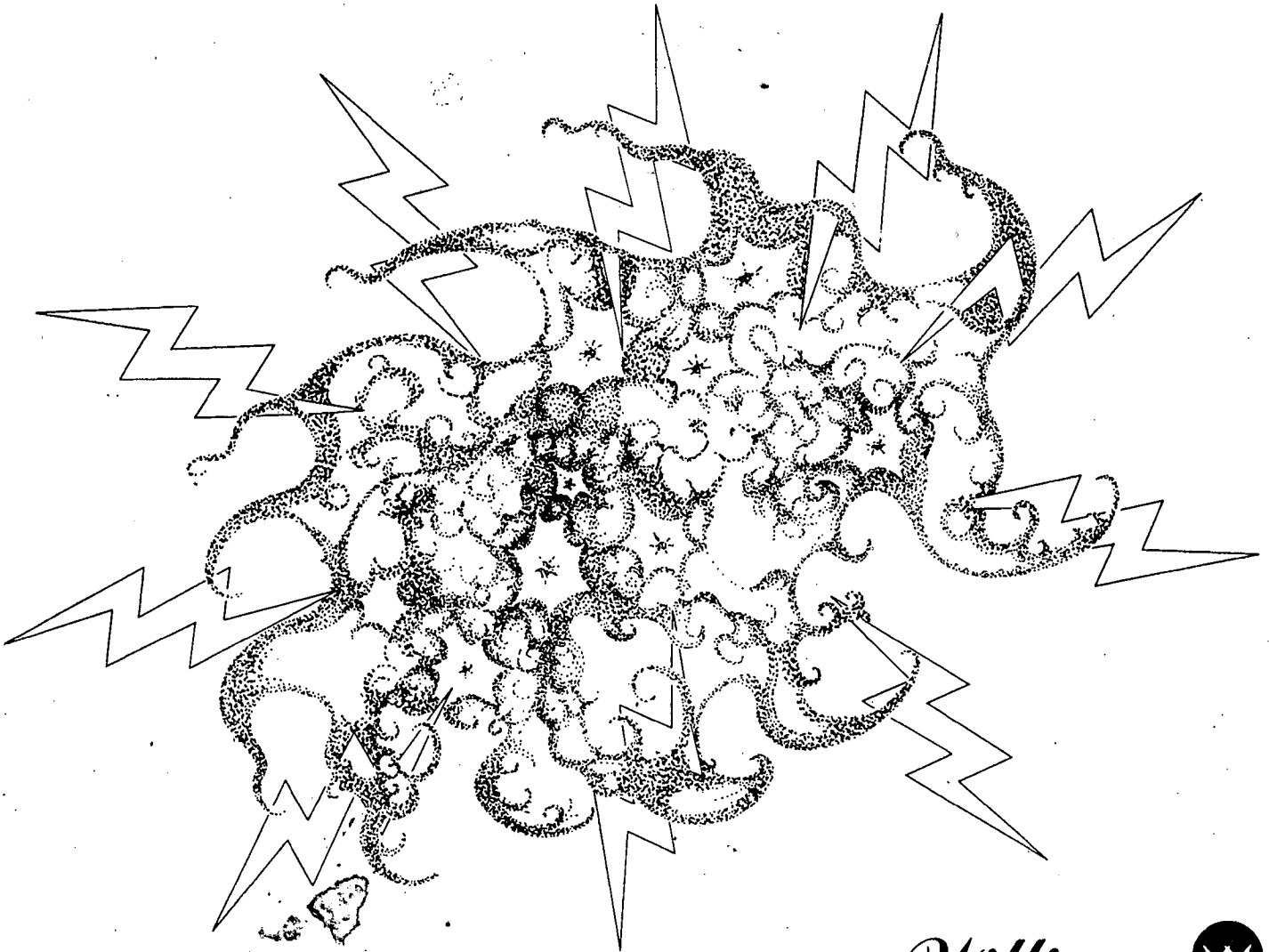


Williams[®]

16P-509-101
Game No. 509
February, 1982

Hyperbowl

INSTRUCTION MANUAL AND DRAWING SET



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This manual provides installation, game operation, bookkeeping, game adjustment, diagnostic, self-test and troubleshooting procedures for HYPER-BALL. Schematic, assembly and wiring diagrams are also included.

SPECIAL CONSIDERATIONS WHEN REPLACING CIRCUIT BOARDS

CPU Board

1. Revision level 7 CPU Boards (batteries located on lower left corner at board) or later boards must be used.
2. Must be equipped with three white-labeled Game ROMs.
3. Jumpers W5, W24, W27, and W28 must be connected. Jumpers W3, W6, W10 and W26 must be removed. With the exception of W25, (Factory Setting Jumper) all other jumpers are not changed.

Control Board

Replaces Driver Board; equipped with four 6821 PIAs.

Sound Board

Must be jumpered for green-labeled sound ROM operation and be equipped with Sound ROM 8. Jumper W3 must be connected and jumper W2 removed.

Power Supply Board

Model D 8345 required (Equipped with relay).

Power Switching Board

Required for ball shooter solenoid DC and isolated 125VAC for the Ball Feed Motor. Secondaries of a second transformer provide 85VAC for the ball shooter solenoid and 115VAC for the motors. The 85VAC is rectified to supply +120VDC to the ball shooter solenoid. The Control Board applies a switched +1.4VDC signal to the Switching Board to pulse the ball shooter solenoid. The Control Board function, enabling the AC drive, is similar to the flipper relay of flipper games. The function is activated during game play and when required during diagnostics, and deactivated in Game Over.

Display Boards

1. Model C 8363 Master Display and 7-digit Slave Displays required.
2. Model D 8910 Alphanumeric Display is required. It uses strobes 4 to 7 and 9 to 16 from the CPU Board via anode drivers on the Control Board and alphanumeric segments from cathode drivers on the Control Board.

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NOTE

FOR PROPER BALL RETURN FLOW, LEGS MUST BE ADJUSTED FOR SHALLOW PLAY-FIELD PITCH. DO NOT CHANGE LEG CASTER ADJUSTMENTS.

INSTALLATION

ASSEMBLY AND INTERCONNECTION

With legs attached to cabinet, proceed as follows:

1. Unlock and remove backglass from backbox.
2. Remove shipping insert and shipping blocks from insert door.
3. Unlatch and open insert door.
4. Unlatch speaker panel, disconnect speaker cable, and remove speaker panel. Close and latch insert door.
5. Reach into the cabinet pedestal hole and pull up the line cord. Insert the line cord into the notch in the cabinet pedestal. **DO NOT PLUG IN AT THIS TIME.**
6. Lift up backbox and position in cabinet pedestal, engaging brackets for support.
7. Secure backbox using two bolts and washers.
8. Unlatch control panel molding and pull out and up on shooter handle to lift molding just free of cabinet.
9. Disconnect 5-pin plug from underside of molding and set control panel molding aside.
10. Carefully remove playfield glass and set it aside. Note that the playfield glass has unique dimensions: 21" x 37" x 3/16".
11. Remove shipping tie-down from ball shooter.
12. Raise playfield and rest it against backbox.
13. Remove two shipping screws from subfloor and slide it toward the front of the cabinet so that the hinged panel at the rear of the cabinet will fold back onto the subfloor.
14. Lower and pull the playfield toward the front of the cabinet so that brackets rest on the front of the cabinet.
15. Untie and pull sleeved playfield cable harness up through pedestal hole. Interconnect the following:
 - Black 36-pin connectors
 - White 36-pin connectors
 - Black 15-pin connectors
 - White 15-pin connectorsNote that a White-Red playfield control function ground lead and a White 4-pin connector remain unterminated at this time.
16. Pull cabinet cables up through the pedestal hole and interconnect the following:
 - White 24-pin connectors
 - White 4-pin connector with one remaining from playfield harness

17. Connect ground braid and White-Red lead from playfield harness under wing nut at bottom of backbox with White-Red lead from insert door.
18. On games with a power switching board mounted on the power panel in the bottom of the cabinet, a White 9-pin connector must be pulled through pedestal hole and connected with a mating connector in the backbox. (On games with the power switching board mounted in the backbox, this interconnection is made at the factory.)
19. Pull the transformer harness up through the pedestal hole and connect the following:
 - White and Blue 6-pin connectors
 - White 12-pin connector to 3J1 on Power Supply Board.
 - White 2-pin connector to 3J9 on Power Supply Board.
20. Unlatch and open insert door. Position remote volume control cable from cabinet, and Sound Board power cable from transformer into the backbox harness and plug connectors into 10J4 and 10J1, respectively.

INSPECTION

1. Check all connectors in backbox for loose wire terminations. Reseat any loose wires by pushing in on the terminal.
2. Push on all connectors attached to Master Display, CPU, Driver, and Sound Boards, and check terminations on upright capacitor and bridge rectifiers at the lower right of the backbox.
3. Gently press on all the socketed IC packages on the CPU and Sound Boards.
4. Check that two fuses on the Sound Board, seven fuses on Power Supply Board, two fuses on Power Switching Board, line fuse on power panel, and fan motor fuse (on back cabinet wall or on Power Panel) are secure.
5. Push on the connectors attached to Slave Display Boards.
6. Check the transformer input connectors in bottom of cabinet for loose wire termination. Reseat any loose wires by pushing in on the terminations.
7. Check the cabinet to coin door connector for loose wire terminations. Reseat any loose wires by pushing in on the terminations.
8. Raise playfield against backbox and check four connectors on Alphanumeric Display, White 3-pin connector, and three White 9-pin connectors.

POWER TURN-ON AND GAME SETUP

This machine **MUST BE PLUGGED INTO A PROPERLY GROUNDED OUTLET TO PREVENT SHOCK HAZARD** and to ensure **PROPER GAME OPERATION**. **DO NOT** use a "cheater" plug to defeat the ground pin on the line cord, and **DO NOT** cut off the ground pin. The line voltage **MUST** agree with that specified on the back of the cabinet or serious damage to the machine could occur. For low-line applications (105 or 210V ac), refer to the power wiring diagram.

1. Raise subfloor hinged panel, placing sleeved playfield harness in cutout, and slide subfloor back to secure hinged panel under lip of cabinet pedestal.
2. Lower playfield into position.
3. Reconnect speaker panel and latch it to backbox; close and latch insert door.
4. Install and lock the backglass.
5. Place 55 balls on the playfield.
6. Carefully replace the playfield glass.
7. Reconnect 5-pin connector to underside of control panel molding.
8. Install control panel molding by positioning feet under cabinet hold-down brackets, aligning the molding control sleeve over the shooter pivot pin, and push into position.
9. Latch molding down and close the coin door.
10. Plug the game in and turn it ON. The game should come on in the game over mode as indicated by the Player 1 score reading zero, game over lights lit, the backup high score to date alternating in the Player Score Displays and factory high score signature indicated in Alphanumeric Display.
11. If the game comes on in the diagnostic mode (*HYPERCANNONS*[™] Player 1 Display showing 04, and *HYPERCANNONS* Player 2 Display showing 00, and Player 1 Score Display showing game identification) turn the game OFF and ON again.
 - a. If the game still comes on in the game over mode, the bookkeeping and game evaluation totals have been reset to zero.
 - b. If the game still comes on in the diagnostic mode, open the coin door and turn the game OFF and ON, twice. This is an indication of the batteries being removed with the power OFF, or coming loose during shipment. This has also resulted in features reverting to factory settings. Any changes from factory settings must be reentered using procedures provided in this manual.

GAME OPERATION

*Indicates adjustable features.

Game Over Mode - Turn game ON; *HYPERCANNONS*[™] (Energy Centers) Player 1 Display indicates 0, Player 1 Score Display indicates 00. All playfield lamps cycle in an attract mode and the alphanumeric display cycles an attract mode message. The factory high score signature is displayed and the Player Score Displays indicates 500,000*. Pressing Z-bomb in Game Over also presents the high score signature and high score displays.

Credit Posting - With 1 credit posted, 1-player standard play is possible. With 2 credits posted, 2-player standard or 1-player extended* play is possible. With 4 or more credits posted, 2-player extended* play is possible.

Game Start - Push 1- or 2-Player Start button. For extended play, push button twice. The number of credits (indicated on the alphanumeric display) is reduced appropriately. The *HYPERCANNONS* Player 1 Display indicates 1* or 4* (for 2-player games, *HYPERCANNONS* Player 2 Display indicates 2* or 5*), Player 1 Score Display flashes; the ball feed motor and ball shooter fan start. Operating the shooter handle switches shoot balls onto the playfield.

Game Play - Lightning bolts light up at the sides of the playfield and "walk" to the top of the playfield. From the top of the playfield the bolts can strike toward the Energy Center. There are five Energy Units for each Energy Center; after five hits on the Energy Center the player's turn is over. Flashing bolts appear between the lift-up targets and the Energy Center. They fire at the Energy Center and maneuver left and right down toward it; should they reach the level adjacent to the Energy Center, all remaining Energy Units are destroyed.

Rotate the shooter handles to aim, and operate the shooter switches to hit lit and flashing bolts. Depress the Z-Bomb pushbutton on the front molding to destroy all bolts. Scoring is awarded for hitting lit bolts. Hitting 30 bolts completes an attack wave, and a bonus (1000 x Wave No.) is awarded for each remaining Energy Unit. The wave no. multiplier remains at 9 for wave 11 and subsequent waves. "COMPLETED" is indicated in the alphanumeric display, then the bonus is indicated and scored.

Bonus features are indicated in the alphanumeric display. Hitting an indicated bolt or spelling a specified word, awards bonus Energy Units (E.U.), Z-Bombs (Z.B.), or Points.

Every fifth wave is a Reflex Wave. A bolt lights randomly and a score is counted down in the alphanumeric display. Hitting the lit bolt stops the countdown and the remaining score is awarded. The Reflex Wave consists of up to 20 opportunities. After the first five opportunities, failing to hit the bolt before the countdown passes zero terminates the wave, and "YOU MISSED" is indicated on the alphanumeric display. A bonus is awarded at the end of a successful Reflex Wave; 50,000 for Wave 5 and 100,000 for Wave 10 and subsequent waves.

When one Energy Unit remains, "CRITICAL" is indicated on the alphanumeric display. A player's turn continues as each wave is completed and terminates when all Energy Units are used up. An additional Energy Center and Z-Bomb is awarded every 400,000* Points.

BOOKKEEPING AND GAME EVALUATION

(Functions 01-12)

1. Set AUTO-UP/MANUAL-DOWN switch to AUTO-UP and depress ADVANCE pushbutton. Test 04 is indicated in the *HYPERCANNONS* Player 1 display, Function 00 in *HYPERCANNONS* Player 2 Display, and Game Identification in Player 1 Score Display.
2. Operate the ADVANCE pushbutton to display Functions 01 thru 04 on the *HYPERCANNONS* Player 2 Display (See Table 1) and record the corresponding totals (number of coins and total paid credits) from the Player 1 Score Display. (To review a total that has been advanced past, set switch to MANUAL-DOWN and operate the ADVANCE pushbutton).
3. Operate the ADVANCE pushbutton to display Function 06 and record the corresponding bonus Energy Centers achieved from the Player 1 Score Display.
4. Operate the ADVANCE pushbutton to display Function 08. Total paid credits is indicated on the Player 1 Score Display.
5. Operate the ADVANCE pushbutton to display Functions 10 and 11. Record the corresponding totals from the Player 1 Score Display.
6. With switch set to MANUAL-DOWN operate ADVANCE to display Function 50 in the *HYPERCANNONS* Player 2 Display. From Function 50 you can return to game over or zero audit totals and return to game over. Perform step 7.a. or 7.b. as desired.
7.
 - a. To return to game over, set the switch to AUTO-UP and depress ADVANCE.
 - b. To zero audit totals and return to game over set switch to AUTO-UP, operate the 1-Player Start button to display 35 in the Player 1 Score Display, and depress ADVANCE.

Table 1. Audit Totals

FUNCTION	DESCRIPTION
00	Game Identification (3509 1)
01	Coins, Left chute (closest to coin door hinge)
02	Coin, center chute
03	Coin, right chute
04	Total Credits
05	Not Used
06	Additional Energy Centers Awarded
07	Not Used
08	Total Credits
09	Not Used
10	Energy Center Time in Minutes
11	Total Energy Centers Played
12	Current High Score to Date
13	Backup High Score to Date

NOTE

DURING EACH COLLECTION AND SERVICE CALL, VERIFY THAT BALL SHOOTER FAN IS RUNNING. OVERHEATING OF BALL SHOOTER COIL MAY RESULT IF FAN STOPS.

GAME ADJUSTMENT PROCEDURE
(Functions 13-41)

Coin door must be open to change settings.

1. Set AUTO-UP/MANUAL-DOWN switch to AUTO-UP and depress ADVANCE pushbutton. Test 04 is indicated in the display; Function 00 in *HYPERCANNONS* Player 2 Display, and game identification in Player 1 Score Display.
2. To raise Function number in *HYPERCANNONS* Player 2 Display, operate ADVANCE pushbutton with switch set to AUTO-UP. To lower Function number operate ADVANCE with it set to MANUAL-DOWN.
3. With desired Function indicated in *HYPERCANNONS* Player 2 Display, raise value in Player 1 Score Display by operating 1-Player Start button with switch set to AUTO-UP; lower value by operating 1-Player Start button with it set to MANUAL-DOWN. Value left in Player 1 Score Display is new setting. For values see Table 2 and (for pricing) Table 3.
4. Repeat sets 2 and 3 until all required adjustments have been made.
5. Operate ADVANCE until Function 50 is indicated in *HYPERCANNONS* Player 2 Display. From Function 50 you can return to game over or restore factory settings. Perform step 6 or 7 as desired.

6. To return to game over, depress ADVANCE with switch set to AUTO-UP.
7. To restore factory settings and zero audit totals:
 - a. Operate 1-Player Start button with switch set to AUTO-UP until 45 is indicated in Player 1 Score Display.
 - b. Depress ADVANCE. The game returns to Test 04, Function 00.
 - c. Set switch to MANUAL-DOWN and depress ADVANCE to indicate Function 50.
 - d. Set switch to AUTO-UP and depress ADVANCE.

RESETTING HIGH SCORE TO DATE

1. Using game adjustment procedure, set Function 13 to the desired reset value.
2. Depress HIGH SCORE RESET pushbutton (or turn game OFF and ON).

HIGH SCORE SIGNATURE

(Functions 42-49)

Functions 42-49 contained in Test 04 will be the high score signature which is indicated on the alphanumeric display. Disregard indication on the Player 1 Score Display when observing these functions.

Table 2. Game Adjustments

FUNCTION	DESCRIPTION	NOTES	FACTORY SETTING
13	Backup High Score to Date	1	500,000
14	Not Used	-	00
15	Not Used	-	00
16	Not Used	-	00
17	Not Used	-	00
18	Maximum Credits	2	30
19	Standard and Custom Pricing Control (00-08)	3,4	01/02
20	Left Coin Slot Multiplier	3,4	01/09
21	Center Coin Slot Multiplier	3,4	04/45
22	Right Coin Slot Multiplier	3,4	01/18
23	Coin Units Required for Credit	3,4	01/05
24	Coin Units Bonus Point	3,4	00/45
25	Minimum Coin Units	3,4	00
26	Not Used	-	01
27	Not Used	-	01
28	Not Used	-	00
29	Maximum Plumb Bob Tilts	-	03
30	Energy Centers - Standard Play	4	02
31	Additional Energy Centers - Extended Play	4	03
32	Reflex Wave Difficulty 00 (Conservative) to 09 (Liberal)	-	05
33	Energy Center Award Level (400,000)	5	04
34	Initial Bolt Speed 00 (Conservative) to 20 (Liberal)	6	12
35	Bolt Feed Rate 00 (Conservative) to 09 (Liberal)	6	05
36	Flashing Bolt Initial Difficulty 00 (Liberal) to 09 (Conservative)	6	05
37	Not Used	-	-
thru 41			

* Second Factory Setting value is with jumper W25 on CPU Board connected.

1. Function 13 may be set to any multiple of 100,000 points.
2. Setting Maximum Credits (Function 18) to zero places the game in a free play mode.
3. With Function 19 set to 00, Functions 20-25 must be set manually. Refer to Table 2 for eight standard pricing schemes (selected by values of 01-08 for Function 19) and custom pricing values.
4. An alternate recommendation is to double the price per credit and increase standard play Energy Centers to 3 and extended play Energy Centers to 7 (settings of 03 and 04 for functions 30 and 31, respectively).
5. Function 33 may be set for any multiple of 100,000 points (01 = 100,000, 02 = 200,000, and so on). No Energy Centers are awarded with it set to 00.
6. Three adjustments (Functions 34, 35 and 36) control initial difficulty and game time. Initial bolt speed (Function 34) controls how fast the bolts move up the side of the playfield. Bolt feed rate (Function 35) adjusts the interval between new bolts. Flashing bolt difficulty (Function 36) sets the initial aggressiveness of the flashing bolt.

DIAGNOSTIC PROCEDURES

DISPLAY TEST

1. Set AUTO-UP/MANUAL-DOWN switch to MANUAL-DOWN and depress ADVANCE. The decimal displays on the insert board should indicate all 0's and the alphanumeric display on the playfield should indicate a star pattern; (that is all segments except the 6 segments that form a zero, and the dot and comma segments).
2. Set the switch to AUTO-UP. Decimal displays in the insert board should sequence from all 0's through all 9's and the alphanumeric display on the playfield should alternate between the star pattern and the zero, with comma and dot segments. Comma segments should come on in the decimal display when odd digits are displayed.
3. To stop cycling, set switch to MANUAL-DOWN. Operate ADVANCE pushbutton to step tests one number at a time. Set switch to AUTO-UP to resume cycling.

SOUND TEST

1. From Display Test depress ADVANCE with the switch set to AUTO-UP. Test 00 should be indicated in the *HYPERCANNONS* Player 1 Display, and the *HYPERCANNONS* Player 2 Display should sequence from 00 thru 06. Different sounds should be produced for 00, 01, 02, 03, and 04.
2. To continuously pulse a single sound, set the toggle switch to MANUAL-DOWN. Operate ADVANCE pushbutton to sequence through sounds one at a time. Set toggle switch to AUTO-UP to resume sequencing.

LAMP TEST

From Sound Test depress ADVANCE with the switch set to AUTO-UP. Test 01 should be indicated in the *HYPERCANNONS* Player 1 Display, and all multiplexed lamps should flash.

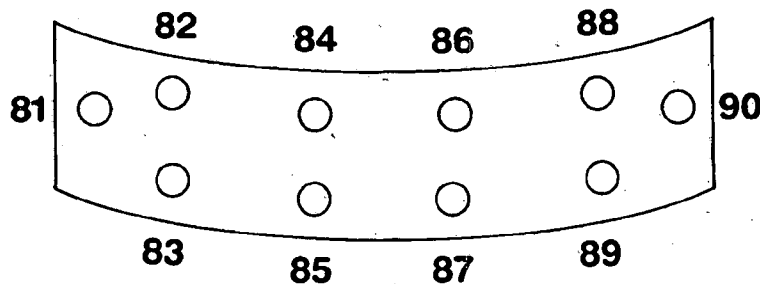
NOTE

DURING EACH COLLECTION AND SERVICE CALL, VERIFY THAT BALL SHOOTER FAN IS RUNNING. OVERHEATING OF BALL SHOOTER COIL MAY RESULT IF FAN STOPS.

COLUMN	1 YEL-BRN 2J12-9	2 YEL-RED 2J12-8	3 YEL-ORN 2J12-7	4 YEL-BLK 2J12-6	5 YEL-GRN 2J12-5	6 YEL-BLU 2J12-3	7 YEL-VIO 2J12-2	8 YEL-GRY 2J12-1
1 RED-BRN 2J14-1	H Lightning Bolt #1 (top)	I Lightning Bolt #3	J Lightning Bolt #5	L Lightning Bolt #1 (top)	M Lightning Bolt #3	N Lightning Bolt #5	P Lightning Bolt #1 (top)	C Lightning Bolt
2 RED-BLK 2J14-2	H Lightning Bolt #2	I Lightning Bolt #4	J Lightning Bolt #6 (bottom)	L Lightning Bolt #2	M Lightning Bolt #4	N Lightning Bolt #6 (bottom)	P Lightning Bolt #2	D Lightning Bolt
3 RED-ORN 2J14-3	H Lightning Bolt #3	I Lightning Bolt #5	K Lightning Bolt #1 (top)	L Lightning Bolt #3	M Lightning Bolt #5	O Lightning Bolt #1 (top)	P Lightning Bolt #3	E Lightning Bolt #3 (bottom)
4 RED-YEL 2J14-4	H Lightning Bolt #4	I Lightning Bolt #6 (bottom)	K Lightning Bolt #2	L Lightning Bolt #4	M Lightning Bolt #6 (bottom)	O Lightning Bolt #2	P Lightning Bolt #4	E Lightning Bolt #2
5 RED-GRN 2J14-5	H Lightning Bolt #5	J Lightning Bolt #1 (top)	K Lightning Bolt #3	L Lightning Bolt #5	N Lightning Bolt #1 (top)	O Lightning Bolt #3	P Lightning Bolt #5	E Lightning Bolt #1 (top)
6 RED-BLU 2J14-6	H Lightning Bolt #6 (bottom)	J Lightning Bolt #2	K Lightning Bolt #4	L Lightning Bolt #6 (bottom)	N Lightning Bolt #2	O Lightning Bolt #4	P Lightning Bolt #6 (bottom)	F Lightning Bolt
7 RED-VIO 2J14-9	I Lightning Bolt #1 (top)	J Lightning Bolt #3	K Lightning Bolt #5	M Lightning Bolt #1 (top)	N Lightning Bolt #3	O Lightning Bolt #5	A Lightning Bolt	G Lightning Bolt
8 RED-GRY 2J14-8	I Lightning Bolt #2	J Lightning Bolt #4	K Lightning Bolt #6 (bottom)	M Lightning Bolt #2	N Lightning Bolt #4	O Lightning Bolt #6 (bottom)	B Lightning Bolt	Y Lightning Bolt

Figure 1. 8 x 8 Lamp Matrix

COLUMN	1A GRY-BRN 2J13-9	2A GRY-RED 2J13-8	3A GRY-ORN 2J13-7	4A GRY-YEL 2J13-6	5A GRY-GRN 2J13-5	6A GRY-BLU 2J13-3	7A GRY-VIO 2J13-2	8A GRY-BLK 2J13-1
9 BLU-BRN 2J15-1	W Lightning Bolt	T Lightning Bolt #2	Player 1 Bomb (top)	Player 2 Bomb (middle)	Energy Center Light	Energy Center Light	Energy Center Light	Not Used
10 BLU-RED 2J15-3	V Lightning Bolt	T Lightning Bolt #3 (bottom)	Player 1 Bomb (middle)	Player 2 Bomb (bottom)	Energy Center Light	Energy Center Light	Energy Center Light	Not Used
11 BLU-ORN 2J15-4	U Lightning Bolt	S Lightning Bolt	Player 1 Bomb (bottom)	Player #1 Light	Energy Center Light	Energy Center Light	Not Used	Not Used
12 BLU-YEL 2J15-5	T Lightning Bolt #1 (top)	R Lightning Bolt	Player 2 Bomb (top)	Player #2 Light	Energy Center Light	Energy Center Light	Not Used	Not Used



ENERGY CENTER LIGHTS (UNDERSIDE)

Figure 2. 4 x 8 Lamp Matrix

CONTROL FUNCTION TEST

1. From Lamp Test depress ADVANCE with the switch set to AUTO-UP. Test 02 should be indicated in the *HYPERCANNONS* Player 1 Display. The Ball Feed Motor is switched on and *HYPERCANNONS* Player 2 Display sequences from 01 thru 09. Corresponding control functions 01 thru 09 are pulsed.
2. To continuously pulse a single control function set switch to MANUAL-DOWN. Operate ADVANCE pushbutton to sequence through the control functions one at a time. Set switch to AUTO-UP to resume sequencing.

