ATARI

The

ATARIANS



Operation, Maintenance
and Service Manual

WARRANTY

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

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

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

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

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

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

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

This document is and contains confidential trade secret information of Atari, Inc.

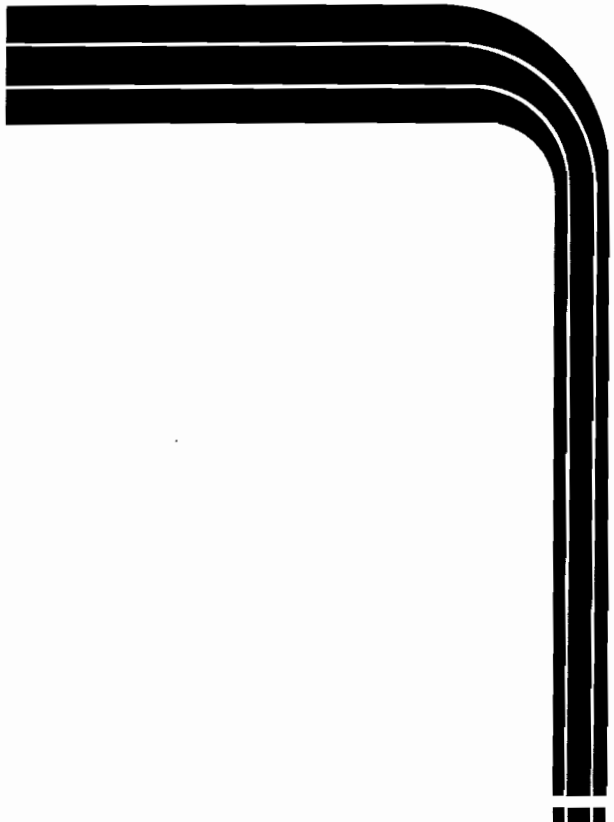
This document is loaned under confidential custody for the sole purpose of operation, maintenance or repair of Atari equipment and may not be used by or disclosed to any person for any other purpose whatever, and remains the property of Atari, Inc.

Neither it nor the information it contains may be reproduced, used, or disclosed to persons not having a need to know consistent with the purpose of the loan, without written consent of Atari, Inc.

THE ATARIANS

Operation, Maintenance and Service Manual

ATARI INC
1265 BORREGAS AVENUE
SUNNYVALE, CALIFORNIA 94086
408/745-2000 ■ TELEX 35-7488



By the Publications Group, Engineering Department

ATARI®

All rights reserved. Copyright © 1977 by Atari, Inc.
No part of this publication may be reproduced by any mechanical, photographic, or electronic process, or in the form of a phonographic recording, nor may it be stored in a retrieval system, transmitted, or otherwise copied for public or private use, without permission from the publisher.

For permission requests, write:

PUBLICATIONS GROUP
ATARI INC.
1265 BORREGAS AVENUE
SUNNYVALE, CA 94086

Lithographed in the U.S.A.

TABLE OF CONTENTS

Subject	Page
I. INTRODUCTION	
1.1 Physical Description of Game	1
1.2 Summary of Game Play	1
II. SPECIFICATIONS	
2.1 General	5
2.2 Electrical	5
2.3 Environmental	5
2.4 Owner/Operator Options for Structuring of Play	5
III. DESCRIPTION OF OPERATION	
3.1 Functional Description of Game	7
3.2 General Information	7
3.2.1 Energizing the Game	
3.2.2 Cabinet and Playfield Components	
3.3 Game Sequence	12
3.3.1 Operating Modes	
3.3.2 Attract Mode	
3.3.3 Game Sequence in Play Mode	
IV. THEORY OF OPERATION	
4.1 General Comments	17
4.2 Components of the Microcomputer System	17
4.2.1 Microprocessing Unit	
4.2.2 Program Memory	
4.2.3 Data Memory	
4.2.4 Memory Output Latches	
4.2.5 Clock Generator	
4.2.6 Tri-State Buffers	
4.2.7 Control Logic	
4.3 Solenoid Driver Circuits	21
4.4 Lamp Driver Circuits	21
4.5 Switch Sensing Circuit	23
4.6 Displays and Display Data	25
4.7 Credit and Match/Ball Display Circuit	26
4.8 Score Display Circuit	27
4.9 Sound Generator and Speaker Driver Circuits	28
V. INSTALLATION INSTRUCTIONS	
5.1 Unpacking Inspection	29
5.2 Assembly of Cabinet at Game Site	31
5.3 Setup Adjustments and Checks	32
5.4 Application of AC Power	33
5.5 Check on Operation of Interlock Switch	34
5.6 Game Structuring	34
5.7 Test Mode of Operation	36

Table of Contents

VI. MAINTENANCE AND ADJUSTMENTS 39
- *6.1 Routine Maintenance* 39
  - *6.1.1 Cleaning of Exterior Cabinet Parts*
  - *6.1.2 Care of the Playfield*
- *6.2 Adjustment of Speaker Volume and Lamp Brightness* 39
- *6.3 Playfield Lamp Replacement* 40

VII. DISASSEMBLY AND ASSEMBLY 41
- *7.1 General Information* 41
- *7.2 Removing and Reinstalling the Score Display PCB* 41

VIII. TROUBLESHOOTING AND REPAIR 43
- *8.1 General Procedure* 43
  - *8.1.1 Identifying the Trouble Area*
  - *8.1.2 Locating the Trouble Cause*
  - *8.1.3 Correcting the Trouble Cause*
  - *8.1.4 Verifying Correct Game Operation*
- *8.2 Test Equipment* 44
  - *8.2.1 Basic Test Equipment*
  - *8.2.2 Optional Test Equipment*
- *8.3 Specific Troubleshooting Information* 45
  - *8.3.1 Coin Mechanism*
  - *8.3.2 Gas Discharge Displays*

IX. SCHEMATICS, DRAWINGS, AND PARTS LISTS 47

LIST OF FIGURES

Figure 2-1 Cabinet Dimensions

Figure 3-1 Functional Block Diagram of The ATARIANS Pinball Game
Figure 3-2 Lower Arch Panel
Figure 3-3 Top View of Playfield

Figure 4-1 Block Diagram of Microcomputer System
Figure 4-2 Simplified Diagram of Basic Solenoid Driver Circuit
Figure 4-3 Simplified Diagram of Basic Lamp Driver Circuit
Figure 4-4 Simplified Diagram of Switch Sensing Circuit
Figure 4-5 Simplified Diagram of Switch Sensing Circuit Waveforms
Figure 4-6 Waveforms for Gas Discharge Displays
Figure 4-7 Arrangement of Connections to Score Panel

Figure 5-1 Illustrated Procedure for Opening and Closing Game Cabinet and Back Box
Figure 5-2 Physical Locations of Certain Connectors Inside the Cabinet
Figure 5-3 Leveling of Cabinet at Game Site
Figure 5-4 Approximate Locations of Game Structuring Adjustments on Processor PCB

Figure 6-1 Approximate Locations of Lamp Brightness and Speaker Volume Adjustments

LIST OF TABLES

Table 1-1 Summary of Game's Advanced Features and Benefits They Provide
Table 1-2 Operator Options

Table 5-1 Switch Settings for Operator Options

I. INTRODUCTION

1.1 PHYSICAL DESCRIPTION OF GAME

Atari's advanced electronics pinball game "The Atarians" introduces a new generation of coin operated amusement products. While the general cabinet layout and styling of conventional pinball games have been retained, important new features are immediately noticeable. The playfield is wider—27 inches versus 20½ inches for most other games—although overall cabinet width is still kept under 30 inches. Player scores and player-up indications appear on an electronic display panel located in the bottom left corner of the playfield. This replaces the outdated score wheel displays mounted on the back box. Two other electronic displays, also located at the bottom of the playfield, show ball number and the number of game credits.

Conventional types of components found on The Atarians playfield include: constant-illumination background lamps, fixed posts, rebound switches mounted behind rubber strap rings, lighted pop bumpers (thumper bumpers), sling shots, drop holes with ejection kickers, spring-action targets, swing gates, two pairs of flippers, and various flush-mounted lamps with colored lenses. Also found, however, is an advanced feature of The Atarians fame: magnetic metal sensor switches beneath the playfield. These replace all rollover button and rollover wire activated switches that are usually found on playfields of pinball games. These sensor switches eliminate the problems encountered when dirt interferes with movement of a rollover button or wire.

Player controls on The Atarians consist of the ball shooter and a pair of side-mounted pushbuttons to operate the four ball flippers, just as in conventional games. A coin door, with two identical coin mechanisms and a START pushbutton are mounted at the front of the cabinet. A backlighted back box with an attractive "The Atarians" graphics panel is mounted on the rear of the cabinet.

Some game sounds are produced by solenoid-operated playfield objects such as flippers, sling shots, top bumpers, etc., but The Atarians game also has a speaker mounted on the underside of the cabinet, near the player. During play, as the player earns score points, electronic signals cause the speaker to produce a variety of tones that add to the excitement of game play.

Table 1-1 gives a summary of these and other of the game's state-of-the-art design features and the benefits they provide.

1.2 SUMMARY OF GAME PLAY

As many as four persons at a time can play The Atarians pinball game. Only one ball is used in the game. It is returned to the ball shooter for the next player, or if a player earns an extra ball.

Whenever the game is not being played, various playfield lamps blink on and off in preset patterns. This action of the lamps serves to capture the attention of potential players and attract them to the game. To start a game sequence one player or more must deposit money in the coin mechanism, then depress the START pushbutton. If replays had been awarded during some previous play sequence, a player need only depress START. The game's Credit Display continuously shows the number of game credits remaining at all times.

After START is depressed the game's main responses are to: reset all player scores to zero, eject the ball from the Outhole to the ball shooter, and reset the playfield to an initial status by turning off all score-related lamps except one.

Next the player operates the ball shooter to send the ball out onto the playfield, and then operate the flippers to bat the ball back out and to keep it away from the outhole. When the ball hits the various playfield scoring objects, or rolls over a magnetic metal sensor, the score points are immediately added to that player's score. The speaker momentarily produces various tone sounds according to the point values scored. These tones are in addition to the sounds made by top bumpers, flippers, sling shots, etc., when they are activated.

The Atarians features an electronic microcomputer system. This senses all switch closures on the

Table 1-1

SUMMARY OF GAME'S ADVANCED DESIGN FEATURES AND BENEFITS THEY PROVIDE

Feature	Benefits
Electronic microcomputer system that replaces electromechanical controls, such as step-up rotary switches and motorized trip relay banks.	Very high reliability and significantly reduced maintenance requirements; also a variety of game functions are possible for the first time.
Large number of options that operator can select at game site to alter game play, including: playfield restoration, replays or not (a choice of 16 different score levels), 3 or 5 balls per player, four choices for game "special," four choices for cost per play, four choices for maximum allowed accumulation of game credits.	Player appeal is enchanced and amount of revenue derived from game plays can be adjusted.
Electronic memory that can retain playfield status after ball reaches outhole, so that player's achievement can be restored for that player's next ball (*even* in multi-player games or after a tilt).	Playfield restoration makes game play more interesting and challenging, thus increasing player enthusiasm. (This has not been a practical feature to offer in games having electromechanical memory systems).
All-electronic displays for score and other information.	Improved readability because displays provide their own illumination and have sharp, distinct characters; numerals can be changed at extremely fast electronic speeds so that players do not lose any score benefits due to lags in score mechanism response.
Wider playfield.	27 inches wide, versus 20 ½ in. for most other games, while cabinet width is kept below 30 inches.
Playfield lamps blink on and off in repeating patterns when game is not in play.	Attention of potential players is captured and they are attracted to the game.
Game sounds also produced by a speaker.	Wider variety of sounds adds to player excitement.
Selection of internal designs and circuit components made for improved reliability and reduced maintenance, specifically:	
• magnetic sensor switches replace *all* rollover button actuated switches. • Adjust-free, sealed contact switches replace all open contact blade switches.	Problems with dirt interfering with movement of rollover buttons are eliminated. Requirements for periodic gap adjustment are eliminated; atmospheric corrosion and dirt/oil build-up on exposed switch contacts is eliminated.
• Rotary solenoids have replaced many linear solenoids.	Rotary solenoids have more positive action and do not require maintenance adjustment.
• Quick-disconnect connectors have in many places been used instead of hard-wired, soldered connections.	Troubleshooting is speeded up and replacement of components is made easier.
• Mechanical linkages do not require periodic lubrication.	Reduced maintenance, costs, and down time.

Features	Benefits
Test Mode of operation provided, with choice of four different test types.	Improves effectiveness of maintenance work, by speeding up troubleshooting steps and by reducing skill level of maintenance personnel.
Speaker volume and playfield lamp brightness (intensity) both adjustable.	Changes to suit background noise level and lighting environment can be made at game site.
Panel on underside of cabinet is of reinforced construction.	Reduces chance of damage to cabinet if player kicks game.

playfield (including those from magnetic sensors); it energizes all solenoids (to activate flippers, outhole and drop hole kickers, pop bumpers and sling shots); it lights the various score-related playfield lamps; and it provides data for the Score and Match/Credit displays. Because the microcomputer and displays operate at extremely fast electronic speeds, there is no danger of a player losing any score benefits should the ball happen to strike two different score objects in rapid succession. Loss of score benefits can happen in conventional electromechanical games due to score motor lag and time delays in relay responses.

In the game play sequence, ways are provided for the player to earn "bonus" and "double bonus" scores. These are collected if the player sends the ball into the left top hole kicker, or when the ball reaches the Outhole. Other aspects of the scoring, the awarding of extra balls and replay game credits, and a final score "matching" feature, are determined by selections chosen in the game's Operator Options. Table 1-2 lists these options and summarizes their effects on game operation. All the options shown in the table are selected simply by setting the positions of switches mounted on a printed circuit board inside the game cabinet. But before selecting any of these options, refer to subparagraph 3.3.3 in Section III of this manual for more information about how options affect game play.

The Playfield Restoration Option is a game feature that warrants special attention. In out-dated pinball games the playfield is restored to its initial status as soon as the ball reaches the Outhole, so that player accomplishments are erased or lost. When the Playfield Restoration Option is *not* selected, The Atarians game operates this way also. But upon selection, the game's microcomputer system memorizes portions of the playfield and saves this information until that player comes up again, at which time the microcomputer restores the playfield. This restoration is done separately for *all four* players. This feature is unique to The Atarians game and is made possible by the game's microcomputer system. Some electromechanical games have offered limited hold over capabilities for certain playfield accomplishments, however none offer such a complete playfield restoration: this capability is not practical in games built using electromechanical technology.

The Atarians game also features a simple means for adjusting the volume of sounds produced by the speaker, and for adjusting the brightness of all playfield lamps. These adjustment capabilities enable the Operator to tailor game performance to the lighting and background noise level that exist at the the game site.

Section III of this manual gives additional information about the game's design and component parts, and a more detailed description of the play sequence and scoring.

Table 1-2 OPERATOR OPTIONS

Name of Option	Summary of Effect on Game Operation
Game Cost	choice #1: Deposit one coin for one game credit Choice #2: Deposit one coin for two game credits Choice #3: Deposit two coins for one game credit Choice #4: (Fourth choice to be determined)
Maximum Allowable Game Credits	Choice #1: Maximum of 5 credits allowed Choice #2: Maximum of 10 credits allowed Choice #3: Maximum of 15 credits allowed Choice #4: Maximum of 20 credits allowed
Playfield Restoration	Choice #1: No restoration Choice #2: Restoration of playfield status separately for each player as soon as player is up
Replays Allowed or Not	Choice #1: Replays not allowed and position of structuring rotary switch has no effect on game operation Choice #2: Replays given for achievement of preselected score levels; game has provision for selection of any one of 16 sets of score levels
Match Score or Not	Choice #1: No match allowed Choice #2: At end of game sequence, players are given one game credit if the last two digits of their score matches the digits showing in the Match Display
Number of Balls	Choice #1: Each player gets 3 balls Choice #2: Each player gets 5 balls
Selection of "Special"	Player earning the "special" receives: Choice #1: One game credit Choice #2: One extra ball Choice #3: 10,000 additional points Choice #4: none of the above
	NOTE: *Before selecting any Options refer to sub-paragraph 3.3.3 in Section III of this manual for more information about how options affect game play. Use the procedure given in paragraph 5.6 of Section V to set up the option selections.*

II. SPECIFICATIONS

2.1 GENERAL

Cabinet Dimensions:	Width 29 in., Depth 51½ in.; for other dimensions refer to Figure 2-1.
Coin Mechanisms:	Two identical mechanisms (connected in parallel)
Cash Box:	Removable; located behind locked access door to coin mechanism assembly.
Power Cord:	Approximately 10 ft. long, extending from rear of cabinet and having grounded three-prong plug for conventional wall outlets.
Power ON/OFF Switch:	Toggle switch concealed on bottom side of cabinet near right front corner; intended for operator use only.
Back Box Lighting:	Five incandescent lamps inside Back Box, each 15 watts; two lamps lighted constantly, and other three with plug-in flasher units that cause them to blink on and off.
Coin Mechanism Lighting:	One GE #47 incandescent lamp mounted inside cabinet.
Convenience Outlet:	Mounted inside cabinet; accepts 3-prong plug from test equipment or soldering iron during troubleshooting or repair of game.
Number of Players:	Any number of persons from 1 to 4 can play.
Flippers:	Total of four flippers; two flippers on left side of playfield are under control of player switch on left side of cabinet, and two flippers on right side under control of switch on right of cabinet.
Self-test Feature:	For troubleshooting purposes game can be put into a Test mode of operation during which any of four types of diagnostic tests can be performed.

2.2 ELECTRICAL

Power Requirement:	Uses conventional wall outlet providing 60-cycle AC (60 Hz, single phase) at 110 volts; power consumption rated at 1000 watts.
Fusing:	Main fuse panel accessible from front of cabinet when coin door is opened. Panel contains the following 3 fuses: 1. Slow Blow Type-3AG, 10A@320VAC 2. Slow Blow Type-3AG, 2A@250 VAC 3. Slow Blow Type-3AG, 2A@250VAC. Six other fuses, connected in the secondary windings, are located in the Power Supply Assembly inside the game cabinet near the rear.
Power Interrupt Switch:	Safety switch mounted inside the cabinet, next to the coin mechanism access door. Switch is in series with power ON/OFF switch and causes removal of AC power to the game when coin door is opened.

2.3 ENVIRONMENTAL

Operating and Storage Temperature Range:	From 32° Fahrenheit to 120° Fahrenheit (Ambient Temperature)

2.4 OPERATOR OPTIONS FOR STRUCTURING OF GAME PLAY

Game has several selectable options for altering play sequences, (such as game cost, replay levels, etc.). Options can be selected at game site by operator. Refer to Table 1-2 for list and brief descriptions.

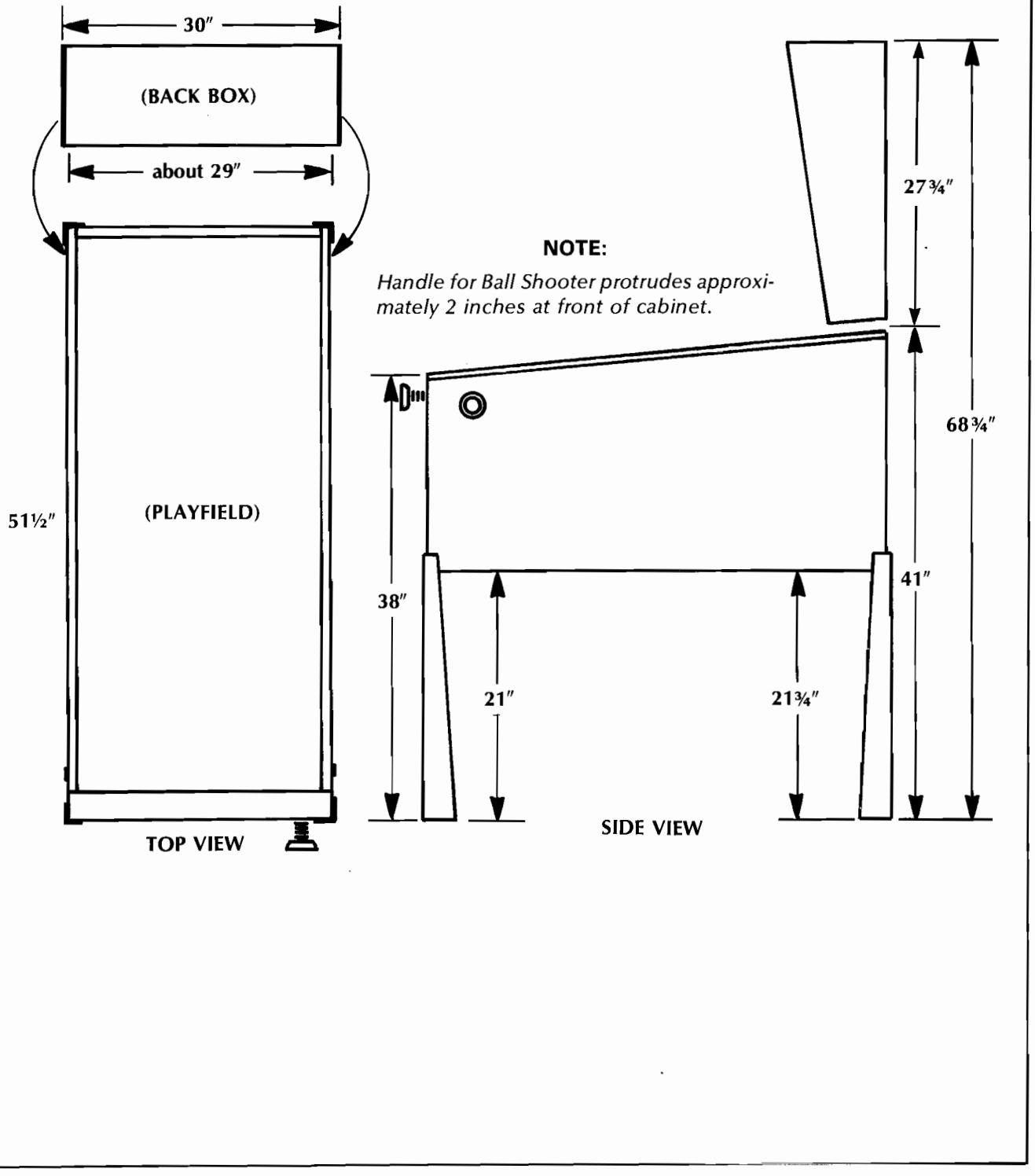


Figure 2-1 Cabinet Dimensions

III. DESCRIPTION OF OPERATION

3.1 FUNCTIONAL DESCRIPTION OF GAME

The block diagram in Figure 3-1 shows the major functional elements of The Atarians pinball game and depicts their interconnections. From the diagram it can be seen that the central element is the microcomputer system, which consists of a microprocessor, memories and control logic.

The basic functions performed during a play sequence can be summarized by saying that switch closure events initiate responses from the microcomputer. The switch closures are produced when a player deposits money in the game, depresses the START pushbutton, operates the ball shooter so that the ball goes out onto the playfield and interacts with playfield objects, and depresses the flipper pushbuttons. Switch closures are also produced if a player tilts the game.

By means of a switch sensing circuit, player switches and Operator Option switches produce Switch Data for the microcomputer. By executing the instructions stored in the pre-programmed portion of its memory, the microcomputer then responds to the Switch Data by energizing various solenoids, lighting various lamps, and produces Sound Data for the speaker and Display Data for the Score, Credit and Ball/Match Displays.

Even when players are not using the game, the microcomputer continues to execute instructions that causes the Credit and previous Score Data to be left showing, and causes various playfield lamps to blink on and off in repetitive patterns.

3.2 GENERAL INFORMATION

The general information about The Atarians pinball game given in this paragraph provides a background for understanding the game sequence description given in paragraph 3.3, and the Installation Instructions given in Section V of this manual.

3.2.1 Energizing the Game:

The game is energized by mating the AC power plug to an active wall outlet and placing the power ON/OFF switch in the "ON" position. The wall outlet must provide the AC power listed in the Specifications, Section II of this manual. The power ON/OFF switch is intended for use only by the operator. It is a two-position toggle switch mounted in a concealed position on the underside of the cabinet, near the right front corner.

3.2.2 Cabinet and Playfield Components:

In addition to the component parts identified in the Introduction, Section I of this manual, the game has certain other components. There are three tilt switches, one a plumb bob type, and the other two slam types. The plumb bob switch consists of a very large carbon pendulum that is suspended inside a circular metal ring. This switch is mounted inside the cabinet on the right sidepanel, near the front. If a player moves the cabinet, either side to side or else by pulling up at one end, so much that the plumb bob is forced against the metal ring, then an electric circuit will be completed. The microcomputer will sense this as a switch closure and will put the game in the "tilt" condition.

The other two tilt switches each consist of a pair of blade switches, one blade in each pair having a metal disk-shaped weight attached on its end. Any sudden mechanical shock applied to the cabinet, such as would occur if a player violently slaps, pounds or kicks the cabinet, will set the weighted blade into vibration. As soon as this blade touches the other blade in its pair, an electric circuit will be completed and the microcomputer will respond by also putting the game in the "tilt" condition. Both slam switches are mounted inside the cabinet; one is in a horizontal plane on the flat panel that forms the underside of the cabinet, and the other is in a vertical plane on the backside of the coin access door.

