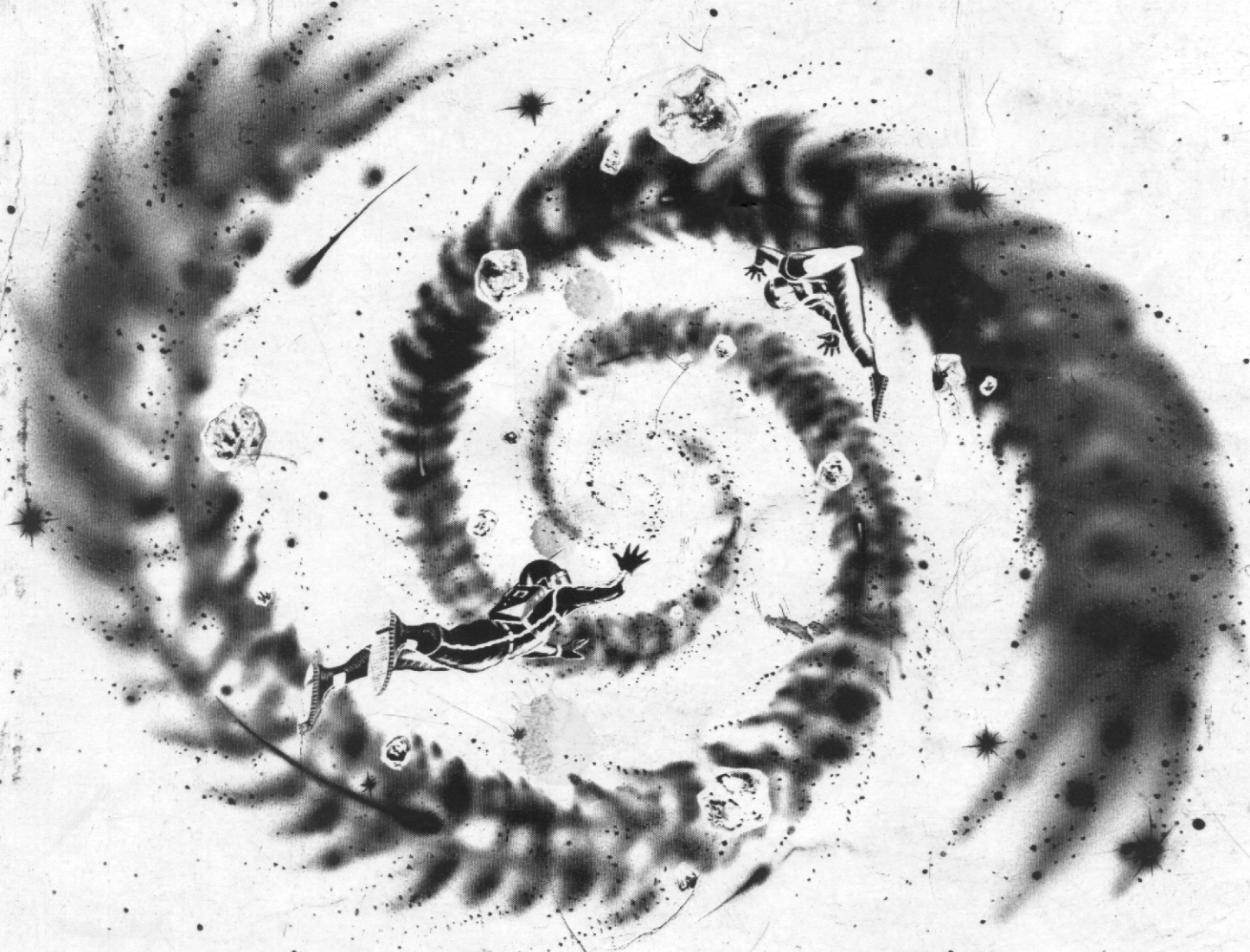
BLACK HOLE

INSTRUCTION MANUAL



Gottlieb
AMUSEMENT GAMES
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A Columbia Pictures Industries Company

FINAL EDITION

APPLICABLE TO ALL GAMES NOT HAVING THE LETTER "S" IN THEIR SERIAL NUMBER

BLACK HOLE (GAME #668)

INSTRUCTION MANUAL

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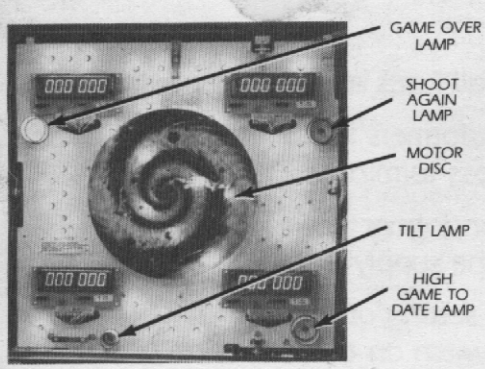
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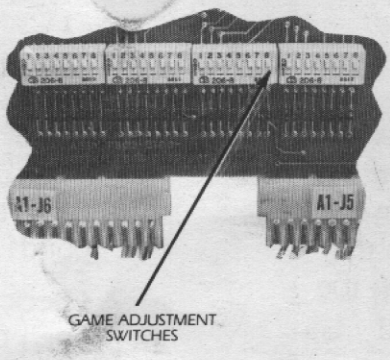
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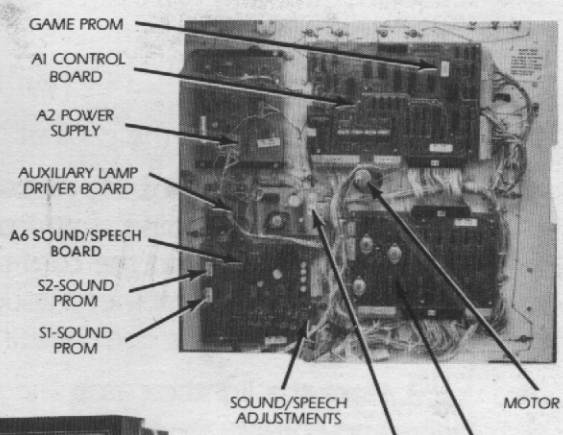
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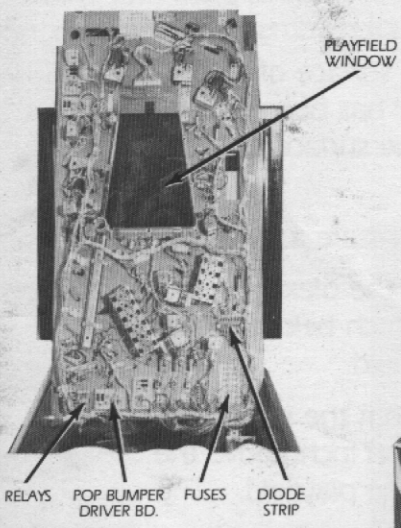
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I. INSTALLATION

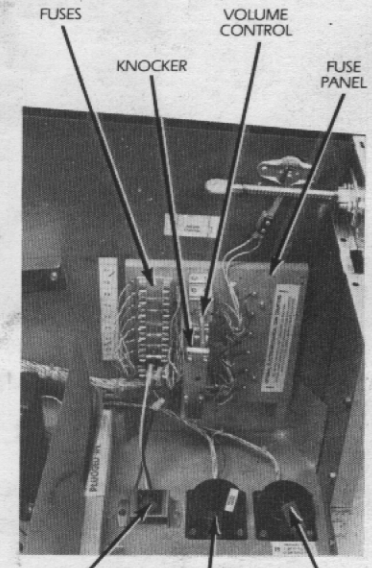


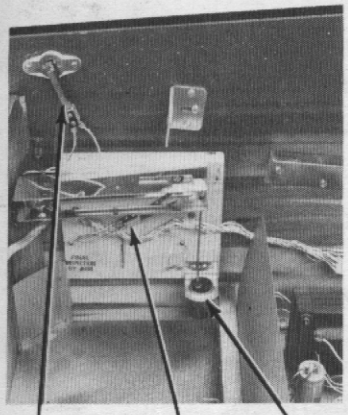


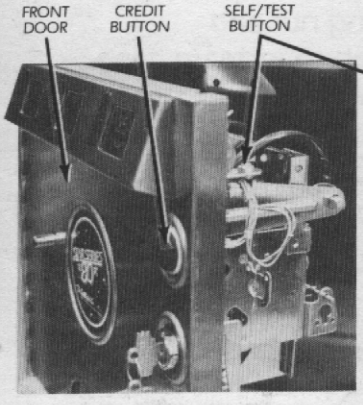


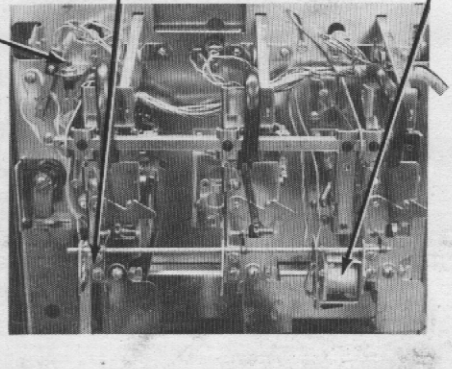


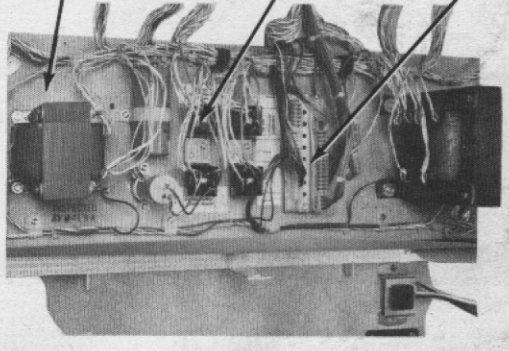








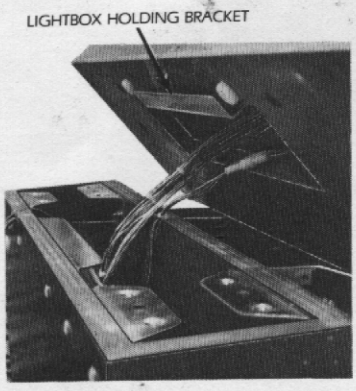




I. INSTALLATION

A. SET-UP

1. Bolt the legs to the cabinet.
2. From the inside of the cabinet, remove the binding strap from the power cord. Feed the cord to the outside of the cabinet through the black plastic line cord housing.
3. Place the lightbox atop the pedestal and 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 in the lightbox.
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.

B. CHECK-OUT

1. Check that all cables are clear of moving parts.
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. Check that the surface of the plexiglass panel has been properly aligned with the surface of the upper playfield.

   The specifications are as follows:

   A. At the top, the plexiglass must be 1/64 of an inch below the surface of the playfield.

   B. At the bottom the plexiglass must be 1/64 of an inch above the surface of the playfield.

   C. Along the sides, flush.

   CAUTION: Clean the plexiglass with glass cleaner and a soft cloth only. Never use abrasive materials.

   NOTE: The allen screws used are 6-32 x 5/8" flatheads, requiring a 5/64 allen wrench.

9. Check that a sponge rubber washer has been inserted underneath the plexiglass at each attachment point.
10. Level the machine.
11. The plumb-bob tilt can be adjusted by loosening the wing nut and raising the plumb-bob to increase its sensitivity, or lowering it to decrease its sensitivity.

    The ball-roll tilt can be adjusted by loosening the front screw or raising the tilt bracket to increase sensitivity, or lowering it to decrease its sensitivity.

12. With the line cord unplugged, drop

a coin into one of the chutes. It should be rejected.

13. Plug game into a properly grounded 3-wire receptacle **ONLY!**

14. 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.

PLAYFIELD REMOVAL

The following procedure must be carefully followed in order to avoid damaging the upper playfield drop target assemblies (coils and targets) and the lower playfield guides as shown in figure one.

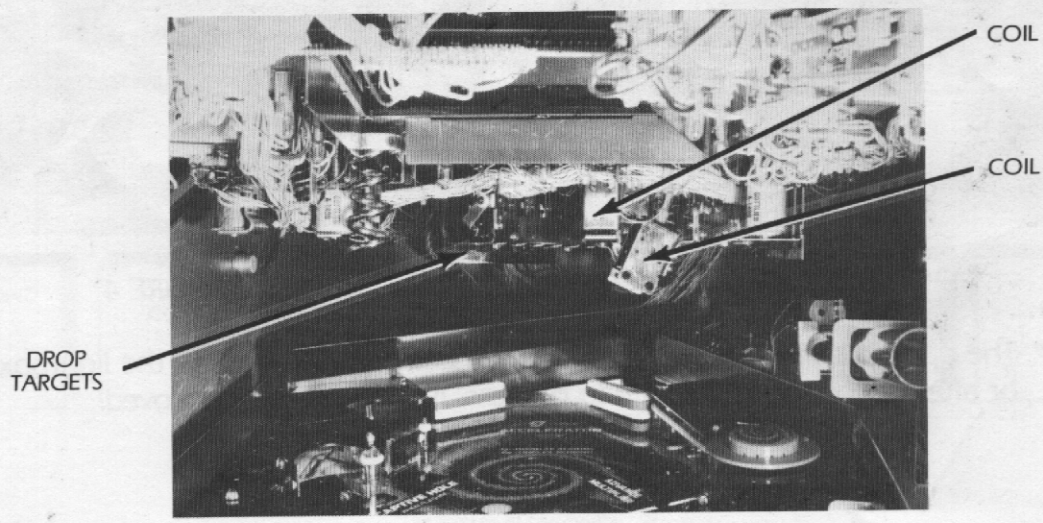


FIGURE 1

UPPER PLAYFIELD

1. Pivot the front end of the upper playfield up until it is at least 12 inches above the front of the cabinet as shown in figure two.

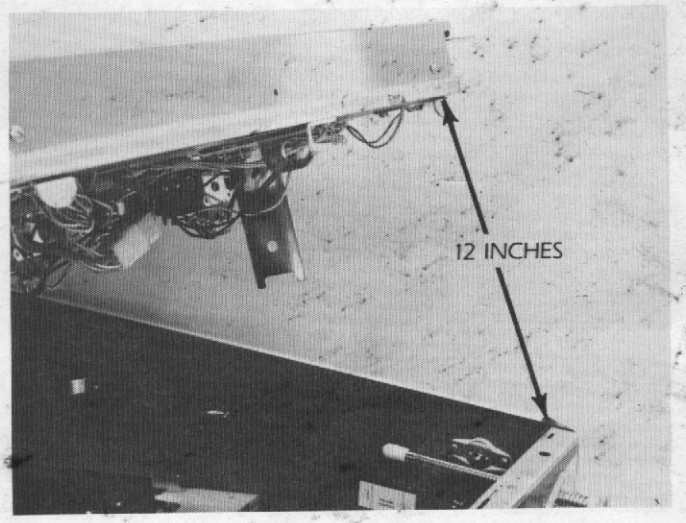


FIGURE 2

I. INSTALLATION

2. Pull the playfield toward you until its back end is 1 to 2 inches from the front end of the playfield support assemblies as shown in figure three.

CAUTION: While completing step two, check that the upper playfield wiring harness, shown in figure four, is clearing the lower playfield.

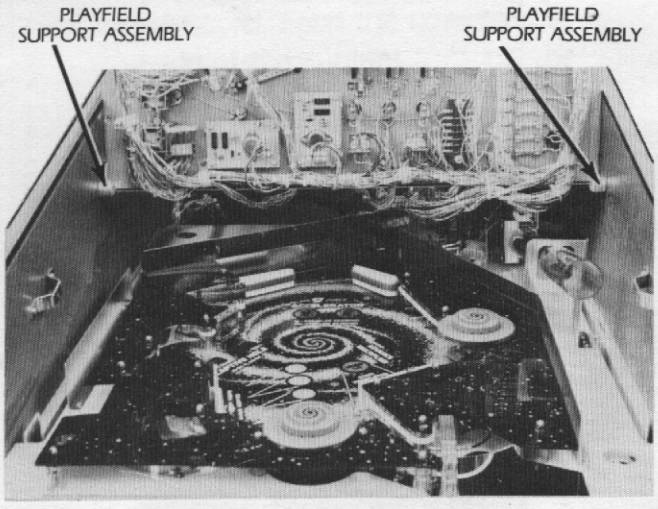


FIGURE 3

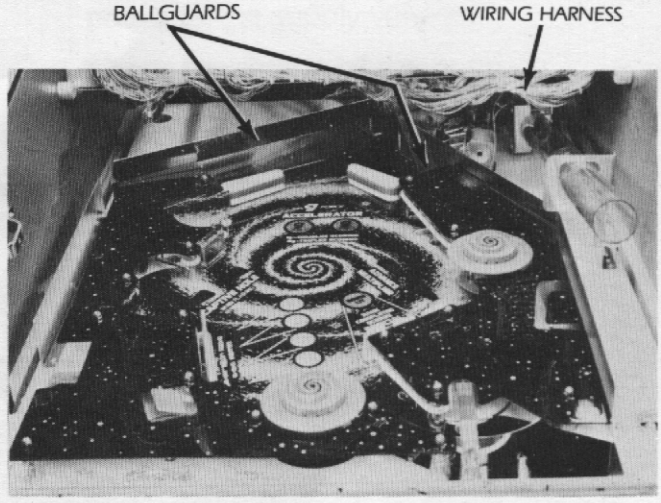


FIGURE 4

3. The upper playfield can now be pivoted back until it rests on the lightbox, or after disconnecting its wiring harness, it can be totally removed.

LOWER PLAYFIELD

1. Remove the bolts from both sides of the playboard as shown in figure five.

2. Pull the playboard straight back to the position shown in figure six.

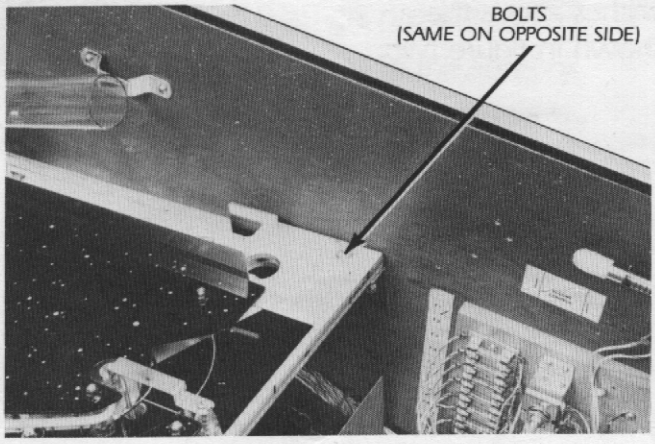


FIGURE 5

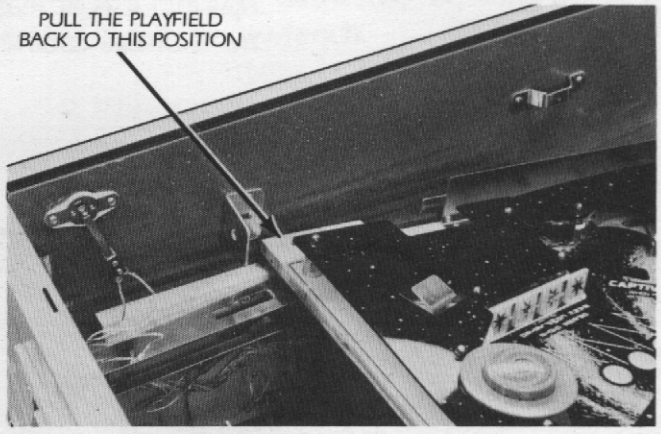
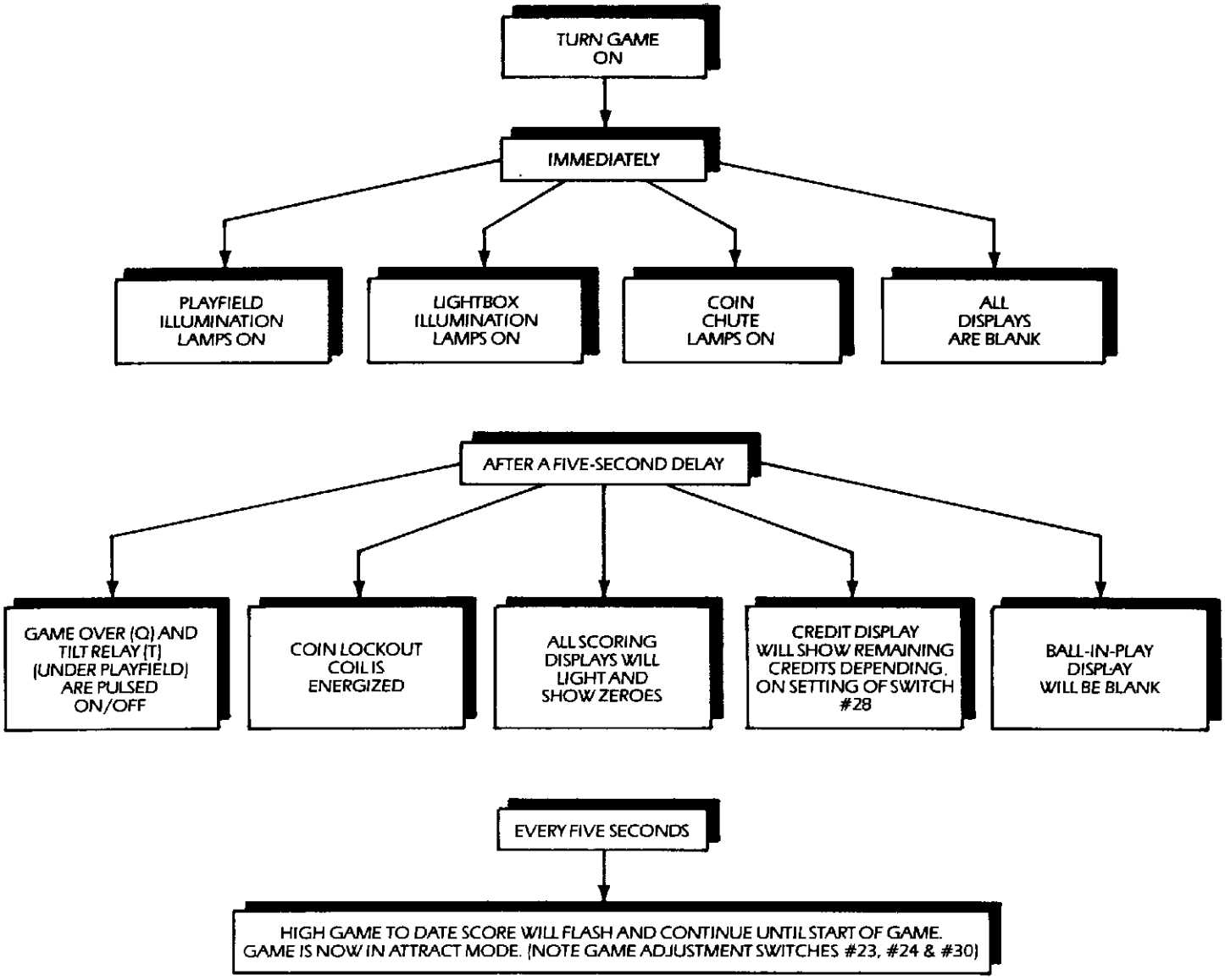


FIGURE 6

3. Pivot the playboard back until it rests against the upper playfield or after disconnecting its wiring harness, it can be totally removed.

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.

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 4 players' score displays and the lower playfield display.

III. GAME OPERATION

B. FIRST PLAYER

1. First player's score display flashes 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, any bonus earned on the lower playfield 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 anytime the first player's 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.
4. Upper playfield captured ball is released; the lower is not.

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. All of the target banks will reset.

IV. GAME PLAY AND SCORING

BALL-CAPTURE

- Completing the yellow spot target sequence enables the upper playfield capture hole. Once enabled, the blue capture hole lamp will flash until a ball is captured.
- The lower playfield capture hole is always active. The 3 blue captive hole arrows will flash until a ball is captured.
- A ball captured on the lower playfield will be remembered from ball-to-ball unless used by any of the players during 3-ball play.
- When the upper playfield capture lamp is lit by a player, it will be remembered for that player.
- Ball captured on upper playfield will be ejected at the end of player's turn.

MULTI-BALL PLAY

- Begins when a ball is shot down to the lower playfield while both capture holes are occupied.
- The lowe playfield ball is released first, resulting in 2-ball play.
- Once both balls have been lost (lower playfield), the third ball will be released (upper playfield), resulting in 3-ball play.
- If the reentry gate is not open when the two balls are returned to the upper playfield, they will both be lost, and 1-ball play will resume.
- During 3-ball play the gate is always open.

BONUS MULTIPLIERS

- Completing the top rollover sequence (upper playfield) advances the "BONUS MULTIPLIER".
- Actuating the rollunder on the lower playfield will also advance the "BONUS MULTIPLIER".
- The rollovers actuated by a player will be remembered for that player.

BONUS (Lower Playfield Only)

- "BONUS" can only be earned on the lower playfield.

  During play, the "BONUS" will accumulate on the lower playfield display.
- Completing either drop target lamp sequence (B-L-A-C-K or H-O-L-E), in order, will light a "g force" accelerator (lower playfield) lamp for double scoring.
- Completing both lamp sequences, (B-L-A-C-K and H-O-L-E), in order, will light both "g force" for triple scoring.
- At the end of a player's turn, the bonus multiplier will be applied to the lower playfield "BONUS" score and added to the player-up's score in the lightbox.
- B-L-A-C-K or H-O-L-E sequences completed will be remembered unless both have been completed, which results in neither being remembered.
- "g force" double scoring will be remembered from ball-to-ball.
- Drop target banks on the lower playfield will not reset until completed for each player.

SPECIAL

- Completing the B-L-A-C-K H-O-L-E lamp sequence lights the white 3-drop target bank on the lower playfield for the "SPECIAL". Completing the bank will award the "SPECIAL".

