

CLEOPATRA

SOLID STATE

GOTTLIEB®

Instruction
Manual



D. Gottlieb & Co.



A Columbia Pictures Industries Company

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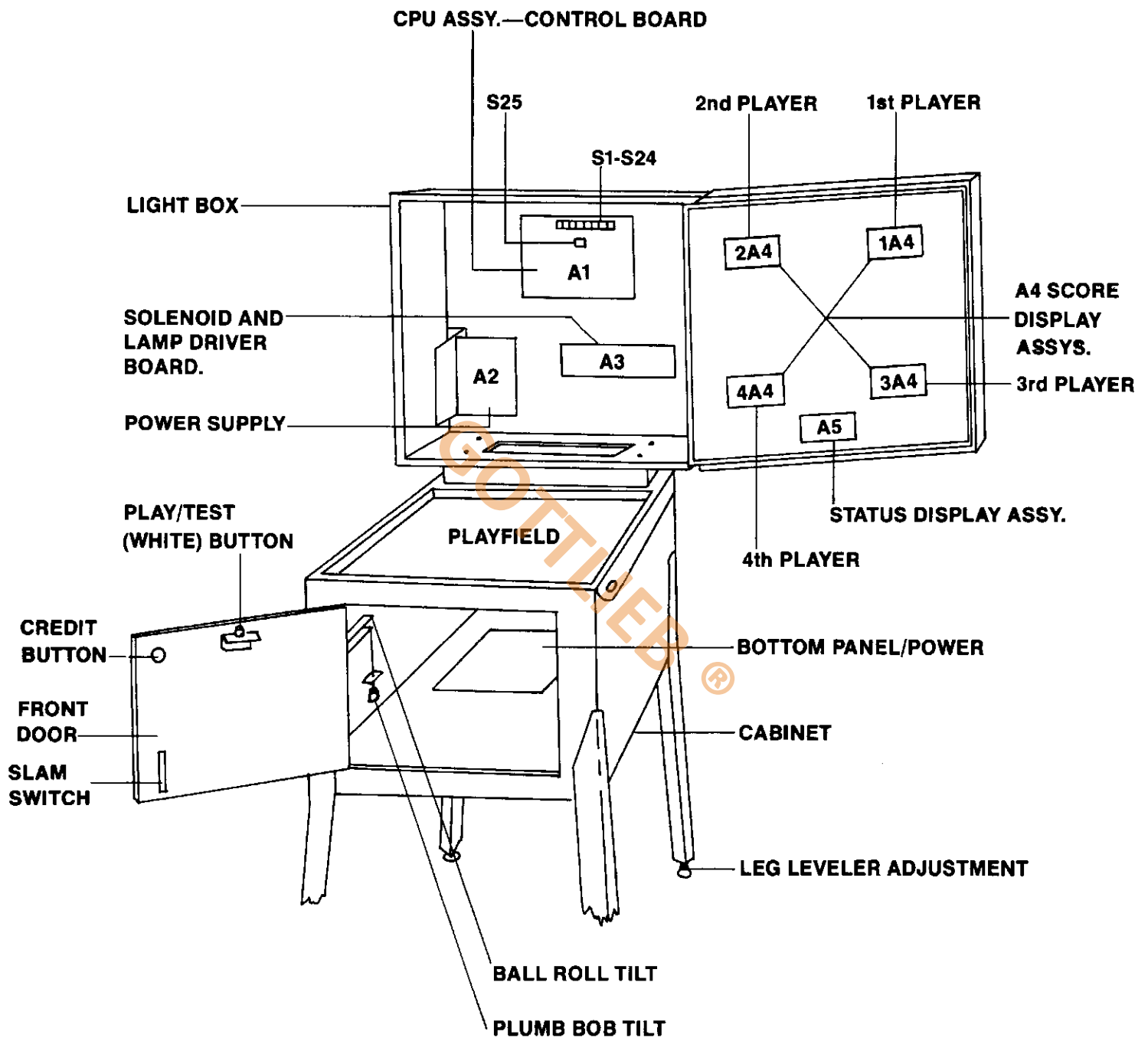
CLEOPATRA (SS)

GENERAL GAME OPERATING INSTRUCTIONS

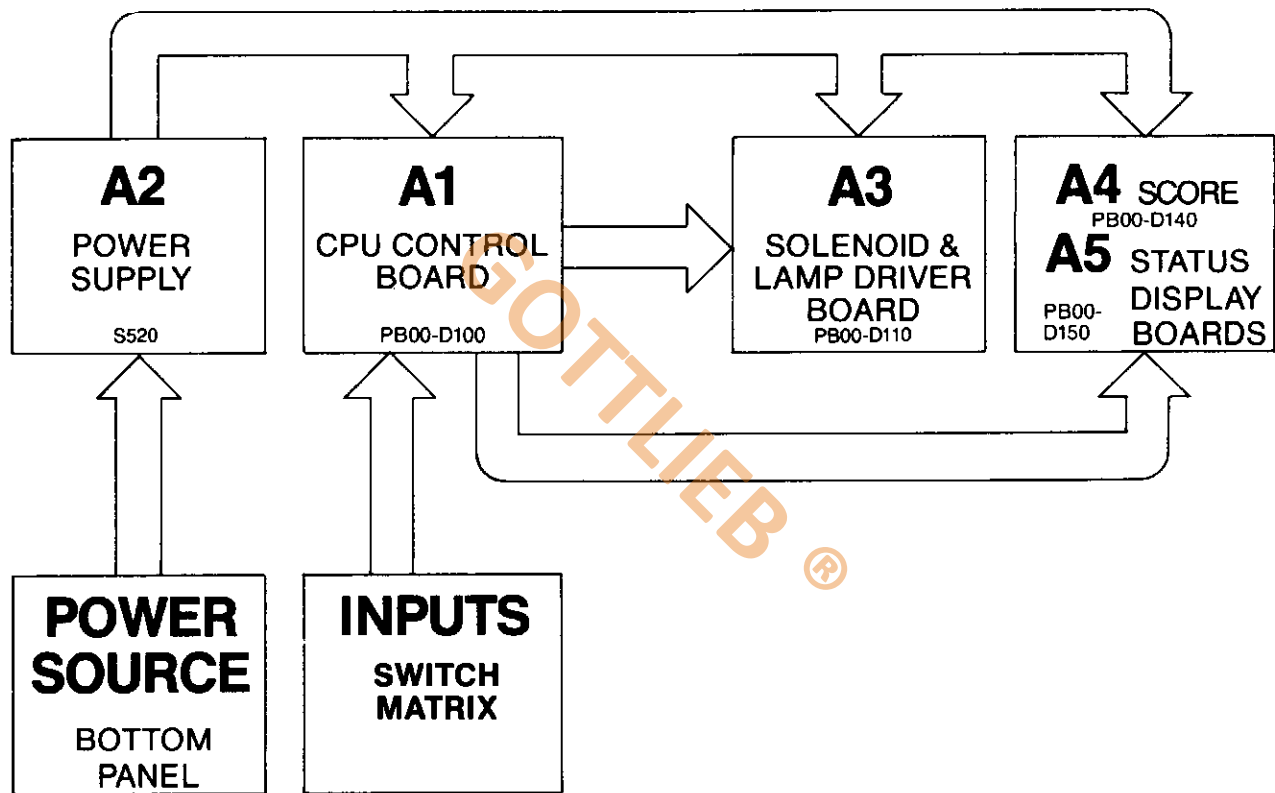
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COMPONENT LOCATION DIAGRAM



BLOCK DIAGRAM



I. INSTALLATION

To assemble the game, first bolt the legs to the cabinet. Place the lightbox atop the pedestal and insert the four #10-32 truss-head screws into the back of the pedestal. Open the lightbox and secure it to the cabinet with the long lightbox bolts. Connect all cables and gently but fully insert the connectors onto the printed circuit boards. Be sure to touch only the edges of the boards.

NOTE: TOUCHING THE STATIC-SENSITIVE MOS COMPONENTS ON THE CPU CONTROL BOARD CAN DAMAGE THEM, MAKING THE GAME INOPERATIVE AND INVALIDATING THE WARRANTY.

Inspecting the following items before plugging in the line cord may prevent future trouble:

1. Check that cables are clear of moving parts.
2. Look for any disconnected wires.
3. Check switches for loose solder or other foreign matter.
4. Check the soldering generally for cold joints.
5. Be certain all fuses are firmly seated.
6. Check the transformers for foreign matter across the terminals.
7. Be sure that the transformer wiring corresponds to the supply voltage.
8. Check the setting of the tilt switch on the underside of the playfield. One blade of this switch is free-floating with a weight on the end.

After levelling the machine, adjust the plumb-bob tilt (on left side of cabinet near front door) to the sensitivity desired.

II. GAME OPERATION

With the line cord unplugged drop a coin into one of the chutes. It should be rejected. Plug the line cord *only* into a properly-grounded 3-wire receptacle of the correct voltage. Turn on the game by pressing the main switch located on the cabinet bottom near the front right corner.

