

Williams[®]

16P-517-101
Game No. 517
November, 1982

DEFENDER

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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, W20, 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

Must be equipped with zero-ohm resistors or wire jumpers (W9-W16) in place of switch matrix drive series resistors R204-R211.

Sound Board

Must be jumpered for ROM operation and be equipped with Sound ROM 15. (Jumpers W2, W5, W7, W9, W10, W12, and W15 connected; W3, W4, W6, W11, and W13 removed).

Power Supply Board

1. Model D 8345 board required (equipped with relay).
2. Fuse F4 (10A SB) for flipper solenoids must be installed.

Display Boards

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

CONTENTS

Assembly and Interconnection	3/4
Inspection	3/4
Power Turn-On	5/6
Backbox Wiring Diagram	7
CPU Board Assembly Drawing	8
CPU Board Logic Diagram	9
Driver Board Assembly Drawing	10
Driver Board Logic Diagram (Sheet 1 of 2)	11
Driver Board Logic Diagram (Sheet 2 of 2)	13
Power Supply Assembly and Schematic Diagrams	14
Power Wiring Diagram	15
Sound Board Assembly Drawing	16
Sound Board Logic Diagram	17/18
Insert Board Wiring Diagram	19
C 8363 Master Display Board Assembly Drawing	20
C 8363 Master Display Board Logic Diagram	21
C 8364 and C 8365 Slave Display Boards Assembly and Schematic Diagrams	22
Cabinet Wiring Diagram	23
Playfield Lamp Wiring Diagram	24
Playfield Solenoid Wiring Diagram	25
Playfield Switch Wiring Diagram	26

Installation

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. Position backbox face-down on top of cabinet with neck opening facing rear of cabinet.
7. Pull five cable connectors from backbox.
8. Reach into pedestal hole of cabinet, pull up ground strap braid wire, and push it into backbox.
9. Remove ties securing cabinet and playfield cables to cabinet and pull these cables up through pedestal hole.
10. Interconnect cabinet and playfield cables with those of backbox. All are shape, size and color-coded:
 - General Illumination Connector: 6-Pin WHITE
 - Switch Connector: 15-Pin WHITE
 - Lamp Connector: 24-Pin WHITE
 - Solenoid Connector: 36-Pin BLACK
 - Cabinet Connector: 36-Pin WHITE
11. Push Remote Volume Control Cable (GRAY), terminated in a 4-Pin connector, and Transformer Secondary Harness, terminated in four connectors: 2-Pin WHITE, 6-Pin BLUE, 9-Pin WHITE, and 12-Pin WHITE into backbox.
12. Lift up backbox and position on cabinet pedestal, engaging brackets for support.
13. Secure backbox to cabinet using two bolts and related washers.
14. Connect ground braid, and WHITE-RED wire under wing nut and washer at bottom of backbox.
15. Guide Remote Volume Control Harness through harness clips on back of backbox and connect 4 Pin connector to Sound Board 10J4.
16. Connect Transformer Secondary cable connectors:
 - 6-Pin BLUE (7 wires) to 6-Pin WHITE (7 wires)
 - 12-Pin WHITE to Power Supply 3J1
 - 2-Pin WHITE to Power Supply 3J9
 - 9-Pin WHITE to Sound Board 10J1

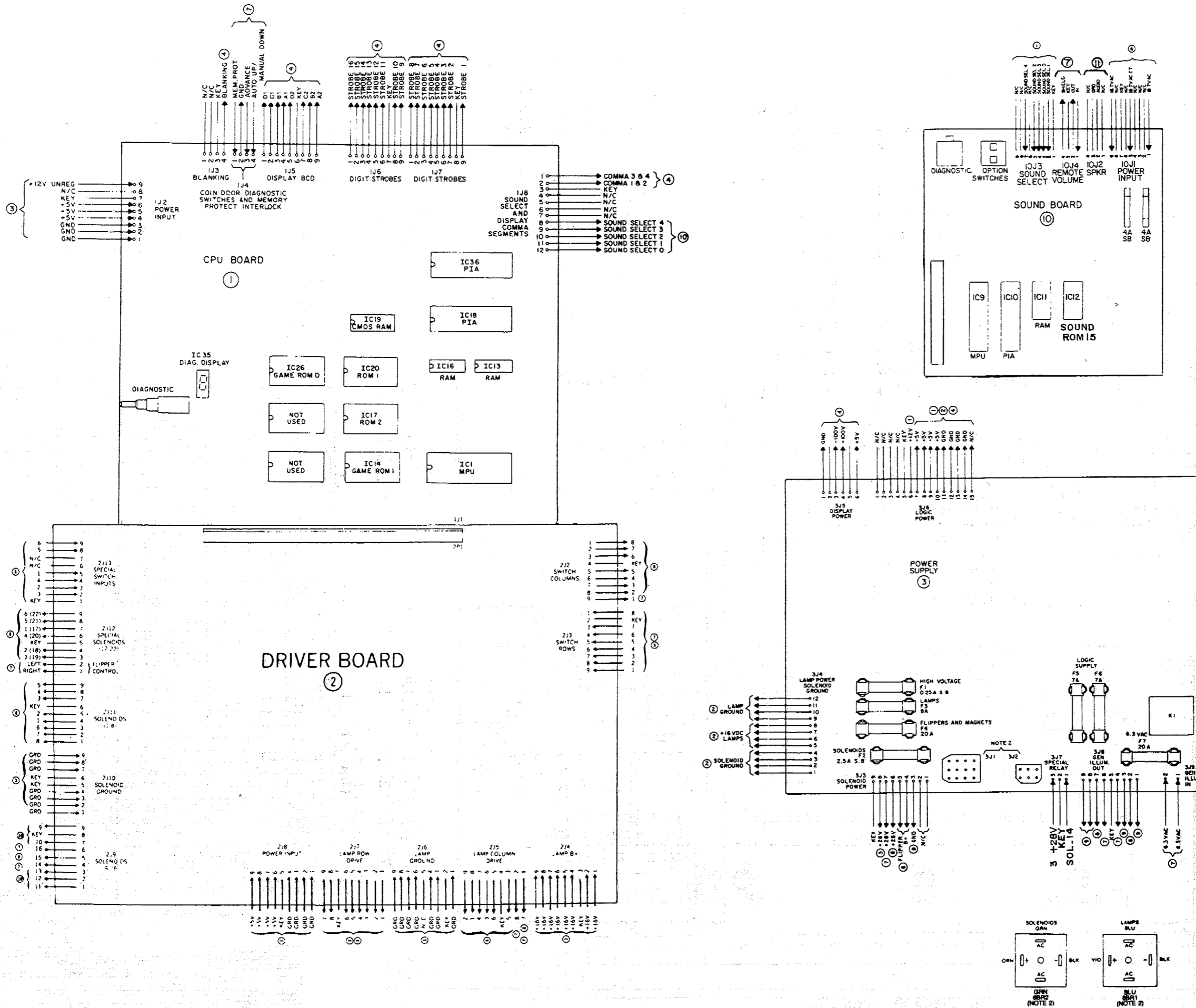
Inspection

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

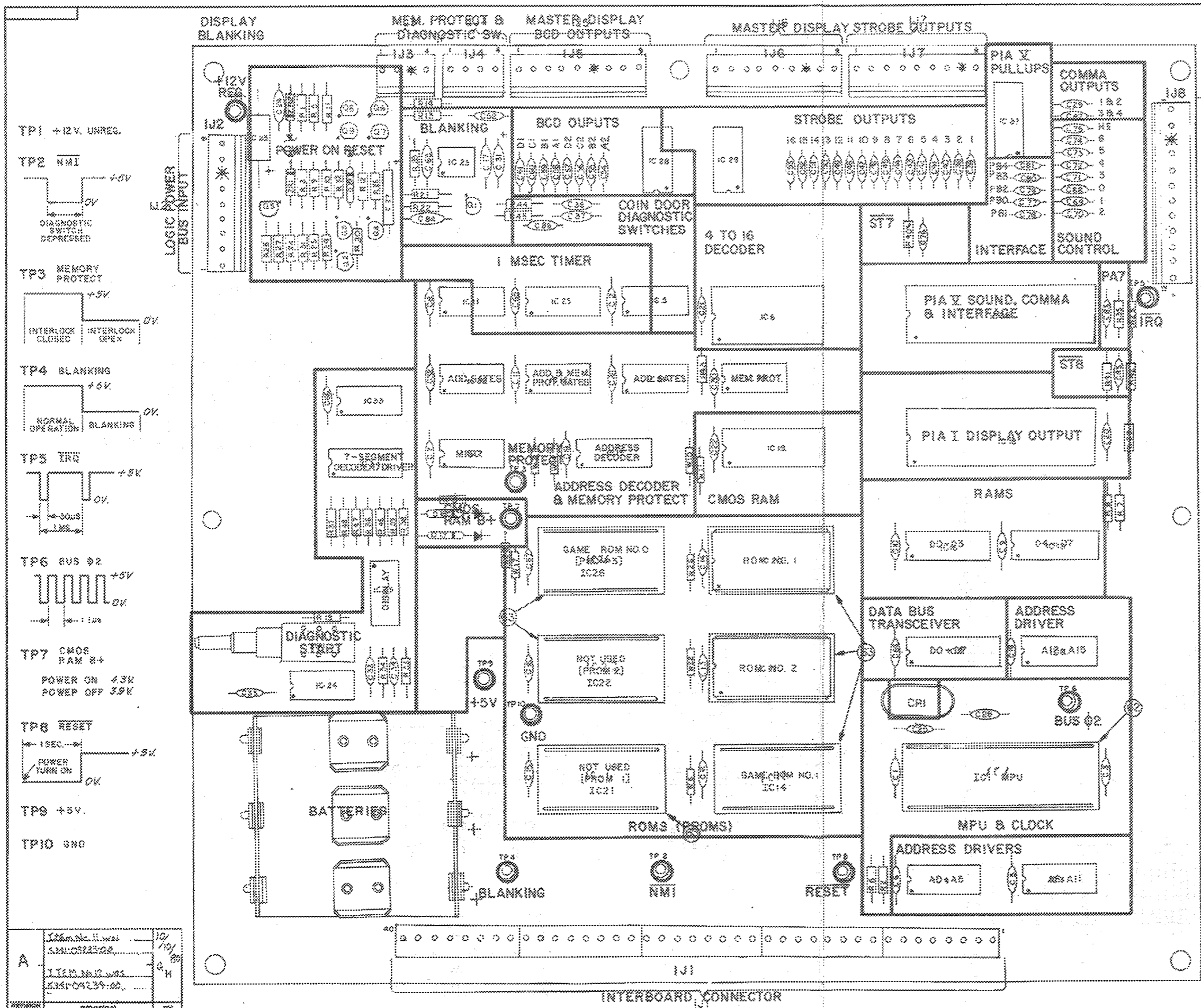
Power Turn-On and Game Setup

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 line cord, and DO NOT cut off ground pin. Line voltage MUST agree with that specified on the back of cabinet or serious damage to machine could occur. For low-line applications (105 or 210V ac), refer to the power wiring diagram.

- A. With the coin door closed, plug game in and turn it ON. Game should come on in Game Over mode as indicated by Player 1 score reading zero, Game Over lights lit, and High Score to Date alternating with player scores.
- B. If game comes on in the Diagnostic Mode (Credits display showing 04, Ball in Play Display showing 00, and Player 1 display showing game identification) turn game OFF and ON again.
 - 1. If game now comes on in Game Over mode, bookkeeping and game evaluation totals have been reset to zero.
 - 2. If game still comes on in Diagnostic Mode, open coin door and turn game OFF, and ON twice. This is an indication of batteries being removed with power OFF or coming loose during shipment. This has also resulted in features reverting to factory settings. Any changes from factory settings must be re-entered using procedures provided in Instruction booklet.
- C. If game still comes on in Diagnostic Mode, refer to troubleshooting procedures in maintenance manual.
- D. Place three balls on playfield next to outhole.
- E. Perform diagnostic tests and make any desired changes to features as described in Instruction booklet.



- 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 ⑫ NOT ASSIGNED
 - ⑬ SPEAKER PANEL
 2. REFER TO POWER WIRING DIAGRAM FOR CONNECTIONS TO 3P1.