IV. GAME PLAY AND SCORING

- Each time the white 3-drop target bank on the lower playfield is completed, the value for the rollunder on the upper playfield advances. Passing the rollunder leading to the upper playfield rollover sequence when its red "SPECIAL" lamp is lit will award the "SPECIAL".

EXTRA BALL

- Completing the lower playfield left drop target bank (4-Bank), when all the targets are lit, will light the "EXTRA BALL" lamp on the left side of the upper playfield. Capturing the ball on the upper playfield, or if ball has already been captured, will award the "EXTRA BALL".
- Each time the white right drop target bank on the lower playfield (3-Bank) is completed, the rollunder value on the upper playfield will advance. Passing the rollunder when its purple lamp is lit will award the "EXTRA BALL".

ADDITIONAL FEATURES

- A captive ball in the upper playfield hole will be kicked out each time a player loses the ball-in-play.

  A tilt will not be recognized during the end-of-ball bonus countdown or during initialization.
- The reentry gate will open and direct the ball onto the upper playfield if either of the two lower playfield drop target banks have been completed or if the ball passes over the right return rollover when its arrow is flashing green.

UPPER PLAYFIELD

RIGHT SIDE ROLLOVER

- Score 500 points when unlit.
- Score 10,000 points when lit.

ROLLUNDER

- Score 5,000 points when unlit.
- Score 10,000 points when lit (white).
- Awards extra ball when purple lamp is lit.
- Awards special when red lamp is lit.

"CAPTIVE HOLE"

- Score 5,000 points.
- Awards extra ball when purple lamp is lit.
- Captures ball when blue lamp is flashing.

DROP TARGETS

- Score 500 points when unlit.
- Score 5,000 points (3-ball) when lit or flashing.
- Score 3,000 points (5-ball) when lit or flashing.
- Hitting drop target with flashing lamp will advance lamp sequence.
- Completing drop target lamp sequence resets bank and lights spinner (5-bank) or lights right side rollover (4-bank).

  Completing either lamp sequence (B-L-A-C-K or H-O-L-E) gives 2X scoring on lower playfield. Lights "g force" accelerator lamp.
- Completing both lamp sequences (B-L-A-C-K and H-O-L-E) lights 3-bank (lower playfield) for special and gives 3X scoring on lower playfield.

RIGHT RETURN ROLLOVER

- Score 500 points when unlit.
- Score 5,000 points and opens gate when flashing.

IV. GAME PLAY AND SCORING

TOP ROLLOVERS

- Score 500 points when unlit.
- Score 3,000 points when lit.
- Completing sequence advances bonus multiplier and resets sequence.

RIGHT SIDE SPOT TARGETS

- Score 500 points when unlit.
- Score 3,000 points when lit.
- Corresponding lamp for 4-yellow drop target bank (lower playfield, 4-bank) will illuminate.
- Completing sequence lights right return rollover and blue hole, which enables captive hole.

POP BUMPERS

- Score 1,000 points (3-ball).
- Score 100 points (5-ball).
- Closes gate except during multi-ball.

SPIN TARGET

- Score 100 points when unlit.
- Score 1,000 points when lit.

TEN-POINT SWITCHES

- Score 10 points.
- Closes gate except during multi-ball.

LOWER PLAYFIELD

LEFT DROP TARGET BANK (4-Bank)

- Score 3,000 points when lit (3-ball).
- Score 1,000 points when lit (5-ball).
- Score 300 points when unlit (3-ball).
- Score 100 points when unlit (5-ball).
- Completing sequence resets bank and opens gate.
- Completing sequence with all targets lit lights hole (upper playfield) for extra ball.

RIGHT DROP TARGET (3-BANK)

- Score 500 points.
- Completing sequence resets bank, opens gate, advances rollunder (upper playfield) value and awards special when lit.

"CAPTIVE HOLE"

- Score 3,000 points.
- Captures ball when flashing.

ROLLUNDER

- Score 100 points.
- Advances multiplier.

POP BUMPERS

- Score 100 points.

LEFT RETURN ROLLOVER

- Score 100 points.

TEN-POINT SWITCHES

- Score 10 points.
  Kicking Target
  Kicking Rubbers

HIGH GAME TO DATE

If the high game to date is 980,000 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
"DO YOU DARE TO ENTER THE BLACK HOLE"	Random
"NO ONE ESCAPES THE BLACK HOLE"	Random

GAME MODE	OCCURRENCE
"SHOOT CAPTIVE HOLE" (Ball on upper playfield)	Random; after captive hole lamp is flashing.
"SHOOT CAPTIVE HOLE" (Ball on lower playfield)	Random
"COMPLETE BANK FOR RE-ENTRY"	Random; while ball is on lower playfield and only until either bank has been completed.
"SHOOT FOR SPECIAL"	Random; after "SPECIAL" lamp is lit.
"EXTRA BALL LIT"	Random; after extra ball lamp is lit.
"ENTER GRAVITY TUNNEL"	Random; after 2 balls are captive.
"RE-ENTRY ACCOMPLISHED"	Each time ball passes from lower playfield to upper playfield (gate must be open).
"RE-ENTRY ATTEMPT HAS FAILED"	Each time ball travels from lower playfield and is lost (gate closed).
"G-FORCE ACCELERATED"	Each time a drop target bank lamp sequence has been completed in order (B-L-A-C-K or H-O-L-E).

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).

COIN CHUTE ADJUSTMENTS

SWITCHES				
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 15	16	MAXIMUM CREDITS
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 23	24	HIGH GAME TO DATE
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 — MUST REMAIN ON

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

SWITCH 31 — MUST REMAIN OFF

SWITCH 32 — BACKGROUND TONE FOR GAMES WITH SOUND BOARD ONLY.
NOTE: If game is equipped with Sound/Speech board this switch must remain off.

ON ..... ON
OFF ..... OFF

(SEE SECTION VI, B)

VI. GAME ADJUSTMENTS

B. 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 BLACK HOLE GAME #668 IS NOT INTER-CHANGEABLE WITH SOUND BOARDS (A6) USED IN GAMES PREVIOUS TO MARS (#666).

C. SOUND/SPEECH ADJUSTMENTS

The Volume potentiometer for adjusting the speaker output is located on the Fuse/Knocker panel. Which is accessible through the front door.

IMPORTANT: All potentiometers (pot) 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:

SB1-1	USED IN SELF-TEST ONLY.	
SB1-2	NOT USED.	
SB1-3	SB1-4	Attract Mode Speech
OFF	OFF	Disabled.
ON	OFF	Every 10 Seconds.
OFF	ON	Every 2 Minutes.
ON	ON	Every 4 Minutes.
SB1-5	ON	Background sound enabled.
	OFF	Background sound disabled.
SB1-6	ON	All Speech enabled.
	OFF	All Speech disabled.
SB1-7	NOT USED	
SB1-8	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

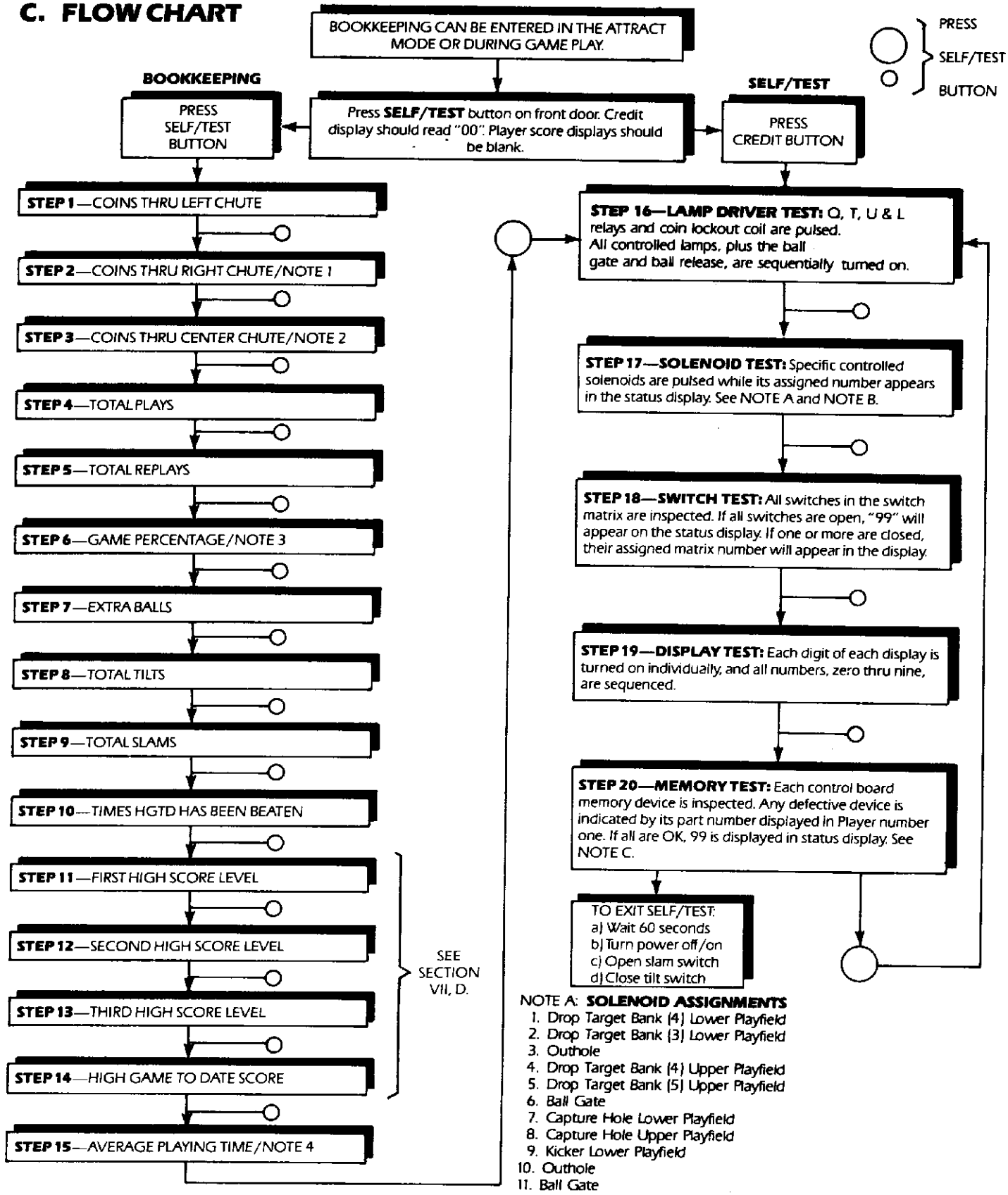
- Pressing the SELF-TEST button inside the front door begins the bookkeeping which are steps 01 through 15.
- The data in any of these steps may be reset to zero while it is displayed by pressing the replay button on the front door.
- THE SELF-TEST BUTTON MUST THEN BE PRESSED TO ENTER ZERO INTO MEMORY.
- 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, D).
- 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. Drop Target Bank (4) Lower Playfield
2. Drop Target Bank (3) Lower Playfield
3. Outhole
4. Drop Target Bank (4) Upper Playfield
5. Drop Target Bank (5) Upper Playfield
6. Ball Gate
7. Capture Hole Lower Playfield
8. Capture Hole Upper Playfield
9. Kicker Lower Playfield
10. Outhole
11. Ball Gate

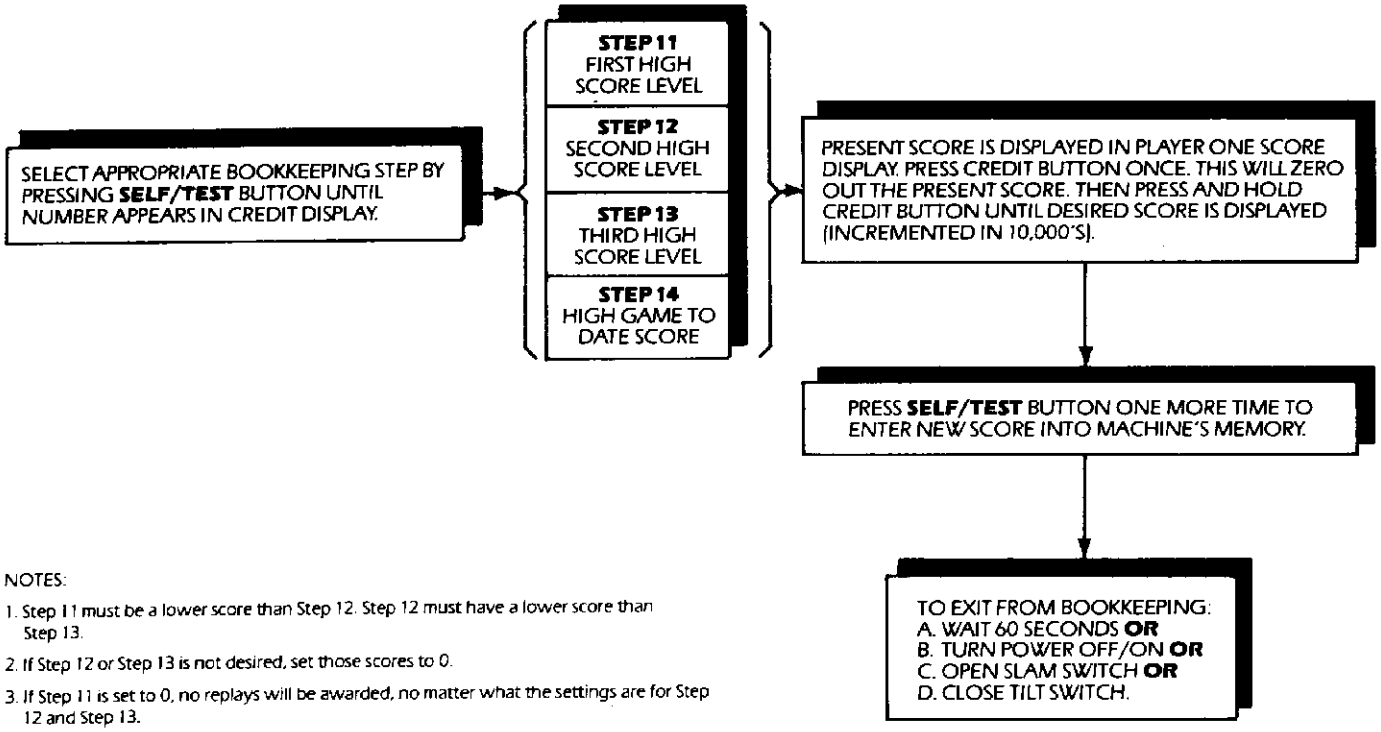
NOTE B: Mechanical coin counters are optional and are not pulsed during solenoid test.

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



NOTES:

1. Step 11 must be a lower score than Step 12. Step 12 must have a lower score than Step 13.
2. If Step 12 or Step 13 is not desired, set those scores to 0.
3. If Step 11 is set to 0, no replays will be awarded, no matter what the settings are for Step 12 and Step 13.

VIII. OPTIONS

A. ELECTRO-MECHANICAL COIN COUNTERS

Electro-mechanical coin counters may be installed on the fuse panel, located inside the cabinet below right-hand flipper switches. Solder lugs are provided which will connect the counters to the electronic circuitry.

1. Position the counter and secure it to the Fuse Panel. Mounting holes are spotted for most standard 24-volt counters.
2. CAUTION: A IN4004 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 (5)

A5 ___ Status Display

A6 ___ Sound/Speech Board

A7 ___ Sound/Speech Power Supply

A8 ___ Pop Bumper Driver Boards (6)

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

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

C. FUSES

FUSE PANEL

F1	Sound/Speech Power Supply 12VAC	½ Amp SLO-BLO
F2	Power Supply 10VAC	5 Amp SLO-BLO
F3	Displays 60VAC	¼ Amp SLO-BLO
F4	Solenoids 25VAC	8 Amp SLO-BLO
F5	Controlled Lamps 8VAC	10 Amp
F6	Playboard Illumination 6.3VAC	10 Amp SLO-BLO
F7	Lightbox 6.3VAC	15 Amp SLO-BLO
F8	Sound/Speech Power Supply 24VDC	1 Amp SLO-BLO

NOTE: F8 is not used in foreign games

IX. GENERAL INFORMATION

C. FUSES (cont.)

UPPER PLAYFIELD FUSES

F10	Right Pop Bumper 38VDC	2½ Amp SLO-BLO
F11	Bottom Left Pop Bumper 38VDC	2½ Amp SLO-BLO
F12	Upper Center Pop Bumper 38VDC	2½ Amp SLO-BLO
F13	Lower Center Pop Bumper 38VDC	2½ Amp SLO-BLO
F14	Five Drop Target Bank 24VDC Four Drop Target Bank 24VDC	2 Amp SLO-BLO
F15	Outhole, Hole Kicker 24VDC	1 Amp SLO-BLO
F16	Trough Ball Gate 24VDC	1 Amp SLO-BLO

LOWER PLAYFIELD FUSES

F17	Kicker (to upper playfield) 24VDC	6¼ Amp SLO-BLO
F18	Four Drop Target Bank 24VDC	2 Amp SLO-BLO
F19	Ball Return Gate 24VDC	1 Amp SLO-BLO
F20	3-Position Drop Target Bank, 24VDC Bank, Hole Kicker	1 Amp SLO-BLO
F21	Right Pop Bumper 24VDC	2 Amp SLO-BLO
F22	Center Pop Bumper 24VDC	2 Amp SLO-BLO

THIS GAME REQUIRES 3 BALLS

D. COIL CHART

SOLENOID COILS

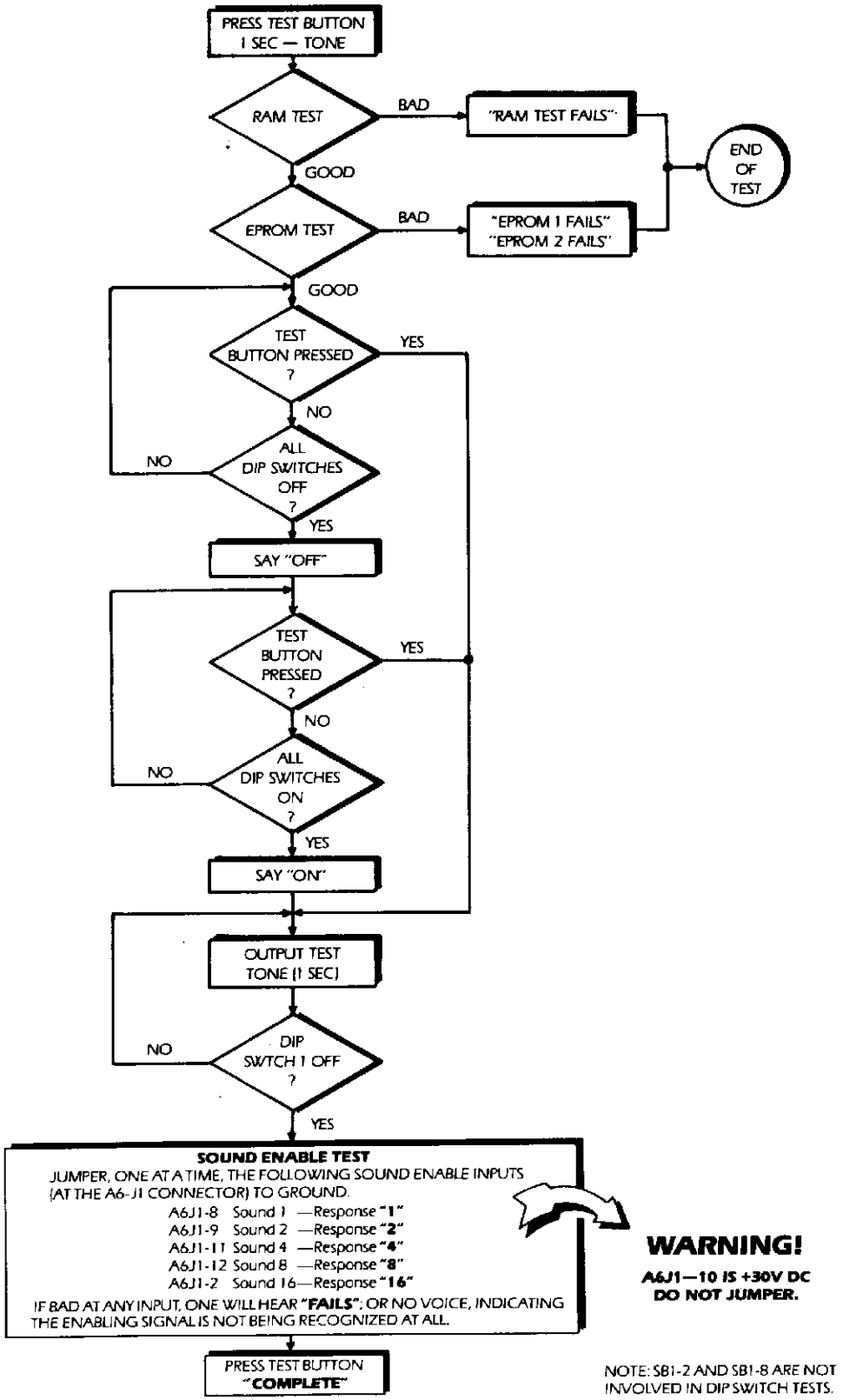
PART NUMBER	GENERAL USAGE*	RESISTANCE (ohms)	NUMBER OF TURNS	WIRE GAUGE	WRAPPER COLOR
A-1496	KICKING RUBBERS POP BUMPERS	2.95	635	#23	Yellow
A-4893	POP BUMPERS BALL KICKER	2.1	535	#22	Red
A-5194	GONG	4.5	780	#24	Blue
A-5195	KNOCKER, HOLE KICKER	12.3	1305	#26	White
A-16570	HOLE KICKER, OUTHOLE	15.5	1450	#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-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 on/off.
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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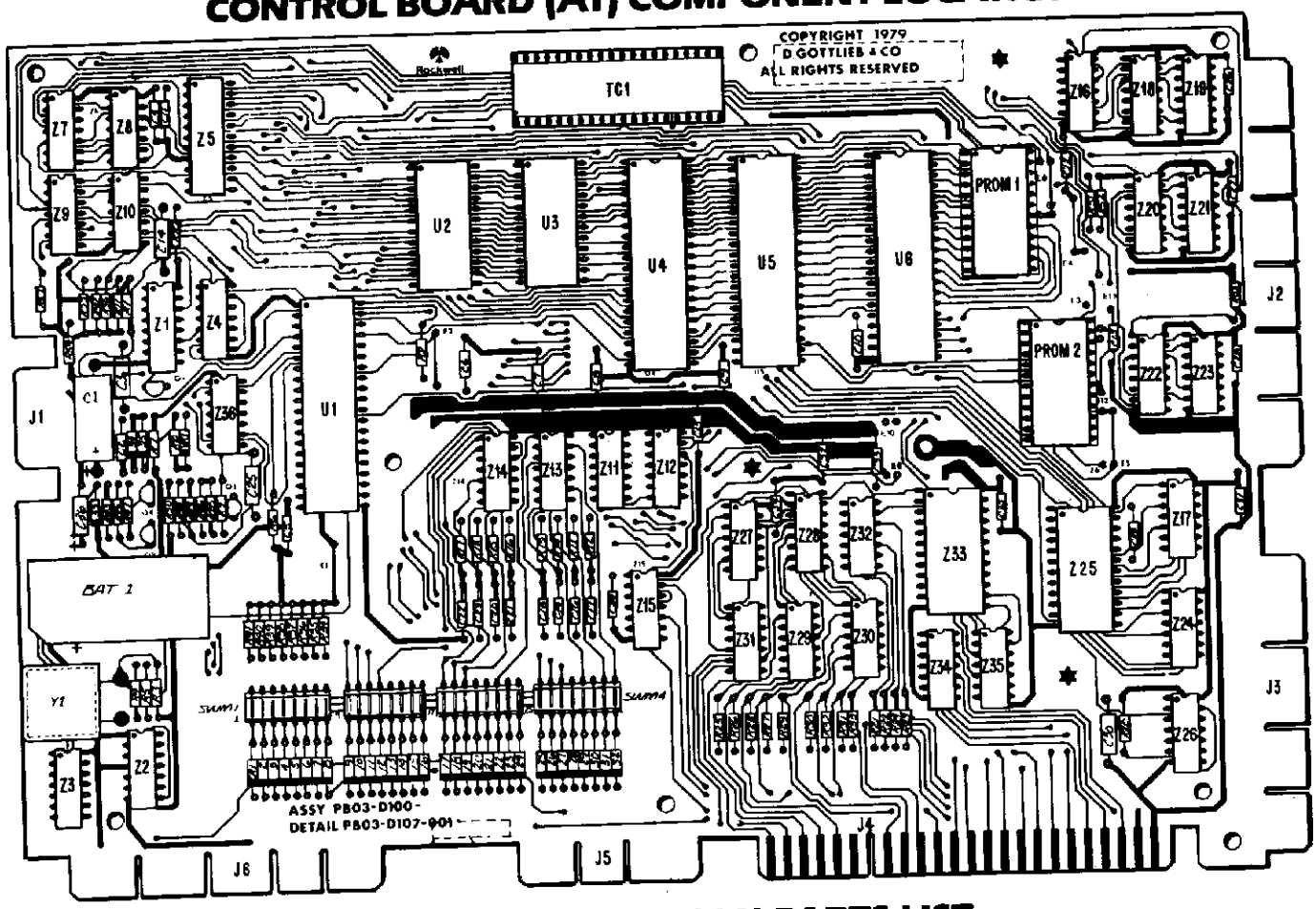
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X. WIRING AND SCHEMATIC DIAGRAMS, PARTS LISTS

CONTROL BOARD (A1) COMPONENT LOCATION



CONTROL BOARD (A1) PARTS LIST

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

NOTE: UNLESS OTHERWISE INDICATED;
1. RESISTORS ARE ±5%, 1/4W.
2. CAPACITORS ARE .01UF, 50V.
3. DIODES ARE TYPE 1N4148.
4. REF. DESIGNATION Z6 NOT USED.

