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ATARI®

Super Breakout™

Operation, Maintenance and Service Manual

Complete with Illustrated Parts Catalog

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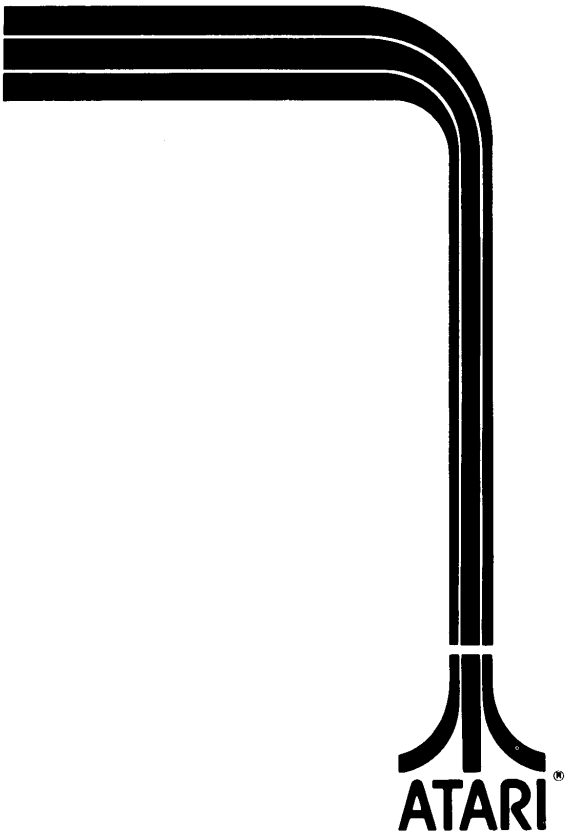

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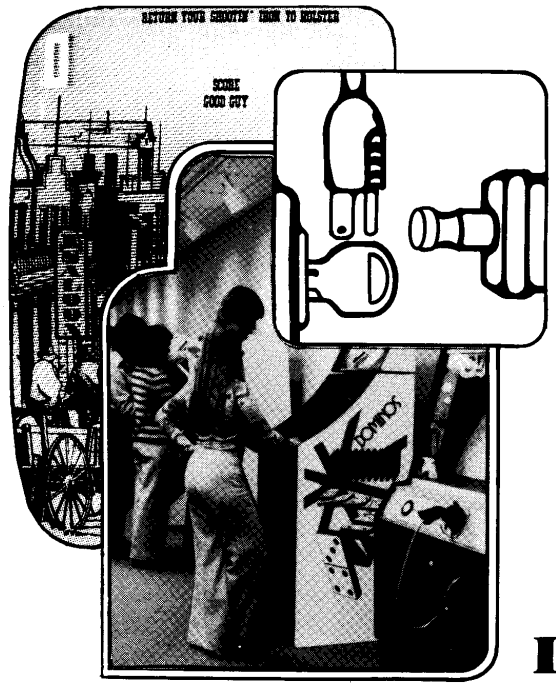


LOCATION SETUP

A. INTRODUCTION

Super Breakout™ is a one- or two-player game developed by Atari Inc. The game is packaged in an upright, floor-resting cabinet illustrated by brightly colored orange, red and white graphics to further enhance potential play. A 19-inch TV monitor is mounted vertically in the top front of the cabinet. The TV monitor viewing screen is shielded by a Plexiglas® panel that also displays colorful graphics.

Player-operated controls are mounted on a control panel directly below the TV monitor viewing screen on the front of the game cabinet as illustrated in Figure 1-1. The controls consist of a Game Select rotary switch, paddle control knob, a red LED serve pushbutton and a one-player start and two-player start pushbutton.

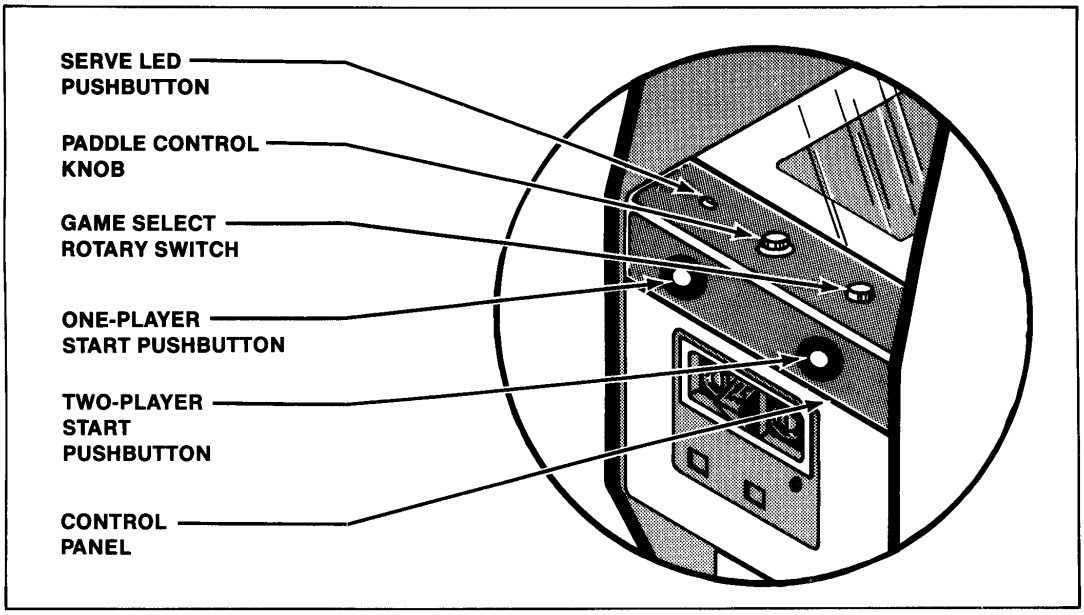


Figure 1-1 Super Breakout Control Panel

The coin mechanism on the front mid portion of the game cabinet, below the control panel, initiates the play. The cash box is located behind a locked access door.

Super Breakout is a ball-and-paddle game; the player's objective is to build up the highest possible point score by hitting the balls toward a wall of bricks, regardless of the game selection. Each time a ball hits a brick, points are added to the player's score. The brick disappears and the ball rebounds. Player accumulated scores are displayed continuously at the bottom of the TV screen. Besides rebounding from the bricks and from the player's paddle(s), the ball also rebounds from the two sidewall boundaries and from the backwall boundary behind the wall of bricks.

B. GAME INSPECTION

Your new Super Breakout game is manufactured ready to play on removal from the shipping carton. Your cooperation is desired in order to supply the final touch of quality control to your game. Please follow the procedures below to ensure that your game is in perfect condition:

1. Examine all external parts of the game cabinet for dents, chips or broken parts.
2. After determining that the game has been received in good condition, unlock and open the rear access door. Carefully inspect the interior and verify the following:
   a. All plug-in connectors are firmly seated.
   b. Remove game PCB as instructed in Steps 1–4 of Section E.
   c. All integrated circuit packages (chips) in sockets on the game printed circuit board are firmly seated.
   d. Replace game PCB as instructed in Step 6 of Section E.
   e. The fuses are all seated snugly in their holders.
   f. No harness wires are disconnected.
   g. No loose foreign objects should be 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 (located on the power supply chassis), the speaker, fluorescent lamp and all other player controls. Also be certain that the TV monitor is securely mounted.

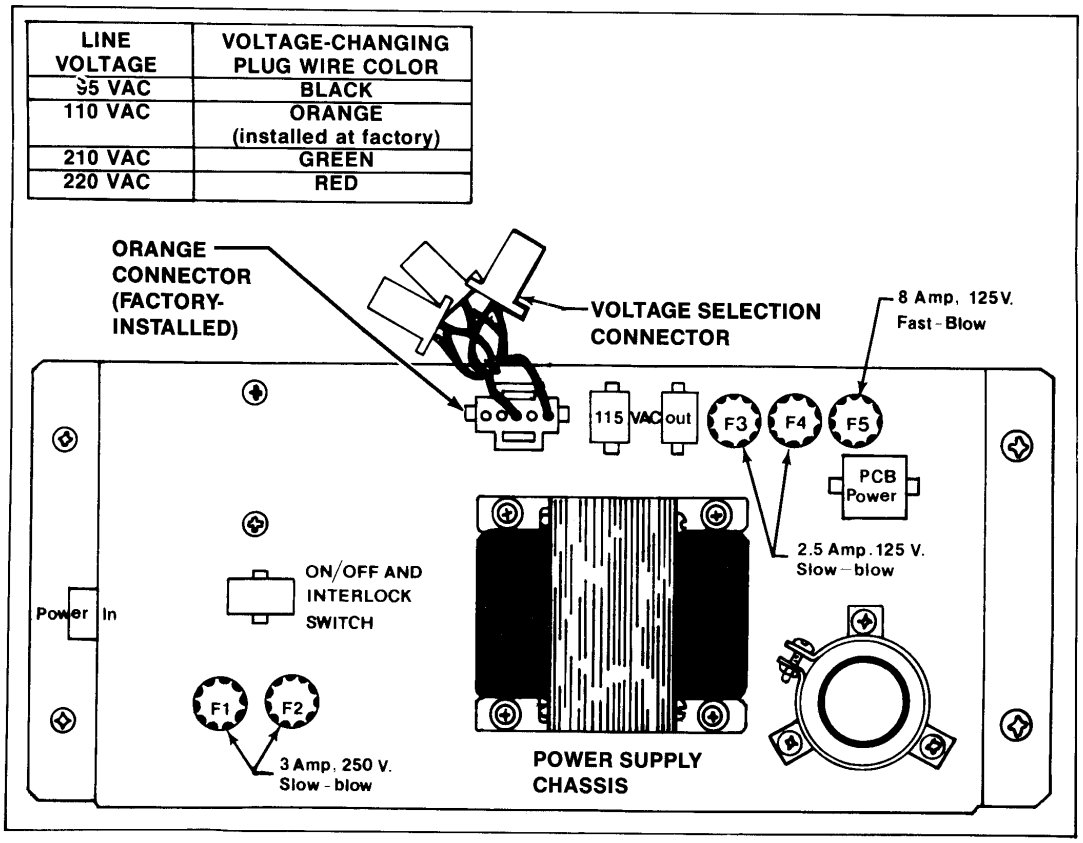


Figure 1-2 Voltage-Selection Connectors

Check the serial number located on the metallic label in the upper left-hand corner on the back of the game cabinet. This serial number also appears 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.

C. INSTALLATION REQUIREMENTS

Voltage Selection

Your Super Breakout game is shipped for operation at 110 VAC, 60 Hz.

IF YOUR LOCAL LINE VOLTAGE IS 110 VAC, perform the following steps:

1. Measure AC line voltage with an AC voltmeter.

2. If AC line voltage is consistently below 100 VAC, plug in the *black* low-voltage connection, on the Power Supply Chassis.*

3. If AC line voltage is approximately 110 VAC, plug in the *orange* connection (factory installed).

IF YOUR LOCAL LINE VOLTAGE IS *NOT* 110 VAC, BUT INSTEAD IS 220 VAC, perform the following steps:

1. Measure AC line voltage with an AC voltmeter.

2. If AC line voltage is consistently below 210 VAC, plug in the *green* low-voltage connection.*

3. If AC line voltage is approximately 220 VAC, plug in the *red* connection.

**Super Breakout 1-3*

**Figure 1-2 shows the four connectors with one of them already plugged in.*

Table 1-1 Installation Requirements

Power Requirements		
Power Supply:	110 VAC @60 Hz 220 VAC @50 Hz	200 Watts
Temperature Range		
On Location and In Storage:	No lower than 0 degrees Celsius (32 degrees Fahrenheit)	
	No higher than 49 degrees Celsius (120 degrees Fahrenheit)	
Humidity Range		
Relative Humidity:	No more than 95%	
Location Space Requirements*		
Height:	169 centimeters (66 inches)	
Width:	62 centimeters (25 inches)	
Depth:	70 centimeters (28 inches)	
TV Monitor	19-inch Black and White	

*See Figure 1-3.

Type of Power Cord

Atari has added a strain-relief cord to your Super Breakout game. The advantage of this type of cord is that if pulled accidentally, the strain relief will hold the cord in place at the cabinet wall. The plastic strain relief "cushions" the impact of the shock and prevents the cord from pulling the wires out of the harness connector.

D. INTERLOCK, POWER ON/OFF SWITCH AND OTHER OPERATOR CONTROLS

To minimize the hazard of electrical shock while you are working on the inside of the game cabinet, two interlock switches have been installed. One is located behind the rear access door and one behind the coin door. These switches remove all the power from the game cabinet while the doors remain open. To help conserve energy, a power on/off switch has been placed on the game so that it can be turned off during closed periods. This switch is located in the

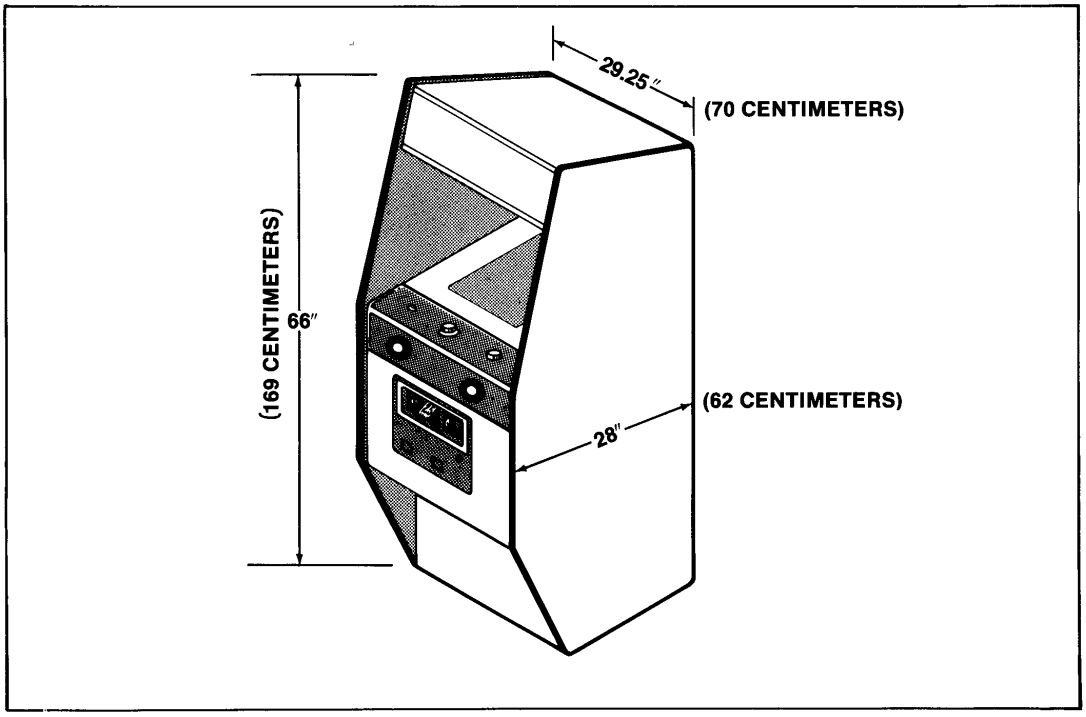


Figure 1-3 Location Set-up Requirements

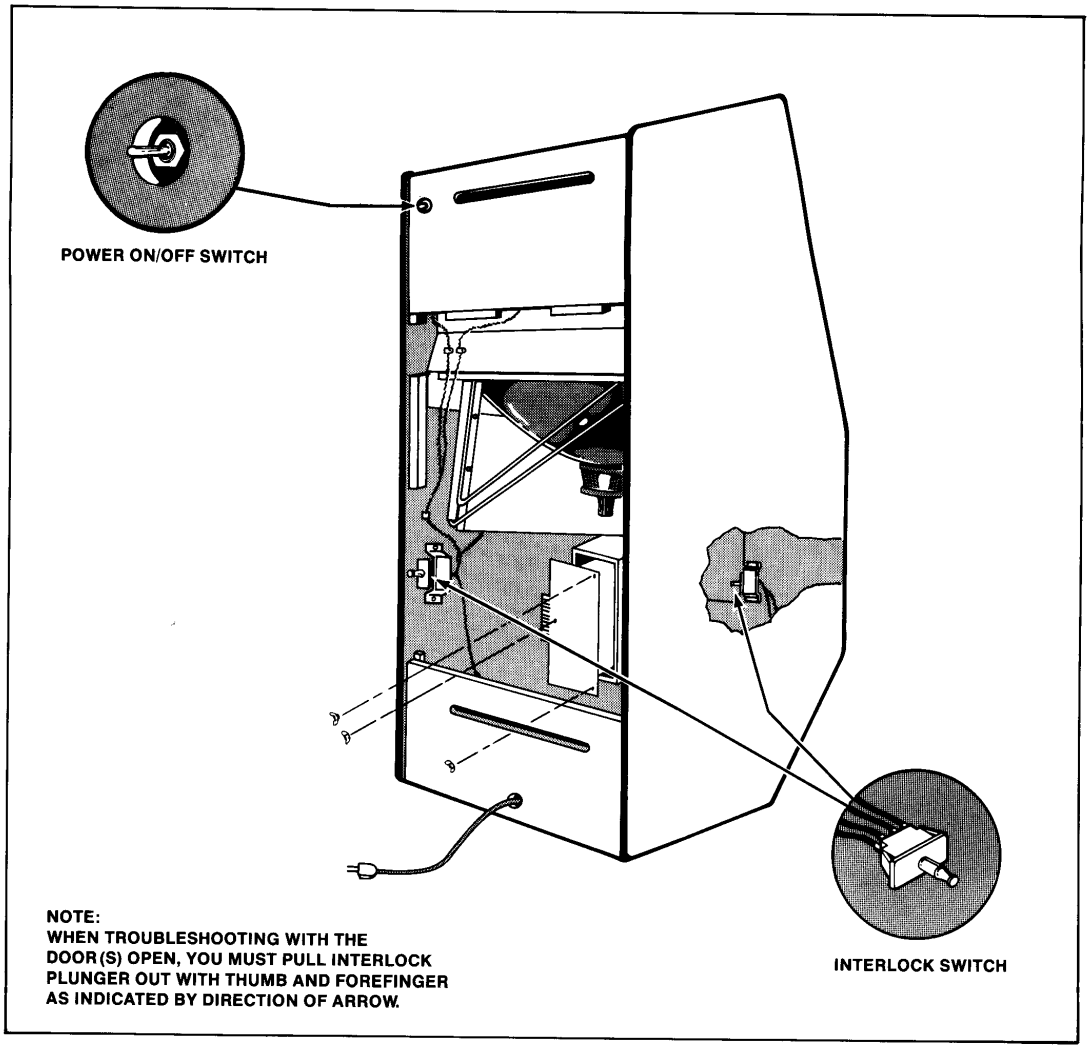


Figure 1-4 Location of Interlock and Power On/Off Switches

upper rear left-hand corner of the game cabinet, as shown in Figure 1-4.

Interlock Switch Checkout Procedure

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

1. Unlock and open the rear access door and the coin door.

2. Plug the AC power cord into your local line AC outlet (110 VAC or 220 VAC).

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

4. Close the rear access and coin door. Within approximately 30 seconds after closing the last door to the game cabinet the TV monitor should display a picture.

5. Slowly open either door to the game cabinet, and the TV picture should reappear, when either the rear access or coin door is opened to approximately one inch.

Table 1-2 Option Settings

OPTION	Switch Settings on 8-Toggle DIP Switch (located at position J8/9 on the Game PCB)								RESULT		
	1	2	3	4	5	6	7	8			
Game instruction language (as displayed on TV screen)	ON	ON							English		
	ON	OFF							German		
	OFF	ON							French		
	OFF	OFF							Spanish		
Coin Mode			ON	ON					Free play		
			ON	OFF					2 Plays/Coin		
			OFF	ON					1 Coin/Play		
			OFF	OFF					2 Coins/Player		
Game Length					ON				5 Balls		
					OFF				3 Balls		
Extended Play Levels (extended play equals one full game)									**Progressive Breakout**	**Cavity Breakout**	**Double Breakout**
						ON	ON	ON	No extended play allowed		
						ON	ON	OFF	200	200	200
						ON	OFF	ON	400	300	400
						ON	OFF	OFF	600	400	600
						OFF	ON	ON	900	700	800
						OFF	ON	OFF	1200	900	1000
						OFF	OFF	ON	1600	1100	1200
						OFF	OFF	OFF	2000	1400	1500

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

7. Close and lock both doors.

E. OPERATOR OPTIONS

The operator options offer maximum player appeal for each game location. These options are listed in Table 1-2. They are preset for a certain game set-up during production. To determine how the switches have been set for the game, compare the attract mode with the information in Table 1-2.

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

NOTE

This game includes a new style of easy-access PCB. The radio frequency shield has been redesigned to use only three individual quarter-turn fasteners as a direct result of field input.

1. Unplug the game power on/off switch and open the rear access door.

2. Locate the radio frequency (RF) shield board assembly immediately inside the game cabinet behind the rear access door (see Figure 1-5). On one end of the assembly is a small PCB with an edge connector coming from the edge of the Super Breakout game PCB. (The RF Shield Assembly is an aluminum box with hundreds of holes.)

3. Turn the three individual quarter-turn fasteners on the RF Shield assembly ¼-turn to the left, or counterclockwise.

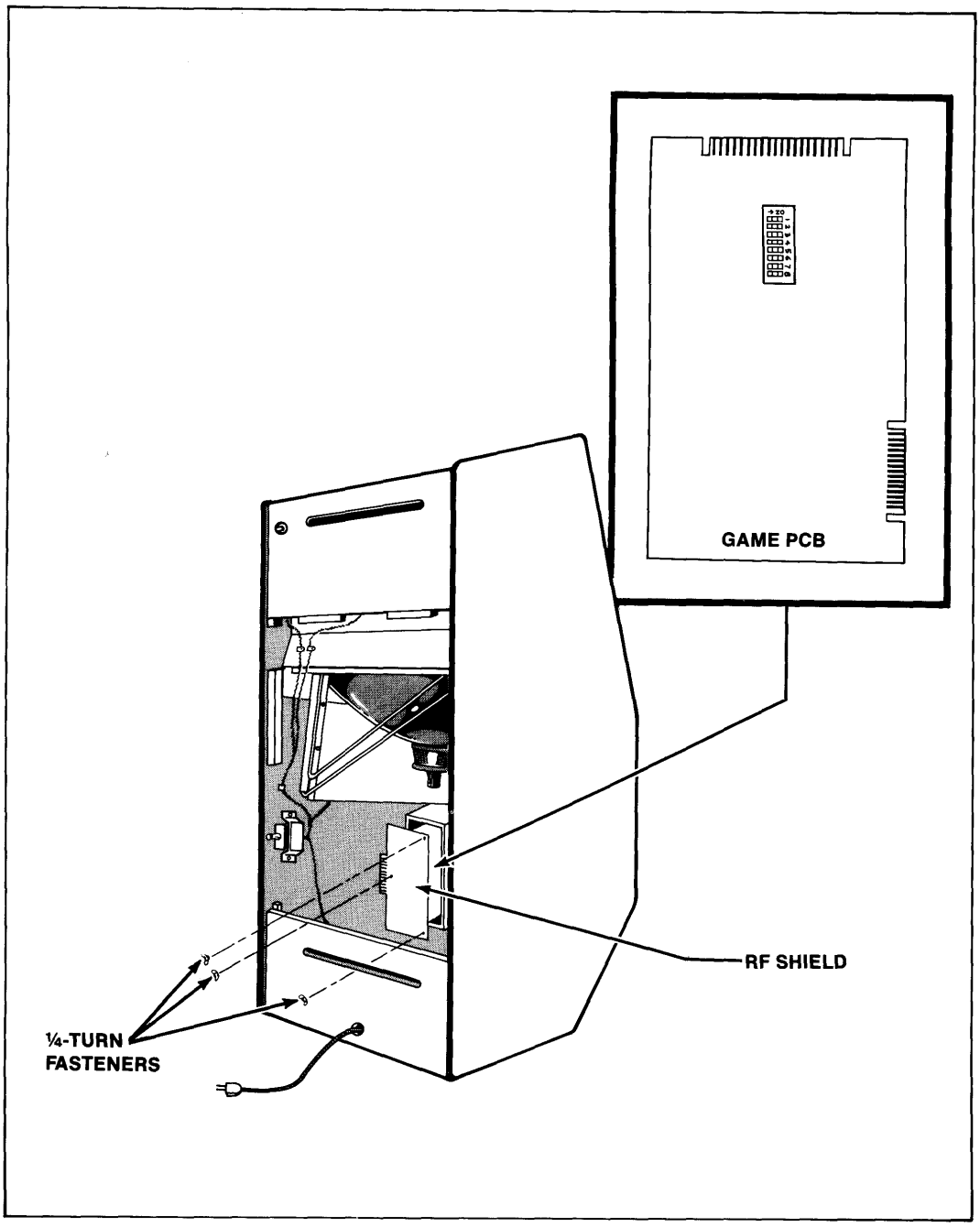


Figure 1-5 Option DIP Switches and Game PCB Location and Removal

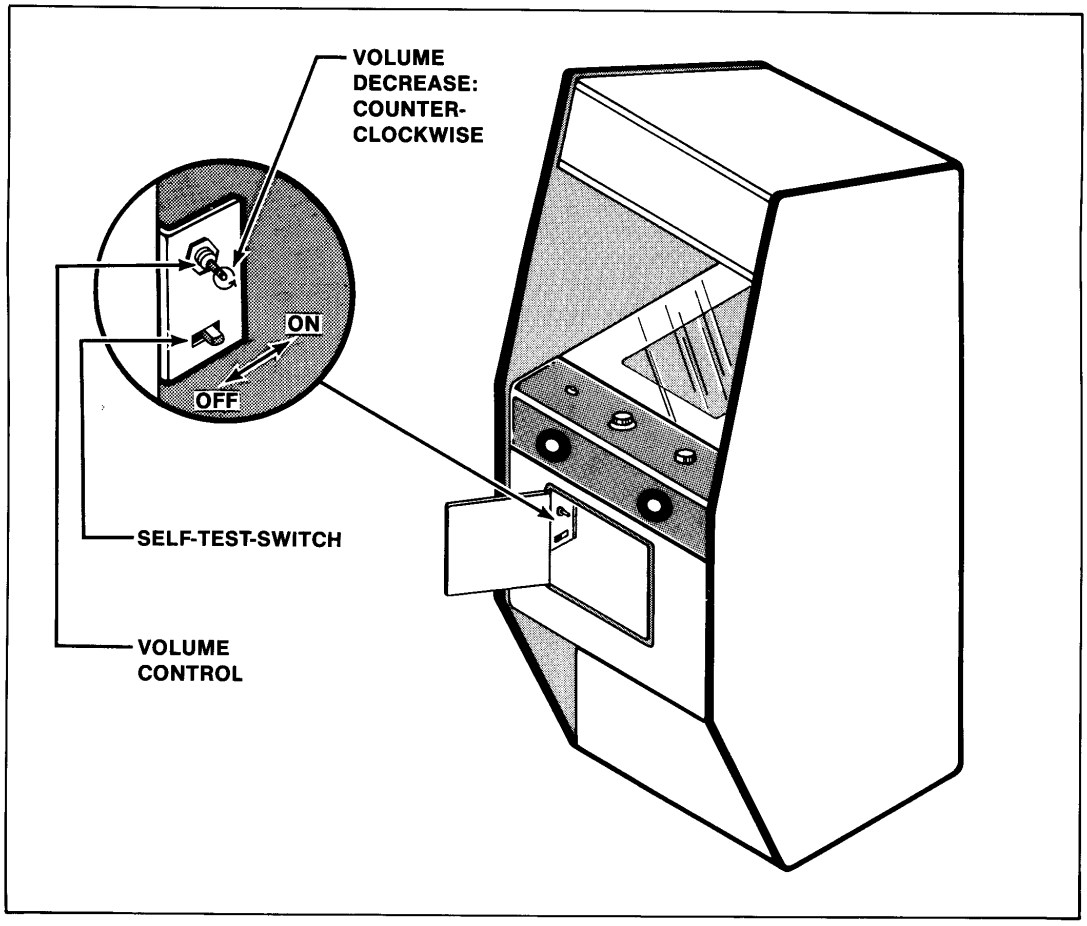


Figure 1-6 Location of Self-Test Switch and Volume Control

4. Carefully pull out the Super Breakout game PCB and the RF Shield board together as a unit. These would not normally need to be separated when making option switch changes.

5. Set the switches for the desired options, as listed in Table 1-2.

6. Reinstall both PCBs by following steps 1 through 4 in reverse order. Do not force or bend the game PCB. Before reinstalling, always inspect the game PCB for damage.

7. Close and lock the rear access door.

8. Plug in the game and verify that all options function by playing the game.

F. SELF-TEST PROCEDURE

Super Breakout will test itself and provide data to demonstrate that the game's circuitry and controls are working properly. This procedure uses the TV monitor and the speaker; no additional equipment is required. See Figure 1-6 for location of the Self-test switch. To start the procedure, slide this switch to on as indicated in the figure. See Table 1-3 for further details and instructions on the self-test. We suggest that you run the self-test each time the coin box is opened.

G. VOLUME CONTROL

If volume is incorrect for your location, open the coin door and adjust the volume control as indicated in Figure 1-6.

Table 1-3 Self-Test Procedure

Instruction	Result if Test Passes	Result if Test Fails
1. Preliminary Set volume level potentiometer (located on a bracket immediately behind and to the left of the coin door) to ½ volume.	Not Applicable	Not Applicable
2. RAM Test Set Self-Test Slide switch (located above the volume potentiometer, immediately behind and to the left of the coin door) to the "on" position.	Clears the Screen	The TV monitor screen displays a pattern, and a series of eight tones (representing D0 through D7 respectively) sound off. A distinct LOW tone indicates a good bit. A HIGH tone indicates the bit is different from what it should be. The test stops (video, no audio) until the self-test switch is turned to "off", and then back on again.
3. ROM Test No operator action required. Immediately follows instruction 2 if it passes. This step automatically tests ROMS 0, 1, 2, 3, and 4 that represent five 1K byte blocks.	When ROMs 0, 1, 2, 3, and 4 checksum correctly no message is displayed on the TV screen.	When ROMs 0, 1, 2, 3, and 4 do not checksum, a message is displayed on the TV screen to indicate the failed ROM number. It also indicates the difference between obtained value and the expected value, in a 2-digit hexadecimal number.
4. Lights and Audio Test Operator should adjust volume control. Immediately follows instruction 3 whether or not it passes.	The one- and two-player start lights and the serve light light up. Four audio tones are also sounded (from high to low tone).	Lights do not turn on. Proceed to instruction 5. Either no tones or missing tones.
5. Switch and Lamp Test Immediately follows instruction 4 whether or not it passes. Rotate Paddle Knob Push all the following switches: SLAM, COIN SWITCHES, PLAYER START SWITCHES, SERVE SWITCH, GAME SELECT KNOB.	Paddle control potentiometer remains displayed. All lights remain lighted. All values from 00 to FF hexadecimal notation should be obtainable. Any movement of the knob should cause the numbers on the screen to move not more than 1 digit in either direction. Each pressed switch generates audible click.	No potentiometer values displayed, and any one or several lights turn off. Values not between 00 and FF. Possibility potentiometer too noisy as a result of a dirty pot. Neither a click or any sound.

GAME PLAY

A. INTRODUCTION

The Super Breakout game has three different modes of operation. These modes are listed and described below:

- ATTRACT—When power is applied or as a result of a game ending with no further credits.
- READY-TO-PLAY—Coins accepted.
- PLAY—Initiated immediately after pressing the one- or two-player start button.

Super Breakout allows the player(s) to select any one of three different action-packed Super Breakout games by turning the game select knob on the control panel to the desired game. The three available Super Breakout games are the following:

- Double
- Cavity
- Progressive

Each game play is explained in later paragraphs under Section D.

B. ATTRACT MODE (See Figure 2-1)

The Attract mode appears in two different versions. The first version occurs immediately after AC power-up of the game or after Self-Test. The second occurs at the end of every game when there is no longer any credit. The difference between these two attract mode versions is appreciable and must be noted.

The first version of the attract mode (power-up) begins when AC power is applied to the game and the power on/off switch is turned "on" (the power switch is located at the top rear of the cabinet as shown in Figure 1-4).

While in the first version of attract mode, the TV monitor displays each game sequentially, beginning with Cavity, for a short time. It then proceeds to Double, to Progressive, and finally returns to Cavity. The screen does not display a paddle but rather an invisible solid line at the bottom of the TV screen (where the paddle normally is displayed).

Immediately upon applying AC power to the game, the first attract mode version is activated and a ball is automatically served. When the ball is served it randomly heads toward the horizontal line; on impact with this line the ball rebounds, then travels towards the brick wall. The ball hits a brick, the ball rebounds and the brick disappears but the serve does not change as a result of having a solid invisible row of paddles that never miss. This continuous rebound action proceeds as the playfields change from Cavity, to Double, to Progressive and back to Cavity, drawing the attention of a passing potential player.

In this attract mode version the last two player scores remain steadily displayed at the bottom of the TV monitor screen, whereas the coin/player credit phrase is displayed blinking at the bottom of the screen.

The sound (or audio) remains muted during the attract mode and neither the one- or two-player start pushbuttons or Serve pushbutton is lighted. These switches and the 3-position rotary switch also remain inoperative during this version of the attract mode.

The second version of the attract mode occurs at the end of every game when there are no longer any credit. When the last ball in the game is served and missed, the second version of the attract mode appears and displays the last game's brick pattern (if any). The paddle(s) disappear, leaving the solid invisible horizontal row of paddles and a flashing coin mode on the screen (corresponding to the operator's option setting), alternating with High Score (if not zero). The required number of balls for the game being displayed are then served and captured to randomly bounce against the playfield objects and boundaries, but never to leave the screen or knock out any bricks until the player adds more credit to the game.

NOTE

The game select rotary switch remains inoperative until credits are provided.

After several seconds lapse, the first version attract mode appears on the screen as described in previous paragraphs under this heading.

C. READY-TO-PLAY MODE (See Figures 2-2, 2-3, 2-4)

The ready-to-play mode exists for each game selection as illustrated in Figure 2-2 (Cavity), Figure 2-3 (Progressive), and Figure 2-4 (Double). This mode is immediately initiated after the coins are accepted by the coin mechanism or at the end of a game with credits remaining. After the coins are accepted, the rotary game select switch becomes active and the screen changes from its current attract mode playfield display sequence to the playfield corresponding to the game select switch setting. For example, if the screen displays a Double Breakout while in the attract mode and the game select switch was set to either Cavity or Progressive, the display would immediately change from the attract mode Double game playfield to the Cavity or Progressive ready-to-play mode playfield.

During the ready-to-play mode the paddle(s) become visible and the ball is no longer automatically served.