Table 4. Control Function Connections

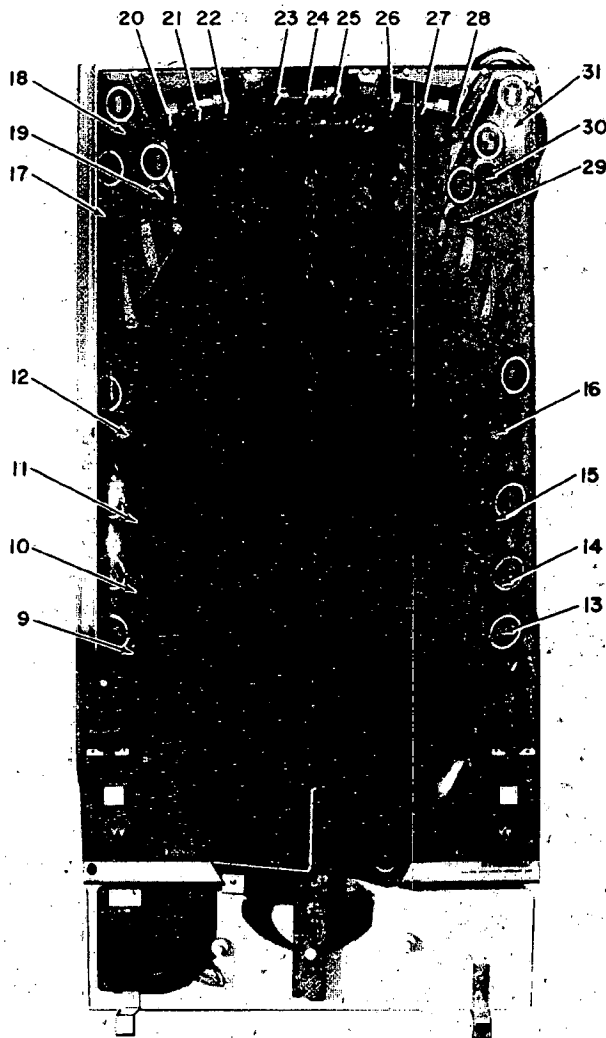
FUNCTION NO.	DESCRIPTION	WIRE COLOR	CONNECTIONS	DRIVER TRANS.	DRIVES
01	HYPER Flash Lamps	BRN-BLK	2P20-1, 8P3-10	Q7	Type 63 Bulbs
02	ENERGY CENTER Flash Lamps	BRN-RED	2P20-2, 8P3-12	Q8	Type 63 Bulbs
03	Player 1 Flash Lamps (Backbox)	BRN-ORN	2P20-8, 9P1-8	Q3	Type 63 Bulbs
04	General Illumination Relay (Backbox)	BRN-YEL	2P20-5, 9P1-9	Q7	5580-09613
05	Not Used		2P20-6		--
06	Coin Lockout	BRN-BLU	2P20-7, 7P1-8, 7P2-4	Q6	SM-35-4000-DC
07	General Illumination Relay (Playfield)	BRN-VIO	2P20-3, 8P3-11	Q1	5580-09613
08	Player 2 Flash Lamps (Backbox)	BRN-GRY	2P20-9, 9P1-7	Q5	Type 63 Bulbs
09*	Ball Shooter	VIO-YEL	2P5-5, 15P5-5, 15P2-3	Q54	Power Switching Board
*	Ball Feed Motor (Switched Ground) (+ 5VDC Pullup)	GRY-GRN	2P5-1, 15P5-2, 15P2-2	Q53	
		GRY-YEL	2P5-2, 5P5-8, 15P2-1	R71	

***NOTES**

1. Connections to Ball Shooter Solenoid (Part No. SD-24.5-1588-DC) from Power Switching Board
+ 80VDC - BLU-GRY 15P3-1,2, 15P5-7, 15P6-2, 8P3-3
Switched Ground -- BLU-VIO 15P3-5,6, 15P5-1, 8P3-7
2. Connections from Power Switching Board for Ball Feed Motor:
115 VAC - ORN-GRY- 15P4-2
AC Return ORN-VIO- 15P4-1

SWITCH TEST

1. From Control Function Test depress ADVANCE with the switch set to AUTO-UP. Test 03 should be indicated in the *HYPERCANNONS* Player 1 Display and any stuck switches in the *HYPERCANNONS* Player 2 Display. As stuck switch(es) is displayed a sound is produced. The display continuously cycles through the stuck switches and as they are opened, the number is removed from the sequence. When all switches are open, the *HYPERCANNONS* Player 2 Display is blank and the sounds stop.
2. If all switches in a row are displayed, first verify that all are open and then check for a short to ground on the row wire.
3. Operate switches; a sound is produced and switch number is momentarily indicated in the ball in play display. If two switches in a row are indicated with one switch closed, check for a short between the column wires; for multiple indication check column wire for short to ground. If two switches in a column are indicated with one switch closed, check for short between row wires.
4. Shorted diodes on all hole switches can cause "rectangle" switch matrix problems as in previous Williams flipper games; however, they will have no noticeable effect in the play of the game. However, if there was a shorted diode at switch 11 with switches 11' and 12 making at the same time, pressing the 1 Player start switch could cause the right coin switch to be recognized and put credits into the game.
5. Switches 20 thru 28 (lift-up targets) are electrically normally closed, and opened when the target is lifted up. The program in diagnostics performs the necessary inversion to make these switches appear as normal. If one of these switches is indicated as stuck the problem can be caused by dirt or foreign material between the Opto-isolator aperture or a defective Opto-Isolator. If a bank of 3 lift-up targets are indicated as stuck, check continuity of the + 5VDC and ground leads thru the 9 pin connectors associated with the target bank. If all 9 switches are indicated as stuck, check continuity of those leads thru the 3-pin 8P4/8J4 connector, Pins 13/15 of the 8P3/8J3 solenoid connector, and the 1 pin connector 6P2 (gray lead) in the back box.



SWITCH NO.	FUNCTION
01	Plumb Bob Tilt
02	2-Player Start
03	1-Player Start
04	Right Chute
05	Center Chute
06	Left Chute
07	Slam Tilt
08	High Score Reset
09	A Hole
10	B Hole
11	C Hole
12	D Hole
13	Y Hole
14	W Hole
15	V Hole
16	U Hole
17	E Hole
18	F Hole
19	G Hole
20	H Lift-up Target
21	I Lift-up Target
22	J Lift-up Target
23	K Lift-up Target
24	L Lift-up Target
25	M Lift-up Target
26	N Lift-up Target
27	O Lift-up Target
28	P Lift-up Target
29	R Hole
30	S Hole
31	T Hole
32	Z-Bomb Switch
33	Left Shooter
34	Right Shooter

COLUMN	1 GRN-BRN 2J3-9	2 GRN-RED 2J3-8	3 GRN-ORN 2J3-7	4 GRN-YEL 2J3-6	5 GRN-BLK 2J3-5	6 GRN-BLU 2J3-3	7 GRN-VIO 2J3-2	8 GRN-GRY 2J3-1
ROW								
1	WHT-BRN 2J4-9 Plumb Bob Tilt 1	A Hole 9	E Hole 17	M Lift-up Target 25	Left Shooter 33	Not Used 41	Not Used 49	Not Used 57
2	WHT-RED 2J4-8 2 Player Start 2	B Hole 10	F Hole 18	N Lift-up Target 26	Right Shooter 34	Not Used 42	Not Used 50	Not Used 58
3	WHT-ORN 2J4-7 1 Player Start 3	C Hole 11	G Hole 19	O Lift-up Target 27	Not Used 35	Not Used 43	Not Used 51	Not Used 59
4	WHT-YEL 2J4-6 Right Chute 4	D Hole 12	H Lift-up Target 20	P Lift-up Target 28	Not Used 36	Not Used 44	Not Used 52	Not Used 60
5	WHT-GRN 2J4-5 Center Chute 5	Y Hole 13	I Lift-up Target 21	R Hole 29	Not Used 37	Not Used 45	Not Used 53	Not Used 61
6	WHT-BLU 2J4-4 Left Chute 6	W Hole 14	J Lift-up Target 22	S Hole 30	Not Used 38	Not Used 46	Not Used 54	Not Used 62
7	WHT-VIO 2J4-3 Slam Tilt 7	V Hole 15	K Lift-up Target 23	T Hole 31	Not Used 39	Not Used 47	Not Used 55	Not Used 63
8	WHT-GRY 2J4-1 High Score Reset 8	U Hole 16	L Lift-up Target 24	Z-Bomb Switch 32	Not Used 40	Not Used 48	Not Used 56	Not Used 64

Figure 3. Playfield Switch Locations and Switch Matrix

INITIATING AUTO-CYCLE MODE

1. Set AUTO-UP/MANUAL-DOWN switch to AUTO-UP and depress ADVANCE pushbutton. Test 04 is indicated in *HYPERCANNONS* Player 1 Display and Function 00 in *HYPERCANNONS* Player 2 Display.
2. Set switch to MANUAL-DOWN and depress ADVANCE to indicate Function 50 in the *HYPERCANNONS* Player 2 Display.
3. Set switch to AUTO-UP and operate 1-Player Start button to indicate 15 in Player 1 Display.
4. Depress ADVANCE pushbutton to start Auto-Cycle mode. Each cycle of this mode sequences thru the Display Test, Sound Test (00), Lamp Test (01), and Control Function Test (02).
5. To terminate the test and return to game over, turn the game OFF and back ON.

CPU BOARD SELF-TEST

Depress the DIAGNOSTIC pushbutton on the left side of the CPU Board. The following indications are provided for a few seconds and then the game attempts to go to game over:

- 0 - Test Passed
- 1 - IC13 RAM Faulty
- 2 - IC16 RAM Faulty
- 3 - IC17 ROM 2 Faulty
- 4 - IC14 ROM 1 Faulty
- 5 - IC20 ROM 0 Faulty
- 6 - Not used
- 7 - Not used
- 8 - IC19 CMOS RAM or Memory Protect Circuit Faulty
- 9 - Coin-door closed, Memory Protect Circuit Faulty, or IC19 CMOS RAM Faulty.

Note that "0" remaining after power turn-on indicates CPU Board lockup.

SOUND BOARD SELF-TEST

Depress DIAGNOSTIC pushbutton on the top of the Sound Board. Several electronic sounds should be produced. This sequence of sounds is repeated until the game is turned OFF and back ON.

TROUBLESHOOTING PROCEDURES

INTRODUCTION

Introduced with HYPERBALL are three unique circuit boards and opto-isolator switch assemblies. The Driver Board has been replaced with a Control Board which performs the functions of the Driver Board and provides drive for a new 12-character Alphanumeric Display Board provided in the playfield. A Power Switching Board is located either in the backbox below the Power Supply or on the Power Panel in the bottom of the cabinet. The Power Switching Board accepts auxiliary transformer secondary outputs and, under control of functions from the control board, switches isolated ac to the ball feed motor and dc to a ball shooter coil.

DISPLAY TROUBLESHOOTING

Fault Isolation

Strobes from the CPU that drive digits on the Player 1 and Player 2 Score Displays via the Master Display Board also drive characters on the Alphanumeric Display via the Control Board. If digit(s) and character(s) with corresponding strobe(s) are both missing, isolate the problem between the CPU Board, Control Board, and Master Display Board by disconnecting strobe input connectors from the Control Board and Master Display Board one at a time. Examples:

1. Character is displayed with connector removed from Master Display Board; fault is on the Master Display Board.
2. Digit is displayed with connector removed from Control Board, fault is on Control Board.
3. Neither character nor digit displayed with connectors removed one at a time; fault is with connector at CPU Board or on CPU board.

Segments are common between Player 1 and Player 2 Score Displays, and *HYPERCANNONS* (Energy Center) Player 2 Display. Isolate Segment problems between the three displays and the Master Display Board by having only one plugged in at a time. Segment problems for the *HYPERCANNONS* Player 1 Display are best isolated by using Digit Display troubleshooting indicated in Figure 4. If inputs to IC2 on the Master Display Board are proper, substitute a known good C8365 4-Digit Slave Display.

If a digit is missing from the Player 1 or Player 2 Score Display, and all characters in the Alphanumeric Display are present, isolate the problem between the displays and the Master Display by exchanging the Player 1 and Player 2 Displays. If a digit is missing from the *HYPERCANNONS* Player 1 and Player 2 Display perform troubleshooting indicated in Figure 4. If the inputs to the digit driver (IC7, IC8, IC12, or IC13) is proper, substitute a known good C-8365 4-digit Slave Display.

For alphanumeric strobe and segment problems resulting in characters or segments missing, first check continuity between the Control Board and the Alphanumeric Display. Next, isolate the problem between the Control Board and the Alphanumeric Display by exchanging the leads and pins at the Control Board connector:

1. Turn the power OFF.
2. Unplug the connector from the Control Board and locate the lead associated with the faulty character or segment.
3. a. Exchange the faulty character lead with an adjacent lead.
b. Exchange the faulty segment lead with one indicated below:
(1) a, d, h, j (3) k, r, p, n
(2) b, c, e, f (4) g, m, comma, dot

Segment Drivers (7-Digit Display)

Set the AUTO-UP/MANUAL DOWN switch to MANUAL-DOWN and depress ADVANCE to enter the Display Characters Test. Depress ADVANCE to step through all digits. Compare the inputs to IC5 (A1-D1) and individual outputs of IC5 (segments a-g) against the required signals as shown in the accompanying figure.

With a display of all 8's, all segments should be on. With a display of all 1's only segments b and c should be on and segments a, d, e, f, and g can be checked for the "OFF" condition. Displaying all 2's allows a check of segment c for the "OFF" condition and displaying all 5's allows a check of segment b.

ADVANCE in manual to a display of all 8's. If any segment is out check corresponding IC9 and IC10 output for the correct voltages for the "ON" condition (as shown in the figure). Next ADVANCE in MANUAL to the all 1's display and check segments a, d, e, f, and g (if any are on) for the "OFF" condition. Next ADVANCE to all 2's and check segment c (if on) for the "OFF" condition. Finally ADVANCE to all 5's and check segment b (if on) for the "OFF" condition.

Strobe Drivers (7 and 12-Character Displays)

Use the Display Characters Test. Check the input, driver input, and strobe driver output for the waveform and/or voltages shown in Figures 4 and 5. Note that the dc voltages indicated in this diagram represent average values with the circuit activated 1/16 of the time and will vary depending on the test equipment used and the present load determined by the number of segments illuminated for the digit being displayed.

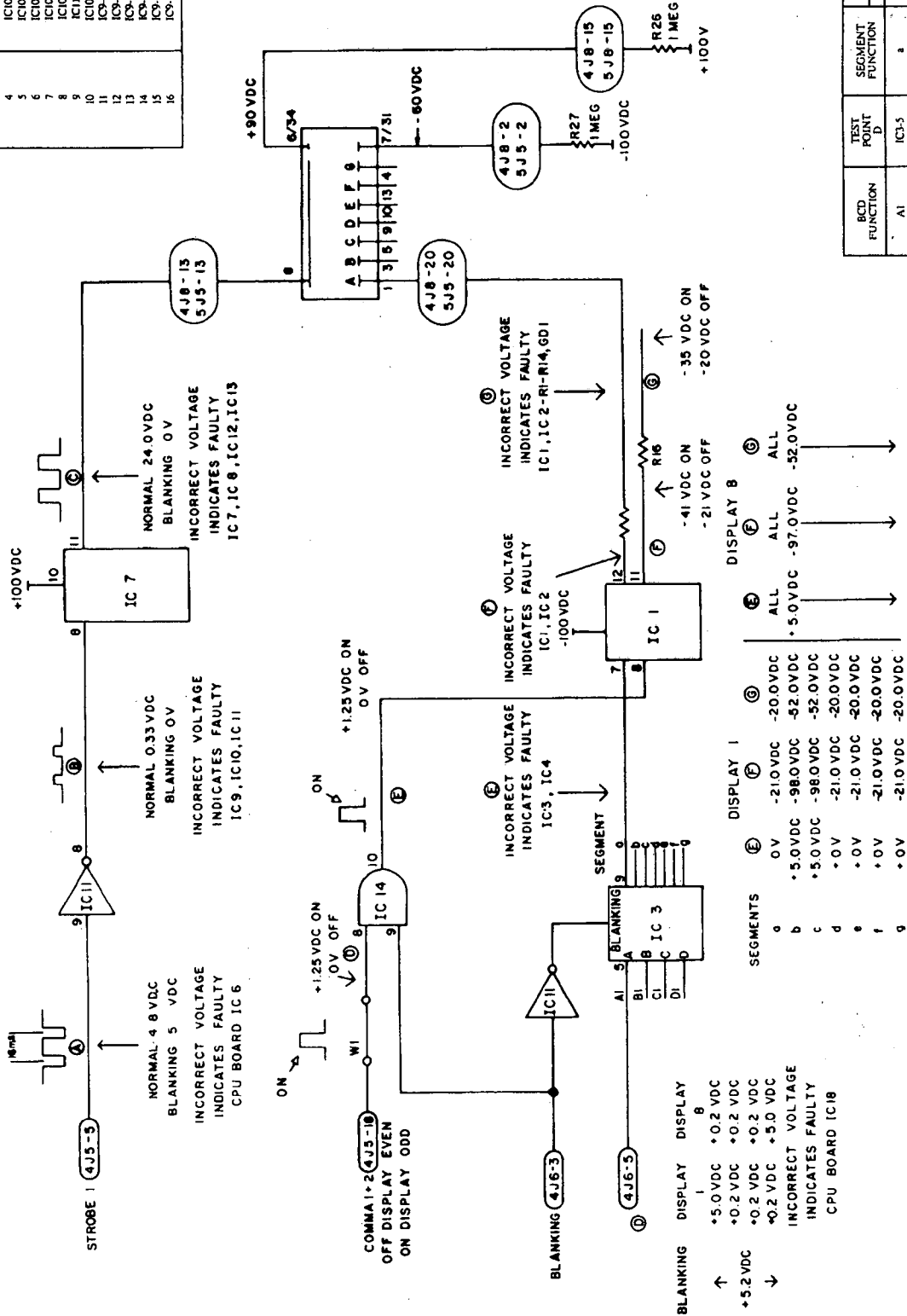
Blanking Circuit

The blanking circuit checks the BLANKING timer output from the CPU Board. BLANKING goes low, the input (inverted by IC3) will inhibit the segment decoders IC13, IC19, and IC20. To check for proper blanking levels, depress the DIAGNOSTIC pushbutton on the CPU Board with the coin door closed.

CONTROL AND POWER SWITCHING BOARDS

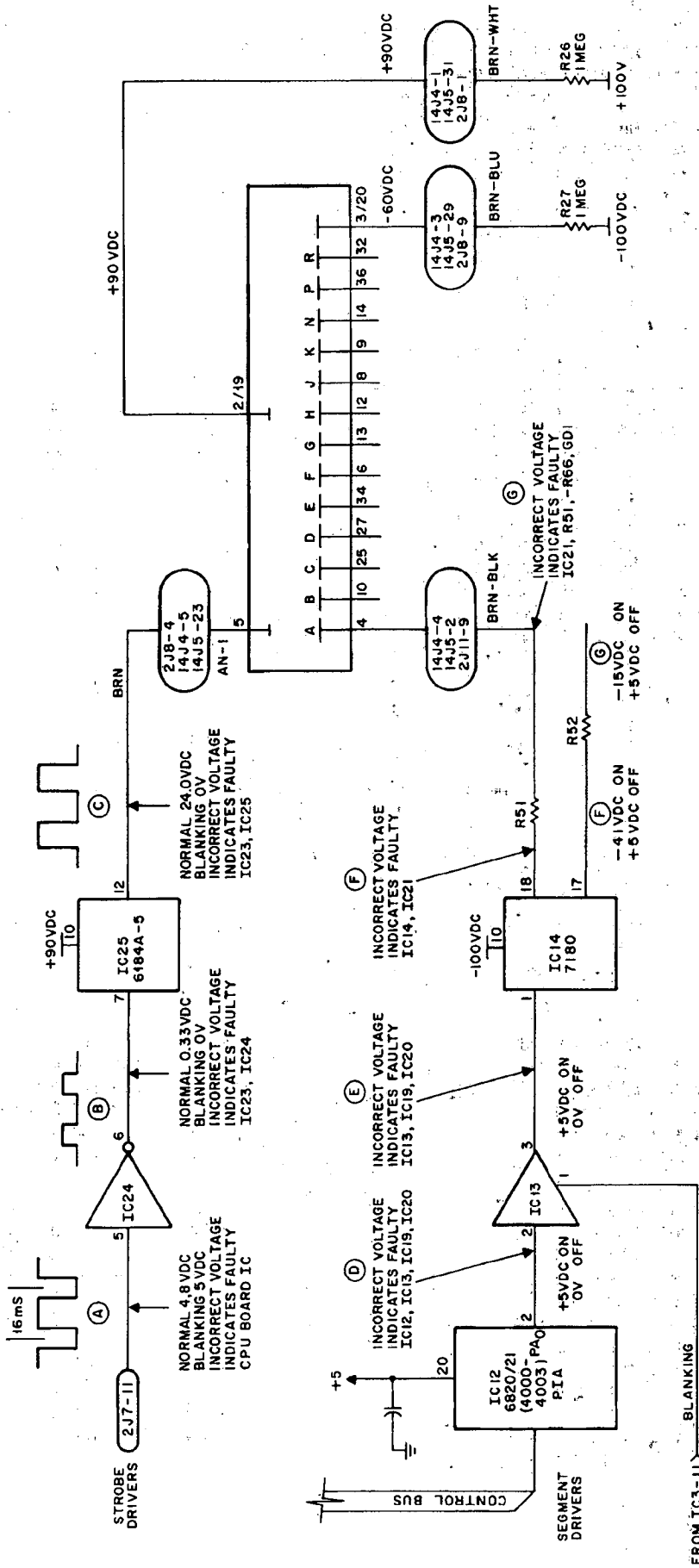
Troubleshooting for alphanumeric display circuitry on the Control Board is provided in the preceding DISPLAY TROUBLESHOOTING paragraphs. Table 5 provides troubleshooting for lamp, control function and switch circuits on the Control Board and Table 6 provides troubleshooting for the Power Switching Board. Note that for problems associated with the Ball Feed Motor and Ball Shooter, first isolate the fault to the Control Board using procedures in Table 6 before using Table 5.

STROBE	A	B	C
1	IC11-9	IC11-8	IC7-11
2	IC11-5	IC11-6	IC13-16
3	IC11-3	IC11-4	IC13-17
4	IC10-1	IC10-2	IC13-15
5	IC10-3	IC10-4	IC13-14
6	IC10-5	IC10-6	IC13-13
7	IC10-13	IC10-12	IC13-11
8	IC10-11	IC10-10	IC13-12
9	IC11-11	IC11-10	IC12-18
10	IC10-9	IC10-8	IC12-18
11	IC9-13	IC9-12	IC12-15
12	IC9-11	IC9-10	IC12-15
13	IC9-8	IC9-7	IC12-14
14	IC9-1	IC9-2	IC12-13
15	IC9-3	IC9-4	IC12-12
16	IC9-5	IC9-6	IC12-11



BCD FUNCTION	TEST POINT D	SEGMENT FUNCTION	TEST POINTS
A1	IC3-5	a	IC1-12
B1	IC3-3	b	IC1-13
C1	IC3-2	c	IC1-14
D1	IC3-4	d	IC1-15
		e	IC3-13
		f	IC3-15
		g	IC3-14
1-2 Comma	IC14-8	-	IC14-10
			IC1-11
			R1 bottom
			R2 bottom
			R3 bottom
			R4 bottom
			R5 bottom
			R7 bottom
			R6 bottom
			R16 bottom

Figure 4. Digit Displays



SEGMENT FUNCTION	TEST POINTS					
	D	E	F	G		
a	IC12-2	IC13-2	IC14-18	R51 top		
b	IC12-3	IC13-14	IC14-17	R52 top		
c	IC12-4	IC13-4	IC14-16	R53 top		
d	IC12-5	IC13-12	IC14-15	R54 top		
e	IC12-6	IC13-6	IC14-14	R55 top		
f	IC12-7	IC13-10	IC14-13	R56 top		
g	IC12-11	IC20-14	IC14-12	R60 top		
h	IC12-8	IC19-4	IC21-17	R57 top		
j	IC12-9	IC19-2	IC21-11	R58 top		
k	IC12-10	IC20-2	IC21-18	R59 top		
m	IC12-12	IC20-4	IC21-16	R61 top		
n	IC12-15	IC19-6	IC21-13	R64 top		
p	IC12-14	IC20-6	IC21-14	R63 top		
r	IC12-13	IC20-12	IC21-15	R62 top		
comma	IC12-16	IC20-10	IC21-12	R65 top		
dot	IC12-17	IC19-10	IC21-11	R66 top		

STROBE	TEST POINTS		
	A	B	C
4	IC23-5	IC23-6	IC22-13
5	IC24-9	IC24-8	IC22-12
6	IC23-9	IC23-8	IC22-11
7	IC23-11	IC23-10	IC22-14
8	IC23-3	IC23-4	IC22-15
10	IC23-13	IC23-12	IC22-16
11	IC23-1	IC23-2	IC22-17
12	IC24-1	IC24-2	IC25-16
13	IC24-13	IC24-12	IC25-15
14	IC24-3	IC24-4	IC25-14
15	IC24-11	IC24-10	IC25-13
16	IC24-5	IC24-6	IC25-12

Figure 5. Alphanumeric Display

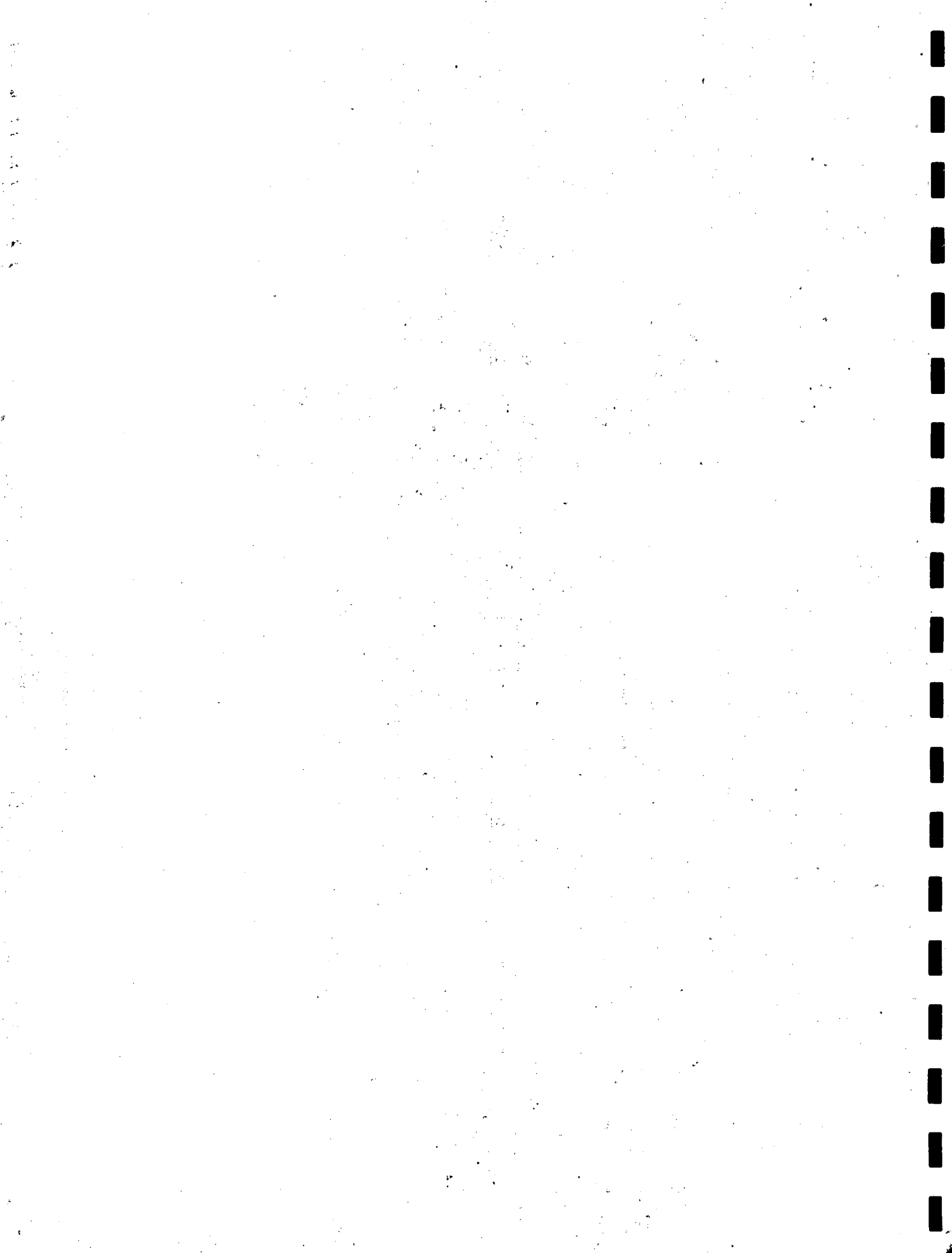
Table 5. Control Board Troubleshooting
REFER TO CONTROL BOARD LOGIC DIAGRAM, PAGE 11.