SPARE GATES

Z3 7404 · Z30 7416
Z12 7404 · Z32 7417
Z27 7404 · Z32 7417
Z29 7416 · Z9 7400
Z29 7416 · Z9 7400
Z36 4069 · Z36 4069
Z36 4069 · Z36 4069

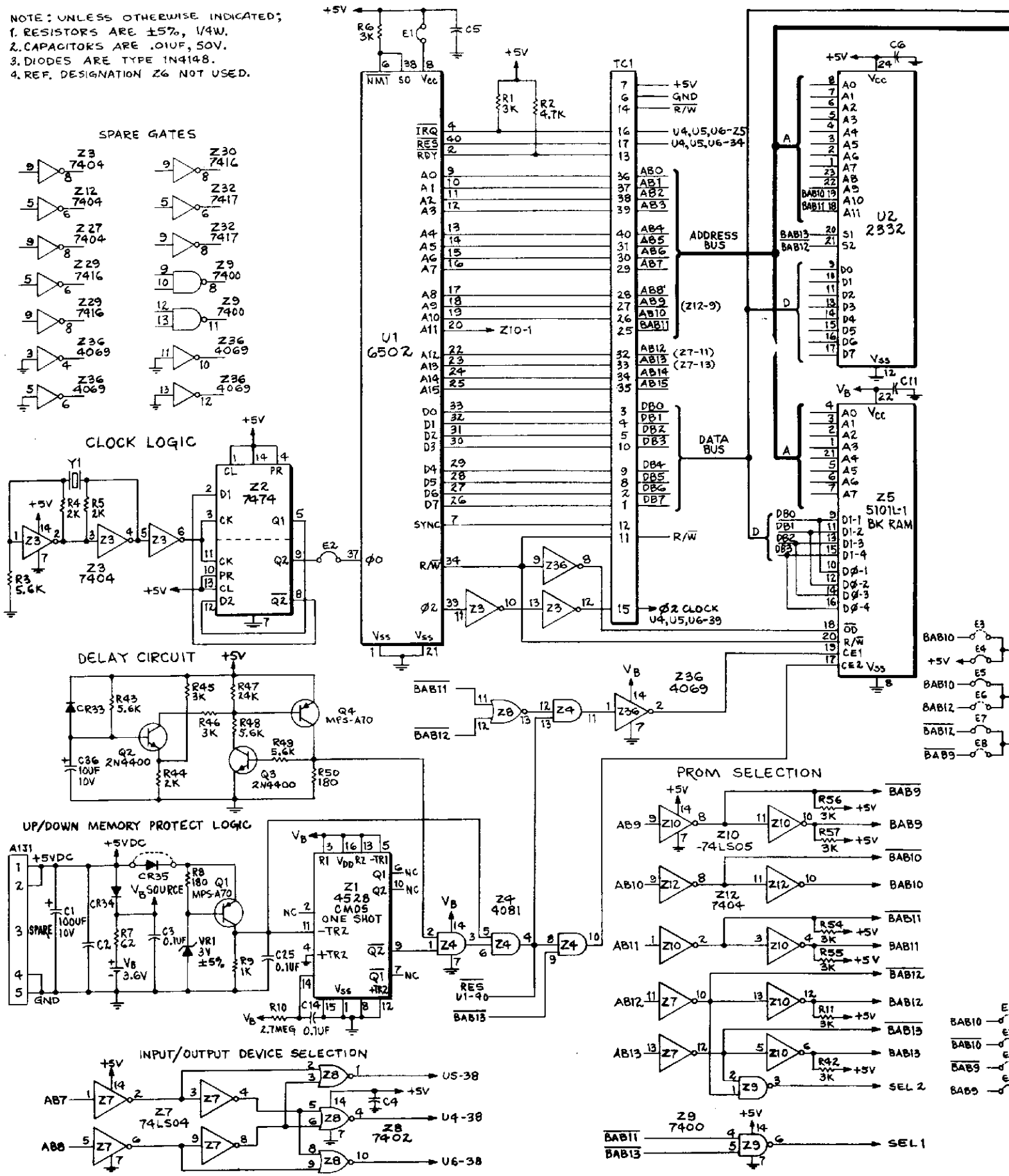
CLOCK LOGIC

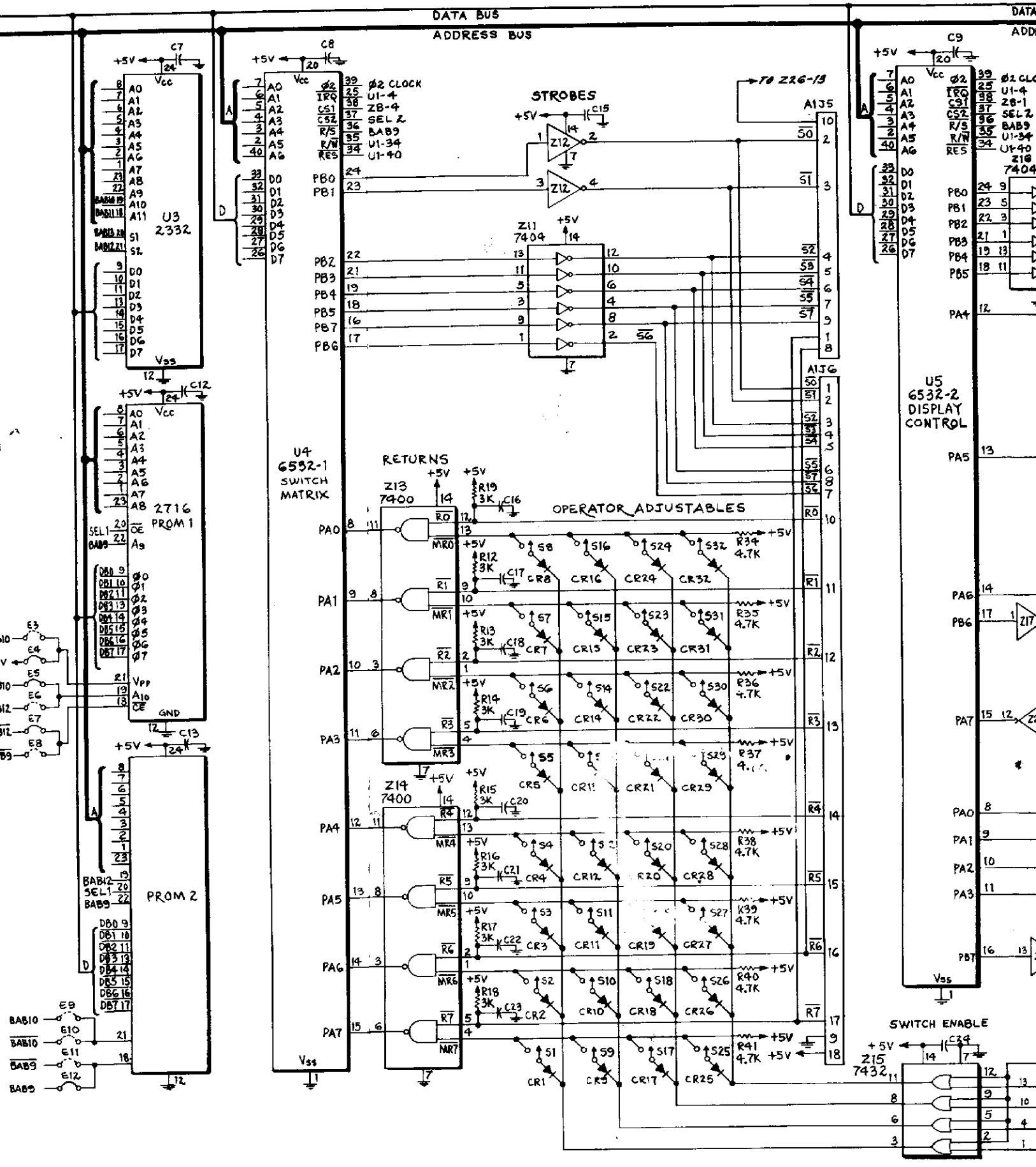
DELAY CIRCUIT

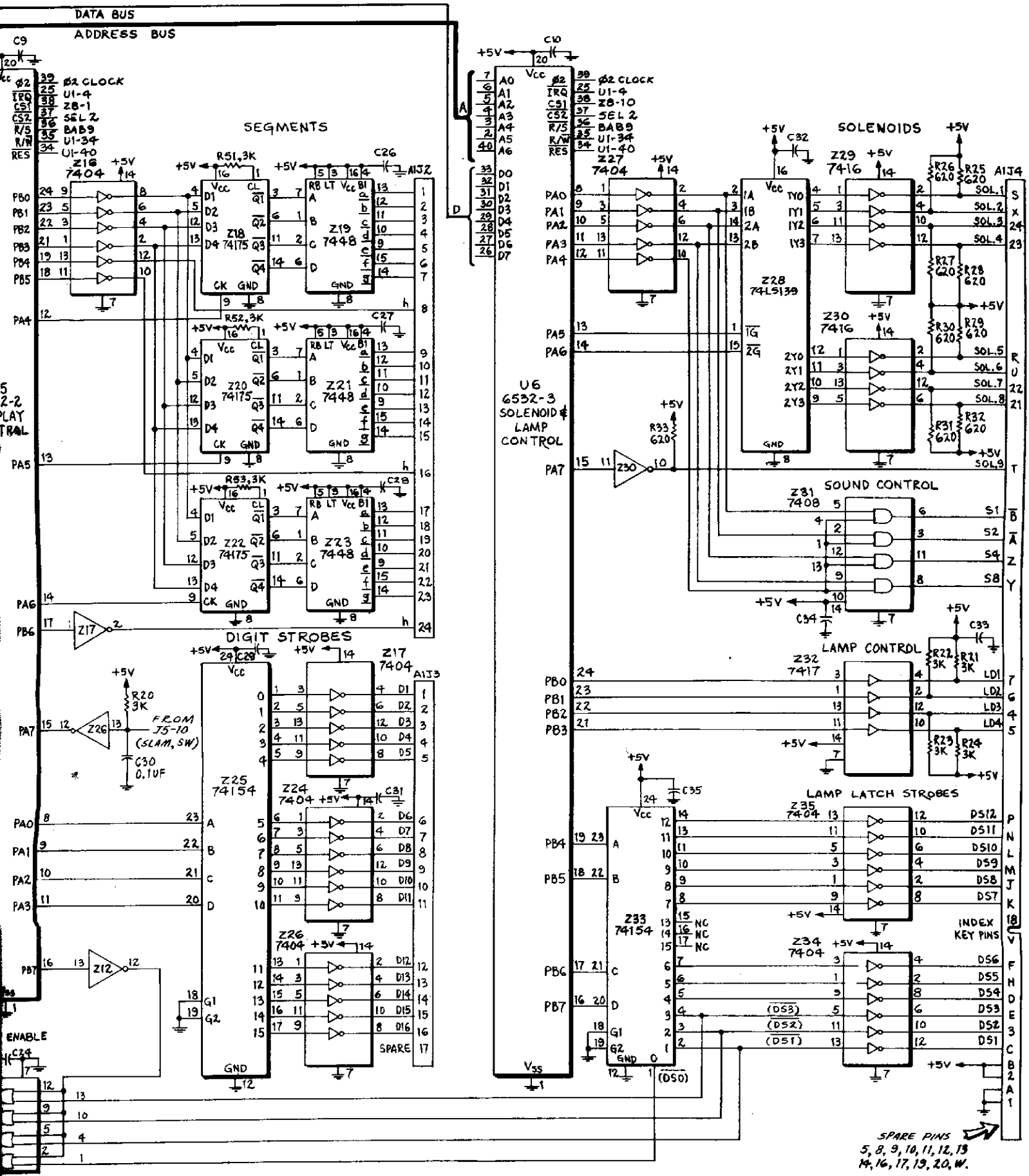
UP/DOWN MEMORY PROTECT LOGIC

INPUT/OUTPUT DEVICE SELECTION

PROM SELECTION

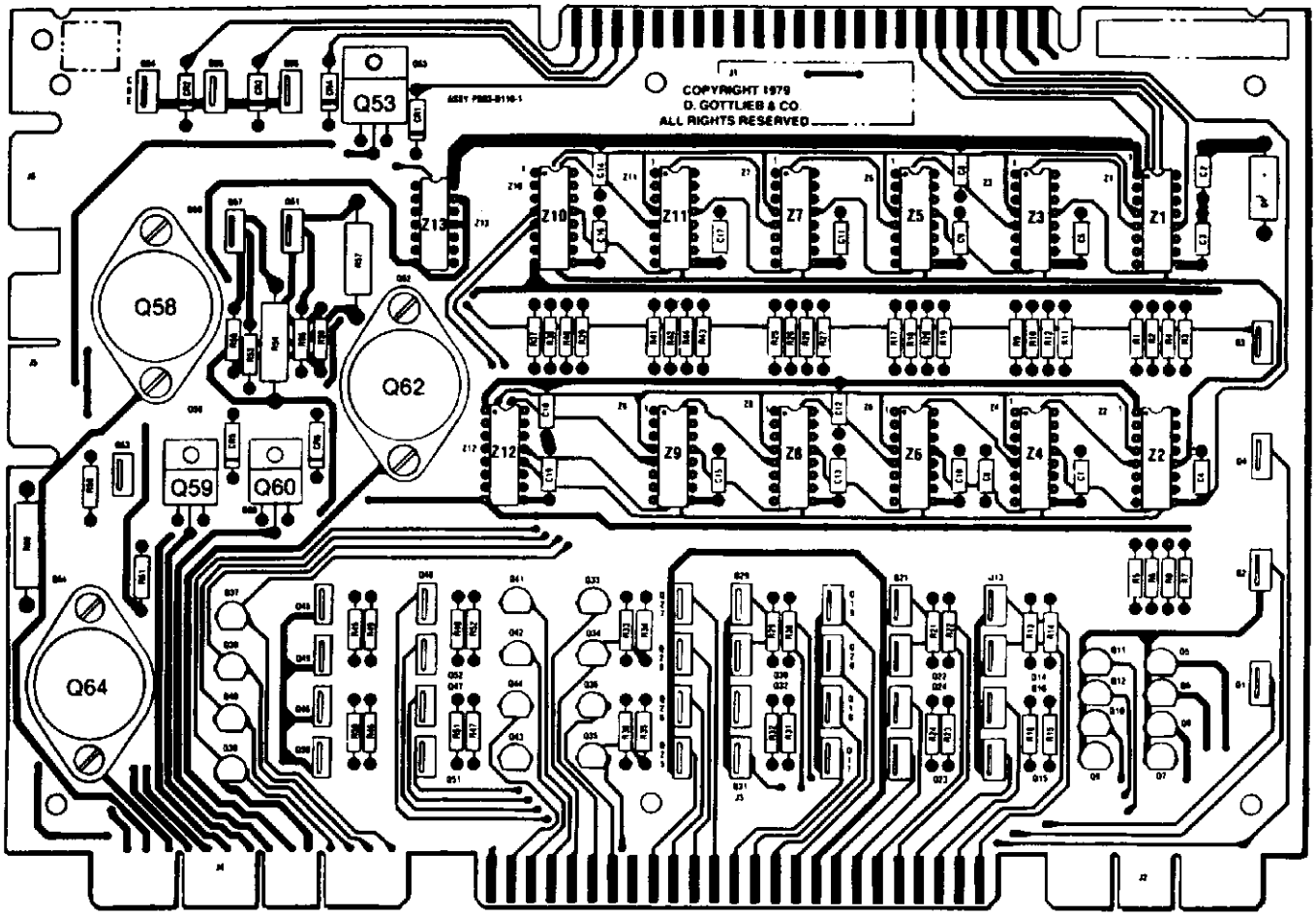



DATA BUS
ADDRESS BUS
STROBES
RETURNS
OPERATOR ADJUSTABLES
SWITCH ENABLE
U3 2332
U4 6532-1 SWITCH MATRIX
U5 6532-2 DISPLAY CONTROL
2716 PROM 1
PROM 2
Z11 7404
Z12
Z13 7400
Z14 7400
Z15 7432
A1J5
A1J6
TO Z26-13
Ø2 CLOCK
U1-4
Z8-4
SEL 2
BA89
U1-34
U1-40
+5V
GND
Vcc
Vss
R12 3K
R13 3K
R14 3K
R15 3K
R16 3K
R17 3K
R18 3K
R19 3K
R34 4.7K
R35 4.7K
R36 4.7K
R37 4.7K
R38 4.7K
R39 4.7K
R40 4.7K
R41 4.7K



D. GOTTLIEB & CO.			
TITLE: CONTROL BOARD (A1)			
USED ON: SYSTEM 80			
DRAWN: [illegible]	APPROVED: BAM	DATE: 12-20-80	E-20916

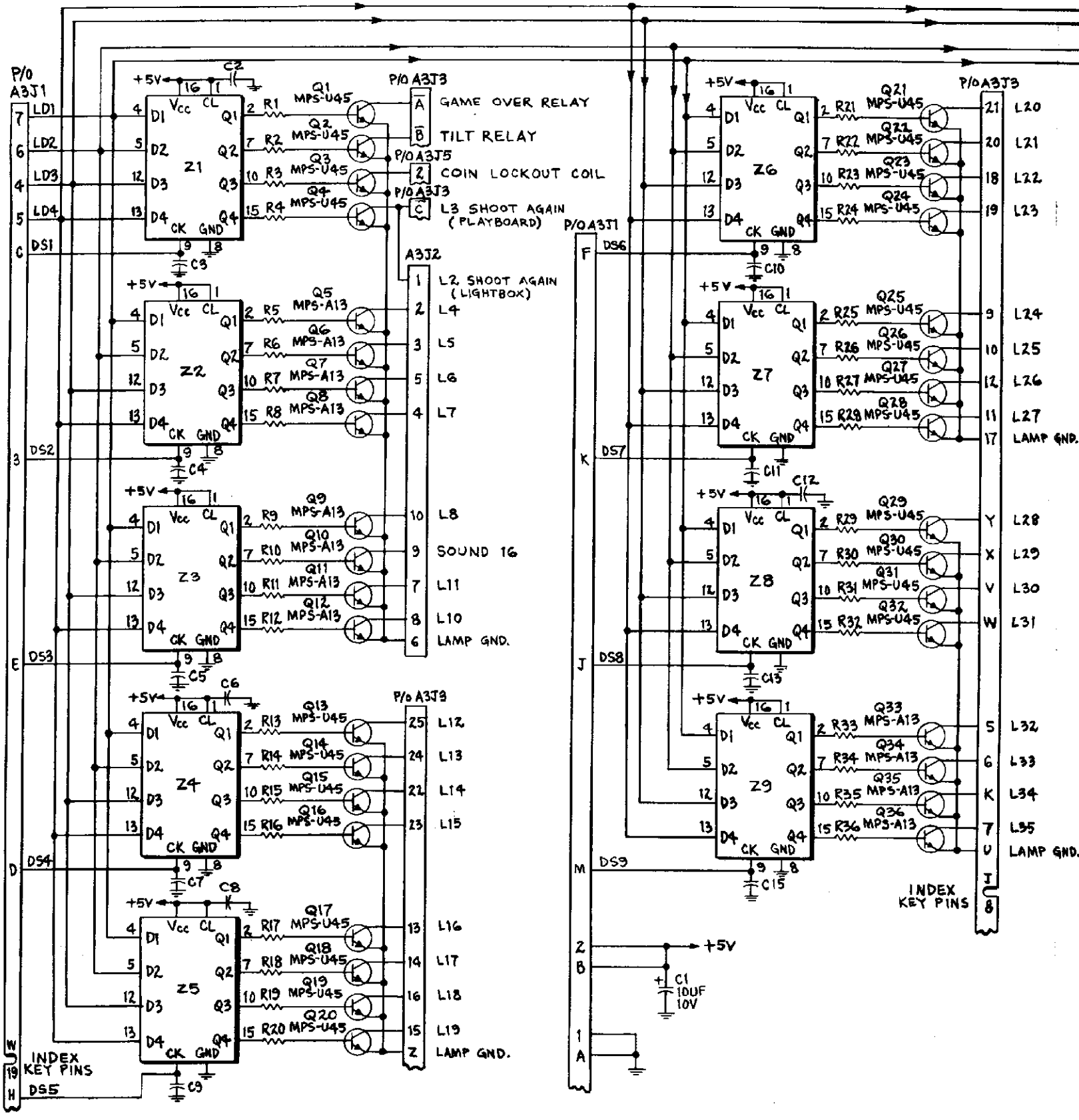
DRIVER BOARD (A3) COMPONENT LOCATION

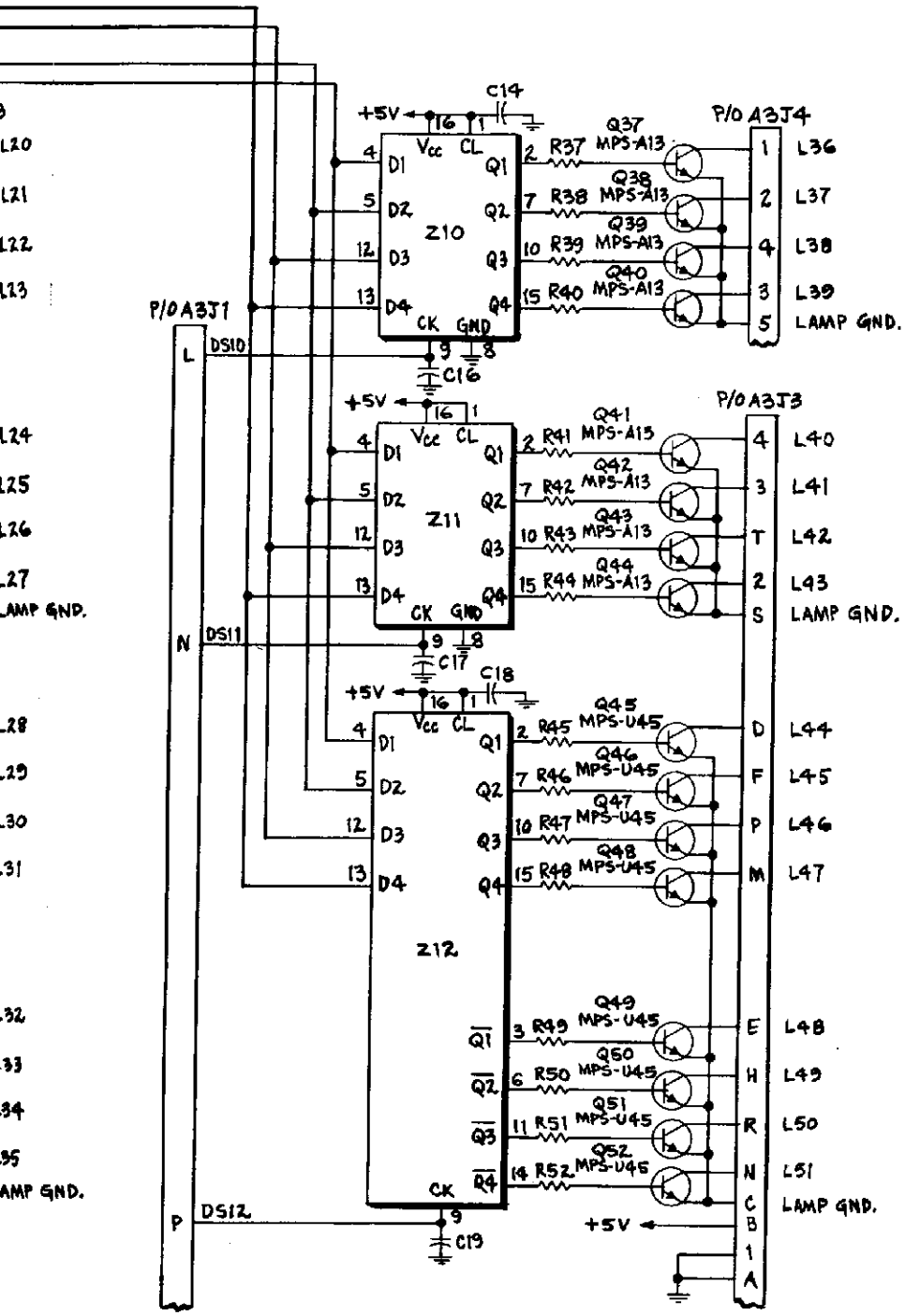


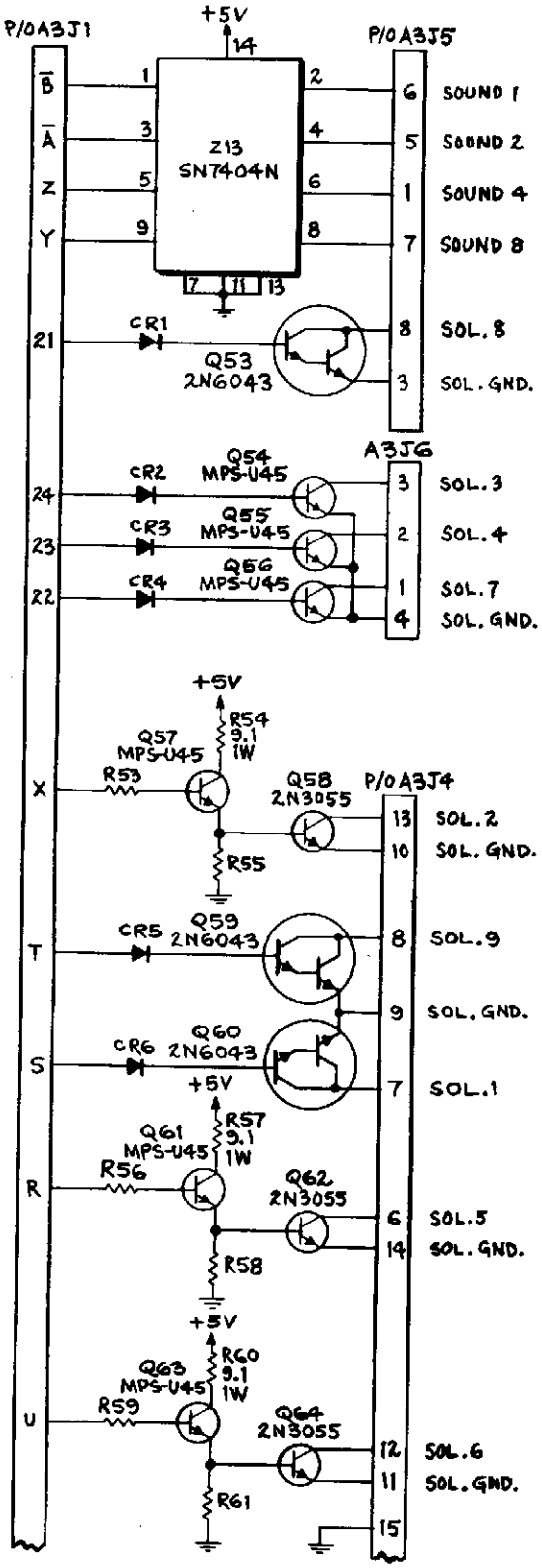


DRIVER BOARD (A3) PARTS LIST

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


P/O A3J1
LD1
LD2
LD3
LD4
DS1
DS2
DS3
DS4
DS5
INDEX KEY PINS
Z1
Z2
Z3
Z4
Z5
Z6
Z7
Z8
Z9
Vcc CL D1 D2 D3 D4 Q1 Q2 Q3 Q4 CK GND
+5V
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C12
C13
C15
C1 10UF 10V
Q1 MPS-U45
Q2 MPS-U45
Q3 MPS-U45
Q4 MPS-U45
R1
R2
R3
R4
P/O A3J3
A GAME OVER RELAY
B TILT RELAY
P/O A3J5
2 COIN LOCKOUT COIL
P/O A3J3
C L3 SHOOT AGAIN (PLAYBOARD)
A3J2
1 L2 SHOOT AGAIN (LIGHTBOX)
Q5 MPS-A13
Q6 MPS-A13
Q7 MPS-A13
Q8 MPS-A13
R5
R6
R7
R8
2 L4
3 L5
5 L6
4 L7
Q9 MPS-A13
Q10 MPS-A13
Q11 MPS-A13
Q12 MPS-A13
R9
R10
R11
R12
10 L8
9 SOUND 16
7 L11
8 L10
6 LAMP GND.
Q13 MPS-U45
Q14 MPS-U45
Q15 MPS-U45
Q16 MPS-U45
R13
R14
R15
R16
P/O A3J3
25 L12
24 L13
22 L14
23 L15
Q17 MPS-U45
Q18 MPS-U45
Q19 MPS-U45
Q20 MPS-U45
R17
R18
R19
R20
13 L16
14 L17
16 L18
15 L19
Z LAMP GND.
P/O A3J1
DS6
DS7
DS8
DS9
Q21 MPS-U45
Q22 MPS-U45
Q23 MPS-U45
Q24 MPS-U45
R21
R22
R23
R24
P/O A3J3
21 L20
20 L21
18 L22
19 L23
Q25 MPS-U45
Q26 MPS-U45
Q27 MPS-U45
Q28 MPS-U45
R25
R26
R27
R28
9 L24
10 L25
12 L26
11 L27
17 LAMP GND.
Q29 MPS-U45
Q30 MPS-U45
Q31 MPS-U45
Q32 MPS-U45
R29
R30
R31
R32
Y L28
X L29
V L30
W L31
Q33 MPS-A13
Q34 MPS-A13
Q35 MPS-A13
Q36 MPS-A13
R33
R34
R35
R36
5 L32
6 L33
K L34
7 L35
U LAMP GND.
INDEX KEY PINS
+5V