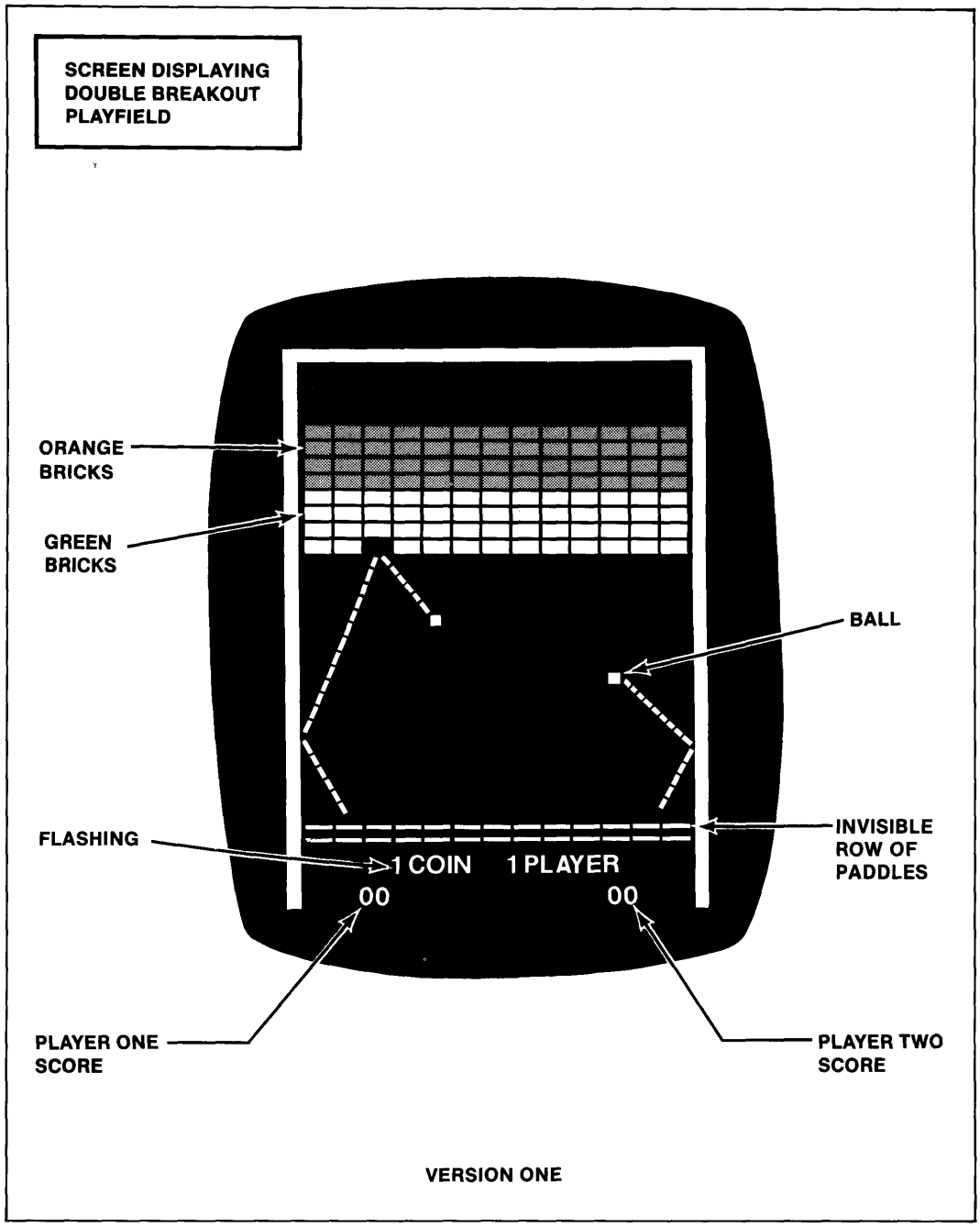


Figure 2-1 Attract Mode

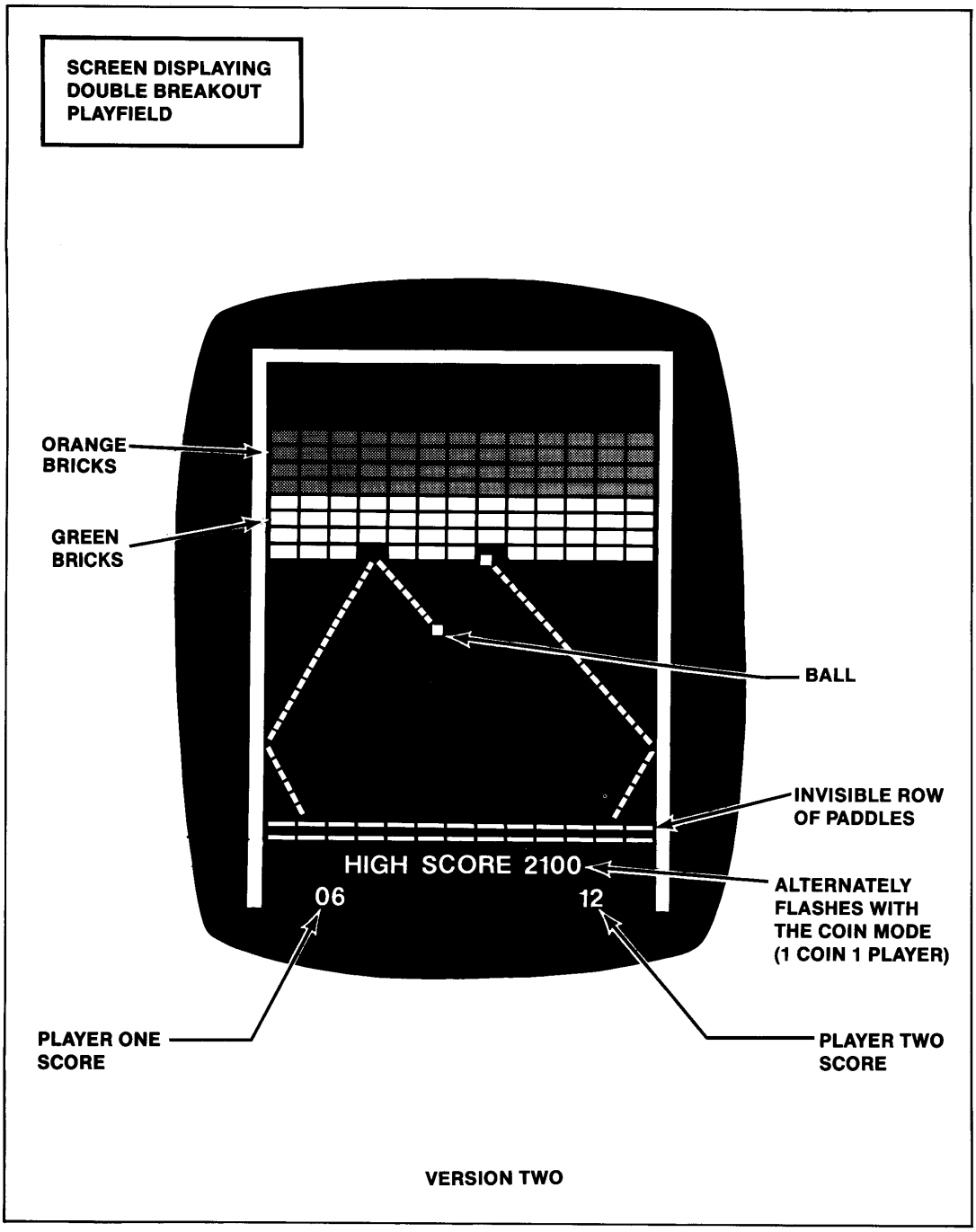


Figure 2-1 Attract Mode

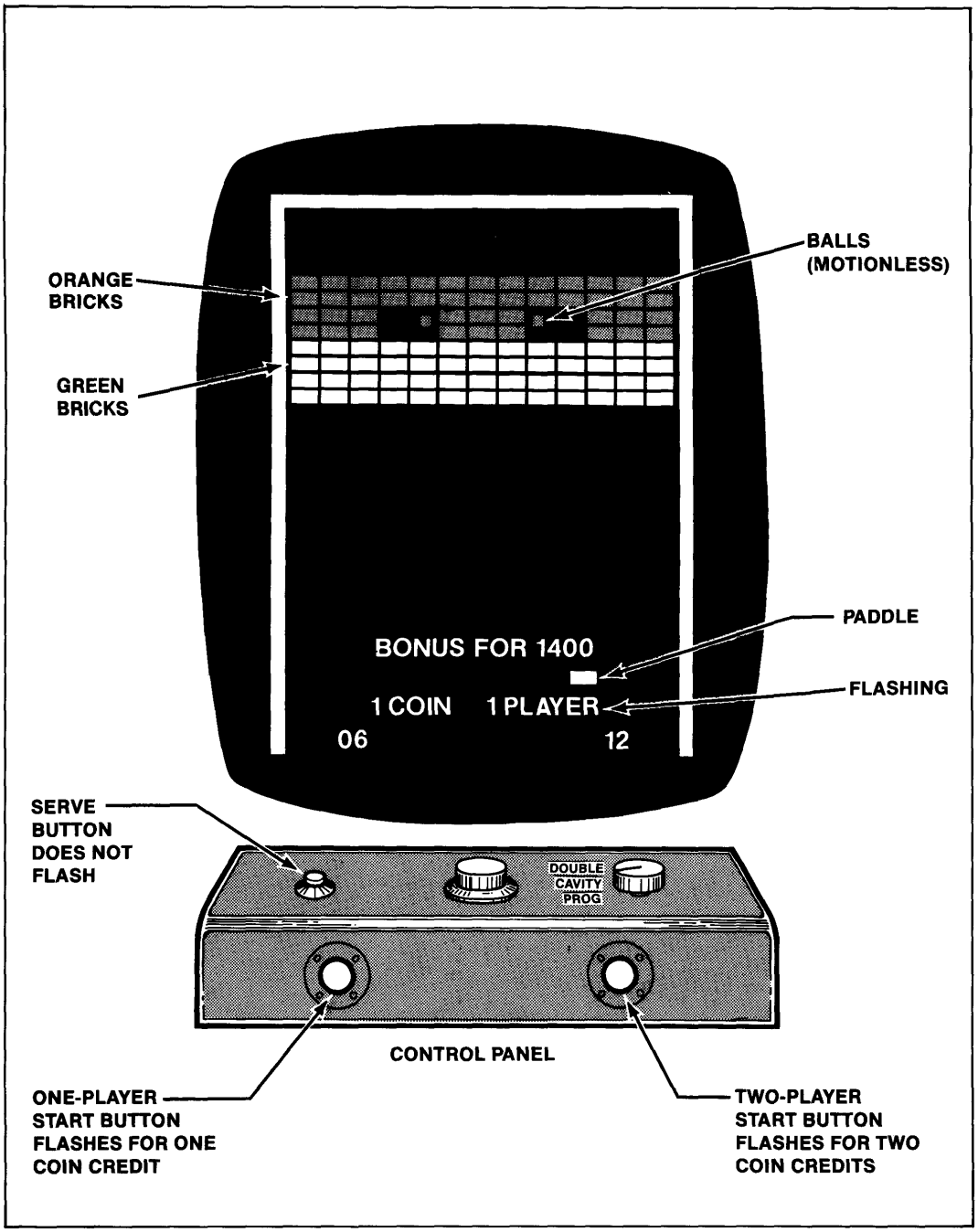


Figure 2-2 Cavity Breakout Ready-to-Play Mode

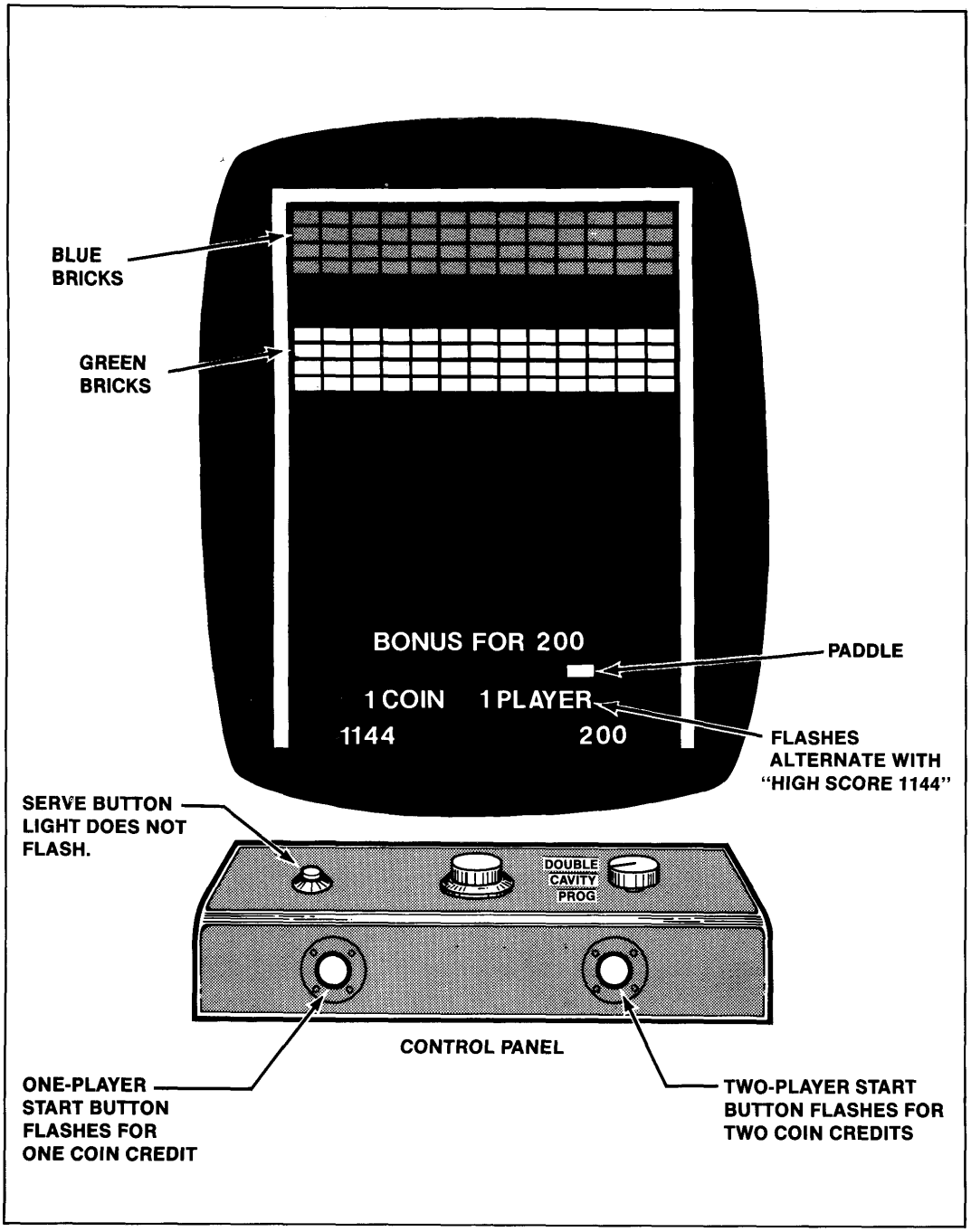


Figure 2-3 Progressive Breakout Ready-to-Play Mode

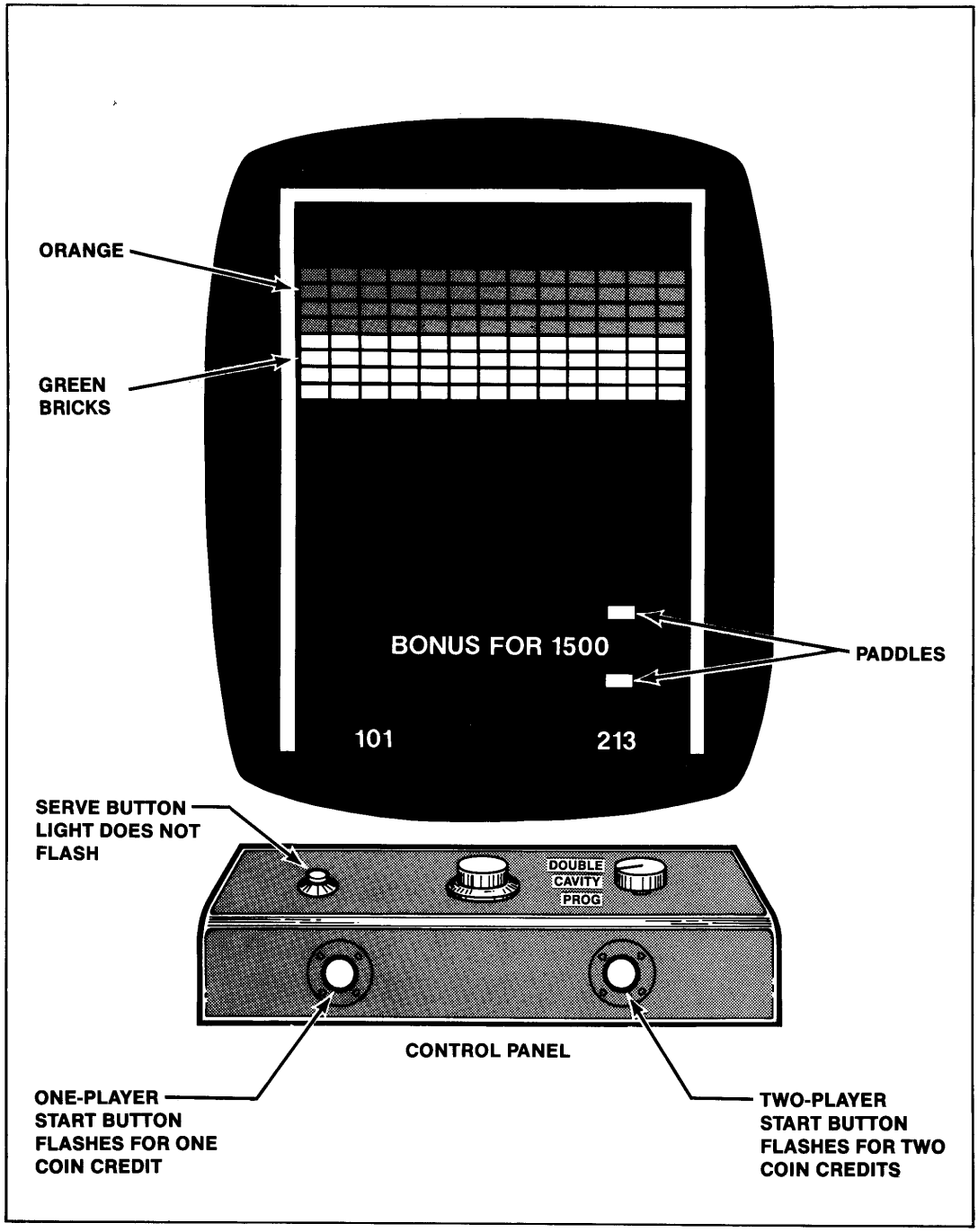


Figure 2-4 Double Breakout Ready-to-Play Mode

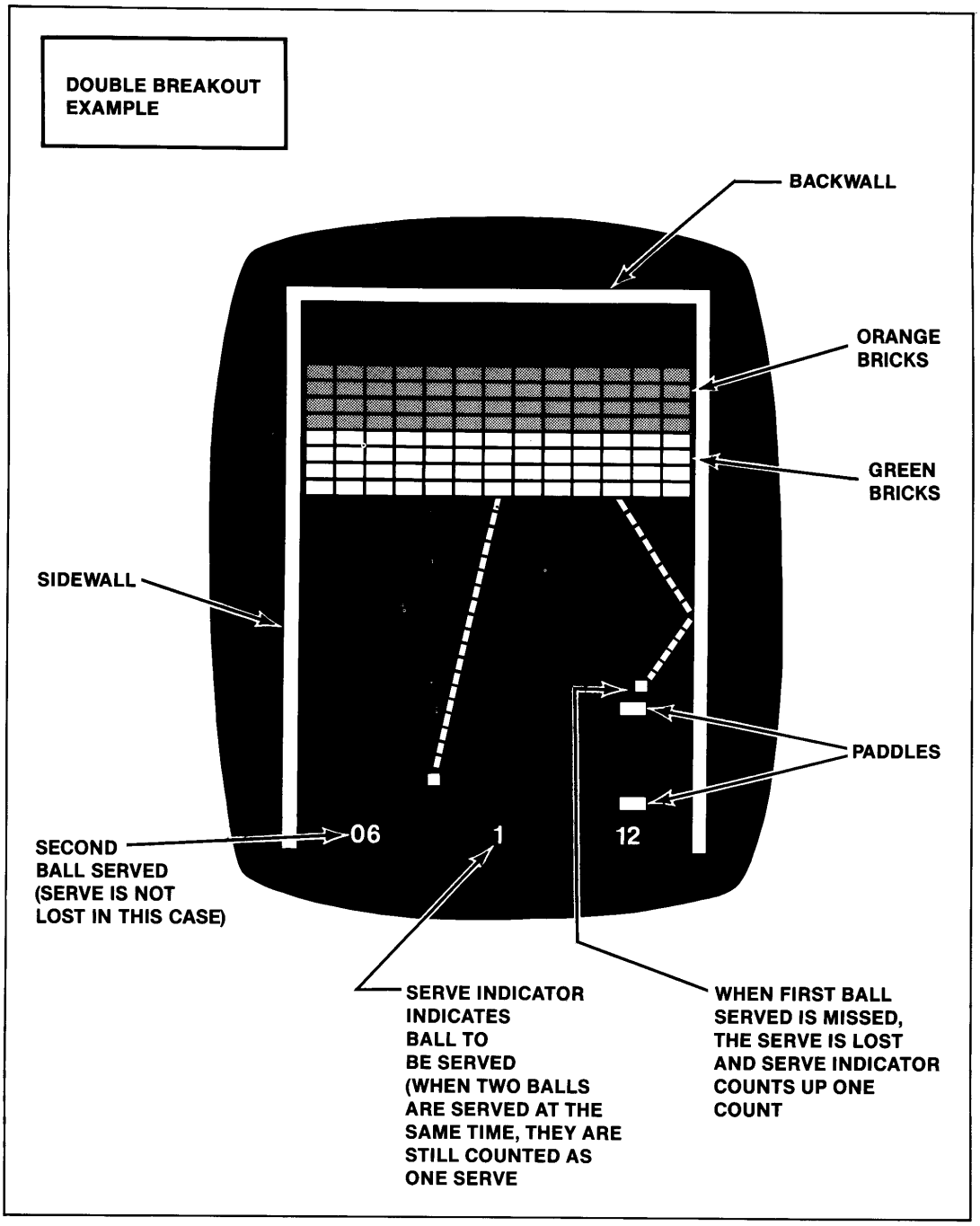


Figure 2-5 General Playfield Description

The screen also displays point requirements for bonuses (operator option), and the player or players have the option of selecting a desired game. The one-player start pushbutton flashes when only one credit has been accumulated. Both buttons flash when two or more credits have been accumulated. The Licon LED serve pushbutton switch remains off (unlighted and inoperative) until either the one- or two-player start pushbutton is pressed.

The game's circuitry has a credit accumulator that can keep track of up to 15 game credits. One credit is subtracted from the accumulator at the beginning of a one-player game, and two credits are subtracted at the beginning of a two-player game. Just after initial application of AC power, the deposit of coins will cause credits to be added. An operator option can be set so that deposit of one coin adds one credit, or else so that it adds two credits. During the first and subsequent play sequences, one credit will also be added each time a player attains the preset bonus score level, provided that a second operator option has been set to allow bonus credits. The game's two start pushbuttons are engraved with the words "One-Player Start" and "Two-Player Start". The lamp behind the one-player button flashes whenever at least one credit is remaining in the credit accumulator, and behind the two-player button whenever at least two credits are remaining, and the program is waiting for the player(s) to push one of these buttons.

D. PLAY MODE

After the ready-to-play mode is displayed, as discussed in the previous paragraphs, the player(s) may select a game by simply setting the game select rotary switch to the desired setting. Either player start switch initiates the play mode for the selected game whenever pressed. The serve lamp begins to flash and the current PLAYER'S SCORE flashes at the bottom of the TV screen. Before the serve switch is pressed for the first time, the player(s) still has the option of changing the game by turning the game select switch. The bonus score needed will be displayed, but the high score will not be displayed.

The play modes of all three selectable games are explained in detail in the following paragraphs.

The ball's initial direction will be random (see Figure 2-5). Although one component of its direction will always be toward the paddle rather than toward the bricks, the ball may even hit a sidewall boundary before it reaches the paddle end of the screen. The ball is never allowed to move in a direction exactly perpendicular to the front surface of the paddle, the bricks or to any of the boundaries. As soon as the first ball appears, the serve buttons go dark (turn off), but the ball number in the mid-lower portion of the screen remains at "1". On subsequent serves, however, the number will be increased by 1 each time a new ball appears on the screen.

With the ball moving on the TV screen, the player must now try to volley, that is, try to manipulate the paddle knob so that the paddle will move to a position that intercepts the ball before it escapes off the screen. If the player succeeds, the ball will rebound off the wall of bricks. The "blip" sound will be produced whenever the ball hits the paddle, and the "bounce" sound whenever the ball hits a boundary.

Whenever the ball hits a brick, that brick will disappear and the ball will rebound. But only one brick can disappear at a time. A "tick" sound is produced to represent each point of the brick's score point value.

A serve ends right after the player fails to volley; the serve button lights up and flashes as soon as the ball has disappeared off the end of the screen. To continue the play sequence a player must again depress the serve button. During two-player games the flashing score in the lower left corner of the TV screen changes from the left (player one) to the right (player two) after player one misses a volley, and vice versa when player two misses a volley. Each player in a two-player game receives an equal number of serves. (The game resets the respective player's last position in a two-player game.)

The play sequence continues as described above until all the balls are served. If no credit is remaining in the credit accumulator at this time, then the game reverts back to the attract mode, version two. But the game will remain in the play mode if one (or both) start buttons are lighted, because this means that credit is remaining in the credit accumulator. After the game reverts to the attract mode, version two, it automatically serves itself a ball. This ball cannot escape, however, because it cannot get past the invisible solid row of paddles at the lower end of the TV screen.

Double (See Figure 2-6)

The Double Breakout game is selected by setting the Game Select rotary switch to "Double." The player then presses the flashing player start pushbutton and serves the ball whenever desired by pressing the flashing red LED serve pushbutton.

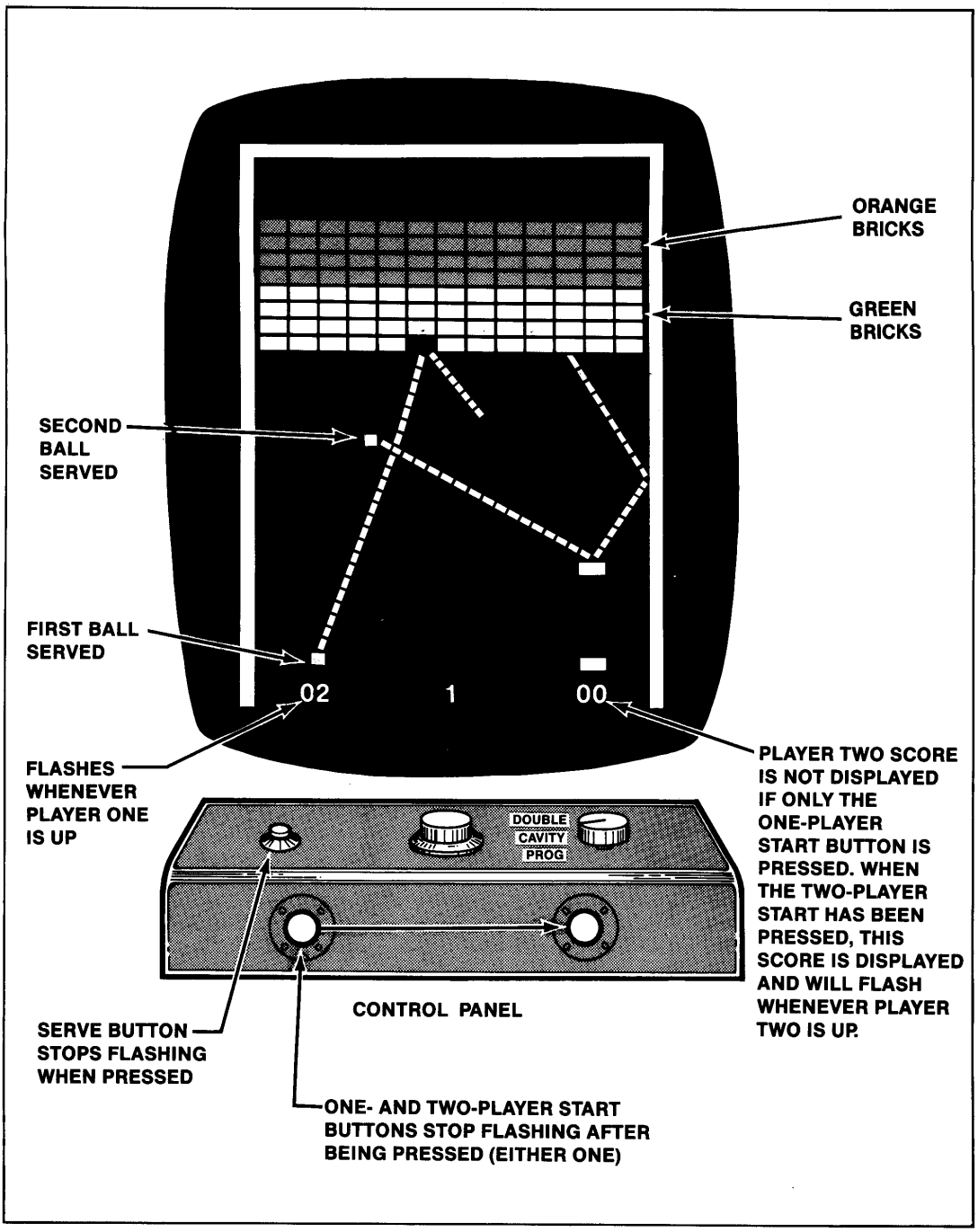


Figure 2-6 Double Breakout Play Mode

Before serving the ball, the double breakout playfield contains 52 orange bricks (4 x 13) at the top of the TV screen and 52 green bricks (4 x 13) immediately below the orange brick wall. The upper two rows of orange bricks are worth 7 points, when struck by a ball, 5 points for the lower two orange rows, 3 points for the upper two rows of green bricks and 1 point for the lower two rows of green bricks. See Table 2-1 for a quick and easy scoring reference. The maximum score for Double Breakout is 2694.

Table 2-1 "Double" Breakout Scoring Chart

Color	brick Row	1 Ball in Playfield	2 Balls in Playfield
orange	1	7	14
orange	2	7	14
orange	3	5	10
orange	4	5	10
green	5	3	6
green	6	3	6
green	7	1	2
green	8	1	2

Two paddles are displayed at the bottom end of the TV screen. When the serve pushbutton is pressed two balls are served. If the first ball served is missed, it counts as a missed serve and goes against the players allotted serves per game; otherwise the second ball is served. If the second ball served is missed after striking the first served ball, the player may continue with the first ball. Each brick knocked out scores according to the last two columns of Table 2-1, depending on how many balls are in the playfield. Either ball may be hit with either paddle, and they will not bounce off the bottom of the upper paddle.

Cavity (See Figure 2-7)

The Cavity Breakout game is selected by setting the game select rotary switch to "Cavity." The player then presses the flashing player start pushbutton. The ball may be served whenever desired by pressing the flashing red LED serve pushbutton.

Before serving the ball, the Cavity Breakout playfield contains 44 orange bricks and 52 (4 x 13) green bricks located immediately below the orange brick wall. At approximately 3 columns in and 2 rows down into the orange brick wall, from both the left and the right of the wall, two cavities exist. These two cavities occupy the space of 4 bricks (a 2 x 2 brick area).

Each cavity contains a captive ball that remains motionless prior to serving the ball. When the ball is served, these captive balls bounce inside the cavity, until the ball is missed. In this case they stop moving, and remain motionless once again until the next ball (if any) is served. As long as the balls remain captive, the bricks surrounding them do not disappear when struck by them, and no points can be accumulated from these balls.

Each brick in the upper two rows of the orange brick wall are worth 7 points when struck by a ball, 5 points for each brick in the lower two orange rows, 3 points for each brick in the upper two green rows and only 1 point for each brick in the lower two rows of green bricks (see Table 2-2).

One paddle is provided in this game, and only one ball is served, unlike Double Breakout. When enough bricks are removed to release a captive ball from its cavity, the score doubles for each brick hit by any one of the two balls in the playfield (as long as the served and freed ball remain active in the playfield). If the third ball is freed, all three balls are played in the playfield, the score triples. If any one of the balls is missed and lost, the score returns to double points. If the second ball is missed and only one ball remains in the playfield, points are then scored as listed under the 1-ball column of Table 2-2.

The maximum score attainable for Cavity Breakout is something less than 3384.