After a five-second delay all score displays will light and read zeroes. During this time T (Tilt) and Q (Game Over) relays will energize and de-energize once. If this does not happen or if the credits fail to light, turn off the game and inspect the normally-closed switch on the ball-roll tilt and on the front door. Turn on the game; if the problem remains, refer to Section VII (Trouble-shooting).

The credit display will show the number of credits remaining and the ball-in-play display will be blank. Five seconds after the score displays light, they will flash the "High Game to Date" score for one second. This cycle continues until the game is started. All playfield lights controlled by the micro-processor will be off.

Insert one or more coins and note that the correct number of credits are added on the credit display according to the information on the coin entrance plate. Press the credit button to reset the game; the ball should now be at the shooter. The first player score reads "0" and flashes, indicating that that player is now scoring. The other player displays are blank and a "1" appears on the ball-in-play display.

Additional players are indicated by a "0" showing in each corresponding player display. Thus if there are three players, a "0" will show in the first three player displays. After the fourth player has been added (or when the credit display reads "0"), the credit button has no effect.

The game features are described in a later section. When the ball enters the outhole, the bonus is scored, the ball is kicked to the shooter, and the display of the player now scoring begins to flash and continues to flash until a score is made. All playfield features reset after each ball. When the "Shoot Again" light is lit, neither the player designation (the flashing display) nor the ball-in-play display changes when the ball enters the outhole. Only one extra ball per ball in play can be given.

The number of balls per game is adjustable. When the last ball enters the outhole, the "Game Over" and "Number to Match" lights come on. A random number appears in the ball-in-play display and if this number matches the last two digits in the player's score, a replay is added to the credit display. At this time a "High Game to Date" score is periodically flashed in all four player displays. When this score is achieved, three replays are given. This feature is adjustable.

Tilting the machine results in the loss of the ball in play or the entire game, depending upon the Tilt Reset adjustment. With this adjustment "on," the game comes on again when the ball enters the outhole, and play resumes. There is a normally-closed switch on the front door and one in the ball-roll tilt. If either of these switches opens from raising the front of the cabinet or pounding the front door, the entire game is ended. The "Game Over" light comes on and for three seconds the coin chute switches and replay button are inactive. This prevents accidental closing of these switches from residual vibration.

III. CLEOPATRA (SS)

GAME FEATURES (5 BALL)

Hitting rollovers and drop targets of corresponding color increases bonus value.

Rollovers score 500 points.

Hitting all rollovers lights side targets alternately for extra ball.

Completing drop targets lights side targets alternately for extra ball and lights center target.

Center target scores 500 points or 5000 points when lit.

Hitting all rollovers and completing drop targets lights side targets alternately for Special.

Drop targets score 1000 points for each hit rollover.

Hole value is 3000 points and spots one top rollover at random. Left hole lights left half of Double Bonus light; right hole lights right half of Double Bonus light. Double bonus is scored when both halves are lit. Double bonus is always scored on last ball.

Bonus is scored and all features reset after each ball.

Pop bumpers score 100 points.

Star rollovers score 5000 points.

FEATURE CHANGES FOR 3-BALL OPERATION

When side targets light for extra ball, they alternate left-right only, and not on-off.

Hole value is 5000 points.

Center pop bumper scores 1000 points.

Note: When testing the game by hand be sure to operate one of the top rollovers, otherwise the drop targets will give no score.

IV. BOOKKEEPING FUNCTIONS AND SELF-TESTING

The circuitry in this game helps the operator perform many bookkeeping functions. The information is shown one step at a time on the first player score display while the step number is shown in the credit display. Pressing the button on the inside of the front door (the play/test button) begins the bookkeeping and advances it to the next step each time the button is pressed. If the button is not pressed within sixty seconds of each step, the machine returns to normal playing condition.

The data in any bookkeeping step may be reset to zero while it is displayed by pressing Switch Button #25 on A1, the CPU control board in the lightbox. Then the play/test button must be pressed to enter the zero.

STEP (Credit Display)	INFORMATION SHOWN (First Player Display)
0	Total coins through #1 coin chute (left chute).
1	Total coins through #2 coin chute.*
2	Total plays.
3	Total replays given.
4	Number of times anti-cheat switches on front door and on ball-roll tilt have opened.
5	Total extra balls.
6	Number of tilts.
7	First high score replay.
8	Second high score replay.
9	Third high score replay.
10	Current "High Game to Date" score.
11	Display test: All digits in first and third player displays step "0" through "9."**
12	Display test: All digits in second and fourth player displays step "0" through "9."**
13	Self-test: All CPU-controlled lights come on for five seconds. Each solenoid is energized one at a time. All closed switches noted by a code number in ball-in-play display.

*If chutes are adjusted to be the same, coins deposited in either chute add only to the #1 chute total.

**If button is not pressed within two 0-9 cycles, machine returns to normal playing condition.

TO CHANGE REPLAY SCORES OR "HIGH GAME TO DATE" SCORE:

- 1) Press the play/test button on the front door at one-second intervals to advance to step 7 (first high score replay).
- 2) Reset the display by pressing Switch Button #25 on A1, the CPU control board.
- 3) Press the replay button. This causes the display to advance by 10,000's. Hold in the replay button until the desired replay score is shown.
- 4) The new score is entered by advancing to the next function by pressing the play/test button.

To eliminate entirely one or more replay scores, set step 7, 8, or 9 at zero (as in #2 above), then press the play/test button to enter the value.

The switches and solenoids are checked in Step 13 in the order given in the following lists. A faulty solenoid or a closed switch that should be open will not stop the test sequence; the code number of the component will be shown in the ball-in-play display. The machine returns to the normal playing condition at the end of the test. It will do so also if a tilt switch is closed, if an anti-cheat switch is opened, or if the power is interrupted.

SOLENOID NUMBER

SOLENOID

1	Outhole
2	Knocker 
3	Tens Chime
4	Hundreds Chime
5	Thousands Chime
6	Right Hole
7	Left Hole
8	Drop Target Bank Reset

SWITCH NUMBER	SWITCH CODE LIST	SWITCH
00		Play/test button (on front door)
01		#1 Coin Chute
02		#2 Coin Chute
03		Replay Button
04		Tilt Switches
10		10 Point Switches
11		Center Pop Bumper
12		Right Side Target
13		Center Target
14		Left Side Target
20		Blue Rollovers
21		Green Rollovers
22		Right and Left Star Rollovers
23		White Drop Target
24		Yellow Drop Target
30		Green Drop Target
31		Red Rollover
32		Red Drop Target
33		Yellow Rollovers
34		White Rollovers
40		Right and Left Pop Bumpers
41		Right Hole
42		Left Hole
43		Blue Drop Target

V. GAME ADJUSTMENTS

A. Playfield Adjustments

Posts controlling access to the left and right outlanes can be adjusted. See page 35. The "conservative" (easier entry) position decreases playing time and scoring while the "liberal" position has the opposite effect.

The game is shipped with adjustable posts in the position found to be suitable for the greatest number of players. Therefore the posts should not be changed unless the need is clearly evident.

B. Lightbox Adjustments

There are 24 switches on the CPU control board (A1). These allow many features of the game to be adjusted to fit the location. The switches are contained in three "packages" of eight switches each, as shown in the following illustration.



WARNING: TURN OFF POWER BEFORE MAKING ADJUSTMENTS!
BE CAREFUL TO TOUCH ONLY THE SWITCHES. DO NOT TOUCH THE STATIC-SENSITIVE MOS COMPONENTS.

1. Coin and Credit

The number of plays (credits) and the number of coins are adjustable. Switches #1 through #4 adjust the first coin chute (#1 chute, on the left). Switches #5 through #8 adjust #2 coin chute.

The two chutes can be adjusted to be the same. When this is done, both chutes are adjusted using switches #1 through #4.

COIN CHUTES	SWITCH 19
Separate.....	OFF
Same.....	ON

COIN CHUTE ADJUSTMENTS

#1 Coin Chute	S1	S2	S3	S4
#2 Coin Chute	S5	S6	S7	S8

Coins/Credits

	1/1	OFF	OFF	OFF	OFF
	1/2	OFF	OFF	OFF	ON
	1/3	OFF	OFF	ON	OFF
	1/4	OFF	OFF	ON	ON
	1/5	OFF	ON	OFF	OFF
	1/6	OFF	ON	OFF	ON
	1/7	OFF	ON	ON	OFF
	1/8	OFF	ON	ON	ON
	1/9	ON	OFF	OFF	OFF
Note 1	2/1	ON	OFF	OFF	ON
	2/2	ON	OFF	ON	OFF
	2/3	ON	OFF	ON	ON
	2/4	ON	ON	OFF	OFF
	2/5	ON	ON	OFF	ON
Note 2	2/3	ON	ON	ON	OFF
Note 3	3/1	ON	ON	ON	ON

Note 1: No credits until second coin is deposited.

Note 2: First coin gives one credit. Second coin gives two credits provided that no score is made between first and second coin. If scoring occurred, second coin becomes a "first" coin, giving one credit.

