

Williams®

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Game No. 500
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Black Knight



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FOREWORD

This instruction and drawing set provides essential installation information unique to BLACK KNIGHT. For game operation, bookkeeping, game adjustment, diagnostic and self-test and basic troubleshooting procedures, refer to the instruction booklet located in the envelope inside the coin door. For detailed troubleshooting and interconnection information, refer to Williams Solid State Flipper Maintenance Manual and Supplements.

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 blue-labeled Flipper ROMs and blue-labeled Game ROMs.
3. Jumpers W3, W10, W11, W14, W17, W19, W10, and W22 must be connected. Jumpers W4, W9, W12, W15, W16, W18, W21, and W23 must be removed. With the exception of W25, (Factory Setting Jumper) all other jumpers are not changed.

Driver Board

Either earlier model D7997 or later model D8341 boards may be used. When earlier boards are used, switch matrix series resistors R204 thru R211 must be zero-ohm or be replaced with wire jumpers.

Sound Board

1. D 8224 required for speech
2. Must be jumpered for white-labeled sound ROM operation and be equipped with Sound ROM 5. (Jumpers W2, W5, W7, W9, W10, W12, and W15 connected; W3, W4, W6, W8, W11, and W13 removed).

Power Supply Board

1. When transformer is mounted in cabinet, D 8345 board (equipped with relay) is required. When transformer is mounted in backbox, earlier D 7999 board is required.
2. F4 (20A SB) for flipper solenoids and magnets must be installed.

Display Boards

Model C 8363 Master Display and 7-digit Slave Displays required.

Optional Speech Module

Requires 5T5001 (IC7), 5T5002 (IC5), 5T5003 (IC6), and 5T5004 (IC4) Speech ROMs.

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Assembly and Interconnection

With legs attached to cabinet and backbox positioned face-down on top of cabinet with the opening facing the rear of the cabinet proceed as follows:

- A. Pull four cables from backbox.
- B. Reach into right side of pedestal hole, pull up ground strap, and push it into backbox.
- C. Remove ties securing cabinet and playfield cables to cabinet and pull up these cables.
- D. Interconnect four cables. They are size and color coded.
- E. Insert line cord into notch in cabinet. DO NOT PLUG IN AT THIS TIME.
- F. Push remote volume control cable, White-Red solenoid ground cable, and transformer cable (terminated with four plugs) into backbox.
- G. Lift up backbox and position on cabinet pedestal, engaging brackets for support.
- H. Remove shipping blocks from insert door.
- I. Secure backbox to cabinet using two bolts and washers.
- J. Connect ground braid and White-Red wire under wing nut and washer at bottom of backbox.
- K. Loosely position remote volume cable and Sound Board power cable in harness and plug connectors into 10J4 and 10J1, respectively.
- L. Connect bridge rectifier connector 6P1/6J1, and plug remaining two transformer connections into 3J1 and 3J9 on the Power Supply Board.

Inspection

- A. Check all connectors in backbox for loose wire terminations. Reseat any loose wires by pushing in on the terminal.
- B. Push on all connectors attached to Master Display, CPU, Driver, and Sound Boards, and check terminations on capacitor and bridge rectifier at the lower right of the backbox.
- C. Gently press on all the socketed IC packages on the CPU and Sound Boards.
- D. Check that two fuses on the Sound Board, seven fuses on Power Supply Board, and two fuses on Insert Board are secure.
- E. Push on the connector attached to Slave Display Boards.
- F. Check that the line fuse in the bottom of the cabinet is secure.
- G. Check the transformer input connector in bottom of cabinet for loose wire termination. Reseat any loose wires by pushing in on the termination.

H. Check the cabinet to coin door connector for loose wire terminations. Reseat any loose wires by pushing in on the terminations.

Power Turn-On and Game Setup

This machine MUST BE PLUGGED INTO A PROPERLY GROUNDED OUTLET to PREVENT SHOCK HAZARD 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. With the coin door closed, 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, and the high score to date alternating with the player scores.
2. If the game comes on in the diagnostic mode (number of credits display showing 04, ball in play display showing 00, and player 1 display showing game identification) turn the game OFF and ON again.
 - a. If the game now 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 the instruction booklet.
3. If the game still comes on in the diagnostic mode, refer to troubleshooting procedures in the maintenance manual.
4. Place three balls on playfield next to outhole.
5. Perform diagnostic tests and make any desired changes to features as described in the instruction booklet.

Black Knight

INSTRUCTION BOOKLET

This booklet provides game operation, bookkeeping, game adjustment, and diagnostic and self-test procedures for BLACK KNIGHT. For installation information refer to the blue-covered game manual. For detailed information refer to Williams Solid State Flipper maintenance Manual.

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Driver Board

Either earlier model D 7997 or later model D 8341 boards may be used. When earlier boards are used, switch matrix series resistors R196 thru R211 must be zero-ohm or be replaced with wire jumpers. Later D 8341 boards do not use series resistors in the switch matrix.

Sound Board

1. D 8224 required for speech
2. Must be jumpered for white-labeled sound ROM operation and be equipped with Sound ROM 5. (Jumpers W2, W5, W7, W9, W10, W12, and W15 connected; W3, W4, W6, W8, W11, and W13 removed).

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1. When transformer is mounted in cabinet, D 8345 board (equipped with relay) is required. When transformer is mounted in backbox, earlier D 7999 board is required.
2. F4 (20A SB) for flipper solenoids and magnets must be installed.

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Optional Speech Module

Requires 5T5001 (IC7), 5T5002 (IC5), 5T5003 (IC6), and 5T5004 (IC4) Speech ROMs.

GAME OPERATION

*Indicates adjustable features.

Game Over Mode - Turn game ON; player 1 score shows 00, all player scores alternate the high score to date, Game Over lights, all playfield lamps cycle in attract mode.

Multi-Ball and Magna-Save are trademarks of Williams Electronics, Inc.

Credit Posting - Insert coin; sound produced, number of credits displayed. If maximum credits* exceeded by coin or high score to date*, credits are posted correctly, coin lockout de-energizes until remaining credits are below maximum. No credits may be won and coins are rejected while lockout is de-energized.

Game Start - Three balls must be resting on ball ramp, locking mechanism, or ball shooter switches (maximum of one ball in ball shooter trough) before game will start. Push credit button, startup tune played, ball served, credit display reduced by 1, player 1 score flashes 00 until first scoring switch is made, ball in play shows 1. Pushing credit button before ball 2 displayed allows additional players.

Bonus Advance - The bonus is advanced (from 1,000 to 49,000) one time by making left ramp rollover, twice by making left and right inside rollovers or outlanes, three times by completing a bank of drop targets, and five times by making left or right inside rollovers as a result of *Magna-Save™* feature. With bonus at maximum and multiplier at 5x, completing a bank of drop targets or making one of the advance switches scores 5,000. Bonus multipliers are advanced from 2X to 5X by making the Turnaround.

Magna-Save Feature* - Completing a drop target 3-bank while associated lamp is still flashing scores 10,000, lights a target arrow, and lights a magnet. If the associated lamp goes out before the bank is completed, the bank is reset. With a magnet lamp lit, operating the corresponding *Magna-Save* button on the side of the cabinet energizes the magnet for a *few seconds and a ball held stationary by the magnet will tend to go through the inside rollover.

Mystery and Spinner - Making the left inside rollover flashes the right ramp rollover for a mystery value. Making the rollover while still flashing awards the mystery value which will be indicated on other player display(s). Making the right inside rollover flashes the spinner.

Multi-Ball™ Play - Making a ball in the lock mechanism when a lock arrow is flashing, lights a lock arrow steadily and lights the lower playfield eject hole. Locking three balls in the mechanism or making the eject hole when lit releases the balls from the mechanism. All scoring and mystery values are tripled while three balls are in play and doubled while two balls are in play. Lock arrows do not flash until turnaround is made.*

Extra Ball - A maximum of four * Extra Balls may be accumulated at one time. Spotting three arrows for both top and/or* both bottom banks lights the left ramp rollover for the first possible extra ball. Spotting all 3-bank arrows lights the Turnaround for the second possible Extra Ball. Spotting all 3-bank arrows alternately lights the left ramp rollover and Turnaround for additional Extra Balls. Making left ramp rollover or Turnaround when lit awards an Extra Ball.

Last Chance* - With locked balls on the last ball of the game, the left and right outside rollovers are lit for a "last chance." Making the rollover when lit releases any locked balls (no *Multi-Ball* scoring). If Extra Ball(s) is won during "last chance", the rollovers are not relit.

Bonus Ball* - With two or more players, a player with the highest score is awarded a bonus ball*. All three balls are released and play is allowed for 30* seconds with both magnet lamps lit. There is no *Multi-Ball* or mystery scoring or playfield Extra Ball feature during the bonus ball. Extra Balls won from Special or high score levels are awarded as additional bonus balls.

Special - Completing all four drop target 3-banks during the bonus ball lights the Turnaround for a possible Special. Making the Turnaround when lit awards a Special.

Memory - 3-bank drop target arrows, locked balls, magnet lamps, and Extra Ball lamps.

Tilt - Ball in play tilted on first closure of ball roll tilt and third* closure of Plumb Bob and playfield tilts. Slam tilt return game to game over.

End of Game - Match Digits* appears in ball in play display, *credit awarded for match. Exceeding high score to date awards *three credits. Match, High Score to Date, and Game Over sounds made as appropriate. A new game cannot be started with more than one ball resting in the ball shooter trough; excess balls must be returned to the playfield and rest on the ball ramp switches.

With Speech Module, the following phrases are produced during game play.

Game start, add players 2, 3, and 4; Random phrase:

Defend thyself, Knight.
I challenge thee to fight me.
You cannot fight and win.
I will slay you, my enemy.
The BLACK KNIGHT will win again.
The BLACK KNIGHT will slay you.
Fight against me, the BLACK KNIGHT.
I will slay thee, Knight.

Achievement

2-ball **Multi-ball** Play

3-ball **Multi-ball** Play

Magna-Save drain

Win free game

Win Extra Ball

**After last regular ball:

1-player

2-,3-, or 4-players

High Score to Date

Match

Game Over

**Produced only if "Bonus Ball" enabled.

Response

Fight against 2 enemies.

Fight against 3 enemies.

Laughter.

I cannot slay you. You win.

Fight me again, Knight.

One enemy cannot fight the

BLACK KNIGHT again.

You win the right to fight the

BLACK KNIGHT again.

You win one fight. I challenge thee again.

The **BLACK KNIGHT** will win again.

Will you challenge the **BLACK KNIGHT** again?

BOOKKEEPING AND GAME EVALUATION

(Functions 01-17)

1. Set AUTO-UP/MANUAL-DOWN switch to AUTO-UP and depress ADVANCE pushbutton. Test 04 is indicated in the credits display, Function 00 in Match display, and Game Identification in Player 1 display.
2. Operate the ADVANCE pushbutton to display Functions 01 thru 04 on the Match display (See Table 1) and record the corresponding totals (number of coins and total paid credits) from the Player 1 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 Functions 05, 06, and 07 in the Match display and record the corresponding free credit totals from the Player 1 display.
4. Operate the ADVANCE pushbutton to display Function 08 in the Match display. Total credits is indicated in the Player 1 display, total free credits in the Player 2 display, and percentage of free credits in the Player 4 display.

Table 1. Audit Totals

FUNCTION	DESCRIPTION		
	PLAYER 1	PLAYER 2	PLAYER 4
00	Game Identification (2500 2)	—	—
01	Coins, Left chute	—	—
	(closest to coin door hinge)	—	—
02	Coin, center chute	—	—
03	Coin, right chute	—	—
04	Total Paid Credits	—	—
05	Special Credits	—	—
06	Replay Score Credits	—	—
07	Match Credits	—	—
08	Total Credits	Free Credits	% Free Credits
09	Total Extra Balls	—	—
10	Ball Time in Minutes	—	—
11	Total Balls Played	—	—
12	Current High Score	—	—
	to Date		
13	Backup High Score	High Score to Date	—
	to Date	Credits Awarded	
14	Replay 1 Score	Times exceeded	—
15	Replay 2 Score	Times exceeded	—
16	Replay 3 Score	Times exceeded	—
17	Replay 4 Score	Times exceeded	—

5. Operate the ADVANCE pushbutton to display Function 09 thru 12 in the Match display and record the corresponding totals from the Player 1 display.
6. Operate the ADVANCE pushbutton to display Functions 13 thru 17 in the Match display and record the corresponding totals from the Player 2 display.
7. With switch set to MANUAL-DOWN operate ADVANCE to display Function 50 in the Match Display. From Function 50 you can return to game over or zero audit totals and return to game over. Perform step 8.a. or 8.b. as desired.
8. 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 credit button to display 35 in the Player 1 display, and depress ADVANCE.

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 Credits display, Function 00 in Match display, and game identification in Player 1 display.
2. To raise Function number in Match 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 Match display, raise value in player 1 display by operating credit button with switch set to AUTO-UP; lower value by operating credit button with it set to MANUAL-DOWN. Value left in Player 1 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 Match 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 Credit button with switch set to AUTO-UP until 45 is indicated in Player 1 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.

FACTORY AUDIT TOTALS (Functions 42-49)

The following factory audit functions are assigned:

- 42 - Total "Last Chance" won
- 43 - Total times *Multi-ball* achieved
- 44 - Total times "Mystery" score won
- 45 - Total "Bonus" balls awarded
- 49 - Number of Auto Cycle Test Passes.

Table 2. Game Adjustments

FUNCTION	DESCRIPTION	NOTES	*FACTORY SETTING
13	Backup High Score to Date [HSTD Credits Awarded]	1	2,500,000
14	Replay 1 Score [Times exceeded]	2	1,000,000
15	Replay 2 Score [Times exceeded]	2	2,000,000
16	Replay 3 Score [Times exceeded]	2	0
17	Replay 4 Score [Times exceeded]	2	0
18	Maximum Credits	3	30
19	Standard and Custom Pricing Control (00-08)	4	01/03
20	Left Coin Slot Multiplier	4	03/09
21	Center Coin Slot Multiplier	4	12/45
22	Right Coin Slot Multiplier	4	03/18
23	Coin Units Required for Credit	4	04/05
24	Coin Units Bonus Point	4	15/45
25	Minimum Coin Units	4	00
26	Match: 00 = Match ON; 01 = Match OFF	—	00
27	Special: 00 = Awards Credit; 01 = Awards Bonus Ball; 02 = Awards Points	—	00
28	Replay Scores: 00 = Awards Credit; 01 = Awards Extra Ball or Bonus Ball	—	00
29	Maximum Plumb Bob Tilts	—	03
30	Number of Balls (03 or 05)	—	03
31	Magna-Save Feature: 03-09 = on time in seconds	5	05
32	Attract Mode Sound: 00 = ON; 01 = OFF	—	00
33	Drop Target Timing: 00-09 = 6-15 seconds	—	03
34	"Bonus Ball" Time: 00 = not allowed; 01-99 = Time in seconds	—	30
35	Bell: 00 = Bell OFF; 01 Bell ON	—	01
36	Extra Ball Difficulty 00 = 1st EB from pair of drop target banks 01 = All EBs from four drop target banks	—	00
37	Multi-Ball Difficulty: 00 = Liberal; 01 = Moderate	—	00
38	Locked Ball lamps: 00 = Memory; 01 = No Memory	—	01
39	Background Sound: 01 = ON; 00 = OFF	—	01
40	High Score Credits	1	03
41	Maximum Extra Balls at one time (00 = No Extra Ball)	—	04

* Second Factory Setting value is with jumper W25 connected.

[] Description in brackets shown in Player 2 Display.

- Function 13 may be set to any multiple of 100,000 points. Setting Function 40 to zero with Function 13 set to any score but zero permits the High Score to Date feature to operate but no credits are awarded.
- Functions 14-17 (Replay Scores) may be set to any multiple of 100,000 points. Setting a function to zero disables the replay score point.
- Setting Maximum Credits (Function 18) to zero places the game in a free play mode.
- 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.
- Magnets always enabled during "Bonus Ball".

RECOMMENDED SCORE LEVELS CREDIT GAMES

3-Ball: *1,000,000; 2,000,000

5-Ball: 2,000,000; 3,000,000

EXTRA BALL

3-Ball: 700,000

5-Ball: 1,000,000

*Factory Setting

DIAGNOSTIC PROCEDURES

Display Digits Test

1. Set AUTO-UP/ to MANUAL-DOWN switch and depress ADVANCE. Displays should indicate all 0's.
2. Set the switch to AUTO-UP. Displays should sequence from all 0's thru all 9's. Comma segments should come on 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 Digits Test depress ADVANCE with the switch set to AUTO-UP. Test 00 should be indicated in the number of Credits display and the Match display sequences 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

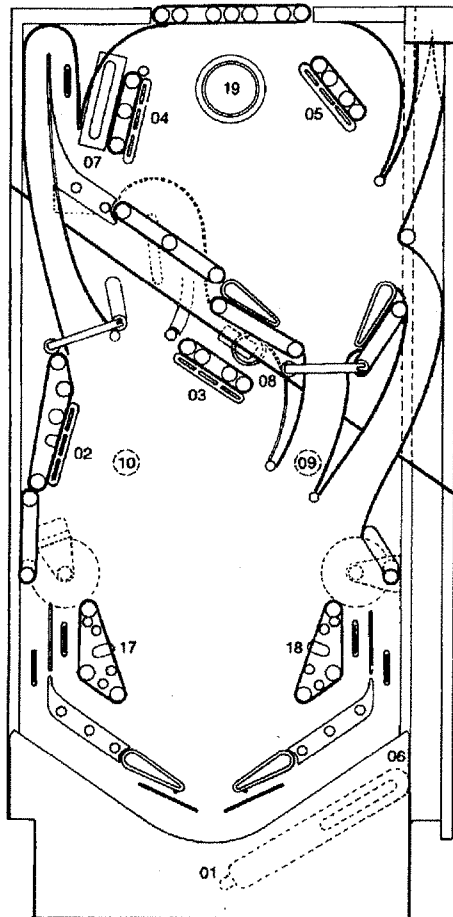
From Sound Test depress ADVANCE with the switch set to AUTO-UP Test 01 should be indicated in the Credits display and all multiplexed lamps should flash.

COLUMN ROW	1 YEL-BRN 2J5-8	2 YEL-RED 2J6-9	3 YEL-ORN 2J5-6	4 YEL-BLK 2J5-7	5 YEL-GRN 2J5-3	6 YEL-BLU 2J5-5	7 YEL-VIO 2J5-1	8 YEL-GRY 2J5-2
1 RED-BRN 2J7-1	SAME PLAYER SHOOTS AGAIN	RIGHT MAGNA- SAVE LAMP	BOTTOM LEFT 3-BANK LAMP	BOTTOM LEFT 3-BANK LOWER ARROW	TOP LEFT 3-BANK LOWER ARROW	LEFT RAMP ROLLUNDER EXTRA BALL WHEN LIT	"2" BONUS	"10" BONUS
2 RED-BLK 2J7-2	BALL IN PLAY	LEFT MAGNA- SAVE LAMP	BOTTOM RIGHT 3-BANK LAMP	BOTTOM LEFT 3-BANK CENTER ARROW	TOP LEFT 3-BANK CENTER ARROW	LEFT LOCK LAMP	"3" BONUS	"20" BONUS
3 RED-ORN 2J7-3	TILT	LEFT OUTLANE	TOP LEFT 3-BANK LAMP	BOTTOM LEFT 3-BANK UPPER ARROW	TOP LEFT 3-BANK UPPER ARROW	NOT USED	"4" BONUS	"30" BONUS
4 RED-YEL 2J7-4	GAME OVER	RIGHT OUTLANE	TOP RIGHT 3-BANK LAMP	2X SCORING	JET BUMPER	NOT USED	"5" BONUS	"40" BONUS
5 RED-GRN 2J7-5	MATCH	RIGHT SPINNER	CENTER LOCK LAMP	BOTTOM RIGHT 3-BANK RIGHT ARROW	TOP RIGHT 3-BANK LOWER ARROW	NOT USED	"6" BONUS	2x
6 RED-BLU 2J7-6	HIGH SCORE TO DATE	RAMP ROLLUNDER	TURNAROUND EXTRA BALL WHEN LIT	BOTTOM RIGHT 3-BANK CENTER ARROW	TOP RIGHT 3-BANK CENTER ARROW	NOT USED	"7" BONUS	3x
7 RED-VIO 2J7-9	CREDITS (PLAY FIELD)	RIGHT INSIDE ROLLOVER	TURNAROUND SPECIAL	BOTTOM RIGHT 3-BANK LEFT ARROW	TOP RIGHT 3-BANK UPPER ARROW	SAME PLAYER SHOOTS AGAIN (PLAYFIELD)	"8" BONUS	4x
8 RED-GRY 2J7-8	BONUS BALL EJECT TIME	LEFT INSIDE ROLLOVER	LOWER PLAYFIELD EJECT HOLE	3X SCORING	RIGHT LOCK LAMP	"1" BONUS	"9" BONUS	5x

Figure 1. Lamp Matrix

Solenoid Test

1. From Lamp Test depress ADVANCE with the switch set to AUTO-UP. Test 02 should be indicated in the Credits display. Display sequences from 01 thru 25. Corresponding solenoids 01 thru 24 are pulsed. Flipper relay is de-energized with subtest 25.
2. To continuously pulse a single solenoid set switch to MANUAL-DOWN. Operate ADVANCE pushbutton sequence through the solenoids one at a time. Set toggle switch to AUTO-UP to resume sequencing.



Sol.

No. Function

01	Ball Release
02	Lower Left 3-Bank Drop Target Reset
03	Lower Right 3-Bank Drop Target Reset
04	Upper Left 3-Bank Drop Target Reset
05	Upper Right 3-Bank Drop Target Reset
06	Ball Ramp Thrower
07	Multi-Ball Release
08	Lower Eject Hole
09	Right Magnet Relay
10	Left Magnet Relay
*11	Special Relay
12	Not Used
13	Not Used
14	Not Used
15	Bell
16	Coin Lockout
17	Left Kicker
18	Right Kicker
19	Jet Bumper
20	Not Used
21	Not Used
22	Not Used

* Special relay located on Power Supply Board (games with transformer in cabinet) or in backbox (games with transformer in backbox).

Figure 2. Playfield Solenoid Locations and Solenoid Chart

Table 4. Solenoid Connections

SOL. NO.	FUNCTION	WIRE COLOR	CONNECTIONS	*DRIVER TRANS.	SOLENOID PART NO.
01	Ball Release	GRY-BRN	2P11-4, 8P3-1	Q15-Q7	SA-23-850-DC
02	Lower Left 3-Bank Drop Target Reset	GRY-RED	2P11-5, 8P3-2	Q17-Q8	SA-23-850-DC
03	Lower Right 3-Bank Drop Target Reset	GRY-ORN	2P11-7, 8P3-3	Q19-Q9	SA-23-850-DC
04	Upper Left 3-Bank Drop Target Reset	GRY-YEL	2P11-8, 8P3-4	Q21-Q10	SA-23-750-DC
05	Upper Right 3-Bank Drop Target Reset	GRY-GRN	2P11-9, 8P3-5	Q23-Q11	SA-23-750-DC
06	Ball Ramp Thrower	GRY-BLU	2P11-3, 8P3-6	Q25-Q14	SG-23-750-DC
07	Multi-Ball Release	GRY-VIO	2P11-2, 8P3-7	Q27-Q15	SG-23-750-DC
08	Lower Eject Hole	GRY-BLK	2P11-1, 8P3-8	Q29-Q16	SG-23-750-DC
*09	Right Magnet Relay	BRN-BLK	2P9-9, 10P3-9	Q31-Q13	SM-35-4000-DC
*10	Left Magnet Relay	BRN-RED	2P9-7, 10P3-10	Q33-Q12	SM-35-4000-DC
11	Special Relay	BRN-ORN	2P9-1, 10P3-11	Q35-Q17	SA-24-750-DC
12	Not Used	BRN-YEL	2P9-2, 10P3-12	Q37-Q18	
13	Not Used	BRN-GRN	2P9-3, 10P3-13	Q39-Q19	
14	Not Used	BRN-BLU	2P9-4, 7P1-16	Q41-Q20	
15	Bell	BRN-VIO	2P9-5, 7P1-17	Q43-Q21	SM29-1000-DC
16	Coin Lockout	BRN-GRY	2P9-6, 7P1-18, 7P2-4	Q45-Q22	SM-35-4000-DC
*17	Left Kicker	BLU-BRN	2P12-7, 8P3-17	Q2-Q1	SG-23-850-DC
*18	Right Kicker	BLU-RED	2P12-4, 8P3-18	Q4-Q5	SG-23-850-DC
*19	Jet Bumper	BLU-ORN	2P12-3, 8P3-19	Q6-Q4	SG-23-850-DC
*20	Not Used	BLU-YEL	2P12-6, 8P3-20	Q8-Q6	
*21	Not Used	BLU-GRN	2P12-8, 8P3-21	Q10-Q2	
*22	Not Used	BLU-BLK	2P12-9, 8P3-22	Q12-Q3	
*	Lower Right Flipper	BLU-VIO	7P1-8, 8P3-3		SF1-19-400 30-750-DC
	Upper Right Flipper	BLK-YEL	7P1-31, 8P3-5		SF1-19-400 30-750-DC
	Lower Left Flipper	BLU-GRY	7P1-10, 8P3-4		SF1-19-400 30-750-DC
	Upper Left Flipper	BLK-GRY	7P1-30, 8P3-9		SF1-19-400 30-750-DC

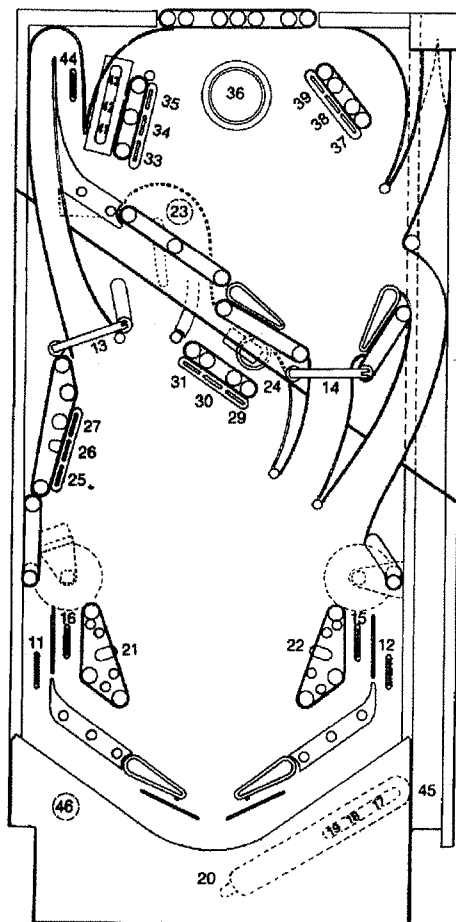
***NOTES:**

- First reference no. for D7997 (earlier) Driver Board; 2nd is for D8341 Driver Board.
- Contacts of solenoids 09 and 10 switch ground to magnets (Part No. 20-8991)
- Special switch connections for solenoids 17 through 19 are as follows:
 17 -- ORN-BRN -- 2P13-5, 8P3-5
 18 -- ORN-RED -- 2P13-3, 8P3-6
 19 -- ORN-BLK -- 2P13-2, 8P3-7
- Flipper button connections are as follows:
 Right -- ORN-VIO 2P12-1, 7P1-7
 Left -- ORN-GRY -- 2P12-2, 7P1-9
- Typical wiring for solenoids and special switches:

Switch Test

- From Solenoid Test depress ADVANCE with the switch set to AUTO-UP. Test 03 should be indicated in the Credits display and any stuck switches in the Master 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 Match display is blank and the sounds stop.
- 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. If proper indications are obtained in Test 03 but matrix problem is suspected in game play, disconnect lamp connectors 2P5 and 2P7. Recheck in game play. Perform CPU Self-Test if problem remains. If problem is cleared, check for short between lamp matrix and jet bumper mounting brackets.
5. Shorted diodes can cause "rectangle" switch matrix problems as follows: Lower left 3-bank right target down, (switch 27) lower right 3-bank center target down (switch 30) and as ball enters the lockup trough making switch 43, a shorted diode at switch 27 would cause switch 46, Playfield Tilt, to be indicated. Note that the "rectangle" is always completed with an incorrect switch diagonally opposite from the switch with the shorted diode.



Switch No.	Function (Score)
01	Plumb Bob Tilt
02	Ball Roll Tilt
03	Credit Button
04	Right Coin Switch
05	Center Coin Switch
06	Left Coin Switch
07	Slam Tilt
08	High Score Reset
09	Right Magnet Button
10	Left Magnet Button
11	Left Outlane (5,000)
12	Right Outlane (5000)
13	Spinner (100/2,500*)
14	Right Ramp Rollunder (500/Mystery)
15	Right Inside Rollover (2,000/10,000**)
16	Left Inside Rollover (2,000/10,000**)
17	Right Ball Ramp
18	Center Ball Ramp
19	Left Ball Ramp
20	Outhole
21	Left Kicker (10)
22	Right Kicker (10)
23	Turnaround (5,000)
24	Lower Playfield Eject Hole (5,000)
25	Lower Left 3-Bank, Lower Target (1,000)
26	Lower Left 3-Bank, Center Target (1,000)
27	Lower Left 3-Bank, Upper Target (1,000)
28	Not Used
29	Lower Right 3-Bank, Right Target (1,000)
30	Lower Right 3-Bank, Center Target (1,000)
31	Lower Right 3-Bank, Left Target (1,000)
32	Not Used
33	Top Left 3-Bank, Lower Target (1,000)
34	Top Left 3-Bank, Center Target (1,000)
35	Top Left 3-Bank, Upper Target (1,000)
36	Jet Bumper (500)
37	Top Right 3-Bank, Lower Target (1,000)
38	Top Right 3-Bank, Center Target (1,000)
39	Top Right 3-Bank, Upper Target (1,000)
40	Not Used
41	Lockup Trough, Bottom (5,000†)
42	Lockup Trough, Center (5,000†)
43	Lockup Trough, Top (5,000†)
44	Left Ramp Rollover (5,000)
45	Ballshooter Trough
46	Playfield Tilt

Note: Second value is lit or flashing value

*Spinner lit for interval after making

right inside rollover

Mystery is 20,000 - 99,000 and lit for interval

after making left inside rollover

**Inside rollovers light when made after using

Magna-Save feature

†Only one lockup trough switch scores for

each locked-up ball

Figure 3. Playfield Switch Locations and Switch Chart

ROW	COLUMN	1 GRN-BRN 2J2-9	2 GRN-RED 2J2-8	3 GRN-ORN 2J2-7	4 GRN-YEL 2J2-6	5 GRN-BLK 2J2-5	6 GRN-BLU 2J2-3	7 GRN-VIO 2J2-2	8 GRN-GRY 2J2-1
1	WHT- BRN 2J3-9	PLUMB BOB TILT 1	RIGHT MAGNET BUTTON 9	RIGHT BALL RAMP 17	LOWER LEFT 3-BANK, LOWER TARGET 25	TOP LEFT 3-BANK LOWER TARGET 33	LOCKUP TROUGH, BOTTOM 41	NOT USED 49	NOT USED 57
2	WHT- RED 2J3-8	BALL ROLL TILT 2	LEFT MAGNET BUTTON 10	CENTER BALL RAMP TARGET 18	LOWER LEFT 3-BANK CENTER TARGET 26	TOP LEFT 3-BANK CENTER TARGET 34	LOCKUP TROUGH, CENTER 42	NOT USED 50	NOT USED 58
3	WHT- ORN 2J3-7	CREDIT BUTTON 3	LEFT OUTLANE 11	LEFT BALL RAMP 19	LOWER LEFT 3-BANK, UPPER TARGET 27	TOP LEFT 3-BANK UPPER TARGET 35	LOCKUP TROUGH, TOP 43	NOT USED 51	NOT USED 59
4	WHT- YEL 2J3-6	RIGHT COIN SWITCH 4	RIGHT OUTLANE 12	OUTHOLE 20	NOT USED STANDUP 28	JET BUMPER 36	LEFT RAMP ROLLOVER 44	NOT USED 52	NOT USED 60
5	WHT- GRN 2J3-5	CENTER COIN SWITCH 5	LEFT SPINNER 13	LOWER KICKER 3-BANK LEFT TARGET 21	LOWER RIGHT 3-BANK RIGHT TARGET 29	TOP RIGHT 3-BANK LOWER TARGET 37	BALLSHOOTER TROUGH 45	NOT USED 53	NOT USED 61
6	WHT- BLU 2J3-4	LEFT COIN SWITCH 6	RIGHT RAMP ROLLUNDER 14	RIGHT KICKER 22	LOWER RIGHT 3-BANK, CENTER TARGET 30	TOP RIGHT 3-BANK CENTER TARGET 38	PLAYFIELD TILT 46	NOT USED 54	NOT USED 62
7	WHT- VIO 2J3-3	SLAM TILT 7	RIGHT INSIDE ROLLOVER 15	TURNAROUND 23	LOWER RIGHT 3-BANK LEFT TARGET 31	TOP RIGHT 3-BANK UPPER TARGET 39	NOT USED 47	NOT USED 55	NOT USED 63
8	WHT- GRY 2J3-1	HIGH SCORE RESET 8	LEFT INSIDE ROLLOVER 16	LOWER PLAYFIELD EJECT HOLE 24	NOT USED STANDUP 32	NOT USED STANDUP 40	NOT USED 48	NOT USED 56	NOT USED 64

Figure 5. 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 Credit display and Function 00 in Match Display.
2. Set switch to MANUAL-DOWN and depress ADVANCE to indicate Function 50 in the Match Display.
3. Set switch to AUTO-UP and operate Credit button to indicate 15 in Player I Display.
4. Depress ADVANCE pushbutton to start Auto-Cycle mode. Each cycle of this mode sequences thru the Display Digits Test, Sound Test (00), Lamp Test (01), and Solenoid 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 - IC17 ROM 2 Faulty
 - 5 - IC20 ROM 1 Faulty
 - 6 - IC14 Game ROM 1 Faulty
 - 7 - IC26 Game ROM 0 Faulty
 - 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.