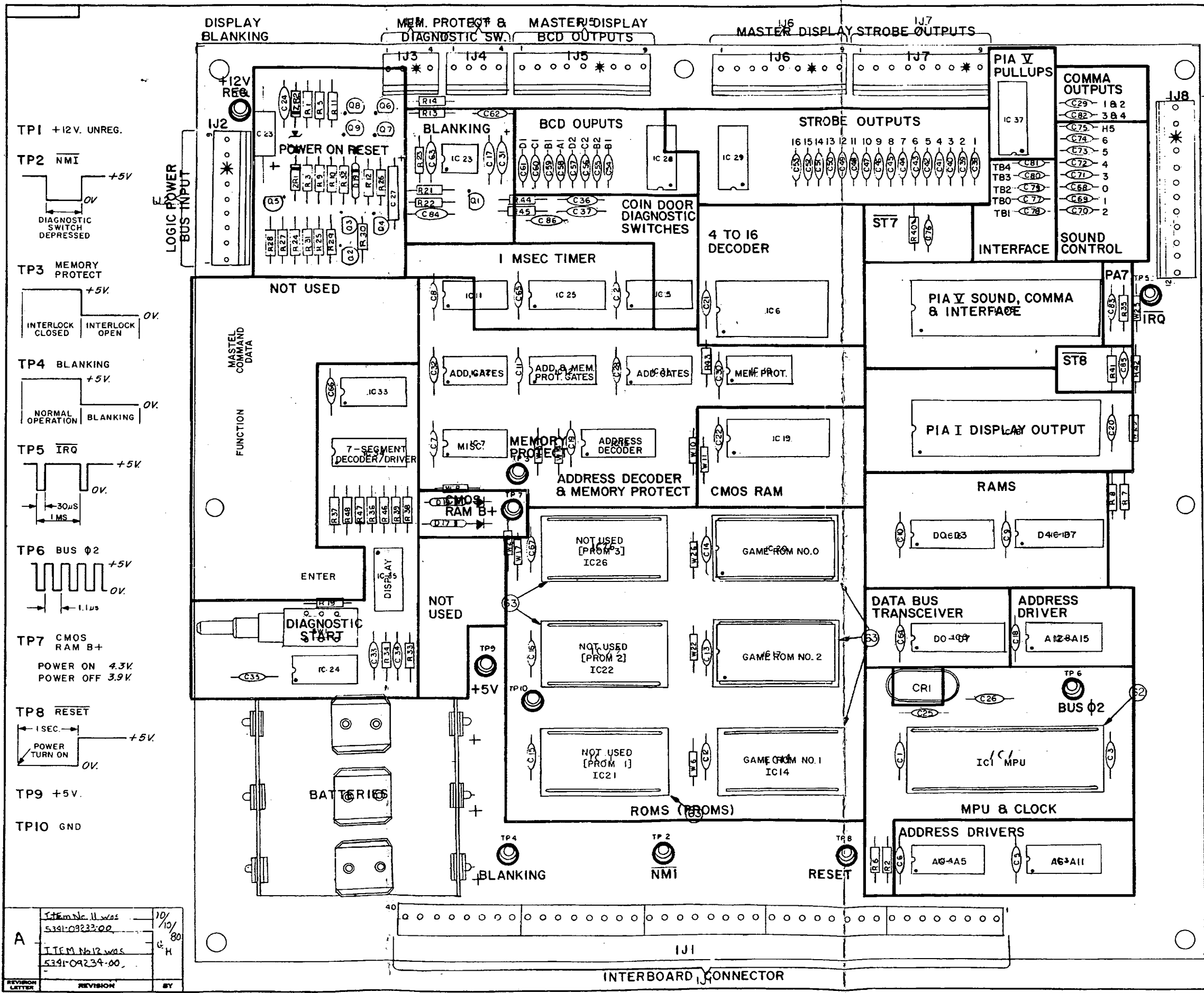
SYMPTOM	FAULTY AREA																														
Player Score Displays proper but Alphanumeric Display and/or Solenoids and controlled lamps do not function.	IC3 Blanking gates.																														
Lamp Column missing in 8x8 OR 4x8 Matrix.	Wiring from 2P12 or 2P13 thru 8P2; Associated drive transistor: <table border="0"> <tr> <td>COL</td> <td>8x8</td> <td>4x8</td> <td>COL</td> <td>8x8</td> <td>4x8</td> </tr> <tr> <td>1</td> <td>Q30</td> <td>Q31</td> <td>5</td> <td>Q42</td> <td>Q43</td> </tr> <tr> <td>2</td> <td>Q33</td> <td>Q34</td> <td>6</td> <td>Q45</td> <td>Q46</td> </tr> <tr> <td>3</td> <td>Q36</td> <td>Q37</td> <td>7</td> <td>Q48</td> <td>Q49</td> </tr> <tr> <td>4</td> <td>Q39</td> <td>Q40</td> <td>8</td> <td>Q51</td> <td>Q52</td> </tr> </table>	COL	8x8	4x8	COL	8x8	4x8	1	Q30	Q31	5	Q42	Q43	2	Q33	Q34	6	Q45	Q46	3	Q36	Q37	7	Q48	Q49	4	Q39	Q40	8	Q51	Q52
COL	8x8	4x8	COL	8x8	4x8																										
1	Q30	Q31	5	Q42	Q43																										
2	Q33	Q34	6	Q45	Q46																										
3	Q36	Q37	7	Q48	Q49																										
4	Q39	Q40	8	Q51	Q52																										
Lamp Column missing in 8x8 AND 4x8 Matrices.	IC9 PIA; IC6 or IC10 Gate; Associated pre-drive transistors <table border="0"> <tr> <td>COL</td> <td>NO.</td> <td>COL</td> <td>NO.</td> </tr> <tr> <td>1</td> <td>Q29</td> <td>5</td> <td>Q41</td> </tr> <tr> <td>2</td> <td>Q32</td> <td>6</td> <td>Q44</td> </tr> <tr> <td>3</td> <td>Q35</td> <td>7</td> <td>Q47</td> </tr> <tr> <td>4</td> <td>Q38</td> <td>8</td> <td>Q50</td> </tr> </table>	COL	NO.	COL	NO.	1	Q29	5	Q41	2	Q32	6	Q44	3	Q35	7	Q47	4	Q38	8	Q50										
COL	NO.	COL	NO.																												
1	Q29	5	Q41																												
2	Q32	6	Q44																												
3	Q35	7	Q47																												
4	Q38	8	Q50																												
Lamp Row Missing	Wiring from 2P14 or 2P13 thru 8P2; IC9 or IC5 PIA; Associated IC1 or IC2 inverter; driver transistors <table border="0"> <tr> <td>ROW</td> <td>NO.</td> <td>ROW</td> <td>NO.</td> <td>ROW</td> <td>NO.</td> </tr> <tr> <td>1</td> <td>Q27</td> <td>5</td> <td>Q23</td> <td>7</td> <td>Q19</td> </tr> <tr> <td>2</td> <td>Q28</td> <td>6</td> <td>Q24</td> <td>10</td> <td>Q20</td> </tr> <tr> <td>5</td> <td>Q25</td> <td>7</td> <td>Q21</td> <td>11</td> <td>Q17</td> </tr> <tr> <td>4</td> <td>Q26</td> <td>8</td> <td>Q22</td> <td>12</td> <td>Q18</td> </tr> </table>	ROW	NO.	ROW	NO.	ROW	NO.	1	Q27	5	Q23	7	Q19	2	Q28	6	Q24	10	Q20	5	Q25	7	Q21	11	Q17	4	Q26	8	Q22	12	Q18
ROW	NO.	ROW	NO.	ROW	NO.																										
1	Q27	5	Q23	7	Q19																										
2	Q28	6	Q24	10	Q20																										
5	Q25	7	Q21	11	Q17																										
4	Q26	8	Q22	12	Q18																										
Single Lamp Out	Solder connection; open diode; shorted bulb or socket.																														
Control Function (1-8) does not operate.	Open Wiring from 2P20 thru 2P3 PIA IC5, IC4, or IC8 Gate, Transistor: <table border="0"> <tr> <td>FUNCTION</td> <td>PRE-DRIVER</td> <td>DRIVER</td> </tr> <tr> <td>1 (Hyper Flash)</td> <td>Q12</td> <td>Q4</td> </tr> <tr> <td>2 (Energy Flash)</td> <td>Q16</td> <td>Q8</td> </tr> <tr> <td>3 (Player 1 Flash)</td> <td>Q11</td> <td>Q3</td> </tr> <tr> <td>4 (Gen. III. BB)</td> <td>Q15</td> <td>Q7</td> </tr> <tr> <td>5 (Not Used)</td> <td>Q10</td> <td>Q2</td> </tr> <tr> <td>6 (Coin Lockout)</td> <td>Q14</td> <td>Q6</td> </tr> <tr> <td>7 (Gen. III. PF)</td> <td>Q9</td> <td>Q1</td> </tr> <tr> <td>8 (Player 2 Flash)</td> <td>Q13</td> <td>Q5</td> </tr> </table>	FUNCTION	PRE-DRIVER	DRIVER	1 (Hyper Flash)	Q12	Q4	2 (Energy Flash)	Q16	Q8	3 (Player 1 Flash)	Q11	Q3	4 (Gen. III. BB)	Q15	Q7	5 (Not Used)	Q10	Q2	6 (Coin Lockout)	Q14	Q6	7 (Gen. III. PF)	Q9	Q1	8 (Player 2 Flash)	Q13	Q5			
FUNCTION	PRE-DRIVER	DRIVER																													
1 (Hyper Flash)	Q12	Q4																													
2 (Energy Flash)	Q16	Q8																													
3 (Player 1 Flash)	Q11	Q3																													
4 (Gen. III. BB)	Q15	Q7																													
5 (Not Used)	Q10	Q2																													
6 (Coin Lockout)	Q14	Q6																													
7 (Gen. III. PF)	Q9	Q1																													
8 (Player 2 Flash)	Q13	Q5																													
Control Function (1-8) Stuck on.	Same as above except check for wiring shorts.																														
Ball shooter (Control Function 9) does not operate.	Determine if fault is on Control Board using procedure in Table 6, Power Switching Board Troubleshooting. If so, proceed with following symptoms.																														
Ball Shooter locks on after replacing fuse on Power Switching Board.	IC5, IC7, IC16, or Q54 faulty.																														
Fault isolated to Control Board and Ball Shooter Does not operate.	IC5, IC16, IC7, or Q54 faulty.																														
Ball Feed Motor does not operate or runs in game over.	Determine if fault is on Control Board using procedure in Table 6 Power Switching Board Troubleshooting. If fault is on Control Board: IC5, IC7, Q53.																														
FOR SWITCHES, SEE BELOW																															
Switch Row does not operate (Switch 25, 26, 27, 20 and 28, 21, 22, 23, or 24 indicated as stuck).	Check wiring from 2P4 thru 8P1; IC17 or IC18 inverter section, IC9 PIA.																														
Switch Row stuck. (Switch 25, 26, 27, 20 and 28, 21, 22, 23, or 24 does not operate).	Switch Row wire shorted to ground; IC17 or IC18 inverter section; IC9 PIA.																														
Switches in Rows 4 thru 8 stuck (Switches 20 thru 24 are open).	Switch Column 3 wire shorted to ground; IC15 inverter; IC9 PIA.																														
Switches in Rows 1 thru 4 stuck. (Switches 25 thru 28 are open).	Switch Column 4 wire shorted to ground; IC15 inverter; IC9 PIA.																														
Closing switch in column causes multiple indication of switches in row (switches 25 thru 28, and 20 thru 24 are open).	Switch column (1, 2, or 5) wire shorted to ground; IC15 or IC16 inverter section; IC9 PIA.																														
Switch Column does not operate (Switches 20 thru 24 for Column 3, or 25 thru 28 for Column 4 are stuck).	Check wiring from 2P3 thru 8P1; IC15 or IC16 inverter section; IC9 PIA.																														
One or two lift-up targets in a bank indicated as stuck.	Dirt or foreign material between opto-isolator aperture or faulty opto-isolator.																														
Bank of three lift-up targets indicated as stuck.	Check continuity of +5VDC and ground thru associated 9-Pin connector.																														
All nine lift-up targets indicated as stuck.	Check continuity of +5VDC and ground thru 3-Pin 8P4/8J4, Pins 13 and 15 of 8P3, and 1-Pin Connector 6P2 (gray lead) in the backbox.																														
Switches 20 thru 28 (lift-up targets) are electrically normally closed, and opened when the target is lifted up. The diagnostic program performs the necessary inversion to make these switches appear as normal. Note, however, that a fault that causes other switches in a row to appear as stuck, will not register a lift-up target as stuck. Conversely, a fault that causes other switches in a row not to operate, registers a lift-up target as stuck.																															

Table 6. Power Switching Board Troubleshooting
REFER TO POWER WIRING DIAGRAM, PAGE 15.

SYMPTOM	CHECK	FAULTY AREA
Ball Feed Motor does not turn.	1. R1, R2	If overheated: Q2, R1, R2.
	2. Across 15P4-1 and -2 for 0 VAC in game over.	125 VAC reading is obtained: Open wiring thru 7P5 to Ball Feed Motor; Ball Feed Motor.
	3. With game in Control Function Test 02 across: a. 15P4-1 and -2 for 125 VAC b. 15P1-1 and -2 for 125 VAC	If a. and b. are both 0V or low: Open wiring from 7T2-11 and -12 to 15P1-1 and -2; Open wiring thru 7P4 to 7T2 primary; 7T2 If only b. is proper: Fuse 15F1. If b. is proper and a. is low: R1, R2, Q2, or IC1
	4. IC1-2 for +0.1 VDC and IC1-1 for +1 VDC.	If IC1-2 is +5 VDC: Open wiring from 15P2-1 to 2P5-1; Control Board. If both are 0V: Open wiring from 15P2-2 to 2P5-2; Control Board. If both are 0.1 VDC, or IC1-1 is +5VDC, or both are correct: IC1
Ball Feed Motor runs in Game Over Mode.	1. Disconnect 15P2	If motor stops: Control Board; Violet-Red Wire from 15P2-1 shorted to ground.
	2. Turn off power and isolate IC1-4. Reapply power.	If motor stops: IC1 If motor still runs: Q2
Ball Shooter does not operate.	1. With game in Control Function Test 02 09; 15P2-3 for +1.4V Pulsing or +0.3 to 100 mVDC.	If no pulsing or 0V: Wiring from 15P2-3 to 2P5-4; Control Board.
	2. 15P1-5 to -8 for 85VAC.	If 0V: Wiring from 7T2 to 15P1; 7T2
	3. 15P3-1 for +120 VDC	If 0V: 15F2 If 15F2 blows immediately, C3; VR2, BR1, 6C2. If 0V and F2 is good: BR1.
	4. 15P3-5 for +118 VDC	If +120 VDC: Open wiring from 15P2-8, -9 to 2P18-1, -2; Q1, D2 If 0V: Wiring to ball shooter; ball shooter coil.
Shooter locks on in Game Over Mode after replacing F2.	Disconnect 15P2	If shooter releases: Short in wiring from Control Board. If still locked on: Q1, D1.

Warning: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. As temporarily permitted by regulation it has not been tested for compliance pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference."



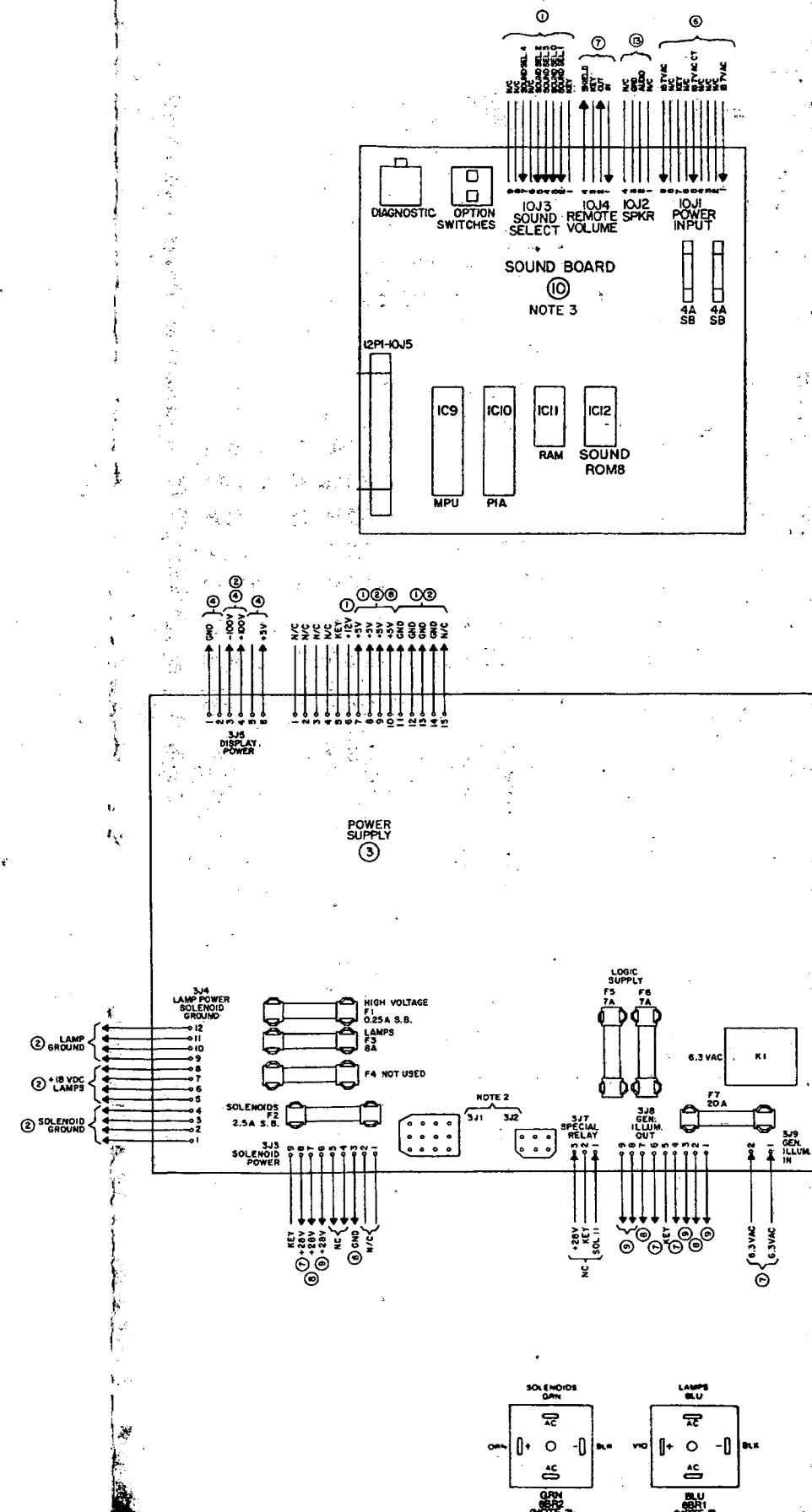
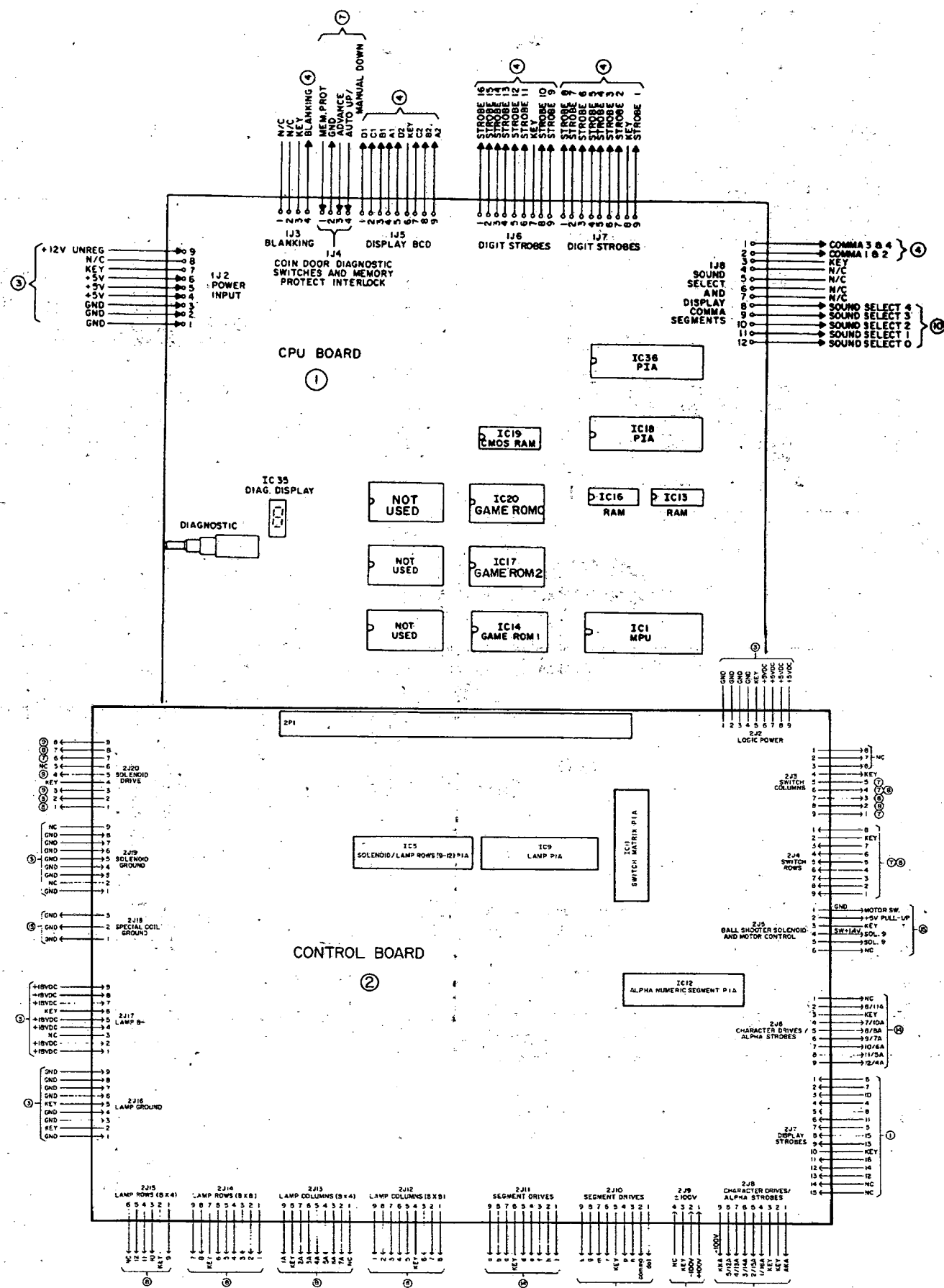