BILL OF MATERIAL				
QTY	PART NO.	REV.	DESCRIPTION	UNIT
1	9799-09001-00		BARE PCB BOARD CPU	1
2	5870-09000-00	IC3A,IC3B	8200 HEX TRISTATE BUFFER	2
4	5881-09000-00	IC8	74LS04 HEX INVERTER	4
4	5882-09002-00	IC9	74LS14 HEX SQUARE WAVE	4
2	5280-09000-00	IC7	74LS00 HEX INVERTER	2
2	5881-09000-00	IC11	74LS90 TRIPPLE 5 INVERTER	2
2	5280-09000-00	IC12	74LS04 HEX INVERTER	2
2	5280-09000-00	IC13,IC14	74LS14 HEX SQUARE WAVE	2
12	5881-09000-00	IC15	74LS04 HEX INVERTER	12
12	5280-09000-00	IC16,IC17	74LS14 HEX SQUARE WAVE	12
12	5280-09000-00	IC18	74LS04 HEX INVERTER	12
12	5280-09000-00	IC19	74LS04 HEX INVERTER	12
12	5280-09000-00	IC20	74LS04 HEX INVERTER	12
12	5280-09000-00	IC21	74LS04 HEX INVERTER	12
12	5280-09000-00	IC22	74LS04 HEX INVERTER	12
12	5280-09000-00	IC23	74LS04 HEX INVERTER	12
12	5280-09000-00	IC24	74LS04 HEX INVERTER	12
12	5280-09000-00	IC25	74LS04 HEX INVERTER	12
12	5280-09000-00	IC26	74LS04 HEX INVERTER	12
12	5280-09000-00	IC27	74LS04 HEX INVERTER	12
12	5280-09000-00	IC28	74LS04 HEX INVERTER	12
12	5280-09000-00	IC29	74LS04 HEX INVERTER	12
12	5280-09000-00	IC30	74LS04 HEX INVERTER	12
12	5280-09000-00	IC31	74LS04 HEX INVERTER	12
12	5280-09000-00	IC32	74LS04 HEX INVERTER	12
12	5280-09000-00	IC33	74LS04 HEX INVERTER	12
12	5280-09000-00	IC34	74LS04 HEX INVERTER	12
12	5280-09000-00	IC35	74LS04 HEX INVERTER	12
12	5280-09000-00	IC36	74LS04 HEX INVERTER	12
12	5280-09000-00	IC37	74LS04 HEX INVERTER	12
12	5280-09000-00	IC38	74LS04 HEX INVERTER	12
12	5280-09000-00	IC39	74LS04 HEX INVERTER	12
12	5280-09000-00	IC40	74LS04 HEX INVERTER	12
12	5280-09000-00	IC41	74LS04 HEX INVERTER	12
12	5280-09000-00	IC42	74LS04 HEX INVERTER	12
12	5280-09000-00	IC43	74LS04 HEX INVERTER	12
12	5280-09000-00	IC44	74LS04 HEX INVERTER	12
12	5280-09000-00	IC45	74LS04 HEX INVERTER	12
12	5280-09000-00	IC46	74LS04 HEX INVERTER	12
12	5280-09000-00	IC47	74LS04 HEX INVERTER	12
12	5280-09000-00	IC48	74LS04 HEX INVERTER	12
12	5280-09000-00	IC49	74LS04 HEX INVERTER	12
12	5280-09000-00	IC50	74LS04 HEX INVERTER	12
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12	5280-09000-00	IC52	74LS04 HEX INVERTER	12
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12	5280-09000-00	IC62	74LS04 HEX INVERTER	12
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12	5280-09000-00	IC65	74LS04 HEX INVERTER	12
12	5280-09000-00	IC66	74LS04 HEX INVERTER	12
12	5280-09000-00	IC67	74LS04 HEX INVERTER	12
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12	5280-09000-00	IC69	74LS04 HEX INVERTER	12
12	5280-09000-00	IC70	74LS04 HEX INVERTER	12
12	5280-09000-00	IC71	74LS04 HEX INVERTER	12
12	5280-09000-00	IC72	74LS04 HEX INVERTER	12
12	5280-09000-00	IC73	74LS04 HEX INVERTER	12
12	5280-09000-00	IC74	74LS04 HEX INVERTER	12
12	5280-09000-00	IC75	74LS04 HEX INVERTER	12
12	5280-09000-00	IC76	74LS04 HEX INVERTER	12
12	5280-09000-00	IC77	74LS04 HEX INVERTER	12
12	5280-09000-00	IC78	74LS04 HEX INVERTER	12
12	5280-09000-00	IC79	74LS04 HEX INVERTER	12
12	5280-09000-00	IC80	74LS04 HEX INVERTER	12
12	5280-09000-00	IC81	74LS04 HEX INVERTER	12
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12	5280-09000-00	IC83	74LS04 HEX INVERTER	12
12	5280-09000-00	IC84	74LS04 HEX INVERTER	12
12	5280-09000-00	IC85	74LS04 HEX INVERTER	12
12	5280-09000-00	IC86	74LS04 HEX INVERTER	12
12	5280-09000-00	IC87	74LS04 HEX INVERTER	12
12	5280-09000-00	IC88	74LS04 HEX INVERTER	12
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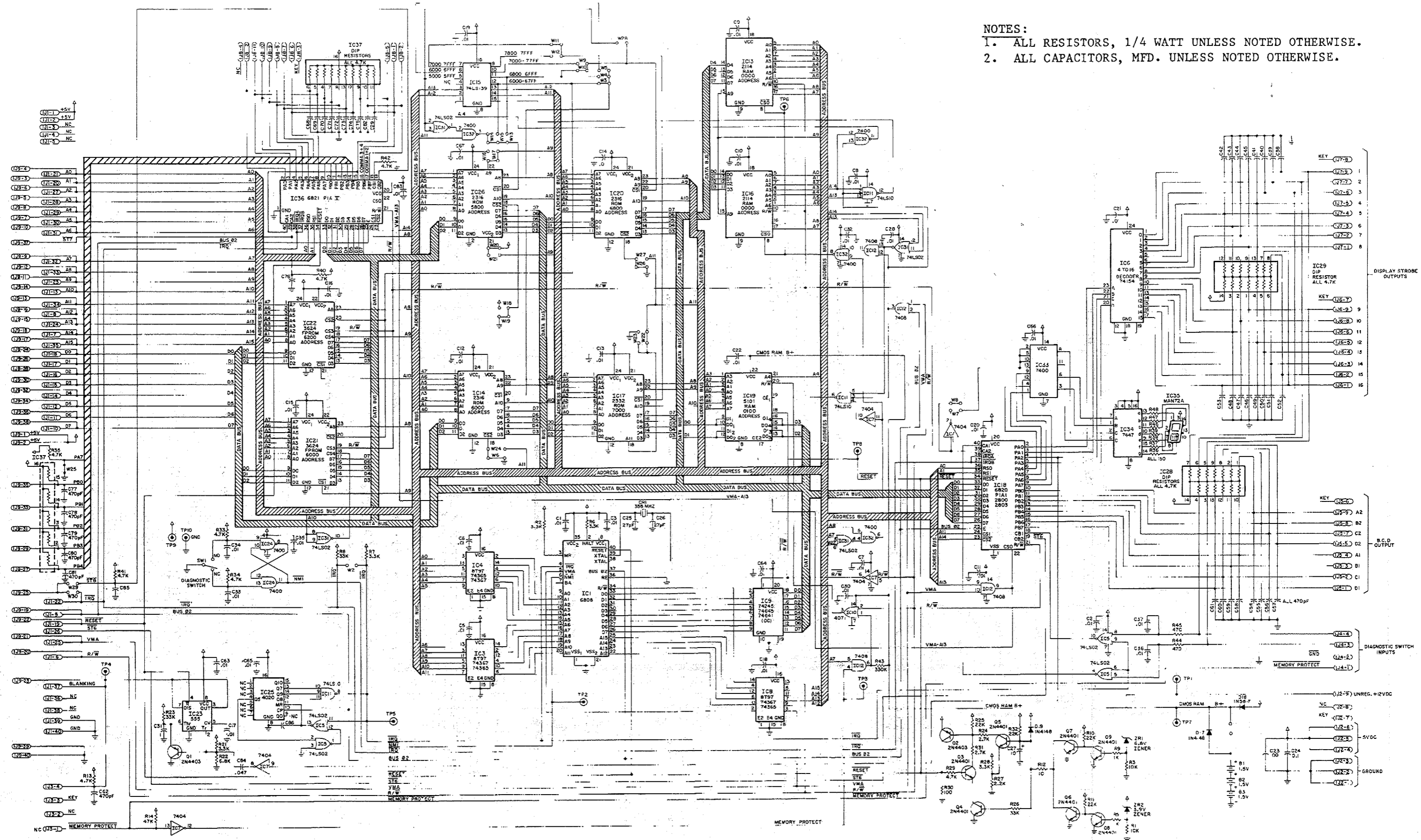
NOTE: USE EITHER 5881-09000-00, 5882-09002-00 OR 5883-09003-00

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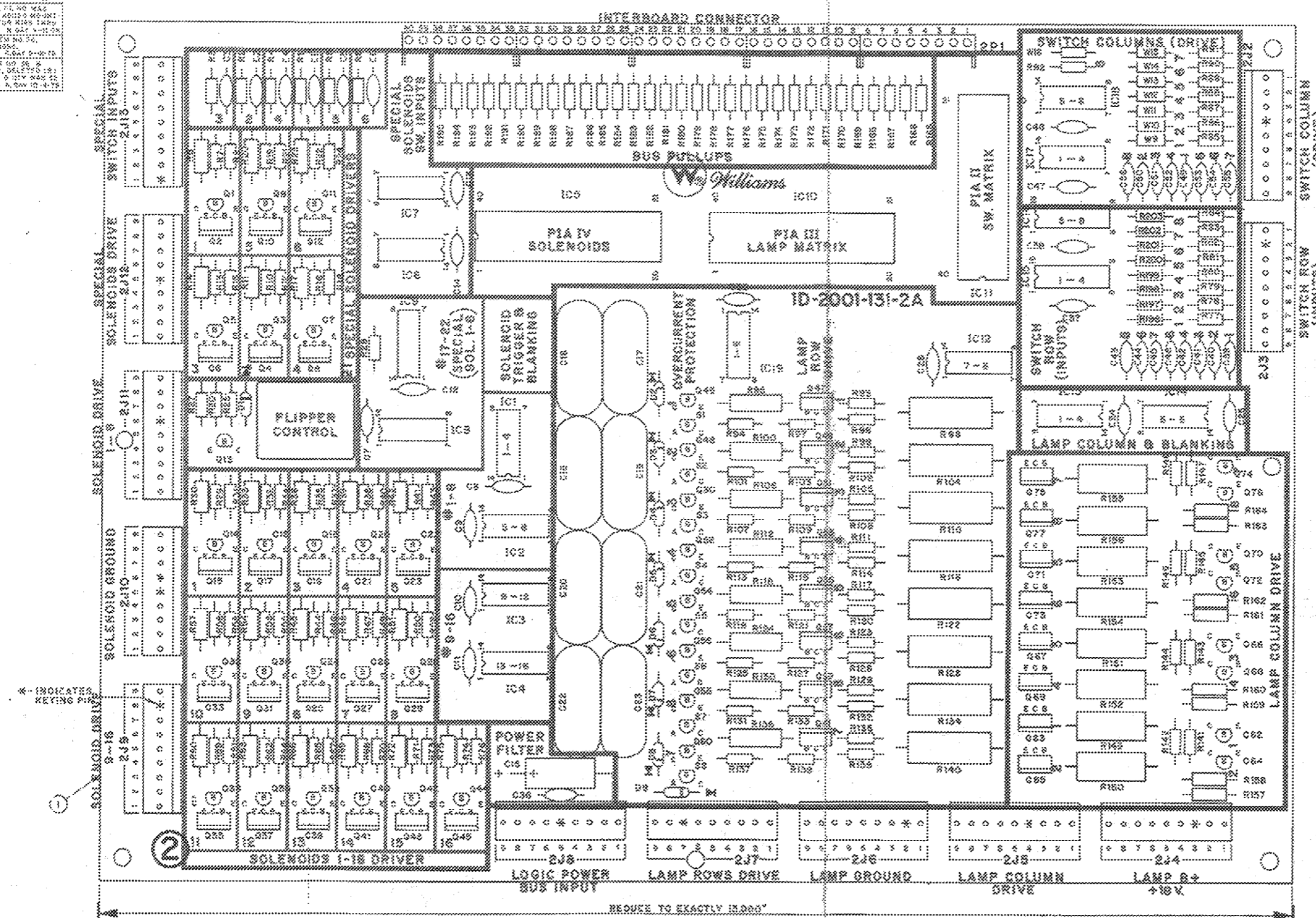
IC26 No. 0	10/10/80
IC26 No. 1	10/10/80
IC26 No. 2	10/10/80
IC26 No. 3	10/10/80

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



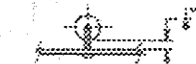
CPU Board Logic Diagram

REV.	REVISION
C	REVISED AND REDESIGNED TO MEET NEW SPECIFICATIONS
D	REVISION TO ADD NEW PARTS AND TO CORRECT DIMENSIONS
E	REVISION TO CORRECT DIMENSIONS AND TO ADD NEW PARTS
F	REVISION TO CORRECT DIMENSIONS AND TO ADD NEW PARTS

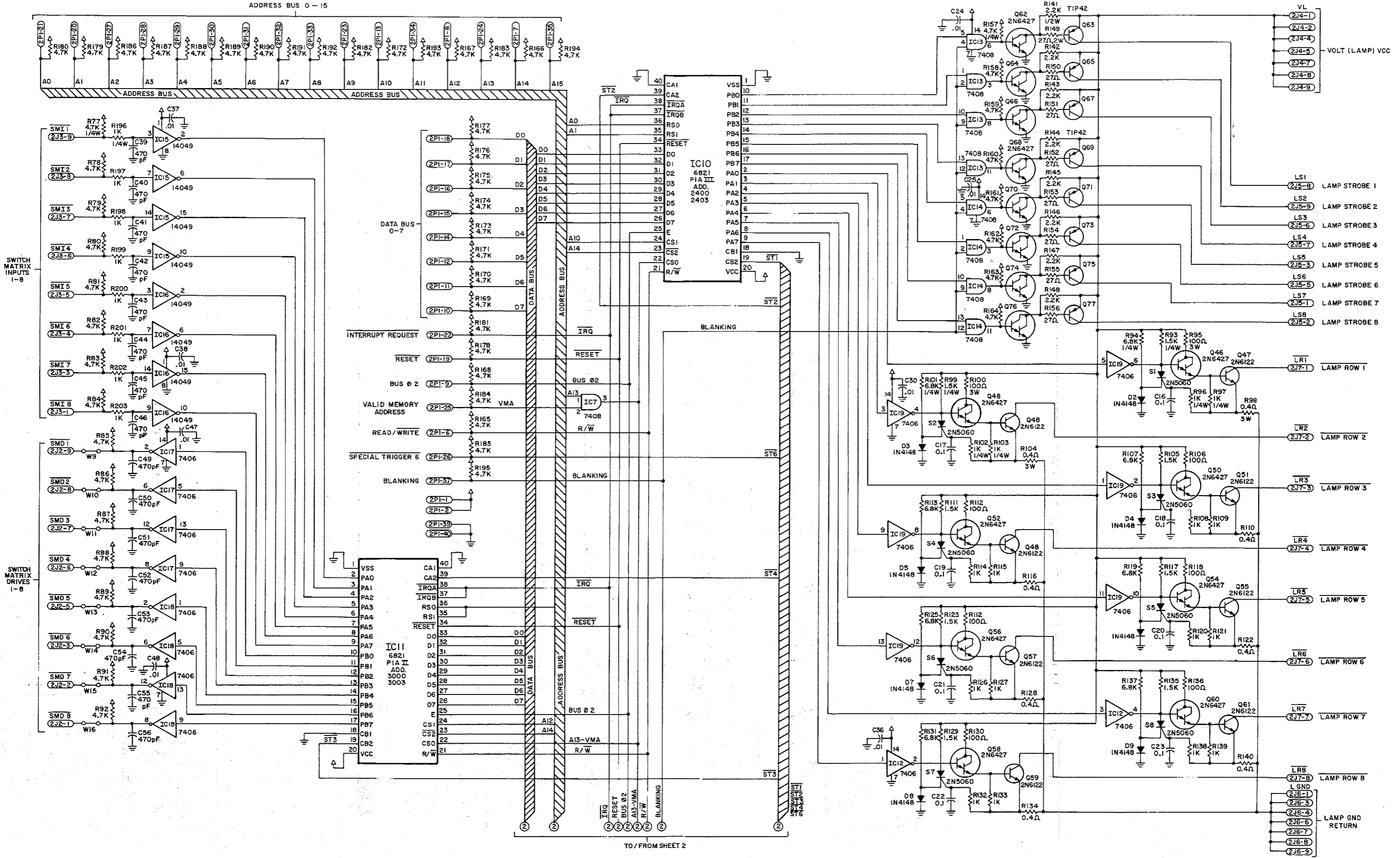


BILL OF MATERIAL				
ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQ. QTY.
1	1A-7001-13	IC1,110	74LS00 QUAD 2-INPUT NANDING LOGIC	1
2	54-0940	IC1,111	74LS04 INVERTER	1
3	54-0914	IC1,112	74LS10 HEX INVERTER	1
4	54-0973	IC1,113	74LS125 MONOSTABLE MULTIVIBRATOR	1
5	54-0977	IC1,114	74LS123 MONOSTABLE MULTIVIBRATOR	1
6	54-0970	IC1,115	74LS139 4-TO-16 DECODE	1
7	54-0906	IC1,116	74LS245 BUFFER	20
8	54-0904	IC1,117	74LS247 DARLINGTON NPN TRANSISTOR	10
9	54-0907	IC1,118	74LS247 DARLINGTON PNP TRANSISTOR	10
10	54-0928	IC1,119	2N4242 40W POWER TRANSISTOR	5
11	54-0919	IC1,120	2N4242 40W POWER TRANSISTOR	8
12	54-0928	IC1,121	2N4242 40W POWER TRANSISTOR	8
13	54-0928	IC1,122	2N4242 40W POWER TRANSISTOR	8
14	54-0928	IC1,123	2N4242 40W POWER TRANSISTOR	8
15	54-0900	IC1,124	74LS00 QUAD 2-INPUT NANDING LOGIC	25
16	54-0900	IC1,125	74LS00 QUAD 2-INPUT NANDING LOGIC	25
17	54-0900	IC1,126	74LS00 QUAD 2-INPUT NANDING LOGIC	10
18	54-0900	IC1,127	74LS00 QUAD 2-INPUT NANDING LOGIC	1
19	54-0900	IC1,128	74LS00 QUAD 2-INPUT NANDING LOGIC	1
20	54-0900	IC1,129	74LS00 QUAD 2-INPUT NANDING LOGIC	1
21	54-0900	IC1,130	74LS00 QUAD 2-INPUT NANDING LOGIC	1
22	54-0904	IC1,131	74LS04 INVERTER	20
23	54-0900	IC1,132	74LS00 QUAD 2-INPUT NANDING LOGIC	22
24	54-0902	IC1,133	74LS02 NOR	22
25	54-0907	IC1,134	74LS07 BUFFER	23
26	54-0917	IC1,135	74LS00 QUAD 2-INPUT NANDING LOGIC	1
27	54-0900	IC1,136	74LS00 QUAD 2-INPUT NANDING LOGIC	2
28	54-0900	IC1,137	74LS00 QUAD 2-INPUT NANDING LOGIC	2
29	54-0904	IC1,138	74LS04 INVERTER	2
30	54-0900	IC1,139	74LS00 QUAD 2-INPUT NANDING LOGIC	5
31	54-0900	IC1,140	74LS00 QUAD 2-INPUT NANDING LOGIC	5
32	54-0907	IC1,141	74LS07 BUFFER	2
33	54-0904	IC1,142	74LS04 INVERTER	1
34	54-0900	IC1,143	74LS00 QUAD 2-INPUT NANDING LOGIC	0
35	54-0907	IC1,144	74LS07 BUFFER	2
36	54-0900	IC1,145	74LS00 QUAD 2-INPUT NANDING LOGIC	2

* R140 thru R145 MUST BE MOUNTED ABOVE SURFACE OF BOARD.