Note 3: No credit until third coin is deposited.

2. Maximum Credits

This adjustment determines the maximum number of games which may be accumulated on the credit display, whether by adding replays or by inserting coins.

MAXIMUM CREDITS	SWITCHES	
	17	18
5	OFF	OFF
8	OFF	ON
10	ON	OFF
15	ON	ON

3.	BALLS PER GAME	SWITCH 9
	3	ON
	5	OFF

4.	MATCH FEATURE	SWITCH 10
	IN	ON
	OUT	OFF

5.	CREDITS DISPLAYED	SWITCH 13
	YES	ON
	NO	OFF

6.	CHIMES WHEN SCORING	SWITCH 20
	YES	ON
	NO	OFF

7.	TILT	SWITCH 12
	BALL IN PLAY ONLY	ON
	GAME OVER	OFF

8. Score Feature

This adjustment determines game mode. (Replay or Extra Ball).

SWITCH 11

REPLAY..... ON
EXTRA BALL.....OFF

9. Chimes When Resetting Game (Tune)

The game may be adjusted to play a tune when the credit button is pressed and a different tune when a coin is dropped.

CREDIT BUTTON TUNE

SWITCH 14

ON ON
OFFOFF

COIN SWITCH TUNE

SWITCH 23

ON ON
OFF.....OFF

10. High Game to Date Feature

When the High Game to Date score is reached, three replays are given and that score becomes the new High Game to Date. That score is flashed periodically on all four player displays at the end of the game.

HIGH GAME TO DATE

SWITCH 21

IN ON
OUT.....OFF

SWITCH 22

11. HIGH GAME TO DATE FEATURE GIVES 3 REPLAYS..... ON
HIGH GAME TO DATE FEATURE GIVES NO REPLAYS OFF

VI. ROUTINE MAINTENANCE

After a successful completion of the self-test, check the playfield for dirt or particles. The playfield should be cleaned frequently with a non-abrasive wax-based cleaner. Any of the polishes made specifically for use on pinball machine playfields may be used. Make certain that kicker fulcrums and all pivot points receive a drop of fine oil. The pop bumper cup switches, the drop target shanks and the discs of Vari-targets should be lightly coated with White Lube, a special Gottlieb lubricant available at distributors.

When the playboard is clean and all components are working properly, start the game and try each feature. Make certain each rollover operates, that each pop bumper scores and kicks correctly and that in general everything works as it should. If an intermittent or dirty switch is found, clean the points by pressing them together with a piece of paper or a business card between them, moving the card back and forth.

WARNING: DO NOT FILE, BURNISH OR IN ANY WAY ABRABE GOLD-PLATED SWITCH CONTACTS.

The only switches whose points may be burnished are the pop bumper cup switches, the rubber-actuated switches on kicking rubber units, and the flipper button switches.

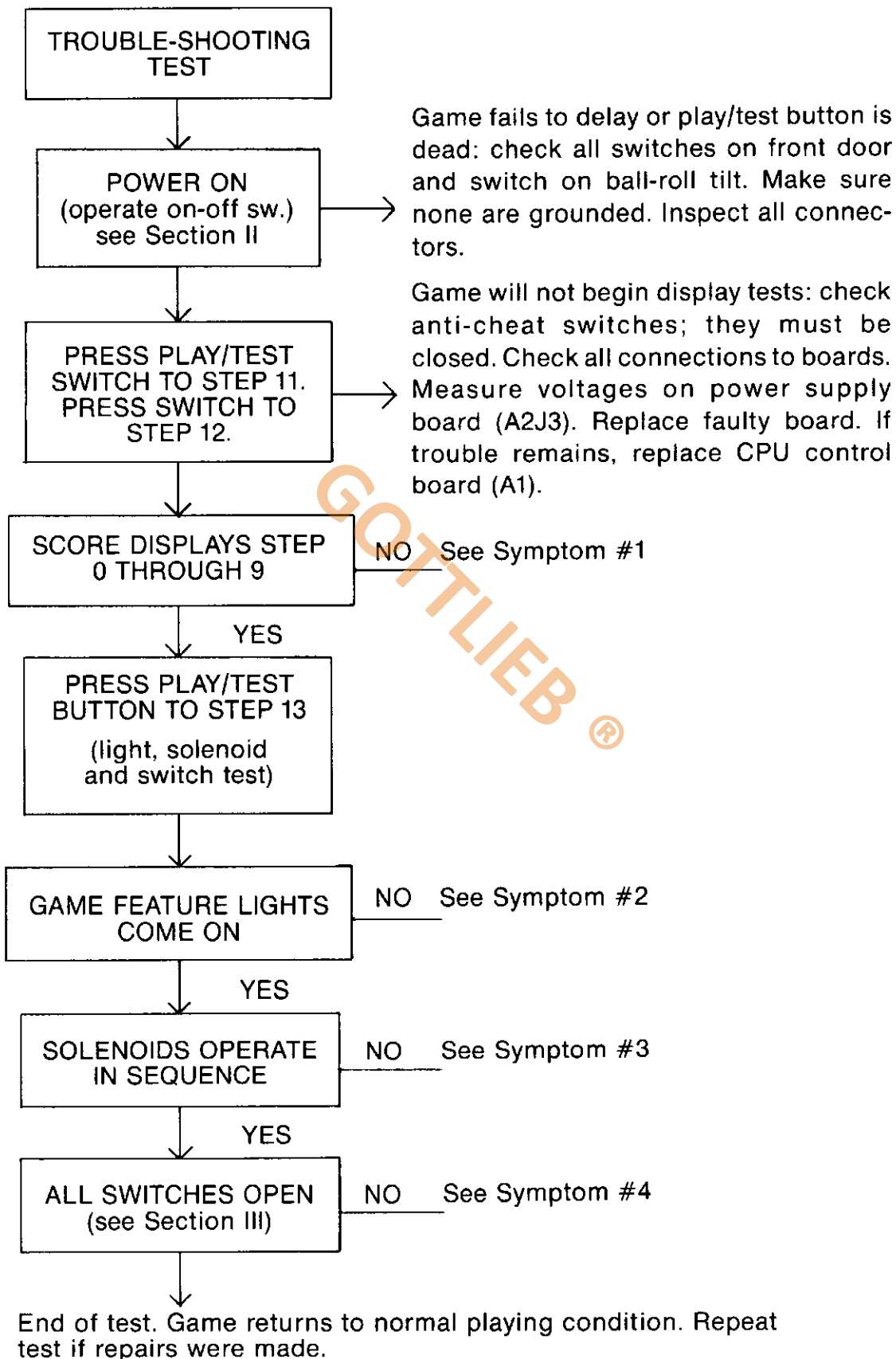
VII. TROUBLE-SHOOTING

Trouble-shooting of the mechanical devices in the game can be held to a minimum by diligent maintenance. Trouble-shooting of the solid-state components is very seldom required and in fact on location is limited to inspection and replacement of entire boards. Detailed diagnosis and repair of boards can be made at a service center or properly equipped shop.

Before replacing the CPU board or driver board, measure the voltages on the power supply board (A2) after first disconnecting the two connectors A2J2 and A2J3. If any fault is found here, replace this board and recheck power supply voltages before reconnecting A2J2 and A2J3. Before replacing anything, check carefully all connectors, crimp connectors and wires. Make certain all grounds are intact.

After any repairs, all connectors *must* be re-connected before the game is turned on.

WARNING! TURN OFF POWER BEFORE REMOVING OR REPLACING ANY OF THE BOARDS.



SYMPTOM #1 DISPLAYS

Note: Before replacing a display, check the connector and the individual crimped wires.

1A) Symptom: One or several display segments or digits always off, always on, or mottled. May appear on one or more players but *not all*.

- Action:
1. Open front door and press play/test button until step 11 or 12 is reached. Note any defective display boards.
 2. Turn power off.
 3. Replace defective score display board (see parts list). Turn power on and repeat 1. If trouble persists, go to 1B2.

1B) Symptom: All player displays improper; segments or digits always on or always off.

- Action:
1. Repeat 1A-1.
 2. Turn power off.
 3. Replace CPU board A1. (see parts list)
 4. Turn power on and repeat 1. If displays are incorrect, refer to board replacement procedure.

1C) Symptom: One or more displays always off.

- Action:
1. Refer to Symptom 1A.

SYMPTOM #2 FEATURE LIGHTS

2A) Symptom: Not all feature lights come on during play.

- Action:
1. Check the wiring and bulb, of lights not working.
 2. Check connectors and crimped wires on the driver board (A3).
 3. Open the front door and press play/test button until step 13 is reached. Feature lights come on.
 4. Turn power off.
 5. Replace driver board A3. (see parts list)
 6. Turn power on and repeat 3. If not correct, turn power off.
 7. Replace CPU board A1. (see parts list)
 8. Turn power on and repeat 3.

2B) Symptom: One or more feature lights always on.

- Action:
1. Perform 2A-2 through 2A-8.