BILL OF MATERIAL				
ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQD NO.
1	5764-09465-X0		BARE PC. BOARD CPU	
2		IC3, IC4, IC8	8T97 HEX TRISTATE BUFFER	3
3	5370-08989-00	IC9	74LS245 OCTAL BUFFER	1
4	5281-09308-X0	IC6	74LS4 4 TO 16 DECODER	1
5	5280-09010-00	IC7	7404 HEX INVERTER	1
6	5281-09235-00	IC11	74LS10 TRIPPLE 3 INVERTER	1
7	5280-08973-00	IC12	7408 QUAD AND	1
8	5340-09409-X0	IC13, IC16	2114-45 1K X4 STATIC RAM	2
9	5281-09246-00	IC15	74LS139 DUAL 2 TO 4 LINE DECODER	1
10	5341-09553-00	IC20	ROM 2K X8 LOWER	1
11	5341-09554-00	IC17	ROM 4K X8 UPPER	1
12	5430-08972-00	IC18, IC36	MC6821 PIA	2
13	5340-09017-00	IC19	MC 5101 CMOS RAM	1
14	5431-09449-00	IC 23	MC 1455P1 TIMER	1
15	5280-09073-00	IC24, IC32, IC33	7400 QUAD 2 INPUT NAND	3
16	5310-09236-00	IC25	4020 CMOS 14 BIT COUNTER	1
17	5310-09237-00	IC10	4071 CMOS QUAD 2 INPUT NOR	1
18	5281-09247-00	IC 5, IC 31	74LS02 QUAD 2 INPUT NOR	2
19	5280-09407-X0	IC34	7447 BCD TO 7 SEG LED DISP	1
20	5271-09411-00	IC 35	MAN 72A 7 SEG LED DISP	1
21	5019-09238-00	IC28, IC29	13 DIP RES./PACK 4.7K OHM	2
22	5019-09223-00	IC37	15 DIP RES./PACK 10K OHM	1
23	5645-09025-00	DS1, DS2	8 STD DIP SWITCHES	2
24	5075-09018-00	ZR1	1N5996 ZENER DIODE 6.8V	1
25	5075-09029-00	ZR2	1N5990 ZENER DIODE 3.9V	1
26	5070-08919-00	D17, D19	1N4148 DIODE	18
27	5160-08938-00	Q3-Q2	2N4401 MPN TRANSISTOR	7
28	5190-09016-00	Q1, Q2	2N4403 PNP TRANSISTOR	2
29	5070-09266-00	D18	1N5817 DIODE	1
30	5520-09020-00	CR1	CRYSTAL 3.58 MHz	1
31	5010-09358-00	R5, R9, R20	RESISTOR FC 1K OHM 5% 1/4W	3
32	5010-08983-00	R2, R6-R8, R21, R28	RESISTOR FC 3.3K OHM 5% 1/4W	6
33	5010-08991-00	R13-R18, R29, R33-R35, R40, R42	RESISTOR FC 4.7K OHM 5% 1/4W	13
34	5010-09086-00	R22	RESISTOR FC 6.8K OHM 5% 1/4W	1
35	5010-09036-00	R19, R30	RESISTOR FC 100 OHM 5% 1/4W	2
36	5010-09187-00	R36-R39, R46-R50	RESISTOR FC 150 OHM 5% 1/4W	9
37	5010-09113-00	R23, R26	RESISTOR FC 33K OHM 5% 1/4W	2
38	5010-09024-00	R1, R3	RESISTOR FC 10K OHM 5% 1/4W	2
39	5010-09241-00	R25, R32, R10, R11	RESISTOR FC 22K OHM 5% 1/4W	4
40	5010-08998-00	R27	RESISTOR FC 2.2K OHM 5% 1/4W	1
41	5010-09039-00	R12	RESISTOR FC 10 OHM 5% 1/4W	1
42	5010-09442-00	R43	RESISTOR FC 330K OHM 5% 1/4W	1
43	5010-08997-00	R24, R31	RESISTOR FC 27K OHM 5% 1/4W	2
44	5010-09083-00	R44, R45	RESISTOR FC 470 OHM 5% 1/4W	2
45	5043-08980-00	C1-C22, C28, C30, C32-C37, C63-C67, C83	CAPACITOR CERAMIC 01MED 50V	36
46	5040-08986-00	C23	CAPACITOR ELECT. 100MFD 10V	1
47	5043-08996-00	C24	CAPACITOR CERAMIC 1MFD 50V	1
48	5043-09169-00	C25, C26	CAPACITOR CERAMIC 27PFD 1KV	2
49	5041-09243-00	C27	CAPACITOR TANT. 10 MFD 10V	1
50	5041-09031-00	C31	CAPACITOR TANT. 1MFD 25V	1
51	5043-09030-00	C84	CAPACITOR CERAMIC 047MFD 50V	1
52	5043-09065-00	C29, C38-C62, C66-C82, C85, C86	CAPACITOR CERAMIC 470PFD 50V	43
53				
54				
55	SEE NOTE		SWITCH MOMENTARY	2
56	588409021-00		BATTERY HOLDER #171	1
57	5791-09026-00	I/J1	HEADER 09-64-1083 8 PIN	5
58	5791-09028-00	W3, W4	HEADER 09-65-1041 4 PIN	2
59				
60	5791-09027-00	I/J2, I/J5-I/J7	HEADER 09-65-1091 9 PIN	4
61	5791-09043-00	I/J8	HEADER 09-65-1121 12 PIN	1
62	5700-08985-00		40 PIN IC SOCKET	1
63	5700-09004-00		24 PIN IC SOCKET	6
64	5010-09534-00	W3, W6, W8, W10, W11, W14, W17, W20, W25, W26, W29, W22	RESISTOR FC 0 OHM 1/4W	13
65	5824-09248-00	TP1-TP10	TEST TERMINALS #1502-1	10

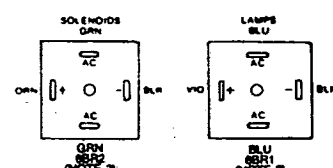
NOTE: USE EITHER 5641-09312-00, 5641-09024-00 OR 5641-09371-00

TOLERANCES		WILLIAMS ELECTRONICS, INC.	
UNLESS OTHERWISE SPECIFIED	FRAC.	8401 N. CALIFORNIA	CHICAGO, ILL. 60618
DECIMAL	±.005	NAME	PIN BALL CPU SUB-ASSEMBLY
HOLE DIA.	±.005	MATERIAL	DATE TREATMENT
ANNUAL	±.010	DATE	SCALE
CONDUCTIVITY	±.010	DATE	SCALE
SCREW THREAD	±.010	DATE	SCALE
		DATE	SCALE

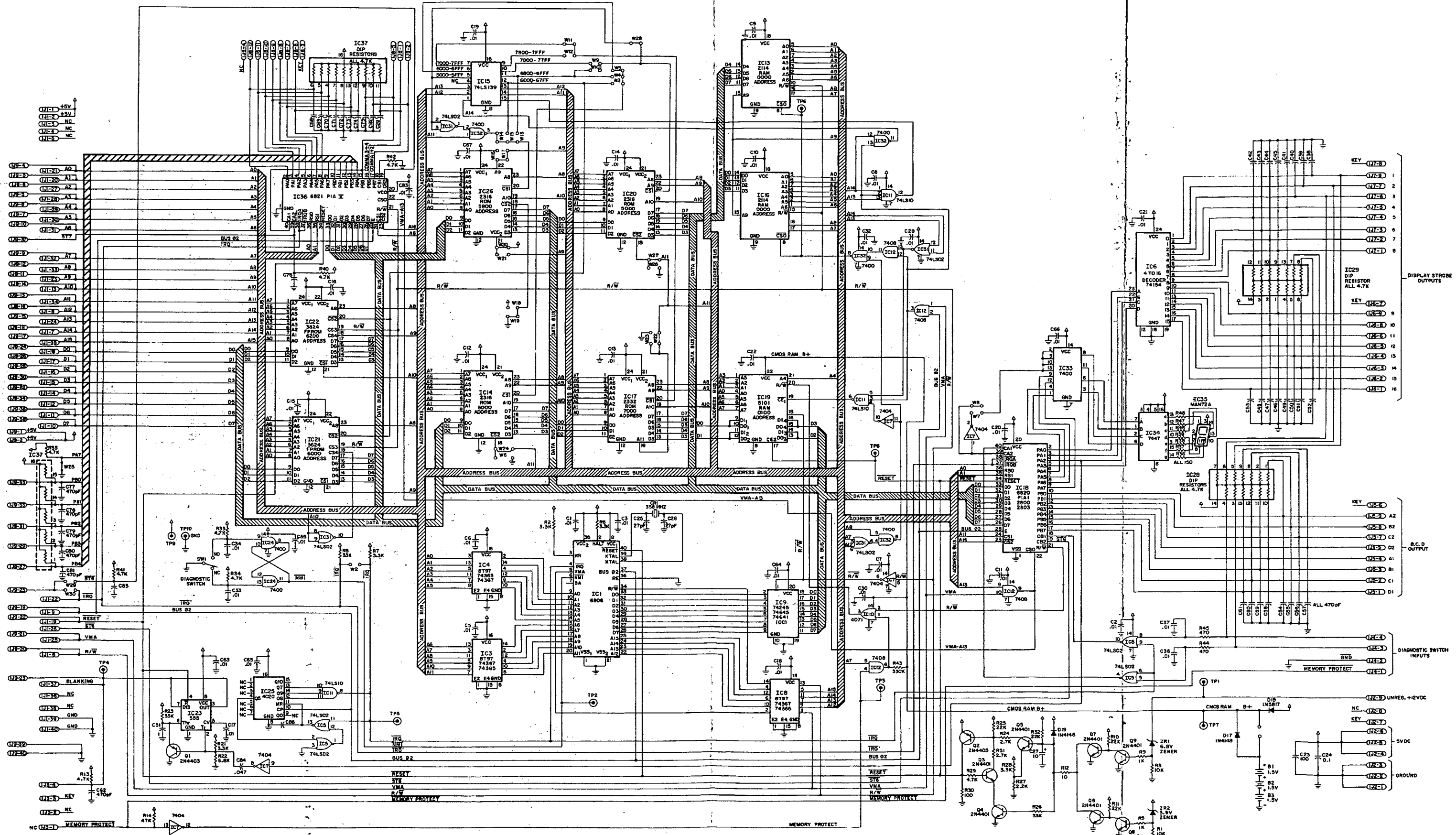
REVISION LETTER	REVISION	BY
A	Item No. 11 was 5341-09233-00	10/10/80
	Item No. 12 was 5341-09234-00	C.H.



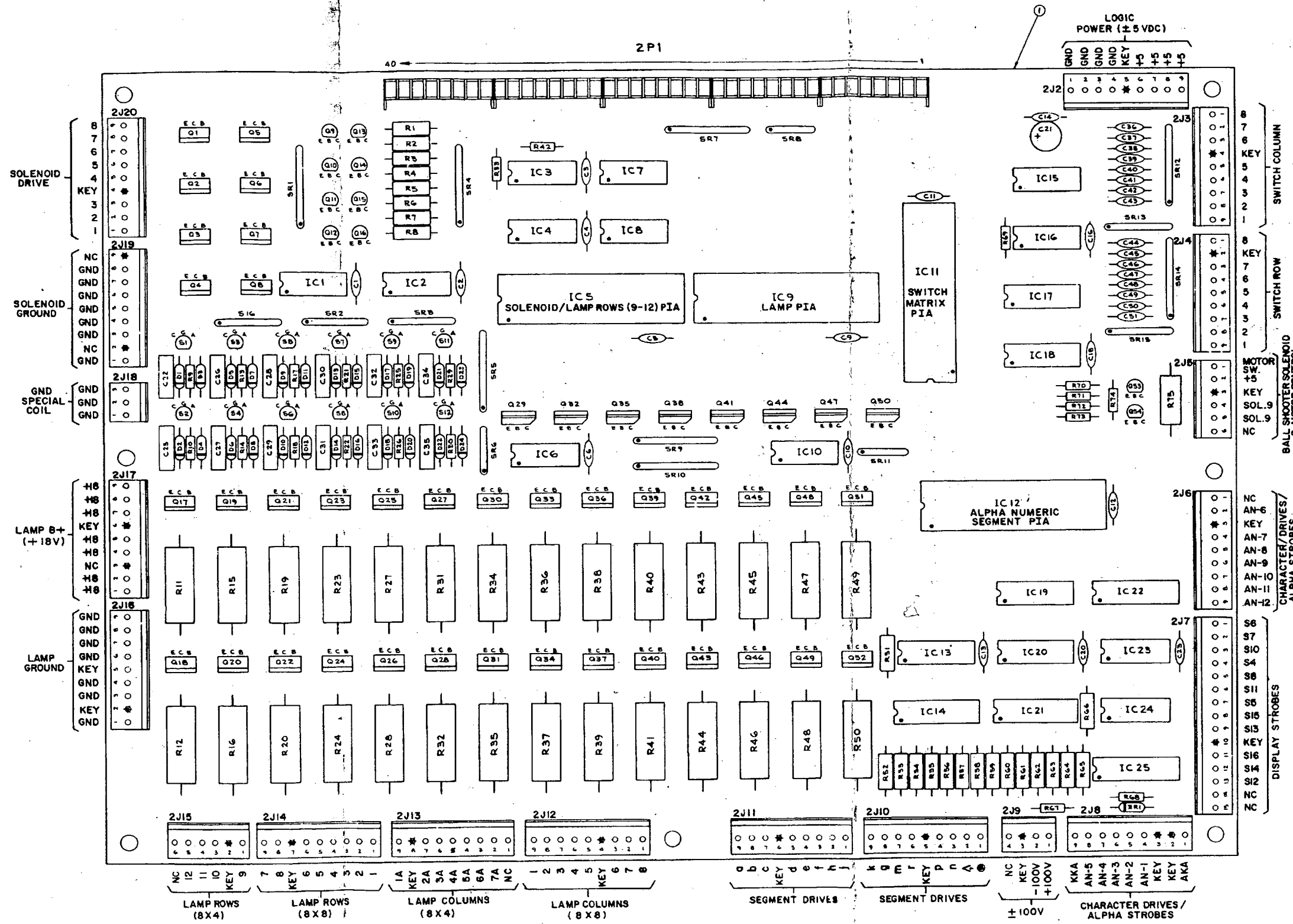
- NOTES:
- CONNECTIONS ARE INDICATED BY CIRCLED NUMBERS AS FOLLOWS:
 - ① CPU BOARD
 - ② CONTROL BOARD
 - ③ POWER SUPPLY BOARD
 - ④ MASTER DISPLAY BOARD
 - ⑤ SLAVE DISPLAY BOARD
 - ⑥ BACKBOX
 - ⑦ CABINET
 - ⑧ PLAYFIELD
 - ⑨ INSERT BOARD
 - ⑩ SOUND BOARD
 - ⑪ NOT ASSIGNED
 - ⑫ NOT ASSIGNED
 - ⑬ SPEAKER PANEL
 - ⑭ ALPHANUMERIC DISPLAY
 - ⑮ POWER SWITCHING BOARD
 - REFER TO POWER WIRING DIAGRAM FOR CONNECTIONS TO 3PI.
 - ON SOUND BOARD, JUMPER W3 MUST BE CONNECTED & W2 REMOVED FOR OPERATION WITH SOUND ROM 8.



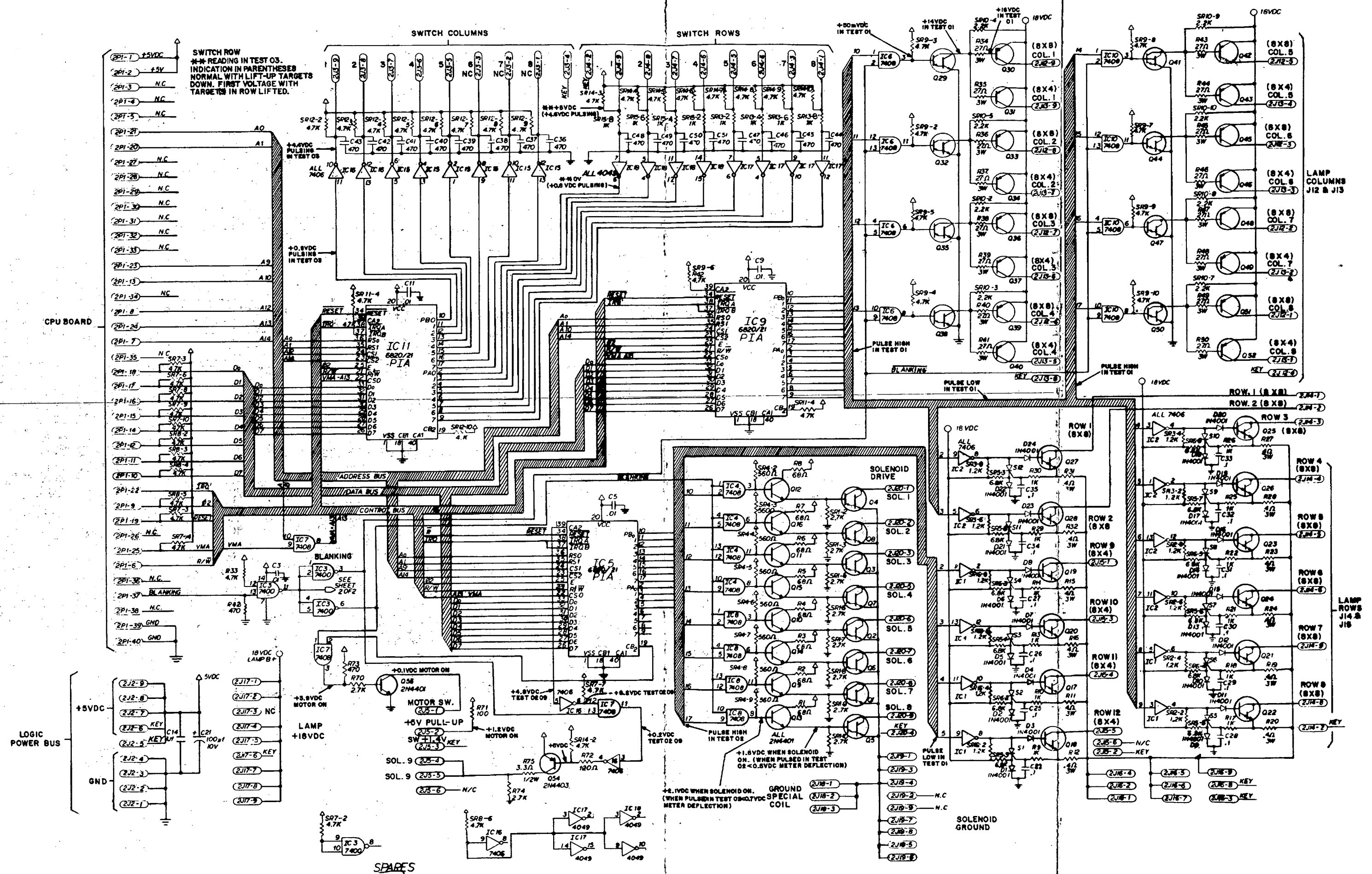
Backbox Wiring Diagram



CPU Board Logic Diagram

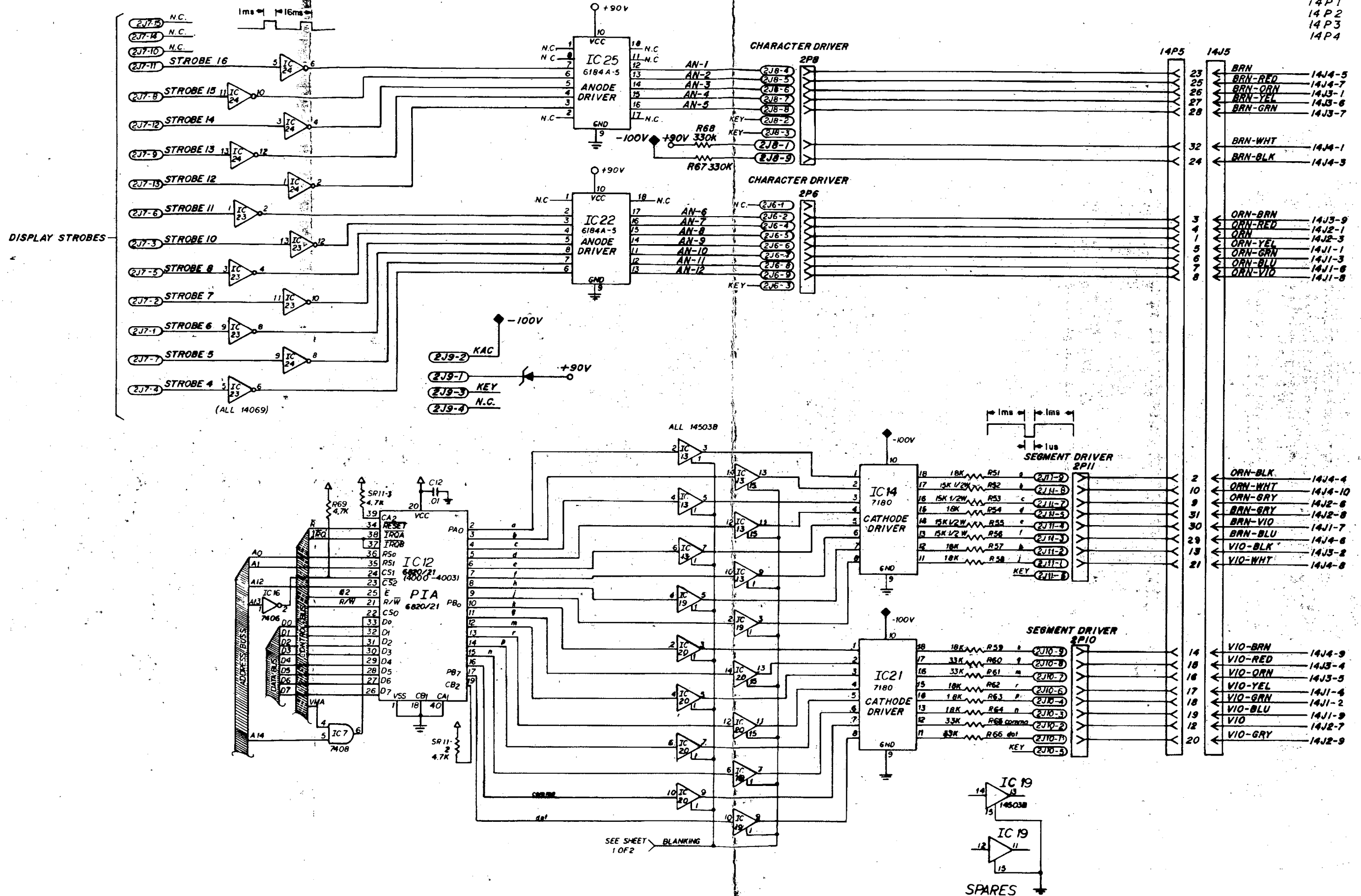


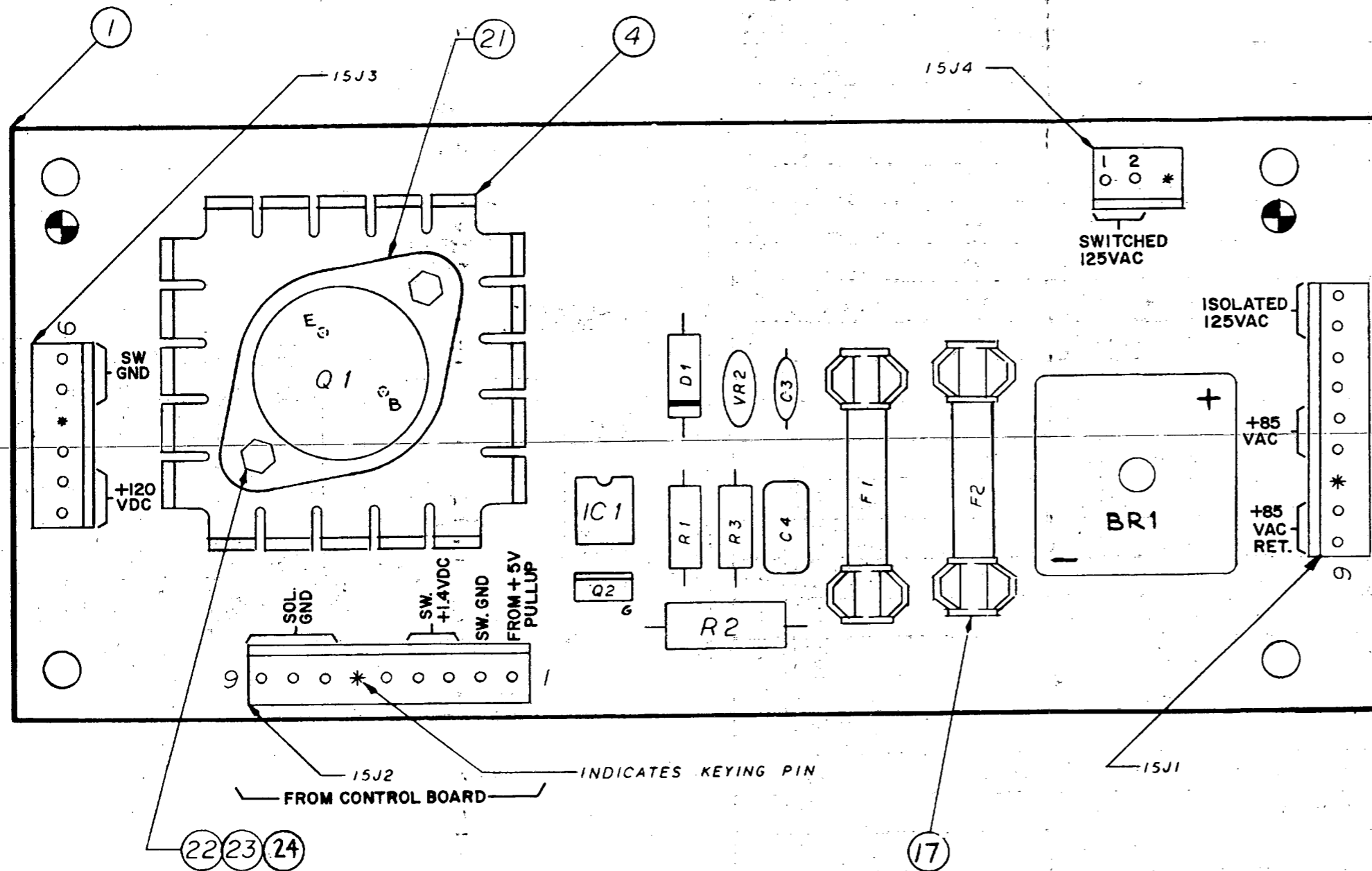
BILL OF MATERIAL				
ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQD. NO.
1	8723-09724-00		BARE P.C. BOARD	1
2	5280-08974-00	IC1, IC2, IC15, IC16	I.C., 7406 HEX. INVERTERS	4
3	5280-08973-00	IC4, IC6, IC7, IC8, IC10	I.C., 7408 QUAD AND	5
4	5180-09075-00	IC3	I.C., 7400 QUAD NAND	1
5	5430-08972-00	IC5, IC9, IC11, IC12	I.C., 7420/21 PIA	4
6	5310-09808-00	IC13, IC19, IC23	I.C., 45088 HEX. 3-STATE BUFFER	3
7	5680-08969-00	IC14, IC21	I.C., 7180A CATH DRIVE	2
8	5310-08975-00	IC17, IC18	I.C., 4049 HEX. INVERTERS	2
9	5680-08968-00	IC22, IC25	I.C., 584 ANODE DRIVE	2
10	5310-08971-00	IC23, IC24	I.C., 4069 HEX. INVERTERS	2
11	5162-09410-00	Q1 THRU Q8, Q11 THRU Q23	TRANSISTOR, NPN DARLINGTON	20
12	5160-08988-00	Q9 THRU Q16	TRANSISTOR, 2N4401 NPN	9
13	5162-09804-00	Q17, Q22, Q23, Q24, Q44, Q47, Q50	TRANSISTOR, 2N4548 NPN DARLINGTON	6
14	5191-08978-00	Q20, Q21, Q25, Q26, Q27, Q28, Q43, Q45, Q46, Q48, Q49, Q51, Q52	TRANSISTOR, TIP42 PNP	16
15	5070-06258-00	D1 THRU D24	DIODE, 1N4001 I.O.A.	24
16	5190-09016-00	Q24	TRANSISTOR, 2N4403 PNP	1
17	5190-09014-00	S1 THRU S12	SCR, 2N6060 O.B.A. 30 V.	12
18	5010-08993-00	R1 THRU R8	RESISTOR, C.F. 1/4 WATT 5%	8
19	5010-09356-00	R9, R10, R13, R14, R17, R18, R21, R22, R23, R26, R29, R30	RESISTOR, C.F. 1/4 WATT 5%	12
20	5012-09087-00	R11, R12, R15, R16, R19, R20, R23, R24, R27, R28, R31, R37	RESISTOR, C.F. 3 WATT 5%	12
21	5010-09416-00	R42, R73	RESISTOR, C.F. 470 Ω 5% 1/4 WATT	2
22	5010-08999-00	R34 THRU R41, R43 THRU R50	RESISTOR, C.F. 27 Ω 5% 5 WATT	16
23	5010-08991-00	R33, R49	RESISTOR, C.F. 4.7K Ω 5% 1/4 WATT	2
24	5010-09036-00	R71	RESISTOR, C.F. 100 Ω 5% 1/4 WATT	1
25	5010-09791-00	R75	RESISTOR, C.F. 3.3K Ω 5% 1 WATT	1
26	5019-09192-00	SR1	SIP, 2.7K Ω 9R 10 PIN 5% 125 W/R @ 70°C	1
27	5019-09182-00	SR2, SR3, SR6	SIP, 1.2K Ω 9R 8 PIN 5% 125 W/R @ 70°C	3
28	5019-09183-00	SR5	SIP, 6.8K Ω 9R 10 PIN 5% 125 W/R @ 70°C	1
29	5019-09184-00	SR6	SIP, 6.8K Ω 9R 10 PIN 5% 125 W/R @ 70°C	1
30	5019-09788-00	SR10	SIP, 2.2K Ω 9R 10 PIN 5% 125 W/R @ 70°C	1
31	5019-09362-00	SR7, SR8, SR12, SR14	SIP, 4.7K Ω 9R 10 PIN 5% 125 W/R @ 70°C	4
32	5019-09028-00	SR13, SR15	SIP, 1K Ω 9R 8 PIN 5% 125 W/R @ 70°C	2
33	5019-09186-00	SR8, SR11	SIP, 1K Ω 9R 8 PIN 5% 125 W/R @ 70°C	2
34	5043-08980-00	C1 THRU C4, C8 THRU C23, C24, C25, C28	CAPACITOR, CERAMIC, 0.01 MFD, 50V, ±20%	15
35	5043-08994-00	C14	CAPACITOR, CERAMIC, 0.1 MFD, 50V, ±20%	1
36	5045-09196-00	C22, C25 THRU C35	CAPACITOR, ALUMINUM ELECT. FRAG 0.1 MFD, 100 V, ±10%	12
37	5040-09421-00	C21	CAPACITOR, RADIAL, 100 MFD, 25 V, ±20%	1
38	5043-09065-00	C36 THRU C51	CAPACITOR, CERAMIC, 470 PFD, 50V, ±20%	16
39	5791-09027-00	2J2, 2J3, 2J4, 2J6, 2J8, 2J10 THRU 2J14, 2J16, 2J17, 2J19, 2J20	9 H 2391, 09-65-1091	14
40	5791-09036-00	2J5, 2J15	6 H 2391, 09-65-1061	2
41	5791-09074-00	2J7	15 H 2391, 09-65-1131	1
42	5791-09028-00	2J9	4 H 2391, 09-65-1041	1
43	5791-09435-00	2J18	3 H 2391, 09-65-1031	1
44	5792-09066-00	2P1	8 P 2145, 09-52-3082	5
45	5010-09113-00	R60, R61, R62, R66	RESISTOR, C.F. 33K Ω 5% 1/4 WATT	4
46	5010-09069-00	R67, R68	RESISTOR, C.F. 330K Ω 5% 1/4 WATT	2
47	5010-08997-00	R70, R74	RESISTOR, C.F. 2.7K Ω 5% 1/4 WATT	2
48	5015-09155-00	SR1	ZENER DIODE, 1N4740 10 V, 5% 1 WATT	1
49	5019-09804-00	SR4	SIP, 500 Ω 9R 10 PIN 5% 125 W/R @ 70°C	1
50	5011-09807-00	R72	RESISTOR, 120 Ω 1/4 W 5%	1
51	5010-08973-00	R51, R54, R57, R58, R59, R63, R64	RESISTOR 18K Ω 1/4 W 5%	5
52	5010-09149-00	R52, R53, R55, R56	RESISTOR 15K Ω 1/4 W 5%	4



