

# the pinball BOOK

## **DRAWING SETS FOR SYSTEMS 7 & 8**

- **schematic and logic diagrams**
- **game pricing**
- **troubleshooting**
- **function-finder glossary**
- **parts**

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# **CHAPTER 1**

## **Level-7 Drawings**

# Game Pricing

**PRICING MADE EASY.** Function 19 allows a *shorthand* method of setting the pricing functions. If a number from one to eight is entered into function 19, a corresponding standard setting (shown in the **Pricing Table**) will be entered into the game. *The rest of the pricing functions are automatically set for that standard.*

**FOR CUSTOM SETTINGS** first set function 19 to zero. Then set the remaining values according to the **Pricing Table**.

**THE GAMES : PRICE RATIO** is equivalent to the ratio  $X : VS$ , where:

- X = COIN-SLOT MULTIPLIER (the number at function 20, 21 or 22)
- V = COIN VALUE
- S = COIN UNITS REQUIRED FOR CREDIT (the number at function 23)

For example at factory settings with quarter chutes the variables produce 1 : 25x1 or one game for 25¢.

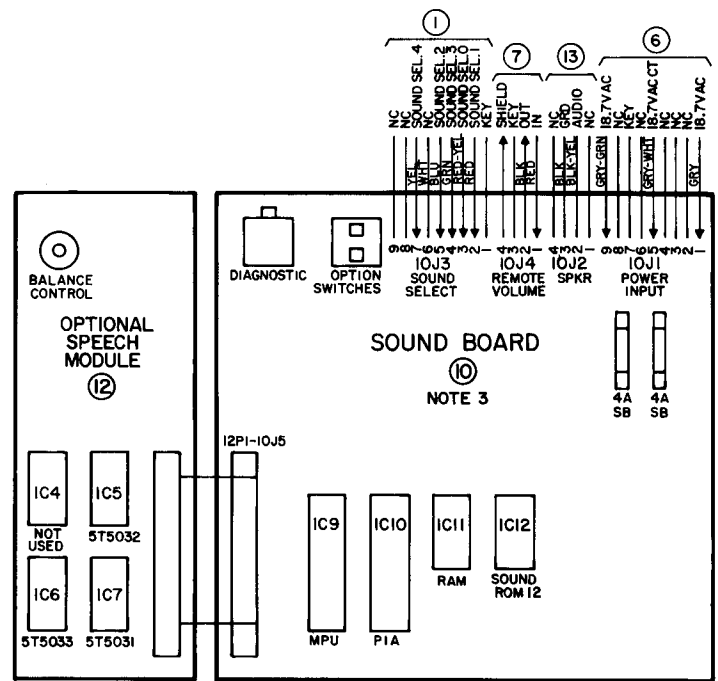
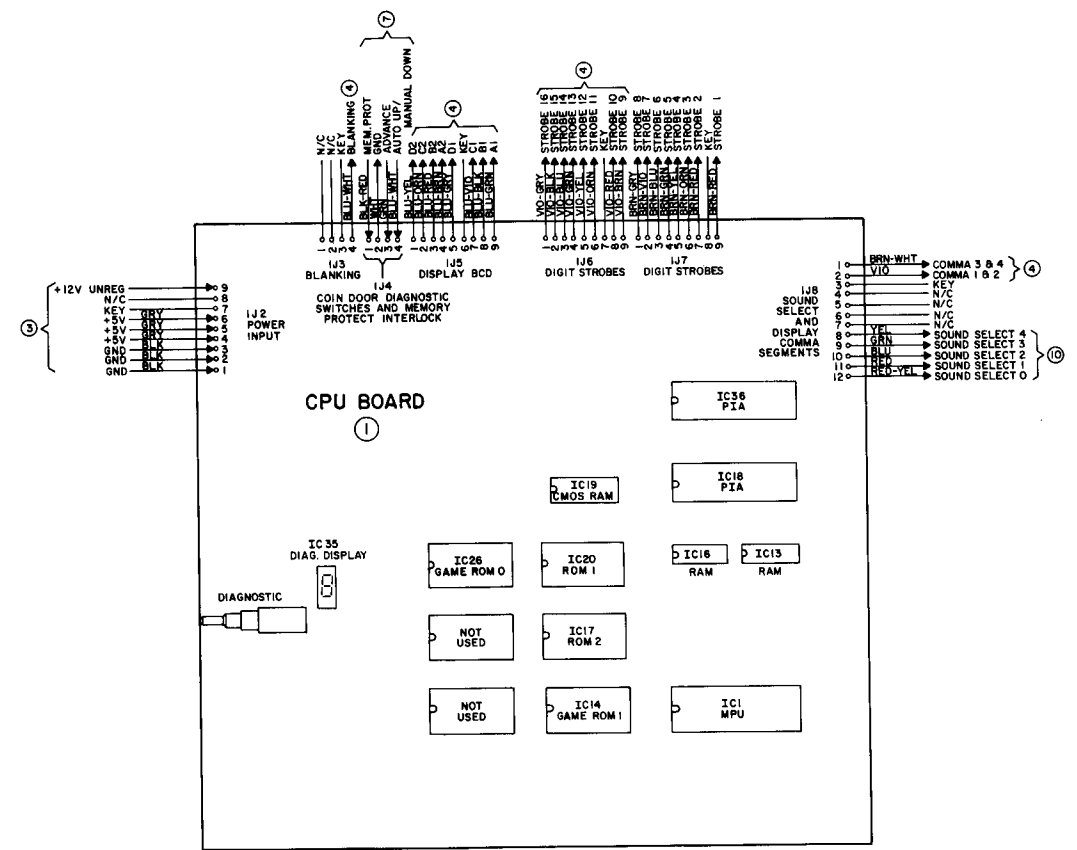
*Handwritten notes:*  
 1 PLAY  
 2 PLAYS  
 5 PLAYS  
 3x1F  
 SF  
 10F  
 LEFT  
 CENTER  
 RIGHT

*Handwritten notes:*  
 4 ( 2 20 10 5 200

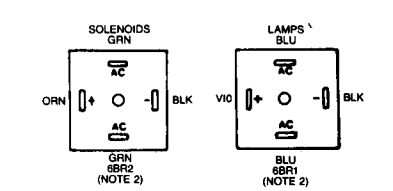
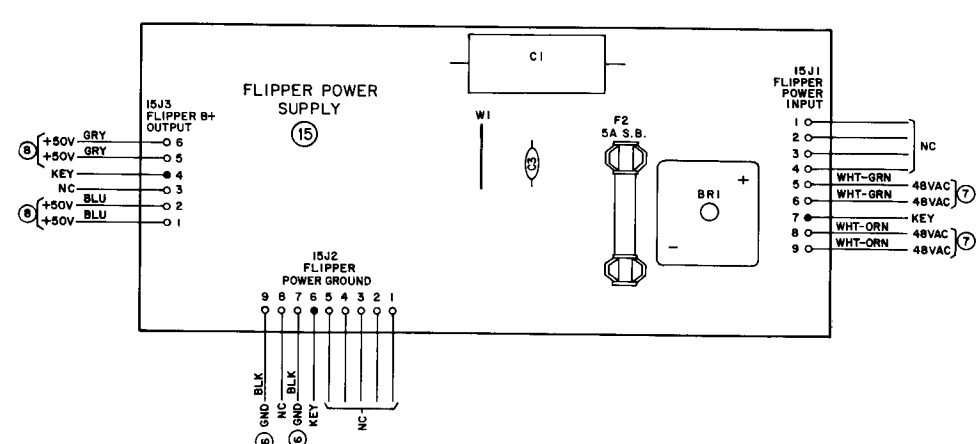
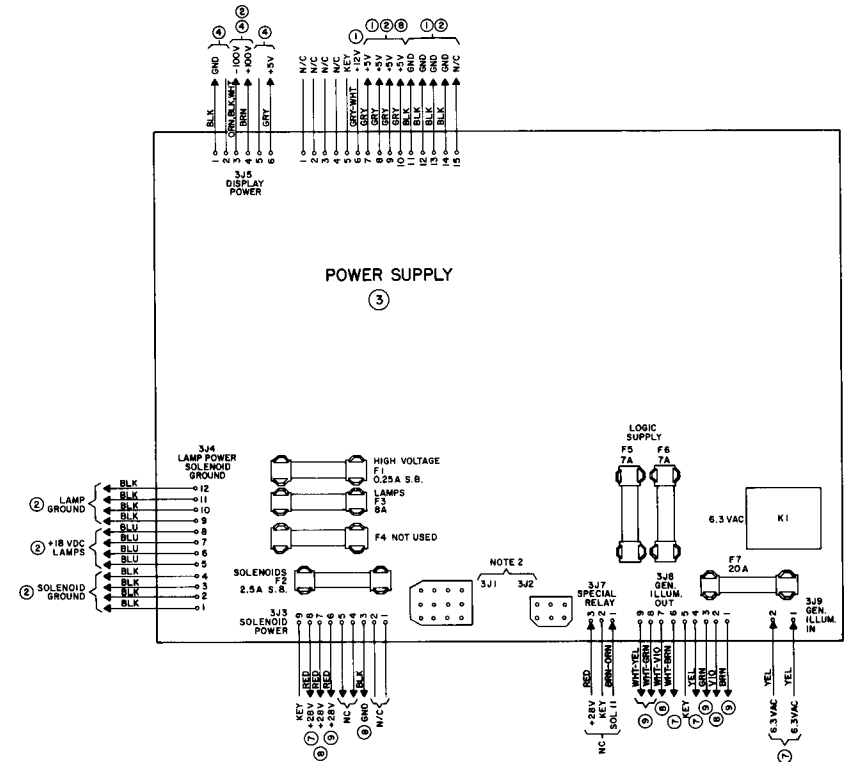
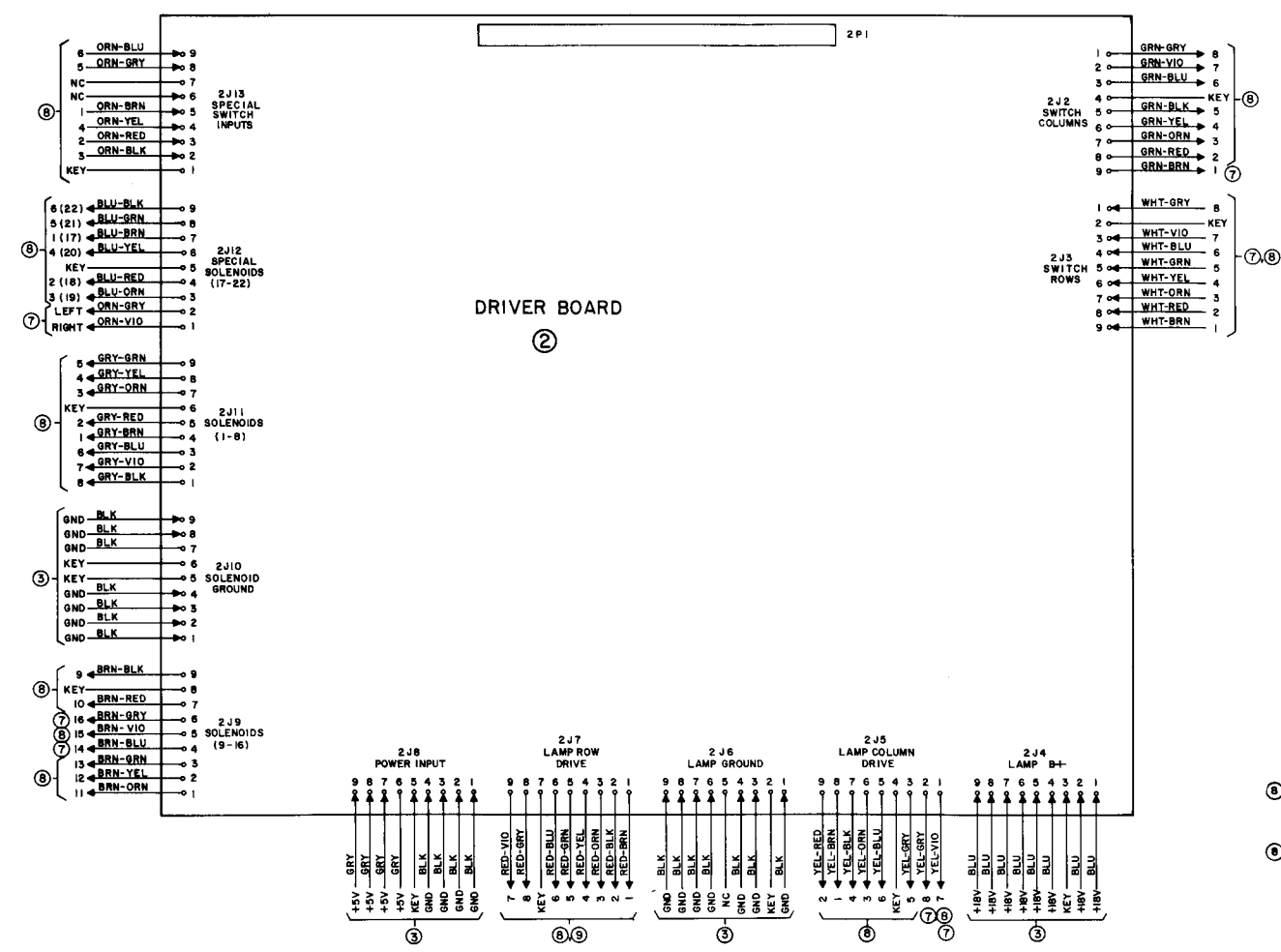
Pricing Table

\*Indicates standard settings by adjusting ONLY function 19

COIN-DOOR MECHANISM	GAMES/PRICE	FUNCTION							
		19	20	21	22	23	24	25	
Twin-Quarter or Quarter, Dollar, Quarter	•1/25¢, 4/\$1	1	1	4	1	1	0	0	
	•1/50¢, 3/\$1, 6/\$2	3	1	4	1	2	4	0	
	•1/50¢, 2/75¢, 3/4 × 25¢, 4/\$1	5	3	15	3	4	15	0	
	2/25¢, 8/\$1	0	2	8	2	1	0	0	
	1/25¢, 3/50¢, 6/\$1	0	1	4	1	1	2	0	
	1/25¢, 5/\$1	0	1	4	1	1	4	0	
	1/25¢	0	1	4	1	1	0	0	
	1/25¢, 3/50¢, 6/4 × 25¢, 7/\$1	0	3	14	3	2	0	0	
1DM, 5DM, 2DM	1/50¢	0	1	4	1	2	0	0	
	•1/1DM, 3/2DM, 10/5DM 2/1DM, 5/2DM, 14/5DM	2	9	45	18	5	45	0	
20¢, 50¢	1/20¢, 3/50¢	0	6	0	15	5	0	0	
1F, 10F, 5F	•1/2F, 3/5F only, 8/10F only	4	1	16	6	2	0	0	
25-Cent, 1 Guilder	•1/25¢, 4/1G 1/25¢, 5/1G	6	1	0	4	1	0	0	
5-Franc, 10 Franc	1/25¢, 5/1G	0	1	0	4	1	4	0	
	•1/5F, 2/10F •1/10F	7	1	0	2	1	0	0	
1-Franc or Twin 1-Franc	1/1F, 3/2F 1/1F	0	1	1	1	1	2	0	
Twin-2 Franc	•1/2F, 3/4F	3	1	4	1	2	4	0	
10 Franc, 20 Franc	•1/10F, 2/20F	7	1	0	2	1	0	0	
Twin 100-Yen	2/100Y	0	2	0	2	1	0	0	
100 Lire, 200 Lire	•1/200 Lire	8	1	0	2	2	0	0	
Twin-1 Sucre	1/3S, 2/5S	0	2	0	2	5	0	0	
Any	Free Play	set function 18 to 0 for free play							

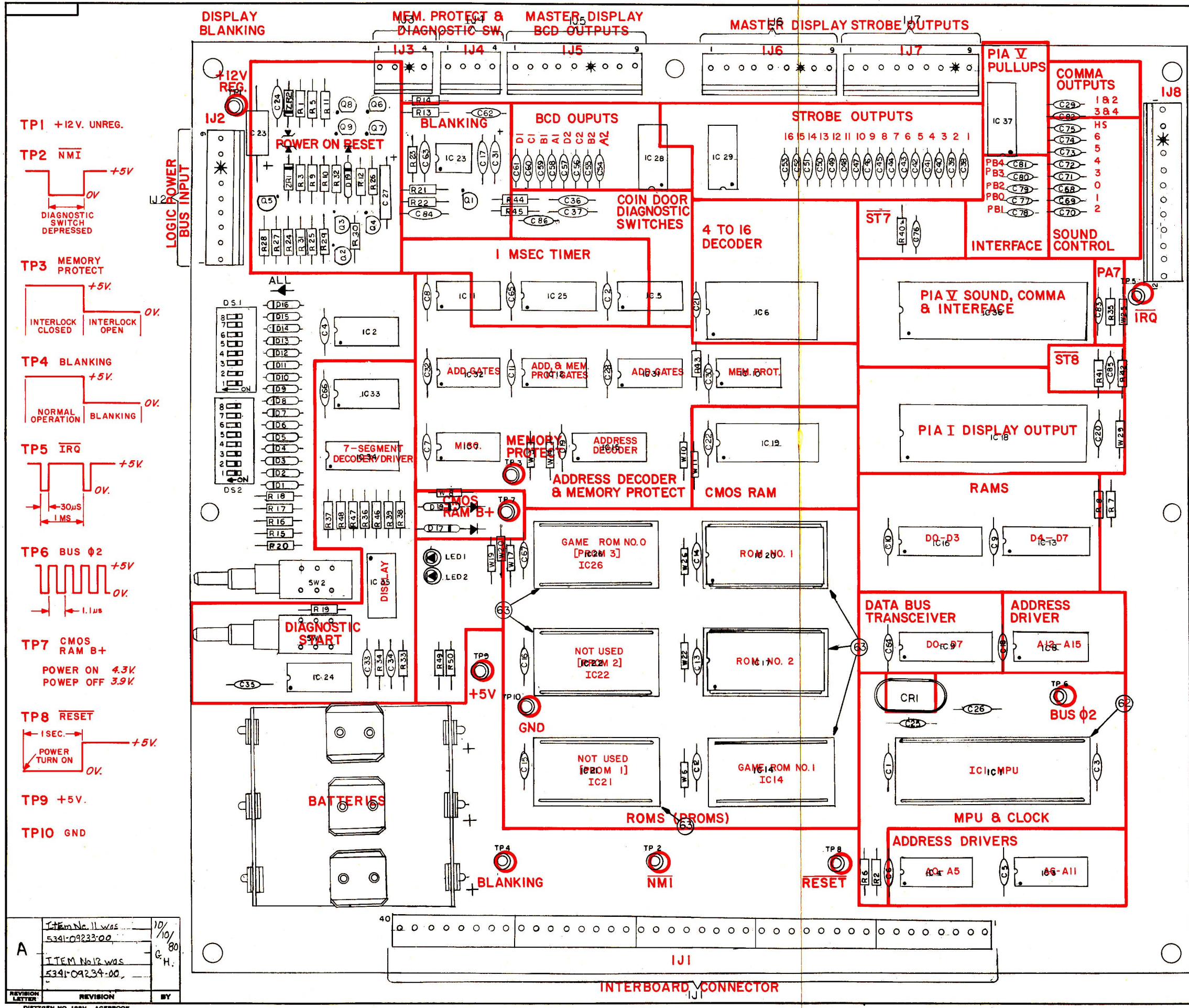


- NOTES:**
- CONNECTIONS ARE INDICATED BY CIRCLED NUMBERS AS FOLLOWS:
    - ① CPU BOARD
    - ② DRIVER BOARD
    - ③ POWER SUPPLY BOARD
    - ④ MASTER DISPLAY BOARD
    - ⑤ SLAVE DISPLAY BOARD
    - ⑥ BACKBOX
    - ⑦ CABINET
    - ⑧ PLAYFIELD
    - ⑨ INSERT BOARD
    - ⑩ SOUND BOARD
    - ⑪ OPTIONAL SPEECH MODULE
    - ⑫ NOT ASSIGNED
    - ⑬ NOT ASSIGNED
    - ⑭ NOT ASSIGNED
    - ⑮ FLIPPER POWER SUPPLY
  - REFER TO POWER WIRING DIAGRAM FOR CONNECTIONS TO 3PI.