SYMPTOM #3 SOLENOIDS

3A) Symptom: Controlled solenoid does not operate during play (may be one or more). NOTE: Flipper, kicking rubber and pop bumper solenoids are non-CPU controlled. They have nothing to do with boards A1 and A3.

- Action:
1. Open front door and press play/test button until step 13 is reached. Each solenoid operates once. (See solenoid list in Section III).
 2. Turn power off.
 3. Raise the playfield and check the solenoid not operating. Replace if damaged. Check for free movement of the device operated by the solenoid.
 4. Inspect connectors and crimped wires on driver board (A3).
 5. Replace driver board A3. (see parts list)
 6. Turn power on and repeat 3A-1. If solenoid does not operate, turn power off.
 7. Inspect connectors and crimped wires on CPU control board (A1). Repeat 3A-1.
 8. Turn power off and replace CPU control board A1. (see parts list)
 9. Turn power on and repeat 3A-1.

3B) Symptom: One or more controlled solenoids always energized.
NOTE: Solenoids other than flippers will overheat if kept energized continuously. Do not allow more than 20 seconds of operation. Follow this with several minutes with the power off.

- Action:
1. Turn power off.
 2. Check coil for shorted or open diode and/or shorted coil. Replace if defective, carefully noting diode polarity.
 3. Turn power on and test solenoid. If a problem still exists, turn game off. Refer to symptom 3A2.

SYMPTOM #4 GAME FEATURES

4A) Symptom: Game feature does not score.

- Action:
1. Open front door and press play/test button until step 13 is reached. Each switch is checked automatically and any closed switch is indicated in code in the ball-in-play display (see Section III and switch code list).
 2. Raise the playfield and locate the faulty switch indicated by the code. The switch should have an approximate 1/16" gap. Check for loose solder or other foreign matter across the points or terminals. Make sure that the device operating the switch operates freely. The code may represent several parallel switches; be sure to check all similar (such as yellow rollovers) switches.

4B) Symptom: Fuse blows repeatedly. May be more than one.

- Action:
1. Note which fuse is affected, and inspect the circuitry controlled by that fuse for shorts, bits of solder across terminals and loose wires.
 2. If either 5 Amp fuse blows, check the bridge involved located on the bottom board.

VIII. SERVICE AND PARTS

All solid-state components are listed in the parts catalog and are available at Gottlieb distributors. When making replacements of any components, always use Gottlieb parts to assure infrequent service calls. The parts catalog lists all current components and their prices, enabling the repairman to quickly and easily select the item he needs. Whenever parts are ordered, state the part number, the part name, the game for which it is intended and, if applicable, the color or design.

IX.

CLEOPATRA (SS)

Lamp Assignments

Latch	Position	Lamp Number	Function
L1	1	1	Game over relay
	2	2	Tilt relay
	3	3	High game to date
	4	4	Same player shoots again*
L2	1	5	Red bonus (left)
	2	6	White bonus (left)
	3	7	Blue bonus (left)
	4	8	Yellow bonus (left)
L3	1	9	Green bonus (left)
	2	10	Red bonus (right)
	3	11	White bonus (right)
	4	12	Blue bonus (right)
L4	1	13	Yellow bonus (right)
	2	14	Green bonus (right)
	3	15	Red bonus arrow
	4	16	White bonus arrow
L5	1	17	Blue bonus arrow
	2	18	Yellow bonus arrow
	3	19	Green bonus arrow
	4	20	Left double bonus
L6	1	21	Right double bonus
	2	22	Yellow out rollover
	3	23	White return rollover
	4	24	Blue return rollover
L7	1	25	Green out rollover
	2	26	Center target
	3	27	(not used)
	4	28	Yellow top rollover
L8	1	29	White top rollover
	2	30	Red top rollover
	3	31	Blue top rollover
	4	32	Green top rollover
L9	1	33	Right Extra Ball
	2	34	Left Extra Ball
	3	35	Left Special
	4	36	Right Special

*One light on the playfield and one in the lightbox.

WIRE COLOR ASSIGNMENTS

LAMP	COLOR
1	White-Blue
2	White-Orange
3	White-Brown
4	White-Green
5	White-Purple
6	White-Yellow
7	Blue-White-Red
8	Orange-White-Red
9	Brown-White-Red
10	Green-White-Red
11	Purple-White-Red
12	Yellow-White-Red
13	Blue-White-Black
14	Orange-White-Black
15	Brown-White-Black
16	Green-White-Black
17	Purple-White-Black
18	Yellow-White-Black
19	White-Blue-Red
20	White-Orange-Red
21	White-Brown-Red
22	White-Green-Red
23	White-Purple-Red
24	White-Yellow-Red
25	White-Blue-Black
26	White-Orange-Black
27	White-Brown-Black
28	White-Green-Black
29	White-Purple-Black
30	White-Yellow-Black
31	Blue-White-White
32	Orange-White-White
33	Brown-White-White
34	Green-White-White
35	Purple-White-White
36	Yellow-White-White

WIRE COLOR ASSIGNMENTS (continued)

STROBE	COLOR
0	Blue
1	Orange
2	Brown
3	Green
4	Purple

RETURNS	
0	Yellow
1	Blue-White
2	Orange-White
3	Brown-White
4	Green-White
5	Purple-White
6	Yellow-White
7	Yellow-Black

SOLENOIDS	
1	Blue-Red
2	Orange-Red
3	Orange-Black
4	Green-Red
5	Purple-Red
6	Yellow-Red
7	Blue-Black
8	Orange-Black

Flipper Switches

Left: Green-Black
Right: Purple-Black

Anti-Cheat Switches

Blue-Black
Orange-Black

CABLE PLUGS FOR SOLID-STATE GAMES

PLUG A1-J1

PIN	WIRE COLOR	FUNCTION
1	_____	Spare
2	*Blue	-12 VDC
3	*Black	Ground
4	*Black	Ground
5	*Red	+5 VDC
6	*Red	+5 VDC

PLUG A1-J2

1	White-Blue-Red	f A
2	White-Orange-Red	g A
3	White-Brown-Red	a A
4	White-Green-Red	b A
5	White-Purple-Red	c A
6	White-Yellow-Red	d A
7	White-Blue-Black	e A
8	_____	Spare
9	_____	Spare
10	_____	Spare
11	White-Purple	f B
12	White-Yellow	g B
13	Brown-White-White	a B
14	Green-White-White	b B
15	Blue-White-Red	c B
16	Orange-White-Red	d B
17	White-Green-Black	e B
18	White-Purple-Black	h A
19	White-Yellow-Black	h B

All wires #22 gauge unless specified * (#18 gauge)

CABLE PLUGS FOR SOLID-STATE GAMES

PLUG A1-J3

PIN	WIRE COLOR	FUNCTION
1	_____	Spare
2	_____	Spare
3	_____	Spare
4	Black	Ground
5	*Red	+5 VDC
6	Blue	D 3
7	Orange	D 4
8	Brown	D 2
9	Green	D 1
10	Purple	D 10
11	Yellow	D 9
12	Blue-White	D 11
13	Orange-White	D 12
14	Brown-White	D 7
15	Green-White	D 8
16	Purple-White	D 6
17	Yellow-White	D 5
18	Blue-Red	D 14
19	Orange-Red	D 13
20	Brown-Red	D 15
21	Green-Red	D 16

All wires #22 gauge unless specified * (#18 gauge)

CABLE PLUGS FOR SOLID-STATE GAMES

PLUG A1-J5

PIN	WIRE COLOR	FUNCTION
1	Blue-Black	Solenoid 7
2	Orange-Black	Solenoid 8
3	White-Green	LD 4
4	White-Brown	LD 3
5	White-Orange	LD 2
6	White-Blue	LD 1
7	Green-Red	Hundreds chime
8	Purple-Red	Thousands chime
9	Yellow-Red	Solenoid 6
10	Blue-White-Red	Tens chime
11	Orange-Red	Knocker
12	Blue-Red	Outhole
13	Brown-White	DS 9
14	Orange-White	DS 7
15	Blue-White	DS 8
16	Yellow	DS 6
17	Purple	DS 5
18	Green	DS 4
19	Brown	DS 3
20	Orange	DS 2
21	Blue	DS 1
22	—	Spare
23	*Red	+5 VDC
24	*Black	Ground

All wires #22 gauge unless specified * (#18 gauge)

CABLE PLUGS FOR SOLID-STATE GAMES

PLUG A1-J6

PIN	WIRE COLOR	FUNCTION
1	Black	Ground
2	Blue-Black	Anti-cheat switch
3	Yellow	Return 0
4	Orange	Strobe 1
5	Brown	Strobe 2
6	Green	Strobe 3
7	Purple	Strobe 4
8	Blue	Strobe 0
9	_____	Spare

PLUG A1-J7

1	White-Green-Black	Outhole
2	Blue	Strobe 0
3	Orange	Strobe 1
4	Brown	Strobe 2
5	_____	Spare
6	Purple	Strobe 4
7	Green	Strobe 3
8	*Black	Ground
9	_____	Spare
10	Yellow-Black	Return 7
11	Yellow-White	Return 6
12	Yellow	Return 0
13	Blue-White	Return 1
14	Orange-White	Return 2
15	Purple-White	Return 5
16	Green-White	Return 4
17	Brown-White	Return 3

