

featuring our Portable Service Menu
and our unique

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



NO HES END PREU QUITE

SEGA™

11th

PINBALL, INC.

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**Please call us at 1-800-542-5377 or
1-708-345-7700 for Technical Support.**

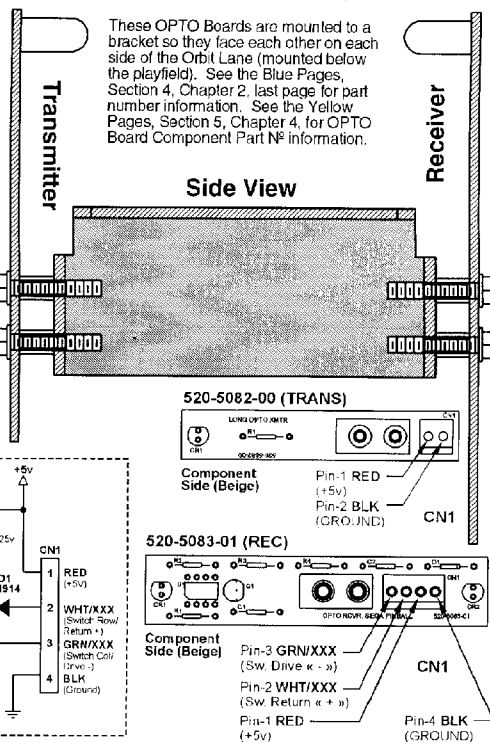
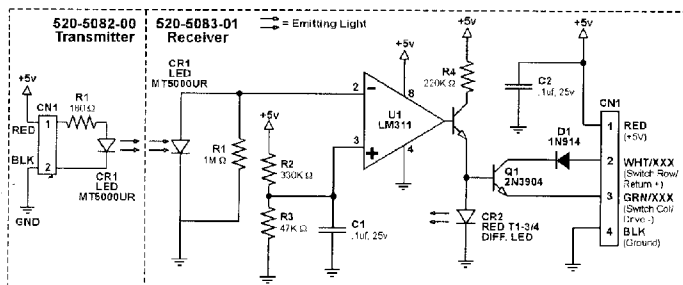
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780-5059-00

Introducing Playfield Switch OPTO "Long-Hop" Boards

A New OPTO Board combination (Transmitter, 520-5082-00, and Receiver, 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.



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

each end of the straw into each LED's into 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.

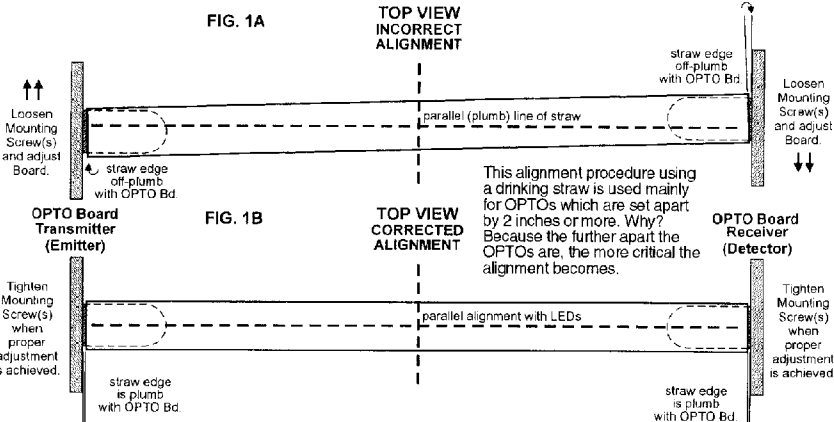
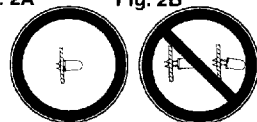


Fig. 2A

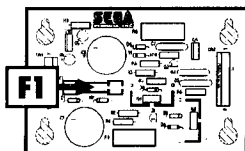
Fig. 2B

Before you attempt this adjustment procedure, ensure the OPTO Mounting Brackets are not bent and ensure the LEDs 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.)





BACKBOX LAYOUT LOCATIONS: Fuses, Bridges, Relays & ROMs

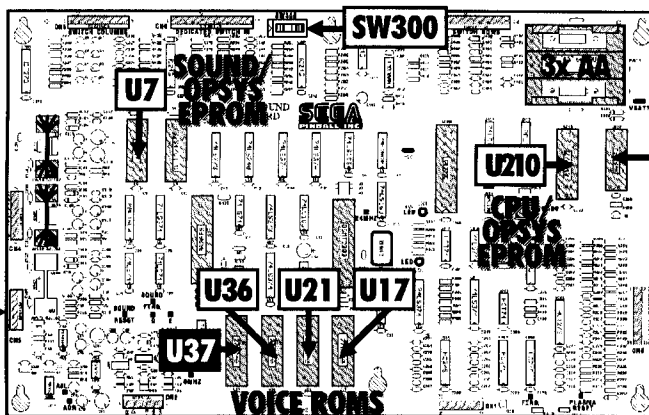


Display Power Supply Bd.

CPU / Sound Board

No Fuses

I / O Power Driver Board



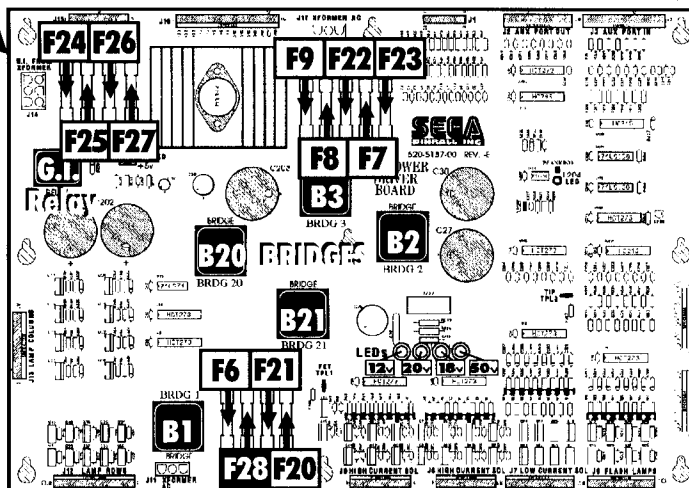
U212
CMOS
RAM

Note:

U37
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



Note:

F28
is Not Used
in this game.

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

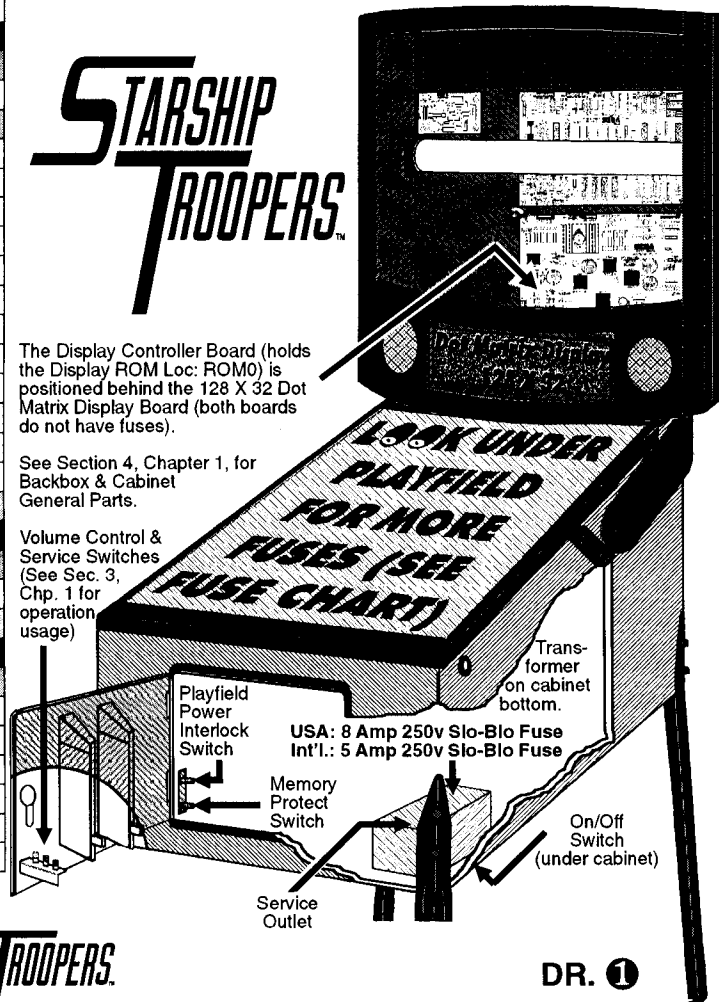
LOC: UNDER PLAYFIELD (By Assemblies Listed)			
n/a	3A 250v S.B.	50v DC	Rt. Flipper (BLU/YEL ↔ RED/YEL)
n/a	3A 250v SB	50v DC	Mini Flipper (BLU/YEL ↔ RED/YEL)
n/a	3A 250v S.B.	50v DC	Lt. Flipper (GRY/YEL ↔ RED/YEL)
n/a	3A 250v S.B.	50v DC	Lt. Magnet (VIO/YEL ↔ BRN/GRN)
n/a	3A 250v S.B.	50v DC	Rt. Magnet (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)



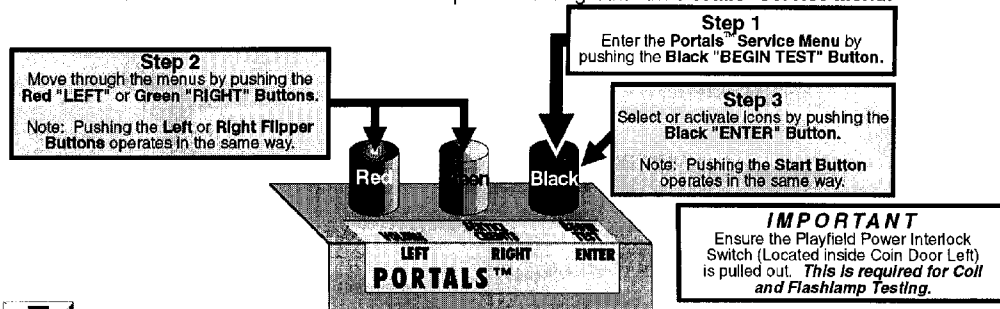
Find-It-In-Front:
Dr. Pinball

STARSHIP TROOPERS™

DR. ①

* 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. ① - 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**:



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.



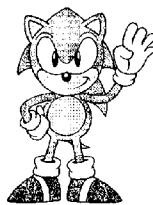
Seen when diagnosis is given. Select any Icon for your next step. "?" gives Help.



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 N°
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 0	965-0254-59
Display EPROM	Not Used	Display Controller Bd.	ROM 3	Not Used



Find-It-In-Front:
Dr. Pinball

FOR:

**STARSHIP
TROOPERS**

DR. ③



From the Main Menu
in Portals
GO TO DIAGNOSTICS
MENU



From the Diagnostics
Menu
GO TO SWITCH
MENU



From the Switch
Menu
GO TO SWITCH OR
ACTIVE SWITCH TEST



From the Switch
Menu
GO TO DEDICATED
SWITCH TEST

SWITCH MATRIX GRID & DEDICATED SWITCHES

Column (Drive)	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	GND IC U206 INPUTS	Ground BLK CN6-P1, -P11
Row (Return)										
1: U400 WHT-BRN CN7-P9	NOT USED	UTROUGH: SKILL SHOT	LEFT BOTTOM S-U (GRN)	LEFT RAMP ENTER	STEPPER MOTOR REAR	LEFT TOP LANE	LEFT TURBO BUMPER	LEFT OUTLANE	1: GRN-BRN CN6-P2	#1 LEFT FLIPPER BUTTON DS-1
2: U400 WHT-RED CN7-P8	4TH COIN SLOT	UTROUGH: BUG HOLE	LEFT MIDDLE S-U (YEL)	LEFT RAMP EXIT	STEPPER MOTOR FRONT	MIDDLE TOP LANE	BOTTOM TURBO BUMPER	LEFT RETURN LANE	2: GRN-RED CN6-P3	#2 LEFT FLIPPER E.O.S (End-of-Stroke) DS-2
3: U400 WHT-ORG CN7-P7	6TH COIN SLOT	NOT USED	LEFT MIDDLE S-U (RED)	LEFT RAMP S-U (YEL)	STEPPER MOTOR BUG	RIGHT TOP LANE	RIGHT TURBO BUMPER	LEFT SLINGSHOT	3: GRN-ORG CN6-P4	#3 RIGHT FLIPPER BUTTON DS-3
4: U400 WHT-YEL CN7-P6	RIGHT COIN SLOT	4-BALL TROUGH #1 (LEFT)	LEFT TOP S-U (YEL)	POP S-U (BLU)	NOT USED	NOT USED	RIGHT RAMP ENTER	RIGHT OUTLANE	4: GRN-YEL CN6-P6	#4 RIGHT FLIPPER E.O.S (End-of-Stroke) DS-4
5: U401 WHT-GRN CN7-P5	CENTER COIN SLOT / DBA	4-BALL TROUGH #2	RIGHT BOTTOM S-U (RED)	POP S-U (GRN)	BRAIN BUG UP	VUK	RIGHT RAMP EXIT	RIGHT RETURN LANE	5: GRN-GRN CN6-P7	#5 MINI FLIPPER BUTTON DS-5
6: U401 WHT-BLU CN7-P3	LEFT COIN SLOT	4-BALL TROUGH #5	RIGHT MIDDLE S-U (YEL)	VUK S-U (GRN)	BRAIN BUG HIT	SUPER VUK	START BUTTON	RIGHT SLINGSHOT	6: GRN-BLU CN6-P8	#6 VOLUME RED BUTTON (Normal) (In Test: LEFT) DS-6
7: U401 WHT-VIO CN7-P2	5TH COIN SLOT	4TH TROUGH VUK OPTO	RIGHT MIDDLE S-U (GRN)	VUK S-U (BLU)	BRAIN BUG UP	LEFT ORBIT	SLAM TILT	NOT USED	7: GRN-VIO CN6-P9	#7 SERV. CRED. (GREEN BUTTON) (Normal) (In Test: RIGHT) DS-7
8: U401 WHT-GRY CN7-P1	NOT USED	SHOOTER LANE	RIGHT TOP S-U (YEL)	RIGHT RAMP S-U (YEL)	UTROUGH POP EXIT HOLE	RIGHT ORBIT	PLUMB BOB TILT	NOT USED	8: GRN-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



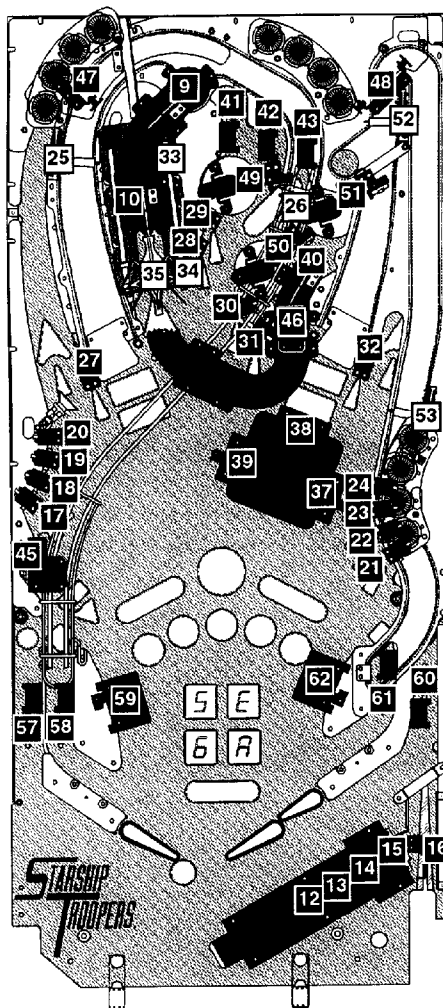
From the Lamp
Menu
GO TO ROW OR
COLUMN TEST

LAMP MATRIX GRID

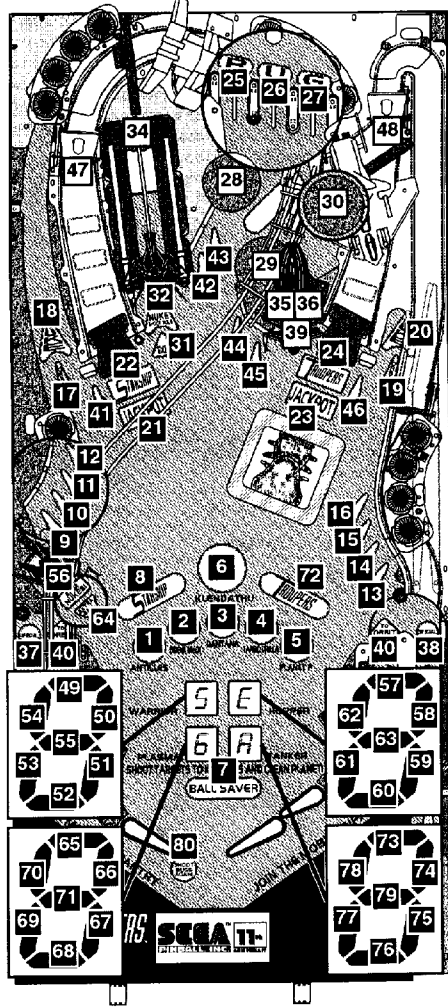
Column (18V)	1: U17 YEL-BRN J13-P9	2: U16 YEL-RED J13-P8	3: U15 YEL-ORG J13-P7	4: U14 YEL-BLK J13-P6	5: U13 YEL-GRN J13-P5	6: U12 YEL-BLU J13-P4	7: U11 YEL-VIO J13-P3	8: U10 YEL-GRY J13-P1
Row (GND)								
1: Q33 RED-BRN J12-P1	ANTILLES #555 Bulb 1	ZEGEMA BEACH #555 Bulb 2	DANTANA #555 Bulb 3	TANGO 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 #555 Bulb 28	BOTTOM TURBO BUMPER #555 Bulb 29	RIGHT TURBO BUMPER #555 Bulb 30	MULTI BALL #44 Bulb 31	SUPER NUKE #44 Bulb 32
5: Q37 RED-GRN J12-P5	NOT USED #33	WARRIOR BUG #555 Bulb 34	2X NUKE #555 Bulb 35	RECON #555 Bulb 36	LEFT OUTLANE #555 Bulb 37	RIGHT OUTLANE #555 Bulb 38	ADVANCE PLANET #555 Bulb 39	LT/RT RETURN LANE #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	S-U (YEL) #555 Bulb 45	RIGHT RAMP NUKE #555 Bulb 46	LEFT RAMP NUKE #555 Bulb 47	RIGHT RAMP NUKE #555 Bulb 48
7: Q39 RED-VIO J12-P7	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-P8	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	PLASMA BUG 7-SEGMENT "A" Red LED 65	PLASMA BUG 7-SEGMENT "B" Red LED 66	PLASMA BUG 7-SEGMENT "C" Red LED 67	PLASMA BUG 7-SEGMENT "D" Red LED 68	PLASMA BUG 7-SEGMENT "E" Red LED 69	PLASMA BUG 7-SEGMENT "F" Red LED 70	PLASMA BUG 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

(Column: Switch Drive Wire)

GRN-XXX

N.O.
Normally Open
Switch Terminal

COM.
Common
Switch Terminal

N.C.
Normally Closed
Switch Terminal

(Row: Switch Return Wire)

WHT-XXX

N.O.
Normally Open
Switch Terminal

COM.
Common
Switch Terminal

Dedicated Sw. Inputs

GRY-XXX

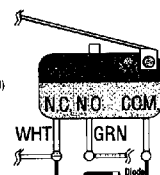
N.O.
Normally Open
Switch Terminal

COM.
Common
Switch Terminal

Ground

BLK

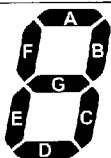
Note:
All Switches require diodes.
Some diodes are located on
Terminal Strips (under playfield)
& not on the switch itself.
D iode
O n
T erminal
S trip



DEDICATED SWITCH SCHEMATIC

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).

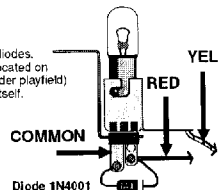


TYPICAL LAMP SCHEMATIC

YEL-XXX
18V
COL

RED-XXX
RED
ROW

Note:
All Lamps require diodes.
Some diodes are located on
Terminal Strips (under playfield)
& not on the lamp itself.
D iode
O n
T erminal
S trip



Find-It-In-Front:
Dr. Pinball

STARSHIP TROOPERS



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 Output Board	D.T. Control Line Color	D.T. Control Line Connect	Power Line Color	Power Line Connection	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 Output Board	D.T. Control Line Color	D.T. Control Line Connect	Power Line Color	Power Line Connection	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	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	BLU-YEL	J10-P1/2	50v dc	23-1100 090-5030-00T

Low Current Coils Group 1		Drive Transistor (D.T.)	Driver Output Board	D.T. Control Line Color	D.T. Control Line Connect	Power Line Color	Power Line Connection	Power Voltage	Coil GA/Turn or Bulb Type
17	STEPPER MOTOR #1	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	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	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	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)

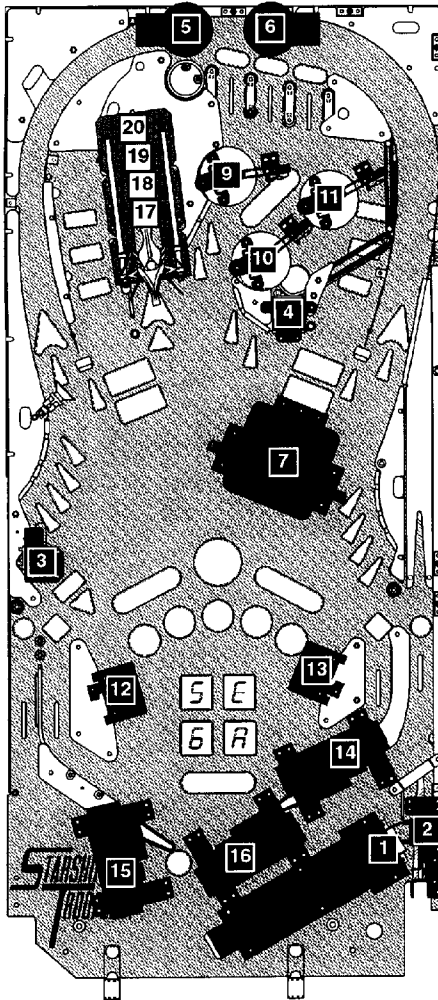
Diode 0 = Terminal Strip (if noted)

Flash Lamps (FLASH)		Drive Transistor (D.T.)	Driver Output Board	D.T. Control Line Color	D.T. Control Line Connect	Power Line Color	Power Line Connection	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

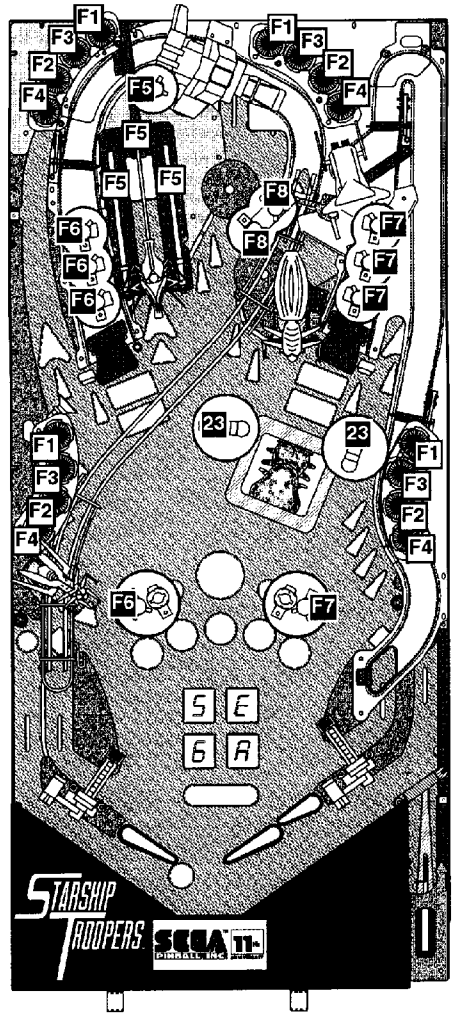
† Note: F5 = 3* #906 Bulb + 1* #89 Bulb



COIL LOCATIONS

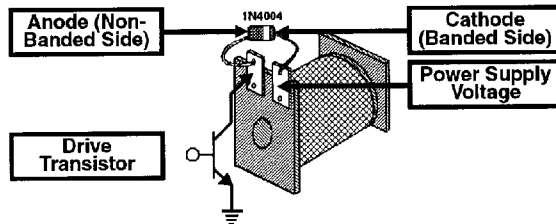


FLASH LAMP LOCATIONS



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.

