featuring our Portals Service Menu and our unique

Find-It-In-Front: Dr. Pinball Section

DR. DR. DR. DR.

NO YES END PREV QUIT

SEGA™ PINBALL, INC.

11th ANNIVERSARY

STARSHIP TROOPERS

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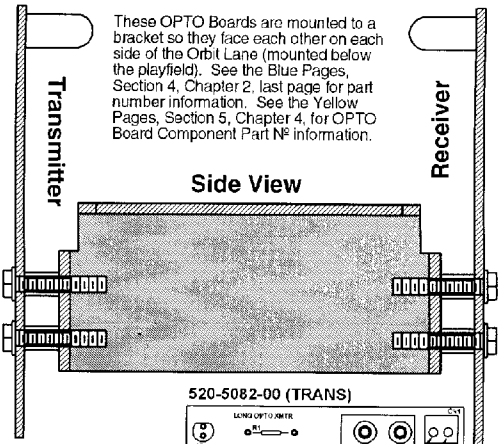
780-5059-00

Introducing Playfield Switch OPTO "Long-Hop" Boards

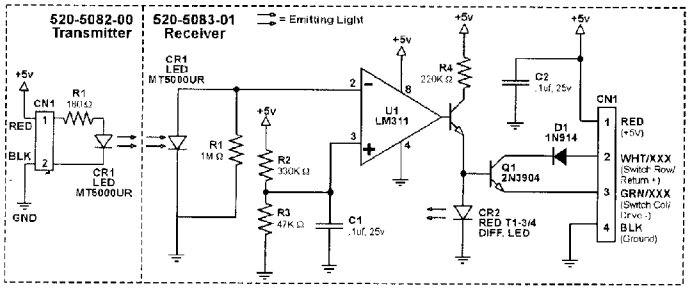
A *New* **OPTO Board combination** (**Trans**mitter, 520-5082-00, and **Rec**eiver, 520-5083-01) was first introduced in our pinball games with ID4: Independence Day and The X-Files. In this game, Starship Troopers, the **OPTO Board combinations** are being used as Playfield Switches to recognize the Left (Sw. 47) & the Right (Sw. 48) Orbit Shots.

Playfield Switch OPTO Boards Theory of Operation & Schematic

The light falling on **LED** (**CR1**) generates a voltage which is applied to the input (Pin-2) of the **LM311 Comparator** (**U1**). **R1** bleeds off excess charge. At about a volt input from **LED** (**CR1**) the **Comparator** (**U1**) trips & drives either **Q1** (during switch line strobes) or the indicator **LED** (**CR2**) (in between strobes). If a switch line is being strobed, the emitter of **Q1** drops to the saturation voltage of the Switch Line Driver, about .3v. This plus the .7 volt drop on the base give a 1v forward bias voltage to **Q1**, which is lower than the 1.7v drop on **LED** (**CR2**) so the current flows through the **Transistor** during strobes. This drives **Q1** on and makes the switch. If the strobe line is high, then the 1.7v path through **LED** (**CR2**) is lower than **Q1**'s bias voltage so current flows through **LED** (**CR2**) and the indicator lights. **D1** prevents reverse bleed, **R2** and **R3** form the voltage divider for the trip point, **R4** is a current limiter for both **Q1** and **CR2**, **C1** and **C2** are general noise-filter caps.

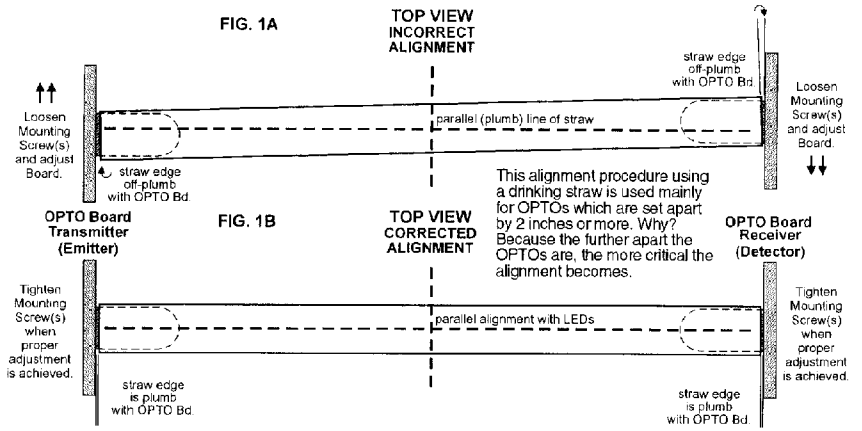


These OPTO Boards are mounted to a bracket so they face each other on each side of the Orbit Lane (mounted below the playfield). See the Blue Pages, Section 4, Chapter 2, last page for part number information. See the Yellow Pages, Section 5, Chapter 4, for OPTO Board Component Part № information.



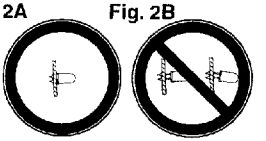
OPTO Alignment Procedure Option

There is an easy way to align your OPTO Boards with a very cheap Tool: an ordinary, everyday ***drinking straw!*** Cut a clean, unused straw to the length that the OPTO Boards are apart (ensure the edges are cut straight). Then slip the **LED**s into each each end of the straw (*Note: You may have to slightly bend the straw in the middle to get both LEDs into the straw*). If the straw edges are not plumb or parallel on each board, an adjustment should be made (see **Fig. 1A**). Adjust the OPTO Boards by loosening the screw(s) (*just enough so the board(s) only move when you touch them*) until the straw edges and the boards are plumb or parallel (see **Fig. 1B**). One or both boards may need to be aligned. If alignment is achieved with just one board, leave the other one alone.

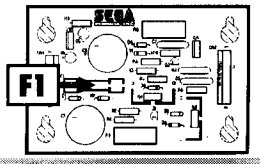


Before you attempt this adjustment procedure, ensure the OPTO Mounting Brackets are not bent and ensure the **LED**s are sitting flush & perpendicular to the board (see **Fig. 2A**). If the **LED** appears not to be flush and/or is bent (see **Fig. 2B**) take the necessary action to correct it (desoldering / soldering is recommended; however, you can carefully bend the **LED** straight & add a dab of silicone to help stabilize the **LED**.)

Fig. 2A **Fig. 2B**



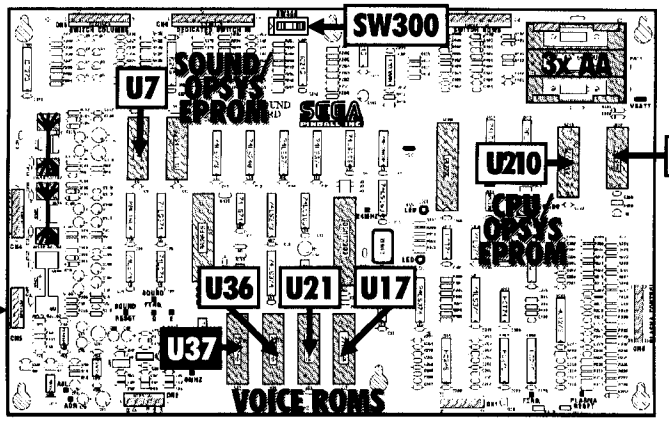
BACKBOX LAYOUT LOCATIONS: Fuses, Bridges, Relays & ROMs



Display Power Supply Bd.

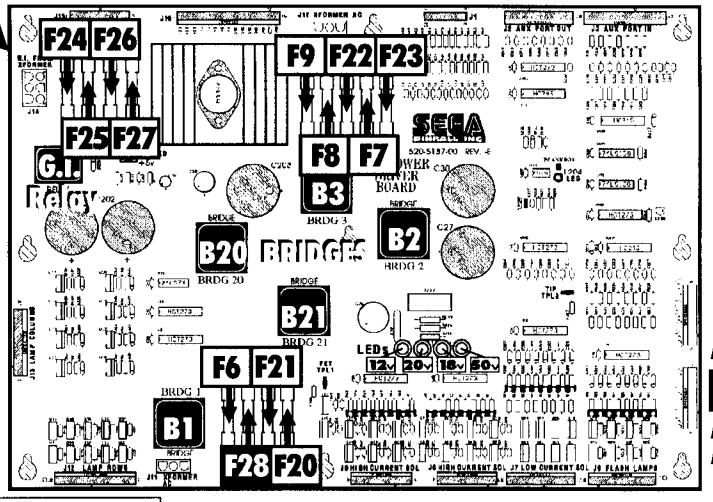
CPU / Sound Board
No Fuses

I / O Power Driver Board



Note:

U37 *is Not Used in this game.*



Note:

F28 *is Not Used in this game.*

*** All BRIDGES rated 35A @ 100v ***	
B1	+50v DC High Current Coils
B2	+20v DC Low Current Coils
B3	+/-12v DC Sound/Display/Logic
B20	+18v DC Illumination
B21	+5v DC Logic Voltage

QUICK REFERENCE FUSE CHART

Backbox Fuses			
LOC: DISPLAY POWER SUPPLY (P.S.) BOARD			
F1	3/4A 250v S.B.	90v DC	High Voltage Display
LOC: I / O POWER DRIVER BOARD			
F6	7A 250v S.B.	50v DC	Primary High Power Coils/Flippers
F7	5A 250v S.B.	20v DC	Low Power Coils
F8	5A 250v S.B.	12v DC	Logic Power
F9	5A 250v S.B.	12v DC	Logic Power
F20	3A 250v S.B.	50v DC	Magnets
F21	3A 250v S.B.	50v DC	Coils
F22	8A 250v S.B.	18v DC	Controlled Lamps
F23	4A 250v S.B.	5v DC	Logic
F24	5A 250v S.B.	6.3v AC	G.I. Lamps (BRN/WHT to WHT/BRN)
F25	5A 250v S.B.	6.3v AC	G.I. Lamps (YEL to WHT/YEL)
F26	5A 250v S.B.	6.3v AC	G.I. Lamps (GRN to WHT/GRN)
F27	5A 250v S.B.	6.3v AC	G.I. Lamps (VIO to WHT/VIO)
F28	3A 250v S.B.	24v AC	**Not Used / Spare**
Cabinet Fuses			
LOC: SERVICE (AC) OUTLET BOX (Cabinet Bottom)			
n/a	8A 250v S.B.	115v AC	Main Fuse Line (Domestic or USA)
n/a	5A 250v S.B.	220v AC	Main Fuse Line (International)
Playfield Fuses			
LOC: UNDER PLAYFIELD (By Assemblies Listed)			
n/a	3A 250v S.B.	50v DC	Rt. Flipper (BLU/YEL↔RED/YEL)
n/a	3A 250v SB	50v DC	Mini Flipper (BLU/YEL↔RED/YEL)
n/a	3A 250v S.B.	50v DC	Lt. Flipper (GRY/YEL↔RED/YEL)
n/a	3A 250v S.B.	50v DC	Lt. Magnet (VIO/YEL↔BRN/GRN)
n/a	3A 250v S.B.	50v DC	Rt. Magnet (VIO/YEL↔BRN/BLU)
n/a	3A 250v S.B.	50v DC	Brain Bug (RED/WHT↔VIO/YEL)

STARSHIP TROOPERS™

The Display Controller Board (holds the Display ROM Loc: ROM0) is positioned behind the 128 X 32 Dot Matrix Display Board (both boards do not have fuses).

See Section 4, Chapter 1, for Backbox & Cabinet General Parts.

Volume Control & Service Switches (See Sec. 3, Chp. 1 for operation usage)

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

The key technical data from various parts of the manual were extracted and combined into the "Find-It-In-Front: Dr. Pinball Section." This section (pages DR. ❶ - ⑩) will assist the technician in locating important technical information needed to troubleshoot the Pinball Machine. Dr. Pinball is also available on the game in the **Portals™ Service Menu**. This variation is in a Flow Chart Help Format. To get into the **Portals™ Service Menu:**

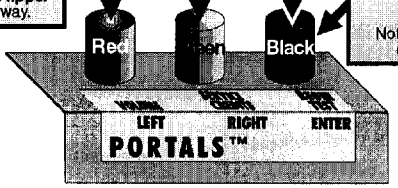
Step 1
Enter the **Portals™ Service Menu** by pushing the **Black "BEGIN TEST" Button.**

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

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



IMPORTANT
Ensure the Playfield Power Interlock Switch (Located inside Coin Door Left) is pulled out. ***This is required for Coil and Flashlamp Testing.***

In our **Portals™ Service Menu**, selecting the "DR" *Icon* will bring the operator/technician into Dr. Pinball (Flow Chart Menus), the "on-screen" diagnostic aide. This is a feature that will allow you to utilize the power of the micro-processor assisting in troubleshooting a problem with the machine in a Flow Chart format (Just follow along & answer the questions.).

☆ ☆ ☆ ☆ HOW IT WORKS ☆ ☆ ☆ ☆

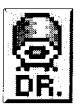
First, the operator/technician must enter the Service Mode (for a complete description of the **Portals™ Service Menu** and **ICONS** see Section 3, Chapter 1). To get into the Service Menu Mode: • Power-up game (if not already) & open the Coin Door. • On the Coin Door is the Portals™ Service Switch 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™ © 1997 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 three (3) Sub-Menus: 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.

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

From the Diagnostics Menu GO TO DR. PINBALL →



From the Dr. Pinball Menu

GO TO COIL, SWITCH OR LAMP FLOW CHARTS

The following are the *Mini-Icons* with explanations for the Dr. Pinball Sub-Menus:

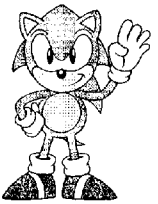
Select a Coil, Lamp, Switch or Flipper to diagnose with "-" or "+" Icon; Then select the "RUN" Icon to activate the choice.
"PREV" goes back to previous question.
"QUIT" exits Portals completely.

Seen when question is being asked on the Display. Select "YES" or "NO" to answer question given.
"END" lets you select a new item to test.

Seen when diagnosis is given.
Select any Icon for your next step.
"?" gives Help.

In Coil Flow Chart Menu, select "PULSE" to pulse the coil selected.

INSTALL 4 BALLS!



STARSHIP TROOPERS is a 4-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

CUSTOM FACTORY ADJUSTMENTS BY COUNTRY*

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
BRAZIL	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
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
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
NETHERLANDS (Holland / Dutch)	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	●	●	●			●	●	●

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

CPU COUNTRY SETTING:	Pos.	1	2	3	4	5	6	7	8
UK (New 50p, 2£ Coin Mech)	ON		●	●	●				
	OFF	●				●	●	●	●

*All countries not noted use the "USA Setting"

ROM SUMMARY TABLE

I.C. NAME	TYPE	BOARD NAME	LOC.	PART Nº
Game ROM	1MB	CPU / Sound Board	U210	965-0250-59
Voice ROM 1	4MB	CPU / Sound Board	U17	965-0251-59
Voice ROM 2	4MB	CPU / Sound Board	U21	965-0252-59
Voice ROM 3	4MB	CPU / Sound Board	U36	965-0255-59
Voice ROM 4	Not Used	CPU / Sound Board	U37	Not Used
Sound EPROM	512K	CPU / Sound Board	U7	965-0253-59

Display EPROM	4MB	Display Controller Bd.	ROM Ø	965-0254-59
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

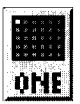
Diode On Terminal Strip

SWITCH MATRIX GRID & DEDICATED SWITCHES

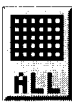
Row (Return) \ Column (Drive)	1 Q1 GRN-BRN CN5-P1	2 Q2 GRN-RED CN5-P3	3 Q3 GRN-ORG CN5-P4	4 Q4 GRN-YEL CN5-P5	5 Q5 GRN-BLK CN5-P6	6 Q6 GRN-BLU CN5-P7	7 Q7 GRN-VIO CN5-P8	8 Q8 GRN-GRY CN5-P9
1 U400 WHT-BRN CN7-P9	NOT USED 1	UTROUGH: SKILL SHOT 9	LEFT BOTTOM S-U (GRN) 17	LEFT RAMP ENTER 25	STEPPER MOTOR REAR DS 33	LEFT TOP LANE 41	LEFT TURBO BUMPER 49	LEFT OUTLANE 57
2 U400 WHT-RED CN7-P8	4TH COIN SLOT 2	UTROUGH: BUG HOLE 10	LEFT MIDDLE S-U (YEL) 18	LEFT RAMP EXIT DS 26	STEPPER MOTOR FRONT DS 34	MIDDLE TOP LANE 42	BOTTOM TURBO BUMPER 50	LEFT RETURN LANE 58
3 U400 WHT-ORG CN7-P7	6TH COIN SLOT 3	NOT USED 11	LEFT MIDDLE S-U (RED) 19	LEFT RAMP S-U (YEL) 27	STEPPER MOTOR BUG DS 35	RIGHT TOP LANE 43	RIGHT TURBO BUMPER 51	LEFT SLINGSHOT 59
4 U400 WHT-YEL CN7-P6	RIGHT COIN SLOT 4	4-BALL TROUGH #1 (LEFT) 12	LEFT TOP S-U (YEL) 20	POP S-U (BLU) 28	NOT USED 36	NOT USED 44	RIGHT RAMP ENTER 52	RIGHT OUTLANE 60
5 U401 WHT-GRN CN7-P5	CENTER COIN SLOT / DBA 5	4-BALL TROUGH #2 13	RIGHT BOTTOM S-U (RED) 21	POP S-U (GRN) 29	BRAIN BUG UP 37	VUK DS 45	RIGHT RAMP EXIT 53	RIGHT RETURN LANE 61
6 U401 WHT-BLU CN7-P3	LEFT COIN SLOT 6	4-BALL TROUGH #3 14	RIGHT MIDDLE S-U (YEL) 22	VUK S-U (GRN) 30	BRAIN BUG HIT DS 38	SUPER VUK DS 46	START BUTTON 54	RIGHT SLINGSHOT 62
7 U401 WHT-VIO CN7-P2	5TH COIN SLOT 7	4-BALL TROUGH VUK OPTO 15	RIGHT MIDDLE S-U (GRN) 23	VUK S-U (BLU) 31	BRAIN BUG UP 39	LEFT ORBIT 47	SLAM TILT 55	NOT USED 63
8 U401 WHT-GRY CN7-P1	NOT USED 8	SHOOTER LANE DS 16	RIGHT TOP S-U (YEL) 24	RIGHT RAMP S-U (YEL) 32	UTROUGH POP EXIT HOLE DS 40	RIGHT ORBIT 48	PLUMB BOB TILT 56	NOT USED 64

IC U206 INPUTS \ GND	Ground BLK CN6-P1, -P11
1 GRY-BRN CN6-P2	#1 LEFT FLIPPER BUTTON DS-1
2 GRY-RED CN6-P3	#2 LEFT FLIPPER E.O.S (End-of-Stroke) DS-2
3 GRY-ORG CN6-P4	#3 RIGHT FLIPPER BUTTON DS-3
4 GRY-YEL CN6-P5	#4 RIGHT FLIPPER E.O.S. (End-of-Stroke) DS-4
5 GRY-GRN CN6-P7	#5 MINI FLIPPER BUTTON DS-5
6 GRY-BLU CN6-P8	#6 VOLUME (RED BUTTON) (Normal) (In Test: LEFT) DS-6
7 GRY-VIO CN6-P9	#7 SERV. CRED. (GREEN BUTTON) (Normal) (In Test: RIGHT) DS-7
8 GRY-BLK CN6-P10	#8 BEGIN TEST (BLACK BUTTON) (Normal) (In Test: ENTER) DS-8

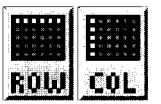
From the Diagnostics Menu GO TO LAMP MENU



From the Lamp Menu GO TO SINGLE LAMP TEST



From the Lamp Menu GO TO TEST ALL LAMPS



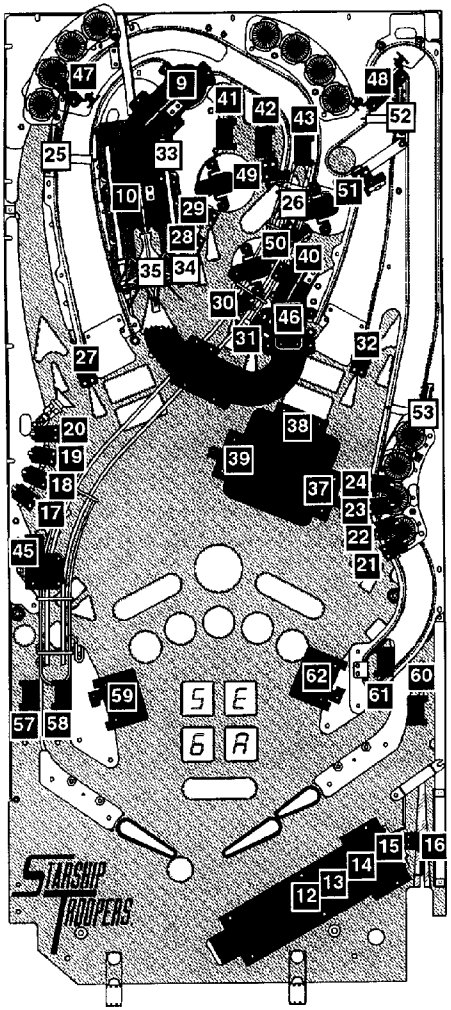
From the Lamp Menu GO TO ROW OR COLUMN TEST

Diode On Terminal Strip

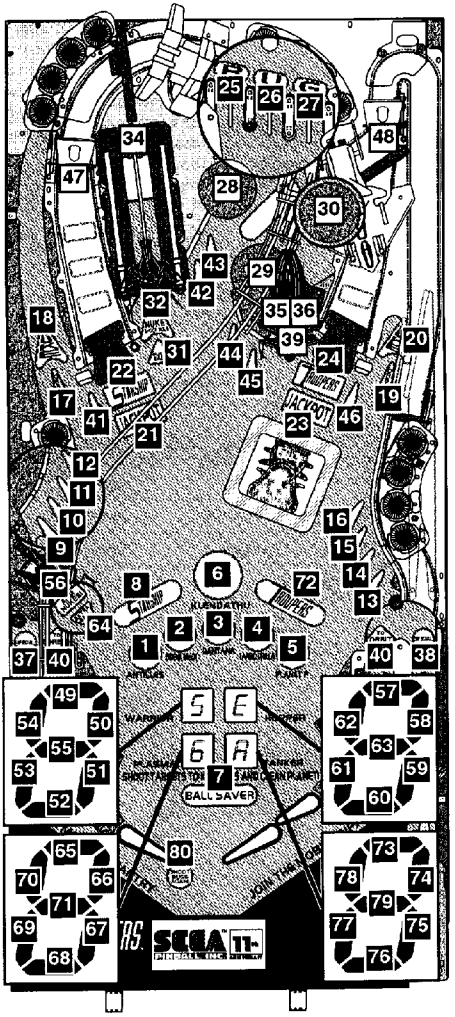
LAMP MATRIX GRID

Row (GND) \ Column (18V)	1: U17 YEL-BRN J13-P9	2: U16 YEL-RED J13-P8	3: U15 YEL-ORG J13-P7	4: U14 YEL-BLK J13-P6	5: U13 YEL-GRN J13-P5	6: U12 YEL-BLU J13-P4	7: U11 YEL-VIO J13-P3	8: U10 YEL-GRY J13-P1
1: Q33 RED-BRN J12-P1	ANTILLES #555 Bulb 1	ZEGEMA BEACH #555 Bulb 2	DANTANA #555 Bulb 3	TANGO URILLA #555 Bulb 4	PLANET B #555 Bulb 5	KLENDATHU #555 Bulb 6	BALL SAVER #555 Bulb 7	STARSHIP (HOTDOG) #555 Bulb 8
2: Q34 RED-BLK J12-P2	LEFT BOTTOM S-U (GRN) #555 Bulb 9	LEFT MIDDLE S-U (YEL) #555 Bulb 10	LEFT MIDDLE S-U (RED) #555 Bulb 11	LEFT TOP S-U (YEL) #555 Bulb 12	RIGHT BOTTOM S-U (RED) #555 Bulb 13	RIGHT MIDDLE S-U (YEL) #555 Bulb 14	RIGHT MIDDLE S-U (GRN) #555 Bulb 15	RIGHT TOP S-U (YEL) #555 Bulb 16
3: Q35 RED-ORG J12-P3	LEFT ORBIT "ORBIT" #555 Bulb 17	LEFT ORBIT NUKE #555 Bulb 18	RIGHT ORBIT "ORBIT" #555 Bulb 19	RIGHT ORBIT NUKE #555 Bulb 20	LEFT RAMP JACKPOT #555 Bulb 21	LEFT RAMP STARSHIP #555 Bulb 22	RIGHT RAMP JACKPOT #555 Bulb 23	RIGHT RAMP TROOPER #555 Bulb 24
4: Q36 RED-YEL J12-P4	(B) UG #555 Bulb 25	B (U) G #555 Bulb 26	BU (G) #555 Bulb 27	LEFT TURBO BUMPER DS #555 Bulb 28	BOTTOM TURBO BUMPER DS #555 Bulb 29	RIGHT TURBO BUMPER DS #555 Bulb 30	MULTI BALL #44 Bulb 31	SUPER NUKE #44 Bulb 32
5: Q37 RED-GRN J12-P5	NOT USED 33	WARRIOR BUG DS #555 Bulb 34	2X NUKE DS #555 Bulb 35	RECON DS #555 Bulb 36	LEFT OUTLANE #555 Bulb 37	RIGHT OUTLANE #555 Bulb 38	ADVANCE PLANET DS #555 Bulb 39	LT/RT RE-TURN LANES #555 Bulb 40
6: Q38 RED-BLU J12-P6	LEFT RAMP S-U (YEL) #555 Bulb 41	POPS S-U (BLU) #555 Bulb 42	POPS S-U (GRN) #555 Bulb 43	VUK S-U (GRN) #44 Bulb 44	VUK S-U (BLU) #44 Bulb 45	RIGHT RAMP S-U (YEL) #555 Bulb 46	LEFT RAMP NUKE DS #555 Bulb 47	RIGHT RAMP NUKE DS #555 Bulb 48
7: Q39 RED-VIO J12-P8	WARRIOR 7-SEGMENT "A" Red LED 49	WARRIOR 7-SEGMENT "B" Red LED 50	WARRIOR 7-SEGMENT "C" Red LED 51	WARRIOR 7-SEGMENT "D" Red LED 52	WARRIOR 7-SEGMENT "E" Red LED 53	WARRIOR 7-SEGMENT "F" Red LED 54	WARRIOR 7-SEGMENT "G" Red LED 55	ARM NUKES #44 Bulb 56
8: Q40 RED-GRY J12-P9	HOPPER 7-SEGMENT "A" Red LED 57	HOPPER 7-SEGMENT "B" Red LED 58	HOPPER 7-SEGMENT "C" Red LED 59	HOPPER 7-SEGMENT "D" Red LED 60	HOPPER 7-SEGMENT "E" Red LED 61	HOPPER 7-SEGMENT "F" Red LED 62	HOPPER 7-SEGMENT "G" Red LED 63	EXTRA BALL #44 Bulb 64
9: Q41 RED-WHT J12-P10	PLASMABUG 7-SEGMENT "A" Red LED 65	PLASMABUG 7-SEGMENT "B" Red LED 66	PLASMABUG 7-SEGMENT "C" Red LED 67	PLASMABUG 7-SEGMENT "D" Red LED 68	PLASMABUG 7-SEGMENT "E" Red LED 69	PLASMABUG 7-SEGMENT "F" Red LED 70	PLASMABUG 7-SEGMENT "G" Red LED 71	TROOPERS (HOTDOG) #555 Bulb 72
10: Q42 RED J12-P11	TANKER 7-SEGMENT "A" Red LED 73	TANKER 7-SEGMENT "B" Red LED 74	TANKER 7-SEGMENT "C" Red LED 75	TANKER 7-SEGMENT "D" Red LED 76	TANKER 7-SEGMENT "E" Red LED 77	TANKER 7-SEGMENT "F" Red LED 78	TANKER 7-SEGMENT "G" Red LED 79	SHOOT AGAIN #555 Bulb 80

SWITCH MATRIX GRID LOCATIONS

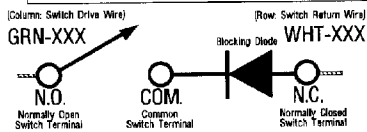


LAMP MATRIX GRID LOCATIONS

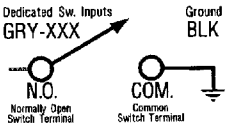


Legend Note: ☐ = Switches/Lamps mounted above playfield. ■ = Switches/Lamps mounted below the playfield.

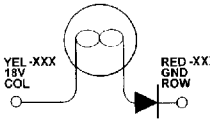
TYPICAL SWITCH SCHEMATIC



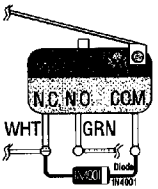
DEDICATED SWITCH SCHEMATIC



TYPICAL LAMP SCHEMATIC

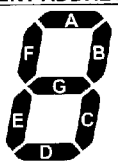


Note:
All Switches require diodes.
Some diodes are located on Terminal Strips (under playfield) & not on the switch itself.
Diode
On
Terminal
Strip

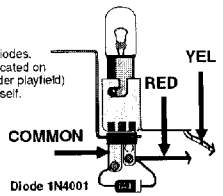


TYPICAL 7-SEGMENT ADDRESS

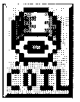
NOTE:
This Game features a 4-Digit 7-Segment Display (located over the Flippers). Each segment is wired into the Lamp Matrix Grid (see previous page).



Note:
All Lamps require diodes.
Some diodes are located on Terminal Strips (under playfield) & not on the lamp itself.
Diode
On
Terminal
Strip



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 or Bulb Type
01	TROUGH UP-KICKER	Q1	I/O Pwr. Drvr.	BRN-BLK	J8-P1	YEL-VIO	J10-P4/5	50v DC	26-1200 090-5044-00T
02	AUTO LAUNCH	Q2	I/O Pwr. Drvr.	BRN-RED	J8-P3	YEL-VIO	J10-P4/5	50v DC	24-940 090-5036-00T
03	VUK	Q3	I/O Pwr. Drvr.	BRN-ORG	J8-P4	YEL-VIO	J10-P4/5	50v DC	26-1200 090-5044-00T
04	SUPER VUK	Q4	I/O Pwr. Drvr.	BRY-YEL	J8-P5	YEL-VIO	J10-P4/5	50v DC	26-1200 090-5044-00T
05	LEFT MAGNET	Q5	I/O Pwr. Drvr.	BRN-GRN	J8-P6	VIO-YEL	J10-P3	50v DC	22-650 090-5042-01
06	RIGHT MAGNET	Q6	I/O Pwr. Drvr.	BRN-BLU	J8-P7	VIO-YEL	J10-P3	50v DC	22-650 090-5042-01
07	BRAIN BUG	Q7	I/O Pwr. Drvr.	BRN-VIO	J8-P8	VIO-YEL RED-WHT	J10-P3	50v DC	22-1080 090-5032-00T
08	EUROPEAN TOKEN DISPENSER	Q8	I/O Pwr. Drvr.	BRN-GRY	J8-P9	YEL-VIO	J10-P4/5	50v DC	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 or Bulb Type
09	LEFT TURBO BUMPER	Q9	I/O Pwr. Drvr.	BLU-BRN	J9-P1	YEL-VIO	J10-P4/5	50v DC	26-1200 090-5044-00T
10	BOTTOM TURBO BUMPER	Q10	I/O Pwr. Drvr.	BLU-RED	J9-P2	YEL-VIO	J10-P4/5	50v DC	26-1200 090-5044-00T
11	RIGHT TURBO BUMPER	Q11	I/O Pwr. Drvr.	BLU-ORG	J9-P4	YEL-VIO	J10-P4/5	50v DC	26-1200 090-5044-00T
12	LEFT SLINGSHOT	Q12	I/O Pwr. Drvr.	BLU-YEL	J9-P5	YEL-VIO	J10-P4/5	50v DC	26-1200 090-5044-00T
13	RIGHT SLINGSHOT	Q13	I/O Pwr. Drvr.	BLU-GRN	J9-P6	YEL-VIO	J10-P4/5	50v DC	26-1200 090-5044-00T
14	MINI FLIPPER	Q14	I/O Pwr. Drvr.	BLU-BLK	J9-P7	RED-YEL BLU-YEL	J10-P1/2	50v DC	22-1080 090-5032-00T
15	LEFT FLIPPER (50v RED/YEL)	Q15	I/O Pwr. Drvr.	ORG-GRY	J9-P8	RED-YEL GRY-YEL	J10-P1/2	50v DC	23-1100 090-5030-00T
16	RIGHT FLIPPER (50v RED/YEL)	Q16	I/O Pwr. Drvr.	ORG-VIO	J9-P9	RED-YEL BLU-YEL	J10-P1/2	50v DC	23-1100 090-5030-00T

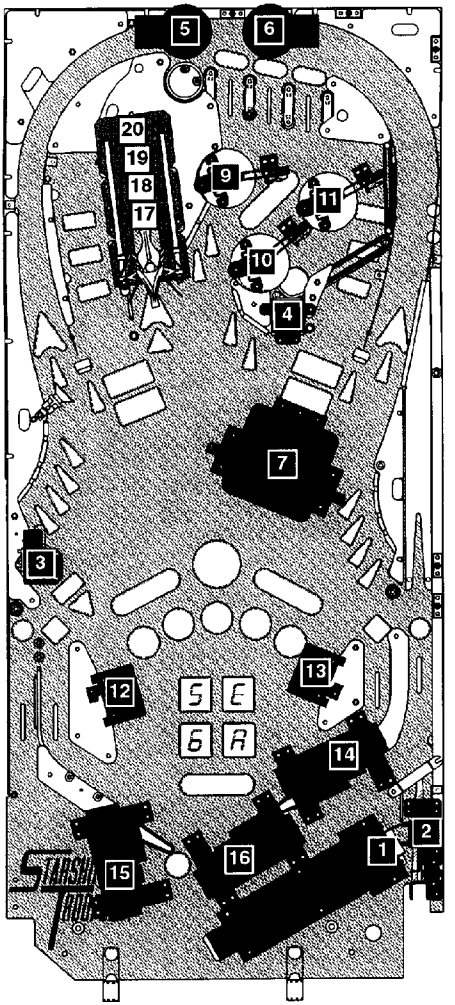
	Low Current Coils Group 1	Drive Transistor (D.T.)	Driver Ouput Board	D.T. Control Line Color	D.T. Control Line Connect	Power Line Color	Power Line Connnection	Power Voltage	Coil GA/Turn or Bulb Type
17	STEPPER MOTOR #1 (DOTS)	Q17	I/O Pwr. Drvr.	VIO-BRN	J7-P2	GRY/RED DOTS	J16-P3	12v DC	Step.Motor 041-5062-00
18	STEPPER MOTOR #2 (DOTS)	Q18	I/O Pwr. Drvr.	VIO-RED	J7-P3	GRY/RED DOTS	J16-P3	12v DC	Step.Motor 041-5062-00
19	STEPPER MOTOR #3 (DOTS)	Q19	I/O Pwr. Drvr.	VIO-ORG	J7-P4	GRY/RED DOTS	J16-P3	12v DC	Step.Motor 041-5062-00
20	STEPPER MOTOR #4 (DOTS)	Q20	I/O Pwr. Drvr.	VIO-YEL	J7-P6	GRY/RED DOTS	J16-P3	12v DC	Step.Motor 041-5062-00
21	NOT USED	Q21	I/O Pwr. Drvr.	VIO-GRN	J7-P7	BRN	N / C	N / C	NOT USED
22	NOT USED	Q22	I/O Pwr. Drvr.	VIO-BLU	J7-P8	BRN	N / C	N / C	NOT USED
23	FLASH BRAIN BUG *2	Q23	I/O Pwr. Drvr.	VIO-BLK	J7-P9	ORG	J6-P10	20v DC	#89 Bulb 165-5000-89
24	OPTIONAL COIN METER	Q24	I/O Pwr. Drvr.	VIO-GRY	J7-P10	RED	J16-P7	5v DC	5v Meter (If Required)

Diode On Terminal Strip (if noted)

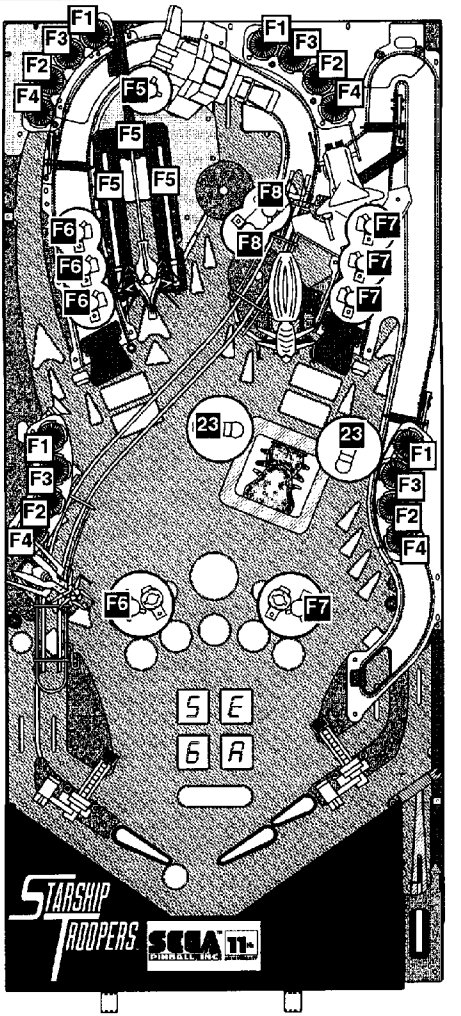
	Flash Lamps (FLASH)	Drive Transistor (D.T.)	Driver Ouput Board	D.T. Control Line Color	D.T. Control Line Connect	Power Line Color	Power Line Connnection	Power Voltage	Bulb Type
F1	#F1 FLASH RED*4	Q25	I/O Pwr. Drvr.	BLK-BRN	J6-P1	ORG	J6-P10	20v DC	#906 Bulb 165-5004-00
F2	#F2 FLASH YELLOW*4	Q26	I/O Pwr. Drvr.	BLK-RED	J6-P2	ORG	J6-P10	20v DC	#906 Bulb 165-5004-00
F3	#F3 FLASH GREEN*4	Q27	I/O Pwr. Drvr.	BLK-ORG	J6-P3	ORG	J6-P10	20v DC	#906 Bulb 165-5004-00
F4	#F4 FLASH BLUE*4	Q28	I/O Pwr. Drvr.	BLK-YEL	J6-P4	ORG	J6-P10	20v DC	#906 Bulb 165-5004-00
F5	#F5 FLASH MULTIBALL*4	Q29	I/O Pwr. Drvr.	BLK-GRN	J6-P5	ORG	J6-P10	20v DC	#906 Bulb† 165-5004-00
F6	#F6 FLASH LT RAMP*4	Q30	I/O Pwr. Drvr.	BLK-BLU	J6-P6	ORG	J6-P10	20v DC	#89 Bulb 165-5000-89
F7	#F7 FLASH RT RAMP*4	Q31	I/O Pwr. Drvr.	BLK-VIO	J6-P7	ORG	J6-P10	20v DC	#89 Bulb 165-5000-89
F8	#F8 FLASH POPS*2	Q32	I/O Pwr. Drvr.	BLK-GRY	J6-P8	ORG	J6-P10	20v DC	#89 Bulb 165-5000-89

† Note: F5 = 3* #906 Bulb + 1* #89 Bulb.

COIL LOCATIONS

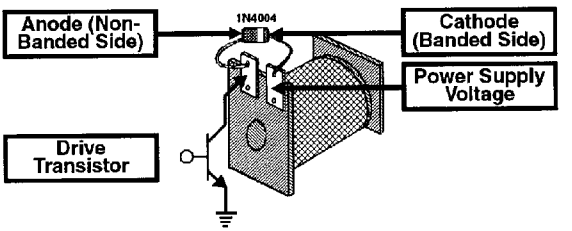


FLASH LAMP LOCATIONS



Legend Note: ☐ = Coils/Flashes mounted above playfield. ■ = Coils/Flashes mounted below the playfield.

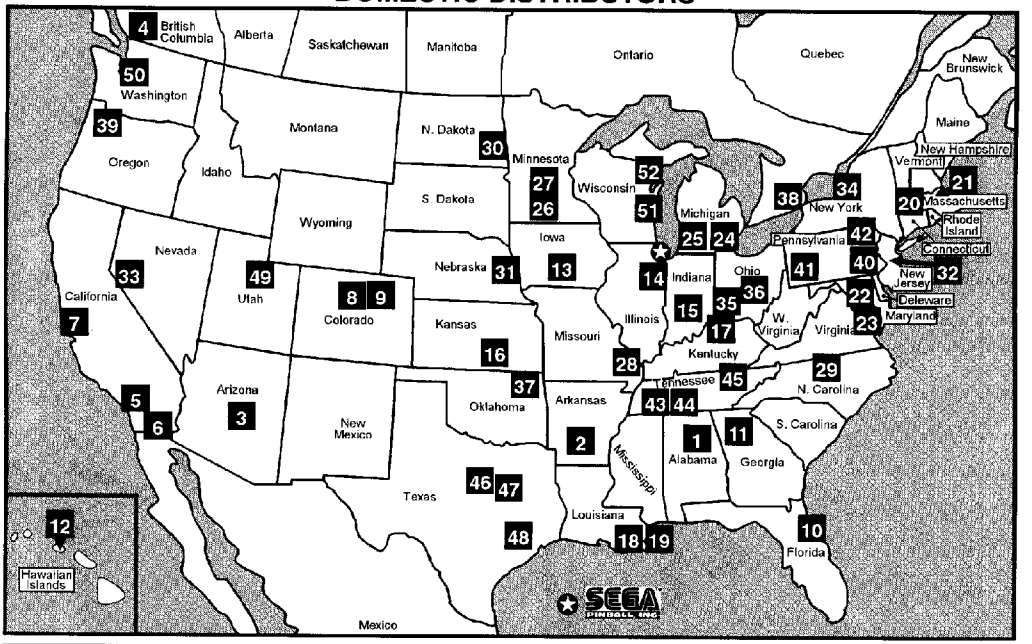
TYPICAL COIL WIRING



Note:
All Coils require diodes. Some diodes are located on Terminal Strips (under playfield) & not on the coil itself.

Diode
On
Terminal
Strip

DOMESTIC DISTRIBUTORS



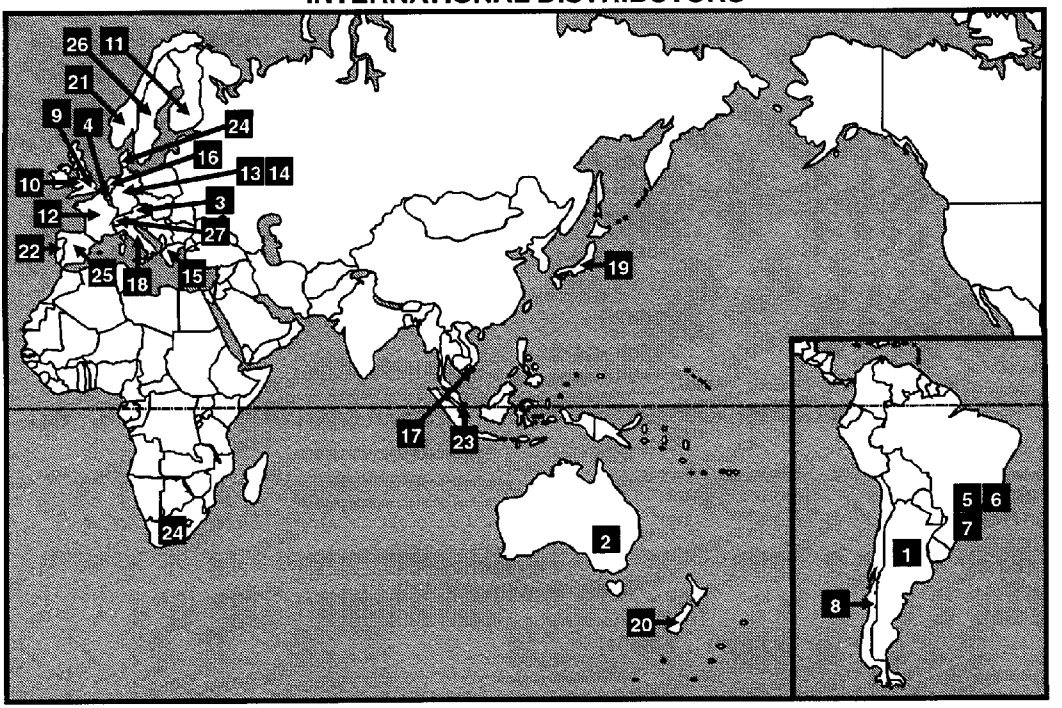
#	STATE/PROVINCE AND CITY		NAME	PHONE
1	AL	Birmingham	Birmingham Vending	205-324-7526
2	AR	N. Little Rock	Godwin Distributing	501-753-1138
3	AZ	Phoezix	Betson Pacific	602-233-0190
4	BC	Bumaby (Can.)	Can. Coin Machine	604-420-4008
5	CA	Buena Park	Betson Pacific	714-228-7500
6		San Diego	Betson Pacific	619-459-0871
7		S. San Francisco	Betson Pacific	415-952-4220
8	CO	Denver	Col. Game Exchange	303-893-4300
9			Mountain Coin	303-427-2133
10	FL	Orlando	Birmingham Vending	407-425-1505
11	GA	Marietta	Game Exchange/SE, Inc.	770-594-7215
12	HI	Ewa Beach	50th State Coin Op.	808-682-4561
13	IA	Des Moines	Greater American Dist.	515-244-2828
14	IL	Chicago	Atlas Distributing	773-276-5005
15	IN	Indianapolis	J. & J. Distributing	317-899-2530
16	KS	Wichita	United Distributors, Inc.	316-263-6181
17	KY	Louisville	Kentucky Coin Machine	502-966-5266
18	LA	Metaine	AMA Distributors, Inc.	504-835-3232
19			New Orleans Novelty	504-888-3500
20	MA	E. Long Meadow	Gekay Sales	413-525-2700
21		Norwood	Mondial Int'l. Dist.	617-769-9966
22	MD	Baltimore	Automated Services	410-646-4100
23			Weiner Distributing	410-525-2600
24	MI	Farmington Hills	Atlas Distributing	810-615-1703
25		Wyoming	Atlas Distributing	616-241-1472
26	MN	Bloomington	Hanson Distributing	612-884-6604

#	STATE/PROVINCE AND CITY		NAME	PHONE
27	MN	Minneapolis	Sandler Vending	612-996-0010
28	MO	St. Louis	J. & J. Distributing	314-645-3393
29	NC	Archdal	Operators Distributing	910-884-5714
30	ND	Fargo	M.H. Associates, Inc.	701-282-7877
31	NE	Omaha	Greater American Dist.	402-553-2812
32	NJ	Springfield	Mondial Int'l. Dist.	201-467-9700
33	NV	Reno	Reno Game Sales	702-829-2080
34	NY	Rochester	Mondial Dist.	716-586-1100
35	OH	Cincinnati	Atlas Distributing	513-771-1909
36		Columbus	Shaffer Dist.	614-421-6800
37	OK	Tulsa	Galaxy Distributing, Co.	918-835-1166
38	ON	Rexdale (Can.)	New Way Sales	416-674-8000
39	OR	Portland	American Coin	503-233-7000
40	PA	Bensalem	Mondial Int'l. Dist.	215-638-1122
41		Pittsburgh	Mondial Int'l. Dist.	412-881-8804
42		Wilkes-Barre	Roth Novelty	717-824-9994
43	TN	Memphis	Games Sales Co., Inc.	901-525-8351
44			Green G.A.M.E.S.	901-353-1000
45		Nashville	Sammons-Pennington	615-244-3020
46	TX	Corsicana	Master Sales	903-874-4740
47		Dallas	Commercial Music	214-741-6381
48		Houston	H.A. Franz, & Co.	713-523-7366
49	UT	Salt Lake City	Struve Distributing	801-328-1636
50	WA	Seattle	American Coin	206-764-9020
51	WI	Green Bay	Pioneer Sales & Svc.	414-468-5200
52		Menomonee Falls	Pioneer Sales & Svc.	414-781-1420

TECHNICAL SUPPORT
SEGA PINBALL, INC.

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** (USA or Canada or elsewhere at 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.	61-29-316-6000
3	Austria, Grazerstrasse	Rupp Austria	43-34-528-6105
4	Belgium, Brussels	Splin S.A.	32-43-62-7677
5	Brazil, Sao Paulo	Parkland	55-11-792-42864
6		Unimax	55-11-533-5615
7		Universe	55-11-575-0731
8	Chile, Santiago	Cuinsa	56-2-696-0167
9	England, London	Electrocoin	44-181-965-2055
10	So. Wales, Cardiff	Electrocoin	44-22-261-5100
11	Finland, Espoo	Pelika Ray Oy	35-8-943-7091
12	France, Aubervilliers	PLF Sa	33-14-811-3131
13	Germany, Berlin	Bally Wulff	49-3-062-0020

#	COUNTRY AND CITY	NAME	PHONE (-011)
14	Germany, Hannover	Bally Wulff	49-511-358-5343
15	Greece, Athens	Greece Coin	30-1-554-1608
16	Holland, Sittart	Veltmeijer Automaten	31-46-452-6444
17	Hong Kong, Kwai Fong	Bondeal Limited	85-2-487-9089
18	Italy (RSM), Serravalle	Technoplay Sa	39-54-990-0361
19	Japan, Tokyo	Data East, Corp.	81-35-370-0708
20	New Zealand, Auckland	Amco Machine Supp.	64-9-846-7606
21	Norway, Oslo	Vendcomatic	47-2-216-0830
22	Portugal, Amadora	Jacinto & Martins	35-11-495-1868
23	Singapore, Singapore	Valibel Technologies	65-748-8404
24	South Africa, Lalucia	Unimac	27-3-152-5544
25	Spain, Madrid	Sente S.A.	34-1-541-7112
26	Sweden, Bromma	Axlon	46-8-704-6580
27	Switzerland, Harkingen	Novomat Ag	41-62-398-4061

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**.

TECHNICAL SUPPORT
SEGA
PINBALL, INC.

POWER REQUIREMENTS

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

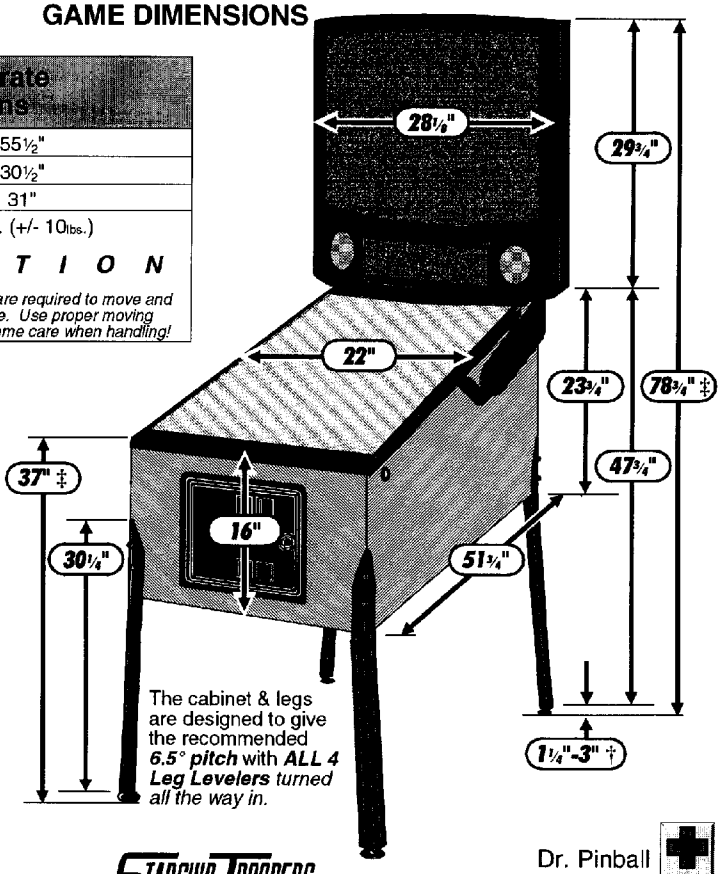
To reduce the possibility of damage, observe **ALL** precautions whenever transporting the game. ***Read & follow*** *Section 1, Chapter 1,* **Game Assembly Procedures**, & **How to Secure the Backbox for Transporting**. Remove the legs & secure the game within the transporting vehicle. *Save and retain all printed information on the game.*

GAME DIMENSIONS

Shipping Crate Dimensions	
Height:	55½"
Width:	30½"
Depth:	31"
Weight:	300lbs. (+/- 10lbs.)

C A U T I O N

At least 2 people are required to move and maneuver game. Use proper moving equipment & extreme care when handling!



N o t e s :

The Leg Levelers can add up to 1¾" ***MORE*** to the overall height.

The overall *FRONT & BACK* dimensions reflect the added +1¼" height from the Leg Levelers turned all the way in.

The cabinet & legs are designed to give the recommended ***6.5° pitch*** with ***ALL 4 Leg Levelers*** *turned all the way in.*

STARSHIP TROOPERS™

General Table of Contents

See Sections 3 & 5, Table Of Contents, for details of that Section and it's Chapters.

Introducing Playfield Switch OPTO "Long-Hop" Boards ..... Inside Front

- ✻ Backbox Layout Locations: Fuses, Bridges, Relays & ROMs ..... DR. ❶
- ✻ Find-It-In-Front: Dr. Pinball Section Explained ..... DR. ❷
- ✻ Install 4-Balls ✻ Diagnostic Aides ✻ CPU DIP Switch Settings ✻ ROM Summary Table ..... DR. ❸
- ✻ Switch Matrix Grid & Dedicated Switches ✻ Lamp Matrix Grid ..... DR. ❹
- ✻ Switch & Lamp Matrix Grid Locations ✻ Typical Switch, Dedicated Switch & Lamp Schematics ✻ Typical 7-Segment Address. ..... DR. ❺
- ✻ Coils Detailed Chart Table ..... DR. ❻
- ✻ Coil & Flash Lamp Locations ✻ Typical Coil Wiring ..... DR. ❼
- ✻ Domestic Distributors ..... DR. ❽
- ✻ International Distributors ..... DR. ❾
- ✻ Power Requirements ✻ Transportation ✻ Game Dimensions ..... DR. ❿

Game Manual General Table of Contents ..... i-ii

SECTION 1 1

Chapter 1, Game Set-Up 1

Game Assembly Procedures 1

➢ ✻ *How to Secure the Backbox for Transporting* ✻ *Leg Leveler Adjustment* ✻ *Easy Access Service System - 3 Positions* *2*

SECTION 2 3

Chapter 1, Game Operation & Features 3

✻ Start of Game Features ✻ During Game Features ✻ End of Game Features 3-4

✻ Instruction Card 4

Chapter 2, Playfield Overview 5

Overview 5

Playfield Top Ball Shots: Layer 1, Layer 2 & Layer 3 7-9

Playfield Bottom Ball Shots: Layer 1 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 Fuses List 49

Chapter 7, Go To Help Screen 51

General Table of Contents Continued on the Next Page

SECTION 4 53

Chapter 1, Parts Identification & Location (The Pink Pages) 53
Overview 53
Backbox (Back Side) & Backbox (Front Side) Assemblies 54-55
Cabinet - General Parts 56
Cabinet & Playfield - Switches 57
Playfield - General Parts (Below) 58
Playfield - General Parts (Above) 59
Playfield - Rubber Parts (Rings Actual Size) 60
Playfield - Plastic (Butyrate), Decals and Mylar 61
Playfield - Metal Posts and Nuts (Actual Size) 62
Playfield - Metal Spacers (Actual Size) 63
Playfield - Plastic Posts and Spacers (Actual Size) 64
Playfield - Wedge Base Bulbs and Sockets (Actual Size) 65
Playfield - Small Bayonet Type Bulbs and Sockets (Actual Size) 66
Playfield - Large Bayonet Type Bulb and Sockets (Actual Size) 67
Playfield - Rails and Ball Guides 68

Chapter 2, Drawings for Major Assemblies & Ramps (The Blue Pages) 69
Overview 69
Ball Shooter (Plunger) Assembly, 500-6146-00-04 ..... (Top) 70
Autoplunger Coil Assy., 500-6092-02 and
Autoplunger Arm Weld Assy., 500-6091-00 ..... (Bot) 70
4-Ball Trough Assembly, 500-6119-24 and Assoc. Part: Ball Trough Enter/Exit Scoop, 535-7329-01 71
Flipper (Left) Assembly, 500-5944-14 and Assoc. Part: Flipper Bat & Shaft Assy., 515-6532-08-05 72
Flipper (Right) Assembly, 500-5944-04 and Assoc. Part: Flipper Bat & Shaft Assy., 515-6532-08-05 73
Flipper (Mini-Right) Assy., 500-5944-02 and Assoc. Part: Mini-Flipper Bat & Shaft Assy., 515-6275-10 73
Turbo Bumper Assemblies, 515-6459-01 (Top); -04 (Bottom); -03 (Switch), (Qty. 3) 74
Slingshot Assembly, 500-5849-01 (Qty. 2) ..... (Top) 75
VUK Assembly, 500-5839-04 ..... (Bot) 75
Super VUK Assembly, 500-6245-02-59 ..... (Top) 76
Brain Bug Assembly, 500-6256-00-59 ..... (Bot) 76-77
Warrior Bug Assembly, 500-6239-00-59 78-79
Plastic Ramp Assembly, 500-6241-00-59 80-81
Wire Ramp Assembly, 500-6248-00-59 ..... (Top) 82
Metal Under Trough Assembly, 500-6243-00-59 ..... (Bot) 82
Plastic Under Trough Assembly, 500-6244-00-59 83
Threaded Bushing Core Assy., 515-6142-00 (Qty. 2) and
Assoc. Part: Magnet Coil (22-650), 090-5042-01 ..... (Top) 84
OPTO & Bracket (Large) Assembly, 500-6242-01-59 ..... (Mid) 84
OPTO & Bracket (Small) Assembly, 500-6242-00-59 ..... (Bot) 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) 93
Chapter 4, Printed Circuit Boards (PCBs) (The Yellow Pages) 95

APPENDIXES A-I 117

➢ *Appendixes A-I Table of Contents (outline of this section) 117*
Appendixes A-I 118-130
➢ *Plastic Part Color Chart ..... Bottom of 129, Top of 130*
Glossary of Terms 131
Parts Order Checklist Notes 132

Limited Warranty, Cautions, Warnings & Notices ..... Inside Back

Game Set-Up

Game Assembly Procedures

(Reference Find-It-In-Front: Dr. Pinball, taking note of pages ii, iii & 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. ***CAUTION:*** *At least 2 people are required to move and maneuver game. Use proper moving equipment & extreme care when handling.* **Pinball game is 300 lbs.+.**

2. Remove all packing material. The four (4) Cabinet Leg Assemblies (Leg Levelers are 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. Leg Bolts, Steel Balls and any miscellaneous parts are in the cash box.

3. Support rear of cabinet and attach rear legs using two leg bolts for each leg. Support front of cabinet and attach front legs using two leg bolts for each leg. ➨Per CE: "The appliance has to be placed in a horizontal position."

4. 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).

5. Remove the Coin Door Keys from the playfield glass, and open the Coin Door. Remove the Backbox Keys hanging inside the Coin Door, unlock the Backbox and open.

6. 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. Ensure Fluorescent Light Tube is seated correctly. Check that all fuses are seated properly. Close and lock the Backbox and secure the keys back inside the Coin Door.

7. Remove the Front Molding & carefully remove the playfield glass and set it aside.

8. Remove all shipping tie downs, shipping blocks, packing foam, shipping instruction pages, etc. (if any) inside the cabinet. ***READ ALL PRINTED INFORMATION!*** Shipping instructions, labels and/or decals describe warnings, cautions, and/or important information specific to the game. **This Game:** ***Before*** you move to **Step 9** - There is a **Playfield Shipping Bracket** attached to the playfield and secured to the cabinet by three (3) #8 x 5/8" Green screws. *Access through the Coin Door.* These ***screws must be removed. Do not remove*** the Shipping Bracket from the playfield (use for future shipping). Save these screws by taping to the side of the cabinet (by holes) or putting the screws into the cash box (save them with the shipping notice regarding this procedure).

9. Raise the playfield and support it, by lifting the Prop Rod (located either on the left or right side, inside the cabinet) and placing the notched end into the hole on the under playfield. See the illustration "Easy Access Service System" opposite this page.

10. Visually inspect all cabinet cables and connector terminations; ensure no wires or cables are pinched and that cable harnesses are not pulled tight.

11. Remove the Plumb Bob tilt from the parts package and install on the pendulum wire on the inside left of the cabinet. Check the plumb tilt and adjust as required. See Section 4, Chapter 1, Parts Identification & Location.

12. 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.

13. With the Leg Levelers turned all the way in (1.25" from floor to bottom of leg), the game pitch is 6.5°; depending on the condition of the floor, adjust the Leg Levelers as required.

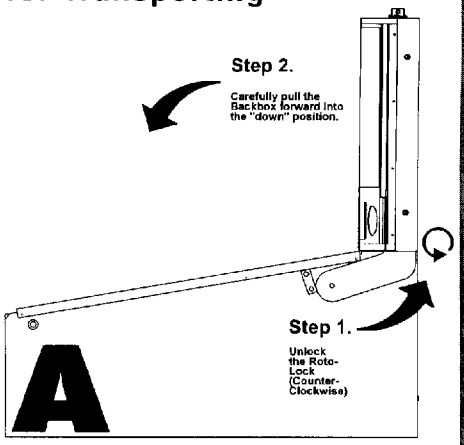
The playfield incline affects difficulty of play. Use the recommended incline; Game difficulty is best varied using game adjustments.

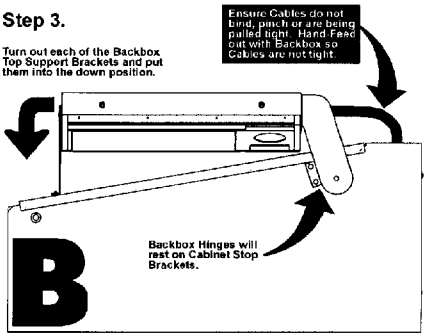
14. If desired, perform any self tests at this time. See Section 3, Chapter 1, Portals™ Service Menu Introduction, and Chapter 2, Go To Diagnostics Menu, for instructions on how to enter "Begin Play Test" and "Game Specific" to test components on the game.

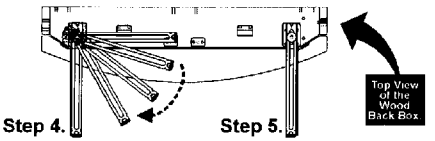
15. **INSTALL 4 BALLS** on the playfield near the outhole and carefully reinstall the playfield glass. (Amount of balls are always specified on decal attached to the lock down assembly.)

16. 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, Go To Adjustments Menu, for instructions on how to enter adjustments. Follow instructions in the tables provided in the manual for suggestions of customizing changes.

How to Secure the Backbox for Transporting

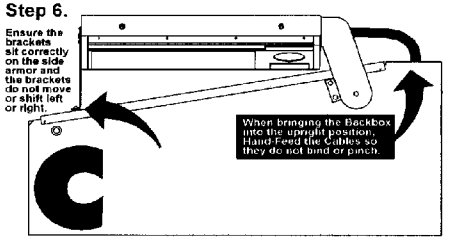






Step 4. Slide one of the brackets down, then up so the notch on the top part of each bracket rests correctly against the stud.

Step 5. Do the same for the other bracket.



See Section 4, Chapter 1, Backbox (Back Side/ Front Side) Assemblies, for part numbers.

Leg Leveler Adjustment

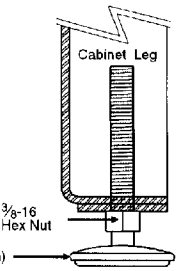
This cabinet is designed to automatically have a 6.5° pitch without any Leg Leveler adjustment!

Attach the four (4) Leg Assemblies to cabinet corners with the eight (8) leg bolts provided. See Section 4, Chapter 1, Cabinet - General Parts, for part numbers.

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

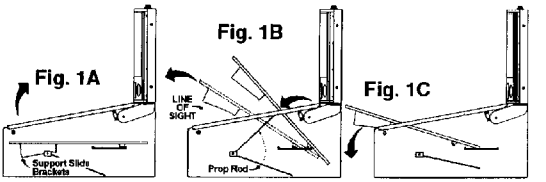
Verify 6.5° pitch. Minor adjustment(s) may be necessary depending on the location floor being level.

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



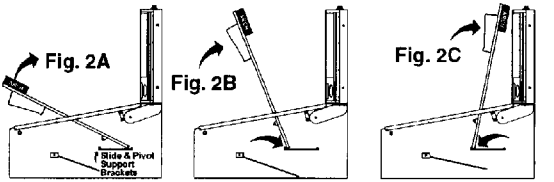
Easy Access Service System - 3 Positions

Carefully lift the playfield ***using the Left and Right Ball Guides*** upward.



Positions 1 & 2

When lifted high enough, the ***Playfield Support Slide Brackets*** (Fig. 1A) can be seen & can clear the cabinet front. At this time, pull the playfield toward the front of the cabinet, checking that the mechanical components clear the cabinet front, then rest the playfield on the ***Playfield Support Slide Brackets*** at the front channel of cabinet (Fig. 1C); Or, the ***Prop Rod*** (located on the right inside of cabinet) can be used by positioning the ***Prop Rod*** end into the receiving playfield hole (Fig. 1B).



Position 3

With the playfield at rest, hold the sides & pull toward the front of the cabinet (approx. 6" to 8"), until resistance is felt from ***Edge Slide Brackets*** stopping against the ***Slide & Pivot Support Brackets*** located on either side of the cabinet (Fig. 2A). At this time, *swivel the playfield* toward the Backbox, then rest on the top edge (Fig. 2B & 2C).

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 with the display indicating the number of credits posted. Press the **START BUTTON** and a start-up sound is produced, and the posted credits are reduced by one. Subsequent players can be added (**up to 6 can play!**) by pressing the **START BUTTON** before the end of ball 1 (with sufficient credit in the game).

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 and/or instructions. 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 only works in a 4-Player game. In all other cases, the individual scores are shown.

Starting League/Tournament 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 would be 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.

Multiball

Multiball is started after completion of certain Feature Modes or may be a mode itself depending on game rules/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 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: **CREDIT**, **EXTRA BALL**, or **SPECIAL**. Adjust to **NONE** if a replay award is not desired.

Video Mode

The video modes ***may*** require the player to "*play on-screen*". The interactive video play ***may*** require the player to use the flipper buttons to play the mode.

End of Game Features

Game Endings

When all player(s) have played all balls (including any Extra Balls), the game ends. If power is interrupted during the course of a game, it will end that game (***see Starting a Normal Game***). Closure of the Plumb Bob Tilt Switch according to the number of tilts set (Default = 2, adjustable) or its prolonged closure will end the current 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 2 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.

Continued Next Page.

End of Game Features Continued

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 Dot Display. Hitting the Start Button locks in the letter or character and proceeds to the next letter. The game then proceeds into the *Game-Over Mode* and then to the *Attract Mode*. (Note: A custom message (adjustable) can be displayed during the *Attract Mode*; enter letters in the same fashion.)

Manual Percentaging

This game is equipped with a Manual Percentage Adjustment. As with our previous games, you can either set operator adjustments for a replay percent or you can set a fixed replay score. See Section 3, Chapter 4, Go To Adjustments Menu, Adjustments 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 appropriate 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.

Instruction Card

Below is a **COPY** of the game instruction card which is included with every game. If your 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 to keep the "COPY" sturdy.)

COPY & CUT

SEGA™ PINBALL, INC.

STARSHIP TROOPERS™

FOLD HERE

STARSHIP TROOPERS

MULTIBALL Bash the *Live Fire Assault Range Warrior* until "Multiball" lights. During ***Multiball***, shoot either *Ramp for* ***Jackpot***. Complete "Hits" on the *Live Fire Assault Range Warrior* or collect ***Jackpots*** to light ***Super Jackpot*** at the *Live Fire Assault Range.*

PLANETS The game begins on the first planet. Clearing all bugs qualifies the *Left Hole* for "Arm Nukes" (*Planet Multiball*) and the *Center Hole* for "Advance Planet." Shooting "Advance Planet" or "Arm Nukes" collects the ***Hurry-Up Value*** and advances to the next planet. Shooting ***Arm Nukes*** begins ***Planet Multiball.***

STRATEGY *Shooting "Advance Planet" increases NUKE values for next Planet Multiball. The more planets saved, the higher the Nuke values!!!*

PLANET MULTIBALL *"Arm Nukes" Hole* begins this ***2-Ball Multiball.*** Complete all *Nuke Shots* and the *Double Nuke Shot* to qualify the *Live Fire Assault Range Warrior* for **SUPER NUKE.**

RECON Completing both *Ramp Shots* qualifies the *Center Hole* for ***Recon.*** Shooting ***Recon*** when lit awards a *Mystery Feature.* ***Note:*** *Each time this feature is qualified, the possible awards are increased.*

ORBITS The *Return Lanes* (by flippers) light the *"Orbit" Feature.* Completing four *Orbit Shots* **LOCKS** one ball. *Locking* two balls awards ***Orbit Multiball.*** During ***Orbit Multiball***, shoot *Orbit Shots* for ***Jackpots.***

Note to Beginners: To score better, shoot at ((FLASHING SHOT)) !!
Be sure to LOOK UP at the Dot Display for instructions when possible.

