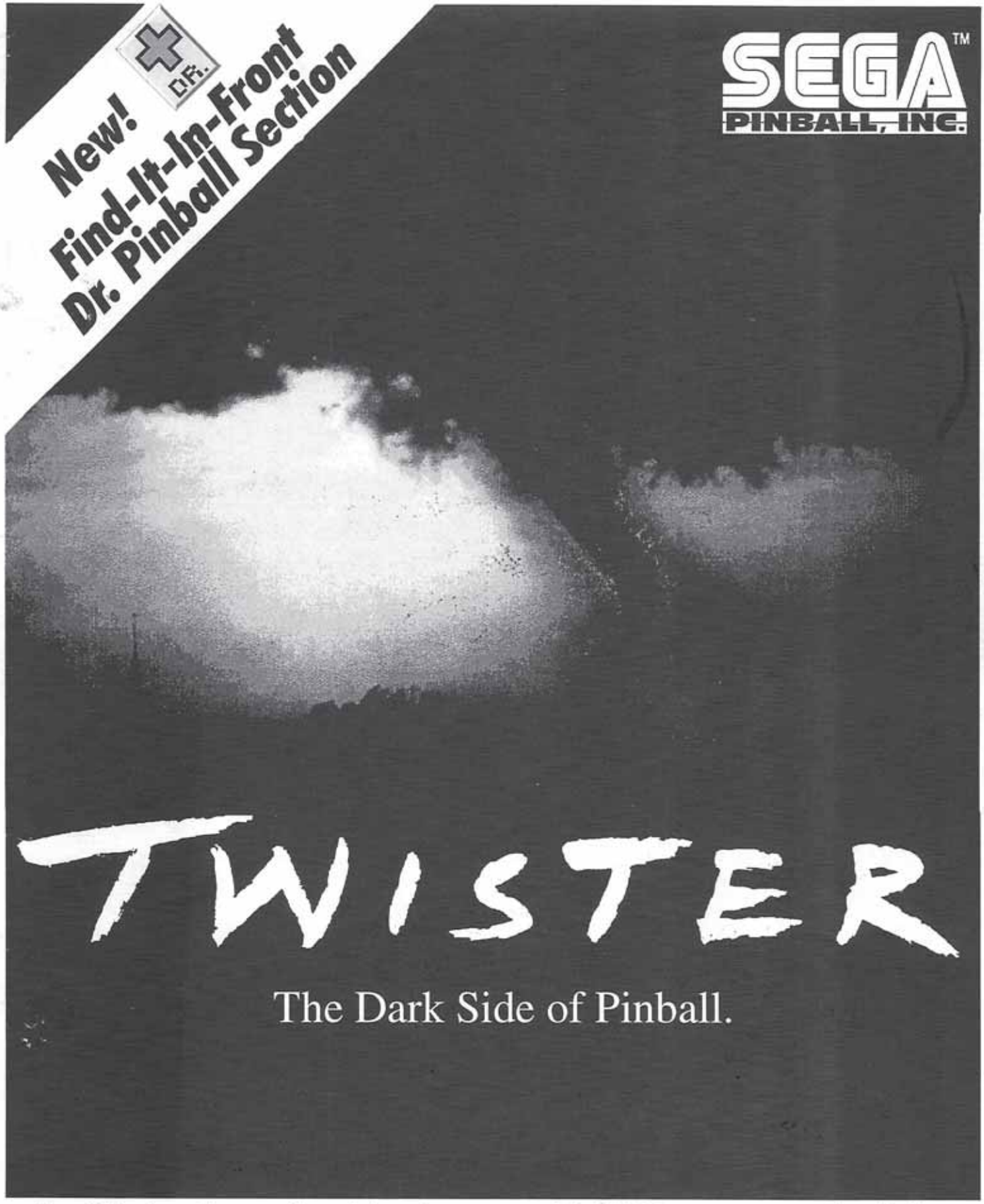

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...why can't a flipper coil be flipped or energized like any other coil?

It can, it should...and now it is!
NEW FLIPPER DESIGN - NO FLIPPER BOARD!

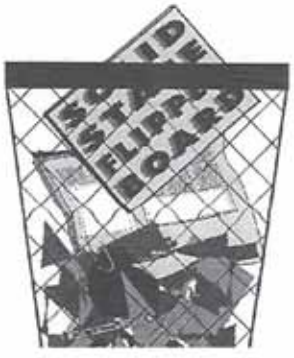
One of the objectives in going to the **White Star Board System**™ was to simplify the system for the Operator. We have taken this line of thinking one step farther by simplifying our flipper circuit. Our pinballs were the first to utilize a ***Solid State Flipper System***. This required more complex circuitry in the form of the Solid State Flipper Board but reduced the overall amount of service calls on the pinball by a good 25% due to increased reliability.

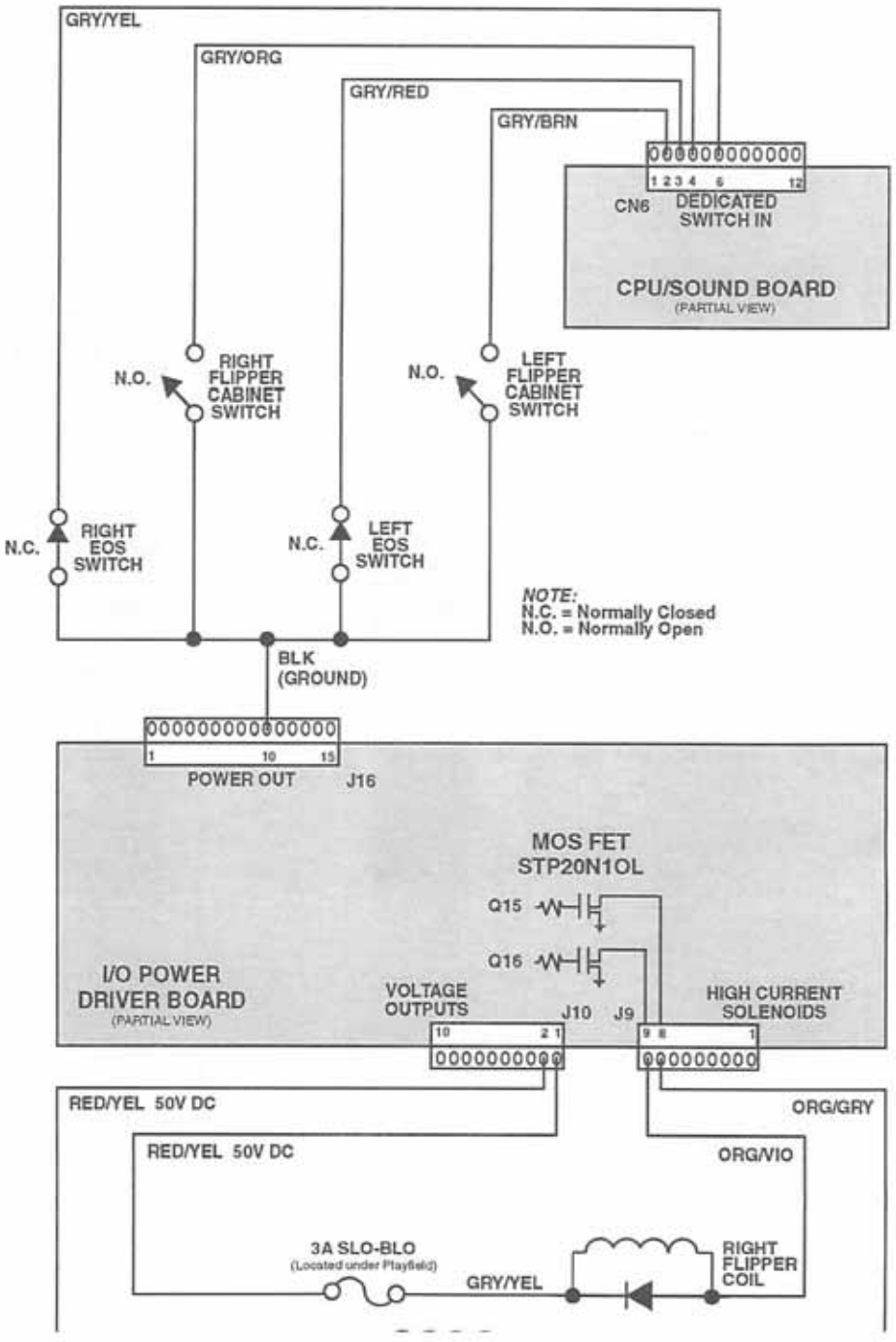
The **White Star Board System**™ has allowed us to *simplify* the flipper circuit to the point where we have *eliminated the flipper board* altogether. The flipper circuit is now configured the same as any other solenoid drive circuit (see below).

Technical Overview

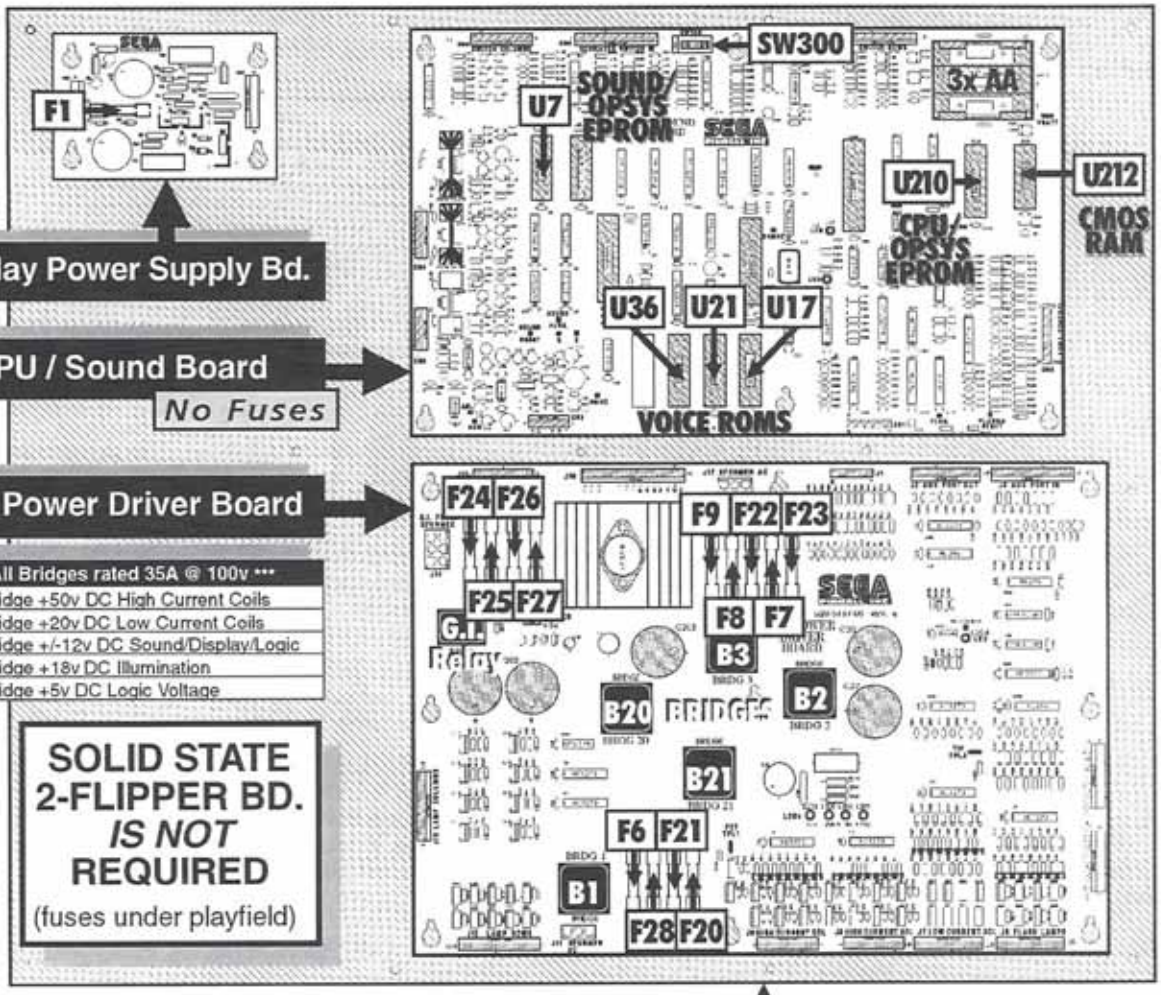
Our ***New Flipper System*** uses one supply voltage (50v DC) for both kick and hold. Once the **Game CPU** detects a flipper cabinet switch closure (during game play) it applies a 40 msec pulse to the gate of the flipper drive transistor (STP20N10L). If it continues to detect a flipper cabinet switch closure (the player holding the button in) it will continue to pulse the flipper drive transistor 1 msec every 12 msecs for the duration of the hold cycle.

The **E.O.S.** (End-Of-Stroke) **Switch** serves the same function as before as it prevents foldback when the player has the flipper energized to capture balls. The **E.O.S. Switch** is a normally closed switch which opens approximately a 1/16" when the flipper is energized. The **Game CPU** will detect a switch closure if the flipper bat is forced back by a high velocity shot or rebound on the playfield and will apply another 40 msec pulse of 50v DC to the coil.

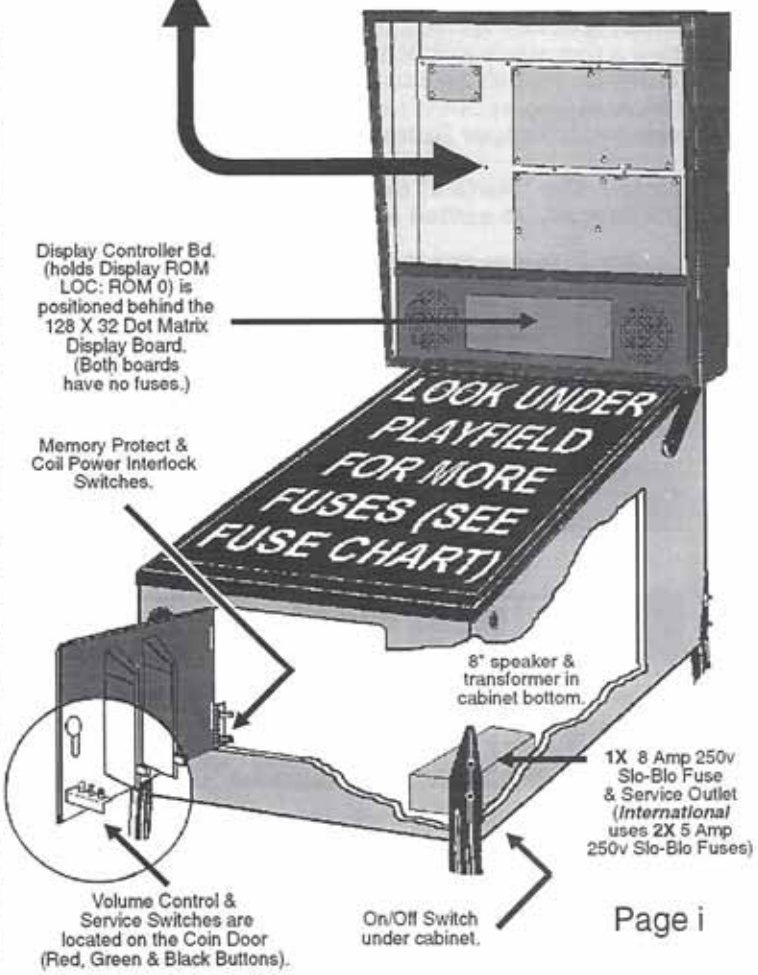




NEW BACKBOX LAYOUT, FUSE & RELAY LOCATIONS

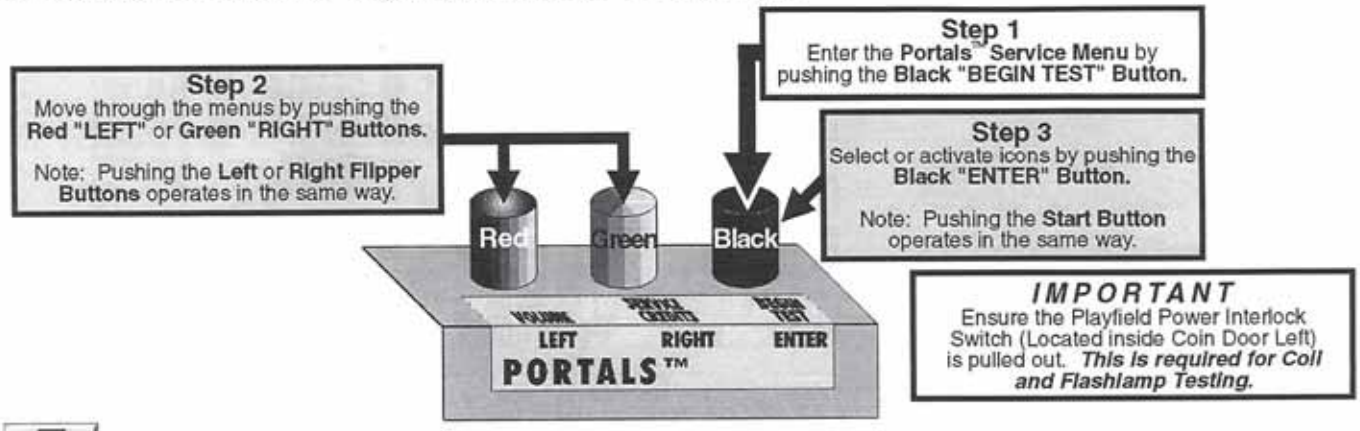


QUICK REFERENCE FUSE CHART	
Backbox Fuses DISPLAY POWER SUPPLY BOARD	
F1	3/4A 250v Slo-Blo 90v DC High Voltage Display
I / O POWER DRIVER BOARD	
F6	7A 250v Slo-Blo 50v DC Primary High Power Coils & Flippers
F7	5A 250v Slo-Blo 20v DC Low Power Coils
F8	5A 250v Slo-Blo 12v DC Logic Power
F9	5A 250v Slo-Blo 12v DC Logic Power
F20	3A 250v Slo-Blo 50v DC Magnet
F21	3A 250v Slo-Blo 50v DC Coils
F22	8A 250v Slo-Blo 18v DC Controlled Lamps
F23	4A 250v Slo-Blo 5v DC Logic
F24	Not Used / Spare (5A 250v Slo-Blo)
F25	5A 250v Slo-Blo 6.3v AC G.I. Lamp Rt./Lt. Side Playfield
F26	5A 250v Slo-Blo 6.3v AC G.I. Lamp Lt. Side P/F & Coin Door
F27	5A 250v Slo-Blo 6.3v AC G.I. Lamp Upper Half Playfield
F28	3A 250v Slo-Blo 24v AC Special Relay/Motors (24v Motor)
Cabinet Fuses SERVICE (AC) OUTLET BOX (CABINET BOTTOM)	
Main Fuse Line: 1X 8A 250v Slo-Blo (Int'l) 2X 5A 250v Slo-Blo	
Under Playfield Fuses BY FLIPPER ASSEMBLIES	
n/a	3A 250v Slo-Blo 50v DC Output (all fuses) Right Flipper
n/a	3A 250v Slo-Blo 50v DC Output Left Flipper
BY MAGNET ASSEMBLIES	
n/a	3A 250v Slo-Blo 50v DC Magnet (for Orbit Ball Diverter)
n/a	3A 250v Slo-Blo 50v DC Magnet (for Magna Disc)



FIND-IT-IN-FRONT: DR. PINBALL SECTION

The key technical data from various parts of the manual was extracted and combined into the "Find-It-In-Front: Dr. Pinball Section." This new section will assist the technician in locating important technical information needed to troubleshoot the machine. To get into the **Portals™ Service Menu:**



We are introducing in our **Portals™ Service Menu** a new icon and diagnostic aid called Dr. Pinball (Flow Chart Menus). This is a feature that will allow the operator/technician to utilize the power of the micro-processor assisting in troubleshooting a problem with the machine.

☆ ☆ ☆ ☆ HOW IT WORKS ☆ ☆ ☆ ☆

First, the operator/technician must enter the Service Mode (for a complete description of the **Portals™ Service Menu** and **ICONS** see Section 3, Chapter 1). To get into the Service Menu Mode: • Power-up game (if not already) & open the Coin Door. • On the Coin Door is the Portals™ Service Switch Set (**Red**, **Green** & **Black Buttons**). Push down the **Black "BEGIN TEST" Button**. Looking at the Video Display you will momentarily see the introductory screen "Service Menu" with a satellite flying from right to left pulling a banner "Portals™ © 1996 SEGA PINBALL, INC.," followed by the **MAIN MENU**.

While in the **MAIN MENU**, select the "DIAG" *Icon*, then select the Cross "DR." *Icon*. This will bring you (the operator / technician) into **DR. PINBALL** (Flow Chart Menus) which offers you a choice of four sub-menus: Flipper "DR.," Coil "DR.," Switch "DR." and Lamp "DR." *Icons*. Selecting a particular sub-menu will give you a choice of which specific Flipper, Coil, Switch or Lamp circuit needs to be diagnosed. The display will now ask a question or give a procedure to follow such as "Does the lamp turn on?" or "Check bridge rectifier BR-20, if short replace." When Dr. Pinball asks a question or request a procedure the Dr. will expect a response such as "no" or "yes" (see below examples of the mini-icons which will prompt the operator). You the operator/technician must respond by using your **Flipper Buttons** to "SELECT" a mini-icon and the **Start Button** to "ENTER" your selection.

Note: The "Portals" service switches located on the coin door can also be used to select and enter mini-icons. In switch test this is required since flipper and start switches are part of the test.

The following are the mini-icons with explanations for the Dr. Pinball Sub-Menus:

Select a Coil, Lamp, Switch or Flipper to diagnose with "-" or "+" Icon; Then "RUN." ("QUIT" exits Portals completely.)

Seen when question is being asked on the Display. "END" lets you select a new item to test; "PREV" goes back to previous question.

Seen when diagnosis is given. "PREV" lets you go back.

In Coil Flow Chart Menu, lets you pulse the coil. "NO." "YES." "END." "PREV." "QUIT"

INSTALL ⑤ BALLS! *TWISTER* is a ⑤-Ball Game!

✻ DIAGNOSTIC AIDS ✻

The *display reads* "OPERATOR ALERT..." — A message displayed during Game Mode or Power-Up to alert the operator of a problem.

OPERATOR ALERT works by monitoring any *switch activated coil* that has the potential to trap a ball when disabled (e.g. in the Auto Launch, Scoop, Eject, etc.). If this assembly has a closed switch indicating a ball is stuck or the switch is *stuck closed*, the **CPU Board** will activate the coil ten times. If the switch remains closed, the game will display a message indicating there is a problem (e.g. "**OPERATOR ALERT AUTOLAUNCH NOT WORKING**"). This not only warns the operator of a problem immediately, but indicates exactly where the operator should look to resolve it.

The *display flashes* "OPEN THE COIN DOOR" — This indicates that CMOS RAM memory (CPU Loc. U212) has been corrupted.

This is caused by either failure in memory (e.g. batteries are dead or faulty **RAM**) or upon installation of updated version of code. Opening the Coin Door will initiate a Factory Restore, by opening the Memory Protect Switch. Check battery voltage at **CMOS RAM** with power off.

CPU DIP SWITCH SETTINGS, LOC. SW300 CPU/SOUND BOARD

GOLDENEYE: CUSTOM FACTORY ADJUSTMENTS BY COUNTRY*

From the Main Menu In Portals" GO TO DIAGNOSTICS MENU →

From the Diagnostics Menu GO TO SWITCH MENU →

From the Switch Menu GO TO DIP SWITCH TEST

*All countries not noted below use the "USA CPU Country Setting"

CPU COUNTRY SETTING:	Pos.	1	2	3	4	5	6	7	8
USA *	ON								
	OFF	●	●	●	●	●	●	●	●

CPU COUNTRY SETTING:	Pos.	1	2	3	4	5	6	7	8
AUSTRIA	ON	●							
	OFF		●	●	●	●	●	●	●

CPU COUNTRY SETTING:	Pos.	1	2	3	4	5	6	7	8
BELGIUM	ON		●						
	OFF	●		●	●	●	●	●	●

CPU COUNTRY SETTING:	Pos.	1	2	3	4	5	6	7	8
CANADA	ON	●	●						
	OFF			●	●	●	●	●	●

CPU COUNTRY SETTING:	Pos.	1	2	3	4	5	6	7	8
ENGLAND (UK)	ON	●		●					
	OFF		●		●	●	●	●	●

CPU COUNTRY SETTING:	Pos.	1	2	3	4	5	6	7	8
FRANCE	ON		●	●					
	OFF	●			●	●	●	●	●

CPU COUNTRY SETTING:	Pos.	1	2	3	4	5	6	7	8
GERMANY	ON	●	●	●					
	OFF				●	●	●	●	●

CPU COUNTRY SETTING:	Pos.	1	2	3	4	5	6	7	8
HOLLAND (DUTCH) & NETHERLANDS	ON				●				
	OFF	●	●			●	●	●	●

CPU COUNTRY SETTING:	Pos.	1	2	3	4	5	6	7	8
ITALY	ON				●				
	OFF	●	●	●		●	●	●	●

CPU COUNTRY SETTING:	Pos.	1	2	3	4	5	6	7	8
JAPAN	ON	●			●				
	OFF		●	●		●	●	●	●

CPU COUNTRY SETTING:	Pos.	1	2	3	4	5	6	7	8
NORWAY	ON		●		●				
	OFF	●		●		●	●	●	●

CPU COUNTRY SETTING:	Pos.	1	2	3	4	5	6	7	8
SWEDEN	ON	●	●		●				
	OFF			●		●	●	●	●

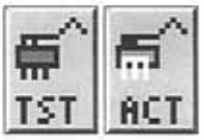
CPU COUNTRY SETTING:	Pos.	1	2	3	4	5	6	7	8
SWITZERLAND	ON			●	●				
	OFF	●	●			●	●	●	●

TWISTER ROM SUMMARY TABLE

I.C. NAME	TYPE	BOARD NAME	LOC.	PART №
Game ROM	1MB	CPU / Sound Board	U210	965-0219-41
Voice ROM 1	4MB	CPU / Sound Board	U17	965-0220-41
Voice ROM 2	Not Used	CPU / Sound Board	U21	Not Used
Voice ROM 3	Not Used	CPU / Sound Board	U36	Not Used
Voice ROM 4	Not Used	CPU / Sound Board	U37	Not Used
Sound EPROM	512K	CPU / Sound Board	U7	965-0221-41
Display EPROM	4MB	Display Controller Bd.	ROM Ø	965-0222-41
Display EPROM	Not Used	Display Controller Bd.	ROM 3	Not Used

From the Main Menu in Portals™ GO TO DIAGNOSTICS MENU

From the Diagnostics Menu GO TO SWITCH MENU



From the Switch Menu GO TO SWITCH OR ACTIVE SWITCH TEST

From the Switch Menu GO TO DEDICATED SWITCH TEST

SWITCH MATRIX GRID & DEDICATED SWITCHES

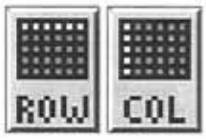
Column (Drive) / Row (Return)	1 Q1 GRN-BRN CN5-1	2 Q2 GRN-RED CN5-3	3 Q3 GRN-ORG CN5-4	4 Q4 GRN-YEL CN5-5	5 Q5 GRN-BLK CN5-6	6 Q6 GRN-BLU CN5-7	7 Q7 GRN-VIO CN5-8	8 Q8 GRN-GRY CN5-9
1 WHT-BRN CN7-9	NOT USED 1	DROP TARGET 9	LEFT TOP LANE 17	DISC MAGNET-Q2 MAG. BD. 25	3-BANK S-U (T) WI 33	5-BALL LOCK #1 (BOTTOM) 41	LEFT TURBO BUMPER 49	LEFT OUTLANE 57
2 WHT-RED CN7-8	4TH COIN SLOT 2	5-BALL TROUGH #1 (LEFT) 10	MIDDLE TOP LANE 18	WEST STAND-UP 26	3-BANK S-U T (W) I 34	5-BALL LOCK #2 42	BOTTOM TURBO BUMPER 50	LEFT RETURN LANE 58
3 WHT-ORG CN7-7	6TH COIN SLOT (FUTURE) 3	5-BALL TROUGH #2 11	RIGHT TOP LANE 19	NW STAND-UP 27	3-BANK S-U TW (I) 35	5-BALL LOCK #3 43	RIGHT TURBO BUMPER 51	LEFT SLINGSHOT 59
4 WHT-YEL CN7-6	RIGHT COIN SLOT 4	5-BALL TROUGH #3 12	LEFT SPINNER 20	NORTH STAND-UP 28	S-U TOP TWI (S) TER 36	5-BALL LOCK #4 44	NOT USED 52	RIGHT OUTLANE 60
5 WHT-GRN CN7-5	CENTER COIN SLOT / DBA 5	5-BALL TROUGH #4 13	LEFT ORBIT 21	NE STAND-UP 29	3-BANK S-U (T) ER 37	5-BALL LOCK VUK 45	NOT USED 53	RIGHT RETURN LANE 61
6 WHT-BLU CN7-3	LEFT COIN SLOT 6	5-BALL TROUGH #5 (RIGHT) 14	RIGHT SPINNER 22	EAST STAND-UP 30	3-BANK S-U T (E) R 38	NOT USED 46	START BUTTON 54	RIGHT SLINGSHOT 62
7 WHT-VIO CN7-2	5TH COIN SLOT (FUTURE) 7	5-BALL TROUGH VUK OPTO 15	RIGHT ORBIT 23	SE STAND-UP 31	3-BANK S-U TE (R) 39	NOT USED 47	SLAM TILT 55	NOT USED 63
8 WHT-GRY CN7-1	NOT USED 8	SHOOTER LANE 16	RIGHT RAMP ENTER 24	DIVERTER MAGNET-Q1 M. BD. 32	RIGHT RAMP EXIT 40	NOT USED 48	PLUMB BOB TILT 56	NOT USED 64

GND / IC U206 INPUTS	Ground BLK CN6-1
1 GRY-BRN CN6-2	LEFT FLIPPER BUTTON DS-1
2 GRY-RED CN6-3	LEFT FLIPPER END-OF-STROKE (E.O.S) DS-2
3 GRY-ORG CN6-4	RIGHT FLIPPER BUTTON DS-3
4 GRY-YEL CN6-6	RIGHT FLIPPER END-OF-STROKE (E.O.S) DS-4
5 NOT USED CN6-7	NOT USED DS-5
6 GRY-BLU CN6-8	Normal: Volume In Test: Left RED BUTTON DS-6
7 GRY-VIO CN6-9	Normal: Service Credits In Test: Right GRN BUTTON DS-7
8 GRY-BLK CN6-10	Normal: Begin Test In Test: Enter BLK BUTTON DS-8

From the Diagnostics Menu GO TO LAMP MENU

From the Lamp Menu GO TO SINGLE LAMP TEST

From the Lamp Menu GO TO TEST ALL LAMPS

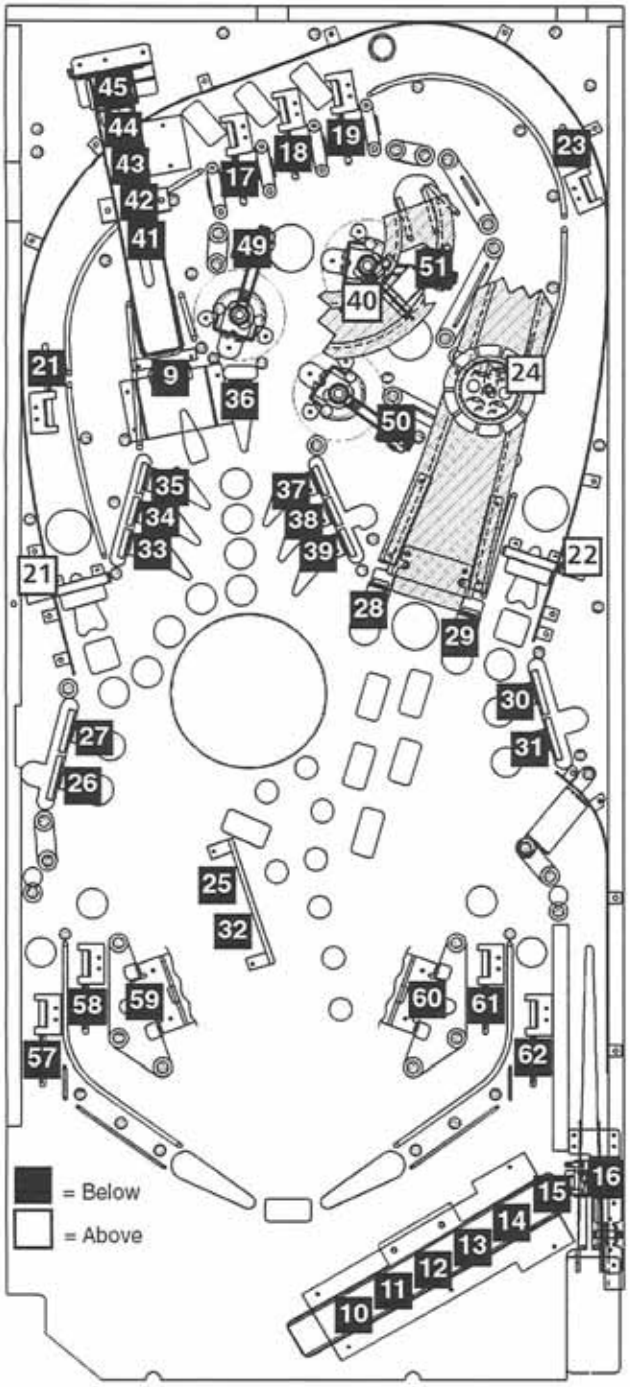


From the Lamp Menu GO TO ROW OR COLUMN TEST

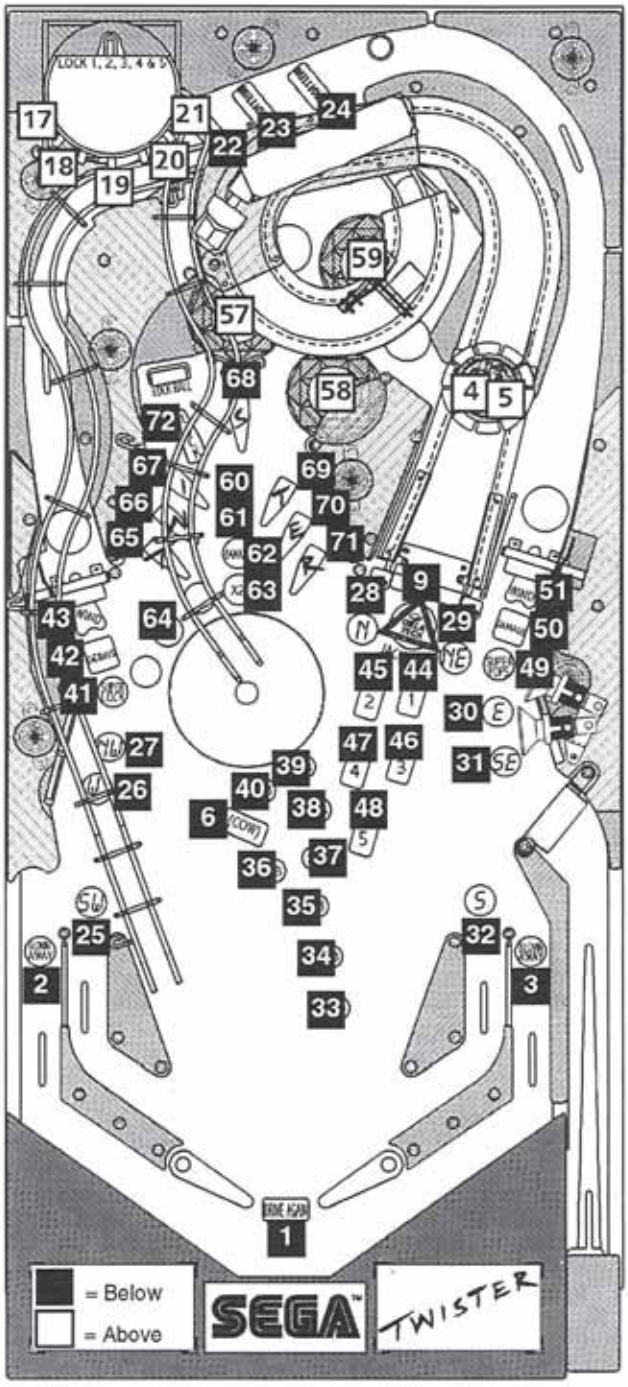
LAMP MATRIX GRID

Column (18v) / Row (GND)	1: U10 YEL-BRN J13-9	2: U11 YEL-RED J13-8	3: U12 YEL-ORG J13-7	4: U13 YEL-BLK J13-6	5: U14 YEL-GRN J13-5	6: U15 YEL-BLU J13-4	7: U16 YEL-VIO J13-3	8: U17 YEL-GRY J13-1
1: Q33 RED-BRN J12-1	DRIVE AGAIN #44 Bulb 1	BLOWN AWAY (LEFT) #44 Bulb 2	BLOWN AWAY (RIGHT) #44 Bulb 3	RAMP ENTER -GREEN LED 4	RAMP ENTER -RED LED 5	COW #555 Bulb 6	NOT USED 7	NOT USED 8
2: Q34 RED-BLK J12-2	JACKPOT #555 Bulb 9	NOT USED 10	NOT USED 11	NOT USED 12	NOT USED 13	NOT USED 14	NOT USED 15	NOT USED 16
3: Q35 RED-ORG J12-3	LOCK 1 #555 Bulb 17	LOCK 2 #555 Bulb 18	MULTIBALL READY #555 Bulb 19	LOCK 3 #555 Bulb 20	LOCK 4 #555 Bulb 21	LEFT TOP LANE #44 Bulb 22	MIDDLE TOP LANE #44 Bulb 23	RIGHT TOP LANE #44 Bulb 24
4: Q36 RED-YEL J12-4	LEFT RE-TURN LANE #44 Bulb 25	WEST STAND-UP #44 Bulb 26	NW STAND-UP #555 Bulb 27	NORTH STAND-UP #555 Bulb 28	NE STAND-UP #555 Bulb 29	EAST STAND-UP #555 Bulb 30	SE STAND-UP #555 Bulb 31	RIGHT RE-TURN LANE #44 Bulb 32
5: Q37 RED-GRN J12-5	TORNADO 1 #555 Bulb 33	TORNADO 2 #555 Bulb 34	TORNADO 3 #555 Bulb 35	TORNADO 4 #555 Bulb 36	TORNADO 5 #555 Bulb 37	TORNADO 6 #555 Bulb 38	TORNADO 7 #555 Bulb 39	TORNADO 8 #555 Bulb 40
6: Q38 RED-BLU J12-6	SUPER LOCK #555 Bulb 41	DEBRIS (LEFT) #555 Bulb 42	WIND (LEFT) #555 Bulb 43	RAMP 1 #555 Bulb 44	RAMP 2 #555 Bulb 45	RAMP 3 #555 Bulb 46	RAMP 4 #555 Bulb 47	RAMP 5 #555 Bulb 48
7: Q39 RED-VIO J12-8	SUPER POPS #555 Bulb 49	DAMAGE (RIGHT) #555 Bulb 50	WIND (RIGHT) #555 Bulb 51	NOT USED 52	NOT USED 53	NOT USED 54	NOT USED 55	NOT USED 56
8: Q40 RED-GRY J12-9	LEFT TUR-BO BUMPER #555 Bulb 57	BOTTOM TUR-BO BUMPER #555 Bulb 58	RIGHT TUR-BO BUMPER #555 Bulb 59	DEBRIS (CENTER) #555 Bulb 60	CHASE #555 Bulb 61	DAMAGE (CENTER) #555 Bulb 62	2X SCORING #555 Bulb 63	SKILL SHOT X2 #44 Bulb 64
9: Q41 RED-WHT J12-10	(T) WISTER #555 Bulb 65	T (W) ISTER #555 Bulb 66	TW (I) STER #555 Bulb 67	TWI (S) TER #555 Bulb 68	TWIS (T) ER #555 Bulb 69	TWIST (E) R #555 Bulb 70	TWISTE (R) #555 Bulb 71	LOCK (ARROW) #555 Bulb 72
10: Q42 NOT USED J12-11	NOT USED 73	NOT USED 74	NOT USED 75	NOT USED 76	NOT USED 77	NOT USED 78	NOT USED 79	NOT USED 80

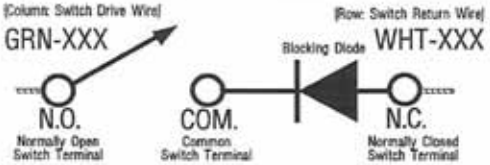
SWITCH MATRIX GRID LOCATIONS



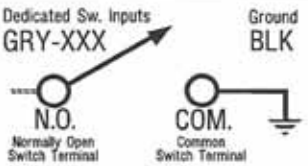
LAMP MATRIX GRID LOCATIONS



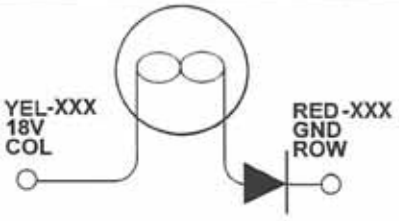
TYPICAL SWITCH SCHEMATIC

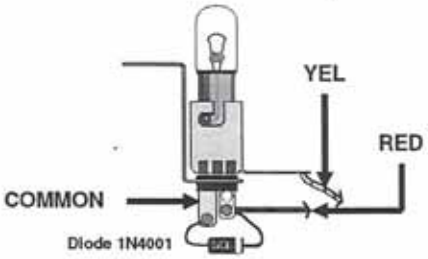


DEDICATED SWITCH SCHEMATIC



TYPICAL LAMP SCHEMATIC





From the Main Menu In Portals* GO TO DIAGNOSTICS MENU →

From the Diagnostics Menu GO TO COIL MENU →

From the Coil Menu GO TO COIL TEST →

From the Coil Menu GO TO CYCLING COILS

COILS DETAILED CHART TABLE

High Current Coils Group 1		Drive Transistor (D.T.)	Driver Ouput Board	D.T. Control Line Color	D.T. Control Line Connect	Power Line Color	Power Line Connnection	Power Voltage	Coil GA/Turn
#1	TROUGH UP-KICKER	Q1	I/O Pwr. Drvr.	BRN-BLK	J8-P1	YEL-VIO	J10-P4/5	50v	24-940 090-5036-01
#2	AUTO LAUNCH	Q2	I/O Pwr. Drvr.	BRN-RED	J8-P3	YEL-VIO	J10-P4/5	50v	23-800 090-5001-02
#3	DROP TARGET RESET	Q3	I/O Pwr. Drvr.	BRN-ORG	J8-P4	YEL-VIO	J10-P4/5	50v	23-800 090-5001-00
#4	DROP TARGET DOWN	Q4	I/O Pwr. Drvr.	BRN-YEL	J8-P5	YEL-VIO	J10-P4/5	50v	32-1800 090-5031-00
#5	FAN MOTOR RELAY	Q5	I/O Pwr. Drvr.	BRN-GRN	J8-P6	BRN	J7-P1	20v	24V DC 10A DPDT
#6	DISC MOTOR RELAY	Q6	I/O Pwr. Drvr.	BRN-VIO	J8-P7	BRN	J7-P1	20v	24V DC 10A DPDT
#7	NOT USED / SPARE	Q7	I/O Pwr. Drvr.						
#8	(EUROPEAN TOKEN DISPENSER)	Q8	I/O Pwr. Drvr.	BRN-GRY	J8-P9	YEL-VIO	J10-P4/5	50v	N/A

High Current Coils Group 2		Drive Transistor (D.T.)	Driver Ouput Board	D.T. Control Line Color	D.T. Control Line Connect	Power Line Color	Power Line Connnection	Power Voltage	Coil GA/Turn
#9	LEFT TURBO BUMPER	Q9	I/O Pwr. Drvr.	BLU-BRN	J9-P1	YEL-VIO	J10-P4/5	50v	26-1200 090-5044-00
#10	BOTTOM TURBO BUMPER	Q10	I/O Pwr. Drvr.	BLU-RED	J9-P2	YEL-VIO	J10-P4/5	50v	26-1200 090-5044-00
#11	RIGHT TURBO BUMPER	Q11	I/O Pwr. Drvr.	BLU-ORG	J9-P4	YEL-VIO	J10-P4/5	50v	26-1200 090-5044-00
#12	LEFT SLINGSHOT	Q12	I/O Pwr. Drvr.	BLU-YEL	J9-P5	YEL-VIO	J10-P4/5	50v	26-1200 090-5044-00
#13	RIGHT SLINGSHOT	Q13	I/O Pwr. Drvr.	BLU-GRN	J9-P6	YEL-VIO	J10-P4/5	50v	26-1200 090-5044-00
#14	SUPER VUK	Q14	I/O Pwr. Drvr.	BLU-BLK	J9-P7	YEL-VIO	J10-P4/5	50v	24-940 090-5036-01
#15	LEFT FLIPPER	Q15	I/O Pwr. Drvr.	ORG-GRY	J9-P8	RED-YEL	J10-P1/2	50v	22-900 090-5020-20
#16	RIGHT FLIPPER	Q16	I/O Pwr. Drvr.	ORG-VIO	J9-P9	RED-YEL	J10-P1/2	50v	22-1080 090-5032-00

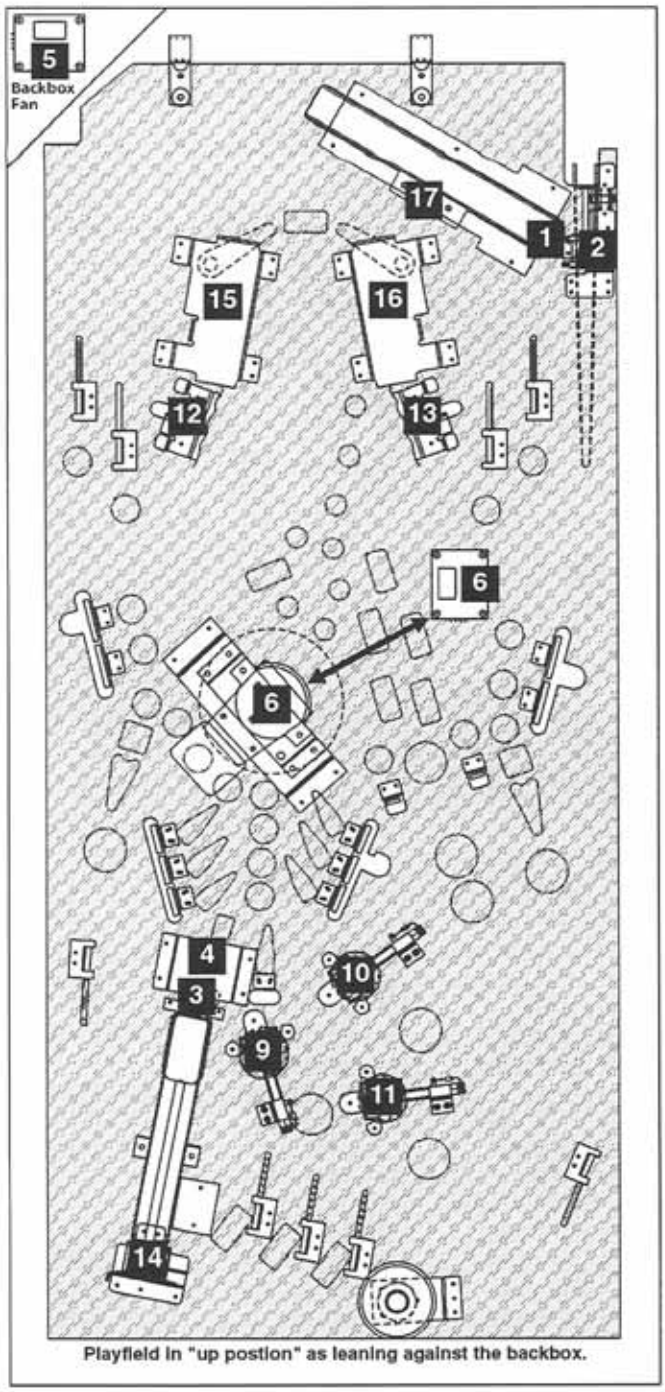
Low Current Coils Group 1		Drive Transistor (D.T.)	Driver Ouput Board	D.T. Control Line Color	D.T. Control Line Connect	Power Line Color	Power Line Connnection	Power Voltage	Coil GA/Turn or Bulb Type
#17	5-BALL TROUGH LOCK BALL	Q17	I/O Pwr. Drvr.	VIO-BRN	J7-P2	BRN	J7-P1	20v	24-940 090-5036-00
#18	NOT USED / SPARE	Q18	I/O Pwr. Drvr.						
#19	NOT USED / SPARE	Q19	I/O Pwr. Drvr.						
#20	NOT USED / SPARE	Q20	I/O Pwr. Drvr.						
#21	NOT USED / SPARE	Q21	I/O Pwr. Drvr.						
#22	FLASH TOP-LEFT*2	Q22	I/O Pwr. Drvr.	VIO-BLU	J7-P8	ORG	J6-P10	20v	#89 165-5000-89
#23	FLASH TOP-RIGHT*1	Q23	I/O Pwr. Drvr.	VIO-BLK	J7-P9	ORG	J6-P10	20v	#89 165-5000-89
#24	(OPTIONAL COIN METER)	Q24	I/O Pwr. Drvr.	VIO-GRY	J7-P10	RED	J16-P7	5v	5v Meter (If Required)

Flash Lamps (FLASH)		Drive Transistor (D.T.)	Driver Ouput Board	D.T. Control Line Color	D.T. Control Line Connect	Power Line Color	Power Line Connnection	Power Voltage	Bulb Type
#F1	UNDER RAMP*2	Q25	I/O Pwr. Drvr.	BLK-BRN	J6-P1	ORG	J6-P10	20v	#89 165-5000-89
#F2	JACKPOT*1 RAMP*1	Q26	I/O Pwr. Drvr.	BLK-RED	J6-P2	ORG	J6-P10	20v	#89 165-5000-89
#F3	DISC*2	Q27	I/O Pwr. Drvr.	BLK-ORG	J6-P3	ORG	J6-P10	20v	#89 165-5000-89
#F4	POPS*3	Q28	I/O Pwr. Drvr.	BLK-YEL	J6-P4	ORG	J6-P10	20v	#89 165-5000-89
#F5	R ORBIT*1 R 2-BANK*1	Q29	I/O Pwr. Drvr.	BLK-GRN	J6-P5	ORG	J6-P10	20v	#89 165-5000-89
#F6	L ORBIT*1 L 2-BANK*1	Q30	I/O Pwr. Drvr.	BLK-BLU	J6-P6	ORG	J6-P10	20v	#89 165-5000-89
#F7	R 3-BANK*1	Q31	I/O Pwr. Drvr.	BLK-VIO	J6-P7	ORG	J6-P10	20v	#89 165-5000-89
#F8	NEAR VUK*1	Q32	I/O Pwr. Drvr.	BLK-GRY	J6-P8	ORG	J6-P10	20v	#89 165-5000-89

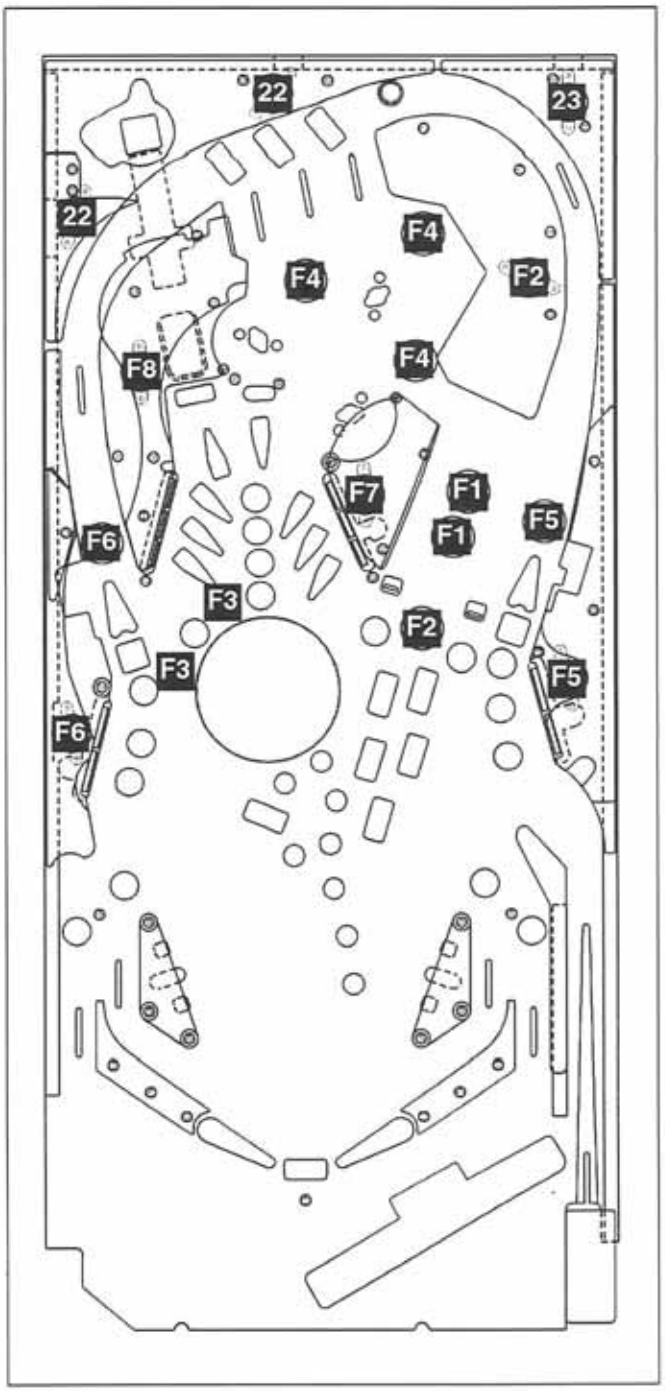
The following is not part of Coil Test but is included for additional information (See Magnet Tests in Sec. 3, Chp. 2):

Aux. Data Line			Driver Ouput Board LOC: Under Playfield	D.T. Control Line Color	D.T. Control Line Connect	Power Line Color	Power Line Connnection	Power Voltage	Coil GA/Turn
N/A	Magna Disc		Magnet Processor/ Driver Board	BLUE	J3-P1	VIO-YEL	I/O Power Bd. J10-P3 to Magnet	50v	22-600 090-5042-01
			Magnet Processor/						22-600

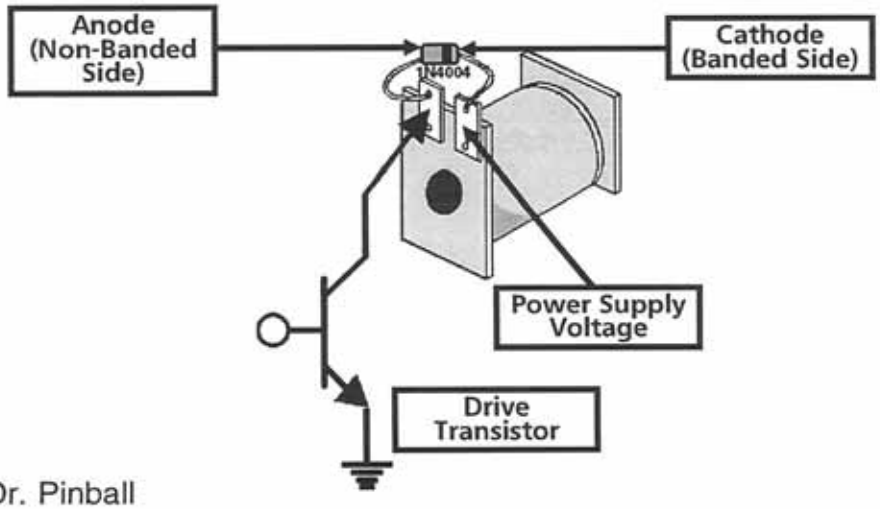
COIL LOCATIONS



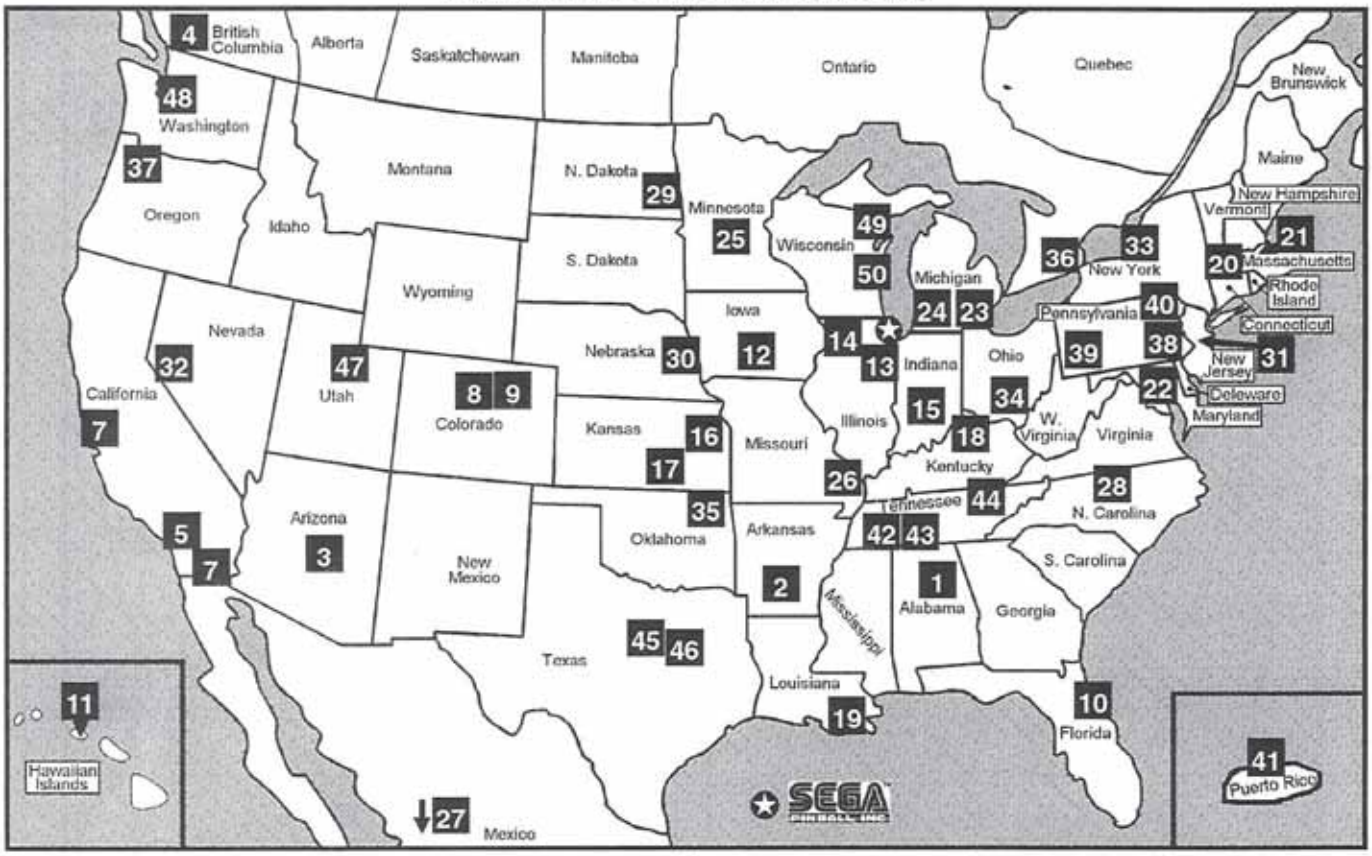
FLASH LAMP LOCATIONS



TYPICAL COIL WIRING



DOMESTIC DISTRIBUTORS

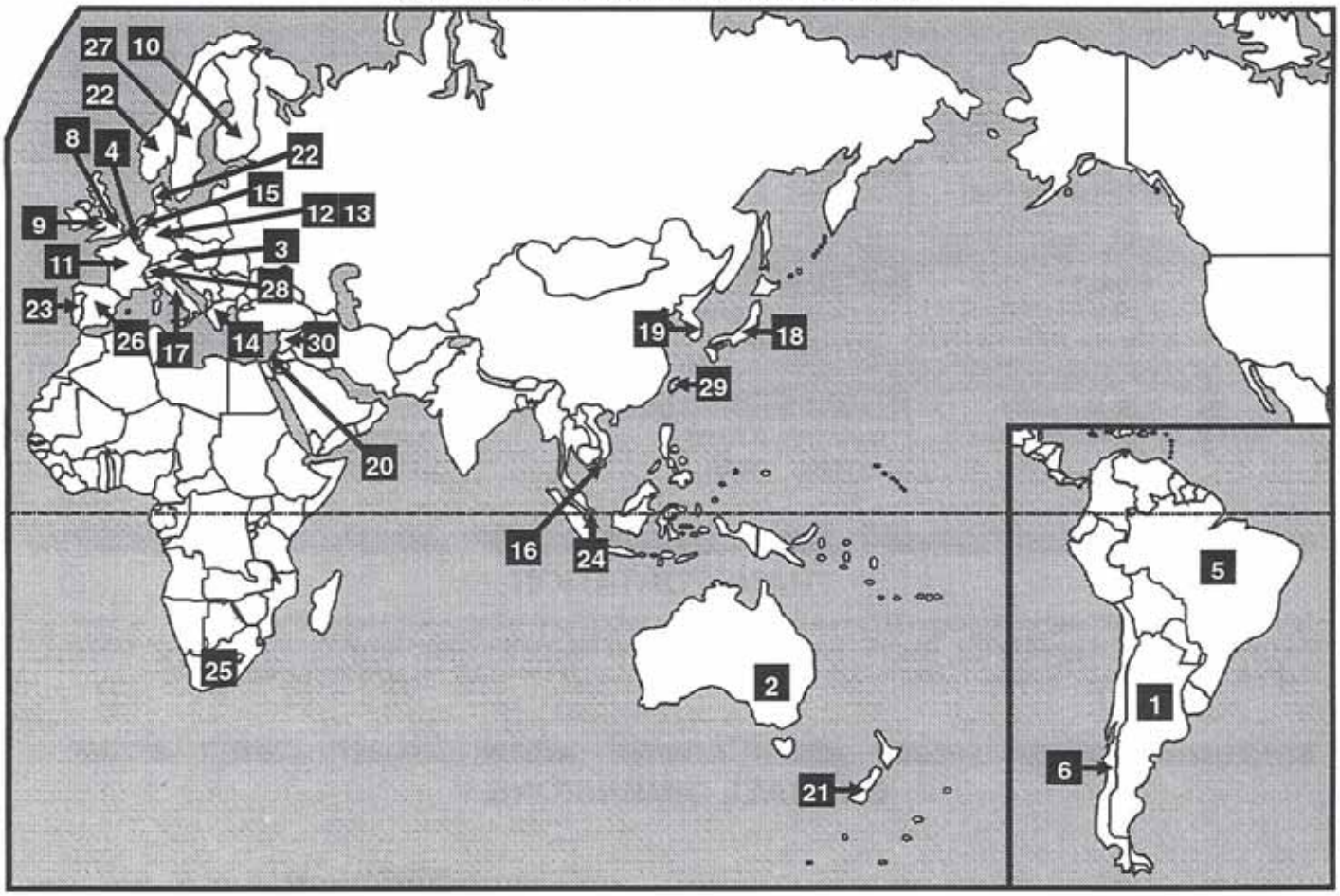


#	STATE/PROVINCE AND CITY		NAME	PHONE
1	AL	Birmingham	Birmingham Vending	205-324-7526
2	AR	N. Little Rock	Godwin Distributing	501-753-1138
3	AZ	Phoezix	Betson Pacific	602-233-0190
4	BC	Burnaby (Can.)	Can. Coin Machine	604-420-4008
5	CA	Buena Park	Betson Pacific	714-228-7500
6	CA	S. San Francisco	Betson Pacific	415-952-4220
7	CA	San Diego	Betson Pacific	619-459-0871
8	CO	Denver	Col. Game Exchange	303-893-4300
9	CO	Denver	Mountain Coin	303-427-2133
10	FL	Orlando	Birmingham Vending	407-425-1505
11	HI	Ewa Beach	50th State Coin Op.	808-682-4561
12	IA	Des Moines	Greater American Dist.	515-244-2828
13	IL	Chicago	Atlas Distributing	312-276-5005
14	IL	Inverness	James Industries	708-358-8000
15	IN	Indianapolis	J. & J. Distributing	317-899-2530
16	KS	Lenexa	Bird Distributing	913-888-8877
17	KS	Wichita	United Distributing	316-263-6181
18	KY	Louisville	Kentucky Coin Machine	502-966-5266
19	LA	Metairie	New Orleans Novelty	504-888-3500
20	MA	E. Long Meadow	Gekay Sales	413-525-2700
21	MA	Norwood	Mondial Int'l. Dist.	617-769-9966
22	MD	Baltimore	Automated Services	410-646-4100
23	MI	Farmington Hills	Atlas Distributing	810-615-1703
24	MI	Wyoming	Atlas Distributing	616-241-1472
25	MN	Bloomington	Hanson Distributing	612-884-6604

#	STATE/PROVINCE AND CITY		NAME	PHONE
26	MO	St. Louis	J. & J. Distributing	314-645-3393
27	MX	Col. Napoles	James Industries	011-525-543-1174
28	NC	Archdal	Operators Distributing	910-884-5714
29	ND	Fargo	M.H. Associates, Inc.	701-282-7877
30	NE	Omaha	Greater American Dist.	402-553-2812
31	NJ	Springfield	Mondial Int'l. Dist.	201-467-9700
32	NV	Reno	Reno Game Sales	702-829-2080
33	NY	Rochester	Mondial Dist.	716-586-1100
34	OH	Cincinnati	Atlas Distributing	513-771-1909
35	OK	Tulsa	Galaxy Distributing, Co.	918-835-1166
36	ON	Rexdale (Can.)	New Way Sales	416-674-8000
37	OR	Portland	American Coin	503-233-7000
38	PA	Bensalem	Mondial Int'l. Dist.	215-638-1122
39	PA	Pittsburgh	Mondial Int'l. Dist.	412-881-8804
40	PA	Wilkes-Barre	Roth Novelty	717-824-9994
41	PR	Carolina	James Industries	809-253-7149
42	TN	Memphis	Games Sales Co., Inc.	901-525-8351
43	TN	Memphis	Green G.A.M.E.S.	901-353-1000
44	TN	Nashville	Sammons-Pennington	615-244-3020
45	TX	Dallas	Commercial Music	214-741-6381
46	TX	Corsicana	Master Sales	903-874-4740
47	UT	Salt Lake City	Struve Distributing	801-328-1636
48	WA	Seattle	American Coin	206-764-9020
49	WI	Menomonee Falls	Pioneer Sales & Svc.	414-781-1420
50	WI	Green Bay	Pioneer Sales & Svc.	414-468-5200

For Parts and Service, call your local distributor. The numbered locations are general areas. View table and map for corresponding numbered distributor. If your state/province does not have a distributor, call the nearest state/province. Distributors and phone numbers are subject to change. Call Sega Pinball, Inc. Technical Support with any questions or if your distributor cannot help you, at 1-800-542-5377 (1-708-345-7700).

INTERNATIONAL DISTRIBUTORS



#	COUNTRY AND CITY	NAME	PHONE (-011)
1	Argentia, Urquiza	Florencia	54-232-5532
2	Australia, Matraville	Amusement Machine Dist.	61-2-316-6000
3	Austria, Ansfelden	TAB Austria	43-72-297-8040
4	Belgium, Brussels	Splin S.A.	32-4-162-7677
5	Brazil, Sao Paulo	Poara Enterprises Ltd.	55-11-278-6838
6	Chile, Santiago	Cuinsa	56-2-696-0167
7	Denmark, Glostrup	Dau Dansk	45-3-670-1087
8	England, London	Electrocoin	44-81-965-6899
9	So. Wales, Cardiff	Electrocoin	44-22-261-5100
10	Finland, Espoo	Pelika Ray Oy	35-804-37091
11	France, Aubervilliers	PLF Sa	33-14-811-3131
12	Germany, Berlin	Bally Wulff	49-3-062-0020
13	Germany, Hannover	Bally Wulff	49-511-358-5312
14	Greece, Athens	Alpha Distributing	30-1-554-1608
15	Holland, Sittart	Veltmeijer Automaten	31-46-526-4444

#	COUNTRY AND CITY	NAME	PHONE (-011)
16	Hong Kong, Kwai Fong	Bondeal Limited	85-2-487-9089
17	Italy (RSM), Serravalle	Technoplay Sa	39-54-990-0361
18	Japan, Tokyo	Data East, Corp.	81-35-370-0718
19	Korea, Seoul	Myung Sun Trading	82-2-771-0461
20	Lebanon, Beirut	Tinker Int'l. Corp.	35-7961141-3688
21	New Zealand, Auckland	Amco Machine Supp.	64-9-846-7606
22	Norway, Oslo	Vendcomatic	47-2-216-0830
23	Portugal, Amadora	Jacinto & Martins	35-11-495-1868
24	Singapore, Singapore	Valibel Technologies	65-748-8404
25	South Africa, Lalucia	Unimac	27-3-152-5544
26	Spain, Madrid	Dast Pim	34-1-541-7112
27	Sweden, Bromma	A-Gruppen Holding	46-8-704-6570
28	Switzerland, Harkingen	Novomat Ag	41-6-261-4061
29	Taiwan ROC, Taipei Hsien	Laxan Corp.	88-62-299-1722
30	Turkey, Iclevent-Istanbul	Emperyal	90-212-663-2081

For Parts and Service, call your local distributor. The numbered locations are general areas. View table and map for corresponding numbered distributor. If your country does not have a distributor, call the nearest country. Distributors and phone numbers are subject to change. Call Sega Pinball, Inc. Technical Support with any questions or if your distributor cannot help you, at 1-708-345-7700.

POWER REQUIREMENTS

This game ***must be connected to a properly grounded outlet to reduce shock hazard*** & insure proper game operation. See Sec. 5, Chp. 3, Cabinet Schematics & Troubleshooting (XFRMR Power Wiring Diagram), for transformer connections required for **Normal**, **High**, and **Low Line** conditions.

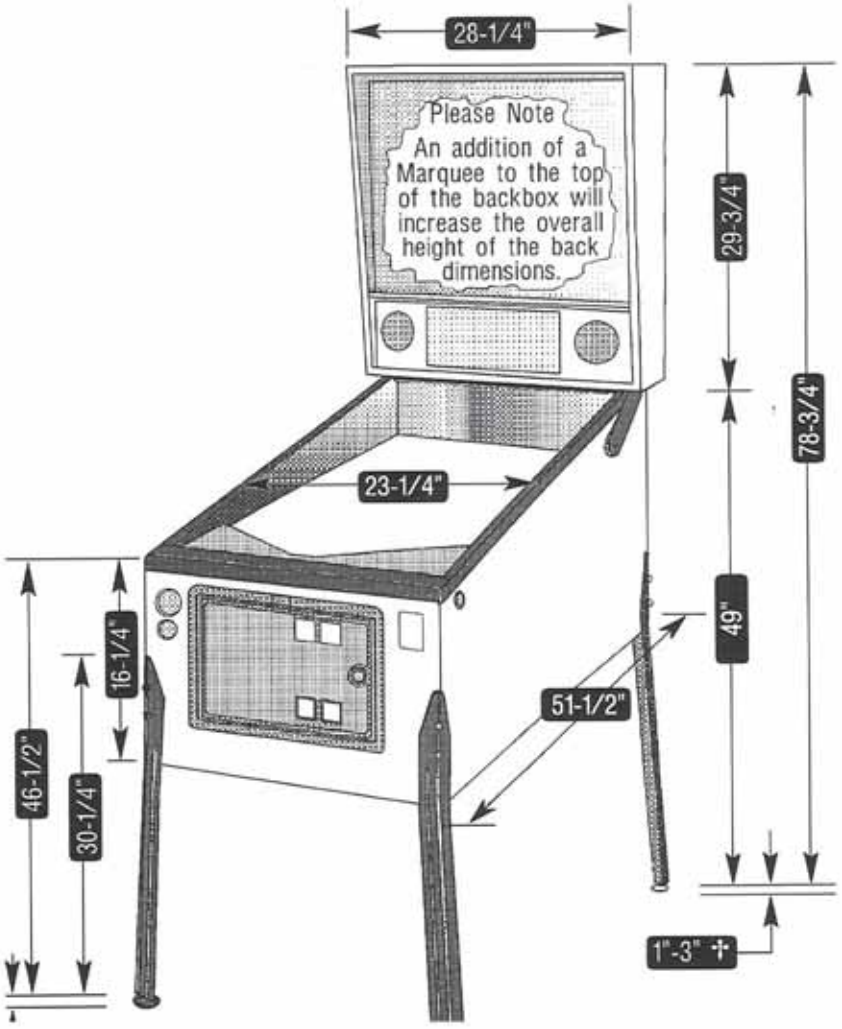
Normal Line:	**110v AC - 125v AC @ 60Hz**	
Domestic uses an 8AMP 250v Slo-Blo Fuse.	**AVG OPERATION**	**MAX OPERATION**
	CURRENT: **2.8AMP**	CURRENT: **8AMP**
	WATTAGE: **329W**	WATTAGE: **940W**
High Line:	**218v AC - 240v AC @ 50Hz**	
Export uses 2 X 5AMP 250v Slo-Blo Fuses. (*England & Hong Kong use an 8AMP 250v S/B Fuse.)	**AVG OPERATION**	**MAX OPERATION**
	CURRENT: **1.8AMP**	CURRENT: **5AMP** | **8AMP*** (England & Hong Kong use an 8A F.)
	WATTAGE: **412W**	WATTAGE: **1145W** | **1832W***
Low Line:	**95v AC - 108v AC @ 50Hz / 60Hz**	
Export Japan Only uses an 8AMP 250v Slo-Blo Fuse.	**AVG OPERATION**	**MAX OPERATION**
	CURRENT: **2.6AMP**	CURRENT: **8AMP**
	WATTAGE: **264W**	WATTAGE: **812W**

TRANSPORTATION

To reduce the possibility of damage, observe the following precautions whenever transporting the game. Lower the backbox and secure it to the cabinet. Remove the legs and secure the game within the transporting vehicle. Reference Section 1, Chapter 1, Game Set-Up for assembly (for disassembly reverse instruction order).

OVERALL DIMENSIONS †

Shipping Crate Dimensions	
Height:	55½"
Width:	30½"
Length:	31"
Weight:	250lbs. (+/- 10lbs.)



† **Note:**
The Leg Levelers can add up to two (2) inches to the overall height of the front & back dimensions.

The cabinet is designed to give a 6.5° pitch with the Leg Levelers turned all the way in.

TWISTER

Table of Contents

SEE SECTIONS 3 & 5, TABLE OF CONTENTS, FOR DETAILS OF THAT SECTION AND IT'S CHAPTERS.

Introduction to Our *New* Flipper Design & Theory of Op..... Inside Front

- *New Backbox Layout, Fuse & Relay Locations (Quick Reference Fuse Chart)..... i*
- *Find-It-In-Front: Dr. Pinball Section ..... ii*

Install 5-Balls..... iii
Diagnostic Aides (Operator Alert... & Open the Coin Door) iii
CPU DIP Switch Settings, Loc. SW300 CPU/SOUND Board..... iii
ROM Summary Table..... iii
Switch Matrix Grid & Dedicated Switches, Lamp Matrix Grid..... iv
Switch Matrix Grid & Lamp Matrix Grid Locations and Typical...Schematics v
Coils Detailed Chart Table vi
Coil & Flash Lamp Locations and Typical Coil Wiring vii

- *Domestic Distributors..... viii*
- *International Distributors..... ix*
- *Power Requirements ..... x*
- *Transportation ..... x*
- *Overall Dimensions..... x*
- *Twister Game Manual General Table of Contents..... xi / xii*

SECTION 1 1

CHAPTER 1, GAME SET-UP 1

- *Game Assembly Procedures 1*
- *Leg Leveler Adjustment 2*
- *Easy Access Service System 2*

SECTION 2 3

CHAPTER 1, GAME OPERTION & FEATURES 3

Start of Game Features 3
During Game Features 3
End of Game Features..... 4

CHAPTER 2, GAME RULES 5

Overview 5
Twister Instruction Card Copy..... 6
Twister Game Rules..... 7-10

SECTION 3 11

CHAPTER 1, PORTALS™ SERVICE MENU INTRODUCTION..... 11

- *Portals™ Service Menu Table of Contents (View for an outline of this section) 11*

Portals™ Service Menu Access & Use / How to Use This Section..... 12 / 13
Portals™ Service Menu Icon Tree..... 14 / 15
Portals™ Service Menu Example..... 16-18

CHAPTER 2, GO TO DIAGNOSTICS MENU..... 19

CHAPTER 3, GO TO AUDITS MENU..... 32 / 33

CHAPTER 4, GO TO ADJUSTMENTS MENU..... 38 / 39

CHAPTER 5, GO TO RESET MENU..... 47

CHAPTER 6, GO TO PRINTER MENU (Special Equipment Required) 49

CHAPTER 7, GO TO HELP SCREEN..... 51

SECTION 4 ..... **53**
CHAPTER 1, PARTS IDENTIFICATION & LOCATION (The Pink Pages) **53**
Backbox - General Parts 54
Cabinet - General Parts 55
Playfield - Major Assemblies 56
Playfield - Ramps 57
Playfield - Rails and Ball Guides 58
Playfield - Butyrate, Decals and Mylar 59
Playfield - General Parts 60
Playfield - Rubber Parts (Rings Actual Size) 61
Playfield - Metal Posts and Spacers (Actual Size) 62
Playfield - Plastic Posts and Spacers (Actual Size) 63
Playfield - Light, Magnet Processor (X2)/Driver & Aux. Relay Boards 64
Playfield - Wedge Base Bulbs, Sockets and Misc. Bulbs (Actual Size) 65
Playfield - Small Bayonet Type Bulb and Sockets (Actual Size) 66
Playfield - Large Bayonet Type Bulb and Sockets (Actual Size) 67
Parts Order Checklist Notes 68

CHAPTER 2, ASSEMBLY DRAWINGS (The Blue Pages) **69**
Overview 69
Ball Shooter (Plunger) Assembly, 500-5744-02-04 70
Autoplunger Coil Assembly, 500-6092-00-41 70
Autoplunger Arm Weld Assembly, 500-6091-00-41 70
5-Ball Trough Assembly, 500-5989-15-XX 71
Lock Ball Assembly, 500-5684-02 71
Ball Trough Enter/Exit Scoop Assembly, 535-7329-01 71
Flipper (Left) Assembly, 500-5944-11 72
Flipper (Right) Assembly, 500-5944-02 73
Turbo Bumper Individual Parts, (Not available as an assembly.) 74
Slingshot (Left & Right) Assemblies, 500-5849-01 75
Super VUK Assembly, 500-5880-00-41 75
Single Drop Target Assembly, 500-6097-00-41 76-77
Dorothy II Canister Assembly, 500-6093-00-41 78
Canister Frame Assembly, 515-6547-00-41 78
Under Trough Assembly, 500-6076-00-41 79
Plastic Ramp Assembly, 500-6009-00-41 80-81
Magna Disc Assembly, 500-5993-00-41 82
Magnet Diverter Individual Parts, (Not available as an assembly.) 83
Back Panel Assembly, 500-6011-00-41 83
Stand-Up Target Assemblies, 500-5321-XX, 500-5857-XX & 500-6075-01 84
Plastic Part Color Chart 84

SECTION 5 ..... **85**
➢ *Schematics & Troubleshooting Table of Contents (outline of this section)* *85*
CHAPTER 1, BACKBOX WIRING (The Yellow Pages) **87**
CHAPTER 2, PLAYFIELD WIRING (The Yellow Pages) **89**
CHAPTER 3, CABINET WIRING (The Yellow Pages) **95**
CHAPTER 4, PRINTED CIRCUIT BOARDS (PCBs) (The Yellow Pages) **97**

APPENDIXES A-H **117**
➢ *Appendixes A-H Table of Contents (outline of this section)* *117*

LIMITED WARRANTY, CAUTIONS, WARNINGS & NOTICES ..... **Inside Back**

TWISTER

Game Set-Up

Game Assembly Procedures

(Refer to the Illustrations on the inside front cover and pages ii & 2)

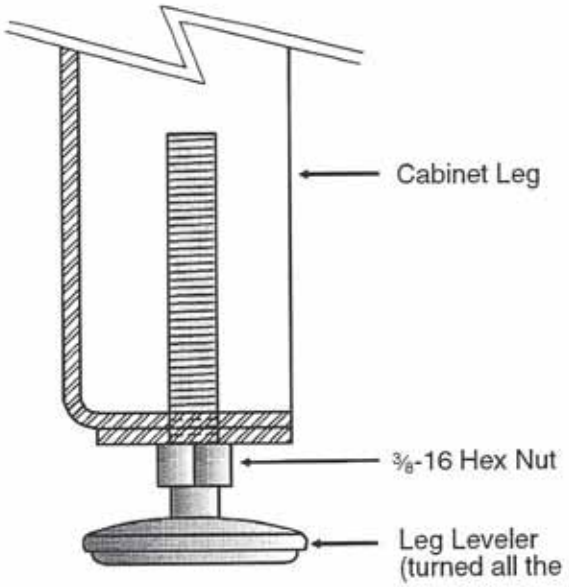
1. Open the top of the carton and lay it on its side with the bottom of the cabinet down. Using the plastic banding strip as a handle, slide the game out of the carton.
2. Remove all packing material. 4 cabinet legs & levelers (attached) are in the corner packing material of the crate. A large Allen Wrench (use for securing the backbox) is inserted and taped to the rear of the cabinet. Miscellaneous parts are in the cash box.
3. Support rear of cabinet and attach rear legs using two leg bolts for each leg.
4. Support front of cabinet and attach front legs using two leg bolts for each leg.
5. While assuring that no cables are being pinched, carefully raise the backbox and secure it in its upright position with the Allen Wrench in the hole in the back of the cabinet and rotating the wrench 270° (¾ turn).
6. Remove the backbox keys from the playfield glass, unlock and carefully remove the backglass. Set the backglass aside. Undo latch on the Backbox Light Insert and slowly swing open (can be removed).
7. Check all connectors in the backbox for loose wire terminations. Reseat any loose wire by pushing in on the terminal. Push on all connectors plugged into the CPU/Sound Board, I/O Power Driver Board, and the Display Power to check that they are properly seated.
8. Check that all fuses are seated properly.
9. Carefully remove the playfield glass and set it aside.
10. Remove all shipping tie downs, shipping blocks, packing foam, shipping instruction pages, etc. (if any). ***READ ALL PRINTED INFORMATION!*** Shipping instructions, labels and/or decals describe warnings, cautions, and/or important information specific to the game.
11. Raise the playfield and support it, by lifting the Stay Arm on the Right Side of the Cabinet and placing the notched end into the hole on the under playfield. See the illustration "Easy Access Service System" opposite this page.
12. Check all cabinet cables and playfield Lamp Boards connector terminations.
13. Remove the Plumb Bob tilt from the parts package and install on the pendulum wire on the inside left of the cabinet. See Section 4, Chapter 1, Parts Identification & Location.
14. Lower the playfield and ensure game is level side-to-side by adjusting Leg Levelers, if required. See the illustration "Leg Leveler Adjustment" opposite this page.
15. With the Leg Levelers turned all the way in, the game pitch is 6.5°; depending on the condition of the floor, adjust the Leg Levelers as required.