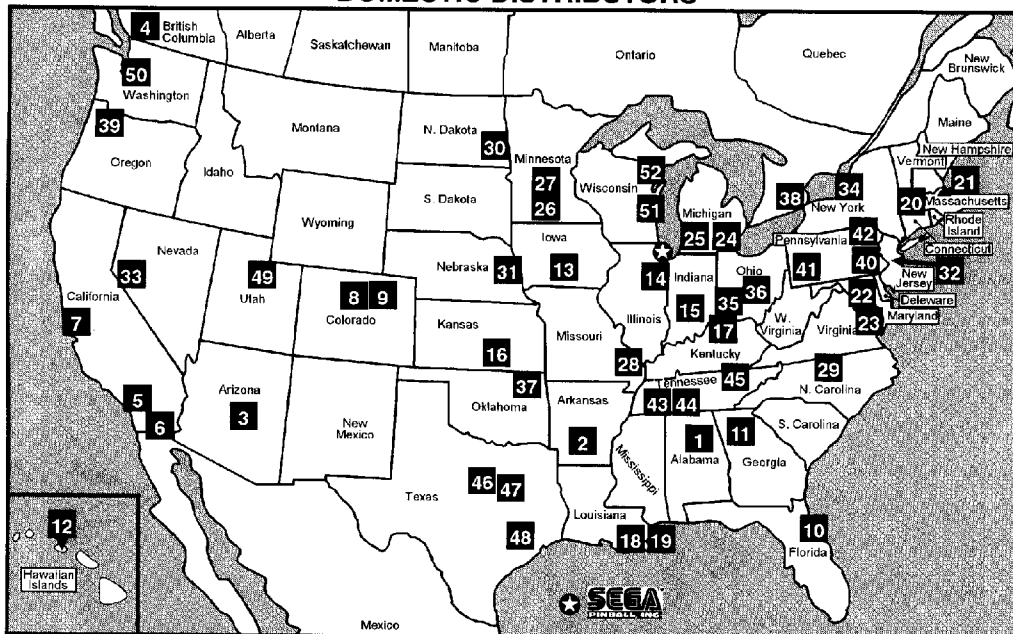
D = diode
O = on
T = terminal
S = strip



Find-It-In-Front:
Dr. Pinball

STARSHIP TROOPERS

DOMESTIC DISTRIBUTORS



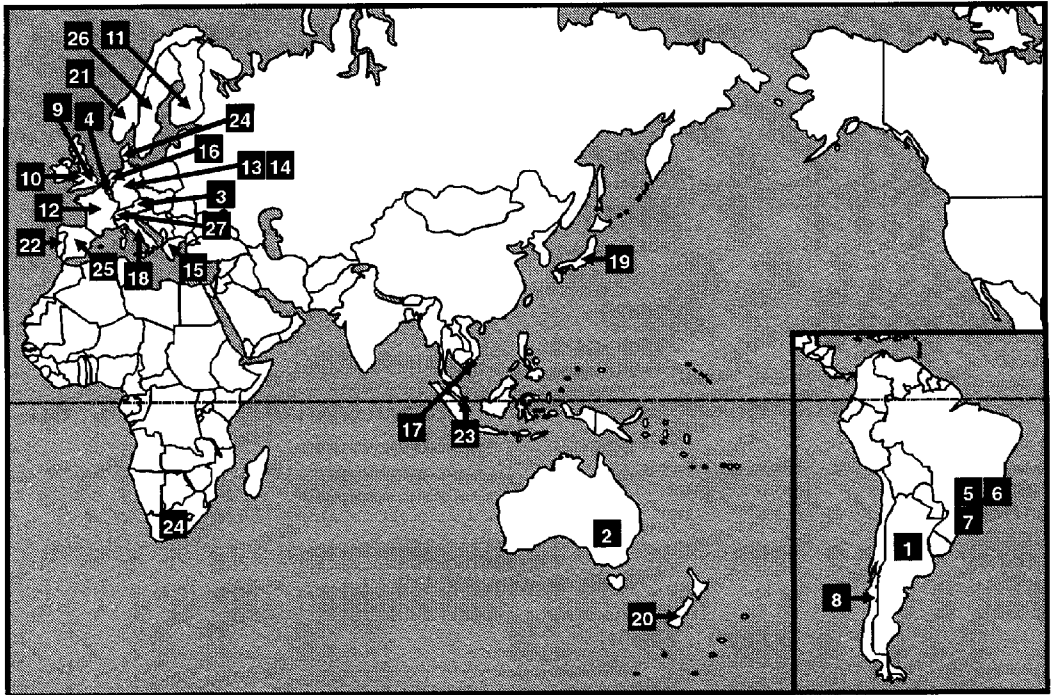
#	STATE/PROVINCE AND CITY	NAME	PHONE	#	STATE/PROVINCE AND CITY	NAME	PHONE
1	AL Birmingham	Birmingham Vending	205-324-7526	27	MN Minneapolis	Sandler Vending	612-996-0010
2	AR N. Little Rock	Godwin Distributing	501-753-1138	28	MO St. Louis	J. & J. Distributing	314-645-3393
3	AZ Phoenix	Betson Pacific	602-233-0190	29	NC Archdal	Operators Distributing	910-884-5714
4	BC Burnaby (Can.)	Can. Coin Machine	604-420-4008	30	ND Fargo	M.H. Associates, Inc.	701-282-7877
5	CA Buena Park	Betson Pacific	714-228-7500	31	NE Omaha	Greater American Dist.	402-553-2812
6	CA San Diego	Betson Pacific	619-459-0871	32	NJ Springfield	Mondial Int'l. Dist.	201-467-9700
7	CA S. San Francisco	Betson Pacific	415-952-4220	33	NV Reno	Reno Game Sales	702-829-2080
8	CO Denver	Col. Game Exchange	303-893-4300	34	NY Rochester	Mondial Dist.	716-586-1100
9	CO Denver	Mountain Coin	303-427-2133	35	OH Cincinnati	Atlas Distributing	513-771-1809
10	FL Orlando	Birmingham Vending	407-425-1505	36	OH Columbus	Shaffer Dist.	614-421-6800
11	GA Marietta	Game Exchange/SE, Inc.	770-594-7215	37	OK Tulsa	Galaxy Distributing, Co.	918-835-1166
12	HI Ewa Beach	50th State Coin Op.	808-682-4561	38	ON Rexdale (Can.)	New Way Sales	416-674-8000
13	IA Des Moines	Greater American Dist.	515-244-2828	39	OR Portland	American Coin	503-233-7000
14	IL Chicago	Atlas Distributing	773-276-5005	40	PA Bensalem	Mondial Int'l. Dist.	215-638-1122
15	IN Indianapolis	J. & J. Distributing	317-899-2530	41	PA Pittsburgh	Mondial Int'l. Dist.	412-881-8804
16	KS Wichita	United Distributors, Inc.	316-263-6181	42	PA Wilkes-Barre	Roth Novelty	717-824-9994
17	KY Louisville	Kentucky Coin Machine	502-966-5266	43	TN Memphis	Games Sales Co., Inc.	901-525-8351
18	LA Metairie	AMA Distributors, Inc.	504-835-3232	44	TN Nashville	Green G.A.M.E.S.	901-353-1000
19	LA Metairie	New Orleans Novelty	504-888-3500	45	TN Nashville	Sammons-Pennington	615-244-3020
20	MA E. Long Meadow	Gekay Sales	413-525-2700	46	TX Corsicana	Master Sales	903-874-4740
21	MA Norwood	Mondial Int'l. Dist.	617-769-9966	47	TX Dallas	Commercial Music	214-741-6381
22	MD Baltimore	Automated Services	410-646-4100	48	TX Houston	H.A. Franz, & Co.	713-523-7366
23	MD Baltimore	Weiner Distributing	410-525-2600	49	UT Salt Lake City	Struve Distributing	801-328-1636
24	MI Farmington Hills	Atlas Distributing	810-615-1703	50	WA Seattle	American Coin	206-764-9020
25	MI Wyoming	Atlas Distributing	616-241-1472	51	WI Green Bay	Pioneer Sales & Svc.	414-468-5200
26	MN Bloomington	Hanson Distributing	612-884-6604	52	WI Menomonee Falls	Pioneer Sales & Svc.	414-781-1420



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)	#	COUNTRY AND CITY	NAME	PHONE (-011)
1	Argentina, Urquiza	Florenda	54-232-5532	14	Germany, Hannover	Bally Wulff	49-511-358-5343
2	Australia, Matraville	Amusement Machine Dist.	61-29-316-6000	15	Greece, Athens	Greece Coin	30-1-554-1608
3	Austria, Grazerstrasse	Rupp Austria	43-34-528-6105	16	Holland, Sittart	Veltmeijer Automaten	31-46-452-6444
4	Belgium, Brussels	Splin S.A.	32-43-62-7677	17	Hong Kong, Kwai Fong	Bondeal Limited	85-2-487-9089
5	Brazil, Sao Paulo	Parkland	55-11-792-42864	18	Italy (RSM), Serravalle	Technoplay Sa	39-54-990-0361
6	Brazil, Sao Paulo	Unimax	55-11-533-5615	19	Japan, Tokyo	Data East, Corp.	81-35-370-0708
7	Brazil, Sao Paulo	Universe	55-11-575-0731	20	New Zealand, Auckland	Amco Machine Supp.	64-9-846-7606
8	Chile, Santiago	Cuinsa	56-2-696-0167	21	Norway, Oslo	Vendomatic	47-2-216-0830
9	England, London	Electrocoin	44-181-965-2055	22	Portugal, Amadora	Jacinto & Martins	35-11-495-1868
10	So. Wales, Cardiff	Electrocoin	44-22-261-5100	23	Singapore, Singapore	Valibel Technologies	65-748-8404
11	Finland, Espoo	Pelika Ray Oy	35-8-943-7091	24	South Africa, Lalucia	Unimac	27-3-152-5544
12	France, Aubervilliers	PLF Sa	33-14-811-3131	25	Spain, Madrid	Sente S.A.	34-1-541-7112
13	Germany, Berlin	Bally Wulff	49-3-062-0020	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.



Dr. Pinball
Find-It-In-Front:

STARSHIP TROOPERS.



DR. ⑨

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.



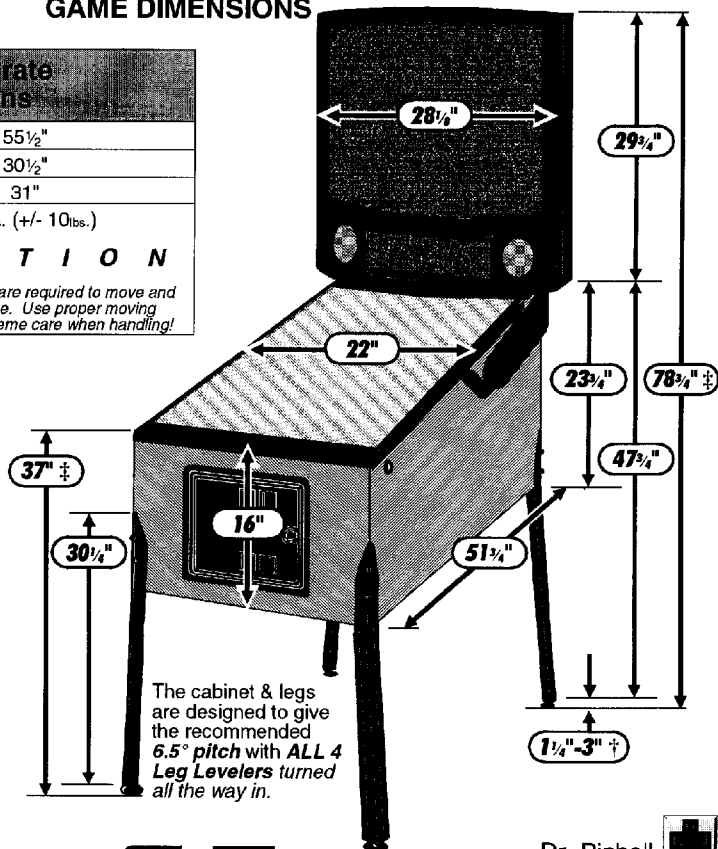
Normal Line:		110v AC - 125v AC @ 60Hz	
Domestic uses an 8AMP 250v Slo-Blo Fuse.	AVG OPERATION		MAX OPERATION
	CURRENT: 2.8AMP WATTAGE: 329w	CURRENT: 8AMP WATTAGE: 940w	
High Line:		218v AC - 240v AC @ 50Hz	
Export uses 2 X 5AMP 250v Slo-Blo Fuses. (*England & Hong Kong use an 8amp 250v 5/8 Fuse.)	AVG OPERATION		MAX OPERATION
	CURRENT: 1.8AMP WATTAGE: 412w	CURRENT: 5AMP WATTAGE: 1145w	8AMP* 1832w* England & Hong Kong use an 8A.F.
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 WATTAGE: 264w	CURRENT: 8AMP 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.)
 CAUTION At least 2 people are required to move and maneuver game. Use proper moving equipment & extreme care when handling!	



Notes:

The Leg Levelers can add up to 1¼" **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™

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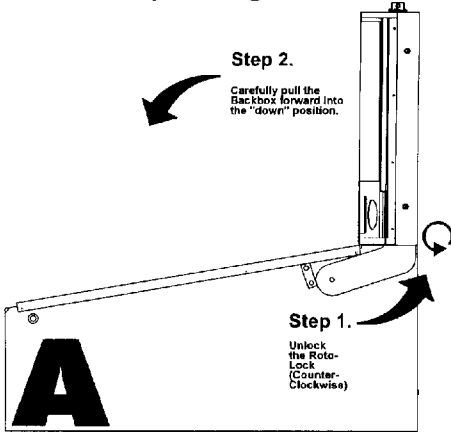
Game Set-Up

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 Board. 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.

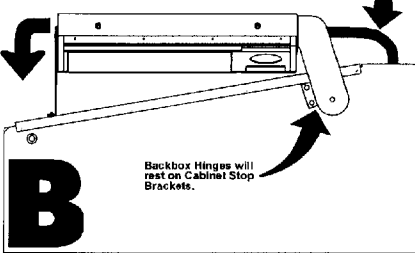
How to Secure the Backbox for Transporting



Step 3.

Turn out each of the Backbox Top Support Brackets and put them into the down position.

Ensure Cables do not bind, pinch or are being pulled from. Hand Feed out with Backbox so Cables are not tight.



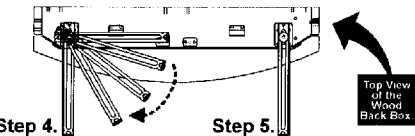
Step 4.

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.

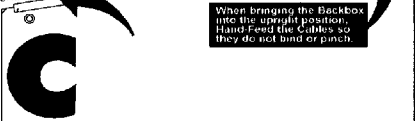
Top View of the Wood Back Box



Step 6.

Ensure the brackets sit correctly on the side armor and the brackets do not move or shift left or right.

When bringing the Backbox into the upright position, Hand Feed the Cables so they do not bind or pinch.



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

Leg Leveler Adjustment

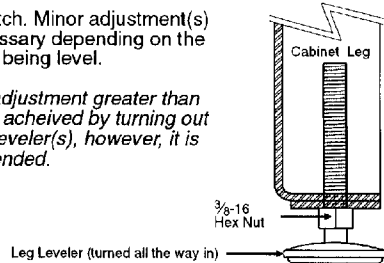
This cabinet is designed to automatically have a 6.5° pitch without any Leg Leveler adjustment!

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!

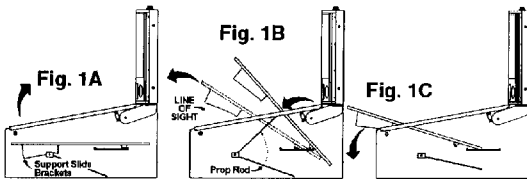
Verify 6.5° pitch. Minor adjustment(s) may be necessary depending on the location floor being level.

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



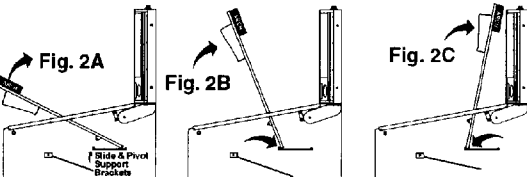
Easy Access Service System - 3 Positions

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 and 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 1/2 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.

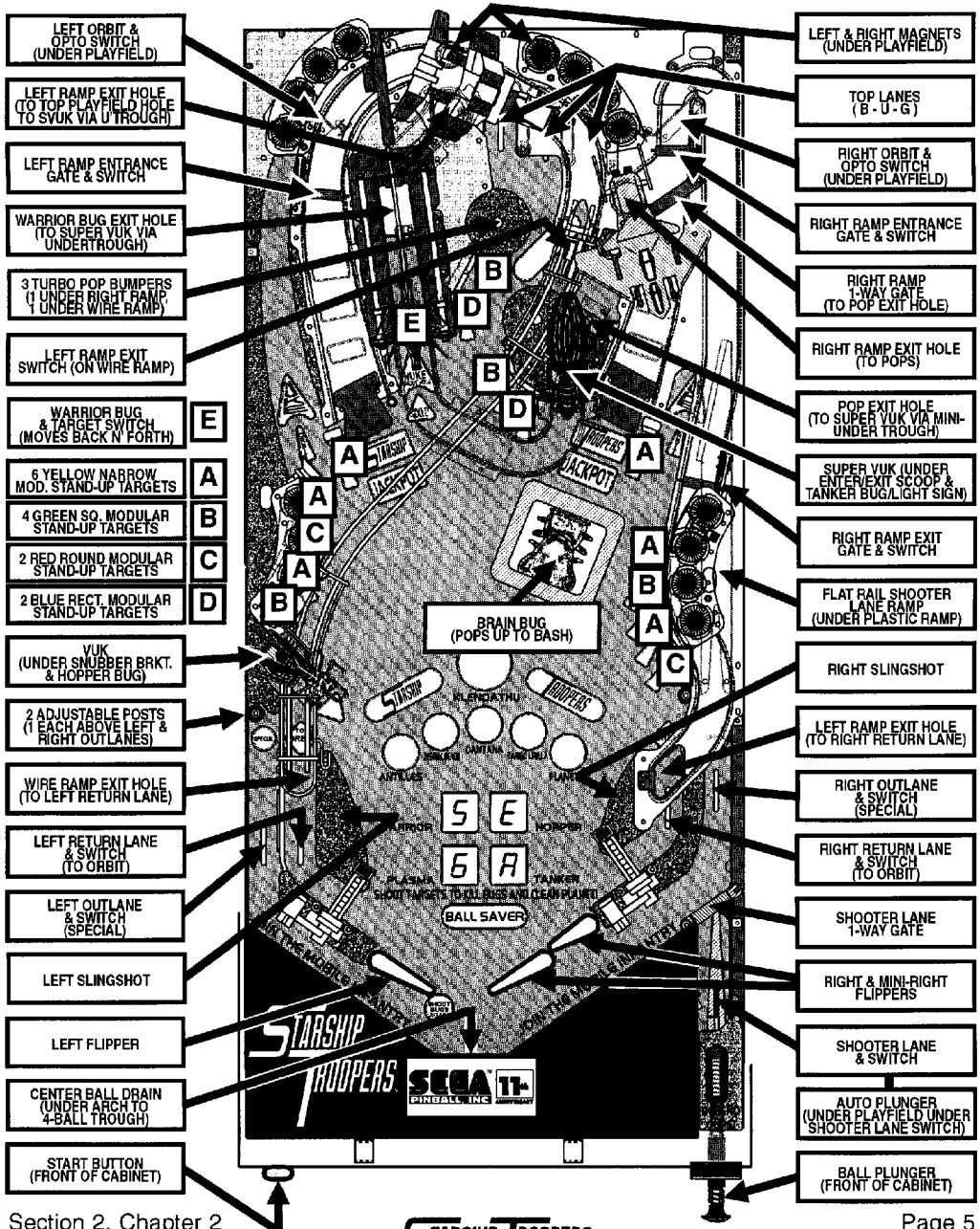
Sega Pinball, Inc. TM & © 1997 Starship Troopers TM & © 1997. TriStar Pictures, Inc. All Rights Reserved.

Sega Part N° 755-5159-00 USA

Playfield Overview

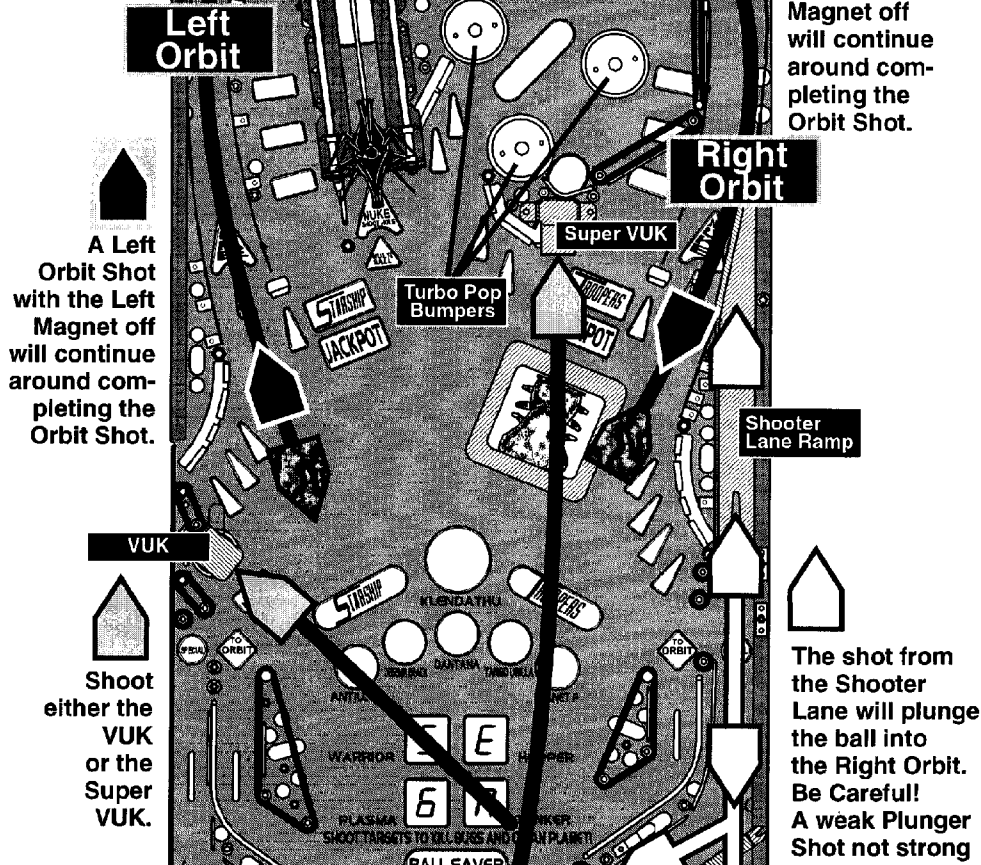
Overview

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.



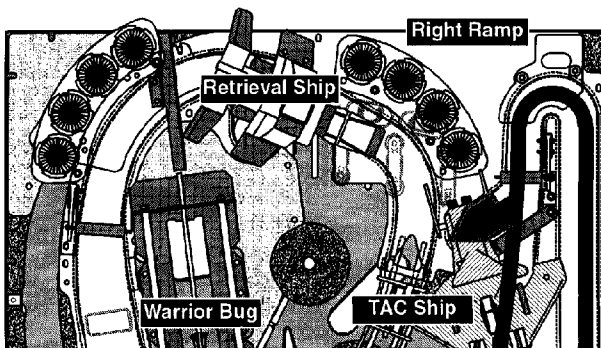
Below is the top of the playfield showing the addition of Screened & Clear Plastic (Butyrate) Pieces.

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



Playfield Top Ball Shots: Layer 3

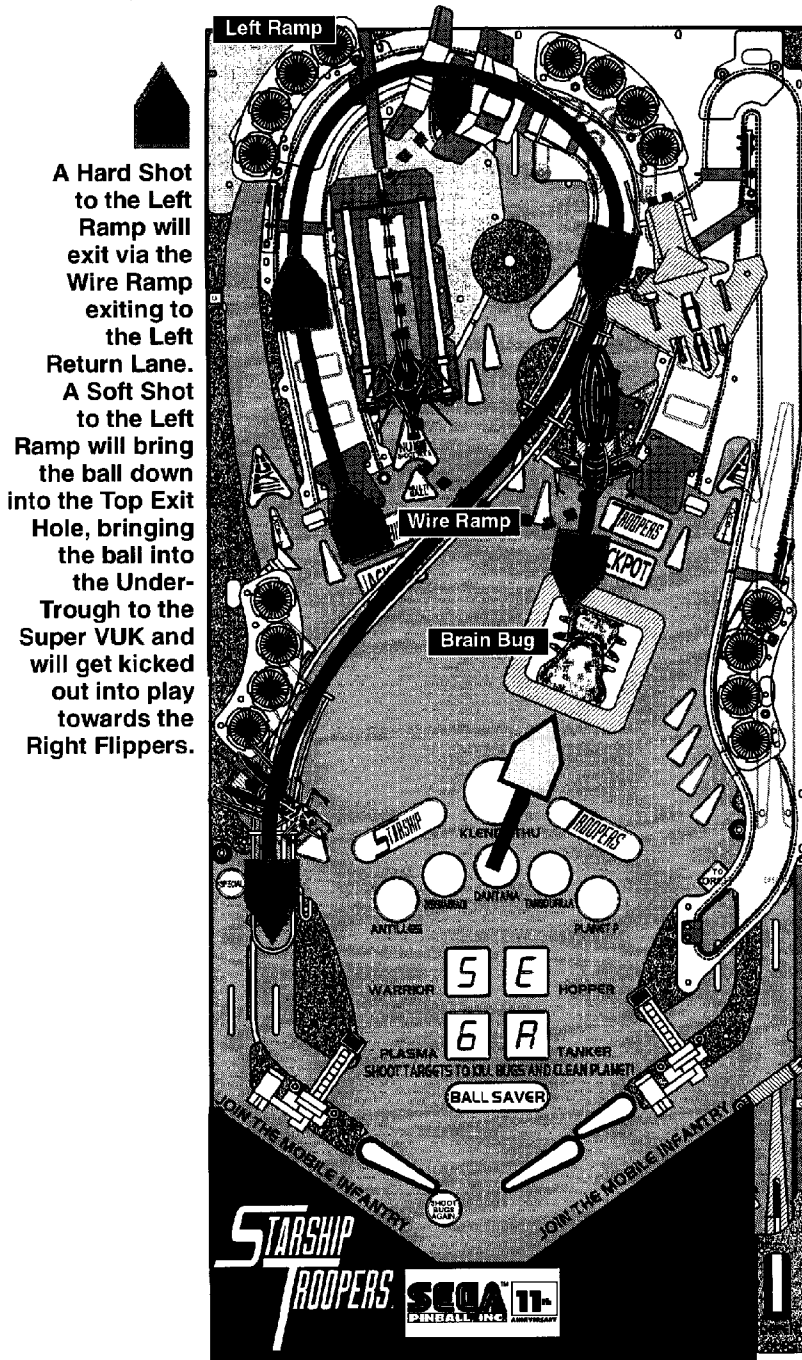
Below is the top of the playfield showing the addition of the Plastic Ramp (with Retrieval & Tac Ships, 3 each 4X Light Assemblies), Wire Ramp, 4X Light Assy. (over Wire Ramp), Pulse Cannons (over the Return Lanes), Hopper Bug (over VUK), Tanker Bug and Light Sign (over Super VUK) and the Bottom Arch.