The game has an electromechanical coin counter mounted inside the cabinet, on the right sidepanel near the plumb bob tilt switch. The microcomputer energizes the counter's solenoid, (causing it to advance by one count), each time the coin mechanism accepts a coin. The coin count is recorded by a counter mounted on the coin mechanism door.

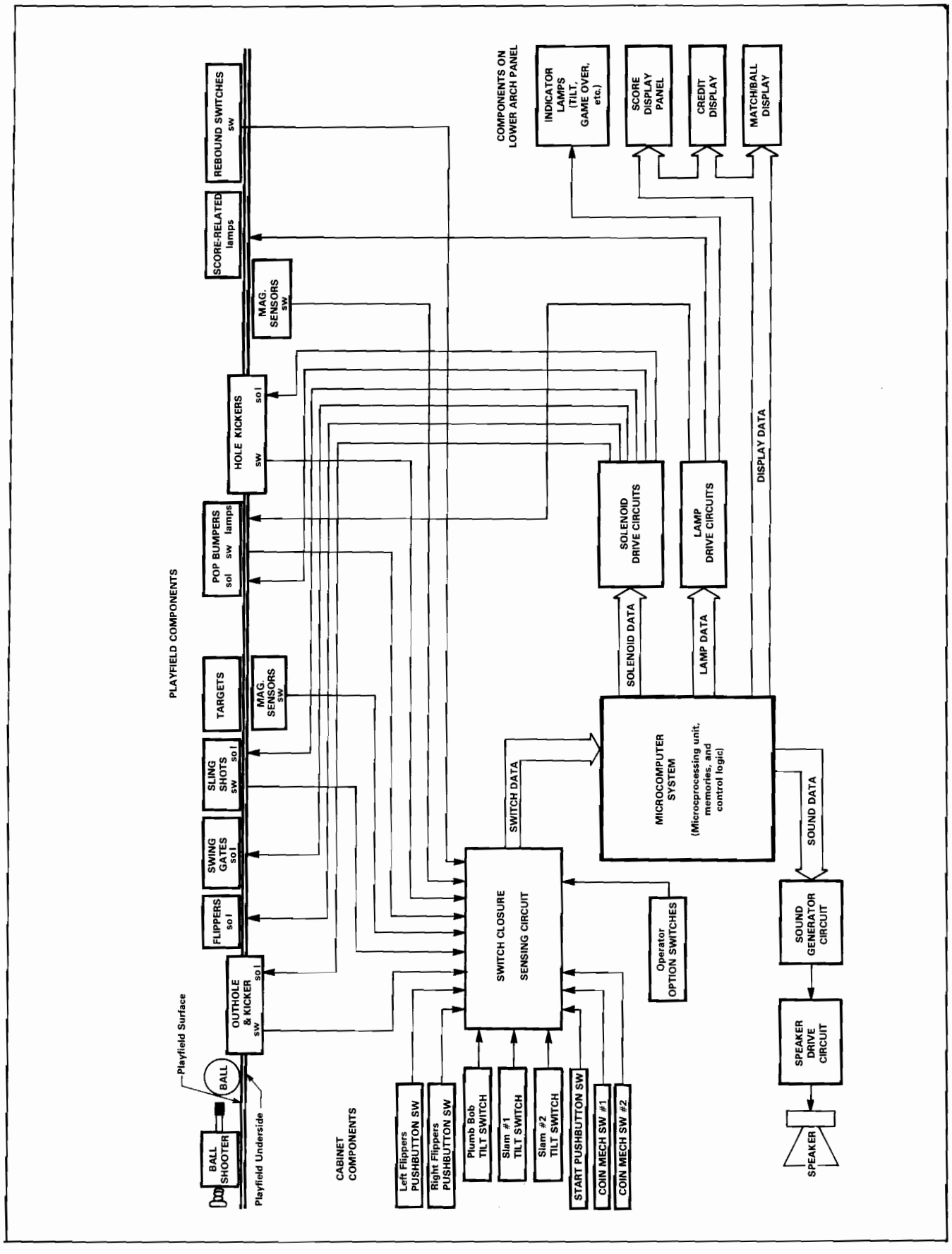


Figure 3-1 Functional Block Diagram of the Atarians Pinball Game

The game's back box operates independently of the microcomputer system. Its illumination is provided by 15-watt, 117-volt AC lamps of the common type found in homes. To cause a lamp to blink on and off, a button-shaped flasher unit is inserted in the lamp socket and then the lamp is screwed down snugly in the socket. The back box is also fused separately from the rest of the game components. There are no score panels or other player indicators on the back box.

The numerals in the game's electronic displays are formed out of bar segments, with a total of seven segments used per digit position. Numerals formed in the segment fashion are also commonly used on hand-held calculators, electronic wrist watches and other consumer products. All three displays—Score, Credit, and Ball/Match—are of the gas-discharge type; therefore the numerals provide their own illumination. The Score Display is arranged in four rows, each row having six digits followed by a player up indication. The rows are positioned one above the other, starting with the first player's score row, then the second player's row, and so on. The Credit and Ball/Match Displays each have only two digits; these two displays are mounted side by side.

All three displays are found on the lower arch panel mounted at the front of the cabinet. Figure 3-2 shows this panel and identifies the displays, as well as four player lamps (labeled 1, 2, 3 and 4), and three other indicator lamps (Tilt, Same Player Shoot Again, and Game Over). The player lamps tell how many players are participating in a game. For example, in a one-player game only the *1* lamp is lighted, in a two-player game only the *1* and *2*, and so forth.

The magnetic metal sensor switches used in The Atarians game are sealed units having only two lead wire connections. They are mounted on the underside of the playfield, and so are not visible to players from the top isde of the playfield. For this reason spots and labels on the playfield graphics design are used for indicating their locations to players. These switches are activated (switch contacts close) when the metal ball passes over them. Their internal construction consists of a permanent magnet and reed-type contacts. These switches therefore have no maintenance adjustments, nor do they require any cleaning of the contacts or lubrication. In the harness wiring beneath the playfield, some of these switches (for example, the three ADVANCE BONUS switches) are wired in parallel. Others are brought separately through the harness to the printed circuit board inside the cabinet.

Figure 3-3 shows a top view of the playfield and identifies the various playfield components. The following descriptions give specific information about these components and will be especially helpful to persons not generally familiar with pinball games.

(a) Ball Shooter. A spring-loaded mechanism, mounted at the front of the cabinet in the right-hand corner, that has a handle protruding from the front. Players pull back and then release this handle, causing the spring to drive forward a rod that propels the

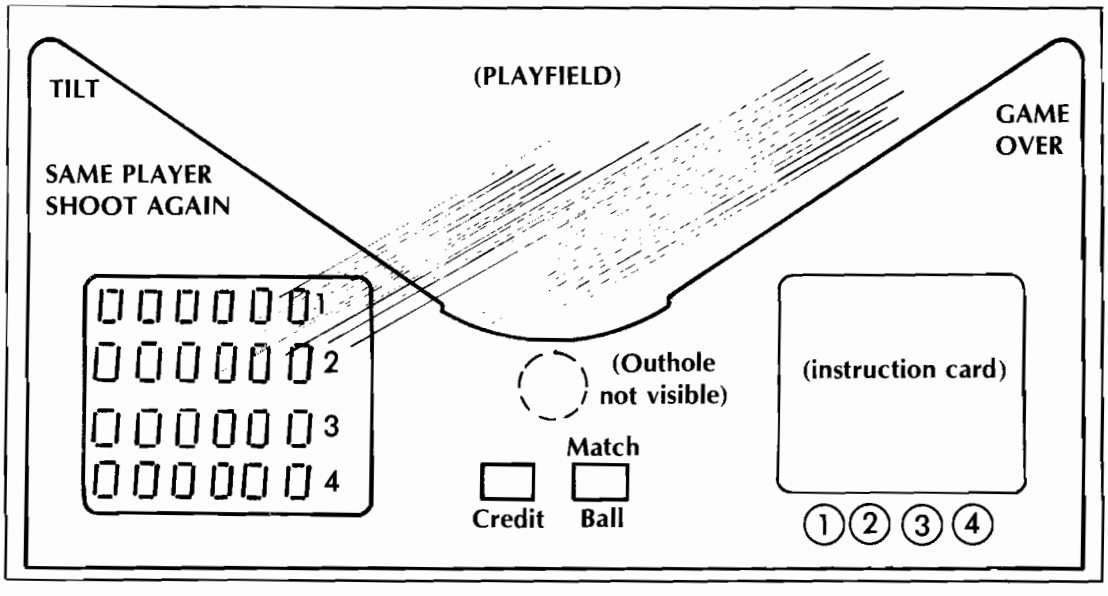


Figure 3-2 Lower Arch Panel

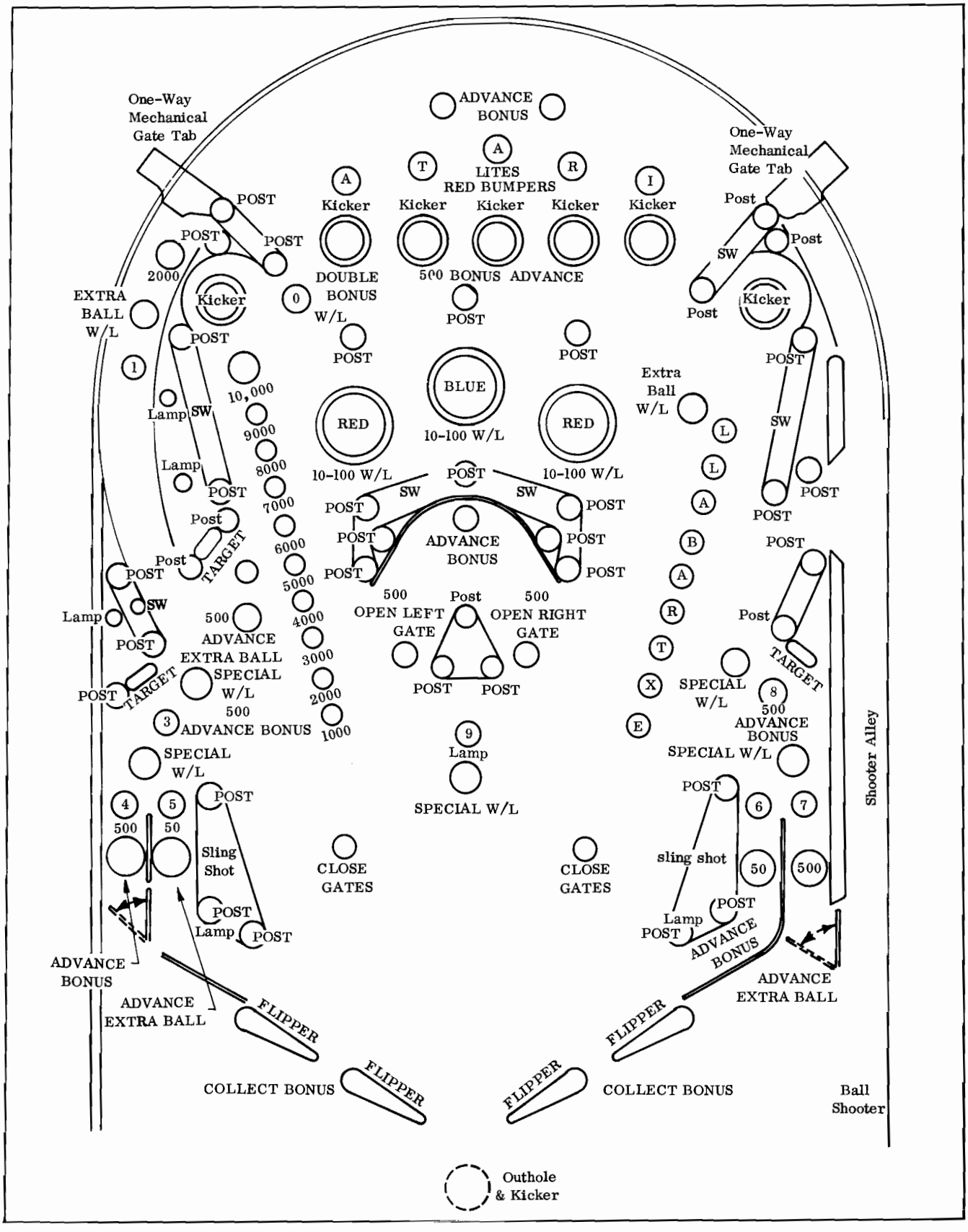


Figure 3-3 Top View of Playfield

ball up the shooter alley in front of the Ball Shooter and out onto the playfield.

(b) Hole Kickers. A hole kicker is cup-shaped depression cut into the surface of the playfield. When a ball falls into this hole during play a switch is closed. The microcomputer senses this switch contact closure and causes a rotary solenoid to be energized. The solenoid drives a mechanical mechanism with a kicker arm that ejects the ball from the hole and sends it back onto the playfield. On The Atarians game the kicker arms for the five drop holes located side-by-side at the extreme top of the playfield are all part of a single mechanism and are driven by one solenoid.

(c) Flippers. These are bat-type levers that are driven by solenoids and are activated when a player depresses pushbuttons mounted on the sidepanels of the game cabinet. On The Atarians game the flippers are connected in pairs; the left two share the same mechanism and are driven by one rotary solenoid activated when the player depresses the pushbutton on the left side of the cabinet. Likewise the right two share a single mechanism and are driven by one rotary solenoid. The players operate the flippers to bat the ball back up the playfield.

(d) Outhole. This is a drop hole with kicker that is located at the very bottom of the playfield. It is concealed from the player's view by the lower arch panel. When the ball falls into this drop hole a switch is closed. The microcomputer senses this switch closure, but does not energize the solenoid to activate the kicker arm unless the player is to receive another ball, or a new player is up. Thus the ball remains lying in the outhole when a game has ended.

(e) Swing Gates. These are movable barriers formed by wire loops connected on one side to the shafts of rotary solenoids. When the solenoid is energized, the barrier rotates through an angle somewhat less than 90 degrees. When the solenoid is deenergized a spring mechanism on the gate forces it back to its initial position. The Atarians game has two swing gates, one on the left side of the playfield and one on the right. The left swing gate, when activated, will divert the ball back onto the playfield and away from the outhole. The right swing gate, when activated, will divert the ball back into the shooter alley and away from the outhole. The left gate's solenoid is energized by the microcomputer when it senses that the OPEN LEFT GATE magnetic metal sensor switch has closed momentarily. This gate remains open until either the ball rolls against and on past the gate, or when either CLOSE GATES magnetic sensor switch has closed. Likewise the right gate is opened when the microcomputer senses that OPEN RIGHT GATE switch has closed, and remains open until the ball rolls past it or either "close gates" switch has closed.

(f) Targets. These are square-shaped objects attached to spring-return shafts that stick up on the surface of the playfield. When hit by the ball, they recoil, then rebound the ball. The Atarians game has three targets, two on the left side of the playfield and one on the right. Unlike targets on conventional electromechanical games, however, the targets on this game do not have switches as part of the target mechanism. Instead the collision of a ball against a target is detected by a magnetic metal sensor switch mounted just in front of the target, under the surface of the playfield.

(g) Pop Bumpers (Thumper Bumpers). These are cylindrically shaped objects that have a ring skirt around the bottom, near the playfield surface. This skirt is spring-loaded and when a ball collides against the bumper with enough force to compress the spring, a switch is closed. The microcomputer senses this closure and responds by energizing a linear solenoid mechanism inside the bumper. When this happens the skirt is forced upward against the ball and impels the ball away from the bumper. Score points are also registered by the switch closure. The bumpers have internal lamps that can be lighted to indicate higher potential score values for hitting the bumper. The Atarians game has three pop bumpers, all lcoated near the top of the playfield.

(h) Sling Shots. These are linear solenoid mechanisms mounted behind rubber strap rings that are strung around fixed posts on the playfield. Two switches, one on each side of the sling shot solenoid, are also mounted behind the rubber strap ring with each sling shot. If the ball hits against the rubber strap with enough force to close either switch, the microcomputer detects the closure and energizes the solenoid. When this happens the arm on the sling shot mechanism suddenly swings forward to rebound the ball. The Atarians game has two sling shots, both near the bottom of the playfield.

(i) Rebound Switches. These are switch mechanisms that are mounted behind rubber ring straps. Whenever a ball hits against the rubber ring with enough force to close the switch, the microcomputer detects the switch closure and registers score points. The ball then rebounds off the rubber strap,

but without the aid of a solenoid. The Atarians game has several rebound switches mounted in scattered locations about the playfield.

(j) Score-Related Lamps. These are lamps mounted beneath the playfield, just below flush-mounted transparent plastic lenses. These lamps are found in various places on the playfield and are lighted at certain times during Play and Attract modes directly by the microcomputer. When lighted these lamps will indicate to the player his accomplishments during the play of a ball.

(k) Background Illumination Lamps. These lamps are lighted continuously during both Attract and Play modes and provide illumination for the playfield graphics. This illumination is particularly helpful in low ambient lighting environments, such as those found in common game sites. The microcomputer has no control over these lamps; they light as soon as power is applied to the game. Their brightness (intensity) can be adjusted, however; refer to Section VI of this manual.

3.3 GAME SEQUENCE

3.3.1 Operating Modes:

The game has the capability of operating in any of three modes—Attract, Play or Test. In normal use the game is kept in Attract and Play modes; it is put in Test mode for maintenance and troubleshooting purposes only. For a description of Test mode refer to paragraph 5.7 in Section V of this manual.

Connecting the power cord to the proper AC power source and placing the power on/off switch in its on position energizes the game and it starts out in the Attract mode. It remains in Attract until a player deposits the number of coins required for a play sequence and then depresses the START pushbutton, at which time the game changes over to Play mode. Whenever AC power to the game is turned off, lock-out coils in the coin mechanisms are de-energized and the game will not accept coins.

During all three operating modes the lamps inside the Back Box continue to operate, and the playfield background illumination lamps remain continuously lighted.

3.3.2 Attract Mode:

During Attract, the flipper controls are disabled, the ball is left lying in the Outhole, and the speaker does not produce any sounds. Also on the playfield certain lamps will be blinking on and off, and other lamps will light up in a repeating sequence, one at a time. Specifically, the five lamps that illuminate ATARI will blink on and off in unison; the nine lamps that illuminate EXTRA BALL will light one at a time, starting with the *E* lamp and progressing on up to the *L* lamp; the ten lamps labeled *1000* through *10,000* will likewise light one at a time in numerical order, starting with the *1000* lamp; the red and blue top bumper lamps will alternately blink on and off; and the nine yellow lamps labeled *1* through *9* will light one at a time. This action of the playfield lamps serves to attract the attention of potential players toward the game.

A description of Attract mode must consider two separate cases—after initial application of AC power to the game, and after completion of a play sequence in Play mode.

After application of power the game responds as follows: the Score Panel will show random numbers, the Credit Display will indicate *00*, and the Match Display will indicate a random number. Furthermore, if at the moment that power was applied the ball had been lying in any kicker hole on the playfield, the microcomputer will sense this condition and energize the kicker solenoid so that the ball is ejected and can roll down into the Outhole.

After completion of a play sequence in the Play mode, the game changes over to the Attract mode after the player's last ball has fallen into the Outhole, and when the MATCH feature is completed (provided that the game is structured to allow the MATCH feature). In the case of this Attract mode, the final player scores from the just completed play sequence remain on the Score Panel, the Credit Display indicates the number of game credits remaining, and the MATCH number remains showing in the Match Display.

3.3.3 Play Mode:

If the Credit Display indicates *00*, no credit is remaining and a player must deposit money into the game in order to change it from Attract to the Play mode. After the coin mechanisms have accepted the proper number of coins required, the game responds as follows: the Score Panel goes blank, the number of game credits for the coins inserted appears in the Credit Display, and the speaker momentarily produces a tone sound. However, the playfield lamps continue to blink on and off. To continue the play sequence the player must next depress the START pushbutton mounted to the left of the coin access door at the front of the cabinet.

If the Credit Display indicates any number other than 00, it means that that number of credits is remaining. A player does not have to deposit more money; instead he or she need only depress START in order to change the game over from the Attract to Play mode.

After a player has depressed START, the game responds as follows:

1) The uppermost row in the Score Panel will show all zeros, and the words 1st UP to the right of the zeros will start to blink on and off.

2) The number in the Credit Display decreases by 1.

3) The Match Display will now become the Ball Display and will indicate *01*, meaning that ball #1 is in play.

4) The ball is ejected from the Outhole and rolls over to the Ball Shooter.

5) The playfield lamps will stop blinking, and 1000 and BALL IN PLAY lamps will be constantly lighted. All other score-ralated lamps remain unlighted.

6) The flipper controls are enabled.

7) On the player panel just above the Ball Shooter the lamp behind the numeral 1 (surrounded by yellow) will light, indicating that so far one player is playing.

Up to this point in the play sequence, and even up until the ball hits the first score point object on the playfield, additional players may be added to the game. They do this by depositing money (if necessary), and by then depressing the START pushbutton. Each time another player does so, the game responds by adding another row of zeros in the Score Panel, decreasing the Credit Display by 1, and lighting another lamp just above the Ball Shooter. However, the maximum number of players allowed is four.

To continue the play sequence the first player next operates the Ball Shooter so that a ball advances up the shooter alley and out onto the playfield. Should it happen that a ball rolls all the way down to the Outhole without achieving any score whatsoever, the Outhole kicker will then eject the ball so that the player can shoot again. But if a ball achieves a score by hitting or rolling over any one playfield component, it is counted as one of the play balls.

As soon as the first score points are earned, the lock-out coils in the coin mechanisms are de-energized and the coin mechanisms will not accept any coins until after the play sequence ends. As soon as score points are earned, they are immediately added to the player's score that appears in the Score Panel. Because the adding of score is done at electronic speeds, there is no danger of losing any score benefits due to score motor lag or other delays found in electromechanical games. The game's speaker also produces sounds when score points are earned, as follows:

1) For each 1000 points a low-pitch, long duration tone.

2) For each remaining 100 points a medium-pitch, medium-duration tone.

3) For each remaining 10 points a high-pitch, short duration tone.

The remainder of this subparagraph 3.3.3 discusses scoring and player scoring strategies, and gives additional information about the effects that the game's Operator Options have on the play sequences when they are selected.

(a) Scoring and Player Scoring Strategies. The numbers of score points awarded for hitting various playfield objects and for rolling over various spots on the playfield are printed in the graphics that are affixed to the playfield surface. For details refer to drawing number 005988 in Section IX of this manual. An examination of this drawing will show that in general the scoring on this game is similar to that of conventional pinball games. The following descriptions of strategies will be helpful in understanding the various ways of earning score points in this game.

In this game the term *bonus* refers to the number of total score points indicated at any one moment by lighted lamps in the string of ten lamps labeled *1000* through *10,000*. This number of BONUS points is added to the player's score if his or her ball drops into the leftmost kicker hole, or when the ball reaches the Outhole. A doubled number of *bonus* points is added if the BONUS SCORE DOUBLED WHEN LIT lamp was lighted at the time this happens. All lamps in the string are unlighted as soon as a *bonus* or *double bonus* has been awarded. A *double bonus* can be earned only once per player per game.

Because the initial status of the playfield has the *1000* lamp already lighted with this bonus feature the minimum possible score earned per ball is 1010 points—the sum of 10 points earned when the ball hits against one 10-point object (lowest score value object), plus 1000 additional bonus points awarded when the ball reaches the Outhole.

Each of the five kicker holes at the top of the playfield is paired up with the light just above it. When the ball falls into the rightmost hole, for example, the lamp under the letter *I* will light. If the player can cause the ball to fall in the center A hole at least once, the top bumpers will light up. After that, each time the ball hits a top bumper, the player receives 100 points (instead of only 10 points when the bumper lamps are unlighted).

Whenever the player rolls the ball over a spot on the playfield that has an ADVANCE BONUS magnetic metal sensor, a lamp in the string of ten lamps labeled *1000* through *10,000* will light, in numerical order. If a ball falls into the leftmost kicker hole, the player collects a number of score points equal to the sum of the values indicated in the lighted lamps, after which time all lamps are unlighted again. After the entire string of ten lamps is lighted, a ball falling into the leftmost kicker hole will earn the maximum of 19,000 points (38,000 points if a *double bonus* lamp had been lighted when the ball fell into the kicker hole).

Whenever the ball rolls over an ADVANCE EXTRA BALL sensor, a lamp in the string of nine lamps labeled EXTRABALL will light, starting with *E* and moving toward the last *L*. After all nine lamps are lighted, a ball falling into the rightmost kicker hole will earn an extra ball for that player. As soon as this happens, the lamps are all unlighted. If an extra ball has been earned, that extra ball must be in play before another extra ball can be awarded.

Whenever the ball rolls over a magnetic metal sensor next to a yellow lamp, the lamp will light. These lamps are labeled with the numerals *1* through *9*. After all are lighted, the player receives an extra ball if the ball rolls over a lighted Extra Ball When Lit lamp.

If the Special Operator Option has been selected, then during play various lamps labeled with arrows will light randomly, one at a time. If the player happens to cause the ball to hit the object that the arrow is pointing to, or to roll over the sensor that the arrow is pointing to, while the lamp is lighted, then the player receives the reward indicated.

