TM-113
1st PRINTING

TOURNAMENT TABLE™

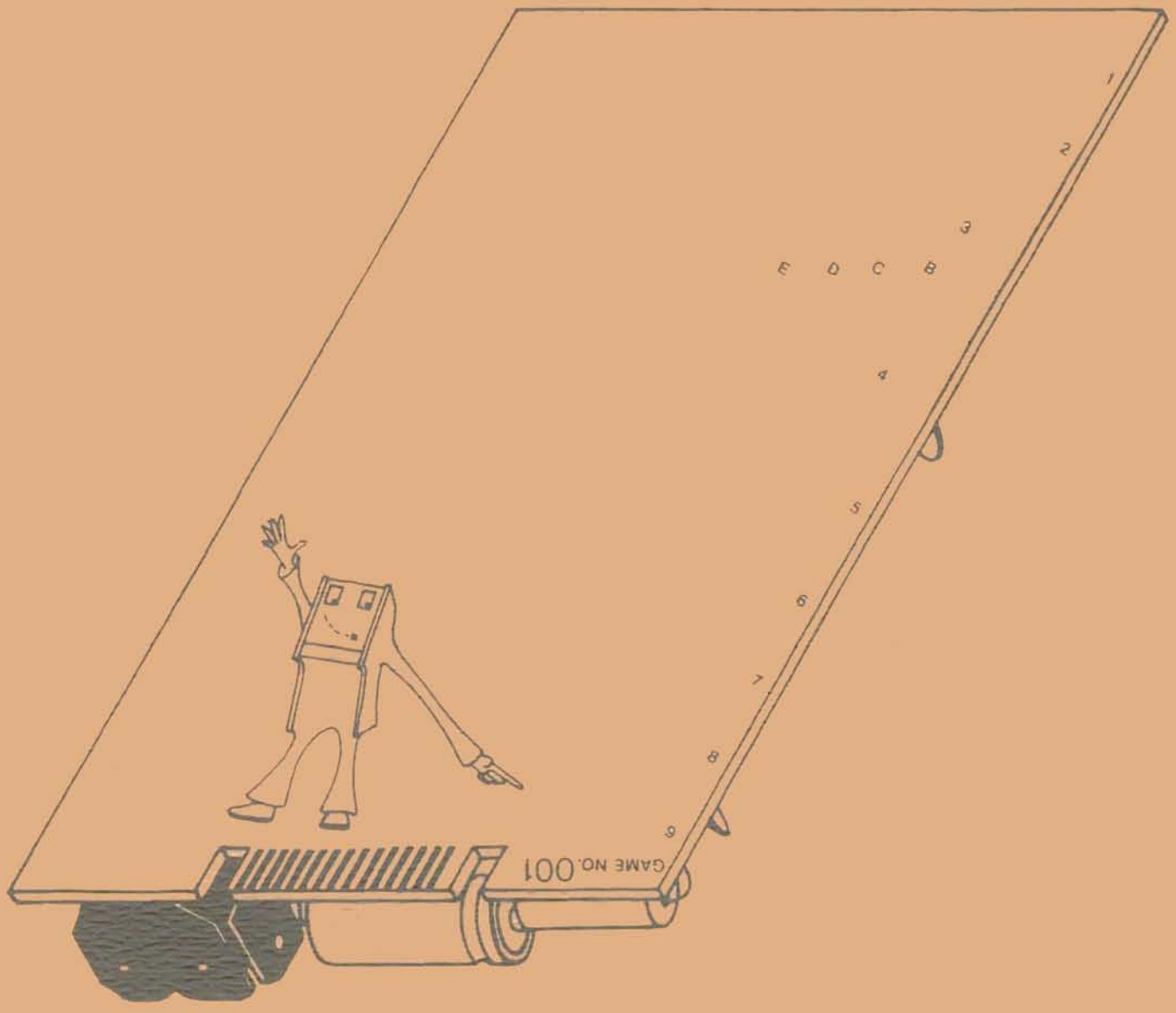
Operation, Maintenance and Service Manual

Complete with Illustrated Parts Catalog

ATARI®

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. Please mention this number whenever calling your distributor for service.



TOURNAMENT TABLE™

Operation, Maintenance and Service Manual

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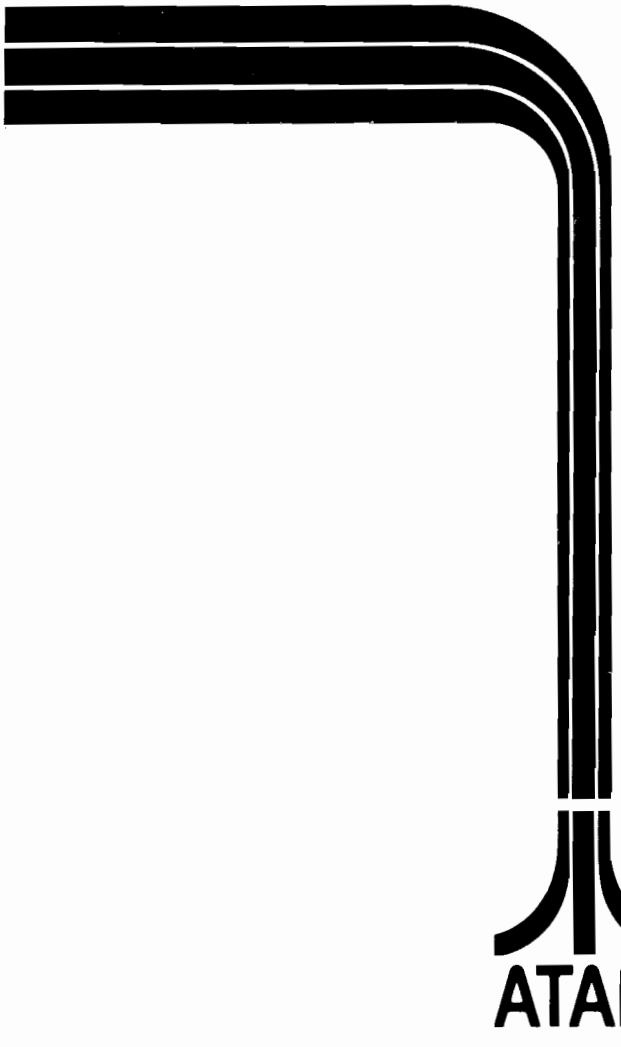

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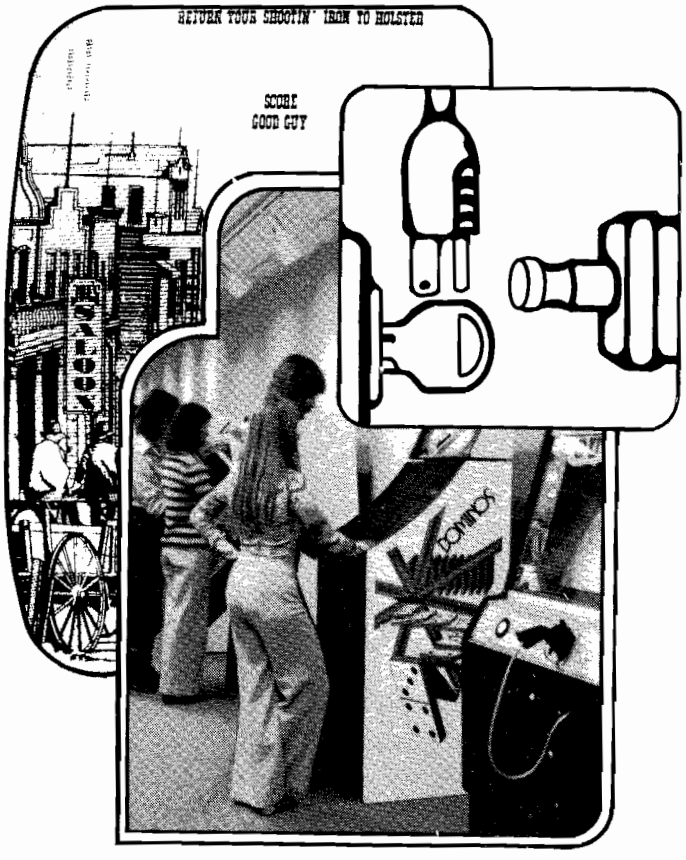


LOCATION SETUP

A. INTRODUCTION

Tournament Table™ is a collection of 12 paddle games contained in Atari's cocktail table cabinet. A 19-inch black-and-white TV monitor is mounted in the center of the cabinet and is tilted slightly forward from a horizontal position. The TV monitor is surrounded by a Plexiglas® control panel on top of the game cabinet. The control panel includes:

- Four sets of player controls
- ONE-PLAYER START button (LED switch)
- TWO-PLAYER START button (LED switch)
- FOUR-PLAYER START button (LED switch)
- GAME SELECT button (LED switch)

} See Figure 1-1

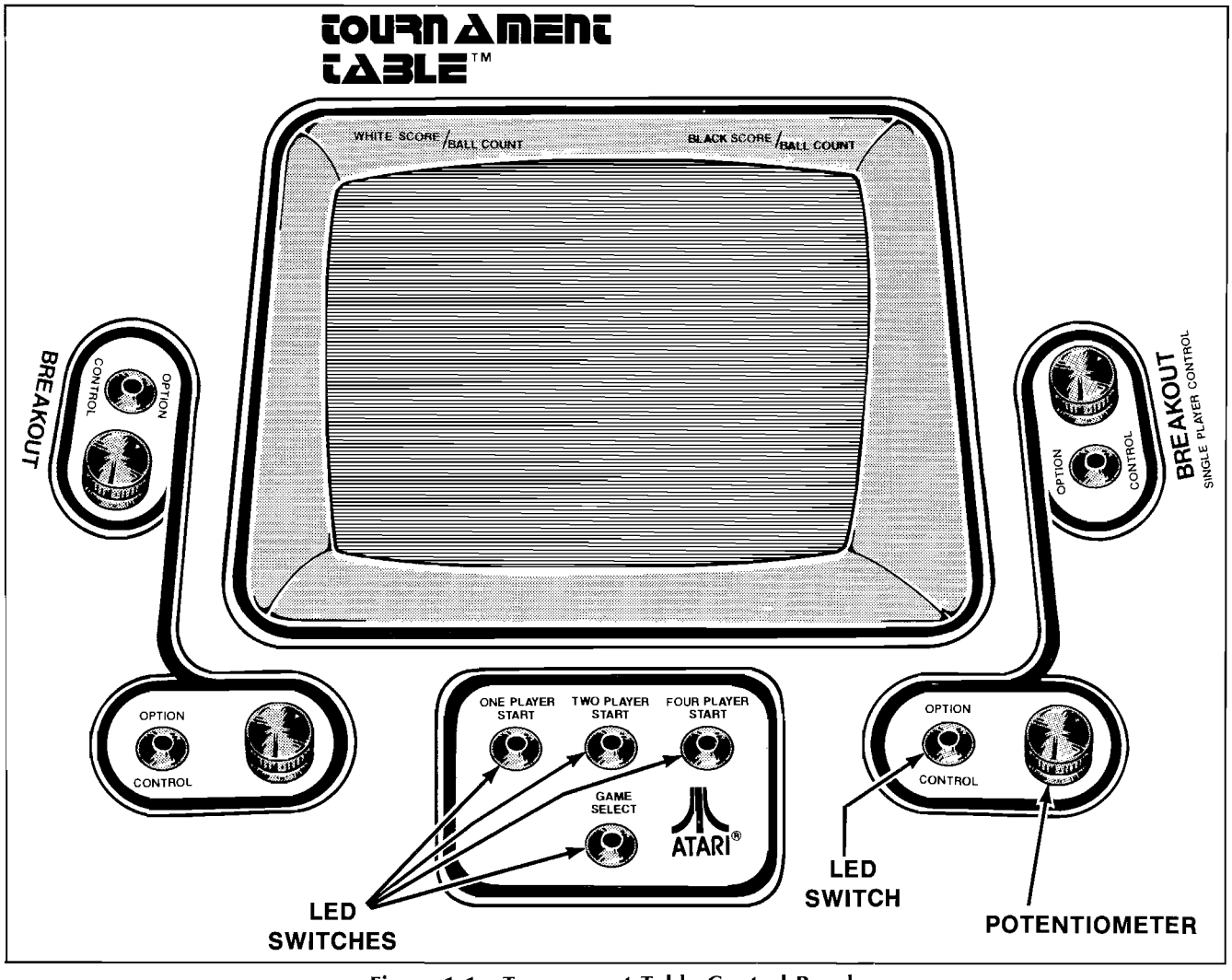


Figure 1-1 Tournament Table Control Panel

The GAME SELECT button is functional at all times except during game play. The start buttons can be activated after the proper amount of coins have cleared the coin acceptor. Each set of player controls consist of an OPTION CONTROL button (LED switch), and a potentiometer. The potentiometer controls the vertical or horizontal movement of the paddle. The OPTION CONTROL button is used to control one of three ball/paddle features (except in Breakout where it functions as a ball serve control).

Tournament Table offers three options/features, each one designated for specific games. See Table 1-1 for Game/Option Designations. The three option/features are:

- WHAMMY: Puts sharp angles on the ball when the OPTION CONTROL button is pressed and held down. If the button is released immediately it appears to distort the direction and speed in which the ball is traveling. Has no effect when the ball is traveling in a direct horizontal line across the screen.

- CATCH: Causes the ball to stick to the paddle when the OPTION CONTROL is pressed and held down. Players can use this feature to aim a hit, pass to a team paddle, or plan strategy. When the button is released the ball will release. The angle at which the ball leaves the paddle depends on which section of the paddle the ball is caught.

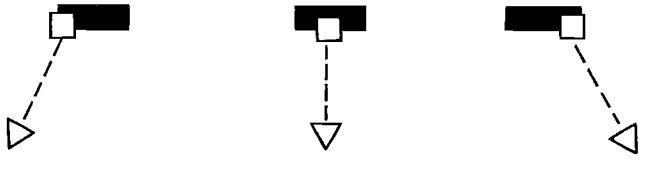


Table 1-1 Game/Option Designations

Game	Option				
	WHAMMY™	CATCH™	JUMP	BALL SERVE	No. of Players
BREAKOUT				X	1 or 2
SOCCER I	X				2 or 4
SOCCER II		X			4
FOOZPONG		X			2 or 4
HOCKEY I	X				2 or 4
HOCKEY II		X			2 or 4
HOCKEY III		X			4
QUADRAPONG		NO OPTION			2 or 4
HANDBALL	X				2 or 4
VOLLEYBALL			X		2 or 4
BASKETBALL I			X		2 or 4
BASKETBALL II		X			2 or 4

It is possible to "scrape" the ball off the paddle by moving the paddle through the edge of the playfield and back.

- JUMP: This feature causes the paddle to jump vertically from the bottom of the playfield to the playfield center when the OPTION CONTROL button is pressed and held down. The paddle will return to its home position when the button is released. The paddle must be jumped before the ball passes through the playfield center or the ball will travel through the paddle instead of bouncing off the paddle.

All of the games (except Breakout, Soccer II and Hockey III) have a two- or four-player version (see Table 1-1). The object in all games is to obtain the highest score when the game ends. You may select a game end score of 11 or 15 points for all games except Breakout. (See Table 1-3, Operator Options.)

There is a time limit of ten minutes for all games except Breakout. A three- or five-ball game is optional for Breakout and there is no time limit. (However, if the player does not push the serve button within 16 seconds, the ball is served automatically.) In Breakout the bricks will refill the playfield indefinitely when they are all hit, and the player has a turn or turns remaining. It is also the only game which includes replay. (See Table 1-3 for Breakout replay levels.) Chapter 2 contains a detailed description of game play for all games.

B. GAME INSPECTION

Tournament Table is manufactured by Atari 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 remove the rear door assembly. Carefully inspect the interior and verify that:
   - All plug-in connectors are firmly seated.
   - All integrated circuits in sockets on the game printed circuit board 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. LOCATION OF SERIAL NUMBER

The serial number for Tournament Table is located in the corner (common to both edge connectors) on the back of the PCB, inside the game cabinet. See the illustration on the inside front cover of this manual.

D. INSTALLATION REQUIREMENTS

Power Requirements and Line Voltage Selection

Tournament Table is shipped for operation at 110 VAC, 60 Hz. Power consumption is approximately 150 watts. However, if your local voltage 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 1-2 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—110 VAC, 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. Use the black plug for low 110 VAC lines and the green plug for low 220 VAC lines.

Temperature Range

Location and storage should not be below 0 degrees Celsius (32 degrees Fahrenheit), and no higher than 49 degrees Celsius (120 degrees Fahrenheit).

Humidity Range

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

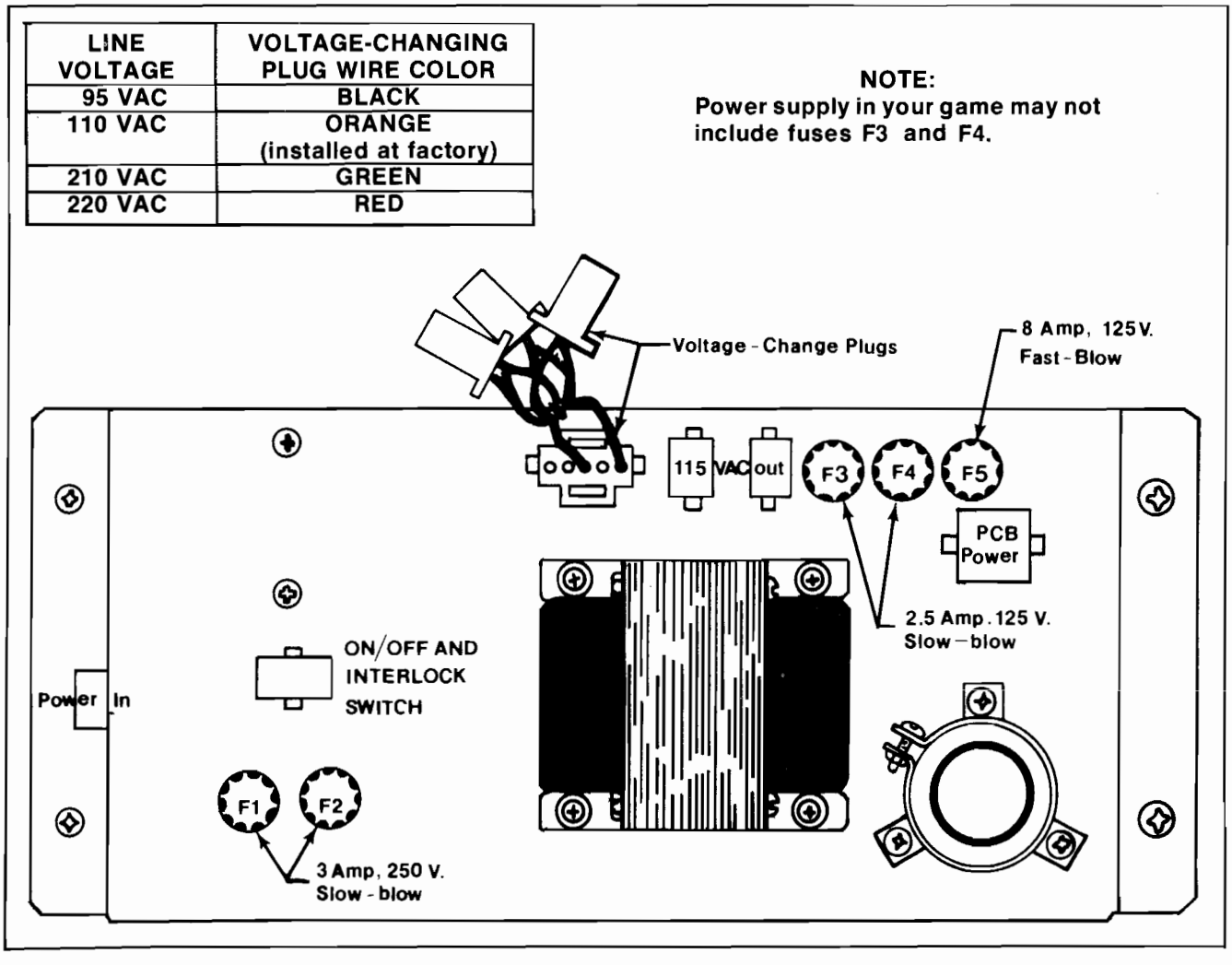
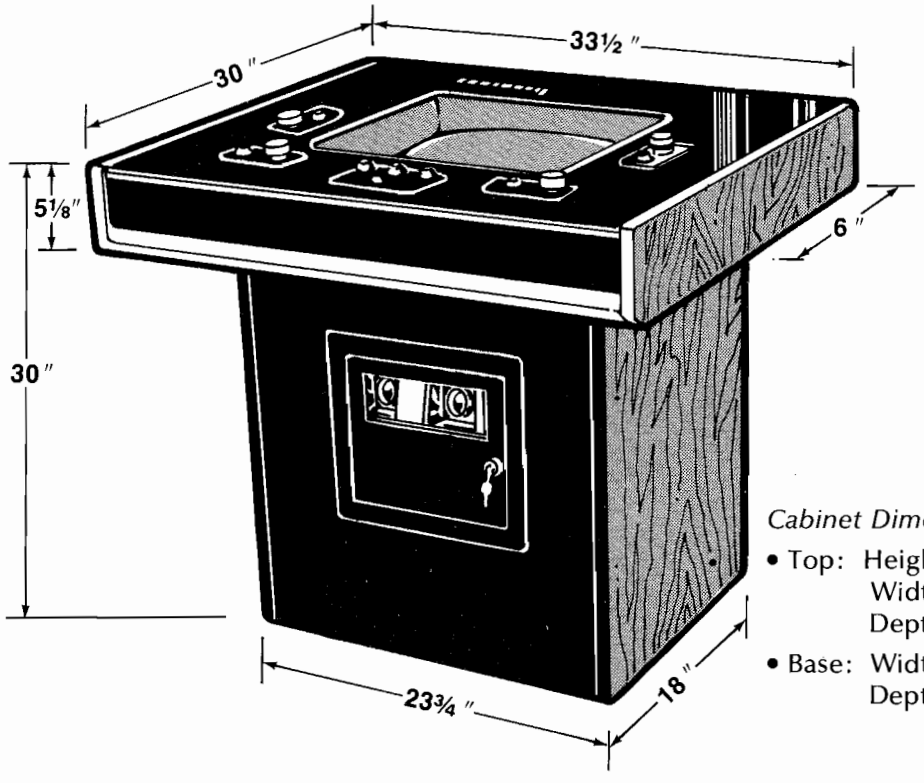


Figure 1-2 Location of Voltage-Changing Plugs on the Power Suppy

Location Space Requirements



Cabinet Dimensions:

- Top: Height—76 centimeters (30 inches)
  Width—85 centimeters (33½ inches)
  Depth—76 centimeters (30 inches)
- Base: Width—60 centimeters (23¾ inches)
  Depth—45 centimeters (18 inches)

Type of Power Cord

Atari has added a strain relief power cord to Tournament Table. 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. Check the power cord assembly periodically for damage.

E. INTERLOCK 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 door assembly and at the coin door. These switches (2) remove all power from the game while one or both of the doors are open. Refer to Figure 1-3 for switch locations.

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

1. Unlock and remove the rear door assembly. Unlock and open the coin door.
2. Plug the AC power cord into a 110-volt source. (If the voltage is consistently less than 110 VAC, make sure that you change the voltage plug to the black plug.)
3. Close both doors. Within approximately 30 seconds the TV monitor should display a picture.
4. Slowly open each door (individually) until the TV monitor picture disappears. The TV monitor picture should disappear when each door is opened less than one inch.
5. If the results of Step 4 are satisfactory, the interlock switches are operating properly. If the picture does not disappear as described, check to see if one of the switches is broken from its mounting or stuck in the on position.
6. Close and lock the rear door assembly. Close and lock the coin door.

F. VOLUME CONTROL

To adjust the volume it is necessary to remove the rear door assembly and locate the game PCB on the right side of the cabinet wall. The volume control may be adjusted without removing the PCB from the cabinet. See Figure 1-3 for location of the volume control.

G. SELF-TEST PROCEDURE

Tournament Table will test itself and provide data to demonstrate that the game's circuitry and controls are working properly. The self-test procedure uses the TV monitor and the speaker; no additional equipment is required. The self-test switch is located on the game PCB, as shown in Figure 1-3. (The rear door assembly must be removed whenever it is necessary to work with the PCB.)

Table 1-2 contains specific details on the self-test procedure. To start the procedure over from the beginning, push the self-test switch up, then again to the down position. This will return the test to Step 1, and can be done at any time during the procedure. We suggest that you run the self-test procedure each time the coin box is emptied.

H. GAME TESTS

Four-Player Games

If the paddles are vertical:

- PLAYER 1 and 3's control will turn counter clockwise to move the paddle up the screen.
- The other controls will turn clockwise to move the paddle up the screen.

If the paddles are horizontal:

- All controls will turn clockwise to move the paddles to the right.

For error correction, check the harness hookup to the potentiometer.

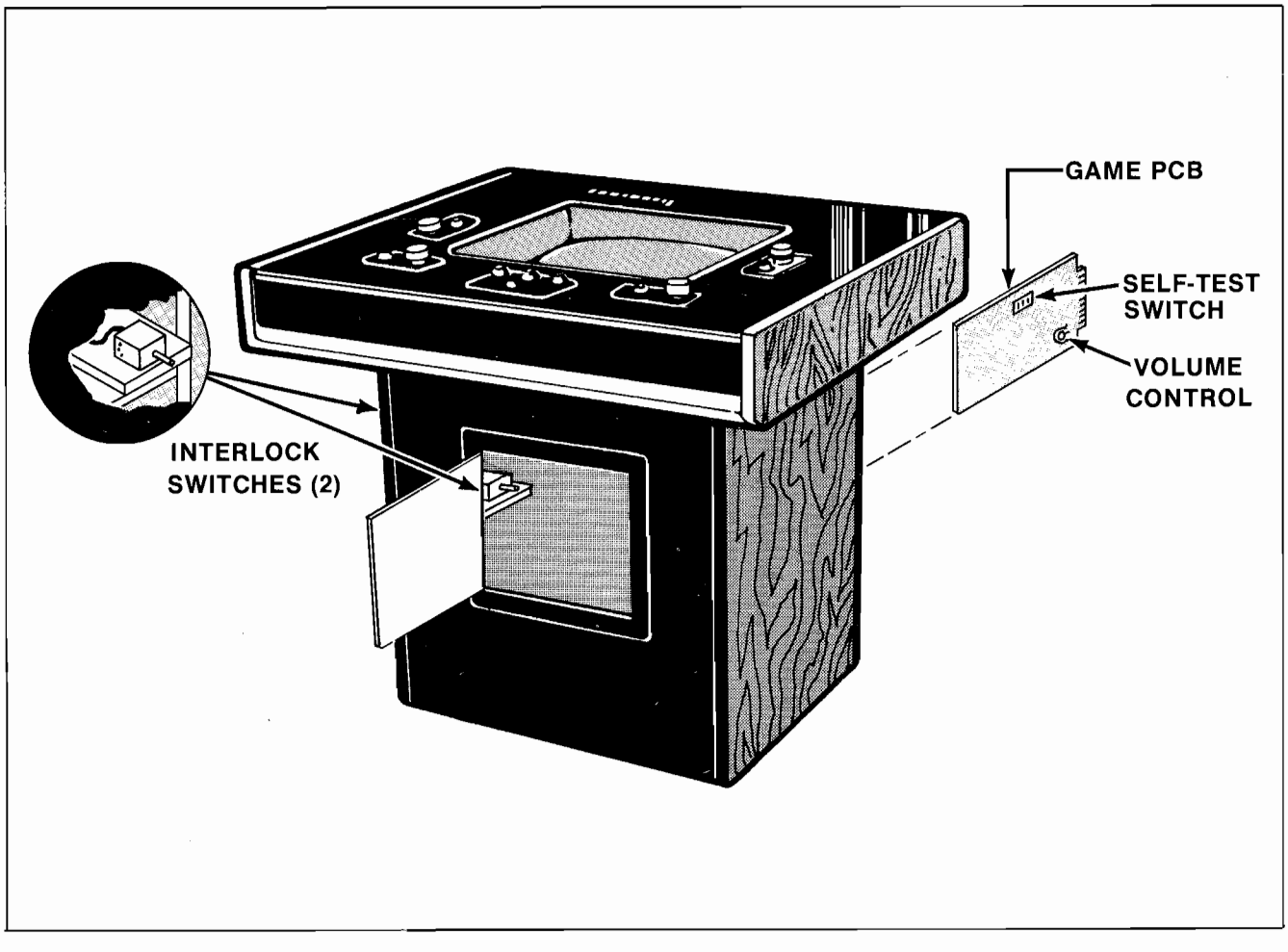


Figure 1-3 Location of Interlock Switches, Self-Test Switch, and Volume Control

Breakout, One-Player

- Start the game and check for the ball count remaining on the screen during game play.
- Check the ball sounds for:
  - — Serve
  - — Paddle hit
  - — Brick hit
  - — Ball out
- When the ball goes out, the game should not shift to the other player.

  Error correction—possible ROM error, audio output chip error (LM 380) if no sound at all, or error in part C010744.

Breakout, Two-Player

- Start the game and check to see if the ball count is replaced by SCORE after the ball is served.
- Check to see if the game shifts to the other player when the ball goes out.

  Error correction—possible ROM error.

Soccer I, Four-Player

- Start the game and check to see that each player has two paddles.
- Check the WHAMMY feature.

  Error correction: possible ROM error, or error in part C010744.

Soccer II, Four-Player

- Start the game and check to see that each player has one paddle.
- Check the CATCH feature.

  Error correction: possible ROM error, or error in part C010744.

Foozpong, Four-Player

- Start the game and check for multiple vertical paddles.

  Error correction: possible ROM error.
- Check the CATCH feature

  Error correction: possible bad switch or line.

Hockey III, Two-Player

- Start the game and check to see that each player has three paddles.

  Error correction: Possible ROM error, or error in part C010744.

Volleyball, Four-Player

- Start the game and check to see that there are two small and two large horizontal paddles.

  Error correction: possible ROM error, or error in part C010744.
- Check the jump feature.

  Error correction: Possible bad switch or line.