Table 2-2 "Cavity" Breakout Scoring Chart

Color	Brick row	1 Ball in Playfield	2 Balls in Playfield	3 Balls in Playfield
orange	1	7	14	21
orange	2	7	14	21
orange	3	5	10	15
orange	4	5	10	15
green	5	3	6	9
green	6	3	6	9
green	7	1	2	3
green	8	1	2	3

Progressive (See Figure 2-8)

The Progressive Breakout game is selected by setting the game select rotary switch to "Progressive." The player then presses the flashing player start

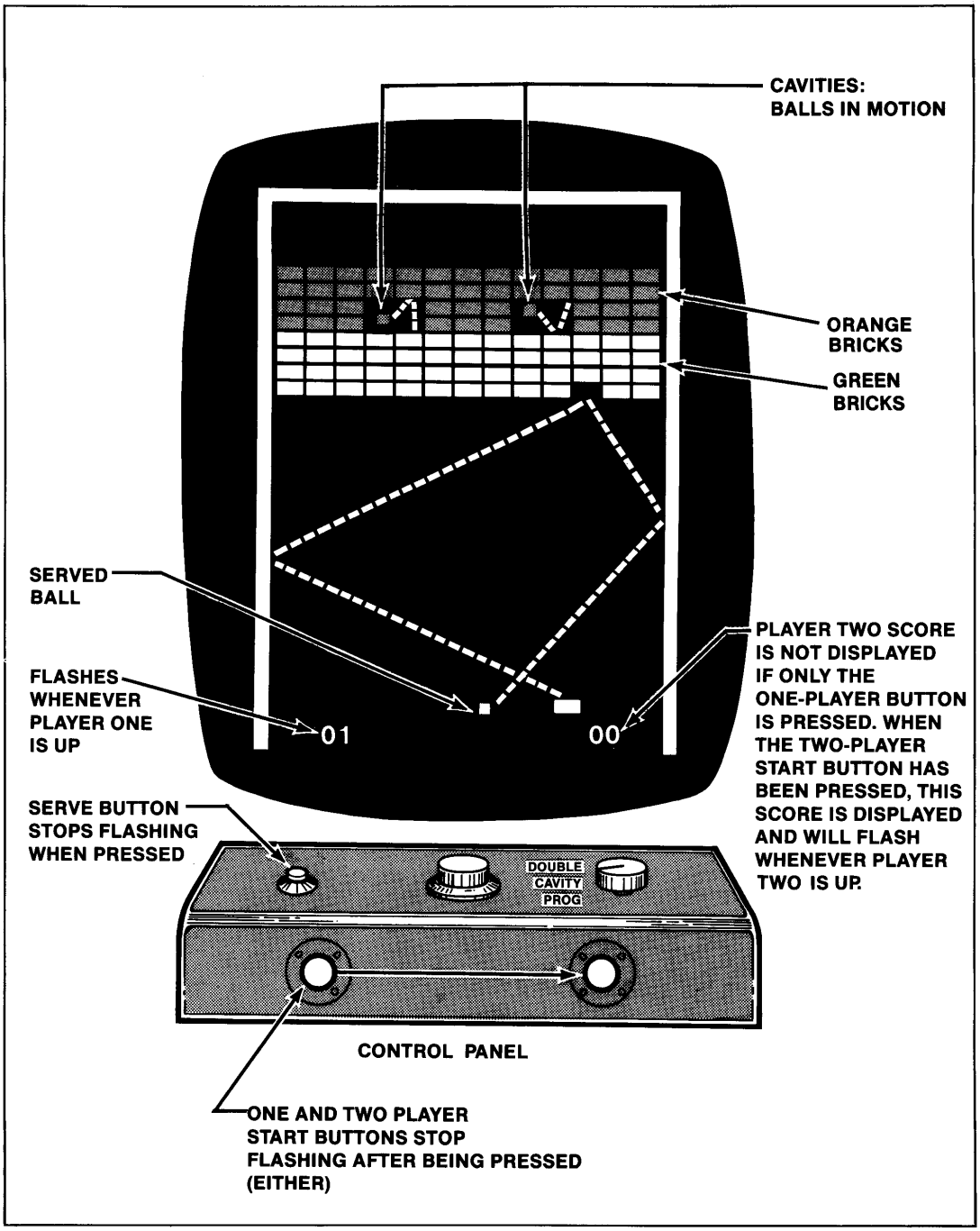


Figure 2-7 Cavity Breakout Play Mode

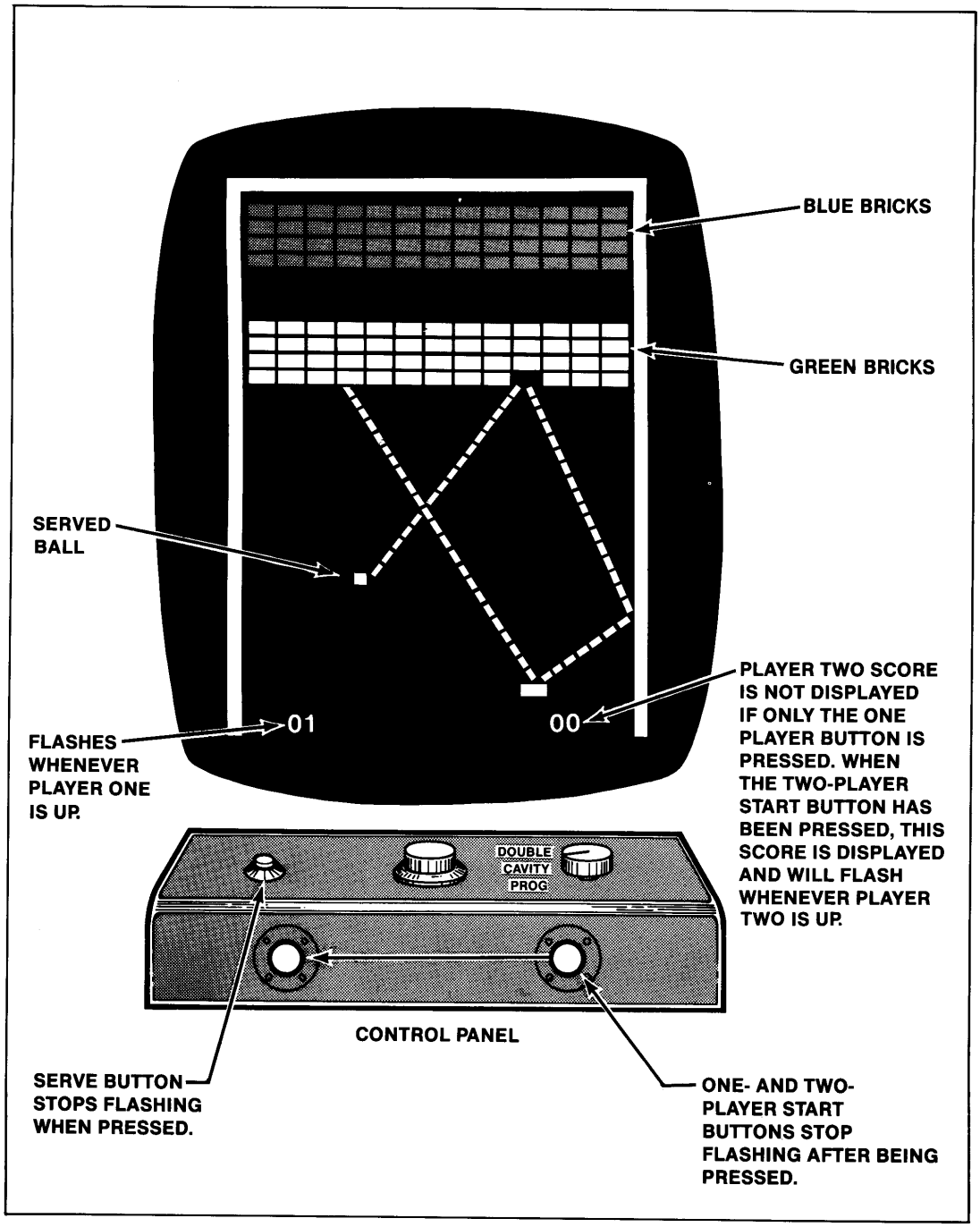


Figure 2-8 Progressive Breakout Play Mode
(Not Yet Scrolled)

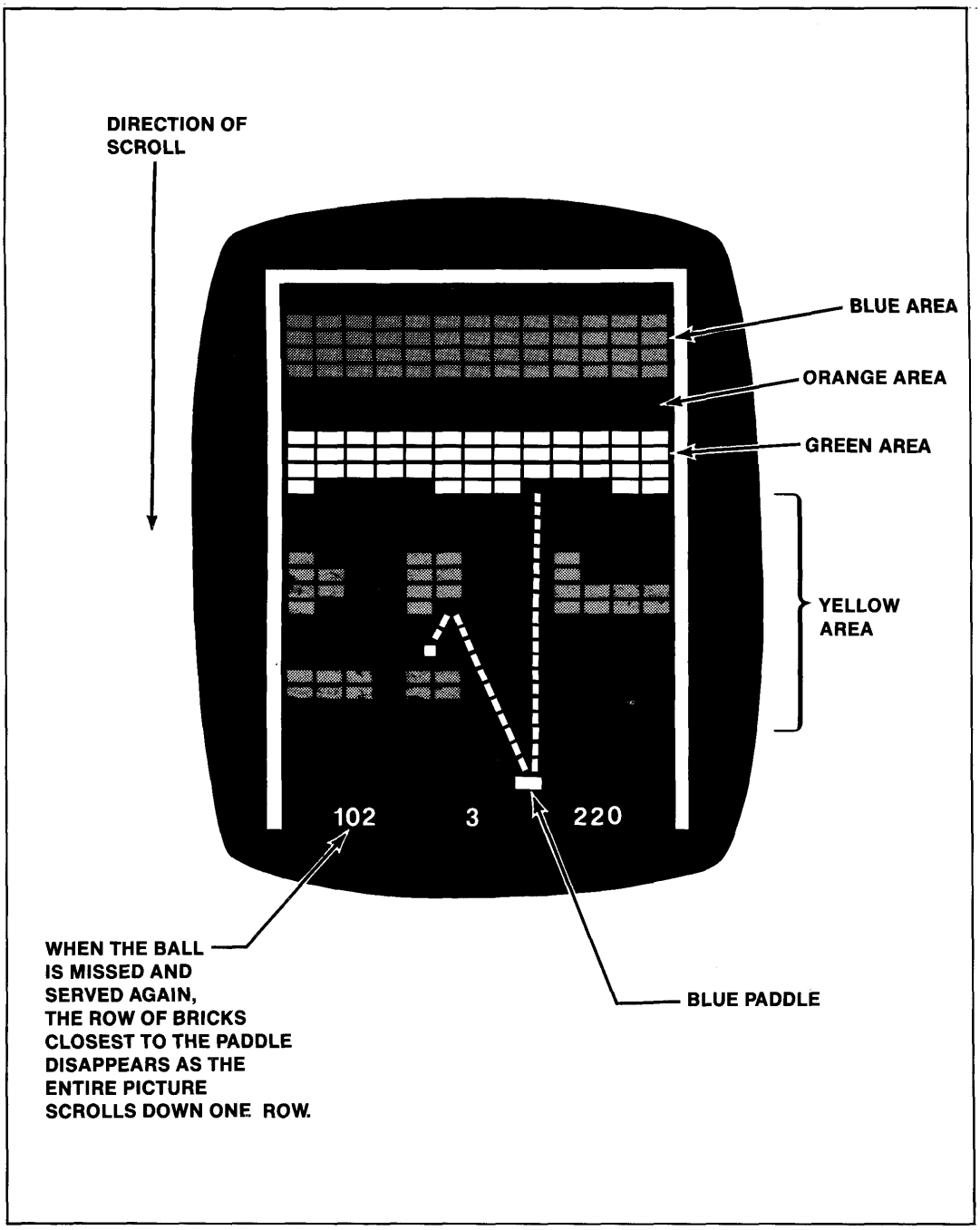


Figure 2-9 Progressive Breakout Scrolling Effect

pushbutton. The ball may be served whenever desired, by pressing the flashing red LED pushbutton.

Before serving the ball, the Progressive Breakout playfield contains two 4 × 13 brick walls (one blue and the other green). The blue brick wall, which consists of 52 bricks, is at the top. Then occurs a space equivalent to this wall. In the middle of the screen is a green brick wall consisting of 52 bricks.

The brick walls move or "scroll" toward the paddle at a rate determined by the number of hits on the ball. As the bricks are knocked out and the walls progressively creep up on the player's paddle, new bricks enter the playfield at a progressively faster rate; four rows of bricks are always separated by four rows of blanks.

As the brick walls scroll down, their colors change (see Figure 2-9) which indicates a new point score for that brick at that instant of time. There are four different colors of bricks, each color with a different score value. The blue bricks are worth 7 points when struck by the ball, 5 points for each orange brick, 3 points for each green brick and 1 point for each yellow brick. See Table 2-3 for a quick and easy reference. Bricks that scroll off the bottom of the screen are lost and are not counted toward or against the player's score.

Table 2-3 Progressive Breakout Scoring Chart

Color	Points per Brick
blue	7
orange	5
green	3
yellow	1

The maximum attainable score for progressive Breakout is infinite.

Ball Speed

Besides the slowest ball speed already described (right after the serve), there are three possible speed-ups. The first speed-up after the serve occurs on the 4th hit, and a second faster speed-up occurs on the 8th hit. The third occurs after the 12th hit and the fourth occurs when a highpoint (either a 5- or 7-point) brick is hit, regardless of previous speed. Ball speed is restored to the slowest value at the beginning of each serve.

Ball Direction

When the ball intercepts the paddle it will rebound in any of four directions, depending on which portion of the paddle was hit (see Figure 2-10). This is still the case after the paddle has been reduced to half its normal size. Note that the ball is not allowed to move in a direction perpendicular to the front surface of the paddle or perpendicular to the edge of the paddle. These directions change with the number of hits of the ball, just like the ball speed changes occur at the 4th, 8th and 12th ball hits.

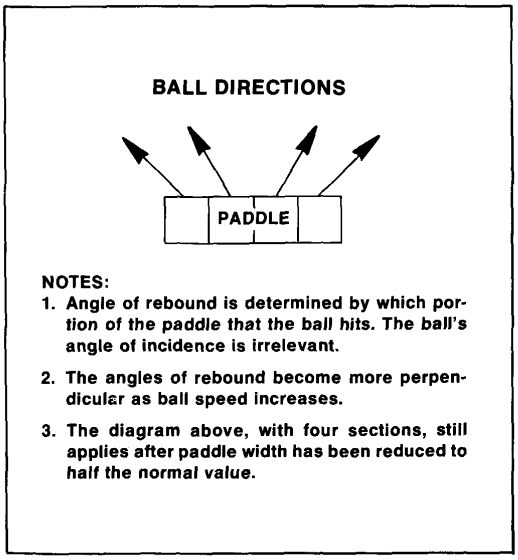
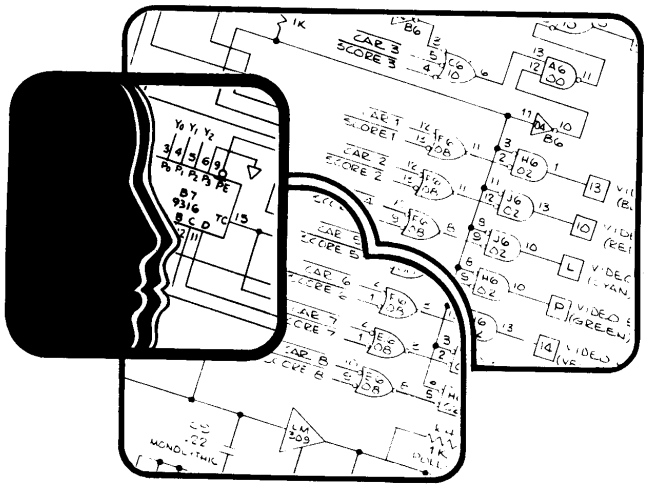


Figure 2-10. Diagram of Ball Rebounds off Paddle

The player must hit the ball first, otherwise bricks cannot be knocked out, and the ball will pass through all the bricks in its path. The ball with also pass through any bricks if it has not gone at least four rows from the last brick hit, and not hit the paddle or the uppermost boundary at the top of the screen.

Immediately on hitting the uppermost boundary at the top of the screen the paddle(s) will reduce to half its width until the next serve if any.



THEORY OF OPERATION

A. GENERAL INFORMATION

This chapter provides a general overview of the theory of operation of the Super Breakout electronics contained on the game printed circuit board (PCB). It also goes into specific detail of the various circuits to explain to an individual of moderate technical background how these circuits should perform. This detailed information has been organized with emphasis placed on troubleshooting the game PCB, circuit by circuit.

The Super Breakout game block diagram of Figure 3-1 illustrates the major components, including all controls remote to the game PCB. The function and direction of the information to and from these various controls is also shown.

The Super Breakout PCB block diagram in Figure 3-2 illustrates the division and function of the various circuits located on the game PCB and how they are controlled by the microprocessor. Refer to Figure 3-2 as you go through the following circuit descriptions.

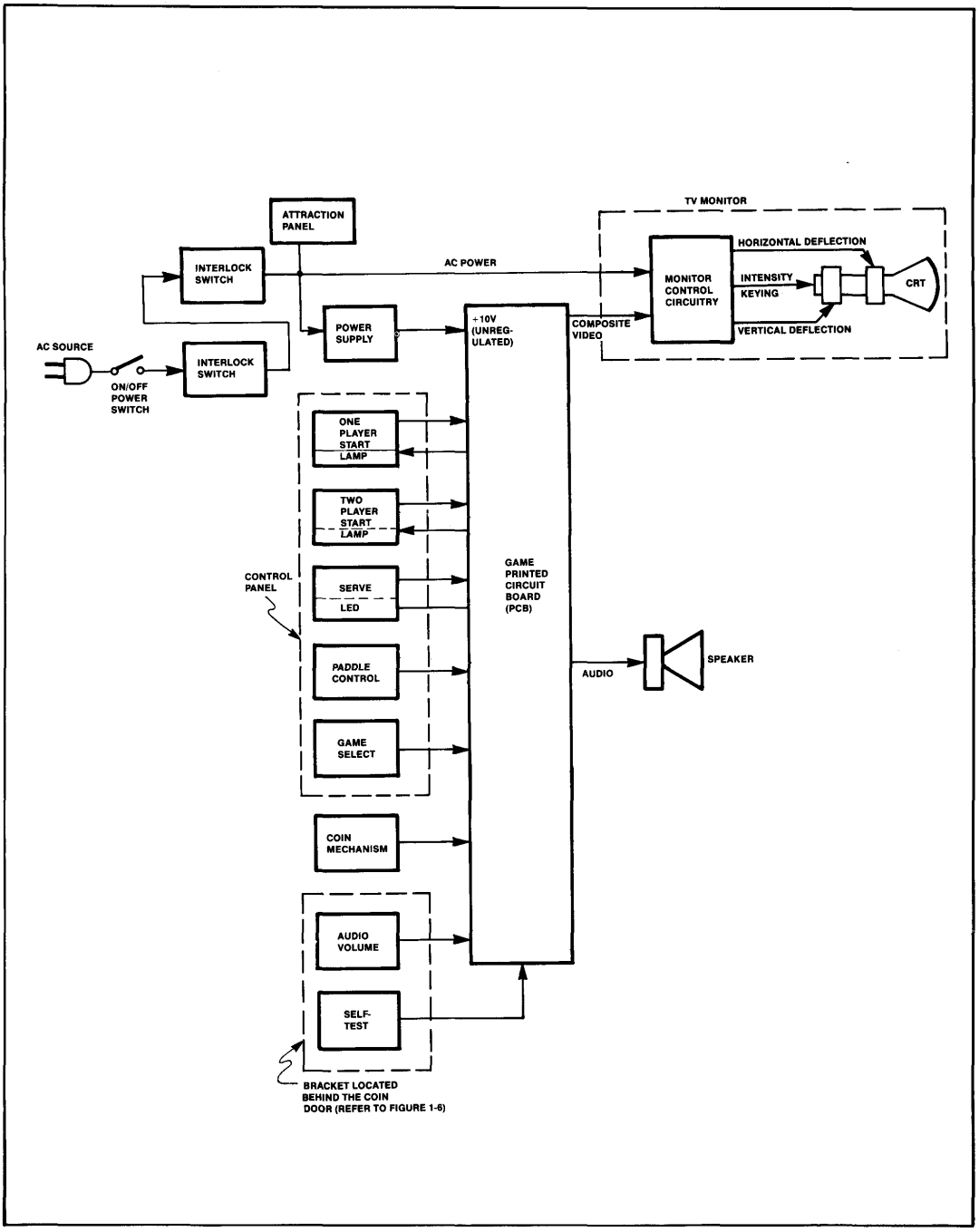


Figure 3-1 Super Breakout Game Block Diagram

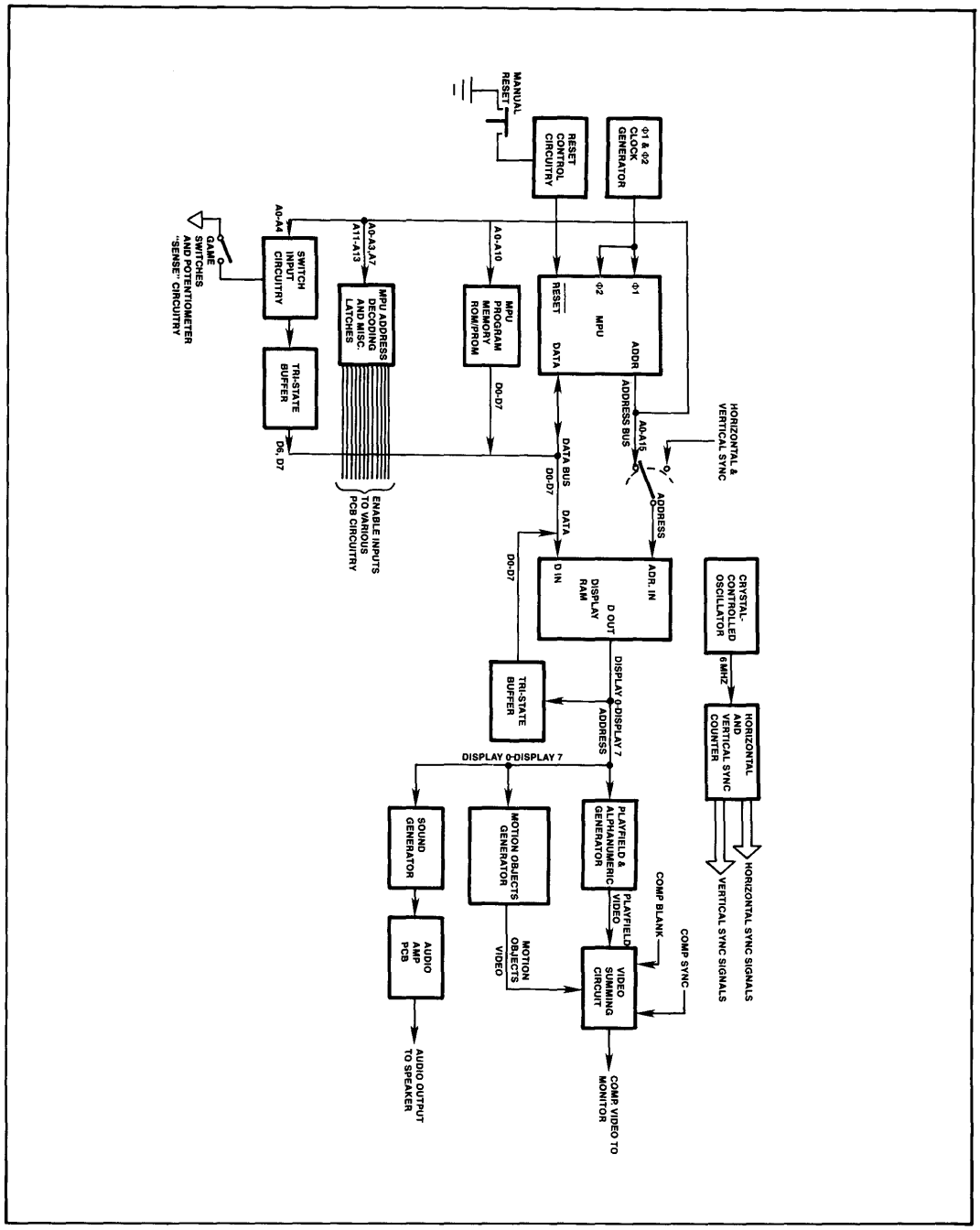


Figure 3-2 Super Breakout PCB Block Diagram

The functional operation of the Super Breakout PCB circuitry begins naturally enough with the microprocessor (or MPU) circuitry. As you go through the various circuit descriptions, you learn how the MPU receives its sequential program insructions from its ROM memory and how it carries out these instructions through the use of its display RAM memory (Section C); how it reads in the game control switches (Section G), and how it writes or outputs the results of its instructions and calculations to the game's other PCB circuitry, such as the playfield generator (Section E), the motion object generator (Section F), and the audio amplifier (Section K).

A circuit description of the standard Atari sync generator (Section D) is also included. This is the only PCB circuitry that functions independently of microprocessor control.

B. POWER SUPPLY (See Figure 3-3, Sheet 1 of 5 and Figure 3-5)

The power supply produces all the necessary game voltage requirements as shown in Figure 3-4.

The PCB receives +10 volts DC, unregulated, at pins B and 2 of the game PCB edge connector; 16.5 VAC to pins C and 3 and D and 4; and 25 VAC to pins W and 19 and X and 20 from the secondary of the transformer located on the Type B power supply chassis.

The +10 volts is rectified and filtered off-board and regulated on-board by the LM323 three-terminal regulator device to a stable +5 volts DC. The +5 volts DC is distributed throughout the PCB to power all logic circuits. The 16.5 VAC is rectified on-board via diodes CR1 and CR2, filtered by capacitor C54 before being regulated by the 7905 to produce the −5 volts DC, required by the voltage comparator, LM319. The 25 VAC input is rectified through diodes CR3 and CR4 filtered by capacitor C55 and supplied as unregulated +20 volts to the TDA 1004 audio amplifier. This +20 volts is also regulated by a three-terminal device 7812 (Q8) to develop +12 volts DC.

C. MICROPROCESSOR CIRCUITRY (See Figure 3-3, Sheet 2 of 5)

The heart of the Super Breakout game PCB is the microprocessor circuitry. A brief description of the major components and their function within the microprocessor circuitry is provided in the following paragraphs. Note that the microprocessor circuitry components include the following:

1. MPU (at location C3)
2. Address buffers (A2, B2 and C2)
3. Data buffers (E3, E4)
4. ROM memory (C1, D1 and E/F1) for -04 version or PROM memory as listed in the PCB assembly parts list for the -03 version (refer to Illustrated Parts Catalog, Section 5).
5. RAM memory (F4, H4, J4, K4, F3, H3, J3, and K3)
6. Address decoding circuitry (E2, F2, D2, E8, and H8, and miscellaneous gates)
7. Φ0 clock driver (A7 and miscellaneous gates)
8. Watchdog reset counter (C6/7 and miscellaneous gates)

MPU, ROM, and RAM (See Figure 3-5)

The microprocessor is the "master controller" behind all action that takes place in the game circuitry. In going through the following paragraphs refer to Table 3-1, MPU Input/Output Signal Descriptions. Upon initialization, the MPU (via A0–A15) addresses data permanently stored in the program ROMs or PROMs. This addressed data then travels to the MPU via its 8-bit data bus (D0 through D7). The MPU decodes this data to determine what action it is to perform next (i.e., "read coin switch 1," "ball speed up," etc.). The MPU uses RAM memory to perform many of these instructions, namely to temporarily store information which it will later recall. The MPU is capable of writing (or putting data into) the RAM and then later reading (pulling data out of) the RAM, via its address bus (A0–A15) and bidirectional data bus (D0–D7).

Address Decoding

The MPU address decoding circuitry performs the critical function of turning on or enabling the appropriate game circuitry (i.e., RAM, ROM, latches, etc.) at the appropriate time, so that information can be transferred back and forth between this game circuitry and the MPU. A memory map defining the MPU circuit is shown in Table 3-2 as reference.

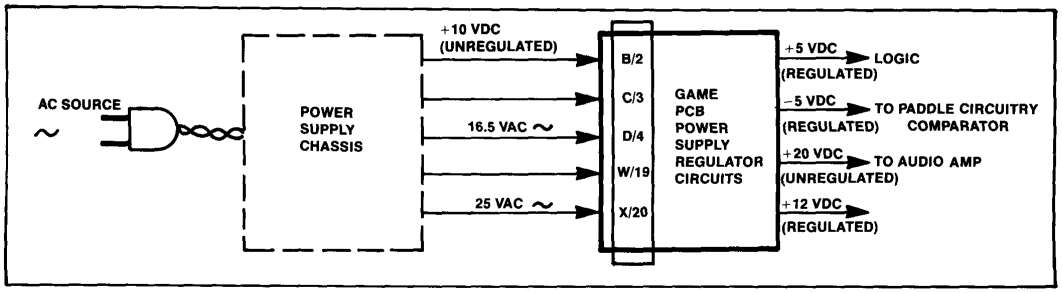


Figure 3-4 Power Supply Simplified Block Diagram

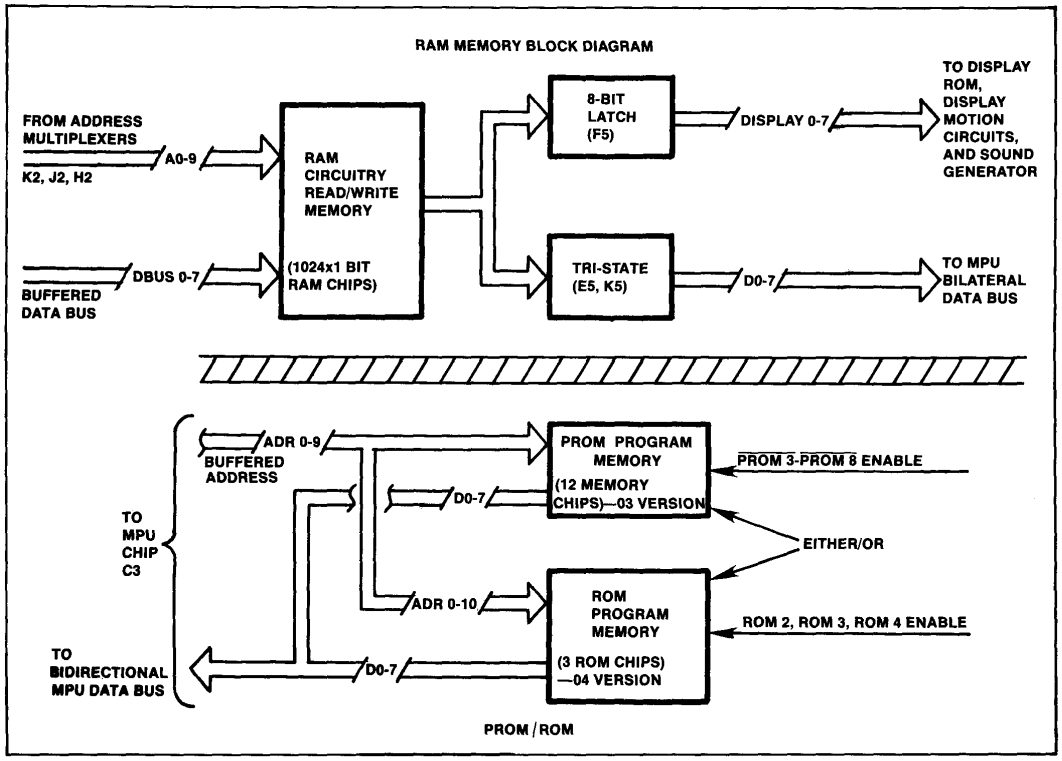


Figure 3-5 Memory Block Diagram

Φ0 Clock Driver (See Figure 3-6)

The basic operating frequency of the microprocessor is established by its Φ0 input (on pin 37 of the MPU device). The Super Breakout MPU runs at an operating frequency of 750 kHz. Examination of Φ1 and Φ2 (pins 3 and 39) waveforms with an oscilloscope should show two signals of opposite polarity with a period of 1.33 microseconds. (The period of any periodic waveform is the measurement of the time it takes to complete one full cycle.) The 750 kHz clock frequencies are derived from the 4H signal. This

Table 3-1 MPU Input/Output Signal Descriptions

Signal	Description/Function	Signal	Description/Function
D0–D7	These eight lines are bi-directional data bus lines.		are loaded into the MPU program counter to point the start of a reset routine.
A0–A15	These sixteen lines are unidirectional MPU address lines to supporting memory (i.e., ROMs, RAMs) and I/O.	$\overline{NMI}$	This input line, while going low, indicates a "non-maskable interrupt" to the MPU. After the MPU concludes its current instruction, it will then proceed to the NMI sequence.
$\overline{IRQ}$	This input, when low, indicates an interrupt to the MPU. After the MPU concludes its current instruction it will proceed to the IRQ sequence.	$\Phi 0$	Clock input
$\overline{RESET}$	When low, this input line resets the MPU on either a "power-up condition" or a Q_D output of the watchdog counter. During the reset sequence prior to RESET going high, the contents of two locations (FFFC, FFFD) in memory	$\Phi 1$, $\Phi 2$	Two-phase, non-overlapping MPU clock outputs.
		R/$\overline{W}$	This output is the read and write signal line, which indicates the direction of data transfers on MPU data bus.

Table 3-2 Atari Inc. Programmed Memory Map

Ø = LOGIC ZERO
1 = LOGIC ONE
X = DON'T CARE
A = LOWER ORDER ADDRESS BITS
D = DATA
M = MASK
R = READ
W = WRITE

ADDRESS																R/W	DATA								FUNCTION
HEXADECIMAL	A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0		D7	D6	D5	D4	D3	D2	D1	D0	
0000-007F	X	X	Ø	Ø	Ø	Ø	Ø	Ø	Ø	A	A	A	A	A	A	A	X	X	X	X	X	X	X	X	X	ZERO PAGE RAM
0400-077F	X	X	Ø	Ø	Ø	A	A	A	A	A	A	A	A	A	A	A	X	X	X	X	X	X	X	X	X	VIDEO DISPLAY RAM
0828	X	X	Ø	Ø	1	Ø	X	X	Ø	Ø	1	Ø	1	Ø	Ø	Ø	R	D	X	X	X	X	X	X	X	SELECT 1
082E	X	X	Ø	Ø	1	Ø	X	X	Ø	Ø	1	Ø	1	1	1	Ø	R	D	X	X	X	X	X	X	X	SERVE SWITCH
0830	X	X	Ø	Ø	1	Ø	X	X	Ø	Ø	1	1	Ø	X	Ø	Ø	R	D	D	X	X	X	X	X	X	LANGUAGE-SW OPTIONS
0831	X	X	Ø	Ø	1	Ø	X	X	Ø	Ø	1	1	Ø	X	Ø	1	R	D	D	X	X	X	X	X	X	COIN MODE-SW OPTIONS
0832	X	X	Ø	Ø	1	Ø	X	X	Ø	Ø	1	1	Ø	X	1	Ø	R	D	X	X	X	X	X	X	X	3 OR 5 BALL-SW OPTION
0832	X	X	Ø	Ø	1	Ø	X	X	Ø	Ø	1	1	Ø	X	1	Ø	R	X	D	X	X	X	X	X	X	MSB OF BONUS-SW OPTION
0833	X	X	Ø	Ø	1	Ø	X	X	Ø	Ø	1	1	Ø	X	1	1	R	D	D	X	X	X	X	X	X	LSB OF BONUS-SW OPTION
0840	X	X	Ø	Ø	1	Ø	X	X	Ø	1	X	X	X	X	X	X	R	D	D	X	X	X	X	X	X	COIN SWITCHES
0880	X	X	Ø	Ø	1	Ø	X	X	1	Ø	X	X	X	X	X	X	R	D	X	X	X	X	X	X	X	2 PLAYER START SWITCH
0880	X	X	Ø	Ø	1	Ø	X	X	1	Ø	X	X	X	X	X	X	R	X	D	X	X	X	X	X	X	1 PLAYER START SWITCH
08C0	X	X	Ø	Ø	1	Ø	X	X	1	1	X	X	X	X	X	X	R	D	X	X	X	X	X	X	X	SELF TEST SWITCH
08C0	X	X	Ø	Ø	1	Ø	X	X	1	1	X	X	X	X	X	X	R	X	D	X	X	X	X	X	X	SLAM SWITCH
0C00	X	X	Ø	Ø	1	1	Ø	X	X	X	X	X	X	X	X	X	R	D	D	D	D	D	D	D	D	VERTICAL SYNC COUNTER
0C10	X	X	X	X	1	1	X	X	X	Ø	Ø	1	X	X	X	D	W	X	X	X	X	X	X	X	X	SERVE LED
0C30	X	X	X	X	1	1	X	X	X	Ø	1	1	X	X	X	D	W	X	X	X	X	X	X	X	X	ONE PLAYER START LIGHT
0C40	X	X	X	X	1	1	X	X	X	1	Ø	Ø	X	X	X	D	W	X	X	X	X	X	X	X	X	TWO PLAYER START LIGHT
0C50	X	X	X	X	1	1	X	X	X	1	Ø	1	X	X	X	D	W	X	X	X	X	X	X	X	X	NMI POT READING ENABLE
0C70	X	X	X	X	1	1	X	X	X	1	1	1	X	X	X	D	W	X	X	X	X	X	X	X	X	COIN COUNTER
0C80	X	X	Ø	Ø	1	1	Ø	Ø	1	X	X	X	X	X	X	X	W	X	X	X	X	X	X	X	X	WATCH DOG
1000	X	X	Ø	1	Ø	Ø	X	X	X	X	X	X	X	X	X	X	W	D	X	X	X	X	X	X	X	LSB OF POT READING
2C00-3FFF	X	X	1	A	A	A	A	A	A	A	A	A	A	A	A	A	R	D	D	D	D	D	D	D	D	PROGRAM
082F	X	X	Ø	Ø	1	Ø	X	X	Ø	Ø	1	Ø	1	1	1	1	R	D	X	X	X	X	X	X	X	SELECT 2
0010	X	X	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	1	Ø	Ø	Ø	X	D	D	D	D	D	D	D	D	HORIZONTAL BALL POSITION
0011	X	X	Ø	Ø	Ø	Ø	Ø	Ø	X	Ø	Ø	Ø	1	Ø	Ø	Ø	1	X	X	X	X	D	D	D	D	NOISE GENERATION BITS
0018	X	X	Ø	Ø	Ø	Ø	Ø	Ø	X	Ø	Ø	Ø	1	1	Ø	Ø	Ø	X	D	D	D	D	D	D	D	VERTICAL BALL POSITION
0019	X	X	Ø	Ø	Ø	Ø	Ø	Ø	X	Ø	Ø	Ø	1	1	Ø	Ø	1	X	D	X	X	X	X	X	X	BALL PICTURE

-03 = PROM -04 = ROM

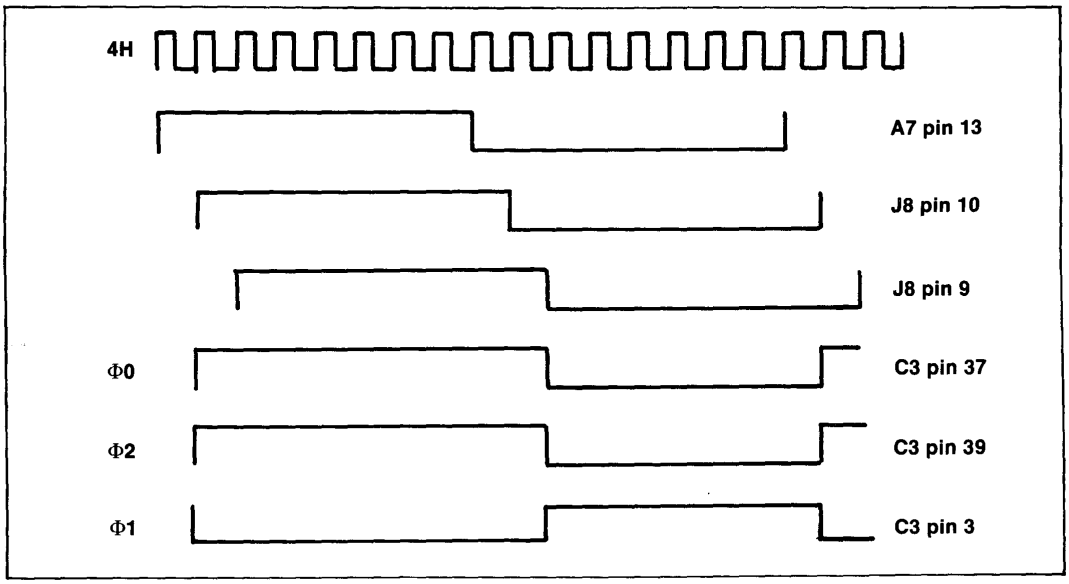


Figure 3-6 Phase 1 and Phase 2 Signal Shaping

4H frequency is generated by the horizontal sync counter P8, pre-shaped by latch A7, and buffered by driver J8 to produce the Φ0 clock input. See Figure 3-7, Phase 1 and Phase 2 Signal Shaping.