All wires #22 gauge unless specified * (#18 gauge)

CABLE PLUGS FOR SOLID-STATE GAMES

PLUG A2-J1

PIN	WIRE COLOR	FUNCTION
1	White-Blue	11.5 VAC
2	White-Orange	11.5 VAC Return
3	*Black	Ground
4	White-Brown	14 VAC
5	White-Purple	14 VAC Return
6	Blue-White-Red	69 VAC
7	Orange-White-Red	69 VAC Return

PLUG A2-J2

1	*Red	+5 VDC
2	*Red	+5 VDC
3	_____	Spare
4	*Black	Ground
5	*Black	Ground
6	*Blue	-12 VDC

PLUG A2-J3

1	White-Blue	+60 VDC
2	_____	Spare
3	White-Orange	+42 VDC
4	_____	Spare
5	Black	Ground
6	_____	Spare
7	Blue-White-Black	+4 VDC
8	Green-White-Red	+8 VDC

All wires #22 gauge unless specified * (#18 gauge)

CABLE PLUGS FOR SOLID-STATE GAMES

PLUG A3-J1

PIN	WIRE COLOR	FUNCTION
1	White-Orange	LD 2
2	White-Brown	LD 3
3	White-Blue	LD 1
4	White-Green	LD 4
5	Blue	DS 1
6	Orange	DS 2
7	Brown	DS 3
8	Blue-Red	Outhole
9	Yellow-Red	Solenoid 6
10	Green	DS 4
11	Blue-Black	Solenoid 7
12	Orange-Black	Solenoid 8
13	Purple	DS 5
14	Yellow	DS 6
15	Orange-White	DS 7
16	Blue-White	DS 8
17	Brown-White	DS 9
18	Purple-Red	Thousands chime
19	Green-Red	Hundreds chime
20	Blue-White-Red	Tens chime
21	Orange-Red	Knocker
22	*Black	Ground
23	*Red	+5 VDC
24	_____	Spare

PLUG A3-J2

1	*Orange-Red	Knocker
2	*Orange-Black	Tens chime
3	*Green-Red	Hundreds chime
4	*Purple-Red	Thousands chime
5	*Black	Ground
6	_____	Spare ground
7	_____	Spare ground

All wires #22 gauge unless specified * (#18 gauge)

CABLE PLUGS FOR SOLID-STATE GAMES

PLUG A3-J3

PIN	WIRE COLOR	FUNCTION
1	Yellow-White-White	L36
2	Purple-White-White	L35
3	Green-White-White	L34
4	Brown-White-White	L33
5	Orange-White-White	L32
6	Blue-White-White	L31
7	White-Purple-Black	L29
8	White-Yellow-Black	L30
9	White-Green-Black	L28
10	*Black	Ground
11	White-Brown-Black	L27
12	White-Blue-Black	L25
13	White-Orange-Black	L26
14	White-Yellow-Red	L24
15	White-Purple-Red	L23
16	White-Brown-Red	L21
17	White-Green-Red	L22
18	White-Orange-Red	L20
19	*Black	Ground
20	White-Blue-Red	L19
21	*Black	Ground

PLUG A3-J4

1	(#16 Gauge) Black	Ground
2	(#16 Gauge) Orange-Black	Solenoid 8
3	_____	Spare ground
4	*Blue-Black	Solenoid 7
5	*Yellow-Red	Solenoid 6
6	*Blue-Red	Outhole
7	(#16 Gauge) Black	Ground
8	_____	Spare ground

All wires #22 gauge unless specified * (#18 gauge)

CABLE PLUGS FOR SOLID-STATE GAMES

PLUG A3-J5

PIN	WIRE COLOR	FUNCTION
1	Purple-White-Black	L17
2	Yellow-White-Black	L18
3	Green-White-Black	L16
4	Brown-White-Black	L15
5	Blue-White-Black	L13
6	Orange-White-Black	L14
7	Yellow-White-Red	L12
8	Purple-White-Red	L11
9	Brown-White-Red	L9
10	Green-White-Red	L10
11	Orange-White-Red	L8
12	Blue-White-Red	L7
13	White-Purple	L5
14	White-Yellow	L6
15	White-Green	L4
16	*Black	Ground
17	White-Brown	L3
18	White-Blue	L1
19	White-Orange	L2

All wires #22 gauge unless specified * (#18 gauge)

CABLE PLUGS FOR SOLID-STATE GAMES

PLUG 1A4-J1

PIN	WIRE COLOR	FUNCTION
1	Purple-White	D 6
2	Yellow-White	D 5
3	Orange	D 4
4	Blue	D 3
5	Brown	D 2
6	Green	D 1
7	White-Purple-Black	h A
8	White-Orange-Red	g A
9	White-Blue-Red	f A
10	White-Blue-Black	e A
11	White-Yellow-Red	d A
12	White-Purple-Red	c A
13	White-Green-Red	b A
14	White-Brown-Red	a A
15	Brown-White-Red	5 VAC
16	Purple-White-Red	5 VAC Return
17	White-Blue	+60 VDC
18	—	Spare
19	Black	Ground

All wires #22 gauge unless specified * (#18 gauge)

CABLE PLUGS FOR SOLID-STATE GAMES

PLUG 2A4-J1

PIN	WIRE COLOR	FUNCTION
1	Blue-Red	D 14
2	Orange-Red	D 13
3	Orange-White	D 12
4	Blue-White	D 11
5	Purple	D 10
6	Yellow	D 9
7	White-Purple-Black	h A
8	White-Orange-Red	g A
9	White-Blue-Red	f A
10	White-Blue-Black	e A
11	White-Yellow-Red	d A
12	White-Purple-Red	c A
13	White-Green-Red	b A
14	White-Brown-Red	a A
15	Brown-White-Red	5 VAC
16	Purple-White-Red	5 VAC Return
17	White-Blue	+60 VDC
18	—	Spare
19	Black	Ground

All wires #22 gauge unless specified * (#18 gauge)

CABLE PLUGS FOR SOLID-STATE GAMES

PLUG 3A4-J1

PIN	WIRE COLOR	FUNCTION
1	Purple-White	D 6
2	Yellow-White	D 5
3	Orange	D 4
4	Blue	D 3
5	Brown	D 2
6	Green	D 1
7	White-Yellow-Black	h B
8	White-Yellow	g B
9	White-Purple	f B
10	White-Green-Black	e B
11	Orange-White-Red	d B
12	Blue-White-Red	c B
13	Green-White-White	b B
14	Brown-White-White	a B
15	Brown-White-Red	5 VAC
16	Purple-White-Red	5 VAC Return
17	White-Blue	+60 VDC
18	_____	Spare
19	Black	Ground

All wires #22 gauge unless specified * (#18 gauge)

CABLE PLUGS FOR SOLID-STATE GAMES

PLUG 4A4-J1

PIN	WIRE COLOR	FUNCTION
1	Blue-Red	D 14
2	Orange-Red	D 13
3	Orange-White	D 12
4	Blue-White	D 11
5	Purple	D 10
6	Yellow	D 9
7	White-Yellow-Black	h B
8	White-Yellow	g B
9	White-Purple	f B
10	White-Green-Black	e B
11	Orange-White-Red	d B
12	Blue-White-Red	c B
13	Green-White-White	b B
14	Brown-White-White	a B
15	Brown-White-Red	5 VAC
16	Purple-White-Red	5 VAC Return
17	White-Blue	+60 VDC
18	_____	Spare
19	Black	Ground

All wires #22 gauge unless specified * (#18 gauge)

CABLE PLUGS FOR SOLID-STATE GAMES

PLUG A5-J1

PIN	WIRE COLOR	FUNCTION
1	_____	Spare
2	Green-Red	D 16
3	Brown-Red	D 15
4	_____	Spare
5	Green-White	D 8
6	Brown-White	D 7
7	White-Purple-Red	c A
8	White-Green-Red	b A
9	White-Purple-Black	h A
10	White-Orange-Red	g A
11	White-Blue-Red	f A
12	White-Blue-Black	e A
13	White-Yellow-Red	d A
14	White-Brown-Red	a A
15	Yellow-White-Red	3 VAC
16	Orange-White-Black	3 VAC Return
17	White-Orange	+42 VDC
18	* Red	+5 VDC
19	Black	Ground

All wires #22 gauge unless specified * (#18 gauge)

CABLE PLUGS FOR SOLID-STATE GAMES

PLUG A6-J1

PIN	WIRE COLOR	FUNCTION
1	Yellow	Return 0
2	Blue-White	Play/test switch
3	Orange-White	#1 coin chute
4	Brown-White	#2 coin chute
5	Green-White	Replay button
6	Purple-White	Tilt pendulum
7	*Brown-Red	Coin chute lights
8	Blue-Black	Anti-cheat switches
9	*Brown-Black	Left flipper switch
10	*Green-Black	Flipper return
11	*Red	Coin lockout
12	*Black	Ball roll tilt ground
13	Spare	
14	*White-Black	Coin chute lights return
15	*Green-Yellow	Earth ground and coin lockout return