When its solenoid is energized, the swing gate on the left side of the playfield will divert the ball back toward the flippers, thereby preventing the ball from rolling into the Outhole. Likewise, the swing gate on the right side of the playfield will divert the ball back into the shooter alley, preventing it from rolling into the Outhole. A separate sensor controls the opening of each gate, but a pair of sensors controls when both gates are closed.

When the player has earned an extra ball, the microcomputer causes the SAME PLAYER SHOOTS AGAIN lamp on the lower arch panel to light. Upon reaching the Outhole, the ball is ejected and the player can then operate the Ball Shooter to send the ball back out onto the playfield. In this situation the status of the playfield is not changed from what it was when the ball reached the Outhole, so that the net effect is the same as if the ball had never left the playfield. Therefore it is possible for a skillful player to earn an extra ball over and over again. But only one ball is awarded per ball in play. In other words, the extra ball must be in play before another extra ball can be awarded.

(b) SPECIAL option. As listed in Table 1-2, the game can be structured to give no reward for earning a SPECIAL, or else can be structured to give one of the following three rewards: one game credit, one extra ball, or 10,000 additional points. When selected, only one SPECIAL can be given per player per game.

A player can earn a SPECIAL in the following ways: by lighting the five lamps labeled A T A R I and the nine lamps labeled 1 through 9, and by causing the ball to hit the object that a lighted SPECIAL WHEN LIT arrow is pointing to, or by causing the ball to roll over the sensor that a lighted SPECIAL WHEN LIT arrow is pointing to.

(c) Playfield Restoration Option. If this option is not selected, the microcomputer restores the playfield to the initial condition after the player's ball reaches the Outhole.

If this option is selected, the microcomputer counts down the bonus as soon as the ball reaches the Outhole, then "memorizes" the playfield status and saves this information until that player comes up again. When the player comes up, the microcomputer restores the playfield. In other words, at the player's next turn the player gets the same playfield status back again. But if a player causes the TILT lamp to light, the microcomputer saves the status of the

playfield that existed at the beginning of that ball, rather than the status that existed at the moment that the tilt occurred.

The game's microcomputer system has a memory capacity large enough to provide playfield restoration for all four players individually.

(d) Match Score Option. If this option is selected, at the end of game play (that is, after the last player's last ball has reached the Outhole) the Ball Display changes into a Match Display. In other words, on the lower arch panel the lamp behind the word BALL will be unlighted, and the lamp behind the word match will light. Then the numerals in the display will momentarily give a roulette effect. After that ceases the number left showing in the Match Display will be the match number.

The microcomputer then compares the match number with the two least significant digits in each player's score. One game credit will be awarded for each match-up. Therefore a maximum of four credits are possible after a four-player game has ended.

(e) Maximum Allowable Game Credits Option. This option places an upper limit on the number of game credits that can be accumulated at any one time. Game credits can be obtained in any of three ways: by depositing money into the game, by earning replays (provided that game is structured to allow replays), and by the Match Option (provided that this option is selected). As soon as the number shown in the Credit Display reaches the maximum selected by the operator (5, 10, 15, or 20), the lockout coils in the coin mechanisms are de-energized. Therefore the coin mechanism will not accept any coins, and players will not be awarded any more replay credits.

After the START pushbutton has been depressed one or more times, the number in the Credit Display will be reduced below the maximum and additional credits can be obtained, but only up to an amount equal to the selected maximum.

IV. THEORY OF OPERATION

4.1 GENERAL COMMENTS

Section IV provides a technical description of electronic circuitry found in The Atarians pinball game. This circuitry is contained on two large printed circuit boards, the Processor PCB and the Auxiliary PCB, both mounted on the floor inside the cabinet. Two smaller boards, the Score Display PCB and the Match/Credit PCB, are mounted beneath the lower arch panel at the front end of the cabinet. The Power Supply Assembly is mounted in the right rear corner of the cabinet. Interconnections between these printed circuit boards, and with the other game components mounted on the playfield and elsewhere in the cabinet, are depicted on drawing number 007199, included in Section IX of this manual. The other drawings and parts listes included in Section IX supplement the descriptions given here.

On the schematic diagrams for the Processor PCB the symbol P (which appears at various inputs to logic gates and other integrated circuits) indicates a connection to +5 volts through a pull-up resistor.

As an aid for locating integrated circuit devices referred to in the documentation, on both PCB schematics and assembly drawings, and on the boards themselves, each IC position is given a letter/number designation. On the PCB the IC devices are arranged in columns (along the short dimension of the board) and rows (along the long dimension). In the designation the letter refers to a column, and the number refers to a row.

Thus, for example, the type-9321 IC device given the designation D1 and drawn near the upper left corner of page 1 of the Processor PCB Schematic (drawing number 006020-01), is found as the first device in the "D" row of devices mounted on that board.

To aid troubleshooting efforts on the playfield harness, each wire leading to a printed circuit board edge connector has been labeled on the wire itself. This labeling information consists of both the connector designation and the pin number on that connector. The labeling is affixed near the wire's connection to the playfield component. Also certain large common wire networks (such as wiring to parallel-connected rebound switches, wiring for solenoid ground returns, the four lamp strobe lines, etc.), have the same color wire for all connections in a given network.

4.2 COMPONENTS OF THE MICROCOMPUTER SYSTEM

The microcomputer system carries out complex tasks of the game by performing a large number of simple tasks. Figure 4-1 shows a block diagram of the microcomputer system and its various interconnecting data, addressing and control buses. The Primary control block in the system is the Microprocessing Unit. It causes the system to perform the desired operations by addressing the Program Memory for an instruction (via the Address Bus), reading that instruction (via the bidirectional Data Bus), and then executing the simple task dictated by that instruction. The Microprocessing Unit uses the Data Memory for temporary storage of data necessary for the execution of future instructions, such as arithmetic operations. The Microprocessing Unit uses the Memory Output Latches for storing the data that is used for producing game sounds, energizing solenoids and lighting lamps.

By sending out signals on the 16-bit Address Bus, the Microprocessing Unit indicates which memory devices (those in the Data Memory, in the Program Memory, or in the Memory Output Latches) are to be addressed.

The Microprocessing Unit both sends and receives data via an 8-bit bidirectional Bus. To the Memory Output Latches, it sends data only; from the Program Memory it receives data only.

The Program Memory consists of ROM devices (read-only memories). These ROMs have been permanently programmed by Atari for use in this particular game. Because the data in the ROMs is therefore a permanent physical characteristic of the devices themselves, their data is not lost when AC power is disconnected from the game or when the device is removed from its socket on the PCB.

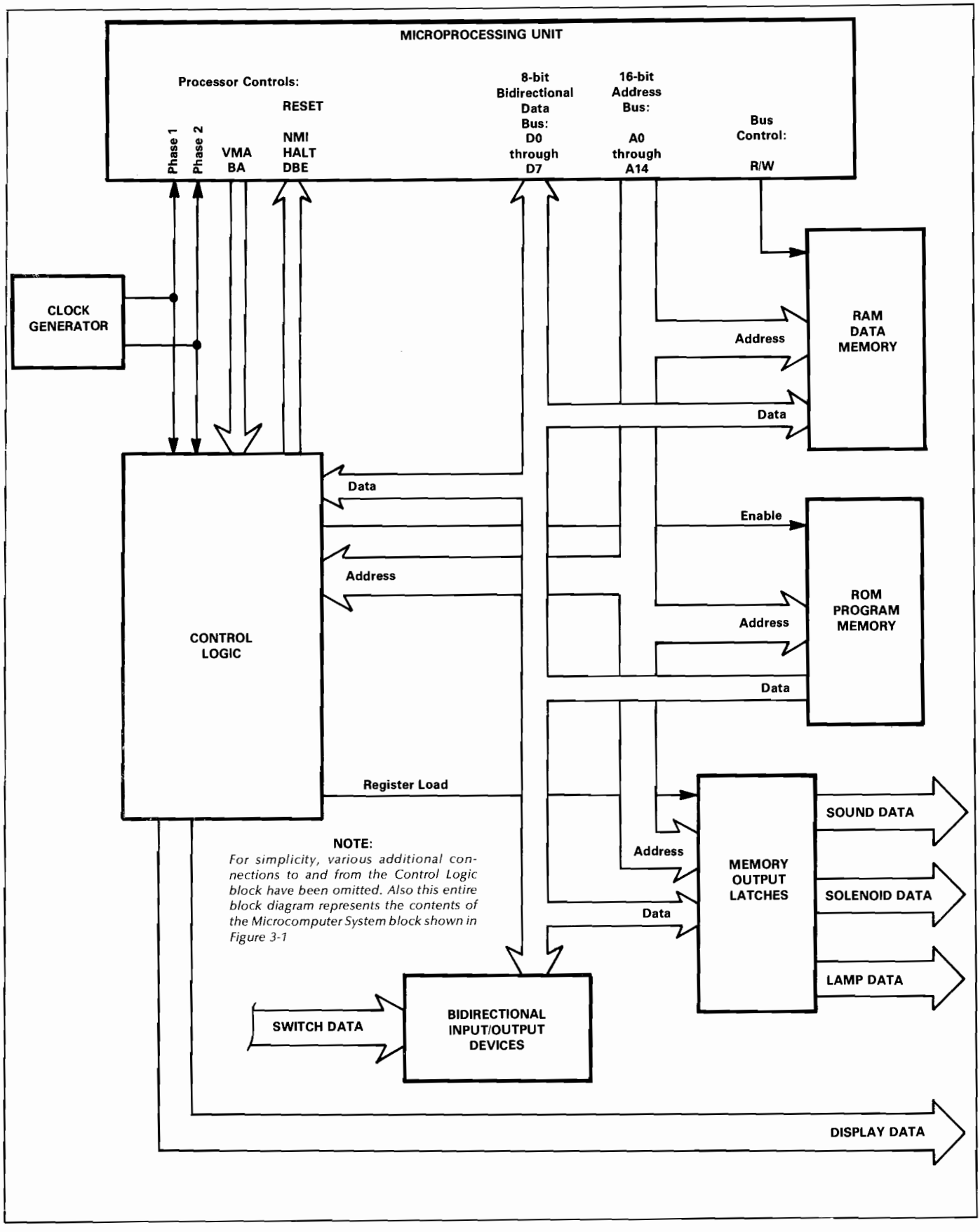


Figure 4-1 Block Diagram of Microcomputer System

However, this permanent programming also means that it is no longer possible to change the data or to write in more data. The addressing of a ROM device by the Microprocessing Unit can only result in the reading of data out of the ROM. The "Enable" signal, produced by the Control Logic, tells the ROMs when to read out their data.

The Data Memory consists of RAM devices (random-access memories). The Microprocessing Unit can both store data in a RAM (called "writing" the RAM) and later recall or retrieve the data (called "reading" the RAM). The Microprocessing Unit has one control line, "R/W," that connects to all RAMs and tells whether a data transfer is a read or a write operation. In order to read from a RAM, the R/W is pulled high, and to write into a RAM, the R/W is pulled low. RAMs are called temporary data storage devices because, unlike ROMs, removal of power will cause all their data to be "erased" (lost).

The Memory Output Latches consist of TTL type-9334 devices. They are addressed by the Microprocessing Unit via the Address Bus, and receive data via the Data Bus. The Register Load signal, produced by the Control Logic, determines when the data is read into the latches.

Tri-state buffers type-8097 as well as the ROMs and RAMs each have an enable/disable control line that determines whether the device's data connections are to pass input data or output data. (The control line for the RAMs is called R/W and that for the ROMs is called Enable.) When its control line is in the disable state, a tri-state device's data connections become a high impedance, the equivalent of removing the device from the circuit. But when the control line is in the enable state, the device's data connections are capable of having normal high and low ("1" and "0") levels.

The Clock Generator produces the two basic clock timing signals used by the game circuitry. They are named "Φ1" (phase 1) and "Φ2" (phase 2). Their frequency governs the overall processing speed of the microcomputer system.

The Control Logic provides processor control interfacing between the Microprocessing Unit and the other blocks in the Microcomputer System. The Control Logic receives two signals from the Microprocessing Unit: VMA (Valid Memory Address) and BA (Bus Available). It also produces four signals used by the Microprocessing Unit: RESET, HALT, NMI (Non-Maskable Interrupt) and DBE (Data Bus Enable.

The following subparagraphs describe the components of the game's microcomputer system in more specific detail. The drawing references made in these subparagraphs are to the Processor PCB schematic (drawing number 004985).

NOTE

References made to the schematic are to sheet 1 of the Processor PCB schematic, unless specified otherwise.

4.2.1 Microprocessing Unit:

The large block drawn along the entire extreme left side of sheet 1 of the schematic represents the Microprocessing Unit. It is built in a 40-pin package that is the largest IC device on the Processor PCB. It is mounted in the first positions in column C on the board.

The signal names for the various Data Bus, Address Bus and Processor Controls are labeled inside the block on the schematic.

4.2.2 Program Memory:

The eight ROM devices in locations E1, E2, E7, E8, E5, E6, E4, and E3 form the program memory. Note that the address inputs of all right ROMs are connected in parallel and are tied to the A0B through A9B signals. These signals are produced by buffer logic connected to the Microprocessing Unit's Address Bus (signals A0 through A9). Also note that all CE2 inputs (pin 10) are tied together and driven by a common signal, and that the CE1 inputs are driven by signals derived from A10 and A11 produced by the Microprocessing Unit. All ROM data terminals are connected in parallel to the Data Bus (D0 through D7) of the Microprocessing Unit.

Although all eight devices are ROMs, they should never be interchanged (that is, E1 unplugged and plugged into the E2 position, and vice versa), because different data has been programmed in each ROM.

Inside each ROM the data is organized in a 1K x 4 format (1000 bits by 4), giving each ROM a capacity of 4000 data bits.

4.2.3 Data Memory:

The four type-2111A devices in locations D7, D6, D8, and D5 form the Data Memory. Note that all address inputs are connected in parallel (together with the ROMs) to the A0B through A9B signals, and that all RAM data terminals are connected in parallel

(together with the ROMs) to the Data Bus. The Microprocessing Unit's R/W bus control signal is buffered and then connected to all RAM R/W inputs.

4.2.4 Memory Output Latches:

The eight type-9334 devices along the right side of the sheet and in the bottom right corner from the Memory Output Latches. The addressing signals applied to each latch (at pins 1, 2, and 3) are derived from the A2, A3, and A7 Address Bus signals. One Data Bus bit is applied to each latch device (for example, bit DO is applied to the latch in location C20, bit D1 to C19, and so forth). The REG LD (Register Load) signal, produced by the Control Logic, is applied to the E (Enable) input of every latch device (at pin 14).

Each latch device has eight outputs, giving a total of 64 LATCH signals. Twelve of these (the signals LATCH 1080 BIT 0 through 4, LATCH 1084 BIT 0 through 4, and Latch 1084 BIT 0 through 4), provide the Sound Data, 32 provide the Lamp Data, and the remaining 20 provide the Solenoid Data. During troubleshooting of solenoids the *solenoid assignments* portion of the Reference List of Memory Address Assignments (included in Section IX of this manual) will be helpful for identifying which playfield component is driven by a specific solenoid signal.

4.2.5 Clock Generator:

The circuit that produces the phase 1 and phase 2 signals is shown along the bottom of the sheet. The basic frequency source is a 1-MHz crystal-controlled oscillator. Its output is then shaped, divided down, and after that, buffered in parallel to produce the two separate signals, phase 1 and phase 2. These two signals are the non-overlapping, non-symmetrical square wave complements required by the Microprocessing Unit. They are also used in the Control Logic.

4.2.6 Tri-State Buffers:

These are the two type-8097 devices in locations C4 and C5 (refer to Zone C6 on sheet 2 of schematic). These devices connect Switch Data, power line phasing information, display address information, and other Control Logic signals to bits D6 and D7 of the Data Bus, and to bits A0 through A5 and A12 through A14 of the Address Bus. Keep in mind that these are Tri-State devices, as described at the beginning of paragraph 4.2.

4.2.7 Control Logic:

The portion of the Control Logic that produces the RESET signal for the Microprocessing Unit is shown at the top left corner of sheet 2. The five type-7493 Counter devices form a single, simple binary counter configuration that is driven by the phase 1 clock signal. The AUDIO CLOCK signal produced by the first 7493 device (at A6 pin 8) is used in the Sound Generator circuit.

If, at any time after power is applied to the game, this counter configuration advances far enough to bring the last stage high (A10 pin 9 high), then the RESET signal will be brought high. (RESET can also be brought to high by manually depressing the RESET pushbutton mounted on the surface of the Processor PCB.) The RESET signal is connected to the Microprocessing Unit. When high, it signals the Microprocessing Unit to begin the restart sequence. The execution of a routine to initialize the processor from its reset condition will be started.

In normal game operation the RESET signal stays low, however, because the WAKE-UP RESET signal (applied at A9 pin 2 and A10 pin 2) periodically goes High, preventing the last counter stages from reaching a high. The WAKE-UP RESET is derived from software programming inside the Microprocessing Unit, and normally goes high approximately once every 100 milliseconds. If some abnormal circumstance occurs, such as a momentary interruption in game power caused by sever transients on the AC power line, then the program sequence inside the Microprocessing Unit may be disrupted and the WAKE-UP RESET signal may remain low for longer than 100 milliseconds. In such a case, a low-to-high-level transition (positive-going edge) on the RESET signal is produced, and the microcomputer system resets itself.

Another signal associated with the Control Logic is the PHASE signal that connects to the Processor PCB at J10 pin K and, after an inversion, is applied at pin 14 of the tri-state buffer in location C5 (see Zone B6 on sheet 2). The PHASE signal is derived from the waveform of the AC power applied to the game. (This is done by means of a simple diode-resistor circuit on the Auxiliary PCB: see Zone B2 on drawing number 006407-01).

The PHASE signal is a symmetrical squarewave having a frequency equal to that of the AC power source. The Microprocessing Unit uses the timing from the PHASE signal as follows: during one half-CYCLE OF PHASE, the Microcomputer senses all switches, and during the other half-cycle it updates the Solenoid Data. With this arrangement solenoids are energized, starting at the very beginning of the power source's half-cycle, when the applied AC

power is at a zero-crossing point (zero energy point). This feature of the game's timing eliminates the power transients that would be produced if the solenoids were suddenly energized or de-energized some time during the peak energy points in the power cycle.

Other portions of the Control Logic are covered in the descriptions given in the remaining paragraphs of Section IV.

4.3 SOLENOID DRIVER CIRCUITS

Twenty of the outputs from the Memory Output Latches constitute the Solenoid Data shown in Figure 4-1. These are the signals LATCH 1080 BIT 4 through 7, LATCH 1084 BIT 4 through 7, LATCH 1088 BIT 4 through 7, and LATCH 108C BIT 0 through 7 (shown on sheet 1 of Processor PCB schematic).

Two of these signals, LATCH 1080 BIT 4 and 5, connect to the Auxiliary PCB (see zones D7 and D8 on schematic drawing number 006407-01), where they each drive a type-7407 Inverter followed by a 2N6044 darlington-connected transistor pair. The remaining eighteen LATCH signals connect to the same types of devices (7404 and 2N6044) on the Processor PCB (see sheet 3 of schematic).

Figure 4-2 shows a simplified diagram of the basic solenoid drive circuit for all solenoids. One side of the solenoid coils connects to the collectors of the 2N6044 transistors; the other side is brought, together with all the other coils, to an unregulated, full-wave rectified DC power supply of about 35 volts amplitude. This power supply is located in the Power Supply Assembly in the right rear corner of the cabinet. Note that a suppression diode is placed across each coil; the diode protects the 2N6044 from reverse inductive kickback (back emf) when the coil is de-energized. The emitters of all 2N6044 devices and the ground side of the 35-volt supply are returned to SOLENOID GRD (at J9, pin 3).

Remember that the microcomputer, by means of the PHASE signal, is able to synchronize the turning on of the solenoids so that it will start only at a zero crossing point (zero power point) of the power line waveform.

4.4 LAMP DRIVER CIRCUITS

Thirty-two of the outputs from the Memory Output Latches constitute the Lamp Data shown in Figure 4-1. These are the BIT 0 through BIT 7 signals LATCH 1000, LATCH 1004, LATCH 1008 and LATCH 100C. All thirty-two signals connect to the type-ULN-2003A devices shown on sheet 2 of the Processor PCB schematic (drawing number 004985). These are open-collector interface devices that accept TTL input levels, and produce the high current outputs needed to light the lamps. Note that these devices connect to a lamp ground (J9, pin 4).

Figure 4-3 shows a simplified diagram of the basic lamp driver circuit. One side of each lamp connects to a ULN-2003A output terminal, and the other side connects to a strobe line on the Auxiliary PCB (STROBE A, STROBE B, etc.). This portion of the circuit is shown in Zones D4 and D5 of the schematic (drawing number 006407-01). In the wiring harness beneath the playfield black wires are used for lamps connecting to STROBE A, green wires for those to STROBE B, blue wires for STROBE C, and red wires for STROBE D.

The Control Logic decodes the LAMP BIT 0 and LAMP BIT 1 signals to produce four transistor base-drive signals, one for each 2N5883. (LAMP BIT 0 and LAMP BIT 1 come from the same circuit that produces the DISPLAY ADRS 1 and DISPLAY ADRS 2 signals, in Zone C3 on sheet 2 of the Processor PCB schematic.) The timing of the four signals driving the 2N5883 transistors is such that any one transistor is brought into conduction only 25% of the time (25% duty cycle). This means that the playfield lamps, which appear to the eye to be of uniform brightness when lighted, are in reality blinking on and off. The 2N6282 transistor acts as a current regulator, under control of the setting of potentiometer R23. This potentiometer provides the capability for lamp brightness adjustment described in Para. 6.2 in Section VI of this manual. The collector of the 2N6282 connects to the lamp power supply in the Power Supply Assembly.

During troubleshooting of the game by service technicians, while operating the game with the cabinet open and power applied, do not hold down the RESET pushbutton (mounted on the Processor PCB) for long periods of time, because doing this will cause the 2N5883 transistors to all be brought into conduction 100% of the time. Lamp current is very high in this situation, and can lead to premature burning out of the lamps.