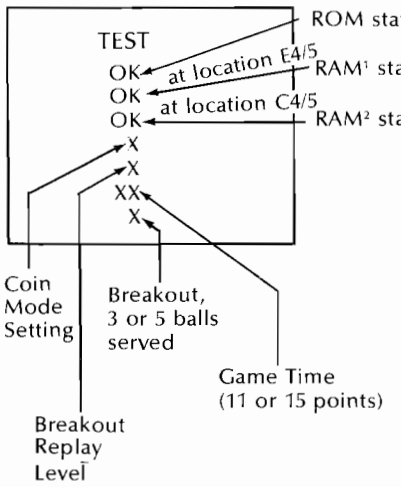
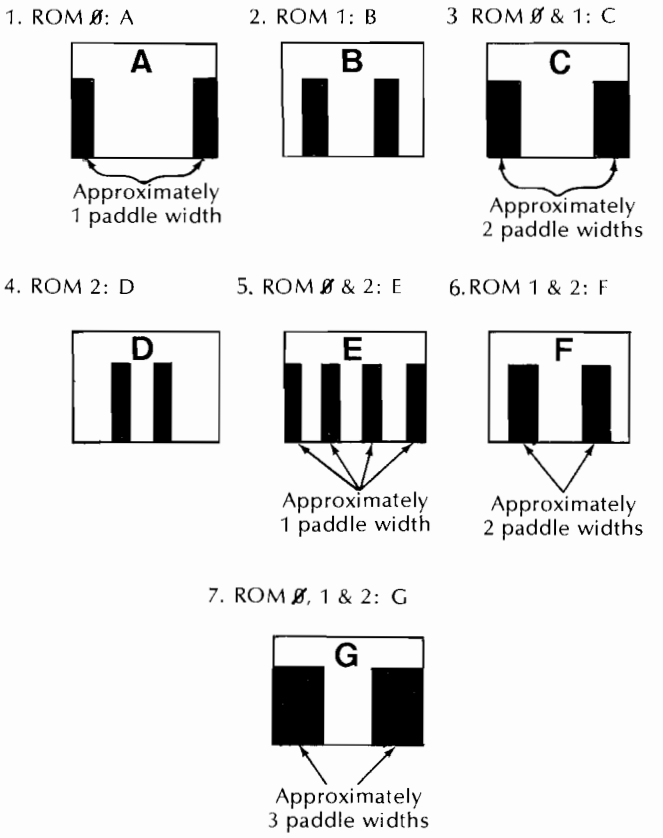
I. OPERATOR OPTIONS

The options programmed for Tournament Table offer maximum player appeal for each game location. These options are listed in Table 1-3.They are preset for a certain game setup during production. To determine how the switches have been set for your game, compare the TV monitor screen during the self-test mode with the information in Table 1-3.

To change the toggle positions of the DIP switches and set the options you desire, remove the rear door assembly and locate the game PCB on the right cabinet wall. Refer to Figure 1-4 for locating the option DIP switches on the game PCB.

Set the switches for the desired options, as shown in Table 1-3. Verify option functions by playing the game.

Table 1-2 Self-Test Procedure

Test Instruction	Results if Test Passes	Results if Test Fails
1 Unlock and remove the rear door assembly. Locate the self-test slide switch on the game PCB as shown in Figure 1-3. Set the self-test switch to the "on" position. ROM and RAM test will follow.	The TV monitor screen will show the following display: 	If ROM is bad, the TV monitor will display a LETTER CODE and corresponding strips on both sides of the screen. The following error screen patterns represent the failing ROMs, as they would appear on the TV monitor: 

		If either RAM is bad, the TV monitor will show 'BD' on the screen if it can be displayed. If RAM[1] (PIA at location E4/5) is bad, a HIGH PITCHED SOUND will occur. If RAM[2] (PIA at location C4/5) is bad, the screen might display: • Bars • White strip • "Glitch" • "Garbage"
2 LED Switch Test Press each button on the control panel.	A low frequency electronic sound will occur each time a button is pressed. (The GAME SELECT and PLAYER START button lights will go off when pressed.) The coin lockout coil will click each time the GAME SELECT button is pressed or released.	No sound will occur. NOTE: If a button is stuck "on" (constant low frequency sound) check the GAME SELECT and START button lights. If they are on, start a Volleyball game—FOUR-PLAYER. If none of the paddles are "jumped" (vertically displaced), the error is the slam or coin switch.
Trip right and left coin switch wires. Close contacts of coin door slam switch. (See Figure 3-1 & Figure 3-7 in Chapter 3 of this manual for locations of coin switch wires and slam switch.)	The same low frequency sound will occur each time a coin wire is tripped, and each time the slam switch contacts are closed and released.	No sound will indicate a stuck or broken switch, or an open or shorted harness.

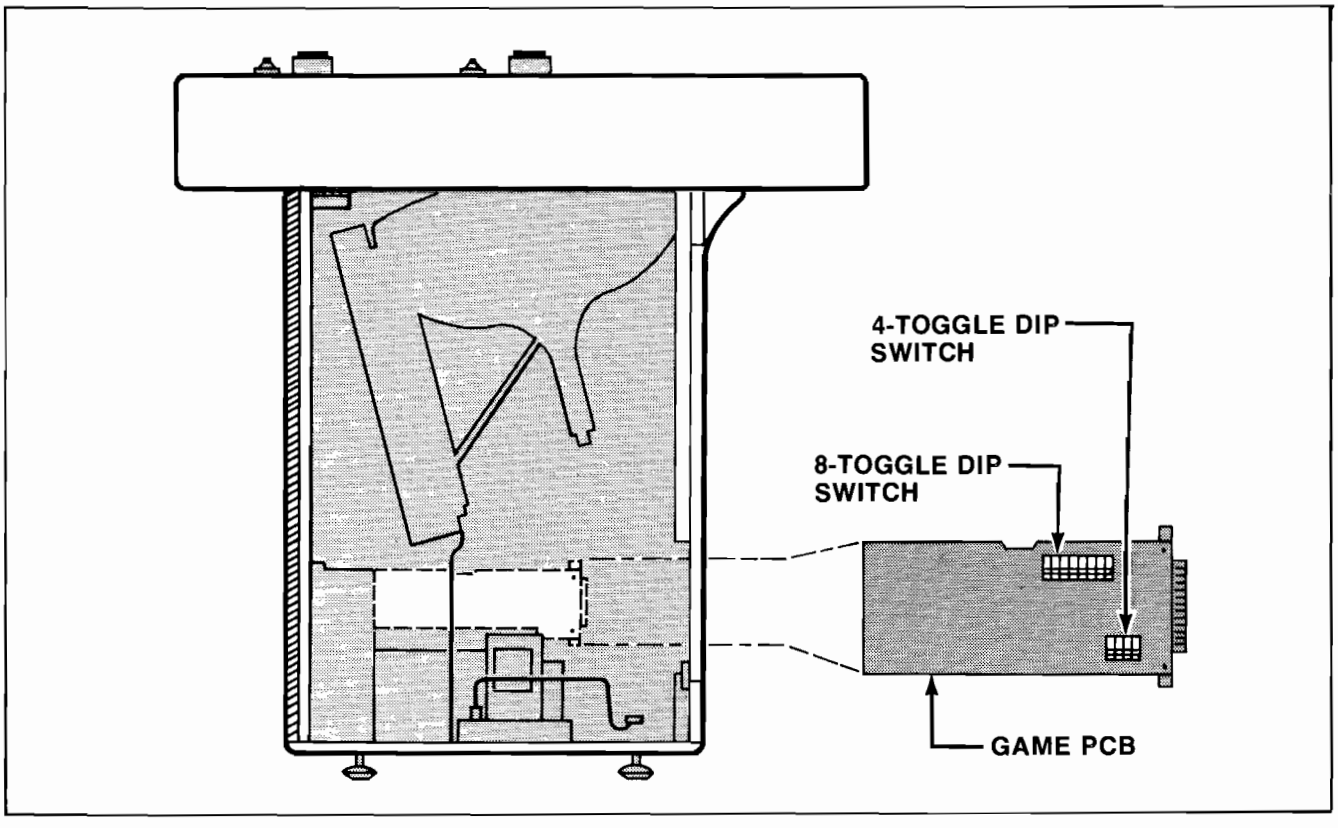


Figure 1-4 Option Switches on Game PCB

Table 1-3 Operator Options

Coin Mode/Game Cost Options	8-Toggle DIP Switch on PCB Toggle No. 1	2	3	4	TV Monitor during Self-Test
Two Coins Per Play—both Left* & Right*	ON	ON	ON	ON	A
One Coin Per Play—both Left & Right	OFF	ON	ON	ON	B
Two Plays Per Coin—both Left & Right	ON	OFF	ON	ON	C
Three Plays Per Coin—both Left & Right	OFF	OFF	ON	ON	D
First Coin—One Play; Second & extra coins—Two Plays Per Coin	ON	ON	OFF	ON	E
First Coin—Two Plays; Second & extra coins—Three Plays Per Coin	OFF	ON	OFF	ON	F
Left—Two Coins Per Play; Right—One Coin Per Play	ON	OFF	OFF	ON	G
Left—One Coin Per Play; Right—Two Plays Per Coin	OFF	OFF	OFF	ON	H
Left—Two Plays Per Coin; Right—Four Plays Per Coin	ON	ON	ON	OFF	I
Left —First Coin—One Play; Second & Extra Coins—Two Plays Per Coin Right —First Coin—Three Plays; Second & Extra Coins—Four Plays Per Coin	OFF	ON	ON	OFF	J

Table 1-3 Operator Options

Option	8-Toggle DIP Switch on PCB Toggle No. 1	2	3	4	TV Monitor During Self-Test
Left—First Coin—Two Plays; Second & Extra Coins—Three Plays Per Coin Right—First Coin—Five Plays; Second & Extra Coins—Six Plays Per Coin	ON	OFF	ON	OFF	K
Left—First Coin—Three Plays; Second & Extra Coins—Four Plays Per Coin Right—First Coin—Seven Plays; Second & Extra Coins—Eight Plays Per Coin	OFF	OFF	ON	OFF	L
Left—Three Coins Per Play. Right—One Coin Per Play	ON	ON	OFF	OFF	M
Left—One Coin Per Play. Right—Three Plays Per Coin	OFF	ON	OFF	OFF	N
Left—First Coin—Three Plays; Second & Extra Coins—Three Plays Per Coin Right—First Coin—Six Plays; Second & Extra Coins—Six Plays Per Coin	ON	OFF	OFF	OFF	O
Four Plays Per Coin—both Left & Right	OFF	OFF	OFF	OFF	P
Game Language (on TV screen)	Toggle No. 5	6	7	8	
English	ON	ON			
French	OFF	ON			
German	ON	OFF			
Spanish	OFF	OFF			
Game Length 11 Points (in Breakout—3 balls served)			ON		11 3
15 points (in Breakout—5 balls served)			OFF		15 5
Breakout Replay One full play granted after scoring required bonus level				OFF	A, B, C, D, or E
No Replay				ON	NO
Breakout Replay Levels	4-Toggle DIP Switch on PCB Toggle No. 1	2	3	4	
Replay granted for: 200 Points	OFF	OFF	ON	OFF	A
250 Points	ON	ON	OFF	OFF	B
300 Points	OFF	ON	OFF	OFF	C
400 Points	ON	OFF	OFF	OFF	D
450 Points	OFF	OFF	OFF	OFF	E
200 Points	Any other switch setting				A

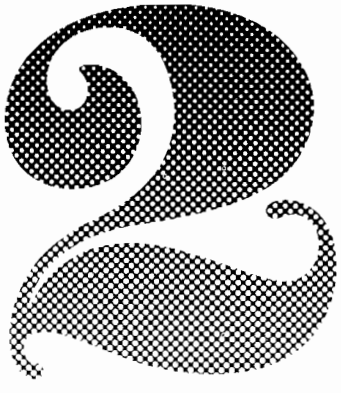
*NOTE: In this table, Left refers to the left coin mechanism, and Right refers to the right coin mechanism, when viewing the front of the game cabinet.

GAME PLAY

The game has three modes of operation: attract (power applied or after the end of a game), ready-to-play (coins accepted), and play (after any START button is activated).

A. ATTRACT MODE (See Figure 2-1)

The attract mode begins when power is applied to the game and ends when the proper amount of coins clear the coin acceptor, or at the end of each game. The TV monitor displays the words GAME OVER and the name of the last game played. The score or scores of the previous game are displayed at the top of the screen. The words on the TV monitor appear in alternating white and grey video levels. Players have the opportunity to set any one of the twelve games with the GAME SELECT button. All controls (except GAME SELECT) and sounds are inactive during this mode.



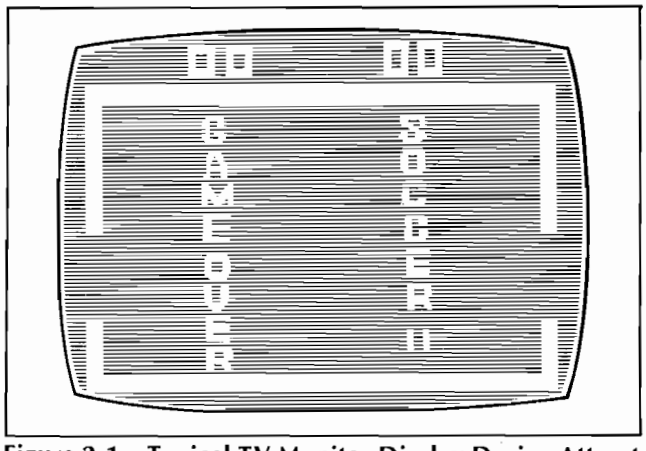


Figure 2-1 Typical TV Monitor Display During Attract Mode

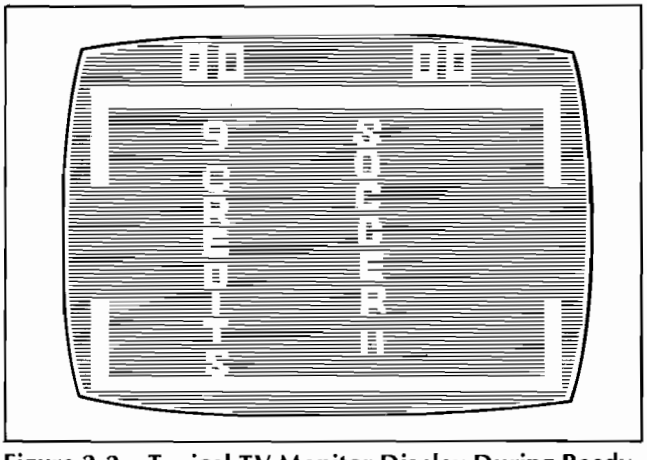


Figure 2-2 Typical TV Monitor Display During Ready-To-Play Mode

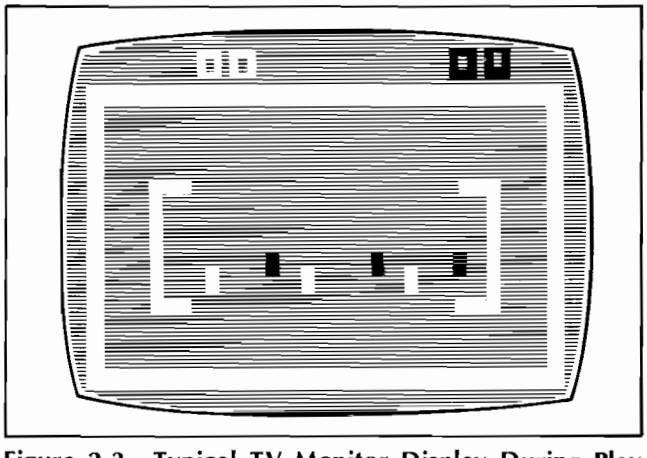


Figure 2-3 Typical TV Monitor Display During Play Mode

B. READY-TO-PLAY MODE (See Figure 2-2)

When the correct amount of coins clear the coin acceptor, the ready-to-play mode is initiated. During this mode the number of credits is displayed on the left side of the screen and the name of the current game is shown on the right side of the TV monitor. Players have the opportunity to set any one of the twelve games with the GAME SELECT button. Each time the button is pressed to change a game, the name of the game changes on the TV monitor. The ready-to-play mode will also occur at the end of game play if there are credits remaining.

The OPTION CONTROL buttons on the control panel stay lit and the START buttons are lit according to the number of credits showing on the TV monitor.

To play any game one credit per player is required. Without at least four credits, the FOUR-PLAYER START button cannot be activated and so on for the other versions. During game play the GAME SELECT button is inoperable.

C. PLAY MODE (See Figure 2-3)

The play mode begins when one of the START buttons is pressed. Pressing a START button removes the words from the screen and sets the playfield for the selected game.

Breakout

In Breakout, a one- or two-player game is optional. A minimum of two credits is required for a two-player game. The controls on the far right of the panel (labeled BREAKOUT SINGLE PLAYER CONTROL), are used for the one-player version. The two-player version uses the same controls along with those on the far left of the panel (labeled BREAKOUT). The OPTION CONTROL button functions as a ball serve.

The object in Breakout is to obtain the highest score. A three- or five-ball game is optional and there is no time limit (see Chapter 1, Table 1-3). When all of the bricks have been hit, the playfield is refilled. There is no limit to the number of times the playfield can be refilled with bricks. When this occurs the ball count remains the same. However, when replay is in use, and a player scores the specified amount of points, one full play is granted. (One credit is given. No credit can be earned during a replay game.) Table 1-3 contains replay levels and the corresponding switch settings. No replay is also optional. The only time replay information is displayed on the screen is during the self-test mode (see Chapter 1, Table 1-2).

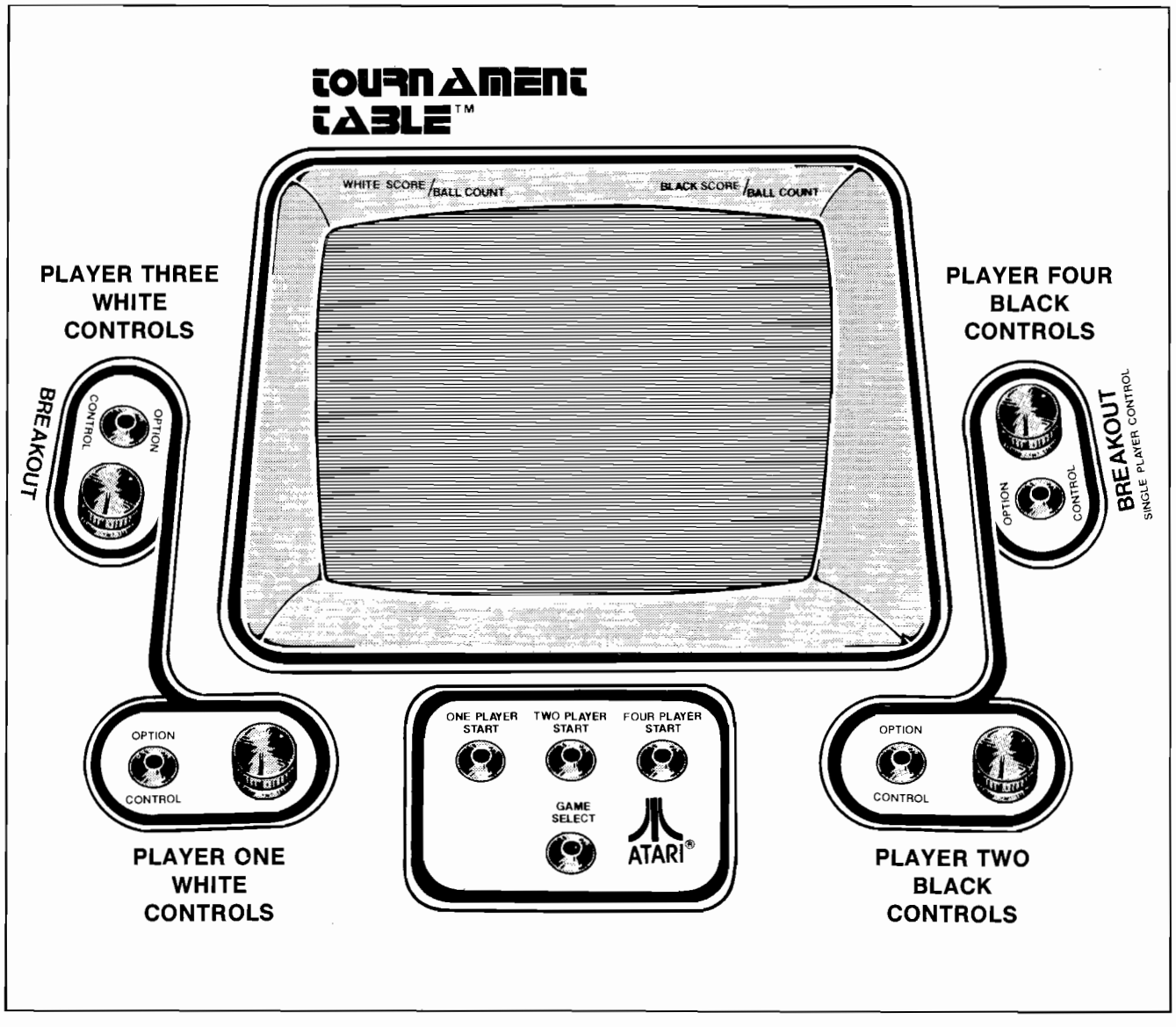


Figure 2-4 Location of Player Controls

In a single-player game the ball count is displayed at the top left of the screen and the score is shown at the top right. The count changes each time the serve (OPTION CONTROL) button is pressed, unless there is a ball in play. In a two-player game the ball count and score locations are reversed for the second player. The difference in the two-player version is that the ball count stays on the screen only until the first contact between the ball and paddle. After initial contact the ball count disappears and the opposite players accumulated score appears on the screen.

The first two rows of bricks are worth three points each, the second two rows are worth five points each, and the last two rows are worth seven points each. The ball speed increases every fourth paddle contact up to the twelfth contact. Maximum speed is reached by hitting any brick in the last three rows. When a player "breaks out" by hitting a ball through the last row of bricks and contacts the back wall, the size of the paddle is cut in half for the remainder of the turn. Each new turn restores the paddle to its original size.

Soccer I

A two- or four-player game may be selected. One credit per player is required to start either game. In a two-player game, controls number one (white team) and two (black team) are used. See Figure 2-4 for location of player controls. In a four-player game all four sets of controls are used. Controls one and three

operate the white team, controls two and four operate the black team. The kickers (paddles) move together in vertical unison on the screen. Each player controls two kickers, whether in a two- or four-player game. In a four-player game, controls three and four operate the striped kickers.

The object in Soccer I is to be the first team to kick 11 or 15 goals, depending on which game end score is selected. See Table 1-3 (Chapter 1) for operator options and the corresponding switch settings. Each goal is worth one point. After a goal is scored, the ball is automatically put into play against the team which did not score. The white team score is always on the top left of the screen, the black team score is always on the top right. In Soccer I, players may use the WHAMMY feature which is described in detail in Chapter 1. A time limit of ten minutes is programmed into the game.

Soccer II

Soccer II is a four-player game. Four credits are needed to start the game. Each player controls one kicker. Controls one and three operate the white team and controls two and four operate the black team (see Figure 2-4 for location of player controls). Players may use the CATCH feature which is described in Chapter 1. Refer to the game play description for Soccer I, which is identical for all other details.

Foozpong

Foozpong is programmed as a two- or four-player game. One credit per player is required to start either game. The CATCH option/feature (see Chapter 1) is available to players in this game. The object of the game is to score 11 or 15 goals (see Table 1-3, Operator Options) or to have the highest score after the ten-minute time limit. Each goal is worth one point.

In two-player Foozpong, player one (see Figure 2-4 for player locations), controls two white rows of paddles and player two controls two black rows of paddles. In a four-player game, player one controls two white rows of paddles, player two controls two black rows of paddles, player three controls two striped rows of white paddles, and player four controls two striped rows of black paddles.

Each row of paddles moves vertically on the screen in unison; however this movement is restricted. Each paddle can move across half the playfield. There are four paddles in each row, but only three paddles appear on the screen at one time. After a goal is scored, the ball is automatically put into play against the team which did not score. The white team score is always on the top left of the screen; the black team score is always on the top right of the screen.

Hockey I

Programmed as a two- or four-player game, Hockey I requires one credit per player to start the action. The WHAMMY feature, described in Chapter 1, is available to players in this game. The object of the game is to score 11 or 15 goals (see Table 1-3, Operator Options) or to have the highest score after the ten minute time limit. Each goal is worth one point.

Players move the hockey sticks (paddles) vertically on the playfield screen with their controls. In a two-player game, each player controls one stick. Player one controls the white hockey stick; player two controls the black stick. (See Figure 2-4 for location of player controls.) In four-player games, the players also control one hockey stick each. Players one and three control the white team; players two and four control the black team. Each team has a forward stick and a goalie stick, the latter being striped.

The hockey sticks can be moved vertically up and down the playfield from edge to edge. After a goal is scored the ball is automatically put into play against the team which did not score. The white team's score is always on the top left of the screen; the black team's score is always on the top right of the screen.

Hockey II

Hockey II is a two- or four-player game and offers the CATCH feature (see Chapter 1). In the two-player version, each player controls two sticks—one forward stick, and one goalie stick. The sticks move simultaneously up and down the screen in a vertical path. Player one controls the white sticks and player two controls the black sticks. The four-player game includes a vertical line of three paddles for each player. Players one and three control the white paddles; players two and four control the black paddles. Figure 2-4 shows the location of player controls. See the game play description for Hockey I for all other details.

Hockey III

This game is for two players only. As in Hockey II, the CATCH feature (see Chapter 1) is programmed into this game. Player one controls three solid white hockey sticks which move in unison; player two controls three solid black sticks which do the same. Fig-

ure 2-4 shows the location of player controls. Refer to the game play description for Hockey I for all other details.

Quadrapong™

Quadrapong gives players the opportunity to shoot at two different goals. Movement of each player's paddle is restricted to one side of a rectangular playfield. Each side of the rectangle has a goal, and each paddle guards a goal. To score, players must hit the ball into either goal guarded by the opposing players. It is possible for players to hit balls into their own goals, thereby adding points to the opponent's score.

The object of the game is to score 11 or 15 points (see Table 1-3, Operator Options) or to have the highest score after the ten minute time limit. Each goal is worth one point. One credit per player is necessary to start a game.

In two-player Quadrapong, player one controls the white paddles; player two controls the black paddles. In a four-player game, players one and three control the white paddles; players two and four control the black paddles. (See Figure 2-4 for location of player controls.) In both versions, the horizontal paddles are larger and solid; the vertical paddles are slightly smaller and striped.

After a goal is scored, the ball is automatically put into play against the team which did not score. The white team score is always on the top left of the screen; the black team score is always on the top right of the screen. There is no option feature for Quadrapong.

Handball

This game is played almost the same as a regular game of handball. A two- or four-player game is optional. In either case players control one paddle each. One credit per player is required to start the action. To win, a player or players must score 11 or 15 points, or have the highest score after the ten minute time limit. See Table 1-3 for operator options and the corresponding switch settings.

All paddles are located on the same side of the playfield. To score, a player must "pass" the other player's paddle. Each time this is accomplished, a player scores one point. The WHAMMY feature is part of the handball action in this game. See the description in Chapter 1 for details on this option feature.

In a two-player game, player one controls the white paddle; player two controls the black paddle. (See Figure 2-4 for location of player controls.) When a paddle is solid, it is that player's turn to hit the ball. After the ball is hit, the paddle will blink. If the ball is hit out of turn (when the paddle is blinking), the opponent scores one point.

In a four-player game, players one and three control the white team; players two and four control the black team. Paddles three and four are striped. The tactics are the same, except that two players are added to the game. Both paddles on one team will blink when it is the other team's turn to hit the ball.

Players move their paddles vertically up and down the playfield. It is possible to make the paddle disappear from the playfield by going beyond the edge or wall. After a goal is scored, the ball is automatically put into play against the team which did not score. The white team score is always on the top left of the screen; the black team score is always on the top right of the screen.

Volleyball

Two or four players can compete in this game. The object is to return the ball over the net which is located at the bottom center of the playfield. To win, a player or players must score 11 or 15 points, or have the highest score after the ten minute time limit. Table 1-3 in Chapter 1 contains information on operator options and the corresponding switch settings.

The paddles move in a horizontal line at the bottom of the playfield. A player or team scores one point when the opponent misses the ball or hits it into the net. In a four-player game, the second player on each team will cover the upper portion of the playfield with a smaller paddle. See Chapter 1 for a description of the JUMP feature, which is programmed into the Volleyball game.

In a two-player game, player one controls the white paddle; player two controls the black paddle. (Figure 2-4 shows the location of player controls.) In a four-player game, players one and three control the white team; players two and four control the black team. After a goal is scored the ball is automatically put into play against the team which did not score. The white team score is always on the top left of the screen; the black team score is always on the top right of the screen.

Basketball I

This game has a two- or four-player version. As in all Tournament Table games, one credit per player is necessary to start the action. Each player controls one paddle that moves in a horizontal line across half of the playfield bottom. Each player or team has a basket. The player or team on the left side of the playfield shoots at the right basket, and the player or team on the right side of the playfield shoots at the left basket. One point is awarded for each basket scored. To win, a player or team must score 11 or 15 points, or have the highest score after the ten minute time limit. See Table 1-3 for information on operator options.

Where the ball is dribbled on the paddle determines the direction in which it will travel. If the ball is dribbled off the right side of the paddle, the ball will shoot to the right. When the ball is caught between the bottom of the playfield and one of the paddles, the ball will eventually bounce through the paddle.

A player or team scores one point when the ball goes through the basket. In a four-player game, the second player controls the smaller paddle located higher on the playfield. See Chapter 1 for a description of the JUMP feature, which is programmed into this game.

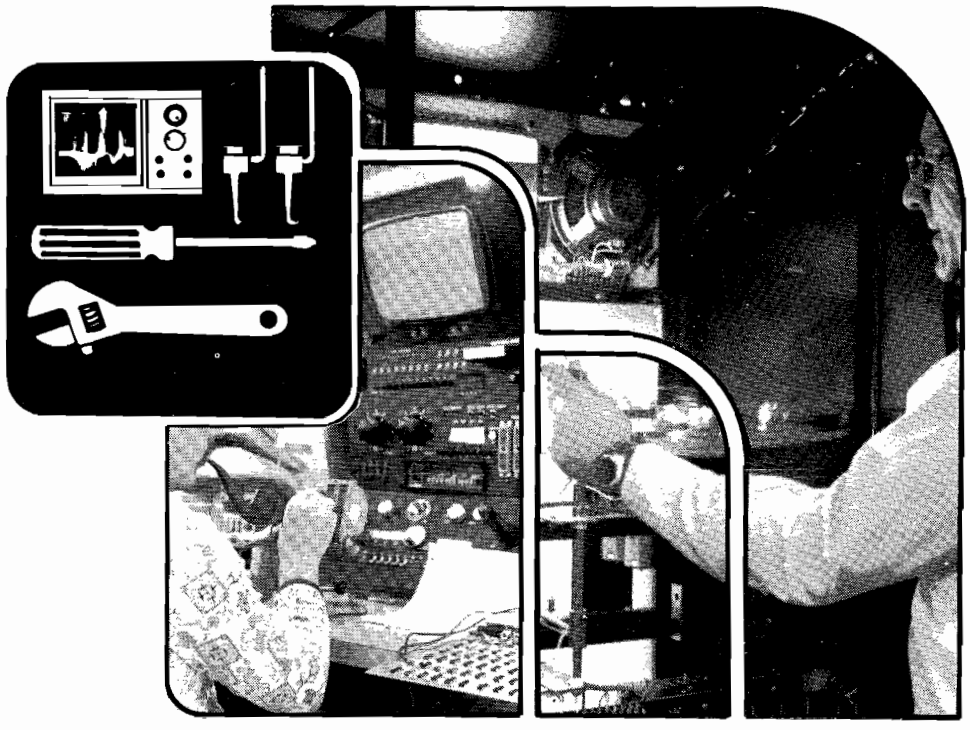
In a two-player game, player one controls the white paddle; player two controls the black paddle. (Figure 2-4 shows the location of player controls.) In a four-player game, players one and three control the white team; players two and four control the black team. After a goal is scored the ball is automatically put into play against the team which did not score. The white team's score is always on the top left of the screen; the black team's score is always on the top right of the screen. It is possible to score points for the opponent player or team by shooting into the wrong basket.