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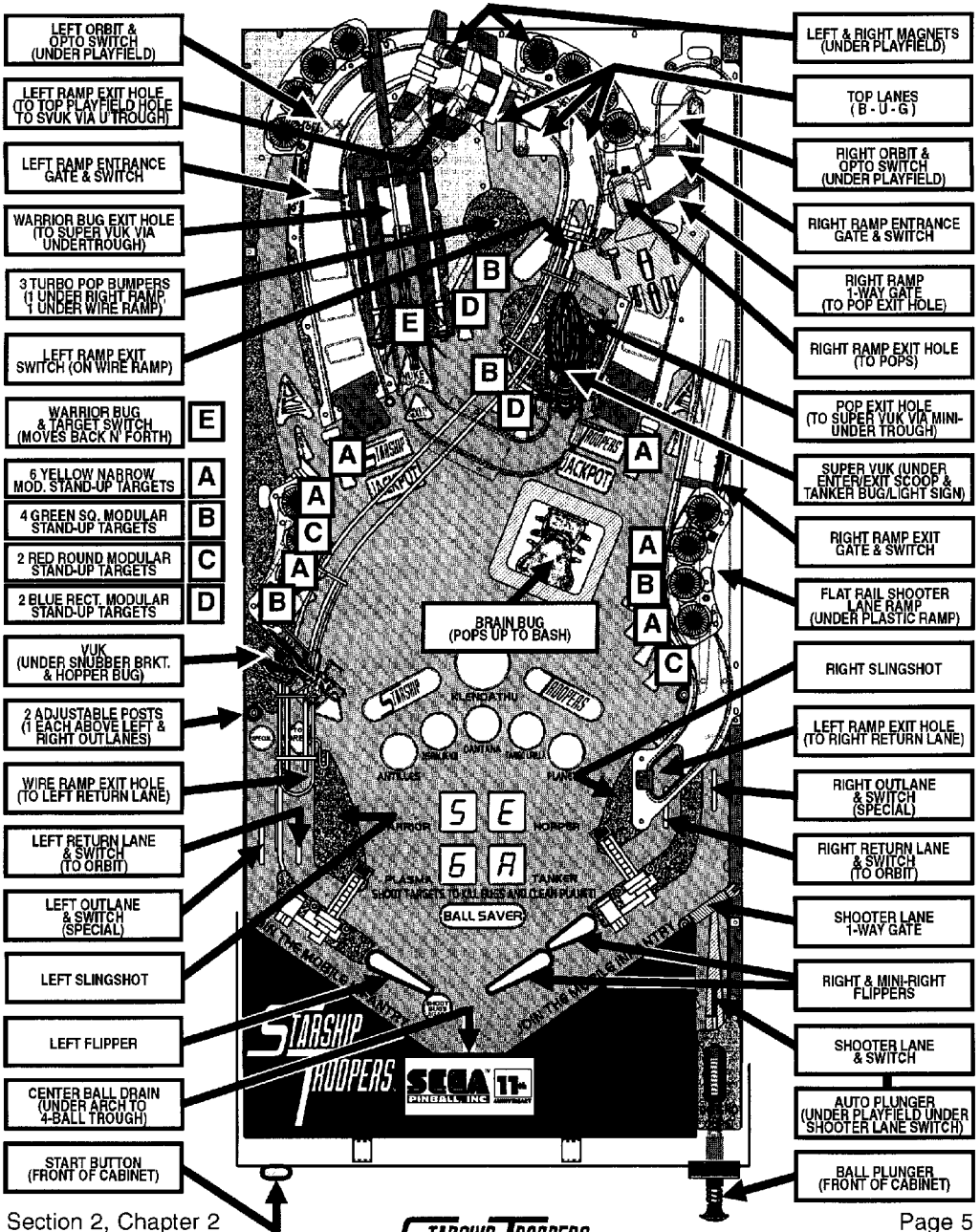
Sega Part № 755-5159-00 USA

Playfield Overview

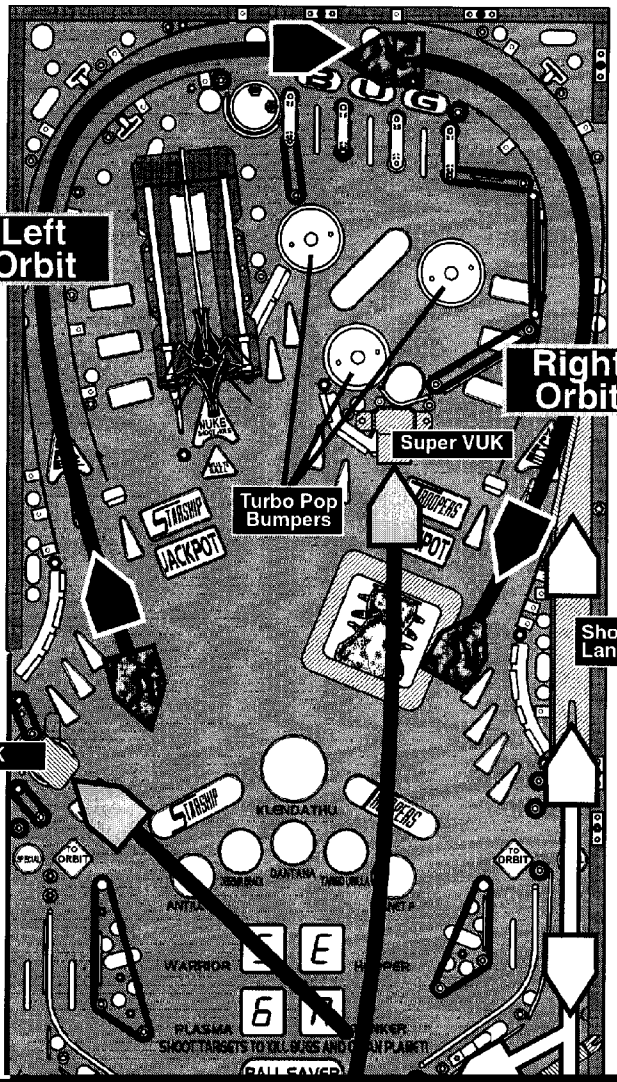
Overview

Below is the ***Starship Troopers Playfield Map*** showing all the Major Items & where the pinball can travel in this game. The balance of this Chapter will show the playfield as it is built up (and 2 views of underneath). For component names & parts mentioned, review Section 4, Chapters 1 (Pink Section) & Chapter 2 (Blue Section).



Playfield Top Ball Shots: Layer 1

Below is the top of the playfield showing the Playfield Wood Rails, Ball Guides, Flat Metal Rails, Flat Rail Shooter Lane Ramp, Posts, Rubber Rings, Target Tops, Ball Snubbers (over VUK), Enter/Exit Scoop (over Super VUK), Flipper Bats, Playfield Hanging Brackets, and Pop Bumpers.



A Right Orbit Shot with the Right Magnet off will continue around completing the Orbit Shot.

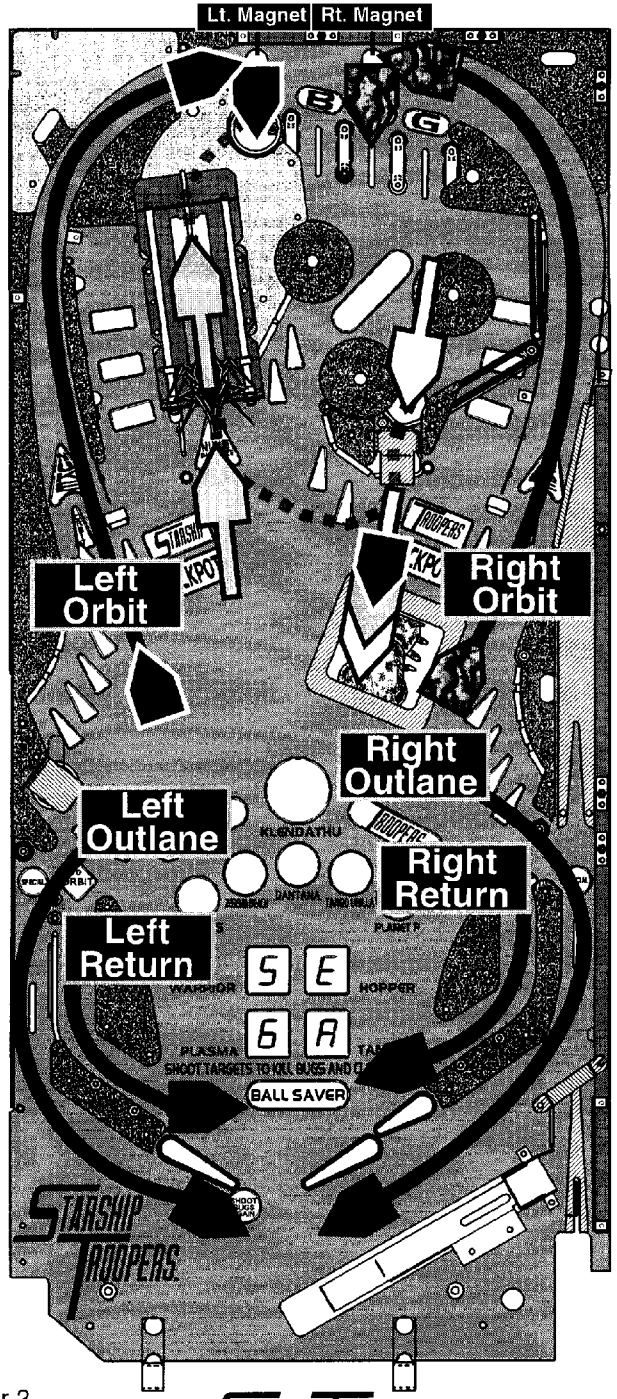
A Left Orbit Shot with the Left Magnet off will continue around completing the Orbit Shot.

Shoot either the VUK or the Super VUK.

The shot from the Shooter Lane will plunge the ball into the Right Orbit. Be Careful! A weak Plunger Shot not strong

Playfield Top Ball Shots: Layer 2

Below is the top of the playfield showing the addition of Screened & Clear Plastic (Butyrate) Pieces.



A Hard Left Orbit Shot with the Left Magnet on will deflect the ball down into the Top Exit Hole, bringing the ball into the Under-Trough to the Super VUK. A Soft Left Orbit Shot with the Left Magnet off can also enter this Exit Hole or the Top Lanes.

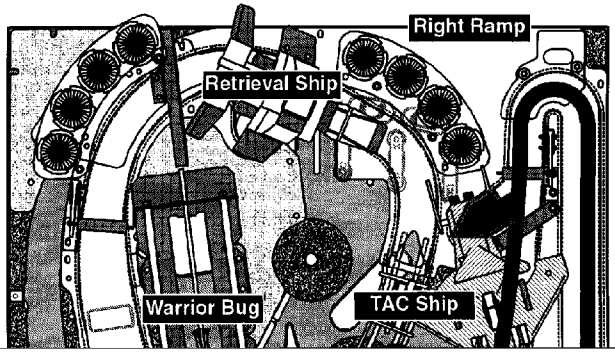
A Hard Right Orbit Shot with the Right Magnet on will deflect the ball down into the Top Lanes, bringing the ball into the Pop Bumper area. A Soft Right Orbit Shot can bring the ball into the Top Lanes or the Exit Hole.

Each hit to the Warrior Bug will push it back until the ball can enter the Bug Exit Hole to the Undertrough advancing the ball to the Super VUK getting shot out towards the right flippers.

The ball can enter the Pop Exit Hole and drop into the Mini-Under-Trough advancing to the Super VUK getting shot out towards the right flippers.

Playfield Top Ball Shots: Layer 3

Below is the top of the playfield showing the addition of the Plastic Ramp (with Retrieval & Tac Ships, 3 each 4X Light Assemblies), Wire Ramp, 4X Light Assy. (over Wire Ramp), Pulse Cannons (over the Return Lanes), Hopper Bug (over VUK), Tanker Bug and Light Sign (over Super VUK) and the Bottom Arch.

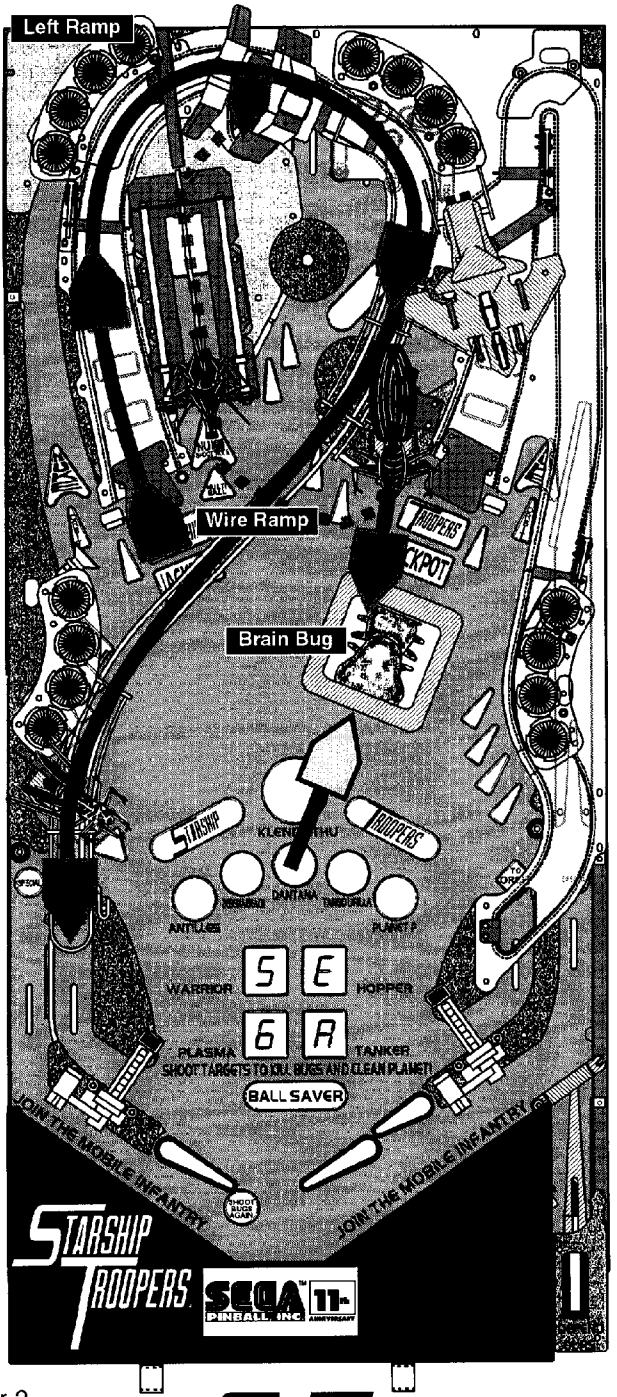


A Hard Shot to the Right Ramp will exit to the Right Return Lane. A Soft Shot may exit

Playfield Top Ball Shots: Layer 3

Below is the top of the playfield (no additional parts shown).

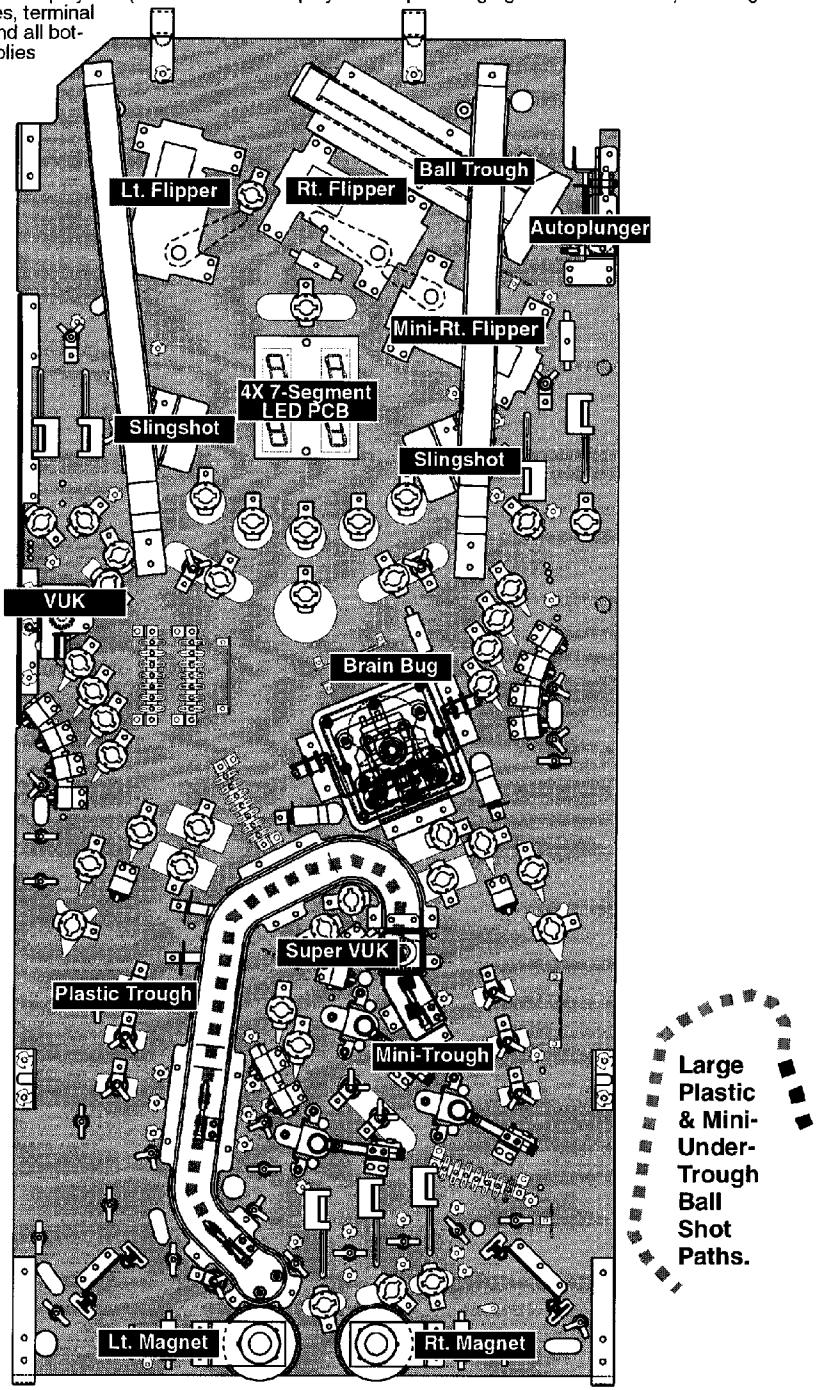
A Hard Shot to the Left Ramp will exit via the Wire Ramp exiting to the Left Return Lane. A Soft Shot to the Left Ramp will bring the ball down into the Top Exit Hole, bringing the ball into the Under-Trough to the Super VUK and will get kicked out into play towards the Right Flippers.



If that Brain Bug Pops up from under the playfield, hit it with the ball!

Playfield Bottom Ball Shots: Layer 1

Below is the bottom of the playfield (as shown as if the playfield is up leaning against the Backbox) showing all bulbs & sockets, fuses, terminal strips, all brackets, and all bottom mounted assemblies (4-Ball Trough, Autoplunger, Left & Right Flippers, Mini-Right Flipper, Slingshots, VUK, Brain Bug, Super VUK, Plastic Trough, Metal Mini-Trough Stand-Up Targets, 4X 7-Segment LED PCB and bottom mounted switches.



Large Plastic & Mini-Under-Trough Ball Shot Paths.

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 19

•• *Go To Switch Menu 20*
••• *Switch Test / Active Switch Test / Dedicated Switch Test 20*
¤ Switch Matrix Grid 20
¤ Switch Matrix Grid Descriptions with Part Numbers and Locations 21
•• *Go To Coil Menu 22*
••• *Single Coil Test / Cycling Coil Test 22*
¤ Playfield Flash Lamp & Coil Locations 22-23
¤ Coils Detailed Chart Table 24-25
•• *Go To Lamp Menu 26*
••• *Single Lamp Test / Test All Lamps / Row & Column Lamp Tests 26*
¤ Lamp Matrix Grid 26
¤ Lamp Matrix Grid Locations 27
•• *Test Flash Lamps 28*
•• *Clear Ball Trough 28*
•• *Technician Alert 28*
•• *Service Phone # 28*
•• *Begin Play Test 28*
•• *Fire Knocker 28*
•• *Sound / Speaker Test 28*
¤ Speaker Phase Testing 29
•• *Begin Burn In 29*
•• *Dot Matrix Test & Dot Matrix Display Explained 29*
•• *Starship Trooppers Specific (Bug Stepper Motor, Brain Bug & LED Tests) 30*
•• *Dr. Pinball (Flow Chart Menus: Coil, Switch & Lamp) 31*

Chapter 3, • GO TO AUDITS MENU 33

¤ Game Audit Table 32
•• *Earnings Audits (Audits 1-12) 33*
•• *Sega Audits (Audits 13-55) 34-35*
•• *StarshipTroopers Audits (Audits 56-99) 35-37*
•• *Go To Printer Menu 37*
••• *Printer Interface, Alison Interface, Nº of Copies Printed (Adj. 51-53) 37*

Chapter 4, • GO TO ADJUSTMENTS MENU 39

¤ Game Adjustment Table 38
•• *Sega Adjustments (Adjustments 1-43) 39-43*
•• *Starship Troopers Adjustments (Adjustments 44+) 44*
•• *Custom Message (Direct Access to Adjustment 29) 46*
•• *Film Star Reset (Special Factory Reset Settings for the Home Environment) 46*

Chapter 5, • GO TO RESET MENU 47

•• *Reset Coin Audits / Reset Game Audits / Factory Reset 47*
¤ Example 48

Chapter 6, • GO TO FUSES LIST 49

•• *Go To Fuses List 49*
¤ Example and Backbox Layout Locations: Fuses, Bridges, Relays & ROMs 49-50

Chapter 7, • Go To Help Screen 51

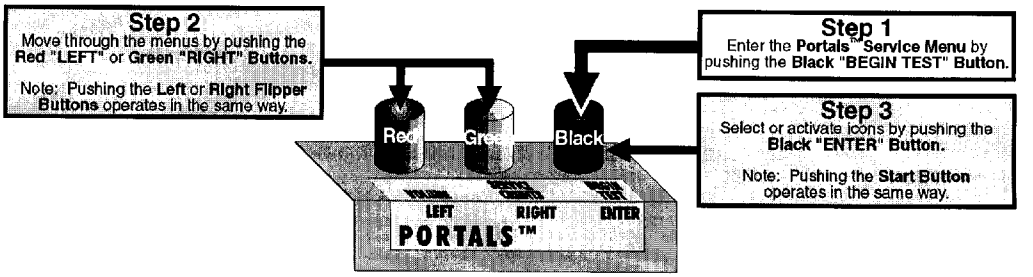
•• *Go To Help Screens (Multi-Level) 51*
¤ Problem / Solution Table 52

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

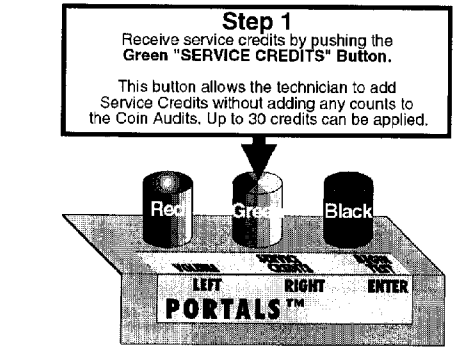
Service Switch Set (Red, Green & Black Buttons) Access & Use

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. ***Important:*** The **Playfield Power Interlock Switch** must be pulled out for electro-mechanical device testing (this is required).

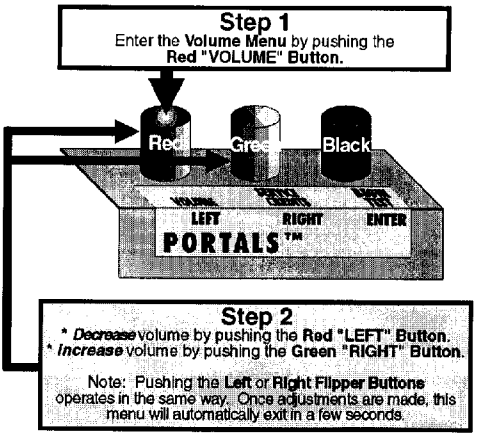
❶ *Entering* **Portals™ Service Menu** *(will not operate in Volume Mode):*

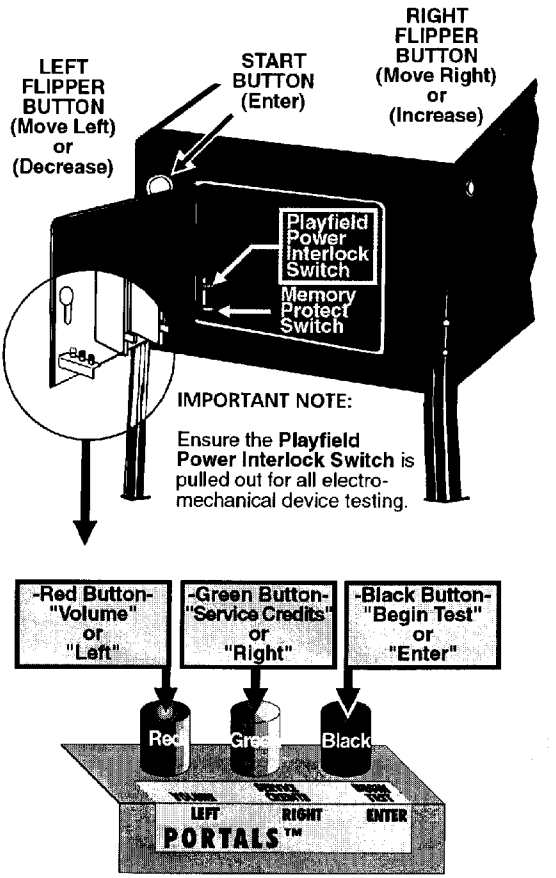


❷ *Adding* **Service Credits** *(will not operate in Service or Volume Modes):*



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



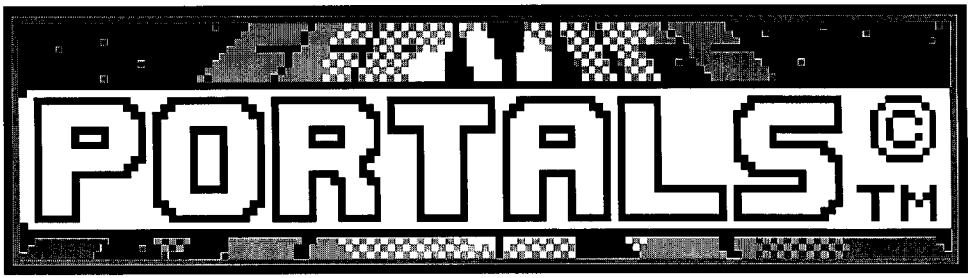


How to Use This Section

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**:

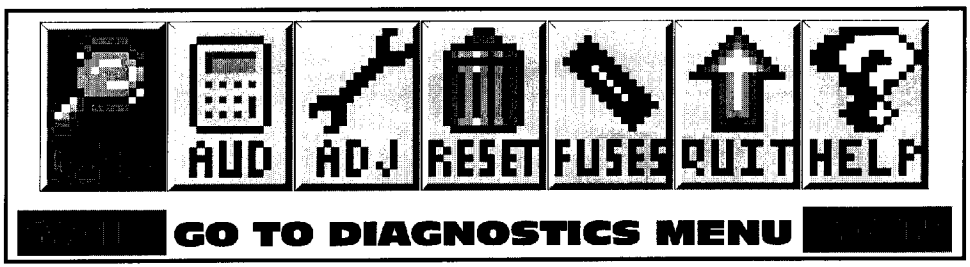


The Coin Door may be closed for security, however, please note with the Coin Door closed, the game's ***MEMORY PROTECT*** is enabled; ***meaning any changes that are made will be not be written to memory.*** If changing adjustments is required, ensure the Coin Door is open.

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:

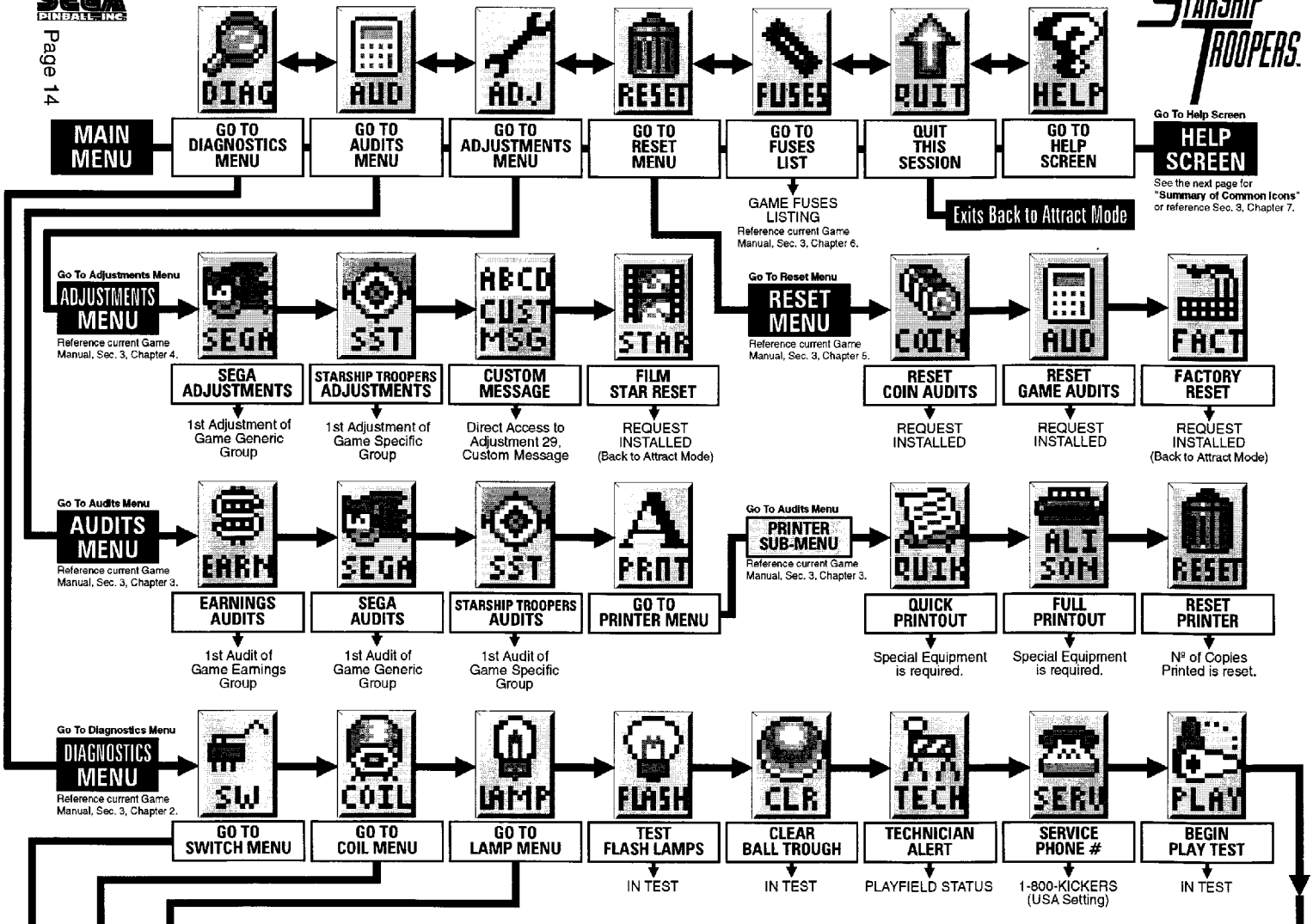


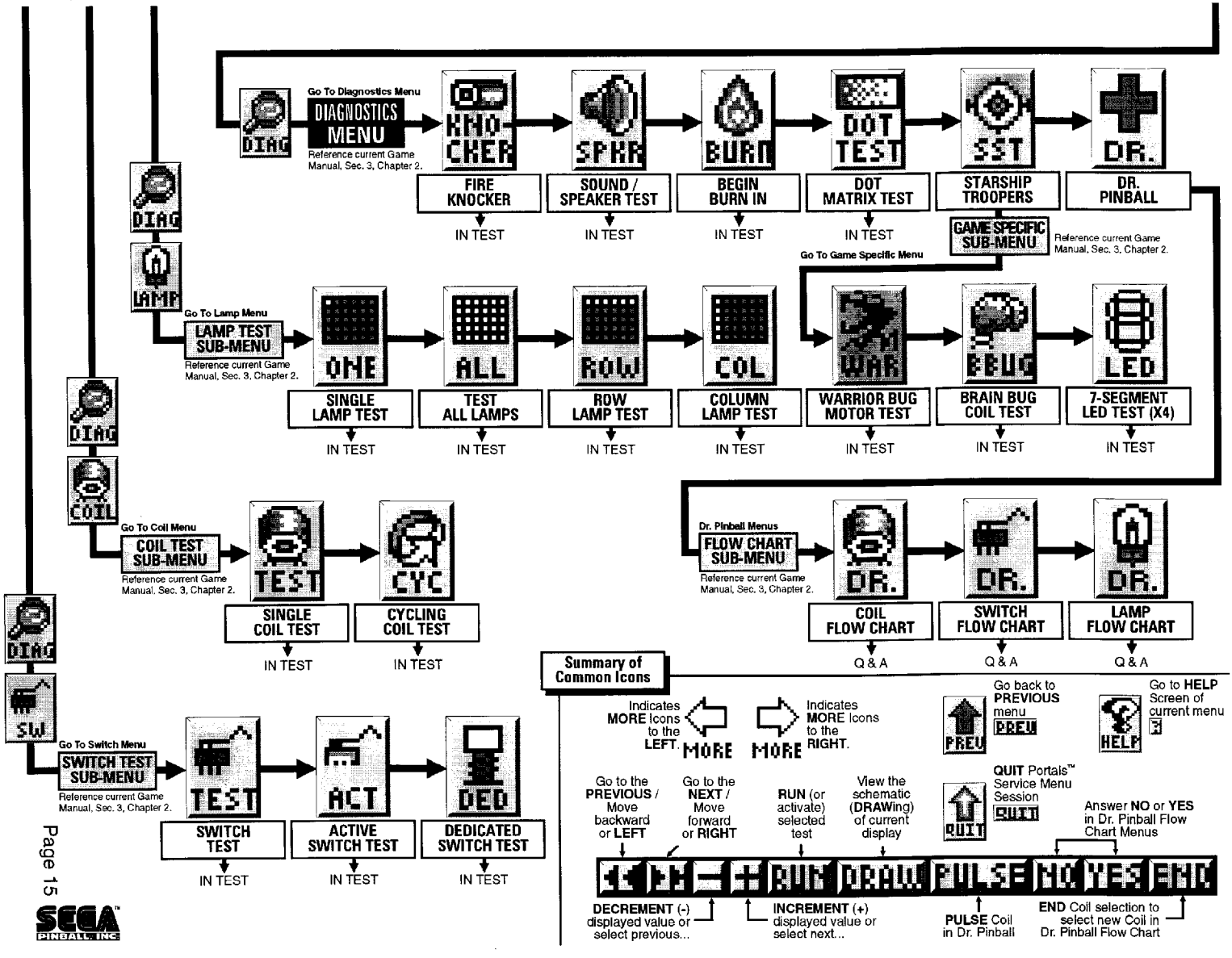
As the operator views the Menu Screen(s), the MORE MORE symbols indicates that there are more *Icons* to select in each direction. The *Icon* selected will blink. Pushing the **Black "ENTER" Button** (or **Start Button**) will select the *Icon* and the Menu Screen will change to the menu selected. Select 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 for *Starship Troopers*





SEGA PINBALL, INC.

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*.

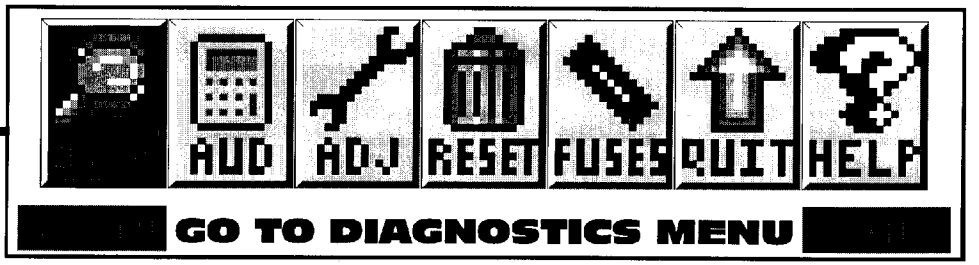
Important Note:

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.***

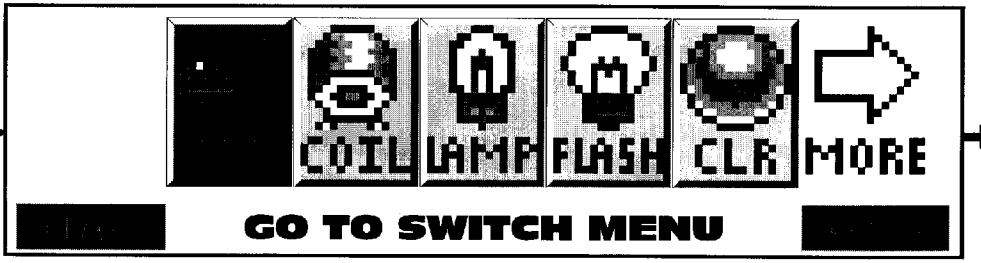
Selecting & activating the "QUIT" *Icon* from any display will exit the *Service Session*.

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).

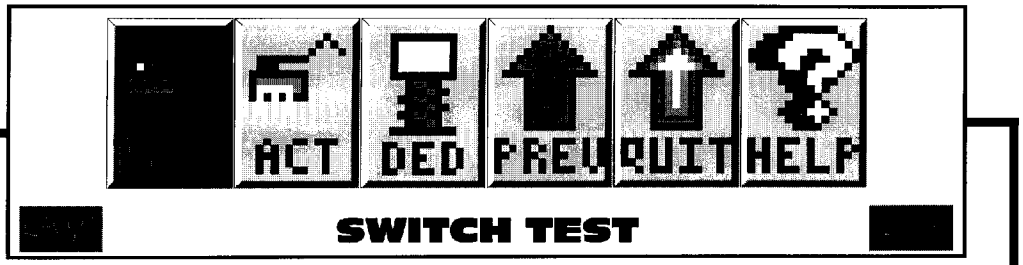


Press the **Black "ENTER" Button** to activate this **ICON**. This will bring up the **DIAGNOSTICS MENU**.

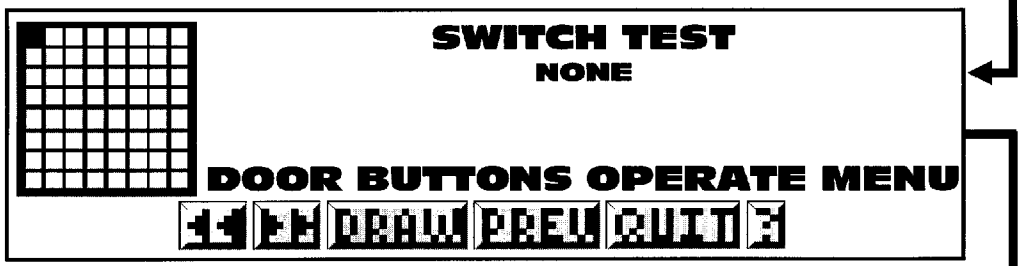


The **DIAGNOSTICS MENU** now appears with the "SW" *Icon* (GO TO SWITCH MENU) flashing. Press the **Black Button** to *activate* this icon. This will bring up the **SWITCH TEST MENU**.

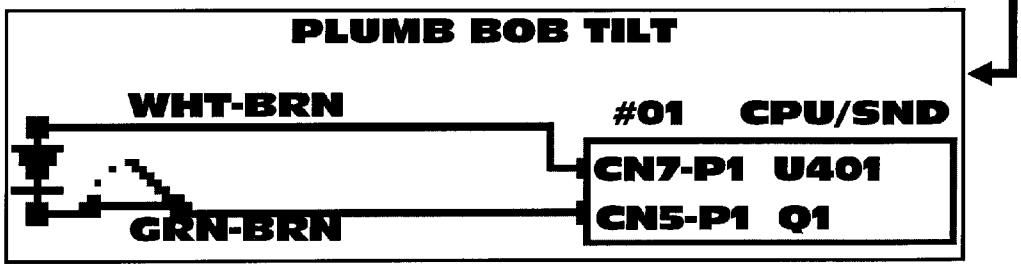
The **SWITCH TEST MENU** now appears with the "TEST" *Icon* (**SWITCH TEST**) flashing.
Press the **Black "ENTER" Button** to *activate* this icon. This will bring up the **Switch Test Display**.



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.

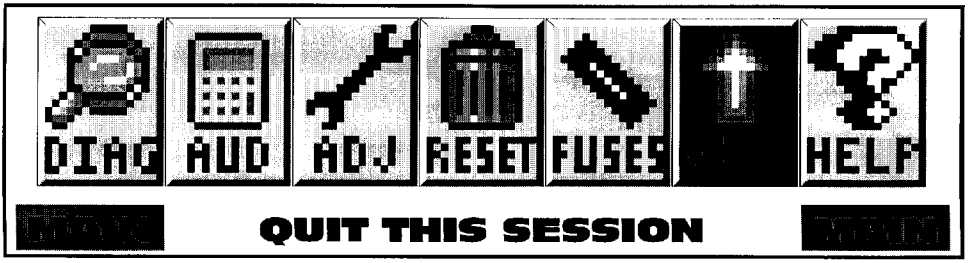
While in Switch or Active Switch Tests, the **Flipper & Start Buttons** are deactivated. Use the **Red "LEFT," Green "RIGHT"** and/or **Black "ENTER" Buttons** to select and activate the **"MINI-ICONS"** at the bottom of the display. In Switch Test, if the "Left Arrow" or "Right Arrow" *Icon* is activated, the display will go to the previous tests (Active and 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***, ***Test Flash Lamps***) may be used for a quick verification of automatic test functions and the manual tests (***Begin Play Test***, ***Single Lamp / All / Row / Column Tests***, and ***Game Specific Test***.) may be used for troubleshooting. All *Icons* and there usages are explained throughout this chapter.

During game play, activation of switches and operation of coils with associated switches are monitored. If the **CPU/Sound 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 Alert***, 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.*

⚠ Caution: Remove pinballs from the Ball Trough prior to lifting the playfield for servicing. This can easily be done in the **Portals™ Service Menu System**. Select the "DIAG" *Icon* from the **MAIN MENU** to go to the **DIAGNOSTICS MENU**. Select the "CLR" *Icon* to enter the **CLEAR BALL TROUGH MENU**. Select the "RUN" *Icon* & press the **Start Button** to remove one ball at a time. This is also useful to retrieve one ball for game testing in ***Begin Play Test*** & ***Game Specific Test***. ***Important:*** The **Power Interlock Switch** must be pulled out.

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:

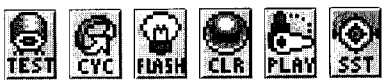
Exit any sub-menu and return to the **MAIN MENU** by selecting & activating the "PREV" *Icons*. If no *Icons* appear in the display because of a testing function or special display (e.g. "Help"), press any button to exit.

Selecting & activating the "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 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 **ONLY** the **Red "LEFT," Green "RIGHT"** and **Black "ENTER" Buttons**. This is required in ***Switch*** & ***Active Switch Tests***, as the **Flipper** & **Start Buttons** are a part of the test.



In ***Single Coil Test***, ***Cycling Coil Test***, ***Test Flash Lamps***, ***Clear Ball Trough, Begin Play Test*** & ***Starship Troopers Specific*** Menu's, the **Power Interlock Switch** (inside Coin Door) must be pulled out. (See ***Access & Use*** in Chapter 1 of this section for the location.)

If the Power Interlock Switch is not pulled out, all electro-mechanical devices (such as Coils) cannot be tested (20v & 50v DC power is disabled). Closing the Coin Door will automatically reset this switch.

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 three parts: Switch Test, Active Switches, and Dedicated Switch Test.

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

Switch Test

To initiate, from the **SWITCH MENU,** select the "TEST" *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 "DRAW" *Mini-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.

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, Drive (Column) Wire, Part Nº, and the "Pin-Outs" from the CPU/SOUND Board.

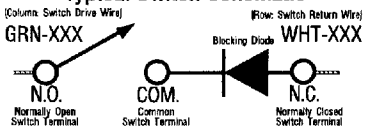
SWITCH MATRIX GRID & DEDICATED SWITCHES

Diode On Terminal Strip

Row (Return) \ Column (Drive)	1 Q1 GRN-BRN CN5-P1	2 Q2 GRN-RED CN5-P3	3 Q3 GRN-ORG CN5-P4	4 Q4 GRN-YEL CN5-P5	5 Q5 GRN-BLK CN5-P6	6 Q6 GRN-BLU CN5-P7	7 Q7 GRN-VIO CN5-P8	8 Q8 GRN-GRY CN5-P9
1 U400 WHT-BRN CN7-P9	NOT USED 1	UTROUGH: SKILL SHOT 9	LEFT BOTTOM S-U (GRN) 17	LEFT RAMP ENTER 25	STEPPER MOTOR REAR D05 33	LEFT TOP LANE 41	LEFT TURBO BUMPER 49	LEFT OUTLANE 57
2 U400 WHT-RED CN7-P8	4TH COIN SLOT 2	UTROUGH: BUG HOLE 10	LEFT MIDDLE S-U (YEL) 18	LEFT RAMP EXIT D05 26	STEPPER MOTOR FRONT D05 34	MIDDLE TOP LANE 42	BOTTOM TURBO BUMPER 50	LEFT RETURN LANE 58
3 U400 WHT-ORG CN7-P7	6TH COIN SLOT 3	NOT USED 11	LEFT MIDDLE S-U (RED) 19	LEFT RAMP S-U (YEL) 27	STEPPER MOTOR BUG D05 35	RIGHT TOP LANE 43	RIGHT TURBO BUMPER 51	LEFT SLINGSHOT 59
4 U400 WHT-YEL CN7-P6	RIGHT COIN SLOT 4	4-BALL TROUGH #1 (LEFT) 12	LEFT TOP S-U (YEL) 20	POP S-U (BLU) 28	NOT USED 36	NOT USED 44	RIGHT RAMP ENTER 52	RIGHT OUTLANE 60
5 U401 WHT-GRN CN7-P5	CENTER COIN SLOT / DBA 5	4-BALL TROUGH #2 13	RIGHT BOTTOM S-U (RED) 21	POP. S-U (GRN) 29	BRAIN BUG UP D07 37	VUK D07 45	RIGHT RAMP EXIT 53	RIGHT RETURN LANE 61
6 U401 WHT-BLU CN7-P3	LEFT COIN SLOT 6	4-BALL TROUGH #3 14	RIGHT MIDDLE S-U (YEL) 22	VUK S-U (GRN) 30	BRAIN BUG HIT D07 38	SUPER VUK D07 46	START BUTTON 54	RIGHT SLINGSHOT 62
7 U401 WHT-VIO CN7-P2	5TH COIN SLOT 7	4-BALL TROUGH VUK OPTO 15	RIGHT MIDDLE S-U (GRN) 23	VUK S-U (BLU) 31	BRAIN BUG UP D07 39	LEFT ORBIT 47	SLAM TILT 55	NOT USED 63
8 U401 WHT-GRY CN7-P1	NOT USED 8	SHOOTER LANE D05 16	RIGHT TOP S-U (YEL) 24	RIGHT RAMP S-U (YEL) 32	UTROUGH POP EXIT HOLE D05 40	RIGHT ORBIT 48	PLUMB BOB TILT 56	NOT USED 64

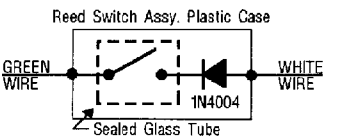
GND IC U206 INPUTS	Ground BLK CN6-P1, -P11
1 GRY-BRN CN6-P2	#1 LEFT FLIPPER BUTTON DS-1
2 GRY-RED CN6-P3	#2 LEFT FLIPPER E.O.S (End-of-Stroke) DS-2
3 GRY-ORG CN6-P4	#3 RIGHT FLIPPER BUTTON DS-3
4 GRY-YEL CN6-P6	#4 RIGHT FLIPPER E.O.S. (End-of-Stroke) DS-4
5 GRY-GRN CN6-P7	#5 MINI FLIPPER BUTTON DS-5
6 GRY-BLU CN6-P8	#6 VOLUME (RED BUTTON) (Normal) (In Test: LEFT) DS-6
7 GRY-VIO CN6-P9	#7 SERV. CRED. (GREEN BUTTON) (Normal) (In Test: RIGHT) DS-7
8 GRY-BLK CN6-P10	#8 BEGIN TEST (BLACK BUTTON) (Normal) (In Test: ENTER) DS-8

Typical Switch Schematic

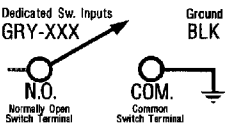


Note:
All Switches require diodes. Some diodes are located on Terminal Strips (under playfield) & not on the switch itself.
Diode On Terminal Strip

Reed Switch Schematic

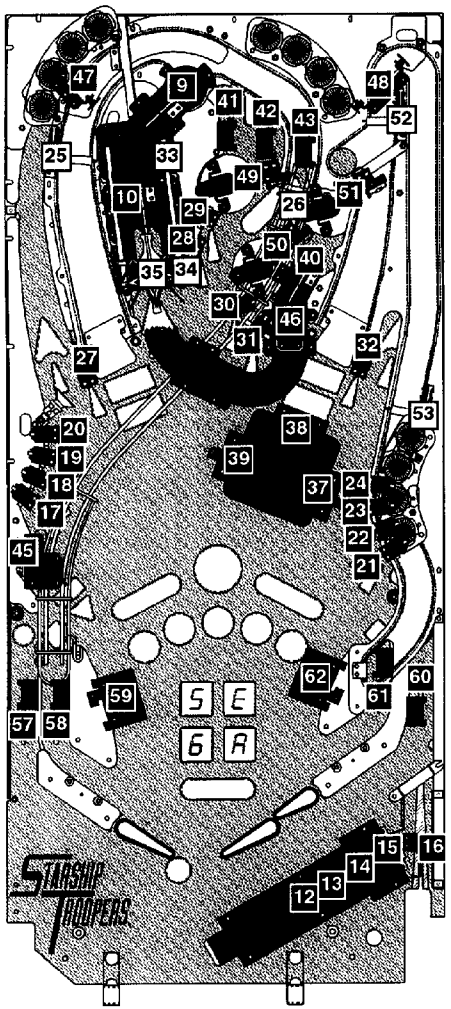


Dedicated Switch Schem.



Switch Matrix Grid Descriptions with Part Numbers and Locations †

† The sw. locations correspond with the Sw. Nº in the table below and the Switch Matrix Grid. *Note:* Diode On Terminal Strip (**DOTS**) if noted.



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 **4** **5** **6** **55** **56**

The following switches are not used:

1 **8** **11** **36** **44** **63** **64**

Sw. Nº	Col. Nº	Row Nº	Sw. Note	Switch Matrix Description		Part Nº
				Note: The ¥ Coin Switch (for Japan) is 180-5091-00		
1	1	1		NOT USED		
2*	1	2		4TH COIN SLOT		180-5024-00
3*	1	3		*6TH COIN SLOT*		*(Future Use)*
4*	1	4		RIGHT COIN SLOT		180-5024-00
5*	1	5		CENTER COIN SLOT / DBA		
6*	1	6		LEFT COIN SLOT		
7*	1	7		*5TH COIN SLOT*		*(Future Use)*
8	1	8		NOT USED		
9	2	1		U'TROUGH: SKILL SHOT		180-5057-00
10	2	2		U'TROUGH: BUG HOLE		
11	2	3		NOT USED		
12	2	4		4-BALL TROUGH #1 (LEFT)		180-5119-00
13	2	5		4-BALL TROUGH #2		
14	2	6		4-BALL TROUGH #3		
15	2	7		4-BALL TROUGH VUK OPTO	TRANS REC	520-5124-00 520-5125-00
16	2	8	DOTS	SHOOTER LANE		500-5096-00
17	3	1		LEFT BOTTOM S-U (GRN)		500-6139-04
18	3	2		LEFT MIDDLE S-U (YEL)		500-6138-06
19	3	3		LEFT MIDDLE S-U (RED)		500-6075-02
20	3	4		LEFT TOP S-U (YEL)		500-6138-06
21	3	5		RIGHT BOTTOM S-U (RED)		500-6075-02
22	3	6		RIGHT MIDDLE S-U (YEL)		500-6138-06
23	3	7		RIGHT MIDDLE S-U (GRN)		500-6139-04
24	3	8		RIGHT TOP S-U (YEL)		500-6138-06
25	4	1		LEFT RAMP ENTER		180-5087-00
26	4	2	DOTS	LEFT RAMP EXIT (on Wire Ramp)		180-5093-00
27	4	3		LEFT RAMP S-U (YEL)		500-6138-06
28	4	4		POP S-U (BLU)		500-6228-05
29	4	5		POP S-U (GRN)		500-6139-04
30	4	6		VUK S-U (GRN)		
31	4	7		VUK S-U (BLU)		500-6228-05
32	4	8		RIGHT RAMP S-U (YEL)		500-6138-06
33	5	1	DOTS	STEPPER MOTOR REAR		180-5119-00
34	5	2	DOTS	STEPPER MOTOR FRONT		
35	5	3	DOTS	STEPPER MOTOR BUG		
36	5	4		NOT USED		
37	5	5		BRAIN BUG UP		180-5165-00
38	5	6	DOTS	BRAIN BUG HIT		
39	5	7		BRAIN BUG UP		
40	5	8	DOTS	U'TROUGH: POP EXIT HOLE		180-5057-00
41	6	1		LEFT TOP LANE		500-6227-02
42	6	2		MIDDLE TOP LANE		
43	6	3		RIGHT TOP LANE		
44	6	4		NOT USED		
45	6	5	DOTS	VUK		180-5116-01
46	6	6	DOTS	SUPER VUK		180-5052-00
47	6	7		LEFT ORBIT (OPTO)	TRANS REC	520-5082-00 520-5083-01
48	6	8		RIGHT ORBIT (OPTO)	TRANS REC	520-5082-00 520-5083-01
49	7	4		TOP TURBO BUMPER		180-5015-03
50	7	2		BOTTOM TURBO BUMPER		
51	7	3		RIGHT TURBO BUMPER		
52	7	4		RIGHT RAMP ENTER		180-5087-00
53	7	5		RIGHT RAMP EXIT		
54*	7	6		START BUTTON		500-6090-06
55*	7	7		SLAM TILT (On Coin Door)		180-5022-00
56*	7	8		PLUMB BOB TILT	HANGER CONTACT	535-5319-00 535-7563-01
57	8	1		LEFT OUTLANE		500-6227-02
58	8	2		LEFT RETURN LANE		
59	8	3		LEFT SLINGSHOT		180-5054-00
60	8	4		RIGHT OUTLANE		500-6227-02
61	8	5		RIGHT RETURN LANE		
62	8	6		RIGHT SLINGSHOT		180-5054-00
63	8	7		NOT USED		
64	8	8				

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. ***Important:*** The **Power Interlock Switch** must be pulled out.

Single Coil Test

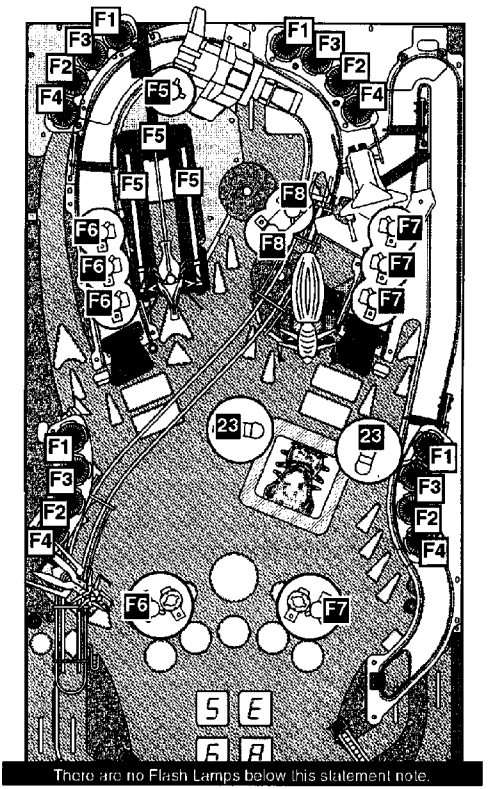
To initiate, from the **COIL MENU**, select the "TEST" *Icon* with either **Red** or **Green Button** and press the **Black Button**. Ensure the **Power Interlock Switch** is pulled out. Select either the "-" or "+" *Icons*. Start with the "+" *Icon* to start the manual Coil Test from #1 (The test runs through Coils 1-24 and Flash Lamps F1-F8; In this game, Coil Positions 23 is used for Flash Lamps.). 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 & 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. ***Important:*** The **Power Interlock Switch** must be pulled out.

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." ***Important:*** The **Power Interlock Switch** must be pulled out.

Playfield Flash Lamp Locations

Type	Description	
#23 (FLASH)	BRAIN BUG*2	(#89 Bulb)
#F1 FLASH	RED*4	(#906 Bulb)
#F2 FLASH	YELLOW*4	(#906 Bulb)
#F3 FLASH	GREEN*4	(#906 Bulb)
#F4 FLASH	BLUE*4	(#906 Bulb)
#F5 FLASH	MULTIBALL*4 (#906*3 / #89*1 Bulb)	
#F6 FLASH	LT RAMP*4	(#89 Bulb)
#F7 FLASH	RT RAMP*4	(#89 Bulb)
#F8 FLASH	POPS*2	(#89 Bulb)

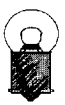


Legend Note:

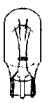
☐ = Flash Lamps mounted above playfield.

■ = Flash Lamps mounted below playfield.

The following bulbs are used for Flash Lamps (see table above for bulb usage).

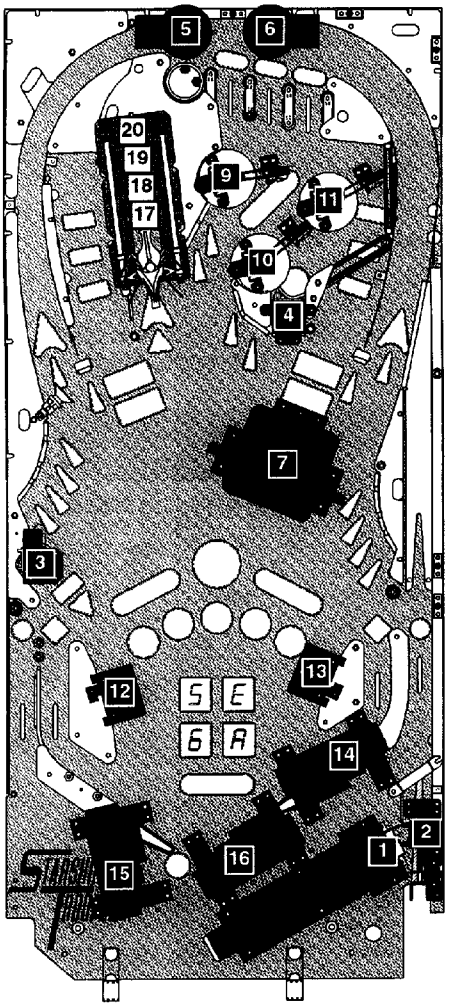


#89 Bulb
(Bayonet)
165-5000-89



#906 Bulb
(Wedge Base)
165-5004-00

Playfield Coil Locations



Type	Coil Description
#1 COIL	TROUGH UP-KICKER (VUK) (26-1200)
#2 COIL	AUTO LAUNCH (50V) (24-940)
#3 COIL	VUK (26-1200)
#4 COIL	SUPER VUK (26-1200)
#5 COIL	LEFT MAGNET (22-650)
#6 COIL	RIGHT MAGNET (22-650)
#7 COIL	BRAIN BUG (22-1080)
#8 COIL	(EUROPEAN TOKEN DISPENSER)
#9 COIL	LEFT TURBO BUMPER (26-1200)
#10 COIL	BOTTOM TURBO BUMPER (26-1200)
#11 COIL	RIGHT TURBO BUMPER (26-1200)
#12 COIL	LEFT SLINGSHOT (26-1200)
#13 COIL	RIGHT SLINGSHOT (26-1200)
#14 COIL	MINI-FLIPPER [50v RED/YEL] (22-1080)
#15 COIL	LEFT FLIPPER [50v RED/YEL] (23-1100)
#16 COIL	RIGHT FLIPPER [50v RED/YEL] (23-1100)
#17 COIL	STEPPER MOTOR #1 (041-5062-00) **DOTS**
#18 COIL	STEPPER MOTOR #2 (041-5062-00) **DOTS**
#19 COIL	STEPPER MOTOR #3 (041-5062-00) **DOTS**
#20 COIL	STEPPER MOTOR #4 (041-5062-00) **DOTS**
#21 COIL	NOT USED
#22 COIL	NOT USED
#23 COIL	FLASH: BRAIN BUG x2 (#89 Bulb)
#24 COIL	(OPTIONAL COIN METER)

Note: Diode On Terminal Strip (**DOTS**) if noted.

Legend Note:

☐ = Coils mounted above playfield.

■ = Coils mounted below playfield.

The following Coil Positions are used for Flash Lamps (see previous page for locations):

23

The following coils are optional:

8 **24**

The following coils are not used:

21 **22**

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 or Bulb Type
01	TROUGH UP-KICKER	Q1	I/O Pwr. Drvr.	BRN-BLK	J8-P1	YEL-VIO	J10-P4/5	50v DC	26-1200 090-5044-00T
02	AUTO LAUNCH	Q2	I/O Pwr. Drvr.	BRN-RED	J8-P3	YEL-VIO	J10-P4/5	50v DC	24-940 090-5036-00T
03	VUK	Q3	I/O Pwr. Drvr.	BRN-ORG	J8-P4	YEL-VIO	J10-P4/5	50v DC	26-1200 090-5044-00T
04	SUPER VUK	Q4	I/O Pwr. Drvr.	BRY-YEL	J8-P5	YEL-VIO	J10-P4/5	50v DC	26-1200 090-5044-00T
05	LEFT MAGNET	Q5	I/O Pwr. Drvr.	BRN-GRN	J8-P6	VIO-YEL	J10-P3	50v DC	22-650 090-5042-01
06	RIGHT MAGNET	Q6	I/O Pwr. Drvr.	BRN-BLU	J8-P7	VIO-YEL	J10-P3	50v DC	22-650 090-5042-01
07	BRAIN BUG	Q7	I/O Pwr. Drvr.	BRN-VIO	J8-P8	VIO-YEL RED-WHT	J10-P3	50v DC	22-1080 090-5032-00T
08	EUROPEAN TOKEN DISPENSER	Q8	I/O Pwr. Drvr.	BRN-GRY	J8-P9	YEL-VIO	J10-P4/5	50v DC	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 or Bulb Type
09	LEFT TURBO BUMPER	Q9	I/O Pwr. Drvr.	BLU-BRN	J9-P1	YEL-VIO	J10-P4/5	50v DC	26-1200 090-5044-00T
10	BOTTOM TURBO BUMPER	Q10	I/O Pwr. Drvr.	BLU-RED	J9-P2	YEL-VIO	J10-P4/5	50v DC	26-1200 090-5044-00T
11	RIGHT TURBO BUMPER	Q11	I/O Pwr. Drvr.	BLU-ORG	J9-P4	YEL-VIO	J10-P4/5	50v DC	26-1200 090-5044-00T
12	LEFT SLINGSHOT	Q12	I/O Pwr. Drvr.	BLU-YEL	J9-P5	YEL-VIO	J10-P4/5	50v DC	26-1200 090-5044-00T
13	RIGHT SLINGSHOT	Q13	I/O Pwr. Drvr.	BLU-GRN	J9-P6	YEL-VIO	J10-P4/5	50v DC	26-1200 090-5044-00T
14	MINI FLIPPER	Q14	I/O Pwr. Drvr.	BLU-BLK	J9-P7	RED-YEL BLU-YEL	J10-P1/2	50v DC	22-1080 090-5032-00T
15	LEFT FLIPPER (50v RED/YEL)	Q15	I/O Pwr. Drvr.	ORG-GRY	J9-P8	RED-YEL GRY-YEL	J10-P1/2	50v DC	23-1100 090-5030-00T
16	RIGHT FLIPPER (50v RED/YEL)	Q16	I/O Pwr. Drvr.	ORG-VIO	J9-P9	RED-YEL BLU-YEL	J10-P1/2	50v DC	23-1100 090-5030-00T

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	STEPPER MOTOR #1	3 DOTS	Q17	I/O Pwr. Drvr.	VIO-BRN	J7-P2	GRY/RED DOTS	J16-P3	12v DC	Step.Motor 041-5062-00
18	STEPPER MOTOR #2	5 DOTS	Q18	I/O Pwr. Drvr.	VIO-RED	J7-P3	GRY/RED DOTS	J16-P3	12v DC	Step.Motor 041-5062-00
19	STEPPER MOTOR #3	8 DOTS	Q19	I/O Pwr. Drvr.	VIO-ORG	J7-P4	GRY/RED DOTS	J16-P3	12v DC	Step.Motor 041-5062-00
20	STEPPER MOTOR #4	8 DOTS	Q20	I/O Pwr. Drvr.	VIO-YEL	J7-P6	GRY/RED DOTS	J16-P3	12v DC	Step.Motor 041-5062-00
21	NOT USED		Q21	I/O Pwr. Drvr.	VIO-GRN	J7-P7	BRN	N/C	N/C	NOT USED
22	NOT USED		Q22	I/O Pwr. Drvr.	VIO-BLU	J7-P8	BRN	N/C	N/C	NOT USED
23	FLASH BRAIN BUG *2		Q23	I/O Pwr. Drvr.	VIO-BLK	J7-P9	ORG	J6-P10	20v DC	#89 Bulb 165-5000-89
24	OPTIONAL COIN METER		Q24	I/O Pwr. Drvr.	VIO-GRY	J7-P10	RED	J16-P7	5v DC	5v Meter (If Required)

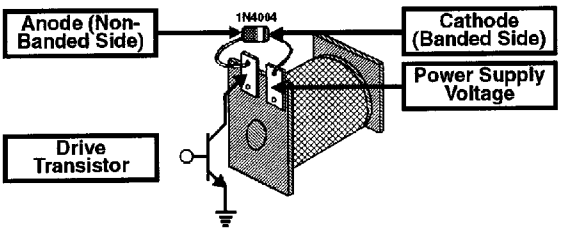
Diode On Terminal Strip (Note 5)

Coils Detailed Chart Table Continued

	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	#F1 FLASH RED*4	Q25	I/O Pwr. Drvr.	BLK-BRN	J6-P1	ORG	J6-P10	20v DC	#906 Bulb 165-5004-00
F2	#F2 FLASH YELLOW*4	Q26	I/O Pwr. Drvr.	BLK-RED	J6-P2	ORG	J6-P10	20v DC	#906 Bulb 165-5004-00
F3	#F3 FLASH GREEN*4	Q27	I/O Pwr. Drvr.	BLK-ORG	J6-P3	ORG	J6-P10	20v DC	#906 Bulb 165-5004-00
F4	#F4 FLASH BLUE*4	Q28	I/O Pwr. Drvr.	BLK-YEL	J6-P4	ORG	J6-P10	20v DC	#906 Bulb 165-5004-00
F5	#F5 FLASH MULTIBALL*4	Q29	I/O Pwr. Drvr.	BLK-GRN	J6-P5	ORG	J6-P10	20v DC	#906 Bulb† 165-5004-00
F6	#F6 FLASH LT RAMP*4	Q30	I/O Pwr. Drvr.	BLK-BLU	J6-P6	ORG	J6-P10	20v DC	#89 Bulb 165-5000-89
F7	#F7 FLASH RT RAMP*4	Q31	I/O Pwr. Drvr.	BLK-VIO	J6-P7	ORG	J6-P10	20v DC	#89 Bulb 165-5000-89
F8	#F8 FLASH POPS*2	Q32	I/O Pwr. Drvr.	BLK-GRY	J6-P8	ORG	J6-P10	20v DC	#89 Bulb 165-5000-89

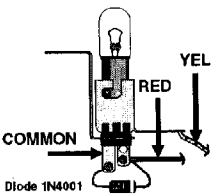
†Note: F5 = 3* #906 Bulb + 1* #89 Bulb.

TYPICAL SWITCH, COIL & LAMP WIRING



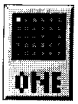
Note:
All Switches, Coils & Lamps require diodes. Some diodes are located on Terminal Strips (under playfield) & not on the switch, coil and/or lamp itself.
Diode
On
Terminal
Strip

See Section 5, Chapter 2, Playfield Diode Terminal Strip & Fuse Locations.



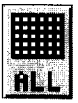
Go To Lamp Menu

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.



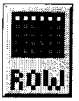
Single Lamp Test

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.



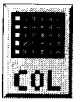
Test All Lamps

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 Grid.



Row & Column Lamp Tests

To initiate, from the **LAMP MENU**, select the "ROW" or "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 Grid (respective to each test) will light-up on the playfield and is indicated in the display.