The playfield incline affects difficulty of play. Use the recommended incline; Game difficulty is best varied using game adjustments.

16. Check the plumb tilt and adjust as required.
17. If desired, perform any self tests at this time. See Section 3, Chapter 1, Portals™ Service Menu Introduction, and Chapter 2, Diagnostics, for instructions on how to enter "Begin Play Test" and "Game Specific" to test components on the game.
18. Slowly swing Backbox Light Insert closed and secure latch. Carefully reinstall and lock the backglass.
19. **INSTALL 5 BALLS** on the playfield near the outhole and carefully reinstall the playfield glass. (Amount of balls are always specified on decal attached to the lock down assembly.)
20. If desired, make Game Pricing (Standard and/or Custom) and Add-A-Ball, Novelty, or X-Ball Play adjustments at this time. See Section 3, Chapter 4, Adjustments, for instructions on how to enter adjustments. Follow instructions in the tables provided in the manual for suggestions of customizing changes.

Leg Leveler Adjustment

This cabinet is designed to automatically have a 6.5° pitch without any Leg Leveler adjustment!



STEP 1

Assemble all (4) legs and levelers as shown in the diagram. Be sure the leveler is turned all the way in.

STEP 2

Attach leg assemblies to cabinet with leg bolts provided.

YOUR PLAYFIELD PITCH IS NOW AT 6.5° AS REQUIRED FOR PROPER GAME PLAY!

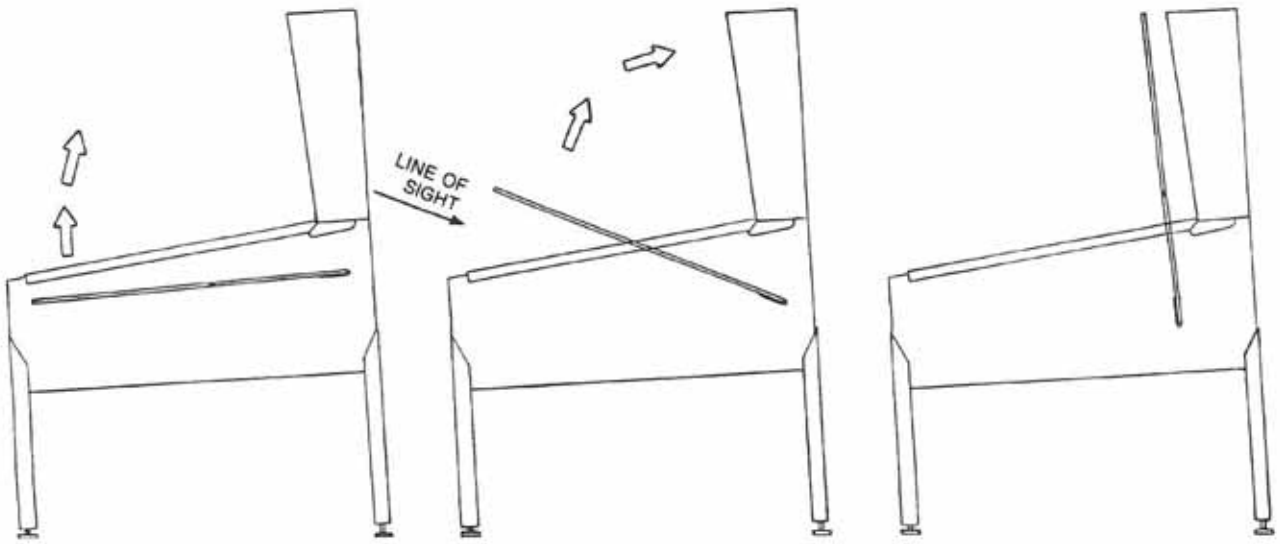
STEP 3

Verify 6.5° pitch. Minor adjustment(s) may be necessary depending on the location floor being level.

For custom adjustment greater than 6.5° can be acheived by turning out the rear leg leveler(s), however, it is not recommended.

Easy Access Service System - 1 Position

Carefully lift the playfield ***using the left and right ball guides*** upward (when lifted high enough support the bottom of the playfield with your hands) until the playfield is completely upright against the backbox. The playfield will "lock" into position with the Keeper Bracket in the cabinet. Push the release button to bring playfield down. ***Reverse procedure when service is complete.***



Game Operation & Features

Start of Game Features

Starting a Normal Game

Insert coin(s), the game generates a sound for the first coin & for each subsequent coin(s) with the display indicating the number of credit(s) posted. Press the **START BUTTON** and a start-up sound is produced, and the posted credit(s) are reduced by one. If the last Game Specific Adjustment, Novice Mode Enabled, is changed to **YES** (Default = **NO**), the display awaits choice from player 1 to select **REGULAR GAME** rules or **NOVICE GAME** rules with the *flipper buttons*. If the player *does not select rules*, the game will default to ***Regular Rules***. After selection (or time-out default to Regular Game) subsequent players can be added (**up to 6 can play!**) by pressing the **START BUTTON** before the end of ball 1. **Note 1:** The subsequent players will play the same game (Novice or Regular) determined by Player's 1 choice.

The display now indicates the player or # of players selected from the total depressions of the **START BUTTON**. The display indicates the ball in play, and a ball is served to the *Shooter Lane*. An introduction is shown followed by Skill Shot Graphics. Pressing the **START BUTTON** after ball 1 of any player will start a new game (if credits are available), ***but only*** if the **START BUTTON** is depressed for 2-3 seconds. This delay is to avoid accidental "re-starts" of a game. (Note: Any ½ credit remaining during game play after the end of ball 1, or power down, will be eliminated.)

Starting Team Play (Doubles!)

Team Play is a four player game. The totals for players 1 & 3 (Team 1) and players 2 & 4 (Team 2) are displayed individually as well as the combined score for both teams. Team Play does not work with less than or more than 4 players. 1-, 2-, 3-, 5- & 6-Player games, the individual scores are shown.

Starting League/Tournmanent Play

After credit is posted, while holding in the **LEFT FLIPPER BUTTON**, press the **START BUTTON**. League Play has now begun. The differences between Normal Game Play and League/Tournament Play are: There is no "auto-percentaging" (awarding extra balls, specials, etc. to players with very low scores on the second or third ball). Mystery Features are awarded in a set order rather than random in Normal Game Play. Percentage Game Features are not automatically advanced as they are for the Regular Play Features.

Starting Pinball Wizard Play

After credit is posted, while holding in the **RIGHT FLIPPER BUTTON**, press the **START BUTTON**. Pinball Wizard Play has now begun. The same as League/Tournament Play, but ooooooh! so much gosh darn harder!

During Game Features

Feature Mode & Combination Shots

Features are lit on the playfield and started by completing certain play shots (e.g. completion of target banks, orbit(s), ramp(s) and/or any combination of the shots). Combination shots (combos) are a series of shots completed in many different variations. For example, a shot to the Ramp with the ball being returned to the Left Inlane then immediately shot to the Orbit of the playfield returning to a Flipper and then shot to another Ramp is a hard combo shot worthy of many points. These combinations vary per game. For feature modes & combos certain points or awards are given after completion. Watch the Video Display for feature details, etc.

Multiball

Multiball is started after completion of certain Feature Modes or may be a mode itself depending on game rules and play. Multiball may vary with the amount of balls used in Multiball depending on game style. Typically, if Multiball play was short, a "restart" option is given. Watch the Video Display for instructions on the restart.

Replay Feature

Replay awards are given as the player exceeds a High Score Level during game play. This can be adjusted with Adjustment 3, Replay Awards (Default=**CREDIT**, adjustable). Players exceeding the High Score Levels can receive a **CREDIT**, an **EXTRA BALL**, or **SPECIAL**. Adjust to **NONE** if a replay award is not desired.

End of Game Features

Game Endings

When all player(s) have played all balls (including any Extra Ball Buyin's), the game ends. If power is interupted during the course of a game, it will end that game (***see Starting a Normal Game***). Depending on the number of tilts set (Default=2, adjustable), or prolonged closure of the Plumb Bob Tilt Switch, tilts the ball in play. Closure of the Slam Tilt Switch on the coin door ends the current game(s).

Match Feature

At the end of each ball, earned bonuses are collected. At the end of the last ball of a game (including any extra balls, if applicable), earned bonuses are collected, then the system produces a random 2-digit number (a multiple of 10; 00 to 90). Matching the last two digits of the player's score with this number awards a credit. In Adj. 11, Match Percentage (Default=**7%**, adjustable) can be changed from 0-10%. Changing the percentage to **0%** displays the "Match Animation" at the end of the game, however, will never match (to award a credit). Changing this adjustment to **OFF** will not display the "Match Animation" nor award a credit.

Entering Initials

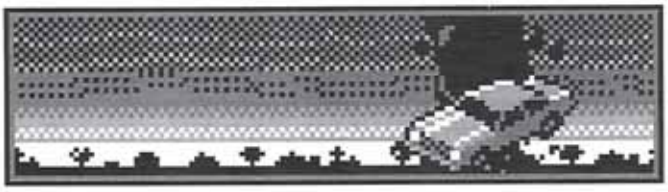
If player achieved a new high score in any of the 3 categories (Regular, Novice or Wizard), the player may enter his/her initials. To enter your initials, use the left & right flipper buttons to choose letter or character as seen on the Visual Display. Hitting the Start Button locks the letter or character in. Procede with the 2nd & 3rd letter. The game then proceeds into the game-over mode and then to the attract mode. A custom message (adjustable) can be displayed during the attract mode.

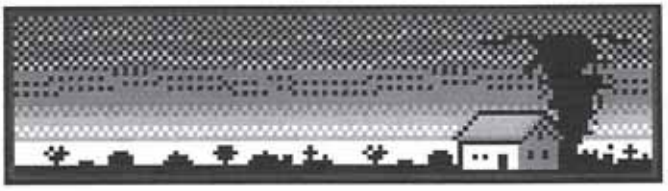
Manual Percentaging

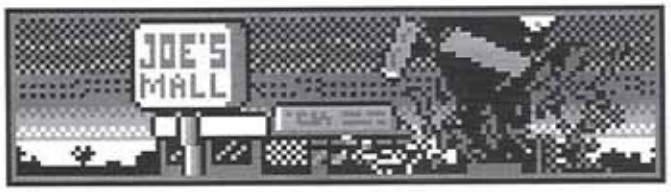
This game is equipped with Manual Percentage Adjustment. As previously with our games, you can either set operator adjustments for a replay percent or you can set a fixed replay score. See Section 3, Chapter 4, Adjustments, Adjustment 1 & 2.

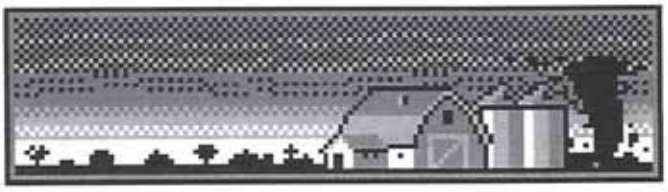
If you set operator adjustments for a particular replay percent, the game will compute a recommended score to keep the game at that replay percentage. If a change is recommended and the game coin door is opened, the display will indicate if the replay is too high or low and make a sound to alert the operator. By pressing the start button, the score to beat will be changed to a more correct level. If you close the coin door or enter the **Portals™ Service Menu**, no score change will be made.

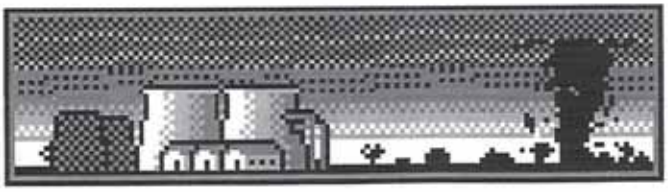
You may choose to ignore the recommended change; for example, you may not think last week's players were the usual crowd. Just close the door and the message will disappear without altering the existing level. Or you may choose to make a different score to beat adjustment; this is done by utilizing Adj. 2, Replay Levels.







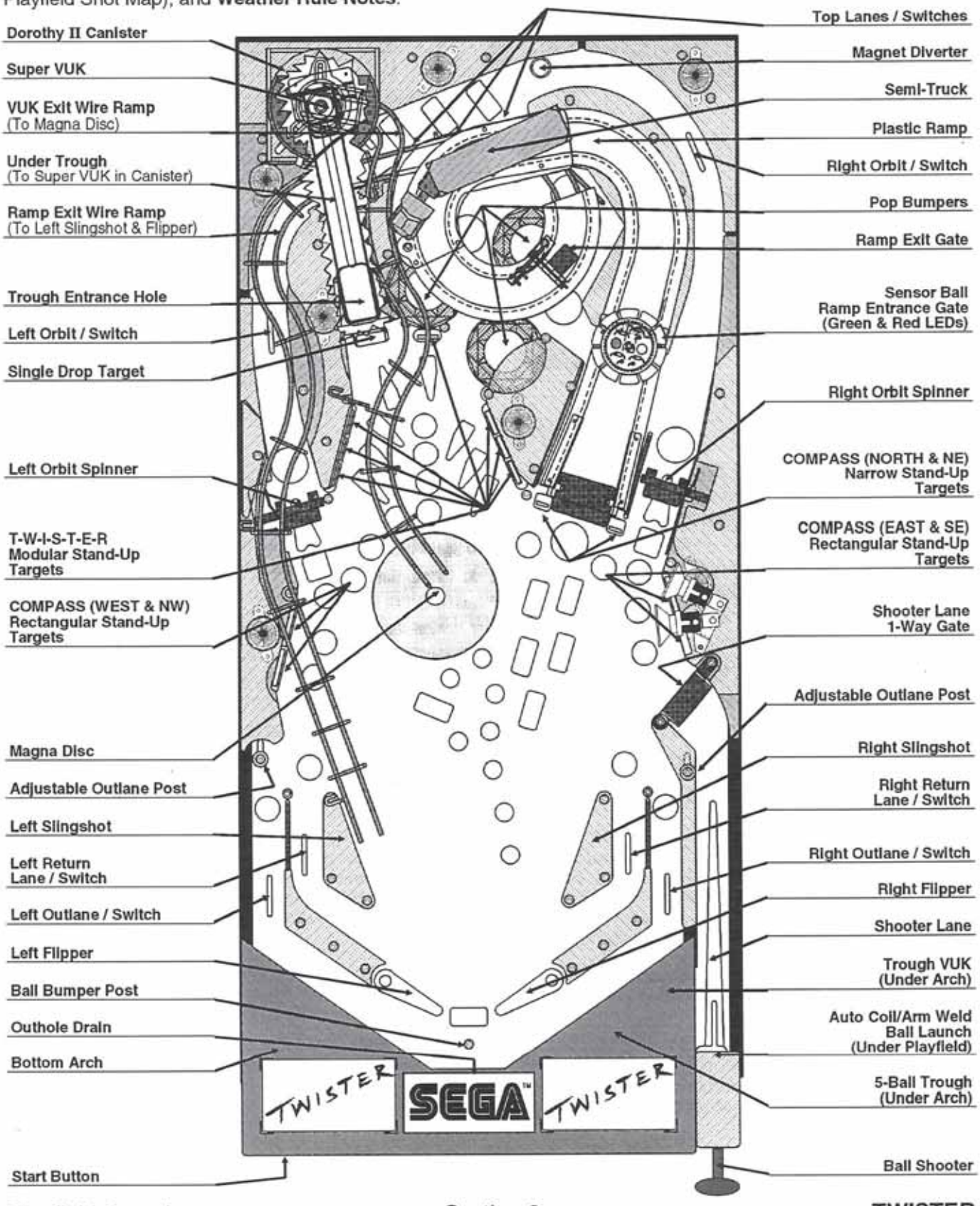




Twister Game Rules

Overview

Below is the **TWISTER** Playfield with all of its component locations indicated (for details on these parts, see Section 4). Read over the components below to help in understanding the effects of the game rules. The rules are numbered and divided into four groups: **Single Ball Play**, **Multiball & Jackpots**, **Twister Features** (with Playfield Shot Map), and **Weather Rule Notes**.



Twister Game Rules

Instruction Card

Below is a copy of the game instruction card which is included with every game. If this card is lost or damaged, simply copy this page and cut out the instruction card as a temporary replacement until a new card is ordered. (Suggestion: Copy & cut along the dotted line and fold in the center. This will keep the "copy" sturdy.)

Copy & Cut

Fold — Fold

TWISTER

CANISTER MULTIBALL Shoot the *Drop Target* to light locks at the revealed *Scoop*. Lock balls for successive ***3-***, ***4-***, and ***5-Ball Multiball***.

CHASE MULTIBALL Shoot the Ramp 5 times to start ***CHASE Multiball***. Shoot as as many playfield switches as you can to cross scoring thresholds. Each threshold adds 1 ball and the final one lights a **Super Jackpot**!

TWISTER TARGETS Complete the ***TWISTER*** *Targets* to start features.

COMPASS POINTS Complete the ***COMPASS POINTS*** for scoring, light **Extra Ball**, and other bonuses.

BEGINNERS' GUIDE TO SEGA PINBALLS:

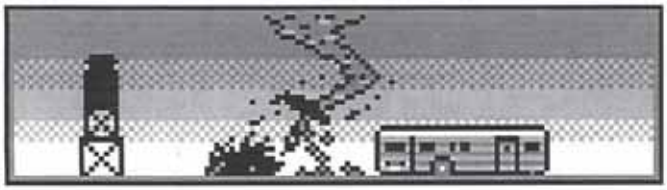
- **TO SCORE MORE, SHOOT WHAT'S FLASHING!**
- **PLAY MULTIBALL AS OFTEN AS POSSIBLE!**
- **GLANCE AT DOT DISPLAY WHILE YOU PLAY!**

 755-5079-00

The remainder of this chapter are the detailed **TWISTER** Game Rules. Please read through for a better understanding of the operation of this game. Some game rules, point values and/or features may change as production continues. The changes, if any, will be describe in manual addendums, if warranted. Please note, that some adjustments (see Section 3, Chapter 4, Adjustments) are designed to customize game play, (i.e. making it harder or easier as players get more familiar with the game).

Code revisions and updates may change as production continues. Code updates will be made available to distributors via ROM, diskette or modem. Changes, if any, will be described with the code updates. See the end of this manual for "Appendix A - Pinball Game Firmware Table," for the latest revision code for all games prior to this game.

See the end of this manual for "Glossary of Terms," for words or acronyms you may not understand. If an acronym or expression is not in this glossary, please call our Technical Support Department, so we may add it in the next game manual. Any other suggestions or comments are always welcome!



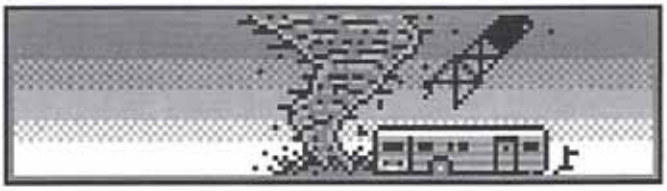
1 GAME RULES SELECT:
NOTE: Go to Adjustments (Section 3, Chapter 4) & change Adj. 52 to "YES". ***The Factory Default*** is "NO" making **REGULAR GAME** selection. If changed to "YES", this rule is in effect. Select **REGULAR GAME** rules or **NOVICE GAME** rules with the *flipper buttons*. If the player *does not select rules*, the game will default to ***Regular Rules***. *(Note: Subsequent players will play the game style chosen by player 1.)*

NOVICE GAME rules give the player a guaranteed minimum game time - ***if the ball drains before this time is up, it will be returned to the player***. When the ball drains after time is up, the game ends.

2 SKILL SHOT
Plunge the ball onto the magnet in the center of the *Magna Disc* to score award shown in the display.

3 TOP LANES
Complete the *Top Lanes* to advance bonus multiplier.

4 TURBO POP BUMPERS
Score the number of hits (XX MORE) shown in the display to advance *Turbo Pop Bumper Value* and score a big value.



5 SUPER POPS
Shoot the *Right Orbit* when lit to score 2M per *Turbo Pop Bumper* hit on the next *Turbo Pop Bumper* visit.

6 WIND
Shoot either *Orbit* where **WIND** is lit to score points, add to bonus, and spot a *Sensor Ball* (bottom center of playfield). Points increase based on how fast the ball was shot into the *Orbit*.

7 SENSOR BALLS
Complete all *Sensor Balls* for **SECRET COW AWARDS!**

8 COMPASS TARGETS
Complete all points of the Compass (6 *Stand-Up Targets* plus the *Left and Right Inlanes*) to score award shown in the display. Shoot the *Compass Targets* for millions during the "Weathervane" Feature.

9 TWISTER TARGETS
Complete **T-W-I-S-T-E-R** in order to score big points plus the next feature. (See **Twister Features** after **Multiball & Jackpots**.) Points awarded = 50M X the number of times the targets were completed on current ball in play.

MULTIBALL & JACKPOTS

10 CHASE MULTIBALL

Every *Ramp Shot* (both the enterance and exit switches must be closed consecutively to quality as a Ramp Shot) during *Single Ball Play* counts down toward **CHASE MULTIBALL.** During **CHASE MULTIBALL** all switch closures advance the Chase Truck (shown in the display) towards a tornado. When the truck reaches the tornado, the **CHASE JACKPOT** is lit at the *Ramp*. Scoring the **CHASE JACKPOT** adds another ball into play to help the player chase another tornado.

11 CANISTER MULTIBALL

Lock balls behind the *Drop Target* to start **CANISTER MULTIBALL** (*Note:* The ball enters an under trough and upon start of *Multiball*, will exit out of the *Canister* via the *Super VUK* and *Wire Ramp* to the *Magna Disc*). The player must lock 3 balls for the first *Multiball*, 4 balls for the second *Multiball*, and 5 balls for the third and subsequent *Multiballs*. When the player is one lock away from starting *Multiball*, the *Drop Target* will reset after being hit after a short time (adjustable, see Section 3, Chapter 4). The player must then knock the *Drop Target* again to re-enable the last lock.

When the correct number of balls are locked, all balls in the lock area will be kicked out onto the magnetic spinning disc assembly, and held there to be spun around before they are released.

12 MULTIBALL JACKPOTS

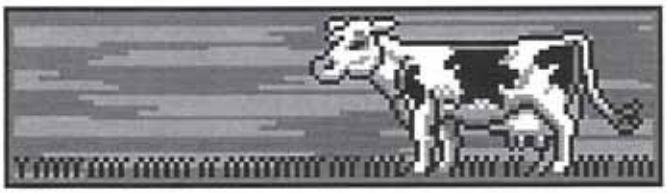
At the start of *Multiball* a *Jackpot* is lit at the *Ramp*. The player must score three *Jackpots* to light the **SUPER JACKPOT** at the lock area. For a short time after the player scores a *Jackpot* (other than the third *Jackpot*) the next *Ramp Jackpot* is doubled for a short time. If the **DOUBLE JACKPOT** is scored (and it is not the third *Jackpot*) a **TRIPLE JACKPOT** will be lit at the *Ramp* for a short time. The most recent player to score a **TRIPLE JACKPOT** gets to enter their initials (displayed during *Attract Mode*). Scoring a **SUPER JACKPOT** starts the whole process over.

Shooting the lock area during *Multiball* increases the *Base Jackpot Value*. The *Base Jackpot Value* is determined by the number of balls locked.

13 SUPER LOCK

If the player shoots the *Left Orbit* when **SUPER LOCK** is lit and then shoots the ball into the lock immediately **INSTANT MULTIBALL** will result.

TWISTER FEATURES



14 DEBRIS
Shoot the *Left Orbit* for **DEBRIS AWARDS**.

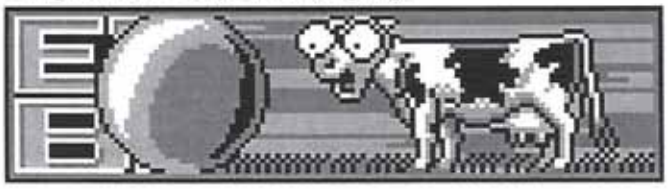
15 CHASE HURRYUP
Shoot the *Ramp* for **CHASE HURRY-UP VALUE**.

16 DAMAGE
Shoot the *Right Orbit* for **DAMAGE AWARDS**.

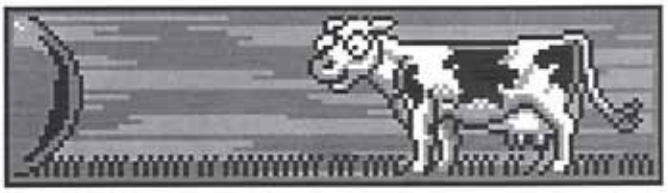
17 2X SCORING
2X SCORING for remainder of the ball in play. When **2X SCORING** is running the *Twister Targets* cannot be completed again.

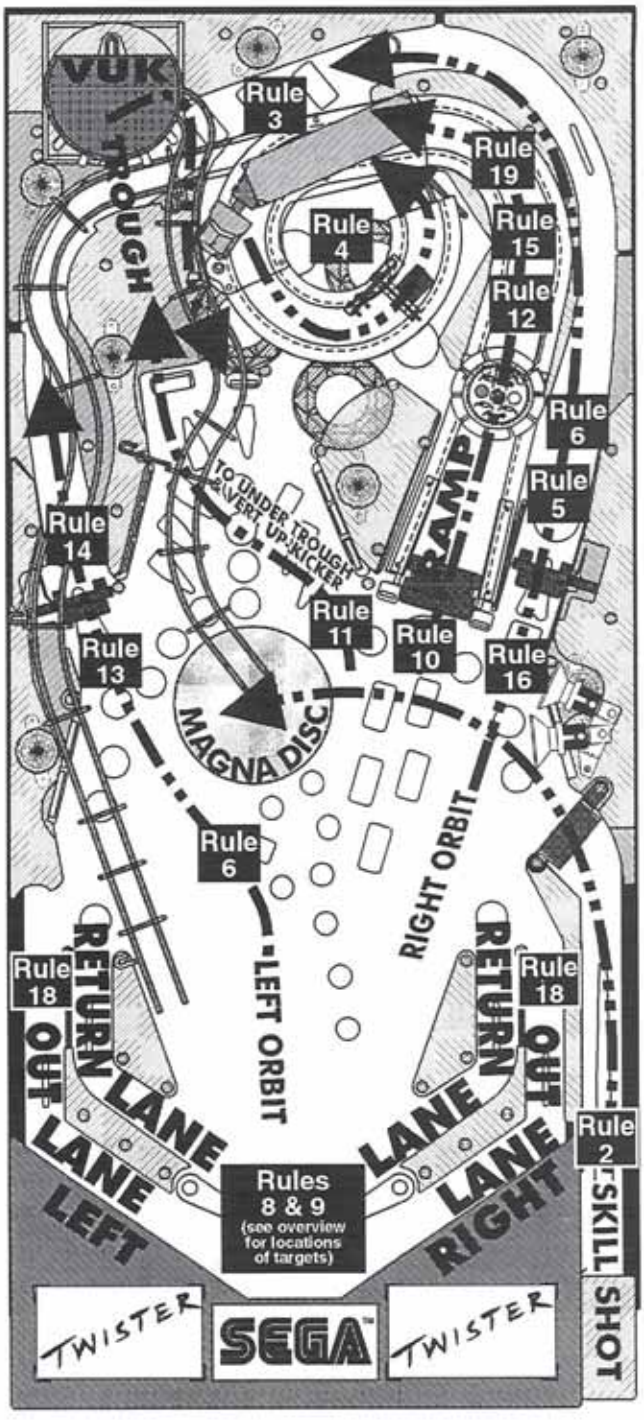
18 BLOWN AWAY
Draining down the *Left* or *Right Outlane* when lit awards a **"BLOWN AWAY" BONUS**.

19 EXTRA BALL
Shoot the *Ramp* when **RED LED** is lit to score an **EXTRA BALL**. The **EXTRA BALL** can be lit from the *Skill Shot*, the *Compass Targets*, or via percentaging.



PLAYFIELD SHOT MAP





COMBINATION SHOTS:

Twister features several Multi-Way Combos. These Combo Shots involve natural sequences of key shots in the game. Several undocumented difficult combos may also be present.

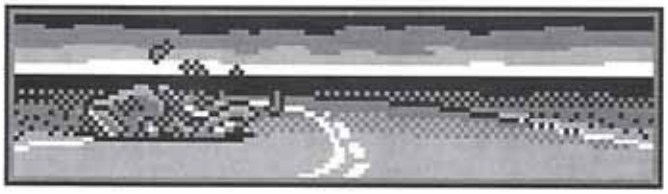
END OF BALL BONUS CALCULATION:

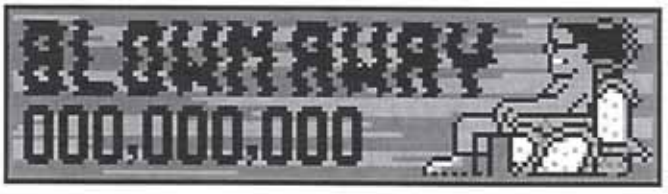
The **BONUS** is awarded based on the number of *Balls Locked*, the number of *Ramp Shots*, the number and speed of *Wind Shots*, the number of *Twister Target Hits* and the *Bonus Multiplier*. An additional bonus may be awarded for completing *Twister Features*. The **BONUS** can be carried over from ball to ball via **BONUS HELD AWARD** from the *Skill Shot* or *Compass Targets*.

WEATHER RULE NOTES

EMERGENCY BROADCAST WARNING:

This is not a test! The Emergency Broadcast System has issued the following warning: Rules & point values are subject to change without notice. *Repeat. This is not a test!*





Portals™ Service Menu Introduction

Section 3
Table of Contents

Chapter 1, Introduction 11
- Service Switch Set Access & Use / How to Use This Section 12/13
- Portals™ Service Menu Icon Tree 14/15
- Portals™ Service Menu Example 16-18

Chapter 2, • Go To Diagnostics Menu & Overview 19
- •• Go To Switch Menu 20
- ••• Switch Test 20
- ••• Active Switch Test 20
- ••• Dip Switch Test & Dedicated Switch Test 20
- ¤ Switch Matrix Grid 20
- ¤ Switch Matrix Locations, Descriptions & Part Numbers 21
- •• Go To Coil Menu 22
- ••• Coil Test 22
- ••• Cycling Coil Test 22
- ¤ Backbox Insert Flash Lamp Locations 22
- ¤ Playfield Coils & Flash Lamp Locations 23
- ¤ Coils Detailed Chart Table 24/25
- •• Go To Lamp Menu 26
- ••• Single Lamp Test 26
- ••• Test All Lamps 26
- ¤ Lamp Matrix Grid 26
- ••• Row Lamp Test 27
- ••• Column Lamp Test 27
- ¤ Lamp Matrix Locations 27
- •• Test Flash Lamps 28
- •• Clear Ball Trough 28
- •• Technicians Alert 28
- •• Service Phone # 28
- •• Begin Play Test 28
- •• Sound/Speaker Test 28
- ¤ Sound Test Chart 28
- ¤ Speaker Phase Testing 29
- •• Begin Burn In 29
- •• Dot Matrix Test 29
- •• TWISTER Specific 30
- •• Flow Chart Menu (Dr. Pinball) 30

Chapter 3, • Go To Audits Menu 33
- ¤ Game Audit Table 32
- •• Earnings Audits 33
- •• Sega Audits 34/35
- •• TWISTER Audits 35-37

Chapter 4, • Go To Adjustments Menu 39
- ¤ Game Adjustment Table 38
- •• Sega Adjustments 39-43
- •• TWISTER Adjustments 44
- •• Custom Pricing 46
- •• Film Star Reset 46

Chapter 5, • Go To Reset Menu 47
- •• Factory Reset 47
- •• Reset Coin Audits 47
- •• Reset Game Audits 47
- ¤ Example 48

Chapter 6, • Go To Printer Menu 49
- •• Quick Printout 49
- •• Full Printout 49
- •• Nº of Copies Printed 49

Chapter 7, • Go To Help Screen 51
- •• Go To Help Screens (Multi-Level) 51
- ¤ Problem/Solution Table 50

Bullet Notes:
- • From Main Menu, Level 1.
- •• From the Sub-Menu, Level 2.
- ••• From the Sub-Menu, Level 3.
- ¤ Added Information/Instruction.

Service Switch Set (Red, Green & Black Buttons) Access & Use

Open Coin Door and view Service Switch Set (see figures below). The Memory Protect Switch is now disabled; when changing adjustments, leave the coin door open, so changes can be made. **Please ensure the Playfield Power Interlock Switch is pulled out for Coil and Flashlamp testing (this is required).**

❶ *Entering* **Portals™ Service Menu** *(will not operate in Volume Mode):*

Step 2
Move through the menus by pushing the **Red "LEFT"** or **Green "RIGHT" Buttons.**

Note: Pushing the **Left** or **Right Flipper Buttons** operates in the same way.

Step 1
Enter the **Portals™ Service Menu** by pushing the **Black "BEGIN TEST" Button.**

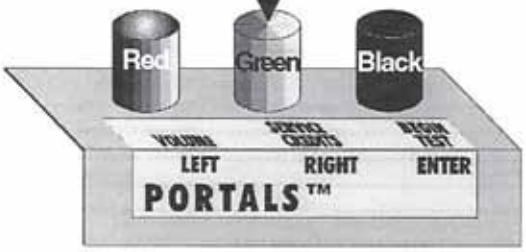
Step 3
Select or activate icons by pushing the **Black "ENTER" Button.**

Note: Pushing the **Start Button** operates in the same way.

❷ *Adding* **Service Credits** *(will not operate in Service or Volume Modes):*

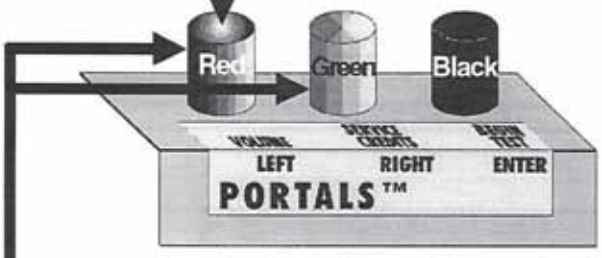
Step 1
Receive service credits by pushing the **Green "SERVICE CREDITS" Button.**

This button allows the technician to add Service Credits without adding any counts to the Coin Audits. Up to 30 credits can be applied.



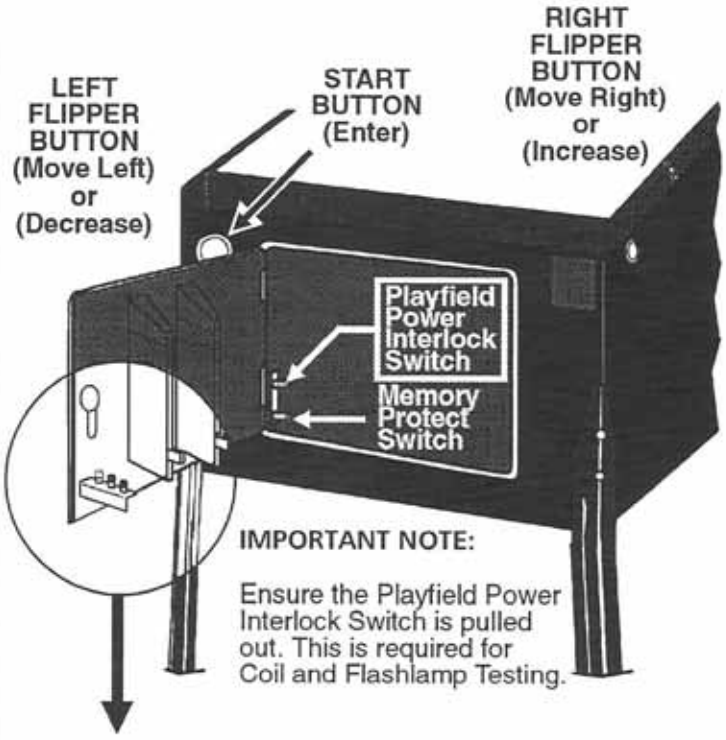
❸ *Entering the* **Volume Menu** *(will not operate in Service Mode):*

Step 1
Enter the **Volume Menu** by pushing the **Red "VOLUME" Button.**



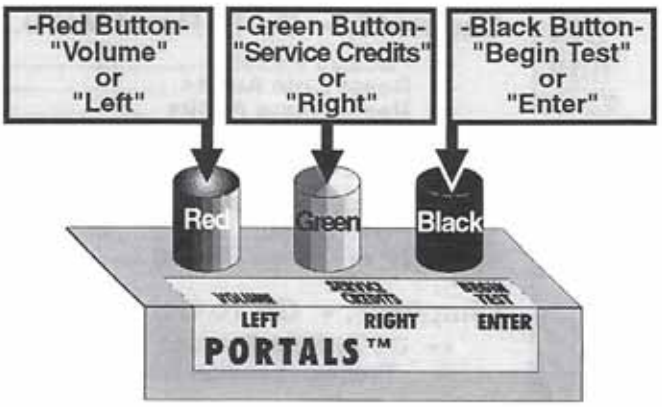
Step 2
* ***Decrease*** volume by pushing the **Red "LEFT" Button.**
* ***Increase*** volume by pushing the **Green "RIGHT" Button.**

Note: Pushing the **Left** or **Right Flipper Buttons** operates in the same way. Once adjustments are made, this menu will automatically exit in a few seconds.



IMPORTANT NOTE:

Ensure the Playfield Power Interlock Switch is pulled out. This is required for Coil and Flashlamp Testing.

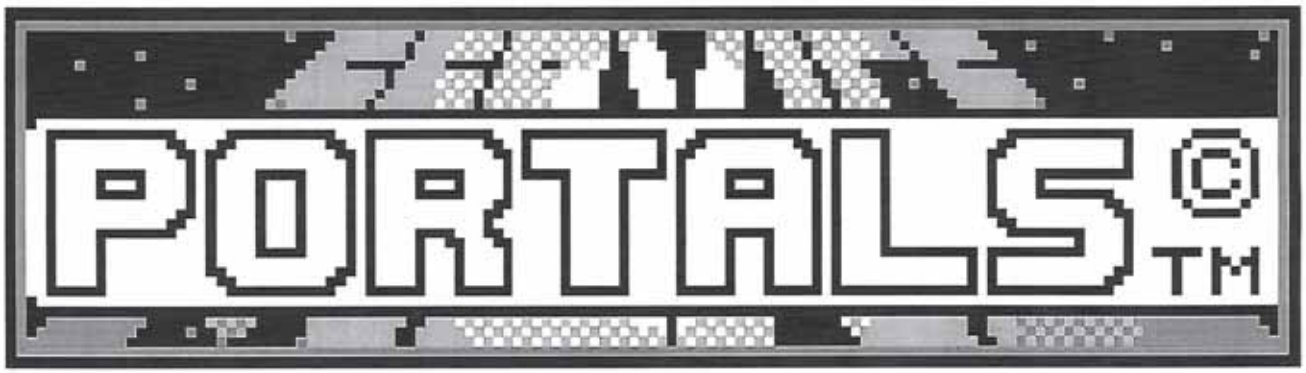


How to Use This Section

This section will cover all functions available in the **Portals™ Service Menu** in a *Step-By-Step* process. This section is divided into chapters which coincide with the **MAIN MENU**. The following pages in this chapter will instruct the operator on how to move through the menus. It's simple, easy and fun to use!

To get into the Service Menu Mode: • Power-up game (if not already) & open the Coin Door. • On the Coin Door is the Service Switch Set (**Red**, **Green** & **Black Buttons**). Push down the **Black "BEGIN TEST" Button**.

Looking at the Video Display you will momentarily see the introductory screen "Service Menu" with a satellite flying from right to left pulling a banner "Portals™ © 1996 SEGA PINBALL, INC.," followed by the **MAIN MENU**:

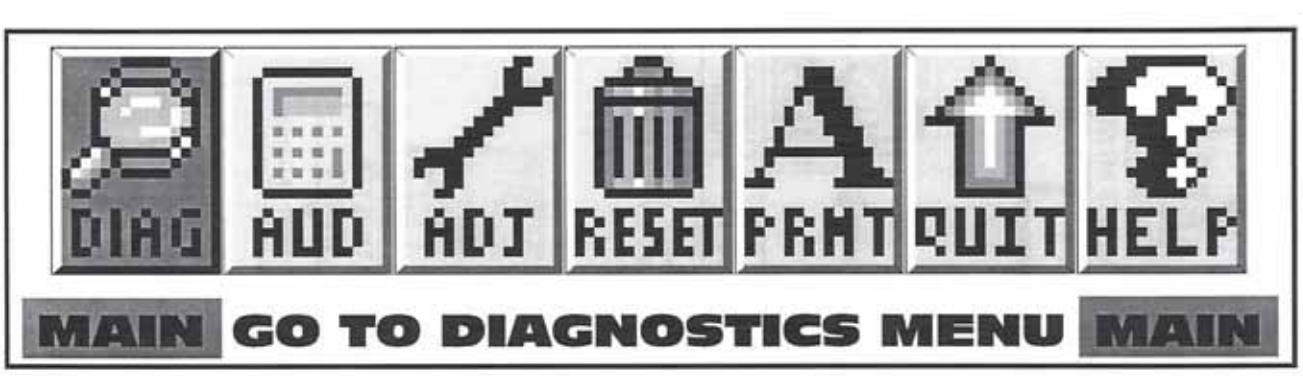


The Coin Door may be closed for security, however, please note with the Coin Door closed, the game's ***MEMORY PROTECT*** is enabled; ***meaning any changes that are made will be not be written to memory***. If changing adjustments is required, ensure the Coin Door is open.

Use the **Red "LEFT" & Green "RIGHT" Buttons** (or **Left** & **Right Flipper Buttons**) to move the selected **ICON** left or right, and the **Black "ENTER" Button** (or **Start Button**) to activate the selected **ICON**. The use of the Service Switch Set (**Red**, **Green**, & **Black Buttons**) *is required* in Switch Test or Active Switch Test, as the **Start & Flipper Buttons** are a part of this test.

For diagnostic purposes, be sure the ***Playfield Power Interlock Switch*** is pulled out so ***Playfield Power*** is not disabled.

The **MAIN MENU** now appears with the "DIAG" *Icon* (**DIAGNOSTICS MENU**) flashing:

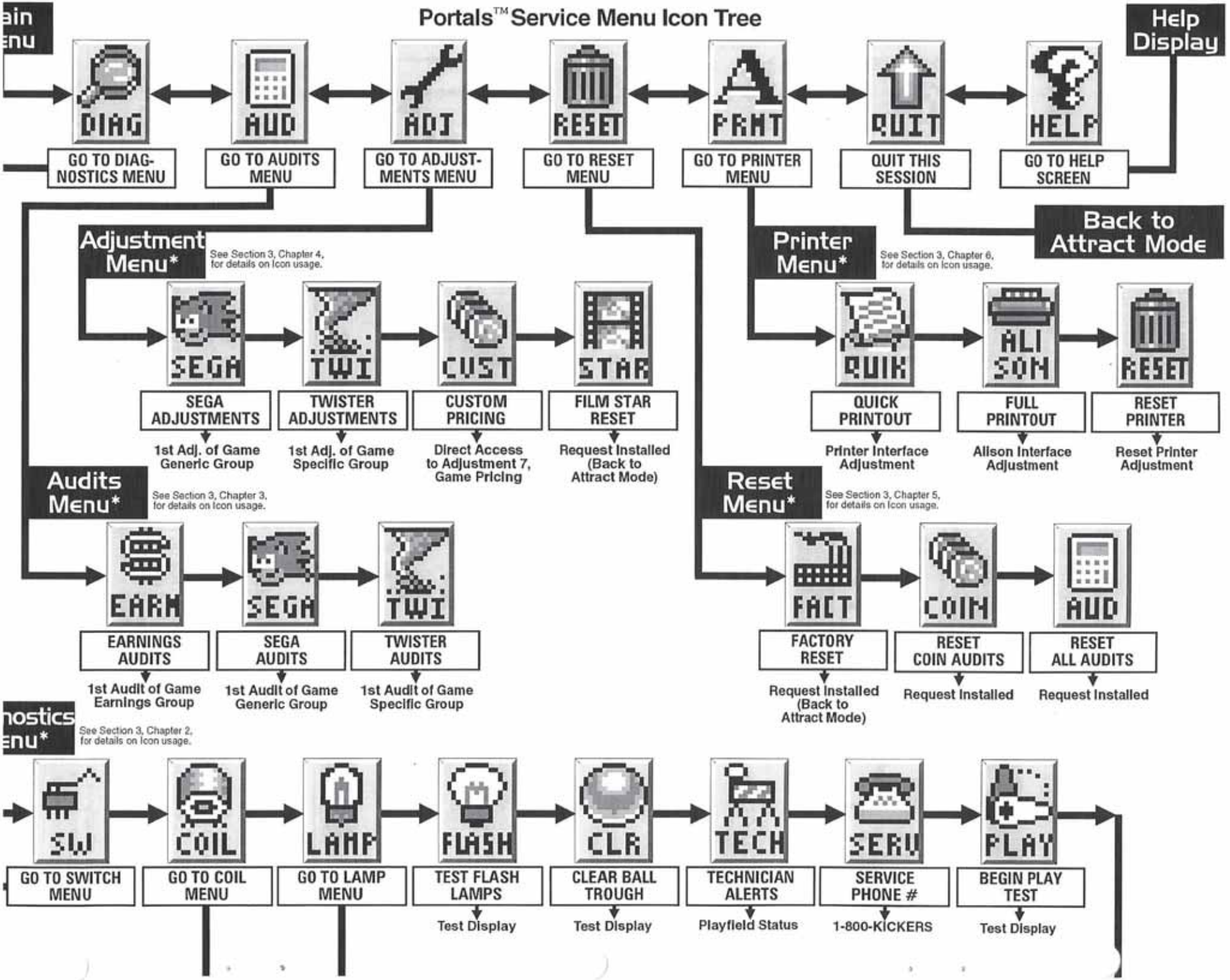


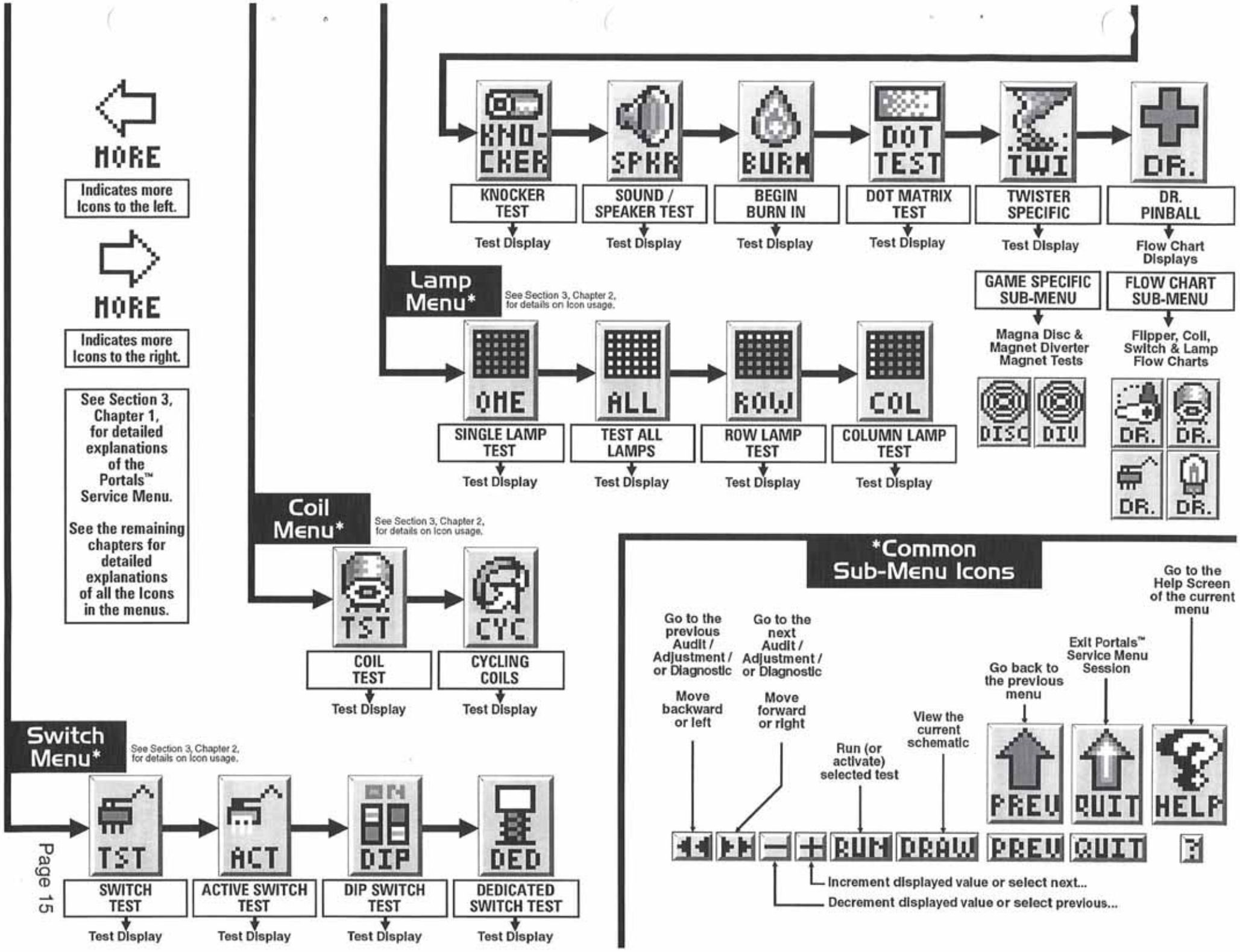
As the operator views the Menu Screen(s), the ⇦ MORE ⇨ MORE symbols indicates that there are more *Icons* to select in each direction. The *Icon* selected will blink. Pushing the **Black "ENTER" Button** (or **Start Button**) will select the *Icon* and the Menu Screen will change to the menu selected. Select the **"PREV"** *Icons* to move backwards through the menu levels. Select the **"QUIT"** *Icon* to completely exit the Service Mode.

View the **Portals™ Service Menu Icon Tree** on the next pages for a complete overview of all menus used in this system. View the last chapter (HELP) if more information is required. Selecting the "QUIT" *Icon* with the **Red "LEFT"** or **Green "RIGHT" Buttons** (or either **Flipper Button**), then pressing the **Black "ENTER" Button** (or **Start Button**) will exit the Service Mode. This applies to the large and small "QUIT" *Icons*.

The **chapters** in this **section**, which coincide with the **MAIN MENU**, will also provide more detailed information which could not fit in the display. Use both the manual and the display to help customize, troubleshoot and/or diagnose faults, if any.

Portals™ Service Menu Icon Tree




MORE
Indicates more Icons to the left.
MORE
Indicates more Icons to the right.
See Section 3, Chapter 1, for detailed explanations of the Portals™ Service Menu.
See the remaining chapters for detailed explanations of all the Icons in the menus.
KNO-CKER
KNOCKER TEST
Test Display
SPKR
SOUND / SPEAKER TEST
Test Display
BURN
BEGIN BURN IN
Test Display
DOT TEST
DOT MATRIX TEST
Test Display
TWI
TWISTER SPECIFIC
Test Display
DR.
DR. PINBALL
Flow Chart Displays
GAME SPECIFIC SUB-MENU
Magna Disc & Magnet Diverter Magnet Tests
DISC
DIV
FLOW CHART SUB-MENU
Flipper, Coil, Switch & Lamp Flow Charts
DR.
DR.
DR.
DR.
Lamp Menu*
See Section 3, Chapter 2, for details on Icon usage.
ONE
SINGLE LAMP TEST
Test Display
ALL
TEST ALL LAMPS
Test Display
ROW
ROW LAMP TEST
Test Display
COL
COLUMN LAMP TEST
Test Display
Coil Menu*
See Section 3, Chapter 2, for details on Icon usage.
TST
COIL TEST
Test Display
CYC
CYCLING COILS
Test Display
Switch Menu*
See Section 3, Chapter 2, for details on Icon usage.
TST
SWITCH TEST
Test Display
ACT
ACTIVE SWITCH TEST
Test Display
DIP
DIP SWITCH TEST
Test Display
DED
DEDICATED SWITCH TEST
Test Display
*Common Sub-Menu Icons
Go to the previous Audit / Adjustment / or Diagnostic
Go to the next Audit / Adjustment / or Diagnostic
Move backward or left
Move forward or right
Run (or activate) selected test
View the current schematic
Go back to the previous menu
Exit Portals™ Service Menu Session
Go to the Help Screen of the current menu
PREV
QUIT
HELP
RUN
DRAW
PREV
QUIT
Increment displayed value or select next...
Decrement displayed value or select previous...

Portals™ Service Menu Example

This example will demonstrate activation of *Icons* in the **DIAGNOSTICS MENU**. The example will show activation of the "SW" *Icon* (**GO TO SWITCH MENU**). In this menu, the switches can be tested individually and also all active switches can be tested. Use the same technique to access all the *Icons* in the **Portals™ Service Menu**. Follow **Portals™ Service Menu Icon Tree** on the previous pages as a guide to help navigate through the entire system (Also, go to the chapter in this manual explaining the icon(s) selected.).

If the display is in any other menu other than the **MAIN MENU**, use the **Red "LEFT" & Green "RIGHT" Buttons** to select the "PREV" *Icon* and press the **Black "ENTER" Button** to activate the **ICON** thus moving back to the previous menu. Do so until **MAIN MENU** appears.

Chapters 2 through 7 will cover all menu items within the **Portals™ Service Menu**. The *Icon* is shown preceding the text. Find the *Icon* in the **Portals™ Service Menu** by navigating with the **Red** or **Green Buttons**. Each chapter started is from the **MAIN MENU**. Within the chapter, the sub-menu's will be covered sequentially with their explanation & function. If the operator *"gets lost"*, select and activate the "PREV" *Icon* until the display indicates **MAIN MENU**. For more help, see Chapter 7.

The "MORE" *symbols* are indicating that *"more icons"* are available which don't appear in the display and which way to move the selection to view the *Icons*.

Important Note:

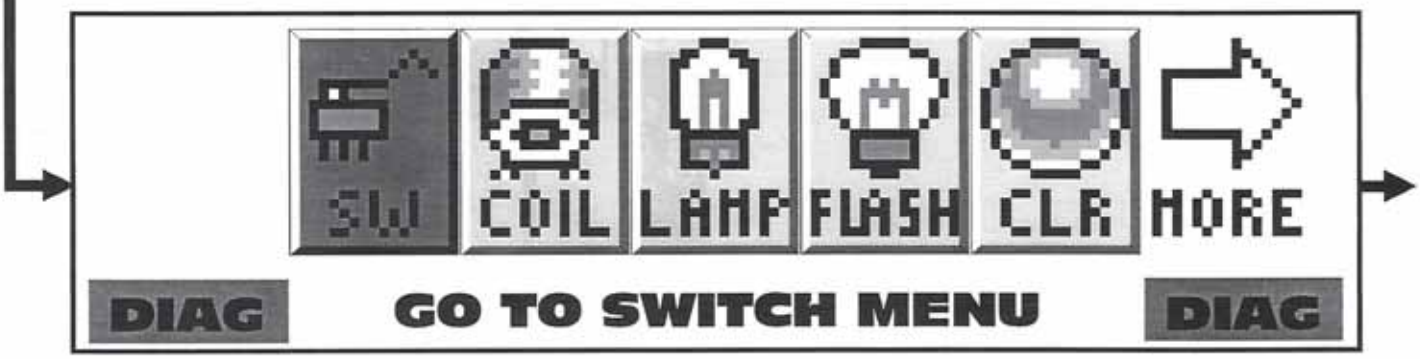
Exit any sub-menu and return to the **MAIN MENU** by selecting & activating the "PREV" *Icons*. ***If no Icons appear in the display because of a testing function or special display (e.g. Help, Schematic Display, etc.), press any service button to exit to the previous menu or sub-menu.***

Selecting & activating the "QUIT" *Icon* from any display will exit the *Service Session.*

Selecting & activating the "HELP" *Icon* will show a help screen. (An explanation of each *Mini-Icon* at that level will cycle continuously until any active button is pressed.)

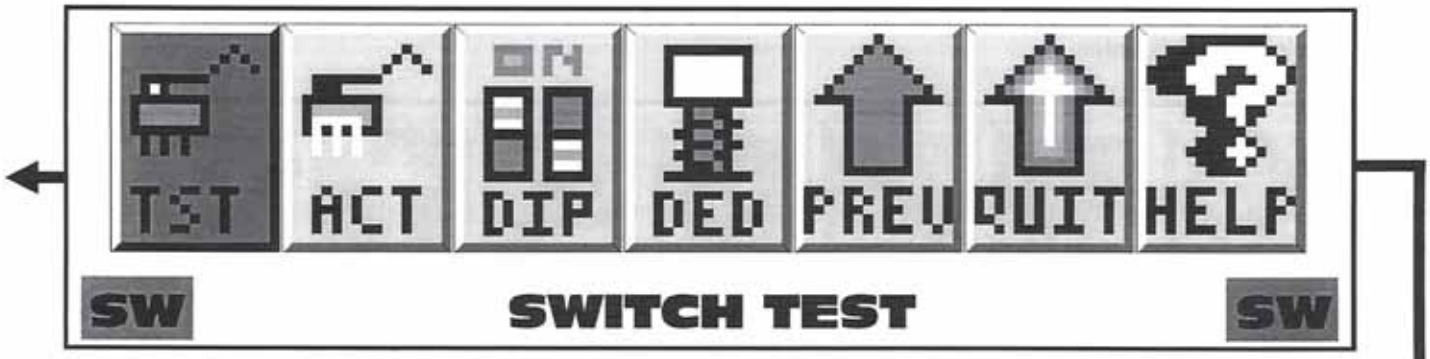
Example: From the **MAIN MENU**, use the **Red "LEFT"** or **Green "RIGHT" Buttons** to select the "DIAG" *Icon* (**GO TO DIAGNOSTICS MENU**).

Press the **Black "ENTER" Button** to activate this **ICON**. This will bring up the **DIAGNOSTICS MENU**.

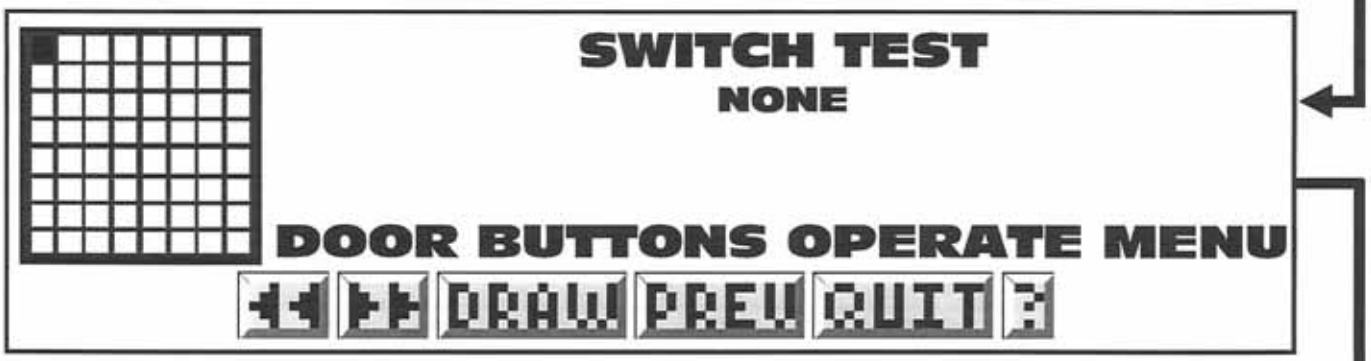


The **DIAGNOSTICS MENU** now appears with the "SW" *Icon* (**GO TO SWITCH MENU**) flashing. Press the **Black Button** to *activate* this icon. This will bring up the **SWITCH TEST MENU**.

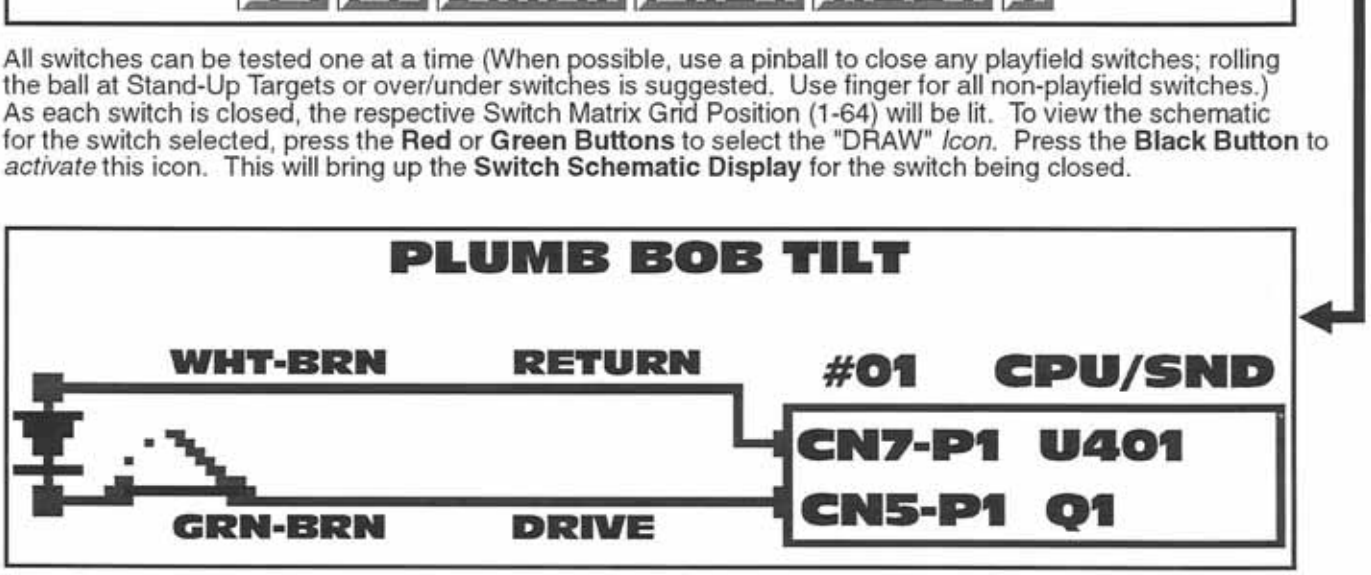
The **SWITCH TEST MENU** now appears with the "TST" *Icon* (**SWITCH TEST**) flashing:
Press the **Black "ENTER" Button** to *activate* this icon. This will bring up the **Switch Test Display**.



The **Switch Test Display** now appears.



All switches can be tested one at a time (When possible, use a pinball to close any playfield switches; rolling the ball at Stand-Up Targets or over/under switches is suggested. Use finger for all non-playfield switches.) As each switch is closed, the respective Switch Matrix Grid Position (1-64) will be lit. To view the schematic for the switch selected, press the **Red** or **Green Buttons** to select the "DRAW" *Icon*. Press the **Black Button** to *activate* this icon. This will bring up the **Switch Schematic Display** for the switch being closed.



An example is shown with Switch #01, Plumb Bob Tilt, selected. The display describes the switch in the Switch Matrix which includes the name of the switch, the Return (Row) Wire and the Drive (Column) Wire, drive transistor, the part number (not shown in the above example) and the "Pin-Outs" from the CPU/Sound Board.

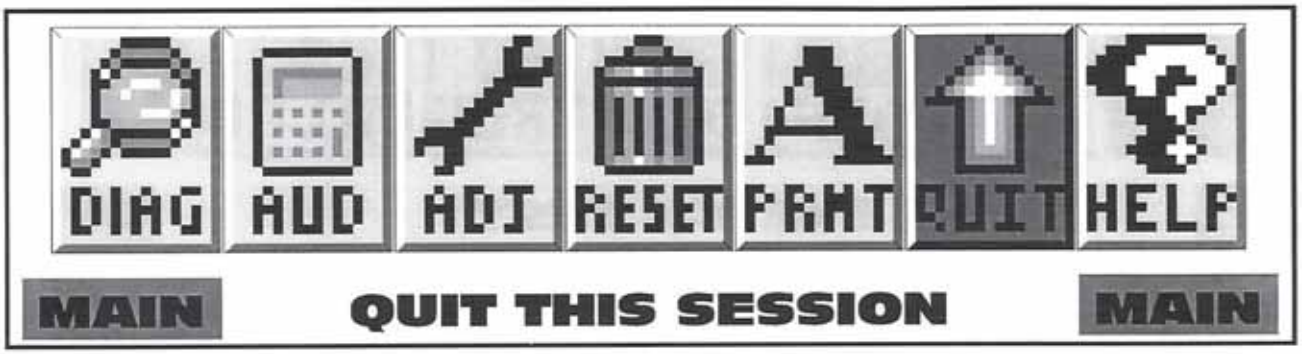
While in Switch or Active Switch Tests, the **Flipper & Start Buttons** are deactivated. Use the **Red "LEFT," Green "RIGHT"** and/or **Black "ENTER" Buttons** to select and activate the **"MINI-ICONS"** at the bottom of the display. In Switch Test, if the "Left Arrow" or "Right Arrow" *Icon* is activated, the display will go to the previous tests (Active, Dip & Dedicated Switch Tests). Use the **Red** or **Green Buttons** to change the selected **ICON** to "PREV"*Icon*. Press the **Black "ENTER" Button** to go to the previous menu.

Note:
In **Dedicated Switch Test**, the **Flipper & Start Buttons** are to be used instead of the **Red**, **Green** & **Black Service Buttons**, as these buttons are deactivated for this test.

Exit out of the sub-menu by activating the big "PREV" *Icon* in the menu. This will bring up the **DIAGNOSTICS MENU**. The Switch Test Session is now complete. See the next page about exiting the **Portals™ Service Menu**.

Exiting the Portals™ Service Menu

All *Icons* will be covered in the chapters of this section with the exception of the "QUIT" *Icon*, in the **MAIN MENU**. Both the large and small *Icons* if selected and activated, will exit the user from the **Portals™ Service Menu**. The display will return back to the **ATTRACT MODE**! To re-enter the **Portals™ Service Menu** follow the instructions at the beginning of this chapter.



If more help is required, see Chapter 7 of this section, and view the various help displays in the game.

Your Notes

Go To Diagnostics Menu

Special Note: If the ***display flashes*** **"OPEN THE COIN DOOR"** the game is indicating that memory has been corrupted. This is caused be either failure in memory (e.g. batteries are dead and/or faulty **RAM**) or upon installation of updated version of game code. Opening the Coin Door will initiate a *Factory Restore*, by opening the ***Memory Protect Switch***. Check battery voltage at **CMOS RAM** with the power off.

Overview

The **Portals™ Service Menu System** provides tests for sounds, display, lamps, switches and coils. Each feature may be tested manually or automatically after entering the **Portals™ Service Menu** (see Chapter 1 of this section). Select the "DIAG" *Icon* from the **MAIN MENU** to go to the **DIAGNOSTICS MENU**. The automatic tests (e.g. Cycling Coils, Flash Lamps, etc.) may be used for a quick verification of automatic test functions and the manual tests (Begin Play Test, Single Lamp/All/Row/Column Tests, etc.) may be used for troubleshooting.

During game play, activation of switches and operation of coils with associated switches are monitored. If the CPU Board does not detect a switch transition ("Stuck Open" / "Stuck Closed") for 50 games, it is considered faulty. When operation of a coil should close or open a switch and does not, the coil is considered faulty. In the Attract Mode, faulty switches and coils (if any) are reported (Select the "TECH" *Icon*, Technician Alerts, from the **DIAGNOSTICS MENU**). Note that reporting of an unused switch does not constitute a problem and that a bad coil could mean that the associated switch requires adjustment.

GO TO DIAGNOSTICS MENU

With the game in the Attract Mode, open the Coin Door and press the **Black "BEGIN TEST" Button**. Select the "DIAG" *Icon* in the **MAIN MENU** with either **Flipper** or **Red "LEFT"** & **Green "Right" Buttons** (upon entry of the **Portals™ Service Menu**, the system defaults with the selection of the "DIAG" *Icon* flashing) and press the **Start** or **Black "ENTER" Buttons**. The **DIAGNOSTICS MENU** appears.

The "MORE" *symbols* are indicating that *"more icons"* are available which don't appear in the display and which way to move the selection to view the *Icons*.

Important Notes:

Exit any sub-menu and return to the **MAIN MENU** by selecting & activating the "PREV" *Icons*. If no *Icons* appear in the display because of a testing function or special display (e.g. "Help"), press any button to exit.

Selecting & activating the "QUIT" *Icon* from any display will exit the Service Session.

Selecting & activating the "HELP" *Icon* from any display will show a help screen. (An explanation of each *Mini-Icon* at that level will cycle continuously until any active button is pressed.)

In Diagnostics, selecting & activating the "-" or "+" *Icons* moves test forwards/backwards. Selecting & activating the "RUN" *Icon* repeats the test on the coil or flash lamp left off at. Selecting & activating the "ARROW" *Icons* moves between tests in the sub-menu. Selecting & activating the "DRAW" *Icon* will show the schematic for that switch or coil.

Some tests require navigation through the menu(s) and selection of the *Icons* with the **Red "LEFT," Green "RIGHT"** and **Black "ENTER" Buttons**. This is required is Switch and Active Switch Tests, as the **Flipper** and **Start Buttons** are a part of the test.

In Coil Test, ensure the **Power Interlock Switch** is pulled out. (See ***Access & Use*** of Chapter 1 of this section for the location.) If the switch is not pulled out, the coils and flash lamps cannot be tested (32v DC and 50v DC are disabled). Closing the Coin Door will automatically reset this switch. Coils and Flash Lamps are checked manually in Coil Test. To automatically check coils, go to Cycling Coils from the **COIL TEST MENU**. To automatically check flash lamps, go to Flash Lamp Test, from the **DIAGNOSTICS MENU**.

GO TO SWITCH MENU

From the **DIAGNOSTICS MENU**, select the "SW" *Icon* with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. Switches are configured in an 8 x 8 Matrix of Columns (Switch Drives) and Rows (Switch Returns) with up to 64 switches possible. The Switch Test Menu consists of four parts: Switch Test, Active Switches, Dip Switch Test and Dedicated Switch Test.

Note: The Flipper & Start Buttons are deactived during Switch Tests.

Switch Test

To initiate, from the **SWITCH MENU**, select the "TST" *Icon* with the **Red** or **Green Button** & press the **Black Button**. In Switch Test, close each switch and observe the display. The display will describe the switch in the Switch Matrix, which includes the switch name, Return (Row) Wire, Drive (Column) Wire, Part Nº, and the "Pin-Outs" from the CPU/SOUND Board. When the switch is released, the information of the last switch closed will remain in the display until another switch is closed or the test is exited. To view the switch schematic, select the mini "DRAW" *Icon* with the **Red** or **Green Button** & press the **Black Button**.

Active Switch Test

To initiate, from the **SWITCH MENU**, select the "ACT" *Icon* with either **Red** or **Green Button** & press the **Black Button**. If still in a previous test, select the "PREV" *Icon* to return to Switch Menu or selecting either of the "ARROW" *Icons* will move through the tests. If any switches are stuck closed (or made from the presence of a pinball), the display sequences through the switch names, Return (Row) Wire, Drive (Column) Wire, drive transistor, Part Nº, and the "Pin-Outs" from the CPU/SOUND Board. This cycle continues until all switches are cleared or until the test is exited.

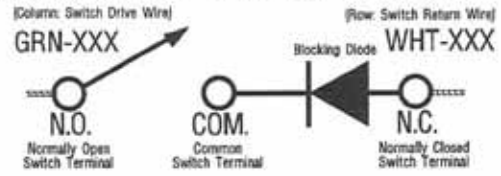
Dip Switch Test

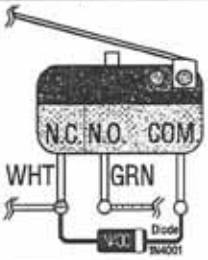
To initiate, from the **SWITCH MENU**, select the "DIP" *Icon* with either **Red** or **Green Button** & press the **Black Button**. The display will indicate the Dip Switch Positions & the country setting the game is set to (e.g. USA, Germany, England, etc.). *See the "Find-It-In Front: Dr. Pinball Section" for Dip Switch Settings.*

Dedicated Switch Test

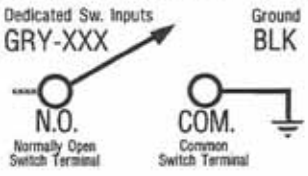
To initiate, from the **SWITCH MENU**, select the "DED" *Icon* with either **Flipper Button** & press the **Start Button** (The service switches are deactivated during this test.). The display will describe the switch which includes the switch name, Return (Row) Wire, Column Wire, Part Nº, and the "Pin-Outs" from the CPU/SOUND Board.

Typical Switch Schematic & Side View





Dedicated Switch Schematic



SWITCH MATRIX GRID

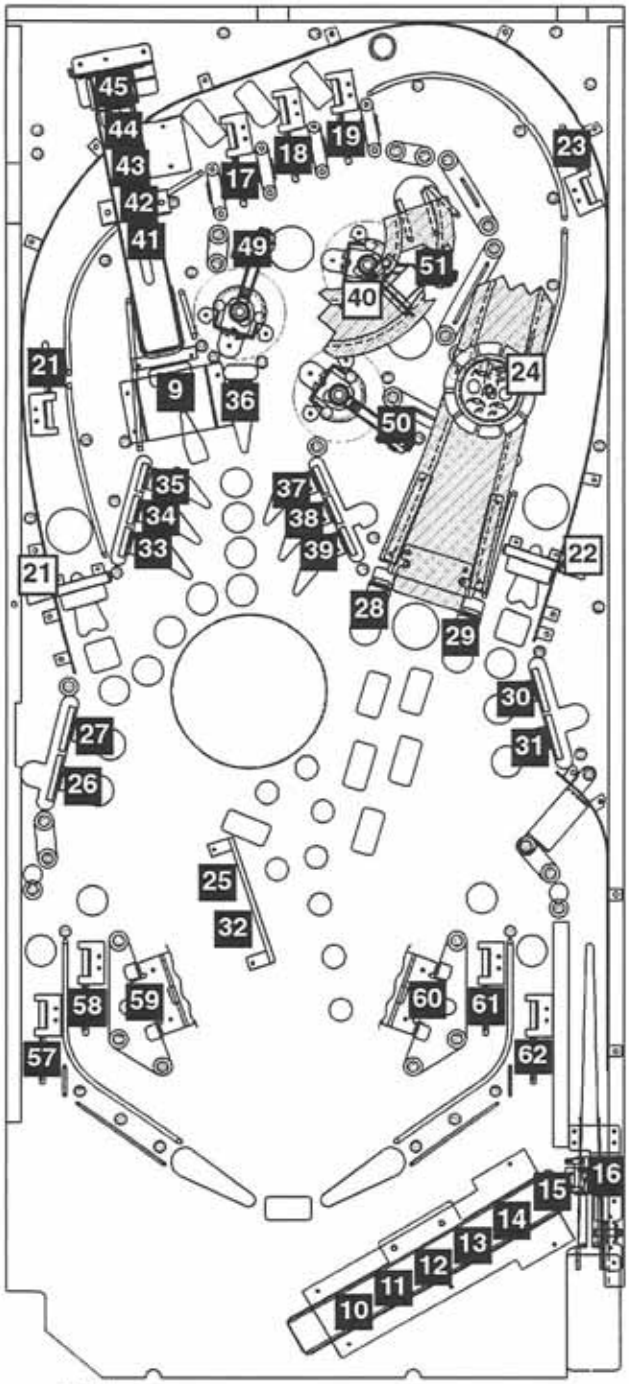
Column (Drive) / Row (Return)	1 Q1 GRN-BRN CN5-1	2 Q2 GRN-RED CN5-3	3 Q3 GRN-ORG CN5-4	4 Q4 GRN-YEL CN5-5	5 Q5 GRN-BLK CN5-6	6 Q6 GRN-BLU CN5-7	7 Q7 GRN-VIO CN5-8	8 Q8 GRN-GRY CN5-9
1 WHT-BRN CN7-9	NOT USED 1	DROP TARGET 9	LEFT TOP LANE 17	DISC MAGNET-Q2 MAG. BD. 25	3-BANK S-U (T) WI 33	5-BALL LOCK #1 (BOTTOM) 41	LEFT TURBO BUMPER 49	LEFT OUTLANE 57
2 WHT-RED CN7-8	4TH COIN SLOT 2	5-BALL TROUGH #1 (LEFT) 10	MIDDLE TOP LANE 18	WEST STAND-UP 26	3-BANK S-U T(W)I 34	5-BALL LOCK #2 42	BOTTOM TURBO BUMPER 50	LEFT RETURN LANE 58
3 WHT-ORG CN7-7	6TH COIN SLOT (FUTURE) 3	5-BALL TROUGH #2 11	RIGHT TOP LANE 19	NW STAND-UP 27	3-BANK S-U TW(I) 35	5-BALL LOCK #3 43	RIGHT TURBO BUMPER 51	LEFT SLINGSHOT 59
4 WHT-YEL CN7-6	RIGHT COIN SLOT 4	5-BALL TROUGH #3 12	LEFT SPINNER 20	NORTH STAND-UP 28	S-U TOP TWI(S) TER 36	5-BALL LOCK #4 44	NOT USED 52	RIGHT OUTLANE 60
5 WHT-GRN CN7-5	CENTER COIN SLOT / DBA 5	5-BALL TROUGH #4 13	LEFT ORBIT 21	NE STAND-UP 29	3-BANK S-U (T) ER 37	5-BALL LOCK VUK 45	NOT USED 53	RIGHT RETURN LANE 61
6 WHT-BLU CN7-3	LEFT COIN SLOT 6	5-BALL TROUGH #5 (RIGHT) 14	RIGHT SPINNER 22	EAST STAND-UP 30	3-BANK S-U T(E)R 38	NOT USED 46	START BUTTON 54	RIGHT SLINGSHOT 62
7 WHT-VIO CN7-2	5TH COIN SLOT (FUTURE) 7	5-BALL TROUGH VUK OPTO 15	RIGHT ORBIT 23	SE STAND-UP 31	3-BANK S-U TE(R) 39	NOT USED 47	SLAM TILT 55	NOT USED 63
8 WHT-GRY CN7-1	NOT USED 8	SHOOTER LANE 16	RIGHT RAMP ENTER 24	DIVERTER MAGNET - Q1 M. BD. 32	RIGHT RAMP EXIT 40	NOT USED 48	PLUMB BOB TILT 56	NOT USED 64

Dedicated Switches

GND / IC U206 INPUTS	Ground BLK CN6-1
1 GRY-BRN CN6-2	LEFT FLIPPER BUTTON DS-1
2 GRY-RED CN6-3	LEFT FLIPPER END-OF-STROKE (E.O.S) DS-2
3 GRY-ORG CN6-4	RIGHT FLIPPER BUTTON DS-3
4 GRY-YEL CN6-6	RIGHT FLIPPER END-OF-STROKE (E.O.S) DS-4
5 NOT USED CN6-7	NOT USED DS-5
6 GRY-BLU CN6-8	Normal: Volume In Test: Left RED BUTTON DS-6
7 GRY-VIO CN6-9	Normal: Service Credits In Test: Right GRN BUTTON DS-7
8 GRY-BLK CN6-10	Normal: Begin Test In Test: Enter BLK BUTTON DS-8

Switch Matrix Descriptions with Part Numbers and Locations †

The switch locations correspond with the Switch Nº in the table below and the Switch Maxtrix Grid.



Legend Note:

☐ = Switches mounted above playfield.

■ = Switches mounted below playfield.