**BILL OF MATERIAL  
FLIPPER POWER SUPPLY C-9939**

ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION
1	5768-09725-00		BARE P.C. BOARD
2	5100-09690-00	BR1	BRDG. REC. 35A 200V
3	5040-09794-00	C1	CAP. ELECTROLYTIC 100 uf 250V AXIAL
4	5043-09072-00	C3	CAP. CERAMIC 0.1 uf 500V
5	5731-09651-00	F2	FUSE 5A S.B. 250V
6	5732-09178-00		FUSE HOLDER
7	5791-09453-00	15J1 & 15J2	9 PIN HEADER
8	5791-09038-00	15J3	6 PIN HEADER

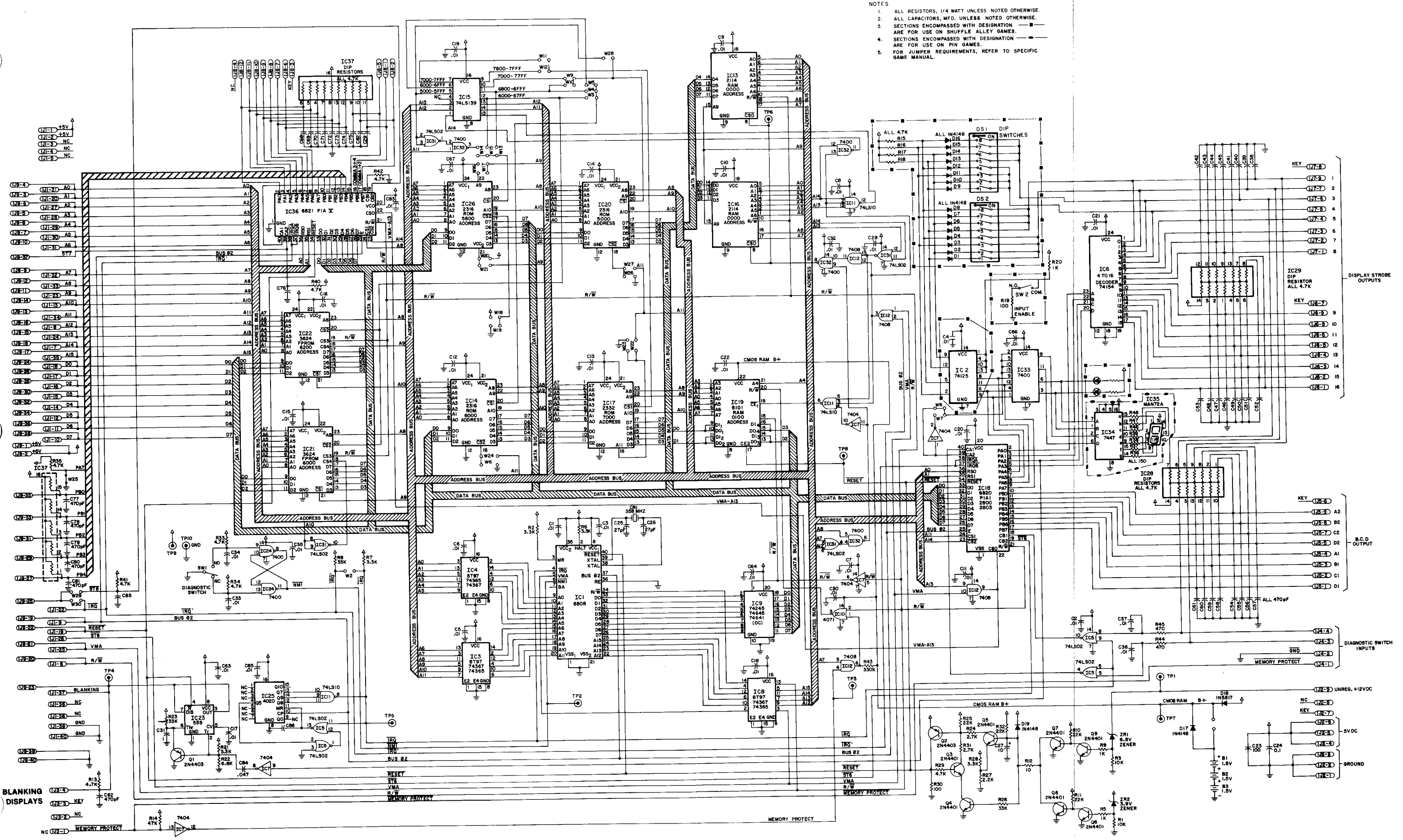


BILL OF MATERIAL				
ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQD. NO.
1	5764-09465-X0	IC2	BARE PC. BOARD CPU	1
2	5280-09408-X0	IC2	74125 HEX TRISTATE BUFFER	1
3	5370-08989-00	IC3,IC4,IC8	8197 HEX TRISTATE BUFFER	3
4	5281-09308-X0	IC9	74LS245 OCTAL BUFFER	1
5	5280-09010-00	IC6	74154 4 TO 16 DECODER	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 4K X8 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 1455 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	IC31,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 4.7K OHM	2
23	5019-09233-00	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	5070-08919-00	DI-017,DI19	IN4148 DIODE	18
28	5160-08938-00	Q3-Q9	2N4401 NPN TRANSISTOR	7
29	5180-09016-00	Q1,Q2	2N4403 PNP TRANSISTOR	2
30	5070-09266-00	D18	IN5817 DIODE	1
31	5520-09020-00	CRI	CRYSTAL 3.58 MHZ	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	5010-09024-00	R1,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-C22,C28,C30,C32-C37,C63-C67,C85	CAPACITOR CERAMIC 101MED 50V	36
47	5040-08986-00	C23	CAPACITOR ELECT. 100MFD 10V	1
48	5043-08996-00	C24	CAPACITOR CERAMIC 1MED 50V	1
49	5043-09169-00	C25,C26	CAPACITOR CERAMIC 27PFD 10V	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 0.47MFD 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	H1	HEADER 09-64-1083 8 PIN	5
58	5791-09028-00	H3,H4	HEADER 09-65-1041 4 PIN	2
59				
60	5791-09027-00	H2,H5-H7	HEADER 09-65-1091 9 PIN	4
61	5791-09043-00	H8	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,W23,W26,W28,W22	RESISTOR FC 0 OHM 1/4W	13
65	5824-09248-00	TP1-TP10	TEST TERMINALS #1502-1	10

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

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

TOLERANCES		UNLESS OTHERWISE SPECIFIED	
FRACTIONAL	±1/64"	DECIMAL	±.0005"
DECIMAL	±.0005"	HOLE DIA.	±.0008"
ANGULAR	±1/2°	CONCENTRICITY	±1/16" DIA.
SCREW THREADS	CLASS 2	MATERIAL	HEAT TREATMENT
DWG. NO.	DATE	APP'D.	SCALE
58085	9-20-80		D-8342



- NOTES
1. ALL RESISTORS, 1/4 WATT UNLESS NOTED OTHERWISE.
  2. ALL CAPACITORS, MFD. UNLESS NOTED OTHERWISE.
  3. SECTIONS ENCOMPASSED WITH DESIGNATION ARE FOR USE ON SHUFFLE ALLEY GAMES.
  4. SECTIONS ENCOMPASSED WITH DESIGNATION ARE FOR USE ON PIN GAMES.
  5. FOR JUMPER REQUIREMENTS, REFER TO SPECIFIC GAME MANUAL.

(N1-1) +5V  
 (N1-2) +5V  
 (N1-3) NC  
 (N1-4) NC  
 (N1-5) NC

(N1-6) (N1-2) A0  
 (N1-7) (N1-2) A1  
 (N1-8) (N1-2) A2  
 (N1-9) (N1-2) A3  
 (N1-10) (N1-2) A4  
 (N1-11) (N1-2) A5  
 (N1-12) (N1-2) A6  
 (N1-13) (N1-2) A7  
 (N1-14) (N1-2) A8  
 (N1-15) (N1-2) A9  
 (N1-16) (N1-2) A10  
 (N1-17) (N1-2) A11  
 (N1-18) (N1-2) A12  
 (N1-19) (N1-2) A13  
 (N1-20) (N1-2) A14  
 (N1-21) (N1-2) A15  
 (N1-22) (N1-2) D0  
 (N1-23) (N1-2) D1  
 (N1-24) (N1-2) D2  
 (N1-25) (N1-2) D3  
 (N1-26) (N1-2) D4  
 (N1-27) (N1-2) D5  
 (N1-28) (N1-2) D6  
 (N1-29) (N1-2) D7  
 (N1-30) (N1-2) +5V  
 (N1-31) (N1-2) +5V  
 (N1-32) (N1-2) +5V  
 (N1-33) (N1-2) +5V  
 (N1-34) (N1-2) +5V  
 (N1-35) (N1-2) +5V  
 (N1-36) (N1-2) +5V  
 (N1-37) (N1-2) +5V  
 (N1-38) (N1-2) +5V  
 (N1-39) (N1-2) +5V  
 (N1-40) (N1-2) +5V

(N1-41) (N1-2) +5V  
 (N1-42) (N1-2) +5V  
 (N1-43) (N1-2) +5V  
 (N1-44) (N1-2) +5V  
 (N1-45) (N1-2) +5V  
 (N1-46) (N1-2) +5V  
 (N1-47) (N1-2) +5V  
 (N1-48) (N1-2) +5V  
 (N1-49) (N1-2) +5V  
 (N1-50) (N1-2) +5V  
 (N1-51) (N1-2) +5V  
 (N1-52) (N1-2) +5V  
 (N1-53) (N1-2) +5V  
 (N1-54) (N1-2) +5V  
 (N1-55) (N1-2) +5V  
 (N1-56) (N1-2) +5V  
 (N1-57) (N1-2) +5V  
 (N1-58) (N1-2) +5V  
 (N1-59) (N1-2) +5V  
 (N1-60) (N1-2) +5V

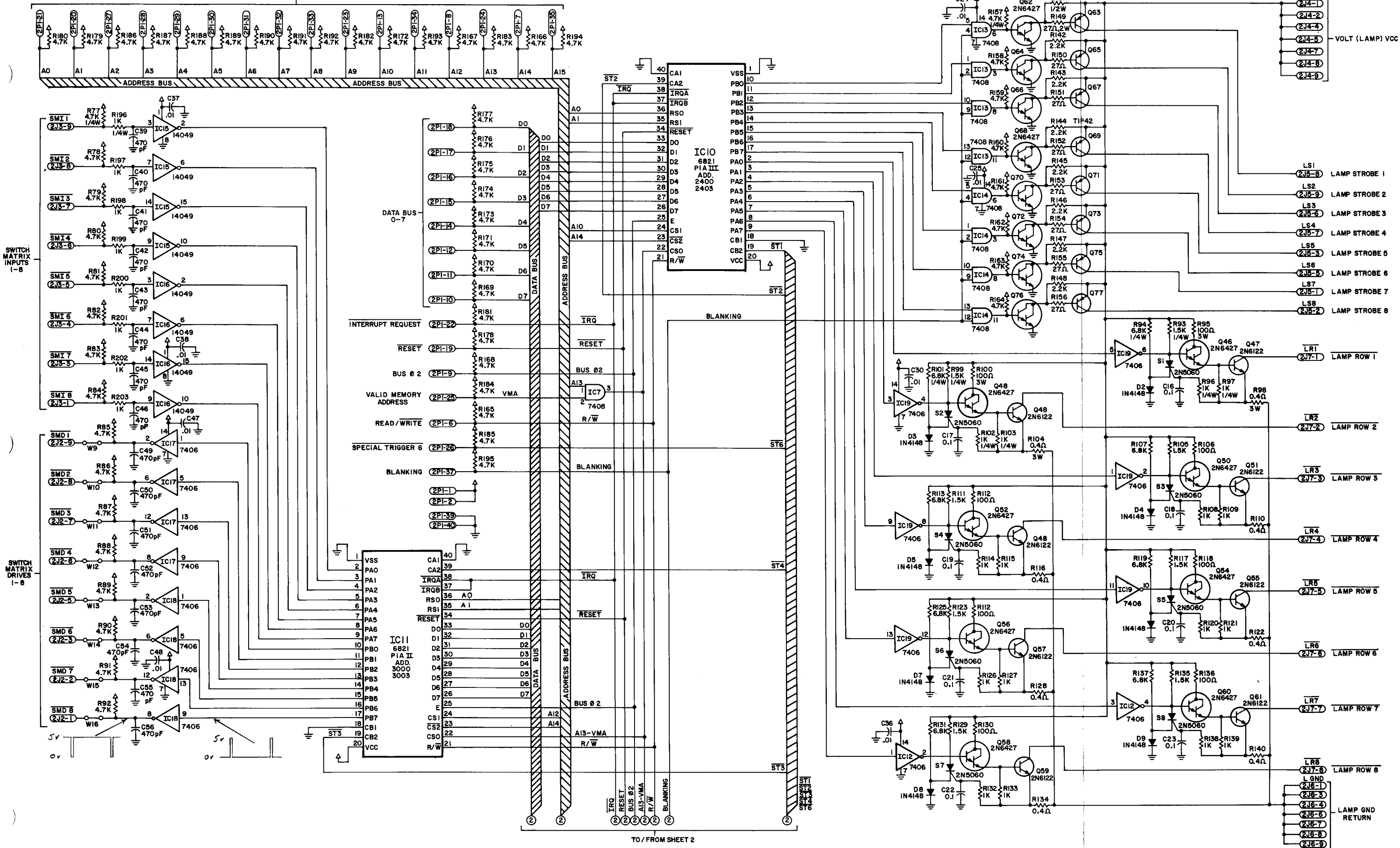
(N1-61) (N1-2) +5V  
 (N1-62) (N1-2) +5V  
 (N1-63) (N1-2) +5V  
 (N1-64) (N1-2) +5V  
 (N1-65) (N1-2) +5V  
 (N1-66) (N1-2) +5V  
 (N1-67) (N1-2) +5V  
 (N1-68) (N1-2) +5V  
 (N1-69) (N1-2) +5V  
 (N1-70) (N1-2) +5V  
 (N1-71) (N1-2) +5V  
 (N1-72) (N1-2) +5V  
 (N1-73) (N1-2) +5V  
 (N1-74) (N1-2) +5V  
 (N1-75) (N1-2) +5V  
 (N1-76) (N1-2) +5V  
 (N1-77) (N1-2) +5V  
 (N1-78) (N1-2) +5V  
 (N1-79) (N1-2) +5V  
 (N1-80) (N1-2) +5V

(N1-81) (N1-2) +5V  
 (N1-82) (N1-2) +5V  
 (N1-83) (N1-2) +5V  
 (N1-84) (N1-2) +5V  
 (N1-85) (N1-2) +5V  
 (N1-86) (N1-2) +5V  
 (N1-87) (N1-2) +5V  
 (N1-88) (N1-2) +5V  
 (N1-89) (N1-2) +5V  
 (N1-90) (N1-2) +5V  
 (N1-91) (N1-2) +5V  
 (N1-92) (N1-2) +5V  
 (N1-93) (N1-2) +5V  
 (N1-94) (N1-2) +5V  
 (N1-95) (N1-2) +5V  
 (N1-96) (N1-2) +5V  
 (N1-97) (N1-2) +5V  
 (N1-98) (N1-2) +5V  
 (N1-99) (N1-2) +5V  
 (N1-100) (N1-2) +5V



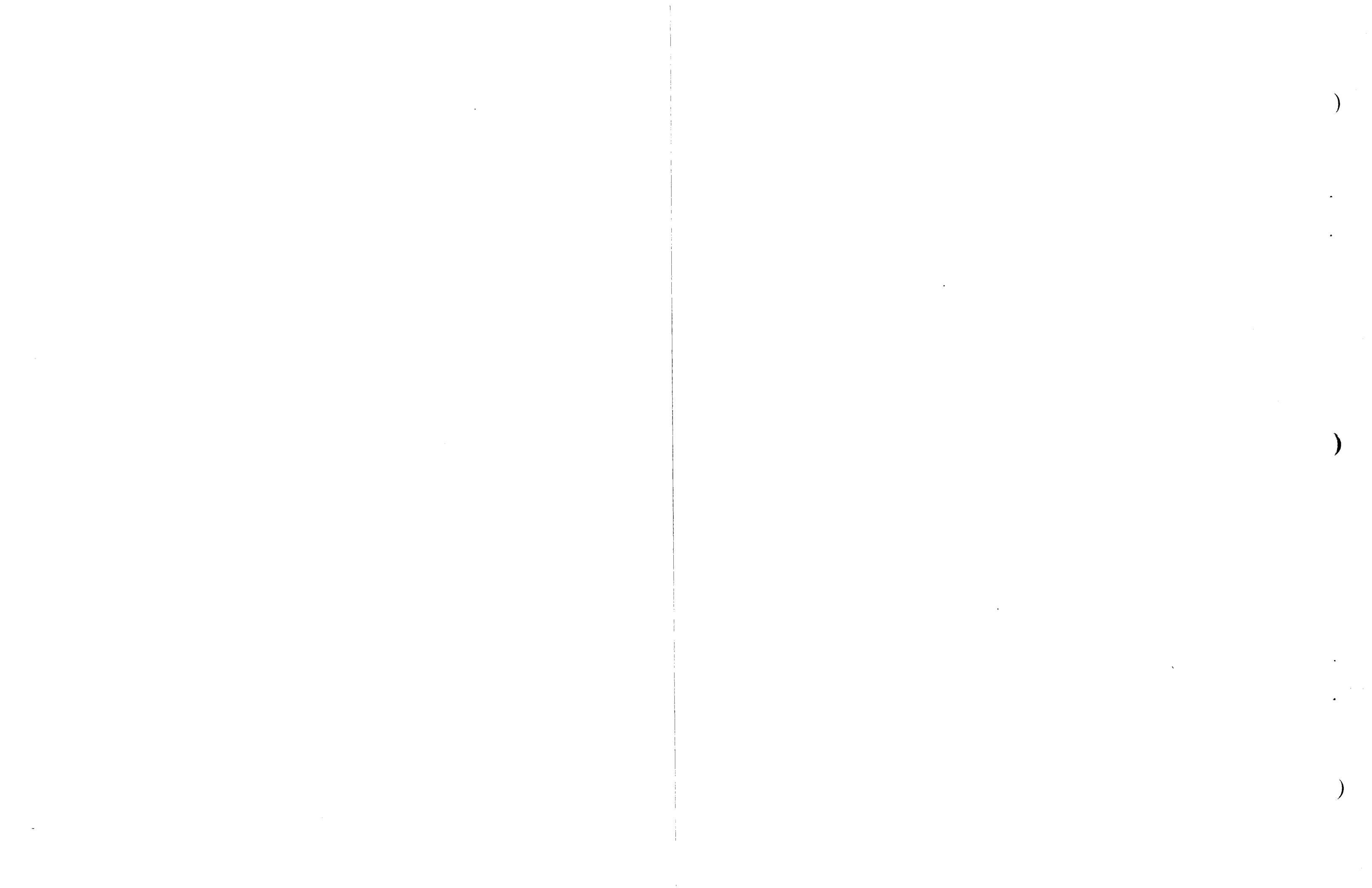


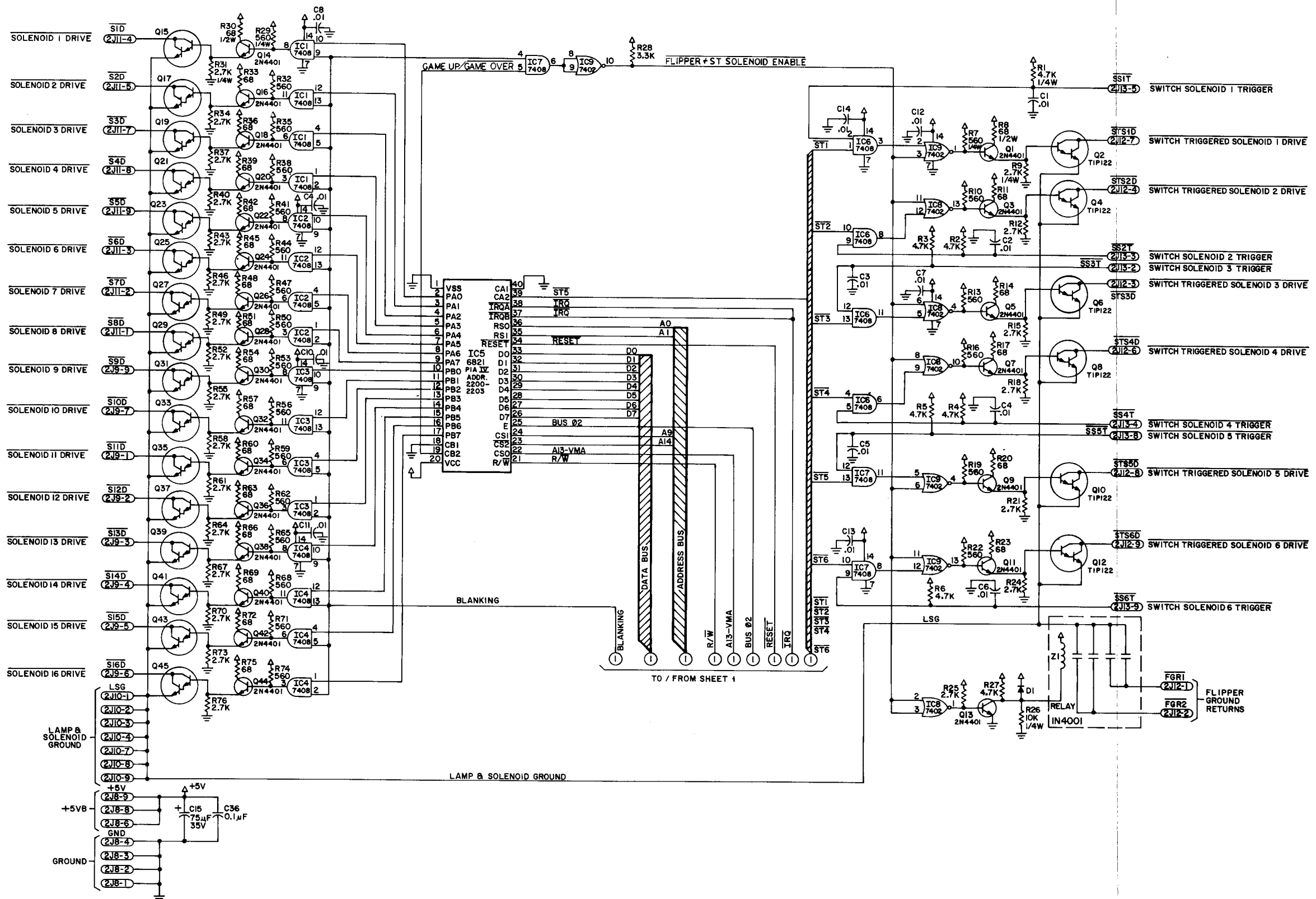
ADDRESS BUS 0 - 15



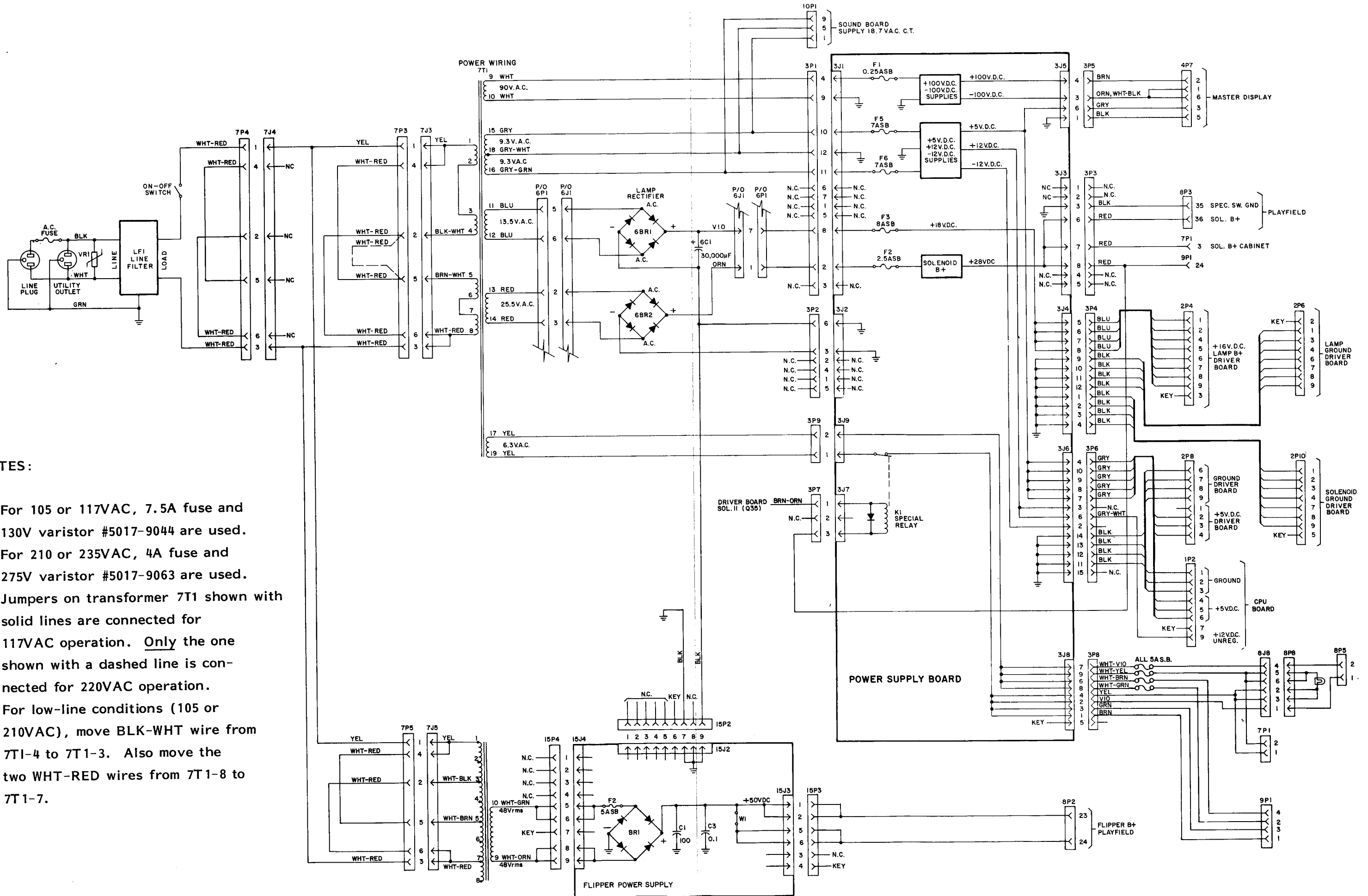
TO / FROM SHEET 2

Driver Board Logic Diagram (Sheet 1 of 2)





