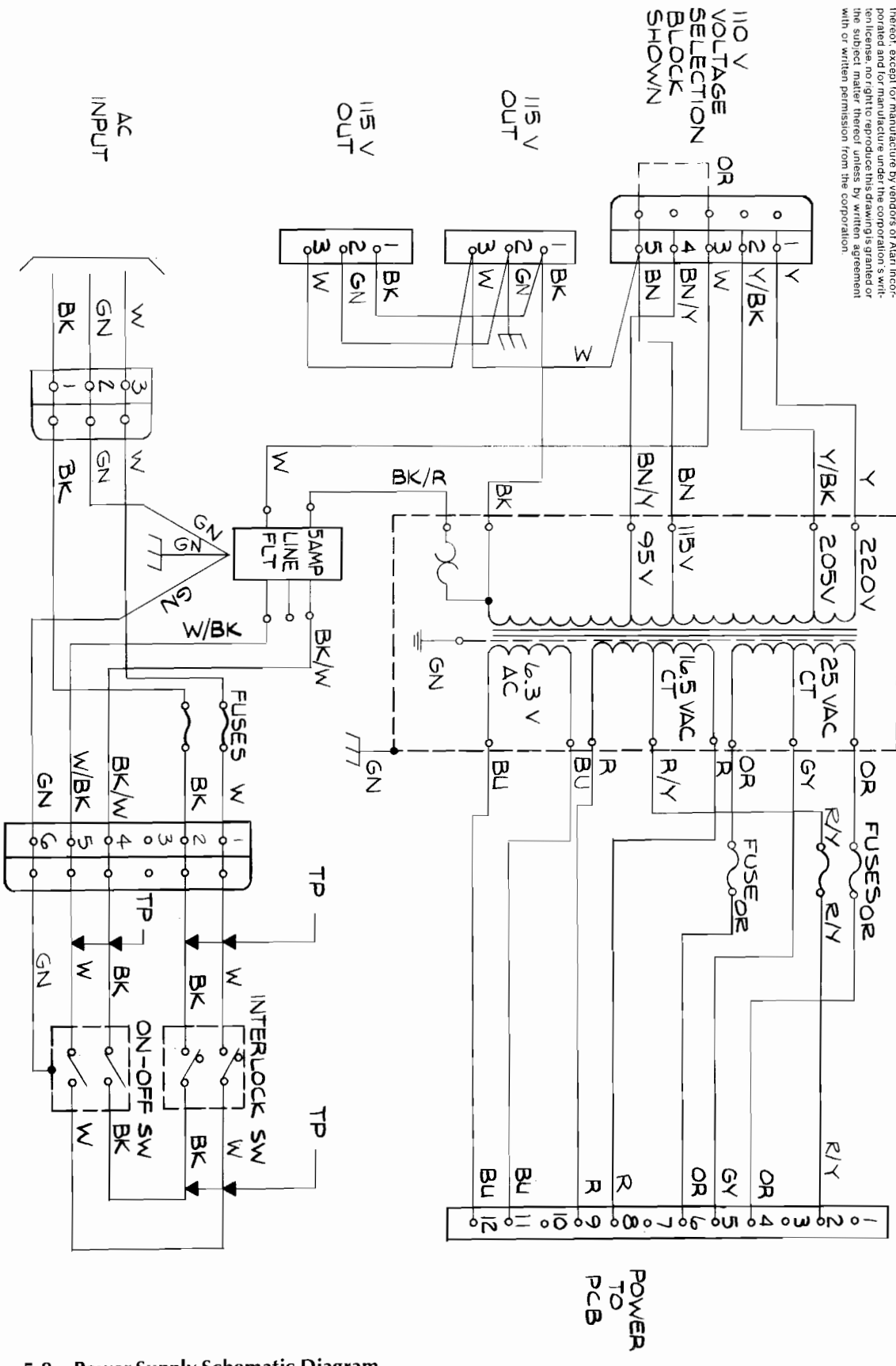

Figure 5-8 Power Supply Schematic Diagram

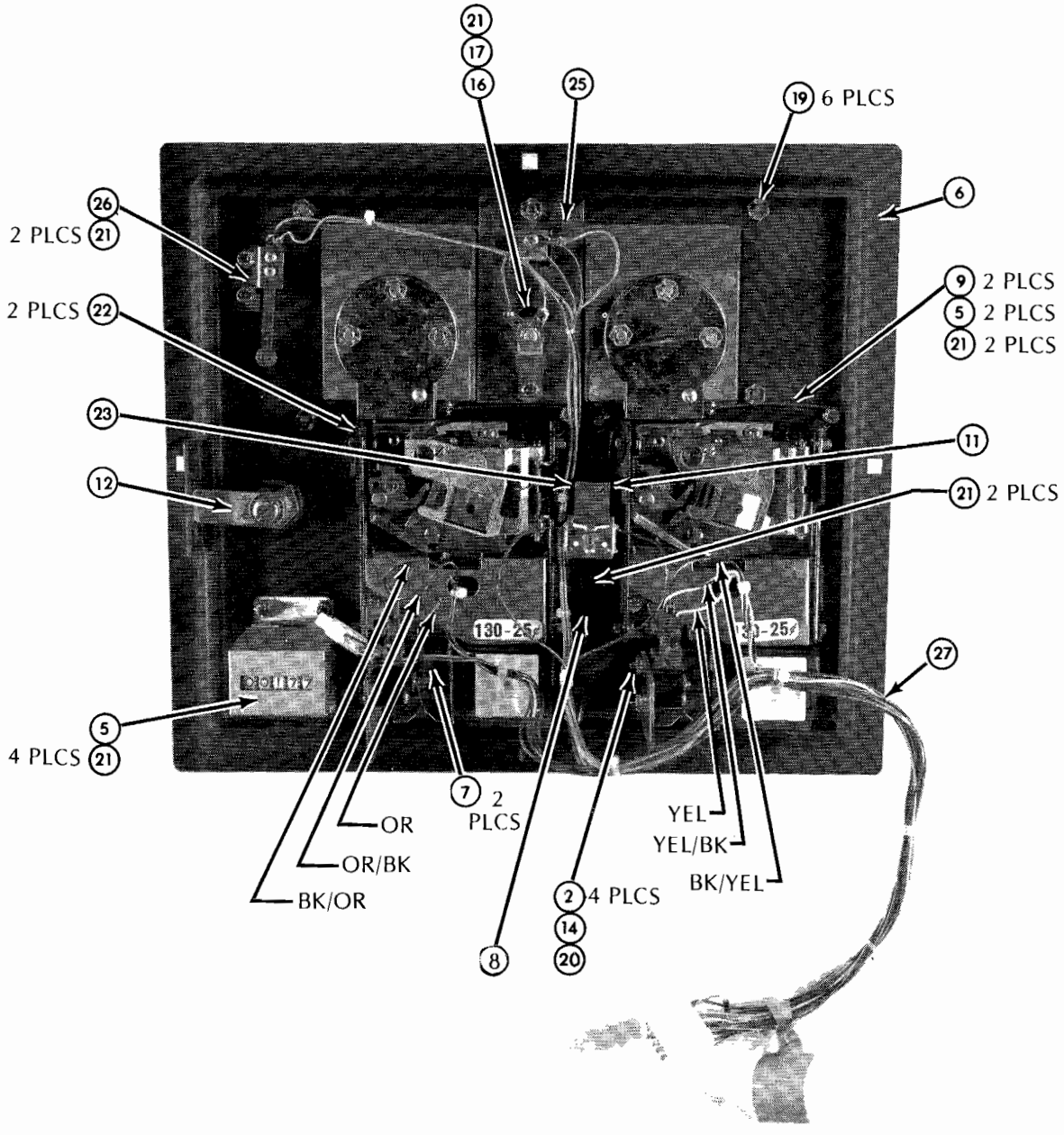

Figure 5-9 Coin Door Assembly A006794-01 through -07 F

Figure 5-9 Coin Door Assembly
Parts List

Item	Part Number	Qty.	Description
1	A007637-01	1	Front Bezel Assy. - Used only on -01 Coin Door Assy.
	A007637-02	Ref.	Front Bezel Assy. - Used only on -02 Coin Door Assy.
	A007637-03	Ref.	Front Bezel Assy. - Used only on -03 Coin Door Assy.
	A007637-04	Ref.	Front Bezel Assy. - Used only on -04 Coin Door Assy.
	A007637-05	Ref.	Front Bezel Assy. - Used only on -05 Coin Door Assy.
	A007637-06	Ref.	Front Bezel Assy. - Used only on -06 Coin Door Assy.
	A007637-07	Ref.	Front Bezel Assy. - Used only on -07 Coin Door Assy.
2	75-9165	4	Nut 6-32
3	A030362-01	1	Coin Lock-Out Assembly
4	A007640-01	2	Coin Switch Assembly
5	A002465-01	1	Coin Counter Assembly
6	004320-01	1	Coin Door Weldment
7	004341-01	2	Secondary Coin Chute
8	004344-01	1	Key Loop
9	004340-01	2	Spring-Return
10	004337-01	2	Bracket, Wire Form
11	004338-01	1	Lock-Out, Wire Form, R.H.
12	004336-01	1	Lock-Out, Wire Form, L.H.
13	004326-01	2	Button, Scavenger
14	75-046	4	Lock Washer, #6
15	006904-01	2	Spacer
16	007359-01	1	Lamp Socket
17	70-11-47	1	Lamp
18	73-3008	2	Retaining "C" Ring, Truarc #5103-25
19	75-9914001	6	Self-Threading Nut, Tinnerman #SR188006
20	75-026S	4	Washer #6
21	75-00516	13	Kepnut, Style 842, Stl., 6-32
22	008629-01	2	Spring
23	71-2118	1	Lock Assembly, Hudson Lock
24	71-1225CU	2	Coin Mechanism for American Quarter only
	71-1205FF	Ref.	Coin Mechanism for Belgian 5 Francs Only
	71-1201MG	Ref.	Coin Mechanism for German Mark only
	71-1201KS	Ref.	Coin Mechanism for Swedish Krona Only
	71-12100YJ	Ref.	Coin Mechanism for Japanese 100 Yen Only
	71-1210PE	Ref.	Coin Mechanism for English 10 Pence Only
	71-1220CA	Ref.	Coin Mechanism for Australian 20-Cent Piece only
25	007753-01	1	Plate, Anti-Probe
26	A007638-01	1	Switch Assembly - Slam
27	A006921-01	1	Harness Assembly

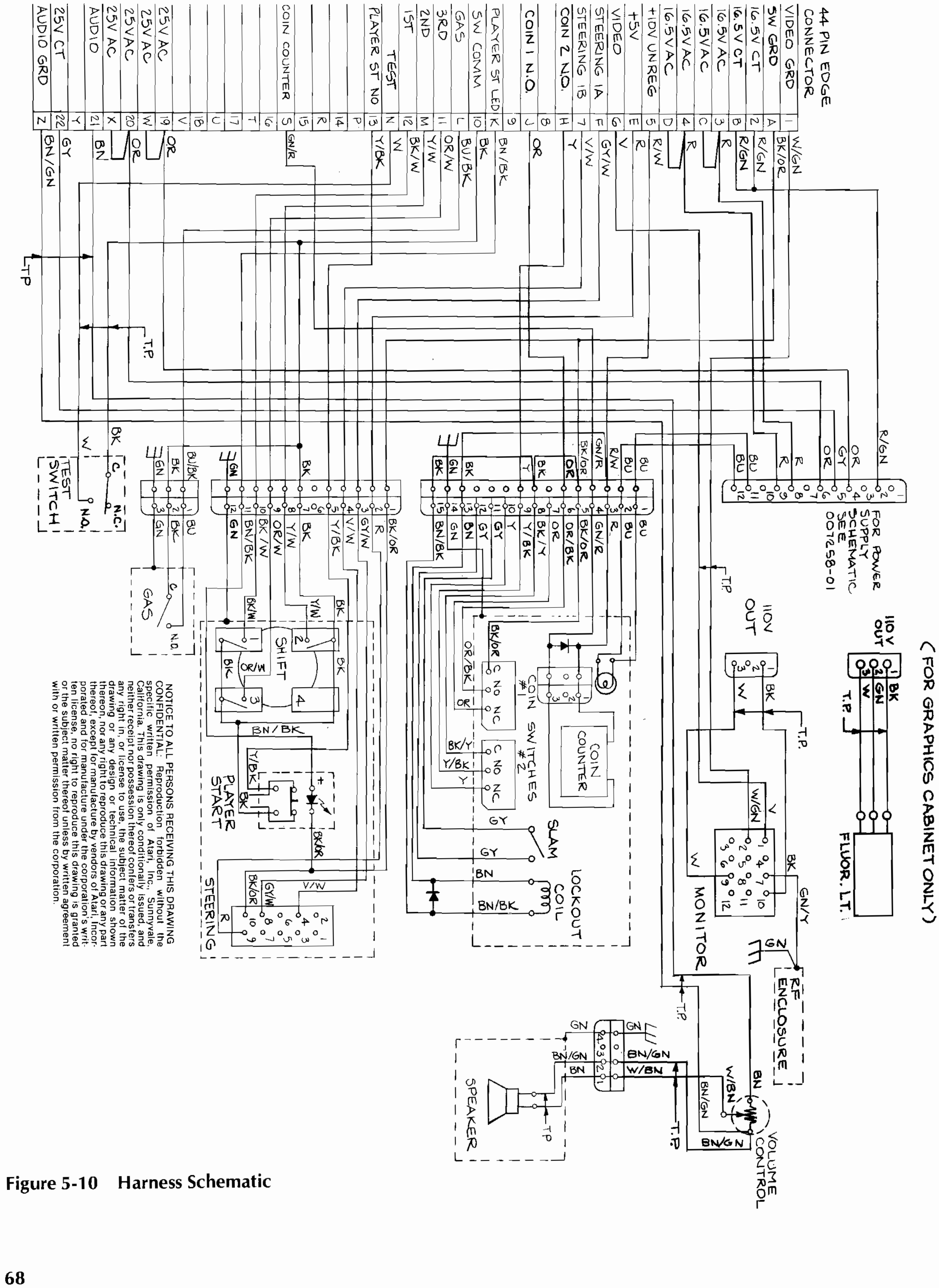

Figure 5-10 Harness Schematic

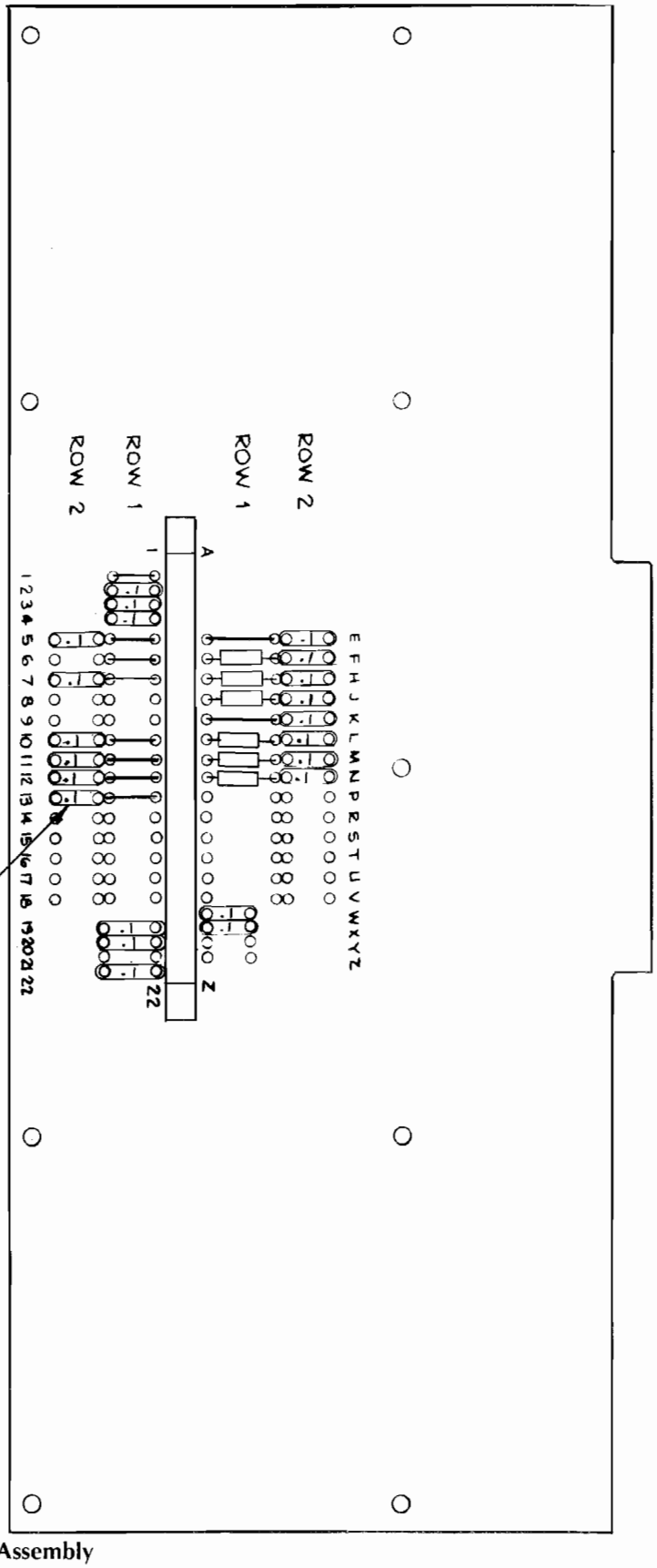

Figure 5-11 RF Shield PCB Assembly
A006446-01 B

Figure 5-11 RF Shield PCB Assembly Parts List

Item	Part Number	Qty.	Description
1	005491-01	1	PC Board
2	79-517222	1	Connector, 44 Pin P.C. Mount
3	41-3003	6	Inductor, 100µh Large Case
4	27-250104	16	Cap, Cer. Disc 0.1µf 25V
5	52-002	8	Jumper, .4 Center
6	52-003	2	Jumper, .6 Center
7	27-A250104	6	Cap, Cer Disc 0.1µf 25V

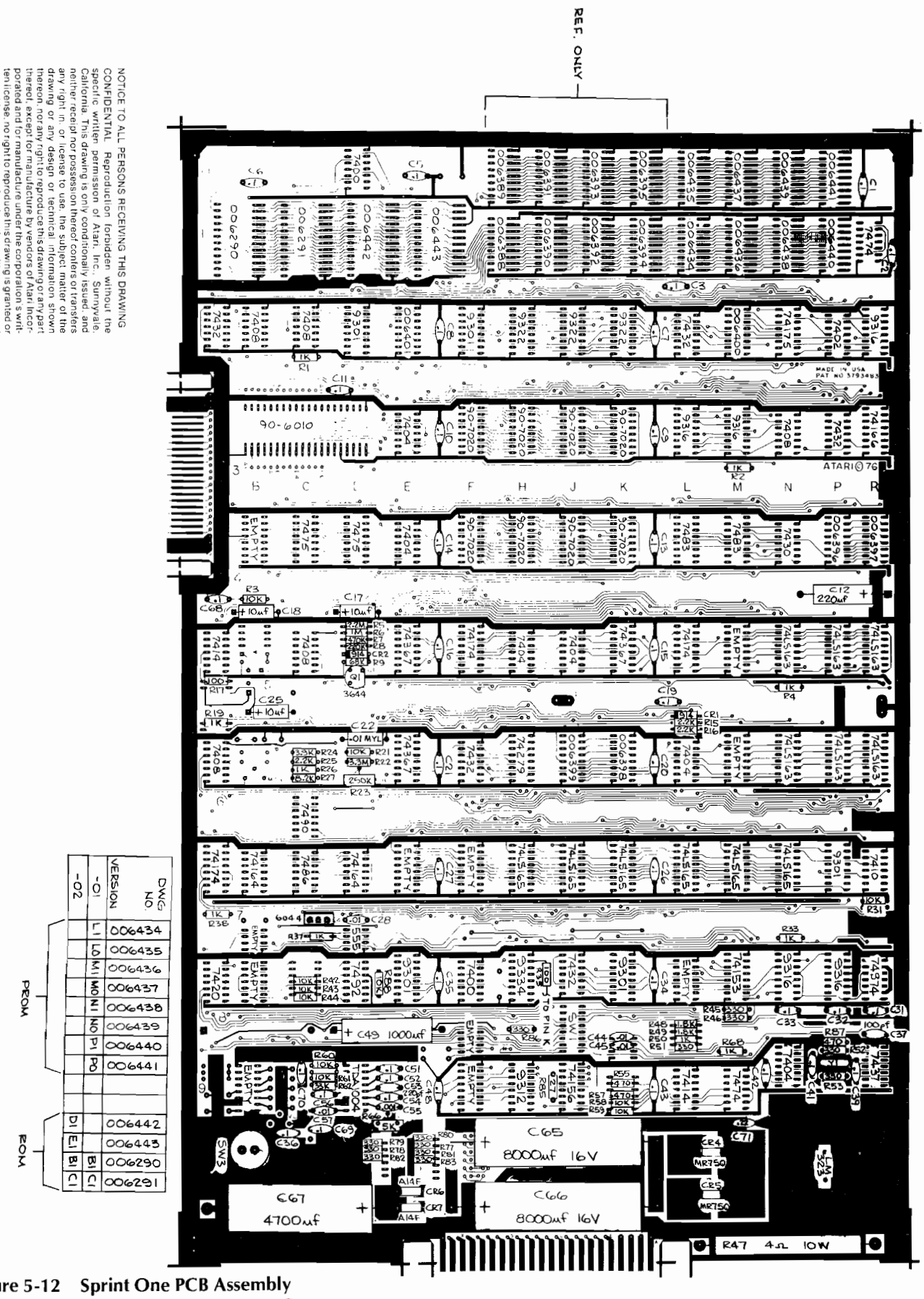

Figure 5-12 Sprint One PCB Assembly A006433-01 and -02 C

Figure 5-12 Sprint One PCB Assembly Parts List -01 Version

Item	Part Number	Qty.	Description	
1	030626-01	1	Sprint One P.C. Board	
2	10-5101	2	Res., Carbon, 5%, ¼W 100 OHM	R17,35
3	10-5102	10	" " " " 1K "	R1,2,4,19,26,33,38,50 68,37
4	10-5103	11	" " " " 10K "	R3,21,31,42-44,58-61, 88
5	10-5105	1	" " " " 1M "	R6
6	10-5182	2	" " " " 1.8K "	R48,49
7	10-5222	3	" " " " 2.2K "	R15,16,25
8	10-5224	1	" " " " 220K "	R8
9	10-5225	1	" " " " 2.2M "	R5
10	10-5331	13	" " " " 330 "	R45,46,51-53,77-83,86
11	10-5333	1	" " " " 33K "	R62
12	10-5335	1	" " " " 3.3M "	R22
13	10-5392	1	" " " " 3.9K "	R24
14	10-5471	3	" " " " 470 "	R87,55,57
15	10-5474	1	" " " " 470K "	R7
16	10-5683	1	" " " " 68K "	R9
17	10-5822	1	" " " " 8.2K "	R27
18	19-808W4P0	1	Res., Wirewound 10W, 4 OHM	R47
19	19-315502	1	Trimpot, 5K OHM	R66
20	19-315254	1	Trimpot, 250K OHM	R23
21				
22	10-5270	1	Res., Carbon, 5%, ¼W 27 OHM	R85
23				
24				
25	21-101103	1	Cap., Mylar, .01uf 100V	C22
26				
27				
28	24-160808	2	Cap., Electrolytic, 8000uf, 16V	C65,66
29	24-250106	3	" " 10uf 25V	C17,18,25
30	24-250108	1	" " 1000uf 25V	C49
31	24-250227	1	" " 220uf 25V	C12
32	24-250478	1	" " 4700uf 25V	C67
33				
34				
35	27-250102	1	Cap., Ceramic Disc, .001uf, 25V	C55
36	27-250103	4	" " " .01uf 25V	C28, ,57,44,45
37	27-250104	37	" " " .1uf 25V	C1-3,5,13-16,19-21 26,27,31-36,41-43, 48,51,52,54,56,39, 6-11,70,68,69
38	27-250224	1	" " " .22uf 25V	C71
39				
40	28-101101	1	Cap., Dipped Mica, 100pf, 100V	C37
41	28-101221	1	" " " 220pf 100V	C53
42				
43				
44				
45				
46	31-A14F	2	Diode, A14F	CR6,7
47	31-MR750	2	Diode, MR750	CR4,5
48	31-1N914	2	Diode, 1N914	CR1,2
49				
50				
51	33-2N3644	1	Transistor, 2N3644	Q1
52				
53	34-2N6044	1	Transistor, 2N6044	Q4
54				
55				
56				
57	37-7400	2	Integrated Circuit, 7400	F8,D0
58	37-7402	1	" " 7402	P2
59	37-7404	6	" " 7404	E3,E4 ,H5,J5,L6,N9