Watchdog RESET

The reset counter in the microprocessor control circuitry consists of a 4-bit decade counter, C6/7. The Q_D output of this counter is the $\overline{\text{RESET}}$ signal to the MPU. Counter C6/7 counts how many times the 128V signal changes states. On every high-to-low transition of 128V, the counter advances to the next count in its sequence. Meanwhile, the TIMER RESET signal, generated by the MPU at various times during its normal instruction sequence, is resetting the counter back to zero. If for some reason the MPU program has strayed from its intended instruction sequence and the TIMER RESET signal does not occur before this counter counts up to a point where the Q_D output goes high, a $\overline{\text{RESET}}$ signal is generated to the MPU. The $\overline{\text{RESET}}$ signal causes the MPU to restart its instruction sequence from the beginning of the program.

D. SYNC GENERATOR (See Figure 3-3, Sheet 1 of 5)

The base frequency of the sync generator is a 12.096-MHz clock, generated by a crystal-controlled oscillator consisting of crystal Y1, inverter N9, and several discrete components. The output of this oscillator is 12 MHz. Examination of this signal with an oscilloscope (at pin 8 of R9) should show the period (or cycle time) to be approximately 83 nanoseconds (.083 microseconds). See Figure 3-7.

This base frequency is then divided down by flip-flop R8 and binary counters P8 through N8: it provides the various horizontal synchronization frequencies (1H through 256H). The final output of this horizontal counter chain is 256H (at pin 11 of N8). This signal is in effect a division of the base frequency (12.096 MHz) by 768, to give a horizontal line frequency of 15,750 Hz. The period of 256H is about 63.5 microseconds. The 256H signal, as well as other horizontal signals, are used to generate the H BLANK and H SYNC timing pulses at flip-flop R1. See Figure 3-8, Horizontal Sync Timing Diagram for the relative timing of these waveforms.

The H SYNC signal is used to clock two stages of vertical sync counters (L3 and M3). This H SYNC signal is divided down by these counters to form the various vertical synchronization

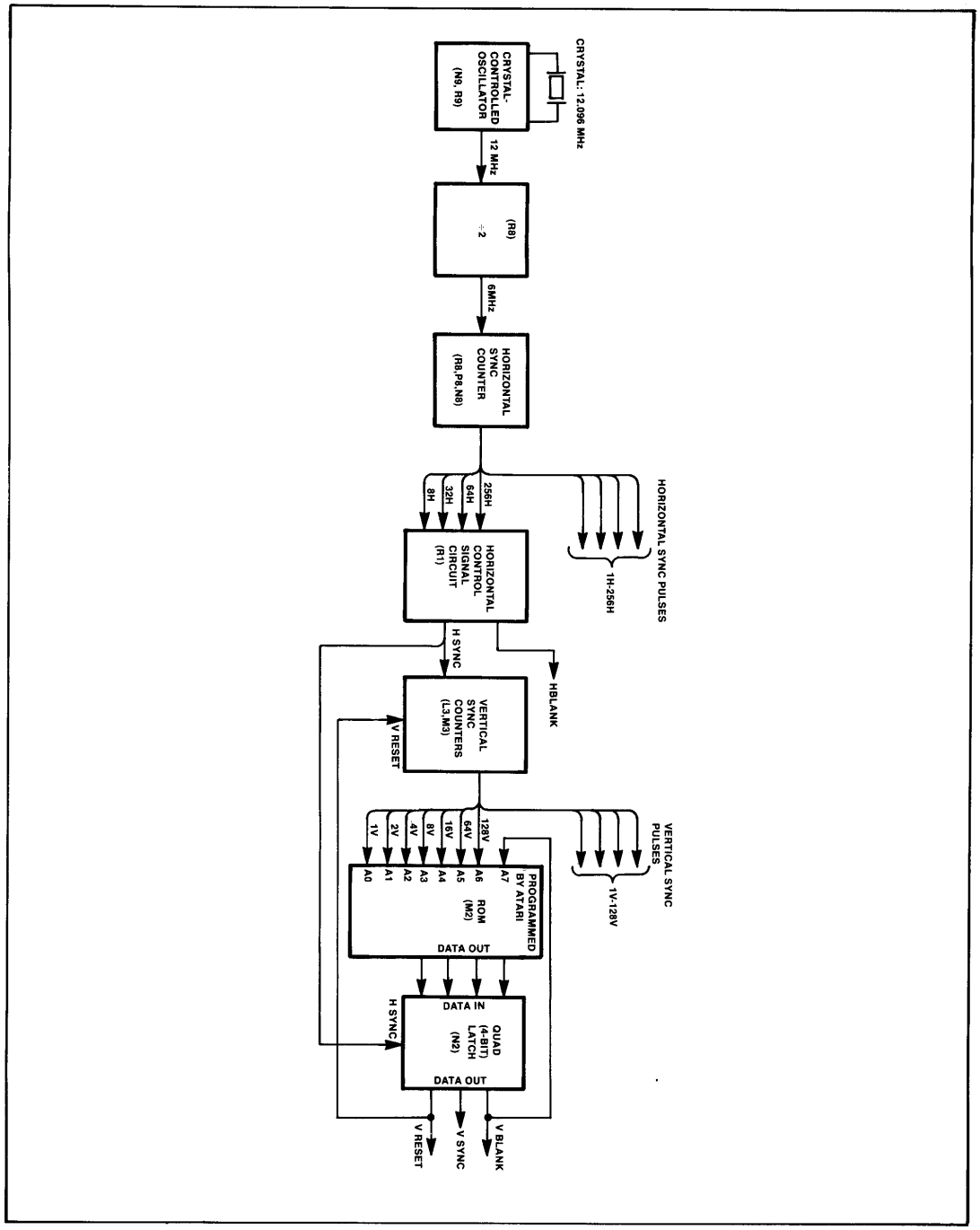


Figure 3-7 Simplified Diagram of Crystal-Controlled Oscillator and TV Sync Circuitry

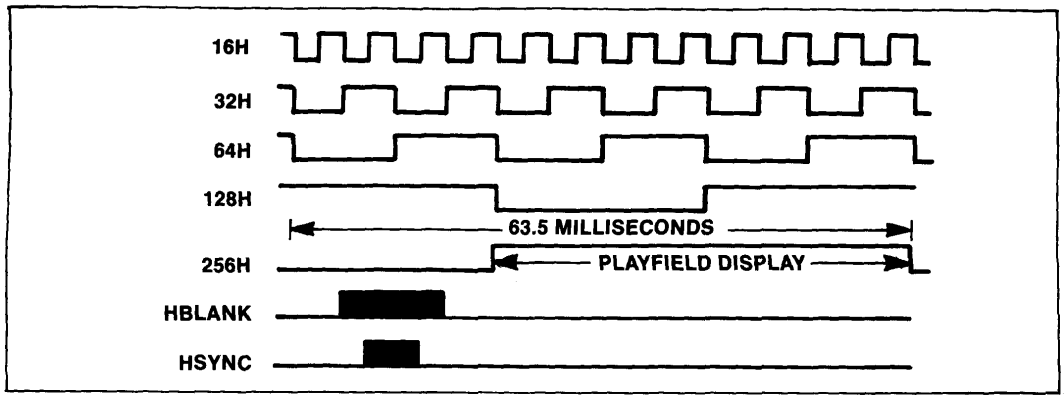


Figure 3-8 Horizontal Sync Timing Diagram

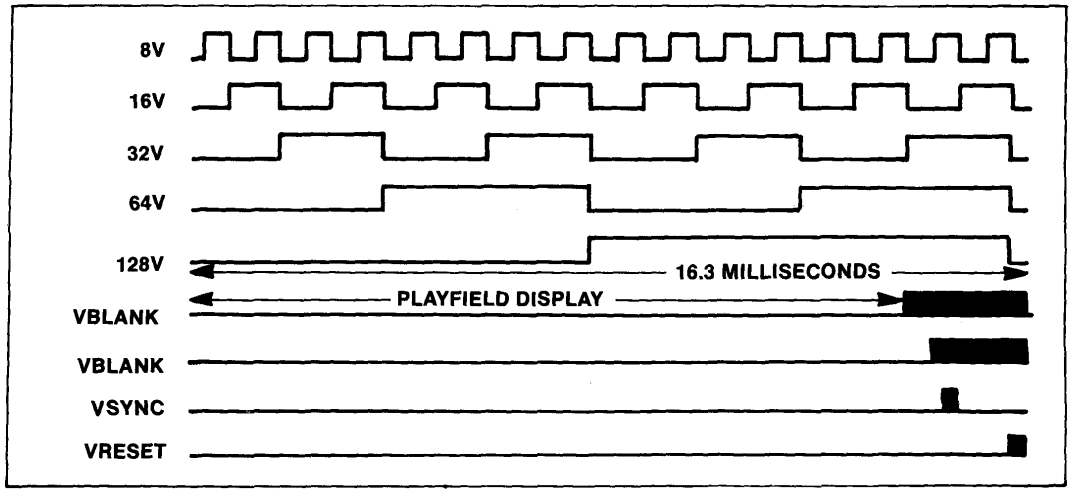


Figure 3-9 Vertical Sync Timing Diagram

frequencies (1V through 128V). These two stages of vertical counters are used, in effect, to do a divide by 262 of the H SYNC signal. This results in the final output of these counters (128V at pin 11 of M3) to be a signal at a frequency of 60 Hz (the period is approximately 16.3 milliseconds). The various vertical frequencies address a sync PROM (M2) whose output data is latched by latch N2. The outputs of this latch are the various polarities and phases of the vertical timing frequency used to synchronize the TV monitor display. These signals all run at a frequency of 60 Hz. See Figure 3-10, Vertical Sync Timing Diagram for the relative timing of these waveforms.

The end result of the horizontal and vertical timing waveforms is to synchronize the TV monitor display (COMP SYNC*). This display consists of 262 horizontal lines per frame, with each line being the time equivalent of 768 12 MHz clock pulses. Each frame is repeated 60 times per second, providing the necessary frequency of display refresh that provides a stable non-flickering display.

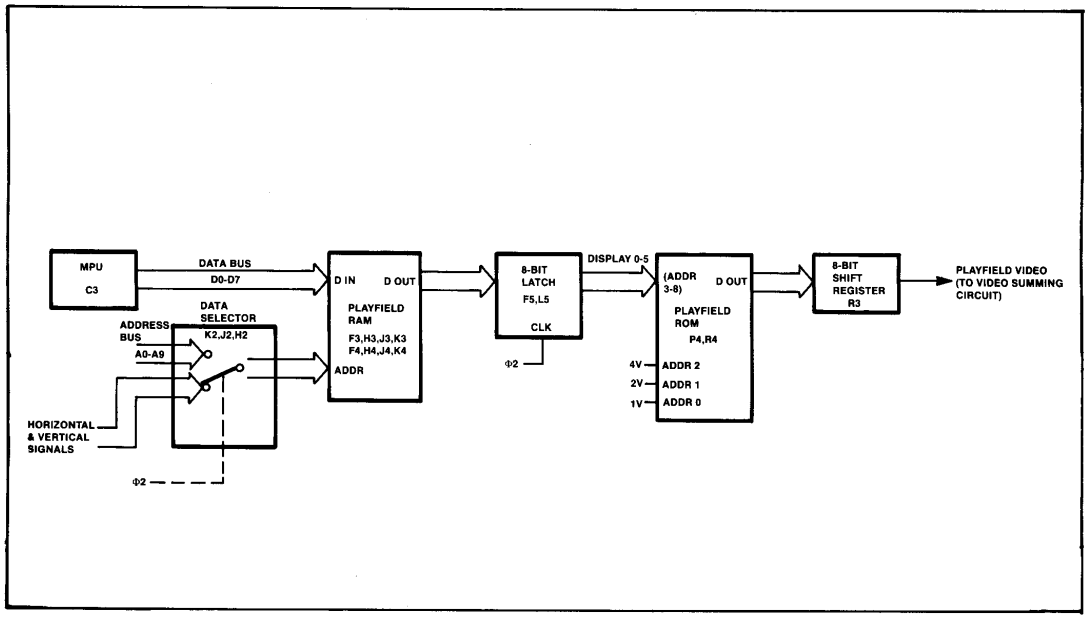


Figure 3-10 Playfield Generator Block Diagram

E. PLAYFIELD GENERATOR (See Figure 3-3, Sheet 4 of 5)

The playfield generator generates both the alphanumeric and playfield data for the TV monitor display. The video is actually generated by graphics ROMs P4 and R4 and 8-bit shift register R3. See Figure 3-10.

Which alphanumeric or playfield characters are to be displayed and where on the screen they are to be placed is controlled by the MPU Display RAM (F4, H4, J4, K4, F3, H3, J3, K3). To understand how MPU-generated data in the display RAM controls placement of these characters, it is first necessary to understand the organization of the playfield display itself. The playfield is structured as a 32 x 32 matrix, consisting of 32 horizontal rows of characters—each row being 32 characters wide. (Actually, only 28 of the 32 rows of characters are visible on the screen, since the bottom four rows are blanked out by the V BLANK* signal during the vertical blanking and retrace period.) Each character is structured as an 8 x 8 block, eight lines high with eight bits of data per line. See Figure 3-11.

Since there are 32 rows of characters, with 32 characters per row, there are a total of 1,024 (32 x 32) positions in which to place a character. The display RAM consists of the eight ICs mentioned above. Each of these chips is a memory size of 1,024 addresses, with one bit of data per address. When all eight of these RAMs are considered as a group,they have a memory size of 1,024 x 8.

Because of the unique way in which the game circuitry is structured, each of 1,024 addresses in the display RAM corresponds to one of the 1,024 possible

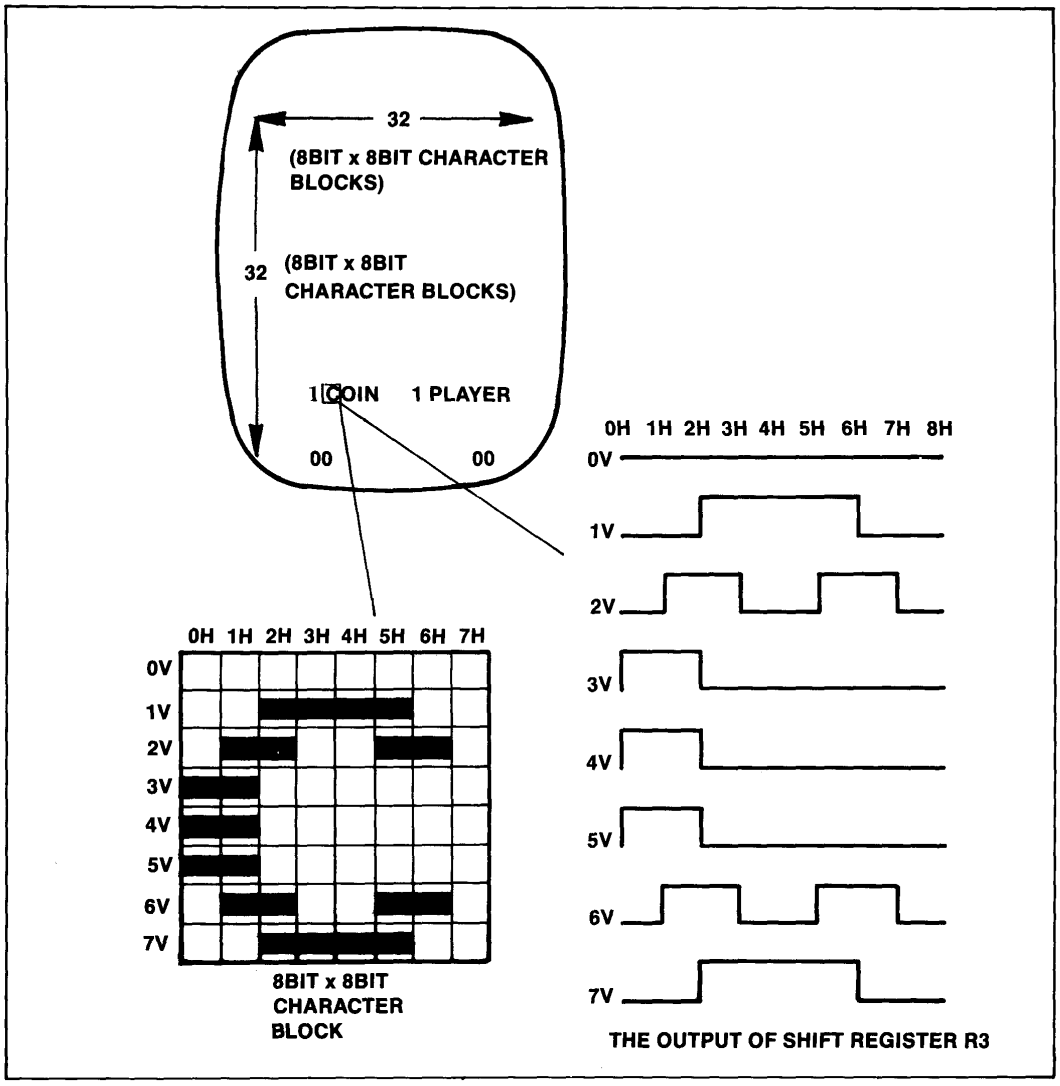


Figure 3-11 Character Display Data

positions in which a character can be placed on the playfield. In other words, for each position on the TV monitor screen in which an 8 x 8 playfield character can be displayed, there is an 8-bit data code stored at a particular address in RAM, which determines what character, if any, is to be displayed in that position.

The method by which the MPU writes the appropriate playfield data to each RAM location, and then the horizontal and vertical timing signals read this data out for actual video generation is known as "cycle-sharing." The circuitry that controls this cycle-sharing technique is composed of the three

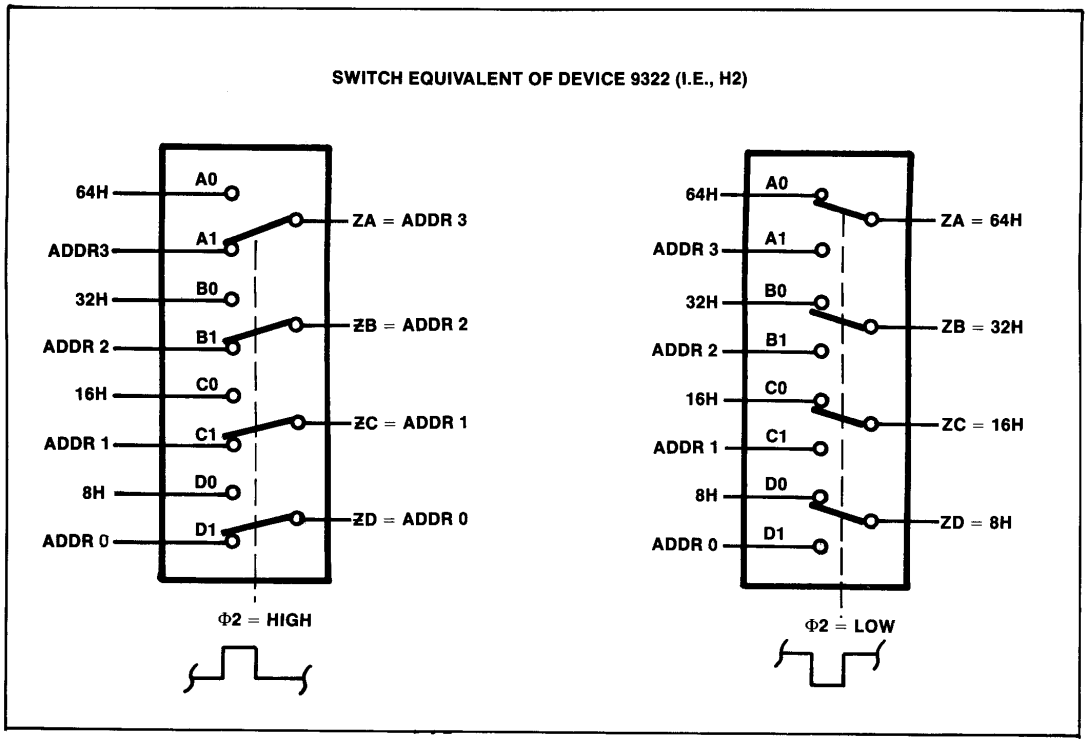


Figure 3-12 Address Multiplexers Equivalent Diagram

2-to-1 multiplexers, K2, J2, and H2, which select one of two sets of addressing information to address the display RAM. This circuitry functions as follows:

1. When MPU Φ2 clock is high, the MPU address bus (A0–A9) addresses various RAM locations, and writes appropriate playfield picture *codes* into them, via the MPU data bus (D0–D7).

2. When Φ2 is low, horizontal sync signals (8H–128H) and vertical sync signals (8V–128V) are now allowed to address this game display RAM and read data out of it. This data being read is latched by latches P2 and M2, and labeled DISPLAY 0–DISPLAY 7 *(See Figure 3-12).*

Since the data was read out of the RAM by the horizontal and vertical sync signals, the picture codes contained by DISPLAY 0–7 always correspond to the portion of the monitor display currently being scanned. Because of this, the DISPLAY 0–7 outputs can be used to generate video information for immediate display. These DISPLAY signals address one of 64 8 x 8 pictures stored in graphics ROMs P4 and R4. The output of the ROMs P4 and R4 is then converted to serial video information by shift register R3.

The $\overline{\text{PLAYFIELD}}$ signal represents all of the playfield and alphanumeric character video information. It is summed into the video summing circuit, as shown on sheet 4 of the schematic diagram.

F. MOTION OBJECT GENERATOR (See Figure 3-3, Sheet 4 of 5)

The motion object generator produces the video for Super Breakout's three moving objects (3 balls).

The actual video information for these objects is stored in ROM K6. This ROM provides a total memory size of 32 x 8 bits. (see Figure 3-13).

The MPU controls the positions and different configurations of this video by information that it stores at selected addresses in the display RAM. Each of the three motion objects corresponds to three bytes of data stored in this RAM: one byte determines which of the pictures in ROM is to be addressed; the second byte determines the vertical position of that motion object; and the third byte determines the horizontal position of the object.

These bytes of RAM data are accessed by horizontal sync signals 8H, 16H, 32H and 64H at the beginning of each horizontal scan line (during the horizontal blanking period, i.e., when 256H is low). Therefore, before each horizontal line is scanned, the motion generator receives the necessary information to tell it what, if any, motion objects are to be displayed on that line.

Vertical position data (DISPLAY 0–DISPLAY 7) is received by vertical line comparators C4 and L4. These comparators determine if a motion object is to be displayed on the line currently being scanned. Take, for example, the data code for an object to be displayed beginning on line 120. The RAM byte data code of 01111000 would be loaded into the comparators. If the vertical line count (as determined by 1V, 2V, 4V, 8V, 16V, 32V, 64V and 128V) is also at 01111000, a compare signal (pin 7 of L5, low) will be generated. This signal initiates one of the three vertical load pulses at K8, $\overline{\text{LDV1A}}$, $\overline{\text{LDV2A}}$, and $\overline{\text{LDV3A}}$. These vertical load pulses are used to load the ROM's video information into appropriate video shift registers.

In review, for each ball, the motion object generator receives one byte of RAM data (DISPLAY 0–7 going to C4 and L4) that controls where that object is to be displayed vertically. The generator receives a second byte of RAM data (DISPLAY 7 going to ROM K6) that selects the ball picture to be displayed. The correct video information for that picture (VID 5–7) is then loaded into the appropriate shift register (N7 for ball 1, L7 for ball 2, and J7 for ball 3).

A third byte of RAM data is necessary to determine where the object picture is to be placed horizontally. This data (DISPLAY 0–7) is loaded into a pair of horizontal counters (R5 and R6 for ball 1, P5 and P6 for ball 2, and N5 and N6 for ball 3). These counter pairs are preset when the horizontal scan of that line begins (256H* goes high). The counters begin counting up at the rate of 6 MHz. When the counter pair reaches a specific point in its count sequence, it gen-

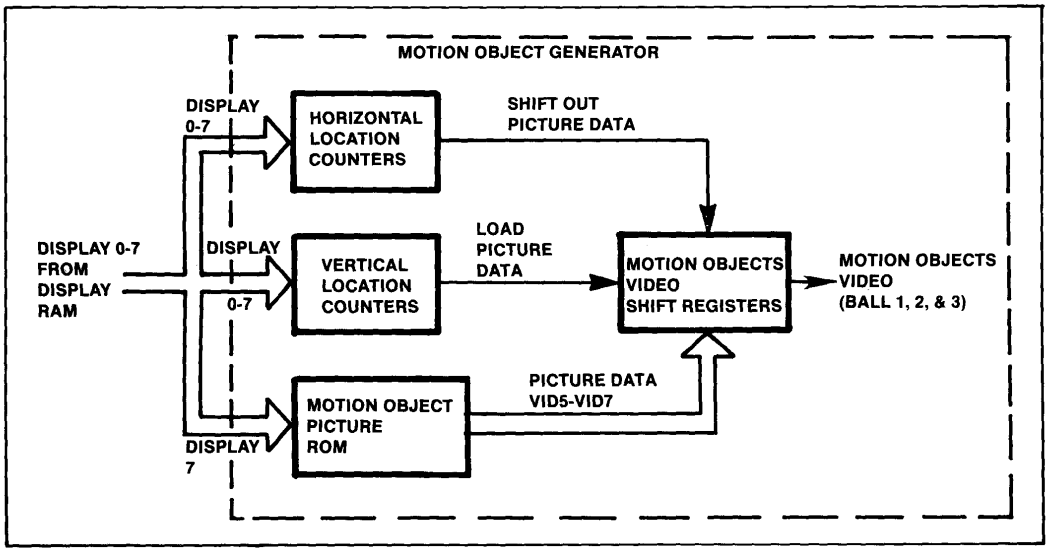


Figure 3-13 Motion Generator Circuit, Simplified Diagram

erates an enable signal that allows the shift register serial data previously loaded into it from the motion object video ROMs to be shifted out. The serial video information for each of the motion objects is then summed into the video summing circuit (as shown on sheet 4 of the schematic diagram).

G. SWITCH INPUT CIRCUITRY (See Figure 3-3, Sheet 1 of 5)

All off-board control switch inputs as well as on-board DIP switch inputs are received and decoded by data selector M8. All switch inputs are multiplexed down to two input lines (pins 7 and 9 of M8) via H9, J9, and MPU address lines ADRO—ADR2. These two lines (pin 7 and 9 of M8 are then gated onto the MPU data bus (D6–D7) by the MPU address decode $\overline{\text{SWITCH}}$. When the MPU wants to look at any switch, it merely addresses that switch and reads back its status on either D6 or D7. See MPU memory map address output and corresponding data input line for any of the game's switches.

H. PADDLE CONTROL (See Figure 3-3, Sheet 2 of 5)

The paddle control is a linear clutched potentiometer (POT) with one side of the resistive element to ground, and the other side to +5 volts. The wiper of the pot is then connected to the inverting input of comparator device L10, pin 10.

A ramp generator comprised of transistors Q1, Q2, and Q6 and capacitor C53 produces a positive-going ramp with a slope determined by capacitor C53. This ramp is inhibited at each VBLANK pulse which occurs on each picture frame. VBLANK turns Q1 "on", which created a direct short across C53, discharging the voltage across it as illustrated in Figure 3-14. When VBLANK goes low Q1 turns "off", removing the short from across C53 and allowing it to begin charging up through Q2.

Voltage follower Q6 buffers the positive ramp to the non-inverting input of comparator L10, pin 9. As the player rotates the paddle knob, the wiper voltage will at times match or cross the ramp voltage and the output of L10, pin 7, will go high. This occurs each and every time these two voltages cross.

This high comparator output is gated to the SENSE 1 line when the $\overline{\text{MASK 1}}$ signal is low and enables the M10, pin 8, gate. $\overline{\text{MASK 2}}$ is always low, inhibiting gate M10, pin 11, because there is only one paddle available to the player for the Super Breakout

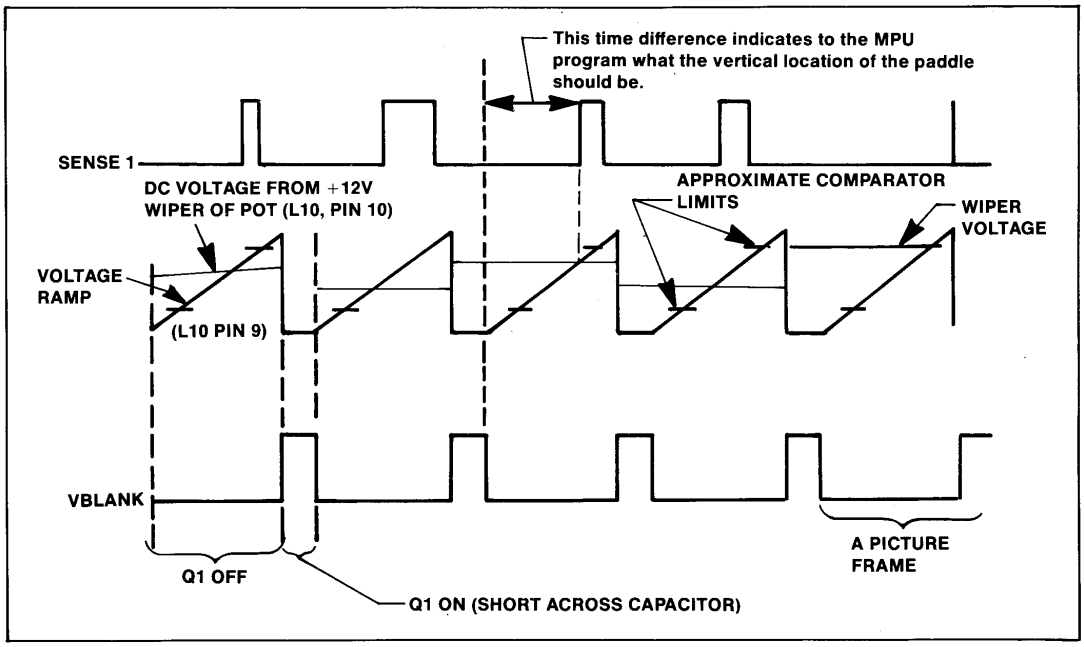


Figure 3-14 Significant Paddle Signals and Timing

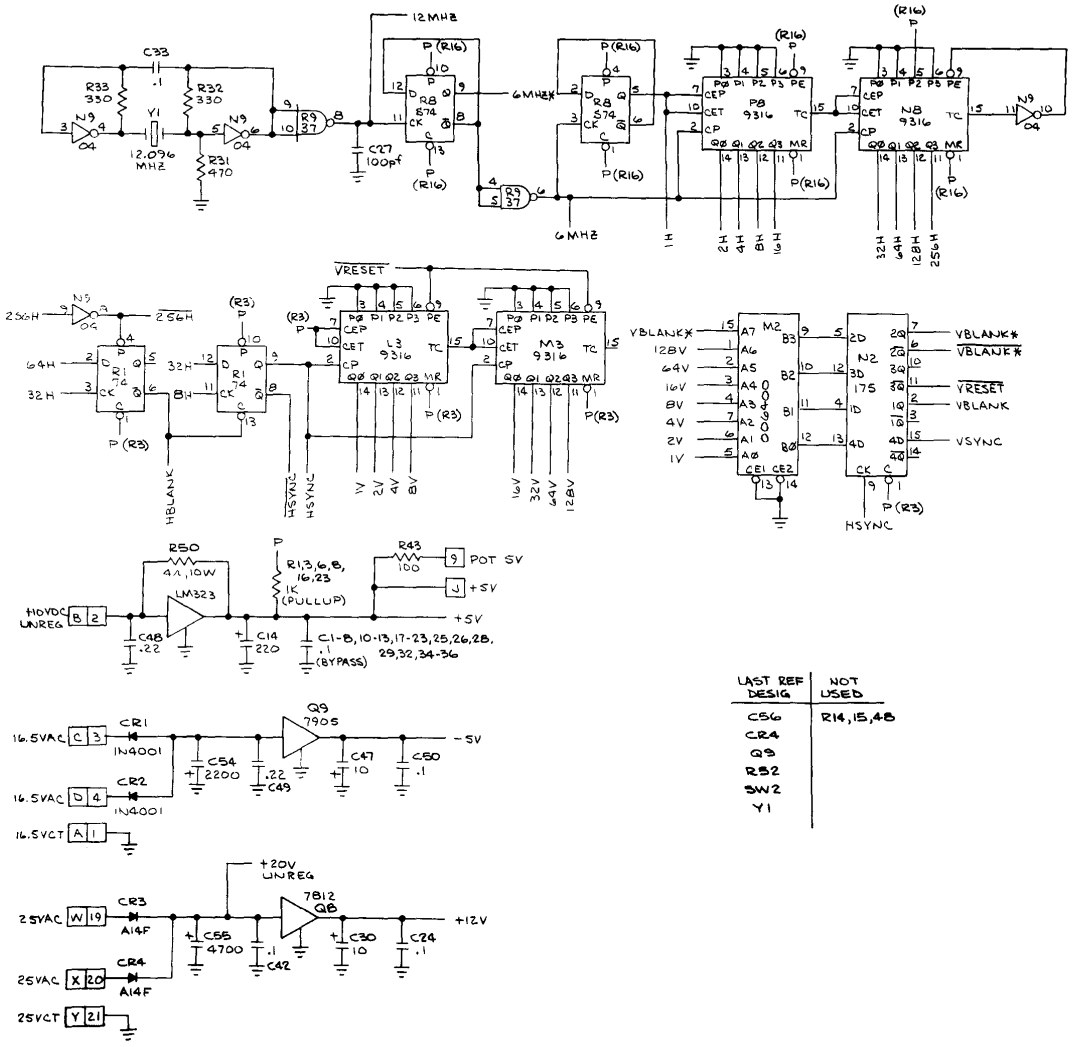
game. Therefore SENSE 2 is always high which enables the logic path for the SENSE 1 signal to M10, pin 6 ($\overline{NMI}$). The $\overline{NMI}$ signal when low flags the microprocessor as to the location of the paddle on the TV screen at any given time.

J. VIDEO OUTPUT (See Figure 3-3, Sheet 4 of 5)

The video output circuit receives all the video signals ($\overline{PLAYFIELD}$, $\overline{BALL\ 1}$, $\overline{BALL\ 2}$, $\overline{BALL\ 3}$) and gates these signals together at NAND gate L6. The composite sync (COMP SYNC*) signal is then summed together with the output of L6 via resistors R52 and R27 to the base of voltage follower device Q5 (2N3643). The signal on the emitter of this transistor then becomes the composite video signal sent to the game's display monitor.