* The following switches are located in the cabinet and are not noted in the diagram above:

2 3 4 5 6 7 54 55 56

The following switches are not used:

1 8 46 47 48 52 53 63 64

Sw. Nº	Col. Nº	Row Nº	Switch Matrix Description	Part Nº
1	1	1	NOT USED	— - — - —
2*	1	2	4TH COIN SLOT (On Coin Door)	— - — - —
3*	1	3	6TH COIN SLOT (FUTURE USE)	— - — - —
4*	1	4	RIGHT COIN SLOT (On Coin Door)	180-5024-00
5*	1	5	CENTER COIN SLOT / DBA	180-5024-00
6*	1	6	LEFT COIN SLOT (On Coin Door)	180-5024-00
7*	1	7	5TH COIN SLOT (FUTURE USE)	— - — - —
8	1	8	NOT USED	— - — - —
9	2	1	DROP TARGET	180-5158-00
10	2	2	5-BALL TROUGH #1 (LEFT)	180-5119-00
11	2	3	5-BALL TROUGH #2	180-5119-00
12	2	4	5-BALL TROUGH #3	180-5119-00
13	2	5	5-BALL TROUGH #4	180-5119-00
14	2	6	5-BALL TROUGH #5 (RIGHT)	180-5119-00
15	2	7	5-BALL TROUGH VUK OPTO TRANS 5-BALL TROUGH VUK OPTO REC	520-5124-00 520-5125-00
16	2	8	SHOOTER LANE	180-5157-00
17	3	1	LEFT TOP LANE	500-5707-00
18	3	2	MIDDLE TOP LANE	500-5707-00
19	3	3	RIGHT TOP LANE	500-5707-00
20	3	4	LEFT SPINNER	180-5010-04
21	3	5	LEFT ORBIT	500-5707-00
22	3	6	RIGHT SPINNER	180-5010-04
23	3	7	RIGHT ORBIT	500-5707-00
24	3	8	RIGHT RAMP ENTER	180-5090-00
25	4	1	DISC MAGNET-Q2 MAG. BD.	*See Note*
26	4	2	WEST STAND-UP (TARGET)	515-6027-00
27	4	3	NW STAND-UP (TARGET)	515-6027-00
28	4	4	NORTH STAND-UP (TARGET)	515-5967-00
29	4	5	NE STAND-UP (TARGET)	515-5967-00
30	4	6	EAST STAND-UP (TARGET)	515-6027-00
31	4	7	SE STAND-UP (TARGET)	515-6027-00
32	4	8	DIVERTER MAGNET-Q1 M. BD.	*See Note*
33	5	1	3-BANK S-U (T) WI <STER>	500-6075-01
34	5	2	3-BANK S-U T (W) I <STER>	500-6075-01
35	5	3	3-BANK S-U TW (I) <STER>	500-6075-01
36	5	4	S-U TOP TWI (S) TER	500-6075-01
37	5	5	3-BANK S-U <TWIS> (T) ER	500-6075-01
38	5	6	3-BANK S-U <TWIS> T (E) R	500-6075-01
39	5	7	3-BANK S-U <TWIS> TE (R)	500-6075-01
40	5	8	RIGHT RAMP EXIT	180-5087-00
41	6	1	5-BALL LOCK #1 (BOTTOM)	181-5001-00 (4-Position Switch Membrane)
42	6	2	5-BALL LOCK #2	
43	6	3	5-BALL LOCK #3	
44	6	4	5-BALL LOCK #4	
45	6	5	5-BALL LOCK VUK	180-5116-00
46	6	6	NOT USED	— - — - —
47	6	7	NOT USED	— - — - —
48	6	8	NOT USED	— - — - —
49	7	4	LEFT TURBO BUMPER	180-5015-03
50	7	2	BOTTOM TURBO BUMPER	180-5015-03
51	7	3	RIGHT TURBO BUMPER	180-5015-03
52	7	4	NOT USED	— - — - —
53	7	5	NOT USED	— - — - —
54*	7	6	START BUTTON	500-6090-02
55*	7	7	SLAM TILT (On Coin Door)	180-5022-00
56*	7	8	PLUMB BOB TILT (Hanger Wire) PLUMB BOB TILT (Contact Wire)	535-5319-00 535-7563-01
57	8	1	LEFT OUTLANE	500-5707-00
58	8	2	LEFT RETURN LANE	500-5707-00
59	8	3	LEFT SLINGSHOT	180-5054-00
60	8	4	RIGHT OUTLANE	500-5707-00
61	8	5	RIGHT RETURN LANE	500-5707-00
62	8	6	RIGHT SLINGSHOT	180-5054-00
63	8	7	NOT USED	— - — - —
64	8	8	NOT USED	— - — - —

TAKE NOTE: For Switches 25 & 32 see Magnet Board Layout in Sec. 5, Chp. 2.
For Dedicated Switches DS-1, -3, -6, -7, & -8 Part Nºs see Sec. 4, Chp. 1, Cabinet - General Parts.
For Dedicated Switches DS-2, & -4 Part Nºs see Sec. 4, Chp. 2, Flipper Assemblies.

GO TO COIL MENU

From the **DIAGNOSTICS MENU**, select the "COIL" *Icon* with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. The coils are listed in groups. The first 2 groups are the High Current Coils. The next group is the Low Current Coils. The next group is the Flash Lamps. The remaining coils are special coils. These coils are listed in a Coils Detailed Chart Table following the Playfield Coil & Flash Lamp Locations.

Coil Test

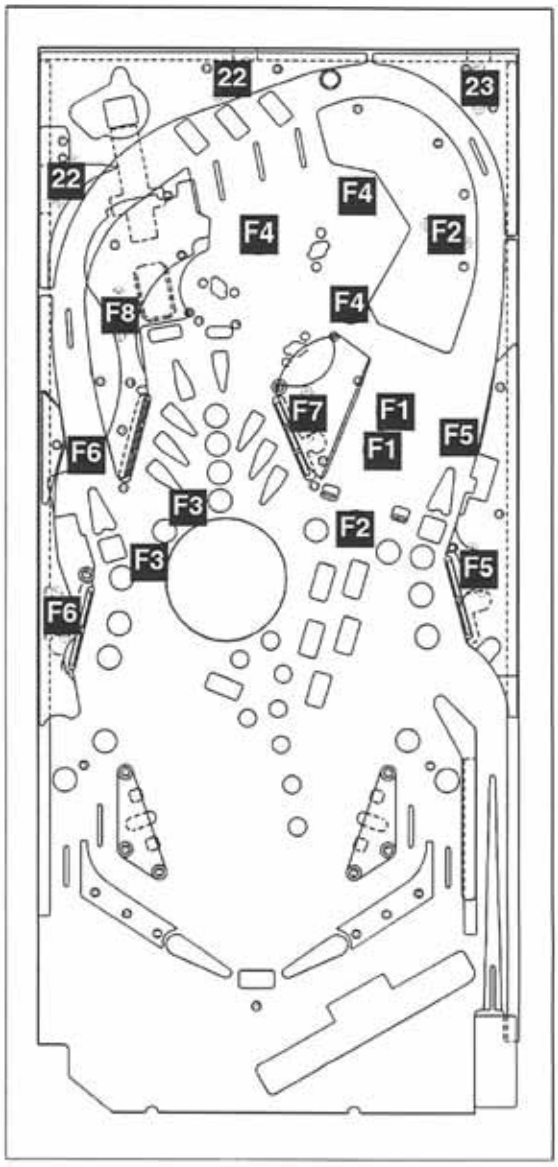
To initiate, from the **COIL MENU**, select the "TST" *Icon* with either **Red** or **Green Button** and press the **Black Button**. Ensure the **Power Interlock Switch** is pulled out. Select either the "-" or "+" *Icons*. Start with the "+" *Icon* to start the manual Coil Test from #1 (The test runs through Coils 1-24 and Flashlamps F1-F8). Press the **Black Button** on the "+" *Icon*, as each coil is selected, the display will describe the coil or flash lamp name with the corresponding number, the wire with colors, the "Pin-Outs" from the I/O Power Driver Board, the coil voltage and gauge-turns (e.g. 23-800). Press the **Black Button** again to move forward in the test. To test and view a particular coil or flash lamp, select the "RUN" *Icon* and press the **Black Button**. Each time the **Black Button** is pushed, the coil or flash lamp will fire on the playfield and/or backbox, with the display indicating the coil or flash lamp information. Continue with the same procedure to run through the entire test.

Cycling Coil Test

To initiate, from the **COIL MENU**, select the "CYC" *Icon* with either **Red** or **Green Button** and press the **Black Button**.. If still in a previous test, select the "PREV" *Icon* to return to Coil Menu or selecting either of the "ARROW" *Icons* will move to Cycling Coil Test (selecting again will return to Coil Test). The test pulses each regular coil or flash lamp sequentially (cycling) on the playfield and backbox. The display indicates "CYCLING COILS."

Playfield Flash Lamp Locations

Type	Description
#22 FLASH	TOP-LEFT*2
#23 FLASH	TOP-RIGHT*1
#F1 FLASH	UNDER RAMP*2
#F2 FLASH	JACKPOT*1 RAMP*1
#F3 FLASH	DISC*2
#F4 FLASH	POPS*3
#F5 FLASH	R ORBIT*1 R 2-BANK *1
#F6 FLASH	L ORBIT*1 L 2-BANK*1
#F7 FLASH	R 3-BANK *1
#F8 FLASH	NEAR VUK*1



Legend Note:

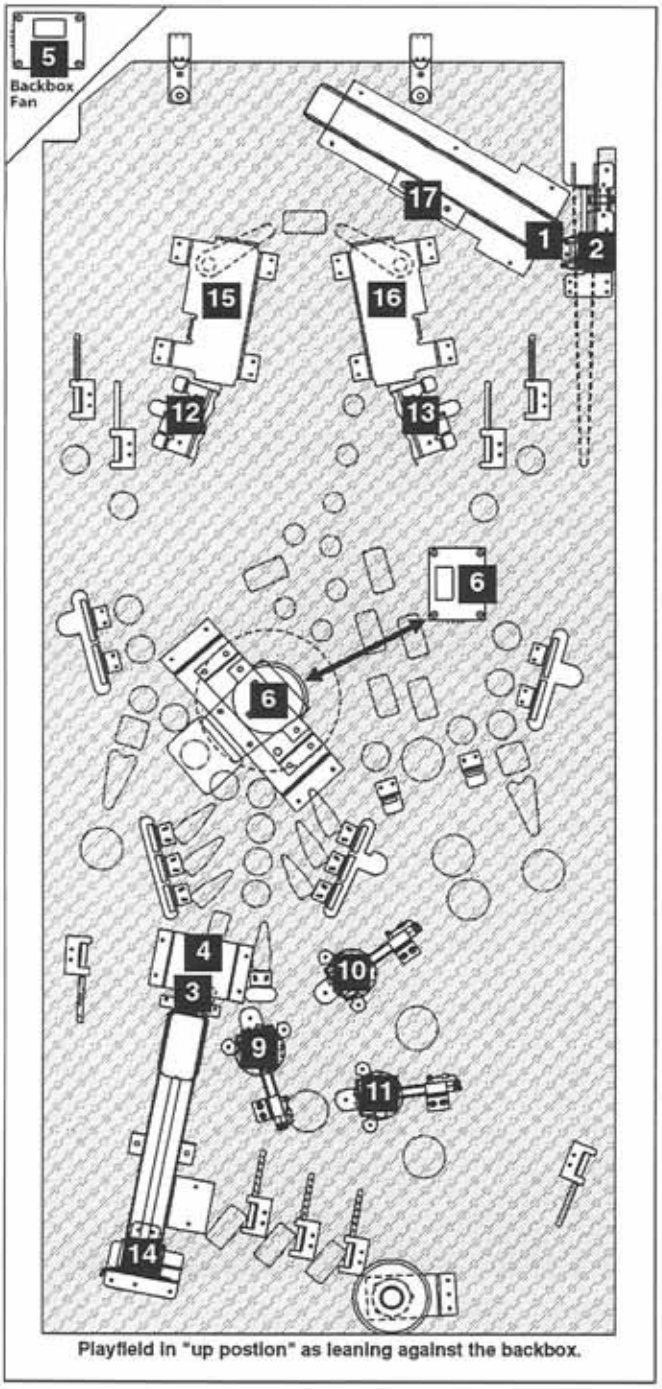
☐ = Flash Lamps mounted above playfield.

■ = Flash Lamps mounted below playfield.

The following bulb is used for Flash Lamps:

#89 Bulb
(Bayonet)
165-5000-99

Playfield Coil Locations



Playfield in "up postion" as leaning against the backbox.

Type	Coil Description
COIL 1	TROUGH UP-KICKER (VUK) (24-940)
COIL 2	AUTO LAUNCH 50V (23-800)
COIL 3	DROP TARGET RESET (23-800)
COIL 4	DROP TARGET DOWN (32-1800)
COIL 5	FAN MOTOR RELAY
COIL 6	DISC MOTOR RELAY
COIL 7	NOT USED / SPARE
COIL 8	(EUROPEAN TOKEN DISPENSER)
COIL 9	LEFT TURBO BUMPER (26-1200)
COIL 10	BOTTOM TURBO BUMPER (26-1200)
COIL 11	RIGHT TURBO BUMPER (26-1200)
COIL 12	LEFT SLINGSHOT (26-1200)
COIL 13	RIGHT SLINGSHOT (26-1200)
COIL 14	SUPER VUK (24-940)
COIL 15	LEFT FLIPPER (22-900)
COIL 16	RIGHT FLIPPER (22-1080)
COIL 17	5-BALL TROUGH LOCK BALL (24-940)
COIL 18	NOT USED / SPARE
COIL 19	NOT USED / SPARE
COIL 20	NOT USED / SPARE
COIL 21	NOT USED / SPARE
COIL 22	FLASH TOP LEFT*2 (See previous page)
COIL 23	FLASH TOP RIGHT*1 (See previous page)
COIL 24	(OPTIONAL COIN METER)

Legend Note:

□ = Coils mounted above playfield.

■ = Coils mounted below playfield.

The following coils are not used:

7 18 19 20 21

The following coils are optional:

8 24

COILS DETAILED CHART TABLE

High Current Coils Group 1		Drive Transistor (D.T.)	Driver Ouput Board	D.T. Control Line Color	D.T. Control Line Connect	Power Line Color	Power Line Connnection	Power Voltage	Coil GA/Turn
#1	TROUGH UP-KICKER	Q1	I/O Pwr. Drvr.	BRN-BLK	J8-P1	YEL-VIO	J10-P4/5	50v	24-940 090-5036-01
#2	AUTO LAUNCH	Q2	I/O Pwr. Drvr.	BRN-RED	J8-P3	YEL-VIO	J10-P4/5	50v	23-800 090-5001-02
#3	DROP TARGET RESET	Q3	I/O Pwr. Drvr.	BRN-ORG	J8-P4	YEL-VIO	J10-P4/5	50v	23-800 090-5001-00
#4	DROP TARGET DOWN	Q4	I/O Pwr. Drvr.	BRN-YEL	J8-P5	YEL-VIO	J10-P4/5	50v	32-1800 090-5031-00
#5	FAN MOTOR RELAY	Q5	I/O Pwr. Drvr.	BRN-GRN	J8-P6	BRN	J7-P1	20v	24V DC 10A DPDT
#6	DISC MOTOR RELAY	Q6	I/O Pwr. Drvr.	BRN-VIO	J8-P7	BRN	J7-P1	20v	24V DC 10A DPDT
#7	NOT USED / SPARE	Q7	I/O Pwr. Drvr.						
#8	(EUROPEAN TOKEN DISPENSER)	Q8	I/O Pwr. Drvr.	BRN-GRY	J8-P9	YEL-VIO	J10-P4/5	50v	N/A

High Current Coils Group 2		Drive Transistor (D.T.)	Driver Ouput Board	D.T. Control Line Color	D.T. Control Line Connect	Power Line Color	Power Line Connnection	Power Voltage	Coil GA/Turn
#9	LEFT TURBO BUMPER	Q9	I/O Pwr. Drvr.	BLU-BRN	J9-P1	YEL-VIO	J10-P4/5	50v	26-1200 090-5044-00
#10	BOTTOM TURBO BUMPER	Q10	I/O Pwr. Drvr.	BLU-RED	J9-P2	YEL-VIO	J10-P4/5	50v	26-1200 090-5044-00
#11	RIGHT TURBO BUMPER	Q11	I/O Pwr. Drvr.	BLU-ORG	J9-P4	YEL-VIO	J10-P4/5	50v	26-1200 090-5044-00
#12	LEFT SLINGSHOT	Q12	I/O Pwr. Drvr.	BLU-YEL	J9-P5	YEL-VIO	J10-P4/5	50v	26-1200 090-5044-00
#13	RIGHT SLINGSHOT	Q13	I/O Pwr. Drvr.	BLU-GRN	J9-P6	YEL-VIO	J10-P4/5	50v	26-1200 090-5044-00
#14	SUPER VUK	Q14	I/O Pwr. Drvr.	BLU-BLK	J9-P7	YEL-VIO	J10-P4/5	50v	24-940 090-5036-01
#15	LEFT FLIPPER	Q15	I/O Pwr. Drvr.	ORG-GRY	J9-P8	RED-YEL	J10-P1/2	50v	22-900 090-5020-20
#16	RIGHT FLIPPER	Q16	I/O Pwr. Drvr.	ORG-VIO	J9-P9	RED-YEL	J10-P1/2	50v	22-1080 090-5032-00

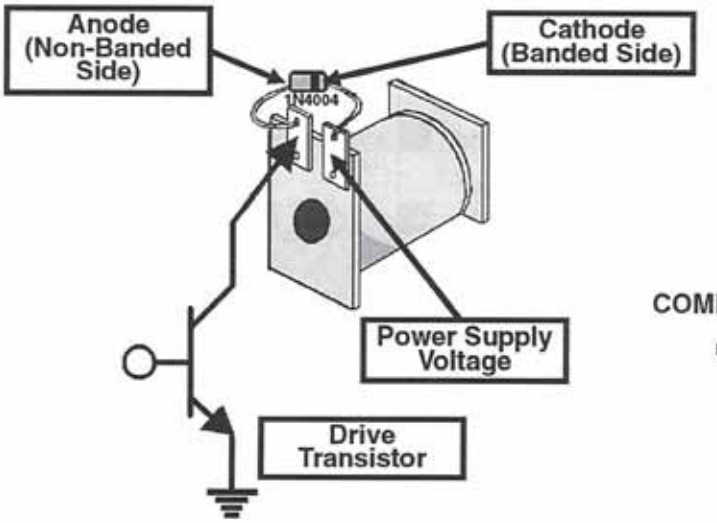
Low Current Coils Group 1		Drive Transistor (D.T.)	Driver Ouput Board	D.T. Control Line Color	D.T. Control Line Connect	Power Line Color	Power Line Connnection	Power Voltage	Coil GA/Turn or Bulb Type
#17	5-BALL TROUGH LOCK BALL	Q17	I/O Pwr. Drvr.	VIO-BRN	J7-P2	BRN	J7-P1	20v	24-940 090-5036-00
#18	NOT USED / SPARE	Q18	I/O Pwr. Drvr.						
#19	NOT USED / SPARE	Q19	I/O Pwr. Drvr.						
#20	NOT USED / SPARE	Q20	I/O Pwr. Drvr.						
#21	NOT USED / SPARE	Q21	I/O Pwr. Drvr.						
#22	FLASH TOP-LEFT*2	Q22	I/O Pwr. Drvr.	VIO-BLU	J7-P8	ORG	J6-P10	20v	#89 165-5000-89
#23	FLASH TOP-RIGHT*1	Q23	I/O Pwr. Drvr.	VIO-BLK	J7-P9	ORG	J6-P10	20v	#89 165-5000-89
#24	(OPTIONAL COIN METER)	Q24	I/O Pwr. Drvr.	VIO-GRY	J7-P10	RED	J16-P7	5v	5v Meter (If Reguired)

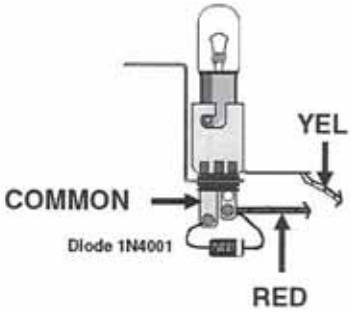
Flash Lamps (FLASH)		Drive Transistor (D.T.)	Driver Ouput Board	D.T. Control Line Color	D.T. Control Line Connect	Power Line Color	Power Line Connnection	Power Voltage	Bulb Type
#F1	UNDER RAMP*2	Q25	I/O Pwr. Drvr.	BLK-BRN	J6-P1	ORG	J6-P10	20v	#89 165-5000-89
#F2	JACKPOT*1 RAMP*1	Q26	I/O Pwr. Drvr.	BLK-RED	J6-P2	ORG	J6-P10	20v	#89 165-5000-89
#F3	DISC*2	Q27	I/O Pwr. Drvr.	BLK-ORG	J6-P3	ORG	J6-P10	20v	#89 165-5000-89
#F4	POPS*3	Q28	I/O Pwr. Drvr.	BLK-YEL	J6-P4	ORG	J6-P10	20v	#89 165-5000-89
#F5	R ORBIT*1 R 2-BANK*1	Q29	I/O Pwr. Drvr.	BLK-GRN	J6-P5	ORG	J6-P10	20v	#89 165-5000-89
#F6	L ORBIT*1 L 2-BANK*1	Q30	I/O Pwr. Drvr.	BLK-BLU	J6-P6	ORG	J6-P10	20v	#89 165-5000-89
#F7	R 3-BANK*1	Q31	I/O Pwr. Drvr.	BLK-VIO	J6-P7	ORG	J6-P10	20v	#89 165-5000-89
#F8	NEAR VUK*1	Q32	I/O Pwr. Drvr.	BLK-GRY	J6-P8	ORG	J6-P10	20v	#89 165-5000-89

The following is not part of Coil Test but is included for additional information (See Magnet Tests in Sec. 3, Chp. 2):

Aux. Data Line			Driver Ouput Board LOC: Under Playfield	D.T. Control Line Color	D.T. Control Line Connect	Power Line Color	Power Line Connnection	Power Voltage	Coil GA/Turn
N/A	Magna Disc		Magnet Processor/ Driver Board	BLUE	J3-P1	VIO-YEL	I/O J10-P3 to Mag. Bd. J1-P1, -2	50v	22-600 090-5042-01
N/A	Magnet Diverter		Magnet Processor/ Driver Board	WHT-BRN	J2-P3	VIO-YEL	I/O J10-P3 to Mag. Bd. J1-P1, -2	50v	22-600 090-5042-01

TYPICAL SWITCH, COIL & LAMP WIRING





GO TO LAMP MENU

From the **DIAGNOSTICS MENU**, select the "LAMP" *Icon* with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. Controlled lamps are configured in and 8 x 10 Matrix of Columns (Lamp Drives) and Rows (Lamp Returns) with up to 80 lamps possible. The Lamp Test Menu consists of four parts: Single Lamp Test, Test All Lamps, Row Lamp Test and Column Lamp Test.

Single Lamp Test

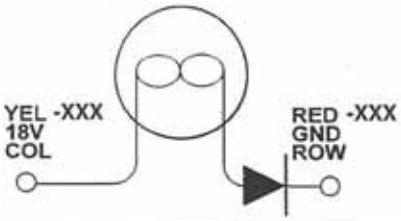
To initiate, from the **LAMP MENU**, select the "ONE" *Icon* with either **Red** or **Green Button** and press the **Black Button**. Select either the "-" or "+" *Icons*. Start with the "+" *Icon* to start the manual Lamp Test from Column 1, Row 1, Switch 1. Press the **Black Button** on the "+" *Icon*, as each lamp is selected, the lamp will light at it's location on the playfield as well as the display, indicating the Lamp Matrix Grid position, lamp name with the corresponding number, Return (Row) Wire & Color, Drive (Column) Wire & Color, and associated drive transistors. Press the **Black Button** again to move forward in the test. To test and view a particular lamp, select the "RUN" *Icon* and press the **Black Button**. Each time the **Black Button** is pushed, the lamp will light-up on the playfield, with the display indicating the lamp information. Continue with the same procedure to run through the entire test.

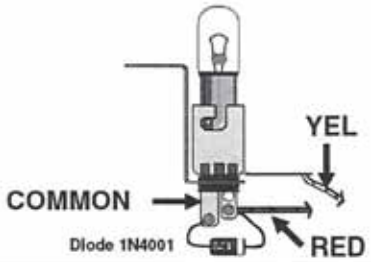
Test All Lamps

To initiate, from the **LAMP MENU**, select the "ALL" *Icon* with either **Red** or **Green Button** and press the **Black Button**. If still in Single Lamp Test (or any 1 of the 4 tests), select the "PREV" *Icon* to return to Lamp Menu or selecting either of the "ARROW" *Icons* will move through the tests, keep activating until Test All Lamps is displayed. The display will indicate "ALL LAMPS ON" and the lamps on the playfield will be lit, alternating between the rows in the Lamp Matrix.

Continued on the next page with Row & Column Lamp Tests.

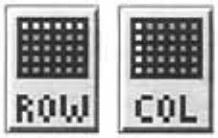
Typical Lamp Schematic & Side View





LAMP MATRIX GRID

Row (GND) \ Column (18V)	1: U10 YEL-BRN J13-9	2: U11 YEL-RED J13-8	3: U12 YEL-ORG J13-7	4: U13 YEL-BLK J13-6	5: U14 YEL-GRN J13-5	6: U15 YEL-BLU J13-4	7: U16 YEL-VIO J13-3	8: U17 YEL-GRY J13-1
1: Q33 RED-BRN J12-1	DRIVE AGAIN #44 Bulb 1	BLOWN AWAY (LEFT) #44 Bulb 2	BLOWN AWAY (RIGHT) #44 Bulb 3	RAMP ENTER -GREEN LED 4	RAMP ENTER -RED LED 5	COW #555 Bulb 6	NOT USED 7	NOT USED 8
2: Q34 RED-BLK J12-2	JACKPOT #555 Bulb 9	NOT USED 10	NOT USED 11	NOT USED 12	NOT USED 13	NOT USED 14	NOT USED 15	NOT USED 16
3: Q35 RED-ORG J12-3	LOCK 1 #555 Bulb 17	LOCK 2 #555 Bulb 18	MULTIBALL READY #555 Bulb 19	LOCK 3 #555 Bulb 20	LOCK 4 #555 Bulb 21	LEFT TOP LANE #44 Bulb 22	MIDDLE TOP LANE #44 Bulb 23	RIGHT TOP LANE #44 Bulb 24
4: Q36 RED-YEL J12-4	LEFT RE-TURN LANE #44 Bulb 25	WEST STAND-UP #44 Bulb 26	NW STAND-UP #555 Bulb 27	NORTH STAND-UP #555 Bulb 28	NE STAND-UP #555 Bulb 29	EAST STAND-UP #555 Bulb 30	SE STAND-UP #555 Bulb 31	RIGHT RE-TURN LANE #44 Bulb 32
5: Q37 RED-GRN J12-5	TORNADO 1 #555 Bulb 33	TORNADO 2 #555 Bulb 34	TORNADO 3 #555 Bulb 35	TORNADO 4 #555 Bulb 36	TORNADO 5 #555 Bulb 37	TORNADO 6 #555 Bulb 38	TORNADO 7 #555 Bulb 39	TORNADO 8 #555 Bulb 40
6: Q38 RED-BLU J12-6	SUPER LOCK #555 Bulb 41	DEBRIS (LEFT) #555 Bulb 42	WIND (LEFT) #555 Bulb 43	RAMP 1 #555 Bulb 44	RAMP 2 #555 Bulb 45	RAMP 3 #555 Bulb 46	RAMP 4 #555 Bulb 47	RAMP 5 #555 Bulb 48
7: Q39 RED-VIO J12-8	SUPER POPS #555 Bulb 49	DAMAGE (RIGHT) #555 Bulb 50	WIND (RIGHT) #555 Bulb 51	NOT USED 52	NOT USED 53	NOT USED 54	NOT USED 55	NOT USED 56
8: Q40 RED-GRY J12-9	LEFT TUR-BO BUMPER #555 Bulb 57	BOTTOM TUR-BO BUMPER #555 Bulb 58	RIGHT TUR-BO BUMPER #555 Bulb 59	DEBRIS (CENTER) #555 Bulb 60	CHASE #555 Bulb 61	DAMAGE (CENTER) #555 Bulb 62	2X SCORING #555 Bulb 63	SKILL SHOT X2 #44 Bulb 64
9: Q41 RED-WHT J12-10	(T) WISTER #555 Bulb 65	T (W) ISTER #555 Bulb 66	TW (I) STER #555 Bulb 67	TWI (S) TER #555 Bulb 68	TWIS (T) ER #555 Bulb 69	TWIST (E) R #555 Bulb 70	TWISTE (R) #555 Bulb 71	LOCK (ARROW) #555 Bulb 72
10: Q42 NOT USED J12-11	NOT USED 73	NOT USED 74	NOT USED 75	NOT USED 76	NOT USED 77	NOT USED 78	NOT USED 79	NOT USED 80



Row and Column Lamp Tests

To initiate, from the **LAMP MENU**, select the "COL" *Icon* with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black Button**. If still in a previous test, select the "PREV" *Icon* to return to Lamp Menu or selecting either of the "ARROW" *Icons* will move through the tests, keep activating until Row or Column Lamp Test (whichever desired) is displayed. In this test, each set of lamps in each row or column of the Lamp Matrix (respective to each test) will light-up on the playfield and is indicated in the display.

Lamp Matrix Location

The lamp locations correspond with the Lamp Number in the Lamp Maxtrix Grid on the previous page.

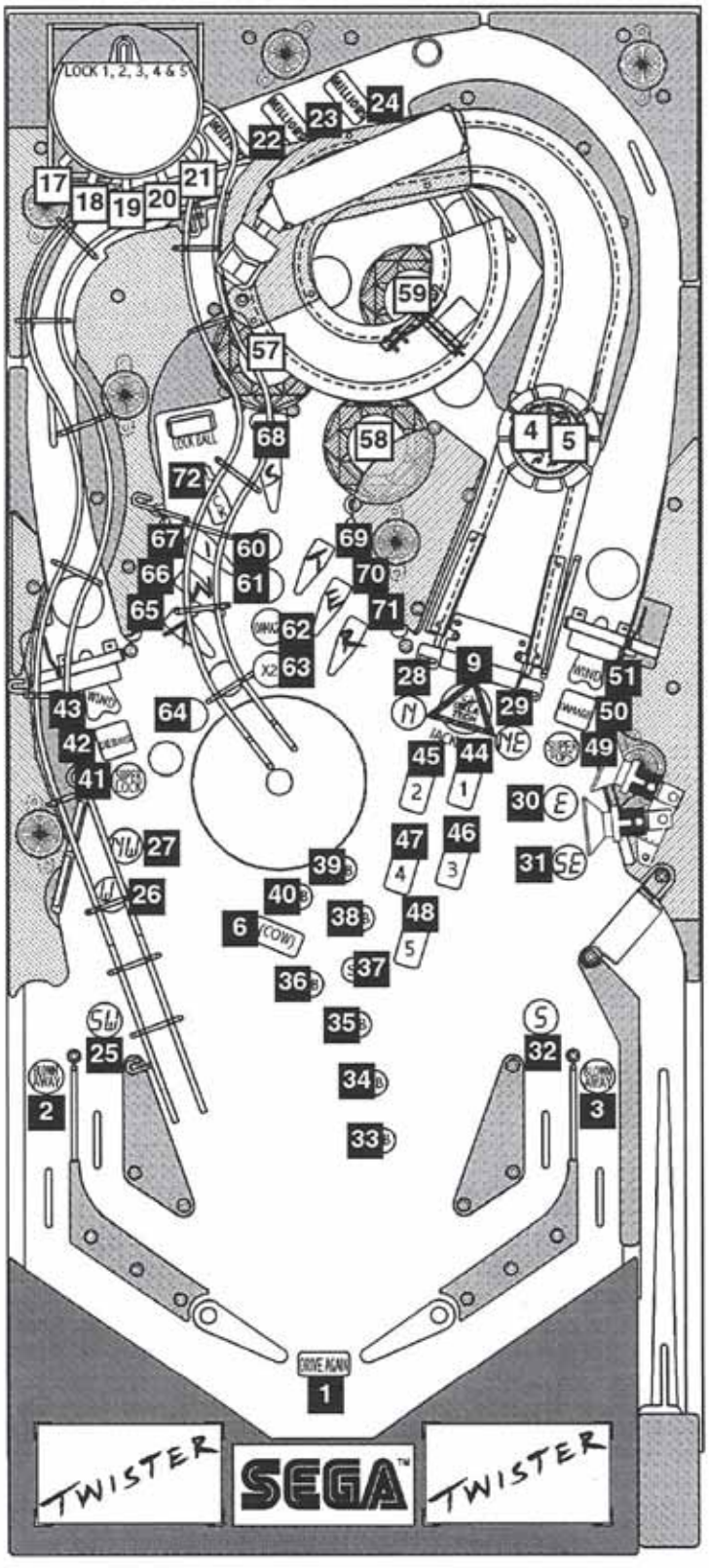
Legend Note:

□ = Lamps mounted above playfield.

■ = Lamps mounted below playfield.

The following Lamps are not used:

7	8	10	11
12	13	14	15
16	52	53	54
55	56	73	74
75	76	77	78
79	80		



The following Bulb is used on the Light Boards, Bumpers, & Ramp Signs:

#555 Bulb (Wedge)
165-5002-00

The following Bulb is used in the remainder of the matrix:

#44 Bulb (Bayonet)
165-5000-44

TEST FLASH LAMPS

From the **DIAGNOSTICS MENU**, select the "FLASH" *Icon* with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. After selecting this *Icon* the display will indicated "CYCLING FLASHERS" and all the flash lamps will cycle continuously until the test is exited. This test is allows the technician to easily spot any burned-out bulbs and replace them.

CLEAR BALL TROUGH

From the **DIAGNOSTICS MENU**, select the "CLR" *Icon* with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. This is provided to allow the technician a simple method of removing the balls from the trough and also, to test functionality of the trough, ensuring proper trough operation. After selecting this *Icon* the display will show a graphic of the ball trough with balls in the trough with it's corresponding switch number. Select the "RUN" *Icon* to eject the ball in the first position. Simultaneously, the display and the playfield will eject the ball to the Trough Up-Kicker, eject from the Trough Up-Kicker into the Shooter Lane and will be ejected onto the playfield where the technician can easily retrieve the pinball or allow the ball(s) to re-enter the trough to continue Clear Ball Trough Test.

⚠ **Caution:** *Continuous use of above test may overheat the Trough Up-Kicker Coil.* ⚠

TECHNICIANS ALERTS

From the **DIAGNOSTICS MENU**, select the "TECH" *Icon* with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. After selecting this *Icon* the display will indicate if there are any faulty switches (i.e., switches that are normally closed but remain open or open switches that have not been closed (activated) in 50 games.)

SERVICE PHONE

From the **DIAGNOSTICS MENU**, select the "SERV" *Icon* with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. After selecting this *Icon* the display will indicate a phone number to call if technical assistance is required.

BEGIN PLAY TEST

From the **DIAGNOSTICS MENU**, select the "PLAY" *Icon* with either **Red "LEFT"** or **Green "RIGHT"** Button and press the **Black "ENTER" Button**. After selecting this *Icon* the technician can test certain play functions to insure all switch activated coils function without entering game play. For example, by rolling the ball over the left outlane switch, the Laser Kick should fire. If it kicks to early or too late, the switch actuator should be adjusted to compensate for this error. If it fails to fire, use the Switch Test or Coil Test to help determine the cause of the failure. During this function, similar tests may be performed on the Vertical Up-Kickers, Ejects, Pop Bumpers, etc. in the game. For unique Play Test functions, select the "GAME SPECIFIC" *Icon* in the **DIAGNOSTICS MENU**.

KNOCKER TEST

From the **DIAGNOSTICS MENU**, select the "KNOCKER" *Icon* with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. The "Knocker" is sounded.

SOUND/SPEAKER TEST

From the **DIAGNOSTICS MENU**, select the "SPKR" *Icon* with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. The BSMT 2000 Sound System produces true digital stereo sound on the Left & Right Speakers (Backbox) and *"Mono"* on the Center Speaker (Bottom of Cabinet). After selecting this *Icon*, select the "-" or "+" *Icons* and press the **Black "ENTER" Button** to activate the first test. Repeat to visually see & hear all tests. Select the "RUN" *Icon* to activate the test chosen without moving to the next test.

During Sound Tests, the display shows the sound board circuit under test and the corresponding sounds. The sound functions allow verification that all channels are functioning properly & that the speaker connections are correct. (Refer to the game manual for detailed testing procedures).

Speaker Phase Testing

Continued

Connections to each of the three speakers are polarized and each must be connected appropriately for the best quality sound. If one speaker has the positive and negative connections reversed with respect to the other two, bass frequencies will not be produced properly and the overall sound quality will be poor.

To test for proper speaker phasing, use the sound test to cycle through the Left, Center, and Right Sine functions. If the Center Sine produces more volume and bass than the Left and Right Sines, the speakers are connected properly. If it produces the same or less, one speaker is connected improperly. To isolate and correct reversed speaker connections, one of two methods may be used.

1. Check each speaker for polarity markings. If the speakers have polarity markings, verify that the single-color wire (BLK, YEL or RED) is connected to the negative (-) terminal.

2. Disconnect the speaker output connector from the CPU / Sound Board and connect a 1.5-volt battery across each speaker pair one at a time while observing the speakers. Make sure the positive battery terminal is connected to the positive lead (CN4- Pin 1, 3 or 6) each time. As the connection is made, check speaker cone movement; proper connections are indicated by outward movement.

Auto / Manual Tests	Sounds Produced
Left Speaker	Left Sine
Both Left & Right Speakers	Center Sine
Right Speaker	Right Sine
Voice Masked ROM 1 (Loc. U17)	Speech Pattern 1

Auto / Manual Tests	Sounds Produced
Voice Masked ROM 2 (Loc. U21)	Not Used
Voice Masked ROM 3 (Loc. U36)	Not Used
Voice Masked ROM 4 (Loc. U37)	Not Used
Sound/OPSYS EPROM (Loc. U7)	Level 1-3 (Music Test)

BEGIN BURN IN

From the **DIAGNOSTICS MENU**, select the "BURN" *Icon* with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. After selecting this *Icon* the Begin Burn-In Test will start. At this stage the game will exercise all CPU I/O Functions (Dot Matrix Display Test, Coil Testing, Lamp Testing, Sound, etc.). This is provided to constantly exercise sounds, coils, etc... Cumulative Burn-In minutes will be displayed. To reset Burn-In minutes to 00, select the "RESET" *Icon* in the **MAIN MENU** and select the "FACT" *Icon* (Factory Reset). See Chapter 5, Go To Reset Menu, of this section.

DOT MATRIX TEST

From the **DIAGNOSTICS MENU**, select the "DOT TEST" *Icon* with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. After selecting this *Icon* the Dot Matrix Test immediately begins. The display will immediately illuminate & cycle for 1 pass of each test continuously for each of the following tests (Pressing any button will exit the test & return to **DIAGNOSTICS MENU**.):

1. Illuminates 1 vertical column of dots, turning it off & illuminating the next column, until each column has been individually lit, while the other columns are off.
2. Illuminates 1 horizontal row of dots, turning it off & illuminating the next row, until each row has been individually lit, while the other rows are off.
3. Illuminates all the dots, except for one column from left to right.
4. Illuminates all the dots except for one row from top to bottom.
5. Illuminates every other dot lit, in both the rows and columns.
6. Illuminates all dots at 30%, 70% & 100% brightness.

Dot Matrix Display Explained

The display utilizes a Micro-Processor Control Board mounted in piggyback fashion to the Dot Matrix Display Driver Board. The purpose behind this board is to provide more information (128 X 32 Dots) to the operator as well as displaying graphics to the player.

The board is controlled by a 6809E Microprocessor and its personality ROM (Unique to the Game). It receives Data, Reset & Clock Information from the CPU/Sound Board via the ribbon cable and sends back multiple Status and Busy Signals to the CPU. This is to insure synchronized communication between the CPU and the Display Controller Board. The Drivers for the rows and columns are provided on 5 surface mounted integrated circuits on the Dot Matrix Display Driver Board.

TWISTER SPECIFIC

From the **DIAGNOSTICS MENU**, select the "TWI" *Icon* with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. After selecting this *Icon* the technician can test and adjust any game specific function(s) from the sub-menu. Similar to "BEGIN PLAY TEST," this menu is used to test the game specific features. The features are the Magnet Diverter and Disc Magnet Tests.

Magna Disc Magnet Test

To initiate, from the **TWISTER SPECIFIC MENU**, select the "DISC" *Icon* with either the **Red** or **Green Button** and press the **Black Button**. In Magnet Test, press and hold the **Start Button** to operate the Magna Disc (Magnet). The display will also indicate the status of the Magnet Switch (Sw. 25) which is transistor Q2 acting as a switch on the Magnet Processor Board. Q2 is switched on by U1 when it senses a ball above the magnet due to a change in the inductance of the magnet coil.

Magnet Diverter Test

To initiate, from the **TWISTER SPECIFIC MENU**, select the "DIV" *Icon* with either the **Red** or **Green Button** and press the **Black Button**. In Magnet Test, press and hold the **Start Button** to operate the Diverter Magnet (right of Top Lanes). The display will also indicate the status of the Magnet Switch (Sw. 32) which is transistor Q1 acting as a switch on the Magnet Processor Board. Q1 is switched on by U1 when it senses a ball above the magnet due to a change in the inductance of the magnet coil.

DR. PINBALL (FLOW CHART MENUS)

To initiate, from the **DIAGNOSTICS MENU**, select the Cross "DR." *Icon* with either the **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. This will bring you (the operator / technician) into **DR. PINBALL** (Flow Chart Menus) which offers you a choice of four sub-menus: Flipper "DR.," Coil "DR.," Switch "DR." and Lamp "DR." *Icons*. Selecting a particular sub-menu will give you a choice of which specific Flipper, Coil, Switch or Lamp circuit needs to be diagnosed. The display will now ask a question or give a procedure to follow such as "Does the lamp turn on?" or "Check bridge rectifier BR-20, if short replace." When Dr. Pinball asks a question or request a procedure the Dr. will expect a response such as "no" or "yes" (see below examples of the mini-icons which will prompt the operator). You the operator/technician must respond by using your **Flipper Buttons** to "SELECT" a mini-icon and the **Start Button** to "ENTER" your selection.

The following are the mini-icons with explanations for the Dr. Pinball Sub-Menus to follow:

➨ Select a Coil, Lamp, Switch or Flipper to diagnose with "-" or "+" Icon; Then "RUN." ("QUIT" exits Portals completely.)

➨ Seen when question is being asked on the Display. "END" lets you select a new item to test; "PREV" goes back to previous question. (Help "?" is still under construction.)

➨ Seen when diagnosis is given. "PREV" lets you go back.

➨ In Coil Flow Chart Menu, lets you pulse the coil. "NO," "YES," "END," "PREV," "QUIT" all work the same.

Flipper Flow Chart

To initiate, from the **DR. PINBALL MENU**, select the Flipper "DR." *Icon* with either the **Red** or **Green Button** and press the **Black Button**. This is the Flipper Flow Chart. Follow the questions, answering by using the mini-icons in the display.

Coil Flow Chart

To initiate, from the **DR. PINBALL MENU**, select the Coil "DR." *Icon* with either the **Red** or **Green Button** and press the **Black Button**. This is the Coil Flow Chart. Follow the questions, answering by using the mini-icons in the display.

Switch Flow Chart

To initiate, from the **DR. PINBALL MENU**, select the Switch "DR." *Icon* with either the **Red** or **Green Button** and press the **Black Button**. This is the Switch Flow Chart. Follow the questions, answering by using the mini-icons in the display.

Lamp Flow Chart

To initiate, from the **DR. PINBALL MENU**, select the Lamp "DR." *Icon* with either the **Red** or **Green Button** and press the **Black Button**. This is the Lamp Flow Chart. Follow the questions, answering by using the mini-icons in the display.

Your Notes

TWISTER
GAME AUDIT TABLE

SEGA PINBALL, INC.

Photocopy for Field Audit Tracking Performance (Use blank columns to fill-in game audit information).

EARNINGS AUDITS 1-12

	Audit Name	Fill-In
1	TOTAL PAID CREDITS	
2	FREE GAME PERCENTAGE	
3	AVERAGE BALL TIME	
4	AVERAGE GAME TIME	
5	COINS THRU LEFT SLOT	
6	COINS THRU RIGHT SLOT	
7	COINS THRU CENTER SLOT	
8	COINS THRU 4TH SLOT	
9	TOTAL COINS	
10	TOTAL EARNINGS	
11	METER CLICKS	
12	SOFTWARE METER	

SPECIAL AUDIT NOTES:

Audits 40-41 & 85-90 are currently ***Not Used***, allowing for ***Future Expansion***, if any. If the code version is upgraded, view Audits in the display and write the audit(s) in blank(s) if any audit(s) were added.

SEGA AUDITS 13-46

	Audit Name	Fill-In		Audit Name	Fill-In		Audit Name	Fill-In
13	TOTAL BALLS PLAYED		30	400.0M—799.9M SCORES				
14	TOTAL EXTRA BALLS		31	800.0M—1.19B SCORES				
15	EXTRA BALL PERCENT		32	1.2B+ SCORES				
16	REPLAY 1 AWARDS		33	AVERAGE SCORES				
17	REPLAY 2+ AWARDS		34	SERVICE CREDITS				
18	TOTAL REPLAYS		35	BALL SEARCH STARTED				
19	REPLAY PERCENT		36	LOST BALL FEEDS				
20	TOTAL SPECIALS		37	LOST BALL GAME STARTS				
21	SPECIAL PERCENT		38	TOTAL BUYIN GAMES				
22	TOTAL MATCHES		39	EXTRA BALL BUYINS				
23	HIGH SCORE AWARDS		40					
24	HIGH SCORE PERCENT		41					
25	TOTAL FREE PLAYS		42	LEFT DRAINS				
26	TOTAL PLAYS		43	CENTER DRAINS				
27	0.0M—99.9M SCORES		44	RIGHT DRAINS				
28	100.0M—199.9M SCORES		45	SLAM TILTS				
29	200.0M—399.9M SCORES		46	TOTAL BALLS SAVED				

TWISTER AUDITS 47- 99

	Audit Name	Fill-In		Audit Name	Fill-In		Audit Name	Fill-In
47	LEFT ORBITS		65	SKILL SHOT MADE		83	TOP LANES COMPLETED	
48	RIGHT ORBITS		66	SKILL SHOT MISSED		84	BONUS HELD	
49	RAMP SHOTS		67	MULTIBALL READY		85		
50	LEFT SPINNER		68	MULTIBALL		86		
51	RIGHT SPINNER		69	3 BALL MULTIBALL		87		
52	DROP TARGET		70	4 BALL MULTIBALL		88		
53	WIND AWARDS		71	5 BALL MULTIBALL		89		
54	COMPASS COMPLETE		72	MBALL RESTART LIT		90		
55	TWISTER COMPLETE		73	MBALL RESTART AWARDED		91	TOTAL REGULAR PLAYS	
56	DEBRIS LIT		74	JACKPOT		92	AVG. REGULAR GAME TIME	
57	CHASE HURRY-UP LIT		75	DOUBLE JACKPOT		93	REGULAR GAME MBALLS	
58	DAMAGE LIT		76	TRIPLE JACKPOT		94	REGULAR GAME REPLAYS	
59	2X SCORING		77	SUPER JACKPOT		95	TOTAL NOVICE PLAYS	
60	DEBRIS AWARDS		78	CHASE MULTIBALL		96	AVG. NOVICE GAME TIME	
61	DAMAGE AWARDS		79	CHASE HURRY-UP SCORED		97	NOVICE GAME MBALLS	
62	SUPER LOCK LIT		80	SUPER LOCK MBALL		98	NOVICE GAME REPLAYS	
63	SUPER POPS LIT		81	COW MULTIBALL		99	AVG. NOVICE BALL SAVES	
64	SUPER POPS SHOTS		82	WEATHERVANE STARTED				

CPU Version: _____ **Date Audited:** _____

Go To Audits Menu

Overview

The **Portals™ Service Menu System** provides 99 Audit Functions for accounting purposes and for evaluation of game difficulty adjustments. The Audit Functions are split into 3 groups. The 1st group, Earnings Audits, are the first 12 most-used audits. The 2nd group, Sega Audits, are the game play generic audits 13-46. The 3rd group, Twister Audits, are the game play specific audits 47- 99; Audits 40-41 & 85-90 are currently ***Not Used,*** allowing for ***Future Expansion,*** if any. If the code version is upgraded, view Audits in the display and write the audit(s) in the blank(s) if any audit(s) were added. Each group may be viewed in the **Portals™ Service Menu** (see Chapter 1, Introduction, of this section). View all audits with the **Game Audit Table** provided (on the previous page).

GO TO AUDITS MENU

With the game in the Attract Mode, open the Coin Door and press the **Black "BEGIN TEST" Button**. Select the "AUD" *Icon* in the **MAIN MENU** with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. The **AUDITS MENU** appears.

Important Notes:

Exit any sub-menu and return to the **MAIN MENU** by selecting & activating the "PREV" *Icons*. If no *Icons* appear in the display because of a testing function or special display (e.g. "Help"), press any button to exit.

Selecting & activating the "QUIT" *Icon* from any display will exit the Service Session.

Selecting & activating the "HELP" *Icon* from any display will show a help screen. (An explanation of each *Mini-Icon* at that level will cycle continuously until any active button is pressed.)

Selecting & activating the "ARROW" *Icons* selects the next or previous audit in the group.

EARNINGS AUDITS (1-12)

From the **AUDITS MENU**, select the "EARN" *Icon* with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. Select and activate the "RIGHT ARROW" *Icon* to view the 1st audit in this group. Continue to select either of the "ARROW" *Icons* to view each audit one at a time. The display will describe the audit number, the audit name, and the audit total or value. The current audit will remain in the display until the next audit is chosen or when the sub-menu is exited.

Au. Nº	Audit Name	Audit Definition
Au. 1	Total Paid Credits	Provides the total number of paid credits.
Au. 2	Free Game Percentage	This percentage is derived from dividing Audit 25, Total Free Plays, by Audit 26, Total Plays.
Au. 3	Average Ball Time	In seconds, the average ball time is derived from the total play time divided by Audit 13, Total Balls Played.
Au. 4	Average Game Time	The average game time is expressed in minutes and seconds.
Au. 5	Coins Thru Left Slot	Provides the total amount of coins registered through the left slot.
Au. 6	Coins Thru Right Slot	Provides the total amount of coins registered through the right slot.
Au. 7	Coins Thru Center Slot	Provides the total amount of coins registered through the center slot.
Au. 8	Coins Thru 4th Slot	Provides the total amount of coins registered through the fourth slot.
Au. 9	Total Coins	Provides the total amount of coins registered through all the slots.
Au. 10	Total Earnings	The total cash value accumulated since the last *Factory Restore* occurred (see Chapter 5, Go to Reset Menu, of this section).
Au. 11	Meter Clicks	Provides the total number of money clicks accumulated. (Based on the country's lowest coin denomination used for the game credit.)
Au. 12	Software Meter	Provides the continuing total of Meter Clicks. This audit cannot be reset; the display shows the constant addition of Meter Clicks.

SEGA AUDITS (13-46)

From the **AUDITS MENU**, select the "SEGA" *Icon* with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. Select and activate the "RIGHT ARROW" *Icon* to view the 1st audit in this group. Continue to select either of the "ARROW" *Icons* to view each audit one at a time. The display will describe the audit number, the audit name, and the audit total or value. The current audit will remain in the display until the next audit is chosen or when the sub-menu is exited.

Au. Nº	Audit Name	Audit Definition
Au. 13	Total Balls Played	Provides the total of regular and extra balls.
Au. 14	Total Extra Balls	Provides the total number of extra balls awarded.
Au. 15	Extra Balls Percent	This percentage is derived from dividing Audit 14, Total Extra Balls, by Audit 26, Total Plays.
Au. 16	Replay 1 Awards	Provides the total awards (credit, extra ball, or audit) for level 1.
Au. 17	Replay 2+ Awards	Provides the total awards (credit, extra ball, or audit) for level(s) 2 or higher.
Au. 18	Total Replays	Provides the total awards (credits, extra balls, or audit only) for exceeding replay score levels.
Au. 19	Replay Percent	The replay total awards for exceeding replay score levels. This percentage is derived from dividing Audit 18, Total Replays, by Audit 26, Total Plays.
Au.20	Total Specials	Provides the total awards (credits, extra balls, or scores) for making specials.
Au. 21	Special Percent	This percentage is derived from dividing Audit 20, Total Specials, by Audit 26, Total Plays.
Au. 22	Total Matches	Provides the total credits awarded for matching the last two digits of the score with the system-generated Match Number at the end of the game. Percentage of match credits is adjustable from 0% to 10% by Ad. 11, Match Percentage, if enabled. (See Chapter 4, Go to Adjustments Menu, of this section.)
Au. 23	High Score Awards	Provides the total credits awarded for exceeding the High-Score-To-Date scores.
Au. 24	High Score Percent	This percentage is derived from dividing Audit 23, High Score Awards, by Audit 26, Total Plays.
Au. 25	Total Free Plays	Provides the total free credits for replays, High-Score-To-Date, Specials, and Match.
Au. 26	Total Plays	This total is derived by adding the sum of Audit 1, Total Paid Credits, and Audit 25, Total Free Plays. Note that free credits are not recorded in the Audit until they are actually used.
Au. 27	0.0M—99.9M Scores	Provides the total number of games the Player's final score was between 0 and 99,999,990 points.
Au. 28	100.0M—199.9M Scores	Provides the total number of games the Player's final score was between 100,000,000 and 199,999,990 points.
Au. 29	200.0M—399.9M Scores	Provides the total number of games the Player's final score was between 200,000,000 and 399,999,990 points.
Au. 30	400.0M—799.9M Scores	Provides the total number of games the Player's final score was between 400,000,000 and 799,999,990 points.
Au. 31	800.0M—1.19B Scores	Provides the total number of games the Player's final score was between 800,000,000 and 1,199,999,990 points.
Au. 32	1.2B+ Scores	Provides the total number of games the Player's final score was over 1,200,000,000 points.
Au. 33	Average Scores	This total is derived from adding the Final Score of each game to a table and dividing this sum by Audit 26, Total Plays.

Sega Audits Continued.

Audit Name		Audit Definition
Au. 34	Service Credits	Provides the total number of Service credits added to the game. (See Chapter 1, Introduction [*Access & Use*] for instructions on how to receive Service Credits.)
Au. 35	Ball Search Started	Provides the number of times the game performed a ball search.
Au. 36	Lost Ball Feeds	Provides the number of times the game added a ball to play when it could not find a ball after ball search.
Au. 37	Lost Ball Game Starts	Provides the number of times the game started with a ball missing from the ball trough at the start of a game.
Au. 38	Total Buyin Games	Provides the number of times a player utilized the Buyin Feature. The Buyin Feature is adjustable using Ad. 34, Buyin Type. (See Chapter 4, Go to Adjustments Menu, of this section.)
Au. 39	Extra Ball Buyins	Provides the total number of times the Extra Ball Buyin Feature was used. The Extra Ball Buyin Feature is adjustable using Ad. 34, Buyin Type. (See Chapter 4, Go to Adjustments Menu, of this section.)
Au. 40		This audit is ***Not Used***, allowing for ***Future Expansion***, if any.
Au. 41		This audit is ***Not Used***, allowing for ***Future Expansion***, if any.
Au. 42	Left Drains	Provides the number of times the ball drained out the left drain.
Au. 43	Center Drains	Provides the number of times the ball drained out the center drain.
Au. 44	Right Drains	Provides the number of times the ball drained out the right drain.
Au. 45	Slam Tilts	Provides the number of times the Slam Tilt switch was activated.
Au. 46	Total Balls Saved	Provides the total number of times the Total Balls Saved Feature was used. This feature is enabled at the start of each ball and is disabled as soon as the ball makes contact with 5 game switches or allocated time expired.

TWISTER AUDITS (47-99)

From the **AUDITS MENU**, select the "TWI" *Icon* with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. Select and activate the "RIGHT ARROW" *Icon* to view the 1st audit in this group. Continue to select either of the "ARROW" *Icons* to view each audit one at a time. The display will describe the audit number, the audit name, and the audit total or value. The current audit will remain in the display until the next audit is chosen or when the sub-menu is exited.

Au. Nº	Audit Name	Audit Definition
Au. 47	Left Orbits	Provides the total number of times this switch was closed.
Au. 48	Right Orbits	Provides the total number of times this switch was closed.
Au. 49	Ramp Shots	Provides the total number of times the Ramp Entrance & Exit switches were closed consecutively (both switches must be closed in order to qualify as a ramp shot).
Au. 50	Left Spinner	Provides the total number of times this switch was closed.
Au. 51	Right Spinner	Provides the total number of times this switch was closed.
Au. 52	Drop Target	Provides the total number of times the Drop Target was hit.
Au. 53	Wind Awards	Provides the total number of times this feature was awarded.
Au. 54	Compass Complete	Provides the total number of times the entire feature bank of targets were completed.
Au. 55	Twister Complete	Provides the total number of times the entire feature bank of targets were completed.

Twister Audits Continued.

	Audit Name	Audit Definition
Au. 56	Debris Lit	Provides the number of times this feature was lit.
Au. 57	Chase Hurry-Up LIt	Provides the number of times this feature was lit.
Au. 58	Damage Lit	Provides the number of times this feature was lit.
Au. 59	2X Scoring	Provides the number of times this feature was lit.
Au. 60	Debris Awards	Provides the number of times this feature was awarded.
Au. 61	Damage Awards	Provides the number of times this feature was awarded.
Au. 62	Super Lock Lit	Provides the number of times this feature was lit.
Au. 63	Super Pops Lit	Provides the number of times this feature was lit.
Au. 64	Super Pops Shots	Provides the number of times the Turbo Bumper Switches were closed during this feature.
Au. 65	Skill Shot Made	Provides the number of times this feature was made.
Au. 66	Skill Shot Missed	Provides the number of times this feature was missed.
Au. 67	Multiball Ready	Provides the number of times this feature was ready to be collected.
Au. 68	Multiball	Provides the number of times this feature was played.
Au. 69	3 Ball Multiball	Provides the number of times this feature was played.
Au. 70	4 Ball Multiball	Provides the number of times this feature was played.
Au. 71	5 Ball Multiball	Provides the number of times this feature was played.
Au. 72	MBall Restart Lit	Provides the number of times this feature was lit.
Au. 73	MBall Restart Awarded	Provides the number of times this feature was awarded.
Au. 74	Jackpot	Provides the number of times this feature was awarded.
Au. 75	Double Jackpot	Provides the number of times this feature was awarded.
Au. 76	Triple Jackpot	Provides the number of times this feature was awarded.
Au. 77	Super Jackpot	Provides the number of times this feature was awarded.
Au. 78	Chase Multiball	Provides the number of times this feature was played.
Au. 79	Chase Hurry-Up Scored	Provides the number of times this feature was awarded.
Au. 80	Super Lock MBall	Provides the number of times this feature was played.
Au. 81	Cow Multiball	Provides the number of times this feature was played.
Au. 82	Weathervane Started	Provides the number of times this feature was started.
Au. 83	Top Lanes Completed	Provides the number of times the 3 Top Lanes switches were closed in combination with the switches lit. The switch closed already lit does not count in completing the Top Lanes.
Au. 84	Bonus Held	Provides the number of times the Bonus was not collected and held over to the next ball in play.
Au. 85		This audit is ***Not Used***, allowing for ***Future Expansion***, if any.
Au. 86		This audit is ***Not Used***, allowing for ***Future Expansion***, if any.
Au. 87		This audit is ***Not Used***, allowing for ***Future Expansion***, if any.
Au. 88		This audit is ***Not Used***, allowing for ***Future Expansion***, if any.
Au. 89		This audit is ***Not Used***, allowing for ***Future Expansion***, if any.
Au. 90		This audit is ***Not Used***, allowing for ***Future Expansion***, if any.

Twister Audits Continued.

Audit Name		Audit Definition
Au. 91	**Total Regular Plays**	Provides the total Regular Games were played.
Au. 92	**Avg. Regular Game Time**	Provides the average game time of Regular played games.
Au. 93	**Regular Game MBalls**	Provides the number of times Multiballs were played in a Regular Game.
Au. 94	**Regular Game Replays**	Provides the number of times replays were awarded in a Regular Game.
Au. 95	**Total Novice Plays**	Provides the total Novice Games were played.
Au. 96	**Avg. Novice Game Time**	Provides the average game time of Novice played games.
Au. 97	**Novice Game MBalls**	Provides the number of times Multiballs were played in a Novice Game.
Au. 98	**Novice Game Replays**	Provides the number of times replays were awarded in a Novice Game.
Au. 99	**Avg. Novice Ball Saves**	Provides the average number of times the Feature "Ball Save" (Freeze) was used to maintain the ball time criteria for a Novice Game.

Audit Note: 1st Way to Reset Audits

To reset audits, from the **MAIN MENU**, select the "ADJ" *Icon*. See Chapter 4, Go to Adjustments Menu, of this section.

Select the "SEGA" *Icon*, from the **ADJUSTMENT MENU**, and advance to Adj. 8, Reset Coin Audits, with the "RIGHT ARROW" *Icon*. Select the "+" *Icon* to change setting to **YES**. When enabled, the *Coin Audits* (5-11) will be reset to zero.

Advance to Adj. 9, Reset Game Audits, with the "RIGHT ARROW" *Icon*. Select the "+" *Icon* to change setting to **YES**. When enabled, *all the audits* will be reset to zero, except for the *Coin Audits* (5-11) and Audit 12, Software Meter (the only audit which cannot be reset to zero).

Audit Note: 2nd Way to Reset Audits

To reset audits, from the **MAIN MENU**, select the "RESET" *Icon*. See Chapter 5, Go to Reset Menu, of this section.

Selection of the "COIN" *Icon*, from the **RESET MENU**, will reset the *Coin Audits* (5-11) to zero.

Selection of the "AUD" *Icon*, from the **RESET MENU**, will reset all audits to zero, except for the *Coin Audits* (5-11) and Audit 12, Software Meter (the only audit which cannot be reset to zero).

TWISTER
GAME ADJUSTMENT TABLE

Some adjustments have a "Drop-Down" Table where further customization is required.

SEGA ADJUSTMENTS 1-43

	Adjustment Name	Factory Setting		Adjustment Name	Factory Setting
1	REPLAYS: FIXED/MANUAL *"Drop-Down"*	10%	23	DEFAULT HIGH SCORE #3	1,950,000,000
2	REPLAY LEVELS *"Drop-Down"*	1	24	DEFAULT HIGH SCORE #4	1,800,000,000
3	REPLAY AWARD	CREDIT	25	DEFAULT HIGH SCORE #5	1,650,000,000
4	FREE GAME LIMIT	5	26	DEFAULT HIGH SCORE #6	1,500,000,000
5	EXTRA BALL LIMIT	3	27	HSTD RESET COUNT	2,000
6	GAME DIFFICULTY *"Drop-Down"*	MODERATE	28	FREE PLAY	NO
7	GAME PRICING *"Drop-Down"*	USA7	29	CUSTOM MESSAGE	ON
8	RESET COIN AUDITS	NO	30	ATTRACT MODE MUSIC	ON
9	RESET GAME AUDITS	NO	31	FLASH LAMP POWER	NORMAL
10	RESET HIGH SCORES	NO	32	COIL PULSE POWER	NORMAL
11	MATCH PERCENTAGE	9%	33	MINIMUM GAME TIME	OFF
12	BALLS PER GAME	3	34	BUYIN TYPE	OFF
13	TILT WARNINGS	1	35	EXTRA BALL BUYIN COUNT	1
14	REPLAY BOOST	YES	36	GAME RESTART	YES
15	CREDIT LIMIT	30	37	EXTRA BALL PERCENTAGE	25%
16	ALLOW HIGH SCORES	YES	38	BILL VALIDATOR	NO
17	HIGH SCORE #1 AWARDS	1	39	TOURNAMENT MODE	NONE
18	HIGH SCORE #2 AWARDS	0	40	EUROPEAN TOKEN DISPENSER	OFF
19	HIGH SCORE #3 AWARDS	0	41	SPECIAL MEMORY	YES
20	HIGH SCORE #4 AWARDS	0	42	LOCATION ID	00
21	DEFAULT HIGH SCORE #1	2,400,000,000	43	GAME ID	00
22	DEFAULT HIGH SCORE #2	2,100,000,000			

TWISTER ADJUSTMENTS 44 - 52

	Adjustment Name	Factory Setting		Adjustment Name	Factory Setting
44	MBALL RESTART	MODERATE	52	NOVICE MODE ENABLED	NO
45	EXTRA BALL MEMORY	ON			
46	LOCK BALL CRITERION	MODERATE			
47	WIND CRITERION	MODERATE			
48	AUTO START ENABLED	NO			
49	DISC ENABLED	YES			
50	5 BALL LOCK ENABLED	YES			
51	DROP TARGET ENABLED	YES			

Go To Adjustments Menu

Overview

The **Portals™ Service Menu System** provides 52 Adjustment Functions to vary game difficulty or customize (i.e. adjusting High Score Levels, the number of balls per game, Extra Ball Buyin, Game Pricing, Default High Scores, etc.). The Adjustment Functions are split into 2 groups. The first group, Sega Adjustments, are the game play generic adjustments (1-43). The second group, Twister Adjustments, are the game play specific adjustments (44- 52). Each group may be viewed manually after entering the **Portals™ Service Menu** (see Chapter 1, Introduction, of this section). All adjustments can be viewed at a glance with the **Game Adjustment Table** provided on the previous page. If a value is changed, the display will indicate **REQUEST INSTALLED**.

GO TO ADJUSTMENTS MENU

With the game in the Attract Mode, open the Coin Door and press the **Black "BEGIN TEST" Button**. Select the "ADJ" *Icon* in the **MAIN MENU** with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. The **ADJUSTMENTS MENU** appears.

Important Notes:

Exit any sub-menu and return to the **MAIN MENU** by selecting & activating the "PREV" *Icons*. If no *Icons* appear in the display because of a testing function or special display (e.g. "Help"), press any button to exit.

Selecting & activating the "HELP" *Icon* from any display will show a help screen. (An explanation of each *Mini-Icon* at that level will cycle continuously until any active button is pressed.)

Selecting & activating the "QUIT" *Icon* from any display will exit the Service Session.

In Adjustments, selecting & activating the "-" *Icon* decrements the value setting. Selecting & activating the "+" *Icon* increments the value setting.

Selecting & activating the "ARROW" *Icons* selects the next or previous adj. in the group.

SEGA ADJUSTMENTS (1-43)

From the **ADJUSTMENTS MENU**, select the "SEGA" *Icon* with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. Select and activate the "RIGHT ARROW" *Icon* to view the 1st adjustment in this group. Continue to select either of the "ARROW" *Icons* to view each adjustment one at a time. Select either the "-" or "+" *Icons* to change the value, if desired. The display will describe the adjustment number, the adjustment name, and the adjustment total or value. The current adjustment will remain in the display until the next adjustment is chosen or when the sub-menu is exited.

Adj. Nº	Adjustment Name	Adjustment Definition
Adj. 1	Replays: Fixed / Manual	Adjust for percentage of awards for Replay Levels (1% through 50%). Lower the automatic value to 0% and the display will indicated Fixed. Replays may be adjusted either for fixed levels or for a system-adjusted manual percentage of replay awards. Four levels may be selected. Adjustments allow awarding of a credit or an extra ball as each level is exceeded. With the manual percentage feature, if the actual replay percentage is higher or lower than that desired, the game computes new recommended manual percentage score(s). When the coin door is subsequently opened the player displays indicate the recommended level and a sound is made to alert the operator of a potential change. This new level is entered into adjustments simply by pressing the **Black "ENTER" Button**. (If the coin door is closed or the operator enters the Portals™ Service Menu, the replay level is not changed.)
Adj. 2	Replay Levels	Adjust the number of replay levels to be active (1 to 4). Once the number of Replay Levels has been selected, a "Drop-Down" Table appears showing Replay Level 1. Adjust Replay Level 1 between 100M - 9.99B. Adjust Replay Level 2, 3 and/or 4 respectively.

Sega Adjustments Continued.

Adjustment Name		Adjustment Definition
Adj. 3	Replay Award	Set for replays to award: **CREDIT, EXTRA BALL, NONE** or **SPECIAL** (When score threshold is achieved, a Playfield Special is lit.)
Adj. 4	Free Game Limit	Adjust the max. # of free games that may be accumulated per game; **0 - 9.**
Adj. 5	Extra Ball Limit	Adjust the max. # of extra balls that may be accumulated per game; **1 - 9** or **OFF.**
Adj. 6	Game Difficulty	Set to **EXTRA EASY, EASY, MODERATE, HARD** or **EXTRA HARD.** *(Note: Additional game features which are not adjusted may also change when adjusting this adjustment; see below table.)* Default is **MODERATE.** Any one of the ***INSTALL*** settings (in a "Drop-Down" Table) for this adjustment may be activated to automatically select settings for multiple adjustments affecting game difficulty. Select and activate the "-" or "+" *Icons* to choose the difficulty level required. After activation, the individual adjustments may be readjusted, if desired. Refer to the **Install Adjustment Table** below for details.

Adjustments which change when set to:	Adj. 6 Extra Easy	Adj. 6 Easy	Adj. 6 Moderate	Adj. 6 Hard	Adj. 6 Extra Hard
(44) MBall Restart	EXTRA EASY	EASY	MODERATE	HARD	EXTRA HARD
(45) Extra Ball Memory	ON	ON	ON	ON	OFF
(46) Lock Ball Criterion	EXTRA EASY	EASY	MODERATE	HARD	EXTRA HARD
(47) Wind Criterion	EXTRA EASY	EASY	MODERATE	HARD	EXTRA HARD

Play Rules: Novelty & 5-Ball, plus Add-A-Ball Settings

The following three combinations are recommended for situations where local laws restrict certain game features regarding the use of replays or the number of balls per game:

Novelty Play Rules - Set to establish recommended settings for no free play or extra balls:

Adj.	*Adjustment Name*	*Setting*	*Adj.*	*Adjustment Name*	*Setting*
1	Replays: Fixed/Manual	Fixed	5	Extra Ball Limit	00
2	Replay Levels	None	11	Match Percentage	Off
3	Replay Award	None	17	High Score #1 Awards	1
4	Free Game Limit	0	18	High Score #2 Awards	0

5-Ball Play Rules - Set to establish recommended settings for 5-ball play:

Adj.	Adjustment Name	*Setting*	*Adj.*	Adjustment Name	*Setting*
1	Replays: Fixed/Manual	07%	5	Extra Ball Limit	3
2	Replay Levels	1	11	Match Percentage	4
3	Replay Award	Credit	12	Balls Per Game	5
4	Free Game Limit	5	17	High Score #1 Awards	1
			18	High Score #2 Awards	0

Add-A-Ball Settings-To disable awarding of credits and provide awards with an extra ball:

Adj.	*Adjustment Name*	*Setting*	*Adj.*	*Adjustment Name*	*Setting*
3	Replay Award	Extra Ball	16	Allow High Scores	No
4	Free Game Limit	00	17-20	High Score #1 - #4 Awards	0
11	Match Percentage	Off			

Adjustment Name	Adjustment Definition
Adj. 7 Game Pricing	There are two methods available for coin switch programming: Standard & Custom. Standard pricing uses a single adjustment as seen in the first display. See the Standard Pricing Table. If "Custom" is selected, a "Drop-Down" Table appears. Select a pricing scheme shown in the **Custom Pricing Table** as seen below.

With Adjustment 7 set to **CUSTOM** operating the Enter Button again initiates a drop down menu representing coin switch pulses for the left, right, center and fourth coin slots. The prescribed the number of pulses are required for one credit. For example, if *Left Coin Pulses,* was set to 02 and *Coin Switch Pulses Required for 1 Credit*, to 01 a coin in the left slot would produce two credits. Further, if *Left Coin Pulses,* was set to 01 and *Coin Switch Pulses Required for 1 Credit*, to 02, two coins in the left slot would be required for one credit.

Coin Switch Pulses Required for Bonus Credit may be set to post bonus credits when a minimum amount of coins are inserted at one time. For example, if *Left Coin Pulses* was set to 01, *Coin Switch Pulses Required for 1 Credit* to 01 and *Coin Switch Pulses Required for Bonus Credit* to 04, one credit would be posted for each of the first three coins in the left slot and two credits for the fourth coin.

Standard/Custom Pricing - Set for the desired pricing scheme from the Standard Pricing Table as indicated on the dot matrix display. For Custom Pricing, set to **CUSTOM**. When set to **CUSTOM**, the following adjustments are utilized to tailor each individual coin chute.

Left Coin Switch Pulses - Set the number of pulses registered for closure of the left coin switch; **00** to **99**.

Right Coin Switch Pulses - Set the number of pulses registered for closure of the right coin switch; **00** to **99**.

Center Coin Switch Pulses - Set the number of pulses registered for closure of the center coin switch; **00** to **99**.

4th Coin Switch Pulses - Set the number of pulses registered for closure of the fourth coin switch; **00** to **99**.

Coin Switch Pulses Required for 1 Credit - Set the number of coin switch pulses required to post one credit; **00** to **99**.

Coin Switch Pulses Required for Bonus Credit - Set the number of coin switch pulses required to award the 1st bonus credit(s); **00** to **99**.

Coin Switch Pulses Required for 2nd Bonus Credit - Set the number of coin switch pulses required to award the 2nd bonus credit; **00** to **99**.

Credits awarded for 1st Bonus - Set the number of credits awarded for achieving the first Bonus level; **00** to **99**.

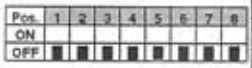
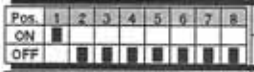
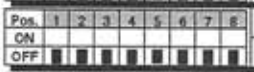
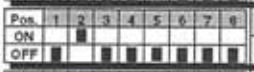
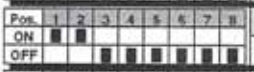
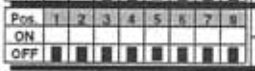
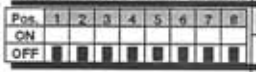
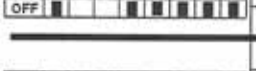
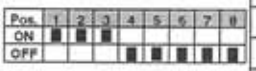
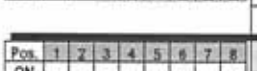
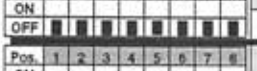
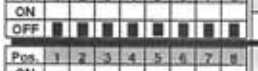
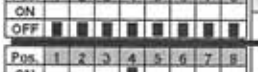
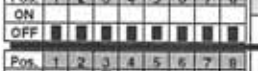
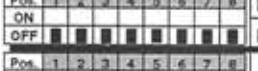
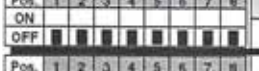
Custom Pricing Table

Coin Mechs					Adjustments							
Left	Right	Center	4th	*Plays/Coins*	Left Pulses	Right Pulses	Mid Pulses	4th Pulses	Pulses /Credit	Pulses /Bonus	Pulses /2nd Bonus	Credit /1st Bonus
25¢	25¢	$1.00	N/U	1/25¢ 3/50¢ 1/25¢ 5/$1.00 1/25¢ 6/$1.00	01 01 05	01 01 05	04 04 20	00 00 00	01 01 04	02 04 20	00 00 00	01 01 01
5*SCH*	10*SCH*	10*SCH*	N/U	1/10 S 1/10 S 4/30 S	01 04	02 08	02 08	00 00	02 06	00 00	00 00	00 00
10*p*	£1	50*p*	20*p*	1/30*p* 2/50*p* 5/£1 1/50*p* 3/£1 1/30*p* 4/£1	01 01 01	15 15 12	06 05 05	02 02 02	03 05 03	00 00 00	00 00 00	00 00 00
20¢	$1.00	N/U	N/U	1/60¢ 2/$1.00	01	05	00	00	03	05	00	01

Standard Pricing Table

on the next page.

Adj. 7 Standard Pricing Select Table

CPU Dip Switch Settings ★ ✦	Country Setting Option	Coin Mechanisms: Left 1st Slot	Center 2nd Slot	Right 3rd Slot	Right 4th Slot	Pricing Scheme Explained (Number of "Plays" for Price Amount Shown)			
	USA 1	25¢	$1	25¢		1/25¢			
	USA 2	25¢	$1	25¢		1/50¢	2/75¢	3/$1	
	USA 3	25¢	$1	25¢		1/50¢			
	USA 4	25¢		25¢		1/50¢			
	USA 5	25¢	$1	25¢		1/50¢	5/$2		
	USA 6	25¢	$1	25¢		1/50¢	2/"4 X 25¢"	3/$1 ($ Bill) ← Used to promote the Bill Validator	
	USA 7 ★	25¢	$1	25¢		1/50¢	4/$1.50	6/$2	
	Austria ★	5S	10S	10S		1/10S	2/15S	3/20S	
	Australia 1 ✦	20¢	$A 1	$A 2		1/$A 1	2/$A 2		
	Australia 2 ✦	20¢	$A 1	$A 2		1/$A 1	2/$A 2		
	Belgium ★	5 BF	20 BF	50 BF		1/20 BF	3/50 BF		
	Canada ★	25¢	25¢	Can$ 1		1/50¢	2/75¢	3/Can$ 1	
	Denmark 1 ✦	1DKr	5 DKr	10 DKr	20 DKr	1/3 DKr	2/5 DKr		
	Denmark 2 ✦	1DKr	5 DKr	10 DKr	20 DKr	1/2 DKr	3/5 DKr	7/10 DKr	
	Finland ✦	1 Fmk	5 Fmk			1/5 Fmk	4/10 Fmk		
	France 1 ★	1 Fr	5 Fr	10 Fr	20 Fr	1/3 Fr	2/5 Fr	5/10 Fr	11/20 Fr
	France 2	1 Fr	5 Fr	10 Fr	20 Fr	1/5 Fr	3/10 Fr	7/20 Fr	
	France 3	1 Fr	5 Fr	10 Fr	20 Fr	1/3 Fr	2/5 Fr	4/10 Fr	9/20 Fr
	Germany 1	1 DM	2 DM	5 DM		1/1 DM	6/"1 X 5 DM"		
	Germany 2	1 DM	2 DM	5 DM		1/2 DM	2/3 DM	3/4 DM	4/5 DM
	Germany 3 ★	1 DM	2 DM	5 DM		1/2 DM	2/3 DM	3/4 DM	5/5 DM
	Germany 4	1 DM	2 DM	5 DM		1/1 DM	6/5 DM		
	Greece ✦	50 Dr		100 Dr		1/50 Dr	3/100 Dr		
	Hong Kong	1 HK$	2 HK$	5 HK$		1/5 HK$			
	Hungary ✦	10 Ft	10 Ft	20 Ft		1/20 Ft	3/40 Ft		
	Italy 1 ★	500 Lit		500 Lit		1/500 Lit			
	Italy 2	500 Lit		500 Lit		1/1000 Lit	3/2000 Lit		
	Japan 1 ★			100¥		1/100¥			
	Japan 2			100¥		1/100¥	3/200¥		
	Korea ✦	100 Won		100 Won		1/100Won			
	Netherlands 1	1 Fls.	1 Fls.	2.5 Fls.		1/1Fls.	3/2.5 Fls.		
	Netherlands 2 ★	1 Fls.	2.5 Fls.	5 Fls.		1/1Fls.	3/2.5 Fls.	6/5 Fls.	
	New Zealand 1 ✦	$NZ 1		$NZ 2		1/$NZ 1	2/$NZ 2		
	New Zealand 2 ✦	$NZ 1		$NZ 2		1/$NZ 1	3/$NZ 2		
	Norway 1 ★	10 NKr	5 NKr	20 NKr		2/10 NKr	1/5 NKr	4/20 NKr	
	Norway 2	10 NKr	5 NKr	20 NKr		1/10 NKr	3/20 NKr		
	Spain ✦	100 Pts		500 Pts		1/100 Pts	6/500 Pts		
	Sweden 1 ★	1 SKr	5 SKr	10 SKr		1/10 SKr	2/15 SKr	3/20 SKr	
	Sweden 2	1 SKr	5 SKr	10 SKr		1/5 SKr			
	Switzerland 1 ★	1 SwF	2 SwF	5 SwF		1/1 SwF	6/5 SwF		
	Switzerland 2	1 SwF	2 SwF	5 SwF		1/1 SwF	3/2 SwF	9/5 SwF	
	UK 1	10p	50p	1£	20p	1/50p	3/1£		
	UK 2	10p	50p	1£	20p	1/40p	3/1£		
	UK 3 ★	10p	50p	1£	20p	1/50p			

Notes: ★ indicates Factory Default for that setting. ✦ indicates a USA Dip Sw. Setting, with Factory Default of USA7.

	Adjustment Name	Adjustment Definition
Adj. 8	**Reset Coin Audits**	Default is **NO**. Select the "+" *Icon* to change to **YES**. ⚠ When enabled, all *Coin Audits* (Audits 5-11), will be reset to zero.
Adj. 9	**Reset Game Audits**	Default is **NO**. Select the "+" *Icon* to change to **YES**. ⚠ When enabled, all audits will be reset to zero, except for the *Coin Audits* (Audits 5-11) and Audit 12, Software Meter (the only audit which cannot be reset to zero).
Adj. 10	**Reset High Scores**	When enabled (set to YES) the High Score Levels and associated initials will be restored to the backup settings when the "+" *Icon* is selected and activated.
Adj. 11	**Match Percentage**	Set Match percent from **00%** to **10%** or **OFF**. At **00**% the match display occurs at the end of the game but never awards a credit.
Adj. 12	**Balls Per Game**	Adjust the number of balls per game; **2** to **5**. Default is **3**.
Adj. 13	**Tilt Warnings**	Adjust the number of plumb bob tilt switch closures before the ball in play is tilted; **1**, **2**, **3** or **OFF.**
Adj. 14	**Replay Boost**	Set to **YES** or **NO**. When set to **YES**, exceeding a replay will set a temporary replay level for each time a replay level is surpassed. This new level will equal the previous replay level (when the replay was awarded) plus 50 Million for each following game, until the replays have all been played. At this time the previous level is resumed.
Adj. 15	**Credit Limit**	Adjust the maximum number of credits that may be posted; **4** to **50**. Default is **30**.

Note: There are 4 of the 6 High Score Levels with associated player initials that are displayed during the attract mode. This provides a High-Score-To-Date feature. When players exceed these levels, the player initials may be entered to replace the previous ones. These levels may be adjusted to award credits and to be reset to backup values after a selected number of games.