LAMP MATRIX GRID

Diode On Terminal Strip

Column (18V) / Row (GND)	1: U17 YEL-BRN J13-P9	2: U16 YEL-RED J13-P8	3: U15 YEL-ORG J13-P7	4: U14 YEL-BLK J13-P6	5: U13 YEL-GRN J13-P5	6: U12 YEL-BLU J13-P4	7: U11 YEL-VIO J13-P3	8: U10 YEL-GRY J13-P1
1: Q33 RED-BRN J12-P1	ANTILLES #555 Bulb 1	ZEGEMA BEACH #555 Bulb 2	DANTANA #555 Bulb 3	TANGO URILLA #555 Bulb 4	PLANET B #555 Bulb 5	KLENDATHU #555 Bulb 6	BALL SAVER #555 Bulb 7	STARSHIP (HOTDOG) #555 Bulb 8
2: Q34 RED-BLK J12-P2	LEFT BOTTOM S-U (GRN) #555 Bulb 9	LEFT MIDDLE S-U (YEL) #555 Bulb 10	LEFT MIDDLE S-U (RED) #555 Bulb 11	LEFT TOP S-U (YEL) #555 Bulb 12	RIGHT BOTTOM S-U (RED) #555 Bulb 13	RIGHT MIDDLE S-U (YEL) #555 Bulb 14	RIGHT MIDDLE S-U (GRN) #555 Bulb 15	RIGHT TOP S-U (YEL) #555 Bulb 16
3: Q35 RED-ORG J12-P3	LEFT ORBIT "ORBIT" #555 Bulb 17	LEFT ORBIT NUKE #555 Bulb 18	RIGHT ORBIT "ORBIT" #555 Bulb 19	RIGHT ORBIT NUKE #555 Bulb 20	LEFT RAMP JACKPOT #555 Bulb 21	LEFT RAMP STARSHIP #555 Bulb 22	RIGHT RAMP JACKPOT #555 Bulb 23	RIGHT RAMP TROOPER #555 Bulb 24
4: Q36 RED-YEL J12-P4	(B) UG #555 Bulb 25	B (U) G #555 Bulb 26	BU (G) #555 Bulb 27	LEFT TURBO BUMPER DOTS #555 Bulb 28	BOTTOM TURBO BUMPER DOTS #555 Bulb 29	RIGHT TURBO BUMPER DOTS #555 Bulb 30	MULTI BALL #44 Bulb 31	SUPER NUKE #44 Bulb 32
5: Q37 RED-GRN J12-P5	NOT USED 33	WARRIOR BUG DOTS #555 Bulb 34	2X NUKE DOTS #555 Bulb 35	RECON DOTS #555 Bulb 36	LEFT OUTLANE #555 Bulb 37	RIGHT OUTLANE #555 Bulb 38	ADVANCE PLANET DOTS #555 Bulb 39	LT/RT RETURN LANES #555 Bulb 40
6: Q38 RED-BLU J12-P6	LEFT RAMP S-U (YEL) #555 Bulb 41	POPS S-U (BLU) #555 Bulb 42	POPS S-U (GRN) #555 Bulb 43	VUK S-U (GRN) #44 Bulb 44	VUK S-U (BLU) #44 Bulb 45	RIGHT RAMP S-U (YEL) #555 Bulb 46	LEFT RAMP NUKE DOTS #555 Bulb 47	RIGHT RAMP NUKE DOTS #555 Bulb 48
7: Q39 RED-VIO J12-P8	WARRIOR 7-SEGMENT "A" Red LED 49	WARRIOR 7-SEGMENT "B" Red LED 50	WARRIOR 7-SEGMENT "C" Red LED 51	WARRIOR 7-SEGMENT "D" Red LED 52	WARRIOR 7-SEGMENT "E" Red LED 53	WARRIOR 7-SEGMENT "F" Red LED 54	WARRIOR 7-SEGMENT "G" Red LED 55	ARM NUKES #44 Bulb 56
8: Q40 RED-GRY J12-P9	HOPPER 7-SEGMENT "A" Red LED 57	HOPPER 7-SEGMENT "B" Red LED 58	HOPPER 7-SEGMENT "C" Red LED 59	HOPPER 7-SEGMENT "D" Red LED 60	HOPPER 7-SEGMENT "E" Red LED 61	HOPPER 7-SEGMENT "F" Red LED 62	HOPPER 7-SEGMENT "G" Red LED 63	EXTRA BALL #44 Bulb 64
9: Q41 RED-WHT J12-P10	PLASMABUG 7-SEGMENT "A" Red LED 65	PLASMABUG 7-SEGMENT "B" Red LED 66	PLASMABUG 7-SEGMENT "C" Red LED 67	PLASMABUG 7-SEGMENT "D" Red LED 68	PLASMABUG 7-SEGMENT "E" Red LED 69	PLASMABUG 7-SEGMENT "F" Red LED 70	PLASMABUG 7-SEGMENT "G" Red LED 71	TROOPERS (HOTDOG) #555 Bulb 72
10: Q42 RED J12-P11	TANKER 7-SEGMENT "A" Red LED 73	TANKER 7-SEGMENT "B" Red LED 74	TANKER 7-SEGMENT "C" Red LED 75	TANKER 7-SEGMENT "D" Red LED 76	TANKER 7-SEGMENT "E" Red LED 77	TANKER 7-SEGMENT "F" Red LED 78	TANKER 7-SEGMENT "G" Red LED 79	SHOOT AGAIN #555 Bulb 80

Lamp Matrix Grid Locations

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

Legend Note:

☐ = Lamps mounted above playfield.

■ = Lamps mounted below playfield.

The following Lamp is not used:

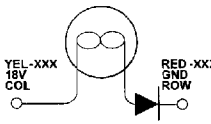
33

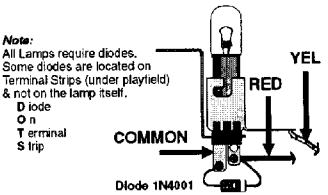
The following Bulbs are used in the Lamp Matrix Grid (See Table Grid for details):
This game Lamp Matrix Grid Positions 49-55, 57-63, 65-71 & 73-79 are Red LEDs located on a 4X 7-Segment Display PCB, Part Nº 520-5166-00.

#555 Bulb (Wedge)
165-5002-00

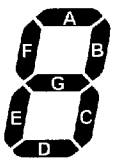
#44 Bulb (Bayonet)
165-5000-44

Typical Switch Schematic & Side View

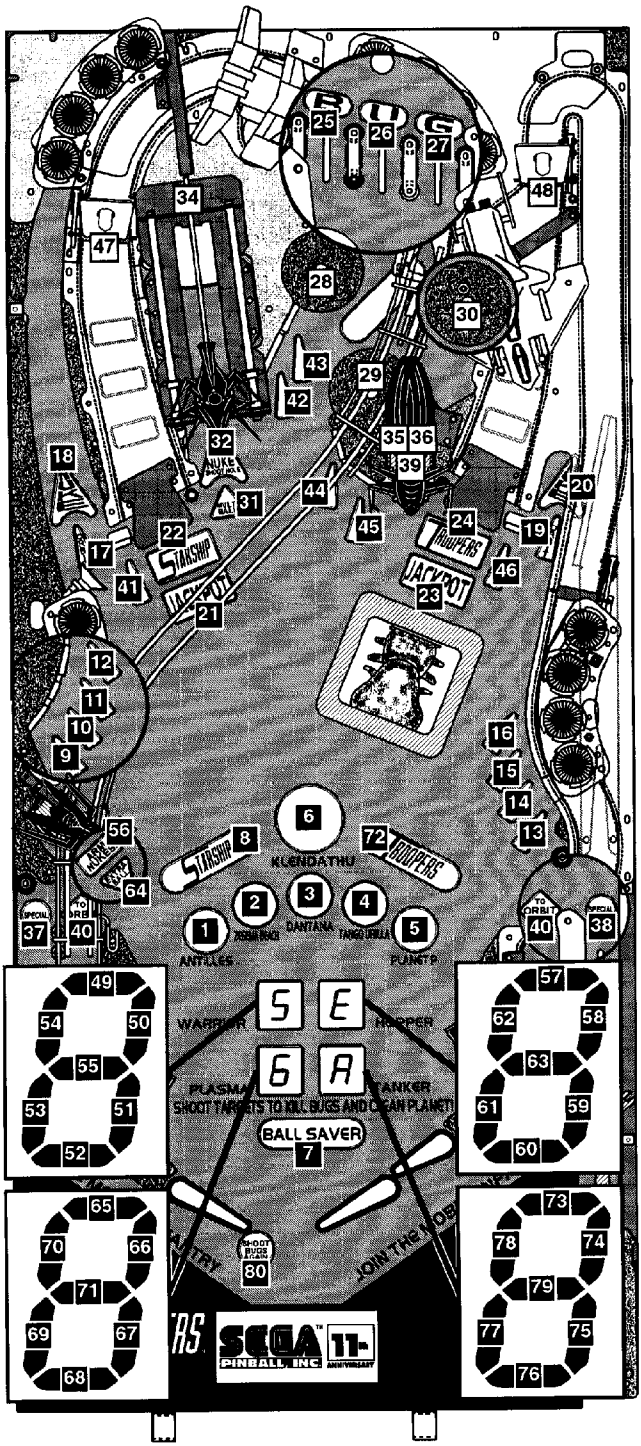




Typical 7-Segment Address



NOTE:
This Game features a 4-Digit 7-Segment Display (located over the Flippers). Each segment is wired into the Lamp Matrix Grid (see drawing & previous page).



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 indicate "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. ***Important:*** The **Power Interlock Switch** must be pulled out.

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. ***Important:*** The **Power Interlock Switch** must be pulled out. ⚠ **Caution:** *Continuous use of above test may overheat the Trough Up-Kicker Coil.* ⚠

Technician Alert

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 (the phone number is different for each *Country Dip Switch Setting*).

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 "Ejects", Slingshots, Vertical Up-Kickers, Pop Bumpers, etc. in the game. For unique Play Test functions, select the "GAME SPECIFIC" *Icon* in the **DIAGNOSTICS MENU**. ***Important:*** The **Power Interlock Switch** must be pulled out.

Fire Knocker

From the **DIAGNOSTICS MENU**, select the "KNOCKER" *Icon* with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. The digitally mastered "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 from Backbox & Cabinet Speakers or *"Mono"* on the Cabinet Speaker (when used by itself). 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 speaker identification and the corresponding sound(s). The sound functions allow verification that both channels are functioning properly & that the speaker connections are correct.

Speaker Phase Testing

Connections to each of 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 one, bass frequencies will not be produced properly and the overall sound quality will be poor.

Speaker Phase Testing Continued

Continued

To test for proper speaker phasing, use the sound test to cycle through the Backbox & Cabinet, and Backbox Sine (repeated) functions. If the Cabinet Sine produces more volume and bass than the Left Sine, 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 Backbox Speaker RED/WHT Wire and the Cabinet Speaker YEL/WHT Wire 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-3 (RED/BLK) or Pin-6 (YEL/BLK)) each time. As the connection is made, check speaker cone movement; proper connections are indicated by outward movement.

Auto / Manual Tests	Sounds Produced
Speaker Test	Tone
Sound/OPSYS EPROM (Loc. U7)	Level 1-3 (Music Test)
Voice ROM 1 (Loc. U17)	Speech Pattern 1
Voice ROM 2 (Loc. U21)	Speech Pattern 2
Voice ROM 3 (Loc. U36)	Speech Pattern 3
Voice ROM 4 (Loc. U37)	Not Used

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:

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.

Note: Pressing any button will exit the test & return to **DIAGNOSTICS MENU**.

Dot Matrix Display Explained

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

Starship Troopers Specific (3 Sub-Tests, see below)

From the **DIAGNOSTICS MENU**, select the "SST" *Icon* with either **Red "LEFT"** or **Green "RIGHT" Button** & press the **Black "ENTER" Button**. This will bring up the **STARSHIP TROOPERS SPECIFIC MENU**. Similar to "BEGIN PLAY TEST," this menu is used to test and adjust the game specific features. The features are the **BUG STEPPER MOTOR TEST, BRAIN BUG TEST,** and **LED TEST.**

Bug Stepper Motor Test

To initiate, from the **STARSHIP TROOPERS SPECIFIC MENU**, select the "WAR" *Icon* with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button. In BUG STEPPER MOTOR TEST**, select the "RUN" *Icon* to begin. The Warrior Bug will continuously cycle back and forth. The Display will indicate Sw. 33 (REAR) as being activated as the Bug moves all the way back; Sw. 34 (FRONT) as being activated as the Bug moves all the way forward. Use a pinball and roll it into the Target Switch, as the switch is closed and the Display will indicate Sw. 35 (BUG) as being activated.

Brain Bug Test

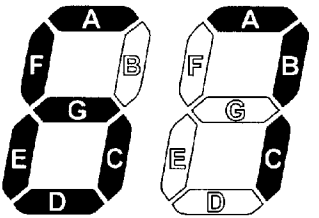
To initiate, from the **STARSHIP TROOPERS SPECIFIC MENU**, select the "BBUG" *Icon* with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button. In BRAIN BUG TEST**, select the "RUN" *Icon* to activate. The Brain Bug will "pop-up." As it does so, the Display will indicate Sw. 37 (UP) and Sw. 39 (UP) as being activated. Continue to hold the **Start Button** to keep the Brain Bug up ***just long enough to use a pinball and roll it into the Brain Bug.*** As the Bug moves back, the switch is closed and the Display will indicate Sw. 38 (HIT) as being activated.

LED Test

To initiate, from the **STARSHIP TROOPERS SPECIFIC MENU**, select the "LED" *Icon* with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button. In LED TEST**, select either the "-" or "+" *Icons.* Start with the "+" *Icon* to start the manual ***LED Test.*** Press the **Black** or **Start Button** on the "+" *Icon*, as each time the *Icon* is activated the numbers in the Display Menu will ***increment by 1*** (e.g. 0, 1, 2, 3; 1, 2, 3, 4; 2, 3, 4, 5; etc.). The numbers in the Display Menu will match the LED Numbers in the Playfield. Activating the "-" *Icon* will ***decrement the numbers by 1.*** Activating either "Arrow" Icons will move in-between the Sub-Menu Tests as described above. An *example* of how to light-up « **6789** » on the playfield (shown below), the following Lamp Maxtrix Grid Positions must be activated:

To make 6 the Upper Left Digit needs the following segments to be lit:

Segments **A** & **C-G** are lit by **Lamp Matrix Grid Positions 49 & 51-55** (Row 7: Columns 1 & 3-7).

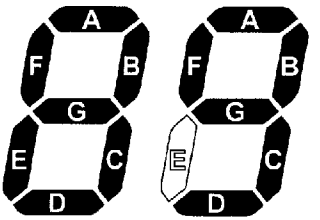


To make 7 the Upper Right Digit needs the following segments to be lit:

Segments **A-C** are lit by **Lamp Matrix Grid Positions 57-59** (Row 8: Columns 1-3).

To make 8 the Lower Left Digit needs the following segments to be lit:

Segments **A-G** are lit by **Lamp Matrix Grid Positions 65-71** (Row 9: Columns 1-7).



To make 9 the Lower Right Digit needs the following segments to be lit:

Segments **A-D, F & G** are lit by **Lamp Matrix Grid Positions 73-76, 78-79** (Row 10: Columns 1-4 & 6-7).

These digits are controlled by the Lamp Matrix Grid. The Upper Left Digit (Warrior) is controlled by Lamp Matrix Grid Positions 49-55; the Upper Right Digit (Hopper) is controlled by Lamp Matrix Grid Positions 57-63; the Lower Left Digit (Plasmabug) is controlled by Lamp Matrix Grid Positions 65-71; and the Lower Right Digit (Tanker) is controlled by Lamp Matrix Grid Positions 73-79; (Note: To test only individual segments of each digit, **GO TO LAMP MENU**, ***SINGLE LAMP TEST.***)

Note: To exit this Menu, select & activate the "PREV" *Icon* to go to the **DIAGNOSTICS MENU** or activate the "QUIT" *Icon* to exit **Portals Service Menu.**

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 three sub-menus: Coil "DR.," Switch "DR." and Lamp "DR." *Icons.* Selecting a particular sub-menu will give you a choice of which specific Coil (any and all coil assemblies such as Flippers, VUKs, Magnets, etc.), 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 or Switch to diagnose with "-" or "+" *Icon*; Then select the "RUN" *Icon* to activate the choice.
"PREV" goes back to previous question.
"QUIT" exits Portals completely.
Help "?" gives direction on button usage.

→ Seen when question is being asked on the Display. Select "YES" or "NO" to answer question given.
"END" lets you select a new item to test.
"PREV", "QUIT" and "?" (see first example above).

→ Seen when diagnosis is given. Select any *Icon* for your next step.
"END" lets you select a new item to test.
"PREV", "QUIT" and "?" (see first example above).

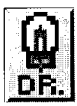
→ In Coil Flow Chart Menu, select "PULSE" to pulse the coil selected.
"END" lets you select a new item to test.
"PREV", "QUIT" and "?" (see first example above).

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.

GAME AUDIT TABLE

Copy for Field Audit Tracking Performance (Use blank columns to fill-in Audit Info.).

SEGA PINBALL, INC.

Earnings Audits 1-12

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

Sega Audits 13-55

	Audit Name	Fill-In		Audit Name	Fill-In		Audit Name	Fill-In
13	TOTAL BALLS PLAYED		28	20M—49.9M SCORES		43		
14	TOTAL EXTRA BALLS		29	50M—69.9M SCORES		44		
15	EXTRA BALL PERCENT		30	70M—99.9M SCORES		45		
16	REPLAY 1 AWARDS		31	100M—129.9M SCORES		46		
17	REPLAY 2+ AWARDS		32	130M+ SCORES		47		
18	TOTAL REPLAYS		33	AVERAGE SCORES		48		
19	REPLAY PERCENT		34	SERVICE CREDITS		49		
20	TOTAL SPECIALS		35	BALL SEARCH STARTED		50		
21	SPECIAL PERCENT		36	LOST BALL FEEDS		51		
22	TOTAL MATCHES		37	LOST BALL GAME STARTS		52	LEFT FLIPPER USED	
23	HIGH SCORE AWARDS		38	LEFT DRAINS		53	RIGHT FLIPPER USED	
24	HIGH SCORE PERCENT		39	CENTER DRAINS		54		
25	TOTAL FREE PLAYS		40	RIGHT DRAINS		55	MINI FLIPPER USED	
26	TOTAL PLAYS		41	SLAM TILTS				
27	0—19.9M SCORES		42	TOTAL BALLS SAVED				

Starship Troopers Audits 56-99 (Audits Subject to Change)

	Audit Name	Fill-In		Audit Name	Fill-In		Audit Name	Fill-In
56	LEFT ORBIT		72	MULTIBALL RESTART LIT		88	RECON LEVEL 4	
57	RIGHT ORBIT		73	MBALL RESTARTED		89	RECON LEVEL 5	
58	LEFT RAMP		74	MBALL JACKPOTS		90	RECON LEVEL 6	
59	RIGHT RAMP		75	SUPER JACKPOT LIT		91	ORBIT MBALL	
60	TOP HOLE		76	SUPER JACKPOTS		92	ORBIT JACKPOTS	
61	WARRIOR HOLE		77	PLANET HURRY-UP LIT		93	MBALL TARGETS COMP.	
62	SUPER VUK (BACK)		78	PLANET HURRY-UP SCORED		94	MULTIBALL %	
63	SUPER VUK (FRONT)		79	NUKE MBALL STARTED		95	RECON SPOTTED	
64	VUK		80	NUKE SCORED		96		
65	POP BUMPER HITS		81	SUPER NUKE SCORED		97		
66	POP BUMPER VISITS		82	KLENDATHU STARTED		98		
67	MBALL SPOTTED		83	RECON LIT		99		
68	WARRIOR HITS		84	RECON SCORED			*CPU Version:*	
69	MBALL READY		85	RECON LEVEL 1			*Display Version:*	
70	MULTIBALL START		86	RECON LEVEL 2			*Date Audited:*	
71	2+ MBALL START		87	RECON LEVEL 3			*Audited By:*	

Location:

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 divided into 3 groups: 1st— **Earnings (Coin) Audits**, are the first 12 most-used Audits; 2nd— **Sega Audits**, are the Game Play Generic Audits 13-55; 3rd— **Starship Troopers Audits**, are the Game Play Specific Audits 56-99; Audits left open (blank space in gray, e.g. Audits 54 & 55) are currently ***Not Used***, allowing for ***Future Expansion***, if any, or are ***Proprietary***. If the code version is upgraded, view Audits in the display & 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, Portals Service Menu Introduction, of this Section). View all audits with the **Game Audit Table** provided on the previous page. Copy page to fill-in important audit information as required.

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 number of times Coin Switch (Sw. 6) was closed.
Au. 6	**Coins Thru Right Slot**	Provides the total number of times Coin Switch (Sw. 4) was closed.
Au. 7	**Coins Thru Center Slot**	Provides the total number of times Coin Switch (Sw. 5) was closed.
Au. 8	**Coins Thru 4th Slot**	Provides the total number of times Coin Switch (Sw. 2) was closed.
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 (13-55)

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 number of regular and extra balls.
Au. 14	Total Extra Balls	Provides the total number of extra balls awarded.
Au. 15	Extra Balls Percent	Provides the percentage total 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	Provides the percentage total from dividing Audit 18, Total Replays, by Audit 26, Total Plays. The percentage reflects replay total awards for exceeding replay score levels.
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 Adjustment 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—19.9M Scores	Provides the total number of games the Player's final score was between 0 and 19,900,000 points.
Au. 28	20M—49.9M Scores	Provides the total number of games the Player's final score was between 20,000,000 and 49,900,000 points.
Au. 29	50M6—69.9M Scores	Provides the total number of games the Player's final score was between 50,000,000 and 69,900,000 points.
Au. 30	70M—99.9M Scores	Provides the total number of games the Player's final score was between 70,000,000 and 99,900,000 points.
Au. 31	100M—129.9M Scores	Provides the total number of games the Player's final score was between 100,000,000 and 129,900,000 points.
Au. 32	130M+ Scores	Provides the total number of games the Player's final score was over 130,000,000 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.
Au. 34	Service Credits	Provides the total number of times Dedicated Switch (DS-7) was closed, not in the Portals™ Service Menu. (See Chapter 1, Introduction [*Access & Use*] for instructions on how to receive Service Credits.)
Au. 35	Ball Search Started	Provides the total number of times the game performed a ball search.
Au. 36	Lost Ball Feeds	Provides the total number of times the game added a ball to play when it could not find a ball after ball search.

Sega Audits Continued.

Audit Name		Audit Definition
Au. 37	Lost Ball Game Starts	Provides the total number of times the game started with a ball missing from the ball trough at the start of a game.
Au. 38	Left Drains	Provides the total number of times Rollover Switch 57 was closed.
Au. 39	Center Drains	Provides the total number of times the game ball had drained with the last switch closed was not Sw. 57 or Sw. 60.
Au. 40	Right Drains	Provides the total number of times Rollover Switch 60 was closed.
Au. 41	Slam Tilts	Provides the total number of times Contact Switch 55 was closed.
Au. 42	Total Balls Saved	Provides the total number of times this 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.
Au. 43-Au. 51		These audits are ***Not Used***, allowing for ***Future Expansion***, if any, and/or ***Proprietary*** (used for programming).
Au. 52	Left Flipper Used	Provides the total number of times Dedicated Switch (DS-1) was closed.
Au. 53	Right Flipper Used	Provides the total number of times Dedicated Switch (DS-3) was closed.
Au. 54		This audits is ***Not Used***, allowing for ***Future Expansion***, if any, and/or ***Proprietary*** (used for programming).
Au. 53	Mini Flipper Used	Provides the total number of times Dedicated Switch (DS-5) was closed.

Starship Troopers Audits (56-99) (Audits Subject to Change)

From the **AUDITS MENU**, select the "SST" *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. 56	Left Orbit	Provides the total number of times this feature was completed. †
Au. 57	Right Orbit	Provides the total number of times this feature was completed. †
Au. 58	Left Ramp	Provides the total number of times this feature was completed. †
Au. 59	Right Ramp	Provides the total number of times this feature was completed. †
Au. 60	Top Hole	Provides the total number of times this feature was completed. †
Au. 61	Warrior Hole	Provides the total number of times this feature was completed. †
Au. 62	Super VUK (Back)	Provides the total number of times this feature was completed. †
Au. 63	Super VUK (Front)	Provides the total number of times this feature was completed. †
Au. 64	VUK	Provides the total number of times this feature was completed. †
Au. 65	Pop Bumper Hits	Provides the total number of times this feature was completed. †
Au. 66	Pop Bumper Visits	Provides the total number of times this feature was completed. †
Au. 67	MBall Spotted	Provides the total number of times this feature was lit. ‡

† Multiple variations of switch closures are used to determine the completion of the feature stated.

Audit Name		Audit Definition
Au. 68	Warrior Hits	Provides the total number of times this feature was completed. †
Au. 69	MBall Ready	Provides the total number of times feature was ready awaiting Multiball. †
Au. 70	Multiball Start	Provides the total number of times Multiball was played. †
Au. 71	2+ MBall Start	Provides the total number of times Multiball was played more than once by a single player in one game. †
Au. 72	Multiball Restart Lit	Provides the total number of times Multiball was played and no Jackpots were collected. ‡
Au. 73	Multiball Restarted	Provides the total number of times Multiball was restarted after Multiball Restart was lit. ‡
Au. 74	MBall Jackpots	Provides the total number of times this feature was awarded. †
Au. 75	Super Jackpot Lit	Provides the total number of times this feature was lit. ‡
Au. 76	Super Jackpots	Provides the total number of times this feature was awarded. †
Au. 77	Planet Hurry-Up Lit	Provides the total number of times this feature was lit. ‡
Au. 78	Planet Hurry-Up Scored	Provides the total number of times this feature was awarded. †
Au. 79	Nuke MBall Started	Provides the total number of times Multiball was played. †
Au. 80	Nuke Scored	Provides the total number of times this feature was awarded. †
Au. 81	Super Nuke Scored	Provides the total number of times this feature was awarded. †
Au. 82	Klendathu Started	Provides the total number of times this feature was started. †
Au. 83	Recon Lit	Provides the total number of times this feature was lit. ‡
Au. 84	Recon Scored	Provides the total number of times this feature was awarded. †
Au. 85	Recon Level 1	Provides the total number of times this feature was awarded. †
Au. 86	Recon Level 2	Provides the total number of times this feature was awarded. †
Au. 87	Recon Level 3	Provides the total number of times this feature was awarded. †
Au. 88	Recon Level 4	Provides the total number of times this feature was awarded. †
Au. 89	Recon Level 5	Provides the total number of times this feature was awarded. †
Au. 90	Recon Level 6	Provides the total number of times this feature was awarded. †
Au. 91	Orbit Mball	Provides the total number of times Multiball was played. †
Au. 92	Orbit Jackpots	Provides the total number of times this feature was awarded. †
Au. 93	MBall Targets Comp.	Provides the total number of times this feature was completed. †
Au. 94	Multiball %	This percentage is derived from dividing Audit 70, Multiball Start, by Audit 26, Total Plays.
Au. 95	Recon Spotted	Provides the total number of times this feature was lit. ‡
Au. 96-Au. 99		At time of printing, these audits are ***Not Used***, allowing for ***Future Expansion***, if any.

† Multiple variations of switch closures are used to determine the completion of the feature stated.
‡ Multiple variations of switch closures are used to determine the lighting of the feature stated.

Use the below space for any additions and/or changes, if any (see the Dot Matrix Display):

Au.	
Au.	
Au.	
Au.	
Au.	
Au.	

Go To Printer Menu

From the **AUDITS MENU**, select the "PRNT" *Icon* with either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. The **PRINTER MENU** appears.

☞ *Special equipment is required for this Sub-Menu*

The **Portals™ Service Menu System** provides 3 Audit Printing 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.

Adjustment 51, Printer Interface (Quick Printout)

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.

Adjustment 52, Alison Interface (Full Printout)

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.

Adjustment 53, Nº of Copies Printed (Reset Printer)

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.

RESETTING AUDIT NOTES:

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).

GAME ADJUSTMENT TABLE

Some adjustments have a "Drop-Down" Table for further customization.

Sega Adjustments 1-43

	Adjustment Name	USA Default	Your Setting		Adjustment Name	USA Default	Your Setting
1	REPLAYS: FIXED/MANUAL ‡	...10%...		23	DEFAULT HIGH SCORE #3	200,000,000	
2	REPLAY LEVELS ‡	1 ...		24	DEFAULT HIGH SCORE #4	175,000,000	
3	REPLAY AWARD	CREDIT		25	DEFAULT HIGH SCORE #5	150,000,000	
4	FREE GAME LIMIT	05		26	DEFAULT HIGH SCORE #6	125,000,000	
5	EXTRA BALL LIMIT	03		27	HSTD RESET COUNT	2,000	
6	GAME DIFFICULTY ‡	MODERATE		28	FREE PLAY	NO	
7	GAME PRICING ‡	USA8		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	KNOCKER VOLUME	NORMAL	
12	BALLS PER GAME	03		34	MINIMUM GAME TIME	OFF	
13	TILT WARNINGS	01		35			
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	01		39	TOURNAMENT MODE	NONE	
18	HIGH SCORE #2 AWARDS	00		40	EURO. TOKEN DISP.	OFF	
19	HIGH SCORE #3 AWARDS	00		41	SPECIAL MEMORY	YES	
20	HIGH SCORE #4 AWARDS	00		42	LOCATION ID	00	00
21	DEFAULT HIGH SCORE #1	250,000,000		43	GAME ID	00	00
22	DEFAULT HIGH SCORE #2	225,000,000					

PLEASE NOTE: All Factory Settings (Defaults) described in the tables above/below and within the Adjustment Definitions are for USA Settings only (CPU/Sound Board Dip Switch 300 Settings 1-8 are all "OFF"). Different countries *may have different* Factory Settings (Defaults).
‡ Adjustments 1, 2, 6 & 7 have "Drop-Down" Tables, see the definitions for explanations.

Starship Troopers Adjustments 44-50

	Adjustment Name	USA Default	Your Setting		Adjustment Name	USA Default	Your Setting
44	MBALL RESTART	MODERATE		49	STEPPER MOTOR ENABLED	YES	
45	EXTRA BALL MEMORY	ON		50	BRAIN BUG ENABLED	YES	
46	MULTIBALL CRITERION	MODERATE					
47	ORBIT CRITERION	MODERATE					
48	RAMP CRITERION	MODERATE					

Go To Adjustments Menu

Overview

The **Portals™ Service Menu System** provides 50 Adjustment Functions to vary game difficulty or to customize (e.g. Adjusting: High Score Levels; Balls per game; Game Pricing; Default High Scores; etc.). The Adjustment Functions are divided into 2 groups: 1st— **Sega Adjustments**, are the Game Play Generic Adjustments (1-43); 2nd— **Starship Troopers Adjustments**, are the Game Play Specific Adjustments (44-50); Adjustment(s) left open (blank space in gray, e.g. Adj. 50) are currently Not Used, allowing for Future Expansion, if any, or are Proprietary. If the code version is upgraded, view Adjustments in the display & write the adjustment(s) in the blank(s) if any adjustment(s) were added. Each group may be viewed manually after entering the **Portals™ Service Menu** (see Chapter 1, Portals™ Service Menu 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 10M - 9.99B. Adjust Replay Level 2, 3 and/or 4 respectively.
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.)

Adjustment Name		Adjustment Definition
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:	Extra Easy	Easy	Moderate	Hard	Extra Hard
(44) MBall Restart	EXTRA EASY	EASY	MODERATE	HARD	EXTRA HARD
(45) Extra Ball Memory	ON	ON	ON	ON	OFF
(46) Multiball Criterion	EXTRA EASY	EASY	MODERATE	HARD	EXTRA HARD
(47) Orbit Criterion	EXTRA EASY	EASY	MODERATE	HARD	EXTRA HARD
(48) Ramp Criterion	EXTRA EASY	EASY	MODERATE	HARD	EXTRA HARD

Play Rules: Novelty & 4-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

4-Ball Play Rules - Set to establish recommended settings for 4-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			

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 **Black "Enter" Button** again initiates a drop down menu representing coin switch pulses for the LEFT, CENTER, RIGHT and 4TH Coin Slots. The prescribed the number of pulses are required for 1 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 2 Credits. Further, if *Left Coin Pulses*, was set to 01 and *Coin Switch Pulses Required for 1 Credit*, to 02, 2 Coins in the Left Slot would be required for 1 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, 1 Credit would be posted for each of the first 3 Coins in the Left Slot and 2 Credits for the 4th Coin.

Sega Adjustment 7 Continued.

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 pulses required to post one credit: **00** to **99**.
Coin Switch Pulses Required for Bonus Credit	Set the number of pulses required to award the 1st Bonus credit(s): **00** to **99**.
Coin Switch Pulses Required for 2nd Bonus Credit	Set the number of 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 Mechanisms					<<< Adjustments >>>							
LEFT	CENTER	RIGHT	4TH	*Plays/Coins*	LEFT Pulses	CENTER Pulses	RIGHT Pulses	4TH Pulses	Pulses /Credit	Pulses /Bonus	Pulses /2nd Bonus	Credit /1st Bonus
25¢	$1.00	25¢	N/U	1/25¢ 3/50¢ 1/25¢ 5/$1.00 1/25¢ 6/$1.00	01 01 05	04 04 20	01 01 05	00 00 00	01 01 04	02 04 20	00 00 00	01 01 01
5SCH	10SCH	10SCH	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*	50*p*	£1	20*p*	1/30*p* 2/50*p* 5/£1 1/50*p* 3/£1 1/30*p* 4/£1	01 01 01	06 05 05	15 02 12	02 02 02	03 05 03	00 00 00	00 00 00	00 00 00
20¢	N/U	$1.00	N/U	1/60¢ 2/$1.00	01	00	05	00	03	05	00	01

Below and the following page is the **Standard Pricing Select Table** for the individual countries listed. The *Pricing Scheme* is determined in two ways - **1:** The CPU/Sound Board Dip Switch (Sw. 300) Setting; and, **2:** The Country Setting Option. For each country listed, the Dip Switch Setting is shown (Column 1). At this time, not all countries have a *unique* Dip Switch Setting. For the countries without a unique setting, the USA Setting (or all positions in the "OFF" position) is used. In lieu of determining the best *Pricing Scheme* for your location, "pre-sets" were made available which would best suit any given situation. If the Factory Default setting is not the selection you feel is best for your location, choose any of the other pre-set settings. If any of these settings do not suit your needs, then **CUSTOM PRICING** will need to be accomplished (however, any "custom" changes made here will be lost after a **FACTORY RESET** so it is suggested to write down your unique set-up).

The Standard Pricing Select Table Explained:

Column 1: CPU/Sound Board Dip Switch 300 Settings: (self-explanatory). **Column 2:** Country Setting Option: The different available pre-sets are listed. **Columns 3-6:** Coin Mechanisms - These show the coinage through the available slots on the Coin Doors. Different countries use different Coin Doors. For example, USA style Coin Doors, which have only 2 coin acceptors (left & right) may utilize the "Center" slot cable for an optional Bill Validator. Different Coin Doors may have up to 4 coin acceptors. **Columns 7-10:** Pricing Scheme Explained - Shows the number of plays received for the monies required determined by the setting selected.

Standard Pricing Select Table

CPU/SOUND BOARD DIP SWITCH 300 SETTINGS	COUNTRY SETTING OPTION † ‡	Coin Mechanisms — COINS THRU ... SLOT: LEFT	CENTER	4TH	Pricing Scheme Explained — Number of 'Plays' for Price Amount Shown			
	USA1	25¢	$1.00	25¢	1 /25¢			
	USA2	25¢	$1.00	25¢	1 /50¢	2 /75¢	3 /$1.00	
	USA3	25¢	$1.00	25¢	1 /50¢			
Pos. 1 2 3 4 5 6 7 8	USA4	25¢		25¢	1 /50¢			
ON / OFF	USA5	25¢	$1.00	25¢	1 /50¢	5 /$2.00		
	USA6	25¢	$1.00	25¢	1 /50¢	2 /'4 X 25¢'	3 /$1.00 Bill	← Used to promote the Bill Validator
	USA7	25¢	$1.00	25¢	1 /50¢	4 /$1.50	6 /$2.00	
	USA8 †	25¢	$1.00	25¢	1 /50¢	3 /$1.00		

Standard Pricing Select Table - *(Continued)*

CPU/SOUND BOARD DIP SWITCH 300 SETTINGS	COUNTRY SETTING OPTION † ‡	Coin Mechanisms ‡ — COINS THRU ... SLOT: LEFT / CENTER / 4TH				Pricing Scheme Explained — Number of Plays for Price Amount Shown			
		Please Note: for all USA Settings, see previous page (bottom).							
	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 /$A 2		
	Belgium †	5 BF	20 BF	50 BF		1 /20 BF	3 /50 BF		
	Brazil †	This country uses unique Tokens and/or Debit Cards *only* (pricing varies).							
		1 'coin'	4 'coins'	1 'coin'		1 /'2 coins'			
	Canada †	25¢	25¢	Can$ 1		1 /50¢	2 /75¢	3/ Can$ 1	
	Denmark 1 ‡	1 DKr	5 DKr	10 DKr	20 DKr	1 /3 DKr	2 /5 DKr		
	Denmark 2 ‡	1 DKr	5 DKr	10 DKr	20 DKr	1 /2 DKr	3 /5 DKr	7 /10DKr	
	Finland ‡	1 Fmk	5 Fmk			1 /5 Fmk	4 /10 Fmk		
	France 1 ‡	1 Fr	5Fr	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 /100 Won			
	Netherlands 1	1 Fls.	1 Fls.	2.5 Fls.		1 /1 Fls.	3 /2.5 Fls.		
	Netherlands 2 †	1 Fls.	2.5 Fls.	5 Fls.		1 /1 Fls.	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			
	UK 1	Same as above (UK1-3); however, with this new Dip Switch Setting (2, 3, & 4 = ON), the *New Style Coin Mech: 50p & 2£ Coins* can be accomodated in the 5th & 6th Coin Slots. (This is *"software controlled"* by noting presence/non-presense of pulses via 1-4.)							
	UK 2								
	UK 3 †								

for New Style Coin Mech: 50p / 2£

Notes: † indicates Factory Default for that setting. ‡ indicates a USA Dip Switch Setting (all positions in the "OFF" position).

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*. Using either of the Flipper Buttons or the **"RED"** and/or **"GREEN" Buttons**, select either of the **"ARROW"** *Icons*. Press the **"BLACK" Button** (*Request Installed* blinks at the top of the display and the letter **A** is indicated in the first position in the display. Vary the letter(s) by operating the Left and Right Flipper Buttons (or **"RED"** or **"GREEN" Buttons**). 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. Select the "<" or ">" characters to back-space (erase) and/or to move forward in an already typed message. After completion, press the **"BLACK" Button**.
Adj. 30	Attract Mode Music	Set to **ON** or **OFF**. When set to **ON**, attraction music / sounds are played between games.

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	Knocker Volume	Set to **NORMAL, LOW** or **OFF**. Default is **NORMAL**. When set to **LOW**, the volume is decreased 50%. When set to **OFF**, no sound is heard when the "knocker" is sounded.
Adj. 34	Minimum Game Time	Set between **0:01** - **8:59** for minimum game time. Default is **OFF**. 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. 35		This adjustment is ***Not Used***, allowing for ***Future Expansion***, if any, and/or ***Proprietary*** (used for programming).
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 & **30%** Extra Ball.
Adj. 40	Euro. Token Disp.	Set to **ON** or **OFF**. When set to **ON**, the operator can enable the "knocker" cable in the cabinet to drive an external device (e.g. European Token Dispenser) 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 the end of this Section 3, Chapter 3, Go To Audits Menu, and Chapter 5, Go to Reset Menu, 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 the end of this Section 3, Chapter 3, Go To Audits Menu, and Chapter 5, Go to Reset Menu, for more details on Factory Reset & Printing.

Starship Troopers Adjustments (44-50)

From the **ADJUSTMENTS MENU**, select the "SST" *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 **MODERATE**. 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	**Multiball Criterion**	Set to **EXEASY, EASY, MODERATE, HARD** or **EXHARD**. Default is **MODERATE**. Determines how the Multiball Feature is started and played.
Adj. 47	**Orbit Criterion**	Set to **EXEASY, EASY, MODERATE, HARD** or **EXHARD**. Default is **MODERATE**. Determines how the Orbit Features are started and played.
Adj. 48	**Ramp Criterion**	Set to **EXEASY, EASY, MODERATE, HARD** or **EXHARD**. Default is **MODERATE**. Determines how the Ramp Features are started and played.
Adj. 49	**Stepper Motor Enabled**	Set to **YES** or **NO**. Default is **YES**. When set to **YES**, the Warrior Bug Stepper Motor is operational. When set to **NO**, the Motor on the assembly (Upper Left, Above Playfield) is disabled. Use the **NO** setting, if the Motor is malfunctioning or is awaiting service and/or repair.
Adj. 50	**Brain Bug Enabled**	Set to **YES** or **NO**. Default is **YES**. When set to **YES**, the Brain Bug Coil is operational. When set to **NO**, the Coil on the assembly (Middle Right, Below Playfield) is disabled. Use the **NO** setting, if the Assembly is malfunctioning or is awaiting service and/or repair.

Custom Message

To go directly to ***Adjustment 29, Custom Message,*** from the **ADJUSTMENT MENU**, select the "CUST MSG" *Icon* either **Red "LEFT"** or **Green "RIGHT" Button** and press the **Black "ENTER" Button**. Set the feature to **CHANGE** selecting the "+" *Icon*. Using either of the Flipper Buttons or the **"RED"** and/or **"GREEN" Buttons**, select either of the **"ARROW"** *Icons*. Press the **"BLACK" Button** (*Request Installed* blinks at the top of the display and the letter **A** is indicated in the first position in the display. Vary the letter(s) by operating the Left and Right Flipper Buttons (or **"RED"** or **"GREEN" Buttons**). 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. Select the "<" or ">" characters to back-space (erase) and/or to move forward in an already typed message. After completion, press the **"BLACK" Button**.

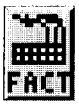
Film Star Reset

To reset the game with *Special Home 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 *Special Setting* automatically changes ***Adjustment 6, Game Difficulty,*** to **EASY** and ***Adjustment 28, Free Play,*** to **YES**. 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.

RESETTING & PRINTING ADJUSTMENTS NOTES:

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 Audit Information

To print audits, from the **AUDITS MENU** select the "PRNT" *Icon*. See Chapter 3, Go to Audits Menu, at the end of that section (*special equipment is 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.

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 reset of ***Coin*** or ***Game Audits*** is performed, the display will indicate **REQUEST INSTALLED** and return to the **RESET MENU**. If a **Factory Reset** is performed, the display will indicate **REQUEST INSTALLED**, the ***Service Session*** is *exited* & returns to the ***Attract Mode***. Please note that once reset, all customized settings are lost! Certain *Audits & Adjustments* 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.)

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

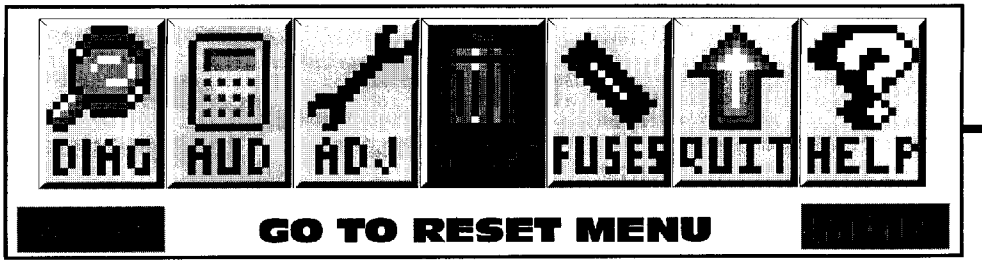
• Reset Game Audits	
Earnings (1-4), Generic/Specific Audits (13+)	
Au. Nº	Description
1-4	The first 4 Audits in the game.
5	Coins Thru Left Slot
6	Coins Thru Right Slot
7	Coins Thru Center Slot
8	Coins Thru 4th Slot
9	Total Coins
10	Total Earnings
11	Meter Clicks
12	Software Meter
13 +	The remainder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

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.**

Example:

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

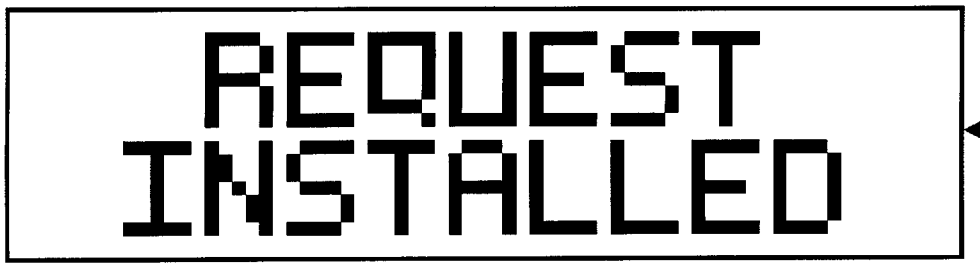


Press the **Black Button** to activate this **ICON**. This will bring up the **RESET MENU**.

The **RESET MENU** now appears with the "COIN" *Icon* (**RESET COIN AUDITS**) flashing:

DO NOT PRESS THE START BUTTON **AFTER SELECTING ANY THREE OF THESE ICONS UNLESS THIS IS WHAT IS DESIRED (SETTINGS WILL BE LOST)! PLEASE READ THE PREVIOUS PAGE FOR EXACTLY WHAT WILL HAPPEN IF ANY OF THESE THREE ICONS ARE ACTIVATED.**

From the **RESET MENU**, select any of the *Icons* ("COIN", "AUD" or "FACT") with either **Red** or **Green Button** and press the **Black Button** to activate the **ICON** chosen.



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 the display will return to the **RESET MENU**.

If the "FACT" *Icon* is chosen and activated, all adjustments will be reset back to the *Factory Settings*. The display will indicate **REQUEST INSTALLED** (momentarily), the ***Service Session*** is automatically *exited* and returns to the ***Attract Mode***.

Go To Fuses List

Overview

The **Portals™ Service Menu System** provides a current Fuse List for this game. The fuses are located in the Backbox (on the Display Power Supply Board and the I/O Power Driver Board), and also in the Cabinet (under the playfield by the Flippers and/or by any unique assembly, such as magnets). See the front of this manual (page **DR. ❶**) for the complete Fuse List in the *Quick Reference Fuse Chart* and note the drawings.

GO TO FUSES LIST

With the game in the Attract Mode, open the Coin Door and press the **Black "BEGIN TEST" Button**. Select the "FUSES" *Icon* in the **MAIN MENU** 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 fuse in this group. Continue to select either of the "ARROW" *Icons* to view each fuse one at a time. The display will describe the fuse identification number (e.g. F1, F6, F7, etc.), location of fuse (i.e. Backbox: Board name located on; or Cabinet: Under the playfield or in Service Outlet), rating of fuse (e.g. 5A 250v S.B. - i.e. 5 Amp, 250 volt, Slo-Blo), and 'use of fuse' (e.g. 90v DC High Voltage Power, etc.). The current fuse listed will remain in the display until the next fuse is chosen or when the sub-menu is exited.

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.

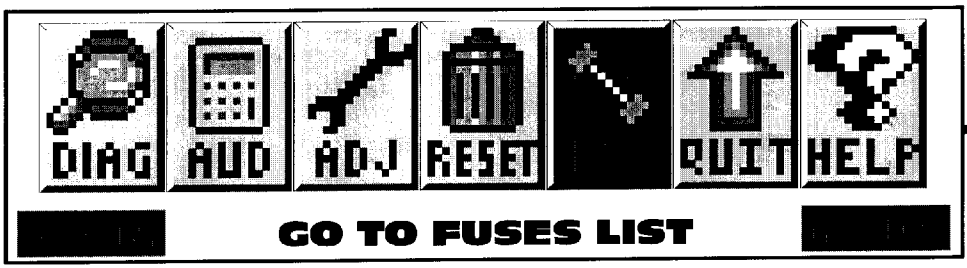
Selecting & activating the "HELP" *Icon* from any display will show a help screen. (An explanation of each *Mini-Icon* at that level will cycle continuously until any active button is pressed.)

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

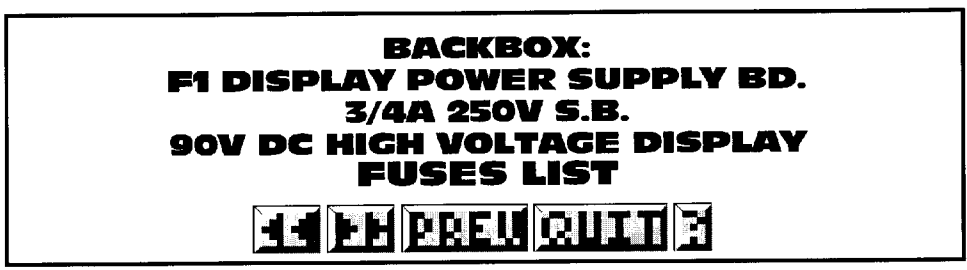
Selecting & activating the "ARROW" *Icons* selects the next or previous fuse in this group.

Example:

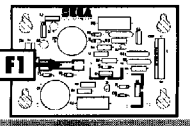
From the **MAIN MENU**, use the **Red** or **Green Buttons** to select the "FUSES" *Icon* (**GO TO FUSES LIST**).



Press the **Black Button** to activate this **ICON**. This will bring up the **FUSES LIST**.



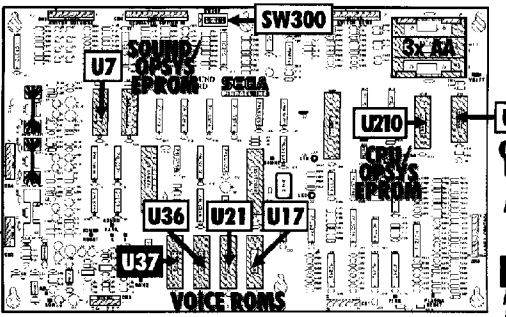
BACKBOX LAYOUT LOCATIONS: Fuses, Bridges, Relays & ROMs



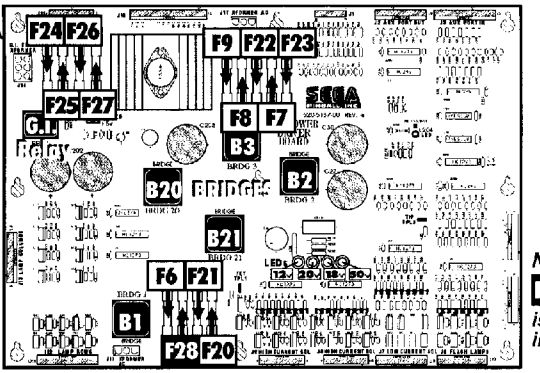
Display Power Supply Bd.

CPU / Sound Board
No Fuses

I / O Power Driver Board



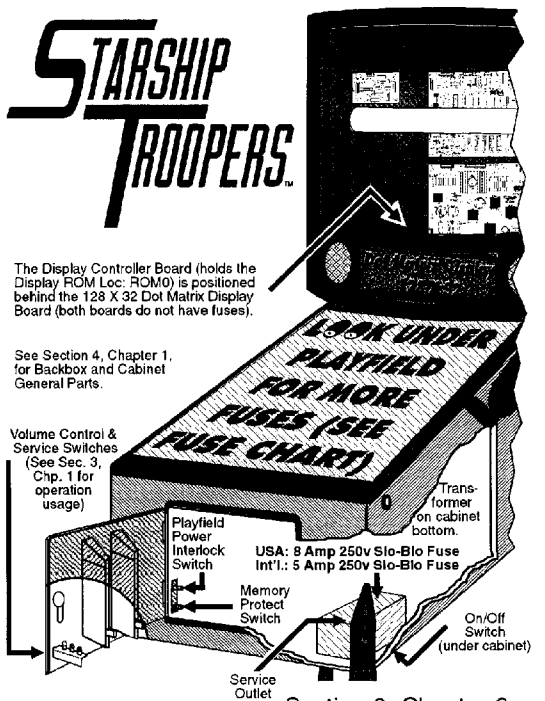
Note:
U37 *is Not Used in this game.*



Note:
F28 *is Not Used in this game.*

*** All BRIDGES rated 35A @ 100v ***	
B1	+50v DC High Current Coils
B2	+20v DC Low Current Coils
B3	+/-12v DC Sound/Display/Logic
B20	+18v DC Illumination
B21	+5v DC Logic Voltage

QUICK REFERENCE FUSE CHART			
Backbox Fuses			
LOC: DISPLAY POWER SUPPLY (P.S.) BOARD			
F1	¾A 250v S.B.	90v DC	High Voltage Display
LOC: I / O POWER DRIVER BOARD			
F6	7A 250v S.B.	50v DC	Primary High Power Coils/Flippers
F7	5A 250v S.B.	20v DC	Low Power Coils
F8	5A 250v S.B.	12v DC	Logic Power
F9	5A 250v S.B.	12v DC	Logic Power
F20	3A 250v S.B.	50v DC	Magnets
F21	3A 250v S.B.	50v DC	Coils
F22	8A 250v S.B.	18v DC	Controlled Lamps
F23	4A 250v S.B.	5v DC	Logic
F24	5A 250v S.B.	6.3v AC	G.I. Lamps (BRN/WHT to WHT/BRN)
F25	5A 250v S.B.	6.3v AC	G.I. Lamps (YEL to WHT/YEL)
F26	5A 250v S.B.	6.3v AC	G.I. Lamps (GRN to WHT/GRN)
F27	5A 250v S.B.	6.3v AC	G.I. Lamps (VIO to WHT/VIO)
F28	3A 250v S.B.	24v AC	**Not Used / Spare**
Cabinet Fuses			
LOC: SERVICE (AC) OUTLET BOX (Cabinet Bottom)			
n/a	8A 250v S.B.	115v AC	Main Fuse Line (Domestic or USA)
n/a	5A 250v S.B.	220v AC	Main Fuse Line (International)
Playfield Fuses			
LOC: UNDER PLAYFIELD (By Assemblies Listed)			
n/a	3A 250v S.B.	50v DC	Rt. Flipper (BLU/YEL↔RED/YEL)
n/a	3A 250v SB	50v DC	Mini Flipper (BLU/YEL↔RED/YEL)
n/a	3A 250v S.B.	50v DC	Lt. Flipper (GRY/YEL↔RED/YEL)
n/a	3A 250v S.B.	50v DC	Lt. Magnet (VIO/YEL↔BRN/GRN)
n/a	3A 250v S.B.	50v DC	Rt. Magnet (VIO/YEL↔BRN/BLU)
n/a	3A 250v S.B.	50v DC	Brain Bug (RED/WHT↔VIO/YEL)



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:	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:	Find all the tests needed to troubleshooting the game.
Review Chapter 3, Go to Audits Menu:	Gather play information and printing functions (downloading).
Review Chapter 4, Go to Adjustments Menu:	Customize the game to vary difficulty of play or to change functions of the game.
Review Chapter 5, Go to Reset Menu:	Reset audits and adjustments to Factory Settings.
Review Chapter 6, Go to Fuses Menu:	View the location & descriptions of the game fuses (the same information is referenced in the Fuse Chart Table on pg. i).

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 troubleshooting. If questions still arise after reading this section completely, call our Technical Support Department.

PROBLEM/SOLUTION TABLE

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

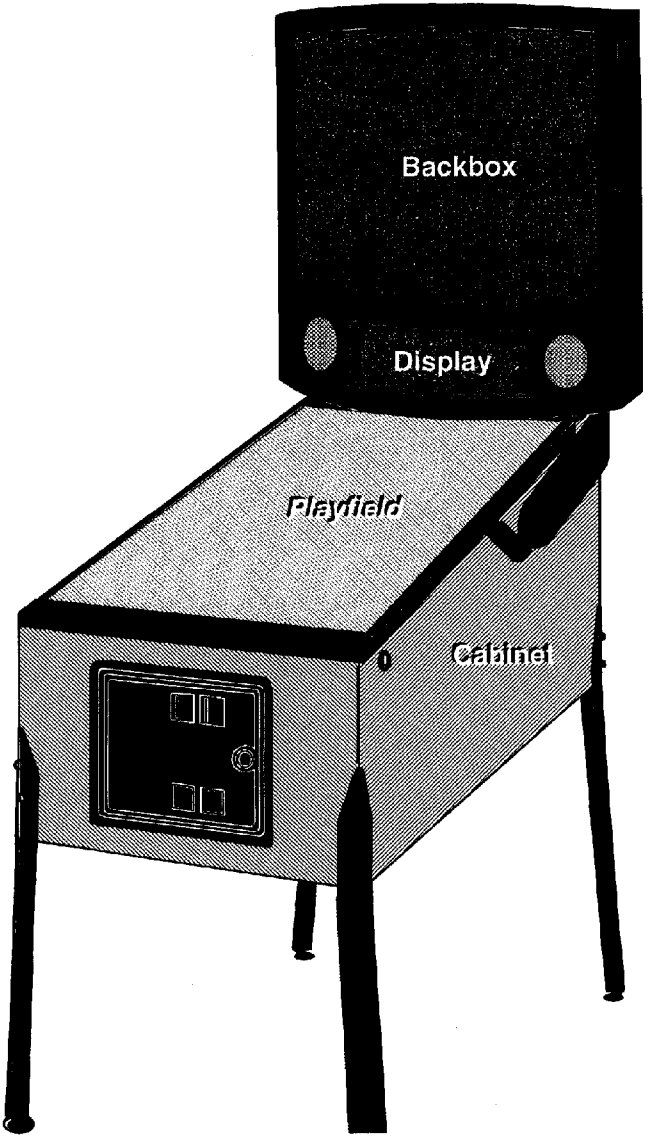
PROBLEM	SOLUTION
Will not enter the Service Mode after depressing the **Black "BEGIN TEST" Button.**	• Check the Service Switch(es) (**Red, Green & Black Buttons**) for loose connections or bad Ground. • Check the associated wiring harness to/from the CPU Board Connector CN14. • Check CPU Board, possibly 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 Section 5, Chapter 4, Schematics & Troubleshooting.
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).
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. • This is normal ***only*** in Diagnostic's Switch & Active Switch Tests (see previous Problem).
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.***
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.)
In **Portals™ Service Menu**, the display seems to lock up, or the Help Display appears to be non-functional.	• If you cannot clear the situation by exiting back one Menu, exit completely out of the **Portals™ Service Menu**, and re-enter. If the problem persists, call Tech. Support for additional help.

Parts Identification & 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 3 groups: Backbox, Cabinet, and Playfield. 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). Major Assemblies & Ramps are detailed in the Blue Pages, Chapter 2, Drawings for Major Assemblies & Ramps.

Important: Read all **"Take Note:"** items.



Section 4 Table of Contents

Chapter 1 (The Pink Pages)

Overview & Table of Contents 53

Backbox -

Backbox (Back Side) Assy. 54
Backbox (Front Side) Assy..... 55

Cabinet -

General Parts..... 56

Cabinet & Playfield -

Switches..... 57

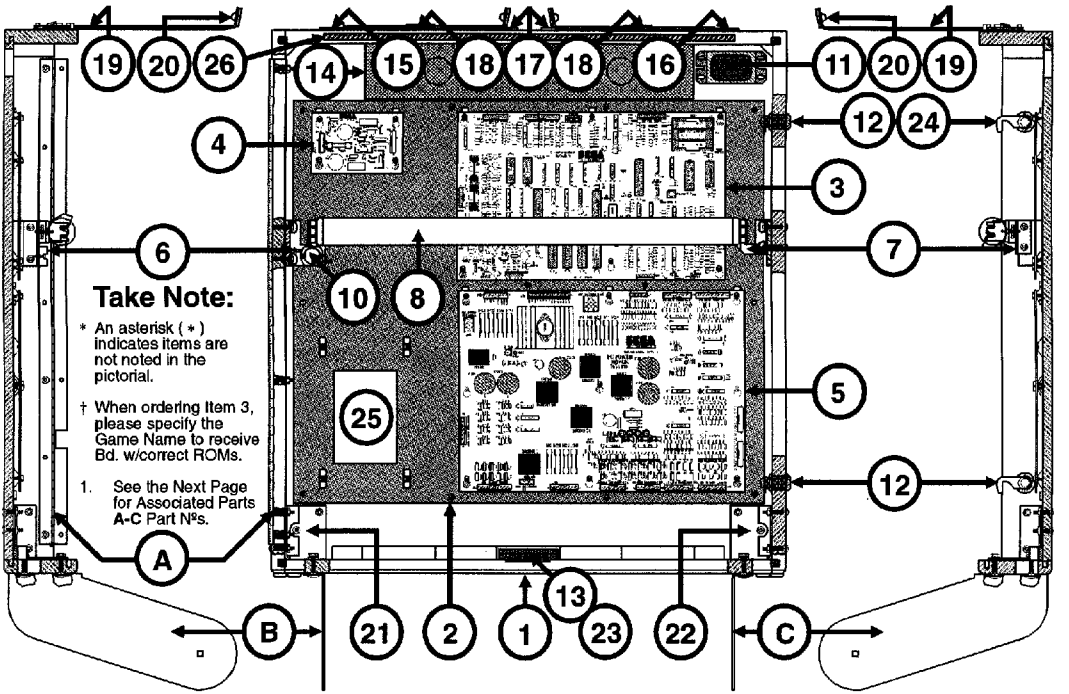
Playfield -

General Parts (Below) 58
General Parts (Above) 59
Rubber Parts..... 60
Plastic, Decals and Mylar 61
Metal Posts and Nuts..... 62
Metal Spacers..... 63
Plastic Posts and Spacers..... 64
Wedge Base Bulbs 65
and Sockets
Small Bayonet Type Bulbs..... 66
and Sockets
Large Bayonet Type Bulb 67
and Sockets
Rails and Ball Guides.....68

Chapter 2 (The Blue Pages)

Overview..... 69
Drawings (Major Assy.) 70-79/84
Drawings (Ramps) 80-83

Backbox (Back Side) Assembly, 505-6002-59-59A (Items 1-37)



Take Note:

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

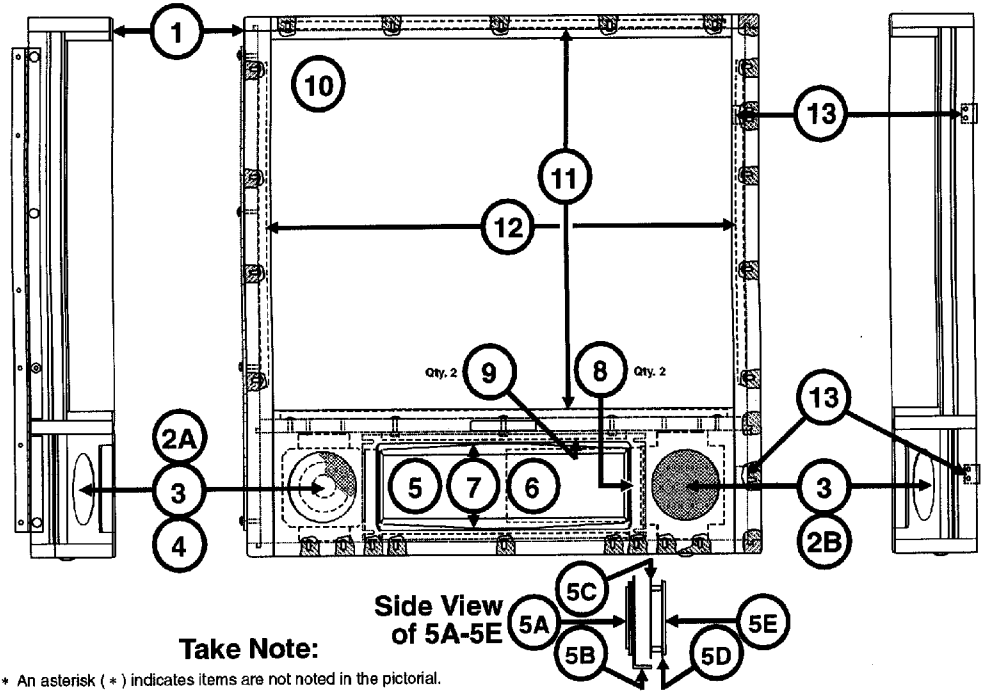
† When ordering Item 3, please specify the Game Name to receive Bd. w/correct ROMs.

