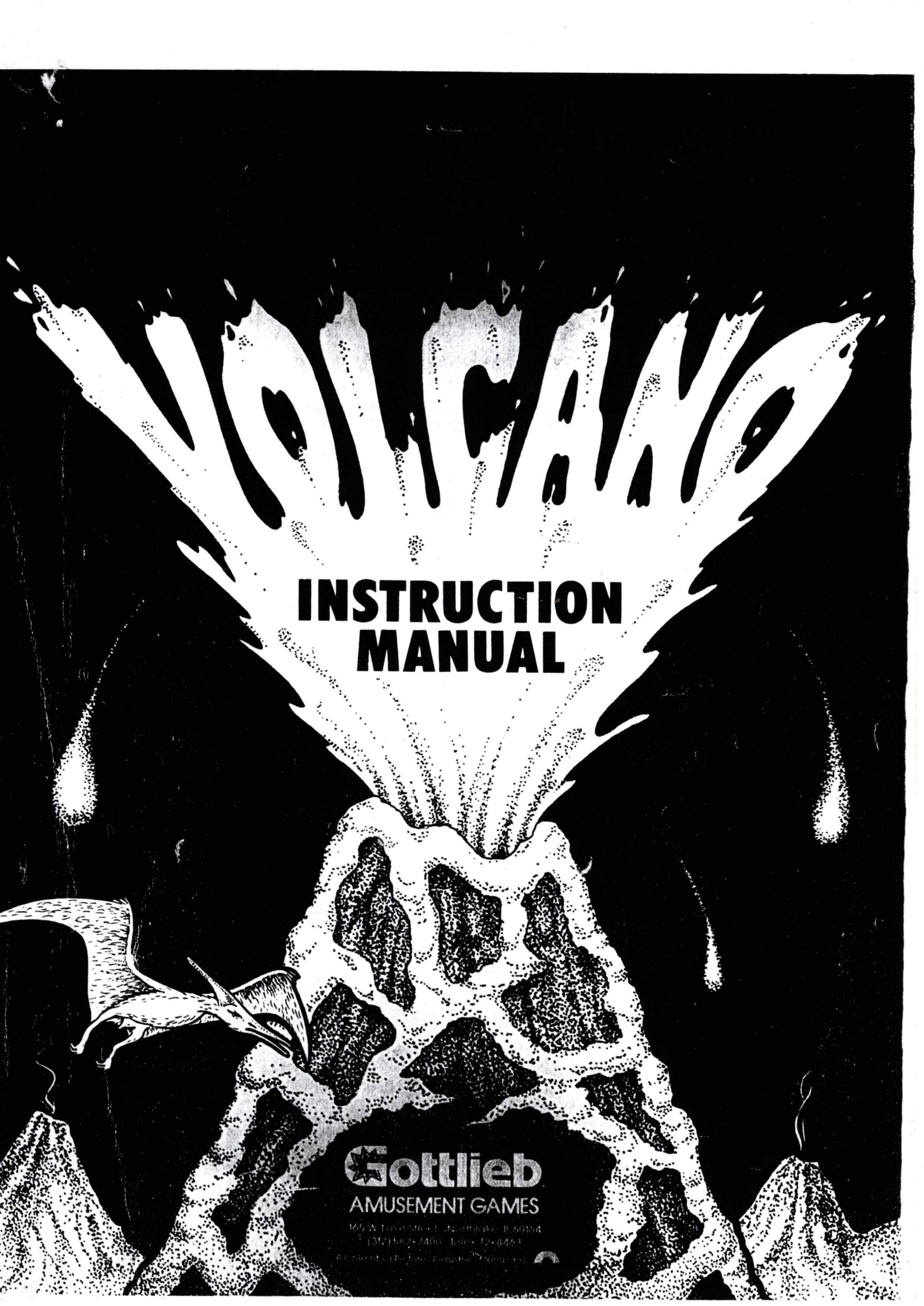




INSTRUCTION MANUAL

Gottlieb
AMUSEMENT GAMES

165 W. 10th Street, New York, N.Y. 10014
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VOLCANO (GAME #667) INSTRUCTION MANUAL

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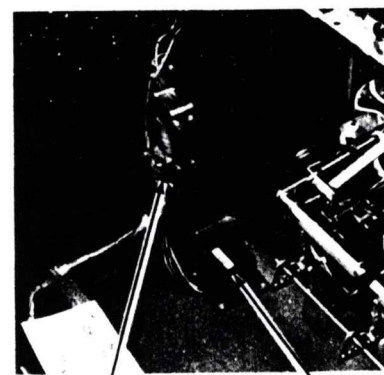
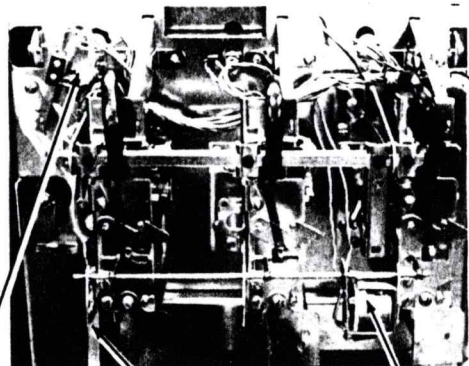
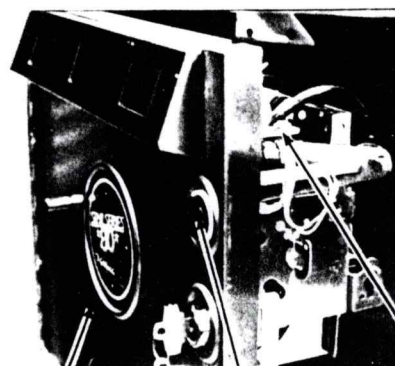
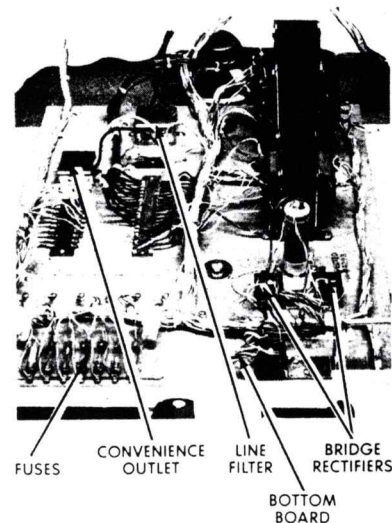
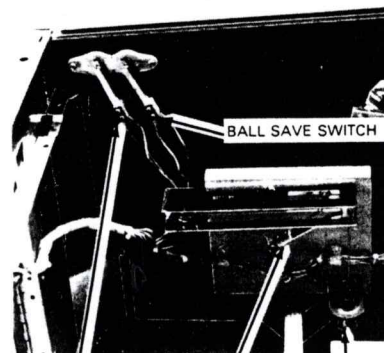
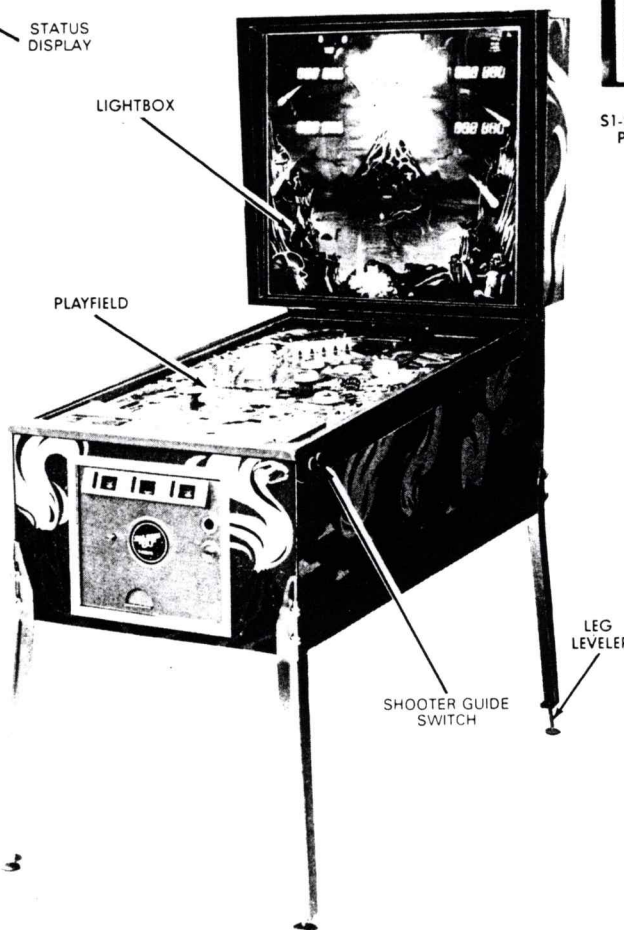
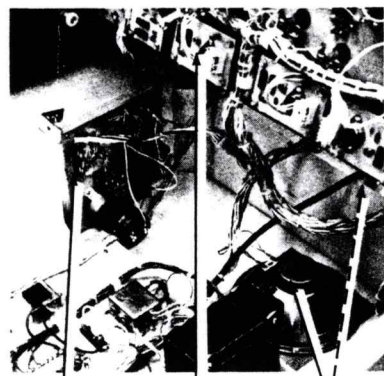
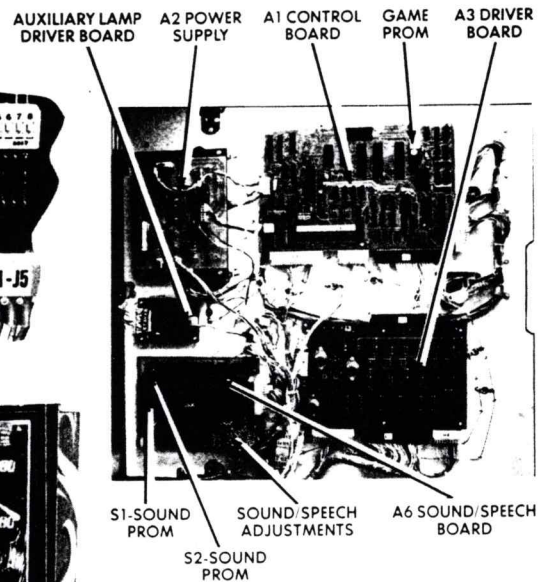
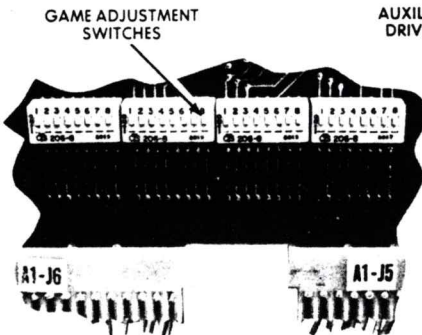
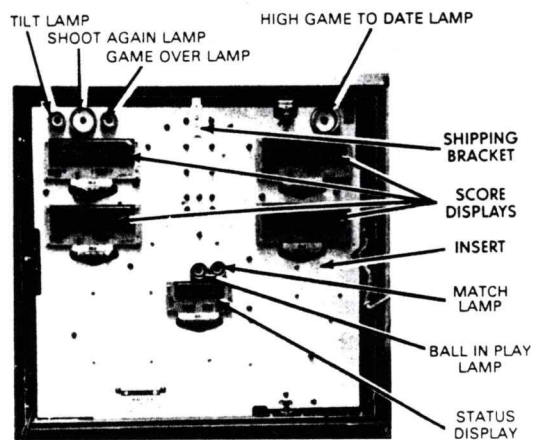
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VOLCANO PROMS

**GAME PROM 667/1
SOUND/SPEECH PROMS 667/S1, 667/S2**

FOR SERVICE, CALL TOLL FREE: 800-323-9121; (ILLINOIS): 800-942-1620

I. INSTALLATION



I. INSTALLATION

A. SET-UP

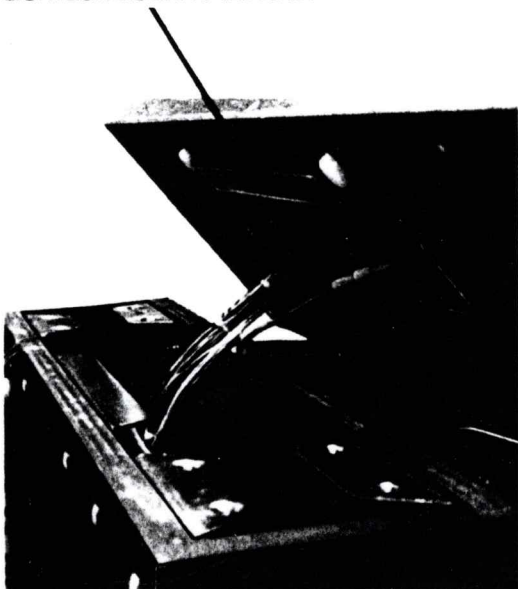
1. Bolt the legs to the cabinet.
2. Feed the line cord through the slot provided in the pedestal.
3. Place the lightbox atop the pedestal, making sure to engage the holding bracket.
4. Insert the key and unlock the lightbox door. Swing the backglass door out.
5. Loosen and lower the shipping bracket at the top center of the lightbox insert panel.
6. Lift the insert; then swing it out.
7. Secure lightbox to cabinet with bolts and washers provided.
8. Connect all cables and secure with cable clamps provided.
9. Open the cabinet door and loosen the front moulding locking arm.
10. Remove the moulding from the playfield.
11. Slide glass forward and let all 3 balls drain to the outhole.

2. Check for any loose wires.
3. Check switches for loose solder or other foreign matter.
4. Be certain all fuses are firmly seated.
5. Check transformers for any foreign matter across terminals.
6. Be sure transformer wiring corresponds to the supply voltage.
7. Check the setting of the normally open tilt switch on the underside of the playfield. One blade should be free-floating with a weight on the end.
8. Level the machine.
9. Adjust the plumb-bob tilt and the ball roll tilt to the sensitivity desired. Both tilt switches are normally open.
10. With the line cord unplugged, drop a coin into one of the chutes. It should be rejected.
11. Plug game into a properly grounded 3-wire receptacle ONLY!
12. Refer to Section VI to make all necessary game adjustments. NOTE: If used, Switches #31 and #32 are special adjustments to make the game liberal or conservative.

B. CHECK-OUT

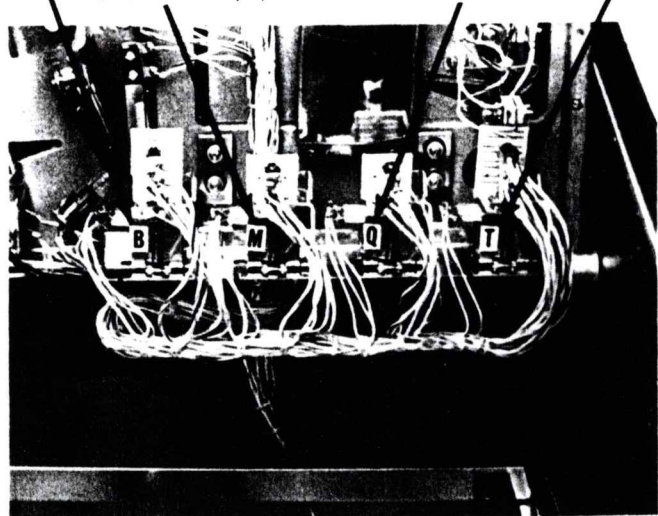
1. Check that all cables are clear of moving parts.

LIGHTBOX HOLDING BRACKET

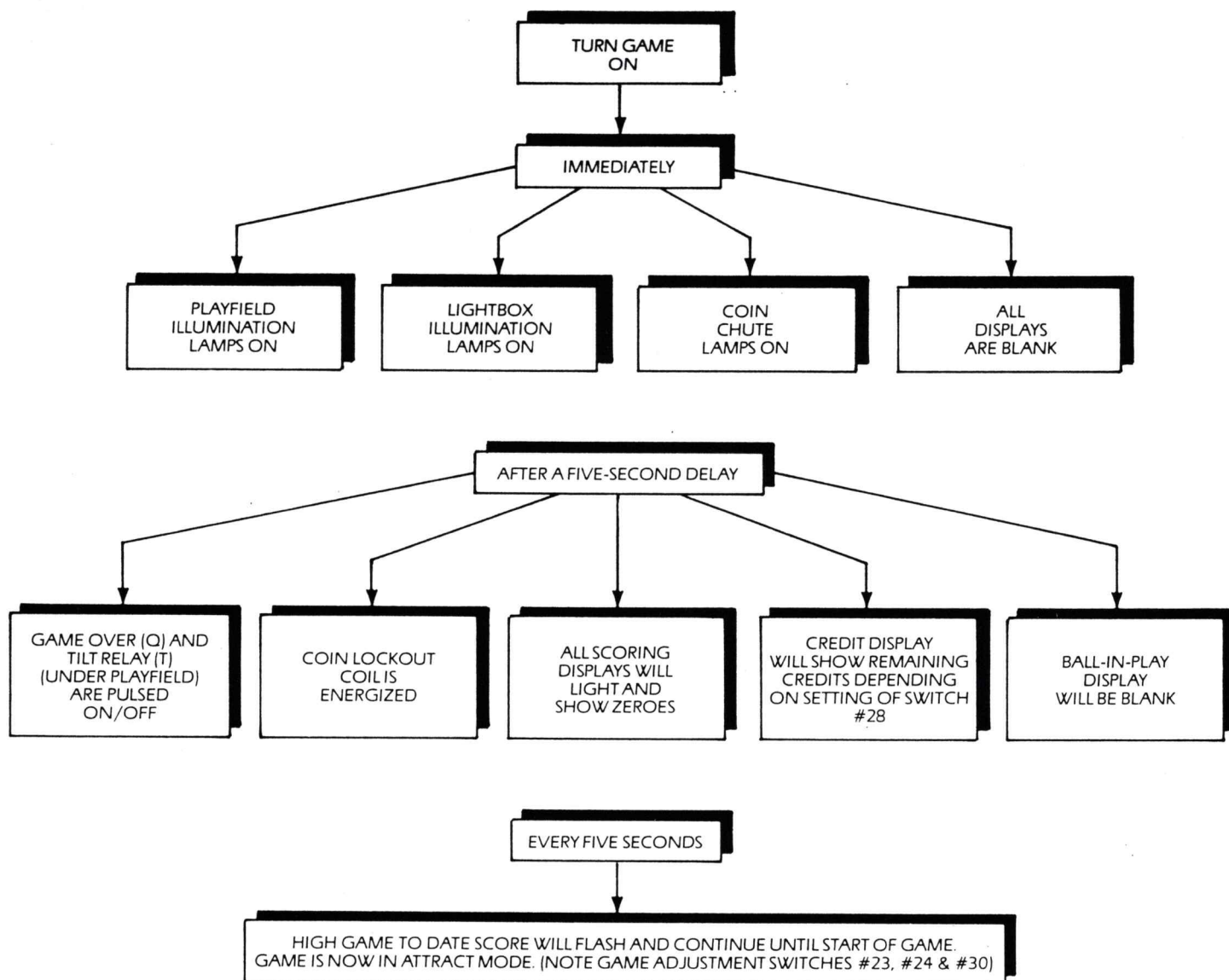


LOCATED ON PLAYBOARD UNDERSIDE

BALL SAVE RELAY (B) TILT RELAY (T)
MOTOR RELAY (M) GAME OVER RELAY (Q)



II. INITIALIZATION



III. GAME OPERATION

A. GAME START

All three balls must be in the ball return trough to start a game.

1. Insert coins into coin chute.
 - a. Coin chute tune is played (dependent on Switch #27).
 - b. Total credits are displayed in status display (dependent on Switch #28).
2. Press Credit Button to start game.
 - a. Credit tune or voice is played.

- b. Total credits displayed decrease by one.
3. All playfield features reset. Ball Shooter Guide moves back and forth.
4. The first player score display flashes a single zero.
5. When the ball is released to the shooter:
 - a. Playfield controlled lamps flash.
 - b. High Game to Date is briefly displayed in all four players' score displays.

III. GAME OPERATION

B. FIRST PLAYER

1. First player's score display flashes single zero.
2. The other players' displays are now blank.
3. A "1" appears on the ball-in-play display.
4. When the ball enters the outhole, the bonus is scored.

C. ADDITIONAL PLAYERS

1. Additional players are indicated by a zero (not flashing) in each corresponding player's display.
2. After the maximum number of players are added, or no more credits remain, the Credit Button has no effect.
3. Additional players can be added any time the first player's first ball is still in play. If the Credit Button is pressed after the first player's first ball has entered the outhole, all players' scores will be erased with the first player's score display showing a flashing zero, indicating a new game only for the first player.

D. EXTRA BALLS

1. When the SHOOT AGAIN lamp is lit, neither the player-up nor the ball-in-play display changes when the ball enters the outhole.
2. Only one extra ball per ball-in-play is given.

E. TILT MODE

1. Tilting the game results in a loss of ball in play.
2. When the game is tilted, all the

playfield lamps go off except the pop bumper lights.

3. All accumulated bonus and bonus multipliers are lost.

F. SLAM MODE

1. If the normally closed slam switch (located inside front door) is opened, the entire game is ended for all players.
2. The GAME OVER lamp comes on.
3. The entire switch matrix is inactive for three seconds.
4. All coins will be rejected if dropped into any coin chute during the three second delay.
5. If the match feature exists (dependent on Switch #18), a replay can be won even if the game is slammed.
6. Game returns to the attract mode.