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Figure 5-12 Sprint One PCB Assembly Parts List -01 Version

Item	Part Number	Qty.	Description		
60	37-7408	5	Integrated Circuit	7408	B2,C2,N3,C5,A6
61	37-7410	1	" "	7410	R7
62	37-7414	2	" "	7414	A5,L9
63	37-7420	1	" "	7420	A8
64	37-7430	1	" "	7430	N4
65	37-7432	5	" "	7432	A2,L2,P3,F6,J8
66	37-7437	1	" "	7437	R9
67	37-7474	2	" "	7474	R1,M9
68	37-74S74	1	" "	74S74	R8
69	37-7475	2	" "	7475	C4,D4
70	37-7483	2	" "	7483	L4,M4
71	37-7486	1	" "	7486	C7
72	37-7490	1	" "	7490	C6/7
73	37-7492	1	" "	7492	D8
74	37-9312	1	" "	9312	H9
75	37-74153	1	" "	74153	M8
76	37-74156	1	" "	74156	J9
77	37-74LS163	6	" "	74LS163	N5,P5,R5, N6,P6,R6
78	37-74164	2	" "	74164	B7,D7
79	37-74LS165	6	" "	74LS165	N7,H7,J7,K7,L7,M7,
80	37-74166	1	" "	74166	R3
81	37-74174	3	" "	74174	F5,L5,A7
82	37-74175	1	" "	74175	N2
83	37-74279	1	" "	74279	H6
84	37-9301	5	" "	9301	D2,F2,P7,E8,K8
85	37-9316	5	" "	9316	R2,L3,M3,N8,P8
86	37-9322	3	" "	9322	H2,J2,K2
87	37-9334	1	" "	9334	H8
88	37-555	1	" "	555	D7/8
89	37-74367	3	" "	74367	E5,K5,E6
90	90-7020	8	" "	21L02A	F3,H3,J3,K3,F4,H4,J4, K4
91	37-LM323	1	Regulator	LM323	
92	37-TDA1004	1	Op-AMP	TDA1004	D9
93					
94					

Item	Part Number	Qty.	Description	
95				
96				
97	62-001	1	Switch, SPST, Momentary	SW3
98				
99	66-118P1T	1	Switch, SPST, x8, DIP	SW1
100				
101				
102				
103	72-1608C	2	Screws, Pan Hd., Phil., 6-32 x ¼ Lg., CRES	
104	75-016	2	Washer, Flat #6	
105	75-056	2	Washer, Lock, Int. Star, #6	
106	75-916C	2	Nut, Hes, #6-32 CRES	
107				
108				
109	78-06001	1	Heatsink, (LM323)	
110	78-06009	1	Heatsink, (TDA1004)	
111	78-13016	A/R	Cement, (TDA1004 Heatsink)	
112	78-16005	1	Silpad (LM323)	
113				
114				
115				
116				
117				
118				
119	79-42040	1	Socket, 40 Pin, Med. Insertion	C3
120				
121				
122				
123	90-102	1	Crystal 12.096	Y1
124				
125				
126				
127	006434-01	1	Sprint I Program Prom I	L1
128	006435-01	1	Sprint I Program Prom 2	L0
129	006436-01	1	Sprint I Program Prom 3	M1
130	006437-01	1	Sprint I Program Prom 4	M0

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Figure 5-12 Sprint One PCB Assembly Parts List -01 Version

Item	Part Number	Qty.	Description	
131	006438-01	1	Sprint I Program Prom 5	N1
132	006439-01	1	Sprint I Program Prom 6	N0
133	006440-01	1	Sprint I Program Prom 7	P1
134	006441-01	1	Sprint I Program Prom 8	P0
135				
136				
137				
138				
139				
140				
141				
142				
143				
144				
145				
146				
147	006396-01	1	Sprint Character Prom LSB	P4
148	006397-01	1	Sprint Character Prom MSB	R4
149				
150				
151	006398-01	1	Sprint Race Car Prom LSB	K6
152	006399-01	1	Sprint Race Car Prom MSB	J6
153				
154				
155	006400-01	1	Sprint Sync Prom	M2
156				
157				
158	006401-01	1	Sprint Adress Decode Prom	E2
159				
160				
161				
162				
163				
164				
165				
166				

Item	Part Number	Qty.	Description	
167	006290-01	1	Sprint Race Trak Rom 1	B1
168	006291-01	1	Sprint Race Trak Rom 2	C1
169	90-6010	1	Integrated Circuit	C3

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Figure 5-12 Sprint One PCB Assembly Parts List -02 Version

Item	Part Number	Qty.	Description	
1	030626-01	1	Sprint I P.C. Board	
2	10-5101	2	Res., Carbon, 5%, ¼W 100 OHM	R17,35
3	10-5102	10	" " " " 1K "	R1,2,4,19,26,33,38,50 68,37
4	10-5103	11	" " " " 10K "	R3,21,31,42-44,58-61, 88
5	10-5105	1	" " " " 1M "	R6
6	10-5182	2	" " " " 1.8K "	R48,49
7	10-5222	3	" " " " 2.2K "	R15,16,25
8	10-5224	1	" " " " 220K "	R8
9	10-5225	1	" " " " 2.2M "	R5
10	10-5331	13	" " " " 330 "	R45,46,51-53,77-83,86
11	10-5333	1	" " " " 33K "	R62
12	10-5335	1	" " " " 3.3M "	R22
13	10-5392	1	" " " " 3.9K "	R24
14	10-5471	3	" " " " 470 "	R87,55,57
15	10-5474	1	" " " " 470K "	R7
16	10-5683	1	" " " " 68K "	R9
17	10-5822	1	" " " " 8.2K "	R27
18	19-808W4P0	1	Res., Wirewound 10W, 4 OHM	R47
19	19-315502	1	Trimpot, 5K OHM	R66
20	19-315254	1	Trimpot, 250K OHM	R23
21				
22	10-5270	1	Res., Carbon, 5%, ¼W 27 OHM	R85
23				
24				
25	21-101103	1	Cap., Mylar, .01uf 100V	C22
26				
27				
28	24-160808	2	Cap., Electrolytic, 8000uf, 16V	C65,66
29	24-250106	3	" " 10uf 25V	C17,18,25
30	24-250108	1	" " 1000uf 25V	C49
31	24-250227	1	" " 220uf 25V	C12
32	24-250478	1	" " 4700uf 25V	C67
33				
34				
35	27-250102	1	Cap., Ceramic Disc, .00luf, 25V	C55
36	27-250103	4	" " ". .01uf 25V	C28, ,57,44,45
37	27-250104	37	" " " .1uf 25V	C1-3,5,13-16,19-23 26,27,31-36,41-43, 48,51,52,54,56,39, 6-11,70,68,69
38	27-250224	1	" " " .22uf 25V	C71
39				
40	28-101101	1	Cap., Dipped Mica, 100pf, 100V	C37,
41	28-101221	1	" " " 220pf 100V	C53
42				
43				
44				
45				
46	31-A14F	2	Diode, A14F	CR6,7
47	31-MR750	2	Diode, MR750	CR4,5
48	31-1N914	2	Diode, 1N914	CR1,2
49				
50				
51	33-2N3644	1	Transistor, 2N3644	Q1
52				
53	34-2N6044	1	Transistor, 2N6044	Q4
54				
55				
56				
57	37-7400	2	Integrated Circuit, 7400	F8,D0
58	37-7402	1	" " 7402	P2
59	37-7404	6	" " 7404	E3,E4,H5,J5,L6,N9

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Figure 5-12 Sprint One PCB Assembly Parts List -02 Version

Item	Part Number	Qty.	Description		
60	37-7408	5	Integrated Circuit	7408	B2,C2,N3,C5,A6
61	37-7410	1	" "	7410	R7
62	37-7414	2	" "	7414	A5,L9
63	37-7420	1	" "	7420	A8
64	37-7430	1	" "	7430	N4
65	37-7432	5	" "	7432	A2,L2,P3,F6,J8
66	37-7437	1	" "	7437	R9
67	37-7474	2	" "	7474	R1,M9
68	37-74S74	1	" "	74S74	R8
69	37-7475	2	" "	7475	C4,D4
70	37-7483	2	" "	7483	L4,M4
71	37-7486	1	" "	7486	C7
72	37-7490	1	" "	7490	C6/7
73	37-7492	1	" "	7492	D8
74	37-9312	1	" "	9312	H9
75	37-74153	1	" "	74153	M8
76	37-74156	1	" "	74156	J9
77	37-74LS163	6	" "	74LS163	N5,P5,R5, N6,P6,R6
78	37-74164	2	" "	74164	B7,D7
79	37-74LS165	6	" "	74LS165	N7,H7,J7,K7,L7,M7,
80	37-74166	1	" "	74166	R3
81	37-74174	3	" "	74174	F5,L5,A7
82	37-74175	1	" "	74175	N2
83	37-74279	1	" "	74279	H6
84	37-9301	5	" "	9301	D2,F2,P7,E8,K8
85	37-9316	5	" "	9316	R2,L3,M3,N8,P8
86	37-9322	3	" "	9322	H2,J2,K2
87	37-9334	1	" "	9334	H8
88	37-555	1	" "	555	D7/8
89	37-74367	3	" "	74367	E5,K5,E6
90	90-7020	8	" "	21L02A	F3,H3,J3,K3,F4,H4,J4, K4
91	37-LM323	1	Regulator	LM323	
92	37-TDA1004	1	Op-AMP	TDA1004	D9
93					
94					

Item	Part Number	Qty.	Description	
95				
96				
97	62-001	1	Switch, SPST, Momentary	SW3
98				
99	66-118P1T	1	Switch, SPST, x8, DIP	SW1
100				
101				
102				
103	72-1608C	2	Screws, Pan Hd., Phil., 6-32 x ¼ Lg., CRES	
104	75-016	2	Washer, Flat #6	
105	75-056	2	Washer, Lock, Int. Star, #6	
106	75-916C	2	Nut, Hes, #6-32 CRES	
107				
108				
109	78-06001	1	Heatsink, (LM323)	
110	78-06009	1	Heatsink, (TDA1004)	
111	78-13016	A/R	Cement, (TDA1004 Heatsink)	
112	78-16005	1	Silpad (LM323)	
113				
114				
115				
116				
117				
118				
119	79-42 040	1	Socket, 40 Pin, Med Insertion	C3
120				
121				
122				
123	90-102	1	Crystal 12.096	Y1
124				
125				
126				
127				
128				
129				
130				

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Figure 5-12 Sprint One PCB Assembly Parts List -02 Version

Item	Part Number	Qty.	Description	
131				
132				
133				
134				
135				
136				
137				
138				
139				
140				
141				
142				
143				
144				
145				
146				
147	006396-01	1	Sprint Character Prom LSB	P4
148	006397-01	1	Sprint Character Prom MSB	R4
149				
150				
151	006398-01	1	Sprint Race Car Prom LSB	K6
152	006399-01	1	Sprint Race Car Prom MSB	J6
153				
154				
155	006400-01	1	Sprint Sync Prom	M2
156				
157				
158	006401-01	1	Sprint Address Decode Prom	E2
159				
160				
161				
162				
163	006442-01	1	Sprint I Program Rom 1	D1
164	006443-01	1	Sprint I Program Rom 2	E1
165				
166				

Item	Part Number	Qty.	Description	
167	006290-01	1	Sprint Race Trak Rom 1	B1
168	006291-01	1	Sprint Race Trak Rom 2	C1
169	90-6010	1	Integrated Circuit	C3

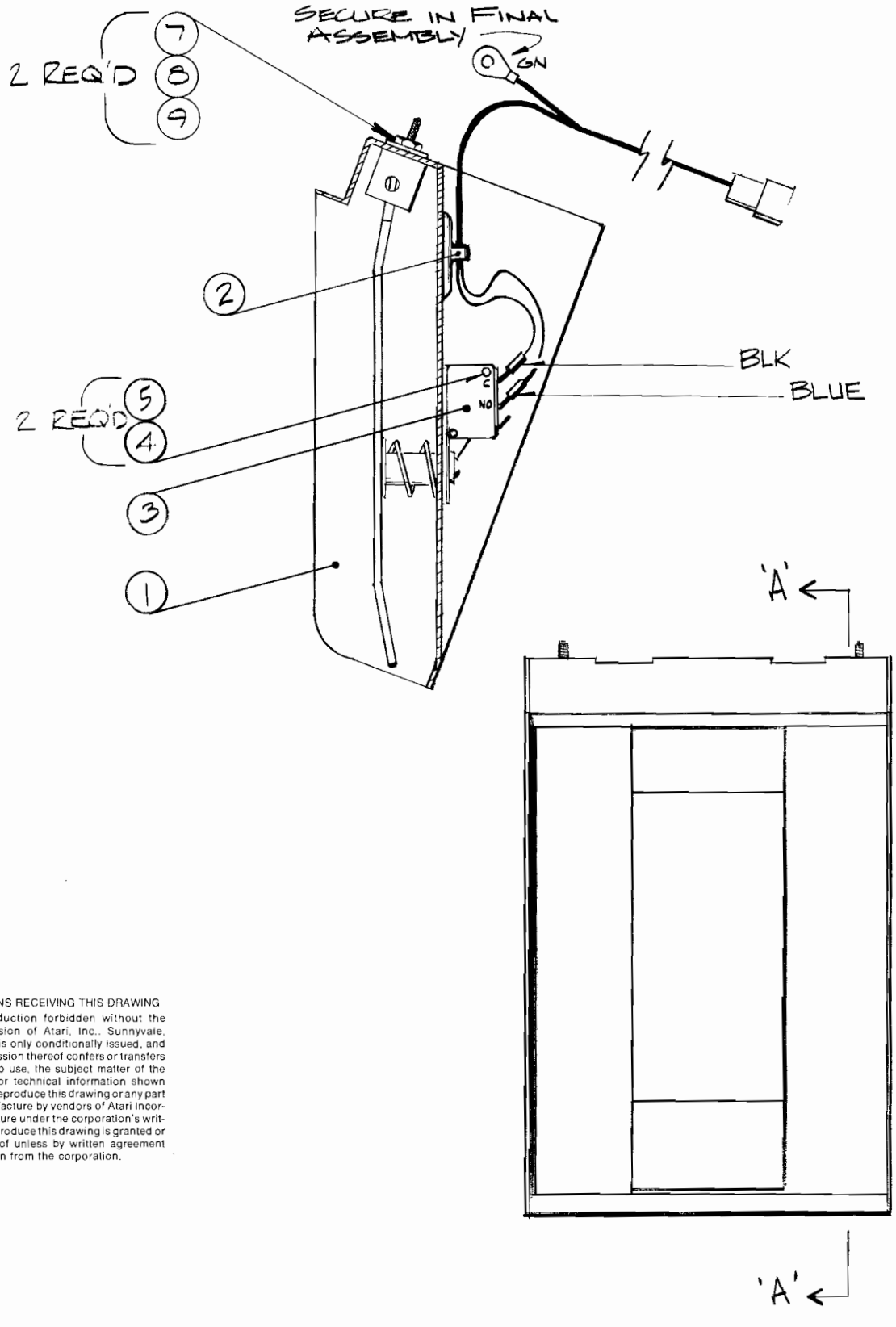

Figure 5-13 Single Foot Pedal Assembly with Harness Assembly A008845-01 C

Figure 5-13 Single Foot Pedal Assembly with Harness Assembly Parts List

Item	Part Number	Qty.	Description
1	A007183-01	1	Foot Pedal Assembly
2	A008955-01	1	Harness Assembly, Foot Pedal
3	A009804-01	1	Assy, Micro Switch & Bracket
4	75-046	2	Lock Washer #6
5	75-916S	2	Nut, Hex, #6-32
6			
7	75-043	2	Washer, Split-Lock, 5/16"
8	75-915S	2	¼"-20 Hex Nut
9	75-5524B	2	Carriage Bolt, Blk, ¼"-20 x 1.50"

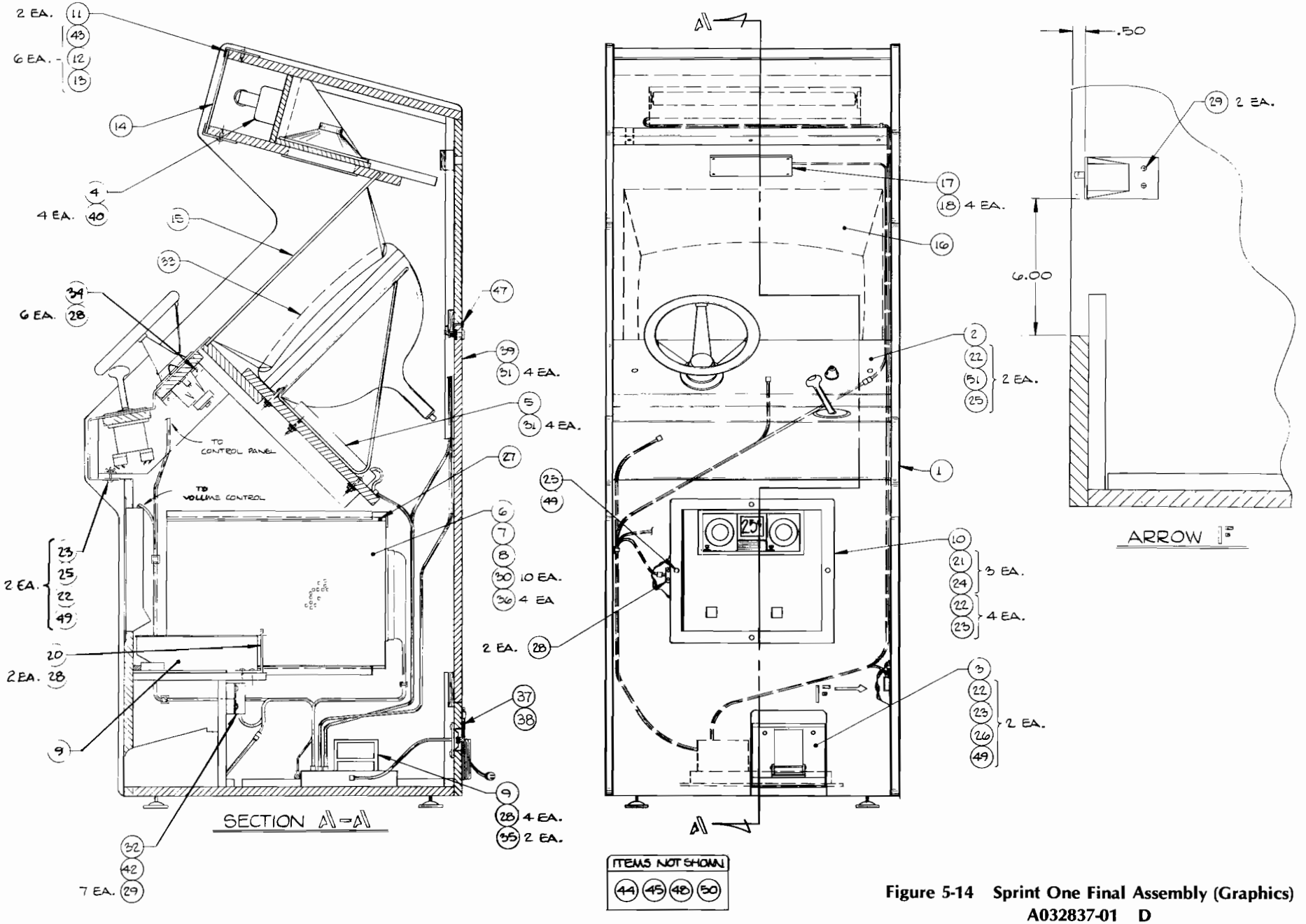

Figure 5-14 Sprint One Final Assembly (Graphics)
A032837-01 D

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Figure 5-14 Sprint One Final Assembly (Graphics)
Parts List

Item	Part Number	Qty.	Description
1	A032840-01	1	Cabinet Ass'y. With Graphics
2	A032837-01	1	Control Panel Assembly
3	A008845-01	1	Single Foot Pedal Assembly
4	A032838-01	1	Display Assembly
5	A005883-01	1	Sliding T.V. Shelf Assembly
6	A009262-01	1	R.F. Shield Box Assembly
7	A006446-01	1	R.F. Shield P.C.B. Assembly
* 8	A006433-02	1	P.C.B. Assembly, Sprint I (Rom Version)
9	A007258-01	1	Power Supply Base Assembly, Type "C"
10	A009083-01	1	Coin Door Assembly
11	003053-01	2	Retainers, Plexiglas
12	75-99090006	6	Well-Nuts #10-32
13	82-8016	6	Screws, Button Hd. Socket Cap. #10-32 X 1.00" Lg.
14	032843-01	1	Attraction Plex. With Graphics
15	005378-02	1	Playfield Plexiglas With Graphics
16	032842-01	1	Cardboard Bezel With Graphics
17	005419-01	1	Speaker, Grill Cover
18	73-77004	4	Rivets, 3/16" OD. X .68 Lg. (.250-.500 Grip.)
19	A007902-01	1	Cash Box Ass'y.
20	006870-01	1	Coin Box Bracket
21	75-5516B	3	Carriage Bolts, ¼-20 X 1.00 Lg. (Black)
22	75-045	6	Washers, Split-Lock #¼
23	75-015S	4	Washers, Flat #¼
24	75-990505S	3	#¼-20 Nylon Locknut
25	75-935	5	Wing Nuts, ¼-20
26	75-915S	2	Hex Nuts, ¼-20
27	72-6808	1	Screw, Sm. Pan Hd., Phil. #8 X ½" Lg.
28	72-6812	20	Screw, Sm. Pan Hd., Phil. #8 X 3/4" Lg.
29	72-6610	16	Screw, Sm. Pan Hd., Phil. #6 X 5/8" Lg.
30	72-6608	10	Screw, Sm. Pan Hd., Phil. #6 X ½" Lg.
31	82-1824	8	Wood Screws, #8 X 1½" Lg. Ft. Hd. Phil.
32	007103-01	1	On/Off Switch Cover
33	006319-03	1	Copyright Decal
34	002728-01	2	Bracket, Control Panel
35	46-201302	2	Fuses, 3 AMP
36	78-24007	4	Cable Tie, Heat Stablized
37	A033016-01	1	Strain Relief Power Cord Ass'y.
38	78-25001	1	Screw Down Tie-Wrap
39	A005906-01	1	Rear Door Assembly
40	72-6820	4	Screw, Sm. Pan Hd., Phil. #8 X 1¼" Lg.