Basketball II

See game play description for Basketball I. The only difference between the two games is that Basketball II offers the CATCH feature, which is described in Chapter 1.

GENERAL NOTE

The game sounds for the various Tournament Table games range from low- to high-pitched electronic noises. Each game function or action has a distinct electronic sound.



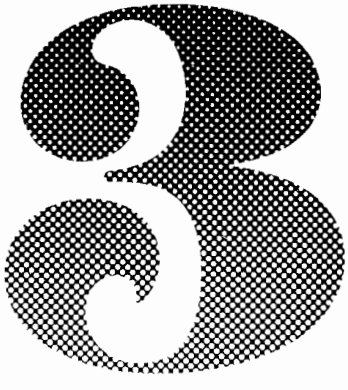
MAINTENANCE AND ADJUSTMENTS

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

NOTE

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. CLEANING

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

B. 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.

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

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 pushing down on a release lever and simultaneously tilting the mechanism back, then lifting it up and out. This is shown in Figure 3-3.

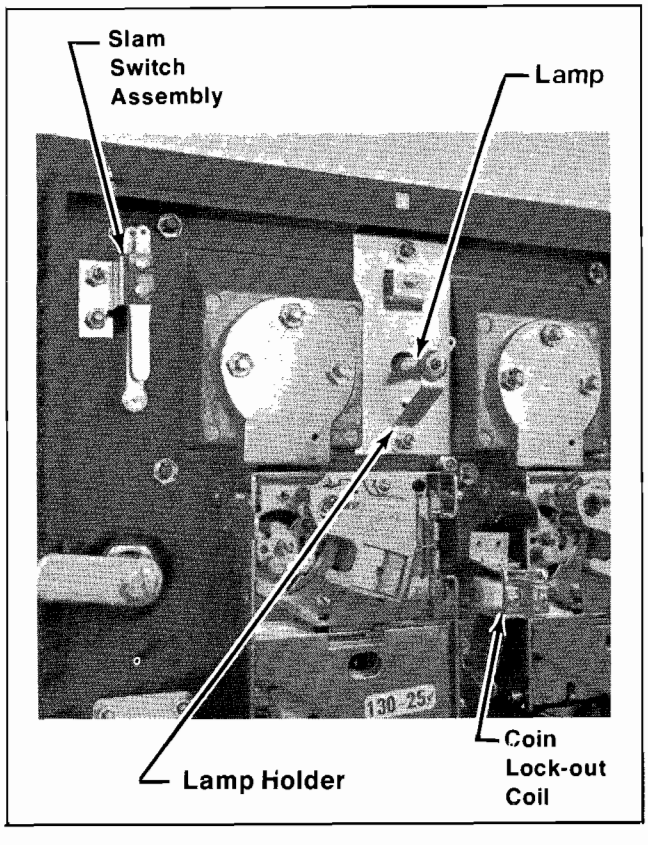


Figure 3-1 Coin Door Assembly

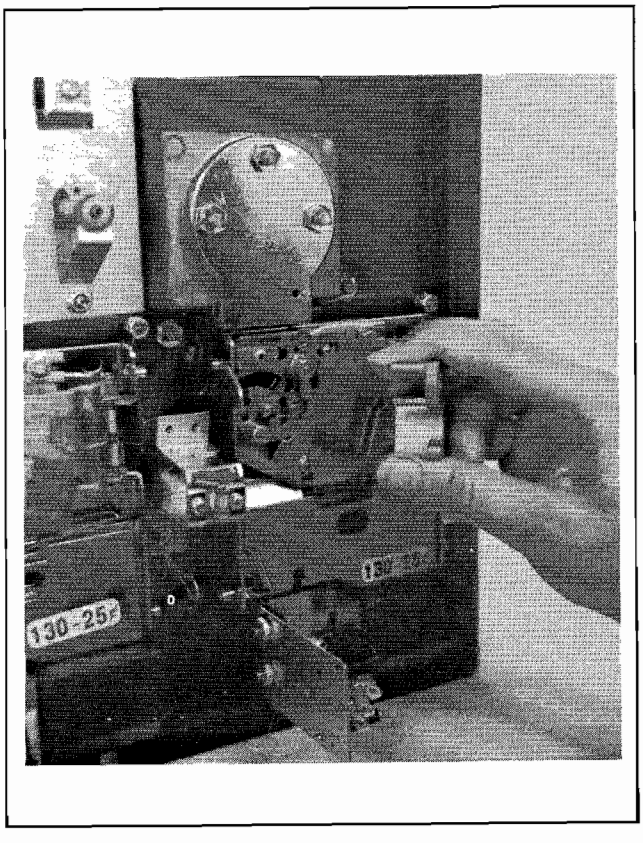


Figure 3-2 Hinging Open the Magnet Gate Assembly

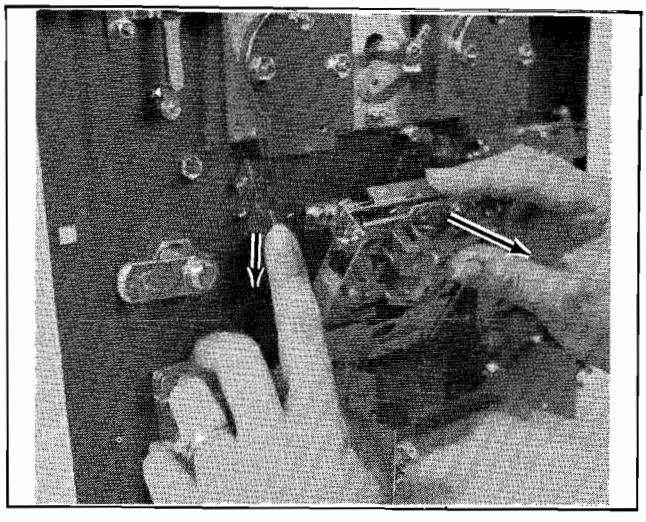


Figure 3-3 Removal of Coin Mechanism

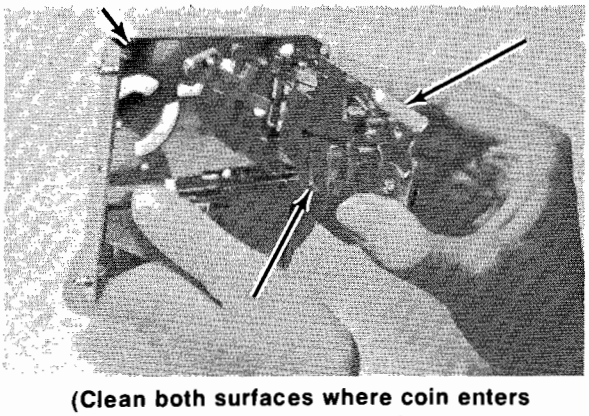
Cleaning of Coin Paths

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 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.



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

Figure 3-4 Surfaces to Clean Inside the Coin Mechanism

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.

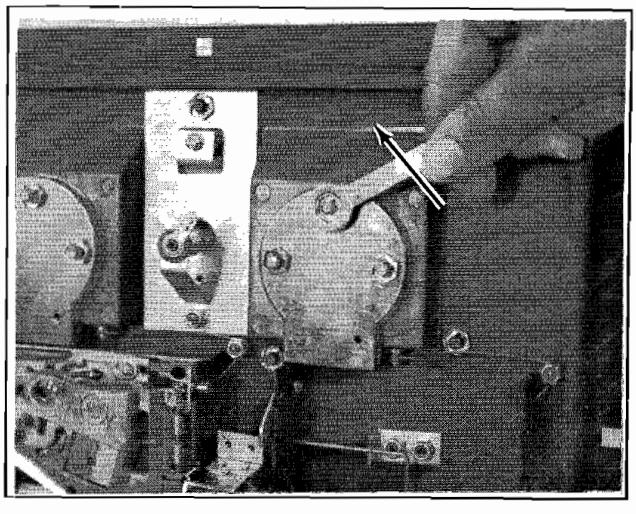


Figure 3-5 Removal of Plate Covering Rear of Coin Slot

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.

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 its trip wire should be as shown in Figure 3-7. Use extreme care when handling or touching these wires.

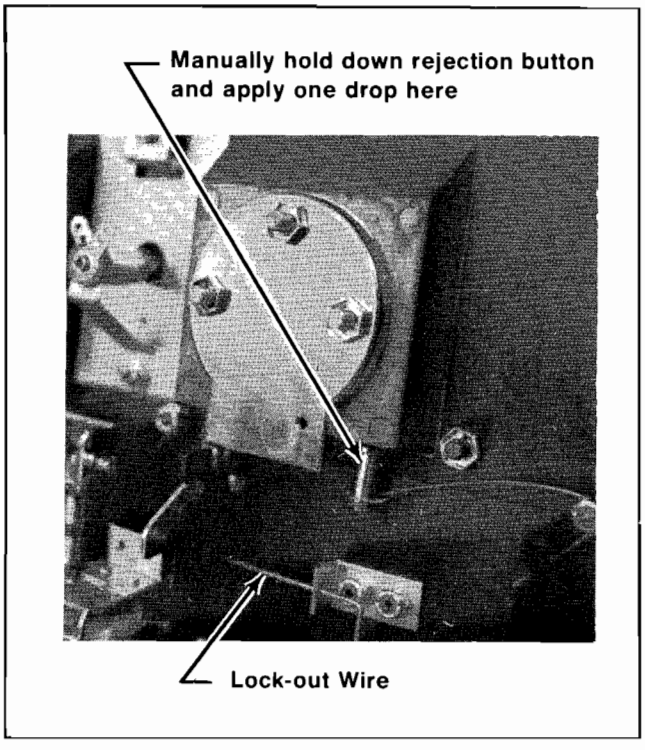


Figure 3-6 Close-Up View of Lubrication Point

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

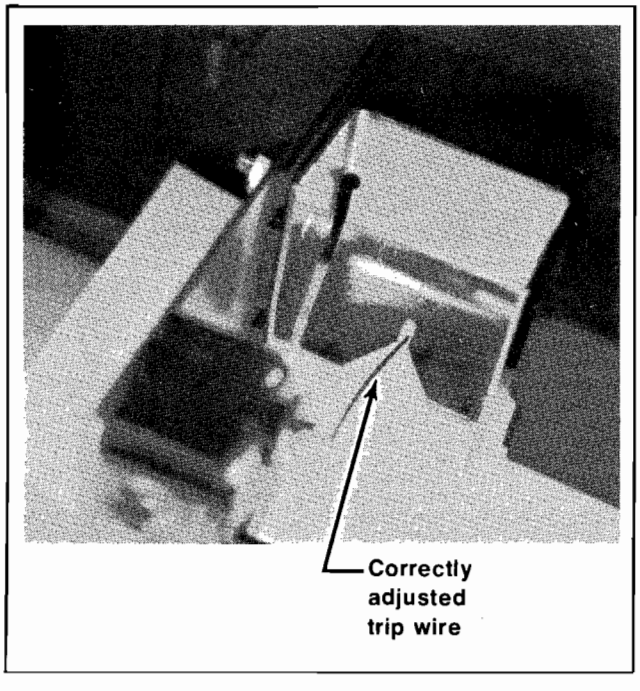


Figure 3-7 Detail View of Coin Switch and Trip Wire

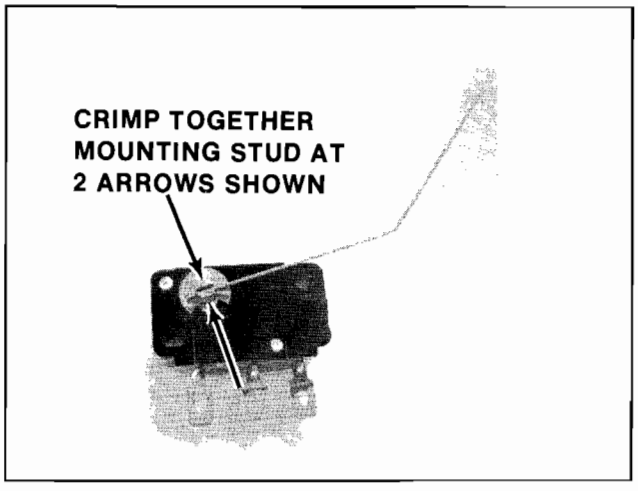


Figure 3-8 Securing the Coin Switch Trip Wire

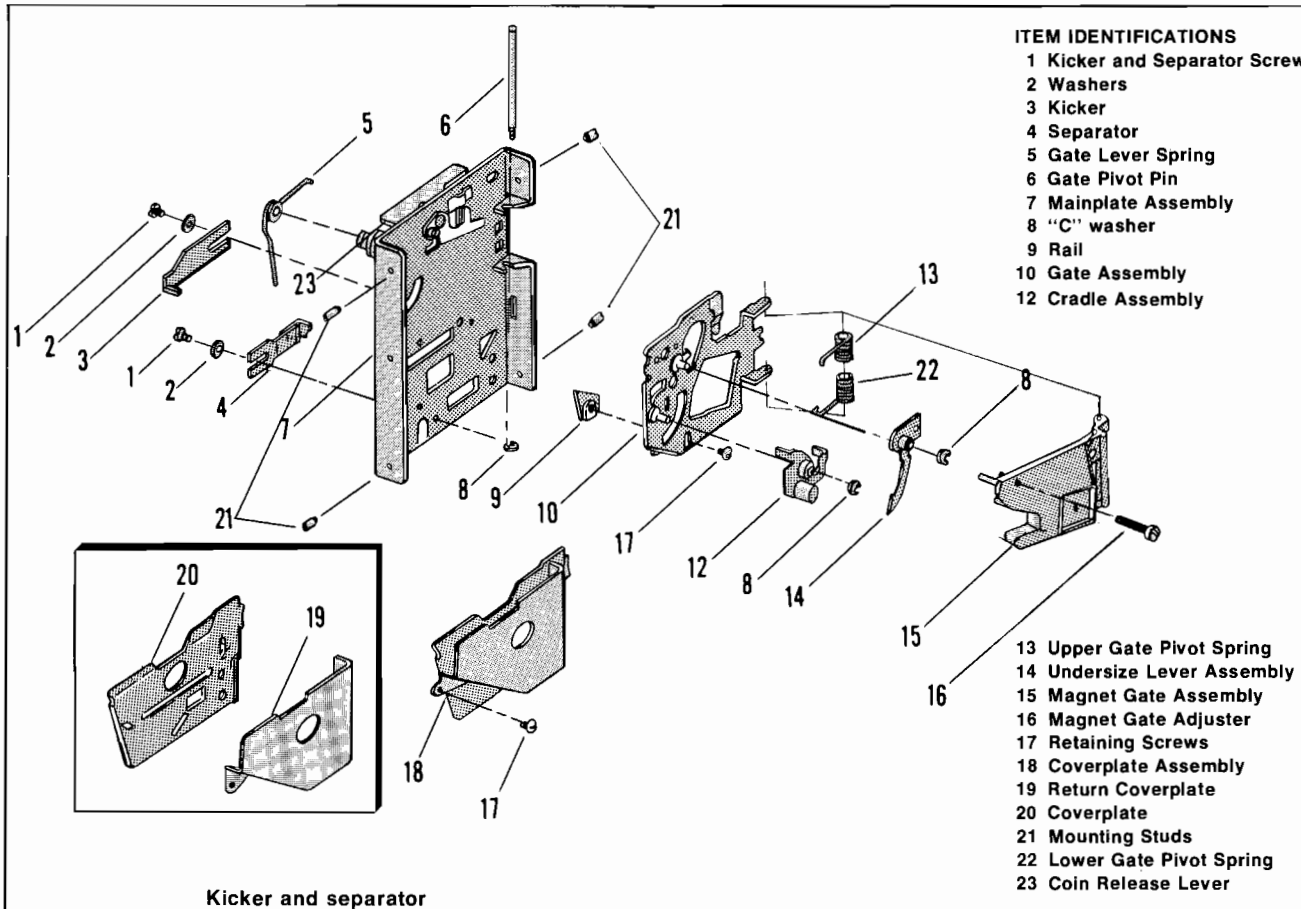
With a wire that is too long, you may have a problem of it catching on the opening in the cash box as a coin is accepted. You can cut off the end of the wire in small increments, making sure it still extends slightly through the "V" of the coin chute.

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. Then take 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). Besides a screwdriver, you will need a set of several coins, including both new and old, worn ones. Figure3-9shows an exploded view of the mechanism and gives procedures for adjusting the kicker, separator, and the magnet gate. These



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

adjustments should only be done by someone who has experience in servicing coin mechanisms and who understands their operation.

General Troubleshooting Hints

The first action is to look for jammed coins. After these have been removed, examine the coin path for presence of 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 build-up 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 troubles still persist, check the conditions and positions of the lock-out wires, and the mechanical adjustments on the coin mechanisms, before suspecting the electronics. If a coin mechanism rejects genuine coins, try to readjust it. If this is not successful, then replace it with a working mechanism.

C. FUSE REPLACEMENT

Tournament Table contains five fuses, three on the power supply assembly and two on the TV monitor assembly. All fuses are easily accessible through the rear door assembly. Replace fuses only with the same type of fuse as follows:

TEC TM-600/623 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

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

D. TV MONITOR ADJUSTMENTS

CAUTION

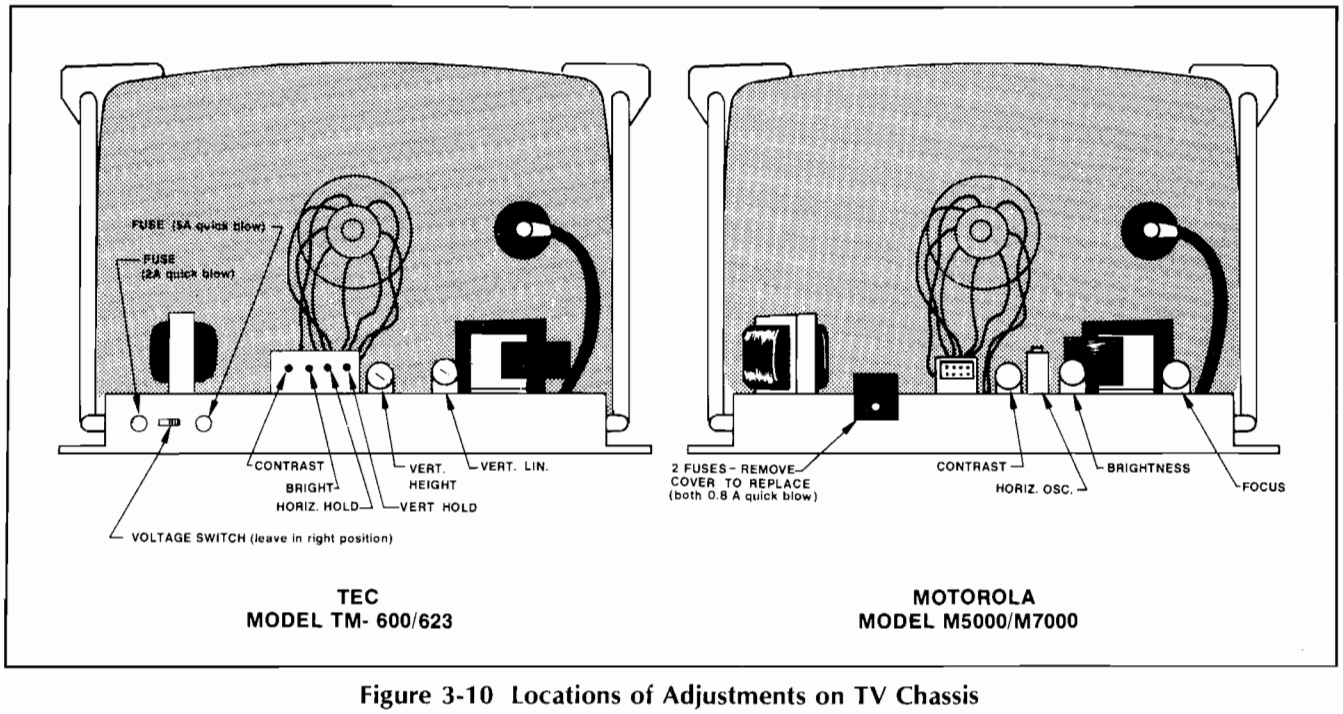
For best results be sure the game has been turned on for a while before making any TV monitor adjustments.

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 should 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, home 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



TEC
MODEL TM- 600/623

MOTOROLA
MODEL M5000/M7000

Figure 3-10 Locations of Adjustments on TV Chassis

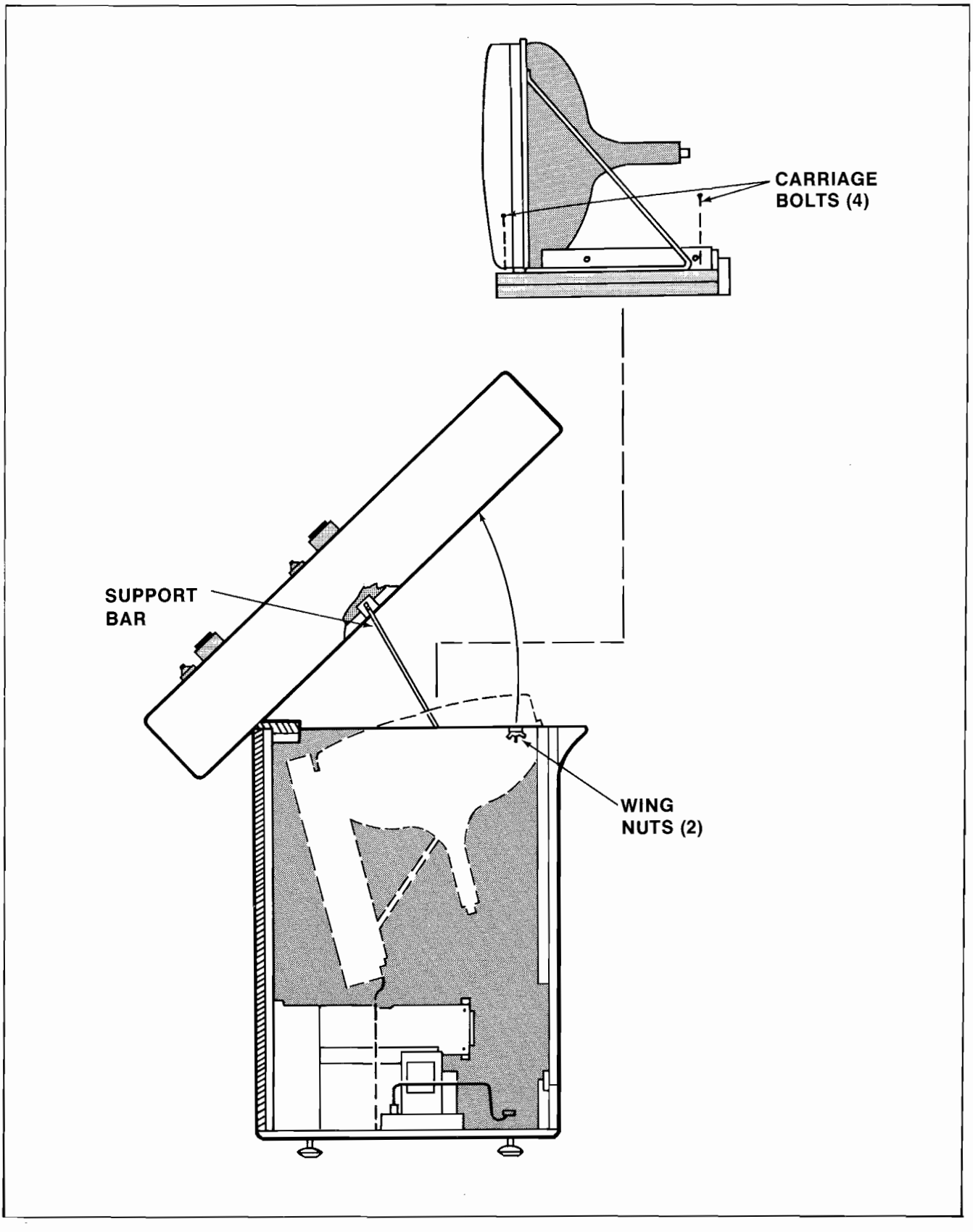


Figure 3-11 TV Monitor Removal

game contains a TV monitor manufactured to Atari 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 bright as possible against the dark 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.

E. TV MONITOR REMOVAL (See Figure 3-11)

Unlock and remove the rear door assembly. Reach in through the back of the cabinet and remove the two wing nuts securing the control panel (top assembly) to the cabinet bottom assembly. The top assembly of the cabinet may now be lifted upward starting from the back of the cabinet. Although the top assembly is balanced to remain in a raised position, the support bar should be used for safety while working inside the cabinet. Next remove the four carriage bolts that secure the monitor to the TV shelf assembly. Disconnect the TV monitor harness and slide the monitor out through the top of the cabinet. As you slide the monitor out of the cabinet, *be certain* that the cabinet does not become unbalanced.

F. LED SWITCH AND ROTARY SWITCH REPLACEMENT (See Figure 3-12)

The LED switches (PLAYER START, GAME SELECT, AND OPTION CONTROL), are accessible for servicing when the cabinet top assembly is raised. Use the following procedure:

1. Unlock and remove the rear door assembly.

2. Reach in through the back of the cabinet and remove the two wing nuts securing the control panel (top assembly) to the cabinet bottom assembly.

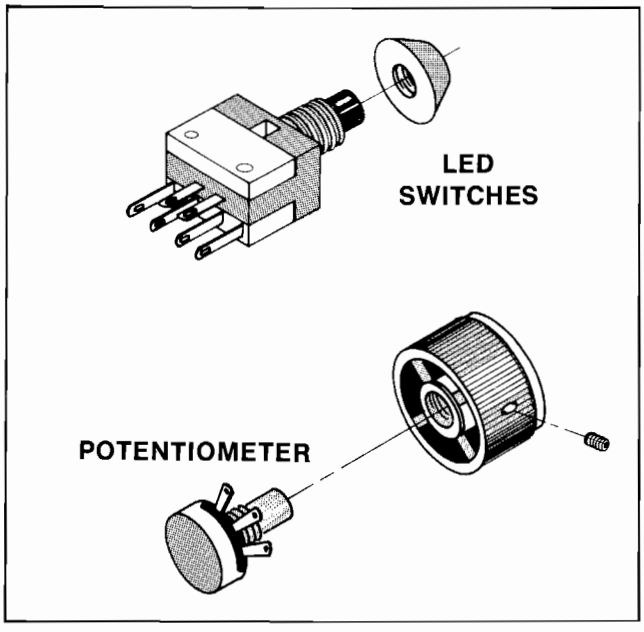


Figure 3-12 LED Switch and Potentiometer Replacement

3. Starting from the back of the cabinet, raise the top assembly. The support bar should be used for safety while working inside the cabinet (see Figure 3-11).

4. Remove all wires from the suspected switch.

5. Turn the switch counterclockwise while holding the cone-shaped nut on the outside of the game cabinet.

6. Install a new switch using the reverse procedure.

7. Reconnect the harness wires.

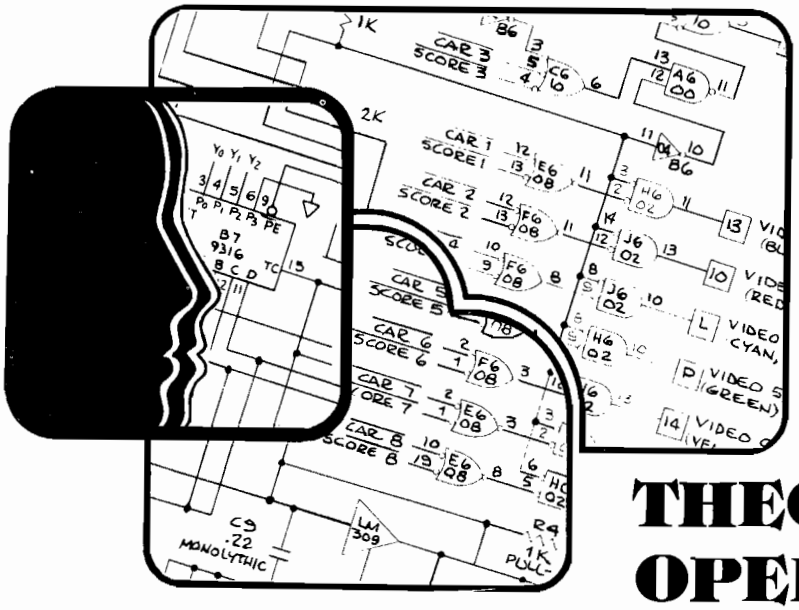
The potentiometers are also accessible for servicing when the cabinet top assembly is raised. After following Steps 1 through 3 above, use the following procedure:

1. Remove all wires from the suspected switch.

2. Remove the knob and hex nut on the control panel.

3. Install a new switch using the reverse procedure.

4. Reconnect the harness wires.

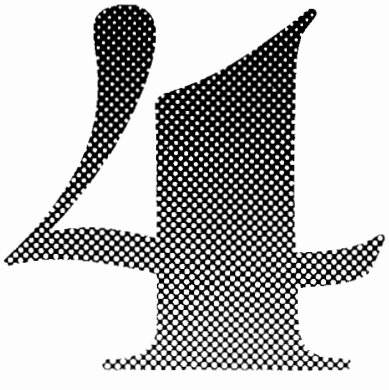


THEORY OF OPERATION

A. GENERAL INFORMATION

The PCB block diagram in Figure 4-1 shows the major controls, circuits and outputs of the game. Figure 4-2 is a block diagram of the Tournament Table game.

The game's television monitor is a self-contained transistorized unit. The composite video signal sent to the monitor differs in many respects from the signal derived from commercial TV broadcasts. The picture appearing on the screen, therefore, is unlike that of a home TV set and the monitor does not produce any sound. See Chapter 6 for a schematic diagram of the TV monitor.