G. GAME OVER

1. When the last ball enters the outhole, the GAME OVER lamp continually flashes.
2. A random number appears in the ball-in-play display. If this number matches the last two digits in any player's score, a replay (dependent on Switch #18) is awarded.
3. HGTD is periodically flashed in all players' displays. When a score higher than this is achieved, an award (dependent on Switches #23 and #24) is given.
4. All captive balls will be ejected and returned to the outhole.
5. The two target banks will reset.

IV. GAME PLAY AND SCORING

SHOOTER GUIDE

When a ball is served to the shooter, drop target lights start sequencing and the shooter lane guide is activated. The right green button freezes the shooter guide and the rotating drop target lights. Hitting any switch except a ten-point switch restarts the drop target lights sequencing.

BALL-SAVE

Hitting any individually lit drop target lights the "BALL-SAVE" on the left outlane. When the left green button is pressed, the BALL-SAVE is activated.

CRATER FREEZE

- Volcano craters are sequentially lit (except during MULTI-BALL).
- Pressing the right green button freezes the crater lights for approximately one second.
- A scoring switch must be hit to enable the button to re-freeze crater lights.

MULTI-BALL PLAY

- When a ball enters a lit crater, it will be captured and another released to the ball shooter.
- Two red lights ("LAVA LEVEL") in the middle of the playfield flash to show how many balls are captured. When one ball is captured, Lava Level One lamp will flash. When two balls are captured, both Lava Level One and Lava Level Two lamps will flash.
- When the third ball is captured, all balls will be launched, one at a time, from the "VOLCANO SHAFT."
- During MULTI-BALL PLAY, playfield scoring is 2X (two times) (3-Ball only). Playfield scoring remains 1X (one time) during 5-Ball play.
- No Volcano craters are lit.
- When two balls enter the outhole, scoring returns to 1X.
- Captive balls are remembered from ball to ball, unless another player uses them. Each player must capture three balls for MULTI-BALL.

MULTIPLIERS

Lava Flow Multiplier (Playfield Scoring)

- Ball entering Craters 2, 3 or 4 will light corresponding lava flow multiplier for a timed period.

Seismic Multiplier (BONUS)

- Increased when an individually lit drop target is hit.

COLLECT BONUS

- "COLLECT SEISMIC VALUE" arrow lights when bonus value reaches 19 (maximum).
- When ball enters hole kicker when ("COLLECT SEISMIC VALUE") is lit.
- After entering outhole.
- Turns off spinner light and resets "SEISMIC MULTIPLIER" to 1X.

SPECIAL

- Ball entering all four craters will light "SPECIAL".
- Awarded when ball enters hole kicker when "SPECIAL" lamp is lit.
- Craters remembered ball to ball.
- "SPECIAL" light remembered ball to ball (3-Ball only).

EXTRA BALL

- Completing both drop target banks will light "EXTRA BALL".
- Awarded when ball enters "FIRE PIT" when "EXTRA BALL" lamp is lit.
- Ball through right outlane with gate closed will light "EXTRA BALL" for one shot only (dependent on setting of Switch 31).

CRATERS

- Capture ball if lit (See MULTI-BALL PLAY).
- Remembered ball to ball for SPECIAL.

CRATER 1

- Score 1000 points.
- Add BONUS.

CRATER 2

- Score 4000 points.
- Add two BONUS.
- Light 2X lava flow multiplier.

IV. GAME PLAY AND SCORING

CRATER 3

- Score 9000 points.
- Add three BONUS.
- Light 3X lava flow multiplier.
- Light spinner (See SPINNER).

CRATER 4

- Score 16,000 points.
- Add four BONUS.
- Light 4X lava flow multiplier.
- Light spinner.

FIRE PIT

- Score 5000 points.
- Award EXTRA BALL when lit.

DROP TARGETS

- Score 100 points unlit.
- Score 1000 points when bank is lit.
- Score 5000 points, light left "BALL SAVE" and advance multiplier when individual lit target is hit.
- Add BONUS.
- Completed target bank resets, lights bank for 1000 point scoring, and lights "OPEN GATE" spot target.

ROLLOVERS AND ROLLUNDER

LEFT RETURN ROLLOVER

- Score 100 points.
- Add BONUS.

LEFT OUTLANE ROLLOVER

- Score 3000 points.

RIGHT OUTLANE ROLLOVER

- Score 5000 points and light "EXTRA BALL" for one shot only when ball gate is closed. (Dep. on switch 31)
- Score 1000 points when "GATE OPEN" lamp is on; Ball Gate closes.

ROLLUNDER

- Score 3000 points.
- Add BONUS.

HOLE KICKER

- Score 3000 points when collect bonus is unlit.
- Award special when lit.
- Collect bonus when lit.

SPOT TARGET

- Score 1000 points.
- Opens right ball gate when lit.
- Turns off target light.

SPINNER

- Score 100 points unlit.
- Score 1000 points when lit.
- Spinner lit when ball enters Crater #3 or Crater #4. (See CRATERS).

TOP POP BUMPERS AND KICKING TARGET

- Score 1000 points (3-BALL).
- Score 100 points (5-BALL).

BOTTOM POP BUMPERS

- Score 100 points.

10-POINT SWITCHES

- Score 10 points.

HIGH GAME TO DATE

If the High Game to Date is 990,000 or greater at the start of a new game, the High Game to Date will automatically reset to 770,000.

V. GAME SPEECH

ATTRACT MODE	OCCURRENCE
---------------------	-------------------

"DANGER VOLCANO"	Random.
"IT'S GONNA BLOW"	Random.
"THROW ME A SACRIFICE"	Random.

GAME MODE	OCCURRENCE
------------------	-------------------

"VOLCANO"	a. Pressing credit button. b. Random scoring.
"SHOOT LIT VOLCANO"	Ball to Shooter.
"BALL SAVE"	Hitting lit drop target.
"LAVA RISING"	Capturing a ball in lit crater.
"ERUPTION"	When MULTI-BALL play is initiated.
"FIRE PIT"	When EXTRA BALL is lit.
"DANGER"	Random during scoring.
"IT'S GONNA BLOW"	When any non-capturing ball enters crater and no ball is in subway.
"THROW ME A SACRIFICE"	Random during scoring.
"TILT, TILT, TILT"	When game is tilted.
"OOOooo"	When game is slammed.

VI. GAME ADJUSTMENTS

A. CONTROL BOARD SWITCH ADJUSTMENTS

There are 32 switches on the control board which permit adjustment of the game parameters. These switches are contained in four packages of eight switches each, as shown below:

S1-S8	S9-S16	S17-S24	S25-S32
-------	--------	---------	---------

Switch settings are recognized only during normal power-up and when starting the first player of a new game (not when additional players are added).

SWITCHES				COIN CHUTE ADJUSTMENTS
S1	S2	S3	S4	Left Chute
S5	S6	S7	S8	Right Chute
S9	S10	S11	S12	Center Chute

NOTE: FOR GERMAN GAMES ONLY, switches S5-S8 adjust the center chute and switches S9-S12 adjust the right chute.

COINS/CREDITS				
OFF	OFF	OFF	OFF	1/1
OFF	OFF	OFF	ON	1/2
OFF	OFF	ON	OFF	1/3
OFF	OFF	ON	ON	1/4
OFF	ON	OFF	OFF	1/5
OFF	ON	OFF	ON	1/6
OFF	ON	ON	OFF	1/7
OFF	ON	ON	ON	1/8
ON	OFF	OFF	OFF	1/9
ON	OFF	OFF	ON	2/1*
ON	OFF	ON	OFF	2/2*
ON	OFF	ON	ON	2/3*
ON	ON	OFF	OFF	2/4*
ON	ON	OFF	ON	2/5*
ON	ON	ON	OFF	1/1 AND 2/3
ON	ON	ON	ON	3/1*

*NO CREDITS UNTIL LAST COIN IS INSERTED.

SWITCH 13	EXTRA CREDITS
ON	Adds 9 credits to center coin chute setting
OFF	No effect

NOTE: FOR GERMAN GAMES ONLY, Switch 13 adds 9 credits to the right coin chute setting, when ON.

SWITCH 14	COIN CHUTE CONTROL
ON	Left and Right Chutes Same
OFF	Left and Right Chutes Separate

NOTE: FOR GERMAN GAMES ONLY, Switch 14 controls the left and center coin chutes.

SWITCHES		MAXIMUM CREDITS
15	16	
OFF	OFF	8
OFF	ON	10
ON	OFF	15
ON	ON	25

SWITCH 17	BALLS PER GAME
ON	3
OFF	5

SWITCH 18	MATCH FEATURE
ON	ON
OFF	OFF

SWITCH 19	REPLAY LIMIT
ON	Limits each player to one replay per game
OFF	No replay limit

SWITCH 20	NOVELTY MODE
ON	Playfield SPECIAL and EXTRA BALL features award 50,000 points and 5 knocks. High score, high game to date, and match features disabled.
OFF	Normal game mode

NOTE: SWITCH 20 overrides SWITCH 21.

SWITCH 21	GAME MODE
ON	Extra Ball
OFF	Replay

NOTE: IF SWITCH 21 is ON, the high game to date and match awards are disabled.

SWITCH 22	PLAYFIELD SPECIAL
ON	Awards Extra Ball
OFF	Awards Special

SWITCHES		HIGH GAME TO DATE
23	24	
OFF	OFF	Not displayed—no award
OFF	ON	Displayed—no award
ON	OFF	Displayed—awards 2 replays
ON	ON	Displayed—awards 3 replays

SWITCH 25	MUST REMAIN ON
------------------	-----------------------

SWITCH 26	REPLAY BUTTON TUNE?
ON	Yes
OFF	No

SWITCH 27	COIN SWITCH TUNE?
ON	Yes
OFF	No

SWITCH 28	CREDITS DISPLAYED?
ON	Yes
OFF	No

SWITCH 29	OFF
------------------	------------

SWITCH 30	ATTRACT FEATURES
ON	ON
OFF	OFF

SWITCHES 31, 32	LIBERAL-CONSERVATIVE
------------------------	-----------------------------

(SEE SECTION VI, B)

B. LIBERAL-CONSERVATIVE ADJUSTMENTS

• Game Adjustment Switch #31

ON (Liberal) — Ball through right outlane with gate closed will light EXTRA BALL for one shot only.

OFF (Conservative) — No EXTRA BALL through right outlane.

VI. GAME ADJUSTMENTS

C. POST ADJUSTMENTS

There is one post adjustment that provides liberal or conservative game play. See Playboard Information (page 31) for post positioning.

THE SOUND/SPEECH BOARD (A6) USED IN VOLCANO GAME #667 IS NOT INTERCHANGEABLE WITH SOUND BOARDS (A6) USED IN GAMES PREVIOUS TO MARS (#666).

D. SOUND/SPEECH ADJUSTMENTS

Volume potentiometer for adjusting the speaker output is located on the bottom board and is accessible through the front door.

IMPORTANT: All potentiometers (pots) on the sound/speech board are factory adjusted for maximum voltage.

Damage to board components may result if settings are changed, unless an oscilloscope and calibration procedure is followed.

SWITCH BANK (SB1) SETTINGS:

SBI-1	USED IN SELF-TEST ONLY.	
SBI-2	NOT USED	
SBI-3	SBI-4	Attract Mode Speech
OFF	OFF	Disabled.
ON	OFF	Every 10 Seconds.
OFF	ON	Every 2 Minutes.
ON	ON	Every 4 Minutes.
SBI-5	ON	Background sound enabled.
	OFF	Background sound disabled.
SBI-6	ON	All Speech enabled.
	OFF	All Speech disabled.
SBI-7	NOT USED	
SBI-8	NOT USED	

SOUND/SPEECH BOARD (A6) TEST SEE SECTION IX, E PAGE 14.

VII. BOOKKEEPING AND SELF TEST

The circuitry in this game helps the operator perform many bookkeeping and game test functions. The information is shown one step at a time in the first player's score display, while the step number is shown in the credit display (refer to flow chart Section VII, C for order and function).

A. BOOKKEEPING

- Pressing the SELF-TEST button inside the front door begins the bookkeeping which are steps 01 through 15.
- The data in any of these steps may be reset to zero while it is displayed by pressing the replay button on the front door.
- **The SELF-TEST button must then be pressed to enter zero into memory.**
- All bookkeeping information is checked against itself to insure that it is correct. If

any data is invalid or bad, that information will flash while it is displayed.

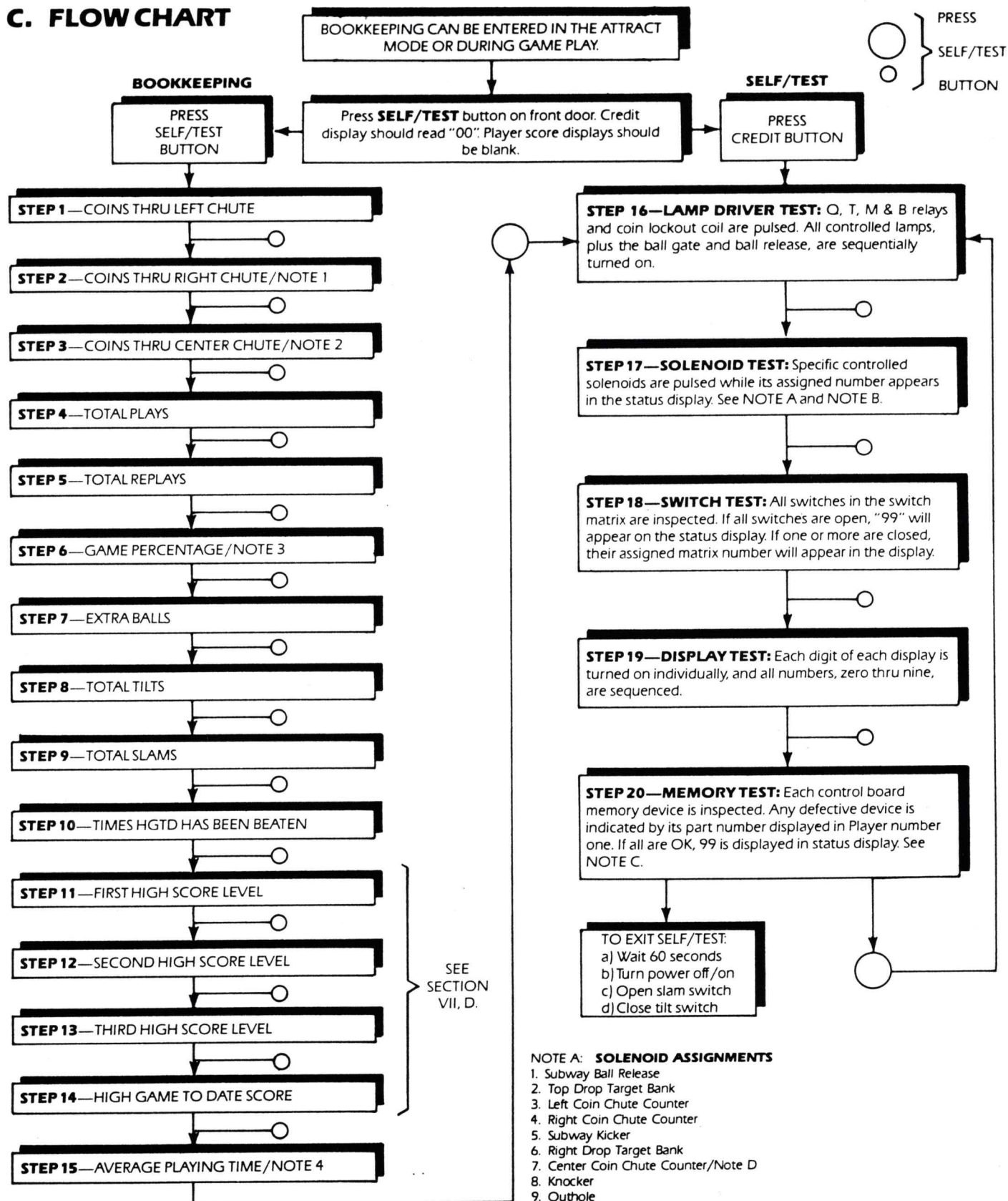
- If the SELF-TEST button is not pressed within 60 seconds of each step, the game will return to the attract mode.

B. SELF-TEST

- Steps 16 through 20 are SELF-TEST or game tests the operator can use for quick troubleshooting.
- All the tests are explained in the flow chart (Section VII, C).
- Each test can be repeated by pressing the replay button on the front door. This starts the test for another 60 seconds.
- If the SELF-TEST button or the replay button is not pressed within 60 seconds, the game will return to the attract mode.

VII. BOOKKEEPING AND SELF TEST

C. FLOW CHART



1. If control board switch #14 is on, Steps 01 and 02 are added together and displayed in Step 01.
2. IN GERMAN GAMES ONLY, Step 02 displays total coins thru center chute, and Step 03 displays total coins thru right chute.
3. If Step 06 is reset, Steps 04 and 05 must also be reset.
4. If Step 15 is reset, Step 04 must also be reset.

NOTE A: SOLENOID ASSIGNMENTS

1. Subway Ball Release
2. Top Drop Target Bank
3. Left Coin Chute Counter
4. Right Coin Chute Counter
5. Subway Kicker
6. Right Drop Target Bank
7. Center Coin Chute Counter/Note D
8. Knocker
9. Outhole

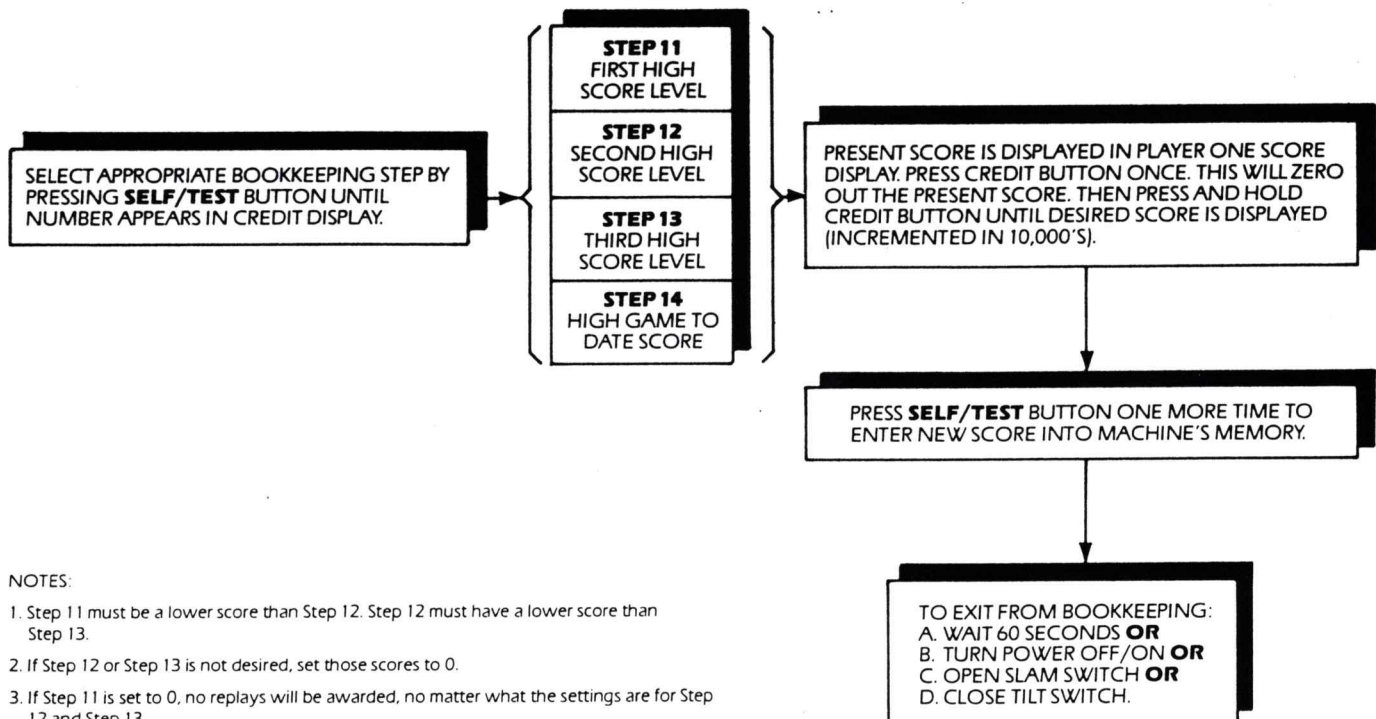
NOTE B: Mechanical coin counters are optional and are not pulsed during solenoid test.

NOTE C: James Bond and later System 80 games will display 7641-1 for a bad 2716 game prom.

NOTE D: FOR GERMAN GAMES ONLY, solenoid #4 is assigned to center coin chute and solenoid #7 is assigned to right coin chute.