PLUG A6-J2

1	*Orange-Red	Knocker
2	*Green-Red	Hundreds chime
3	*Purple-Red	Thousands chime
4	*Orange-Black	Tens chime
5	*Red	24 VDC
6	*Red	24 VDC

All wires #22 gauge unless specified *(#18 gauge)

CABLE PLUGS FOR SOLID-STATE GAMES

PLUG A6-J3

PIN	WIRE COLOR	FUNCTION
1	Yellow-Black	Game over light
2	White-Brown	High game to date light
3	White-Green	Shoot Again light
4	Brown-White-Red	5 VAC
5	Green-White-Red	+8 VDC offset
6	Purple-White-Red	5 VAC Return
7	Yellow-White-Red	3 VAC
8	Blue-White-Black	+4 VDC offset
9	Orange-White-Black	3 VAC Return
10	White-Brown-Black	Tilt light
11	*White	6 VDC
12	(#16 Gauge) White-Red	6.3 VAC (lightbox)
13	(#16 Gauge) White-Black	6.3 VAC Return
14	*Green-Yellow	Earth ground
15	_____	Spare

PLUG A6-J4

1	White-Brown	High game to date light
2	*Black	Ground
3	*Black	Ground
4	*Black	Ground
5	*Black	Ground
6	(#16 Gauge) White	6 VDC
7	(#16 Gauge) White-Black	6.3 VAC Return
8	_____	Spare
9	_____	Spare

All wires #22 gauge unless specified * (#18 gauge)

CABLE PLUGS FOR SOLID-STATE GAMES

PLUG A6-J5

PIN	WIRE COLOR	FUNCTION
1	(#16 Gauge) Brown-Red	6.3 VAC (playboard)
2	*Brown-Black	Flipper switch
3	*Brown-Black	Flipper switch
4	*Green-Black	Left flipper sw.
5	*Purple-Black	Right flipper sw.
6	Yellow-Black	Game Over light
7	White-Green	Shoot Again light
8	White-Brown-Black	Tilt light
9	(#16 Gauge) Red	24 VDC
10	(#16 Gauge) Black	Ground
11	(#16 Gauge) Black	Ground
12	(#16 Gauge) Black	Ground

All wires #22 gauge unless specified * (#18 gauge)

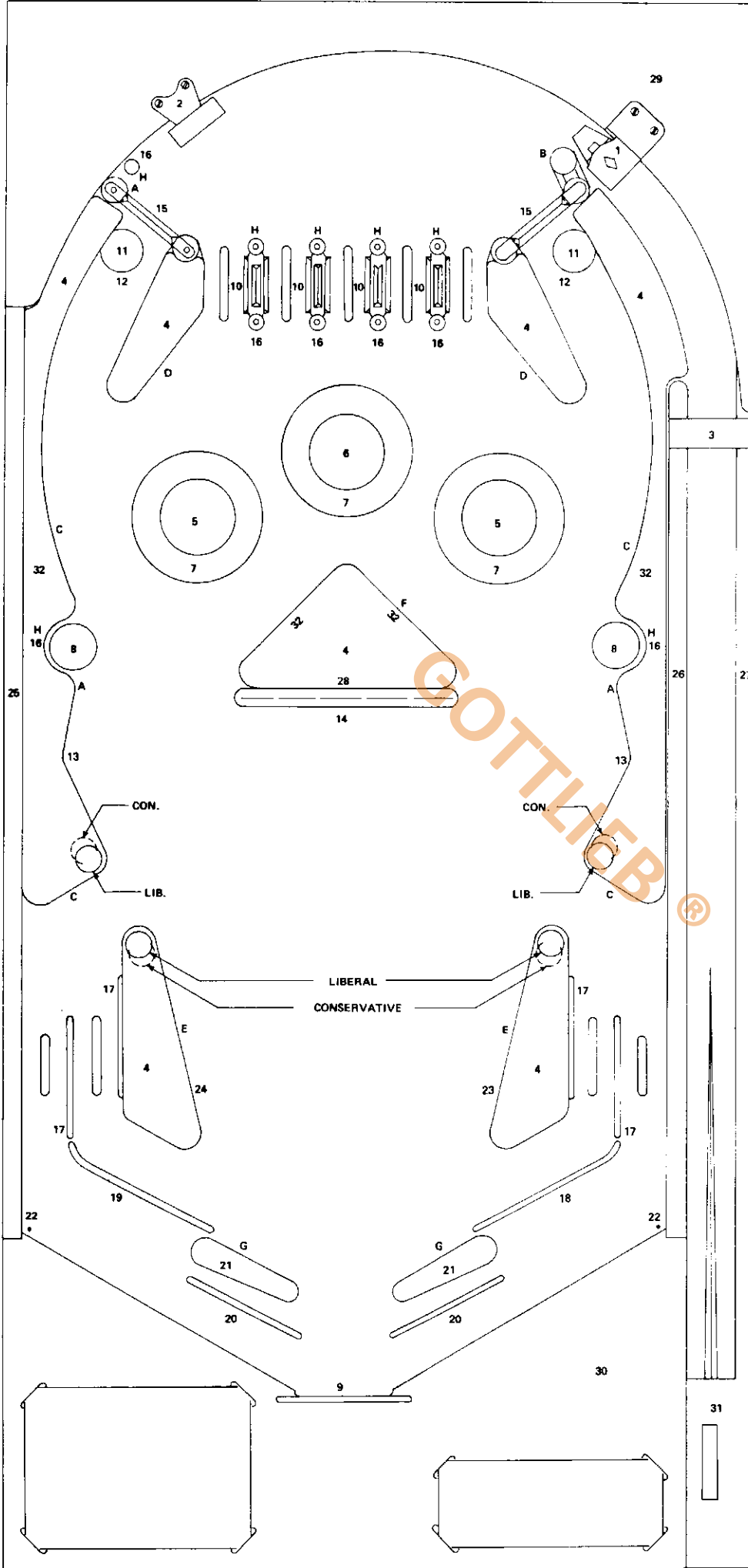
PLAYBOARD INFORMATION

RUBBER RINGS

- A - A-10217 (3) White
- B - A-10218 (1) White
- C - A-10221 (4) White
- D - A-10222 (2) White
- E - A-10223 (2) White
- F - A-10225 (1) White
- G - A-13151 (2) Red
- H - A-15705 (11) White
(Mini Post Screw)

PARTS LIST

1. A-3290 Ball Gate.
2. A-9148 Ball Rebound Rubber.
3. A-8215 Ball Deflector.
4. C-17408 Plastic Shield Set.
5. Yellow Pop Bumper A-10436 and A-11425 White Cap Stamped in Blue.
6. Red Pop Bumper A-10436 and A-16883 White Cap Stamped in Red.
7. B-8246 Pop Bumper Platter. (3)
8. C-15707 Red Plastic Base Plate with Red Plastic C-15708 Sw. Arm. (2)
9. C-15707 Red Plastic Base Plate with White Plastic C-15708 Sw. Arm.
10. C-15647 Red Plastic Rollover Guide. (4)
11. D-11966 Red Rollover Insert. (2)
12. D-11968 White Rollover Button. (2)
13. A-17385 Round Plastic Target Stamped in Gold. (B-17132 Target & Sw. Assem.) (2)
14. 5 Pos. Drop Target Bank with B-11905 (1) Each-White, Red, Blue, Yellow and Green.
15. A-17300 Wire Rollunder Gate. (2)
16. A-14792 Mini Post Screw. (11)
17. A-4832 Ball Guide Rail. — (Wire Form) (4)
18. A-14571 Ball Guide Rail. — (Wire Form) (1)
19. A-14572 Ball Guide Rail. — (Wire Form) (1)
20. A-13798 Ball Guide Rail. — (Wire Form) (2)
21. C-13150 White Flipper. (2)
22. A-10542 Steel Pin. (2)
23. A-15836 Right Kicking Rubber.
24. A-15838 Left Kicking Rubber.
25. C-7393 Wood Rail. (Left Side)
26. C-9771 Wood Rail. (Center)
27. C-13977 Wood Rail. (Right Side)
28. A-17286 Wide Target Assembly.
29. D-4806 Top Arch with "H" & "B"- "G" Pos.
30. D-13647-1A Card Holder.
31. C-9767 Ball Shooter Gate.
32. A-18070 Ball Guide Rail. — (Wire Form)
- C-11561 White Plastic Post 1" High. (29)
- C-11562 White Plastic Post 1-3/16" High. (4)
- A-14487 White Plastic Split Post Base. (6)
- A-14488 White Plastic Split Post Cap. (6)
- LIB. = LIBERAL.
- CON. = CONSERVATIVE.