Driver Board Logic Diagram  
(Sheet 2 of 2)



**NOTES:**

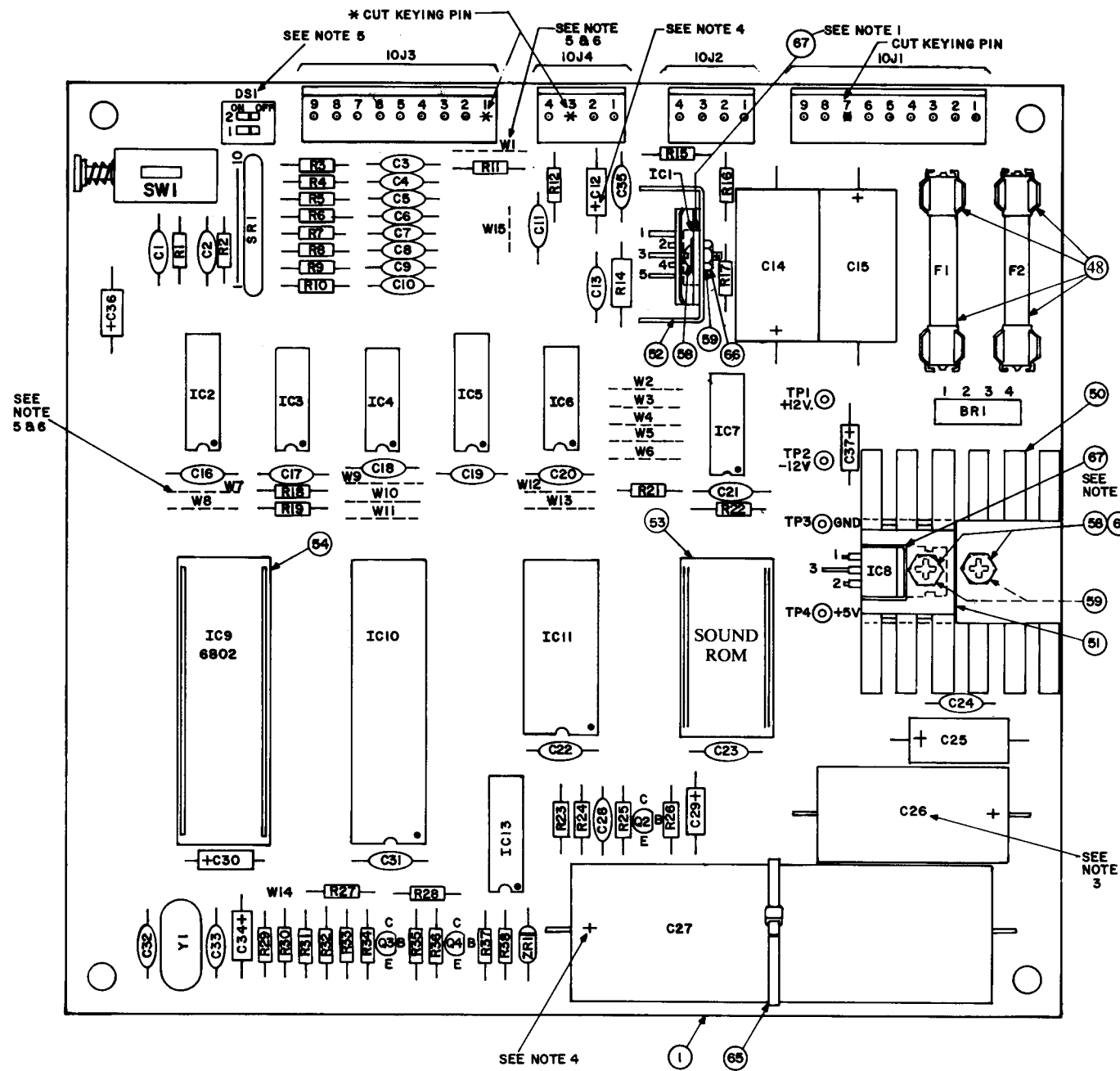
1. For 105 or 117VAC, 7.5A fuse and 130V varistor #5017-9044 are used.
2. For 210 or 235VAC, 4A fuse and 275V varistor #5017-9063 are used.
3. Jumpers on transformer 7T1 shown with solid lines are connected for 117VAC operation. Only the one shown with a dashed line is connected for 220VAC operation.
4. For low-line conditions (105 or 210VAC), move BLK-WHT wire from 7T1-4 to 7T1-3. Also move the two WHT-RED wires from 7T1-8 to 7T1-7.

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	ZR1	1N5996A 6.8V ZENER DIODE	1
16				
17	5100-09357-00	BR1	MDA 200/3N253	1
18	5100-09158-00		BRIDGE RECTIFIER	0
19	5520-09020-00	Y1	3.58 MHz CRYSTAL	1
20	5010-09036-00	R1,R18,R19,R21,R22, R27,R30,R31, R32	RESISTOR, FC, 4.7K OHM, 5% 1/4 WATT	9
21	5010-09358-00	R2 thru R10	RESISTOR, FC, 100 OHM, 5% 1/4W	9
22	5010-09181-00	R12,R15,R28,R36,R38	RESISTOR, FC, 1K OHM, 5% 1/4W	5
23	5010-09161-00	R14	RESISTOR, FC, 1 OHM, 10% 1/2 WATT	1
24	5010-09161-00	R16	RESISTOR, FC, 2.2 OHM, 5% 1/4 WATT	1
25	5010-09361-00	R17	RESISTOR, FC, 220 OHM, 5% 1/2 WATT	1
26	5010-08983-00	R23, R24, R26	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	5043-08980-00	C1, C16 thru C23, C31	CAPACITOR, CER. .01 MFD. 50V. +80%, -20%	10
32	5043-09065-00	C2 thru C10	CAPACITOR, CER. .470 PFD. 50V. +20%	9
33	5043-09345-00	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	C13, 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	5040-08986-00	C25	CAPACITOR, ELECT. 100 MFD. 10V. +20%	1
39	5040-08893-00	C26	CAPACITOR, ELECT. 1,000 MFD. 25V. +20%	1
40	5040-09376-00	C27	CAPACITOR, ELECT. 4700 MFD. 16V. +20%	1
41	5043-09180-00	C28	CAPACITOR, CER. 47 PFD. 1K V. +20%	1
42	5040-09343-00	C29	CAPACITOR, ELECT. 10 MFD. 20V	1
43	5043-09169-00	C32, C33	CAPACITOR, CER. DISC, 27 PFD. 1KV. +10%	2
44	5041-09163-00	C34	CAPACITOR, TANTALUM 2.2 MFD. 15V. +20%	1
45	5041-09031-00	C37	CAPACITOR, TANTALUM 1 MFD. 25V. +20%	1
46	5641-09658-00	SW1	MOMENTARY SWITCH SPDT	1
47	5645-09330-00	DS1	2 STD, DIP SWITCH	1
48	5731-06314-00	F1, F2	4 AMP SLOW BLOW FUSE	2
49	5732-09178-00		FUSEHOLDER	4
50	5705-09172-00		HEAT SINK THERMALLOY #6072B	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	10J1, 10J3	9 PIN MALE CONNECTOR 09-65-1091	2
56	5791-09028-00	10J2, 10J4	4 PIN MALE CONNECTOR 09-65-1041	2
57				
58	4006-01003-06		6-32x3/8" P-PH-S	3
59	4406-01117-00		6-32 HEX NUT	3
60	5010-09534-00		0 OHM RESISTOR	A/R
61	5824-09248-00	TP1 THR 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		TIE WRAP	1
66	4703-00007-00		#6 EXT. LOCKWASHER	3
67	20-9229		THERMAL COMPOUND	.01

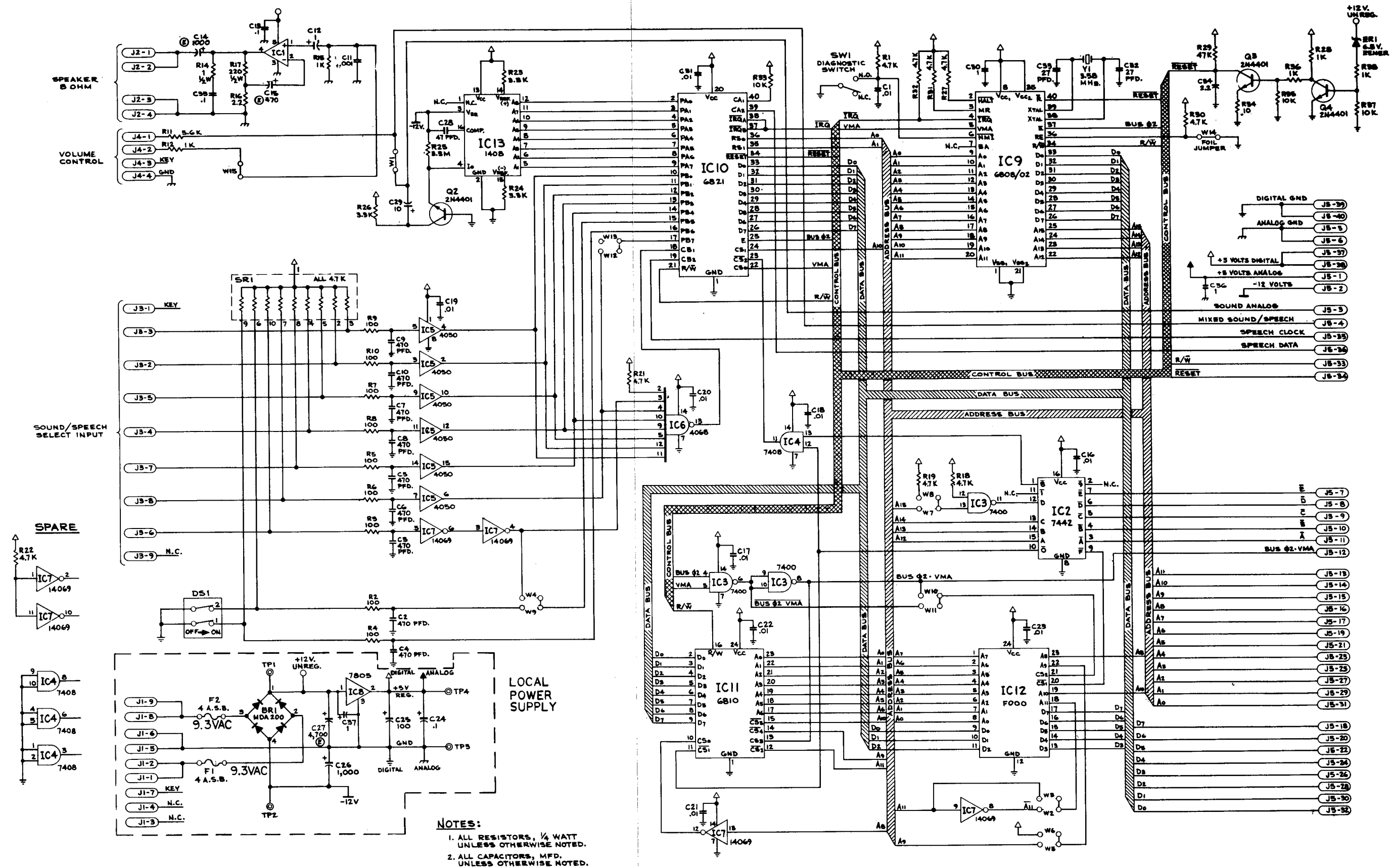
NOTES:

- USE THERMAL COMPOUND BETWEEN IC1 AND IC8, AND HEAT SINKS.
- CAUTION: AVOID STATIC DISCHARGE DAMAGE TO MOS LOGIC.
- OBSERVE INDEX MARK OF ALL INTEGRATED CIRCUITS:  
 DIODES D1, D2, AND ZR1;  
 CAPACITORS C12, C14, C15, C25, C26, C27;  
 CONNECTORS 10J1, 10J2, 10J4, 10J3, 10J5;  
 POSITION OF TRANSISTORS Q1, Q2, Q3, Q4.



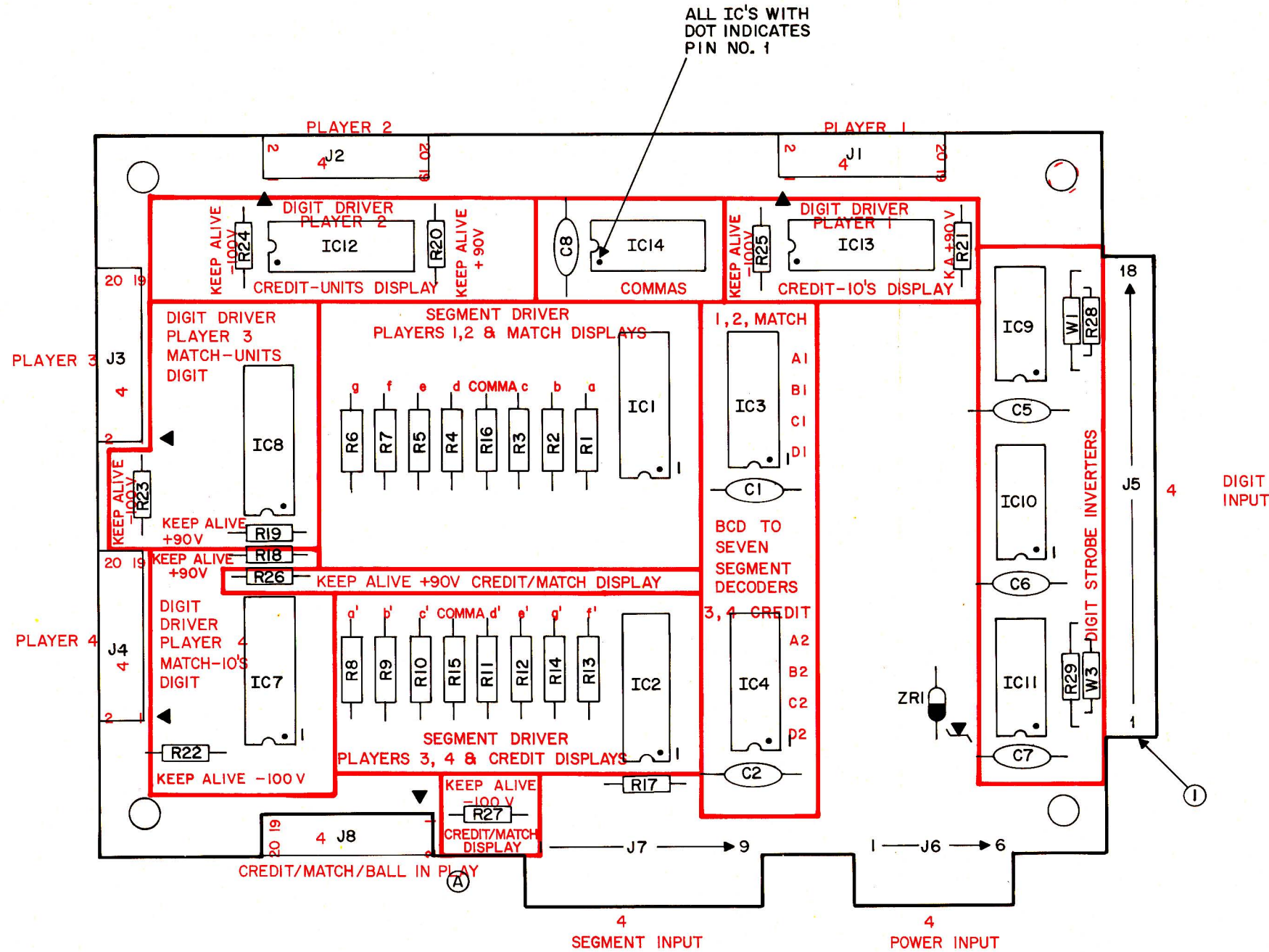
SOUND BOARD JUMPERS

JUMPERS USED	ROM TYPE	FORMAT	GAMES USED IN
W2, W5, W7, W9, W10, W15	2K x 8 2516, 2716	Sound & Speech	Gorgar, Blackout, Firepower, Black Knight, Jungle Lord, Pharaoh,
W1, W2, W5, W7, W9, W10, W15	2K x 8 2516, 2716	Sound Only	Defender Video & Pin, Solar Fire, Barracora, Hyperball, Stargate, Cosmic Gunfight, Varkon, Time Fantasy, Laser Cue, Star Light, Firepower II
W3, W4, W5, W7, W10, W15	4K x 8 2532	Sound & Speech	Sinistar (Upright & Cockpit-Front)
W1, W3, W4, W5, W7, W10, W15	4K x 8 2532	Sound Only	Robotron, Joust Video & Pin, Bubbles, Sinistar (Cockpit-Rear), Blaster
W1, W2, W4, W5, W7, W10, W15	2K x 8 2516, 2716	Sound Only	Warlok
W1, W3, W6, W7, W9, W11, W12, W15	512 x 8 7641	Sound Only	Big Strike



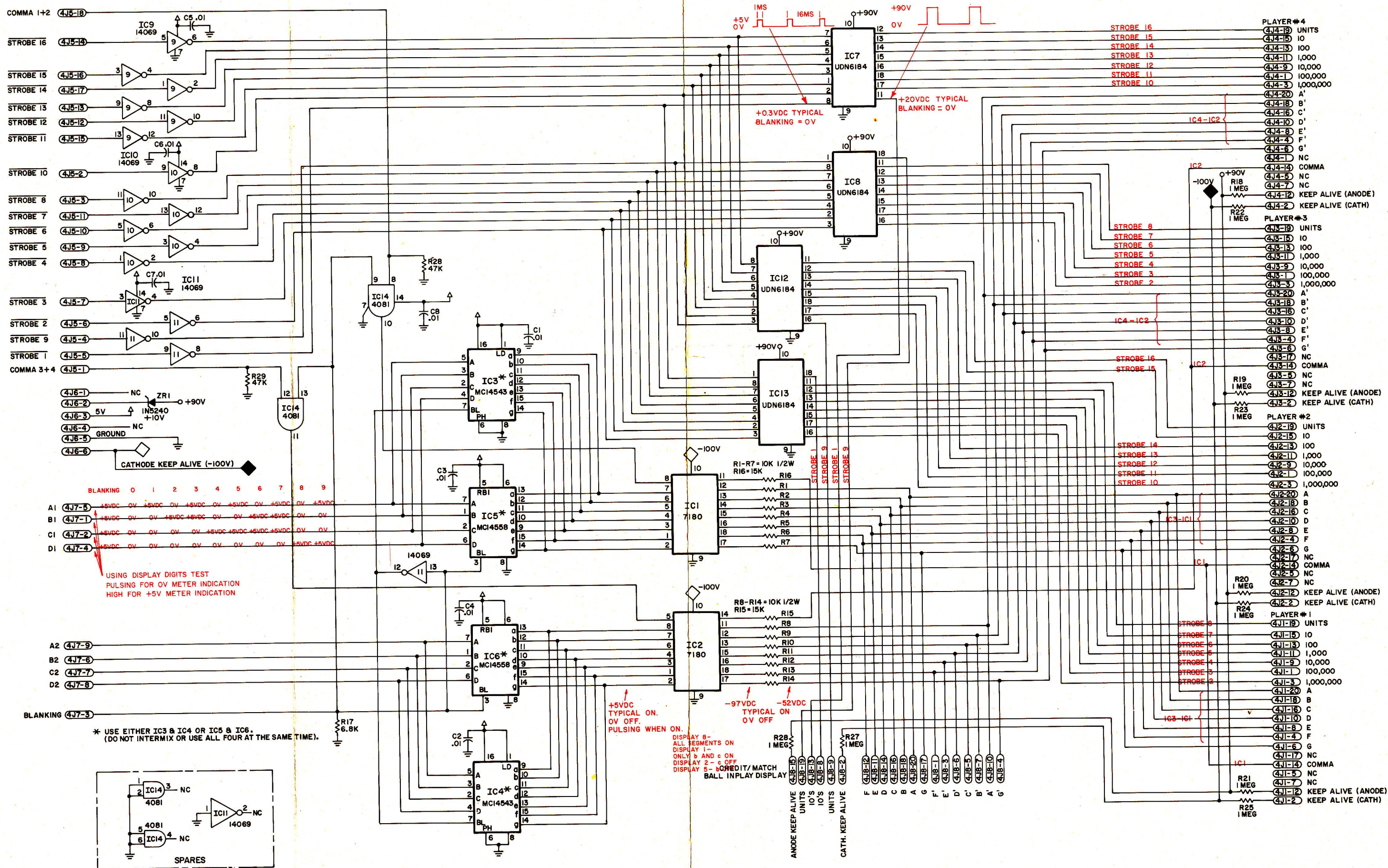
BILL OF MATERIAL

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



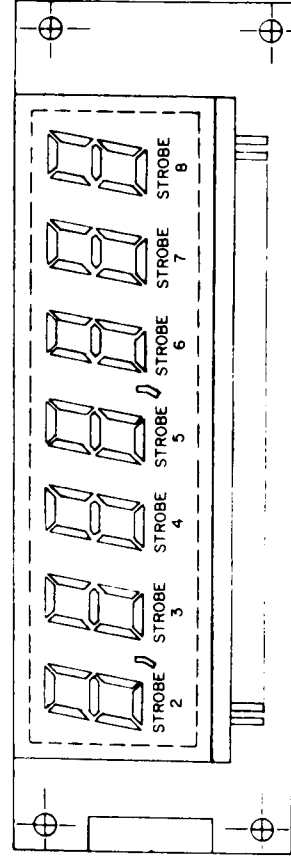
DIGIT CROSS REFERENCE

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



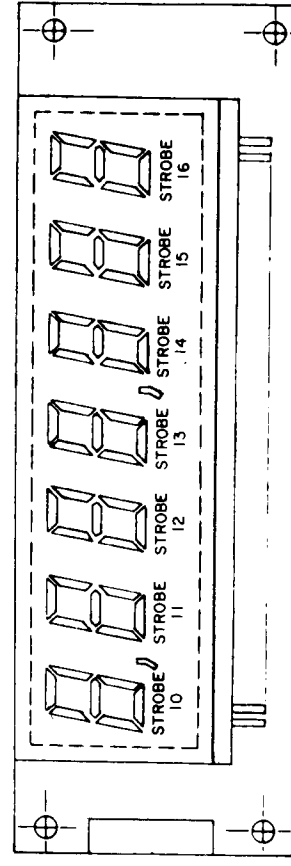


PLAYERS #1 AND 3



5J1  
5J3

PLAYERS #2 AND 4



5J2  
5J4

4J1/5J1 (PLAYER 1)