Adj. 16	**Allow High Scores**	Set to enable (set to **YES**) or disable the four high score levels by setting to zero.
Adj. 17	**High Score #1 Awards**	Adjust the number of awards (**0** to **4**) awarded for exceeding level 1 (the highest of the four levels).
Adj. 18	**High Score #2 Awards**	Adjust the number of awards (**0** to **3**) awarded for exceeding level 2.
Adj. 19	**High Score #3 Awards**	Adjust the number of awards (**0** to **2**) awarded for exceeding level 3.
Adj. 20	**High Score #4 Awards**	Adjust the number of awards (**0** to **1**) awarded for exceeding level 4.
Adj. 21-26	**Default High Score #1 - #6**	Adjust the score level to which the world record, (level 1) (the highest of the four levels) may be altered. This adjustment is not affected by Adj. 27, HSTD Reset Count. Adjust the backup score to which levels **2 - 6** may be reset, respectively.
Adj. 27	**HSTD Reset Count**	**HSTD** (**H**igh **S**core **T**o **D**ate). Adjust the number of games between automatic resets of high score levels to backup settings and ball time averager adjustments; **100** to **9,900** or **OFF** (no reset or adjustment). Default is **2,000**.
Adj. 28	**Free Play**	When set to **YES**, no coins are required for games.
Adj. 29	**Custom Message**	Set to **ON** or **OFF**. When set to **ON**, this function is used to establish a custom message periodically displayed during the attract mode. Set the feature to **CHANGE** selecting the "+" *Icon* The letter A is indicated in the first position in the display. Vary the letter by operating the left and right flippers. With the desired letter indicated, depress the **Start Button** to lock in the letter and advance to the next character. Repeat this procedure until the desired message is completed in the display.
Adj. 30	**Attract Mode Music**	Set to **ON** or **OFF**. When set to **ON**, attraction music is played between games.

Sega Adjustments Continued.

	Adjustment Name	Adjustment Definition
Adj. 31	Flash Lamp Power	Set to **NORMAL**, **DIM** or **OFF**. When set to **NORMAL** the flash lamps are active, when **DIM** the flash lamps impulse power is reduced by **25%** and when **OFF** the flash lamps will not flash.
Adj. 32	Coil Pulse Power	Set to **NORMAL, HARD** or **SOFT**. When **HARD** the coil pulse power is ***increased*** by **12.5%** of the normal pulse rate. When set to **SOFT** the coil pulse power is ***decreased*** by **12.5%** of the normal pulse rate. These adjustments are provided to compensate for Low Line or High Line voltage conditions where the solenoids appear to kicking too weak or too hard. Adjust as required.
Adj. 33	Minimum Game Time	Default is **OFF**. Set between **0:01 - 8:59** for minimum game time. If the last ball in play drains prior to what the game time is set for, another ball will be served into the shooter lane and normal play will continue. Subsequent balls will continue to do be served into the shooter lane if the last ball still drains prior to and up until minimum game time is satisfied.
Adj. 34	Buyin Type	Set to **Extra Ball Buyin**. When set to **EXTRA BALL**, the game is set to Extra Ball Buyin. When set to **FEATURE,** the game is set to Game (Feature) Buyin. Set to **OFF** to make Buyin Type inoperative.
Adj. 35	Extra Ball Buyin Count	**1**, **0** or **UNLIMITED**. Default is **1**. Allows the operator to adjust the number of Extra Ball Buyins allowed after normal game play. Review Section 2, Chapter 1, Game Operations & Features for details.
Adj. 36	Game Restart	Set to **YES** or **NO**. When set to **YES**, a new game may be started during any ball after the first ball is completed (if credits are available). (Note-Pressing start during the first ball will add additional players.) When set to **NO**, the game disables the **Start Button** after the first ball until the final ball is in play. Review Section 2, Chapter 1, Game Operations & Features for details.
Adj. 37	Extra Ball Percentage	Set from **0** to **50**. Allows the operator to adjust how frequently the Extra Ball feature is made available to the player.
Adj. 38	Bill Validator	Set to **YES** or **NO**. When set to **YES ,** the display, in game attract mode, will show an "*Insert Bill Animation.*" When set to **NO,** the display, in game attract mode will show "*Insert Coin Animation.*"
Adj. 39	Tournament Mode	Set to **NONE, PINBALL EXPO, IFPA-PAPA** or **HOME**. Tournament Mode determines the default conditions to quickly prepare a game for tournament play. When this setting is changed all audits will be reset and all adjustments will be initiated to the particular style selected. The game will then return to game over attract mode, as if a Factory Reset had been performed. **NONE** - Same as a Factory Reset conditions. **IFPA**-Straight 50¢ play, no replay, no Extra Ball, no High Scores, 2 Tilt Warnings and No Match. **PINBALL EXPO-PAPA-** Same as **IFPA** settings except Free Play is enabled. **HOME**-Sets game for Free Play, extra ball play, no replay, **10%** Match & Extra Ball percent **30%**.
Adj. 40	European Token Dispenser	Set to **ON** or **OFF**. When set to **ON**, the operator can enable the "knocker" cable in the cabinet to drive an external device without the game giving a replay.
Adj. 41	Special Memory	Set to **YES** or **NO**. When set to **YES**, the lit 'Special' light will be retained in memory from ball to ball for the same player. When set to **NO**, the lit 'Special' light will go out at the end of each ball.
Adj. 42	Location ID	**00** to **9999**. Allows the operator to assign a location identification number to the audit print-out sheet. (Will not be affected by Factory Reset.) See Chp. 5, Go to Reset Menu & Chp. 6, Go to Printer Menu, of this section for more details on Factory Reset & Printing.
Adj. 43	Game ID	**00** to **9999**. Allows the operator to assign a game identification number to the audit print-out sheet. (Will not be affected by Factory Reset.) See Chp. 5, Go to Reset Menu & Chp. 6, Go to Printer Menu, of this section for more details on Factory Reset & Printing.

TWISTER ADJUSTMENTS (44 - 52)

From the **ADJUSTMENTS MENU**, select the "TWI" *Icon* with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. Select and activate the "RIGHT ARROW" *Icon* to view the 1st adjustment in this group. Continue to select either of the "ARROW" *Icons* to view each adjustment one at a time. Select either the "-" or "+" *Icons* to change the value, if desired. The display will describe the adjustment number, the adjustment name, and the adjustment total or value. The current adjustment will remain in the display until the next adjustment is chosen or when the sub-menu is exited.

Adj. Nº	Adjustment Name	Adjustment Definition
Adj. 44	**MBall Restart**	Set to **EXEASY, EASY, MODERATE, HARD** or **EXHARD**. Default is **EASY**. Determines how Multiball can restart.
Adj. 45	**Extra Ball Memory**	Set to **ON** or **OFF**. Default is **ON**. When set to **ON**, the lit 'Extra Ball' light will be retained in memory from ball to ball for the same player. When set to **OFF**, the lit 'Extra Ball' light will go out at the end of each ball.
Adj. 46	**Lock Ball Criterion**	Set to **EXEASY, EASY, MODERATE, HARD** or **EXHARD**. Default is **MODERATE**. Determines how the Lock Ball Feature is played.
Adj. 47	**Wind Criterion**	Set to **EXEASY, EASY, MODERATE, HARD** or **EXHARD**. Default is **MODERATE**. Determines how the Wind (Twister) Rule is played.
Adj. 48	**Auto Start Enabled**	Set to **YES** or **NO**. Default is **NO**. When set to **YES**, the game will auto start with receipt of appropriate credit (e.g. if your game is set for 2 coins = 1 credit, if not credits are posted in the game, upon placement of 2 coins, the game will automatically start.).
Adj. 49	**Disc Enabled**	Set to **YES** or **NO**. Default is **YES**. When set to **YES**, the Magna Disc Motor is enabled. Set to **NO** to turn off. Use this adjustment if motor is being serviced and to keep game operational.
Adj. 50	**5 Ball Lock Enabled**	Set to **YES** or **NO**. Default is **YES**. Keep setting on **YES** if all components are functioning normally. Set to **NO** if the under playfield trough switches or the VUK in the canister is being serviced or is malfunctioning **and** the Single Drop Target works. When set to **NO** the game will produce a ***VIRTUAL LOCK***. The first time the Drop Target is hit (and then resets) will light "Lock Lit". The second hit of the Drop Target will then light the "Lock", locking 1 "phantom" ball. Upon Multiball, the balls will come from the under arch 5-Ball Trough instead. (*Note:* With this adjustment set to **NO** the Drop Target will immediately reset after it is dropped.)
Adj. 51	**Drop Target Enabled**	Set to **YES** or **NO**. Default is **YES**. Keep setting on **YES** if all components are functioning normally. Set to **NO** if the Single Drop Target is malfunctioning. This will keep the Drop Target in the down position. Thus, when a ball passes over the "downed" target, goes into the trough to the VUK, the VUK will produce the "Lock Lit" and return the ball into play. The next time the ball falls into the VUK it will "lock" the ball. Consecutive balls will register on the trough switches and act in the same manner.
Adj. 52	**Novice Mode Enabled**	Set to **YES** or **NO**. Default is **Yes**. When set to **YES**, before game play, the player can choose Novice Play (a 1-Ball Game with a guaranteed play time). **NOVICE GAME** rules give the player a guaranteed minimum game time - ***if the ball drains before the time is up, it will be returned to the player.*** When the ball drains after the time is up, the game ends). When set to **NO**, this feature is turned off, and defaults to Regular Game Play.

Custom Pricing

To go directly to Adjustment 7, Game Pricing, from the **ADJUSTMENT MENU**, select the "CUST" *Icon* either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. See details of this adjustment (Adj. 7) earlier in this chapter.

Film Star Reset

To reset the game with special settings (not the normal Factory Setting), from the **ADJUSTMENT MENU**, select the "STAR" *Icon* either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. This setting is determined to be ideal for the home environment. See Chapter 5, Go to Reset Menu, of this section, to change to factory defaults if changes made are not desired.

Adjustment Note: Resetting Adjustments

To reset adjustments, from the **MAIN MENU** select the "RESET" *Icon*. See Chapter 5, Go to Reset Menu, of this section.

Selection of the "FACT" *Icon*, from the **RESET MENU**, will reset all adjustments to the *Factory Settings* (except for Proprietary Adjustments). The display will return to the **Attract Mode**. To perform any other functions, the system must be entered again by pressing the **Black "BEGIN TEST" Button** on the coin door (see Chapter 1, Introduction, of this section).

Adjustment Note: Printing Game Information

To print audits, from the **MAIN MENU** select the "PRNT" *Icon*. See Chapter 6, Go to Printer Menu, of this section (special equipment required).

Selection of the "QUIK" *Icon*, from the **PRINTER MENU**, will start a quick print.

Selection of the "ALISON" *Icon*, from the **PRINTER MENU**, will start a Full Printout (Downloads to a PC).

Selection of the "RESET" *Icon*, from the **PRINTER MENU**, will reset the total Nº of copies value to zero.

Your Notes

Go To Reset Menu

Overview

The **Portals™ Service Menu System** provides three (3) functions to reset adjustments and/or audits back to the *Factory Setting*. See Chapter 3, Go to Audits Menu, and Chapter 4, Go to Adjustments Menu, for the Game Audits & Adjustments Information. If a Factory Reset is performed, the Service Session is exited and returns to the Attract Mode. If reset of Coin or Game Audits is performed, the display will indicate **REQUEST INSTALLED** and return to the **RESET MENU**. Please note that once reset, all customized settings are lost! Certain audits and adjustments however cannot be reset (refer to the details below).

GO TO RESET MENU

With the game in the Attract Mode, open the Coin Door and press the **Black "BEGIN TEST" Button**. Select the "RESET" *Icon* in the **MAIN MENU** with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. The **RESET MENU** appears.

Important Notes:

Exit any sub-menu and return to the **MAIN MENU** by selecting & activating the "PREV" *Icon*.

Selecting & activating the "QUIT" *Icon* from the display will exit the Service Session.

Selecting & activating the "HELP" *Icon* from the display will show a help screen. (An explanation of each *Mini-Icon* at that level will cycle continuously until any active button is pressed.)

FACTORY RESET

From the **RESET MENU**, select the "FACT" *Icon* with either **Red** or **Green Button** and press the **Black Button**. ⚠ All adjustments will be reset to *Factory Settings* (except for Proprietary Adjustments). The display will indicate **REQUEST INSTALLED** and exit the Service Session. See Chapter 4, Go to Adjustments Menu, of this section, for the *Factory Settings* in the **Game Adjustment Table**.

RESET COIN AUDITS

From the **RESET MENU**, select the "COIN" *Icon* with either **Red** or **Green Button** and press the **Black Button**. ⚠ All Coin Audits (See **Fig. 1**) will be reset to Factory Settings. The display will indicate **REQUEST INSTALLED** and return to the **RESET MENU**. Coin Audits can also be reset from the **ADJUSTMENTS MENU, SEGA ADJUSTMENT 8**. See Chapter 4, Go to Adjustments Menu, of this section. After selecting this *Icon*, all of the ***Coin Audits (5-11)*** are reset to zero.

RESET GAME AUDITS

From the **RESET MENU**, select the "AUD" *Icon* with either **Red** or **Green Button** and press the **Black Button**. ⚠ All Game Audits (See **Fig. 2**) will be reset to Factory Settings. The display will indicate **REQUEST INSTALLED** and return to the **RESET MENU**. Game Audits can also be reset from the **ADJUSTMENTS MENU, SEGA ADJUSTMENT 9**. See Chapter 4, Go to Adjustments Menu, of this section. After selecting this *Icon*, all of the ***Audits*** are reset to zero, except for the Coin Audits (Audits 5-11) and Audit 12, Software Meter. Audit 12 is the only audit which cannot be reset.

Fig. 1

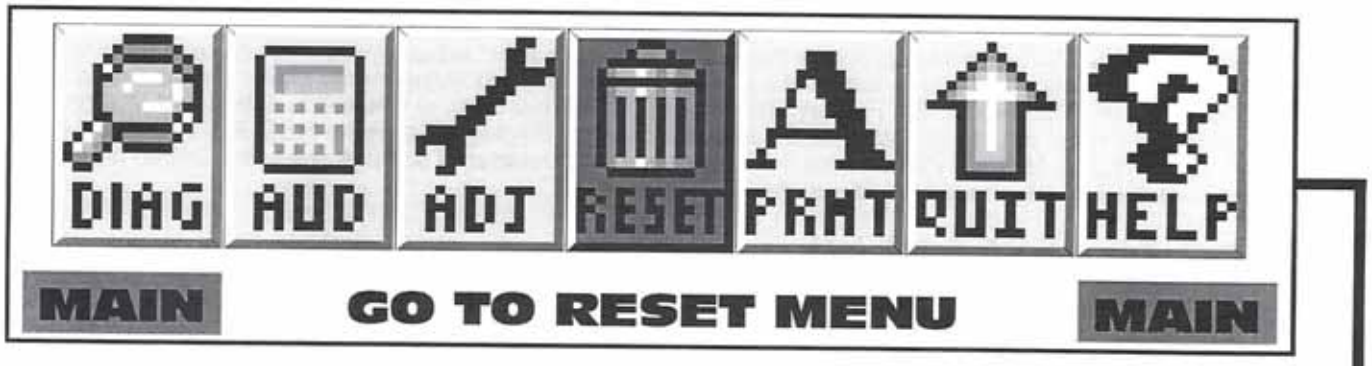
• Reset Coin Audits	
Earnings Audits (Coin Audits Only 5-11)	
Au. Nº	Description
1-4	The first 4 Audits in the game.
5	Coins Thru Left Slot
6	Coins Thru Right Slot
7	Coins Thru Center Slot
8	Coins Thru 4th Slot
9	Total Coins
10	Total Earnings
11	Meter Clicks
12	Software Meter
13 +	The remainder of the Audits.

Fig. 2

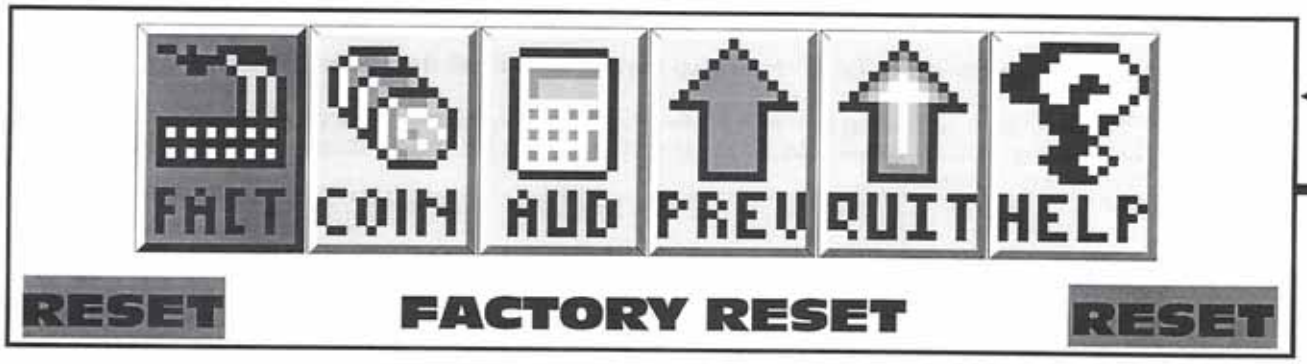
• Reset Game Audits	
Earnings (1-4), Generic/Specific Audits (13+)	
Au. Nº	Description
1-4	The first 4 Audits in the game.
5	Coins Thru Left Slot
6	Coins Thru Right Slot
7	Coins Thru Center Slot
8	Coins Thru 4th Slot
9	Total Coins
10	Total Earnings
11	Meter Clicks
12	Software Meter
13 +	The remainder of the Audits.

Example:

From the **MAIN MENU**, use the **Red** or **Green Buttons** to select the "RESET" *Icon* (**GO TO RESET MENU**).



Press the **Black Button** to activate this **ICON**. This will bring up the **RESET MENU**.



The **RESET MENU** now appears with the "FACT" *Icon* (**FACTORY RESET**) flashing:

CAUTION: IF CUSTOMIZED SETTINGS ARE MADE TO THE GAME, DO NOT PRESS THE START BUTTON OR THESE SETTINGS WILL BE LOST!

Press the **Black Button** to activate this icon. This will reset all adjustments back to *Factory Settings*.

The **REQUEST INSTALLED** now appears momentarily and the *Service Session* is automatically exited with the display returning to the **ATTRACT MODE**.

If the "COIN" or "AUD" *Icons* are chosen and activated, the affected audits (see previous page) will be reset, the display will indicate **REQUEST INSTALLED** and return to the **RESET MENU**.

Go To Printer Menu

Overview

☞ SPECIAL EQUIPMENT IS REQUIRED FOR THIS MENU

The **Portals™ Service Menu System** provides 3 Adjustment Functions to print information on a "Hand-Held" printer, download game information to a Laptop PC or clear the printout count. A printer interface board, hand-held printer and/or a special software program is required to run this menu. Entering this menu and selection/activation of the *Icons* without this equipment/software will not affect the game.

GO TO PRINTER MENU

With the game in the Attract Mode, open the Coin Door and press the **Black "BEGIN TEST" Button**. Select the "PRNT" *Icon* in the **MAIN MENU** with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. The **PRINTER MENU** appears.

Important Notes:

Exit any sub-menu and return to the **MAIN MENU** by selecting & activating the "PREV" *Icons*. If no *Icons* appear in the display because of a testing function or special display (e.g. "Help"), press any button to exit.

Selecting & activating the "HELP" *Icon* from any display will show a help screen. (An explanation of each *Mini-Icon* at that level will cycle continuously until any active button is pressed.)

Selecting & activating the "QUIT" *Icon* from any display will exit the Service Session.

In printer adjustments, selecting & activating the "-" or "+" *Icons* is necessary to start a printout or download.

Selecting & activating the "ARROW" *Icons* selects the next /previous *Icon* in the sub-menu.

QUICK PRINTOUT ADJUSTMENT (53) (Printer Interface)

From the **PRINTER MENU**, select the "QUIK" *Icon* with either **Red** or **Green Button** and press the **Black Button**. Select the "+" *Icon* and press the **Black Button** to start the printout. Only the Earnings Audits can be printed out to a "Hand-Held" Printer.

FULL PRINTOUT ADJUSTMENT (54) (Alison Interface)

From the **PRINTER MENU**, select the "ALISON" *Icon* with either **Red** or **Green Button** and press the **Black Button**. Select the "+" *Icon* and press the **Black Button** to start the download. A special software program and a Lap Top PC is required. All game audits (Earnings, Sega & Game Specific) can be retrieved.

Nº OF COPIES PRINTED ADJUSTMENT (55)

From the **PRINTER MENU**, select the "RESET" *Icon* with either **Red** or **Green Button** and press the **Black Button**. Select the "+" *Icon* and press the **Black Button** to start the clear the "Nº of copies printed" count total.

PORTALS™ SERVICE MENU

PROBLEM/SOLUTION TABLE

Use this table for a quick simple solution(s) guide. For more technical assistance view Section 5.

PROBLEM	SOLUTION
Will not enter the Service Mode after depressing the **Black "BEGIN TEST" Button**.	• Check the Service Switch(es) for loose connections or bad Ground. • Check the assoicated wiring harness to/from the CPU Board Connector CN14. • Check CPU Board, possibly failed.
Service Buttons (**Red, Green** and **Black**) are nonfunctional.	• Check the Service Switches for poor connections or broken wires.
The display blanks out.	• Check the Dot Matrix Display for loose wiring harness connections. • Check Bridge Rectifier 3 & 8 Amp Slo Blo Fuse. Refer to the Game Manual.
Icons "*scroll*" along continuously in the **MAIN MENU**.	• If the Service Switch Set and/or the Coin Door was replaced, ensure the Locking Mechanism on the **Green Button** is removed. If the Green Button "clicks" and locks into an up/down position, the Green Button has this lock switch. Remove it. (Ref. to Service Bulletin #74.)
The **Start** and **Flipper Buttons** do not select or activate *Icons* in the **SWITCH TEST MENU**.	• This is normal. These switches are deactivated, as they are a part of the Switch Test. Use the **Red "LEFT" or Green "RIGHT" & Black "ENTER" Buttons** in this Sub-Menu (See Chapter 1).
Some *Icons* appear non-functional in the **PRINTER MENU(S)**.	• If no printing equipment is connected, the "-" *Icon*, "+" *Icon* and "RUN" *Icon* will appear not to function (See Chapter 5).
Some *Icons* appear non-functional in the **GAME SPECIFIC MENU** under the **DIAGNOSTICS MENU**.	• If there is no other test under this Menu, the "Left Arrow" & "Right Arrow" *Icons* will appear not to function. The remaining *Icons* should function as normal. Note: If there is no Game Specific Special Test, the "GAME SPECIFIC" *Icon* will not invoke another display.
The display returns to the **ATTRACT MODE** exiting the Service Session from the **FACTORY RESET MENU**.	• This is normal. After a **FACTORY RESET**, the Service Session is automatically exited (See Chapter 4).
In **COIL TEST MENU**, the coils and flashlamps ***do not*** fire after activating the "RUN" *Icon*.	• Ensure the **POWER INTERLOCK SWITCH** (See figure on front inside cover) ***is pulled out***.
Can't move selection of *Icon* with the **Left** and/or **Right Flipper Buttons**.	• Check the **Flipper Buttons** for loose connections or bad Ground and refer to the Game Manual Flipper Troubleshooting Flowchart.
In **Portals™ Service Menu**, the volume cannot be adjusted with the Red or Green Buttons.	• The Volume adjustment can only be made when the Service Menu is exited. The **Volume Mode** is entered by pressing the **Red "VOLUME" Button**. Then use the **Red** or **Green Button** to increase/decrease volume. (Red "LEFT" decrements; Green "RIGHT" increments.)

Go To Help Screen

Overview

The **Portals™ Service Menu System** provides help screens in each display (except if the display is in a testing mode). Each screen is basic and some terms may vary. At the beginning of each chapter in this section, *Icons* are shown and described to give detail of the particular function of the individual *Icons*. The table on the previous page was designed to help answer some questions of situations which may arise.

GO TO HELP SCREEN

With the game in the Attract Mode, open the Coin Door and press the **Black "BEGIN TEST" Button**. Select the "HELP" *Icon* in the **MAIN MENU** with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. The **HELP SCREEN** appears cycling through the different icon usages pertinent to that menu level.

MENU HELP SCREEN
USE THE RED OR GREEN BUTTONS TO CHANGE THE SELECTED ICON. PRESS THE BLACK BUTTON TO ACTIVATE THE SELECTED ICON. THE FLIPPER & START BUTTONS FUNCTION IN THE SAME WAY.

Important Notes:

Exit any sub-menu and return to the **MAIN MENU** by selecting & activating the "PREV" *Icons*. If no *Icons* appear in the display because of a testing function or special display (e.g. "Help"), press any button to exit.

Selecting & activating the "HELP" *Icon* from any display will show a help screen. (An explanation of each *Mini-Icon* at that level will cycle continuously until any active button is pressed.)

Selecting & activating the "QUIT" *Icon* from any display will exit the Service Session.

These "Mini-Icons" vary in functionality depending in what sub-menu they are used. Refer to the beginning of each chapter in this section for the function they serve in that menu or select the "HELP" *Icons* in the display where the *Icon* in question is being used.

Review Chapter 1, Introduction, on how to enter the **Portals™ Service Menu**. The chapter outlines the entire **Portals™ Service Menu**. View the **Icon Tree** in this manual which describes the names and menu descriptions of each *Icon*. View the display, after selecting and activating either of the "HELP" or "?" *Icons*.

Review Chapter 2, Go to Diagnostics Menu, to find all the tests needed to troubleshooting the game.

Review Chapter 3, Go to Audits Menu, and Chapter 4, Go to Adjustments Menu, to gather play information and to customize the game to vary difficulty of play or to change functions of the game.

Review Chapter 5, Go to Reset Menu, to reset audits and adjustments to Factory Settings.

Review Chapter 6, Go to Printer Menu, to start downloading or printing functions. Special equipment is required for this function.

This concludes the **Portals™ Service Menu**. Review the Table of Contents at the beginning of this manual, and the detailed Table of Contents for Section 3 to quickly find the information required. The remainder of the sections in this manual will cover all the parts in this game and provide helpful information to aide in trouble- shooting. If questions still arise after reading this section completely, call our Technical Support Department.

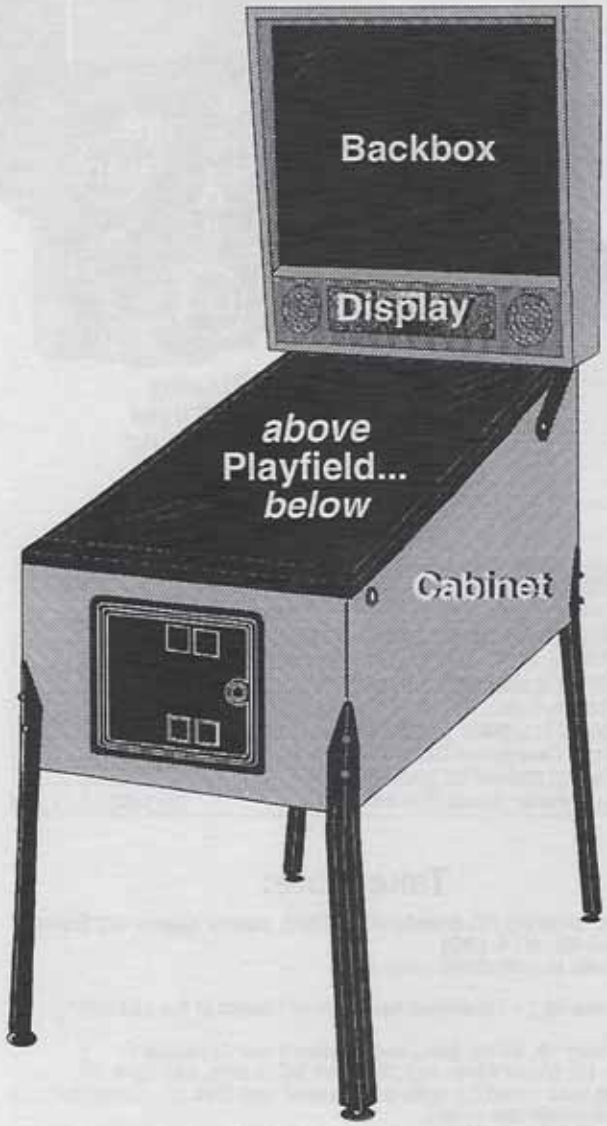
Your Help Notes:

Parts Identifcation & Location (The Pink Pages)

Overview

This section provides the part numbers and locations of all the components in the pinball machine. The parts are arranged in basically four groups: Backbox, Cabinet, Above and Below Playfield. (Some parts may be considered both above & below the playfield (i.e. sockets & bulbs); the part will be grouped where it is predominant.) Generic parts which may change as production continues (quantity and/or size) are listed together. Quantities greater than 0 indicates that the part is used in this game. Since quantity changes *may occur*, an item indicating "0" may be used. Compare the item which needs to be replaced with the drawings provided (the posts, sockets, bulbs and rubber rings are drawn actual size). Some parts which are complex (made up of numerous parts) will be noted and detailed in this Section, Chapter 2, Assembly Drawings.

Section 4, Chapter 1 Table of Contents



Backbox -
General Parts 54

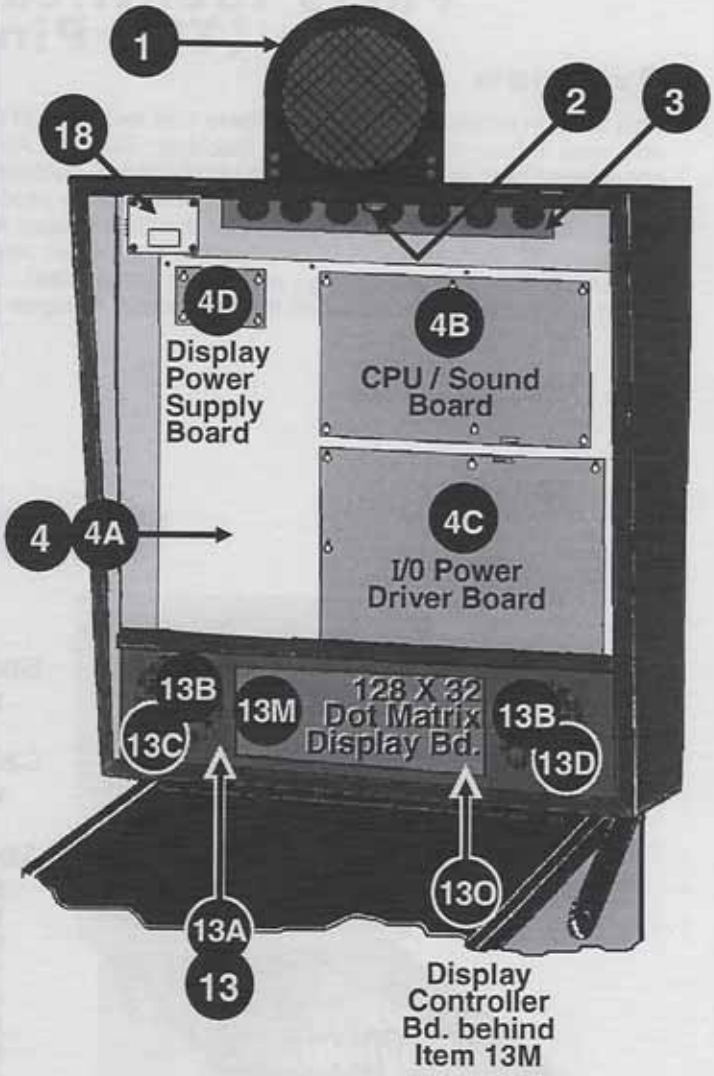
Cabinet -
General Parts 55

Above Playfield -
Major Assemblies 56
Ramps 57
Rails & Ball Guides 58
Butyrate, Decals & Mylar 59
General Parts 60
Rubber Parts *(Actual Size)* 61
Metal Posts & Spacers *(Actual Size)* 62
Plastic Posts & Spacers *(Actual Size)* 63
Wedge Base Bulbs & Sockets *(Actual Size)* 65
Miscellaneous Bulbs *(Actual Size)* 65
Bayonet Type Bulbs & Sockets *(Actual Size)* 66-67

Below Playfield -
Wedge Base Bulbs & Sockets *(Actual Size)* 65
Miscellaneous Bulbs *(Actual Size)* 65
Bayonet Type Bulbs & Sockets *(Actual Size)* 66-67
Light Boards (and any other misc. boards) 64

Backbox - General Parts

Nº	Part Name	SPI Part Nº
1	Backbox Twister Fan Assy.	500-6077-00
ORDERING ABOVE (ITEM 1) ASSEMBLY PART Nº WILL INCLUDE:		
1A*	Fan Housing	545-5706-01
1B*	Fan Motor Assy. (includes 1C,1D & 1E)	515-6531-00
1C*	Fan Motor Wiring Harness/Cable	036-5201-01-41
1D*	Neon Bulb	165-5021-00
1E*	Capacitor, 2.2 UF 200-250v Disc	125-5000-02
1F*	Fan Mounting Bracket	535-7702-00
1G*	#6-32 Stop Nut (Qty. 2) (top of Item 1C)	240-5005-00
1H*	#6 X 5/8" HWHSMS Green (Qty. 6)	234-5002-04
1I*	Tamper Proof (Qty. 6)	237-5947-00
1J*	Pop Rivet 1/8" ø X 3/8" (Qty. 26)	249-5018-01
1K*	Washer M3 3.2IDX9ODX.8THK (Qty. 26)	242-5043-00
1L*	Fan Blade	545-5707-00
1O*	Fan Screen (Qty. 2)	535-7724-00
1N*	Fan Screen Top (Qty. 3)	535-7732-00
2	Lock Plate	535-5860-00
	Back Box Lock	355-5008-00
	#8 X 5/8" Tamper Proof (Qty. 2)	237-5947-00
3	7-Vent Hole Grill 2½" x 18"	545-5072-02
4	PCB Mounting Plate Assembly	500-5126-41-41
ORDERING ABOVE (ITEM 4) ASSEMBLY PART Nº WILL INCLUDE:		
4A	PCB Mounting Plate	535-5809-03
4B†	**CPU / Sound (1 X 4MB) Board**	**520-5136-41**
4C	**I / O Power Driver Board**	**520-5137-01**
4D	**Display Power Supply Board**	**520-5138-00**
4E†	#6 X 3/4" HWH Screw (Qty. 4)	234-5003-00
4F*	#8-32 X 3/8" HWH Screw (Qty. 15)	237-5967-00
5 *	Twister Back Glass Assembly	515-5450-00-41
ORDERING ABOVE (ITEM 5) ASSEMBLY PART Nº WILL INCLUDE:		
5A*	Plastic Extrusion 26" (Top)	545-5018-04
5B*	Plastic Extrusion 21-3/8" (Left & Right)	545-5018-07
5C*	Glass Channel 26-1/16" (Bottom)	545-5021-01
5D*	Twister Artwork Film	830-5241-00
5E*	Glass 26" X 22-1/2"	660-5008-00
5F*	2-Side Tape (.5')	626-5005-00
6 *	Fluorescent Light Bracket Right Assy.	515-6545-00-XX
ORDERING ABOVE (ITEM 6) ASSEMBLY PART Nº WILL INCLUDE:		
6A*	Fluorescent Light Bracket Left	535-7739-01
6B*	Lamp Holder (Self-Locking)	077-5214-00
6C*	#6-32 X 5/8" PPH Mach. SEMS Screw	232-5203-00
6D*	Starter Base (with Leads)	077-5213-00
6E*	#4-40 X 1/2" PPH Mach. SEMS (Qty. 2)	237-5813-00
7 *	Fluorescent Light Bracket Right Assy.	515-6545-01-XX
ORDERING ABOVE (ITEM 7) ASSEMBLY PART Nº WILL INCLUDE:		
7A*	Fluorescent Light Bracket Right	535-7739-00
7B*	Lamp Holder (Self-Locking)	077-5214-00
7C*	#6-32 X 5/8" PPH Mach. SEMS Screw	232-5203-00
8 *	#10-24 X 1-1/4" Car. Bolt Sq. Neck (Qty. 4)	231-5012-00
9 *	#10-24 Keps Nut (Qty. 4) (with Item 8)	240-5207-00
10 *	Fluorescent Tube - F20R12-SPX30	165-5031-00
11 *	Starter - Fluorescent FS2 Light	165-5011-01
12 *	Ballast - SP2 120v 60Hz 13W (UL)	010-5007-00
13 *	Twister Speaker Panel Assembly	500-5995-02-41
ORDERING ABOVE (ITEM 13) ASSEMBLY PART Nº WILL INCLUDE:		
13A	Speaker Housing (includes spkr. hooks)	545-5180-02
—	Speaker Hook (Qty. 2)	545-5555-00
13B	Speaker Grill with Artwork	830-5646-00
13C	Speaker Backplate (cover unused side)	820-6157-00
13D	Speaker 4" QUAM #960334) (Rt. side)	031-5006-00
13E*	#6 X 3/8" HWH Screw (Qty. 8)	234-5000-00
13F*	Speaker Butyrate (Lexan)	830-5436-00
13G*	Foam (3/16" Thick) (Qty. 2.8')	626-5026-00
13H*	Post Machine Screw (Hi-Lo) (Qty. 5)	530-5263-01
13I*	Spacer (.144" ID X .31 OD X 1) (Qty. 5)	254-5001-00
13J*	Static Shield (Between Items M & O)	535-6437-00
13K*	Edge Protector (Qty. 2)	545-5592-01
13L*	#6-32 Keps Nut (Qty. 2)	240-5008-00
13M††	**128 X 32 Dot Matrix Display Board**	**520-5052-00**
13N*	1/4" Hex Spacer (1/2") (Qty. 4)	254-5008-03
13O†	**Display Controller Board**	**520-5055-01**
13P*	RF Shield (above Item O facing Item J)	820-5092-00
13Q*	#6-32 X 1/4" PPH (SEMS) (Qty. 5)	232-5200-00
13R*	Ground Strap (4") (Qty. 2)	600-5006-04
13S*	Ground Strap (12") (Qty. 2)	600-5006-12
13T*	Speaker Wiring Harness/Cable	036-5388-01-41



Nº	Part Name	SPI Part Nº
14 *	Ribbon Cable, 14-Pin (Display Controller Board to Dot Matrix Display Board)	036-5260-00-41
15 *	Ribbon Cable, 20-Pin (CPU/Sound Board to I/O Power Driver Board)	036-5000-04
16 *	Ribbon Cable, 26-Pin (CPU/Sound Board to Display Controller Board)	036-5001-00
17 *	Fuse Description Decal (See Page i in front of manual for fuse locations.)	820-6152-41
18	Aux. Relay Board (For the Fan)	820-5010-00

Take Note:

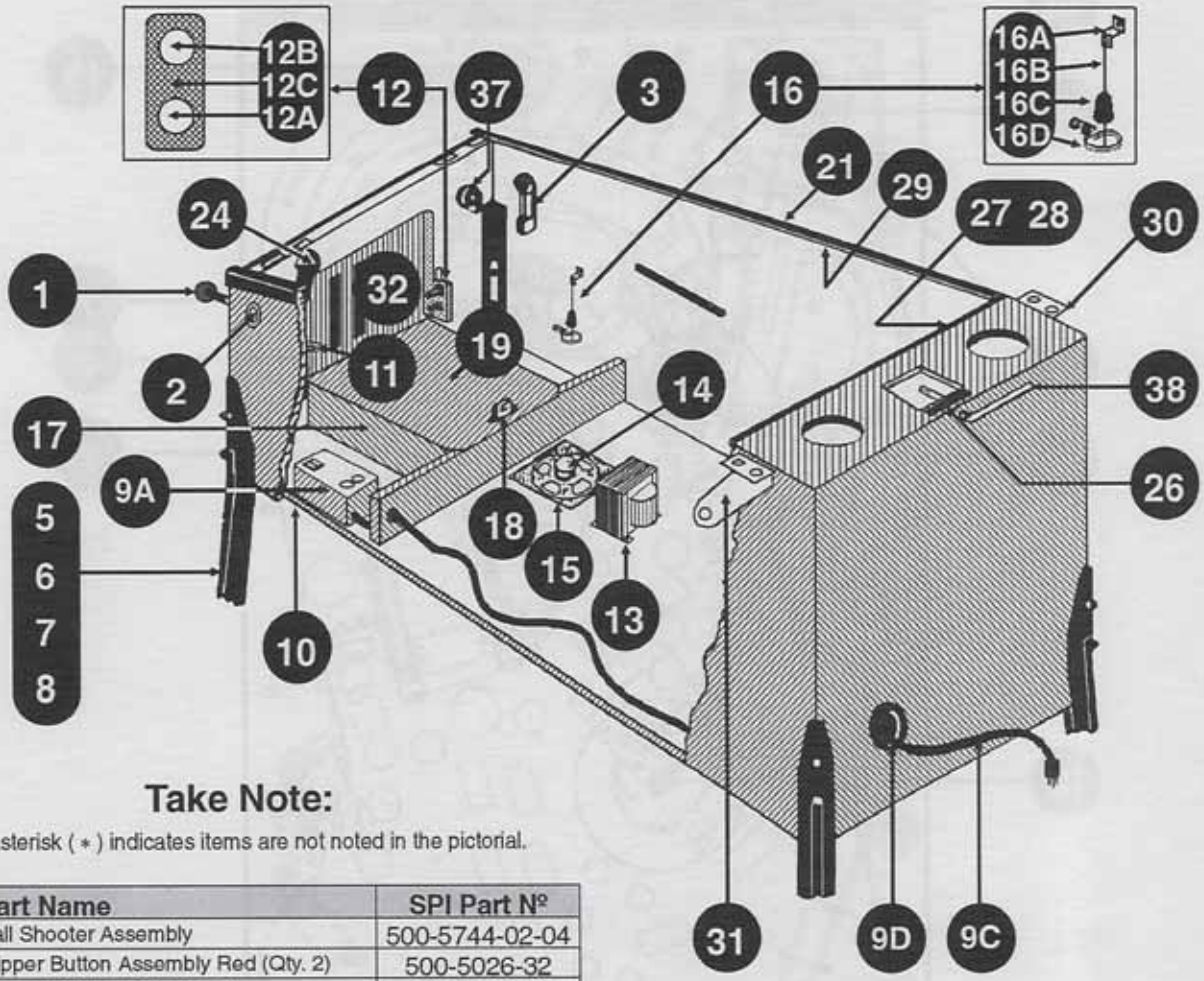
† When ordering PC Boards with ROMS, please specify the Game (Items 4B, 4D & 13O)

†† Indicate Manufacturer (Item 13M).

* An asterisk (*) indicates items are not noted in the pictorial.

1. For Item 1B, Motor Assy. specifications see Appendix F.
2. Item 1B, Motor Assy., includes Item 1C, Cable, with Item 1D, Neon Bulb (used for spike suppresion) and Item 1E, Capacitor (to eliminate line noise).
3. Items 6 & 7 the "-XX" needs to be included when ordering these parts. The -XX indicates use for all games & will include any revisions as production of future games warrants.
4. Item 8 fastens Items 6 & 7 to the inside of the Back Box.
5. Most parts included in assemblies can be ordered separately.

Cabinet - General Parts



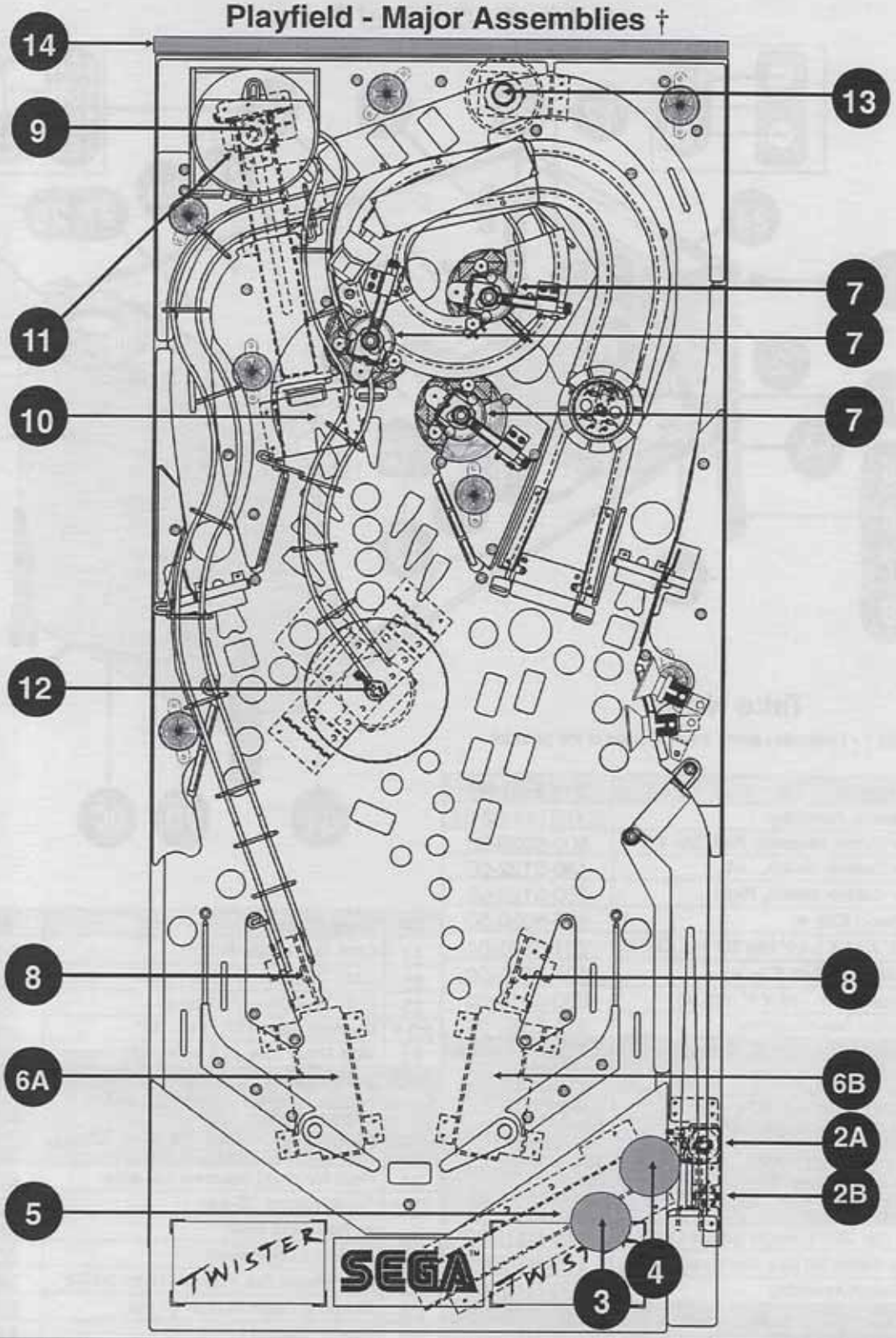
Take Note:

* An asterisk (*) indicates items are not noted in the pictorial.

Nº	Part Name	SPI Part Nº
1	Ball Shooter Assembly	500-5744-02-04
2	Flipper Button Assembly Red (Qty. 2)	500-5026-32
3	Flipper Cabinet Switch, Left	180-5122-00
4 *	Flipper Cabinet Switch, Right	180-5122-00
5	Leg (Black) (Qty. 4)	535-5020-50
6	Bolt 3/8" X 16 X 2-1/2" Hex 5/8" Hd. (Qty. 8)	231-5001-01
7	Leg Bolt Back Plate (Qty. 4)	535-5703-00
8	Leg Leveler 3/8" - 16 X 3" (Qty. 4)	500-5017-00
9 *	Power Box Sub-Assembly	515-5360-00
ORDERING ABOVE (ITEM 9) SUB-ASSY. PART Nº WILL INCLUDE:		
9A	Power Box	535-5932-00
9B*	Service Outlet (US)	180-5008-01
9C	Line Cord 10' ROJ 3" Max.	034-5000-10
9D	Recessed Cup for Line Cord	545-5122-00
9E*	Line Filter	150-5000-00
9F*	Varistor TNR159211KM	150-5001-00
9G*	Fuse 8 Amp (Domestic)	200-5000-05
9H*	Fuse Holder	205-5001-00
9I*	Power Box Decal	820-6123-00
10	Power Sw. DPST Toggle (Under Cab.)	180-5001-00
11	Service Switch Set (RED, GRN, BLK BUTTONS)	180-5012-03
12	Dual Switch Assembly	500-5808-00
ORDERING ABOVE (ITEM 12) ASSEMBLY PART Nº WILL INCLUDE:		
12A	Memory Protect Switch	180-5000-00
12B	Interlock Switch	180-5136-00
12C	Bracket	535-6958-00
13	Transformer	010-5011-00
14	Speaker - Round - 8" ø	031-5005-00
15	Speaker Grill 7" x 7"	535-6830-00
16	Plumb Bob Tilt Assembly	500-5023-00
ORDERING ABOVE (ITEM 16) ASSEMBLY PART Nº WILL INCLUDE:		
16A	Tilt Hanger Bracket	535-5221-00
16B	Tilt Hanger Wire (Attached to "16A")	535-5319-00
16C	Tilt Plumb Bob (Attached to "16B")	535-5029-00
16D	Tilt Contact Wire	535-7563-01

Nº	Part Name	SPI Part Nº
17	Cash Box Plastic Bottom	545-5090-00
18	Cash Box Lock Bracket (wire)	535-7562-00
19	Cash Box Cover (Validator)	535-5013-03
20 *	Playfield Glass (T.P.) 21" x 43"	660-5001-00
21	Side Armor (Qty. 2) (Left & Right Same)	535-7297-02
ABOVE (ITEM 21) IS HELD SECURED BY:		
Front	#10-24 X 1-1/4" Carriage Bolt and #10-24 Hex Nut	231-5012-00 240-5202-00
Middle	#8 X 5/8" Tmpr. Proof Trq. Scrw. (Qty. 2)	237-5947-00
Back	#8 X 3/4" Phil. Flat Head Screw (Qty. 2)	237-5922-00
24	Front Molding Lockdown Assembly	500-5020-01
25 *	Front Molding - Black	500-5757-01-00
26	#1 Roto Lock Male	355-5006-01
	#1 Roto Lock Female	355-5006-02
27	Rear Plastic Ext. Playfield Glass 20-3/8"	545-5038-00
28	Mounting Foam Rubber for Ext.	626-5001-00
29	Plastic Channel Left & Right	545-5017-00
30	Backbox Hinge Left	515-5987-00
31	Backbox Hinge Right	515-5987-01
32	Coin Door (with Validator) USA only	500-5018-171
33 *	Snap-In Keeper Female Rt./Lt. (Qty. 2)	355-5016-02
34 *	Snap-In Keeper Male (Qty. 2) on Playfield	355-5016-01
35 *	Catch Bracket (Qty. 2)	535-7700-00
36 *	Prop Rod	535-7553-00
37	Start Button Switch Assy. (Red) (Flip. Style)	500-6090-02
38	Hex Key Allen Wrench 5/16"	777-0001-00

Playfield - Major Assemblies †



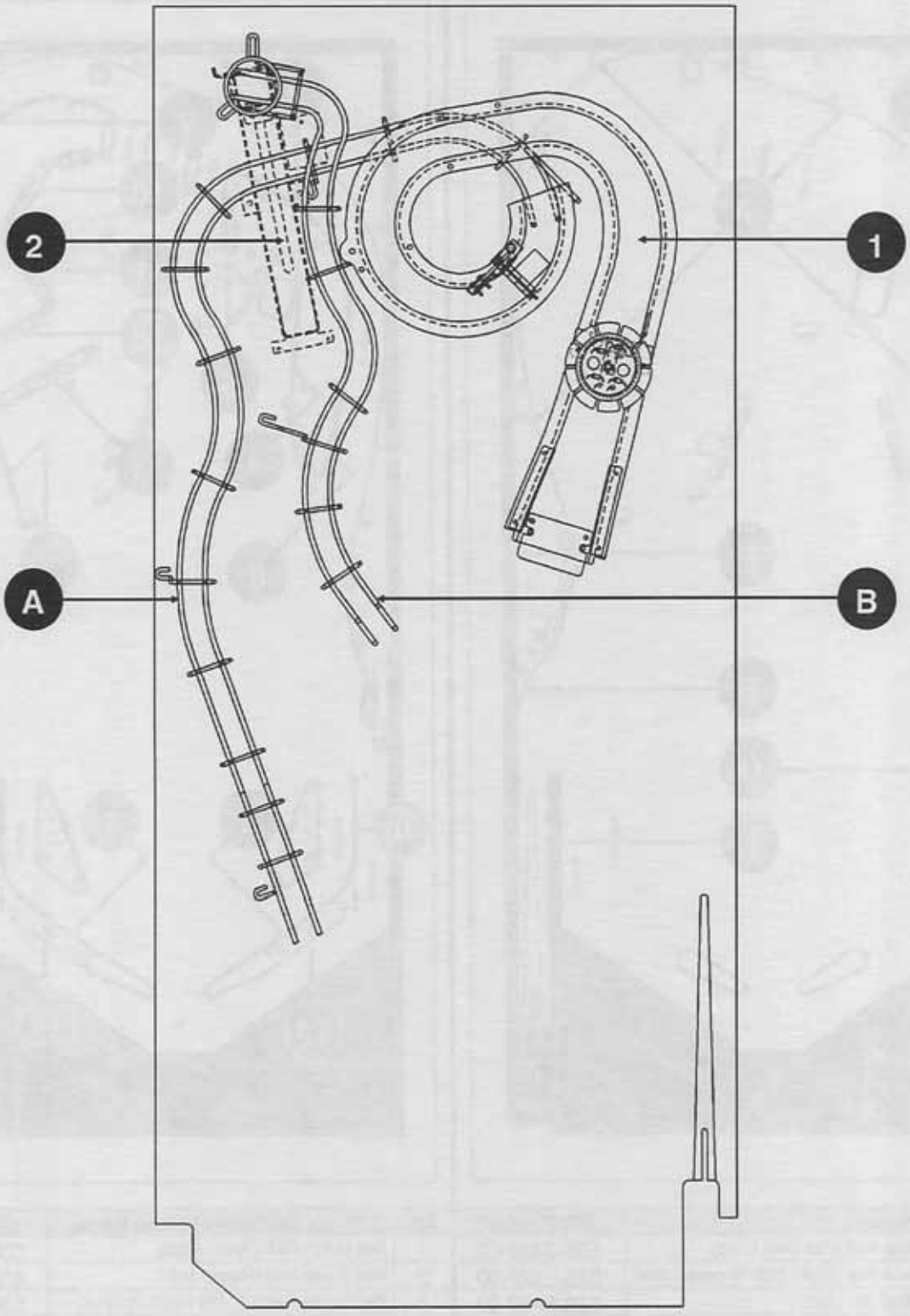
Nº	Assembly Name	PG.†	Part Nº	Nº	Assembly Name	PG.†	Part Nº
1 ‡	Ball Shooter (Plunger) Assy.	pg 70	500-5744-02-04	7	Turbo Bumper Ind. Parts (Qty. 3)	pg 74	See Sec. 4, Chp. 2
2A*	Autoplunger Coil Assembly	pg 70	500-6092-00-41	8	Slingshot (Lt. & Rt.) Assy. (Qty. 2)	pg 75	500-5849-01
2B*	Autoplunger Arm Weld Assy.	pg 70	500-6091-00-41	9	Super VUK Assembly	pg 75	500-5880-00-41
3	5-Ball Trough Assembly	pg 71	500-5989-15-XX	10	Single Drop Target Assembly	pg 76	500-6097-00-41
4	Lock Ball Assembly	pg 71	500-5684-02	11	Dorothy II Canister Assembly	pg 78	500-6093-00-41
5	Ball Trough Enter/Exit Scoop Assy.	pg 71	535-7329-01	12	Magna Disc Assembly	pg 79	500-5993-00-41
6A	Flipper (Left) Assembly	pg 72	500-5944-11	13	Magnet Diverter Individual Parts	pg 83	See Sec. 4, Chp. 2
6B	Flipper (Right) Assembly	pg 73	500-5944-02	14	Back Panel Assembly	pg 83	500-6011-00-41

† See Section 4, Chapter 2, Assembly Drawings (with indicated page) to identify the components of each assembly above.

‡ Item is located on the cabinet.

* Items 2A & 2B are separate assemblies but work together.

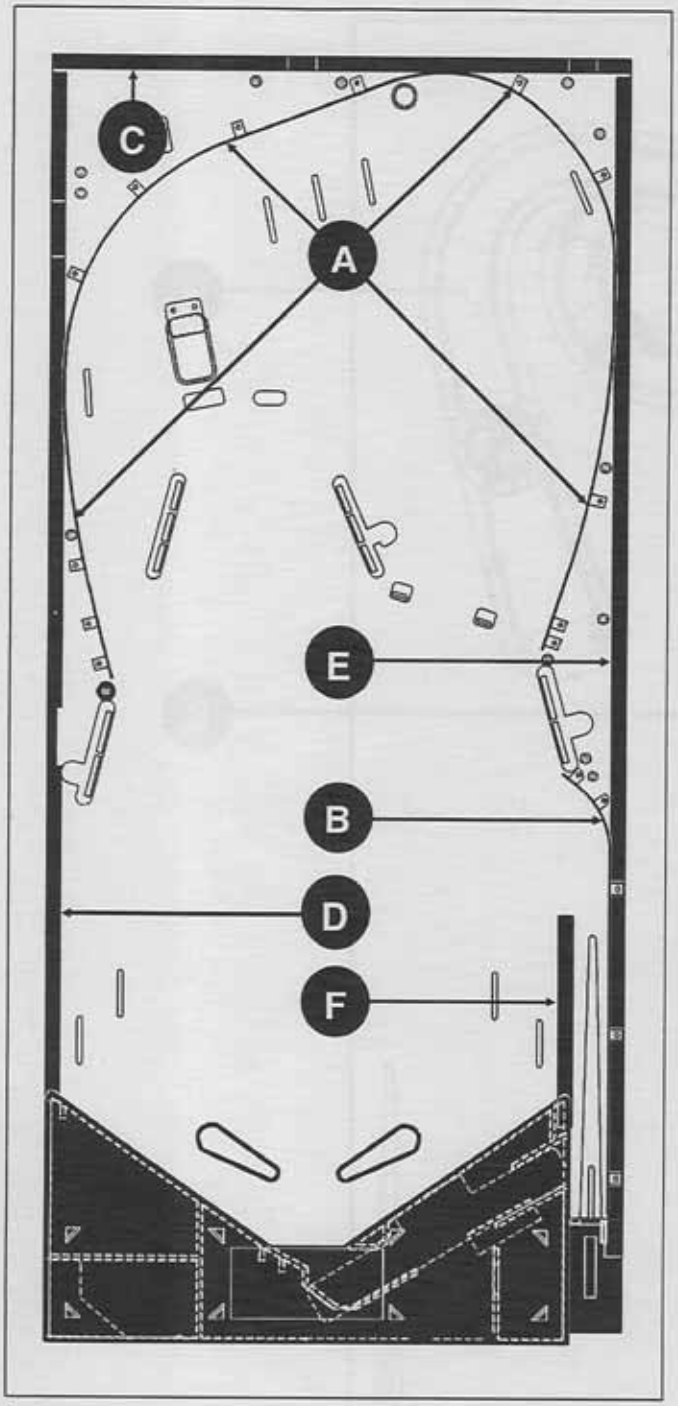
Playfield - Ramps †

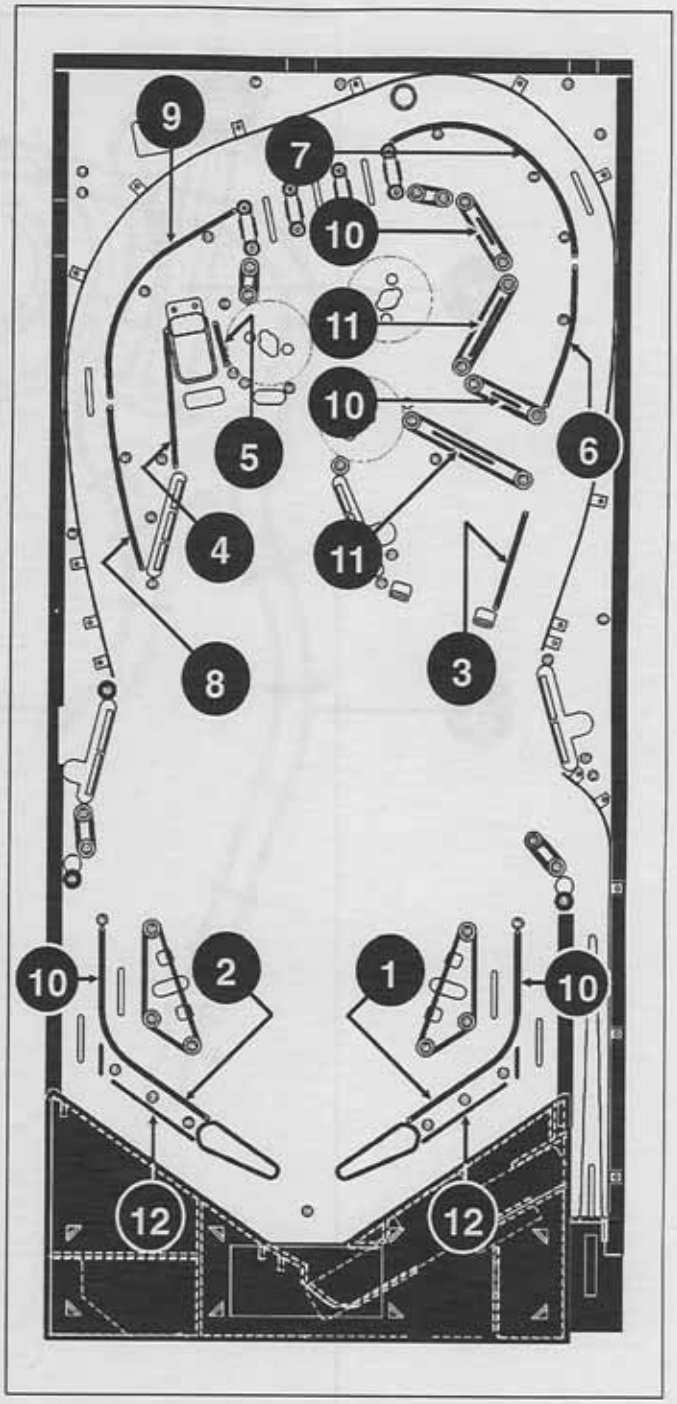


Nº	Assembly Ramp Name	PG.†	Part Nº	Nº	Wire Ramp Name	PG.	Part Nº
1	Plastic Ramp Assembly	pg 80	500-6009-00-41	A	Left Return Wire Ramp	n/a	515-6366-00
2	Under Trough Assembly	pg 82	500-6076-00-41	B	VUK Wire Ramp	n/a	515-6367-00

† See Sec. 4, Chp. 2, Assy. Drawings, for details of Items 1-2.

Playfield - Rails and Ball Guides

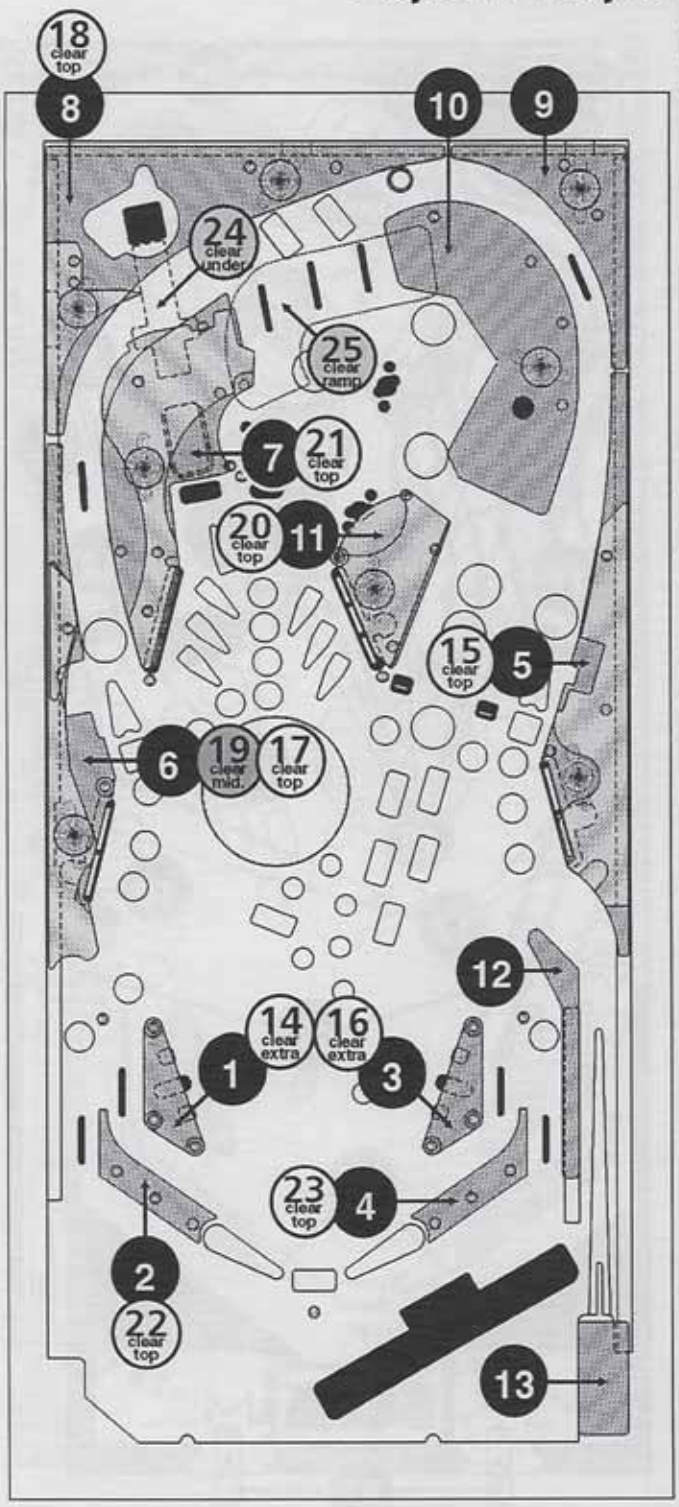




Nº	Rail Name	SPI Part Nº
A	Flat Metal Rail (Full Orbit Loop)	535-7422-00
B	Flat Metal Rail (Right Side Shooter Lane)	535-7427-00
C	Wood Rail 20" (Top)	525-5420-00
D	Wood Rail 36" (Left Side)	525-5419-00
E	Wood Rail 40" (Right Side)	525-5007-39
F	Wood Rail 7" (Left of Shooter Lane)	525-5007-40

Nº	Ball Guides / Wire Forms Name	SPI Part Nº
1	Ball Guide Rail (Flipper Right)	535-7560-01
2	Ball Guide Rail (Flipper Left)	535-7560-00
3	Ball Guide Rail 3.5" (By Right Spinner)	535-6492-08
4	Ball Guide Rail 4.75" (Lt. Upper Trough)	535-6492-04
5	Ball Guide Rail 1.5" (Rt. Upper Trough)	535-6492-13
6	Ball Guide Rail (Right Orbit Lower)	535-7716-00
7	Ball Guide Rail (Right Orbit Upper)	535-7717-00
8	Ball Guide Rail (Left Orbit Lower)	535-7718-00
9	Ball Guide Rail (Left Orbit Upper)	535-7719-00
10	1" Wire Form (Qty. 4) (Flip./Under Ramp)	535-5300-05
11	2.25" Wire Form (Qty. 2) (Under Ramp)	535-5300-12
12	3.5" Wire Form (Qty. 2) (By Flippers)	535-5300-03

Playfield - Butyrate, Decals and Mylar



Nº	Screened Butyrate Name	SPI Part Nº
	Buty. Sheet Screened (01-12) (Complete)	830-5483-XX
1	Butyrate 1 - Left Slingshot Cover	830-5483-01
2	Butyrate 2 - Left Return Lane Cover	830-5483-02
3	Butyrate 3 - Right Slingshot Cover	830-5483-03
4	Butyrate 4 - Right Return Lane Cover	830-5483-04
5	Butyrate 5 - Right Side	830-5483-05
6	Butyrate 6 - Left Side	830-5483-06
7	Butyrate 7 - Center Left Side Top	830-5483-07
8	Butyrate 8 - Top Left Side	830-5483-08
9	Butyrate 9 - Top Right Side	830-5483-09
10	Butyrate 10 - Center Right Side Top	830-5483-10
11	Butyrate 11 - Lower Right Side Top	830-5483-11
12	Butyrate 12 - Shooter Lane Cover	830-5483-12
13	Butyrate 13 - Bottom Arch	830-5483-13

Nº	Clear Butyrate Name	SPI Part Nº
	Buty. Sheet Clear (001-015) (Complete)	830-5498-XXX
14	Butyrate 001 - Lt. Slingshot Cover-extra	830-5498-001
15	Butyrate 002 - Right Side	830-5498-002
16	Butyrate 003 - Rt. Slingshot Cover-extra	830-5498-003
17	Butyrate 004 - Left Side	830-5498-004
18	Butyrate 005 - Left Corner	830-5498-005
19	Butyrate 006 - Left Side (Small)	830-5498-006
20	Butyrate 009 - Lower Pop Bumper	830-5498-009
21	Butyrate 010 - Center Left Top	830-5498-010
22	Butyrate 011 - Left Return Lane	830-5498-011
23	Butyrate 012 - Right Return Lane	830-5498-012
24	Butyrate 013 - Under Trough	830-5498-013
25	Butyrate 014 - Plastic Ramp Cover	830-5498-014
26 *	Butyrate 015 - Keychain	830-5498-015
The following last 3-digits were not used on 830-5498-XXX: -007, -008		

Nº	Extra Clear Butyrate Name	SPI Part Nº
n/a	Clear Butyrate (cable tied to Wire Ramp)	830-5903-01

Nº	Mylar Name	SPI Part Nº
M1 *	Twister Mylar Sheet (Complete)	820-5855-00
M2 *	Mylar Slingshot Area (Qty. 2)	820-5821-00
M3 *	Mylar Cover Discs (Cabinet) (Qty. 2)	820-5041-00

Nº	Decal Name	SPI Part Nº
	Twister Decal Sheet (Complete)	820-6133-XX
	Ramp: Ramp -01, Ramp -17 (covers Clear Buty #014) **Cannister:** Dorothy II -21, Canister Labels -22, On Flat Bracket -34, U-Shaped -32 & -33 **Spinners:** Lt. Back -05, Lt. Front -06, Rt. Back -07, Rt. Front -08 **Drop Target:** Front -23, Top -24 **Stand-Up Targets:** N -15, NW -12, NE -16, SE -14, W -11, E -13 **Pop Bumpers:** Center -18, Left -19, Right -20 **Bottom Arch:** Center -02, Left -09, Right -10 **Misc:** Keychain -03 (covers Clear Buty #015), Install 5-Balls -04, Service Switch Set -35 **Not Used:** -25 through -31	
D1 *	Magna Disc Decal	830-5481-00
D2 *	"Suitable for Indoor Use Only (UL)"	820-6001-01
D3 *	"High Voltage Label (UL)"	820-6082-01
D4 *	"Pricing Decal Sheet"	820-6094-00
D5 *	"Power Box Decal - USA"	820-6123-01
D6 *	"Danger Coin Door Label (UL)"	820-6140-00
D7 *	"UL Listing Label"	820-6141-00
D8 *	"Fuse Lable (UL)"	820-6143-00
D9 *	"PCB Fuse Location/Decriptions"	820-6152-41

Take Note:

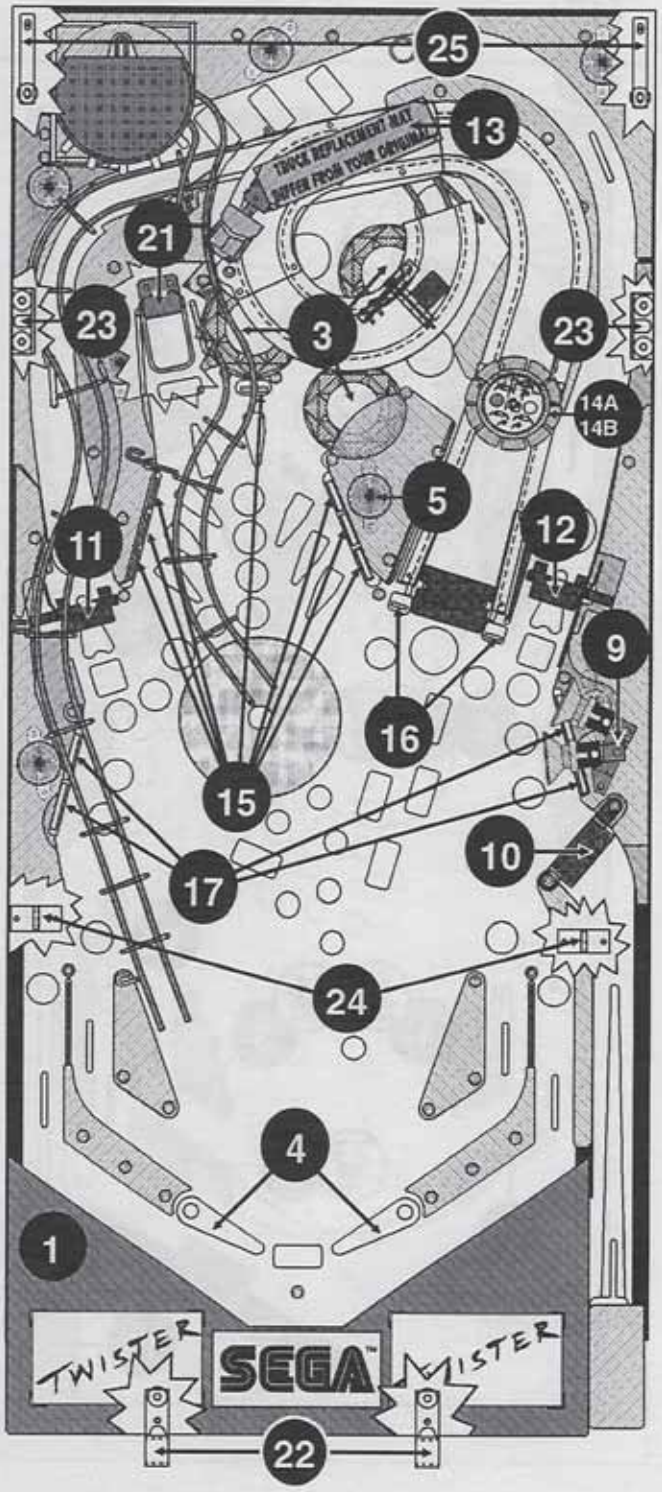
* An asterisk (*) indicates items are not noted in the pictorial.

1. To order the entire decal, screened butyrate or clear butyrate sheets, use the Part Nº with the "-XX" or "-XXX" ending. For individual pieces replace the "-XX" or "-XXX" with appropriate last 2- or 3-digit number.
   Attention: Individual pieces may not be available.
2. Most butyrate pieces are part of butyrate assemblies. For components on the assemblies (bulbs, sockets, spacers, light covers, etc.) identify and find the part on the following pages in this Section & Chapter. (Light Covers are listed in Playfield - General Parts).

Playfield - General Parts

Nº	Above Playfield Part Name	SPI Part Nº
1	Bottom Arch Assembly (Plastic)	500-6005-00-41
ORDERING ABOVE (ITEM 1) ASSEMBLY PART Nº WILL INCLUDE:		
1A*	Bottom Arch (Plain)	545-5302-08
1B*	#6-32 X 1-1/4" PPH MS (Qty. 2)	237-5508-00
1C*	Spacer 3/4" Plastic 3/8" (Gray) (Qty. 2)	254-5000-07
1D*	#6-32 Nylon Stop Nut (Qty. 2)	240-5005-00
1E*	Bottom Arch Shooter Lane Butyrate -13	830-5483-13
1F*	Nelson Protect Strip 8-9/16" (Qty. 2)	545-5212-02
2 *	1-1/16" Steel Balls (Qty. 5)	260-5000-00
3	Pop Bumper Cap Clear (Qty. 3)	550-5057-01
4	Flipper & Shaft Assy. White with Sega Saturn™ Logo ©1996 (Qty. 2)	515-5133-08-05
5	Mini-Mars Light Cover Clear (Qty. 8)	550-5031-01
6 *	Rubber Light Cover Red (Qty. 3)	545-5014-02
7 *	Rubber Light Cover Green (Qty. 9)	545-5014-04
8 *	Rubber Light Cover Yellow (Qty. 4)	545-5014-06
9	Spot-Light Assembly	500-6109-00-41
ORDERING ABOVE (ITEM 9) ASSY. PART Nº WILL INCLUDE:		
9A*	Wdge Laydown Sckt. (Notched) (Qty. 2)	077-5026-01
9B*	#555 Wedge Base Bulb (Qty. 2)	165-5002-00
9C*	Bracket	535-6992-01
9D*	Rivet ø 1/8" X 1/8 (Nickel) (Qty. 2)	249-5008-00
9E*	Reflector (Qty. 2)	545-5409-01
9F*	Cable Harness	036-5402-17
10	Flap Gate Assembly	500-5919-00-41
ORDERING ABOVE (ITEM 10) ASSY. PART Nº WILL INCLUDE:		
10A*	Flap Gate Bracket	535-6387-00
10B*	Flap Gate	535-7195-00
10C*	Rebound Hinge Pin	535-5372-01
11	Spinner Assembly (Left)	500-5655-00-41
ORDERING ABOVE (ITEM 11) ASSY. PART Nº WILL INCLUDE:		
11A*	Spinner Bracket Left	535-5127-00
11B*	Spinner Sub-Assembly	515-5553-00
11C*	Micro Switch	180-5010-04
11D*	#2-56 X 1/2 PHMS (Qty. 2)	237-5806-00
11E*	Split Lock Washer (Qty. 2)	244-5001-00
11F*	Switch Body Protect	535-6539-00
11G*	#6 X 1/2 HWH (Qty. 2)	234-5001-02
11H*	Spinner Wire Harness/Cable Left	036-5402-03-41
12	Spinner Assembly (Right)	500-5656-00-41
ORDERING ABOVE (ITEM 12) ASSY. PART Nº WILL INCLUDE:		
12A*	Spinner Bracket Right	535-5128-00
12B-12G*	*(Items 12B through 12G are identical to Items 11B through 11G above.)*	See Part Nºs for Items 11B thru 11G.
12H*	Spinner Wire Harness/Cable Left	036-5402-04-41
13	Semi-Truck	830-5805-00
14A	Sensor Ball Top - Clear	545-5701-00
14B	Sensor Ball Bottom - Chrome	545-5702-00
Note:	The above Items 13 & 14 are part of the Ramp Assy., 500-6009-00-41, a Major Assembly. See Section 4, Chapter 2, for balance of items (or any other items attached to the ramp.)	
15	Module Stand-Up Target Clear (Qty. 7)	500-6075-01
16	Narrow Rect. S-U Target White (Qty. 2)	500-5857-08
17	Rectangular S-U Target White (Qty. 4)	500-5321-08
Note:	See Section 4, Chapter 2, (last page) for balance of items of above Target Assemblies.	
18 *	Ball Trap "Spring Wire" (by mid. pop b.)	535-5650-00
19 *	Ball Trap "L" Bracket (behind canister)	535-7744-00
20 *	Ball Trap "Butyrate" Brackets (Qty. 3)	535-7784-00
21	Ball Stop Bracket	535-7280-01

Nº	Below Playfield Part Name	SPI Part Nº
22	Playfield Hanging Bracket (Qty. 2)	535-5216-03
23	Pivot Pin Bracket Assembly (Qty. 2)	500-6088-00
ORDERING ABOVE (ITEM 23) ASSY. PART Nº ***WILL NOT*** INCLUDE:		
23A*	Pivot Bracket Screws (Qty. 4)	237-5907-00
23B*	T-Nuts (Qty. 4)	240-5101-00
24	Outlane Adjustable Post Plate (Qty. 2)	535-5091-00
25	Snap-In Keeper Male RT/LT (Qty. 2)	355-5016-01



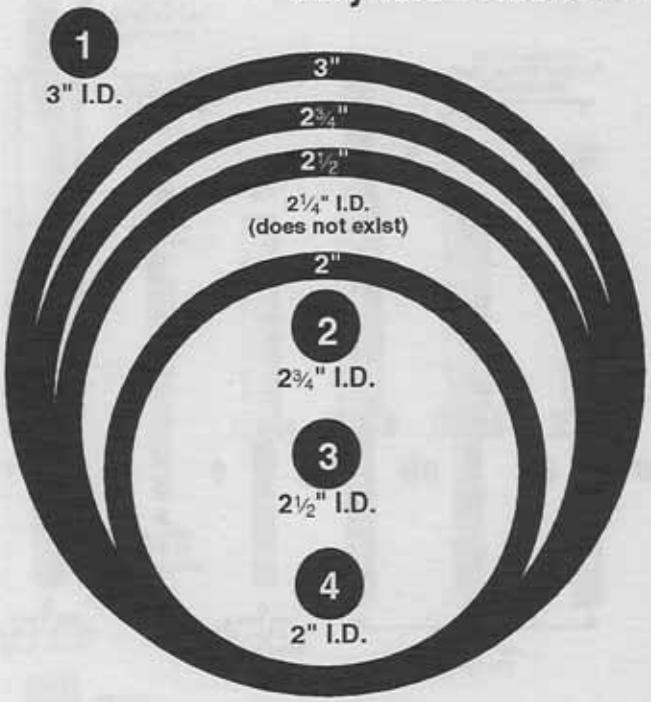
Nº	The Playfield	SPI Part Nº
P1 *	Playfield Screened (No Parts)	830-5141-00
P2 *	Playfield Complete with all Parts	505-0000-41-41

Take Note:

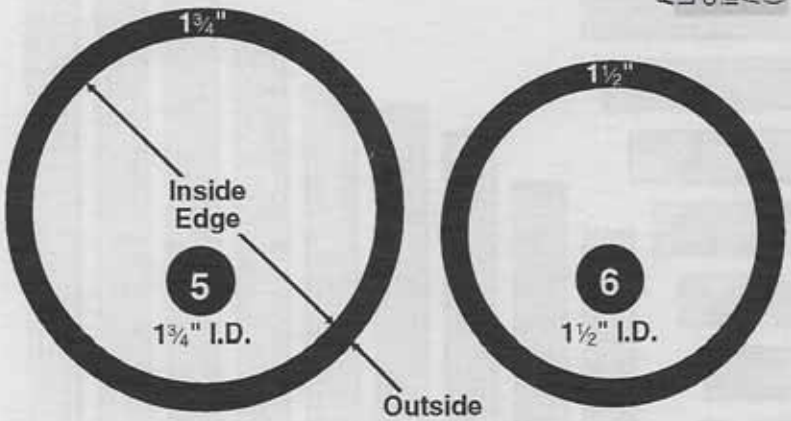
* An asterisk (*) indicates items are not noted in the pictorial.