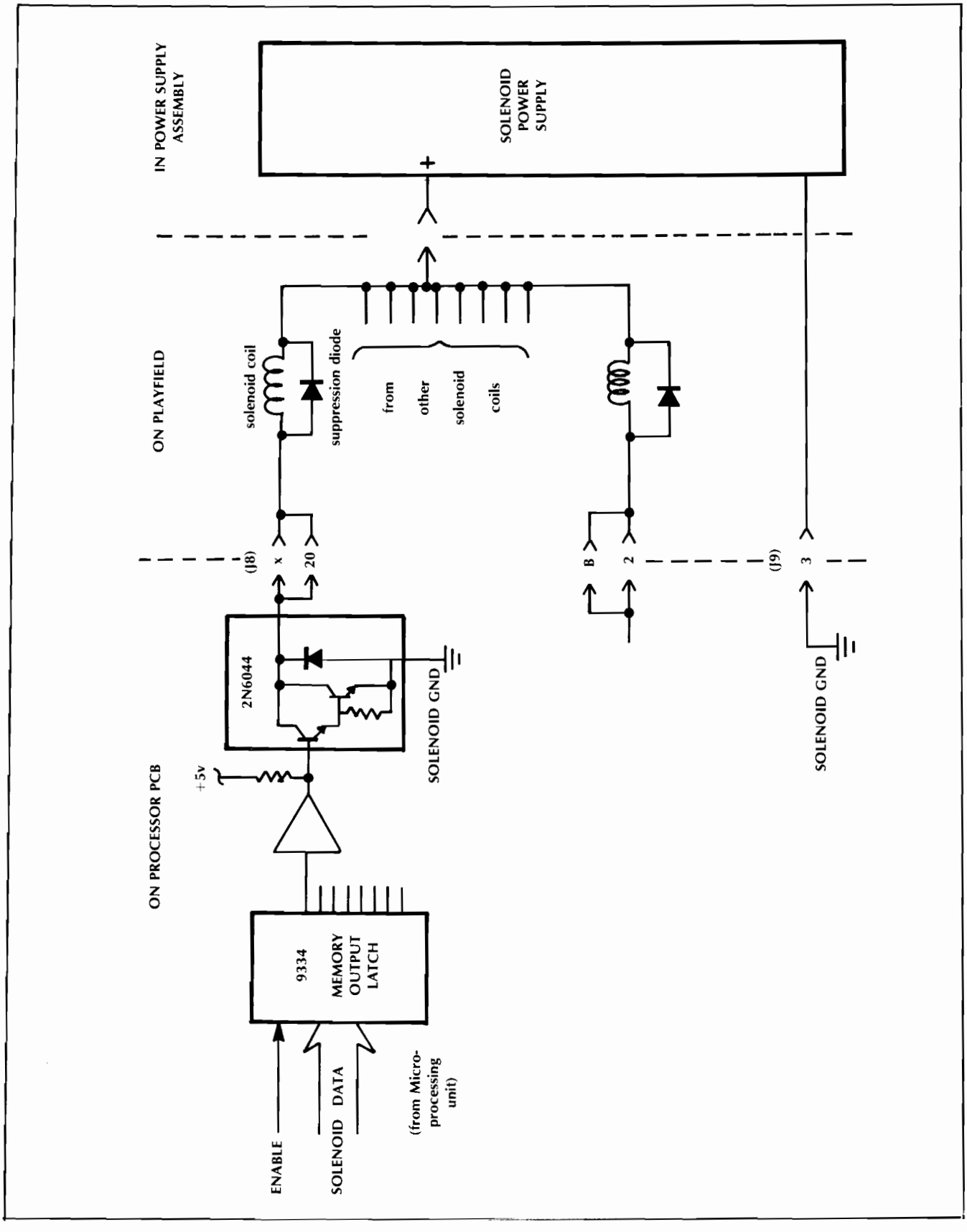


Figure 4-2 Simplified Diagram of Basic Solenoid Driver Circuit

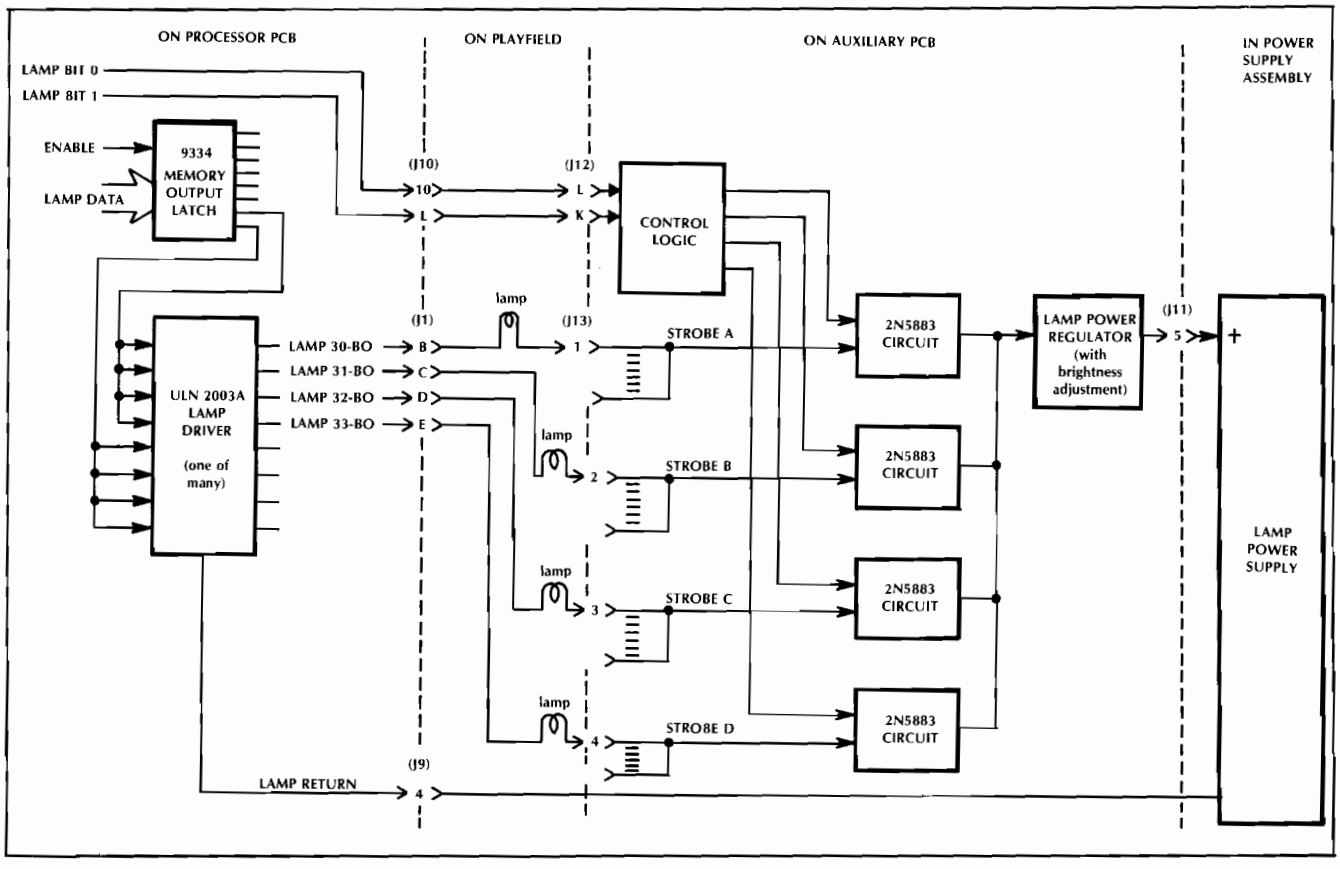


Figure 4-3 Simplified Diagram of Basic Lamp Driver Circuit

4.5 SWITCH SENSING CIRCUIT

The switch sensing circuit accepts switch closure information as an input, and produces Switch Data as an output. This Switch Data is sent to the microcomputer system on a single signal line. Figure 4-4 shows a simplified diagram of the switch sensing circuit. The NO (normally open) contacts of the various playfield switches and certain cabinet switches are connected together in the playfield harness wiring, and then a common lead is brought to the Processor PCB at connector J7 (pins 5 & 6). (Refer to sheet 2 of the Processor PCB schematic.) On the board's artwork, the NO contacts from the Operator Option Switches (along with signals derived from the rest of the cabinet switches—COIN 1, COIN 2, START, and SLAM), are also connected electronically to this point. Also, this point is connected to a resistor tied to +5 Volts, and to the pin 13 input of the type 7414 Inverter in location C9 (in Zone B6 of the schematic). The output of this Inverter, C9 pin 12, is the Switch Data line, which is applied to pin 12 of the type-8097 tri-state buffer in location C5. The device terminal at C5 pin 11 is connected to bit D7 of the Microprocessing Unit's bidirectional Data Bus.

By means of a multiplexing technique, the switch closure information being sent on the Switch Data line is derived from the timing of addressing signals being sent out by the Microprocessing Unit over the Address Bus. To determine whether or not a specific switch is closed, the Microprocessing Unit compares the timing of that switch's address code with the state of the Switch Data signal being received at that moment on bit D7 of the Data Bus.

Figure 4-5 illustrates simplified waveform diagrams that illustrate this timing comparison multiplex technique for an example circuit having only eleven switches.

In the actual game, anytime that the Microprocessing Unit addresses a specific switch, and that switch is closed at that moment, the SWITCH COMMON line will be low. The 7414 Inverter changes this to high, and a high goes out on the Data Bus on bit D7. So when the Microprocessing Unit reads back a high in that location on the Data Bus, it knows that that specific switch had been closed.

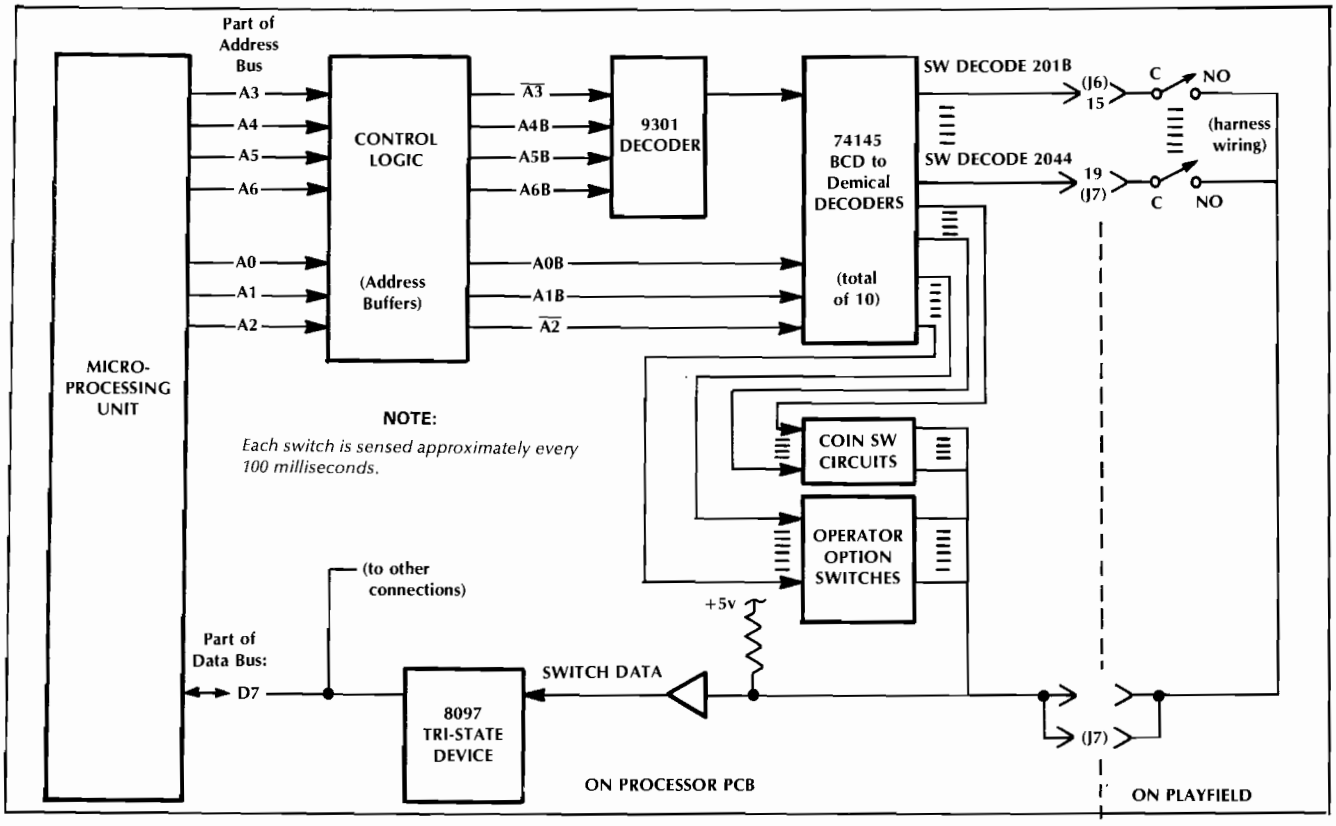


Figure 4-4 Simplified Diagram of Switch Sensing Circuit

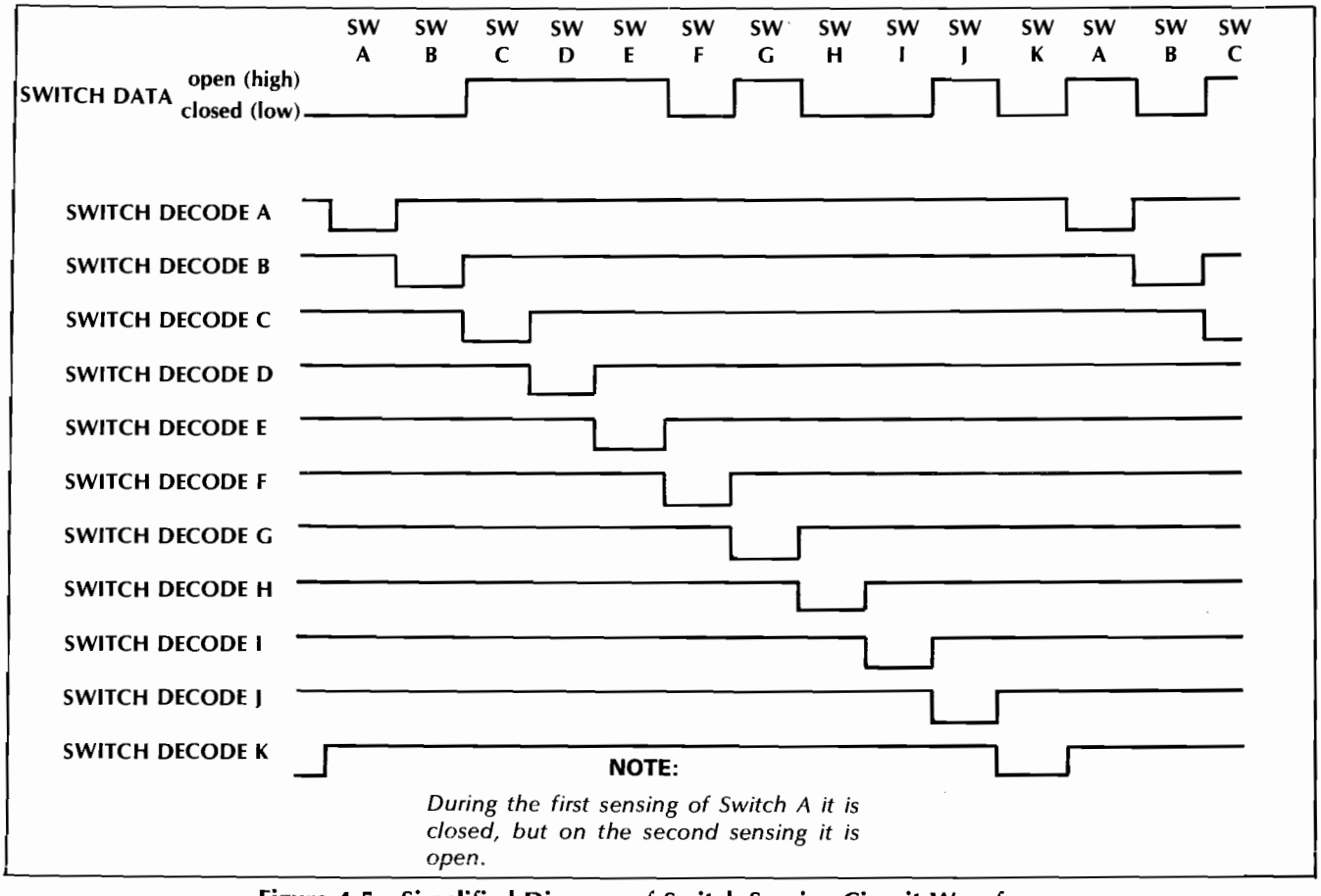


Figure 4-5 Simplified Diagram of Switch Sensing Circuit Waveforms

are wired in parallel, the switch number will appear in the display when each of these switches are activated. For example, the rebound switches (except for the four adjacent to the sling shots) will all show the same number when activated, although a tone will be produced each time. To activate the magnetic metal sensor switches mounted beneath the playfield, roll or slide the ball over the playfield surface just above the switch. Don't forget to check the three tilt switches and the coin mechanism switches. The switch numbers are identified on the schematics with an ST prefix.

In the solenoid test, the game will automatically energize all the solenoids momentarily, one at a time, in a set sequence, so that each will be exercised. The sequence is repeated over and over again, as long as the game is kept in this test mode. By close observation of each game solenoid, any that are not exercised will immediately be noticeable.

In the replay score level display test the three socre levels, designated *low*, *medium* and *high* (set up by the replay rotary switch in the game's replays option) will be displayed inthe score display. This test provides a quick way to confirm that the rotary switch has been placed in the desired position, and to confirm that the reply score level information shown on the instruction card is correct.

These tests can be performed by persons not having special technical maintenance skills in working on electronic games. These persons should keep the cabinet closed at all times while operating the game in the test mode. Maintenance technicians can also operate the game with the cabinet open as well, but the following warning *must* be strictly observed at all times:

WARNING

Due to exposed voltages when the cabinet is open, only persons familiar with safety measures and repair procedures on electrical equipment should ever apply AC power and operate the game while the game cabinet is left open.

The procedure for putting the game into the test mode is similar to the procedure given in Paragraph 5.6, Game Structuring, for setting the Operator Option switches. The only difference is that the operating mode option should be set for the test mode (refer to Table 5-1 for switch setting). The choice of which of the four tests is to be selected is done by means of the settings on the test option (refer again to Table 5-1).

Each time that AC power is re-applied to the game, the microcomputer system automatically senses the settings on all the option switches. But if maintenance technicians are operating the game with the cabinet open and wish to change a switch setting (such as changing from the lamp test to solenoid test), after making the change they must manually depress the RESET pushbutton located on the Processor PCB. By doing this they will force the microcomputer system to sense all switch settings. The approximate location of the RESET pushbutton is shown in Figure 5-4.

VI. MAINTENANCE AND ADJUSTMENTS

6.1 ROUTINE MAINTENANCE

Because of the extensive use of solid-state electronic circuitry to replace many electromechanical components, this Atari game should require very little maintenance and only occasional adjustment.

Requirements for periodic lubrication, gap adjustments and contact cleaning have been eliminated. In particular, potentiometer shafts should *never* be lubricated.

6.1.1 Cleaning of Exterior Cabinet Parts:

The exterior parts of the game cabinet and glass may be cleaned with any non-abrasive household cleaner. If desired, special coin machine cleaners which leave no residue can be obtained from distributors.

6.1.2 Care of the Playfield:

The surface of the playfield has a finish chosen for its long-wearing property. To maintain this property, as well as to insure continued player appeal, check the condition of the surface of the playfield periodically to make sure that it is both clean and free of foreign material. Also, periodically check the condition of the ball to make sure that its surface is smooth and clean. Immediately replace any ball that is chipped, burred, corroded or pitted. A defective ball will cause damage to the playfield surface in a very short time.

To clean the playfield surface use only water and a mild, non-abrasive household cleaner. Avoid excessive use of the water, and be careful not to allow any residue to collect around any of the playfield components, especially around the hole kickers. *Do not* use waxes or polishes of any kind on the playfield surface.

6.2 ADJUSTMENT OF SPEAKER VOLUME AND LAMP BRIGHTNESS

Two simple manual potentiometer adjustments are provided on the Auxiliary PCB inside the game cabinet. Figure 6-1 shows the approximate locations of these potentiometers and arrows on the figure show the directions of adjustment for increasing speaker volume and lamp brightness. (The exact locations of the potentiometers are shown on the drawing number A006407-01 in Section IX of this manual. The speaker volume potentiometer is indicated by the symbol R1, and the lamp brightness potentiometer by the symbol R23.)

Use the following to procedure to perform these adjustments.

Step 1) Place the Power on/off switch in the OFF position.

NOTE

These adjustments must be made only while AC power to the game has been shut off, because when the game is energized, voltage potential differences as great as 200 volts are present on the surface of the board.

Step 2) Unlock the coin access door, open up the cabinet, raise the playfield, and prop it up with the support bar. (Figure 5-1 gives a procedure for doing this.)

Step 3) Locate the Auxiliary PCB in the left rear corner of the cabinet interior.

Step 4) Find the adjustment potentiometers shown in Figure 6-1.

Step 5) Each potentiometer has a stud that projects from the top of the potentiometer body; the stud is free to move and the adjustment is made by using one's finger to force the stud in the direction desired for increase or decrease.

CAUTION

While moving the stud be careful to keep your hand and arms away from the large heat sink in one corner of the board. Otherwise, if the heat sink is still hot or very warm, touching it may cause a burn.

Step 6) After the adjustments have been made, lower the playfield back down to its normal position, close up the cabinet, lock the coin access door, and place the power on/off switch in its on position.

6.3 PLAYFIELD LAMP REPLACEMENT

To maintain player appeal for the game, we recommend that you periodically check for burned-out lamps on the playfield. A quick check of all playfield lamps can be made using the Lamp Test when the game has been put into the test mode of operation (refer to Paragraph 5.7 in Section V of this manual).

All burned-out lamps should be replaced as soon as they are discovered.

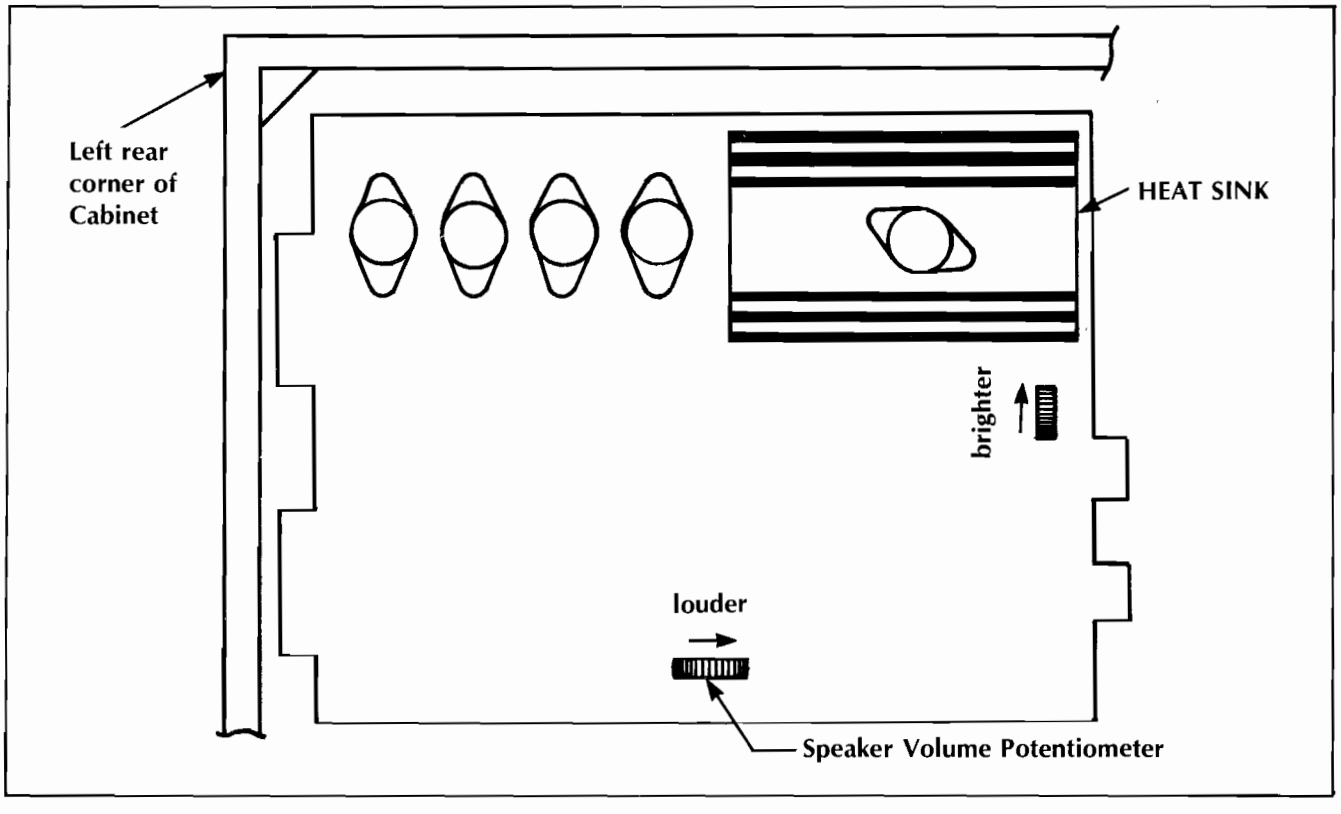


Figure 6-1 Approximate Locations of Lamp Brightness and Speaker Volume Adjustments

VII. DISASSEMBLY AND ASSEMBLY

7.1 GENERAL INFORMATION

This section gives procedures for disassembly and re-assembly of the Score Display PCB. All other PCBs may be disassembled and assembled by using common sense.

When working inside the game cabinet, always check to make sure that the interlock safety switch is neither in the defeat position nor stuck in the ON position.

7.2 REMOVING AND REINSTALLING THE SCORE DISPLAY PCB.

7.2.1 Remove six screws that attach metal display mounting to wooden playfield.

7.2.2 Remove two connectors from Score Display PCB.

7.2.3 Flip metal display panel over.

7.2.4 Remove four screws that attach Score Display PCB to metal display panel.

7.2.5 Reinstall by reversing preceding steps 1 through 7.2.4.

VIII. TROUBLESHOOTING AND REPAIR

8.1 GENERAL PROCEDURE

NOTE

This section describes troubleshooting procedures in detail sufficient for a person with moderate technical ability to understand. However, for those interested in gaining more information on advanced game technology, especially the electronics, we recommend reading the **Video Game Operator's Handbook,** *manual no. TM-043. This book is available from Atari, Inc., attn. Customer Service Dept., 2175 Martin Avenue, Santa Clara, CA 95050 for $5.00 each, or from your distributor.*

8.1.1 Identifying the Trouble Area:

The first troubleshooting step should be to note all observable trouble symptoms. Examples of symptoms are: depositing a coin produces no game response, no sound coming out of the speaker at any time, no numerals on score panel. At the same time also note the game features that still work. A systematic way of checking game operation is to put the game in Test mode (see Section V of this manual). Carefully train your eye to pick upo all clues; by doing this an experienced troubleshooter can often spot tthe cause of a trouble even before he opens the cabinet.

Keeping these observations in mind, use the understanding of game operation gained from the theory of operation (Section IV) and the schematic drawings (Section IX). Next narrow down the suspected cause of the trouble to a specific area or areas of the game: the coin mechanism, power supply, harness and playfield components (switches, solenoids, lamps), speaker, displays, printed circuit boards and power cord. Be careful not to overlook possible trouble areas that may seem too obvious: a power cord plug that has worked loose from the wall outlet and is no longer fully seated in the receptacle, a coin access door that is not fully closed (thus causing the interrupt switch to block the AC power path to the game), the power on/off switch left in the OFF position, or one or more fuses blown.

IMPORTANT NOTICE

When ordering replacement parts from your Atari distributor, we recommend that you also specify game name and serial number, and a clear description of the part, along with the part number.

8.1.2 Locating the Trouble Cause:

Once a problem has been narrowed down to one or more areas, the next step is to perform various tests and measurements to isolate a specific cause of the trouble. Remember that sometimes a very complicated problem, such as erratic game operation, can be traced to a simple cause—a printed circuit board not being properly mated with an edge connector. Start with the most suspect area and trace backwards from the point where the trouble is observable, using a process of elimination to eventually locate the faulty component, connection, etc. For example, if no sound is audible during game play, first check for a signal at the speaker leads. if there is still no signal, then systematically check back through the various components of the sound generation circuit.