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

4J2/5J2 (PLAYER 2)

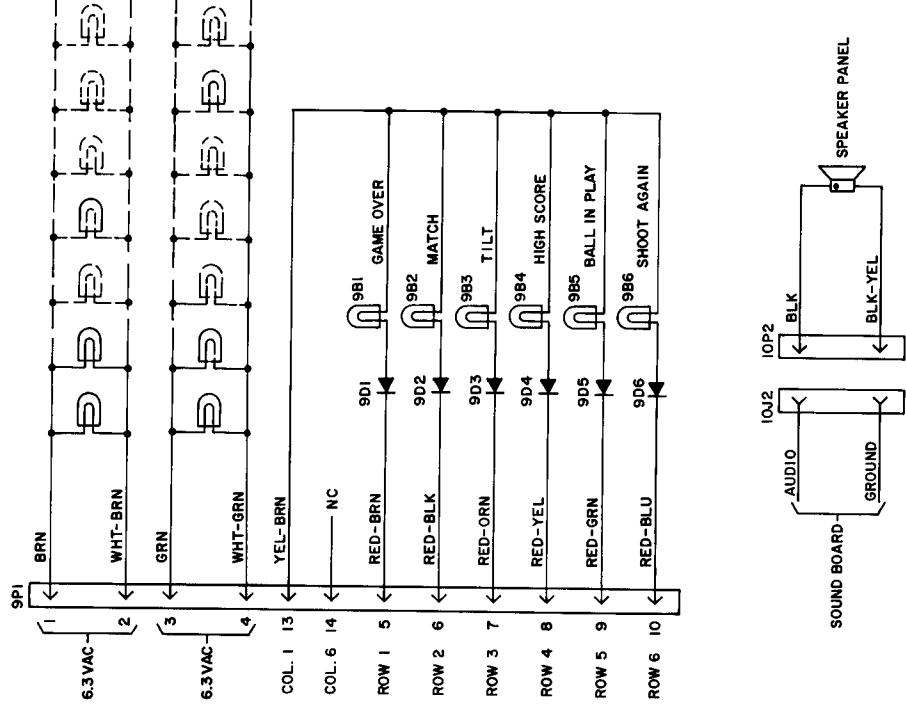
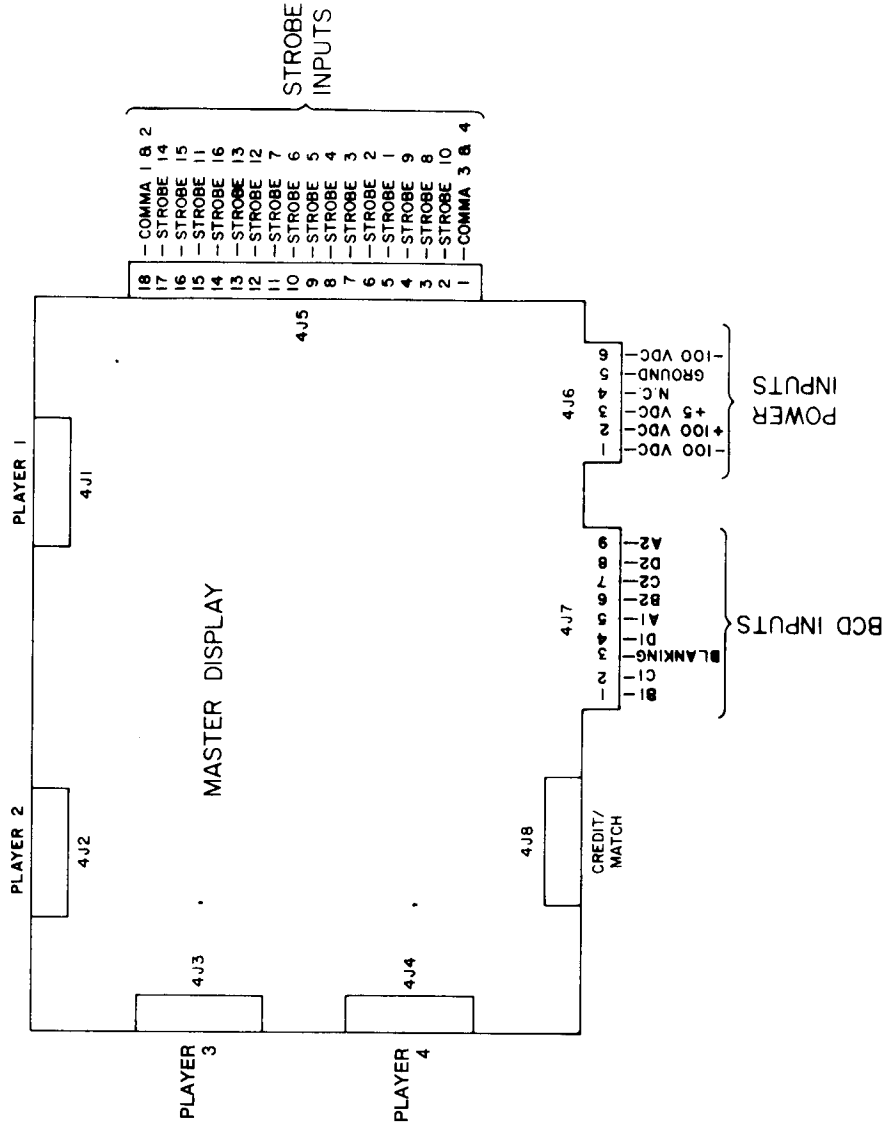
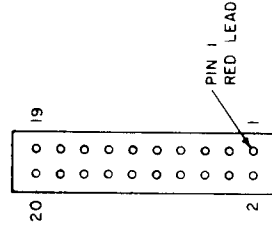
- 1 100,000's
- 2 -100V KEEP ALIVE
- 3 1,000,000's
- 4 f SEGMENT
- 5 N/C
- 6 g SEGMENT
- 7 +100V (N/C)
- 8 e SEGMENT
- 9 10,000's
- 10 d SEGMENT
- 11 1,000's
- 12 +100V KEEP ALIVE
- 13 100's
- 14 COMMA
- 15 10's
- 16 c SEGMENT
- 17 N/C
- 18 b SEGMENT
- 19 UNITS
- 20 a SEGMENT

4J8/5J5 (CREDIT/MATCH)

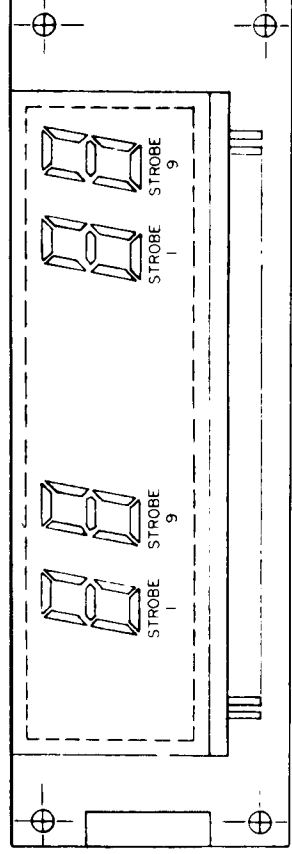
- 1 f Segment (Credit)
- 2 -100V Keep Alive
- 3 e Segment
- 4 g Segment
- 5 c Segment
- 6 d Segment
- 7 b Segment
- 8 10's
- 9 Units
- 10 a Segment
- 11 e Segment
- 12 f Segment
- 13 10's
- 14 d Segment
- 15 +100V Keep Alive
- 16 c Segment
- 17 g Segment
- 18 b Segment
- 19 Units
- 20 a Segment

DETAIL A

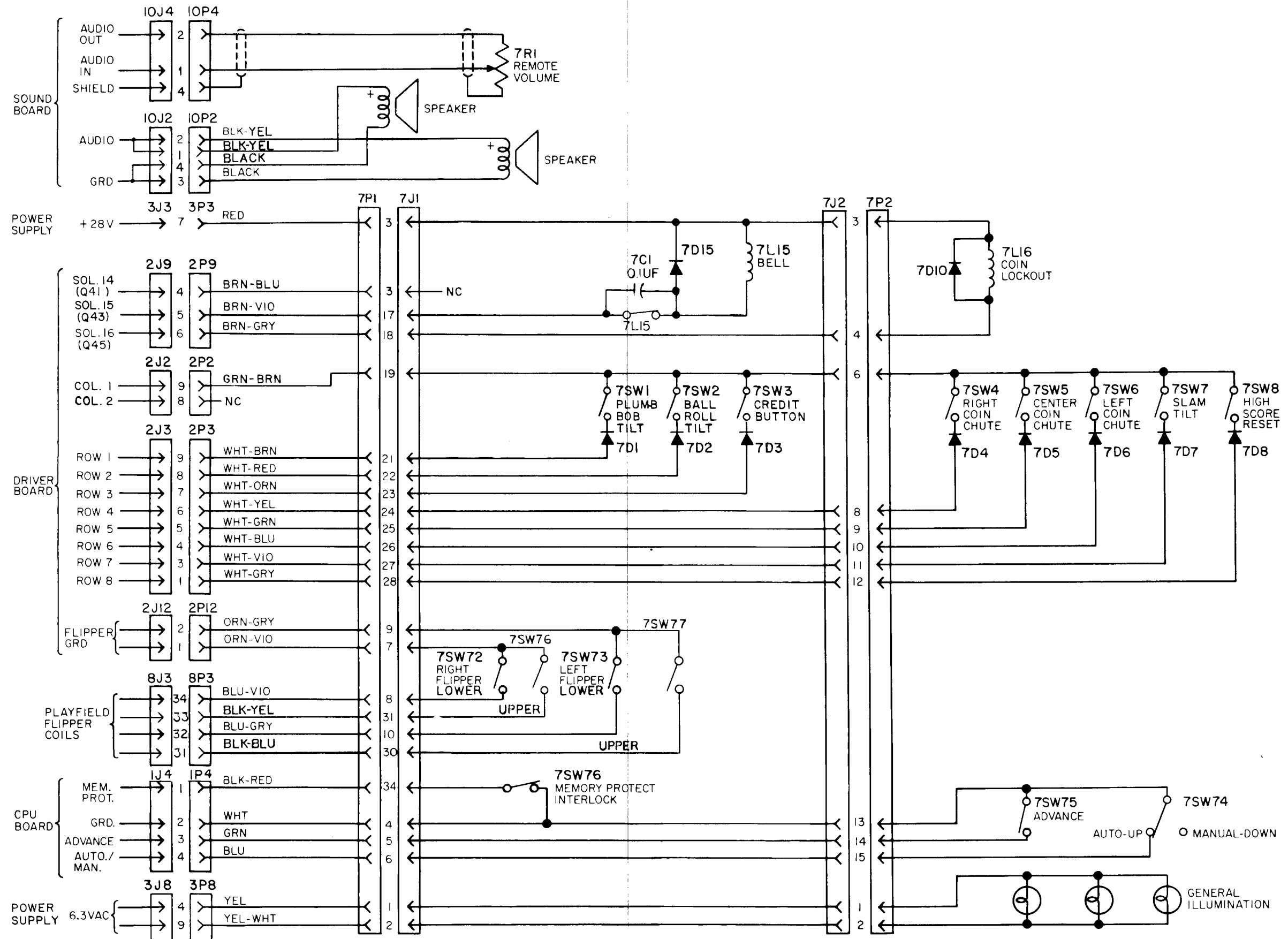
4J1 - 4J4, 4J8  
5J1 - 5J5  
CONNECTORS

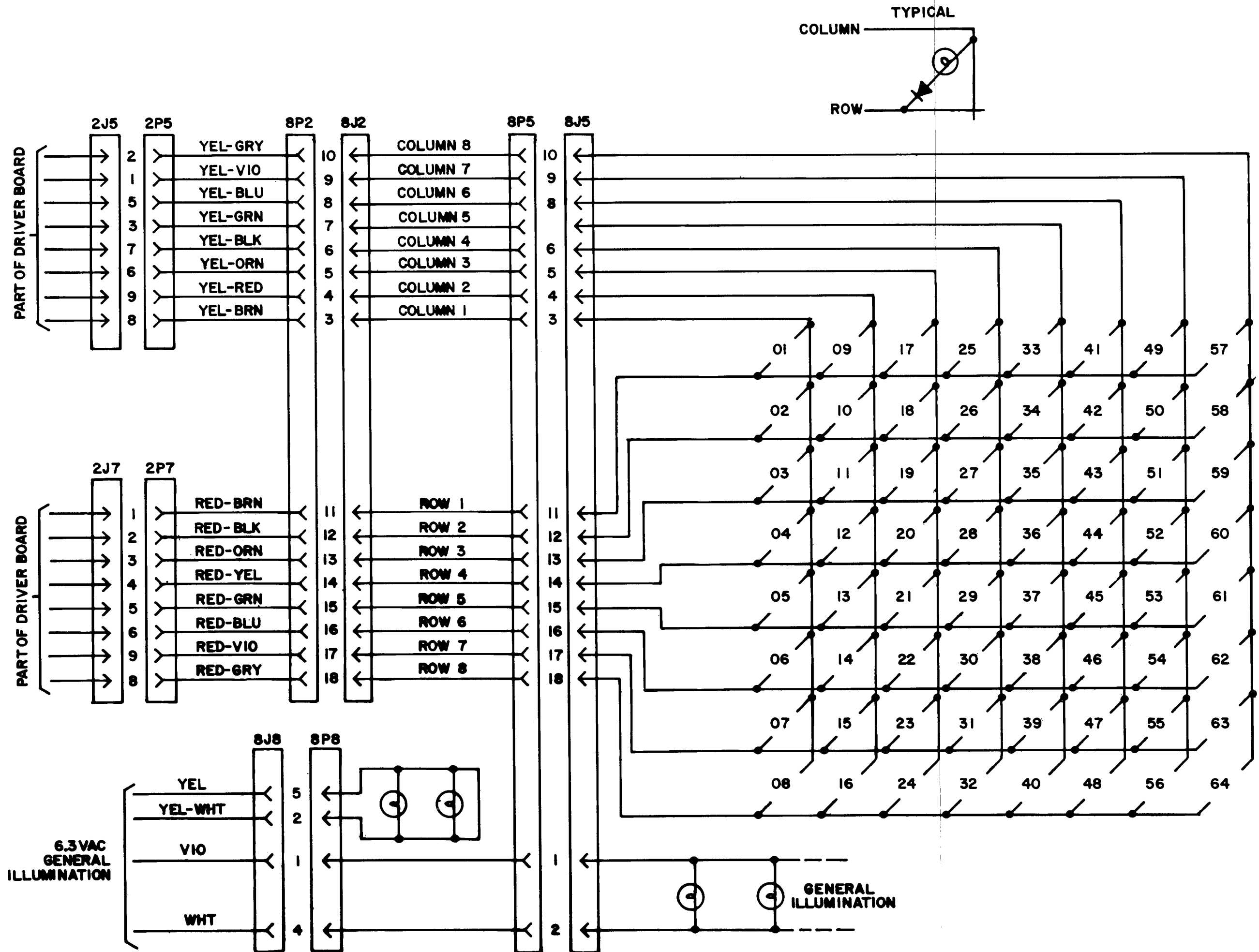


CREDITS / BALL IN PLAY

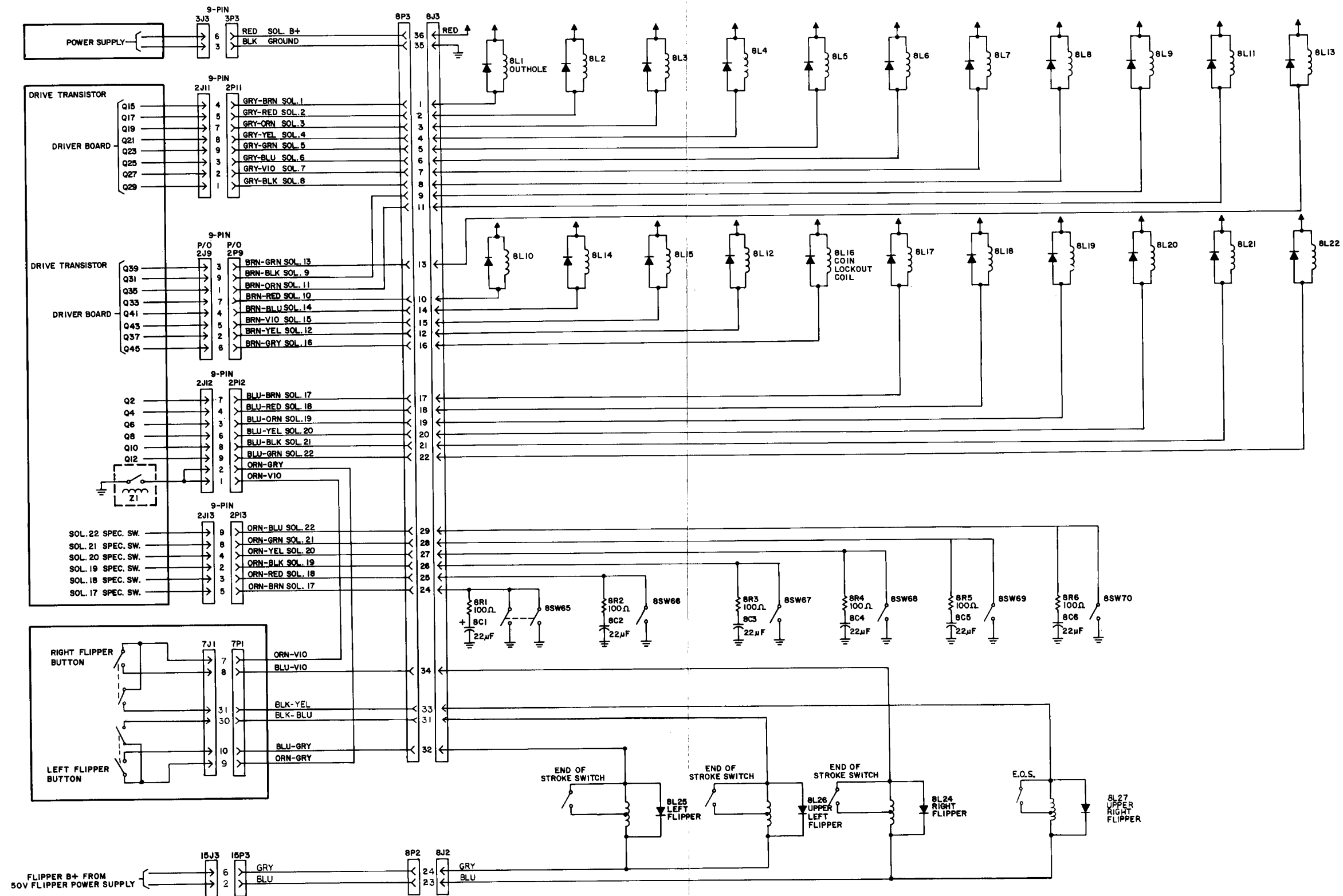


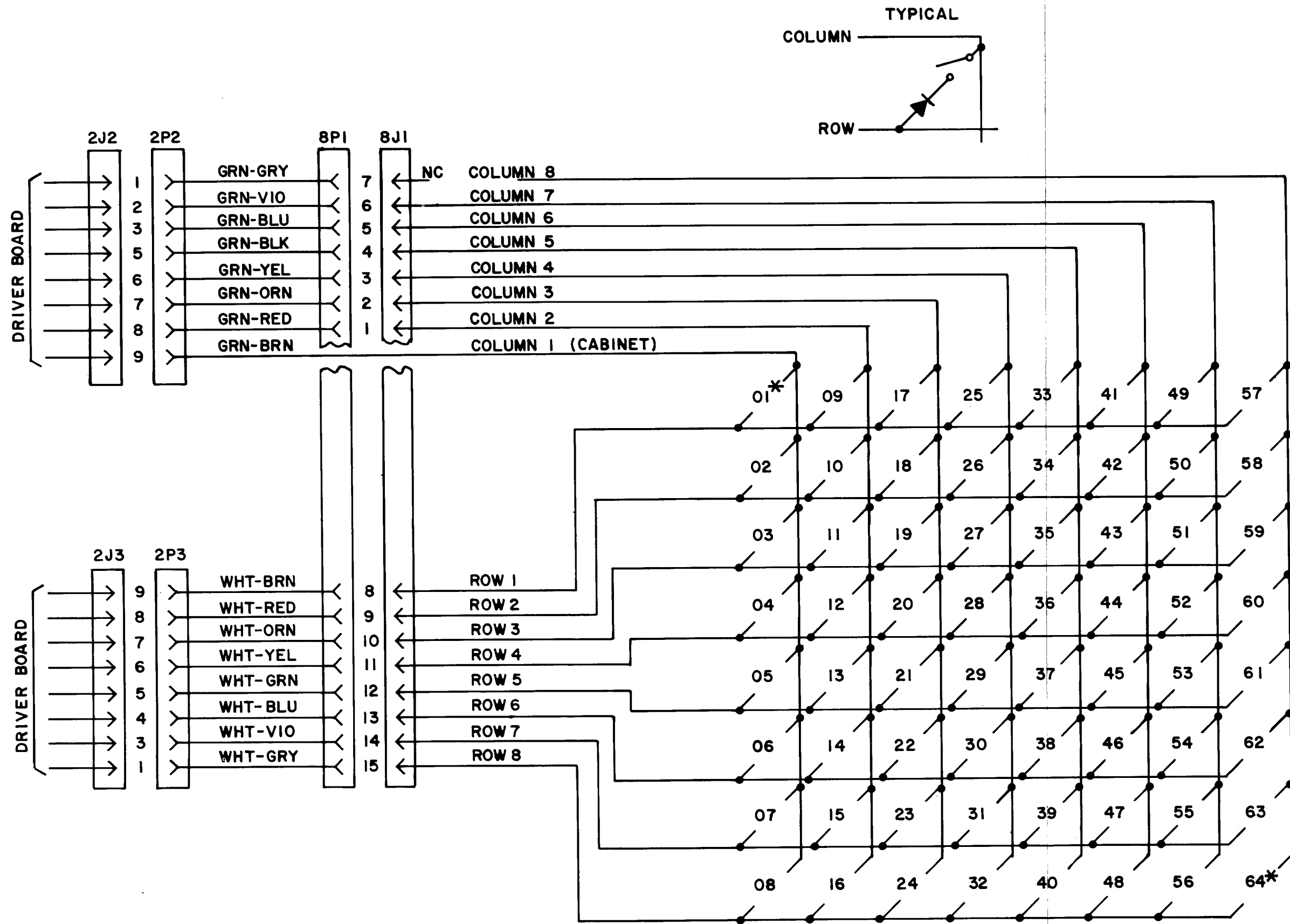
5J5





Playfield Lamp Wiring Diagram





\* SEE CABINET WIRING DIAGRAM FOR CONNECTIONS FOR CABINET SWITCHES.