VII. BOOKKEEPING AND SELF TEST

D. HOW TO RESET HIGH SCORE LEVELS OR HIGH GAME TO DATE SCORES



VIII. OPTIONS

A. ELECTRO-MECHANICAL COIN COUNTERS

Electro-mechanical coin counters may be installed on the bottom board, directly behind the 7-position fuse block. Solder lugs are provided which will connect the counters to the electronic circuitry.

1. Position the counter and secure it to the bottom board. Mounting holes are spotted for most standard 24 volt counters.
2. CAUTION: A 1N4004 diode must be connected across each counter with the cathode lead connected to the solder lug with the RED-BLACK-BLACK wire.
3. Connect one counter lead to each of the two solder lugs provided for each counter.
4. The counter should increment once when the respective coin chute switch is closed.

IX. GENERAL INFORMATION

A. PRINTED CIRCUIT BOARDS ARE DESIGNATED AS FOLLOWS:

- A1 — Control Board
- A2 — Power Supply
- A3 — Driver Board
- A4 — Score Displays (4)
- A5 — Status Display
- A6 — Sound/Speech Board
- A8 — Pop Bumper Driver Boards (4)
- A11 — Auxiliary Lamp Driver Board—
Lightbox

Printed circuit board connectors will be labeled AX-JX. For example, A3-J4 is the connector J4 on the driver board (A3).

B. WIRE COLORS ARE SHOWN AS NUMBERS:

0 Black	5 Green
1 Brown	6 Blue
2 Red	7 Purple
3 Orange	8 Slate
4 Yellow	9 White

For example, 688 is a BLUE-SLATE-SLATE striped wire.

C. FUSES

BOTTOM BOARD

F1	Lightbox Illumination	8 Amp SLO-BLO
F2	Playboard Illumination	8 Amp SLO-BLO
F3	Controlled Lamps	7-1/2 Amp
F4	Sound Board	2 Amp SLO-BLO
F5	Power Supply	5 Amp SLO-BLO
F6	Solenoids	8 Amp SLO-BLO
F7	Displays	1/4 Amp SLO-BLO
F8	Primary Fuse 110 VAC	5 Amp SLO-BLO
	Primary Fuse 220 VAC	2.5 Amp SLO-BLO

SOUND/SPEECH POWER SUPPLY

F9	Sound, Speech	1 Amp SLO-BLO
----	---------------	---------------

PLAYBOARD

F10	Center Pop Bumper	2.5 Amp Slo/Blo
F11	Left Top Pop Bumper	2.5 Amp Slo/Blo
F12	Right Bottom Pop Bumper	2.5 Amp Slo/Blo
F13	Left Bottom Pop Bumper	2.5 Amp Slo/Blo
F14	Outhole, Subway Ball Release.	2 Amp Slo/Blo
F15	Top and Right Drop Target Banks, Subway Kicker.	2.5 Amp Slo/Blo
F16	Fire Pit	5 Amp Slo/Blo
F17	Hole Kicker and Ball Release	2.5 Amp Slo/Blo

IX. GENERAL INFORMATION

D. COIL CHART

SOLENOID COILS

PART NUMBER	GENERAL USAGE*	RESISTANCE (ohms)	NUMBER OF TURNS	WIRE GAUGE	WRAPPER COLOR
A-1496	KICKING RUBBERS POP BUMPERS	2.95	635	#23	Yellow
A-4893	POP BUMPERS BALL KICKER	2.1	535	#22	Red
A-5194	GONG	4.5	780	#24	Blue
A-5195	KNOCKER, HOLE KICKER	12.3	1305	#26	White
A-16570	HOLE KICKER, OUTHOLE	15.5	1450	#27	Green
A-17875	FLIPPERS	2.8/40.0	560/1100	#24/31	Yellow
A-17891	5 BANK RESET	3.35	850	#22	White
A-18102	3 BANK RESET, 7 BANK RESET USES 2	9.0	1430	#24	Red
A-18318	4 BANK RESET	6.7	1130	#24	Orange
A-19300	BALL KICKER	7.8	1075	#25	Orange
A-20095	SUPER FLIPPER	1.55/35.5	450/900	#22/31	Red

RELAY COILS

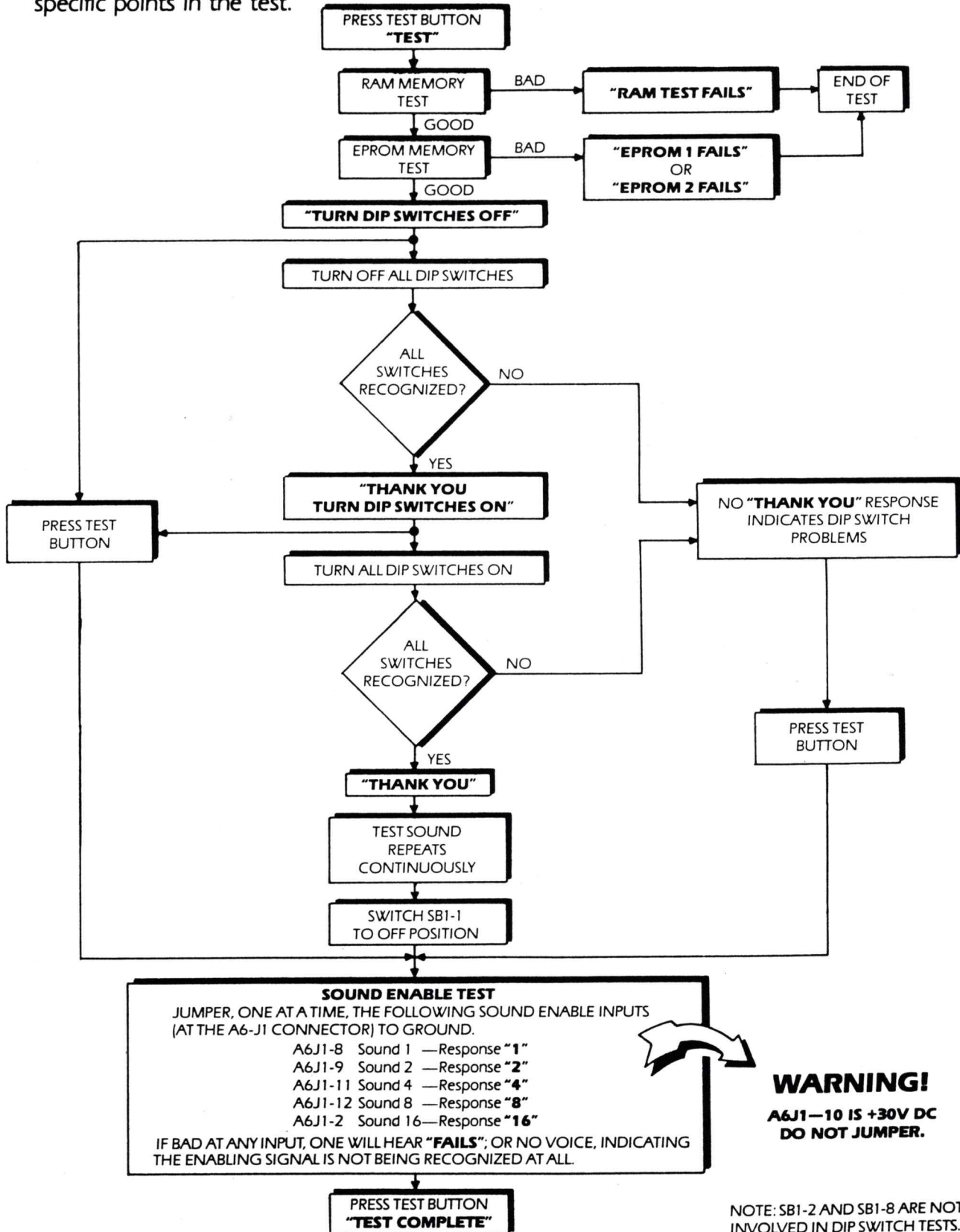
A-16890	Q, T, AND COIN LOCKOUT RELAYS	231.0	4000	#35	Orange
A-17564 A-20558	GATE RELAY	156.0	3400	#34	White
A-18642	MEMORY/ DROP TARGETS	58.0	1590	#33	White

*Coils may vary from game to game. Check game manual for exact coil usage.

IX. GENERAL INFORMATION

E. SOUND/SPEECH BOARD (A6) TEST

1. Game must be in game over mode to initiate test.
2. Pressing the test button on the sound board will initiate the test.
3. The test must be completed to enable the sound board or game power must be turned off/on.
4. Words in bold print with quotation marks are the voice responses the sound board issues at specific points in the test.



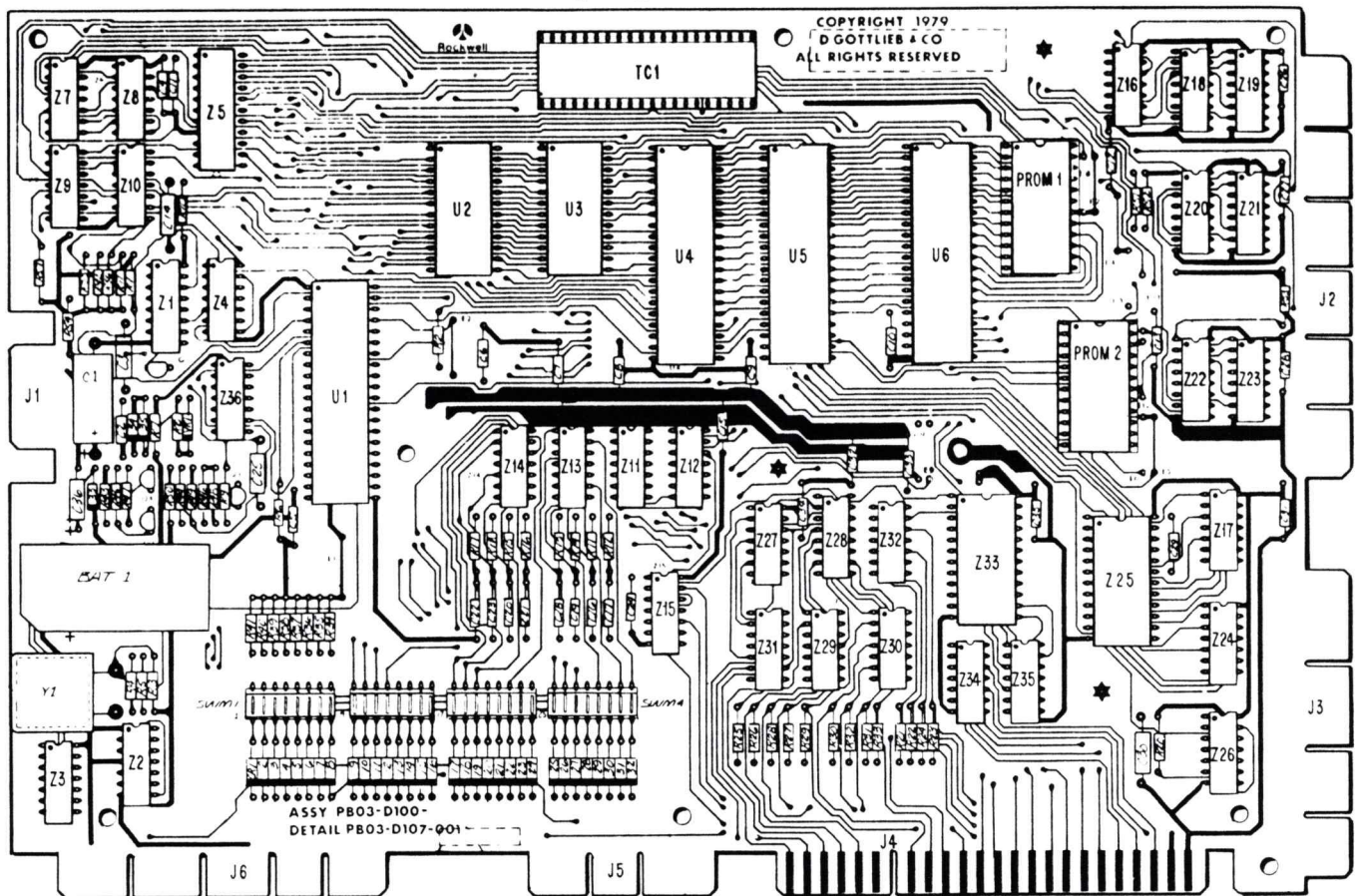
X. WIRING AND SCHEMATIC DIAGRAMS, PARTS LISTS

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X. WIRING AND SCHEMATIC DIAGRAMS, PARTS LISTS

CONTROL BOARD (A1) COMPONENT LOCATION

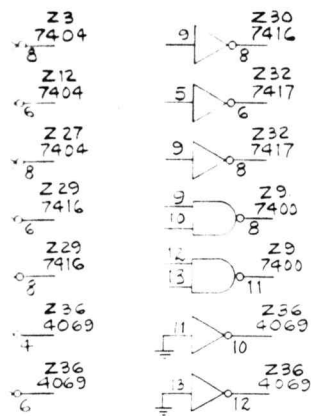


CONTROL BOARD (A1) PARTS LIST

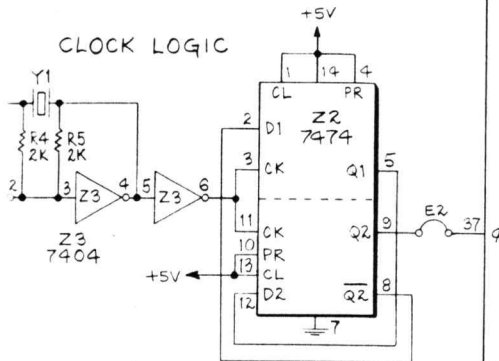
REFERENCE	DESCRIPTION	PART NUMBER	REFERENCE	DESCRIPTION	PART NUMBER
BAT.1	Battery—3.6V	326R10-002	U3	ROM	R3272-12
C1	Capacitor, 100 mfd., 10V		U4, U5, U6	RIOT	R6532-18
C2,	Capacitor, .01 mfd., 50V		VR1	Zener Diode—3.0V, 5%	1N5225B or 1N5987B
C4-C13,			Y1	Crystal, 3.579545 MHZ	333R08-001
C15-C24,			Z1	IC-CMOS—Dual 1 Shot	SCL4528B
C26-C29,			Z2	IC—Dual Flip Flop	SN7474N
C31-C35			Z3, Z11,	IC—Hex Inverter	SN7404N
C3, C14,	Capacitor, .1 mfd., 50V		Z12, Z16,		
C25, C30			Z17, Z24,		
CR1-CR35	Diode, GP	1N4148	Z26, Z27,		
Q1, Q4	Transistor—PNP	MPS-A70	Z34, Z35		
Q2, Q3	Transistor, NPN (Motorola)	2N440	Z4	IC-CMOS—Quad 2 Input "AND"	SCL4081B
R1, R6,	Resistor, 3.0K ohm, 5%, 1/4W		Z5	IC-RAN/CMOS	P5101-L
R11-R24,			Z7	IC—Hex Inverter	SN74LS04N
R42, R45,			Z8	IC—2 Input "NOR"	SX7402N
R46, R48,			Z9, Z13,	IC—2 Input "NAND"	SN7400N
R51-R57			Z14		
R2,	Resistor, 4.7K ohm, 5%, 1/4W		Z10	IC—Open Collector Inverter	SN74LS05N
R34-R41			Z15	IC—2 Input—"OR"	SN7432N
R3, R43,	Resistor, 5.6K ohm, 5%, 1/4W		Z18, Z20	IC—"D" Flip Flop	SN74175N
R49			Z22		
R4, R5,	Resistor, 2.0K ohm, 5%, 1/4W		Z19, Z21,	IC—4 to 7 Decoder	SN7448N
R44			Z23		
R7	Resistor, 62 ohm, 5%, 1/4W		Z25, Z33	IC—4 to 16 Decoder	SN74154N
R8, R50	Resistor, 180 ohm, 5%, 1/4W		Z28	IC—2-to-4 Decoder	SN74LS139N
R9	Resistor, 1K ohm, 5%, 1/4W		Z29, Z30	IC—Hex Inverter—OC/HV	SN7416N
R10	Resistor, 2.8M ohm, 5%, 1/4W		Z31	IC—2 Input "AND"	SN7408N
R25-R33	Resistor, 620 ohm, 5%, 1/4W		Z32	IC—Hex Buffer—OC	SN7417N
R47	Resistor, 24K ohm, 5%, 1/4W		Z36	IC—CMOS	MM74C04 or
SW1-SW4	Dip Switch Pak—8 Position	341R31-005		Socket—DIL, 24 PIN	SCL4069B
TC1	Socket, 40 Pin	640379-3		Spacer, Cork	640361-3
U1	CPU	R6502-13			131R06-001
U2	ROM	R3273-12			

UNLESS OTHERWISE INDICATED;
RESISTORS ARE $\pm 5\%$, 1/4W.
CAPACITORS ARE .01 μ F, 50V.
DIODES ARE TYPE IN4148.
DESIGNATION Z6 NOT USED.

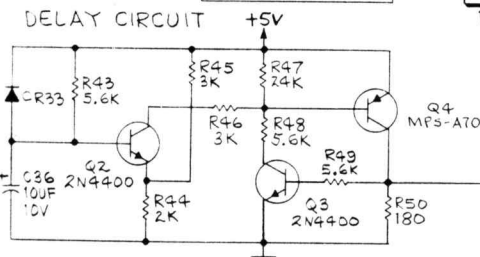
SPARE GATES



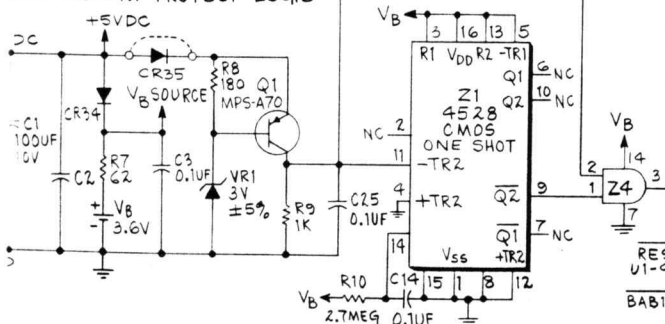
CLOCK LOGIC



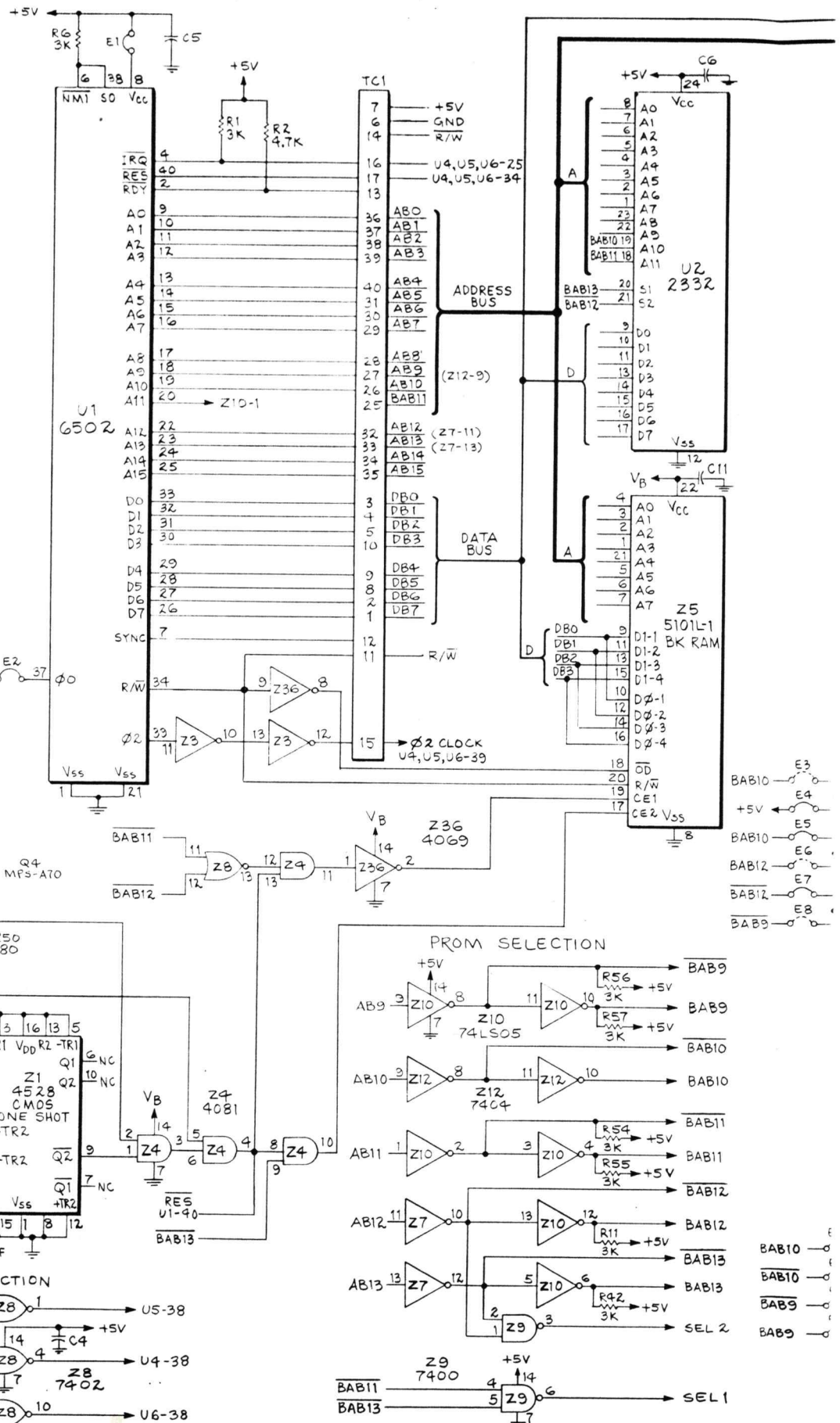
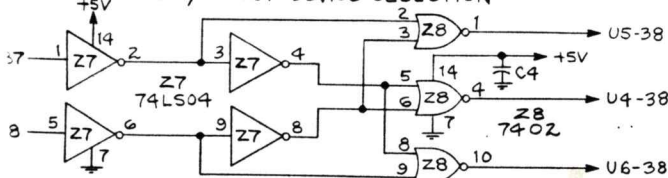
DELAY CIRCUIT