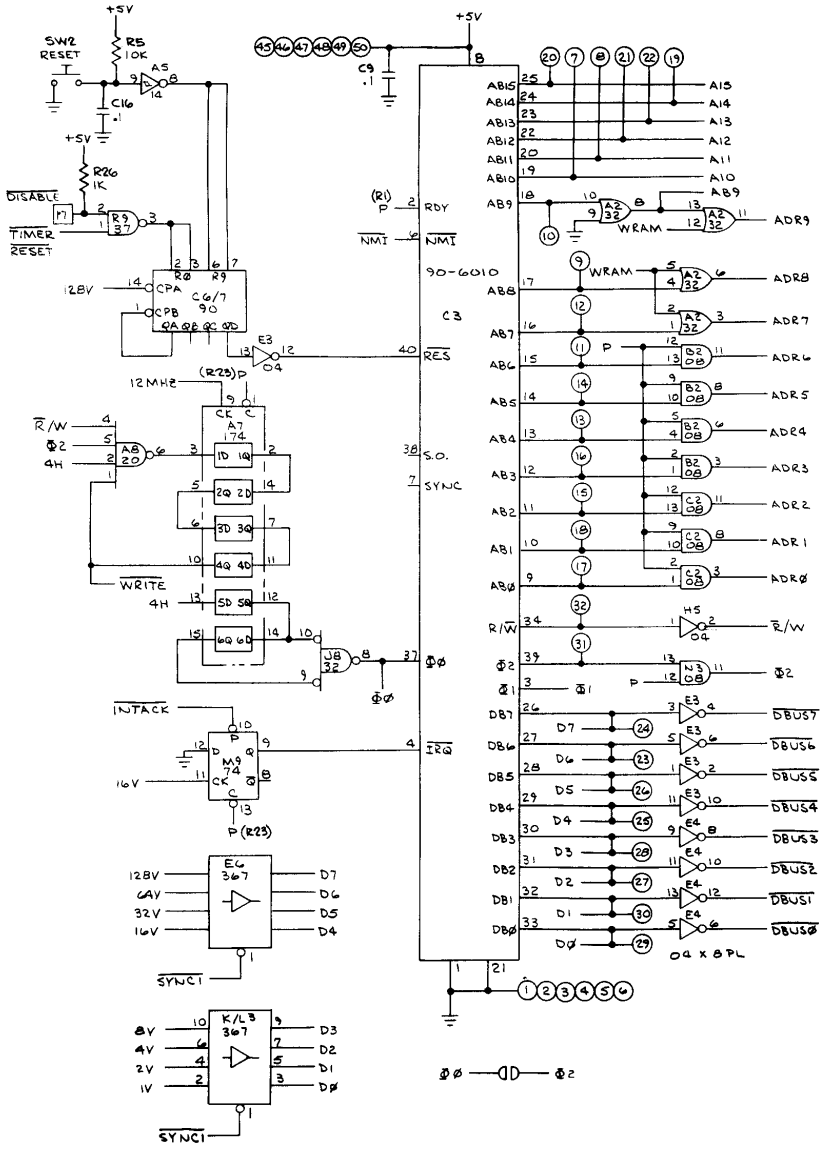
K. AUDIO OUTPUT (See Figure 3-3, Sheet 5 of 5)

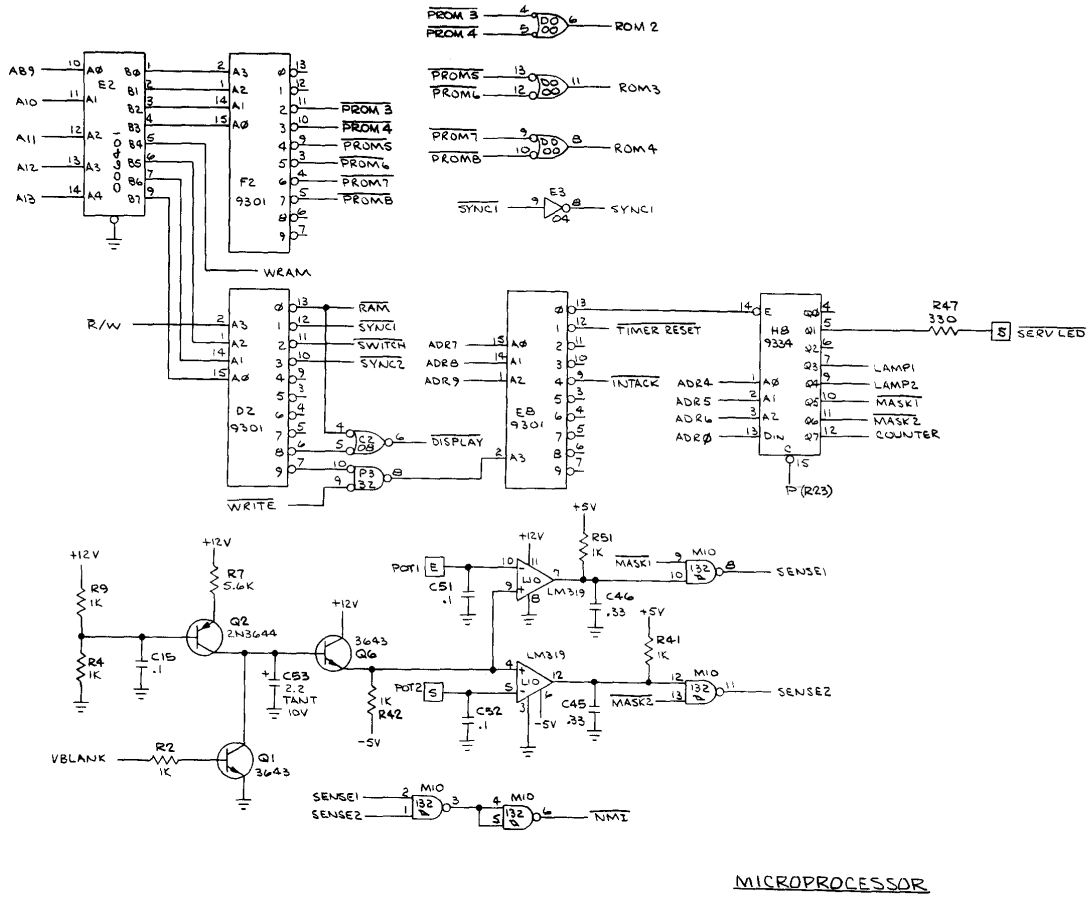
The audio output of the audio generator is applied to one leg of a 5K ohm potentiometer (located behind the coin door next to the self-test switch as illustrated in Figure 1-6 of Section 1 of this manual). Varying the wiper position of the potentiometer varies the signal input to Audio Amplifier device D9. The output of the audio amplifier is then connected to an 8-ohm speaker located in the attraction panel over the TV monitor screen.



LAST REF DESIG	NOT USED
C56	R14,15,48
CR4	
Q9	
R52	
SW2	
Y1	

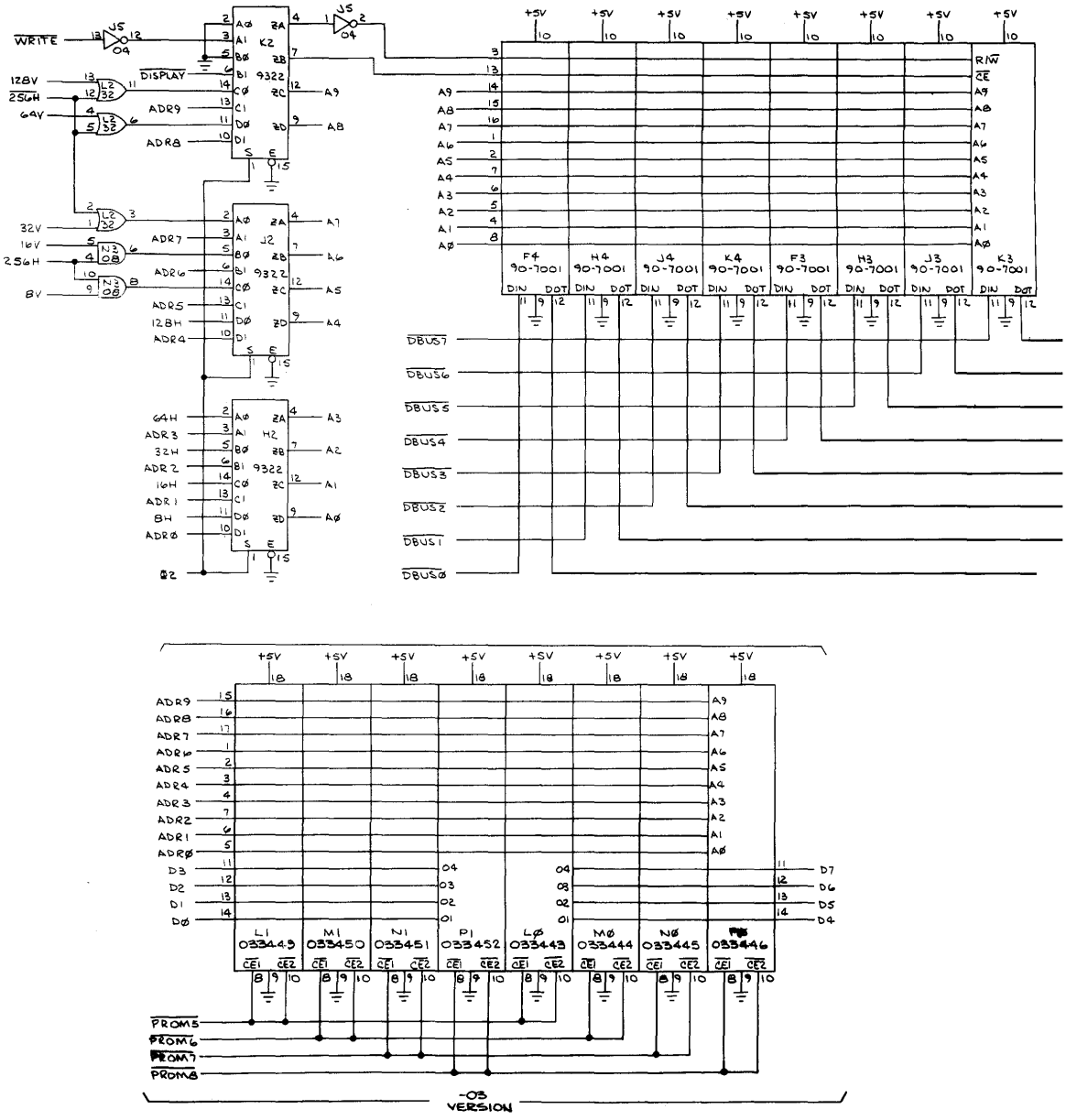
Figure 3-3 Super Breakout Schematic Diagram Sheet 1 of 5


+5V
SW2
RESET
R5
10K
A5
C16
.1
R26
1K
DISABLE
TIMER
RESET
R9
37
128V
CPA
CPB
C6/7
90
R0
R9
E3
04
(R23)P
12MHZ
CK
A7
174
R/W
Φ2
4H
A8
20
1D 1Q
2D 2Q
3D 3Q
4D 4Q
5D 5Q
6D 6Q
WRITE
4H
J8
32
ΦØ
INTACK
M9
74
16V
P(R23)
EG
367
12BV
6AV
32V
16V
D7
D6
D5
D4
SYNC1
K/L8
367
8V
4V
2V
1V
D3
D2
D1
DØ
SYNC1
C9
.1
45 46 47 48 49 50
B
(R1)
P
RDY
NMI
NMI
90-6010
C3
RES
S.O.
SYNC
ΦØ
IRQ
ABI5
ABI4
ABI3
ABI2
ABI1
ABI0
AB9
AB8
AB7
AB6
AB5
AB4
AB3
AB2
AB1
ABØ
R/W
Φ2
Φ1
DB7
DB6
DB5
DB4
DB3
DB2
DB1
DBØ
D7
D6
D5
D4
D3
D2
D1
DØ
20 7 8 21 22 19
A15
A14
A13
A12
A11
A10
AB9
A2
32
WRAM
ADR9
ADR8
ADR7
ADR6
ADR5
ADR4
ADR3
ADR2
ADR1
ADRØ
H5
04
R/W
N3
08
Φ2
Φ1
E3
E4
DBUS7
DBUS6
DBUS5
DBUS4
DBUS3
DBUS2
DBUS1
DBUSØ
04 X 8 PL
1 2 3 4 5 6
ΦØ
Φ2

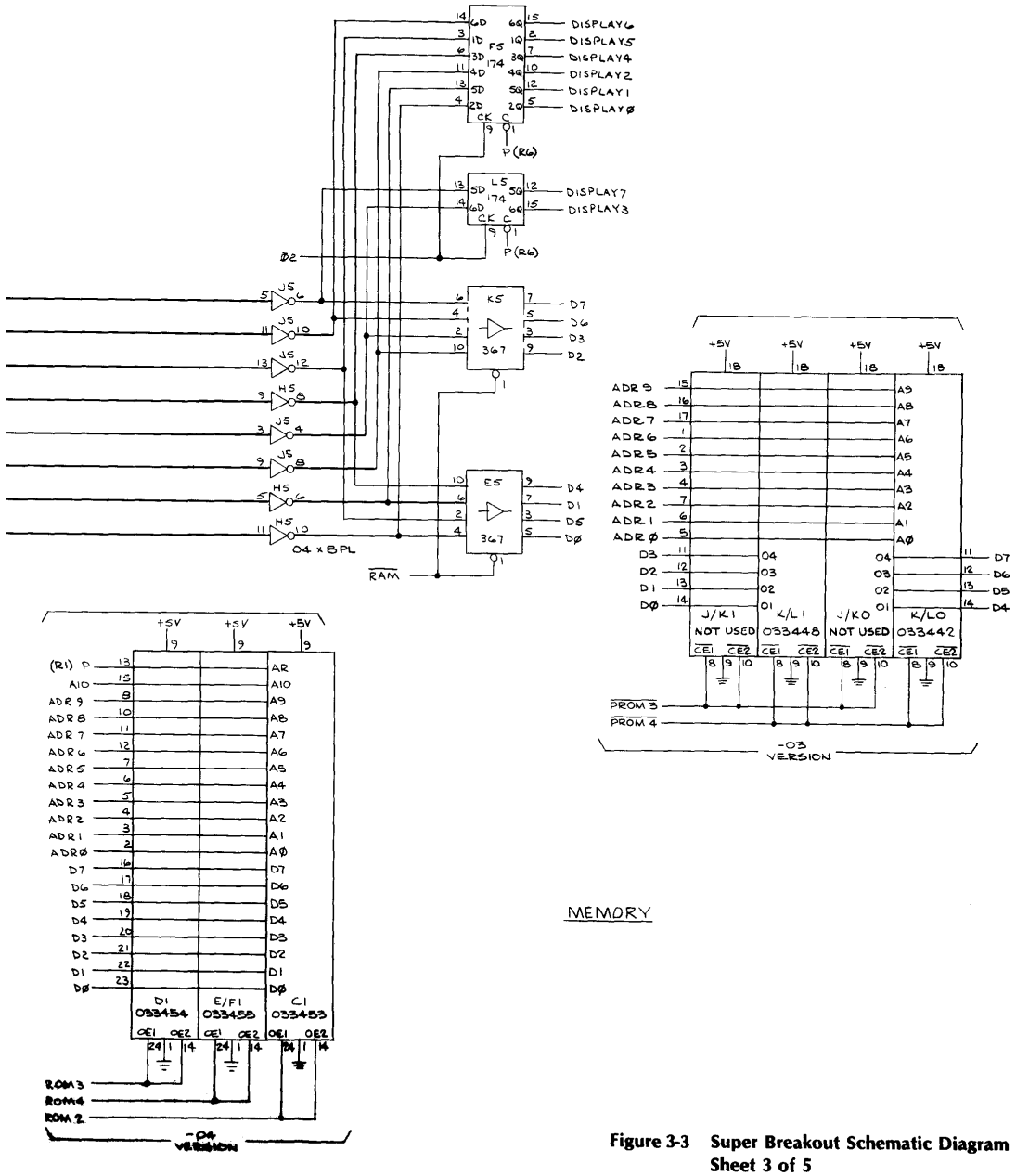


MICROPROCESSOR

Figure 3-3 Super Breakout Schematic Diagram Sheet 2 of 5

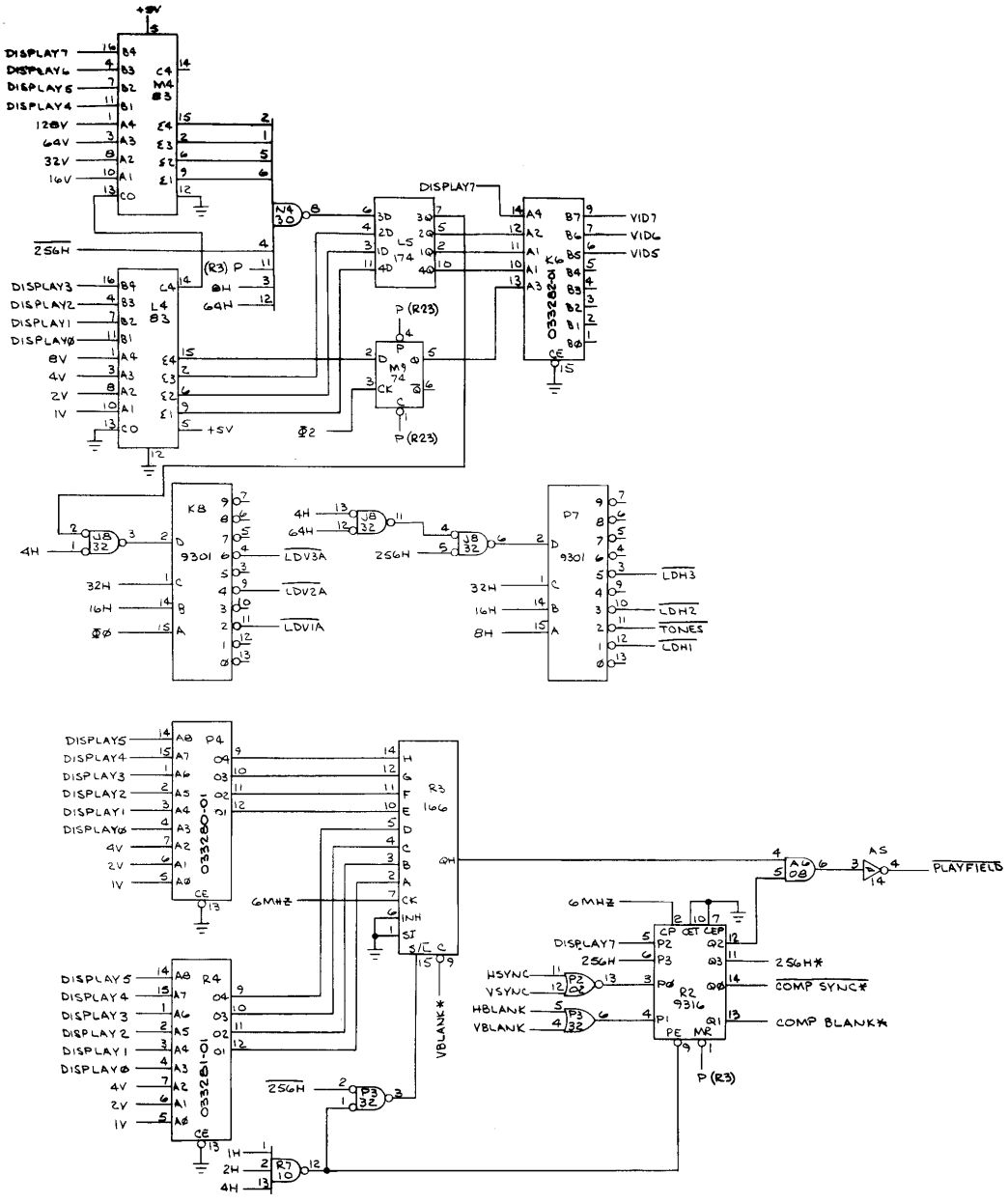

WRITE
DISPLAY
128V
256H
64V
32V
16V
8V
ADR9
ADR8
ADR7
ADR6
ADR5
ADR4
128H
64H
ADR3
32H
ADR2
16H
ADR1
8H
ADR0
Φ2
K2
J2
H2
9322
A9
A8
A7
A6
A5
A4
A3
A2
A1
A0
RW
CE
DBUS7
DBUS6
DBUS5
DBUS4
DBUS3
DBUS2
DBUS1
DBUS0
F4 90-7001
H4 90-7001
J4 90-7001
K4 90-7001
F3 90-7001
H3 90-7001
J3 90-7001
K3 90-7001
DIN
DOT
+5V

ADR9
ADR8
ADR7
ADR6
ADR5
ADR4
ADR3
ADR2
ADR1
ADR0
D3
D2
D1
D0
D7
D6
D5
D4
L1 033449
M1 033450
N1 033451
P1 033452
L0 033443
M0 033444
N0 033445
P0 033446
CE1
CE2
PROM5
PROM6
PROM7
PROM8
+5V
-03 VERSION



MEMORY

Figure 3-3 Super Breakout Schematic Diagram Sheet 3 of 5


DISPLAY7
DISPLAY6
DISPLAY5
DISPLAY4
128V
64V
32V
16V
256H
DISPLAY3
DISPLAY2
DISPLAY1
DISPLAY0
8V
4V
2V
1V
(R3) P
8H
64H
P (R23)
Φ2
+5V
VID7
VID6
VID5
4H
32H
16H
ΦØ
LDV3A
LDV2A
LDV1A
LDH3
LDH2
TONES
LDH1
DISPLAY5
DISPLAY4
DISPLAY3
DISPLAY2
DISPLAY1
DISPLAY0
4V
2V
1V
6MHZ
VBLANK*
1H
2H
4H
HSYNC
VSYNC
HBLANK
VBLANK
DISPLAY7
256H
P (R3)
256H*
COMP SYNC*
COMP BLANK*
AS
PLAYFIELD

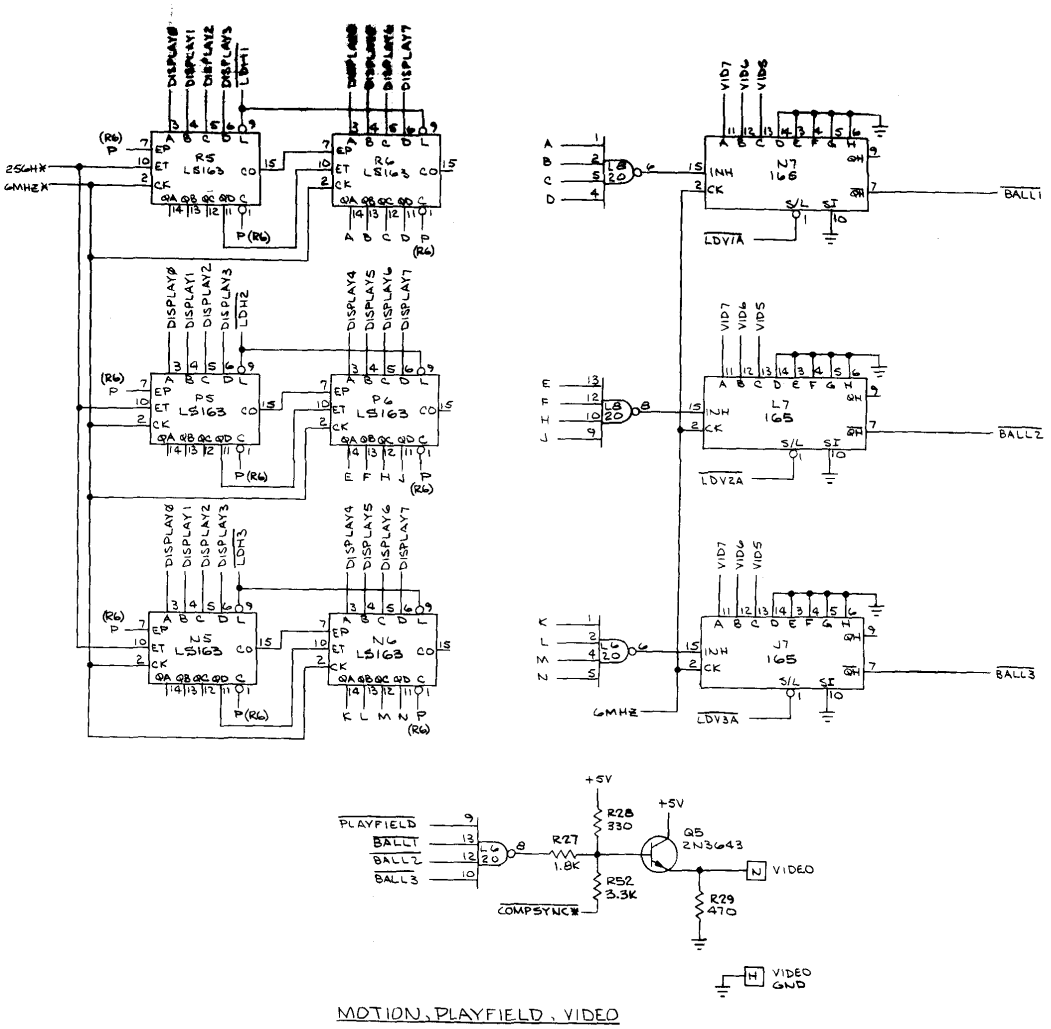
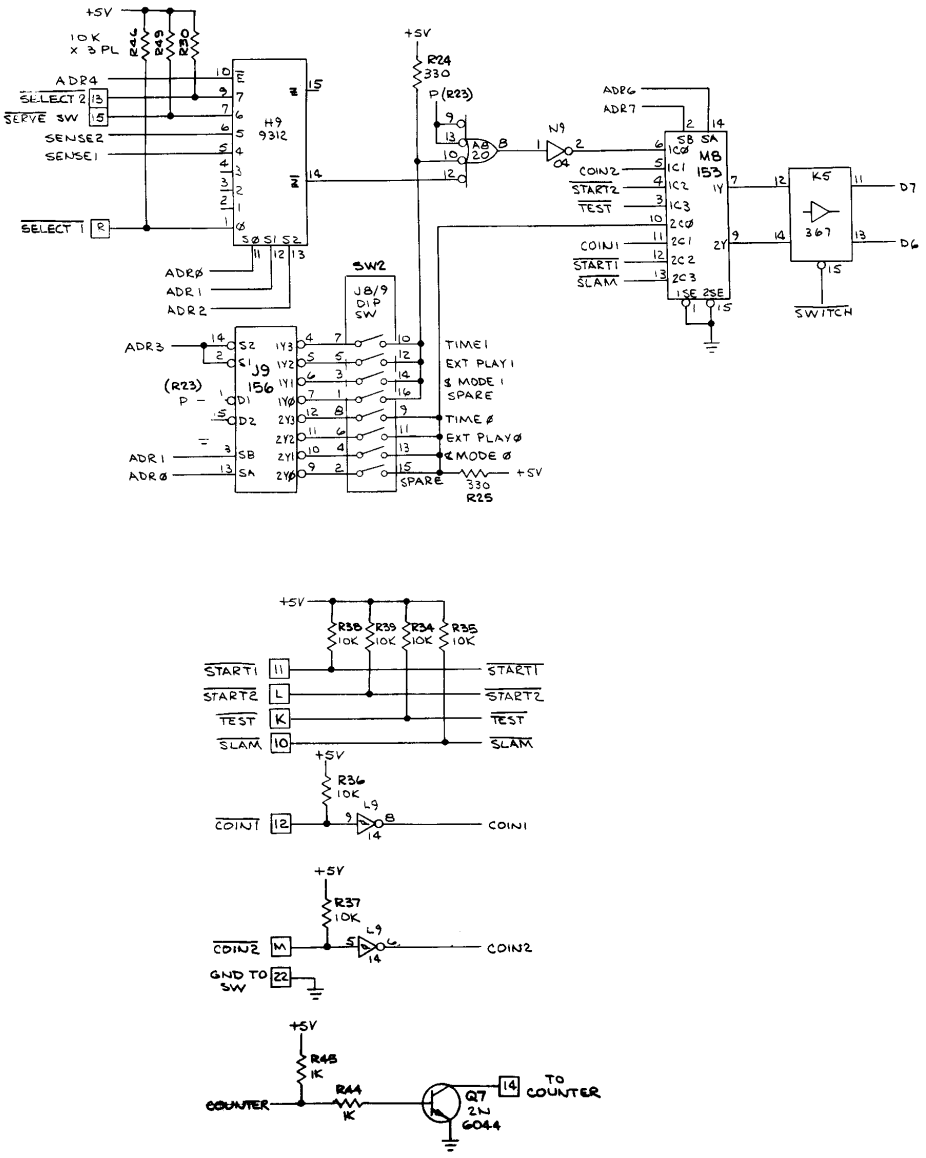


Figure 3-3 Super Breakout Schematic Diagram
Sheet 4 of 5


+5V
10K
X 3 PL
R26
R29
R30
ADR4
SELECT 2
SERVE SW
SENSE2
SENSE1
SELECT 1
H9
9312
R24
330
P (R23)
N9
ADR6
ADR7
COIN2
START2
TEST
COIN1
START1
SLAM
MB
153
K5
367
D7
D6
SWITCH
ADRØ
ADR1
ADR2
SW2
DIP SW
ADR3
J9
156
(R23)
P –
TIME1
EXT PLAY1
MODE 1
SPARE
TIMEØ
EXT PLAYØ
MODEØ
SPARE
330
R25
R35
R39
R34
R35
START1
START2
TEST
SLAM
R36
COIN1
R37
COIN2
GND TO SW
R43
1K
R44
1K
COUNTER
Q7
2N
6044
TO COUNTER

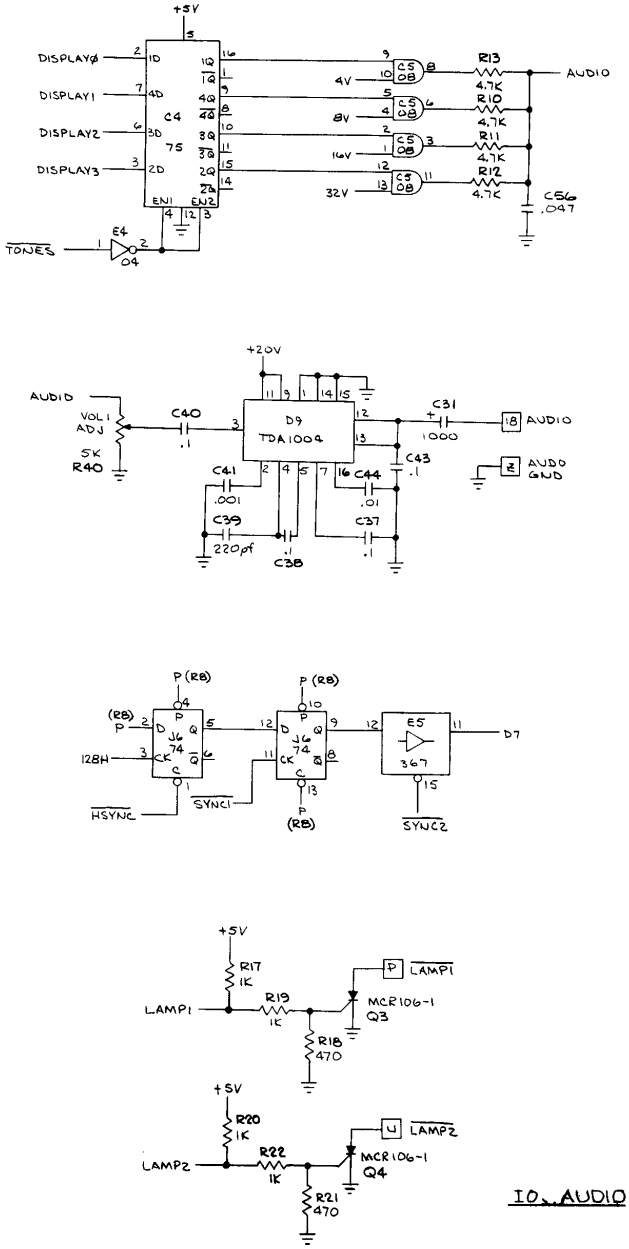
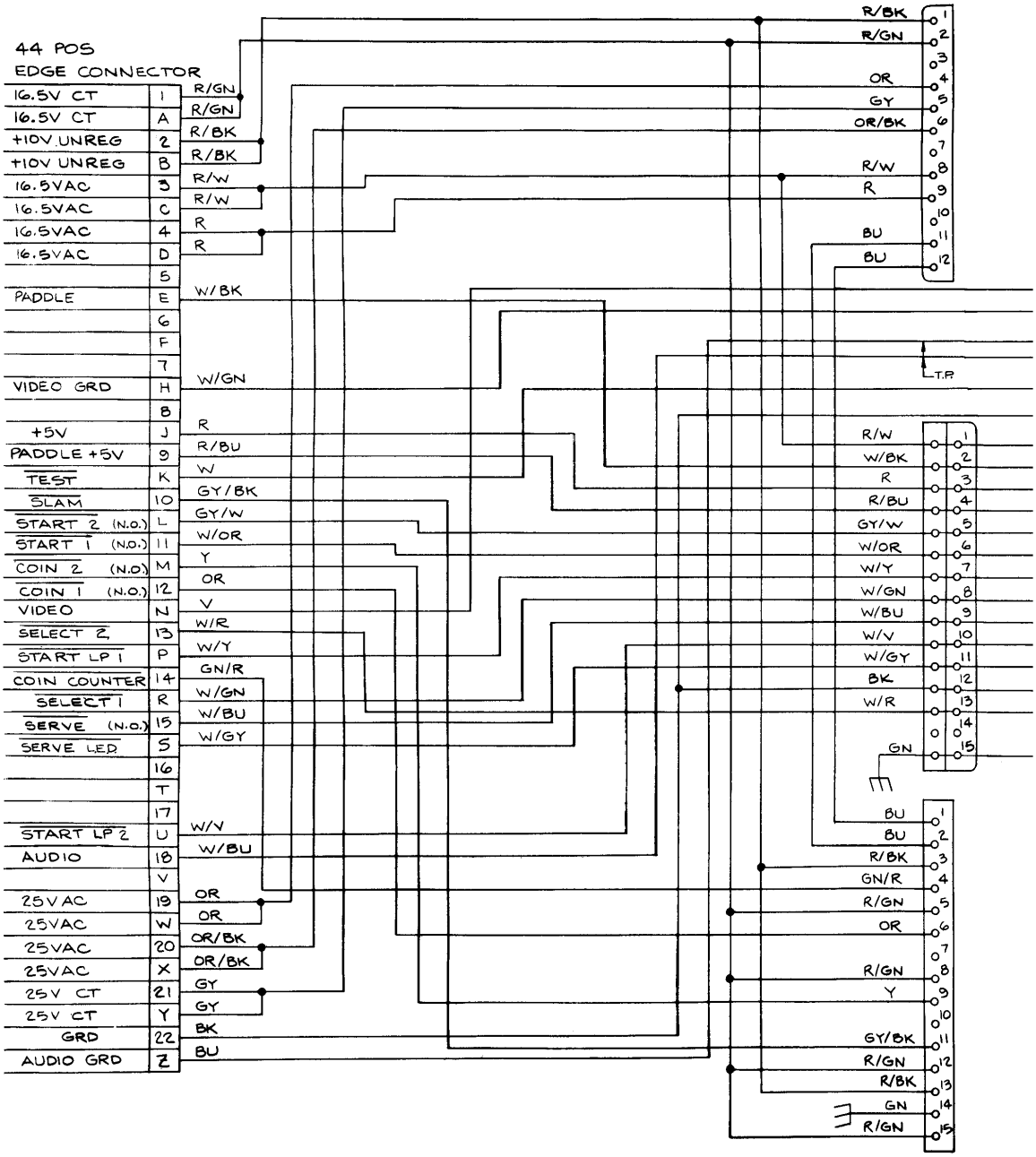


Figure 3-3 Super Breakout Schematic Diagram
Sheet 5 of 5


44 POS
EDGE CONNECTOR
16.5V CT 1 R/GN
16.5V CT A R/GN
+10V UNREG 2 R/BK
+10V UNREG B R/BK
16.5VAC 3 R/W
16.5VAC C R/W
16.5VAC 4 R
16.5VAC D R
5
PADDLE E W/BK
6
F
7
VIDEO GRD H W/GN
8
+5V J R
PADDLE +5V 9 R/BU
TEST K W
SLAM 10 GY/BK
START 2 (N.O.) L GY/W
START 1 (N.O.) 11 W/OR
COIN 2 (N.O.) M Y
COIN 1 (N.O.) 12 OR
VIDEO N V
SELECT 2 13 W/R
START LP 1 P W/Y
COIN COUNTER 14 GN/R
SELECT 1 R W/GN
SERVE (N.O.) 15 W/BU
SERVE LED S W/GY
16
T
17
START LP 2 U W/V
AUDIO 18 W/BU
V
25VAC 19 OR
25VAC W OR
25VAC 20 OR/BK
25VAC X OR/BK
25V CT 21 GY
25V CT Y GY
GRD 22 BK
AUDIO GRD Z BU
R/BK 1
R/GN 2
3
OR 4
GY 5
OR/BK 6
7
R/W 8
R 9
10
BU 11
BU 12
T.P
R/W 1
W/BK 2
R 3
R/BU 4
GY/W 5
W/OR 6
W/Y 7
W/GN 8
W/BU 9
W/V 10
W/GY 11
BK 12
W/R 13
14
GN 15
BU 1
BU 2
R/BK 3
GN/R 4
R/GN 5
OR 6
7
R/GN 8
Y 9
10
GY/BK 11
R/GN 12
R/BK 13
GN 14
R/GN 15