Item	Part Number	Qty.	Description
41	A006312-02	1	Main Harness Assembled To Volume Control
42	A009509-01	1	Power Switch & Harness Assembly
43	75-07021	6	#10 Nylon Black Washers
44	ST-095	1	Self Test Chart
45	TM-095	1	Illustrated Parts Catalog & Tech. Manual
46	81-702	2	Tip-N-Tell Indicator
47	005233-01	1	Rear Door Seal
48	A005901-XX	1	Shipping Container Assembly
49	75-5524B	4	Carriage Bolts, ¼-20 X 1.50 Lg. (Black)
50	006305-01	1	Printed Poly Bag
51	75-07002	2	Washer, Flat

*A substitute for Item 8 is A006433-01, Qty. of 1, P.C.B. Ass'y., Sprint I, (Rom Version).

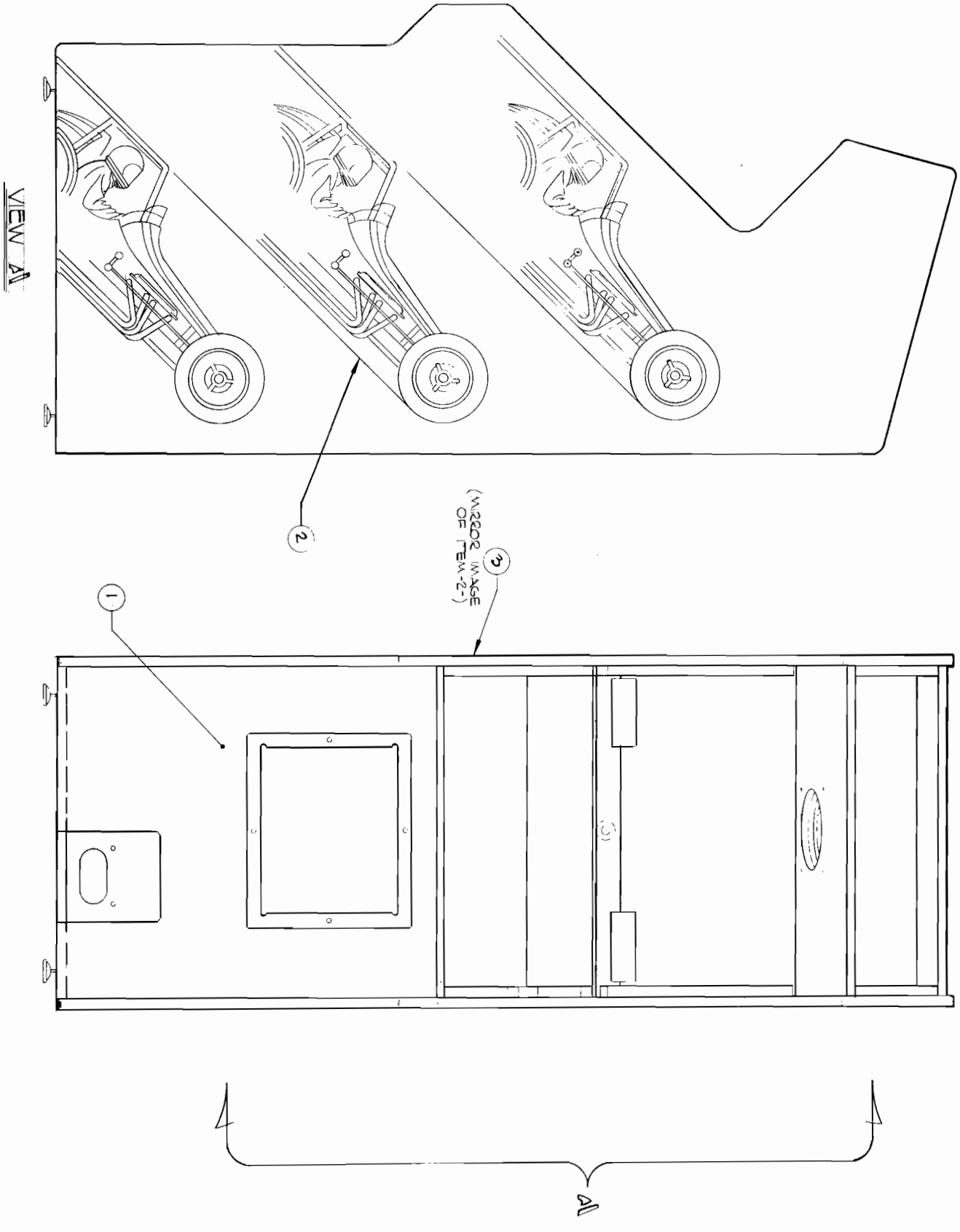

Figure 5-15 Cabinet Assembly (Graphics)
A032840-01 D

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Figure 5-15 Cabinet Assembly (Graphics)
Parts List

Item	Part Number	Qty.	Description
1	A032836-01	1	Cabinet Assembly
2	032841-02	1	Side Panel Artwork, Right
3	032841-01	1	Side Panel Artwork, Left

KP020

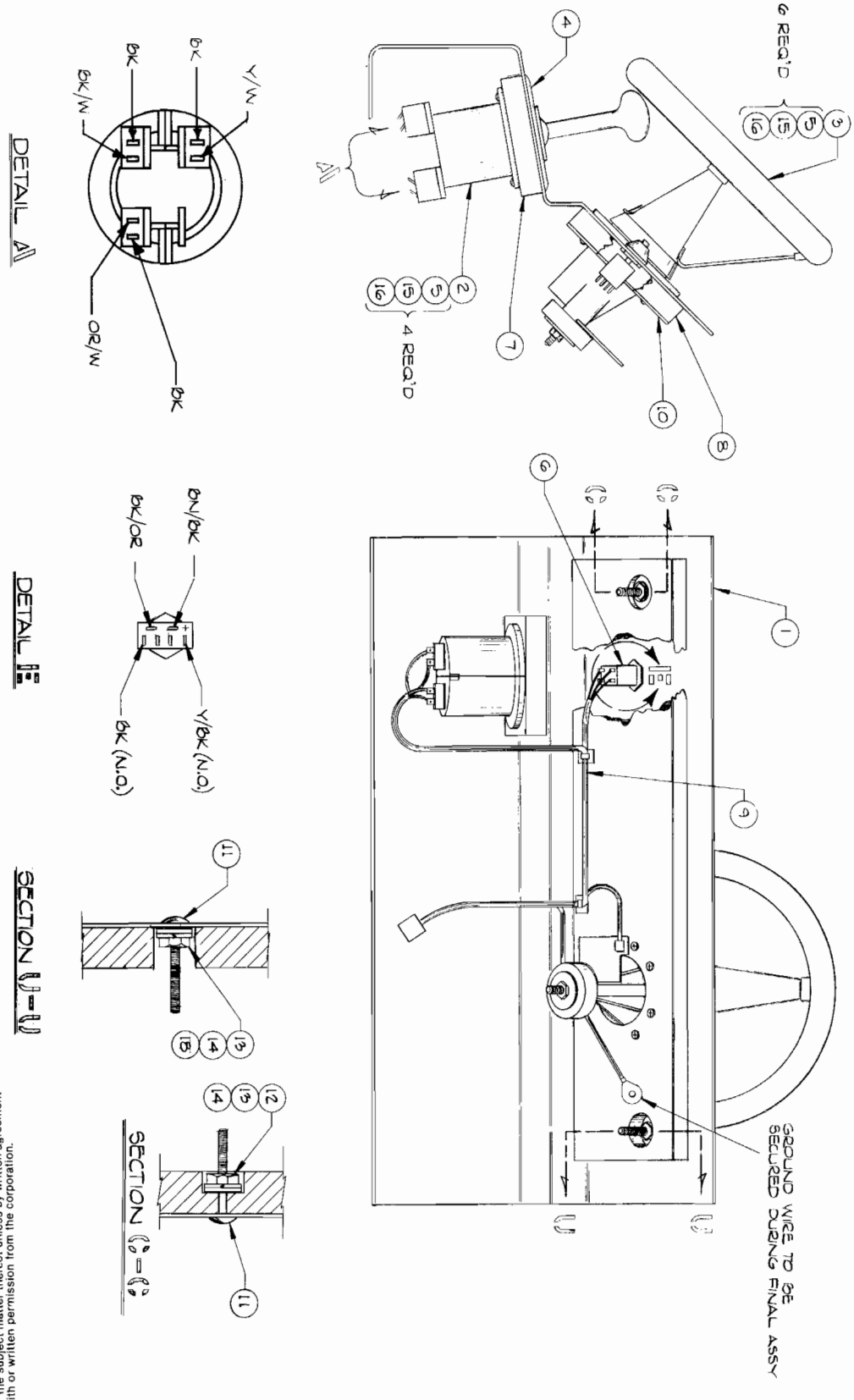

Figure 5-16 Control Panel Assembly (Graphics)
A032834-01 D

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Figure 5-16 Control Panel Assembly (Graphics)
Parts List

Item	Part Number	Qty.	Description
1	A032844-01	1	Control Panel W/Graphics
2	A000608-02	1	"N" Shift Assembly
3	A000598-02	1	Steering Wheel Assy.
4	005255-01	1	Shift Bezel
5	85-22F114	10	Screws, #10-24 X 7/8" Lg., "F" Type Phil.
6	62-002	1	Led Switch
7	005889-01	1	Shift, Spacer Block
8	**032846-01**	1	Control Panel Support
9	A006313-01	1	Harness, Control Panel
10	000567-01	1	Bow Washer
11	75-5524B	2	Carriage Bolts, ¼-20 X 1½" Lg.
12	75-015S	1	Washer, Flat, ¼"
13	75-045	2	Washer, Split-Lock, ¼"
14	75-915S	2	Hex Nuts, ¼-20
15	75-040	10	Washer, Split-Lock, #10
16	75-010S	10	Washer, Flat, #10
17	001856-01	1	Bezel, Alum.
18	75-019S	1	Washer, Flat

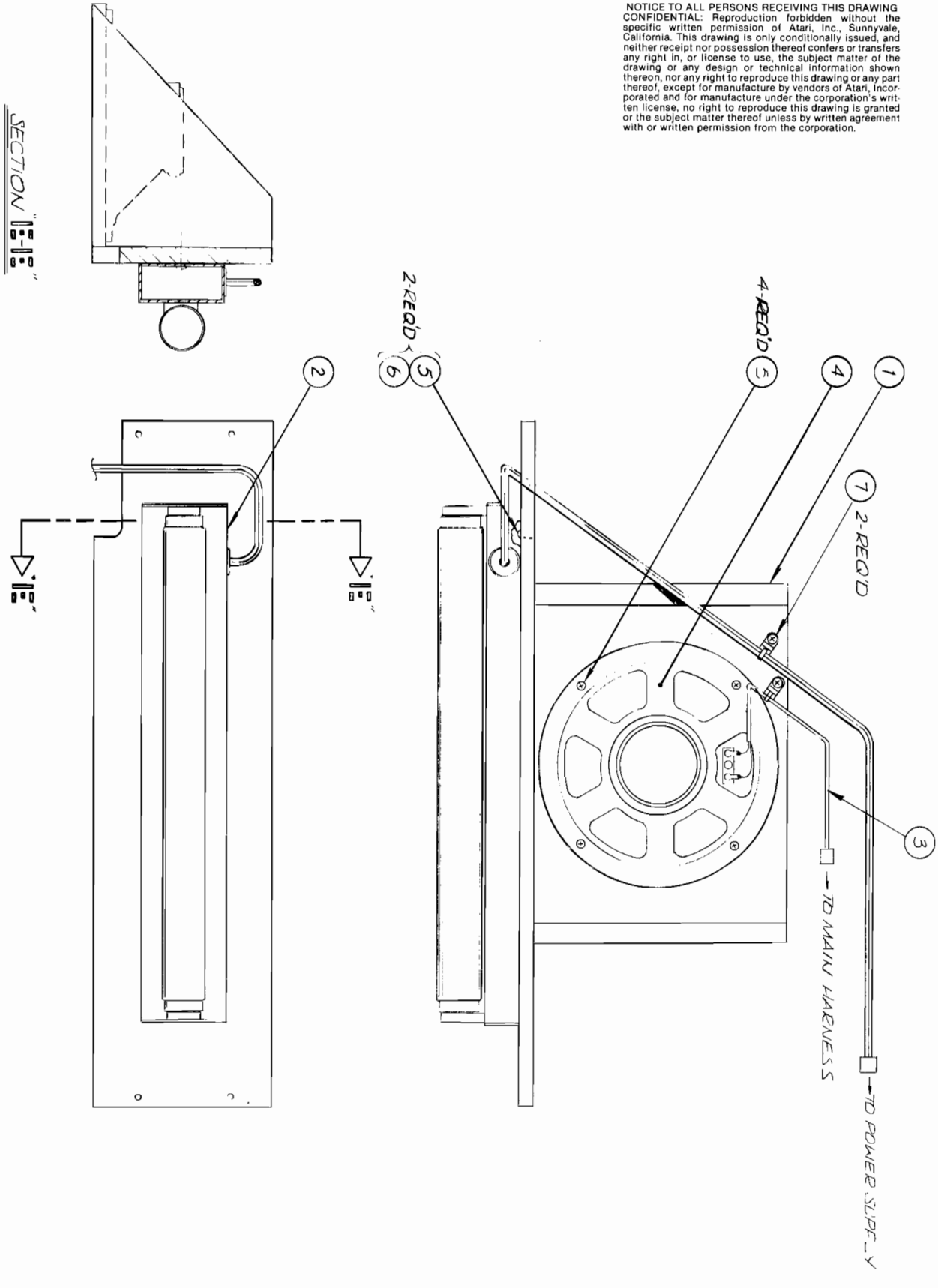

Figure 5-17 Display Assembly (Graphics)
A032838-01 D

Figure 5-17 Display Assembly (Graphics)
Parts List

Item	Part Number	Qty.	Description
1	A005374-01	Ref	Display Light Support Assembly
2	A006917-01	1	Fluorescent Light Assembly (18 inch)
3	A009063-01	1	Speaker Harness Assembly
4	48-001	1	Speaker, 8"
5	72-6810	6	Screws, S.M. Pan Hd. Phil. #8 x 5/8" Lg
6	75-010S	2	Washers, Flat, #10
7	72-6610	2	Screws, S.M. Pan. Hd. Phil #6 x 5/8" Lg

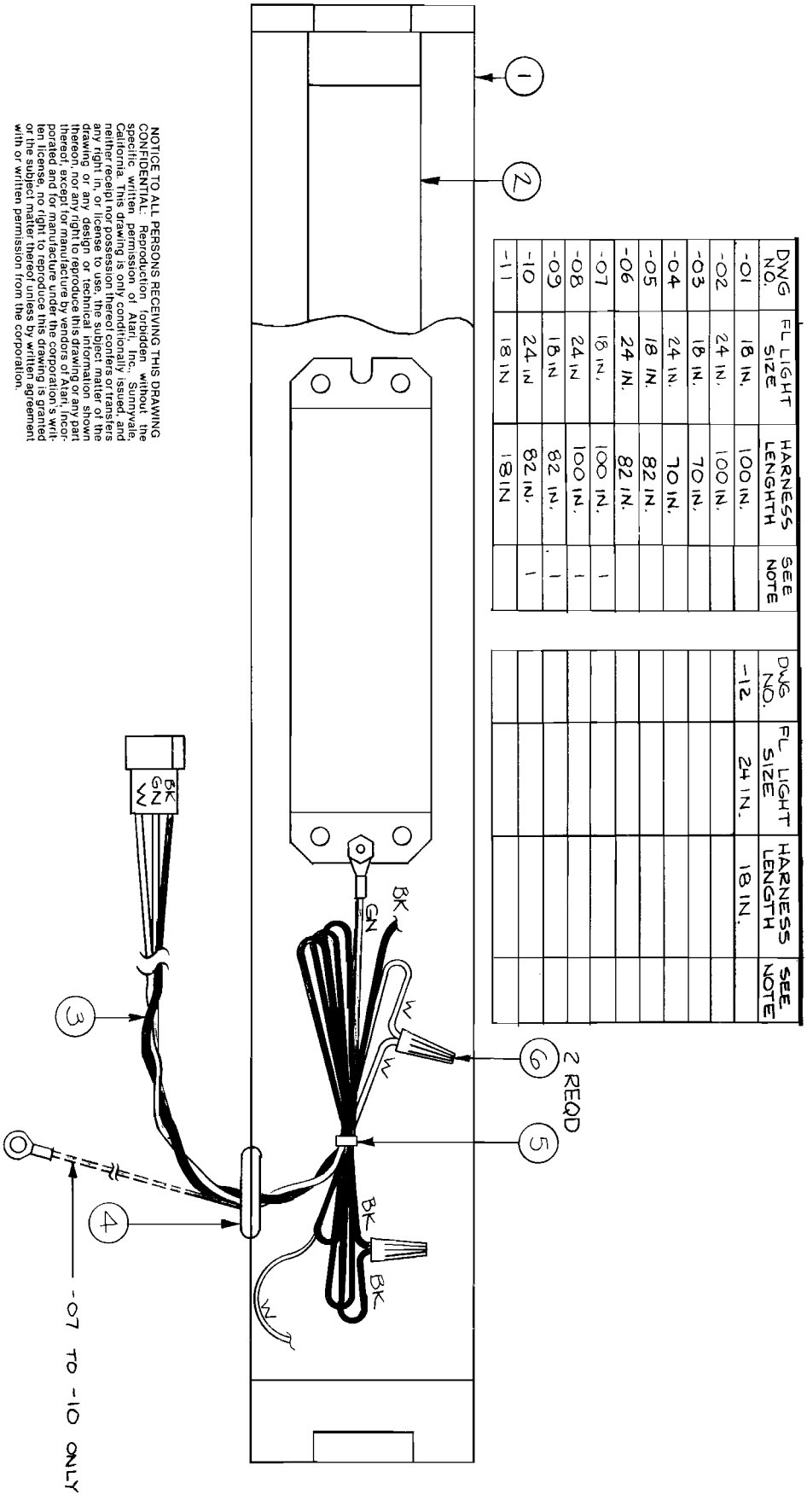

Figure 5-18 Fluorescent Lamp Assembly (Graphics)
A006917-01 D

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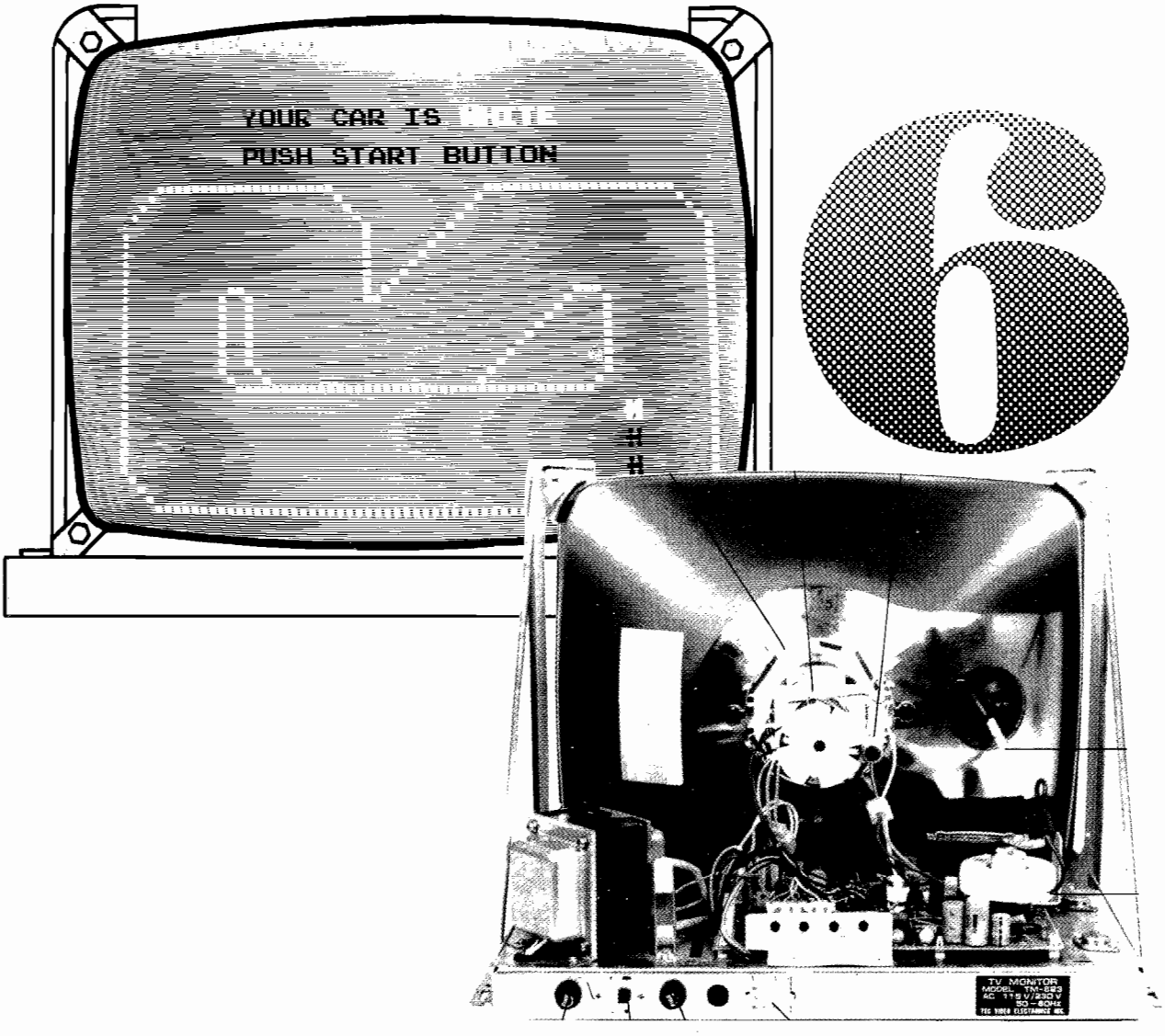
Figure 5-18 Fluorescent Lamp Assembly (Graphics)
Parts List

Item	Part Number	Qty.	Description
1	93-104	1	Gibson Fluorescent Fixture 18 inch
2	70-303	1	Fluorescent Tube 18 inch (or Equivalent)
3	A006916-01	1	Fluorescent Light Harness, 100"
4	78-2652	1	Grommet, Rubber
5	78-24001	A/R	Tie Wrap
6	79-561816	2	Wire Nut, Ideal 71-B



6

TV MONITOR SERVICING INFORMATION

This chapter provides servicing information taken from the Motorola and TEC service manuals. Each manual has been reprinted by permission of the respective monitor manufacturer.