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).

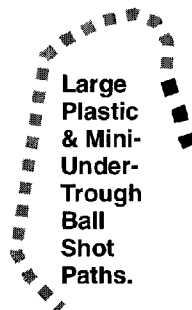
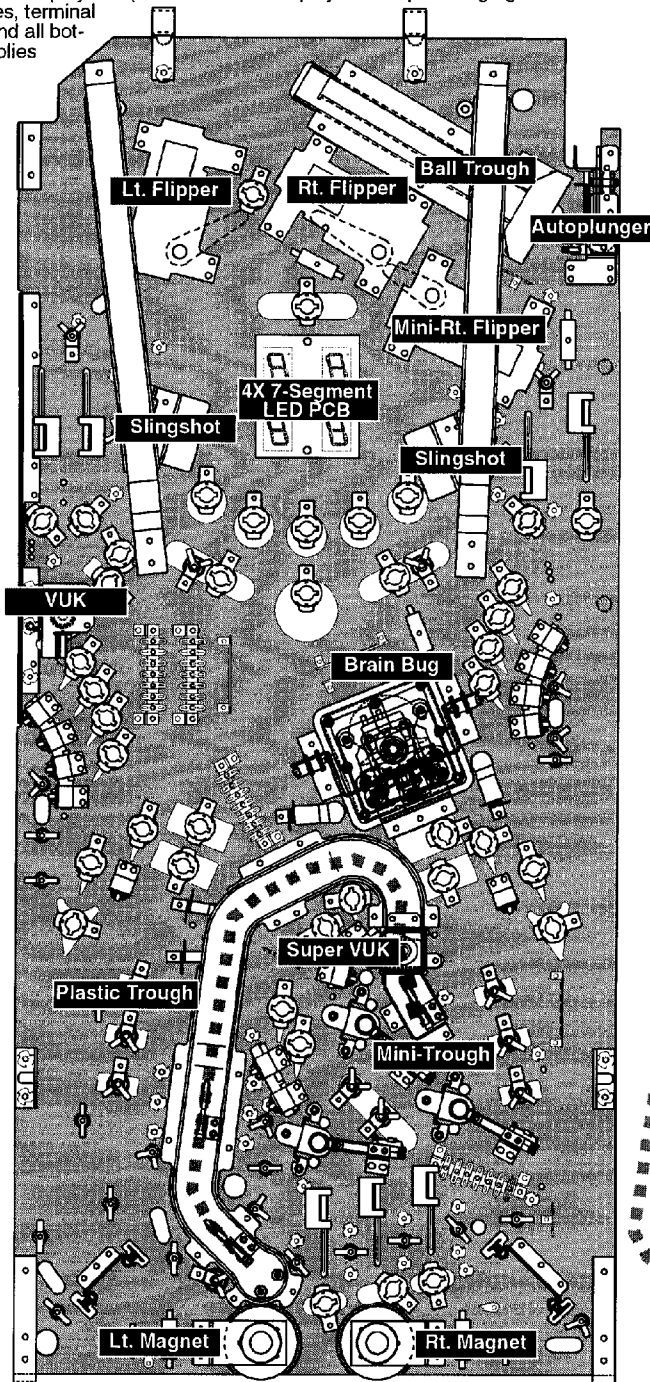


A Hard Shot to the Left Ramp will exit via the Wire Ramp exiting to the Left Return Lane. A Soft Shot to the Left Ramp will bring the ball down into the Top Exit Hole, bringing the ball into the Under-Trough to the Super VUK and will get kicked out into play towards the Right Flippers.

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, Auto-plunger, 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


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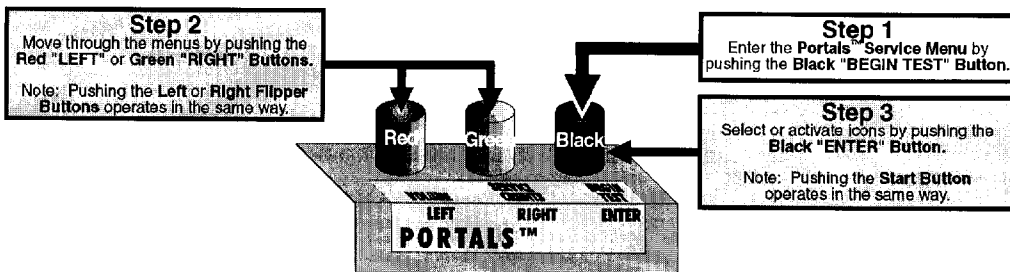

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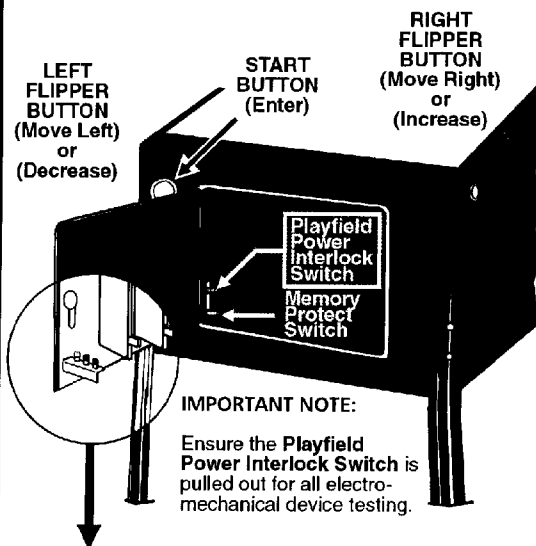
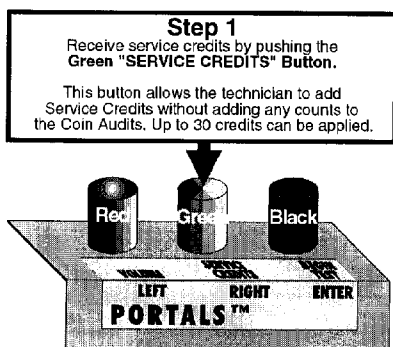
Service Switch Set (Red, Green & Black Buttons) Access & Use

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).

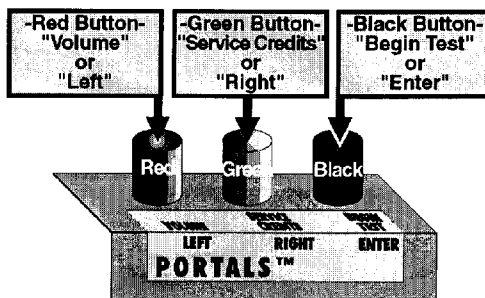
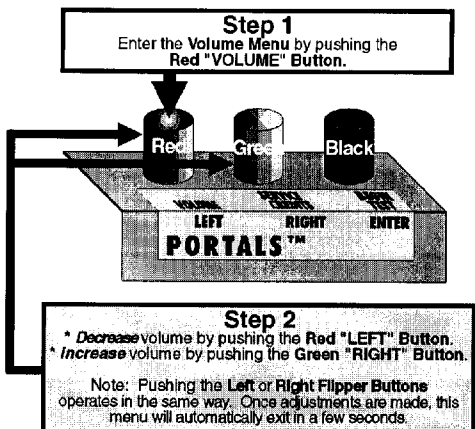
① Entering Portals™ Service Menu (will not operate in Volume Mode):



② Adding Service Credits (will not operate in Service or Volume Modes):



③ Entering the Volume Menu (will not operate in Service Mode):

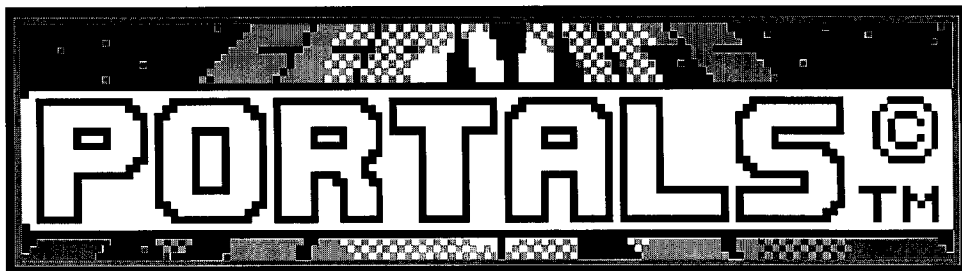


How to Use This Section

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**:

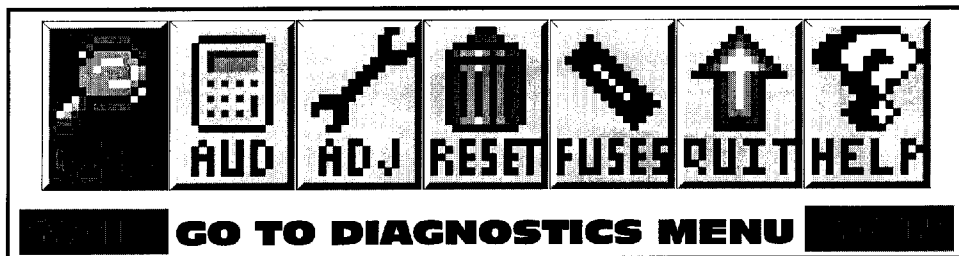


The Coin Door may be closed for security, however, please note with the Coin Door closed, the game's **MEMORY PROTECT** is enabled; *meaning any changes that are made will be not be written to memory*. If changing adjustments is required, ensure the Coin Door is open.

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.

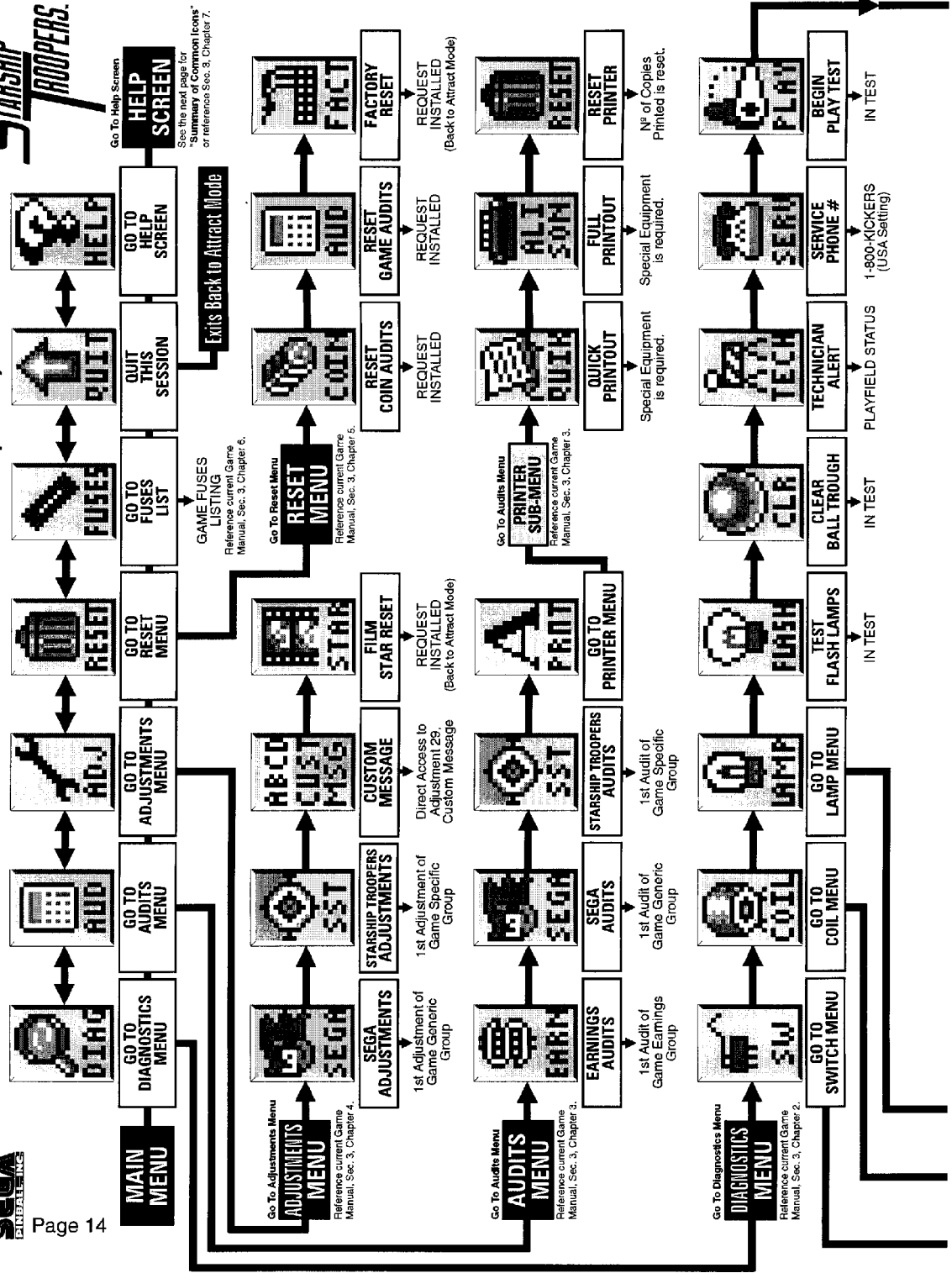
The **MAIN MENU** now appears with the "DIAG" *Icon* (**DIAGNOSTICS MENU**) flashing:



As the operator views the Menu Screen(s), the   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 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:



PREV

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.



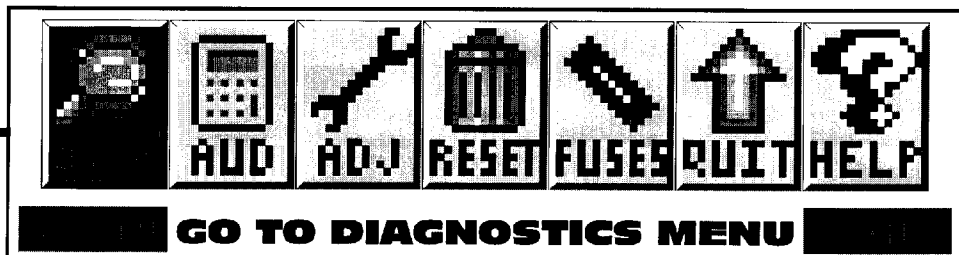
QUIT

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

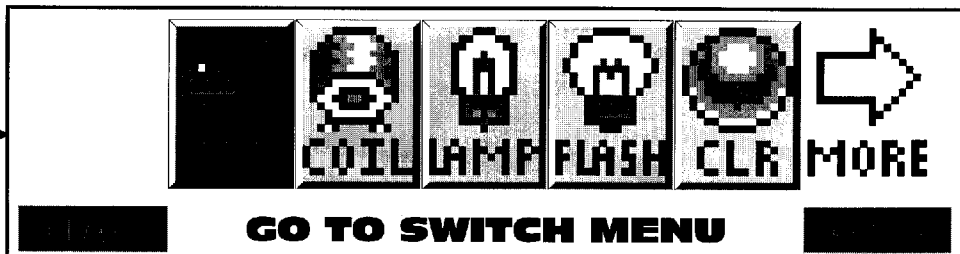


Selecting & activating the "HELP" *Icon* will show a help screen. (An explanation of each *Mini-Icon* at that level will cycle continuously until any active button is pressed.)

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

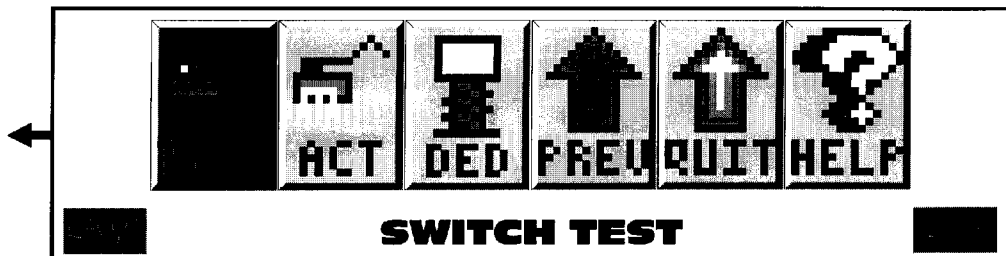


Press the Black "ENTER" Button to activate this *ICON*. This will bring up the **DIAGNOSTICS MENU**.

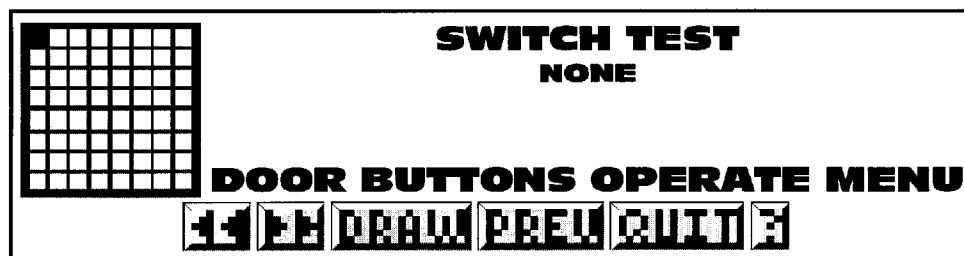


The **DIAGNOSTICS MENU** now appears with the "SW" *Icon* (GO TO SWITCH MENU) flashing. Press the Black Button to activate this icon. This will bring up the **SWITCH TEST MENU**.

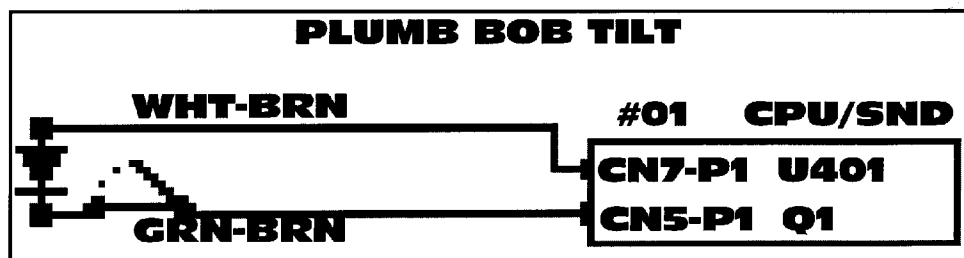
The **SWITCH TEST MENU** now appears with the "TEST" *Icon* (SWITCH TEST) flashing:
Press the **Black "ENTER" Button** to *activate* this icon. This will bring up the **Switch Test Display**.



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**.

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.

[illegible]

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 by 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 N^o, 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 N^o, 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

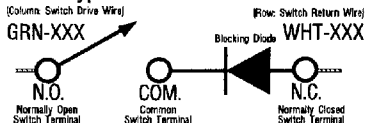
To initiate, from the **SWITCH MENU**, select the "DED" *Icon* with either **Flipper Button** & press the **Start Button** (The service switches are deactivated during this test.). The display will describe the switch which includes the Switch Name, Return (Row) Wire, Drive (Column) Wire, Part N^o, and the "Pin-Outs" from the CPU/SOUND Board.

SWITCH MATRIX GRID & DEDICATED SWITCHES

Column (Drive)	1 GRN-BRN CNE-P1	2 GRN-RED CNE-P3	3 GRN-ORG CNE-P4	4 GRN-YEL CNE-P5	5 GRN-BLK CNE-P6	6 GRN-BLU CNE-P7	7 GRN-VIO CNE-P8	8 GRN-GRY CNE-P9
Row (Return)	1 U400 WHT-BRN CNE-P9 NOT USED	UTROUGH: SKILL SHOT	LEFT BOTTOM S-U (GRN)	LEFT RAMP ENTER	STEPPER MOTOR REAR	LEFT TOP LANE	LEFT TURBO BUMPER	LEFT OUTLANE
2 U400 WHT-RED CNE-P8	4TH COIN SLOT	UTROUGH: BUG HOLE	LEFT MIDDLE S-U (YEL)	LEFT RAMP EXIT	STEPPER MOTOR FRONT	MIDDLE TOP LANE	BOTTOM TURBO BUMPER	LEFT RETURN LANE
3 U400 WHT-ORG CNE-P7	6TH COIN SLOT	NOT USED	LEFT MIDDLE S-U (RED)	LEFT RAMP S-U (YEL)	STEPPER MOTOR BUG	RIGHT TOP LANE	RIGHT TURBO BUMPER	LEFT SLINGSHOT
4 U400 WHT-YEL CNE-P6	RIGHT COIN SLOT	4-BALL TROUGH #1 (LEFT)	LEFT TOP S-U (YEL)	POP S-U (BLU)	NOT USED	NOT USED	RIGHT RAMP ENTER	RIGHT OUTLANE
5 U401 WHT-GRN CNE-P6	CENTER COIN SLOT / DBA	4-BALL TROUGH #2	RIGHT BOTTOM S-U (RED)	POP S-U (GRN)	BRAIN BUG UP	VUK	RIGHT RAMP EXIT	RIGHT RETURN LANE
6 U401 WHT-BLU CNE-P3	LEFT COIN SLOT	4-BALL TROUGH #3	RIGHT MIDDLE S-U (YEL)	VUK S-U (GRN)	BRAIN BUG HIT	SUPER VUK	START BUTTON	RIGHT SLINGSHOT
7 U401 WHT-VIO CNE-P2	5TH COIN SLOT	4-BALL TROUGH VUK OPTO	RIGHT MIDDLE S-U (GRN)	VUK S-U (BLU)	BRAIN BUG UP	LEFT ORBIT	SLAM TILT	NOT USED
8 U401 WHT-GRY CNE-P1	NOT USED	SHOOTER LANE	RIGHT TOP S-U (YEL)	RIGHT RAMP S-U (YEL)	UTROUGH POP EXIT HOLE	RIGHT ORBIT	PLUMB BOB TILT	NOT USED

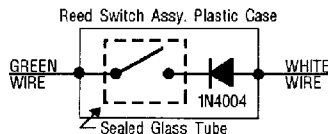
IC 1236 INPUTS	Ground
1 GRN-BRN CNE-P2	#1 LEFT FLIPPER BUTTON DS-1
2 GRN-RED CNE-P3	#2 LEFT FLIPPER E.O.S (End-of-Stroke) DS-2
3 GRN-ORG CNE-P4	#3 RIGHT FLIPPER BUTTON DS-3
4 GRN-YEL CNE-P6	#4 RIGHT FLIPPER E.O.S (End-of-Stroke) DS-4
5 GRN-GRN CNE-P7	#5 MINI FLIPPER BUTTON DS-5
6 GRN-BLU CNE-P8	#6 VOLUME (RED BUTTON) (Normal) (In Test: LEFT) DS-6
7 GRN-VIO CNE-P9	#7 SERV. CRED. (GREEN BUTTON) (Normal) (In Test: RIGHT) DS-7
8 GRN-BLK CNE-P10	#8 BEGIN TEST (BLACK BUTTON) (Normal) (In Test: ENTER) DS-8

Typical Switch Schematic

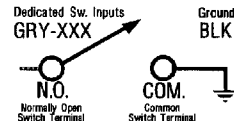


Note:
All Switches require diodes. Some diodes are located on Terminal Strips (under playfield) & not on the switch itself.
D code On T Terminal Strip

Reed Switch Schematic

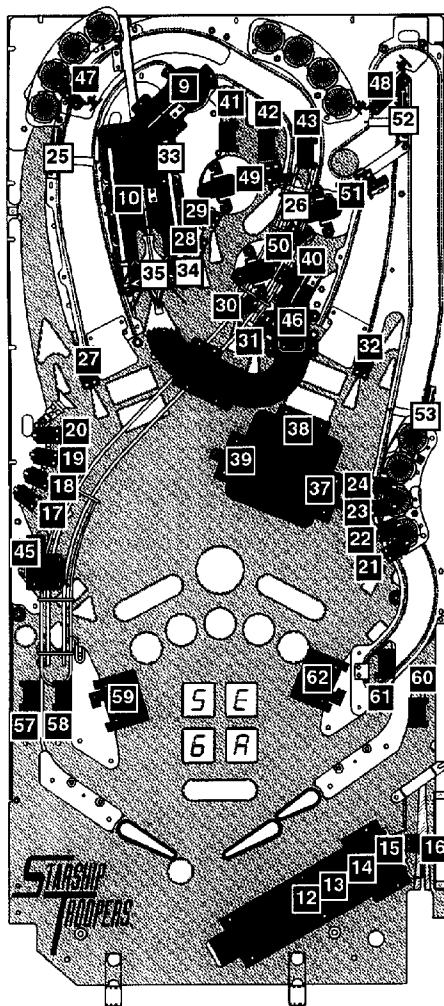


Dedicated Switch Schem.



Switch Matrix Grid Descriptions with Part Numbers and Locations †

† The sw. locations correspond with the Sw. N° 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. N°	Col. N°	Row N°	Switch Matrix Description	Part N°
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	
5*	1	5	CENTER COIN SLOT / DBA	180-5024-00
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)	
13	2	5	4-BALL TROUGH #2	180-5119-00
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	
34	5	2	DOTS STEPPER MOTOR FRONT	180-5119-00
35	5	3	DOTS STEPPER MOTOR BUG	
36	5	4	NOT USED	
37	5	5	BRAIN BUG UP	
38	5	6	DOTS BRAIN BUG HIT	180-5165-00
39	5	7	BRAIN BUG UP	
40	5	8	DOTS U'TROUGH: POP EXIT HOLE	180-5057-00
41	6	1	LEFT TOP LANE	
42	6	2	MIDDLE TOP LANE	500-6227-02
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	
50	7	2	BOTTOM TURBO BUMPER	180-5015-03
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	
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		
64	8	8	NOT USED	



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.