)

)

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# **CHAPTER 2**

## **Level-8 Drawings**

# Game Pricing

**PRICING MADE EASY.** Function 19 allows a *shorthand* method of setting the pricing functions. If a number from one to eight is entered into function 19, a corresponding standard setting (shown in the **Pricing Table**) will be entered into the game. *The rest of the pricing functions are automatically set for that standard.*

**FOR CUSTOM SETTINGS** first set function 19 to zero. Then set the remaining values according to the **Pricing Table**.

**THE GAMES : PRICE RATIO** is equivalent to the ratio  $X : VS$ , where:

$X$  = COIN-SLOT MULTIPLIER (the number at function 20, 21 or 22)

$V$  = COIN VALUE

$S$  = COIN UNITS REQUIRED FOR CREDIT (the number at function 23)

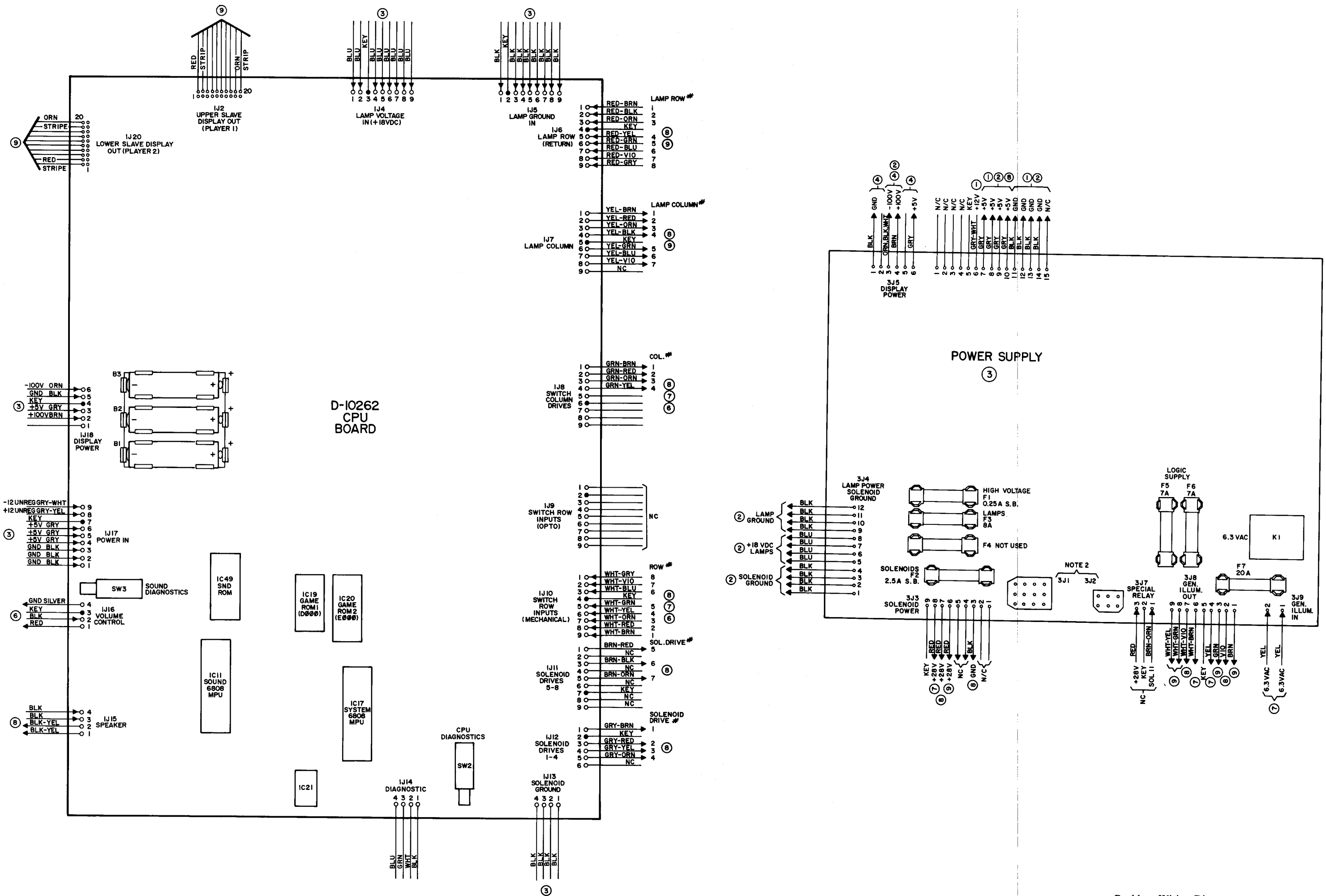
For example at factory settings with quarter chutes the variables produce 1 : 25x1 or one game for 25¢.

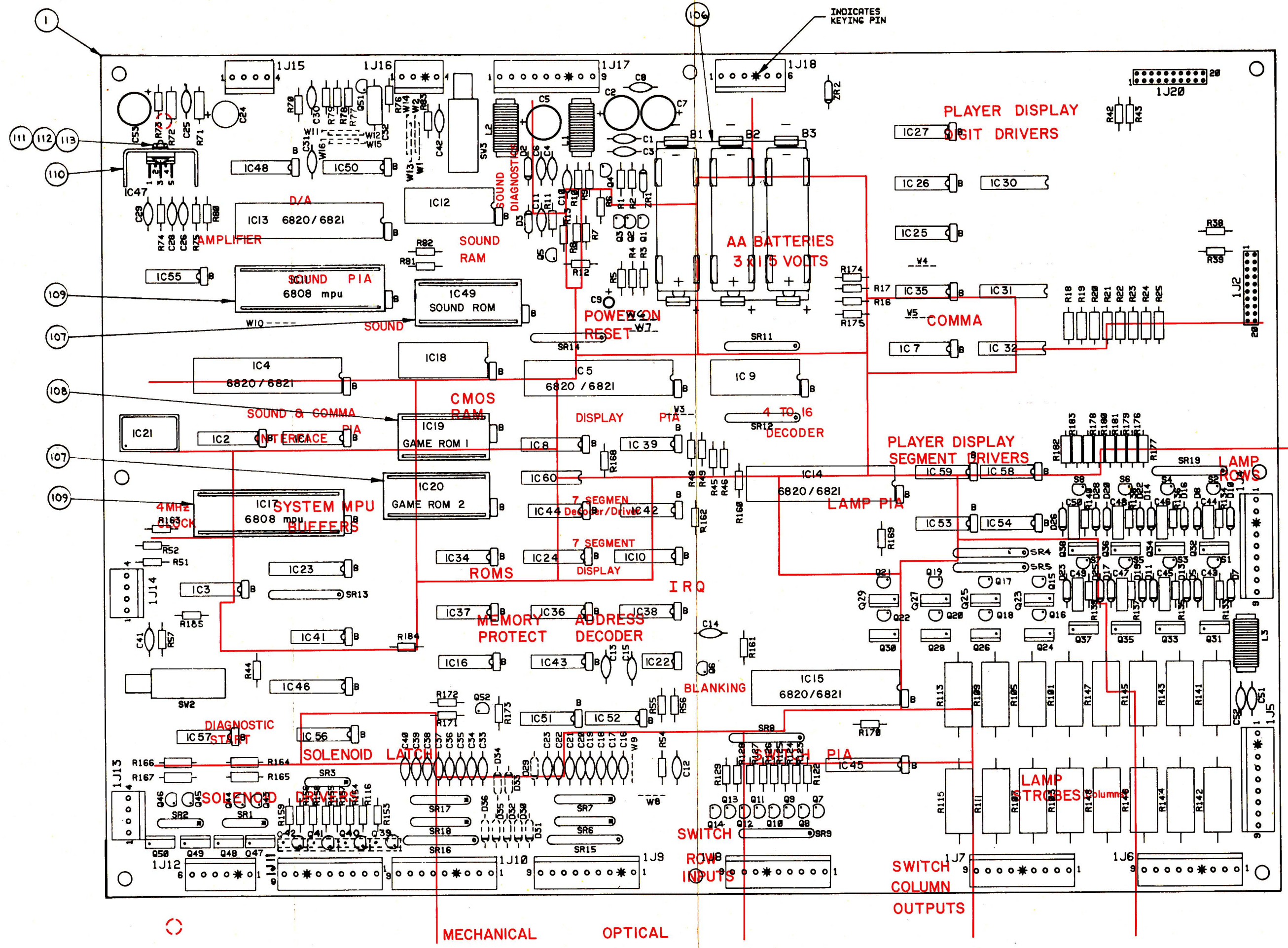
*Pricing Table*

•Indicates standard settings by adjusting ONLY function 19

COIN-DOOR MECHANISM	GAMES/PRICE	FUNCTION						
		19	20	21	22	23	24	25
Twin-Quarter or Quarter, Dollar, Quarter	•1/25¢, 4/\$1	1	1	4	1	1	0	0
	•1/50¢, 3/\$1, 6/\$2	3	1	4	1	2	4	0
	•1/50¢, 2/75¢, 3/4 × 25¢, 4/\$1	5	3	15	3	4	15	0
	2/25¢, 8/\$1	0	2	8	2	1	0	0
	1/25¢, 3/50¢, 6/\$1	0	1	4	1	1	2	0
	1/25¢, 5/\$1	0	1	4	1	1	4	0
	1/25¢	0	1	4	1	1	0	0
	1/25¢, 3/50¢, 6/4 × 25¢, 7/\$1	0	3	14	3	2	0	0
1/50¢	0	1	4	1	2	0	0	
1DM, 5DM, 2DM	•1/1DM, 3/2DM, 10/5DM	2	9	45	18	5	45	0
	2/1DM, 5/2DM, 14/5DM	0	13	65	26	5	65	0
20¢, 50¢	1/20¢, 3/50¢	0	6	0	15	5	0	0
1F, 10F, 5F	•1/2F, 3/5F only, 8/10F only	4	1	16	6	2	0	0
25-Cent, 1 Guilder	•1/25¢, 4/1G	6	1	0	4	1	0	0
	1/25¢, 5/1G	0	1	0	4	1	4	0
5-Franc, 10 Franc	•1/5F, 2/10F	7	1	0	2	1	0	0
	•1/10F	8	1	0	2	2	0	0
1-Franc or Twin 1-Franc	1/1F, 3/2F	0	1	1	1	1	2	0
	1/1F	0	1	1	1	1	0	0
Twin-2 Franc	•1/2F, 3/4F	3	1	4	1	2	4	0
10 Franc, 20 Franc	•1/10F, 2/20F	7	1	0	2	1	0	0
Twin 100-Yen	2/100Y	0	2	0	2	1	0	0
100 Lire, 200 Lire	•1/200 Lire	8	1	0	2	2	0	0
Twin-1 Sucre	1/3S, 2/5S	0	2	0	2	5	0	0
Any	Free Play	set function 18 to 0 for free play						

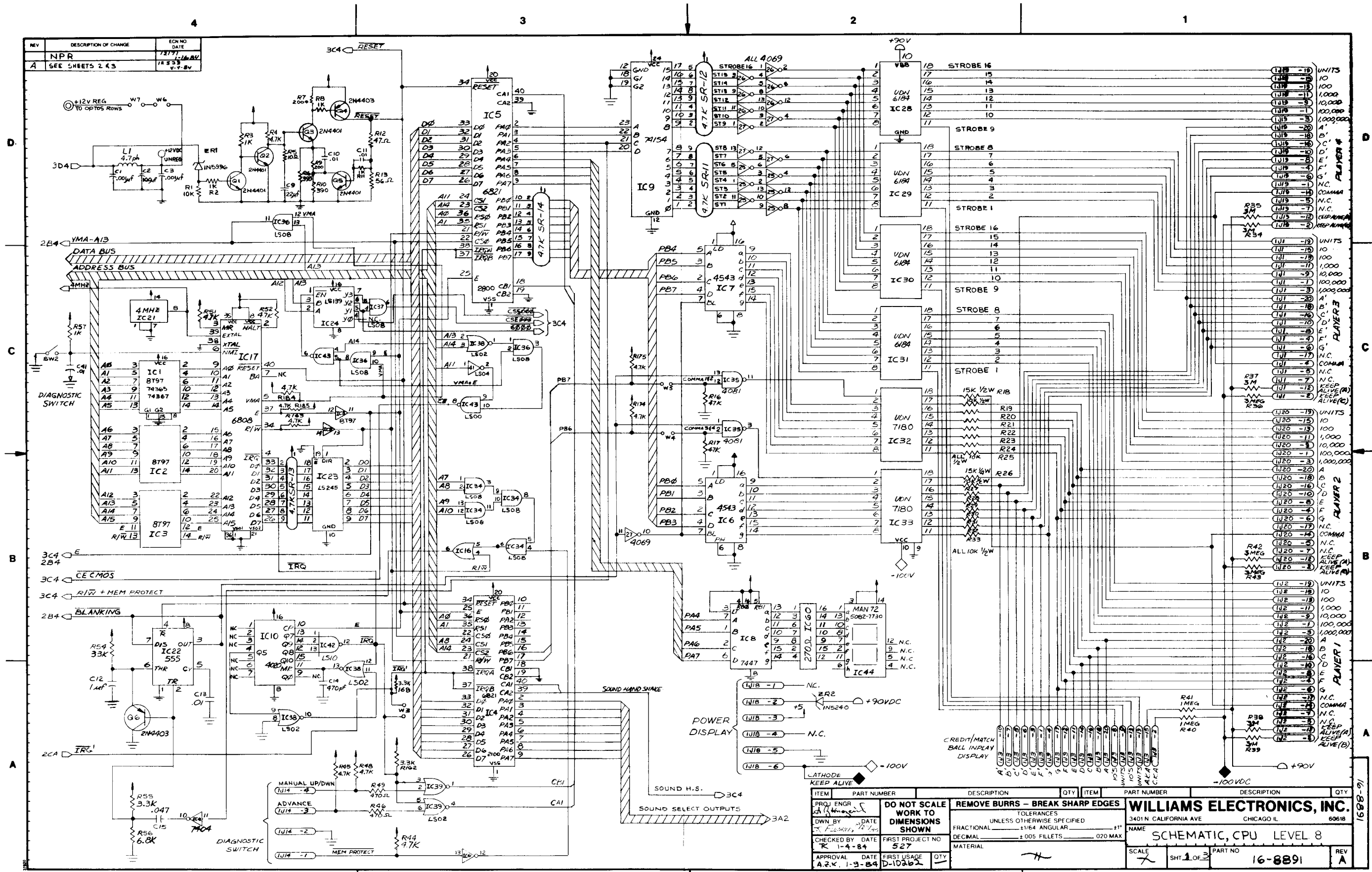






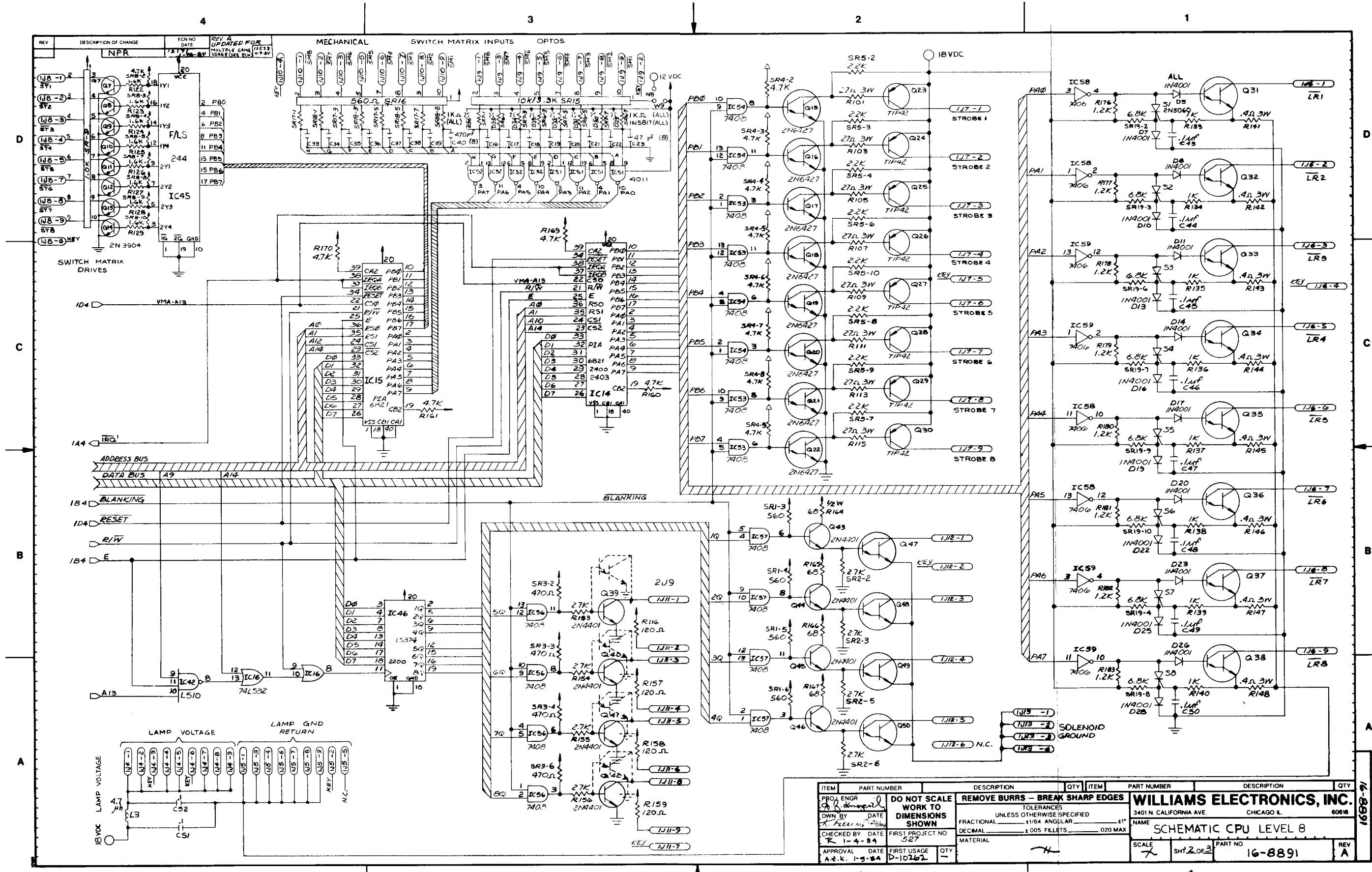
NOTE:  
 1. FOR SCHEMATIC, REFER TO DWG. #16-8891.  
 2. SEE ROM SUMMARY FOR PART NUMBERS OF SOCKETED CHIPS.