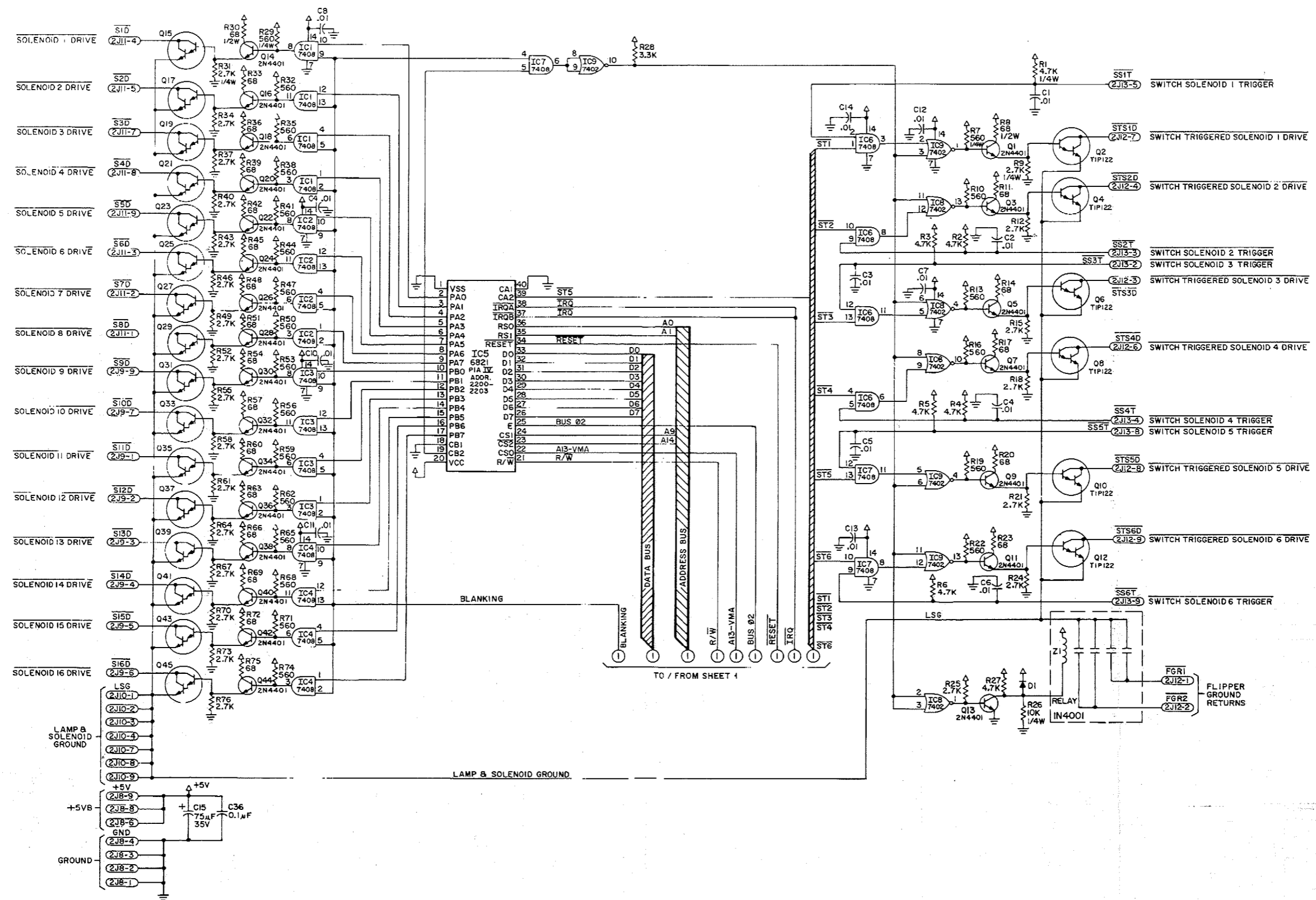


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TO / FROM SHEET 2

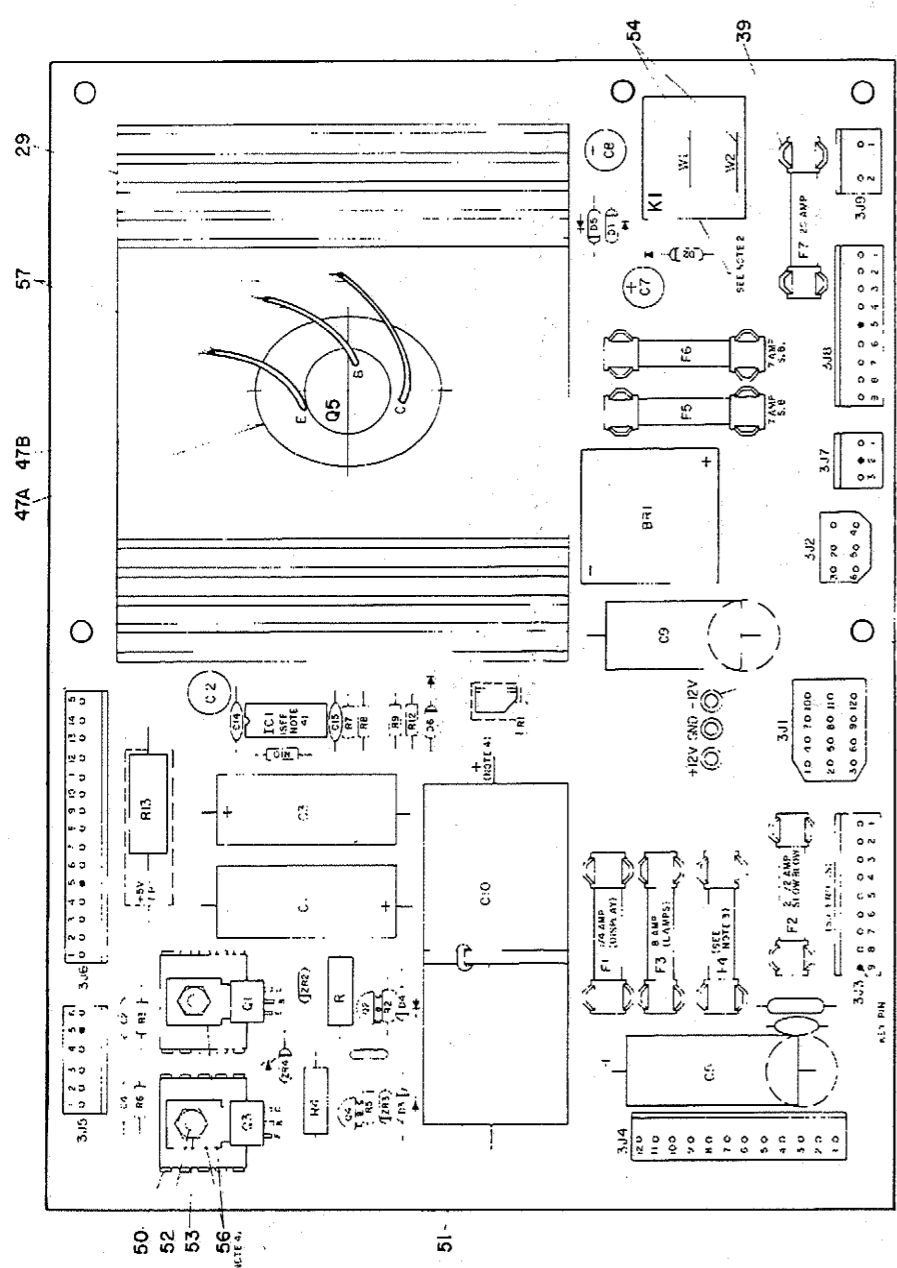
Driver Board Logic Diagram (Sheet 1 of 2) 11/12



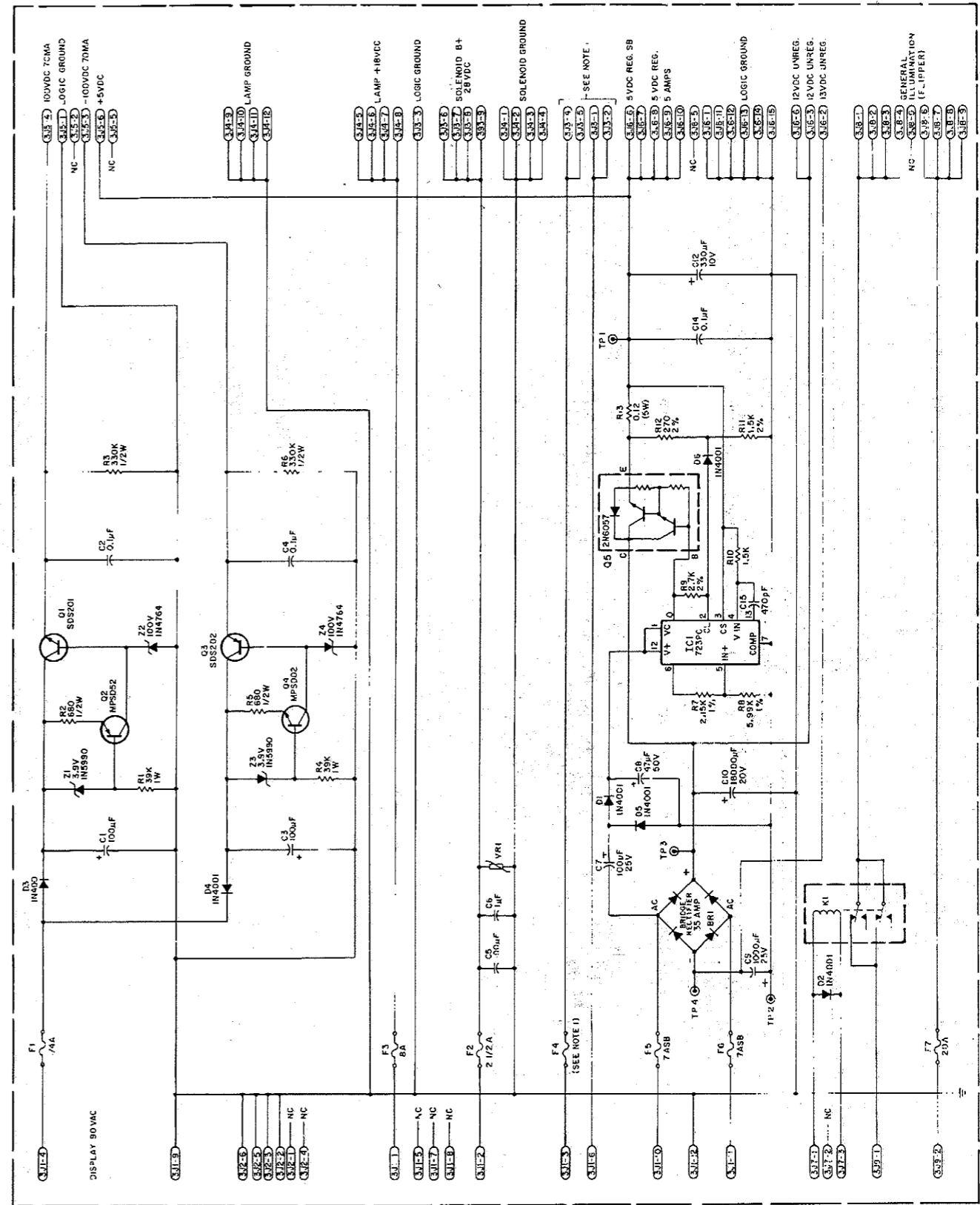
Driver Board Logic Diagram (Sheet 2 of 2) 13