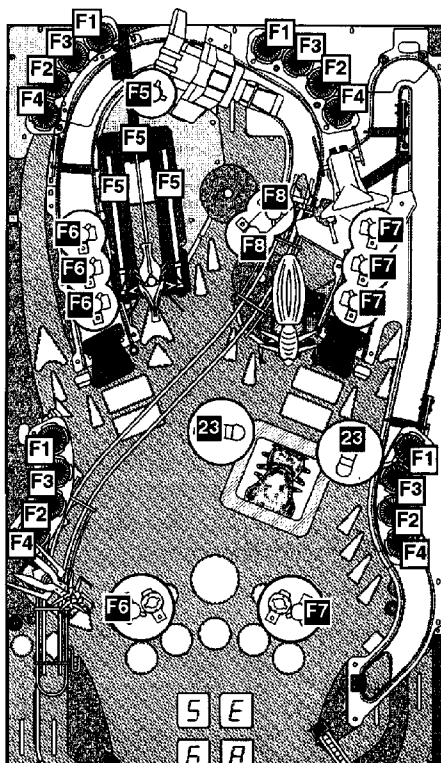


Cycling Coil Test

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).



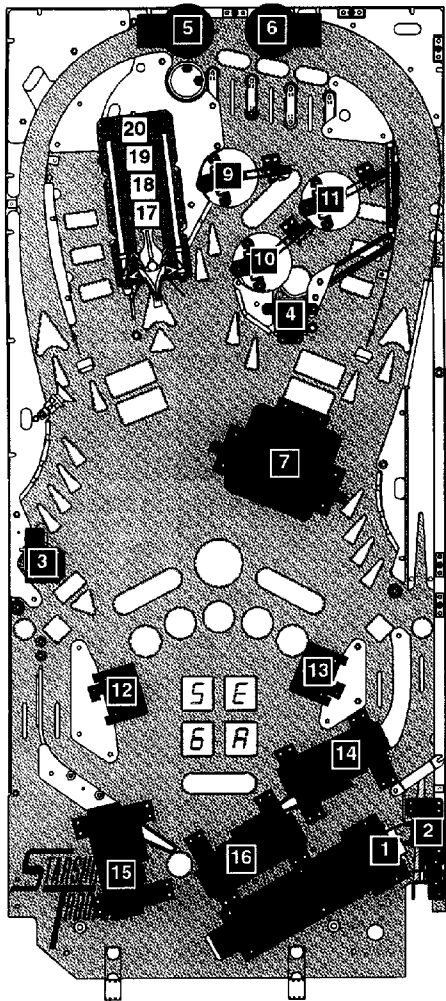
#89 Bulb
(Bayonet)
165-5000-09



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

There are no Flash Lamps below this statement note.

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*2 (#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 Output Board	D.T. Control Line Color	D.T. Control Line Connect	Power Line Color	Power Line Connection	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 Output Board	D.T. Control Line Color	D.T. Control Line Connect	Power Line Color	Power Line Connection	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 RED-YEL	J10-P1/2	50v DC	23-1100 090-5030-00T

Low Current Coils Group 1		Drive Transistor (D.T.)	Driver Output Board	D.T. Control Line Color	D.T. Control Line Connect	Power Line Color	Power Line Connection	Power Voltage	Coil GA/Turn or Bulb Type
17	STEPPER MOTOR #1	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	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	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	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)

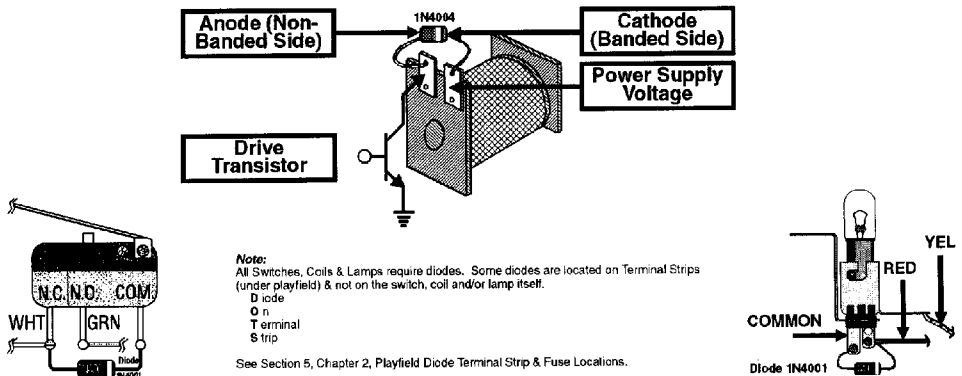
Dots On Terminal Strip (noted)

Coils Detailed Chart Table Continued

Flash Lamps (FLASH)		Drive Transistor (D.T.)	Driver Output Board	D.T. Control Line Color	D.T. Control Line Connect	Power Line Color	Power Line Connection	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 = 3x #906 Bulb + 1x #89 Bulb

TYPICAL SWITCH, COIL & LAMP WIRING





Go To Lamp Menu

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



Single Lamp Test

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



Test All Lamps

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

		Di- a- g- n- o- s- t- i- c- s M- e- n- u		LAMP MATRIX GRID																			
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															
Row (GND)	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 TUR- BO BUMPER #555 Bulb 28	BOTTOM TUR- BO BUMPER #555 Bulb 29	RIGHT TUR- BO BUMPER #555 Bulb 30	MULTI BALL #44 Bulb 31	SUPER NUKE #44 Bulb 32															
5: Q37 RED-GRN J12-P5	NOT USED #555 Bulb 33	WARRIOR BUG #555 Bulb 34	2X NUKE #555 Bulb 35	RECON #555 Bulb 36	LEFT OUTLANE #555 Bulb 37	RIGHT OUTLANE #555 Bulb 38	ADVANCE PLANET #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 #555 Bulb 47	RIGHT RAMP NUKE #555 Bulb 48															
7: Q39 RED-VIO J12-P7	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	PLASABUG 7- SEGMENT 'A' Red LED 65	PLASABUG 7- SEGMENT 'B' Red LED 66	PLASABUG 7- SEGMENT 'C' Red LED 67	PLASABUG 7- SEGMENT 'D' Red LED 68	PLASABUG 7- SEGMENT 'E' Red LED 69	PLASABUG 7- SEGMENT 'F' Red LED 70	PLASABUG 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 4X7-Segment Display PCB, Part N° 520-5166-00.

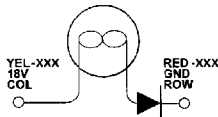


#555 Bulb (Wedge)
165-5002-00

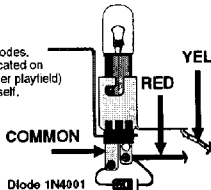


#44 Bulb (Bayonet)
165-5000-44

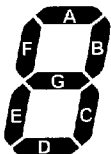
Typical Switch Schematic & Side View



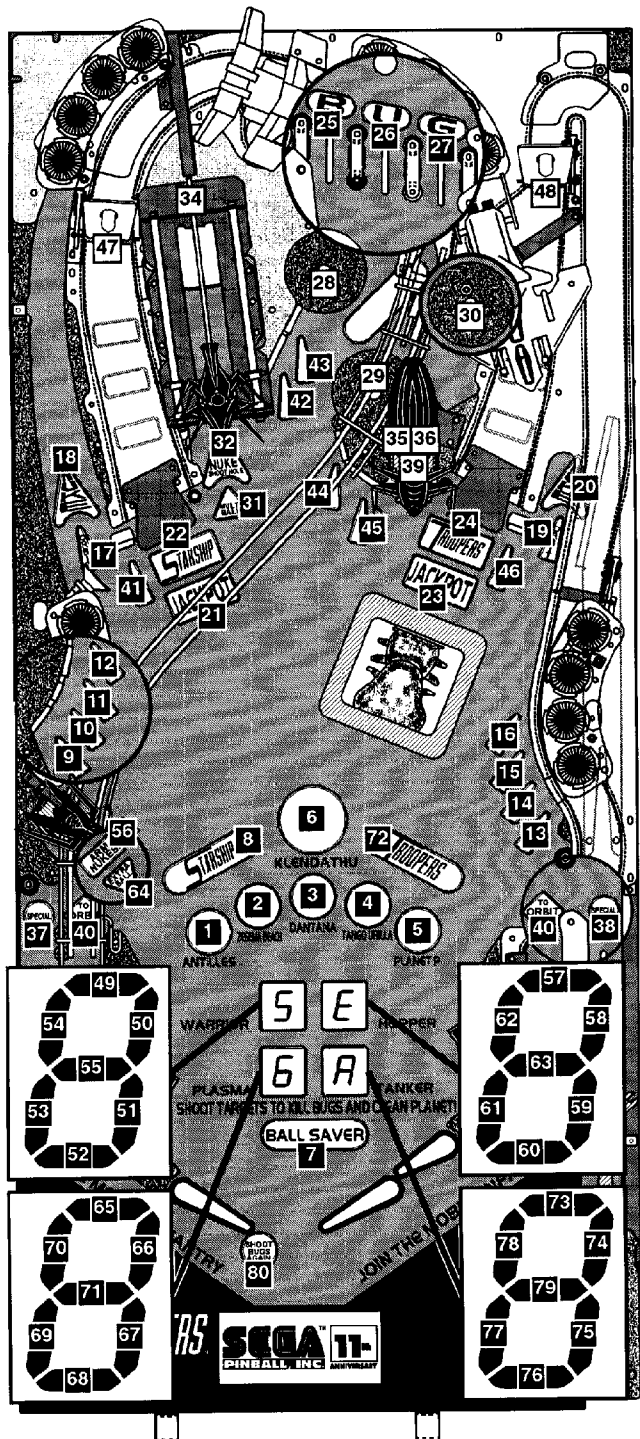
Note:
All Lamps require diodes.
Some diodes are located on Terminal Strips (under playfield) & not on the lamp itself.
D iode
O n
T ermi-
n al
S trip



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 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 outline 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", Sling-shots, 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 Kicker

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

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

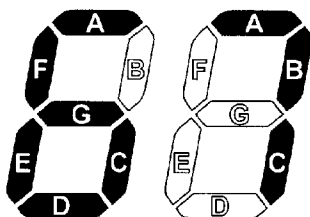
To initiate, from the **STARSHIP TROOPERS SPECIFIC MENU**, select the "LED" *Icon* with either **Red "LEFT"** or **Green "RIGHT"** **Button** and press the **Black "ENTER"** **Button**. In **LED TEST**, select either the "-" or "+" *Icons*. Start with the "+" *Icon* to start the manual **LED Test**.

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:



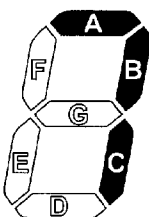
To make **6** the Upper Left Digit needs the following segments to be lit:

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



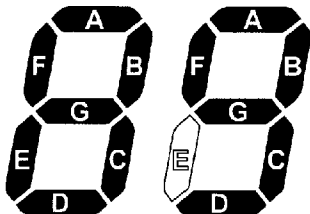
To make **7** the Upper Right Digit needs the following segments to be lit:

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



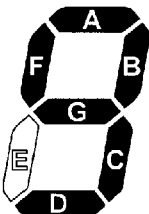
To make **8** the Lower Left Digit needs the following segments to be lit:

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.



57A-SK IP 7-DOPE-S

GAME AUDIT TABLE

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



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			
69 MBALL READY		85 RECON LEVEL 1			
70 MULTIBALL START		86 RECON LEVEL 2			
71 2+ MBALL START		87 RECON LEVEL 3			

CPU Version:
Display Version:
Date Audited:
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 <i>Factory Restore</i> 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. N°	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	50M—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. N°	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.



Starship Troopers Audits Continued (Audits Subject to Change)

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	Klondathu 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)

retrieved.

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



Adjustment 53, N° 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 "N° 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).



STARSHIP TROOPERS

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:



PREV

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.



HELP

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.)



QUIT

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 indicate 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.)



Sega Adjustments Continued.

Adjustment Name		Adjustment Definition
Adj. 4	Free Game Limit	Adjust the max. # of <i>Free Games</i> that may be accumulated per game; 0 - 9 .
Adj. 5	Extra Ball Limit	Adjust the max. # of <i>Extra Balls</i> that may be accumulated per game; 1 - 9 or OFF . 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.
Adj. 6	Game Difficulty	

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			

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.

Adj. 7 Game Pricing

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
10p	50p	£1	20p	1/30p 2/50p 5/£1 1/50p 3/£1 1/30p 4/£1	01 01 01	06 05 05	15 15 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			Pricing Scheme Explained				
			COINS THRU ... SLOT:			Number of "Plays" for Price Amount Shown				
			LEFT	CENTER	4TH					
		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¢				
		USA4	25¢		25¢	1 / 50¢				
		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			

Pos.
ON
OFF

1

2

3

4

5

6

7

8

Standard Pricing Select Table - (Continued)

CPU/SOUND BOARD DIP SWITCH 300 SETTINGS		COUNTRY SETTING OPTION 1 †		Coin Mechanisms COINS THRU ... SLOT: LEFT CENTER 4TH			Pricing Scheme Explained Number of "Plays" for Price Amount Shown		
Pos. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100		ON		Please Note: for all USA Settings, see previous page (bottom).					
OFF		Austria †		5S 10S 10S			1/10S 2/15S 3/20S		
ON		Australia 1 †		20¢ \$A 1 \$A 2			1/\$A 1 2/\$A 2		
OFF		Australia 2 †		20¢ \$A 1 \$A 2			1/\$A 1 2/\$A 2		
ON		Belgium †		5 BF 20 BF 50 BF			1/20 BF 3/50 BF		
OFF		Brazil †		This country uses unique Tokens and/or Debit Cards only (pricing varies).			1/2 coins		
ON		Canada †		25¢ 25¢ Can\$ 1			1/50¢ 2/75¢ 3/ Can\$ 1		
OFF		Denmark 1 †		1 DKr 5 DKr 10 DKr 20 DKr			1/3 DKr 2/5 DKr		
ON		Denmark 2 †		1 DKr 5 DKr 10 DKr 20 DKr			1/2 DKr 3/5 DKr 7/10DKr		
OFF		Finland †		1 Fmk 5 Fmk			1/5 Fmk 4/10 Fmk		
ON		France 1 †		1 Fr 5Fr 10 Fr 20 Fr			1/3 Fr 2/5 Fr 5/10 Fr 11/20 Fr		
OFF		France 2		1 Fr 5 Fr 10 Fr 20 Fr			1/5 Fr 3/10 Fr 7/20 Fr		
ON		France 3		1 Fr 5 Fr 10 Fr 20 Fr			1/3 Fr 2/5 Fr 4/10 Fr 9/20 Fr		
OFF		Germany 1		1 DM 2 DM 5 DM			1/1 DM 6/11 X 5 DM		
ON		Germany 2		1 DM 2 DM 5 DM			1/2 DM 2/3 DM 3/4 DM 4/5 DM		
OFF		Germany 3 †		1 DM 2 DM 5 DM			1/2 DM 2/3 DM 3/4 DM 5/5 DM		
ON		Germany 4		1 DM 2 DM 5 DM			1/1 DM 6/5 DM		
OFF		Greece †		50 Dr 100 Dr			1/50 Dr 3/100 Dr		
ON		Hong Kong †		1 HK\$ 2 HK\$ 5 HK\$			1/5 HK\$		
OFF		Hungary †		10 Ft 10 Ft 20 Ft			1/20 Ft 3/40 Ft		
ON		Italy 1 †		500 Lit 500 Lit			1/500 Lit		
OFF		Italy 2		500 Lit 500 Lit			1/1000 Lit 3/2000 Lit		
ON		Japan 1 †		100¥ 100¥			1/100¥		
OFF		Japan 2		100¥ 100¥			1/100¥ 3/200¥		
ON		Korea †		100 Won 100 Won			1/100 Won		
OFF		Netherlands 1		1 Fls. 1 Fls. 2.5 Fls.			1/1 Fls. 3/2.5 Fls.		
ON		Netherlands 2 †		1 Fls. 2.5 Fls. 5 Fls.			1/1 Fls. 3/2.5 Fls. 6/5 Fls.		
OFF		New Zealand 1 †		\$NZ 1 \$NZ 2			1/\$NZ 1 2/\$NZ 2		
ON		New Zealand 2 †		\$NZ 1 \$NZ 2			1/\$NZ 1 3/\$NZ 2		
OFF		Norway 1 †		10 NKr 5 NKr 20 NKr			2/10 NKr 1/5 NKr 4/20 NKr		
ON		Norway 2		10 NKr 5 NKr 20 NKr			1/10 NKr 3/20 NKr		
OFF		Spain †		100 Pts 500 Pts			1/100 Pts 6/500 Pts		
ON		Sweden 1 †		1 SKr 5 SKr 10 SKr			1/10 SKr 2/15 SKr 3/20 SKr		
OFF		Sweden 2		1 SKr 5 SKr 10 SKr			1/5 SKr		
ON		Switzerland 1 †		1 SwF 2 SwF 5 SwF			1/1 SwF 6/5 SwF		
OFF		Switzerland 2		1 SwF 2 SwF 5 SwF			1/1 SwF 3/2 SwF 9/5 SwF		
ON		UK 1		10p 50p 1£ 20p			1/50p 3/1£		
OFF		UK 2		10p 50p 1£ 20p			1/40p 3/1£		
ON		UK 3 †		10p 50p 1£ 20p			1/50p		
OFF		UK 1							
ON		UK 2							
OFF		UK 3 †							

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 accommodated in the 5th & 6th Coin Slots. (This is "software controlled" by noting presence/non-presence of pulses via 1-4.)

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



Sega Adjustments Continued.

Adjustment Name	Adjustment Definition
Adj. 8 Reset Coin Audits	Default is NO . Select the "+" icon to change to YES . ⚠ When enabled, all <i>Coin Audits</i> (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 <i>Coin Audits</i> (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 (High Score To Date). 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 (<i>Request Installed</i> 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.



Sega Adjustments Continued.

Adjustment Name	Adjustment Definition
Adj. 31 Flash Lamp Power	Set to NORMAL , DIM or OFF . When set to NORMAL the flash lamps are active, when DIM the flash lamps impulse power is reduced by 25% and when OFF the flash lamps will not flash.
Adj. 32 Coil Pulse Power	Set to NORMAL , HARD or SOFT . When HARD the coil pulse power is <i>increased</i> by 12.5% of the normal pulse rate. When set to SOFT the coil pulse power is <i>decreased</i> 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 Klocker 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 <i>Not Used</i> , allowing for <i>Future Expansion</i> , if any, and/or <i>Proprietary</i> (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 <i>all audits will be reset and all adjustments will be initiated</i> to the particular style selected. The game will then return to <i>Game Over Attract Mode</i> , as if a <i>Factory Reset</i> had been performed. NONE - Same as a <i>Factory Reset</i> 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 <i>Free Play is enabled</i> . 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 <i>Factory Reset</i> .) See the end of this Section 3, Chapter 3, Go To Audits Menu, and Chapter 5, Go to Reset Menu, for more details on <i>Factory Reset & Printing</i> .
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 <i>Factory Reset</i> .) See the end of this Section 3, Chapter 3, Go To Audits Menu, and Chapter 5, Go to Reset Menu, for more details on <i>Factory Reset & Printing</i> .



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. N ^o	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 "QUICK" *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 N° 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. N°	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. N°	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.

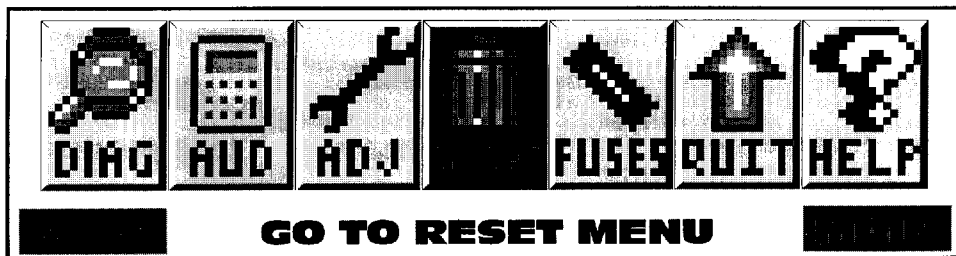


Factory Reset

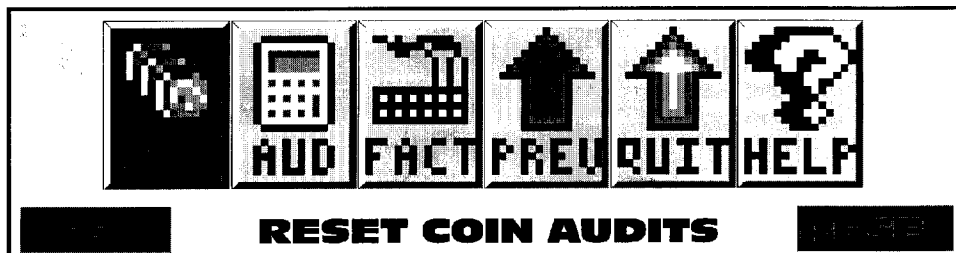
From the **RESET MENU**, select the "FACT" *Icon* with either **Red** or **Green Button** and press the **Black Button**. ⚠ All adjustments will be reset to **Factory Settings** (except for Proprietary Adjustments). The display will indicate **REQUEST INSTALLED** and exit the Service Session. See Chapter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



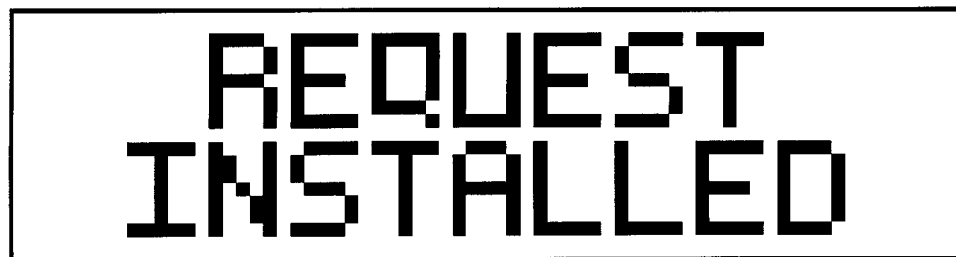
The **RESET MENU** now appears with the "COIN" *Icon* (**RESET COIN AUDITS**) flashing:



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. 1) 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 "QUIT" *Icon* from any display will exit the Service Session.



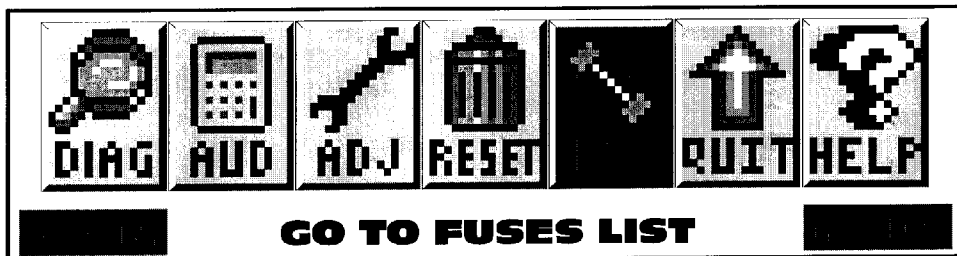
Selecting & activating the "HELP" *Icon* from any display will show a help screen. (An explanation of each *Mini-Icon* at that level will cycle continuously until any active button is pressed.)



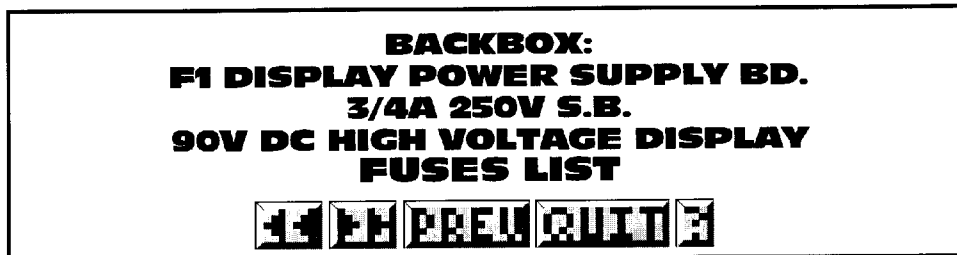
Selecting & activating the "ARROW" *Icons* selects the next or previous fuse in this group.

Example:

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

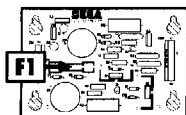


Press the **Black Button** to activate this **ICON**. This will bring up the **FUSES LIST**.





BACKBOX LAYOUT LOCATIONS: Fuses, Bridges, Relays & ROMs

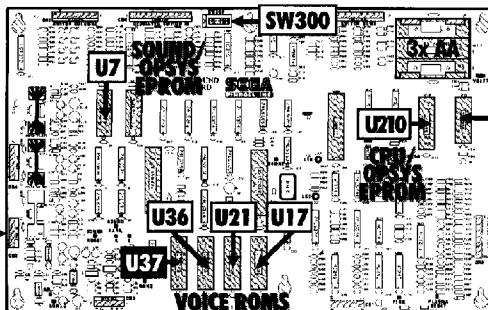


Display Power Supply Bd.

CPU / Sound Board

No Fuses

I/O Power Driver Board



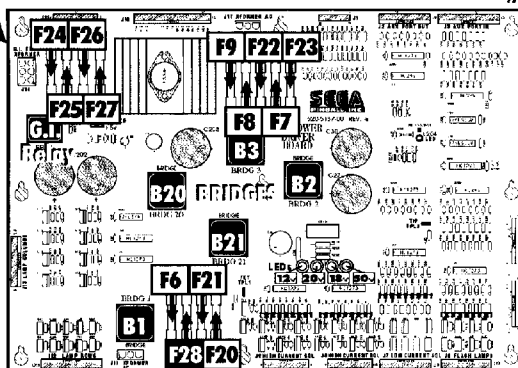
U212
CMOS RAM

Note:

U37
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



Note:

F28
is Not Used
in this game.