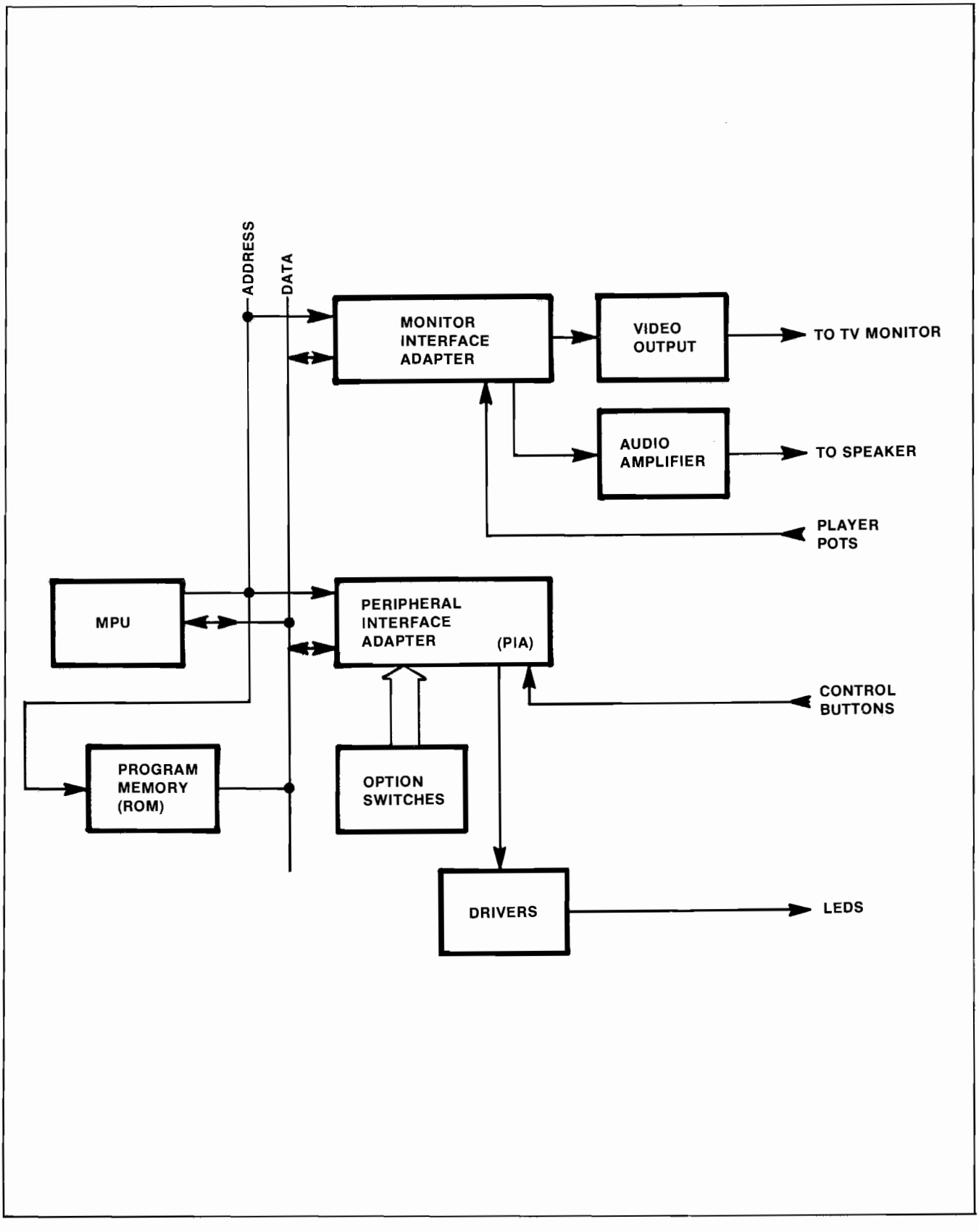


Figure 4-1 Tournament Table PCB Block Diagram

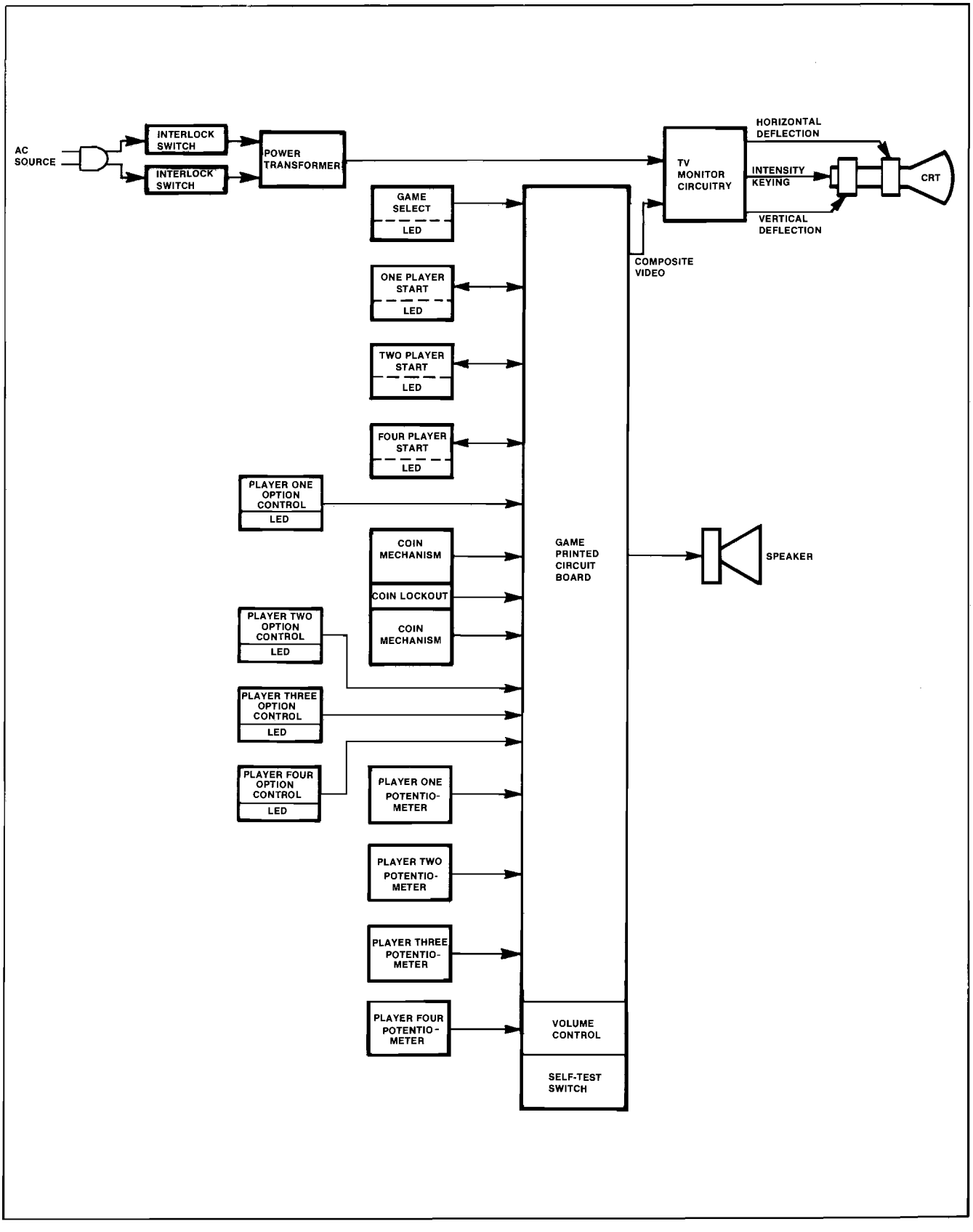


Figure 4-2 Game Block Diagram

The game's composite video signal produces only four video levels instead of the continuous shades of grey seen on a home TV screen. The video levels are light grey, grey, white, and black.

On the game PCB schematic diagram, the symbol "P" (appearing at various inputs of integrated circuit devices) indicates a connection of +5 volts DC through a pullup resistor (see Figure 4-3). For easy reference, the game PCB is divided into grid sections. Along the short side of the board, these sections are identified by letters A through E. Along the long side of the board, the numbers 1 through 9 are used. For example, sheet 2 of Figure 4-3 illustrates the microporcessor E3 at the right side of the drawing. The microporcessor is found at coordinates E and 3 on the PCB.

A monitor interface adapter, which is controlled by the microprocessing unit (MPU), performs the following functions:

- Produces all horizontal and vertical sync functions.
- Generates video for all objects.
- Generates all sound.

The MPU reads player pots through this adapter by measuring the charge rate of a capacitor charging through each pot.

Input interface adapters read switches (option, player control, and start switches); and function as outputs for the LED control, and the coin lockout control.

B. POWER SUPPLIES (Bottom Right of Schematic Sheet 1, Figure 4-3)

Two voltages are used on the Tournament Table PCB: voltage-regulated +5 volts DC and unregulated +10 volts DC. The voltage regulated +5 volts DC provides Vcc for most of the PCB's integrated circuits. Unregulated +10 volts DC provides V+ for the LM 380 audio amplifier.

C. CRYSTAL OSSCILLATOR AND TV SYNC COUNTDOWN CHAINS

A 3.57 MHz crystal oscillator generates the basic clock frequency that is divided down by the monitor interface adapter to produce TV synchronization signals. The signals are used to produce the TV monitor raster, consisting of horizontal lines at a horizontal frequency of 15.7 KHz.

D. MICROCOMPUTER

The microcomputer is the control center for the circuitry that makes up the game action. The microprocessing unit (MPU) sends out addresses on its address bus and accepts from, or outputs data onto the data bus. The Address Decoder receives the address, translates the address code, and enables the circuitry called by the MPU. When the MPU is reset by receiving a low, and then a high on its RESET line, its outputs address the program memory to put data onto the data bus. The MPU reads this data and uses it to address the main program.

The main program instructs the MPU to execute operations, and instructs at which address to execute them. This controls the flow of data on the bus and "reads" inputs and "writes" to outputs. Data may flow into the MPU from program memory, random-access memory (RAM), or from tri-state drivers from the input and option switches.

Data may flow out of the MPU to the RAM, to the peripheral interface adapter, or to the monitor interface adapter.

E. MICROCOMPUTER WATCHDOG

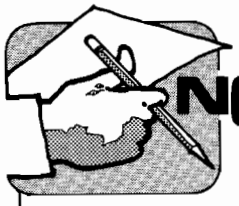
The watchdog circuit is connected to the $\overline{\text{RES}}$ input of the MPU. This circuit prevents the microcomputer from going into a program loop. When the MPU is functioning properly it will periodically pulse the "TIMER RESET" line. This tells the watchdog (B7, D8) that the MPU is okay, so that no action is taken by the watchdog.

If the MPU fails, the "TIMER RESET" line is not pulsed. The watchdog then is not told that the MPU is okay. The watchdog then restarts the program by forcing the $\overline{\text{RESET}}$ low, then high. (If successive $\overline{\text{TIMER RESET}}$ pulses do not occur within 80 ms, the program will restart.

When the microcomputer is functioning properly, the watchdog will not reset the MPU.

F. VIDEO OUTPUT (Lower Right of Schematic Sheet 2)

The video output circuitry receives both the playfield and motion information, selects the proper grey scale shading, and sums the signals with blanking signals. The circuitry then provides a composite video output.



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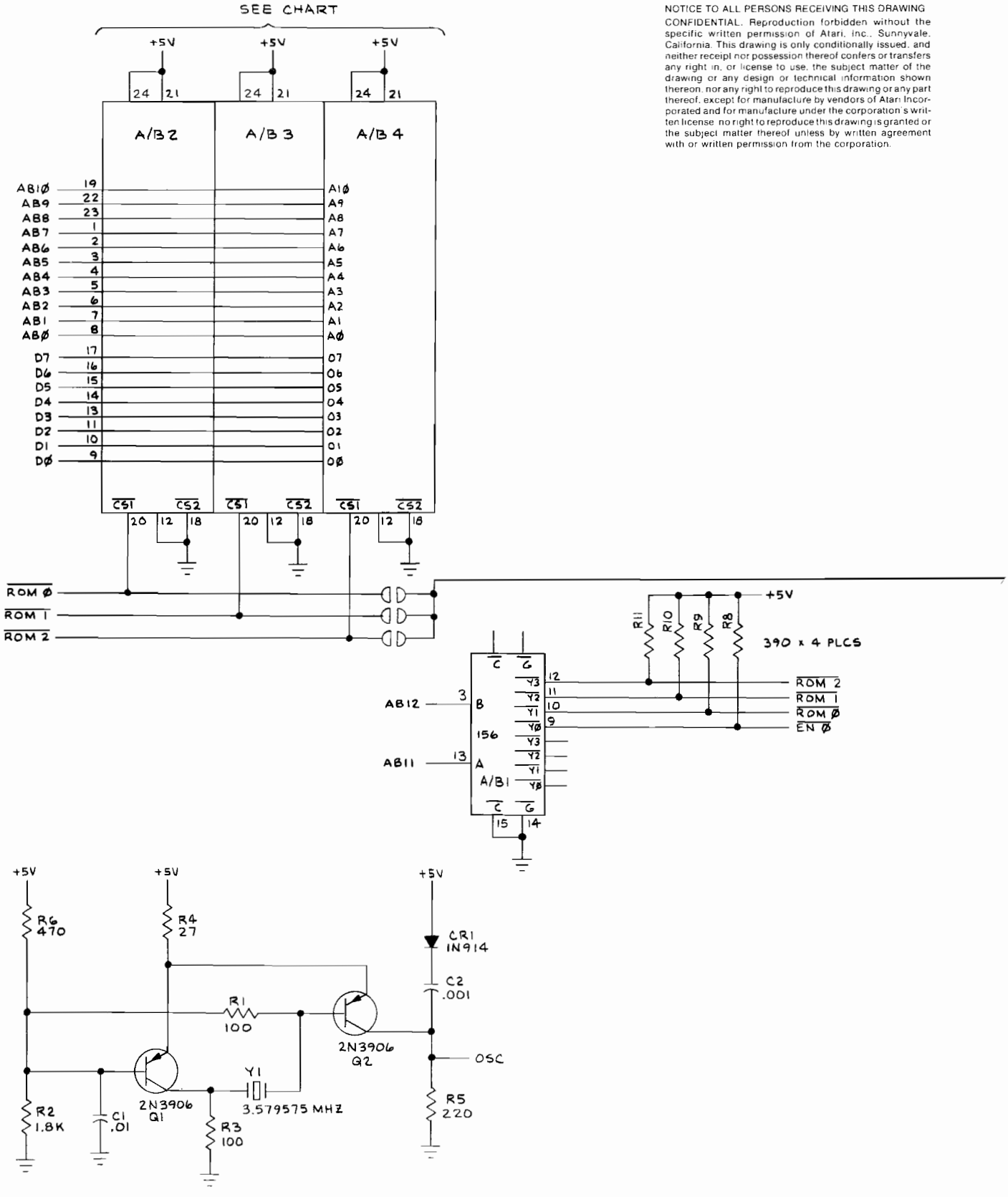
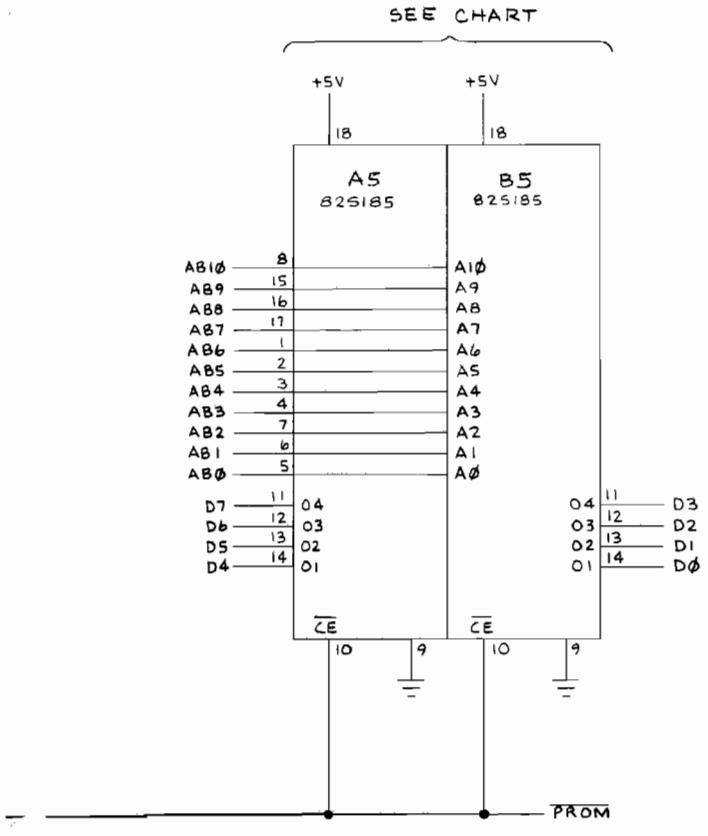




LOC \ VERS	-01	-02	-03	-04
A/B2	030751	—	030751	030751
A/B3	030752	030752	—	030752
A/B4	030753	030753	030753	—
A5	—	030754	030756	030758
B5	—	030755	030757	030759

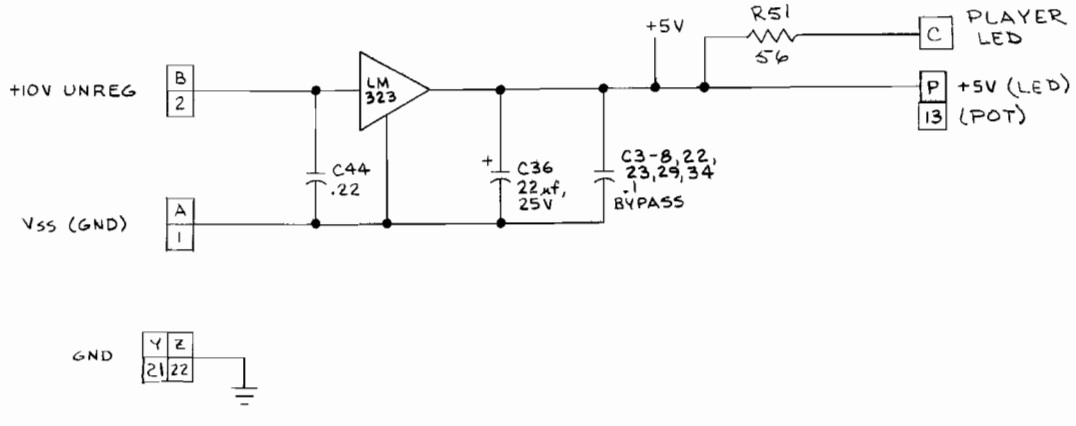
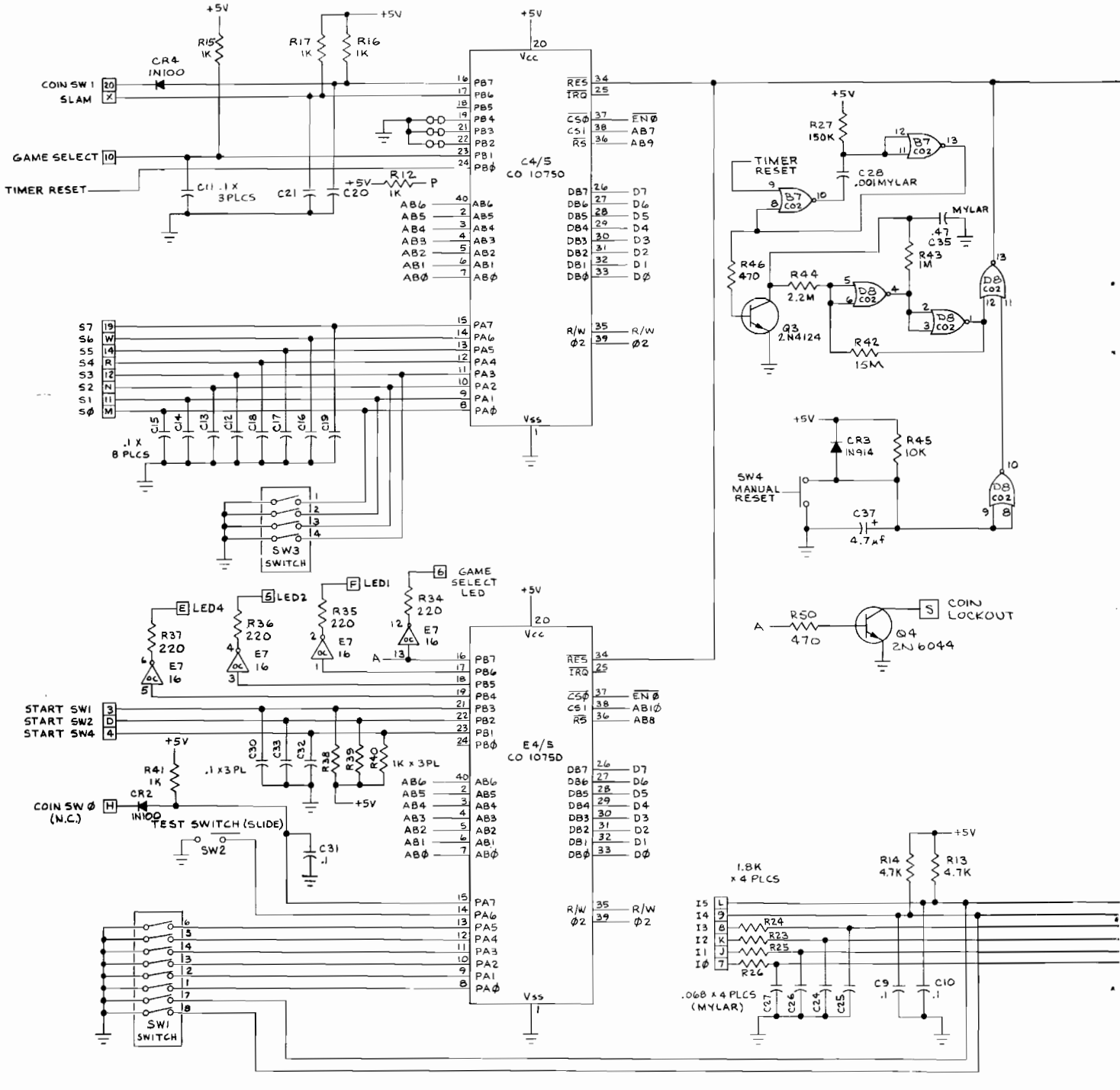


Figure 4-3 Tournament Table PCB Schematic Diagram Sheet 1 of 2



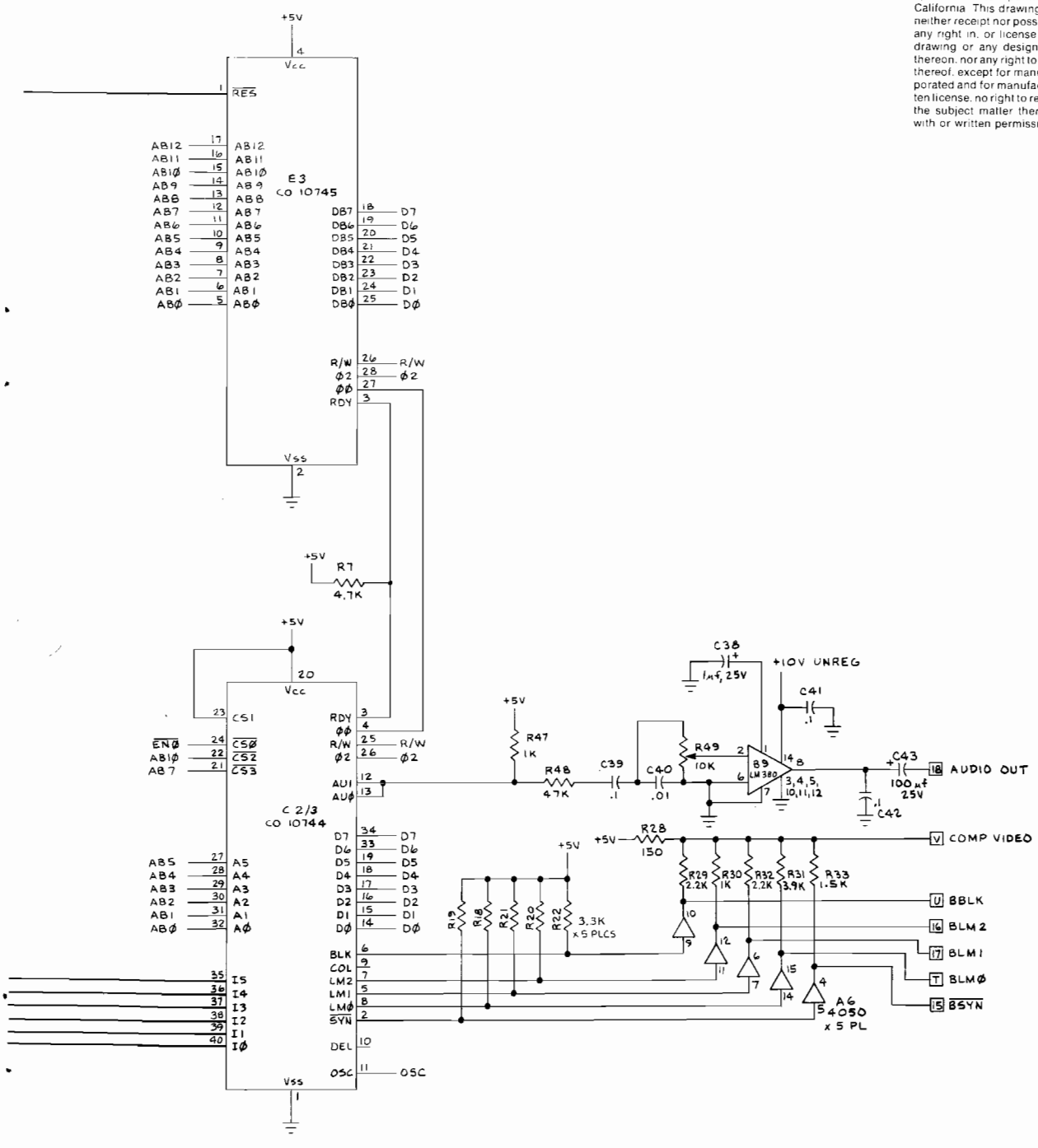
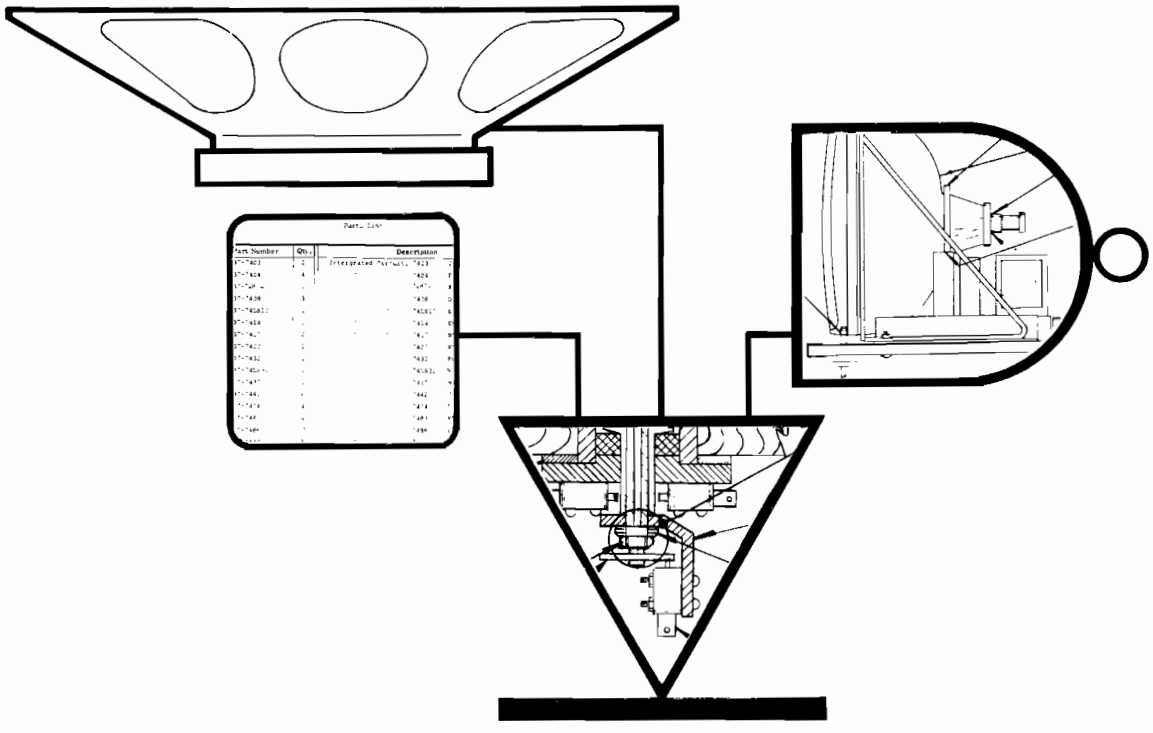


Figure 4-3 Tournament Table PCB Schematic Diagram Sheet 2 of 2

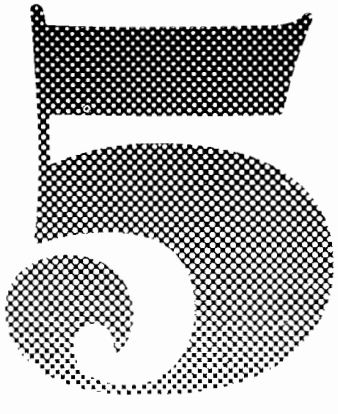


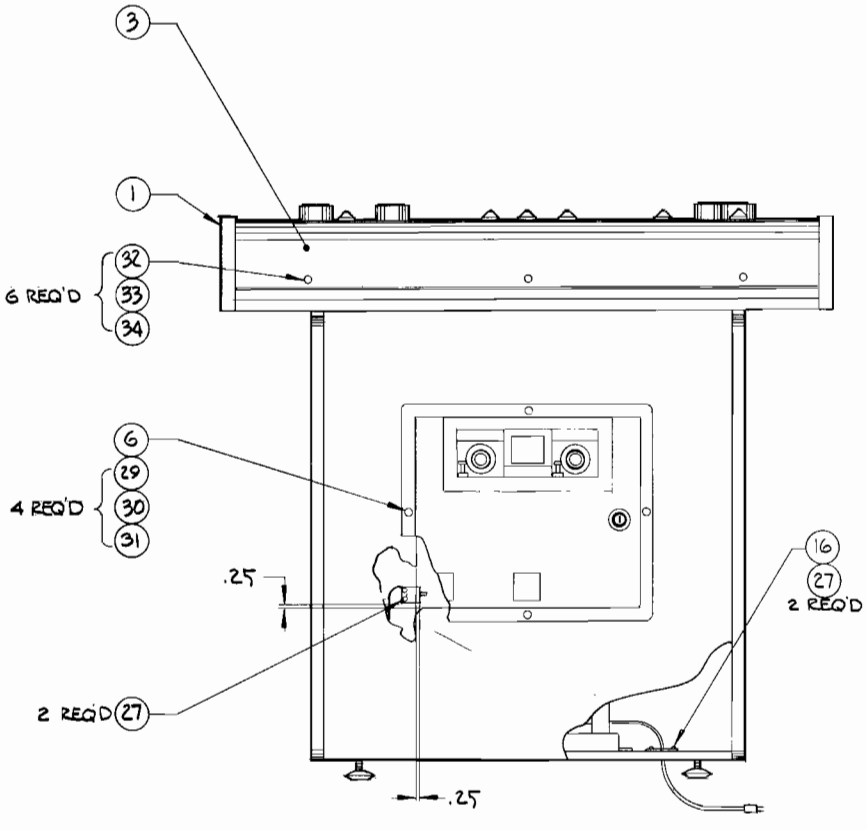
ILLUSTRATED PARTS CATALOG

The purpose of this Chapter is to provide you with the necessary information for ordering replacement parts for the Tournament Table Game.