Substitution of parts is a legitimate and easy way to isolate the cause. For instance, if the PCB is the suspected trouble area, remove it and substitute a known-to-be-good PCB. Then check for correct game operation.

While locating the trouble cause, use the technical descriptions in Section IV as guides for correct circuit-level operation, and the schematic drawings of Section IX as roadmaps for tracing signal flow paths.

The test equipment for use in troubleshooting is discussed in paragraph 8.2.

8.1.3 Correcting the Trouble Cause:

In practice, the steps required to correct troubles can range from simple adjustments (correctly seating a PCB in an edge connector, changing the setting on a potentiometer, fully mating connectors in the harness wiring), to repair of loose connections and repleacment of defective parts. Extreme

care should be exercised when removing integrated circuit devices and discrete components. Use a 40-watt maximum soldering iron with a small tip designed especially for IC work. To remove an IC device, follow this procedure:

> Clip all leads and lift the IC package out, leaving two rows of leads. Then remove leads individually with a soldering iron and needle-nose pliers. Finally, evacuate the holes with a solder sucker. Afterwards clean the area thoroughly, using an approved PCB cleaning solution to remove any traces of flux and dirt. Alcohol will do in a pinch, if necessary.

The microprocessor, read-only memories, and random-access memories are removed simply by pulling them out of their sockets. When placing them into their sockets, make certain they are placed in the correct socket.

Insert the new IC device using an IC insertion tool, making sure that the reference notch is oriented correctly and that the device's leads are not bent during insertion into the board. Afterwards, be sure to solder each lead on *both* sides of the PCB, using as little solder as possible. After soldering, clean the area thoroughly to remove the flux.

Observe the same removal and insertion procedures when replacing discrete components. Trim the leads as close as possible and be sure to orient diodes and capacitors correctly.

8.1.4 Verifying Correct Game Operation:

After locating and correcting the cause of a trouble, re-energize the game and perform a final check for correct game operation. Doing this will verify that your troubleshooting was correct. If the game operation is still not correct, go back and double-check your work. Make sure that any replaced components were installed correctly. If this was done properly, then start the troubleshooting steps over again. Keep in mind that there may be more than one trouble at a time, and that correcting one trouble can sometimes bring previously undetectable troubles to light.

This verification is especially important when the original trouble had been intermittent, that is, was not happening all the time.

8.2 TEST EQUIPMENT

Troubleshooting on an electronic game essentially consists of checking for the presence of various signals and of examining their condition. A signal can be thought of as acting like a "messenger" that carries instructions from one unit or circuit to another. Many different types of signals are produced in a video game, and for this reason several unusual and perhaps unfamiliar types of test instruments are used during troubleshooting. Each instrument has its own set of advantages and disadvantages for examining a given type of signal, and both the depth of the intended troubleshooting capability and budget will determine what instruments will be needed. Some instruments are basic and essential, no matter what size of service facility, while other optional instruments are desirable because they make troubleshooting easier and quicker.

8.2.1 Basic Test Equipment:

(a) The Logic Probe. This is a test instrument designed for fast verification of digital IC outputs. It is small, convenient to carry, easy to read, and relatively inexpensive. The logic probe derives its power from the system under test; it has two power leads, one for connection to ground and the other to +5 volts DC. When the logic probe's tip is held against a digital signal point, three colored lamps in the tip will indicate the signal's condition or state, as follows:

- The red lamp lit indicates a *high* or logic level 1 (for TTL components, this is +2.4 to +5 volts)
- The white lamp lit indicates a *low* or logic level 0 (for TTL components, this is 0 to +0.8 volt)
- The blue lamp lit indicates that the signal is changing states
- No lamps lit indicate the grey region between 0 and 1 (for TTL this is between +0.8 and +2.4 volts)

A circuit shorted to ground will illuminate the white lamp and an open circuit will illluminate the red lamp.

The logic probe is readily available from electronic supply sources; a commercial model found satisfactory is the Kurz-Kasch model LP 520.

(b) The Logic Pulser. This test instrument is similar in size and shape to the logic probe, and it also derives its power from the system under test. When the logic pulser's tip is held against a digital signal point, the source and skin capabilities of the pulser override any IC output and the point is driven to the

opposite logic level. If the point that the logic pulser is held against is low, pressing the switch on the side of the pulser will introduce a high pulse. Conversely, pulsing a high line will pull that line low momentarily.

During troubleshooting the logic pulser allows stimulation of in-circuit ICs with a shaped digital pulse. For example, a certain feature of the game may not be working and you suspect that a circuit is not receiving the necessary signal. Use the pulser to imitate that signal: if the circuit begins working, you have provided that the signal was in fact missing and you can begin tracking it down. This technique is very similar to jumping coils in electromechanical games such as pinball machines.

In addition to the regular "pulse" button, there is another switch mounted on the logic pulser. When this switch is set in the "rep" mode, the instrument pulses the digital signal point at a 5-Hz rate or 5 times per second. This extremely low rate is slow enough to allow watching events initiated by the pulser. Counter outputs, for example, are more easily observed when the counter is pulsed or clocked at this rate.

The logic pulser is also readily available from electronic supply sources; a commercial model found satisfactory is the Kurz-Kasch model HL 583.

(c) Oscilloscope. The most versatile test instrument, and also the most expensive, is the oscilloscope. The high-speed TTL integrated circuits used in video games produce fast-rise-time signals. The oscilloscope should have a 50-MHz bandwidth, dual trace and dual time base capability. These latter features allow examination of both input and output signals simultaneously, so that precise timing relationships can be checked. The oscilloscope should also have provision for internal or external sync.

Of the newer, solid-state oscilloscopes, a satisfactory model is the Tektronix 465.

(d) VOM or Volt-Ohmineter. This common measuring instrument is extremely useful in video game troubleshooting. It can be used to check line voltage, transformer secondary windings, continuity, resistance, power supply voltages, and to some extent used for measurements in the analog circuitry.

One commercial model found satisfactory is the Simpson 260.

8.2.2 OPTIONAL TEST EQUIPMENT

The Logic Comparator. This test instrument's main benefit is that it can be used to check the functioning of an integrated circuit device while the device is still in place on the printed circuit board. The logic comparator performs the check by comparing the suspect ICs functioning with that of an identical-type reference IC mounted in the instrument itself. Suppose that the functioning of a type-74195 device on the PCB is suspected to be defective. First insert a program card with a known-to-be-good 74195 into the logic comparator, and then clip the comparator test leads onto the leads of the suspect device. If there are any logic state differences between the reference IC and the suspect IC under test, then an LED on the logic comparator will light up to indicate which output is not functioning correctly. Once a defective IC has been located, it should be replaced.

Logic comparators are readily available from electronic supply sources.

8.3 SPECIFIC TROUBLESHOOTING INFORMATION

The following subparagraphs give additional troubleshooting information about certain areas of the game.

8.3.1 COIN MECHANISM:

If a player inserts a coin and the game does not respond, first check the coin mechanism. If pressing the coin rejector button forces the rejector mechanism to return the coin, then examine the coin to make sure that it is genuine. If it is, then use a set of your own test coins (which should include both very new and very old, worn coins) to determine whether or not the player's coin is undersize or underweight. If your test coins are also returned, this indicates that servicing of the coin acceptor portion of the coin mechanism is called for. Generally the cause of this particular problem is an improperly adjusted magnet gate.

Inside the coin mechanism a magnet is used to test the metallic composition of the coin. Highly magnetic coins, such as those made of steel or iron, will be retained by the magnet and can be returned by actuating the wiper operating lever. Coins having comparatively high magnetic properties will be slowed down by the magnet, and will drop off the end of the rail short of the "accept" entrance and be returned. Coins having little or no magnetic properties, such as brass or zinc coins, will pass through the

magnetic field so fast that they will overshoot the "accept" entrance and be returned.

A magnetic gate adjusted with too large a gap may pass both genuine and counterfeit coins. An adjustment with too small a gap can lead to rejection of some or even all coins. Over a period of time, the screw that adjusts the magnet gate has a tendency to work loose, resulting in a gradual narrowing of the gate. At first, only the thickest (i.e., newest) coins are rejected. As time passes, more and more coins are rejected until finally player complaints lead to the calling of the game repairman.

If pressing the coin rejector button does not cause the coin to be returned, and if the game still does not respond, then check the coin mechanism to see if the coin is jammed inside.

If you are certain that the coin is genuine, and that the coin passes through the coin mechanism and into the cash box, then the lack of game response is probably due to some kind of electrical trouble. Check for signals at the electrical contacts of the coin mechanism before moving on to the harness and other parts of the circuitry.

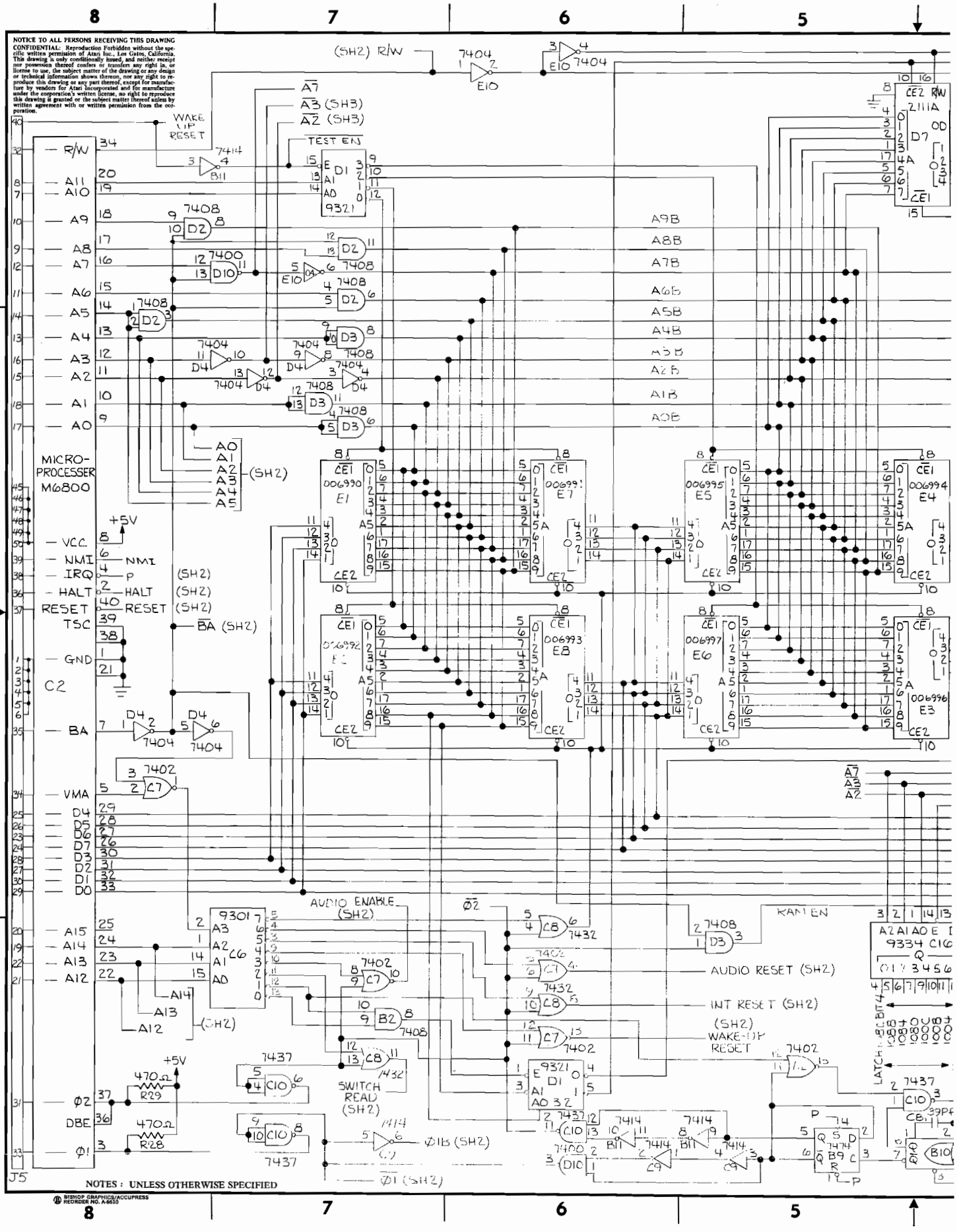
8.3.2 GAS DISCHARGE DISPLAYS:

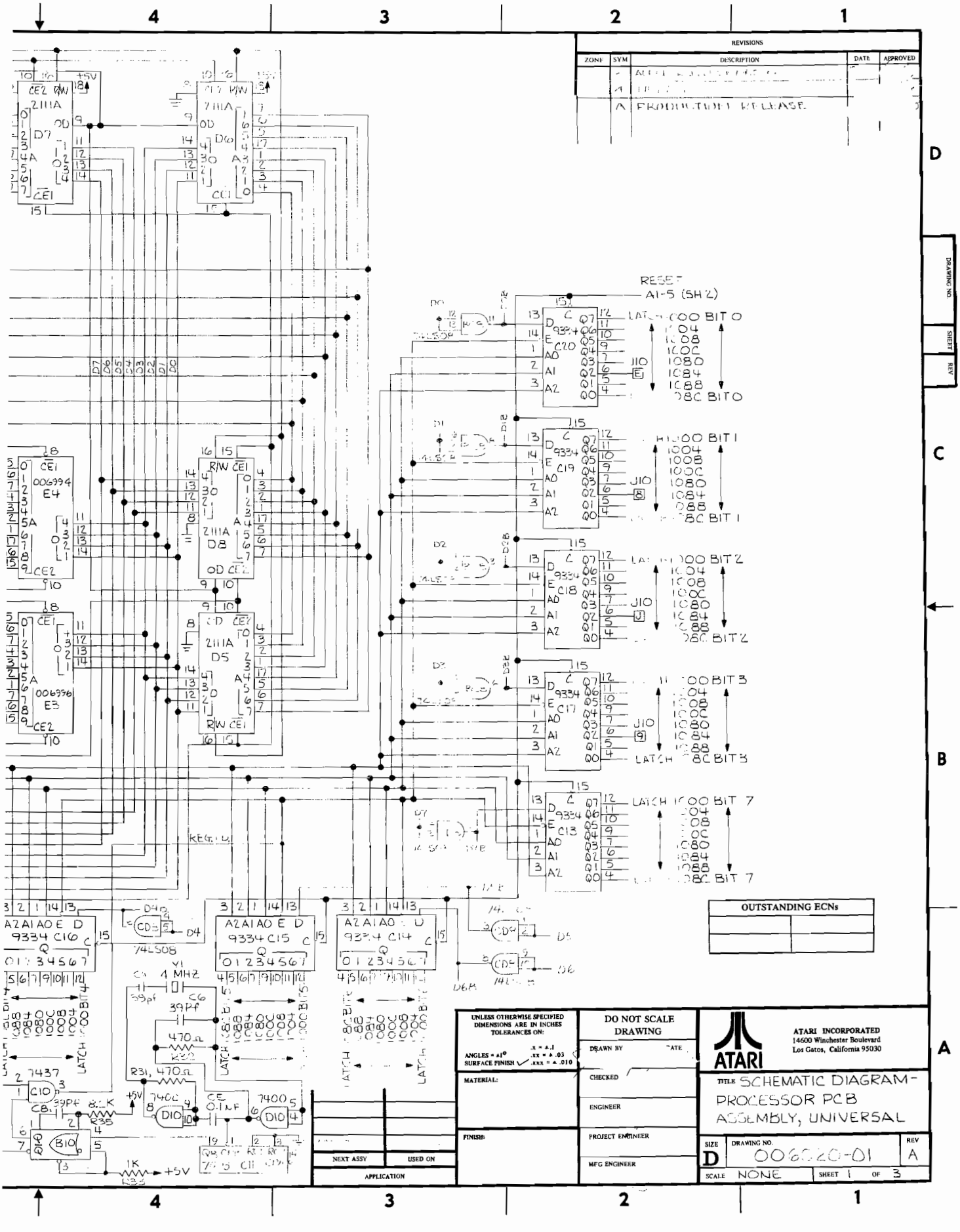
Remember that after the lower arch panel has been removed the display boards are exposed, and that during subsequent opertion of the game the −100 and +100 volt signals are present in this area (a total potential difference of 200 volts while displays are lighted). At all times when troubleshooting the gas discharge displays *observe and practice sensible safety precautions.* And also remember that the 200-volt potential difference is present all the time on the Auxiliary PCB surface during game operation, in the area of the board where the −100 and +100 volt regulated power supply is built.

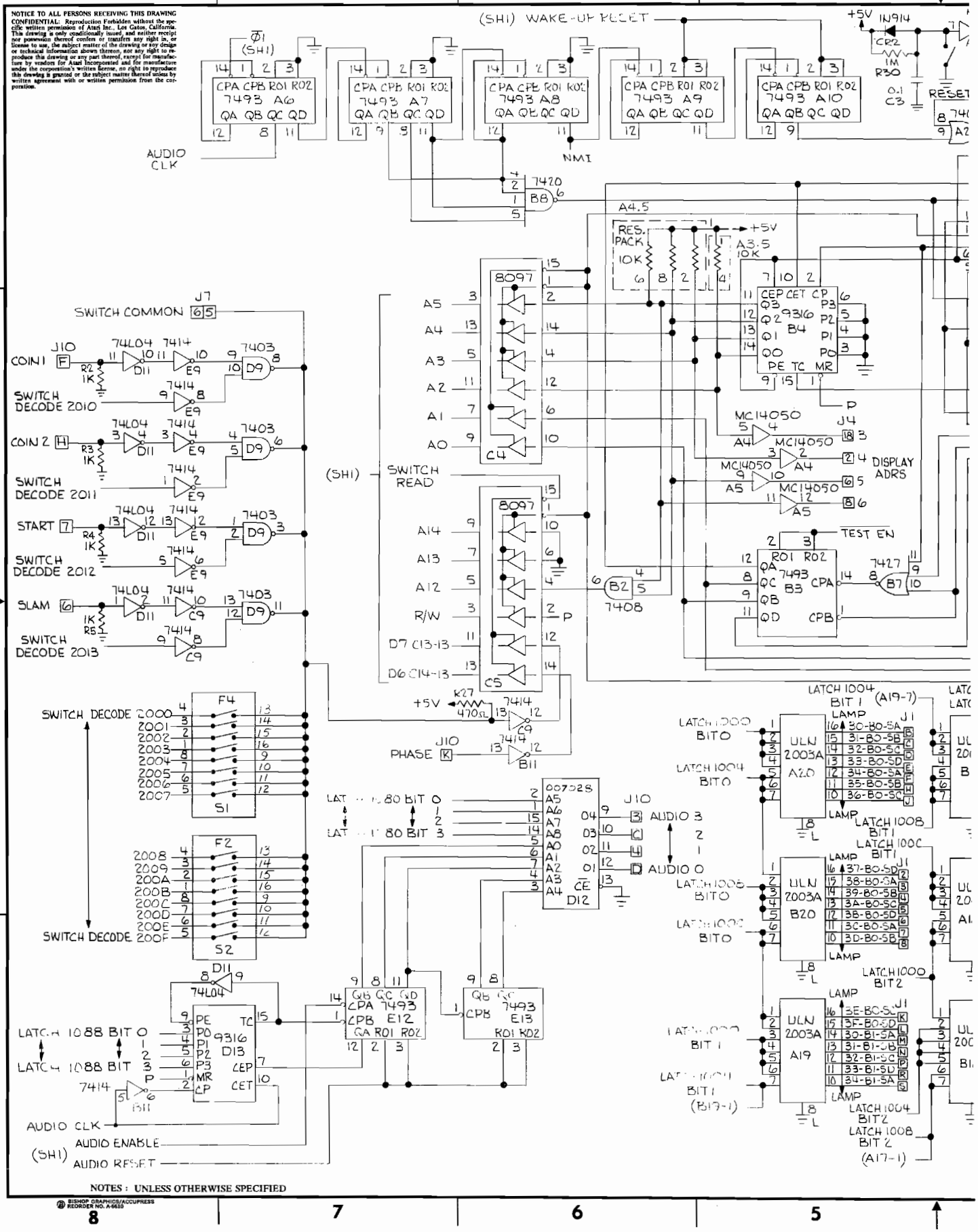
Because the score panel itself consists of a glass plate, be careful not to damage it during handling, especially while removing it from or inserting it into its edge connector. Failure to observe this precaution can lead to cracking or otherwise damaging the plate.

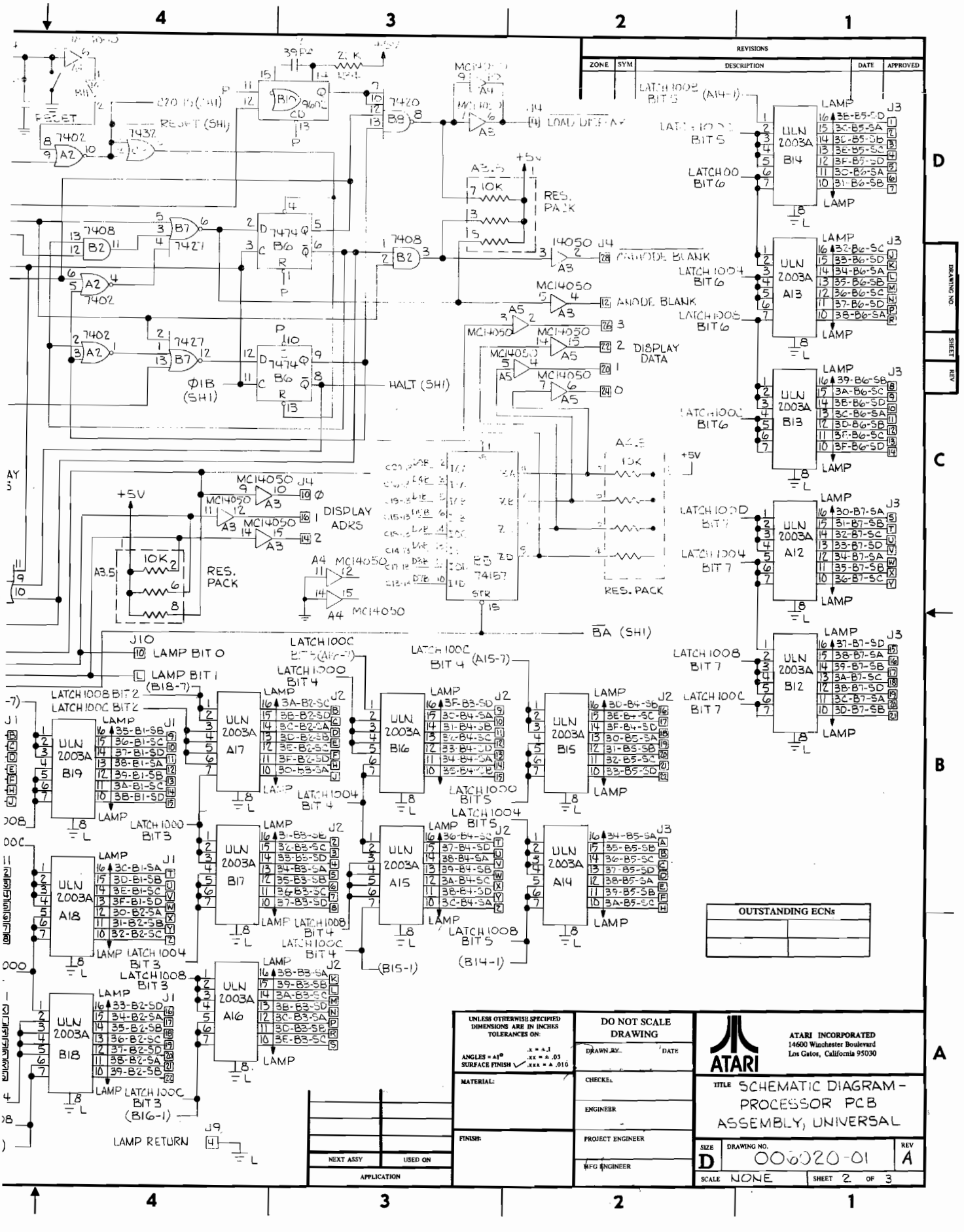
IX. SCHEMATICS, DRAWINGS AND PARTS LISTS

Number	Description
A006020-01	Schematic, Parts List & Assembly Processor PCB
A006407-01	Schematic, Parts List & Assembly Auxiliary PCB
A004924-01	Schematic, Parts List & Assembly Score Display PCB
A006096-01	Schematic, Parts List & Assembly Match/Credit Display PCB