QUICK REFERENCE FUSE CHART

Backbox Fuses

LOC: DISPLAY POWER SUPPLY (P.S.) BOARD

F1	¼A 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 Assembly Used)

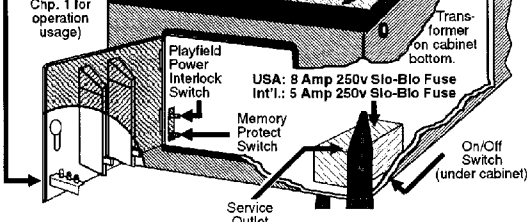
n/a	3A 250v S.B.	50v DC	Rt. Flipper (BLU/YEL ↔ RED/YEL)
n/a	3A 250v S.B.	50v DC	Mini Flipper (BLU/YEL ↔ RED/YEL)
n/a	3A 250v S.B.	50v DC	Lt. Flipper (GRY/YEL ↔ RED/YEL)
n/a	3A 250v S.B.	50v DC	Lt. Magnet (VIO/YEL ↔ BRN/GRN)
n/a	3A 250v S.B.	50v DC	Rt. Magnet (VIO/YEL ↔ BRN/BLU)
n/a	3A 250v S.B.	50v DC	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 and Cabinet General Parts.

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



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 and 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 and 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 and 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.



PORTALS™ SERVICE MENU PROBLEM/SOLUTION TABLE

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



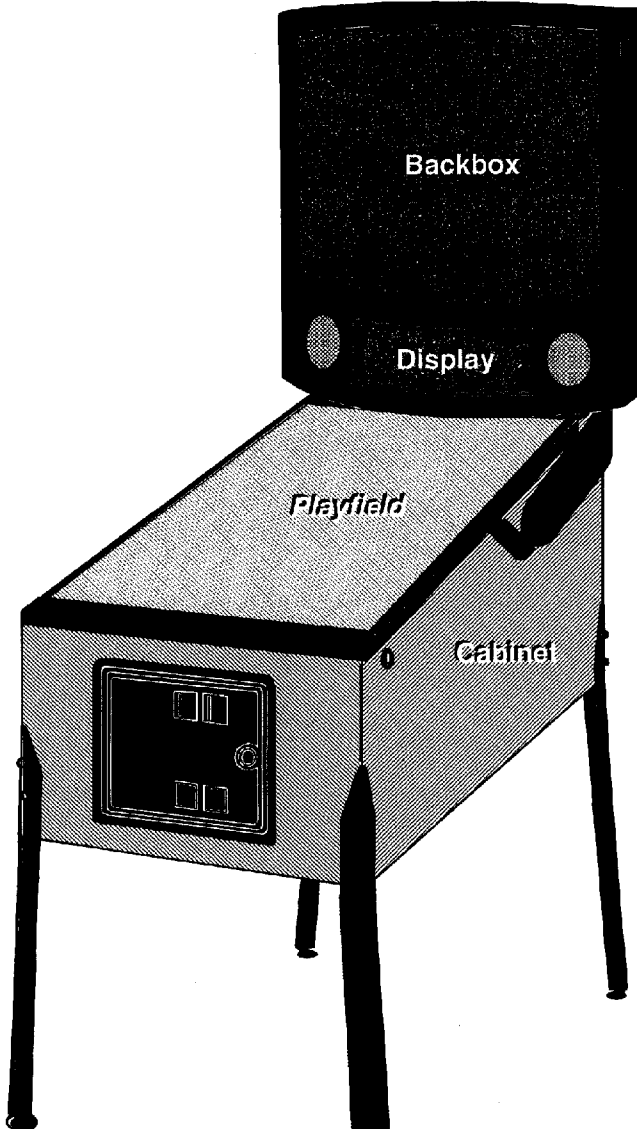
PROBLEM	SOLUTION
Will not enter the Service Mode after depressing the Black "BEGIN TEST" Button .	• Check the Service Switch(es) (Red, Green & Black Buttons) for loose connections or bad Ground. • Check the associated wiring harness to/from the CPU Board Connector CN14. • Check CPU Board, possibly failed.
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 " <i>scroll</i> " 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 <i>Icons</i> 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 <i>Icon</i> 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 <i>Icons</i> appear non-functional in the PRINTER MENU(S) .	• If no printing equipment is connected, the "-<i>Icon</i>", "+<i>Icon</i>" and "RUN" <i>Icon</i> will appear not to function (See Chapter 5).
Some <i>Icons</i> 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" <i>Icons</i> will appear not to function. The remaining <i>Icons</i> should function as normal. Note: If there is no Game Specific Special Test, the "GAME SPECIFIC" <i>Icon</i> 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 " <i>Icon</i> .	• 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.



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Plastic Posts and Spacers 64

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and Sockets

Small Bayonet Type Bulbs 66

and Sockets

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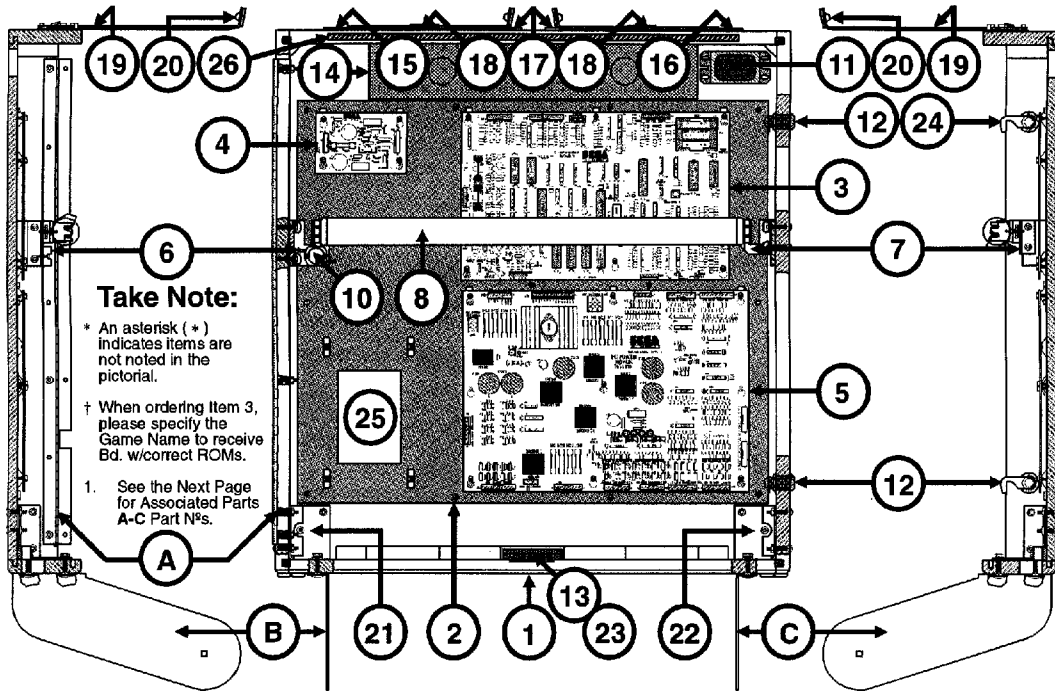
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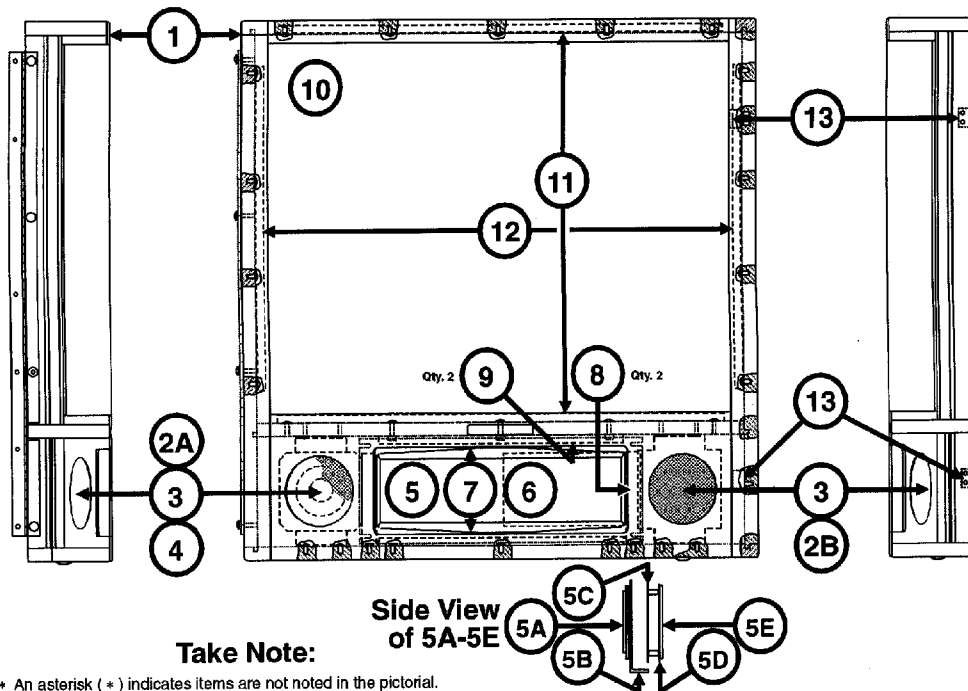
Drawings (Ramps) 80-83

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



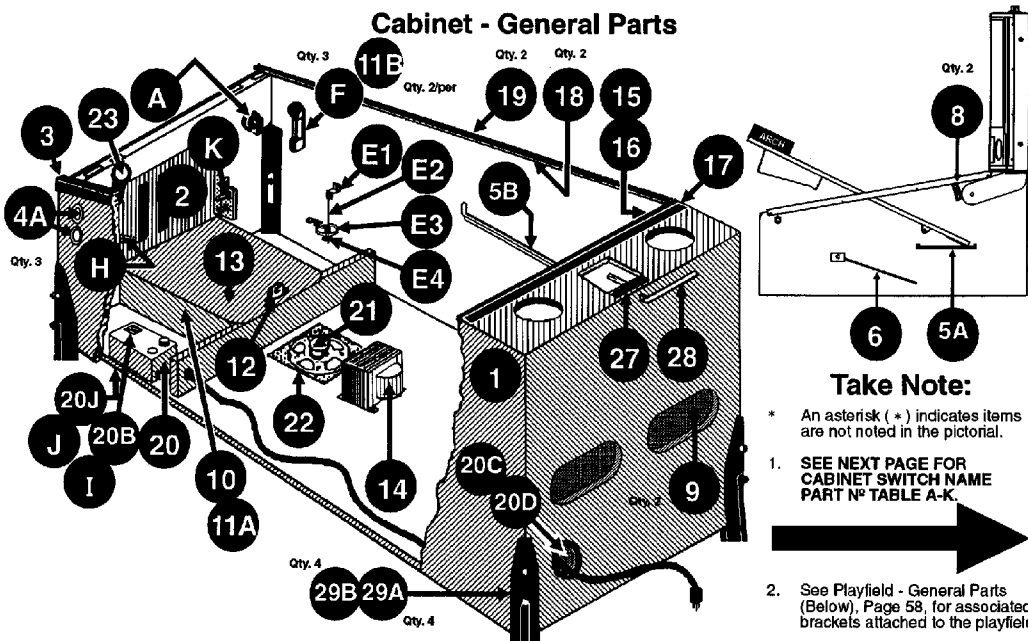
Nº	Individual Part Name (Back)	QTY.	SPI Part Nº	Nº	Individual Part Name (Back)	QTY.	SPI Part Nº
1	Backbox Housing (Wood)	1	525-5453-01	15	Top Support Mounting Bracket Left	1	515-6704-00
2	PCB Metal Mounting Plate	1	535-5809-04	16	Top Support Mounting Bracket Right	1	515-6704-01
Item 2 secured by: #8 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	17	Support Mounting Bracket (Small)	2	515-6706-00
4	Display Power Supply Board	1	520-5138-00	Items 15, 16 & 17 secured by: #8 X 3/8" PFH MS (Zinc) (Qty. 10) (237-5902-00)			
5	I/O Power Driver Board	1	520-5137-01	18	Support Bracket	2	535-8041-00
Items 3, 4 & 5 secured by: #6-32 X 3/8" HWH MS (Qty. 19) (237-5903-00)							
6	Fluorescent Light Bracket Assy. Left	1	515-6545-00	Item 18 secured by: #6 X 3/8" HWH MS (Zinc) (Qty. 4) (237-5903-00)			
ORDERING ABOVE ITEMS REQUIRES PARTS WILLING TO WAIT							
6A	Fluorescent Light Bracket Left	1	535-7739-01	19	*Swing-Out Arm* Top Support Bracket	2	535-8040-00
6B	Lamp Holder (Self-Locking)	1	077-5214-00	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" PFH MS (Sems) Zinc (Qty. 2) (232-5401-00)			
6C	#8-32 X 5/8" PPH MS (Sems) Zinc	1	232-5203-00	20	Deflector Pad	2	545-5428-00
6D	Starter Base (With Leads)	1	077-5213-00	21	Corner Support Bracket Left	1	515-6703-00
6E	#4-40 X 1/2" PPH MS (Sems) Zinc	2	237-5813-00	22	Corner Support Bracket Right	1	515-6703-01
7	Fluorescent Light Bracket Assy. Right	1	515-6545-01	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)			
ORDERING ABOVE ITEMS REQUIRES PARTS WILLING TO WAIT							
7A	Fluorescent Light Bracket Right	1	535-7739-00	23	Door Restraint Bracket	1	535-8127-00
7B-7C	Identical to Items 6B-6C above	See 6B-6C		Items 23 secured by: #6 X 1/2" HWH AB (Zinc) Blue (Qty. 2) (234-5101-05)			
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	24	Lock Mounting Plate	2	535-8128-00
9*	3/4" Reinforced Strapping Tape (6")	1	626-5040-00	Items 24 secured by: #6 X 1/2" HWH AB (Zinc) Blue (Qty. 4/per) (234-5101-05)			
10	Starter - Fluorescent (FS2 Light)	1	165-5011-01	25	Fuse Description Decal Game Nº 59	1	820-6152-59
11	Ballast Assembly	1	500-6143-00	26	1" of 3/8" X 1/4" Poly Foam Tape	2.41	626-5038-00
ORDERING ABOVE ITEMS REQUIRES PARTS WILLING TO WAIT							
11A	Ballast (SP2 120v 60Hz 13W UL)	1	010-5007-00	27*	Fuse Label (UL)	1	820-6143-00
11B	Wire Lock (NYT) Clear JN418-212	3	055-5146-00	28*	Backbox Date Label	1	820-5091-00
11C	Fluor. Light Cable Wiring Harness	1	036-5402-15	29*	Ribbon Cable, 20-Pin	1	036-5000-04
Item 11 secured by: #6 X 3/8" HWH AB (Zinc) (Qty. 2) (234-5000-00)							
12	Backbox Lock & Key	2	355-5018-01	30*	Ribbon Cable, 26-Pin	1	036-5001-80
13	#1 Roto Lock Female (R2-0002-02)	1	355-5006-02	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.			
Item 13 secured by: #10-24 X 1-3/4" C.B.S.N. (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)							
14	Back Vent Grill 2-1/2" X 18"	1	545-5072-02	31*	Display Cable Wiring Harness	1	036-5409-01
Item 14 secured by: Staple 5/16" (Qty. 24) (631-5000-00)							
Items 33-35 & 37 secured by: #6 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)							
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	32*	Fluor. Power Cable Wiring Harness	1	036-5414-10
33*	1" Clamp (Single)	9	040-5000-09	33*	1" Clamp (Single)	9	040-5000-09
34*	3/4" Clamp (Single)	3	040-5000-08	34*	3/4" Clamp (Single)	3	040-5000-08
35*	1/2" Clamp (Single)	1	040-5000-06	35*	1/2" Clamp (Single)	1	040-5000-06
36*	1/4" Clamp (Double)	3	040-5000-23	36*	1/4" Clamp (Double)	3	040-5000-23
37*	Screw Down Cable Tie	2	040-5005-00	37*	Screw Down Cable Tie	2	040-5005-00

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



Nº	Individual Part Name (Front)	QTY	SPI Part Nº	Nº	Individual Part Name (Front)	QTY	SPI Part Nº
1	Backbox Door Pane (Wood)	1	525-5453-02	9	Plastic Shield Bracket (Top/Bottom)	2	515-6682-00
Item 1 contains #6-32 Insert Nuts (Qty. 48) (240-5320-00) Inlaid in the Door Pane and Sega Logo Stick-On Plate (Qty. 1) (535-7877-00).				Items 9-9 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)			
2A	Speaker Mounting Plate (Left - Black)	1	515-6681-00	10	Backglass Assembly (Game Nº 59)	1	515-5450-00-59
2B	Speaker Mounting Plate (Right - Raw)	1	515-6681-01	CHASSIS - FRONT SIDE			
3	Speaker Grill (Left Black w/o Artwork)	2	535-8081-00	10A	Backglass - Lexan (Front)	1	545-5733-00
4	Speaker 4 X 4 Quam (#89-9572)	1	031-5004-00	10B	Screened Film (Game Nº 59) (Middle)	1	830-5259-00
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), #10-24 Keps Nut (Qty. 4) (240-5207-00) and Rivet - 1/8" x 3/16" (Qty. 8) (249-5001-00)				10C	Backglass - Bulkyrate Cover (Back)	1	545-5753-00
5	Dot Matrix Display Board Assembly	1	515-6713-00	11	Backglass Assy. Retainer Brkt. (Top/Bot.)	2	535-8001-00
5A Dot Matrix Display Board 128 X 32				12	Backglass Assy. Retainer Brkt. (Sides)	2	535-8002-00
5B Dot Matrix Display Holder				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)			
5C Static Shield				13	Lock Bracket	2	535-8037-00
5D RF Shield (Display PCB Control)				Item 13 secured by: #8-32 X 3/8" HWH MS (Sems) Zinc (Qty. 4) (237-5903-00)			
5E Display Controller Board				14*	1' of 3/8" X 1/4" Poly Foam Tape	3.33	626-5038-00
5F* Edge Protector				15*	Speaker Cable Wiring Harness	1	036-5388-01
5G* Ribbon Cable, 14-Pin (connects 5A to 5B)				16*	1" Clamp (Single)	3	040-5000-09
5H* 3/16" X 3/8" Spacer Gray				SEE THE PREVIOUS PAGE FOR LOCATIONS:			
5I* #6-32 X 1/2" HWH Swage (Sems) Zn				ASSOCIATED PARTS ARE NOT INCLUDED WITH THE BACKBOX ASSEMBLIES.			
5J* 1/2" X 1/4" Hex Spacer #6-32 Tap							
5K* 3/4" X 1/4" Hex Spacer #6-32 Tap							
5L* 1/2" X 5/16" X .144 I.D. Spacer Tap							
5M* #6-32 X 1/4" PPH MS (Sems) Zinc							
5N* #6-32 X 3/4" PPH MS (Sems) Zinc							
5O* Ground Strap - 25"							
5P* Ground Strap - 41"							
5Q* 5-1/2" Cable Tie							
5R* 1/2" Clamp (Single)							
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				

Cabinet - General Parts



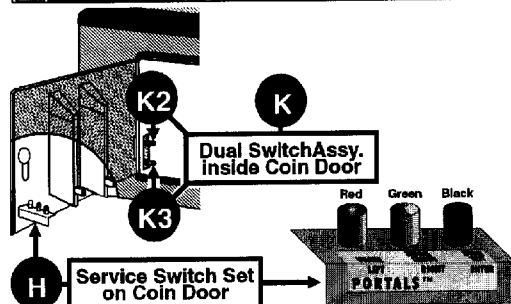
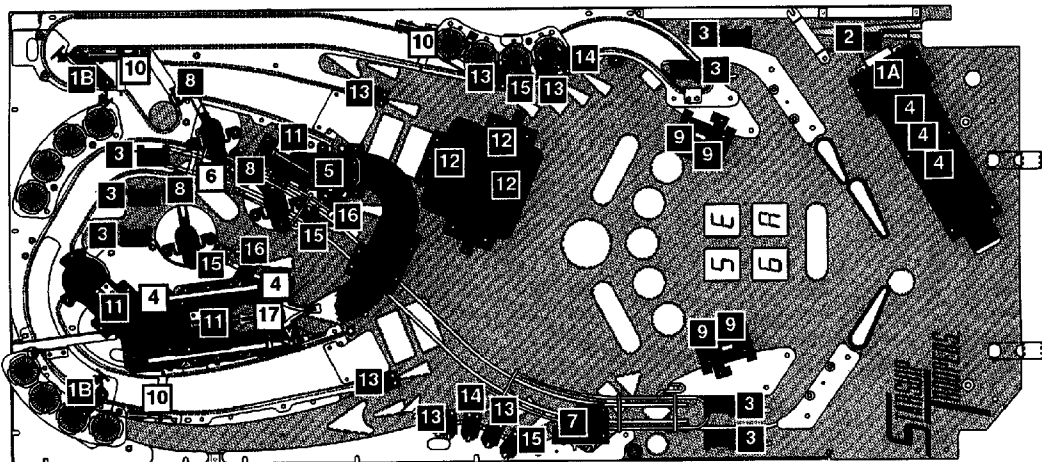
Take Note:

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

- SEE NEXT PAGE FOR CABINET SWITCH NAME PART N° TABLE A-K.
- See Playfield - General Parts (Below), Page 58, for associated brackets attached to the playfield.

N°	Cabinet Part Name	QTY.	SPI Part N°	N°	Cabinet Part Name	QTY.	SPI Part N°
1	Game 59 Screened Cabinet (Plain)	1	525-6000-59	20	Power Input Box Sub-Assy. (no Vol. pct)	1	515-5360-01
2	Coin Door (with Validator) USA only	1	500-5018-172	ORDERING ABOVE ITEMS DIS-ASSY PARTS WITHIN 10			
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)				20A*	Power Box (Plain)	1	535-5932-00
3	Ball Shooter (Plunger) Assembly	1	500-6146-00-04	20B	Service Outlet (for USA)	1	180-5008-01
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)				20C	Line Cord 10' RCJ 3" Max.	1	034-5000-10
4A	Flipper Button Assembly Red	3	500-5026-32	20D	Recessed Cup for Line Cord	1	545-5122-00
4B*	Pal Nut for Flipper Button	3	240-5003-00	20E*	Line Filter	1	150-5000-00
Item 4 is fitted with: O-Ring 11/32" X 7/32" X 1/16" (Qty. 1/pep) (545-5850-00)				20F*	Varistor TNR159211KM	1	150-5001-00
5A	Slide & Pivot Support Bracket - Right	1	535-5989-00	20G*	Fuse 8 Amp (Domestic)	1	200-5000-05
5B	Slide & Pivot Support Bracket - Left	1	535-5990-00	20H*	Fuse Holder	1	205-5001-00
Item 5A/B secured by: #10-24 X 1-1/4" Carriage Bolt Sq. Neck (3/pep) (231-5012-00) and #10-24 KEPS Nut (3/pep) (240-5207-00)				20I*	On/Off Switch Plate	1	535-5224-01
6	Prop Rod	1	535-7553-00	20J	On/Off Switch Toggle (Under Cabinet)	1	180-5001-00
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)				20K*	Power Box Decal	1	820-6123-01
7*	Mylar Carriage Bolt Cover Disc	6	820-5041-00	20L*	Fuse Label UL Decal	1	820-6148-00
8	Back Box Stop Block (outside Cabinet)	2	545-5795-00	21	Speaker - Round - 8" ø 8010HC 4Ω	1	031-5007-00
Item 8 secured by: Hinge Spacer (1/pep) (530-5099-00), Washer 1/4" I.D. X 1" O.D. (1/pep) (242-5009-00), 1/4"-20 X 1-1/4" Carriage Bolt Sq. Neck (2/pep) (231-5003-00) and 1/4"-20 Flange Nut (2/pep) (240-5300-00)				22	Speaker Grill 7" X 7"	1	545-5072-03
9	Grills 2-1/2" X 18" (on Back & Bottom)	2	545-5072-02	23	Front Molding Lockdown Assembly	1	500-5020-01
10	Cash Box Plastic Bottom	1	545-5090-00	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)			
11A	Foam Rubber 1/2" X 3/4" (behind Item 10)	1	626-5004-00	24*	Front Molding Lockdown Spring	1	265-5008-00
11B	Foam Strip (2/pep Flipper Switch Front/Back)	6	626-5042-00	25*	Front Molding - Black	1	500-5757-01-00
12	Cash Box Lock Bracket (wire)	1	535-7562-00	26*	P/F Glass (Imprd.) 21" X 43" X 3/16"	1	660-5001-00
13	Cash Box Cover (Validator)	1	535-5013-03	27	#1 Roto Lock Male	1	355-5006-01
14	Transformer with Ballast Winding	1	010-5012-00	Note: #1 Roto Lock Female (on Backbox)			
15	Rear Glass Channel 20% Length	1	545-5038-00	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)			
16	Foam Rubber 3/8" X 3/16" (in Item 15)	1	626-5001-00	28	Hex Key Allen Wrench 5/16"	1	777-0001-00
17	Cabinet Pedestal Bracket	1	535-8035-00	29	Leg Assembly	4	500-5921-50
Item 17 secured by: #8 X 3/4" PPH (Zinc) (Qty. 3) (237-5822-00)				ORDERING ABOVE ITEMS DIS-ASSY PARTS WITHIN 10			
18	Plastic Channel 42% Lg. (Lt. & Rt.)	2	545-5017-00	29A	Leg (Black)	4	535-5020-50
19	Side Armor "with holes" (Lt. & Rt.)	2	535-7297-02	29B	Leg Leveler 3/8" - 16 X 3"	4	500-5017-00
Item 18 secured by: #10-24 X 1" Carriage Bolt Sq. Neck (2/pep) (231-5021-00), #10-24 Hex Nut (2/pep) (240-5202-00) and #8 X 5/8" Tamper Proof (237-5947-00)				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/pep) (231-6001-01)			
				31*	Plastic Backpanel Shield (Black)	1	545-5838-01
				Item 31 secured by: #8 X 1/2" PPH (Black) (Qty. 4) (237-5805-00)			
				32*	Corrugated Tubing 1 1/4" 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.
- ± 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.