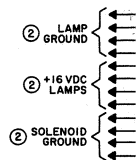
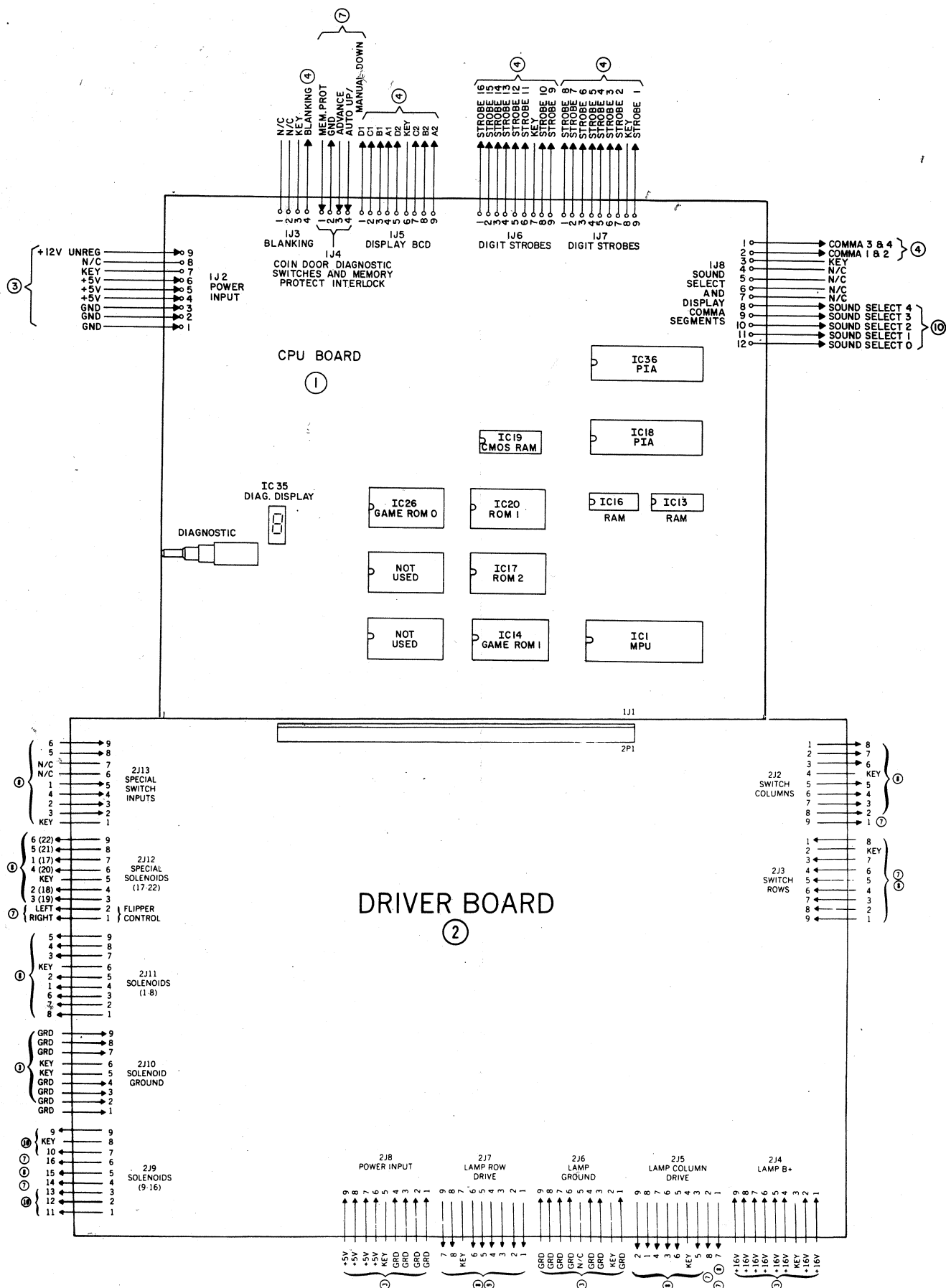
SOUND BOARD SELF-TEST

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

Vocabulary	Located in ROM
KNIGHT	5T 5001 (IC7)
BLACK	5T 5001
DEFEND	5T 5001
CHALLENGE	5T 5001
THEE (THE)	5T 5002 (IC5)
WILL	5T 5002
YOU	5T 5002
I	5T 5002
AGAIN	5T 5002 and 5T 5003 (IC6)
SLAY	5T 5003
CANNOT	5T 5003
SELF	5T 5003
ENEMY	5T 5003 and 5T 5004 (IC4)

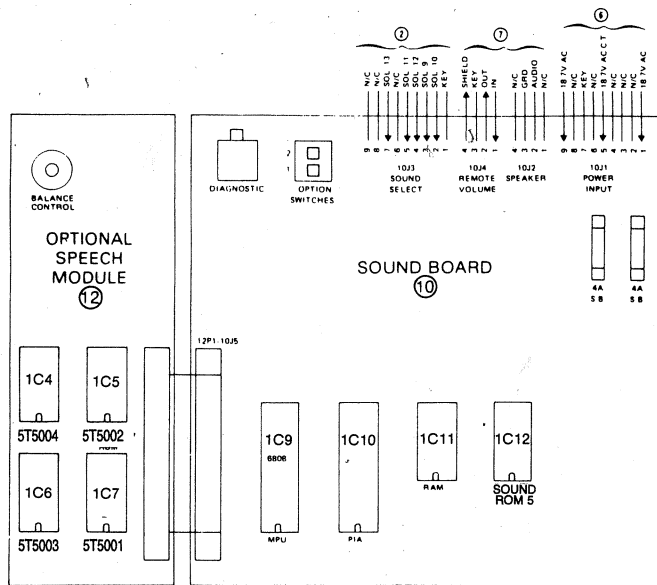
The IC4 Speech ROM contains laughter and "F" and "R" sounds. The laughter, "F" and "R" sounds, and the following partial or composite words produced in game play are not produced in diagnostics.

WIN	ENEMIES	THREE
ME	THYSELF	AND
TO (TWO)	FIGHT	MY
AGAINST	RIGHT	



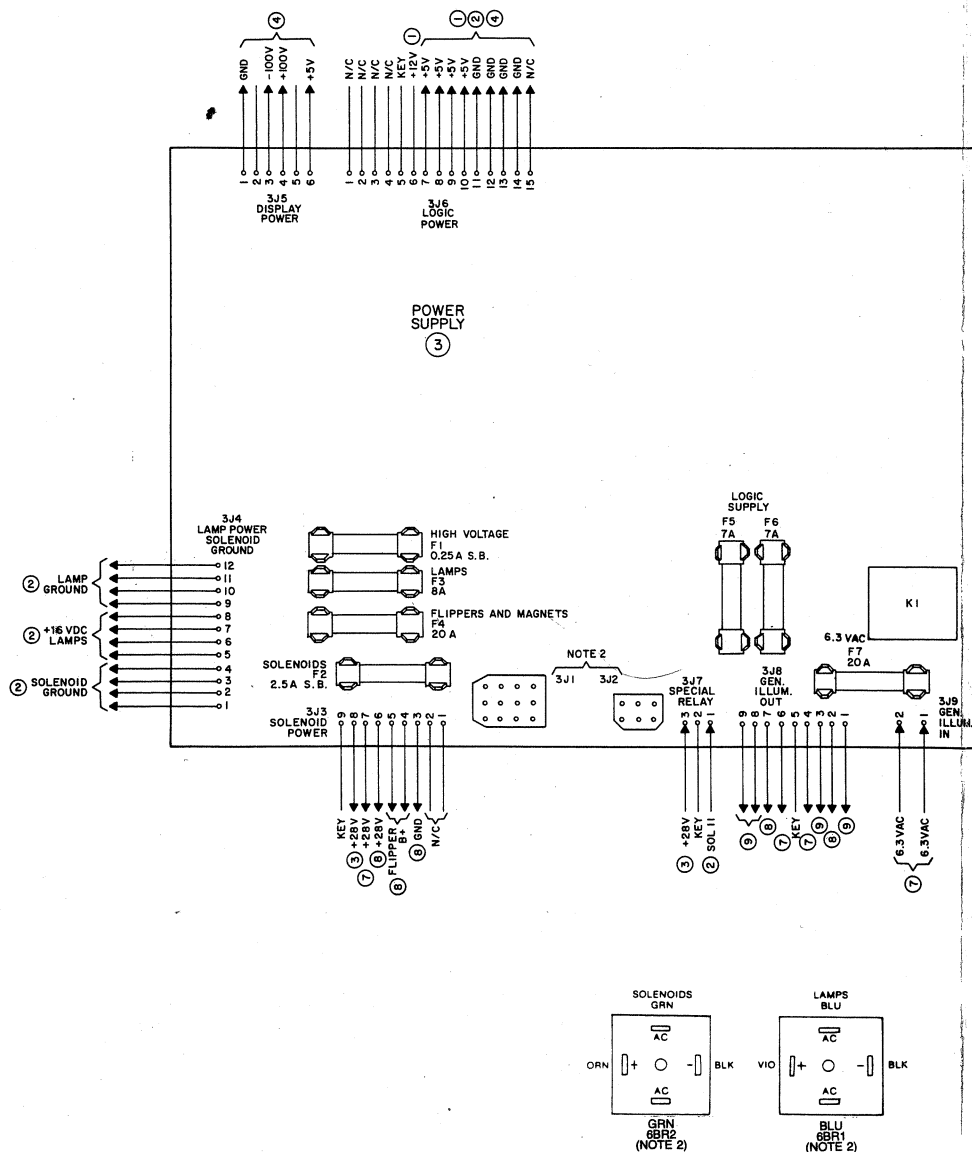
14 } ④
2 }

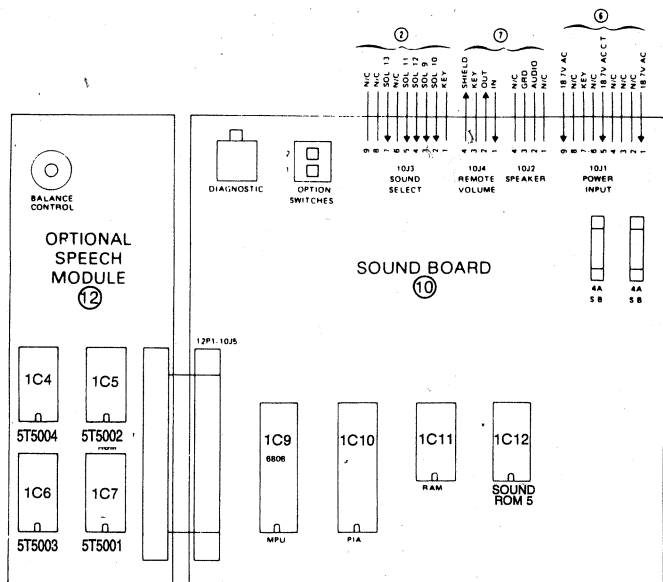
ECT 4 } ⑩
ECT 3 }
ECT 2 }
ECT 1 }
ECT 0 }



NOTES:

- CONNECTIONS ARE IN CIRCLED NUMBERS AS
 - CPU BOARD
 - DRIVER BOARD
 - POWER SUPPLY BOARD
 - MASTER DISPLAY BOARD
 - SLAVE DISPLAY BOARD
 - BACKBOX
 - CABINET
 - PLAYFIELD
 - INSERT BOARD
 - SOUND BOARD
 - NOT ASSIGNED
 - SPEECH MODULE
- REFER TO POWER WIRING FOR CONNECTIONS TO

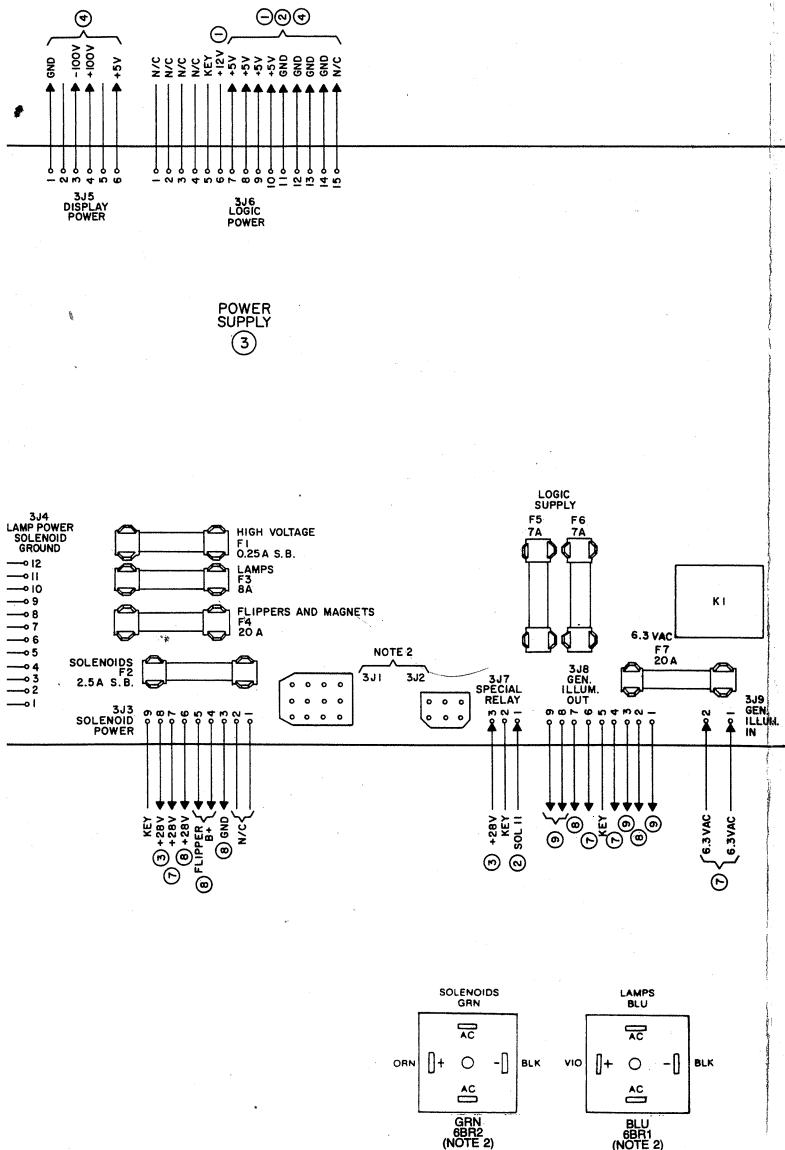


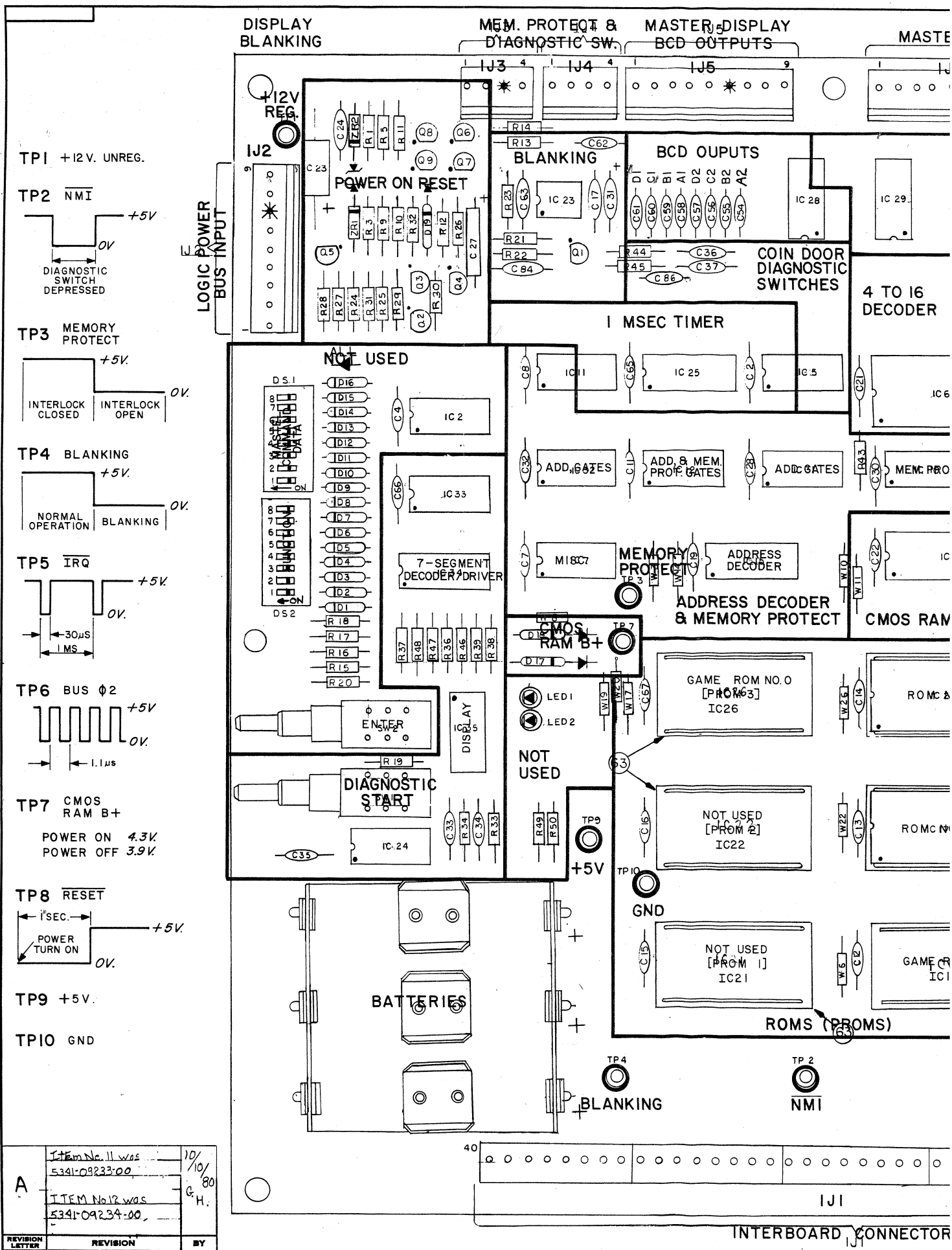
**NOTES:**

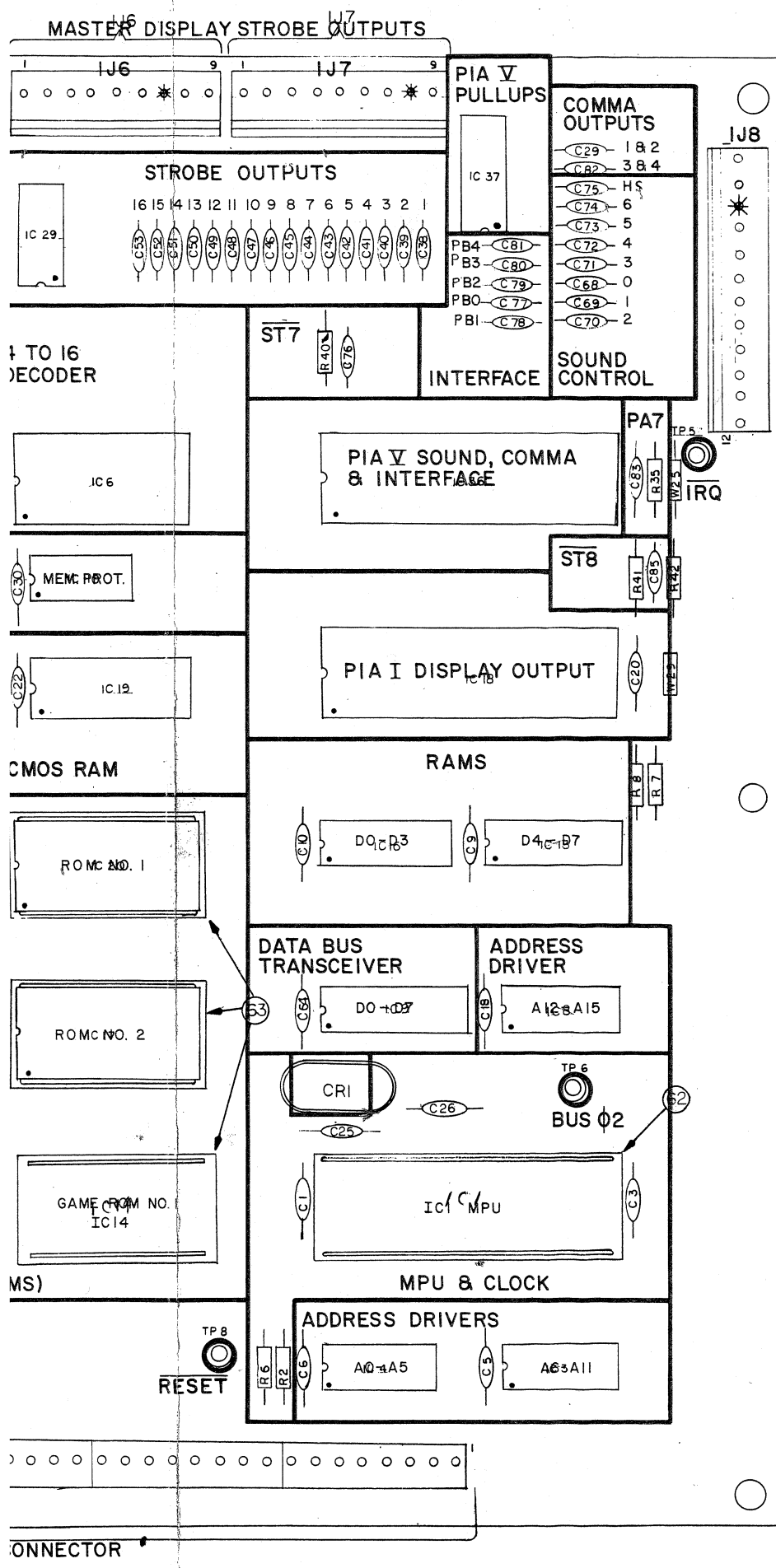
1. CONNECTIONS ARE INDICATED BY CIRCLED NUMBERS AS FOLLOWS:

- ① CPU BOARD
- ② DRIVER 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 SPEECH MODULE

2. REFER TO POWER WIRING DIAGRAM FOR CONNECTIONS TO 3P1.





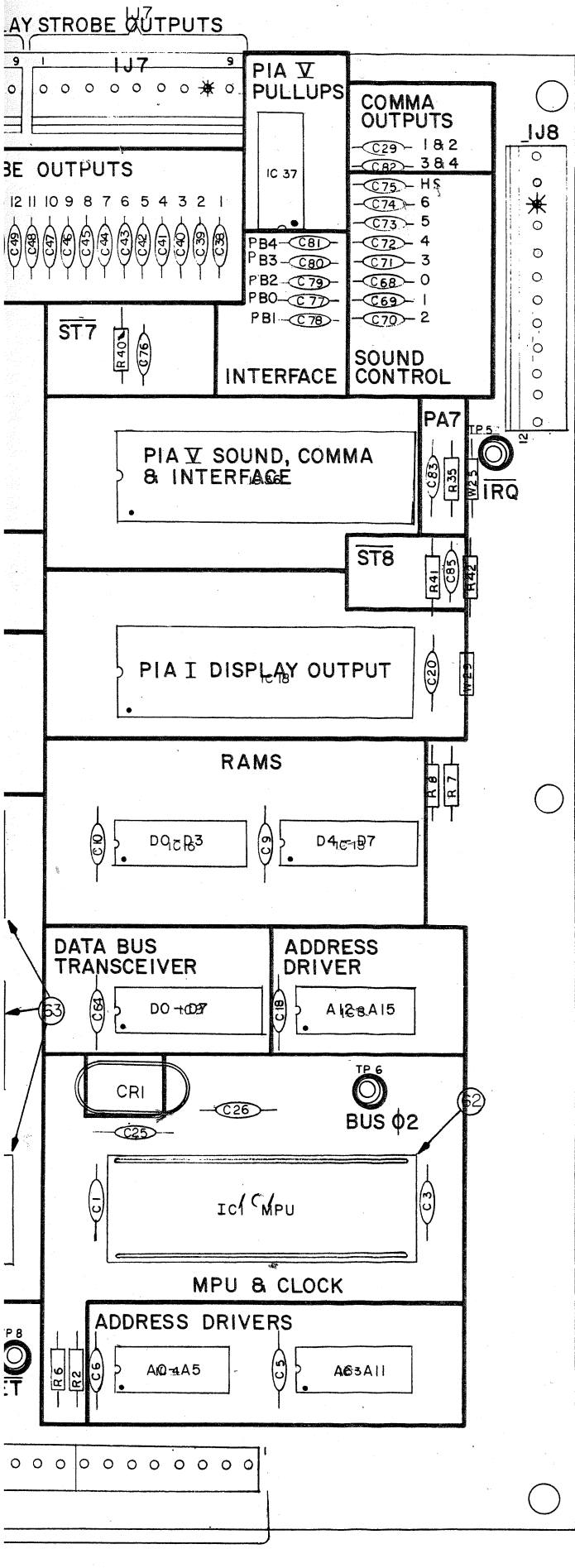


BILL OF MATERIAL

ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION
1	5764-09405-X0	IC2	BARE PC BOARD CPU
2	5280-09408-X0	IC2	74125 HEX TRISTATE BUFFER
3	5370-08989-00	IC3, IC4, IC8	8T97 HEX TRISTATE BUFFER
4	5281-09308-X0	IC9	74LS245 OCTAL BUFFER
5	5280-09010-00	IC6	74154 4 TO 16 DECODER
6	5280-09013-00	IC7	7404 HEX INVERTER
7	5281-09235-00	IC11	74LS10 TRIPPLE 3 INVERT
8	5280-08973-00	IC12	7408 QUAD AND
9	5340-09409-X0	IC13, IC16	2114-45 1K X4 STATIC RA
10	5281-09246-00	IC15	74LS139 DUAL 2 TO 4 LINE
11	5341-09553-00	IC20	ROM 2K X8 LOWER
12	5341-09554-00	IC17	ROM 4K X8 UPPER
13	5430-08972-00	IC18, IC36	MC6821 PIA
14	5340-09017-00	IC19	MC 5101 CMOS RAM
15	5431-09449-00	IC23	MC 1455 PI TIMER
16	5280-09073-00	IC24, IC32, IC33	7400 QUAD 2 INPUT NAND
17	5310-09236-00	IC25	4020 CMOS 14 BIT COUNT
18	5310-09237-00	IC10	4071 CMOS QUAD 2 INPUT
19	5281-09247-00	IC5, IC31	74LS02 QUAD 2 INPUT NOR
20	5280-09407-X0	IC34	7447 BCD TO 7 SEG LED DI
21	5671-09411-00	IC35	MAN 72A 7 SEG LED DISP
22	5019-09238-00	IC28, IC29	13 DIP RES./PACK 4.7K OHM
23	5019-09223-00	IC37	15 DIP RES./PACK 10K OHM
24	5645-09025-00	DS1, DS2	8 STD DIP SWITCHES
25	5075-09018-00	ZR1	IN5996 ZENER DIODE 6.8V
26	5075-09039-00	ZR2	IN5990 ZENER DIODE 3.9V
27	5070-08919-00	DI+DI7, DI9	IN4148 DIODE
28	5160-08938-00	Q3-Q9	2N4401 NPN TRANSISTOR
29	5190-09016-00	Q1, Q2	2N4403 PNP TRANSISTOR
30	5070-09266-00	D18	IN5817 DIODE
31	5520-09020-00	CRI	CRYSTAL 3.58 MHz
32	5010-09358-00	R5, R9, R20	RESISTOR FC 1K OHM 5%
33	5010-08983-00	R2, R6-R8, R21, R28	RESISTOR FC 3.3K OHM 5%
34	5010-08991-00	R13-R18, R29, R33-R35, R40-R42	RESISTOR FC 4.7K OHM 5%
35	5010-09086-00	R22	RESISTOR FC 6.8K OHM 5%
36	5010-09036-00	R19, R30	RESISTOR FC 100 OHM 5%
37	5010-09187-00	R36-R39, R46-R50	RESISTOR FC 150 OHM 5%
38	5010-09113-00	R23, R26	RESISTOR FC 33K OHM 5%
39	5010-09034-00	R4, R3	RESISTOR FC 10K OHM 5%
40	5010-09241-00	R25, R32, R10, R11	RESISTOR FC 22K OHM 5%
41	5010-08998-00	R27	RESISTOR FC 2.2K OHM 5%
42	5010-09039-00	R12	RESISTOR FC 10 OHM 5%
43	5010-09442-00	R43	RESISTOR FC 330K OHM 5%
44	5010-08997-00	R24, R31	RESISTOR FC 27K OHM 5%
45	5010-09083-00	R44, R45	RESISTOR FC 470 OHM 5%
46	5043-08980-00	C1-C22, C28, C30, C32-C37, C63-C67, C83	CAPACITOR CERAMIC 10MFD
47	5040-08986-00	C23	CAPACITOR ELECT. 100MFD
48	5043-08996-00	C24	CAPACITOR CERAMIC 1MFD
49	5043-09169-00	C25, C26	CAPACITOR CERAMIC 27PF
50	5041-09243-00	C27	CAPACITOR TANT. 10 MFD 11
51	5041-09031-00	C31	CAPACITOR TANT. 1MFD 25
52	5043-09030-00	C84	CAPACITOR CERAMIC .047M
53	5043-09065-00	C29, C38-C62, C68-C82, C85, C86	CAPACITOR CERAMIC 470PF
54	5671-09019-00	LED1, LED2	LED-RED
55	SEE NOTE	SW1, SW2	SWITCH MOMENTARY
56	5881-09021-00		BATTERY HOLDER #171
57	5791-09026-00	HJ1	HEADER 09-64-1083 8 PI
58	5791-09028-00	HJ3, HJ4	HEADER 09-65-1041 4 PI
59			
60	5791-09027-00	HJ2, HJ5-HJ7	HEADER 09-65-1091 9 PI
61	5791-09043-00	HJ8	HEADER 09-65-1121 12 PI
62	5700-08985-00		40 PIN IC SOCKET
63	5700-09004-00		24 PIN IC SOCKET
64	5010-09534-00	W3, W6, W8, W10, W11, W14, W17, W19, W20, W25, W26, W29, W22	RESISTOR FC 0 OHM 1/4W
65	5824-09248-00	TP1-TP10	TEST TERMINALS #1502

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

TOLERANCES		QTY.
UNLESS OTHERWISE SPECIFIED		
FRACTIONAL	21/64"	
DECIMAL	-.0005"	
HOLE DIA.	+.0005" - .0001"	
ANGULAR	1/8"	
CONCENTRICITY	T.I.R. .008"	
SCREW THREADS	CLASS 8	
MATERIAL		HEAT TREATMENT
DATE 9-20-80		APPD.
SCALE		D-83