1. See the Next Page for Associated Parts **A-C** Part Nºs.

Nº	Individual Part Name (Back)	QTY.	SPI Part Nº
1	Backbox Housing (Wood)	1	525-5453-01
2	PCB Metal Mounting Plate	1	535-5809-04
	Item 2 secured by: #8 X 1/2" HWH AB (Zinc) Blue (Qty. 13) (234-5101-05) **and** #8 Washer (Qty. 3) (242-5005-00)		
3 †	CPU/Sound Board (Mono)	1	520-5136-10
4	Display Power Supply Board	1	520-5138-00
5	I/O Power Driver Board	1	520-5137-01
	Items 3, 4 & 5 secured by: #8-32 X 3/8" HWH MS (Qty. 19) (237-5903-00)		
6	Fluorescent Light Bracket Assy. Left	1	515-6545-00
	ORDERING ABOVE ITEM NO. SUB-ASSY. PART NO. WILL INCLUDE:		
6A	Fluorescent Light Bracket Left	1	535-7739-01
6B	Lamp Holder (Self-Locking)	1	077-5214-00
6C	#6-32 X 5/8" PPH MS (Sems) Zinc	1	232-5203-00
6D	Starter Base (with Leads)	1	077-5213-00
6E	#4-40 X 1/2" PPH MS (Sems) Zinc	2	237-5813-00
7	Fluorescent Light Bracket Assy. Right	1	515-6545-01
	ORDERING ABOVE ITEM NO. SUB-ASSY. PART NO. WILL INCLUDE:		
7A	Fluorescent Light Bracket Right	1	535-7739-00
7B-7C	Identical to Items 6B-6C above.		See 6B-6C
	Items 6 & 7 secured by: #10-24 X 1-1/4" Carriage Bolt Sq. Neck (Qty. 4) (231-5012-00) **and** #10-24 Keps Nut (Qty. 4) (240-5207-00)		
8	Fluorescent Tube (F20T12CW)	1	165-5031-02
9*	3/4" Reinforced Strapping Tape (6")	1	626-5040-00
10	Starter - Fluorescent (FS2 Light)	1	165-5011-01
11	Ballast Assembly	1	500-6143-00
	ORDERING ABOVE ITEM NO. SUB-ASSY. PART NO. WILL INCLUDE:		
11A	Ballast (SP2 120v 60Hz 13W UL)	1	010-5007-00
11B	Wire Lock (NYT) Clear JN418-212	3	055-5146-00
11C	Fluor. Light Cable Wiring Harness	1	036-5402-15
	Item 11 secured by: #6 X 3/8" HWH AB (Zinc) (Qty. 2) (234-5000-00)		
12	Backbox Lock & Key	2	355-5018-01
13	#1 Roto Lock Female (R2-0002-02)	1	355-5006-02
	Item 13 secured by: #10-24 X 1-3/4" CBSN (Qty. 2) (231-5022-00), #10-32 Nylon Stop Nut (Qty. 2) (240-5203- 00) **and** #10 Washer 7/32" ID X .5" OD X 1/16" (Qty. 2) (242-5003-00)		
	Note: #1 Roto Lock Male (on Cabinet)	1	*355-5006-01*
14	Back Vent Grill 2-1/2" X 18"	1	545-5072-02
	Item 14 secured by: Staple 5/16" (Qty. 24) (631-5000-00)		

Nº	Individual Part Name (Back)	QTY.	SPI Part Nº
15	Top Support Mounting Bracket Left	1	515-6704-00
16	Top Support Mounting Bracket Right	1	515-6704-01
17	Support Mounting Bracket (Small)	2	515-6706-00
	Items 15, 16 & 17 secured by: #8 X 3/8" PFH MS (Zinc) (Qty. 10) (237-5902-00)		
18	Support Bracket	2	535-8041-00
	Item 18 secured by: #8 X 3/8" HWH MS (Zinc) (Qty. 4) (237-5903-00)		
19	"Swing-Out Arm" Top Support Bracket	2	535-8040-00
	Items 19 secured by: Washer 1/4" ID X 1" OD X .049" Thk (Qty. 2) (242-5009-00), Washer #10 7/32" ID X .5" OD X 1/16" Thk (Qty. 2) **and** #10-32 X 3/8" PPH MS (Sems) Zinc (Qty. 2) (232-5401-00)		
20	Deflector Pad	2	545-5428-00
21	Corner Support Bracket Left	1	515-6703-00
22	Corner Support Bracket Right	1	515-6703-01
	Items 21 & 22 secured by: #10-24 X 1-1/4" Carriage Bolt Sq. Neck (Qty. 4) (231-5012-00), #10-24 X 1" C.B.S.N. (Qty. 4) (231-5021-00) **and** #10-24 Keps Nut (Qty. 8) (240-5207-00)		
23	Door Restraint Bracket	1	535-8127-00
	Items 23 secured by: #6 X 1/2" HWH AB (Zinc) Blue (Qty. 2) (234-5101-05)		
24	Lock Mounting Plate	2	535-8128-00
	Items 24 secured by: #6 X 1/2" HWH AB (Zinc) Blue (Qty. 4/per) (234-5101-05)		
25	Fuse Description Decal Game Nº 59	1	820-6152-59
26	1' of 3/8" X 1/4" Poly Foam Tape	2.41	626-5038-00
27*	Fuse Label (UL)	1	820-6143-00
28*	Backbox Date Label	1	820-5091-00
29*	Ribbon Cable, 20-Pin	1	036-5000-04
30*	Ribbon Cable, 26-Pin	1	036-5001-80
	Item 29 (20-Pin) connects the CPU/Sound Board to the I/O Power Driver Board. **Item 30 (26-Pin) connects** the CPU/Sound Board to the Display Controller Board.		
31*	Display Cable Wiring Harness	1	036-5409-01
	Item 31 "-01" will include 2 Ferrite Core Halves (125-5021-00); "-00" does not include them.		
32*	Fluor. Power Cable Wiring Harness	1	036-5414-10
33*	1" Clamp (Single)	9	040-5000-09
34*	3/4" Clamp (Single)	3	040-5000-08
35*	1/2" Clamp (Single)	1	040-5000-06
36*	1/4" Clamp (Double)	3	040-5000-23
37*	Screw Down Cable Tie	2	040-5005-00
	Items 33-35 & 37 secured by: #8 X 1/2" HWH AB (Zinc) Blue (Qty. 15) (234-5101-05); Item 36 secured by: #5 X 1/2" HWH AB (Zinc) Red (Qty. 3) (234-5001-02)		

Backbox (Front Side) Assembly, 505-6002-59-59B (Items 1-16)



Take Note:

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

Nº	Individual Part Name (Front)	QTY.	SPI Part Nº
1	Backbox Door Pane (Wood)	1	525-5453-02
	Item 1 contains #8-32 Insert Nuts (Qty. 46) (240-5320-00) inlaid in the Door Pane and Sega Logo Stick-On Plate (Qty. 1) (535-7877-00).		
2A	Speaker Mounting Plate (Left - Black)	1	515-6681-00
2B	Speaker Mounting Plate (Right - Raw)	1	515-6681-01
3	Speaker Grill (Left Black w/o Artwork)	2	535-8081-00
4	Speaker 4 X 4 Quam (#89-9572)	1	031-5004-00
	Items 2A/B, 3 & 4 secured by: #8-32 X 3/8" HWH MS (Sems) Zinc (Qty. 4) (237-5903-00), #10-24 X 1-1/4" CB Sq. Neck (Black) (Qty. 4) (231-5012-00), #1C-24 Keps Nut (Qty. 4) (240-5207-00) **and** Rivet - 1/8" ø X 3/16" (Qty. 8) (249-5001-00)		
5	Dot Matrix Display Board Assembly	1	515-6713-00
	ORDER THE ABOVE ITEM AS A UNIT OR ORDER THE FOLLOWING:		
5A	Dot Matrix Display Board 128 X 32	1	520-5052-00
5B	Dot Matrix Display Holder	2	535-8005-00
5C	Static Shield	1	535-6437-00
5D	RF Shield (Display PCB Control)	1	820-5082-00
5E	Display Controller Board	1	520-5055-01
5F*	Edge Protector	2	545-5592-01
5G*	Ribbon Cable, 14-Pin (connects 5A to 5E)	1	036-5260-00
5H*	3/16" X 3/8" Spacer Gray	4	254-5000-18
5I*	#6-32 X 1/2" HWH Swage (Sem) Zn	4	237-5976-03
5J*	1/2" X 1/4" Hex Spacer #6-32 Tap	5	254-5008-03
5K*	3/4" X 1/4" Hex Spacer #6-32 Tap	1	254-5008-04
5L*	1/2" X 5/16" X .144 I.D. Spacer Tap	3	254-5014-00
5M*	#6-32 X 1/4" PPH MS (Sems) Zinc	5	232-5200-00
5N*	#6-32 X 3/4" PPH MS (Sems) Zinc	3	237-5504-00
5O*	Ground Strap - 25"	2	600-5006-25
5P*	Ground Strap - 41"	2	600-5006-41
5Q*	5-1/2" Cable Tie	3	040-5001-06
5R*	1/2" Clamp (Single)	1	040-5000-06
6	Plastic Shield (Display Cover)	1	545-5800-00
7	Showcase Bezel (Black Plastic)	1	545-5752-01
8	Display Retainer Bracket (Sides)	2	535-8036-00

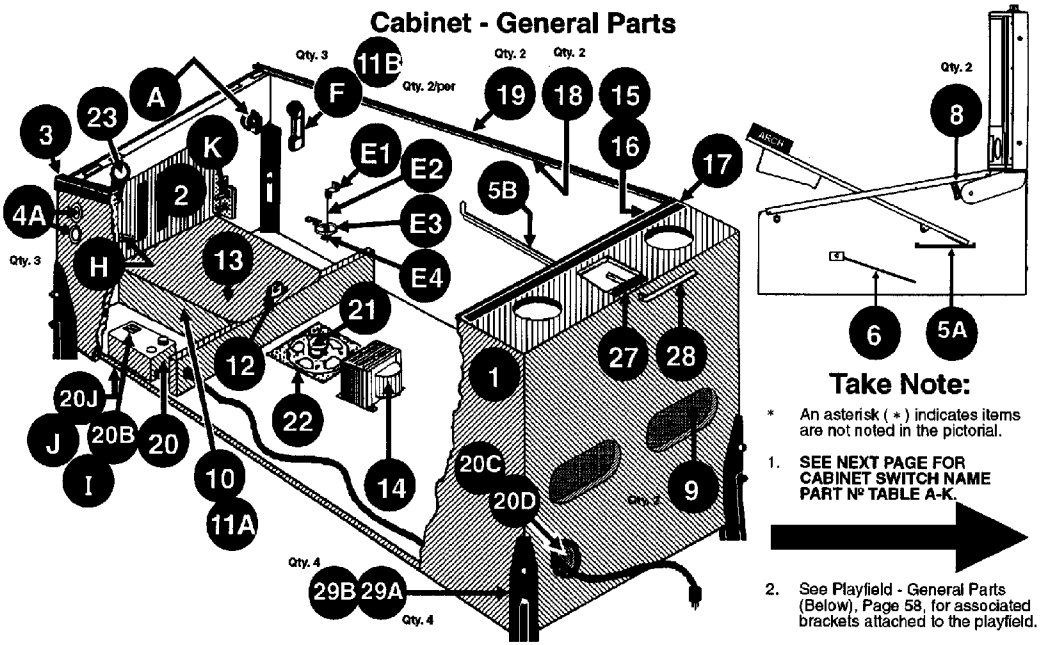
Nº	Individual Part Name (Front)	QTY.	SPI Part Nº
9	Plastic Shield Bracket (Top/Bottom)	2	515-6682-00
	Items 8-9 secured by: #8-32 X 3/8" HWH AB Zinc (Qty. 3) (237-5903-00), #10-24 X 1-1/4" Carriage Bolt Sq. Neck (Black) (Qty. 3) (231-5012-00), #10-24 Keps Nut (Qty. 3) (240-5207-00) **and** #6-32 Nylon Stop Nut (Qty. 8) (240-5005-00)		
10	Backglass Assembly (Game Nº 59)	1	515-5450-00-59
	ORDER THE ABOVE ITEM AS A UNIT OR ORDER THE FOLLOWING:		
10A	Backglass - Lexan (Front)	1	545-5748-00
10B	Screened Film (Game Nº 59) (Middle)	1	830-5259-00
10C	Backglass - Bulvrate Cover (Back)	1	545-5753-00
11	Backglass Assy. Retainer Brkt. (Top/Bot.)	2	535-8001-00
12	Backglass Assy. Retainer Brkt. (Sides)	2	535-8002-00
	Items 11 & 12 secured by: #10-24 X 1-1/4" Carriage Bolt Sq. Neck (Qty. 2) (231-5012-00), #10-24 Keps Nut (Qty. 2) (240-5207-00), #8-32 X 3/8" HWH MS (Qty. 7) (237-5903-00) **and** #6 X 1/2" HWH AB (Qty. 6) (234-5101-05)		
13	Lock Bracket	2	535-8037-00
	Item 13 secured by: #8-32 X 3/8" HWH MS (Sems) Zinc (Qty. 4) (237-5903-00)		
14*	1' of 3/8" X 1/4" Poly Foam Tape	3.33	626-5038-00
15*	Speaker Cable Wiring Harness	1	036-5388-01
16*	1" Clamp (Single)	3	040-5000-09

SEE THE PREVIOUS PAGE FOR LOCATIONS:

ASSOCIATED PARTS ARE NOT INCLUDED WITH THE BACKBOX ASSEMBLIES.

Nº	Assoc. Backbox Part Name	QTY.	SPI Part Nº
A	Backbox Hinge (Full Length Left Side)	1	390-5031-00
	Item A secured to Backbox by: #10-24 X 1-1/4" CB Sq. Neck (Black) (Qty. 8) (231-5012-00) **and** #10-24 Keps Nut (Qty. 8) (240-5207-00)		
B	Pivot Hinge Left	1	535-7999-00
C	Pivot Hinge Right	1	535-7999-01
	Items B & C **secured to Backbox** by: 1/4"-20 X 1-1/4" C.B. Sq. Neck (Qty. 4) (231-5003-00) **and** 1/4"-20 Flange Nut (Qty. 4) (240-5300-00) Items B & C **secured to Cabinet** by: 1/4"-20 X 7/8" Carriage Bolt Sq. Neck (Qty. 2) (231-5014-00), Hinge Spacer (Qty. 2) (530-5099-00), Washer 1/4" I.D. X 7/8" O.D. (Qty. 2) (242-5016-00), Washer 1/4" I.D. X 1" O.D. (Qty. 2) (242-5009-00) **and** 1/4"-20 Flange Nut (Qty. 2) (240-5300-00)		

Cabinet - General Parts



Take Note:

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

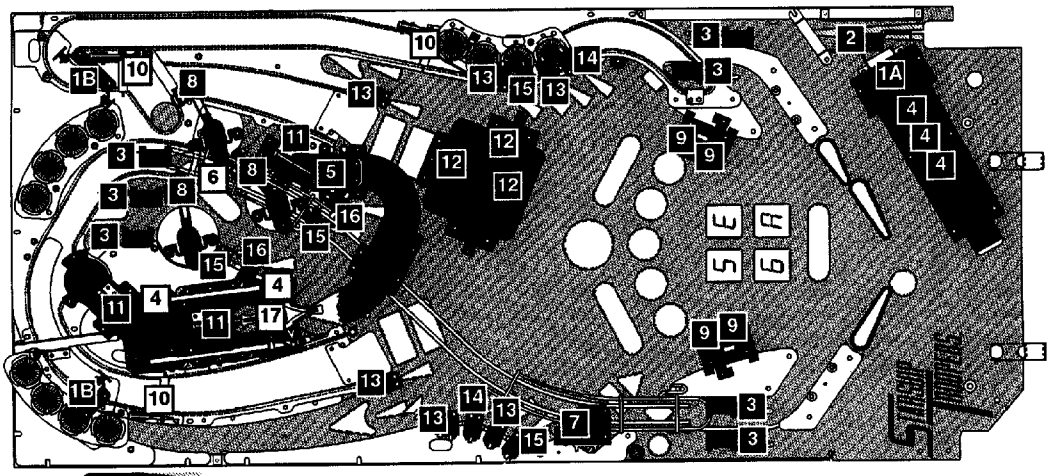
1. **SEE NEXT PAGE FOR CABINET SWITCH NAME PART Nº TABLE A-K.**

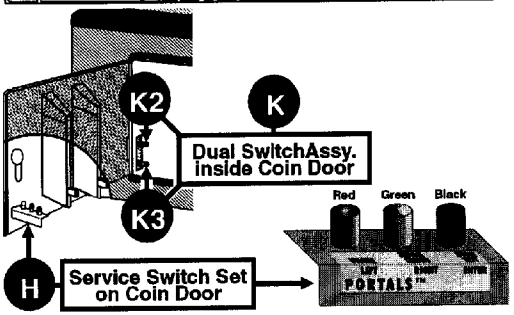
2. See Playfield - General Parts (Below), Page 58, for associated brackets attached to the playfield.

Nº	Cabinet Part Name	QTY.	SPI Part Nº
1	Game 59 Screened Cabinet (Plain)	1	525-6000-59
2	Coin Door (with Validator) USA only	1	500-5018-172
	Item 2 secured by: 1/4"-20 X 1-1/4" Carriage Bolt Sq. Neck (Qty. 4) (231-5003-00) **and** 1/4"-20 Flange Nut (Qty. 4) (240-5300-00)		
3	Ball Shooter (Plunger) Assembly	1	500-6146-00-04
	Item 30 secured by: Support Plate (535-5027-00), #10-32 X 3/8" HWH Swage (Serr) (Qty. 3) (237-5985-00) **and** #6 X 5/8" HWH (Qty. 2) (234-5002-04)		
4A	Flipper Button Assembly Red	3	500-5026-32
4B*	Pal Nut for Flipper Button	3	240-5003-00
	Item 4 is fitted with: O-Ring 11/32" X 7/32" X 1/16" (Qty. 1/per) (545-5850-00)		
5A	Slide & Pivot Support Bracket - Right	1	535-5989-00
5B	Slide & Pivot Support Bracket - Left	1	535-5990-00
	Item 5A/B secured by: #10-24 X 1-1/4" Carriage Bolt Sq. Neck (3/per) (231-5012-00) **and** #10-24 KEPS Nut (3/per) (240-5207-00)		
6	Prop Rod	1	535-7553-00
	Item 6 secured by: #10-24 X 1-3/4" Carriage Bolt Sq. Neck (231-5022-00), Washer #10 7/32" ID X .5" OD X 1/16" Thk **and** #10-24 Nylon Stop Nut (240-5206-00)		
7*	Mylar Carriage Bolt Cover Disc	6	820-5041-00
8	Back Box Stop Block (outside Cabinet)	2	545-5795-00
	Item 8 secured by: Hinge Spacer (1/per) (530-5099-00), Washer 1/4" I.D. X 1" O.D. (1/per) (242-5009-00), 1/4"-20 X 1-1/4" Carriage Bolt Sq. Neck (2/per) (231-5003-00) **and** 1/4"-20 Flange Nut (2/per) (240-5300-00)		
9	Grills 2-1/2" X 18" (on Back & Bottom)	2	545-5072-02
10	Cash Box Plastic Bottom	1	545-5090-00
11A	Foam Rubber 1/2" X 3/4" (behind Item 10)	1	626-5004-00
11B	Foam Strip (2/per Flipper Switch Front/Back)	6	626-5042-00
12	Cash Box Lock Bracket (wire)	1	535-7562-00
13	Cash Box Cover (Validator)	1	535-5013-03
14	Transformer with Ballast Winding	1	010-5012-00
15	Rear Glass Channel 20⅜" Length	1	545-5038-00
16	Foam Rubber 3/8" X 3/16" (In Item 15)	1	626-5001-00
17	Cabinet Pedestal Bracket	1	535-8035-00
	Item 17 secured by: #8 X 3/4" PFH (Zinc) (Qty. 3) (237-5822-00)		
18	Plastic Channel 42⅝" Lg. (Lt. & Rt.)	2	545-5017-00
19	Side Armor "with holes" (Lt. & Rt.)	2	535-7297-02
	Item 19 secured by: #10-24 X 1" Carriage Bolt Sq. Neck (2/per) (231-5021-00), #10-24 Hex Nut (2/per) (240-5202-00) **and** #8 X 5/8" Tamper Proof (237-5947-00)		

Nº	Cabinet Part Name	QTY.	SPI Part Nº
20	Power Input Box Sub-Assy. (no Vol. pot)	1	515-5360-01
	ORDERING ABOVE ITEM 20 SUB-ASSY. PART Nº WILL INCLUDE:		
20A*	Power Box (Plain)	1	535-5932-00
20B	Service Outlet (for USA)	1	180-5008-01
20C	Line Cord 16' ROJ 3' Max.	1	034-5000-10
20D	Recessed Cup for Line Cord	1	545-5122-00
20E*	Line Filter	1	150-5000-00
20F*	Varistor TNR159211KM	1	150-5001-00
20G*	Fuse 8 Amp (Domestic)	1	200-5000-05
20H*	Fuse Holder	1	205-5001-00
20I*	On/Off Switch Plate	1	535-5224-01
20J	On/Off Switch Toggle (Under Cabinet)	1	180-5001-00
20K*	Power Box Decal	1	820-6123-01
20L*	Fuse Label UL Decal	1	820-6143-00
21	Speaker - Round - 8" ø 8010HC 4Ω	1	031-5007-00
22	Speaker Grill 7" X 7"	1	545-5072-03
23	Front Molding Lockdown Assembly	1	500-5020-01
	Item 23 secured by: #10-24 X 1-1/4" Carriage Bolt (Qty. 2) (231-5012-00) **and** #10-24 Keps Nut (Qty. 2) (240-5207-00)		
24*	Front Molding Lockdown Spring	1	265-5008-00
25*	Front Molding - Black	1	500-5757-01-00
26*	P/F Glass (Tmprd.) 21" X 43" X 3/16"	1	660-5001-00
27	#1 Roto Lock Male	1	355-5006-01
	Note: #1 Roto Lock Female (on Backbox)	1	*355-5006-02*
	Item 27 secured by: #10-24 X 1-3/4" Carriage Bolt Sq. Neck (Qty. 2) (231-5022-00) **and** #10-24 Nylon Stop Nut (Qty. 2) (240-5206-00)		
28	Hex Key Allen Wrench 5/16"	1	777-0001-00
29	Leg Assembly	4	500-5921-50
	ORDERING ABOVE ITEM 29 SUB-ASSY. PART Nº WILL INCLUDE:		
29A	Leg (Black)	4	535-5020-50
29B	Leg Leveler 3/8" - 16 X 3"	4	500-5017-00
	Item 29 secured by: Leg Bolt Back Plate (535-5703-00) **and** Leg Bolt 3/8" X 16 X 2-1/2" Hex 5/8" Hd. (2/per) (231-5001-01)		
31*	Plastic Backpanel Shield (Black)	1	545-5838-01
	Item 31 secured by: #6 X 1/2" PPH (Black) (Qty. 4) (237-5805-00)		
32 *	Corrugated Tubing 1¼" ø (Black), (12')	3	605-5008-00
	Above Item covers the Cables W.H. (16"/ea.) going into the Backbox from the Cabinet.		

Cabinet & Playfield - Switches





Take Note:

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

1. For switches used corresponding to the Switch Matrix Grid of this game, see Section 3, Chapter 2, ...Diagnostics.
2. For location of the Cabinet Switches, see the previous page.
3. ‡ Items 13-17, Stand-Up Targets, see the Plastic Part Color Chart on Plastic Posts and Spacers, further in this chapter, for other color alternatives, if color desired is not available.
4. **Legend Note:** Items noted with a white square ❒ are mounted above the playfield; items noted with a black square ■ are mounted below the playfield or on/in the cabinet.

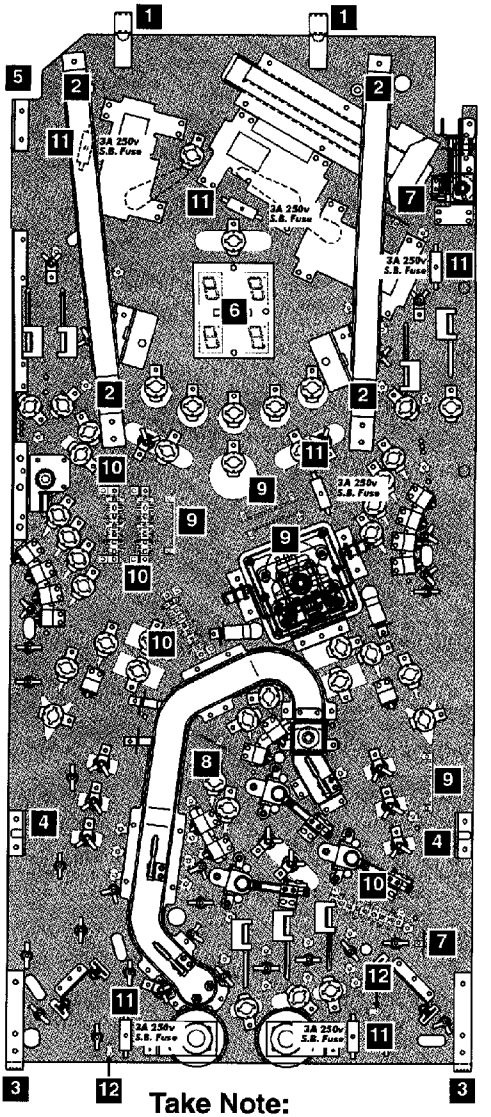
Nº	Cabinet Switch Name	QTY.	Part Nº
A	Start Button Sw. Assy. (Yellow Flip. Style)	1	500-6090-06
B*	Coin Door Switch (USA)	4	180-5024-00
	Coin Door Switch (¥ Japan)	n/a	180-5091-00
C	Lamp Round Assembly (Red)	1	5[illegible]-6[illegible]-00
D*	Slam Tilt Switch (On Coin Door)	1	180-5022-00
E	Cabinet Plumb Bob Tilt Switch	1	n/a
ORDER ONLY INDIVIDUAL PARTS NEEDED - NO ASSEMBLY AVAILABLE			
E1	Tilt Hanger Bracket	1	535-5221-00
E2	Tilt Hanger Wire (Attached to bracket)	1	535-5319-00
E3	Tilt Contact Wire	1	535-7563-01
E4	Tilt Plumb Bob (Atch'd to hanger wire)	1	535-5029-00
F	Flipper Cabinet Sw. - Self-Cleaning	3	180-5160-00
G*	EOS Switch (on Lwr. Flippers)	2	180-5149-00
H	Service Switch Set (X3 on Coin Door)	1	180-5012-03
I	Service Outlet	1	180-5008-01
J	On/Off Switch	1	180-5001-00
K	Dual Switch Assembly	1	500-5808-00
ORDERING ABOVE ITEM ASSEMBLY PART WILL INCLUDE			
K1*	Mounting Bracket	1	535-6958-00
K2	Playfield Power Interlock Switch (Top)	1	180-5136-00
K3	Memory Protect Switch (Bottom)	1	180-5000-00

Nº	Playfield Switch Name	QTY.	Part Nº
1A	OPTO TRANS Board	1	520-5124-00
	OPTO REC Board	1	520-5125-00
1B	OPTO TRANS Board	2	520-5082-00
	OPTO REC Board	2	520-5083-01
2	Shooter Lane Switch Assembly	1	500-6096-00
ORDERING ABOVE ITEM ASSEMBLY PART WILL INCLUDE			
2A*	Micro Switch	1	180-5157-00
2B*	Bracket	1	535-6173-00
2C*	#2-56 X 3/8" HWH Screw	2	237-5938-01
2D*	Diode, 1N4001	1	112-5001-00
3	Micro Sw. Rollover Assy. (Rt. Brkt.)	7	500-6227-02
4	Micro Switch (Roller Actuator)	5	180-5119-00
5	Micro Switch (on: Super VUK)	1	180-5052-00
6	Micro Switch (on: Wire Ramp)	1	180-5093-00
7	Micro Switch ("Y" Actuator) (on: VUK)	1	180-5116-01
8	Turbo Bumper Switch	3	180-5015-03
9	Slingshot Micro Switch	4	180-5054-00
10	Micro Switch (Roll-Under Gate)	3	180-5087-00
11	Micro Switch (High Form)	3	180-5057-00
12	Limit Switch (Cherry #E33-90N)	3	180-5165-00
13‡	Modular S-U Target Narrow (Yellow)	6	500-6138-06
14‡	Modular S-U Target Round (Red)	2	500-6075-02
15‡	Modular S-U Target Square (Green)	4	500-6139-04
16‡	Modular S-U Target Rectangle (Blue)	2	500-6228-05
17‡	Sw. & Target Assy. 1" X 1½" Rect. (White)	1	515-6027-08

SEE ABOVE PARTIAL CABINET DRAWING (H & K) AND PREVIOUS PAGE FOR CABINET SWITCH A-K LOCATIONS.

Playfield - General Parts (Below)

Nº	Below Playfield Part Name	QTY.	SPI Part Nº
1	Playfield Hanger Bracket	2	535-5216-03
	Item 1 secured by: #8 X 1/2" HWH AB (Zinc) Blue (Qty. 1/per) (234-5101-05) **and** #8-32 X 5/8" HWH Swage (Ser) Zinc (Qty. 1/per) (237-5975-03)		
2	Playfield Support Slide Bracket	2	535-6862-02
	Item 2 secured by: #8 X 1/2" HWH AB (Zinc) Blue (Qty. 2/per) (234-5101-05) **and** #8-32 X 5/8" HWH Swage (Serr) Zinc (Qty. 1/per) (237-5975-03)		
3	Edge Slide Bracket	2	535-5988-00
	Item 3 secured by: #4 X 1/2" PFH (Zinc) (Qty. 3/per) (237-5840-00)		
4	Pivot Pin Bracket Welded Assembly	2	500-5329-00
	Item 4 secured by: #6-32 X 5/8" HWH Swage (Serr) Zinc (Qty. 2/per) (237-5975-03)		
5	Playfield Shipping Bracket	1	535-7729-00
	Item 5 **secured to the Playfield** by: #8-32 X 1" Carriage Bolt Sq. Neck (Qty. 2) (231-5031-00) **and** #8-32 Nylon Stop Nut (Qty. 2) (240-5102-00) Item 5 **secured to the Cabinet** by: #8 X 5/8" HWH AB (Zinc) Green (Qty. 3) (234-5102-04)		
Note:	Please Read Section 1, Chapter 1, Game Set-Up, Item 8, regarding above Item 5 Bracket.		
6	4X Display (7-Segment) PCB	1	520-5166-00
	Item 6 secured by: #6 X 5/8" HWHW AB (Qty. 3) (234-5002-04) **and** 1/4" Slf. Rtn. Spacer White (Qty. 3) (234-5007-02)		
7	2-Lug Diode Terminal Strip	2	055-5203-00
8	3-Lug Diode Terminal Strip	1	055-5204-03
9	5-Lug Diode Terminal Strip	4	055-5204-05
10	7-Lug Diode Terminal Strip	4	055-5202-07
	Items 7-10 secured by: #6 X 3/8 HWH AB Zinc (Qty. 16) (234-5000-00). ***NOTE:*** *Items 7-10 use 1N4001 Diodes (Qty. 18) (112-5001-00)* **and** *1N4004 Diodes (Qty. 4) (112-5004-00). 1N4001 Diodes are for Switches & Lamps, 1N4004 Diodes are for Coils/Motors. See Section 5, Chapter 2, Playfield Diode Terminal Strip & Fuse Locations for Diode Usage & Wire Colors.*		
11	3A 250v Slo-Blo Fuse	6	200-5000-08
	Fuse Clip Holder (Socket)	6	205-5000-01
	Item 11, Fuse Clip Holder(s) secured by: #6 X 1/2" PPH AB (Qty. 1/per) (237-5805-00)		
12	#8 Solder Lug	2	055-5140-08
	Diode, 1N4001	2	112-5001-00
	Item 12 secured by: #6 X 5/8" HWH AB Zinc (Green) (Qty. 1/per) (234-5002-04).		



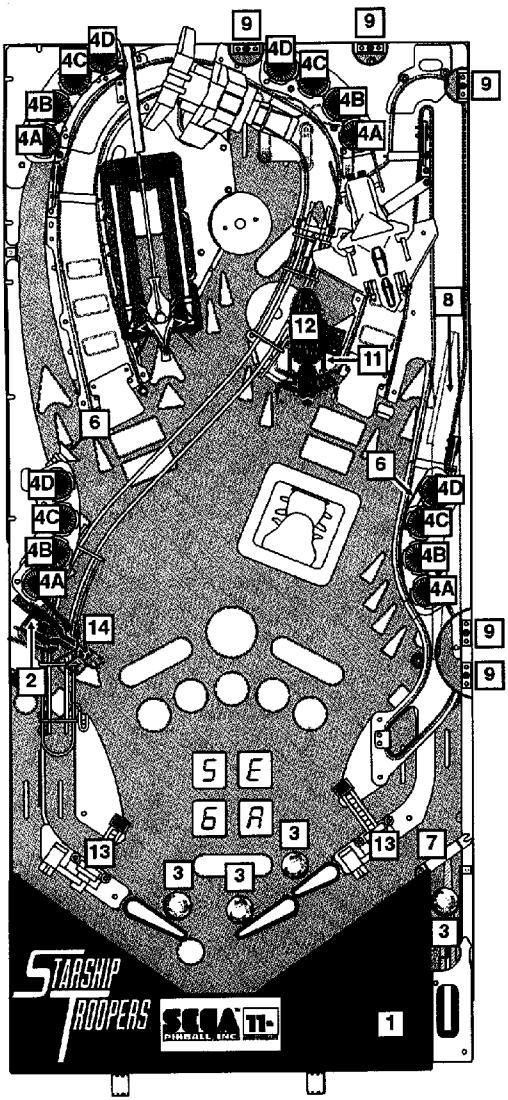
Take Note:

* An asterisk (*) indicates items are not shown on this page.

1. For Sockets & Bulbs (drawings & part numbers) see Pgs. 65-67.
2. For Switches & Targets see previous page 57.
3. For OPTO Switches see the Blue Pages, Sec. 2, Chp. 2 and for PCB parts see the Yellow Pages, Sec. 5, Chp. 4.
4. For Major Assemblies, Ramps and/or Under Troughs, see the Blue Pages, Sec. 2, Chp. 2
   Note: Tubing is used to insulate various cables/lugs. Tubing can only be ordered in 12" increments. Cut the amount required for each application. Cut sizes are variable in length. The quantities reflect total lengths required for entire game (averaged up to nearest foot).
5. **Legend Note:** Items noted with a black square ■ are mounted below the playfield.

Nº	Miscellaneous Part Name	QTY.	SPI Part Nº
n/a *	3½" Plastic Post (holds cables)	9	545-5253-01
n/a *	4" Cable Tie PLT1MXMR	218	040-5001-01
n/a *	4" Cable Tie Black	3	040-5007-00
n/a *	5½" Cable Tie PLT1.5I	10	040-5001-02
n/a *	5½" Cable Tie PLT1.5M-XMR	159	040-5001-06
n/a *	10" Cable Tie	2	040-5001-05
n/a *	Insulating Tubing ⅛" ø (CLR) (12" Long)	3	605-5006-00
n/a *	Insulating Tubing #18 (Teflon) (12" Long)	1	605-5003-00
n/a *	Heat Shrink Tubing ⅛" ø (BLK) (12" Lg.)	2	605-5002-00
n/a *	Heat Shrink Tubing ⅛" ø PUI-24 (12" Lg.)	5	605-5006-00
n/a *	Heat Shrink Tubing ¼" ø (CLR) (12" Lg.)	3	605-5004-00
n/a *	Heat Shrink Tubing ¼" ø (BLK) (12" Lg.)	2	605-5004-01
n/a *	Heat Shrink Tubing ¼" ø (WHT) (12" Lg.)	1	605-5010-00
n/a *	Split Flex Tubing 1¼" ø (12" Long)	2	605-5008-00
n/a *	Split Flex Tubing ¼" ø (12" Long)	3	605-5008-01
n/a *	Split Flex Tubing ½" ø (12" Long)	1	605-5008-02
n/a *	Braided Expandable Tubing ¼" ø (12")	6	605-5012-02

Playfield - General Parts (Above)



Nº	Above Playfield Name	QTY.	SPI Part Nº
n/a *	Playfield Screened (No Parts)	1	830-5159-00
	Playfield Complete with all Parts		505-6004-59-59
1	Bottom Arch Assembly (Plastic)	1	500-6005-00-59
ORDERING ABOVE ITEM (1) ASSEMBLY PART Nº WILL INCLUDE:			
1A*	Bottom Arch without "Fork" (Plain)	1	545-5302-08
1B*	Bottom Arch Shooter Lane Butyrate -14	1	830-5926-14
1C*	Spacer 3/4" Plastic 3/8" (Gray)	2	254-5000-07
1D*	#6-32 X 1-1/4" PPH MS	2	237-5508-00
1E*	#6-32 Nylon Stop Nut	2	240-6005-00
1F*	Nelson Protect Strip 8-9/16"	2	545-6212-02
1G*	Bottom Arch Trim (12")	1	545-5835-00
1H*	#8 Washer	2	242-5005-00
1**	Bottom Arch Fence (@ Shooter Lane)	1	535-7901-00

Item 1 secured by: #10-24 X 2-1/4" PPH MS (Zinc) (Qty. 2) (237-5859-00). *Note: Decals are not included with the above assembly. See Playfield - Butyrate, Decals & Mylar (Pg. 60).*

2	Snubber Bracket (under Item 14)	1	535-8155-00

Item 2 secured by: #8-32 X 5/8" HWH Swage (Serr) Zinc (Qty. 1) (237-5975-03) **and** #8 X 1/2" HWH AB (Zinc) Blue (Qty. 1) (234-5101-05)

3	1-1/16" Steel Balls	4	260-5000-00
4A	Mini-Mars Light Cover Snap-In (Blue)	4	550-5030-05
4B	Mini-Mars Light Cover Snap-In (Yellow)	4	550-5030-06
4C	Mini-Mars Light Cover Snap-In (Green)	4	550-5030-04
4D	Mini-Mars Light Cover Snap-In (Red)	4	550-5030-02
5A*	Rubber Lite Cover RED (on Pops/Sign)	4	545-5014-02
5B*	Rubber Lite Cover ORG	1	545-5014-07
5C*	Rubber Lite Cover BLU (on Sign)	1	545-5014-05
5D*	Rubber Lite Cover FLUOR. ORG.	3	545-5014-10
6	Light Reflector	2	545-5409-01
7	1-Way Gate Mounting Bracket	1	535-5269-06
	Wire Gate (for above)	1	535-5307-09

Items 7 secured by: #6 X 1/2" PTH A (Zinc) (Qty. 1) (237-5809-00)

8	Flat Rail Shooter Lane Ramp	1	535-8145-00

Items 8 secured by: #4 X 1/2" PFH (Black) (Qty. 2) (237-5840-00)

9	Ramp Mounting Bracket Type #1	5	515-6508-00

Items 9 secured by: #6 X 1/2" PTH A (Zinc) (Qty. 2/per) (237-5809-00)
***NOTE:** For the Hex Spacers supporting the Ramp, see page 63 and compare size for Part Number identification.*

10*	Slingshot Butyrate Protect Washer	4	242-5059-00

Note: Item 10 dimensions = .187" I.D. X .875" O.D. X .046" Thick (Zinc)

11	SVUK Enter/Exit Scoop (under Item 12)	1	535-8154-00

Item 11 secured by: #8-32 X 1" HWH MS (Zinc) (Qty. 2) (237-5890-01) **and** #8-32 Nylon Stop Nut (Qty. 2) (240-5102-00)

12	Tanker Bug Assembly	1	500-6254-00-59
12A	Tanker Bug	1	880-5006-00
12B*	Mounting Bracket	1	535-8180-00
12C*	Screened Plastic -20' Assy.	1	515-6777-20-59
	This assembly (12C) includes:		
	Wedge Base Offset Socket	*3*	*077-5029-00*
	Rivet, 1/8" ø X 5/32" Lg.	*3*	*249-5009-00*
	#555 Wedge Base Bulb	*3*	*165-5002-00*
	Rubber Light Cover - Red	*1*	*545-5014-02*
	Rubber Light Cover - Blue	*1*	*545-5014-05*
	Rubber Light Cover - Fluor. Org.	*1*	*545-5014-10*
12D	Cable Wiring Harness	1	036-5429-01-59
12E	4" Cable Tie Blk.	1	040-5007-00

Item 12 supported by: 1" X 1/4" Hex Spacer #6-32 Tap (Qty. 2) (254-5008-06)

13	Pulse Cannon	2	880-5007-00

Item 13 secured on: Screen Plastic (Butyrate) -12 & -13 (Left & Right Return Lanes) (830-5926-12 & -13) **with** #6 X 3/8" HWH AB Zinc (Qty. 2/per) (234-5000-00)

14	Hopper Bug Assembly	1	500-6253-00-59
ORDERING ABOVE (ITEM 14) ASSEMBLY PART Nº WILL INCLUDE:			
14A	Hopper Bug	1	880-5005-00
14B*	Hopper Bug Mounting Bracket	1	535-8179-00
14C*	#8 X 1/2" HWH AB (Zinc) Blue	1	234-5101-05

Item 14 secured by: #6 X 1/2" PTH A (Zinc) (237-5809-00);
Supported by: 1-1/8" X 1/4" Hex Spacer #6-32 Tap. (Qty. 2) (254-5008-17).

15*	Rubber Button Plug (Black) 3/8"	1	546-5362-01

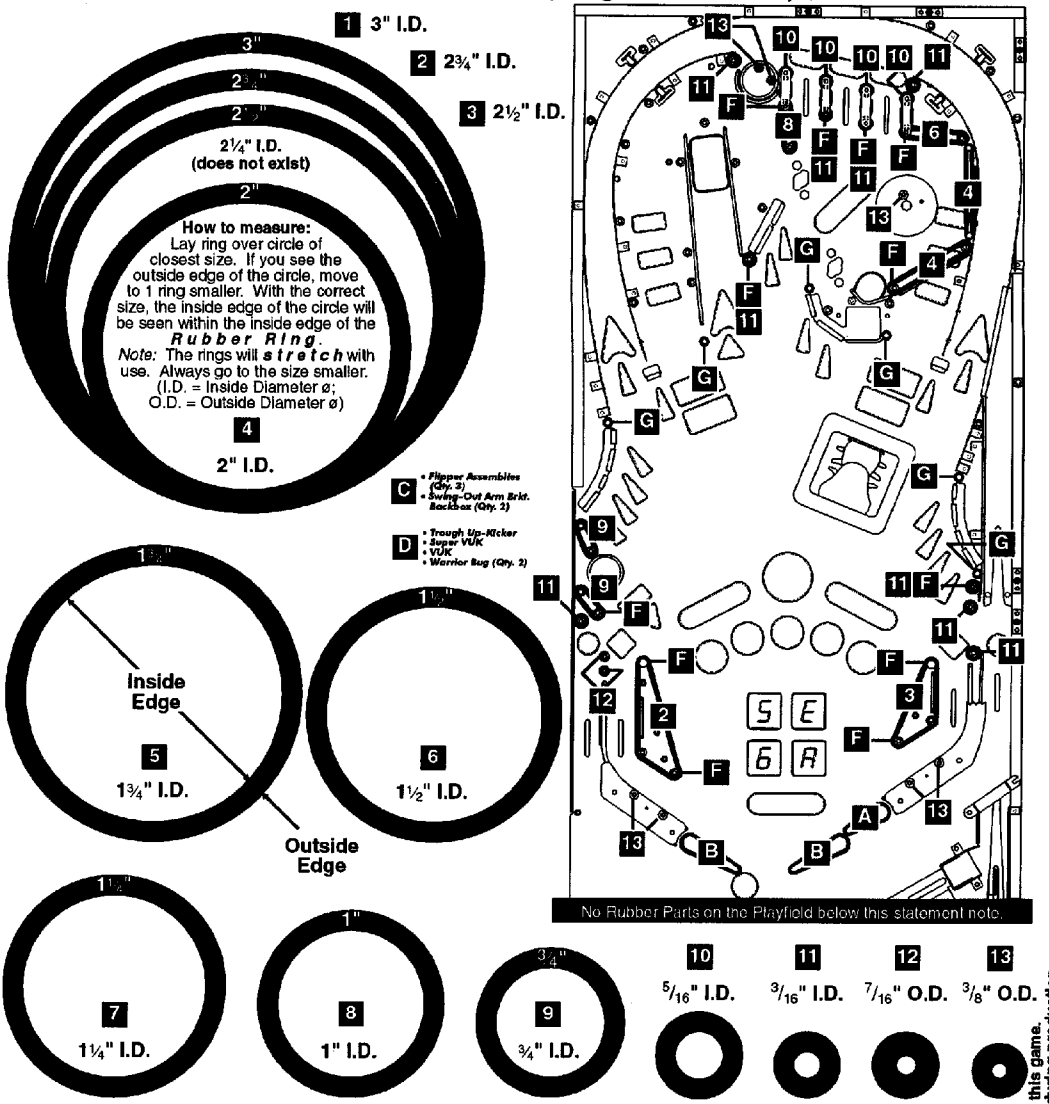
Special Note: Order Item 15 if a Post was added/removed at Center Drain to "hide" hole.

Take Note:

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

1. Some unique parts (such as Plastic Toys) may be a part of a Major Assy.; see the Blue Pages for parts not appearing on this page. If you still cannot find the part required, call Sega Pinball Technical Support, 1-800-542-5377.
2. **Legend Note:** Items noted with a white square ❒ are mounted above the playfield.

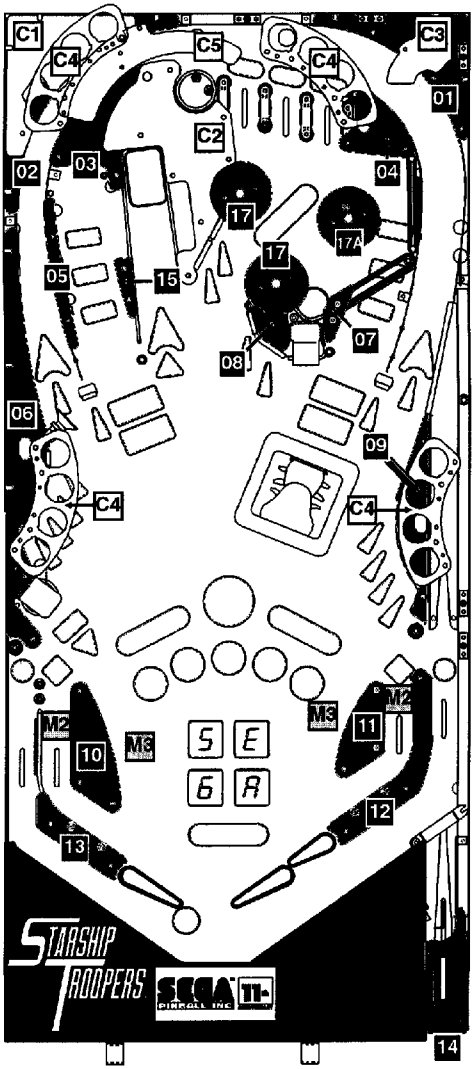
Playfield - Rubber Parts (Rings Actual Size) †



Nº	Rubber Part Name	QTY.	Part Nº	Nº	Rubber Part Name	QTY.	Part Nº
A	Small Flipper Rubber Ring	1	545-5207-00	4	2" I.D. Black Rubber Ring	2	545-5348-08
B	Large Flipper Rubber Ring	2	545-5277-00				
C*	Rubber Deflector Pad (Bumper)	5	545-5428-00	6	1½" I.D. Black Rubber Ring	1	545-5348-07
D*	Rubber Bumper (Grommet)	5	545-5105-00				
				8	1" I.D. Black Rubber Ring	1	545-5348-05
F	Post Rubber (Sleeve Short)	12	545-5151-00	9	¾" I.D. Black Rubber Ring	2	545-5348-04
G	Post Rubber (Sleeve Tall)	6	545-5308-00	10	5/16" I.D. Black Rubber Ring	4	545-5348-02
				11	3/16" I.D. Black Rubber Ring	9	545-5348-01
2	2¾" I.D. Black Rubber Ring	1	545-5348-20	12	7/16" O.D. Black Rubber Ring	2	545-5348-17
3	2½" I.D. Black Rubber Ring	1	545-5348-09	13	⅜" O.D. Black Rubber Ring	7	545-5348-19

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

Playfield - Plastic (Butyrate), Decals and Mylar



Nº	Plastic (ButYrate) Name	QTY.	SPI Part Nº
	Entire Plastic Sheet Screened (01-21)		830-5926-XX
	Entire Plastic Sheet Clear (C1-C5)		830-5927-XX
01	Screened Plastic (Top Rt. Crnr. of Playfield)	1	830-5926-01
02	Screened Plastic (Top Lt. Crnr. of Playfield)	1	830-5926-02
03	Screened Plastic (Inner Left Orbit)	1	830-5926-03
04	Screened Plastic (Inner Right Orbit)	1	830-5926-04
05	Screened Plastic (by Left Ramp, Left Side)	1	830-5926-05
06	Screened Plastic (Left Side of Playfield)	1	830-5926-06
07	Screened Plastic (Around VUK Right Side)	1	830-5926-07
08	Screened Plastic (Around VUK Left Side)	1	830-5926-08
09	Screened Plastic (Right Side of Playfield)	1	830-5926-09
10	Screened Plastic (Left Slingshot Cover)	1	830-5926-10
11	Screened Plastic (Right Slingshot Cover)	1	830-5926-11
12	Screened Plastic (Right Return Lane)	1	830-5926-12
13	Screened Plastic (Left Return Lane)	1	830-5926-13
14	Screened Plastic (Arch over Shooter Lane)	1	830-5926-14
15	Screened Plastic (Left Ramp Right Side)	1	830-5926-15
16*	Screened Plastic (Keychain)	1	830-5926-16
17	Screened Plastic (Lt./Bot. Pop Cap Tops)	2	830-5926-17
17A	Screened Plastic (Rt. Pop Cap w/hole)	2	830-5926-17A
18*	Screened Plastic (Ramp Enter Sign Right)	1	830-5926-18
19*	Screened Plastic (Ramp Enter Sign Left)	1	830-5926-19
20*	Screened Plastic (Tanker Bug Sign)	1	830-5926-20
21*	Screened Plastic (Warrior Bug Sign)	1	830-5926-21

Items 18, 19, 20 & 21 have sockets riveted to the Screened Plastic. If any one of these individual pieces are required, and riveting (or removal of rivets) is not an option, order 515-6777-XX-59 which will include the riveted sockets, bulbs, rubber lite covers & cable attached to each Screened Plastic (replace the "-XX-" with 18, 19, 20 and/or 21).

C1	Clear Plastic (mates with 02 above)	1	830-5927-01

Supported by: 1/2" X 1/4" Hex Spacer #6-32 Tap (Qty. 3) (254-5008-03) & 1/2" X 3/8" Spacer Gray (Qty. 2) (254-5000-01).

C2	Clear Plastic (mates with 03 above)	1	830-5927-02

Supported by: 1/2" X 1/4" Hex Spacer #6-32 Tap (Qty. 5) (254-5008-03), 1" X 1/4" Hex Spacer #6-32 Tap (Qty. 1) (254-5008-06) & 3/8" X 1/4" Hex Spacer #6-32 Tap (Qty. 1) (254-5008-12)

C3	Clear Plastic (on Ramp (Upr. Rt.))	1	830-5927-03
C4	Clear Plastic (4X Dome Mtg. Base)	4	830-5927-04

Item C4 have sockets riveted to the Screened Plastic. If this individual piece is required, and riveting (or removal of rivets) is not an option, order 515-6778-01-59 which will include the riveted sockets, bulbs, Mini-Mars & cable attached to the Screened Plastic.

C5	Clear Plastic (Upper Left Ramp)	4	830-5927-05

Nº	Mylar Name	QTY.	SPI Part Nº
M1*	Mylar Pad - Starship Troopers	1	820-5868-00
M2	Mylar Square Pad - Ball Drop	2	820-5815-00
M3	Mylar Sling Shot Protector	2	820-5821-00
n/a*	Mylar Cover Discs (on Cabinet)	6	820-5041-00

Nº	Game #59 Decal Name	QTY.	SPI Part Nº
	Entire Game #59 Decal Sheet		820-6213-XX
	Note: View last 2-digit number on decal for desired individual replacement (individual pieces *may not* be available, in which case the entire sheet must be ordered).		
n/a*	Game Specific Backbox Fuse Loc.	1	820-6152-59

Nº	Generic Decal Name	QTY.	SPI Part Nº
n/a*	"Suitable for Indoor Use Only (UL)"	1	820-6001-01
n/a*	"High Voltage Label (UL)"	2	820-6082-01
n/a*	"Power Box Decal - USA"	1	820-6123-01
n/a*	"Danger Coin Door Label (UL)"	1	820-6140-00
n/a*	"UL Listing Label"	1	820-6141-00
n/a*	"Fuse Lable (UL)"	1	820-6143-00
n/a*	"Start" (Word & Arrow) Decal	1	820-6177-00

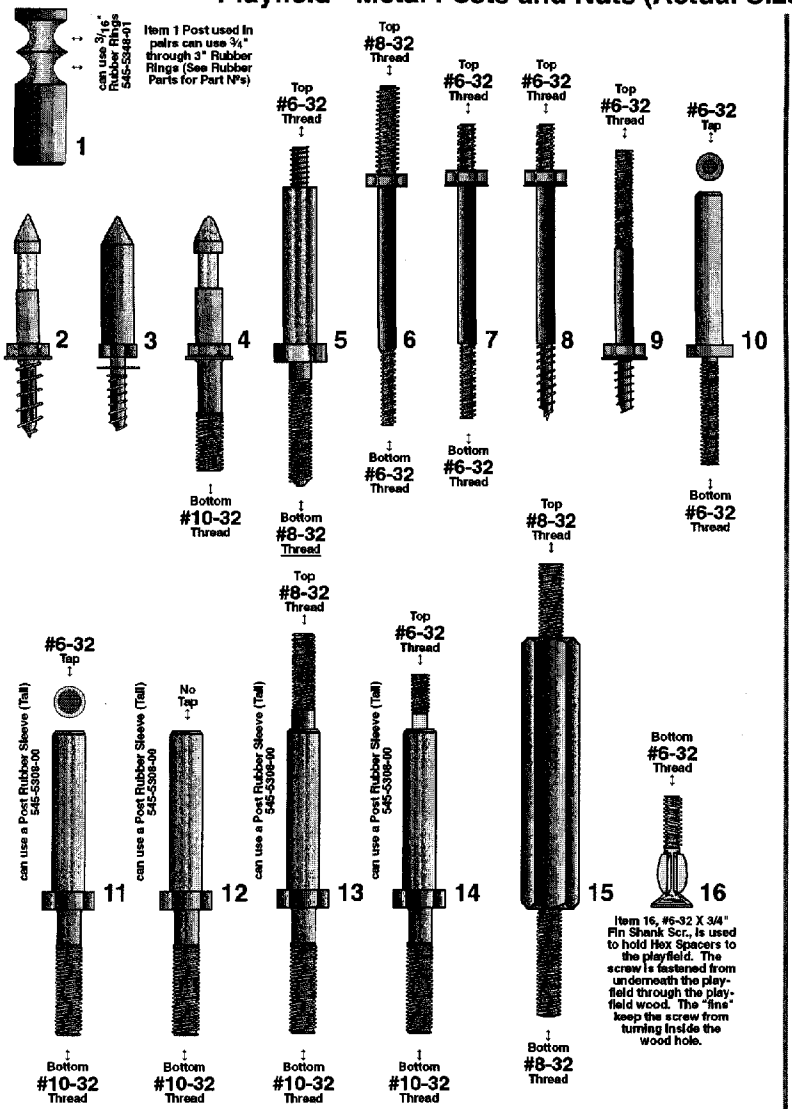
Plastic Screened **Plastic Clear** **Mylar**

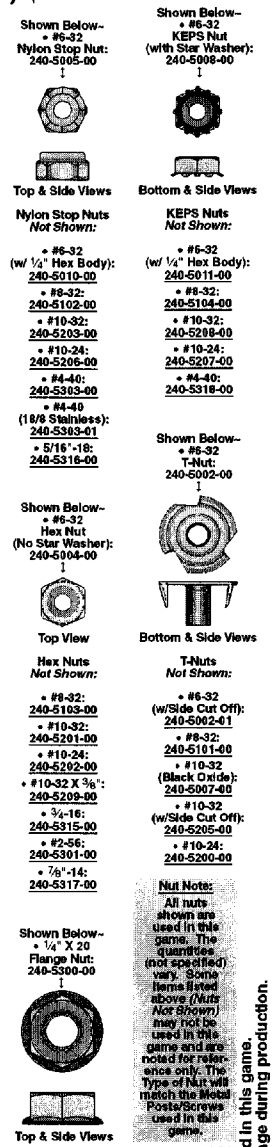
Take Note:

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

1. To order the entire Decal or Plastic (Screened or Clear) sheets, use the Part Nº with the "-XX" ending. For individual pieces replace the "-XX" with appropriate last 2-digit number. *Attention: Individual pieces may not be available.*
2. **Legend Note:** Items noted with a black square ■ are Screened; ...a white square □ are Clear; ...a gray square ■ are Mylar.

Playfield - Metal Posts and Nuts (Actual Size) †



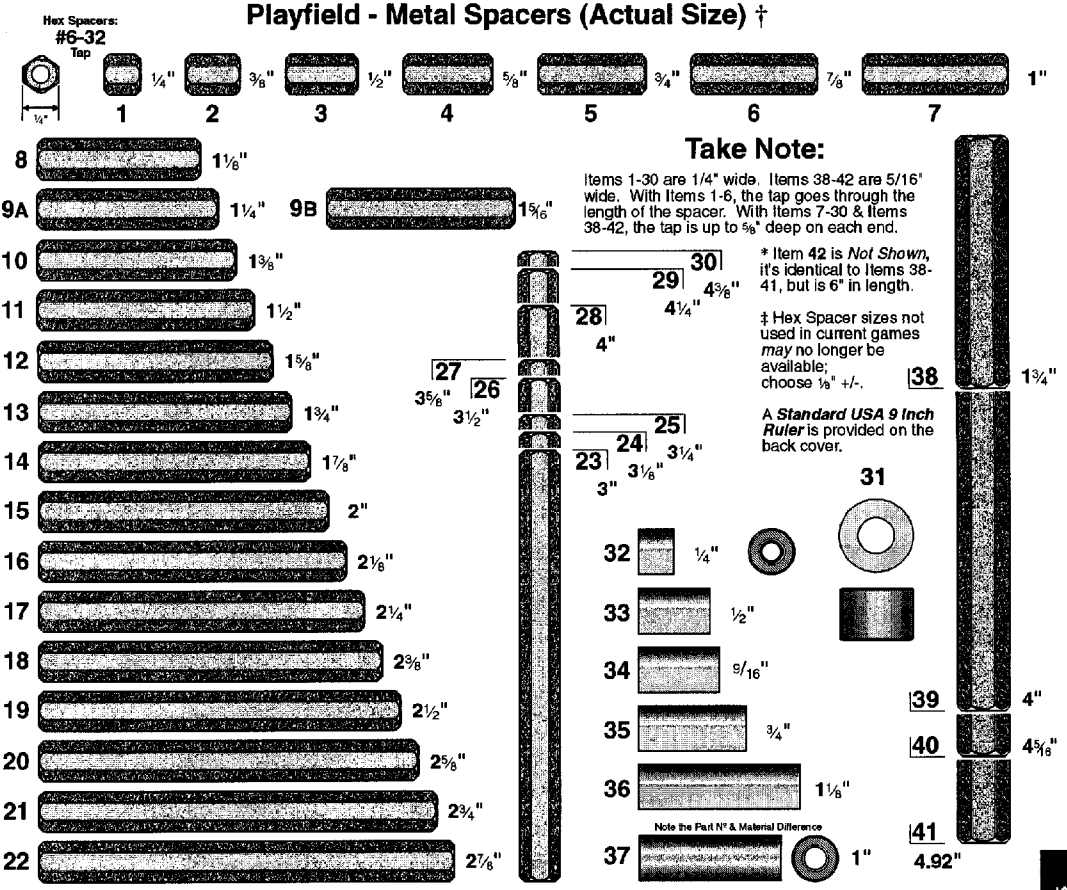

Shown Below~ • #6-32 Nylon Stop Nut: 240-5005-00
Top & Side Views
Shown Below~ • #6-32 KEPS Nut (with Star Washer): 240-5008-00
Bottom & Side Views
Nylon Stop Nuts *Not Shown:*
• #6-32 (w/ 1/4" Hex Body): 240-5010-00
• #8-32: 240-5102-00
• #10-32: 240-5203-00
• #10-24: 240-5206-00
• #4-40: 240-5303-00
• #4-40 (18/8 Stainless): 240-5303-01
• 5/16"-18: 240-5316-00
KEPS Nuts *Not Shown:*
• #6-32 (w/ 1/4" Hex Body): 240-5011-00
• #8-32: 240-5104-00
• #10-32: 240-5208-00
• #10-24: 240-5207-00
• #4-40: 240-5318-00
Shown Below~ • #6-32 Hex Nut (No Star Washer): 240-5004-00
Top View
Shown Below~ • #6-32 T-Nut: 240-5002-00
Bottom & Side Views
Hex Nuts *Not Shown:*
• #8-32: 240-5103-00
• #10-32: 240-5201-00
• #10-24: 240-5202-00
• #10-32 X 3/8": 240-5209-00
• 3/4-16: 240-5315-00
• #2-56: 240-5301-00
• 7/8"-14: 240-5317-00
T-Nuts *Not Shown:*
• #6-32 (w/Side Cut Off): 240-5002-01
• #8-32: 240-5101-00
• #10-32 (Black Oxide): 240-5007-00
• #10-32 (w/Side Cut Off): 240-5205-00
• #10-24: 240-5200-00
Shown Below~ • 1/4" X 20 Flange Nut: 240-5300-00
Top & Side Views
Nut Note: All nuts shown are used in this game. The quantities (not specified) vary. Some items listed above *(Nuts Not Shown)* may not be used in this game and are noted for reference only. The Type of Nut will match the Metal Posts/Screws used in this game.

Nº	Metal Post Name	QTY.	SPI Part Nº	Nº	Metal Post Name	QTY.	SPI Part Nº
1	Stand-Off Double Groove Post 1 1/16"	0	530-5103-00	9	Post #8-32 Top / Wood Screw Bottom	0	530-5263-01
2	Mini-Post Wood Screw	6	530-5004-00	10	Post #6-32 Top / #6-32 Bottom	0	530-5127-00
3	Mini-Post Wood Screw (no or more)	0	530-5004-00	11	Post Hex Base #6-32 Tap/#10-32 Bot.	4	530-5332-01
4	Mini-Post Mach. Screw / #10-32 Bot.	4	530-5005-00	12	Post Hex Base (No Tap)/#10-32 Bot.	2	530-5332-00
5	Post Fasten #8-32 Top / #8-32 Bot.	0	530-5007-00	13	Post Hex Base #8-32 Top/#10-32 Bot.	0	530-5332-02
6	Post Fasten #8-32 Top / #6-32 Bot.	1	530-5008-00	14	Post Hex Base #6-32 Top/#10-32 Bot.	0	530-5332-03
7	Post Fasten #6-32 Top / #6-32 Bot.	23	530-5012-02	15	Playfield Support #8-32 Top/Bottom	0	530-5285-00
8	Post Fstn. #6-32 Top / Wood Scr. Bot.	18	530-5010-02	16	#6-32 X 3/4" Fin Shank Screw	5	237-5921-02

Miscellaneous Nuts (Not Shown; *some items listed below may not be used in this game and are noted for reference only*):
• Plastic Pal Nut (for Flipper Buttons), 240-5003-00 • #6-32 Acorn Cap (WHT), 240-5000-00 • #6-32 Acorn Cap (BLK), 240-5006-00 •
• #6-32 Wing Nut, 240-5001-00 • #8-32 Wing Nut, 240-5100-00 • 1/4" -20 Wing Nut, 240-5302-00

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

Playfield - Metal Spacers (Actual Size) †



Take Note:

Items 1-30 are 1/4" wide. Items 38-42 are 5/16" wide. With Items 1-6, the tap goes through the length of the spacer. With Items 7-30 & Items 38-42, the tap is up to ⅝" deep on each end.

* Item **42** is *Not Shown*, it's identical to Items 38-41, but is 6" in length.

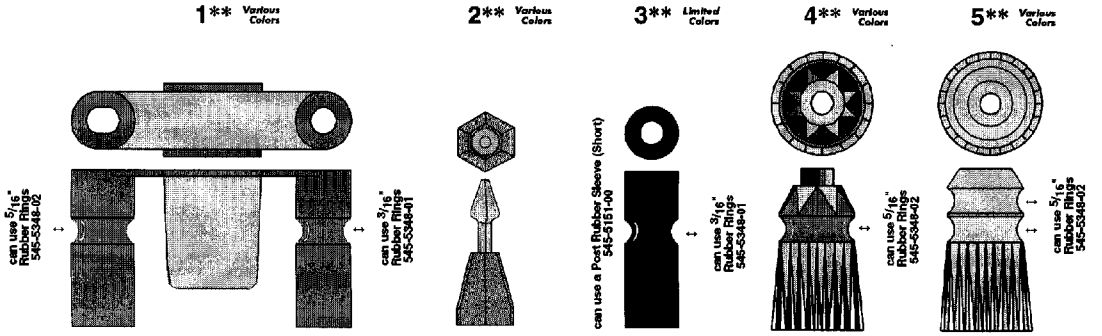
‡ Hex Spacer sizes not used in current games *may* no longer be available; choose ⅛" +/-.

A ***Standard USA 9 Inch Ruler*** is provided on the back cover.

Nº	Metal Spacer Name	QTY.	SPI Part Nº
1	¼" X ¼" Hex Spacer #6-32 Tap	0	254-5008-13
2	⅜" X ¼" Hex Spacer #6-32 Tap	1	254-5008-12
3	½" X ¼" Hex Spacer #6-32 Tap	15	254-5008-03
4	⅝" X ¼" Hex Spacer #6-32 Tap	0	254-5008-02
5	¾" X ¼" Hex Spacer #6-32 Tap	1	254-5008-04
6	⅞" X ¼" Hex Spacer #6-32 Tap	0	254-5008-05
7	1" X ¼" Hex Spacer #6-32 Tap	2	254-5008-06
8	1⅛" X ¼" Hex Spacer #6-32 Tap	5	254-5008-17
9A	1¼" X ¼" Hex Spacer #6-32 Tap	1	254-5008-11
9B	1⅝" X ¼" Hex Spacer #6-32 Tap	0	254-5008-18
10	1⅜" X ¼" Hex Spacer #6-32 Tap	0	254-5008-19
11	1½" X ¼" Hex Spacer #6-32 Tap	2	254-5008-09
12	1⅝" X ¼" Hex Spacer #6-32 Tap	0	254-5008-31
13	1¾" X ¼" Hex Spacer #6-32 Tap	2	254-5008-10
14	1⅞" X ¼" Hex Spacer #6-32 Tap	0	254-5008-20
15	2" X ¼" Hex Spacer #6-32 Tap	3	254-5008-07
16	2⅛" X ¼" Hex Spacer #6-32 Tap	5	254-5008-32
17	2¼" X ¼" Hex Spacer #6-32 Tap	0	254-5008-08
18	2⅜" X ¼" Hex Spacer #6-32 Tap	0	254-5008-21
19	2½" X ¼" Hex Spacer #6-32 Tap	6	254-5008-16
20	2⅝" X ¼" Hex Spacer #6-32 Tap	0	254-5008-22
21	2¾" X ¼" Hex Spacer #6-32 Tap	0	254-5008-23
22	2⅞" X ¼" Hex Spacer #6-32 Tap	0	254-5008-24
23	3" X ¼" Hex Spacer #6-32 Tap	0	254-5008-25
24	3¼" X ¼" Hex Spacer #6-32 Tap	0	254-5008-27
25	3¼" X ¼" Hex Spacer #6-32 Tap	1	254-5008-26
26	3½" X ¼" Hex Spacer #6-32 Tap	0	254-5008-28
27	3⅝" X ¼" Hex Spacer #6-32 Tap	0	254-5008-29
28	4" X ¼" Hex Spacer #6-32 Tap	0	254-5008-30
29	4⅜" X ¼" Hex Spacer #6-32 Tap	0	254-5008-14
30	4¼" X ¼" Hex Spacer #6-32 Tap	0	254-5008-15
31	⅜" X ½" Spacer (Used with Backbox)	6	530-5099-00
32	¼" X 5/16" X .144" I.D. Spacer Tap.	1	254-5014-03
33	½" X 5/16" X .144" I.D. Spacer Tap.	3	254-5014-00
34	9/16" X 5/16" X .144" I.D. Spacer Tap.	0	254-5014-04
35	¾" X 5/16" X .144" I.D. Spacer Tap.	0	254-5014-01
36	1⅛" X 5/16" X .144" I.D. Spacer Tap.	0	254-5014-02
37	1" X 5/16" X .144" I.D. Spacer Tap.	0	254-5014-05
38	1¾" X 5/16" Hex Spacer #6-32 Tap	1	254-5018-06
39	4" X 5/16" Hex Spacer #6-32 Tap	0	254-5018-04
40	4⅝" X 5/16" Hex Spacer #6-32 Tap	0	254-5018-05
41	4.92" X 5/16" Hex Spacer #6-32 Tap	0	254-5018-02
42	6" X 5/16" Hex Spacer #6-32 Tap	0	254-5018-03

† 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) †

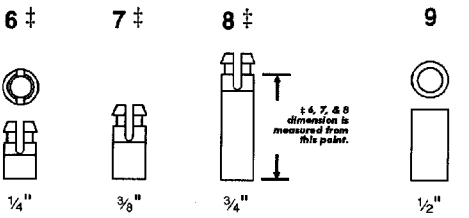


Items 3-5 Posts used in pairs can use ¾" through 3" Rubber Rings (See Rubber Parts for Part Nºs)

Take Note:

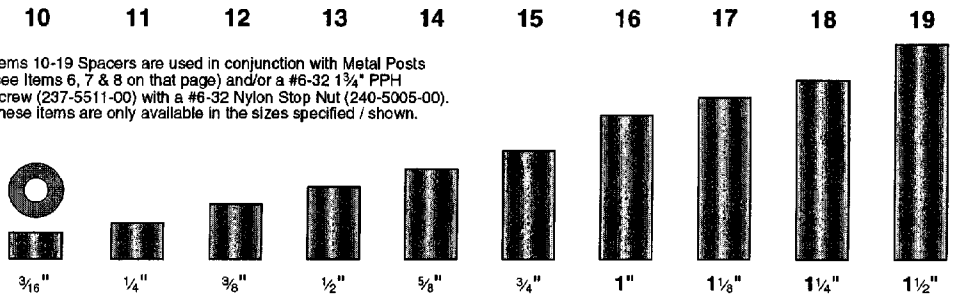
PLASTIC PART COLOR CHART					
Nº	Color	Nº	Color	Nº	Color
-00	Black	-06	Yellow	-12	Fluor. Blue
-01	Clear	-07	Orange	-13	Teal Green
-02	Red	-08	White	-14	Gray
-03	Amber	-09	Purple	-15	Luminescent
-04	Green	-10	Fluor. Orange	-16	Gold
-05	Blue	-11	Fluor. Green		

** Items 1-2 and 4-5 come in various colors. These posts may not be available in every color; i.e. Item 3 is currently only available in Orange (-07), Teal Green (-13), Gold (-16) & Black (-00, Standard Color). The "-XX" in Part Nºs which may come in various colors should be replaced with the desired 2-Digit Nº. corresponding to the color desired. *Not all colors may be available.*



‡ Items 6, 7 & 8 (Board Spacers) dimensions are measured from bottom to just under cut-away (see pictorial above).

—Items 10-19 Spacers are used in conjunction with Metal Posts (see Items 6, 7 & 8 on that page) and/or a #6-32 1¾" PPH Screw (237-5511-00) with a #6-32 Nylon Stop Nut (240-5005-00). These items are only available in the sizes specified / shown.

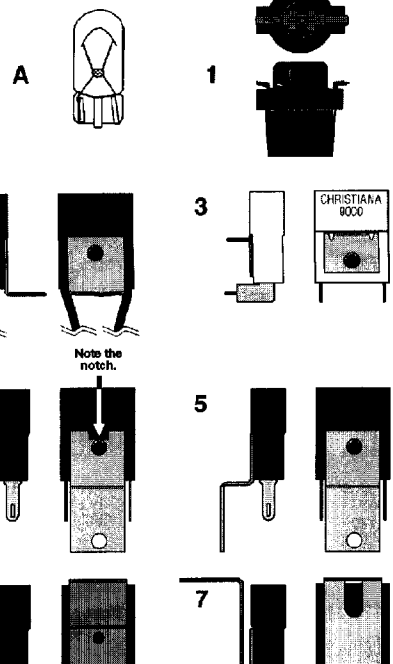


Nº	Plastic Post/Spacer Name	QTY.	SPI Part Nº	Nº	Plastic Post/Spacer Name	QTY.	SPI Part Nº
1**	Top Lane Mini-Light Hood (Flu. Org.)	4	550-5061-10	10	3/16" X ⅜" Spacer Gray (4 for Dot Display)	4	254-5000-18
2**	Mini-Jewel Post (CLEAR)	7	550-5052-01			Ø	
3**	1 1/16" Single Groove Post (BLK)	43	550-5059-00			Ø	
				13	½" X ⅜" Spacer Gray	3	254-5000-01
						Ø	
6 ‡	¼" Slf. Rtn. Spacer White	3	254-5007-02	15	¾" X ⅜" Spacer Gray	2	254-5000-07
				16	1" X ⅜" Spacer Gray	2	254-5000-04
						Ø	

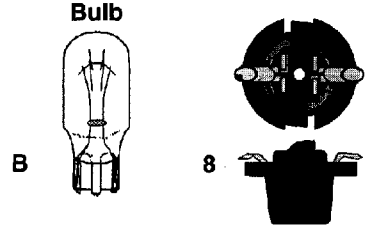
† Items with Ø Qty. are not used in this game. Size and/or quantities may change during production.

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

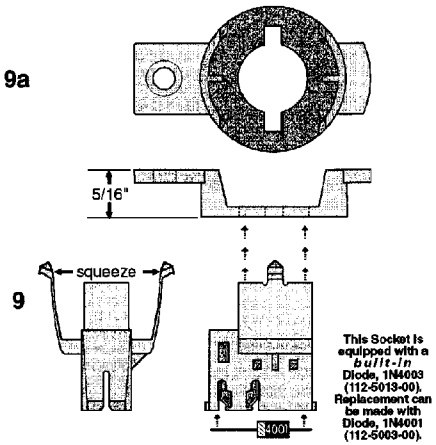
#555 Bulb



#906 Bulb



The below Snap-On Socket Bracket currently is available in two height sizes (Item 9a is 5/16" High and Item 9b is 19/32" High.)