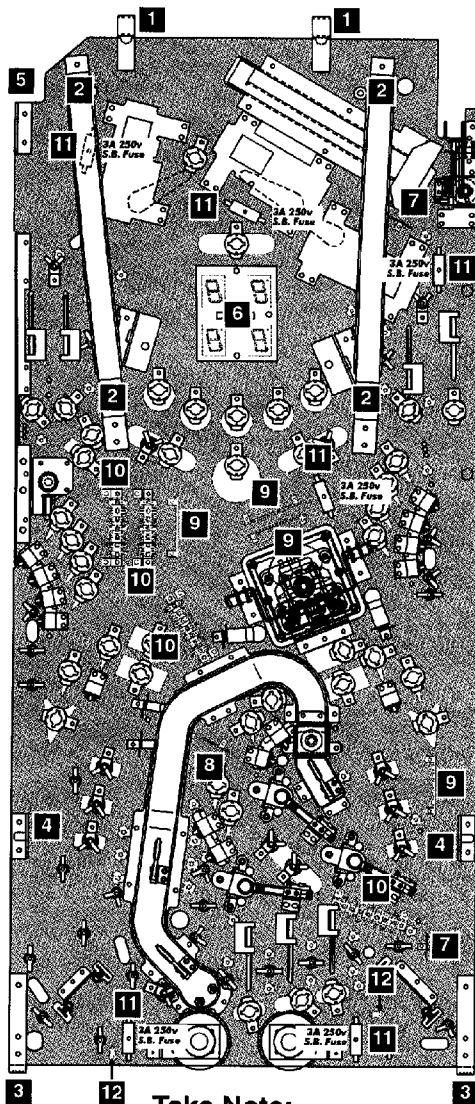
Nº	Cabinet Switch Name	QTY.	Part Nº	Nº	Playfield Switch Name	QTY.	Part Nº
A	Start Button Sw. Assy. (Yellow Flip. Style)	1	500-6090-06	1A	OPTO TRANS Board	1	520-5124-00
B*	Coin Door Switch (USA)	4	180-5024-00		OPTO REC Board	1	520-5125-00
	Coin Door Switch (¥ Japan)	n/a	180-5091-00	1B	OPTO TRANS Board	2	520-5082-00
					OPTO REC Board	2	520-5083-01
D*	Slam Tilt Switch (On Coin Door)	1	180-5022-00	2	Shooter Lane Switch Assembly	1	500-6096-00
E	Cabinet Plumb Bob Tilt Switch	1	n/a				
ORDERING PARTS WHEN ORDERING PARTS IN THIS SECTION							
E1	Tilt Hanger Bracket	1	535-5221-00	2A*	Micro Switch	1	180-5157-00
E2	Tilt Hanger Wire (Attached to bracket)	1	535-5319-00	2B*	Bracket	1	535-5173-00
E3	Tilt Contact Wire	1	535-7563-01	2C*	#2-56 X 3/8" HWH Screw	2	237-5938-01
E4	Tilt Plumb Bob (Attach'd to hanger wire)	1	535-5029-00	2D*	Diode, 1N4001	1	112-5001-00
F	Flipper Cabinet Sw. - Self-Cleaning	3	180-5160-00	3	Micro Sw. Rollover Assy. (Rt. Brkt.)	7	500-6227-02
G*	EOS Switch (on Lwr. Flippers)	2	180-5149-00	4	Micro Switch (Roller Actuator)	5	180-5119-00
H	Service Switch Set (X3 on Coin Door)	1	180-5012-03	5	Micro Switch (on: Super VUK)	1	180-5052-00
I	Service Outlet	1	180-5008-01	6	Micro Switch (on: Wire Ramp)	1	180-5093-00
J	On/Off Switch	1	180-5001-00	7	Micro Switch ("Y" Actuator) (on: VUK)	1	180-5116-01
K	Dual Switch Assembly	1	500-5808-00	8	Turbo Bumper Switch	3	180-5015-03
ORDERING PARTS WHEN ORDERING PARTS IN THIS SECTION							
K1*	Mounting Bracket	1	535-6958-00	9	Slingshot Micro Switch	4	180-5054-00
K2	Playfield Power Interlock Switch (Top)	1	180-5136-00	10	Micro Switch (Roll-Under Gate)	3	180-5087-00
K3	Memory Protect Switch (Bottom)	1	180-5000-00	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 1 1/4" 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/pcr) (234-5101-05) and #8-32 X 5/8" HWH Swage (Serr) Zinc (Qty. 1/pcr) (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/pcr) (234-5101-05) and #8-32 X 5/8" HWH Swage (Serr) Zinc (Qty. 1/pcr) (237-5975-03)			
3	Edge Slide Bracket	2	535-5988-00
Item 3 secured by: #4 X 1/2" PFH (Zinc) (Qty. 3/pcr) (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/pcr) (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 #6-32 Nylon Stop Nut (Qty. 2) (240-5102-00)			
Item 5 secured to the Cabinet by: #6 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" Sil. Rin. 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 HWHW 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" PFH AB (Qty. 1/pcr) (237-6805-00)			
12	#8 Solder Lug	2	055-5140-08
	Diode, 1N4001	2	112-5001-00
Item 12 secured by: #6 X 5/8" HWHW AB Zinc (Green) (Qty. 1/pcr) (234-5002-04).			



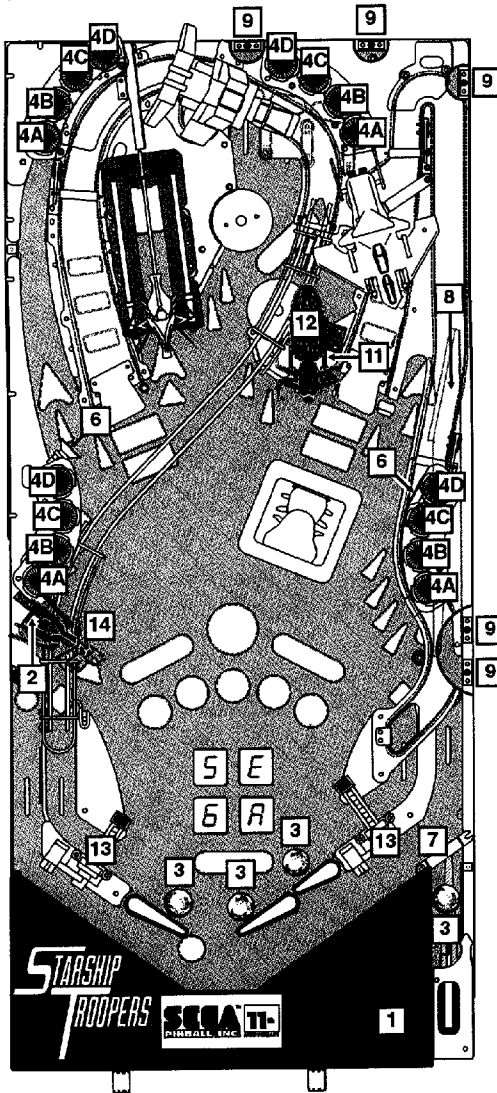
Take Note:

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

- For Sockets & Bulbs (drawings & part numbers) see Pgs. 65-67.
 - For Switches & Targets see previous page 57.
 - For OPTO Switches see the Blue Pages, Sec. 2, Chp. 2 and for PCB parts see the Yellow Pages, Sec. 5, Chp. 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).
- Legend Note:** Items noted with a black square ■ are mounted below the playfield.

Nº	Miscellaneous Part Name	QTY.	SPI Part Nº
n/a *	3 1/2" 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 *	5 1/2" Cable Tie PLT1.5I	10	040-5001-02
n/a *	5 1/2" Cable Tie PLT1.5M-XMR	159	040-5001-06
n/a *	10" Cable Tie	2	040-5001-05
n/a *	Insulating Tubing 1/8" 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 1/8" Ø (BLK) (12" Lg.)	2	605-5002-00
n/a *	Heat Shrink Tubing 1/8" Ø PUI-24 (12" Lg.)	5	605-5006-00
n/a *	Heat Shrink Tubing 1/4" Ø (CLR) (12" Lg.)	3	605-5004-00
n/a *	Heat Shrink Tubing 1/4" Ø (BLK) (12" Lg.)	2	605-5004-01
n/a *	Heat Shrink Tubing 1/4" Ø (WHT) (12" Lg.)	1	605-5010-00
n/a *	Split Flex Tubing 1 1/4" Ø (12" Long)	2	605-5008-00
n/a *	Split Flex Tubing 1 1/4" Ø (12" Long)	3	605-5008-01
n/a *	Split Flex Tubing 1 1/2" Ø (12" Long)	1	605-5008-02
n/a *	Braided Expandable Tubing 1/4" Ø (12")	6	605-5012-02

Playfield - General Parts (Above)



Take Note:

* An asterisk (*) Indicates Items are not noted in the pictorial.

- 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.
- Legend Note:** Items noted with a white square  are mounted above the playfield.

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

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
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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 Fops/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) (237-5808-00)

8	Flat Rail Shooter Lane Ramp	1	535-8145-00
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Items 8 secured by: #4 X 1/2" PPH (Black) (Qty. 2) (237-5840-00)

9	Ramp Mounting Bracket Type #1	5	515-6508-00
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Items 9 secured by: #6 X 1/2" PTH A (Zinc) (Qty. 2/par) (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
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Note: Item 10 dimensions = .187" I.D. X .875" O.D. X .048" Thick (Zinc)

11	SVUK Enter/Exit Scoop (under Item 12)	1	535-8154-00
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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	880-5008-00
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" x 5/32" Lg.	3	249-5009-00
	#555 Wedge Base Bulb	3	165-5002-00
	Rubber Lite Cover - Red	1	545-5014-02
	Rubber Lite Cover - Blue	1	545-5014-05
	Rubber Lite Cover - Fluor. Org.	1	545-5014-10
12D	Cable Wiring Harness	1	036-5428-01-58
12E	4" Cable Tie Blk.	1	040-5007-00

Item 12 supported by: 1" X 1/4" Hex Spacer #8-32 Tap (Qty. 2) (254-5008-06)

13	Pulse Cannon	2	880-5007-00
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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/par) (234-5000-00)

14	Hopper Bug Assembly	1	500-6253-00-59
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ORDERING ABOVE ITEM 14) ASSEMBLY PARTS 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

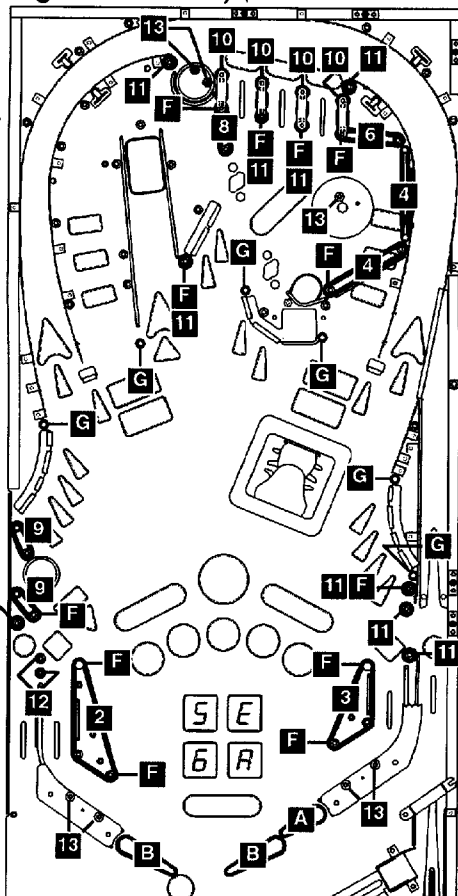
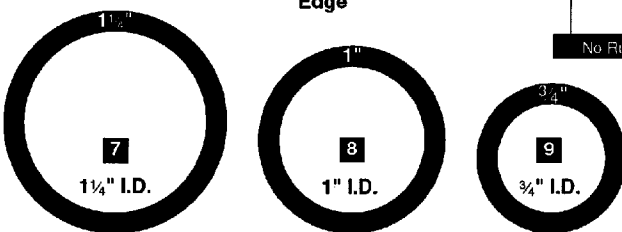
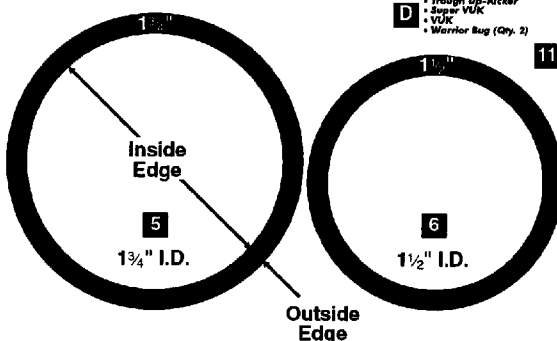
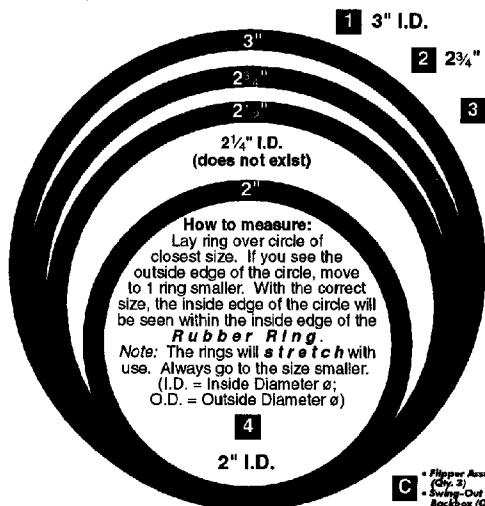
Item 14 secured by: #6 X 1/2" PTH A (Zinc) (237-5809-00);

Supported by: 1-1/8" X 1/4" Hex Spacer #8-32 Tap (Qty. 2) (254-5008-17).

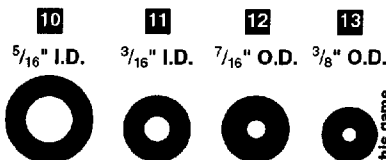
15*	Post (for Pulse Cannon)	1	535-5232-01
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Special Note: Order Item 15 if a Post was added/removed at Center Drain to "hide" hole.

Playfield - Rubber Parts (Rings Actual Size) †



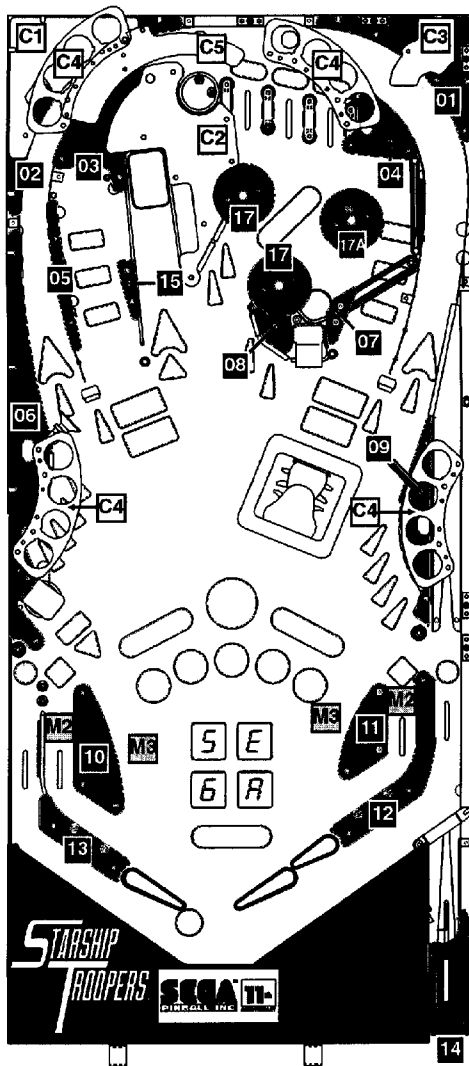
No Rubber Parts on the Playfield below this statement note.



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	5	1 1/2" I.D. Black Rubber Ring	1	545-5348-07
C*	Rubber Deflector Pad (Bumper)	5	545-5428-00	6	1 1/4" I.D. Black Rubber Ring	1	545-5348-06
D*	Rubber Bumper (Grommet)	5	545-5105-00	7	1 1/2" O.D. Black Rubber Ring	1	545-5348-05
E	Bumper	1	545-5105-00	8	1" I.D. Black Rubber Ring	1	545-5348-05
F	Post Rubber (Sleeve Short)	12	545-5151-00	9	3/4" 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
H	Black Ring	1	545-5348-09	11	3/16" I.D. Black Rubber Ring	9	545-5348-01
I	Black Ring	1	545-5348-09	12	7/16" O.D. Black Rubber Ring	2	545-5348-17
J	Black Ring	1	545-5348-09	13	3/8" 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



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 N° 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.

N°	Plastic (Butyrate) Name	QTY.	SPI Part N°
	Entire Plastic Sheet Screened (01-21)		830-5926-XX
	Entire Plastic Sheet Clear (C1-C5)		830-5927-XX
01	Screened Plastic (Top Rt. Cmr. of Playfield)	1	830-5926-01
02	Screened Plastic (Top Lt. Cmr. 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/whole)	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 16, 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 life covers & cable attached to each Screened Plastic (replace the "-XX-" with 16, 19, 20 and/or 21).

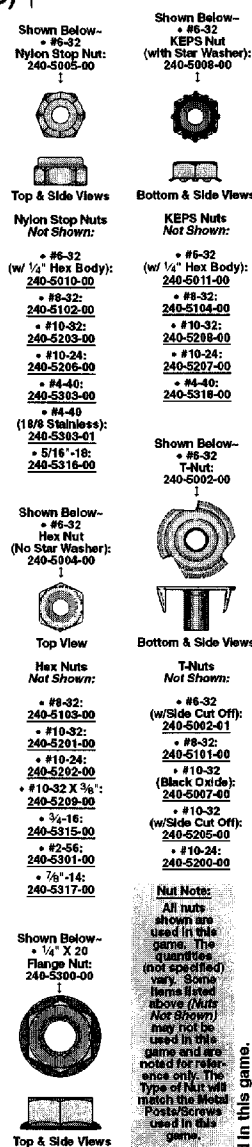
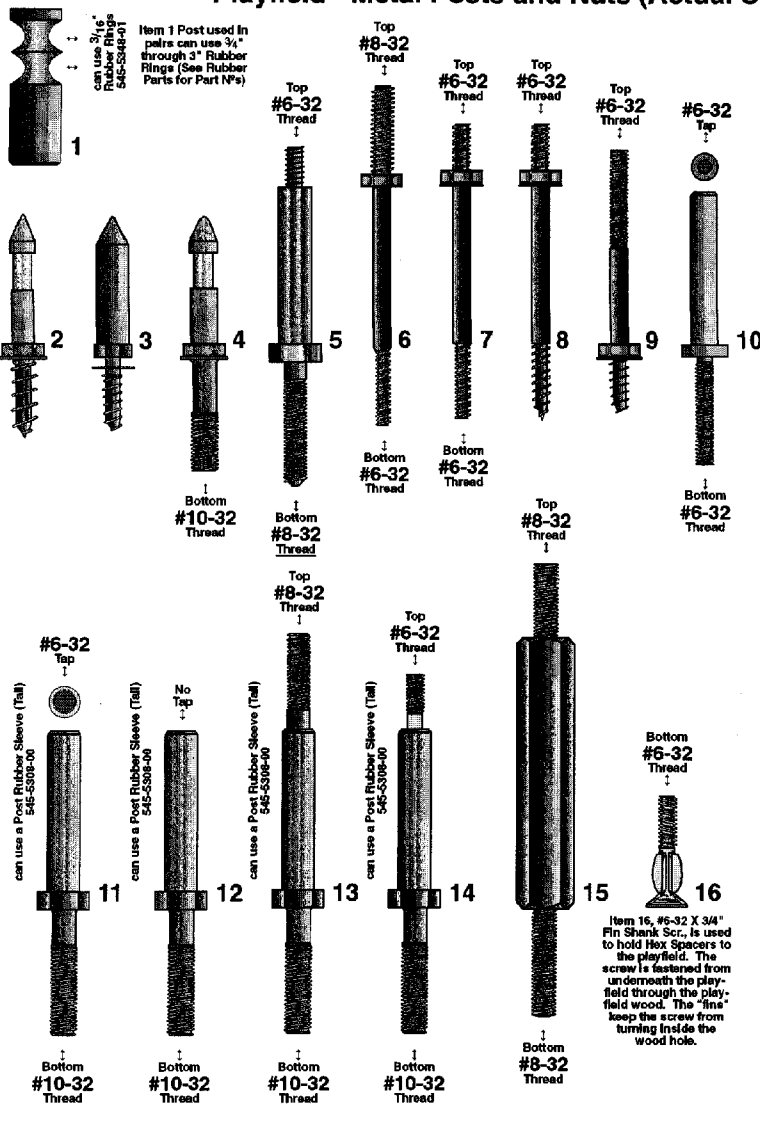
C1	Clear Plastic (mates with 02 above)	1	830-5927-01
Supported by: 1/2" X 1/4" Hex Spacer #6-32 Tap (Qty. 3) (254-5008-03) & 1/2" X 3/8" Spacer Gray (Qty. 2) (254-5000-01).			
C2	Clear Plastic (mates with 03 above)	1	830-5927-02
Supported by: 1/2" X 1/4" Hex Spacer #6-32 Tap (Qty. 5) (254-5008-03), 1" 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

N°	Mylar Name	QTY.	SPI Part N°
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

N°	Game #59 Decal Name	QTY.	SPI Part N°
	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

N°	Generic Decal Name	QTY.	SPI Part N°
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 Label (UL)*	1	820-6143-00
n/a*	*Star* (Word & Arrow) Decal	1	820-6177-00

Playfield - Metal Posts and Nuts (Actual Size) †



Nº	Metal Post Name	QTY	SPI Part Nº	Nº	Metal Post Name	QTY	SPI Part Nº
1	Mini-Post Wood Screw	0	530-5004-00	11	Post Hex Base #6-32 Tap / #10-32 Bot.	4	530-5332-01
2	Mini-Post Wood Screw	6	530-5004-00	12	Post Hex Base (No Tap) / #10-32 Bot.	2	530-5332-00
3	Mini-Post Wood Screw	4	530-5005-00	13	Post Fasten #8-32 Top / #6-32 Bot.	1	530-5008-00
4	Mini-Post Mach. Screw / #10-32 Bot.	4	530-5005-00	14	Post Fasten #8-32 Top / #6-32 Bot.	23	530-5012-02
5	Post Fasten #6-32 Top / #10-32 Bot.	18	530-5010-02	15	Post Fasten #6-32 Top / Wood Scr. Bot.	18	530-5010-02
6	Post Fasten #8-32 Top / #6-32 Bot.	1	530-5008-00	16	#6-32 X 3/4" Fin Shank Screw	5	237-5921-02
7	Post Fasten #8-32 Top / #6-32 Bot.	23	530-5012-02				
8	Post Fstn. #6-32 Top / Wood Scr. Bot.	18	530-5010-02				

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

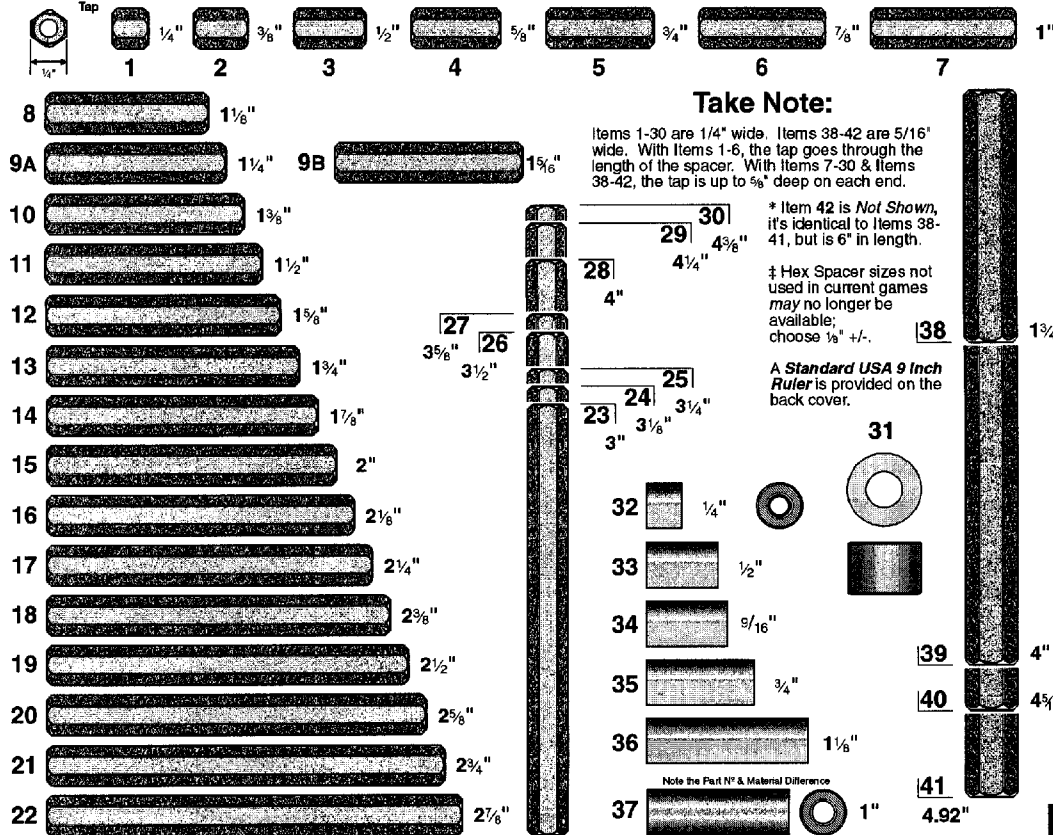
† Items with QTY are not used in this game.
 Size and/or quantities may change during production.

Playfield - Metal Spacers (Actual Size) †

Hex Spacers:

#6-32

Tap



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 5/8" 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 1/8" +/-.