Control Board Logic Diagram (Sheet 1 of 2)

VIA:
14P1
14P2
14P3
14P4

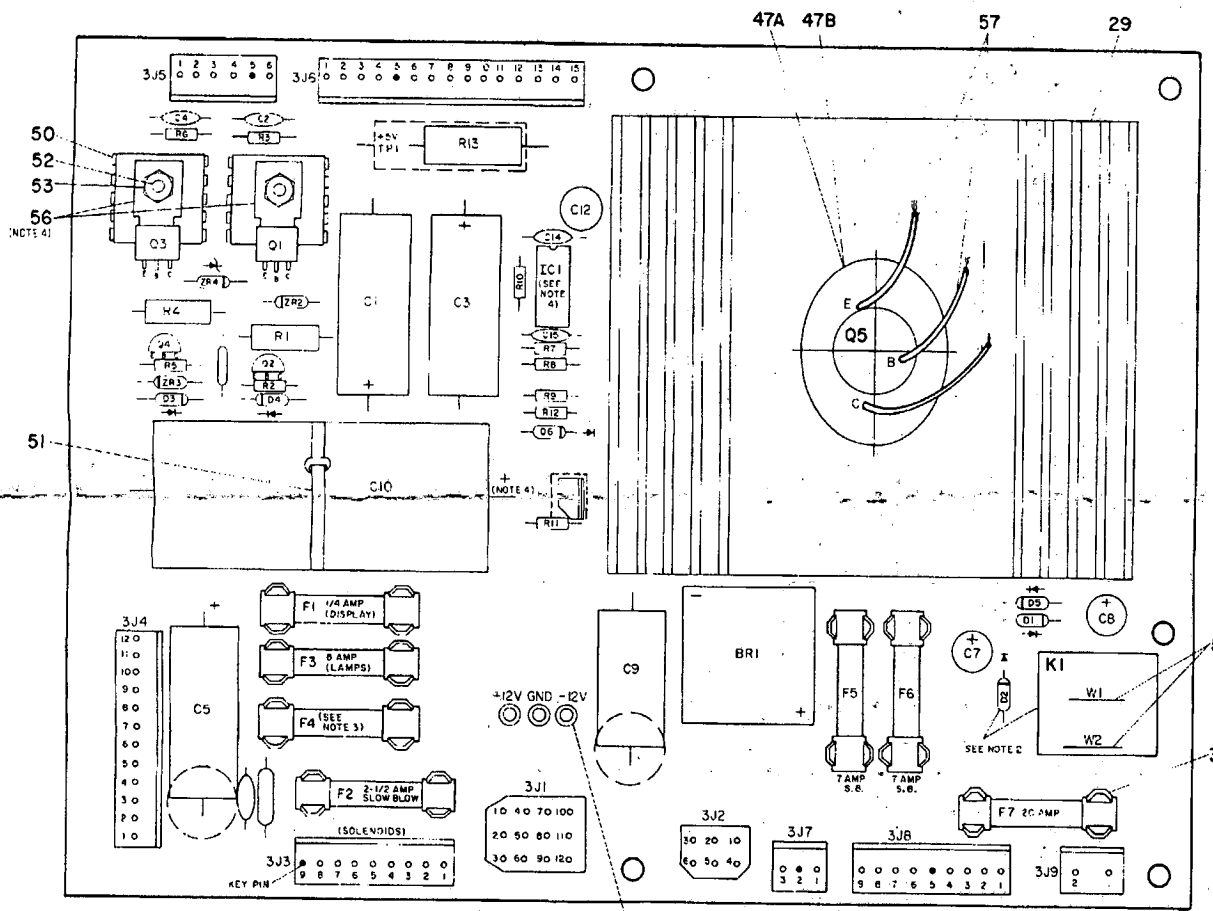




BILL OF MATERIAL				
ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D NO.
1	5768-09725-00		BARE PC BOARD	1
2	5162-09802-00	Q1	TRANS NPN DARLINGTON	1
3	5490-09805-00	IC1	MOC 3030 Z.C. TRIAC DRIVER	1
4	5705-09801-00		HEAT SINK	1
5	5017-09044-00	VR2	VAR 130V 10J	1
6	5100-09690-00	BR1	BRDG REC. 35 A. 200V	1
7	5131-09864-00	Q2	TRIAC 6AMPS 400V	1
8	5070-09799-00	D1	DIODE 1N5404 3.0A	1
9				
10	5043-09072-00	C3	CAP 0.1uf 500V +80% -20% DISC	1
11	5045-09795-00	C4	CAP 0.01 uf 400 VDC METALIZED POLY ± 10%	1
12	5010-09787-00	R1	RES 150Ω 1/2 W 5%	1
13	5010-09861-00	R2	RES 51Ω 1/2 W 5%	1
14	5010-09789-00	R3	RES 39Ω 1/2 W 5%	1
15	5730-06311-00	F1	FUSE 3 A 250V	1
16	5731-06314-00	F2	FUSE 4A 5.8 250V	1
17	5732-09178-00		FUSE HOLDER	4
18	5791-09027-00	15J1 & 15J2	9H 2391 (09-65-1091)	2
19	5791-09038-00	15J3	6H 2391 (09-65-1061)	1
20	5791-09435-00	15J4	3H 2391 (09-65-1031)	1
21	5701-09652-00		THERMAL PAD	1
22	4005-01016-07		M5-40 X 7/16 P-RH	2
23	4405-01117-00		5-40 HEX NUT	2
24	4701-00023-00		LW *5 SPLIT	2

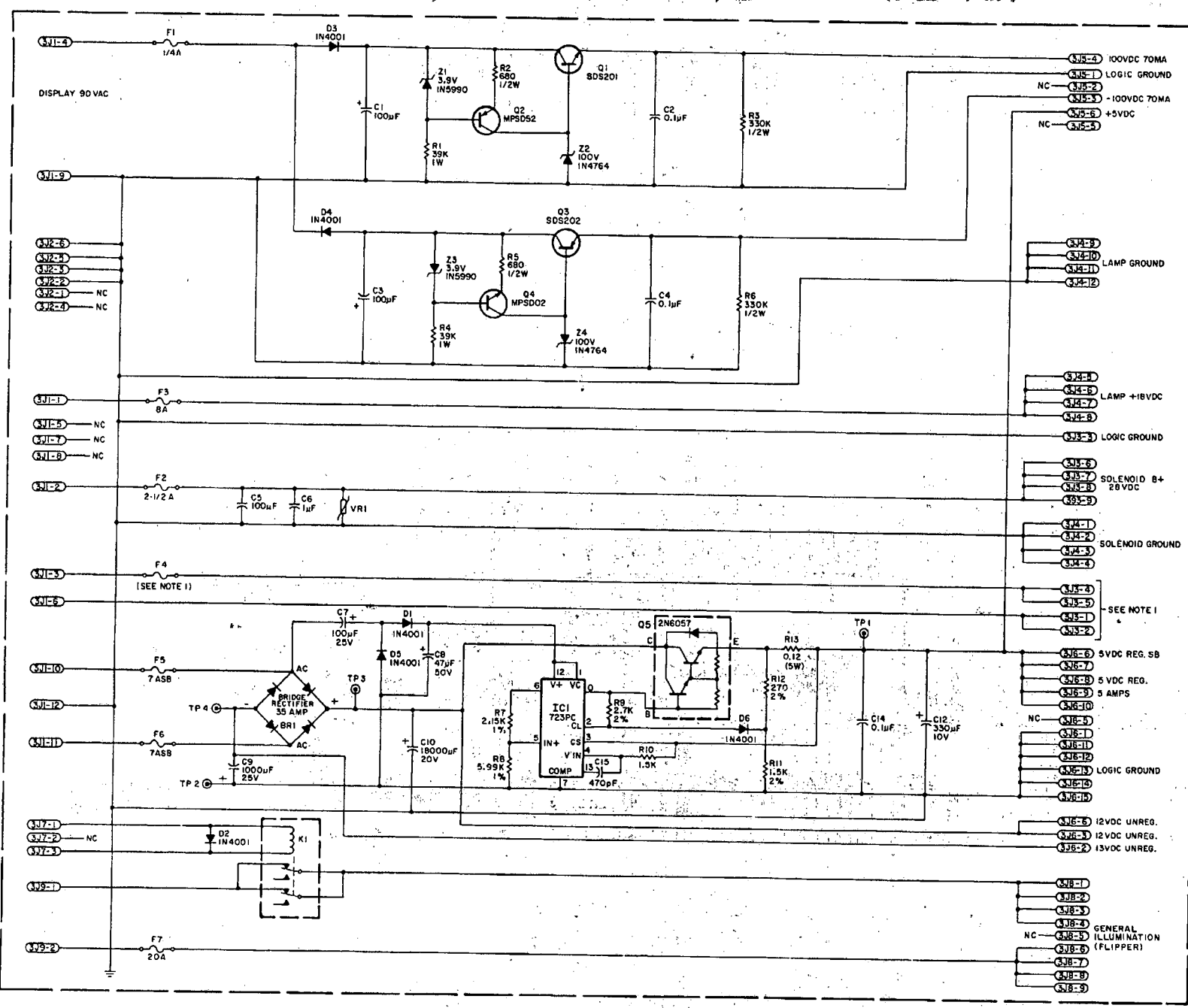
BILL OF MATERIAL

ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D NO.
1	5763-09466		BARE P.C. BOARD	1
2	5033-09426	R7	RESISTOR, 2.15K, 1%, 1/4 W, METAL FILM	1
3	5013-09427	R8	RESISTOR, 4.99K, 1%, 1/4 W, METAL FILM	1
4	5017-09428	R11	RESISTOR, 1.5K, 2%, 1/4 W, CARBON FILM	1
5	5010-09085	R10	RESISTOR, 2.7K, 2%, 1/4 W	1
6	5010-09541	R9	RESISTOR, 2.7K, 2%, 1/4 W	1
7	5010-09508	R12	RESISTOR, 270 OHM, 2%, 1/4 W, CARBON FILM	1
8	5012-09429	R13	POWER RESISTOR, 0.12 OHM, 5%, 5W	1
9	5010-09536	R1, R4	RESISTOR, 39K, 5%, 1 W	2
10	5010-09061	R2, R5	RESISTOR, 680 OHM, 2 W	2
11	5010-09069	R3, R6	RESISTOR, 330K, 5%, 1/2 W	2
12	5040-09419	C10	CAP., ELECTROLYTIC, 18,000 MFD, 20V, AXIAL	1
13	5040-09420	C9	CAP., ELECTROLYTIC, 1,000 MFD, 25V, RADIAL OR AXIAL	1
14	5040-09423	C12	CAP., ELECTROLYTIC, 330 MFD, 10V, RADIAL	1
15	5043-09065	C15	CAPACITOR, 470 pFD	1
16	5040-09053	C1, C3	CAPACITOR, 100 MFD, ELECT., 150V	2
17	5040-09070	C5	CAPACITOR, 100 MFD, ELECT., 100V, AXIAL OR RADIAL	1
18	5043-09537	C14	CAPACITOR, 0.1 MFD, 50V, DISC.	1
19	5070-09446		DIODE, IN4001	6
20	5070-06258	D1, D2, D3, D4, D5, D6	ZENER, IN5990, 3.9V, 5% 2	
21	5075-09059	ZR1, ZR3	ZENER, IN4764, 100V, 5% 2	
22	5075-09060	ZR2, ZR4	ZENER, IN4764, 100V, 5% 2	
23	5060-09424	IC1	VOLTAGE REGULATOR, MC1223, PC	1
24	5043-09443	C2, C4, C6	CAPACITOR, 0.1 MFD, 200V, DISC.	3
25	5040-09421	C7	CAPACITOR, 100 MFD, 25V, RADIAL	1
26	5164-09037	Q1	TRANSISTOR, SDS 201 NPN	1
27	5164-09056	Q4	TRANSISTOR, MPS 102 NPN	1
28	5194-09058	Q3	TRANSISTOR, SDS 202 PNP	1
29	5194-09055	Q2	TRANSISTOR, MPS 052 PNP	1
30	5705-04431		HEAT SINK	1
31	5791-09074	J35	CONNECTOR, 6 PIN (H)	1
32	5791-09074	J36	CONNECTOR, 15 PIN (H)	1
33	5791-09027	J38, J39	CONNECTOR, 9 PIN (H)	2
34	5791-09038	J32	CONNECTOR, 6 PIN (H)	1
35	5791-09043	Q5	TRANSISTOR, POWER, 2N6087 NPN	1
36	5791-09425	J34	CONNECTOR, 12 PIN (H)	1
37	5791-09435	J37	CONNECTOR, 3 PIN (H)	1
38	5791-09436	J39	CONNECTOR, 2 PIN (H)	1
39	5791-09068	J31	CONNECTOR, 12 PIN	1
40	5732-09178		FUSE HOLDER	14
41	5731-09128	F2	FUSE, 2-1/2 AMP, S.R.	1
42	5730-09071	F3	FUSE, 8 AMP	1
43	5730-06508	F4	FUSE, 10 AMP, OR, 1/200V	1
44	5730-06567	F7	FUSE, 15 AMP	1
45	5730-09127	F5	FUSE, 20 AMP	1
46	5731-08761	F1	FUSE, 20 AMP	1
47	5017-09061	VR1	VARIABLE RESISTOR	1
48	5700-09445		SOCKET	1
49	5701-09538		MICA INSULATOR	1
50	5580-09553	K1	RELAY, 24 VDC, 10 AMP, DPDT	1
51	5824-09248		TERMINAL, #1502-1 (TEST POST)	3
52	5100-09418	BR-1	BRIDGE RECTIFIER, 35 AMP, 100V	1
53	5705-09042		HEAT SINK	2
54	3A-7520-1		TIE WRAP	1
55	4005-01016-07		5-40 X 7/16 R.H. MECH. SCREW	2
56	4405-01117		3-40 HEX NUT	2
57		W1, W2	JUNIPER, #18 AWG	2
58	5040-09422	C8	CAPACITOR, 47 MFD, 50V, RADIAL	1
	20-9229		THERMAL COMPOUND	1
			LEAD WIRE, #18 AWG (3")	3
	5731-09432	F6, F5	FUSE, 7A, S.B., 250V	2

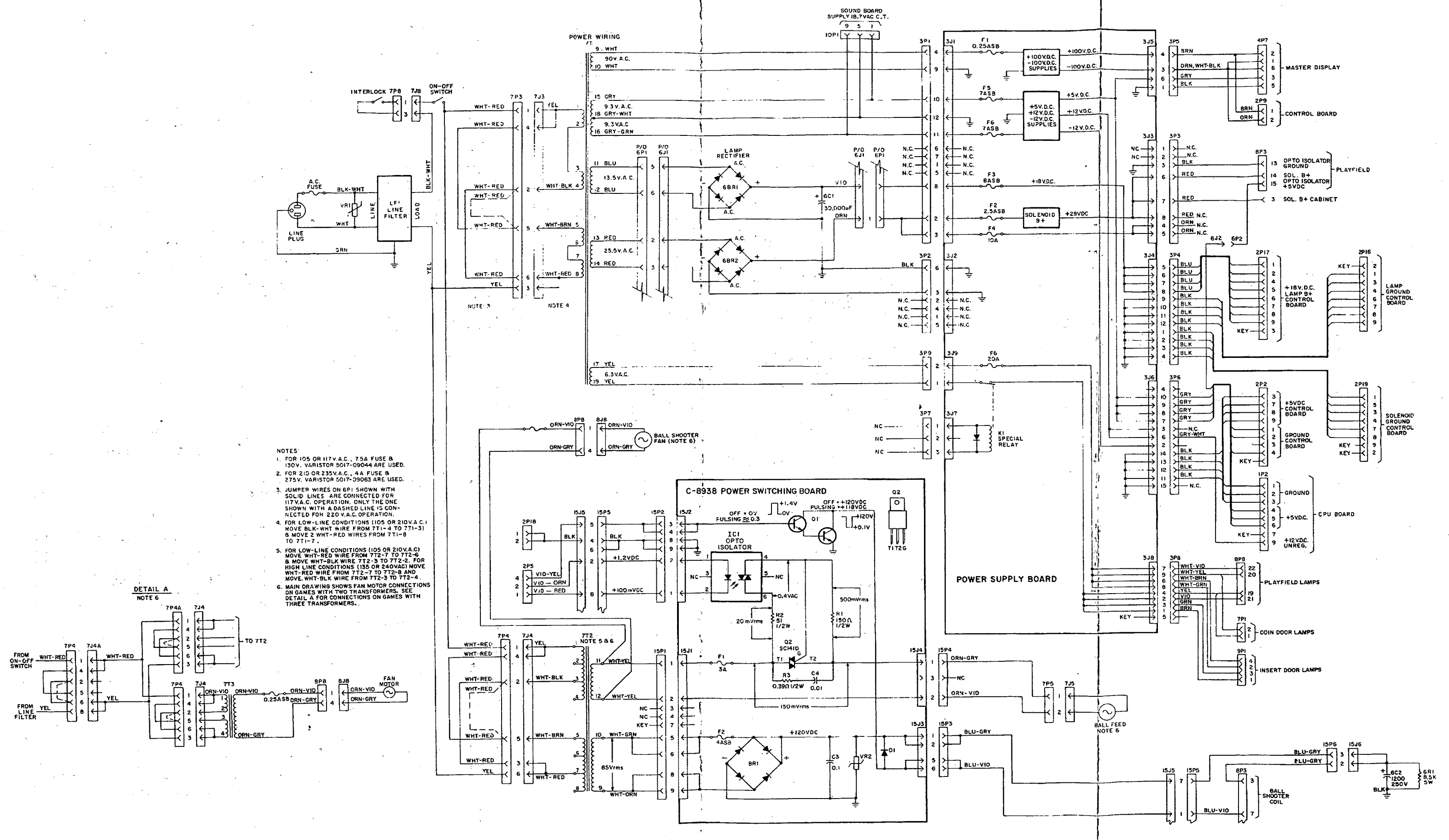


NOTES:
 1. HEAT SINK COMPOUND MUST BE APPLIED BETWEEN TRANSISTOR AND HEAT SINK.
 2. FOR BLACKOUT AND FUTURE GAMES WITH SAME FEATURE REMOVE JUMPERS (W1 & W2) AND INSERT RESISTOR R1, R2, R3 AND R4.
 3. ON FLIPPER GAMES F4 IS 10 AMPS OR (DUAL ACTION FLIPPERS); 15 AMPS ON SHUFFLE ALL CYS F4 IS 20 AMPS.
 4. OBSERVE INDEX MARK OF INTEGRATED CIRCUIT. POLARITY OF CAPACITORS, DIODE AND POSITION OF TRANSISTOR.
 5. REFERENCE DWS 5: SCHEMATIC 18-8786.

Power Supply Assembly and Schematic Diagrams



NOTE:
 1. ON FLIPPER GAMES F4 IS 10 AMPS, OR 15 AMPS ON DUAL ACTION FLIPPERS. J33-4 & 5 IS 28V FOR FLIPPERS COILS, J33-1 & 2 ARE NOT CONNECTED.
 2. ON SHUFFLE ALL CYS F4 IS 20AMPS J33-1 & 2 & J33-3 & 4 IS 6.3VAC FOR GENERAL ILLUMINATION.
 3. UNLESS OTHERWISE INDICATED ALL RESISTORS ARE 1/4 WATT.



- NOTES
- FOR 105 OR 117V.A.C., 7.5A FUSE & 130V. VARISTOR 5017-09044 ARE USED.
 - FOR 210 OR 235V.A.C., 4A FUSE & 275V. VARISTOR 5017-09063 ARE USED.
 - JUMPER WIRES ON 6P1 SHOWN WITH SOLID LINES ARE CONNECTED FOR 117V.A.C. OPERATION. ONLY THE ONE SHOWN WITH A DASHED LINE IS CONNECTED FOR 220V.A.C. OPERATION.
 - FOR LOW-LINE CONDITIONS (105 OR 210V.A.C.) MOVE BLK-WHT WIRE FROM 7T1-4 TO 7T1-3) B MOVE 2 WHT-RED WIRES FROM 7T1-8 TO 7T1-7.
 - FOR LOW-LINE CONDITIONS (105 OR 210V.A.C.) MOVE WHT-RED WIRE FROM 7T2-7 TO 7T2-6 B MOVE WHT-BLK WIRE 7T2-3 TO 7T2-2. FOR HIGH LINE CONDITIONS (135 OR 240VAC) MOVE WHT-RED WIRE FROM 7T2-7 TO 7T2-8 AND MOVE WHT-BLK WIRE FROM 7T2-3 TO 7T2-4.
 - MAIN DRAWING SHOWS FAN MOTOR CONNECTIONS ON GAMES WITH TWO TRANSFORMERS. SEE DETAIL A FOR CONNECTIONS ON GAMES WITH THREE TRANSFORMERS.