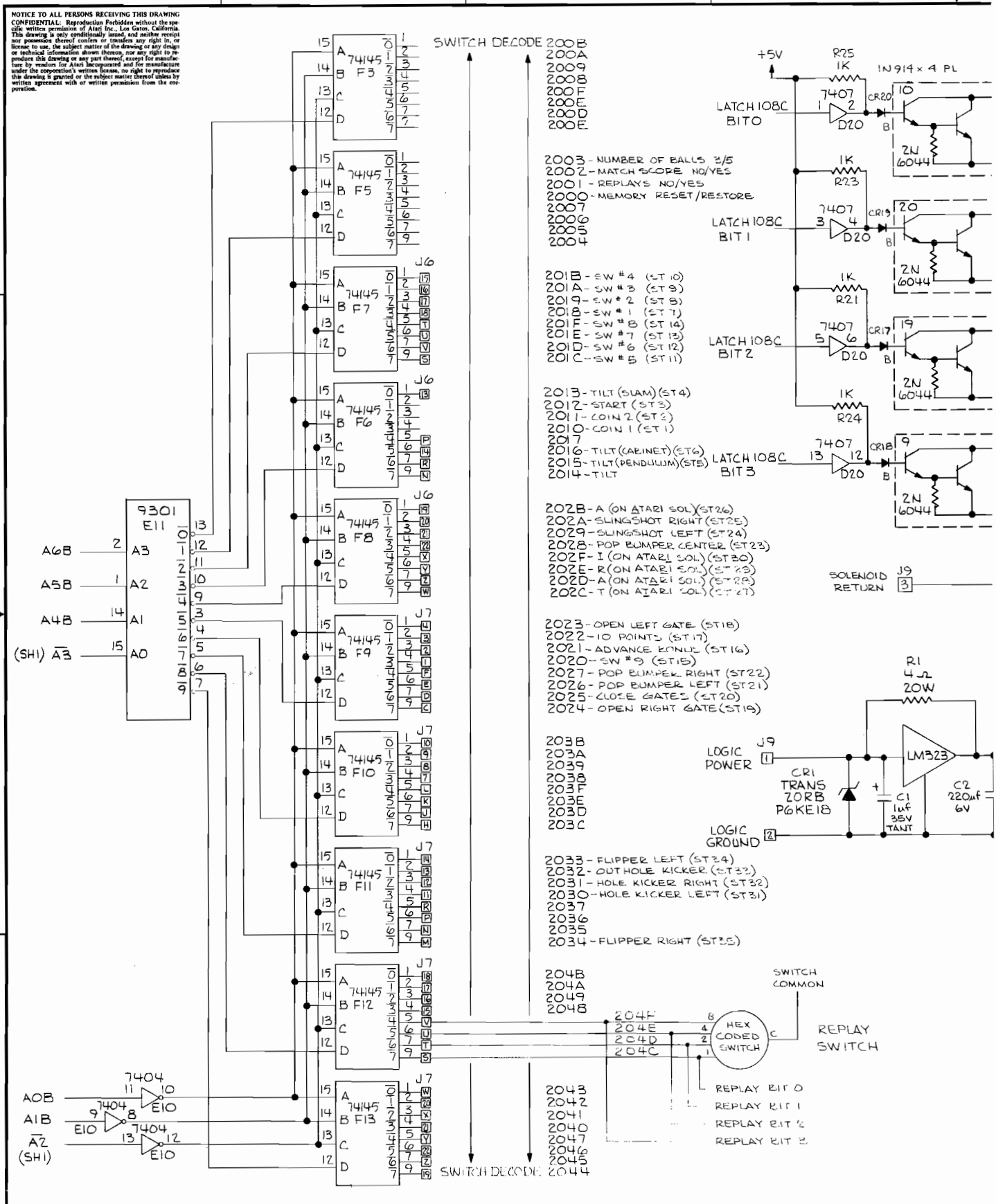

NOTICE TO ALL PERSONS RECEIVING THIS DRAWING CONFIDENTIAL: Reproduction Forbidden without the specific written permission of Atari Inc., Los Gatos, California. This drawing is only conditionally issued, and neither receipt nor possession thereof confers or transfers any right in, or license to use, the subject matter of the drawing or any design or technical information shown thereon, nor any right to reproduce this drawing or any part thereof, except for manufacture by vendors for Atari incorporated and for manufacture under the corporation's written license, no right to reproduce this drawing is granted or the subject matter thereof unless by written agreement with or written permission from the corporation.
8
7
6
5
D
C
B
A
MICRO-PROCESSER M6800
R/W
A11
A10
A9
A8
A7
A6
A5
A4
A3
A2
A1
A0
VCC
NMI
IRQ
HALT
RESET
TSC
GND
C2
BA
VMA
D4
D5
D6
D7
D3
D2
D1
D0
A15
A14
A13
A12
Φ2
DBE
Φ1
J5
(SH2) R/W
WAKE UP RESET
TEST EN
A7
A3 (SH3)
A2 (SH3)
A0
A1
A2
A3
A4
A5
(SH2)
+5V
NMI
IRQ (SH2)
HALT (SH2)
RESET (SH2)
BA (SH2)
A9B
A8B
A7B
A6B
A5B
A4B
A3B
A2B
A1B
A0B
006990 E1
006992 E2
006993 E8
006994 E4
006995 E5
006996 E3
006997 E6
006999 E7
9321
9301
7404
7408
7400
7402
7414
7437
7432
AUDIO ENABLE (SH2)
AUDIO RESET (SH2)
INT RESET (SH2)
WAKE-UP RESET (SH2)
SWITCH READ (SH2)
RAM EN
470Ω R29
470Ω R28
ΦIB (SH2)
Φ1 (SH2)
NOTES : UNLESS OTHERWISE SPECIFIED
BISHOP GRAPHICS/ACCUPRESS REORDER NO. A-6610


REVISIONS
ZONE | SYM | DESCRIPTION | DATE | APPROVED
A PRODUCTION RELEASE
RESET
A1-5 (SH'Z)
LATCH 1C00 BIT 0
LATCH 1C00 BIT 1
LATCH 1C00 BIT 2
LATCH 1C00 BIT 3
LATCH 1C00 BIT 7
OUTSTANDING ECNs
DO NOT SCALE DRAWING
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON:
ANGLES = ±1° SURFACE FINISH
MATERIAL:
FINISH:
DRAWN BY
CHECKED
ENGINEER
PROJECT ENGINEER
MFG ENGINEER
NEXT ASSY
USED ON
APPLICATION
ATARI INCORPORATED
14600 Winchester Boulevard
Los Gatos, California 95030
TITLE SCHEMATIC DIAGRAM - PROCESSOR PCB ASSEMBLY, UNIVERSAL
SIZE D
DRAWING NO. 006020-01
REV A
SCALE NONE
SHEET 1 OF 3


NOTICE TO ALL PERSONS RECEIVING THIS DRAWING CONFIDENTIAL: Reproduction Forbidden without the specific written permission of Atari Inc., Los Gatos, California. This drawing is only conditionally issued, and neither receipt nor possession thereof confers or transfers any right in, or license to use, the subject matter of the drawing or any design or technical information shown thereon, nor any right to reproduce this drawing or any part thereof, except for manufacture by vendors for Atari Incorporated and for manufacture under the corporation's written license, no right to reproduce this drawing is granted or the subject matter thereof unless by written agreement with or written permission from the corporation.
(SH1) WAKE-UP RESET
+5V
1N914
CR2
1M
R30
0.1
C3
RESET
Φ1 (SH1)
CPA CPB R01 R02
7493 A6 QA QB QC QD
7493 A7
7493 A8
7493 A9
7493 A10
AUDIO CLK
NMI
7420
B8
A4.5
RES. PACK
10K
A3.5
8097
C4
C5
A5
A4
A3
A2
A1
A0
A14
A13
A12
R/W
D7 C13-13
D6 C14-13
SWITCH READ
(SH1)
CEP CET CP
9316
B4
PE TC MR
P0 P1 P2 P3
Q0 Q1 Q2 Q3
MC14050
J4
DISPLAY ADRS
TEST EN
7493
B3
7427
B7
7408
B2
J7
SWITCH COMMON
J10
COIN 1
COIN 2
START
SLAM
74L04
7414
7403
D11
E9
C9
D9
R2 1K
R3 1K
R4 1K
R5 1K
SWITCH DECODE 2010
SWITCH DECODE 2011
SWITCH DECODE 2012
SWITCH DECODE 2013
PHASE
B11
K27
470Ω
F4
F2
S1
S2
SWITCH DECODE 2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
200A
200B
200C
200D
200E
SWITCH DECODE 200F
007328
CE
D12
AUDIO 3
AUDIO 2
AUDIO 1
AUDIO 0
LATCH 1088 BIT 0
LATCH 1088 BIT 3
D13
E12
E13
QB QC QD
CPA 7493
CPB
R01 R02
AUDIO CLK
AUDIO ENABLE
AUDIO RESET
LATCH 1004 BIT 1 (A19-7)
LATCH 1000 BIT 0
LATCH 1004 BIT 0
LATCH 1008 BIT 0
LATCH 100C BIT 0
LATCH 1000 BIT 1
LATCH 1004 BIT 1 (B19-1)
LATCH 1000 BIT 2
LATCH 1004 BIT 2
LATCH 1008 BIT 2 (A17-1)
ULN 2003A
A20
B20
A19
LAMP
J1
30-B0-SA
31-B0-SB
32-B0-SC
33-B0-SD
34-B0-SA
35-B0-SB
36-B0-SC
37-B0-SD
38-B0-SA
39-B0-SB
3A-B0-SC
3B-B0-SD
3C-B0-SA
3D-B0-SB
3E-B0-SC
3F-B0-SD
30-B1-SA
31-B1-SB
32-B1-SC
33-B1-SD
34-B1-SA
NOTES : UNLESS OTHERWISE SPECIFIED
BISHOP GRAPHICS/ACCUPRESS REORDER NO. A-6610

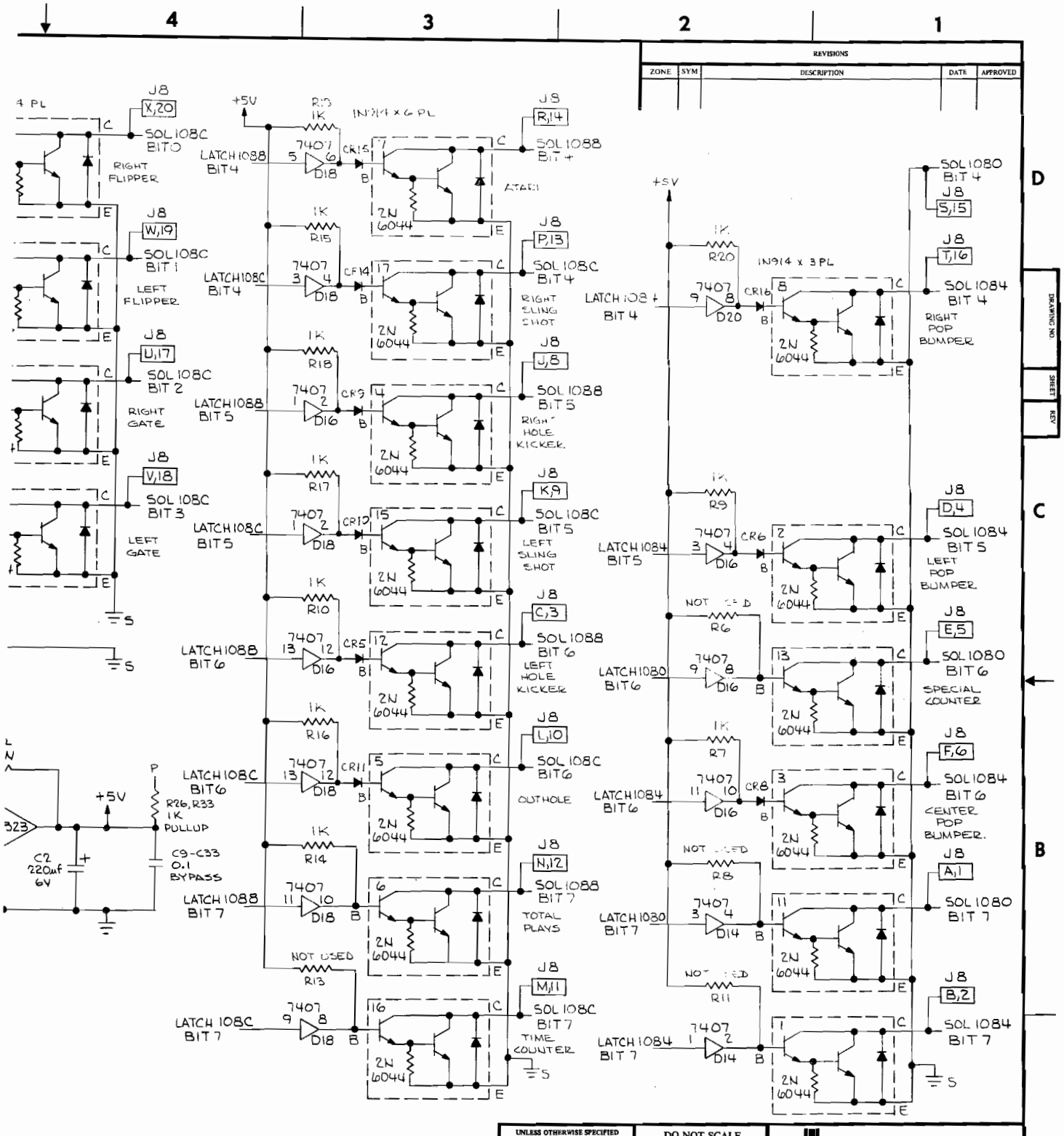

REVISIONS
ZONE | SYM | DESCRIPTION | DATE | APPROVED
RESET
RESET (SH1)
7402
7432
7408
7427
7474
7420
7486
MC14050
10K
RES. PACK
LOAD DISPLAY
BLANK
ANODE BLANK
DISPLAY DATA
DISPLAY ADRS
HALT (SH1)
LAMP BIT 0
LAMP BIT 1
LAMP RETURN
ULN 2003A
LAMP
OUTSTANDING ECNs
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON:
ANGLES = ±1°
SURFACE FINISH
.x = ±.1
.xx = ± .03
.xxx = ± .010
DO NOT SCALE DRAWING
DRAWN BY
DATE
CHECKED
ENGINEER
PROJECT ENGINEER
MFG ENGINEER
MATERIAL:
FINISH:
NEXT ASSY
USED ON
APPLICATION
ATARI INCORPORATED
14600 Winchester Boulevard
Los Gatos, California 95030
TITLE SCHEMATIC DIAGRAM - PROCESSOR PCB ASSEMBLY, UNIVERSAL
SIZE D
DRAWING NO. 006020-01
REV A
SCALE NONE
SHEET 2 OF 3

NOTICE TO ALL PERSONS RECEIVING THIS DRAWING
CONFIDENTIAL: Reproduction Forbidden without the specific written permission of Atari Inc., Los Gatos, California. This drawing is only conditionally issued, and neither receipt nor possession thereof confers or transfers any right in, or license to use, the subject matter of the drawing or any design or technical information shown thereon, nor any right to reproduce this drawing or any part thereof, except for manufacture by vendors for Atari Incorporated and for manufacture under the corporation's written license, no right to reproduce this drawing is granted or the subject matter thereof unless by written agreement with or written permission from the corporation.



NOTES : UNLESS OTHERWISE SPECIFIED

BISHOP GRAPHICS/ACCUPRESS REORDER NO. A-6610



REVISIONS				
ZONE	SYM	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON:
ANGLES = ±1°
SURFACE FINISH
x = ±.1
xx = ±.03
xxx = ±.010

DO NOT SCALE DRAWING

DRAWN BY | DATE

MATERIAL:

FINISH:

CHECKED

ENGINEER

PROJECT ENGINEER

MFG ENGINEER

NEXT ASSY | USED ON

APPLICATION

ATARI

ATARI INCORPORATED
14600 Winchester Boulevard
Los Gatos, California 95030

TITLE SCHEMATIC DIAGRAM - PROCESSOR PCB ASSEMBLY, UNIVERSAL

SIZE D | DRAWING NO. 006020-01 | REV A

SCALE NONE | SHEET 3 OF 3

DRAWING NO. | SHEET | REV

GAME #1

12/16/76

ATARI™ Innovative leisure

KEE GAMES a wholly owned subsidiary of Atari, Inc.

ASSEMBLY TITLE / PROCESSOR PCB ASSY	P/L A006020-01
PARTS LIST SPECIFICATION	Page 1 of 2
Drawn	Next Assembly: A006016-01
Checked	Mech. Eng.
Proj. Eng.	Elec. Eng. / Rev.
Prepared by:	Mfg. Eng. / A

Rev.	Description	Date	Apprv.	Rev.	Description	Date	Apprv.
A	Production Release						

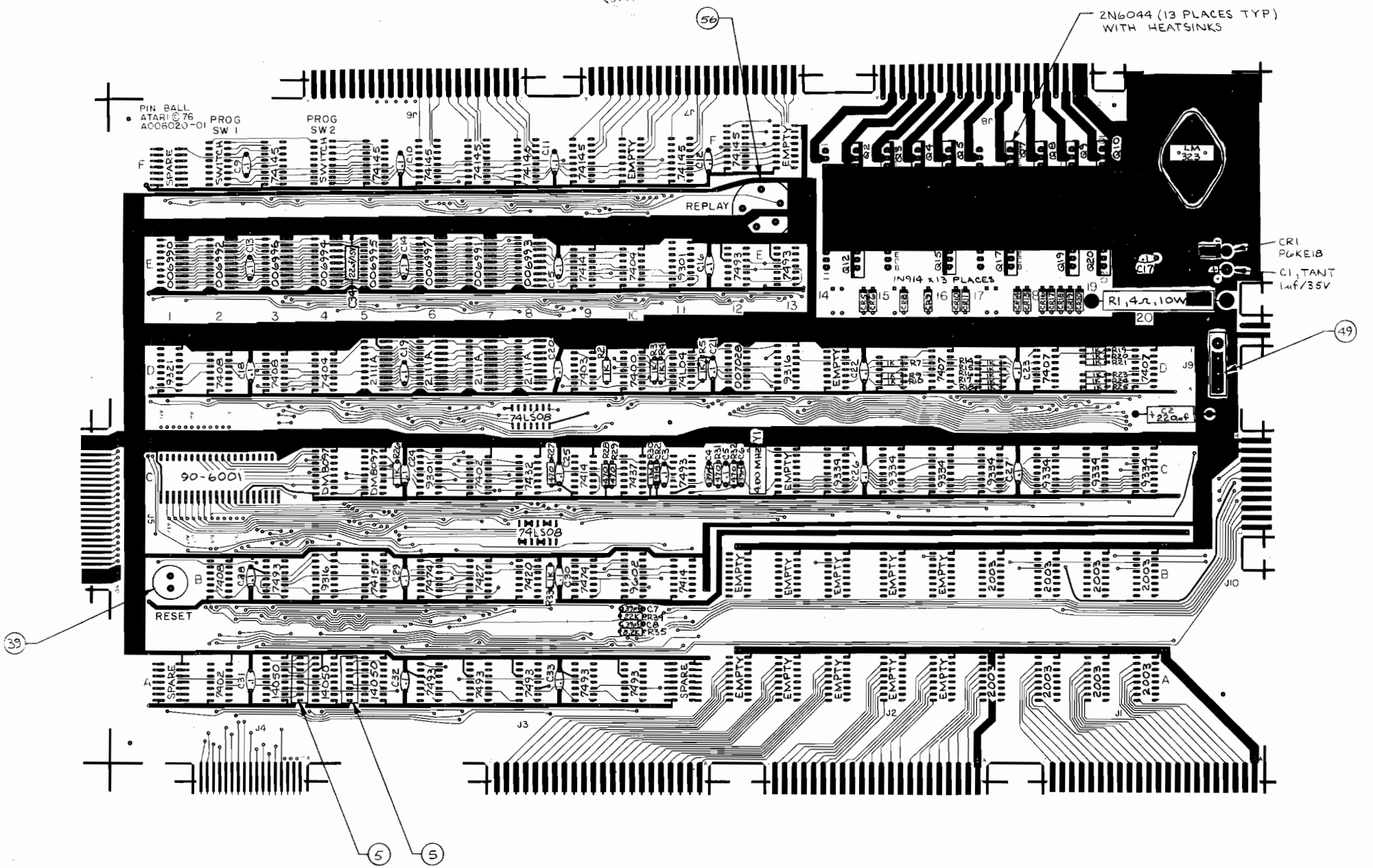
Item	Part Number	Qty.	Description
1	006021-01	1	PCB, Blank, Processor Board
2	10-5102	20	Res.CC, 1K, 1/4w, 5% R2-5, 7, 9, 10, 14-21, 23-26, 33
3	10-5223	1	Res.CC, 22K, 1/4w, 5% R34
4	10-5471	5	Res.CC, 470, 1/4w, 5% R27-29, 31, 32
5	10-5822	1	Res.CC, 8.2K 1/4w, 5% R35
6	19-007	2	Res.Ntwk, 10K, CTS#750-81-R10K
7	19-808W4P0	1	Res.WW, 4.0 ohms, 10w R1
8	24-250227	1	Capacitor, Electrolytic, 25WVDC, 220ufd C2
9	27-250104	27	Capacitor, Ceramic, 25V, 0.1ufd C3, 5, 9-33
10	28-101390	4	Capacitor, Mica, 100V, 39pfd C4, 6-8
11	31-P6KE18	1	Transient Suppressor Diode, P6KE18 CR1
12	31-1N914	14	Diode, 1N914 CR2, 5, 6, 8-11, 14-20
13	34-2N6044	13	Transistor, NPN, 2N6044 Q2-5, 7-10, 12, 15, 17, 19, 20
14	37-LM323	1	Integrated Circuit, LM323
15	37-MC1413	8	Integrated Circuit, MC1413
16	37-MC14050	3	Integrated Circuit, MC14050 A3, A4, A5
17	37-74L04	1	Integrated Circuit, 74L04 D11
18	37-7400	1	Integrated Circuit, 7400 D10
19	37-7402	2	Integrated Circuit, 7402 A2, C7
20	37-7403	1	Integrated Circuit, 7403 D9
21	37-7404	2	Integrated Circuit, 7404 D4, E10
22	37-7407	3	Integrated Circuit, 7407 D16, D18, D20
23	37-7408	3	Integrated Circuit, 7408 B2, D2, D3
24	37-7414	3	Integrated Circuit, 7414 B11, E9, C9
25	37-7420	1	Integrated Circuit, 7420 B8
26	37-7427	1	Integrated Circuit, 7427 B7
27	37-7432	1	Integrated Circuit, 7432 C8
28	37-7437	1	Integrated Circuit, 7437 C10
29	37-7474	2	Integrated Circuit, 7474 B6, B9
30	37-7493	9	IC, 7493 A6, A7, A8, A9, A10, B3, C11, E12, E13
31	37-74145	8	IC, 74145 F3, F5, F6, F7, F8, F9, F11, F12
32	37-74157	1	IC, 74157 B5