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

Nº	Metal Spacer Name	Qty.	SPI Part Nº	Nº	Metal Spacer Name	Qty.	SPI Part Nº
1	1/4" X 1/4" Hex Spacer #6-32 Tap	0	254-5008-01	23	3/4" X 1/4" Hex Spacer #6-32 Tap	1	254-5008-15
2	3/8" X 1/4" Hex Spacer #6-32 Tap	1	254-5008-12	24	3/4" X 1/4" Hex Spacer #6-32 Tap	1	254-5008-16
3	1/2" X 1/4" Hex Spacer #6-32 Tap	15	254-5008-03	25	3/4" X 1/4" Hex Spacer #6-32 Tap	1	254-5008-17
4	5/8" X 1/4" Hex Spacer #6-32 Tap	0	254-5008-04	26	3/4" X 1/4" Hex Spacer #6-32 Tap	1	254-5008-18
5	3/4" X 1/4" Hex Spacer #6-32 Tap	1	254-5008-04	27	3/4" X 1/4" Hex Spacer #6-32 Tap	1	254-5008-19
6	1" X 1/4" Hex Spacer #6-32 Tap	0	254-5008-06	28	3/4" X 1/4" Hex Spacer #6-32 Tap	1	254-5008-20
7	1" X 1/4" Hex Spacer #6-32 Tap	2	254-5008-06	29	3/4" X 1/4" Hex Spacer #6-32 Tap	1	254-5008-21
8	1 1/8" X 1/4" Hex Spacer #6-32 Tap	5	254-5008-17	30	3/4" X 1/4" Hex Spacer #6-32 Tap	1	254-5008-22
9A	1 1/4" X 1/4" Hex Spacer #6-32 Tap	1	254-5008-11	31	3/4" X 1/4" Hex Spacer #6-32 Tap	1	254-5008-23
10	1 1/2" X 1/4" Hex Spacer #6-32 Tap	0	254-5008-09	32	3/4" X 1/4" Hex Spacer #6-32 Tap	1	254-5008-24
11	1 3/4" X 1/4" Hex Spacer #6-32 Tap	2	254-5008-09	33	3/4" X 1/4" Hex Spacer #6-32 Tap	1	254-5008-25
12	2" X 1/4" Hex Spacer #6-32 Tap	0	254-5008-10	34	3/4" X 1/4" Hex Spacer #6-32 Tap	1	254-5008-26
13	2 1/8" X 1/4" Hex Spacer #6-32 Tap	2	254-5008-10	35	3/4" X 1/4" Hex Spacer #6-32 Tap	1	254-5008-27
14	2 1/4" X 1/4" Hex Spacer #6-32 Tap	3	254-5008-07	36	3/4" X 1/4" Hex Spacer #6-32 Tap	1	254-5008-28
15	2 1/2" X 1/4" Hex Spacer #6-32 Tap	5	254-5008-32	37	3/4" X 1/4" Hex Spacer #6-32 Tap	1	254-5008-29
16	2 3/8" X 1/4" Hex Spacer #6-32 Tap	0	254-5008-07	38	3/4" X 1/4" Hex Spacer #6-32 Tap	1	254-5008-30
17	2 1/2" X 1/4" Hex Spacer #6-32 Tap	0	254-5008-07	39	3/4" X 1/4" Hex Spacer #6-32 Tap	1	254-5008-31
18	2 3/4" X 1/4" Hex Spacer #6-32 Tap	0	254-5008-07	40	3/4" X 1/4" Hex Spacer #6-32 Tap	1	254-5008-32
19	2 1/2" X 1/4" Hex Spacer #6-32 Tap	6	254-5008-16	41	3/4" X 1/4" Hex Spacer #6-32 Tap	1	254-5008-33
20	2 3/4" X 1/4" Hex Spacer #6-32 Tap	0	254-5008-16	42	3/4" X 1/4" Hex Spacer #6-32 Tap	1	254-5008-34

† 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) †

1** Various Colors

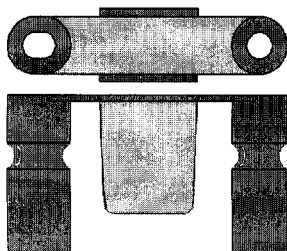
2** Various Colors

3** Limited Colors

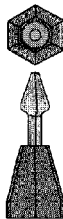
4** Various Colors

5** Various Colors

can use 5/16" Rubber Rings 545-5348-02



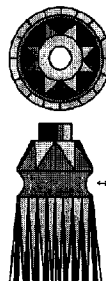
can use 3/16" Rubber Rings 545-5348-01



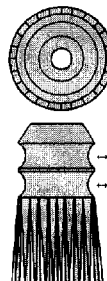
can use a Post Rubber Sleeve (Short) 545-5161-00



can use 3/16" Rubber Rings 545-5348-01



can use 5/16" Rubber Rings 545-5348-02



can use 5/16" Rubber Rings 545-5348-02

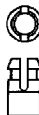
Items 3-5 Posts used in pairs can use 3/4" through 3" Rubber Rings (See Rubber Parts for Part N°s)

Take Note:

PLASTIC PART COLOR CHART					
N°	Color	N°	Color	N°	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 N°s which may come in various colors should be replaced with the desired 2-Digit N°, corresponding to the color desired. *Not all colors may be available.*

6 ‡



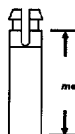
1/4"

7 ‡



3/8"

8 ‡



3/4"

9



1/2"

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

10

11

12

13

14

15

16

17

18

19

—Items 10-19 Spacers are used in conjunction with Metal Posts (see Items 6, 7 & 8 on that page) and/or a #6-32 1 3/4" 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.



3/16"



1/4"



3/8"



1/2"



5/8"



3/4"



1"



1 1/8"



1 1/4"



1 1/2"

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

N°	Plastic Post/Spacer Name	QTY.	SPI Part N°	N°	Plastic Post/Spacer Name	QTY.	SPI Part N°
1**	Top Lane Mini-Light Hood (Flu. Org.)	4	550-5061-10	10	3/16" X 3/8" Spacer Gray (4 for Dot Display)	4	254-5000-18
2**	Mini-Jewel Post (CLEAR)	7	550-5052-01				
3**	1 1/16" Single Groove Post (BLK)	43	550-5059-00				
				13	1/2" X 3/8" Spacer Gray	3	254-5000-01
6 ‡	1/4" Slf. Rtn. Spacer White	3	254-5007-02	15	3/4" X 3/8" Spacer Gray	2	254-5000-07
				16	1" X 3/8" Spacer Gray	2	254-5000-04

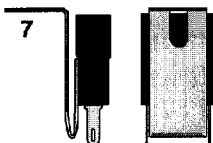
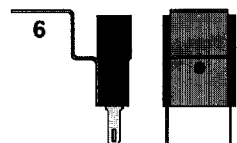
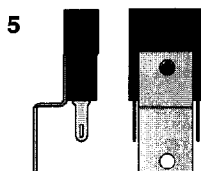
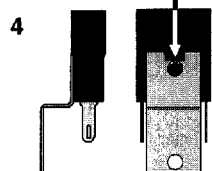
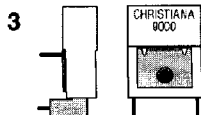
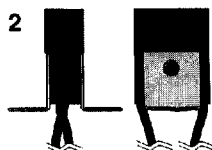
Playfield - Wedge Base Bulbs and Sockets (Actual Size) †

#555 Bulb

A



1

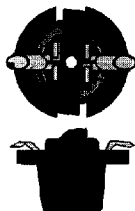


#906 Bulb

B



8



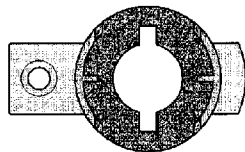
Take Note:

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

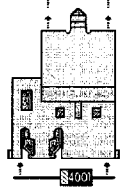
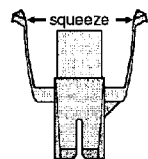
- Item 1 Socket was used on PC Light Boards to position bulbs vertically.
- Item 2 Socket has 2 Wires attached are approximately 12" ea.
- Item 3 Socket was used on PC Light Boards to position bulbs horizontally.
- Item 4 Socket is normally used with Reflectors.
- If Item 7 Socket is desired, order Item 6 for replacement.
>>>Item 7 Socket is no longer available.<<<
- 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.
- Item 8 Socket is sometimes used in conjunction with Mini-Mars or special Plastic (Butyrate) assemblies.
- See the start of this chapter for Fluor. Bulb & Associated Parts.
See the end of this chapter for Misc. Bulbs, Boards & Parts.

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.)

9a



9



This Socket is equipped with a built-in Diode, 1N4003 (112-5013-00). Replacement can be made with Diode, 1N4001 (112-5003-00).

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
	Base (WB) Socket		
2	Turbo Pop Bumper Socket	3	077-5206-00
3	PC Light Board (with WB Socket)	1	077-5206-01
4	Laydown WB Socket (with notch)	6	077-5026-01
	PC Light Board (without notch)		
6	WB Offset Socket (Step-Bracket)	23	077-5029-00

Nº	#906 Bulb & Socket Name	QTY.	SPI Part Nº
B	#906 Wedge Base Bulb	19	165-5004-00
8	Socket	1	077-5206-01

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
	Socket Mounting Board		112-5003-00

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

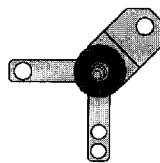
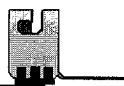
Playfield - Small Bayonet Type Bulbs and Sockets (Actual Size) †

#44 Bulb

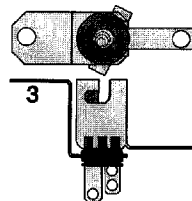
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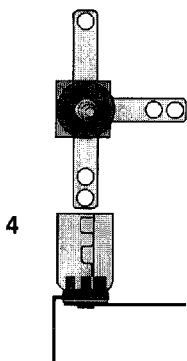
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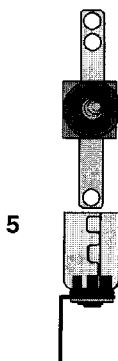
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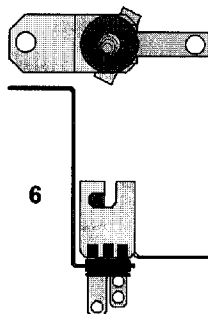
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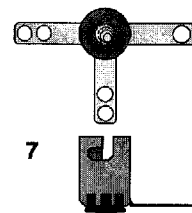
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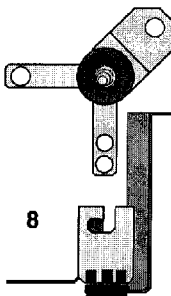
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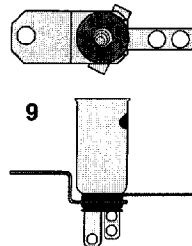
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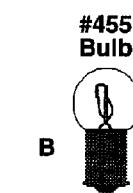
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8

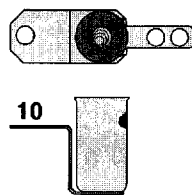


9



B

#455 Bulb



10

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	3-Lug Laydown Socket	0	077-5003-00
6	3-Lug Stand-Up Long Socket	0	077-5005-00
7	2-Lug Stand-Up Long Socket	0	077-5001-00
8	3-Lug Stand-Up Long Socket	0	077-5004-00
9	3-Lug Stand-Up Long Socket	0	077-5012-00

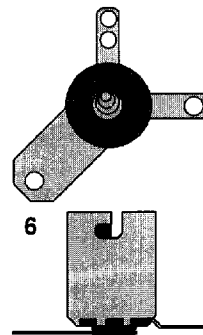
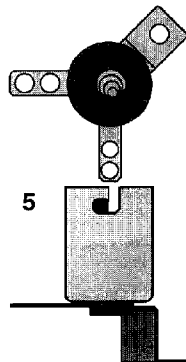
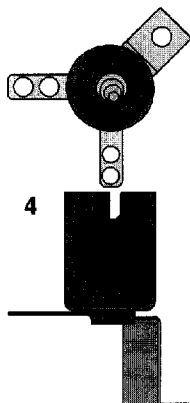
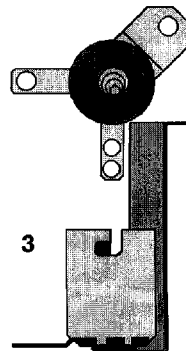
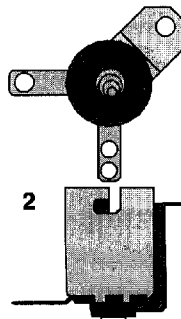
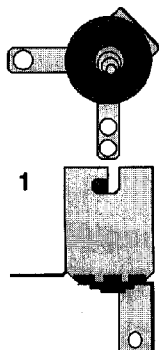
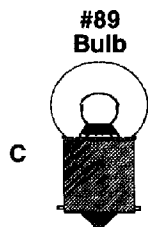
Nº	#455 Bulb & Socket Name	QTY.	SPI Part Nº
B	#455 Bayonet Bulb	0	165-5003-00
10	3-Lug Stand-Up Long Socket	0	077-5012-00

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.

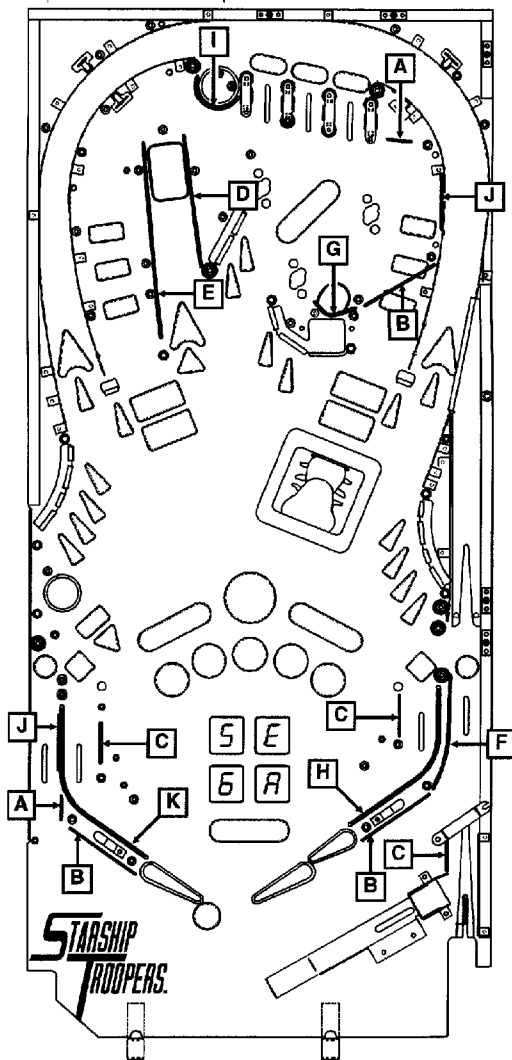
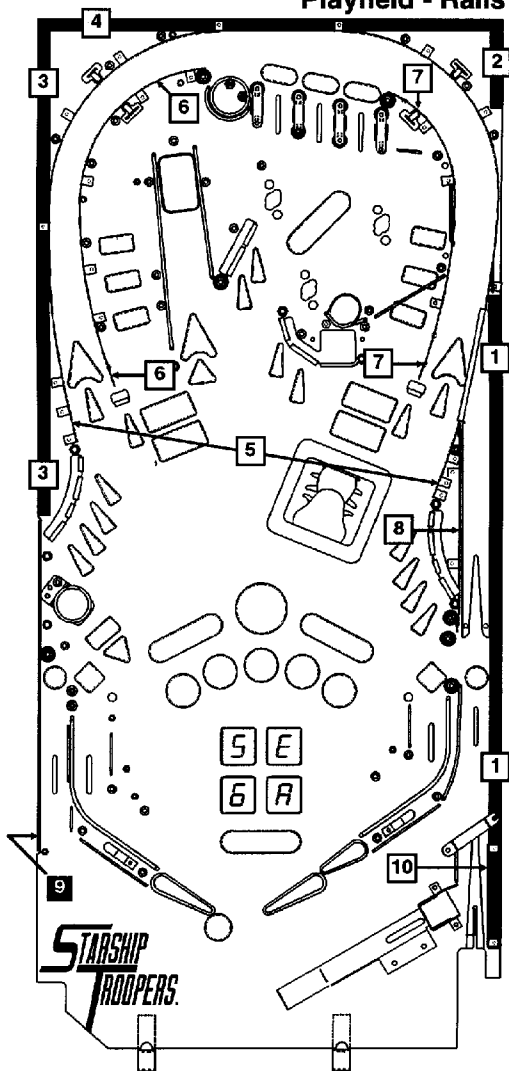
Playfield - Large Bayonet Type Bulb and Sockets (Actual Size) †



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

Nº	#89 Bulb & Socket Name	QTY.	SPI Part Nº
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

Playfield - Rails and Ball Guides †



Nº	Rail Name	QTY	SPI Part Nº	Nº	Ball Guide Name	QTY	SPI Part Nº
1	Wood Rail 28-5/8"	1	525-5007-51	A	Metal Ball Guide Wire Form 1"	2	535-5300-05
2	Wood Rail 3-3/8"	1	525-5007-49	B	Metal Ball Guide Wire Form 3-1/2"	3	535-5300-03
3	Wood Rail 21-3/16"	1	525-5007-50	C	Metal Ball Guide Wire Form 1-3/4"	3	535-5300-09
4	Wood Rail 20-1/4"	1	525-5007-05	D	Ball Guide Rail (5-3/4")	1	535-5356-00
Items 1-4 secured by: #6 X 1-1/4" PPH A (Zinc) (Qty. 14) (237-5804-00)							
5	Flat Metal Rail (Main Loop Right)	1	515-6758-00	E	Ball Guide Rail (#17, 8-1/2")	1	535-5356-17
6	Flat Metal Rail (Inner Loop Left)	1	515-6759-00	F	Ball Guide Rail (#1)	1	535-8146-00
7	Flat Metal Rail (Inner Loop Right)	1	515-6760-00	G	Ball Guide Rail (#2)	1	535-8148-00
8	Flat Metal Rail (Shooter Ramp Left)	1	515-6761-00	H	Ball Guide Rail (#4)	1	535-8149-00
9	Flat Metal Rail (by Left Outlane)	1	535-8156-00	I	Ball Guide Rail (Top P/F Exit Hole)	1	535-8147-00
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	J	B. G. Rail (Lt. Outlane & Rt. Orbit)	2	535-7595-00
Item 10 secured by: #5 X 1-1/2" PPH (Zinc) (Qty. 2) (232-5007-00)							
				K	Ball Guide Rail (Left Outlane)	1	535-7560-00

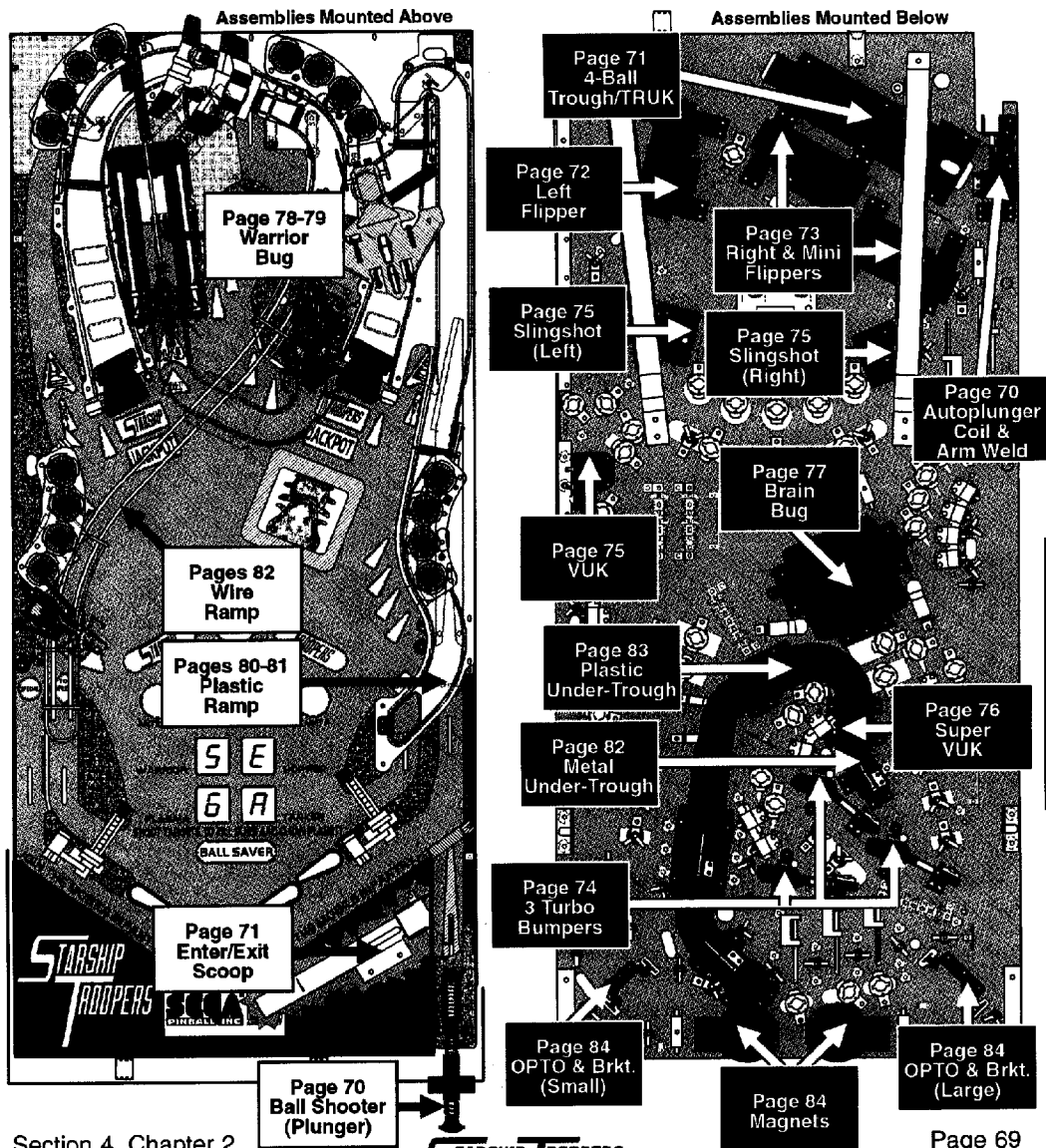
Legend Note: Items noted with a white square □ are mounted above the playfield; items noted with a black square ■ are mounted below the playfield.

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

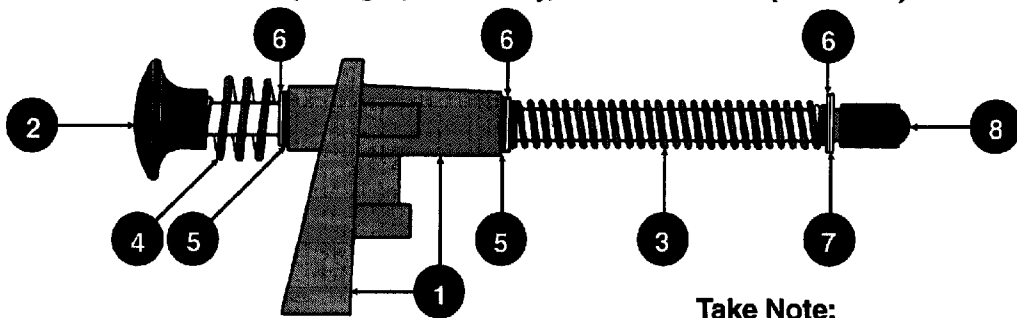
Drawings for Major Assemblies & Ramps (The Blue Pages)

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 N°. 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 N° and/or description as noted. Replacement parts may be substituted with revised parts which may have a different Part N°. View any special notes on each page of this chapter. For General Part N°s 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	Nº	Individual Part Name	Qty.	SPI Part Nº
1	Housing (Shooter Assembly)	1	535-5067-02	8	Plunger Tip (Black 50 Duro)	1	545-5276-00
2	Rod Assembly (w/ Black Knob)	1	515-6557-00	ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY.			
3	Comp. Spring (Green, .035" ø)	1	266-5001-04	Nº	Associated Part Name	Qty.	SPI Part Nº
4	Compression Spring (Short Plunger)	1	266-5010-00	n/a *	Support Plate	1	535-5027-00
5	Bushing, 3/8" I.D. (Oilite)	2	280-5010-00	n/a *	#10-32 X 3/8 SHWH (Serr) Swage	3	237-5985-00
6	Washer, 3/8" I.D. X 5/8" O.D. X 1/16"	3	242-5014-00	n/a *	#6 X 5/8" HWW AB (Zinc) Green	2	234-5002-04
7	Retaining Ring, 3/8" ø Shaft	1	270-5012-00				

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.

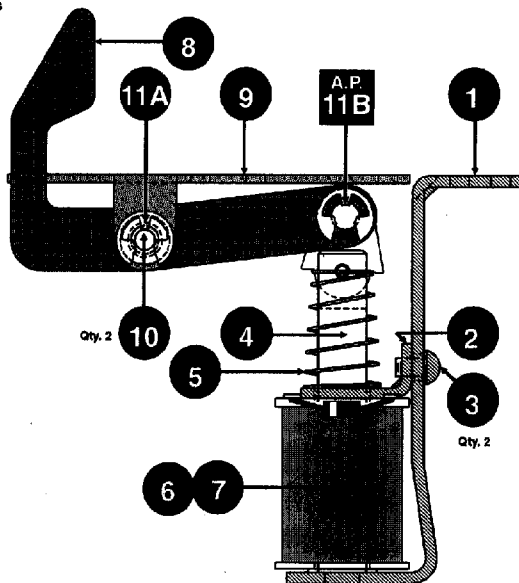
- Associated Part, Item 11B, fastens both of these two (2) assemblies together (500-6092-01, Items 1-7 to 500-6091-00, Items 8-11).