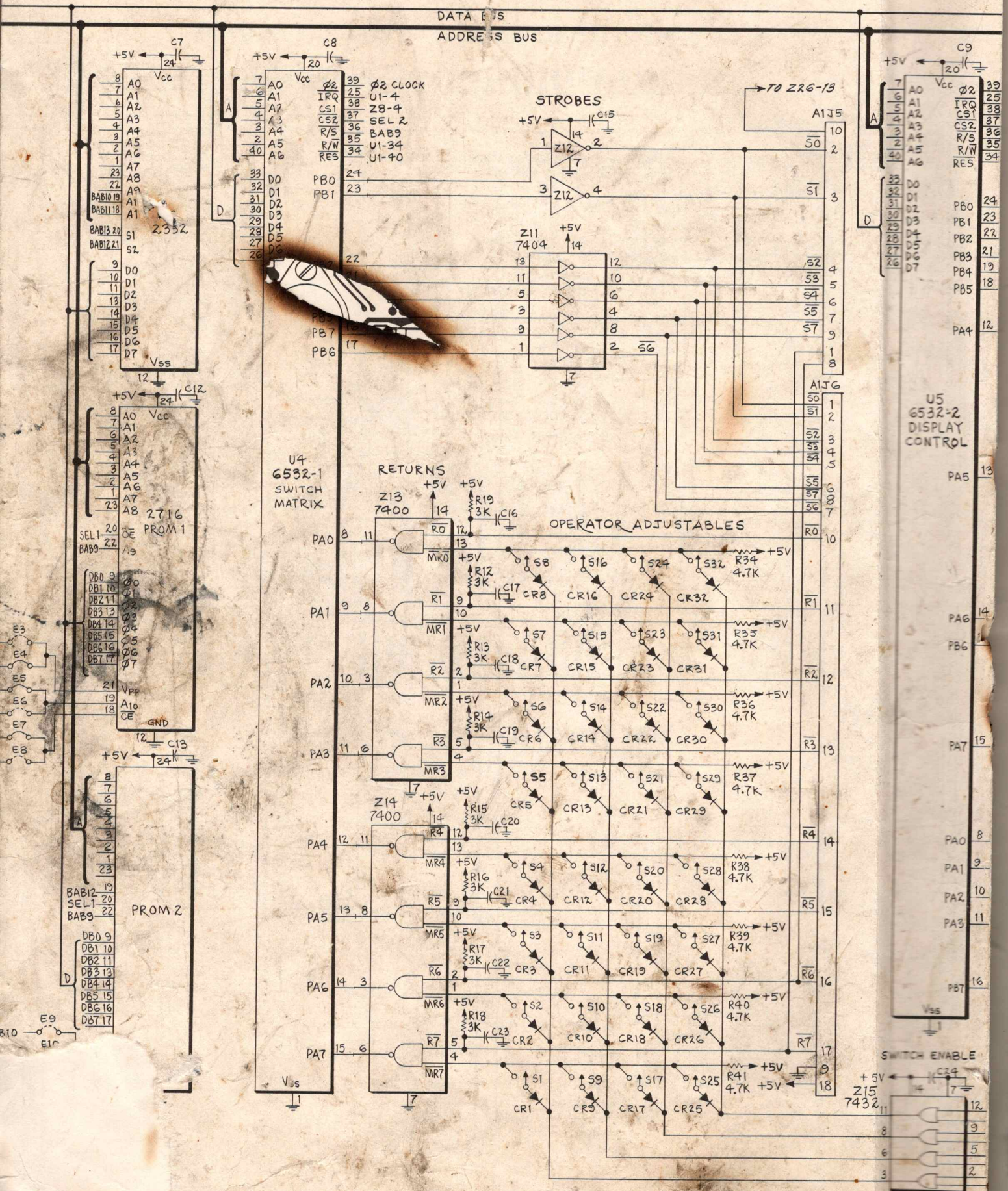
OWN MEMORY PROTECT LOGIC



INPUT/OUTPUT DEVICE SELECTION

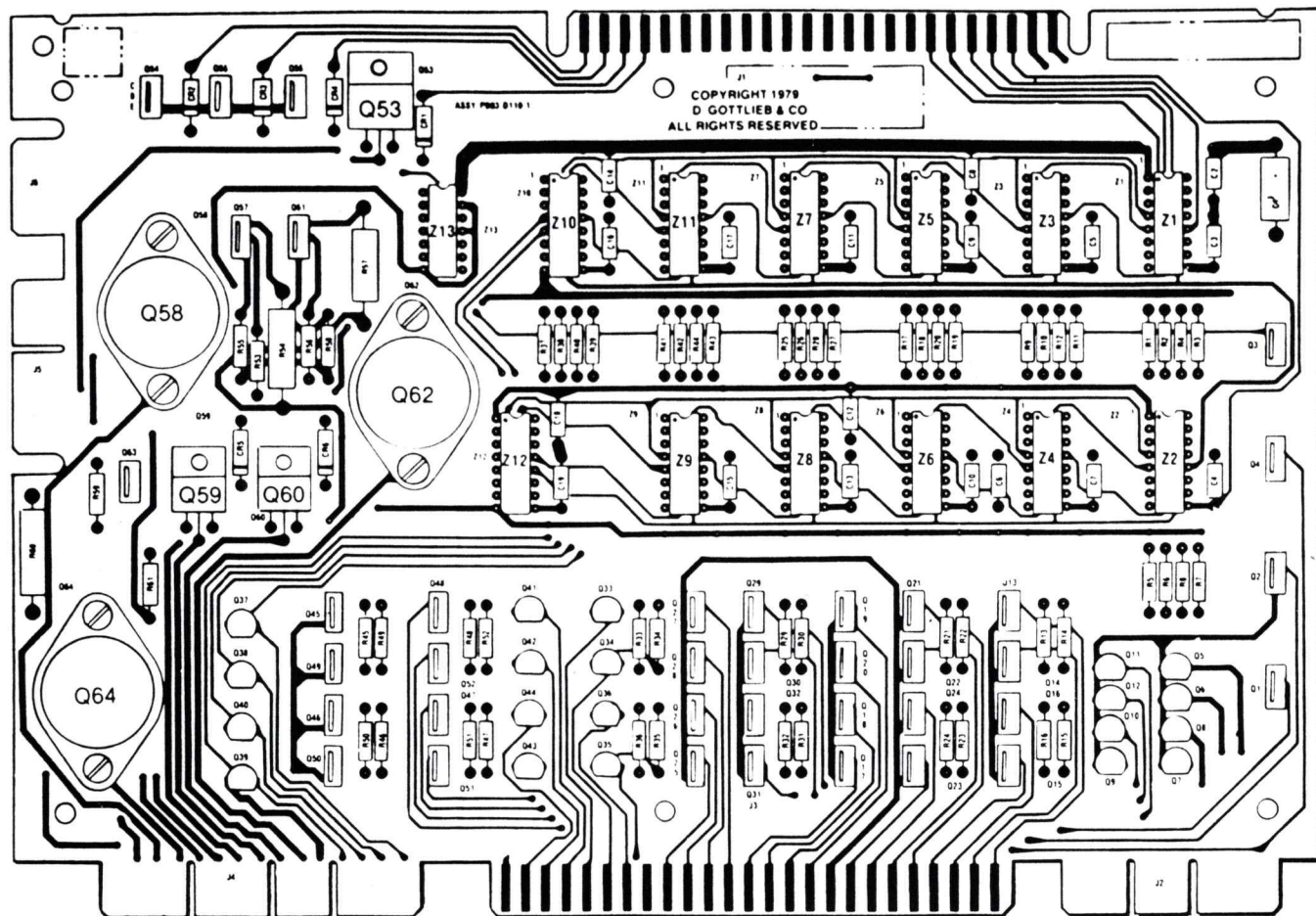


X. WIRING AND SCHEMATIC DIAGRAMS, PARTS LISTS



X. WIRING AND SCHEMATIC DIAGRAMS, PARTS LISTS

DRIVER BOARD (A3) COMPONENT LOCATION

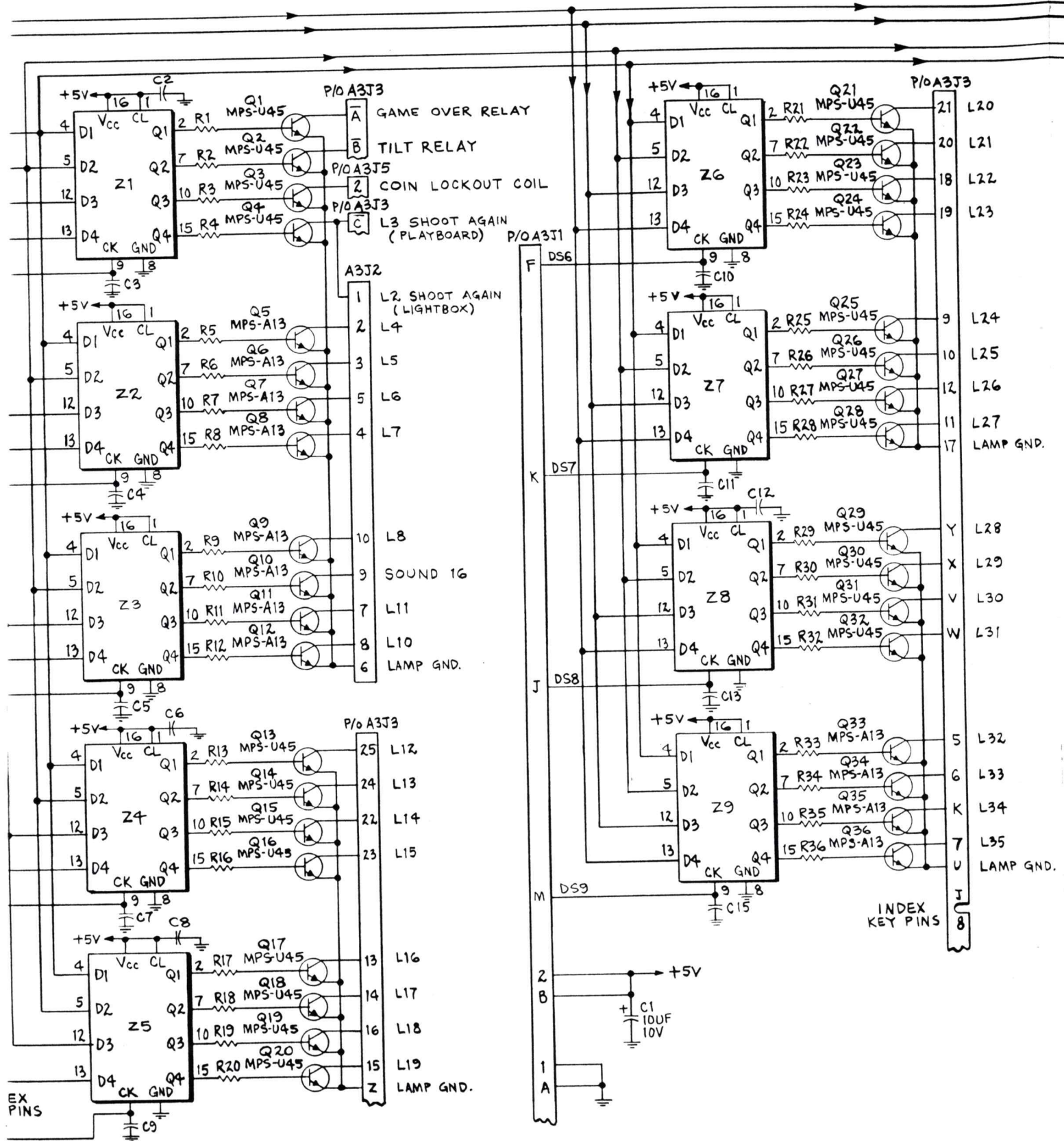


DRIVER BOARD (A3) PARTS LIST

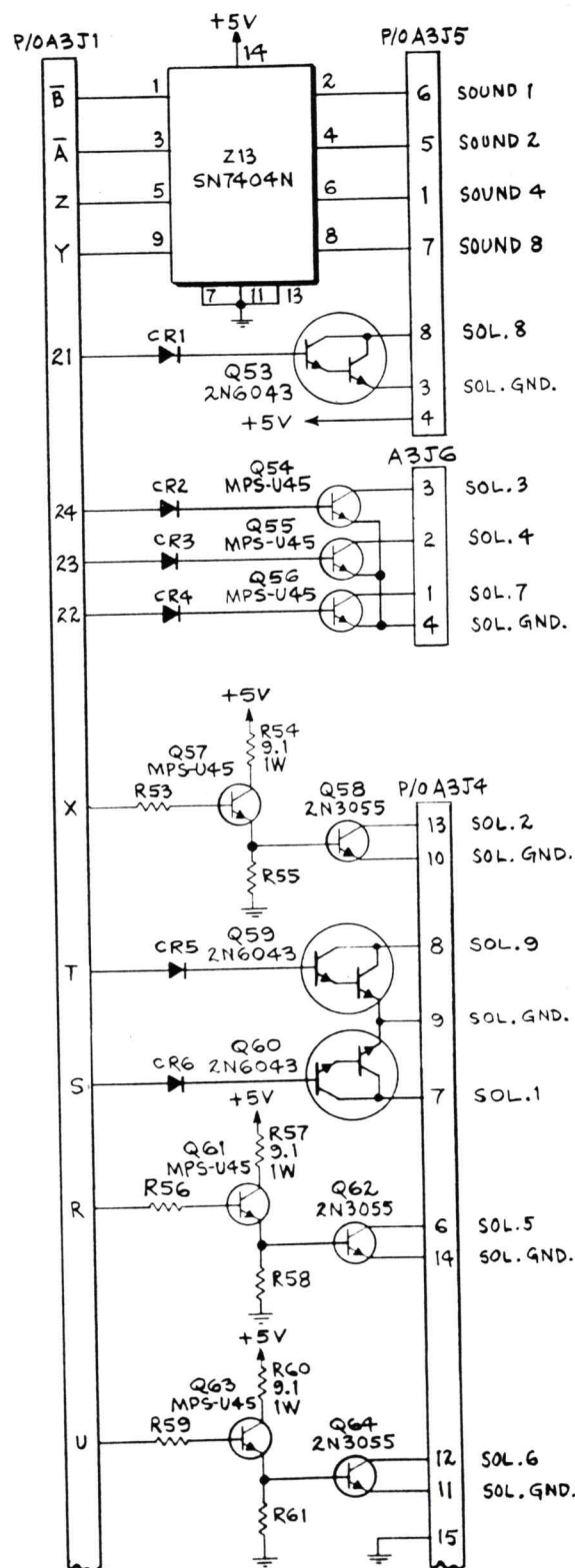
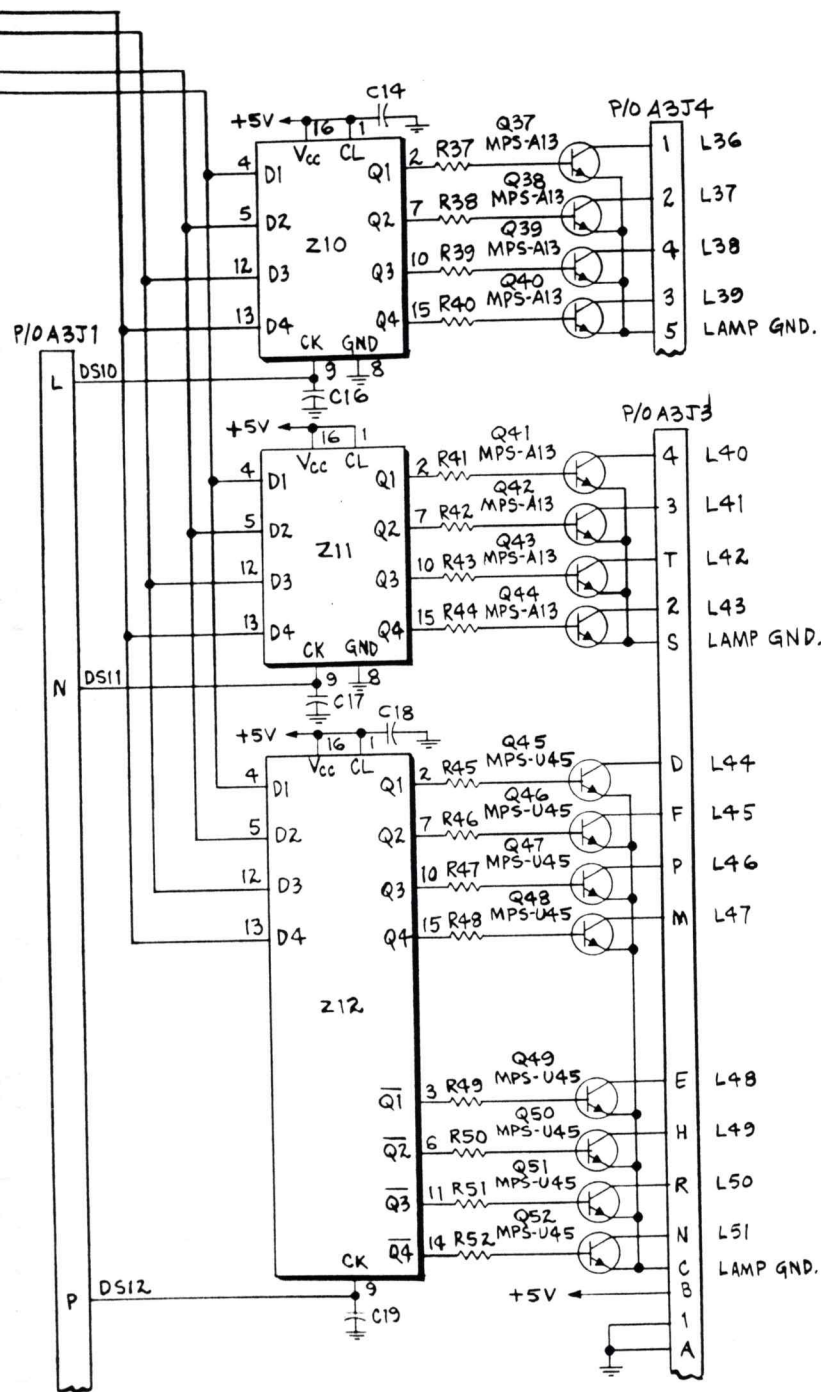
REFERENCE	DESCRIPTION	PART NUMBER
C1	Capacitor, 10 mfd., 10V	
	Tantalum	
C2-C19	Capacitor, 01 mfd., 50V	
CR1-CR6	Diode—Silicon	1N4148
R1-R53,	Resistor, 1000 ohm, 5%, 1/4W	
R61, R55,		
R56, R58,		
R59		
R54, R57,	Resistor, 9.1 ohm, 5%, 1W	
R60		
Q1-Q4,	Transistor, NPN, Darlington	MPS-U45
Q13-Q32,		
Q45-Q52,		
Q54-Q57,		
Q63		
Q5-Q12,	Transistor, NPN, Darlington	MPS-A13
Q33-Q44		
Q53, Q59,	Transistor, NPN, Darlington	2N6043
Q60		
Q58, Q62,	Transistor, NPN	2N3055
Q64		
Z1-Z12	I.C. Quad "D" Latch Flip Flop	SN74175N
Z13	I.C. Hex Inverter	SN7404N
	Insulator—Thermalloy	43-03-4