BILL OF MATERIAL

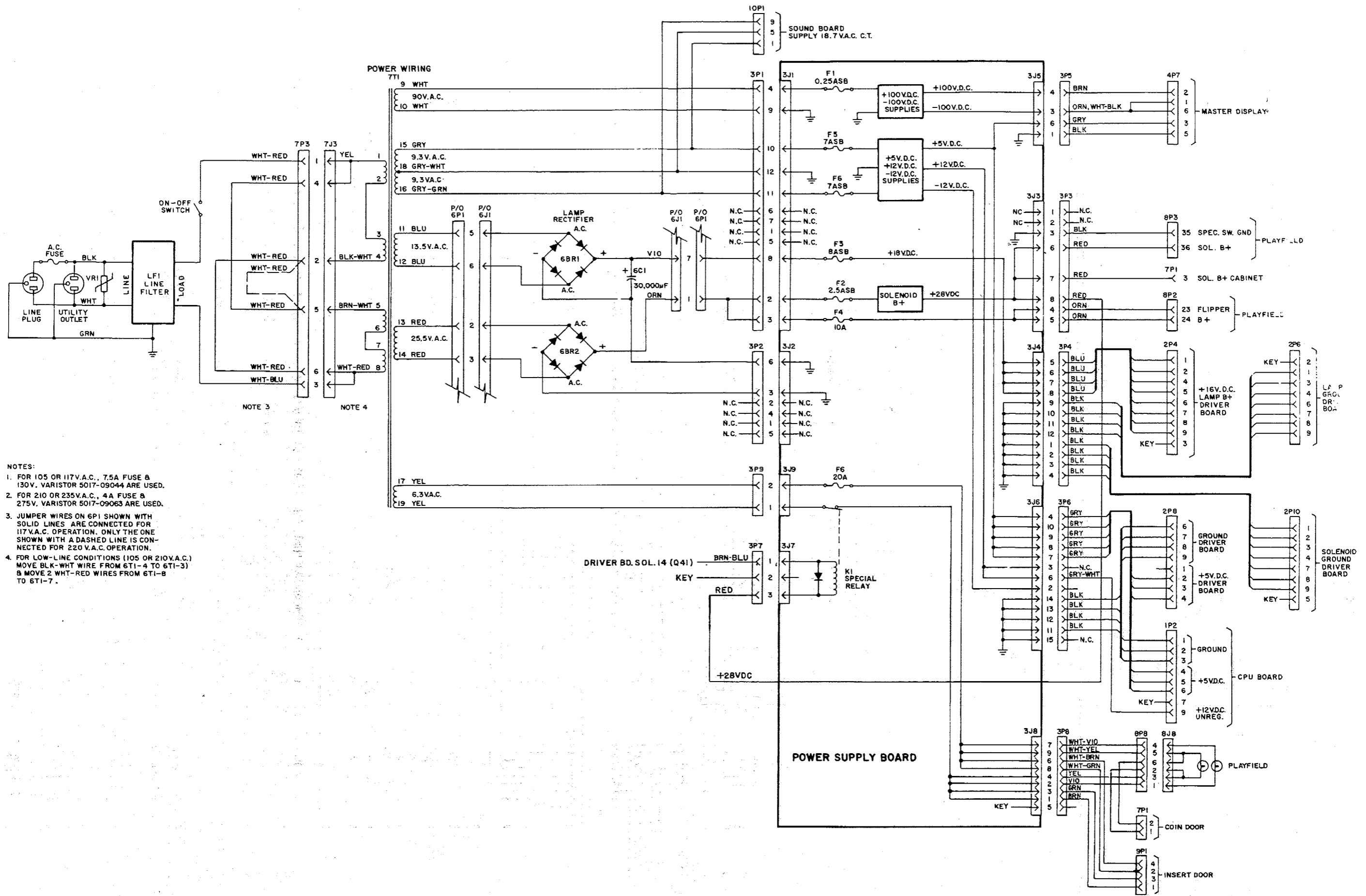
ITEM NO.	PART DESIGNATION	PKC NO.	DESCRIPTION	REQ'D NO.
1	87	5765-09466	BARE P.C. BOARD	1
2	88	5011-09426	RESISTOR, 2.1K, 1%	1
3	88	5013-09427	RESISTOR, 2.1K, 1%	1
4	88	5010-09428	RESISTOR, 2.1K, 1%	1
5	88	5010-09485	RESISTOR, 2.1K, 1%	1
6	88	5010-09511	RESISTOR, 2.1K, 1%	1
7	88	5010-09508	RESISTOR, 2.1K, 1%	1
8	88	5012-09429	RESISTOR, 2.1K, 1%	1
9	88	5010-09536	RESISTOR, 2.1K, 1%	1
10	88	5010-09561	RESISTOR, 2.1K, 1%	1
11	88	5010-09069	RESISTOR, 2.1K, 1%	1
12	88	5010-09119	RESISTOR, 2.1K, 1%	1
13	88	5010-09230	RESISTOR, 2.1K, 1%	1
14	88	5010-09893	RESISTOR, 2.1K, 1%	1
15	88	5010-09421	RESISTOR, 2.1K, 1%	1
16	88	5013-09465	RESISTOR, 2.1K, 1%	1
17	88	5010-09170	RESISTOR, 2.1K, 1%	1
18	88	5010-09446	RESISTOR, 2.1K, 1%	1
19	88	5010-09258	RESISTOR, 2.1K, 1%	1
20	88	5010-09059	RESISTOR, 2.1K, 1%	1
21	88	5010-09059	RESISTOR, 2.1K, 1%	1
22	88	5010-09119	RESISTOR, 2.1K, 1%	1
23	88	5010-09423	RESISTOR, 2.1K, 1%	1
24	88	5010-09421	RESISTOR, 2.1K, 1%	1
25	88	5010-09017	RESISTOR, 2.1K, 1%	1
26	88	5010-09036	RESISTOR, 2.1K, 1%	1
27	88	5010-09036	RESISTOR, 2.1K, 1%	1
28	88	5010-09036	RESISTOR, 2.1K, 1%	1
29	88	5010-09036	RESISTOR, 2.1K, 1%	1
30	88	5010-09036	RESISTOR, 2.1K, 1%	1
31	88	5010-09036	RESISTOR, 2.1K, 1%	1
32	88	5010-09036	RESISTOR, 2.1K, 1%	1
33	88	5010-09036	RESISTOR, 2.1K, 1%	1
34	88	5010-09036	RESISTOR, 2.1K, 1%	1
35	88	5010-09036	RESISTOR, 2.1K, 1%	1
36	88	5010-09036	RESISTOR, 2.1K, 1%	1
37	88	5010-09036	RESISTOR, 2.1K, 1%	1
38	88	5010-09036	RESISTOR, 2.1K, 1%	1
39	88	5010-09036	RESISTOR, 2.1K, 1%	1
40	88	5010-09036	RESISTOR, 2.1K, 1%	1
41	88	5010-09036	RESISTOR, 2.1K, 1%	1
42	88	5010-09036	RESISTOR, 2.1K, 1%	1
43	88	5010-09036	RESISTOR, 2.1K, 1%	1
44	88	5010-09036	RESISTOR, 2.1K, 1%	1
45	88	5010-09036	RESISTOR, 2.1K, 1%	1
46	88	5010-09036	RESISTOR, 2.1K, 1%	1
47	88	5010-09036	RESISTOR, 2.1K, 1%	1
48	88	5010-09036	RESISTOR, 2.1K, 1%	1
49	88	5010-09036	RESISTOR, 2.1K, 1%	1
50	88	5010-09036	RESISTOR, 2.1K, 1%	1
51	88	5010-09036	RESISTOR, 2.1K, 1%	1
52	88	5010-09036	RESISTOR, 2.1K, 1%	1
53	88	5010-09036	RESISTOR, 2.1K, 1%	1
54	88	5010-09036	RESISTOR, 2.1K, 1%	1
55	88	5010-09036	RESISTOR, 2.1K, 1%	1
56	88	5010-09036	RESISTOR, 2.1K, 1%	1
57	88	5010-09036	RESISTOR, 2.1K, 1%	1
58	88	5010-09036	RESISTOR, 2.1K, 1%	1



NOTES:
 1. P.C. BOARD COMPONENTS ARE MOUNTED ON THE REVERSE SIDE OF THE BOARD.
 2. ALL COMPONENTS ARE TO BE MOUNTED ON THE BOARD PER THE MOUNTING INSTRUCTIONS.
 3. ALL COMPONENTS ARE TO BE MOUNTED ON THE BOARD PER THE MOUNTING INSTRUCTIONS.
 4. OBSERVE THE MOUNTING INSTRUCTIONS FOR THE TRANSISTORS AND DIODES.
 5. REFER TO THE MOUNTING INSTRUCTIONS FOR THE TRANSISTORS AND DIODES.

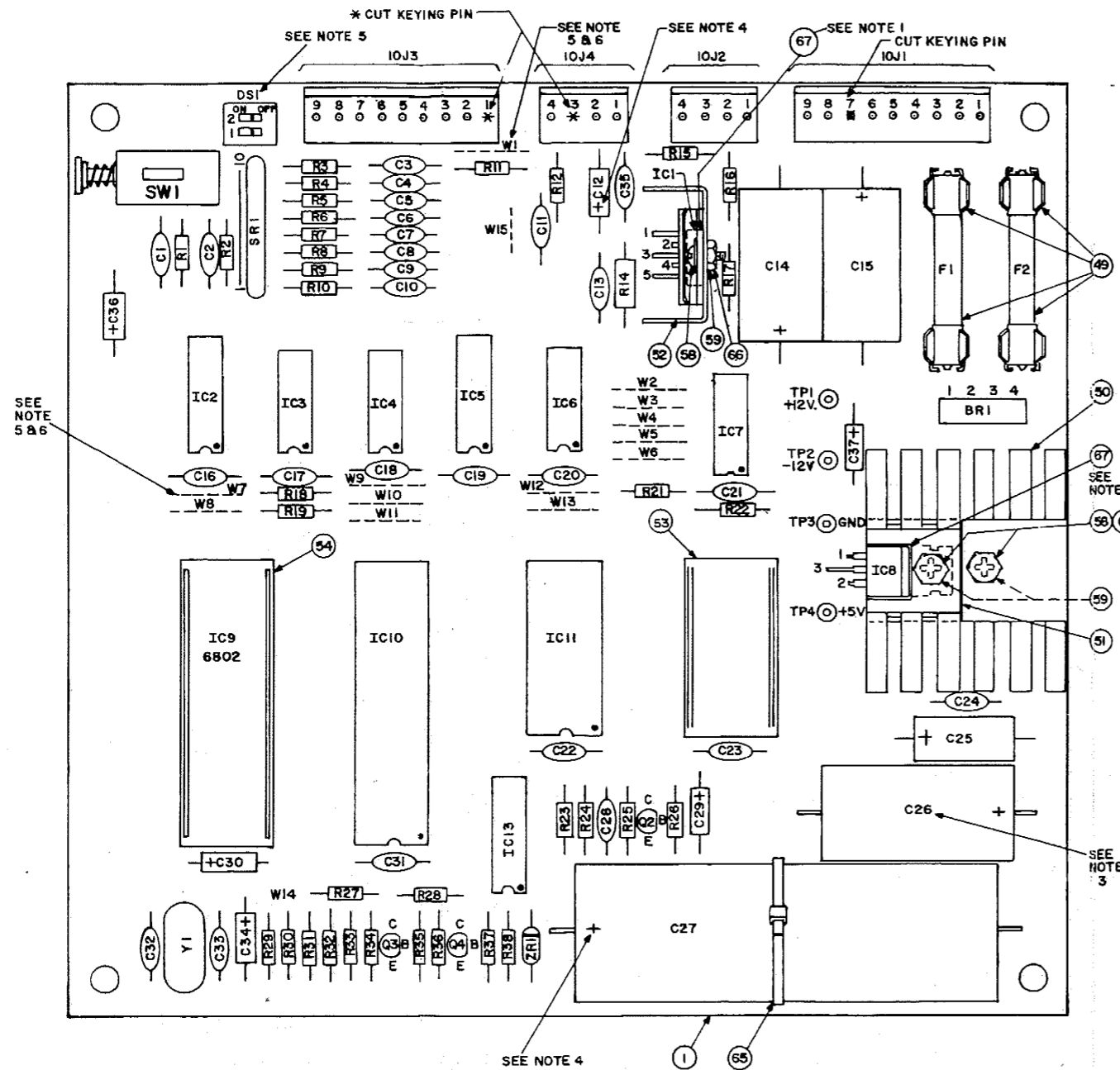


NOTE:
 1. ON FLUORESCENT LAMP BALLASTS, USE 15 AMP.
 ON DUAL ACTION FLUORESCENT BALLASTS, USE 15 AMP.
 ON SHUFFLE ALL 50/60 HZ IS 20 AMPS 3.3-1 & 2.
 ON SHUFFLE ALL 50/60 HZ IS 20 AMPS 3.3-1 & 2.
 2. UNLESS OTHERWISE INDICATED ALL RESISTORS ARE IN OHMS (0.1/1/10 WATT)



- NOTES:
1. FOR 105 OR 117V.A.C., 7.5A FUSE & 130V. VARISTOR 5017-09044 ARE USED.
 2. FOR 210 OR 235V.A.C., 4A FUSE & 275V. VARISTOR 5017-09063 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-B TO 6T1-7.

BILL OF MATERIAL



ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D. NO.
1	01-2 01-146-6		BARE P.C. BOARD REV F	1
2	5370-09156-00	IC1	TDA 2002 V AUDIO AMPLIFIER	1
3	5280-09012-00	IC2	7442 BCD-DEC DECODER	1
4	5280-09073-00	IC3	7400 QUAD 2 INPUT NAND	1
5	5280-08973	IC4	7408 QUAD 2 INP. AND GATE	1
6	5310-09153-00	IC5	4050 BUFFER	1
7	5310-09154-00	IC6	4068 8 INPUT NAND GATE	1
8	5310-08971-00	IC7	4069 HEX INVERTER	1
9	5250-09157-00	IC8	7805 5 VOLT REG. W/TO 220 CASE	1
10	5430-08972-00	IC10	6821 P.I.A.	1
11	5340-09003-00	IC11	6810 RAM	1
12	5371-09152-00	IC13	1408 D/A CONVERTER	1
13	5160-08938-00	Q2, Q3, Q4	2N4401 NPN TRANSISTOR	3
14				
15	5075-09018-00	7R1	1N5996A 6.8V ZENER DIODE	1
16				
17	5100-09357-00	BR1	MDA 200/3N253 BRIDGE RECTIFIER	1
18	5100-09158-00		3.58 MHZ CRYSTAL	1
19	5520-09020-00		RESISTOR, FC, 4.7K OHM, 5% 1/4 WATT	9
	5010-08991-00	R1, R18, R19, R21, R22, R27, R30, R31, R32		
20	5010-09036-00	R2 thru R10	RESISTOR, FC, 100 OHM, 5% 1/4W	9
21	5010-09358-00	R12, R15, R28, R36, R38	RESISTOR, FC, 1K OHM, 5% 1/4W	5
22	5010-09181-00	R14	RESISTOR, FC, 1 OHM, 10% 1/2 WATT	1
23	5010-09151-00	R16	RESISTOR, FC, 2.2 OHM, 5% 1/4 WATT	1
24	5010-09361-00	R17	RESISTOR, FC, 220 OHM, 5% 1/2 WATT	1
25				
26	5010-08993-00	R23, R24, R25	RESISTOR, FC, 3.3K OHM, 5% 1/4 WATT	3
27	5010-09179-00	R25	RESISTOR, FC, 3.3M OHM, 5% 1/4 WATT	1
28	5010-09035-00	R29	RESISTOR, FC, 47K OHM, 5% 1/4 WATT	1
29	5010-09034-00	R33, R35, R37	RESISTOR, FC, 10K OHM, 5% 1/4 WATT	3
30	5010-09039-00	R34	RESISTOR, FC, 10 OHM, 5% 1/4 WATT	1
31	5045-08980-00	C1, C16 thru C23, C31	CAPACITOR, CER. .01 MFD. 50V. +80%, -20%	10
32	5045-09065-00	C2 thru C10	CAPACITOR, CER. 470 PFD. 50V. +-20%	9
33	5045-09345-00	C11	CAPACITOR, CER. .001 MFD. +-20% 100V.	1
34	5040-09365-00	C12, C30, C36	CAPACITOR, ELECT. 1 MFD. 63V. -10 +50%	3
35	5043-08996-00	C15, C24, C35	CAPACITOR, CER. .1 MFD. 50V. +-20%	3
36	5040-09165-00	C14	CAPACITOR, ELECT. 1,000 MFD. 16V. +-20%	1
37	5040-09164-00	C15	CAPACITOR, ELECT. 470 MFD. 10V. +-20%	1
38	5040-08998-00	C25	CAPACITOR, ELECT. 100 MFD. 10V. +-20%	1
39	5040-08993-00	C26	CAPACITOR, ELECT. 1,000 MFD. 25V. +-20%	1
40	5040-09376-00	C27	CAPACITOR, ELECT. 4700 MFD. 16V. +-20%	1
41	5045-09180-00	C28	CAPACITOR, CER. 47 PFD. 1K V. +-20%	1
42	5040-09343-00	C29	CAPACITOR, ELECT. 10 MFD. 20V	1
43	5045-09169-00	C32, C33	CAPACITOR, CER. DISC, 27 PFD. 1KV. +-10%	2
44	5041-09163-00	C34	CAPACITOR, TANTALUM 2.2 MFD. 15V. +-20%	1
45	5041-09051-00	C37	CAPACITOR, TANTALUM 1 MFD. 25V. +-20%	1
46	5641-09658-00	SW1	MOMENTARY SWITCH SPDT	1
47	5645-09350-00	DS1	2 STD. DIP SWITCH	1
48	5731-06314-00	F1, F2	4 AMP SLOW BLOW FUSE	2
49	5732-09178-00		FUSEHOLDER	2
50	5705-09172-00		HEAT SINK THERMALLOY #6012B	1
51	5705-09173-00		HEAT SINK THERMALLOY #6071B	1
52	5705-09199-00		HEAT SINK THERMALLOY #6030	1
53	5700-09004-00		24 PIN SOCKET	1
54	5700-08985-00		40 PIN SOCKET	1
55	5791-09027-00	IOJ1, IOJ3	9 PIN MALE CONNECTOR 09-65-1091	2
56	5791-09028-00	IOJ2, IOJ4	4 PIN MALE CONNECTOR 09-65-1041	2
57				
58	4006-01003-06		6-32x3/8" P-PH-S	5
59	4405-01117-00		6-32 HEX NUT	5
60	5010-09534-00		0 OHM RESISTOR	A/R
61	5824-09248-00	TP1 THRU TP4	TERMINAL #1502-1	4
62	5010-09363-00	R11	RESISTOR, FC, 5.6K OHM 5% 1/4 WATT	1
63				
64	5019-09362-00	SR1	RESISTOR, 4.7K OHM 10 PIN SIP	1
65	03-7520-1		TIC WRAP	1
66	4703-00007-00		#6 EXT. LOCKWASHER	5
67	20-9279		THERMAL COMPOUND	10