continued on sheet 2/2

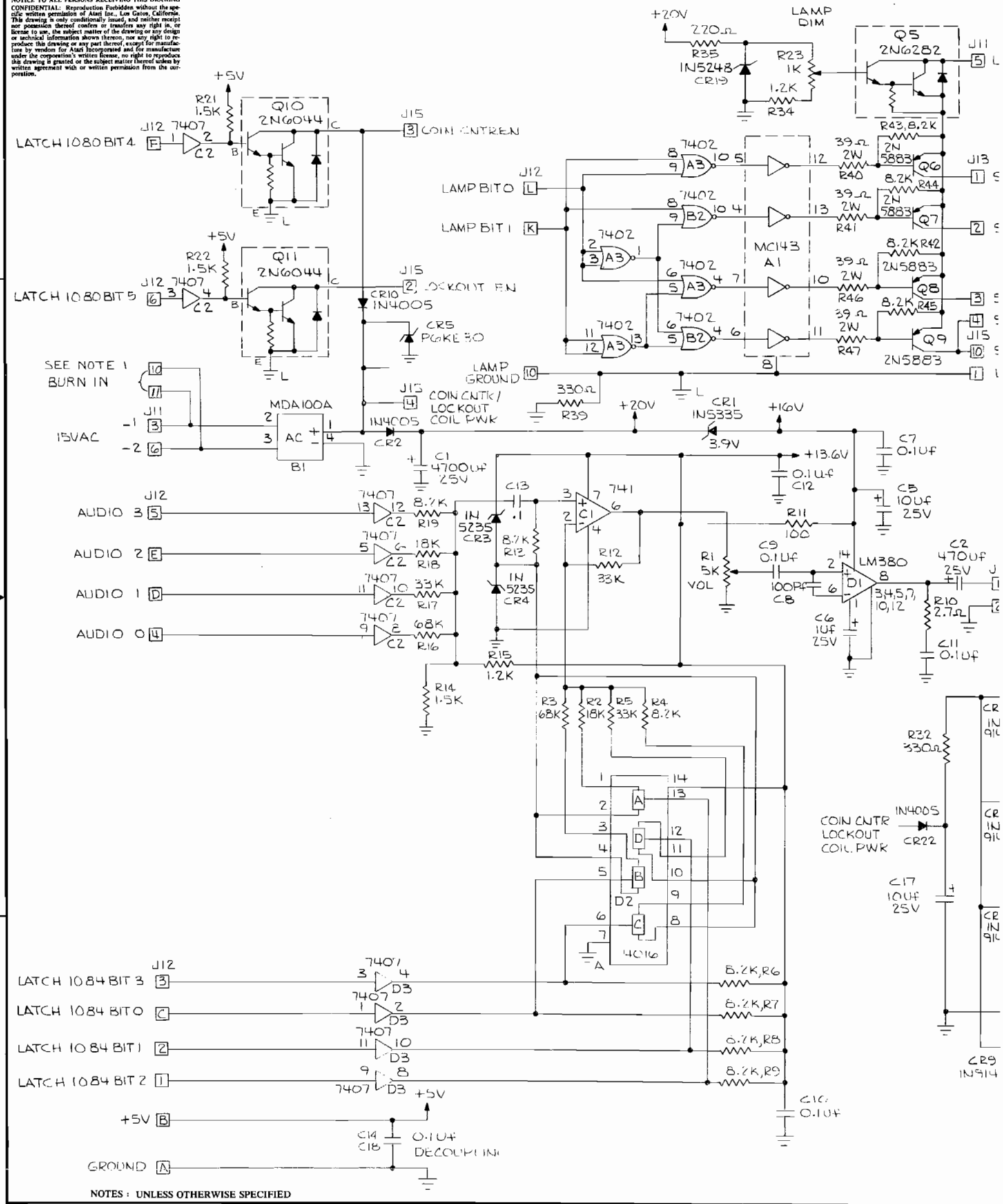
GAME #1

ASSEMBLY TITLE PROCESSOR PCB ASSY	P/L A006020-01 REV. A
PARTS LIST SPECIFICATION	Page 2 of 2

Item	Part Number	Qty.	Description
33	37-8097	2	Integrated Circuit, 8097 C4, C5
34	37-9301	2	Integrated Circuit, 9301 C6, E11
35	37-9316	2	Integrated Circuit, 9316 B4, D13
36	37-9321	1	Integrated Circuit, 9321 D1
37	37-9334	7	IC, 9334 C14, C15, C16, C17, C18, C19, C20
38	37-9602	1	Integrated Circuit, 9602 B10
39	62-001	1	Switch, Pushbutton, SPST
40	66-118P1T	2	Switch, DIP, 8-Station/sw. F2, F4
41	72-1608S	2	Screw, Mach., Pan Hd., Phillips, 6-32 x 1/2"Lg.
42	75-056	6	Washer, Lock, Internal Tooth, #6
43	75-916S	2	Nut, Hex, Regular Pattern, 6-32, Steel
44	78-06001	1	Heatsink, Wakefield Type #690
45	78-06011	13	Heatsink, IERC Type #PB2-2U
46	79-42416T	1	Socket, Integrated Circuit, DIP-16
47	79-42518	8	Socket, Integrated Circuit, DIP-18, Silver Cont.
48	79-42540	1	Socket, Integrated Circuit, DIP-40, Silver Cont.
49	79-58122	1	Header (connector) 4 pin
50	90-108	1	Crystal, 4.0000 MHz
51	90-7012	1	PROM, 82S131 (Blank)
52	90-7015	4	RAM, (256x4) 2111A D5, D6, D7, D8
53	90-7017	8	PROM, 82S137 (Blank - for fabbing items 64-71)
54	90-6001	1	Integrated Circuit C1
55	37-74LS08	2	Integrated Circuit, 74LS08 B/C8, C/D8
56	66-12FP1T	1	Switch, Hex, Amp #435167-1
57	10-5105	1	Resistor, Carbon Comp., 1 Meg, 1/4w, 5% R30
58	29-006	1	Capacitor, Tantalum, 35WVDC, 1.0ufd C1
59	78-16005	1	Silpad
60	75-016	2	Washer, Flat, Regular Pattern, #6
61	75-914S	13	Nut, Hex, Regular Pattern, 4-40, Steel
62	75-054	13	Washer, Lock, Internal Tooth, #4
63	72-1406C	13	Screw, Mach., Pan Hd., Phil., 4-40 x 3/8"L, CRES
64	006990-01	1	PROM, 82S137, Game 1 Program, 1-1LSB E1
65	006991-01	1	PROM, 82S137, Game 1 Program, 1-1MSB E7
66	006992-01	1	PROM, 82S137, Game 1 Program, 1-2LSB E2
67	006993-01	1	PROM, 82S137, Game 1 Program, 1-2MSB E8
68	006994-01	1	PROM, 82S137, Game 1 Program, 1-3LSB E4
69	006995-01	1	PROM, 82S137, Game 1 Program, 1-3MSB E5
70	006996-01	1	PROM, 82S137, Game 1 Program, 1-4LSB E3
71	006997-01	1	PROM, 82S137, Game 1 Program, 1-4MSB E6
72	007028-01	1	PROM, 82S131, Game 1 Audio D12
73	29-007	1	Capacitor, Tantalum, 15WVDC, 22ufd, C34


PIN BALL
ATARI © 76
A006020-01
PROG SW 1
PROG SW2
2N6044 (13 PLACES TYP) WITH HEATSINKS
LM 323
REPLAY
RESET
90-6001
74LS08
400 MHz
1N914 x13 PLACES
CR1 PUKE18
C1, TANT 1uf/35V
R1, 4Ω, 10W
+22uf
SPARE
EMPTY
J1
J2
J3
J4
J9
J10
56
49
39
5
5

NOTICE TO ALL PERSONS RECEIVING THIS DRAWING
CONFIDENTIAL: Reproduction Forbidden without the specific written permission of Atari Inc., Los Gatos, California. This drawing is only conditionally issued, and neither receipt nor possession thereof confers or transfers any right in, or license to use, the subject matter of the drawing or any design or technical information shown thereon, nor any right to reproduce this drawing or any part thereof, except for manufacture by vendors for Atari Incorporated and for manufacture under the corporation's written license, no right to reproduce this drawing is granted or the subject matter thereof stolen by written agreement with or written permission from the corporation.

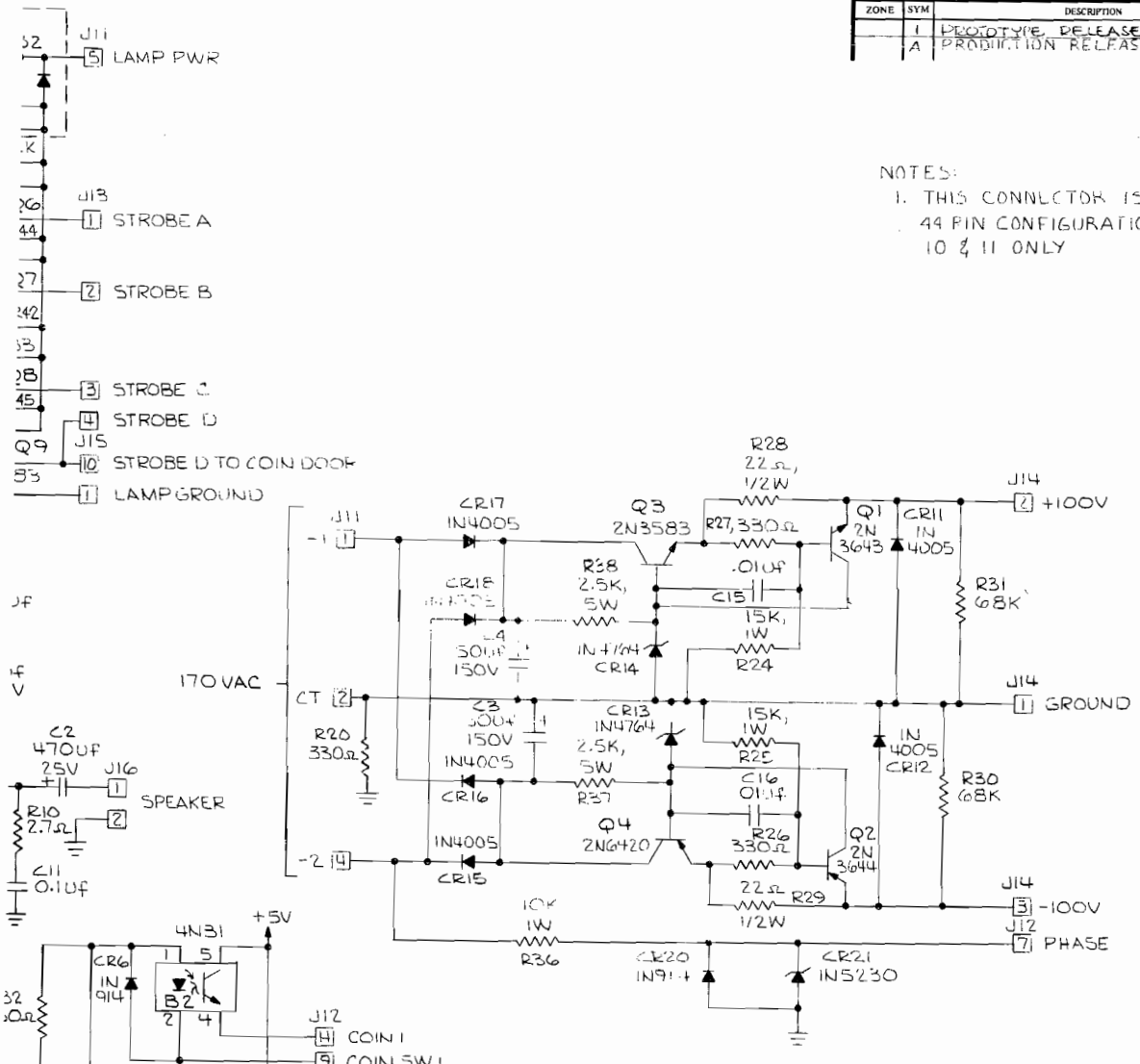


NOTES : UNLESS OTHERWISE SPECIFIED

BISHOP GRAPHICS/ACCUPRESS
REORDER NO. A-6610

REVISIONS				
ZONE	SYM	DESCRIPTION	DATE	APPROVED
	1	PROTOTYPE RELEASE		
	A	PRODUCTION RELEASE	12/17/76	

NOTES:
1. THIS CONNECTOR IS PART OF A 44 PIN CONFIGURATION USING PINS 10 & 11 ONLY



OUTSTANDING ECNs	

A006407-01	PINBALL
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON:
ANGLES = ±1° .x = ±.1 .xx = ±.03 .xxx = ±.010
SURFACE FINISH
MATERIAL:
FINISH:

DO NOT SCALE DRAWING
DRAWN BY: DATE
CHECKED
ENGINEER
PROJECT ENGINEER
MFG ENGINEER

ATARI INCORPORATED
14600 Winchester Boulevard
Los Gatos, California 95030

TITLE SCHEMATIC DIAGRAM - AUXILIARY BOARD PINBALL

SIZE D | DRAWING NO. 006407-01 | REV A
SCALE NONE | SHEET 1 OF

DRAWING NO. | SHEET | REV.

ATARI™ Innovative leisure

KEE GAMES a wholly owned subsidiary of Atari Inc.

12/16/76

ASSEMBLY TITLE / AUXILIARY PCB ASSY **P/L** A006407-01

PARTS LIST SPECIFICATION Page 1 of 2

Drawn	Next Assembly: A006016-01	
Checked	Mech. Eng.	
Proj. Eng.	Elec. Eng.	Rev.
Prepared by:	Mfg. Eng.	A

Rev.	Description	Date	Apprv.	Rev.	Description	Date	Apprv.
A	Production Release						

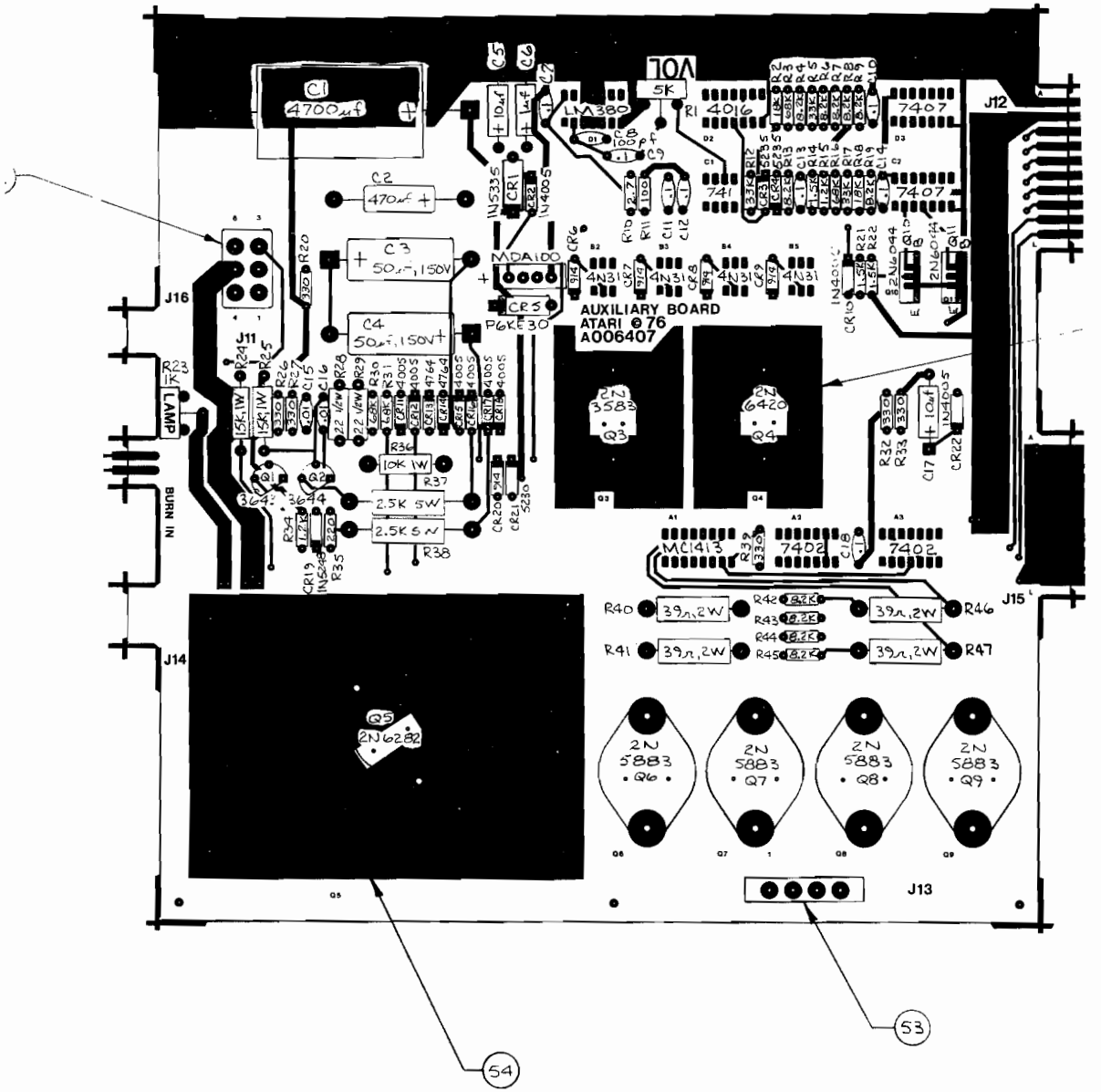
Item	Part Number	Qty.	Description	
1	006408-01	1	PCB, Blank, Auxiliary Board	
2	10-5122	2	Res.CC, 1.2K, 1/4w, 5%	R15, 34
3	10-5152	3	Res.CC, 15K, 1/4w, 5%	R14, 21, 22
4	10-5183	2	Res.CC, 18K, 1/4w, 5%	R2, 18
5	10-52P7	1	Res.CC, 2.7 ohms, 1/4w, 5%	R10
6	10-5331	6	Res.CC, 330 ohms, 1/4w, 5%	R20, 26, 27, 32, 33, 39
7	10-5333	3	Res.CC, 33K, 1/4w, 5%	R5, 12, 17
8	10-5683	4	Res.CC, 68K, 1/4w, 5%	R3, 16, 30, 31
9	10-5822	11	Res.CC, 8.2K 1/4w, 5%	R4, 6-9, 13, 19, 42-45
10	11-5220	2	Res.CC, 22 ohms, 1/2w, 5%	R28, R29
11	12-5153	2	Res.CC, 15K, 1w, 5%	R24, R25
12	13-5390	4	Res.CC, 39 ohms, 2w, 5%	R40, 41, 46, 47
13	16-5252	2	Resistor, w.w., 2500 ohms, 5w, 5%	R37, R38
14	19-311102	1	Trimpot, 1000 ohms	R23
15	19-311502	1	Trimpot, 5000 ohms	R1
16	24-151506	2	Capacitor, Electrolytic, 150WVDC, 50ufd,	C3, C4
17	24-250106	2	Capacitor, Electrolytic, 25WVDC, 10ufd,	C5, C17
18	24-250478	1	Capacitor, Electrolytic, 25WVDC, 4700ufd,	C1
19	24-250477	1	Capacitor, Electrolytic, 25WVDC, 470ufd,	C2
20	24-250105	1	Capacitor, Electrolytic, 25WVDC, 1.0ufd	C6
21	27-250104	8	Capacitor, Ceramic, 25V, 0.1ufd	C7, 9-14, 18
22	27-250103	2	Capacitor, Ceramic, 25V, .01ufd	C15, C16
23	28-101101	1	Capacitor, Mica, 100V, 100pfd	C8
24	3A-MDA100A	1	Rectifier Assembly, Bridge, MDA100A	
25	31-1N914	5	Diode, 1N914	CR6-CR9, CR20
26	31-1N4005	9	Rectifier, 1N4005	CR2, 10-12, 15-18, 22
27	32-P6KE30	1	Transient Suppressor Diode, P6KE30	CR5
28	32-1N5235	2	Diode, Zener, 1N5235	CR3, CR4
29	32-1N5248	1	Diode, Zener, 1N5248	CR19
30	32-1N4764	2	Diode, Zener, 1N4764	CR13, CR14
31	33-2N3644	1	Transistor, PNP, 2N3644	Q2
32	33-2N5883	4	Transistor, PNP, 2N5883	Q6-Q9

continued on sheet 2/2

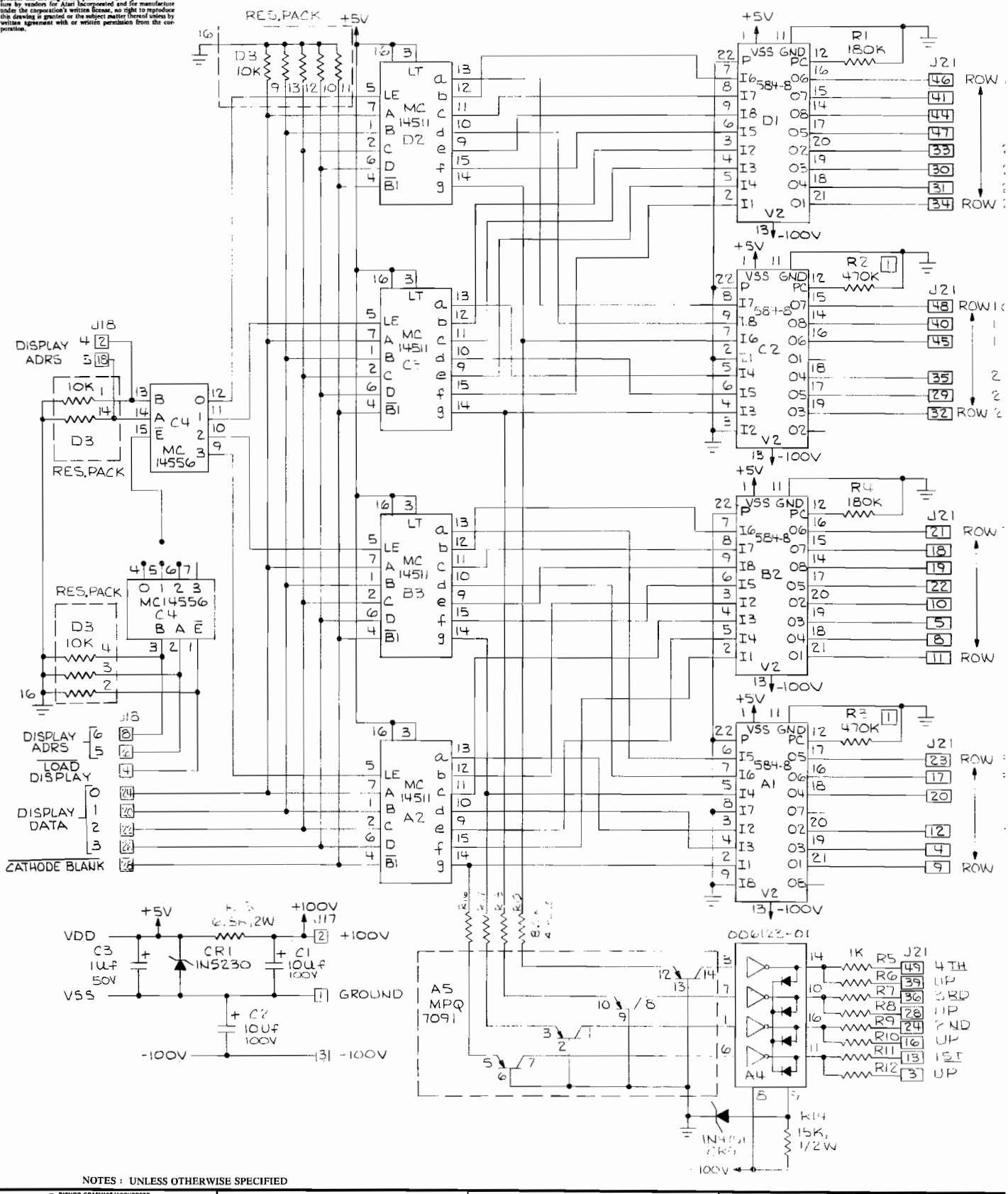
ASSEMBLY TITLE AUXILIARY PCB ASSEMBLY **P/L** A006407-01 REV. A

PARTS LIST SPECIFICATION Page 2 of 2

Item	Part Number	Qty.	Description	
33	34-2N3643	1	Transistor, NPN, 2N3643	Q1
34	34-2N3583	1	Transistor, NPN, 2N3583	Q3
35	34-2N6044	2	Transistor, NPN, 2N6044	Q10, Q11
36	34-2N6282	1	Transistor, NPN, 2N6282	Q5
37	33-2N6420	1	Transistor, PNP, 2N6420	Q4
38	37-LM380	1	Integrated Circuit, LM380	D1
39	37-MC1413	1	Integrated Circuit, MC1413 (ULN2003)	A1
40	37-741	1	Integrated Circuit, 741	C1
41	37-4016	1	Integrated Circuit, 4016	D2
42	37-7402	2	Integrated Circuit, 7402	A2, A3
43	37-7407	2	Integrated Circuit, 7407	D3, C2
44	38-4N31	4	Optical Isolator, 4N31	B2, B3, B4, B5
45	10-5221	1	Resistor, Carbon Comp., 220 ohms, 1/4w, 5%	R35
46	72-1608S	14	Screw, Mach., Pan Hd., Phillips, 6-32 x 1/2"Lg.	
47	75-016S	14	Washer, Flat, Regular Pattern, #6	
48	75-056	18	Washer, Lock, Internal Tooth, #6	
49	75-916S	14	Nut, Hex, Regular Pattern, 6-32, Steel	
50	12-5103	1	Resistor, Carbon Comp., 10K ohm, 1w, 5%	R36
51	78-06002	2	Heatsink, Thermalloy #6111B-66	
52	79-58123	1	Header, 6-pin, Amp #350431-1	
53	79-58124	1	Header, 4-pin, Amp #350761-4	
54	004897-01	1	Heatsink, Modified Wakefield #641	
55	32-1N5335	1	Diode, Zener, 1N5335	CR1
56	32-1N5230	1	Diode, Zener, 1N5230	CR21
57	10-5101	1	Resistor, Carbon Comp., 100 ohms, 1/4w, 5%	R11
58	78-16008	1	Silpad, TO-3	
59	78-16011	2	Silpad, TO-66	

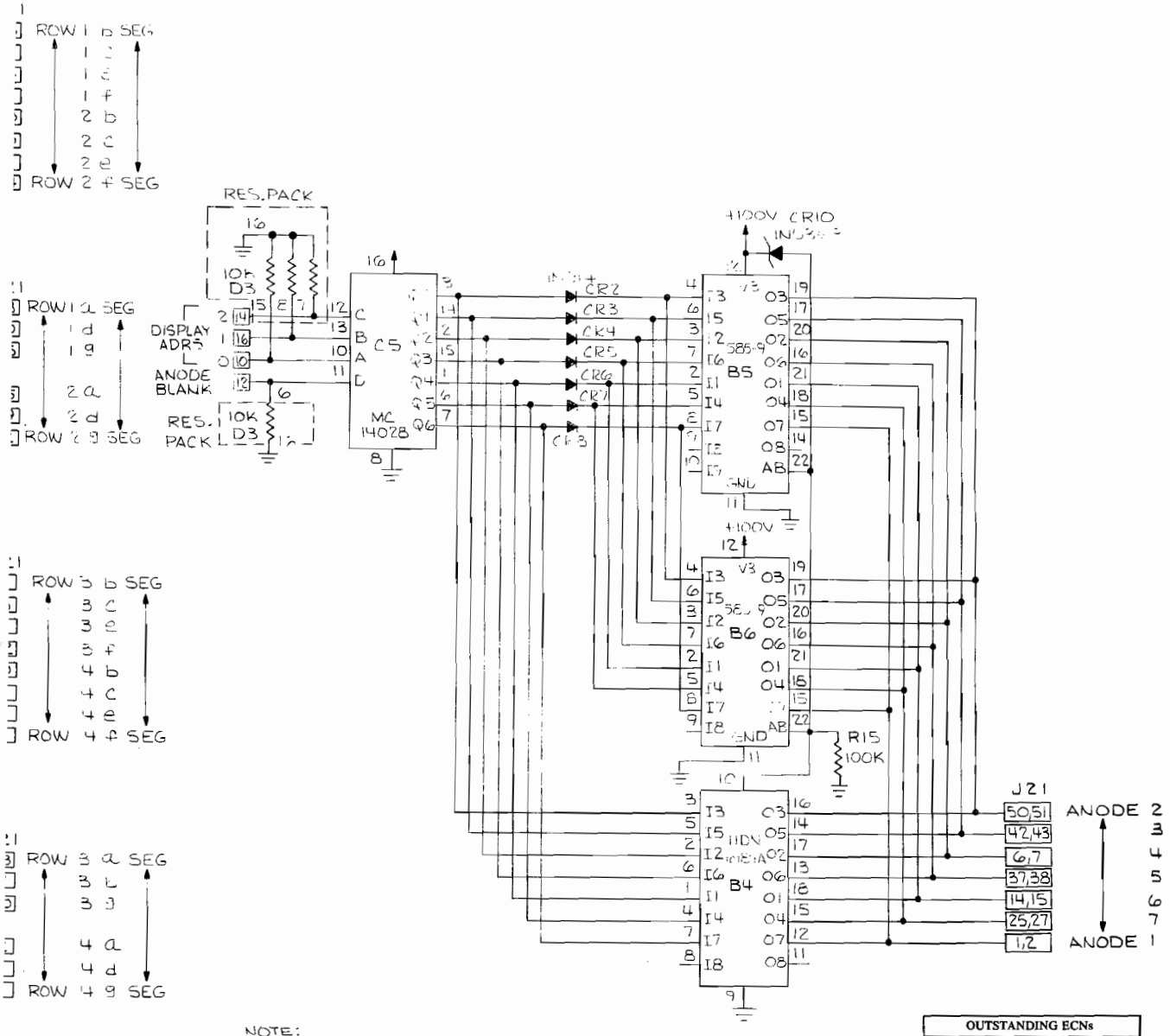

AUXILIARY BOARD
ATARI ©76
A006407
C1
4700uf
C2
470uf
C3
50uf, 150V
C4
50uf, 150V
VOL
5K
LM380
4016
7407
7402
MC1413
J11
J12
J13
J14
J15
J16
LAMP
BURN IN
2N 5883 Q6
2N 5883 Q7
2N 5883 Q8
2N 5883 Q9
2N 3583 Q3
2N 6420 Q4
2N 6282 Q5
MDA100
P6KE30
10K 1W
2.5K 5W
2.5K 5W
39Ω, 2W
8.2K
330
10uf
1uf
.1
.01
1000pf
4N31
1N4005
1N5335
1N5230
2N6044
2N6045
51
2 PLACES
53
54

NOTICE TO ALL PERSONS RECEIVING THIS DRAWING
CONFIDENTIAL: Reproduction Forbidden without the specific written permission of Atari Inc., Los Gatos, California. This drawing is only conditionally issued, and neither receipt nor possession thereof confers or transfers any right in, or license to use, the subject matter of the drawing or any design or technical information shown thereon, nor any right to reproduce this drawing or any part thereof, except for manufacture by vendors for Atari Incorporated and for manufacture under the corporation's written license, no right to reproduce this drawing is granted or the subject matter thereof unless by written agreement with or written permission from the corporation.