Your game will include either the Motorola or TEC monitor, depending on their availability during production.

MODELS
M5000-155
M7000-155

MOTOROLA
Service Manual

CAUTION

No work should be attempted on any exposed monitor chassis by anyone not familiar with servicing procedures and precautions.

A. GENERAL INFORMATION

This manual contains information on the M5000/M7000 monitor series and the +5 volt logic power supply. The M5000 uses a 19-inch CRT and the M7000 uses a 23-inch CRT. All CRTs are of the magnetic deflection type with integral implosion protection.

All monitor power supplies are capable of producing both +73 and +12 volts regulated from either 115-volt or 230-volt AC input to the transformer primary. All monitor variations described herein require a composite video input signal.

Input and output connections for the monitors are made through a 12-pin connector plug located at the rear of the chassis. Inputs consist of composite video, audio, and 115/220 volt AC three-wire.

All monitors employ: four stages of video amplification, a two-stage sync separator, a two-stage vertical integrator, a four-stage horizontal sweep circuit, a three-stage vertical sweep circuit, a one-stage spot kill, a one stage blanking amplifier; and a regulated, full-wave bridge power supply.

Model Breakdown Chart

Model	Video Input	19" CRT	23" CRT
M5000-155	Composite	X	
M7000-155	Composite		X

SAFETY WARNING

CAUTION

No work should be attempted on an exposed monitor chassis by anyone not familiar with servicing procedures and precautions.

1. Safety procedures should be developed by habit so that technicians rushed with repair work automatically take precautions.

2. A good practice, when working on any unit, is to first ground the chassis and to use only one hand when testing circuitry. This will avoid the possibility of carelessly putting one hand on chassis or ground and the other on an electrical connection which could cause a severe electrical shock.

3. Extreme care should be used in *handling the picture tube* as rough handling may cause it to implode due to atmospheric pressure (14.7 lbs. per sq. in.). Do not nick or scratch glass or subject it to any undue pressure in removal or installation. When handling, safety goggles and heavy gloves should be worn for protection. Discharge picture tube by shorting the anode connection to chassis ground (not cabinet or other mounting parts). When discharging, go from ground to anode or use a well-insulated piece of wire. When servicing or repairing the monitor, if the cathode ray tube is replaced by a type of tube other than that specified under the Motorola Part Number as original equipment in this Service Manual, then avoid prolonged exposure at close range to unshielded areas of the cathode ray tube. Possible danger of personal injury from unnecessary exposure to X-ray radiation may result.

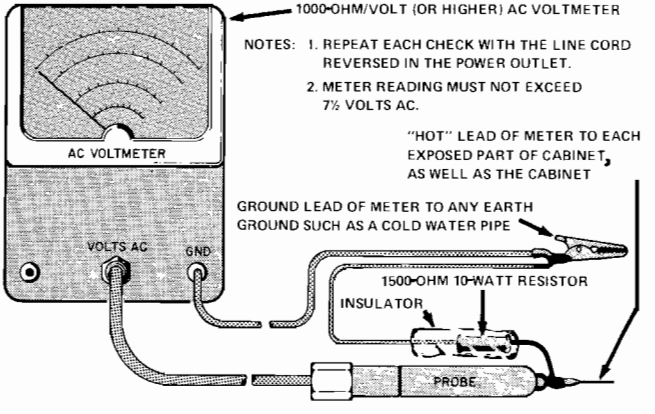
4. An *isolation transformer* should always be used during the servicing of a unit whose chassis is connected to one side of the power line. Use a transformer of adequate power rating as this protects the serviceman from accidents resulting in personal injury from electrical shocks. It will also protect the chassis and its components from being

MOTOROLA Data Products CAROL STREAM, ILLINOIS 60187
PART NO. 68P25253A47

damaged by accidental shorts of the circuitry that may be inadvertently introduced during the service operation.

5. Always *replace protective devices,* such as fishpaper, isolation resistors and capacitors and shields after working on the unit.

6. *Before returning a serviced unit,* the service technician must thoroughly test the unit to be certain that it is completely safe to operate without danger of electrical shock. *Do not use a line isolation transformer when making this test.*



Voltmeter Hook-up for Safety Check

In addition to practicing the basic and fundamental electrical safety rules, the following test, which is related to the minimum safety requirements of the Underwriters Laboratories, should be performed by the service technician before any unit which has been serviced is installed in a game again.

A 1000-ohm-per-volt AC voltmeter is prepared by shunting it with a 1500-ohm, 10-watt resistor. The safety test is made by contacting one meter probe to any portion of the unit exposed to the operator such as the cabinet trim, hardware, controls, knobs, etc., while the other probe is held in contact with a good "earth" ground such as a cold water pipe.

The AC voltage indicated by the meter must not exceed 7½ volts. A reading exceeding 7½ volts indicates that a potentially dangerous leakage path exists between the exposed portion of the unit and earth ground. Such a unit represents a potentially serious shock hazard to the operator.

The above test should be repeated with the power plug reversed, when applicable.

Never reinstall a monitor which does not pass the safety test until the fault has been located and corrected.

Table 6-1 Motorola Monitor Electrical Specifications

	MODEL M5000-155	MODEL M7000-155
PICTURE TUBE	19" measured diagonally (48.2 cm); 184 sq. inch viewing area (1188 sq. cm); 114° deflection angle; integral implosion protection; P4 phosphor standard	23" measured diagonally (58.4 cm); 282 sq. inch viewing area (1820 sq. cm); 110° deflection angle; integral implosion protection; P4 phosphor standard
POWER INPUT	115/230 VAC, 110 Watts (nominal); 60 Hz provision for 230 VAC, 50 Hz	
FUSES	M5000-155, M7000-155—0.8A	
+73 VOLT SUPPLY	Electronically regulated over AC inputs from 103 VAC to 130 VAC, or 260 VAC to 260 VAC	
VIDEO INPUT	0.5 Volts to 2.5 Volts P/P maximum, composite for 50V at CRT	
RESOLUTION	500 lines at picture center	
LINEARITY	Within 3%, measured with standard EIA ball chart and dot pattern	

Table 6-1 Motorola Monitor Electrical Specifications

HIGH VOLTAGE	17KV (nominal)	
HORIZONTAL BLANKING INTERVAL	11 microseconds typical (includes retrace and delay)	
SCANNING FREQUENCY	Horizontal: 15,750 Hz±500 Hz; Vertical: 50/60 Hz	
ENVIRONMENT	Operating temperature: 10°C to 55°C (ambient) Storage Temperature: −40°C to +65°C Operating Altitude: 10,000 ft. maximum (3048 meters) Designed to comply with applicable DHEW rules on X-Radiation CSA certified for use in coin-operated amusements in a combustible enclosure UL listed under specification 1410 (electronic components)	
TYPICAL DIMENSIONS	14.11" H, 18.18" W, 14.83" D (35.8 x 46 x 37.6 cm)	16.72" H, 21.56" W, 16.18" D (42.4 x 54.7 x 41 cm)

Specifications subject to change without notice.

B. SERVICE NOTES

Circuit Tracing

Component reference numbers are printed on the top and bottom of the three circuit cards to facilitate circuit tracing. In addition, control names are also shown and referenced on the schematic diagram in this manual.

Transistor elements are identified as follows: E—Emitter, B—Base, C—Collector.

Component Removal

Removing components from an etched circuit card is facilitated by the fact that the circuitry (copper foil) appears on one side of the circuit card only and the component leads are inserted straight through the holes and are not bent or crimped.

It is recommended that a solder extracting gun be used to aid in component removal. An iron with a temperature-controlled heating element would be desirable since it would reduce the possibility of damaging the circuit card foil due to over-heating.

The nozzle of the solder extracting gun is inserted directly over the component lead and when sufficiently heated, the solder is drawn away, leaving the lead free from the copper foil. This method is particularly suitable in removing multi-terminal components.

CRT Replacement

Use extreme care in handling the CRT, as rough handling may cause it to implode due to high vacuum pressure. Do not nick or scratch glass or subject it to any undue pressure in removal or installation. Use goggles and heavy gloves for protection. In addition, be sure to disconnect the monitor from all external voltage sources.

1. Discharge CRT by shorting 2nd anode to ground; then remove the CRT socket, deflection yoke and 2nd anode lead.

2. Remove CRT from the front of the chassis by loosening and removing four screws, one in each corner of the CRT.

Adjustments

A non-metallic tool is recommended when performing the following adjustments.

Regulator Adjustment

NOTE

Misadjustment of the +73 volt regulator or the horizontal oscillator may result in damage to the horizontal output transistor or pulse-limiter diode. The following procedure is recommended to insure reliable operation.

1. Connect the monitor to an AC line supply; then adjust supply to 120 volts (240 volts in some applications).

2. Apply test signal to proper input. Signal should be of same amplitude and sync rate as when monitor is in service.

3. Adjust HOR. SET coil L1 until display is stable.

4. Connect a DC digital voltmeter or equivalent precision voltmeter to the emitter of the regulator output transistor, Q17, or any +73 volt test point.

5. Adjust the 73V ADJUST. control, R93, for an output of +73 volts. *Do not* rotate the control through its entire range; damage to the monitor may result.

6. When adjustment is complete, the AC line supply can be varied between 103 and 130 volts AC to check for proper regulator operation. With the regulator operating properly, changes in display size should be negligible.

Horizontal Hold/Oscillator Adjustment

Adjust the core of HOR. SET coil L1 until the horizontal blanking lines are vertical or the CRT display is stable (synced).

Vertical Height/Linearity Adjustment

1. Connect a test generator whose output is similar to the display signal normally used.

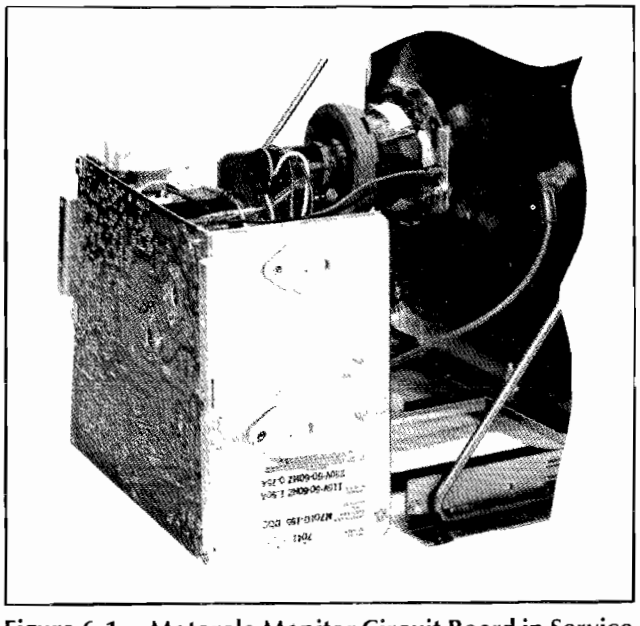


Figure 6-1 Motorola Monitor Circuit Board in Service Position

2. Rotate the vertical size control, R60, until the smallest display is obtained.

3. Adjust the vertical linearity control, R64, until the top and bottom of the test pattern is equally spaced.

4. Readjust R60 until the desired display height is obtained.

5. Readjust R64, if necessary, as in Step 2 above.

Focus Adjustment

The best overall focus of the display is obtained by adjusting the focus control, R42, for best focus at a point which is near the center and approximately 1/3 down from the top of the display.

Monitor Servicing

The monitor circuit board may be installed in a service position to provide easier access to the circuit foil when servicing the monitor (see Figure 6-1).

C. THEORY OF OPERATION

Power Supply

The power supplies are transformer-operated, full-wave, regulated supplies which maintain constant output voltages for input line variations of 103 volts AC to 130 volts AC, or 206 volts AC to 260 volts AC. Regulation of the output voltages is accomplished by using positive feedback through the integrated circuit reference amplifier.

+73 Volt Supply (See Figures 6-3, 6-4)

When the +73 volt supply attempts to increase, the voltage at pin 3 of IC1 will increase, while the voltage at pin 2 remains constant due to D20. The increasing voltage at pin 3 will cause the output voltage of the reference amplifier (pin 6) to increase the forward bias of Q19. The collector voltage of Q19, forward bias of Q18, and the base current of Q17 will all decrease. The resultant proportional increase of Q17 collector-to-emitter voltage will cancel the attempted output voltage increase.

When the +73 volt supply bus attempts to decrease; the voltage at pin 3 of IC1 will decrease while the voltage at pin 2 remains constant. The decreasing voltage at pin 3 will cause the reference amplifier output voltage at pin 6 to decrease the forward bias of Q19. The collector voltage of Q19, the forward bias of Q18 and the base current of Q17 will increase. The collector-to-emitter voltage of Q17, which is in series

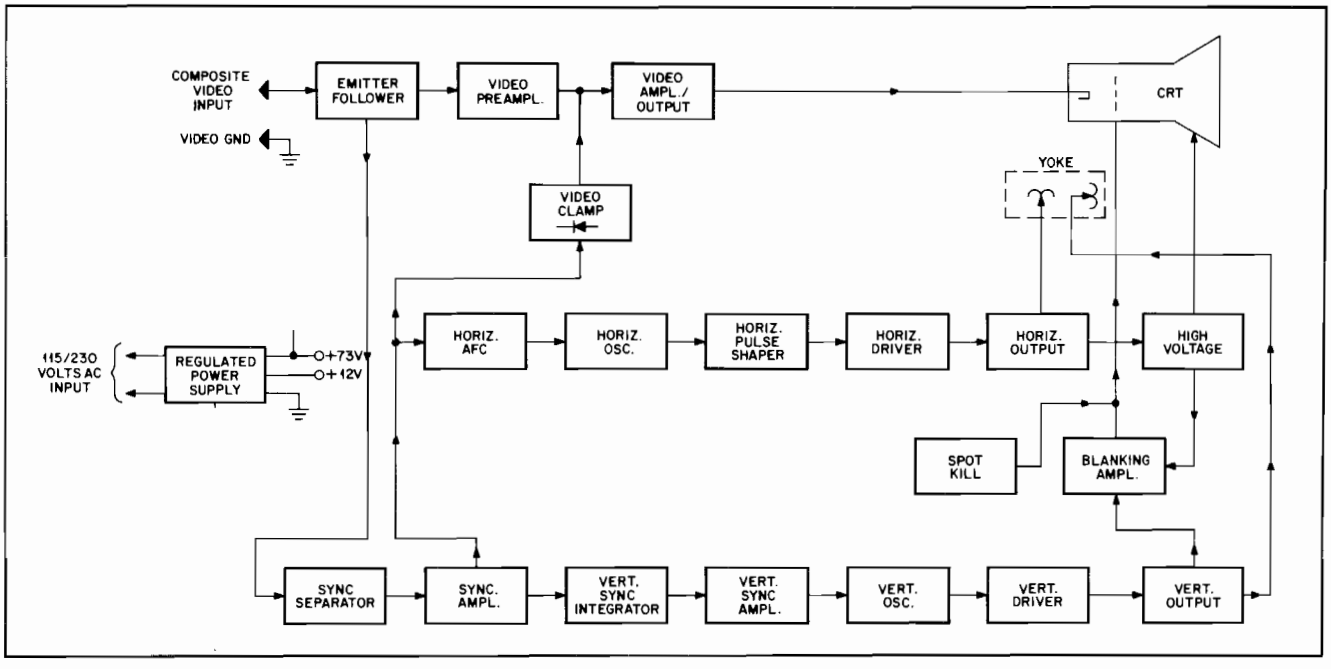


Figure 6-2 Motorola Monitor Block Diagram

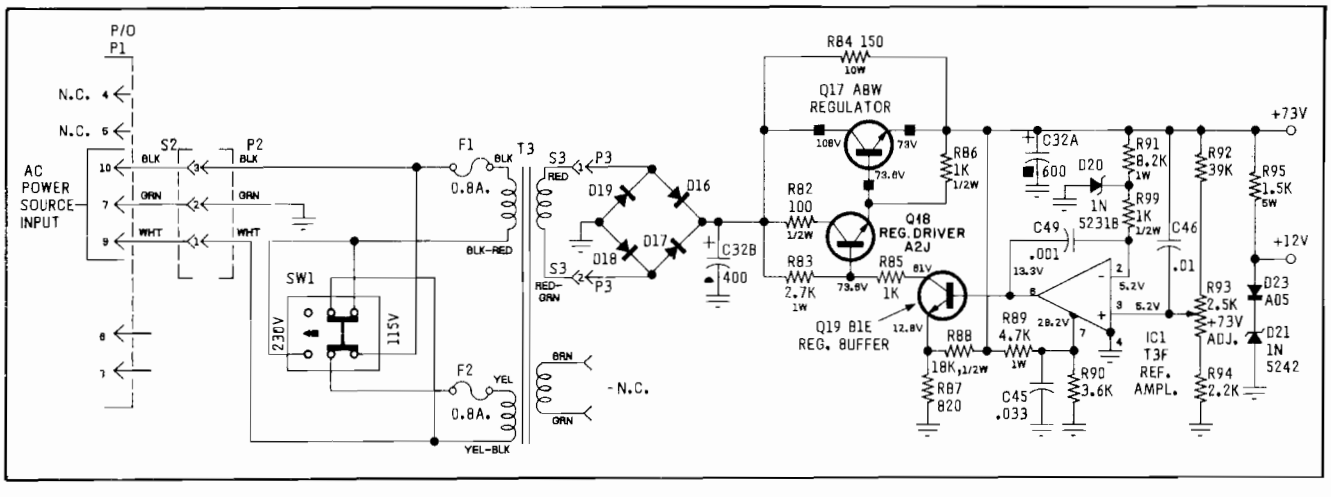


Figure 6-3 +73 Volt Supply Circuit

with the output, will decrease proportionally to the attempted decrease in the outbut bus.

Resistor R84 shunts a portion of the output current around Q17 so less power is dissipated within the device. Resistor R82 is the current-limiting resistor for Q18, and R86 controls the leakage current of Q17. Resistors R83 and R85 are the collector load for Q19, and R88 and R87 provide an emitter voltage for Q19 within the range of IC1's output voltage variations. Capacitor C45 filters high frequency variations from the voltage at pin 7 of IC1, and C49 is a Miller-effect capacitor which eliminates instability.

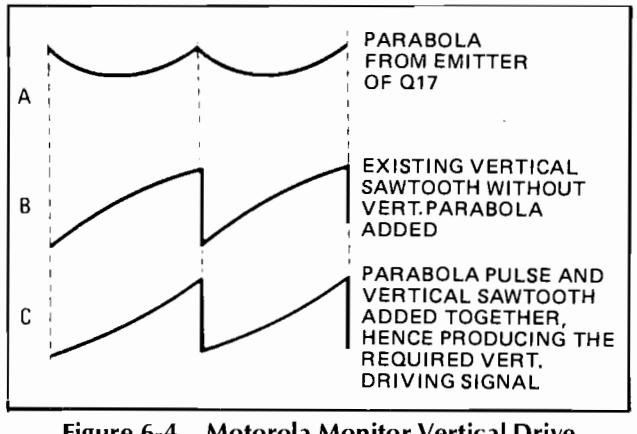


Figure 6-4 Motorola Monitor Vertical Drive Waveform

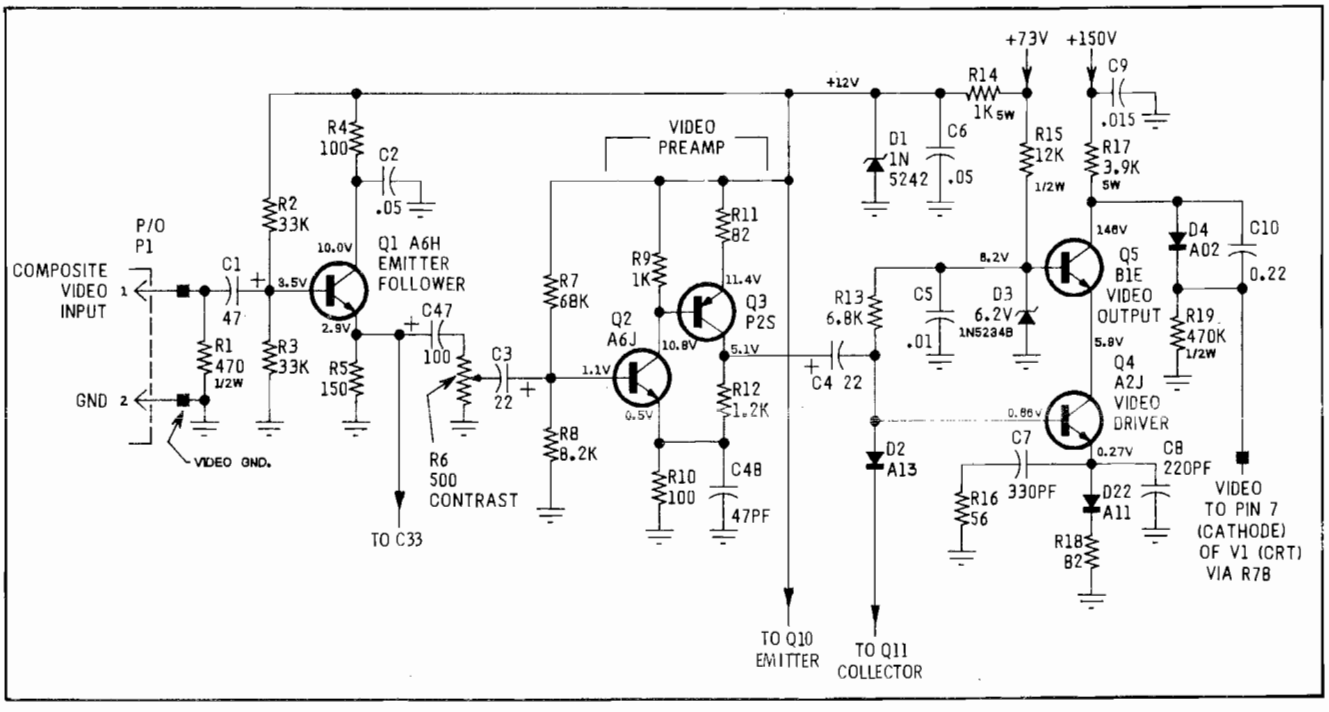


Figure 6-5 Motorola Monitor Video Amplifiers and Output Circuit

Capacitor C32A filters horizontal frequency variations from the output bus.

Resistor R91 provides bias current for D20, and the value of R99 presents an impedance from pin 2 of IC1 to AC ground (through D20). Capacitor C46 couples high frequency voltage variations, which occur at the output bus, back to pin 3—preventing oscillations for proper operation of the reference amplifier. Resistors R92, R93, and R94 provide voltage division such that the adjustment of R93 can be set equal to the voltage of pin 2 of IC1. Resistor R95 provides bias current for D21 and also provides the +12 volt output. Diode D23 is necessary to temperature-compensate for variations within D21. Capacitor C32B filters AC variations from the output of the full-wave bridge.