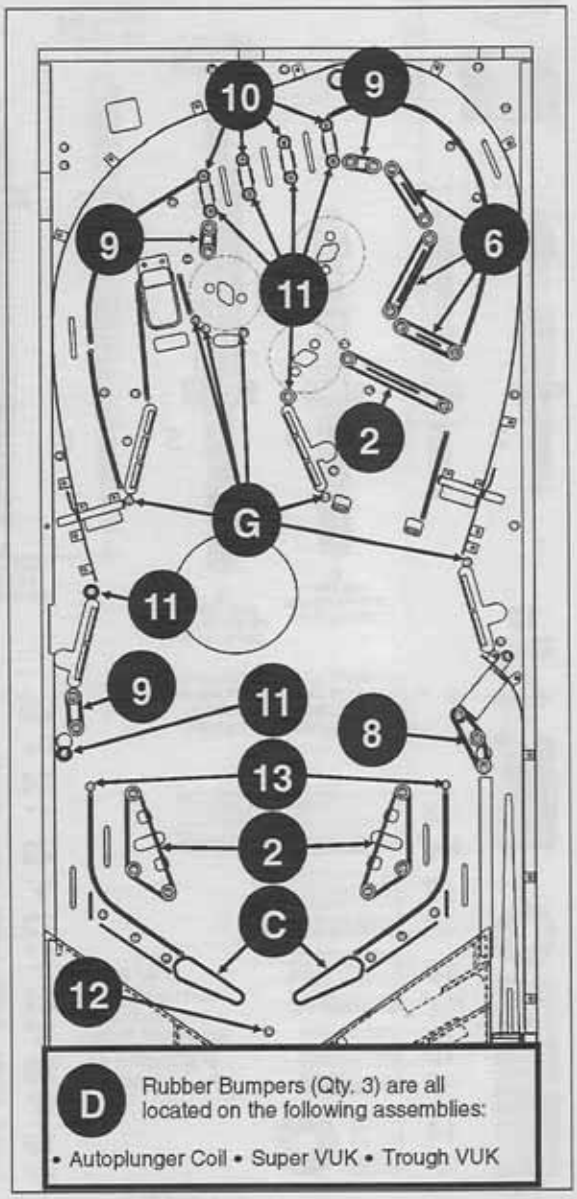
1. Items 24 & 25, Snap-In Keeper (F) & Brckt., located in cabinet.
2. For rubber parts, metal & plastic posts, sockets & bulbs, see the following pages in this chapter.
3. Also see Section 4, Chapter 2, for breakdown of parts on Major Assemblies.

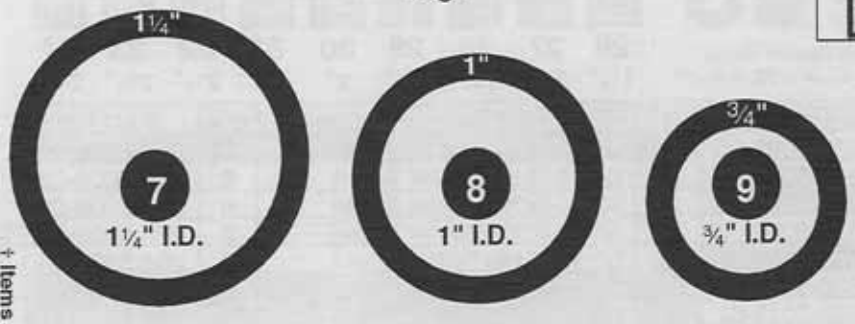
Playfield - Rubber Parts (Rings Actual Size) †

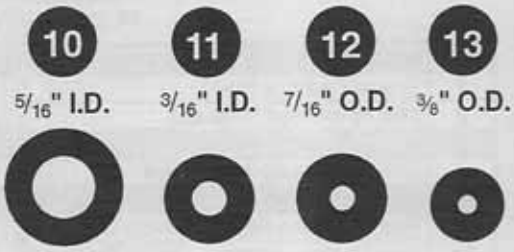


How to measure:
Lay ring over circle of closest size. If you see the outside edge of the circle, move to one ring smaller. With the correct size you will see the inside edge of the circle around the inside of the rubber ring.
Note: The rings will ***stretch*** with use. Always go to the size smaller.
(I.D. = Inside Diameter ø; O.D. = Outside Diameter ø)





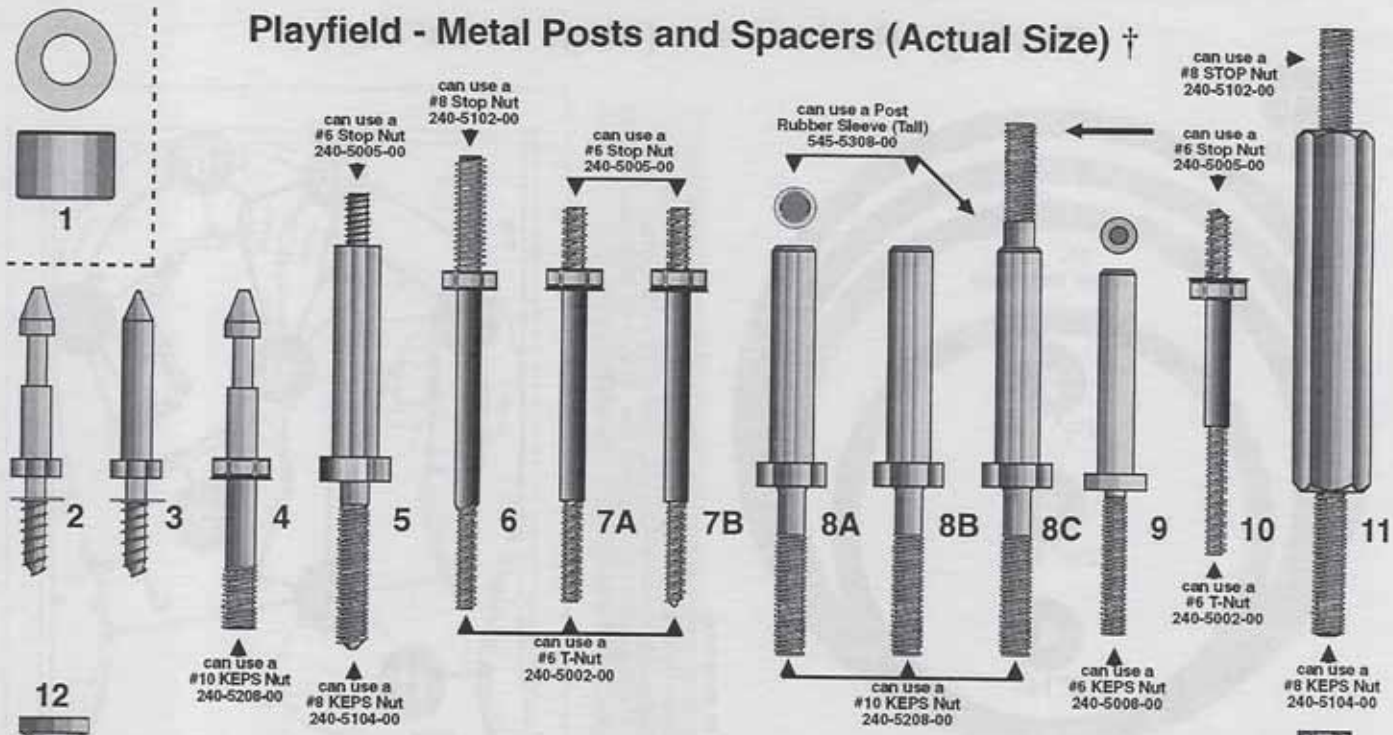


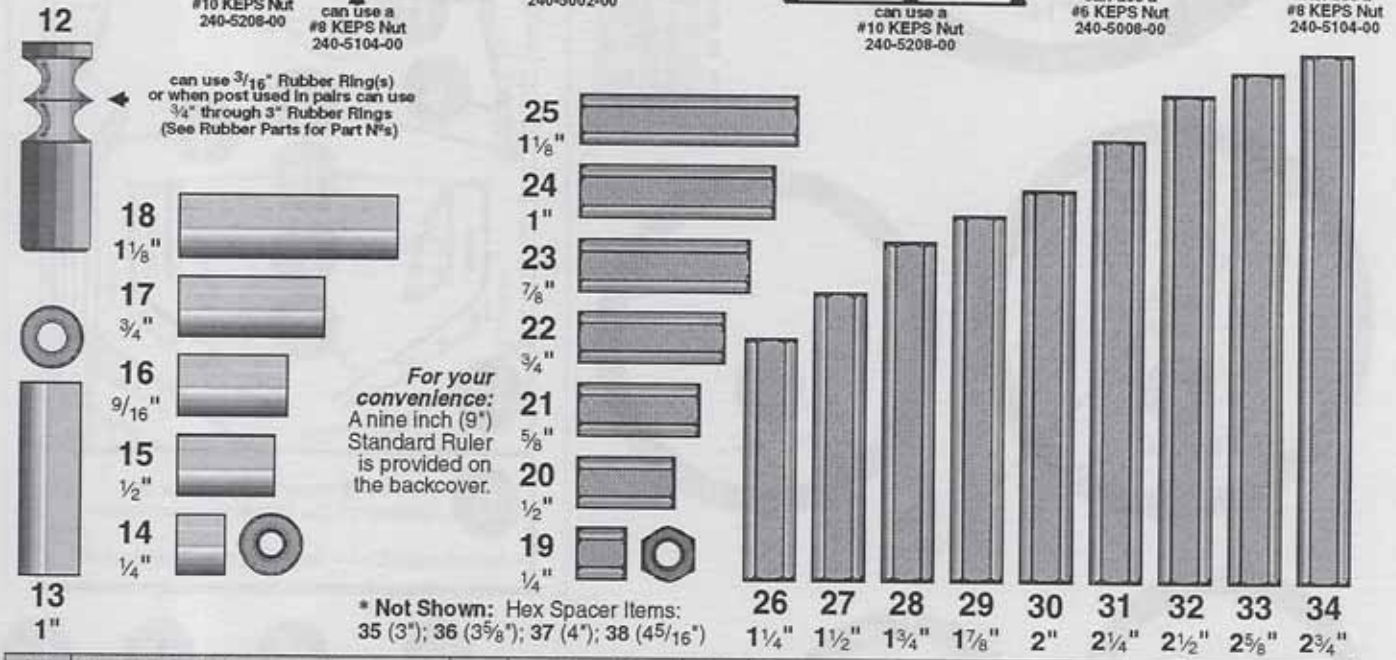


† Items with Ø Qty. are not used in this game. Size and/or quantities may change during production.

№	Rubber Part Name	QTY.	Part №	№	Rubber Part Name	QTY.	Part №
A	Rubber Bushing (Small)	0	545-5192-00	4	2" I.D. Black Rubber Ring	0	545-5348-08
B	Small Flipper Rubber Ring	0	545-5207-00	5	1¾" I.D. Black Rubber Ring	0	545-5348-21
C	Large Flipper Rubber Ring	2	545-5277-00	6	1½" I.D. Black Rubber Ring	3	545-5348-07
D	Rubber Bumper (Grommet)	3	545-5105-00	7	1¼" I.D. Black Rubber Ring	0	545-5348-06
E	Bumper Post Rubber	0	545-5009-00	8	1" I.D. Black Rubber Ring	1	545-5348-05
F	Post Rubber (Sleeve Short)	0	545-5151-00	9	¾" I.D. Black Rubber Ring	3	545-5348-04
G	Post Rubber (Sleeve Tall)	6	545-5308-00	10	5/16" I.D. Black Rubber Ring	4	545-5348-02
1	3" I.D. BLK Rubber Ring	0	545-5348-10	11	3/16" I.D. Black Rubber Ring	7	545-5348-01
2	2¾" I.D. Black Rubber Ring	3	545-5348-20	12	7/16" O.D. Black Rubber Ring	1	545-5348-17
3	2½" I.D. Black Rubber Ring	0	545-5348-09	13	⅜" O.D. Black Rubber Ring	2	545-5348-19

Playfield - Metal Posts and Spacers (Actual Size) †





For your convenience: A nine inch (9") Standard Ruler is provided on the backcover.

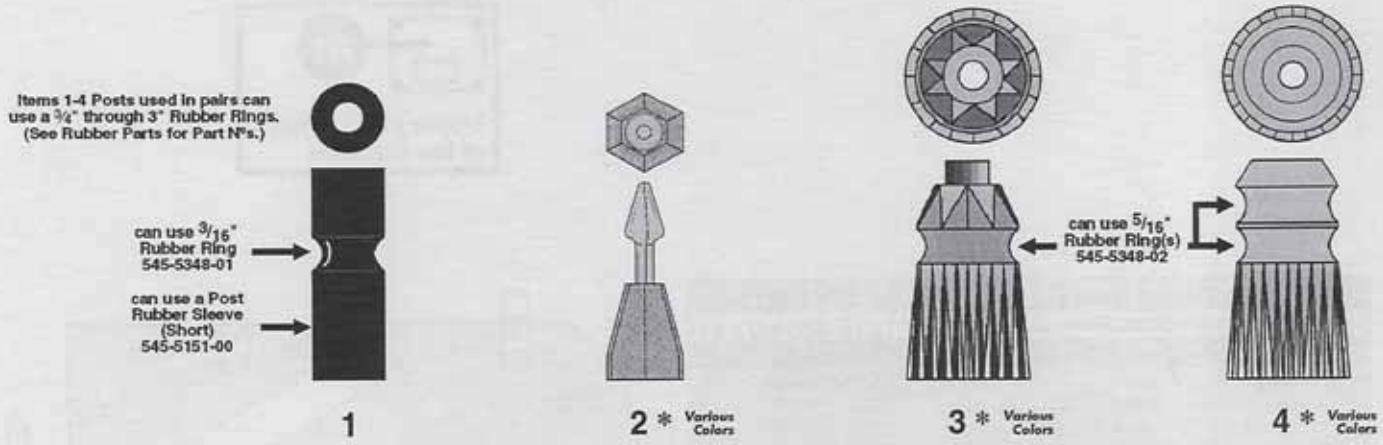
*** Not Shown:** Hex Spacer Items: **35** (3"); **36** (3 5/8"); **37** (4"); **38** (4 5/16")

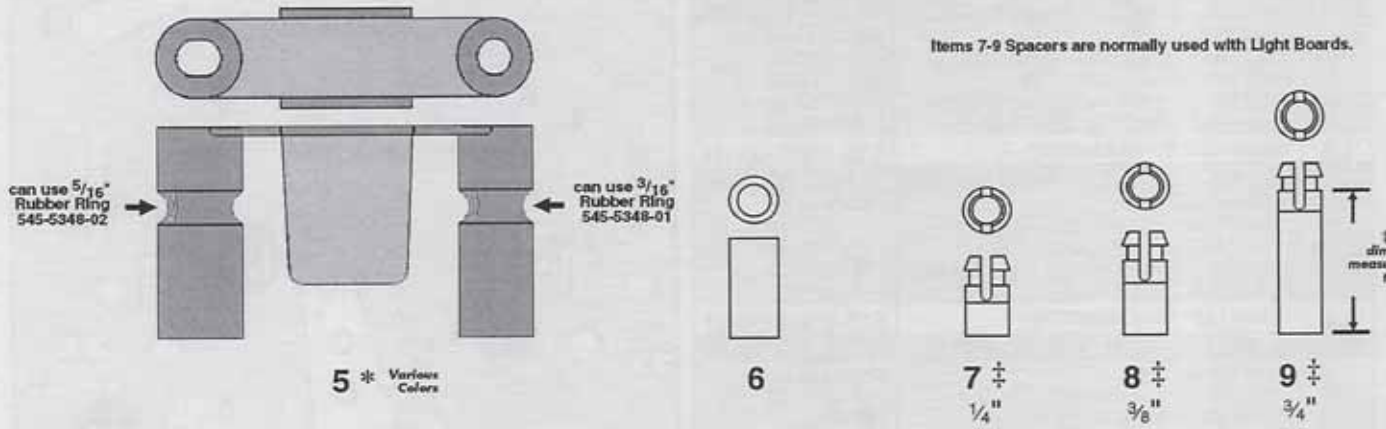
Nº	Metal Post/Spacer Name	QTY.	Part Nº	Nº	Metal Post/Spacer Name	QTY.	Part Nº
1	Spacer Backbox Hinge	2	530-5099-00	19	1/4" #6-32 Hex Spacer Tapped	0	254-5008-00
2	Mini-Post-Wood Threaded	1	530-5004-00	20	1/2" #6-32 Hex Spacer Tapped	5	254-5008-03
3	Mini-Post-Wood Thrd. (no cut-away)	0	530-5004-01	21	5/8" #6-32 Hex Spacer Tapped	8	254-5008-02
4	Mini-Post-Machine Threaded	2	530-5005-00	22	3/4" #6-32 Hex Spacer Tapped	8	254-5008-04
5	Bumper Post -Machine Threaded	0	530-5007-00	23	7/8" #6-32 Hex Spacer Tapped	3	254-5008-05
6	Post Fastening Screw #8-32 Top	3	530-5008-00	24	1" #6-32 Hex Spacer Tapped	0	254-5008-06
7A	Post Machine Screw #6-32 Top	31	530-5012-02	25	1 1/8" #6-32 Hex Spacer Tapped	0	254-5008-17
7B	Post Wood Screw #6-32 Top	6	530-5010-02	26	1 1/4" #6-32 Hex Spacer Tapped	1	254-5008-11
8A	Bumper Post Hex Base #8-32 Tap.	0	530-5332-01	27	1 1/2" #6-32 Hex Spacer Tapped	1	254-5008-09
8B	Bumper Post Hex Base Untapped	4	530-5332-00	28	1 3/4" #6-32 Hex Spacer Tapped	0	254-5008-10
8C	Bumper Post Hex Base w/#8-32 Male	0	530-5332-02	29	1 7/8" #6-32 Hex Spacer Tapped	0	254-5008-20
9	Bumper Post #6-32 Tap.	0	530-5127-00	30	2" #6-32 Hex Spacer Tapped	2	254-5008-07
10	Post Machine Screw	5	530-5263-01	31	2 1/4" #6-32 Hex Spacer Tapped	0	254-5008-18
11	Mini-Playfield Support	0	530-5285-00	32	2 1/2" #6-32 Hex Spacer Tapped	1	254-5008-16
12	Stand-Off Double Groove 1 1/16"	0	530-5102-00	33	2 5/8" #6-32 Hex Spacer Tapped	0	254-5008-08
13	1" X 5/16" X .144" I.D. Spacer Tap.	5	254-5001-00	34	2 3/4" #6-32 Hex Spacer Tapped	0	254-5008-15
14	1/4" X 5/16" X .144" I.D. Spacer Tap.	0	254-5014-03	35 *	3" #6-32 Hex Spacer Tapped	0	254-5008-14
15	1/2" X 5/16" X .144" I.D. Spacer Tap.	0	254-5014-00	36 *	3 5/8" #6-32 Hex Spacer Tapped	1	254-5008-25
16	9/16" X 5/16" X .144" I.D. Spacer Tap.	0	254-5014-04	37 *	4" #6-32 Hex Spacer Tapped	0	254-5008-21
17	5/8" X 5/16" X .144" I.D. Spacer Tap.	0	254-5014-01	38 *	4 5/16" X .144" I.D. Hex Spacer	0	254-5018-00
18	1 1/8" X 5/16" X .144" I.D. Spacer Tap.	0	254-5014-02				

Take Note: An asterisk (•) indicates spacer *Not Shown* due to space.

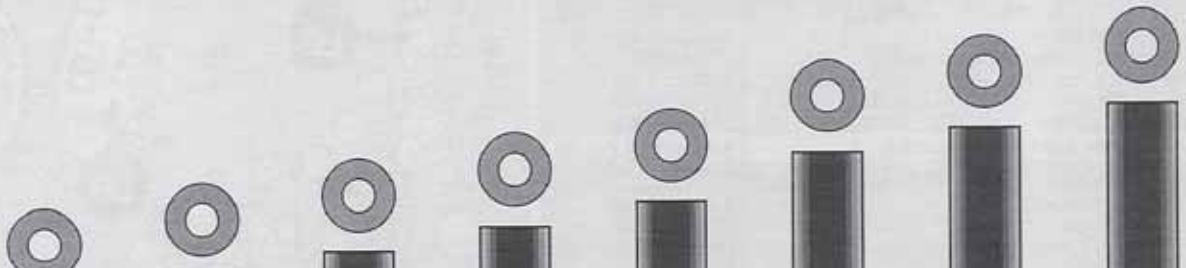
† Items with Ø Qty. are not used in this game. Size and/or quantities may change during production.

Playfield - Plastic Posts and Spacers (Actual Size) †





Items 10-17 Spacers are used in conjuntion with Metal Posts (previous page: Items 6, 7A & 7B) and/or a #6-32 1¾" PPH Screw (237-5511-00) with a #6 Stop Nut (240-5005-00).



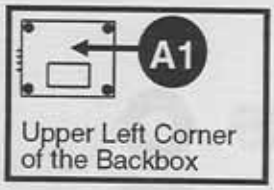
* Items 2, 3 & 4 (Jewel Posts) and Item 5 (Light Hood) come in various colors, see the Plastic Part Color Chart at the end of Sec. 4, Chp. 2. Replace the last 2-digits (or -XX) with desired color replacement (some colors may not be available).
‡ Items 7, 8 & 9 (Light Board Spacers) dimensions are measured from bottom to just under cut-away (see pictorials above).

Nº	Plastic Post/Spacer Name	QTY.	Part Nº	Nº	Plastic Post/Spacer Name	QTY.	Part Nº
1	1 1/16" Stand-Off *Single* Groove Post	55	550-5059-00	10	1/4" X 3/8" Spacer Gray	1	254-5000-02
2 *	Mini-Jewel Post	0	550-5052-XX	11	3/8" X 3/8" Spacer Gray	6	254-5000-12
3 *	*Single* Groove Jewel Post Clear	1	550-5034-01	12	1/2" X 3/8" Spacer Gray	0	254-5000-01
4 *	*Double* Groove Jewel Post	0	545-5209-XX	13	5/8" X 3/8" Spacer Gray	0	254-5000-14
5 *	Top Lane Mini-Light Hood Red	4	550-5061-02	14	3/4" X 3/8" Spacer Gray	3	254-5000-07
6	1/2" X 3/8" Spacer Narrow White	0	254-5000-03	15	1" X 3/8" Spacer Gray	2	254-5000-04
7 ‡	1/4" Slf. Rtn. Spacer White	0	254-5007-02	16	1 1/8" X 3/8" Spacer Gray	1	254-5000-06
8 ‡	3/8" Slf. Rtn. Spacer White	31	254-5007-01	17	1 1/4" X 3/8" Spacer Gray	0	254-5000-05
9 ‡	3/4" Slf. Rtn. Spacer White	0	254-5007-03				

Take Note: See the (*) and (‡) notes above this table.

† Items with Ø Qty. are not used in this game. Size and/or quantities may change during production.

Playfield - Light, Magnet Processor (X2)/Driver & Aux. Relay Boards †

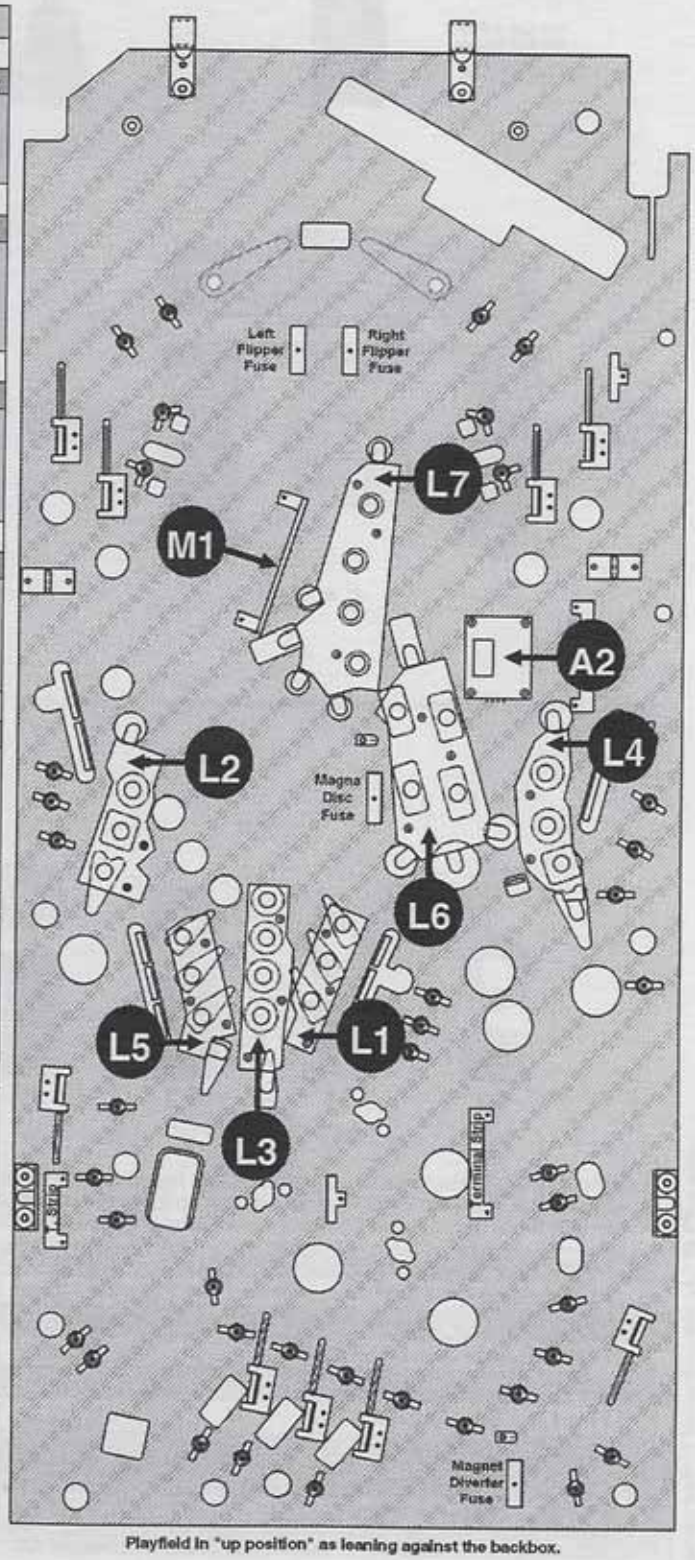


Nº	Light Board Name	SPI Part Nº
L1	Twister Light Board Assembly - 1	515-6368-01-41
ORDERING ABOVE (ITEM L1) ASSEMBLY PART Nº WILL INCLUDE:		
—	**Light Board -01**	**520-5145-01**
—	#555 Wedge Base Socket (Qty. 3)	077-5007-00
—	#555 Wedge Base Bulb (Qty. 3)	165-5002-00
—	Spacer 3/8" Plastic Slf. Rtn. (Qty. 3)	254-5007-01
L2	Twister Light Board Assembly - 2	515-6368-02-41
ORDERING ABOVE (ITEM L2) ASSEMBLY PART Nº WILL INCLUDE:		
—	**Light Board -02**	**520-5145-02**
—	#555 Wedge Base Socket (Qty. 3)	077-5007-00
—	#555 Wedge Base Bulb (Qty. 4)	165-5002-00
—	Light Bd. Laydown Wedge Base Socket	077-5207-00
—	Spacer 3/8" Plastic Slf. Rtn. (Qty. 3)	254-5007-01
L3	Twister Light Board Assembly - 3	515-6368-03-41
ORDERING ABOVE (ITEM L3) ASSEMBLY PART Nº WILL INCLUDE:		
—	**Light Board -03**	**520-5145-03**
—	#555 Wedge Base Socket (Qty. 4)	077-5007-00
—	#555 Wedge Base Bulb (Qty. 5)	165-5002-00
—	Light Bd. Laydown Wedge Base Socket	077-5207-00
—	Spacer 3/8" Plastic Slf. Rtn. (Qty. 3)	254-5007-01
L4	Twister Light Board Assembly - 4	515-6368-04-41
ORDERING ABOVE (ITEM L4) ASSEMBLY PART Nº WILL INCLUDE:		
—	**Light Board -04**	**520-5145-04**
—	#555 Wedge Base Socket (Qty. 3)	077-5007-00
—	#555 Wedge Base Bulb (Qty. 5)	165-5002-00
—	Light Bd. Laydn. Wdg. Bs. Sckt. (Qty. 2)	077-5207-00
—	Spacer 3/8" Plastic Slf. Rtn. (Qty. 3)	254-5007-01
L5	Twister Light Board Assembly - 5	515-6368-05-41
ORDERING ABOVE (ITEM L5) ASSEMBLY PART Nº WILL INCLUDE:		
—	**Light Board -05**	**520-5145-05**
—	#555 Wedge Base Socket (Qty. 3)	077-5007-00
—	#555 Wedge Base Bulb (Qty. 4)	165-5002-00
—	Light Bd. Laydown Wedge Base Socket	077-5207-00
—	Spacer 3/8" Plastic Slf. Rtn. (Qty. 3)	254-5007-01
L6	Twister Light Board Assembly - 6	515-6368-06-41
ORDERING ABOVE (ITEM L6) ASSEMBLY PART Nº WILL INCLUDE:		
—	**Light Board -06**	**520-5145-06**
—	#555 Wedge Base Socket (Qty. 4)	077-5007-00
—	#555 Wedge Base Bulb (Qty. 8)	165-5002-00
—	Light Bd. Laydn. Wdg. Bs. Sckt. (Qty. 4)	077-5207-00
—	Spacer 3/8" Plastic Slf. Rtn. (Qty. 3)	254-5007-01
L7	Twister Light Board Assembly - 7	515-6368-07-41
ORDERING ABOVE (ITEM L7) ASSEMBLY PART Nº WILL INCLUDE:		
—	**Light Board -07**	**520-5145-07**
—	#555 Wedge Base Socket (Qty. 4)	077-5007-00
—	#555 Wedge Base Bulb (Qty. 9)	165-5002-00
—	Light Bd. Laydn. Wdg. Bs. Sckt. (Qty. 5)	077-5207-00
—	Spacer 3/8" Plastic Slf. Rtn. (Qty. 3)	254-5007-01

Take Note:

1. Individual Light Boards can only be ordered as assemblies.
2. Sockets, bulbs & spacers may be ordered separately.
3. For pictorials of Sockets, Bulbs & Spacers, view pages before and after this page.

Nº	Miscellaneous Board Name	SPI Part Nº
M1	Magnet Processor (X2) / Driver Board	520-5143-00
A1	Aux. Relay Board (in Backbox for Fan)	520-5010-00
A2	Aux. Relay Board (under P/F for Disc)	520-5010-00



Playfield in "up position" as leaning against the backbox.

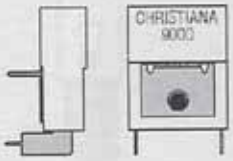
Playfield - Wedge Base Bulbs, Sockets and Misc. Bulbs (Actual Size) †

A
#555

1
This socket is normally used on Light Boards to position bulbs vertically. (Use w/#555 & #906 Bulbs.)

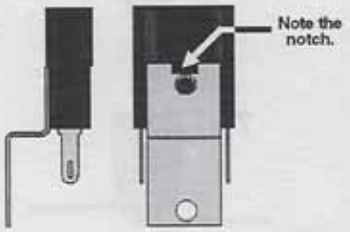
2
This socket is normally used in Pop Bumpers. (Use #555 Bulbs only.)

3
This socket is normally used on Light Boards to position bulbs horizontally. (Use w/#555 & #906 Bulbs.)

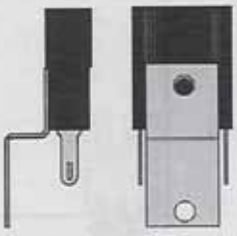


Replacement Note: Socket color may be either black or white.

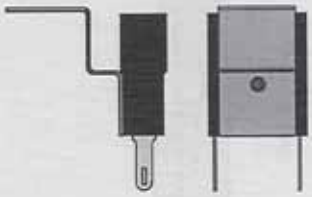
4
This socket is normally used with Reflectors.



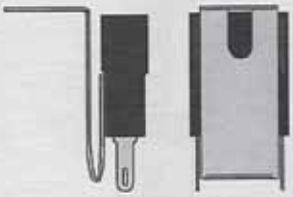
5



6



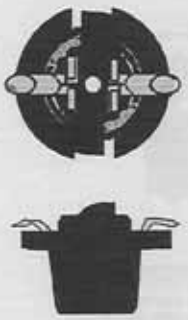
7



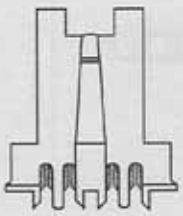
Replacement Note: If this style socket is desired, order Item 6 for replacement. This socket is not available.

B
#906

8
This socket is sometimes used in conjunction with Mini-Mars or special Butyrate assemblies.



9
This socket was used with an alternate insert using Insulation Displacement Connection vs. a Soldered-On Connection.



C
Neon

This Neon Bulb is used with Motors for voltage spike suppression.

D
OPTO LED

This OPTO LED (Ultra Bright Red) is used on OPTO Boards only.

Nº	#555 Bulb & Socket Name	QTY.	Part Nº
A	#555 Wedge Base Bulb	48	165-5002-00
1	#555 Wedge Base (WB) Socket	24	077-5007-00
2	Turbo Pop Bumper Socket	3	077-5206-00
3	Light Board Laydown WB Socket	14	077-5207-00
4	Laydown WB Socket (with notch)	2	077-5026-01
5	Laydown WB Socket (without notch)	0	077-5026-00
6	WB Offset Socket (Step-Bracket)	5	077-5029-00
7	WB Offset Socket (use Item 6)	0	077-5029-01

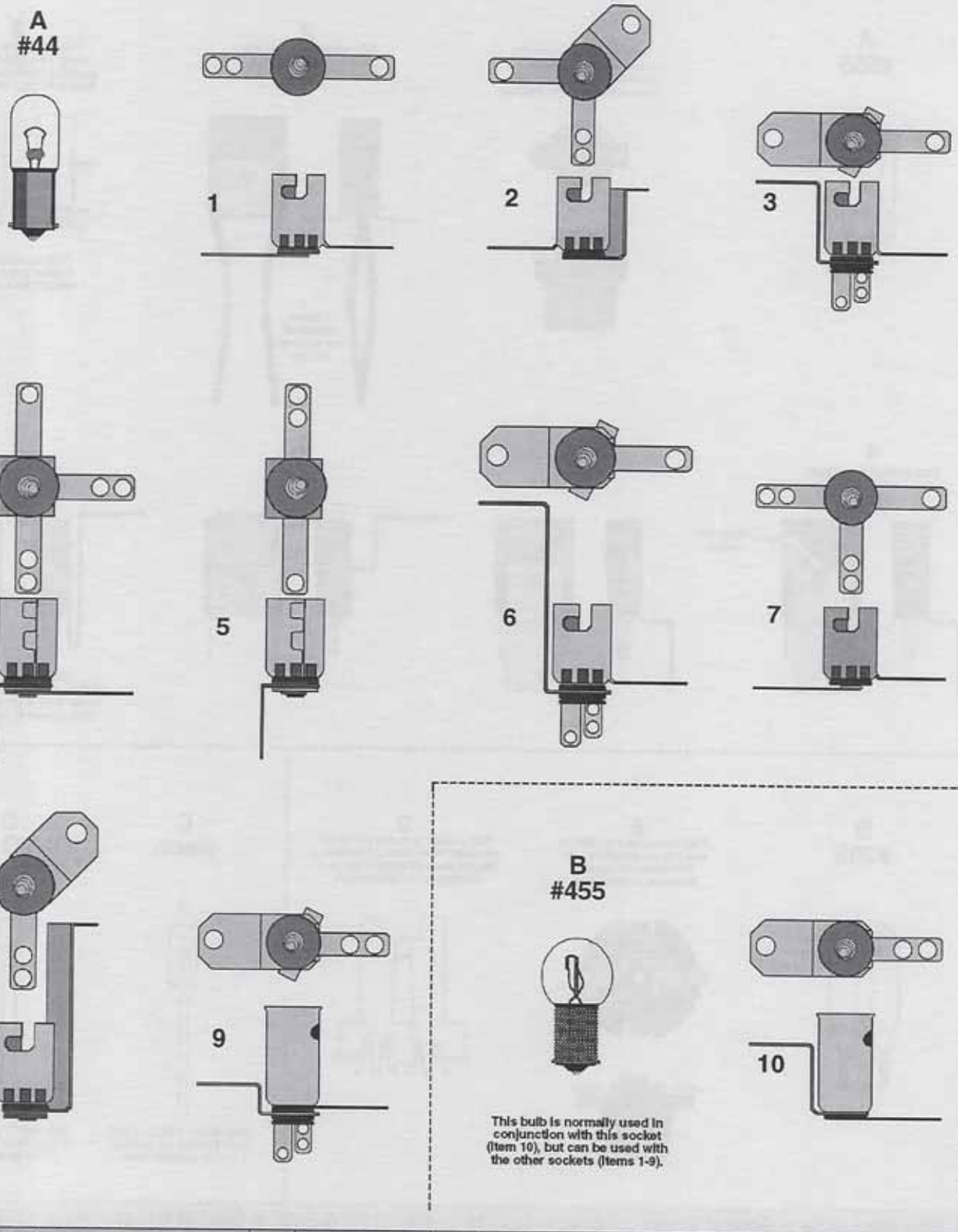
Nº	#906 Bulb & Socket Name	QTY.	Part Nº
B	#906 Wedge Base Bulb	0	165-5004-00
8	#906 Wedge Base Socket	0	077-5016-00
9	#555/#906 IDC Wedge Base Socket	0	077-5110-00

Nº	Miscellaneous Bulb Name	QTY.	Part Nº
C	Neon NE-2 Bulb (used with Motors)	2	165-5021-00
D	LED (MT5000UR) Ultra Bright OPTO	2	165-5100-00

See start of this chapter for Fluor. Bulb & assoc. parts.

† Items with Ø Qty. are not used in this game. Size and/or quantities may change during production.

Playfield - Small Bayonet Type Bulb and Sockets (Actual Size) †



This bulb is normally used in conjunction with this socket (Item 10), but can be used with the other sockets (Items 1-9).

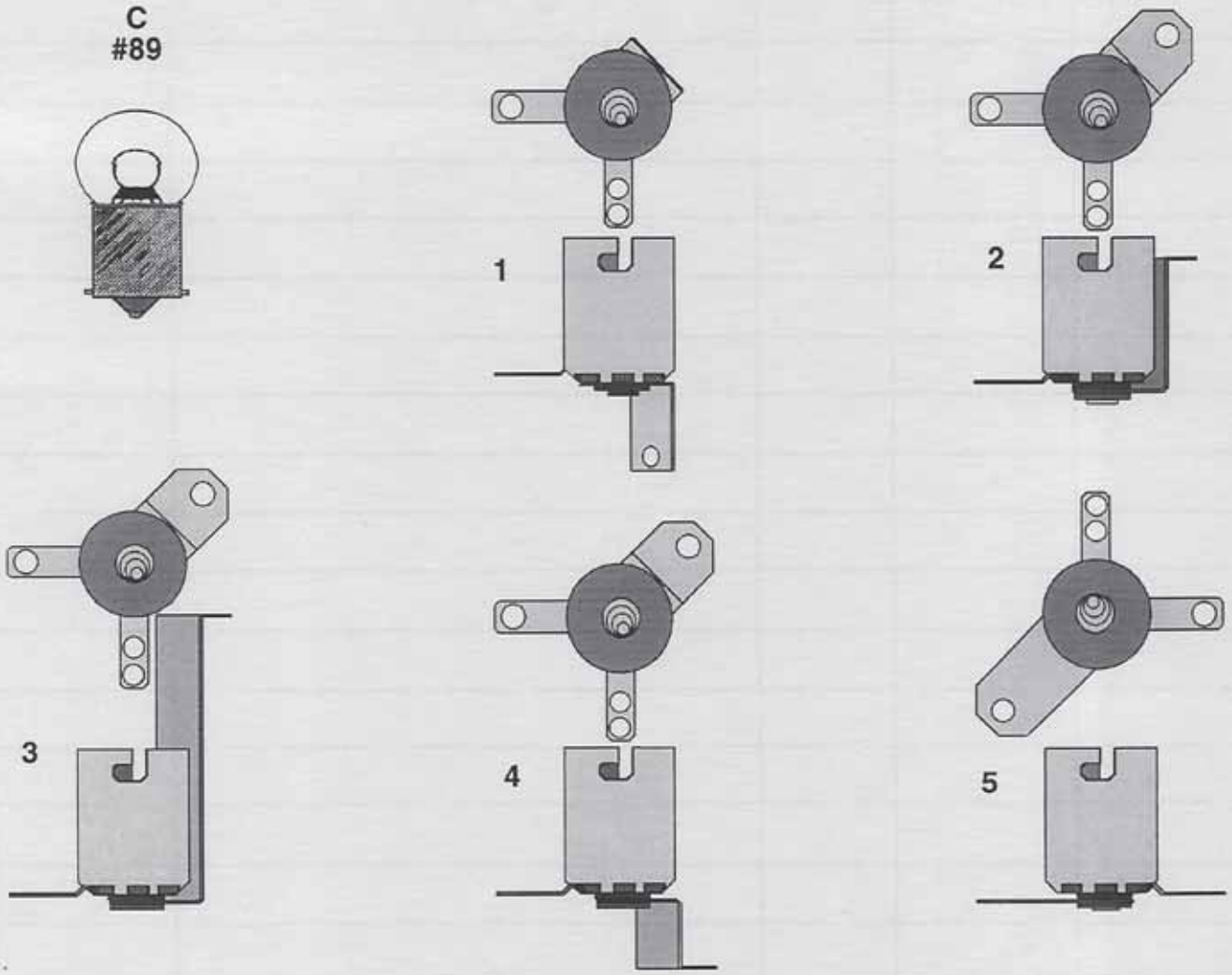
Nº	#44 Bulb & Socket Name	QTY.	Part Nº
A	#44 Bulb	49	165-5000-44
1	2-Lug Staple Down Socket	38	077-5000-00
2	2-Lug Stand-Up Short Socket	0	077-5002-00
3	3-Lug Stand-Up Short Socket	0	077-5008-00
4	3-Lug Laydown Socket	1	077-5006-00
5	2-Lug Laydown Socket	0	077-5003-00
6	3-Lug Stand-Up Long Socket	10	077-5009-00

Nº	#44 Socket Name	QTY.	Part Nº
7	3-Lug Staple Down Socket	0	077-5001-00
8	2-Lug Stand-Up Long Socket	0	077-5005-00
9	3-Lug Stand-Up Long Shell Socket	0	077-5013-00

Nº	#455 Bulb & Socket Name	QTY.	Part Nº
B	#455 Twinkle Bulb	0	165-5003-00
10	1-Lug Stand-Up Long Shell Socket	0	077-5012-00

† Items with Ø Qty. are not used in this game. Size and/or quantities may change during production.

Playfield - Large Bayonet Type Bulb and Sockets (Actual Size) †



† Items with Ø Qty. are not used in this game. Size and/or quantities may change during production.

Take Note:

1. Item C, #89 Bulb, in this game are used only as Flash Lamps.
2. Item 2, 2-Lug Stand-Up Short Socket, in this game are used with the Mini-Mars.
3. Item 3, 2-Lug Stand-Up Long Socket, in this game are used under the Playfield.

Nº	#89 Bulb & Socket Name	QTY.	Part Nº	Nº	#89 Socket Name	QTY.	Part Nº
C	#89 Bulb	18	165-5000-89	3	2-Lug Stand-Up Long Socket	10	077-5102-00
1	Laydown Standard Socket	0	077-5100-00	4	Stand-Up Socket Rev. Short	0	077-5103-00
2	2-Lug Stand-Up Short Socket	8	077-5101-00	5	Straight Leg Socket	0	077-5107-00

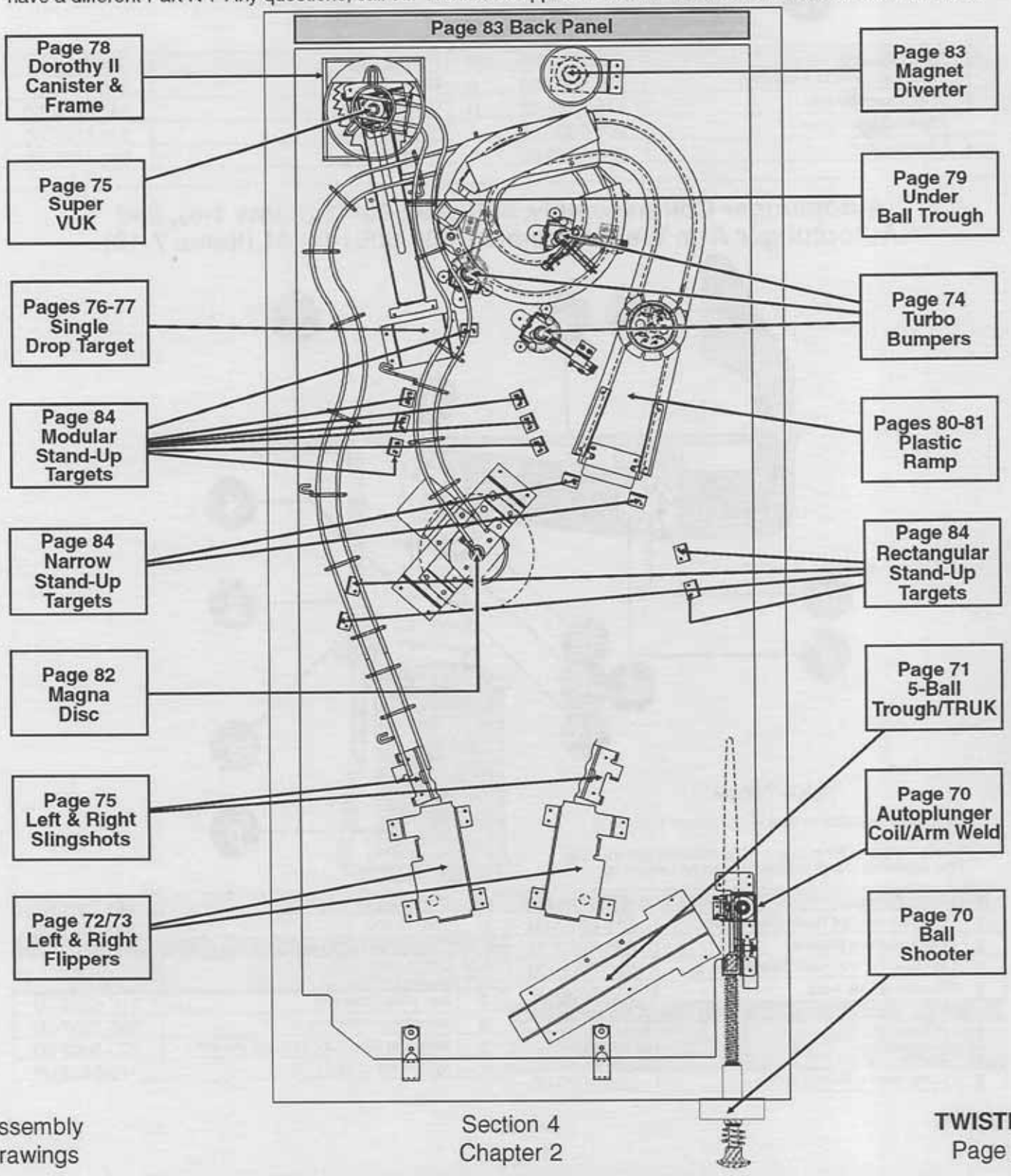
Parts Order Checklist Notes

Date Ordered	Part №	Qty.	Description	Date Received

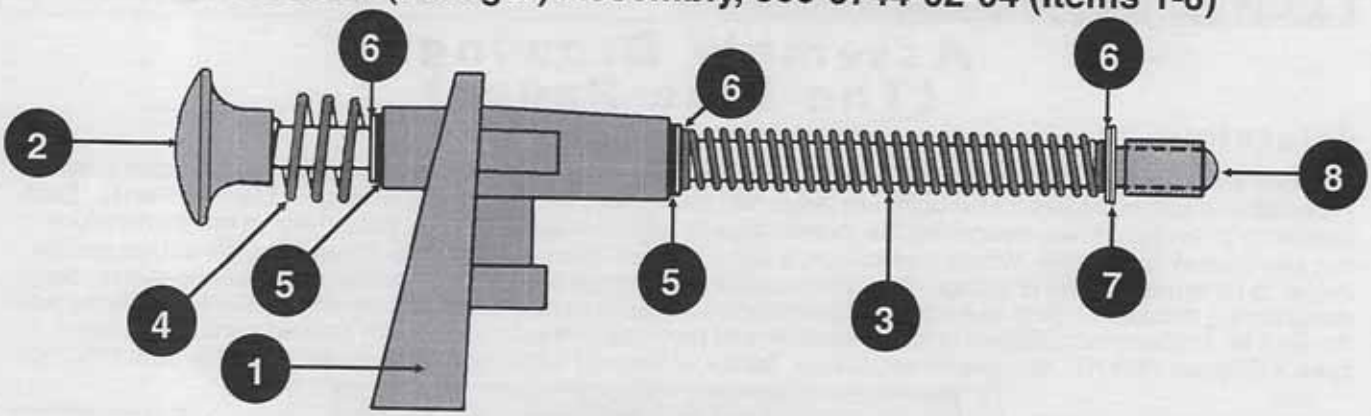
Assembly Drawings (The Blue Pages)

Overview

This chapter expands Chapter 1 of this section (The Pink Pages). The Part Numbers for all Major Assemblies are provided and can be ordered as a complete assembly (exception: Turbo Bumper & Magnet Diverter Parts). Each assembly is broken down, describing the individual parts and/or sub-assemblies (with the part numbers) which can be ordered separately. Where multiple parts are riveted or assembled as sub-assemblies the sub-assembly needs to be ordered. The drawings show the location of the individual parts. Note that minor changes may be made during production (e.g. coil size, addition/deletion of minor parts). Always verify the part to be replaced with the Part Nº and/or description as noted. Replacement parts may be substituted with revised parts which may have a different Part Nº. Any questions, call our Technical Support 1-800-542-5377 USA/Canada or 708-345-7700.

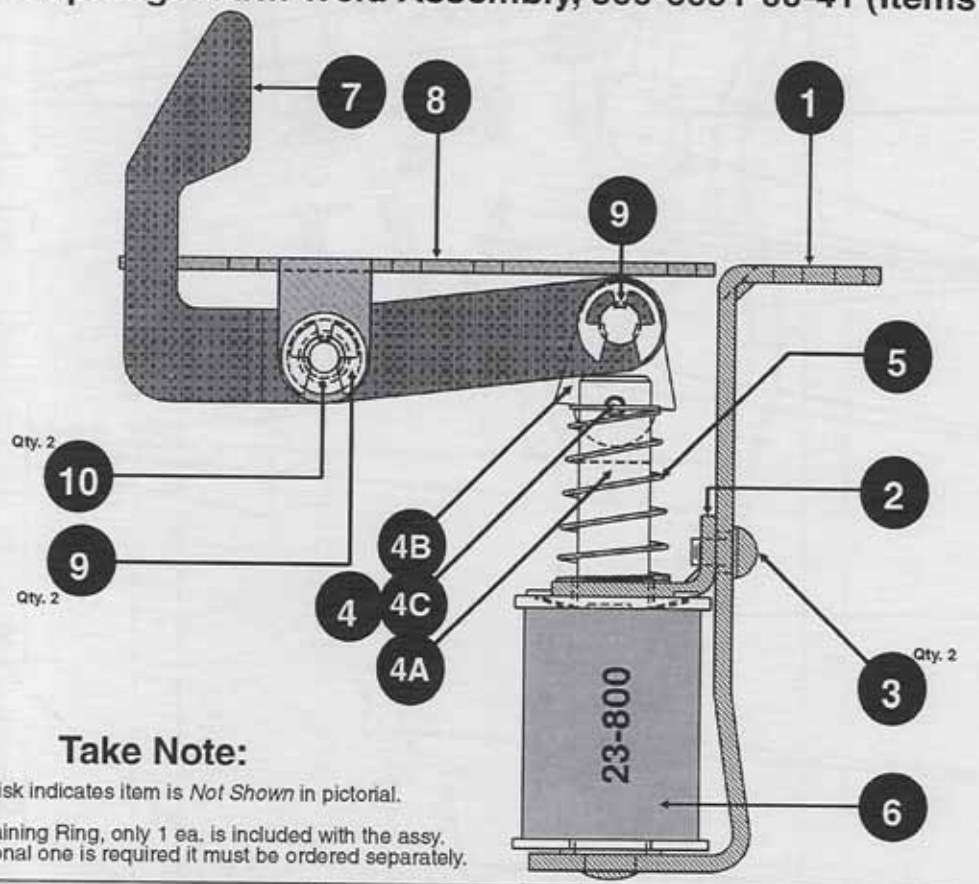


Ball Shooter (Plunger) Assembly, 500-5744-02-04 (Items 1-8)



Nº	Part Name	SPI Part Nº	Nº	Part Name	SPI Part Nº
1	Housing (Shooter Assembly)	535-5067-00	5	Busing (Qty. 2)	280-5010-00
2	Rod Assembly Red	515-5924-02	6	Washer (Qty. 3)	242-5014-00
3	Spring Large Green	266-5001-04	7	Retaining Ring	270-5012-00
4	Spring Small	266-5010-00	8	Plunger Tip	545-5276-00

Autoplunger Coil Assembly, 500-6092-00-41 (Items 1-6), and Autoplunger Arm Weld Assembly, 500-6091-00-41 (Items 7-10)



Take Note:

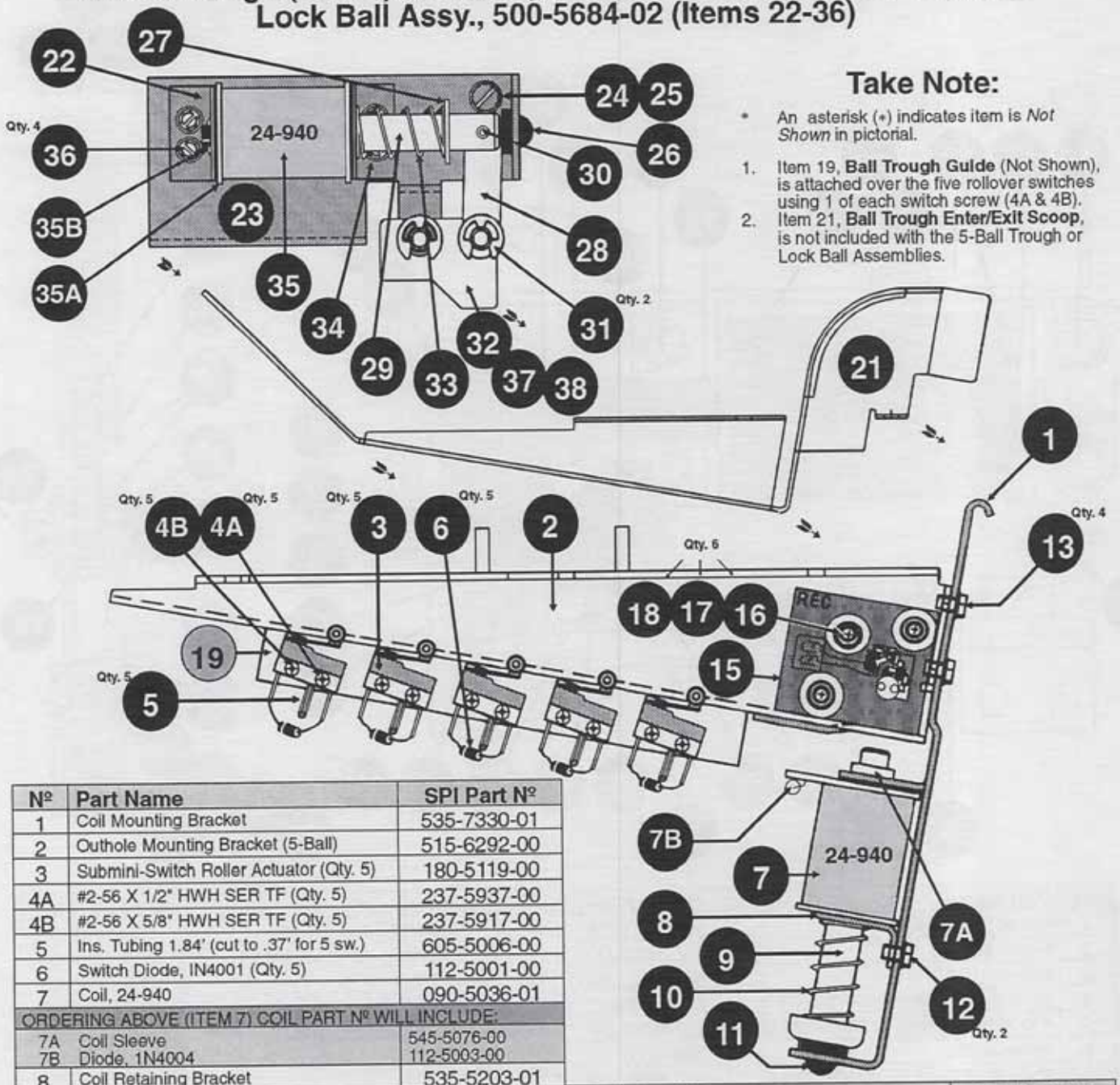
* An (*) asterisk indicates item is *Not Shown* in pictorial.

1. Item 9, Retaining Ring, only 1 ea. is included with the assy. If the additional one is required it must be ordered separately.

Nº	Part Name	SPI Part Nº
1	Autoplunger Coil Bracket Assembly	515-6527-00
2	Coil Retaining Bracket	535-5203-03
3	#8-32 X 1/4" PR HWS SEMS (Qty. 2)	232-5300-00
4	Plunger & Link Assy.	515-5338-00
ORDERING ABOVE (ITEM 4) ASSEMBLY PART Nº WILL INCLUDE:		
4A	Plunger (2")	530-5025-01
4B	Plunger Link	545-5293-00
4C	Roll Pin 1/8"	251-5008-00
5	Compression Return Spring	266-5020-00

Nº	Part Name	SPI Part Nº
6	Coil, 23-800	090-5001-02
ORDERING ABOVE (ITEM 6) COIL PART Nº WILL INCLUDE:		
6A*	Coil Sleeve	545-5031-00
6B*	Diode, 1N4004	112-5003-00
7	Arm Weld Assembly	515-6526-00
8	Autoplunger Fulcrum	535-7697-00
9	Retaining Ring (Qty. 2) (1 ea. not incl.)	270-5002-00
10	Nyliner 1/4" (Qty. 2)	545-5423-00

5-Ball Trough (OPTO) Assembly, 500-5989-15-XX (Items 1-20), and Lock Ball Assy., 500-5684-02 (Items 22-36)



Take Note:

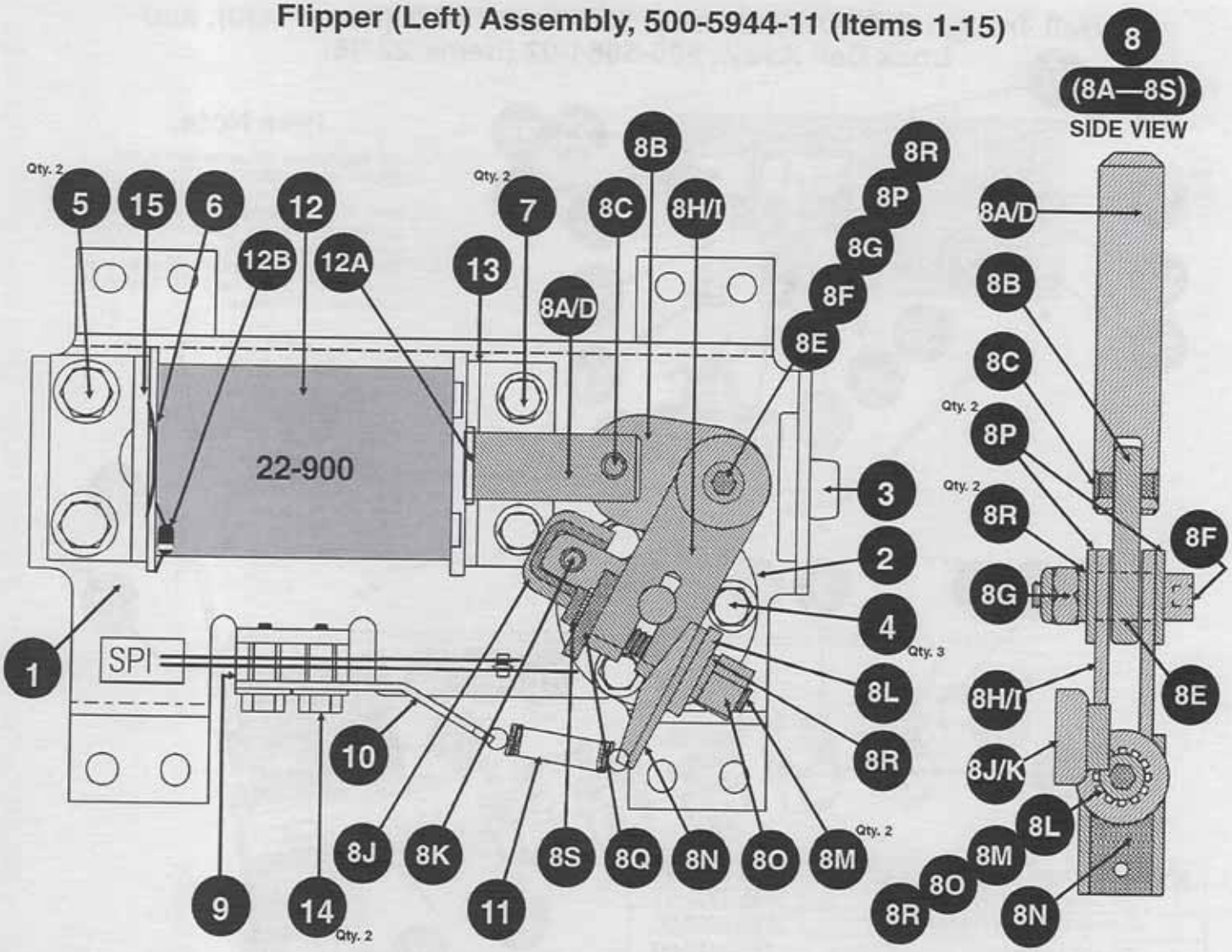
* An asterisk (*) indicates item is *Not Shown* in pictorial.

1. Item 19, **Ball Trough Guide** (Not Shown), is attached over the five rollover switches using 1 of each switch screw (4A & 4B).
2. Item 21, **Ball Trough Enter/Exit Scoop**, is not included with the 5-Ball Trough or Lock Ball Assemblies.

Nº	Part Name	SPI Part Nº
1	Coil Mounting Bracket	535-7330-01
2	Outhole Mounting Bracket (5-Ball)	515-6292-00
3	Submini-Switch Roller Actuator (Qty. 5)	180-5119-00
4A	#2-56 X 1/2" HWH SER TF (Qty. 5)	237-5937-00
4B	#2-56 X 5/8" HWH SER TF (Qty. 5)	237-5917-00
5	Ins. Tubing 1.84' (cut to .37' for 5 sw.)	605-5006-00
6	Switch Diode, IN4001 (Qty. 5)	112-5001-00
7	Coil, 24-940	090-5036-01
ORDERING ABOVE (ITEM 7) COIL PART Nº WILL INCLUDE:		
7A	Coil Sleeve	545-5076-00
7B	Diode, 1N4004	112-5003-00
8	Coil Retaining Bracket	535-5203-01
9	Plunger Assembly	515-5941-01
10	Compression Spring	266-5020-00
11	Rubber Bumper (Grommet)	545-5105-00
12	#8-32 X 3/8" HWH SER TF (Qty. 2)	237-5903-00
13	#8-32 X 3/8" HWH SWAGE (Qty. 4)	237-5964-00
14	OPTO Transmitter (TRANS) Board	520-5124-00
15	OPTO Receiver (REC) Board	520-5125-00
16	OPTO PCB Tube Spacer (Qty. 6)	530-5308-02
17	OPTO PCB Rubber Grommet (Qty. 6)	545-5518-00
18	#6-32 X 5/8" HWH SWAGE (Qty. 6)	237-5976-04
19 *	Trough Ball Guide	535-7725-00
20 *	Ball Trough Wiring Harness/Cable	036-5399-05-41
21	Ball Trough Enter/Exit Scoop	535-7329-01
22	Plunger/Core Stop Assembly	515-5088-00
23	Lock Ball Bracket Assembly	515-5817-01
24	3/4" X 3/8" Spacer Gray	254-5000-07
25	#8-32 PPH X 1" LG	232-5606-00

Nº	Part Name	SPI Part Nº
26	Rubber Bumper (Grommet)	545-5105-00
27	Retaining Ring 7/16" ø Shaft	270-5005-00
28	Link, Lock Ball (Stainless Steel)	535-6649-00
29	Plunger ø 7/16" X 2.25" Lg.	530-5250-01
30	Roll Pin 1/8"	251-5008-00
31	Retaining Ring, 1/4" ø (Qty. 2)	270-5002-00
32	Lock Ball Cam Assy. (Stainless Steel)	515-5815-02
33	Compression Spring	266-5000-00
34	Coil Retaining/Support Bracket	535-6658-00
35	Coil, 24-940	090-5036-00
ORDERING ABOVE (ITEM 35) COIL PART Nº WILL INCLUDE:		
35A	Coil Sleeve	545-5031-00
35B	Diode, 1N4004	112-5003-00
36	#6-32 X 3/8" HWH SWAGE (Qty. 4)	237-5976-02
37	Washer 1/4" ID X 1/2" OD X 1/16" THK	242-5008-00
38	Washer 1/4" ID X 7/16" OD X 1/32" THK	242-5012-00

Flipper (Left) Assembly, 500-5944-11 (Items 1-15)



№	Part Name	SPI Part №
1	Flipper Base (Left)	535-7275-01
2	Flipper Bushing	545-5594-00
3	Deflector Pad (Bumper)	545-5428-00
4	#6-32 X .38" HWH TF SWAGE (Qty.3)	237-5976-02
5	#10-32 X .38" HWH TF SERR (Qty. 2)	237-5961-00
6	Spring Washer	269-5002-00
7	#8-32 X .38 HWH TF SWAGE (Qty. 2)	237-5975-00
8	Plunger, Link & Pawl (Left) Sub-Assy.	515-6518-01
ORDERING ABOVE (ITEM 8) SUB-ASSY. PART № WILL INCLUDE:		
8A	Flipper Plunger/Link Assembly (ordering 8A includes 8B-8D)	515-6304-01
8B	Flipper Link	545-5611-00
8C	Spirol Pin ø.156" X 1/2" Lg.	251-5015-00
8D	Flipper Plunger with Flat	530-5349-01
8E	Extended Flipper Bushing	530-5139-01
8F	#10-32 X 7/8" Lg. SOC HD	237-5966-00
8G	#10-32 Nylon Stop Nut	240-5203-00
8H	Pawl (Mounting Link) (Left) Sub-Assy.	515-6305-01
8I	Pawl (Mounting Link) (Left) *Plain*	535-7271-01
8J	Switch Actuator	545-5612-00
8K	Rivet 1/8" ø X 1/4" Lg.	249-5003-00
8L	Washer .105" THK .203" I.D. X .63" O.D.	242-5039-00
8M	#10-32 SOC HD X 1.25" Lg. (Qty. 2)	237-5950-01
8N	Return Bracket	535-7353-00
8O	#10-32 X 9/32" Long 3/8" Hex Nut	240-5209-00
8P	Wshr. .06" THK (same I.D./O.D.) (Qty. 2)	242-5038-00
8Q	Washer .105" THK .203" I.D. X .63" O.D.	242-5039-01
8R	#10-32 Split Lock Washer (Qty. 2)	244-5003-00
8S	#10 Star Washer	246-5002-00

№	Part Name	SPI Part №
9	Power (End of Stroke) Switch	180-5149-00
10	Switch Plate/Spring Return Bracket	535-7354-00
11	Flipper Return Spring	265-5035-00
12	Coil 22-900 (YEL)	090-5020-20
ORDERING ABOVE (ITEM 12) COIL PART № WILL INCLUDE:		
12A	Coil Sleeve	545-5388-00
12B	Coil Diode, 1N4004	112-5003-00
13	Coil Support Bracket	535-7356-00
14	#6-32 X .63" HWH SWAGE (Qty.2)	237-5976-00
15	Coil Stop Sub-Assembly	515-6308-01
ORDERING ABOVE (ITEM 15) SUB-ASSY. PART № WILL INCLUDE:		
—	Coil Stop with with .093" ø Hole	530-5350-01
—	Shading Ring	530-5123-00
—	Coil Stop Bracket	535-7355-00

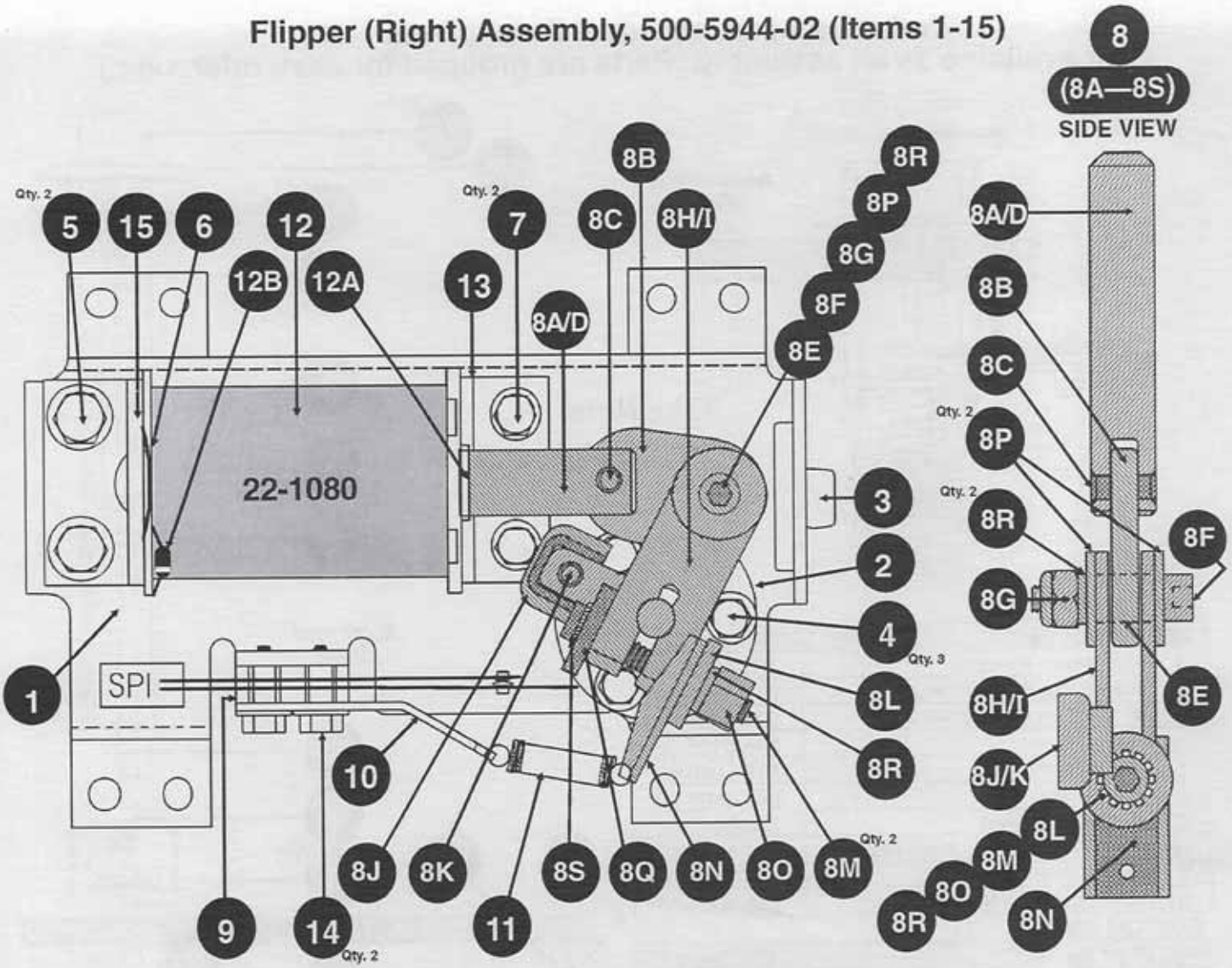
Take Note:

1. ***IMPORTANT:*** When replacing Item 8B, Flipper Link, we advise replacing with entire Item 8A, Flipper Plunger/ Link Assembly due to overall wear & tear.
2. ‡‡‡ Check all other components and replace as required. ‡‡‡

ASSOCIATED PART(S) NOT INCLUDED WITH THE ABOVE ASSEMBLY

№	Associated Part Name	SPI Part №
n/a	Flipper & Shaft Assy. White with Sega Saturn™ Logo ©1996	515-5133-08-05

Flipper (Right) Assembly, 500-5944-02 (Items 1-15)



Nº	Part Name	SPI Part Nº
1	Flipper Base (Right)	535-7275-00
2	Flipper Bushing	545-5594-00
3	Deflector Pad (Bumper)	545-5428-00
4	#6-32 X .38" HWH TF SWAGE (Qty.3)	237-5976-02
5	#10-32 X .38" HWH TF SERR (Qty. 2)	237-5961-00
6	Spring Washer	269-5002-00
7	#8-32 X .38 HWH TF SWAGE (Qty. 2)	237-5975-00
8	Plunger, Link & Pawl (Right) Sub-Assy.	515-6518-00
ORDERING ABOVE (ITEM 8) SUB-ASSY. PART Nº WILL INCLUDE:		
8A	Flipper Plunger/Link Assembly (ordering 8A includes 8B-8D)	515-6304-01
8B	Flipper Link	545-5611-00
8C	Spirol Pin ø.156 X 1/2" Lg.	251-5015-00
8D	Flipper Plunger with Flat	530-5349-01
8E	Extended Flipper Bushing	530-5139-01
8F	#10-32 X 7/8" Lg. SOC HD	237-5966-00
8G	#10-32 Nylon Stop Nut	240-5203-00
8H	Pawl (Mounting Link) (Right) Sub-Assy.	515-6305-00
8I	Pawl (Mounting Link) (Right) Plain	535-7271-00
8J	Switch Actuator	545-5612-00
8K	Rivet 1/8" ø X 1/4" Lg.	249-5003-00
8L	Washer .105" THK .203" I.D. X .63" O.D.	242-5039-00
8M	#10-32 SOC HD X 1.25" Lg. (Qty. 2)	237-5950-01
8N	Return Bracket	535-7353-00
8O	#10-32 X 9/32" Long 3/8" Hex Nut	240-5209-00
8P	Wshr. .06" THK (same I.D./O.D.) (Qty. 2)	242-5038-00
8Q	Washer .105" THK .203" I.D. X .63" O.D.	242-5039-01
8R	#10-32 Split Lock Washer (Qty. 2)	244-5003-00
8S	#10 Star Washer	246-5002-00

Nº	Part Name	SPI Part Nº
9	Power (End of Stroke) Switch	180-5149-00
10	Switch Plate/Spring Return Bracket	535-7354-00
11	Flipper Return Spring	265-5035-00
12	Coil 22-1080 (YEL-GRN)	090-5032-00
ORDERING ABOVE (ITEM 12) COIL PART Nº WILL INCLUDE:		
12A	Coil Sleeve	545-5388-00
12B	Coil Diode, 1N4004	112-5003-00
13	Coil Support Bracket	535-7356-00
14	#6-32 X .63" HWH SWAGE (Qty.2)	237-5976-00
15	Coil Stop Sub-Assembly	515-6308-01
ORDERING ABOVE (ITEM 15) SUB-ASSY. PART Nº WILL INCLUDE:		
—	Coil Stop with .093" ø Hole	530-5350-01
—	Shading Ring	530-5123-00
—	Coil Stop Bracket	535-7355-00

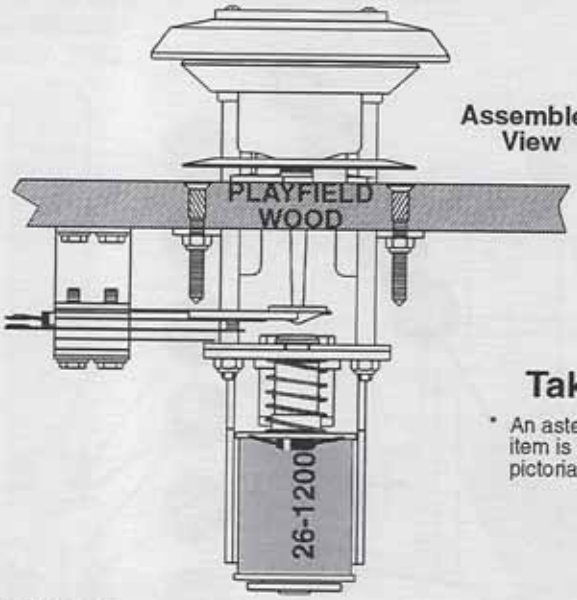
Take Note:

1. ***IMPORTANT:*** When replacing Item 8B, Flipper Link, we advise replacing with entire Item 8A, Flipper Plunger/ Link Assembly due to overall wear & tear.
2. ‡‡‡ Check all other components and replace as required. ‡‡‡

ASSOCIATED PART(S) NOT INCLUDED WITH THE ABOVE ASSEMBLY

Nº	Associated Part Name	SPI Part Nº
n/a	Flipper & Shaft Assy. White with Sega Saturn™ Logo ©1996	515-5133-08-05

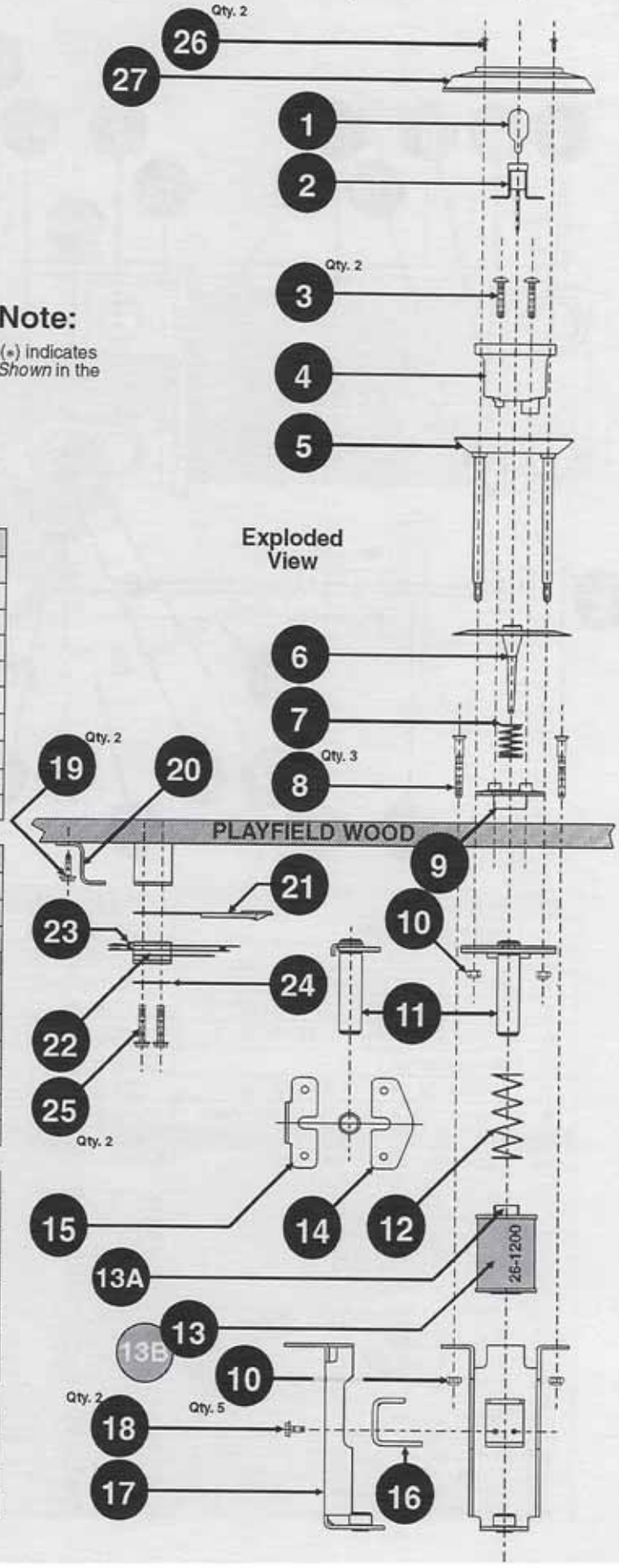
Turbo Bumper Individual Parts (Items 1-28)
(Not available as an assembly. Parts are grouped for easy reference.)



Assembled View

Take Note:

* An asterisk (*) indicates item is *Not Shown* in the pictorial.