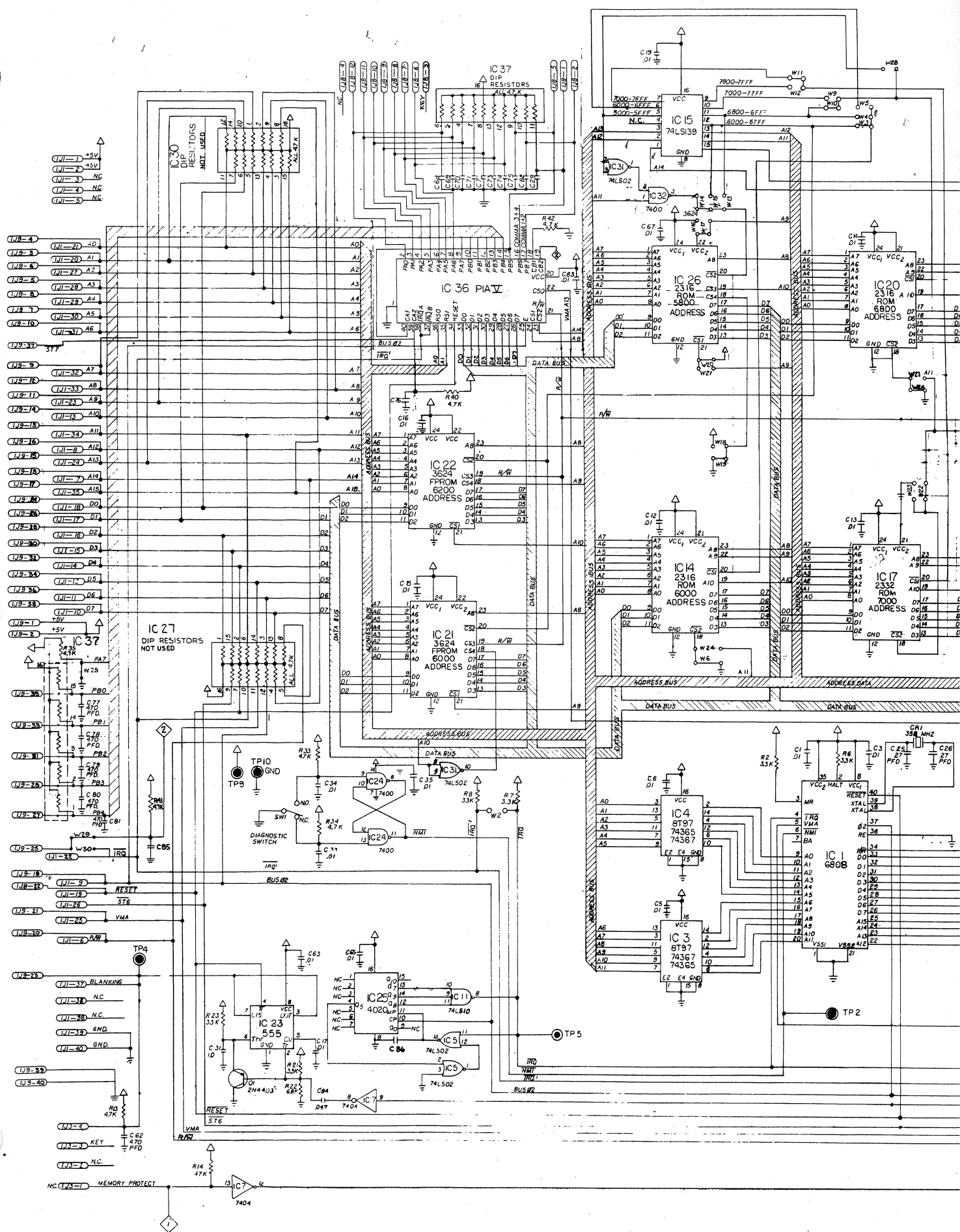


BILL OF MATERIAL

ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQD NO.
1	5764-09405-X0		BARE PC. BOARD CPU	1
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5	5280-09010-00	IC6	74154 4 TO 16 DECODER	1
6	5280-09013-00	IC7	7404 HEX INVERTER	1
7	5281-09235-00	IC11	74LS10 TRIPPLE 3 INVERTER	1
8	5280-08973-00	IC12	7408 QUAD AND	1
9	5340-09409-X0	IC13,IC16	2114-45 1K X4 STATIC RAM	2
10	5281-09246-00	IC15	74LS139 DUAL 2 TO 4 LINE DECODER	1
11	5341-09553-00	IC20	ROM 2K X8 LOWER	1
12	5341-09554-00	IC17	ROM 4KX8 UPPER	1
13	5430-08972-00	IC18,IC36	MC6821 PIA	2
14	5340-09017-00	IC19	MC 5101 CMOS RAM	1
15	5431-09449-00	IC23	MC 14555 P1 TIMER	1
16	5280-09073-00	IC24,IC32,IC33	7400 QUAD 2 INPUT NAND	3
17	5310-09236-00	IC25	4020 CMOS 14 BIT COUNTER	1
18	5310-09237-00	IC10	4071 CMOS QUAD 2 INPUT NOR	1
19	5281-09247-00	IC5,IC31	74LS02 QUAD 2 INPUT NOR	2
20	5280-09407-X0	IC34	7447 BCD TO 7 SEG LED DISP	1
21	5671-09411-00	IC35	MAN 72A 7 SEG LED DISP	1
22	5019-09238-00	IC28,IC29	13 DIP RES./PACK 47K OHM	2
23	5019-09223-00	IC37	15 DIP RES./PACK 10K OHM	1
24	5645-09025-00	DS1,DS2	8 STD DIP SWITCHES	2
25	5075-09018-00	ZR1	IN5996 ZENER DIODE 6.8V	1
26	5075-09039-00	ZR2	IN5990 ZENER DIODE 3.9V	1
27	5070-08918-00	D1-D17,D19	1N4148 DIODE	18
28	5160-08938-00	Q3-Q9	2N4401NPN TRANSISTOR	7
29	5190-09016-00	Q1,Q2	2N4403 PNP TRANSISTOR	2
30	5070-09266-00	D18	1N5817 DIODE	1
31	5520-09020-00	CR1	CRYSTAL 3.58MHZ	1
32	5010-09358-00	R5,R9,R20	RESISTOR FC 1K OHM 5% 1/4W	3
33	5010-08983-00	R2,R6-R8,R21,R28	RESISTOR FC 3.3K OHM 5% 1/4W	6
34	5010-08991-00	R13-R18,R29,R33-R35,R40,R42	RESISTOR FC 4.7K OHM 5% 1/4W	13
35	5010-09086-00	R22	RESISTOR FC 6.8K OHM 5% 1/4W	1
36	5010-09036-00	R19,R30	RESISTOR FC 100 OHM 5% 1/4W	2
37	5010-09187-00	R36-R39,R46-R50	RESISTOR FC 150 OHM 5% 1/4W	9
38	5010-09113-00	R23,R26	RESISTOR FC 33K OHM 5% 1/4W	2
39	5010-09034-00	R4,R3	RESISTOR FC 10K OHM 5% 1/4W	2
40	5010-09241-00	R25,R32,R10,R11	RESISTOR FC 22K OHM 5% 1/4W	4
41	5010-08998-00	R27	RESISTOR FC 2.2K OHM 5% 1/4W	1
42	5010-09039-00	R12	RESISTOR FC 10 OHM 5% 1/4W	1
43	5010-09442-00	R43	RESISTOR FC 330K OHM 5% 1/4W	1
44	5010-08997-00	R24,R31	RESISTOR FC 27K OHM 5% 1/4W	2
45	5010-09083-00	R44,R45	RESISTOR FC 470 OHM 5% 1/4W	2
46	5043-08980-00	C1-C12,C28,C30,C32-C37,C63-C67,C83	CAPACITOR CERAMIC 10MFD 50V	36
47	5040-08986-00	C23	CAPACITOR ELECT. 100MFD 10V	1
48	5043-08996-00	C24	CAPACITOR CERAMIC 1MFD 50V	1
49	5043-09169-00	C25,C26	CAPACITOR CERAMIC 27PFD 1KV	2
50	5041-09243-00	C27	CAPACITOR TANT. 10 MFD 10V	1
51	5041-09031-00	C31	CAPACITOR TANT. 1MFD 25V	1
52	5043-09030-00	C84	CAPACITOR CERAMIC .047MFD 50V	1
53	5043-09065-00	C29,C38-C62,C68-C82,C85,C86	CAPACITOR CERAMIC 470PFD 50V	43
54	5671-09019-00	LED1,LED2	LED-RED	2
55	SEE NOTE	SW1,SW2	SWITCH MOMENTARY	2
56	5881-09021-00		BATTERY HOLDER #171	1
57	5791-09026-00	HJ1	HEADER 09-64-1083 8 PIN	5
58	5791-09028-00	HJ3,HJ4	HEADER 09-65-1041 4 PIN	2
59				
60	5791-09027-00	HJ2,HJ5-HJ7	HEADER 09-65-1091 9 PIN	4
61	5791-09043-00	HJ8	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,W19,W20,W25,W26,W29,W32	RESISTOR FC 0 OHM 1/4W	13
65	5824-09248-00	TP1-TP10	TEST TERMINALS #1502-1	10

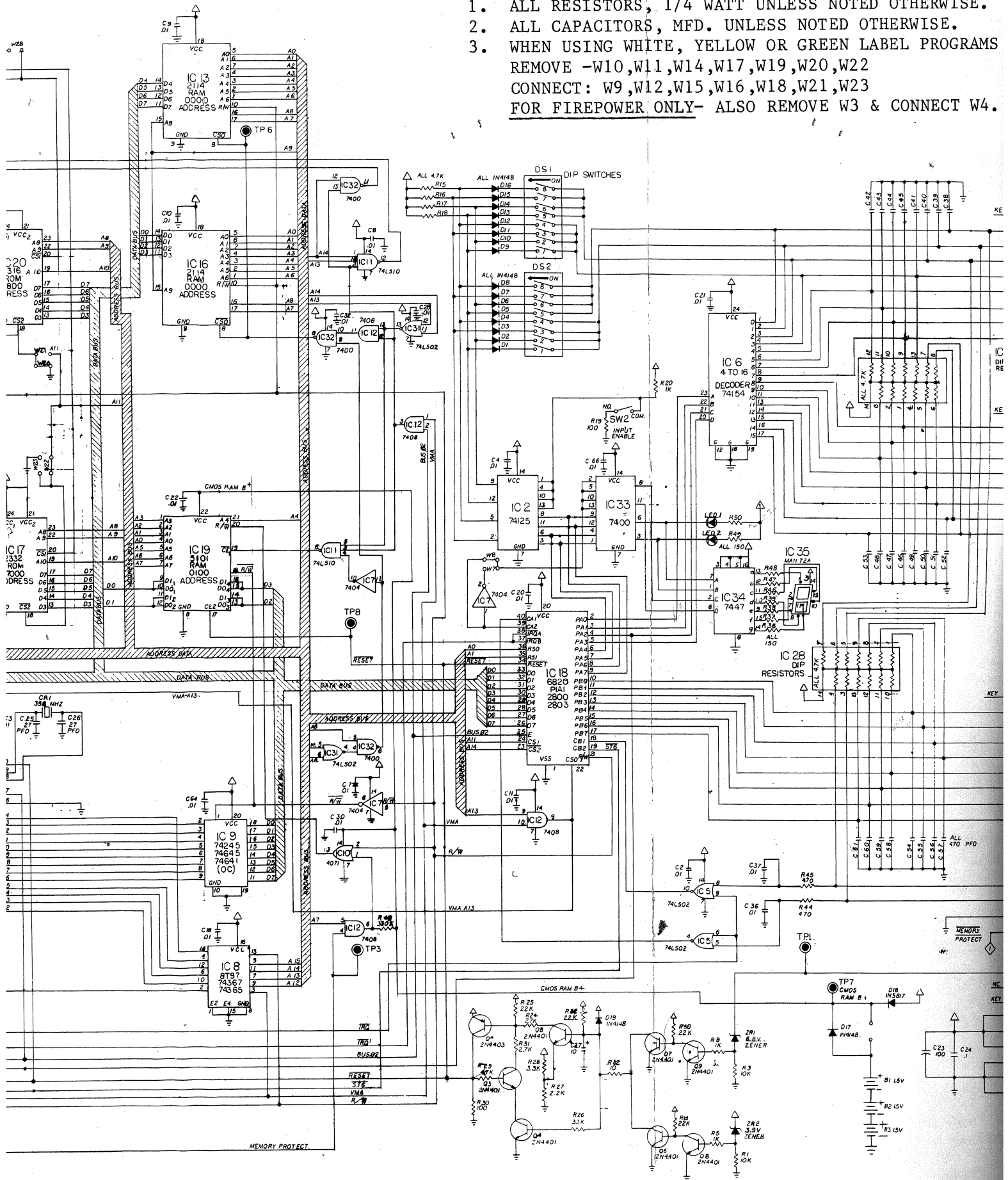
NOTE: USE EITHER 5641-09312-00, 5641-09024-00 OR 5641-09371-00

[illegible]



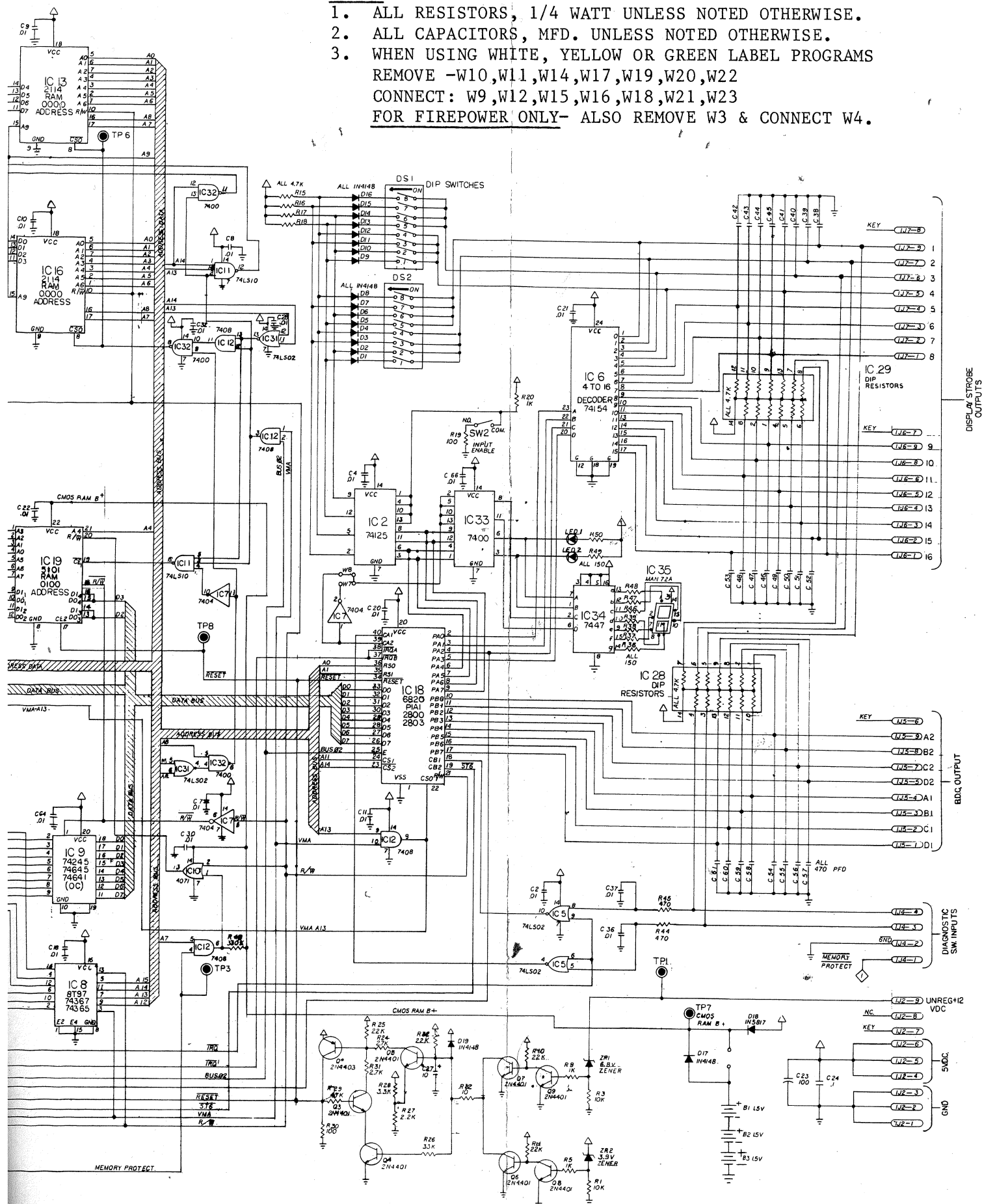
NOTES:

1. ALL RESISTORS, 1/4 WATT UNLESS NOTED OTHERWISE.
2. ALL CAPACITORS, MFD. UNLESS NOTED OTHERWISE.
3. WHEN USING WHITE, YELLOW OR GREEN LABEL PROGRAMS REMOVE -W10,W11,W14,W17,W19,W20,W22 CONNECT: W9,W12,W15,W16,W18,W21,W23 FOR FIREPOWER ONLY- ALSO REMOVE W3 & CONNECT W4.

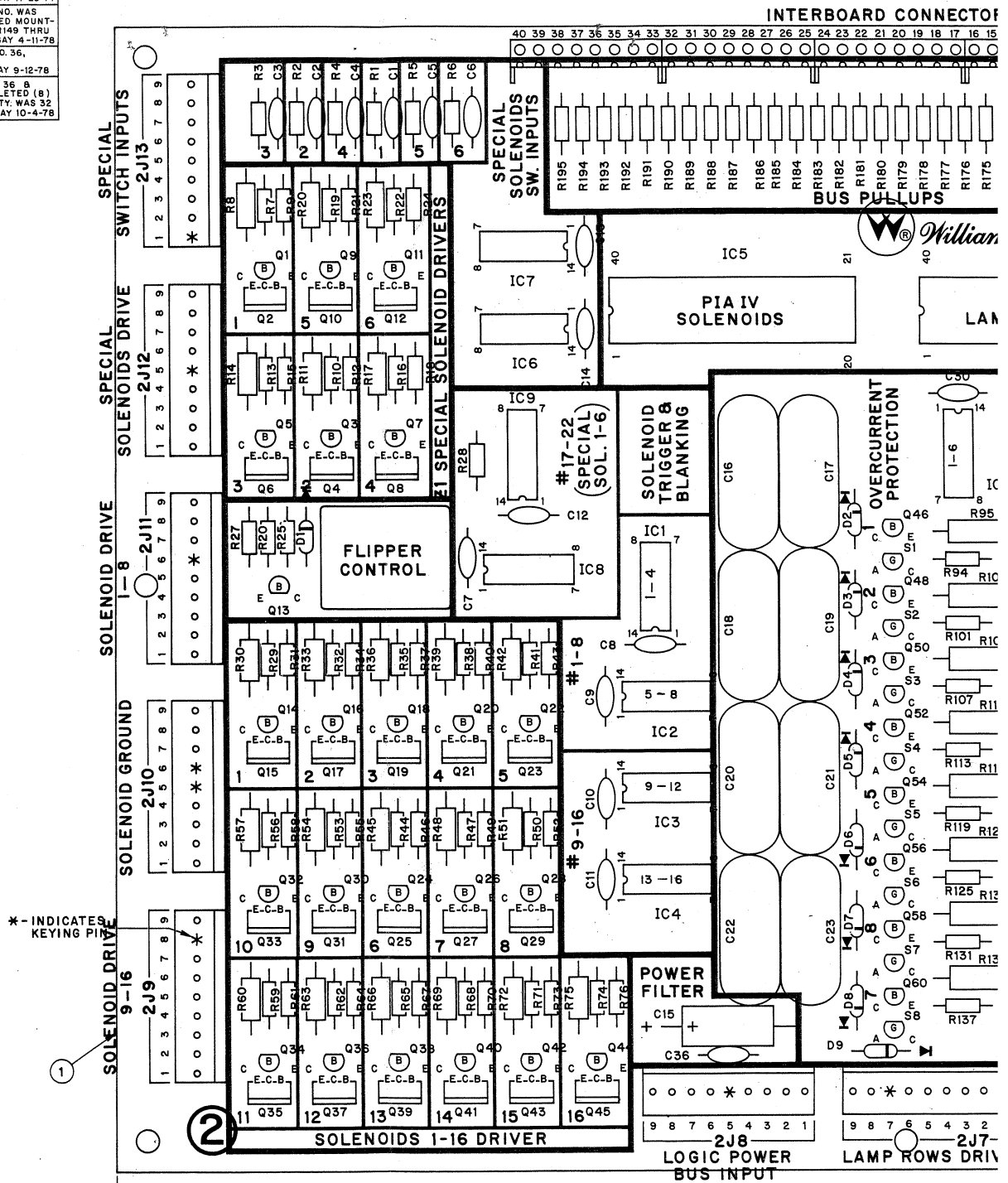


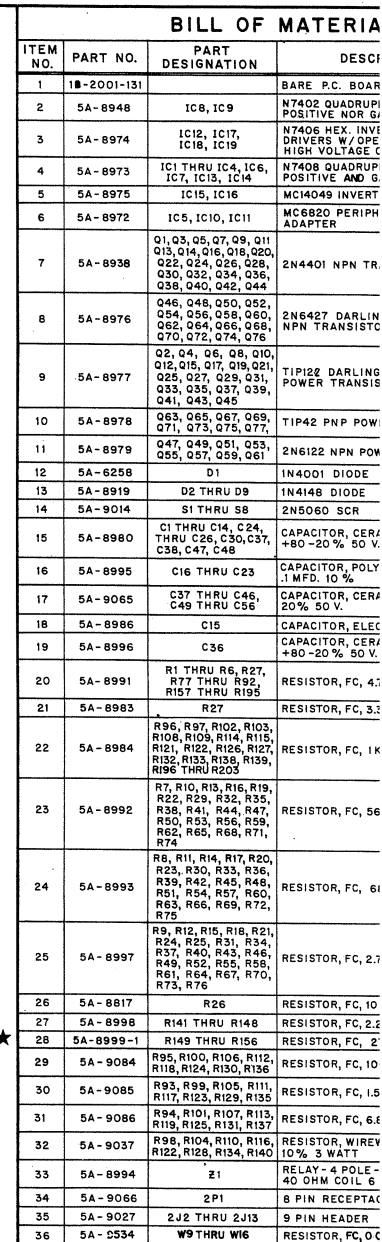
NOTES:

1. ALL RESISTORS, 1/4 WATT UNLESS NOTED OTHERWISE.
2. ALL CAPACITORS, MFD. UNLESS NOTED OTHERWISE.
3. WHEN USING WHITE, YELLOW OR GREEN LABEL PROGRAMS
REMOVE -W10,W11,W14,W17,W19,W20,W22
CONNECT: W9,W12,W15,W16,W18,W21,W23
FOR FIREPOWER ONLY- ALSO REMOVE W3 & CONNECT W4.



REVISION LETTER	REVISION
C	REVISED AND REDRAWN R. GAY 11-28-77
D	ITEM NO. 26, PT. NO. WAS 5A-8999 & ADDED MOUNT- ING NOTE FOR R149 THRU R156. R. GAY 4-11-78
E	DELETED ITEM NO. 36, PT. NO. 5A-8985, E.C.O. R. GAY 9-12-78
F	ADDED ITEM NO. 36 & ITEM NO. 22, DELETED (B) RESISTORS & QTY. WAS 32 E.C.O. 4624 R. GAY 10-4-78

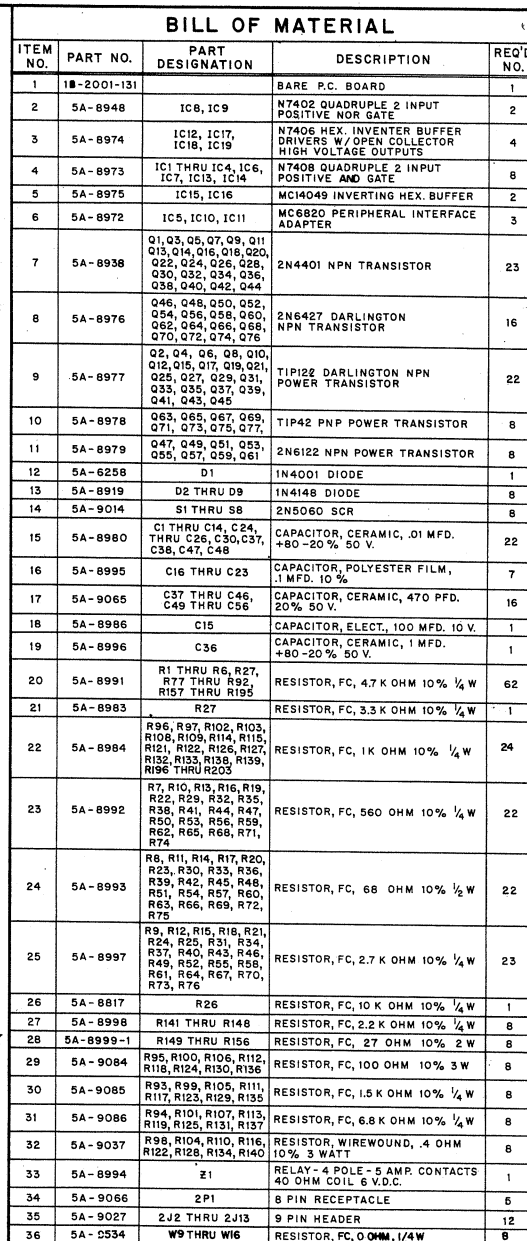




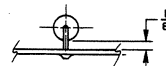
SUBSIDIARY OF XCOR CORP
3401 N. CALIFORNIA CHICAGO, ILL. 606

DRIVER BOARD ASSEMBLY				
DWN	DATE	APP'D	SCALE	P

OWN. R. Gay	DATE 8-16-77	APP'D. 1	SCALE 2=1	PR
----------------	-----------------	-------------	--------------	----



★ R149 THRU R156 MUST BE MOUNTED $\frac{1}{8}$ "
ABOVE SURFACE OF BOARD.

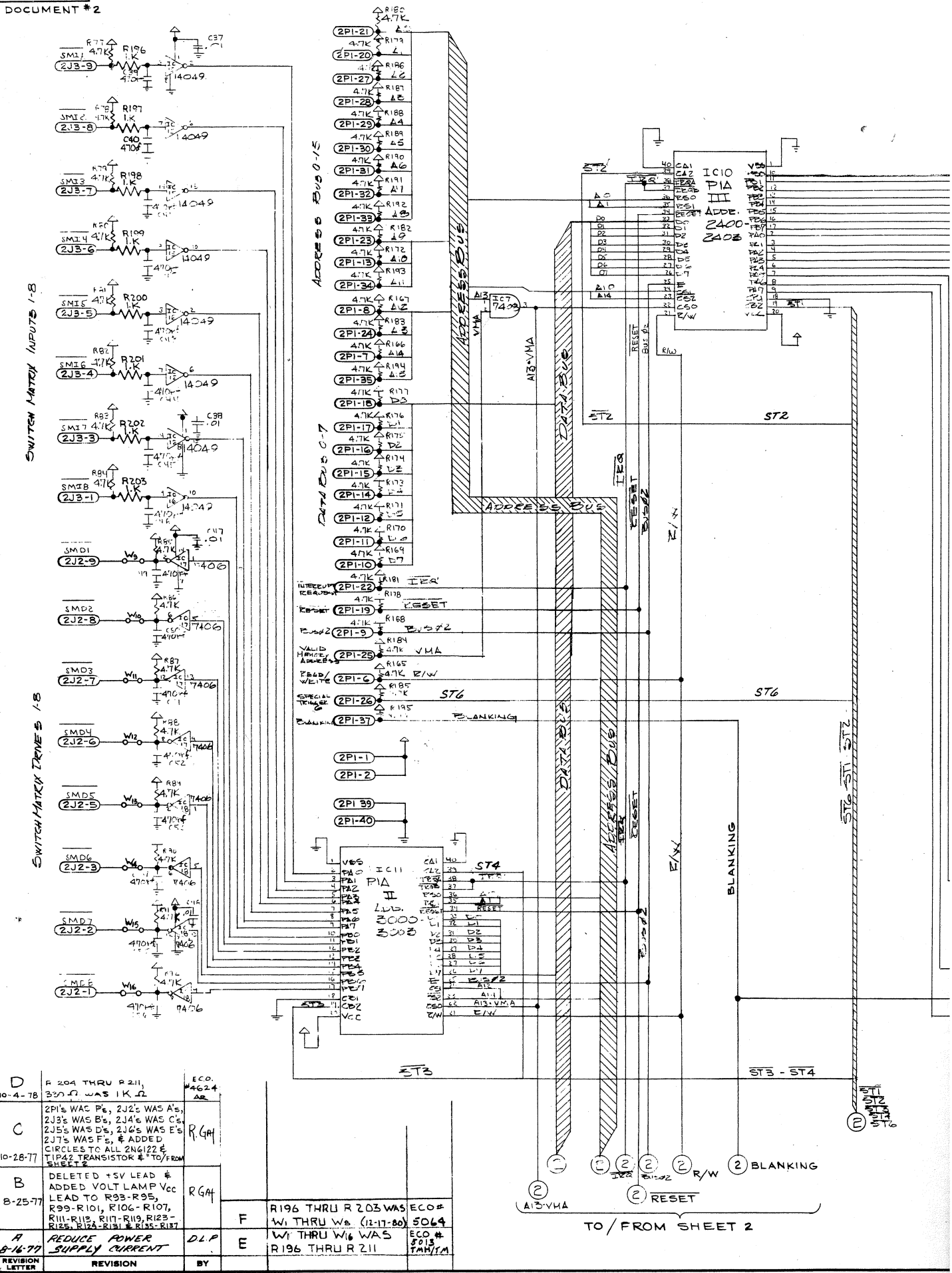


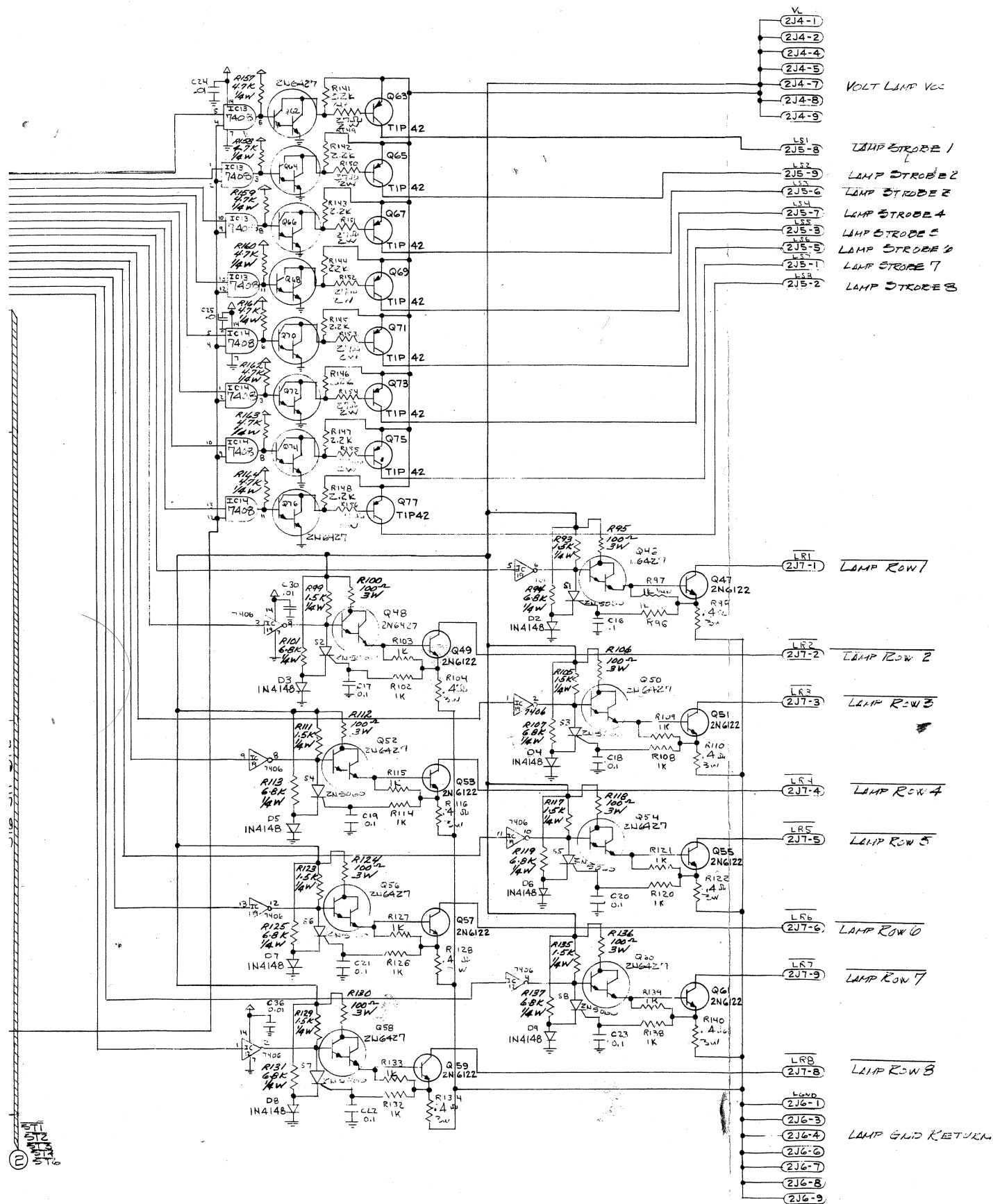
WILLIAMS ELECTRONICS, INC.