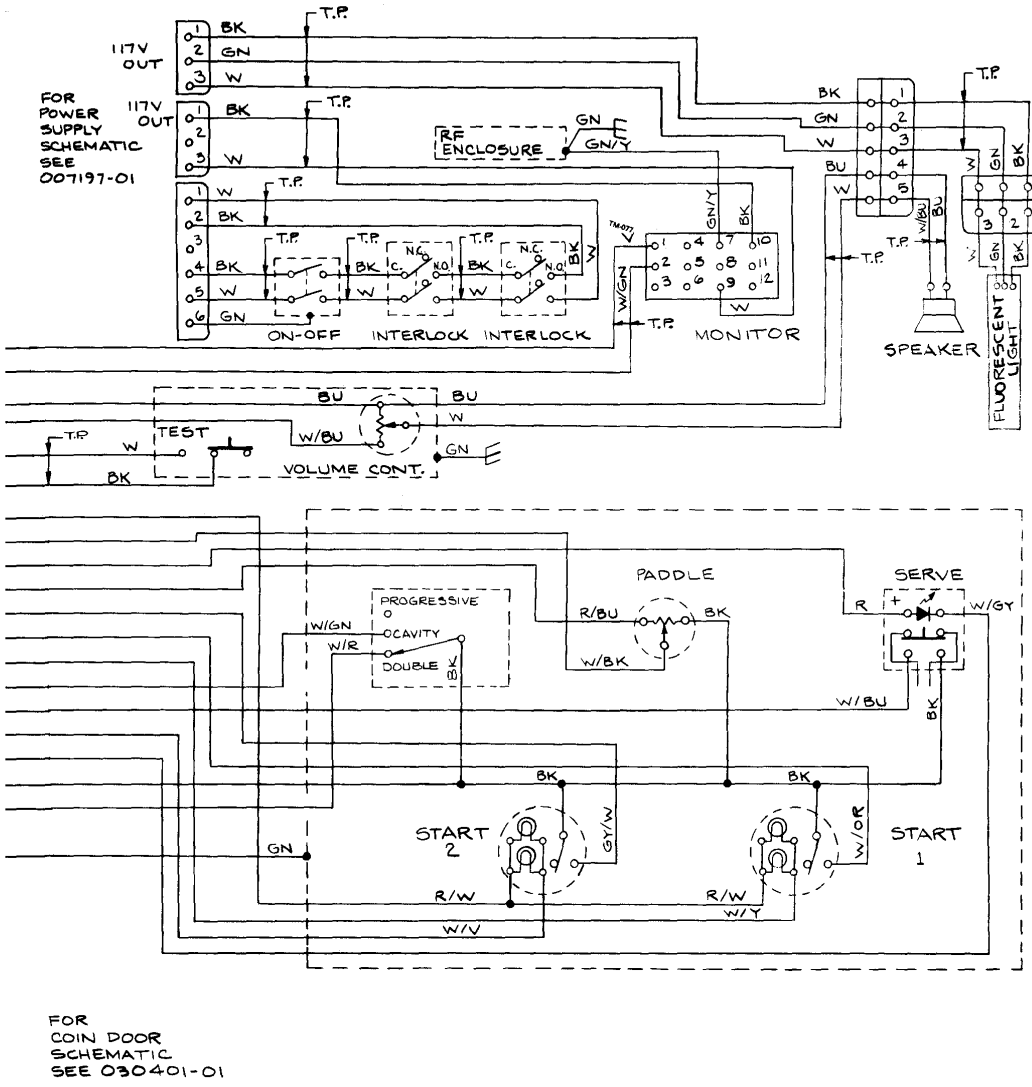


Figure 3-15 Super Breakout Harness Schematic Diagram 003255-01 D

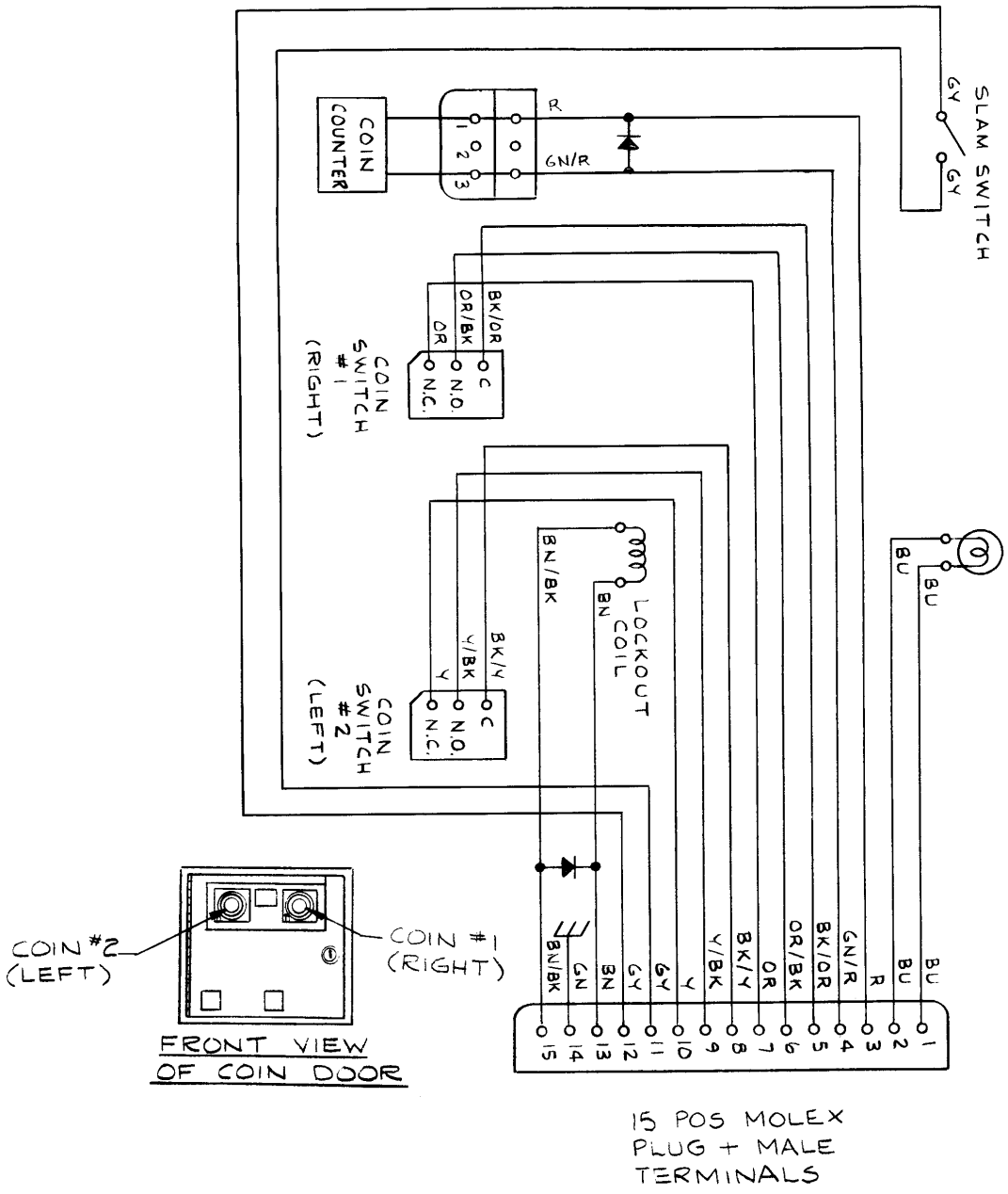


Figure 3-16 Coin Door Schematic Diagram
030401-01 B

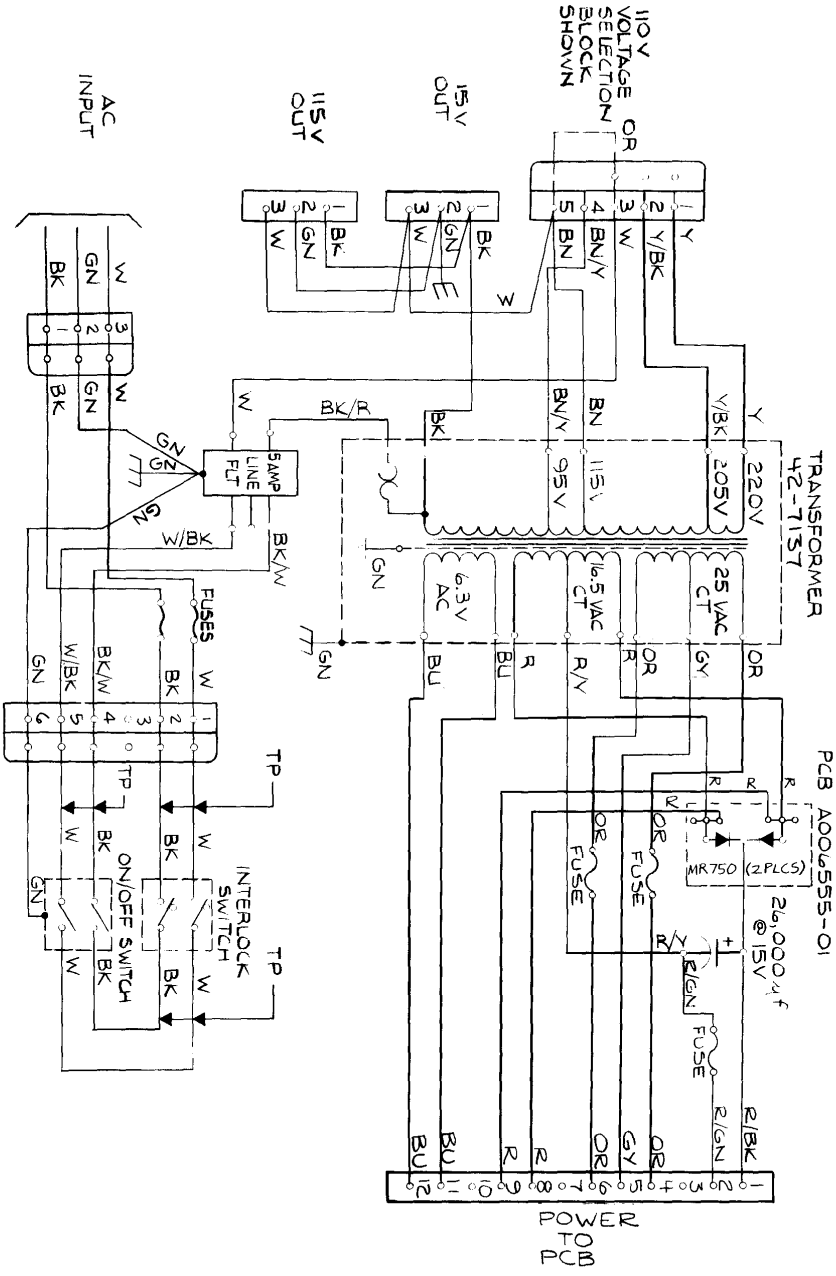
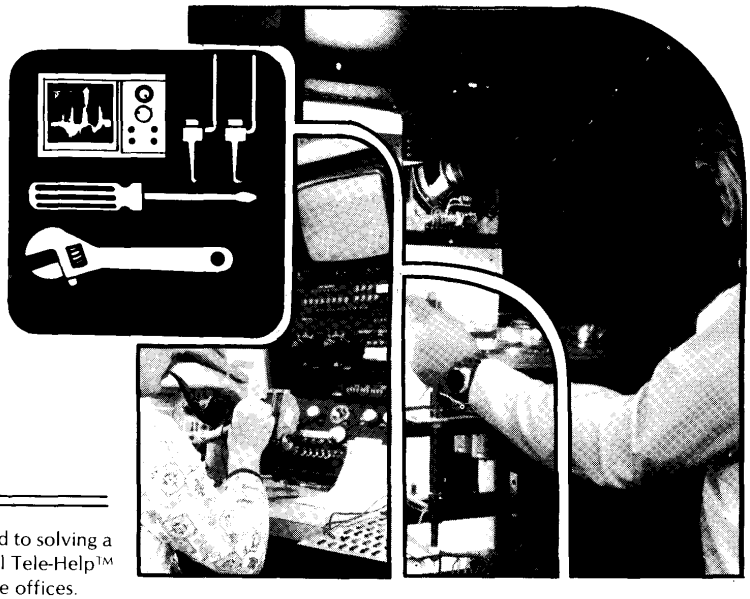


Figure 3-17 Type B Power Supply Schematic Diagram 007197-01 C



MAINTENANCE AND ADJUSTMENTS

NOTE

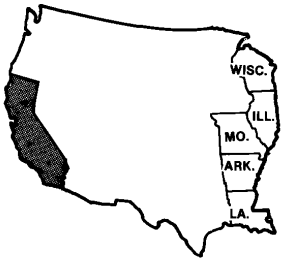
If reading through this manual does not lead to solving a specific maintenance problem, you can call Tele-Help™ at the following two Atari Customer Service offices.

WEST and CENTRAL U.S.A.

Atari Coin-Op Customer Service
1344 Bordeaux Drive, Sunnyvale, CA 94086
Telex 17-1103
(Monday - Friday, 7:30 - 4:00 pm Pacific Time)

From California, Alaska, or Hawaii, dial (408) 745-2900

From anywhere else in this area, dial toll-free (800) 538-1611



EAST U.S.A.

Atari Inc.
New Jersey Customer Service Office
46 Colonial Drive, Piscataway, NJ 08854
Telex 37-9347
(Monday - Friday, 8:30 - 5:00 pm Eastern time)

From New Jersey dial (201) 981-0490

From anywhere else in this area, dial toll-free (800) 631-5374

A. CLEANING

The exteriors of game cabinets and Plexiglas® 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 acrylic plastic panels, because any dust can scratch the surface and result in fogging the plastic.

B. COIN MECHANISM

Components On Coin Door

Figure 4-1 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. Powering the game causes the lock-out wires to retract far enough to allow genuine coins to reach the coin box. When AC power to the game has already been turned off, the lock-out coil is de-energized, causing the lock-out wires to move out far enough to divert coins 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 defeat 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 4-2. 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 4-3.

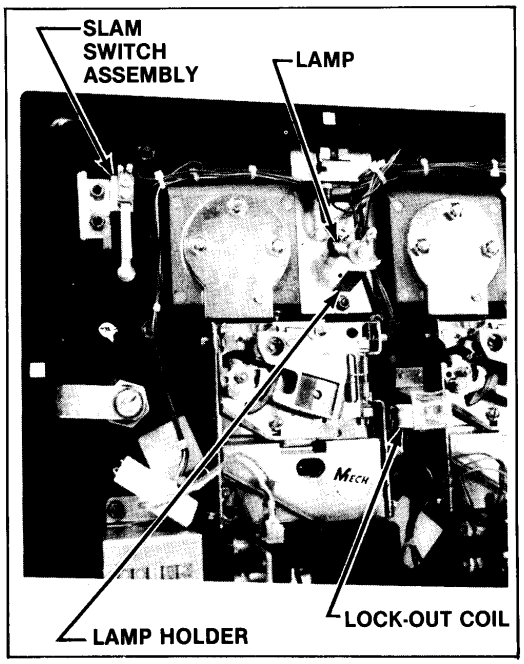


Figure 4-1 Coin Door Assembly

Plexiglas® is a registered trademark of Rohm & Haas Company.

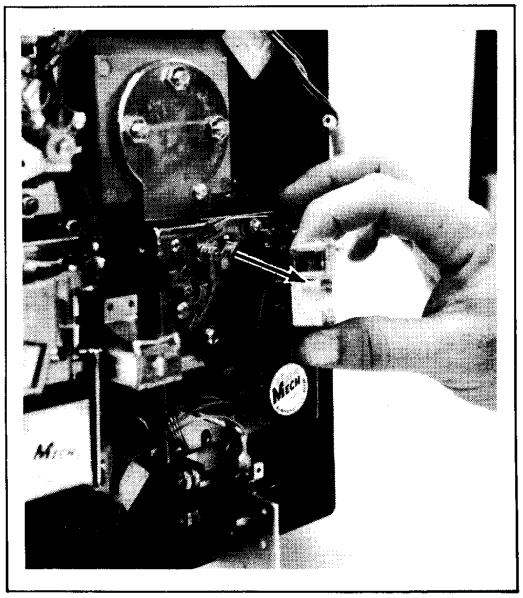


Figure 4-2 Hinging Open the Magnet Gate Assembly

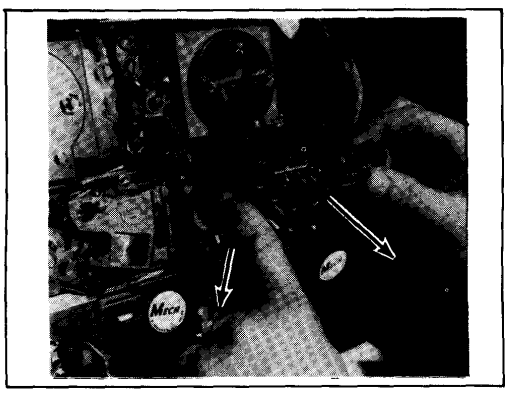


Figure 4-3 Removal of Coin Mechanism

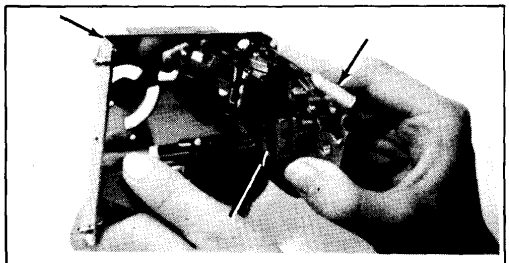
Cleaning of Coin Paths

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 4-4 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 4-4 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 3/8-inch wrench and remove all three nuts that secure the cover plate (refer to Figure 4-5). 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.

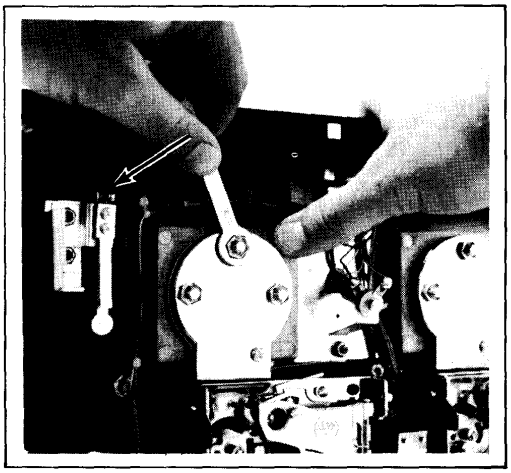


Figure 4-5 Removal of Plate Covering Rear of Coin Slot

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 4-6 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 4-7. Use extreme care when handling or touching these wires.

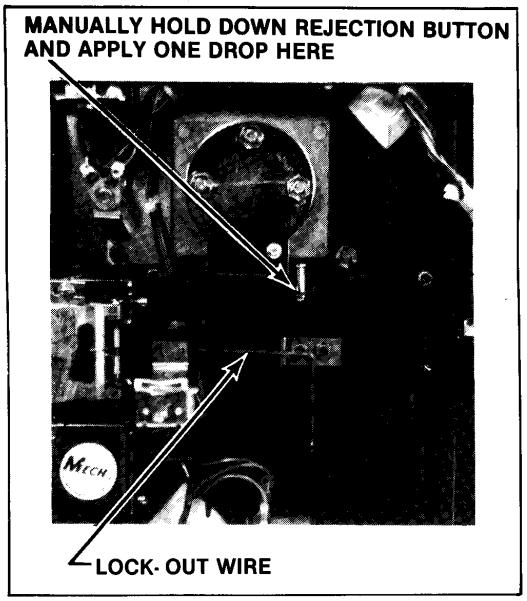


Figure 4-6 Close-Up View of Lubrication Point

In Figure 4-7 you will note that the coin switch trip wire is oriented into the "V" of the secondary coin chute. The wire should extend to only about 1/8" beyond the chute.

A retaining clip holds the wire onto the switch actuating stud. If you should loose a retaining clip, all is not lost. Just crimp the switch actuating stud over the trip wire with a pair of pliers.

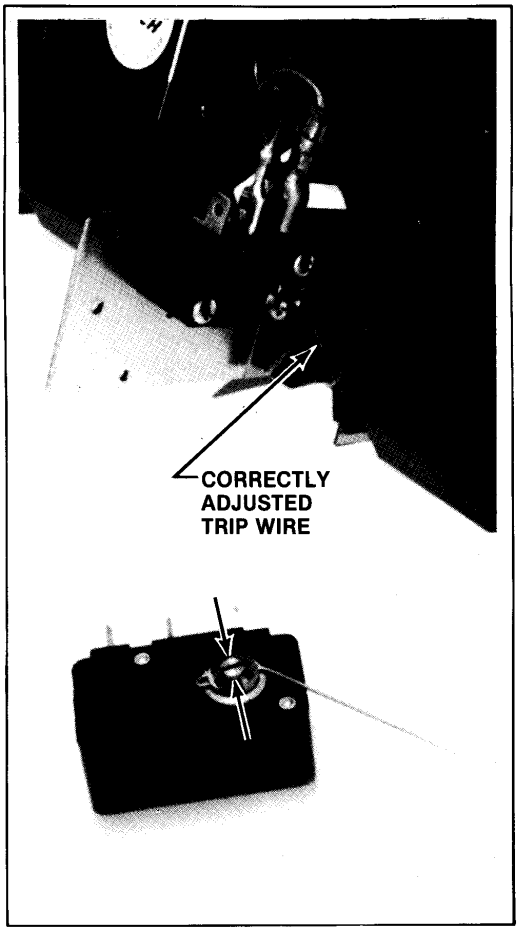


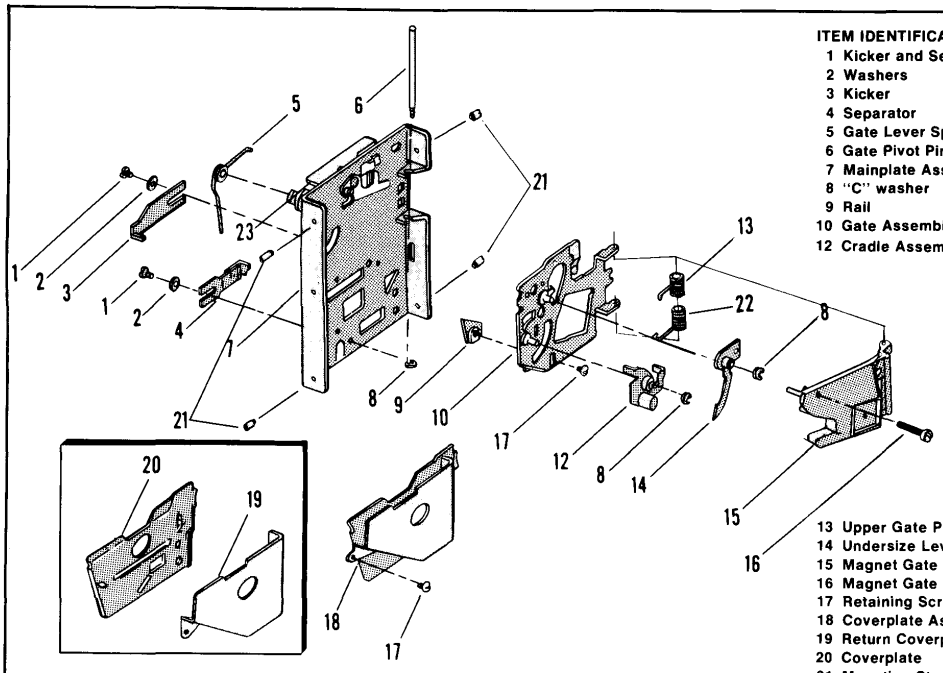
Figure 4-7 Detail View of Coin Switch and Trip Wire

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. Figure 4-8 shows an exploded view of the mechanism and gives procedures for adjusting the kicker, separator, and the magnet gate. These adjustments should only be done by someone who has experienced 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



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 4-8 Adjustments on Coin Mechanism

C. 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 whilethe 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 brig htness 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 4-9 shows the location of the adjustments on both TV monitors used by Atari. Your game contains a TV monitor manufactured to Atari specifications by either Motorola or TEC Video electronics.

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.

D. FUSE REPLACEMENT

Super Breakout contains seven fuses, five on the power supply assembly in the lower part of the cabinet and two on the TV monitor assembly. Power supply fuses are accessible through the lower rear door assembly. TV fuses are accessible through the

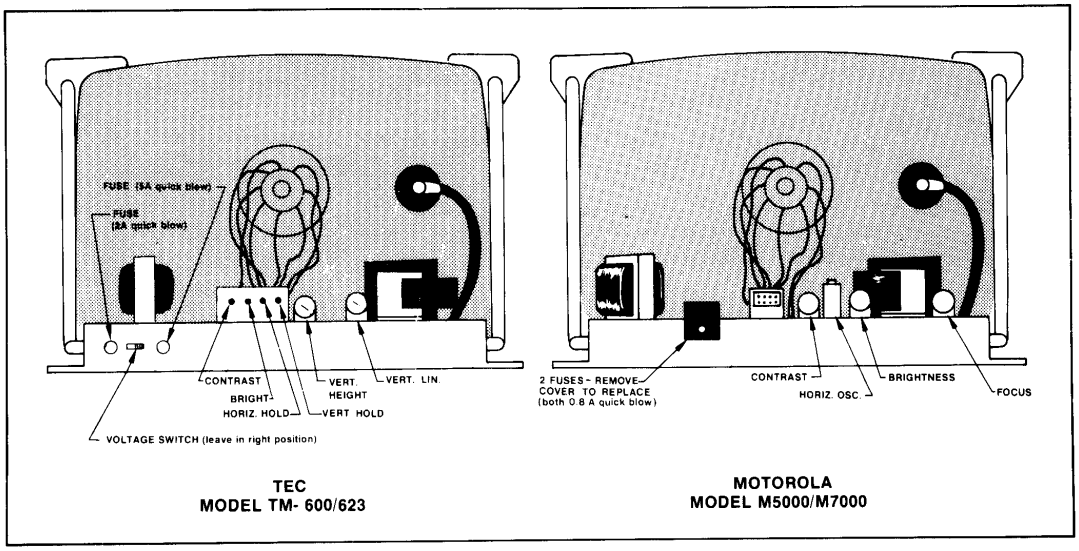


Figure 4-9 Locations of Adjustments on TV Chassis

TV MONITOR REMOVAL

1. Unfasten two smooth pan-head bolts from the control panel by holding down the bolt heads with one hand and using the other hand to remove the wing nuts. These wing nuts are located on the inside of the cabi net, and can be reached through the coin door.
2. Unplug control panel Molex connectors.
3. Remove control panel.
4. Slide out playfield Plexiglas shield.
5. Remove cardboard bezel.
6. Remove wood TV monitor retainer board.
7. Unplug TV monitor chassis connector.
8. Slide out TV monitor shelf through rear access door.

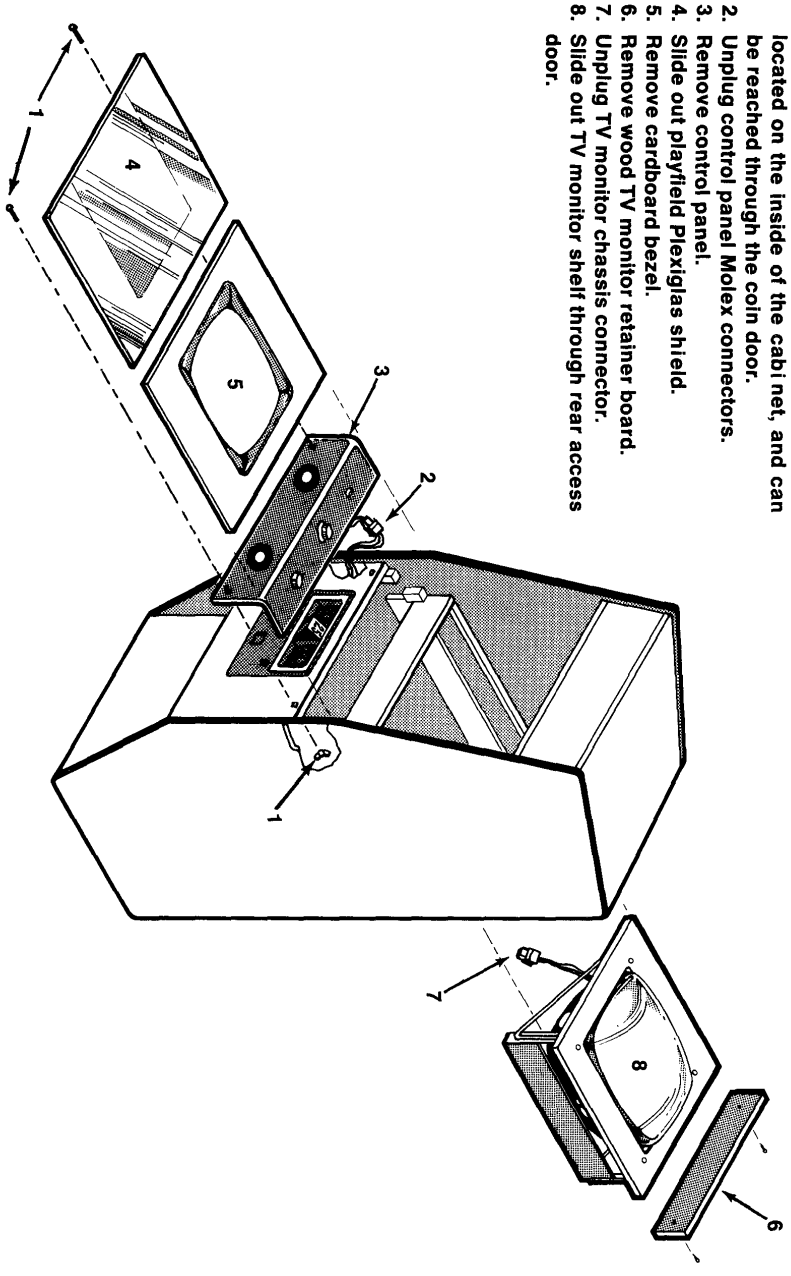


Figure 4-10 TV Monitor Removal

LAMP/SPEAKER ASSEMBLY REMOVAL

1. **Remove three button-head screws.**
2. **Remove Plexiglas retainer.**
3. **Remove Plexiglas shield.**
4. **Slide out lamp/speaker assembly.**

FLUORESCENT LAMP REMOVAL

5. **Remove retainer clips which hold built in socket.**
6. **Gently rotate fluorescent bulb until it slips out of socket. Remove fluorescent bulb.**

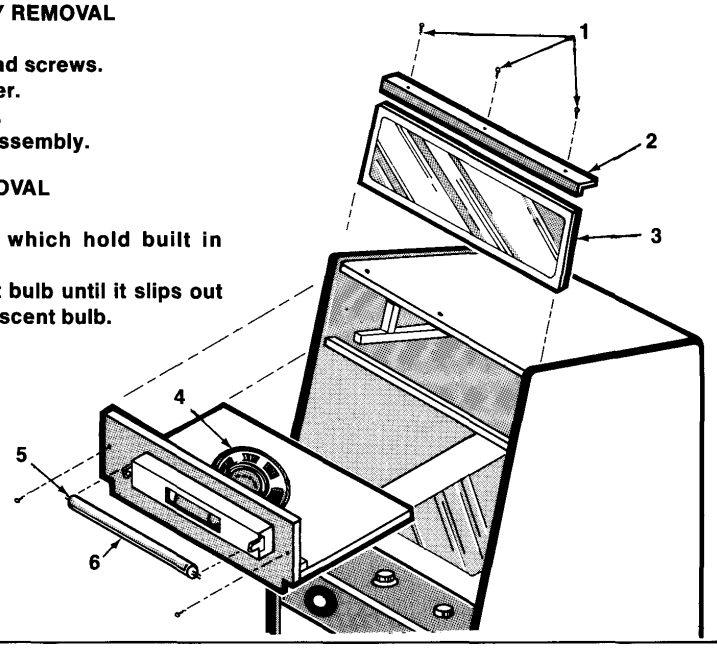


Figure 4-11 Lamp/Speaker and Fluorescent Lamp Removal

upper service panel door. Replace fuses only with the same type 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
Fuses F3 and F4—3AG 2.5-amp slow-blow, 125 volts
Fuse F5—3AG 8-amp fast-blow, 125 volts

E. TV MONITOR REMOVAL (See Figure 4-10)

If the TV monitor proves to be at fault, remove the monitor as shown in Figure 4-10.

F. LAMP/SPEAKER ASSEMBLY REMOVAL (See Figure 4-11)

Super Breakout contains a combined fluorescent lamp and speaker assembly, located at the inside top of the game cabinet assembly. To replace this assembly or any subcomponent, remove the Plexiglas retainer and shield as shown in Figure 4-11.

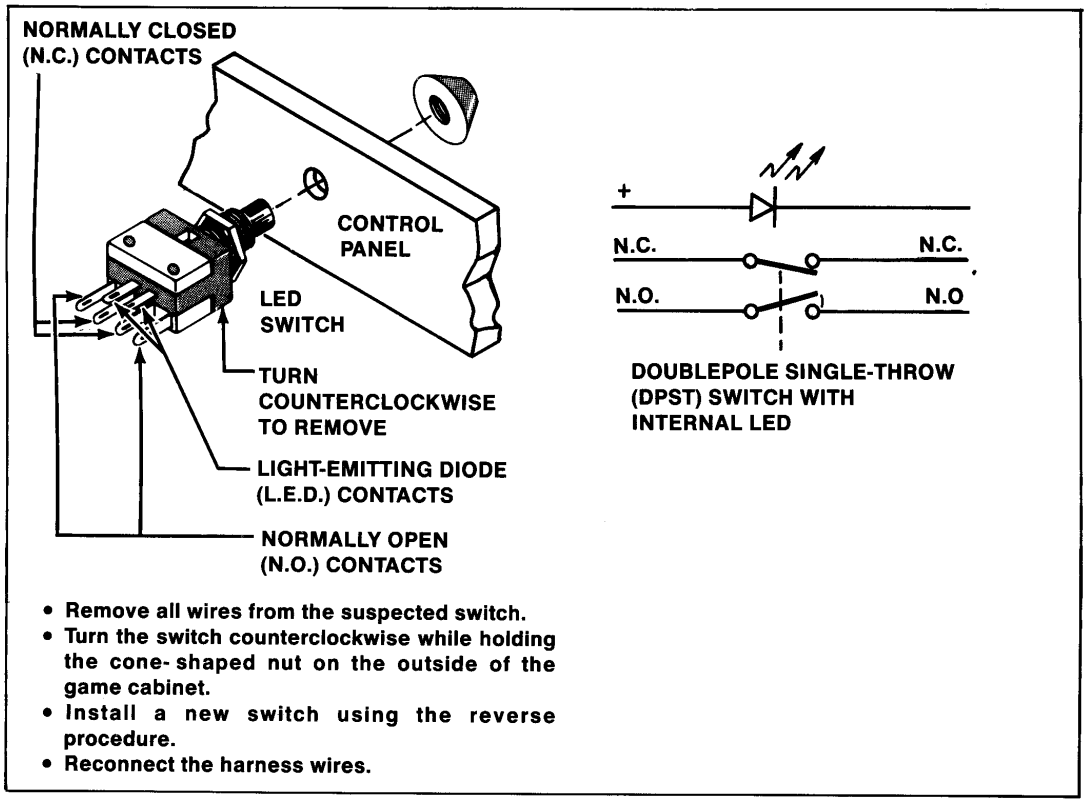


Figure 4-12 LED (LICON) Serve Switch Removal

G. LED (LICON) SERVE SWITCH REMOVAL (See Figure 4-12)

The LED serve switch on the front panel has a very low failure rate. In case this switch should ever be suspect, first test it. To test the switch perform the following steps:

1. Unlock and open the coin door.
2. Remove the wires from the suspected switch.
3. Set Multimeter to ohms scale.
4. Set ohms scale to R x 1, then zero the meter.
5. Connect multimeter leads to appropriate LED switch contacts. (See Figure 4-12 for designation of switch contacts.)
6. Check contacts (push switch button in and out) for closed and open continuity.
7. If the contacts do not operate sharply or always remain closed or open, then replace the LED swich as outlined in Figure 4-12.