NOTES:

1. USE THERMAL COMPOUND BETWEEN IC1 AND IC8, AND HEAT SINKS.

2. CAUTION: AVOID STATIC DISCHARGE DAMAGE TO MOS LOGIC.

3. SYMBOLS SHOWN ON COMPONENTS ARE FOR REFERENCE ONLY. DO NOT SCREEN OR STAMP.

4. OBSERVE INDEX MARK OF ALL INTEGRATED CIRCUITS:

DIODES D1, D2, AND ZR1;

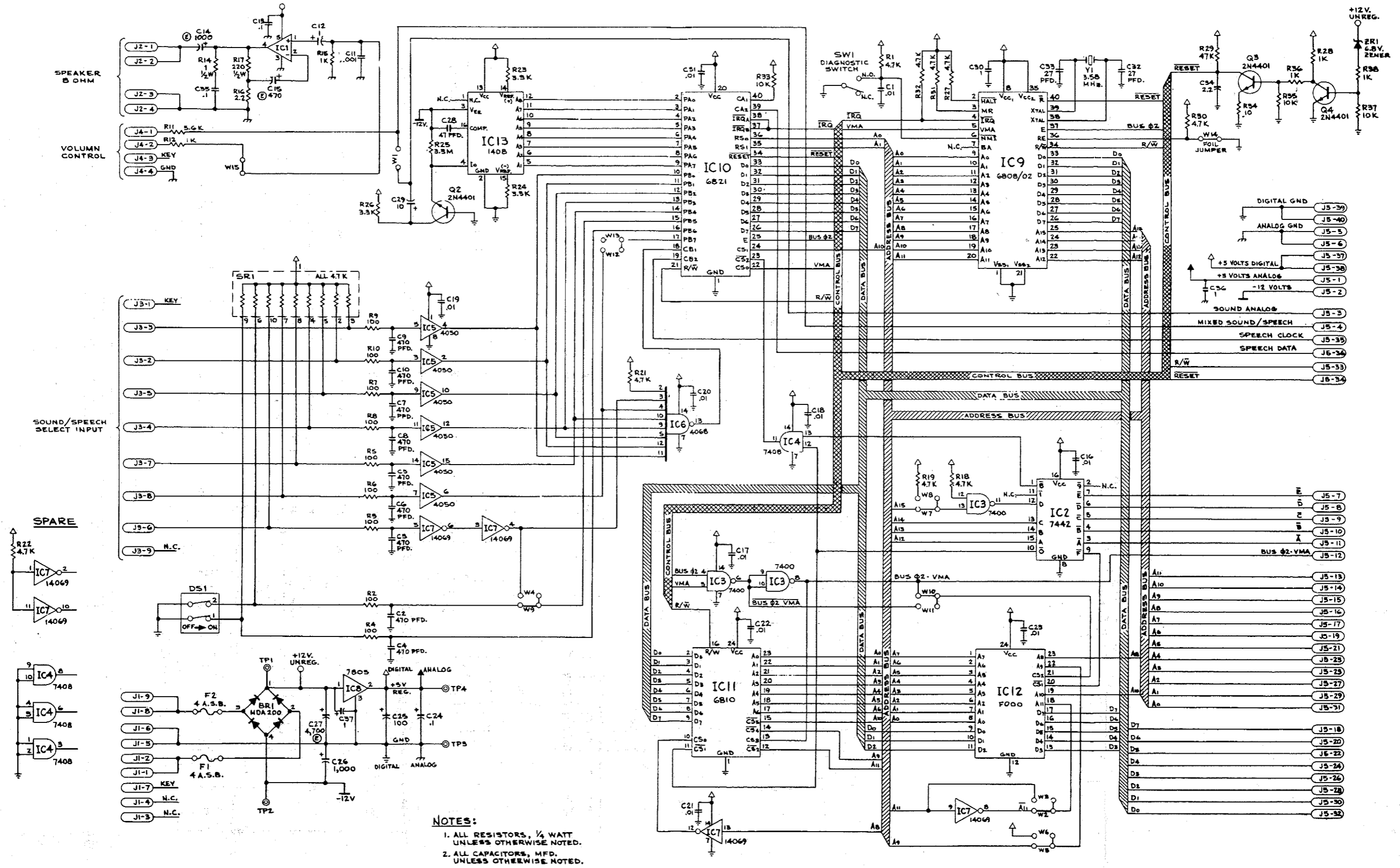
CAPACITORS C12, C14, C15, C25, C26, C27;

CONNECTORS IOJ1, IOJ2, IOJ3, IOJ4, IOJ5;

POSITION OF TRANSISTORS Q1, Q2, Q3, Q4.

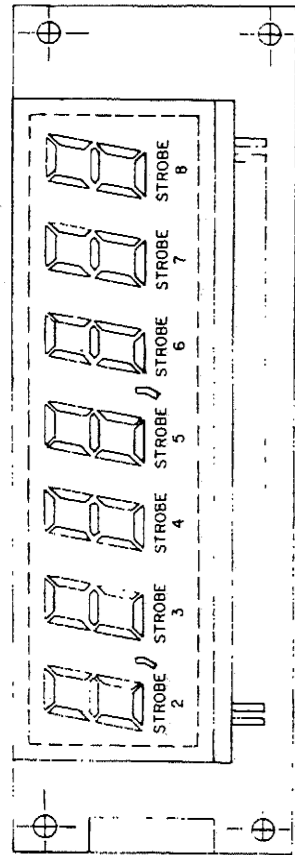
5. JUMPERS

- W2) W31
- W3) W41
- W4) W51
- W5) W61
- W10) W11) JUT
- W12)
- W13)



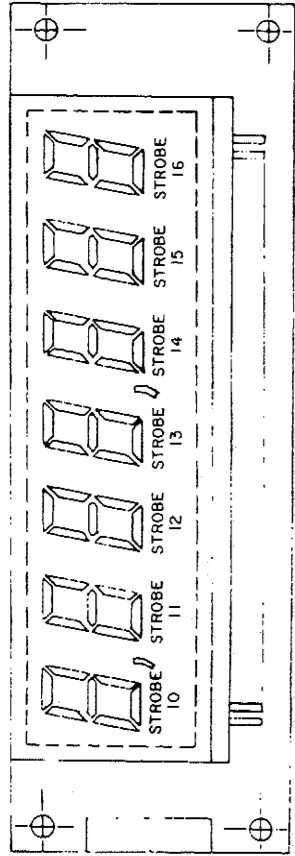
NOTES:
 1. ALL RESISTORS, 1/4 WATT UNLESS OTHERWISE NOTED.
 2. ALL CAPACITORS, MFD. UNLESS OTHERWISE NOTED.

PLAYER #1



5J1
5J5

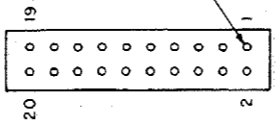
PLAYER #2



5J2
5J4

DETAIL A

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



4J1/5J1 (PLAYER 1)

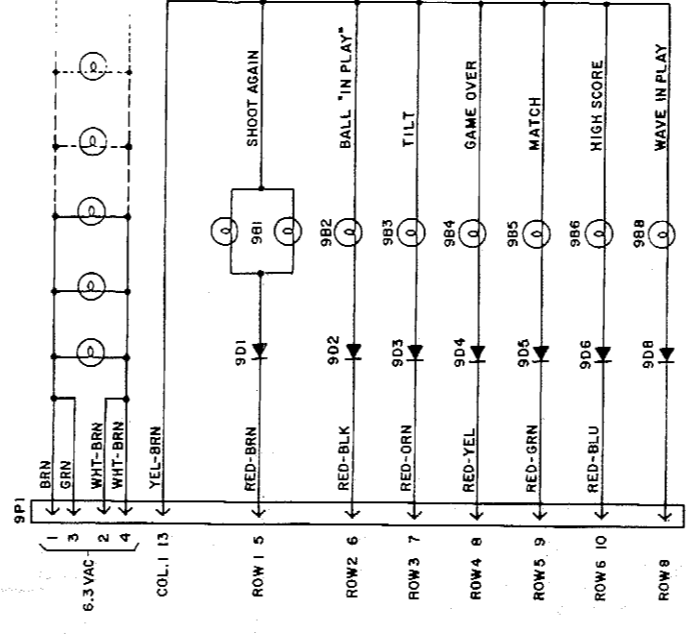
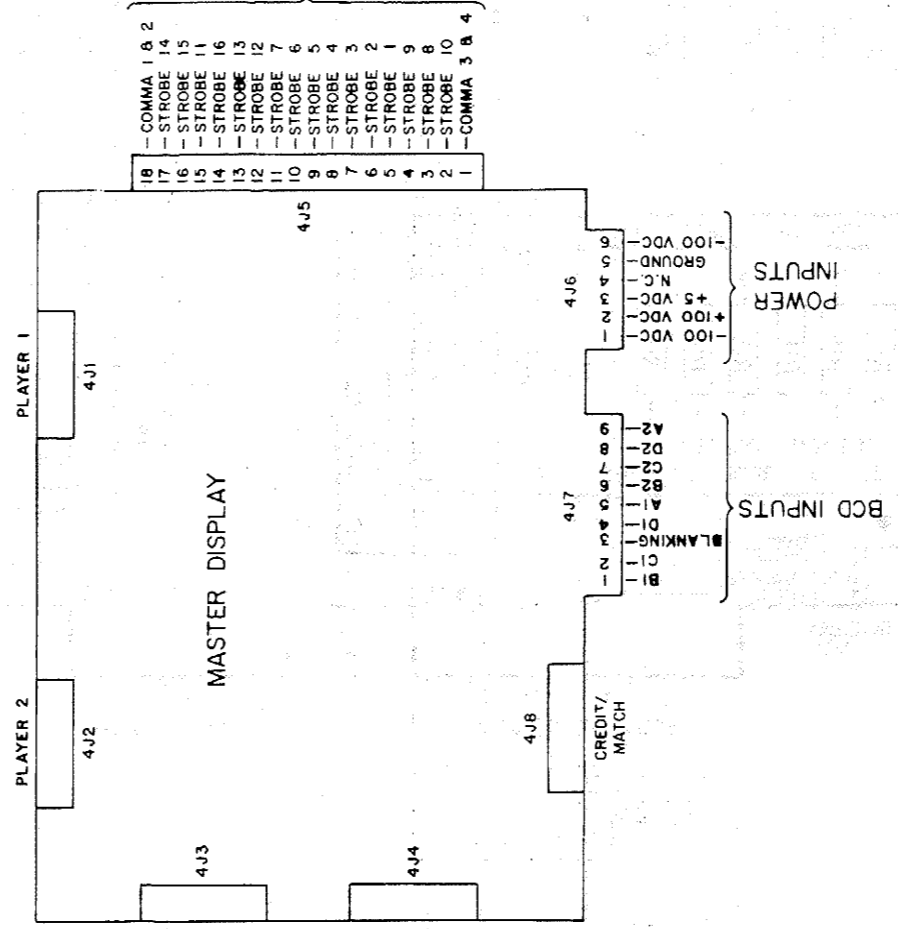
- 1 100,000's
- 2 -100V KEEP ALIVE
- 3 1,000,000's
- 4 f' SEGMENT
- 5 N/C
- 6 9' SEGMENT
- 7 +100V (N/C)
- 8 e' SEGMENT
- 9 10,000's
- 10 d' SEGMENT
- 11 1,000's
- 12 +100V KEEP ALIVE
- 13 100's
- 14 COMMA
- 15 10's
- 16 c' SEGMENT
- 17 N/C
- 18 b' SEGMENT
- 19 UNITS
- 20 a' SEGMENT

4J2/5J2 (PLAYER 2)

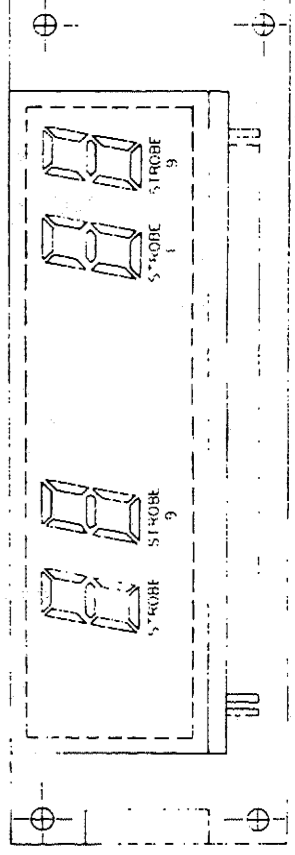
- 1 100,000's
- 2 -100V KEEP ALIVE
- 3 1,000,000's
- 4 f' SEGMENT
- 5 N/C
- 6 9' SEGMENT
- 7 +100V (N/C)
- 8 e' SEGMENT
- 9 10,000's
- 10 d' SEGMENT
- 11 1,000's
- 12 +100V KEEP ALIVE
- 13 100's
- 14 COMMA
- 15 10's
- 16 c' SEGMENT
- 17 N/C
- 18 b' SEGMENT
- 19 UNITS
- 20 a' SEGMENT

4J8/5J5 (CREDIT/MATCH)