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





1. THE FOLLOWING ITEM NUMBERS ARE NOT SHOWN: 17, 18, 20, 21, 24

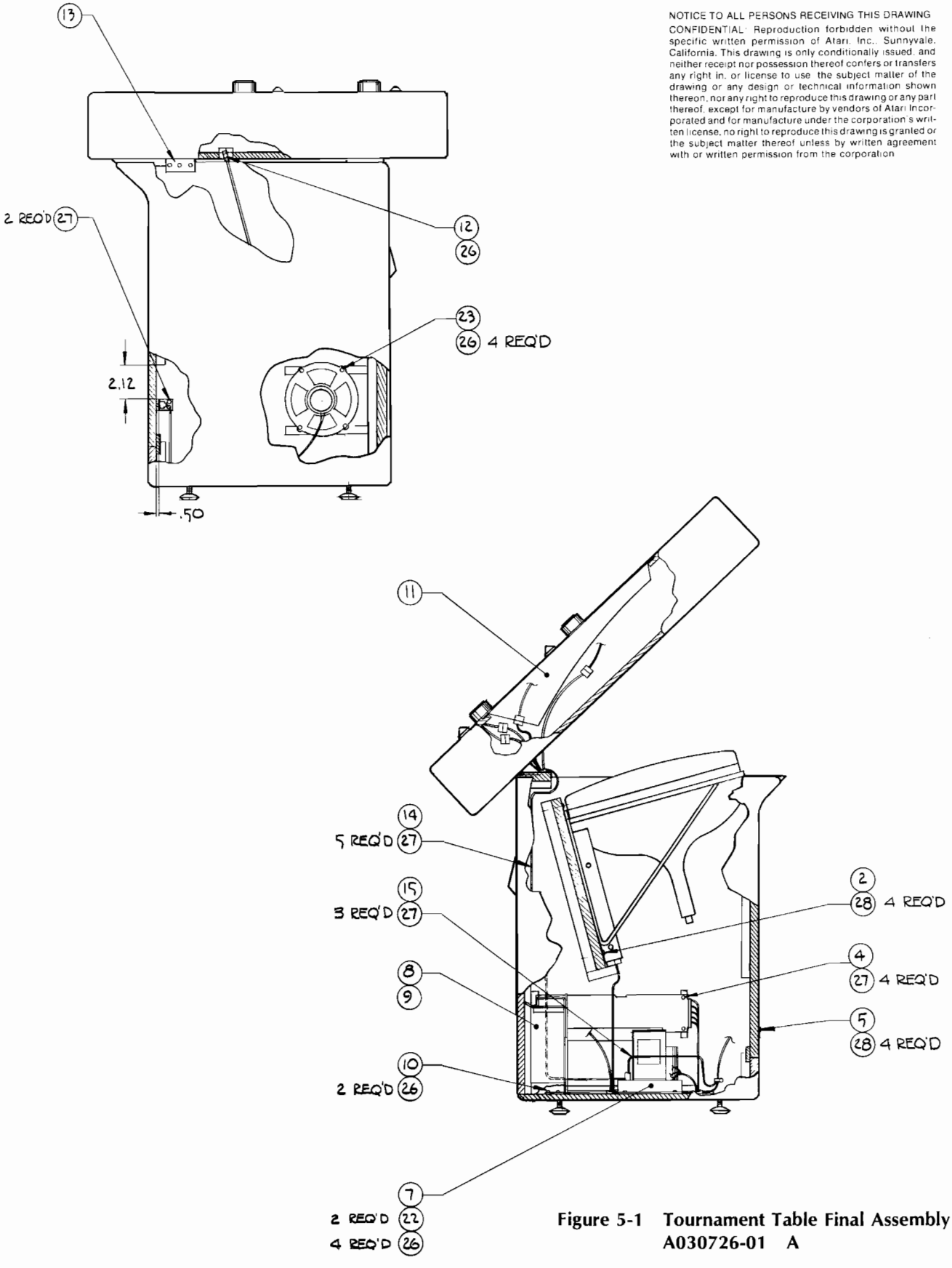


Figure 5-1 Tournament Table Final Assembly A030726-01 A

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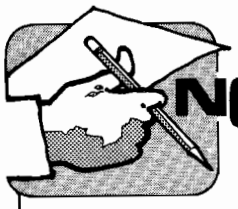
Figure 5-1 Tournament Table Final Assembly Parts List

Item	Part Number	Qty.	Description
1	A030714-01	1	Assy., Cabinet, Bottom & Top
2	A030715-01	1	Assy., T.V. Shelf - See Figure 5-2
3	A030716-01	1	Assy., Plex, Top/Control Panel- See Figure 5-3
4	A030170-01	1	Tournament Table PCB Assy- See Figure 5-4
5	A030709-02	1	Assy., Door W/Lock
6	A006794-XX	1	Coin Door Assy - See Figure 5-5
7	A007197-01	1	Power Supply Assy Type B - See Figure 5-6
8	A009548-01	1	Assy., Coin Box Lid
9	009549-01	1	Coin Box
10	030717-01	1	Bracket (Coin Box)
11	030733-01	1	Bezel W/Graphics
12	030722-01	1	Support Bar
13	002728-01	2 Ref	Bracket, Panel Mtg.
14	A030729-01	1	Main Harness
15	A030819-01	1	Interlock Switch & Harness
16	A007784-01	1	Strain Relief Power Cord Assy
17	005233-01	1	Rear Door Seal
18	006305-01	1	Printed Poly Bag
19	TM-113	1	Tech Manual & IPC
20	030734-01	1	Patent Drawing
21	ST-113	1	Self Test Procedure Chart
22	46-2023002	2	Fuse 3 AMP (Slow Blow)
23	48-009	1	Speaker 8"
24	030728-01	1	Harness Schematic - See Figure 5-7
25			
26	72-68125	11	Screw SM Ph Phil. #8 x 3/4" Lg
27	72-6610	18	Screw SM Ph Phil. #6 x 5/8" Lg
28	72-68205	8	Screw SM Ph Phil. #8 x 1.25 Lg
29	75-5516B	4	Carriage Bolt ¼-20 x 1.00" Lg Blk
30	75-015S	4	Washer Flat, ¼
31	75-990505S	4	Nut, Lock Shallow Pat. Nylon ¼-20
32	75-99090006	6	Well Nut, Blind Hole Fastener
33	82-8016	6	Screw, But., Hd., Socket #10-32 x 1.00" Lg
34	75-07021	6	Washer, Flat, Black Nylon #10



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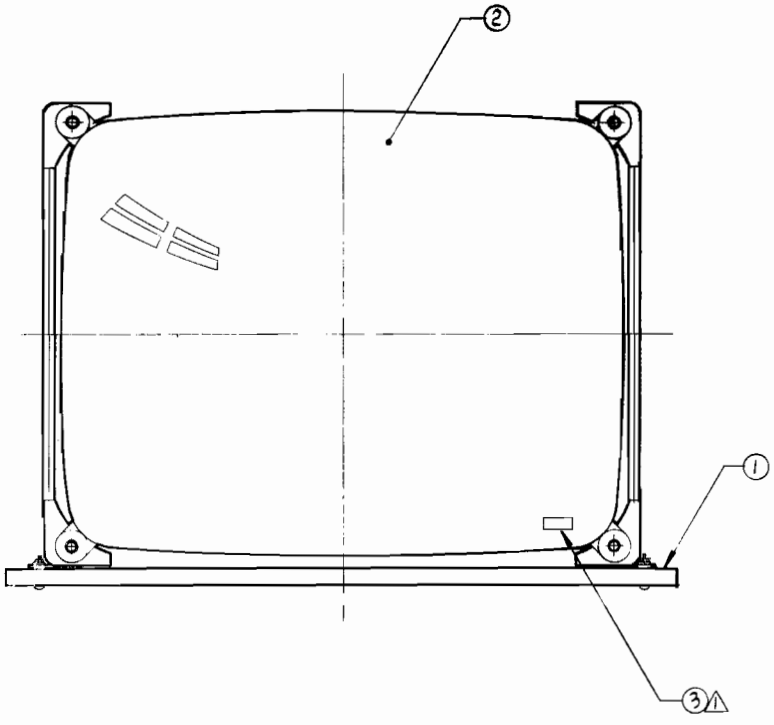


⚠1 LOCATION OF DECAL MAY CHANGE AT THE DISCRETION OF MANUFACTURING.

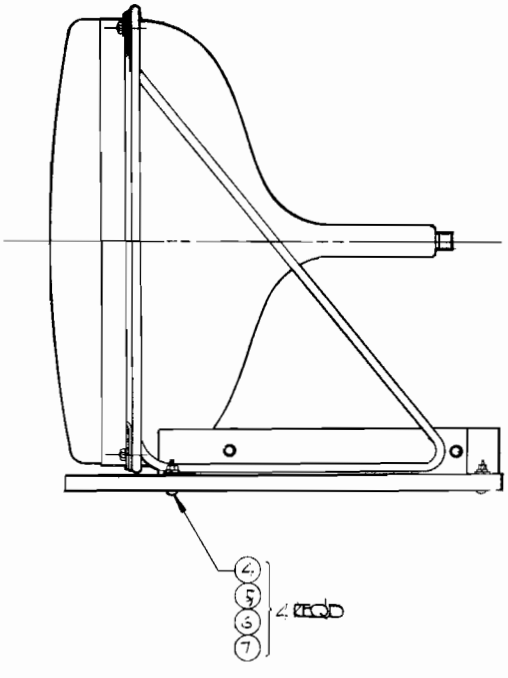
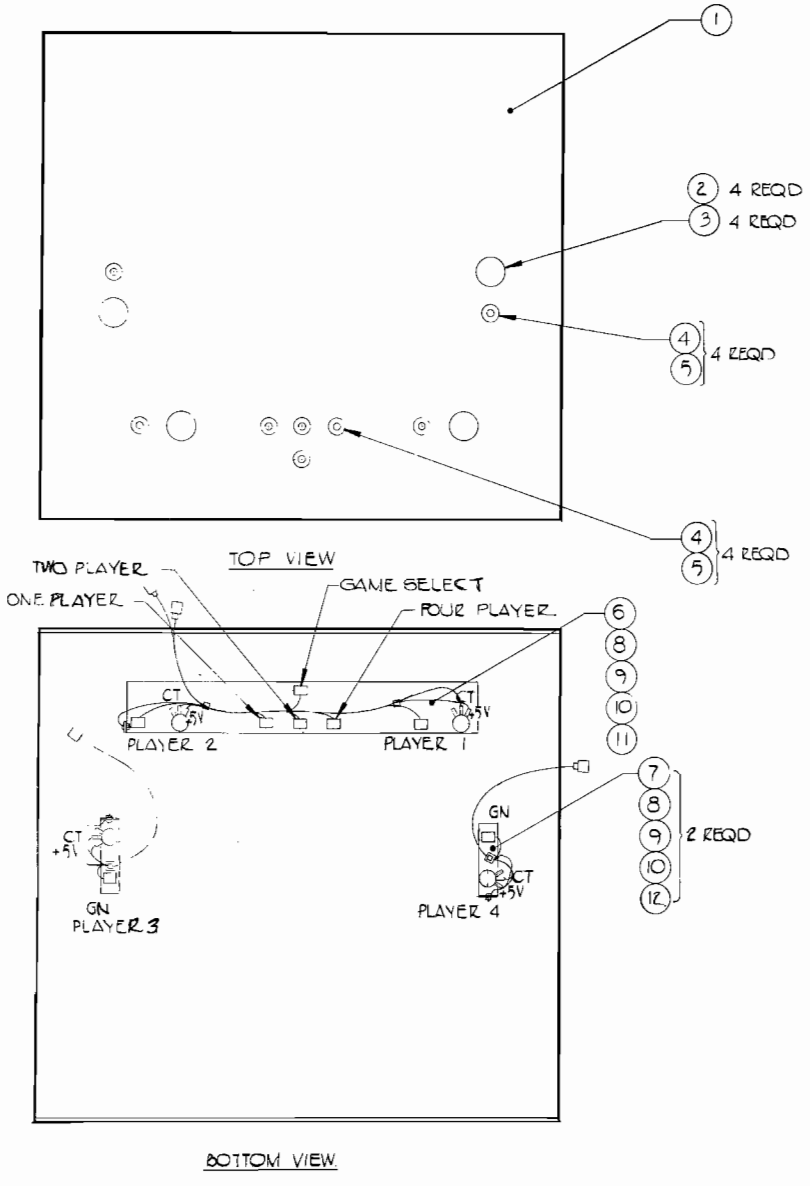
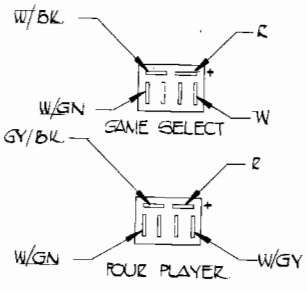


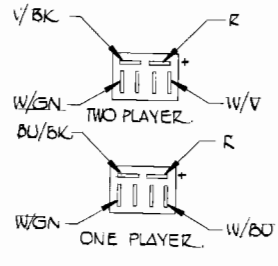
Figure 5-2 TV Shelf Assembly A030715-01 A

Figure 5-2 TV Shelf Assembly
Parts List

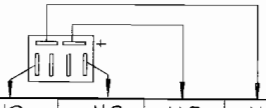
Item	Part Number	Qty.	Description
1	92-029	1	TEC (TM-600) 19" B/W Monitor
2	030708-01	1	Shelf, T.V.
3	006319-0	1	Copyright Decal 1978
4	75-5120N	4	Bolt, Carriage, #10-24 X 1.25 Lg.
5	75-010S	4	Washer, Flat #10
6	75-040	4	Washer, Split-Lock #10
7	75-911S	4	Hex Nut, #10-24







PLAYER #	+5V	CT
1	R	BK/R
2	R	BK/BN
3	R	BK
4	R	BK



PLAYER #	N.O.	N.O.	N.O.	N.O.
1	W/R	W/GN	R/W	BK
2	W/BU	W/GN	R/W	BK
3	W	W/GN	R/W	BK
4	W	W/GN	R/W	BK

Figure 5-3 Control Panel Assembly A030716-01 B

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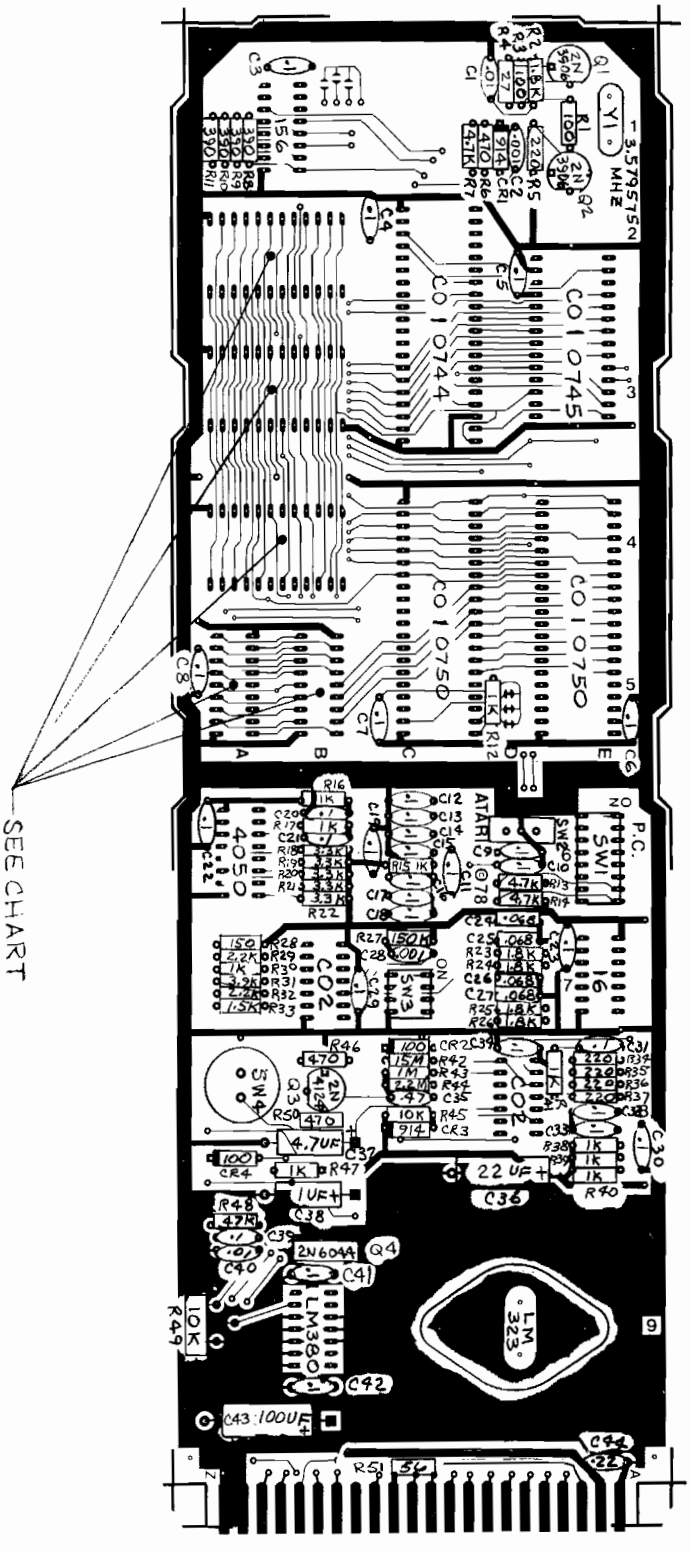
Figure 5-3 Control Panel Assembly
Parts List

Item	Part Number	Qty.	Description
1	030721-01	1	Plex, Top Control Panel W/Graphics
2	19-9036	4	Allen Bradley Potentiometer (EJC1N056F105UA)
3	73-831	4	Knob (Kurz-Kasch #1907-3BB)
4	62-002	8	Led Switch
5	001856-03	8	Alum. Bushing
6	030724-01	1	Main Grounding Plate
7	030723-01	2	Grounding Plate
8	75-2608S	3	Screw, Mach., Round Hd. #6-32 X .50 Lg.
9	75-046	3	Washer, Split-Lock
10	75-926S	3	Nut, Mach., Hex, S.P. #6-32
11	A030730-01	1	Front Control Harness
12	A030731-01	2	Side Control Harness



LOC / VERS	-01	-02	-03	-04
A/B 2	030751	—	030751	030751
A/B 3	030752	030752	—	030752
A/B 4	030753	030753	030753	—
A5	—	030754	030756	030758
B5	—	030755	030757	030759

Figure 5-4 Tournament Table PCB Assembly A030170-01 A

Figure 5-4 Tournament Table PCB Assembly Parts List

ATARI®

-01 Version

Item	Part Number	Qty.	Description	
1	030171-01	1	Printed Circuit Board	
2	10-5270	1	Res, Carbon, 5%, ¼W, 27 OHM	R4
3	10-5101	2	" " " " 100 "	R1,3
4	10-5151	1	" " " " 150 "	R28
5	10-5221	5	" " " " 220 "	R5,34,35,36,37
6	10-5391	4	" " " " 390 "	R8,9,10,11
7	10-5471	3	" " " " 470 "	R6,46,50
8	10-5102	10	" " " " 1K "	R12,15,16,17,30,38 39,40,41,47
9	10-5152	1	" " " " 1.5K	R33
10	10-5182	5	" " " " 1.8K	R2,23,24,25,26
11	10-5222	2	" " " " 2.2K	R29,32
12	10-5332	5	" " " " 3.3K	R18,19,20,21,22
13	10-5392	1	" " " " 3.9K	R31
14	10-5472	3	" " " " 4.7K	R7,13,14
15	10-5103	1	" " " " 10K	R45
16	10-5473	1	" " " " 47K	R48
17	10-5154	1	" " " " 150K	R27
18	10-5105	1	" " " " 1M	R43
19	10-5225	1	" " " " 2.2M	R44
20	10-5156	1	Res, Carbon, 5%, ¼W, 15M	R42
21	19-315103	1	Trimpot, 5%, ¼W, 10K	R49
22	21-101102	1	Cap, Mylar, .001uf	C28
23	21-101683	4	" " .068uf	C24,25,26,27
24	21-101474	1	" " .47uf	C35
25	24-250105	1	Cap, Elec. 1uf, 25V	C38
26	24-250475	1	" " 4.7uf, 25V	C37
27	24-250226	1	" " 22uf, 25V	C36
28	24-250107	1	" " 100uf, 25V	C43
29	27-250102	1	Cap, Cer Disc .001uf, 25V	C2
30	27-250103	2	" " " .01uf, 25V	C1,40
31	27-250104	30	" " " .1uf, 25V	C3-8,11-23,29-34,39, 41,42,C9,10
32	29-011	1	Cap, Cer Mono. .22uf, 12V,	C44
33	31-1N100	2	Diode, 1N100	CR2,4
34	31-1N914	2	" 1N914	CR1,3
35	33-2N3906	2	Transistor, 2N3906	Q1,2
36	34-2N4124	1	" 2N4124	Q3
37	37-4050	1	Int. Ckt. 4050	A6
38	37-74C02	2	" " 74C02	B7,D8

Item	Part Number	Qty.	DESCRIPTION	
39	37-7416	1	INT. CKT. 7416	E7
40	37-74156	1	" " 74156	A/B1
41	37-LM323	1	Regulator LM323	
42	37-LM380	1	OP-AMP LM380	B9
43	62-001	1	Switch, MOM, SPST	SW4
44	66-114P1T	1	Switch, SPST, X4, DIP	SW3
45	66-118P1T	1	" " X8, DIP	SW1
46	69-004	1	Switch, SPDT, SLIDE	SW2
47	72-1608C	2	Screw, Pan Hd, Phil, #6-32 x ½ Lg, Cres	
48	75-016	2	Washer, Flat, #6	
49	75-056	2	Washer, Lock, INT, #6	
50	75-916C	2	Nut, Hex, #6-32, CRES	
51	78-06001	1	Heatsink (LM323)	
52	78-16005	1	Silpad (LM323)	
53	79-42728	1	Socket, 28 PIN, Low Insertion	
54	79-42740	3	Socket, 40 PIN, Low Insertion	
55	C010177-1	1	Crystal, 3.579575 MHZ	
56	C010744	1	Custom IC (TIA)	C2/3
57	C010745	1	IC (6507)	E3
58	C010750	2	IC (PIA 6532)	C4/5,E4/5
59	030929	1	Play 12 Program Rom 0	A/B2
60	030752	1	Play 12 Program Rom 1	A/B3
61	030753	1	Play 12 Program Rom 2	A/B4
62				
63	10-5560	1	Res, Carbon, 5%, 1/4W, 56 Ohm	R51
64	34-2N6044	1	Transistor, 2N6044	Q4

Figure 5-4 Tournament Table PCB Assembly Parts List

ATARI®

-02 Version

Item	Part Number	Qty.	Description	
1	030171-01	1	Printed Circuit Board	
2	10-5 270	1	Res, Carbon, 5%, ¼W, 27 OHM	R4
3	10-5101	2	" " " " 100 "	R1,3
4	10-5151	1	" " " " 150 "	R28
5	10-5221	5	" " " " 220 "	R5,34,35,36,37
6	10-5391	4	" " " " 390 "	R8,9,10,11
7	10-5471	3	" " " " 470 "	R6,46,50
8	10-5102	10	" " " " 1K "	R12,15,16,17,30,38 39,40,41,47
9	10-5152	1	" " " " 1.5K	R33
10	10-5182	5	" " " " 1.8K	R2,23,24,25,26
11	10-5222	2	" " " " 2.2K	R29,32
12	10-5332	5	" " " " 3.3K	R18,19,20,21,22
13	10-5392	1	" " " " 3.9K	R31
14	10-5472	3	" " " " 4.7K	R7,13,14
15	10-5103	1	" " " " 10K	R45
16	10-5473	1	" " " " 47K	R48
17	10-5154	1	" " " " 150K	R27
18	10-5105	1	" " " " 1M	R43
19	10-5225	1	" " " " 2.2M	R44
20	10-5156	1	Res, Carbon, 5%, ¼W, 15M	R42
21	19-315103	1	Trimpot, 5%, ¼W, 10K	R49
22	21-101102	1	Cap, Mylar, .001uf	C28
23	21-101683	4	" " .068uf	C24,25,26,27
24	21-101474	1	" " .47uf	C35
25	24-250105	1	Cap, Elec. 1uf, 25V	C38
26	24-250475	1	" " 4.7uf, 25V	C37
27	24-250226	1	" " 22uf, 25V	C36
28	24-250107	1	" " 100uf, 25V	C43
29	27-250102	1	Cap, Cer Disc .001uf, 25V	C2
30	27-250103	2	" " " .01uf, 25V	C1,40
31	27-250104	30	" " " .1uf, 25V	C3-8,11-23,29-34,39, 41,42, C9,10
32	29-011	1	Cap, Cer Mono. .22uf, 12V,	C44
33	31-1N100	2	Diode, 1N100	CR2,4
34	31-1N914	2	" 1N914	CR1,3
35	33-2N3906	2	Transistor, 2N3906	Q1,2
36	34-2N4124	1	" 2N4124	Q3
37	37-4050	1	Int. Ckt. 4050	A6
38	37-74C02	2	" " 74C02	B7,D8

Item	Part Number	Qty.	DESCRIPTION	
39	37-7416	1	INT. CKT. 7416	E7
40	37-74156	1	" " 74156	A/B1
41	37-LM323	1	Regulator LM323	
42	37-LM380	1	OP-AMP LM380	B9
43	62-001	1	Switch, MOM, SPST	SW4
44	66-114P1T	1	Switch, SPST, X4, DIP	SW3
45	66-118P1T	1	" " X8, DIP	SW1
46	69-004	1	Switch, SPDT, SLIDE	SW2
47	72-1608C	2	Screw, Pan Hd, Phil, #6-32 x ½ Lg, CRES	
48	75-016	2	Washer, Flat, #6	
49	75-056	2	Washer, Lock, INT, #6	
50	75-916C	2	Nut, Hex, #6-32, CRES	
51	78-06001	1	Heatsink (LM323)	
52	78-16005	1	Silpad (LM323)	
53	79-4278	1	Socket, 28 Pin, Low Insertion	
54	79-4270	3	Socket, 40 Pin, Low Insertion	
55	C010177-1	1	Crystal, 3.579575 MHZ	
56	C010744	1	Custon 1C (TIA)	C2/3
57	C010745	1	IC (6507)	E3
58	C010750	2	IC (PIA6532)	C4/5, E4/5
59	030752	1	Play 12 Program ROM 1	A/B3
60	030753	1	Play 12 Program ROM 2	A/B4
61	030754	1	Play 12 Program PROM 0	A5
62	030755	1	Play 12 Program PROM 0	B5
63				
64	10-5560	1	Res, Carbon, 5%, 1/4W, 56 Ohm	R51
65	34-2N6044	1	Transistor, 2N6044	Q4

Figure 5-4 Tournament Table PCB Assembly Parts List

ATARI®

-03 Version

Item	Part Number	Qty.	Description	
1	030171-01	1	Printed Circuit Board	
2	10-5270	1	Res, Carbon, 5%, ¼W, 27 OHM	R4
3	10-5101	2	" " " " 100 "	R1,3
4	10-5151	1	" " " " 150 "	R28
5	10-5221	5	" " " " 220 "	R5,34,35,36,37
6	10-5391	4	" " " " 390 "	R8,9,10,11
7	10-5471	3	" " " " 470 "	R6,46,50
8	10-5102	10	" " " " 1K "	R12,15,16,17,30,38 39,40,41,47
9	10-5152	1	" " " " 1.5K	R33
10	10-5182	5	" " " " 1.8K	R2,23,24,25,26
11	10-5222	2	" " " " 2.2K	R29,32
12	10-5332	5	" " " " 3.3K	R18,19,20,21,22
13	10-5392	1	" " " " 3.9K	R31
14	10-5472	3	" " " " 4.7K	R7,13,14
15	10-5103	1	" " " " 10K	R45
16	10-5473	1	" " " " 47K	R48
17	10-5154	1	" " " " 150K	R27
18	10-5105	1	" " " " 1M	R43
19	10-5225	1	" " " " 2.2M	R44
20	10-5156	1	Res, Carbon, 5%, ¼W, 15M	R42
21	19-315103	1	Trimpot, 5%, ½W, 10K	R49
22	21-101102	1	Cap, Mylar, .001uf	C28
23	21-101683	4	" " .068uf	C24,25,26,27
24	21-101474	1	" " .47uf	C35
25	24-250105	1	Cap, Elec. 1uf, 25V	C38
26	24-250475	1	" " 4.7uf, 25V	C37
27	24-250226	1	" " 22uf, 25V	C36
28	24-250107	1	" " 100uf, 25V	C43
29	27-250102	1	Cap, Cer Disc .001uf, 25V	C2
30	27-250103	2	" " " .01uf, 25V	C1,40
31	27-250104	30	" " " .1uf, 25V	C3-8,11-23,29-34,39, 41,42,C9,10
32	29-011	1	Cap, Cer Mono. .22uf, 12V,	C44
33	31-1N100	2	Diode, 1N100	CR2,4
34	31-1N914	2	" 1N914	CR1,3
35	33-2N3906	2	Transistor, 2N3906	Q1,2
36	34-2N4124	1	" 2N4124	Q3
37	37-4050	1	Int. Ckt. 4050	A6
38	37-74C02	2	" " 74C02	B7,D8

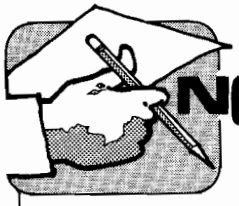
Item	Part Number	Qty.	DESCRIPTION	
39	37-7416	1	INT. CKT. 7416	E7
40	37-74156	1	" " 74156	A/B1
41	37-LM323	1	Regulator LM323	
42	37-LM380	1	OP-AMP LM380	B9
43	62-001	1	Switch, MOM, SPST	SW4
44	66-114P1T	1	Switch, SPST, X4, DIP	SW3
45	66-118P1T	1	" " X8, DIP	SW1
46	69-004	1	Switch, SPDT, SLIDE	SW2
47	72-1608C	2	Screw, Pan Hd, Phil, #6-32 x ½ Lg, CRES	
48	75-016	2	Washer, Flat, #6	
49	75-056	2	Washer, Lock, INT, #6	
50	75-916C	2	Nut, Hex, #6-32, CRES	
51	78-06001	1	Heatsink (LM323)	
52	78-16005	1	Silpad (LM323)	
53	79-4278	1	Socket, 28 Pin, Low Insertion	
54	79-4270	3	Socket, 40 Pin, Low Insertion	
55	C010177-1	1	Crystal, 3.579575 MHZ	
56	C010744	1	Custon 1C (TIA)	C2/3
57	C010745	1	IC (6507)	E3
58	C010750	2	IC (PIA6532)	C4/5, E4/5
59	030929	1	Play 12 Program ROM 0	A/B2
60	030753	1	Play 12 Program ROM 2	A/B4
61	030756	1	Play 12 Program PROM 1	A5
62	030757	1	Play 12 Program PROM 1	B5
63				
64	10-5560	1	Res, Carbon, 5%, 1/4W, 56 Ohm	R51
65	34-2N6044	1	Transistor, 2N6044	Q4