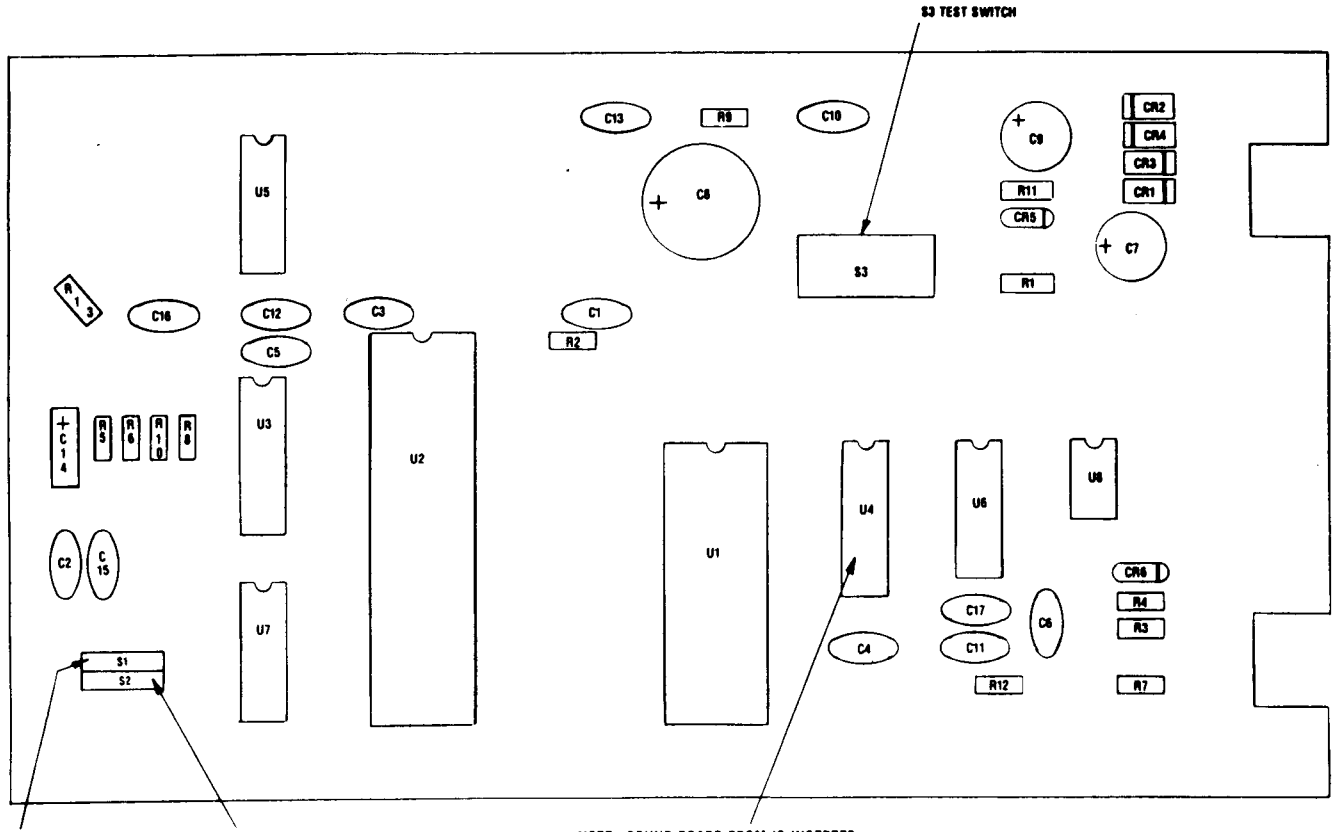


NOTE: UNLESS OTHERWISE SPECIFIED;

1. RESISTORS ARE 1.0K, ±5%, 1/4W.
2. CAPACITORS ARE .01UF, 20%, 50V.
3. DIODES ARE TYPE 1N4148.
4. INTEGRATED CIRCUITS ARE SN74175N.
5. TRANSISTOR TYPES MPS-A13 AND MPS-U45 ARE NPN DARLINGTONS.

D. GOTTLIEB & CO.			
TITLE: DRIVER BOARD (A3)			
USED ON: SYSTEM 80			
DRAWN	APPROVED	DATE	E-20915
B.P.R.	RAM	12-12-80	

SOUND BOARD (A6) COMPONENT LOCATION



S1
OFF = CONTINUOUS SOUND
ON = SCORING SOUNDS ONLY

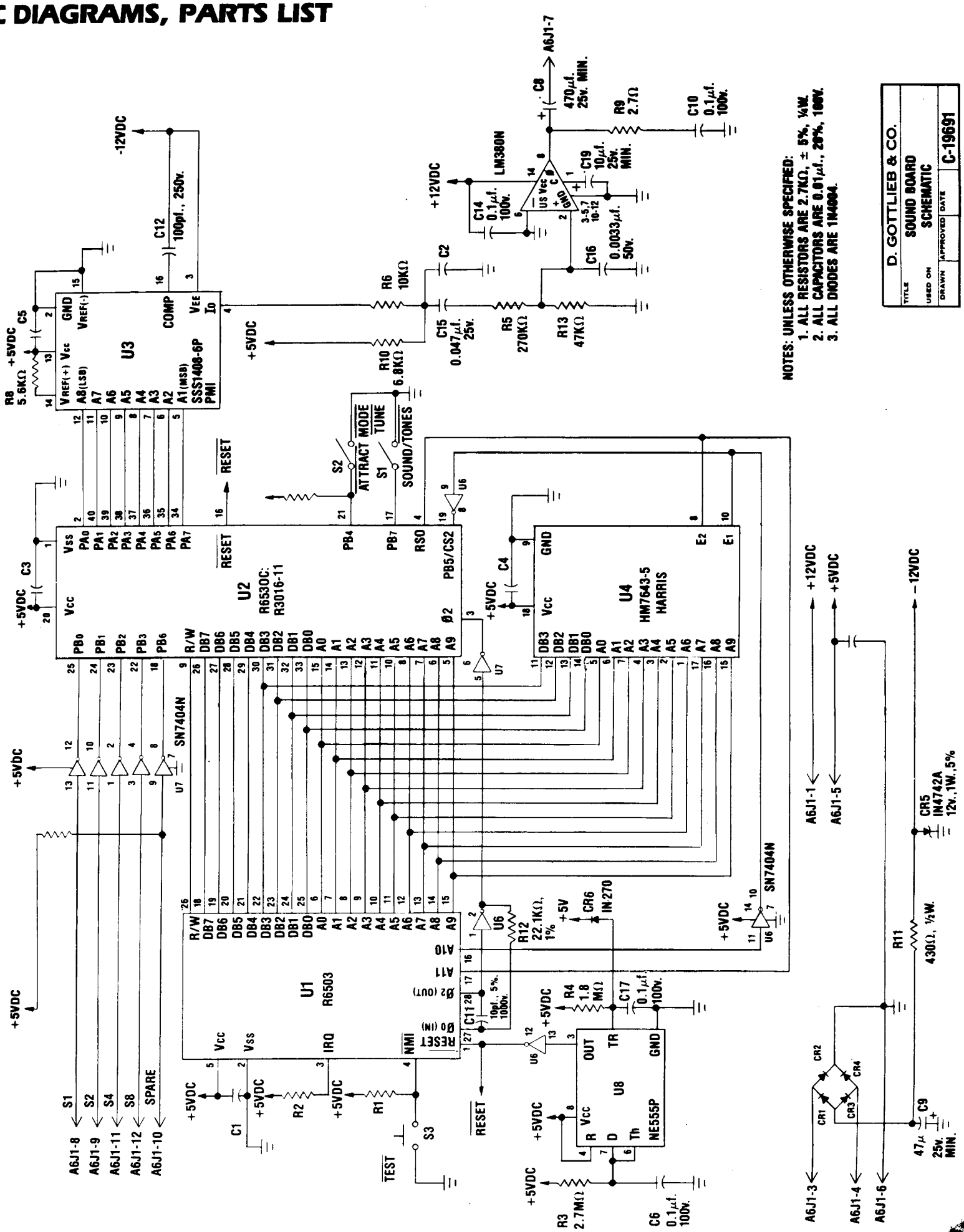
S2
OFF = NO ATTRACT TUNE
ON = ATTRACT TUNE EVERY 6 MINUTES

NOTE: SOUND BOARD PROM IS INSERTED WITH INDENT NOTCH UP. PROM IS MARKED WITH GAME NUMBER.

D. GOTTLIEB & CO.			
TITLE / USED ON	SOUND BOARD COMPONENT LOCATION—SYSTEM 80		
DRAWN	APPROVED	DATE	C-19829

SOUND BOARD (A6) PARTS LIST

REFERENCE	DESCRIPTION	PART NUMBER
R1, R2, R7	RESISTOR—2.7KΩ, ¼W, 5%	
R9	RESISTOR—2.7Ω, ¼W, 5%	
R10	RESISTOR—6.8KΩ, ¼W, 5%	
R11	RESISTOR—430Ω, ½W, 5%	
R3	RESISTOR—2.7MΩ, ¼W, 5%	
R4	RESISTOR—1.8MΩ, ¼W, 5%	
R12	RESISTOR—22.1KΩ, ¼W, 1%	
R6	RESISTOR—10KΩ, ¼W, 5%	
R8	RESISTOR—5.6KΩ, ¼W, 5%	
R5	RESISTOR—270KΩ, ¼W, 5%	
R13	RESISTOR—47KΩ, ¼W, 5%	
C1, C5	CAPACITOR—0.01 MICROFARAD, 100V, 20%—KEMET	
C7, C9	CAPACITOR—47 MICROFARAD, 25V	
C8	CAPACITOR—470 MICROFARAD, 25V	
C6, C10, C13, C17	CAPACITOR—0.1 MICROFARAD, 100V, 20%—KEMET	
C11	CAPACITOR—10 PICOFARAD, 1000V, 5%	
C12	CAPACITOR—100 PICOFARAD, 250V, 20%	
C15	CAPACITOR—0.047 MICROFARAD, 25V, 20%	
C16	CAPACITOR—0.0033 MICROFARAD, 50V, 20%	
C14	CAPACITOR—10 MICROFARAD, 25V	
U1	IC—CPU	R6503
U2	IC-ROM/RAM/1/O	R6530C:R3016-11
U3	IC—DAC	SSS1408-6P
U4	IC—PROM	HM7643-5
U8	IC—TIMER	NE555P
U6, U7	IC—INVERTER	SN7404N
U5	IC—AMPLIFIER	LM380N
CR1, CR4	DIODE	1N4004
CR5	ZENER DIODE—12V, 1W, 5%	1N4742A
CR6	DIODE	1N270
S1, S2	2 POSITION DIP SWITCH	76SB02
S3	PUSH BUTTON SWITCH	EVQ-PAR-11K
PROM SOCKET	SOCKET, 18 PIN	640359-1


D. GOTTLIEB & CO.
TITLE SOUND BOARD SCHEMATIC
USED ON
DRAWN APPROVED DATE
C-19691
NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE 2.7KΩ, ± 5%, ¼W.
2. ALL CAPACITORS ARE 0.01μf., 20%, 100V.
3. ALL DIODES ARE 1N4004.
U1 R6503
U2 R6530C: R3016-11
U3 SSS1408-6P PMI
U4 HM7643-5 HARRIS
U6 SN7404N
U7 SN7404N
U8 NE555P
LM380N
-12VDC
+12VDC
+5VDC
RESET
TEST
ATTRACT MODE
TUNE
SOUND/TONES
S1
S2
S3
S4
S8
SPARE
A6J1-1
A6J1-3
A6J1-4
A6J1-5
A6J1-6
A6J1-7
A6J1-8
A6J1-9
A6J1-10
A6J1-11
A6J1-12
C1 C2 C3 C4 C5 C6 C8 C9 C10 C12 C14 C15 C16 C17 C19
R1 R2 R3 R4 R5 R6 R8 R9 R10 R11 R12 R13
CR1 CR2 CR3 CR4 CR5 CR6
IN4742A 12v.,1W.,5%
IN270

SYSTEM 80 SOUND CIRCUITRY

When the System 80 Sound/Speech Board is to be replaced by the Sound Board, the System 80's circuitry must be altered in the following manner:

1. The Sound Speech Board is removed from its connector A6J1.

2. The Sound Board (A6) is then installed in the same connector (A6J1) vacated by the sound/speech board in step one.

3. The Sound/Speech Power Supply Board, A7, is removed from its connector, A12J3.

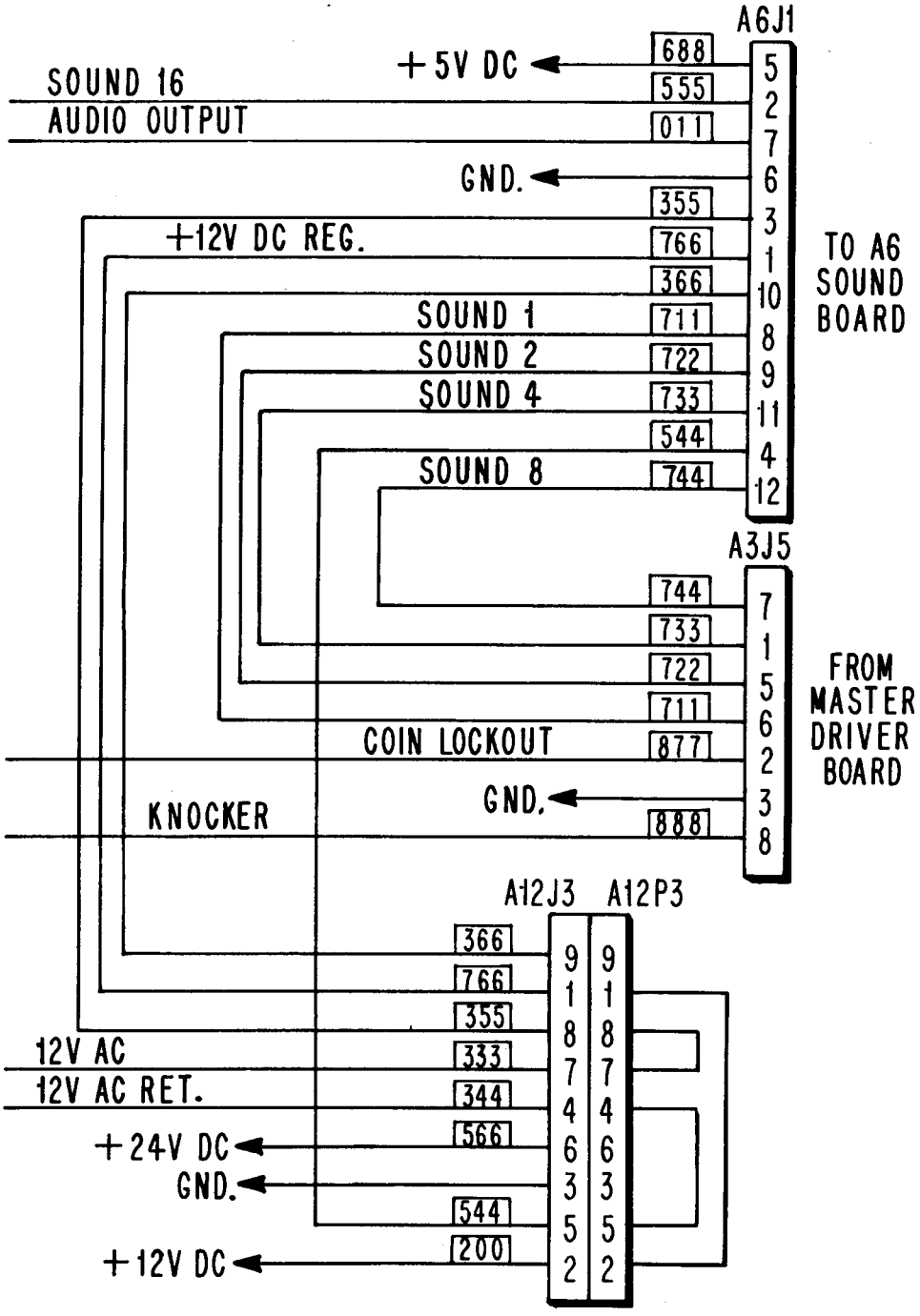
4. The female connector A12J3, and its male connector A12P3, are then connected.

   In doing so 12VDC, 12VAC and a return for the 12VAC return will be available for use by the Sound Board.

5. Once this procedure has been completed power can be safely applied to the game and the Sound Board.

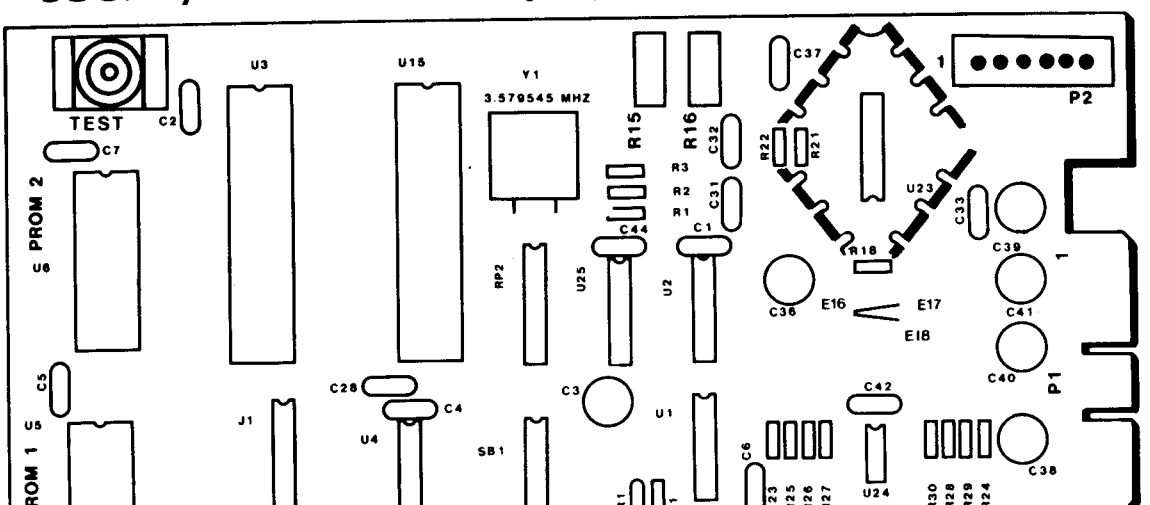
WARNING:

THESE BOARDS ARE NOT INTERCHANGEABLE. INSTALLING ONE OF THESE BOARDS IN A GAME WHICH DOES NOT HAVE THE PROPER CIRCUITRY WILL SEVERELY DAMAGE THAT BOARD.