Video Amplifiers and Output (See Figure 6-5)

The composite video signal is coupled to the emitter-follower Q1 through the input connector P1 and capacitor C1. Transistor Q1 is a buffer stage which matches the impedance of the signal source to the video preamplifer and the sync separator stages. Resistor R1 is a terminating resistor for the video signal source, and resistors R2, R3, R4, and R5 form the biasing network for the stage. Capacitor C2 bypasses higher video frequencies to ground. The composite video signal is coupled from the emitter of Q1 to the sync separator Q10 through C33 and to the contrast control R6 through C47.

The contrast control varies the amplitude and couples the composite video signal to the base of Q2 through capacitor C3. Transistors Q2 and Q3 are complimentary, direct-coupled, common emitter amplifiers. The voltage gain (approximately 12) of the preamplifier stage is controlled by the feedback arrangement of R9, R10, R11, and R12. Resistors R7 and R8 provide the base bias voltage for Q2. Capacitor C48 is used for high-frequency peaking.

The output of the video preamplifier stage is coupled to the video output stage through capacitor C4. Diode D2 clamps the video signal to approximately +0.7 volts (DC restoration) when a sync pulse turns on the sync amplifier Q11. The video output stage is connected in a cascade configuration. Transistor Q4 is a common emitter amplifier and Q5 is connected in a common base arrangement. Capacitors C7, C8, and resistor R16 are used for high-frequency compensation, and resistor R18 controls the gain of the stage to approximately 47. Diode D3 maintains the base of Q5 at +6.2 volts, while capacitor C5 filters the video signal variations from the base voltage. Resistor R13 provides a DC bias path for D2, and R19 and D4 are used to limit the current through the CRT.

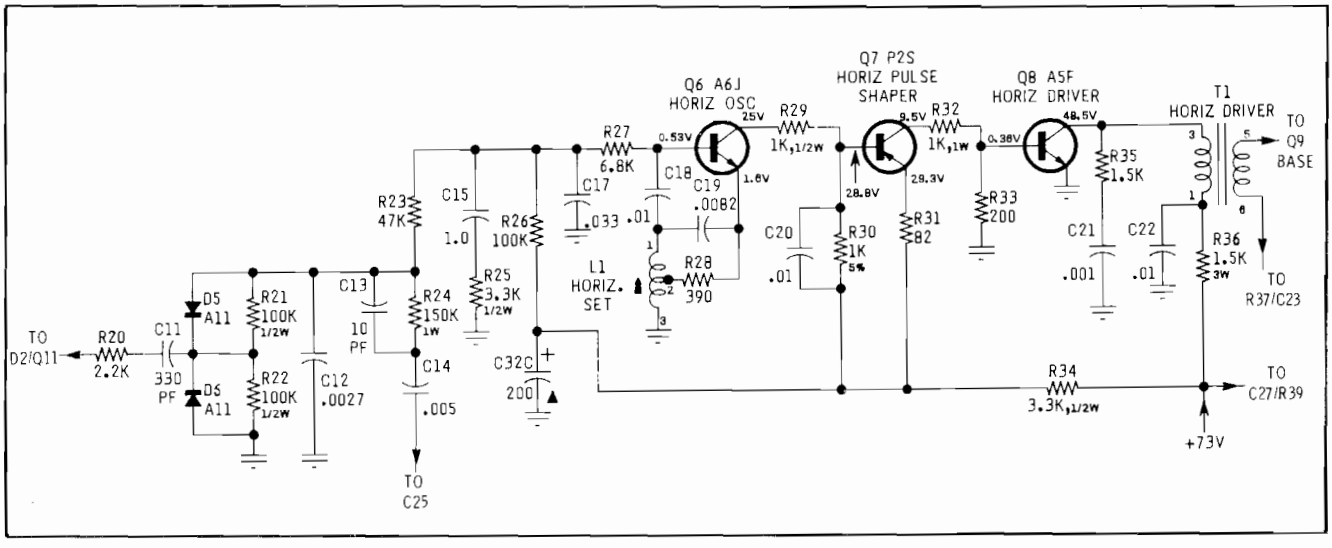


Figure 6-6 Motorola Monitor Horizontal Deflection Circuit

Capacitor C10 AC-couples the video from the collector of Q5 to the cathode of the CRT if D4 turns off due to high beam currents. Resistor R17 is the collector load for Q5, and R15 provides the bias current for the zener diode D3. Capacitors C9 and C6 filter video frequencies from the +150 volt and +12 volt supplies. Resistor R14 and zener diode D1 are used to supply +12 volts for Q1, Q2, and Q3.

D. HORIZONTAL DEFLECTION CIRCUITS (See Figure 6-6)

Phase Detector (See Figure 6-7)

The phase detector consists of two diodes (D5 and D6) in a keyed clamp circuit. Two inputs are required to generate the required output, one from the horizontal sync amplifier, Q11, and one from the horizontal output circuit, Q9. The required output must be of the proper polarity and amplitude to correct phase differences between the input horizontal sync pulses and the horizontal time base.

The horizontal output (Q9) collector pulse is integrated into a sawtooth by R24 and C12. During horizontal sync time, diodes D5 and D6 conduct, which shorts C12 to ground. This effectively clamps the sawtooth on C12 to ground at sync time. If the horizontal time base is in phase with the sync (waveform A), the sync pulse will occur when the sawtooth is passing through its AC axis, and the net charge on C12 will be zero (waveform B). If the horizontal time base is lagging the sync, the sawtooth on C12 will be clamped to ground at a point negative from the AC axis. This will result in a positive DC charge on C12 (waveform C). The positive polarity causes the horizontal oscillator to speed up and correct the phase lag. Likewise, if the horizontal time base is leading the sync, the sawtooth on C12 will be clamped at a point positive from its AC axis. This results in a net negative charge on C12 which is the required polarity to slow the horizontal oscillator (waveform D).

Components R23, C15, R25 and C17 comprisé the phase detector filter. The bandpass of this filter is chosen to provide correction of horizontal oscillator phase without ringing or hunting. Capacitor C13 times the phase detector for correct centering of the picture on the raster.

Horizontal Oscillator

The horizontal oscillator employs the principles of the Hartley-type oscillator. Its operating frequency is sensitive to its DC base input voltage, thus permitting the frequency of the oscillator to be varied by the output voltage of the phase detector. The main frequency-determining components are L1, C19, and R28. The oscillator operates as a switch being biased alternately into saturation and cut-off. The initial forward starting bias is supplied via R26.

Horizontal Pulse Shaper and Driver

The horizontal pulse shaper Q7 serves as a buffer stage between the horizontal oscillator and driver. Capacitor C20 and resistor R30 combine to shape the input waveform to the required duty cycle of 50%, which is necessary to drive the horizontal output stage.

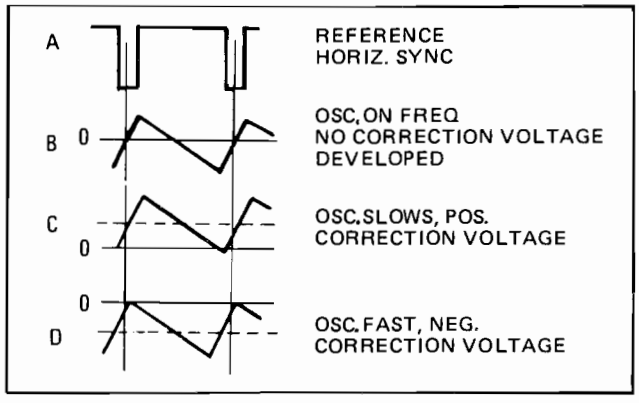


Figure 6-7 Motorola Monitor Horizontal Deflection Waveforms

The horizontal driver Q8 operates as a switch to driving horizontal output transistor Q9 through T1. Because of the low impedance drive and fast switching times, very little power is dissipated in Q8.

Resistor R35 and capacitor C21 provide damping to suppress ringing in the primary of T1 when Q8 goes into cut-off. Resistor R36 is used for limiting current in the collector of Q8, and C22 filters the horizontal frequency variations from the DC side of the transformer primary.

Horizontal Output (See Figure 6-8)

The secondary of T1 provides the required low drive impedance for Q9. Resistor R37 limits current in the base of Q9, while capacitor C23 provides additional reverse bias to keep Q9 turned off during the horizontal retrace pulse. Transistor Q9 operates as a switch which once each horizontal time period connects the supply voltage across the parallel combination of the horizontal deflection yoke and the primary of T2. The required sawtooth deflection current through the horizontal yoke is formed by the L-R time constant of the yoke and output transformer primary. The horizontal retrace pulse charges C27 through D8 to provide operating voltage for G2 of the CRT. Momentary transients at the collector of Q9, should they occur, are limited to the voltage on C27, since D8 will conduct if the collector voltage exceeds this value.

The damper diode D7 conducts during the period between retrace and turn-on of Q9 to reduce retrace overshoot; capacitor C28 is the retrace tuning capacitor. Capacitor C25 blocks DC from deflection yoke. Components R38 and C26 are damping components for the width and linearity coils. Capacitor C32D is charged through D10, developing the video output supply voltage.

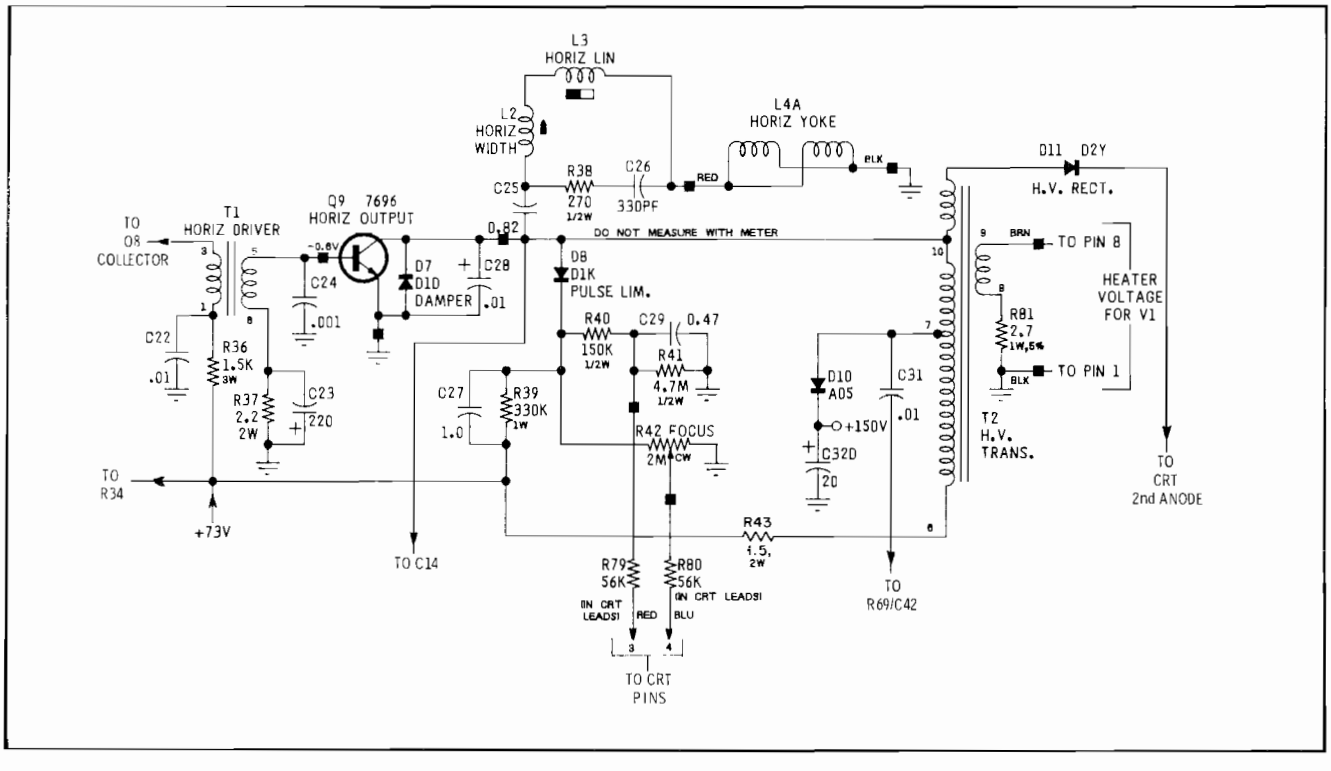


Figure 6-8 Motorola Monitor Horizontal Output Circuit

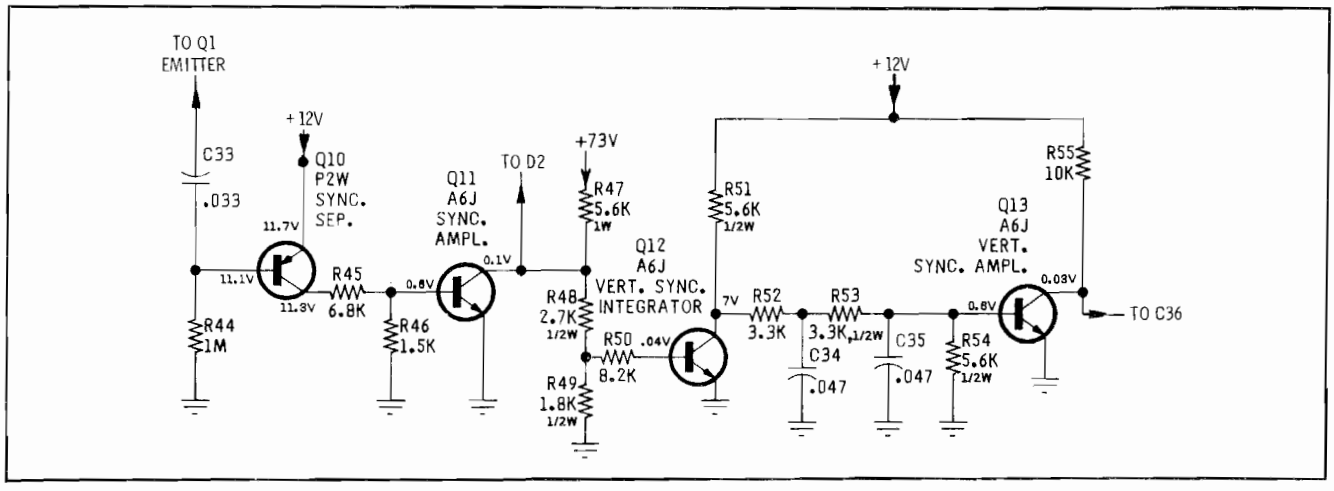


Figure 6-9 Motorola Monitor Sync Circuit

Sync Circuits (See Figure 6-9)

The video signal is coupled from the emitter of Q1 to the base of Q10 through C33. The negative-going sync tips turn on Q10 and are clamped to the value of the base voltage due to the base-emitter diode junction. The video information within the composite video signal, however, is less negative and Q10 remains off between each sync tip. Therefore, the waveform at the collector of Q10 will contain only the composite sync pulse information.

Resistors R45 and R46 provide base bias for Q11. The composite sync pulses are amplified and inverted by Q11 where they are coupled to the vertical sync integrator Q12, the horizontal phase detector, and the video clamp diode D2. Resistors R47, R48, and R49, are the collector load for Q11, and also provide base bias for Q12. Resistor R50 limits current through the base-emitter junction of Q12, and R51 is its collector load. Components R52, C34, R53, C35, and R54 form a double integrator which removes the horizontal pulses from the composite sync signal, leaving the vertical pulses to be amplified by Q13 and coupled to the vertical oscillator.

Vertical Oscillator and Output (See Figure 6-10)

The vertical oscillator is a relaxation oscillator and operates at a free-running frequency that is set by

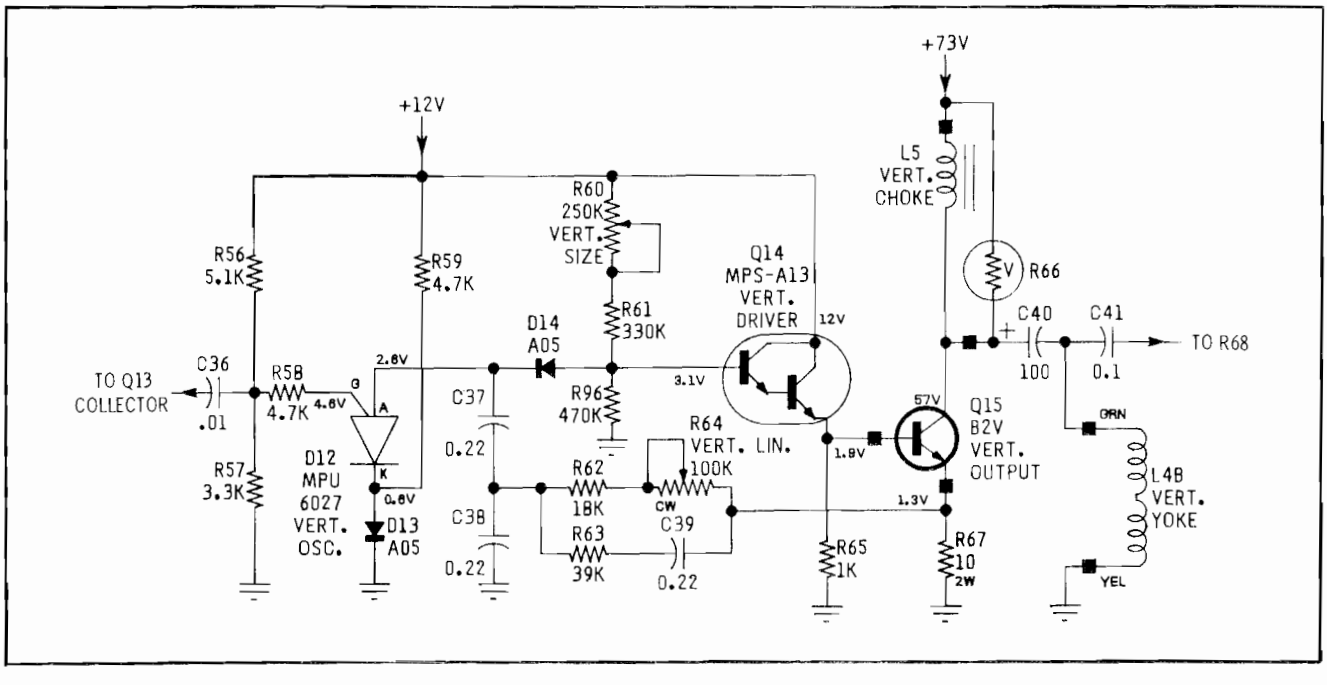


Figure 6-10 Motorola Monitor Vertical Oscillator Circuit

the value of resistors R56 and R57. The series combination of C37 and C38 charges through D14, R61, and R60, until D12 turns on. This occurs when the anode voltage of D12 exceeds the gate voltage by approximately 1.0 volt. When D12 conducts, C37 and C38 are discharged to nearly zero volts; then D12 turns off and the cycle repeats. The value of R61 and the setting of R60 determines the amplitude of the waveform.

Diode D14 provides a small incremental voltage above ground to overcome the forward base-emitter drop of Q14; D13 provides temperature compensation for the output stage. Resistor R96 provides a constant oscillator load for variations in input impedance of Q14. Transistor Q14 is an emitter-follower used to transform the high impedance drive sawtooth to a low impedance drive for Q15.

The vertical choke L5 acts as a current source during linear scan time and provides a high-voltage pulse to aid retrace when Q15 shuts off. To limit this pulse to a safe value, a varistor, R66, is connected across the choke.

Since the impedance of the choke decreases when the collector current of Q15 increases, severe vertical non-linearity will result unless some compensation is employed.

Resistors R64 and R62 couple the emitter voltage of Q15 to the junction of C37 and C38. This path is resistive, and the waveform coupled back will be integrated by C38. This results in a pre-distortion of the drive sawtooth. This is done to compensate for the non-linear charging of C37, C38 and the changing impedance of C5. An additional feedback path through R63 and C39 serves to optimize the drive waveshape for best linearity. Capacitor C40 couples the signal to the vertical yoke winding and blocks DC.

Spot Kill (See Figure 6-11)

The spot kill circuitry is used to reduce the effect of the electron beam concentrating on one area of the CRT after the monitor is turned off. The circuitry is accomplished by raising the arm of potentiometer R73 to the +150 volt level and, therefore, increasing the brightness to maximum to dissipate the high-voltage charge that normally remains in the CRT.

When the monitor is operating, transistor Q20 is on and its collector is near zero volts. Capacitor C44 charges through the base-emitter junction of Q20 and R97. Resistor R72 provides the base bias voltage required to keep Q20 on. When the monitor is turned

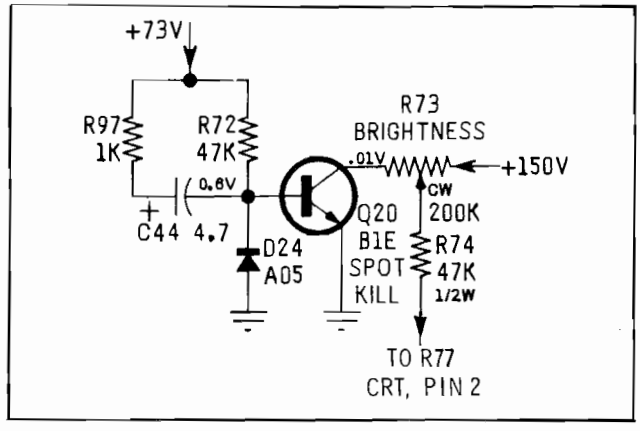


Figure 6-11 Motorola Monitor Spot Killer Circuit

off, the falling +73 volts is coupled to the base of Q20 to turn off the transistor causing its collector voltage to rise to approximately +150 volts. Diode D24 prevents the negative voltage swing at the base of Q20 from exceeding the reverse voltage rating of the transistor.

Blanking Amplifier (see Figure 6-12)

The blanking amplifier combines both the vertical and horizontal retrace pulses to turn off the electron beam in the CRT once every horizontal line and once every vertical field.

Capacitor C41 couples the vertical retrace pulses and capacitor C31 couples the horizontal retrace pulses to the blanking amplifier. Resistor R68 determines the amplitude of the vertical pulses, while R69 determines the amplitude of the horizontal pulses. Capacitor C42 bypasses R69 to couple the leading and trailing edges of the horizontal retrace pulses to the amplifier. Resistor R70 allows C41 to discharge when the retrace pulses swing below zero volts. Diode D15 prevents the retrace overshoot from exceeding the reverse voltage rating of Q20. Resistor R71 permits Q20 to turn off between retrace pulses, while R75 and R76 provide the collector voltage for Q20. Capacitor C43 couples the blanking pulses to the control grid of the CRT.