Take Special Note:

Item 9 Socket is the new Insulation Displacement Connection (IDC) Style. This new design is used in the same application as PC Light Boards, allowing for easier bulb replacement. This style is solderless, and has a built-in diode. This socket is secured to the playfield or component by Items 9a & 9b Snap-On Socket Brackets, or *may* also be snapped into Item 9c Socket Mounting Board (specially designed Clear Plastic piece) where sockets are positioned too close together. Just squeeze the "side arms" of the socket together and pull away from the bracket or mounting board for easy #555 Bulb replacement.

Nº	#555 Bulb & Socket Name	QTY.	SPI Part Nº
A	#555 Wedge Base Bulb	54	165-5002-00
[illegible]	[illegible]	[illegible]	[illegible]
2	Turbo Pop Bumper Socket	3	077-5206-00
[illegible]	[illegible]	[illegible]	[illegible]
4	Laydown WB Socket (with notch)	6	077-5026-01
[illegible]	[illegible]	[illegible]	[illegible]
6	WB Offset Socket (Step-Bracket)	23	077-5029-00
[illegible]	[illegible]	[illegible]	[illegible]

Nº	#906 Bulb & Socket Name	QTY.	SPI Part Nº
B	#906 Wedge Base Bulb	19	165-5004-00
[illegible]	[illegible]	[illegible]	[illegible]

Nº	#555 IDC Socket Name	QTY.	SPI Part Nº
9	#555 *New* IDC Snap-On Socket	41	077-5216-00
9a	5/16" Ht. Snap-On Socket Bracket	41	545-5760-18
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Socket Mounting Board	[illegible]	Not Used in this Game

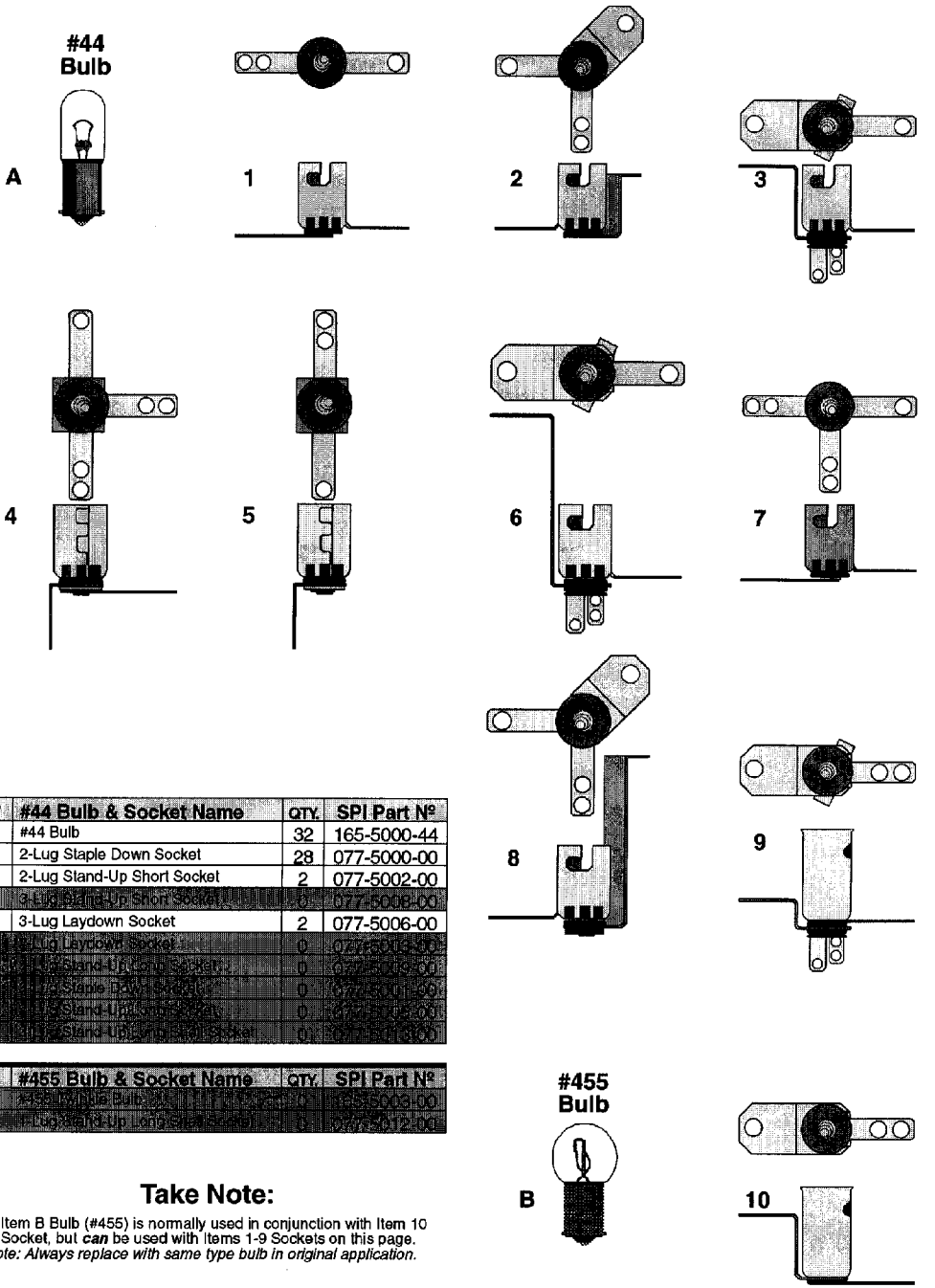
Take Note:

* An asterisk (*) indicates items are not shown on this page.

1. Item 1 Socket **was** used on PC Light Boards to position bulbs vertically.
2. Item 2 Socket has 2 Wires attached are approximately 12" ea.
3. Item 3 Socket was used on PC Light Boards to position bulbs horizontally.
4. Item 4 Socket is normally used with Reflectors.
5. If Item 7 Socket is desired, order Item 6 for replacement.
   >>>Item 7 Socket is no longer available.<<<
6. Item B Bulb (#906) is normally used in conjunction with Item 8 Socket, but ***can*** be used with Items 1-7 Sockets on this page.
   Note: Always replace with same type bulb in original application.
7. Item 8 Socket is sometimes used in conjunction with Mini-Mars or special Plastic (Butyrate) assemblies.
8. See the start of this chapter for Fluor. Bulb & Associated Parts. See the end of this chapter for Misc. Bulbs, Boards & Parts.

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

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



Nº	#44 Bulb & Socket Name	QTY.	SPI Part Nº
A	#44 Bulb	32	165-5000-44
1	2-Lug Staple Down Socket	28	077-5000-00
2	2-Lug Stand-Up Short Socket	2	077-5002-00
3	3-Lug Stand-Up Short Socket	0	077-5008-00
4	3-Lug Laydown Socket	2	077-5006-00
5	2-Lug Laydown Socket	0	077-5003-00
6	2-Lug Stand-Up Socket	0	077-5005-00
7	2-Lug Staple Down Socket	0	077-5001-00
8	3-Lug Stand-Up Socket	0	077-5007-00
9	2-Lug Stand-Up Short Socket	0	077-5004-00

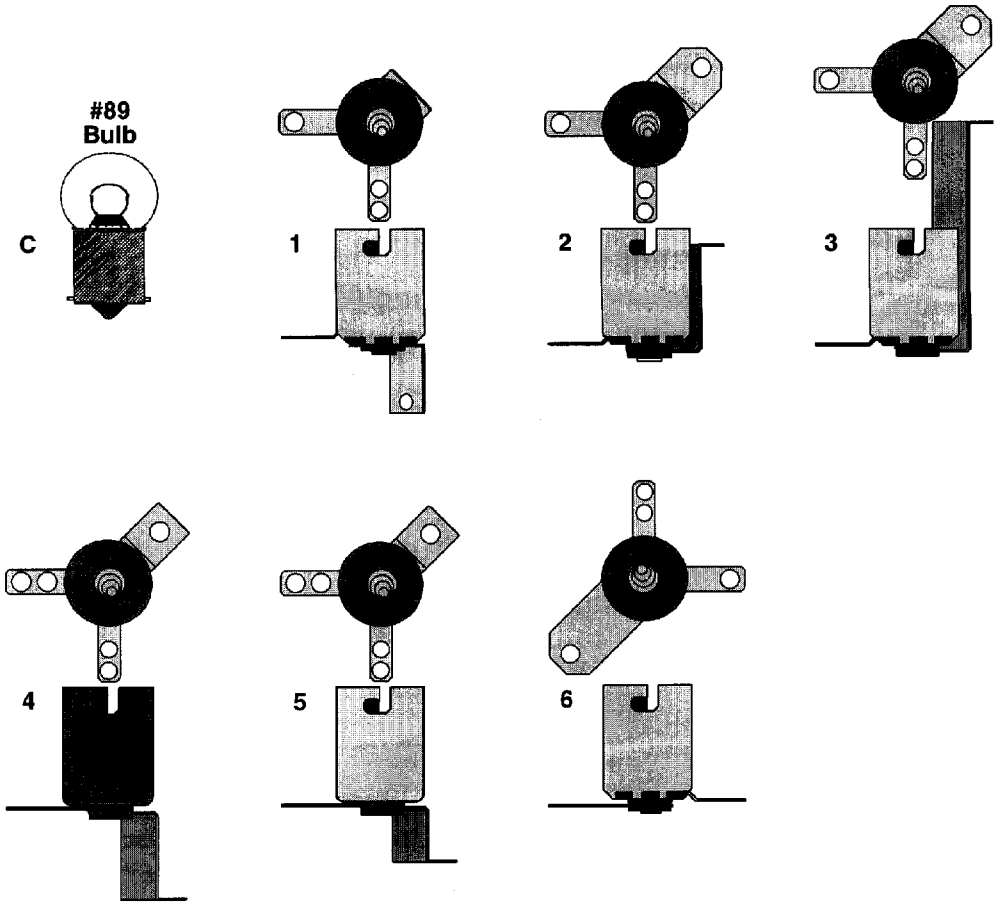
Nº	#455 Bulb & Socket Name	QTY.	SPI Part Nº
B	#455 Wedge Bulb	0	165-5003-00
10	2-Lug Stand-Up Long Socket	0	077-5012-00

Take Note:

Item B Bulb (#455) is normally used in conjunction with Item 10 Socket, but ***can*** be used with Items 1-9 Sockets on this page.
Note: Always replace with same type bulb in original application.

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

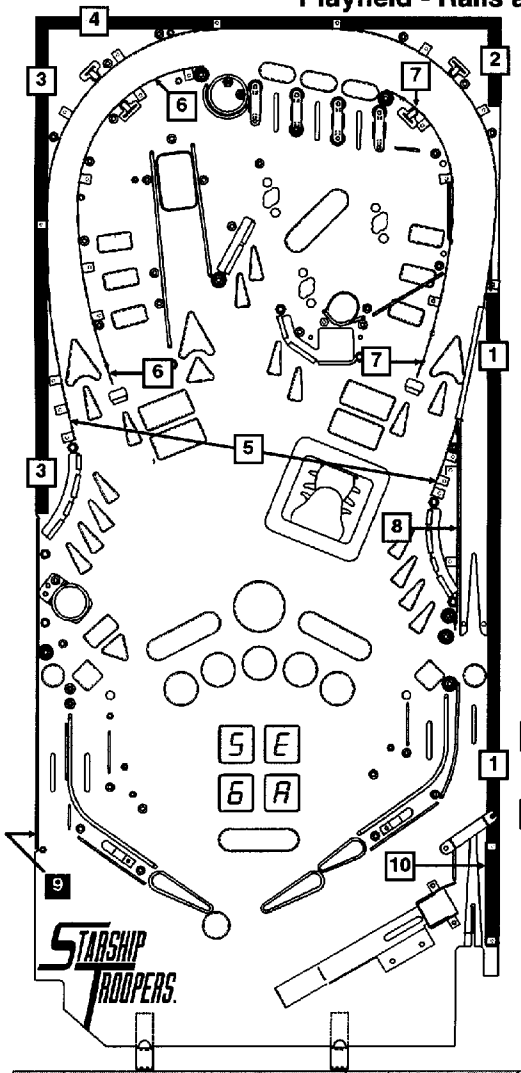
Playfield - Large Bayonet Type Bulb and Sockets (Actual Size) †

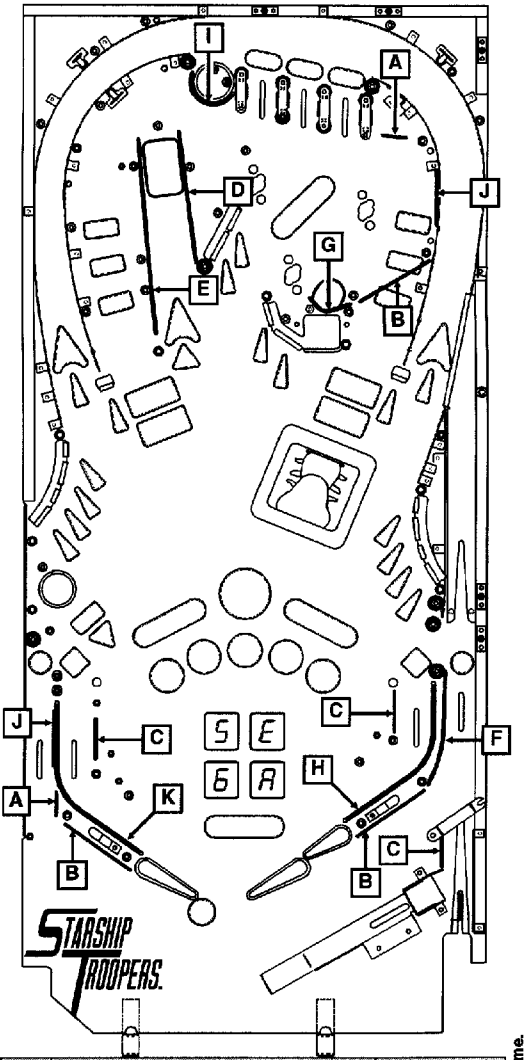


№	#89 Bulb & Socket Name	QTY.	SPI Part №
C	#89 Bulb	13	165-5000-89
1	Laydown Standard Socket	2	077-5100-00
2	2-Lug Stand-Up Short Socket	1	077-5101-00
3	2-Lug Stand-Up Long Socket	10	077-5102-00

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

Playfield - Rails and Ball Guides †





Nº	Rail Name	QTY.	SPI Part Nº
1	Wood Rail 28-5/8"	1	525-5007-51
2	Wood Rail 3-3/8"	1	525-5007-49
3	Wood Rail 21-3/16"	1	525-5007-50
4	Wood Rail 20-1/4"	1	525-5007-05
Items 1-4 secured by: #6 X 1-1/4" PFH A (Zinc) (Qty. 14) (237-5804-00)			
5	Flat Metal Rail (Main Loop Right)	1	515-6758-00
6	Flat Metal Rail (Inner Loop Left)	1	515-6759-00
7	Flat Metal Rail (Inner Loop Right)	1	515-6760-00
8	Flat Metal Rail (Shooter Ramp Left)	1	515-6761-00
9	Flat Metal Rail (by Left Outlane)	1	535-8156-00
Items 5-9 secured by: #6 X 1/2" HWH AB (Zinc) Blue (Qty. 30) (234-5101-05)			
10	Flat Metal Rail (by Shooter Lane)	1	535-6707-01
Item 10 secured by: #6 X 1-1/2" PPH (Zinc) (Qty. 2) (232-5007-00)			

Nº	Ball Guide Name	QTY.	SPI Part Nº
A	Metal Ball Guide Wire Form 1"	2	535-5300-05
B	Metal Ball Guide Wire Form 3-1/2"	3	535-5300-03
C	Metal Ball Guide Wire Form 1-3/4"	3	535-5300-09
D	Ball Guide Rail (5-3/4")	1	535-5356-00
E	Ball Guide Rail (#17, 8-1/2")	1	535-5356-17
F	Ball Guide Rail (#1)	1	535-8146-00
G	Ball Guide Rail (#2)	1	535-8148-00
H	Ball Guide Rail (#4)	1	535-8149-00
I	Ball Guide Rail (Top P/F Exit Hole)	1	535-8147-00
J	B. G. Rail (Lt. Outlane & Rt. Orbit)	2	535-7595-00
K	Ball Guide Rail (Left Outlane)	1	535-7560-00

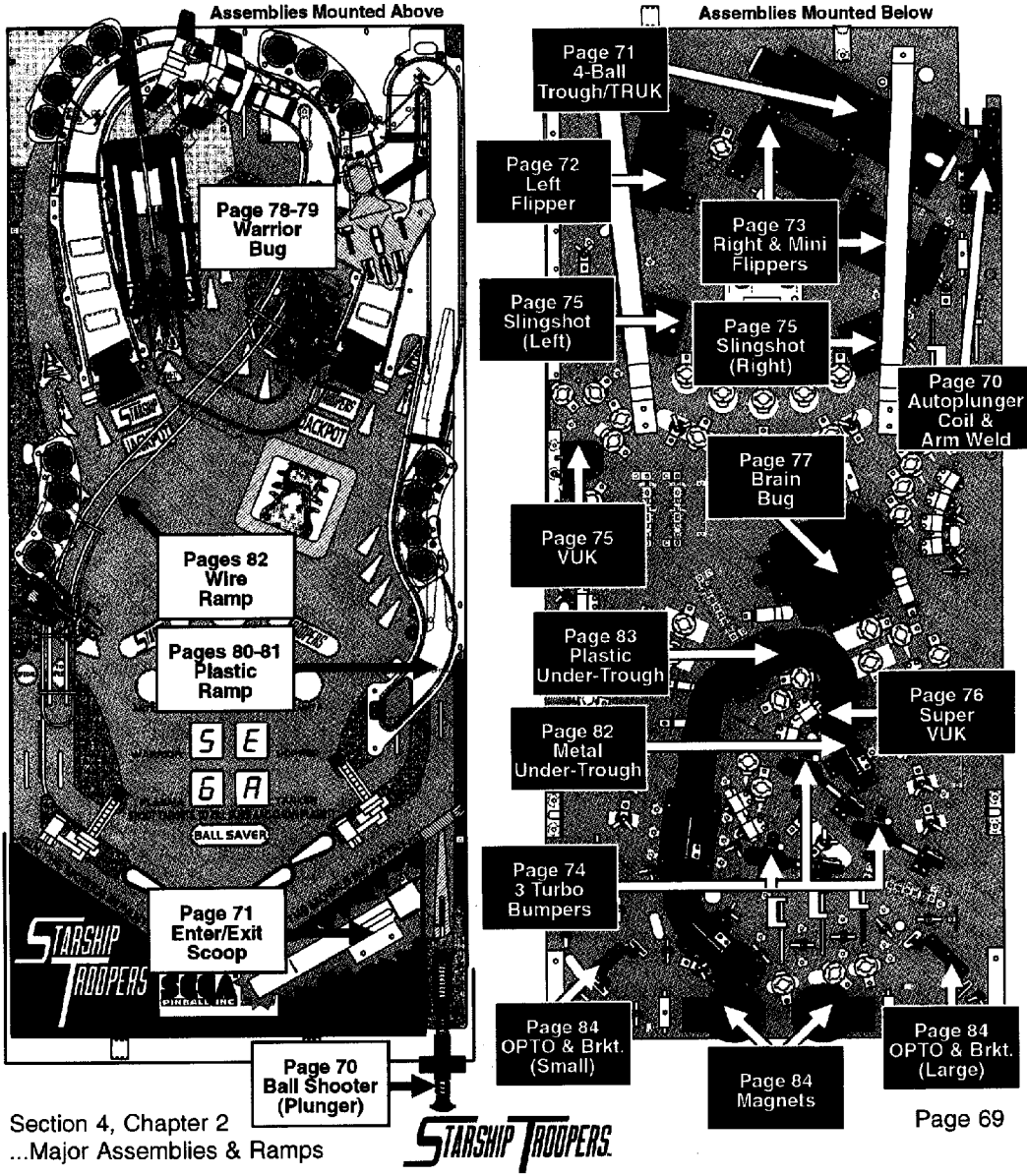
Legend Note: Items noted with a white square ❒ are mounted above the playfield; items noted with a black square ■ are mounted below the playfield.

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

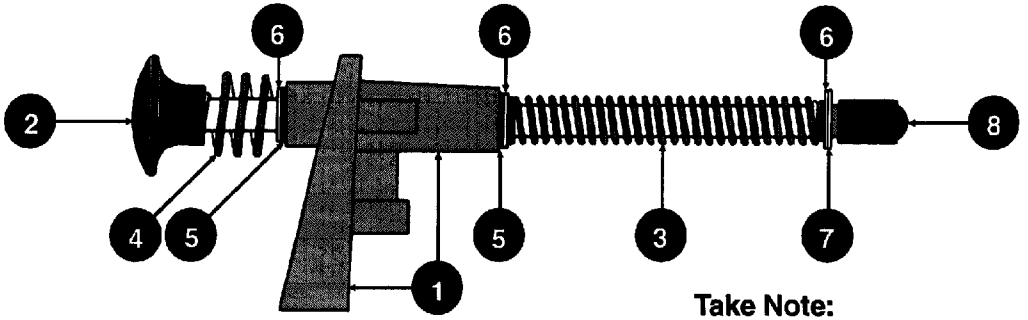
Drawings for Major Assemblies & Ramps (The Blue Pages)

Overview

Drawings are provided for the Major Assemblies in this game with individual parts of each assembly numbered. Items noted with a white circle (①) are mounted above the playfield; items noted with a black circle (❶) are mounted below. All numbered parts describe the name, quantity and Part Nº. Where multiple parts are riveted &/or assembled as sub-assemblies, the sub-assembly needs to be ordered. Minor changes may be made during production. 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. View any special notes on each page of this chapter. For General Part Nºs or items not described in this chapter, see the Pink Pages: Chapter 1, of this section. Call our Technical Support Office at 800-542-5377 in USA/Canada or at 708-345-7700 with any questions.



Ball Shooter (Plunger) Assembly, 500-6146-00-04 (Items 1-8)



Take Note:

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

Nº	Individual Part Name	QTY.	SPI Part Nº
1	Housing (Shooter Assembly)	1	535-5067-02
2	Rod Assembly (w/ Black Knob)	1	515-6557-00
3	Comp. Spring (Green, .035" ø)	1	266-5001-04
4	Compression Spring (Short Plunger)	1	266-5010-00
5	Bushing, 3/8" I.D. (Oilite)	2	280-5010-00
6	Washer, 3/8" I.D. X 5/8" O.D. X 1/16"	3	242-5014-00
7	Retaining Ring, 3/8" ø Shaft	1	270-5012-00
8	Plunger Tip (Black 50 Duro)	1	545-5276-00

ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY.

Nº	Associated Part Name	QTY.	SPI Part Nº
n/a *	Support Plate	1	535-5027-00
n/a *	#10-32 X 3/8 SHWH (Serr) Swage	3	237-5985-00
n/a *	#6 X 5/8" HWW AB (Zinc) Green	2	234-5002-04

Autoplunger Coil Assembly, 500-6092-02 (Items 1-7), and Autoplunger Arm Weld Assembly, 500-6091-00 (Items 8-11A) and Assoc. Part: Retaining Ring, 1/4" ø Shaft, 270-5002-00 (Item 11B)

Take Note:

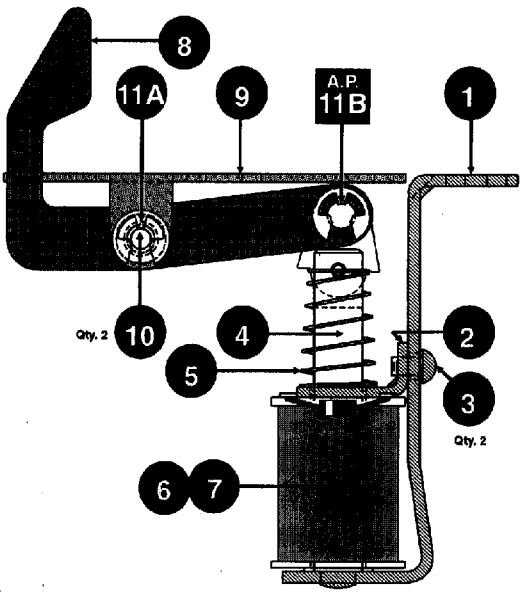
* An (*) asterisk indicates item is *Not Shown* in pictorial.

1. Associated Part, Item 11B, fastens both of these two (2) assemblies together (500-6092-01, Items 1-7 to 500-6091-00, Items 8-11).

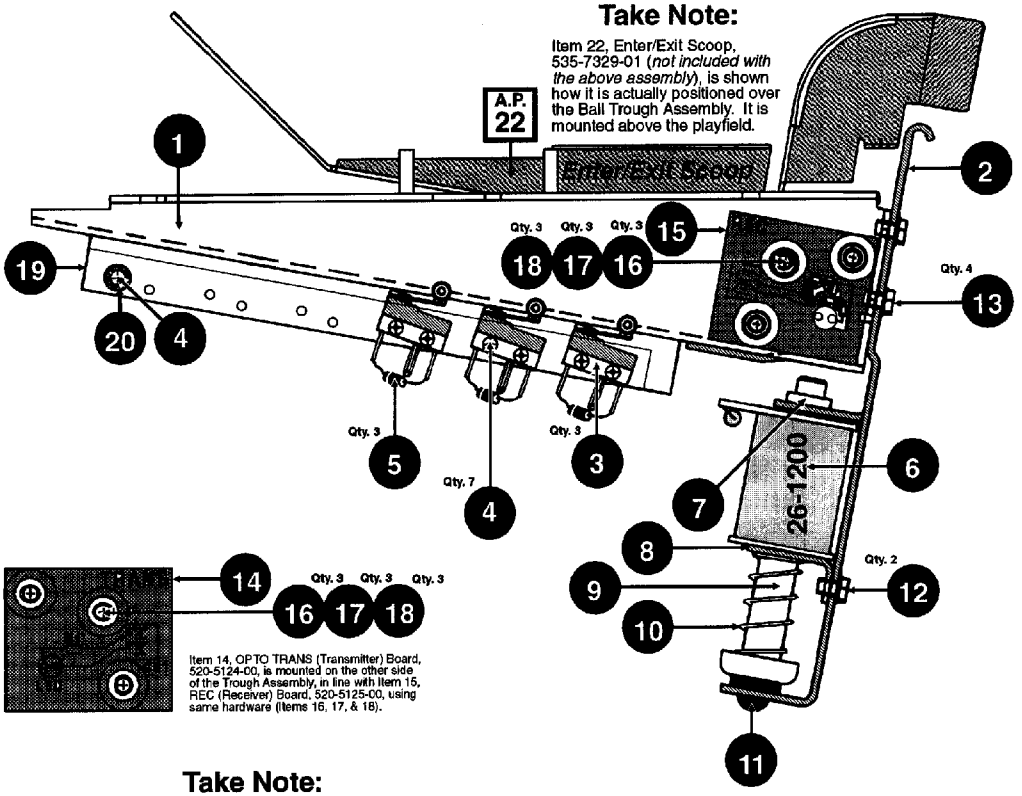
Nº	Individual Part Name	QTY.	SPI Part Nº
Autoplunger Coil Assy., 500-6092-01 (Items 1-7)			
1	Autoplunger Coil Bracket Assembly	1	515-6527-00
2	Coil Retainer Bracket	1	535-5203-03
3	#8-32 X 1/4" PPH MS (Sems) Zinc	2	232-5300-00
4	Plunger & Link Assembly	1	515-5338-00
[illegible]	[illegible]	[illegible]	[illegible]
4A	Plunger 2"	1	530-5026-01
4B	Plunger Link	1	545-5293-00
4C	Roll Pin, 1/8" ø X 5/8" Lg.	1	231-5008-00
5	Compression Return Spring	1	266-5020-00
6	Coil, 24-940	1	090-5036-00T
[illegible]	[illegible]	[illegible]	[illegible]
—	Diode, 1N4004 (positioned at top)	1	112-5003-00
7	Coil Sleeve	1	545-5031-00
Autoplunger Arm Weld Assy., 500-6091-00 (Items 8-11)			
8	Arm Weld Assembly	1	515-6526-00
9	Autoplunger Fulcrum	1	535-7697-00
10	Nyliner, 1/4" (Thomson #4I1-FF)	2	545-5423-00
11A	Retaining Ring, 1/4" ø Shaft	1	270-5002-00

ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY.

Nº	Associated Part Name	QTY.	SPI Part Nº
11B	Retaining Ring, 1/4" ø Shaft	1	270-5002-00
n/a *	#8 X 1/2 HWH AB (Zinc) Blue	9	234-5101-05



4-Ball Trough (OPTO) Assembly, 500-6119-24 (Items 1-21) and Associated Part: Ball Trough Enter/Exit Scoop, 535-7329-01 (Item 22)



Take Note:

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

1. *The Lock Ball Assembly is no longer required.* Ball Position (1) is determined by the OPTO Switch; therefore, a 4-Ball Trough, requires only 3 Submini-Switch Roller Actuators.

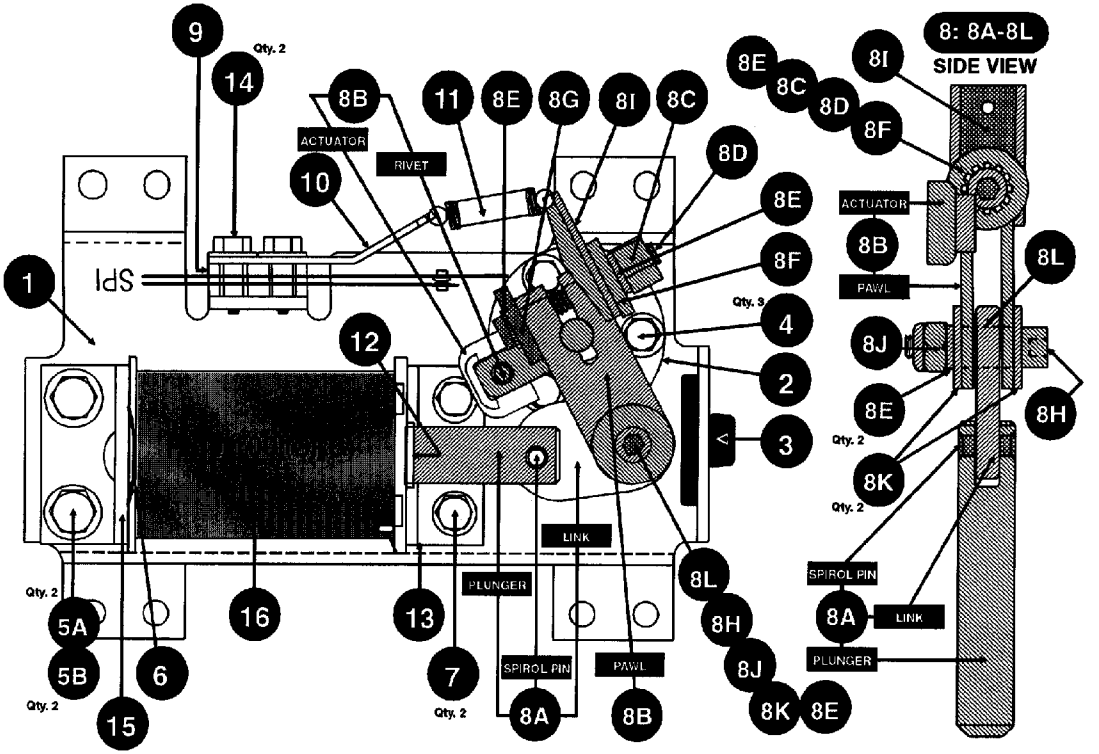
Nº	Individual Part Name	QTY.	SPI Part Nº
1	Ball Trough Outhole Mounting Bracket	1	515-6580-00
2	Coil Mounting Bracket	1	535-7330-01
3	Submini-Switch Roller Actuator	3	180-5119-00
4	#2-56 X 1/2" HWH (Ser) TF 3/16" Hd.	7	237-5937-01
5	Switch Diode, IN4001	3	112-5001-00
6	Coil, 26-1200	1	090-5044-00T
—	Diode, 1N4004 (positioned at top)	1	112-5003-00
7	Coil Sleeve	1	545-5076-00
8	Coil Retaining Bracket	1	535-5203-03
9	Plunger Assembly	1	515-5941-01
10	Compression Spring	1	266-5020-00
11	Rubber Bumper (Grommet)	1	545-5105-00
12	#8-32 X 1/4" HWH (Serr) Zinc TF	2	237-5964-00
13	#8-32 X 3/8" HWH Swage (Serr) Zinc	4	237-5975-00

Nº	Individual Part Name	QTY.	SPI Part Nº
14	OPTO Transmitter (TRANS) Board	1	520-5124-00
15	OPTO Receiver (REC) Board	1	520-5125-00
16	OPTO PCB Tube Spacer	6	530-5308-02
17	OPTO PCB Rubber Grommet	6	545-5518-00
18	#6-32 X 5/8" HWH Swage (Serr) Zinc	6	237-5976-04
19	Trough Ball Guide Plate	1	535-7801-00
20	1/4" X 5/16" X .144" I.D. Spacer Tap.	1	254-5014-03
21*	Cable Wiring Harness	1	036-5399-04

ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY.

Nº	Associated Part Name	QTY.	SPI Part Nº
22	Ball Trough Enter / Exit Scoop	1	535-7329-01
n/a *	#8 X 1/2" HWH AB (Zinc) Blue	9	234-5101-05
Note: Above item secures this 4-Ball Trough & Scoop to the playfield.			
n/a *	1-1/16" Steel Balls	4	260-5000-00

Flipper (Left) Assembly, 500-5944-14 (Items 1-16)
and Associated Part: Flipper Bat & Shaft Assy., 515-6532-08-05 (Item 17*)



Nº	Individual Part Name	QTY.	SPI Part Nº
1	Flipper Base Plate Kit (Left)	1	515-6617-01
ORDERING ABOVE ITEM NUMBER FOR ASSEMBLY PART NO. WILL INCLUDE:			
—	Flipper Base Plate (Right) already threaded with all necessary Thread Forming Screws (Items 4, 5A, 7 & 15)		
2	Flipper Bushing	1	545-5594-00
3	Deflector Pad (Bumper)	1	545-5428-00
4	#6-32 X 3/8" HWH Swage (Serr) Zinc	3	237-5976-02
5A	#10-32 X 3/8" SHWH Swage (Sr) Zn.	2	237-5985-00
5B	#10 Split Lock Washer	2	244-5003-00
6	Spring Washer	1	269-5002-00
7	#8-32 X 3/8" HWH Swage (Serr) Zinc	2	237-5975-00
8	Plunger, Link & Pawl (Left) Sub-Assy.	1	515-6518-01
ORDERING ABOVE ITEM NUMBER FOR ASSEMBLY PART NO. WILL INCLUDE:			
8A	**Flipper Plunger/Link Sub-Assy.**	1	515-6304-01
includes	*Flipper Link*	*1*	*545-5611-00*
includes	*Spirol Pin ø 5/32" X 7/16" Lg.*	*1*	*251-5015-01*
includes	*Flipper Plunger with "Flat"*	*1*	*530-5349-01*
8B	**Pawl (Mntg. Link) (Left) Sub-Assy.**	1	515-6305-01
includes	*Pawl (Mounting Link) (Left) Plain*	*1*	*535-7271-01*
includes	*Switch Actuator*	*1*	*535-5612-00*
includes	*Rivet, 1/8" ø X 1/4" Lg.*	*1*	*249-5003-00*
8C	#10-32 X 9/32" Long 3/8" Hex Nut	1	240-5209-00
8D	#10-32 SOC HD X 1.25" Lg.	1	237-5950-01
8E	#10 Star Washer	3	246-5002-00
8F	Wshr. .203"ID X .63"OD X .105" THK	1	242-5039-00
8G	Washer (same as 8F but w/angle cut)	1	242-5039-01
8H	#10-32 X 7/8" Lg. SOC HD	1	237-5968-00
8I	Return Bracket	1	535-7353-00
8J	#10-32 Nylon Stop Nut	1	240-5203-00
8K	Wshr. .203"ID X .63"OD X .062" THK	2	242-5038-00
8L	Flipper Bushing (Extended)	1	530-5139-01

Nº	Individual Part Name	QTY.	SPI Part Nº
9	Power (End of Stroke) Switch	1	180-5149-00
10	Switch Plate/Spring Return Lt. Brkt.	1	535-7354-01
11	Flipper Return Spring	1	265-5035-00
12	Coil Sleeve	1	545-5388-00
13	Coil Support Bracket	1	545-7356-00
14	#6-32 X 5/8" HWH Swage (Serr) Zinc	2	237-5976-04
15	Coil Stop Sub-Assembly	1	515-6308-01
ORDERING ABOVE ITEM NUMBER FOR ASSEMBLY PART NO. WILL INCLUDE:			
15A	Coil Stop with with .093" ø Hole	1	530-5350-01
15B	Shading Ring	1	590-5123-00
15C	Coil Stop Bracket	1	535-7355-00
16	Coil, 23-1100 (ORG)	1	090-5030-00T
ORDERING ABOVE ITEM NUMBER FOR ASSEMBLY PART NO. WILL INCLUDE:			
—	Diode, 1N4004 (positioned at top)	1	112-5003-00

ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY.

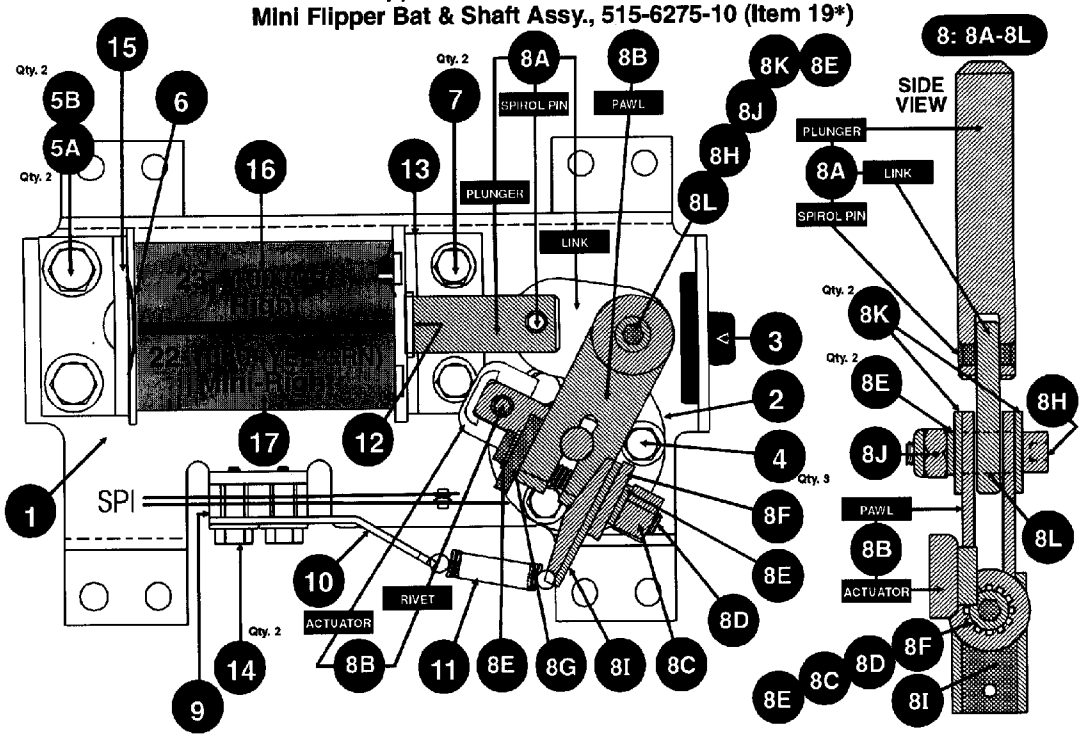
Nº	Associated Part Name	QTY.	SPI Part Nº
17*	Flipper Bat & Shaft (Knurled-End) Assy. White with Sega Saturn™ Logo ©1997	1	515-6532-08-05
n/a *	Large Flipper Rubber Ring	1	545-5277-00
n/a *	#10 X 1/2" HWH MS (Serr) Zinc ST	8	237-5949-00
Note: Above item secures this Flipper to the playfield.			

Take Note:

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

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

Flipper (Right) Assy., 500-5944-04 (Items 1-16), Flipper (Mini-Right) Assy. 500-5944-02 (Items 1-15 + 17) and Assoc. Parts: Flipper Bat & Shaft Assy., 515-6532-08-05 (Item 18*) & Mini Flipper Bat & Shaft Assy., 515-6275-10 (Item 19*)



Nº	Individual Part Name	QTY.	SPI Part Nº
1	Flipper Base Plate Kit (Right)	1	515-6617-00
ORDERING ABOVE ITEM (1) ASSY. PART NO. INCLUDES:			
—	Flipper Base Plate (Right) already threaded with all necessary Thread Forming Screws (Items 4, 5A, 7 & 15)		
2	Flipper Bushing	1	545-5594-00
3	Deflector Pad (Bumper)	1	545-5428-00
4	#6-32 X 3/8" HWH Swage (Serr) Zinc	3	237-5976-02
5A	#10-32 X 3/8" SHWH Swage (Sr) Zn.	2	237-5985-00
5B	#10 Split Lock Washer	2	244-5003-00
6	Spring Washer	1	269-5002-00
7	#8-32 X 3/8" HWH Swage (Serr) Zinc	2	237-5975-00
8	Plunger, Link & Pawl (Rt.) Sub-Assy.	1	515-6518-00
ORDERING ABOVE ITEM (8) ASSY. PART NO. INCLUDES:			
8A	**Flipper Plunger/Link Sub-Assy.**	1	515-6304-01
Includes:	*Flipper Link*	*1*	*545-5611-00*
Includes:	*Spirol Pin ø 5/32" X 7/16" Lg.*	*1*	*251-5015-01*
Includes:	*Flipper Plunger with "Flat"*	*1*	*530-5349-01*
8B	**Pawl (Mntg. Link) (Rt.) Sub-Assy.**	1	515-6305-00
Includes:	*Pawl (Mounting Link) (Rt.) Plain*	*1*	*535-7271-00*
Includes:	*Switch Actuator*	*1*	*545-5812-00*
Includes:	*Rivet, 1/8" ø X 1/4" Lg.*	*1*	*249-5003-00*
8C	#10-32 X 9/32" Long 3/8" Hex Nut	1	240-5209-00
8D	#10-32 SOC HD X 1.25" Lg.	1	237-5950-01
8E	#10 Star Washer	3	246-5002-00
8F	Wshr. .203"ID X .63"OD X .105" THK	1	242-5039-00
8G	Washer (same as 8F but w/angle cut)	1	242-5039-01
8H	#10-32 X 7/8" Lg. SOC HD	1	237-5966-00
8I	Return Bracket	1	535-7353-00
8J	#10-32 Nylon Stop Nut	1	240-5203-00
8K	Wshr. .203"ID X .63"OD X .062" THK	2	242-5038-00
8L	Flipper Bushing (Extended)	1	530-5139-01

Nº	Individual Part Name	QTY.	SPI Part Nº
9	Power (End of Stroke) Switch	1	180-5149-00
10	Switch Plate/Spring Return Rt. Brkt.	1	535-7354-00
11	Flipper Return Spring	1	265-5035-00
12	Coil Sleeve	1	545-5388-00
13	Coil Support Bracket	1	535-7356-00
14	#6-32 X 5/8" HWH Swage (Serr) Zinc	2	237-5976-04
15	Coil Stop Sub-Assembly	1	515-6308-01
ORDERING ABOVE ITEM (15) ASSY. PART NO. INCLUDES:			
—	Coil Stop with with .093" ø Hole	1	530-5350-01
—	Shading Ring	1	590-5123-00
—	Coil Stop Bracket	1	535-7355-00
16	Coil, 23-1100 (ORG) for Right	1	090-5030-00T
ORDERING ABOVE ITEM (16) COIL ASSY. PART NO. INCLUDES:			
—	Diode, 1N4004 (positioned at top)	1	112-5003-00
17	Coil, 22-1080 (YEL-GRN) for Mini-Rt.	1	090-5032-00T
ORDERING ABOVE ITEM (17) COIL ASSY. PART NO. INCLUDES:			
—	Diode, 1N4004 (positioned at top)	1	112-5003-00

ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY.

Nº	Associated Part Name	QTY.	SPI Part Nº
18*	Flipper Bat & Shaft (Knurled-End) Assy. White with Sega Saturn™ Logo ©1997	1	515-6532-08-05
19*	Mini Flip. Bat & Shaft Assy. Fluor. Org.	1	515-6275-10
n/a *	Large Flipper Rubber Ring	1	545-5277-00
n/a *	Mini Flipper Rubber Ring	1	545-5207-00
n/a *	#10 X 1/2" HWH MS (Serr) Zinc ST	16	237-5949-00

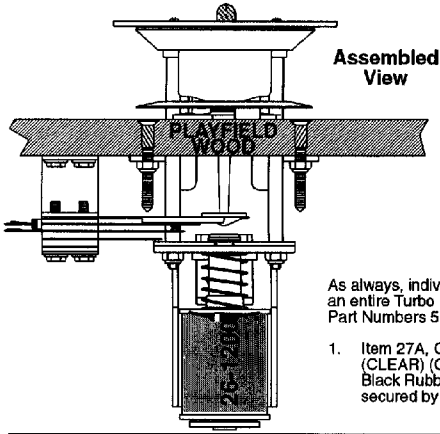
Note: Above item secures both Flipper Assemblies to the playfield.

Take Note:

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

1. ***IMPORTANT:*** Read "**Take Note:**" Items 1 & 2 on previous page.

Turbo Bumper Top Assy., 515-6459-01 (Qty. 3) (Items 1-10A), Turbo Bumper Bottom Assy., 515-6459-04 (Qty. 3) (Items 10B-19), Turbo Bumper Switch Assy., 515-6459-03 (Qty. 3) (Items 20-25) and Assoc. Parts: See Table Below (Items 26-29)

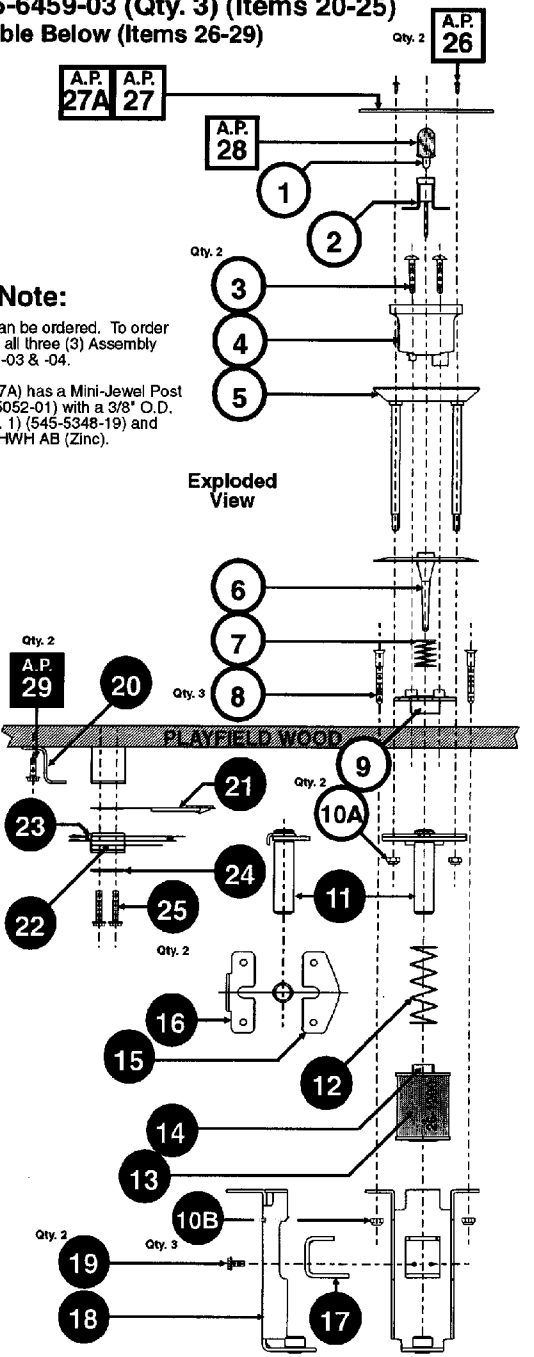


Assembled View

Take Note:

As always, individual parts can be ordered. To order an entire Turbo Bumper, use all three (3) Assembly Part Numbers 515-6459-01, -03 & -04.

1. Item 27A, Cap (Buty. -17A) has a Mini-Jewel Post (CLEAR) (Qty. 1) (550-5052-01) with a 3/8" O.D. Black Rubber Ring (Qty. 1) (545-5348-19) and secured by a #6 X 3/8" HWH AB (Zinc).



Exploded View

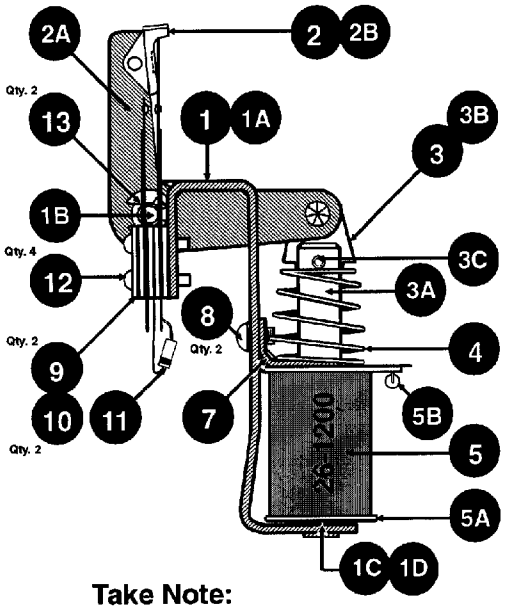
Nº	Individual Part Name	QTY.	SPI Part Nº
Turbo Bumper Top Assy., 515-6459-01 (Items 1-10A)			
1	#555 Wedge Base Bulb	1	165-5002-00
2	#555 Wedge Base Socket	1	077-5206-00
3	#5 X 7/8" PRH AB (Zinc)	2	237-5826-00
4	Bumper Body	1	545-5197-00
5	Ring Assembly	1	515-5085-00
6	Bumper Skirt	1	545-5607-00
7	Bumper Skirt Spring	1	266-5048-00
8	#6-32 X 1-3/16" Spiral Fin Shank	3	237-5957-00
9	Bumper Base	1	545-5195-00
10A	#6-32 Nylon Stop Nut	2	240-5005-00
Turbo Bumper Bottom Assy., 515-6459-04 (Items 10B-19)			
10B	#6-32 Nylon Stop Nut	3	240-5005-00
11	Plunger	1	530-5348-00
12	Coil Spring	1	266-5047-00
13	Coil, 26-1200	1	090-5044-00T
ORDERING ABOVE (ITEM 13) COIL PART Nº WILL INCLUDE:			
—	Diode, 1N4004 (positioned at top)	1	112-5003-00
14	Coil Sleeve	1	545-5031-00
15	Fiber Yoke	1	545-5609-00
16	Metal Yoke	1	535-7346-00
17	Metal Yoke Stop	1	535-7347-00
18	Coil Bracket Welded Assembly	1	515-5939-00
19	#6-32 X 1/4" HWH Swage (Serr) Zinc	2	237-5976-01
Turbo Bumper Switch Assy., 515-6459-03 (Items 20-25)			
20	Switch Bracket	1	535-7342-00
21	Spoon Switch Actuator	1	545-5610-01
22	Stack Switch	1	180-5015-03
23	Switch Diode, 1N4001	1	112-5001-00
24	Switch Body Protect Plate	1	535-7344-00
25	#6-32 X 3/4" HWH Swage (Serr) Zinc	2	237-5976-05

ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY.

Nº	Assoc. Part Name	QTY.	SPI Part Nº
26	#4 X 1/2" PFH (Zinc) (2/per)	6	237-5840-00
27	Cap (Buty. -17) (Lt. / Bot.)	2	830-5926-17
27A	Cap (Buty. -17A, has hole for Post) (Rt.)	1	830-5926-17A
28	Rubber Lite Cover RED (1/per)	3	545-5014-02
29	#8 X 1/2" HWH AB (Zinc) Blue (2/per)	6	234-5101-05

Note: Above Item 29 secures Item 20 to the playfield.

Slingshot Assembly, 500-5849-01 (Qty. 2) (Items 1-13)



Take Note:

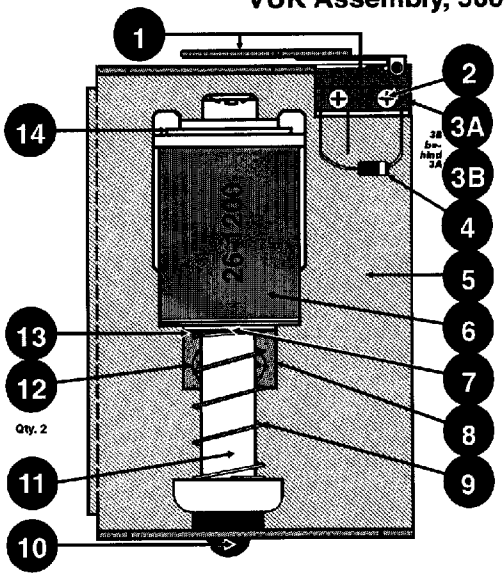
* An asterisk (*) indicates item is *Not Shown* in pictorial.

Nº	Individual Part Name	QTY.	SPI Part Nº
1	Slingshot Bracket Assembly	1	515-5339-01
ORDERING ABOVE ITEM 1 SUB-ASSY PART Nº WILL INCLUDE:			
1A	Slingshot Bracket	1	535-5919-01
1B	Hinge Stud	1	530-5034-01
1C	Armature Stop	1	530-5017-01
1D	Shading Ring	1	530-5307-00
2	Arm & Tip Assembly	1	515-5340-01
ORDERING ABOVE ITEM 2 SUB-ASSY PART Nº WILL INCLUDE:			
2A	Arm	1	515-5341-01
2B	Kicker Tip	1	545-5216-01
2C	Rivet 1/8" ø x 1/4" Lg.	1	249-5003-00
3	Plunger & Link Assembly	1	515-5338-00
ORDERING ABOVE ITEM 3 SUB-ASSY PART Nº WILL INCLUDE:			
3A	Plunger 2" Lg.	1	530-5025-01
3B	Plunger Link	1	545-5293-00
3C	Roll Pin 1/8" ø x 5/8" Lg.	1	251-5008-00
4	Compression Spring	1	266-5020-00
5	Coil, 26-1200	1	090-5044-00T
ORDERING ABOVE ITEM 5 COIL PART Nº WILL INCLUDE:			
—	Diode, 1N4004 (positioned at top)	1	112-5003-00
6	Coil Sleeve	1	545-5031-00
7	Coil Retaining Bracket	1	535-5203-03
8	#8-32 X 1/4" PPH MS (Sems) Zinc	2	232-5300-00
9	Slingshot Switch	2	180-5054-00
10	Switch Body Protect Plate	2	535-5045-00
11	Switch Diode, 1N4001	2	112-5001-00
12	#6-32 X 5/8" HWH Swage (Serr) Zinc	4	237-5976-04
13	Retaining Ring, 1/4" ø Shaft	2	270-5002-00

ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY.

Nº	Associated Part Name	QTY.	SPI Part Nº
n/a *	2-1/2" I.D. Black Rubber Ring (Right)	1	545-5348-09
n/a *	2--3/4" I.D. Black Rubber Ring (Left)	1	545-5348-20
n/a *	#8 X 1/2" HWH AB (Zinc) Blue (3 per)	6	234-5101-05
Note: Above item secures both Slingshots to the playfield.			

VUK Assembly, 500-5839-04 (Items 1-14)

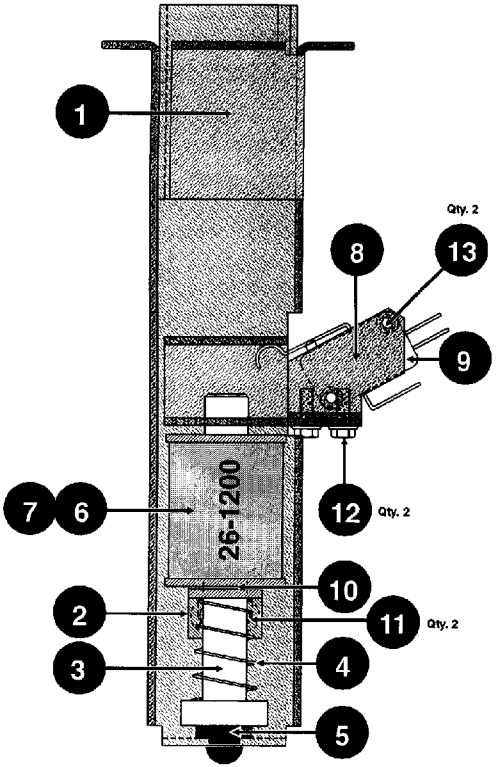


Nº	Individual Part Name	QTY.	SPI Part Nº
1	Micro Switch (Heavy Duty "Y" Acutator)	1	180-5116-01
2	#2-56 X 1/2" HWH MS (Ser) 3/16" Hd.	2	237-5937-01
3A	Switch Body Protect Plate	1	535-6539-00
3B	Switch Insulation (Fiche Paper)	1	545-5759-00
4	Switch Diode, 1N4001	1	112-5001-00
5	VUK Bracket	1	535-6607-00
6	Coil, 26-1200	1	090-5044-00T
ORDERING ABOVE ITEM 6 COIL PART Nº WILL INCLUDE:			
—	Diode, 1N4004 (positioned at top)	1	112-5003-00
7	Coil Sleeve	1	545-5076-00
8	Coil Retainer Bracket	1	535-5203-03
9	Compression Spring	1	266-5020-00
10	Rubber Bumper (Grommet)	1	545-5105-00
11	Plunger Assembly	1	515-5941-01
12	#8-32 X 1/4" PPH MS (Sems) Zinc	2	232-5300-00
13	Crescent Spring Washer	1	269-5002-00
14	Coil Lug Insulation (Fiche Paper)	1	545-5431-00

ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY.

Nº	Associated Part Name	QTY.	SPI Part Nº
n/a *	#8 X 1/2" HWH AB (Zinc) Blue	3	234-5101-05
Note: Above item secures this VUK to the playfield.			

Super VUK Assembly, 500-6245-02-59 (Items 1-15)



Take Note:

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

1. Note: The Switch Diode, 1N4001, is not located on this assembly (nor included); it's located on a terminal strip under the playfield.

Nº	Individual Part Name	QTY.	SPI Part Nº
1	SVUK Weldment Bracket Assembly	1	515-6744-02
2	Coil Retainer Bracket	1	535-5203-03
3	Plunger Assembly	1	515-5941-01
4	Compression Spring	1	266-5020-00
5	Rubber Bumper (Grommet)	1	545-5105-00
6	Coil, 26-1200	1	090-5044-00T
ORDERING ABOVE (ITEM 6) COIL PART Nº WILL INCLUDE:			
— *	Diode, 1N4004 (positioned at top)	1	112-5003-00
7	Coil Sleeve	1	545-5076-00
8	SVUK Switch Bracket	1	535-8144-00
9	Micro Switch	1	180-5052-00
10	Spring Wshr. 17/32" ID X 3/4" X 1/16"	1	269-5002-00
11	#8-32 X 1/4" PPH MS (Sems) Zinc	2	232-5300-00
12	#6-32 X 3/8" HWH Swage (Serr) Zinc	2	237-5976-02
13	#4-40 X 5/8" HWH MS (Serr) Zinc ST	2	237-5945-00
14*	Heat Shrink Tubing 1/8 ø BLK (.125")	1	605-5002-00
15*	Cable Wiring Harness	1	036-5429-05-59

ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY.

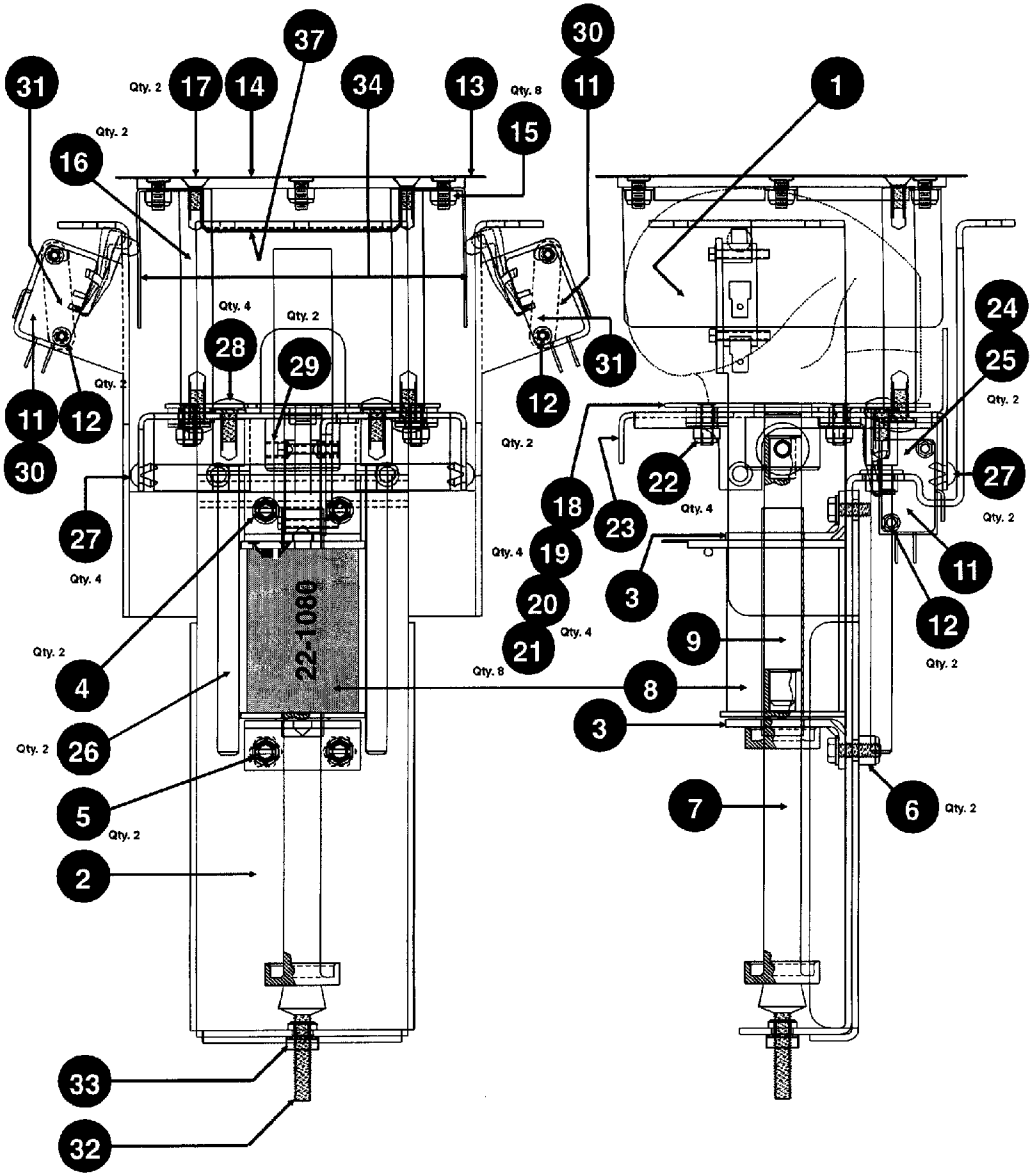
Nº	Associated Part Name	QTY.	SPI Part Nº
n/a *	#8 X 1/2" HWH AB (Zinc) Blue	2	234-5101-05
Note: Above item secures this Super VUK to the playfield.			
n/a *	Super VUK Enter/Exit Scoop	1	535-8154-00
n/a *	#8-32 X 1" HWH MS (Zinc)	2	237-5890-01
n/a *	#8-32 Nylon Stop Nut	2	240-5102-00
Note: Above item is located above the Super VUK.			

Brain Bug Assembly, 500-6256-00-59 (Items 1-38)

Nº	Individual Part Name	QTY.	SPI Part Nº
1	Brain Bug	1	880-5004-00
2	Mounting Bracket Weldment Assy.	1	515-6790-00
3	Coil Support Bracket	2	535-7356-00
4	#8-32 X 3/8" HWH MS Type	2	237-5903-00
5	#8-32 X 1/2" HWH Swage (Serr) Zinc	2	237-5975-01
6	#8-32 Nylon Stop Nut	2	240-5102-00
7	Plunger Assembly	1	515-6792-00
8	Coil, 22-1080 (YEL-GRN)	1	090-5032-00T
ORDERING ABOVE (ITEM 8) COIL PART Nº WILL INCLUDE:			
—	Diode, 1N4004 (positioned at top)	1	112-5003-00
9	Coil Sleeve (with extension)	1	545-5847-00
10	Rubber Bumper (Grommet)	1	545-5105-00
11	Limit Switch (Cherry #E33-90N)	3	180-5165-00
12	#4-40 X 5/8" HWH MS (Serr) Zinc ST	6	237-5945-00
13	Window Flap Assembly	1	515-6789-00
14	Window	1	545-5845-00
15	#6-32 Nylon Stop Nut (1/4" Hex Body)	8	240-5010-00
16	Support Pin	2	530-5497-00
17	#8-32 X 3/8" PFH MS (Zinc)	2	237-5902-00
18	Slide Plate Assembly	1	515-6791-00
19	Nylon Spacer (Richo #R905-3)	4	254-5023-00
20	Wshr. .265" X 1/2" X .047" Stainless	4	242-5060-00
21	Wshr. 1/4" ID X 1/2" OD X .062 Teflon	8	242-5040-01
22	#6-32 Nylon Stop Nut	4	240-5005-00
23	Base Plate Assembly	1	515-6793-00
24	Switch Mounting Bracket	1	535-8197-00
25	Rivet, 1/8" ø X 3/16" Lg.	2	249-5001-00
26	Guide Pin	2	530-5496-00
27	Plasti-Plug (ITW FASATX#207-12055-00)	6	545-5846-00
28	#10-32 X 3/8" PPH MS (Sems) Zinc	4	232-5401-00
29	#10-32 X 3/8" Soc. Hd. Cap Scrw. Zn.	2	237-5845-00
30	Switch Diode, 1N4001	2	112-5001-00
31	#4-40 Nut Plate	1	535-8212-00
32	Adj. Spindle Stop	1	280-5014-00
33	#10-32 Keps Nut	1	240-5208-00
34	Deflector	2	535-8262-00
35*	PEM Nut Plate (Inside Item 1)	1	515-6811-00
36*	#6-32 X 1/2" PPH MS (Zinc) (for Item 1)	4	237-5502-00
37	Wire Form (Ball Trap Prevention)	1	535-8245-00
38*	Cable Wiring Harness	1	036-5429-17-59

ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY.

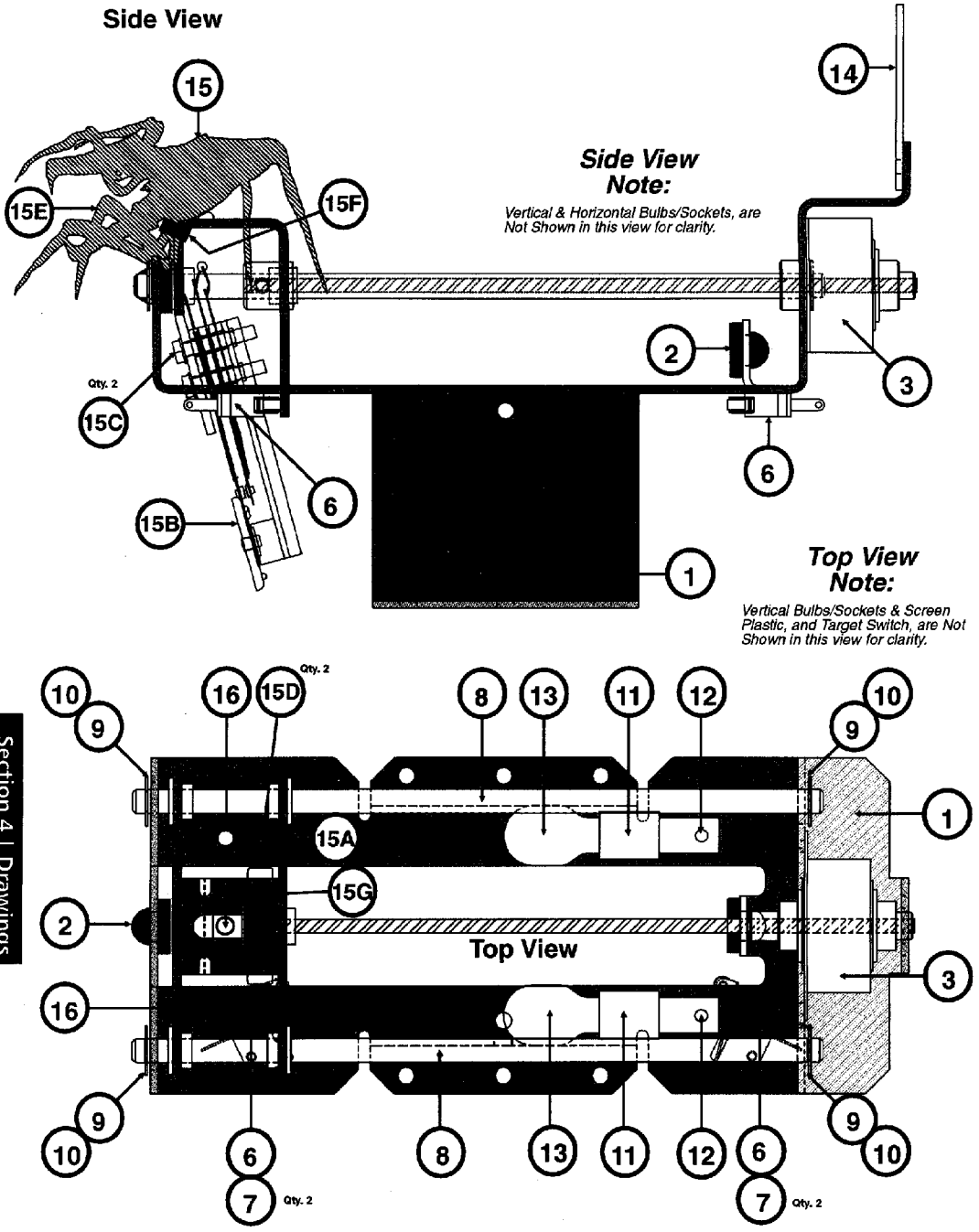
Nº	Associated Part Name	QTY.	SPI Part Nº
n/a *	#8 X 1/2" HWH AB (Zinc) Blue	7	234-5101-05
Note: Above item secures this Brain Bug Assy. to the playfield.			