Figure 5-4 Tournament Table PCB Assembly Parts List

ATARI® -04 Version

Item	Part Number	Qty.	Description	
1	030171-01	1	Printed Circuit Board	
2	10-5270	1	Res, Carbon, 5%, ¼W, 27 OHM	R4
3	10-5101	2	" " " " 100 "	R1,3
4	10-5151	1	" " " " 150 "	R28
5	10-5221	5	" " " " 220 "	R5,34,35,36,37
6	10-5391	4	" " " " 390 "	R8,9,10,11
7	10-5471	3	" " " " 470 "	R6,46,50
8	10-5102	10	" " " " 1K "	R12,15,16,17,30,38 39,40,41,47
9	10-5152	1	" " " " 1.5K	R33
10	10-5182	5	" " " " 1.8K	R2,23,24,25,26
11	10-5222	2	" " " " 2.2K	R29,32
12	10-5332	5	" " " " 3.3K	R18,19,20,21,22
13	10-5392	1	" " " " 3.9K	R31
14	10-5472	3	" " " " 4.7K	R7,13,14
15	10-5103	1	" " " " 10K	R45
16	10-5473	1	" " " " 47K	R48
17	10-5154	1	" " " " 150K	R27
18	10-5105	1	" " " " 1M	R43
19	10-5225	1	" " " " 2.2M	R44
20	10-5150	1	Res, Carbon, 5%, ¼W, 15M	R42
21	19-315103	1	Trimpot, 5%, ¼W, 10K	R49
22	21-101102	1	Cap, Mylar, .001uf	C28
23	21-101683	4	" " .068uf	C24,25,26,27
24	21-101474	1	" " .47uf	C35
25	24-250105	1	Cap, Elec. 1uf, 25V	C38
26	24-250475	1	" " 4.7uf, 25V	C37
27	24-250226	1	" " 22uf, 25V	C36
28	24-250107	1	" " 100uf, 25V	C43
29	27-250102	1	Cap, Cer Disc .001uf, 25V	C2
30	27-250103	2	" " " .01uf, 25V	C1,40
31	27-250104	30	" " " .1uf, 25V	C3-8,11-23,29-34,39, 41,42,C9,10
32	29-011	1	Cap, Cer Mono. .22uf, 12V,	C44
33	31-1N100	2	Diode, 1N100	CR2,4
34	31-1N914	2	" 1N914	CR1,3
35	33-2N3906	2	Transistor, 2N3906	Q1,2
36	34-2N4124	1	" 2N4124	Q3
37	37-4050	1	Int. Ckt. 4050	A6
38	37-74C02	2	" " 74C02	B7,D8

Item	Part Number	Qty.	DESCRIPTION	
39	37-7416	1	INT. CKT. 7416	E7
40	37-74156	1	" " 74156	A/B1
41	37-LM323	1	Regulator LM323	
42	37-LM380	1	OP-AMP LM380	B9
43	62-001	1	Switch, MOM, SPST	SW4
44	66-114P1T	1	Switch, SPST, X4, DIP	SW3
45	66-118P1T	1	" " X8, DIP	SW1
46	69-004	1	Switch, SPDT, SLIDE	SW2
47	72-1608C	2	Screw, Pan Hd, Phil, #6-32 x ½ Lg, CRES	
48	75-016	2	Washer, Flat, #6	
49	75-056	2	Washer, Lock, INT, #6	
50	75-916C	2	Nut, Hex, #6-32, CRES	
51	78-06001	1	Heatsink (LM323)	
52	78-16005	1	Silpad (LM323)	
53	79-4278	1	Socket, 28 Pin, Low Insertion	
54	79-4270	3	Socket, 40 Pin, Low Insertion	
55	C010177-1	1	Crystal, 3.579575 MHZ	
56	C010744	1	Custon 1C (TIA)	C2/3
57	C010745	1	IC (6507)	E3
58	C010750	2	IC (PIA6532)	C4/5, E4/5
59	030929	1	Play 12 Program ROM 0	A/B2
60	030752	1	Play 12 Program ROM 1	A/B3
61	030758	1	Play 12 Program PROM 2	A5
62	030759	1	Play 12 Program PROM 2	B5
63				
64	10-5560	1	Res, Carbon, 5%, 1/4W, 56 Ohm	R51
65	34-2N6044	1	Transistor , 2N6044	Q4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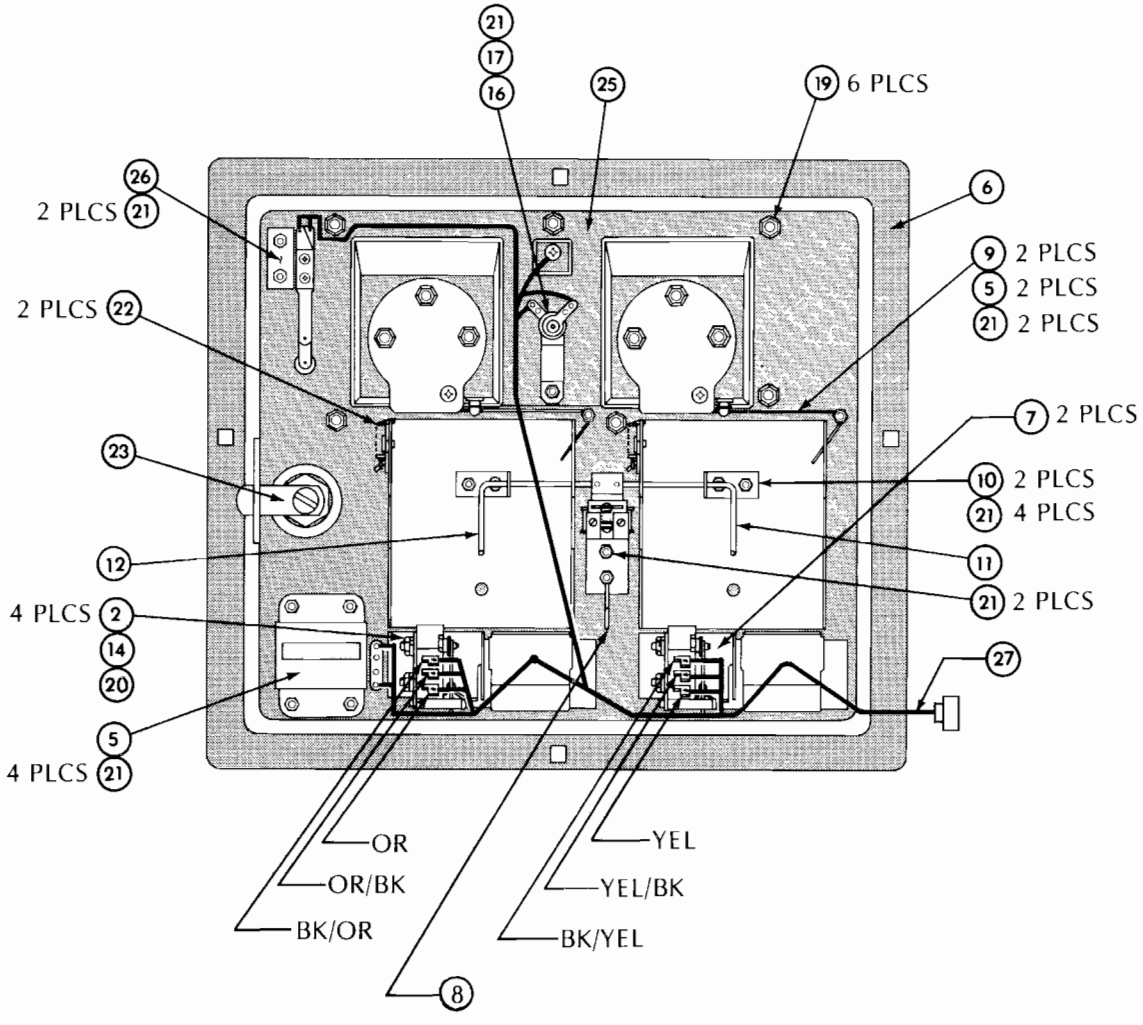


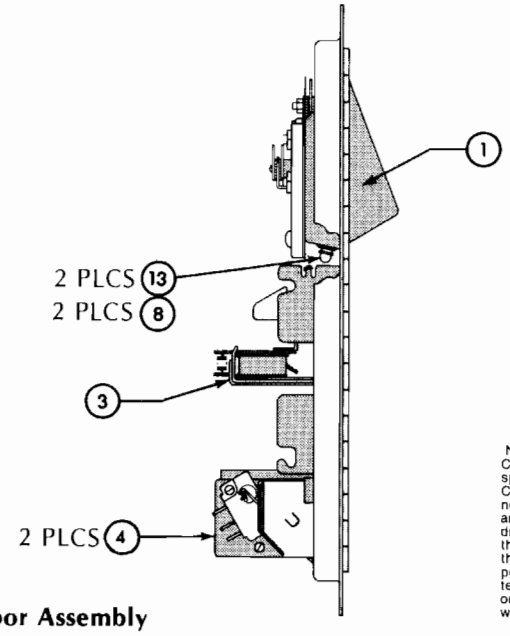


Figure 5-5 Coin Door Assembly A006794-01 through -07 F

Figure 5-5 Coin Door Assembly Parts List

ATARI®

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	A007639-01	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

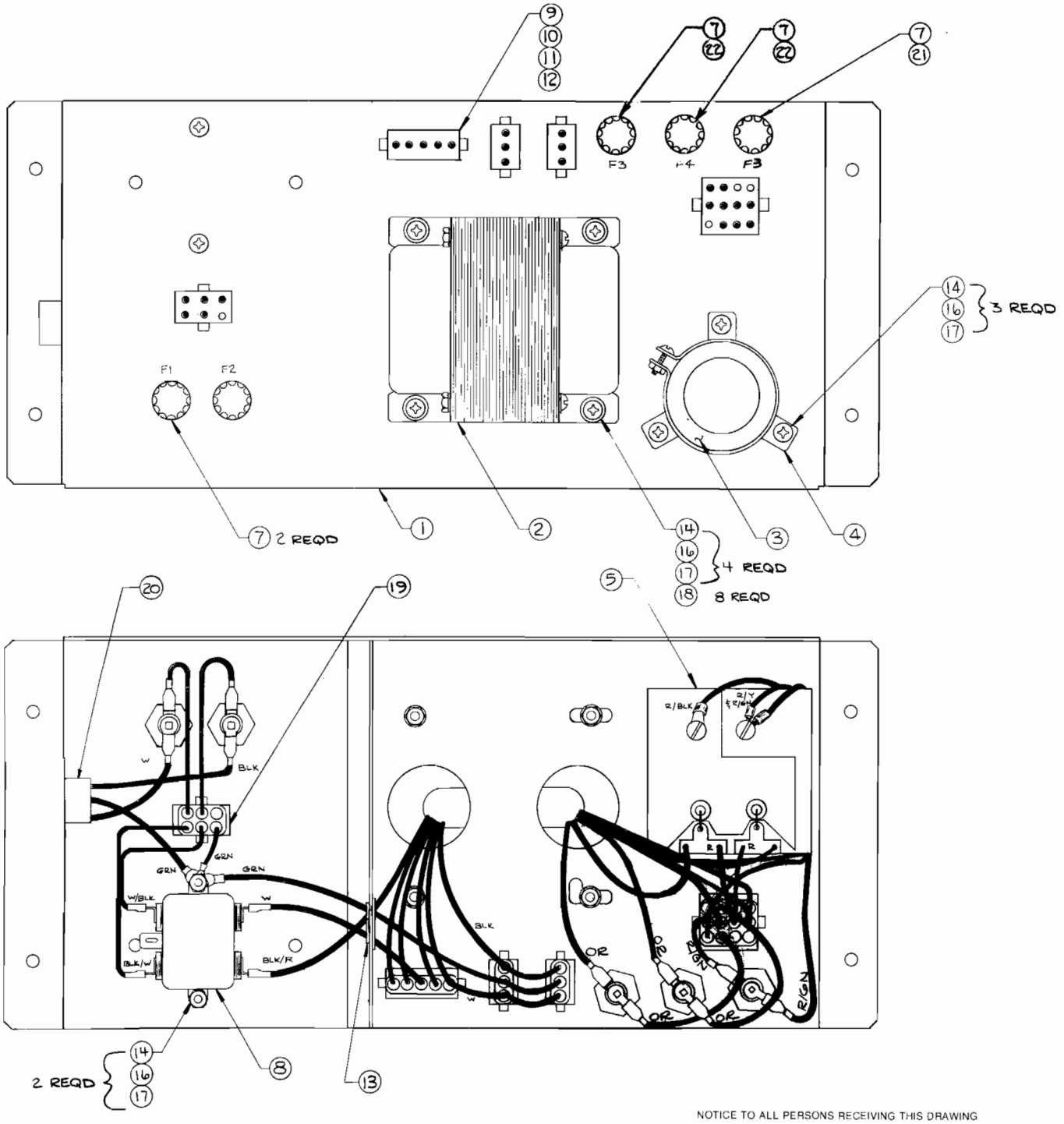


Figure 5-6 Power Supply Assembly A007197-01 H

Figure 5-6 Power Supply Assembly Parts List

Item	Part Number	Qty.	Description
1	A009266-01	1	Power Supply Base Weldment Assembly
2	A006886-01	1	Transformer Termination Assembly "Type B"
3	29-053	1	Cap., Sprague Electrolytic 26,000uf @ 15V
4	78-70501SC	1	Brkt., Cap. Mtg. Sprague #4586-48
5	A006555-01	1	P.C. Board Rectifier
6			
7	79-4411004	5	Fuse Holder, Panel Mounting
8	41-2003	1	Filter, Power Line, 5 AMP
9	A006958-01	A/R	Volt Sel Block 95V
10	A006958-02	"	Volt Sel Block 110V
11	A006958-03	"	Volt Sel Block 205V
12	A006958-04	"	Volt Sel Block 220V
13	78-2708	1	Grommet,Plastic
14	72-1810S	9	Screw Pan Hd., #8-32 x 5/8"Lg.
15			
16	75-048	9	Washer, Split-Lock #8
17	75-918S	9	Nut Hex #8
18	75-018S	8	Washer Flat #8
19	A007192-01	1	Power Switch Termination
20	A007444-01	1	Power In Harness
21	46-203801	1	Fuse, 8 AMP, 125V, 3 AG Fast Acting
22	46-201251	2	Fuse, 2½ AMP, 125V, Slow Acting

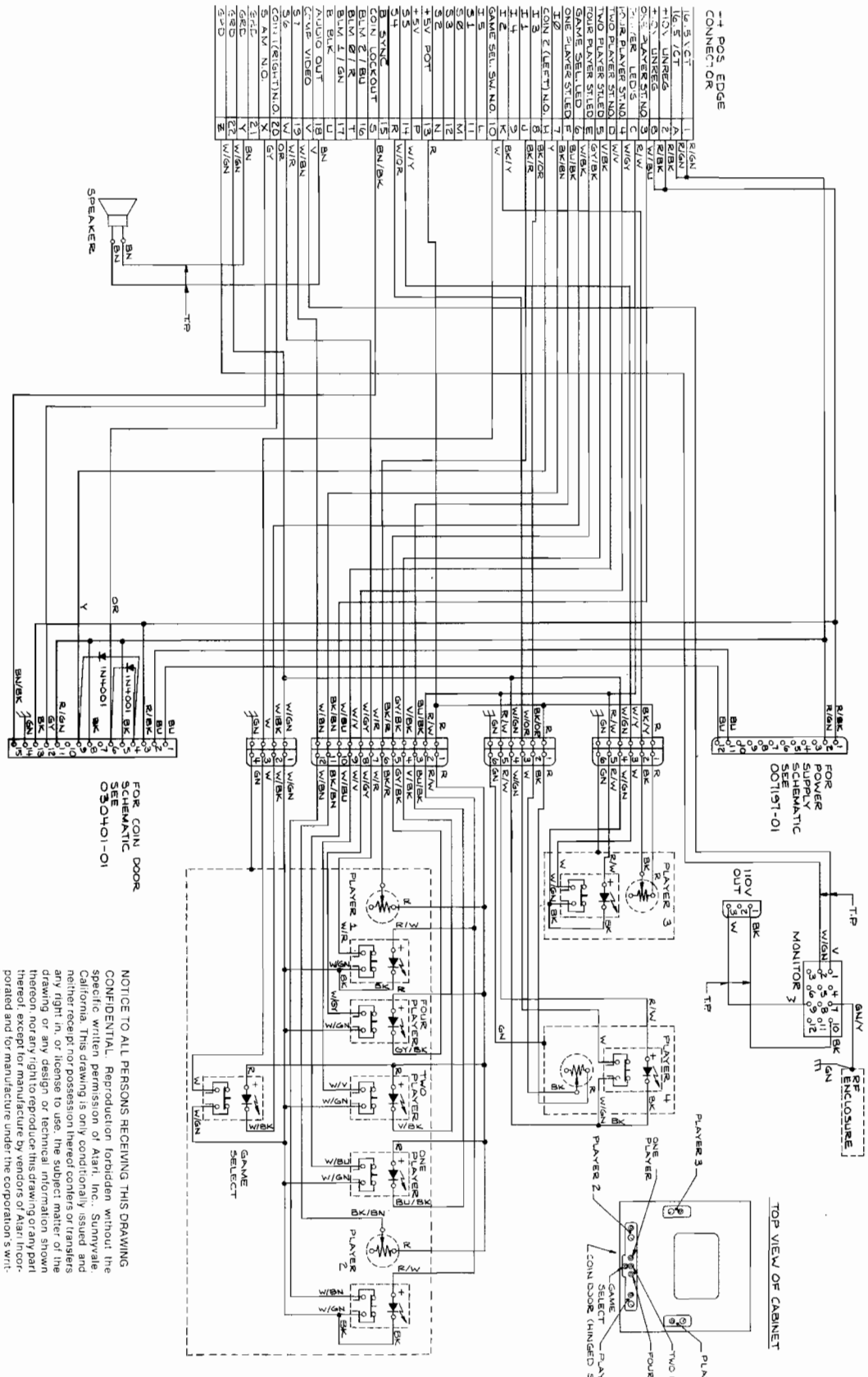
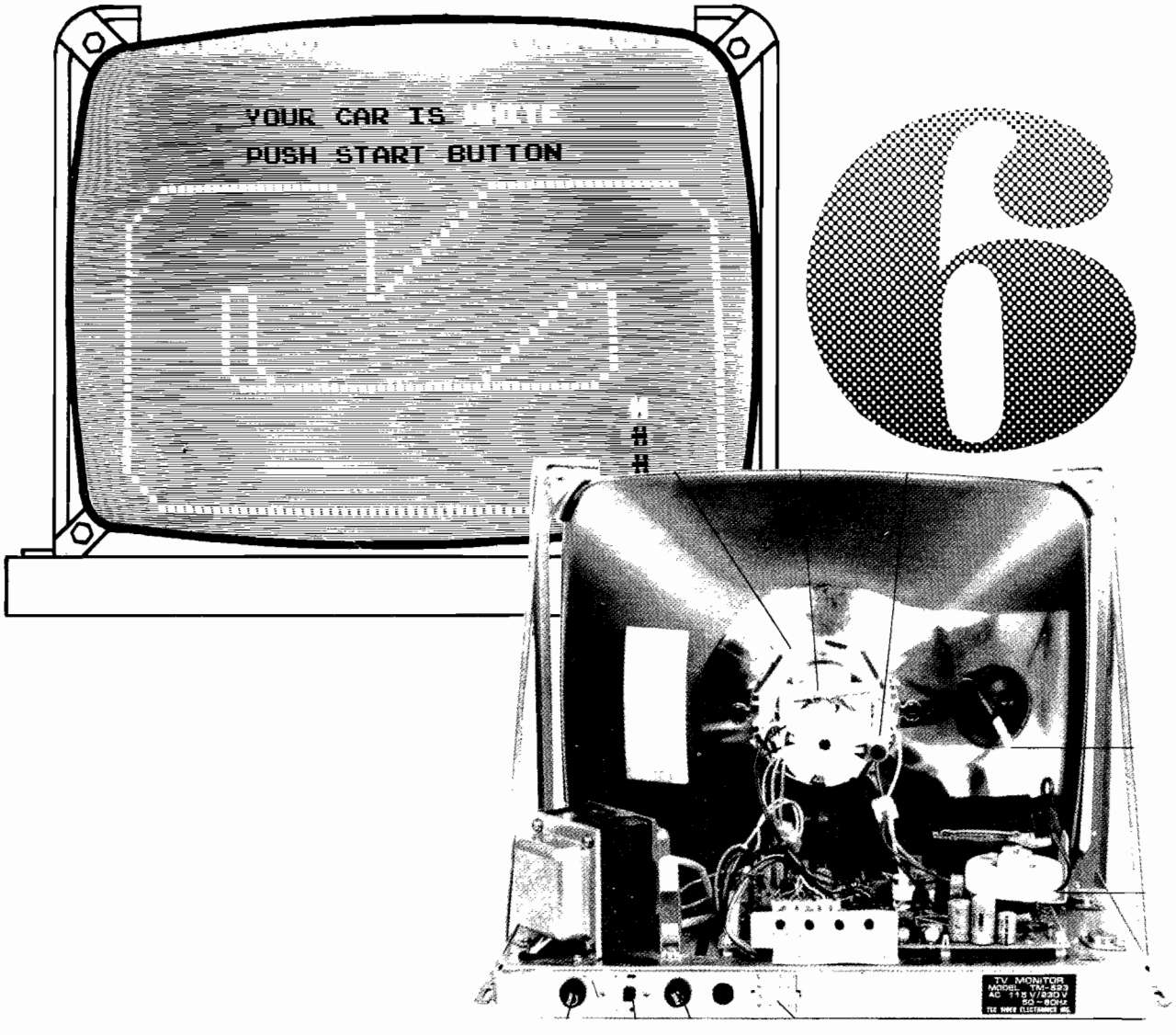


Figure 5-7 Harness Schematic



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 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.

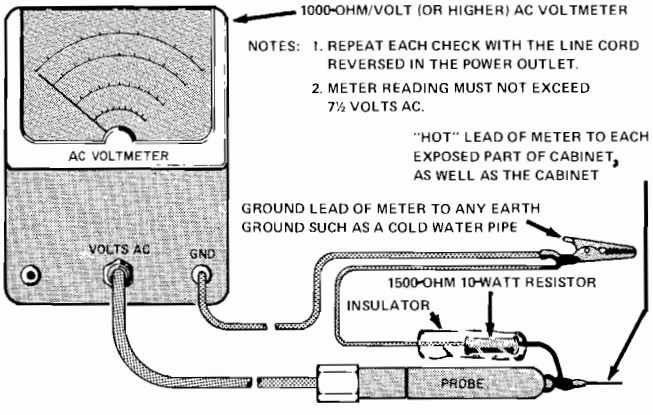
4. An *isolation transformer* should always be used during the servicing of a unit whose chassis is connected to one side of the power line. Use a transformer of adequate power rating as this protects the serviceman from accidents resulting in personal injury from electrical shocks. It will also protect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

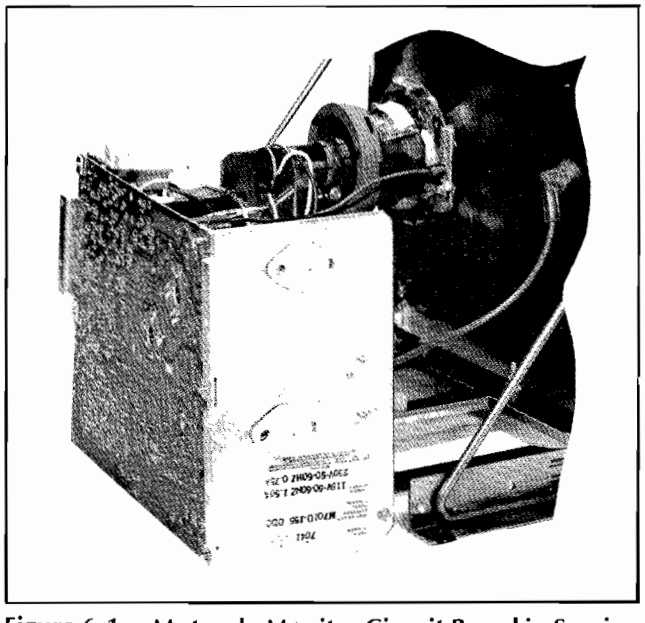


Figure 6-1 Motorola Monitor Circuit Board in Service Position

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

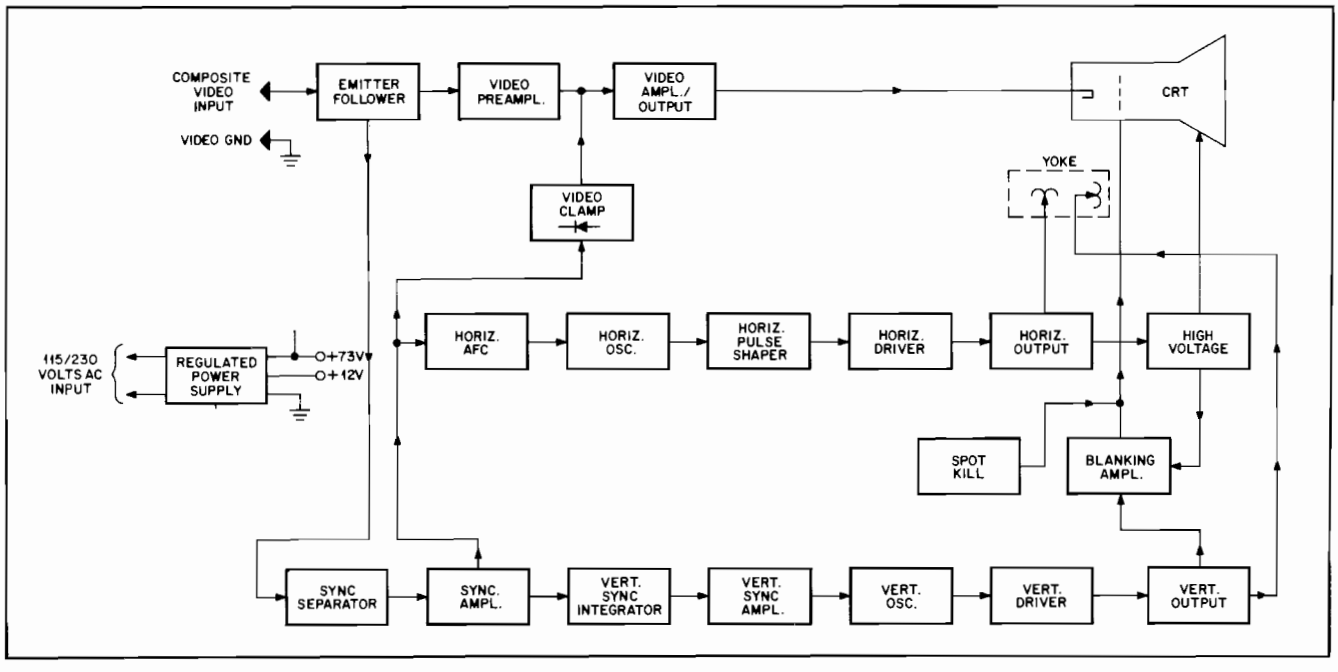


Figure 6-2 Motorola Monitor Block Diagram

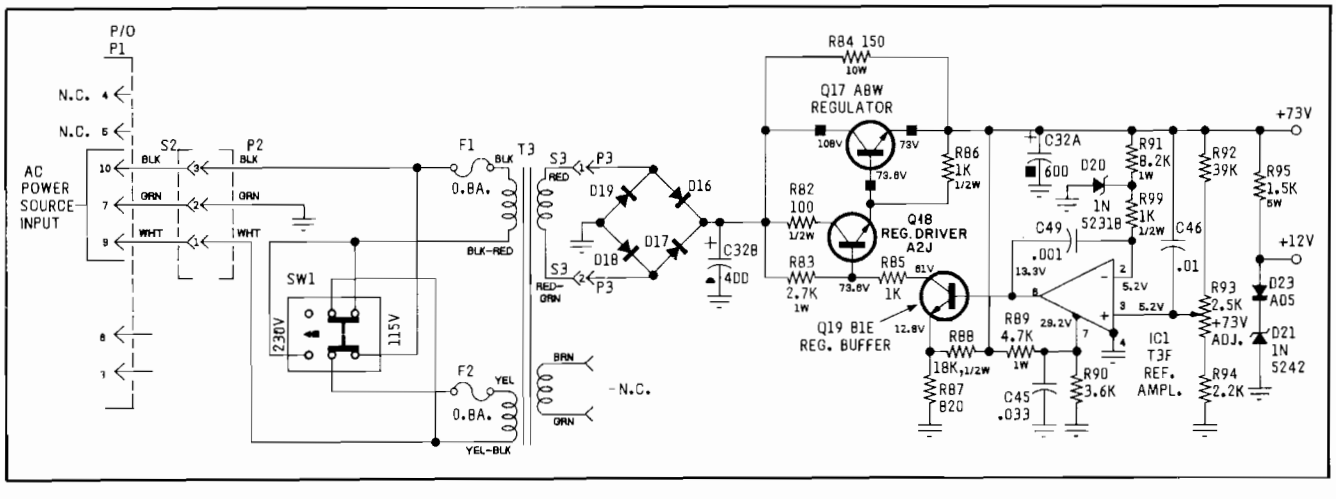


Figure 6-3 +73 Volt Supply Circuit

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.

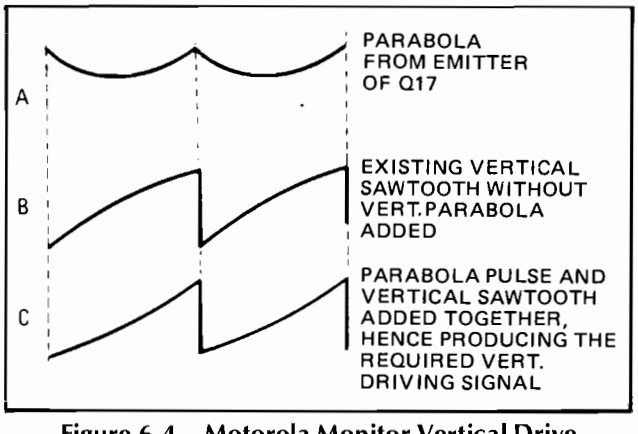


Figure 6-4 Motorola Monitor Vertical Drive Waveform

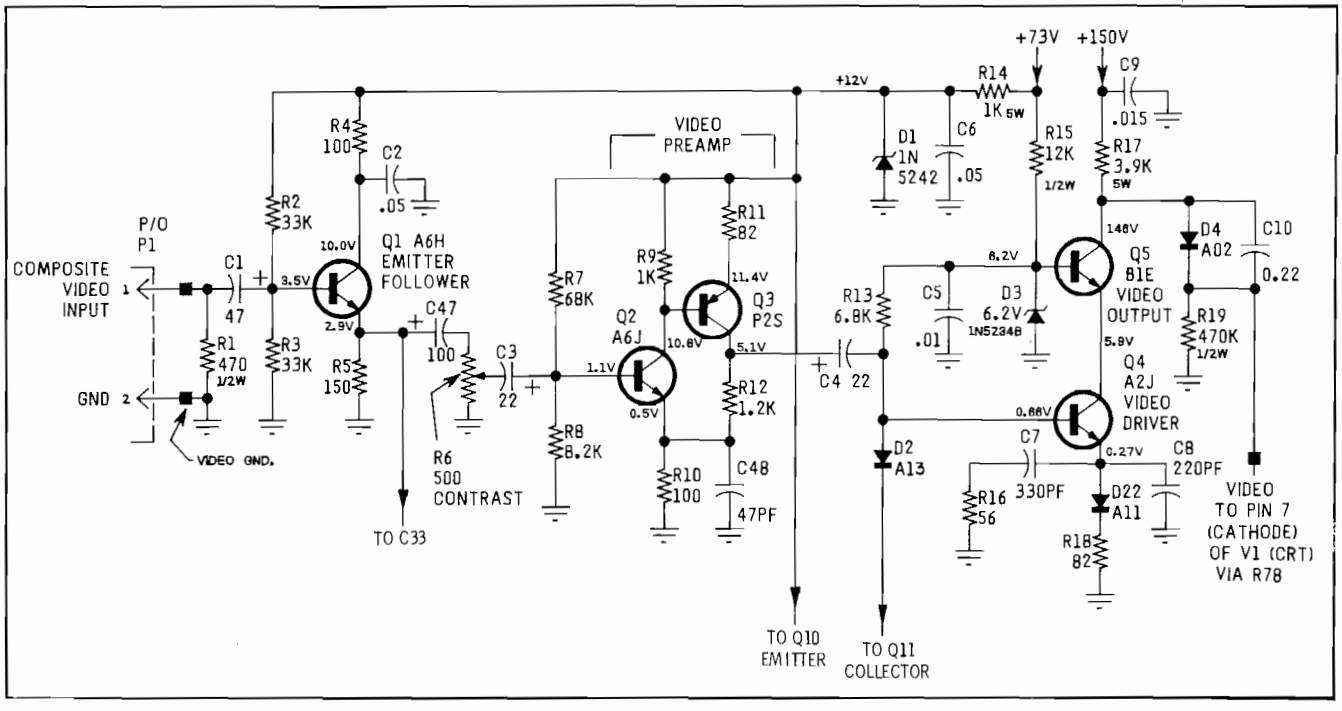


Figure 6-5 Motorola Monitor Video Amplifiers and Output Circuit

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.