A6J1
+5V DC
688
SOUND 16
AUDIO OUTPUT
555
011
GND.
355
+12V DC REG.
766
366
SOUND 1
711
SOUND 2
722
SOUND 4
733
544
SOUND 8
744
5 2 7 6 3 1 10 8 9 11 4 12
TO A6 SOUND BOARD
A3J5
744
733
722
711
COIN LOCKOUT
877
GND.
KNOCKER
888
7 1 5 6 2 3 8
FROM MASTER DRIVER BOARD
A12J3
A12P3
366
766
355
12V AC
333
12V AC RET.
344
+24V DC
566
GND.
544
+12V DC
200
9 1 8 7 4 6 3 5 2
9 1 8 7 4 6 3 5 2

X. WIRING AND SCHEMATIC DIAGRAMS, PARTS LISTS

SOUND/SPEECH BOARD (A6) COMPONENT LOCATION

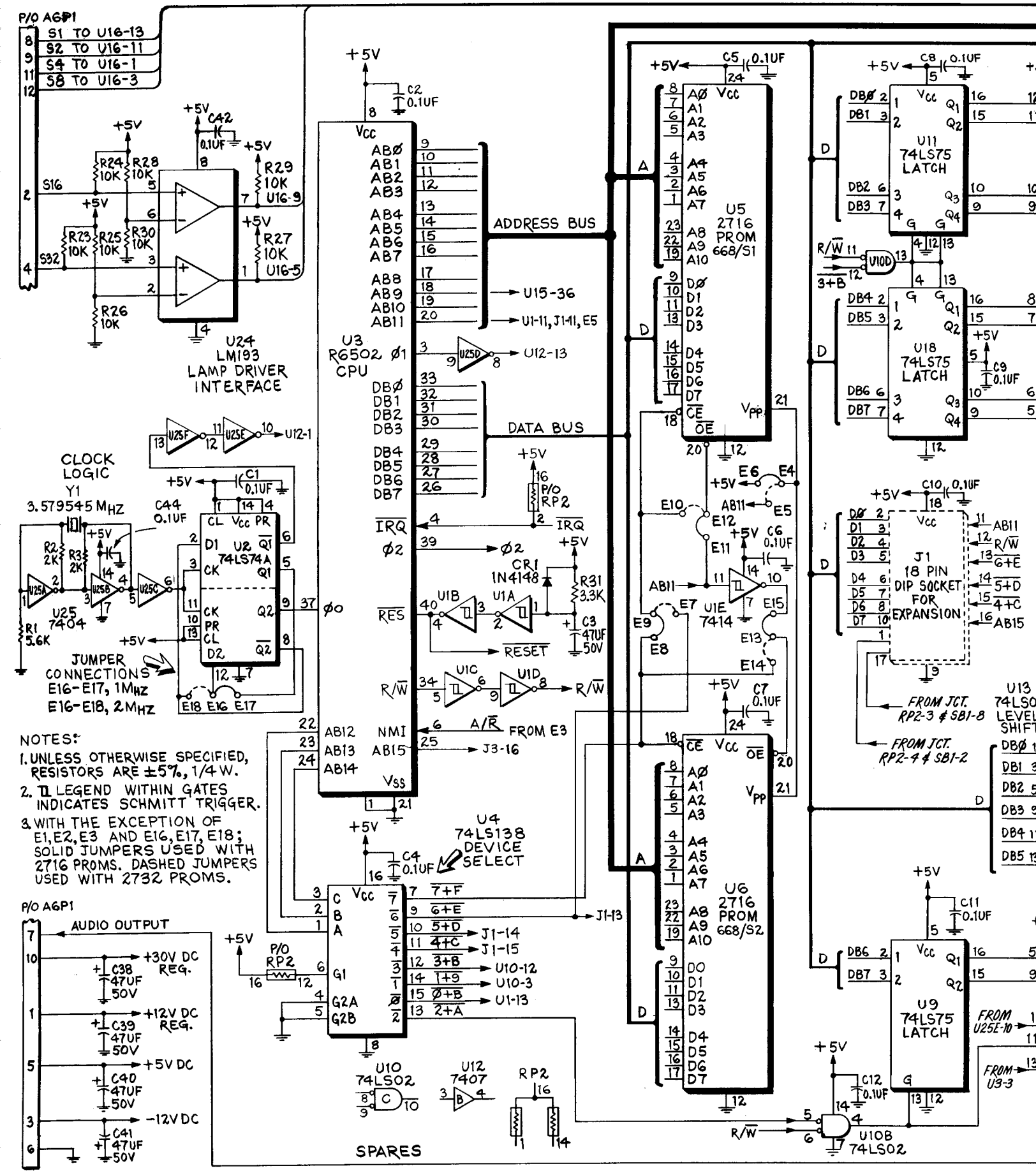


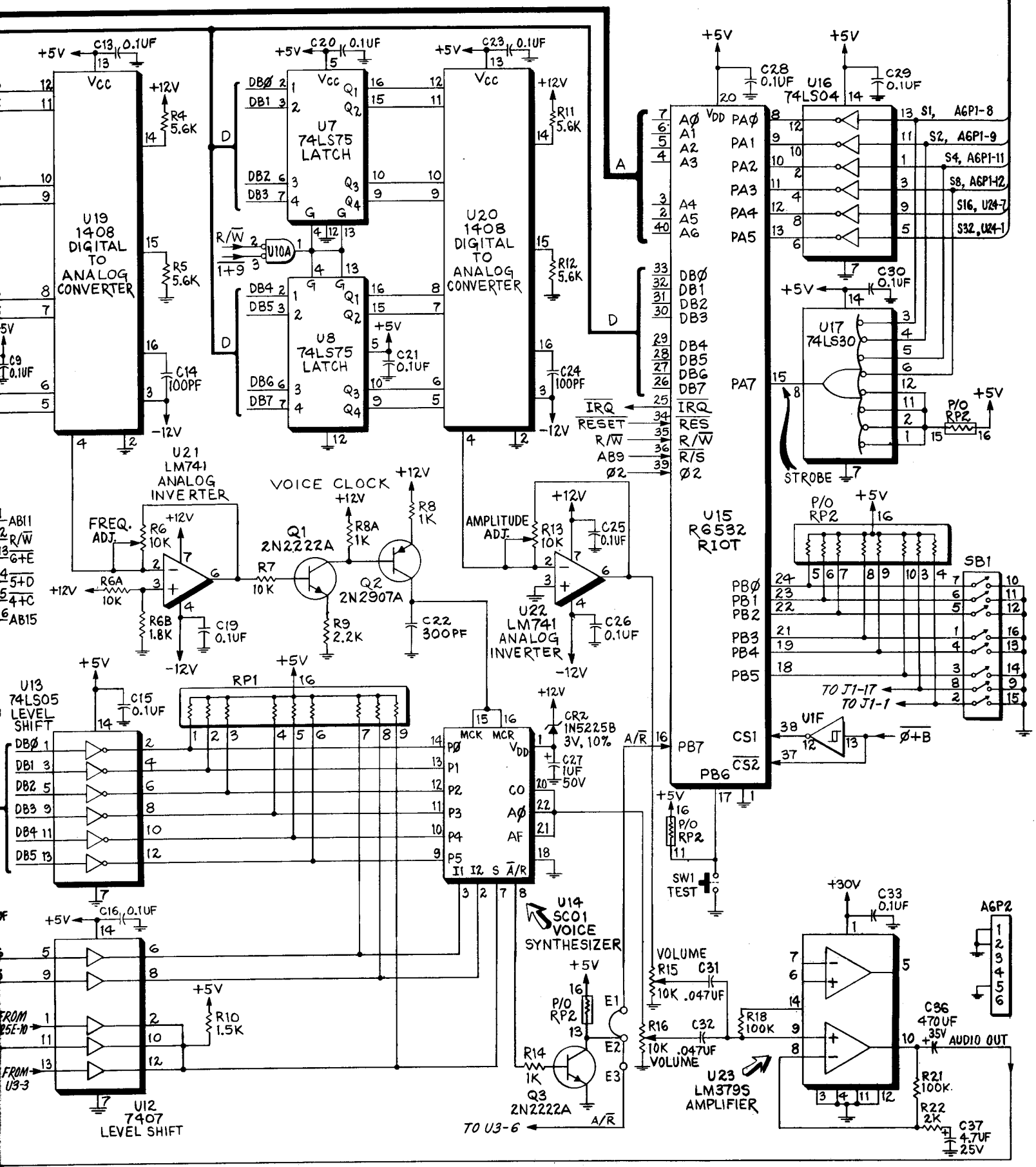
SOUND/SPEECH BOARD (A6) PARTS LIST

REFERENCE	DESCRIPTION	PART NUMBER
C1, C2, C4-C13, C15, C16, C21, C23, C25, C26, C28,	Capacitor, .1 UF 25V, CMD	
C31-C32 C42, C44	Capacitor, 0.05 MF, 25V, CMD	
C37	Capacitor, 4.7 MF, 25V Tantalum	
C3, C38-C41	Capacitor, 47 MF, 50V	
C14, C24	Capacitor, 100 PF, 250V, 20%	
C22	Capacitor, 300 PF, CMD	
C27	Capacitor, 1 UF, 50V, TNT	
C36	Capacitor, 470 MF, 35V	
CR1	Diode	1N4148
CR2	Diode, Zener	1N5225B
Q1, Q3	Transistor, NPN	2N2222A
Q2	Transistor, PNP	2N2907A
R1, R4, R5, R11, R12	Resistor, 5.6K ohm, 1/4W	
R2, R3	Resistor, 2K ohm, 1/4W, 5%	
R6, R13	Potentiometer, 10K, Bourns	3006-103
R7	Resistor, 10K ohm, 1/4W, 5%	
R8, R14	Resistor, 1K ohm, 1/4W, 5%	
R9	2.2K ohm, 5%, 1/4W	
R10	Resistor, 1.5K ohm, 1/4W, 5%	
R15, R16	Potentiometer, 10K, CTS	X201R
R18, R21	Resistor, 100K ohm, 1/4W	

REFERENCE	DESCRIPTION	PART NUMBER
R22	Resistor, 2K ohm, 1/4W, 5%	
R23-R30	Resistor, 10K ohm, 1/4W	
R31	Resistor, 3.3K ohm, 1/4W, 5%	
RP1, RP2	Resistor, Dip	4116R-002-222
SB1	Dip Switch	1008-692
SW1	Moment Pushbutton Switch	
U1	IC, Trigger	7414
U2	IC	SN74LS74N
U3	CPU	R6502-13
U4	IC	SN74LS138N
U5, U6	E Prom	2716
U7-U9, U11, U18	IC	SN74L75
U10	IC	SN74LS02N
U12	IC	SN7407N
U13	IC, Inverter	SN74LS05N
U14	Voice Chip	SC01
U15	RRIOT	R6532-18
U16	IC	SN74LS04N
U17	IC	SN74LS30N
U19, U20	Converter, PMI	1408A-6P
U21, U22	IC	LM741CP
U23	IC	LM379S
U24	IC, Dual Comparitor	LM193
U25	Inverter	7404
Y1	Crystal, 3.579545 MHZ	
	Socket 22 Pin Dip	
	Socket 24 Pin (2)	640361-3
	Socket 40 Pin (2)	640379-3

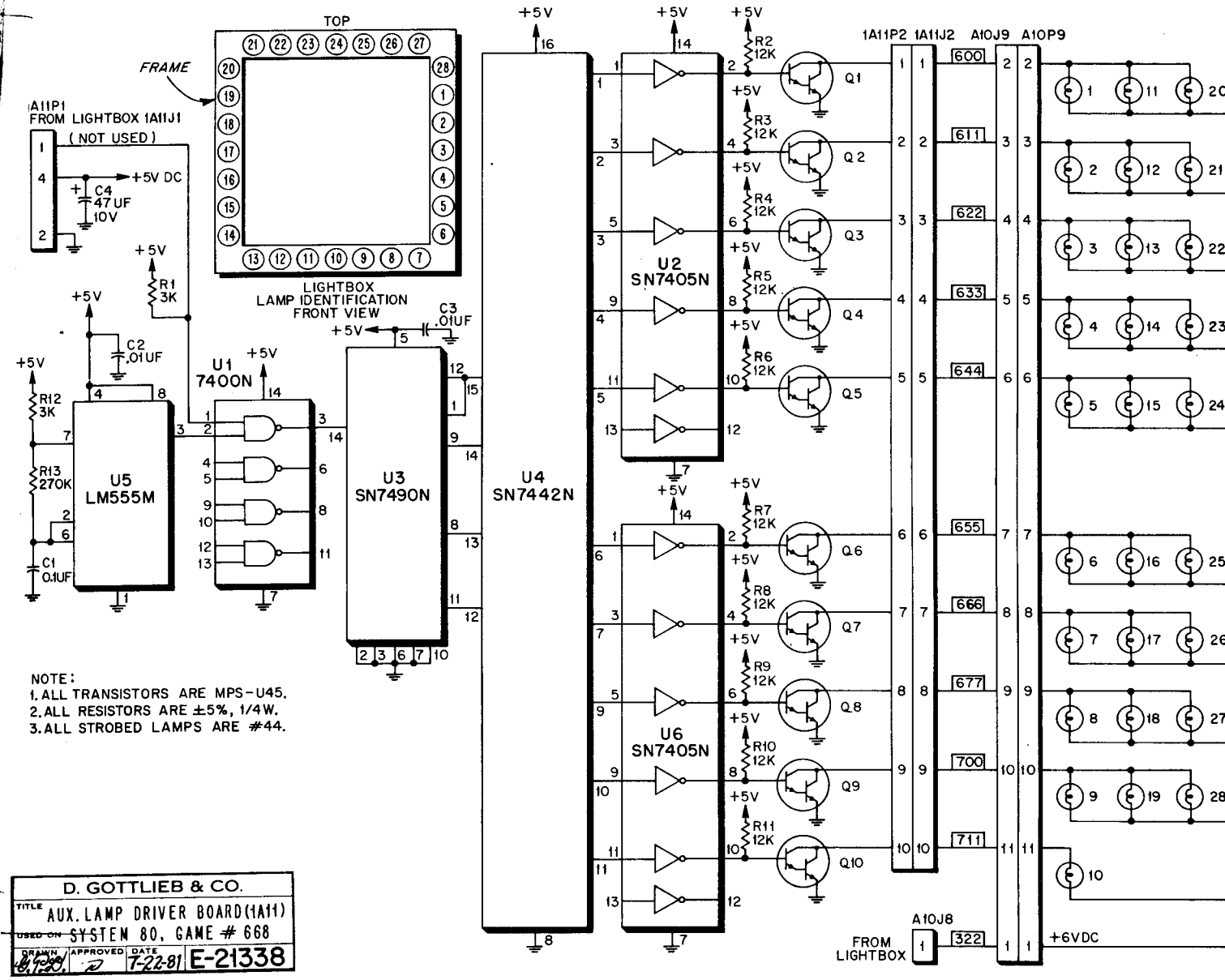
NOTE: The following components are mounted on the non-component side of the board:
R6A 10K ohm, R6B 1.8K ohm and R8A 1K ohm


P/O A6P1
S1 TO U16-13
S2 TO U16-11
S4 TO U16-1
S8 TO U16-3
U24 LM193 LAMP DRIVER INTERFACE
U3 R6502 CPU
ADDRESS BUS
DATA BUS
U5 2716 PROM 668/S1
U6 2716 PROM 668/S2
U11 74LS75 LATCH
U18 74LS75 LATCH
U9 74LS75 LATCH
J1 18 PIN DIP SOCKET FOR EXPANSION
CLOCK LOGIC
Y1 3.579545 MHZ
U25 7404
U2 74LS74A
JUMPER CONNECTIONS
E16-E17, 1MHZ
E16-E18, 2MHZ
U4 74LS138 DEVICE SELECT
U10 74LS02
U12 7407
RP2
U10B 74LS02
SPARES
AUDIO OUTPUT
+30V DC REG.
+12V DC REG.
+5V DC
-12V DC
FROM JCT. RP2-3 & SB1-8
FROM JCT. RP2-4 & SB1-2
FROM U25E-10
FROM U3-3
NOTES:
1. UNLESS OTHERWISE SPECIFIED, RESISTORS ARE ±5%, 1/4W.
2. ⊓ LEGEND WITHIN GATES INDICATES SCHMITT TRIGGER.
3. WITH THE EXCEPTION OF E1, E2, E3 AND E16, E17, E18; SOLID JUMPERS USED WITH 2716 PROMS. DASHED JUMPERS USED WITH 2732 PROMS.



D. GOTTLIEB & CO.	
TITLE	SOUND/SPEECH BOARD A6
USED ON	SYSTEM 80, GAME # 668
DRAWN	APPROVED
DATE	4-23-81
	E-21337

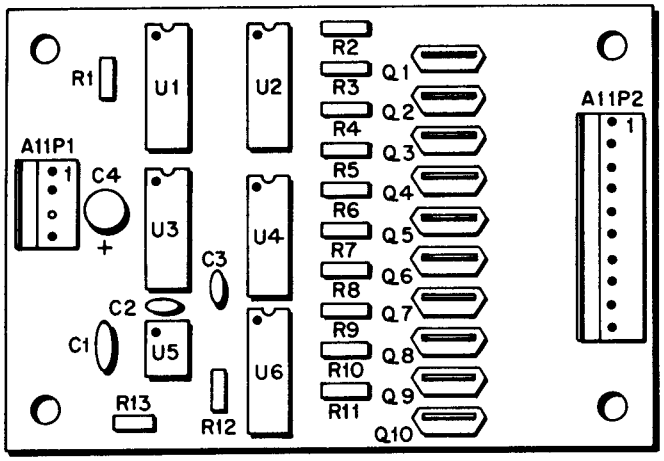
X. WIRING AND SCHEMATIC DIAGRAMS, PARTS LISTS



NOTE:
1. ALL TRANSISTORS ARE MPS-U45.
2. ALL RESISTORS ARE ±5%, 1/4W.
3. ALL STROBED LAMPS ARE #44.

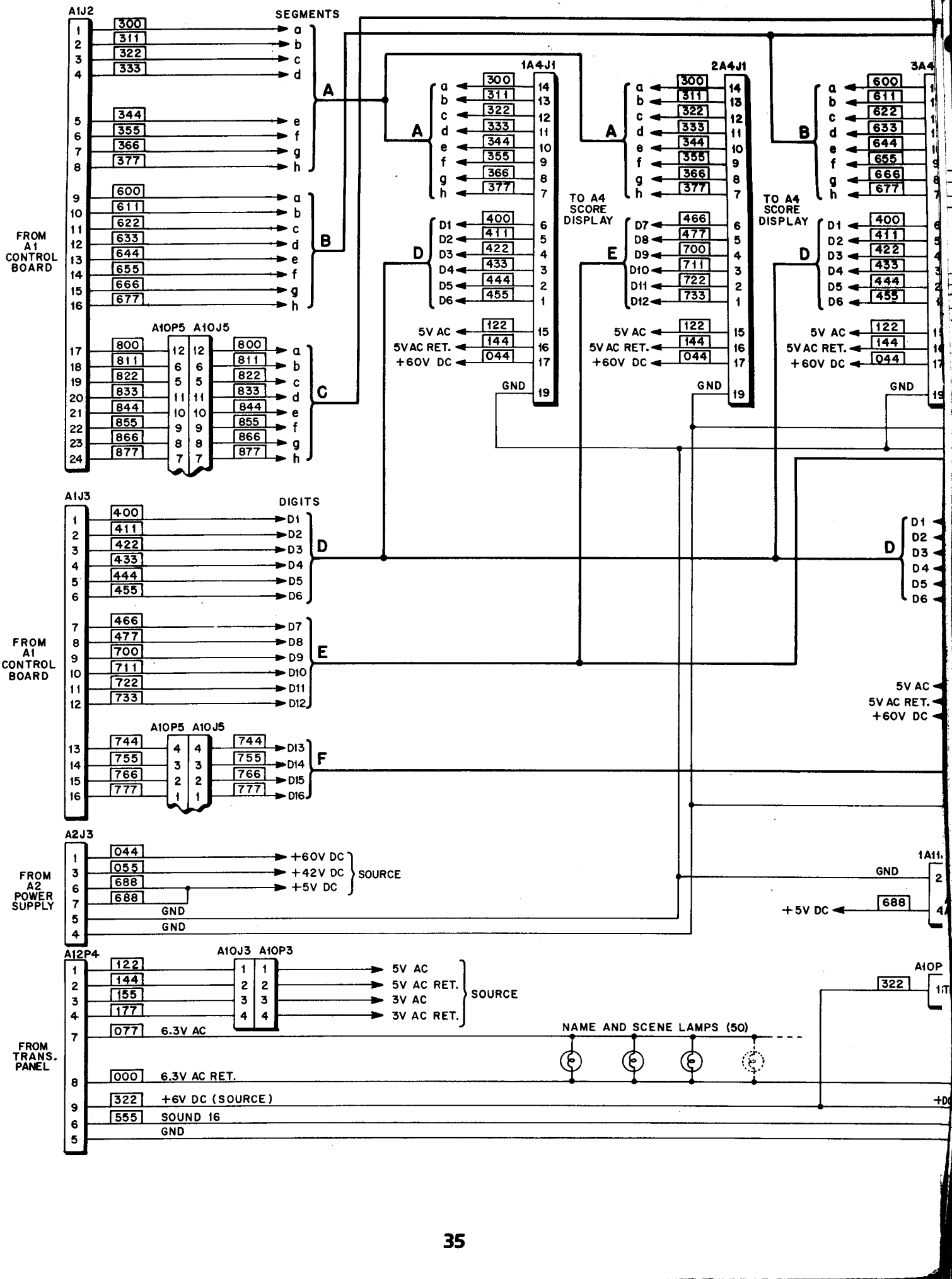
D. GOTTLIEB & CO.			
TITLE AUX. LAMP DRIVER BOARD (1A11)			
USED ON SYSTEM 80, GAME # 668			
DRAWN	APPROVED	DATE 7-22-81	E-21338

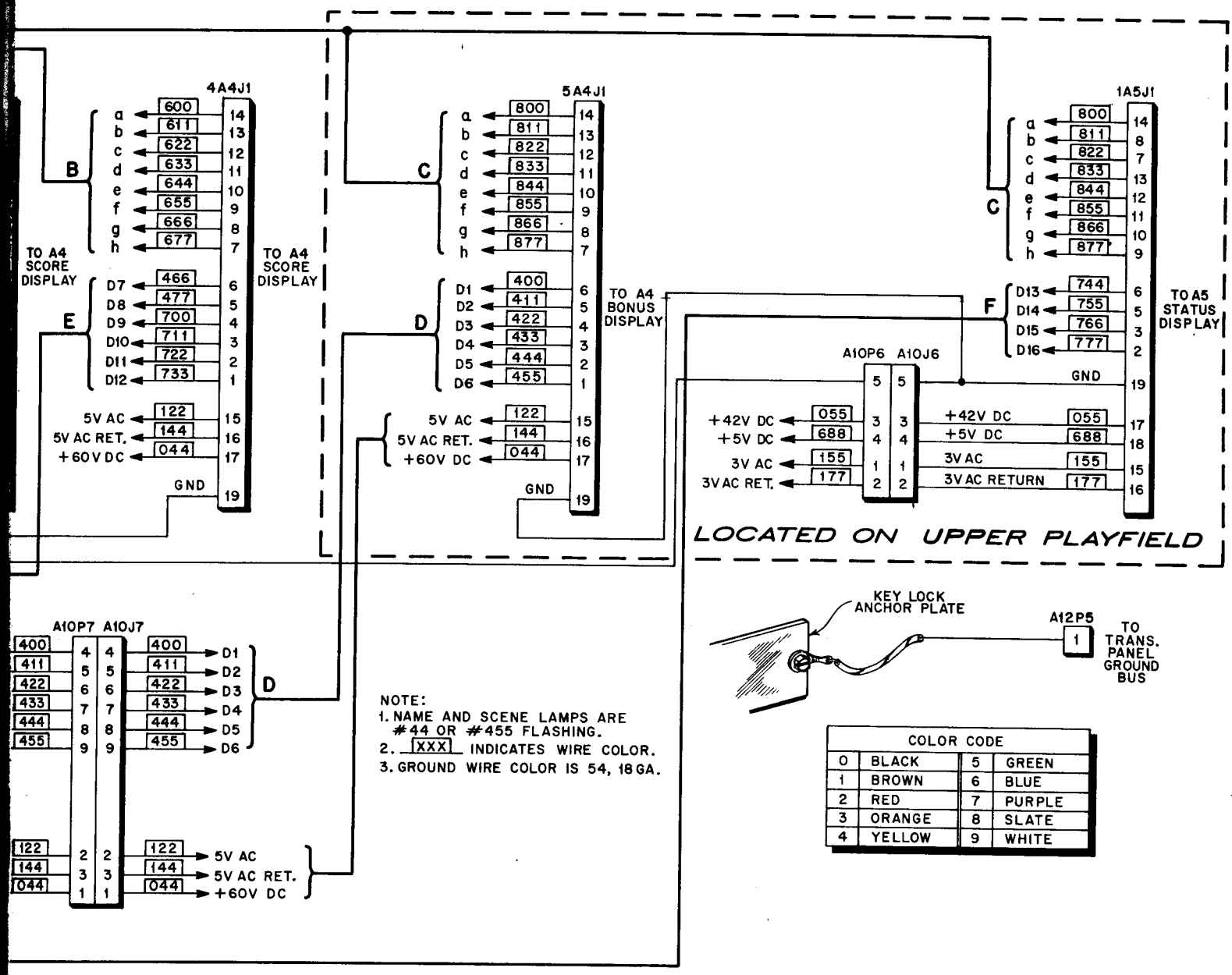
AUXILIARY LAMP DRIVER BOARD (A11) COMPONENT LOCATION

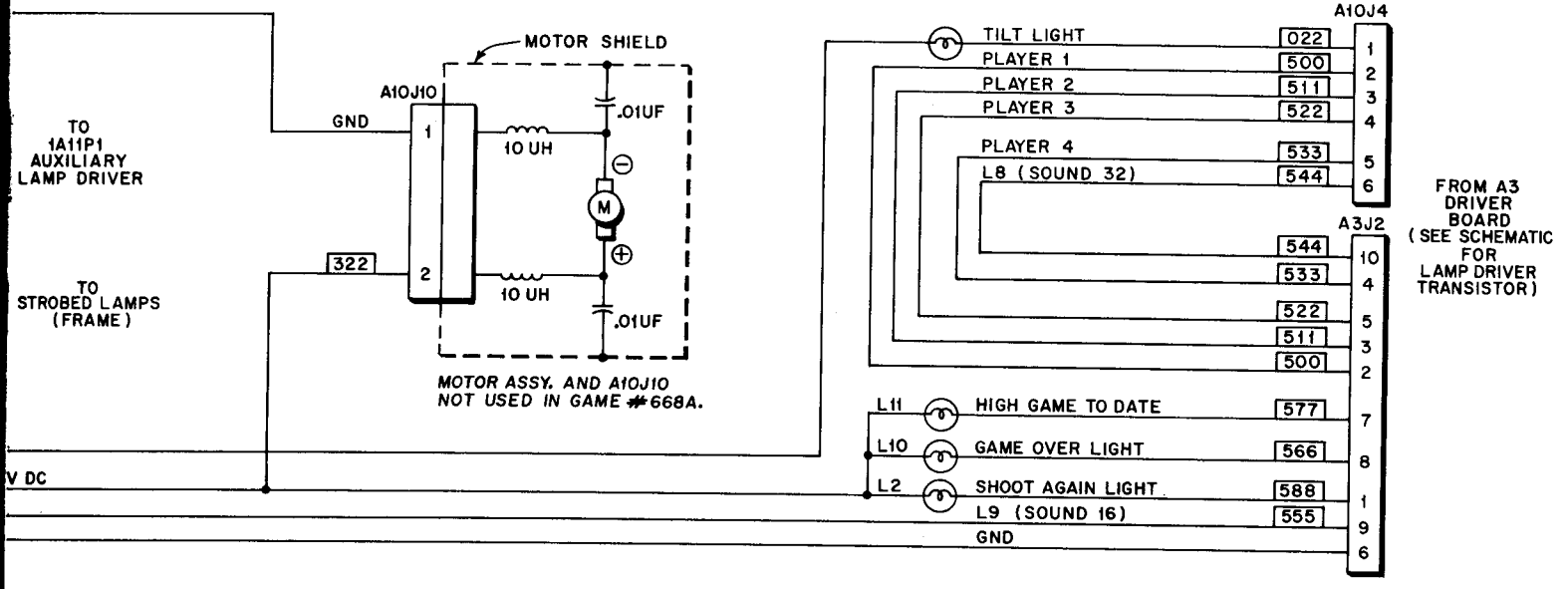


AUXILIARY LAMP DRIVER BOARD (A11) PARTS LIST

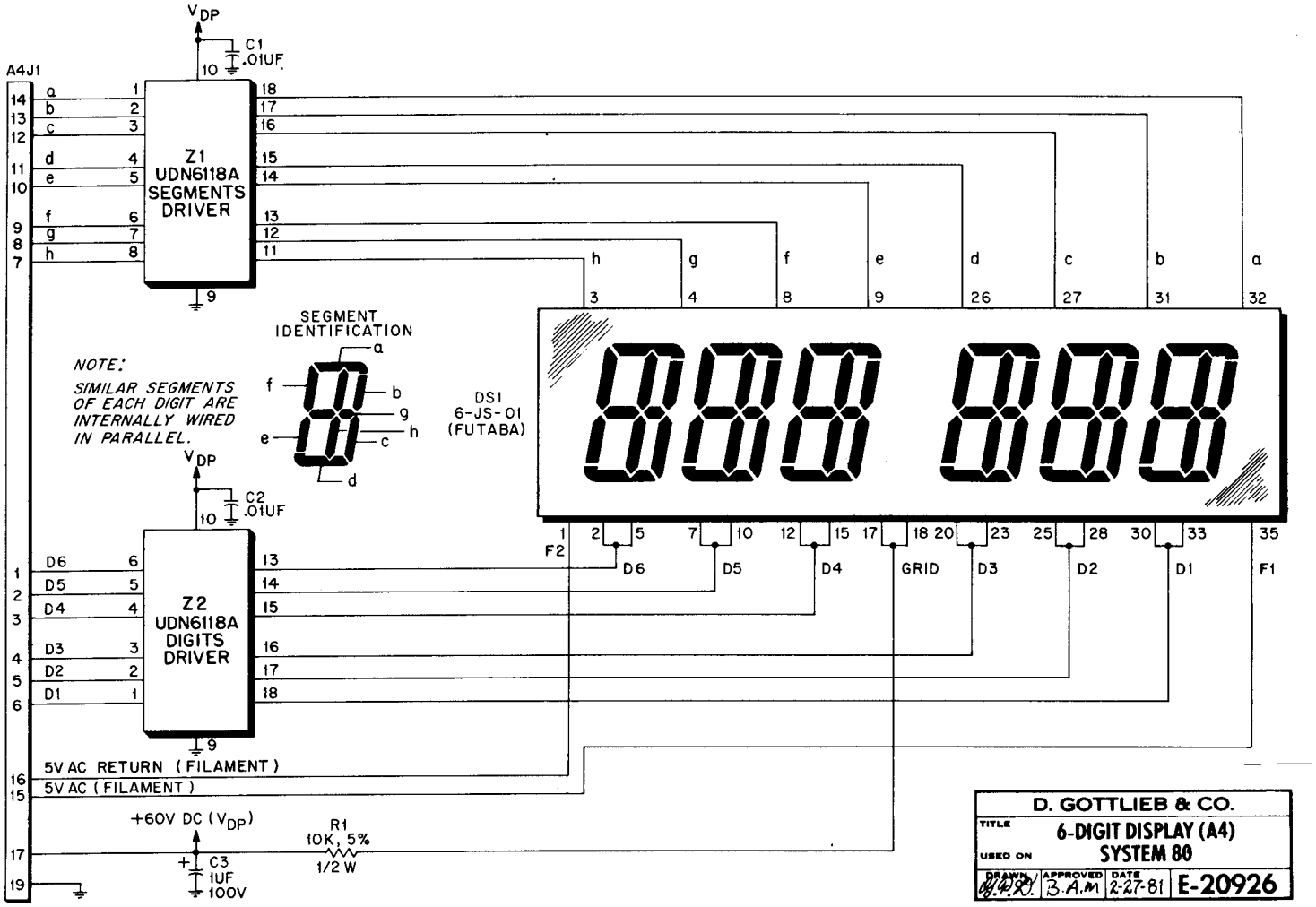
REFERENCE	DESCRIPTION	PART NUMBER
C1	CAPACITOR, .1 MFD, 100V CERAMIC RADIAL LEAD	
C2-C3	CAPACITOR, .01 MFD, 100V RADIAL LEAD	
C4	CAPACITOR, 47 MFD, 10V ELECTROLYTIC RADIAL LEAD	
Q1-Q10	TRANSISTOR, NPN DARLINGTON	MPS-U45
R1, R12	RESISTOR, 3K OHM, 5%, 1/4 W	
R2-R11	RESISTOR, 12K OHM, 5%, 1/4 W	
R13	RESISTOR, 270K 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	10 POS. SQUARE WIRE FRICTION LOCK CONNECTOR	
P1	4 POS. SQUARE WIRE FRICTION LOCK CONNECTOR	