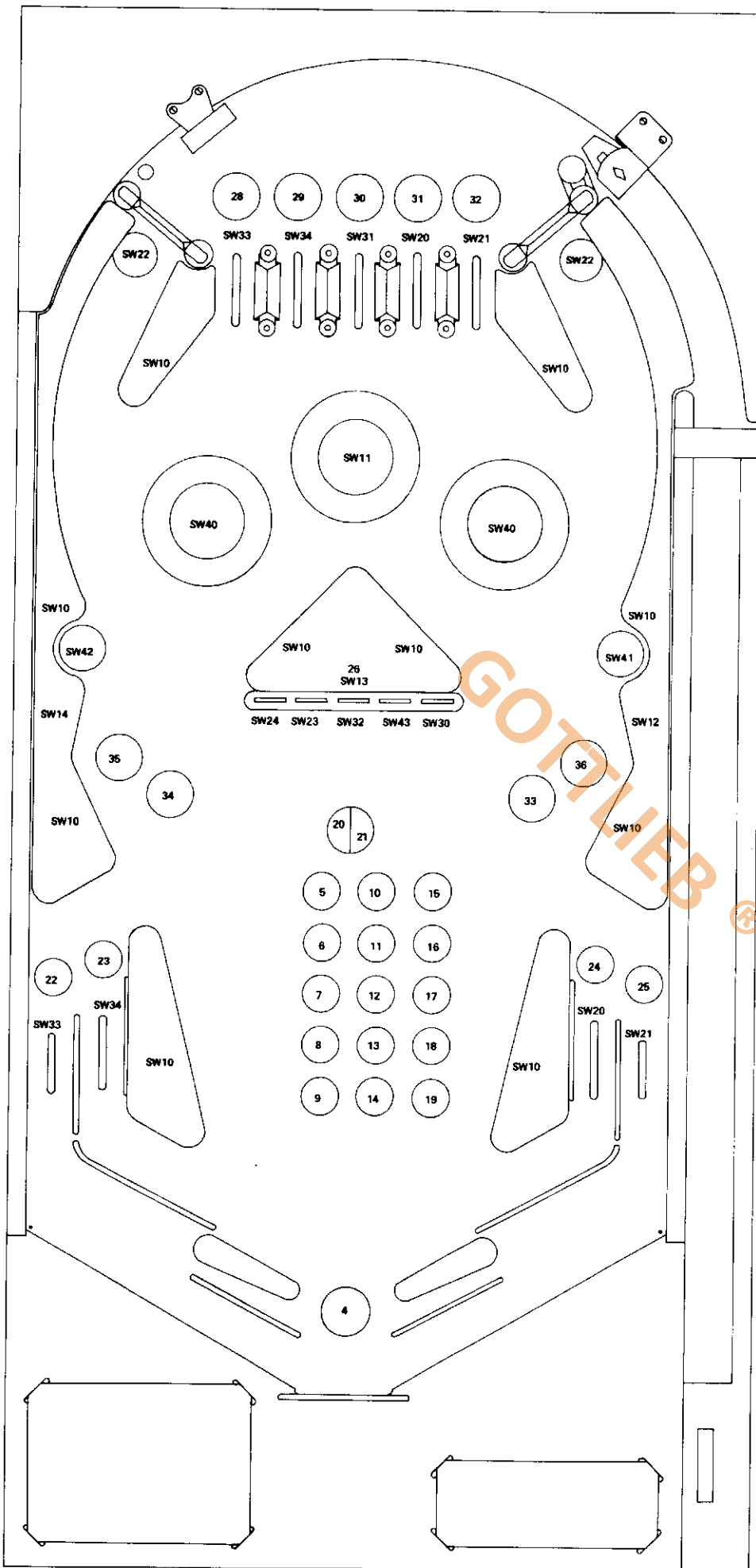
SWITCH MATRIX AND LAMP LOCATION

SWITCHES ON MATRIX

SW. MATRIX NUMBER	SW. FUNCTION
SW00	Test Button (On Front Door)
SW01	# Coin Chute (On Front Door)
SW02	#2 Coin Chute (On Front Door)
SW03	Replay Button (On Front Door)
SW04	Tilt Switches
SW10	10 Point Switches (10)
SW11	Center Pop Bumper
SW12	Right Side Target
SW13	Center Target
SW14	Left Side Target
SW20	Blue Rollovers (2)
SW21	Green Rollovers (2)
SW22	Right & Left Star Rollovers (2)
SW23	White Drop Target
SW24	Yellow Drop Target
SW30	Green Drop Target
SW31	Red Rollover
SW32	Red Drop Target
SW33	Yellow Rollovers (2)
SW34	White Rollovers (2)
SW40	Right & Left Pop Bumpers (2)
SW41	Right Hole
SW42	Left Hole
SW43	Blue Drop Target

CPU CONTROLLED LAMPS

LAMP NUMBER	LAMP FUNCTION
1	Game Over Relay (Lamp in Lightbox)
2	Tilt Relay (Lamp in Lightbox)
3	High Game To Date (In Lightbox)
4	Same Player Shoots Again (Playfield & Lightbox).
5	Red Bonus - Left
6	White Bonus - Left
7	Blue Bonus - Left
8	Yellow Bonus - Left
9	Green Bonus - Left
10	Red Bonus - Right
11	White Bonus - Right
12	Blue Bonus - Right
13	Yellow Bonus - Right
14	Green Bonus - Right
15	Red Bonus - Arrow
16	White Bonus - Arrow
17	Blue Bonus - Arrow
18	Yellow Bonus - Arrow
19	Green Bonus - Arrow
20	Left Double Bonus
21	Right Double Bonus
22	Yellow Out Rollover
23	White Return Rollover
24	Blue Return Rollover
25	Green Out Rollover
26	Center Target
27	Not Used
28	Yellow Top Rollover
29	White Top Rollover
30	Red Top Rollover
31	Blue Top Rollover
32	Green Top Rollover
33	Right Extra Ball
34	Left Extra Ball
35	Left Special
36	Right Special



PARTS LIST

ELECTRONIC COMPONENTS

PB00-D100	Control Board (A1) (Less Prom)
S520	Power Supply Board (A2)
PB00-D110	Master Driver Board (A3)
PB00-D140	Display Board—Score (A4)
PB00-D150	Display Board—Ball in Play, Credit (A5)
MMI-6351-1J	Prom (Must have name of game)
#5K1	Line Filter
#VK-438	Bridge Rectifier
#VL-038	Bridge Rectifier
#1N-270	Germanium Diode
#1N-4004	Diode

MECHANICAL COMPONENTS

A-17906	Bracket and Stop—Pop Bumper
A-17907	Bracket and Stop—Hole Kickers, Contact Kickers
A-17908	Bracket and Stop—Flipper
A-17958	Bracket and Stop—Target Bank Reset
B-17543	Ball Roll Tilt Switch Assembly
B-17838	Flipper Button Switch Assembly
B-17842	Contact Kicker Switch Assembly
B-18076	5000 When Lit Target Switch Assembly
B-18079	Rubber Contact Switch Assembly
B-18080	Rollover Button Switch Assembly
B-18083	Rollover Switch Assembly
B-18085	Hole Kicker Switch Assembly
B-18086	Contact Kicker Switch Assembly—Scoring
B-18089	Pop Bumper Switch Assembly
B-18091	Coin Chute Switch Assembly
B-18092	Replay Button Switch Assembly
B-18095	Drop Target Switch Assembly
#E-69-01A	Play/Test Switch
	Carbon Tilt Bob