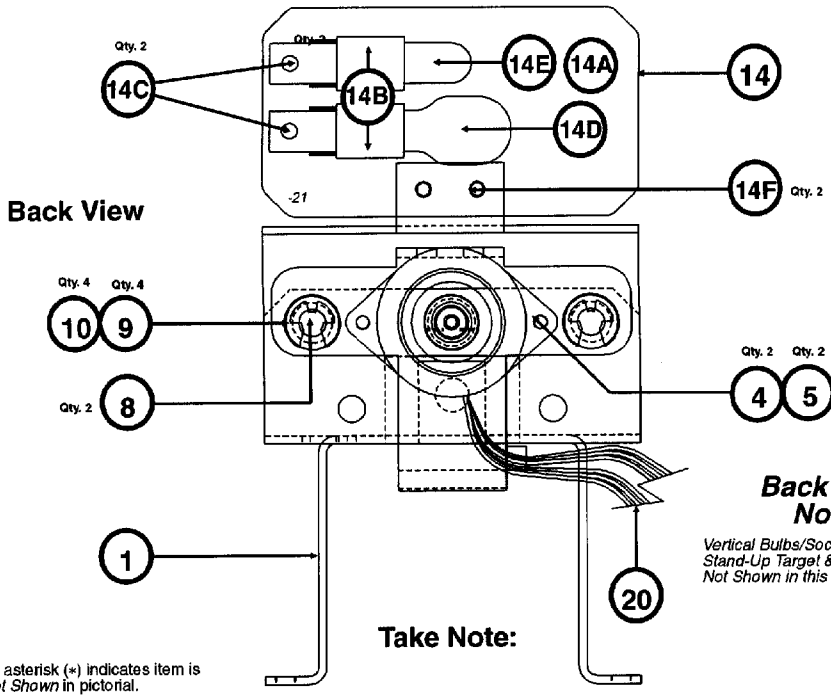
Take Note:

* An asterisk (*) in the Brain Bug Parts Table (previous page) indicates item is *Not Shown* in pictorial above.

Warrior Bug Assembly, 500-6239-00-59 (Items 1-17)
(Part Number Tables on next page)



Warrior Bug Assembly, 500-6239-00-59 (Items 1-17) *Continued*



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

1. For Item 3, HSI Stepper Motor, see Appendix -F- (bottom of Page 127) for the detailed Motor Specifications.
2. Note: The Switch Diode, 1N4001, (Qty. 3), 2-Micro Switches & 1-S-U Target are not located on this assembly (nor included); all 3 are located on a terminal strip under the playfield.
3. Item 14 has sockets riveted to the Plastic Piece; for individuals who can't remove rivets the 515-6777-21-59 Assy. must be ordered.
4. Item 15B-1, Switch & Target 1" X 1-1/2" Rectangle White, is a riveted assembly referencing (a), (b), (c) & (d) Part Numbers, for the individuals who can remove rivets and only require the unique item, otherwise just order the 515-6027-08 Part Number.

Nº	Individual Part Name	QTY.	SPI Part Nº
1	Warrior Bug Assembly Base	1	535-8152-00
2	Rubber Bumper (Grommet)	2	545-5105-00
3	HSI Stepper Motor Sub-Assembly	1	515-6794-00-59
ORDERING ABOVE ITEM 3 STEPPER MOTOR SUB-ASSY WILL INCLUDE:			
3A	HSI Stepper Motor	1	041-5062-00
3B	Stepper Motor Shaft, 7"	1	530-5503-00
3C	7-Pin Connector (CE100F22-07FR.DR.)	1	045-5157-07
3D	Polarizing Key (PK156D)	1	060-5000-00
4	#4-40 X 1/2" PPH MS (Sems) Zinc	2	237-5813-00
5	#4-40 Nylon Stop Nut	2	240-5303-00
6	Micro Switch (Roller Actuator)	2	180-5119-00
7	#2-56 X 3/8" HWH MS (Ser) 3/16" Hd.	4	237-5938-01
8	Support Pin, 7.18" Lg.	2	530-5449-02
9	Washer 1/4" ID X 7/16" OD X 1/32"	4	242-5012-00
10	Retaining Ring, 1/4" ø Shaft	4	270-5002-00
11	Laydown WB Socket (with notch)	2	077-5026-01
12	Rivet, 1/8" ø X 5/32" Lg.	2	249-5009-00
13	#906 Wedge Base (WB) Bulb	2	165-5004-00
14	Screened Plastic (Butyrate) -21 Assy.	1	515-6777-21-59
14A	Screened Plastic (Butyrate) -21	1	830-5926-21
14B	WB Offset (with Step-Bracket) Socket	2	077-5029-00
14C	Rivet, 1/8" ø X 5/32" Lg.	2	249-5009-00
14D	#906 Wedge Base (WB) Bulb	1	165-5004-00
14E	#555 Wedge Base (WB) Bulb	1	165-5002-00
14F	#6-32 X 3/8" HWH Swage (Ser) Zinc	2	237-5976-02

Nº	Individual Part Name	QTY.	SPI Part Nº
15	Warrior Bug Sub-Assembly	1	515-6775-00-59
ORDERING ABOVE ITEM 15 SUB-ASSY WILL INCLUDE:			
15A	Carriage Assembly (with Bearings)	1	515-6766-00
15B	Warrior Bug Target Sub-Assembly	1	515-6776-08-59
	Item 15B consists of 15B-1, 15B-2 and 15B-3:		
15B-1	*Sw. & Target 1" X 1-1/2" Rect. Wht.*	*1*	*515-6027-08*
	Item 15B-1 consists of (a)-(d):		
	(a) Stack Switch (Radius End)	*(1)*	*180-5133-00*
	(b) Target 1" X 1-1/2" White Plain	*(1)*	*545-5145-08*
	(c) Rivet, 1/8" ø X 3/16" Lg.	*(1)*	*249-5001-00*
	(d) Washer #4 ID X 5/16" OD X 1/32"	*(1)*	*242-5017-00*
15B-2	*Switch Back Plate*	*1*	*535-6452-00*
15B-3	*Foam Pad*	*1*	*626-5029-00*
15C	#6-32 X 3/4" HWH Swage (Serr) Zinc	2	237-5976-05
15D	#8-32 X 3/8" Soc. Hd. Cap Scr. (Zn)	2	237-5897-00
15E	Warrior Bug Toy	1	860-5003-00
15F	4" Cable Tie (Black)	1	040-5007-00
15G	Rubber (Grommet) (used on OPTO PCBs)	1	545-5518-00
15H*	Cable Wiring Harness	1	036-5429-16-59
16	Clear Bumper	2	280-5012-00
17*	Cable Wiring Harness	1	036-5429-15-59
	Corrugated Tubing ½" ø (Black), (12")	2	605-5013-00

Above Item covers the Cable Wiring Harness (1.25) on the Warrior Bug Assembly.

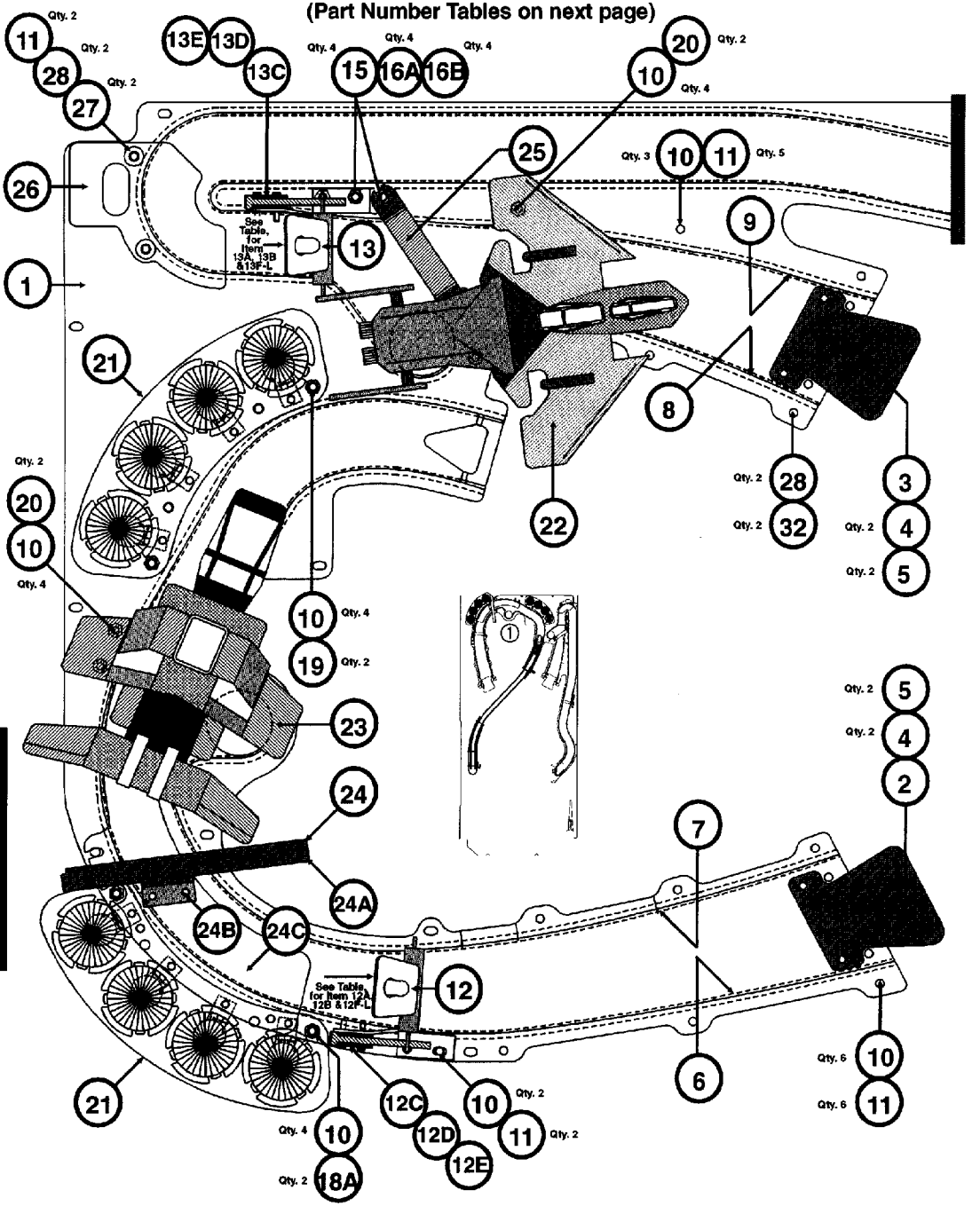
ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY.

Nº	Associated Part Name	QTY.	SPI Part Nº
n/a *	#8-32 X 5/8" HWH Swage (Serr) Zinc	6	237-5975-03

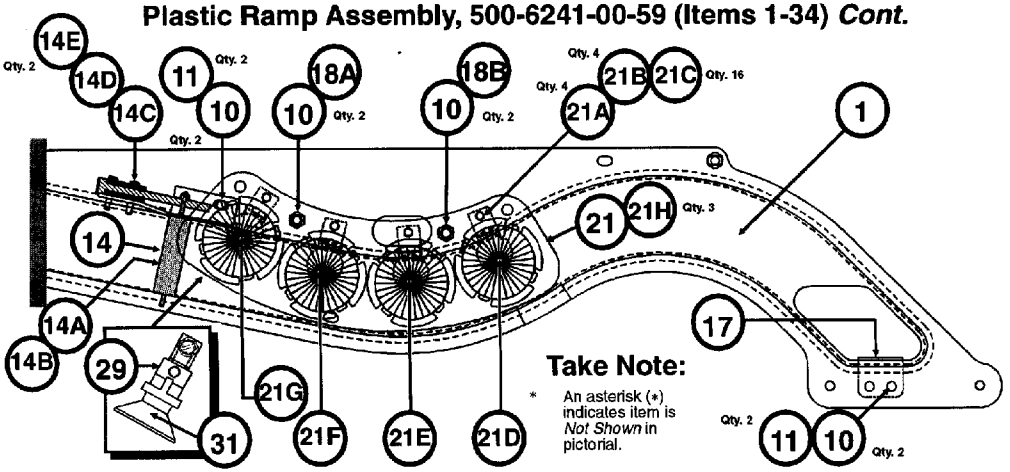
Note: Above Item secures this Warrior Bug Assy. to the playfield.

Plastic Ramp Assembly, 500-6241-00-59 (Items 1-34)

(Part Number Tables on next page)



Plastic Ramp Assembly, 500-6241-00-59 (Items 1-34) *Cont.*



Nº	Individual Part Name	QTY.	SPI Part Nº
1	Plastic Ramp (Plain)	1	545-5839-00
2	Ramp Flap (Left Entrance)	1	535-8159-00
3	Ramp Flap (Right Entrance)	1	535-8160-00
4	Rivet, 1/8" ø X 3/16" Lg.	4	249-5001-00
5	Washer 9/64" ID X 5/16" OD X 1/3"	4	242-5017-00
6	Ramp Protector (Lt. Entr., Lt. Side)	1	535-8161-01
7	Ramp Protector (Lt. Entr., Rt. Side)	1	535-8162-01
8	Ramp Protector (Rt. Entr., Lt. Side)	1	535-8163-01
9	Ramp Protector (Rt. Entr., Rt. Side)	1	535-8164-02
10	#6-32 X 3/8" PPH MS (Sems) Zinc	35	232-5201-00
11	#6-32 Nylon Stop Nut	19	240-5005-00
12	Gate & Sign Assembly (Enter Left)	1	515-6774-02-59
ORDERING ABOVE ITEM 12 SUB-ASSY PART Nº WILL INCLUDE:			
12A	Gate Bracket	1	535-6303-02
12B	Wire Form	1	535-6304-03
12C	Micro Switch (Wire Gate)	1	180-5087-00
12D	Switch Diode, 1N4001	1	112-5001-00
12E	#2-56 X 3/8" HWH MS(Ser) 3/16" Hd.	2	237-5938-01
—	Sign Sub-Assembly (Incl. 12F-12K)	1	515-6777-19-59
12F	*Screened Plastic (Buty) -19 Sign Lt.*	*1*	*830-5926-19*
12G	*WB Offset (w/Step-Bracket) Socket*	*1*	*077-5029-00*
12H	*#555 Wedge Base Bulb*	*1*	*165-5002-00*
12I	*Rivet, 1/8" ø 3/16" Lg.*	*1*	*249-5001-00*
12J	*#6 Lock Washer*	*1*	*246-5000-00*
12K	*Rubber Lite Cover Fluor. Orange*	*1*	*545-5014-10*
12L	#6 X 3/8" HWH AB (Zinc)	2	234-5000-00
12M*	Enter Left Cable Wiring Harness	1	036-5429-02-59
13	Gate & Sign Assembly (Enter Right)	1	515-6774-03-59
ORDERING ABOVE ITEM 13 SUB-ASSY PART Nº WILL INCLUDE:			
13A	Gate Bracket	1	535-6303-03
13B	Wire Form	1	535-6304-03
13C	Micro Switch (Wire Gate)	1	180-5087-00
13D	Switch Diode, 1N4001	1	112-5001-00
13E	#2-56 X 3/8" HWH MS(Ser) 3/16" Hd.	2	237-5938-01
—	Sign Sub-Assembly (Incl. 13F-13K)	1	515-6777-18-59
13F	*Screened Plastic (Buty) -18 Sign Rt.*	*1*	*830-5926-18*
13G	*WB Offset (w/Step-Bracket) Socket*	*1*	*077-5029-00*
13H	*#555 Wedge Base Bulb*	*1*	*165-5002-00*
13I	*Rivet, 1/8" ø 3/16" Lg.*	*1*	*249-5001-00*
13J	*#6 Lock Washer*	*1*	*246-5000-00*
13K	*Rubber Lite Cover Fluor. Orange*	*1*	*545-5014-10*
13L	#6 X 3/8" HWH AB (Zinc)	2	234-5000-00
13M*	Enter Right Cable Wiring Harness	1	036-5429-03-59
14	Gate Assembly (Wire Form Exit)	1	515-6490-01
ORDERING ABOVE ITEM 14 SUB-ASSY PART Nº WILL INCLUDE:			
14A	Gate Bracket	1	535-7613-02
14B	Wire Form	1	535-6304-03
14C	Micro Switch (Wire Gate)	1	180-5087-00
14D	Switch Diode, 1N4001	1	112-5001-00
14E	#2-56 X 3/8" HWH MS(Ser) 3/16" Hd.	2	237-5938-01

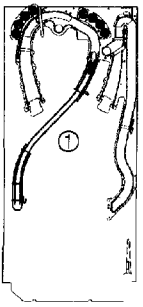
Nº	Individual Part Name	QTY.	SPI Part Nº
15	1/2" X 1/4" Hex Spacer #6-32 Tap.	4	254-5008-03
16A	#6-32 X 1/4" PPH MS (Sems) Zinc	4	232-5200-00
16B	#6-32 X 3/8" PPH MS (Sems) Zinc	4	232-5201-00
17	Ramp Protector (Right Exit Hole)	1	535-8167-00
18A	1-1/8" X 1/4" Hex Spacer #6-32 Tap.	3	254-5008-17
18B	1" X 1/4" Hex Spacer #6-32 Tap.	1	254-5008-06
19	1-1/2" X 1/4" Hex Spacer #6-32 Tap.	2	254-5008-09
20	2-1/2" X 1/4" Hex Spacer #6-32 Tap.	4	254-5008-16
21	4X Light & Clear Plastic Assembly	3	515-6778-01-59
ORDERING ABOVE ITEM 21 SUB-ASSY PART Nº WILL INCLUDE:			
21A	WB Offset (w/Step-Bracket) Socket	4	077-5029-00
21B	#906 Wedge Base Bulb	4	165-5004-00
21C	Rivet, 1/8" ø 3/16" Lg. and #6 Lock Washer (Riveting)	16	249-5001-00
—*		16	246-5000-00
21D	Mini-Mars Light Cover Snap-in Blue	1	550-5030-05
21E	Mini-Mars Light Cover Snap-in Yellow	1	550-5030-06
21F	Mini-Mars Light Cover Snap-in Green	1	550-5030-04
21G	Mini-Mars Light Cover Snap-in Red	1	550-5030-02
21H	Clear Plastic (Dome Mounting Base)	1	830-5927-04
21I*	FL Lamp F1-F4 Cable Wiring Harness	1	036-5429-09-59
Note: *Above Item 21, 4X Light & Clear Plastic Assy., (Qty. 1) (515-6778-01-59) is also located over the Wire Ramp by the Hopper Bug. Assembly (Item 14 in the Pink Pages, Sec. 4, Chp. 1, Page 59).*			
22	TAC Fighter Toy	1	880-5001-00
23	Retrieval Ship Toy	1	880-5002-00
24	Motor Shaft Guard Assembly	1	515-6778-05-59
ORDERING ABOVE ITEM 24 SUB-ASSY PART Nº WILL INCLUDE:			
24A	Motor Shaft Guard	1	535-8216-00
24B	Rivet, 1/8" ø 3/16" Lg.	2	249-5001-00
24C	Clear Plastic (Butyrate) -05	1	830-5927-05
24D*	#6 X 1/2" PTH A (Zinc)	2	237-5809-00
25	1-Way Gate Mounting Bracket	1	535-5269-06
	Wire Gate (for above)	1	535-5307-09
26	Clear Plastic (Butyrate) -03	1	830-5927-03
27	1/2" X 3/8" Spacer Gray	2	254-5000-01
28	#6-32 X 1" PPH MS (Sems) Zinc	4	232-5206-00
29	Laydown WB Socket (with notch)	1	077-5026-01
30*	#555 Wedge Base Bulb (In Item 31)	1	165-5002-00
31	Light Reflector	1	545-5409-01
32	3/8" X 3/8" Spacer Gray	2	254-5000-12
33*	Clear Plastic Rt. Rmp. Enter Cover	1	830-5927-06
34*	Ramp Rt. Exit Cable Wiring Harness	1	036-5429-07-59

ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY.

Nº	Associated Part Name	QTY.	SPI Part Nº
n/a *	#4 X 5/8" PFH (Black)	4	237-5833-00

Note: Above item secures the Ramp Flaps to the playfield.

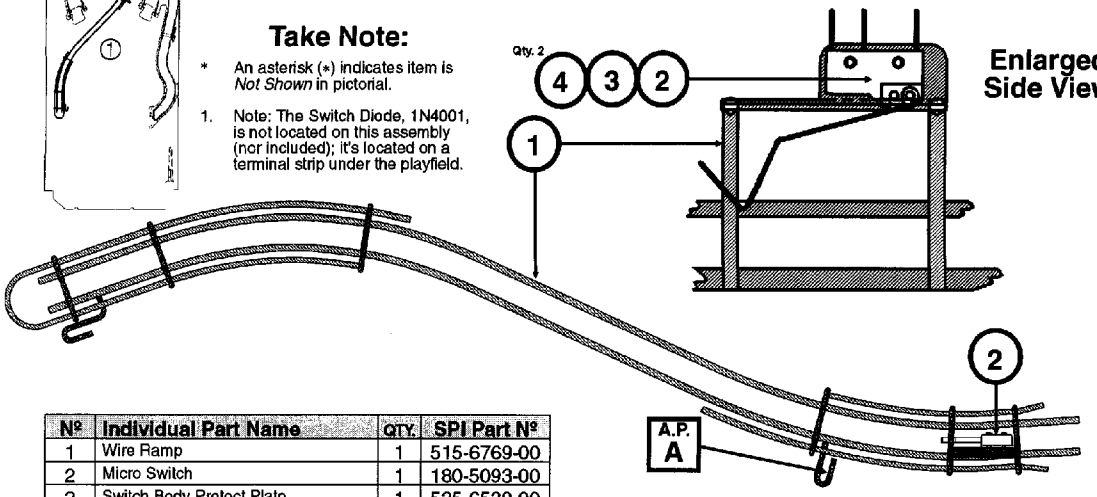
Wire Ramp Assembly, 500-6248-00-59 (Items 1-5)



Take Note:

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

1. Note: The Switch Diode, 1N4001, is not located on this assembly (nor included); it's located on a terminal strip under the playfield.

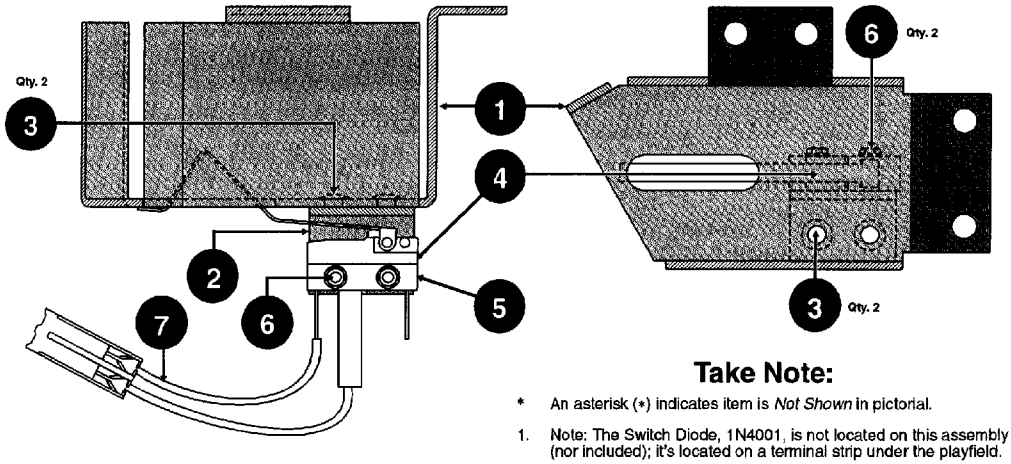


Nº	Individual Part Name	QTY.	SPI Part Nº
1	Wire Ramp	1	515-6769-00
2	Micro Switch	1	180-5093-00
3	Switch Body Protect Plate	1	535-6539-00
4	#2-56 X 1/2" HWH MS (Ser) 3/16" Hd.	2	237-5937-01
5*	Left Ramp Exit Cable Wiring Harness	1	036-5429-06-59

ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY.

Nº	Associated Part Name	QTY.	SPI Part Nº
A	1-3/4" X 1/4" Hex Spacer #6-32	1	254-5018-06

Metal Under-Trough Assembly, 500-6243-00-59 (Items 1-7)



Take Note:

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

1. Note: The Switch Diode, 1N4001, is not located on this assembly (nor included); it's located on a terminal strip under the playfield.

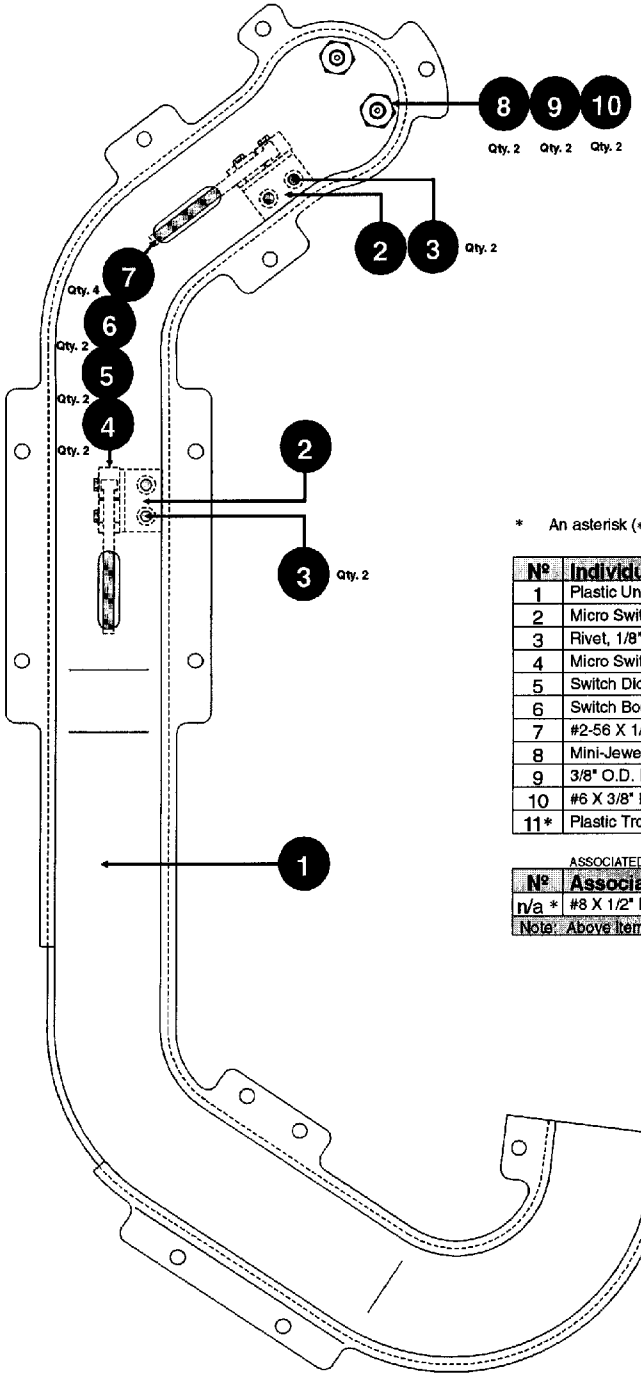
Nº	Individual Part Name	QTY.	SPI Part Nº
1	Metal Under-Trough (Small VUK)	1	535-8157-00
2	Micro Switch Bracket	1	535-7319-05
3	Rivet, 1/8" ø X 5/32" Lg.	2	249-5009-00
4	Micro Switch (High Form)	1	180-5057-00
5	Switch Body Protect Plate	1	535-6539-00
6	#2-56 X 1/2" HWH MS (Ser) 3/16" Hd.	2	237-5937-01
7	Metal Trough Cable Wiring Harness	1	036-5429-04-59

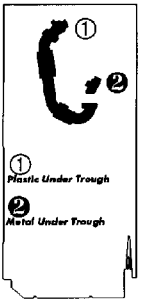
ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY.

Nº	Associated Part Name	QTY.	SPI Part Nº
n/a *	#8 X 1/2" HWH AB (Zinc) Blue	4	234-5101-05

Note: Above item secures this Metal Under-Trough to the playfield.

Plastic Under-Trough Assembly, 500-6244-00-59 (Items 1-11)





Take Note:

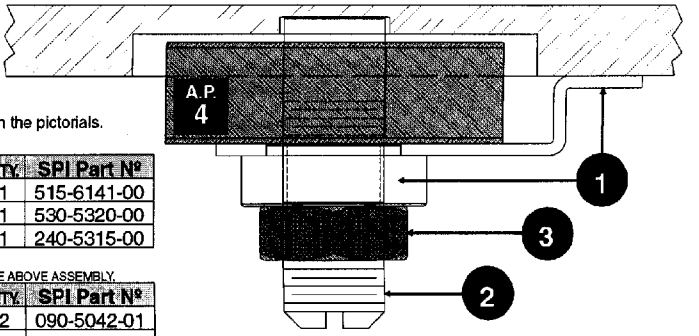
* An asterisk (*) indicates item is *Not Shown* in pictorial.

Nº	Individual Part Name	QTY.	SPI Part Nº
1	Plastic Under-Trough	1	545-5841-00
2	Micro Switch Bracket	2	535-7319-05
3	Rivet, 1/8" ø X 3/16" Lg.	4	249-5001-00
4	Micro Switch (High Form)	2	180-5057-00
5	Switch Diode, 1N4001	2	112-5001-00
6	Switch Body Protect Plate	2	535-6539-00
7	#2-56 X 1/2" HWH MS (Ser) 3/16" Hd.	4	237-5937-01
8	Mini-Jewel Post (CLEAR)	2	550-5052-01
9	3/8" O.D. Black Rubber Ring	2	545-5348-19
10	#6 X 3/8" HWH AB (Zinc)	2	234-5000-00
11*	Plastic Trough Cable Wiring Harness	1	036-5429-12-59

ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY.

Nº	Associated Part Name	QTY.	SPI Part Nº
n/a *	#8 X 1/2" HWH AB (Zinc) Blue	14	234-5101-05
Note: Above item secures this Plastic Under-Trough to the playfield.			

Threaded Bushing Core Assembly, 515-6142-00 (Qty. 2) (Items 1-3)
and Associated Part: Magnet Coil (22-650), 090-5042-01 (Qty. 2) (Item 4)



Take Note:

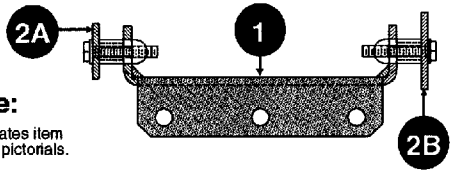
* An asterisk (*) indicates item is *Not Shown* in the pictorials.

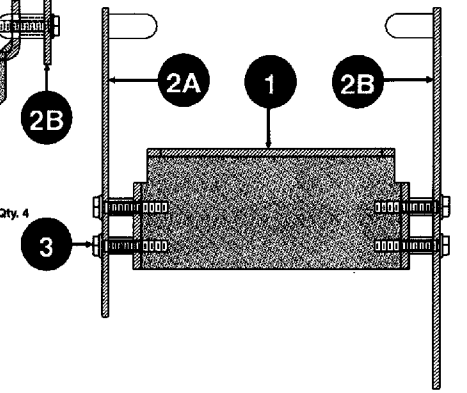
Nº	Individual Part Name	QTY.	SPI Part Nº
1	Threaded Bushing Weld Assembly	1	515-6141-00
2	Threaded Core Plug	1	530-5320-00
3	3/4"-16 Hex Nut	1	240-5315-00

ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY.

Nº	Associated Part Name	QTY.	SPI Part Nº
4	Magnet Coil, 22-650 (12" Leads) (1/per)	2	090-5042-01
n/a *	#8 X 1/2 HWH AB (Zinc) Blue	6	234-5101-05
Note: Above item secures both Bushing Weld Assy. to the playfield.			

OPTO & Bracket (Large) Assembly, 500-6242-01-59 (Items 1-3)





Take Note:

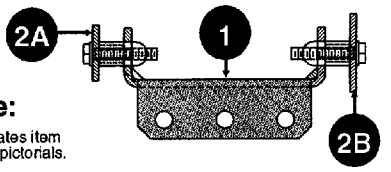
* An asterisk (*) indicates item is *Not Shown* in the pictorials.

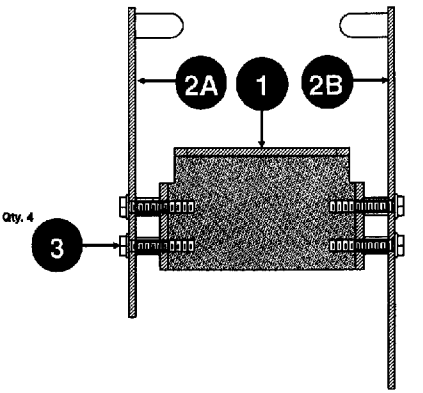
Nº	Individual Part Name	QTY.	SPI Part Nº
1	OPTO Mounting Bracket (Large)	1	515-6768-01
2A	OPTO Transmitter (TRANS) Board	1	520-5082-00
2B	OPTO Receiver (REC) Board	1	520-5083-01
3	#4-40 X 5/8" HWH (Serr) Zinc	4	237-5945-00

ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY.

Nº	Associated Part Name	QTY.	SPI Part Nº
n/a *	#8 X 1/2 HWH AB (Zinc) Blue	3	234-5101-05
Note: Above item secures OPTO Assy. to the playfield.			

OPTO & Bracket (Small) Assembly, 500-6242-00-59 (Items 1-3)





Take Note:

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

Nº	Individual Part Name	QTY.	SPI Part Nº
1	OPTO Mounting Bracket (Small)	1	515-6768-00
2A	OPTO Transmitter (TRANS) Board	1	520-5082-00
2B	OPTO Receiver (REC) Board	1	520-5083-01
3	#4-40 X 5/8" HWH (Serr) Zinc	4	237-5945-00

ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY.

Nº	Associated Part Name	QTY.	SPI Part Nº
n/a *	#8 X 1/2 HWH AB (Zinc) Blue	3	234-5101-05
Note: Above item secures OPTO Assy. to the playfield.			

Table of Contents

☐ Coils Detailed Chart Table 86

• 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
■ General Illumination Circuit Detailed Wiring Diagram 89
☐ Playfield Switch Wiring Diagram & Playfield Lamp Wiring Diagram 90
■ Playfield Diode Terminal Strip & Fuse Descriptions & Locations 91
☐ 3-Flipper Circuit Wiring Diagram 92

• Chapter 3, Cabinet Wiring 93
■ Transformer Power Wiring Diagram 93
☐ Cabinet / Coin Door Wiring Diagram 94

• Chapter 4, Printed Circuit Boards (PCBs) 95
■ Trough Up-Kicker OPTO Boards Theory of Operation & Schematic 95
■ Trough Up-Kicker OPTO Boards Component Layout & Parts 95
☐ OPTO Troubleshooting 95-96
☐ Single Trough OPTO Boards Alignment / Test 96
■ Playfield Sw. OPTO "Long-Hop" Bds. Theory of Operation & Schematic 97
■ Playfield Switch OPTO "Long-Hop" Boards Component Layout & Parts 97
☐ Dot Matrix Display/Display Controller Bd. Combined Display Connections 98
■ Display Power Supply Board Schematic 99
■ Display Power Supply Board Component Layout & Parts 99
☐ Display Controller Board Schematic 100
☐ Display Controller 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
■ 4X 7-Segment Display Board Schematic 116
■ 4X 7-Segment Display Board Component Layout & Parts 116

Use the below ***Coils Detailed Chart Table*** in conjunction with Sec. 5, Chp. 1, Backbox Board Layout Wiring Diagram and Backbox I/O Power Driver Board Detailed Wiring Diagram (I/O Board Connectors J6, J7, J8 & J9):

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 or Bulb Type
01	TROUGH UP-KICKER	Q1	I/O Pwr. Drvr.	BRN-BLK	J8-P1	YEL-VIO	J10-P4/5	50v DC	26-1200 090-5044-00T
02	AUTO LAUNCH	Q2	I/O Pwr. Drvr.	BRN-RED	J8-P3	YEL-VIO	J10-P4/5	50v DC	24-940 090-5036-00T
03	VUK	Q3	I/O Pwr. Drvr.	BRN-ORG	J8-P4	YEL-VIO	J10-P4/5	50v DC	26-1200 090-5044-00T
04	SUPER VUK	Q4	I/O Pwr. Drvr.	BRY-YEL	J8-P5	YEL-VIO	J10-P4/5	50v DC	26-1200 090-5044-00T
05	LEFT MAGNET	Q5	I/O Pwr. Drvr.	BRN-GRN	J8-P6	VIO-YEL	J10-P3	50v DC	22-650 090-5042-01
06	RIGHT MAGNET	Q6	I/O Pwr. Drvr.	BRN-BLU	J8-P7	VIO-YEL	J10-P3	50v DC	22-650 090-5042-01
07	BRAIN BUG	Q7	I/O Pwr. Drvr.	BRN-VIO	J8-P8	VIO-YEL RED-WHT	J10-P3	50v DC	22-1080 090-5032-00T
08	EUROPEAN TOKEN DISPENSER	Q8	I/O Pwr. Drvr.	BRN-GRY	J8-P9	YEL-VIO	J10-P4/5	50v DC	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 or Bulb Type
09	LEFT TURBO BUMPER	Q9	I/O Pwr. Drvr.	BLU-BRN	J9-P1	YEL-VIO	J10-P4/5	50v DC	26-1200 090-5044-00T
10	BOTTOM TURBO BUMPER	Q10	I/O Pwr. Drvr.	BLU-RED	J9-P2	YEL-VIO	J10-P4/5	50v DC	26-1200 090-5044-00T
11	RIGHT TURBO BUMPER	Q11	I/O Pwr. Drvr.	BLU-ORG	J9-P4	YEL-VIO	J10-P4/5	50v DC	26-1200 090-5044-00T
12	LEFT SLINGSHOT	Q12	I/O Pwr. Drvr.	BLU-YEL	J9-P5	YEL-VIO	J10-P4/5	50v DC	26-1200 090-5044-00T
13	RIGHT SLINGSHOT	Q13	I/O Pwr. Drvr.	BLU-GRN	J9-P6	YEL-VIO	J10-P4/5	50v DC	26-1200 090-5044-00T
14	MINI FLIPPER	Q14	I/O Pwr. Drvr.	BLU-BLK	J9-P7	RED-YEL BLU-YEL	J10-P1/2	50v DC	22-1080 090-5032-00T
15	LEFT FLIPPER (50v RED/YEL)	Q15	I/O Pwr. Drvr.	ORG-GRY	J9-P8	RED-YEL GRY-YEL	J10-P1/2	50v DC	23-1100 090-5030-00T
16	RIGHT FLIPPER (50v RED/YEL)	Q16	I/O Pwr. Drvr.	ORG-VIO	J9-P9	RED-YEL BLU-YEL	J10-P1/2	50v DC	23-1100 090-5030-00T

	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	STEPPER MOTOR #1	DOTS	Q17	I/O Pwr. Drvr.	VIO-BRN	J7-P2	GRY/RED DOTS	J16-P3	12v DC	Step.Motor 041-5062-00
18	STEPPER MOTOR #2	DOTS	Q18	I/O Pwr. Drvr.	VIO-RED	J7-P3	GRY/RED DOTS	J16-P3	12v DC	Step.Motor 041-5062-00
19	STEPPER MOTOR #3	DOTS	Q19	I/O Pwr. Drvr.	VIO-ORG	J7-P4	GRY/RED DOTS	J16-P3	12v DC	Step.Motor 041-5062-00
20	STEPPER MOTOR #4	DOTS	Q20	I/O Pwr. Drvr.	VIO-YEL	J7-P6	GRY/RED DOTS	J16-P3	12v DC	Step.Motor 041-5062-00
21	NOT USED		Q21	I/O Pwr. Drvr.	VIO-GRN	J7-P7	BRN	N / C	N / C	NOT USED
22	NOT USED		Q22	I/O Pwr. Drvr.	VIO-BLU	J7-P8	BRN	N / C	N / C	NOT USED
23	FLASH BRAIN BUG *2		Q23	I/O Pwr. Drvr.	VIO-BLK	J7-P9	ORG	J6-P10	20v DC	#89 Bulb 165-5000-89
24	OPTIONAL COIN METER		Q24	I/O Pwr. Drvr.	VIO-GRY	J7-P10	RED	J16-P7	5v DC	5v Meter (If Required)

Diode On Terminal Strip (if noted)

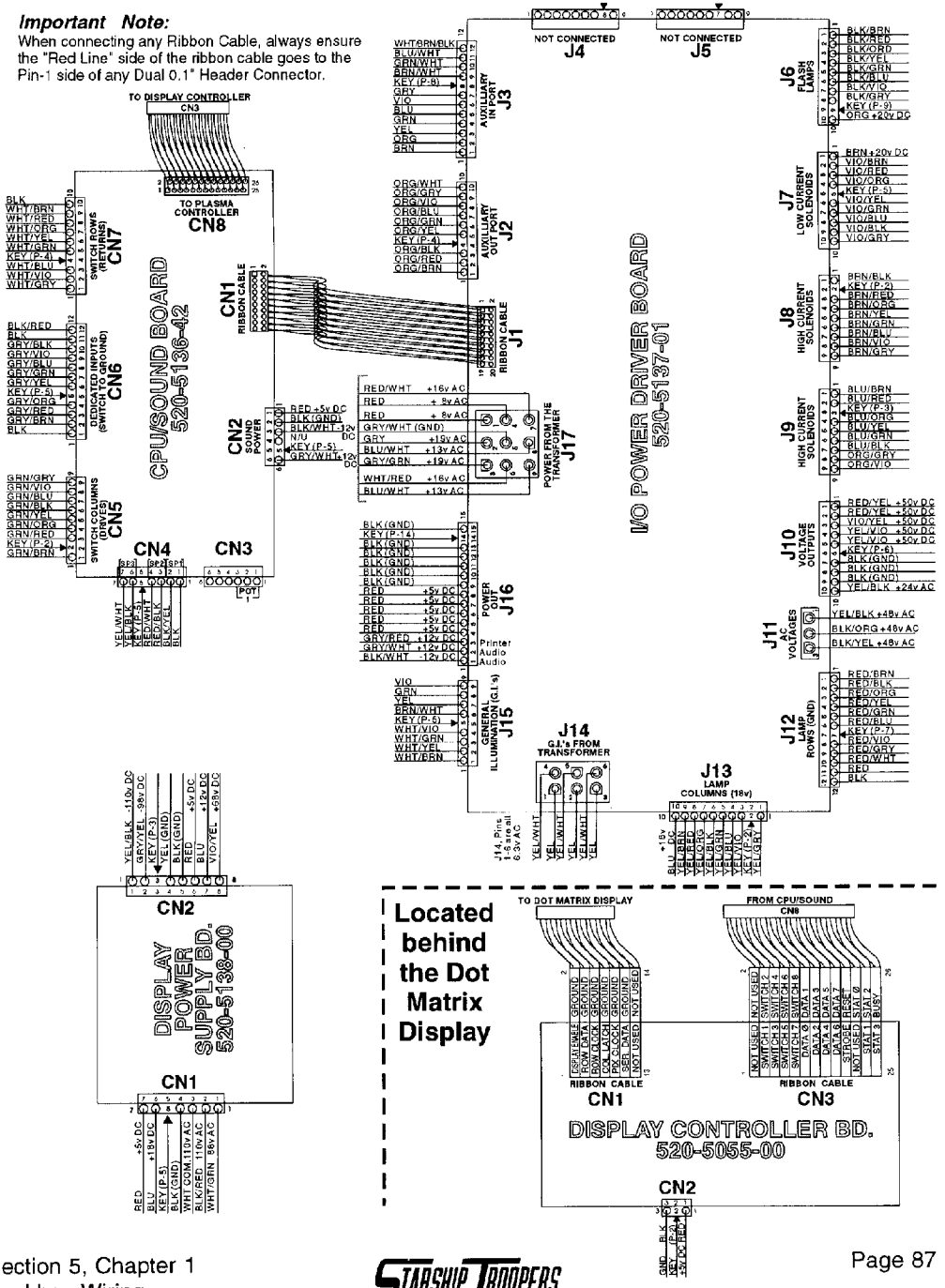
	Flash Lamps (FLASH)	Drive Transistor (D.T.)	Driver Ouput Board	D.T. Control Line Color	D.T. Control Line Connect	Power Line Color	Power Line Connnection	Power Voltage	Bulb Type
F1	#F1 FLASH RED*4	Q25	I/O Pwr. Drvr.	BLK-BRN	J6-P1	ORG	J6-P10	20v DC	#906 Bulb 165-5004-00
F2	#F2 FLASH YELLOW*4	Q26	I/O Pwr. Drvr.	BLK-RED	J6-P2	ORG	J6-P10	20v DC	#906 Bulb 165-5004-00
F3	#F3 FLASH GREEN*4	Q27	I/O Pwr. Drvr.	BLK-ORG	J6-P3	ORG	J6-P10	20v DC	#906 Bulb 165-5004-00
F4	#F4 FLASH BLUE*4	Q28	I/O Pwr. Drvr.	BLK-YEL	J6-P4	ORG	J6-P10	20v DC	#906 Bulb 165-5004-00
F5	#F5 FLASH MULTIBALL*4	Q29	I/O Pwr. Drvr.	BLK-GRN	J6-P5	ORG	J6-P10	20v DC	#906 Bulb† 165-5004-00
F6	#F6 FLASH LT RAMP*4	Q30	I/O Pwr. Drvr.	BLK-BLU	J6-P6	ORG	J6-P10	20v DC	#89 Bulb 165-5000-89
F7	#F7 FLASH RT RAMP*4	Q31	I/O Pwr. Drvr.	BLK-VIO	J6-P7	ORG	J6-P10	20v DC	#89 Bulb 165-5000-89
F8	#F8 FLASH POPS*2	Q32	I/O Pwr. Drvr.	BLK-GRY	J6-P8	ORG	J6-P10	20v DC	#89 Bulb 165-5000-89

† Note: F5 = 3* #906 Bulb + 1* #89 Bulb.

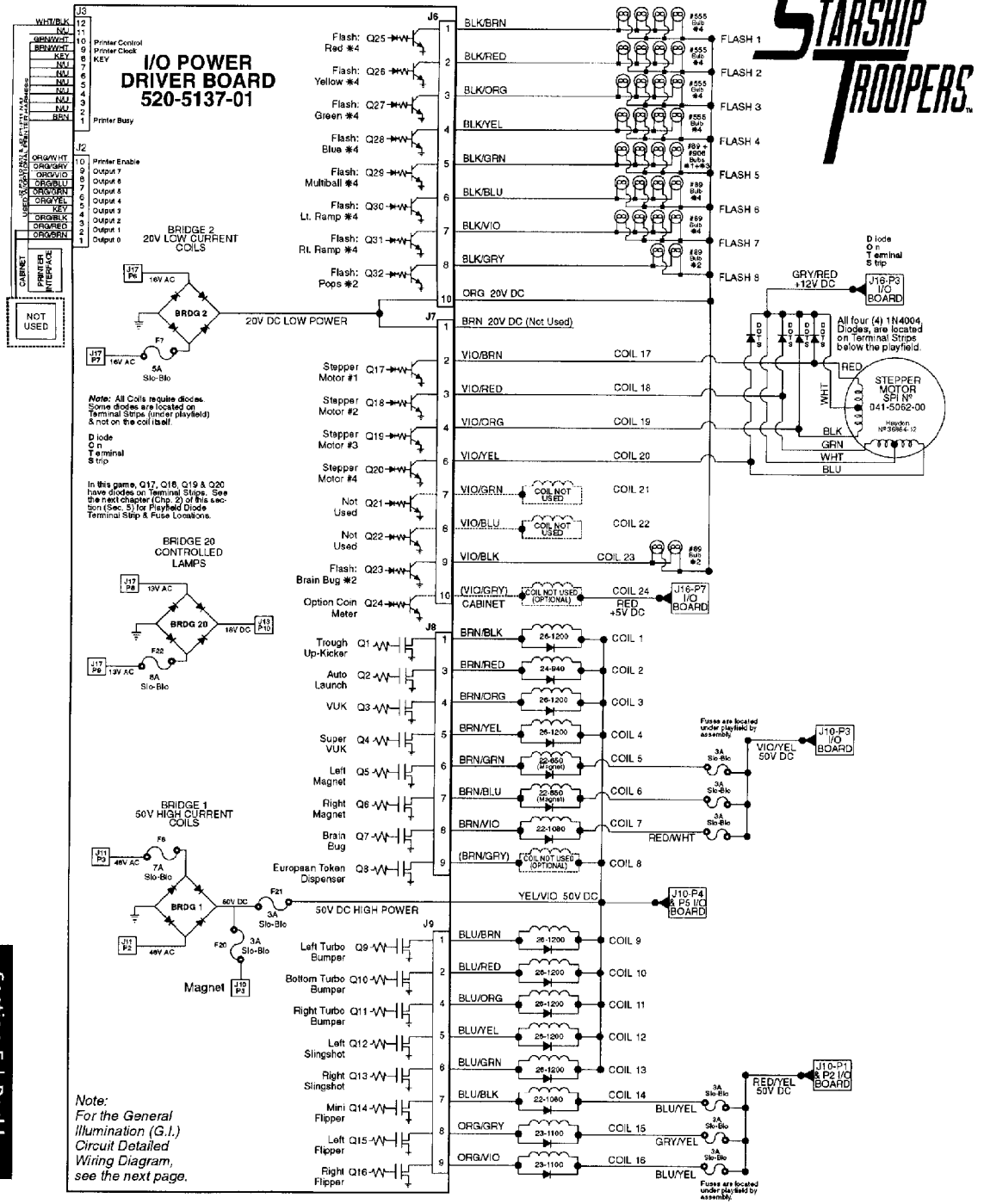
Backbox Wiring

Backbox Board Layout Wiring Diagram

Important Note:
When connecting any Ribbon Cable, always ensure the "Red Line" side of the ribbon cable goes to the Pin-1 side of any Dual 0.1" Header Connector.

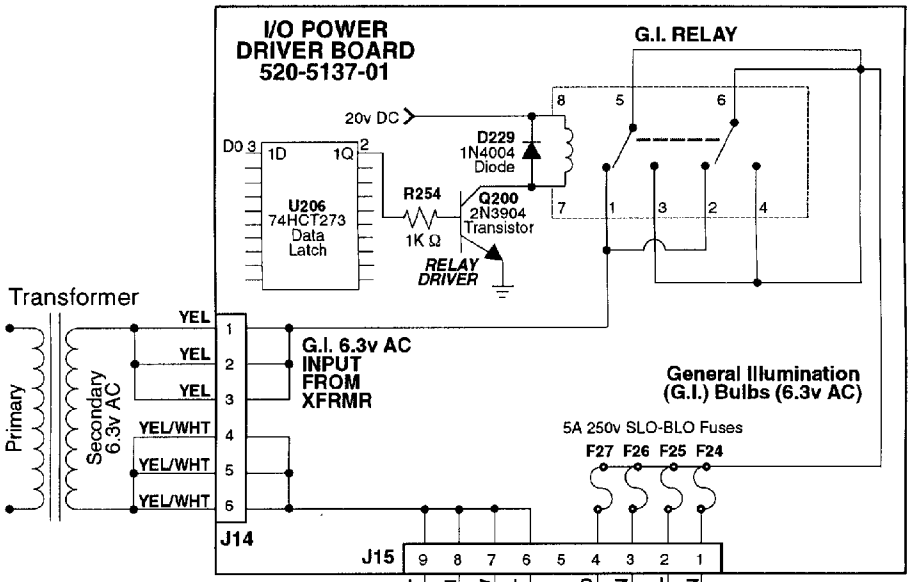


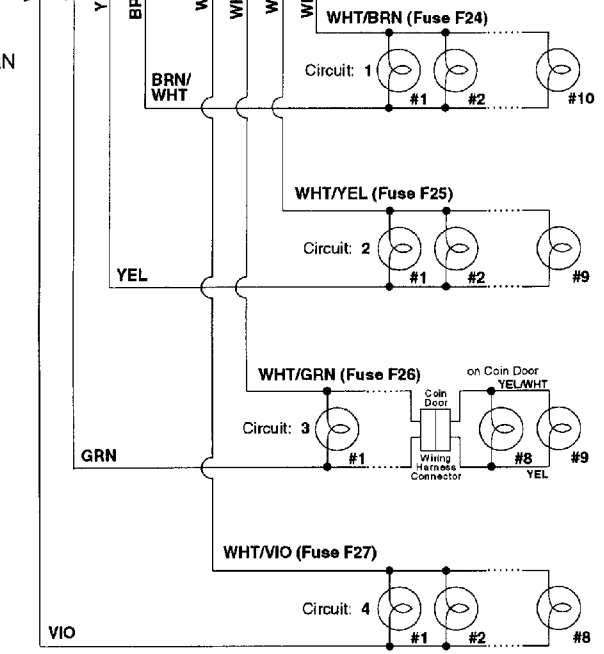
Backbox I/O Power Driver Board Detailed Wiring Diagram



Playfield Wiring

General Illumination Circuit Detailed Wiring Diagram



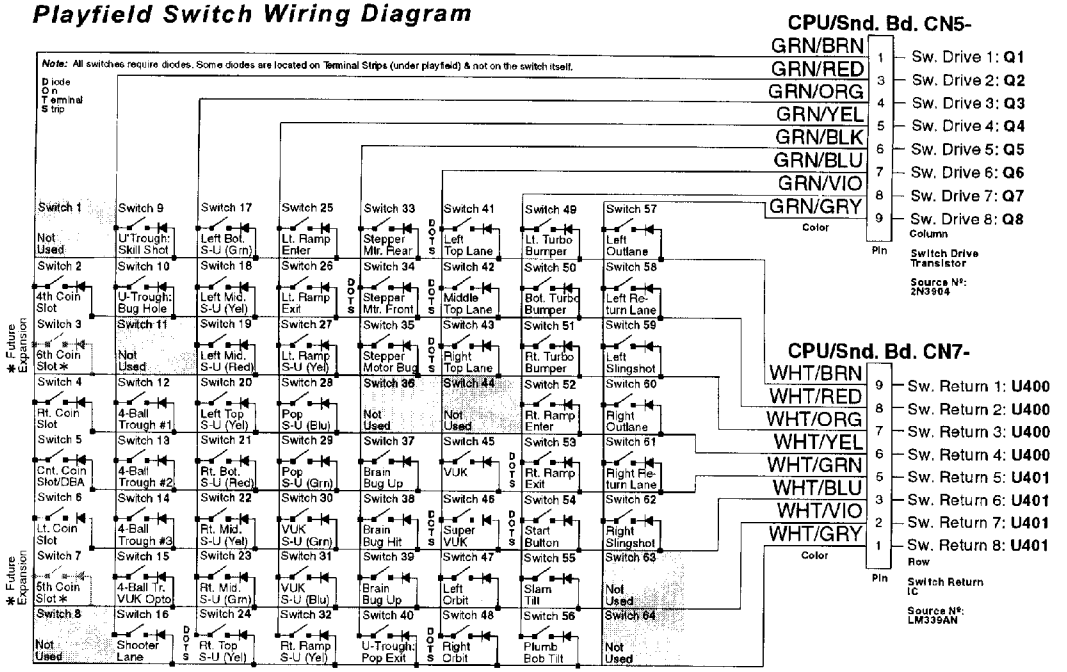


G.I. Bulbs (6.3v AC) General Location
(Strings Noted by Fuse & Wire Colors):

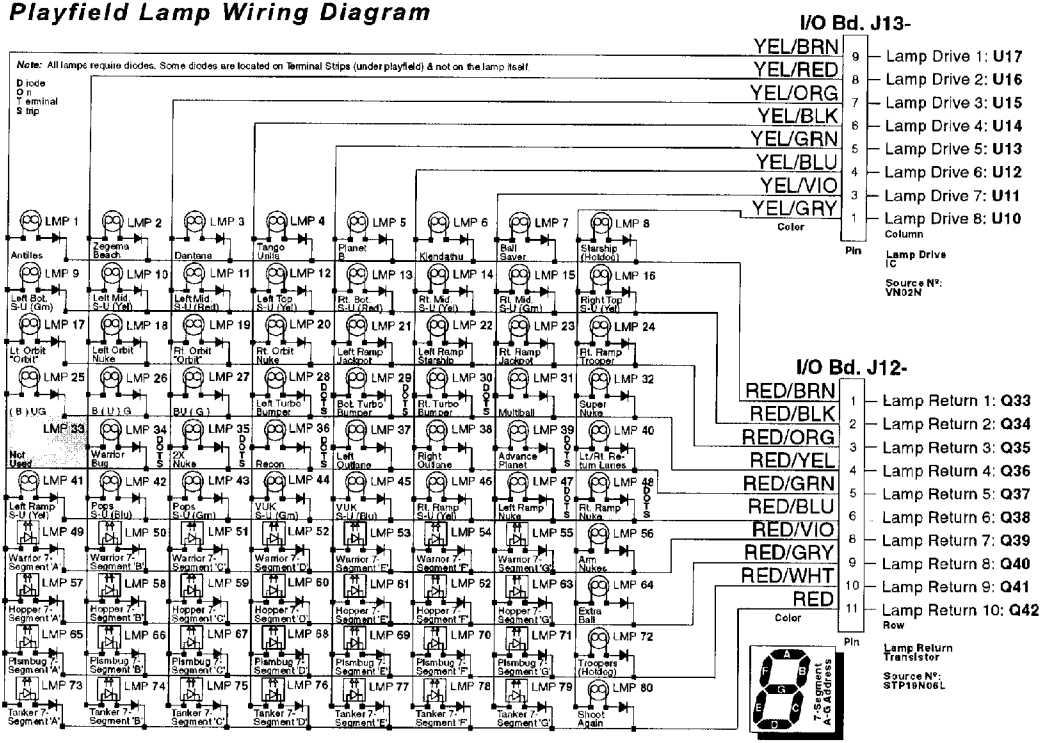
Circuit 1: F24	J15-P6 to J15-P1;	
Location:	BRN/WHT to WHT/BRN	
Under Upper Left Playfield:	10 Ea. #44 Bulb *	
Circuit 2: F25	J15-P7 to J15-P2	
Location:	YEL to WHT/YEL	
Under Lower Left Playfield:	7 Ea. #44 Bulb *	
Above Lt. Mid. P/F & Lt. Return Ln.:	2 Ea. #555 Bulb *	
Circuit 3: F26	J15-P8 to J15-P3	
Location:	GRN to WHT/GRN	
Under Upper Right Playfield:	7 Ea. #44 Bulb *	
In Coin Door:	2 Ea. #555 Bulb *	
Circuit 4: F27	J15-P9 to J15-P4	
Location:	VIO to WHT/VIO	
Under Lower Right Playfield:	6 Ea. #44 Bulb *	
Above Rt. Ramp & Rt. Return Ln.:	2 Ea. #555 Bulb *	

* *G.I. Bulb quantities may change during production.*

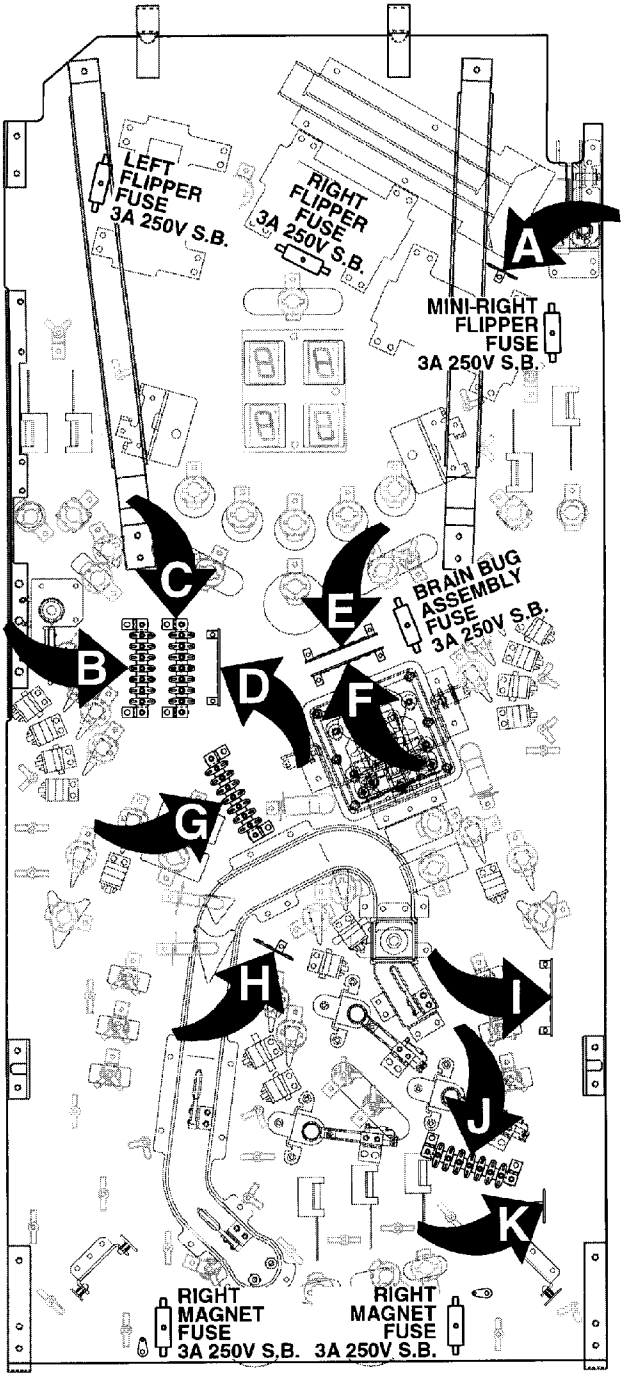
Playfield Switch Wiring Diagram



Playfield Lamp Wiring Diagram



Playfield Diode Terminal Strip & Fuse Descriptions & Locations



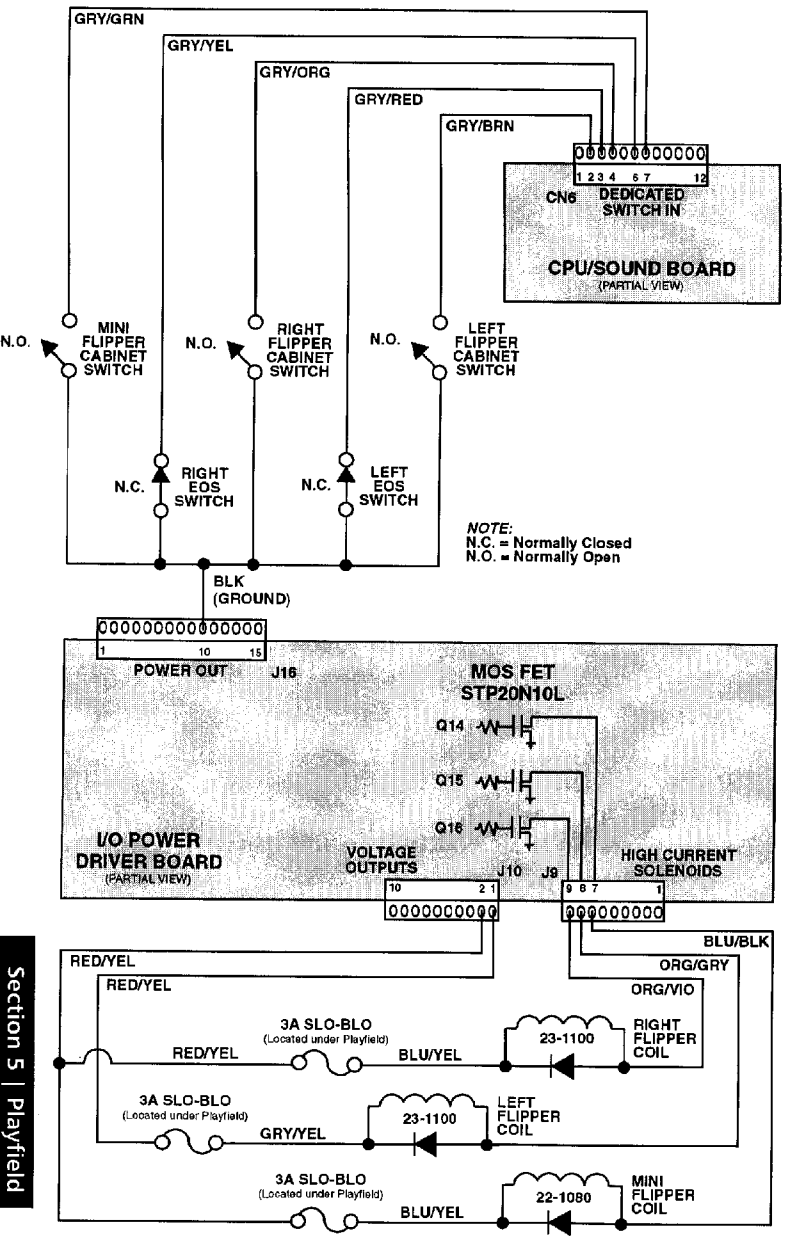
All switches, lamps, coils require diodes. The diodes not physcially located on the switch, lamp or coil are located on Terminal Strips under the playfield. The Switch & Lamp Matrix Grids also note which switch or lamp has a diode on a Terminal Strip (noted by "DOTS" meaning "Diode on Terminal Strip"). Also noted in this playfield drawing are the location of all Fuses (3A 250v S.B.) located under the playfield.

See the Pink Pages, Playfield - General Parts (Below) (Page 58) for Terminal Strips, Diodes, Fuses & Holders Part Numbers.

Nº	Diode Type / PNº	DIODE for	WIRE COLORS
A	1N4001	Switch 16	GRY
	112-5001-00	Shooter Ln.	WHT/GRY
B	1N4001	Lamp 35	ORG/GRN
	112-5001-00	2X Nuke	RED/GRN
	1N4001	Lamp 36	GRN
	112-5001-00	Recon	RED/GRN
	1N4001	Lamp 39	ORG
	112-5001-00	Adv. Planet	RED/GRN
C	1N4001	Lamp 47	BLU
	112-5001-00	Lt. Ramp	RED/BLU
	1N4001	Lamp 48	ORG/BLU
	112-5001-00	Rt. Ramp	RED/BLU
	1N4001	Lamp 34	ORG/GRN
	112-5001-00	Warrior Bug	RED/GRN
D	1N4001	Switch 45	ORG/GRN
	112-5001-00	VUK	WHT/GRN
	1N4001	Switch 38	ORG/WHT
	112-5001-00	Brain Bug	WHT/BLU
E & F	1N4004	Coil 19	BLK
	112-5003-00	Step. Mtr. 3	VIO/ORG
	1N4004	Coil 17	RED
	112-5003-00	Step. Mtr. 1	VIO/BRN
		+12v DC	WHT
			GRY/RED
	1N4004	Coil 20	BLU
	112-5003-00	Step. Mtr. 4	VIO/YEL
	1N4004	Coil 18	GRN
	112-5003-00	Step. Mtr. 2	VIO/RED
G	1N4001	Switch 33	ORG/BRN
	112-5001-00	S. Mtr. Rear	WHT/BRN
	1N4001	Switch 34	ORG/RED
	112-5001-00	S. Mtr. Front	WHT/RED
	1N4001	Switch 35	ORG/BLK
	112-5001-00	S. Mtr. Bug	WHT/ORG
H	1N4001	Lamp 29	RED/YEL
	112-5001-00	Bot. Pop	YEL/GRN
I	1N4001	Switch 46	BLU
	112-5001-00	Super VUK	WHT/BLU
	1N4001	Switch 40	GRY
	112-5001-00	Pop Hole	WHT/GRY
J	1N4001	Lamp 28	RED/YEL
	112-5001-00	Left Pop	YEL/BLK
	1N4001	Lamp 30	RED/YEL
	112-5001-00	Right Pop	YEL/BLU
K	1N4001	Switch 26	RED
	112-5001-00	Lt. Ramp Exit	WHT/RED

3-Flipper Circuit Wiring Diagram

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.