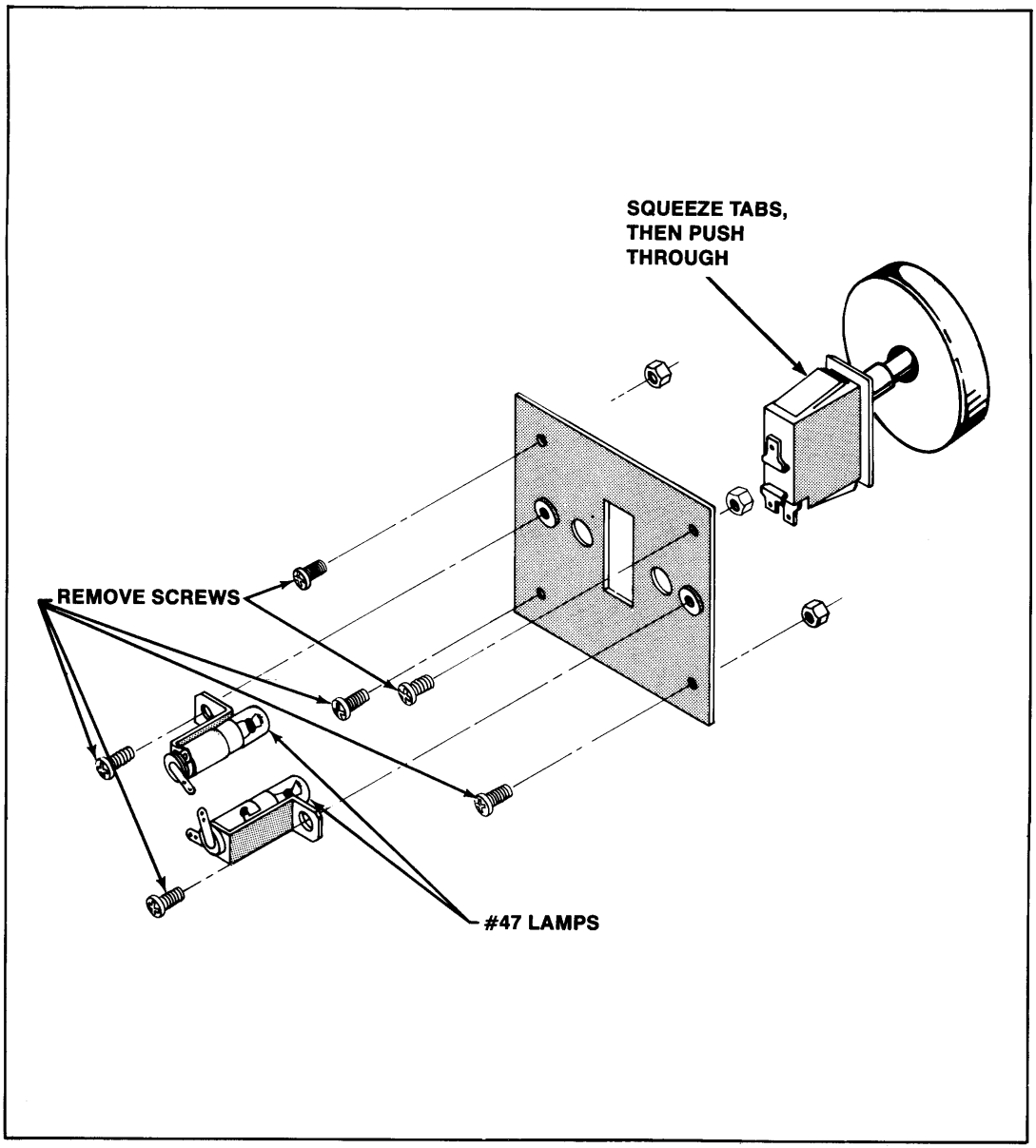


Figure 4-13 Lamp Start Switch Removal

H. LAMP START SWITCH (See Figure 4-13)

The one-player and two-player start pushbutton switches on the control panel are each backlighted by two #47 lamps. The swiches themselves are cherry switches with gold-plated contacts. To replace either start switch, see the procedure outlined in Figure 4-13.

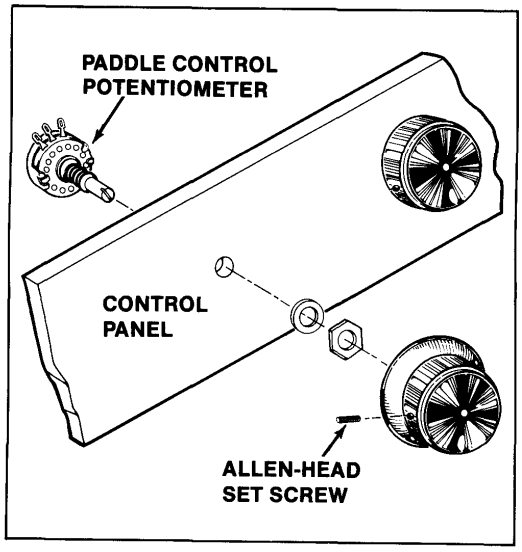


Figure 4-14 Paddle Control Removal

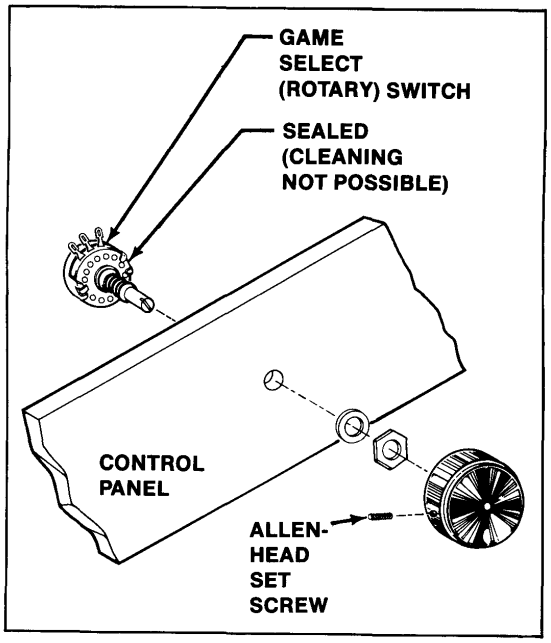


Figure 4-15 Game Select Switch Removal

J. PADDLE KNOB (POTENTIOMETER) REMOVAL (See Figure 4-14)

The paddle knob on the control panel is a potentiometer made with resistive carbon material. After frequent use, the carbon material begins rubbing off the potentiometer. This results in a fine dust that can cause the potentiometer to not perform smoothly or linearly. This problem can be detected by performing the potentiometer test, as described in the game's self-test procedure. (See Chapter 1 for details on the self-test procedure.)

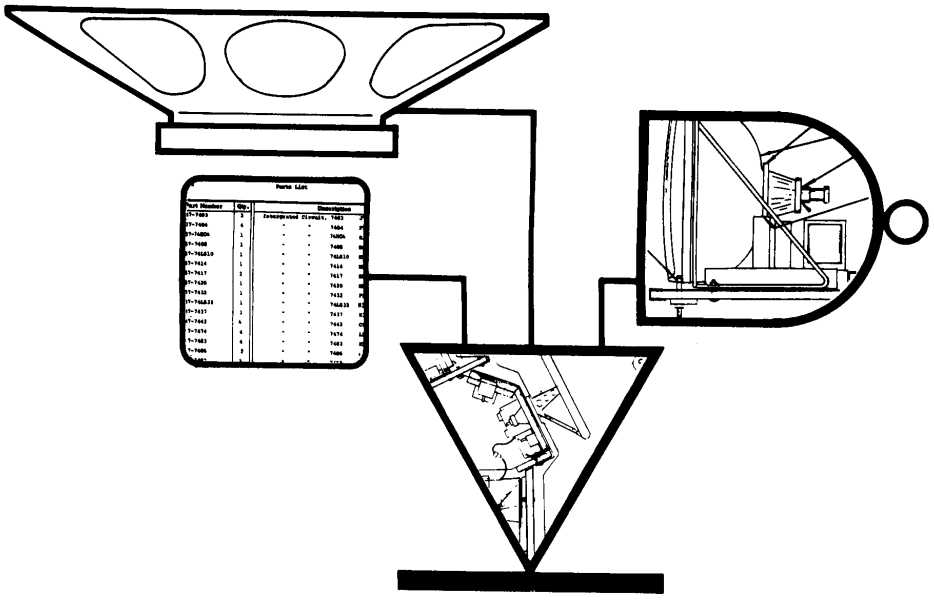
If it does become necessary to replace this control, follow the procedure outlined in Figure 4-14.

K. GAME SELECT SWITCH REMOVAL (See Figure 4-15)

If you need to replace this three-position rotary switch, follow the procedure shown in Figure 4-15.

The purpose of this chapter is to provide you with the necessary information for ordering replacement parts for the Super Breakout game.

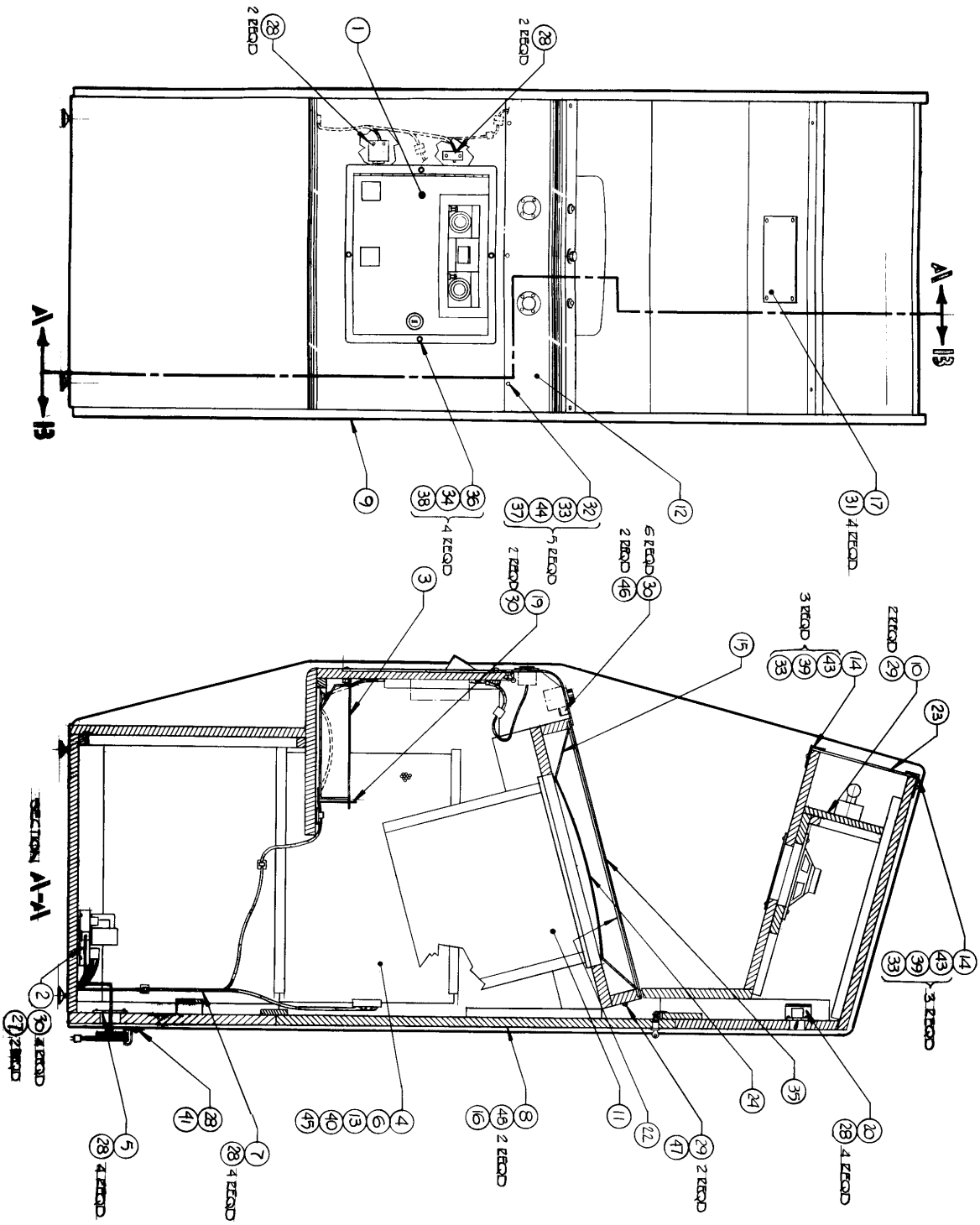
When ordering parts from your distributor, give the part number, part name, applicable figure number of this catalog, and the serial number of your Super Breakout game. This will help to avoid confusion and mistakes in your order. We hope the results will be less downtime and more profit from your game.



ILLUSTRATED PARTS CATALOG

The purpose of this chapter is to provide you with the necessary information for ordering replacement parts for the Super Breakout game.

When ordering parts from your distributor, give the part number, part name, applicable figure number of this catalog, and the serial number of your Super Breakout 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.



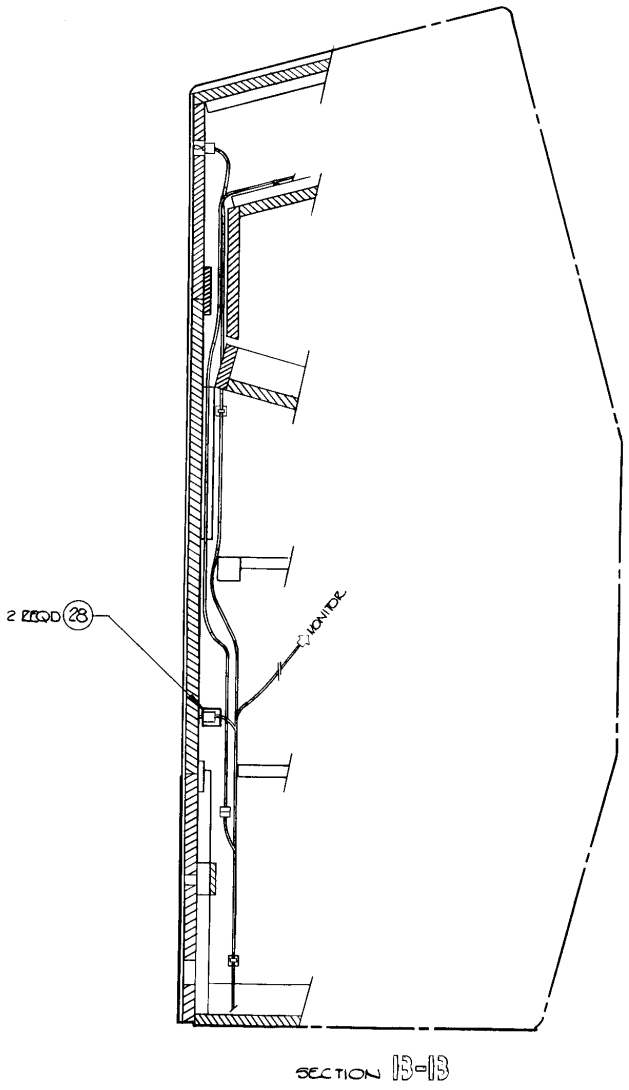


Figure 5-1 Final Cabinet Assembly
A033260-01 D

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Figure 5-1 Final Cabinet Assembly Parts List

Item	Part Number	Qty.	Description
1	A009083-01	1	Assembly, Coin Door
2	A007197-01	1	" Power Supply, Type "B"
3	A007902-01	1	" Cash Box
4	A030867-01	1	" R.F. Shield Enclosure
5	A033016-01	1	" Power Cord
6	*A033160-03	1	" Game Board (Super Breakout) (PROM)
7	A033256-02	1	" Pot, Switch & Harness
8	A032907-01	1	" Rear Door
9	A033259-01	1	" Cabinet W/Graphics
10	A033261-01	1	" Flour. Light/Speaker
11	A033262-01	1	" Monitor
12	A033456-01	1	" Control Panel
13	A033264-01	1	" R.F. P.C.B. End Board
14	003053-01	2	Retainer, Plexiglas
15	004809-03	1	Bezel, Vacuum Formed
16	005233-01	1	Seal, Rear Door
17	005419-01	1	Grill, Speaker
18	006305-01	1	Bag, Printed Poly
19	006870-01	1	Bracket, Coin Box
20	007103-01	1	Cover, On/Off Switch
21	033095-01	2	Label, Shipping
22	033137-01	1	Shield, Monitor Plexiglas W/Graphics
23	033138-01	1	Attraction, Plexiglas W/Graphics
24	033265-01	1	Overlay, Monitor W/Graphics
25	ST-118	1	Self Test Chart
26	TM-118	1	Tech Manual & IPC
27	46-2023002	2	Fuses, Slow Blow, 3 AMP
28	72-6610	20	Screw, Sht. Met., Pan Hd., Phil. #6 x 5/8" Lg.
29	72-6620	4	Screw, Sht. Met., Pan Hd., Phil., #6 X 1¼" Lg.
30	72-6812	12	Screw, Sht. Met., Pan Hd., Phil. #8 x 3/4" Lg
31	73-77015	4	Pop Rivet, 3/16 O.D. x .68" Lg, Blk
32	75-010S	5	Washer, Flat, #10
33	75-040	11	Washer, Split-Lock, #10
34	75-015S	4	Washer, Flat #¼
35	009439-01	1	Cover, Smoke Plexiglas
36	75-5516B	4	Bolt, Carriage, #¼-20 x 1.0" Blk
37	75-931	5	Wing Nut, #10-24
38	75-990505S	4	Nut, Lock, Shallow Pattern, #¼-20
39	75-99090006	6	Well Nut, Blind Hole Fastener, #10-32
40	72-6808	1	Screw, Sht. Met., Pan Hd. Phil., #8 x ½" Lg
41	78-25001	1	Tie Wrap, Screw Down
42	81-702	2	Tip-N-Tell Indicator
43	82-8016	6	Screw, Button Hd., Soc. Cap, #10-32 x 1.0" Lg, Blk
44	75-5120B	5	Bolt, Carriage, #10-24 x 1¼" Lg, Blk
45	72-1406S	4	Screw, Mach. Pan Hd., Phil, #4-40 x 3/8" Lg
46	033266-01	2	Bracket, Control Panel
47	033132-01	1	Support, Rear Plex
48	82-1824	2	Screw, Wood, Flat Hd., #8 X 1.50 Lg.
*	A033160-04	(ROM)	Is An Acceptable Substitute For A033160-03 (Item 6)

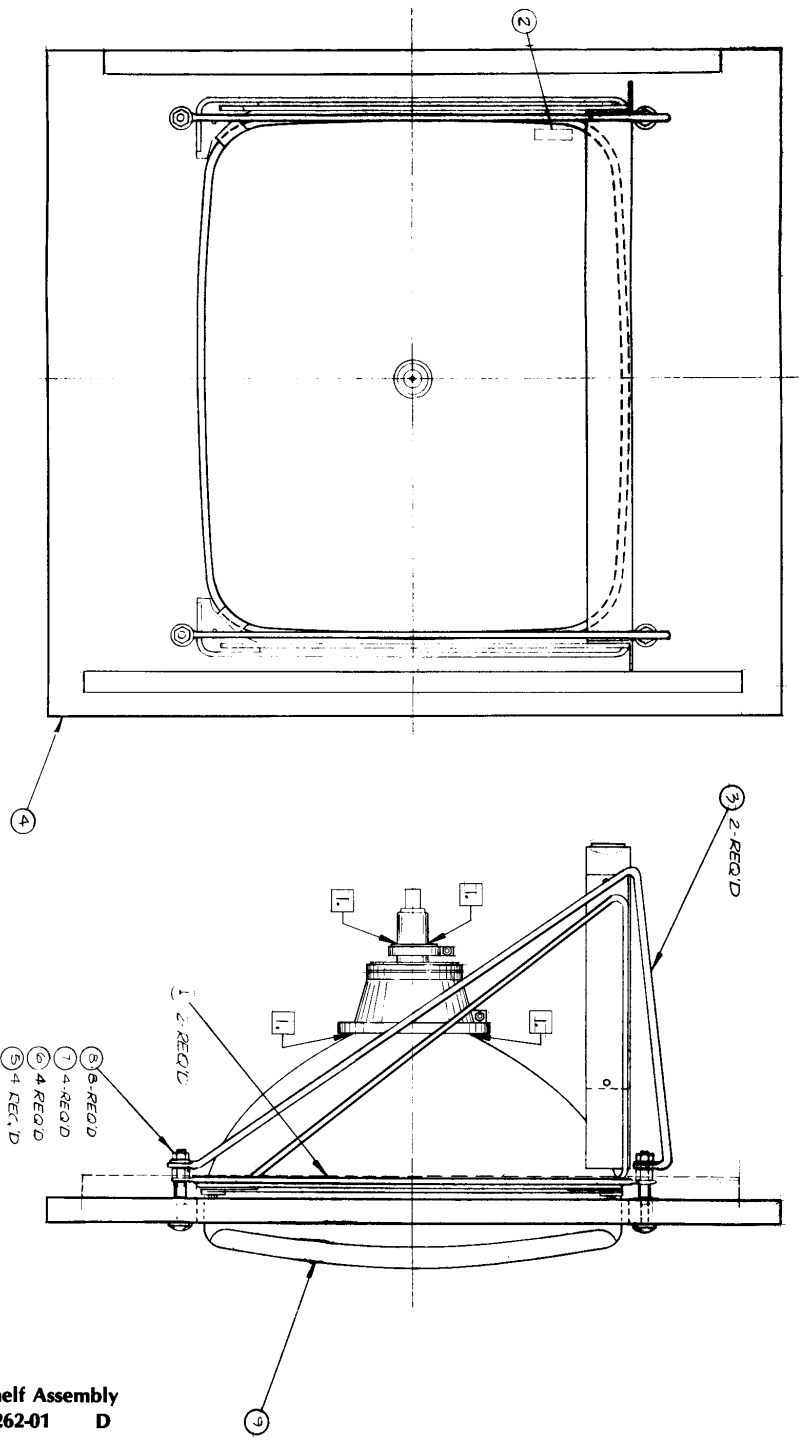

Figure 5-2 TV Shelf Assembly
A033262-01 D

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Figure 5-2 TV Shelf Assembly Parts List

Item	Part Number	Qty.	Description
1	003694-01	2	Bar, Tie
2	006319-03	1	Decal, Copyright (1978)
3	009236-01	2	Support, Monitor
4	033134-01	1	Board, Monitor Mount
5	74-3504S	4	Spacer, Tubular Non-Threaded #¼ x .25 Lg
6	75-045	4	Washer, Split-Lock #¼
7	75-5532N	4	Bolt, Carriage, #¼-20 x 2.00" Lg
8	75-915S	8	Nut, Hex #¼-20
9	92-033	1	Monitor, 19", B & W

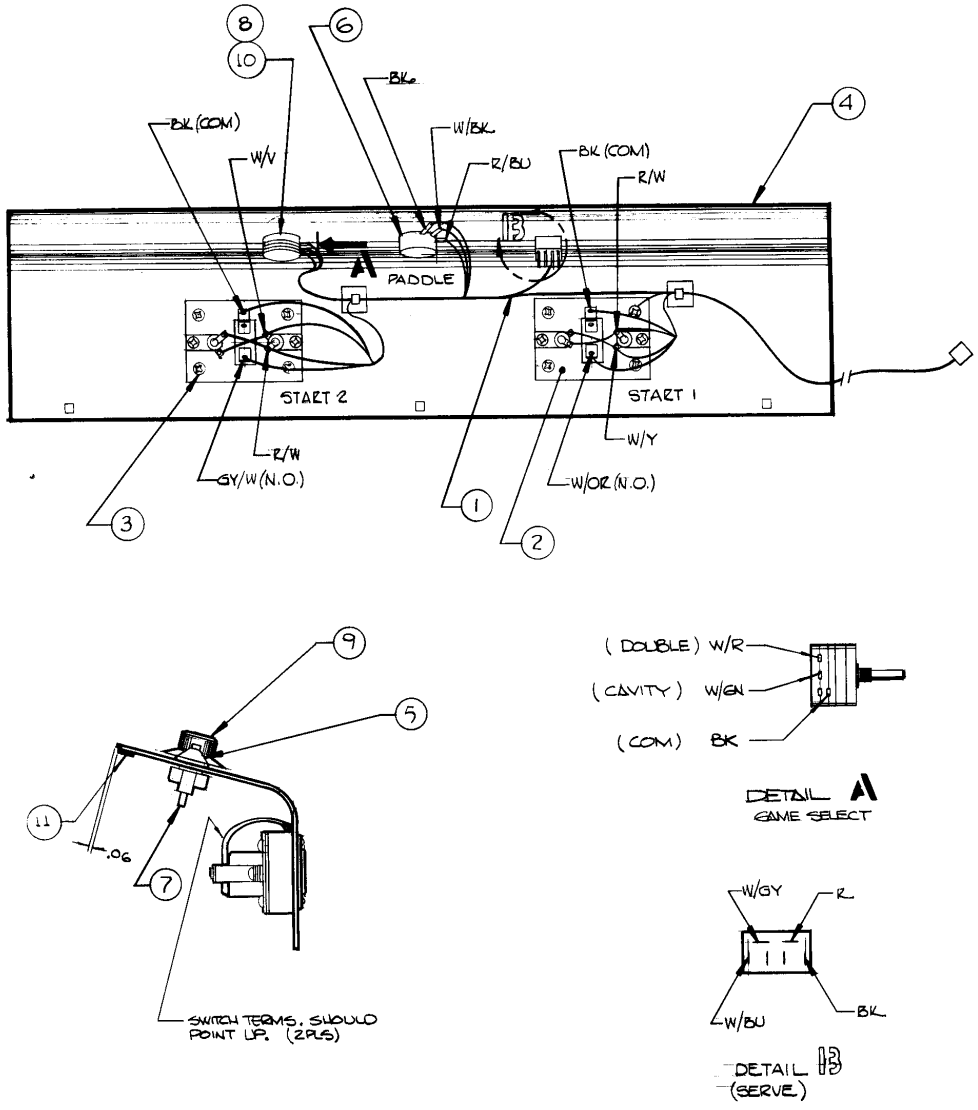

Figure 5-3 Control Panel Assembly
A033436-01 D

Figure 5-3 Control Panel Assembly Parts List

Item	Part Number	Qty.	Description
1	A033257-01	1	Assembly, Harness
2	A007357-06	1	Assembly, Double Lite Start Switch (1 Player)
3	A007357-07	1	Assembly, " " " " (2 Player)
4	033457-01	1	Panel, Control W/Graphics
5	001856-01	1	Bezel, Alum.
6	19-9022	1	Pot, 5K, Slip-Clutch, Short Shaft
7	62-002	1	Switch, Licon - Led
8	73-819	1	Knob, Black
9	73-825	1	Knob, Black With Skirt
10	64-01010301	1	Switch, Rotary (Stackpole)
11	78-6900402	1	Tape, Foam, Adhesive, Blk.

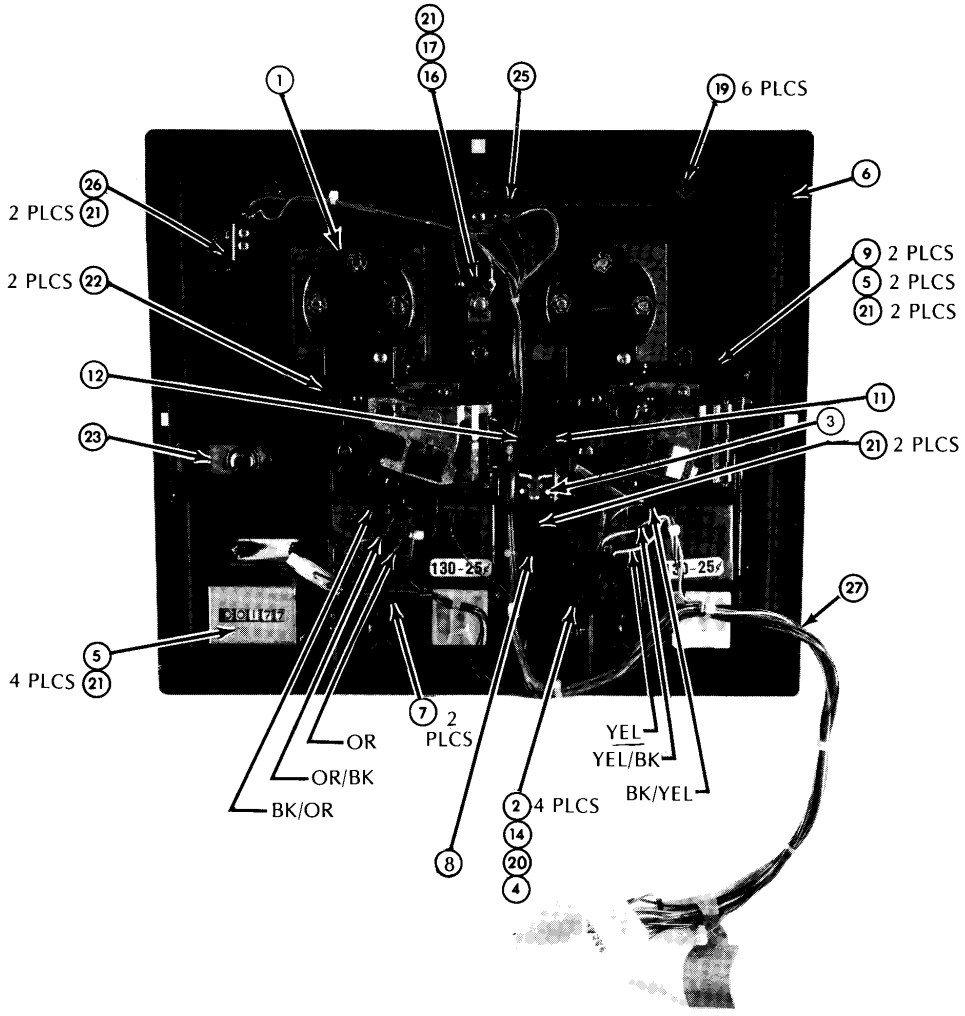

Figure 5-4 Coin Door Assembly
A009083-01 C

Figure 5-4 Coin Door Assembly
Parts List

Item	Part Number	Qty.	Description
1	A007637-01	1	Front Bezel Assy.—Used only on -01 Coin Door Assy.
	A007637-02	Ref.	Front Bezel Assy.—Used only on -02 Coin Door Assy.
	A007637-03	Ref.	Front Bezel Assy.—Used only on -03 Coin Door Assy.
	A007637-04	Ref.	Front Bezel Assy.—Used only on -04 Coin Door Assy.
	A007637-05	Ref.	Front Bezel Assy.—Used only on -05 Coin Door Assy.
	A007637-06	Ref.	Front Bezel Assy.—Used only on -06 Coin Door Assy.
	A007637-07	Ref.	Front Bezel Assy.—Used only on -07 Coin Door Assy. See Figure 5-5
2	75-9165	4	Nut, 6-32
3	A030362-01	1	Coin Lock-Out Assembly, See Figure 5-6
4	A007640-01	2	Coin Switch Assembly, See Figure 5-7
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
	71-125FB	Ref.	Coin Mechanism for Belgian 5 Francs Only
	71-1205FF	Ref.	Coin Mechanism for German Mark Only
	71-1201MG	Ref.	Coin Mechanism for Swedish Krona Only
	71-1201KS	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

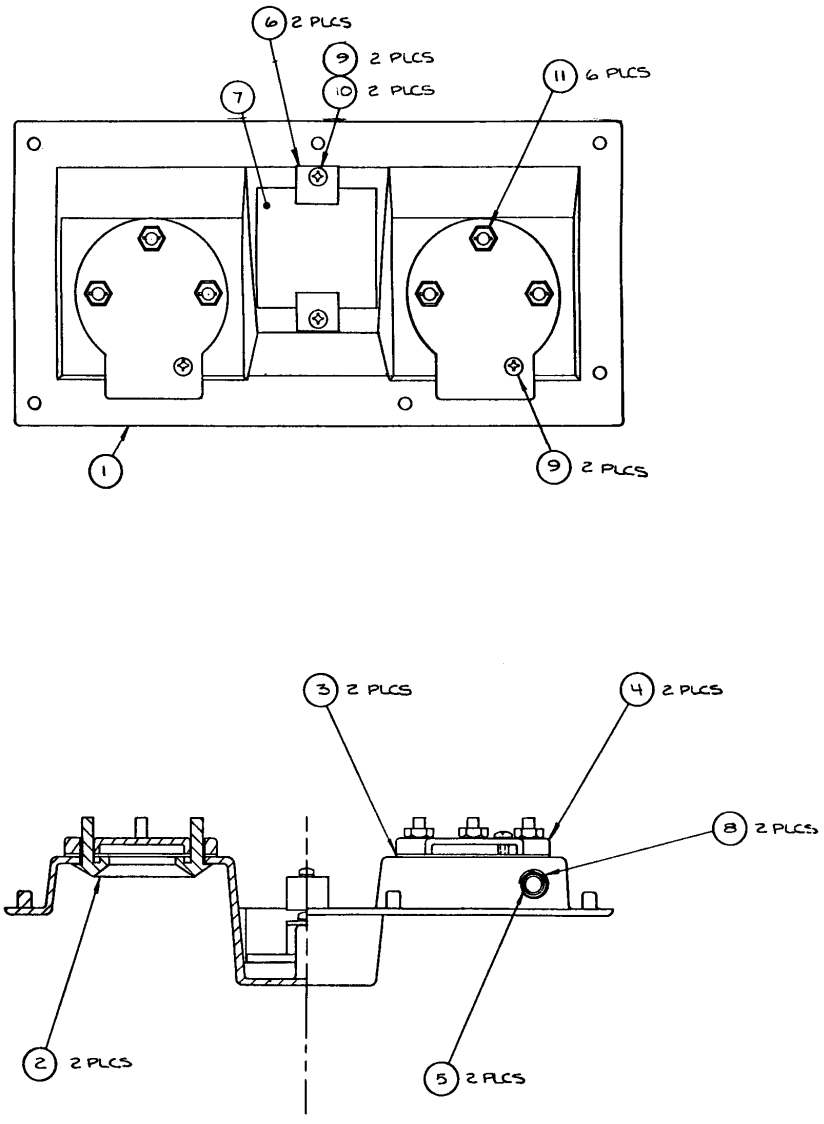

Figure 5-5 Front Bezel Assembly
A007637-01 thru -07 D

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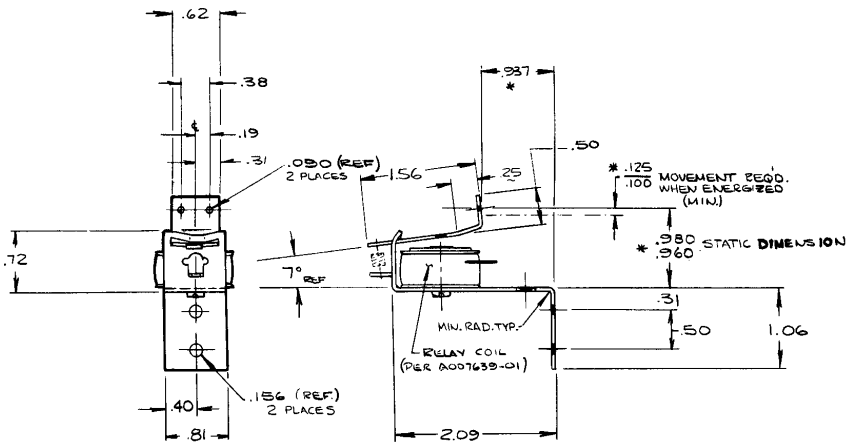
Figure 5-5 Front Bezel Assembly Parts List

Item	Part Number	Qty.	Description
1	004328-01	1	Bezel
2	See below	2	Ring
3	004331-01	2	Coin Shield
4	004332-01	2	Primary Coin Chute
5	004327-01	2	Bearing, Scavenger Button
6	004329-01	2	Clamp, Price Plate
7	See Below	1	Price Plate
8	73-3009	2	Retaining "C" Ring, Truarc #5103-37
9	72-1604S	4	Mach. Scr., 6-32 x ¼ Lg. Pan Hd., Phil
10	75-046	2	Washer, #6, Split-Lock
11	75-9914001	6	Self-Threading Nut, Tinnerman #SR188006

DASH NO	ITEM 2	ITEM 7	DENOMINATION
-01	004330-01	004343-01	25¢
-02	004330-01	004343-06	5 FR
-03	009153-01	004343-04	1 DM
-04	004330-01	004343-03	1 KR
-05	009520-01	004343-05	100 Y
-06	007752-01	004343-02	10 P
-07	007752-01	004343-07	20¢ AUST.