A1J2
SEGMENTS
FROM A1 CONTROL BOARD
A10P5 A10J5
A1J3
DIGITS
FROM A1 CONTROL BOARD
A2J3
FROM A2 POWER SUPPLY
+60V DC
+42V DC
+5V DC
SOURCE
GND
A12P4
A10J3 A10P3
5V AC
5V AC RET.
3V AC
3V AC RET.
SOURCE
FROM TRANS. PANEL
6.3V AC
6.3V AC RET.
+6V DC (SOURCE)
SOUND 16
GND
NAME AND SCENE LAMPS (50)
1A4J1
2A4J1
3A4
TO A4 SCORE DISPLAY
TO A4 SCORE DISPLAY
5V AC
5V AC RET.
+60V DC
GND
1A11
A10P

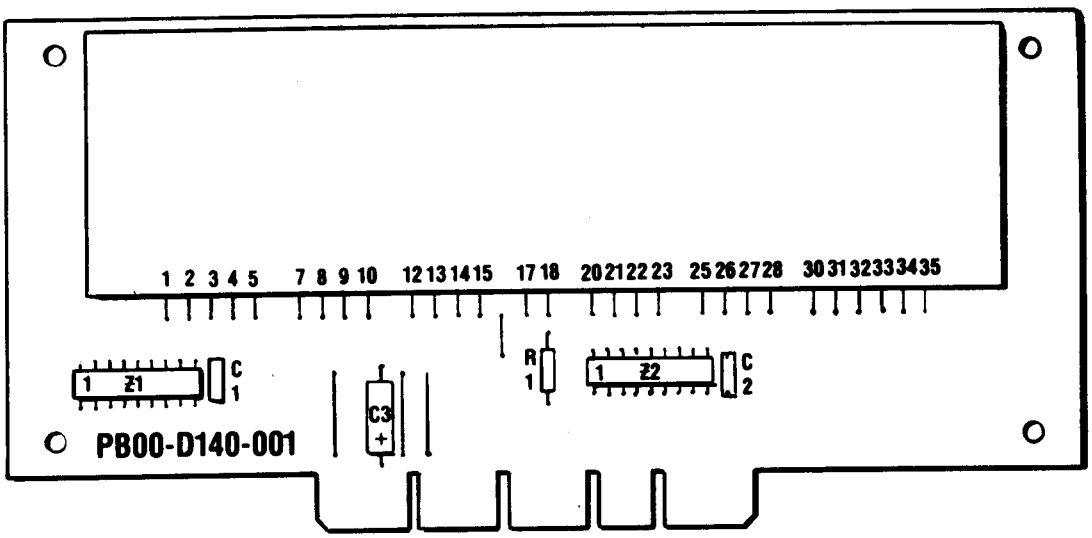




D. GOTTLIEB & CO.
TITLE LIGHTBOX SCHEMATIC DIAGRAM
USED ON SYSTEM 80, GAME # 668
DRAWN APPROVED DATE 8-4-81 E-21339

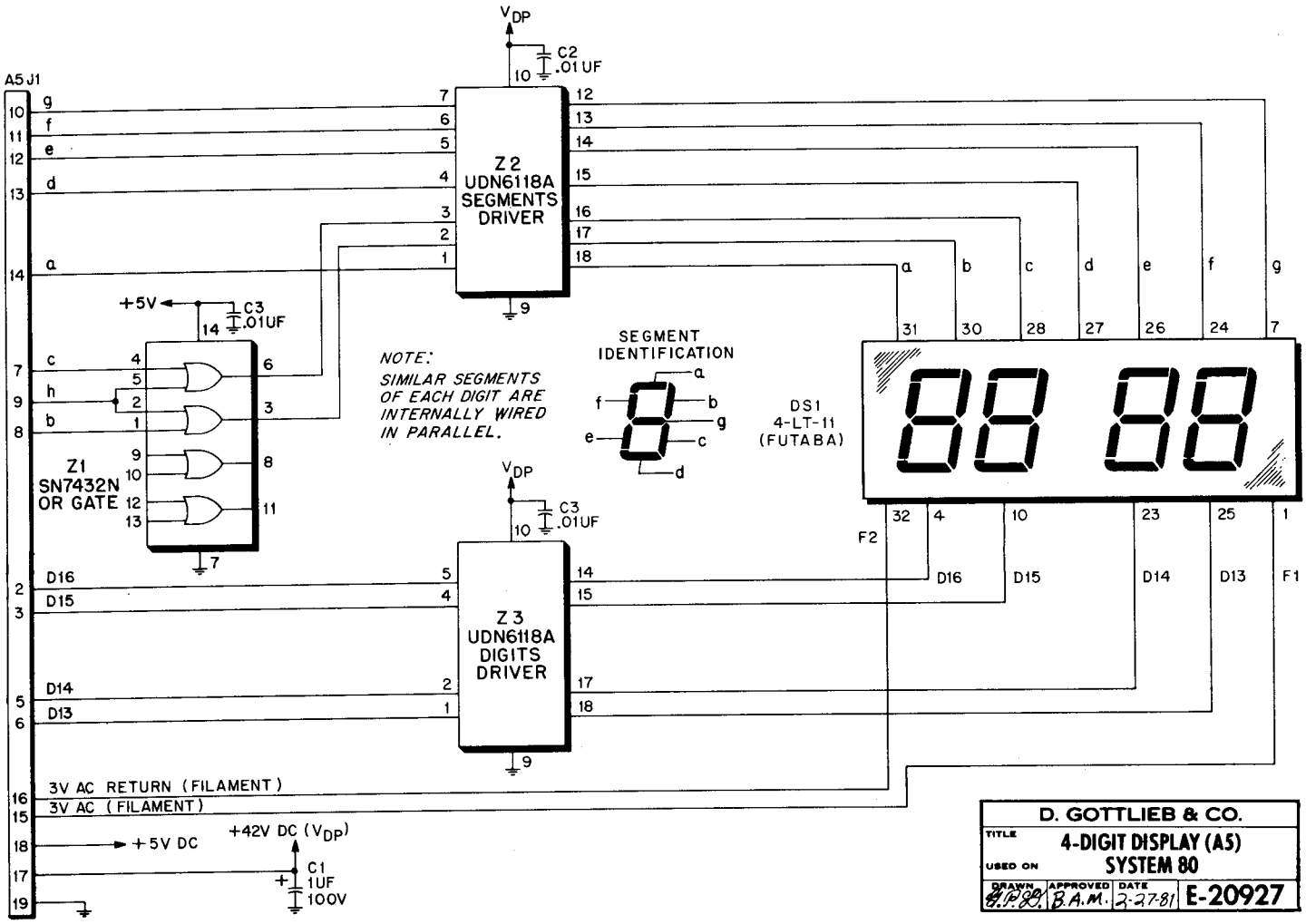


6-DIGIT DISPLAY (A4) COMPONENT LOCATION

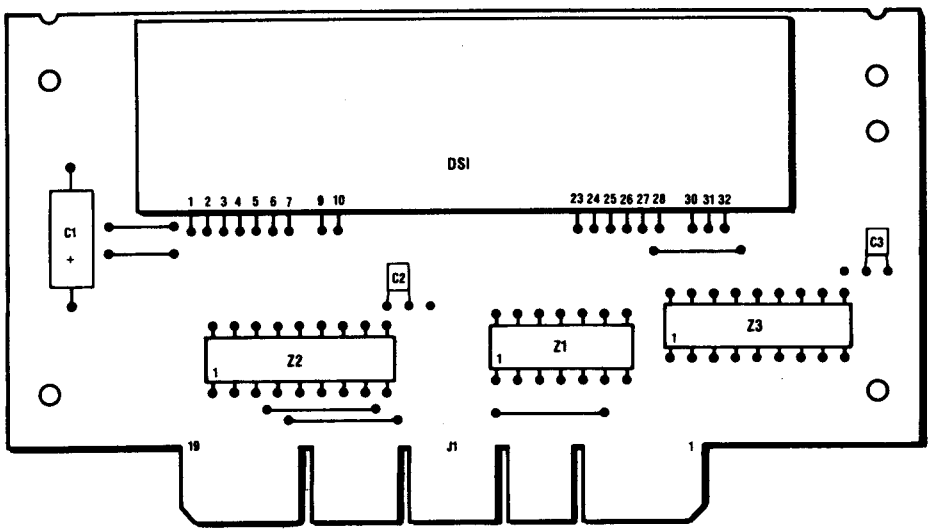


6-DIGIT DISPLAY (A4) PARTS LIST

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



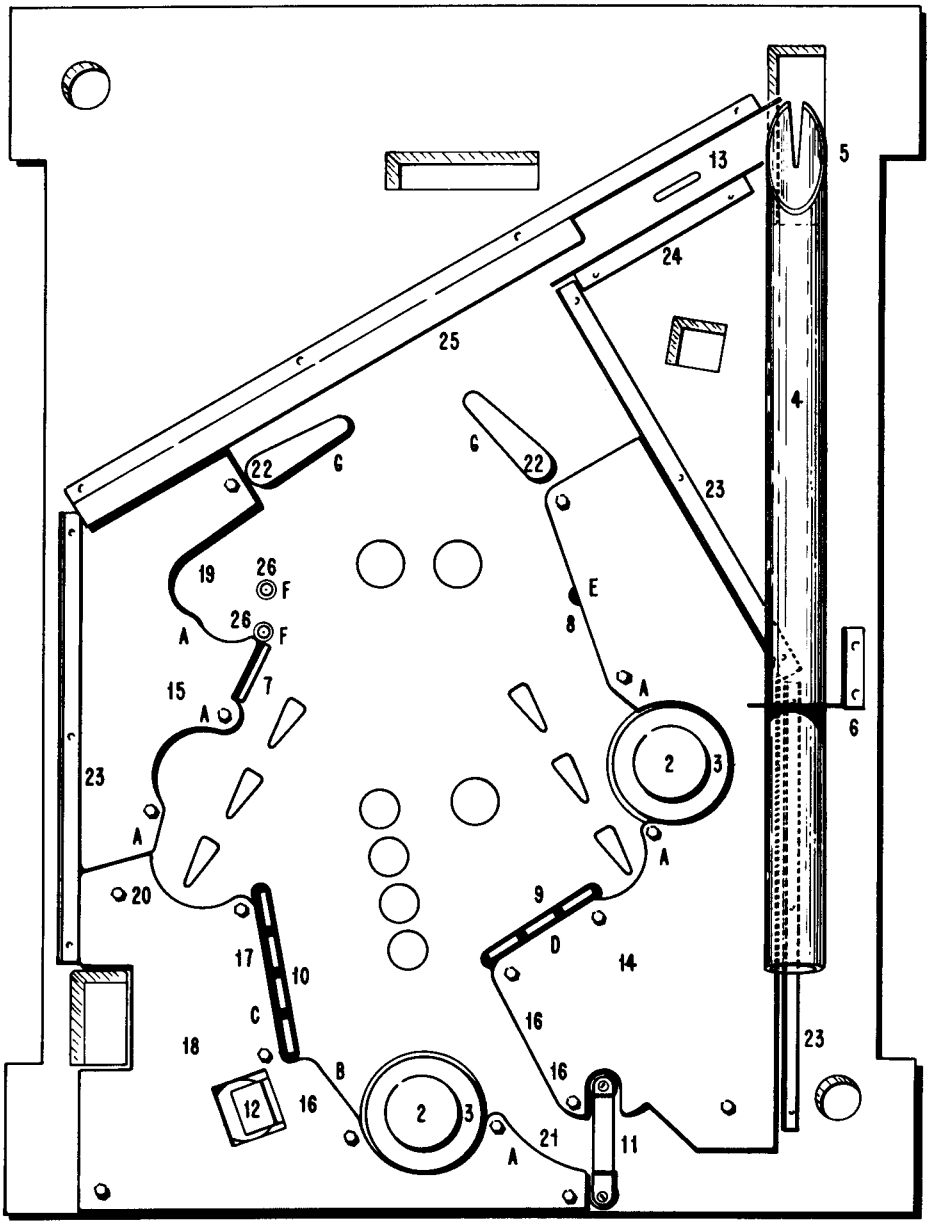
4-DIGIT DISPLAY (A5) COMPONENT LOCATION



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 SCHEMATIC DIAGRAMS, PARTS LIST



PLAYBOARD INFORMATION

BOTTOM PLAYBOARD

RUBBER RINGS

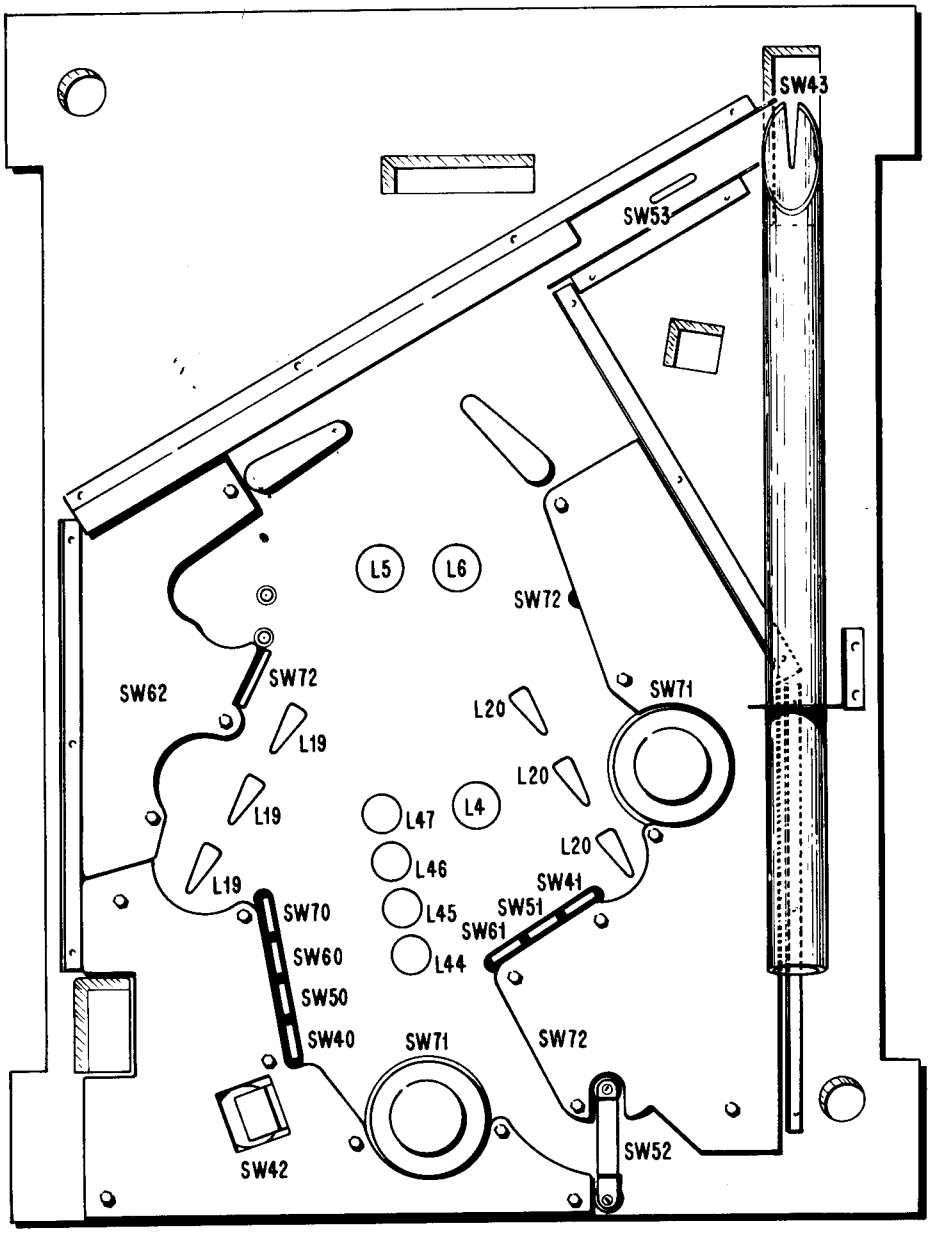
A	A-10217	(6)
B	A-10220	(1)
C	A-10221	(1)
D	A-10223	(1)
E	A-10224	(1)
F	A-15705	(2)
G	A-13151	(2)

PART LIST

1. D-21304 Plastic Set
2. Blue Pop Bumper D-10435 & A-21298 in Black (2)
3. C-10433 Blue Pop Bumper Skirt (2)
4. B-21179 Tube
5. B-21178 Kicker Unit
6. C-21180 Tube Support Bracket
7. A-21039 Kicking Target
8. A-15836 Kicking Rubber
9. A-13179 White Drop Target in Gold
10. A-13179 Yellow Drop Target in Gold
11. A-9869 Gate Shield (USE A-4706 WIREFORM)
12. A-21159 Ball Snubber
13. C-21222 Ball Return Unit
14. B-21163 Ball Guide Rail
15. A-21162 Ball Guide Rail
16. A-18070 Ball Guide Rail (3)
17. A-17106 Ball Guide Rail
18. A-8514 Ball Guide Rail
19. B-21153 Metal Flat Rail
20. B-21152 Metal Flat Rail
21. B-21154 Metal Flat Rail
22. C-13150 White Jumbo Flipper
23. B-21155 Guard Rail (3)
24. B-21156 Guard Rail
25. D-21157 Guard Rail
26. A-14792 Mini Post Screw (2)

C-11561 1" High Post (23)
C-11562 1 3/16" High Post (3)

X. WIRING AND SCHEMATIC DIAGRAMS, PARTS LIST

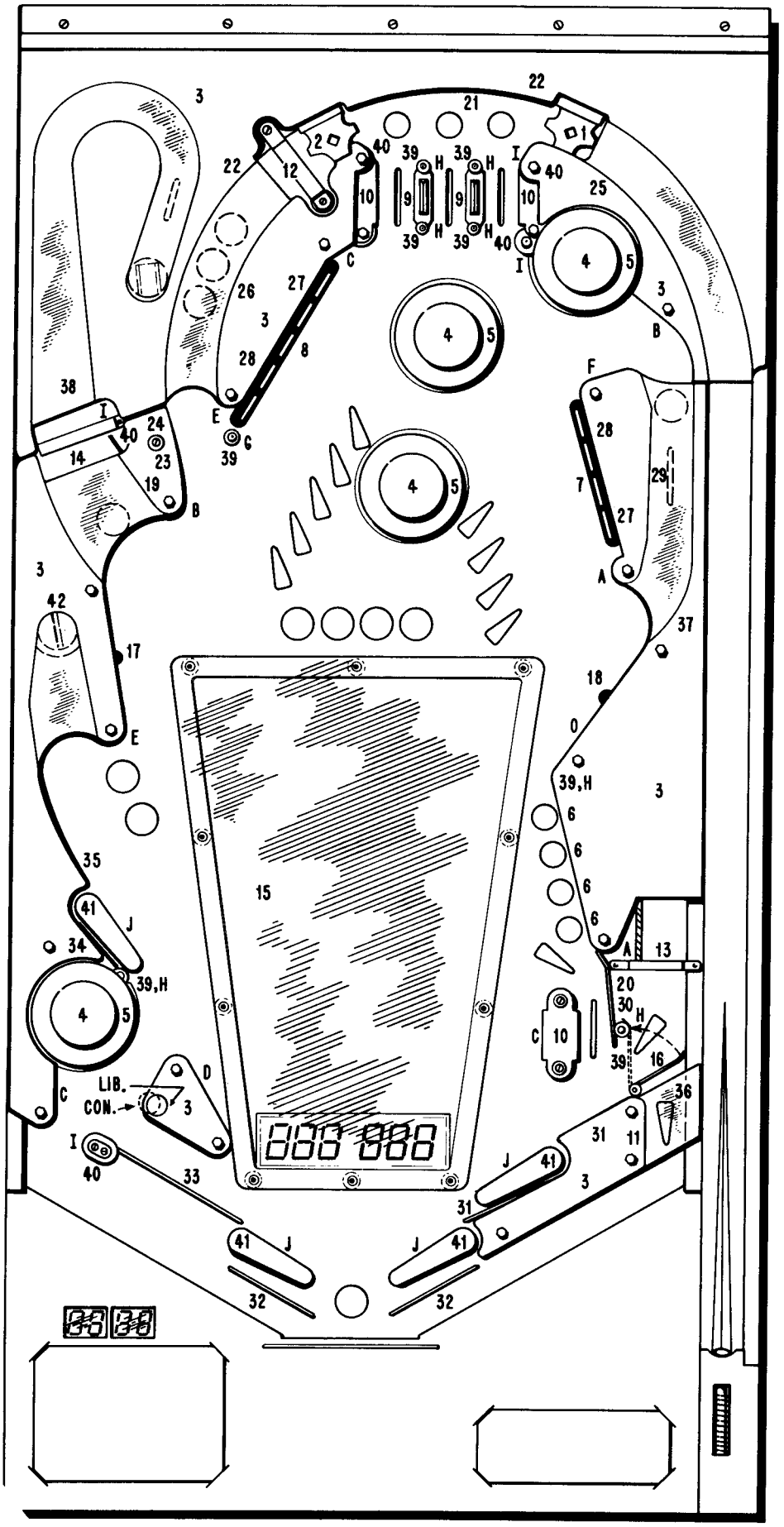


PLAYBOARD SWITCH AND LAMP ASSIGNMENTS

BOTTOM PLAYBOARD

SWITCH MATRIX NUMBER	SWITCH ASSIGNMENT
40	Left #1 Drop Target
41	Right #1 Drop Target
42	Hole Kicker Switch
43	Ball Tube Kicker Switch
50	Left #2 Drop Target
51	Right #2 Drop Target
52	Rollunder Gate
53	Track Switch
60	Left #3 Drop Target
61	Right #3 Drop Target
62	Return Rollover
70	Left #4 Drop Target
71	Lower Level Pop Bumpers
72	10 Point Switches and Kicking Targets

LAMP NUMBER	LAMP ASSIGNMENT
L4	3 Pos. Bank Special Lower Playfield
L5	"+ 1X" Scoring (L) Lower Playfield
L6	"+ 1X" Scoring (R) Lower Playfield
L19	Hole Lights (Arrows) Lower Playfield
L20	Loop Lights (Arrows)
L44	#1 Drop Target Light Lower Playfield
L45	#2 Drop Target Light Lower Playfield
L46	#3 Drop Target Light Lower Playfield
L47	#4 Drop Target Light Lower Playfield