- 1 f' Segment (Credit)
- 2 -100V Keep Alive
- 3 e' Segment
- 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



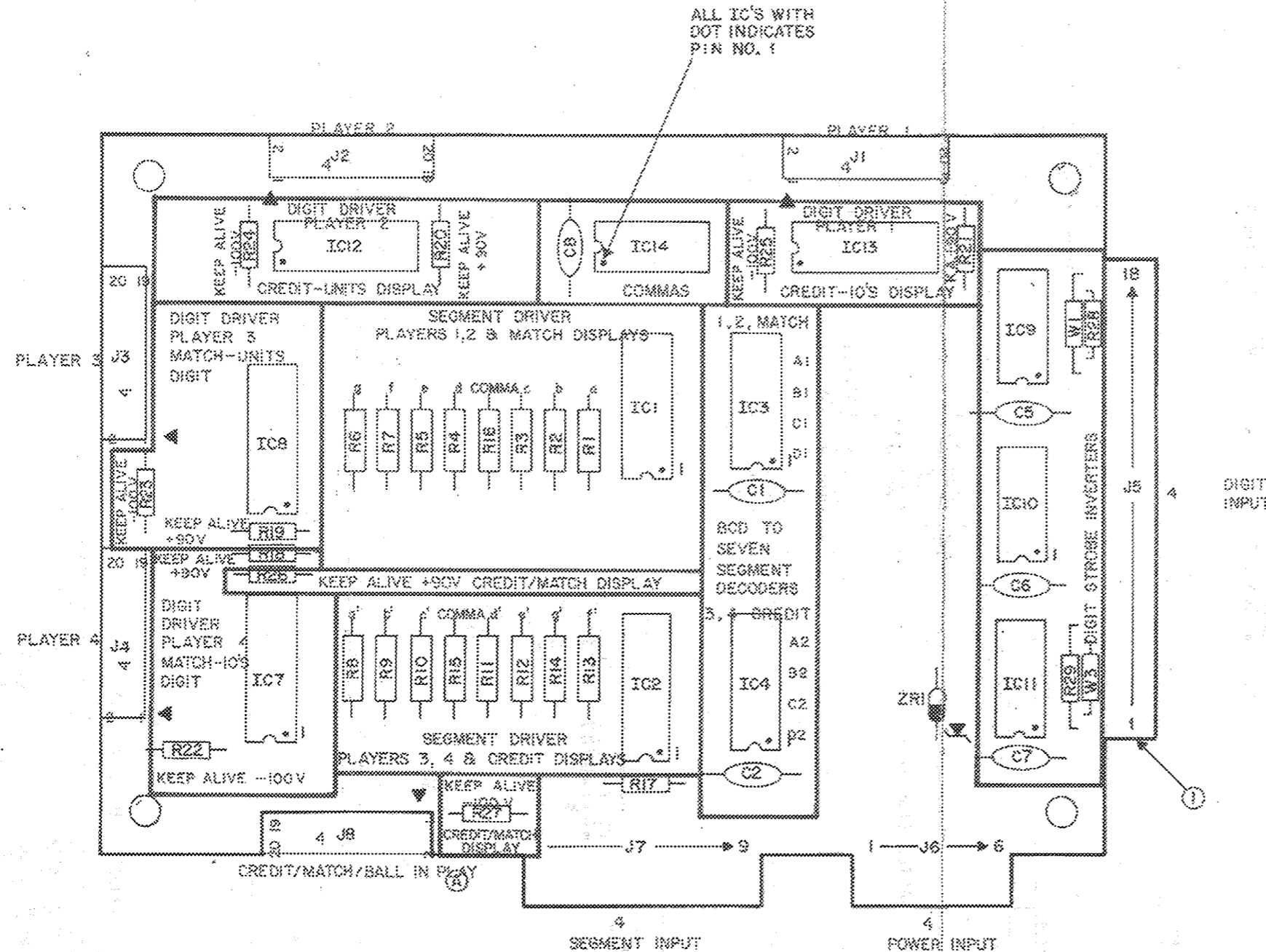
CREDITS / BALL IN PLAY



5J5

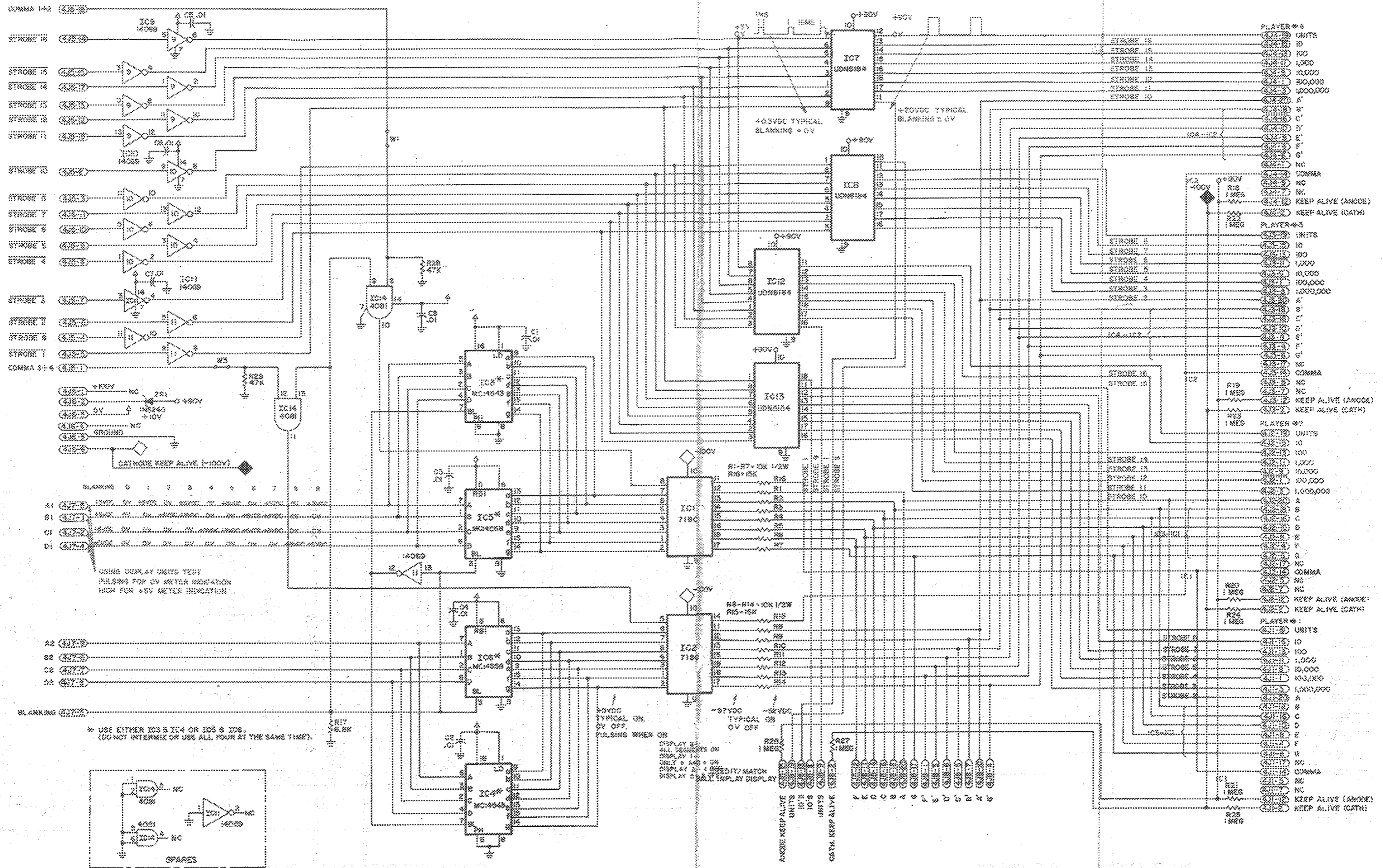
BILL OF MATERIAL

ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D NO.
1	5750-09461		BASE P.C. BOARD	1
2	5310-08971	IC3, IC10, IC11	MC14069 HEX INVERTER	3
3	5310-08970	IC3, IC4	MC14543 BCD TO SEVEN SEGMENT LATCH/DECODER/DRIVER	2
4	5680-08949	IC1, IC2	HDN-7180 GAS DISCHARGE DISPLAY SEGMENT DRIVER	2
5	5680-08948	IC7, IC8, IC12, IC13	HDN-6184A OR HDN-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	#X1	1N4740A ZENER DIODE 10V, 5%, 1 WATT	1
9	5043-08980	C1, C2 CS THIRD CS	CAPACITOR, CERAMIC, 0.01 HYD., 50V, +50 -50V	6
10	5010-09035	R28, R29	RESISTOR, FC, 47K OHM, 5%, 1/4 WATT	2
11	5010-09085	R17	RESISTOR, FC, 6.8K OHM, 5%, 1/4 WATT	1
12	5010-08982	R18 THRU R27	RESISTOR, FC, 5 NEG. OHM, 5%, 1/4 WATT	10
13	5791-09437	J1 THRU J4, J8	20 PIN DINNOR HEADER	5
14	5010-09149	R15, R16	RESISTOR, FC, 15K OHM, 5%, 1/2 WATT	2
15	5010-09534	R1, R3	RESISTOR, 0 OHM	2



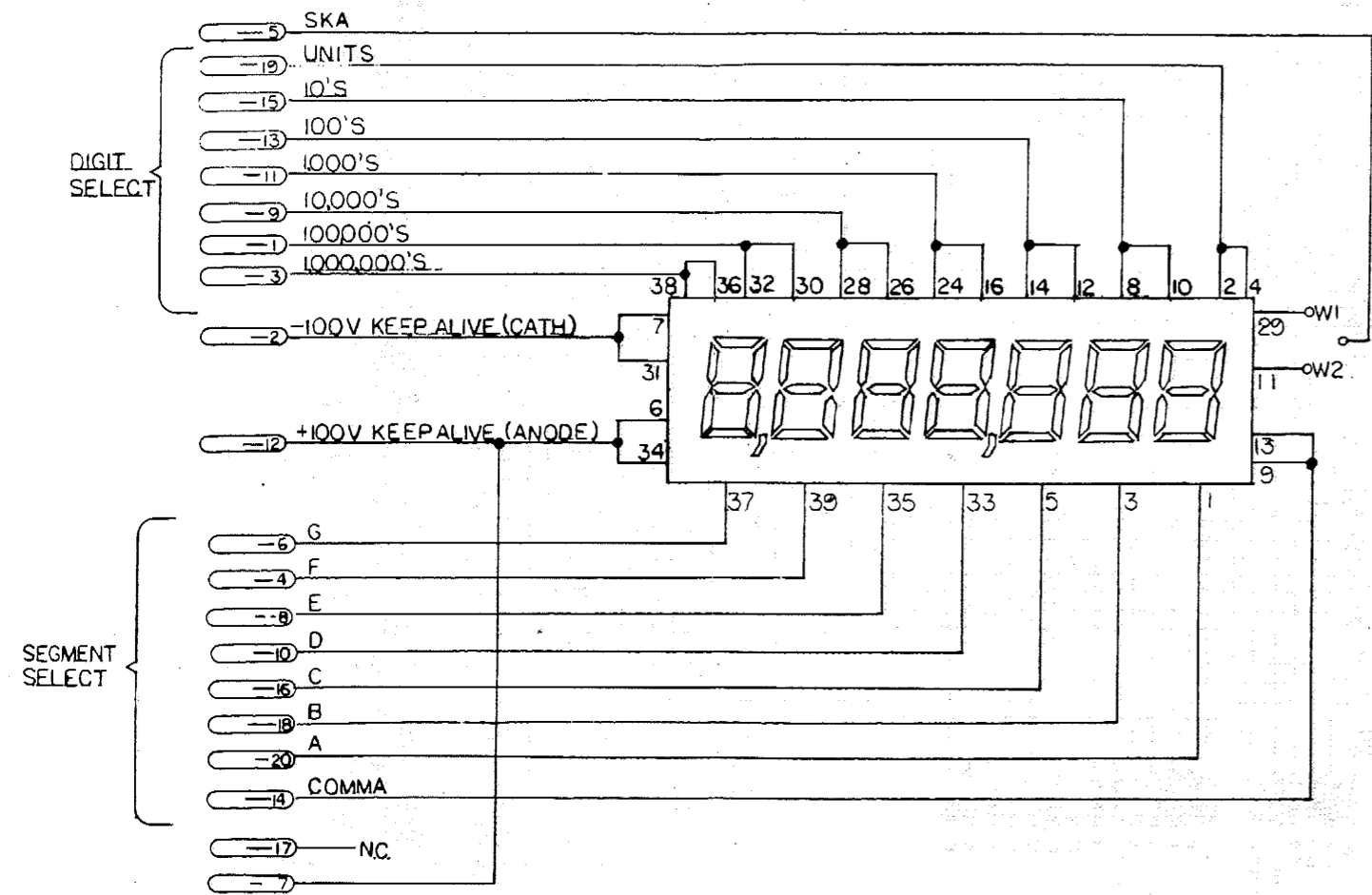
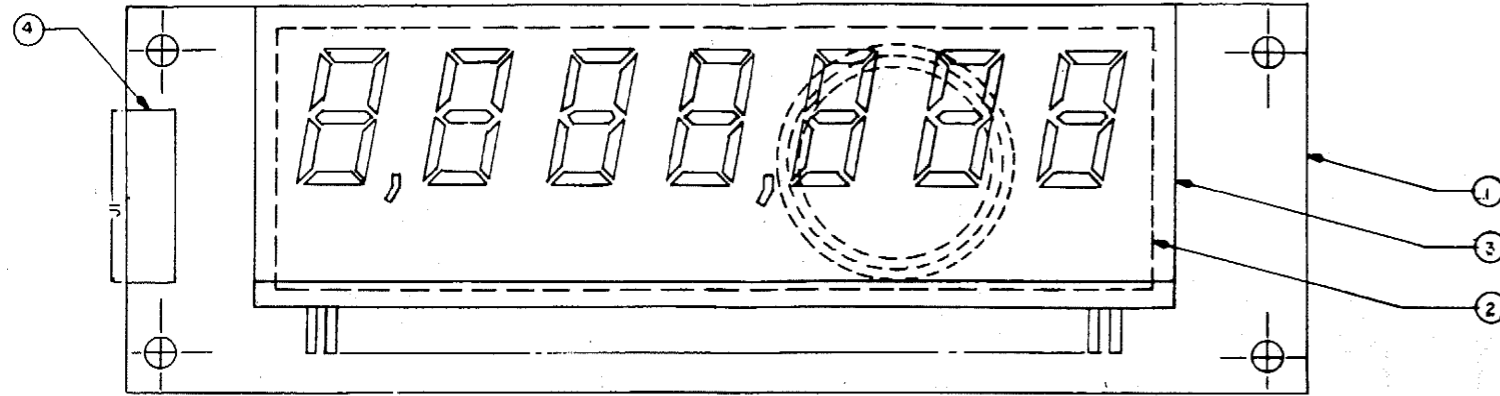
DIGIT CROSS REFERENCE