WILLIAMS ELECTRONICS, INC.
SUBSIDIARY OF XCOR CORPORATION
3401 N. CALIFORNIA CHICAGO, ILL. 60618 CORNELIA 7-2240

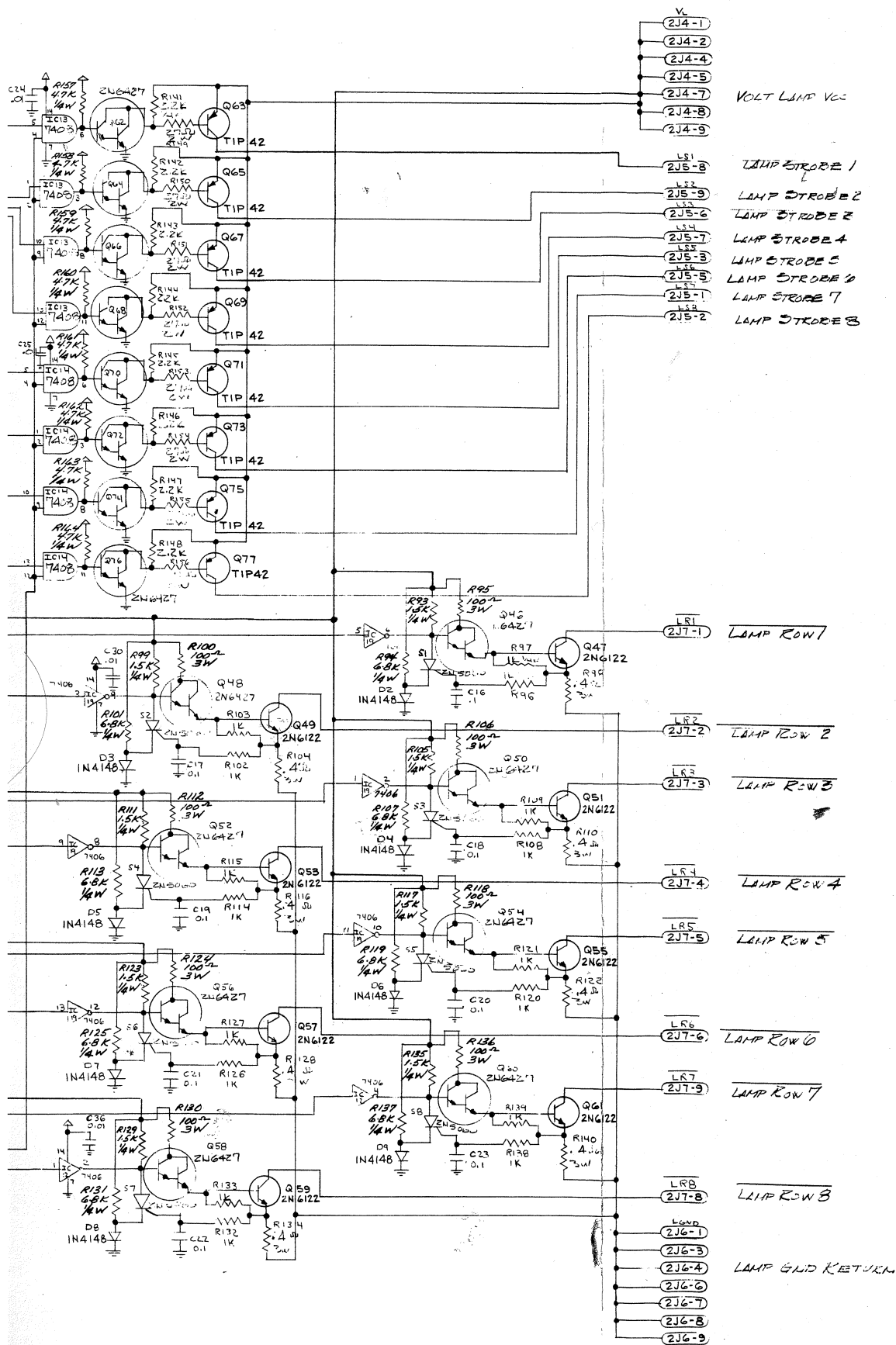
PART NAME
DRIVER BOARD ASSEMBLY

DWN. R. Gay	DATE 8-16-77	APP'D.	SCALE 2=1	PART NO. D-7997
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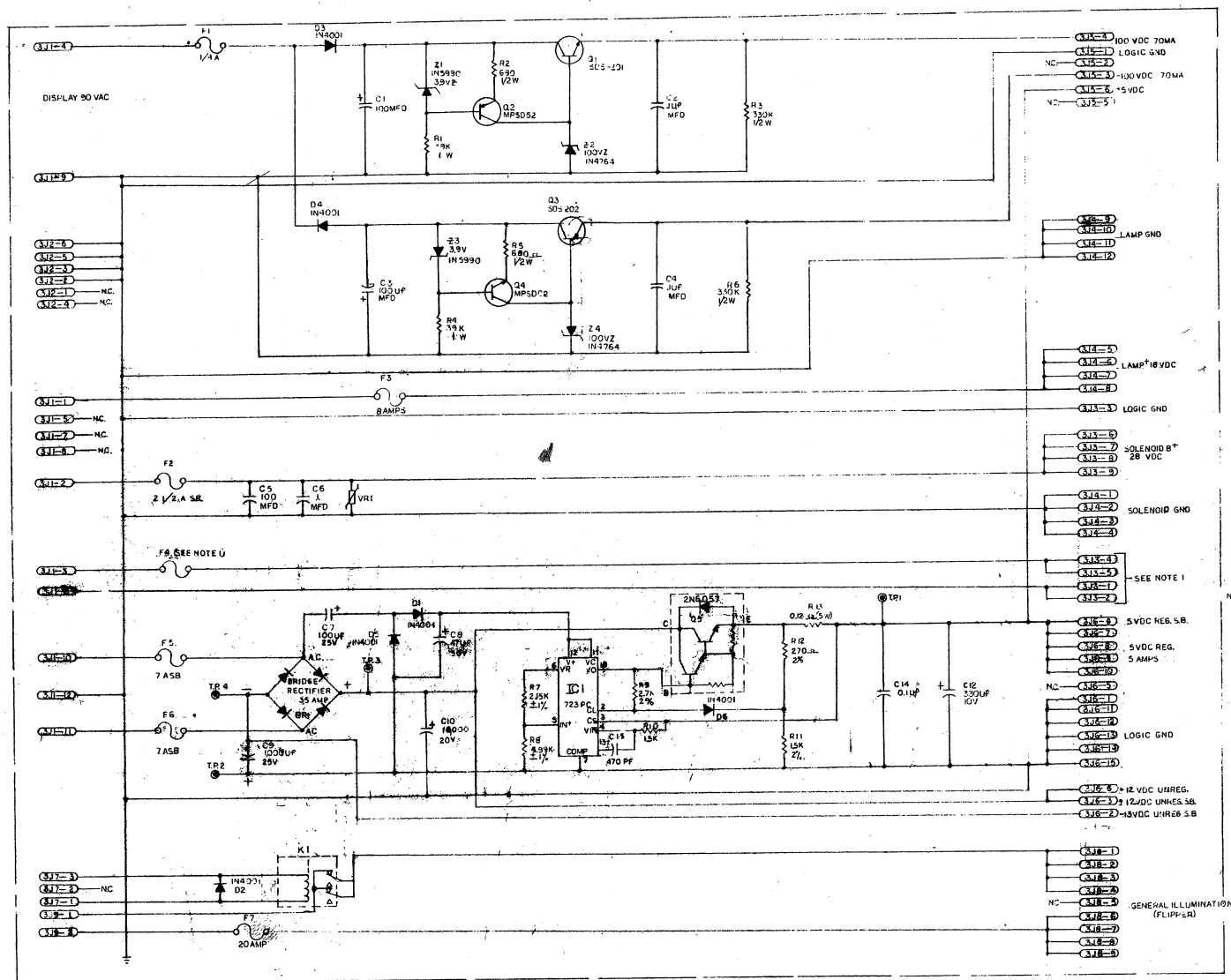




TOLERANCES		WILLIAMS ELECTRIC	
UNLESS OTHERWISE SPECIFIED		SUBSIDIARY OF THE CHICAGO ELECTRIC COMPANY	
FRACTIONS	± 1/64	3401 N. CALIFORNIA	CHICAGO
DECIMALS	± .008	NAME SCHEMATIC, D1	
HOLES	± .008	MATERIAL	
ANGULAR	± 1/2°	HEAT TREAT	
DATE	1/77	APP'D.	SCALE

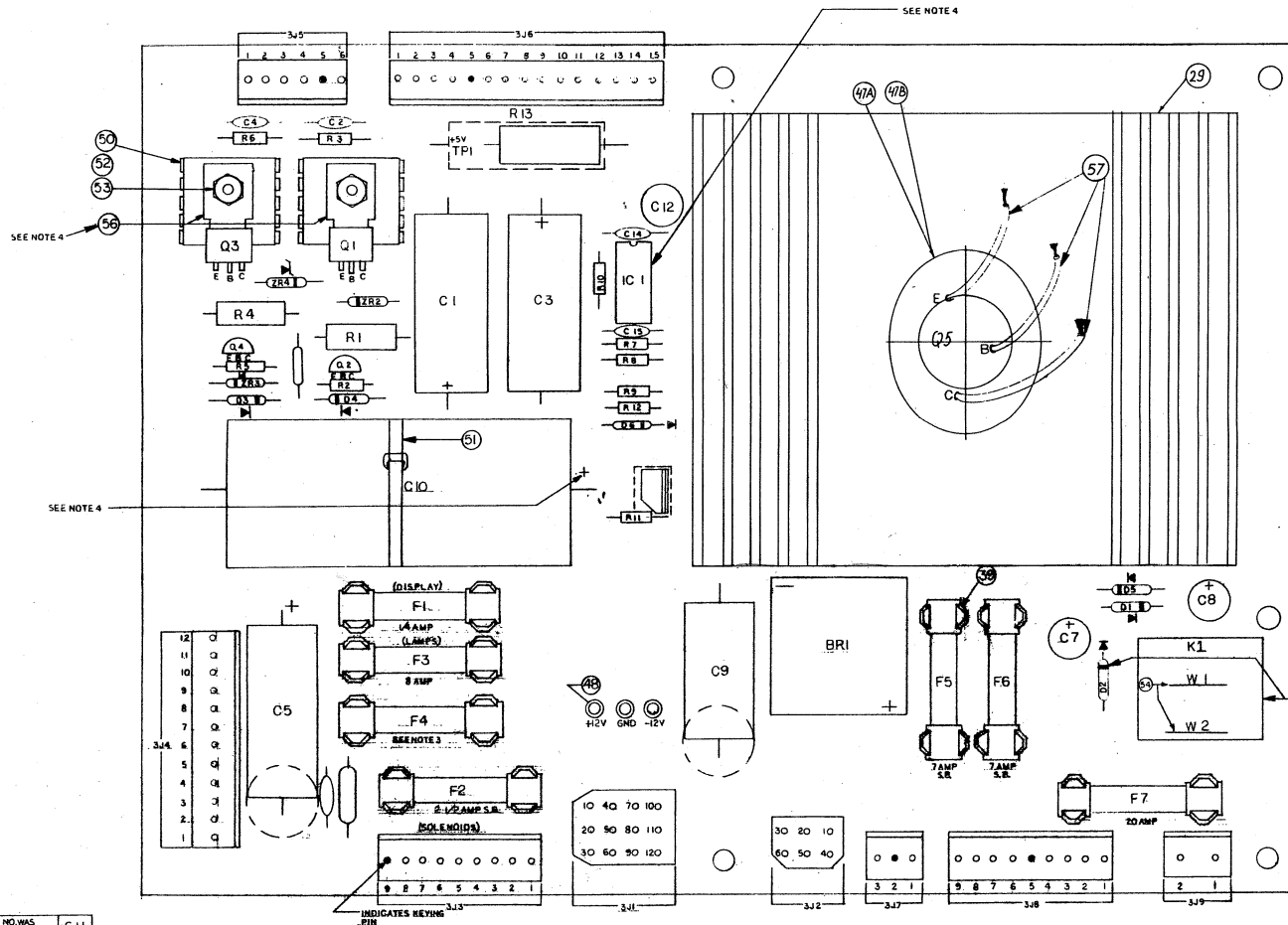


TOLERANCES		WILLIAMS ELECTRONIC MFG. CORP.	
UNLESS OTHERWISE SPECIFIED		SUBSIDIARY OF THE HARRIS CORP.	
FRACTIONS	± 1/64	3401 N. CALIFORNIA	CHICAGO 18, ILL.
DECIMALS	± .005	CORNELIA 7-2240	
HOLES	± .005	NAME SCHEMATIC, DRIVER BOARD	
ANGULAR	± 1/2°	MATERIAL	
		HEAT TREATMENT	
		FINISH	
DATE	11/77	APP'D.	SCALE
WJD			16-7997



NOTE 1: ON FLUORESCENT LAMP IS 10 AMP'S, 100VDC AND 3-5.28VDC FOR FLUORESCENT LAMP. 3-3.1 AND 2 IS NOT CONNECTED ON SHUTTLE ALL SYSTEMS IS 20 AMP'S, 3-3.1 AND 2 AND 3-3.1 IS 5.6VDC FOR GENERAL ILLUMINATION. 2. UNLESS OTHERWISE INDICATED ALL RESISTORS ARE 1/4 WATT.

TOLERANCES		QTY.	ASSEMBLY ON
RESISTORS	±1%		
CAPACITORS	±5%		
DIODES	±5%		
TRANSISTORS	±5%		
RELAYS	±5%		
CONNECTORS	±5%		
WELDS	±5%		
WIRING	±5%		
SCHEMATIC POWER SUPPLY			
DATE	10/10/68	100789	XP



- 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 AND W2) AND INSERT RELAY K1, DIODE D2 AND J17.
 3. ON FLIPPER GAMES F4 IS 10 AMPS OR (DUAL ACTION FLIPPERS) 15 AMPS ON SHUFFLE ALLEYS F4 IS 20 AMPS.
 4. OBSERVE INDEX MARK OF INTEGRATED CIRCUIT, POLARITY OF CAPACITORS, DIODES AND POSITION OF TRANSISTORS.
 5. REFERENCE DWGS: SCHEMATIC 16-8786

BILL OF MATERIAL

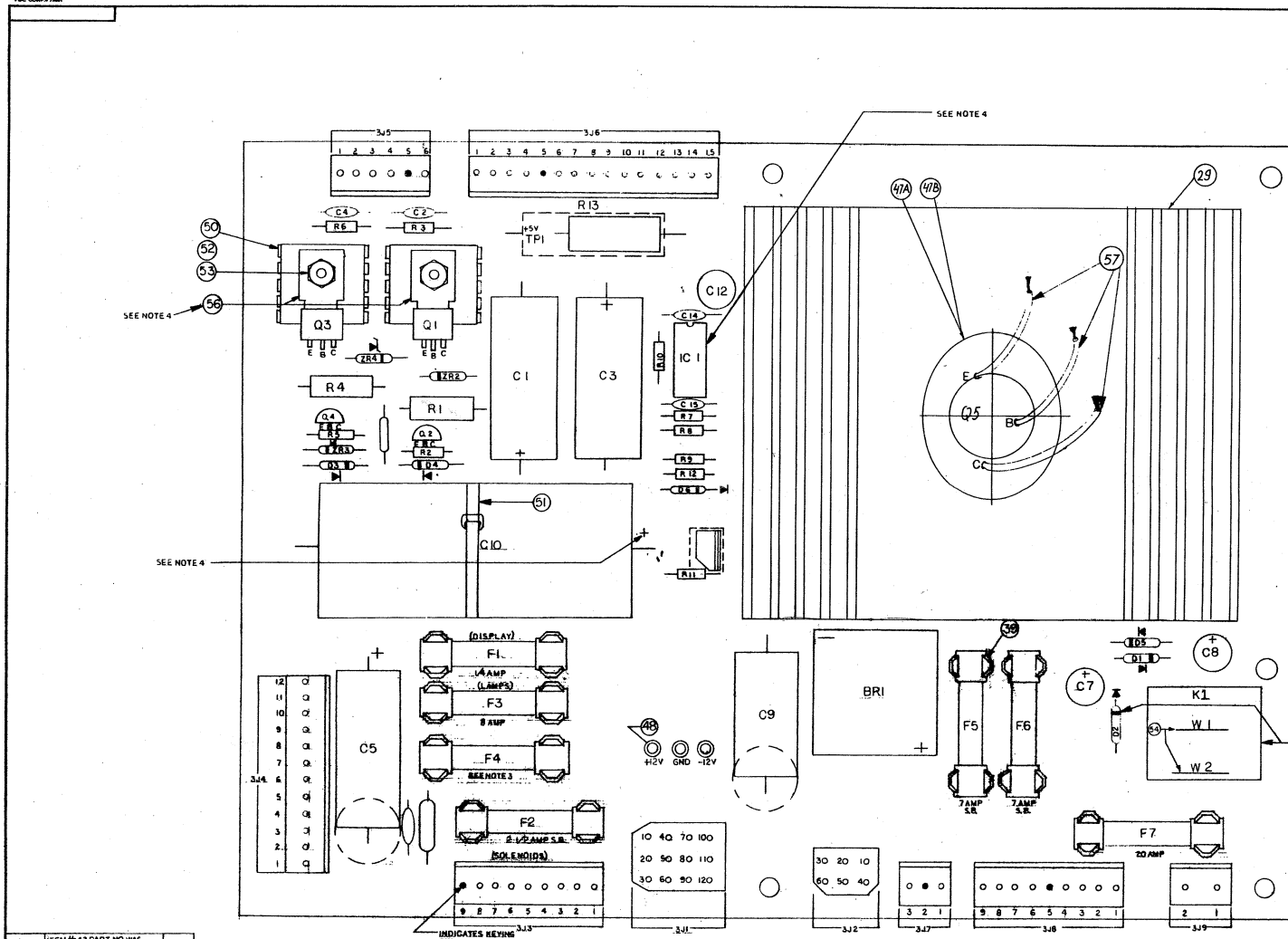
ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D
EX 1	5765-09468-00	R1	BAKE PC BOARD	1
EX 2	5013-09426-00	R7	RESISTOR 2.5K $\pm 1\%$ 1/4W METAL FILM	1
EX 3	5013-09427-00	R8	RESISTOR 4.99K $\pm 1\%$ 1/4W METAL FILM	1
EX 4	5010-09418-00	R11	RESISTOR 1.5K $\pm 1\%$ 1/4W CARBON FILM	1
EX 5	5010-09085-00	R10	RESISTOR 1.5K $\pm 5\%$ 1/4W	1
EX 6	5010-09541-00	R9	RESISTOR 2.7K $\pm 2\%$ 1/4W	1
EX 7	5010-09508-00	R12	RESISTOR 270 OHMS $\pm 2\%$ 1/4W	1
EX 8	5012-09429-00	R13	POWER RESISTOR 1/4W 5W $\pm 5\%$	1
EX 9	5010-09536-00	R1, R4	RESISTOR 39K $\pm 5\%$ 1W	2
EX 10	5010-09061-00	R2, R5	RESISTOR 680 OHMS $\pm 1\%$ 2W	2
EX 11	5010-09069-00	R3, R6	RESISTOR 330K 5W 1/2W	2
EX 12	5040-09419-00	C10	CAP. ELECTROLYTIC 18,000UF 25V	1
EX 13	5040-09420-00	C9	CAP. ELECTROLYTIC 1000UF 25V	1
EX 14	5040-09423-00	C12	CAP. ELECTROLYTIC 3300UF 10V RADIAL	1
EX 15	5043-09059-00	C15	CAPACITOR 470 pF	1
EX 16	5040-09053-00	C1, C3	CAPACITOR 100 MFD ELECT. 150V	2
EX 17	5040-09070-00	C5	CAPACITOR 100 MFD ELECT. 100V	1
EX 18	5070-09416-00	C14	CAPACITOR 1MFD 50V DISC.	1
EX 19	5070-09518-00	D1, D2, D3, D4, D5, D6	DIODE 1N4001	6
EX 20	5075-09059-00	Z1, Z2, Z3	GENERAL PURPOSE 3.3V $\pm 5\%$	2
EX 21	5075-09060-00	Z1, Z2, Z3	GENERAL PURPOSE 100V $\pm 5\%$	2
EX 22	5060-09424-00	Q1	VOLTAGE REGULATOR MC723 PC	1
EX 23	5043-09443-00	C2, C4, C6	CAPACITOR 0.1UF 200V DISC.	3
EX 24	5040-09424-00	C7	CAPACITOR 100UF 25V RADIAL	1
EX 25	5164-09057-00	Q1	TRANSISTOR, SDS: 201NPN	1
EX 26	5164-09058-00	Q4	TRANSISTOR MP3 002 NPN	1
EX 27	5194-09058-00	Q3	TRANSISTOR, SDS 202 PNP	1
EX 28	5194-09055-00	Q2	TRANSISTOR MP3 002 PNP	1
EX 29	5705-04431-00		HEAT SINK	1
EX 30	5731-09067-00	J15	CONNECTOR 6 PIN (H)	1
EX 31	5731-09074-00	J16	CONNECTOR 13 PIN (H)	1
EX 32	5731-09067-00	J17, J18	CONNECTOR 3 PIN (H)	2
EX 33	5731-09038-00	J12	CONNECTOR 6 PIN (H)	1
EX 34	5162-08455-00	Q5	TRANSISTOR, POWER, 2N5087 NPN	1
EX 35	5731-09043-00	J14	CONNECTOR 12 PIN (H)	1
EX 36	5731-09435-00	J17	CONNECTOR 3 PIN (H)	1
EX 37	5731-09436-00	J19	CONNECTOR 2 PIN (H)	1
EX 38	5731-09068-00	J11	CONNECTOR 12 PIN	1
EX 39	5732-09178-00		FUSE HOLDER	1 S.
EX 40	5731-09128-00	F2	FUSE 2-1/2 AMP 50V	1
EX 41	5730-09071-00	F3	FUSE BAMP	1
EX 42	5730-08508-00	F4	FUSE 10 AMP 15 AMP	1 L.
EX 43	5730-09127-00	F7	FUSE 20 AMP	1
EX 44	5731-08761-00	F1	FUSE, 20 AMP	1
EX 45	5017-09061-00	V1	VARIATOR	1
EX 46A	5700-09445-00		SOCKET	1
EX 47B	5701-09538-00		MICA INSULATOR	1
EX 47	5580-09559-00	K1	RELAY 24VDC 10AMP DPDT	1
EX 48	5854-09248-00		TERMINAL #1502-1 (TEST POST)	3
EX 49	5600-09418-00	BR-1	BRIDGE RECTIFIER 35AMPS 100V	1
EX 50	5705-09042-00		HEAT SINK	2
EX 51	3A-7520-1		TIE WRAP	1
EX 52	4005-01046-07		5-40 X 1/16 RH MECH. SCREW	2
EX 53	4405-01117-00		5-40 HEX NUT	2
EX 54		W1, W2	JUMPER #18 AWG	2
EX 55	5040-09428-00	C8	CAPACITOR 47UF 50V RADIAL	1
EX 56	20-9229		THERMAL COMPOUND	1
EX 57			LEAD WIRE #18 AWG (S)	2
EX 58	5731-09432-00	F5, F5	FUSE 7A 5B 250V	2

DRAWING	REVISION NO.
PCB	0
SCHEMATIC	0
PCA	0
PL	0

REVISION DRAWINGS: SCHEMATIC 168786-00

TOLERANCES		WILLIAMS ELECTRONICS, INC.		REV.		APPROVAL BY	
UNLESS OTHERWISE SPECIFIED		3801 N. CALIFORNIA	CHICAGO, ILL. 60631	DATE		APPROVED BY	
FRACTIONAL	1/16"						
DECIMAL	0.001"						
ANGLE	1/16"						
WELD	1/16"						
CONCENTRICITY	1/16"						
POSITION	1/16"						
FORM	1/16"						
DATE	10/08/85	BY	10-07-85	SCALE			

A	ITEM #42 PART NO. WAS 5730-08508-00 5730-08507-00 1 DESCRIPTION CHANGE ITEM #57 DESCRIPTION CHANGE.	G.H.
9-23-80	ITEM #42 PART NO. WAS 5010-09429-00 5010-09429-00 1 ITEM #57 PART NO. WAS 5010-09421-00 5010-09421-00 1 ITEM #23 REVISED DESCRIPTION	
REVISION	REVISION	BY



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 AND W2) AND INSERT RELAY K1, DIODE D2 AND J17

3. ON FLIPPER GAMES F4 IS 10 AMPS OR (DUAL ACTION FLIPPERS)

15 AMPS ON SHUFFLE ALLEYS F4 IS 20 AMPS.

4. OBSERVE INDEX MARK OF INTEGRATED CIRCUIT, POLARITY OF CAPACITORS, DIODES AND POSITION OF TRANSISTORS.

5. REFERENCE DWG'S: SCHEMATIC 16-8786

BILL OF MATERIAL

ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D
1	5730-09426-00	R6	RESISTOR 2.0K ± 5% 1/4W MFR	1
2	5730-09427-00	R8	RESISTOR 4.9K ± 5% 1/4W MFR	1
3	5010-09428-00	R11	RESISTOR 1.5K ± 5% 1/4W CARBON	1
4	5000-09085-00	R10	RESISTOR 0.5K ± 5% 1/4W	1
5	5010-09541-00	R9	RESISTOR 2.7K ± 5% 1/4W	1
6	5010-09508-00	R12	RESISTOR 270 OHMS ± 5% 1/4W	1
7	5012-09429-00	R13	POWER RESISTOR 1/2 OHMS ± 5% 5W	1
8	5010-09536-00	R1, R4	RESISTOR 39K ± 5% 1W	2
9	5010-09061-00	R2, R5	RESISTOR 680 OHMS ± 5% 1W	2
10	5010-09069-00	R3, R6	RESISTOR 330K 2W 1/2W	2
11	5040-09419-00	C10	CAP ELECTROLYTIC 18000UF 25V	1
12	5040-09420-00	C5	CAP ELECTROLYTIC 1000UF 25V	1
13	5040-09423-00	C12	CAP ELECTROLYTIC 3300UF 10V RADIAL	1
14	5043-09659-00	C15	CAPACITOR 470 pF	1
15	5040-09053-00	C13	CAPACITOR 100 MFD ELECT. 150V	2
16	5040-09070-00	C5	CAPACITOR 100 MFD ELECT. 100V	1
17	5043-09537-00	C14	CAPACITOR 1MFD 50V DISC.	1
18	5070-09416-00	C14	CAPACITOR 1MFD 50V DISC.	1
19	5070-09258-00	D1, D3, D4, D5, D6	DIODE 1N4001	6
20	5070-09059-00	Z1, Z2, Z3	ZENER 1N2993 3.3VZ ± 5%	3
21	5075-09060-00	Z2, Z3, Z4	ZENER 1N2994 10VZ ± 5%	2
22	5060-09431-00	IC1	VOLTAGE REGULATOR MC7232 PC	1
23	5043-09443-00	C1, C4, C6	CAPACITOR 0.1UF 200V DISC.	3
24	5040-09421-00	C7	CAPACITOR 100UF 25V RADIAL	1
25	5164-09057-00	Q1	TRANSISTOR SDS-201NPN	1
26	5164-09058-00	Q4	TRANSISTOR MPS 002 NPN	1
27	5194-09058-00	Q3	TRANSISTOR SDS 202 PNP	1
28	5194-09055-00	Q2	TRANSISTOR MPS 002 PNP	1
29	5705-04431-00		HEAT SINK	1
30	5730-09047-00	3J5	CONNECTOR 6 PIN (P)	1
31	5730-09074-00	3J8	CONNECTOR 15 PIN (M)	1
32	5730-09067-00	3J9, 3J3	CONNECTOR 3 PIN (M)	2
33	5730-09038-00	3J2	CONNECTOR 6 PIN (M)	1
34	5162-09425-00	Q5	TRANSISTOR, POWER, 2N6087 NPN	1
35	5730-09043-00	3J4	CONNECTOR 12 PIN (M)	1
36	5730-09435-00	3J7	CONNECTOR 3 PIN (M)	1
37	5730-09436-00	3J9	CONNECTOR 2 PIN (M)	1
38	5730-09068-00	3J1	CONNECTOR 12 PIN	1
39	5732-09178-00		FUSE HOLDER	15
40	5730-09128-00	F2	FUSE 2-1/2 AMP 50V	1
41	5730-09071-00	F3	FUSE 5 AMP	1
42	5730-09068-00	F4	FUSE 10 AMP 15 AMP	1
43	5730-09067-00	F7	FUSE 20 AMP	1
44	5730-09061-00	F1	FUSE 20 AMP	1
45	5017-09061-00	VR1	VARIATOR	1
46A	5700-09445-00		SOCKET	1
47B	5701-09538-00		MICA INSULATOR	1
47	5580-09555-00	K1	RELAY 24VDC 10AMP DPDT	1
48	5824-09249-00		TERMINAL #1502-1 (TEST POST)	3
49	5100-09418-00	BR-1	BRIDGE RECTIFIER 35AMPS 100V	1
50	5705-09042-00		HEAT SINK	2
51	3A-7520-1		TIE WRAP	1
52	3405-0106-07		5-40 X 1/16 RH. MECH. SCREW	2
53	3405-0117-00		5-40 HEX NUT	2
54		W1, W2	JUMPER #18 AWG	2
55	5040-09422-00	C8	CAPACITOR 47UF 50V RADIAL	1
56	20-9229		THERMAL COMPOUND	1
57			LEAD WIRE #18 AWG (3)	3
58	5730-09432-00	F6, F5	FUSE 7A 50V 250V	2

DRAWING	REVISION & NO.
PCB	1
SCHEMATIC	1
PCA	1
PL	1

REVISION DRAWING: SCHEMATIC 168786-00

TOLERANCES		UNLESS OTHERWISE SPECIFIED	
FRACTIONAL	DECIMAL	ANGLE	WELD DIA.
MATERIAL		TREATMENT	
WILLIAMS ELECTRONIC, INC.		POWER SUPPLY BOARD SUB-ASSEMBLY	
3401 N. CALIFORNIA CHICAGO, ILL. 60618 CORNELIA 2-8880			
DATE	APP'D.	SCALE	
10-10-80			

A	ITEM #42 PART NO. WAS 5730-06508-00	G.H.
9-23-80	5730-06567-00 1 DESCRIPTION CHANGE	
	ITEM #57 DESCRIPTION CHANGE	
	ITEM #58 PART NO. WAS 5010-09061-00	
	ITEM #59 PART NO. WAS 5010-09061-00	
	ITEM #60 PART NO. WAS 5730-09071-00	
REVISION	REVISION	BY
1		

SOLENOID 1 DRIVE

SOLENOID 2 DRIVE

SOLENOID 3 DRIVE

SOLENOID 4 DRIVE

SOLENOID 5 DRIVE

SOLENOID 6 DRIVE

SOLENOID 7 DRIVE

SOLENOID 8 DRIVE

SOLENOID 9 DRIVE

SOLENOID 10 DRIVE

SOLENOID 11 DRIVE

SOLENOID 12 DRIVE

SOLENOID 13 DRIVE

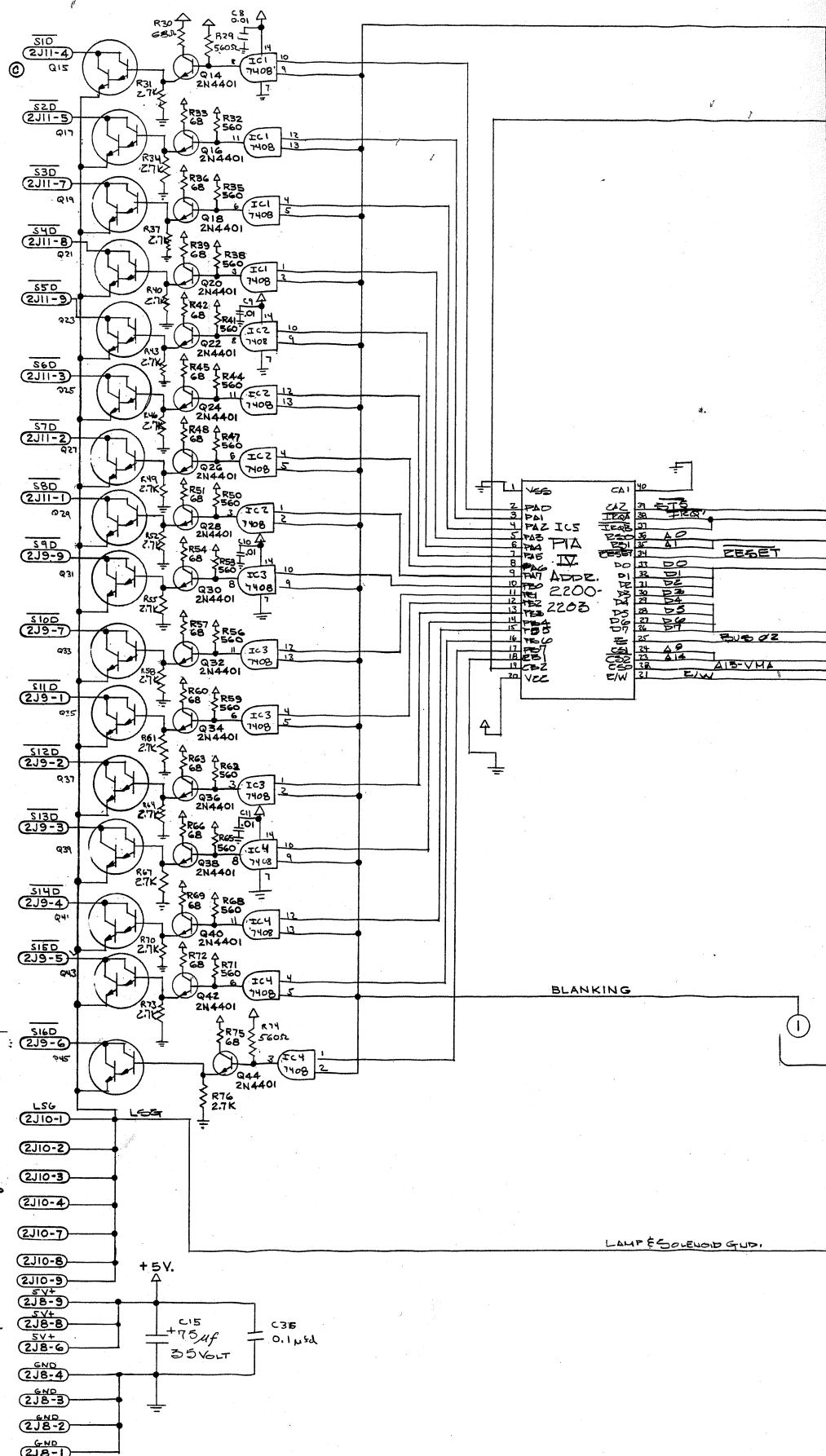
SOLENOID 14 DRIVE

SOLENOID 15 DRIVE

SOLENOID 16 DRIVE

LAMP & SOLENOID GROUND

C	CHANGE TIP 120 TO VENDOR SELECTED DARLINGTON	E.C.O. 4889
B	2J18'S WAS G'S, 2J19'S WAS H'S, 2J10'S WAS J'S, 2J11 WAS K'S, 2J12 WAS L'S 2J13'S WAS M'S & ADDED 1 TO FROM SHEET 1" & CIRCLES TO ALL 2N4401 TRANSISTORS	P. 487 10-28-77
1	REVISION "A"	
REVISION LETTER	REVISION	BY



LAMP & SOLENOID GND.