PLAYBOARD INFORMATION

TOP PLAYFIELD

RUBBER RINGS

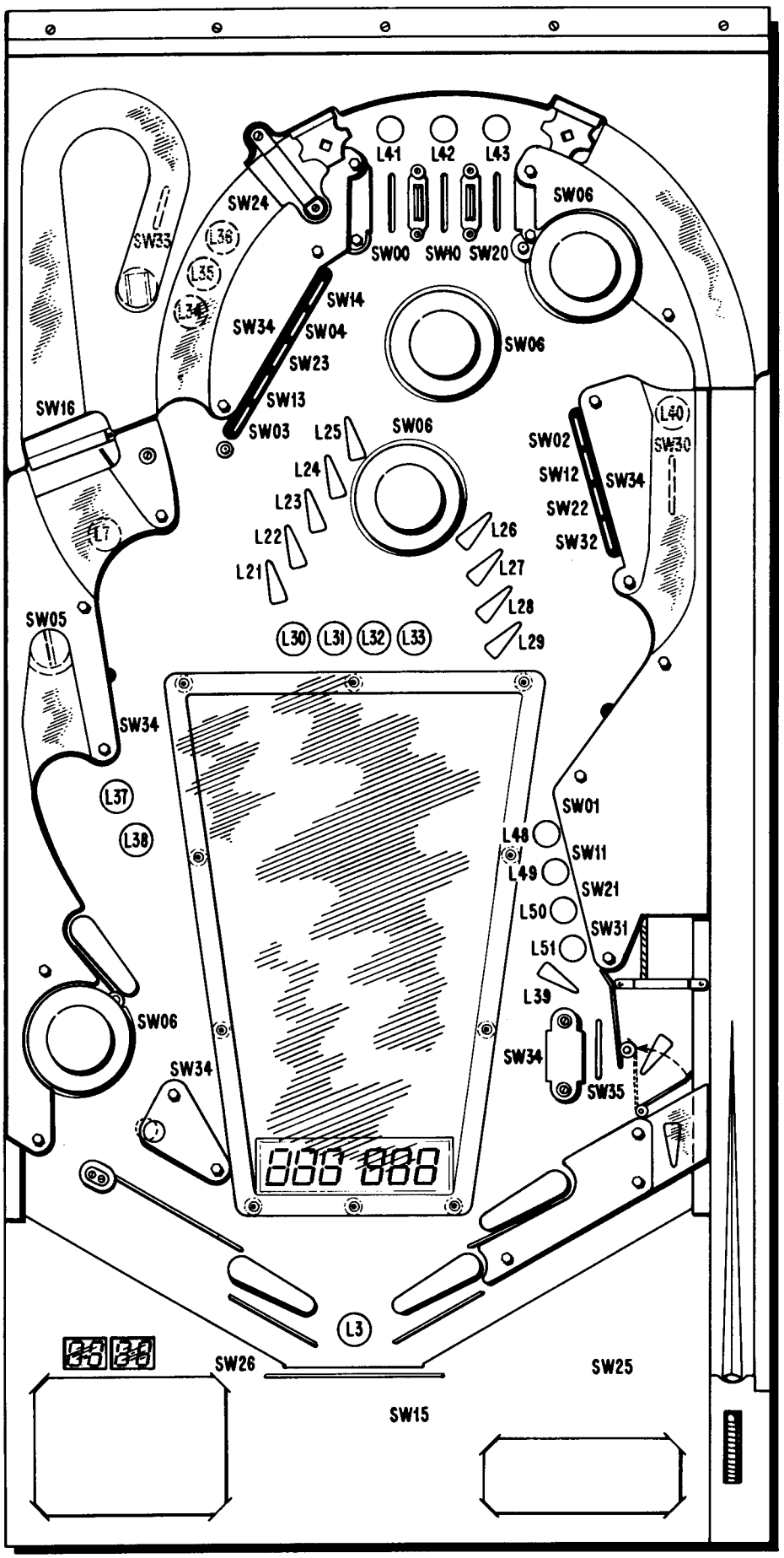
A	A-10217	(2)
B	A-10218	(2)
C	A-10219	(3)
D	A-10221	(2)
E	A-10222	(2)
F	A-10223	(1)
G	A-14793	(1)
H	A-15704	(7)
I	A-17493	(4)
J	A-13151	(4)

PARTS LIST

1. A-19645 Ball Gate Right
2. A-19646 Ball Gate Left
3. E-21229 Plastic Set
4. Blue Pop Bumper D-10435 and A-21298 Cap in Black (4)
5. C-10433 Blue Pop Bumper Skirt (4)
6. A-9374 Yellow Plastic Target (4)
7. Black Drop Target Bank - "Hole"
8. Black Drop Target Bank - "Black"
9. C-15647 Rollover Guide (2)
10. A-9395 2⅛" Guide Rail (3)
11. A-9393 1⅛" Guide Rail
12. A-4869 Rollunder Gate Shield (USE A-4706 WIREFORM)
13. A-17300 Gate Shield (USE A—17299 WIREFORM)
14. A-20388 Swinging Target
15. D-21140 Window
16. A-21160 Ball Return Gate
17. A-21366 Kicking Rubber
18. A-15836 Kicking Rubber
19. A-21158 Ball Deflecter
20. A-20645 Plastic Tubing
21. D-21166 Top Arch Rod
22. B-19875 Arm Rod Support Post (2)
23. B-19873 Top Arch End Post
24. B-19874 Top Arch End Cap
25. B-21165 Ball Guide Rail
26. B-21164 Ball Guide Rail
27. A-18070 Ball Guide Rail (2)
28. A-17650 Ball Guide Rail (2)
29. A-4832 Ball Guide Rail
30. A-14686 Ball Guide Rail
31. A-17106 Ball Guide Rail (2)
32. A-13798 Ball Snubber (2)
33. A-18563 Ball Guide Rail
34. A-6612 Ball Guide Rail
35. C-21149 Metal Flat Rail
36. A-8688 Metal Flat Rail
37. B-21150 Metal Flat Rail
38. C-21151 Metal Flat Rail
39. A-14792 Mini-Post (8)
40. C-17492 White Siamese Post (5)
41. C-13150 White Jumbo Flipper (4)
42. A-16038 Ball Snubber

TOP

C-11561 1" High Post (29)
C-11562 1 3/16" High Post (4)
A-14487 Split Post Base (3)
A-14488 Split Post Cap (3)



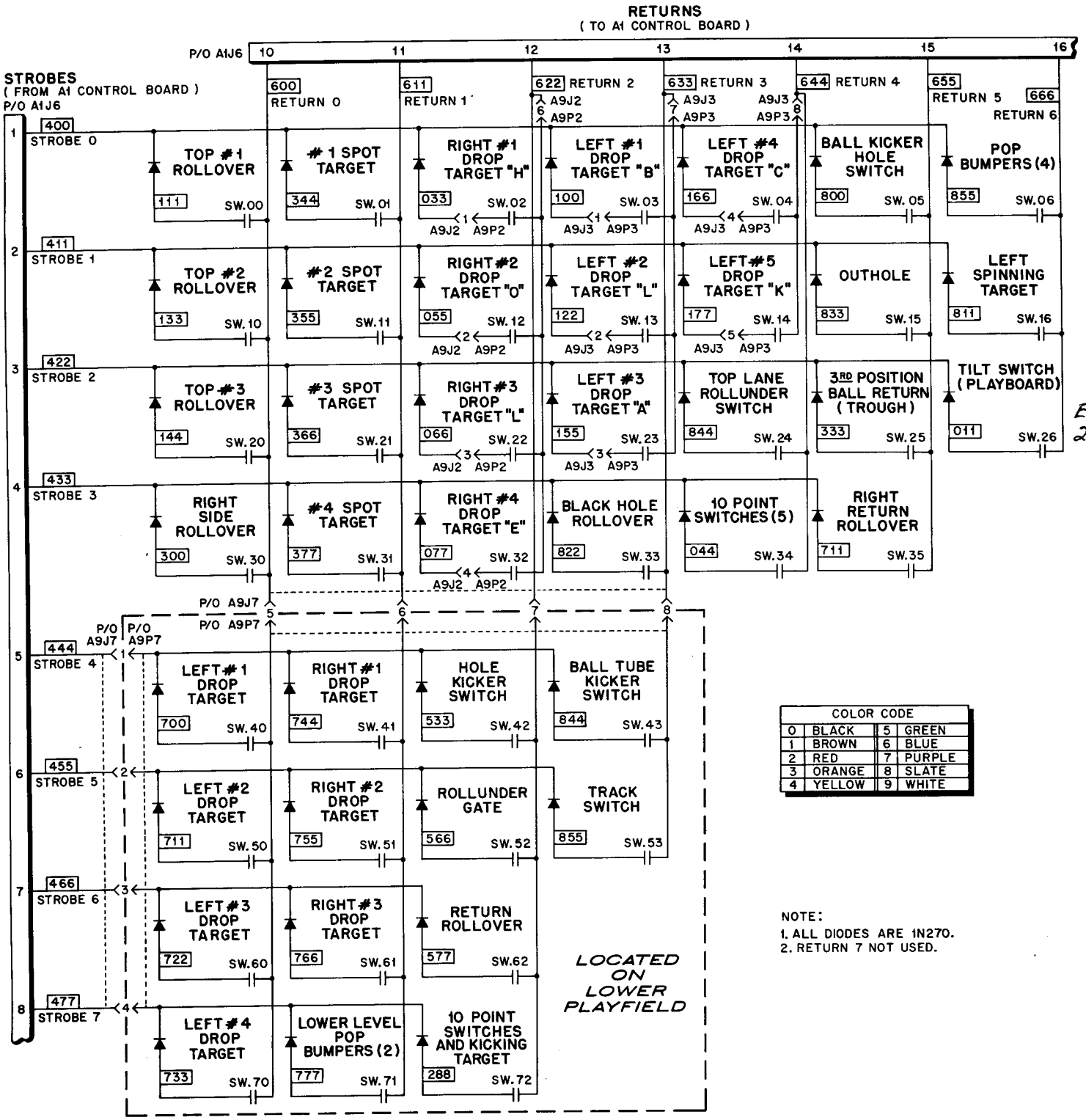
PLAYBOARD SWITCH AND LAMP ASSIGNMENTS

TOP PLAYFIELD

SWITCH MATRIX NUMBER	SWITCH ASSIGNMENT
00	Top #1 Rollover
01	#1 Spot Target
02	Right #1 Drop Target "H"
03	Left #1 Drop Target "B"
04	Left #4 Drop Target "C"
05	Ball Kicker Hole Switch
06	Pop Bumpers 4
10	Top #2 Rollover
11	#2 Spot Target
12	Right #2 Drop Target "O"
13	Left #2 Drop Target "L"
14	Left #5 Drop Target "K"
15	Outhole
16	Left Spinning Target
20	Top #3 Rollover
21	#3 Spot Target
22	Right #3 Drop Target "L"
23	Left #3 Drop Target "A"
24	Top Lane Rollunder Switch
25	3rd Position Ball Return (Trough)
26	Tilt Switch Playboard
30	Right Side Rollover
31	#4 Spot Target
32	Right #4 Drop Target "E"
33	Black Hole Rollover
34	10 Point Switches (5)
35	Right Return Rollover

LAMP NUMBER	LAMP ASSIGNMENT
L3	Shoot Again
L7	Left Spinning Target
L21	"B" Drop Target Light
L22	"L" Drop Target Light
L23	"A" Drop Target Light
L24	"C" Drop Target Light
L25	"K" Drop Target Light
L26	"H" Drop Target Light
L27	"O" Drop Target Light
L28	"L" Drop Target Light
L29	"E" Drop Target Light
L30	2X Multiplier
L31	3X Multiplier
L32	4X Multiplier
L33	5X Multiplier
L34	Top Lane Top Lane X1 (10,000)
L35	Top Lane #2 (Extra Ball)
L36	Top Lane #3 (Special)
L37	Top Hole #1 (Captive)
L38	Top Hole #2 (Extra Ball)
L39	Right Return Rollover
L40	Right Side Rollover
L41	#1 Top Rollover
L42	#2 Top Rollover
L43	#3 Top Rollover
L48	#1 Spot Target Light
L49	#2 Spot Target Light
L50	#3 Spot Target Light
L51	#4 Spot Target Light

X. WIRING AND SCHEMATIC DIAGRAMS, PARTS LISTS



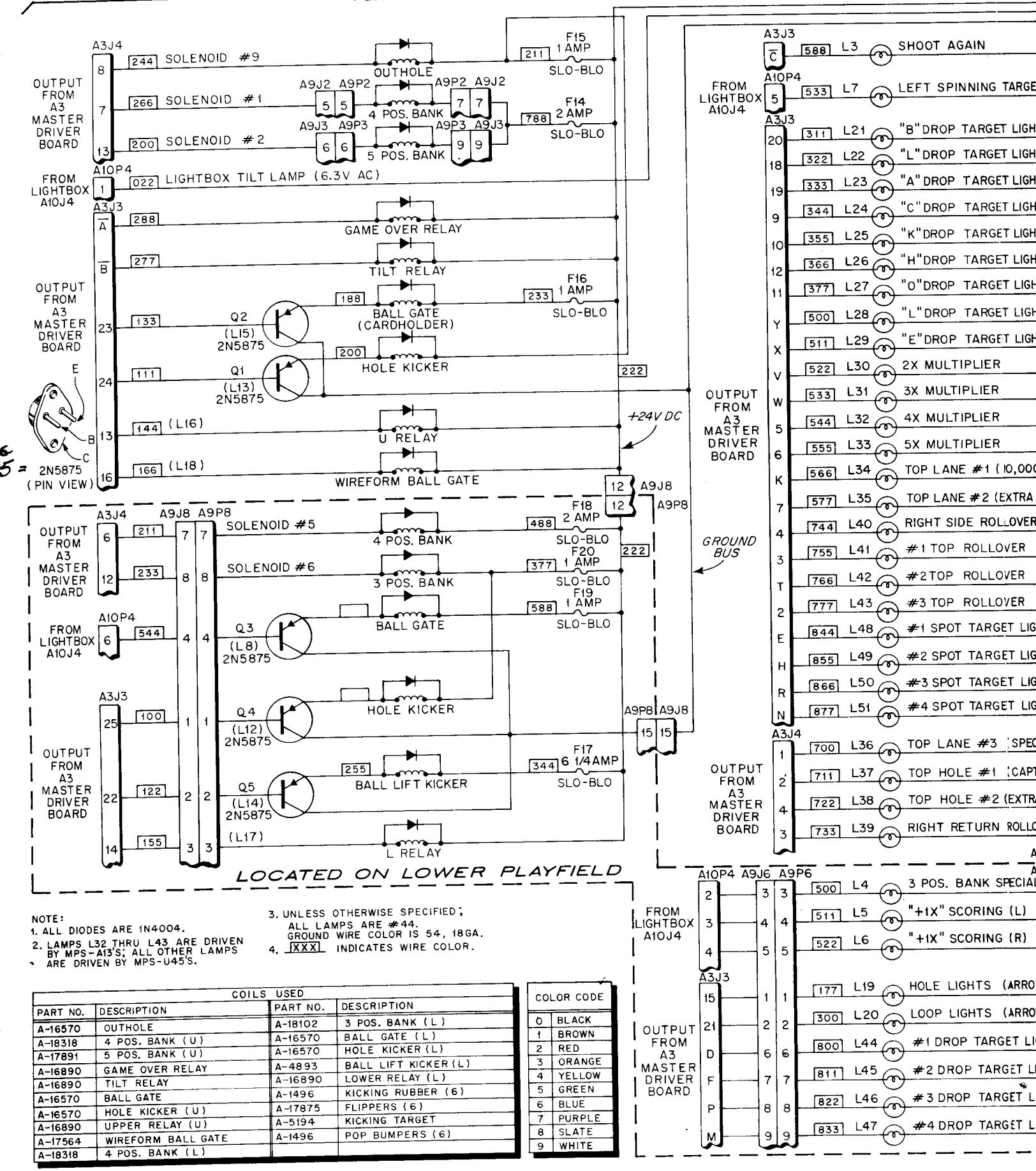
ECG 285 =

COLOR CODE			
0	BLACK	5	GREEN
1	BROWN	6	BLUE
2	RED	7	PURPLE
3	ORANGE	8	SLATE
4	YELLOW	9	WHITE

NOTE:
1. ALL DIODES ARE 1N270.
2. RETURN 7 NOT USED.

D. GOTTLIEB & CO.			
TITLE	UPPER AND LOWER PLAYFIELD SWITCH MATRIX		
USED ON	SYSTEM 80, GAME #668		
APPROVED	DATE	24 JUNE 1981	E-21340

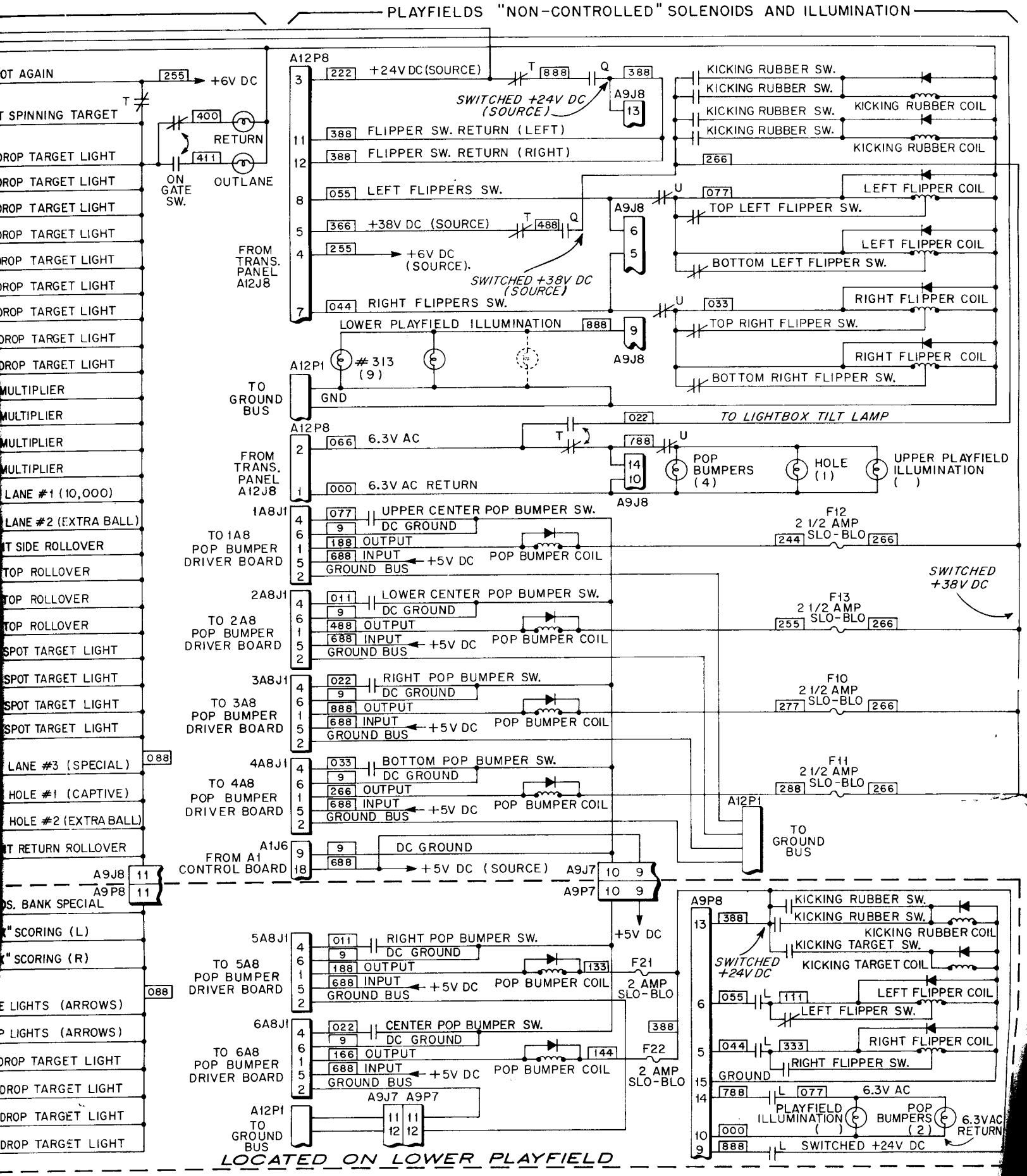
PLAYFIELDS "CONTROLLED" SOLENOIDS AND ILLUMINATION



NOTE:
1. ALL DIODES ARE 1N4004.
2. LAMPS L32 THRU L43 ARE DRIVEN BY MPS-A13'S; ALL OTHER LAMPS ARE DRIVEN BY MPS-U45'S.
3. UNLESS OTHERWISE SPECIFIED; ALL LAMPS ARE #44. GROUND WIRE COLOR IS 54, 18GA.
4. [XXX] INDICATES WIRE COLOR.

COILS USED			
PART NO.	DESCRIPTION	PART NO.	DESCRIPTION
A-16570	OUTHOLE	A-18102	3 POS. BANK (L)
A-18318	4 POS. BANK (U)	A-16570	BALL GATE (L)
A-17891	5 POS. BANK (U)	A-16570	HOLE KICKER (L)
A-16890	GAME OVER RELAY	A-4893	BALL LIFT KICKER (L)
A-16890	TILT RELAY	A-16890	LOWER RELAY (L)
A-16570	BALL GATE	A-1496	KICKING RUBBER (6)
A-16570	HOLE KICKER (U)	A-17875	FLIPPERS (6)
A-16890	UPPER RELAY (U)	A-5194	KICKING TARGET
A-17564	WIREFORM BALL GATE	A-1496	POP BUMPERS (6)
A-18318	4 POS. BANK (L)		

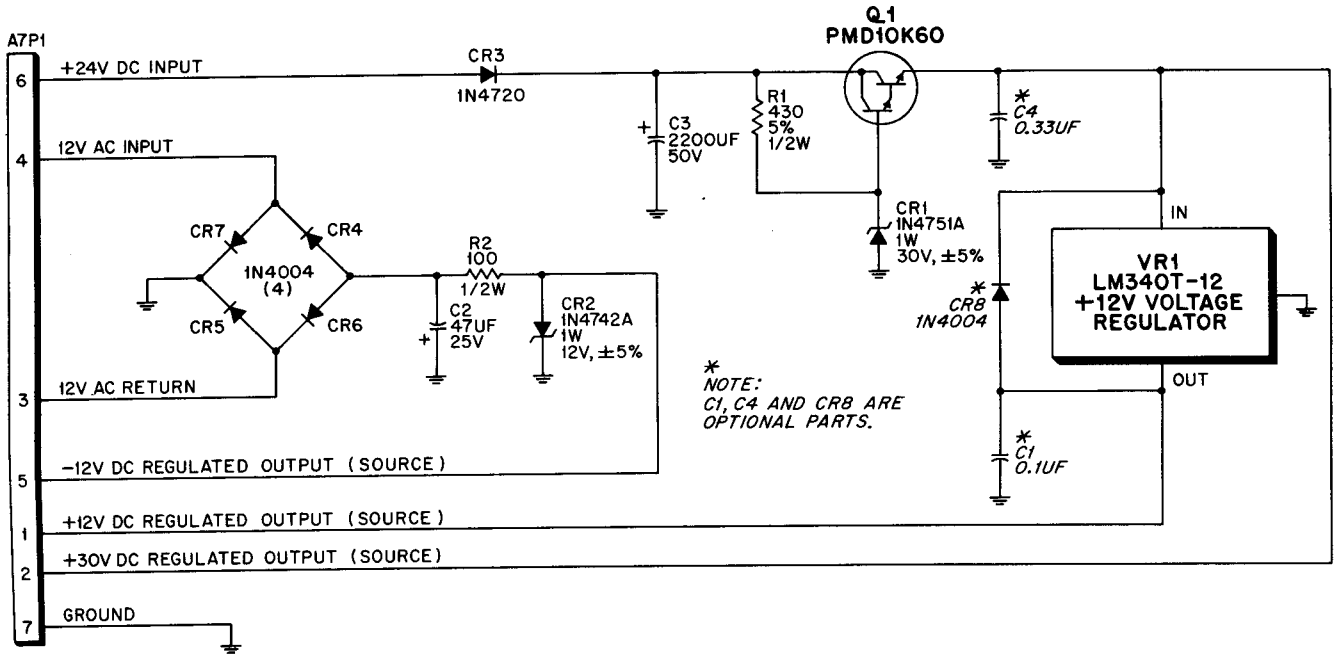
COLOR CODE	
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2	RED
3	ORANGE
4	YELLOW
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6	BLUE
7	PURPLE
8	SLATE
9	WHITE



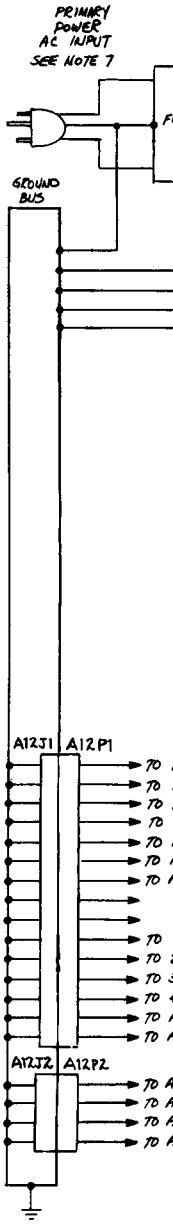
D. GOTTLIEB & CO.