P/O	A3J1
7	LD1
6	LD2
4	LD3
5	LD4
C	DS1
3	DS2
E	DS3
D	DS4
W	
19	INDEX KEY PIN
H	DS5

X. WIRING AND SCHEMATIC



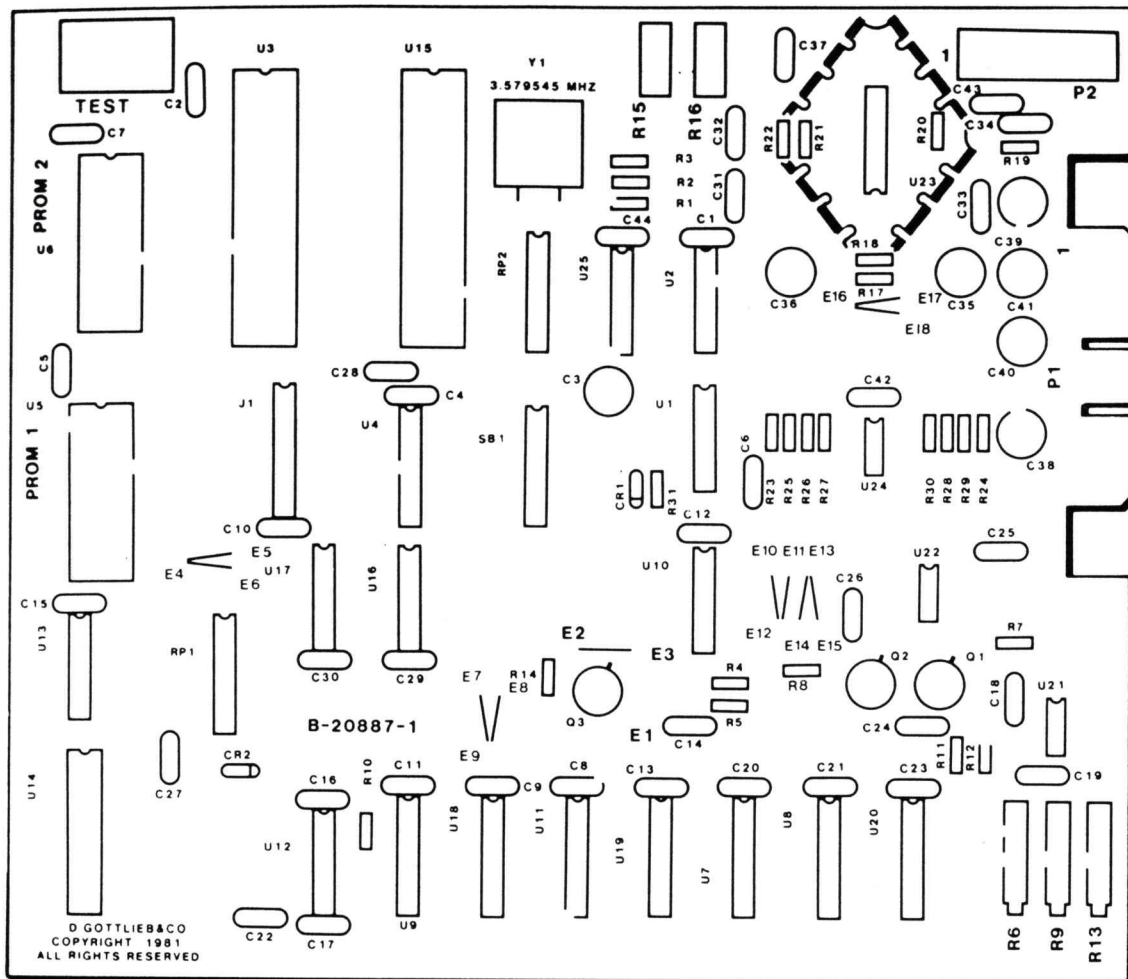
DIAGRAMS, PARTS LISTS



D. GOTTLIEB & CO.			
TITLE		DRIVER BOARD (A3)	
USED ON		SYSTEM 80	
DRAWN	APPROVED	DATE	E-20915
8/22/77	RAM	12/12/80	

X. WIRING AND SCHEMATIC DIAGRAMS, PARTS LISTS

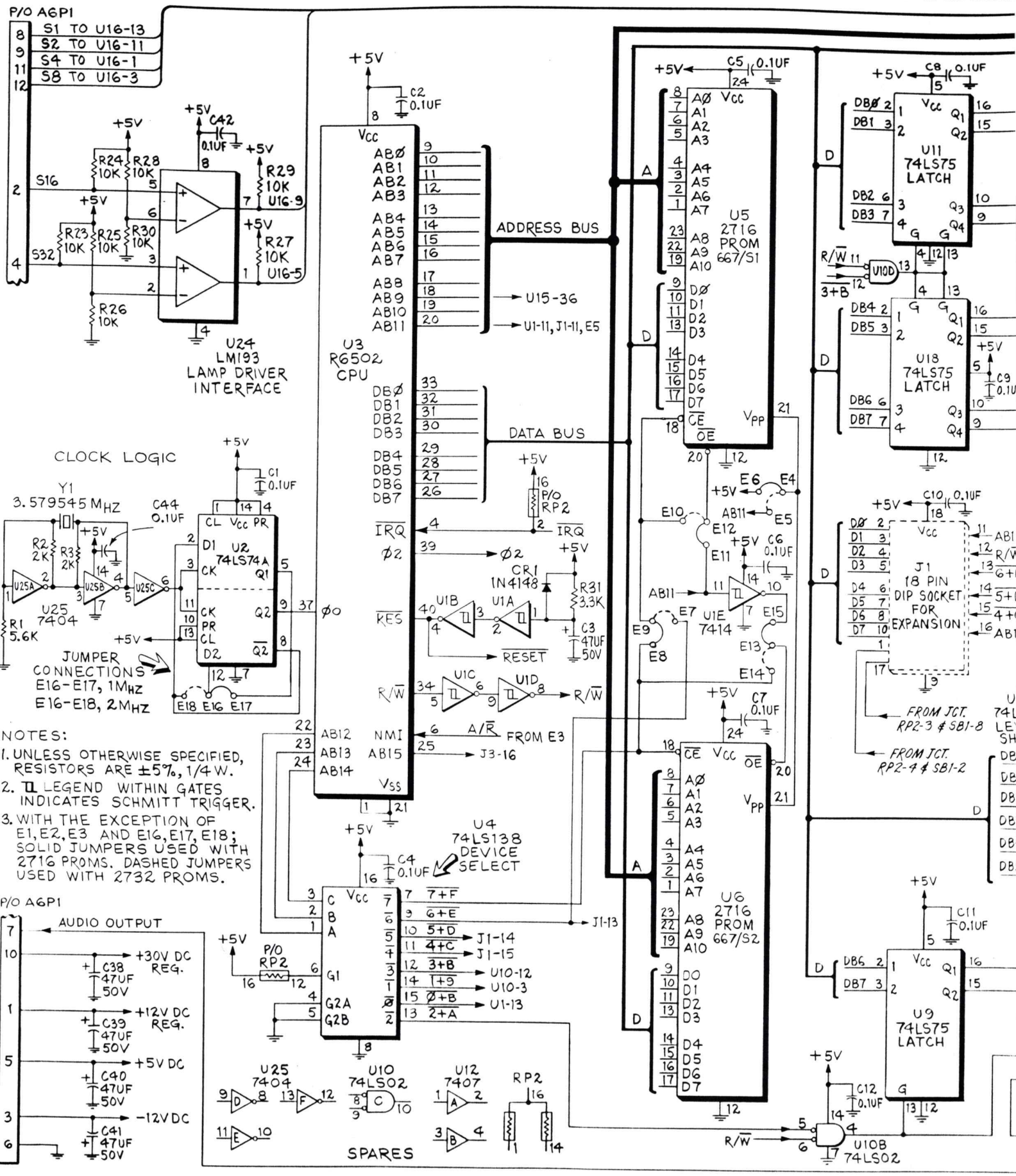
SOUND/SPEECH BOARD (A6) COMPONENT LOCATION



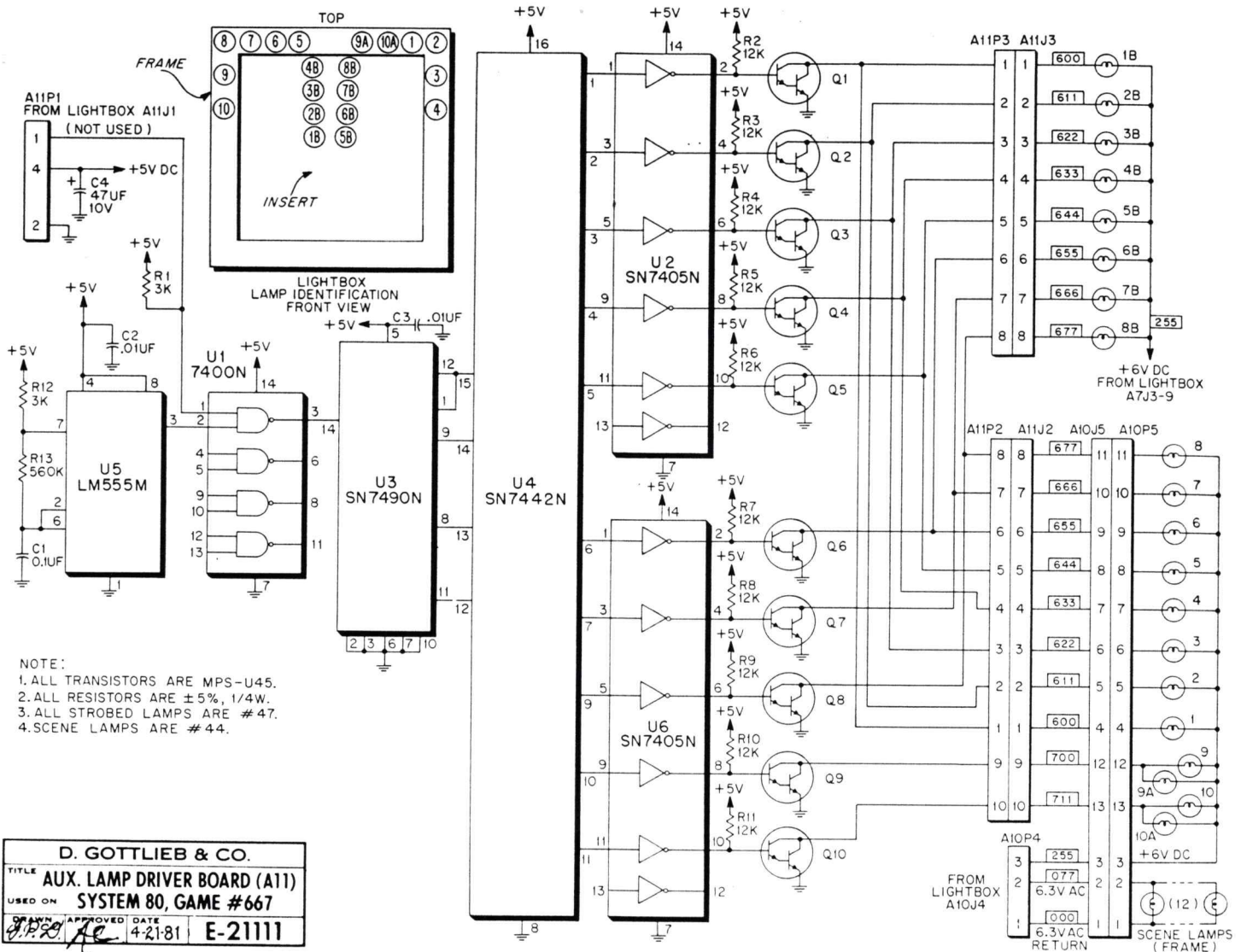
SOUND/SPEECH BOARD (A6) PARTS LIST

REFERENCE	DESCRIPTION	PART NUMBER	REFERENCE	DESCRIPTION	PART NUMBER
C1, C2,	Capacitor, .1 UF 25V, CMD		R19, R22	Resistor, 150K ohm, 1/4W, 5%	
C4-C13,			R23-R30	Resistor, 10K ohm, 1/4W	
C15, C16,			R31	Resistor, 3.3K ohm, 1/4W, 5%	
C18-C21,			RP1, RP2	Resistor, Dip	4116R-002-222
C23, C25, C26,			SB1	Dip Switch	1008-692
C28-C34, C37,			SW1	Moment Pushbutton Switch	
C42, C43, C44			U1	IC, Trigger	7414
C3, C38-C41	Capacitor, 47 MF, 50V		U2	IC	SN74LS74N
C14, C24	Capacitor, 100 PF, 250V, 20%		U3	CPU	R6502-13
C17	Capacitor, .002 MF, CMD		U4	IC	SN74LS138N
C22	Capacitor, 300 PF, CMD		U5, U6	E Prom	2716
C27	Capacitor, 1 UF, 50V, TNT		U7-U9, U11, U18	IC	SN74L75
C35, C36	Capacitor, 470 MF, 35V		U10	IC	SN74LS02N
CR1	Diode	1N4148	U12	IC	SN7407N
CR2	Diode, Zener	1N5225B	U13	IC, Inverter	SN74LS05N
Q1, Q3	Transistor, NPN	2N2222A	U14	Voice Chip	SC01
Q2	Transistor, PNP	2N2907A	U15	RR10T	R6532-18
R1, R4, R5,	Resistor, 5.6K ohm, 1/4W		U16	IC	SN74LS04N
R11, R12			U17	IC	SN74LS30N
R2, R3	Resistor, 2K ohm, 1/4W, 5%		U19, U20	Converter, PMI	1408A-6P
R6, R13	Potentiometer, 10K, Bourns	3006-103	U21, U22	IC	LM741CP
R7	Resistor, 10M ohm, 1/4W, 5%		U23	IC	LM379S
R8, R14	Resistor, 1K ohm, 1/4W, 5%		U24	IC, Dual Comparitor	LM193
R9	Potentiometer, 2M, Bourns	3006P-205	U25	Inverter	7404
R10	Resistor, 1.5K ohm, 1/4W, 5%		Y1	Crystal, 3.579545 MHZ	
R15, R16	Potentiometer, 10K, CTS	X201R		Socket 22 Pin Dip	
R17, R18, R20,	Resistor, 1.8M ohm, 1/4W			Socket 24 Pin (2)	640361-3
R21				Socket 40 Pin (2)	640379-3

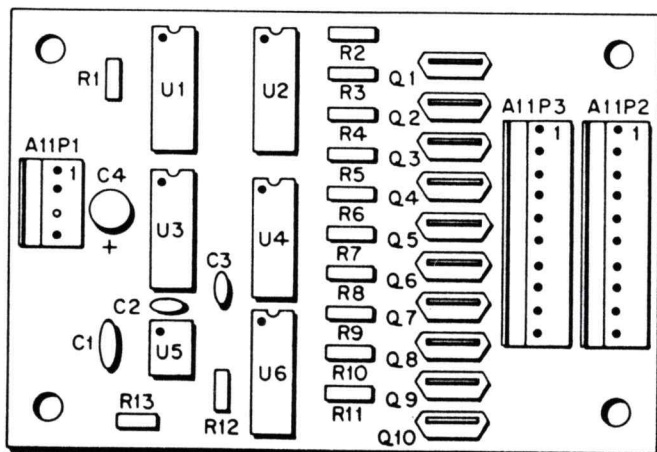
X. WIRING AND SCHEM



X. WIRING AND SCHEMATIC DIAGRAMS, PARTS LISTS



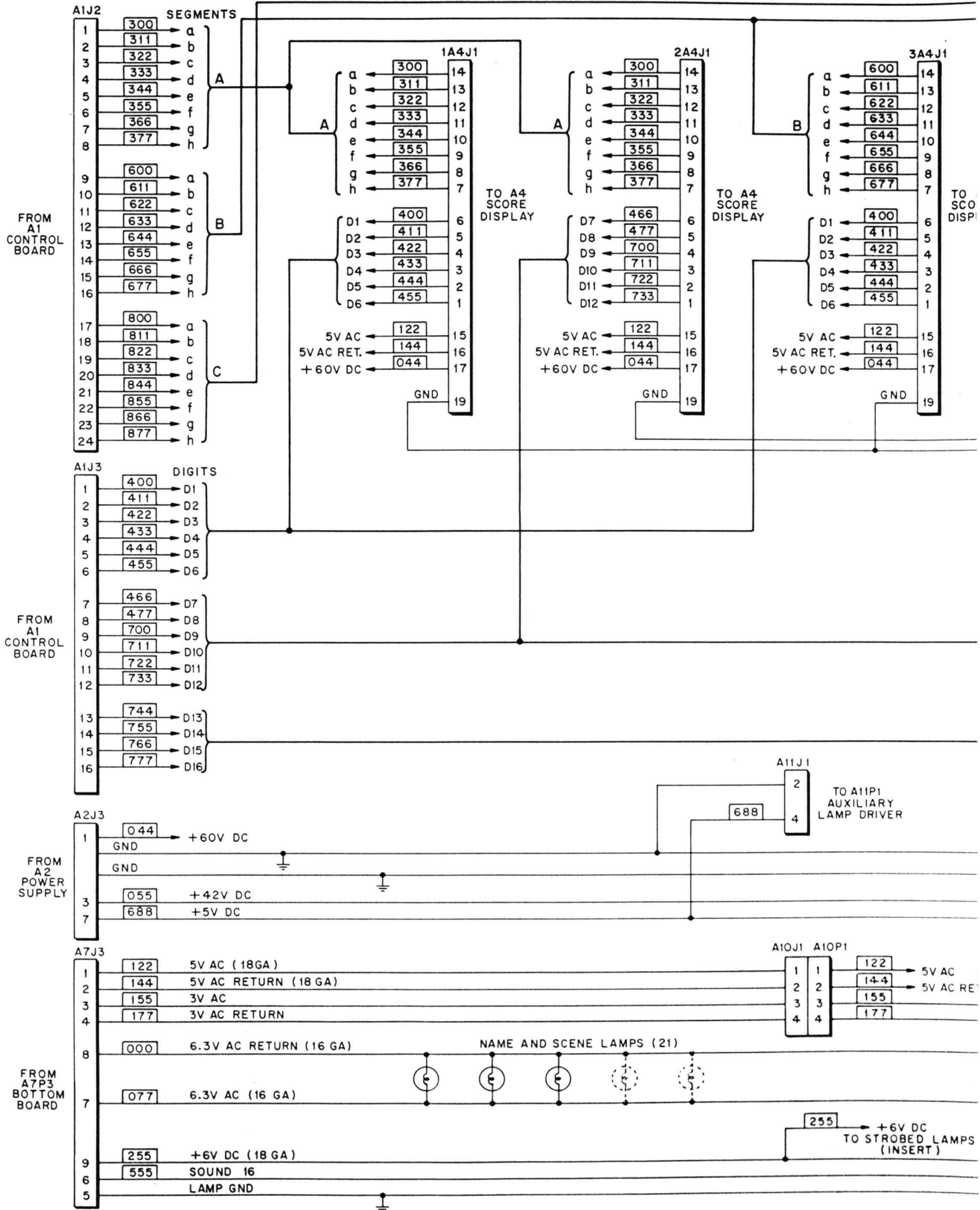
AUXILIARY LAMP DRIVER BOARD (A11) COMPONENT LOCATION



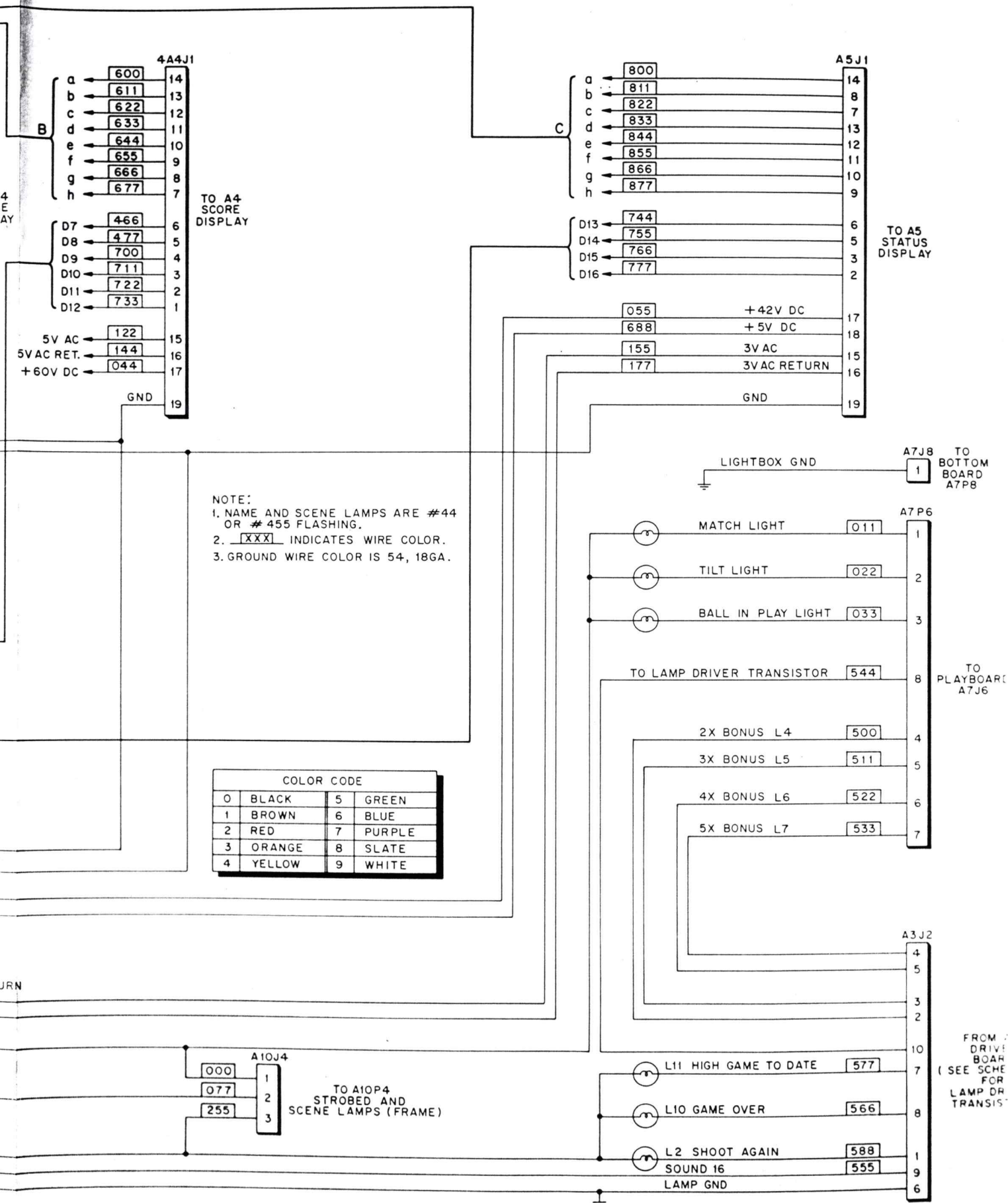
AUXILIARY LAMP DRIVER BOARD (A11) PARTS LIST