1 DRIVE

2 DRIVE

3 DRIVE

4 DRIVE

5 DRIVE

6 DRIVE

7 DRIVE

8 DRIVE

9 DRIVE

10 DRIVE

11 DRIVE

12 DRIVE

13 DRIVE

14 DRIVE

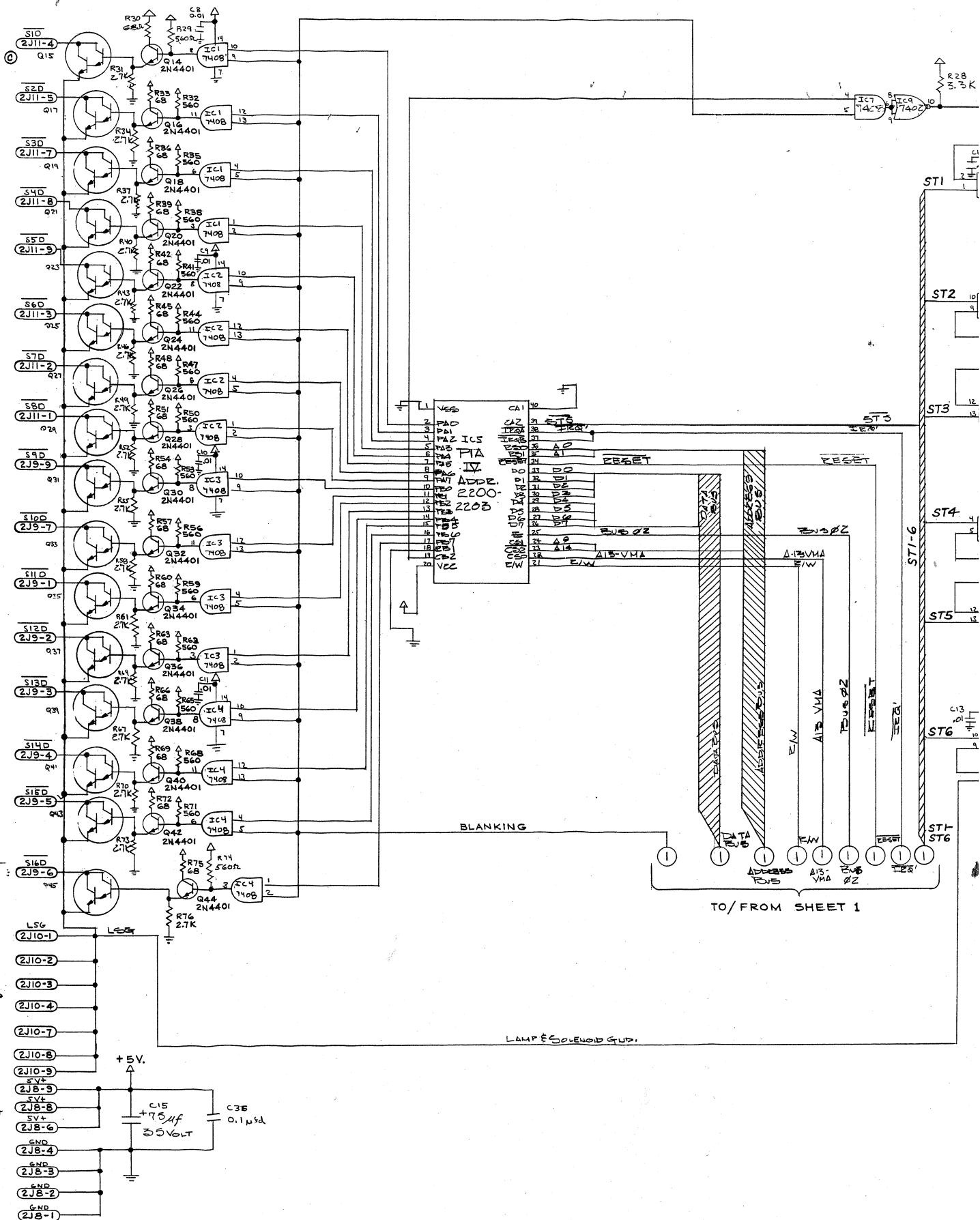
15 DRIVE

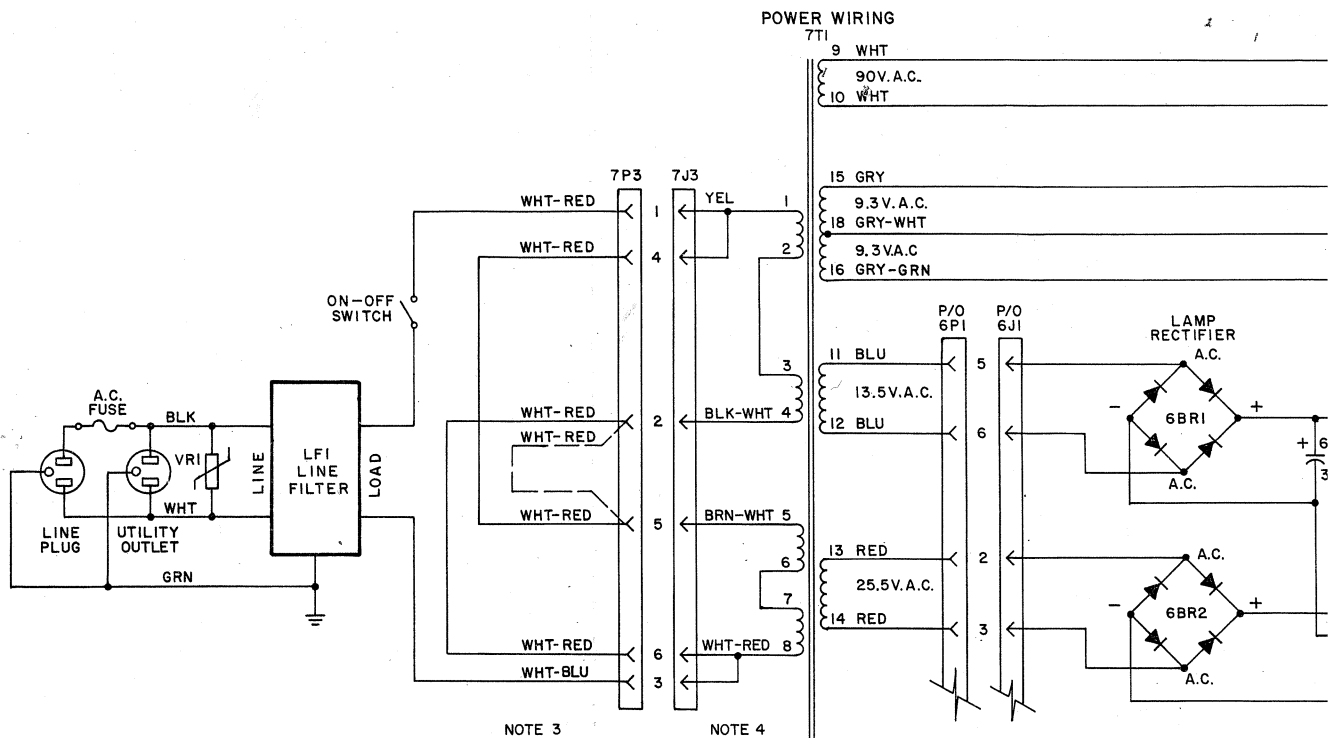
16 DRIVE

OLD GROUND

5V B+

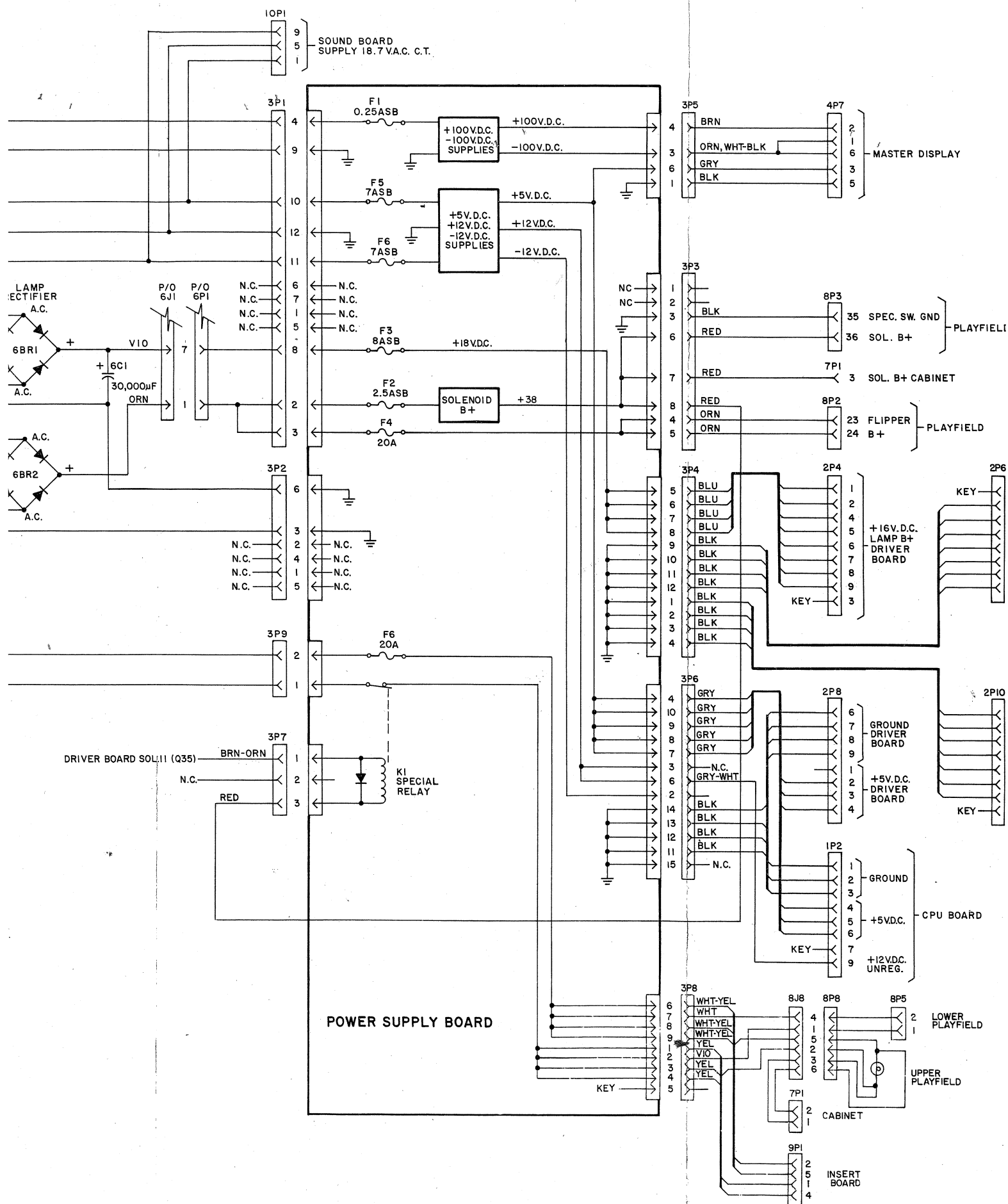
GND.

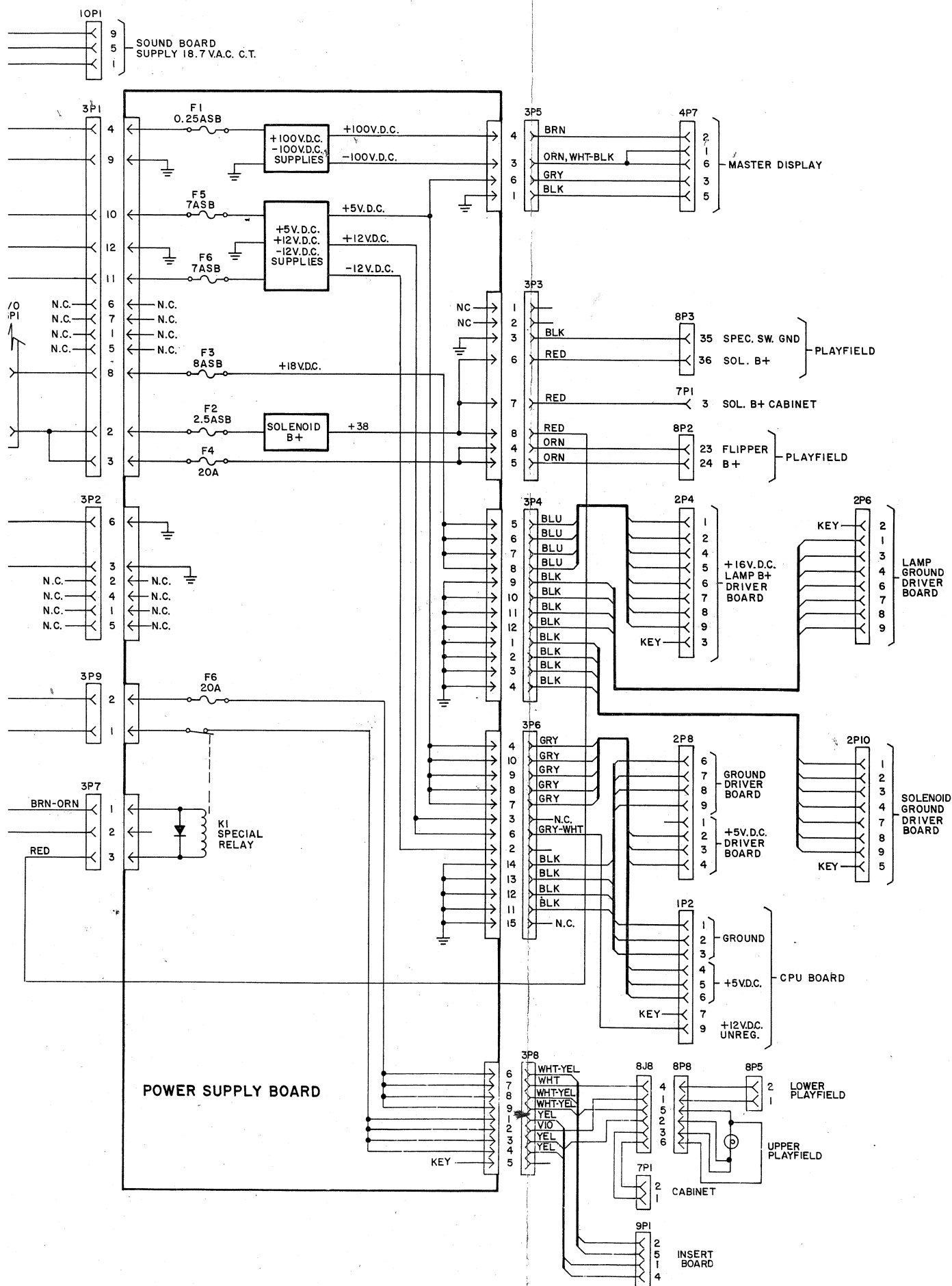




NOTES:

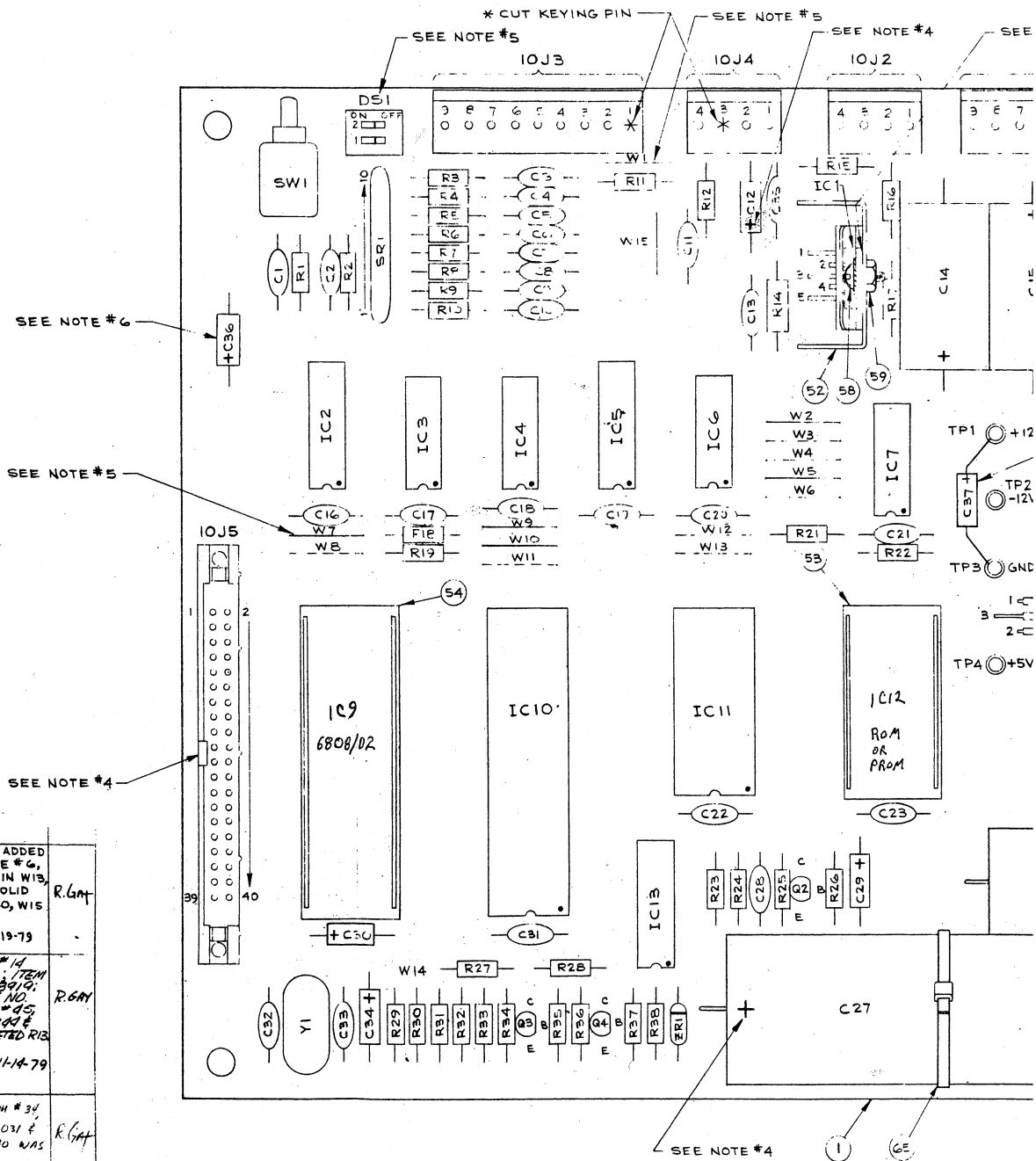
1. FOR 105 OR 117V.A.C., 7.5A FUSE & 130V. VARISTOR #5A-9044 ARE USED.
2. FOR 210 OR 235V.A.C., 4A FUSE & 275V. VARISTOR #5A-9063 ARE USED.
3. JUMPER WIRES ON 6P1 SHOWN WITH SOLID LINES ARE CONNECTED FOR 117V.A.C. OPERATION. ONLY THE ONE SHOWN WITH A DASHED LINE IS CONNECTED FOR 220V.A.C. OPERATION.
4. FOR LOW-LINE CONDITIONS (105 OR 210V.A.C.) MOVE BLK-WHT WIRE FROM 6T1-4 TO 6T1-3) & MOVE 2 WHT-RED WIRES FROM 6T1-8 TO 6T1-7.





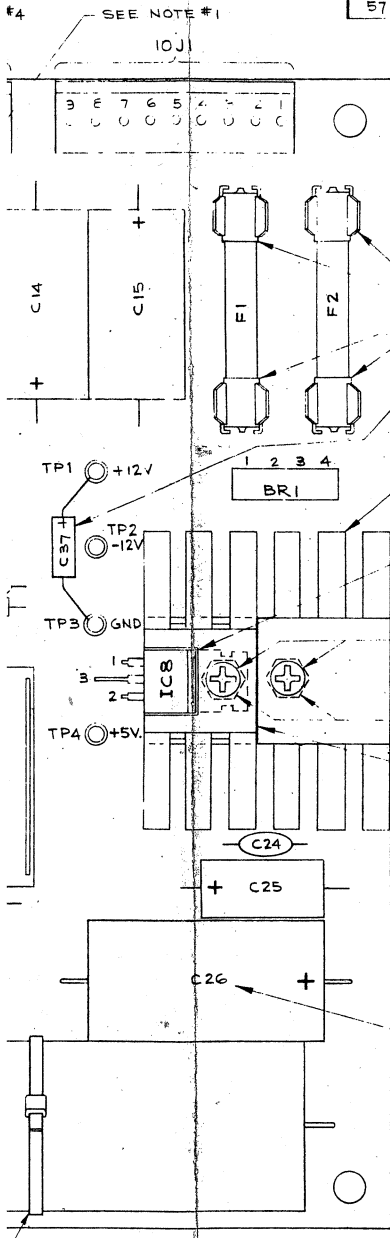
Power Wiring Diagram
13

ITEM NO.	PART NO.	PART DESIGNATION	DES
58			6-32 X .003" BI
59			6-32 HEX
60		W1, W2, W3, W4, W5, W6, W7, W8, W9, W10, W11	WIRE JUMP
61	5A-9248	TP1 THR TP4	TERMINAL
62	5A-9363	R11	RESISTOR 5% 1/4 W
64	5A-9362	SRI	RESISTOR 10 PIN S
65	3A-7520-1		TIE WRAP



E	REVISED NOTES, ADDED ITEM #45 & NOTE #6, RELOCATED W15, IN W15, DASH LINE WAS SOLID LINE & ITEM #60, W15 WAS W16 E.C.O.	11-19-79	R.G.M.
D	DELETED ITEM #14, PT. NO. 5A-9016, ITEM #16, PT. NO. 5A-9019, ITEM #25, PT. NO. 5A-9314, ITEM #45, PT. NO. 5A-9363, IN ITEM #21, DELETED R13, QTY. WAS 6 E.C.O. 4764	11-14-79	R.G.M.
C	ADDED C36, ITEM #34, PT. NO. WAS 5A-9031 & QTY. WAS 1, & C30 WAS 01 MFD.	10-29-79	R.G.M.
B	RELOCATED ITEM #62, ADDED R1 & R12 TO ITEM #14, QTY. WAS 3	10-1-79	R.G.
A	ITEM #13, A.D. 5A-9016, ITEM #32, A.D. 5A-9016, ITEM #62, A.D. 5A-9016	10-4-79	R.G.
REVISION LETTER	REVISION	BY	

IN	DESCRIPTION	REQ'D. NO.	ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D. NO.
	6-32 X 3/8" BINDER HEAD SCREW	3	48	5A-9314	F1, F2	4 AMP SLOW BLOW FUSE	2
	6-32 HEX NUT	3	49	5A-9178		FUSE HOLDER	4
W7.	WIRE JUMPER 22 GAUGE	7	50	5A-9172		HEAT SINK THERMALLOY*6072B	1
1	WIRE WITH INSULATION	4	51	5A-9173		HEAT SINK THERMALLOY*6071B	1
	TERMINAL #1502-1	1	52	5A-9199		HEAT SINK THERMALLOY*6030	1
	RESISTOR, FC, 5.6 KOHM	1	53	5A-9004		24 PIN SOCKET	1
	5% 1/4 WATT	1	54	5A-8985		40 PIN SOCKET	1
	RESISTOR, 4.7 K OHM	1	55	5A-9027	10J1, 10J3	9 PIN MALE CONNECTOR	2
	10 PIN SIP	1	56	5A-9028	10J2, 10J4	4 PIN MALE CONNECTOR	2
	TIE WRAP	1	57	5A-9349	10J5	40 PIN RIBBON HEADER	1



NOTES:

- USE THERMAL COMPOUND BETWEEN ICs 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 D1, D2, AND ZR1.
- CAPACITORS C12, C14, C15, C24, C25, C27.
- CONNECTORS 10J1, 10J2, 10J3, 10J4, 10J5.
- POSITION OF TRANSISTORS Q1, Q2, Q3, Q4.
- DS1 - 1 SELECTS SOUNDS/NOTES
- 2 SELECTS SPEECH/NO SPEECH (W9/W4)
- W1 - SPEECH MODULE STATUS
- IN - SPEECH MODULE NOT ATTACHED
- OUT - SPEECH MODULE ATTACHED
- W14 - MPU INTERNAL RAM ENABLE
- W7 & W8 - MEMORY MAP CONTROL
- W12 & W13 - PB7 STATUS CONTROL (W13 NEVER USED)
- W4 & W9 - PB5 STATUS CONTROL
6. SOLDERED ON TOP OF BOARD
- INSTALL THESE JUMPERS FOR FOLLOWING GAMES:
- W15, W8, W12, W4, W1, W3, W6, W11 FOR:

WORLD CUP
DISCO FEVER
CONTACT
POKERO
PHOENIX
ARISTOCRAT SHUFFLE
POMPLI SHUFFLE
KING TUT SHUFFLE
TAURUS SHUFFLE

SOUND ROM 1

W15, W8, W12, W4, W1, W2, W5, W10, FOR:

FLASH
STELLAR WARS
TRI ZONE
TIME WARP

SOUND ROM 1
5A-9158

W7, W15, W9, W1, (SEE NOTE #5) W2, W5, W10 FOR:

GORGAR, SOUND ROM 2 - JT-9960

IC12 SELECTION STRAPPING:

(2K x 8)	(1K x 4)	(512 x 8)
W2	W3	W3
W2 IN	W3 IN	W3 IN
W2	W3	W3

BILL OF MATERIAL

ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D. NO.
1	IC-2001-146-3		BARE P.C. BOARD	1
2	5A-9156	IC1	TDA2002 V AUDIO AMPLIFIER	1
3	5A-9012	IC2	7442 BCD-DEC DECODER	1
4	5A-9073	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/TO220 CASE	1
10	5A-8972	IC10	6821 P.I.A.	1
11	5A-9003	IC11	6810 RAM	1
12	5A-9152	IC13	1408 D/A CONVERTER	1
13	5C-8938	Q2, Q3, Q4	2N4401 NPN TRANSISTOR	3
14				
15	5A-9018	ZR1	1N5996 6.8V. ZENER DIODE	1
16				
17	5A-9158 OR 5A-9357	BR1	MDA 200/3N253 BRIDGE RECTIFIER	1
18	5A-9020	Y1	3.58 MHZ CRYSTAL	1
19	5B-8991	R1, R18, R19, R21, R22, R27, R30, 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, R28, 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. $\pm 20\%$	11
32	5A-9065	C2 THRU C10	CAPACITOR, CERAMIC, .470 PFD. 50 V. $\pm 20\%$	9
33	5A-9345	C11	CAPACITOR, CERAMIC, .001 MFD. 20% 100 V.	1
34	5A-9365	C12, C30, C36	CAPACITOR, ELECTROLYTIC, 1 MFD. 63 V. $\pm 50\%$	3
35	5A-8996	C13, C24, C35	CAPACITOR, CERAMIC, .1 MFD. 50 V. $\pm 20\%$	3
36	5A-9165 5A-9165-1	C14	CAPACITOR, ELECTROLYTIC, 800 MFD. 16 V. OR 1,000 MFD. 15 V. $\pm 20\%$	1
37	5A-9164 5A-9164-1	C15	CAPACITOR, ELECTROLYTIC, 500 MFD. 15 V. OR 470 MFD. 25 V. $\pm 20\%$	1
38	5A-8986	C25	CAPACITOR, ELECTROLYTIC, 100 MFD. 10 V. $\pm 20\%$	1
39	5A-8893	C26	CAPACITOR, ELECTROLYTIC, 1,000 MFD. 25 V. $\pm 20\%$	1
40	5A-9046	C27	CAPACITOR, ELECTROLYTIC, 12,000 MFD. 16 V. $\pm 20\%$	1
41	5A-9180	C28	CAPACITOR, CERAMIC, 47 PFD. 1K V. $\pm 20\%$	1
42	5A-9343	C29	CAPACITOR, ELECTROLYTIC, 10 MFD. 25 V. LOW LEAK $\pm 20\%$	1
43	5A-9169	C32, C33	CAPACITOR, CERAMIC DISC, 27 PFD. 1K V. $\pm 10\%$	2
44	5A-9163	C34	CAPACITOR, TANTALUM, 2.2 MFD. 15 V. $\pm 20\%$	1
45	5A-9031	C37	CAPACITOR, TANTALUM, 1 MFD. 25 V. $\pm 20\%$	1
46	5A-9024	SW1	MOMENTARY SWITCH SPDT	1
47	5A-9330	DS1	2 STD. DIP SWITCH	1

TOLERANCES		QTY.		ASSEMBLY ON	
UNLESS OTHERWISE SPECIFIED					
FRACTIONAL	±1/64"				
DECIMAL	±.005"				
HOLE DIA.	±.005"				
ANGULAR	±1/8°				
CONCENTRICITY	±.005"				
SCREW THREADS	CLASS 2				
DATE 9-23-79		APP'D. 10/1/79		SCALE 2:1	
DRAWN R44				D-B223	

WILLIAMS ELECTRONICS, INC.
SUBSIDIARY OF THE SEBORG CORP.
3401 N. CALIFORNIA CHICAGO, ILL. 60618 267-2240
NAME SOUND BOARD SUB-ASSEM

REQ'D. NO.	ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D. NO.
3	48	5A-6314	F1, F2	4 AMP SLOW BLOW FUSE	2
3	49	5A-9178		FUSE HOLDER	4
7	50	5A-9172		HEAT SINK THERMALLOY #6072B	1
4	51	5A-9173		HEAT SINK THERMALLOY #6071B	1
1	52	5A-9199		HEAT SINK THERMALLOY #6030	1
1	53	5A-9004		24 PIN SOCKET	1
1	54	5A-8985		40 PIN SOCKET	1
1	55	5A-9027	10J1, 10J3	9 PIN MALE CONNECTOR	2
1	56	5A-9028	10J2, 10J4	4 PIN MALE CONNECTOR	2
1	57	5A-9349	10J5	40 PIN RIBBON HEADER	1

NOTES:

- USE THERMAL COMPOUND BETWEEN IC'S AND HEAT SINK.
- CAUTION: AVOID STATIC DISCHARGE DAMAGE TO MOS LOGIC.
- SYMBOLS SHOWN ON COMPONENTS ARE FOR REFERENCE ONLY. DO NOT SCREEN OR STAMP.

- OBSERV. INDEX MARK OF ALL INTEGRATED CIRCUITS, DIODES D1, D2, AND ZR1.

CAPACITORS C12, C13, C15, C25, C21, C27.

CONNECTORS 10J1, 10J2, 10J4, 10J3, 10J5.

POSITION OF TRANSISTORS Q1, Q2, Q3, Q4.

- DS1 - 1 SELECTS SOUNDS/NOTES

- 2 SELECTS SPEECH/NO SPEECH (W9/W4)

W1 - SPEECH MODULE STATUS

IN - SPEECH MODULE NOT ATTACHED

OUT - SPEECH MODULE ATTACHED

W14 - MPU INTERNAL RAM ENABLE

W7 & W8 - MEMORY MAP CONTROL

W12 & W13 - PB7 STATUS CONTROL (W13 NEVER USED)

- W4 & W9 - PB5 STATUS CONTROL

6. SOLDERED ON TOP OF BOARD

INSTALL THESE JUMPERS FOR FOLLOWING GAMES:

W15, W6, W12, W4, W1, W3, W6, W11 FOR:

WORLD CUP
DISCO FEVER
CONTACT
POKIRINO
PHOENIX
ARISTOCRAT SHUFFLE
POMPEII SHUFFLE
KING TUT SHUFFLE
TAURUS SHUFFLE

SOUND ROM 1

W15, W8, W12, W4, W1, W2, W5, W10, FOR:

FLASH
STILLAR WARS
TRI ZONL
TIME WARP

SOUND ROM 1
5A-9198

W7, W15, W9, W1, (SEE NOTE #5) W2, W5, W10 FOR:

GORGAR, SOUND ROM 2 - JT-4960

IC 12 SELECTION STRAPPING:

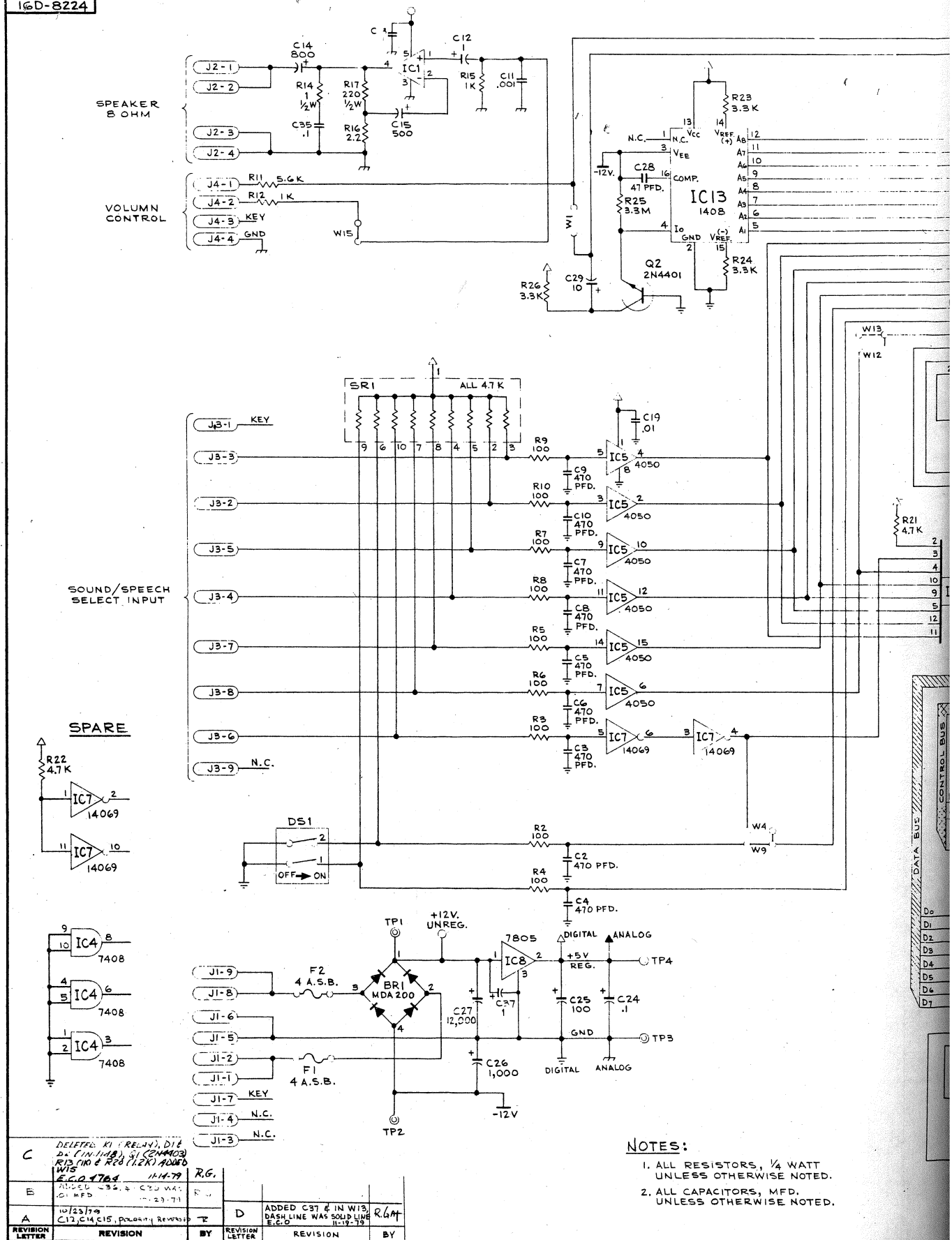
(2K x 8)	(1K x 8)	(512 x 8)
W2	W3	W3
W5 IN	W5 IN	W5 IN
W11	W11	W11