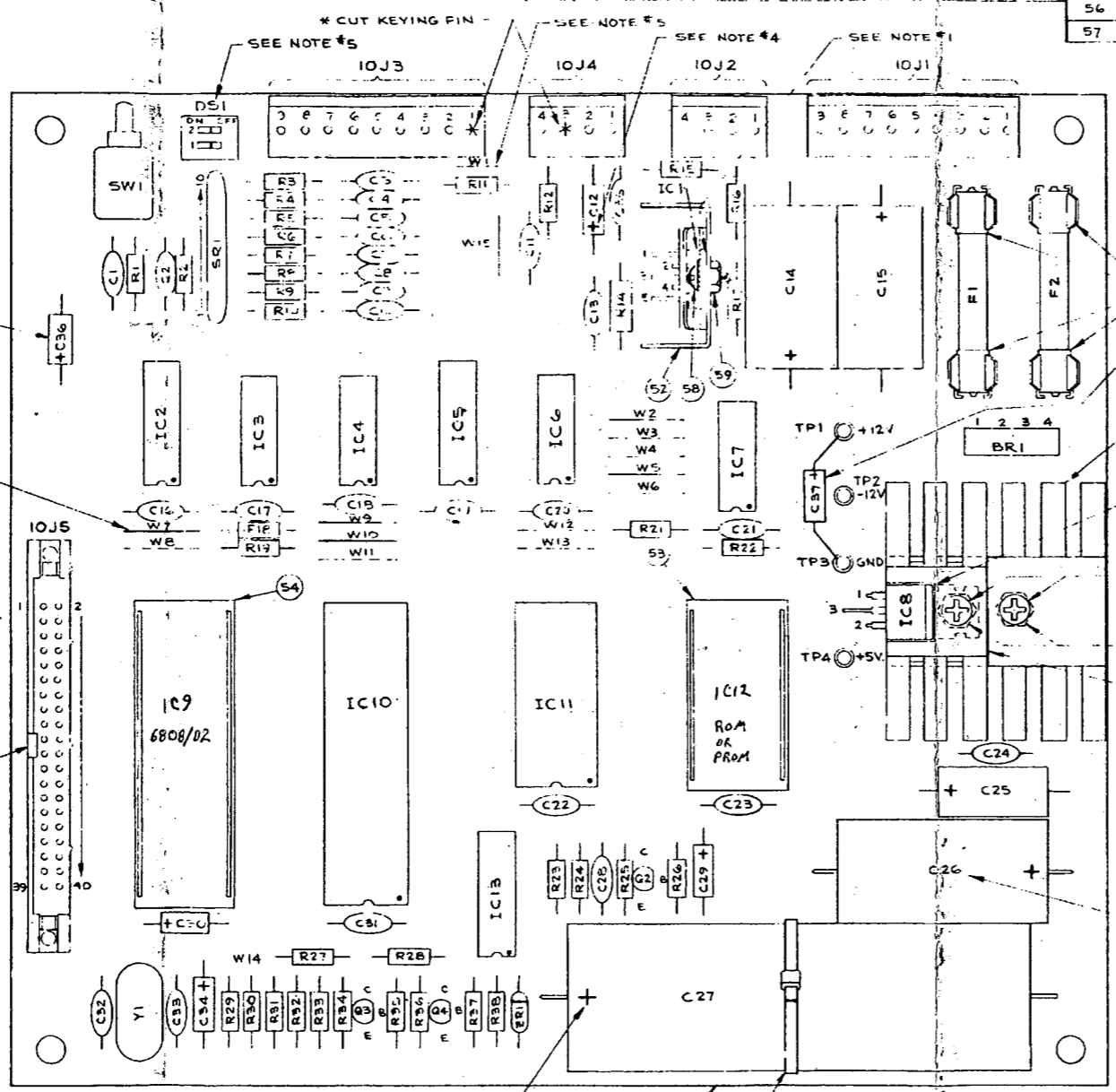
DETAIL A
NOTE 6

Power Wiring Diagram

BILL OF MATERIAL

ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D. NO.	ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D. NO.
58			6-32 x 3/8 BINDER HEAD SCREW	3	48	5A-9314	F1, F2	4 AMP SLOW BLOW FUSE	2
59			6-32 HEX NUT	3	49	5A-9178		FUSE HOLDER	4
60			WIRE JUMPER 22 GAUGE WIRE WITH INSULATION	7	50	5A-9172		HEAT SINK THERMALLOY #607B	1
61	CA-9248	TP1 THR TPA	TERMINAL # 502-1	1	51	5A-9173		HEAT SINK THERMALLOY #6071B	1
62	5A-9163	R11	RESISTOR, FC, 1/2 WATT 5% 1/4 WATT	1	52	5A-9199		HEAT SINK THERMALLOY #6030	1
64	5A-9542	SR1	RESISTOR, 4.7K OHM 10 PIN DIP	1	53	5A-9004		24 PIN SOCKET	1
65	3A-7520-1		TIE WRAP	1	54	5A-8985		40 PIN SOCKET	1
					55	5A-9027	10J1, 10J3	9 PIN MALE CONNECTOR	2
					56	5A-9028	10J2, 10J4	4 PIN MALE CONNECTOR	2
					57	5A-9349	10J5	40 PIN RIBBON HEADER	1

ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D. NO.
1	IC-2001-146-3		BARE P.C. BOARD	1
2	5A-9154	IC1	TDA2002 V AUDIO AMPLIFIER	1
3	5A-9012	IC2	7442 BCD-DEC DECODER	1
4	5A-9013	IC3	7400 QUAD 2 INPUT NAND	1
5	5A-8973	IC4	7408 QUAD 2 INP. AND GATE	1
6	5A-9153	IC5	4050 BUFFER	1
7	5A-9154	IC6	4068 8 INPUT NAND GATE	1
8	5A-8971	IC7	14069 HEX INVERTER	1
9	5A-9157	IC8	7805 5 VOLT REG. W/TC220 CASE	1
10	5A-8972	IC10	6B21 P.I.A.	1
11	5A-9003	IC11	6B10 RAM	1
12	5A-9152	IC13	1408 D/A CONVERTER	1
13	5C-8936	Q2, Q3, Q4	2N4401 NPN TRANSISTOR	3
14				
15	5A-9018	ZR1	1N5996 6.5V. ZENER DIODE	1
16				
17	5A-9158 OR 5A-9357 5A-9020	BR1	MDA 200/3N253 BRIDGE RECTIFIER	1
18		Y1	3.58 MHz CRYSTAL	1
19	5B-8991	R1, R19, R21, R27, R27, R27, R31, R32	RESISTOR, FC, 4.7K OHM 5% 1/4 WATT	9
20	5B-9036	R2 THRU R10	RESISTOR, FC, 100 OHM 10% 1/4 WATT	9
21	5A-8984	R12, R15, R26, R36, R38	RESISTOR, FC, 1K OHM 10% 1/4 WATT	5
22	5A-9181	R14	RESISTOR, FC, 1 OHM 10% 1/2 WATT	1
23	5A-9161	R16	RESISTOR, FC, 2.2 OHM 10% 1/4 WATT	1
24	5A-9361	R17	RESISTOR, FC, 220 OHM 10% 1/2 WATT	1
25				
26	5B-8983	R23, R24, R26	RESISTOR, FC, 3.3K OHM 10% 1/4 WATT	3
27	5A-9179	R25	RESISTOR, FC, 3.3M OHM 10% 1/4 WATT	1
28	5A-9359	R29	RESISTOR, FC, 47K OHM 5% 1/4 WATT	1
29	5B-8817	R33, R35, R37	RESISTOR, FC, 10K OHM 10% 1/4 WATT	3
30	5B-9039	R34	RESISTOR, FC, 10 OHM 10% 1/4 WATT	1
31	5A-8980	C1, C16 THRU C23 C31	CAPACITOR, CERAMIC, .01 MFD. 50 V. ±20%	11
32	5A-9065	C2 THRU C10	CAPACITOR, CERAMIC, 470 PFD. 50 V. ±20%	9
33	5A-9345	C11	CAPACITOR, CERAMIC, .001 MFD. 20V. 100 V.	1
34	5A-9345	C12, C30, C36	CAPACITOR, ELECTROLYTIC, 1 MFD. 6.3 V. 10% ±50%	3
35	5A-8994	C13, C24, C35	CAPACITOR, CERAMIC, 1 MFD. 50 V. ±20%	3
36	5A-9165 5A-9165-1	C14	CAPACITOR, ELECTROLYTIC, 800 MFD. 16 V. OR 1000 MFD. 15 V. ±20%	1
37	5A-9164 5A-9164-1	C15	CAPACITOR, ELECTROLYTIC, 500 MFD. 15 V. OR 470 MFD. 25 V. ±20%	1
38	5A-8986	C25	CAPACITOR, ELECTROLYTIC, 100 MFD. 10 V. ±20%	1
39	5A-8993	C26	CAPACITOR, ELECTROLYTIC, 1,000 MFD. 25 V. ±20%	1
40	5A-9046	C27	CAPACITOR, ELECTROLYTIC, 12,000 MFD. 16 V. ±20%	1
41	5A-9180	C28	CAPACITOR, CERAMIC, 47 PFD. 1K V. ±20%	1
42	5A-9343	C29	CAPACITOR, ELECTROLYTIC, 10 MFD. 25 V. LOW LEAKAGE	1
43	5A-9169	C32, C33	CAPACITOR, CERAMIC DISC, 27 PFD. 1K V. ±10%	2
44	5A-9163	C34	CAPACITOR, TANTALUM, 2.2 MFD. 15 V. ±20%	1
45	5A-9031	C37	CAPACITOR, TANTALUM, 1 MFD. 25 V. ±20%	1
46	5A-9024	SW1	MOMENTARY SWITCH 6PDT	1
47	5A-9330	DS1	2 STD. DIP SWITCH	1

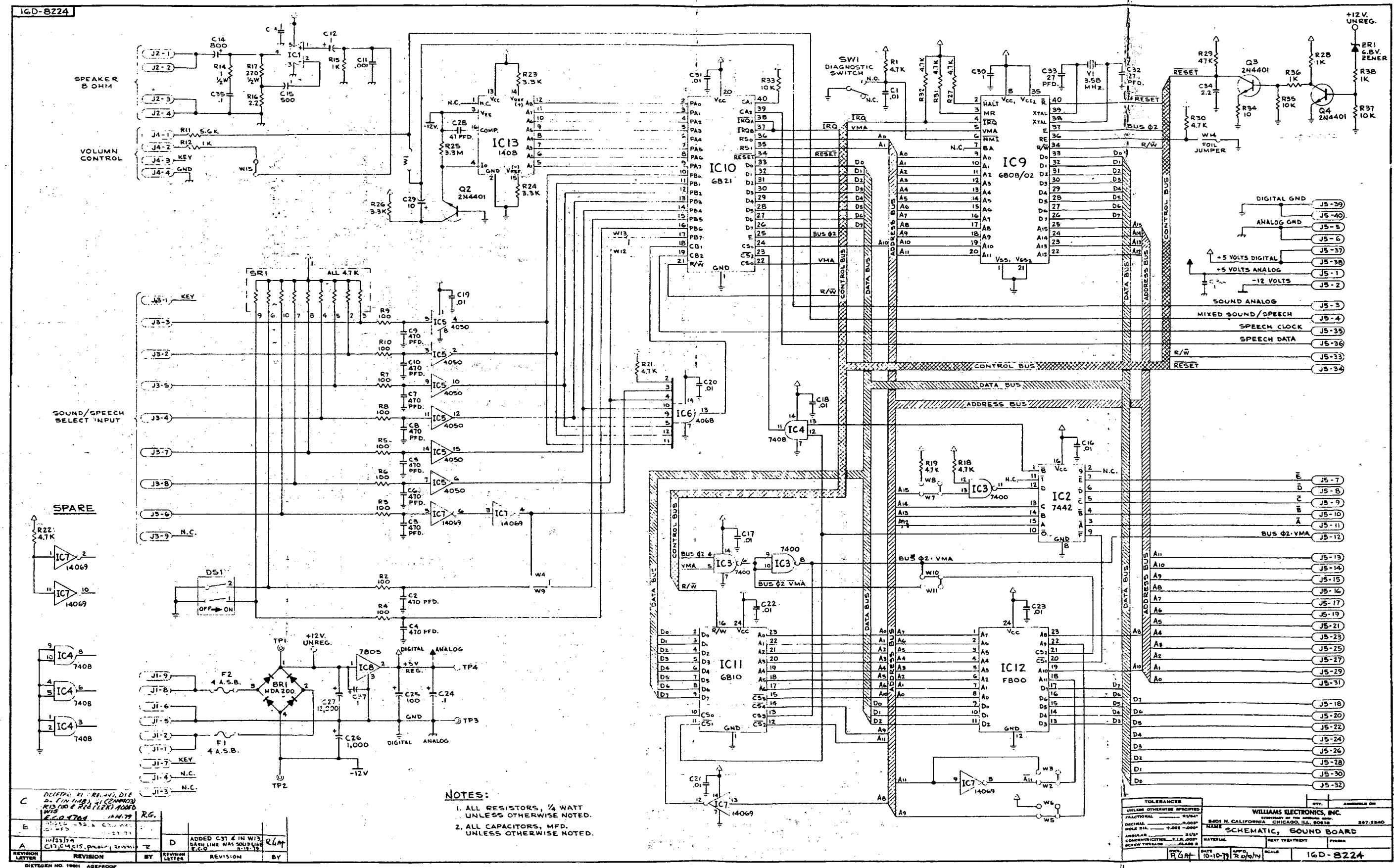


NOTES:

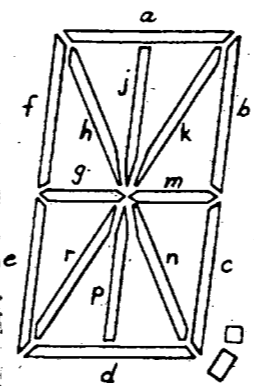
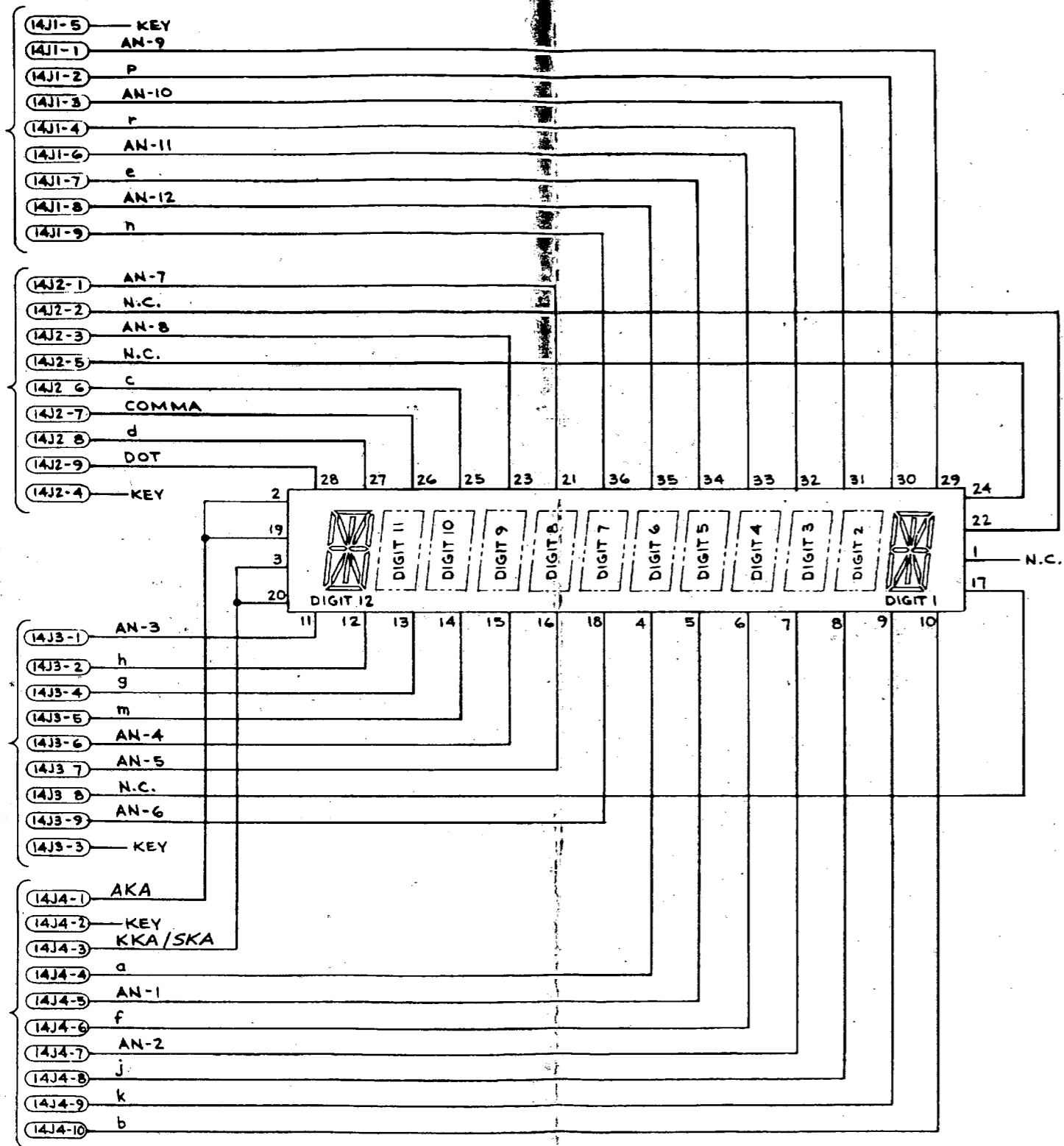
- USE THERMAL COMPOUND BETWEEN IC AND HEAT SINK.
- CAUTION: AVOID STATIC DISCHARGE DAMAGE TO MOS LOGIC.
- SYMBOLS SHOWN ON COMPONENTS ARE FOR REFERENCE ONLY. DO NOT SCREEN OR STAMP.
- OBSERVE INDEX MARK OF ALL INTEGRATED CIRCUITS, DIODES DI, DZ, AND ZR1.
- CAPACITORS C12, C14, C15, C21, C24, C27, CONNECTORS 10J1, 10J2, 10J3, 10J5, INSTEAD OF TRANSISTORS Q1, Q2, Q3, Q4.
- J6 - 1 SELECTS SOUNDS/NOTES
2 SELECTS SPEECH/NO SPEECH (W/ W/ W)
- 7 - SPEECH MODULE STATUS
IN - SPEECH MODULE NOT ATTACHED
OUT - SPEECH MODULE ATTACHED
- W1 - MPU INTERNAL RAM ENABLE
W7 & W8 - MEMORY MAP CONTROL
W12 & W13 - PRG STATUS CONTROL (W15 NEVER USED)
W16 & W19 - PDS STATUS CONTROL
6 - SOLDERED ON TOP OF BOARD
INTERNAL TIE-UP JUMPERS FOR FOLLOWING GAMES:
W15, W16, W17, W18, W19, W20, W21, W22, W23, W24 FOR:
WORLD CUP
DISCO FEVER
CONTACT
PORK RNO
PHOENIX
ARISTOCRAT SHUFFLE
POPPLE SHUFFLE
KING TUT SHUFFLE
FAKUS SHUFFLE
W15, W18, W19, W21, W22, W23, W24, W25, W26, W27 FOR:
FLASH
STELLAR WARS
TRI ZONE
FINE WARP
W7, W15, W19, W21 (SEE NOTE #5) W22, W25, W26 FOR:
GORGAR
SOUND ROM 1
ST-360
- IC12 SELECTION STRAPPING:
LX X 4 (LX X 4) (LX X 4)
W2 W1 W3
A IN W2 IN W3 IN
W4 W5 W6 W7

E	REVISED NOTES, ADDED ITEM #45 & NOTE #6, RELOCATED W15, IN W15 DASH LINE WAS SOLID LINE & ITEM #60, W15 WAS W16 EC.O. 11-19-79	R.G.M.
D	DELETED ITEM #14 BY NO. 25-0016 ITEM #16 BY NO. 25-0016 ITEM #18 BY NO. 25-0016 ITEM #25 BY NO. 25-0016 ITEM #45 BY NO. 25-0016 IN ITEM #25, DELETED R10 CITY, WAS 6 E.C.O. 9/26 11-14-79	R.G.M.
C	ADDED C36, ITEM #34 BY NO. WAS SA-9031 & Q17 WAS 1, & C30 WAS 01 MFD. E.C.O. 9/26 10-27-79	K.H.H.
B	REVISION 10-27-79	
A	REVISION 10-27-79	

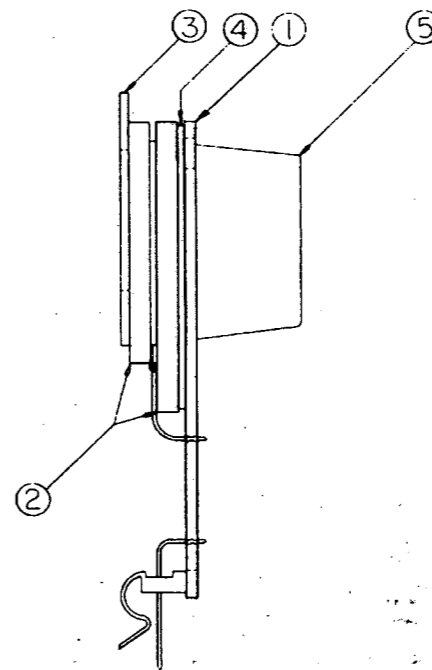
TOLERANCES		UNLESS OTHERWISE SPECIFIED	
FRAC TIONAL	±0.001"	ASSEMBLE ON	
DECIMAL	±0.001"	WILLIAMS ELECTRONICS, INC.	
MILS DIA.	±0.001"	8201 N. CALIFORNIA CHICAGO, ILL. 60618 887-8560	
ANGLE	±0.5°	SOUND BOARD SUB-ASSEM	
CONCENTRICITY	±0.001"	MATERIAL	FINISH
CREW THREADS	CLASS 2	HEAT TREATMENT	
DATE	9-25-79	SCALE	1:1
APP'D.	R.G.M.	DATE	9-25-79
BY		SCALE	1:1
REVISION		DATE	9-25-79
BY		SCALE	1:1



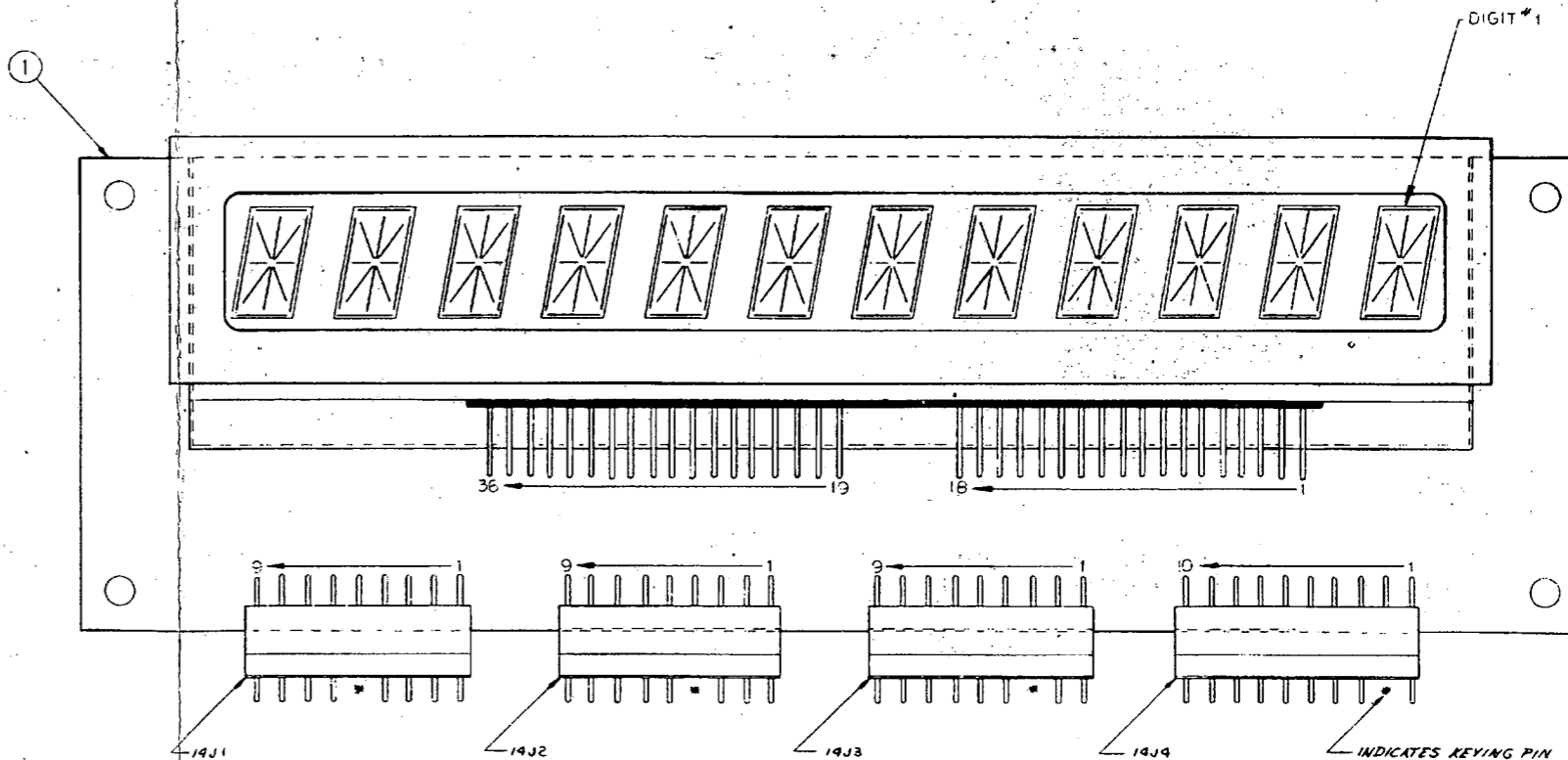
Sound Board Logic Diagram

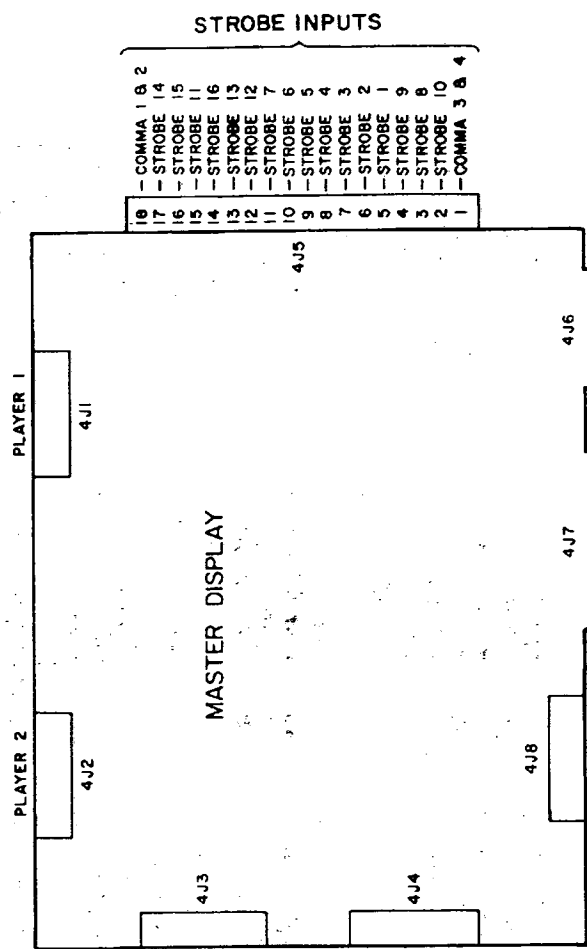
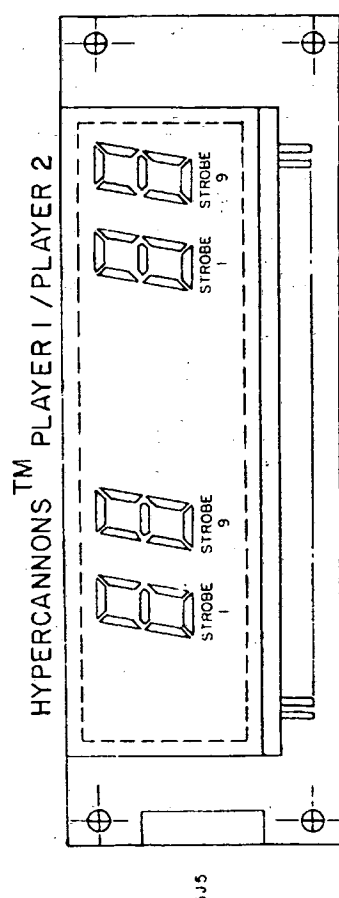
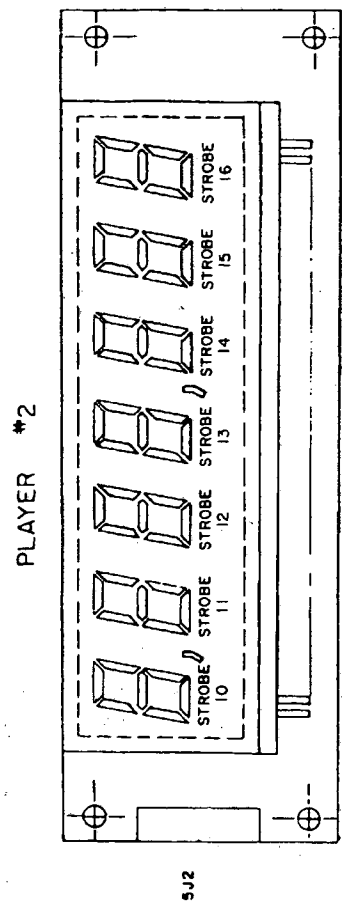
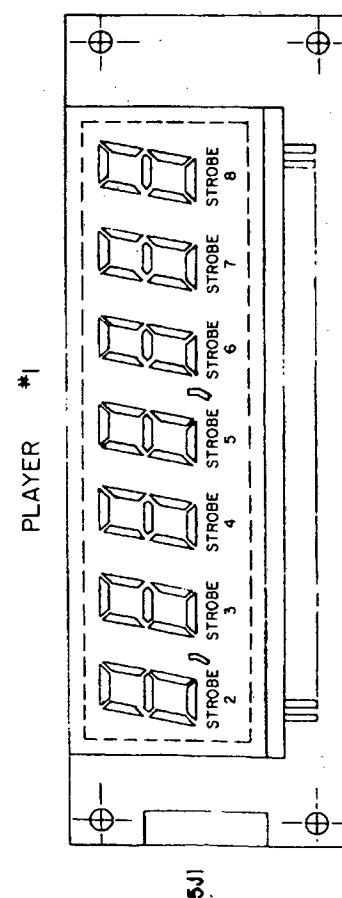