DIGIT	7-SEGMENT DECODER/DRIVER	STROBE INVERTER
0	IC3/IC1	1 (IC13)
1	IC3/IC1	2 (IC12)
2	IC3/IC1	3 (IC7)
3	IC3/IC1	4 (IC8)
4	IC3/IC1	5 (IC13)
5	IC3/IC1	6 (IC13)
6	IC3/IC1	7 (IC13)
7	IC3/IC1	8 (IC13)
8	IC3/IC1	9 (IC13)
9	IC3/IC1	10 (IC13)
10	IC3/IC1	11 (IC13)
11	IC3/IC1	12 (IC13)
12	IC3/IC1	13 (IC13)
13	IC3/IC1	14 (IC13)
14	IC3/IC1	15 (IC13)
15	IC3/IC1	16 (IC13)
16	IC3/IC1	17 (IC13)
17	IC3/IC1	18 (IC13)
18	IC3/IC1	19 (IC13)
19	IC3/IC1	20 (IC13)
20	IC3/IC1	21 (IC13)
21	IC3/IC1	22 (IC13)
22	IC3/IC1	23 (IC13)
23	IC3/IC1	24 (IC13)
24	IC3/IC1	25 (IC13)
25	IC3/IC1	26 (IC13)
26	IC3/IC1	27 (IC13)
27	IC3/IC1	28 (IC13)
28	IC3/IC1	29 (IC13)
29	IC3/IC1	30 (IC13)



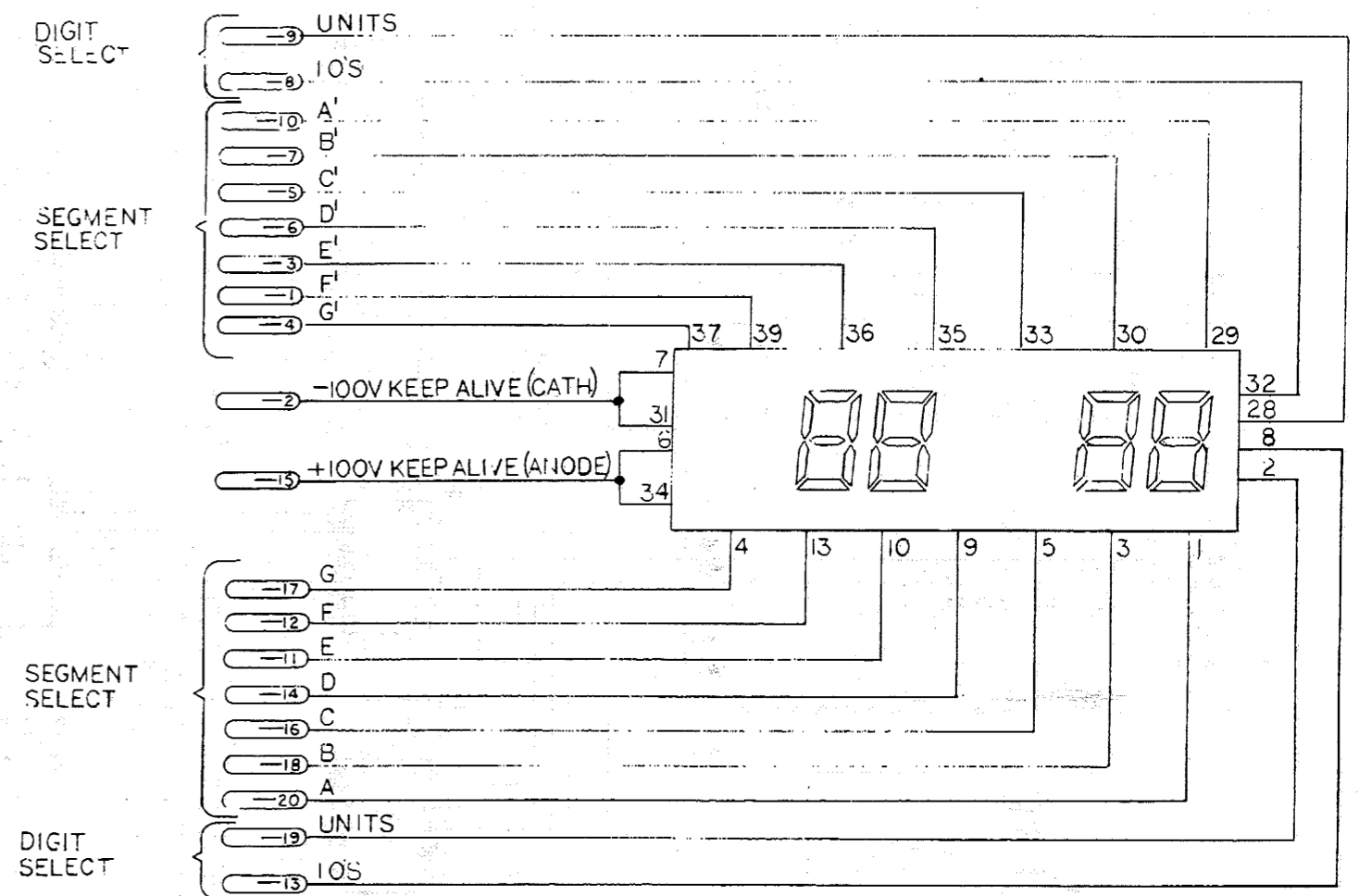
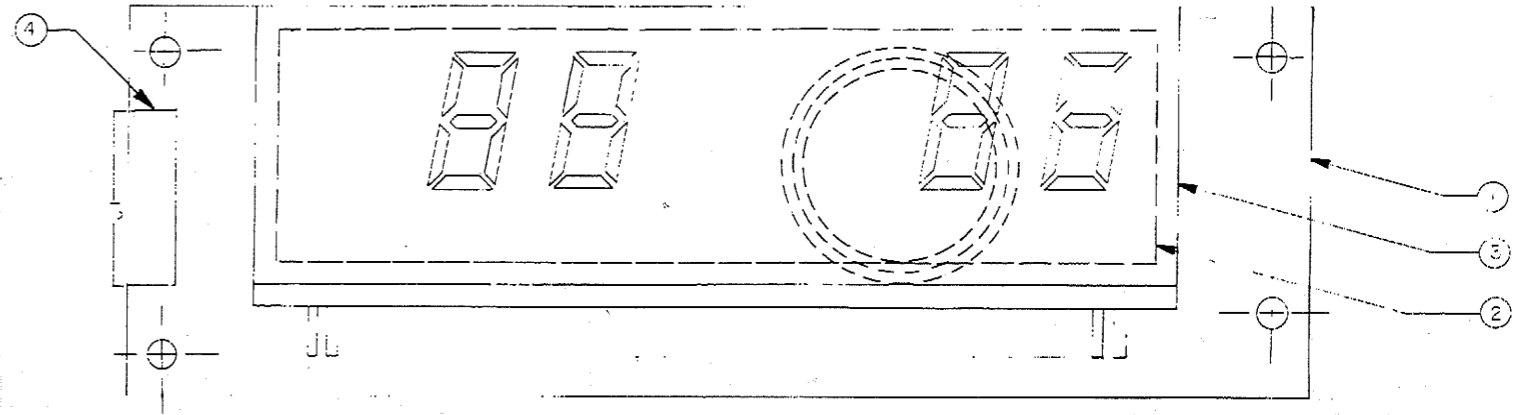
C 8363 Master Display Board Logic Diagram 21

BILL OF MATERIAL				
ITEM	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D.
1	5161-0544B-00		SLAVE DISPLAY P.C. BOARD	1
2	23-6545		DISPLAY MTG ADHESIVE FOAM	1
3	5670-0544B-00		7 DIGIT DISPLAY	1
4	5751-0541B-00	J1	20 PIN RIBBON HEADER	1
5	03-1513-2		CAPLUG	1

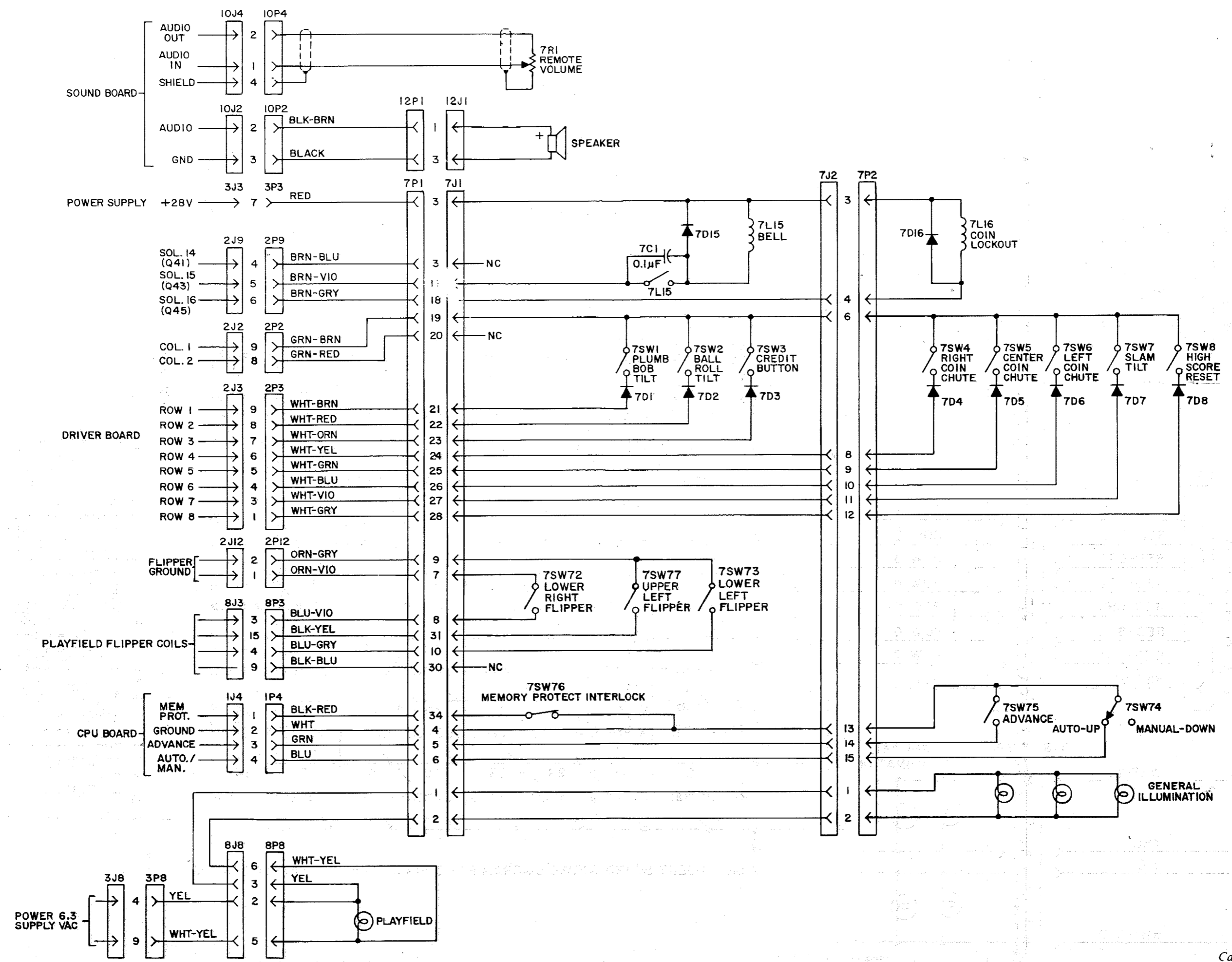


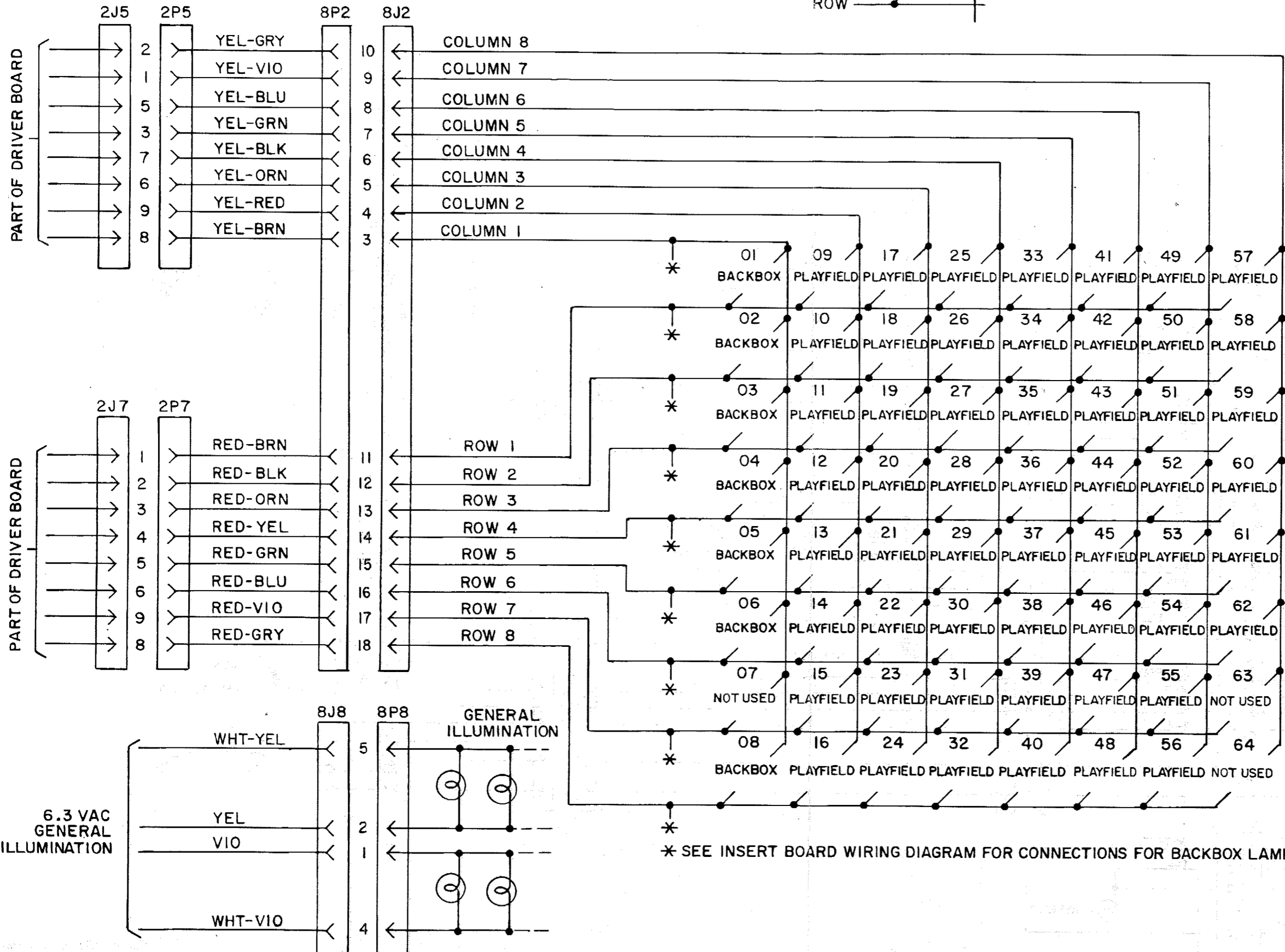
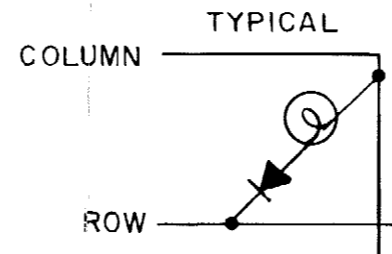
C 8364 PLAYER SLAVE DISPLAY