BILL OF MATERIAL

ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D. NO.
1	IC-2001-146-3		BARE P.C. BOARD	1
2	5A-9156	IC1	TDA2002V AUDIO AMPLIFIER	1
3	5A-9012	IC2	7442 BCD-DEC DECODER	1
4	5A-9073	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/T0220 CASE	1
10	5A-8972	IC10	6821 P.I.A.	1
11	5A-9003	IC11	6810 RAM	1
12	5A-9152	IC13	1408 D/A CONVERTER	1
13	5C-8938	Q2, Q3, Q4	2N4401 NPN TRANSISTOR	3
14				
15	5A-9018	ZR1	1N5996 6.8V. ZENER DIODE	1
16				
17	5A-9158 OR 5A-9357	BR1	MDA 200/3N253 BRIDGE RECTIFIER	1
18	5A-9020	Y1	3.58 MHz CRYSTAL	1
19	5B-8991	R1, R19, R21, R22, R27, R30, R31, R32	RESISTOR, FC, 4.7K OHM 5% 1/4 WATT	9
20	5B-9086	R2 THRU R10	RESISTOR, FC, 100 OHM 10% 1/4 WATT	9
21	5A-8984	R12, R15, R28, 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. $\pm 20\%$	11
32	5A-9065	C2 THRU C10	CAPACITOR, CERAMIC, 470 PFD. 50 V. $\pm 20\%$	9
33	5A-9345	C11	CAPACITOR, CERAMIC, .001 MFD. 20 V. 100 V.	1
34	5A-9365	C12, C30, C36	CAPACITOR, ELECTROLYTIC 1 MFD. 6.3 V. -10/+50%	3
35	5A-8996	C13, C24, C35	CAPACITOR, CERAMIC, .1 MFD. 50 V. $\pm 20\%$	3
36	5A-9165 5A-9165-1	C14	CAPACITOR, ELECTROLYTIC, 800 MFD. 16 V. OR 1,000 MFD. 15 V. $\pm 20\%$	1
37	5A-9164 5A-9164-1	C15	CAPACITOR, ELECTROLYTIC, 500 MFD. 15 V. OR 470 MFD. 25 V. $\pm 20\%$	1
38	5A-8986	C25	CAPACITOR, ELECTROLYTIC, 100 MFD. 10 V. $\pm 20\%$	1
39	5A-8893	C26	CAPACITOR, ELECTROLYTIC, 1,000 MFD. 25 V. $\pm 20\%$	1
40	5A-9046	C27	CAPACITOR, ELECTROLYTIC, 12,000 MFD. 16 V. $\pm 20\%$	1
41	5A-9180	C28	CAPACITOR, CERAMIC, 47 PFD. 1K V. $\pm 20\%$	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. $\pm 10\%$	2
44	5A-9163	C34	CAPACITOR, TANTALUM, 2.2 MFD. 15 V. $\pm 20\%$	1
45	5A-9031	C37	CAPACITOR, TANTALUM, 1 MFD. 25 V. $\pm 20\%$	1
46	5A-9024	SW1	MOMENTARY SWITCH SPDT	1
47	5A-9330	DS1	2 STD. DIP SWITCH	1

TOLERANCES		QTY.	APPROX. ON
UNLESS OTHERWISE SPECIFIED:			
FRACTIONAL	21/64"	WILLIAMS ELECTRONICS, INC.	
DECIMAL	0.005"	SUBSIDIARY OF THE REBURG CORP.	
HOLE DIA.	0.005"	3401 N. CALIFORNIA CHICAGO, ILL. 60618	
ANGULAR	0.005"	287-2240	
CONCENTRICITY	0.005"	NAME	
SCREW THREADS	0.005"	SOUND BOARD SUB-ASSEM	
MATERIAL		HEAT TREATMENT	FINISH
DATE	9-23-79	SCALE	2:1
APP'D.	R44	D-8223	

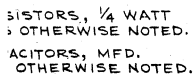
16D-8224



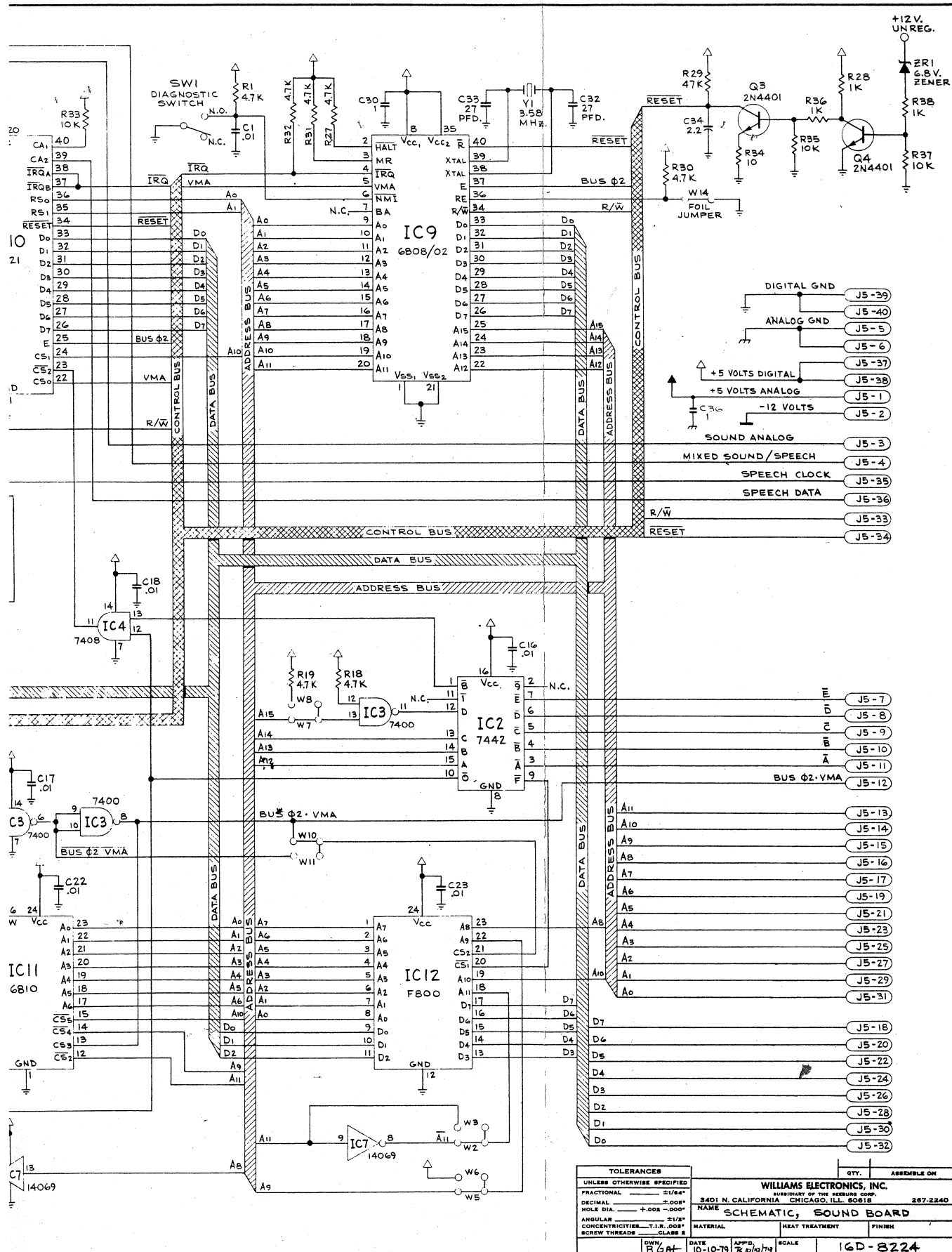
NOTES:

1. ALL RESISTORS, 1/4 WATT UNLESS OTHERWISE NOTED.
2. ALL CAPACITORS, MFD. UNLESS OTHERWISE NOTED.

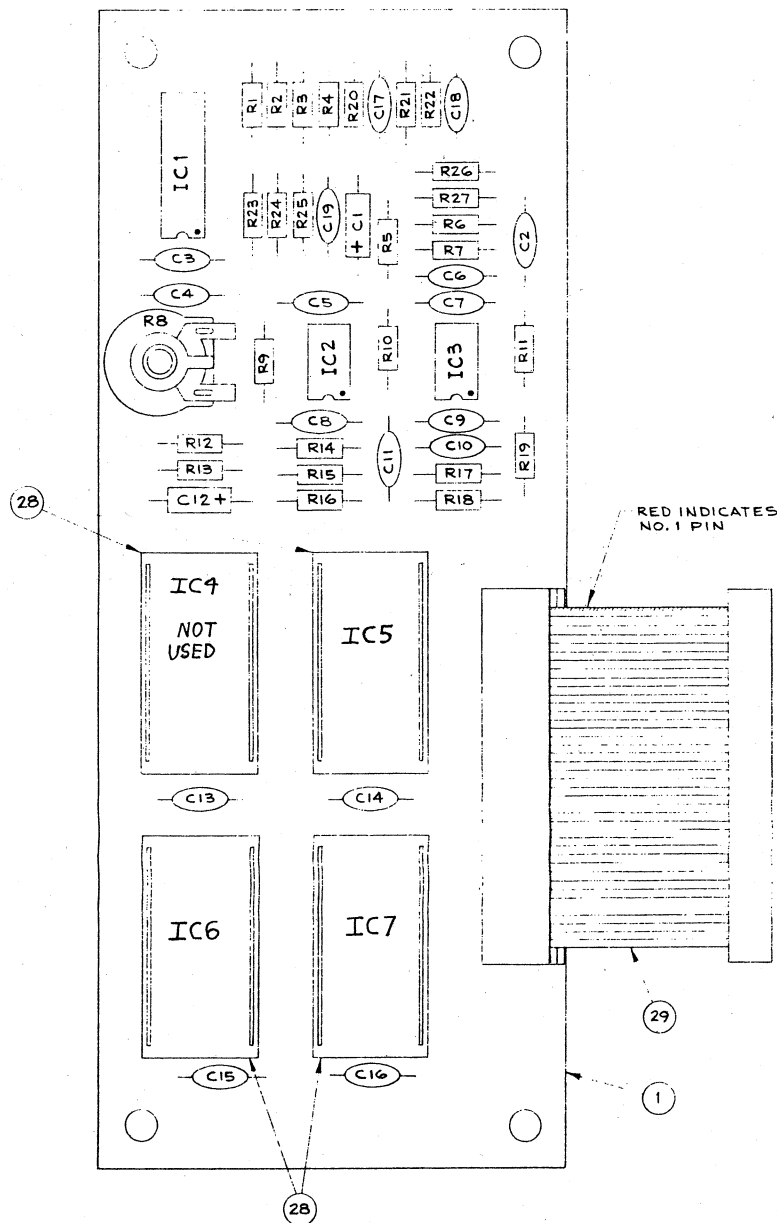
C	DELETED (1) (RELIN) DIE 20 (PIN 148) 31 (SMD403) R13 (10 & R28 (12K) 4000 W15 R.G.			
	E.C.D. 4764 11-14-79 R.G.			
E	R13 (10 & R28 (12K) 4000 W15 R.G.			
A	10/23/79 C12, C14, C15, POLARITY REVERSED R.G.			
REVISION LETTER	REVISION	BY	REVISION LETTER	BY



TOLERANCES			
UNLESS OTHERWISE SPECIFIED		WILLIAM	
FRACTIONAL	$\pm 1/64"$	SUBSIDIARY	
DECIMAL	$\pm .005"$	3401 N. CALIFORNIA C	
MIL DIA.	$\pm .002$	NAME	
ANGULAR	$\pm 1/8"$	SCHEMATIC	
CONCENTRICITIES	T.I.R. $\pm .005"$	MATERIAL	
SCREW THREADS	CLASS 2	NEAR	
DWN/	DATE	APP'D	SCALE
RGAT	10-10-79	8/10/79	



C-8225



BILL OF MATERIAL

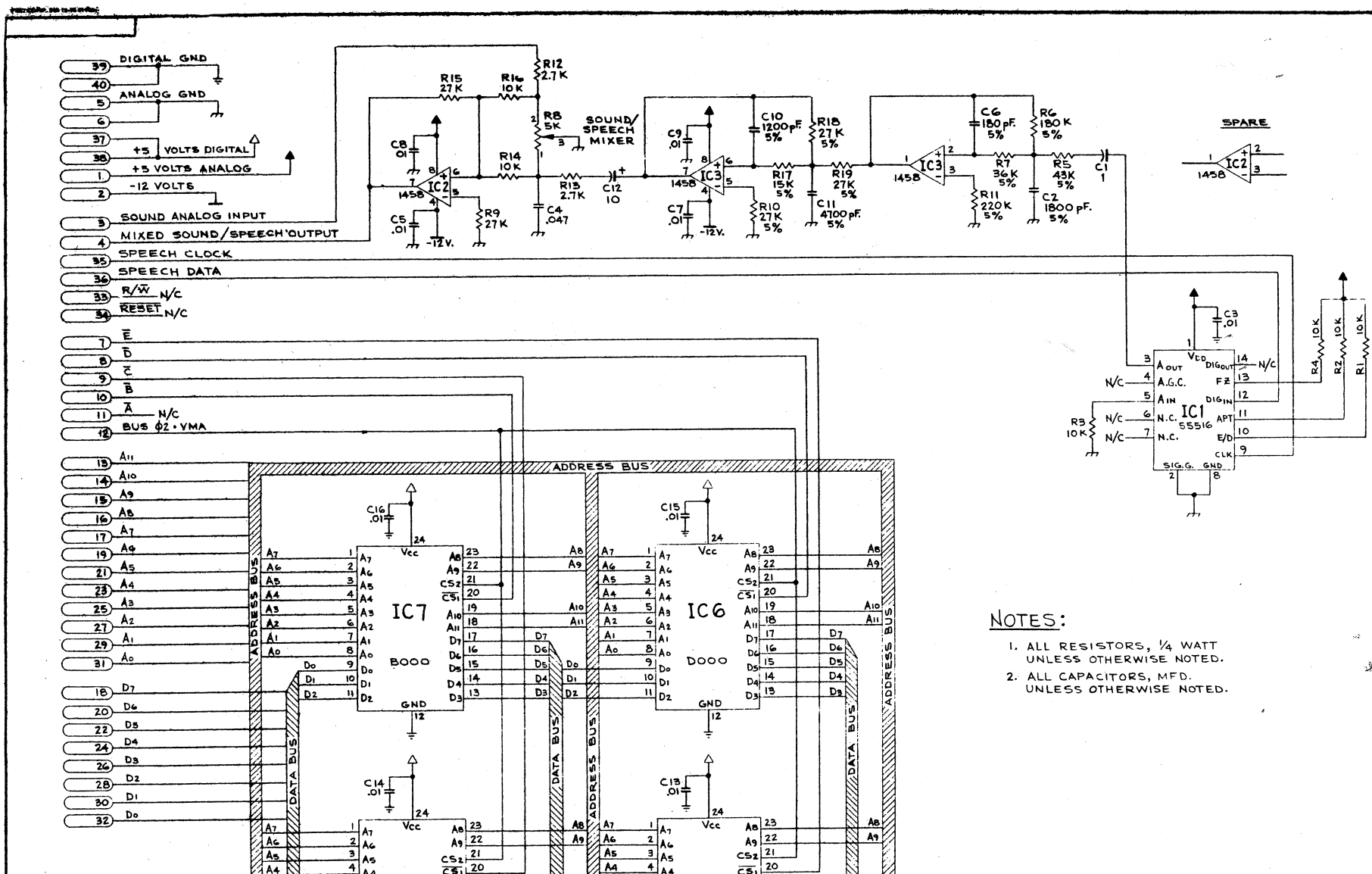
ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQD. NO.
1	IC-2001-148-2		BARE P.C. BOARD	1
2	5A-9334	IC1	3417 CONTINUOUSLY VARIABLE SLOPE DELTA MODULATOR	1
3	5A-9321	IC2, IC3	1458 DUAL OP-AMP.	2
4	5A-8992	R1, R4, R22, R23	RESISTOR, FC, 560 OHM 10% 1/4 WATT	4
5	5A-8776	R2	RESISTOR, FC, 68K OHM 5% 1/4 WATT	1
6	5A-8983	R3	RESISTOR, FC, 3.3K OHM 10% 1/4 WATT	1
7	5B-8817	R5, R16	RESISTOR, FC, 10K OHM 10% 1/4 WATT	2
8	5A-8773	R6	RESISTOR, FC, 18K OHM 5% 1/4 WATT	1
9	5A-9353	R7	RESISTOR, FC, 6.2K OHM 5% 1/4 WATT	1
10	5A-9324	R9, R10, R11, R15, R18, R19	RESISTOR, FC, 27K OHM 10% 1/4 WATT	6
11	5B-8997	R12, R13	RESISTOR, FC, 2.7K OHM 10% 1/4 WATT	2
12	5A-8772	R14, R17	RESISTOR, FC, 15K OHM 5% 1/4 WATT	2
13	5A-9314	R20	RESISTOR, FC, 1.2K OHM 10% 1/4 WATT	1
14	5A-9331	R21	RESISTOR, FC, 13K OHM 10% 1/4 WATT	1
15	5A-9185	R8	POTENTIOMETER, 5K OHM	1
16	5A-9218	R24	RESISTOR, FC, 2.2M OHM 10% 1/4 WATT	1
17	5A-8984	R25, R27	RESISTOR, FC, 1K OHM 10% 1/4 WATT	1
18	5A-9356	R26	RESISTOR, FC, 820 OHM 5% 1/4 WATT	1
19	5A-9031	C1	CAPACITOR, TANTALUM, 1 MFD. 20% 25 VOLT	1
20	5A-8980	C2, C3, C5, C7, C8, C9, C13 THRU C16	CAPACITOR, CERAMIC, .01 MFD. +80%-20% 50 VOLT	10
21	5A-9030	C4	CAPACITOR, CERAMIC, .047 MFD. 20% 50 VOLT	1
22	5A-9347	C6	CAPACITOR, CERAMIC, 1800 PFD. 5% 50 VOLT	1
23	5A-9346	C10	CAPACITOR, CERAMIC, 1200 PFD. 5% 50 VOLT	1
24	5A-9348	C11	CAPACITOR, CERAMIC, 4700 PFD. 5% 50 VOLT	1
25	5A-9343	C12	CAPACITOR, ELECTROLYTIC, 10 MFD. 20% 25 VOLT LOW LEAK	1
26	5A-9263	C17	CAPACITOR, .33 MFD. 20% 200 VOLT	1
27	5A-8996	C18, C19	CAPACITOR, CERAMIC, .1 MFD. 20% 25 VOLT	2
28	5A-9004		24 PIN SOCKET	4
29	5A-9354	J1	RIBBON CABLE ASSEM	1

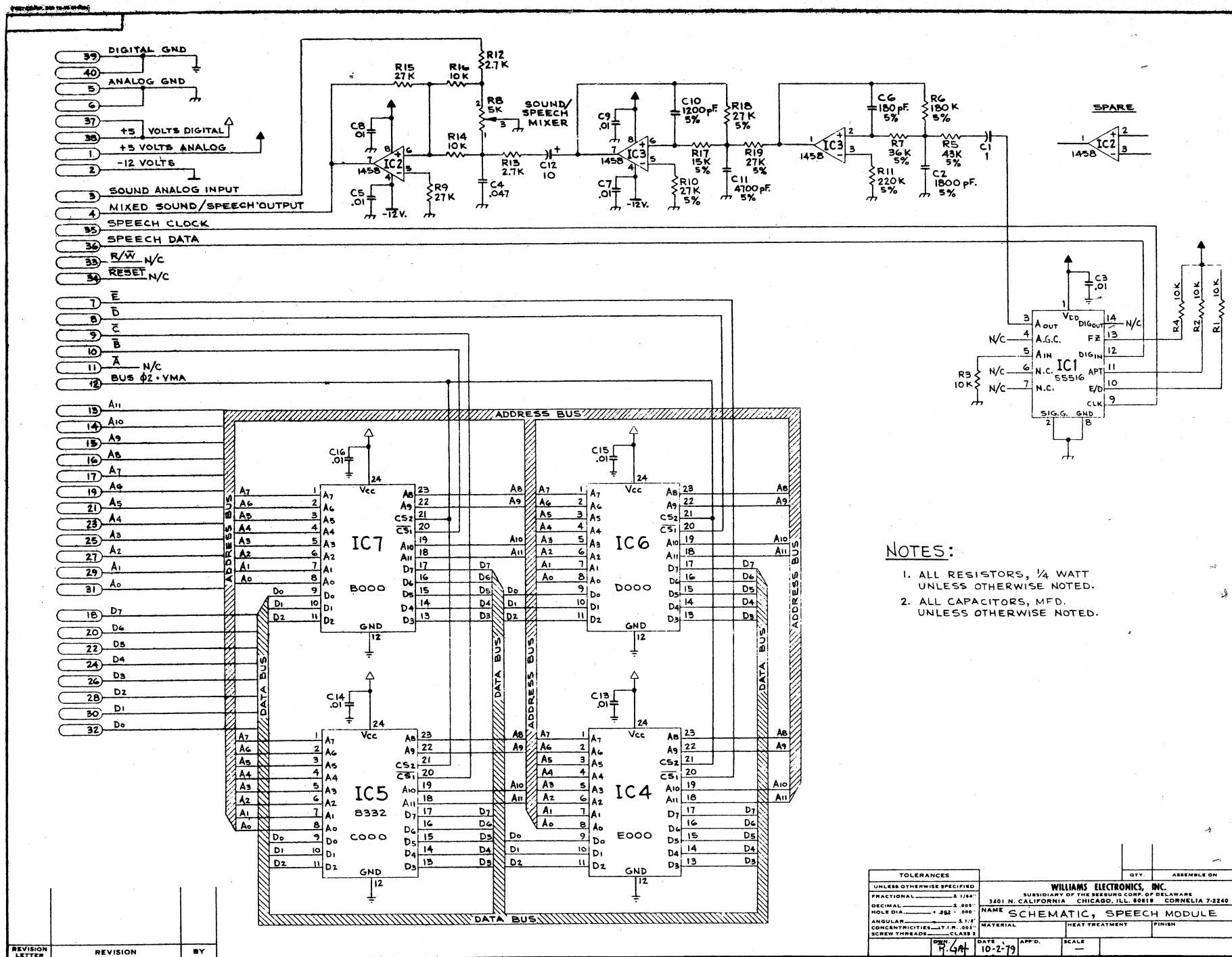
REVISION	REVISION	BY

TOLERANCES		QTY.		ASSEMBLE ON	
UNLESS OTHERWISE SPECIFIED					
FRACTIONAL	± 1/16"	WILLIAMS ELECTRONICS, INC.			
DECIMAL	± .005"	SUBSIDIARY OF THE BEEBORG CORP. OF DELAWARE			
HOLE DIA	± .002" - .004"	3801 N. CALIFORNIA CHICAGO, ILL. 60614 CORNELIA 7-2240			
ANGULAR	± 1/2°	NAME SPEECH MODULE ASSEMBLY			
CONCENTRICITIES	± .003"	MATERIAL			
SCREW THREADS	CLASS 2	HEAT TREATMENT			
FINISH		FINISH			
DWN.	DATE	APPD.	SCALE	C-8225	
R 44	9-28-79		2:1		

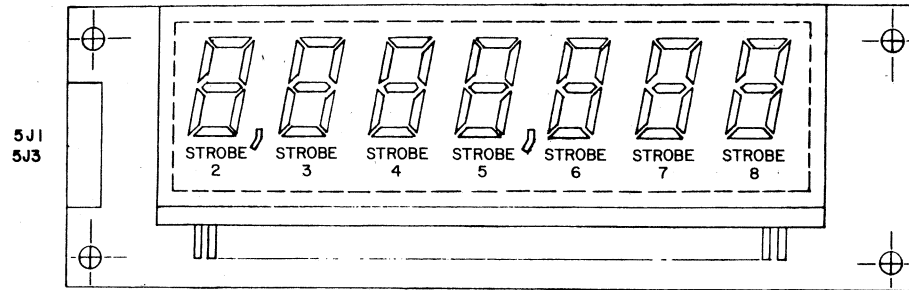
REVISION LETTER	REVISION	BY

TOLERANCES		QTY.	ASSEMBLE ON
UNLESS OTHERWISE SPECIFIED			
FRACTIONAL	2 1/64"		
DECIMAL	.005"		
HOLE DIA.	+.002 - .000"		
ANGULAR	± 1/8°		
CONCENTRICITIES	T.Y.R. .003"		
SCREW THREADS	CLASS 2		
DATE		APPD.	SCALE
9-28-79			2:1
C-8225			

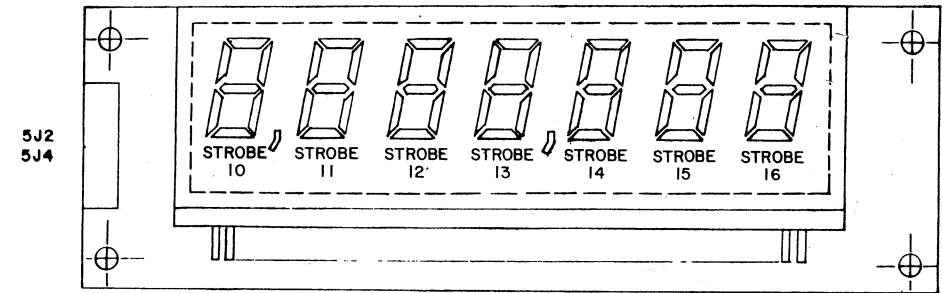




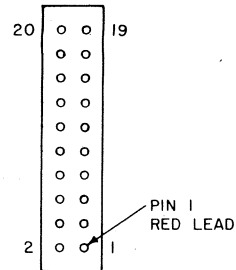
PLAYERS #1 & #3



PLAYERS #2 & #4



DETAIL A
4J1 - 4J4, 4J8
5J1 - 5J5
CONNECTORS



4J1/5J1 (PLAYER 1)
4J3/5J3 (PLAYER 3)

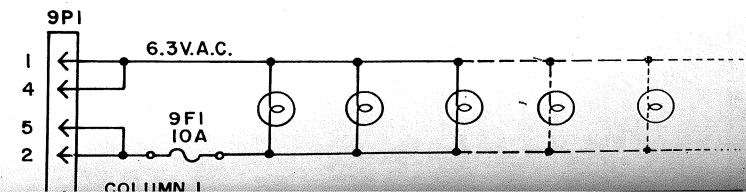
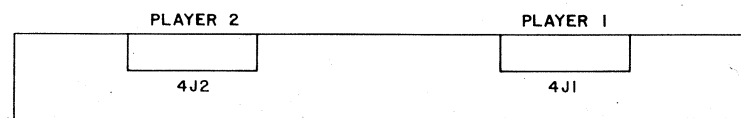
1	100,000's
2	-100V KEEP ALIVE
3	1,000,000's
4	f SEGMENT
5	N/C
6	g SEGMENT
7	+100V (N/C)
8	e SEGMENT
9	10,000's
10	d SEGMENT
11	1,000's
12	+100V KEEP ALIVE
13	100's
14	COMMA
15	10's
16	c SEGMENT
17	N/C
18	b SEGMENT
19	UNITS
20	a SEGMENT

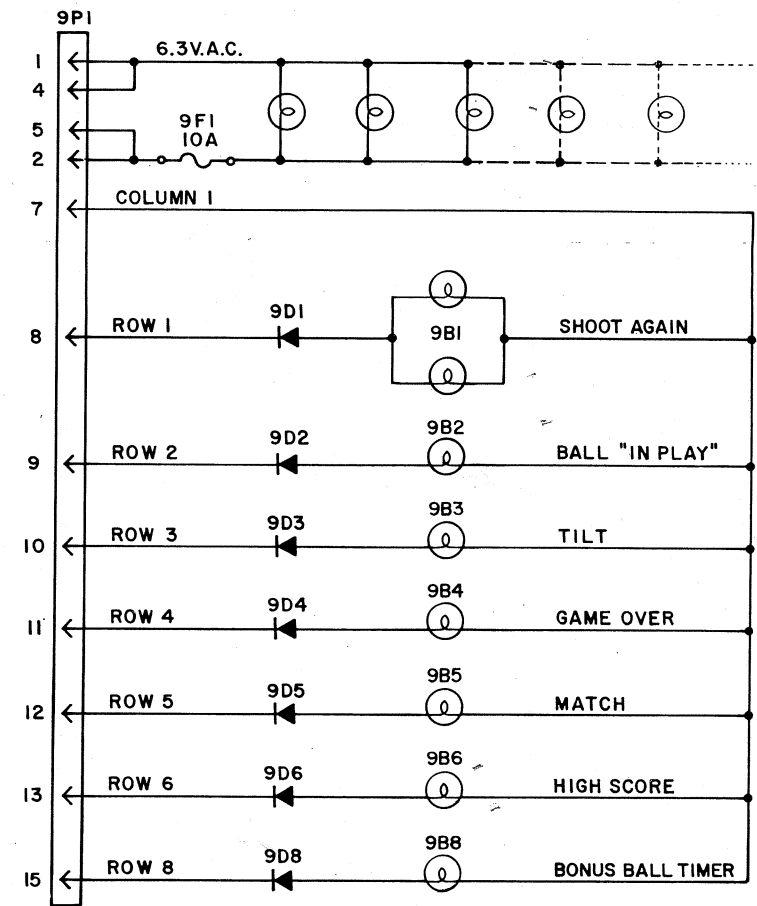
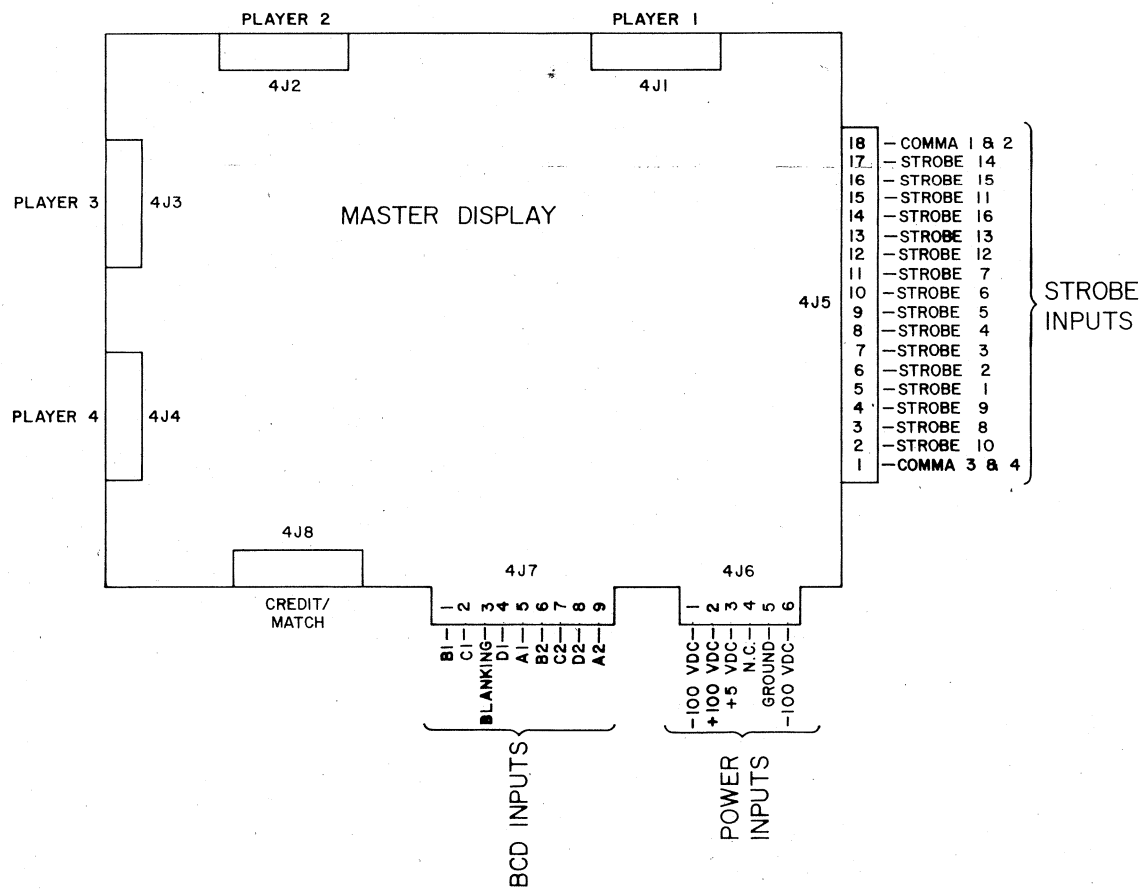
4J2/5J2 (PLAYER 2)
4J4/5J4 (PLAYER 4)

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

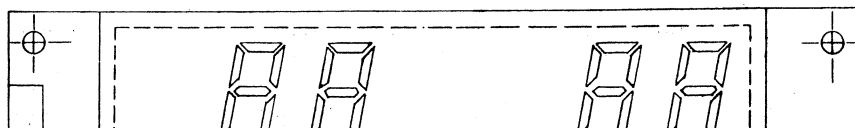
4J8/5J5 (CREDIT/MATCH)

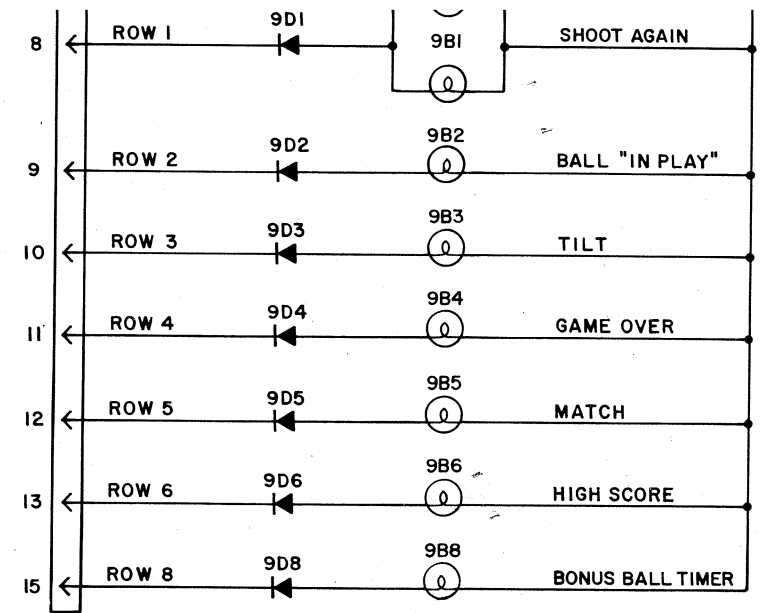
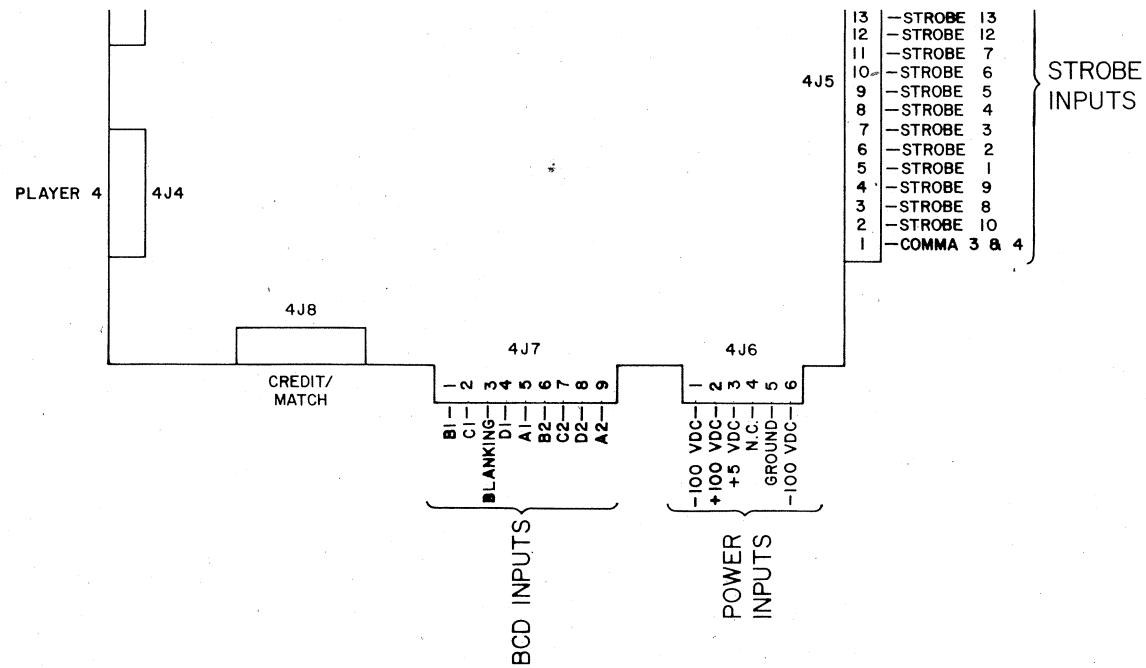
1	f' Segment (Credit)	
2	-100V Keep Alive	
3	e' Segment	Credit
4	g' Segment	
5	c' Segment	
6	d' Segment	
7	b' Segment	
8	10's	
9	Units	
10	a' Segment	Match
11	e Segment	
12	f Segment	
13	10's	
14	d Segment	
15	+100V Keep Alive	
16	c Segment	Match
17	g Segment	
18	b Segment	
19	Units	
20	a Segment	