Exploded View

TOP GROUP

Nº	Part Name	SPI Part Nº
1	#555 Wedge Base Bulb	165-5002-00
2	#555 Wedge Base Socket	077-5206-00
3	#5 X 7/8" PH RH (AB) (Qty. 2)	237-5826-00
4	Bumper Body	545-5197-00
5	Ring Assembly	515-5085-00
6	Bumper Skirt	545-5607-00
7	Bumper Skirt Spring	266-5048-00
8	#6-32 X 1-3/16" Spiral Shank (Qty. 3)	237-5957-00
9	Bumper Base	545-5195-00
10	#6-32 Nylon Stop Nut (Qty. 5)	240-5005-00

BOTTOM GROUP

Nº	Part Name	SPI Part Nº
11	Plunger	530-5348-00
12	Coil Spring	266-5047-00
13	Coil 26-1200	090-5044-00
ORDERING ABOVE (ITEM 13) COIL PART Nº WILL INCLUDE:		
13A	Coil Sleeve	545-5031-00
13B*	Coil Diode, 1N4004	112-5003-00
14	Fiber Yoke	545-5609-00
15	Metal Yoke	535-7346-00
16	Metal Yoke Stop	535-7347-00
17	Coil Bracket Welded Assembly	515-5939-00
18	#6-32 X 1/4" HWHTF (SERR) (Qty. 2)	237-5952-00

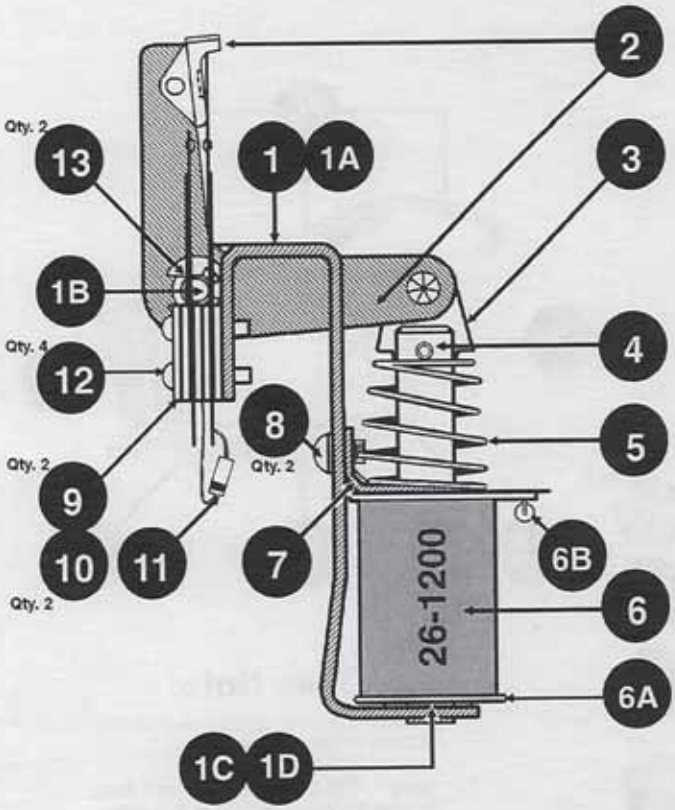
SWITCH GROUP

Nº	Part Name	SPI Part Nº
19	#6 X 1/2" HWH (AB) (Qty. 2)	234-5001-02
20	Switch Bracket	535-7342-00
21	Spoon Switch Actuator	545-5610-01
22	Stack Switch	180-5015-03
23	Switch Diode, 1N4001	112-5001-00
24	Switch Plate	535-7344-00
25	#6-32 X 3/4" HWHMS (SERR) (Qty. 2)	237-5958-00

ASSOCIATED GROUP

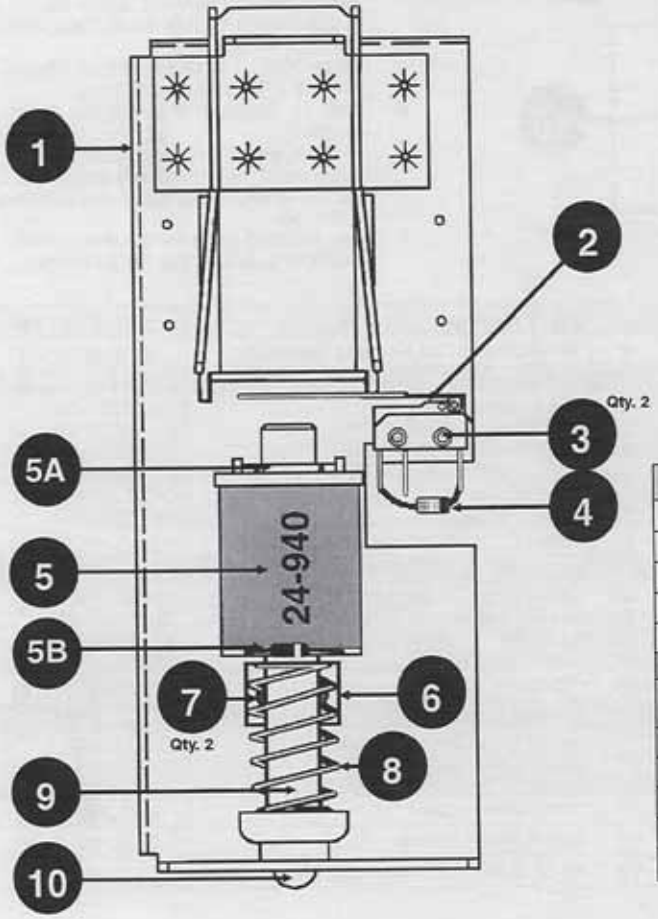
Nº	Part Name	SPI Part Nº
26	#4 X 3/4" PH RH (T25) (holds cap) (Qty. 2)	237-5873-00
27	Plastic Bumper Cap Cover Red	550-5057-02
28 *	Rubber Light Cover Red	545-5014-02

Slingshot (Left & Right) Assemblies, 500-5849-01 (Items 1-13)



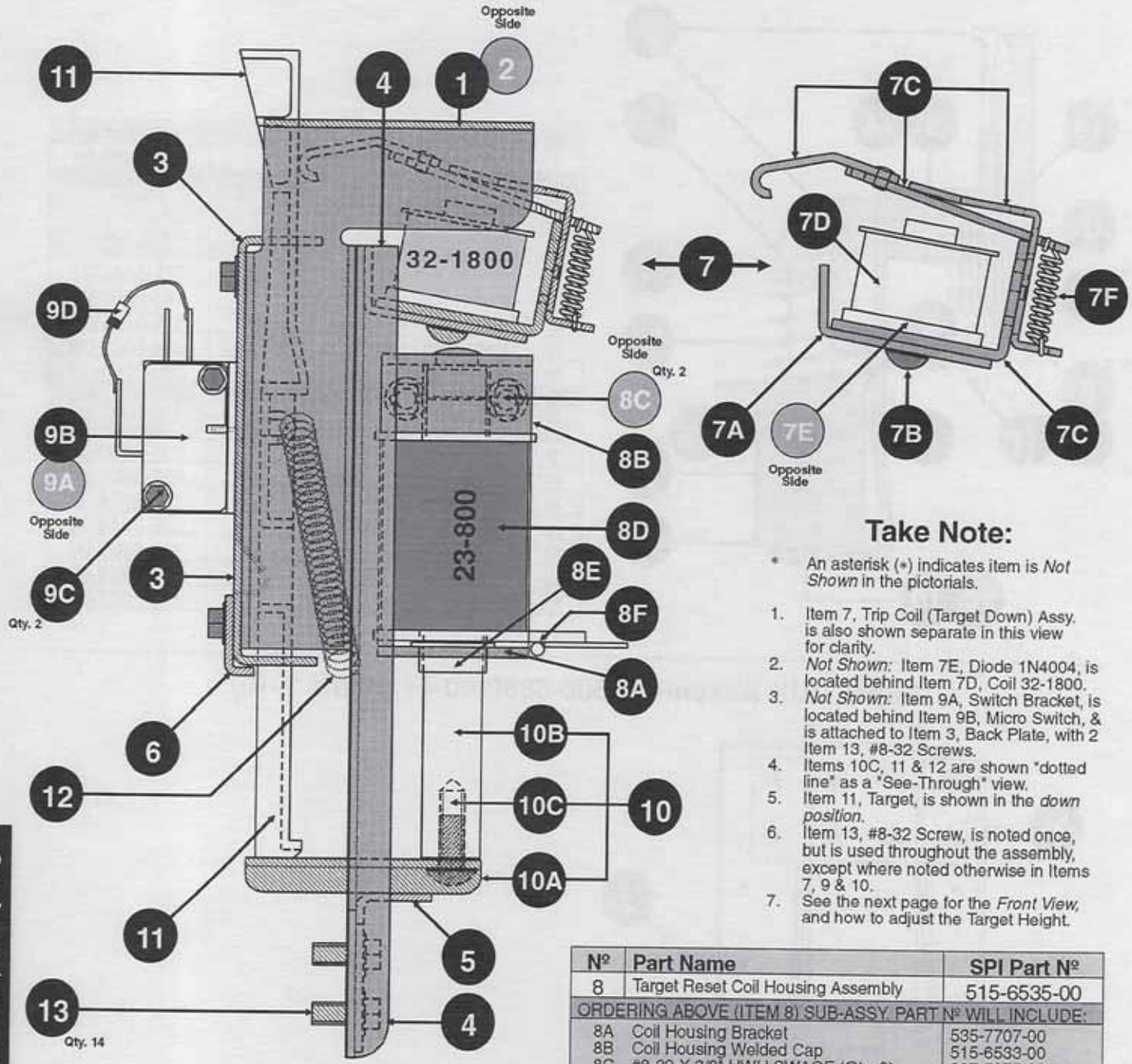
Nº	Part Name	SPI Part Nº
1	Slingshot Bracket Assembly	515-5339-01
ORDERING ABOVE (ITEM 1) SUB-ASSY. PART Nº WILL INCLUDE:		
1A	Slingshot Bracket	535-5919-01
1B	Hinge Stud	530-5034-01
1C	Armature Stop	530-5017-01
1D	Shading Ring	530-5307-00
2	Arm & Tip Assembly	515-5340-01
3	Armature Link	545-5062-00
4	Plunger & Link Assembly	515-5338-00
5	Compression Spring	266-5020-00
6	Coil 26-1200	090-5044-00
ORDERING ABOVE (ITEM 6) COIL PART Nº WILL INCLUDE:		
6A	Coil Sleeve	545-5031-00
6B	Coil Diode, 1N4004	112-5003-00
7	Coil Retaining Bracket	535-5203-03
8	#8-32 X 1/4" Screw (Qty. 2)	232-5300-00
9	Slingshot Switch (Qty. 2)	180-5054-00
10	Tension Switch Plate (Qty. 2)	535-7344-00
11	Switch Diode, 1N4001	112-5001-00
12	#6-32 X 5/8" HWH TF (Qty. 4)	237-5928-00
13	Retaining Ring 1/4" ø (Qty. 2)	270-5002-00

Super VUK Assembly, 500-5880-00-41 (Items 1-10)



Nº	Part Name	SPI Part Nº
1	Super VUK Weld Assembly	515-6123-00
2	Micro Switch (Loop Type)	180-5116-00
3	#2-56 X 1/2" HWHS MS TF (Qty. 2)	232-5937-00
4	Switch Diode, 1N4001	112-5001-00
5	Coil, 24-940	090-5036-01
ORDERING ABOVE (ITEM 5) COIL PART Nº WILL INCLUDE:		
5A	Coil Sleeve	545-5076-00
5B	Coil Diode, 1N4004	112-5003-00
6	Coil Retaining Bracket	535-5203-01
7	#8-32 X 1/4" PPH (Lock-Tite) (Qty. 2)	232-5300-00
8	Compression Spring	266-5020-00
9	Plunger Assembly	515-5941-01
10	Rubber Bumper (Grommet)	545-5105-00

Single Drop Target Assy. (Side View), 500-6097-00-41 (Items 1-13)



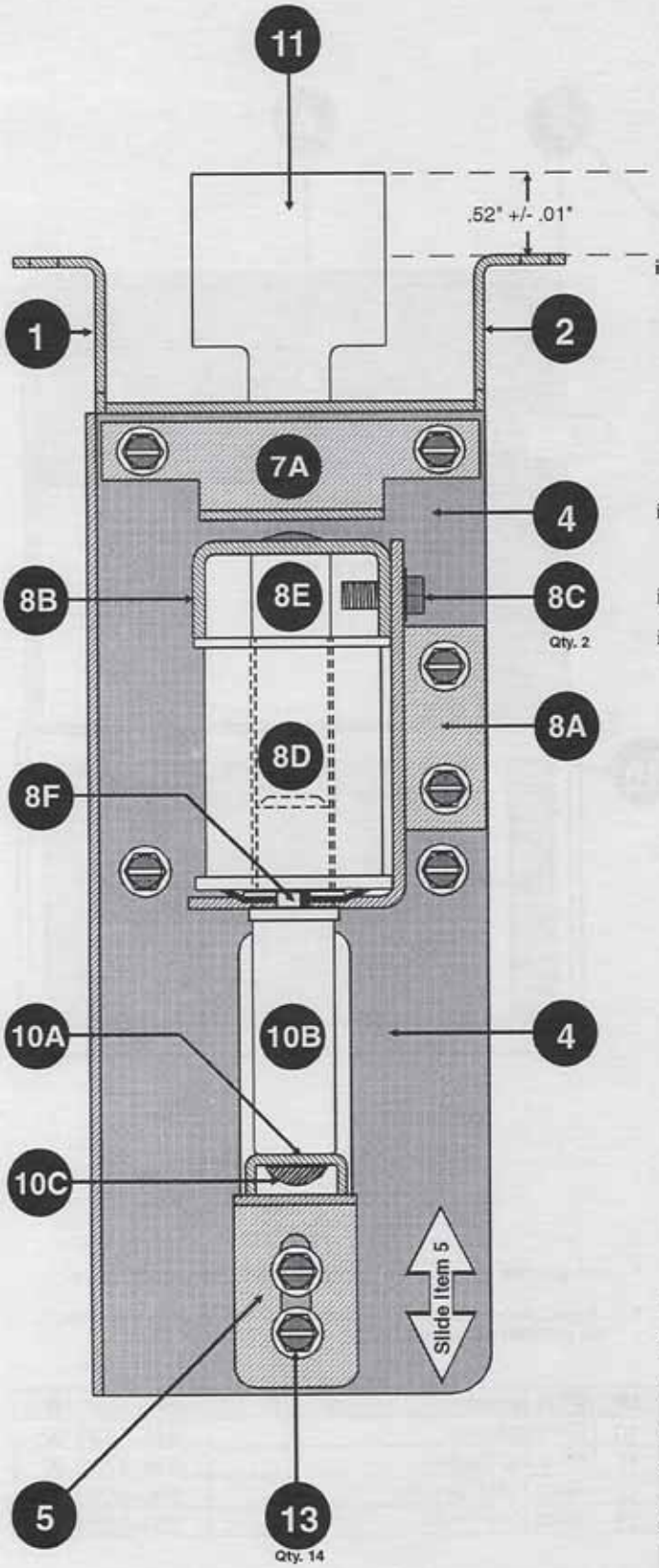
Take Note:

* An asterisk (*) indicates item is *Not Shown* in the pictorials.

1. Item 7, Trip Coil (Target Down) Assy. is also shown separate in this view for clarity.
2. *Not Shown:* Item 7E, Diode 1N4004, is located behind Item 7D, Coil 32-1800.
3. *Not Shown:* Item 9A, Switch Bracket, is located behind Item 9B, Micro Switch, & is attached to Item 3, Back Plate, with 2 Item 13, #8-32 Screws.
4. Items 10C, 11 & 12 are shown "dotted line" as a "See-Through" view.
5. Item 11, Target, is shown in the *down position.*
6. Item 13, #8-32 Screw, is noted once, but is used throughout the assembly, except where noted otherwise in Items 7, 9 & 10.
7. See the next page for the *Front View,* and how to adjust the Target Height.

Nº	Part Name	SPI Part Nº
1	Single Drop Target Left Side Bracket	535-7714-00
2	Single Drop Target Right Side Bracket	535-7714-01
3	Single Drop Target Back Plate	535-7713-00
4	Single Drop Target Support Bracket	535-7712-00
5	Height Adjustment Bracket	535-7709-00
6	Target Retainer Bracket	535-7728-00
7	"Target Down" (Trip Coil) Bracket Assy.	515-6538-00
ORDERING ABOVE (ITEM 7) SUB-ASSY. PART Nº WILL INCLUDE:		
7A	Trip Coil Mounting Bracket	535-7711-00
7B	#8-32 X 3/8" PPH (SEMS)	232-5301-00
7C	Trip Coil Welded Assy. (includes 7D-F)	515-6534-00
7D	Coil, 32-1800	090-5031-00
7E*	Diode, 1N4004	112-5003-00
7F	Spring	265-5024-00

Nº	Part Name	SPI Part Nº
8	Target Reset Coil Housing Assembly	515-6535-00
ORDERING ABOVE (ITEM 8) SUB-ASSY. PART Nº WILL INCLUDE:		
8A	Coil Housing Bracket	535-7707-00
8B	Coil Housing Welded Cap	515-6533-00
8C	#8-32 X 3/8" HWH SWAGE (Qty. 2)	237-5975-00
8D	Coil 23-800 (includes 8E & 8F)	090-5001-00
8E	Coil Sleeve	545-5709-00
8F	Diode, 1N4004	112-5003-00
9	Single Drop Target Switch Assembly	515-6536-00
ORDERING ABOVE (ITEM 9) SUB-ASSY. PART Nº WILL INCLUDE:		
9A*	Single Drop Target Switch Bracket	535-7710-00
9B	Single Drop Target Micro Switch	180-5158-00
9C	#4-40 5/8" HWH TF (Qty. 2)	237-5945-00
9D	Diode, 1N4001	112-5001-00
10	Plunger & Lift Bracket Assembly	515-6537-00
ORDERING ABOVE (ITEM 10) SUB-ASSY. PART Nº WILL INCLUDE:		
10A	Single Drop Target Lift Bracket	535-7706-00
10B	Single Drop Target Plunger	530-5410-00
10C	#10-32 X 3/8" PPH (SEMS)	232-5401-00
11	Drop Target White	545-5533-01
12	Target Reset Spring	265-5003-00
13	#8-32 X 3/8" HWH SWAGE (Qty. 14)	237-5975-00



Target Height Adjustment Procedure:

i. Adjust the height of the top of Item 11, Target, at .52" (+/- .01"), [just over ½ inch] relative to Items 1 & 2, Lt. & Rt. Side Brackets, as shown left. (Item 11, Target, should be in the *down position.*)

Note: This adjustment procedure should have the top side of Item 11, Target, "flush to approximately 1/16 inch" ***above*** *the playfield surface after reinstalling to the underside of the playfield.*

Keeping the top side of the target (in the down position) from "flush to approximately 1/16 inch" ***above*** the playfield will **prevent a ball trap from occuring**.

ii. Loosen Item 13, #8-32 Screws, holding Item 5, Height Adjustment Plate, attached to Item 4, Support Bracket. (Hint: Loosen the screws just enough so that the adjustment plate will move only when touched.)
iii. Slide Item 5, Height Adjustment Plate, either up or down, causing Item 10A, Lift Bracket, to raise or lower the target to desired height.
iv. Tighten Item 13, #8-32 Screws, when proper adjustment is made.

Take Note:

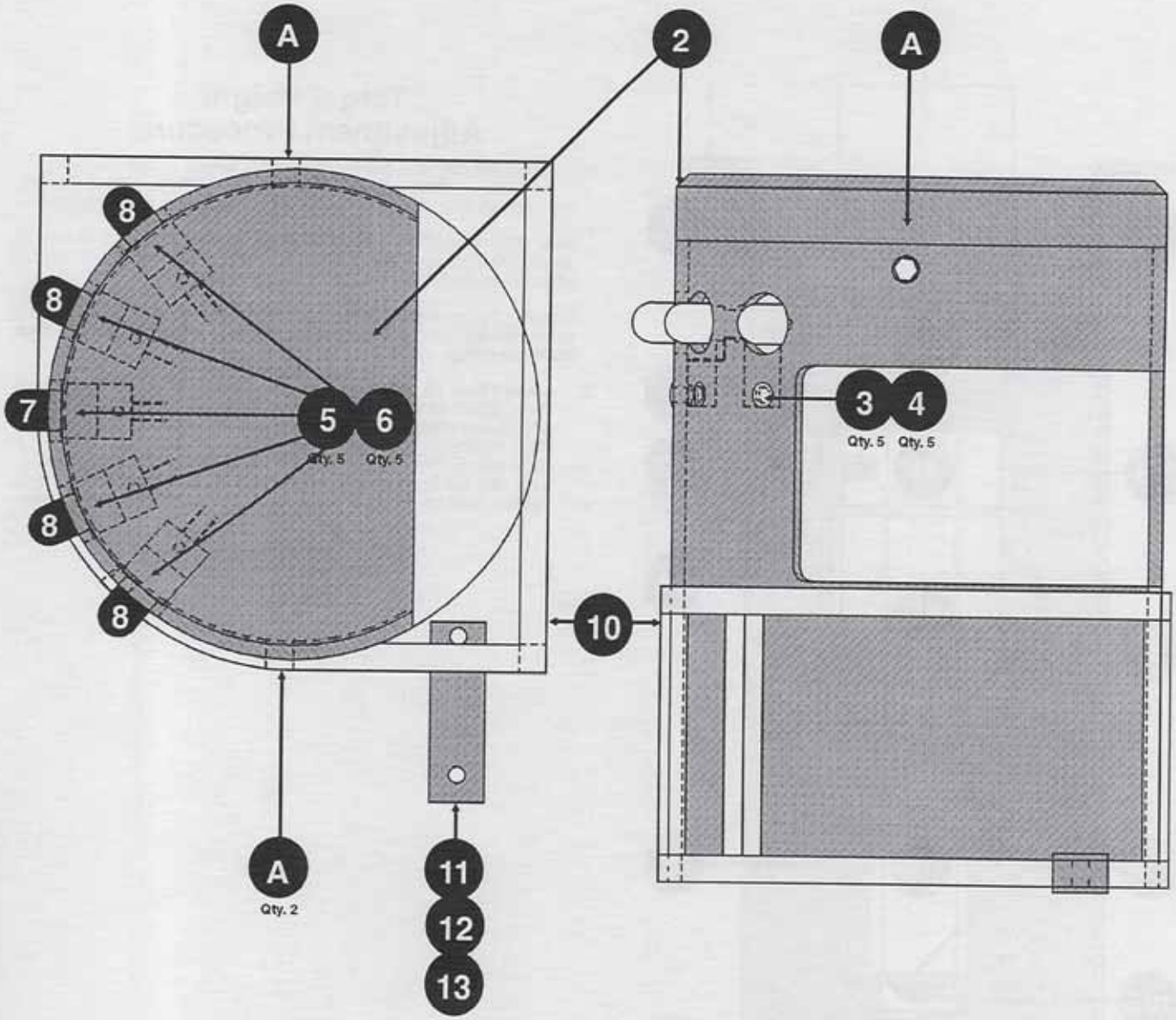
* An asterisk (*) indicates item is *Not Shown* in the pictorials.

1. *Not Shown:* Item 7, Trip Coil (Target Down) Assy. is *Not Shown* in this view to maintain clarity.
2. *Not Shown:* Item 9, Switch Assy., is located on the back of Item 3, Back Plate.
3. Item 8E, Coil Sleeve, and Item 10B, Plunger, are shown "dotted line" as a "See-Through" view.
4. Item 13, #8-32 Screw, is noted once, but is used throughout the assembly, except where noted otherwise in Items 7, 9 & 10.
5. Item 11, Target, is shown in the *down position.*
6. See the previous page for the *Side View,* for parts not noted on this view.

Nº	Associated Part Name	SPI Part Nº
n/a*	Decal Front	820-6133-23
n/a*	Decal Top	820-6133-24

Items 1-13 listed on the previous page.

Dorothy II Canister Assembly, 500-6093-00-41 (Items 1-9), and Canister Frame Assembly, 515-6547-00-41 (Items 10-13)



Take Note:

* An asterisk (*) indicates item is *Not Shown* in the pictorials.

1. Associated parts are not included with the assembly and must be ordered separately.

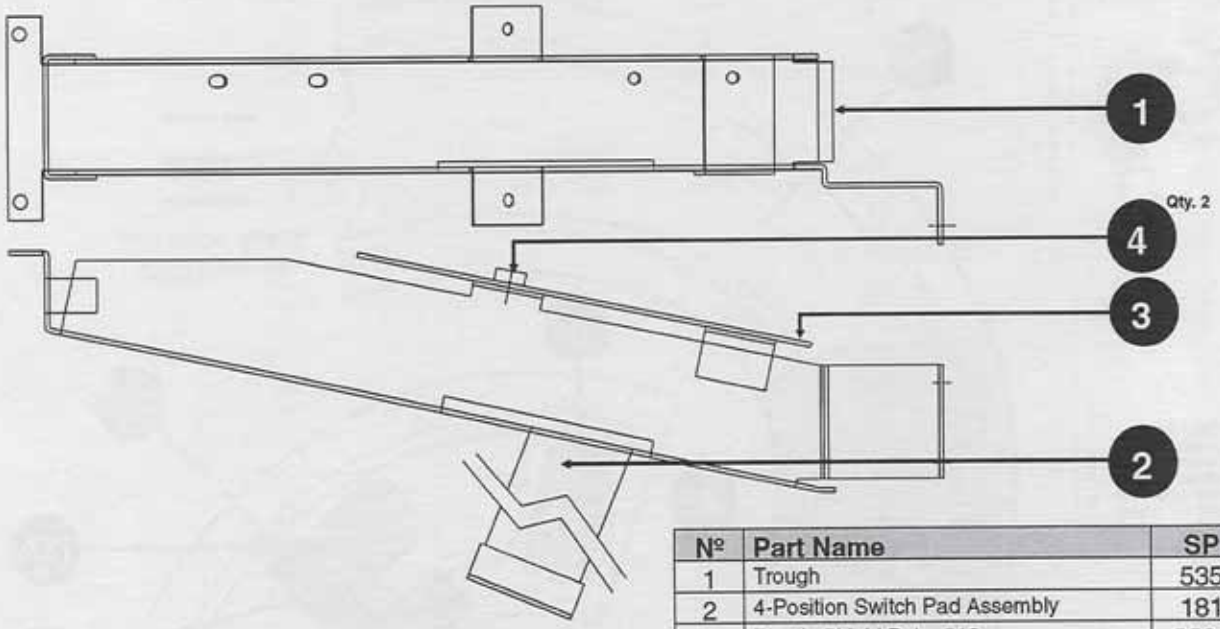
Nº	Part Name	SPI Part Nº
1	Canister	545-5693-00
2	Canister Lid	545-5693-01
3	Rivet ø .125" X .156" Lg. (Qty. 5)	249-5009-00
4	Star Washer 5/16" (Qty. 5)	242-5017-00
5	Wedge Offset Brckt. Socket (Qty. 5)	077-5029-00
6	#555 Wedge Base Bulb (Qty. 5)	165-5002-00
7	Rubber Light Cover Green	545-5014-04
8	Rubber Light Cover Yellow (Qty. 4)	545-5014-06
9 *	Wiring Harness/Cable	036-5402-02-41

Nº	Part Name	SPI Part Nº
10	Canister Frame	545-5693-02
11	Mounting Bracket	535-7723-00
12	#6-32 Nylon Stop Nut	240-5005-00
13	#6-32 X 5/8" HWH	237-5928-00

ASSOCIATED PART(S) NOT INCLUDED WITH THE ABOVE ASSEMBLY

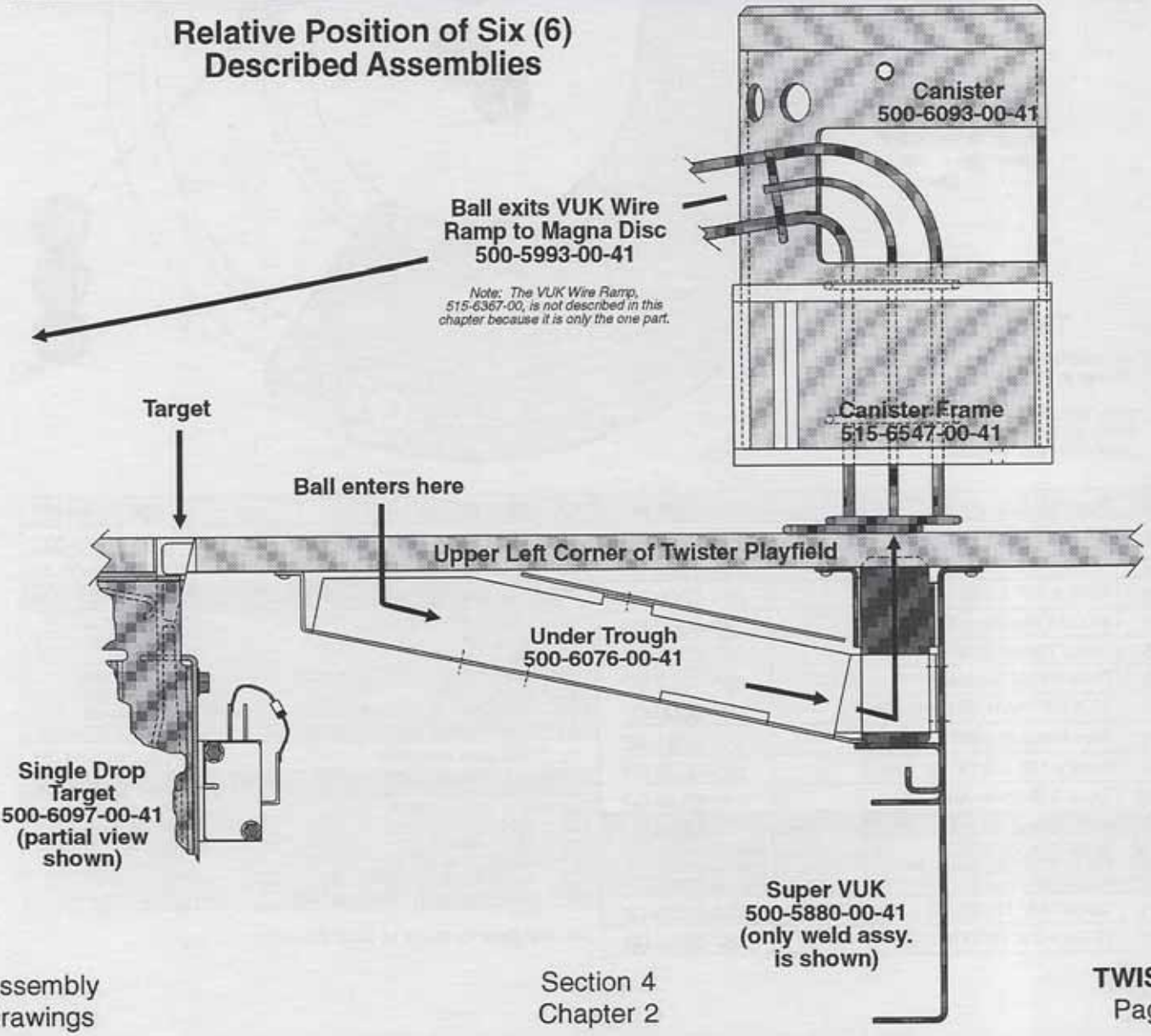
Nº	Associated Part Name	SPI Part Nº
A	#6 X 3/8" HWH (Qty. 2) (Fastens Lid)	234-5000-00
B *	Cable Tie (Canister to Frame)	040-5001-06

Under Trough Assembly, 500-6076-00-41 (Items 1-4)

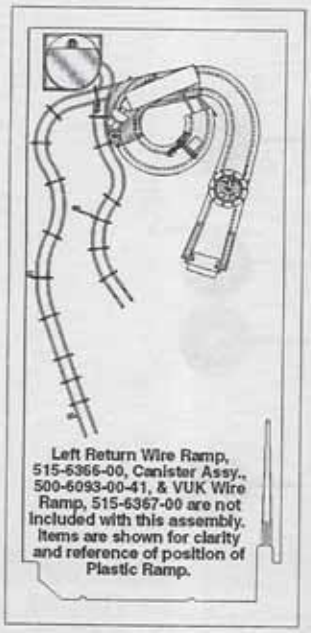


Nº	Part Name	SPI Part Nº
1	Trough	535-7683-00
2	4-Position Switch Pad Assembly	181-5001-00
3	Plastic Shield Buty -013	830-5498-013
4	#6-32 X 3/8" HWH SWAGE SER (Qty. 2)	237-5976-02

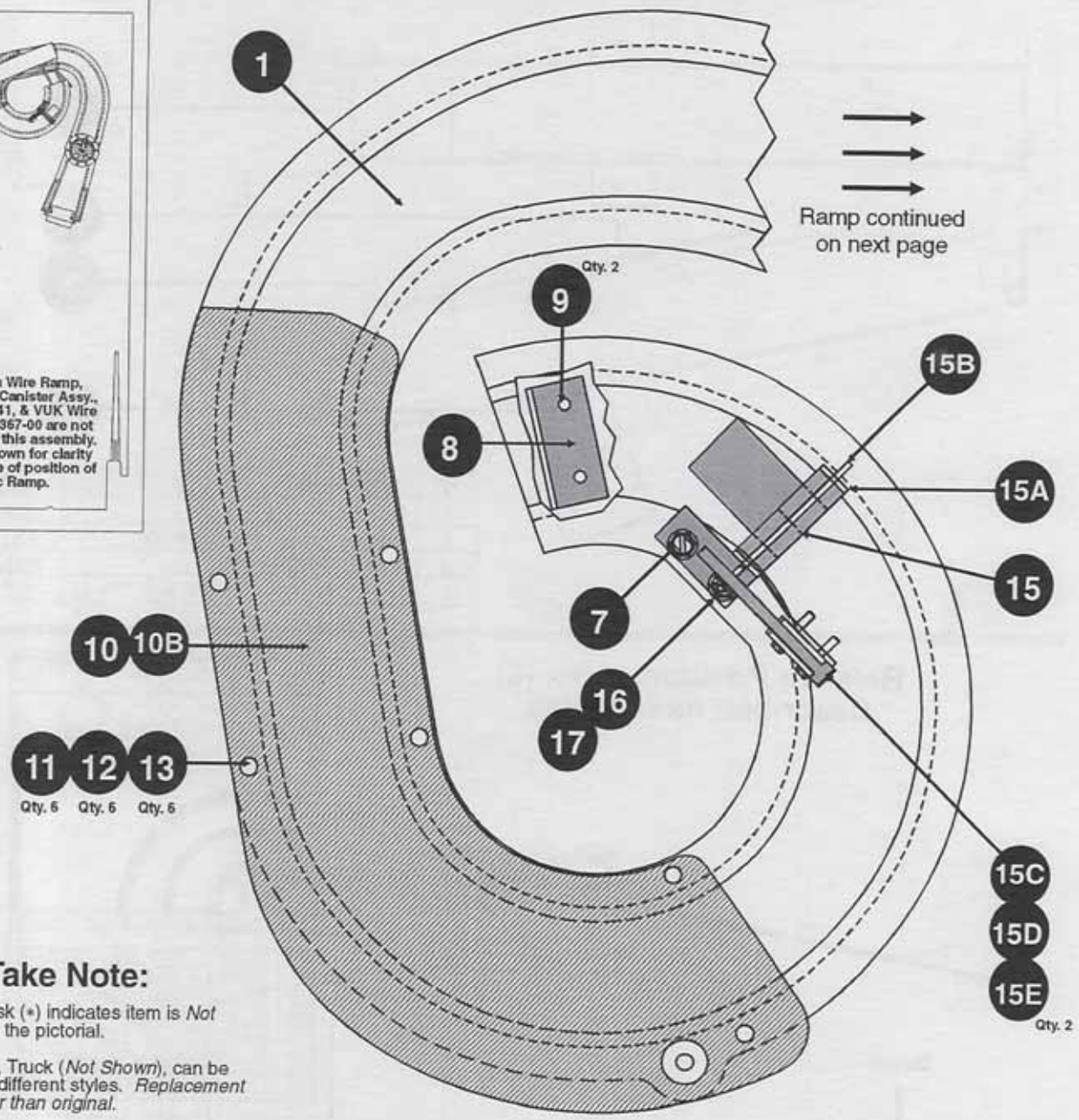
Relative Position of Six (6) Described Assemblies



Plastic Ramp Assembly, 500-6009-00-41 (Items 1-20)



Left Return Wire Ramp, 515-6366-00, Canister Assy., 500-6093-00-41, & VUK Wire Ramp, 515-6367-00 are not included with this assembly. Items are shown for clarity and reference of position of Plastic Ramp.



Take Note:

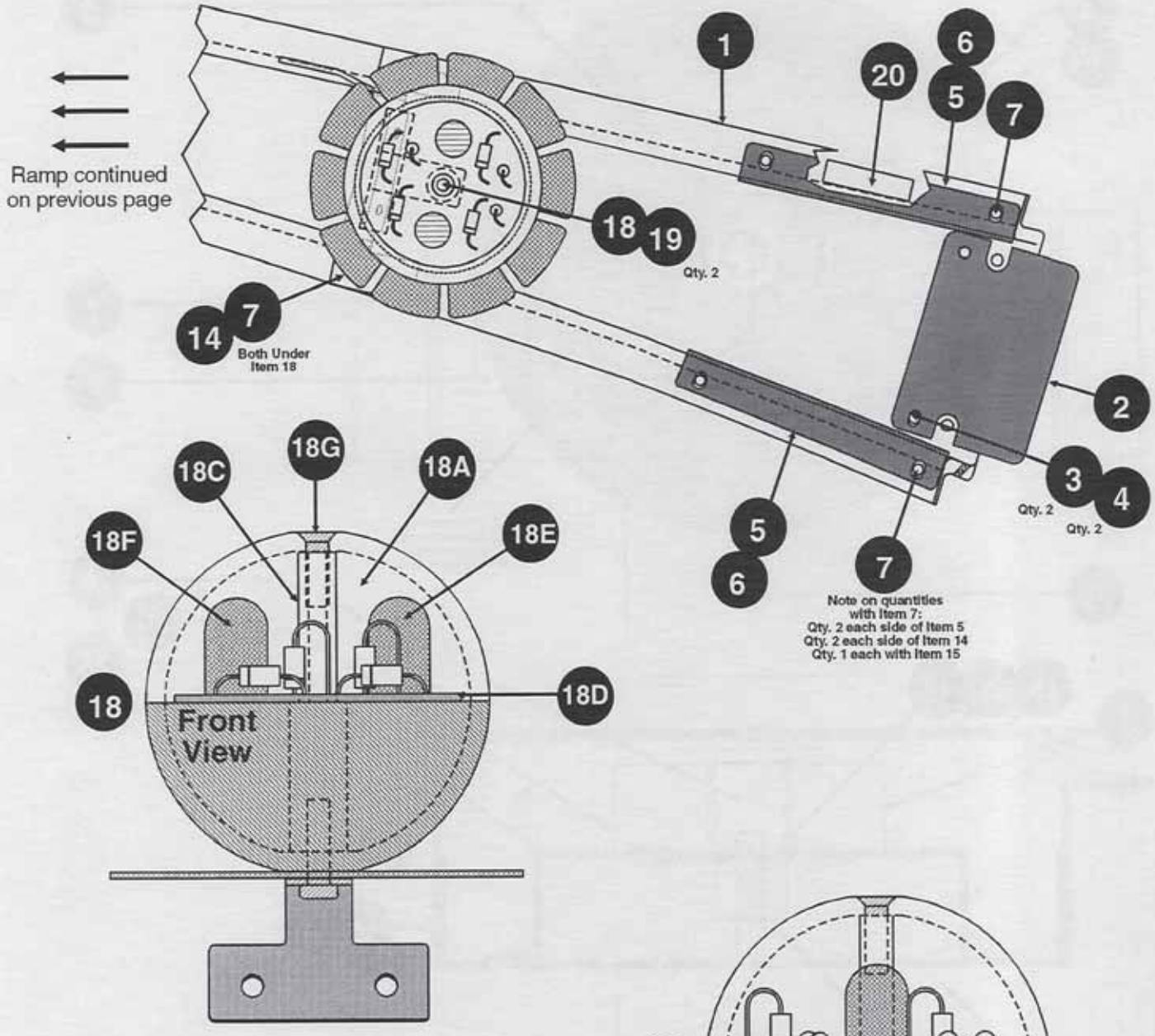
* An asterisk (*) indicates item is *Not Shown* in the pictorial.

1. Item 10A, Truck (*Not Shown*), can be three (3) different styles. *Replacement may differ than original.*

№	Part Name	SPI Part №
1	Plastic Ramp (Plain)	545-5628-00
2	Outer Ramp Flap	535-7208-00
3	Rivet ø 1/8" X 5/32" Lg. (Qty. 2)	249-5009-00
4	#6 Lock Washer (Qty. 2)	246-5000-00
5	Ramp Protect Plate (Qty. 2)	535-6707-01
6	Double-Side Spectape 3/4" (1.46')	626-5027-00
7	#6 X 3/8" HWH AB (Zinc) (Qty. 7)	234-5000-00
8	Wire Ramp Bracket	535-5291-00
9	Rivet ø 1/8" X 5/32" Lg. (Qty. 2)	249-5009-00
10	Truck & Butyrate Assembly	515-6549-00
ORDERING ABOVE (ITEM 10) SUB-ASSY. PART № WILL INCLUDE:		
10A*	Truck (Not Shown)	830-5805-00
10B	Ramp Cover Butyrate -14	830-5498-14
10C*	Cable Tie (Qty. 2)	040-5001-06
11	Spacer 3/8" Plastic 3/8" (Gray) (Qty. 6)	254-5000-12
12	#6-32 X 3/4" HWH MS (Qty. 6)	237-5893-00

№	Part Name	SPI Part №
13	#6-32 Nylon Stop Nut (Qty. 6)	240-5005-00
14	Enter Gate Assembly	515-6359-00-41
ORDERING ABOVE (ITEM 14) SUB-ASSY. PART № WILL INCLUDE:		
14A*	Enter Gate Bracket	535-7303-00
14B*	Wire Form	535-7304-00
14C*	Micro Switch	180-5090-00
14D*	#2-56 X 1/2" HWH SERR (Qty. 2)	237-5937-00
14E*	Diode, 1N4001	112-5001-00
14F*	#2-56 Hex Nut (Qty. 2)	240-5301-00
14G*	Enter Gate Wiring Harness/Cable	036-5402-06-41
15	Exit Gate Assembly	515-6490-01-41
ORDERING ABOVE (ITEM 15) SUB-ASSY. PART № WILL INCLUDE:		
15A	Exit Gate Bracket	535-7613-02
15B	Wire Form	535-6304-03
15C	Micro Switch	180-5087-00
15D	Diode, 1N4001	112-5001-00
15E	#2-56 X 3/8" HWH MS SERR (Qty. 2)	237-5938-00
15F*	Exit Gate Wiring Harness/Cable	036-5402-05-41

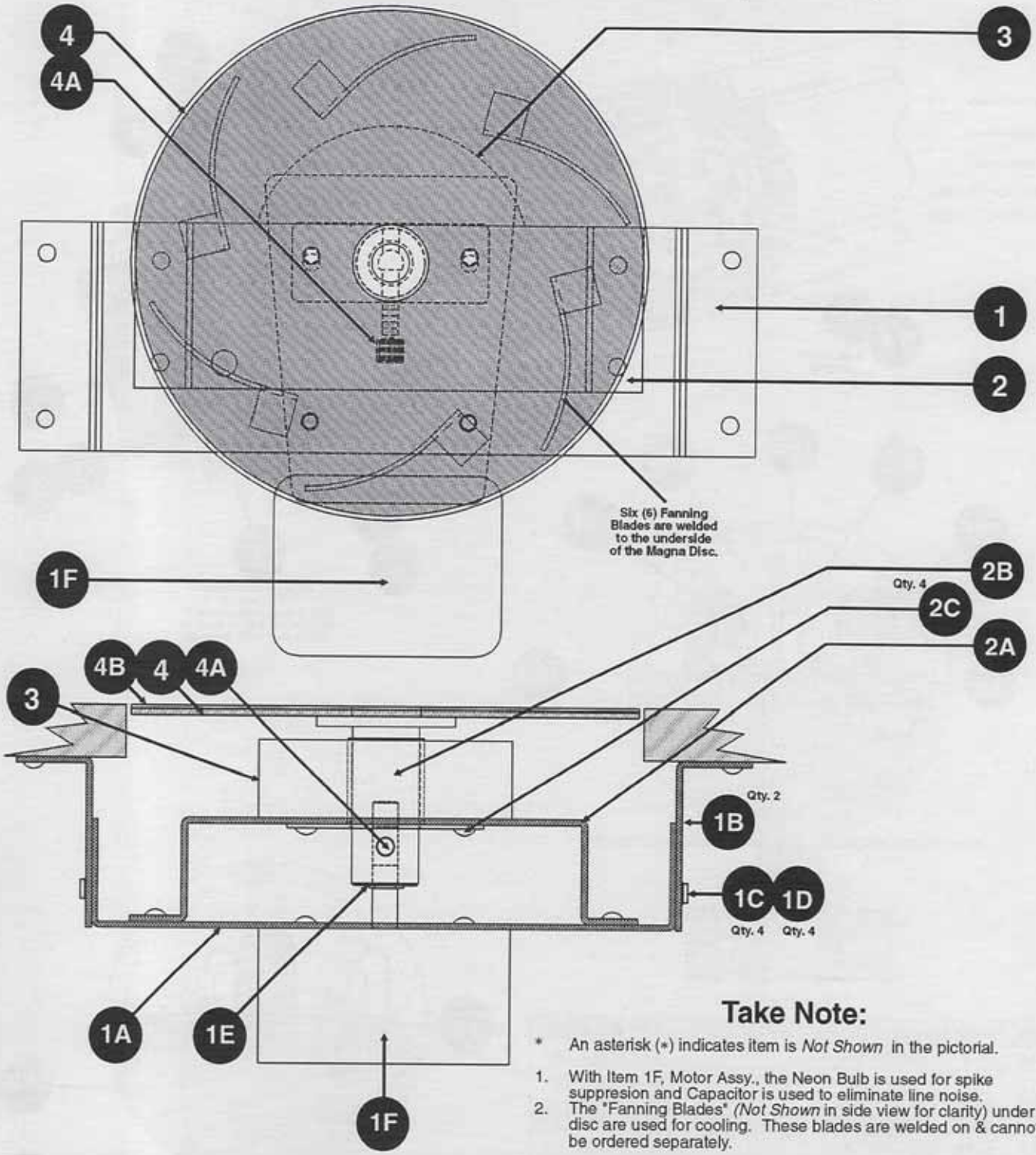
See next page for items 16-20 of this table.



Nº	Part Name	SPI Part Nº
16	#6 X 1/2 HMS SERR	237-5924-00
17	2-1/2" #6-32 Hex Spacer Tapped	254-5008-16
18	Sensor Ball Assembly	500-6089-00-41
ORDERING ABOVE (ITEM 8) SUB-ASSY. PART Nº WILL INCLUDE:		
18A	Sensor Ball - Top Clear	545-5701-00
18B	Sensor Ball - Bottom Chrome	545-5702-00
18C	Sensor Ball - Shaft	530-5406-00
18D	LED Board (Flufftronics®)	520-5144-00
18E	LED (Large) Green	165-5032-04
18F	LED (Large) Red	165-5032-02
18G	#10-24 X 1/2" PFH MS (Zinc)	237-5918-00
18H	Sensor Ball - Mounting Bracket	535-7693-00
18I	#6-32 X 3/8" PPH MS SEMS (Zinc)	232-5201-00
18J	Sensor Ball - "Flight"	545-5705-00
19	#6 X 1/4" HWH SMS SWAGE (Qty. 2)	237-5976-01
20	Foam Rubber	626-5000-00

See previous page for Items 1-15 of this table.

Magna Disc Assembly, 500-5993-00-41 (Items 1-4)



Take Note:

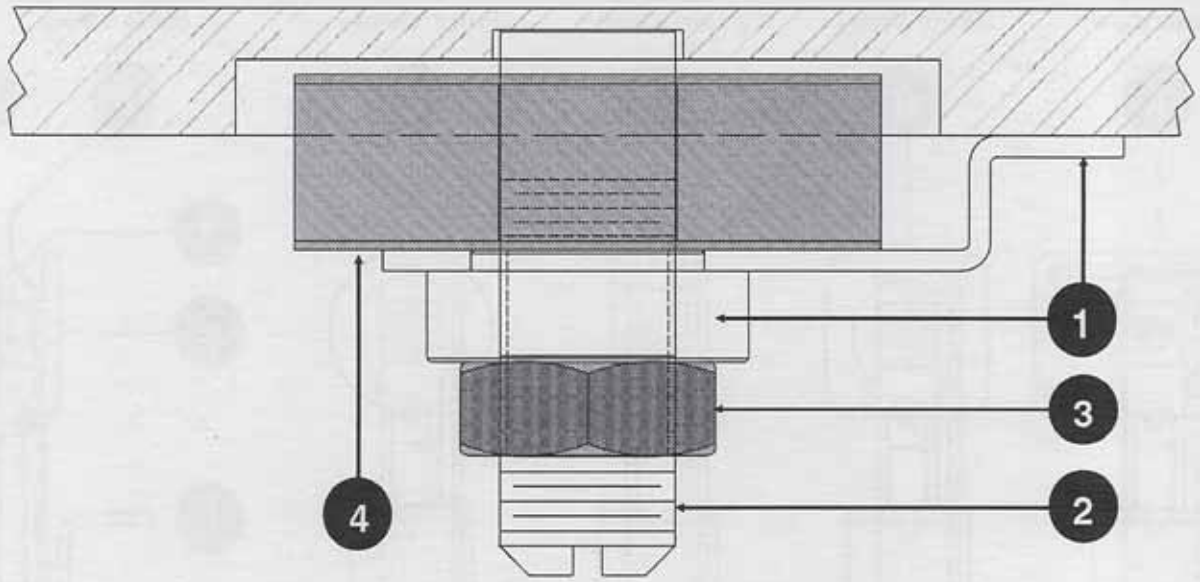
* An asterisk (*) indicates item is *Not Shown* in the pictorial.

1. With Item 1F, Motor Assy., the Neon Bulb is used for spike suppresion and Capacitor is used to eliminate line noise.
2. The "Fanning Blades" *(Not Shown* in side view for clarity) under the disc are used for cooling. These blades are welded on & cannot be ordered separately.

Nº	Part Name	SPI Part Nº
1	Motor Bracket Assembly	515-6350-00-41
ORDERING ABOVE (ITEM 1) SUB-ASSY. PART Nº WILL INCLUDE:		
1A	Motor Mounting Bracket	535-7403-00
1B	Support Bracket (Qty. 2)	535-7404-00
1C	#8-32 X 1/2" HWH SWAGE (Qty. 4)	237-5975-01
1D	#8 Washer (Qty. 4)	242-5005-00
1E	1/4" Retaining Ring (on shaft)	270-5002-00
1F	Motor Assembly, includes:	515-6347-00-41
	* Motor Wiring Harness/Cable	036-5201-00-41
	* Neon Bulb	165-5021-00
	* Capacitor 2.2 UF 200-250v Disc	125-5002-00
	* #8-32 X 1/2" HWH SWAGE (Qty. 4)	237-5975-01

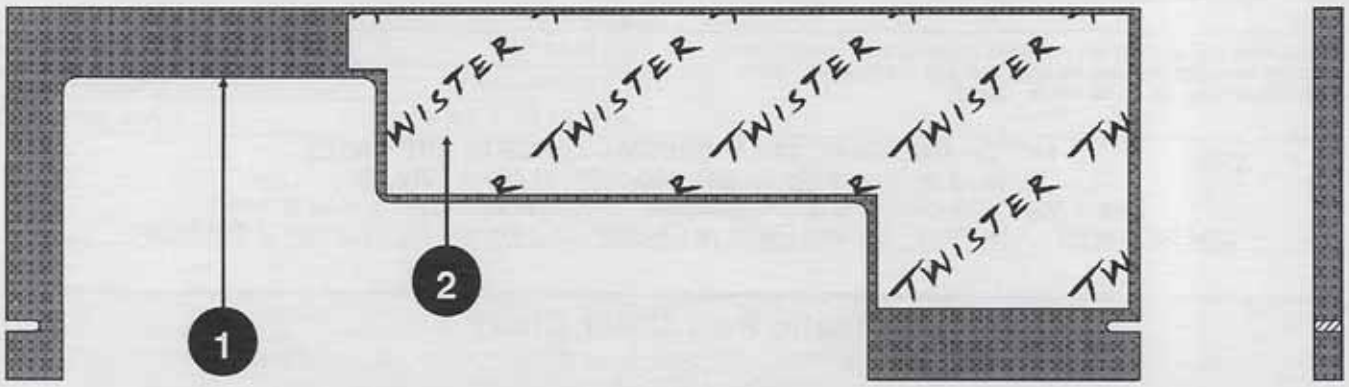
Nº	Part Name	SPI Part Nº
2	Bracket & Sleeve Assembly	515-6348-00-41
ORDERING ABOVE (ITEM 2) SUB-ASSY. PART Nº WILL INCLUDE:		
2A	Magnet Bracket	535-7407-00
2B	Sleeve	545-5626-00
2C	#8-32 X 1/2" HWH SWAGE (Qty. 4)	237-5975-01
2D *	Circular Dbl. Sided Foam (Qty. 3)	626-5036-00
3	Magnet 22-600	090-5042-01
4	Disc & Bushing Assembly	515-6349-00
ORDERING ABOVE (ITEM 4) SUB-ASSY. PART Nº WILL INCLUDE:		
4A	#8-32 X 3/8" Socket Head Cap Screw	237-5897-00
4B	Disc Decal	830-5481-00

Magnet Diverter Individual Parts (Items 1-4)
(Not available as an assembly. Located under playfield by Right Outlane.)



Nº	Part Name	SPI Part Nº	Nº	Part Name	SPI Part Nº
1	Welded Bracket Threaded Bushing Assy.	515-6141-00	3	3/4"-16 Hex Nut	240-5315-00
2	Threaded Core	530-5320-00	4	Magnet (22-600)	090-5042-00

Back Panel Assembly, 500-6011-00-41 (Items 1-3)



Take Note:

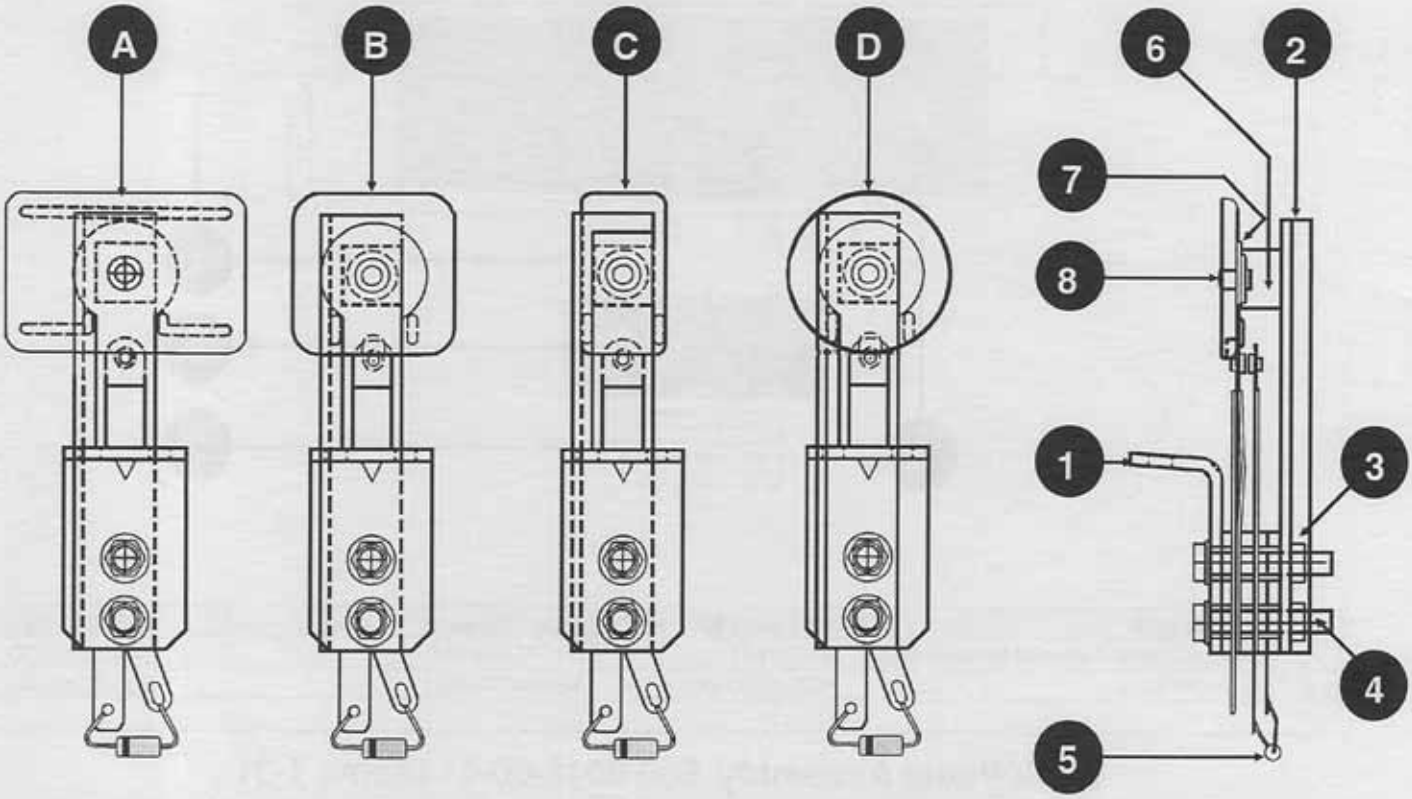
* An asterisk (*) indicates item is *Not Shown* in the pictorial.

1. Item 2, Molded Twister Cover, is a 3D representation of a Twister and is secured to Item 1, Back Panel, with Item 3, Screws.

Nº	Part Name	SPI Part Nº	Nº	Part Name	SPI Part Nº
1	Back Panel (Wood)	525-5324-00	3 *	#6 X 1/2" PPH (Black) Screw (Qty. 6)	237-5805-00
2	Molded Twister Cover (Plastic)	545-5694-00			

Stand-Up Target Assemblies: †

500-5321-XX 1" X 1-1/2" Rectangle	500-5232-XX 1" Square	500-5857-XX Narrow Rectangle	500-5835-XX 1" Round	All
(Front View)	(Front View)	(Front View)	(Front View)	(Side View)



Nº	Switch & Target Name	QTY.	Part Nº
A	Sw. & Target Assy. 1" X 1½" Rect. (Flat)	4	515-6027-XX
B	Switch & Target Assembly 1" Square (Flat)	0	515-5162-XX
C	Sw. & Target Assy. Narrow Rectangle (Flat)	2	515-5967-XX
D	Switch & Target Assembly 1" Round (Flat)	0	515-5966-XX

† Items with a Ø quantity are not used in this game. The following are the color breakdowns for item(s) **A** & **C** (replace the "-XX"):
A -08 White (Qty. 4); C -08 White (Qty. 2)

Nº	Part Names for A, B, C & D	Part Nº
1	Mounting Bracket	535-6896-00
2	Switch Back Plate	535-6452-00
3	6-32 Nyloc	240-5010-00
4	6-32 X ¾ HWH Ser. (Type C) (Qty. 2)	237-5958-00
5	Switch Diode, 1N4001	112-5001-00
6	Foam Pad	626-5029-00
7	Washer 5/16"	242-5017-00
8	Rivet 1/8" ø X 3/16"	249-5001-00

NOTE: THIS GAME ONLY, SPECIAL TARGETS ARE USED:
Module Stand-Up Target, 500-6075-01 Clear (Qty. 7)
Please Note: Individual parts are not available. The whole assembly must be ordered.
See this section, Chapter 1, General Parts, or Chapter 2, Overview, for locations of this target.

Plastic Part Color Chart

(As applicable for all parts which are available in various colors.)
The "-XX" should be replaced with the following 2-Digit Number for the color desired:

-01:	Clear	-06:	Yellow	-11:	Flourescent Green
-02:	Red	-07:	Orange	-12:	Flourescent Blue
-03:	Amber	-08:	White	-13:	Teal Green
-04:	Green	-09:	Purple	-14:	Gray
-05:	Blue	-10:	Flourescent Orange	-15:	Luminescent

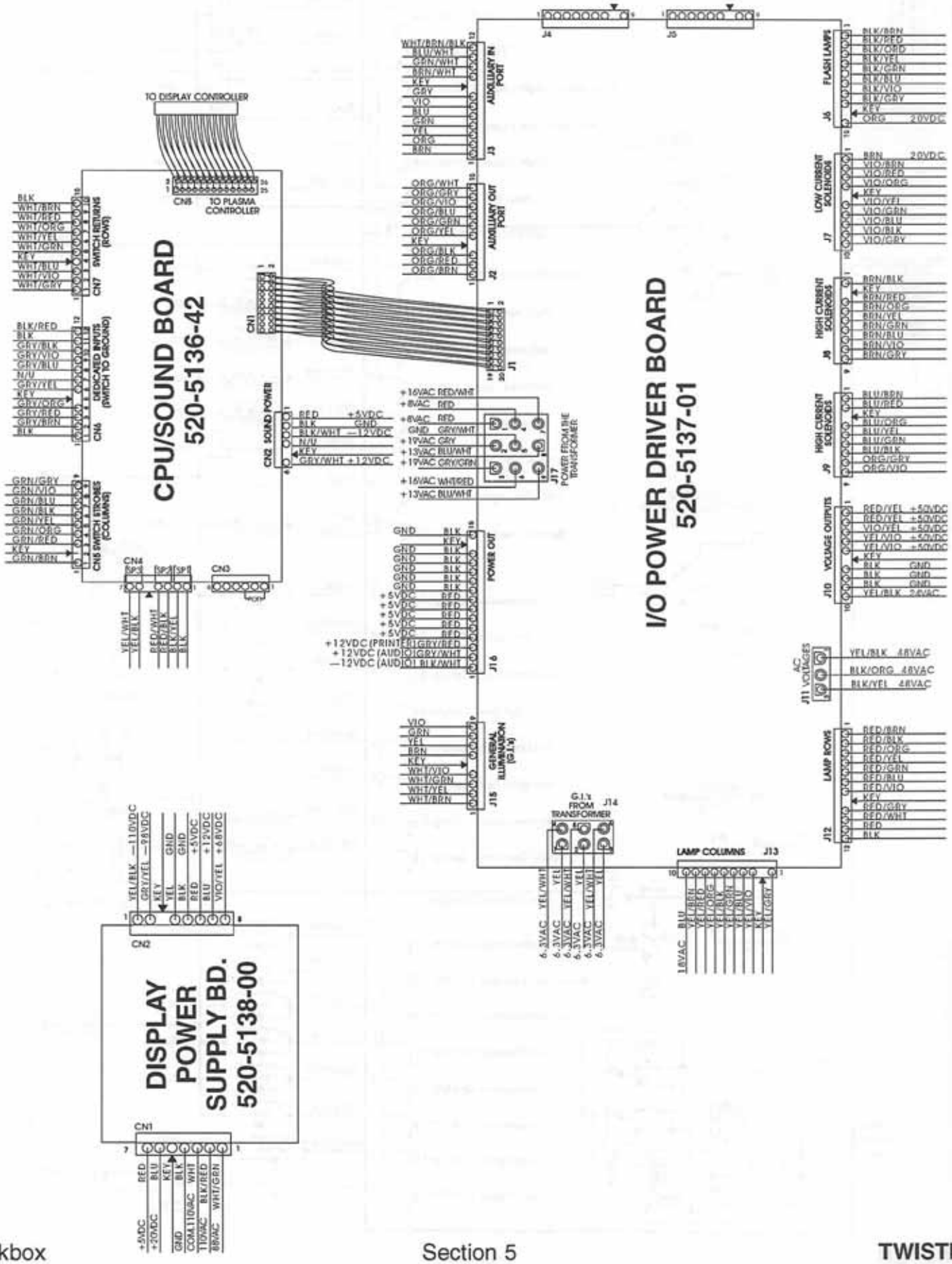
Section 5
Table of Contents

- **Chapter 1, Backbox Wiring 87**
  - Backbox Board Layout Wiring Diagram 87
  - Backbox I/O Power Driver Board Detailed Wiring Diagram 88
- **Chapter 2, Playfield Wiring 89**
  - *New 2-Flipper Circuit Wiring Diagram (No SSFB Required!) 89*
  - Playfield Magnet Processor/Driver Schematic & Theory of Operation 90
  - Playfield Magnet Processor/Driver Board Parts 91
  - Playfield Trough Up-Kicker OPTO Theory of Operation & Schematic 92
  - Playfield Single Trough OPTO Alignment & Test 93
  - Playfield Switch & Lamp Wiring Diagrams 94
- **Chapter 3, Cabinet Wiring 95**
  - Transformer Power Wiring Diagram 95
  - Cabinet/Coin Door Wiring Diagram 96
- **Chapter 4, Printed Circuit Boards (PCBs) 97**
  - Dot Matrix & Controller Board Combined Display Connections 97
  - Display Controller Board Schematic 98
  - Display Controller Board Component Layout 99
  - Display Power Supply Board Schematic 100
  - Display Power Supply Board Component Layout & Parts 101
  - I/O Power Driver Board Theory of Operation 102
  - I/O Power Driver Board Schematic (Sheet 1 of 5) 103
  - I/O Power Driver Board Schematic (Sheet 2 of 5) 104
  - I/O Power Driver Board Schematic (Sheet 3 of 5) 105
  - I/O Power Driver Board Schematic (Sheet 4 of 5) 106
  - I/O Power Driver Board Schematic (Sheet 5 of 5) 107
  - I/O Power Driver Board Component Layout 108
  - I/O Power Driver Board Parts 109
  - CPU/Sound Board Theory of Operation 110
  - CPU/Sound Board Schematic (Sheet 1 of 3) 111
  - CPU/Sound Board Schematic (Sheet 2 of 3) 112
  - CPU/Sound Board Schematic (Sheet 3 of 3) 113
  - CPU/Sound Board Component Layout 114
  - CPU/Sound Board Parts 115-116

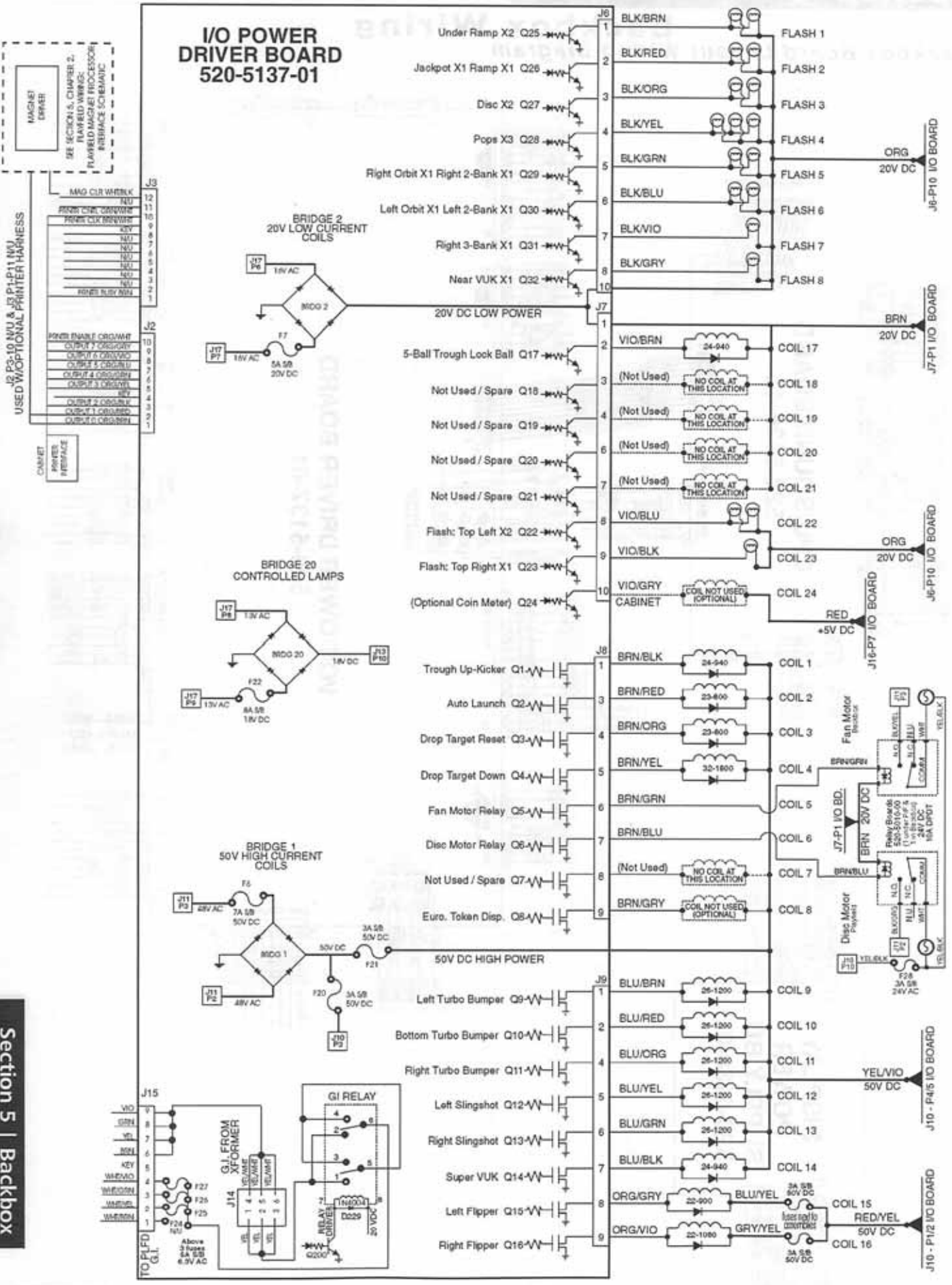
Your Notes

Backbox Wiring

Backbox Board Layout Wiring Diagram



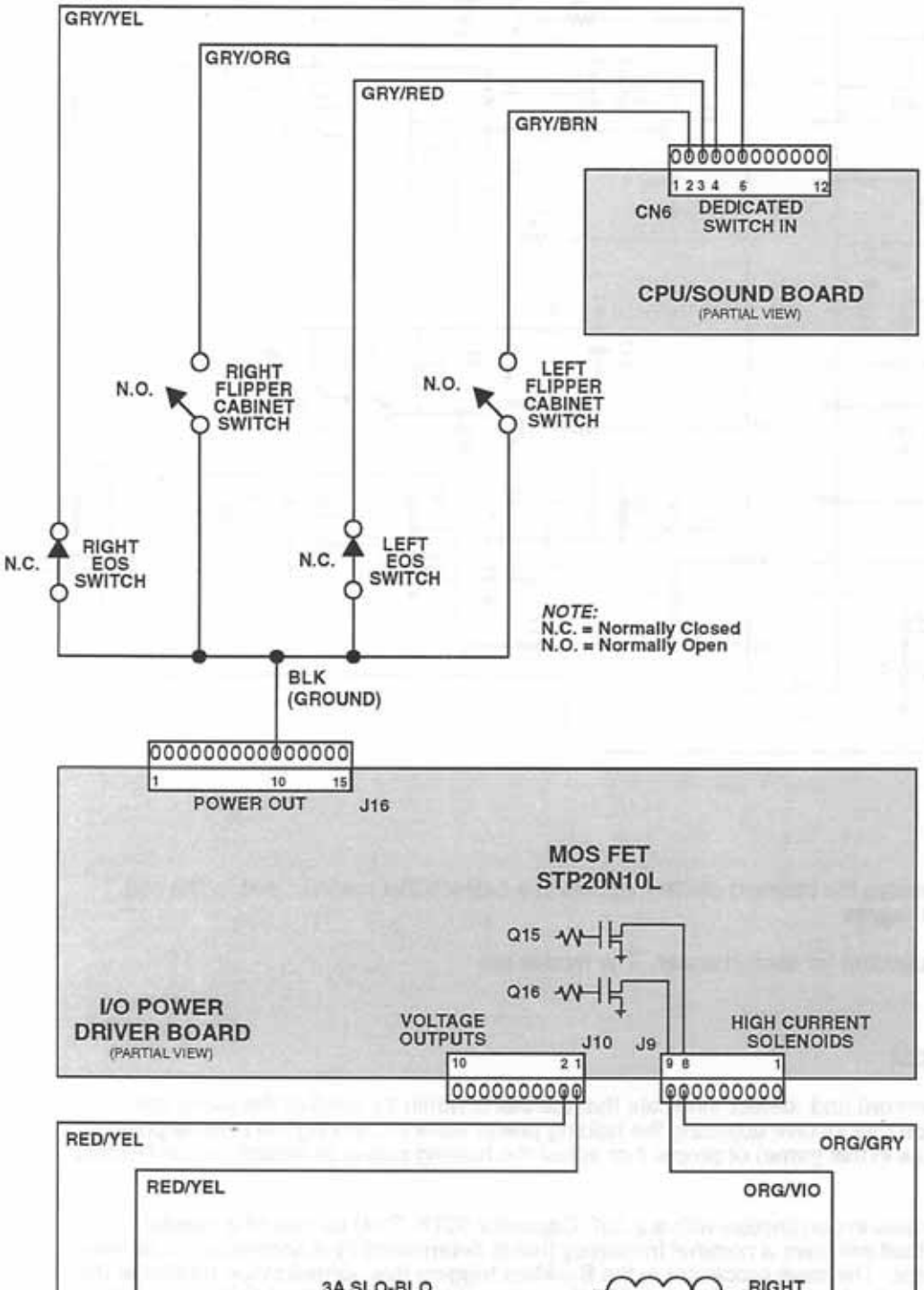
Backbox I/O Power Driver Board Detailed Wiring Diagram



Playfield Wiring

New 2-Flipper Circuit Wiring Diagram (No SSFB Required!)

The **White Star Board System**™ has allowed us to *simplify* the flipper circuit to the point where we have *eliminated the flipper board* all together. The flipper circuit is now configured the same as any other solenoid drive circuit.

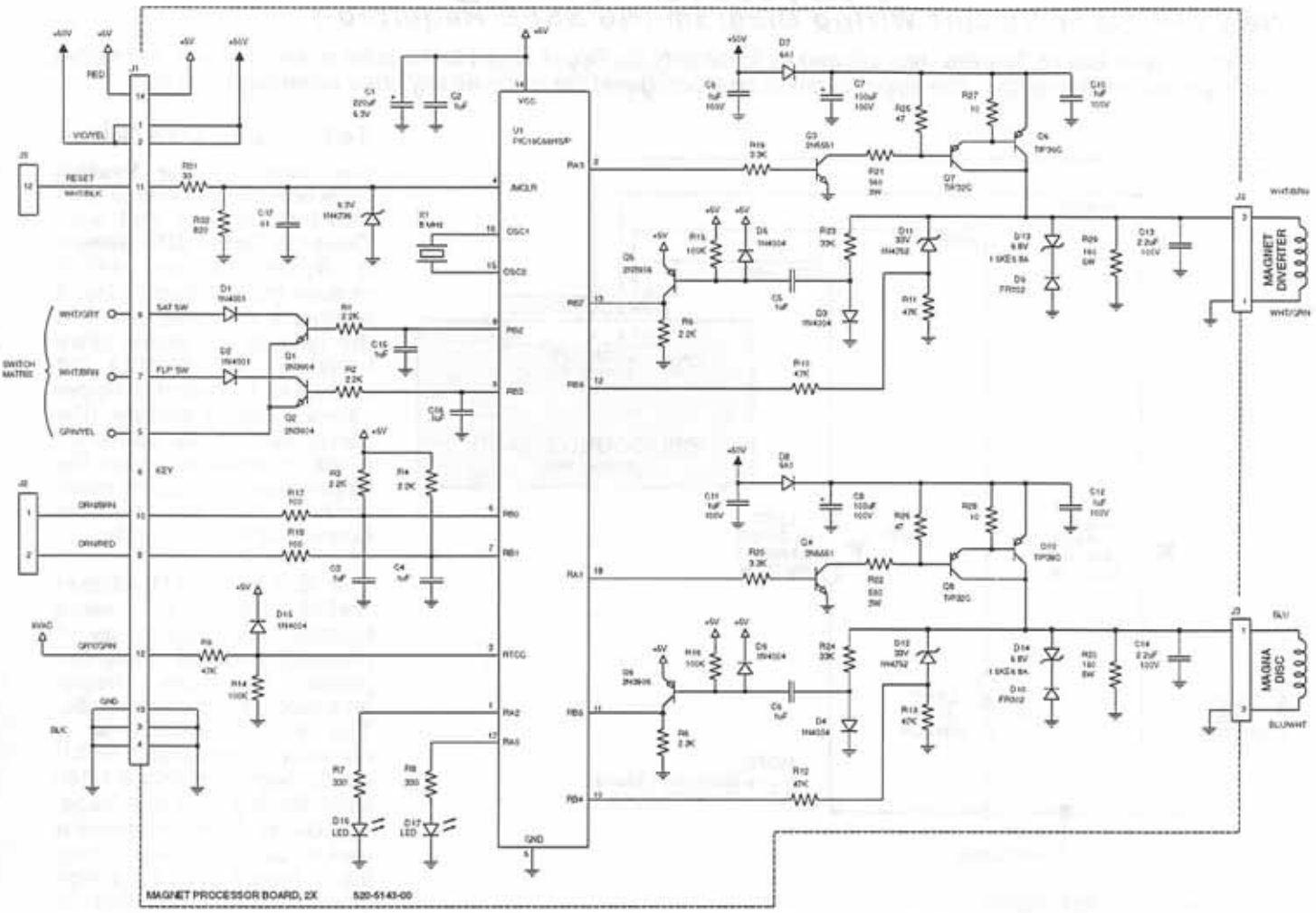


Technical Overview

Our ***New Flipper System*** uses one supply voltage (50v DC) for both kick and hold. Once the **Game CPU** detects a flipper cabinet switch closure (during game play) it applies a 40 msec pulse to the gate of the flipper drive transistor (STP20N10L). If it continues to detect a flipper cabinet switch closure (the player holding the button in) it will continue to pulse the flipper drive transistor 1 msec every 12 msecs for the duration of the hold cycle.

The **E.O.S.** (End-Of-Stroke) **Switch** serves the same function as before as it prevents foldback when the player has the flipper energized to capture balls. The **E.O.S. Switch** is a normally closed switch which opens approximately a 1/16" when the flipper is energized. The **Game CPU** will detect a switch closure if the flipper bat is forced back by a high velocity shot or rebound on the playfield and will apply another 40 msec pulse of 50v DC to the coil.

Playfield Magnet Processor/Driver Schematic & Theory of Operation



Theory of Operation

The Magnet Processor Board operates the playfield electromagnets in a bidirectional manner; that is, the coil operates both as a sensor and a magnet.

There are three main modes of operation for each channel. The modes are:

- 1. Detect the ball
- 2. Grab the ball
- 3. Hold and Detect the ball

The board cannot "grab" (full-power on) and "detect" (indicate that the ball is within it's field) at the same time. There are other modes of operation that involve adjusting the holding power while monitoring the relative position of the ball to gradually release it (as in this game) or propel it or adjust the holding power to minimize over-heating the magnet.

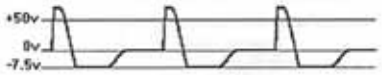
To detect the pinball, the coil operates in conjunction with a 2.2uF Capacitor (C13, C14) as part of a parallel resonant LC Tank Circuit. This circuit will have a nominal frequency that is determined by a normalization routine in the Magnet Board Sub-Processor. The main processor in the Backbox triggers this normalization routine at the start of each ball in play by resetting the board. This insures that this nominal frequency of the LC Tank Circuit, which will be used as the reference for subsequent magnet operations, remains as precise as possible. Immediately on coming out of reset, the "MAG2" LED should blink twice.

Continued on the next page.

Theory of Operation Continued

The nominal frequency of operation is determined by $f = \frac{1}{2\pi\sqrt{LC}}$

and has values typically between 700 and 800 Hz, depending on the magnetic properties of the core and bracket. A waveform analysis technique is employed to determine this frequency as this is more practical than attempting to filter the main +50V coil supply. So, rather than being presented with a sine wave, the technician will note a complex waveform like this:



This is an example of the *Detect Waveform*, which is used briefly during normalization and during *Detect Mode*. Parts of it are also buried in more complex waveforms like the ones employed in *Hold and Detect Mode*, and the monitored-release mode that walks the ball off the right of the Magna Disc (Twister) after a skill-shot. The waveform is synchronous to the line, 60Hz or 50Hz - the initial rise corresponds to a point a few degrees before the each peak, as monitored by the input from the 9v AC supply on J1 Pin-12. This charges the 2.2uF Cap. with a very narrow pulse from the main driver. The Cap. then discharges through the coil at a rate determined by the vector sum of the reactive elements in the circuit. If a pinball is within the electromagnet coil's field, it will change the relative permeability of the field slightly, and result in a slightly longer discharge to the -7.5v level shown.

The negative voltage is a consequence of the zener diode (D13, D14) and fast-recovery diode (D9, D10) that form a negative clip limiter to prevent destruction of the drive transistor (Q9, Q10) and work in conjunction with the under-damping resistor (R29, R30) to provide a smoothly damped waveform that dissipates energy quickly on the negative-half of the cycle. The positive half of the cycle is less damped to insure accurate reads to the zero-cross point read by a DC-isolated charge-pump circuit (D3, D4, D5, D6, C5, C6, Q5, Q6, R15, R16, R23, R24). Output from this circuit to the microcontroller (U1) provides the reference to determine the slope values associated with a *Tank Circuit* de-tuned by the pinball.