SEGMENT DIAGRAM

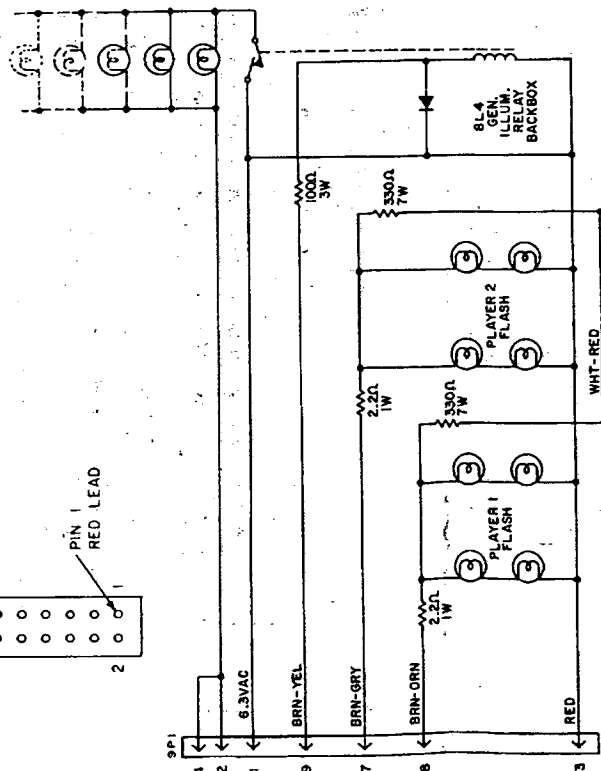
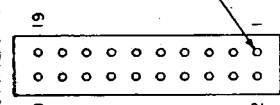


BILL OF MATERIAL				
ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D NO.
1	5769-09712-00		BARE P.C. BOARD	1
2	5670-63612-00		12 DIGIT ALPHANUMERIC DISPLAY	1
3	23-8555		FOAM DISPLAY (FRONT)	1
4	23-8554		FOAM DISPLAY (BACK)	1
5	03-7573-2		CAPLUG	1
6	5791-09721-00	14J4	10 PIN HEADER (03-75-1101)	1
7	5791-09720-00	14J1-14J3	9 PIN HEADER (03-75-1091)	3





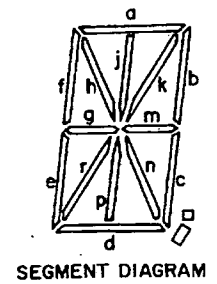
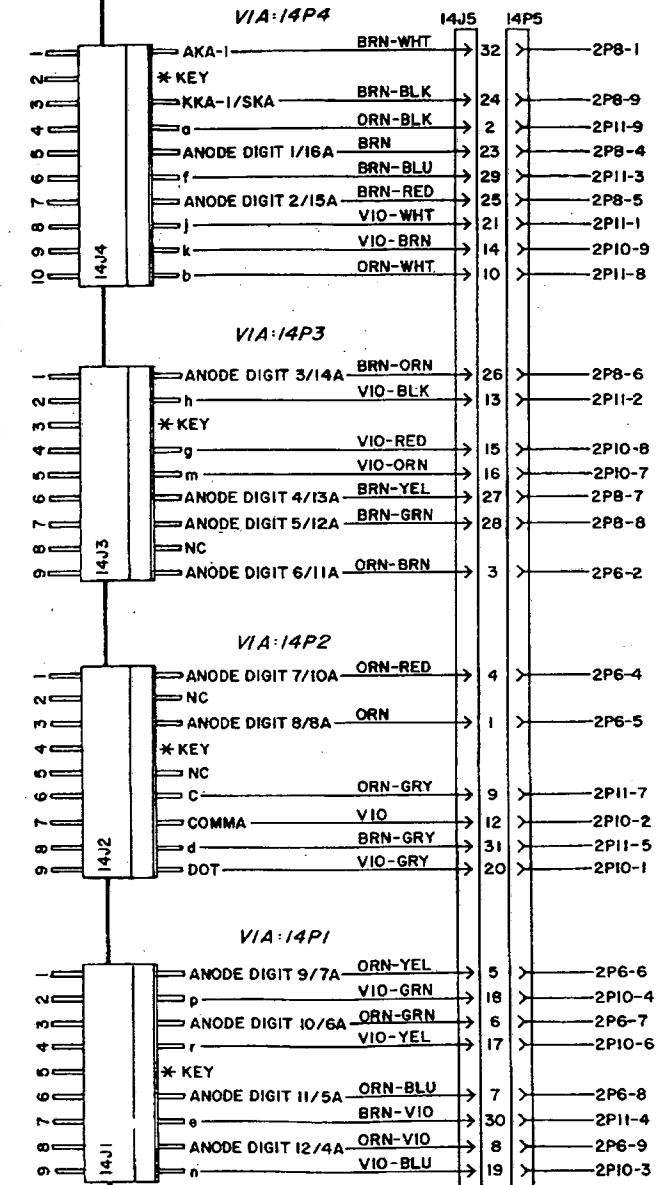
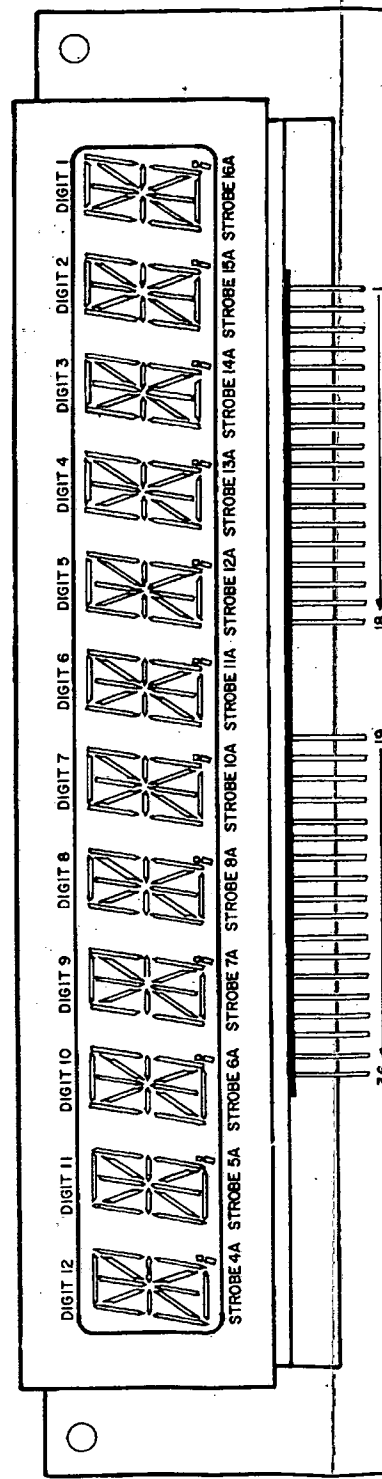
DETAIL A
4J1, 4J2, 4J8
5J1, 5J2, 5J5
CONNECTORS



- 4J1/5J1 (PLAYER 1)
- | | |
|----|------------------|
| 1 | 100,000's |
| 2 | -100V KEEP ALIVE |
| 3 | 1,000,000's |
| 4 | f SEGMENT |
| 5 | N/C |
| 6 | g SEGMENT |
| 7 | +100V (N/C) |
| 8 | e SEGMENT |
| 9 | 10,000's |
| 10 | d SEGMENT |
| 11 | 1,000's |
| 12 | +100V KEEP ALIVE |
| 13 | 100's |
| 14 | COMMA |
| 15 | 10's |
| 16 | c SEGMENT |
| 17 | N/C |
| 18 | b SEGMENT |
| 19 | UNITS |
| 20 | a SEGMENT |

- 4J2/5J2 (PLAYER 2)
- | | |
|----|------------------|
| 1 | 100,000's |
| 2 | -100V KEEP ALIVE |
| 3 | 1,000,000's |
| 4 | f SEGMENT |
| 5 | N/C |
| 6 | g SEGMENT |
| 7 | +100V (N/C) |
| 8 | e SEGMENT |
| 9 | 10,000's |
| 10 | d SEGMENT |
| 11 | 1,000's |
| 12 | +100V KEEP ALIVE |
| 13 | 100's |
| 14 | COMMA |
| 15 | 10's |
| 16 | c SEGMENT |
| 17 | N/C |
| 18 | b SEGMENT |
| 19 | UNITS |
| 20 | a SEGMENT |

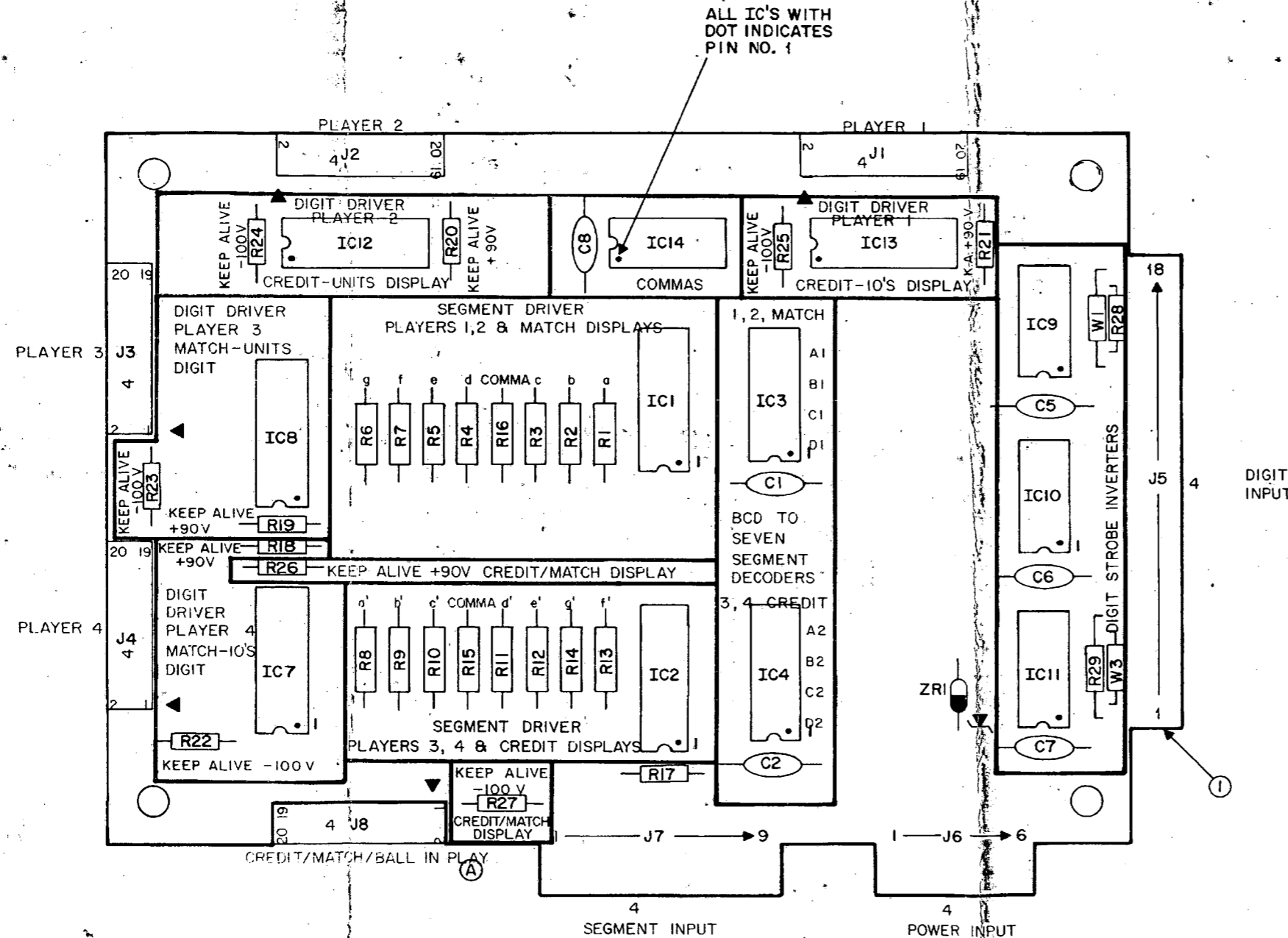
- HYPERCANNONS™ PLAYER 1 / PLAYER 2
4J8/5J5
- | | |
|----|--------------------|
| 1 | f Segment (Credit) |
| 2 | -100V Keep Alive |
| 3 | e Segment |
| 4 | g Segment |
| 5 | c Segment |
| 6 | d Segment |
| 7 | b Segment |
| 8 | 10's |
| 9 | Units |
| 10 | a Segment |
| 11 | e Segment |
| 12 | f Segment |
| 13 | 10's |
| 14 | d Segment |
| 15 | +100V Keep Alive |
| 16 | c Segment |
| 17 | g Segment |
| 18 | b Segment |
| 19 | Units |
| 20 | a Segment |



Display Wiring Diagram

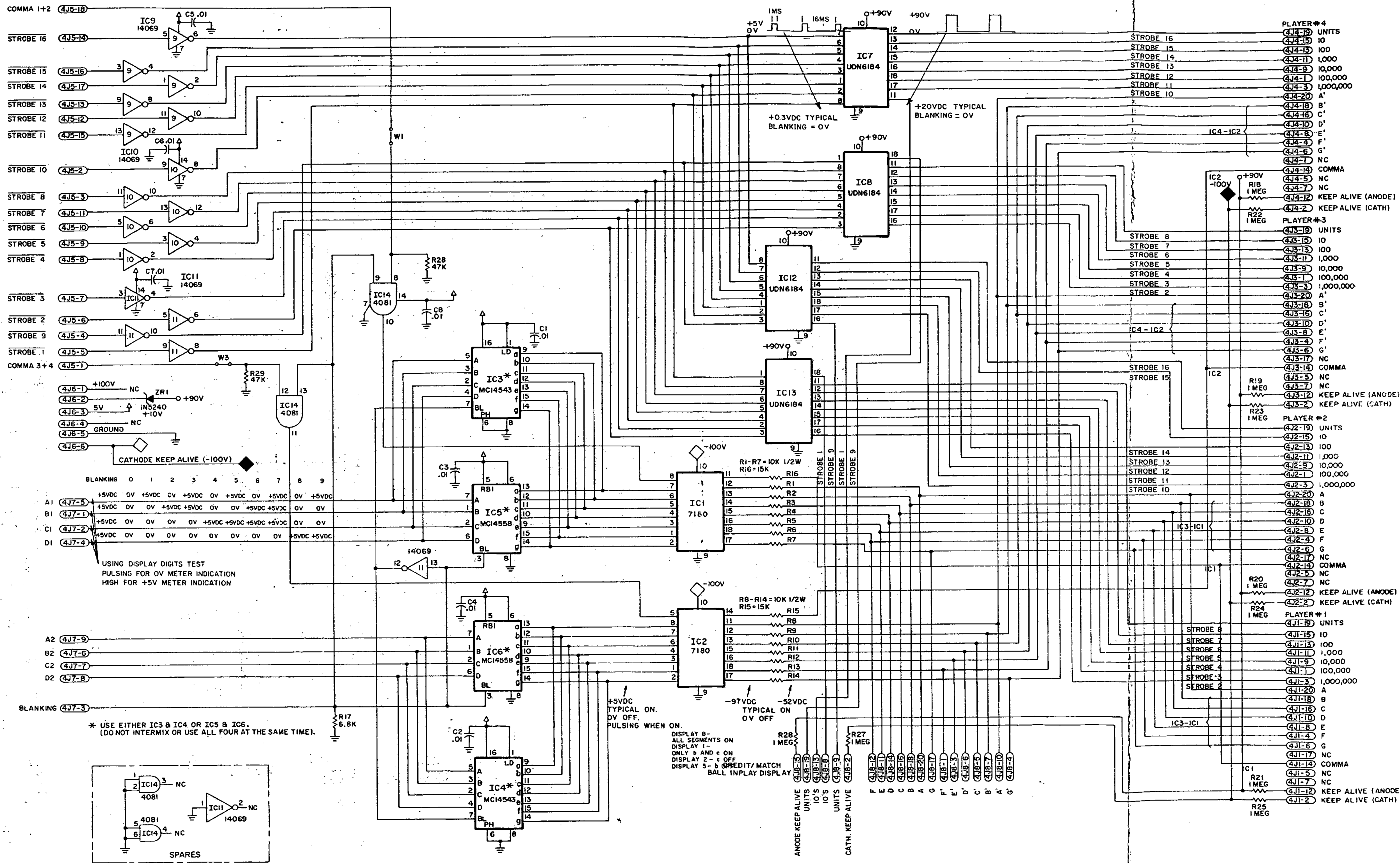
BILL OF MATERIAL

ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D NO.
1	5760-09461		BARE P.C. BOARD	1
2	5310-08971	IC9, IC10, IC11	MC14069 HEX INVERTER	3
3	5310-08970	IC3, IC4	MC14543 BCD TO SEVEN SEGMENT LATCH/DECODER/DRIVER	2
4	5680-08969	IC1, IC2	UDN-7180 GAS DISCHARGE DISPLAY SEGMENT DRIVER	2
5	5680-08968	IC7, IC8, IC12, IC13	UDN-6184A OR UDN-6118A GAS DISCHARGE DISPLAY SEGMENT DR.	4
6	5310-09450	IC14	MC14081 QUAD 2-INPUT AND GATE	1
7	5010-08981	R1-R14	RESISTOR, FC, 10K OHM, 5%, 1/2 WATT	14
8	5075-09135	ZR1	IN4740A ZENER DIODE 10V, 5%, 1 WATT	1
9	5043-08980	C1, C2, C5 THRU C8	CAPACITOR, CERAMIC, 0.01 MFD., 50V, +80 -20%	6
10	5010-09035	R28, R29	RESISTOR, FC, 47K OHM, 5%, 1/4 WATT	2
11	5010-09086	R17	RESISTOR, FC, 6.8K OHM, 5%, 1/4 WATT	1
12	5010-08982	R18 THRU R27	RESISTOR, FC, 3 MEG. OHM, 5%, 1/4 WATT	10
13	5791-09437	J1 THRU J4, J8	20 PIN RIBBON HEADER	5
14	5010-09149	R15, R16	RESISTOR, FC, 15K OHM, 5%, 1/2 WATT	2
15	5010-09534	W1, W3	RESISTOR, 0 OHM	2



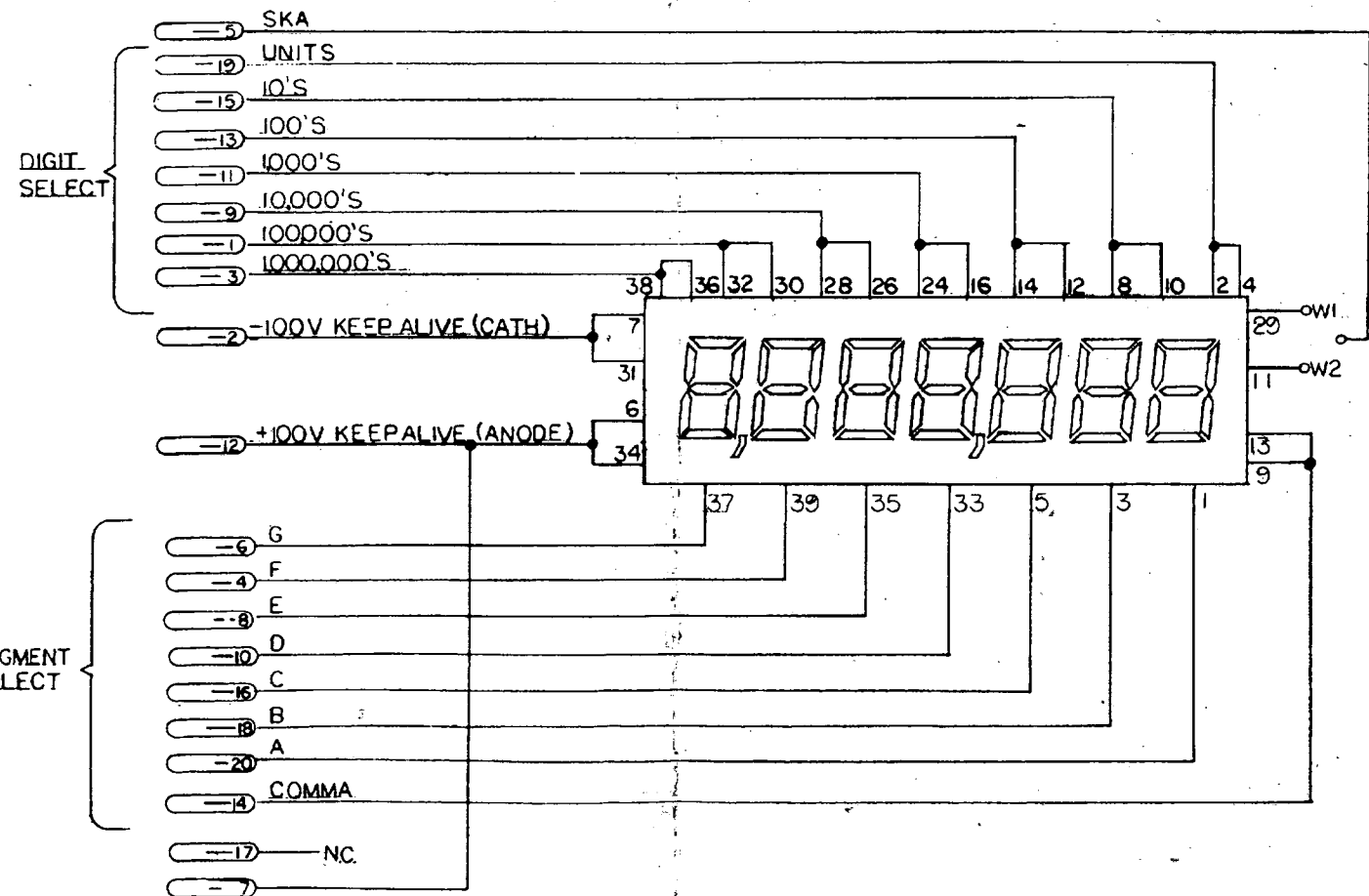
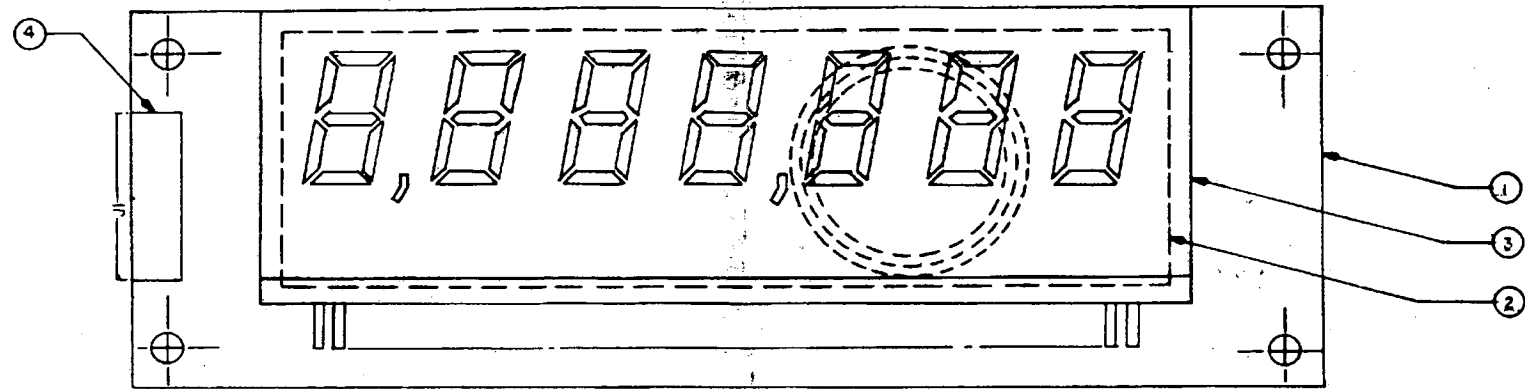
DIGIT CROSS REFERENCE