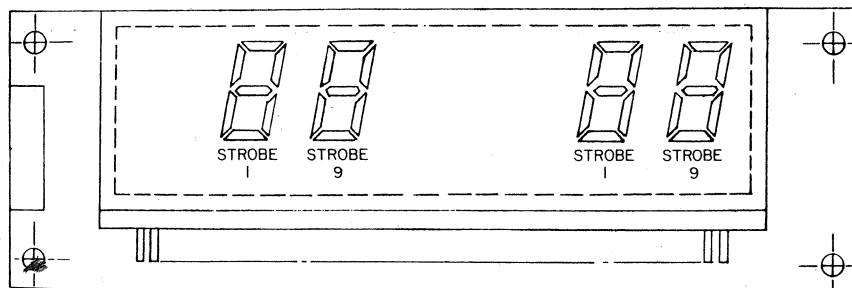


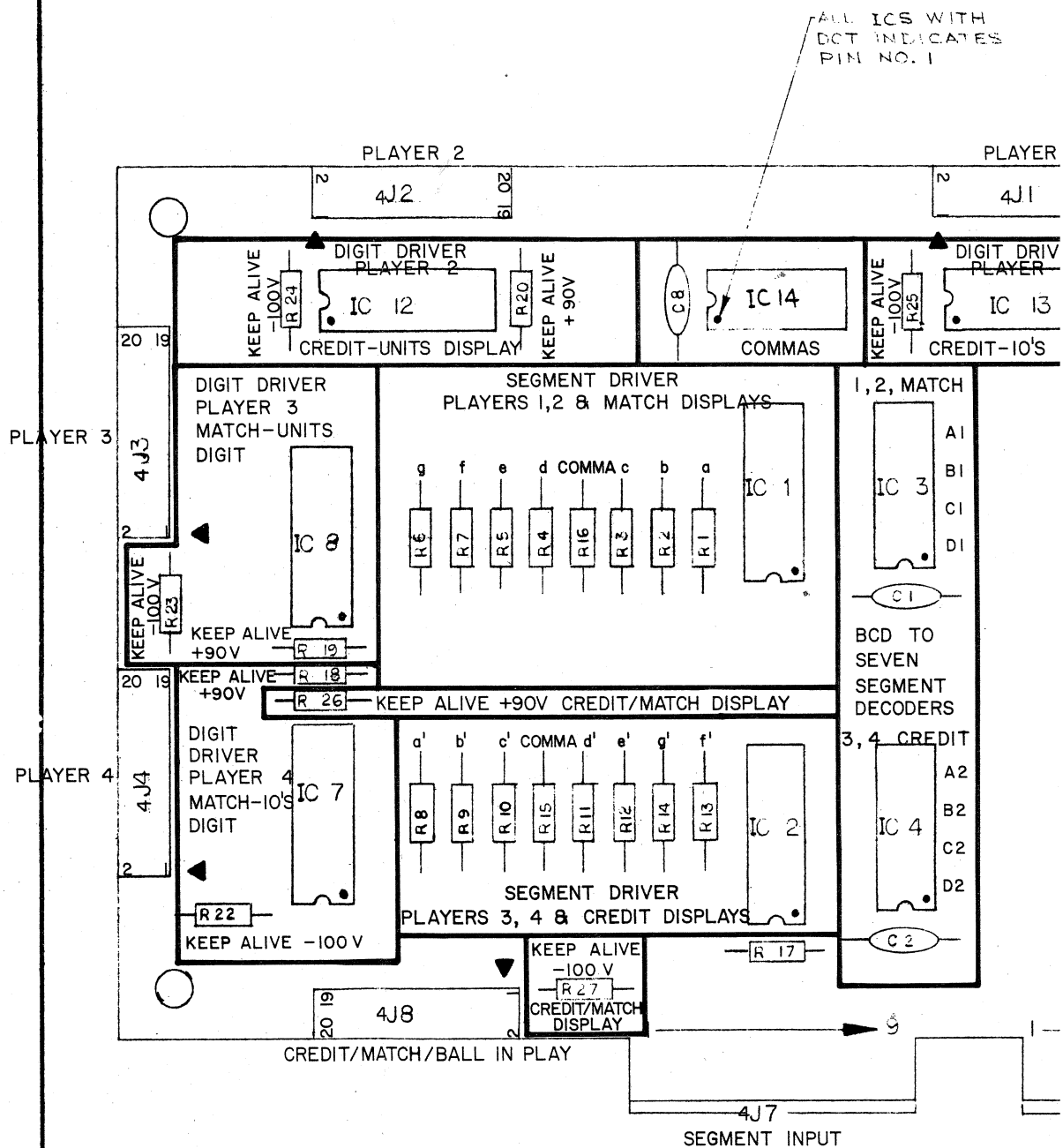
CREDITS / BALL IN PLAY



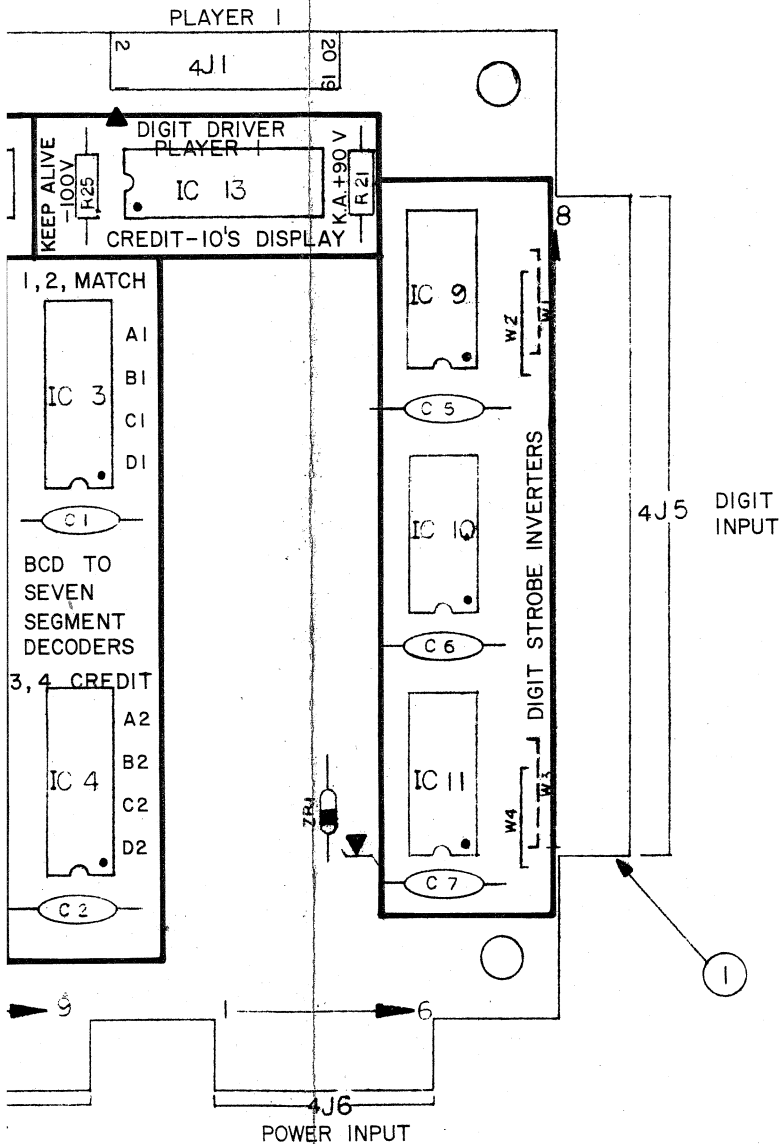


CREDITS / BALL IN PLAY





L IC'S WITH
T INDICATES
IN NO. 1



BILL OF MATERIAL

ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D U.D.
1	IC-2001-152-B		BARE P.C. BOARD	1
2	5A-8971	IC 9, IC 10, IC 11	MC14069 HEX. INVERTER	3
3	5A-8970	IC 3, IC 4	MC14543 BCD TO SEVEN SEGMENT LATCH/DECODER/DRIVER	2
4	5A-8969	IC 1, IC 2	UDN-7180 GAS DISCHARGE DISPLAY SEGMENT DRIVER	2
5	5A-8968	IC 7, IC 8, IC 12, IC 13	UDN-6184A OR UDN-6118A GAS DISCHARGE DISPLAY SEGMENT DR.	4
6		IC 14	MC14081 QUAD 2-INPUT AND GATE	1
7	5B-8981	R1-R14	RESISTOR, FC, 10K OHM, 10% 1/2 WATT	14
8	5A-9135	ZR1	IN4740A ZENER DIODE 10V, 5% 1W	1
9	5A-8980	C1, C2, C5 THRU C8	CAPACITOR CERAMIC, 01 MFD, 50V	6
10		W2, W4	JUMPER #22 GA SOLID WIRE	2
11	5A-9086	R17	RESISTOR, FC, 6.8K OHM 10% 1/4 WATT	1
12	5B-8982	R18 THRU R27	RESISTOR, FC, 3 MEG. OHM 10% 1/4 WATT	10
13		J8, J1 THRU J4	20 PIN RIBBON HEADER	5
14		R15, R16	RESISTOR, 15K OHM, 10% 1/2 WATT	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	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)

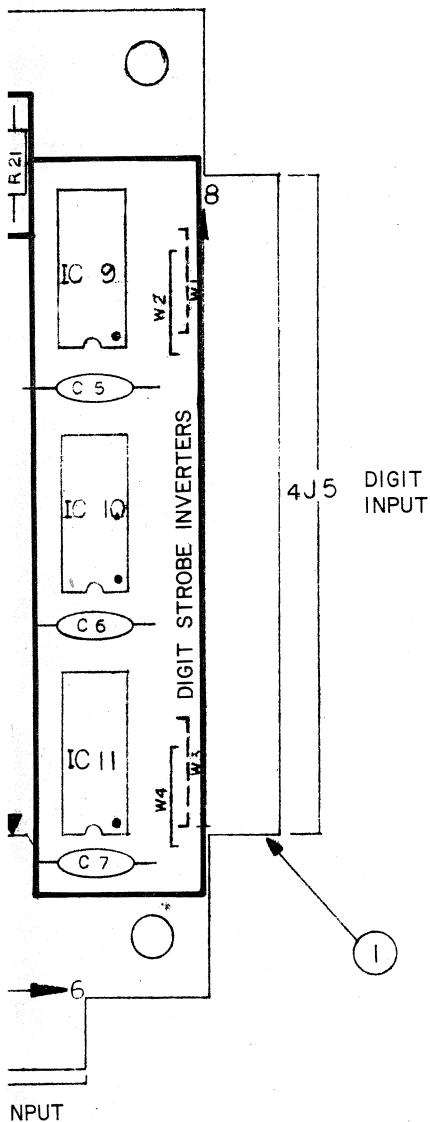
TOLERANCES		QTY.		ASSEMBLE ON	
UNLESS OTHERWISE SPECIFIED					
FRACTIONAL		± 1/64"			
DECIMAL		± .005"			
HOLE DIA.		+ .002 - .000"			
ANGULAR		± 1/2°			
CONCENTRICITIES		T.I.R. .003"			
SCREW THREADS		CLASS 2			
WILLIAMS ELECTRONICS, INC.					
SUBSIDIARY OF THE SEEBURG CORP. OF DELAWARE					
3401 N. CALIFORNIA CHICAGO, ILL. 60618 CORNELIA 7-2240					
NAME MASTER DISPLAY BOARD ASSEMBLY					
MATERIAL		HEAT TREATMENT		FINISH	
DWN.	DATE	APP'D.	SCALE		
G.H.	5-23-80		2:1	5990	

BILL OF MATERIAL

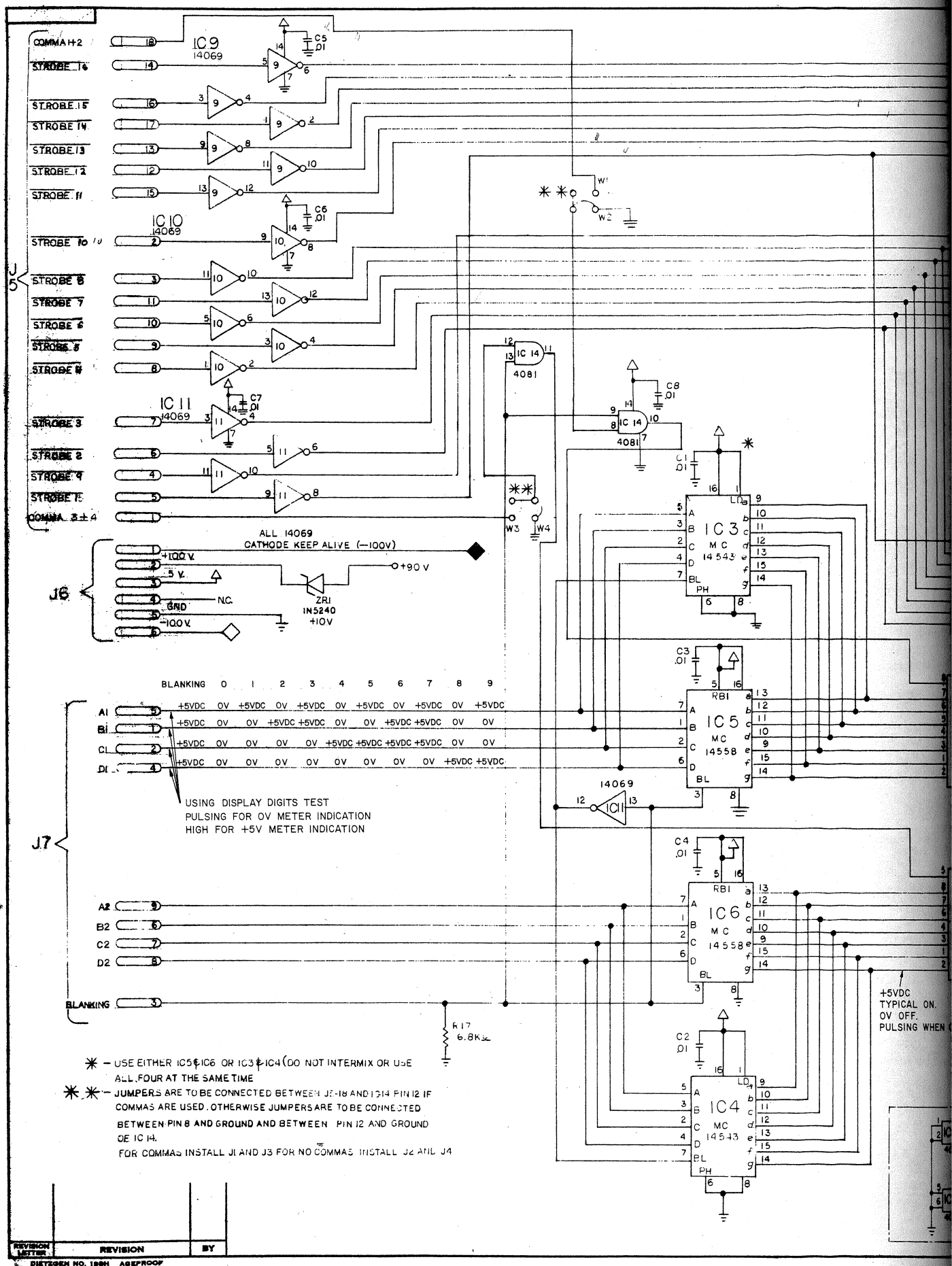
ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D QTY.
1	IC-2001-152-B		BARE P.C. BOARD	1
2	5A-8971	IC9, IC10, IC11	MC14069 HEX. INVERTER	3
3	5A-8970	IC3, IC4	MC14543 BCD TO SEVEN SEGMENT LATCH/DECODER/DRIVER	2
4	5A-8969	IC1, IC2	UDN-7180 GAS DISCHARGE DISPLAY SEGMENT DRIVER	2
5	5A-8968	IC7, IC8, IC12, IC13	UDN-6184A OR UDN-6118A GAS DISCHARGE DISPLAY SEGMENT DR.	4
6		IC14	MC14081 QUAD 2-INPUT AND GATE	1
7	5B-8981	R1-R14	RESISTOR, FC, 10K OHM, 10% 1/2 WATT	14
8	5A-9135	2R1	IN4740A ZENER DIODE 10V, 5% 1W	1
9	5A-8980	C1, C2, C5 THRU C8	CAPACITOR CERAMIC, 01 MFD. 50V	6
10		W2, W4	JUMPER #22 GA SOLID WIRE	2
11	5A-9086	R17	RESISTOR, FC, 6.8K OHM 10% 1/4 WATT	1
12	5B-8982	R18 THRU R27	RESISTOR, FC, 3 MEG. OHM 10% 1/4 WATT	10
13		J8, J1 THRU J4	20 PIN RIBBON HEADER	5
14		R15, R16	RESISTOR, 15K OHM, 10% 1/2 WATT	2

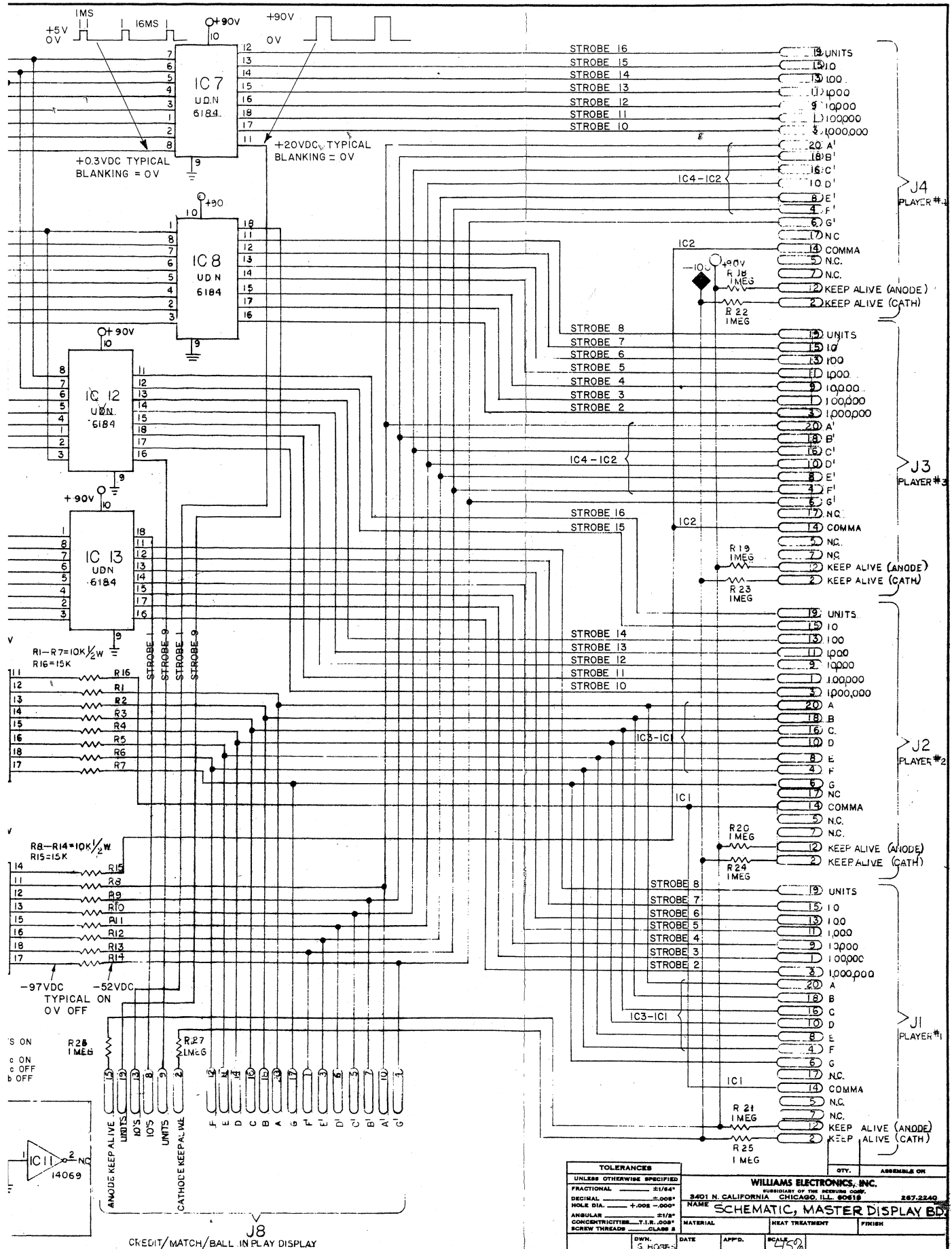
DIGIT CROSS REFERENCE

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	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)

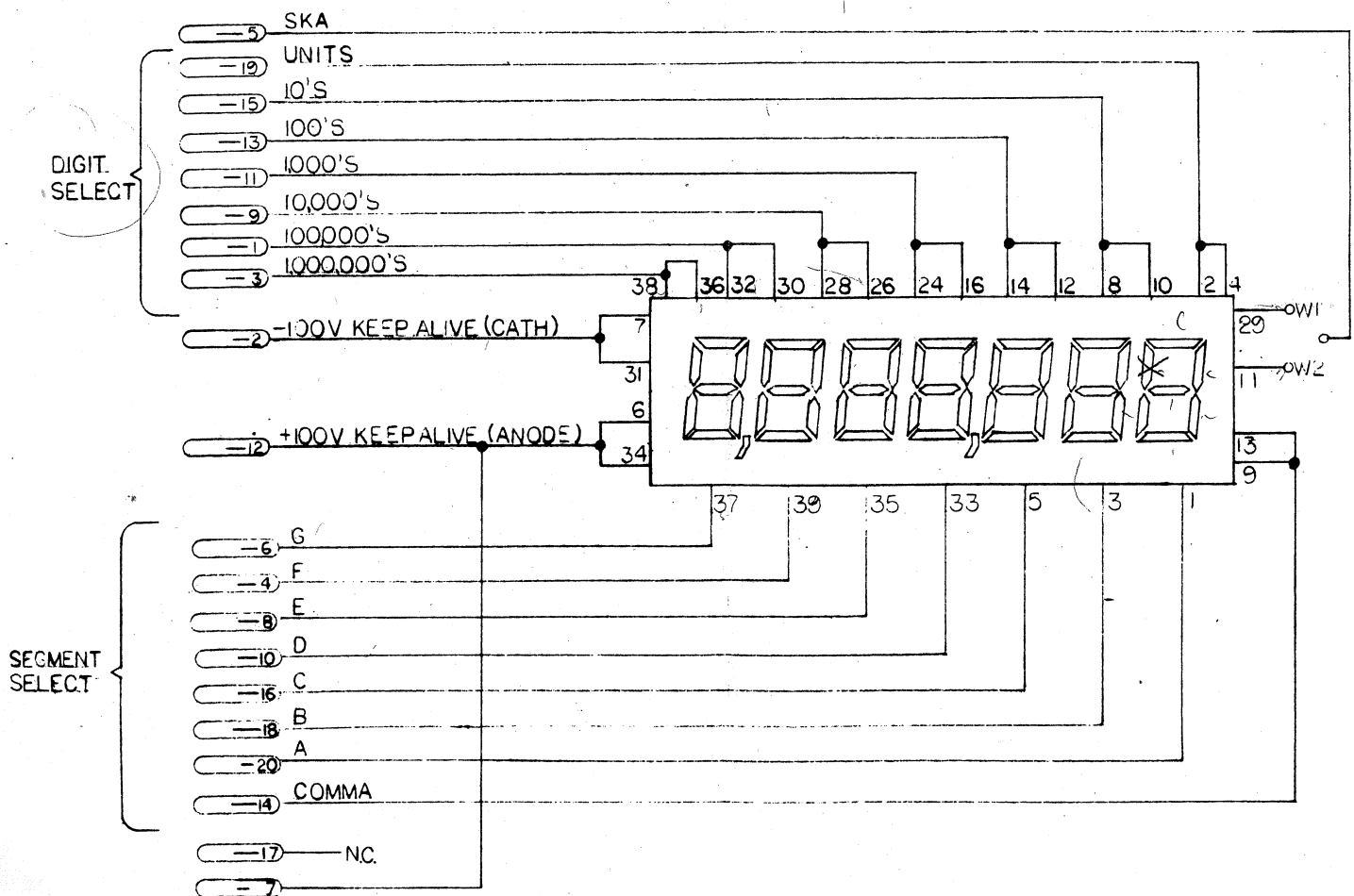
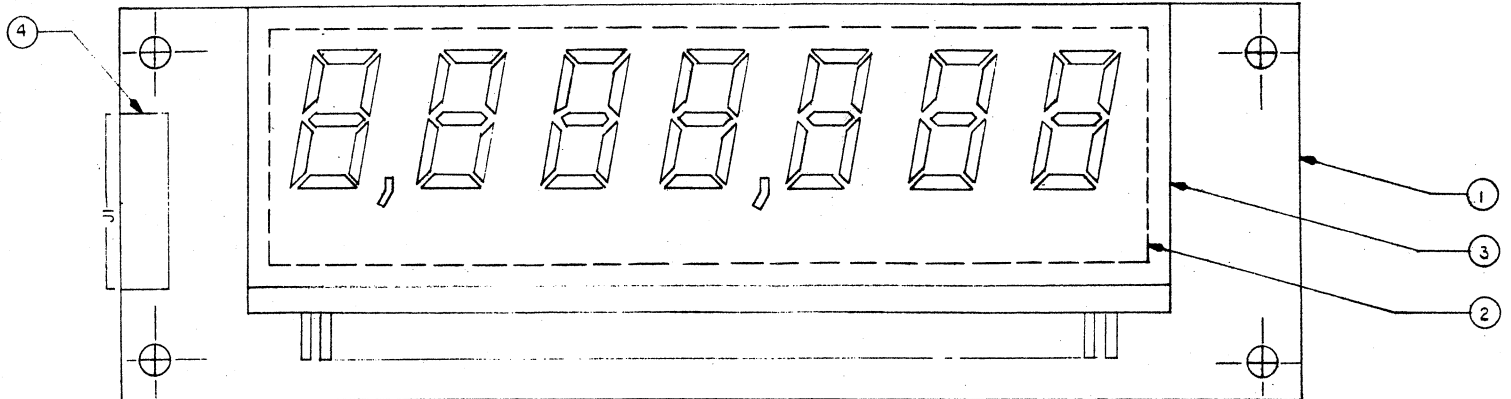


TOLERANCES		QTY.		ASSEMBLY ON	
UNLESS OTHERWISE SPECIFIED					
FRACTIONAL $\pm 1/64"$					
DECIMAL $\pm .005"$					
HOLE DIA. $\pm .002 - .006"$					
ANGULAR $\pm 1/2^\circ$					
CONCENTRICITIES T.I.R. .003"					
SCREW THREADS CLASS 2					
WILLIAMS ELECTRONICS, INC. SUBSIDIARY OF THE SEEBURG CORP. OF DELAWARE 3401 N. CALIFORNIA CHICAGO, ILL. 60618 CORNELIA 7-2240					
NAME MASTER DISPLAY BOARD ASSEMBLY					
MATERIAL		HEAT TREATMENT		FINISH	
OWN.	DATE	APP'D.	SCALE		
G.H.	5-23-80		2:1	5492	



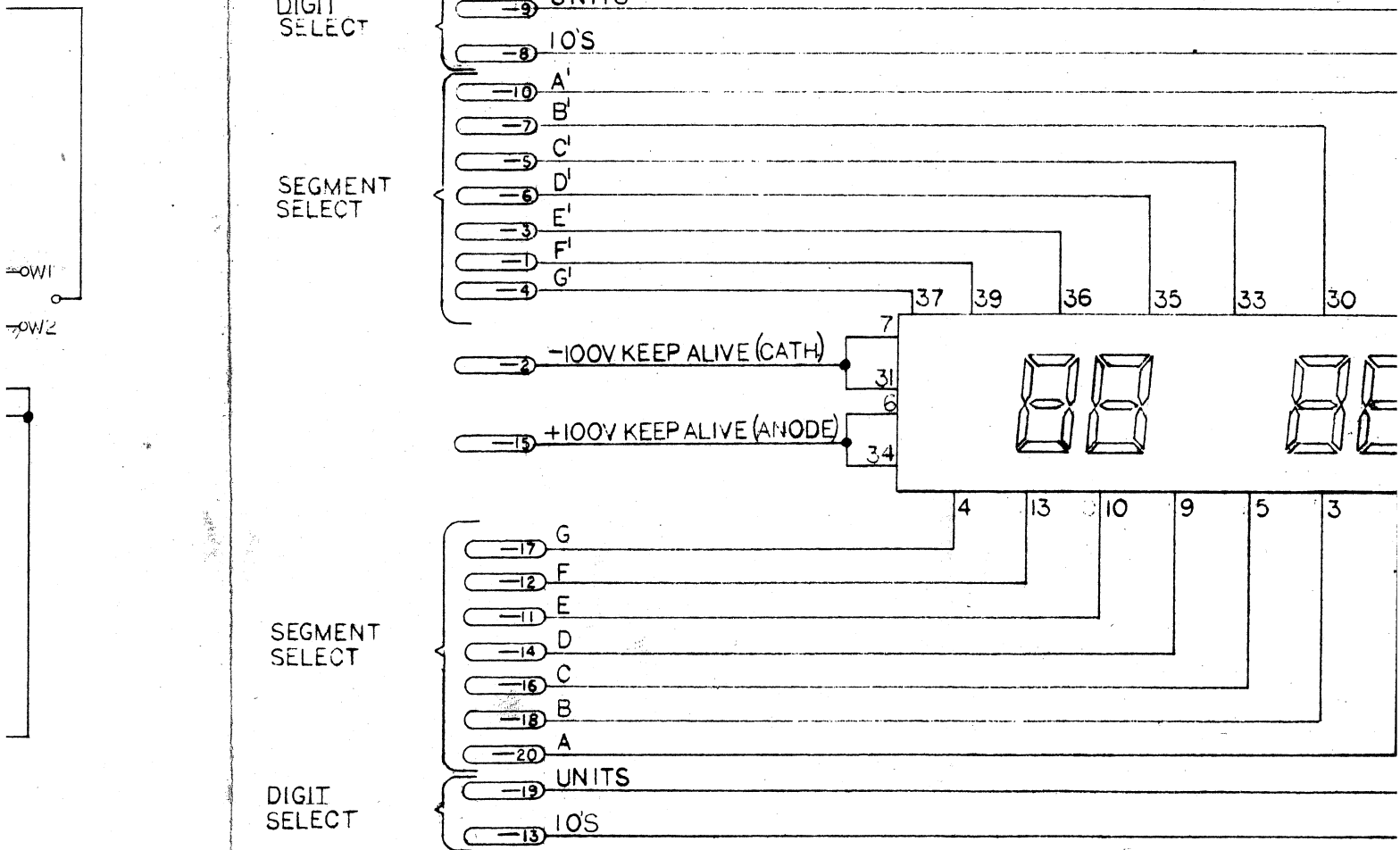
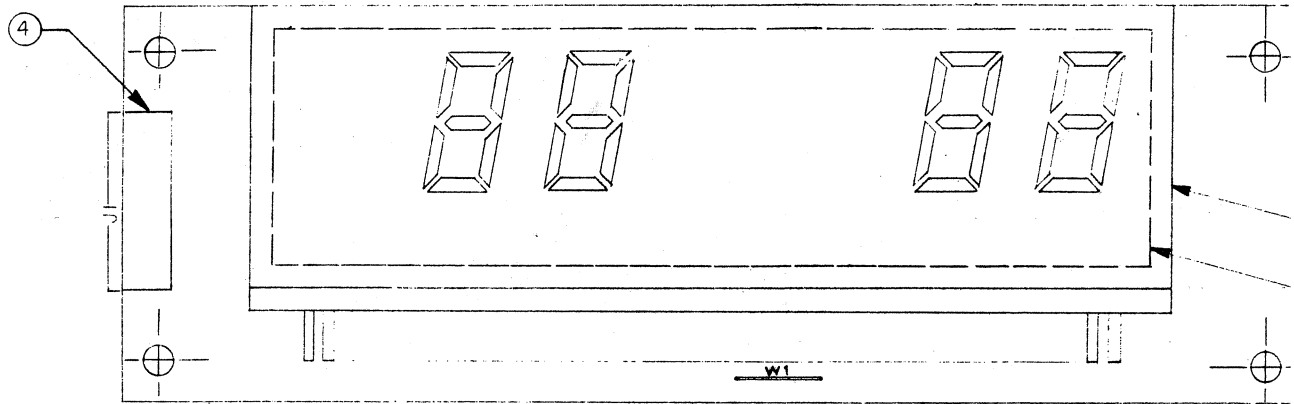