Grab Mode simply drives the magnet full on without detection, and *Hold and Detect Mode* applies pulse-width modulated power to the magnet and runs the detect routine during the "off" portions of the waveform. In the latter mode, data concerning the ball is fed back to the main processor through switch matrix drives (Q1, Q2, D1, D2). The main processor controlls the Magnet Board via the enables on J1-8, 10.

Playfield Magnet Processor/Driver Board Parts

ITEM	QTY	REF-DESGINATOR	DESC./MFR.
		RESISTORS	
1	6	R1-R6	2.2K 1/4W
2	2	R7-R8	330 1/4W
3	5	R9-R13	47K 1/4W
4	3	R14-R16	100K 1/4W
5	2	R17-R18	100 1/4W
6	2	R19-R20	3.3K 1/4W
7	2	R21-R22	560 3W
8	2	R23-R24	33K 1/4W
9	2	R25-R26	47 1/4W
10	2	R27-R28	10 1/4W
11	2	R29-R30	160 5W
12	1	R31	33 1/4W
13	1	R32	820 1/4W
		CAPACITORS	
14	1	C1	220uF 6.3V (Rad Elec Panasonic ECE-AOJU221 or eqv.)
15	5	C2-C6	.1uF 25V (Axial Cer)
16	2	C15-C16	.01uF 25V (Axial Cer)
17	2	C7-C8	100uF 100V (Rad Elec Panasonic ECE-A2AU101 or eqv.)
18	4	C9-C12	.1uF 100V (Axial Cer)
19	2	C13-C14	2.2uF 100V (NPO Poly Panasonic ECQ-E1225K or eqv.)
20	1	C17	.01uF 25V (Axial Cer)

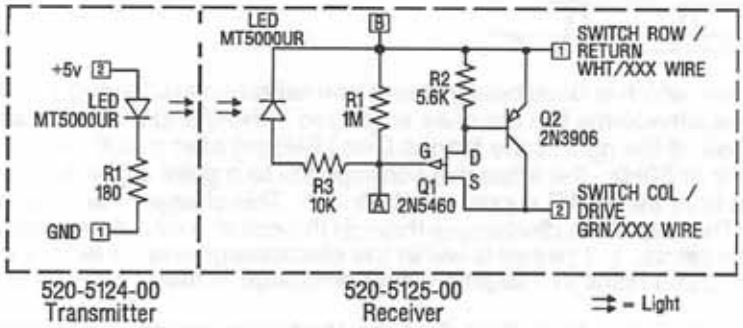
ITEM	QTY	REF-DESGINATOR	DESC./MFR.
		DIODES	
21	7	D1-D6,D15	1N4004
22	2	D7-D8	6A 100V (Fast Diodes Inc. 6A1 or eqv.)
23	2	D9-D10	3A 100V (Fast Diodes Inc. FR302 or eqv.)
24	2	D11-D12	33V 1W (Zener 1N4752)
25	2	D14-D15	6.8V 5W (TVS Zener Gen. Inst. 1.5KE6.8A or eqv.)
26	2	D16-D17	T1 3/4 (Red Diffused LED)
		TRANSISTORS	
27	2	Q1-Q2	2N3904
28	2	Q3-Q4	2N5551
29	2	Q5-Q6	2N3906
30	2	Q7-Q8	TIP32C
31	2	Q9-Q10	TIP36C
		MISCELLANEOUS	
32	1	X1	8MHZ (Ceramic Res. w/ Int. Caps)
33	1	U1	(PIC16C54-HS/P Microchip OTP MCR.)
34	1	SOCKET	18-Pin Dip Socket, (.300" w.)
35	1	J1	15 X .156" (Male Locking Hdr.)
36	2	J2-J3	3 X .156" (Male Locking Hdr.)
37	2	HEATSINKS	EG&G (286AB or eqv.)
38	2 sets	SOT-93	Sil Pads, Heat-Sink Screws, Nuts, Washers

Trough Up-Kicker OPTO
Theory of Operation & Schematic

Theory of Operation

As light from the Transmitter falls on the Receiver LED, it generates a Positive Bias Voltage (0.7v to 1.5v) which is applied to the gate of **Q1**, turning **Q1** off. When **Q1** is held off, no current flows through **Q2**'s Base, the transistor is off acting as an *OPEN SWITCH.* When the light is interrupted (*BLOCKED*) **R1** bleeds the gate voltage off of **Q1** allowing it to conduct, switching **Q2** on, which acts as a *CLOSED SWITCH.*

Fig. 1



TAKE NOTE:
LED MT5000UR
(Ultra Bright Red)
Sega Pinball Part N²
165-5100-00

Troubleshooting

1. Volt Meter Test (indicates normal operating condition):

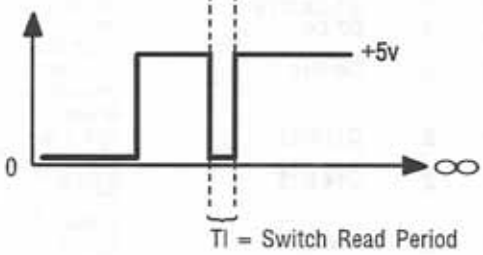
A. **OPEN OPTO** (Light Falling on LED) = *SWITCH OPEN.* Place meter leads across points **A** and **B** (Refer to Schematic Drawing Fig. 1 above). It should read approximately 0.8 - 1.2v DC.

B. **CLOSED OPTO** (Light Blocked) = *SWITCH CLOSED.* Place meter leads across points **A** and **B** (Refer to Schematic Drawing Fig. 1 above). It should read approximately 0.0 - 0.1v DC.

2. Oscilloscop Test (indicates normal operating condition):

Fig. 2A

Fig. 2B



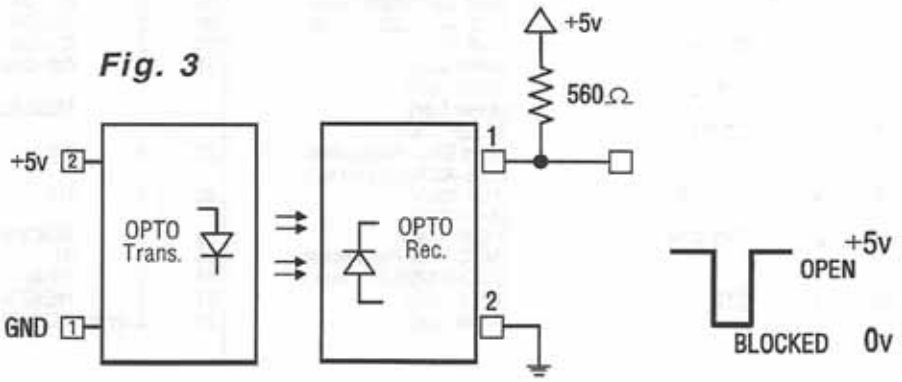
A. **OPEN OPTO** (Light Falling on LED) = *SWITCH OPEN.* Place Scope lead at **Pin-1** of OPTO Rec. Board with Scope Grounded (See Fig. 1). The Scope should display a **STEADY +5v** as shown in Fig. 2A, Wave Form Diagram.

B. **CLOSED OPTO** (Light Blocked) = *SWITCH CLOSED.* Place Scope lead at **Pin-1** of OPTO Rec. Board with Scope Grounded (See Fig. 1). The Scope should display a **PULSE STREAM** indicating **Q2** has switched "On" as shown in Fig. 2B, Wave Form Diagram. This is your Switch Drive Pulse.

3. Bench Test (See Fig. 3 Below):

Disconnect the OPTO Transmitter / Receiver Board from the circuit. Connect one side of a 560W Pull-up Resistor to **Pin-1** of the OPTO Receiver Bd. and the other side of the resistor to a 5v DC source. Connect **Pin-2** to GND. Connect a +5v DC source to **Pin-1** of the Transmitter & GND to **Pin-2.** Align with the Receiver OPTO approx. 3" distance. Using your Volt-Meter or an Oscilloscope, monitor **Pin-1** while *BLOCKING* and *UNBLOCKiNG* the ***BEAM*** from the Trans. The output will be approx. +5v DC when the ***BEAM IS NOT BLOCKED*** and approx. Øv when the ***BEAM IS BLOCKED.***

Fig. 3

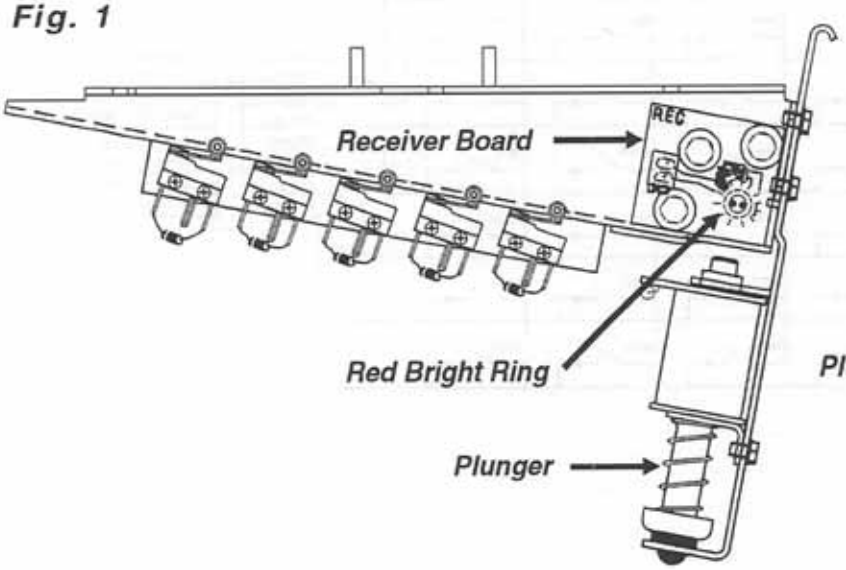


Single Trough OPTO Alignment / Test

When a working OPTO is installed and connected in a game, the transmitter should light when the power is switched on. With the playfield in Service Position #1 (playfield pulled forward resting on the playfield support brackets) and the game on, the light should show up as a "RED BRIGHT RING" through the back of the Receiver Board around the Receiver LED (See Fig. 1). With the game in Switch Test Mode, lifting the Trough Plunger with a fingertip should block the Beam and cause the Switch Positon to trigger (See Fig. 2). View Fig. 3a & 3b for a sectional view of the Light Path (note alignment) and what happens as a ball breaks the light beam.

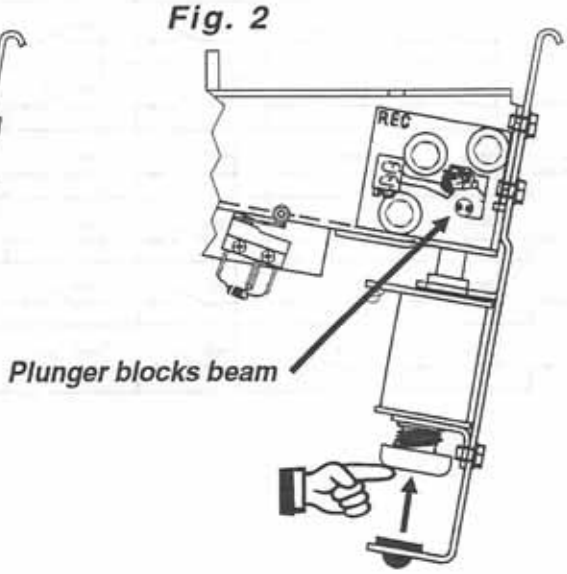
View facing trough (with playfield in Service Position #1)

Fig. 1



Lift plunger to check switch as shown.

Fig. 2



Sectional view from right

Fig. 3a

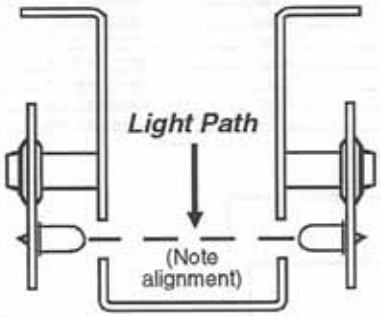
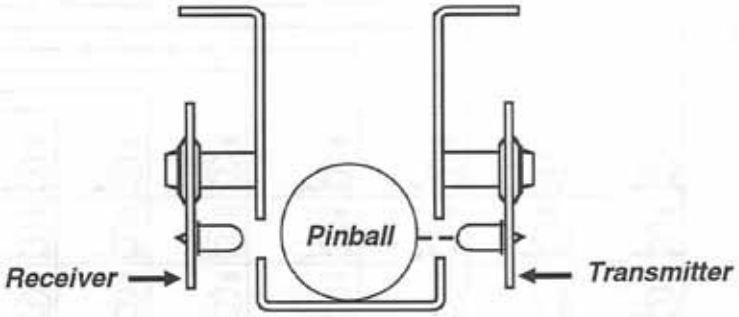


Fig. 3b

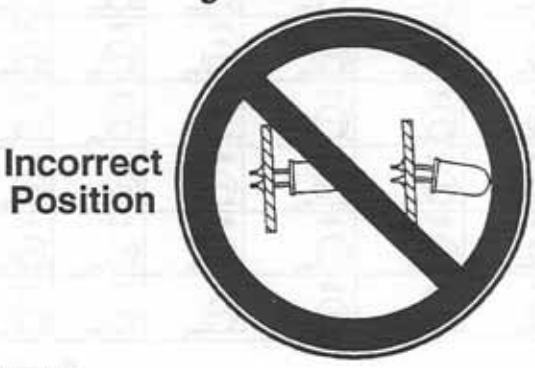


IMPORTANT

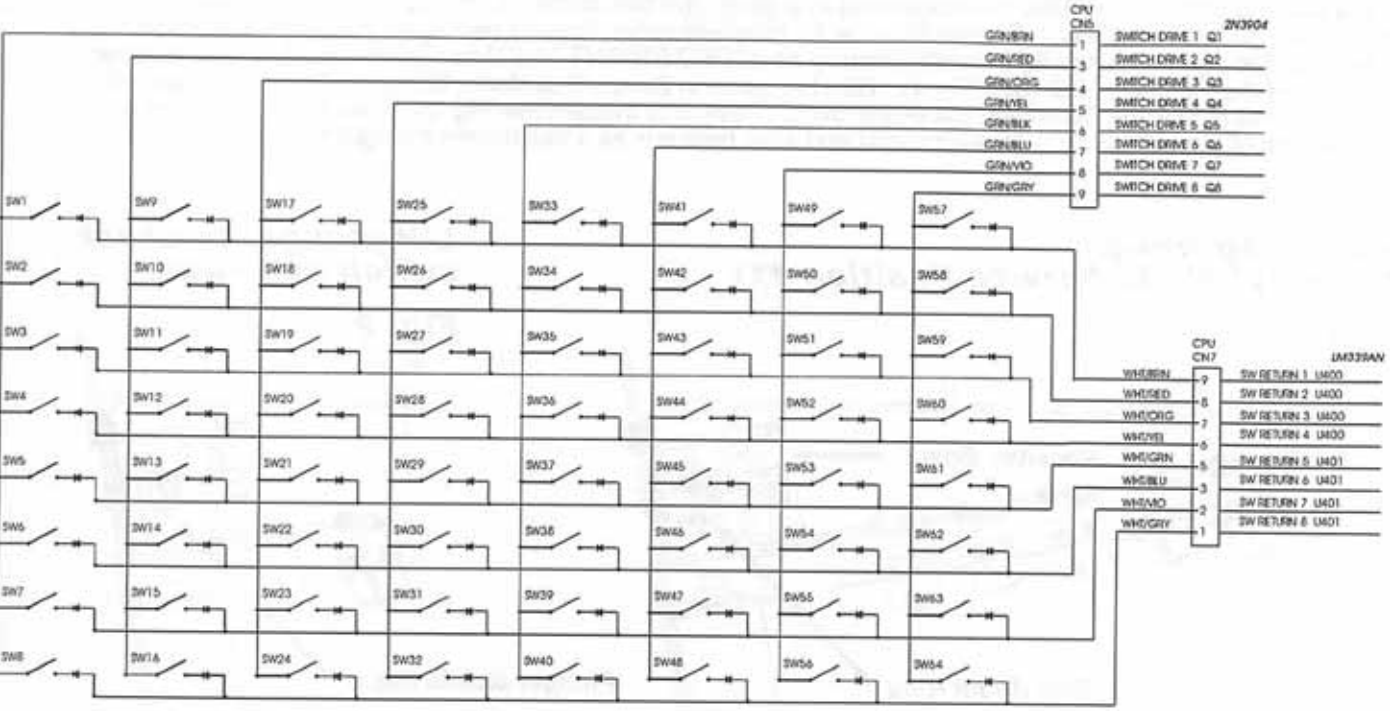
If replacement of LED is required, insure that is mounted correctly before and after soldering (See Fig. 4a & 4b).

Fig. 4a

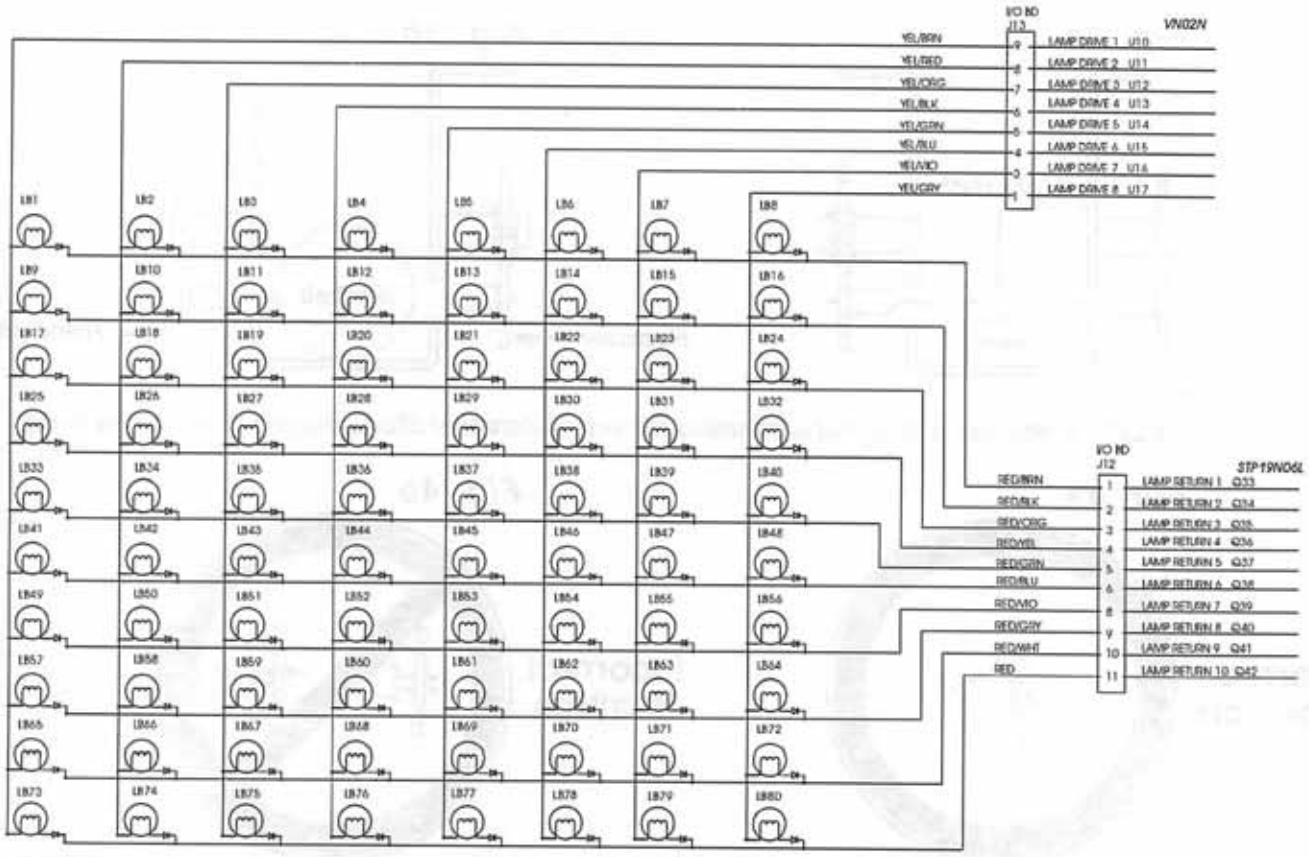
Fig. 4b



Playfield Switch Diagram

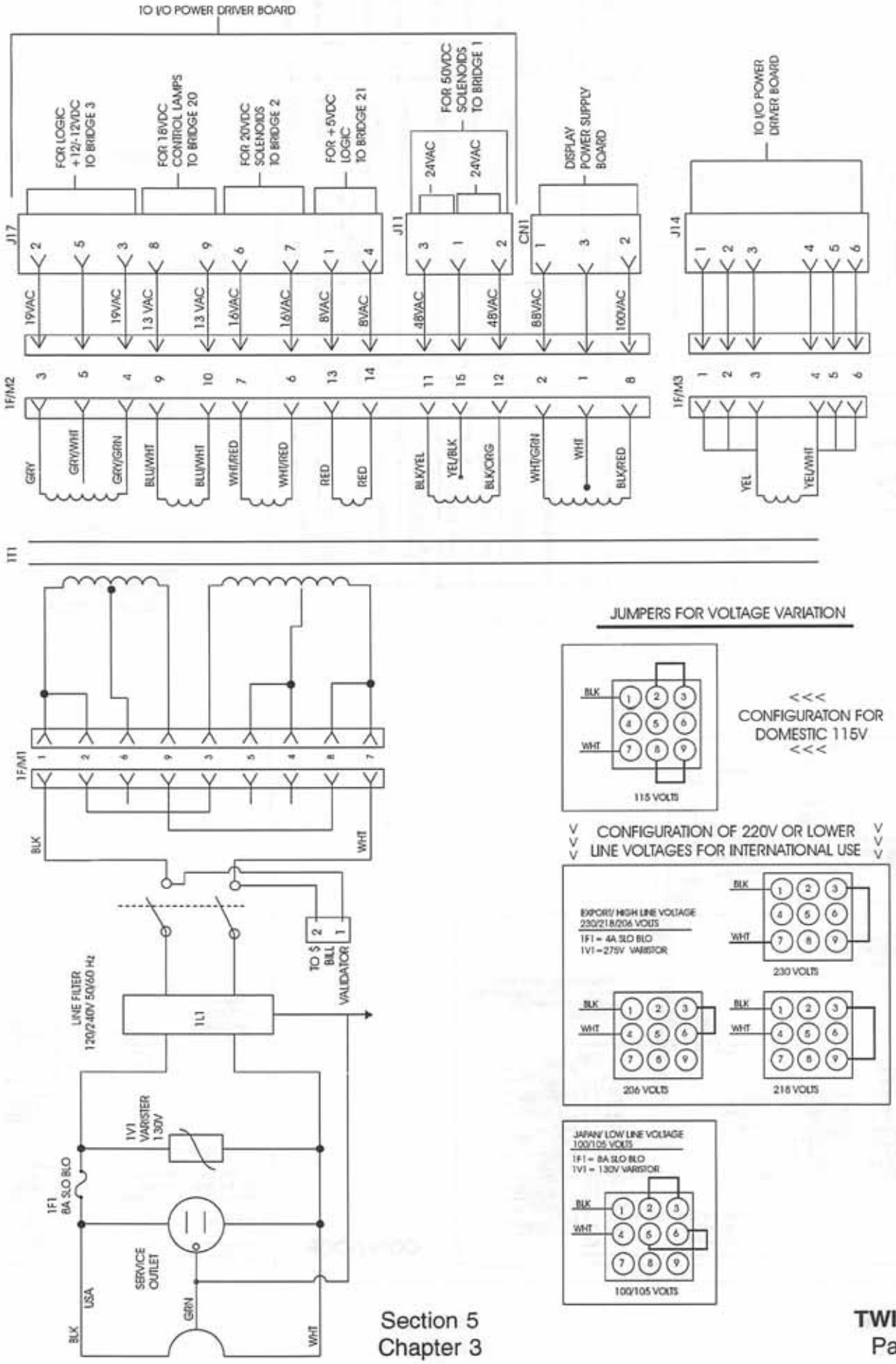


Playfield Lamp Wiring Diagram

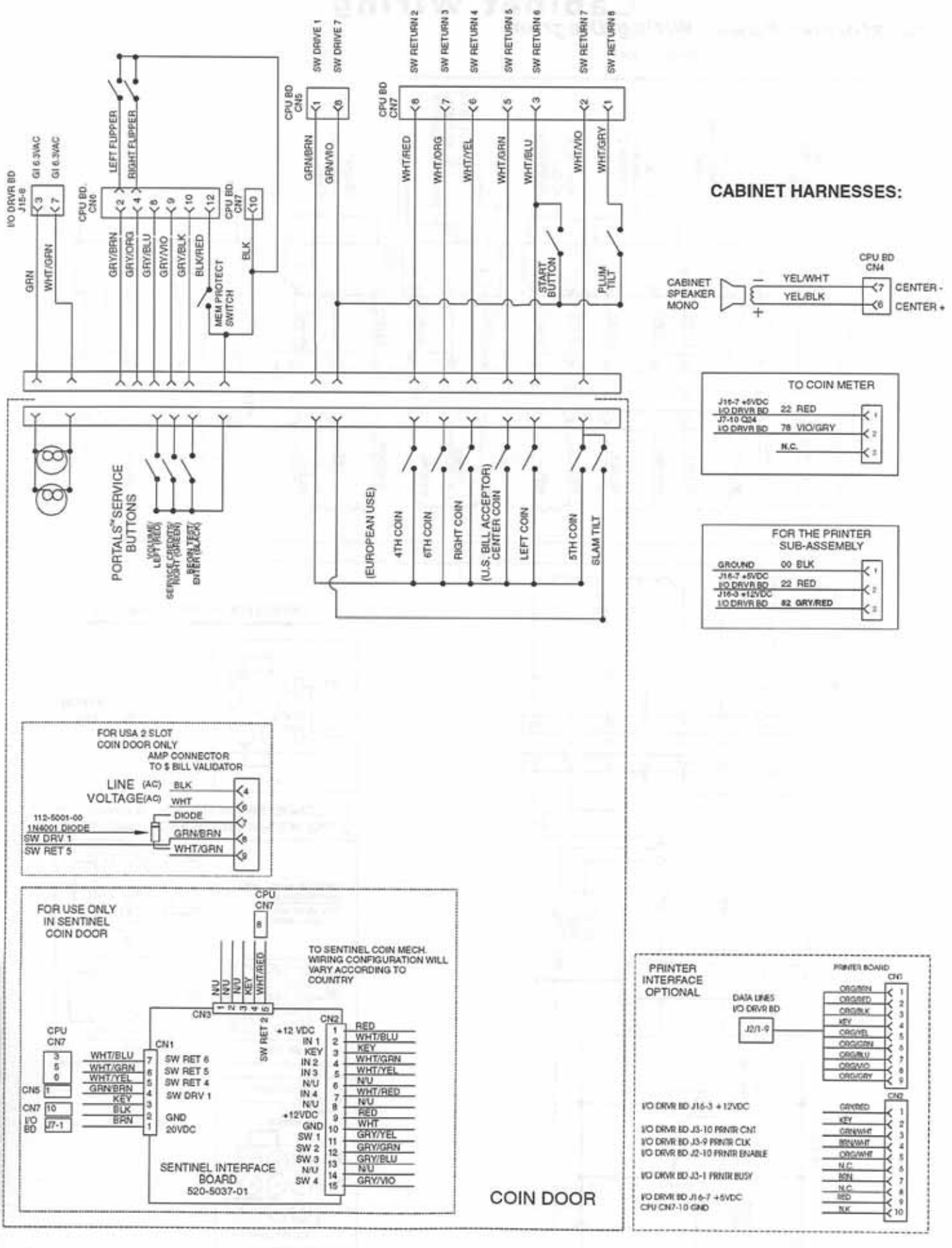


Cabinet Wiring

Transformer Power Wiring Diagram

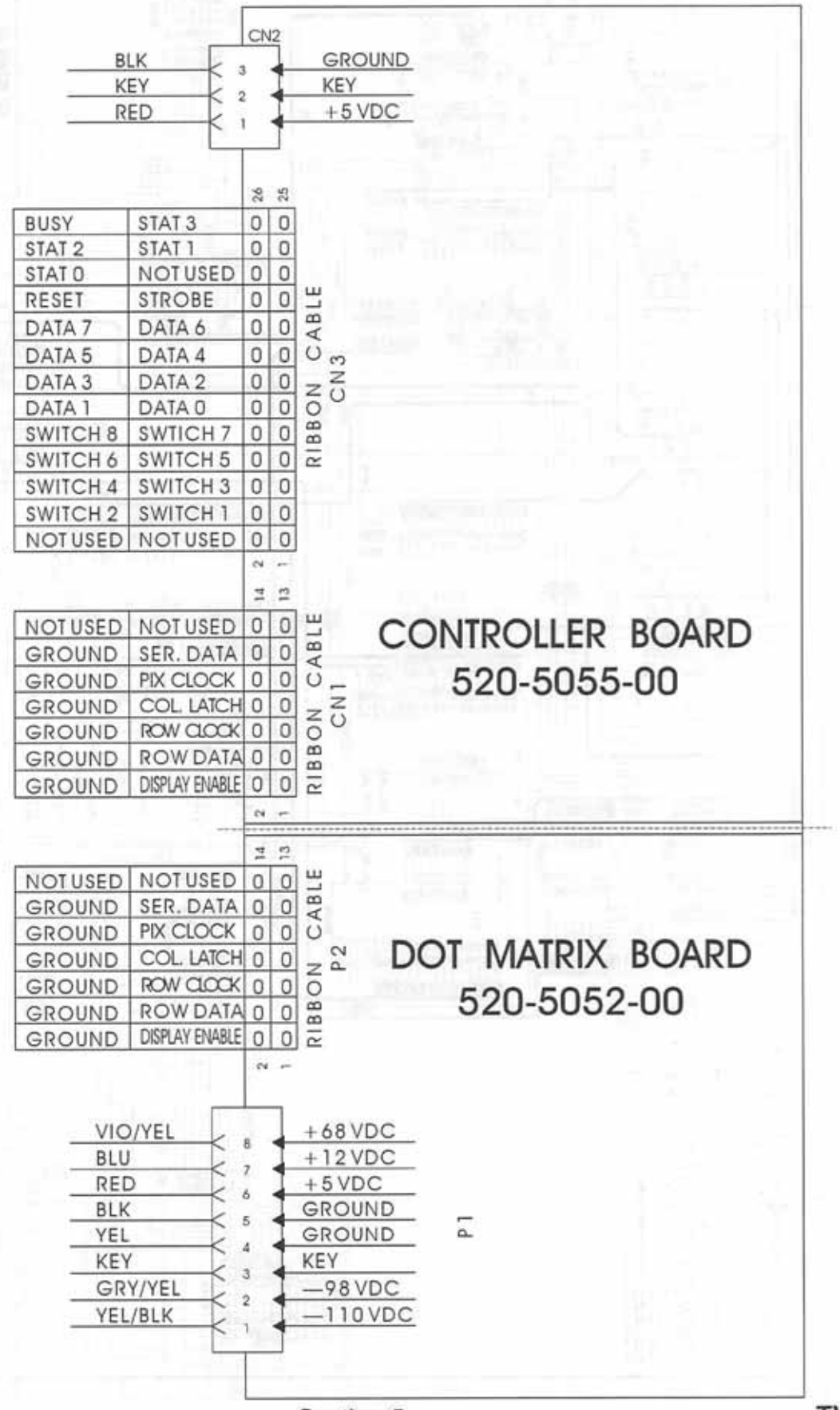


Cabinet/Coin Door Wiring Diagram

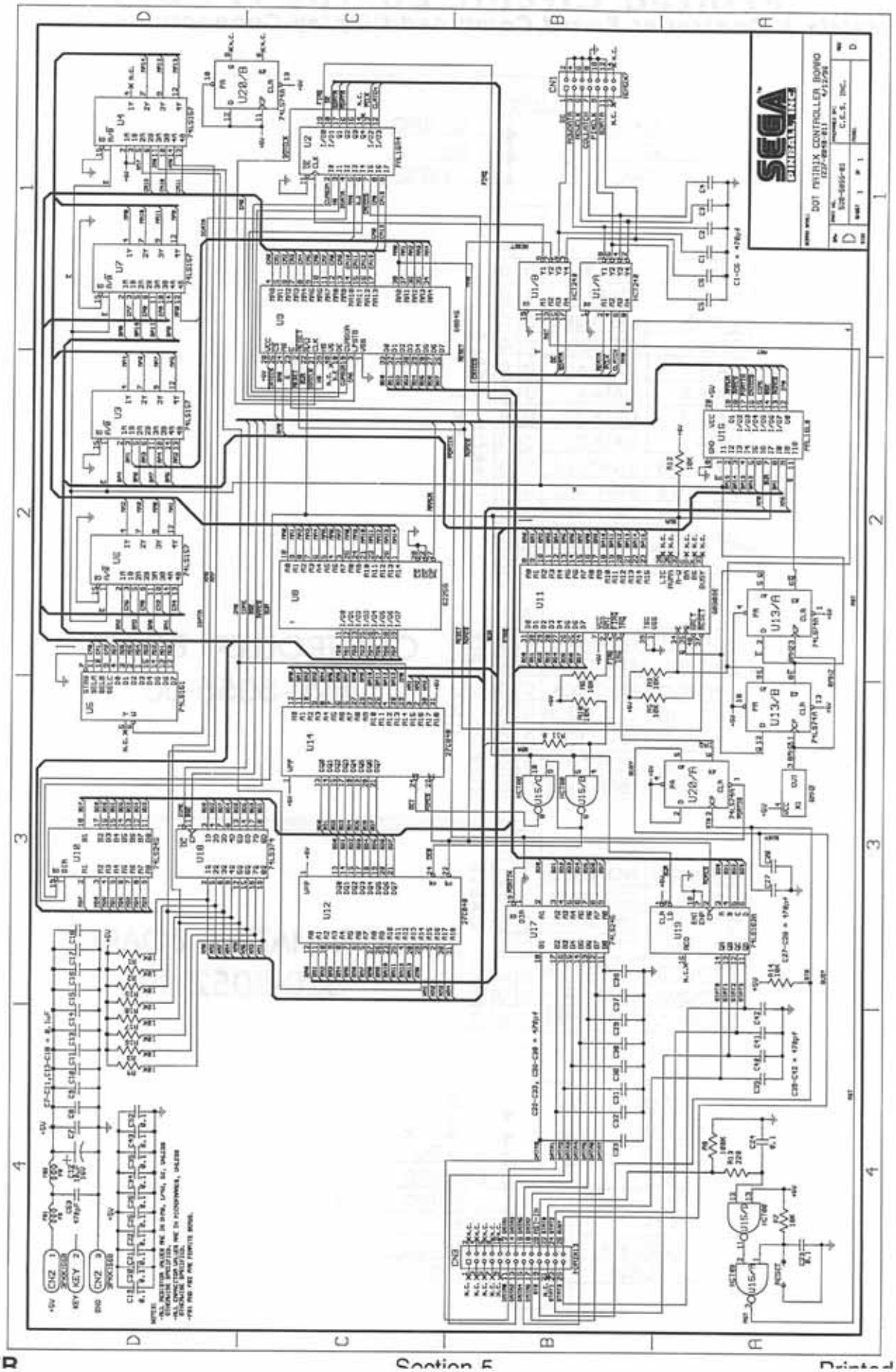


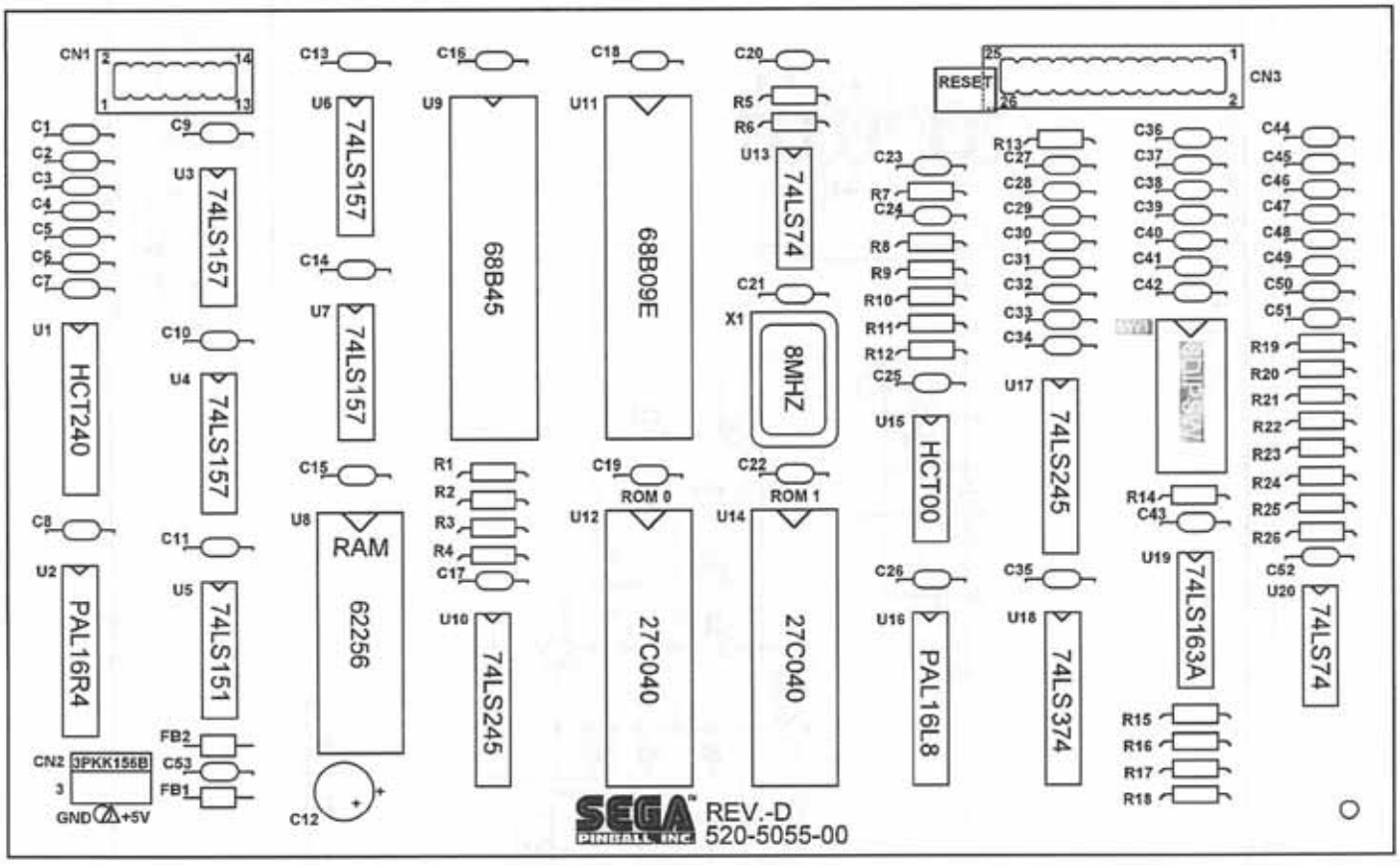
Printed Circuit Boards (PCBs)

Dot Matrix & Controller Board Combined Display Connections



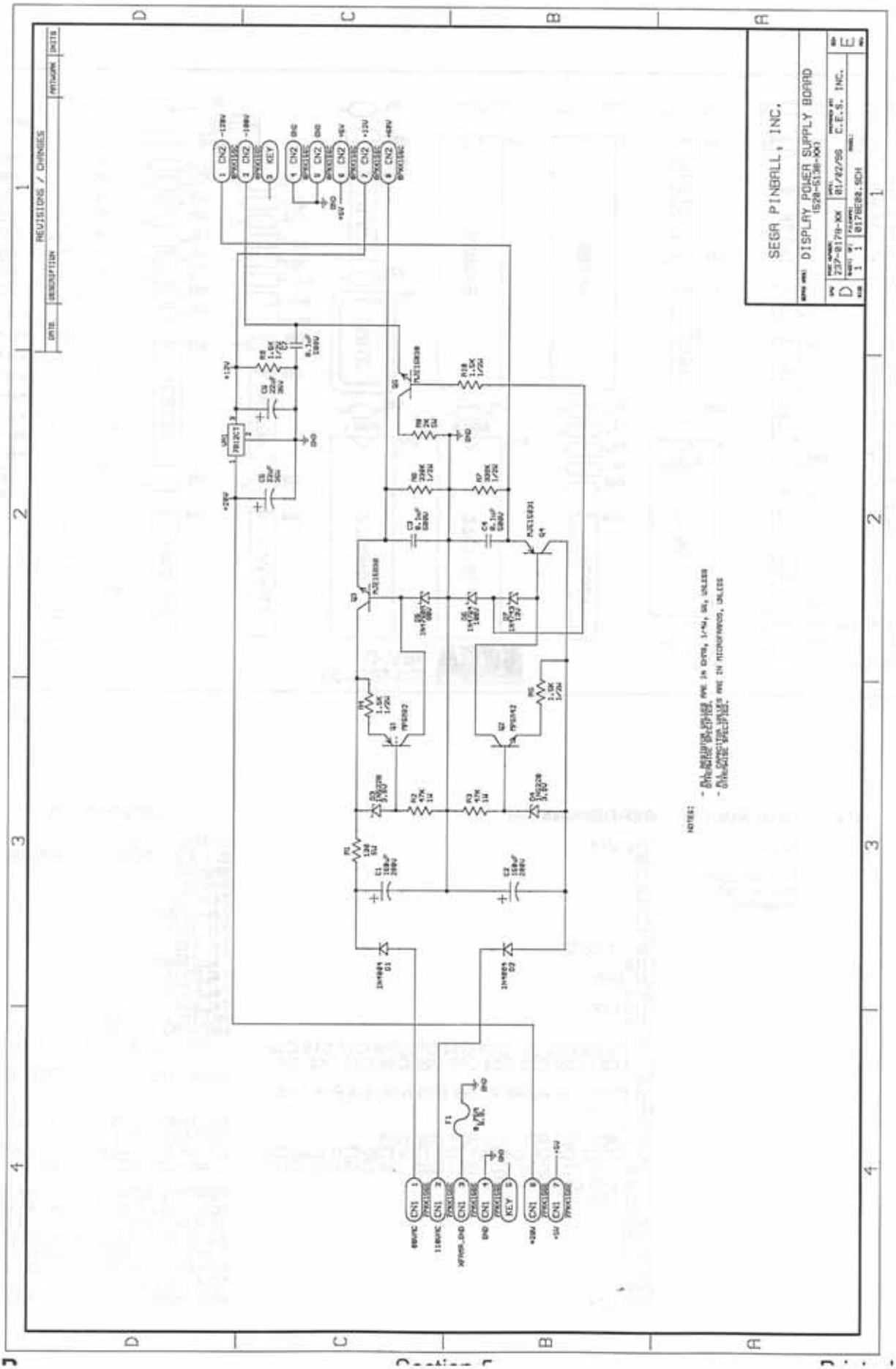
Display Controller Board Schematic

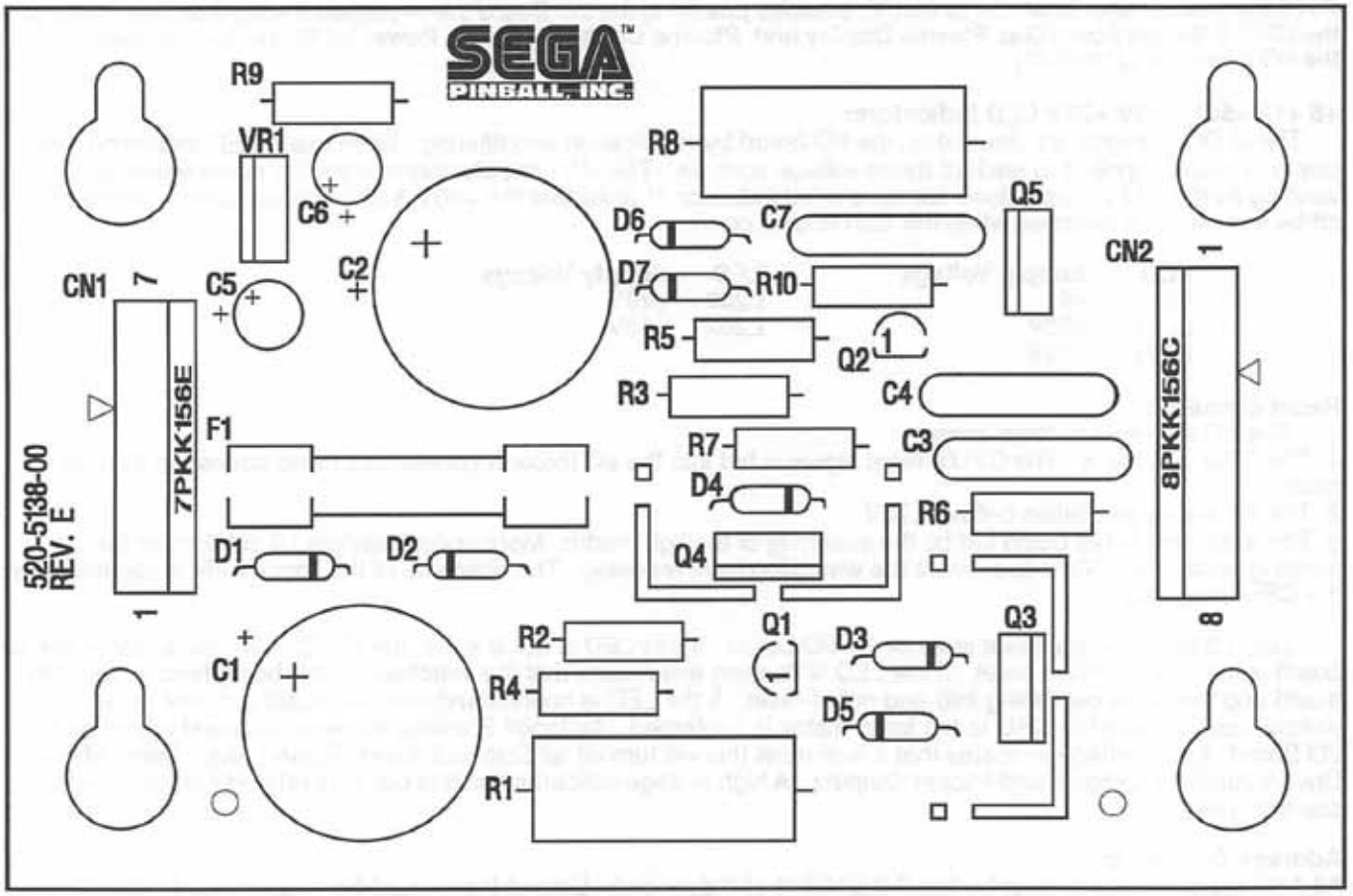




ITEM	QTY	PART NUMBER	REF-DESIGNATOR	DESCRIPTION
1	2	Note:	U12 U14	32-PIN SOCKET
2	1		U8	32K X 8 STATIC RAM (62256L-10PC)
3	1	Part Numbers	U11	68B09E
4	1	are not yet	U9	68B45
5	1	available.	U15	74HCT00
6	1		U1	74HCT240
7	1		U5	74LS151
8	4		U3 U4 U6 U7	74LS157
9	1		U19	74LS163A
10	2		U7, U10	74LS245
11	1		U18	74LS374
12	2		U13 U20	74LS74
13	1		U16	PAL16L8 (15CN)
14	1		U2	PAL16R4 (25CN)
15	23		C7 C8 C9 C10 C11 C13 C14 C15 C16 C17 C18 C19 C20 C21 C22 C23 C24 C25 C26 C34 C35 C43 C52	.1 mF (104) AXIAL CER. CAP
16	1		R8	100K OHM 1/4 W C.F. RES. 5%
17	15		R1 R2 R3 R4 R5 R6 R7 R9 R10 R12 R14 R15 R16 R17 R18	
18	1		R13	220 OHM 1/4 W C.F. RES. 5%
19	0		R19 R20 R21 R22 R23 R24 R25 R26	NOT STUFFED
20	21		C1 C2 C3 C4 C5 C6 C27 C28 C29 C30 C31 C32 C33 C36 C37 C38 C39 C40 C41 C42 C44 C45 C46 C47 C48 C49 C50 C51 C53	470 pF (471) AXIAL CER. CAP (C44—C51 NOT STUFFED)
21	2		FB1 FB2	FERRITE BEAD (2743001182)
22	1		C12	100uF 25V CAP (RADIAL ELEC)
23	1		CN3	13-PIN DUAL ROW .1" HDR CONN.
24	1		CN2	3-PIN KK-156 CONN. (540445-3)
25	1		CN1	7-PIN DUAL ROW .1" HDR. CONN.
26	1		X1	8Mhz CLOCK OSCILLATOR
27	0		SW1	NOT STUFFED
28	1		U12 U14	4MB ROM (U14 NOT STUFFED)

Display Power Supply Board Schematic





ITEM	QTY	PART NUMBER	REF-DESIGNATOR	DESCRIPTION
1	1	Note:	F1	S.B. 0.5A
2	2		Q3 Q4	HEATSINKS - AAVID #563002
3	2	Part Numbers	C2 C1	200V 150uF RADIAL LYTIC
4	4	are not yet	R10 R9 R5 R4	1/2W 1.5K
5	2	yet availalbe.	R7 R6	1/2W 330K
6	2		R2 R3	1W 47K
7	1		R1	5W 130
8	1		R8	5W 2K
9	2		D3 D4	3.9V 5228
10	1		D5	68V 4760A
11	1		D6	100V 4764
12	1		D7	13V 4743
13	1		Q1	MPSA92
14	1		Q2	MPSA42
15	3		C3 C4 C7	500V 0.1uF CERAMIC DISK
16	1		Q4	MJE15031
17	2		Q3 Q5	MJE15030
18	2		C5 C6	25V 22uF RADIAL LYTIC
19	1		VR1	7812CT
20	1		CN2	8pkk156 (PIN3=KEY)
21	2		D1 D2	1N4004
22	1		CN1	7PKK156E (PIN5=KEY)
23	2		Q3 Q4	6/32 KEY NUT
24	2		Q3 Q4	6/32 X 3/8 SCREW
25	2		F1	FUSECLIPS

I/O Power Driver Board Theory of Operation

5V Supply:
An AC voltage of approximately 9V comes into the board at [J17-(1-4)] this AC voltage is then full-wave rectified by bridge BRDG 21 and filtered by capacitor C203. The resulting voltage is 11VDC which is inserted into a linear voltage regulator for the output of 5VDC. This 5V regulated voltage can be adjusted by potentiometer R116 the voltage should be set to 5.00V. Besides powering the I/O Board the regulated 5 volts supplies power to the CPU & Sound Board Gas Plasma Display and Plasma Controller Board. Power for these devices comes off the I/O Board on [J16-(4-8)].

+5 +12 +50V +18V +20V LED Indicators:
These DC voltages are derived on the I/O board by rectification and filtering. Each has a LED indicating that power is being supplied to each of these voltage sources. The -12V supply comes from the same transformer winding as the +12V thus it does not have a led indicator. ** Note that the +50V &+20V power sources are turned off by the interlock switches when the coin door is open.

LED	Supply Voltage	LED	Supply Voltage
L2	+5	L200	+20V
L201	+50V	L202	+18V
L203	+12V		

Reset Circuitry:
The I/O will reset in three cases:
1. The CPU is in reset. The CPU's reset signal is fed into the I/O through connector J1 and forces the I/O into reset.
2. The 5V supply has fallen bellow 4.75V.
3. The watchdog is not being fed by the scanning of the light matrix. More specifically pin 19 of U6 must be toggling once every 50ms to prevent the watchdog from resetting. The scanning of the light matrix is controlled by the CPU through J1.

LED L204 shows the reset state of the I/O board. If this LED is not lit either the 5VDC is below 4.75V or the CPU board is holding the I/O in reset. If the LED is flashing this means that the watchdog is not being feed by the CPU board and the I/O is oscillating into and out of reset. If the LED is continuously on the board is out of reset and communication from the CPU to the lamp matrix is confirmed. Testpoint Blanking is the actual reset signal on the I/O Board. A low voltage indicates that it is in reset this will turn off all Solenoid drivers Flash Lamps Lamp Matrix Drivers Auxiliary Outputs and Flipper Outputs. A high voltage indicates that it is out of reset and normal operation can take place.

Address Decoding:
All Address decoding is done by two 74LS138 (1 of 8 decoder). Both of these must be in operation for the I/O Board to function properly.

Solenoid Drivers & Flash Lamps:
J8 & J9 are high side drivers for driving solenoids and other heavy loads. Each connector has its own buffer driving 8 drivers. J8 & J9 consist of MOSFET drivers 20N10L which can easily & safely be tested by clipping one end of a clip-lead to test point FET TPL1 and then the other to the corresponding gate resistor R1-R16 (see note 1). This will apply 3.4V to the gate of the MOSFET transistor thus switching it on. J7 & J6 each are a bank of 8 low side driver for driving lamps or other lower current solenoids. They use a bipolar power transistor TIP122 which can also be tested by using test point TIP TPL3 and the corresponding resistors R17-R32 (see note 1).

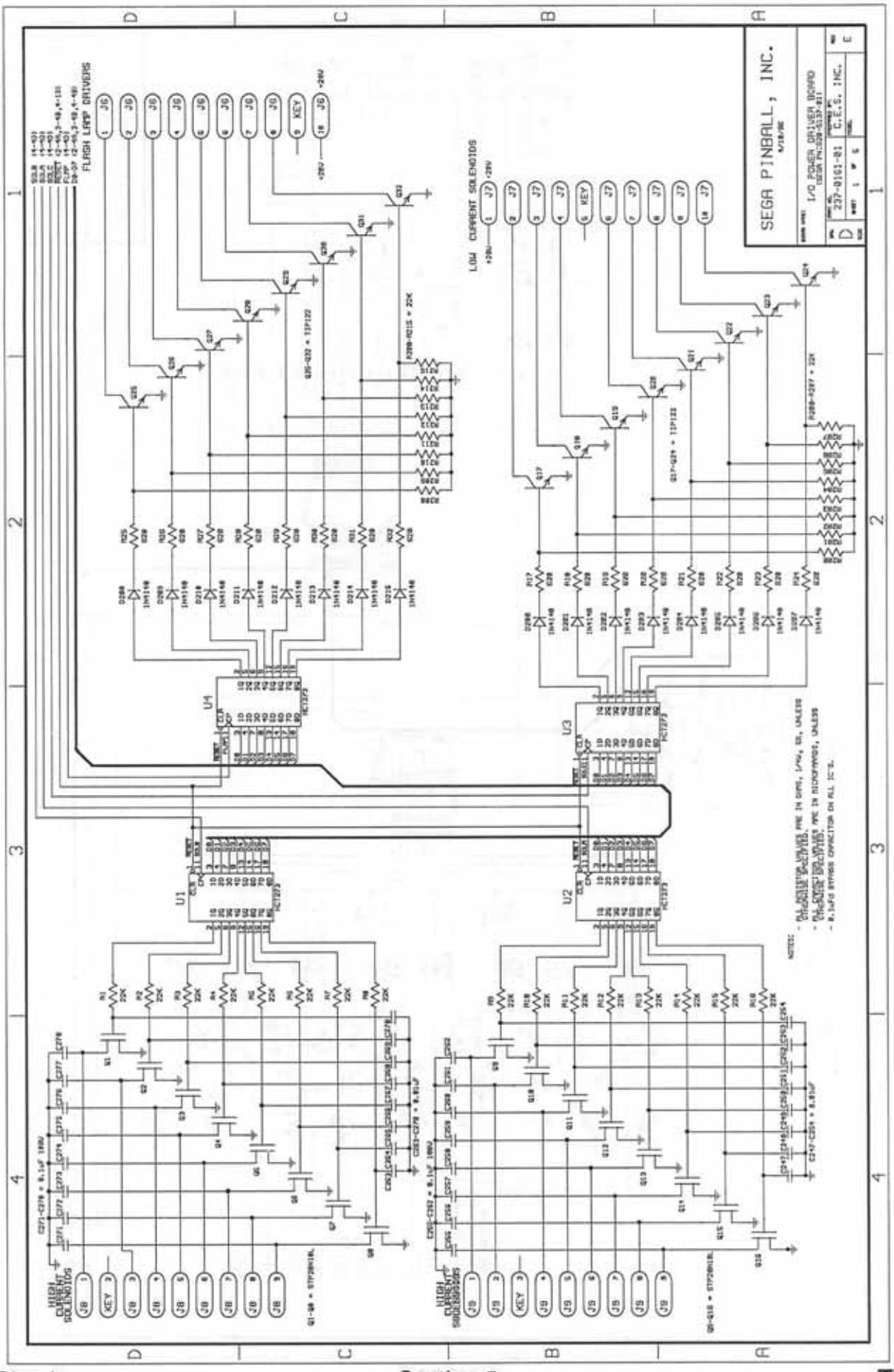
Note 1 * Clip on the resistor side with the white stripe.
** R1 controls Q1 and R2 controls Q etc...

Auxiliary In & Out:
J2 8 CMOS Outputs sometimes used for a printer interface.
J3 8 CMOS Inputs general purpose inputs.

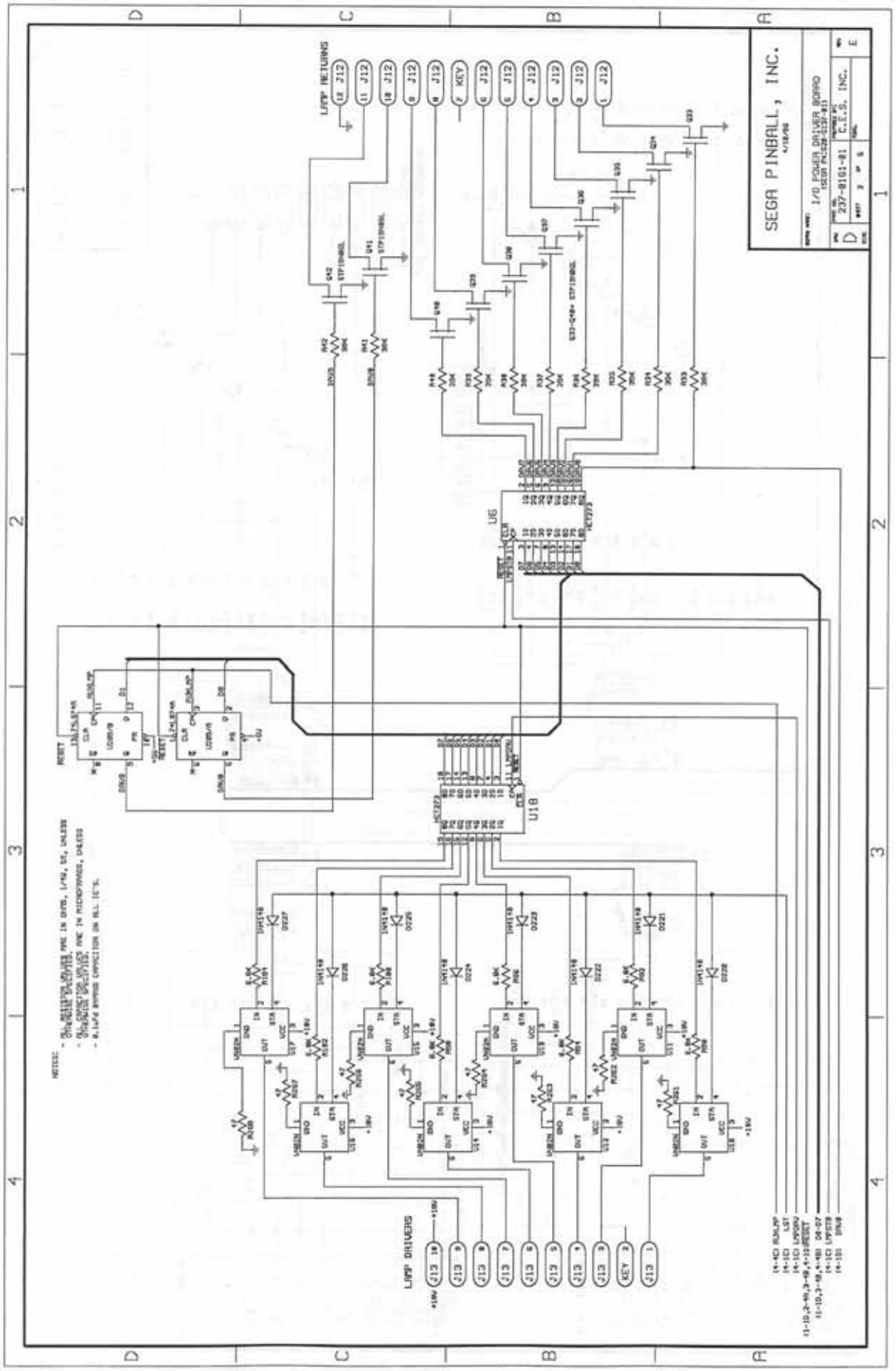
Lamp Matrix:
J12 has 10 low side drivers for the lamp strobes which consist of 19N06L MOSFETS. Only one lamp strobe should be low at any time. Again the scanning of the lamp strobes keeps the I/O from resetting. J13 has 8 high side drivers with each having a status indicator. All the status indicators are logically 'OR'ed together and fed back to the CPU. The status can identify open loads (for example open lamp filaments or intermittent connections) and short circuits. These drivers are also short-circuit protected.

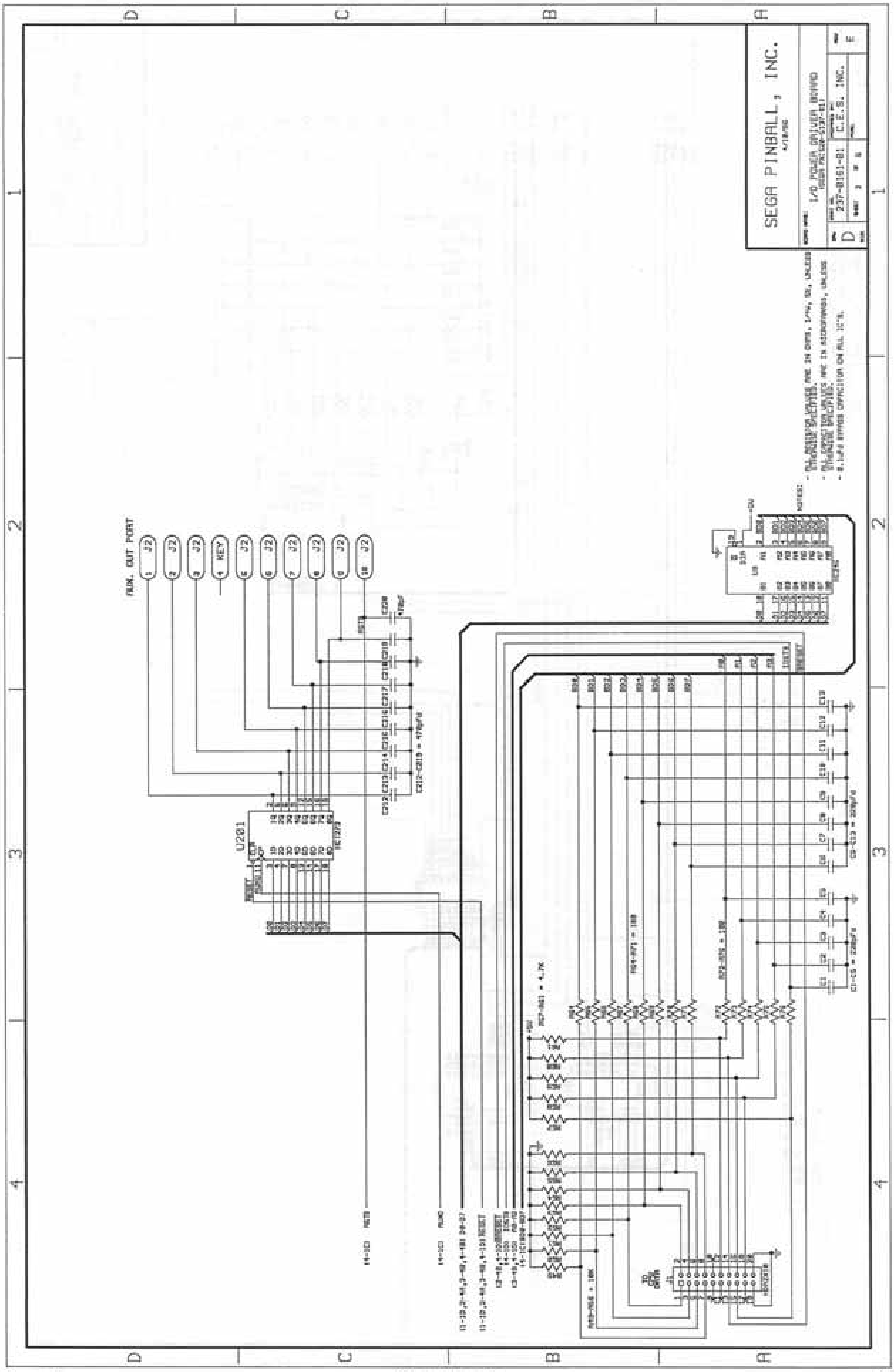
General Illumination (G.I.) Lights:
J15 has 6VAC switched on and off by a relay on the I/O Board. The relay is controlled by Q200 which supplies power to the 24V coil winding to activate the relay. There are 4 taps on J15 each fused at 5A for this 6VAC source.

I/O Power Driver Board Schematic (Sheet 1 of 5)

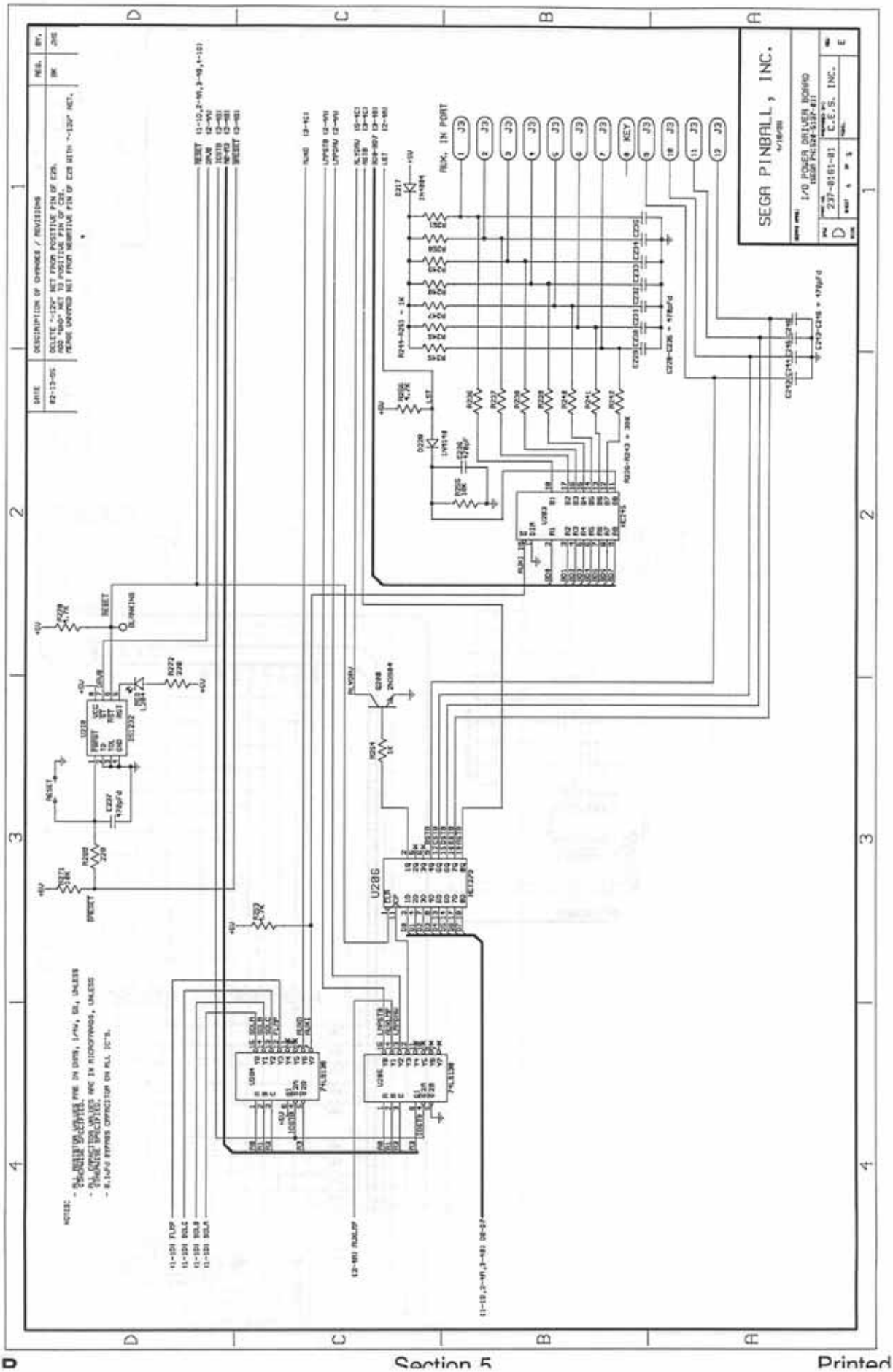


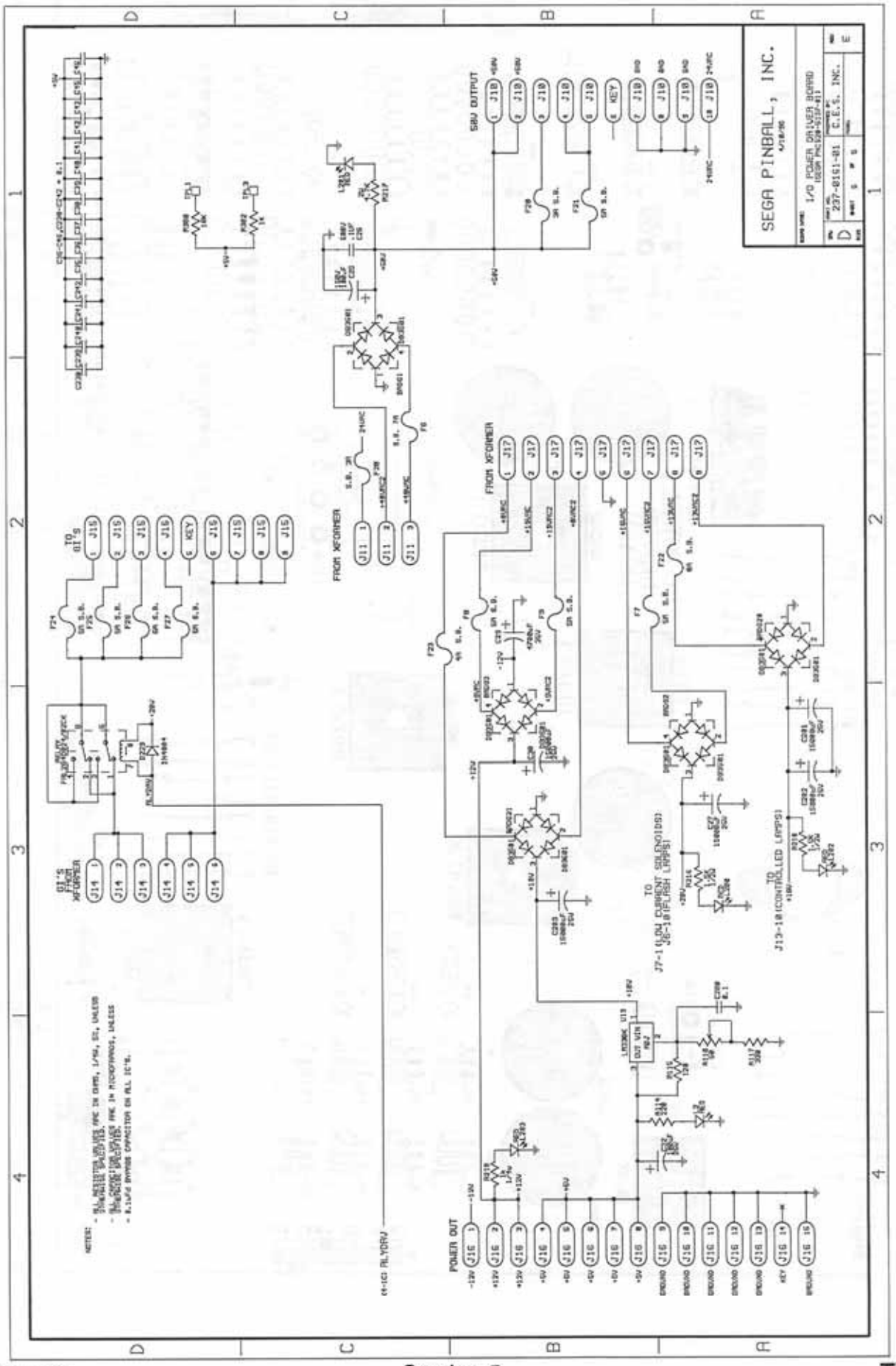
I/O Power Driver Board Schematic (Sheet 2 of 5)



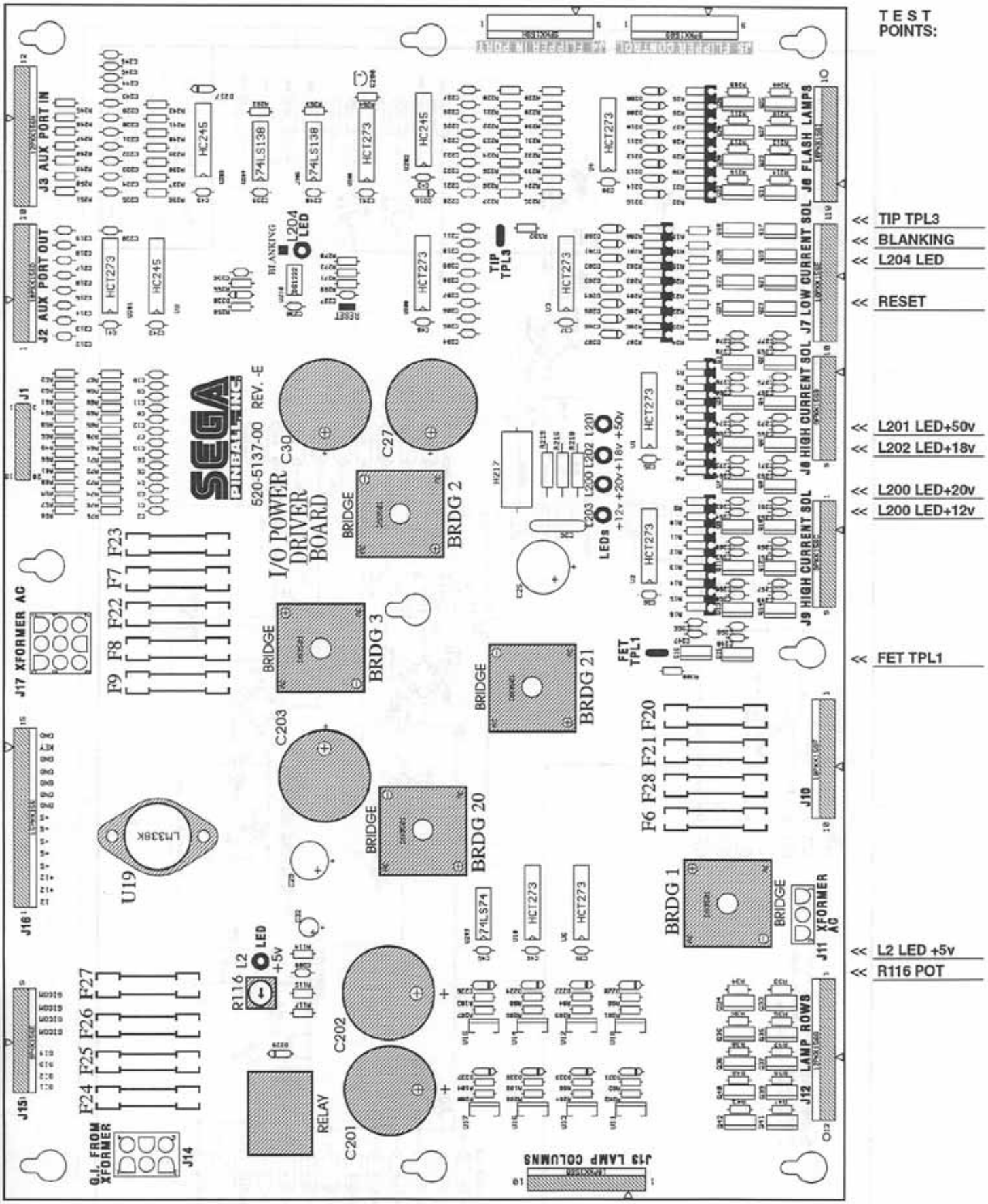

SEGA PINBALL, INC.
I/O POWER DRIVER BOARD
C.E.S. INC.
AUX. OUT PORT
U201
D
C
B
A
1
2
3
4

I/O Power Driver Board Schematic (Sheet 4 of 5)




SEGA PINBALL, INC.
I/O POWER DRIVER BOARD
SRU OUTPUT
FROM XFORMER
TO GI'S
GI'S FROM XFORMER
TO J7-1(LOW CURRENT SOLENOIDS) J8-1(FLASH LAMPS)
TO J13-1(CONTROLLED LAMPS)
POWER OUT

I/O Power Driver Board Component Layout



I/O Power Driver Board Parts

ITEM	QTY	PART NUMBER	REF-DESIGNATOR	DESCRIPTION
1	16	Note: Part Numbers are not yet available.	C260 C259 C258 C257 C256 C278 C271 C255 C261 C262 C277 C276 C275 C274 C273 C272	100V 104 (0.1uF)
2	22		C204 C206 C207 C208 C209 C210 C211 C235 C234 C228 C229 C230 C231 C232 C233 C219 C217 C216 C215 C214 C212 C213 C237 C218 C236 C205 C243 C245 C246 C244	471 (470pF) AXIAL CAP (C204—C11 Not Stuffed)
3	16		C263 C264 C265 C270 C269 C268 C267 C266 C247 C254 C253 C252 C251 C250 C249 C248	103 (0.01uF)
4	13		C7 C8 C9 C10 C11 C12 C13 C1 C2 C3 C4 C5 C6	221 (220pF)
5	0		C227 C226 C220 C221 C222 C223 C224 C225	Not Stuffed
6	17		C35 C36 C37 C38 C39 C40 C41 C42 C43 C45 C46 C200 C239 C238 C240 C241 C242	104 (0.1uF)
7	16		Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q16 Q15 Q14 Q13 Q12 Q11 Q10 Q9	20N10L
8	32		R2 R3 R4 R5 R6 R7 R8 R16 R15 R14 R13 R12 R11 R10 R9 R200 R201R202 R203 R204 R205 R206 R207 R215 R214 R213 R212 R211 R210 R209 R208 R1	22K
9	16		R17 R32 R18 R19 R20 R21 R22 R23 R24 R31 R30 R29 R28 R27 R26 R25	620
10	17		R237 R236 R40 R39 R38 R37 R36 R35 R34 R33 R238 R239 R240 R241 R242 R42 R41	39K
11	13		R64 R72 R73 R74 R75 R76 R71 R70 R69 R68 R67 R66 R65	100
12	8		R90 R92 R94 R96 R98 R100 R102 R104	6.8K
13	1		R115	120
14	0		R221 R220 R222 R223 R224 R225 R226 R227	Not Stuffed
15	9		R254 R248 R249 R250 R251 R232 R246 R247 R245 R233 R234 R235 R230 R231 R228 R229 R302	1K 1/4 W REST. (R228—R235 Not Stuffed)
16	8		R262 R261 R263 R264 R265 R266 R267 R268	47K 1/4W RESISTOR
17	2		R269 R114	220K 1/4W RESISTOR
18	8		R57 R58 R59 R60 R61R252 R253 R256 R270 R49	4.7K 1/4W RES. (R252 Not Stuffed)
19	11		R271 R56 R55 R54 R53 R52 R51 R50 R255 R300	10K
20	2		R117 R272	330
21	8		U6 U4 U18 U2 U1 U200 U3 U201 U206	74HCT273 (U200 Not Stuffed)
22	1		RESET	Not Stuffed
23	1		R219	1/4W 1K
24	2		R218 R216	1/2W 1.5K
25	7		F24 F25 F26 F27 F8 F9 F7	S.B. 5A
26	1		F6	S.B. 7A
27	1		F23	S.B. 4A
28	1		F22	S.B. 8A
29	3		F20 F21 F28	S.B. 3A
30	1		J15	9PKK156 (PIN 5=KEY)
31	1		J16	15PKK156
32	1		U210	DS1232
33	1		Q200	2N3904
34	1		C32	25V 100uF RADIAL LYTIC
35	1		J1	20 PIN 0.1 DUAL ROW HEADER
36	1		U202 U203	74HC245 (U202 Not Stuffed)
37	10		Q41 Q33 Q34 Q35 Q36 Q37 Q38 Q39 Q40 Q42	19N06L
38	6		L203 L202 L204 L200 L2 L201	RED LED
39	1		J2	10PKK156 (PIN 4=KEY)
40	1		R116	50 OHM POT
41	16		Q23 Q22 Q21 Q20 Q19 Q18 Q26 Q27 Q28 Q29 Q30 Q31 Q32 Q17 Q25 Q24	TIP122
42	1		C25	150V 100uF RADIAL LYTIC
43	1		U9	74LS245
44	1		C29	35V 4700uF RADIAL LYTIC
45	1		RELAY	FRL264D024/02CK RELAY
46	0		J5	Not Stuffed
47	1		U209	74LS74
48	0		J4	Not Stuffed
49	2		U204 U205	74LS138
50	1		C26	500V .1UF CERAMIC DISK
51	1		U19	LM338K
52	5		BRDG20 BRDG3 BRDG1 BRDG2 BRDG21	DB3501
53	5		C202 C203 C201 C30 C27	25V 15000uF RADIAL LYTIC
54	25		D208 D225 D226 D221D220 D223 D227 D224 D222 D200 D201 D202 D203 D204 D205 D206 D207 D209 D210 D211 D212 D213 D214 D215 D228	1N4148
55	2		D217 D216 D229	1N4004 (D216 Not Stuffed)
56	2		TPL3 TPL1	TEST POINT LOOPS
57	1		J7	10PKK156 (PIN 5=KEY)
58	1		J6	10PKK156 (PIN 9=KEY)
59	8		U17 U16 U15 U14 U13 U12 U11 U10	VN02N
60	1		J11	10-84-4030 (3 PIN MOLEX)
61	1		J12	12PKK156 (PIN 7=KEY)
62	1		J17	10-84-4090 (9 PIN MOLEX)
63	1		BLANKING	TEST POINT - DO NOT STUFF
64	1		R217	2W 4.7K SANDBAR
65	1		J13	10PKK156 (PIN 2=KEY)
66	1		J14	10-84-4060 (6 PIN MOLEX)
67	1		J10	10PKK156 (PIN 6=KEY)
68	1		J3	12PKK156 (PIN 8=KEY)
69	1		J9	9PKK156 (PIN 3=KEY)
70	1		J8	9PKK156 (PIN 2=KEY)
71	26			FUSECLIPS
72	1		U19	HEATSINK

CPU/Sound Board Theory of Operation

CPU Section:

The CPU is a 68B09E (U209) with up to 8Mbytes of CPU code space (U210). The CPU code is bank selected by the use of U211and each bank consists of 16Kbytes. 8Kbytes of RAM (U212) is available to the CPU. The RAM is battery backed and has a write protected area. Battery back up is accomplished by 3-AA Cells which have a test point VB to check the battery voltage status. The write protected area consists of 512 Bytes used for storing game settings. This section of RAM can only be written to when the coin door is open. The coin door switch comes into the CPU on CN6-12 and is fed into the address decoding PAL U213. When this memory protect signal is low writes to the protected RAM area are prohibited. Address decoding for the system is accomplished by one PAL U213 and one 1-of-8 decoder U214.