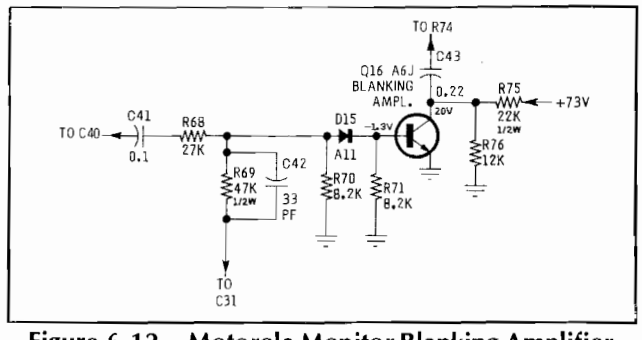


Figure 6-12 Motorola Monitor Blanking Amplifier Circuit

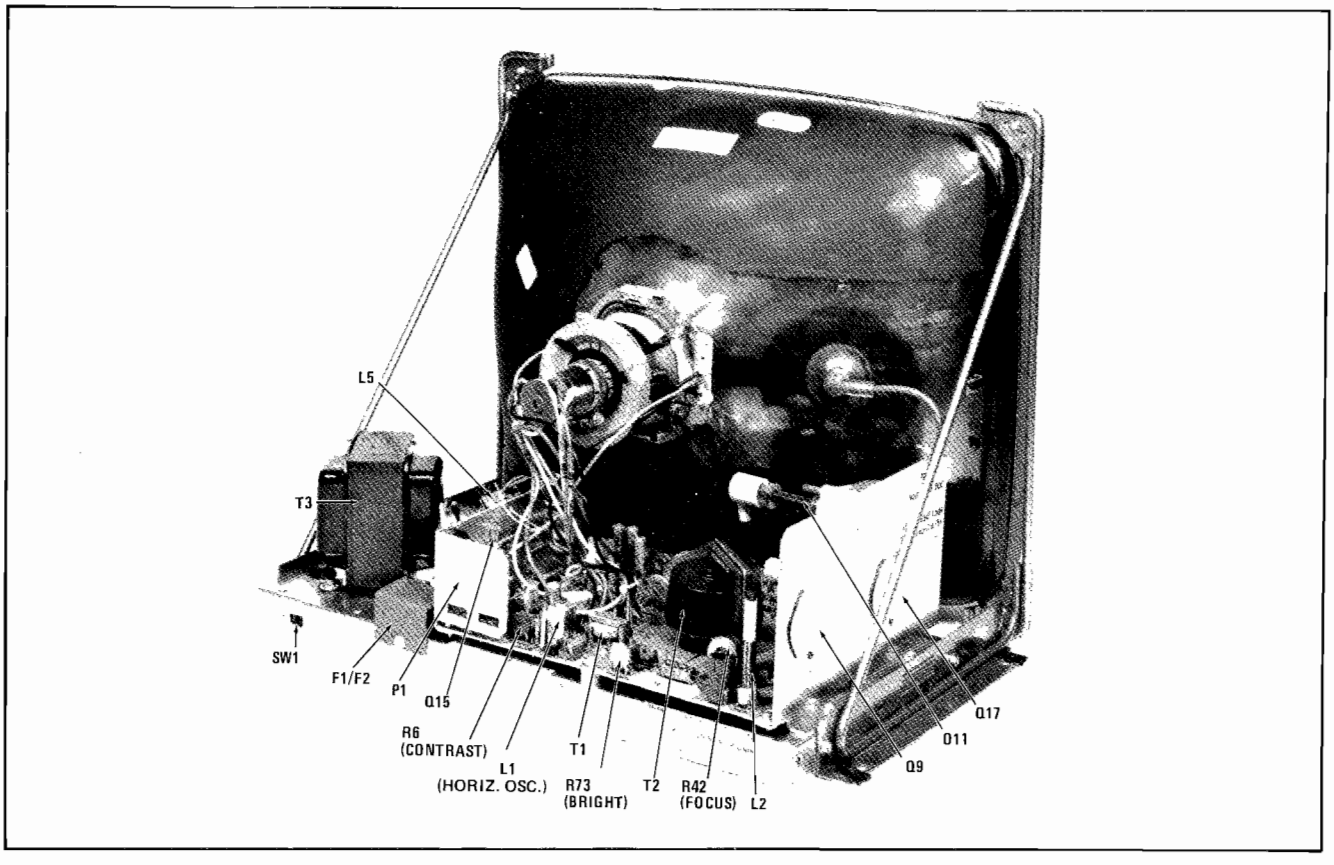


Figure 6-13 Motorola Monitor Chassis Rear View —Component Location

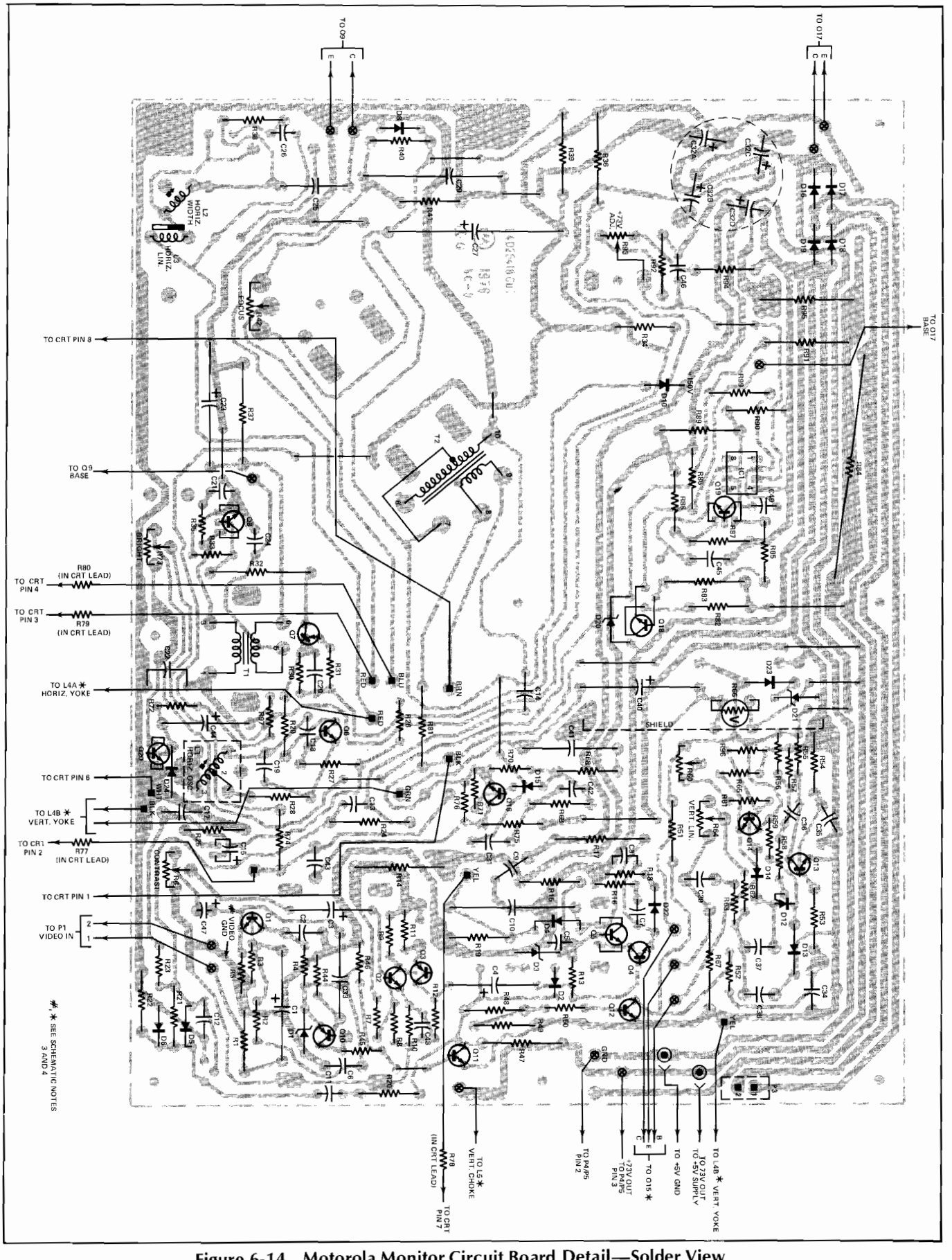


Figure 6-14 Motorola Monitor Circuit Board Detail—Solder View

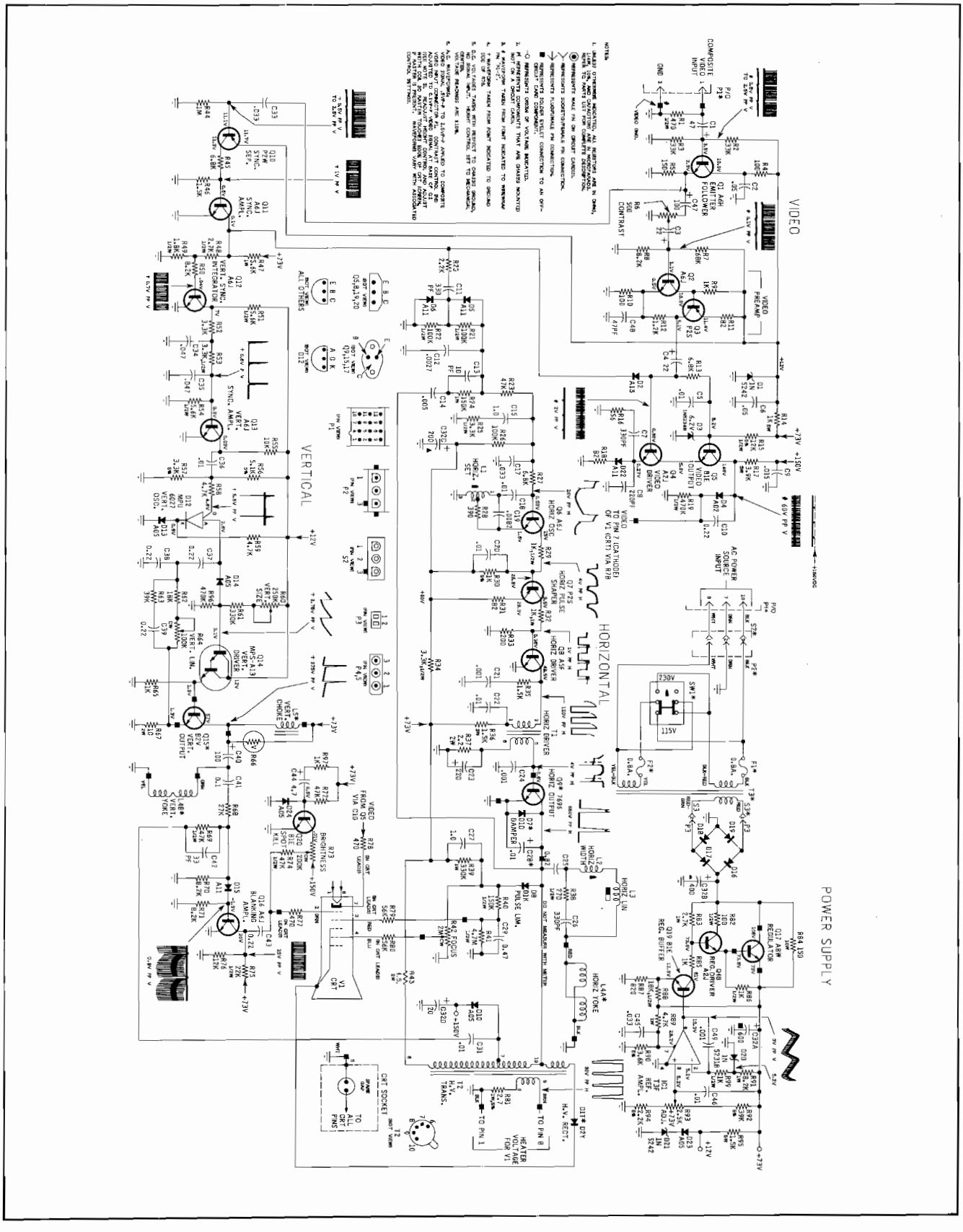


Figure 6-15 Motorola Monitor Schematic Diagram

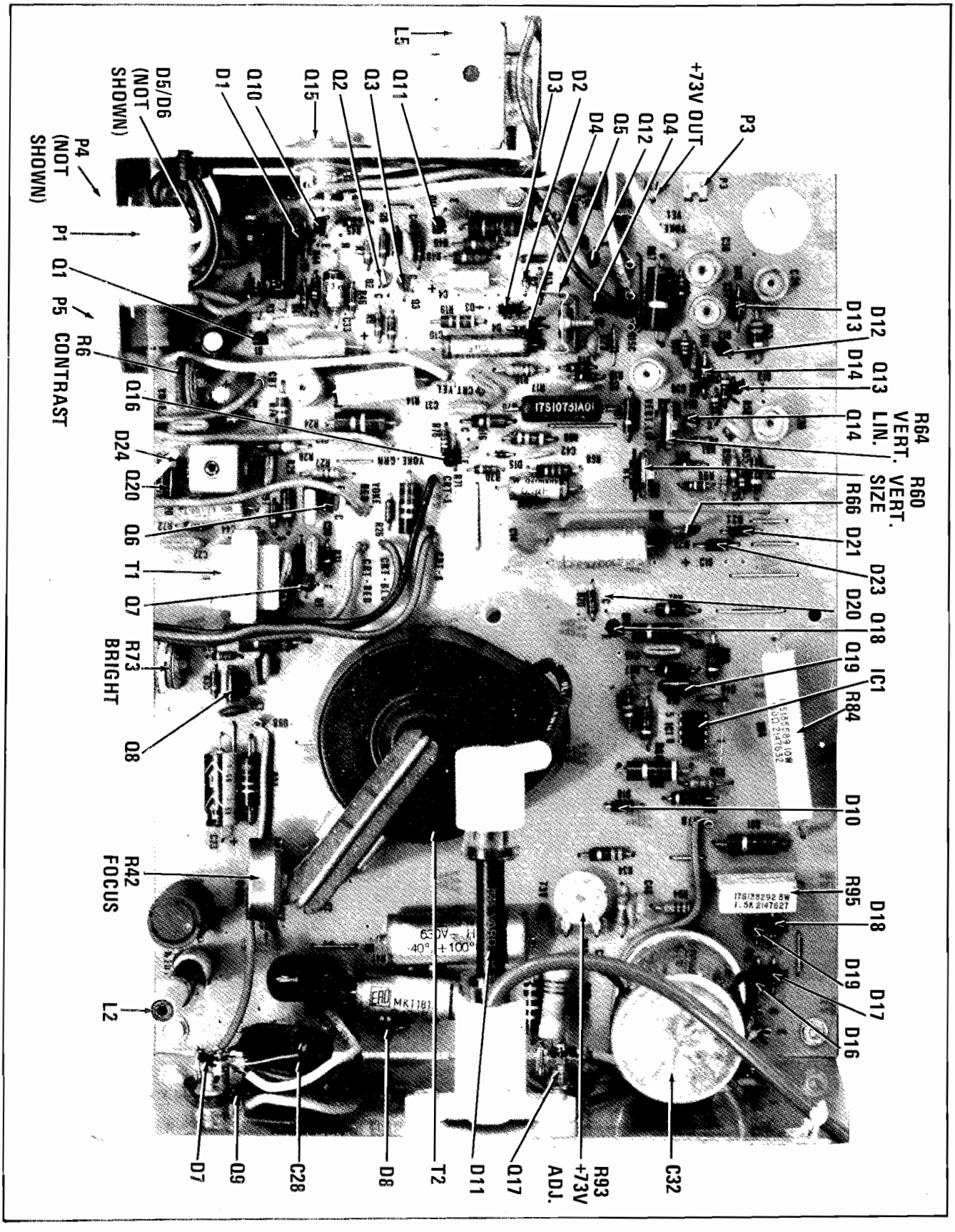


Figure 6-16 Motorola Monitor Circuit Board Detail—Component Location

Table 6-2 Motorola Replacement Part Numbers

REF. NO.	PART NUMBER	DESCRIPTION
Capacitors:		
All values are in Microfarads unless otherwise noted.		
C1	23S10255A27	47, 50V; Lytic
C2	21S135660	.05, +80–20, Z5V, 50V; Cer. Disc.
C3, C4	23S187A26	22, 25V; Lytic
C5	21S180E60	.01, +80–20; Z5V, 50V; Cer. Disc.
C6	21S135660	.05, +80–20, Z5V, 50V; Cer. Disc.
C7	21S131625	330pf, 10%, X5F, 500V; Cer. Disc.
C8	21S180B87	220pf, 10%, X5F, 500V; Cer. Disc.
C9	8S10191B99	.015, 10%, 250V; Poly.
C10	8S10212B18	0.22, 10%, 400V; Mtlz. Poly.
C11	21S131625	330pf, 10%, X5F, 500V; Cer. Disc.
C12	21S180C41	.0027, 10%, Z5F, 500V; Cer. Disc.
C13	21S180C02	10pf, 10%, N150, 500V; Cer. Disc.
C14	21S180D34	.005, 20%, Z5F, 1KV; Cer. Disc.
C15	23S10229A32	1.0, 16V; Lytic
C17	8S10191B90	.033, 10%, 250V; Poly.
C18	8S10299B28	.01, 10%, 100V; Polycarb.
C19	8S10299B29	.0082, 10%, 100V; Polycarb.
C20	8S10191B98	.01, 10%, 250V; Poly.
C21	21S180B51	.001, 10%, X5F, 500V; Cer. Disc.
C22	8S10191B98	.01, 10%, 250V; Poly.
C23	23S10255B50	150, 10V; Lytic
C24	21S180B51	.001, 10%, X5F, 500V; Cer. Disc.
C25	8S10299B27	0.82, 10%, 200V; Mtlz. Polycarb.
C26	21S131625	330pf, 10%, X5F, 500V; Cer. Disc.
C27	8S10212A11	1.0, 10%, 630V; Mtlz. Poly.
C28	8S10571A06	.01, 5%, 1200V; Polyprop. Foil
C29	8S10212B53	0.47, 10%, 630V; Mtlz. Poly.
C31	8S10191B98	.01, 10%, 250V; Poly.
C32	23S10255B73	20/200, 400/125, 600/100, 200/50; Lytic
C33	8S10191A51	.033, 10%, 160V; Poly.
C34, C35	8S10191A32	.047, 10%, 250V; Poly.
C36	21S180E60	.01, +80–20, Z5V, 50V; Cer. Disc.
C37, 38, 39	8S10191B67	0.22, 10%, 250V; Poly.
C40	23S10255A60	100, 63V; Lytic
C41	8S10212B16	0.1, 20%, 400V; Mtlz. Poly.
C42	21S180C82	0.33, 10%, N150, 500V; Cer. Disc.
C43	8S10191B67	0.22, 10%, 250V; Poly.
C44	23S10255B28	4.7, 100V; Lytic
C45	8S10191B90	.033, 10%, 250V; Poly.
C46	21S132492	.01, +80–20, Z5V, 100V; Cer. Disc.
C47	23S10255B63	100, 10V; Lytic
C48	21S180D56	47pf, 10%, N750, 100V; Cer. Disc.
C49	21S180B51	.001, 10%, X5F, 500V; Cer. Disc.
Diodes:		
D1	48S10813A03	Diode, Silicon, Zener; IN5242
D2	48D67120A13	Diode; A13
D3	48S10813A01	Diode, Silicon, Zener; IN5234B
D4	48S191A02	Rectifier, Silicon; 91A02
D5, D6	48D67120A11	Diode; A11
D7	48S134921	Diode, Damper; D1D
D8	48S134978	Diode, Pulse Lim; D1K
D10	48S191A05	Rectifier, Silicon; 91A05
D11	48S137114	Rectifier, H.V., D2Y
D12	48S137638	Vert. Osc.; MPU6027
D13, D14	48S191A05	Rectifier, Silicon; 91A05
D15	48D67120A11	Diode; A11
D16, D17, D18, D19	48S191A05	Rectifier, Silicon; 91A05
D20	48S10813A02	Diode, Silicon, Zener; 1N5231B
D21	48S10813A03	Diode, Silicon, Zener; 1N5242
D22	48D67120A11	Diode; A11
D23, D24	48S191A05	Rectifier, Silicon; 91A05

Table 6-2 Motorola Replacement Part Numbers

Ref. No.	Part No.	Description
Fuses:		
F1, F2	65S138269	Fuse, 0.8A–250V
Integrated Circuits:		
IC1	51S10732A01	Ref. Ampl.; T3F
Coils/Chokes:		
L1	24C25448A01	Coil, Horiz. Osc.
L2	24D25603A09	Coil, Horiz. Width
L3	24D25248A14	Coil, Horiz. Lin.
L4	24D25261A09	Coil, Defl. (M5000-155, M5010-155)
L4	24D25261A10	Coil, Defl. (M7000-155, M7010-155)
L5	25D25221C12	Choke, Vertical
Transistors:		
Q1	48S137171	Emitter Follower; A6H
Q2	48S137172	Video Pre-Ampl.; A6J
Q3	48S137127	Video Pre-Ampl.; P2S
Q4	48S134952	Video Driver; A2J
Q5	48S137476	Video Output; B1E
Q6	48S137172	Horiz. Osc.; A6J
Q7	48S137127	Horiz. Pulse Shaper; P2S
Q8	48S137093	Horiz. Driver; A5F
Q9	48S137570	Horiz. Output; B2L
Q10	48S137173	Sync Separator; P2W
Q11	48S137172	Sync Ampl.; A6J
Q12	48S137172	Vert. Sync Integrator; A6J
Q13	48S137172	Vert. Sync Ampl.; A6J
Q14	48S137639	Vert. Driver; MPS A13
Q15	48S137596	Vert. Output; B2V
Q16	48S137172	Blanking Ampl.; A6J
Q17	48S137368	Regulator; A8W
Q18	48S134952	Reg. Driver; A2J
Q19	48S137476	Reg. Buffer; B1E
Q20	48S137476	Spot Kill; B1E
Resistors/Controls:		
NOTE: Only power or special resistors are listed. Use the description when ordering standard values of fixed resistors up to 2 watts.		
R6	18D25245A27	Control, Contrast; 500
R14	17S135204	100, 10%, 5W
R17	17S10731A01	3.9K, 5%, 5W
R36	17S10130B07	1.5K, 10%, 3W
R42	18D25218A14	Control, Focus; 2M
R60	18D25245A29	Vert. Size; 250K
R64	18D25245A31	Vert. Lin.; 100K
R66	6S10201A04	Varistor, 1 ma, 120V, 0.5W
R73	18D25245A28	Control, Brightness; 200K
R84	17S135589	150, 10%, 10W
R93	18D25245A21	Control, +73V out Adj.; 2.5K
R95	10731A03	1.5K, 10%, 5W
Switches:		
SW1	40S10624A07	Switch, Slide; D.P. D.T.
Transformers:		
T1	25D25221A05	Horiz.Driver
T2	24D25240B23	H.V. Transformer
T3	25D25239B20	Transformer, Power (M5010-155, M7010-155)
T3	25D25239B30	Transformer, Power (M5000-155, M7000-155)
Misc. Electrical Parts:		
V1	96S241A01	19"–CRT; Type 19VARP4 (M5000/M5010)
V1	96S10848A01	23"–CRT; Type M22VATP4 (M7000/ M7010)
Mechanical Parts:		
	9B25456A01	Block, Fuse (F1, 2)
	42D25158C01	Clamp, Defl. Coil
	26S10251A08	Heat Sink (Q5)
P1	15S10183A69	Housing, Connector; Female (12-Contact, Less Contacts)
	39S10184A67	Contact, Plug; 5 Req'd M5000/M7000, 9 Req'd; M5010/M7010
P2	15S10183A82	Housing, Connector; Male (3-Contact, Less Contacts), M5000/M7000
P2	15S10183A81	Housing, Connector; Female (3-Contact, Less Contacts), M5010/M7010
	39S10184A67	Contact, Plug; 3 Req'd for P2
P3	28S10586A35	Header, Connector; 2-Contact

Table 6-2 Motorola Replacement Part Numbers

REF. NO.	PART NUMBER	DESCRIPTION	REF. NO.	PART NUMBER	DESCRIPTION
P4, P5	15S10183B12	Housing, Connector; Female (3-Contact, Less Contacts) M5010/ M7010		14B25459A01	Insulator, Fuse Cover (F1, 2)
	39S10184A84	Contact, Plug; 3 ea. Req'd for P5, M5010/ M7010		14A562353	Insulator, Mica (Q9, Q15, Q17)
S2	15S10183A81	Housing, Connector; Female (3-Contact, Less Contacts), M5000/M7000		14C25230A01	Insulator, Molded (On D11 Body)
S2	15S10183A82	Housing, Connector; Male (3-Contact, Less Contacts), M5010/M7010		14S10157A30	Insulator, Nylon (2-Req'd.); Mtg. P.C. Board
	39S10184A64	Contact, Receptacle; 3 Req'd. for S2		14S10550A02	Insulator, Transistor Cover (Q9, Q15, Q17)
S3	15S10183A94	Housing, Connector; Female (2-Contact, Less Contacts)		3S136050	Screw, Tpg; 6-20x½ CLU Pan (Mtg. Q9, Q15, Q17 and D11 Socket)
	39S10184A72	Contact, Receptacle; 3 Req'd. for S3		9D25470A01	Socket, CRT; Incl's. R77, R78, R79, R80
				9D25201A01	Socket, H.V. and CRT Anode
				9C63825A03	Socket, Power Transistor Q9, Q15, Q17)
				41D65987A01	Spring Special; CRT Aquadag Gnd.