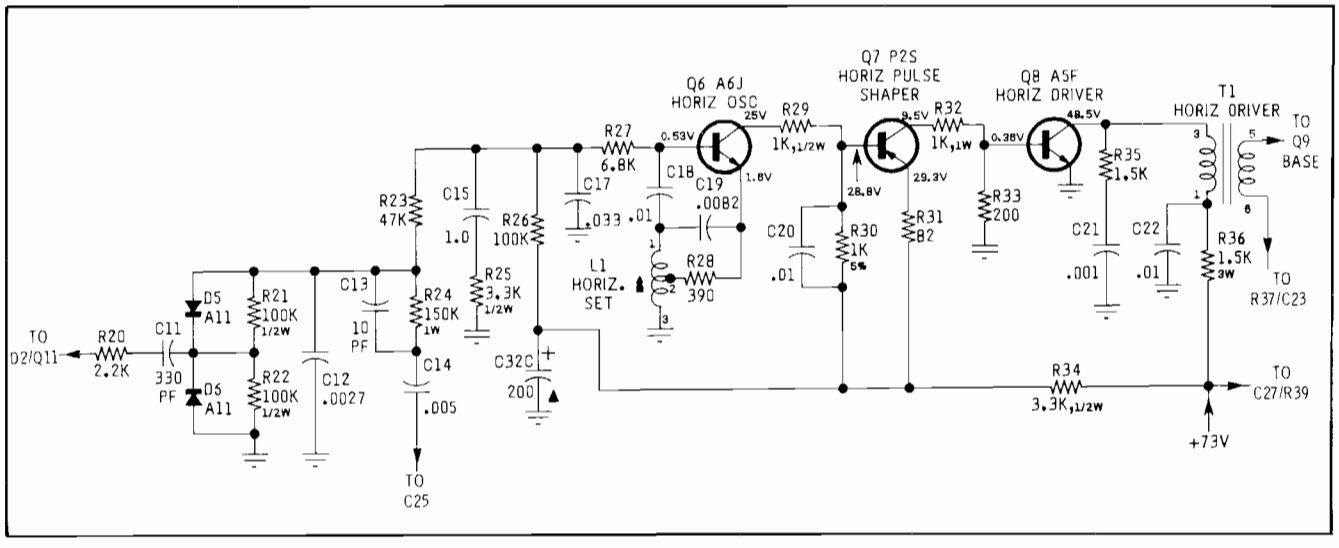


Figure 6-6 Motorola Monitor Horizontal Deflection Circuit

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 comprise 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.

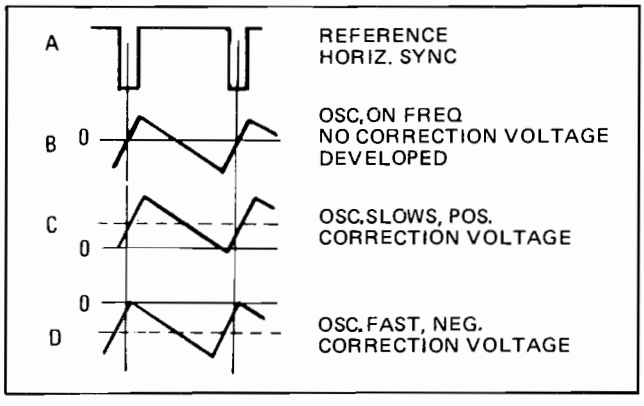


Figure 6-7 Motorola Monitor Horizontal Deflection Waveforms

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.

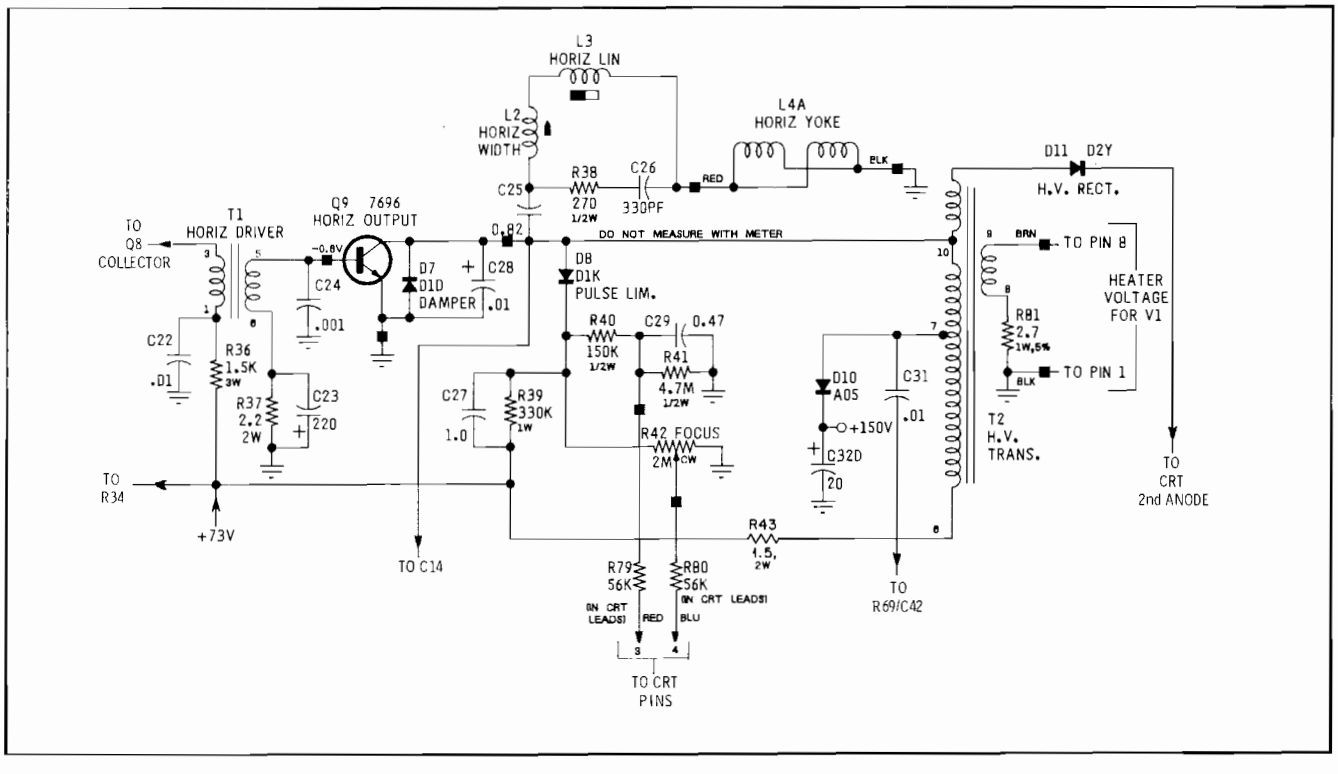


Figure 6-8 Motorola Monitor Horizontal Output Circuit

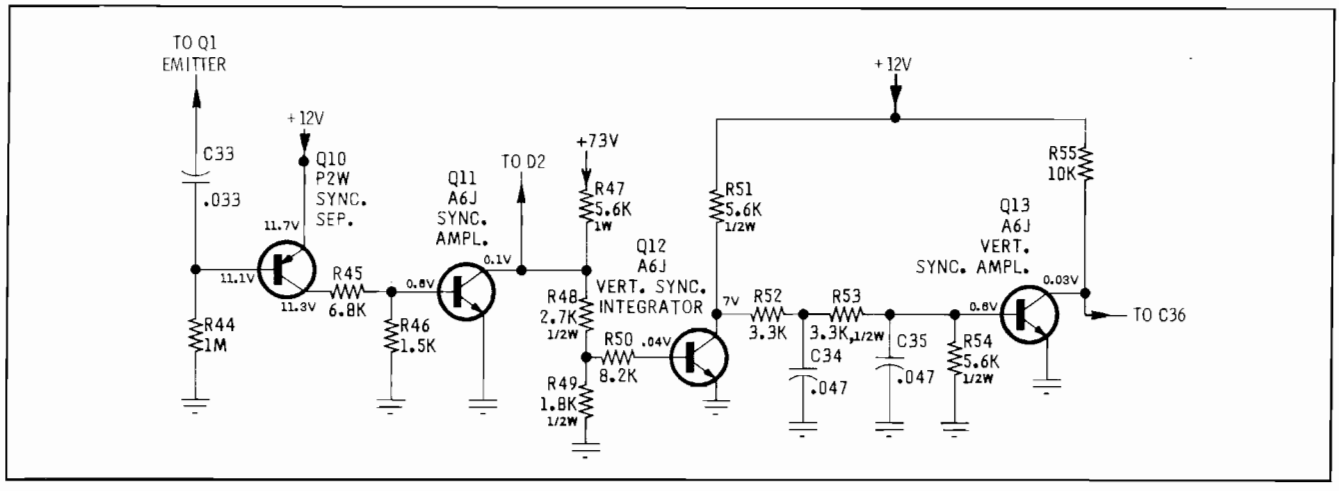


Figure 6-9 Motorola Monitor Sync Circuit

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

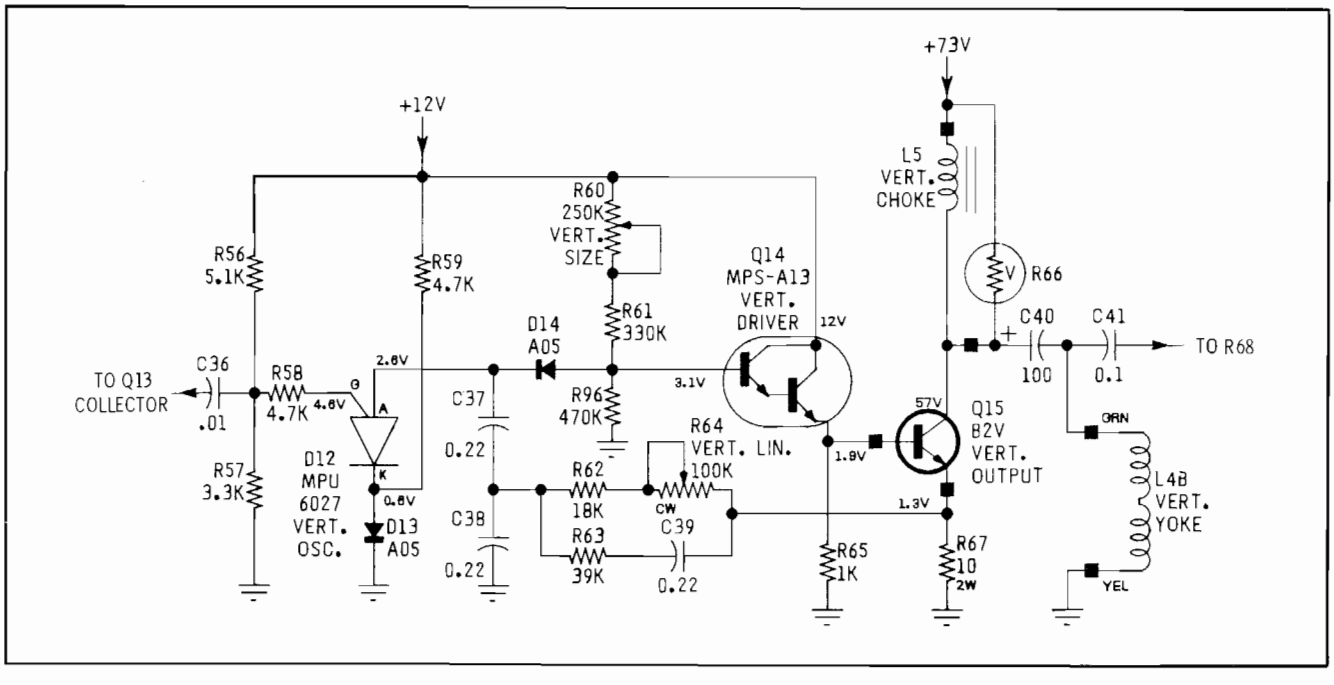


Figure 6-10 Motorola Monitor Vertical Oscillator Circuit

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

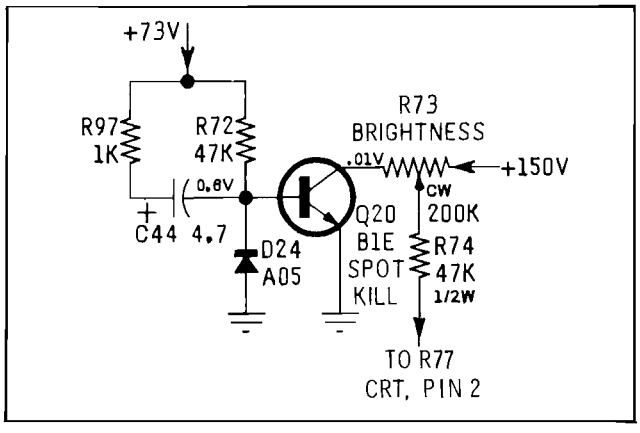


Figure 6-11 Motorola Monitor Spot Killer Circuit

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.

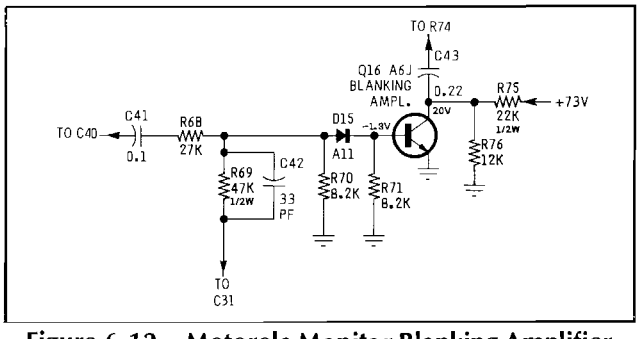


Figure 6-12 Motorola Monitor Blanking Amplifier Circuit

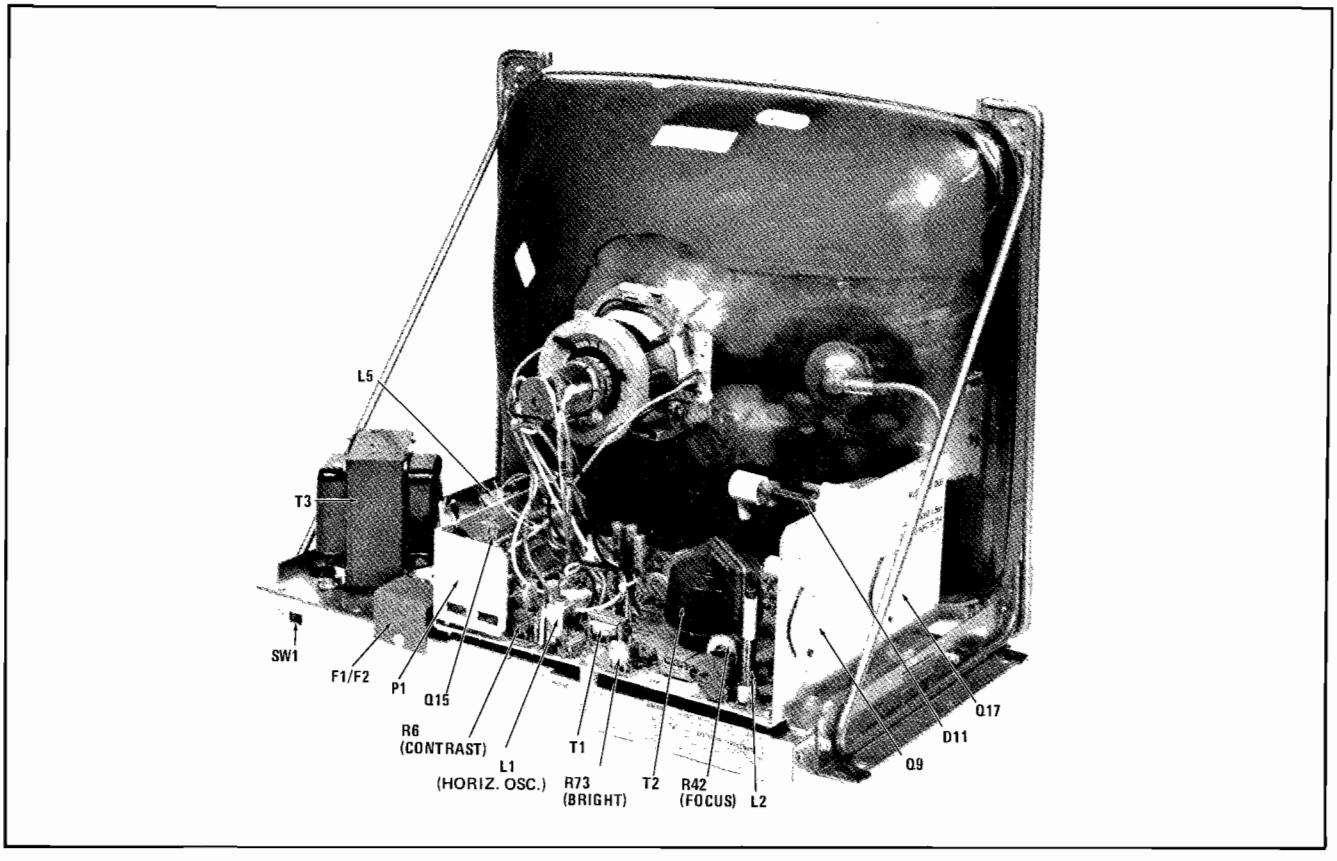


Figure 6-13 Motorola Monitor Chassis Rear View —Component Location

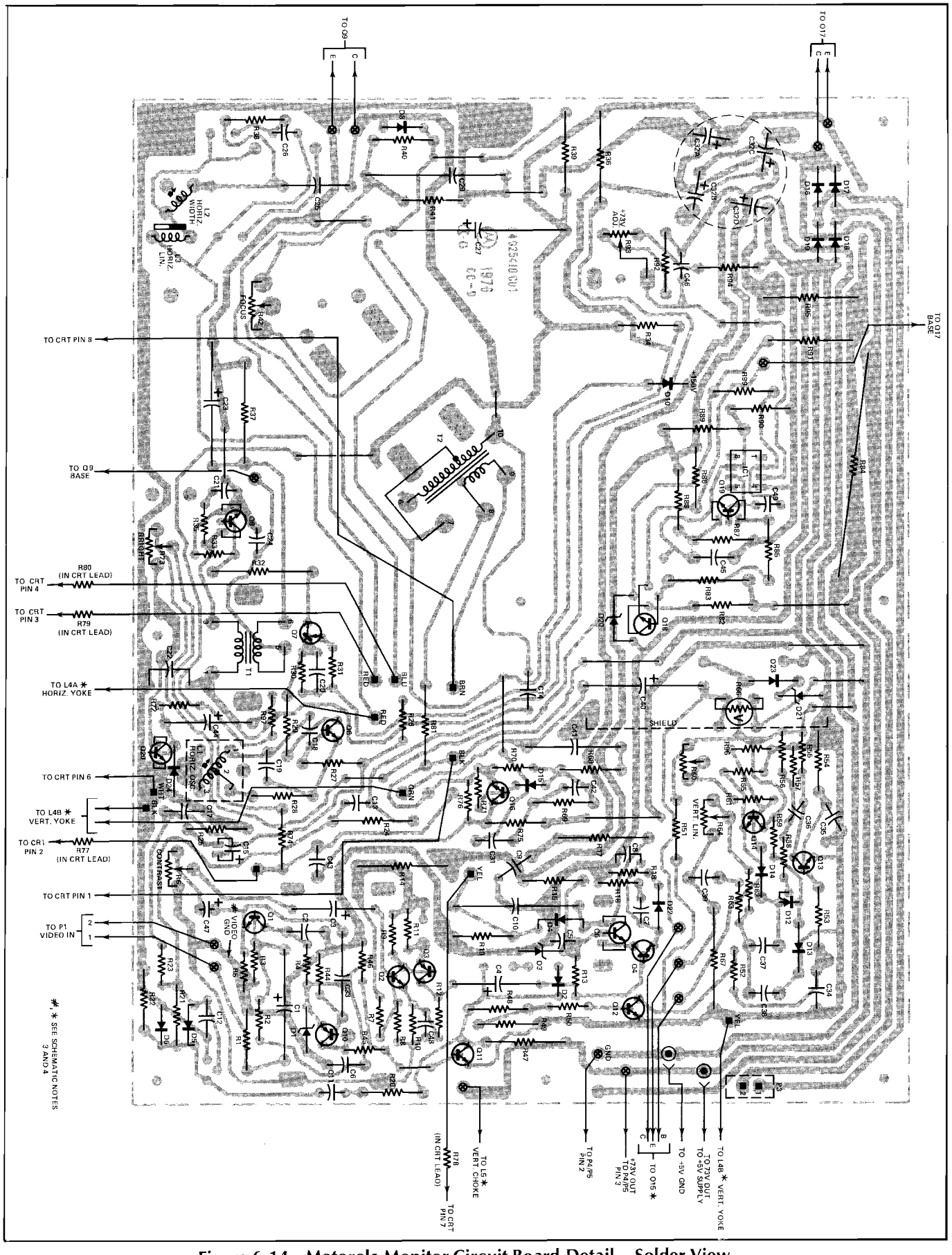


Figure 6-14 Motorola Monitor Circuit Board Detail—Solder View

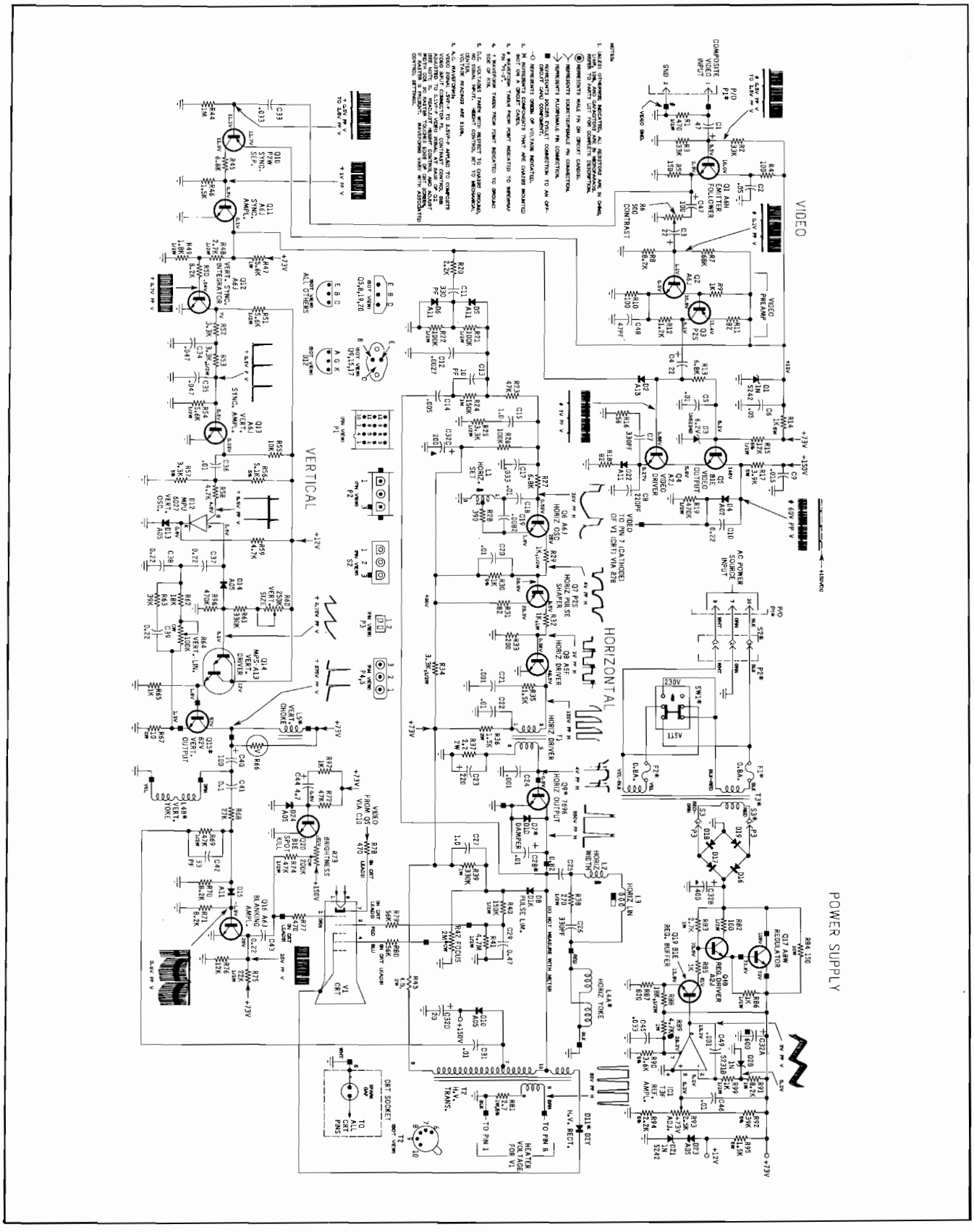


Figure 6-15 Motorola Monitor Schematic Diagram

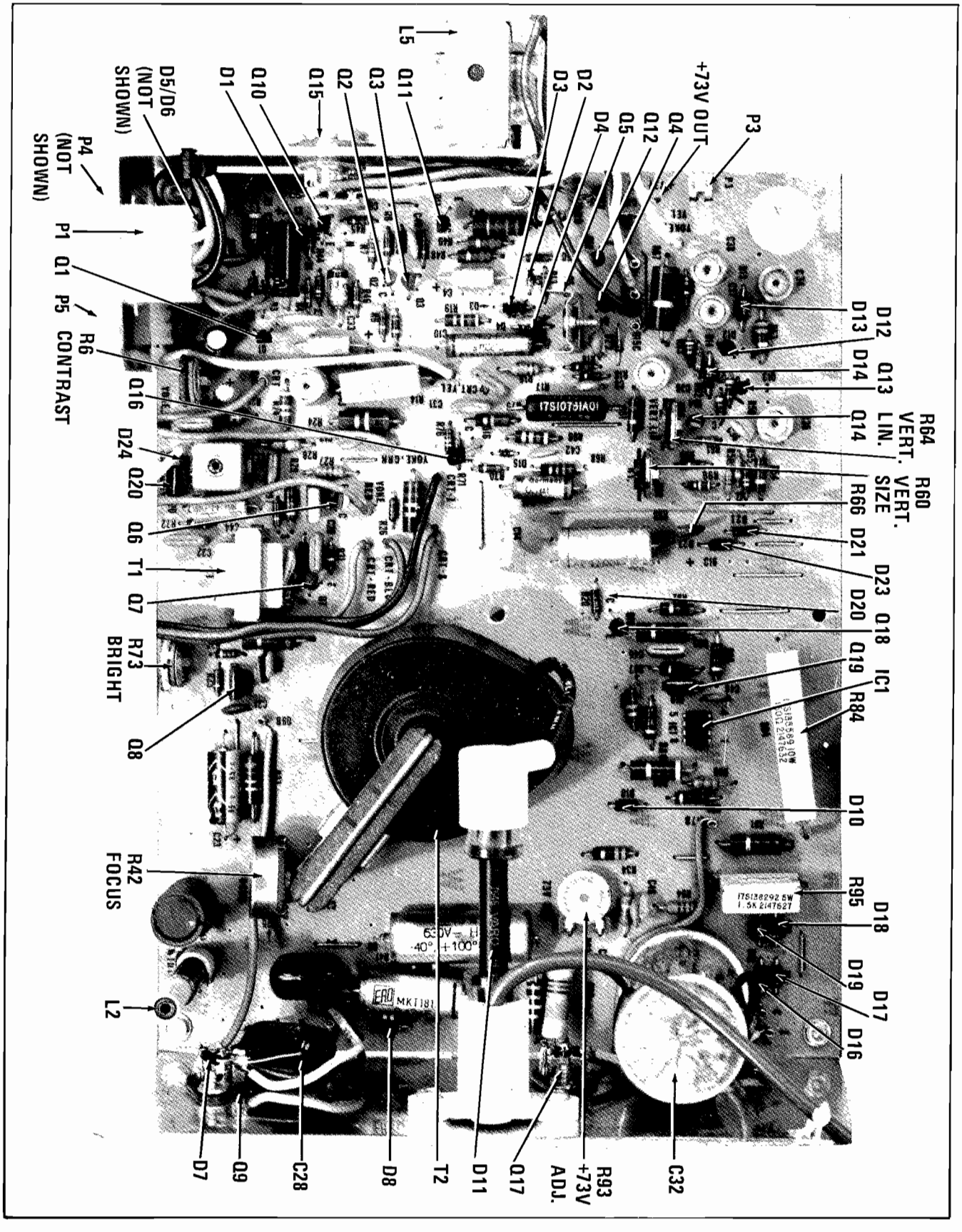


Figure 6-16 Motorola Monitor Circuit Board Detail—Component Location

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

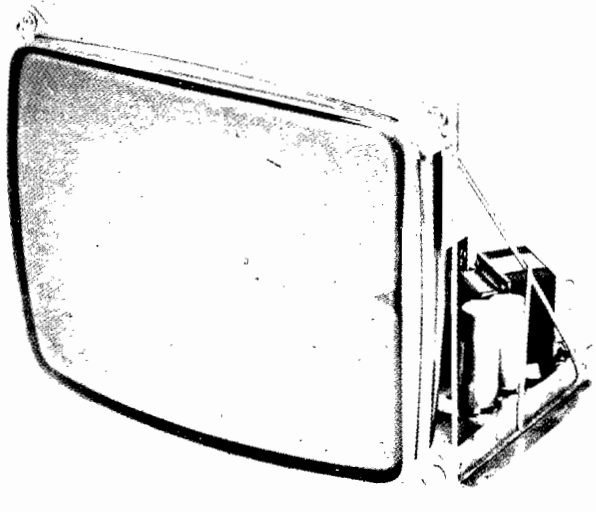
Horizontal Retrace Time
12 microseconds maximum