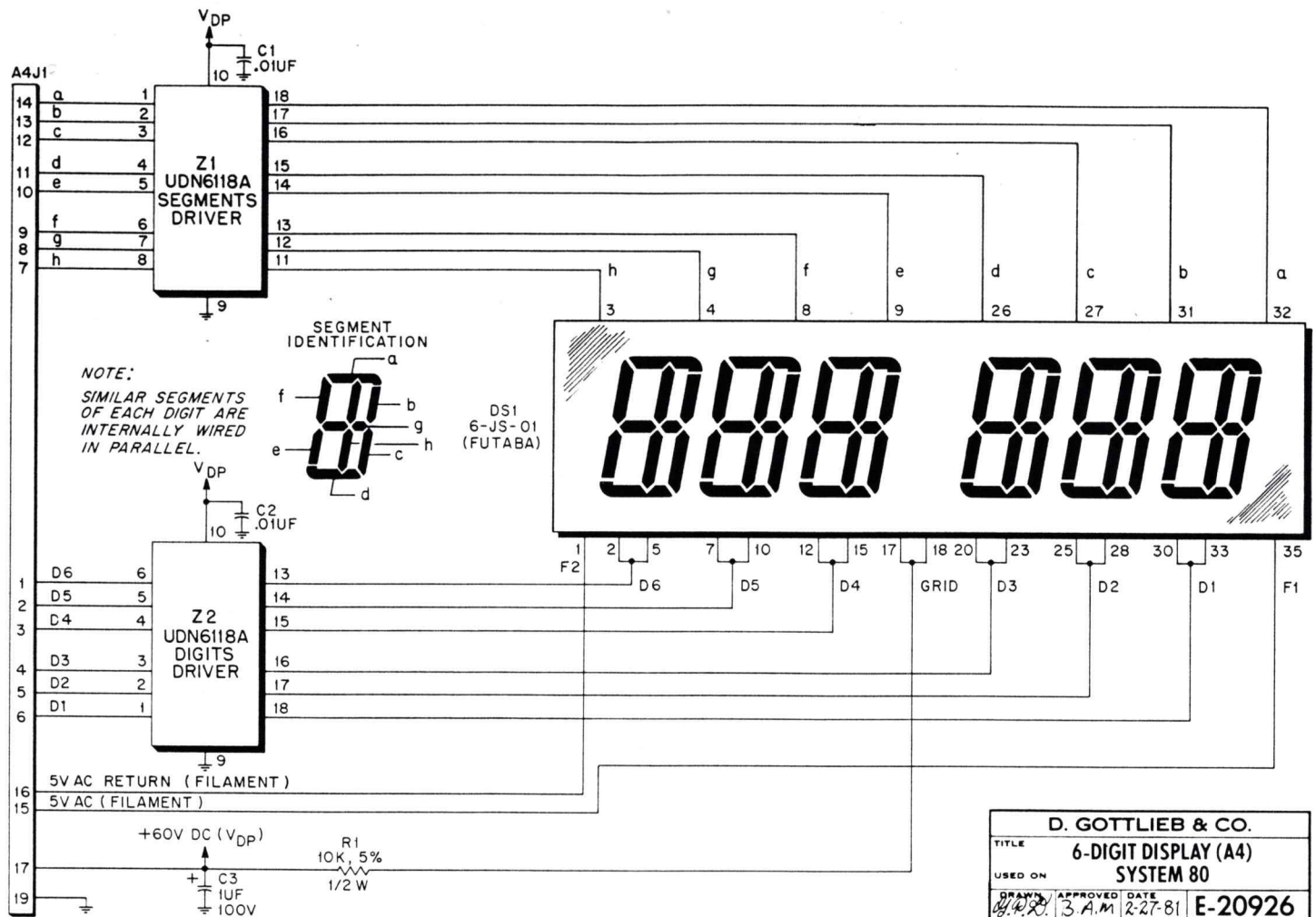
REFERENCE	DESCRIPTION	PART NUMBER
C1	CAPACITOR, .1 MFD, 100V	
C2-C3	CERAMIC RADIAL LEAD CAPACITOR, .01 MFD, 100V	
C4	CAPACITOR, 47 MFD, 10V	
Q1-Q10	TRANSISTOR, NPN DARLINGTON	MPS-U45
R1, R12	RESISTOR, 3K OHM, 5%, 1/4 W	
R2-R11	RESISTOR, 12K OHM, 5%, 1/4 W	
R13	RESISTOR, 560K OHM, 5%, 1/4 W	
U1	I.C. 2-INPUT NAND	SN7400N
U2, U6	I.C. INVERTER	SN7405N
U3	I.C. DECADE COUNTER	SN7490N
U4	I.C. DECODER	SN7442N
U5	I.C. TIMER	LM555N
P2, P3	10 POS. SQUARE WIRE FRICTION LOCK CONNECTOR	
P1	4 POS. SQUARE WIRE FRICTION LOCK CONNECTOR	

X. WIRING AND SCHEMATIC

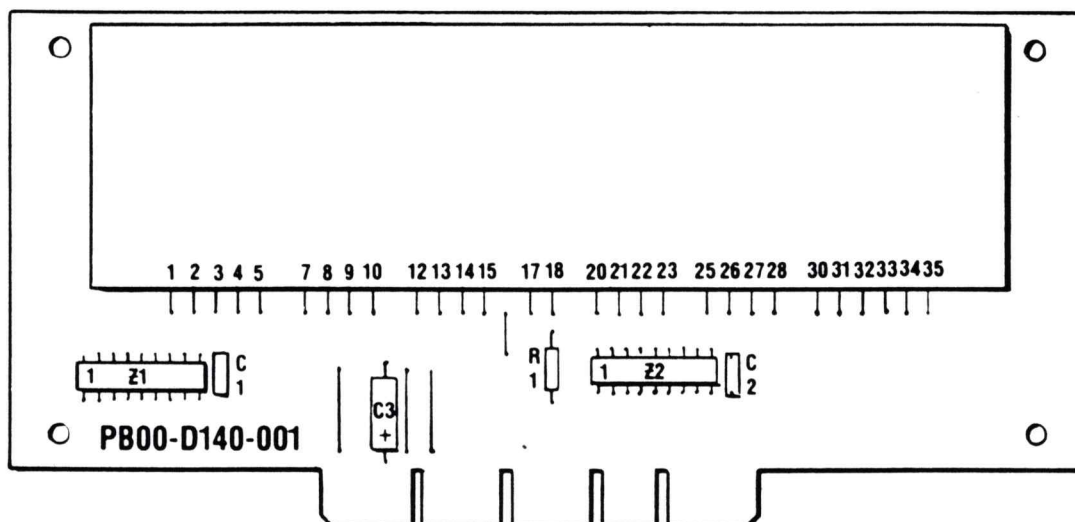


WIRING DIAGRAMS, PARTS LISTS





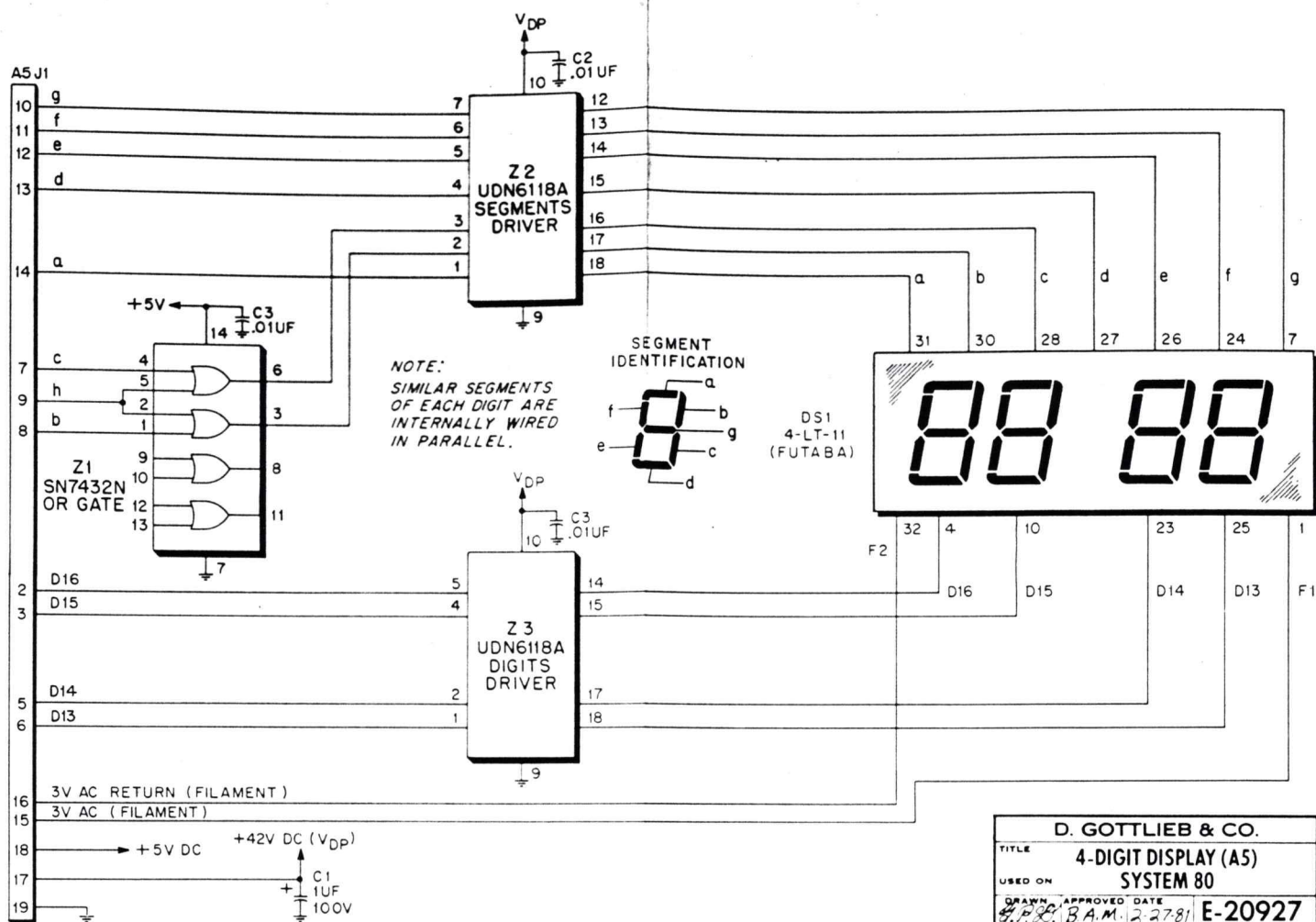
6-DIGIT DISPLAY (A4) COMPONENT LOCATION



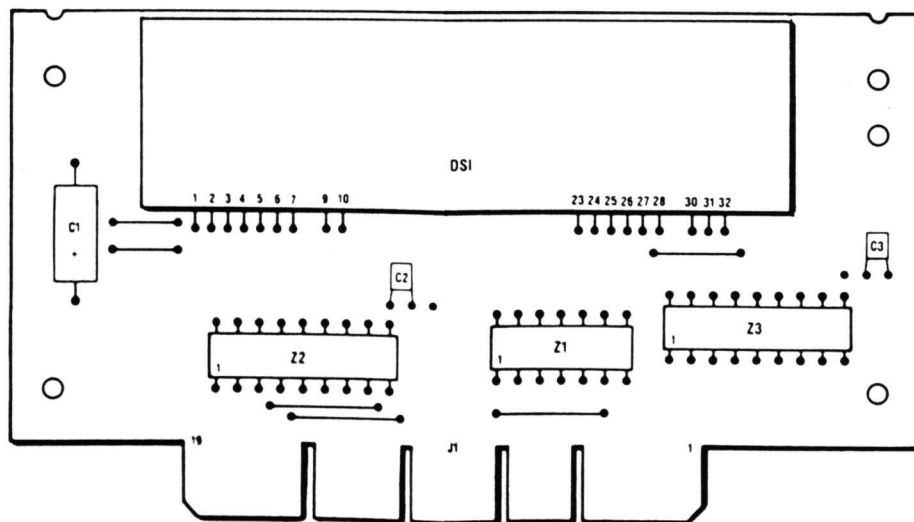
6-DIGIT DISPLAY (A4) PARTS LIST

REFERENCE	DESCRIPTION	PART NUMBER
C1, C2	Capacitor, .01 mfd., 100V Kemet	C320C103MIR5CA
C3	Capacitor, 1 mfd., 100V Sprague	TE1400
DS1	6-Digit Display Tube—FUTABA	6-JS-01
R1	Resistor, 10K ohm, 5%, 1/2W	RC20GF103
Z1, Z2	IC—Fluorescent Display Driver—Sprague	UDN6118A

DIAGRAMS, PARTS LISTS



4-DIGIT DISPLAY (A5) COMPONENT LOCATION



4-DIGIT DISPLAY (A5) PARTS LIST

REFERENCE	DESCRIPTION	PART NUMBER
C1	Capacitor, 1 mfd., 100V Sprague	TE1400
C2, C3	Capacitor, .01 mfd., 100V Kemet	C320C103MIR5CA
DS1	4-Digit Display Tube—FUTABA	4-LT-11
Z1	IC—Quad or Gate—T.I.	SN7432N
Z2, Z3	IC—Fluorescent Display Driver—Sprague	UDN6118A

X. WIRING AND SCHEMA

PLAYBOARD INFORMATION

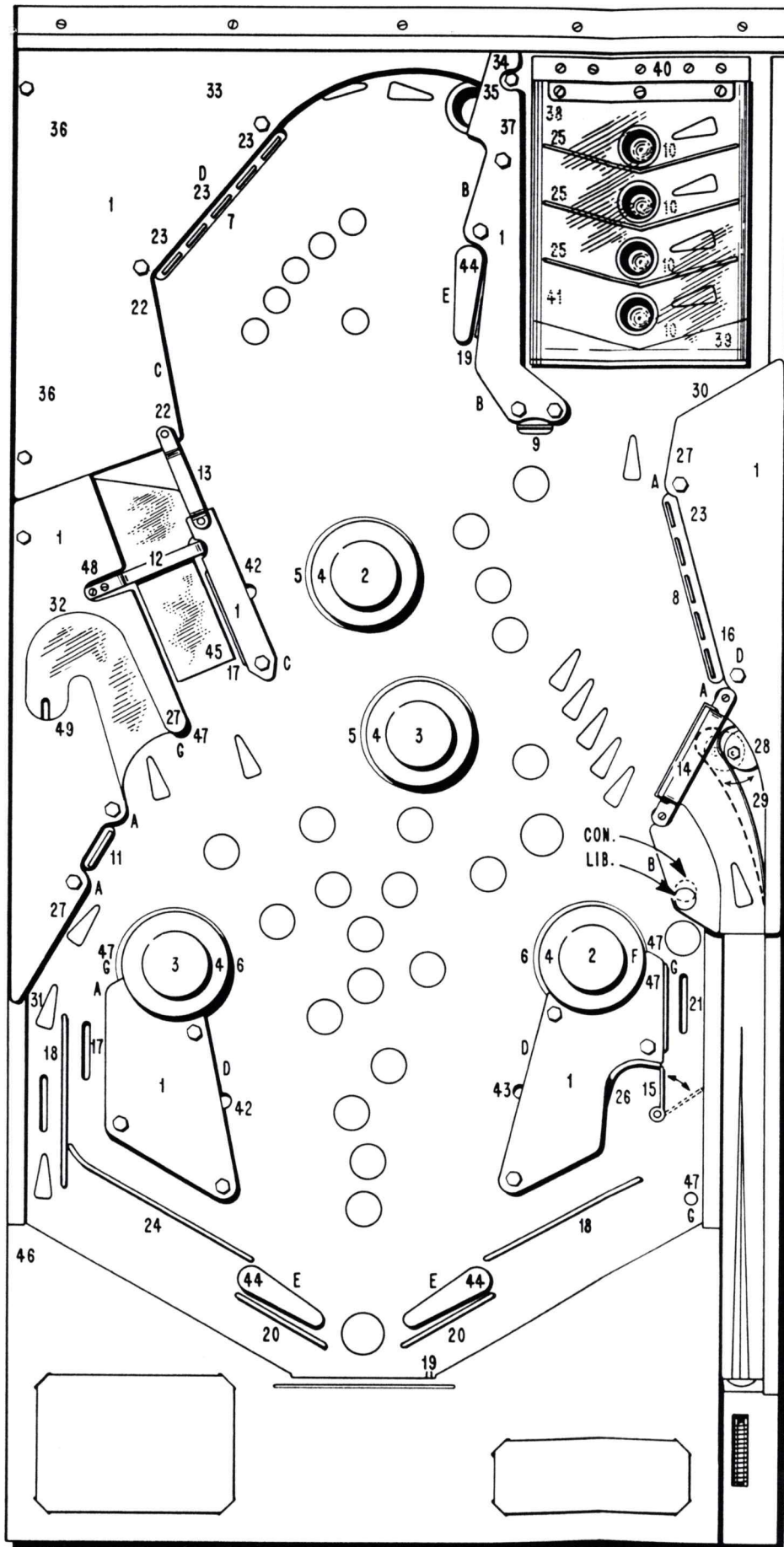
RUBBER RINGS

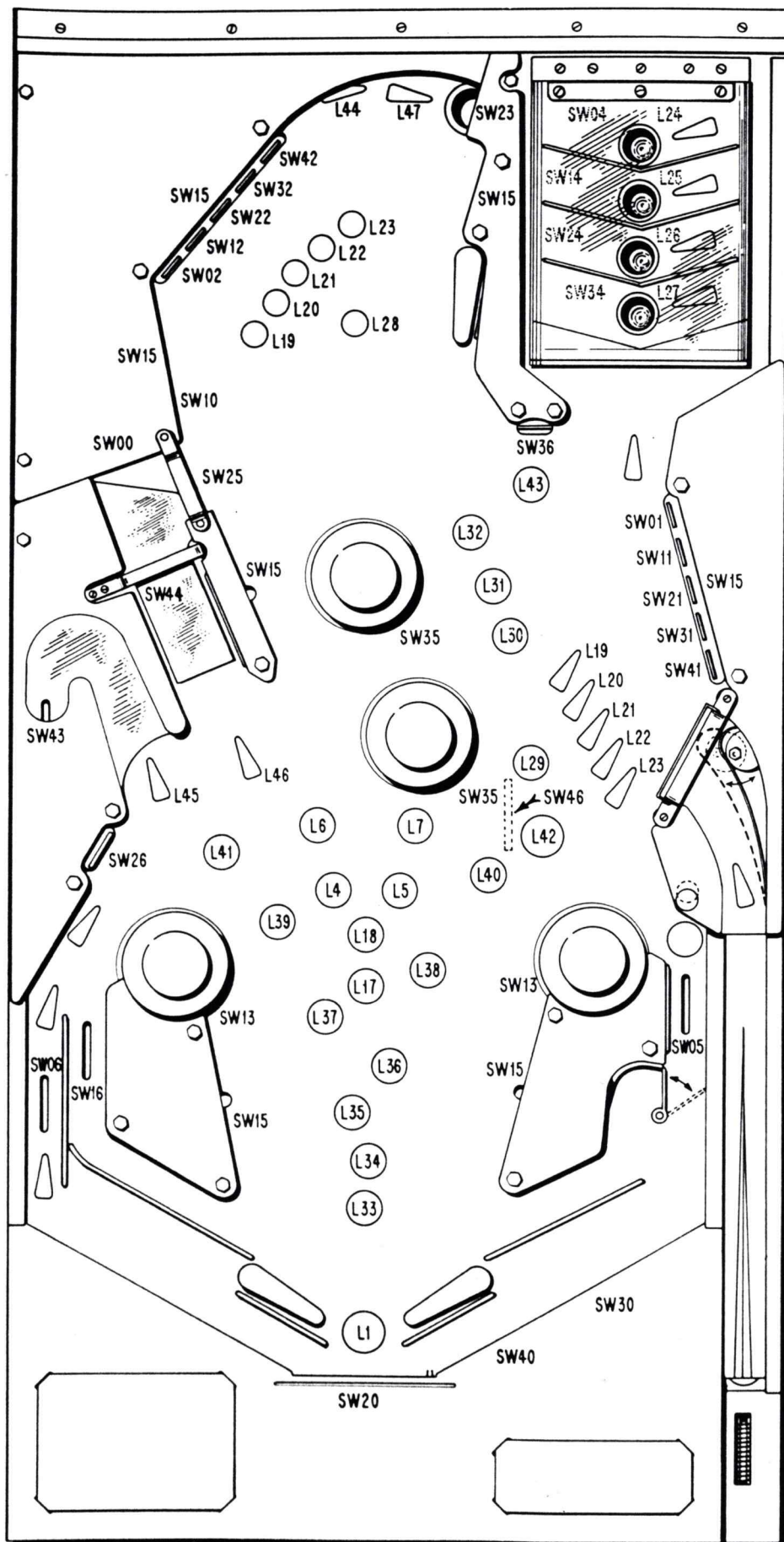
A	A-10217	5/16"	(5)
B	A-10220	1-1/2"	(3)
C	A-10222	2-1/2"	(2)
D	A-10223	3"	(4)
E	A-13151		(3)
F	A-14793		(1)
G	A-15705		(4)