BILL OF MATERIAL				
ITEM	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D.
1	5161-0544B-00		CREDIT/MATCH SLAVE P.C. BOARD	1
2	23-6545		FOAM DISPLAY - BACK	1
3	5670-0544B-00		4 DIGIT DISPLAY	1
4	5751-0541B-00	J1	20 PIN RIBBON HEADER	1
5	23-6546		FOAM DISPLAY - FRONT	1
6	03-1513-2		CAPLUG	1



C 8365 CREDIT/MATCH SLAVE DISPLAY

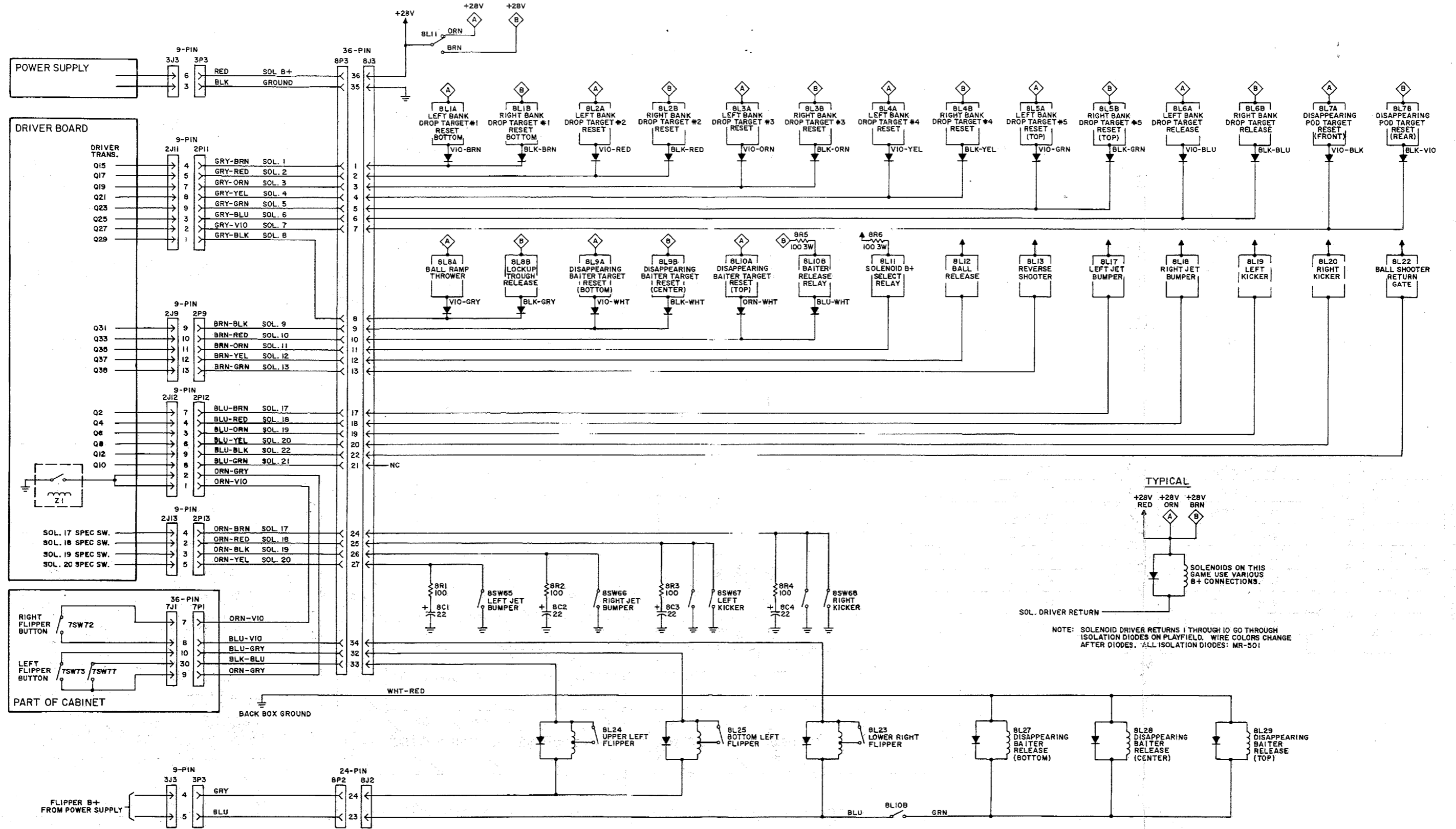




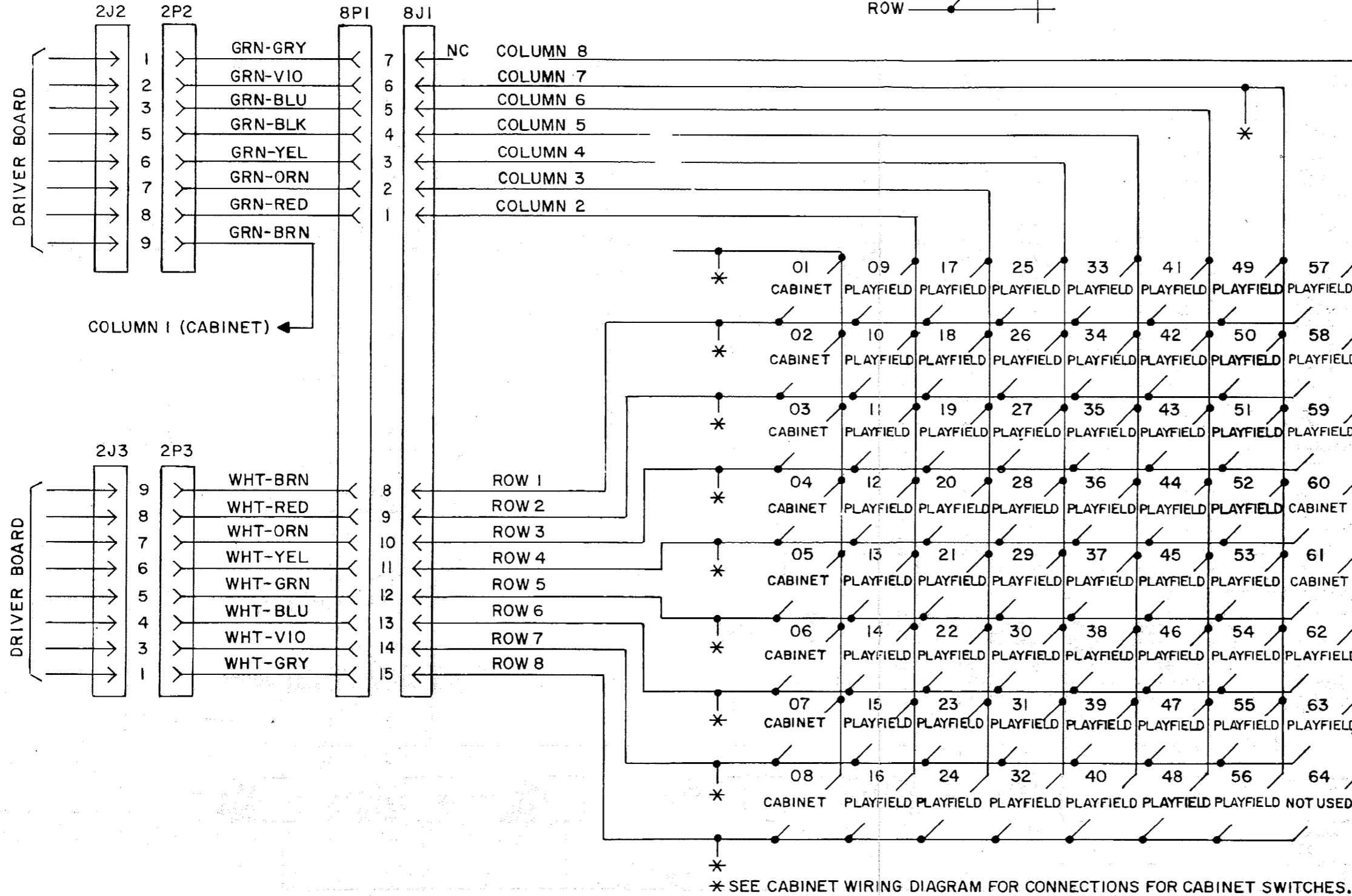
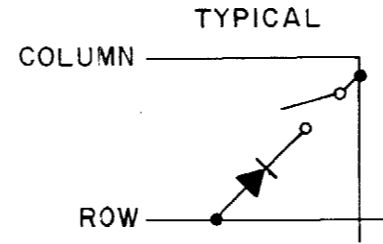
- Lamp No. Function**
- *01 Same Player Shoots Again
 - *02 Ball in Play
 - *03 Tilt
 - *04 Game Over
 - *05 Match
 - *06 High Score To Date
 - 07 Not Used
 - *08 Wave In Play
 - 09 Humanoid 1 (Left)
 - 10 Humanoid 2
 - 11 Humanoid 3
 - 12 Humanoid 4
 - 13 Humanoid 5
 - 14 Humanoid 6
 - 15 Humanoid 7
 - 16 Humanoid 8
 - 17 Humanoid 9
 - 18 Humanoid 10 (Right)
 - 19 Left Mutant 1 (Bottom)
 - 20 Left Mutant 2
 - 21 Left Mutant 3
 - 22 Left Mutant 4
 - 23 Left Mutant 5 (Top)
 - 24 Right Mutant 1 (Bottom)
 - 25 Right Mutant 2
 - 26 Right Mutant 3
 - 27 Right Mutant 4
 - 28 Right Mutant 5 (Top)
 - 29 Humanoid Value 1,000
 - 30 Humanoid Value -2,000
 - 31 Humanoid Value -3,000
 - 32 Humanoid Value -4,000
 - 33 Humanoid Value -5,000
 - 34 Humanoid Value Multiplier 2X
 - 35 Humanoid Value Multiplier 3X
 - 36 Humanoid Value Multiplier 4X
 - 37 Humanoid Value Multiplier 5X
 - 38 Humanoid Value Multiplier 10X
 - 39 Bomber Lane 1
 - 40 Bomber Lane 2
 - 41 Bomber Lane 3
 - 42 Bomber Lane 4
 - 43 Swarmer 1 (Upper Right)
 - 44 Swarmer 2 (Center Right)
 - 45 Swarmer 3 (Lower Right)
 - 46 Swarmer 4 (Lower Left)
 - 47 Swarmer 5 (Center Left)
 - 48 Swarmer 6 (Upper Left)
 - 49 Smart Bomb 1 (Bottom)
 - 50 Smart Bomb 2 (Center)
 - 51 Smart Bomb 3 (Top)
 - 52 Lockup 1
 - 53 Lockup 2
 - 54 Lockup 3
 - 55 Baiter 1 (Bottom)
 - 56 Baiter 2 (Center)
 - 57 Baiter 3 (Top)
 - 58 Same Player Shoots Again (Playfield)
 - 59 Warp W/Lit
 - 60 MULTI-BALL Play
 - 61 Reverse
 - 62 Gate
 - 63 Not Used
 - 64 Not Used

* SEE INSERT BOARD WIRING DIAGRAM FOR CONNECTIONS FOR BACKBOX LAMPS.

NOTE:
*Lamps 1 through 8 are located in Backbox.



Playfield Solenoid Wiring Diagram



- Switch**
- | No. | Function (Score*) |
|------|--|
| **01 | Plumb Bob Tilt |
| **02 | Ball Roll Tilt |
| **03 | Credit Button |
| **04 | Right Coin |
| **05 | Center Coin |
| **06 | Left Coin |
| **07 | Slam Tilt |
| **08 | High Score Reset |
| 09 | Bomber Lane 1 Rollover (1,000/3,000) |
| 10 | Bomber Lane 2 Rollover (1,000/3,000) |
| 11 | Bomber Lane 3 Rollover (1,000/3,000) |
| 12 | Bomber Lane 4 Rollover (1,000/3,000) |
| 13 | Left Lander Drop Target 1 (Bottom) (500/5,000) |
| 14 | Left Lander Drop Target 2 (500/5,000) |
| 15 | Left Lander Drop Target 3 (500/5,000) |
| 16 | Left Lander Drop Target 4 (500/5,000) |
| 17 | Left Lander Drop Target 5 (Top) (500/5,000) |
| 18 | Left Mutant Bull's Eye Target 1 (Bottom) (10/2,000) |
| 19 | Left Mutant Bull's Eye Target 2 (10/2,000) |
| 20 | Left Mutant Bull's Eye Target 3 (10/2,000) |
| 21 | Left Mutant Bull's Eye Target 4 (10/2,000) |
| 22 | Left Mutant Bull's Eye Target 5 (Top) (10/2,000) |
| **23 | Right Lander Drop Target 1 (Bottom) (500/5,000) |
| **24 | Right Lander Drop Target 2 (500/5,000) |
| **25 | Right Lander Drop Target 3 (500/5,000) |
| **26 | Right Lander Drop Target 4 (500/5,000) |
| **27 | Right Lander Drop Target 5 (Top) (500/5,000) |
| 28 | Right Mutant Bull's Eye Target 1 (Bottom) (10/2,000) |
| 29 | Right Mutant Bull's Eye Target 2 (10/2,000) |
| 30 | Right Mutant Bull's Eye Target 3 (10/2,000) |
| 31 | Right Mutant Bull's Eye Target 4 (10/2,000) |
| 32 | Right Mutant Bull's Eye Target 5 (Top) (10/2,000) |
| 33 | Disappearing Baiter Target (Bottom) (3,000) |
| 34 | Disappearing Baiter Target (Center) (3,000) |
| 35 | Disappearing Baiter Target (Top) (3,000) |
| 36 | Swarmer Bull's Eye Target (Top) (10/3,000) |
| 37 | Swarmer Bull's Eye Target (Bottom) (10/3,000) |
| 38 | Swarmer Standup (10/3,000) |
| 39 | Disappearing Pod Target (Bottom) (10,000) |
| 40 | Disappearing Pod Target (Top) (10,000) |
| 41 | Pod Bull's Eye Target (10,000) |
| 42 | Lockup Trough (Bottom) |
| 43 | Lockup Trough (Center) |
| 44 | Lockup Trough (Top) |
| 45 | Lockup Trough Rollover |
| 46 | Outhole |
| 47 | Ball Ramp (Right) |
| 48 | Ball Ramp (Center) |
| 49 | Ball Ramp (Left) |
| 50 | Ball Shooter Trough |
| 51 | Left Outlane (5,000) |
| 52 | Right Outlane (5,000) |
| 53 | Left Flipper Return Lane (3,000) |
| 54 | Right Flipper Return Lane (3,000) |
| 55 | Left Jet Bumper (1,000) |
| 56 | Right Jet Bumper (1,000) |
| 57 | Left Kicker (10) |
| 58 | Right Kicker (10) |
| 59 | Flipper Lane Change Switch |
| **60 | Smart Bomb |
| **61 | Reverse |
| 62 | Not Used |
| 63 | Playfield Tilt |
| 64 | Not Used |

NOTES:
 *Second Value when lit or flashing
 **Switches 1 through 8 and 60 and 61 are located in cabinet.