TEC VIDEOELECTRONICS INC.
SERVICE MANUAL

A. GENERAL

TM-600 and TM-623 is a television monitor for video games. It is designed for operation either from a power supply of 115 volts/50–60 Hz AC or 230 volts/ 50–60 Hz AC. The complete monitor incorporates a picture tube, an integrated circuit, 20 silicon transistors, 18 silicon diodes, 2 germanium diodes, and a high-voltage selenium diode.

This model is equipped with 5V/3A power supply for the operation of the TTL control board and operation double-pulse-type AFC circuit to obtain a stable picture.

B. SPECIFICATIONS

Power Supply Input
115 volts/230 volts 50–60 Hz ±10%

Power Consumption
60 watts

Video input
0.5 volts composite P/P for 100 volts
2.5 volts P/P maximum
Sync negative at input

Picture Tube
19″ (500 mm), 114° deflection for Model TM-600
23″ (584.2 mm), 114° deflection for Model TM-623
Integral implosion protection

High Voltage
18 KV nominal at 0 microamperes beam current

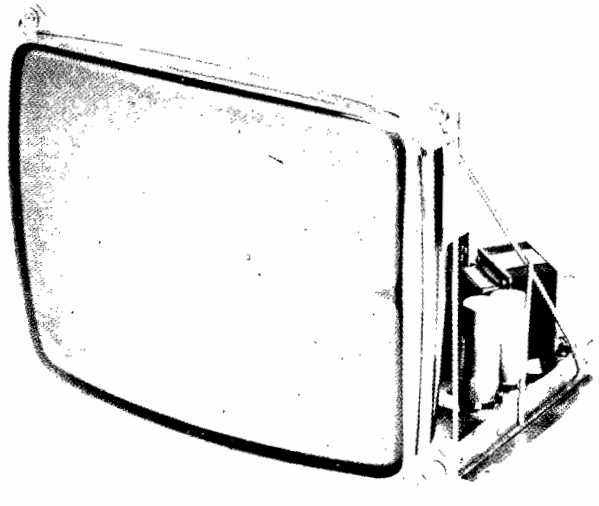
Horizontal Retrace Time
12 microseconds maximum

Resolution
500 lines minimum at picture center

Scaning Frequency
Horizontal: 15.750 Hz ±500 Hz
Vertical: 50–60 Hz

Tone Burst Amplifier
5 watts peak output with TTL drive at nominal line, fully adjustable. 4 watts peak output at low line.

Environment
Operation: Maximum ambient temperature 50°C (122°F)
Storage: Temperature range from −40°C to +65°C



Model TM-600 and TM-623 Monitors

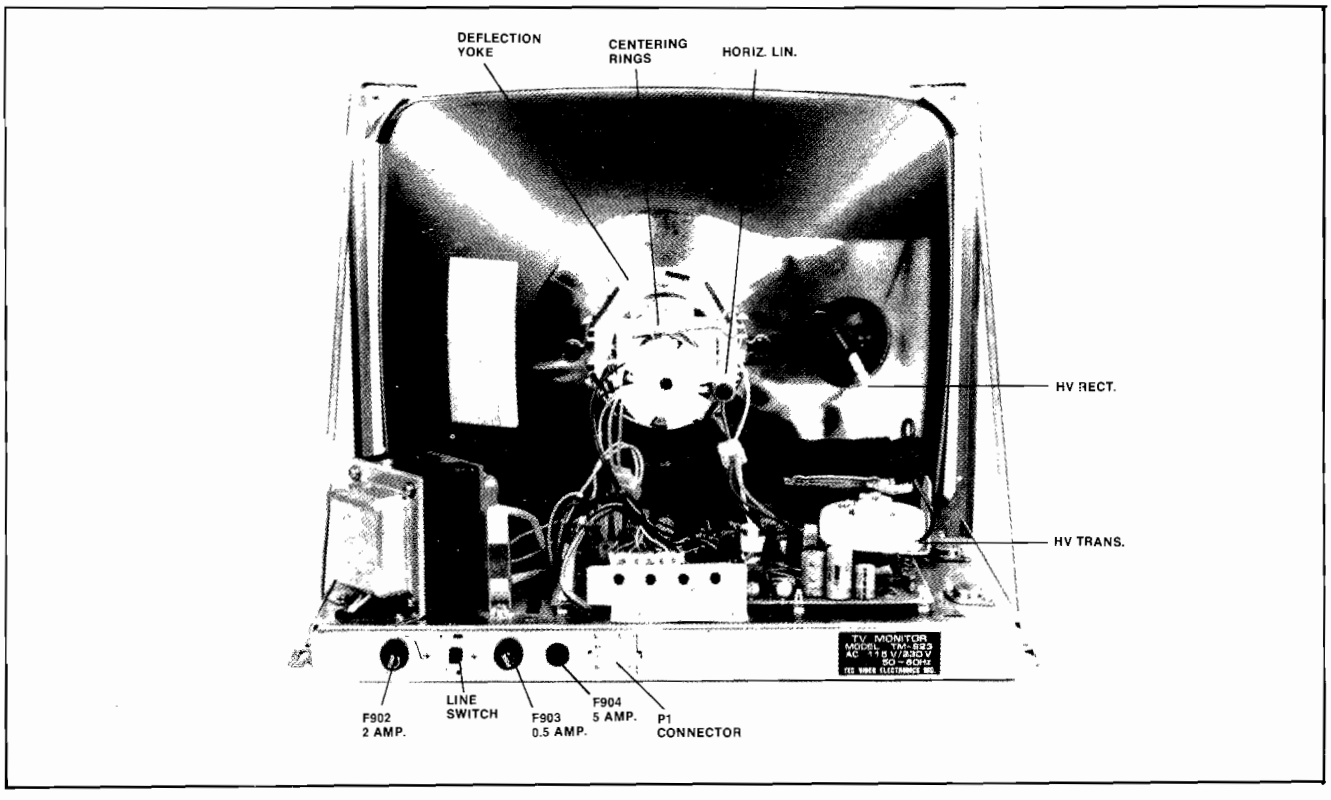


Figure 6-17 TEC Monitor Chassis, Rear View

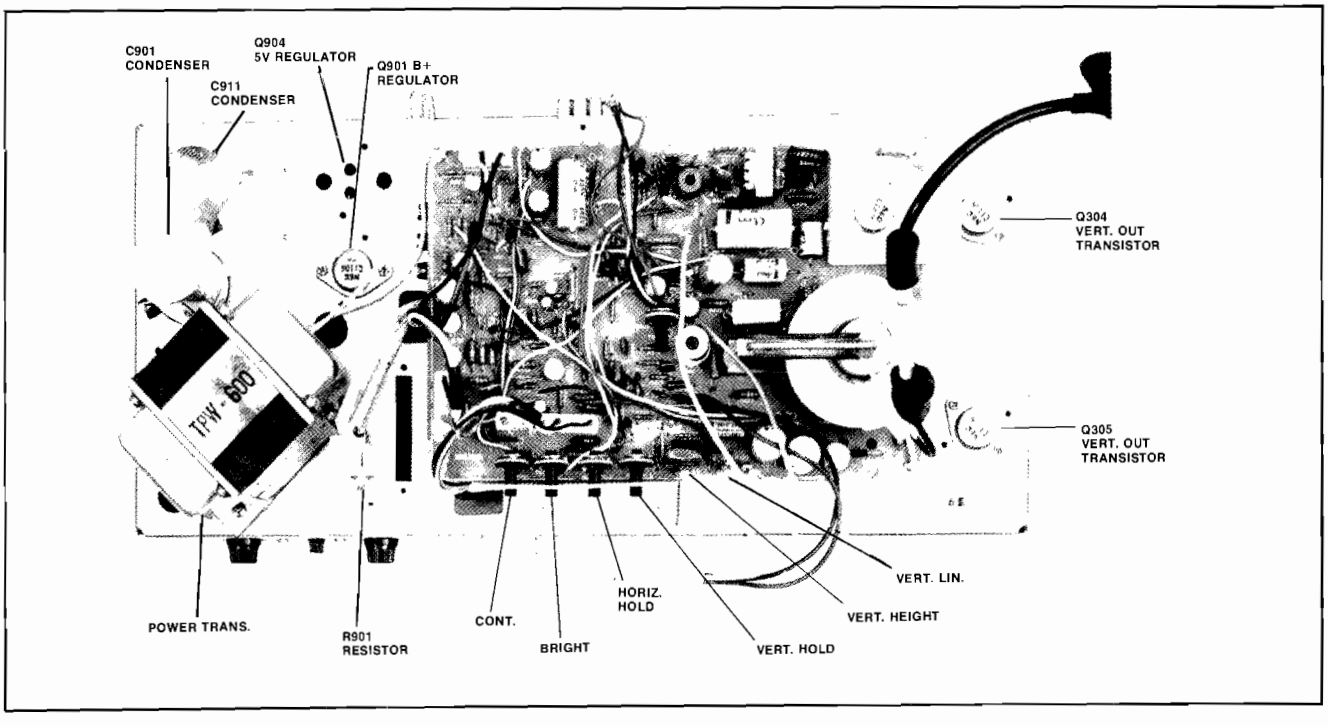


Figure 6-18 TEC Monitor Chassis, Top View

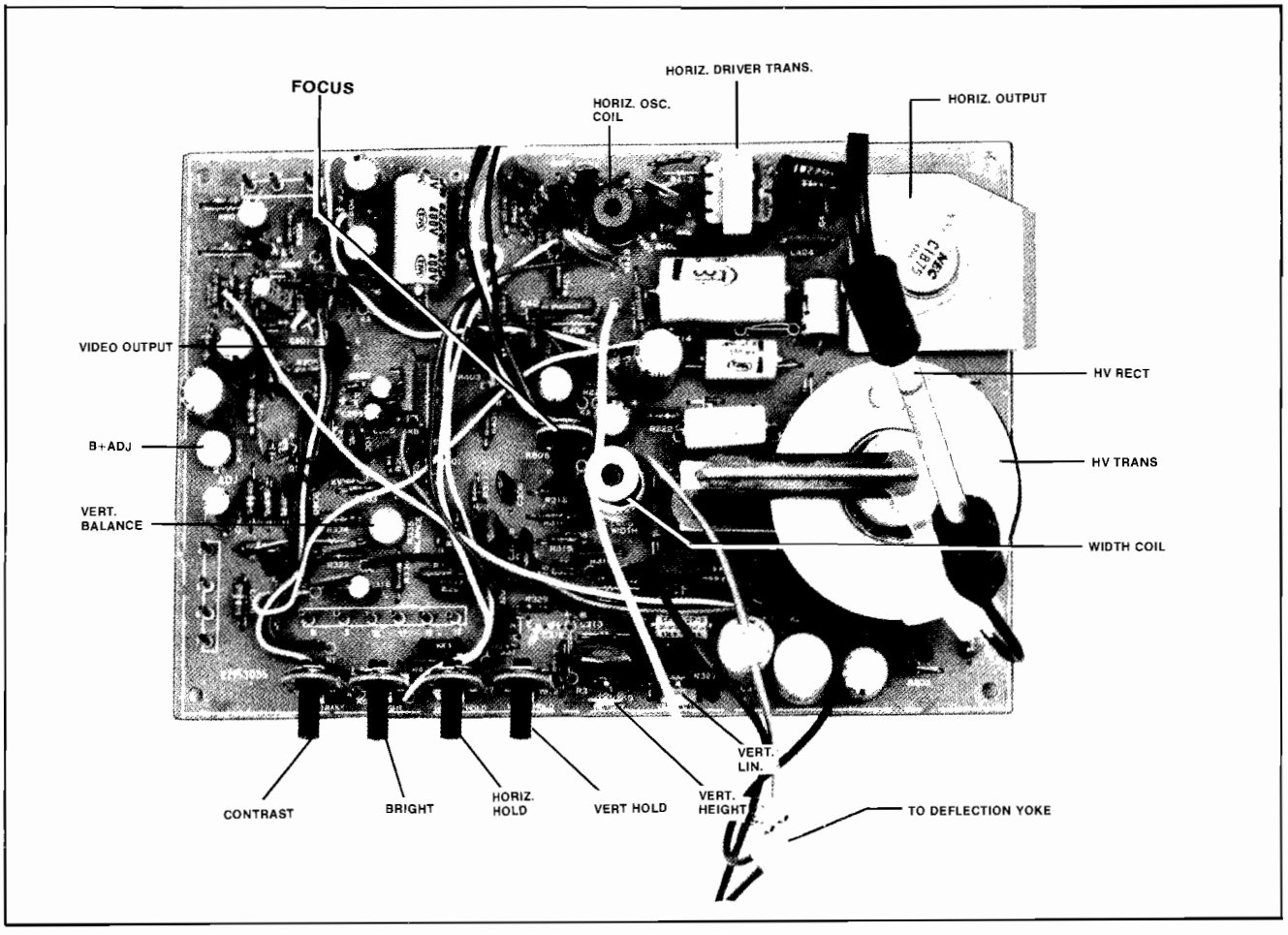


Figure 6-19 TEC Monitor Printed Circuit Board, Top View

Table 6-3 TEC Monitor Replacement Parts Numbers

Ref. No.	Part No.	Description	
Electrical Parts:			
PCB1	2215303600	Main PCB	
A801	485TM60003	CRT PCB	
Transistor and IC:			
Q200	5310500202	MPS9700T or MPS834	1st Video Amp
Q201	5310500261	MPS9750T or MPS4356	2nd Video Amp
Q202	5310500410	2N6558 or MPSU-10	Video Output
Q301	5310500261	MPS9750T or MPS4356	Sync Separator
Q302	5310500201	MPS9700U or MPS834	Vert Osc
Q303	5300500201	MPS9700U or MPS834	Vert Amp
Q304 Q305	4310400030	2SC1106 or 2N6307	Vert Output
Q400	5310500202	MPS9700T or MPS834	Phase Inv
Q401	5310500202	MPS9700T or MPS834	Horiz Osc
Q402	5310500410	2N6558 or MJE9742 or 2N4354	Horiz Amp
Q403	5310400040	2SC1875 or MJ205	Horiz Output
*Q901	5310400030	2SC1106 or MJ3430	Power Regulator

Table 6-3 TEC Monitor Replacement Parts Numbers

Ref. No.	Part No.	Description	
Q902	5310500410 or 5310500070	2N6558 MPS-U04	Regulator Amp
Q903	5310500280	LM1796 or MPS-D01	Reference Amp
Q904	5310500450	MJ2955	5V Regulator
CRT and Diode:			
* V801	5380000060	500SB4	CRT
D203	5340200280	MR9712 or IN4004	Silicon Diode L. V. Rectifier
D204	5340200430	IN4148 or IN4002	Silicon Diode Blanking Clip
D205	5340200430	IN4148 or IN4002	Silicon Diode Blanking Clip
D206	5340200430	IN4148 or IN4002	Silicon Diode Blanking Clip
D207	534020280	MR9712 or IN4004	200V Rect
D301	5340200260	MR-9701	Rectifier Silicon Diode
D401	5340100040	AA143	Phase Det
D402	5340100040	AA143	Phase Det
D403	5340200300	MR9722	Damper
*D404	5340400120	TV20-2K80J or HS30/lb	H.V. Rectifier
D801	5340200290	MR9713	400V Rectifier
D901	5340200270	MR9704 or IN4005	Rectifier Silicon Diode
D902	5340200270	MR9704 or IN4005	Rectifier Silicon Diode
D903	5340200270	MR9704 or IN4005	Rectifier Silicon Diode
D904	5340200270	MR9704 or IN4005	Rectifier Silicon Diode
D906	5340300220 or 5340300310	IN5858A IN6002A	Zener Diode
D907, D908, D909, D910	5340200690	MDA970-1	Rectifier
Coils and Trans:			
*L401	589515015	TDY1005	D.Y. Coil
L402	589512015	HCH1005	Horiz Choke Coil
L403	589512012	HC2-035	Choke Coil
L404	589512012	HC2-035	Choke Coil
L405	589514013	AZ-9177DM	Width Coil
L406	589514016	LH-15J54	Lin Coil

Ref. No.	Part No.	Description	
T401	589514015	TLN-506BX	Horiz Osc
T402	589518012	TLN-519	Horiz Drive
* T403	589517017	TFB-1006AS	F.B.T.
* T901	589519021	TPW-600	Power Trans
Resistors			
R201	RD-4L471J	470 ohm J	¼ W
R202	RD-4L223J	22 K ohm J	¼ W
R203	RD-4L563J	56 K ohm J	¼ W
R204	RD-4L471J	470 ohm J	¼ W
R205	RD-4L332J	3.3 K ohm J	¼ W
R206	RD-2L823J	82 K ohm J	½ W
R207	RD-4L560J	56 ohm J	¼ W
R208	RD-4L102J	1 K ohm J	¼ W
R210	RS-029562J	5.6 K ohm J	2 W
R215	RD-42101J	1 K ohm J	¼ W
* R216	RD-4L101J	100 ohm J	¼ W
* R217	RD-4L470J	47 ohm J	½ W
R218	RD-4L223J	22 K ohm J	¼ W
R219	RD-4L563J	56 K ohm J	¼ W
R220	RD-4L102J	1 K ohm J	¼ W
R221	RD-4L102J	1 K ohm J	¼ W
R222	RD-2L102J	1 K ohm J	½ W
R223	RD-2L102J	1 K ohm J	½ W
R224	RD-2L122J	1.2 K ohm J	½ W
* R226	RS01P101J	100 ohm J	1 W
R227	RD-2L123J	12 K ohm J	½ W
R228	RD-2L105J	1.5 K ohm J	½ W
R229	RD-4M681J	680 ohm J	¼ W
R302	RD-4M331J	330 ohm J	¼ W
R303	RD-4L562J	5.6 K ohm J	¼ W
R304	RD-4M102J	1 K ohm J	¼ W
R308	RD-4M104J	100 K ohm J	¼ W
R309	RD-4M155T	1.5 M ohm J	¼ W
R310	RD-4M332J	3.3 K ohm J	¼ W
R311	RD-4M563J	56 K ohm J	¼ W
R312	RD-4L182J	1.8 K ohm J	¼ W
R313	RD-4L153J	15 K ohm J	¼ W
R314	RD-4L183J	18 K ohm J	¼ W
R315	RD-4L203J	20 K ohm J	¼ W
R316	RS-2P333J	33 K ohm J	½ W
R327	RD-4L104J	100 K ohm J	¼ W
R320	RD-4L124J	120 K ohm J	¼ W

Table 6-3 TEC Monitor Replacement Parts Numbers

Ref. No.	Part No.	Description
R322	RD-4L224J	220 K ohm J ¼ W
R323	RD-4L433J	43 K ohm J ¼ W
R324	RD-4L471J	470 ohm J ¼ W
R326	RD-4L152J	1.5 K ohm J ¼ W
R339	RD-4L101J	100 ohm J ¼ W
R331	RD-4M331J	330 ohm J ¼ W
R332	RD-4L102J	1 K ohm J ¼ W
R333	RS01P682J	6.8 K ohm J 1 W
R334	RD-2L183J	18 K ohm J ½ W
R336	RD-4L221J	220 ohm J ¼ W
R337	5160122901	2.2 ohm J ½ W
R338	RS-2P150J	15 ohm J ½ W
R339	5160112901	1.2 ohm J ½ W
R340	RS01P220T	22 ohm J 1 W
R401	RD-4L153J	15 K ohm J ¼ W
R402	RD-4L821J	820 ohm J ¼ W
R403	RD-4M561J	560 ohm J ¼ W
R404	RD-4M103J	10 K ohm J ¼ W
R405	RD-4M103J	10 K ohm J ¼ W
R406	RD-4L272J	2.7 K ohm J ¼ W
R407	RD-4L681J	680 ohm J ¼ W
R408	RS02P682J	4.7 K ohm J ½ W
R419	RD-4L270J	27 ohm J ¼ W
R410	RD-4L182J	1.8 K ohm J ¼ W
R411	RD-4L151J	150 ohm J ¼ W
R412	RD-4L561J	560 ohm J ¼ W
R413	RS01P682J	6.8 K ohm J 1 W
R414	RD-2L221J	220 ohm J ½ W
R415	5160122903	2.2 ohm J 1 W
R416	RD-2L569J	5.6 ohm J ½ W
R417	RS02P182J	1.8 K ohm J 2 W
R418	RS01P123J	12 K ohm J 1 W
*R420	RX05P220J	22 ohm J 5 W
*R421	RD-2L569J	5.6 ohm J ½ W
R422	RD-4L153J	47 ohm J 1 W
R425	RD-4L153J	15 K ohm J ¼ W
R426	55337153	15 K ohm J ¼ W
R802	RD-2L154J	150 K ohm J ½ W
R804	RD-2L474J	470 K ohm J ½ W
R811	RD-2L561J	2MΩJ ½ W
*R901	RX20P251J	250 ohm J 20 W
R902	RD-2L101J	1 K ohm J ½ W
R903	RD-2L123J	12 K ohm J ½ W
R904	RD-2L123J	12 K ohm J ½ W
R905	RD-2L223J	22 K ohm J ½ W
R906	RD-2L563J	56 K ohm J ½ W
R907	RD-2L563J	56 K ohm J ½ W
R909	RD-2L682J	6.8 K ohm J ½ W
Controls:		
R211	553102005E	1 K ohm Contrast
R319	553104005B	100 K ohm Vert. Hold
R321	553124008B	220 K ohm Vert. Height
R327	553472008B	4.7 K ohm Vert. Linearity
R335	553102007B	1 K ohm Vert. Balance
R427	553303005B	30 K ohm Horiz Hold
R803	553254005B	250 K ohm Bright
R805	553205005B	2 M ohm Focus
R908	553472007B	4.7 K ohm B+ADJ
Capacitors:		
C201	CE2G1C470	47 mF 16V
C202	CE2G1F101	100 mF 25V
C203	CE2G1C220	22 mF 16V
C204	CE2G1H101	100 mF 35V
C205	CE2G1C220	22 mF 16V
C206	C1SL1H561K	560 pF K 50V
C207	CE2G0J221	220 mF 6.3V
C208	5270322401	0.22 mF M 400V
C209	CE2G2F229	2.2 mF 315V
C210	CE2G1H220	22 mF 35V
C211	CE2G1H339	3.3 mF 50V
C213	CK1F2H102K	0.001 mF 500V
C220	CE2G2F220	2.2 mF 250V
C301	CQ1M1H473K	0.047 mF K 50V
C304	CK1B1H391K	470 pF K 50V
C305	CE2G1H478	0.47 mF 50V
C306	56405333	0.033 mF K 50V
C307	CQ1M1H562K	0.0056 mF K 50V
C308	CQ1M1H273K	0.027 mF K 50V
C309	CQ1M1H123K	0.012 mF K 50V
C311	CQ1M1H124K	0.12 mF K 50V
C312	CQ1M1H392K	0.0039 mF K 50V
C313	DS5D1C229M	2.2 mF 16V
C314	CQ1M1H474J	0.47 mF 50V
C315	CQ1M1H333K	0.033 mF K 50V
C316	CF2G1A470	47 mF 10V