PARTS LIST

- D-21032 Plastic Shield Set.
- Orange Pop Bumper D-10435 and A-21068 Cap in Black (2).
- Orange Pop Bumper D-10435 and A-21070 Cap in Black (2).
- C-10433 Orange Pop Bumper Skirt (4).
- B-8246 Pop Bumper Platter (2).
- A-20535 Pop Bumper Trim Platter (2).
- A-21066 Red Drop Target in Yellow (5).
- A-21066 Yellow Drop Target in Red (5).
- A-9374 1" Diameter Yellow Plastic Target.
- A-9374 1" Diameter Red Plastic Target (4).
- A-21039 Kicking Target.
- A-20388 Spinning Target (Use with A-21011 Shield).
- A-4869 Rollunder Shield (Use with A-4706 Wire).
- A-1673 Ball Gate Shield (Use with A-1674 Wire).
- A-21056 Ball Return Gate.
- A-3722 Ball Guide Rail.
- A-4832 Ball Guide Rail (2).
- A-4834 Ball Guide Rail (2).
- A-6931 Ball Guide Rail (2).
- A-13798 Ball Snubber Rail (2).
- A-17106 Ball Guide Rail.
- A-17650 Ball Guide Rail (2).
- A-18070 Ball Guide Rail (4).
- A-19996 Ball Guide Rail.
- B-20956 Ball Guide Rail (3).
- A-21012 Ball Guide Rail.
- A-20362 Flat Rail Support Clip (3).
- A-21007 Rotate Cam.
- D-21010 Metal Flat Rail (Use with A-21007 Cam).
- B-21014 Metal Flat Rail (Use with A-20362 Clip).
- B-21015 Metal Flat Rail (Use with A-20362 Clip).
- B-21016 Metal Flat Rail (Use with A-20362 Clip).
- D-21013 Top Arch Rod.
- B-19873 Top Arch End Post.
- B-19874 Top Arch End Cap.
- B-19875 Arch Rod Support Post (2).
- A-21107 Ball Snubber (Hole Kicker).
- C-20954 Elevated Target Board.
- B-20965 Bottom Mounting Bracket.
- C-20967 Top Mounting Bracket.
- C-20969 Clear Plastic Hood.
- A-15636 Left Kicking Rubber (2).
- A-15638 Right Kicking Rubber.
- C-13150 White Jumbo Flipper (3).
- B-20995 Ball Return (Chute).
- B-21001 Save-A-Ball Unit.
- A-14792 Mini Post (5).
- C-17492 White Siamese Post.
- A-16701 Ball Kicker.
- C-11561 Clear 1" High Post (28).
- A-14487 Split Post Base (2).
- A-14488 Split Post Cap (2).

CON. = Conservative.
LIB. = Liberal.



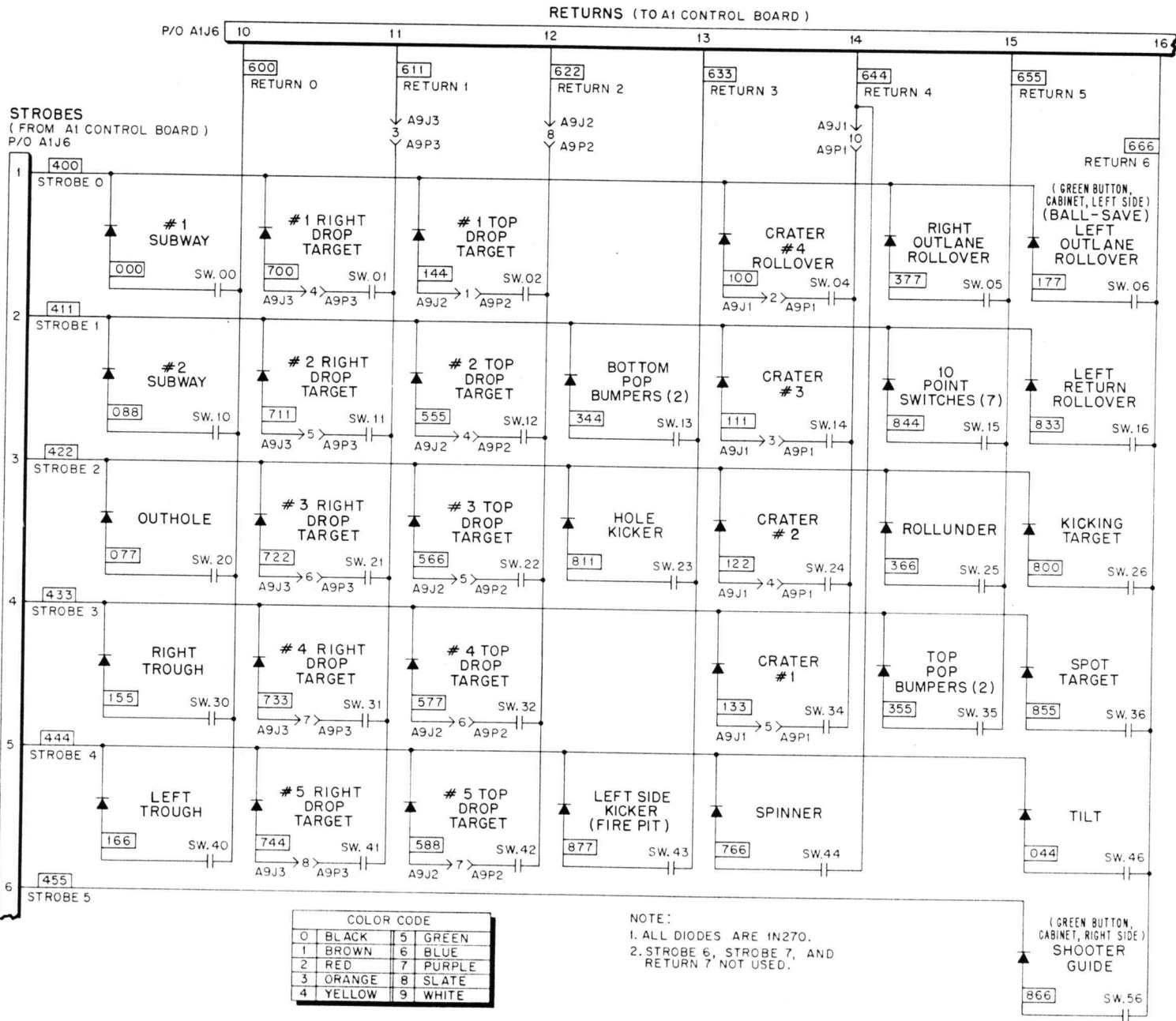


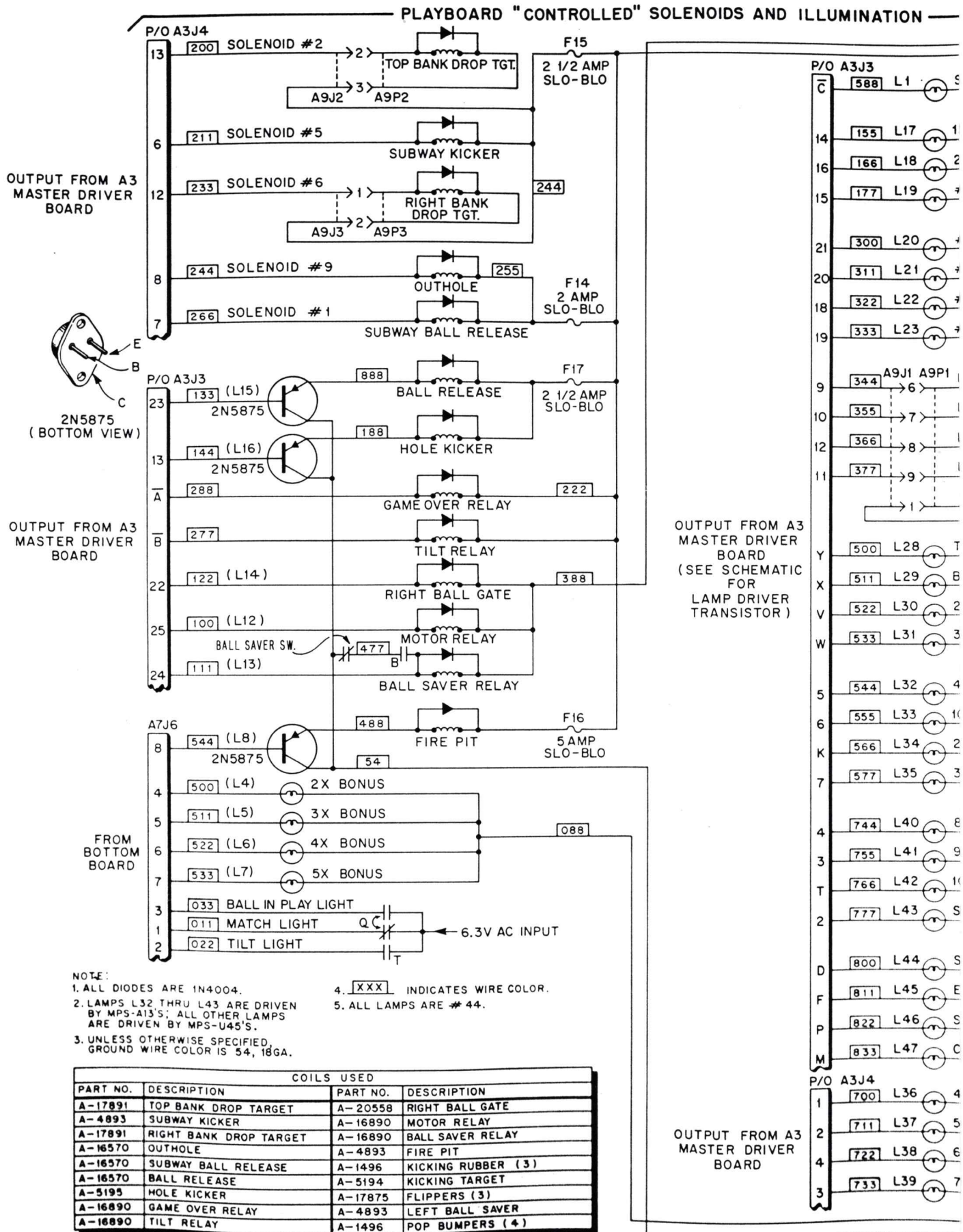
PLAYBOARD SWITCH AND LAMP ASSIGNMENTS

SWITCH MATRIX NUMBER	SWITCH ASSIGNMENT
00	#1 Subway
01	#1 Right Drop Target
02	#1 Top Drop Target
04	Crater #4
05	Right Outlane Rollover
06	Left Outlane Rollover
10	#2 Subway
11	#2 Right Drop Target
12	#2 Top Drop Target
13	Bottom Pop Bumpers (2)
14	Crater #3
15	10 Point Switches (7)
16	Left Return Rollover
20	Outhole
21	#3 Right Drop Target
22	#3 Top Drop Target
23	Hole Kicker
24	Crater #2
25	Rollunder
26	Kicking Target
30	Right Trough
31	#4 Right Drop Target
32	#4 Top Drop Target
34	Crater #1
35	Top Pop Bumpers (2)
36	Spot Target
40	Left Trough
41	#5 Right Drop Target
42	#5 Top Drop Target
43	Left Side Kicker
44	Spinner
46	Tilt (Playboard)

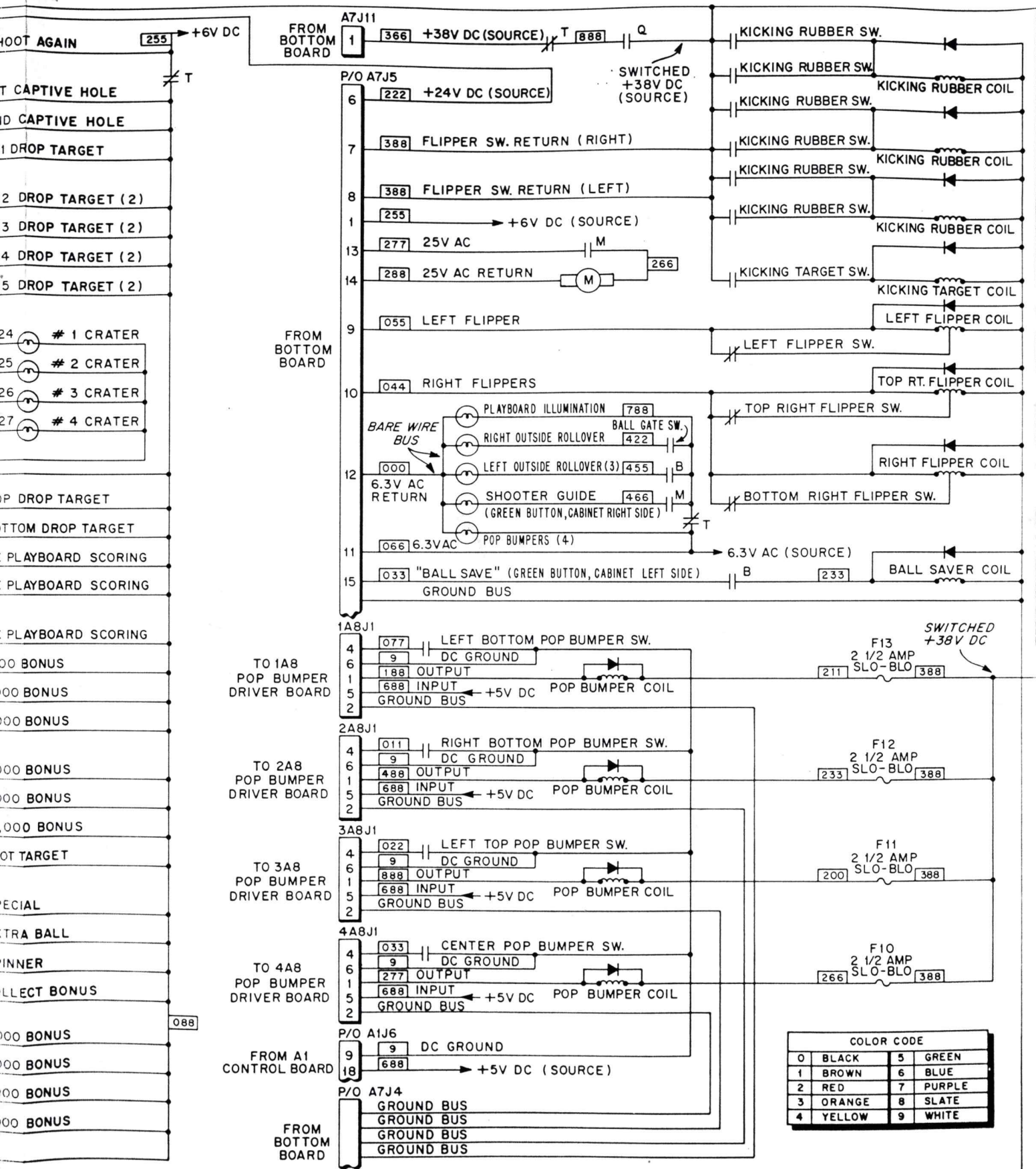
LAMP NUMBER	LAMP ASSIGNMENT
L1	Shoot Again
L4	2X Multiplier
L5	3X Multiplier
L6	4X Multiplier
L7	5X Multiplier
L17	Lava Level One
L18	Lava Level Two
L19	#1 Drop Target (2)
L20	#2 Drop Target (2)
L21	#3 Drop Target (2)
L22	#4 Drop Target (2)
L23	#5 Drop Target (2)
L24	Crater #4
L25	Crater #3
L26	Crater #2
L27	Crater #1
L28	Top Drop Target
L29	Bottom Drop Target
L30	2X Lava Flow Multiplier
L31	3X Lava Flow Multiplier
L32	4X Lava Flow Multiplier
L33	1000 Bonus
L34	2000 Bonus
L35	3000 Bonus
L36	4000 Bonus
L37	5000 Bonus
L38	6000 Bonus
L39	7000 Bonus
L40	8000 Bonus
L41	9000 Bonus
L42	10,000 Bonus
L43	Spot Target
L44	Special
L45	Extra Ball
L46	Spinner
L47	Collect Seismic Value

X. WIRING AND SCHEMATIC DIAGRAMS, PARTS LISTS

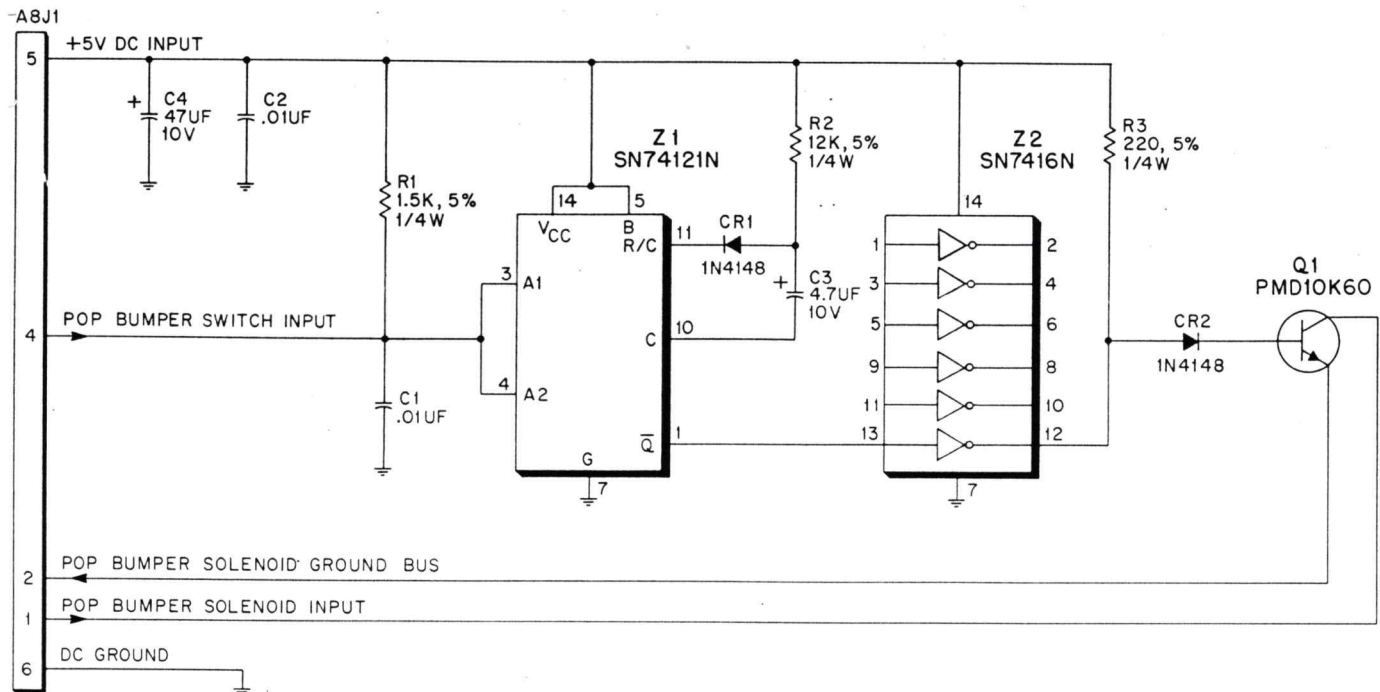




PLAYBOARD "NON-CONTROLLED" SOLENOIDS AND ILLUMINATION

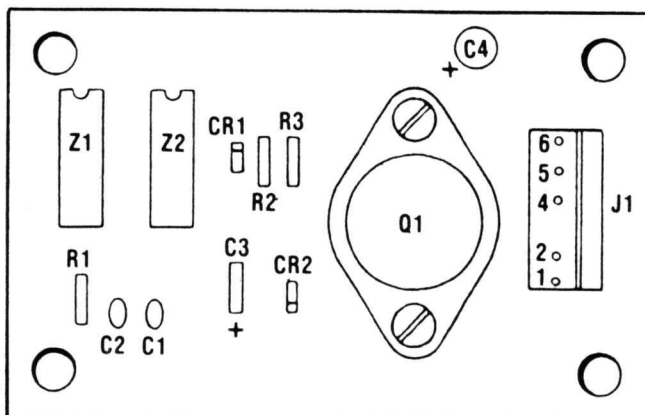


X. WIRING AND SCHEMATIC DIAGRAMS, PARTS LISTS



D. GOTTLIEB & CO.			
TITLE POP BUMPER DRIVER BOARD (A8)			
SYSTEM 80			
USED ON	DATE	APPROVED	DATE
8/22/81	13AM	2-9-81	D-20923