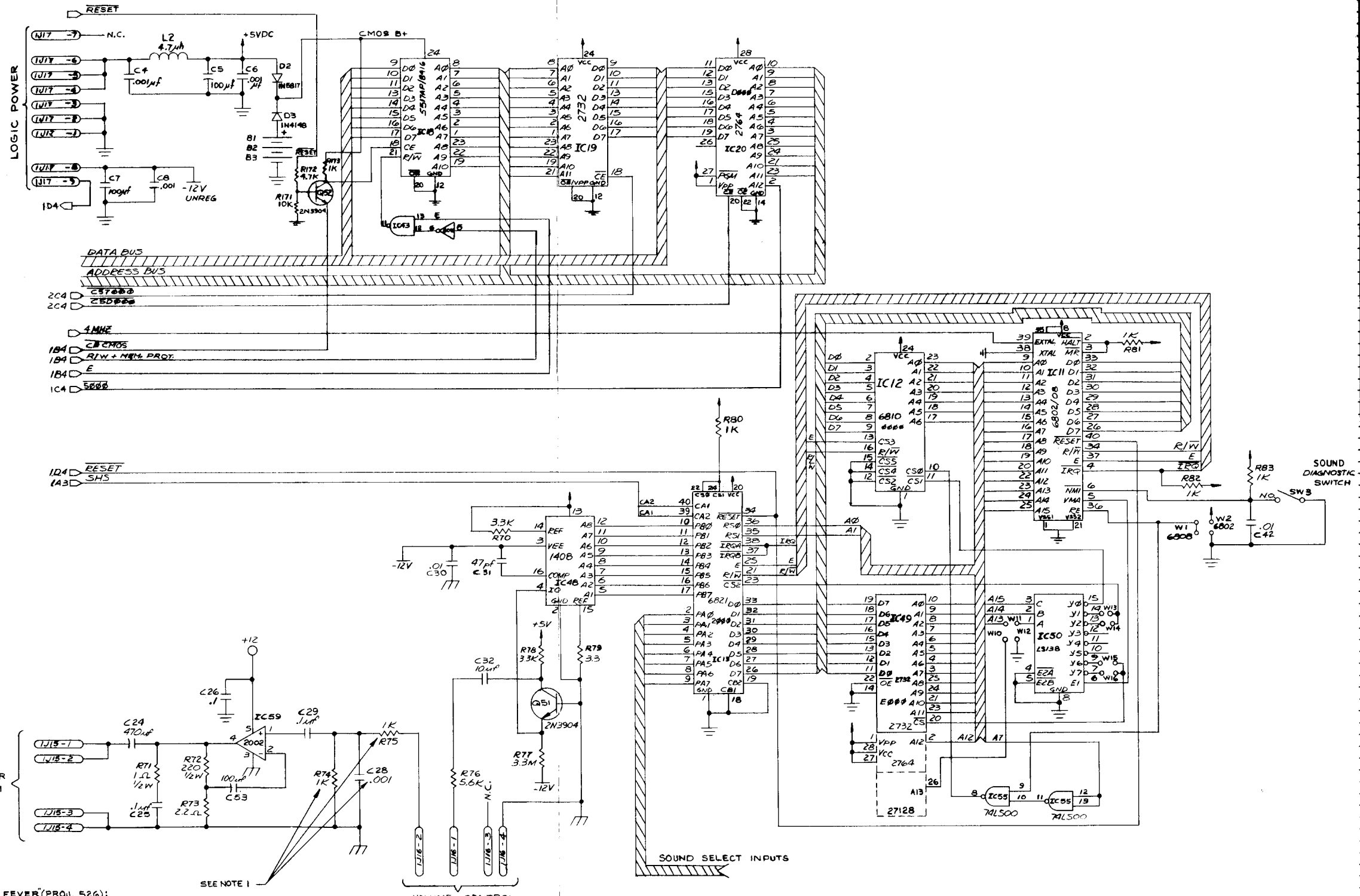
REV	DESCRIPTION OF CHANGE	ECN NO	DATE
NPR		12777	1-16-84
A	SEE SHEETS 2 & 3	12533	4-2-84

ITEM	PART NUMBER	DESCRIPTION	QTY	ITEM	DESCRIPTION	QTY
PROJ ENGR		DO NOT SCALE		<b>WILLIAMS ELECTRONICS, INC.</b> 3401 N. CALIFORNIA AVE CHICAGO IL 60618 NAME SCHEMATIC, CPU LEVEL 8 SCALE SHT 1 OF 3 PART NO 16-8891 REV A		
DWN BY		WORK TO				
CHECKED BY		DIMENSIONS				
APPROVAL DATE		SHOWN				
		FIRST PROJECT NO	527			
		MATERIAL				



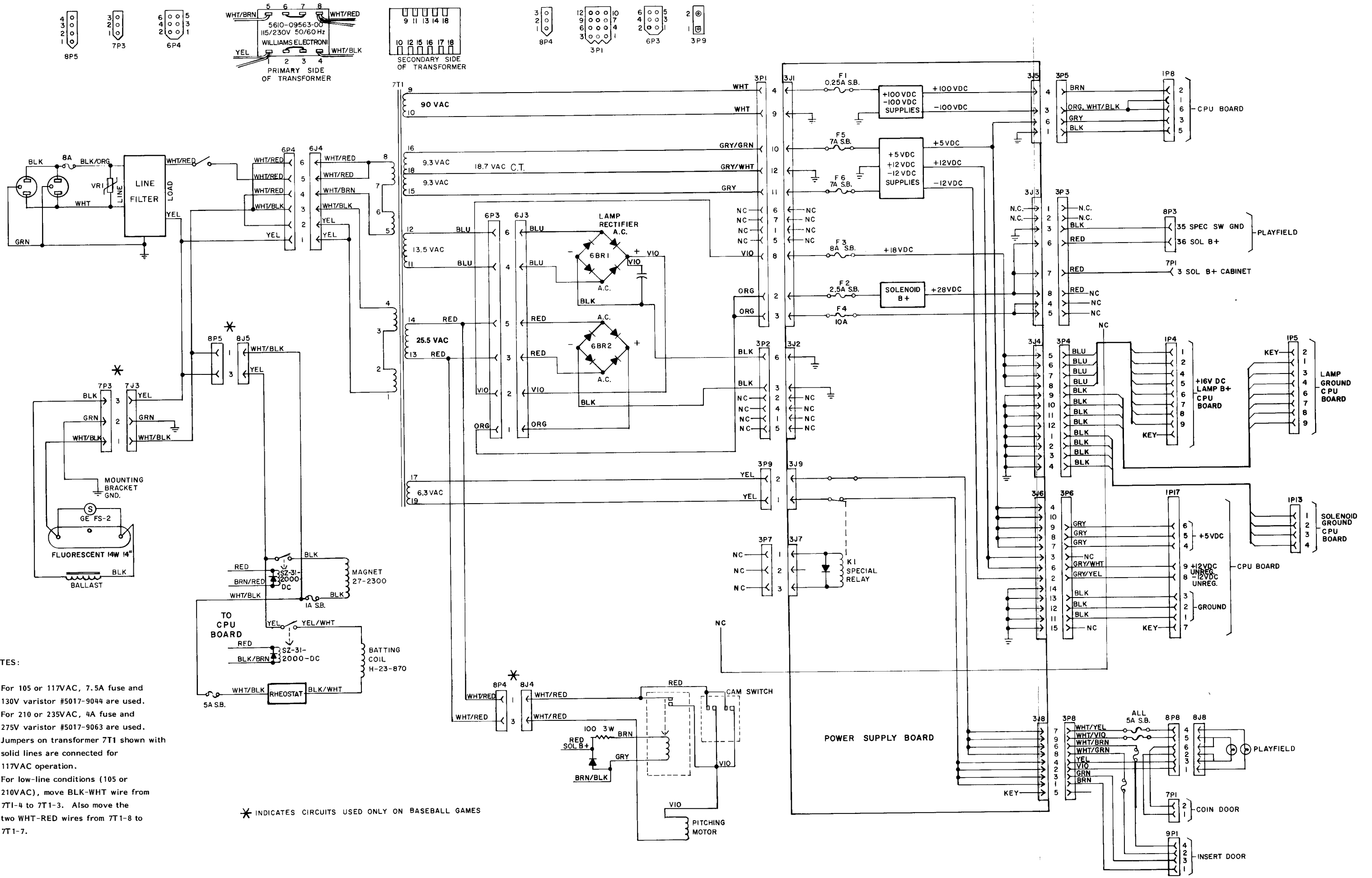
ITEM	PART NUMBER	DESCRIPTION	QTY	ITEM	PART NUMBER	DESCRIPTION	QTY
PROJ ENGR		DO NOT SCALE		<b>WILLIAMS ELECTRONICS, INC.</b> 3401 N. CALIFORNIA AVE CHICAGO ILL. 60618 <b>SCHEMATIC CPU LEVEL 8</b>			
CHK'D BY		WORK TO DIMENSIONS SHOWN					
CHECKED BY	DATE	FIRST PROJECT NO	527	TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTIONAL ±1/64 ANGULAR ±1° DECIMAL ±.005 FILLETS .020 MAX			
APPROVAL	DATE	FIRST USAGE	QTY	MATERIAL SCALE 1:1 SHT 2 OF 3 PART NO 16-8891 REV A			

REV	DESCRIPTION OF CHANGE	ECN NO	DATE
	NEW PART RELEASE	1277	1-16-84
A	UPDATED FOR MULTIPLE GAME USAGE (SEE ECN)	1283	4-7-84



NOTES:  
 1. FOR "PENNANT FEVER" (PROJ. 526):  
 R74 - 4700 pF CAP  
 R75 - 150 K Ω  
 C28 - .01 μF CAP

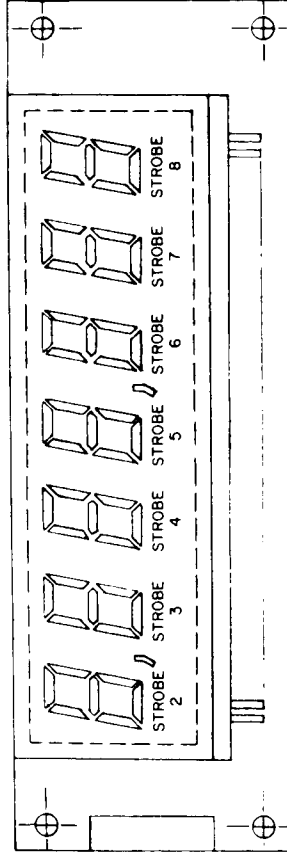
ITEM	PART NUMBER	DESCRIPTION	QTY	ITEM	PART NUMBER	DESCRIPTION	QTY
PROJ ENGR		DO NOT SCALE		<b>WILLIAMS ELECTRONICS, INC.</b> 3401 N. CALIFORNIA AVE CHICAGO, ILL. 60618 NAME: SCHEMATIC, CPU LEVEL 8 SCALE: 1:1 SHT. 3 OF 3 PART NO: 16-8891 REV: A			
OWN BY		WORK TO DIMENSIONS SHOWN					
CHECKED BY		REMOVE BURRS - BREAK SHARP EDGES		TOLERANCES UNLESS OTHERWISE SPECIFIED: FRACTIONAL ±1/64 ANGULAR ±1° DECIMAL ±.005 FILLETS ±.020 MAX MATERIAL			
APPROVAL		FIRST PROJECT NO: 527		MATERIAL:			
DATE		FIRST USAGE		APPROVAL DATE: 1-9-84			



- NOTES:
1. For 105 or 117VAC, 7.5A fuse and 130V varistor #5017-9044 are used.
  2. For 210 or 235VAC, 4A fuse and 275V varistor #5017-9063 are used.
  3. Jumpers on transformer 7T1 shown with solid lines are connected for 117VAC operation.
  4. For low-line conditions (105 or 210VAC), move BLK-WHT wire from 7T1-4 to 7T1-3. Also move the two WHT-RED wires from 7T1-8 to 7T1-7.

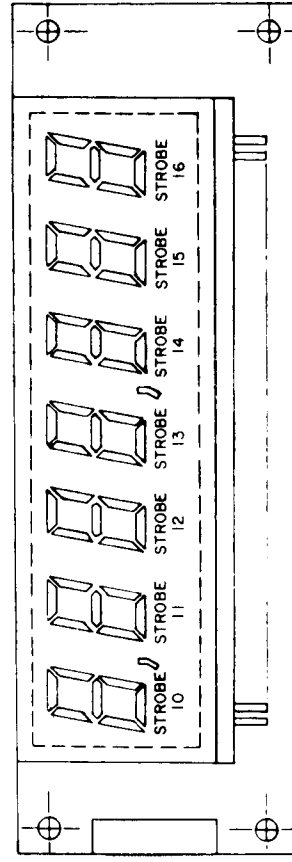
\* INDICATES CIRCUITS USED ONLY ON BASEBALL GAMES

PLAYERS #1 AND 3



5J1  
5J3

PLAYERS #2 AND 4



5J2  
5J4

4J1/5J1 (PLAYER 1)

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

4J2/5J2 (PLAYER 2)

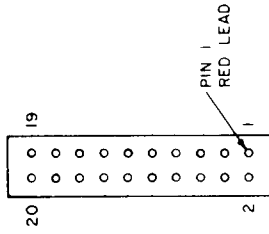
- 1 100,000's
- 2 -100V KEEP ALIVE
- 3 1,000,000's
- 4 f SEGMENT
- 5 N/C
- 6 g SEGMENT
- 7 +100V (N/C)
- 8 e SEGMENT
- 9 10,000's
- 10 d SEGMENT
- 11 1,000's
- 12 +100V KEEP ALIVE
- 13 100's
- 14 COMMA
- 15 10's
- 16 c SEGMENT
- 17 N/C
- 18 b SEGMENT
- 19 UNITS
- 20 a SEGMENT

4J8/5J5 (CREDIT/MATCH)

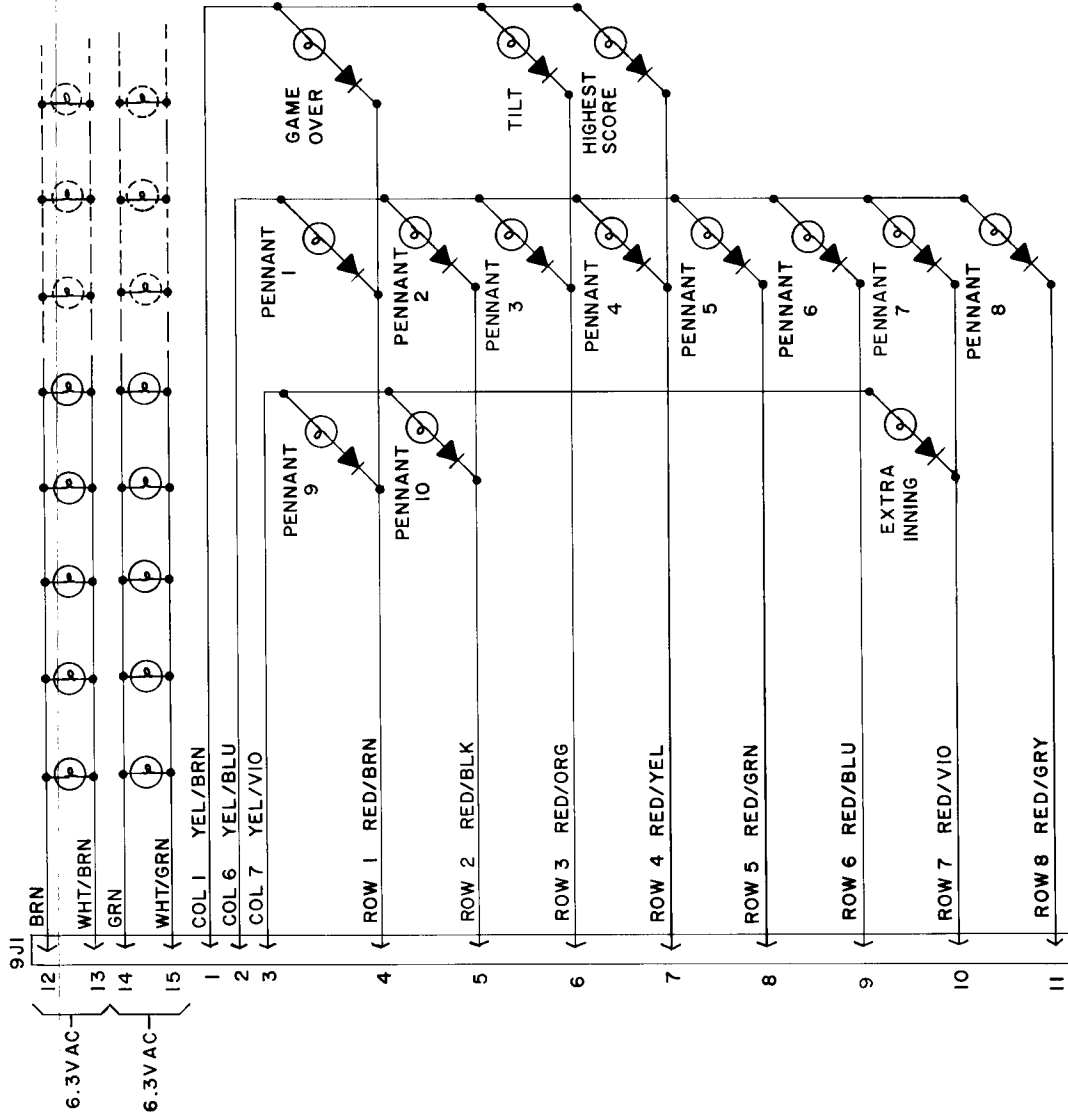
- 1 f Segment (Credit)
- 2 -100V Keep Alive
- 3 e Segment
- 4 g Segment
- 5 c Segment
- 6 d Segment
- 7 b Segment
- 8 10's
- 9 Units
- 10 a Segment
- 11 e Segment
- 12 f Segment
- 13 10's
- 14 d Segment
- 15 +100V Keep Alive
- 16 c Segment
- 17 g Segment
- 18 b Segment
- 19 Units
- 20 a Segment

DETAIL A

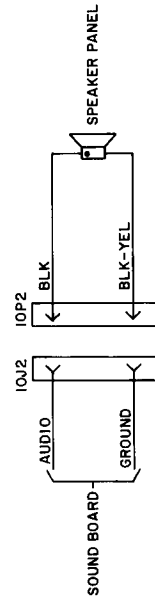
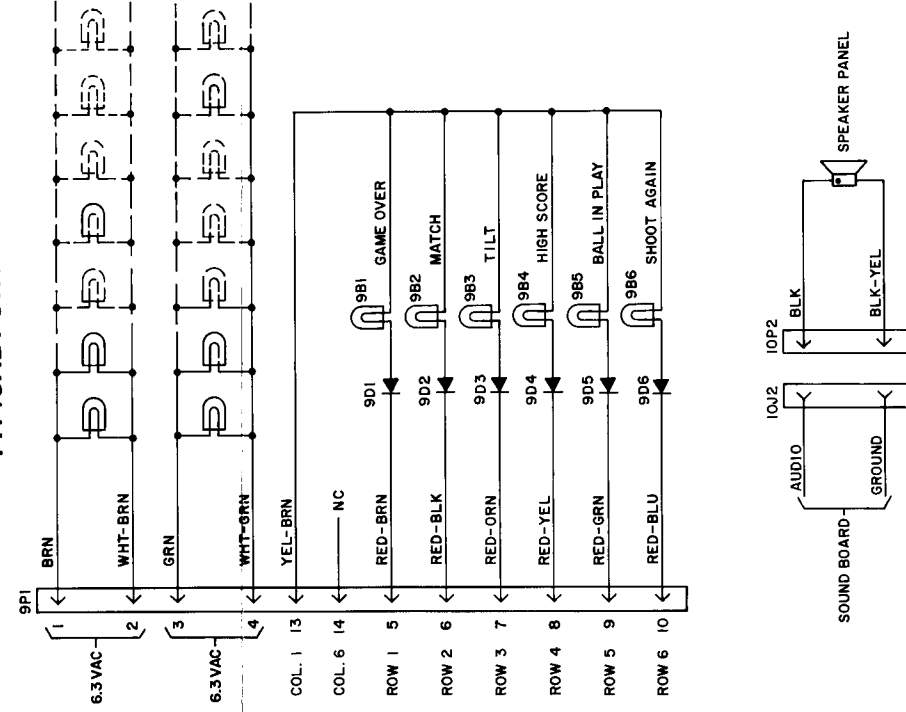
4J1 - 4J4, 4J8  
5J1 - 5J5  
CONNECTORS