Table 6-3 TEC Monitor Replacement Parts Numbers

Ref. No.	Part No.	Description	
C317	CE2G2A101	100 mF	100V
C318	CK1E2H103K	0.01 mF	500V
C319	5270310301	0.01 mF	630V
C401	CQ1M1H103K	0.01 mF K	50V
C402	CQ1M1H103K	0.01 mF K	50V
C403	CQ1M1H393K	0.039 mF K	50V
C404	CK1B2H151	150 mF	500V
C405	CE2G1H339	3.3 mF	50V
C406	CQ1M1H104K	0.1 mF K	50V
C407	CQ1M1H223K	0.022 mF J	50V
C408	CQ1M1H683K	0.068 mF J	50 V
C409	CE2G1F470	47 mF	25V
C410	CK1B2H681K	680 pF K	500V
C411	CK1B2H222K	0.0022 mF K	500V
C412	CK1B1H152K	0.0015 mF K	50V
C413	CK1B1H102K	0.001 mF K	50V
*C414	CK1B3D471K	470 pF K	2KV
C415	CQ1M2A104K	0.1 mF K	100V
*C416	5270333201	0.0033 mF	1.5KV
C417	CE2G2C100	10 mF	160V
C418	5270333401	0.33 mF K	200V
C419	56635101	100 mF	35V
C420	56625471	470 mF	25V
C801	5270356302	0.056 mF K	630V
*C901	5240700400	450 mF	200V
C902		100 mF	160 V
C904	F2G2C229	2.2 mF	160V
C905	CK1F2H102K	0.001 mF	500V
C911	56625105	10000 mF	25V
C912	56616018	1 mF	16V
Discharge Gaps:			
Z801, Z802, Z803	599030001	EGP-H751A	
Switches:			
*SW-1	PE13-1567	115V/230V Power Line Slide Switch	

Ref. No.	Part No.	Description
Fuses:		
*F902	6990620011	250V 2 Amp.
*F903	5990610013	250V 0.5 Amp.
F904	5990630010	30V 5 Amp.
Mechanical Parts:		
*K001	22-463020	Mate-N-Lock Connector (AMP)
	60085005	Edge Collector (Molex)
	S-A3915	Transistor Socket (SMK)
	*TM60085001	Fuse Holder
or	*TM60085001	Fuse Holder
K005	1-380826-0	Stand-Off Fastener (AMP)
P401	PE19-1569	4P Plug Assy. (Yoke Line)
P402	PE19-1570	4F Recep Assy (Yoke Line)
P403	PE19-1571	3P Connector Assy. (Video Input)
A621	PE19-1572	4P Connector Assy. (Q901 Line)
A631	PE19-1573	6P Connector Assy. (Q304/Q305 Line)
P406	PE19-1574	2P Plug Assy. (Heater Line)
P407	PE19-1575	2P Recep Assy. (Heater Line)
TE901	PE19-1576	Terminator, 6 Pin
E001	135431015	Ground Plate
F001	22-164001	Frame
H003	5432001-1	Plate Heat Sink A
Q403D	54320011	Plate Heat Sink C

NOTE

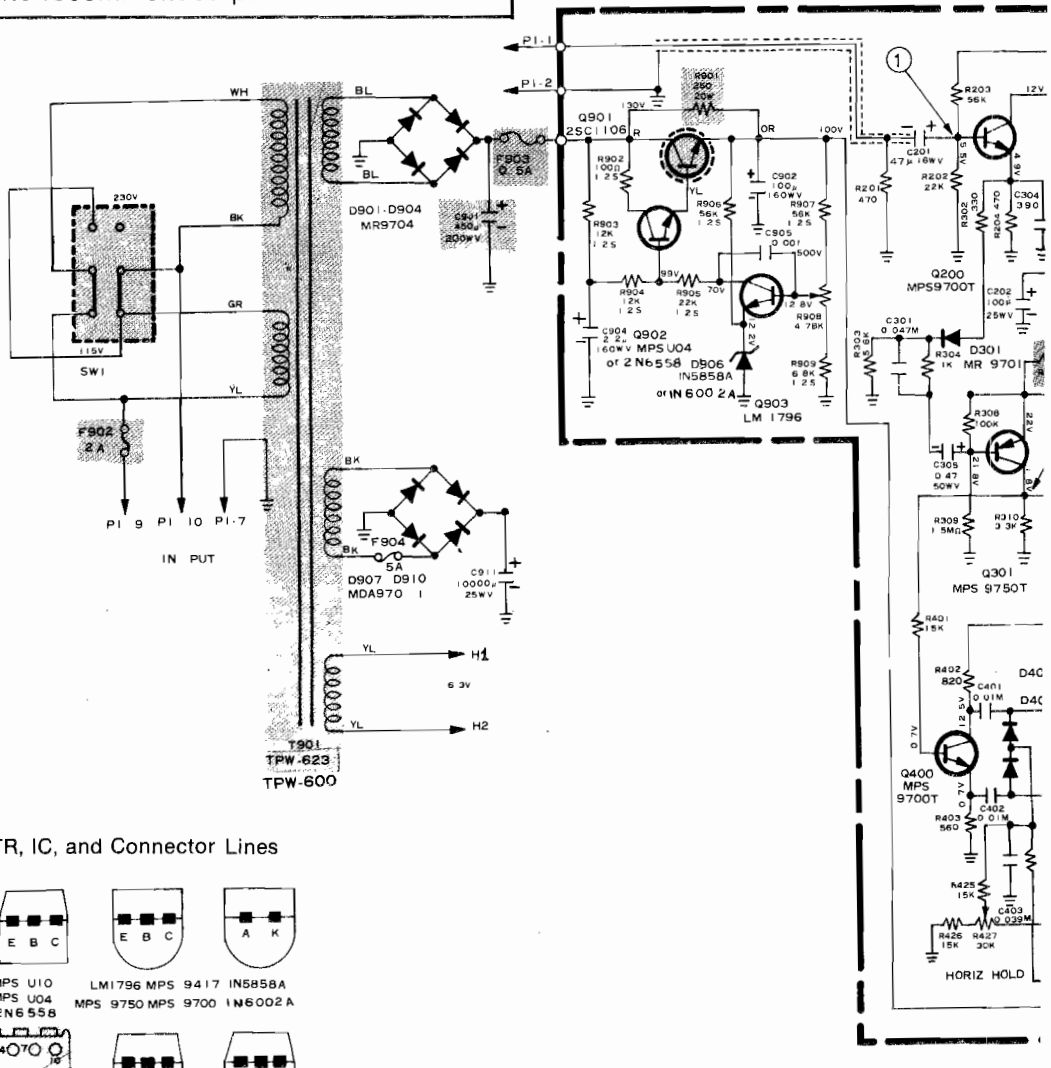
1. Design and specifications are subject to change without notice.
2. J—Indicates ± 5% tolerance
   K—Indicates ±10% tolerance
   M—Indicates ±20% tolerance

WARNING

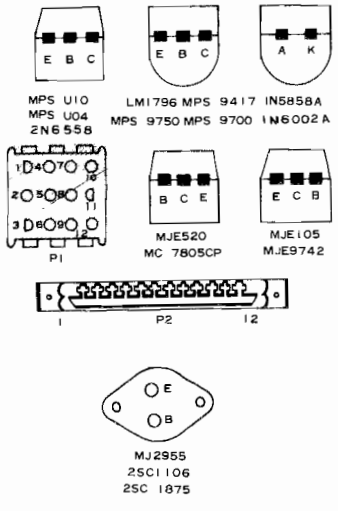
Safety-Critical Components

Components marked with an asterisk (*) on the parts list and with gray shading in the schematic have special characteristics important for safety.

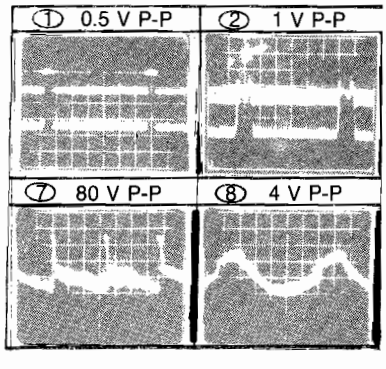
You may create shock, fire, or other hazards by using a replacement that does not have the same characteristics as the recommended part.



TR, IC, and Connector Lines

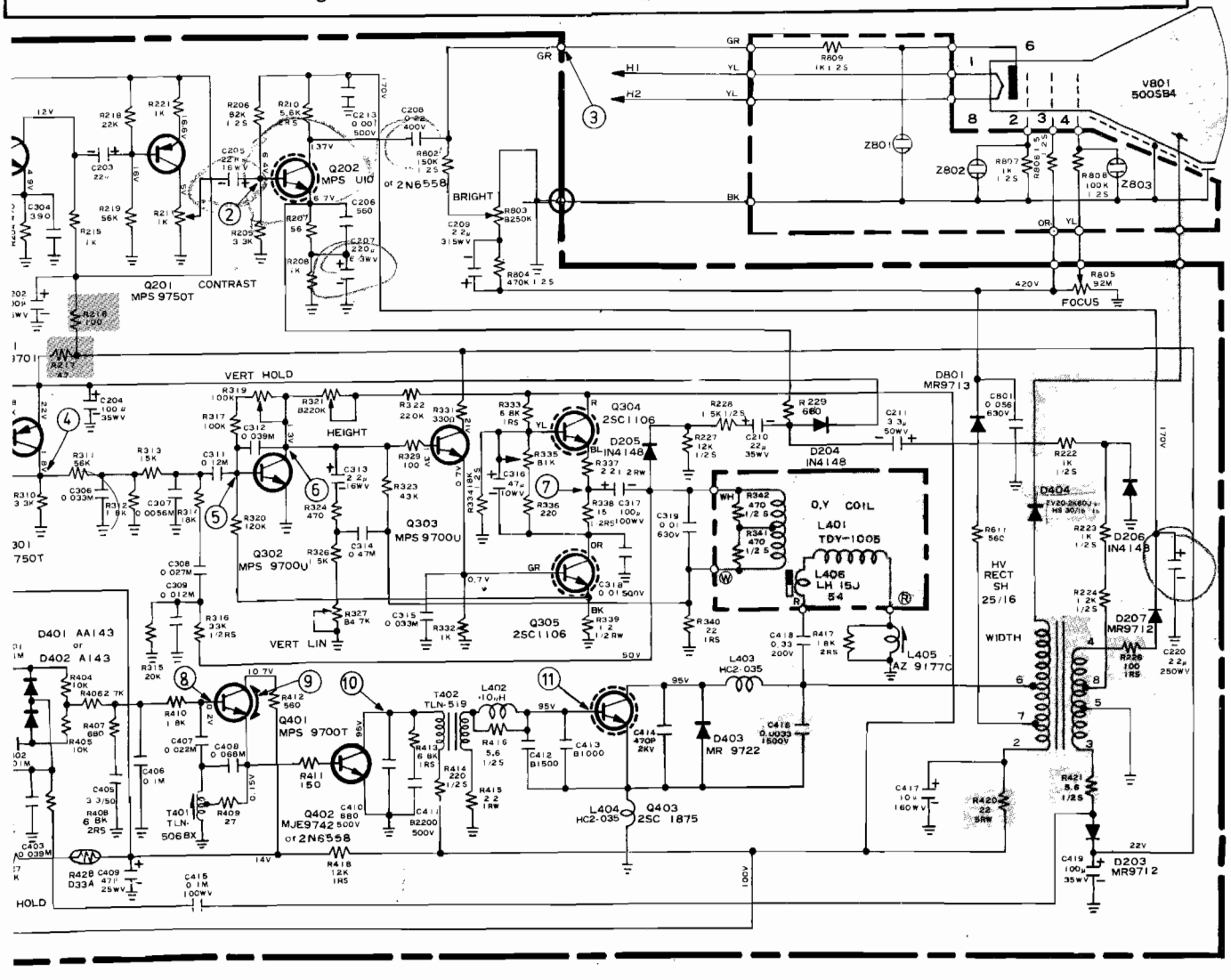


WAVE FORMS



NOTES

1. Unless otherwise specified, all resistance values are in ohms.
2. Unless otherwise specified, in the schematic diagram all capacitor values less than 1 are expressed in mfd, and values more than 1 are in pfd.
3. Voltage readings are taken with VTVM from point indicated on chassis to ground.
4. All waveforms are measured with strong signal input and contrast set to give normal picture.
5. This schematic diagram covers basic or representative chassis only. There *may* be some differences between actual components on chassis and the schematic diagram.



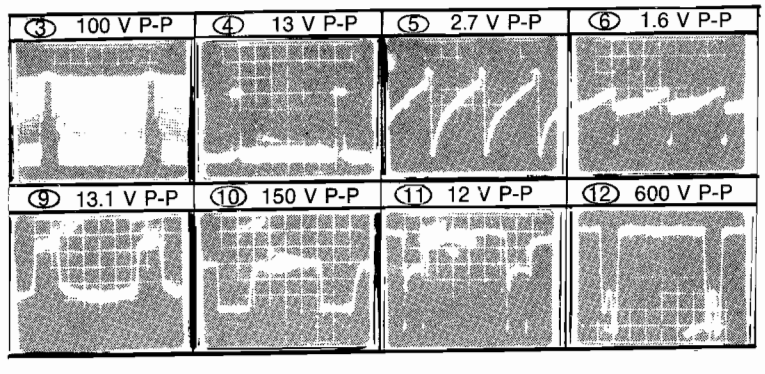
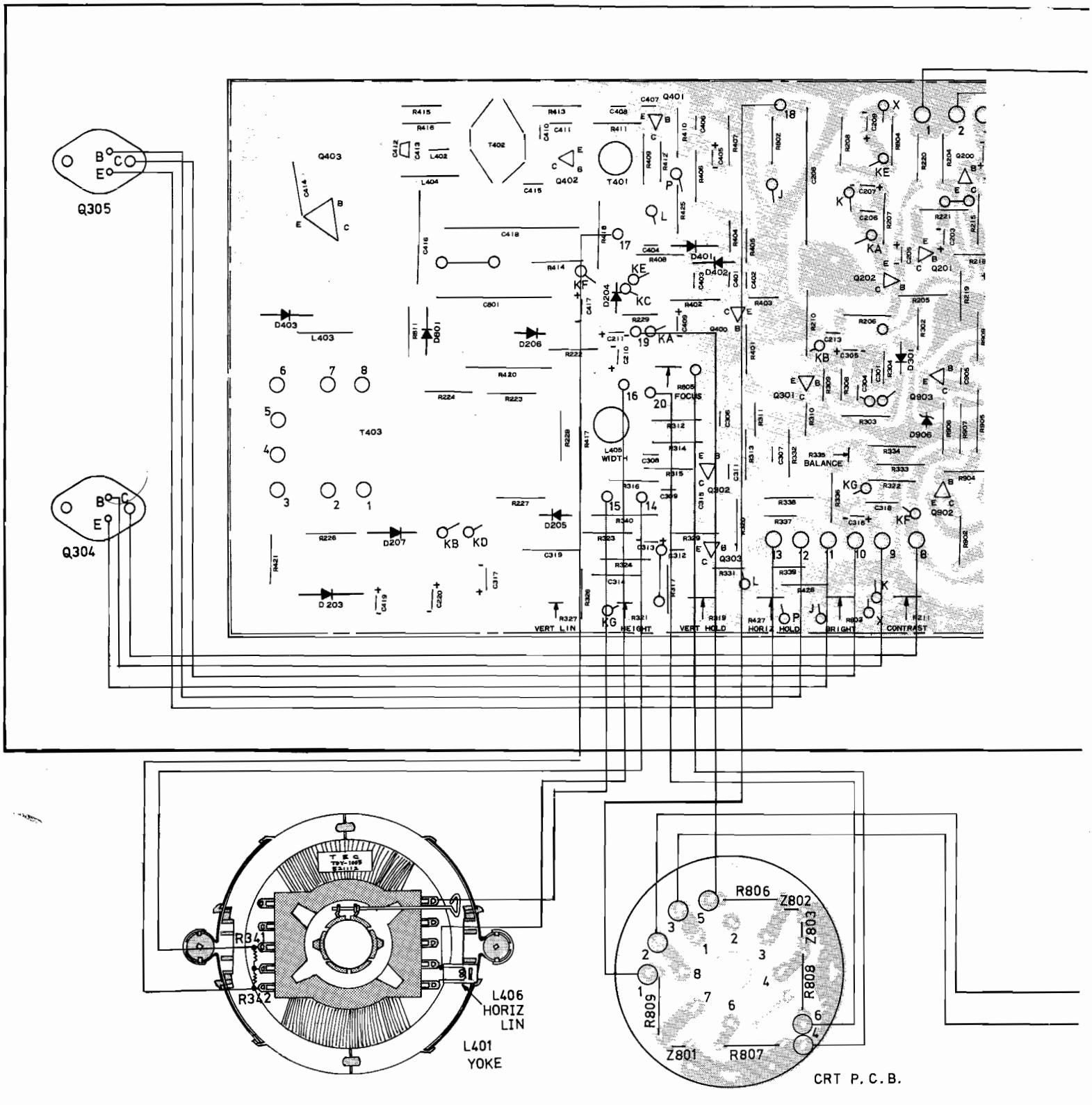


Figure 6-20 TEC Monitor Schematic Diagram


Q305
B
C
E
Q304
B
C
E
T403
T402
T401
Q401
Q402
Q403
Q400
Q201
Q202
Q301
Q302
Q303
Q902
Q903
D401
D402
D403
D204
D206
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D205
D203
D801
D906
L403
L404
L405
WIDTH
FOCUS
BALANCE
VERT LIN
HEIGHT
VERT HOLD
HORIZ HOLD
BRIGHT
CONTRAST
R341
R342
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LIN
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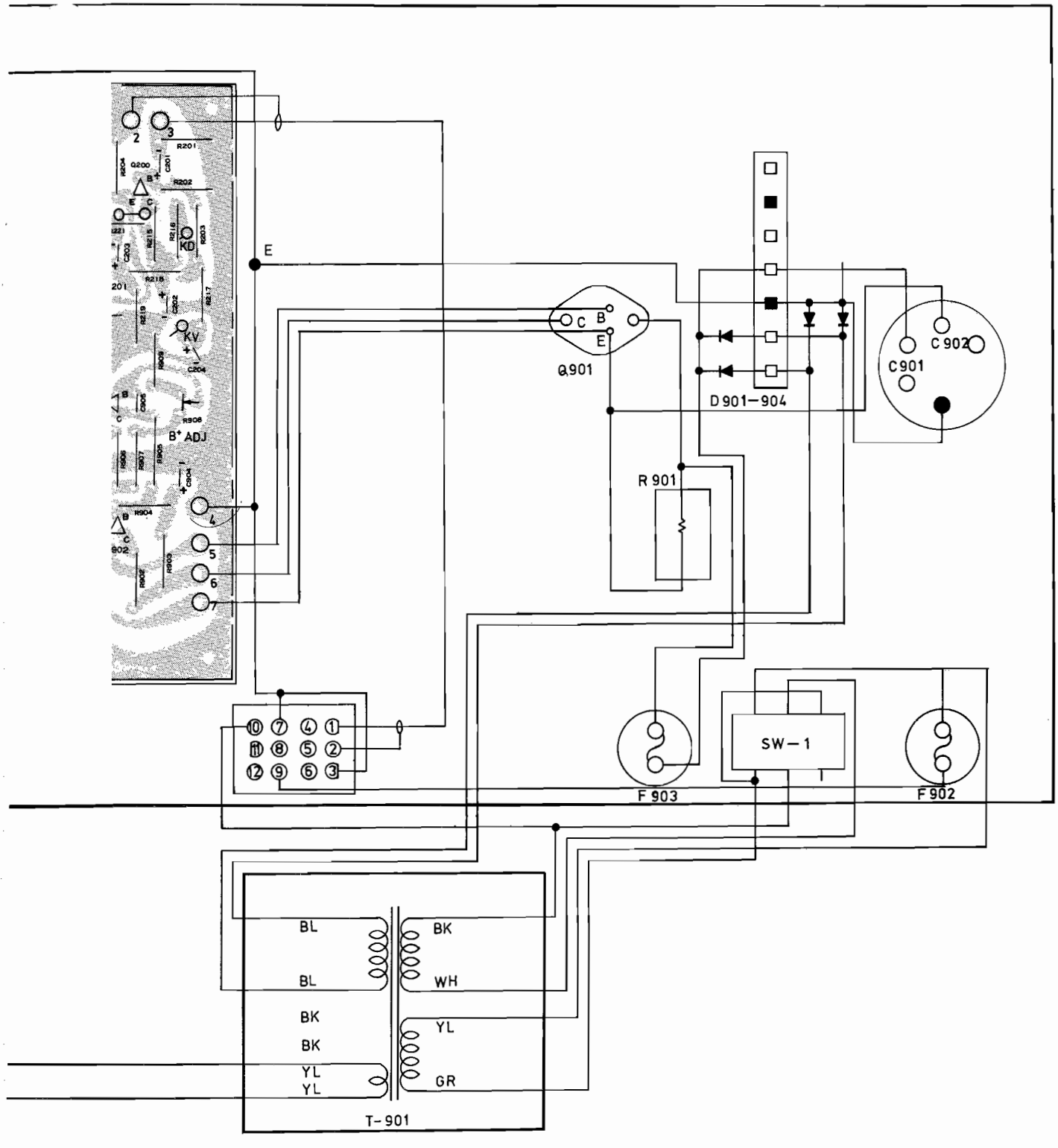
YOKE
R806
Z802
Z803
R808
R807
Z801
R809
CRT P.C.B.



BOTTOM VIEW

Figure 6-21 TEC Monitor Wiring Diagram

TM-095
1st Printing

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(c) Seller's examination of said products discloses to Seller's satisfaction that such alleged defects existed and were not caused by accident, misuse, neglect, alteration, improper repair, installation or improper testing.

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