PARTS LIST

CONTROL BOARD

PB00-D100

1	MMI-6351-1J	Prom — Monolithic Memories
2	15-24-1151	Molex Connector — (TC1, TC2)
1	CA-08P02	Plug
1	CA-08-160-000	Cover
1	41B901CD05-1	Battery Pack — 3.6V. General Electric
2	V-1003	Battery Clip-Richo
1	44-111-021	Switch-Push Button — (S 25)
3	10040-008	Molex-Switch Matrix — (Slum 1, 2, 3)
1	CA-18SE-10SD	IC Socket — 18 Pin-Circuit Ass'y
1	333R08-001	Crystal — 3.579545 MHZ.
1	11660CF	MOS/LSI-CPU-(U1)
2	10696EE	MOS/LSI-GPIØ-(U2, U3)
1	A1753 CD	MOS/LSI-ROM/RAM/IØ (U4)
1	A1752 CE	MOS/LSI-ROM/RAM/IØ (U5)
1	10788PA	MOS/LSI-GPKD (U6)
1	SCL4081BE	IC-Quad and — Sol. St. Scientific (Z1)
1	SN74154N	IC-4 to 16 Decoder — T.I. (Z30)
4	SN7405N	IC-Hex Inverter — OC — T.I. (Z9, 27, 28, 29)
1	SN7416N	IC-Hex Inverter — OC/HV. — T.I. (Z26)
5	SN7404N	IC-Hex Inverter — T.I. (Z8, Z13, 14, 25, 24)
4	SN7417N	IC-Hex Buffer — OC (Z6, 7, 11, 12)
1	SN74H21N	IC-Dual 4-Input and — T.I. (Z15)
2	SN7448N	IC-4 to 7 Decoder T.I. (Z16, 17)
4	SN7408N	IC-Quad 2 Input and — T.I. (Z18, 19, 20, 21)
1	P5101L-3	CMOS-Static Ram (256X4) (Z22)
2	CD4049CN	IC-Hex Buffer/Conv. — National (Z3, 4)
1	SN74LS05N	IC-LP Hex Inverter — OC — T.I. (Z5)
1	SCL4528BE	IC-Dual One Shot — Sol. St. Scientific (Z2)
6	461RO2-001	Transistor, PNP (MPS-A70) (Q1-6)
36	742RO1-001	Diode, GP (1N4148) (CR1-24, 26-37)
2	721RO1-025	Resistor-1 OHM, 1/4 W. 5% (R107-R108)
1	721RO1-068	Resistor-62 OHM, 1/4 W. 5% (R133)
12	721RO1-092	Resistor-620 OHM, 1/4 W. 5% (R45-R56)
3	721RO1-097	Resistor-1K OHM, 1/4 W. 5% (R109, 156, 157)
31	721RO1-107	Resistor-2.7K OHM, 1/4 W. 5% (R11-16, 25-32, 73-80, 99-106, 147)
54	721RO1-117	Resistor-6.8K OHM, 1/4 W. 5% (R3-10, 33-44, 57-62, 82-98, 122-131, 162)
17	721RO1-123	Resistor-12K OHM, 1/4 W. 5% (R134-145, 149-153)
21	721RO1-130	Resistor-24K OHM, 1/4 W. 5% (R1, 2, 17-24, 65-72, 81, 154, 155)
15	721RO1-131	Resistor-27K OHM, 1/4 W. 5% (R110-121, 160, 161, 163)
1	10/40/80000	Capacitor — 10 Micro-Farad, 40V. — Siemens (C20)
1	ECE-B25V100L	Capacitor — 100 Micro-Farad, 25V. — Matsushita (C17)
1	ECE-B10V100L	Capacitor — 100 Micro-Farad, 10V. — Matsushita (C16)
26	C320C103MIR5CA	Capacitor — 0.1 Micro-Farad, 100V. — Sprague/Kemet (C1-15, 18, 19, 22-30, 33)
2	703RO1-003	Capacitor — 0.1 Micro-Farad, 100V. (C31, C32)
1	1N703	Diode — Motorola/Siemens (CR38)
1	721RO1-175	Resistor — 1.8M, 1/4 W. 5% (R158)
1	721RO1-179	Resistor — 2.7M, 1/4 W. 5% (R159)
1	CA-08SE-105D	Socket (TC3)

PARTS LIST **MASTER DRIVER BOARD** **PB00-D110**

9	SN74175N	Integrated Circuit, Quad "D" Flip-Flop-T.I. (Z1-Z9)
38	721R01-097	Resistor-1K OHM, 5%, 1/4 W. (R1-R38)
1	721R01-052	Resistor-13 OHM, 5%, 1/4 W. (R39)
14	C320C103MIR5CA	Capacitor-.01 Micro-Farad, 20%, 100V. — Kemet (C2-C15)
1	T320B106-010AS	Capacitor-10 Micro-Farad, 10V. — Kemet (C1)
5	MPS-U45	Transistor, NPN — Motorola (Q1-Q4, Q29)
32	MPS-A13	Transistor, NPN — Motorola (Q5-Q24, Q33-Q44)
7	2N6043	Transistor, NPN — Motorola (Q25-Q28, Q30-Q32)
1	2N3055	Transistor, NPN — RCA (Q45)
1	43-03-4	Insulator — Thermalloy (Q45 Ref.)

GOTTlieb®

PARTS LIST
6 DIGIT DISPLAY
PB00-D140

1	721R01-121	Resistor, 10K, 1/2 W., 5% (R1)
1	TE1400	Capacitor — 1 Micro-Farad 100V. (C3)
2	C320C103MIR5CA	Capacitor — .01 Micro-Farad, 100V. (C1, C2)
2	UDN6118A	IC-Fluorescent Dis. Driver — Sprague (Z1, Z2)
1	6-JS-01	6 Digit Display — Futaba Ind. U.S.A.

4 DIGIT DISPLAY
PB00-D150

1	TE1400	Capacitor — 1 Micro-Farad, 100V. — Sprague (C1)
2	C320C103MIR5CA	Capacitor — .01 Micro-Farad, 100V. — Kemet (C2, C3)
2	UDN6118A	IC — Fluorescent Dis. Driver — Sprague (Z2, Z3)
1	SN7432N	IC — Quad or Gate — T.I. (Z1)
1	4-LT-11	4 Digit Display — Futaba Ind. U.S.A. (DS1)
9	721R01-107	Resistor — 2.7K, 1/4 W., $\pm 5\%$ (R1-R9)
11	721R01-137	Resistor — 47K, 1/4 W., $\pm 5\%$ (R10-R20)

PARTS LIST **POWER SUPPLY** **S520**

1	RC42GF18R2	Resistor, .18 OHM, 2 W. $\pm$ 5% (R1)
3	RC20GF101	Resistor, 100 OHM, $\frac{1}{2}$ W. $\pm$ 5% (R2, R101, R201)
1	RC20GF431	Resistor, 430 OHM, $\frac{1}{2}$ W. $\pm$ 5% (R3)
1	RC20GF681	Resistor, 680 OHM, $\frac{1}{2}$ W. $\pm$ 5% (R21)
1	C173BNA	Resistor, 1.2K OHM, $\frac{1}{2}$ W. $\pm$ 1% (R5) MEPCO
1	RC20GF202	Resistor, 2K OHM, $\frac{1}{2}$ W. $\pm$ 5% (R6)
2	RC20GF152	Resistor, 1.5K OHM, $\frac{1}{2}$ W. $\pm$ 5% (R7, R8)
1	RC20GF222	Resistor, 2.2K OHM, $\frac{1}{2}$ W. $\pm$ 5% (R9)
2	RC20GF153	Resistor, 15K OHM, $\frac{1}{2}$ W. $\pm$ 5% (R10, R11)
1	RC20GF102	Resistor, 1K OHM, $\frac{1}{2}$ W. $\pm$ 5% (R12)
1	RC20GF270	Resistor, 27 OHM, $\frac{1}{2}$ W. $\pm$ 5% (R13)
1	RC20GF123	Resistor, 12K OHM, $\frac{1}{2}$ W. $\pm$ 5% (R14)
2	RC20GF103	Resistor, 10K OHM, $\frac{1}{2}$ W. $\pm$ 5% (R15, R18)
1	RC20GF242	Resistor, 2.4K OHM, $\frac{1}{2}$ W. $\pm$ 5% (R17)
2	RC20GF201	Resistor, 200 OHM, $\frac{1}{2}$ W. $\pm$ 5% (R102, R202)
1	RC20GF471	Resistor, 470 OHM, $\frac{1}{2}$ W. $\pm$ 5% (R22)
1	115R102A	Pot. 1K OHM, 2 W. 10% (R4) CTS
1	115R501A	Pot. 500 OHM, 2W. 10% (R16) CTS
1	PMD12K40	Transistor (Q1) Power Monolithics
1	MJE340K	Transistor (Q2) Motorola
1	2N3416	Transistor (Q3)
1	MPSA43	Transistor (Q4) Motorola
2	MR751	Diode, 3 AMP (CR1, CR2) Motorola
2	1N4002	Diode, 1 AMP, 100 V. (CR3, CR4) Motorola
3	1N914	Diode (CR5, CR22, CR23)
4	1N4004	Diode, 1 AMP, 400 V. (CR6, CR7, CR8, CR9)
1	1N4753	Diode (CR10) Motorola
1	1N4742A	Diode (CR11) Motorola
1	1N4746A	Diode (CR12) Motorola
1	1N4738A	Diode (CR21) Motorola
2	1N4734A	Diode (CR101, CR201) Motorola
2	S0306SL3	Rectifier (SCR101, SCR201)
1	UA723CL	+ 5 V. Regulator (LIC1) TI
1	UA79MI2CKC	-12 V. Regulator (IC1) TI
1	7735	Capacitor 2.9K Micro-Farad 30 V. (C1)
1	8101-100W5RO221K	Capacitor 220 Pico-Farad 16 V. (C2) Erie
1	7545	Capacitor 470 Micro-Farad 10 V. (C3) TI
1	7732	Capacitor 1K Micro-Farad 35 V. (C4) TI
1	7345	Capacitor 47 Micro-Farad 50 V. (C5) TI
1	CEO2W	Capacitor 200 Micro-Farad 150 V. (C6) Towa
1	8121-050651104M	Capacitor 0.1 Micro-Farad 10 V. (C7)
1	7745	Capacitor 10 Micro-Farad 160 V. (C8)
2	UK10-204	Capacitor 0.2 Micro-Farad 10 V. (C101, C201)
1	09-60-1071	Connector (J1) Molex
1	09-67-1061	Connector (J2) Molex
1	09-67-1081	Connector (J3) Molex