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

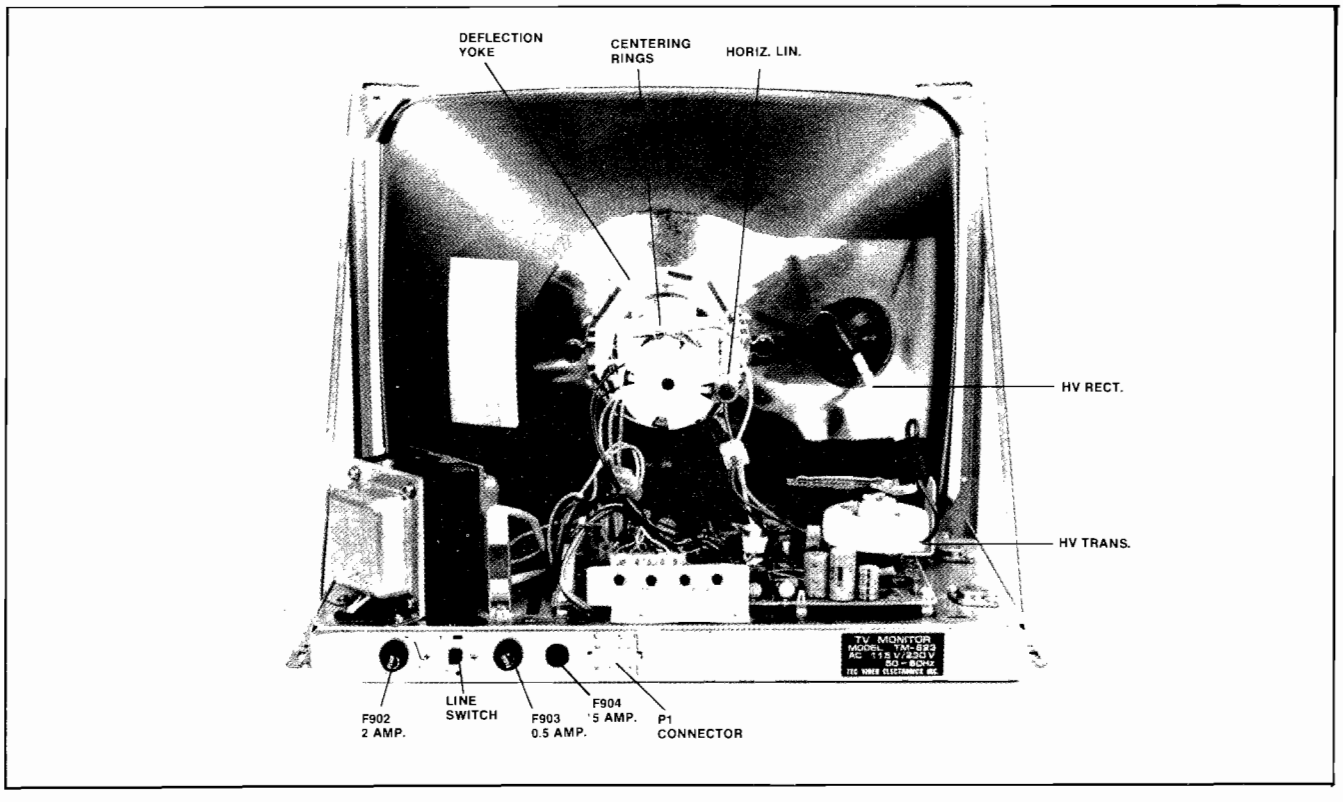


Figure 6-17 TEC Monitor Chassis, Rear View

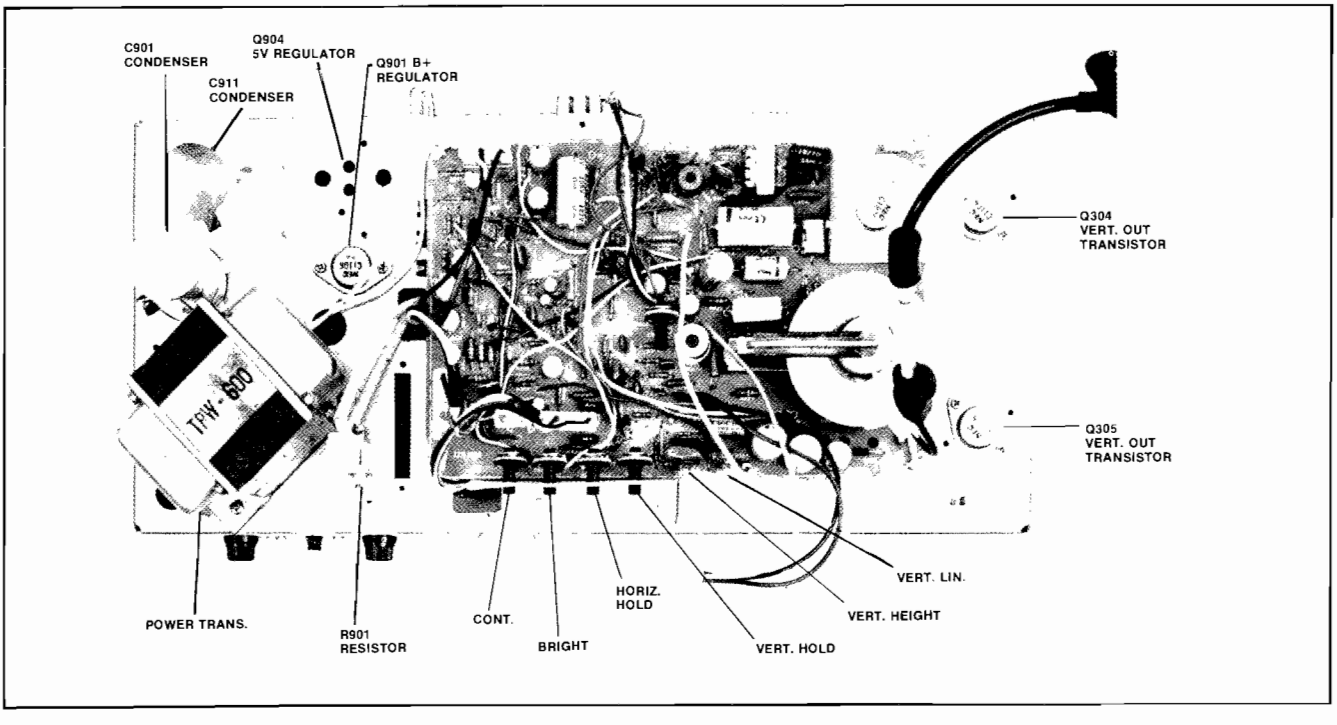


Figure 6-18 TEC Monitor Chassis, Top View

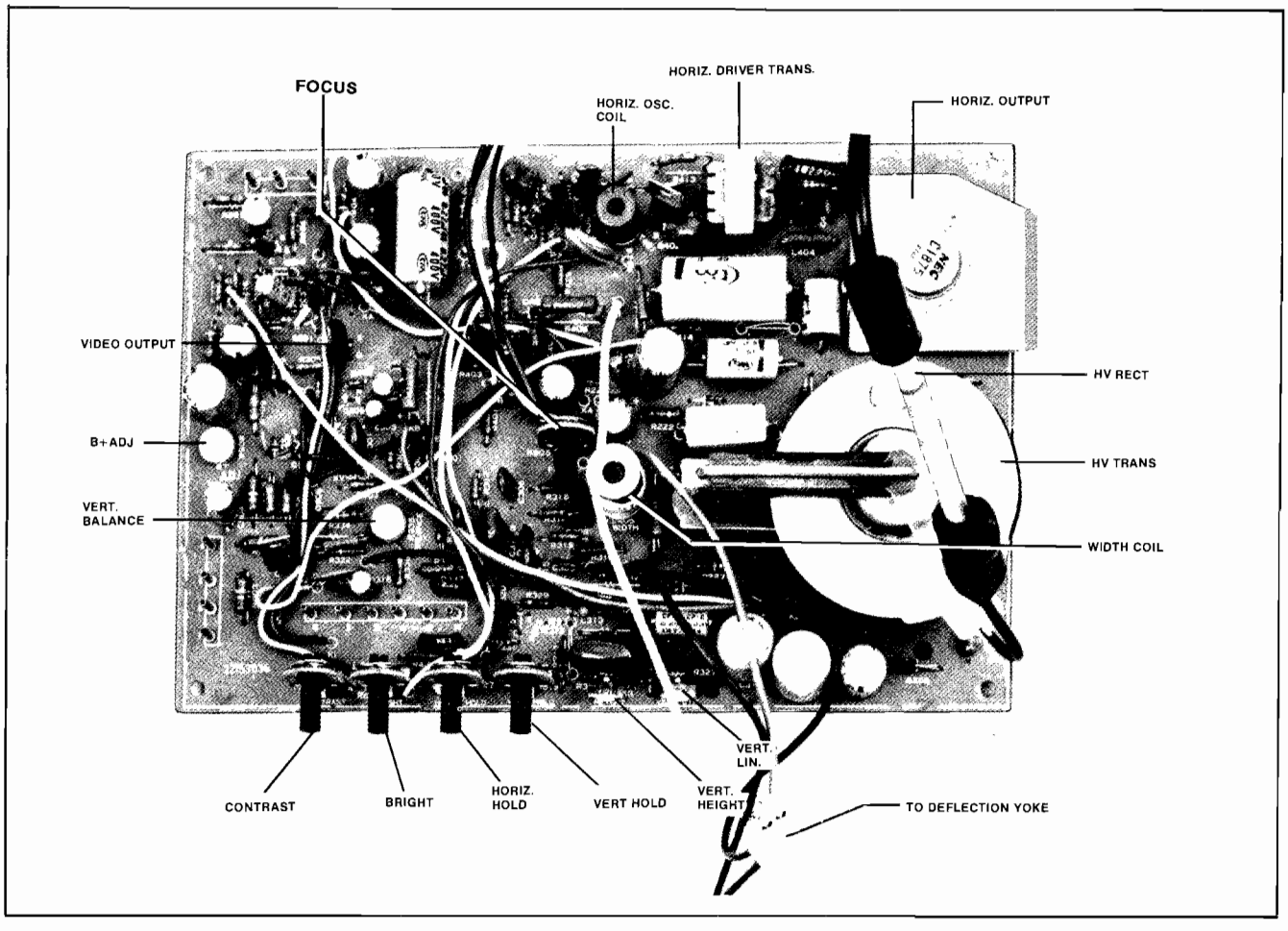


Figure 6-19 TEC Monitor Printed Circuit Board, Top View

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	2N6558	Regulator Amp
	or 5310500070	MPS-U04	
Q903	5310500280	LM1796	Reference Amp
		or MPS-D01	
Q904	5310500450	MJ2955	5V Regulator
CRT and Diode:			
* V801	5380000060	500SB4	CRT
D203	5340200280	MR9712	Silicon Diode
		or IN4004	L. V. Rectifier
D204	5340200430	IN4148	Silicon Diode
		or IN4002	Blanking Clip
D205	5340200430	IN4148	Silicon Diode
		or IN4002	Blanking Clip
D206	5340200430	IN4148	Silicon Diode
		or IN4002	Blanking Clip
D207	534020280	MR9712	200V Rect
		or IN4004	
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	H.V. Rectifier
		or HS30/lb	
D801	5340200290	MR9713	400V Rectifier
D901	5340200270	MR9704	Rectifier
		or IN4005	Silicon Diode
D902	5340200270	MR9704	Rectifier
		or IN4005	Silicon Diode
D903	5340200270	MR9704	Rectifier
		or IN4005	Silicon Diode
D904	5340200270	MR9704	Rectifier
		or IN4005	Silicon Diode
D906	5340300220	IN5858A	Zener Diode
	or 5340300310	IN6002A	
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

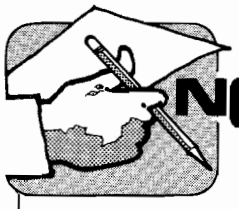
Table 6-3 TEC Monitor Replacement Parts Numbers

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



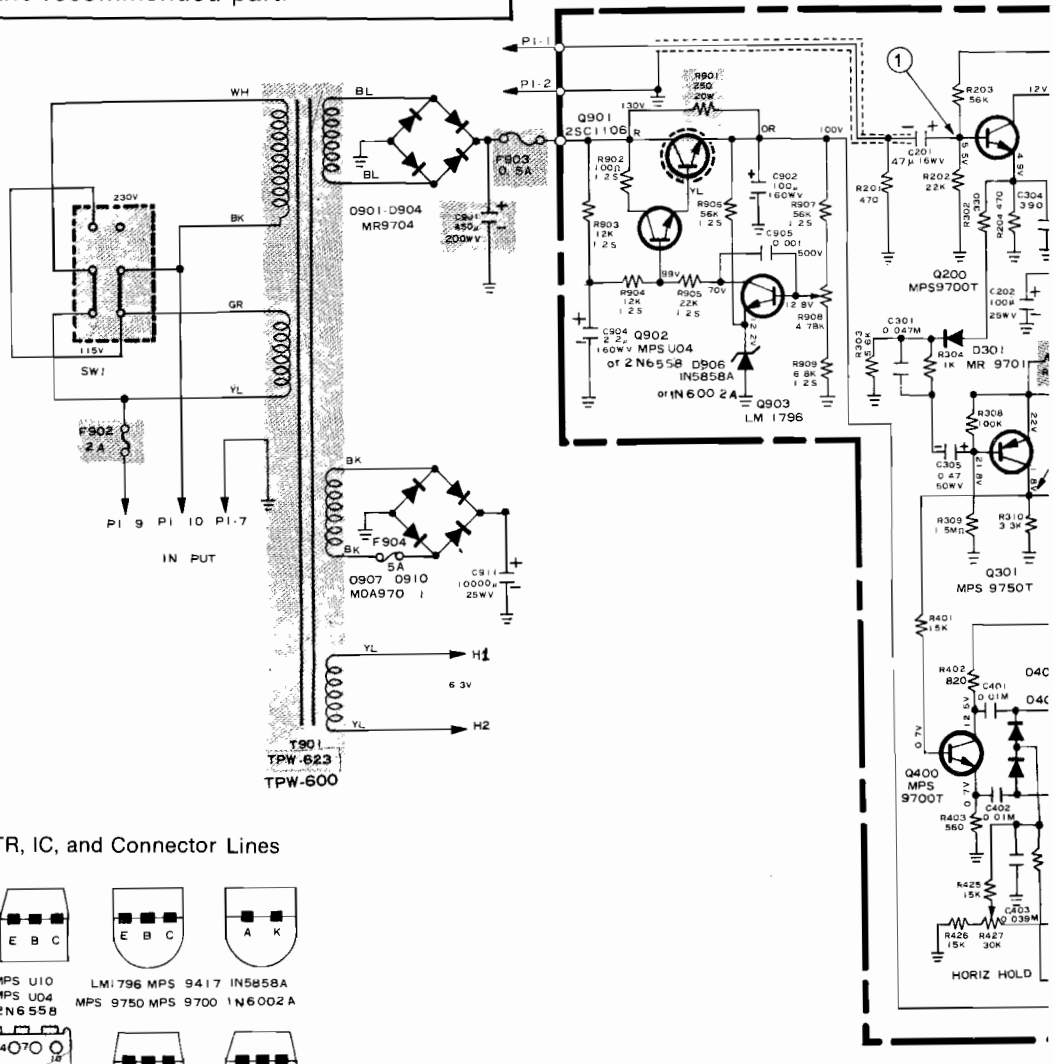
NOTES

WARNING

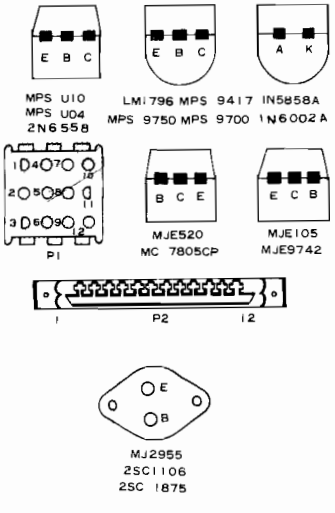
Safety-Critical Components

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

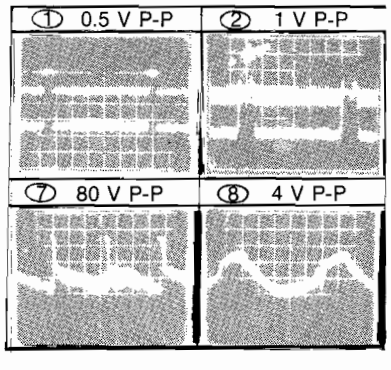
You may create shock, fire, or other hazards by using a replacement that does not have the same characteristics as the recommended part.



TR, IC, and Connector Lines

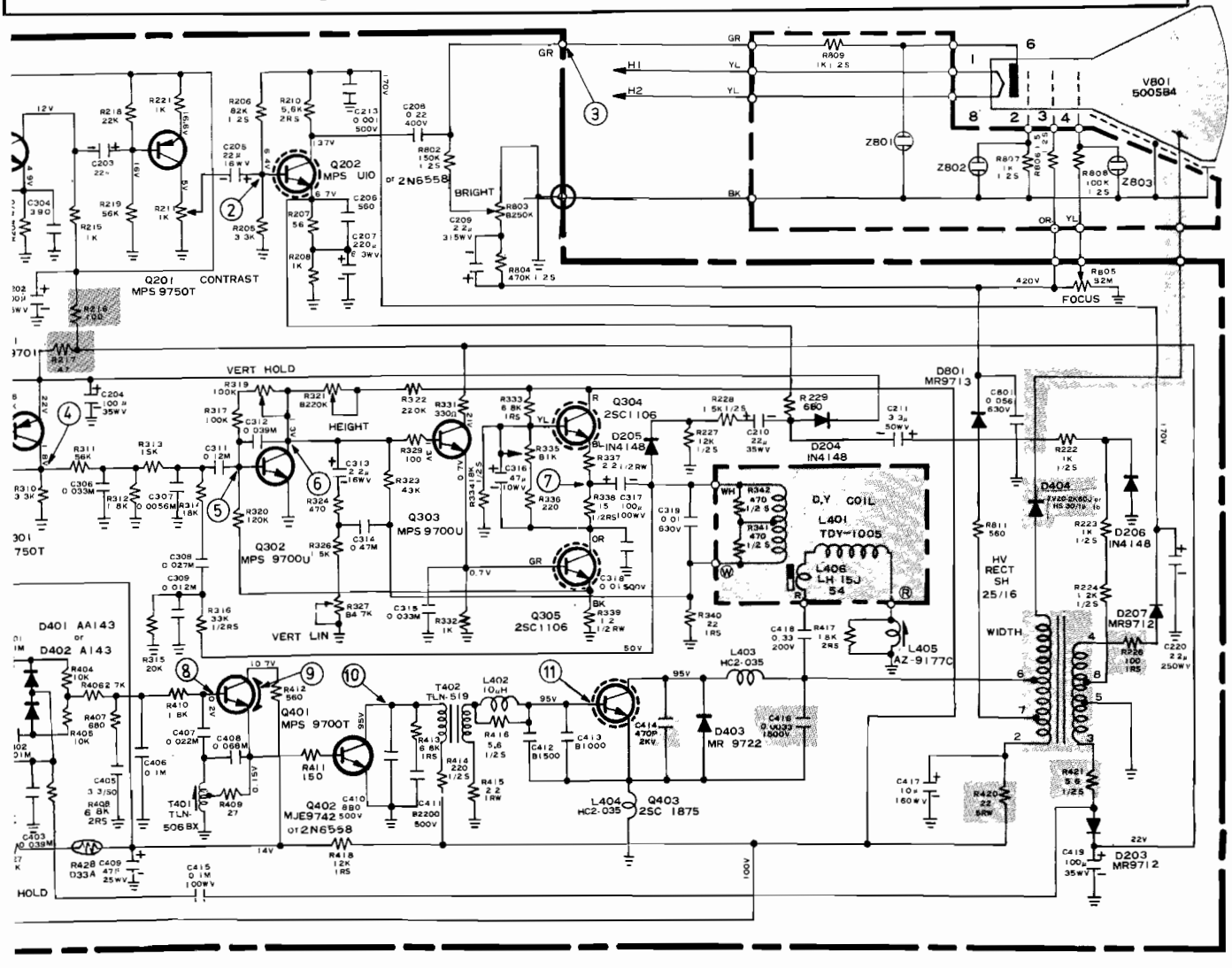


WAVE FORMS



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.



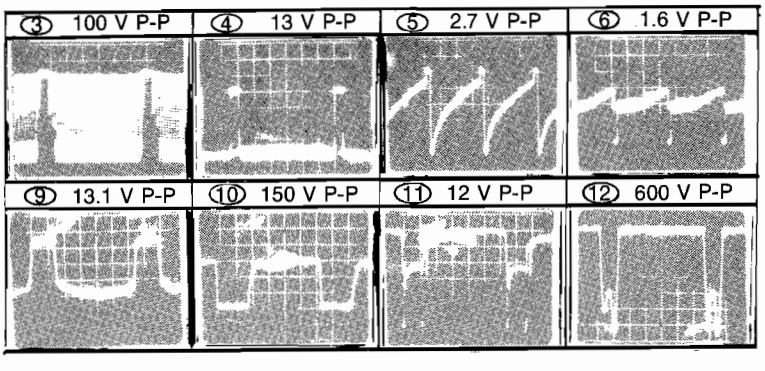
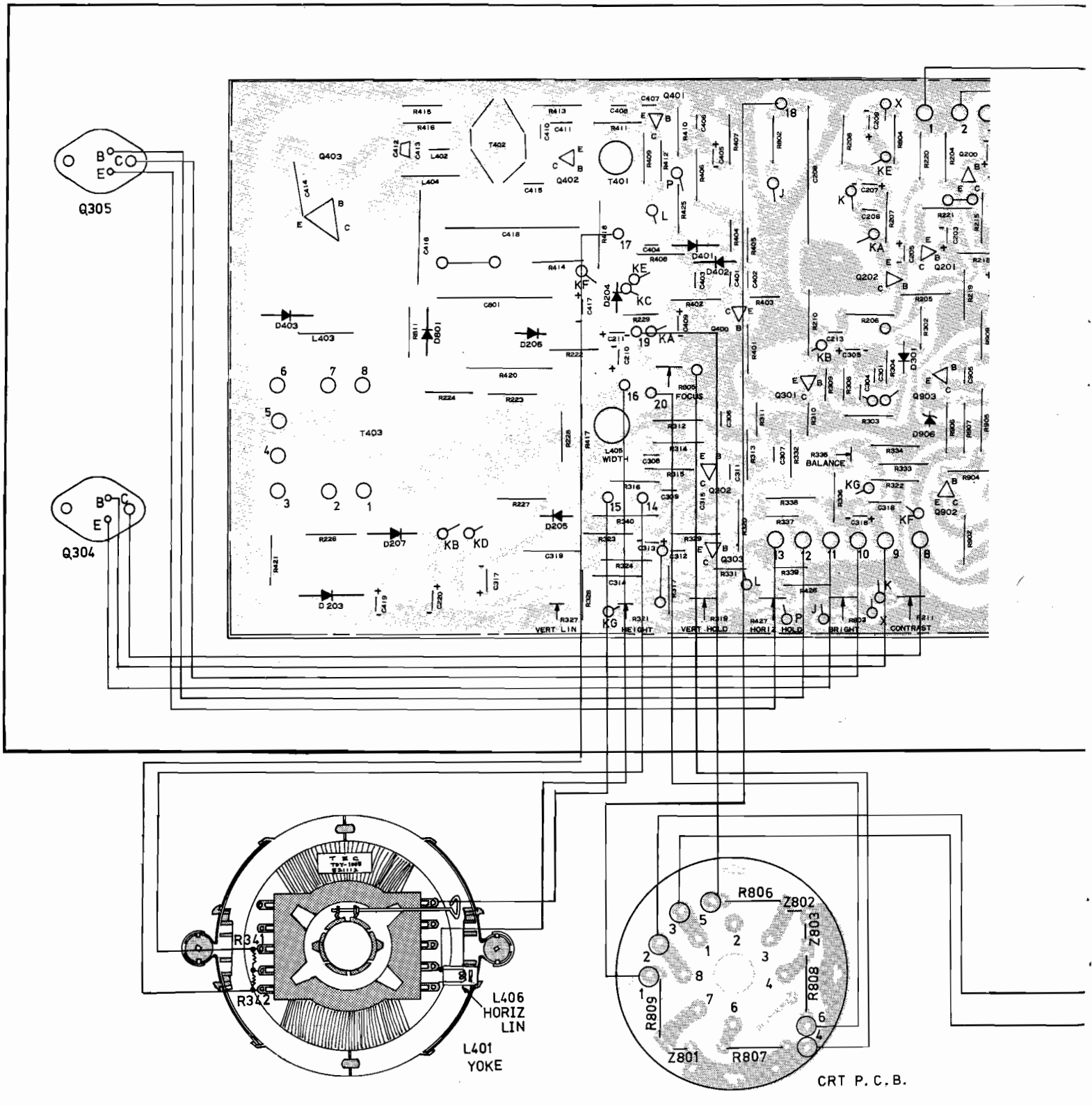


Figure 6-20 TEC Monitor Schematic Diagram


Q305
Q304
T403
T402
T401
Q401
Q402
Q403
L403
L404
L405
WIDTH
FOCUS
BALANCE
VERT LIN
HEIGHT
VERT HOLD
HORIZ HOLD
BRIGHT
CONTRAST
Q201
Q202
Q301
Q302
Q303
Q902
Q903
D203
D205
D206
D207
D401
D402
D403
D801
D906
R341
R342
L406
HORIZ
LIN
L401
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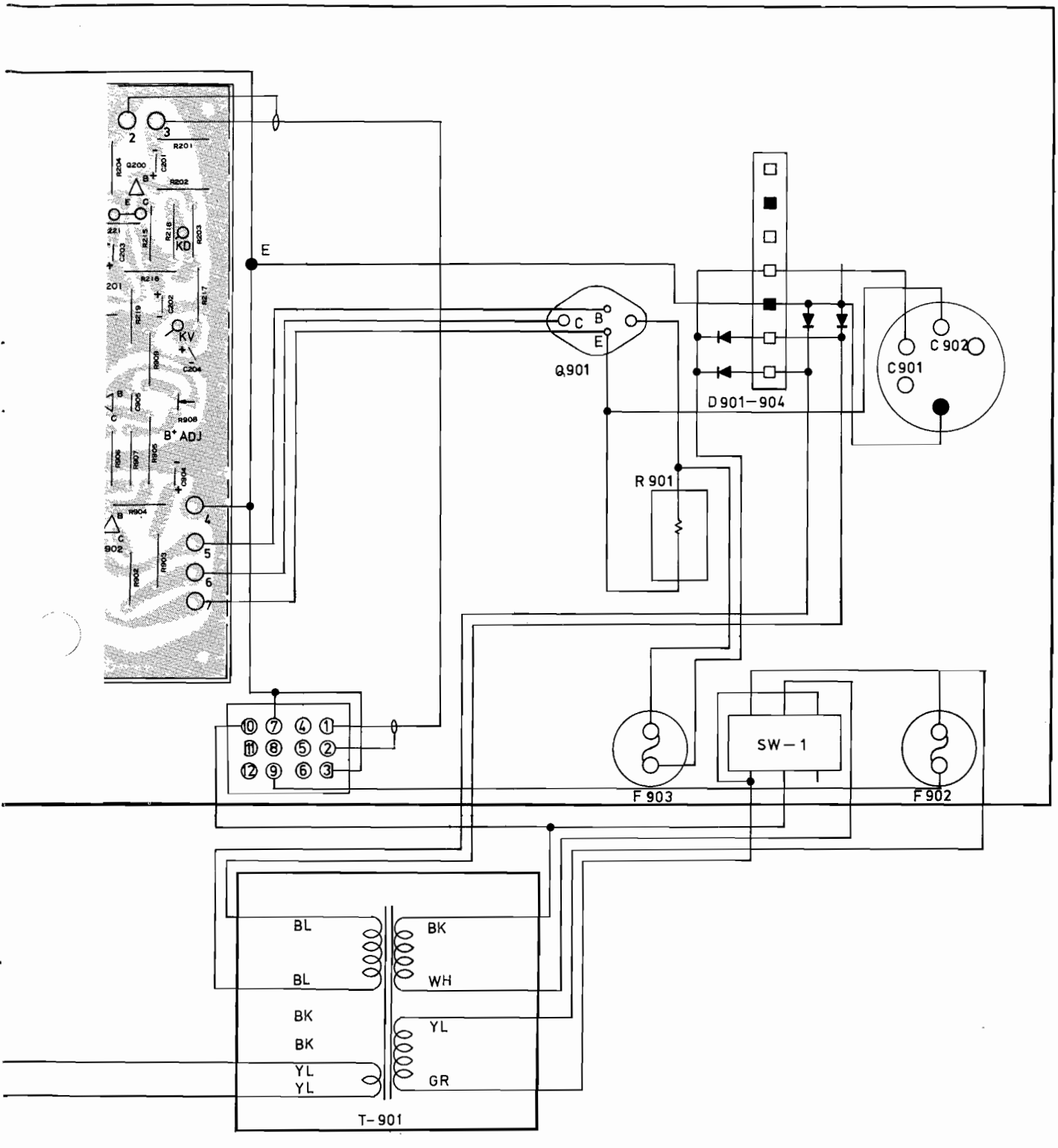
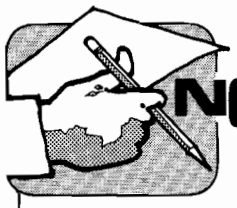
R806
Z802
Z803
R808
R809
Z801
R807
CRT P.C.B.



BOTTOM VIEW

Figure 6-21 TEC Monitor Wiring Diagram



NOTES

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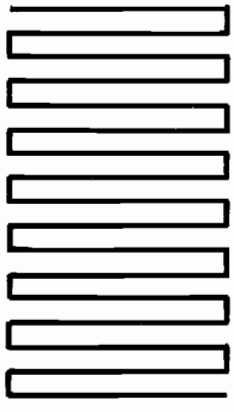

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Permit #1004
Sunnyvale, CA

First Fold

WARRANTY

Seller warrants that its printed circuit boards and parts thereon are free from defects in material and workmanship under normal use and service for a period of ninety (90) days from date of shipment. Seller warrants that its television monitors (in games supplied with monitors) are free from defects in material and workmanship under normal use and service for a period of thirty (30) days from date of shipment. None of the Seller's other products or parts thereof are warranted.

If the products described in this manual fail to conform to this warranty, Sellers' sole liability shall be, at its option, to repair, replace, or credit Buyer's account for such products which are returned to Seller during said warranty period, provided:

(a) Seller is promptly notified in writing upon discovery by Buyer that said products are defective;

(b) Such products are returned prepaid to Sellers' plant; and

(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.

In no event shall Seller be liable for loss of profits, loss of use, incidental or consequential damages.

EXCEPT FOR ANY EXPRESS WARRANTY SET FORTH IN A WRITTEN CONTRACT BETWEEN SELLER AND BUYER WHICH CONTRACT SUPERSEDES THE TERMS OF THIS ORDER, THIS WARRANTY IS EXPRESSED IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND OF ALL OTHER OBLIGATIONS OR LIABILITIES ON THE SELLER'S PART, AND IT NEITHER ASSUMES NOR AUTHORIZES ANY OTHER PERSON TO ASSUME FOR THE SELLER ANY OTHER LIABILITIES IN CONNECTION WITH THE SALE OF PRODUCTS UNDER THIS ORDER.

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