NOTES:
1. Dimensions shown are dim's req'd. to interchange & replace relay with existing equipment in field and production.
2. Break & deburr all sharp corners.
3. Dimensions taken from tooled part.
   Dimensions with * are specified dims. required in tooling by Engineering to have part interchange with prior buyout part.
4. Coil data: 10 VDC ±2, 50Ω resistance current 200 ma maximum.
5. Manufacturer: Coin Mech, Inc.

DETAIL OF RELAY COIL (A007639-01)

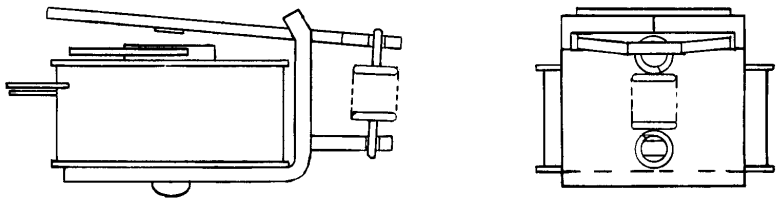
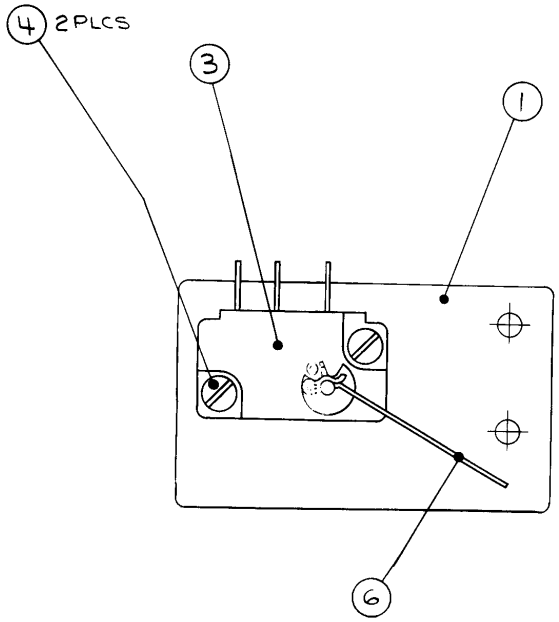


Figure 5-6 Coin Lockout Assembly A030362-01 A



ITEM	PART NO.	DESCRIPTION	QTY
1	004342-01	SWITCH MTG PLATE	1
2			
3	65-441C	SWITCH, OMRON C-5G3-3	1
4	72-HA 4412	SCR, M3, *4-40 x 3/4 LG ROLL TIGHT SELF TAPPING	2
5			
6	008824-01	WIREFORM, CHERRY	1

Figure 5-7 Coin Switch Assembly A007640-01 D

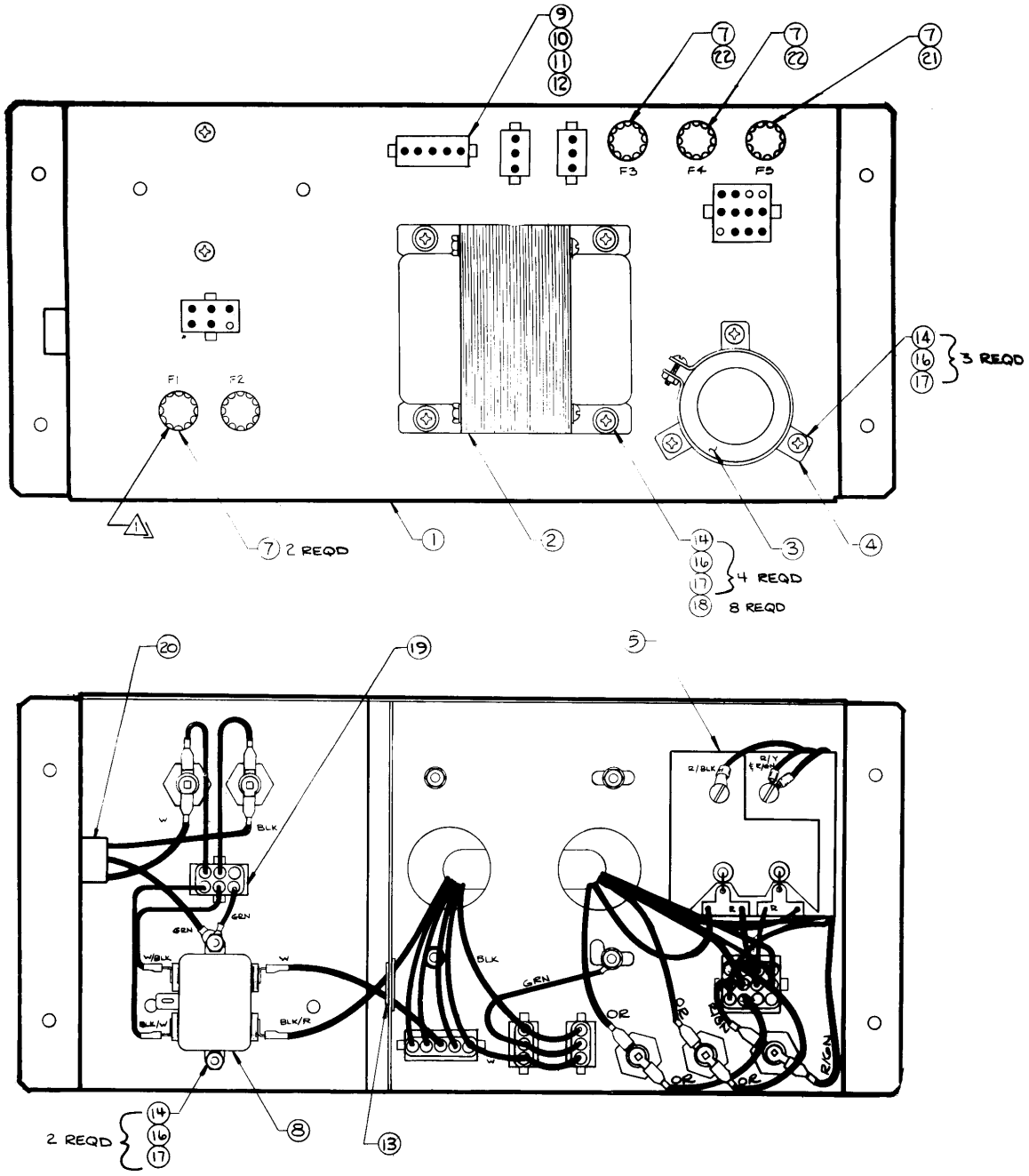


Figure 5-8 Type B Power Supply Assembly
A007197-01 D

Figure 5-8 Type B Power Supply 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

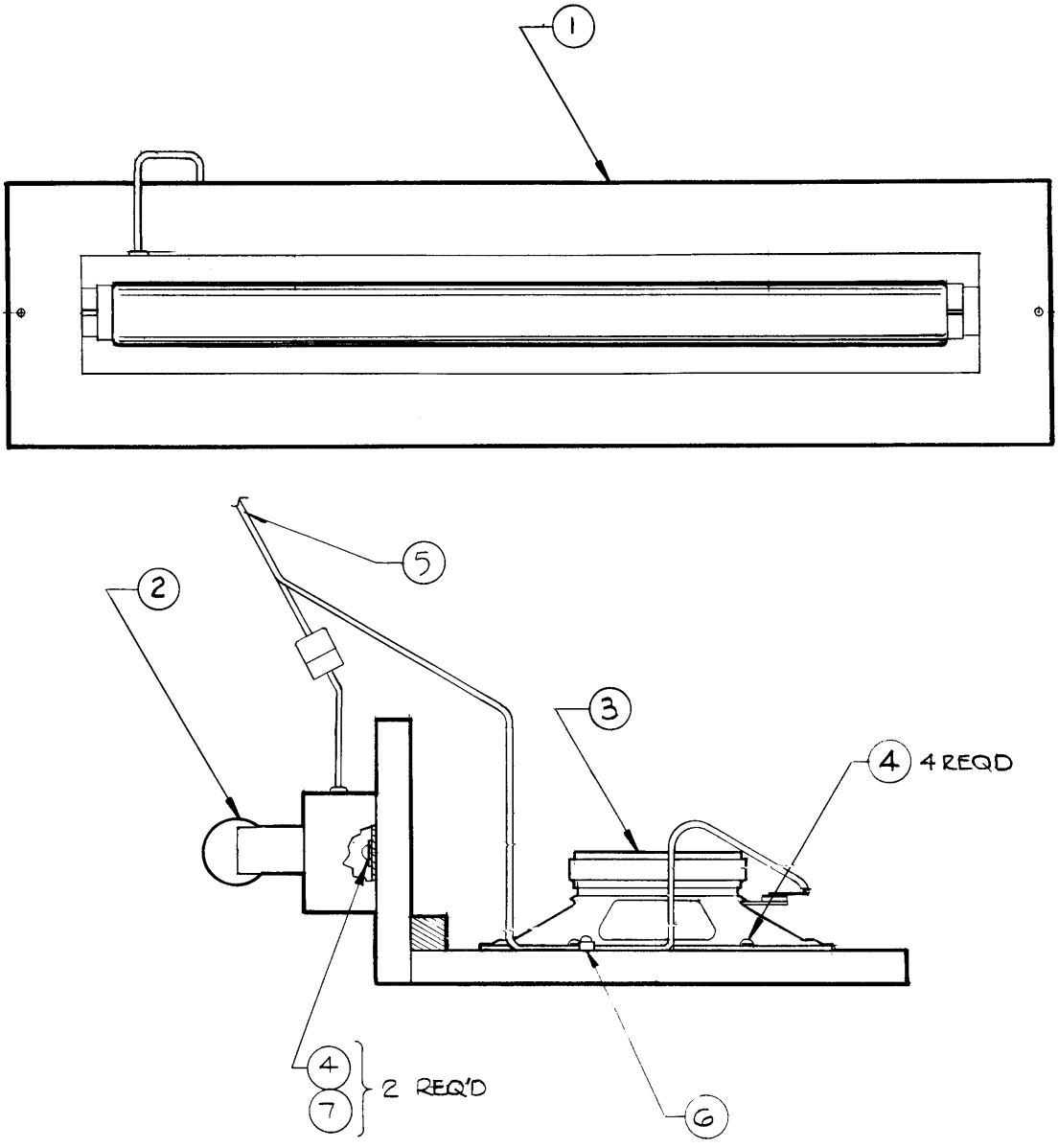


Figure 5-9 Fluorescent Light and Speaker Mount Assembly A033261-01 C

Figure 5-9 Fluorescent Light and Speaker Mount Parts List

Item	Part Number	Qty.	Description
1	A009396-01	1	Assembly, Light & Speaker Board
2	A005495-01	1	Assembly, 18" Flourescent
3	48-001	1	Speaker, 8"
4	72-6810	6	Screw, Sht. Met., Pan Hd., Phil. #8 x5/8"Lg
5	A005819-01	1	Assy, Light & Speaker Harness
6	72-6610	1	Screw Sht. Met. Pan HD., Phil #6 x 5/8" Lg
7	75-010S	2	Washer, Flat, #10

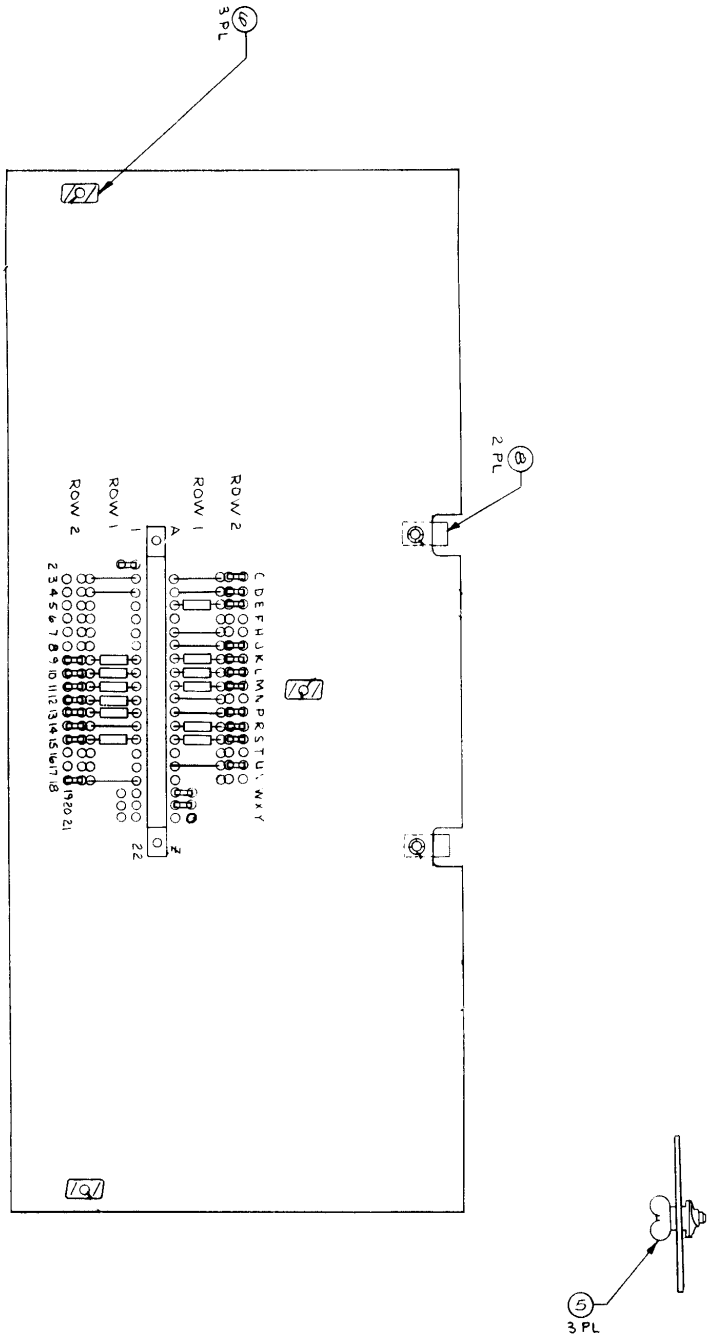


Figure 5-11 RF Shield PCB Assembly A033264-01 D

Figure 5-11 RF Shield PCB Assembly Parts List

Item	Part Number	Qty.	Description
1	030835-01	1	P.C. Board
2	2D-1016	22	Capacitor, Mono, 0.1uf, 50V
3	41-3003	12	Inductor, 100uH
4	52-003	11	Jumper, .600 Centers
5	75-E6106081	3	Wingscrew, #6-32 x 1/2 Lg
6	75-992302	3	Fastener, 1/4 Turn, #6-32, Nylon
7	79-517222	1	Connector, 44 Pin P.C. Mount
8	030868-01	2	Mount, Connector

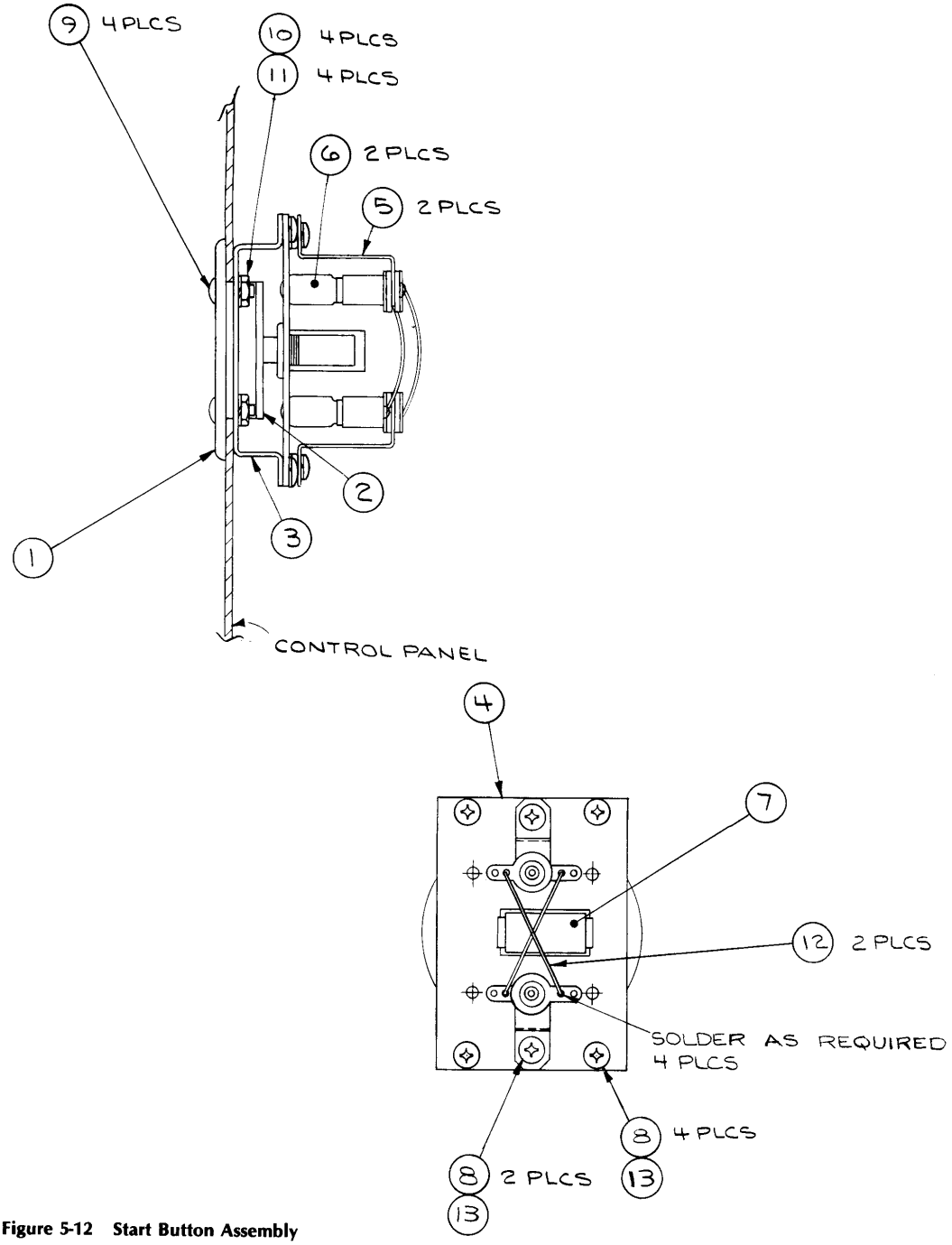


Figure 5-12 Start Button Assembly
A007357-06, 07 E

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Figure 5-12 Start Button Assembly Parts List

Item	Part Number	Qty.	Description
1	006530-01	1	Bezel
2	006535-06	1	Button (One Player Start)*
3	006532-01	1	Chassis
4	A006533-01	1	Switch Mtg. Plate Assy
5	79-4317	2	Lamp Socket
6	70-11-47	2	Lamp
7	62-020	1	Switch, Cherry, E68-50A
8	72-1603	6	Mach. Screw, 6-32 x 3/16" Lg., Pan Hd., Phil.
9	82-8808	4	Screw, Button Hd. Socket, 8-32 x ½" Lg., Black
10	75-918S	4	Nut, 8-32
11	75-048	4	Washer, #8, Split-Lock
12	004577-19	2	Jumper Wire, Black
13	75-046	6	Washer, Split-Lock #6
			* Alternate:
			006535-07 | 1 | Button (Two Player Start)

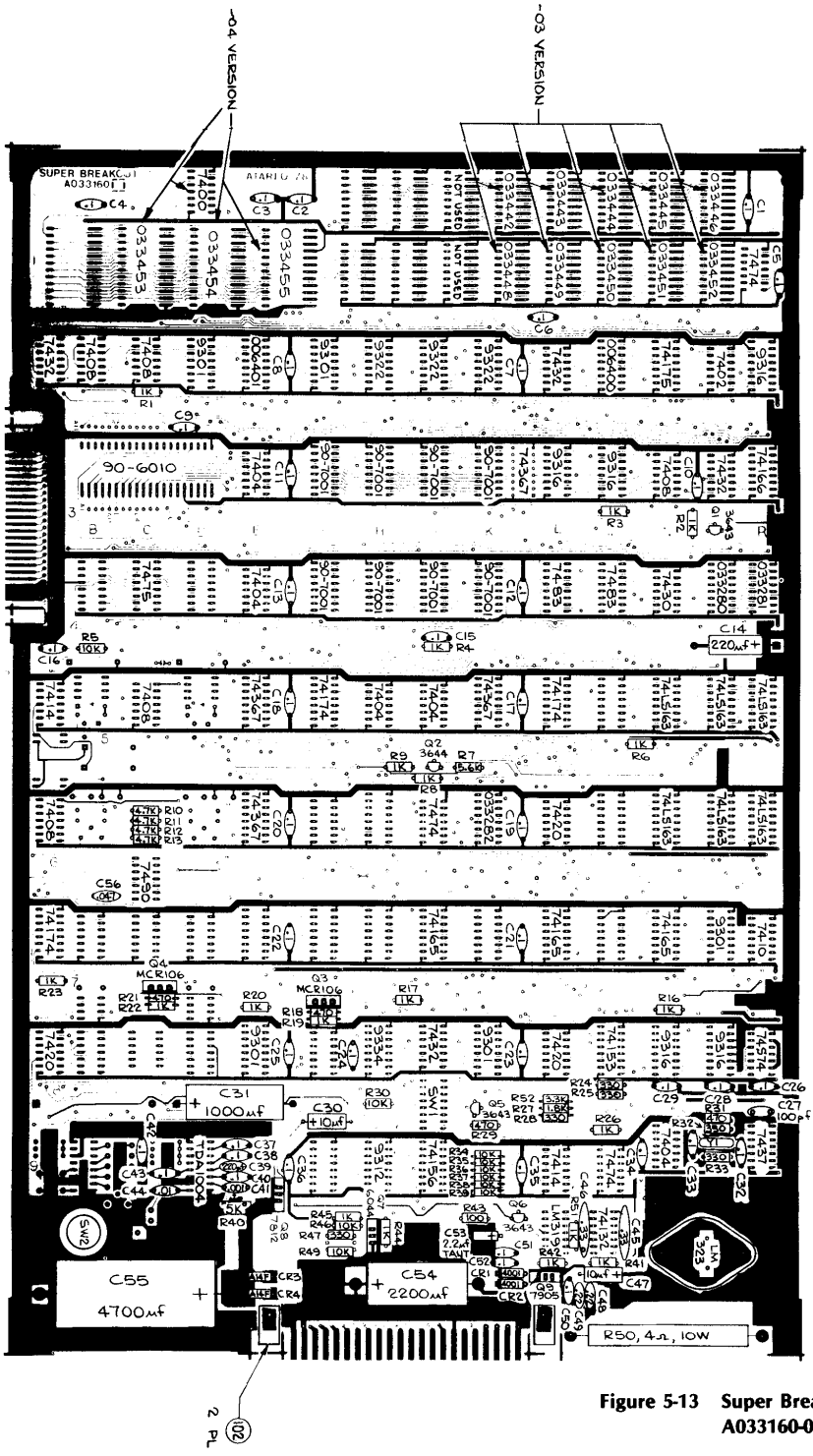

Figure 5-13 Super Breakout PCB Assembly A033160-03, -04 A

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Figure 5-13 Super Breakout PCB Assembly Parts List -03 Version

Item	Part Number	Qty.	Description	
1	033161-01	1	P.C. Board	
2	10-5101	1	Res., Car. Comp., ¼W, 5%, 100 OHM	R43
3	10-5331	6	" " " " " 330 "	R24,25,28,32,33,47
4	10-5471	4	" " " " " 470 "	R18,21,29,31
5	10-5102	19	" " " " " 1K "	R1-4,6,8,9,16,17, 19,20,22,23,26,41, 42,44,45,51
6	10-5182	1	" " " " " 1.8K "	R27
7	10-5472	4	" " " " " 4.7K "	R10-13
8	10-5562	1	" " " " " 5.6K "	R7
9	10-5103	10	" " " " " 10K "	R5,30,34-39,46,49
10	10-5332	1	Res., Car. Comp., ¼W, 5% 3.3K OHM	R52
11	19-315502	1	Trim Pot, 5K OHM	R40
12	19-808W4P0	1	Res., Wirewound, 4 OHM, 10W	R50
13				
14				
15	24-250106	2	Cap., Electrolytic, 25V, 10uf	C30,47
16	24-250227	1	" " " 220uf	C14
17	24-250108	1	" " " 1000uf	C31
18	24-250228	1	" " " 2200uf	C54
19	24-250478	1	" " " 4700uf	C55
20	27-250102	1	" Ceramic Disc, " .001uf	C41
21	27-250332	2	" " " " .33uf	C45,46
22	27-250222	2	" " " " .22uf	C48,49
23	27-250103	1	" " " " .01uf	C44
24	27-250104	40	" " " " .1uf	C1-13,15-26,28,29, 32-38,40,42,43, 50-52
25	28-101221	1	Cap., Dipped Mica, 100V, 220pf	C39
26	28-101102	1	Cap., Dipped Mica, 100V, 100pf	C27
27	29-010	1	Cap., Tantalum, 2.2uf	C53
28	27-250473	1	Cap., Ceramic Disc, 25V, .047uf	C56
29				
30				
31	31-1N4001	2	Diode, 1N4001	CR1,2
32	31-A14F	2	Diode, A14F	CR3,4
33				
34				
35				
36	33-2N3644	1	Transistor, 2N3644	Q2
37	34-2N3643	3	Transistor, 2N3643	Q1,5,6
38	34-2N6044	1	Transistor, 2N6044	Q7
39	35-MCR106-1	2	Thyristor, MCR106-1	Q3,4
40				
41				
42				
43	37-7402	1	Integrated Circuit, 7402	P2
44	37-7404	5	" " 7404	E3,E4,H5,J5,N9
45	37-7408	5	" " 7408	B2,C2,N3,C5,A6
46	37-7410	1	" " 7410	R7
47	37-7414	2	" " 7414	A5,L9
48	37-7420	3	" " 7420	L6,A8,L8
49	37-7430	1	" " 7430	N4
50	37-7432	4	" " 7432	A2,L2,P3,J8
51	37-7437	1	" " 7437	R9
52	37-7474	3	" " 7474	R1,J6,M9
53	37-74S74	1	" " 74S74	R8
54	37-7475	1	" " 7475	C4
55	37-7483	2	" " 7483	L4,M4
56	37-7490	1	" " 7490	C6/7
57	37-74132	1	" " 74132	M10
58	37-74153	1	" " 74153	M8
59	37-74156	1	" " 74156	J9
60	37-74LS163	6	Integrated Circuit, 74LS163	N5,N6,P5,P6,R5,R6

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Figure 5-13 Super Breakout PCB Assembly Parts List -03 Version

Item	Part Number	Qty.	Description
61	37-74165	3	Integrated Circuit, 74165 J7,L7,N7
62	37-74166	1	" " 74166 R3
63	37-74174	3	" " 74174 F5,L5,A7
64	37-74175	1	" " 74175 N2
65	37-74367	4	" " 74367 K/L3,E5,K5,E6
66	37-9301	5	" " 9301 D2,F2,P7,E8,K8
67	37-9312	1	" " 9312 H9
68	37-9316	5	" " 9316 R2,L3,M3,N8,P8
69	37-9322	3	" " 9322 H2,J2,K2
70	37-9334	1	" " 9334 H8
71	37-LM319	1	Integrated Circuit, LM319 L10
72	37-7812	1	Regulator, 7812 Q8
73	37-7905	1	Regulator, 7905 Q9
74	37-LM323	1	Regulator, LM323
75	37-TDA1004	1	Audio Amp, TDA1004 D9
76			
77			
78	62-001	1	Switch SPST, Momentary SW2
79	66-118P1T	1	Switch SPST x 8, DIP SW1 J8/9
80			
81			
82	72-1608C	2	Screw, Pan Hd. Phil., 6-32 x ½ Lg. CRES
83	75-016	2	Washer, Flat #6
84	75-056	2	Washer, Lock, Int. Star, #6
85	75-916C	2	Nut, Hex, 6-32, CRES
86			
87			
88	78-06001	1	Heatsink (LM323)
89	78-06022	1	Heatsink (TDA1004)
90	78-13016	A/R	Cement (TDA1004 Heatsink)
91	78-16005	1	Silpad (LM323)
92			
93			
94	79-42C40	1	Socket, 40 Pin, Med. Insertion C3
95			
96			

Item	Part Number	Qty.	Description
97	90-102	1	Crystal, 12.096 MHZ Y1
98			
99	90-6010	1	Microprocessor C3
100	90-7001	8	RAM, 2102-1 F3,H3,J3,K3,F4, H4,J4,K4
101			
102	030868-01	2	Mount, Connector
103			
104	006400-01	1	Sync PROM M2
105	006401-01	1	Decoder E2
106			
107	033280-01	1	Super Breakout Playfield Char. PROM LS P4
108	033281-01	1	Super Breakout Playfield Char. PROM MS R4
109	033282-01	1	Super Breakout Ball Picture PROM K6
110			
111			
112			
113	033443-01	1	Super Breakout Program PROM 3000 MS L0
114	033444-01	1	" " " " 3400 MS M0
115	033445-01	1	" " " " 3800 MS N0
116	033446-01	1	" " " " 3C00 MS P0
117	033449-01	1	" " " " 3000 LS L1
118	033450-01	1	" " " " 3400 LS M1
119	033451-01	1	" " " " 3800 LS N1
120	033452-01	1	" " " " 3C00 LS P1
121			
122	033442-01	1	" " " " 2C00 MS K/L0
123			
124	033448-01	1	" " " " 2C00 LS K/L1

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Figure 5-13 Super Breakout PCB Assembly Parts List -04 Version

Item	Part Number	Qty.	Description
1	033161-01	1	P.C. Board
2	10-5101	1	Res., Car. Comp., ¼W, 5%, 100 OHM R43
3	10-5331	6	" " " " " 330 " R24,25,28,32,33,47
4	10-5471	4	" " " " " 470 " R18,21,29,31
5	10-5102	19	" " " " " 1K " R1-4,6,8,9,16,17, 19,20,22,23,26,41, 42,44,45,51
6	10-5182	1	" " " " " 1.8K " R27
7	10-5472	4	" " " " " 4.7K " R10-13
8	10-5562	1	" " " " " 5.6K " R7
9	10-5103	10	" " " " " 10K " R5,30,34-39,46,49
10	10-5332	1	Res., Car. Comp., ¼W, 5% 3.3K OHM R52
11	19-315502	1	Trimpot, 5K OHM R40
12	19-808W4P0	1	Res., Wirewound, 4 OHM, 10W R50
13			
14			
15	24-250106	2	Cap., Electrolytic, 25V, 10uf C30,47
16	24-250227	1	" " " 220uf C14
17	24-250108	1	" " " 1000uf C31
18	24-250228	1	" " " 2200uf C54
19	24-250478	1	" " " 4700uf C55
20	27-250102	1	" Ceramic Disc, " .001uf C41
21	27-250332	2	" " " " .33uf C45,46
22	27-250222	2	" " " " .22uf C48,49
23	27-250103	1	" " " " .01uf C44
24	27-250104	40	" " " " .1uf C1-13,15-26,28,29, 32-38,40,42,43, 50-52
25	28-101221	1	Cap., Dipped Mica, 100V, 220pf C39
26	28-101102	1	Cap., Dipped Mica, 100V, 100pf C27
27	29-010	1	Cap., Tantalum, 2.2uf C53
28	27-250473	1	Cap., Ceramic Disc, 25V, .047uf C56
29			
30			
31	31-1N4001	2	Diode, 1N4001 CR1,2
32	31-A14F	2	Diode, A14F CR3,4
33			
34			
35			
36	33-2N3644	1	Transistor, 2N3644 Q2
37	34-2N3643	3	Transistor, 2N3643 Q1,5,6
38	34-2N6044	1	Transistor, 2N6044 Q7
39	35-MCR106-1	2	Thyristor, MCR106-1 Q3,4
40			
41			
42	37-7400	1	Integrated Circuit, 7400 D0
43	37-7402	1	" " 7402 P2
44	37-7404	5	" " 7404 E3,E4,H5,J5,N9
45	37-7408	5	" " 7408 B2,C2,N3,C5,A6
46	37-7410	1	" " 7410 R7
47	37-7414	2	" " 7414 A5,L9
48	37-7420	3	" " 7420 L6,A8,L8
49	37-7430	1	" " 7430 N4
50	37-7432	4	" " 7432 A2,L2,P3,J8
51	37-7437	1	" " 7437 R9
52	37-7474	3	" " 7474 R1,J6,M9
53	37-74S74	1	" " 74S74 R8
54	37-7475	1	" " 7475 C4
55	37-7483	2	" " 7483 L4,M4
56	37-7490	1	" " 7490 C6/7
57	37-74132	1	" " 74132 M10
58	37-74153	1	" " 74153 M8
59	37-74156	1	" " 74156 J9
60	37-74LS163	6	Integrated Circuit 74LS163 N5,N6,P5,P6,R5,R6

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Figure 5-13 Super Breakout PCB Assembly Parts List -04 Version

Item	Part Number	Qty.	Description	
61	37-74165	3	Integrated Circuit, 74165	J7,L7,N7
62	37-74166	1	" " 74166	R3
63	37-74174	3	" " 74174	F5,L5,A7
64	37-74175	1	" " 74175	N2
65	37-74367	4	" " 74367	K/L3,E5,K5,E6
66	37-9301	5	" " 9301	D2,F2,P7,E8,K8
67	37-9312	1	" " 9312	H9
68	37-9316	5	" " 9316	R2,L3,M3,N8,P8
69	37-9322	3	" " 9322	H2,J2,K2
70	37-9334	1	" " 9334	H8
71	37-LM319	1	Integrated Circuit, LM319	L10
72	37-7812	1	Regulator, 7812	Q8
73	37-7905	1	Regulator, 7905	Q9
74	37-LM323	1	Regulator, LM323	
75	37-TDA1004	1	Audio Amp, TDA1004	D9
76				
77				
78	62-001	1	Switch SPST, Momentary	SW2
79	66-118P1T	1	Switch SPST x 8, DIP	SW1 J8/9
80				
81				
82	72-1608C	2	Screw, Pan Hd. Phil., 6-32 x ½ Lg. CRES	
83	75-016	2	Washer, Flat #6	
84	75-056	2	Washer, Lock, Int. Star, #6	
85	75-916C	2	Nut, Hex, 6-32, CRES	
86				
87				
88	78-06001	1	Heatsink (LM323)	
89	78-06022	1	Heatsink (TDA1004)	
90	78-13016	A/R	Cement (TDA1004 Heatsink)	
91	78-16005	1	Silpad (LM323)	
92				
93				
94	79-42C40	1	Socket, 40 Pin, Med. Insertion	C3
95				
96				

Item	Part Number	Qty.	Description	
97	90-102	1	Crystal, 12.096 MHZ	Y1
98				
99	90-6010	1	Microprocessor	C3
100	90-7001	8	RAM, 2102-1	F3,H3,J3,K3,F4,H4, J4,K4
101				
102	030868-01	2	Mount, Connector	
103				
104	006400-01	1	Sync PROM	M2
105	006401-01	1	Decoder	E2
106				
107	033280-01	1	Super Breakout Playfield Char. PROM LS	P4
108	033281-01	1	Super Breakout Playfield Char. PROM MS	R4
109	033282-01	1	Super Breakout Ball Picture PROM	K6
110	033453-01	1	Super Breakout Program ROM 2800	C1
111	033454-01	1	Super Breakout Program ROM 3000	D1
112	033455-01	1	Super Breakout Program ROM 3800	E/F1