DIGIT	7-SEGMENT DECODER/DRIVER	STROBE (DRIVER)
Credit 10's	IC4/IC2	1 (IC13)
Credit Units	IC4/IC2	9 (IC12)
Match 10's	IC3/IC1	1 (IC7)
Match Units	IC3/IC1	9 (IC8)
#1 1,000,000's	IC3/IC1	2 (IC13)
#1 100,000's	IC3/IC1	3 (IC13)
#1 10,000's	IC3/IC1	4 (IC13)
#1 1,000's	IC3/IC1	5 (IC13)
#1 100's	IC3/IC1	6 (IC13)
#1 10's	IC3/IC1	7 (IC13)
#1 Units	IC3/IC1	8 (IC13)
#2 1,000,000's	IC3/IC1	10 (IC12)
#2 100,000's	IC3/IC1	11 (IC12)
#2 10,000's	IC3/IC1	12 (IC12)
#2 1,000's	IC3/IC1	13 (IC12)
#2 100's	IC3/IC1	14 (IC12)
#2 10's	IC3/IC1	15 (IC12)
#2 Units	IC3/IC1	16 (IC12)
#3 1,000,000's	IC4/IC2	2 (IC8)
#3 100,000's	IC4/IC2	3 (IC8)
#3 10,000's	IC4/IC2	4 (IC8)
#3 1,000's	IC4/IC2	5 (IC8)
#3 100's	IC4/IC2	6 (IC8)
#3 10's	IC4/IC2	7 (IC8)
#3 Units	IC4/IC2	8 (IC8)
#4 1,000,000's	IC4/IC2	10 (IC7)
#4 100,000's	IC4/IC2	11 (IC7)
#4 10,000's	IC4/IC2	12 (IC7)
#4 1,000's	IC4/IC2	13 (IC7)
#4 100's	IC4/IC2	14 (IC7)
#4 10's	IC4/IC2	15 (IC7)
#4 Units	IC4/IC2	16 (IC7)
#1 Comma	-/IC1	2.5 (IC13)
#2 Comma	-/IC2	10.13 (IC12)
#3 Comma	-/IC1	2.5 (IC8)
#4 Comma	-/IC2	10.13 (IC7)



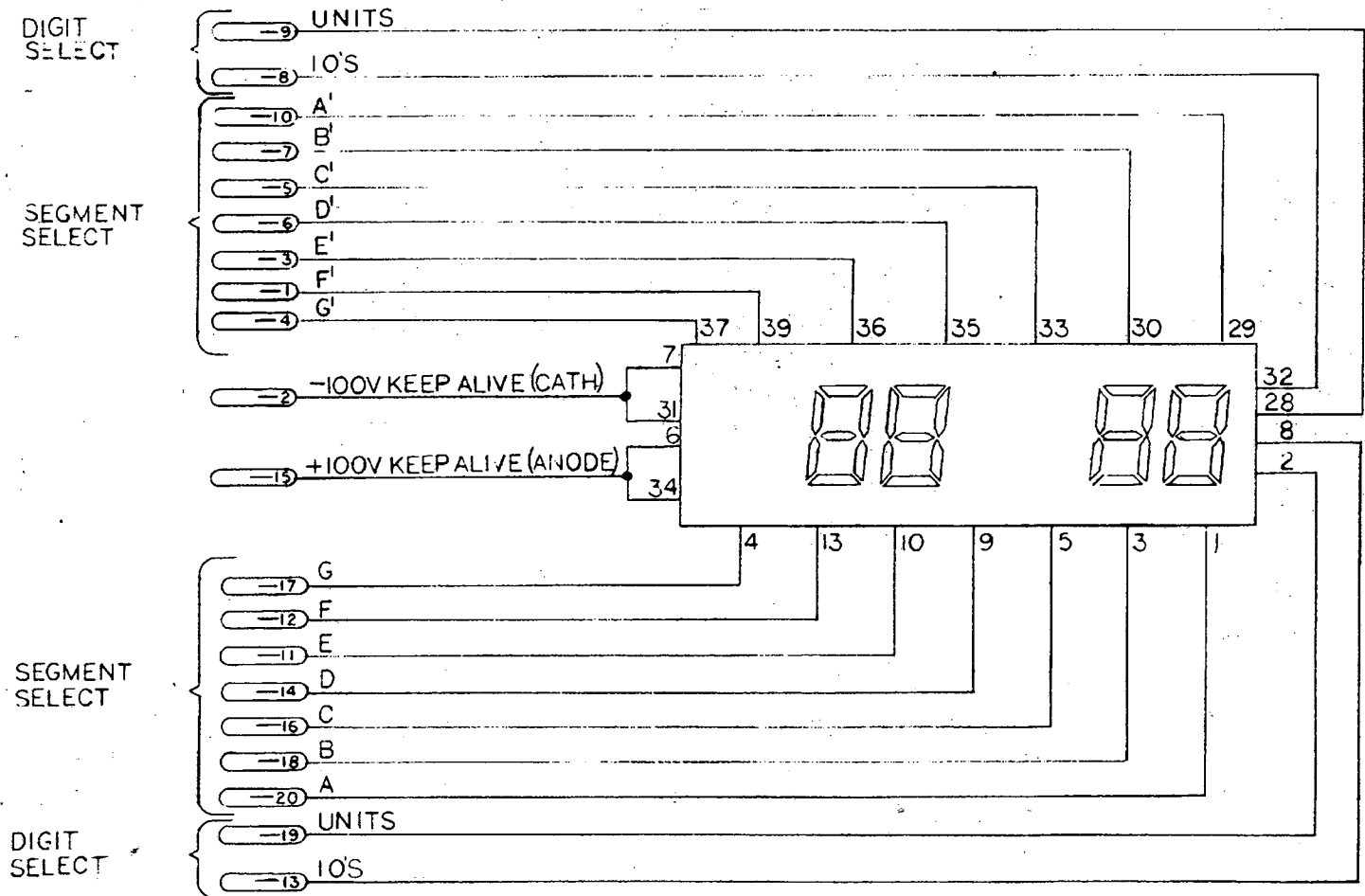
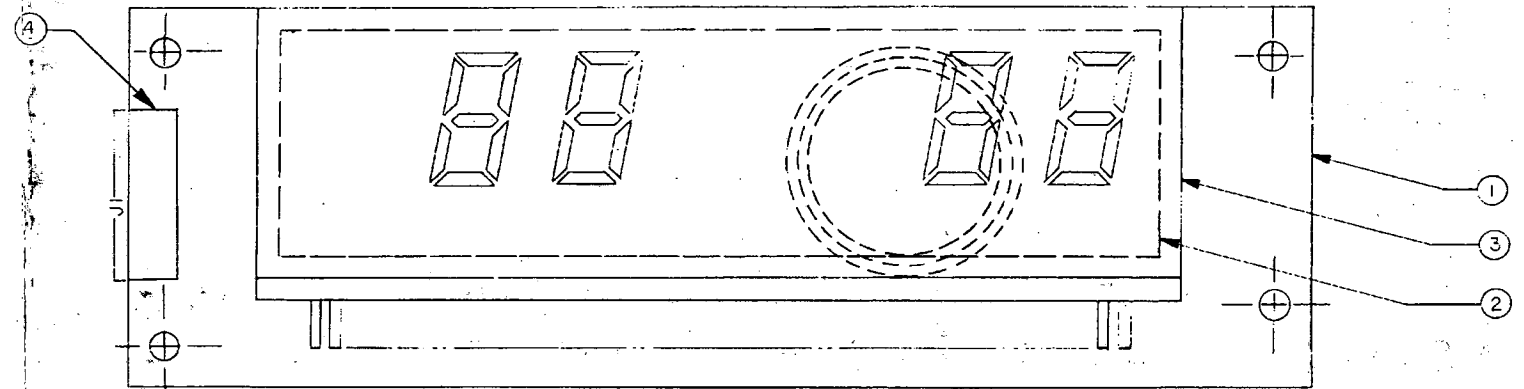
Master Display Board Logic Diagram

BILL OF MATERIAL				
ITEM	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D
1	5761-0844B-KP		SLAVE DISPLAY P.C. BOARD	1
2	23-6545		DISPLAY MTD ADHESIVE FOAM	1
3	5670-0844B-KP		7 DIGIT DISPLAY	1
4	5751-0844B-KP	J1	20 PIN RIBBON HEADER	1
5	05-7513-2		CAPLUG	1

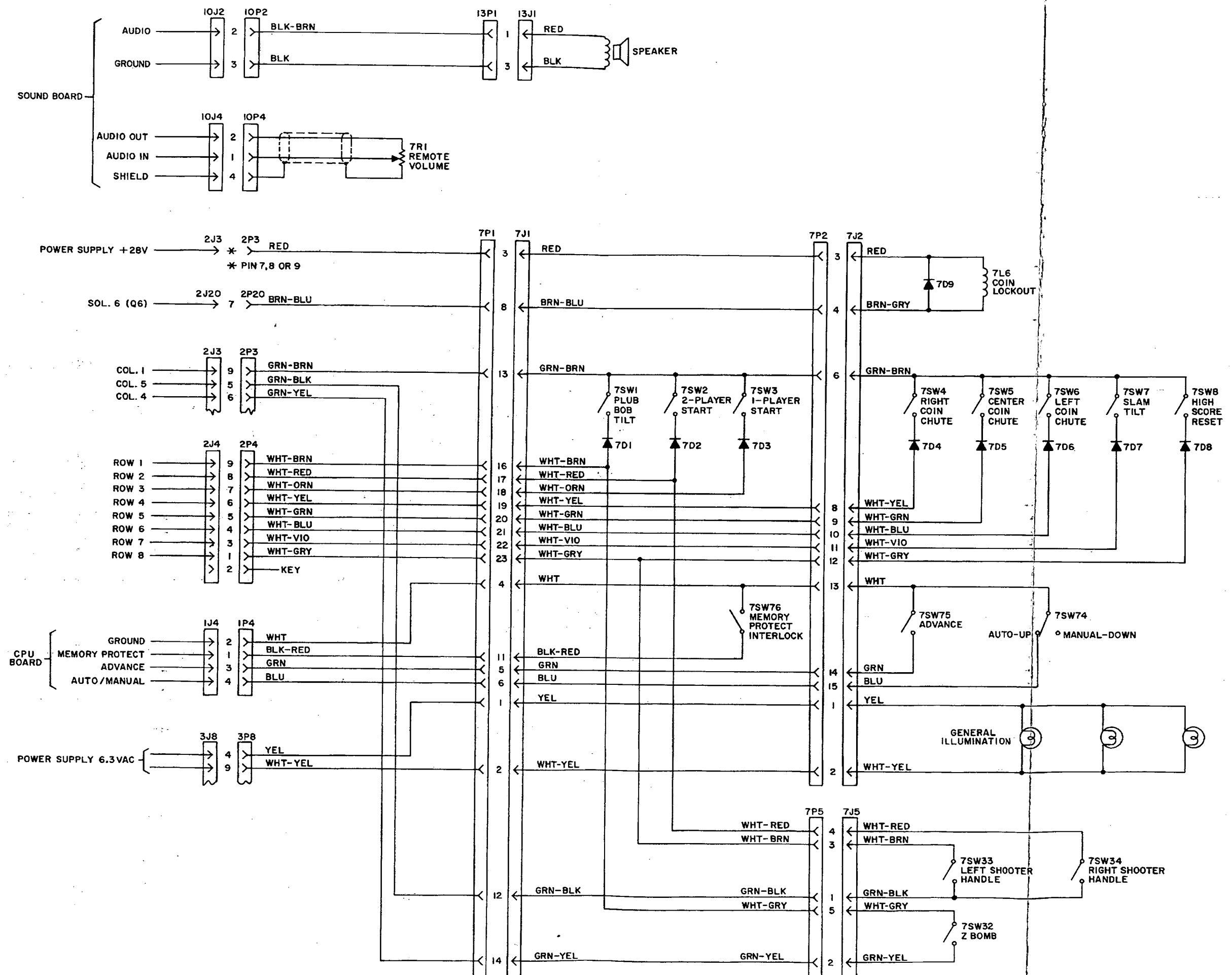


C 8364 PLAYER SLAVE DISPLAY

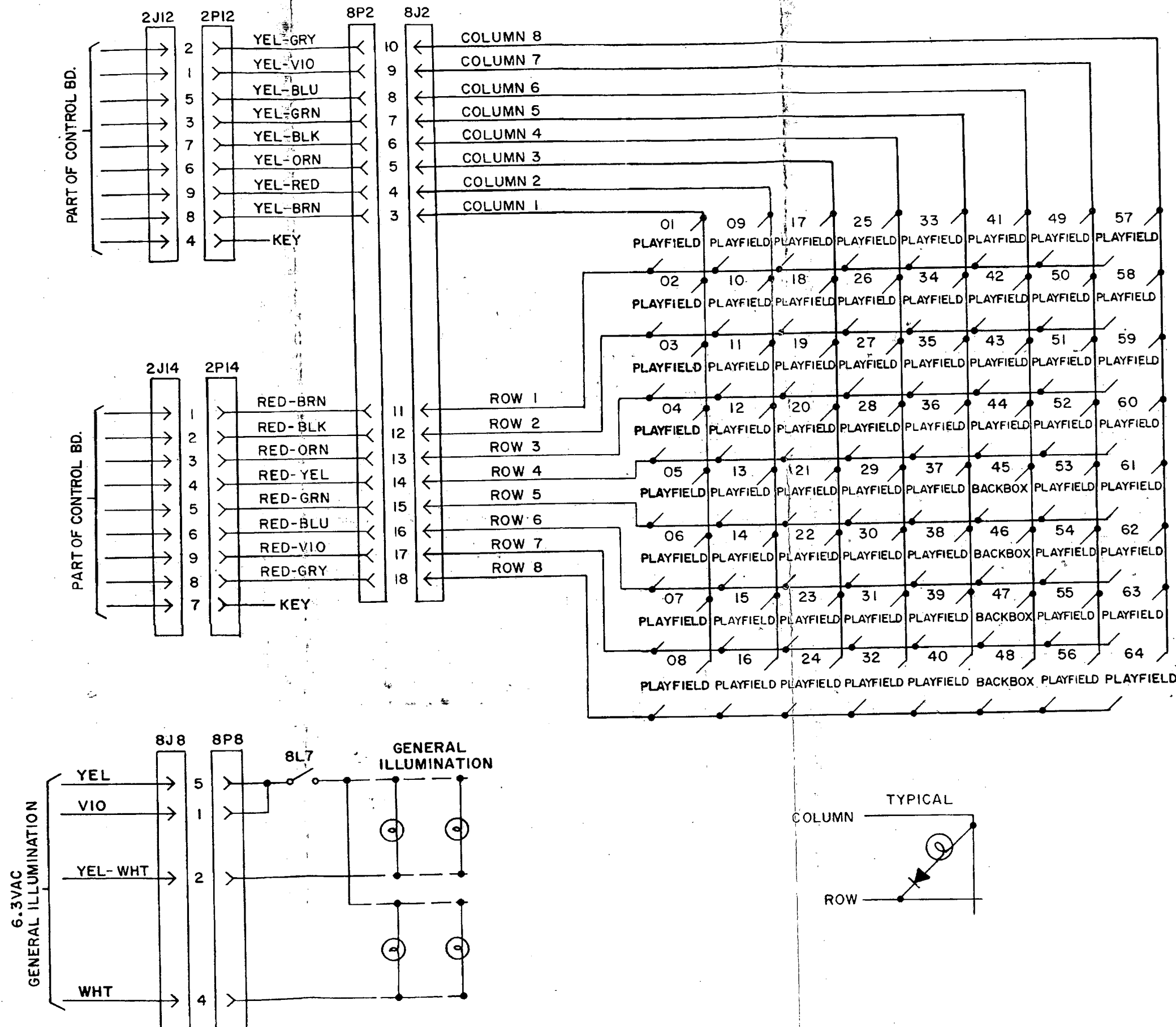
BILL OF MATERIAL				
ITEM	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D
1	5761-0844B-00		CREDIT/MATCH SLAVE PC BOARD	1
2	23-6545		FOAM DISPLAY - BACK	1
3	5670-0844B-00		4 DIGIT DISPLAY	1
4	5751-0844B-00	J1	20 PIN RIBBON HEADER	1
5	23-6546		FOAM DISPLAY - FRONT	1
6	05-7513-2		CAPLUG	1



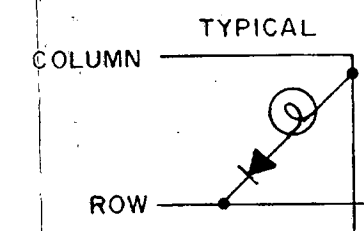
C 8365 CREDIT/MATCH SLAVE DISPLAY

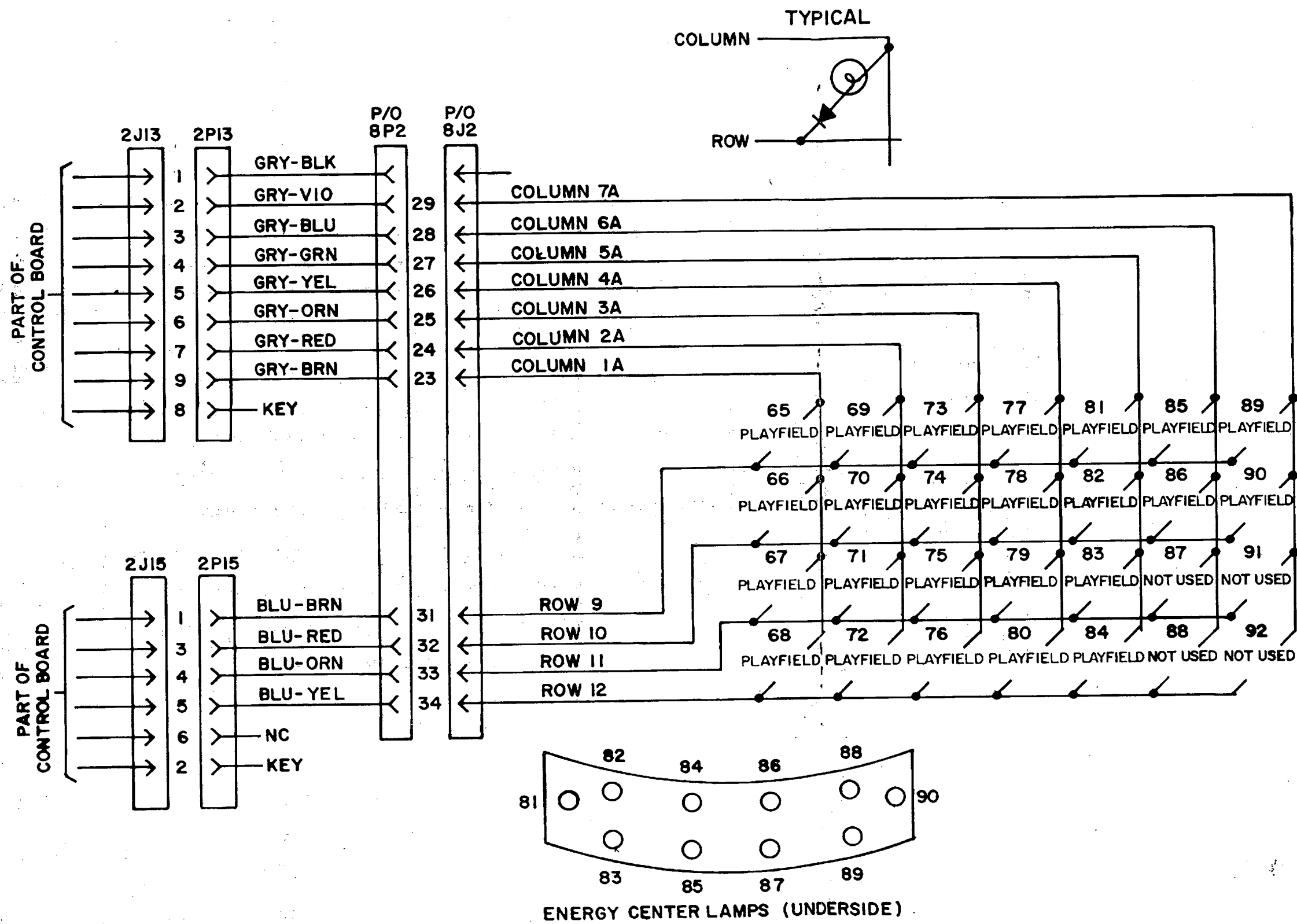


Cabinet Wiring Diagram

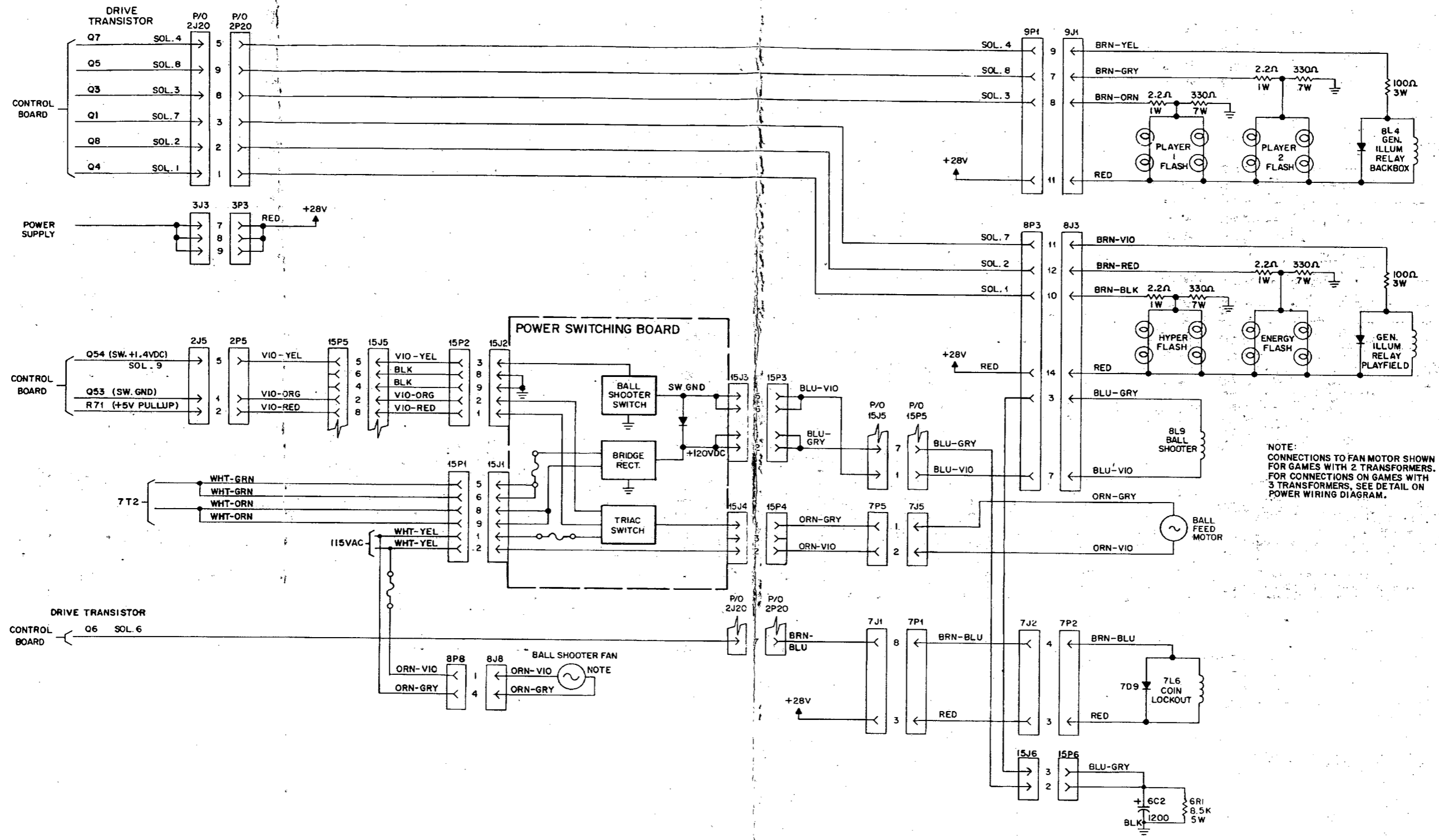


LAMP NO.	DESCRIPTION
01	H Lightning Bolt #1 (top)
02	H Lightning Bolt #2
03	H Lightning Bolt #3
04	H Lightning Bolt #4
05	H Lightning Bolt #5
06	H Lightning Bolt #6 (bottom)
07	I Lightning Bolt #1 (top)
08	I Lightning Bolt #2
09	I Lightning Bolt #3
10	I Lightning Bolt #4
11	I Lightning Bolt #5
12	I Lightning Bolt #6 (bottom)
13	J Lightning Bolt #1 (top)
14	J Lightning Bolt #2
15	J Lightning Bolt #3
16	J Lightning Bolt #4
17	J Lightning Bolt #5
18	J Lightning Bolt #6 (bottom)
19	K Lightning Bolt #1 (top)
20	K Lightning Bolt #2
21	K Lightning Bolt #3
22	K Lightning Bolt #4
23	K Lightning Bolt #5
24	K Lightning Bolt #6 (bottom)
25	L Lightning Bolt #1 (top)
26	L Lightning Bolt #2
27	L Lightning Bolt #3
28	L Lightning Bolt #4
29	L Lightning Bolt #5
30	L Lightning Bolt #6 (bottom)
31	M Lightning Bolt #1 (top)
32	M Lightning Bolt #2
33	M Lightning Bolt #3
34	M Lightning Bolt #4
35	M Lightning Bolt #5
36	M Lightning Bolt #6 (bottom)
37	N Lightning Bolt #1 (top)
38	N Lightning Bolt #2
39	N Lightning Bolt #3
40	N Lightning Bolt #4
41	N Lightning Bolt #5
42	N Lightning Bolt #6 (bottom)
43	O Lightning Bolt #1 (top)
44	O Lightning Bolt #2
45	O Lightning Bolt #3
46	O Lightning Bolt #4
47	O Lightning Bolt #5
48	O Lightning Bolt #6 (bottom)
49	P Lightning Bolt #1 (top)
50	P Lightning Bolt #2
51	P Lightning Bolt #3
52	P Lightning Bolt #4
53	P Lightning Bolt #5
54	P Lightning Bolt #6 (bottom)
55	A Lightning Bolt
56	B Lightning Bolt
57	C Lightning Bolt
58	D Lightning Bolt
59	E Lightning Bolt #3 (bottom)
60	E Lightning Bolt #2
61	E Lightning Bolt #1 (top)
62	F Lightning Bolt
63	G Lightning Bolt
64	Y Lightning Bolt





LAMP NO.	DESCRIPTION
65	W Lightning Bolt
66	V Lightning Bolt
67	U Lightning Bolt
68	T Lightning Bolt #1 (top)
69	T Lightning Bolt #2
70	T Lightning Bolt #3 (bottom)
71	S Lightning Bolt
72	R Lightning Bolt
73	Player 1 Bomb (top)
74	Player 1 Bomb (middle)
75	Player 1 Bomb (bottom)
76	Player 2 Bomb (top)
77	Player 2 Bomb (middle)
78	Player 2 Bomb (bottom)
79	Player #1 Light
80	Player #2 Light
81	Energy Center Light
82	Energy Center Light
83	Energy Center Light
84	Energy Center Light
85	Energy Center Light
86	Energy Center Light
87	Energy Center Light
88	Energy Center Light
89	Energy Center Light
90	Energy Center Light



NOTE:
 CONNECTIONS TO FAN MOTOR SHOWN
 FOR GAMES WITH 2 TRANSFORMERS.
 FOR CONNECTIONS ON GAMES WITH
 3 TRANSFORMERS, SEE DETAIL ON
 POWER WIRING DIAGRAM.