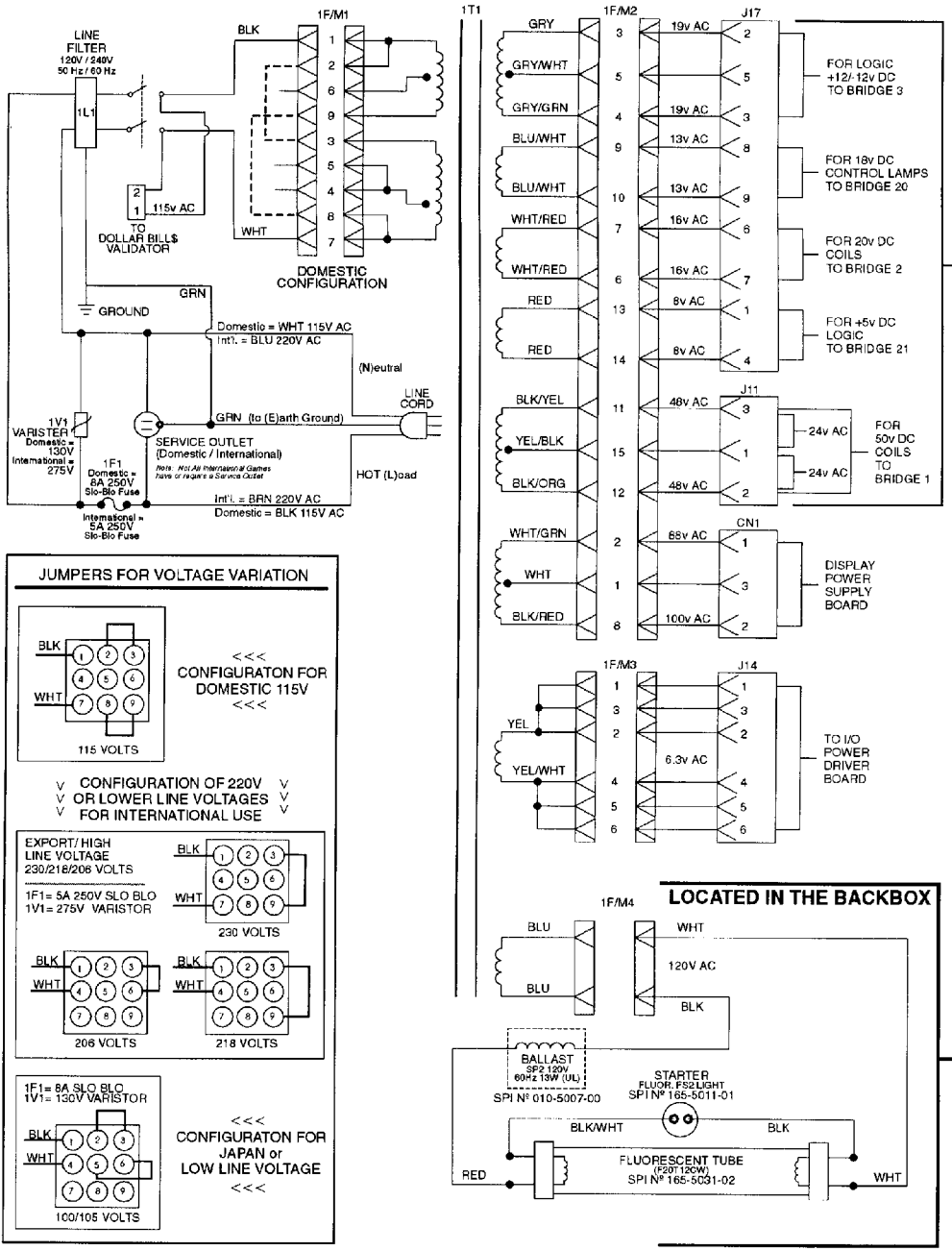
Technical Overview

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.

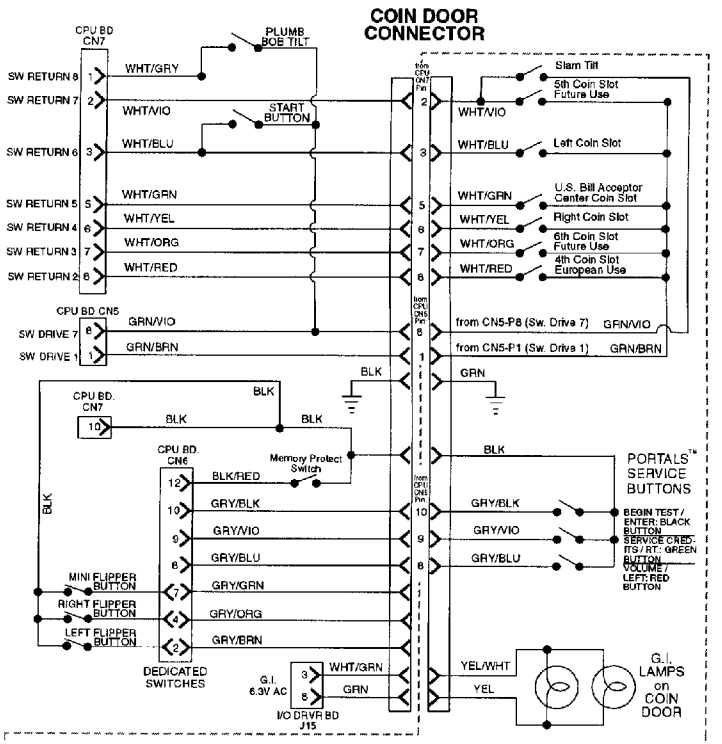
The **E.O.S.** (End-Of-Stroke) **Switch** serves the same function as before as it prevents foldback when the player has the flipper energized to capture balls. The **E.O.S. Switch** is a normally closed switch which opens approximately a 1/16" when the flipper is energized. The **Game CPU** will detect 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.

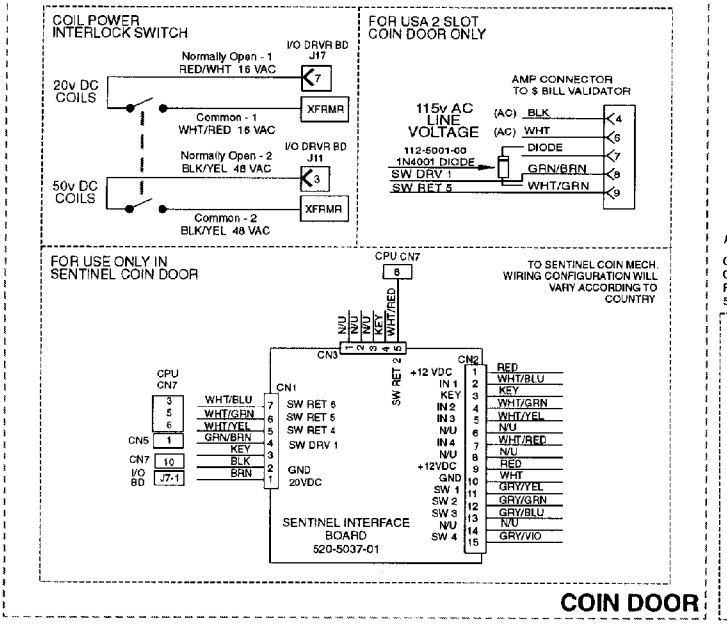
Cabinet Wiring

Transformer Power Wiring Diagram

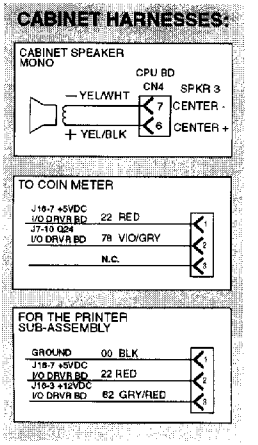


Cabinet/Coin Door Wiring Diagram



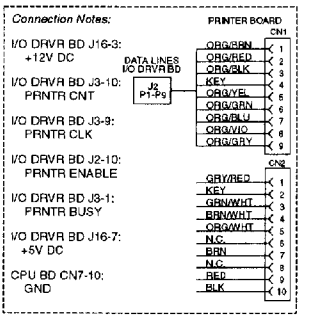


CABINET HARNESSES:



PRINTER INTERFACE OPTIONAL

Cable Wiring Harness Part Nº:
038-5408-00
RS-232 Printer Interface Board Part Nº:
520-5069-00

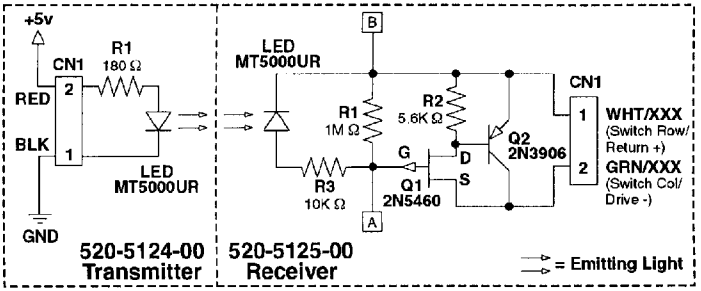


Printed Circuit Boards (PCBs)

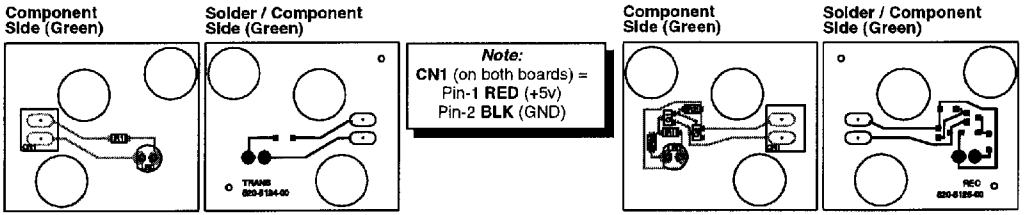
Trough Up-Kicker OPTO Boards Theory of Operation & Schematic

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.*



Trough Up-Kicker OPTO Boards Component Layout & Parts



520-5124-00 (TRANS)

520-5125-00 (REC)

ITEM	QTY	PART NUMBER	REF-DESIGNATOR
A	1	**520-5124-00**	OPTO Transmitter Board
1	1	165-5100-00	LED
2	1	121-5067-00	R1
3	1	045-5111-02	CN1
B	1	**520-5125-00**	OPTO Receiver Board
1	1	165-5100-00	LED
2	1	121-5068-00	R1
3	1	121-5069-00	R2
4	1	121-5011-00	R3
5	1	110-5006-00	Q1
6	1	110-5004-00	Q2
7	1	045-5111-02	CN1

LED MT5000UR
(T1-3/4 GaAlAs)
(Ultra Bright Red)
Sega Pinball Part №
165-5100-00

DESCRIPTION

Complete PCB Assembly
LED MT5000UR (Ultra Bright Red)
180 Ω 1/8W Chip Res. (CRCW)
2X, .156" Rt. Angle (26-60-5020) Conn.
Complete PCB Assembly
LED MT5000UR (Ultra Bright Red)
1M Ω 1/8W Chip Res. (CRCW)
5.6K Ω 1/8W Chip Res. (CRCW)
10K Ω 1/8W Chip Res. (CRCW)
2N5460, Transistor (P-FET SOT-23)
2N3906, Transistor (PNP SOT-23)
2X, .156" Rt. Angle (26-60-5020) Conn.

OPTO Troubleshooting

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

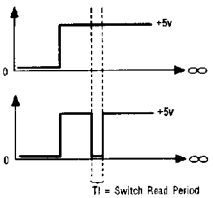
A. **OPEN OPTO** (Light Falling on LED) = *SWITCH OPEN.* Place meter leads across points **A** and **B** (Refer to Schematic Drawing above, 520-5125-00 Receiver Side). It should read approximately 0.8 - 1.2v DC.

B. **CLOSED OPTO** (Light Blocked) = *SWITCH CLOSED.* Place meter leads across points **A** and **B** (Refer to Schematic Drawing above, 520-5125-00 Receiver Side). It should read approximately 0.0 - 0.1v DC.

2. Oscilloscope Test (indicates normal operating condition):

Fig. A

Fig. B



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

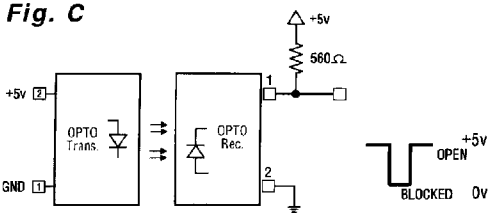
B. **CLOSED OPTO** (Light Blocked) = *SWITCH CLOSED.* Place Scope lead at **Pin-1** of OPTO Rec. Board with Scope Grounded (see Schematic). The Scope should display a **PULSE STREAM** indicating **Q2** has switched "On" as shown in **Fig. B**, Wave Form Diagram. This is your Switch Drive Pulse.

OPTO Troubleshooting Continued Next Page.

3. Bench Test (See Fig. C):

Disconnect the OPTO Transmitter / Receiver Board from the circuit. Connect one side of a 560Ω 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. 0v when the ***BEAM IS BLOCKED.***

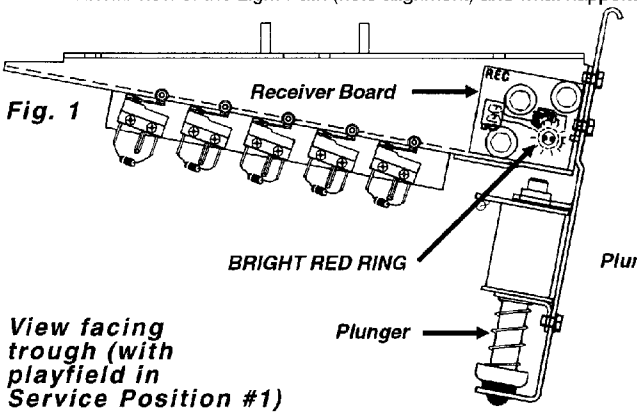
Fig. C



Single Trough OPTO Boards Alignment / Test

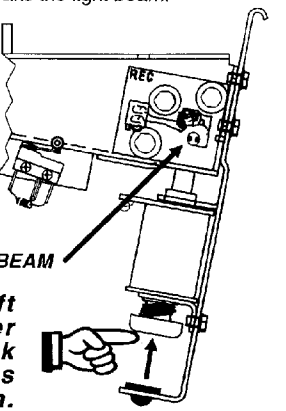
When a working **OPTO** is installed and connected in a game, the transmitter should light when the power is switched on. With the playfield in Service Position #1 (playfield lifted up in the half-way position resting on the Prop Rod) and the game on, the light should show up as a **BRIGHT RED RING** 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 Position 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.

Fig. 1



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

Fig. 2



Lift plunger to check switch as shown.

Sectional view from right (Fig. 3a & 3b)

I M P O R T A N T
*If replacement of **LED** is required, insure that is **mounted correctly** before and after soldering (See **Fig. 4a / 4b**).*

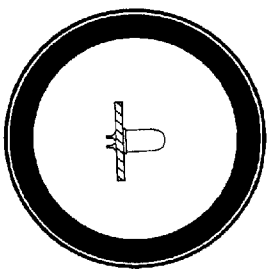


Fig. 4a
Correct Position

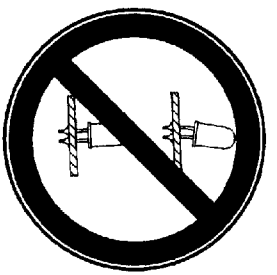
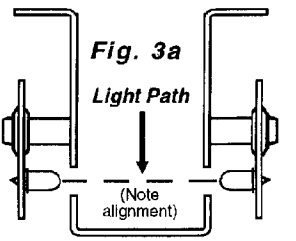
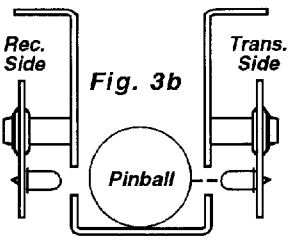
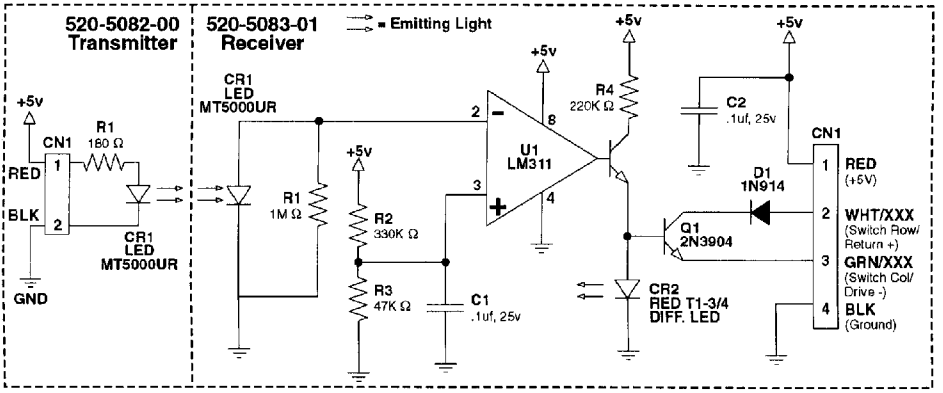


Fig. 4b
Incorrect Position



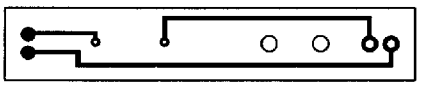


Playfield Sw. OPTO "Long-Hop" Boards Theory of Operation & Schematic



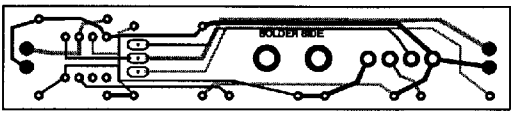
The light falling on **LED (CR1)** generates a voltage which is applied to the input (Pin-2) of the **LM311 Comparator (U1)**. **R1** bleeds off excess charge. At about a volt input from **LED (CR1)** the **Comparator (U1)** trips & drives either **Q1** (during switch line strobes) or the indicator **LED (CR2)** (in between strobes). If a switch line is being strobed, the emitter of **Q1** drops to the saturation voltage of the Switch Line Driver, about .3 volts. This plus the .7 volt drop on the base give a 1v forward bias voltage to **Q1**, which is lower than the 1.7v drop on **LED (CR2)** so the current flows through the **Transistor** during strobes. This drives **Q1** on and makes the switch. If the strobe line is high, then the 1.7v path through **LED (CR2)** is lower than **Q1**'s bias voltage so current flows through **LED (CR2)** and the indicator lights. **D1** prevents reverse bleed, **R2** and **R3** form the voltage divider for the trip point, **R4** is a current limiter for both **Q1** and **CR2**, **C1** and **C2** are general noise-filter caps.

Playfield Switch OPTO "Long-Hop" Boards Component Layout & Parts



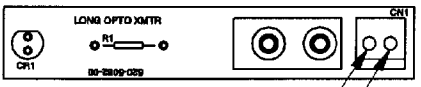
520-5082-00 (TRANS)

Solder Side (Green)



Solder Side (Green)

520-5083-01 (REC)

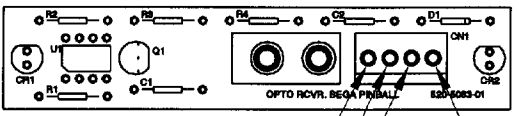


Component Side (Beige)

Pin-1 **RED** (+5v)

Pin-2 **BLK** (GROUND)

CN1



Component Side (Beige)

Pin-3 **GRN/XXX** (Sw. Drive « - »)

Pin-2 **WHT/XXX** (Sw. Return « + »)

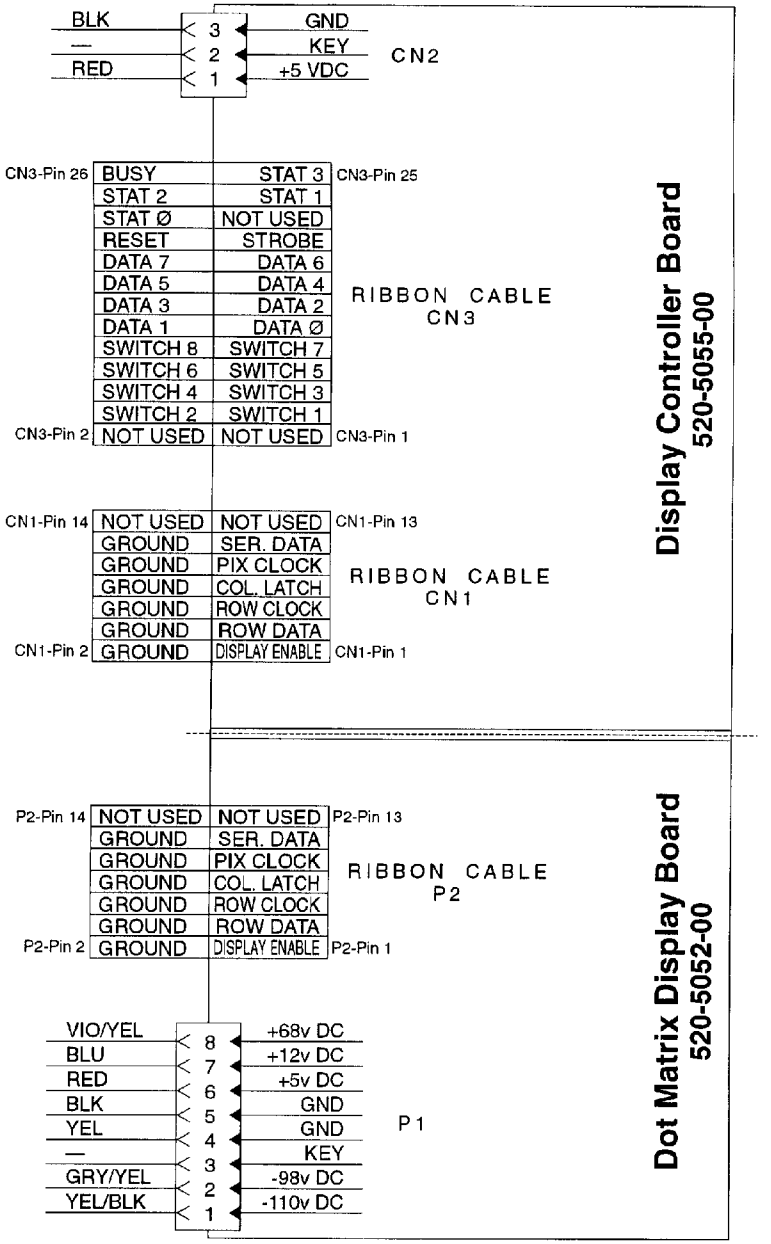
Pin-1 **RED** (+5v)

CN1

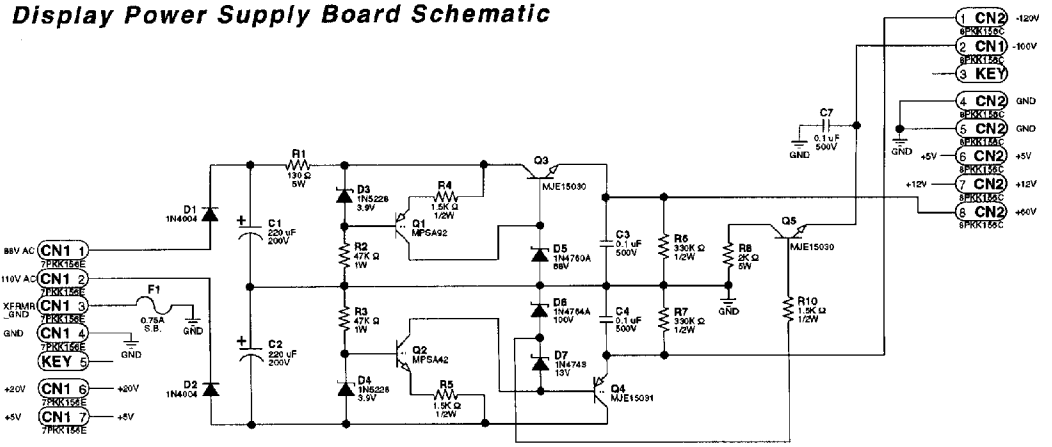
Pin-4 **BLK** (GROUND)

Note: *In this game, these OPTO Boards are used as Playfield Orbit Switches. See the Switch Matrix Grid (Pg. 90). 1 Pair are used for Switch 47, Left Orbit (GRN-BLU, WHT-VIO). 1 Pair are used for Switch 48, Right Orbit (GRN-BLU, WHT-GRY).*

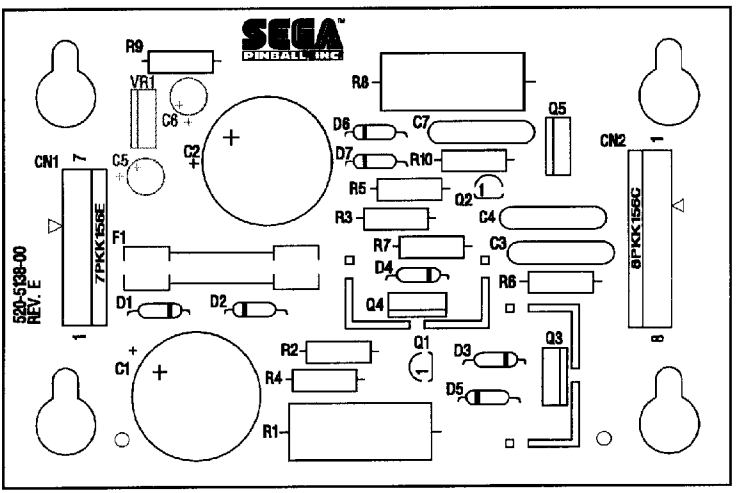
ITEM	QTY	PART NUMBER	REF-DESIGNATOR	DESCRIPTION
A	1	**520-5083-01**	OPTO Receiver Board	**Complete PCB Assembly**
1	1	165-5100-00	**CR1**	**LED MT5000UR** (Ultra Bright Red)
2	1	165-5099-00	**CR2**	**LED T1-3/4 RED DIFFUSER**
3	1	112-5014-00	D1	1N914, Diode
4	1	121-5013-00	R1	1M Ω 1/4W Res., 5%
5	1	121-5037-00	R2	330K Ω 1/4W Res., 5%
6	1	121-5032-00	R3	47K Ω 1/4W Res., 5%
7	1	121-5014-00	R4	220 Ω 1/4W Res., 5%
8	2	125-5023-00	C1, C2	.1uF, 25v, Axial Ceramic Cap.
6	1	100-5025-00	U1	LM311
7	1	110-0069-00	Q1	2N3904, Transistor
8	1	045-5200-04	CN1	4X1, .156" Locking Straight Hdr. Conn. (Molex 50-84-1040)
B	1	**520-5082-00**	OPTO Transmitter Board	**Complete PCB Assembly**
1	1	165-5100-00	**CR1**	**LED MT5000UR** (Ultra Bright Red)
2	1	121-5066-00	R1	180 Ω 1/4W Res.
3	1	045-5206-02	CN1	2X1, .156" Locking Straight Hdr. Conn. (Molex 50-84-1020)


BLK
—
RED
3
2
1
GND
KEY
+5 VDC
CN2
CN3-Pin 26
BUSY
STAT 3
CN3-Pin 25
STAT 2
STAT 1
STAT Ø
NOT USED
RESET
STROBE
DATA 7
DATA 6
DATA 5
DATA 4
DATA 3
DATA 2
DATA 1
DATA Ø
SWITCH 8
SWITCH 7
SWITCH 6
SWITCH 5
SWITCH 4
SWITCH 3
SWITCH 2
SWITCH 1
CN3-Pin 2
NOT USED
NOT USED
CN3-Pin 1
RIBBON CABLE
CN3
CN1-Pin 14
NOT USED
NOT USED
CN1-Pin 13
GROUND
SER. DATA
GROUND
PIX CLOCK
GROUND
COL. LATCH
GROUND
ROW CLOCK
GROUND
ROW DATA
CN1-Pin 2
GROUND
DISPLAY ENABLE
CN1-Pin 1
RIBBON CABLE
CN1
Display Controller Board
520-5055-00
P2-Pin 14
NOT USED
NOT USED
P2-Pin 13
GROUND
SER. DATA
GROUND
PIX CLOCK
GROUND
COL. LATCH
GROUND
ROW CLOCK
GROUND
ROW DATA
P2-Pin 2
GROUND
DISPLAY ENABLE
P2-Pin 1
RIBBON CABLE
P2
VIO/YEL
BLU
RED
BLK
YEL
—
GRY/YEL
YEL/BLK
8
7
6
5
4
3
2
1
+68v DC
+12v DC
+5v DC
GND
GND
KEY
-98v DC
-110v DC
P1
Dot Matrix Display Board
520-5052-00

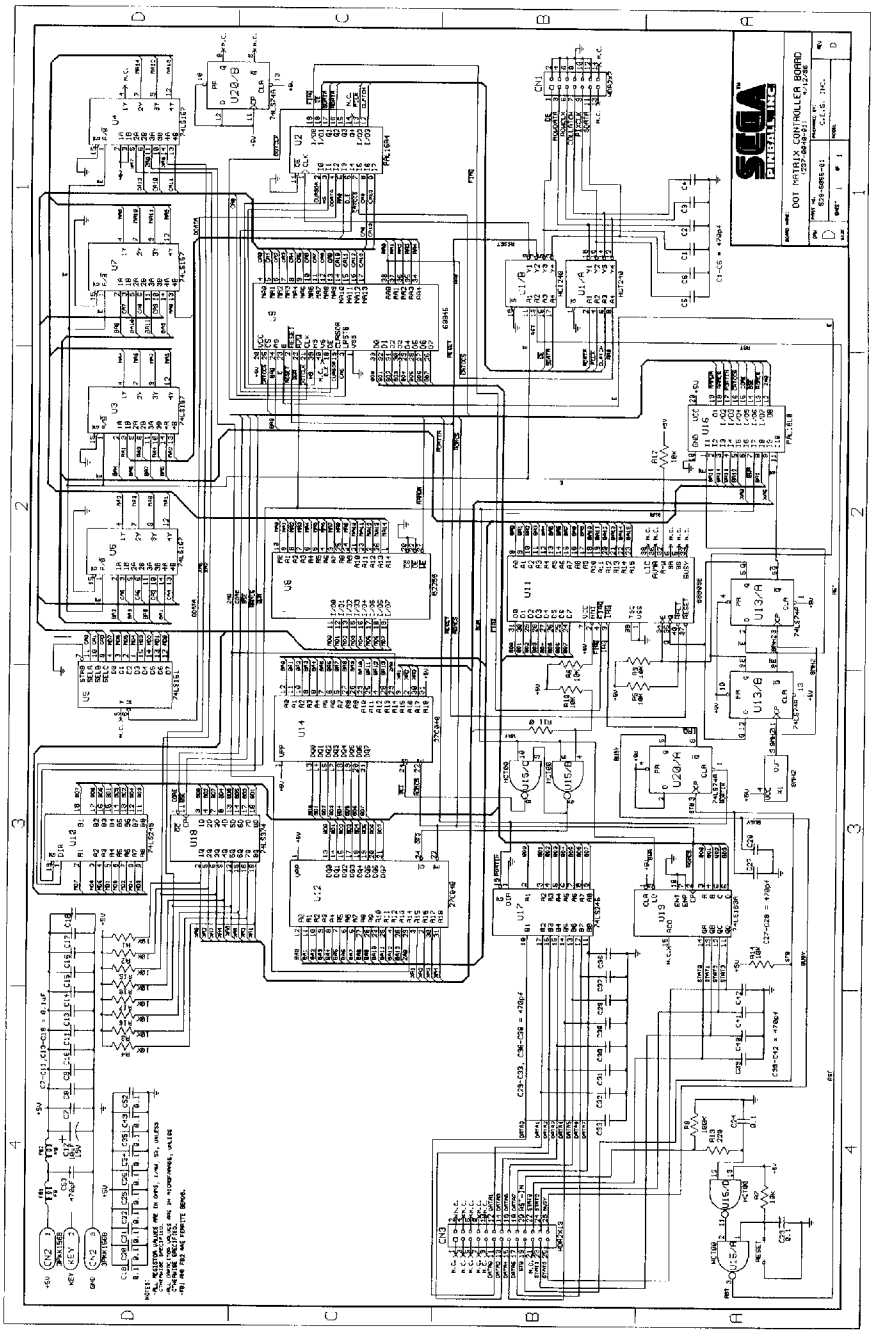
Display Power Supply Board Schematic

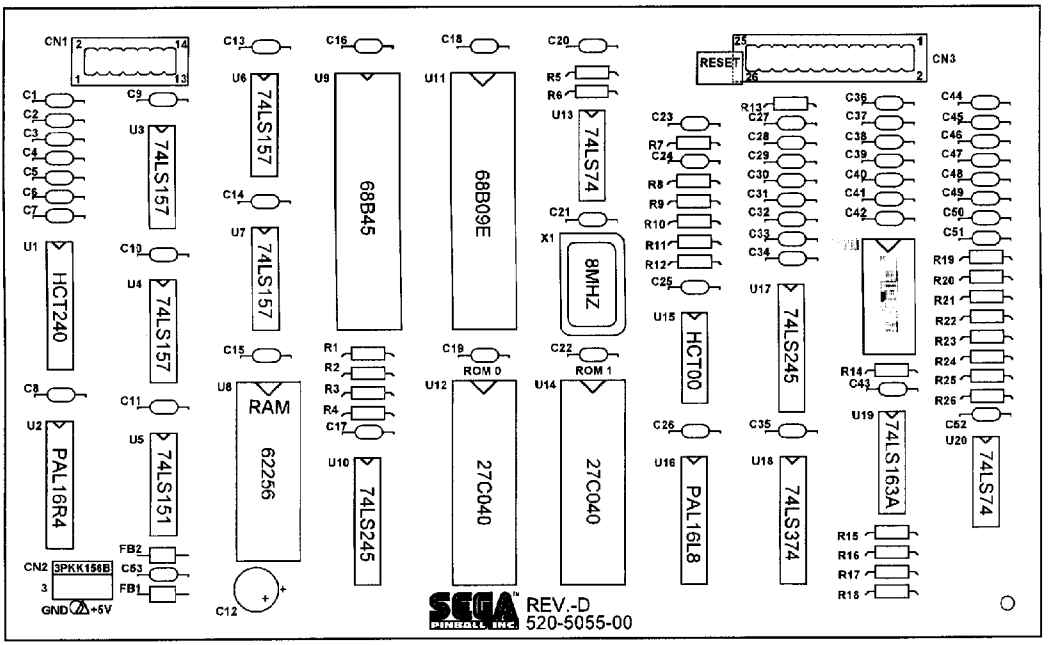


Display Power Supply Board Component Layout & Parts



ITEM	QTY	PART NUMBER	REF-DESIGNATOR	DESCRIPTION (NS = Not Stuffed)
—	1	520-5138-00	Display Power Supply Board	Complete PCB Assembly
1	1	200-5000-17	F1	3/4A (0.75A) S.B. Fuse
2	2	535-5000-11	Q3, Q4	Heatsinks - AAVID #563002
3	2	125-5044-00	C1, C2	220uF, 200v, Radial Lytic Cap.
4	4	121-5038-00	R4, R5, R9, R10	1.5K Ω 1/2W Res. (R9: NS)
5	2	121-5059-00	R6, R7	330K Ω 1/2W Res.
6	2	121-5060-00	R2, R3	47K Ω 1W Res.
7	1	121-5061-00	R1	130 Ω 5W Res.
8	1	121-5062-00	R8	2K Ω 5W Res.
9	2	112-0053-00	D3, D4	1N5228, 3.9v, Diode
10	1	112-0062-00	D5	1N4760A, 68v, Diode
11	1	112-0049-00A	D6	1N4764A, 100v, Diode
12	1	112-0061-00	D7	1N4743, 13v, Diode
13	1	110-0100-00	Q1	MPSA92, Transistor
14	1	110-0082-00	Q2	MPSA42, Transistor
15	3	125-5035-00	C3, C4, C7	0.1uF, 500v, Ceramic Disk Cap.
16	1	110-0103-00	Q4	MJE15031, Transistor
17	2	110-0101-00	Q3, Q5	MJE15030, Transistor
18	0	125-5003-00	C5, C6	22uF, 25v, Rad. Lytic Cap. (C5, C6: NS)
19	0	124-5003-00	VR1	7812CT (VR1: NS)
20	1	045-5015-08	CN2	8PKK156 (PIN3=KEY)
21	2	112-5003-00	D1, D2	1N4004, Diode
22	1	045-5015-07	CN1	7PKK156E (PIN5=KEY)
23	2	240-5008-00	Q3, Q4	6/32 KEPS Nut
24	2	237-5501-00	Q3, Q4	6/32 X 3/8" PPH Screw
25	2	205-0004-00	F1	Fuse Clips





ITEM	QTY	PART NUMBER	REF-DESIGNATOR	DESCRIPTION (NS = Not Stuffed)
—	1	520-5055-00	Display Controller Board	Complete PCB Assembly
1	2	077-5217-00	U12, U14	32-Pin, IC Dip Socket
2	1	100-0397-00	U8	32K X 8 Static RAM (62256L-10PC)
3	1	100-0189-01	U11	68B09E
4	1	100-0233-00	U9	68B45
5	1	100-0351-00	U15	74HCT00
6	1	100-5001-00	U1	74HCT240
7	1	100-5000-00	U5	74LS151
8	4	100-0046-00	U3, U4, U6, U7	74LS157
9	1	100-0049-00	U19	74LS163A
10	2	100-0058-00	U7, U10	74LS245
11	1	100-0064-00	U18	74LS374
12	2	100-0037-00	U13, U20	74LS74
13	1	965-0107-00	**U16 - ORANGE DOT** (Note the type of PAL)	PAL16L8 (15CN), (Programmed) **- ORANGE DOT**
14	1	965-0108-00	**U2 - ORANGE DOT** (Note the type of PAL)	PAL16R4 (25CN), (Programmed) **- ORANGE DOT**
15	23	125-5031-00	C7>C11, C13>C26, C34, C35, C43, C52	.1 uF, (104), Axial Cer. Cap
16	1	121-5051-00	R8	100K Ω 1/4W C.F. Res. 5%
17	15	121-5011-00	R1>R7, R9, R10, R12, R14>R18	10K Ω 1/4W Res. 5%
18	1	121-5014-00	R13	220 Ω 1/4W C.F. Res. 5%
19	0	n/a	R19>R26	(R19>R26: NS)
20	21	125-5028-00	C1>C6, C27>C33, C36>C42, C44>C51, C53	470pF, (471), Axial Cap (C44>C51: NS)
21	2	n/a	FB1, FB2	Ferrite Bead (2743001182)
22	1	125-5015-00	C12	100uF, 25v, Cap. (Radial Elec.)
23	1	045-5015-26	CN3	13-Pin, Dual Row .1" HDR Conn.
24	1	045-5015-03	CN2	3-Pin, KK-156 Conn. (540445-3)
25	1	045-5015-02	CN1	7-Pin, Dual Row .1" Hdr. Conn.
26	1	140-0013-00	X1	8Mhz Clock Oscillator
27	0	Not Used	SW1	(SW1: NS)
28	1	(See Pg. **DR. ⑧** Table)	U12 U14 (ROM 0)	4MB ROM (U14: NS)

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 below 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 (3 of 8 decoder). Both of these must be in operation for the I/O Board to function properly.

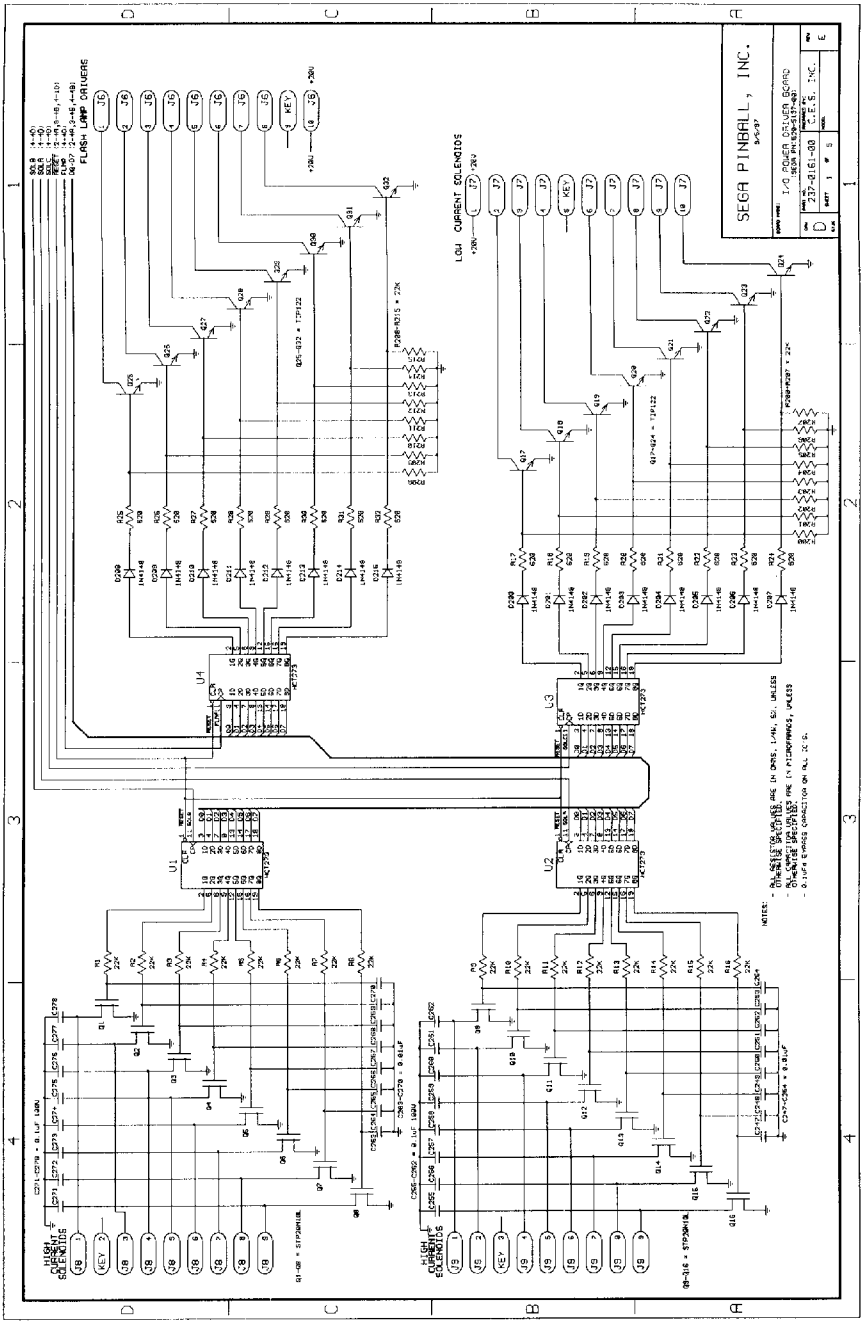
Solenoid Drivers & Flash Lamps:
J8 & J9 are high side drivers for driving solenoids and other heavy loads. Each connector has its own buffer driving 8 drivers. J8 & J9 consist of MOSFET drivers 20N10L which can easily & safely be tested by clipping one end of a clip-lead to test point FET TPL1 and then 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).

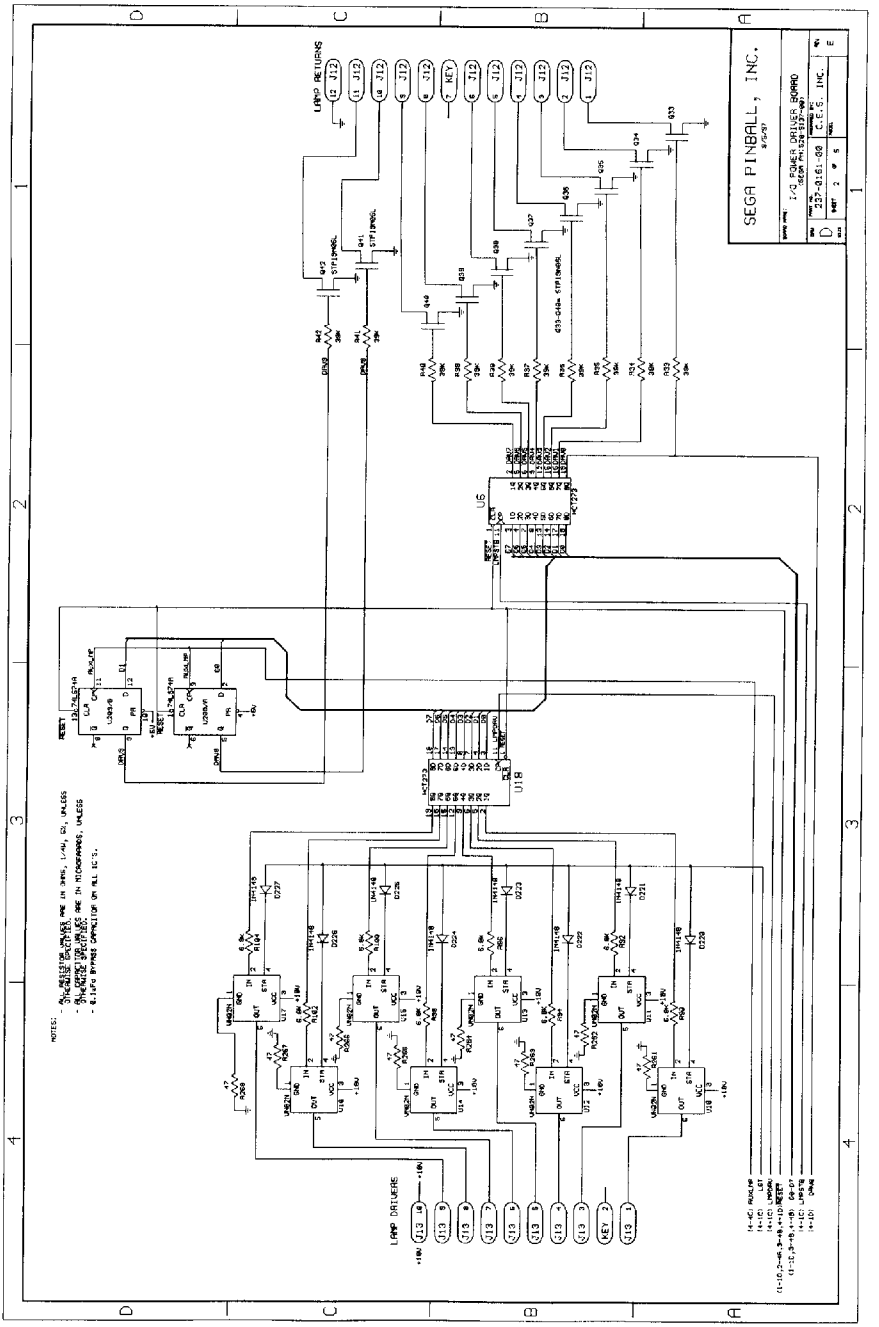
Note 1 * Clip on the resistor side with the white stripe.
** R1 controls Q1 and R2 controls Q etc...

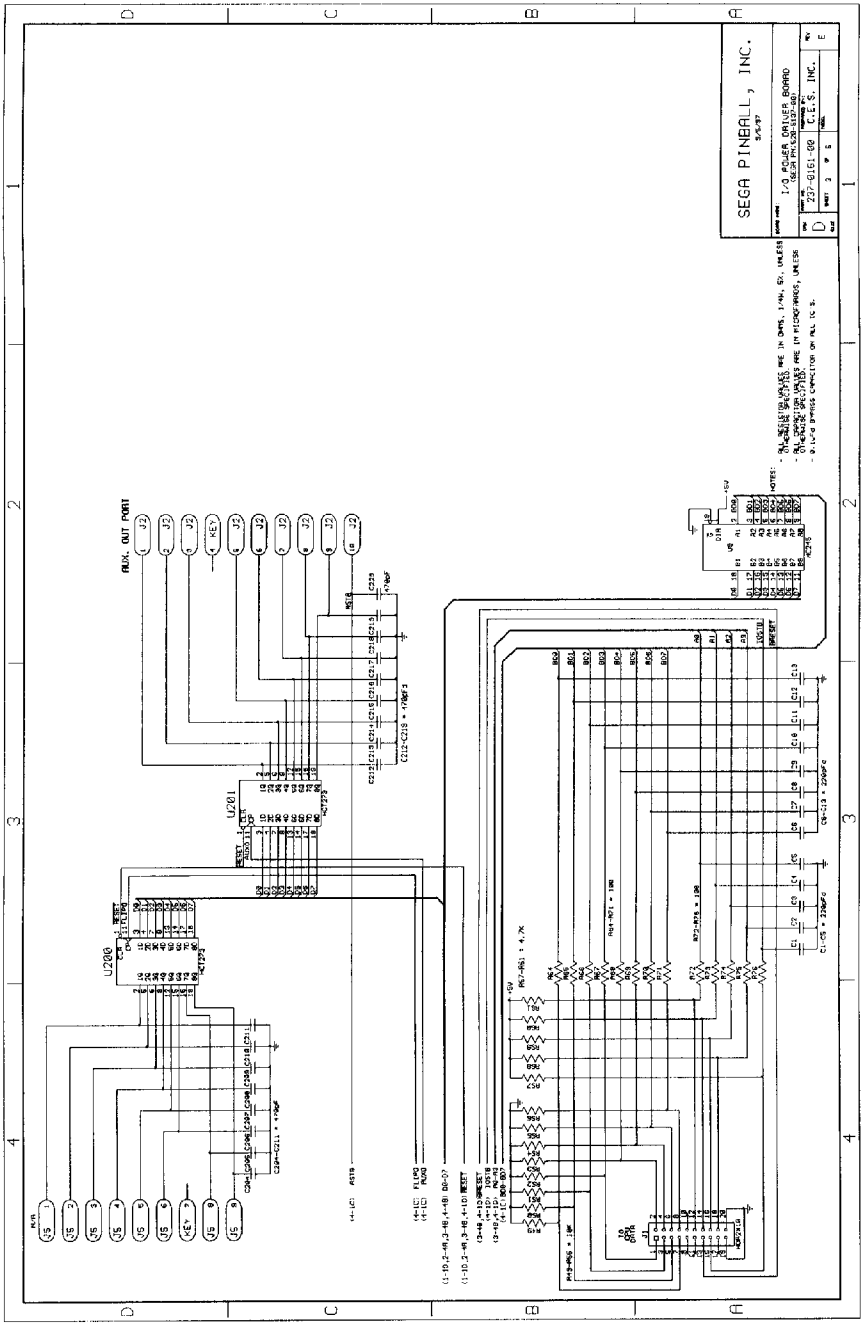
Auxiliary In & Out:
J2 8 CMOS Outputs sometimes used for a printer interface.
J3 8 CMOS Inputs general purpose inputs.

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.

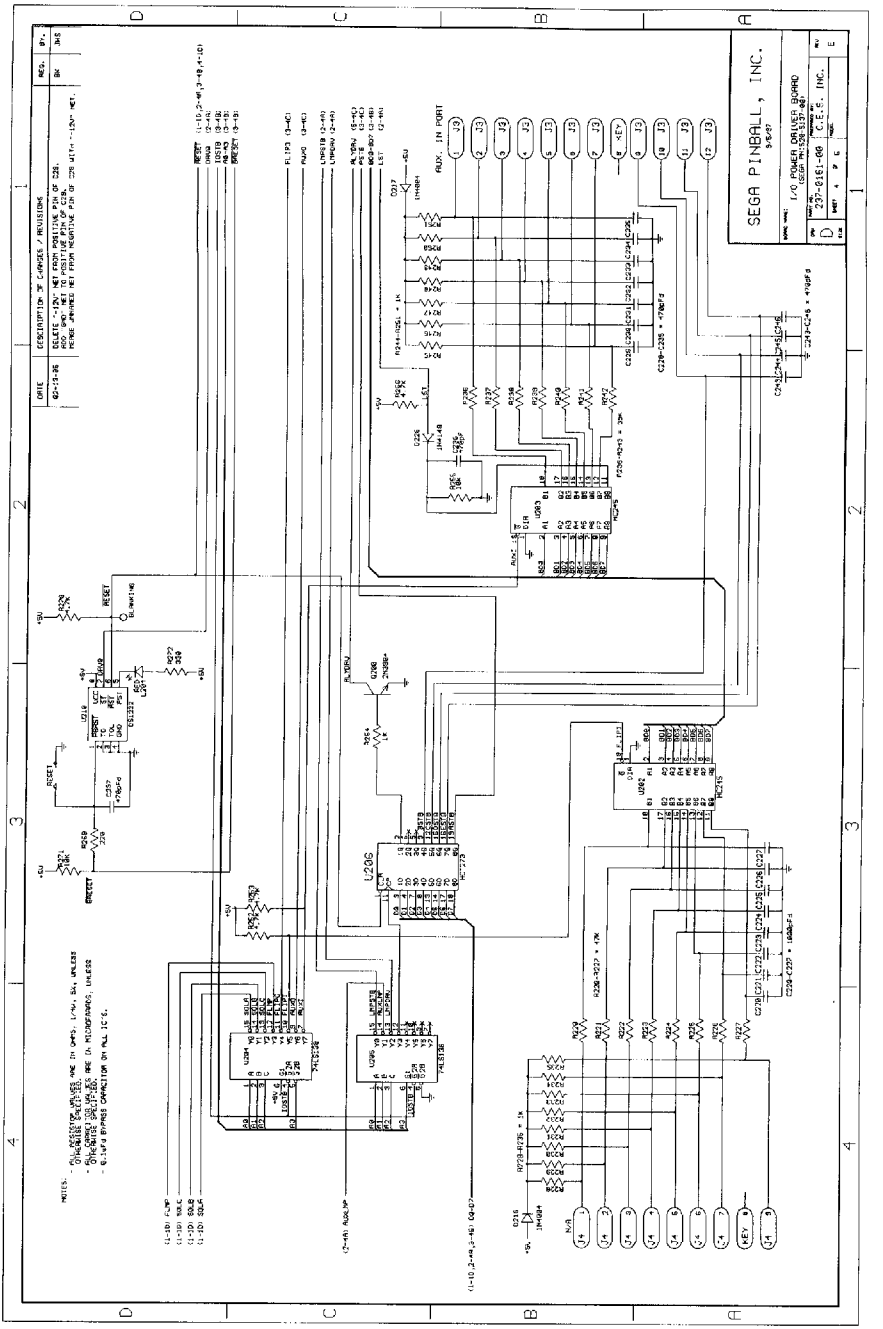
General Illumination (G.I.) Lights:
J15 has 6VAC switched on and off by a relay on the I/O Board. The relay is controlled by Q200 which supplies power to the 24V coil winding to activate the relay. There are 4 taps on J15 each fused at 5A for this 6VAC source.


SEGA PINBALL, INC.
I/O POWER DRIVER BOARD
D-237-0161-00
C.E.S. INC.
FLASH LAMP DRIVERS
LOW CURRENT SOLENOIDS
HIGH CURRENT SOLENOIDS
HIGH CURRENT SOLENOIDS
U1
U2
U3
U4

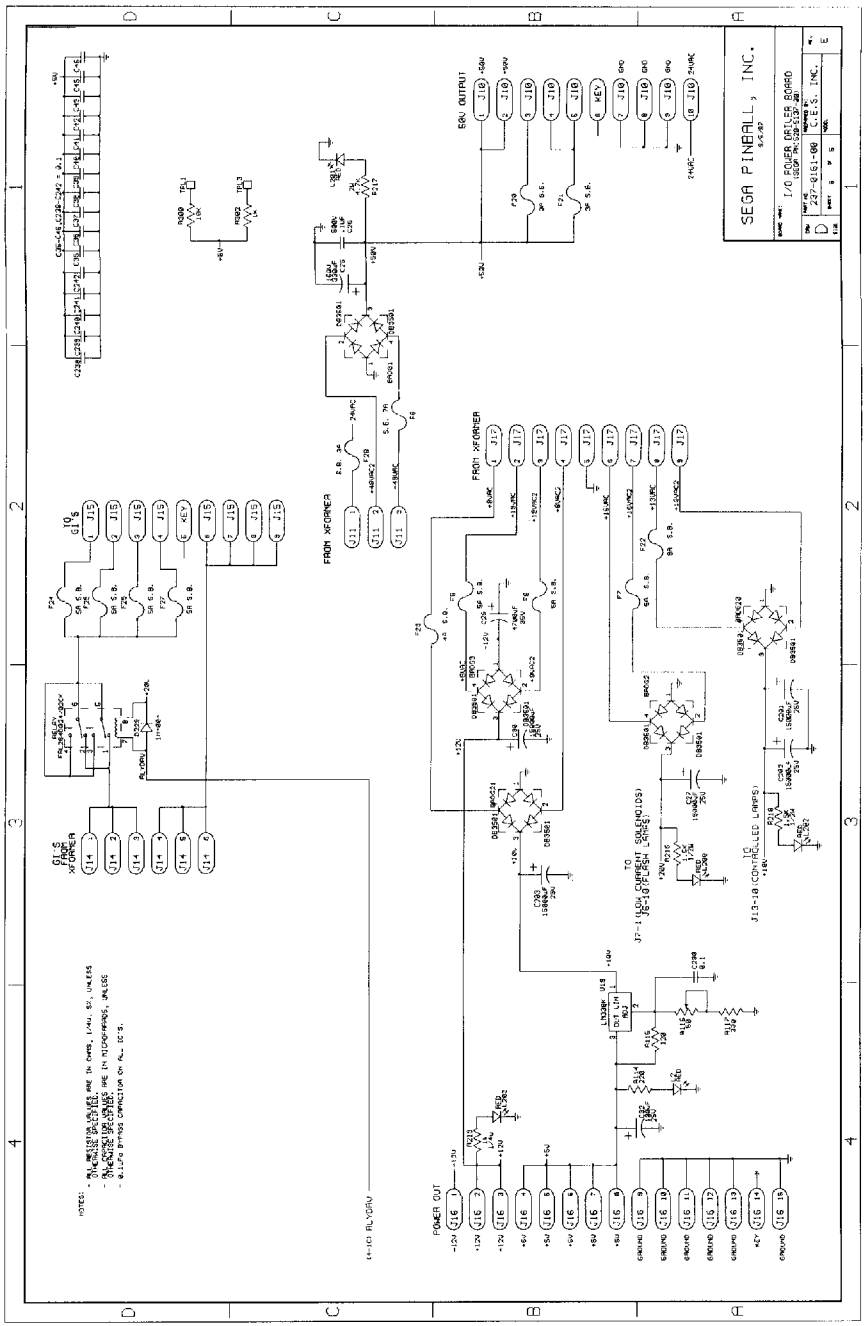

SEGA PINBALL, INC.
I/O POWER DRIVER BOARD
LAMP RETURNS
LAMP DRIVERS
U6
U18


SEGA PINBALL, INC.
I/O POWER DRIVER BOARD
C.E.S. INC.
AUX. OUT PORT
U201
U200

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



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

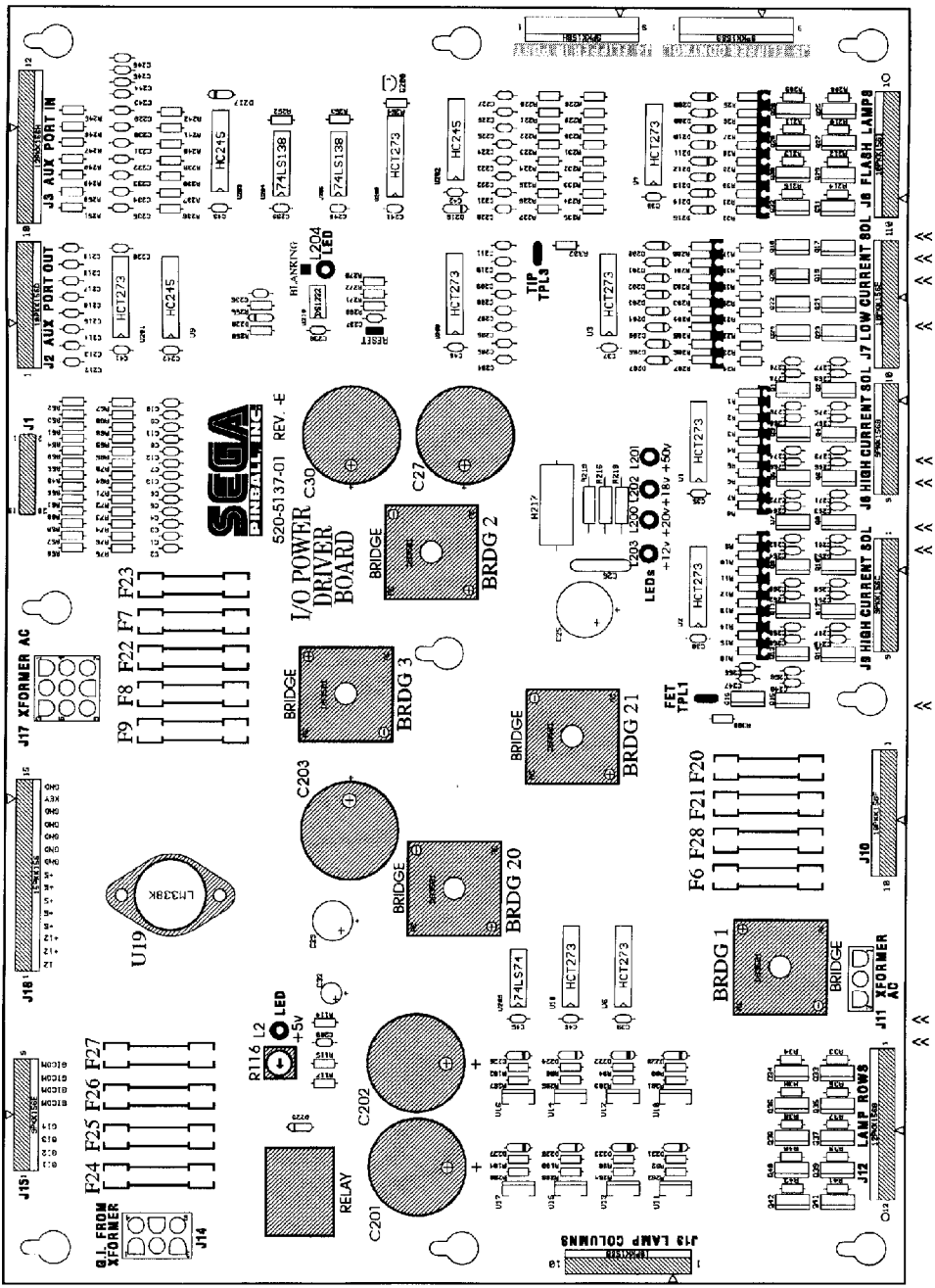


Section 5, Chapter 4
Printed Circuit Boards (PCBs)

STARSHIP TROOPERS

Page 107

Section 5 | PCBs


TEST POINTS:
TIP TPL3
BLANKING
L204 LED
RESET
L201 LED+50v
L202 LED+18v
L200 LED+20v
L200 LED+12v
FET TPL1
L2 LED +5v
R116 POT
J3 AUX PORT IN
J2 AUX PORT OUT
J8 FLASH LAMPS
J7 LOW CURRENT SOL
J8 HIGH CURRENT SOL
J8 HIGH CURRENT SOL
J17 XFORMER AC
J13 LAMP COLUMNS
J12 LAMP ROWS
J11 XFORMER AC
J10
J1
J14 FROM XFORMER
520-5137-01 REV. E
I/O POWER DRIVER BOARD
SEGA PINBALL INC
BRDG 1
BRDG 2
BRDG 3
BRDG 20
BRDG 21
BRIDGE
RELAY
U19
LH1338K
74LS138
74LS74
HC245
HCT273
C201
C202
C203
C27
C30
BLANKING
RESET
TIP TPL3
LEDs
L2 LED +5v
R116 L2

I/O Power Driver Board Parts

ITEM	QTY	PART NUMBER	REF-DESIGNATOR	DESCRIPTION (NS = Not Stuffed)
—	1	520-5137-01	I/O Power Driver Board	Complete PCB Assembly
1	16	125-5027-00	C255>C262, C271>C278	0.1uF, (104), 100v, Cap.
2	22	125-5028-00	C204>C219, C228>C237, C243>C246	470pF, (471), Axial Cap. (C204>C211: NS)
3	16	125-5029-00	C247>C254, C263>C270	0.01uF, (103), 100v Cap.
4	13	125-5030-00	C7 C8 C9 C10 C11 C12 C13 C1 C2 C3 C4 C5 C6	220pF, (221), Cap.
5	0	n/a	C220>C227	(C220>C227: NS)
6	17	125-5031-00	C35>C43, C45, C46, C200, C238>C242	0.1uF, (104), Cap.
7	16	110-0106-00	Q1>Q16	20N10L STP Transistor
8	32	121-5042-00	R1>R16, R200>R215	22K Ω 1/4W Res.
9	16	121-5003-00	R17>R32	620 Ω 1/4W Res.
10	17	121-5045-00	R33>R42, R236>R242	39K Ω 1/4W Res.
11	13	121-5007-00	R64>R76	100 Ω 1/4W Res.
12	8	121-5029-00	R90, R92, R94, R96, R98, R100, R102, R104	6.8K Ω 1/4W Res.
13	1	121-5030-00	R115	120 Ω 1/4W Res.
14	0	n/a	R220>R227	(R220>R227: NS)
15	9	121-5009-00	R228>R235, R245>R251, R254, R302	1K Ω 1/4W Res. (R228>R235: NS)
16	8	121-5032-00	R261>R268	47K Ω 1/4W Res.
17	2	121-5033-00	R114, R269	220 Ω 1/4W Res.
18	8	121-5021-00	R49, R57>R61, R252, R253, R256, R270	4.7K Ω 1/4W Res. (R252: NS)
19	11	121-5011-00	R50>R56, R255, R271, R300	10K Ω 1/4W Res.
20	2	121-5036-00	R117, R272	330 Ω 1/4W Res.
21	8	100-5019-00	U1>U4, U6, U18, U200, U201, U206	74HCT273 (U200: NS)
22	1	n/a	RESET	(RESET: NS)
23	1	121-5009-00	R219	1K Ω 1/4W Res.
24	2	121-5038-00	R216, R218	1.5K Ω 1/2W Res.
25	7	200-5000-01	F7>F9, F24>F27	5A 250v S.B. Fuse
26	1	200-5000-03	F6	7A 250v S.B. Fuse
27	1	200-5000-06	F23	4A 250v S.B. Fuse
28	1	200-5000-05	F22	8A 250v S.B. Fuse
29	3	200-5000-08	F20, F21, F28	3A 250v S.B. Fuse
30	1	045-5013-00	J15	9PKK156 (PIN 5=KEY)
31	1	045-5016-00	J16	15PKK156
32	1	100-5023-00	U210	DS1232
33	1	110-0069-00	Q200	2N3904, Transistor.
34	1	125-5032-00	C32	100uF, 25v, Radial Lytic Cap.
35	1	045-5015-01	J1	20-Pin, 0.1 Dual Row Header
36	1	100-0338-00	U202, U203	74HC245 (U202: NS)
37	10	110-0088-00	Q33>Q42	19N06L STP Transistor
38	6	165-5099-00	**L2, L200>L204**	**LED T1-3/4 DIFFUSER LED**
39	1	045-5014-01	J2	10PKK156 (PIN 4=KEY)
40	1	121-5039-00	R116	50 Ω Pot
41	16	110-0067-00	Q17>Q32	TIP122
42	1	125-5033-00	C25	100uF, 150v, Radial Lytic Cap.
43	1	110-0058-00	U9	74LS245
44	1	125-5034-00	C29	4700uF, 35v, Radial Lytic Cap.
45	1	190-5002-00	RELAY	FRL264D024/02CK Relay
46	0	n/a	J5	(J5: NS)
47	1	100-0037-00	U209	74LS74
48	0	n/a	J4	(J4: NS)
49	2	100-0148-00	U204, U205	74LS138
50	1	125-5035-00	C26	1UF, 500v, Ceramic Disk Cap.
51	1	100-0356-00	U19	LM338K
52	5	124-5000-00	BRDG1, BRDG2, BRDG3, BRDG20, BRDG21	DB3501
53	5	125-5036-00	C27, C30, C201>C203	15000uF, 25v, Radial Lytic Cap.
54	25	112-0054-00	D200>D215, D220>D227	1N4148, Diode
55	2	112-5003-00	D216, D217, D229	1N4004, Diode (D216: NS)
56	2	n/a	TPL1, TPL3	*Test Point Wire (24ga.) Loops*
57	1	045-5014-01	J7	10PKK156 (PIN 5=KEY)
58	1	045-5014-01	J6	10PKK156 (PIN 9=KEY)
59	8	110-0089-00	U10>U17	VN02N
60	1	045-0014-03	J11	10-84-4030 (3 PIN MOLEX)
61	1	045-5015-00	J12	12PKK156 (PIN 7=KEY)
62	1	045-0014-09	J17	10-84-4090 (9 PIN MOLEX)
63	1	n/a	BLANKING	*Test Point - Do Not Stuff*
64	1	121-5050-00	R217	4.7K Ω 2W Res. (SANDBAR)
65	1	045-5014-01	J13	10PKK156 (PIN 2=KEY)
66	1	045-0014-06	J14	10-84-4060 (6 PIN MOLEX)
67	1	045-5014-01	J10	10PKK156 (PIN 6=KEY)
68	1	045-5015-00	J3	12PKK156 (PIN 8=KEY)
69	1	045-5013-00	J9	9PKK156 (PIN 3=KEY)
70	1	045-5013-00	J8	9PKK156 (PIN 2=KEY)
71	26	205-0004-00	F6>F9, F20>F28	Fuse Clips
72	1	n/a	U19	Heatsink (5v Reg.)

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 8 strobes 'low' to *activate* a Single Column of switches. The *Switch Return Signals* are fed into CN7 [SWITCH ROWS] 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 Closure*. If *false switches* are appearing, check that none of the 2N3904 Transistors are permanently pulling the *strobe line low*. Only one strobe from CN5 [SWITCH COLUMNS] should be *low at any time*. CN6 [DEDICATED SWITCH IN] 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 Board is 8 bits wide. There are separate *Input* and *Output Busses*. The *Input Bus* from the Plasma Controller to the CPU/Sound Board comes in on CN8 [PLASMA CONTROL]-Pins 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-Pins 11-18. Status back from the Plasma Controller comes in on CN8-Pins 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 CN8-Pin 19 [**PSTB** - *Plasma Strobe*]. The 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.