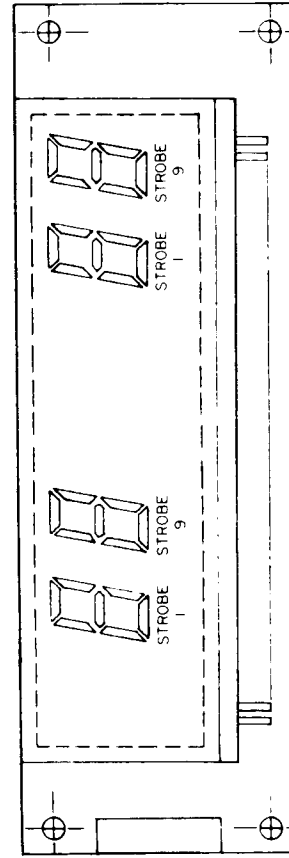
TYPICAL FOR BASE BALL



TYPICAL FOR PINBALL

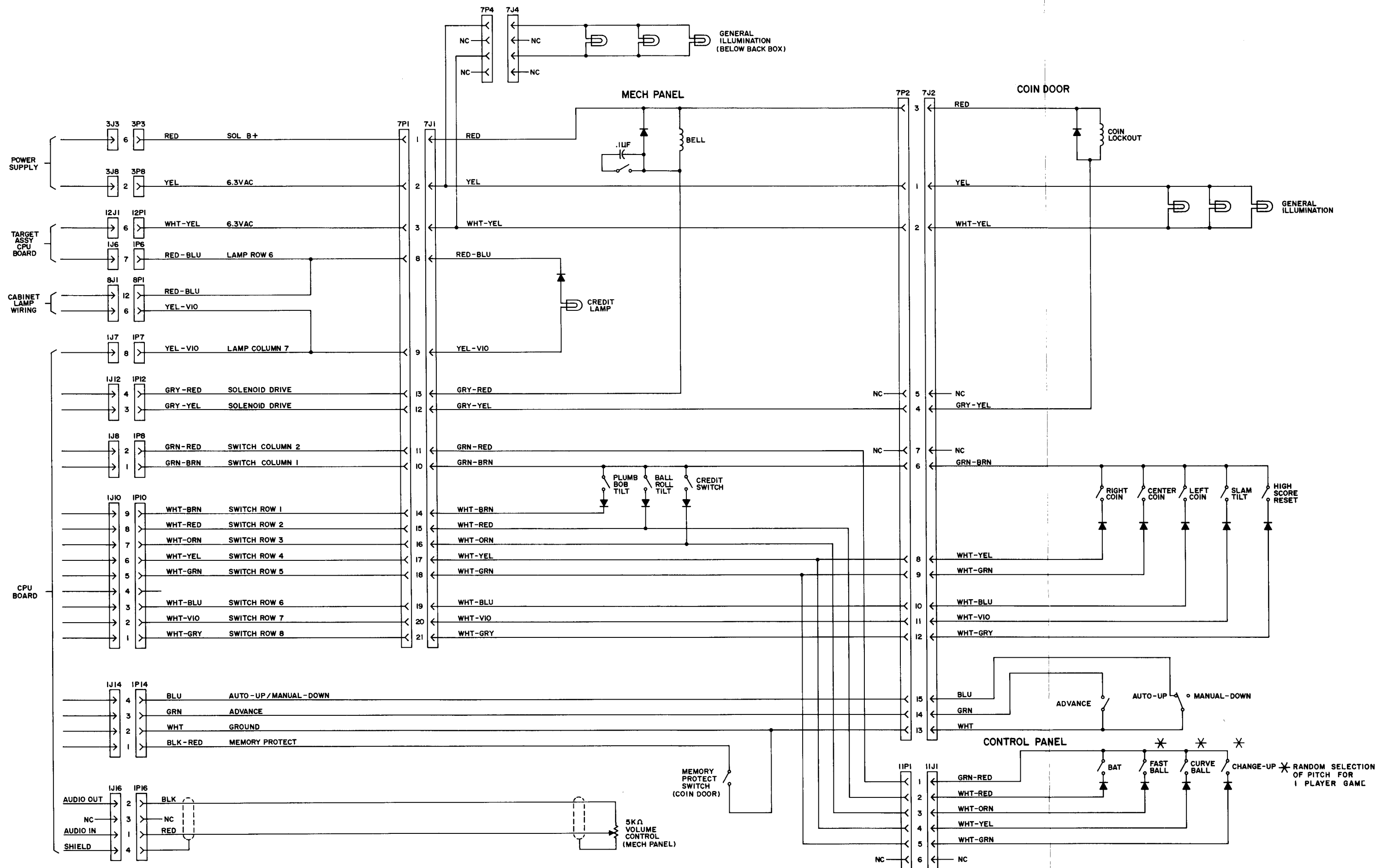


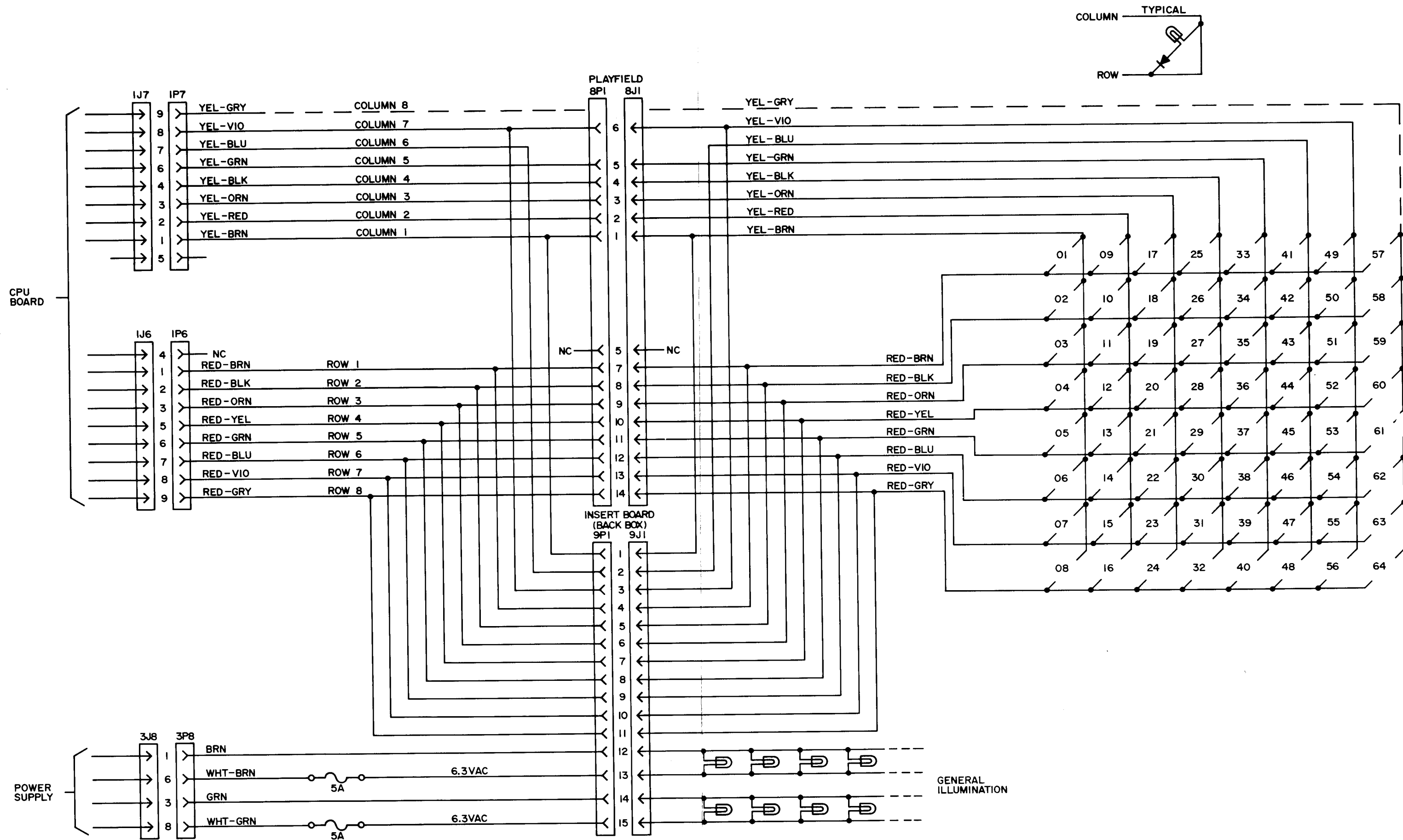
CREDITS / BALL IN PLAY

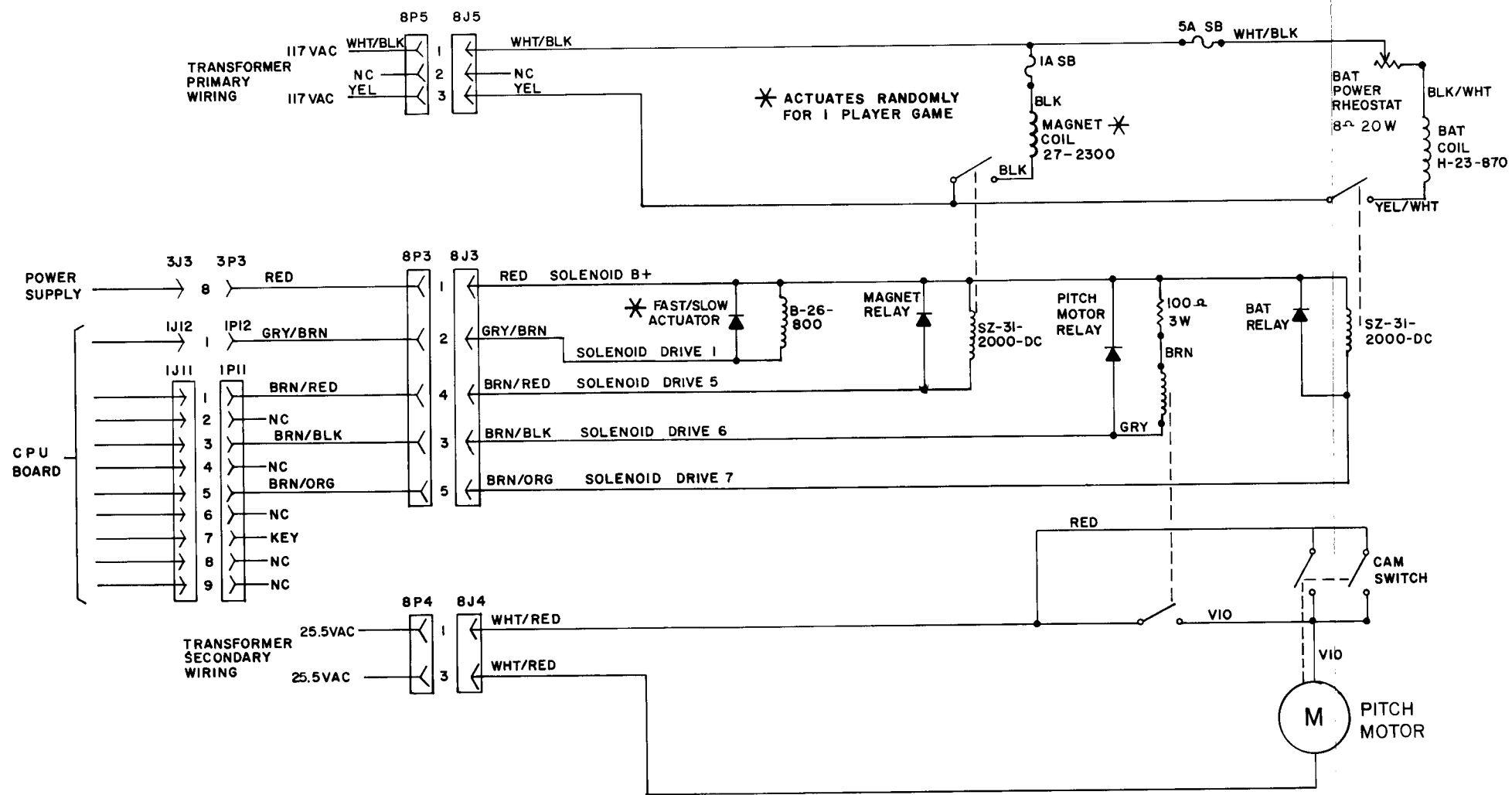


5J5



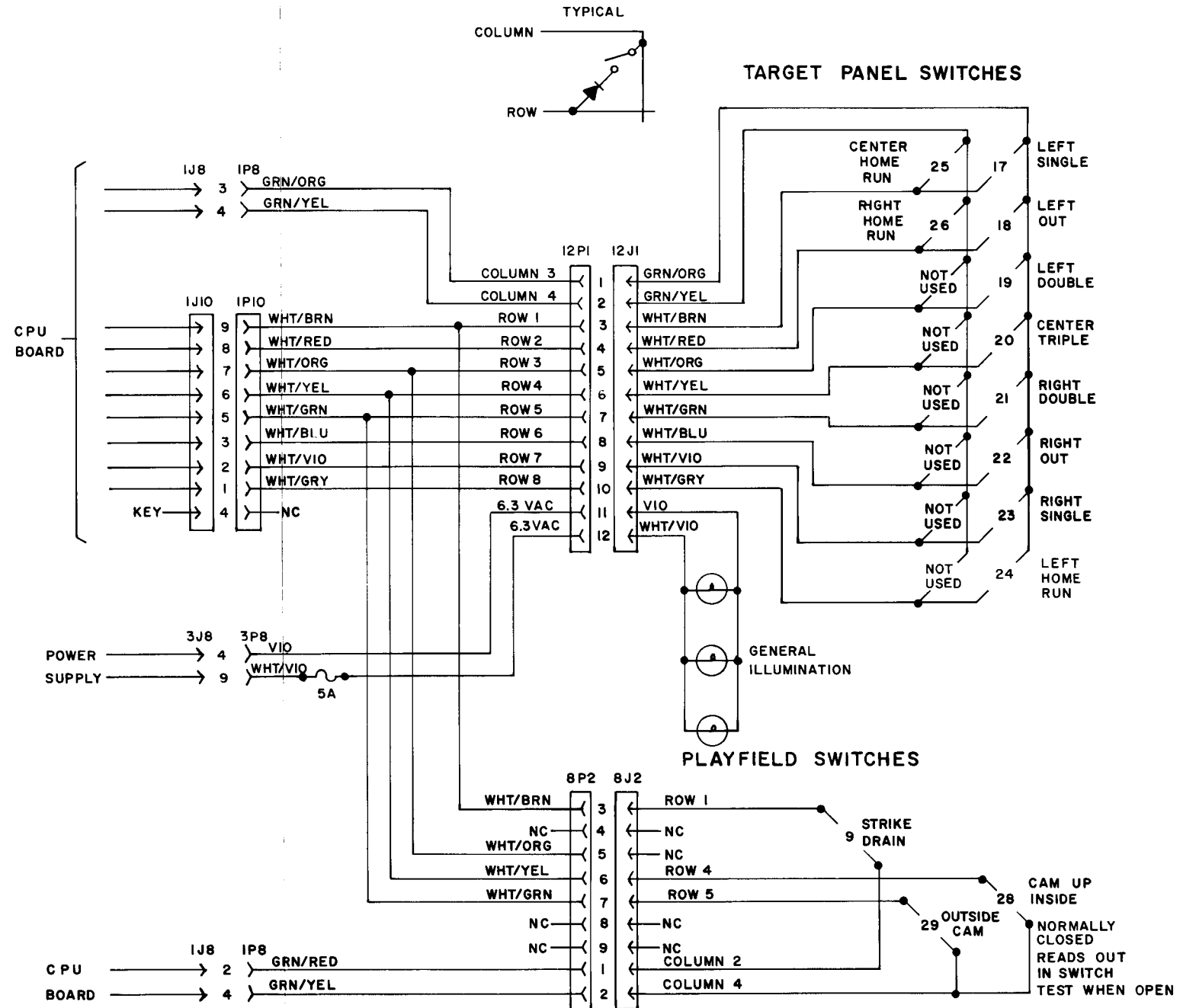






PENNANT FEVER PLAYFIELD  
SOLENOID DIAGRAM

41	5730-06508	P3	FUSE, 8 AMP	
42				
43				
44	5731-08761	P1	FUSE, 1/4 AMP	1
45	5017-09061	VR1	VARIATOR 47V	1
46	5580-09555	K1	RELAY, 24 VDC, 10 AMP, DPDT	1
47A	5700-09445		SOCKET	
47B	5701-09538		MICA INSULATOR	1
48	5824-09248		TERMINAL, #1502-1 (TEST POST)	3
49	5100-09418	BR-1	BRIDGE RECTIFIER, 35 AMP, 100V	1
50	5705-09042		HEAT SINK	2
51	3A-7520-1		TIE WRAP	1
52	4005-01016-07		5-40 x 7/16 R.H. MECH. SCREW	2
53	4405-0117		5-40 HEX NUT	2
54		W1, W2	JUMPER, #18 AWG	2
55	5040-09422	C8	CAPACITOR, 47 MFD, 50V, RADIAL	1
56	20-9229		THERMAL COMPOUND	
57			LEAD WIRE, #18 AWG (3")	3
58	5731-09432	P6, P5	FUSE, 7A, S.B., 250V	2



PENNANT FEVER SWITCH DIAGRAM

# **CHAPTER 3**

## **Assemblies**

### **Common**

### **To Both Systems**

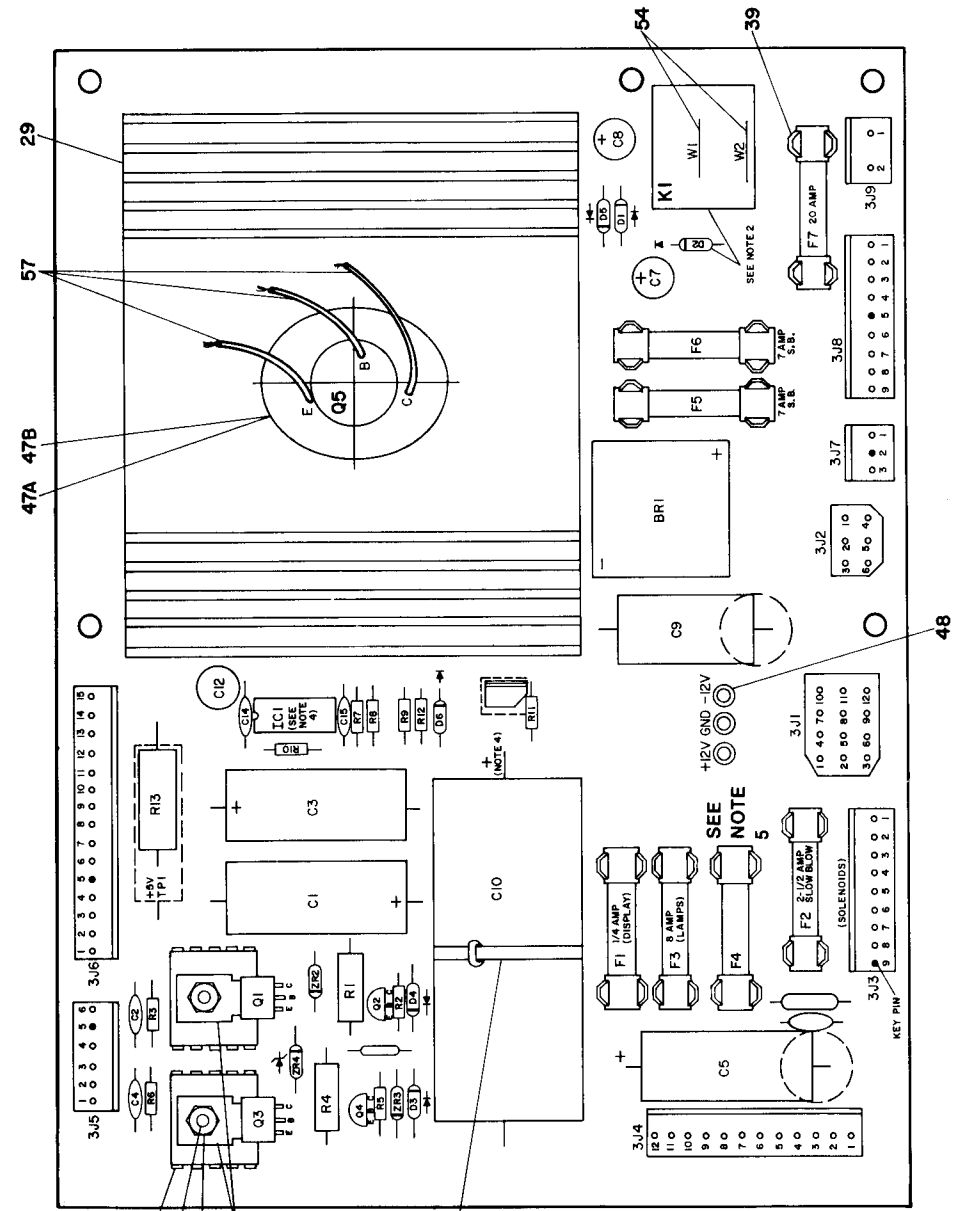
# A Word About Troubleshooting

**WILLIAMS PROVIDES EXTENSIVE DIAGNOSTICS** in the games it manufactures. These can be a dramatic timesaver in your servicing work. Familiarity with the drawing set and instruction manual can also enhance troubleshooting. In the few instances when you can't find the problem using built-in diagnostics, these rules of thumb should help...

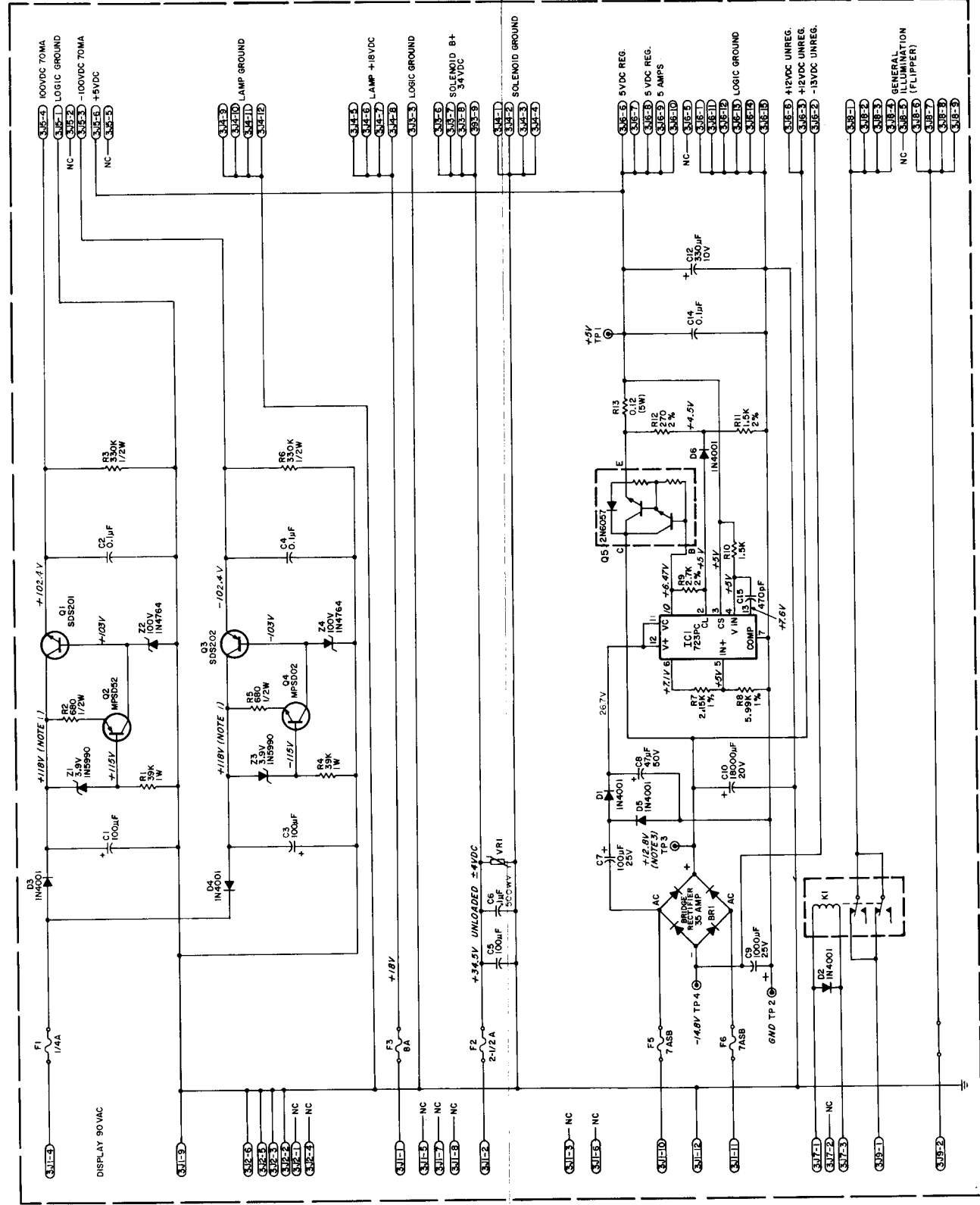
1. **GIVE YOUR GAME A VISUAL INSPECTION** in the suspected area. Bad connections are common in older games.
2. **THINK OVER THE SYMPTOMS** and then jot them down. Keeping notes pins down the details of your problem and prevents wasted time going over the same tests.
3. **YOUR ANALYSIS SHOULD REVEAL** which tools you need: Multimeter (analog or digital), logic probe, oscilloscope or other diagnostic equipment. Gather your tools.
4. **CHECK YOUR VOLTAGES.** Check regulated and unregulated DC voltages first at the output of the power supply. If any DC voltage is missing check your AC voltage at the fuse (with reference to its return line to the transformer). Use your **Power-Wiring Diagram** and **Interboard-Wiring Diagram** to find the fuse's location.
5. **SWAP INTERCHANGEABLE BOARDS** and chips that relate to your problem.
6. **ONCE YOU'VE ISOLATED THE SUSPECTED CIRCUIT** use your logic probe or oscilloscope to test for normal operation.