TITLE: PLAYFIELDS SOLENOIDS AND ILLUMINATI
USED ON: SYSTEM 80, GAME #668
DRAWN: APPROVED: DATE: 7-27-81 E-21

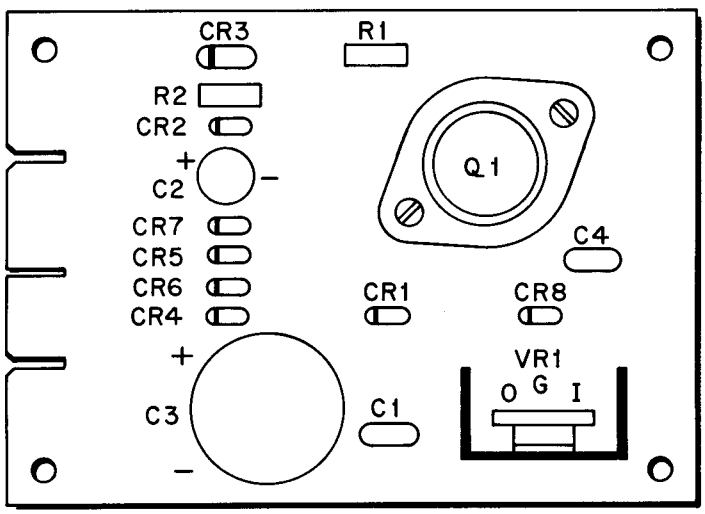
X. WIRING AND SCHEMATIC DIAGRAMS, PARTS LISTS



D. GOTTLIEB & CO.			
TITLE	SOUND/SPEECH BOARD POWER SUPPLY A7		
USED ON	SYSTEM 80, GAME # 668		
DRAWN	APPROVED	DATE 8-5-81	D-21343

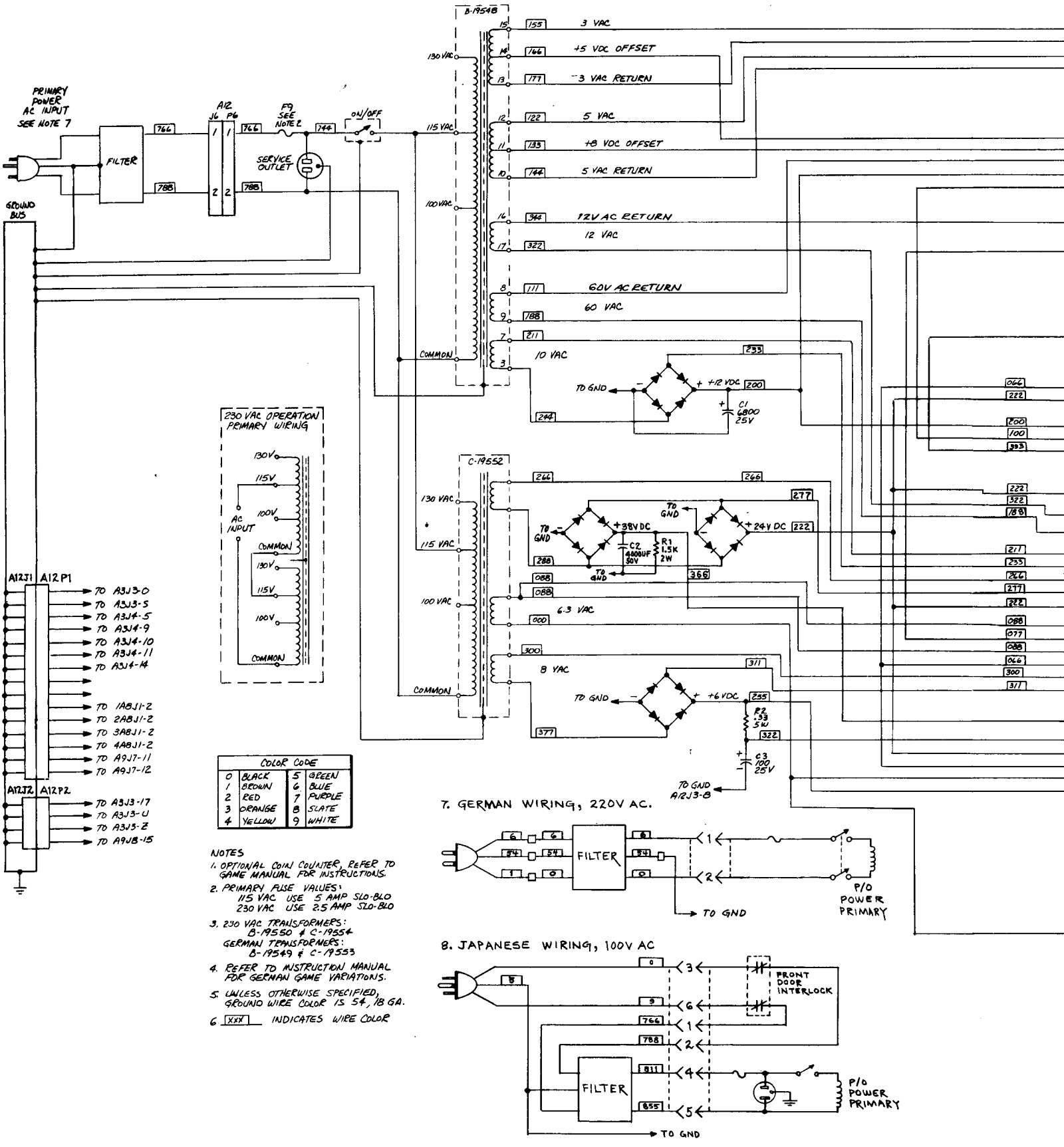


SOUND/SPEECH POWER SUPPLY (A7) COMPONENT LOCATION



SOUND/SPEECH POWER SUPPLY (A7) PARTS LIST

REFERENCE	DESCRIPTION	PART NUMBER
C1	Capacitor 0.1UF	
C2	47UF, 25 Volt	
C3	2200 UF, 50 Volt	
C4	0.33 UF	
CR1	Diode, Zener 30-V, ± 5%, 1W	1N4751A
CR2	Diode, Zener 12V, ± 5%, 1W	1N4742A
CR3	Diode	1N4720
CR4,CR5,CR6 CR7,CR8	Diode	1N4004
R1	Resistor 430 OHM, 5%, ½ Watt	
R2	Resistor 100 OHM, ½ Watt	
Q1	Transistor, Darlington Pair	PMD10K60
VR1	+ 12Volt Voltage Regulator	LM 340T-12



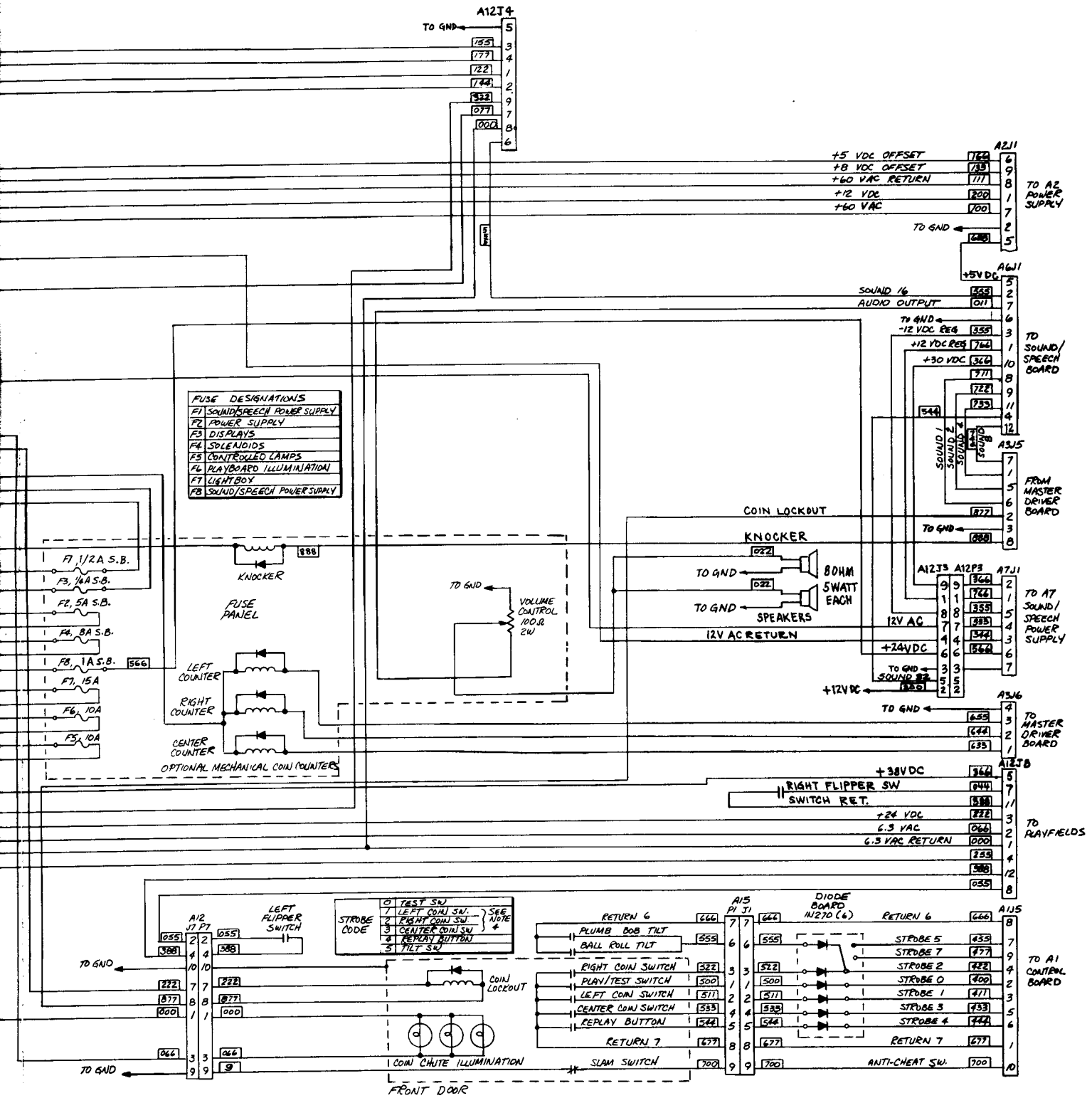
COLOR CODE			
0	BLACK	5	GREEN
1	BROWN	6	BLUE
2	RED	7	PURPLE
3	ORANGE	8	SLATE
4	YELLOW	9	WHITE

NOTES

1. OPTIONAL COIN COUNTER, REFER TO GAME MANUAL FOR INSTRUCTIONS.
2. PRIMARY FUSE VALUES:
   115 VAC USE 5 AMP SLO-BLO
   230 VAC USE 2.5 AMP SLO-BLO
3. 230 VAC TRANSFORMERS:
   B-19550 & C-19554
   GERMAN TRANSFORMERS:
   B-19549 & C-19553
4. REFER TO INSTRUCTION MANUAL FOR GERMAN GAME VARIATIONS.
5. UNLESS OTHERWISE SPECIFIED, GROUND WIRE COLOR IS 54, 18 GA.
6. [XXX] INDICATES WIRE COLOR

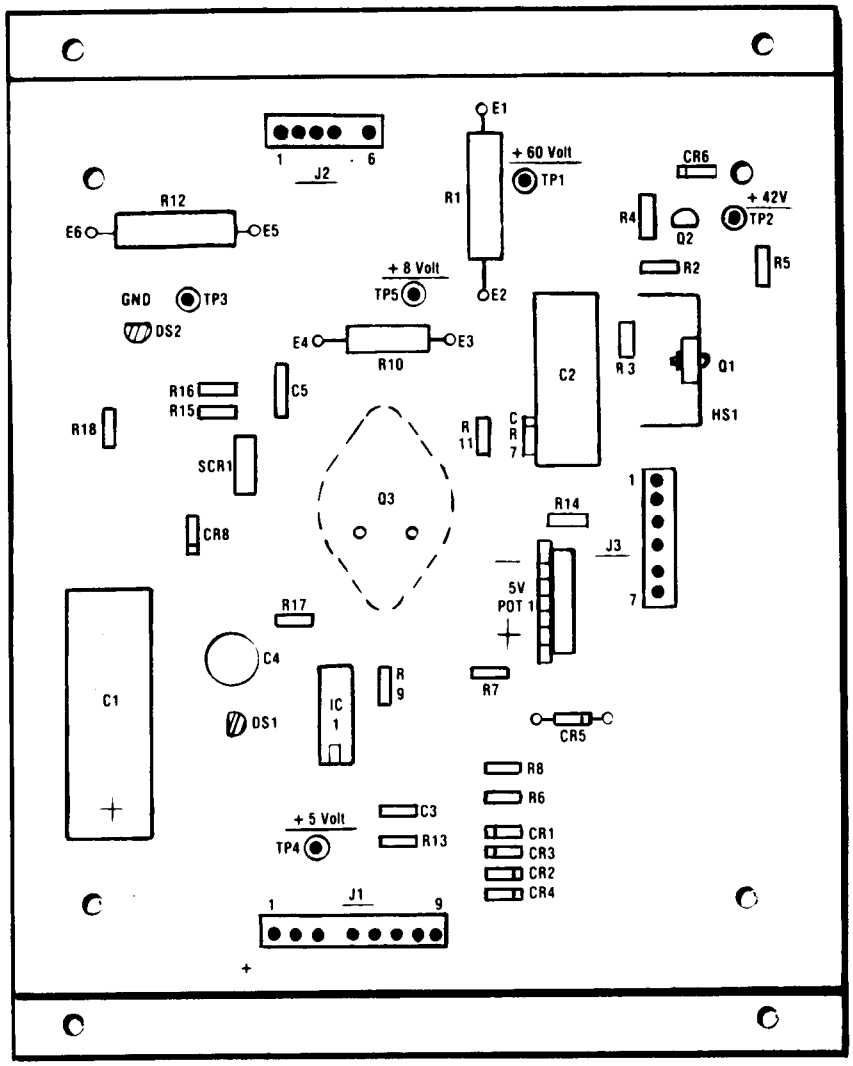
7. GERMAN WIRING, 220V AC.

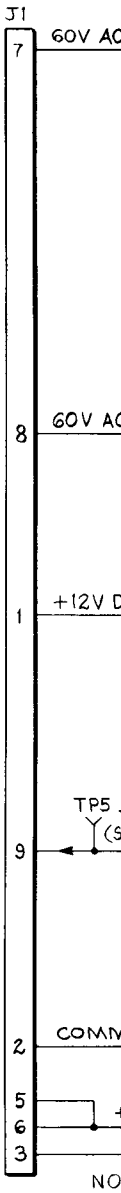
8. JAPANESE WIRING, 100V AC



D. GOTTLIEB & CO.			
TITLE: BOTTOM BOARD AND CABINET			
USED ON: SYSTEM 80			
DRAWN: R	APPROVED:	DATE: 8-5-81	E-21342

POWER SUPPLY (A2) COMPONENT LOCATION

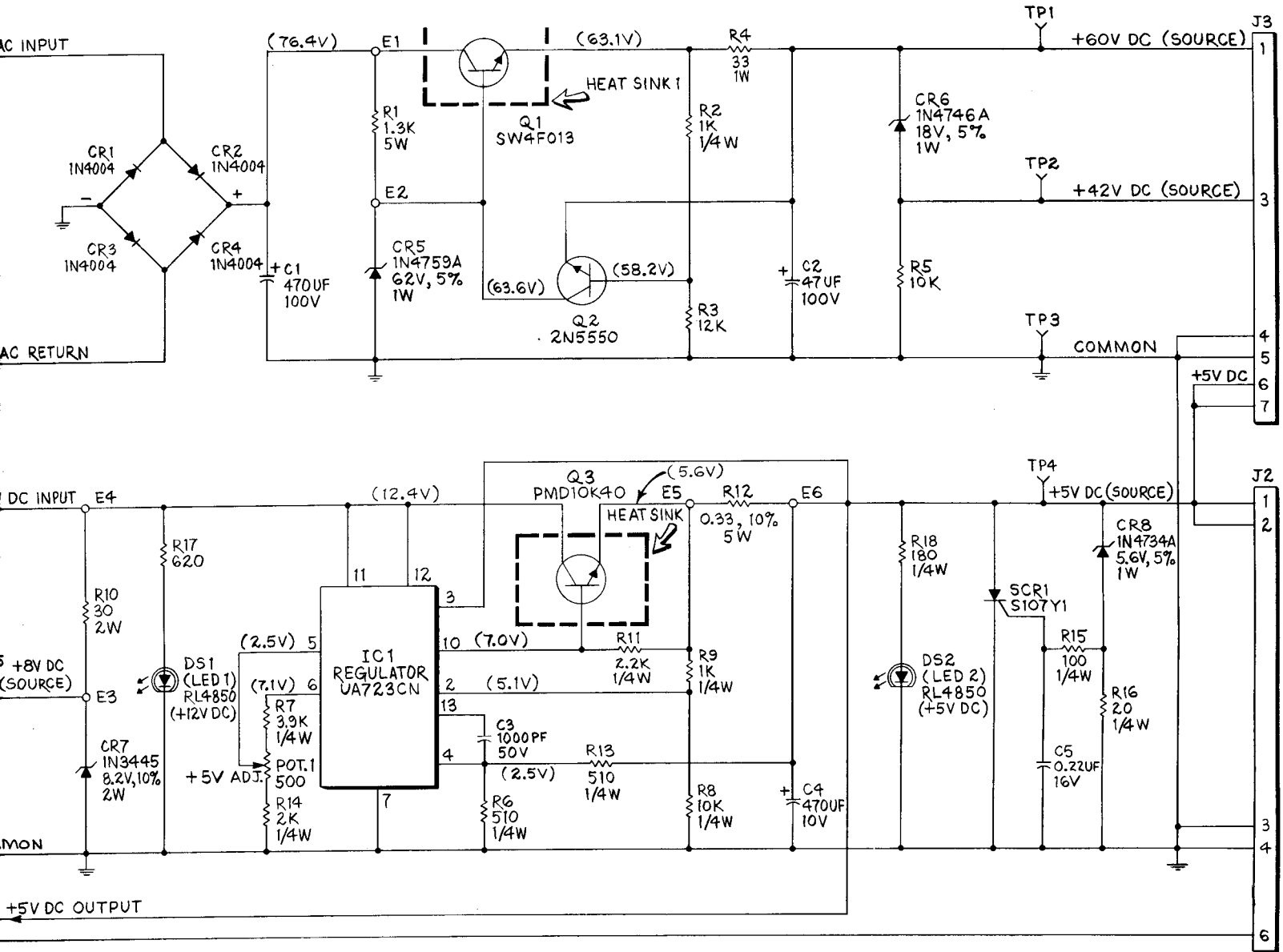




POWER SUPPLY (A2) PARTS LIST

REFERENCE	DESCRIPTION	PART NUMBER
C1	Capacitor, 470 mfd., 100V	
C2	Capacitor, 47 mfd., 100V	
C3	Capacitor, 1000 Picofarad, 50V	
C4	Capacitor, 470 mfd., 10V	
C5	Capacitor, 2 mfd., +80%, −20%, 16V	
CR1-CR4	Diode	1N4004
CR5	Diode, Zener, 62V, 5%, 1W	1N4759A
CR6	Diode, Zener, 18V, 5%, 1W	1N4746A
CR7	Diode, Zener, 8.2V, 10%, 2W	1N3445
CR8	Diode, Zener, 5.6V, 5%, 1W	1N4734A
DS1, DS2	Diode, Light Emitting	CM4-22
E1-E6	Turret Terminal	
IC1	I.C.—14 Pin Dip	UA723CN
J1	Connector, 9 Pin, Molex	
J2	Connector, 6 Pin, Molex	
J3	Connector, 7 Pin, Molex	
POT1	Potentiometer, 500 ohm, CTS	115R501A
Q1	Transistor, NPN, National	SW4F013
Q2	Transistor, NPN	2N5550
Q3	Transistor, Darlington, LAMBDA	PMD10K40
R1	Resistor, 1.3K ohm, 10%, 5W	
R2, R9	Resistor, 1K ohm, 5%, 1/4W	
R3	Resistor, 12K ohm, 5%, 1/2W	

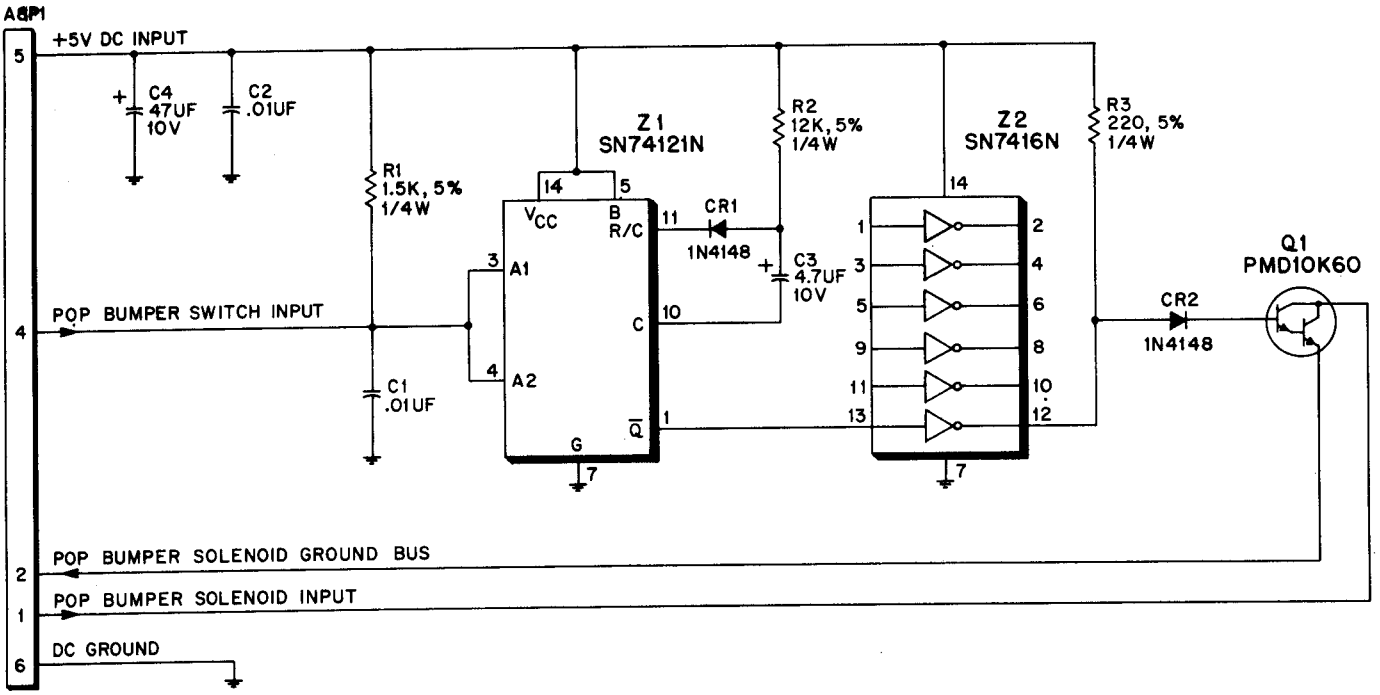
REFERENCE	DESCRIPTION	PART NUMBER
R4	Resistor, 33 ohm, 5%, 1W	
R5	Resistor, 10K ohm, 5%, 1/2W	
R6, R13	Resistor, 510 ohm, 5%, 1/4W	
R7	Resistor, 3.9K ohm, 5%, 1/4W	
R8	Resistor, 10K ohm, 5%, 1/4W	
R10	Resistor, 30 ohm, 5%, 2W	
R11	Resistor, 2.2K ohm, 5%, 1/4W	
R12	Resistor, .33 ohm, 10%, 5W (Wirewound)	
R14	Resistor, 2K ohm, 5%, 1/4W	
R15	Resistor, 100 ohm, 5%, 1/4W	
R16	Resistor, 20 ohm, 5%, 1/4W	
R17	Resistor, 620 ohm, 5%, 1/2W	
R18	Resistor, 180 ohm, 5%, 1/4W	
SCR1	Silicon Controlled Rectifier	S107Y1
TP1-TP5,	Turret Terminal	
	Eyelet	GS2-3
	Heat Sink Mounting Plate	
	Heat Sink, Thermalloy	
	Insulator	INS-3
	Insulator	DM111
	Spacer—6-32 Thread x 5/32	
	Spacer—6-32 Thread x 1/8	



NOTE: UNLESS OTHERWISE SPECIFIED,
1. RESISTORS ARE ±5%, 1/2W.
2. VOLTAGES ARE DC WITH RESPECT TO CIRCUIT GROUND.
3. ALL VOLTAGES ARE AT NOMINAL LINE VOLTAGE (115V AC).

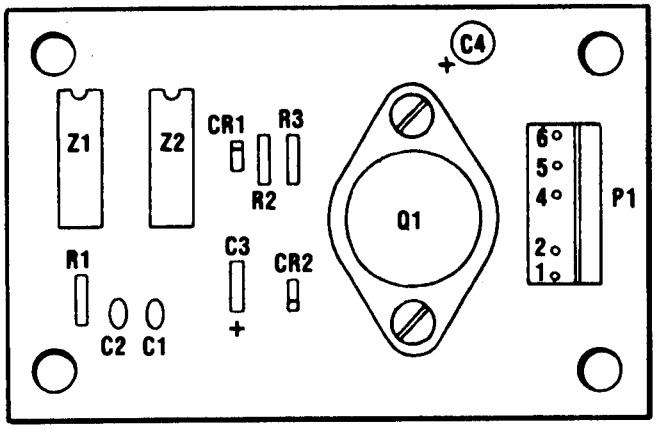
D. GOTTLIEB & CO.			
TITLE / USED ON	POWER SUPPLY (A2) SYSTEM 80		
DRAWN	APPROVED	DATE	E-20922
[illegible]	BAM	2-3-81	

X. WIRING AND SCHEMATIC DIAGRAMS, PARTS LISTS



D. GOTTLIEB & CO.			
TITLE POP BUMPER DRIVER BOARD (A8)			
USED ON SYSTEM 80			
DRAWN	APPROVED	DATE	D-20923
	BAM	2-9-81	

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
P1	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