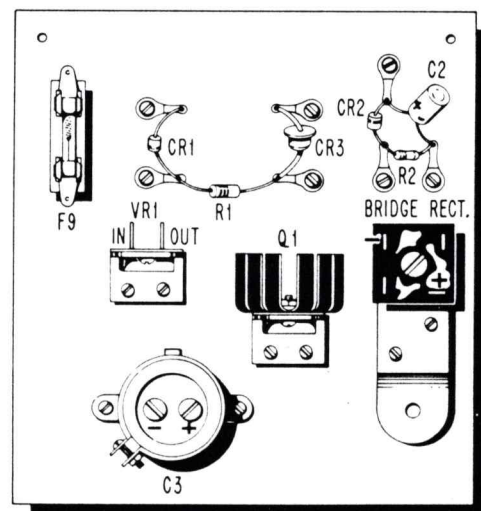
POP BUMPER DRIVER BOARD (A8) COMPONENT LOCATION



POP BUMPER DRIVER BOARD (A8) PARTS LIST

REFERENCE	DESCRIPTION	PART NUMBER
C1, C2	Capacitor, .01 mfd., 20%, 100V	
C3	Capacitor, 4.7 mfd., 10%, 10V	
C4	Capacitor, 47 mfd., 10V	
CR1, CR2	Diode	1N4148
J1	Connector	09-65-1061
R1	Resistor, 1.5K ohm, 5%, 1/4W	
R2	Resistor, 12K ohm, 5%, 1/4W	
R3	Resistor, 220 ohm, 1/4W, 5%	
Q1	Transistor—LAMBDA	PMD10K60
Z1	IC	SN74121N
Z2	IC	SN7416N

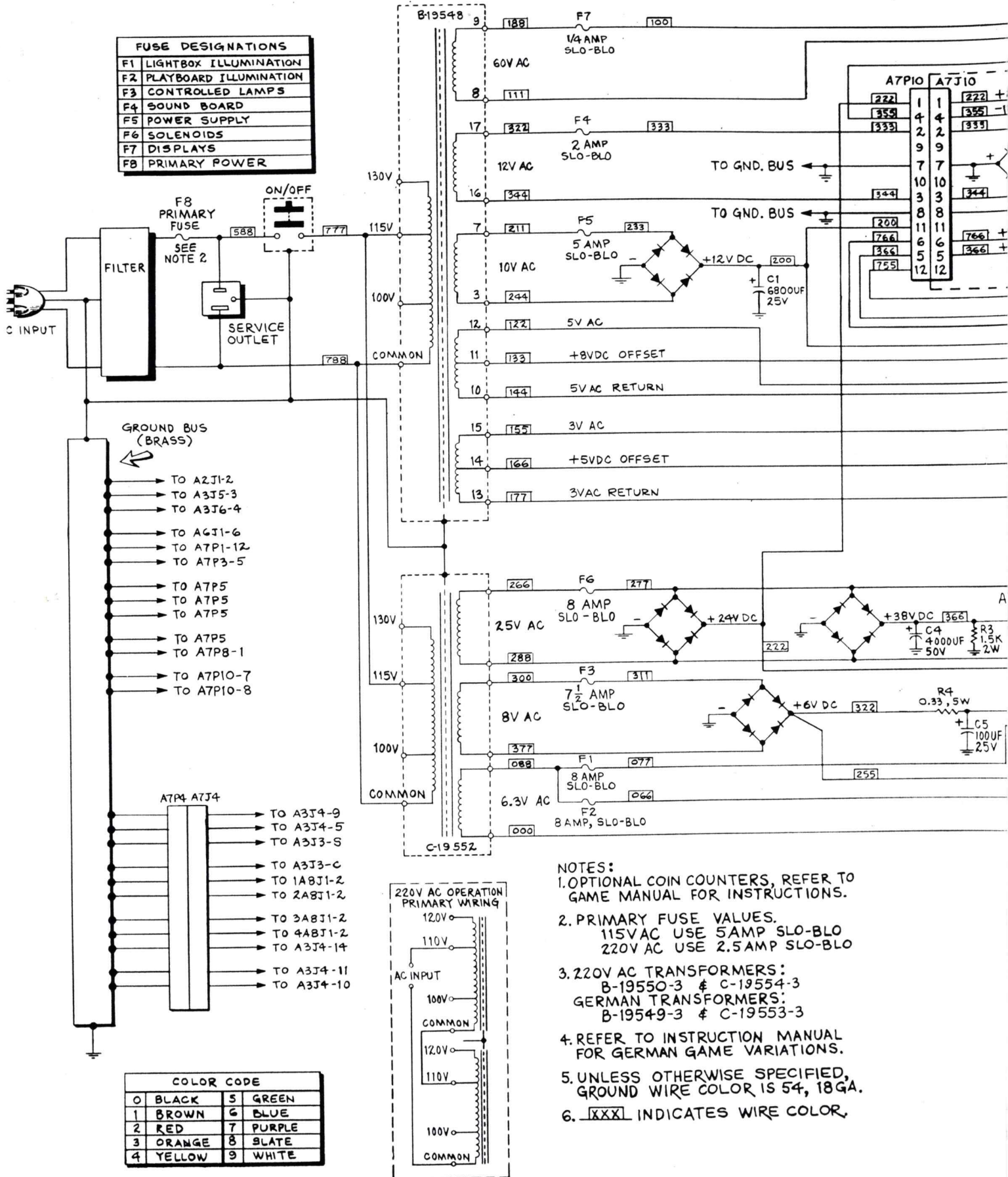
SOUND/SPEECH BOARD (A6) POWER SUPPLY COMPONENT LOCATION



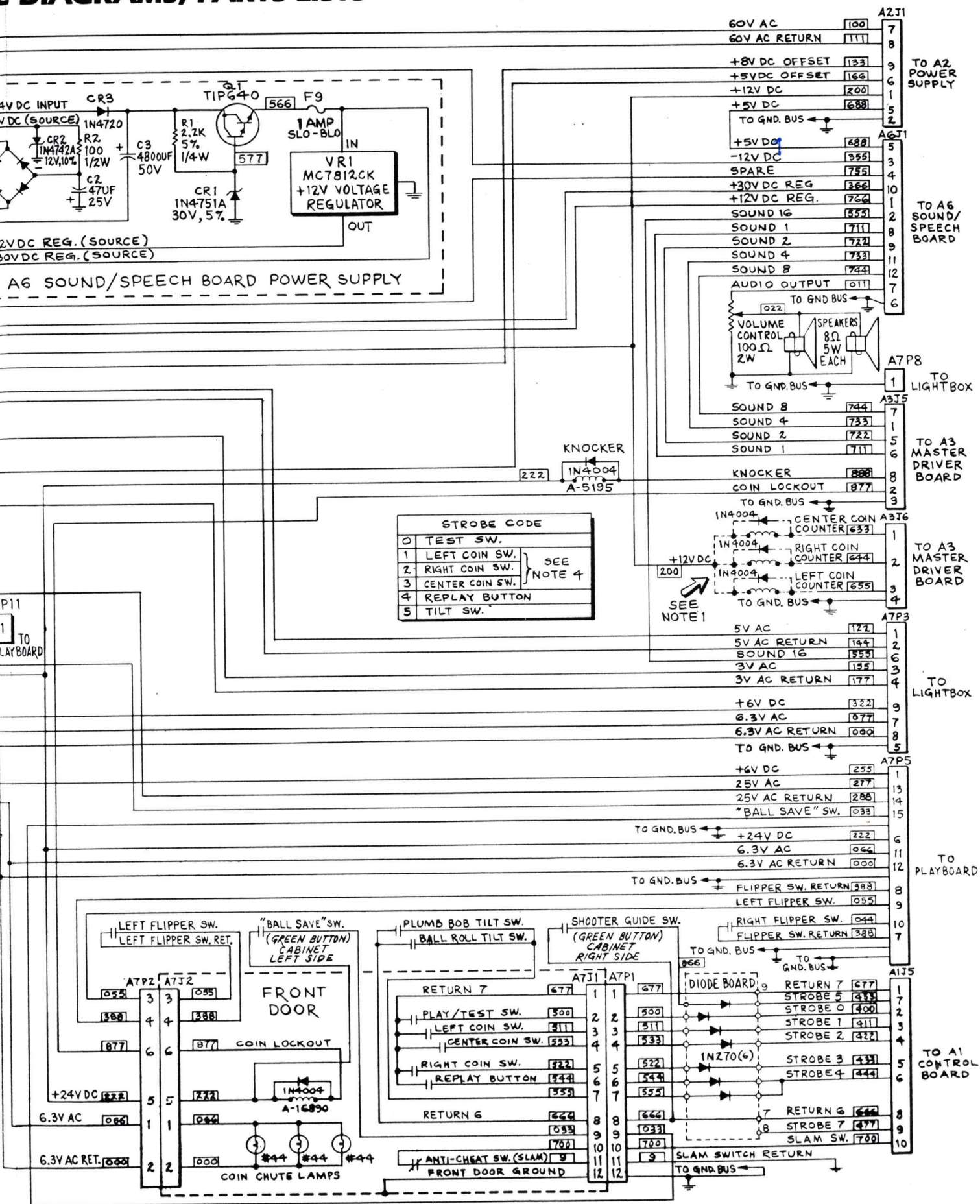
SOUND/SPEECH BOARD (A6) POWER SUPPLY PARTS LIST

REFERENCE	DESCRIPTION	PART NUMBER
C2	Capacitor, 47 UF, 25V	
C3	Capacitor, 4800 mfd., 50V, E1-Rd	
CR1	Diode, 30V, 1W, 5%, Zener	1N4751A
CR2	Diode, 12V, 10%, Zener	1N4742A
CR3	Diode	1N4720
F9	Fuse, 1 Amp, SLO-BLO	
Q1	Transistor, Darlington	T1P640
R1	Resistor, 2.2K ohm, 1/4W, 5%	
R2	Resistor, 100 ohm, 1/2W, 5%	
VR1	Voltage Regulator	MC7812CK
	Bridge Rectifier and Mounting Bracket	
	Fuse Block	350-308

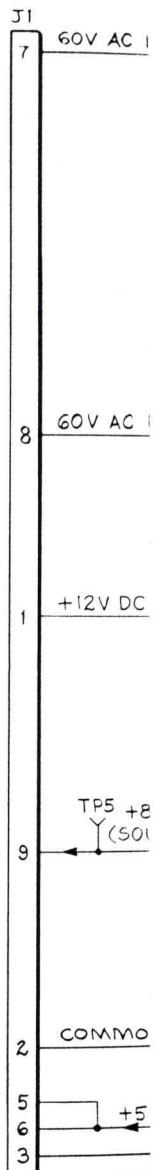
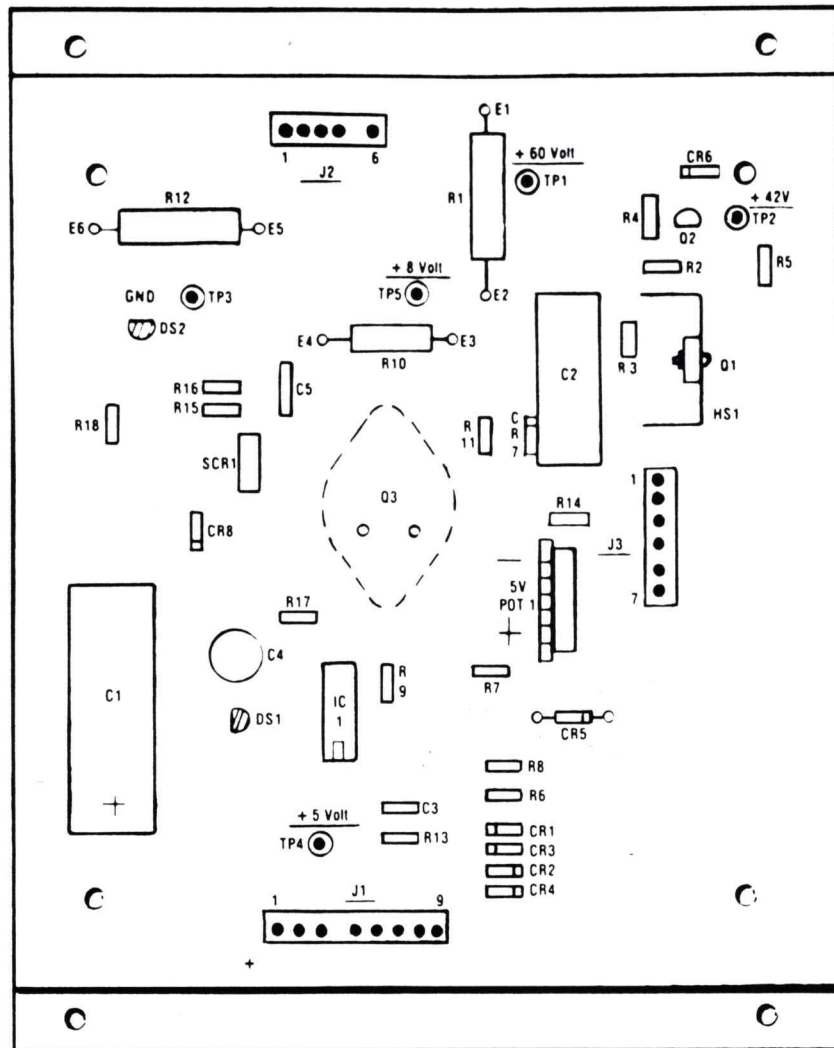
X. WIRING AND SCHEMATIC



C DIAGRAMS, PARTS LISTS



POWER SUPPLY (A2) COMPONENT LOCATION

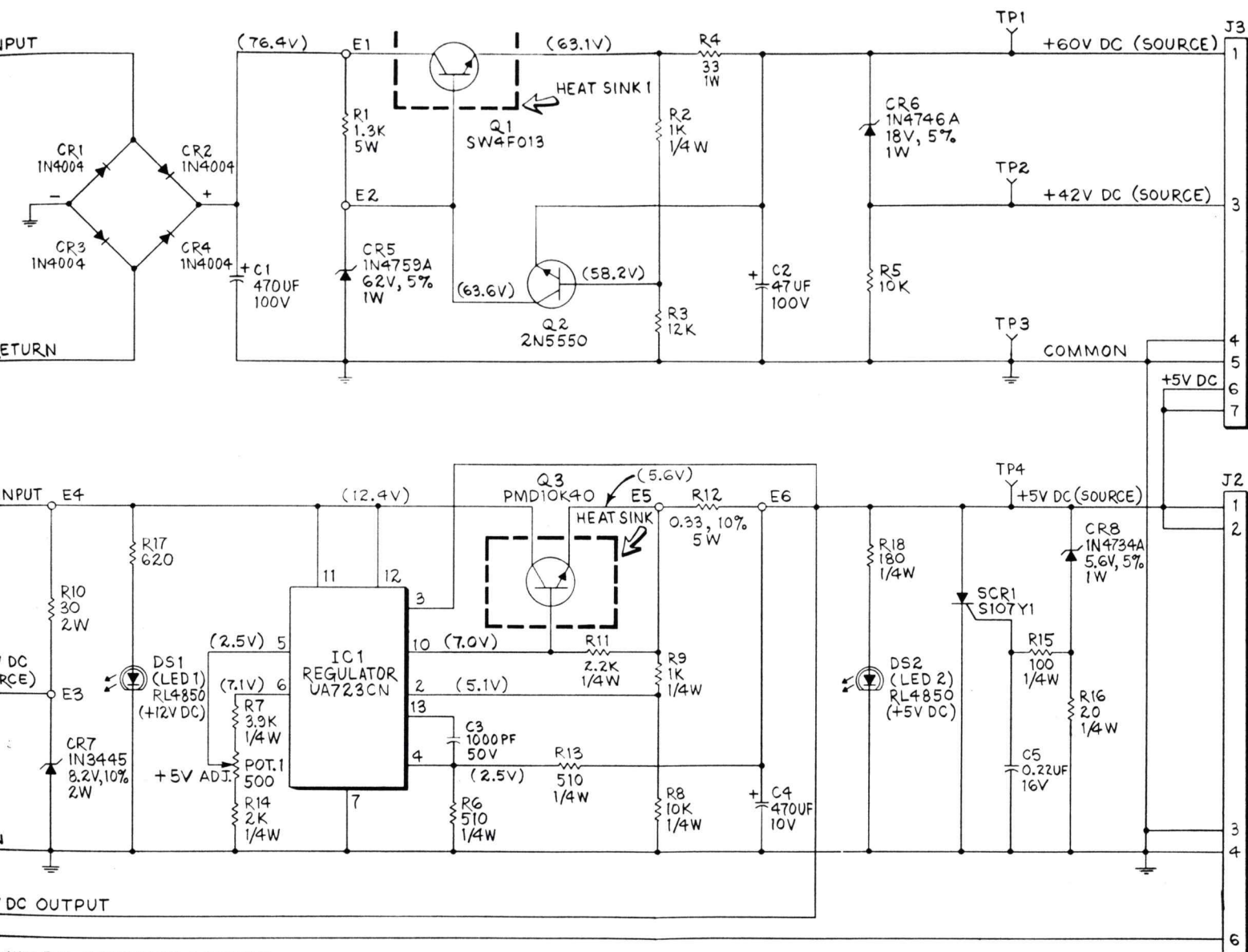


POWER SUPPLY (A2) PARTS LIST

REFERENCE	DESCRIPTION	PART NUMBER	REFERENCE	DESCRIPTION	PART NUMBER
C1	Capacitor, 470 mfd., 100V		R4	Resistor, 33 ohm, 5%, 1W	
C2	Capacitor, 47 mfd., 100V		R5	Resistor, 10K ohm, 5%, 1/2W	
C3	Capacitor, 1000 Picofarad, 50V		R6, R13	Resistor, 510 ohm, 5%, 1/4W	
C4	Capacitor, 470 mfd., 10V		R7	Resistor, 3.9K ohm, 5%, 1/4W	
C5	Capacitor, 2 mfd., +80%, -20%, 16V		R8	Resistor, 10K ohm, 5%, 1/4W	
CR1-CR4	Diode	1N4004	R10	Resistor, 30 ohm, 5%, 2W	
CR5	Diode, Zener, 62V, 5%, 1W	1N4759A	R11	Resistor, 2.2K ohm, 5%, 1/4W	
CR6	Diode, Zener, 18V, 5%, 1W	1N4746A	R12	Resistor, 33 ohm, 10%, 5W (Wirewound)	
CR7	Diode, Zener, 8.2V, 10%, 2W	1N3445	R14	Resistor, 2K ohm, 5%, 1/4W	
CR8	Diode, Zener, 5.6V, 5%, 1W	1N4734A	R15	Resistor, 100 ohm, 5%, 1/4W	
DS1, DS2	Diode, Light Emitting	CM4-22	R16	Resistor, 20 ohm, 5%, 1/4W	
E1-E6	Turret Terminal		R17	Resistor, 620 ohm, 5%, 1/2W	
IC1	I.C.—14 Pin Dip	UA723CN	R18	Resistor, 180 ohm, 5%, 1/4W	
J1	Connector, 9 Pin, Molex		SCR1	Silicon Controlled Rectifier	S107Y1
J2	Connector, 6 Pin, Molex		TP1-TP5,	Turret Terminal	
J3	Connector, 7 Pin, Molex			Eyelet	GS2-3
POT1	Potentiometer, 500 ohm, CTS	115R501A		Heat Sink Mounting Plate	
Q1	Transistor, NPN, National	2N4F013		Heat Sink, Thermalloy	
Q2	Transistor, NPN	2N5550		Insulator	INS-3
Q3	Transistor, Darlington, LAMBDA	PMD10K40		Insulator	DM111
R1	Resistor, 1.3K ohm, 10%, 5W			Spacer—6-32 Thread x 5/32	
R2, R9	Resistor, 1K ohm, 5%, 1/4W			Spacer—6-32 Thread x 1/8	
R3	Resistor, 12K ohm, 5%, 1/2W				

NOTE
1. RES
2. VOL
3. ALI

IC DIAGRAMS, PARTS LISTS



UNLESS OTHERWISE SPECIFIED,
RESISTORS ARE $\pm 5\%$, 1/2W.
VOLTAGES ARE DC WITH RESPECT TO CIRCUIT GROUND.
VOLTAGES ARE AT NOMINAL LINE VOLTAGE (115V AC).

D. GOTTLIEB & CO.			
TITLE		POWER SUPPLY (A2)	
USED ON		SYSTEM 80	
DRAWN	APPROVED	DATE	E-20922
B.P.2	BAM	2-3-81	