BILL OF MATERIAL

ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D NO.
1	5013-09426	R7	RESISTOR, 2.15K, 1%, 1/4W,	1
2	5013-09427	R8	METAL FILM	1
3	5013-09427	R8	RESISTOR, 4.99K, 1%, 1/4W,	1
4	5010-09428	R11	METAL FILM	1
5	5010-09085	R10	RESISTOR, 1.5K, 2%, 1/4W,	1
6	5010-09541	R9	CARBON FILM	1
7	5010-09508	R11	RESISTOR, 2.7K, 2%, 1/4W	1
8	5012-09429	R13	RESISTOR, 2.7K, 2%, 1/4W	1
9	5010-09536	R1, R4	CARBON FILM	1
10	5010-09061	R2, R5	POWER RESISTOR, 0.12 OHM, 5%, 5W	2
11	5010-09061	R3, R6	RESISTOR, 330K, 5%, 1/2W	2
12	5040-09419	C10	RESISTOR, 680 OHM, 2W	2
13	5040-09420	C9	CAP., ELECTROLYTIC, 18,000 MFD, 20V, AXIAL	1
14	5040-09423	C12	CAP., ELECTROLYTIC, 1,000 MFD, 25V, RADIAL OR AXIAL	1
15	5043-09065	C15	CAP., ELECTROLYTIC, 330 MFD, 10V, RADIAL	1
16	5040-09053	C1, C3	CAPACITOR, 470 pFD	2
17	5040-09070 or	C5	CAPACITOR, 100 MFD, ELECT., 150V	2
18	5040-09537	C14	CAPACITOR, 100 MFD, ELECT., 100V, AXIAL OR RADIAL	1
19	5043-09446 or	D1, D2, D3, D4, D5, D6	CAPACITOR, 0.1 MFD, 50V, DISC.	6
20	5070-09054	ZR1, ZR3	DIODE, 1N4001 or 1N4004	2
21	5075-09059	ZR2, ZR4	ZENER, 1N5990, 3.9V, 5Z	2
22	5075-09060	ZR2, ZR4	ZENER, 1N4764, 100V, 5Z	2
23	5060-09424	IC1	VOLTAGE REGULATOR, 723	1
24	5043-09072	C2, C4, C6	CAPACITOR, 0.1 MFD, 25V, DISC	3
25	5040-09421	C7	CAPACITOR, 100 MFD, 25V, RADIAL	1
26	5164-09056	Q1	TRANSISTOR, SDS 201 NPN	1
27	5134-09058	Q4	TRANSISTOR, SDS 202 PNP	1
28	5194-09055	Q2	TRANSISTOR, SDS 202 PNP	1
29	5705-04431	Q3	HEAT SINK	1
30	5791-09067	J35	CONNECTOR, 6 PIN (H)	1
31	5791-09074	J36	CONNECTOR, 15 PIN (H)	1
32	5791-09077	J38, J33	CONNECTOR, 9 PIN (H)	2
33	5791-09077	J32	CONNECTOR, 6 PIN (H)	1
34	5162-09425	Q5	TRANSISTOR, POWER, 2N6087 NPN	1
35	5791-09043	J34	CONNECTOR, 12 PIN (H)	1
36	5791-09043	J37	CONNECTOR, 3 PIN (H)	1
37	5791-09436	J39	CONNECTOR, 2 PIN (H)	1
38	5791-02068	J31	CONNECTOR, 12 PIN	1
39	5732-09178	F2	FUSE HOLDER	12
40	5731-09128	F2	FUSE, 2-1/2 AMP, S.B.	1

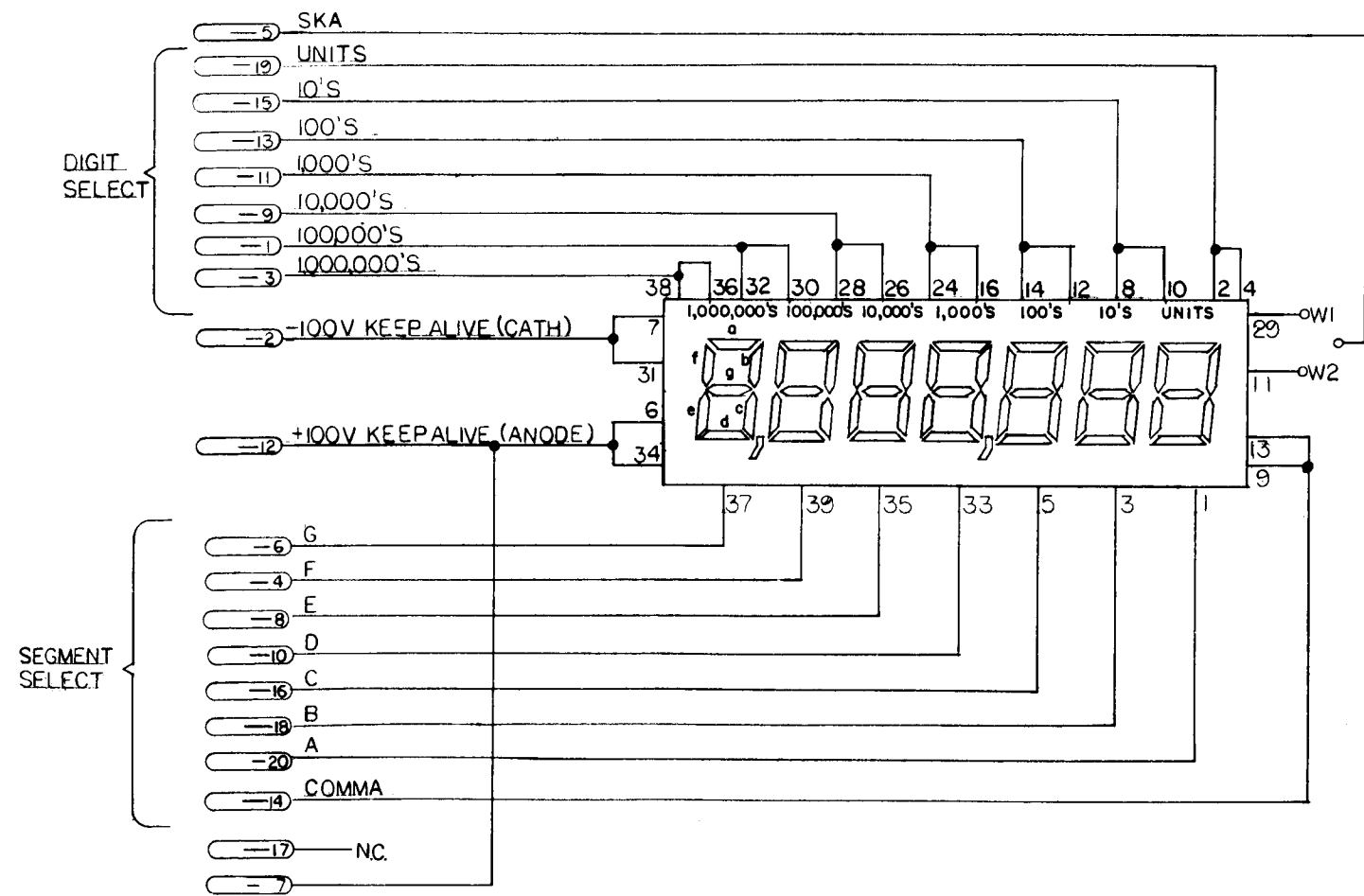
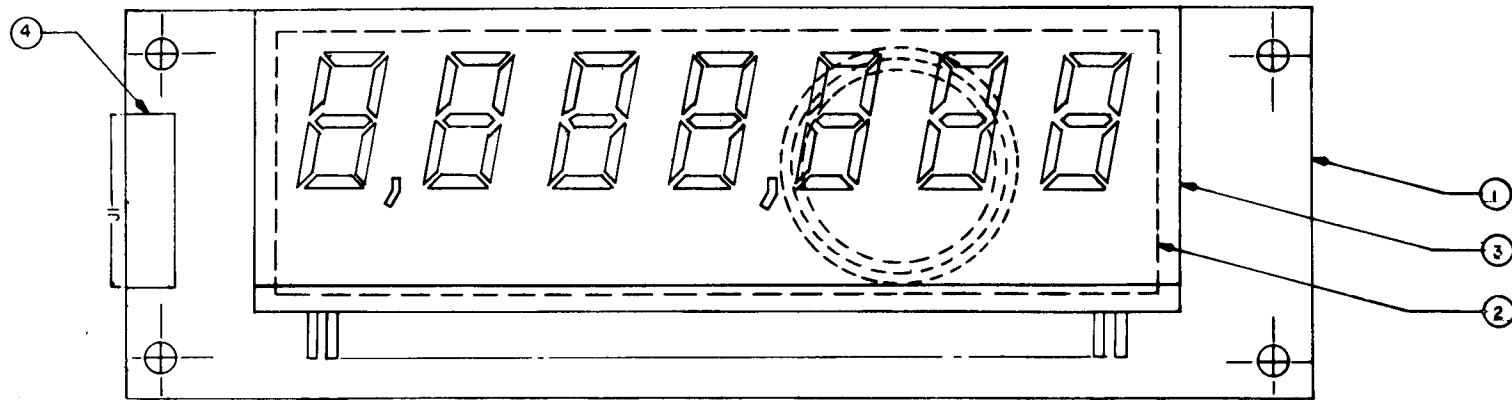


- NOTES:
1. HEAT SINK COMPOUND MUST BE APPLIED BETWEEN TRANSISTOR AND HEAT SINK.
  2. FOR BLACKOUT AND FUTURE GAME WITH SAME FEATURE REMOVE JUMPERS (W1 & W2) AND INSERT RELAY KI, DIODE D2 and 3J7.
  3. OBSERVE INDEX MARK OF INTEGRATED CIRCUIT, POLARITY OF CAPACITORS, DIODE AND POSITION OF TRANSISTORS.
  4. REFERENCE DWG'S: SCHEMATIC 16-8786.
  5. 10A/2 FLIPPER; 15A/3 FLIPPER; 20A/4 FLIPPER; NOT USED/NO FLIPPER.



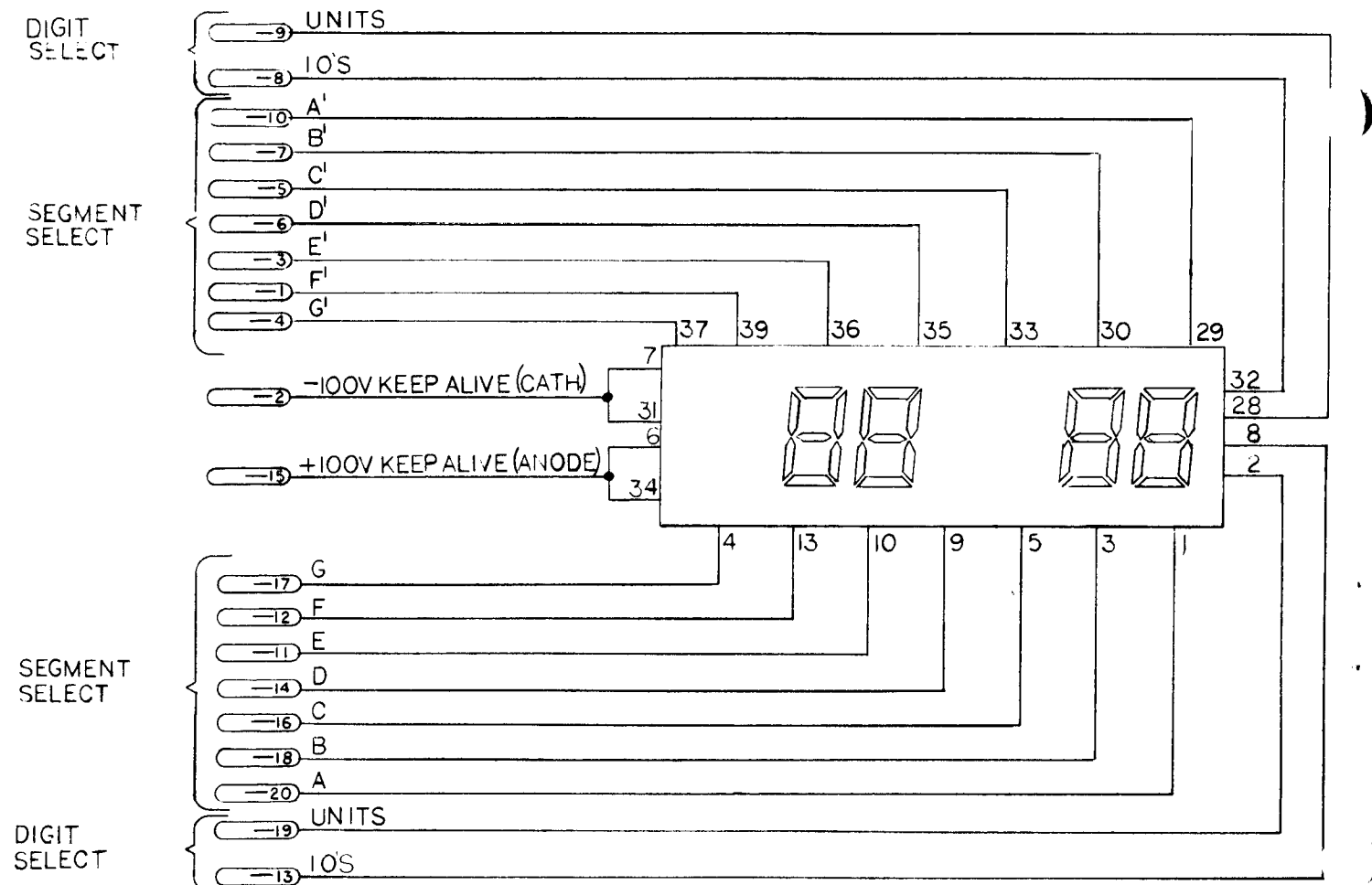
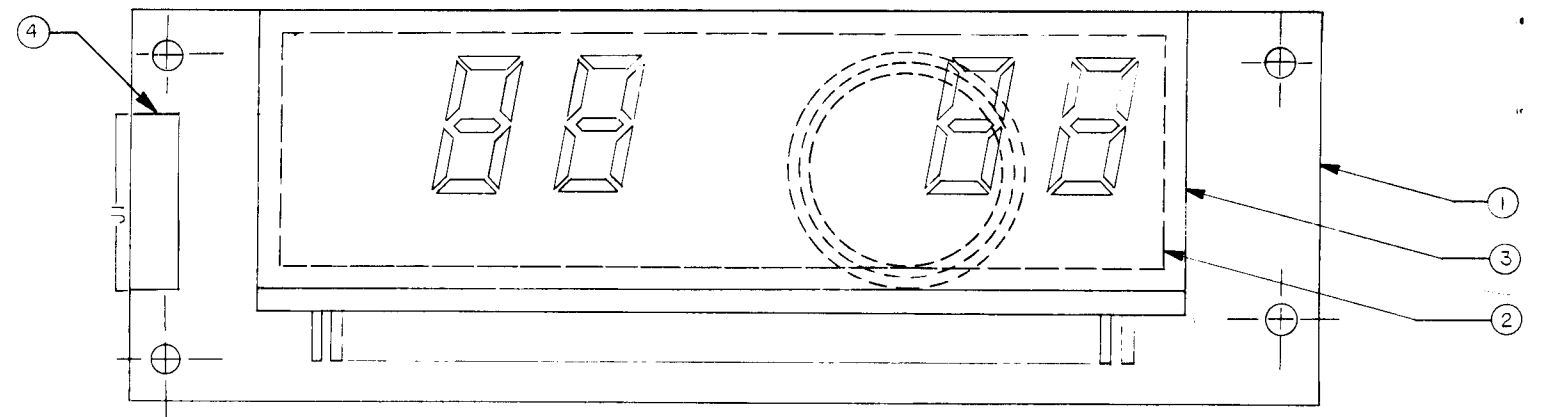
1. DISPLAY VOLTAGE MEASURED WITH DIGITS DISPLAY TEST ON & DISPLAYS AT ALL ZEROS.
2. UNLESS OTHERWISE INDICATED ALL RESISTORS ARE IN OHMS (Ω) 1/4 WATT.
3. TP3 UNREG. +12VDC TYPICAL READOUT NOT TO GO LOWER THAN +10.5V OR INTERMITTENT RESET WILL OCCUR.

BILL OF MATERIAL				
ITEM	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D
1	5762-0848B-XP		SLAVE DISPLAY P.C. BOARD	1
2	23-6548		DISPLAY MTG ADHESIVE FOAM	1
3	5670-0848B-XP		7 DIGIT DISPLAY	1
4	5781-0848B-XP	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	57610546B-00		CREDIT/MATCH SLAVE P.C. BOARD	1
2	23-6548		FOAM DISPLAY - BACK	1
3	5670-0848B-00		4 DIGIT DISPLAY	1
4	5781-0848B-00	J1	20 PIN RIBBON HEADER	1
5	23-6546		FOAM DISPLAY - FRONT	1
6	03-1513-2		CAPLUG	1



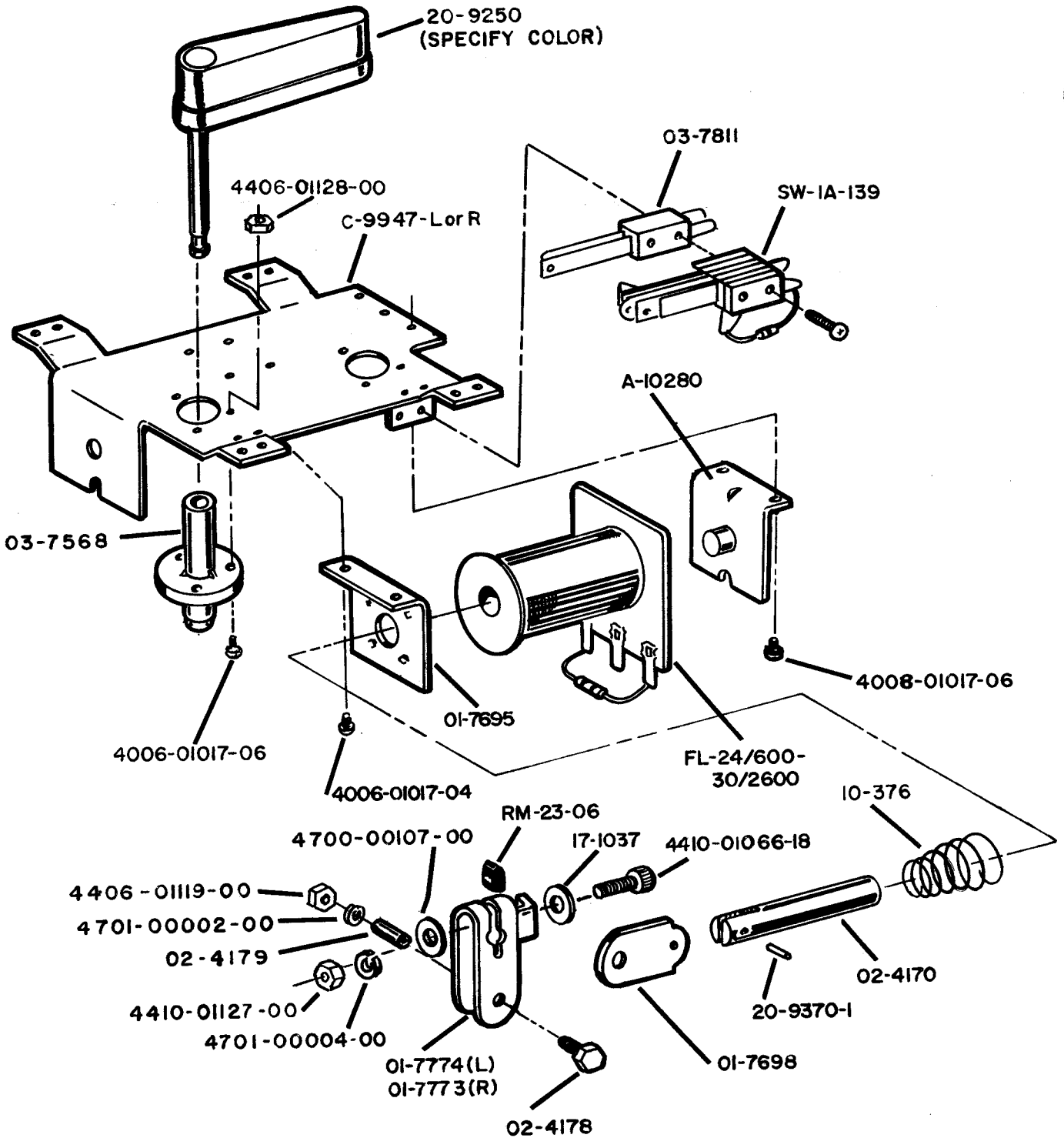
C 8365 CREDIT/MATCH SLAVE DISPLAY



# Function Finder

## A glossary of terms used on *WILLIAMS'* pinball schematics

FUNCTION	DEFINITION
<b>BLANKING</b>	<b>Normally-high signal</b> which is low during power-up and comes high (+5VDC) after reset. Prevents system from locking on lamps and solenoids.
<b>BUS 02</b>	<b>System clock</b> — runs at 1 MHz.
<b>CA1</b>	<b>CONTROL-A ONE</b> — control line for port A on PIA (input to PIA).
<b>CA2</b>	<b>CONTROL-A TWO</b> — PIA input or output.
<b>CB1</b>	<b>CONTROL-B ONE</b> — PIA input that controls port B.
<b>CB2</b>	<b>CONTROL-B TWO</b> — PIA input or output.
<b>CE1</b>	<b>CHIP-ENABLE ONE-NOT</b> — input to IC. When low, it allows IC to operate.
<b>CMOS RAM B +</b>	<b>Battery supply</b> for CMOS RAM. This voltage should measure at least +3.8V with no power applied to CPU board.
<b>CS0, CS1, CS2</b>	<b>CHIP SELECT 0, 1, 2</b> — PIA input used to partially decode addressing of PIA. With CS0 and CS1 high and CS2 low, PIA is selected.
<b>IRQ</b>	<b>INTERRUPT REQUEST-NOT</b> — Normally-pulsing MPU input. When low, $\overline{\text{IRQ}}$ tells processor to temporarily change routine in program.
<b>IRQ A and IRQ B</b>	<b>INTERRUPT REQUEST A and B-NOT</b> — outputs of PIA (tied together in our system) which stay high until PIA needs bus.
<b>MEMORY PROTECT</b>	<b>Signal which comes from coin door.</b> Tells if coin door is open (+5V) or closed (0V). Prevents access to CMOS RAM when coin door is closed. You can't change GAME ADJUSTMENTS when this signal is low.
<b>NMI</b>	<b>NON-MASKABLE INTERRUPT</b> — MPU-input interrupt that can't be ignored (active low). Tells processor to enter diagnostics.
<b>PA0-PA7 and PB0-PB7</b>	<b>Ports of PIA</b> which can be configured as inputs or outputs (individually or collectively). Usually they should be pulsing.
<b>R/W</b>	<b>READ/WRITE-NOT</b> — MPU output. When high, MPU reads data bus. When low, MPU writes on data bus.
<b>RESET</b>	<b>RESET-NOT</b> — Input to MPU. When low, processor isn't running. Used to initialize system or restart it. Must be at least 4.0 VDC before system will come up.
<b>ST1 ST6</b>	<b>Solenoid Trigger One through Six Not</b> —Signals which come from different PIA's. Should be high except when switch-triggered solenoids (17-22) are tested during solenoid test.
<b>VMA</b>	<b>Valid Memory Address</b> —Output of MPU which goes high every time addresses are stable (high or low). VMA is low whenever addresses are in transition.



**NOTE:**

The coil part-number shown is used on *LASER CUE* pinball and *STAR LIGHT* pinball. Check the solenoid chart in your instruction manual for the part number used in your game.

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