BILL OF MATERIAL				
ITEM	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D.
1	IC-2001-153-A		SLAVE DISPLAY P.C. BOARD	1
2	23A-6534		DISPLAY MTG ADHESIVE FOAM	1
3			7 DIGIT DISPLAY	1
4		J1	20 PIN RIBBON HEADER	1



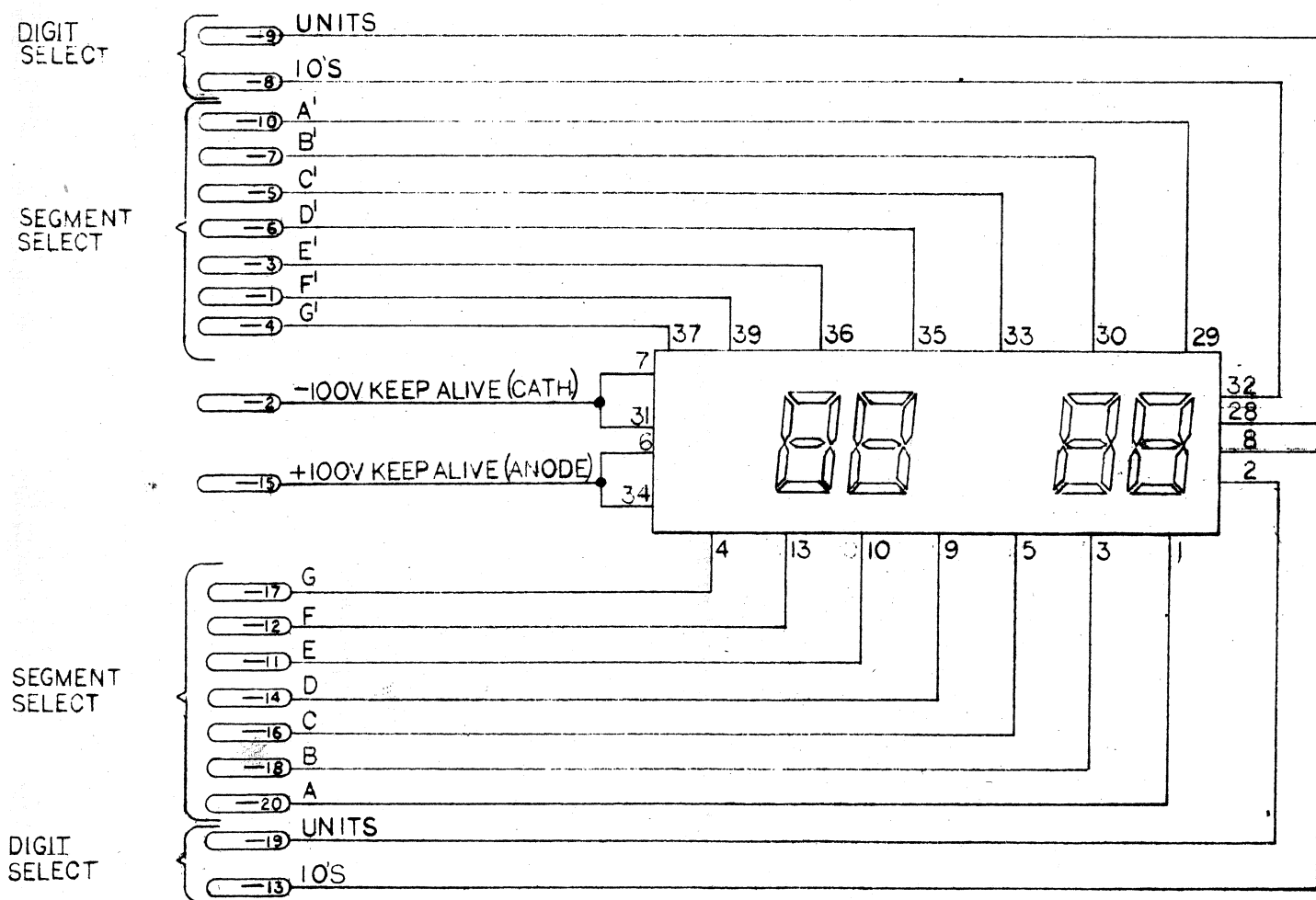
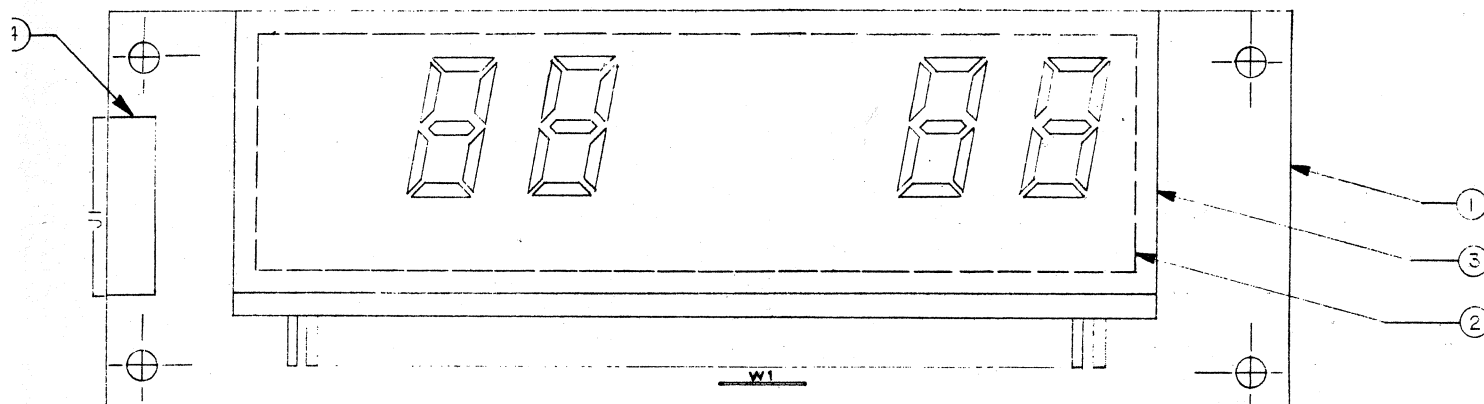
C 8364 PLAYER SLAVE DISPLAY

BILL OF MATERIAL				
ITEM	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D
1	IC-2001-154-A		CREDIT/MATCH SLAVE FC. BOARD	1
2	43A-6534		DISPLAY MTG ADHESIVE FOAM	1
3			4 DIGIT DISPLAY	1
4		J1	20 PIN RIBBON HEADER	1
5		W1	JUMPER #20 GA SOLID WIRE	1

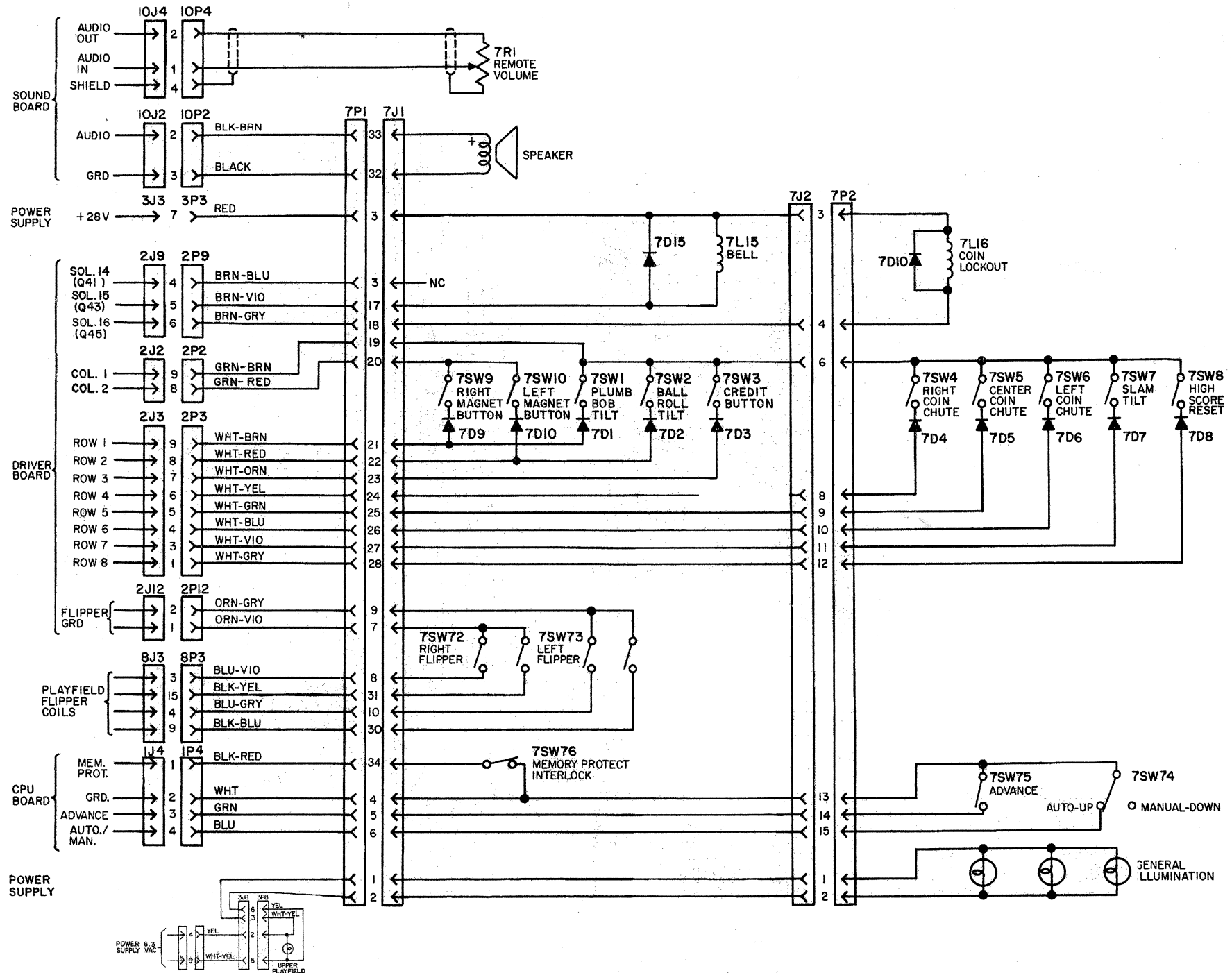


C 8365 CREDIT/MATCH SLAVE DISPLAY

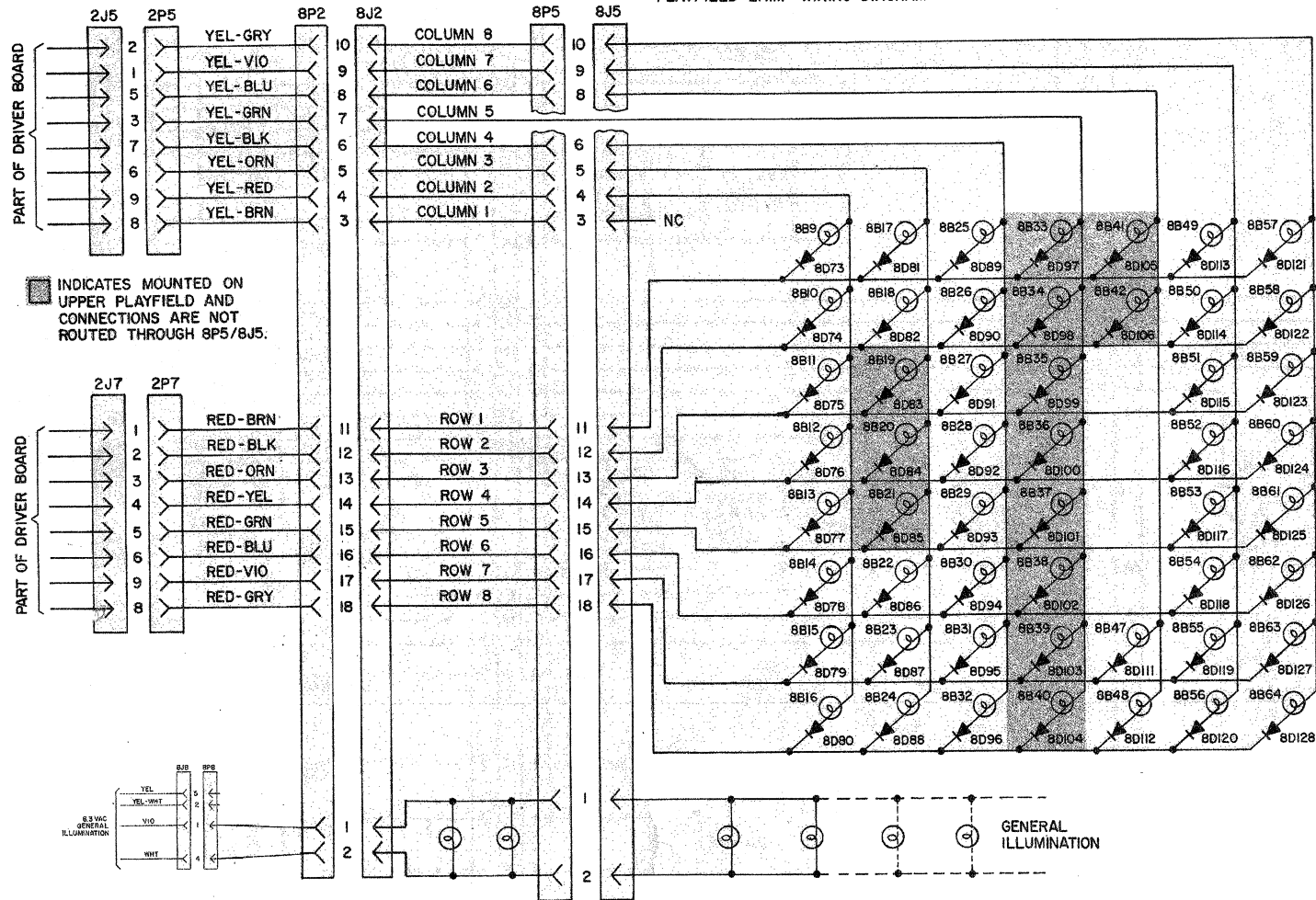
BILL OF MATERIAL				
ITEM	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D
1	IC-2001-154-A		CREDIT/MATCH SLAVE PC BOARD	1
2	23A-6534		DISPLAY MTG ADHESIVE FOAM	1
3			4 DIGIT DISPLAY	1
4		J1	20 PIN RIBBON HEADER	1
5		W1	JUMPER #20 GA SOLID WIRE	1



C 8365 CREDIT/MATCH SLAVE DISPLAY

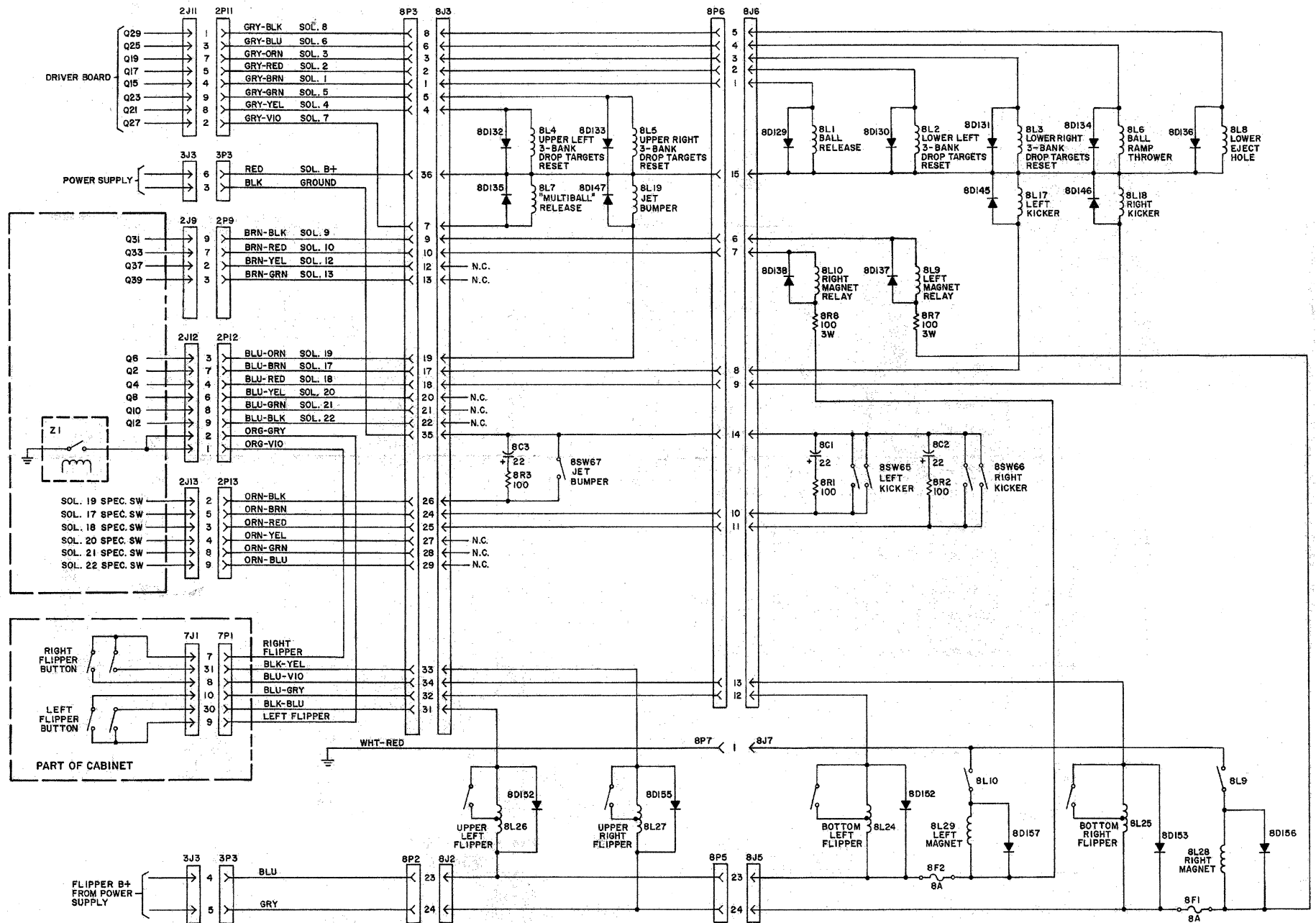


BLACK KNIGHT PLAYFIELD LAMP WIRING DIAGRAM

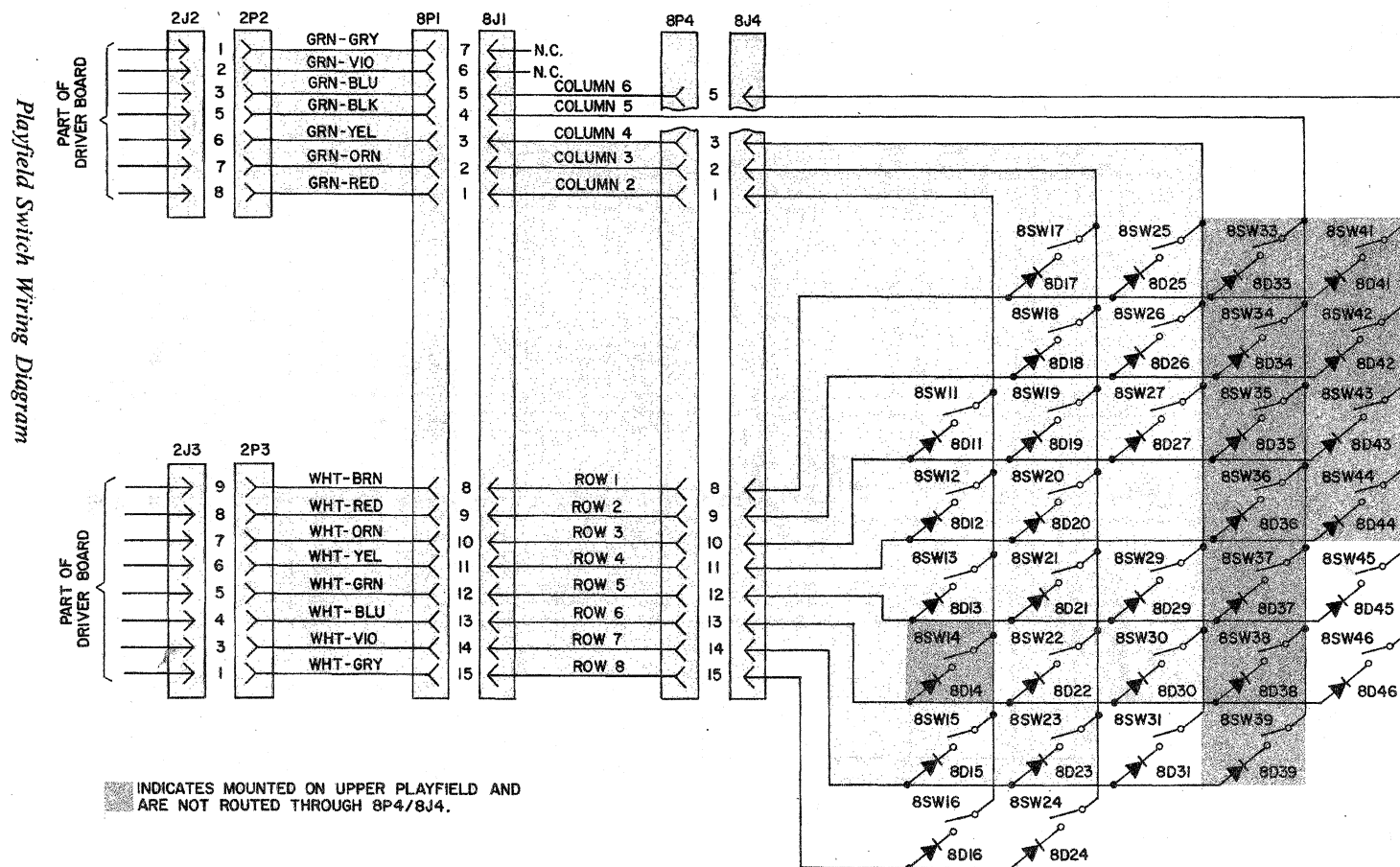


Bulb No.	Function
01	Same Player Shoots Again (Backbox)
02	Ball in Play
03	Tilt
04	Game Over
05	Match
06	High Score to Date
07	Credits (Playfield)
08	Bonus Ball Timer
09	Right <i>Magna-Save</i>
10	Left <i>Magna-Save</i>
11	Left Outlane
12	Right Outlane
13	Right Spinner
14	Ramp Rollover
15	Right Inside Rollover
16	Left Inside Rollover
17	Bottom Left 3-Bank Lamp
18	Bottom Right 3-Bank Lamp
19	Top Left 3-Bank Lamp
20	Top Right 3-Bank Lamp
21	Center Lock Lamp
22	Turnaround Extra Ball When Lit
23	Turnaround Special
24	Lower Playfield Eject Hole
25	Bottom Left 3-Bank, Lower Arrow
26	Bottom Left 3-Bank, Center Arrow
27	Bottom Left 3-Bank, Upper Arrow
28	3X Scoring
29	Bottom Right 3-Bank, Right Arrow
30	Bottom Right 3-Bank, Center Arrow
31	Bottom Right 3-Bank, Left Arrow
32	3X Scoring
33	Top Left 3-Bank, Lower Arrow
34	Top Left 3-Bank, Center Arrow
35	Top Left 3-Bank, Upper Arrow
36	Jet Bumper
37	Top Right 3-Bank, Lower Arrow
38	Top Right 3-Bank, Center Arrow
39	Top Right 3-Bank, Upper Arrow
40	Right Lock Lamp
41	Left Ramp Rollover Extra Ball When Lit
42	Left Lock Lamp
43	Not Used
44	Not Used
45	Not Used
46	Not Used
47	Same Player Shoots Again (Playfield)
48	"1" Bonus
49	"2" Bonus
50	"3" Bonus
51	"4" Bonus
52	"5" Bonus
53	"6" Bonus
54	"7" Bonus
55	"8" Bonus
56	"9" Bonus
57	"10" Bonus
58	"20" Bonus
59	"30" Bonus
60	"40" Bonus
61	2x
62	3x
63	4x
64	5x

Playfield Solenoid Wiring Diagram



BLACK KNIGHT PLAYFIELD SWITCH WIRING DIAGRAM



Switch

No. Function (Score)

- 09 Right Magnet Button
- 10 Left Magnet Button
- 11 Left Outlane (5,000)
- 12 Right Outlane (5,000)
- 13 Spinner (100/2,500*)
- 14 Right Ramp Rollunder (500/Mystery)
- 15 Right Inside Rollover (2,000/10,000**)
- 16 Left Inside Rollover (2,000/10,000**)
- 17 Right Ball Ramp
- 18 Center Ball Ramp
- 19 Left Ball Ramp
- 20 Outhole
- 21 Left Kicker (10)
- 22 Right Kicker (10)
- 23 Turnaround (5,000)
- 24 Lower Playfield Eject Hole (5,000)
- 25 Lower Left 3-Bank, Lower Target (1,000)
- 26 Lower Left 3-Bank, Center Target (1,000)
- 27 Lower Left 3-Bank, Upper Target (1,000)
- 28 Lower Left 3-Bank, Standup (10)
- 29 Lower Right 3-Bank, Right Target (1,000)
- 30 Lower Right 3-Bank, Center Target (1,000)
- 31 Lower Right 3-Bank, Left Target (1,000)
- 32 Lower Right 3-Bank, Standup (10)
- 33 Top Left 3-Bank, Lower Target (1,000)
- 34 Top Left 3-Bank, Center Target (1,000)
- 35 Top Left 3-Bank, Upper Target (1,000)
- 36 Jet Bumper (500)
- 37 Top Right 3-Bank, Lower Target (1,000)
- 38 Top Right 3-Bank, Center Target (1,000)
- 39 Top Right 3-Bank, Upper Target (1,000)
- 40 Top Right 3-Bank, Standup (10)
- 41 Lockup Trough, Bottom (5,000†)
- 42 Lockup Trough, Center (5,000†)
- 43 Lockup Trough, Top (5,000†)
- 44 Left Ramp Rollover (5,000)
- 45 Ballshooter Trough
- 46 Playfield Tilt

Note: Second value is lit or flashing value

* Spinner lit for interval after making right inside rollover

Mystery is 20,000 - 99,000 and lit for interval after making left inside rollover

** Inside rollovers light when made after using *Magna-Save* feature

† Only one lockup trough switch scores for each locked-up ball

COLUMN ROW	1 YEL-BRN 2J5-8	2 YEL-RED 2J5-9	3 YEL-ORN 2J5-6	4 YEL-BLK 2J5-7	5 YEL-GRN 2J5-3	6 YEL-BLU 2J5-5	7 YEL-VIO 2J5-1	8 YEL-GRY 2J5-2
1 RED-BRN 2J7-1	SAME PLAYER SHOOTS AGAIN	RIGHT MAGNA- SAVE™ LAMP	BOTTOM LEFT 3-BANK LAMP	BOTTOM LEFT 3-BANK, LOWER ARROW	TOP LEFT 3-BANK LOWER ARROW	LEFT RAMP ROLLUNDER EXTRA BALL WHEN LIT	"2" BONUS	"10" BONUS
2 RED-BLK 2J7-2	BALL IN PLAY	LEFT MAGNA- SAVE™ LAMP	BOTTOM RIGHT 3-BANK LAMP	BOTTOM LEFT 3-BANK CENTER ARROW	TOP LEFT 3-BANK CENTER ARROW	LEFT LOCK LAMP	"3" BONUS	"20" BONUS
3 RED-ORN 2J7-3	TILT	LEFT OUTLANE	TOP LEFT 3-BANK LAMP	BOTTOM LEFT 3-BANK UPPER ARROW	TOP LEFT 3-BANK UPPER ARROW	NOT USED	"4" BONUS	"30" BONUS
4 RED-YEL 2J7-4	GAME OVER	RIGHT OUTLANE	TOP RIGHT 3-BANK LAMP	2X SCORING	JET BUMPER	NOT USED	"5" BONUS	"40" BONUS
5 RED-GRN 2J7-5	MATCH	RIGHT SPINNER	CENTER LOCK LAMP	BOTTOM RIGHT 3-BANK, RIGHT ARROW	TOP RIGHT 3-BANK LOWER ARROW	NOT USED	"6" BONUS	2x
6 RED-BLU 2J7-6	HIGH SCORE TO DATE	RAMP ROLLUNDER	TURNAROUND EXTRA BALL WHEN LIT	BOTTOM RIGHT 3-BANK, CENTER ARROW	TOP RIGHT 3-BANK CENTER ARROW	NOT USED	"7" BONUS	3x
7 RED-VIO 2J7-9	CREDITS (PLAY- FIELD)	RIGHT INSIDE ROLLOVER	TURNAROUND SPECIAL	BOTTOM RIGHT 3-BANK, LEFT ARROW	TOP RIGHT 3-BANK UPPER ARROW	SAME PLAYER SHOOTS AGAIN (PLAYFIELD)	"8" BONUS	4x
8 RED-GRY 2J7-8	BONUS BALL TIME	LEFT INSIDE ROLLOVER	LOWER PLAYFIELD EJECT HOLE	3X SCORING	RIGHT LOCK LAMP	"1" BONUS	"9" BONUS	5x

Lamp Matrix

COLUMN ROW	1 GRN-BRN 2J2-9	2 GRN-RED 2J2-8	3 GRN-ORN 2J2-7	4 GRN-YEL 2J2-6	5 GRN-BLK 2J2-5	6 GRN-BLU 2J2-3	7 GRN-VIO 2J2-2	8 GRN-GRY 2J2-1
1 WHT-BRN 2J3-9	PLUMB BOB TILT 1	RIGHT MAGNET BUTTON 9	RIGHT BALL RAMP 17	LOWER LEFT 3-BANK LOWER TARGET 25	TOP LEFT 3-BANK LOWER TARGET 33	LOCKUP TROUGH, BOTTOM 41	NOT USED 49	NOT USED 57
2 WHT-RED 2J3-8	BALL ROLL TILT 2	LEFT MAGNET BUTTON 10	CENTER BALL RAMP TARGET 18	LOWER LEFT 3-BANK, CENTER TARGET 26	TOP LEFT 3-BANK CENTER TARGET 34	LOCKUP TROUGH, CENTER 42	NOT USED 50	NOT USED 58
3 WHT-ORN 2J3-7	CREDIT BUTTON 3	LEFT OUTLANE 11	LEFT BALL RAMP 19	LOWER LEFT 3-BANK, UPPER TARGET 27	TOP LEFT 3-BANK UPPER TARGET 35	LOCKUP TROUGH, TOP 43	NOT USED 51	NOT USED 59
4 WHT-YEL 2J3-6	RIGHT COIN SWITCH 4	RIGHT OUTLANE 12	OUTHOLE 20	NOT USED STANDUP 28	JET BUMPER 36	LEFT RAMP ROLLOVER 44	NOT USED 52	NOT USED 60
5 WHT-GRN 2J3-5	CENTER COIN SWITCH 5	LEFT SPINNER 13	LOWER KICKER 3-BANK, LEFT TARGET 21	LOWER RIGHT 3-BANK RIGHT TARGET 29	TOP RIGHT 3-BANK LOWER TARGET 37	BALLSHOOTER TROUGH 45	NOT USED 53	NOT USED 61
6 WHT-BLU 2J3-4	LEFT COIN SWITCH 6	RIGHT RAMP ROLLUNDER 14	RIGHT KICKER 22	LOWER RIGHT 3-BANK, CENTER TARGET 30	TOP RIGHT 3-BANK CENTER TARGET 38	PLAYFIELD TILT 46	NOT USED 54	NOT USED 62
7 WHT-VIO 2J3-3	SLAM TILT 7	RIGHT INSIDE ROLLOVER 15	TURNAROUND 23	LOWER RIGHT 3-BANK, LEFT TARGET 31	TOP RIGHT 3-BANK UPPER TARGET 39	NOT USED 47	NOT USED 55	NOT USED 63
8 WHT-GRY 2J3-1	HIGH SCORE RESET 8	LEFT INSIDE ROLLOVER 16	LOWER PLAYFIELD EJECT HOLE 24	NOT USED STANDUP 32	NOT USED STANDUP 40	NOT USED 48	NOT USED 56	NOT USED 64

Switch Matrix

WARNINGS & NOTICES

WARNING

FOR SAFETY AND RELIABILITY, substitute parts and equipment modifications are not recommended.

USE OF NON-BALLY PARTS or circuit modifications may cause injuries or equipment damage.

SUBSTITUTE PARTS OR MODIFICATIONS may void FCC Type Acceptance.

THIS GAME IS PROTECTED by Federal copyright, trademark and patent laws. Unauthorized software or hardware modifications may be illegal under Federal law.

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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. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. 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.

WARNING

Transport this game **ONLY** with hinged backbox down!

WARNING

FCC STICKER. Check the back of your game for an FCC sticker. When *BALLY* ships a game, the game has been found to comply with FCC Rules. The sticker is proof. If the sticker is missing, legal repercussions to the owner and distributor of the game may result. If your game (manufactured after December 1982) has no FCC sticker, call *BALLY* for advice. Or write us a note on your game-registration card. Be sure the card bears your game's serial number.

WARNING

THREE-WIRE PLUG. Prevent shock hazard and assure proper game operation! Only plug this game into a properly grounded outlet. **DO NOT** use a "cheater" plug to defeat the power cord's ground pin. **DO NOT** cut off the ground pin.

RF-INTERFERENCE NOTICE

YOUR GAME'S CABLE-HARNESS PLACEMENT and ground-strap routing are very important. They are designed to keep RF radiation and conduction within levels accepted by FCC Regulations.

MAINTAIN THESE LEVELS. Servicing may require that you disconnect harnesses or ground straps. When you're finished, reposition and reconnect them as they were.

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