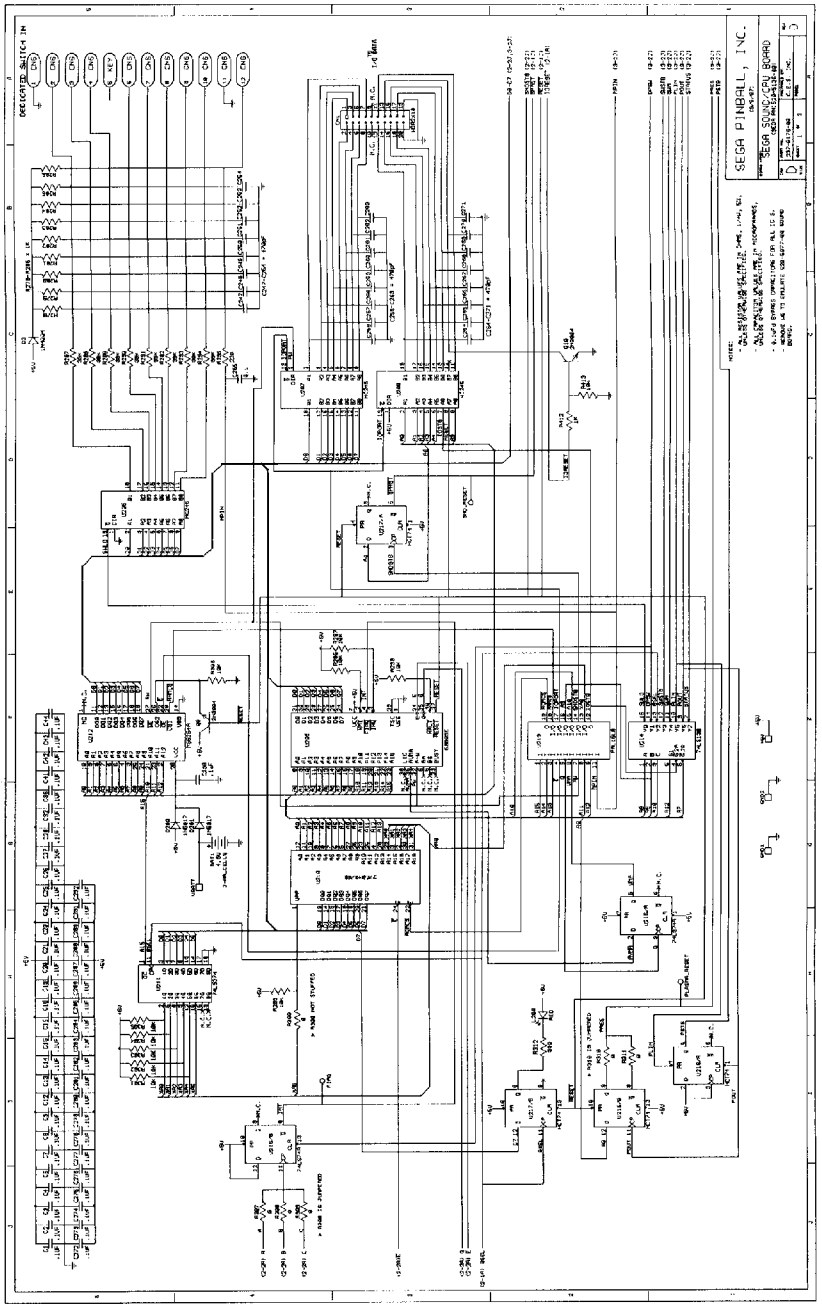
Sound calls are made from the CPU's 68B09E U200 to the sound section by latching data into U5. The sound section's CPU 68BO9E (U6) reads in this data and handles the interfacing to the BSMT.

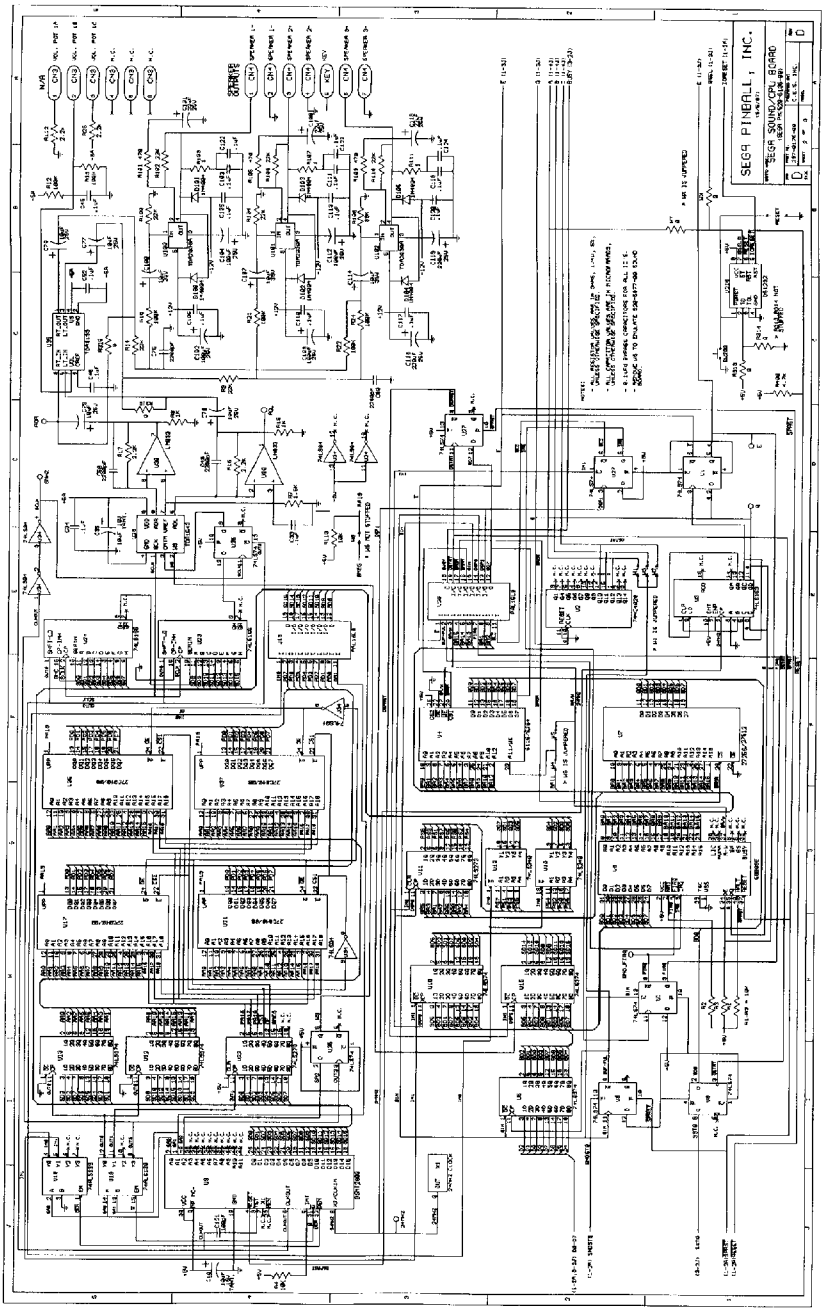
Other Test Points:
E & Q - The CPU signals for both 68B09E processors. Should be at 2Mhz with Q leading **E** by 500 nsec.

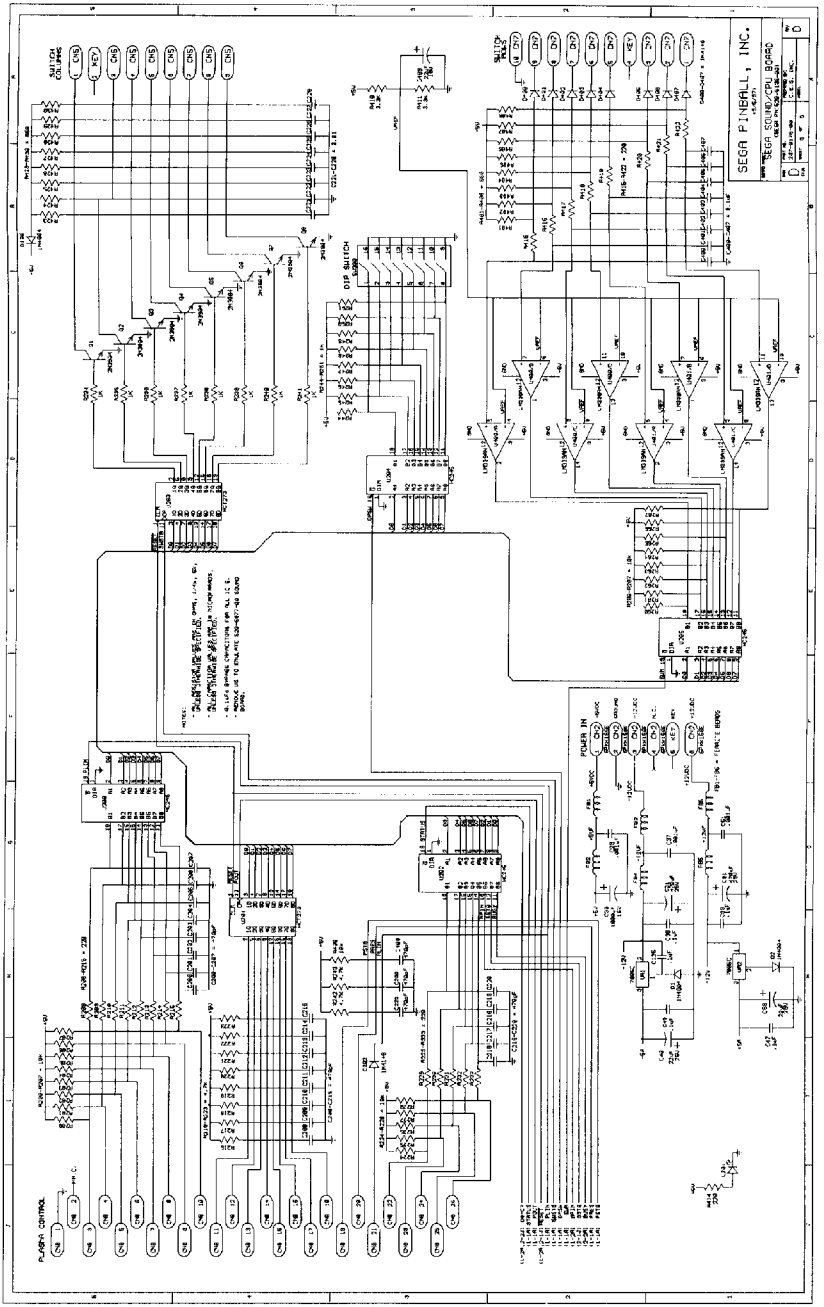
24Mhz - The oscillator used for the BSMT & derivation of E & Q.

SND-FIRQ - The sound sections CPU interupt.

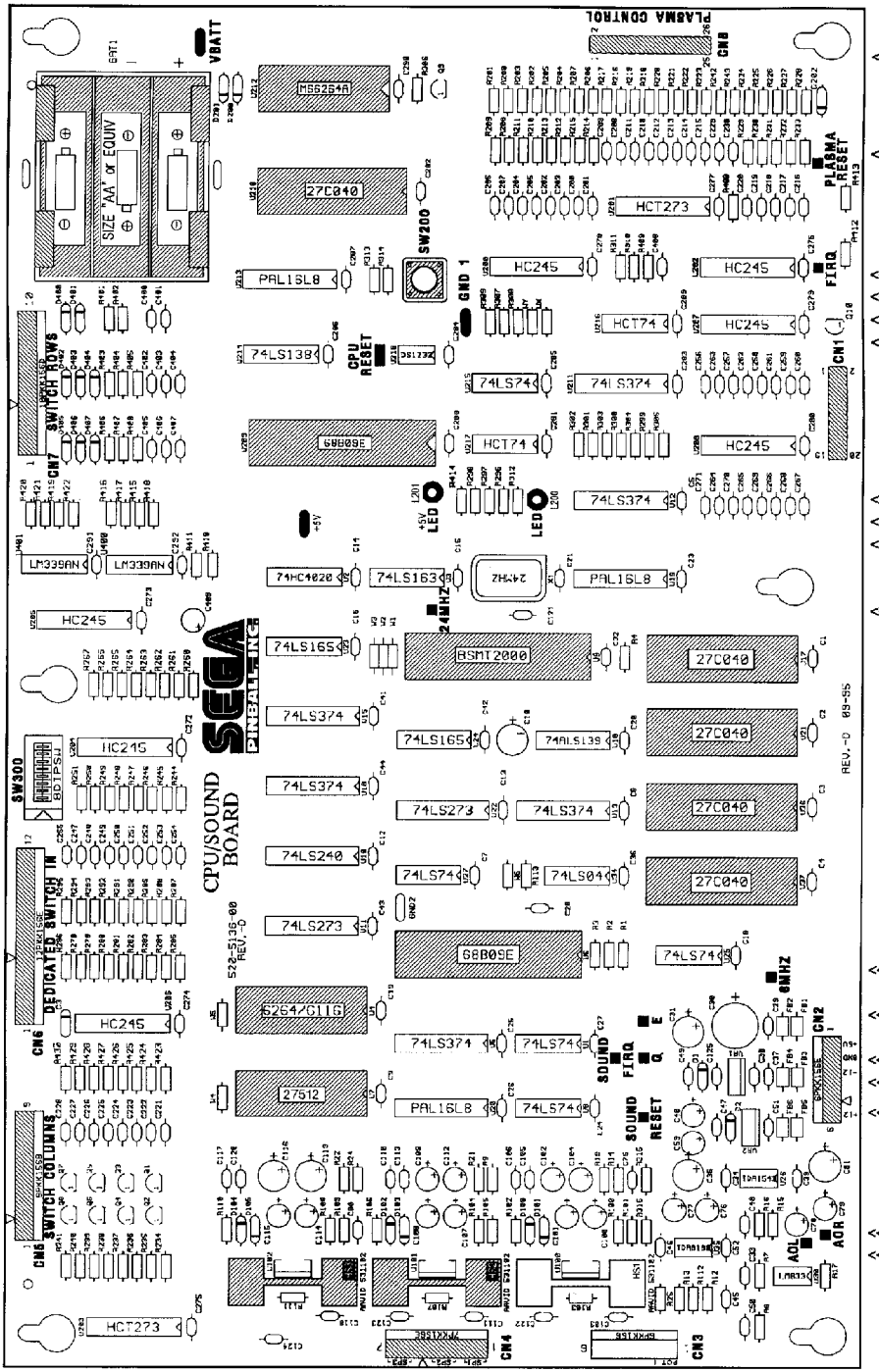
6Mhz - This clock is generated internally on the BSMT and is used for shifting the data samples into th DAC.


SEGA PINBALL, INC.
SEGA SOUND/CPU BOARD


SEGA PINBALL, INC.
SEGA SOUND/CPU BOARD


SEGA PINBALL, INC.
SEGA SOUND/CPU BOARD
DIP SWITCH
POWER IN
PLAYER CONTROL

CPU/Sound Board Component Layout



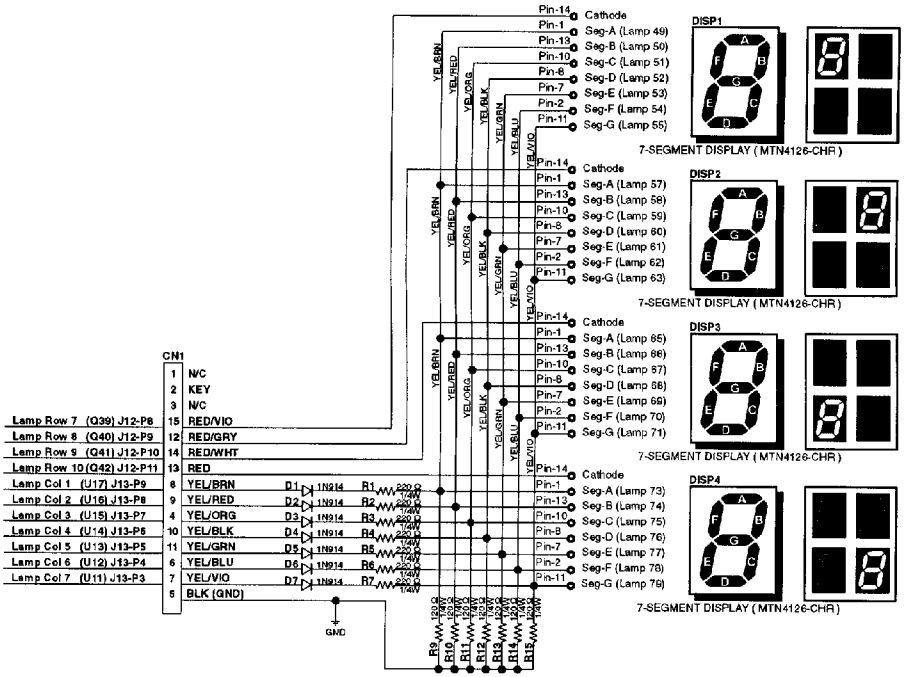
TEST POINTS:

- << VBATT
- << PLASMA RESET
- << FIRQ
- << SW200
- << GROUND 1
- << CPU RESET
- << L201 LED+5v
- << L200 LED
- << +5v
- << 24 Mhz
- << 6 Mhz
- << E
- << SOUND FIRQ
- << Q
- << SOUND RESET
- << AOR
- << AOL

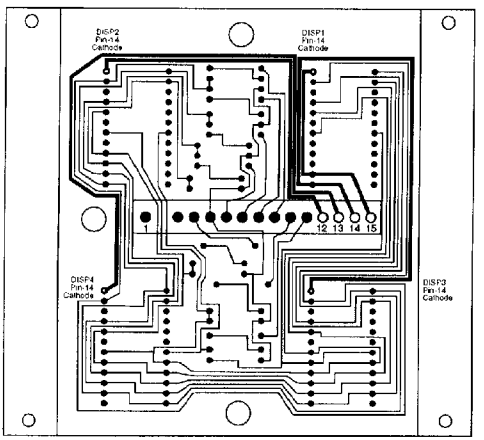
CPU/Sound Board Parts

ITEM	QTY	PART NUMBER	REF-DESIGNATOR	DESCRIPTION (NS = Not Stuffed)
—	1	520-5136-00	CPU/Sound Board	Complete PCB Assembly
1	1	124-5001-00	VR2	7805 +5v Regulator
2	5	121-5051-00	R12, R13, R19, R21, R22, R24	100K Ω 1/4W Res. (R19: NS)
3	2	121-5009-00	R103, R107, R111	1K Ω 1/4W Res. (R103: NS)
4	38	121-5011-00	R1>R4, R113, R200>R207, R224>R228, R244>R251, R260>R267, R296>R299, R301>R306, R409, R413	10K Ω 1/4W Res. (R200>R207, R409, R413: NS)
5	5	121-5023-00	R9, R14, R100, R102, R104, R106, R110	22K Ω 1/4W Res. (R100, R102: NS)
6	20	121-5009-00	R15, R8, R234>R241, R278>R286, R412	1K Ω 1/4W Res.
7	4	121-5043-00	R16, R17, R25, R112	2.2K Ω 1/4W Res.
8	1	121-5018-00	R7	1.5K Ω 1/4W Res.
9	2	121-5046-00	R101, R105, R109	470K Ω 1/4W Res. (R101: NS)
10	9	121-5045-00	R108, R287>R294	39K Ω Res.
11	1	121-5036-00	R312	330 Ω 1/4W Res.
12	12	n/a	R300, R308>R311, R313>R316, WX, WY	0Ω *Jumper Wire (24ga.)*
13	15	121-5033-00	R208>R215, R229>R33, R414>R422	220K Ω 1/4W Res. (R208>R215: NS)
14	11	121-5021-00	R216>R223, R242, R243, R400	4.7K Ω 1/4W Res.
15	16	121-5047-00	R401>R408, R423>R430	560 Ω 1/4W Res.
16	2	121-5048-00	R410, R411	3.3K Ω 1/4W Res.
17	1	100-0049-00	U3	74LS163
18	1	(See Pg. **DR. ❸** Table)	U7	27512 EPROM
19	1	045-5015-07	CN4	7PKK156 (PIN5=KEY)
20	1	Not Used	RESET	*Do Not Stuff*
21	5	(See Pg. **DR. ❸** Table)	U17, U21, U36, U37, U210	27C040 EPROM
22	2	100-5008-00	U23, U24	74LS165
23	4	125-5017-00	C76>C79	10uF, 25v, Radial Lytic Cap.
24	4	125-5020-00	C40, C59, C101, C108, C115	22uF, 25v, Radial Lytic Cap. (C101: NS)
25	2	125-5017-00	C100, C10,7 C114	10uF, 35v, Radial Lytic Cap. (C100: NS)
26	2	125-5015-00	C102, C104, C109, C112	100uF, 25v, Rad. Lte. Cap. (C102, C104: NS)
27	1	125-5014-00	C409	22uF, 16v, Radial Lytic Cap.
28	1	100-5016-00	U35	TDA1899
29	1	125-5037-00	C30	1000uF, 16v, Radial Lytic Cap.
30	1	100-0027-00	U34	74LS04
31	1	100-0043-00	U18	74ALS139
32	6	100-0064-00	U5, U12, U13, U15, U16, U211	74LS374
33	1	100-0249-00	U2	74HC4020
34	1	100-0149-00	U10	74LS240
35	6	n/a	W1>W6	0Ω *Jumper Wire (24ga.)*
36	2	125-5012-00	C31, C81	470uF, 25v, Radial Lytic Cap.
37	2	125-5017-00	C10, C35	10uF, 16v, Radial Tant. Cap.
38	2	125-5019-00	C116, C119	220uF, 25v, Radial Lytic Cap.
39	1	045-5015-06	CN2	6PKK156 (PIN 5=KEY)
40	1	140-0011-00	X1	24Mhz
41	1	105-0116-00	U9	BSMT2000
42a	1	965-0136-00	**U19 - YELLOW DOT**	PAL16L8 (Programmed) - **YELLOW DOT**
42b	1	965-0137-00	**U20 - WHITE DOT**	PAL16L8 (Programmed) - **WHITE DOT**
42c	1	965-6504-00	**U213- BLUE DOT**	PAL16L8 (Programmed) - **BLUE DOT**
43	5	100-0037-00	U1, U8, U25, U27, U215	74LS74
44	3	125-5043-00	C29, C87, C51	0.001uF, (102), Cap.
45	79	125-5031-00	C1>C5, C7>C9, C12>C16, C18>C21, C23>C26, C28, C32>C34, C36, C38, C39, C41>C47, C49, C52, C102 C103, C105, C106, C110, C111, C113, C117, C118, C120, C122>C125, C255, C272>C292, C400>C407	0.1uF, (104), Axial Cer. Cap. (C102, C103, C105, C106: NS)
46	1	125-5038-00	C121	100pF, (101), Cap.
47	4	125-5039-00	C48, C50, C75, C80	0.0022uF, (222), Cap.
48	39	125-5028-00	C200>C220, C229, C230, C247>C254, C256>C271	470pF, (471), Cer. Cap. (C200>C207: NS)
49	8	125-5029-00	C221>C228, C408	0.01uF, (103), Cap. (C408: NS)
50	1	045-5015-06	CN3	6PKK156
51	1	100-0375-00	U30	LM833
52	2	100-0022-00	U22 U11	74LS273
53	7	112-5003-00	D1>D3, D100>D105	1N4004, Diode (D100, D101: NS)
54	2	112-5008-00	D200, D201	1N5817, Diode
55	8	112-0054-00	D202, D400>D407	1N4148, Diode (D202: NS)
56	1	124-5002-00	VR1	7905 -5v Regulator
57	2	100-5016-20	U100>U102	TDA2030V (U100: NS)
58	1	100-5018-00	U26	TDA1543
59	1	n/a	SW200	B3F4000
60	1	165-5099-00	**L200**	**LED T1-3/4 DIFFUSER LED**
61	1	165-5099-00	**L201**	**LED T1-3/4 DIFFUSER LED**
62	2	100-5015-00	U216, U217	HCT74
63	1	100-0148-00	U214	74LS138
64	1	105-0046-00	U212	MS6264A
65	1	100-0189-01	U6, U209	68B09E
66	1	545-5685-00	BAT1 BATTERY HOLDER	3-AA CELLS 4.5v
67	1	045-5015-01	CN1	20-Pin, 0.1 HEADER
68	10	n/a	6MHZ AOR Q AOL 24MHZ	*Test Points* - NS
69	10	110-0069-00	Q1>Q10	2N3904, Transistor
70	1	045-5013-00	CN5	9PKK156 (PIN 2=KEY)
71	2	100-5019-00	U201, U203	74HCT273
72	6	100-0338-00	U200, U202, U204>U208	74HC245 (U200: NS)
73	1	100-5023-00	U218	DS1232
74	1	045-5015-26	CN8	26-Pin, 0.1 HEADER
75	1	045-5014-01	CN7	10PKK156 (PIN 4=KEY)
76	4	n/a	VBATT +5V GND1, GND2	*Test Point Wire (24ga.) Loops*
77	1	045-5015-00	CN6	12PKK156 (PIN 5=KEY)
78	1	181-5002-00	SW300	8-Pin, Dip Switch
79	2	100-0377-00	U400, U401	LM339AN
80	1	105-0052-05	U4	6116 RAM
81	3	535-5000-10	U100>U102	AAVID 531102
82	3	077-5209-00	U6, U9, U209	40-Pin, IC Socket
83	5	077-5217-00	U17, U21, U36, U37, U210	32-Pin, IC Socket
84	3	077-5208-00	U4, U7, U212	28-Pin, IC Dip Socket

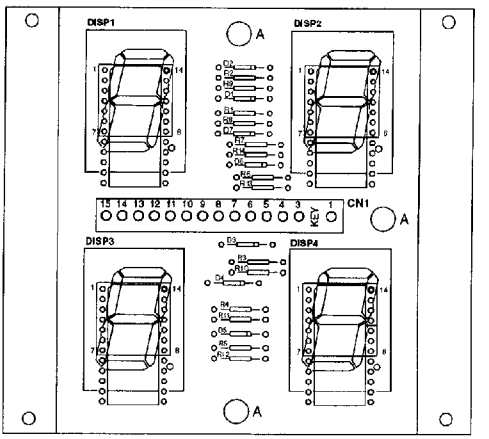
4X 7-Segment Display Board Schematic



4X 7-Segment Display Board Component Layout & Parts



520-5166-00



Solder Side (Green) Trace shown bold from CN1 Pin-12 through CN1 Pin-15 to DISP1 through DISP4 Socket Pin-14, Cathode, respectively.

Component Side (Beige)

ITEM	QTY	PART NUMBER	REF-DESIGNATOR	DESCRIPTION
—	1	520-5166-00	4X 7-Segment Display Bd.	Complete PCB Assembly
1	7	121-5014-00	R1>R7	220 Ω 1/4W Res.
2	7	121-5030-00	R8>R14	120 Ω 1/4W Res.
3	7	112-5014-00	D1>D7	1N914, Diode
4	4	165-5040-00	DISP1, DISP2, DISP3, DISP4	1" 7-Seg. Red Disp (MTN4126-CHR)
5	4	045-5160-24	DISP1, DISP2, DISP3, DISP4	24-Pin Socket .6"w X .3"h (SPC SP-242T)
6	1	045-5161-15	CN1	15X1 Reverse-Mount .156" Hdr.

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, CPU/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).

- **Appendix I, Stand-Up Targets (Happ Modular & Regular) 130**
  ...gives a pictoral view with the name and part number of all the Single Stand-Up Targets used (also gives the Color Code Chart).

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

- **Parts Order Checklist Notes 132**
  ...keep track of your parts ordered through your distributor for this game.

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	(128K)	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	A02-0	B5	960-5007-00
CPU	(256K)	965-0042-00	A02-0	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
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	A1.04	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	A1.06	U8	960-5009-00

EPROM	Chip Size	Part Nº	Ver.	Loc.	Raw Part Nº
Star Trek 25th Anniversary					
CPU	(512K)	965-0072-00	A2.01	C5	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	A2.06	ROM 0	960-5010-00
Display	(2M)	965-0087-00	A2.06	ROM 1	960-5010-00
	(Used on Display PCB 520-5055-00)				
		-OR-			
Display	(4M)	965-0087-04	A2.06	ROM 0	960-5015-00
	(Used on Display PCB 520-5055-01)				
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	A5.13	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	A3.03	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	A3.01	ROM 0	960-5015-00
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

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Table continued on the next page.

APPENDIX A
Pinball Game Firmware Table

EPROM	Chip Size	Part Nº	Ver.	Loc.	Raw Part Nº
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 Board 520-5003-04)			
CPU	(512K)	965-0195-00	A4.00	C5	960-7001-02
Voice 1	(4M)	965-0196-00		U17	960-5015-00
Voice 2	(4M)	965-0197-00		U21	960-5015-00
Sound	(512K)	965-0199-00		U7	960-7001-02
Display*	(4M)	965-0200-00	A4.00	ROM 0	960-5015-00
Display*	(4M)	965-0201-00	A4.00	ROM 3	960-5015-00
Batman Forever		(CPU Board 520-5003-04)			
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

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

Games hereon use the White Star Board System™:

ROM	Chip Size	Part Nº	Ver. ✓Sum	Loc.	Raw Part Nº
Apollo 13					
CPU / Sound Board:		**520-5136-00 (Stereo)**			
Game ROM	(1M)	965-0208-00	A5.01 $09FF	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 Bd:		**520-5055-01**			
Display	(4M)	965-0213-00	A5.00 $B92B	ROM 0	960-5015-00
Golden Eye					
CPU / Sound Board:		**520-5136-00 (Stereo)**			
Game ROM	(1M)	965-0214-42	A4.04 $3FFF	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 Bd:		**520-5055-01**			
Display	(4M)	965-0218-42	A4.00 $E6ED	ROM 0	960-5015-00
Twister					
CPU / Sound Board:		**520-5136-10 (Mono)**			
Game ROM	(1M)	965-0219-41	A4.05 $E9FF	U210	960-5009-00
Voice 1	(4M)	965-0220-41		U17	960-5015-00
Voice 2	(4M)	965-0223-41		U21	960-5015-00
Sound	(512K)	965-0221-41		U7	960-7001-02
Display Controller Bd:		**520-5055-01**			
Display	(4M)	965-0222-41	A4.01 $FD01	ROM 0	960-5015-00
ID4: Independence Day					
CPU / Sound Board:		**520-5136-10 (Mono)**			
Game ROM	(1M)	965-0224-45	A2.02 $9CFF	U210	960-5009-00
Voice 1	(4M)	965-0225-45		U17	960-5015-00
Voice 2	(4M)	965-0226-45		U21	960-5015-00
Sound	(512K)	965-0227-45		U7	960-7001-02
Display Controller Bd:		**520-5055-01**			
Display	(4M)	965-0228-45	A2.00 $ABF7	ROM 0	960-5015-00

ROM	Chip Size	Part Nº	Ver. ✓Sum	Loc.	Raw Part Nº
Space Jam					
CPU / Sound Board:		**520-5136-10 (Mono)**			
Game ROM	(1M)	965-0229-43	A3.00 $E6FF	U210	960-5009-00
Voice 1	(4M)	965-0230-43		U17	960-5015-00
Voice 2	(4M)	965-0231-43		U21	960-5015-00
Voice 3	(4M)	965-0232-43		U36	960-5015-00
Sound	(512K)	965-0233-43		U7	960-7001-02
Display Controller Bd:		**520-5055-01**			
Display	(4M)	965-0234-43	A3.00 $ØØ57	ROM 0	960-5015-00
The Star Wars Trilogy - Special Edition (S.E.)					
CPU / Sound Board:		**520-5136-10 (Mono)**			
Game ROM	(1M)	965-0235-56	A4.03 $5EFF	U210	960-5009-00
Voice 1	(4M)	965-0236-56		U17	960-5015-00
Voice 2	(4M)	965-0237-56		U21	960-5015-00
Sound	(512K)	965-0238-56		U7	960-7001-02
Display Controller Bd:		**520-5055-01**			
Display	(4M)	965-0239-56	A4.00 $8817	ROM 0	960-5015-00
The Lost World: Jurassic Park					
CPU / Sound Board:		**520-5136-10 (Mono)**			
Game ROM	(1M)	965-0240-53	A2.01 $C2FF	U210	960-5009-00
Voice 1	(4M)	965-0241-53		U17	960-5015-00
Voice 2	(4M)	965-0242-53		U21	960-5015-00
Sound	(512K)	965-0243-53		U7	960-7001-02
Display Controller Bd:		**520-5055-01**			
Display	(4M)	965-0244-53	A2.01 $7F46	ROM 0	960-5015-00
The X-Files					
CPU / Sound Board:		**520-5136-10 (Mono)**			
Game ROM	(1M)	965-0245-46	A3.02 $DFFF	U210	960-5009-00
Voice 1	(4M)	965-0246-46		U17	960-5015-00
Voice 2	(4M)	965-0247-46		U21	960-5015-00
Sound	(512K)	965-0248-46		U7	960-7001-02
Display Controller Bd:		**520-5055-01**			
Display	(4M)	965-0249-46	A3.00 $66D0	ROM 0	960-5015-00
Starship Troopers					
CPU / Sound Board:		**520-5136-10 (Mono)**			
Game ROM	(1M)	965-0250-59		U210	960-5009-00
Voice 1	(4M)	965-0251-59	GAME CODE IN PRODUCTION	U17	960-5015-00
Voice 2	(4M)	965-0252-59		U21	960-5015-00
Voice 3	(4M)	965-0255-59		U36	960-5015-00
Sound	(512K)	965-0253-59		U7	960-7001-02
Display Controller Bd:		**520-5055-01**			
Display	(4M)	965-0254-59		ROM 0	960-5015-00

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

Table Nº	Type	Source Number	SEGA PINBALL™	N T E®	E C G®	Radio Shack®	R C A®
	RECTIFICATION, BLOCKING AND/OR DAMPENING DIODES						
1	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
	Diode	T6A10L	112-5006-01	- — - — -	- — - — -	- — - — -	- — - — -
	Diode	FR302	112-5009-00	- — - — -	ECG588	- — - — -	SK5014
	ZENER DIODES						
2	Diode	1N4742A 12v	112-0061-00	NTE142A	ECG142A	276-563	SK12V
	Diode	1N4760B 68v	112-0062-00B	NTE5092A	ECG5092A	- — - — -	SK68V
	Diode	1N4764A 100v	112-0049-00A	NTE5096A	ECG5096A	- — - — -	SK100V
	Diode	1N5228 3.9v	112-0053-00	NTE5007A	ECG5007A	- — - — -	SK3A9
	Diode	1N5234B 6.2v	112-0047-00B	NTE5013A	ECG5013A	276-561	SK6A2
	Diode	1N5379 110v	112-0072-00	NTE5157	ECG5157	- — - — -	SK110X
	Diode	1N6267A 6.8v	112-5011-00	- — - — -	ECG4902	- — - — -	- — - — -
	Diode	1N4752A 33v	112-5010-00A	- — - — -	- — - — -	- — - — -	SK33V
	Diode	1N4736 6.8v 1w	112-5007-00	- — - — -	- — - — -	- — - — -	- — - — -
	TRANSISTORS - TYPE FET, NPN, PNP AND/OR SCR						
3	FET Trans.	STP20N10L	110-0106-00	- — - — -	ECG2943	- — - — -	- — - — -
	FET Trans.	STP19N06L	110-0088-00	- — - — -	- — - — -	- — - — -	- — - — -
	FET Trans.	VN02	110-0089-00	- — - — -	- — - — -	- — - — -	- — - — -
	NPN Trans.	2N4401	- — - — -	NTE85	ECG85	276-2009	SK3124A
	NPN Trans.	2N6427	110-0070-00	NTE48	ECG48	- — - — -	SK4906
	NPN Trans.	MJE340	110-0071-00	NTE157	ECG157	- — - — -	SK3747
	NPN Trans.	MPSA42	110-0082-00	NTE287	ECG287	- — - — -	SK3232
	NPN Trans.	2N3904	110-0069-00	NTE123AP	ECG123AP	276-2009	- — - — -
	NPN Trans.	TIP122	110-0067-00	NTE261	ECG261	276-2068	SK3896
	NPN Trans.	MJE15030	110-0101-00	NTE375	ECG375	- — - — -	SK9118
	PNP Trans.	2N5401	110-0078-00	NTE288	ECG288	- — - — -	SK3434
	PNP Trans.	MJE15031	110-0103-00	NTE292	ECG292	- — - — -	SK3441
	PNP Trans.	MJE350	110-0072-00	NTE374	ECG374	- — - — -	SK9042
	PNP Trans.	MPSA92	110-0100-00	NTE288	ECG278	- — - — -	SK3434
	PNP Trans.	TIP42	110-0068-00	NTE332	ECG332	- — - — -	SK9236
	PNP Trans.	TIP32C	110-0081-00	NTE292	ECG292	- — - — -	SK3441
	PNP Trans.	TIP36C	110-0077-00	NTE393	ECG393	- — - — -	SK3961
	SCR Trans.	2N5060	110-0074-00	NTE5400	ECG5400	276-1067	SK3950
	SCR Trans.	SCR2800B	110-0083-00	- — - — -	ECG5463 / 65 / 66 / 68		- — - — -
	BRIDGE RECTIFIERS (BR)			Comments:			
4	BR (Present)	DB or CM3501	124-5000-00	For White Star I/O Bds., BR = 35 Amp @ 100v P.I.V.			
	BR (Old)	MDA2501	124-2501-00	BR = 25 Amp @ 100v P.I.V.			
	BR (Old)	MDA3502	124-3502-00	BR = 35 Amp @ 200v P.I.V.			
	RELAYS			Comments:			
5	Relay	FRL-264 D024/02CK	190-5002-00	For PPB, Power Supply, & White Star I/O Boards, Relay = 24v DC 10 Amp DPDT			
	Relay	FRL-264 D006/04CV	190-5001-00	For CPU Boards, Relay = 6v DC 5 Amp 4 Pole DT			

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 J6b 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 & Bullwinkle & 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
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
32. ID4: Independence Day	JUL 96 780-5045-00	—	U210	n/a	n/a
33. Space Jam	OCT 96 780-5043-00	—	U210	n/a	n/a
34. The Star Wars Trilogy - S.E.	FEB 97 780-5056-00	—	U210	n/a	n/a
35. The Lost World: J.P.	JUN 97 780-5053-00	—	U210	n/a	n/a
36. The X-Files	AUG 97 780-5046-00	—	U210	n/a	n/a
37. Starship Troopers	NOV 97 780-5059-00	—	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	[illegible]	*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	[illegible]	520-5002-02	520-5000-00	520-5014-01 7 Digit Alpha/Numeric Combined
Torpedo Alley	[illegible]	520-5002-02	520-5000-00	520-5014-01 7 Digit Alpha/Numeric Combined
Time Machine	[illegible]	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 or 5080/-00 (Qty. 2) 4-Flip. (2X2)	520-5077-00	520-5047-02	520-5052-00 128 X 32	520-5055-01

Table continued on the next page.

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 & Bullwinkle & 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.	EPROM 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
32. ID4: Independence Day	JUL 96 780-5045-00	—	U210	n/a	n/a
33. Space Jam	OCT 96 780-5043-00	—	U210	n/a	n/a
34. The Star Wars Trilogy - S.E.	FEB 97 780-5056-00	—	U210	n/a	n/a
35. The Lost World: J.P.	JUN 97 780-5053-00	—	U210	n/a	n/a
36. The X-Files	AUG 97 780-5046-00	—	U210	n/a	n/a
37. Starship Troopers	NOV 97 780-5059-00	—	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

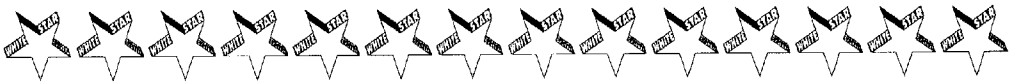
Game Name	Flipper	Sound	Power Supply	Display X-Digit
Laser War	2-Flipper Board Not Required	***initial:*** 520-5002-00 ***replaced with:*** 520-5002-02 520-5002-01 was not used.	520-5000-00	Master: 520-5004-00 plus: 7 Digit Alpha/Numeric 520-5005-00 (Qty. 2) 7 Digit Numeric 520-5006-00 (Qty. 2) 4 Digit Numeric 520-5007-00
Secret Service	2-Flipper Board Not Required	520-5002-02	520-5000-00	520-5014-01 7 Digit Alpha/Numeric Combined
Torpedo Alley	2-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 or 5080/-00 (Qty. 2) 4-Flip. (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	520-5070 or 5080/-00 (Qty. 2) 4-Flip. (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



Games hereon use the White Star Board System™:

Game Name	Flipper	I/O Power Driver	CPU / Sound †	Display Power Supply	Dot Matrix Display	Display Controller
Apollo 13	520-5080-00 2-Flipper	520-5137-00	520-5136-00	520-5138-00	520-5052-00 128 X 32	520-5055-01
Golden Eye	520-5080-00 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	520-5136-10	520-5138-00	520-5052-00 128 X 32	520-5055-01
ID4: Independence Day	3-Flipper Bd. Not Required	520-5137-01	520-5136-10	520-5138-00	520-5052-00 128 X 32	520-5055-01
Space Jam	2-Flipper Bd. Not Required	520-5137-01	520-5136-10	520-5138-00	520-5052-00 128 X 32	520-5055-01
The Star Wars Trilolgy - S.E.	2-Flipper Bd. Not Required	520-5137-01	520-5136-10	520-5138-00	520-5052-00 128 X 32	520-5055-01
The Lost World: J.P.	2-Flipper Bd. Not Required	520-5137-01	520-5136-10	520-5138-00	520-5052-00 128 X 32	520-5055-01
The X-Files	2-Flipper Bd. Not Required	520-5137-01	520-5136-10	520-5138-00	520-5052-00 128 X 32	520-5055-01
Starship Troopers	3-Flipper Bd. Not Required	520-5137-01	520-5136-10	520-5138-00	520-5052-00 128 X 32	520-5055-01

† ***Note:*** To order Game Specific CPU/Sound Board please specify Game Name; -00 = Stereo; -10 = Mono.

APPENDIX E
Generic Coil Cross-Reference Guide † ‡

STANDARD COILS					
GA-TURNS	Res. (Ω)	SPI PART Nº	GA-TURNS	Res. (Ω)	SPI PART Nº
20-400	1.0 Ω	090-5021-00	24-940 †	5.5 Ω	090-5036-00T
22-500	1.7 Ω	090-5017-00			090-5036-00B
22-600	2.2 Ω	090-5023-00	25-1240	9.3 Ω	090-5034-00
23-700	3.1 Ω	090-5022-00	26-1200 †	10.3 Ω	090-5044-00T
23-750	3.4 Ω	090-5019-00			090-5044-00B
23-800 †	3.6 Ω	090-5001-00T	27-1300	14.2 Ω	090-5003-00
		090-5001-00B	27-1400	14.7 Ω	090-5015-00
23-840	4.0 Ω	090-5005-00	27-1500	16.3 Ω	090-5004-00T
23-1200	7.1 Ω	090-5008-00			090-5004-00B
23½-765	3.6 Ω	090-5037-03	28-1050	11.5 Ω	090-5046-00
24-900	5.0 Ω	090-5002-00	29-2000	33.6 Ω	090-5016-00

NOTE: Ohm values may vary +/- .03Ω depending on meter calibration.

FLIPPER COILS			
GAUGE-TURNS	Res. (Ω)	COLOR	SPI PART Nº
21-900 †	*not available*	RED	090-5020-10T
22-750/30-2600 ‡	2.6 / 92.0 Ω	N/A	090-5011-00
22-900 †	3.4 Ω	YEL	090-5020-20T
22-1080 †	4.3 Ω	YEL/GRN	090-5032-00T
			090-5032-00B
23-620/30-2600 ‡	2.4 / 75.0 Ω	N/A	090-5006-00
23-700/30-2600 ‡	3.0 / 83.5 Ω	N/A	090-5013-00
23-800/30-2600 ‡	2.8 / 90.5 Ω	N/A	090-5012-00
23-900	3.8 Ω	GRN	090-5020-30
23-1100	5.1 Ω	ORG	090-5030-00
24-1570	9.5 Ω	N/A	090-5025-00
25-1800	13.8 Ω	BLU/GRN	090-5041-00

† Coil Part Nºs ending with a "T" signifies the Diode is on the top of the lug; ...ending with a "B" signifies the Diode is on the bottom of the lug.
‡ These coils are dual-wound.

MAGNET COILS		
GA-TURNS	Res. (Ω)	SPI PART Nº
22-650	4.3 Ω	090-5042-00

MINI-COILS		
GA-TURNS	Res. (Ω)	SPI PART Nº
31-1500	52.0 Ω	090-5054-00
32-1800	50.2 Ω	090-5031-00

LUGLESS COILS		
GA-TURNS	Res. (Ω)	SPI PART Nº
23-800	3.6 Ω	090-5053-00

NOTE: All Coil Part Nºs listed ***Do Not Include*** Coil Sleeves (must be ordered separately).

Flipper Coil Table ‡ ††

GAME NAME	Nº of Flippers	LOWER FLIPPERS SPI Nº / Gauge-Turns / Color		UPPER FLIPPERS SPI Nº / Gauge-Turns / Color	
		LEFT	RIGHT	LEFT	RIGHT
Laser War ‡	2	090-5011-00 **22-750 / 30-2600**	SAME	Not Used	Not Used
Secret Service ‡	3	090-5006-00 **23-620 / 30-2600**	SAME	Not Used	090-5006-00 **23-620 / 30-2600**
Torpedo Alley ‡	3	090-5011-00 **22-750 / 30-2600**	090-5013-00 **23-700 / 30-2600**	Not Used	090-5012-00 **23-800 / 30-2600**
Time Machine ‡	2	090-5011-00 **22-750 / 30-2600**	SAME	Not Used	Not Used

‡ These coils are dual-wound.

Playboy 35th Anniversary ††	2	090-5020-02 **22-900 -YEL-**	SAME	Not Used	Not Used
ABC Monday Night Football ††	2	090-5020-02 **22-900 -YEL-**	SAME	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.

Robocop	2	090-5020-20 **22-900 -YEL-**	SAME	Not Used	Not Used
Phantom of the Opera	2	090-5020-20 **22-900 -YEL-**	SAME	Not Used	Not Used
Back to the Future	2	090-5020-20 **22-900 -YEL-**	SAME	Not Used	Not Used
The Simpsons	2	090-5020-20 **22-900 -YEL-**	SAME	Not Used	Not Used
Checkpoint	2	090-5020-20 **22-900 -YEL-**	SAME	Not Used	Not Used
Teenage Mutant Ninja Turtles	2	090-5020-30 **23-900 -GRN-**	SAME	Not Used	Not Used
Batman	2	090-5020-30 **23-900 -GRN-**	SAME	Not Used	Not Used
Star Trek 25th Anniversary	2	090-5020-30 **23-900 -GRN-**	SAME	Not Used	Not Used
Hook	2	090-5030-00 **23-1100 -ORG-**	090-5020-30 **23-900 -GRN-**	Not Used	Not Used
Lethal Weapon 3	2	090-5030-00 **23-1100 -ORG-**	SAME	Not Used	Not Used

Table continued on the next page.

APPENDIX E
Flipper Coil Table †

GAME NAME	Nº of Flippers	LOWER FLIPPERS SPI Nº / Gauge-Turns / Color		UPPER FLIPPERS SPI Nº / Gauge-Turns / Color	
		LEFT	RIGHT	LEFT	RIGHT
Star Wars	2	090-5032-00 **22-1080 -YEL/GRN-**	SAME	Not Used	Not Used
Rocky & Bullwinkle & Friends	2	090-5020-30 **23-900 -GRN-**	SAME	Not Used	Not Used
Jurassic Park	3	090-5020-30 **23-900 -GRN-**	SAME	Not Used	090-5030-00 **23-1100 -ORG-**
Last Action Hero	2	090-5020-30 **23-900 -GRN-**	SAME	Not Used	Not Used
Tales from the Crypt	3	090-5032-00 **22-1080 -YEL/GRN-**	SAME	Not Used	090-5041-00 **25-1800 -BLU/GRN-**
The Who's Tommy	3	090-5020-30 **23-900 -GRN-**	SAME	090-5041-00 **25-1800 -BLU/GRN-**	Not Used
WWF Royal Rumble	4	090-5032-00 **22-1080 -YEL/GRN-**	SAME	090-5041-00 **25-1800 -BLU/GRN-**	SAME
Guns N' Roses	3	090-5032-00 **22-1080 -YEL/GRN-**	SAME	090-5030-00 **23-1100 -ORG-**	Not Used
Maverick	3	090-5032-00 **22-1080 -YEL/GRN-**	SAME	Not Used	090-5032-00 **22-1080 -YEL/GRN-**
Mary Shelley's Frankenstein	3	090-5030-00 **23-1100 -ORG-**	SAME	Not Used	090-5030-00 **23-1100 -ORG-**
Baywatch	4	090-5030-00 **23-1100 -ORG-**	090-5020-30 **23-900 -GRN-**	090-5025-00 **24-1570 -N/A-**	090-5030-00 **23-1100 -ORG-**
Batman Forever	3	090-5032-00 **22-1080 -YEL/GRN-**	090-5020-20 **22-900 -YEL-**	Not Used	090-5020-30 **23-900 -GRN-**
Apollo 13	2	090-5032-00 **22-1080 -YEL/GRN-**	SAME	Not Used	Not Used
Golden Eye	2	090-5032-00 **22-1080 -YEL/GRN-**	SAME	Not Used	Not Used
Twister	2	090-5020-20 **22-900 -YEL-**	090-5032-00 **22-1080 -YEL/GRN-**	Not Used	Not Used
ID4: Independence Day	3	090-5032-00 **22-1080 -YEL/GRN-**	SAME	Not Used	090-5020-30 **23-900 -GRN-**
Space Jam †	2	090-5032-00T **22-1080 -YEL/GRN-**	090-5020-20T **22-900 -YEL-**	Not Used	Not Used
The Star Wars Trilogy - Special Edition †	2	090-5032-00T **22-1080 -YEL/GRN-**	SAME	Not Used	Not Used
The Lost World: Jurassic Park †	2	090-5032-00T **22-1080 -YEL/GRN-**	SAME	Not Used	Not Used
The X-Files †	2	090-5032-00T **22-1080 -YEL/GRN-**	SAME	Not Used	Not Used
Starship Troopers †	3	090-5030-00T **23-1100 -ORG-**	SAME	Not Used	090-5032-00T **22-1080 -YEL/GRN-**

† Coil Part Nºs ending with a "T" signifies the Diode is on the top of the lug (on the coil-winding side);
Coil Part Nºs ending with a "B" signifies the Diode is on the bottom of the lugs.

APPENDIX F
Motor Specification Table

Game Name	Function	Specifications	Part Nº
Laser War 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 Movement	Motor 24v A.C. 60 RPM CW	515-5222-00
Robocop			
Phantom of the Opera	Organ Up/Down Movement	Bowman Motor 24v 60Hz 3W 11 RPM CCW	515-5256-00
Back to the Future The Simpsons			
Checkpoint	Mag Wheel (in Backbox)	Motor D.C. (KEN)	041-5005-00
	Shaker	Johnson Motor (Vibrator)	041-5002-00
Teenage Mutant Ninja Turtles	Spinning Pizza Ball Deflector	Gear Motor 24v A.C. 325 RPM CW	515-5397-00
Batman	Bar Target Up/Down Movement	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. 3½ RPM	500-5421-00
	Cooling Fan (for Transporter F/X)	4½" Motor 12v	041-5014-00
Hook			
Lethal Weapon 3	Spinning Light	Motor 2½ v A.C. 4000 RPM CCW	041-5017-00
Star Wars	Bar Target Up/Down Movement	Bowman Motor 24v 60hz 3W 11 RPM CCW	515-5256-00
	R2D2 Robot Left/Right 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" Forward/Back Movement	Autotrol Model E Motor 24v 60hz 4W 3 RPM CCW	041-5023-00
Jurassic Park	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
	Shaker	Johnson Motor (Vibrator)	041-5002-00
Last Action Hero	Crane Left/Right Movement	Multi Products Motor 12v D.C. #3312 OSC	041-5027-00
	Shaker	Johnson Motor (Vibrator) 10.5v D.C. 10 AMP 2950 RPM CW	041-5029-00
Tales from the Crypt	Tombstone Up/Down Movement	Bowman Motor 24v A.C. 6 RPM CCW	515-5900-00
	Shaker	Johnson Motor (Vibrator) 10.5v D.C. 10 AMP 2950 RPM CW	041-5029-00

Table continued on the next page.

APPENDIX F
Motor Specification Table

Game Name	Function	Specifications	Part Nº
The Who's Tommy	Mirror Up/Down Movement	Bowman Motor 24v A.C. 6 RPM CCW	515-5900-00
	Flipper Blinders	Servo Motor (94102)	041-5032-00
	Spinning Airplane Propellers	Motor D.C.	041-5033-00
WWF Royal Rumble	Shaker	Johnson Motor (Vibrator) 10.5v D.C. 10 AMP 2950 RPM CW	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 (94102)	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 Rotational Orbit	Multi Products Motor 24v A.C. 50/60Hz 3W 6 RPM CCW	515-6487-00
	Shaker	Johnson Motor (Vibrator) 10.5v D.C. 10 AMP 2950 RPM CW	041-5029-00
Golden Eye	Satellite Left/Right Movement	Bowman Motor 24v A.C. 60Hz 3W 6 RPM CW	515-6528-00
Twister	Spinning Disc with Magnet	Multi Products Motor 24v A.C. 50/60Hz 3W 325 RPM CCW	515-6347-00
	Backbox Fan (Tornado Wind)	Multi Products Motor 24v A.C. 50/60Hz 3W 3600 RPM CW	515-6531-00
ID4: Independence Day	Alien Head Open/Close Movement	Servo Motor (94322)	041-5045-00
Space Jam			
The Star Wars Trilogy - S.E.	X-Wing Left/Right Movement	Bowman Motor 24v A.C. 60Hz 3W 10 RPM CCW	515-6383-01
The Lost World: J.P.	Snagger & Center Link Lift Up/Down Movement	Multi Products Motor 20v D.C. 9 RPM Non-Directional	515-6715-03
	Shaker	Johnson Motor (Vibrator) 10.5v D.C. 10 AMP 2950 RPM CW	041-5029-00
The X-Files	X-File Cabinet Lift Up/Down Movement	Multi Products Motor 20v D.C. 9 RPM CCW	041-5057-00
Starship Troopers	Warrior Bug Forward/Reverse Movement	Haydon Switch & Instrument, Inc. Stepper Motor, Series 36000: 1.4"ø (Non-Captive Shaft) HSI #36864-12 (Unipolar) / Travel per Step = .004 Step Angle = 15° / 12v D.C. / 4.6W	515-6794-00-SS

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)
- 124 Regulators & Bridge Rectifiers
- 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

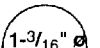
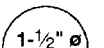
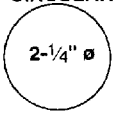
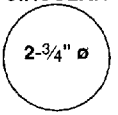
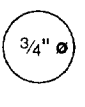
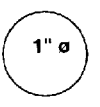
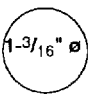
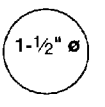
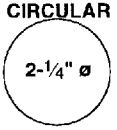
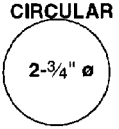
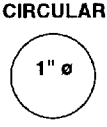
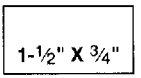
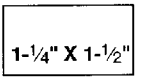
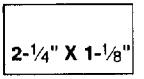
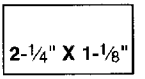
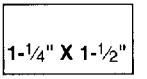
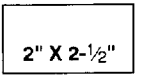
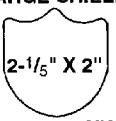
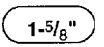
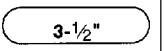
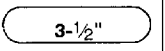
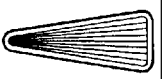
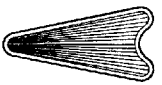
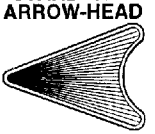
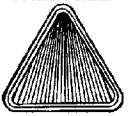
VI. **HANDLES, LOCKS, CATCHES & LATCHES, KEYS & HINGES**
- 355- Handles, Locks, Catches & Latches and Keys
- 390- Hinges

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)

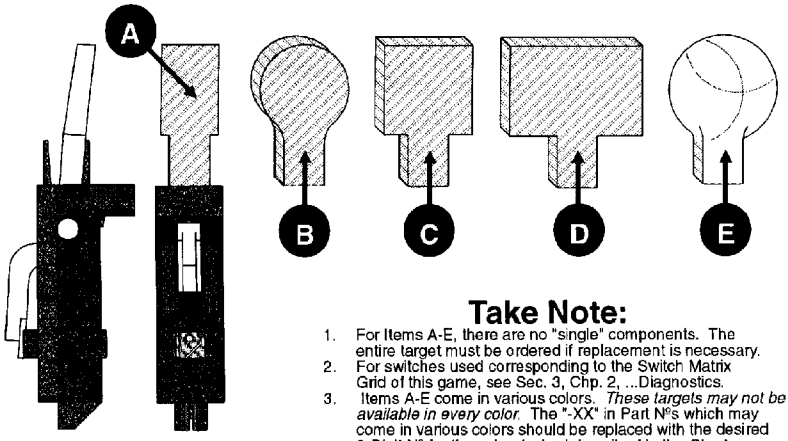
Patterns: STARBURST / STIPPLE	STARBURST CIRCULAR	STARBURST CIRCULAR	STARBURST CIRCULAR	STARBURST CIRCULAR	STARBURST CIRCULAR
	5/8" ø	3/4" ø	1" ø	 1-3/16" ø	 1-1/2" ø
	550-5000-XX	550-5001-XX	550-5002-XX	550-5003-XX	550-5004-XX
STARBURST CIRCULAR	STARBURST CIRCULAR	PLAIN CIRCULAR	PLAIN CIRCULAR	PLAIN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

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

Instructions: Parts which may come in various colors (i.e. targets, some posts, playfield inserts, etc.) end in a 2-digit Nº which correspond to the color of that part. The "-XX" in Part Nºs which may come in various colors should be replaced with the desired 2-Digit Nº. corresponding to the color desired. *Not all colors may be available.*

PLASTIC PART COLOR CHART											
Nº	Color	Nº	Color	Nº	Color	Nº	Color	Nº	Color	Nº	Color
-00	Black	-03	Amber	-06	Yellow	-09	Purple	-12	Fluor. Blue	-15	Luminescent
-01	Clear	-04	Green	-07	Orange	-10	Fluor. Orange	-13	Teal Green	-16	Gold
-02	Red	-05	Blue	-08	White	-11	Fluor. Green	-14	Gray		

APPENDIX I
Stand-Up Targets

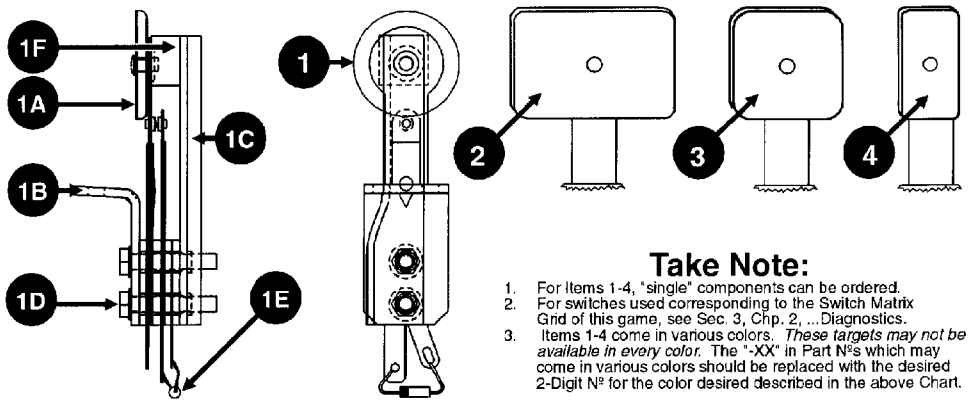


Take Note:

1. For Items A-E, there are no "single" components. The entire target must be ordered if replacement is necessary.
2. For switches used corresponding to the Switch Matrix Grid of this game, see Sec. 3, Chp. 2, ...Diagnostics.
3. Items A-E come in various colors. *These targets may not be available in every color.* The "-XX" in Part Nºs which may come in various colors should be replaced with the desired 2-Digit Nº for the color desired described in the Chart.

PLASTIC PART COLOR CHART	
Nº	Color
-00	Black
-01	Clear
-02	Red
-03	Amber
-04	Green
-05	Blue
-06	Yellow
-07	Orange
-08	White
-09	Purple
-10	Fluor. Orange
-11	Fluor. Green
-12	Fluor. Blue
-13	Teal Green
-14	Gray
-15	Luminescent
-16	Gold

Nº	Stand-Up Target Name	Part Nº
A	Modular Stand-Up Target Narrow	500-6138-XX
B	Modular Stand-Up Target Round	500-6075-XX
C	Modular Stand-Up Target Square	500-6139-XX
D	Modular Stand-Up Target Rectangle	500-6228-XX
E	Modular Stand-Up Target 1" Spherical	500-6189-XX



Take Note:

1. For Items 1-4, "single" components can be ordered.
2. For switches used corresponding to the Switch Matrix Grid of this game, see Sec. 3, Chp. 2, ...Diagnostics.
3. Items 1-4 come in various colors. *These targets may not be available in every color.* The "-XX" in Part Nºs which may come in various colors should be replaced with the desired 2-Digit Nº for the color desired described in the above Chart.

Nº	Stand-Up (Flat) Target Name	Part Nº
1	1" Round Stand-Up Target Assy.	500-5835-XX
ORDERING ABOVE (ITEM 1) ASSY. PART Nº WILL INCLUDE:		
1A‡	Switch & Target Assy. 1" Round	515-5966-XX
1B	Mounting Bracket	535-6896-00
1C	Switch Back Plate	535-6452-00
1D	6-32 X ¾ HWH Swage (Qty. 2)	237-5976-05
1E	Switch Diode, 1N4001	112-5001-00
1F	Foam Pad	626-5029-00

‡ Note: Item 1A, is a riveted Sub-Assy. which includes the following items for reference: A1— Stack Switch Radius End (180-5133-00), A2— Washer 5/16" (242-5017-00), A3— Rivet 1/8" ø X 3/16" (249-5001-00) and A4— 1" Round Target (545-5456-XX).

2	1" X 1½" Stand-Up Rect. Target Assy.	500-5321-XX
ORDERING ABOVE (ITEM 2) ASSY. PART Nº WILL INCLUDE:		
2A‡	Sw. & Target Assy. 1" X 1½" Rect. Items 2B-F are identical to 1B-F	515-6027-XX Same as 1B-F

Item 2 Table Note continued in the next column.

Nº	Stand-Up (Flat) Target Name	Part Nº

‡ Note: Item 2A, is a riveted Sub-Assy. which includes the following items for reference: A1— Stack Switch Radius End (180-5133-00), A2— Washer 5/16" (242-5017-00), A3— Rivet 1/8" ø X 3/16" (249-5001-00) and A4— Rectangular Target (545-5145-XX).

3	1" Sq. Stand-Up Target Assy.	500-5232-XX
ORDERING ABOVE (ITEM 3) ASSY. PART Nº WILL INCLUDE:		
3A‡	Sw. & Target Assy. 1" Square Items 3B-F are identical to 1B-F	515-5162-XX Same as 1B-F

‡ Note: Item 3A, is a riveted Sub-Assy. which includes the following items for reference: A1— Stack Switch Radius End (180-5133-00), A2— Washer 5/16" (242-5017-00), A3— Rivet 1/8" ø X 3/16" (249-5001-00) and A4— 1" Square Target (545-5470-XX).

4	Narrow Stand-Up Target Assy.	500-5835-XX
ORDERING ABOVE (ITEM 4) ASSY. PART Nº WILL INCLUDE:		
4A‡	Sw. & Target Assy. Narrow Items 4B-F are identical to 1B-F	515-5967-XX Same as 1B-F

‡ Note: Item 4A, is a riveted Sub-Assy. which includes the following items for reference: A1— Stack Switch Square End (180-5132-00), A2— Washer 5/16" (242-5017-00), A3— Rivet 1/8" ø X 3/16" (249-5001-00) and A4— Narrow Target (545-5210-XX).

GLOSSARY OF TERMS

A Followed after a number means "Amp." or Ampage in an expression relating to an electrical object. (e.g. 8A).

AC (Acronym) **A**lternating **C**urrent.

Adj. (Abbreviation) Adjustment(s).

Assy. (Abbreviation) Assembly.

Au. (Abbreviation) Audit(s).

Bd. (Abbreviation) Board.

BOT (Abbreviation) Bottom.

Brkt. (Abbreviation) Bracket.

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 or I, Plastic Part Color Chart or Section 4, Chapter 1, Playfield - Plastic Posts & Spacers.

Combination (Combo) [Shot] Any variable pinball shot(s) made successively.

Conn. (Abbreviation) Connector.

CMOS Short for COSMOS (Complementary Symmetry M.O.S.); Complementary Metal-Oxide Semi-Conductor.

CN (Abbreviation) Connector (e.g. **CN**5-P3).

CT (Abbreviation) Center.

DC (Abbreviation) Direct Current.

DT (Abbreviation) Drop Target(s).

DOTS (Acronym) **D**iode **O**n **T**erminal **S**trip.

EB (Abbreviation) Extra Ball.

Eject Playfield surface device to kick ball back into play; Saucer.

EPROM (Acronym) **E**rasable **P**rogrammable **R**ead **O**nly **M**emory. Can be erased using UV Light and re-programmed.

e.g. (Abbreviation) Latin- Exempli gratia. For Example.

EOS (Acronym) **E**nd-**O**f-**S**troke (i.e. Switch for flipper).

F (Abbreviation) Fuse (i.e. F23).

GA-Turn Gauge & Turn describing the windings on a coil (e.g. 23-800, 23 is the gauge of wire and 800 is the amount of windings.

G.I. (Abbreviation) General Illumination (Lamps).

HWH (Abbreviation) Hex Washer Head.

IC (Acronym) **I**ntegrated **C**ircuit (As in after 24-Pin IC).

ID or I.D. (Acronym) **I**nside **D**imension.

I.e. (Abbreviation) Latin- Id est. That is.

IO or I/O (Abbreviation) Input / Output (e.g. I/O Power Driver Bd.)

LT, Lt. or L. (Abbreviation) Left.

Laser Kick A coil/plunger used above the playfield to kick pinball back into play.

LED (Acronym) **L**ight **E**mitting **D**iode.

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 (Abbreviation) Magnet Board.

M-BALL or MBALL (Abbreviation) Multiball™ More than 1 ball in game play.

MID (Abbreviation) Middle

Non-Reflexive See Reflexive.

No. or Nº or # (Abbreviation) Number

NPF (Acronym) **N**o **P**roblem **F**ound.

N.C. or NC (Abbreviation) Normally Closed.

N.O. or NO (Abbreviation) Normally Open.

NS (Abbreviation) Not Stuffed. (Use in Part Listings, Sec. 5)

OD or O.D. (Abbreviation) Outside Dimension.

P (Abbreviation) Pin (e.g. CN5-**P**3).

PCB (Acronym) **P**rinted **C**ircuit **B**oard

P/F (Abbreviation) Playfield.

PIA LED (Acronym) **P**eripheral **I**nterface **A**dapter **L**ight **E**mitting **D**iode.. 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.

PPH (Abbreviation) Phillips Pan Head.

Pop(s) Another term for Turbo Bumper(s).

PPB (Acronym) Playfield Power Board ("Popcorn-Popping Bd.").

PREV (Abbreviation) Previous.

PSB (Abbreviation) Power Supply Board

RAM (Acronym) **R**andom **A**ccess **M**emory. RAM **can** store input instructions and supply output information.

Reflexive/Non-Reflexive Reflexive—Solenoid Drive Transistor is enabled directly by a switch closure on the (Relating to CPU Boards) 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 (Acronym) **R**ead **O**nly **M**emory. ROM **cannot** store input instructions but can supply output information. ROM can be programmed only once.

RMA (Abbreviation) Return Merchandise Authorization Number

RT, Rt. or R. (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 achieved.

SMB (Abbreviation) Shaker Motor Board.

Solenoid A coil used for Electro Magnetic devices such as relays, flippers, slingshots, etc.

SSFB (Abbreviation) Solid State Flipper Board.

STEP Refers to the service switches on the coin door.

Sub-Assy. (Abbreviation) Sub-Assembly.

S-U or S/U (Abbreviation) Stand-Up (targets).

TM (Abbreviation) 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 repetitive manner to bounce the ball to the other side. Skilled players can rebound the ball off the slingshot.

Tri-Ball Three balls in play.

TTL (Abbreviation) Transistor-Transistor Logic

Upr. (Abbreviation) Upper.

V or v (Abbreviation) Volt(s).

Ver. (Abbreviation) Version.

VUK (Acronym) **V**ertical **U**p-**K**icker (Super or Standard).

X (Abbreviation) "Times" A multiplier; also used in dimensions.

X-Ball An undetermined number of ball(s) during game play.

Zener Diode A semi-conductor diode used for voltage regulation. Application depends on reverse break-down voltage.

"-00B" "B" at the end of Coil Part Numbers signifies that the diode is attached to the bottom of the lug.

"-00T" "T" at the end of Coil Part Numbers signifies that the diode is attached to the top of the lug (the side nearest the coil-winding).

Parts Order Checklist Notes

Date Ordered	Part Nº	Qty.	Description	Date Received

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TECHNICAL SUPPORT

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Inch fractions defined:

1/16" 1/8" 1/4" 1/2" 3/4"

Standard USA 9 Inch Ruler (From the top to the bottom edge is 11")

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