NOTES : UNLESS OTHERWISE SPECIFIED

BISHOP GRAPHICS/ACCUPRESS
REORDER NO. A-6610



NOTE:
1. IF B4 (UDN6184A) IS USED, THEN B5 & B6(585-9), CR2-CR8 (IN914), AND R15 (100K) ARE OMITTED.

REVISIONS				
ZONE	SYM	DESCRIPTION	DATE	APPROVED
	A	[illegible]		

OUTSTANDING ECNs	

DRAWING NO. 004924 SHEET 1 REV -

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: ANGLES = ±1° SURFACE FINISH ✓ .x = ±.1 .xx = ±.03 .xxx = ±.010

DO NOT SCALE DRAWING

DRAWN BY | DATE

CHECKED

ENGINEER

PROJECT ENGINEER

MFG ENGINEER

MATERIAL:

FINISH:

NEXT ASSY | USED ON

APPLICATION

ATARI INCORPORATED
14600 Winchester Boulevard
Los Gatos, California 95030

TITLE SCHEMATIC DIAGRAM - SCORE PANEL DRIVE 2

SIZE D | DRAWING NO. 004924-XX | REV A

SCALE | SHEET 1 OF 1

(Preferred)

12/16/76

ASSEMBLY TITLE / SCORE DISPLAY PCB Ass P/L A004924-01

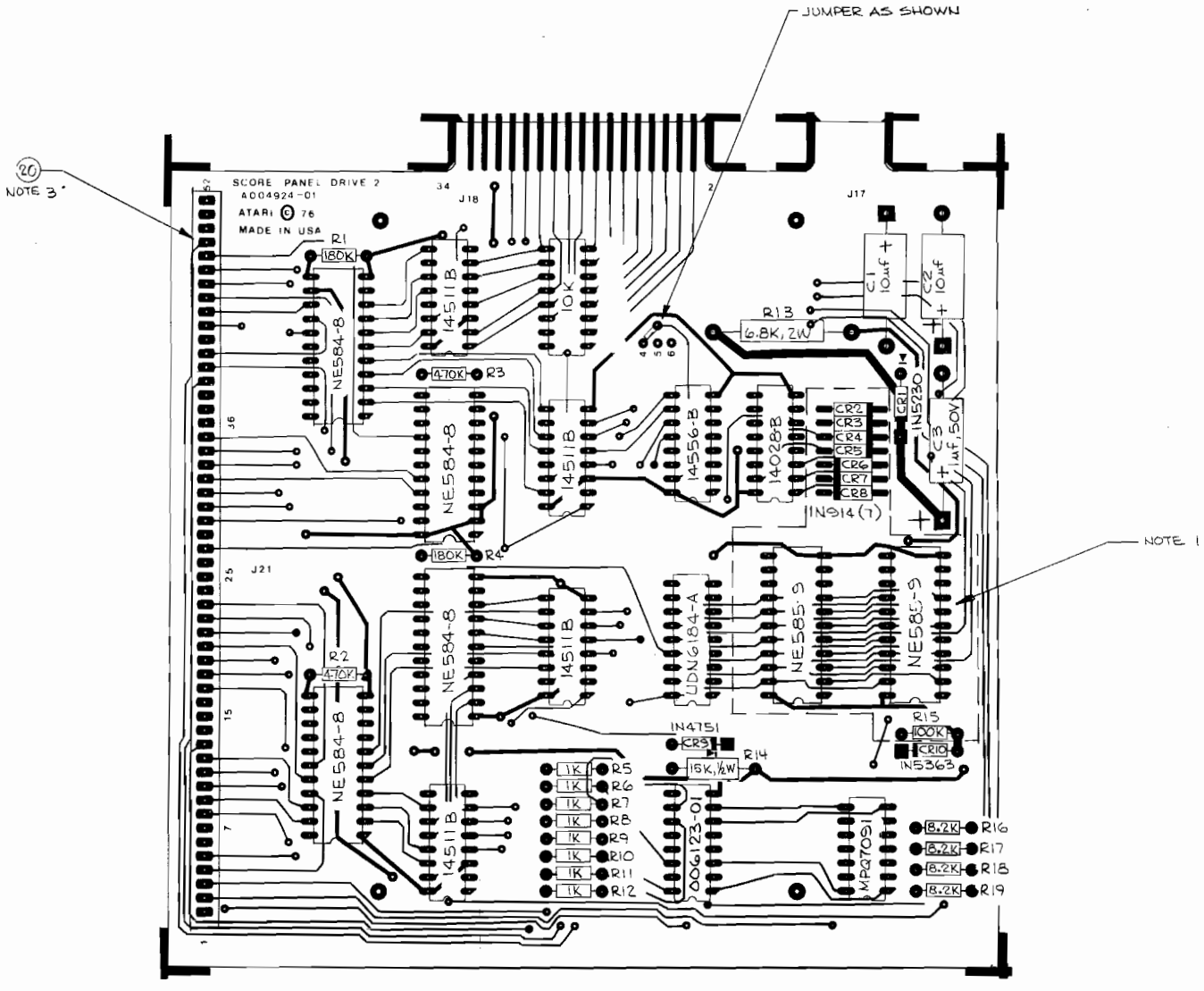
PARTS LIST SPECIFICATION Page 1 of 1

Drawn	Next Assy: A006743-01	
Checked	Mech. Eng.	
Proj. Eng.	Elec. Eng.	Rev. A
Prepared by:	Mfg. Eng.	

Rev.	Description	Date	Apprv.	Rev.	Description	Date	Apprv.
A	Production Release						

Item	Part Number	Qty.	Description
1	004922-01	1	PCB, Blank, Score Panel Drive
2	10-5102	8	Res., Carbon Comp., 1000 ohms, 1/4w, 5% R5-12
3	10-5184	2	Res., Carbon Comp., 180K ohms, 1/4w, 5% R1, 4
4	10-5474	2	Res., Carbon Comp., 470Kohms, 1/4w, 5% R2, 3
5	10-5822	4	Res., Carbon Comp., 8200 ohms, 1/4w, 5% R16-19
6	11-5153	1	Res., Carbon Comp., 15K ohms, 1/2w, 5% R14
7	13-5682	1	Res., Carbon Comp., 6800 ohms, 2w, 5% R13
8	24-101106	2	Capacitor, Electrolytic, 100WVDC, 10ufd C1-2
9	24-500105	1	Capacitor, Electrolytic, 50WVDC, 1.0ufd C3
10	32-1N4751	1	Diode, Zener, 1N4751 CR9
11	32-1N5230	1	Diode, Zener, 1N5230 CR1
12	19-008	1	Res. Network, 10K ohms, CTS# 761-1-R10K
13	37-MC14028	1	Integrated Circuit, MC14028
14	37-MC14511	4	Integrated Circuit, MC14511
15	37-MC14556	1	Integrated Circuit, MC14556
16	37-MPQ7091	1	Integrated Circuit, MPQ7091
17	37-UDN6184A	1	Integrated Circuit, UDN6184A
18	37-584-8	4	Integrated Circuit, 584-8
19	006123-01	1	Integrated Circuit, MC1413, 75V (Atari Custom)
20	004770-01	1	Connector, Score Panel
21	72-1408S	4	Screw, Mach., Pan Hd., Phil., 4-40 x 1/2"Lg., Stl
22	32-1N5363	1	Diode, Zener, 1N5363 CR10

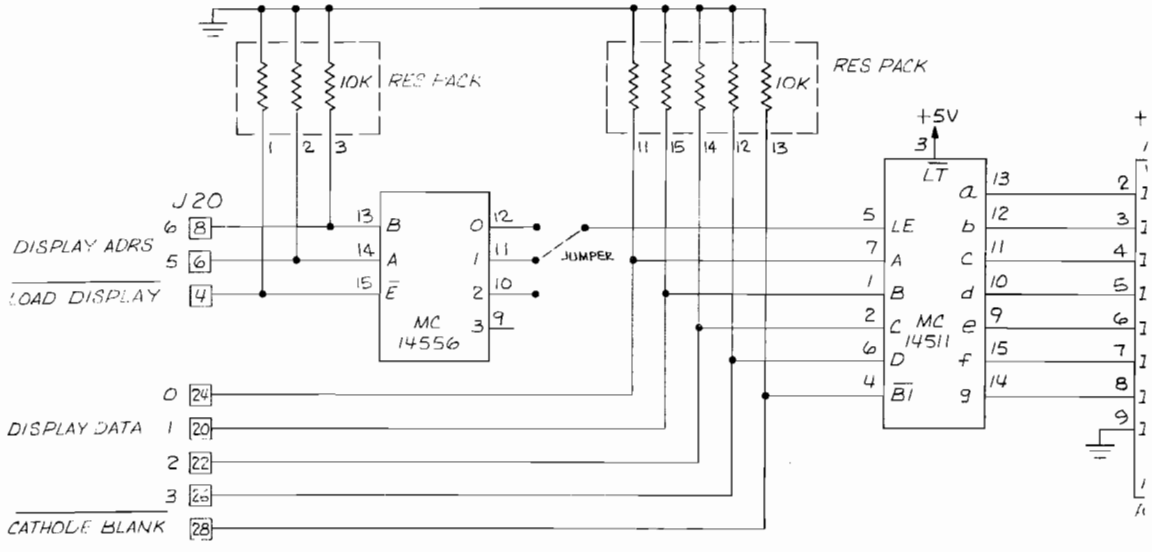
NOTE: This is the preferred assembly parts list for the Score Display PCB, to be used when item 17 is obtainable. If item 17 is unavailable (only) use the assembly parts list, A004924-02 as an alternate procedure.

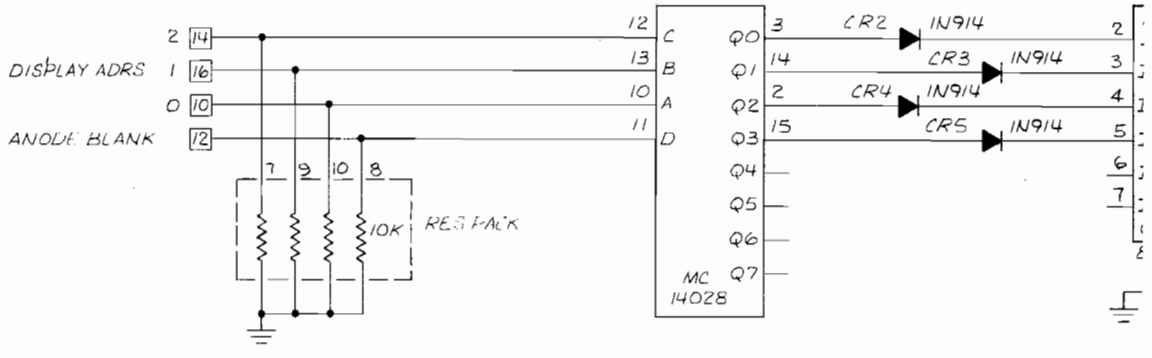


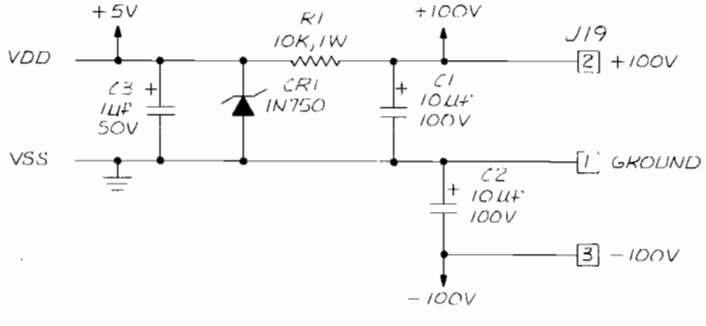
NOTES:

1. IF UDN6184-A IS USED, DO NOT USE NE585-9 (QTY 2), OMIT IN914 DIODES CR2-CR8 (QTY 7), AND OMIT R15 (100K).
2. USE THIS ASSEMBLY WITH 004925-01 REV "A" P.C. BDS.
3. ITEM 20, CONNECTOR, MOUNTS ON COMPONENT SIDE OF BOARD.

NOTICE TO ALL PERSONS RECEIVING THIS DRAWING
CONFIDENTIAL: Reproduction Forbidden without the specific written permission of Atari Inc., Los Gatos, California. This drawing is only conditionally issued, and neither receipt nor possession thereof confers or transfers any right in, or license to use, the subject matter of the drawing or any design or technical information shown thereon, nor any right to reproduce this drawing or any part thereof, except for manufacture by vendors for Atari Incorporated and for manufacture under the corporation's written license, no right to reproduce this drawing is granted or the subject matter thereof unless by written agreement with or written permission from the corporation.



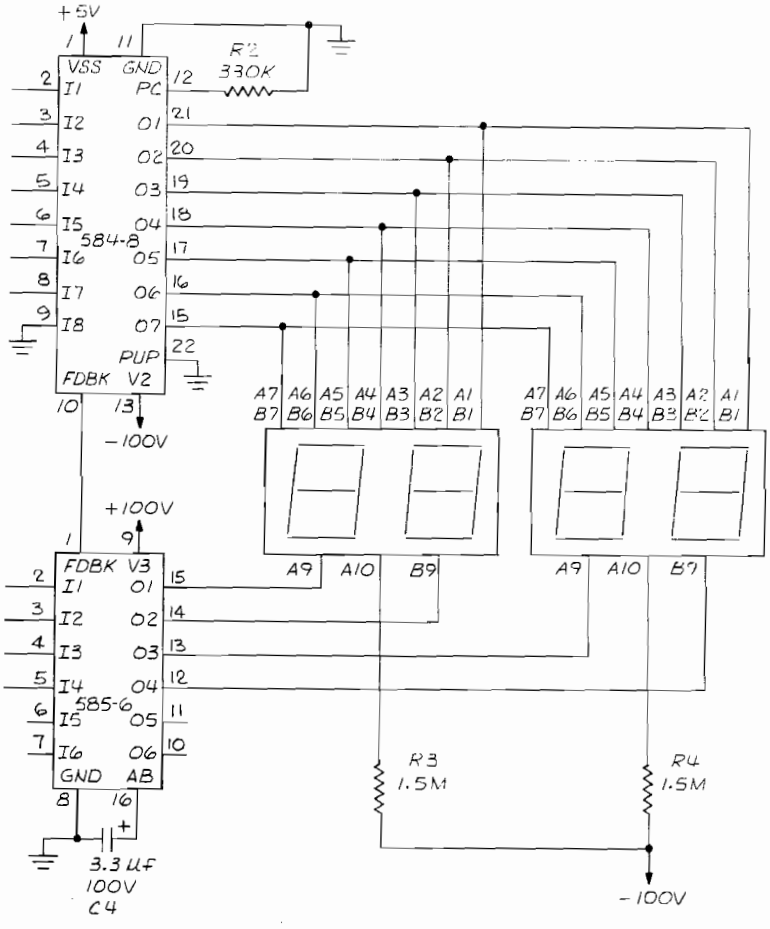




NOTES : UNLESS OTHERWISE SPECIFIED

BISHOP GRAPHICS/ACCUPRESS REORDER NO. A-0610

REVISIONS				
ZONE	SYM	DESCRIPTION	DATE	APPROVED
	A	[illegible] RELEASE		



OUTSTANDING ECNs	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: ANGLES = ±1° SURFACE FINISH ✓ .x = ±.1 .xx = ± .03 .xxx = ± .010	DO NOT SCALE DRAWING	ATARI INCORPORATED 14600 Winchester Boulevard Los Gatos, California 95030
MATERIAL:	DRAWN BY / DATE	TITLE SCHEMATIC DIAGRAM — MATCH/CREDIT DISPLAY BOARD PINBALL
FINISH:	CHECKED / ENGINEER / PROJECT ENGINEER / MFG ENGINEER	SIZE D · DRAWING NO. 006096-01 · REV A · SCALE NONE · SHEET 1 OF 1

NEXT ASSY	USED ON
APPLICATION	

12/16/76

ATARI™ Innovative leisure

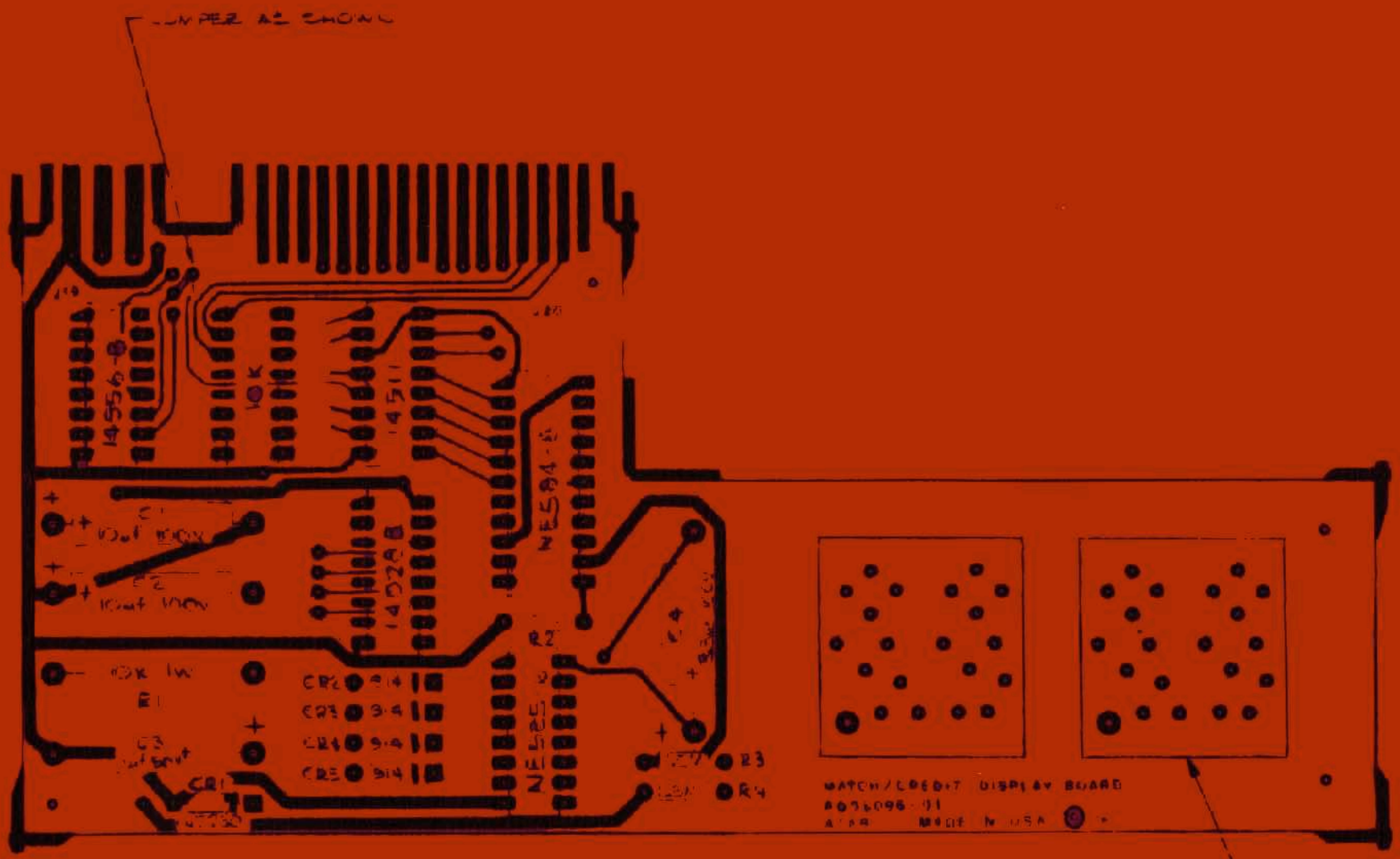
ASSEMBLY TITLE / MATCH/CREDIT DISPLAY BOARD **P/L** A006096-01

PARTS LIST SPECIFICATION Page 1 of 1

Drawn	Next Assy: A005988-01	
Checked	Mech. Eng.	
Proj. Eng.	Elec. Eng	REV. A

Rev.	Description	Date	Apprv.	Rev.	Description	Date	Apprv.
A	Production Release						

Item	Part Number	Qty.	DESCRIPTION	
1	006104-01	1	PCB, Blank, Match/Credit Display Board	
2	10-5155	2	Resistor, Carbon Comp., 1.5 Megohms, 1/4w, 5%	R3, 4
3	10-5334	1	Resistor, Carbon Comp., 330K ohms, 1/4w, 5%	R2
4	12-5103	1	Resistor, Carbon Comp., 10K ohms, 1w, 5%	R1
5	24-500105	1	Capacitor, Electrolytic, 50 WVDC, 1.0 ufd	C3
6	24-101335	1	Capacitor, Electrolytic, 100 WVDC, 3.3 ufd	C4
7	24-101106	2	Capacitor, Electrolytic, 100 WVDC, 10 ufd	C1, 2
8	32- 1N5230	1	Diode, Zener, 1N5230	CR1
9	37-MC14028	1	Integrated Circuit, MC14028	
10	37-MC14511	1	Integrated Circuit, MC14511	
11	37-MC14556	1	Integrated Circuit, MC14556	
12	37-584-8	1	Integrated Circuit, 584-8	
13	37-585-6	1	Integrated Circuit, 585-6	
14	19-008	1	Resistor Network, 10K ohms, CTS # 761-1-R10K	
15	31-1N914	4	Diode, 1N914	CR2-5
16	79-41001	2	Socket, Beckman Type CS-352	
17				


JUMPER AS SHOWN
14556-B
10K
1411
1402A-B
NE592-N
C1
10uf 10V
C2
10uf 10V
10K 1W
R1
C3
CR1
CR2
CR3
CR4
CR5
R2
C4
R3
R4
WATCH/CREDIT DISPLAY BOARD
A036096-01
MADE IN USA

(16) 2 PLCS



ATARI INC
1265 BORREGAS AVENUE
SUNNYVALE, CALIFORNIA 94086
408 745-2000 ■ TELEX 35-7468