A watchdog is used to monitor the CPU and the 5V supply. If the 5V supply is below 4.75 the watchdog will hold the CPU board & I/O board in reset. The watchdog must be fed at a rate of 250ms or faster. The signal used to feed the watchdog comes from the EPROM bank select signal used to load U211. The CPU has a timer interrupt used as a heartbeat for the system this signal comes from counter U2. The clock for this counter is the CPU Q clock. Clearing the timer interrupt is done by reading the DIP switch. The timer interrupt can be observed at test point FIRQ. In normal operation "FIRQ" should be toggling at a rate of 976Hz.

The I/O interface CN1 is buffered by 2 HC245 chips. The CPU's reset line is buffered by Q10 and fed over to the I/O through CN1. An I/O strobe signal is feed through CN1-15 and is used to notify the I/O that a valid address is being sent.

Switches:

The switch-matrix consists of 8 2N3904 transistors which pull one of eight stobes low to activate a single column of switches. The switch return signals are fed into CN7 and are highly filtered and compared to a 2.5V reference voltage. The switch return voltage must be below 2.5V to make a valid switch closer. If false switches are appearing check that none of the 2N3904 transistors are permanently pulling the strobe line low. Only one strobe from CN5 should be low at any time. CN6 is a dedicated bank of input switches. Switches connected to CN6 are connected to ground instead of a strobe and may be read at any time.

Plasma Interface:

The data path for communication to and from the plasma controller is 8bits wide. There are separate input and output busses. The input bus from the plasma controller to the CPU comes in on [CN8-(3-10)] and is fed into U200 for input to the CPU's data bus. Data going out to the controller comes from the CPU's data bus through U201 and onto [CN8-(11-18)]. Status back from the plasma comes in on [CN8-(22-26)]and is fed into U202 for input to the CPU's data bus. Two control signals that go out to the plasma controller are PRES (Plasma Reset) and PSTB (Plasma Strobe). Plasma Reset is software controllable through U216/B and also has a test point "Plasma Reset". The Plasma Strobe signal to the controller is generated from U216/A and is used to latch data into the plasma controller.

Sound Section:

The audio section consists of a BSMT sound chip U9 Sound EPROMs (U17 U21 U36 U37) 68B09E U6 and Sound Code EPROM U7. The BSMT latches sound EPROM addresses in U13 & U12 for output to the Sound EPROMs. Sound Data from the EPROMs is read through U19 to the BSMT. The EPROMs are bank selected by U22. When the BSMT has sound data to be played out to the speakers it loads 16 bits into a 16 bit shift register made up of U24 & U23. The data stream from the shift register is serially shifted into a stereo 16 bit Digital to Analog Converter (DAC). When the system is operating properly the ws(word select) input of the DAC will be toggling. The ws input is used to latch the right and left channel sound data into the DAC. If the ws line is not oscillating no analog signal will come out of the DAC. The DAC outputs are a controlled current source. These outputs are converted to a voltage by an operational amplifier U30 to form the analog signal. Test points AOR and AOL are the outputs of the operational amplifier. These outputs are then fed directly into three power amplifiers (TDA2030A) or optionally into an analog volume control chip U35 for a potentiometer volume control. The analog section has its own +5V & -5V derived from VR1 & VR2. These separate supply voltages are for the DAC U26 Operational Amplifier U30 and analog volume control U35.

Sound calls are made from the CPU's 68B09E U200 to the sound section by latching data into U5. The sound section's CPU 68BO9E (U6) reads in this data and handles the interfacing to the BSMT.

Other Test Points:

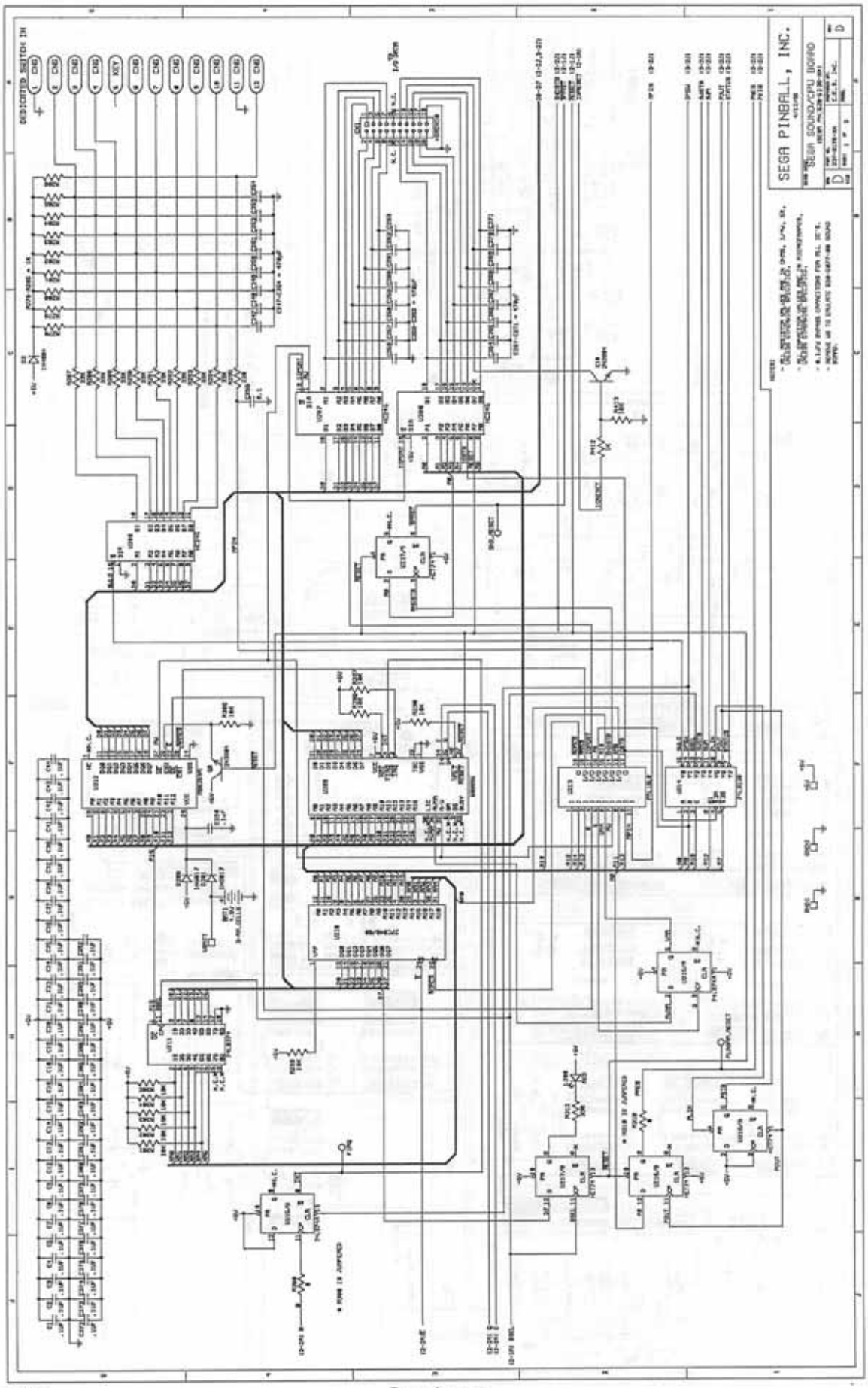
E & Q - The CPU signals for both 68B09E processors. Should be at 2Mhz with Q leading E by 500 nsec.

24Mhz - The oscillator used for the BSMT & derivation of E & Q.

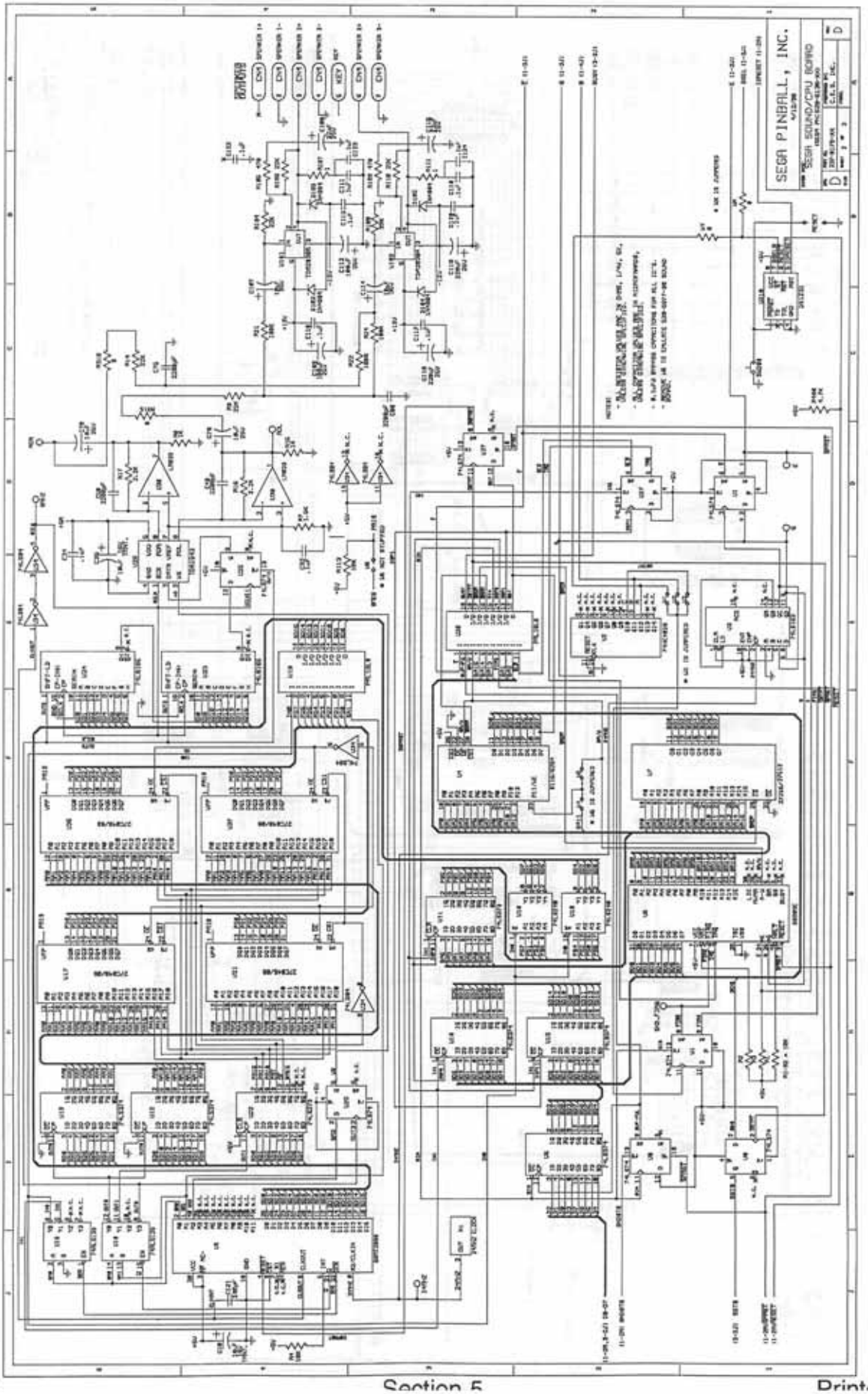
SND-FIRQ - The sound sections CPU interupt.

6Mhz - This clock is generated internally on the BSMT and is used for shifting the data samples into th DAC.

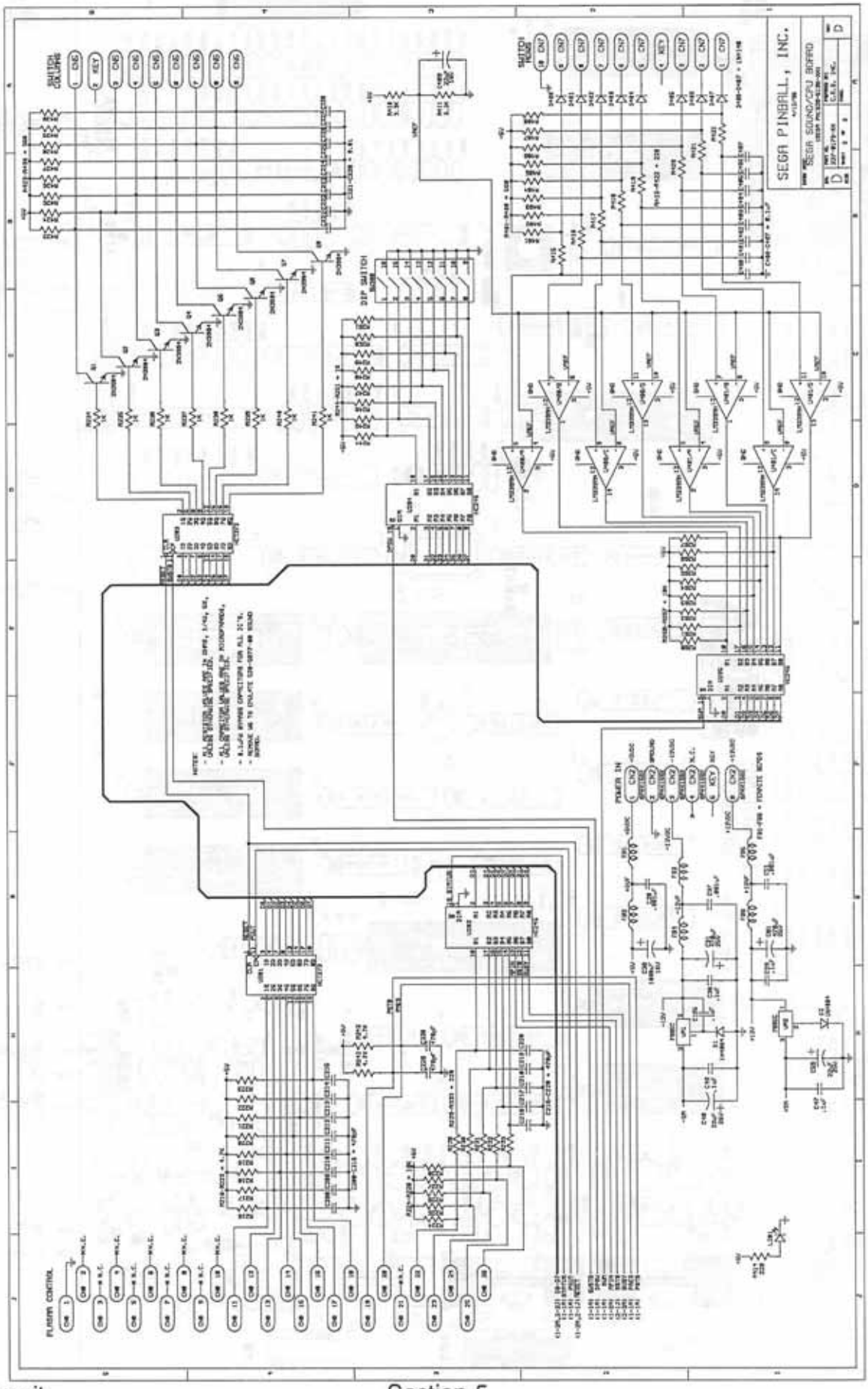
CPU/Sound Board Schematic (Sheet 1 of 3)



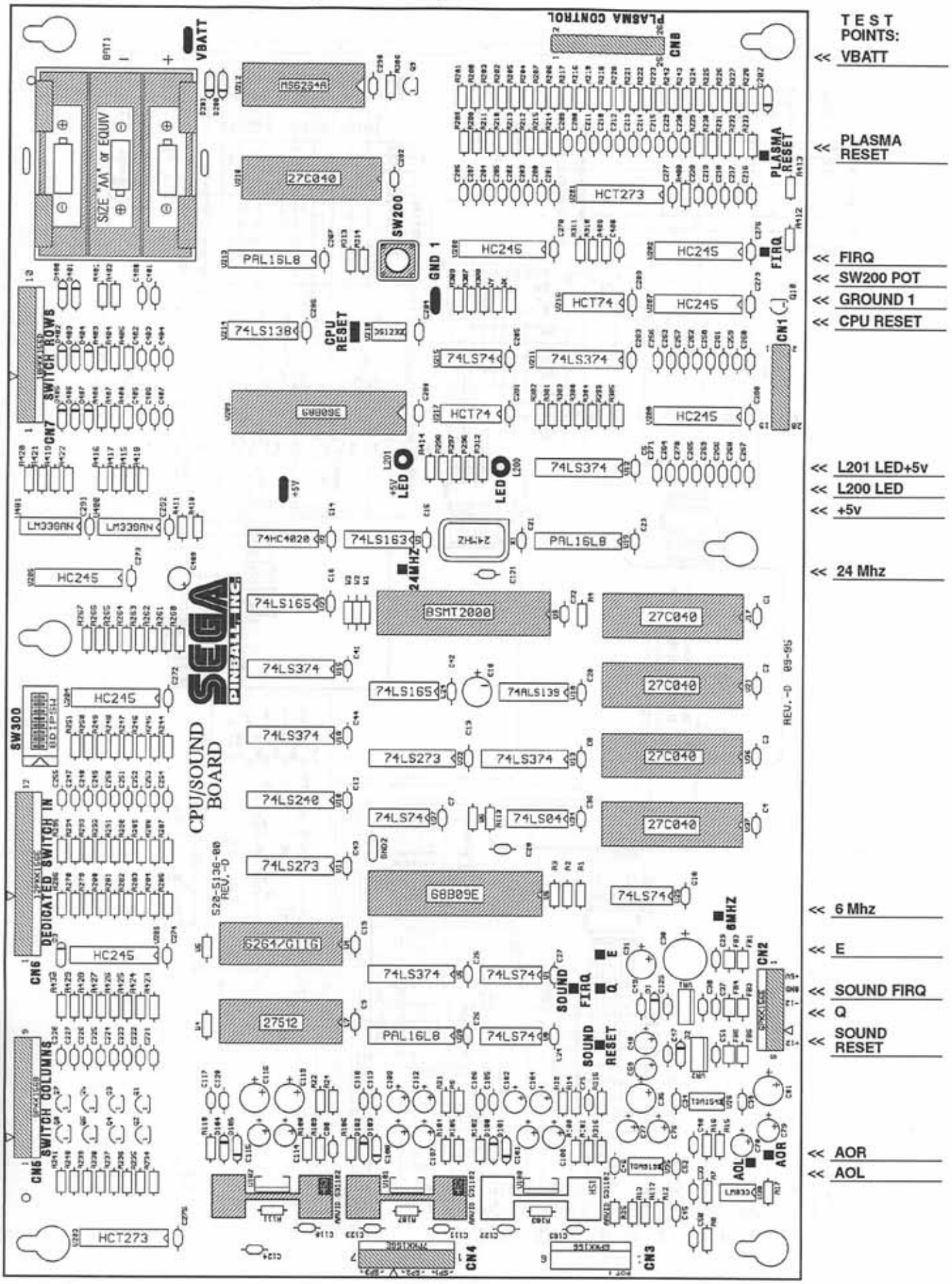
CPU/Sound Board Schematic (Sheet 2 of 3)



CPU/Sound Board Schematic (Sheet 3 of 3)



CPU/Sound Board Component Layout



CPU/Sound Board Parts

ITEM	QTY	PART NUMBER	REF-DESIGNATOR	DESCRIPTION
1	1	Note:	VR2	7805
2	5		R13 R24 R21 R12 R19 R22	100K 1/4W RES. (R19 Not Stuffed)
3	2	Part Numbers	R111 R103 R107	1K 1/4W RES. (R103 Not Stuffed)
4	38	are not yet available.	R4 R3 R2 R1 R113 R306 R301 R302 R303 R305 R304 R299 R296 R298 R297 R247 R248 R249 R251 R250 R246 R245 R244 R266 R267 R265 R264 R263 R228 R227 R226 R225 R224 R200 R201 R202 R203 R204 R205 R206 R207 R262 R261 R260 R409 R413	10K1/4W RES. (R200-R207 R409 R413 Not Stuffed)
5	5		R14 R104 R110 R102 R100 R106 R9	22K1/4W RES. (R100 R102 Not Stuffed)
6	20		R15 R8 R241 R240 R239 R238 R237 R236 R235 R234 R278 R279 R280 R281 R282 R283 R285 R286 R284 R412	1K 1/4W RES.
7	4		R25 R17 R16 R112	2.2K
8	1		R7	1.5K
9	2		R105 R101 R109	470K 1/4W RES. (R101 Not Stuffed)
10	9		R108 R294 R293 R292 R291 R290 R289 R288 R287	39K
11	1		R312	330
12	12		R311 R310 R307 R309 R308 R300 R313 R316 R315 R314 WX WY	0
13	15		R295 R229 R230 R231 R232 R233 R215 R214 R213 R212 R211 R210 R209 R208 R414 R422 R421 R420 R419 R418 R417 R416 R415	220K 1/4W RES. (R208—R215 Not Stuffed)
14	11		R223 R222 R221 R220 R219 R218 R217 R216 R243 R242 R400	4.7K 1/4W RES.
15	16		R408 R407 R406 R405 R404 R403 R402 R401 R430 R429 R428 R427 R426 R425 R424 R423	560
16	2		R411 R410	3.3K 1/4W RES.
17	1		U3	74LS163
18	1		U7	27512
19	1		CN4	7PKK156 (PIN5=KEY)
20	1		RESET	DO NOT STUFF
21	5		U37 U36 U21 U17 U210	27C040
22	2		U24 U23	74LS165
23	4		C76 C78 C79 C77	25V 10uF RADIAL LYTIC
24	4		C59 C101 C108 C115 C40	25V 22uF RADIAL LYTIC (C101 Not Stuffed)
25	2		C100 C107 C114	35V 10uF RADIAL LYTIC (C100 Not Stuffed)
26	2		C102 C104 C109 C112	25V 100uF RADIAL LYTIC (C102/104 N.Stff
27	1		C409	16V 22uF RADILA LYTIC
28	1		U35	TDA1899
29	1		C30	16V 1000uF RADIAL LYTIC
30	1		U34	74LS04
31	1		U18	74ALS139
32	6		U16 U12 U13 U15 U211U5	74LS374
33	1		U2	74HC4020
34	1		U10	74LS240
35	6		W2 W3 W1 W4 W5 W6	0
36	2		C81 C31	25V 470uF RADIAL LYTIC
37	2		C10 C35	16V 10uF RADIAL TANT.
38	2		C116 C119	25V 220uF RADIAL LYTIC
39	1		CN2	6PKK156 (PIN 5=KEY)
40	1		X1	24MHZ
41	1		U9	TMS32010
42	3		U19 U20 U213	PAL16L8
43	5		U27 U1 U25 U8 U215	74LS74
44	3		C29 C37 C51	102 (0.001uF)
45	79		C2 C12 C13 C14 C15 C20 C1 C42 C24 C32 C28 C43 C16 C103 C23 C27 C52 C36 C21 C26 C39 C47 C105 C120 C44 C46 C34 C25 C4 C19 C8 C41 C49 C3 C33 C9 C38 C18 C106 C45 C7 C118 C110 C122 C124 C113 C123 C5 C117 C111 C125 C290 C289 C288 C287 C286 C285 C284 C283 C282 C281 C280 C279 C278 C277 C276 C275 C273 C272 C255 C274 C292 C291 C407 C406 C405 C404 C400 C403 C401 C402 C102 C103	104 (0.1uF) AXIAL CER. CAP. (C102 C103 C105 C106 Not Stuffed)
46	1		C121	101 (100pF)
47	4		C48 C50 C75 C80	222 (0.0022uF)
48	41		C270 C269 C268 C267 C271 C265 C266 C262 C261 C260 C259 C263 C256 C257 C258 C249 C248 C247 C254 C250 C251 C252 C220 C219 C218 C217 C216 C215 C213 C212 C211 C210 C209 C208 C200 C201 C202 C203 C205 C206 C207 C230 C229 C253 C214 C204 C264 C408	471 (470pF) CER. CAP (C200—C107, C408 Not Stuffed)
49	8		C221 C222 C223 C225 C226 C227 C228 C224 C408	103 (0.01uF)
50	1		CN3	6PKK156
51	1		U30	LM833
52	2		U22 U11	74LS273
53	7		D1 D100 D2 D103 D104 D101 D105 D102 D3	1N4004 (D100 D101 Not Stuffed)
54	2		D201 D200	1N5817
55	8		D407 D406 D405 D404 D403 D402 D401 D400 D202	1N4148 (D202 Not Stuffed)
56	6		FB6 FB4 FB5 FB2 FB1 FB3	FB
57	1		VR1	7905
58	2		U102 U100 U101	TDA2030V (U100 Not Stuffed)
59	1		U26	TDA1543
60	1		SW200	B3F4000

THIS PARTS LIST IS CONTINUED ON THE NEXT PAGE.

CPU/Sound Board Parts Continued

ITEM	QTY	PART NUMBER	REF-DESIGNATOR	DESCRIPTION
61	1	Note:	L200	RED LED
62	1		L201	RED LED
63	2	Part Numbers	U217 U216	HCT74
64	1	are not yet	U214	74LS138
65	1	available.	U212	MS6264A
66	1		U209 U6	68B09E
67	1		BAT1 BATTERY HOLDER	3-AA CELLS 4.5V
68	1		CN1	20 PIN 0.1 HEADER
69	10		6MHZ AOR Q AOL 24MHZ	TEST POINTS - Not Stuffed
70	10		Q9 Q3 Q4 Q5 Q6 Q7 Q8 Q1 Q2 Q10	2N3904
71	1		CN5	9PKK156 (PIN 2=KEY)
72	2		U201 U203	74HCT273
73	6		U207 U206 U202 U200 U205 U208 U204	74HC245 (U200 Not Stuffed)
74	1		U218	DS1232
75	1		CN8	26 PIN 0.1 HEADER
76	1		CN7	10PKK156 (PIN 4=KEY)
77	4		VBATT +5V GND2 GND1	TEST POINT LOOPS
78	1		CN6	12PKK156 (PIN 5=KEY)
79	1		SW300	8 PIN DIPSWITCH
80	2		U401 U400	LM339AN
81	1		U4	6264
82	3		U100 U101 U102	AAVID 531102

Your Notes

Appendixes A through H

Appendix
Table of Contents

- **Appendix A, Pinball Game Firmware Table 118-119**
  ...describes the EPROM with its chip size, the Sega Pinball Inc. Part Nº, version (if applicable), and CPU Board & CPU/Sound Board pin location(s).

- **Appendix B, Semi-Conductors / Integrated Circuits / Relay Cross-Reference Table 120**
  ...describes diodes and transistors with Source Nº, Sega Pinball Inc. Part Nº, NTE Nº, ECG Nº, Radio Shack Part Nº (If applicable) and RCA Part Nº (If applicable).

- **Appendix C, CPU Jumper Table 121**
  ...provides the Game Manufactured Date and Manual Part Nº, the CPU version, the ROM Position, and the Jumpers Installed and Removed.

- **Appendix D, Board Type Table..... 122-123**
  ...provides Part Nº for Flipper Boards, Old Board System (Sound, Power Supply) and New Board System (I/O Power Driver, CU/Sound, Display Power Supply) and Display Boards.

- **Appendix E, Generic Coil Cross-Reference Guide and Flipper Coil Table 124-125**
  ...provides the Coils used with Part Nº and Gauge-Turns (of the coil).

- **Appendix F, Motor Specification Table 126-127**
  ...provides all the Motor information used on the games (Motor Type, Function and Part Nº).

- **Appendix G, Part Number Prefix Classification Codes..... 128**
  ...explains how our Part Numbers are developed to help sort parts easier.

- **Appendix H, Playfield Inserts (Plastic Light Covers) 129**
  ...gives a pictoral view with the name and part number of all the inserts used (also gives the Color Code Chart).

- **Glossary of Terms 130-131**
  ...gives definitions or explanations of some pinball terms and acronyms.

APPENDIX A
Pinball Game Firmware Table

EPROM	Chip Size	Part Nº	Ver.	Loc.	Raw Part Nº
Laser War					
CPU	(256K)	965-0004-00		C5	960-5007-00
Sound (Old)	(256K)	965-0005-00		J5	960-5007-00
Sound (Old)	(256K)	965-0006-00		J6	960-5007-00
Sound (Old)	(256K)	965-0007-00		J7	960-5007-00
		- OR -			
Sound	(256K)	965-0008-00		7F	960-5007-00
Sound 1	(512K)	965-0009-00		6F	960-7001-02
Sound 2	(512K)	965-0010-00		4F	960-7001-02
Secret Service					
CPU	(256K)	965-0011-00	A-6	B5	960-5007-00
CPU	(256K)	965-0012-00	A-6	C5	960-5007-00
Voice 1	(512K)	965-0014-00		6F	960-7001-02
Voice 2	(512K)	965-0015-00		4F	960-7001-02
Sound	(256K)	965-0013-00		7F	960-5007-00
Torpedo Alley					
CPU	(256K)	965-0016-00	A02-1	B5	960-5007-00
CPU	(256K)	965-0017-00	A02-1	C5	960-5007-00
Voice 1	(512K)	965-0019-00		6F	960-7001-02
Voice 2	(512K)	965-0020-00		4F	960-7001-02
Sound	(256K)	965-0018-00		7F	960-5007-00
Time Machine					
CPU	(256K)	965-0021-00	A02-3	B5	960-5007-00
CPU	(256K)	965-0022-00	A02-3	C5	960-5007-00
Voice 1	(512K)	965-0024-00		6F	960-7001-02
Voice 2	(512K)	965-0025-00		4F	960-7001-02
Sound	(256K)	965-0023-00		7F	960-5007-00
Playboy 35th Anniversary					
CPU	(256K)	965-0046-00	A02-3	B5	960-5007-00
CPU	(256K)	965-0047-00	A02-3	C5	960-5007-00
Voice 1	(512K)	965-0049-00		6F	960-7001-02
Voice 2	(512K)	965-0050-00		4F	960-7001-02
Sound	(256K)	965-0048-00		7F	960-5007-00
ABC Monday Night Football					
CPU	(256K)	965-0031-00	A02-7	B5	960-5007-00
CPU	(256K)	965-0032-00	A02-7	C5	960-5007-00
Voice 1	(512K)	965-0034-00		6F	960-7001-02
Voice 2	(512K)	965-0035-00		4F	960-7001-02
Sound	(256K)	965-0033-00		7F	960-5007-00
Robocop					
CPU	(256K)	965-0036-00	A03-4	B5	960-5007-00
CPU	(256K)	965-0037-00	A03-4	C5	960-5007-00
Voice 1	(512K)	965-0039-00		6F	960-7001-02
Voice 2	(512K)	965-0040-00		4F	960-7001-02
Sound	(256K)	965-0038-00		7F	960-5007-00
Phantom of the Opera					
CPU	(256K)	965-0026-00	A03-2	B5	960-5007-00
CPU	(256K)	965-0027-00	A03-2	C5	960-5007-00
Voice 1	(512K)	965-0029-00		6F	960-7001-02
Voice 2	(512K)	965-0030-00		4F	960-7001-02
Sound	(256K)	965-0028-00		7F	960-5007-00
Back to the Future					
CPU	(256K)	965-0041-00	SA-2	B5	960-5007-00
CPU	(256K)	965-0042-00	SA-2	C5	960-5007-00
Voice 1	(512K)	965-0044-00		6F	960-7001-02
Voice 2	(512K)	965-0045-00		4F	960-7001-02
Sound	(256K)	965-0043-00		7F	960-5007-00
The Simpsons					
CPU	(256K)	965-0051-00	A02-7	B5	960-5007-00
CPU	(256K)	965-0052-00	A02-7	C5	960-5007-00
Voice 1	(512K)	965-0054-00		6F	960-7001-02
Voice 2	(512K)	965-0055-00		4F	960-7001-02
Sound	(256K)	965-0053-00		7F	960-5007-00
Checkpoint					
CPU	(256K)	965-0056-00	A1-7	B5	960-5007-00
CPU	(256K)	965-0134-00	A1-7	C5	960-5007-00
Voice 1	(1M)	965-0057-00		F7	960-5009-00
Voice 2	(1M)	965-0058-00		F5	960-5009-00
Sound	(256K)	965-0059-00		F4	960-5007-00
Display	(512K)	965-0060-00	CP80	U8	960-7001-02

EPROM	Chip Size	Part Nº	Ver.	Loc.	Raw Part Nº
Teenage Mutant Ninja Turtles					
CPU	(256K)	965-0061-00	A1.04	B5	960-5007-00
CPU	(256K)	965-0062-00	A1.04	C5	960-5007-00
Voice 1	(1M)	965-0063-00		F5/6	960-5009-00
Voice 2	(1M)	965-0064-00		F4/5	960-5009-00
Sound	(256K)	965-0065-00		F7	960-5007-00
Display	(512K)	965-0066-00		U8	960-7001-02
Batman					
CPU	(128K)	965-0067-00	A1.06	B5	960-5006-00
CPU	(256K)	965-0135-00	A1.06	C5	960-5007-00
Voice 1	(2M)	965-0068-00		U17	960-5010-00
Voice 2	(1M)	965-0069-00		U21	960-5009-00
Sound	(256K)	965-0070-00		U7	960-5007-00
Display	(1M)	965-0071-00	A1.02	U8	960-5009-00
Star Trek 25th Anniversary					
CPU	(512K)	965-0072-00	A2.00	B5	960-7001-02
Voice 1	(2M)	965-0073-00		U17	960-5010-00
Voice 2	(2M)	965-0074-00		U21	960-5010-00
Sound	(256K)	965-0075-00		U7	960-5007-00
Display	(1M)	965-0076-00	A1.09	U8	960-5009-00
Hook					
CPU	(512K)	965-0077-00	A4.08	C5	960-7001-02
Voice 1	(2M)	965-0078-00		U17	960-5010-00
Voice 2	(2M)	965-0079-00		U21	960-5010-00
Sound	(256K)	965-0080-00		U7	960-5007-00
Display	(1M)	965-0081-00	A4.01	U8	960-5009-00
Lethal Weapon 3					
CPU	(512K)	965-0082-00	A2.07	C5	960-7001-02
Voice 1	(2M)	965-0083-00		U17	960-5010-00
Voice 2	(2M)	965-0084-00		U21	960-5010-00
Sound	(256K)	965-0085-00		U7	960-5007-00
Display	(2M)	965-0086-00		ROM 1	960-5010-00
Display	(2M)	965-0087-00		ROM 2	960-5010-00
Display	(4M)	965-0087-04	A2.06	ROM 0	960-5015-00
Star Wars					
CPU	(512K)	965-0119-00	A1.03	C5	960-7001-02
Voice 0	(4M)	965-0132-00		U17	960-5015-00
Voice 1	(2M)	965-0133-00		U21	960-5010-00
Sound	(256K)	965-0131-00		U7	960-5007-00
Display	(2M)	965-0120-00	A1.04	ROM 0	960-5010-00
Display	(2M)	965-0121-00	A1.04	ROM 1	960-5010-00
	(Used on Display PCB 520-5055-00)				
	-OR-				
Display	(4M)	965-0122-00	A1.05	ROM 0	960-5015-00
	(Used on Display PCB 520-5055-01)				
Rocky & Bullwinkle & Friends					
CPU	(512K)	965-0138-00	A1.30	C5	960-7001-02
Voice 0	(4M)	965-0139-00		U17	960-5015-00
Voice 1	(2M)	965-0140-00		U21	960-5010-00
Sound	(256K)	965-0141-00		U7	960-5007-00
Display	(4M)	965-0142-00	A1.30	ROM 0	960-5015-00
Jurassic Park					
CPU	(512K)	965-0143-00	A5.10	C5	960-7001-02
Voice 0	(4M)	965-0144-00		U17	960-5015-00
Voice 1	(2M)	965-0145-00		U21	960-5010-00
Sound	(256K)	965-0146-00		U7	960-5007-00
Display	(4M)	965-0147-00	A5.10	ROM 0	960-5015-00
Last Action Hero					
CPU	(512K)	965-0148-00	A1.12	C5	960-7001-02
Voice 0	(4M)	965-0149-00		U17	960-5015-00
Voice 1	(2M)	965-0150-00		U21	960-5010-00
Sound	(256K)	965-0151-00		U7	960-5007-00
Display	(4M)	965-0152-00	A1.06	ROM 0	960-5015-00
Tales from the Crypt					
CPU	(512K)	965-0157-00	A3.00	C5	960-7001-02
Voice 0	(4M)	965-0158-00		U17	960-5015-00
Voice 1	(2M)	965-0159-00		U21	960-5010-00
Sound	(256K)	965-0160-00		U7	960-5007-00
Display	(4M)	965-0161-00	A3.00	ROM 0	960-5015-00

Table continued on the next page.

Table Notes:
Game Revisions can be updated after the production run. This table is accurate as of the printing of this manual. To see if any changes occurred, the next game manual will include updates. The version stated is USA. If there is a question of what revision number any particular ROM is and the next game manual(s) are not available, call our Technical Support Department.

APPENDIX A
Pinball Game Firmware Table

EPROM	Chip Size	Part Nº	Ver.	Loc.	Raw Part Nº
The Who's Tommy					
CPU	(512K)	965-0162-00	A4.00	C5	960-7001-02
Voice 1	(4M)	965-0165-00		U17	960-5015-00
Voice 2	(4M)	965-0166-00		U21	960-5015-00
Voice 3	(4M)	965-0167-00		U36	960-5015-00
Voice 4	(4M)	965-0168-00		U37	960-5015-00
Sound	(512K)	965-0164-00		U7	960-7001-02
Display	(4M)	965-0163-00	A4.00	ROM 0	960-5015-00
WWF Royal Rumble					
CPU	(512K)	965-0169-00	A1.06	C5	960-7001-02
Voice 1	(4M)	965-0172-00		U17	960-5015-00
Voice 2	(4M)	965-0173-00		U21	960-5015-00
Voice 3	(4M)	965-0174-00		U36	960-5015-00
Sound	(512K)	965-0171-00		U7	960-7001-02
Display	(4M)	965-0170-00	A1.02	ROM 0	960-5015-00
Guns N' Roses					
CPU	(512K)	965-0175-00	A3.00	C5	960-7001-02
Voice 1	(4M)	965-0178-00		U17	960-5015-00
Voice 2	(4M)	965-0179-00		U21	960-5015-00
Voice 3	(4M)	965-0180-00		U36	960-5015-00
Voice 4	(4M)	965-0181-00		U37	960-5015-00
Sound	(512K)	965-0177-00		U7	960-7001-02
Display	(4M)	965-0176-00	A3.00	ROM 0	960-5015-00
Maverick					
CPU	(512K)	965-0182-00	A4.04	C5	960-7001-02
Voice 1	(4M)	965-0186-00		U17	960-5015-00
Voice 2	(4M)	965-0187-00		U21	960-5015-00
Voice 3	(4M)	965-0187-01		U36	960-5015-00
Sound	(512K)	965-0185-00		U7	960-7001-02
Display*	(4M)	965-0183-00	A4.01	ROM 0	960-5015-00
Display*	(4M)	965-0184-00	A4.01	ROM 3	960-5015-00
Mary Shelley's Frankenstein					
CPU	(512K)	965-0188-00	A1.03	C5	960-7001-02
Voice 1	(4M)	965-0192-00		U17	960-5015-00
Voice 2	(4M)	965-0193-00		U21	960-5015-00
Voice 3	(4M)	965-0194-00		U36	960-5015-00
Sound	(512K)	965-0191-00		U7	960-7001-02
Display*	(4M)	965-0189-00	A1.03	ROM 0	960-5015-00
Display*	(4M)	965-0190-00	A1.03	ROM 3	960-5015-00
Baywatch					
CPU	(512K)	965-0195-00	A4.01	C5	960-7001-02
Voice 1	(4M)	965-0196-00		U17	960-5015-00
Voice 2	(4M)	965-0197-00		U21	960-5015-00
Voice 3	(Correction Note: 2M/U36 was not used in this game.)				
Sound	(512K)	965-0199-00		U7	960-7001-02
Display*	(4M)	965-0200-00	A4.01	ROM 0	960-5015-00
Display*	(4M)	965-0201-00	A4.01	ROM 3	960-5015-00
Batman Forever					
CPU	(512K)	965-0202-00	A3.02	C5	960-7001-02
Voice 1	(4M)	965-0203-00		U17	960-5015-00
Voice 2	(4M)	965-0204-00		U21	960-5015-00
Sound	(512K)	965-0205-00		U7	960-7001-02
Display*	(4M)	965-0206-00	A3.00	ROM 0	960-5015-00
Display*	(4M)	965-0207-00	A3.00	ROM 3	960-5015-00

New Board System Starts Here

ROM	Chip Size	Part Nº	Ver.	Loc.	Raw Part Nº
Apollo 13					
CPU / Sound Board:					
Game ROM	(1M)	965-0208-00	A4.00	U210	960-5009-00
Voice 1	(4M)	965-0209-00		U17	n/a (masked)
Voice 2	(4M)	965-0210-00		U21	n/a (masked)
Voice 3	(4M)	965-0211-00		U36	n/a (masked)
Sound	(512K)	965-0212-00		U7	960-7001-02
Display Controller Board:					
Display	(4M)	965-0213-00	A4.01	ROM 0	960-5015-00
Golden Eye					
CPU / Sound Board:					
Game ROM	(1M)	965-0214-42	A4.02	U210	960-5009-00
Voice 1	(4M)	965-0215-42		U17	n/a (masked)
Voice 2	(4M)	965-0216-42		U21	n/a (masked)
Sound	(512K)	965-0217-42		U7	960-7001-02
Display Controller Board:					
Display	(4M)	965-0218-42	A4.02	ROM 0	960-5015-00
Twister					
CPU / Sound Board:			IN PRODUCTION		
Game ROM	(1M)	965-0219-41		U210	960-5009-00
Voice 1	(4M)	965-0220-41		U17	n/a (masked)
Sound	(512K)	965-0221-41		U7	960-7001-02
Display Controller Board:					
Display	(4M)	965-0222-41		ROM 0	960-5015-00

*** Note: Display EPROMS (4M) for Maverick thru Batman Forever require an access time of 120 Nsec or faster.**

Table Notes:
Game Revisions can be updated after the production run. This table is accurate as of the printing of this manual. To see if any changes occurred, the next game manual will include updates. The version stated is USA. If there is a question of what revision number any particular ROM is and the next game manual(s) are not available, call our Technical Support Department.

APPENDIX B
Semi-Conductors / Integrated Circuits / Relays Cross-Reference Table

Table 1 Diodes	Source Nº	SEGA PINBALL™ Part Nº	NTE Nº	ECG Nº	Radio Shack ® Part Nº	RCA ® Part Nº
Rectification, Blocking and/or Dampening						
Diode	1N4001	112-5001-00	NTE552	ECG552	- — - — -	SK9000
Diode	1N4004	112-5003-00	NTE116	ECG116	276-1103	SK3312
Diode	1N5401	112-0056-00	NTE5801	ECG5801	276-1143	SK9004
Diode	1N5404	112-5004-00	NTE5804	ECG5804	276-1144	SK9007

Table 2 Diodes	Source Nº	SEGA PINBALL™ Part Nº	NTE Nº	ECG Nº	Radio Shack ® Part Nº	RCA ® Part Nº
Zener						
Diode	1N4742A 12v	112-0061-00	NTE142A	ECG142A	276-563	SK12V
Diode	1N4760B 68v	112-0062-00	NTE5092A	ECG5092A	- — - — -	SK68V
Diode	1N4764 100v	112-0049-00	NTE5096A	ECG5096A	- — - — -	SK100V
Diode	1N5228 3.9v	112-0053-00	NTE5007A	ECG5007A	- — - — -	SK3A9
Diode	1N5234B 6.2v	112-0047-00	NTE5013A	ECG5013A	276-561	SK6A2
Diode	1N5379 110v	112-0072-00	NTE5157	ECG5157	- — - — -	SK110X

Table 3 Bridge Rectifiers	Source Nº	SEGA PINBALL™ Part Nº	Comments
Bridge Rectifier	CM3501	112-0052-00	35 Amp @ 100v P.I.V.
Bridge Rectifier	MDA2501	112-0054-00	25 Amp @ 100v P.I.V.
Bridge Rectifier	MDA3502	112-0057-00	35 Amp @ 200v P.I.V.

Table 4 Transistors	Source Nº	SEGA PINBALL™ Part Nº	NTE Nº	ECG Nº	Radio Shack ® Part Nº	RCA ® Part Nº
Transistor	2N4401	- — - — -	NTE85	ECG85	276-2009	SK3124A
Transistor	2N5060, SCR	110-0074-00	NTE5400	ECG5400	276-1067	SK3950
Transistor	2N5401	110-0078-00	NTE288	ECG288	- — - — -	SK3434
Transistor	2N6427	110-0070-00	NTE48	ECG48	- — - — -	SK4906
Transistor	MJE15031	110-0103-00	NTE375	ECG375	- — - — -	SK9118
Transistor	MJE340	110-0071-00	NTE157	ECG157	- — - — -	SK3747
Transistor	MJE350	110-0072-00	NTE374	ECG374	- — - — -	SK9042
Transistor	MPSA92	110-0100-00	NTE288	ECG278	- — - — -	SK3434
Transistor	MPSA42	110-0082-00	NTE287	ECG287	- — - — -	SK3232
Transistor	NPN, 2N3904	110-0069-00	NTE123	- — - — -	- — - — -	- — - — -
Transistor	NPN, TIP122	110-0067-00	NTE261	ECG261	276-2068	SK3896
Transistor	PNP, TIP42	110-0068-00	NTE332	ECG332	- — - — -	SK9236
Transistor	TIP32C	110-0071-00	NTE292	ECG292	- — - — -	SK3441
Transistor	TIP36C	110-0077-00	NTE393	ECG393	- — - — -	SK3961

Table 5 Relays	Source Nº	SEGA PINBALL™ Part Nº	Comments
PPB Relay	FRL264 P024/02CK	190-5002-00	24v DC 10 Amp DPDT
Power Supply Relay	FRL264 P024/02CK	190-5003-00	24v DC 10 Amp DPDT
CPU Relay	- — - — -	190-5001-00	6v DC 5 Amp 4 Pole

APPENDIX C
CPU Jumper Table

Game Name	Game Mfg. Date and Manual PN	CPU Ver.	EPROM Position	Jumpers Installed	Jumpers Removed
1. Laser War	MAY 87 780-5001-00	1 2	5C 5B, 5C	J4 J6a J7a J4 J5a J6a	J5 J6 J7b J5 J5b J6b
2. Secret Service	MAR 88 780-5002-00	2	5B, 5C	J4	J5
3. Torpedo Alley	AUG 88 780-5003-00	2	5B, 5C	J4	J5
4. Time Machine	DEC 88 780-5004-00	2	5B, 5C	J4	J5
5. Playboy 35th Anniversary	MAY 89 780-5005-00	2	5B, 5C	J4	J5
6. ABC Monday Night Football	SEP 89 780-5007-00	2	5B, 5C	J4	J5
7. Robocop	NOV 89 780-5006-00	2	5B, 5C	J4	J5
8. Phantom of the Opera	JAN 90 780-5008-00	2	5B, 5C	J4	J5
9. Back to the Future	JUN 90 780-5009-00	3	5B, 5C	J4	J5
10. The Simpsons	SEP 90 780-5012-00	3	5B, 5C	J4	J5
11. Checkpoint	FEB 91 780-5010-00	3	5B, 5C	J4	J5
12. Teenage Mutant Ninja Turtles	MAY 91 780-5017-00	3	5B, 5C	J4	J5
13. Batman	JUL 91 780-5011-00	3	5B, 5C	J4	J5
14. Star Trek 25th Anniversary	OCT 91 780-5014-00	3	5C	J5	J4
15. Hook	JAN 92 780-5019-00	3	5C	J5	J4
16. Lethal Weapon 3	JUN 92 780-5026-00	3	5C	J5	J4
17. Star Wars	OCT 92 780-5024-00	3	5C	J5	J4
18. Rocky & Bull-winkle & Friends	FEB 93 780-5022-00	3	5C	J5	J4
19. Jurassic Park	APR 93 780-5020-00	3	5C	J5	J4
20. Last Action Hero	AUG 93 780-5027-00	3	5C	J5	J4
21. Tales from the Crypt	NOV 93 780-5018-00	3	5C	J5	J4
22. The Who's Tommy	FEB 94 780-5028-00	3	5C	J5	J4
23. WWF Royal Rumble	MAY 94 780-5023-00	3	5C	J5	J4
24. Guns N' Roses	JUL 94 780-5029-00	3	5C	J5	J4
25. Maverick	SEP 94 780-5031-00	3	5C	J5	J4
26. Mary Shelley's Frankenstein	DEC 94 780-5036-00	3	5C	J5	J4
27. Baywatch	MAR 95 780-5033-00	3	5C	J5	J4
28. Batman Forever	JUL 95 780-5038-00	3	5C	J5	J4

Game Name	Game Mfg. Date and Manual PN	CPU Ver.	ROM Position	Jumpers Installed	Jumpers Removed
29. Apollo 13	NOV 95 780-5044-00	—	U210	n / a	n / a
30. Golden Eye	FEB 96 780-5042-00	—	U210	n / a	n / a
31. Twister	APR 96 780-5041-00	—	U210	n / a	n / a

† Additional Information for Installed / Removed Jumpers (List 1-28 only):

Board Combinations with **ROM** at Location **5C** (Game 1, Ver1) **Installed** J1b, J3, J4, J6a, **J7a** & J8 **Removed** J1a, J2, J5, **J6** & **J7b**

Board Combinations w/ **ROM** at Locations **5B, 5C** (Game 1, Ver2) **Installed** J1b, J3, J4, **J5a, J6a, J7b** & J8 **Removed** J1a, J2, J5, **J5b, J6b,** & **J7a**

Board Combinations w/ **ROM** at Locations **5B, 5C** (Games 2-12, Ver2/3) **Installed** J1b, J3, **J4, J5b, J6b,** J7b & J8 **Removed** J1a, J2, **J5, J5a, J6a** & J7a

Board Combinations with **ROM** at Locations **5C** (Games 14+, Ver3) **Installed** J1b, J3, **J5,** J5b, J6b, J7b & J8 **Removed** J1a, J2, **J4,** J5a, J6a & J7a

* Version 1 has a 2K RAM which is a 24-pin IC in Position 5D; Versions 2 & 3 have a 8K RAM which is a 28-PIN IC in Position 5D.

APPENDIX D
Board Type Table

Game Name	Flipper	Sound	Power Supply	Display X-Digit
Laser War	2-Flipper Board Not Required	***initial:*** 520-5002-00 ***replaced with:*** 520-5002-02 520-5002-01 was not used.	520-5000-00	Master: 520-5004-00 plus: 7 Digit Alpha/Numeric 520-5005-00 (Qty. 2) 7 Digit Numeric 520-5006-00 (Qty. 2) 4 Digit Numeric 520-5007-00
Secret Service	3-Flipper Board Not Required	520-5002-02	520-5000-00	520-5014-01 7 Digit Alpha/Numeric Combined
Torpedo Alley	3-Flipper Board Not Required	520-5002-02	520-5000-00	520-5014-01 7 Digit Alpha/Numeric Combined
Time Machine	2-Flipper Board Not Required	520-5002-02	520-5000-00	520-5014-01 7 Digit Alpha/Numeric Combined
Playboy 35th Anniversary	520-5033-00 2-Flip. (for 100 games)	520-5002-02	520-5000-00	520-5014-01 7 Digit Alpha/Numeric Combined
ABC Monday Night Football	520-5033-00 2-Flip. (for 100 games)	520-5002-02	520-5000-00	520-5030-00 16 Digit Alpha/Numeric Combined
Robocop	520-5033-00 2-Flipper	520-5002-02	520-5000-00	520-5030-00 16 Digit Alpha/Numeric Combined
Phantom of the Opera	520-5033-00 2-Flipper	520-5002-02	520-5000-00	520-5030-00 16 Digit Alpha/Numeric Combined
Back to the Future	520-5033-00 2-Flipper	520-5002-02	520-5000-00	520-5030-00 16 Digit Alpha/Numeric Combined
The Simpsons	520-5033-00 2-Flipper	520-5002-03	520-5000-00	520-5030-00 16 Digit Alpha/Numeric Combined

Game Name	Flipper	Sound	Power Supply	Dot Matrix Display	Display Controller
Checkpoint	520-5033-00 2-Flipper	520-5002-03	520-5047-00	520-5042-00 128 X 16	Not Required with 128 X 16
Teenage Mutant Ninja Turtles	520-5033-00 2-Flipper	520-5002-03	520-5047-00	520-5042-00 128 X 16	Not Required with 128 X 16
Batman	520-5033-00 2-Flipper	520-5050-01	520-5047-00	520-5042-00 128 X 16	Not Required with 128 X 16
Star Trek 25th Anniversary	520-5033-00 2-Flipper	520-5050-01	520-5047-00	520-5042-00 128 X 16	Not Required with 128 X 16
Hook	520-5033-00 2-Flipper	520-5050-01	520-5047-00	520-5042-00 128 X 16	Not Required with 128 X 16
Lethal Weapon 3	520-5033-00 2-Flipper	520-5050-01	520-5047-01	520-5052-00 128 X 32	520-5055-00
Star Wars	520-5033-00 2-Flipper	520-5050-02	520-5047-01	520-5052-00 128 X 32	520-5055-00
Rocky & Bullwinkle & Friends	520-5033-00 2-Flipper	520-5050-02	520-5047-01	520-5052-00 128 X 32	520-5055-00
Jurassic Park	520-5076-00 3-Flipper	520-5050-02	520-5047-02	520-5052-00 128 X 32	520-5055-00
Last Action Hero	520-5070-00 2-Flipper	520-5050-03	520-5047-02	520-5052-00 128 X 32	520-5055-00
Tales from the Crypt	520-5076-00 3-Flipper	520-5050-03	520-5047-02	520-5052-00 128 X 32	520-5055-01
The Who's Tommy	520-5076-00 3-Flipper	520-5077-00	520-5047-02	520-5052-00 128 X 32	520-5055-01
WWF Royal Rumble	520-5070-00 (Qty. 2) 4-Flipper (2X2)	520-5077-00	520-5047-02	520-5052-00 128 X 32	520-5055-01

Table continued on the next page.

APPENDIX D
Board Type Table

Game Name	Flipper	Sound	Power Supply	Dot Matrix Display	Display Controller
Guns N' Roses	520-5076-00 3-Flipper	520-5077-00	520-5047-02	520-5052-00 128 X 32	520-5055-01
Maverick	520-5076-00 3-Flipper	520-5050-03	520-5047-03	520-5075-00 192 X 64	520-5092-01
Mary Shelley's Frankenstein	520-5076-00 3-Flipper	520-5077-00	520-5047-03	520-5075-00 192 X 64	520-5092-01
Baywatch	520-5080-00 (Qty. 2) 4-Flipper (2X2)	520-5126-02	520-5047-03	520-5075-00 192 X 64	520-5092-01
Batman Forever	520-5076-00 3-Flipper	520-5126-02	520-5047-03	520-5075-00 192 X 64	520-5092-01

NEW BOARD SYSTEM

Game Name	Flipper	I/O Power Driver	CPU / Sound	Display Power Supply	Dot Matrix Display	Display Controller
Apollo 13	520-5070-00 2-Flipper	520-5137-00	520-5136-00	520-5138-00	520-5052-00 128 X 32	520-5055-01
Golden Eye	520-5070-00 2-Flipper	520-5137-00	520-5136-00	520-5138-00	520-5052-00 128 X 32	520-5055-01
Twister	2-Flipper Bd. Not Required	520-5137-01	520-5136-00	520-5138-00	520-5052-00 128 X 32	520-5055-01

APPENDIX E
Generic Coil Cross-Reference Guide

SEGA PINBALL™ Part Nº	Gauge-Turns	SEGA PINBALL™ Part Nº	Gauge-Turns	SEGA PINBALL™ Part Nº	Gauge-Turns	SEGA PINBALL™ Part Nº	Gauge-Turns
090-5000-00	22-700	090-5011-00	22-750	090-5020-00	Not Used	090-5030-00	23-1100
090-5001-00	23-800	090-5012-00	26-800	090-5020-01	21-900	090-5032-00	22-1080
090-5001-01	23-800	090-5013-00	23-700	090-5020-02	22-900	090-5034-00	25-1240
090-5002-00	24-900	090-5014-00	23-600	090-5020-10	21-900	090-5036-00	24-940
090-5003-00	27-1300	090-5015-00	27-1400	090-5020-20	22-900	090-5036-01	24-940
090-5004-00	27-1500	090-5016-00	29-2000	090-5020-30	23-900	090-5037-03	23½-765
090-5005-00	23-840	090-5017-00	22-500	090-5021-00	20-400		
090-5006-00	23-800	090-5018-00	23-800	090-5022-00	23-700	090-5041-00	25-1800
090-5008-00	23-1200	090-5019-00	23-750	090-5023-00	22-600	090-5046-00	28-1050
				090-5025-00	24-1570		

Flipper Coil Table

Game Name	Flipper: **Lower Right** SEGA PINBALL™ Part Nº w/Ga.-Turns	Flipper: **Lower Left** SEGA PINBALL™ Part Nº w/Ga.-Turns	Flipper: **Upper Right** SEGA PINBALL™ Part Nº w/Ga.-Turns	Flipper: **Upper Left** SEGA PINBALL™ Part Nº w/Ga.-Turns
Laser Wars	090-5011-00 22-750/30-2600	SAME AS LOWER RIGHT	Not Used	Not Used
Secret Service	090-5006-00 23-620/30-2600	SAME AS LOWER RIGHT	SAME AS LOWER RIGHT	Not Used
Torpedo Alley	090-5013-00 23-700/30-2600	090-5011-00 22-750/30-2600	090-5012-00 26-800	Not Used
Time Machine	090-5011-00 22-750/30-2600	SAME AS LOWER RIGHT	Not Used	Not Used
Playboy 35th Anniversary †	090-5020-02 22-900	SAME AS LOWER RIGHT	Not Used	Not Used
ABC Monday Night Football †	090-5020-02 22-900	SAME AS LOWER RIGHT	Not Used	Not Used
Robocop	090-5020-20 22-900	SAME AS LOWER RIGHT	Not Used	Not Used
Phantom of the Opera	090-5020-20 22-900	SAME AS LOWER RIGHT	Not Used	Not Used
Back to the Future	090-5020-20 22-900	SAME AS LOWER RIGHT	Not Used	Not Used
The Simpsons	090-5020-20 22-900	SAME AS LOWER RIGHT	Not Used	Not Used
Checkpoint	090-5020-20 22-900	SAME AS LOWER RIGHT	Not Used	Not Used
Teenage Mutant Ninja Turtles	090-5020-30 23-900	SAME AS LOWER RIGHT	Not Used	Not Used
Batman	090-5020-30 23-900	SAME AS LOWER RIGHT	Not Used	Not Used
Star Trek 25th Anniversary	090-5020-30 23-900	SAME AS LOWER RIGHT	Not Used	Not Used
Hook	090-5020-30 23-900	090-5030-00 23-1100	Not Used	Not Used
Lethal Weapon 3	090-5030-00 23-1100	SAME AS LOWER RIGHT	Not Used	Not Used
Star Wars	090-5032-00 22-1080	SAME AS LOWER RIGHT	Not Used	Not Used

† A very small % of these games used a 090-5020-20 coil which used a proto-type Solid State Flipper System. The two types of coils both are 22-900 coils; the only difference being the addition of the 1N5404 Diode on the (-02) coils which was used in the Deger Design.

Table continued on the next page.

APPENDIX E
Flipper Coil Table

Game Name	Flipper: **Lower Right** SEGA PINBALL™ Part Nº w/Ga.-Turns	Flipper: **Lower Left** SEGA PINBALL™ Part Nº w/Ga.-Turns	Flipper: **Upper Right** SEGA PINBALL™ Part Nº w/Ga.-Turns	Flipper: **Upper Left** SEGA PINBALL™ Part Nº w/Ga.-Turns
Rocky & Bullwinkle & Friends	090-5020-30 23-900	**SAME AS LOWER RIGHT**	Not Used	Not Used
Jurassic Park	090-5020-30 23-900	**SAME AS LOWER RIGHT**	090-5030-00 23-1100	Not Used
Last Action Hero	090-5020-30 23-900	**SAME AS LOWER RIGHT**	Not Used	Not Used
Tales from the Crypt	090-5032-00 22-1080	**SAME AS LOWER RIGHT**	090-5041-00 25-1800	Not Used
The Who's Tommy	090-5020-30 23-900	**SAME AS LOWER RIGHT**	Not Used	090-5041-00 25-1800
WWF Royal Rumble	090-5032-00 22-1080	**SAME AS LOWER RIGHT**	090-5041-00 25-1800	**SAME AS UPPER RIGHT**
Guns N' Roses	090-5032-00 22-1080	**SAME AS LOWER RIGHT**	Not Used	090-5030-00 23-1100
Maverick	090-5032-00 22-1080	**SAME AS LOWER RIGHT**	090-5032-00 22-1080	Not Used
Mary Shelley's Frankenstein	090-5030-00 23-1100	**SAME AS LOWER RIGHT**	090-5030-00 23-1100	Not Used
Baywatch	090-5020-30 23-900	090-5030-00 23-1100	**SAME AS LOWER LEFT**	090-5025-00 24-1570
Batman Forever	090-5020-20 22-900	090-5032-00 22-1080	090-5020-30 23-900	Not Used
Apollo 13	090-5032-00 22-1080	**SAME AS LOWER RIGHT**	Not Used	Not Used
Golden Eye	090-5032-00 22-1080	**SAME AS LOWER RIGHT**	Not Used	Not Used
Twister	090-5032-00 22-1080	090-5020-20 22-900	Not Used	Not Used

APPENDIX F
Motor Specification Table

Game Name	Function	Specifications	Part Nº
Laser Wars Secret Service Torpedo Alley Time Machine Playboy 35th Anniversary	No motors were used on the games listed on the shaded lines.		
ABC Monday Night Football	Goal Post Up/Down	Motor 24v A.C. 60 RPM CW	515-5222-00
Robocop			
Phantom of the Opera	Organ Up/Down	Bowman Motor 24v 60hz 3W 11 RPM CCW	515-5256-00
Back to the Future The Simpsons			
Checkpoint	Shaker	Johnson Motor (Vibrator)	041-5002-00
	Mag Wheel (in Backbox)	Motor D.C. (KEN)	041-5005-00
Teenage Mutant Ninja Turtles	Spinning Pizza Ball Deflector	Gear Motor 24v A.C. 325 RPM CW	515-5397-00
Batman	Bar Target Up/Down	Bowman Motor 24v 60hz 3W 11 RPM CCW	515-5256-00
Star Trek 25th Anniversary	Swinging Target	Bowman Motor 24v 22½ RPM	515-5534-00
	Transporter F/X	Gear Motor 24v A.C. 3.5 RPM	500-5421-00
	Cooling Fan for Transporter F/X	4½" Motor 12v	041-5014-00
Hook			
Lethal Weapon 3	Spinning Light	Motor 2.5v A.C. 4000 RPM CCW	041-5017-00
Star Wars	Bar Target Up/Down	Bowman Motor 24v 60hz 3W 11 RPM CCW	515-5256-00
	R2D2 Robot Movement	Bowman Motor 24v A.C. 22½ RPM CW	515-5571-00
	Death Star Rotation	Bowman "G" Motor 24v A.C. 60hz 6 RPM CW	515-5570-00
Rocky & Bullwinkle & Friends	Nell Log "Cutting Blade" Movement	Autotrol Model E Motor 24v 60hz 4W 3 RMP CCW	041-5023-00
Jurassic Park	Shaker	Johnson Motor Vibrator	041-5002-00
	T-Rex Left/Right Movement	Multi Motor 5v D.C.	041-5025-00
	T-Rex Up/Down Movement	Bowman Motor 24v 11 RPM CW	041-5026-00

Table Continued on the next page.

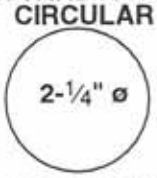
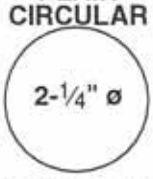
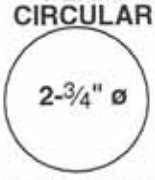
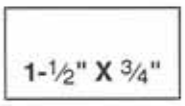
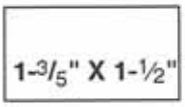
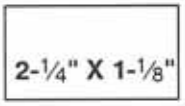
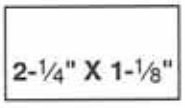
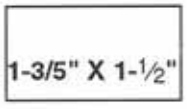
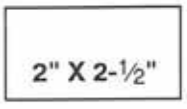
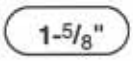
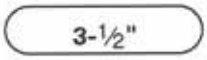
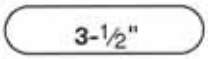
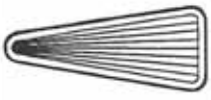
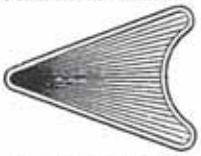
APPENDIX F
Motor Specification Table

Game Name	Function	Specifications	Part Nº
Last Action Hero	Crane Left/Right Movement	Multi Prod. #3312 Motor OSC 12v D.C.	041-5027-00
	Shaker	Motor Vibrator	041-5029-00
Tales from the Crypt	Shaker	Motor Vibrator	041-5029-00
	Tombstone Up/Down	Bowman Motor 24v A.C. 6 RPM CCW	515-5900-00
The Who's Tommy	Mirror Up/Down	Bowman Motor 24v A.C. 6 RPM CCW	515-5900-00
	Flipper Blinders	Servo Motor	041-5032-00
	Spinning Airplane Propellers	Motor D.C.	041-5033-00
WWF Royal Rumble	Shaker	Motor Vibrator	041-5029-00
Guns N' Roses			
Maverick, The Movie	Turning Paddle Wheel	Motor 24v A.C. 10 RPM	041-5036-00
Mary Shelley's Frankenstein	Creature Head Left/Right Movement	Servo Motor	041-5032-00
Baywatch			
Batman Forever	Cannon Left/Right Movement	Bowman Motor 24v A.C. 60Hz 3W 6 RPM CCW	515-6383-00
Apollo 13	Rocket Up/Down Movement	Bowman Motor 24v A.C. 60Hz 3W 6 RPM CCW	515-6383-00
	Moon Unit Up/Down Movement	Multi Products Motor 24v A.C. 50/60Hz 3W 6 RPM CCW	515-6487-00
	Shaker	Motor Vibrator	041-5029-00
Golden Eye	Satellite Left/Right Movement	Bowman Motor 24v A.C. 60Hz 3W 6 RPM CW	515-6528-00
Twister	Magnet Spinner	Multi Products Motor 24v A.C. 50/60Hz 3W 325 RPM CCW	515-6347-00
	Back Box Fan for Tornado Wind	Multi Products Motor 24v A.C. 50/60Hz 3W 3600 RPM CW	515-6531-00

APPENDIX G
Part Number Prefix Classification Codes

I.	**ELECTRICAL SOURCE AND ENERGY AND SIGNAL CONVERTERS**	
	010-	Transformers
	031-	Speakers
	090-	Solenoids
II.	**CONDUCTORS, CONNECTORS AND INSULATORS**	
	034-	Line Cords
	036-	Cable and Harness Assemblies
	041-	Motors
	045-	Connectors (All Types)
	077-	Lamp Sockets
III.	**CIRCUITS AND CIRCUIT ELEMENTS**	
	100-	ICs
	110-	Transistors
	112-	Diodes
	121-	Resistors
	123-	Resistors (Variable & Adjustable)
	125-	CAPS
	140-	Crystals
	165-	Light Bulbs
	180-	Switches
	190-	Relays
IV.	**BOLTS, SCREWS, NUTS, AND WASHERS**	
	231-	Bolts
	232-	Screws (Pan Head)
	234-	Screws (HXW)
	237-	Screws (Misc.)
	240-	Nuts (Misc.)
	242-	Washers (Flat, Round)
	244-	Washers (Split Lock)
	246-	Washers (Lockers, External Tooth)
V.	**MECHANICAL COMPONENTS**	
	249-	Rivets
	251-	Pins (Dowel)
	254-	Stand-Offs, Spacers and Shims
	260-	Steel Ball
	265-	Springs (Extension)
	266-	Springs (Compression)
	269-	Springs (Washers - Belleville, Wave)
	280-	Grommets and Bushing
VI.	**HANDLES, LOCKS, CATCHES & LATCHES, KEYS & HINGES**	
	355-	Handles, Locks, Catches & Latches and Keys
	390-	Hinges
VII.	**FABRICATED PARTS (IN-HOUSE ASSEMBLIES)**	
	500-	End Product (Systems and Models)
	515-	Sub-Assemblies
	520-	P.C. Boards
	522-	Display Glass
	525-	Wood Parts
	530-	Screw Machined Parts
	535-	Fabricated Parts
	545-	Molded (Extruded) Parts (Rubber Rings, Molded Plastic)
	550-	Molded (Inserts)
VIII.	**BULK MATERIALS**	
	600-	Braided Ground Wire
	601-	Stranded Wire
	602-	Ribbon Cable
	605-	Sleeving (Shrink Tubing)
	626-	Foam Rubber
IX.	**MISCELLANEOUS**	
	705-	Packing & Shipping Items
	820-	Decals and Labels (Sets & Misc.)
	820-	Butyrate
	900-	Game Posters
	960-	EPROM (Raw Part)
	965-	EPROM (Programmed Part)

APPENDIX H
Playfield Inserts (Plastic Light Covers)

Patterns: STARBURST  STIPPLE 	STARBURST CIRCULAR  5/8" ø 550-5000-XX	STARBURST CIRCULAR  3/4" ø 550-5001-XX	STARBURST CIRCULAR  1" ø 550-5002-XX	STARBURST CIRCULAR  1-3/16" ø 550-5003-XX	STARBURST CIRCULAR  1-1/2" ø 550-5004-XX
STARBURST CIRCULAR  2-1/4" ø 550-5005-XX	STARBURST CIRCULAR  2-3/4" ø 550-5006-XX	PLAIN CIRCULAR  3/4" ø 550-5007-XX	PLAIN CIRCULAR  1" ø 550-5008-XX	PLAIN CIRCULAR  1-3/16" ø 550-5009-XX	PLAIN CIRCULAR  1-1/2" ø 550-5010-XX
PLAIN CIRCULAR  2-1/4" ø 550-5011-XX	PLAIN CIRCULAR  2-3/4" ø 550-5012-XX	STIPPLE CIRCULAR  1" ø 550-5048-XX	STIPPLE 1" SQUARE  1" 550-5019-XX	ROLLOVER BUTTON BASE  550-5026-XX	WHITE STAR *(only in white)*  545-5015-00
STIPPLE RECTANGULAR  1-1/2" X 3/4" 550-5018-XX	STIPPLE RECTANGULAR  1-3/5" X 1-1/2" 550-5051-XX	STARBURST RECTANGULAR  2-1/4" X 1-1/8" 550-5044-XX	PLAIN RECTANGULAR  2-1/4" X 1-1/8" 550-5049-XX	PLAIN RECTANGULAR  1-3/5" X 1-1/2" 550-5050-XX	PLAIN RECTANGULAR  2" X 2-1/2" 550-5063-XX
STARBURST MINI SHIELD  1" X 1" 550-5024-XX	STARBURST LARGE SHIELD  2-1/5" X 2" 550-5025-XX	MINI HOT DOG  1-5/8" 550-5020-XX	BEVEL HOT DOG  3-1/2" 550-5021-XX	PLAIN HOT DOG  3-1/2" 550-5022-XX	BANANA  550-5023-XX
STARBURST ARROW-SHORT  550-5013-XX	STARBURST ARROW-LARGE  550-5014-XX	STARBURST ARROW-HEAD  550-5015-XX	STARBURST BULLET  550-5016-XX	STARBURST TRIANGLE  550-5017-XX	

Note: The shapes and sizes shown above are not to scale. Some shapes may no longer be available in every color.

Plastic Part Color Chart (As applicable for all parts which can come in various colors.):
The "-XX" should be replaced with the following 2-digit number for the color desired.

-01:	CLEAR	-06:	YELLOW	-11	FLUORESCENT GREEN
-02:	RED	-07:	ORANGE	-12	FLUORESCENT BLUE
-03:	AMBER	-08:	WHITE	-13	TEAL GREEN
-04:	GREEN	-09:	PURPLE	-14	GRAY
-05:	BLUE	-10	FLUORESCENT ORANGE	-15	*NEW:* LUMINESCENT

GLOSSARY OF TERMS

A	Followed after a number means "Amp." or Ampage in an expression relating to an electrical object. e.g. 8A (eight amps).
AC	Acronym: Alternating Current.
Adj.	Abbreviation: Adjustment(s).
A.L.I.S.O.N. Interface	See Section 3, Chapter 6.
Au.	Abbreviation: Audit(s).
BOT	Abbreviation: Bottom.
Bridge Rectifier	A configuration of a diode that allows current to flow in one direction producing both positive and negative pulsating DC Voltages.
COLOR CODING	See Appendix H, Color Chart (Bottom) or Section 4, Chapter (last page).
Combination (Combo)	[Shot]. Any variable pinball shot(s) made succesively.
CMOS	Short for COSMOS (Complementary Symmetry M.O.S.); Complementary Metal-Oxide Semi-Conductor.
CT	Abbreviation: Center.
DC	Abbreviation: Direct Current.
DT	Abbreviation: Drop Target(s).
EB	Acronym: Extra Ball.
Eject	Playfield surface device to kick ball back into play.
EPROM	Acronym: Erasable Programmable Read Only Memory. Can be erased using UV Light and re-programmed.
e.g.	Abbreviation: Latin- Exempli gratia. For Example.
EOS	Acronym: End-of-Stroke.
G.I.	Abbreviation: General Illumination (Lamps).
IC	Acronym: Integrated Circuit (As in after 24-Pin IC)
i.e.	Abbreviation: Latin- Id est. That is.
LT	Abbreviation: Left.
Laser Kick	A coil/plunger used above the playfield to kick pinball back into play.
LED	Light emitting diode.
Loop	[Shot] Continuously up a ramp and back to the flipper.
Lwr.	Abbreviation: Lower.
Orbit	[Shot] From the left or right flipper around the back rail of the playfield back to the flipper.
MB	Acronym: Magnet Board.
M-BALL or MBALL	Abbreviation: Multiball™.
MID	Abbreviation: Middle
Non-Reflexive	See Reflexive.
No. or Nº or #	Abbreviation: Number
NPF	Acronym: No Problem Found.
N.C. or NC	Abbreviation: Normally Closed.
N.O. or NO	Abbreviation: Normally Open.
PCB	Acronym: Printed Circuit Board
PIA LED	Acronym: Peripheral Interface Adapter. This is a diagnostic LED on the CPU; it should not be lit during normal operation of a pinball game.
Plumb Bob Tilt	Weight on Tilt Assembly.
Pop(s)	Another term for Turbo Bumper(s).
PPB	Playfield Power Board (Generic Term to describe Acronym with no true definition).
PSB	Acronym: Power Supply Board

GLOSSARY OF TERMS

P/F	Abbreviation: Playfield
RAM	Acronym: Random Access Memory. RAM **can** store input instructions and supply output information.
RED	Abbreviation: Red.
Reflexive/Non-Reflexive (Relating to CPU Boards)	**Reflexive**—Solenoid Drive Transistor is enabled directly by a switch closure on the solenoid assembly (Ver. 1/2). **Non-Reflexive**—Solenoid Drive Transistor is enabled by the CPU after reading a switch closure in the Switch Matrix (Ver. 3). Also note: All CPU Boards are backwards compatible (e.g. Jurassic Park/Ver. 3 to Time Machine/ Ver. 2). Swapping a Ver. 2 Board to a Ver. 3 is not possible due to the special solenoids section (i.e. Slingshots, Turbo Bumpers, etc.) changing from REFLEXIVE to NON-REFLEXIVE on Ver. 3 Boards.
Relay	An automatic switch operated by current in a coil.
ROM	Aconym: Read Only Memory. ROM **cannot** store input instructions but can supply output information. ROM can be programmed only once.
RT	Abbreviation: Right.
RO	Abbreviation: Rollover (switches).
Saucer	See Eject.
Scoop	A hole into the playfield. A metal scoop is in place to guide the ball into the kick-back under the playfield.
Slam Tilt	A switch which closes when the game is slammed into or the Coin Door is slammed shut. Depending on adjustable settings, will cancel game in play when the number of closures required is sufficed.
SMB	Acronym: Shaker Motor Board.
Solenoid	A coil used for Electro Magnetic devices such as relays, flippers, slingshots, etc.
SSFB	Acronym: Solid State Flipper Board.
STEP	Refers to the service switches on the coin door.
S-U	Abbreviation: Stand-Up (targets).
TM	Acronym: Trademark
Transfer	[Shot] Maneuvering the ball in play from one flipper to the other. With flipper in the up position and the ball cradled by that flipper one would activate the flipper button in a quick repetive manner to bounce the ball to the other side. Skilled players can rebound the ball off the slingshot.
TTL	Acronym: Transistor-Transistor Logic
Upr.	Abbreviation: Upper.
V or v	Abbreviation: Volt(s).
Ver.	Abbreviation: Version.
VUK	Acronym: Vertical Up-Kicker.
X	Acronym: "Times" A multiplier.
Zener Diode	A semi-conductor diode used for voltage regulation. Application depends on reverse break-down voltage.

GLOSSARY OF TERMS

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PRINTED CIRCUIT BOARDS (GAME LOGIC) 60 DAYS

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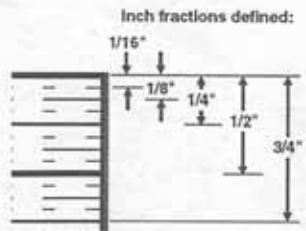
SUBSTITUIONS OF PARTS OR EQUIPMENT MODIFICATIONS MAY VOID FCC TYPE ACCEPTANCE.

Warning

THIS EQUIPMENT GENERATES, USES, AND CAN RADIATE RADIO FREQUENCY ENERGY, AND IF NOT INSTALLED AND USED IN ACCORDANCE WITH THE INSTRUCTIONS MANUAL, MAY CAUSE INTERFERENCE TO RADIO COMMUNICATIONS. IT HAS BEEN TESTED AND FOUND TO COMPLY WITH THE LIMITS FOR A CLASS A COMPUTING DEVICE PURSUANT TO SUBPART J OF PART 15 OF FCC RULES, WHICH ARE DESIGNED TO PROVIDE REASONABLE PROTECTION AGAINST SUCH INTERFERENCE WHEN OPERATED IN A COMMERCIAL ENVIRONMENT. OPERATION OF THIS EQUIPMENT IN A RESIDENTIAL AREA IS LIKELY TO CAUSE INTERFERENCE IN WHICH CASE THE USER AT HIS OWN EXPENSE WILL BE REQUIRED TO TAKE WHATEVER MEASURES MAY BE REQUIRED TO CORRECT THE INTERFERENCE.

RF INTERFERENCE NOTICE, CABLE HARNESS PLACEMENTS AND GROUND STRAP ROUTING ON THIS GAME HAVE BEEN DESIGNED TO KEEP RF RADIATION AND CONDUCTION WITHIN LEVELS ACCEPTED BY THE FCC RULES. TO MAINTAIN THESE LEVELS, REPOSITION HARNESSES AND RECONNECT GROUND STRAPS TO THEIR ORIGINAL PLACEMENTS, IF THEY BECOME DISCONNECTED DURING MAINTENANCE.

Notices



ALTHOUGH EVERY EFFORT IS PUT INTO MAKING THIS MANUAL (AND ALL OTHER DOCUMENTS RELATING TO THIS PRODUCT) ACCURATE AND COMPLETE, PLAYFIELD COMPONENTS, FEATURES, RULES, PROGRAMMING AND OPERATION ARE SUBJECT TO CHANGE WITH OR WITHOUT NOTICE.

IF YOU HAVE ANY QUESTIONS, NEED TECHNICAL ADVICE OR HAVE COMMENTS, CALL US TOLL-FREE (USA or CANADA) AT 1-800-KICKERS (542-5377) OR (708) 345-7700.

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