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
4A	Plunger 2"	1	530-5025-01
4B	Plunger Link	1	545-5283-00
4C	Roller Pin, 1/8" ø X 5/8" Lg.	1	261-5008-00
5	Compression Return Spring	1	266-5020-00
6	Coil, 24-940	1	090-5036-00T
ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY.			
n/a *	Plods, IN4004 (positioned at top)	1	112-5003-00
7	Coil Sleeve	1	545-5031-00

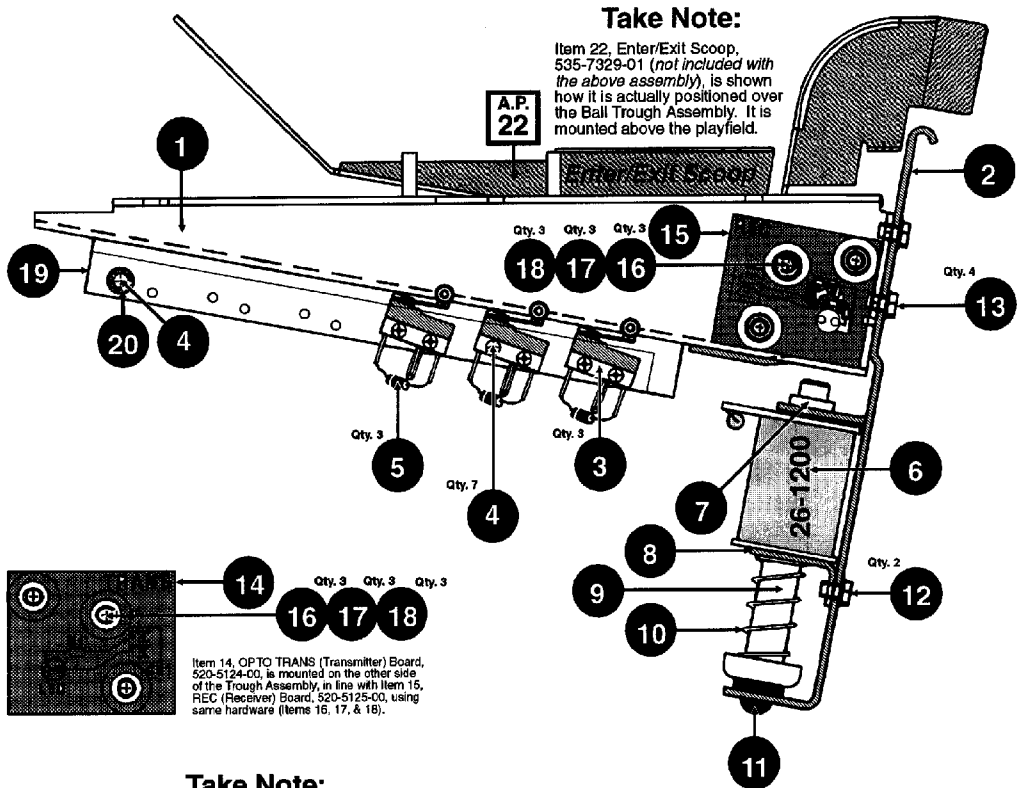
Autoplunger Arm Weld Assy, 500-6091-00 (Items 8-11)			
8	Arm Weld Assembly	1	515-6526-00
9	Autoplunger Fulcrum	1	535-7697-00
10	Nyliner, 1/4" (Thomson #411-FF)	2	545-5423-00
11A	Retaining Ring, 1/4" ø Shaft	1	270-5002-00

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 HWW 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.

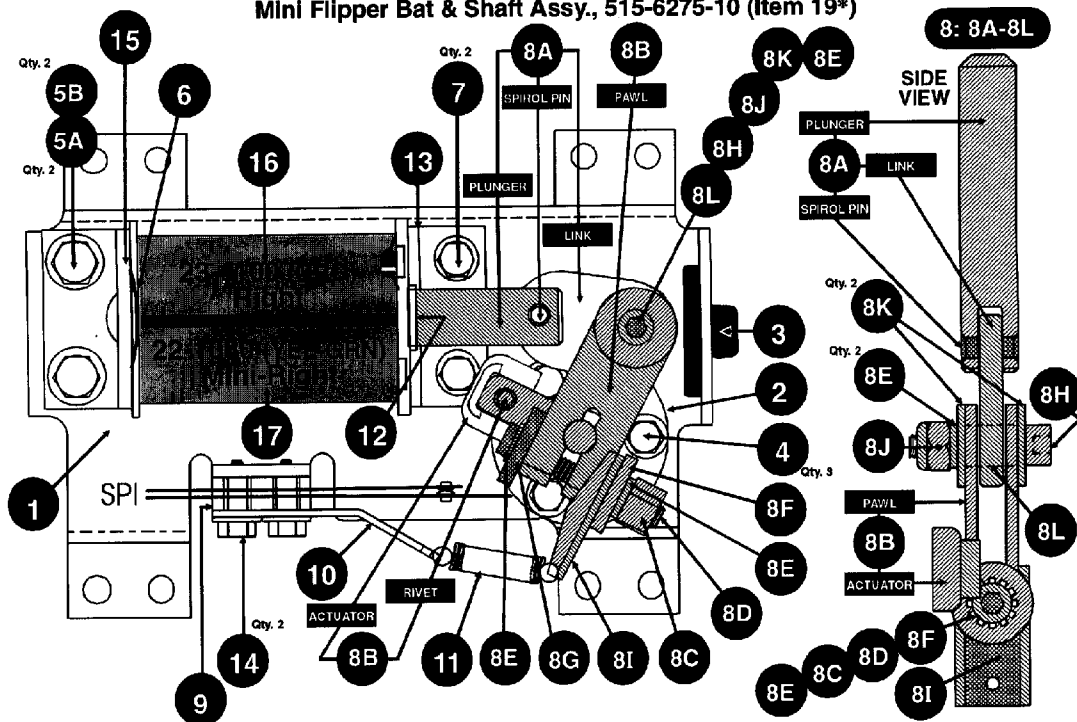
Nº	Individual Part Name	QTY	SPI Part Nº	Nº	Individual Part Name	QTY	SPI Part Nº
1	Ball Trough Outhole Mounting Bracket	1	515-6580-00	14	OPTO Transmitter (TRANS) Board	1	520-5124-00
2	Coil Mounting Bracket	1	535-7330-01	15	OPTO Receiver (REC) Board	1	520-5125-00
3	Submini-Switch Roller Actuator	3	180-5119-00	16	OPTO PCB Tube Spacer	6	530-5308-02
4	#2-56 X 1/2" HWH (Ser) TF 3/16" Hd.	7	237-5937-01	17	OPTO PCB Rubber Grommet	6	545-5518-00
5	Switch Diode, 1N4001	3	112-5001-00	18	#6-32 X 5/8" HWH Swage (Ser) Zinc	6	237-5976-04
6	Coil, 26-1200	1	090-5044-00T	19	Trough Ball Guide Plate	1	535-7801-00
Diode, 1N4004 (positioned at top)				20	1/4" X 5/16" X .144" I.D. Spacer Tap.	1	254-5014-03
7	Coil Sleeve	1	545-5076-00	21*	Cable Wiring Harness	1	036-5399-04
8	Coil Retaining Bracket	1	535-5203-03	ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY.			
9	Plunger Assembly	1	515-5941-01	Nº	Associated Part Name	QTY	SPI Part Nº
10	Compression Spring	1	266-5020-00	22	Ball Trough Enter / Exit Scoop	1	535-7329-01
11	Rubber Bumper (Grommet)	1	545-5105-00	n/a *	#8 X 1/2" HWH AB (Zinc) Blue	9	234-5101-05
12	#8-32 X 1/4" HWH (Ser) Zinc TF	2	237-5964-00	Note: Above item secures this 4-Ball Trough & Scoop to the playfield.			
13	#8-32 X 3/8" HWH Swage (Ser) Zinc	4	237-5975-00	n/a *	1-1/16" Steel Balls	4	260-5000-00

Section 4 | Drawings



Take Note:

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	Nº	Individual Part Name	QTY	SPI Part Nº
1	Flipper Base Plate Kit (Right)	1	515-6617-00	9	Power (End of Stroke) Switch	1	180-5149-00
ORDERING INFORMATION: Flipper Base Plate (Right) already threaded with all necessary Thread Forming Screws (Items 4, 5A, 7 & 15)				10	Switch Plate/Spring Return Rt. Brkt.	1	535-7354-00
2	Flipper Bushing	1	545-5594-00	11	Flipper Return Spring	1	265-5035-00
3	Deflector Pad (Bumper)	1	545-5428-00	12	Coil Sleeve	1	545-5388-00
4	#6-32 X 3/8" HWH Swage (Serr) Zinc	3	237-5976-02	13	Coil Support Bracket	1	535-7356-00
5A	#10-32 X 3/8" SHWH Swage (Sr) Zn.	2	237-5985-00	14	#6-32 X 5/8" HWH Swage (Serr) Zinc	2	237-5976-04
5B	#10 Split Lock Washer	2	244-5003-00	15	Coil Stop Sub-Assembly	1	515-6308-01
6	Spring Washer	1	269-5002-00	ORDERING INFORMATION: FLIPPER (RIGHT) COIL STOP SUB-ASSEMBLY PART NAME			
7	#8-32 X 3/8" HWH Swage (Serr) Zinc	2	237-5975-00	—	Coil Stop with With .093" ø Hole	1	530-6360-01
8	Plunger, Link & Pawl (Rt.) Sub-Assy.	1	515-6518-00	—	Shading Ring	1	580-5123-00
ORDERING INFORMATION: FLIPPER (RIGHT) COIL STOP SUB-ASSEMBLY PART NAME				—	Coil Stop Bracket	1	535-7355-00
8A	Flipper Plunger/Link Sub-Assy.	1	515-6304-01	16	Coil, 23-1100 (ORG) for Right	1	090-5030-00T
includes:	Flipper Link	1	545-5811-00	ORDERING INFORMATION: FLIPPER (RIGHT) COIL STOP SUB-ASSEMBLY PART NAME			
includes:	Spirol Pin ø 5/32" X 7/16" Lg	1	251-5015-01	—	Diode, 1N4004 (positioned at top)	1	112-5003-00
includes:	Flipper Plunger with 'Flat'	1	530-5349-01	17	Coil, 22-1080 (YEL-GRN) for Mini-Rt.	1	090-5032-00T
8B	Pawl (Mini-Link) (Rt.) Sub-Assy.	1	515-6305-00	ORDERING INFORMATION: FLIPPER (RIGHT) COIL STOP SUB-ASSEMBLY PART NAME			
includes:	Pawl (Mounting Link) (Rt.) Pair	1	535-7271-00	—	Diode, 1N4004 (positioned at top)	1	112-5003-00
includes:	Switch Actuator	1	545-5812-00	ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY			
includes:	Rivet, 1/8" ø X 1/4" Lg.	1	249-6003-00	Nº	Associated Part Name	QTY	SPI Part Nº
8C	#10-32 X 9/32" Long 3/8" Hex Nut	1	240-5209-00	18*	Flipper Bat & Shaft (Knurled-End)	1	515-6532-08-05
8D	#10-32 SOC HD X 1 1/8" Lg.	1	237-8950-01	Assy. White with Saga Saturn™ Logo ©1987			
8E	#10 Star Washer	3	246-5002-00	19*	Mini Flip. Bat & Shaft Assy. Fluor. Org.	1	515-6275-10
8F	Wahr., 2031D X .63" OD X .105" THK	1	242-5039-00	n/a *	Large Flipper Rubber Ring	1	545-5277-00
8G	Washer (same as 8F but w/angle cut)	1	242-6039-01	n/a *	Mini Flipper Rubber Ring	1	545-5207-00
8H	#10-32 X 7/8" Lg. SOC HD	1	237-8966-00	n/a *	#10 X 1/2" HWH MS (Serr) Zinc ST	16	237-5949-00
8I	Return Bracket	1	535-7353-00	Note: Above item secures both Flipper Assemblies to the playfield.			
8J	#10-32 Nylon Stop Nut	1	240-6203-00				
8K	Wahr., 2031D X .63" OD X .062" THK	2	242-6038-00				
8L	Flipper Bushing (Extended)	1	530-5139-01				

Take Note:

* An asterisk (*) indicates item is *Not Shown* in pictorial.
 1. **IMPORTANT:** Read "Take Note:" Items 1 & 2 on previous page.

Qty. 2 **A.P. 26**



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).



Qty. 2

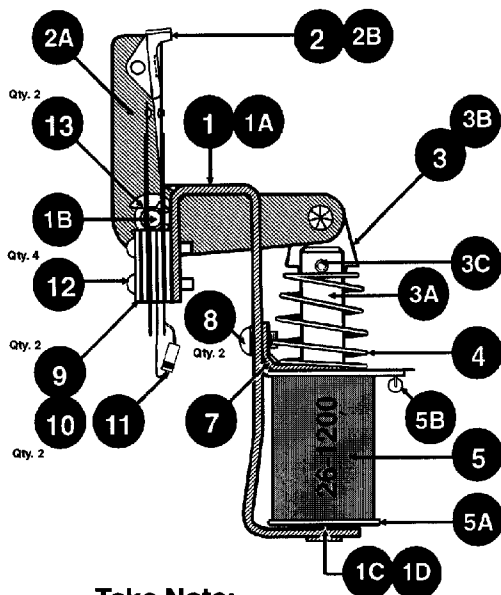


Turbo Bumper Switch Assy., 515-6459-03 (Items 20-25)		
20	Switch Bracket	1 535-7342-00
21	Spoon Switch Actuator	1 545-5610-01
22	Slack Switch	1 180-5015-03
23	Switch Diode, 1N4001	1 112-5001-00
24	Switch Body Protection Plate	1 535-7344-00
25	#6-32 X 3/4" HWH Swage (Serr) Zinc	2 237-5976-05

Nº	Assoc. Part Name	QTY.	SPI Part Nº
26	#4 X 1/2" PFH (Zinc) (2/per)	6	237-5840-00
27	Cap (Buty -17C) (Lt / Bot.)	2	830-5926-17
27A	Cap (Buty -17A, has hole for Post.) (Rt.)	1	830-5926-17A
28	Rubber Lite Cover RZC (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.

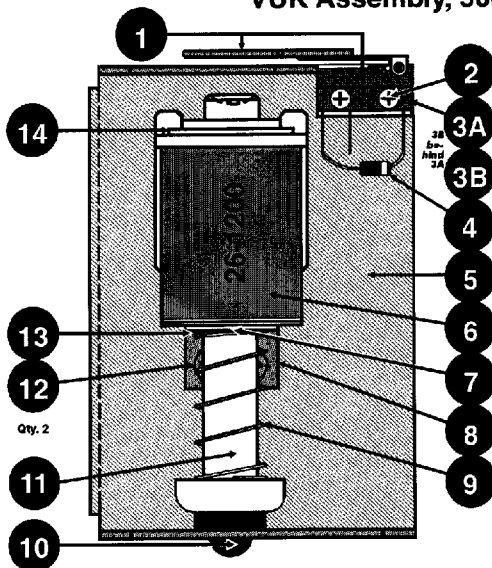
Nº	Individual Part Name	Qty.	SPI Part Nº
1	Slingshot Bracket Assembly	1	515-5339-01
ORDERING ABOVE ITEM 1 SUB-ASSEMBLY WILL INCLUDE:			
1A	Slingshot Bracket	1	535-5919-01
1B	Hinge Stud	1	530-5094-01
1C	Armature Stop	1	530-5017-01
1D	Shading Ring	1	530-5307-00
2	Arm & Tip Assembly	1	515-5340-01
ORDERING ABOVE ITEM 2 SUB-ASSEMBLY WILL INCLUDE:			
2A	Arm	1	515-5341-01
2B	Kicker Tip	1	545-5216-01
2C	Pin 1/8" Ø x 1/4" Lg.	1	249-5003-00
3	Plunger & Link Assembly	1	515-5338-00
ORDERING ABOVE ITEM 3 SUB-ASSEMBLY 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)



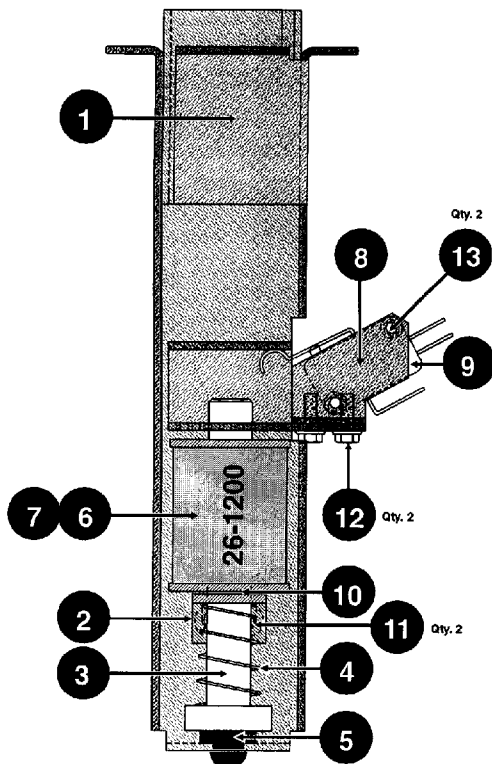
Nº	Individual Part Name	Qty.	SPI Part Nº
1	Micro Switch (Heavy Duty "Y" Acuator)	1	180-5116-01
2	#2-56 X 1/2" HWH MS (Ser) 3/16" Hd.	2	237-5937-01
3A	Switch Body Protect Plate	1	535-6539-00
3B	Switch Insulation (Fiche Paper)	1	545-5759-00
4	Switch Diode, 1N4001	1	112-5001-00
5	VUK Bracket	1	535-6607-00
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

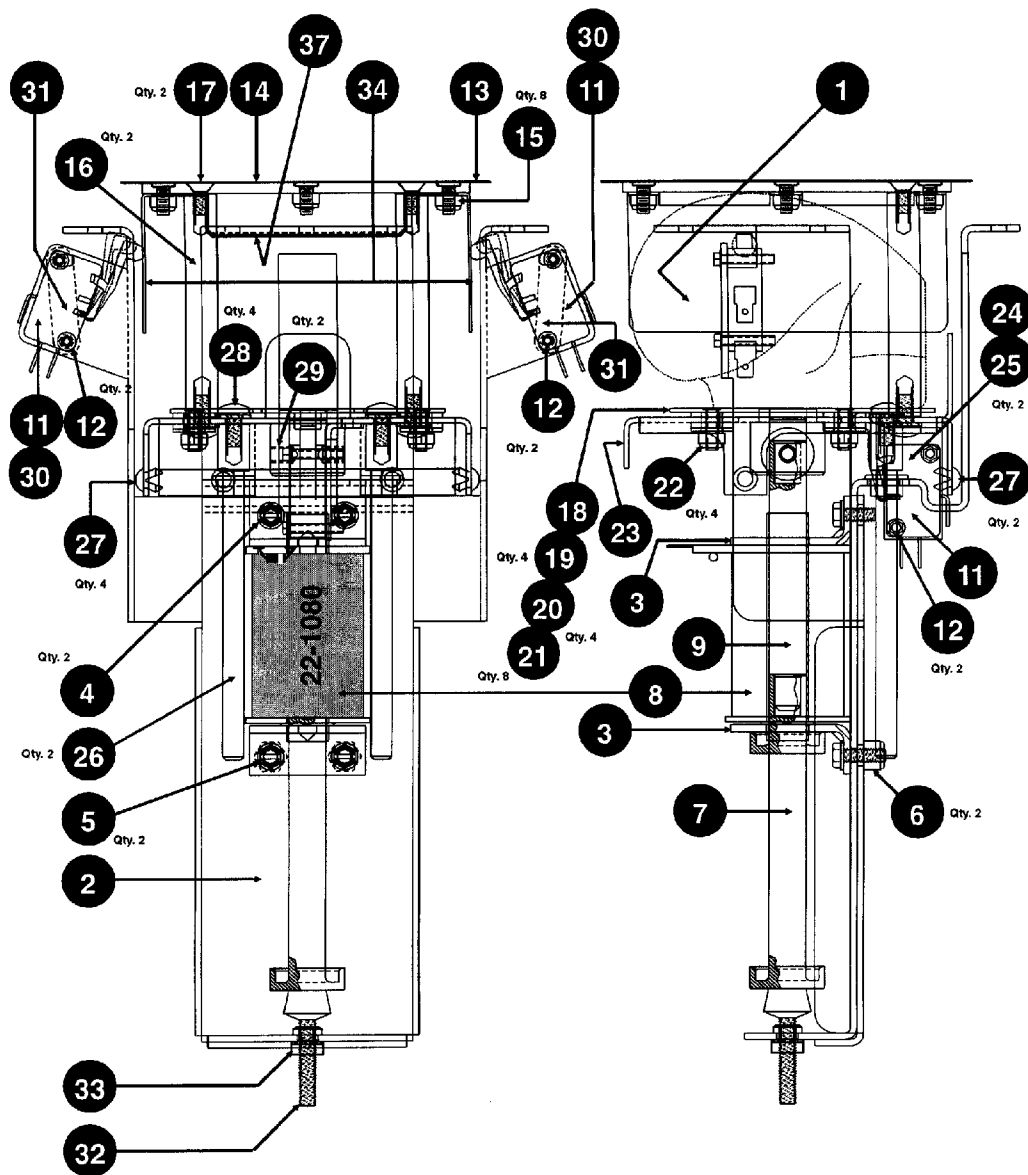
ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY.

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

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

Nº	Individual Part Name	QTY.	SPI Part Nº	Nº	Individual Part Name	QTY.	SPI Part Nº
1	Brain Bug	1	880-5004-00	21	Wshr. 1/4" ID X 1/2" OD X .062 Teflon	8	242-5040-01
2	Mounting Bracket Weldment Assy.	1	515-6790-00	22	#6-32 Nylon Stop Nut	4	240-5005-00
3	Coil Support Bracket	2	535-7356-00	23	Base Plate Assembly	1	515-6793-00
4	#8-32 X 3/8" HWH MS Type	2	237-5903-00	24	Switch Mounting Bracket	1	535-8197-00
5	#8-32 X 1/2" HWH Swage (Serr) Zinc	2	237-5975-01	25	Rivet, 1/8" ø X 3/16" Lg.	2	249-5001-00
6	#8-32 Nylon Stop Nut	2	240-5102-00	26	Guide Pin	2	530-5496-00
7	Plunger Assembly	1	515-6792-00	27	Plasti-Plug (TW FASATX#207-12055-00)	6	545-5846-00
8	Coil, 22-1080 (YEL-GRN)	1	090-5032-00T	28	#10-32 X 3/8" PPH MS (Sems) Zinc	4	232-5401-00
ORDERING ABOVE ITEM 8 COIL PART Nº WILL INCLUDE:				29	#10-32 X 3/8" Soc. Hd. Cap Scrw. Zn.	2	237-5845-00
—	Diode, 1N4004 (positioned at top)	1	112-5003-00	30	Switch Diode, 1N4001	2	112-5001-00
9	Coil Sleeve (with extension)	1	545-5847-00	31	#4-40 Nut Plate	1	535-8212-00
10	Rubber Bumper (Grommet)	1	545-5105-00	32	Adj. Spindle Stop	1	280-5014-00
11	Limit Switch (Cherry #E33-90N)	3	180-5165-00	33	#10-32 Keps Nut	1	240-5208-00
12	#4-40 X 5/8" HWH MS (Serr) Zinc ST	6	237-5945-00	34	Deflector	2	535-8262-00
13	Window Flap Assembly	1	515-6789-00	35*	PEM Nut Plate (Inside Item 1)	1	515-6811-00
14	Window	1	545-5845-00	36*	#6-32 X 1/2" PPH MS (Zinc) (for Item 1)	4	237-5502-00
15	#6-32 Nylon Stop Nut (1/4" Hex Body)	8	240-5010-00	37	Wire Form (Ball Trap Prevention)	1	535-8245-00
16	Support Pin	2	530-5497-00	38*	Cable Wiring Harness	1	036-5429-17-59
17	#8-32 X 3/8" PFH MS (Zinc)	2	237-5902-00	ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY.			
18	Slide Plate Assembly	1	515-6791-00	Nº	Associated Part Name	QTY.	SPI Part Nº
19	Nylon Spacer (Richo #R905-3)	4	254-5023-00	n/a *	#8 X 1/2" HWH AB (Zinc) Blue	7	234-5101-05
20	Wshr. .265" X 1/2" X .047" Stainless	4	242-5060-00	<i>Note: Above item secures this Brain Bug Assy. to the playfield.</i>			

Brain Bug Assembly, 500-6256-00-59 (Items 1-38) *Continued*
(Part Number Tables on previous page)

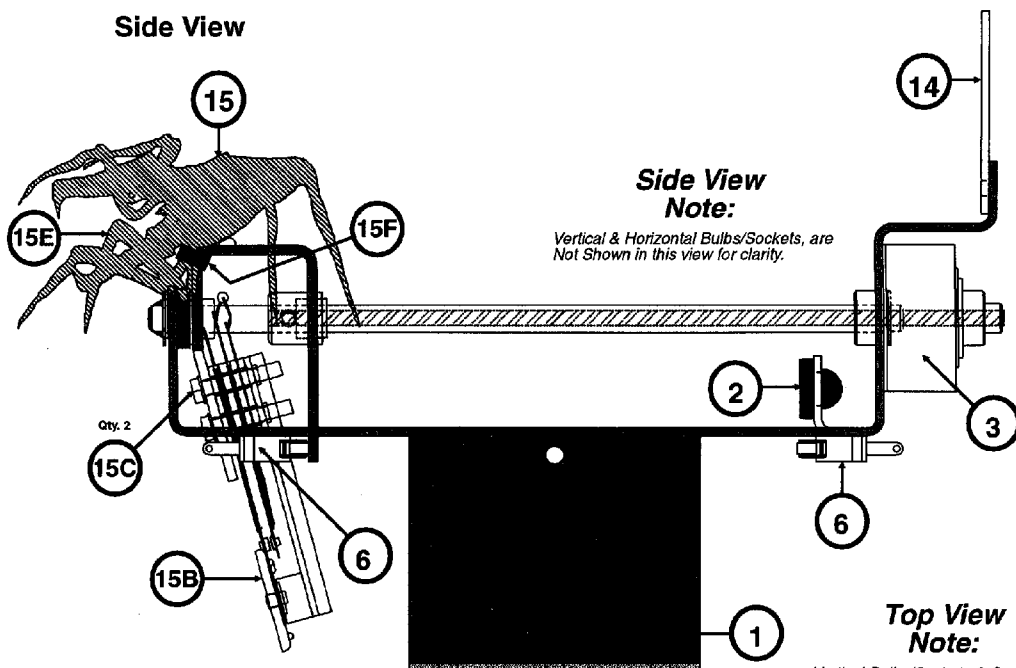


Take Note:

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

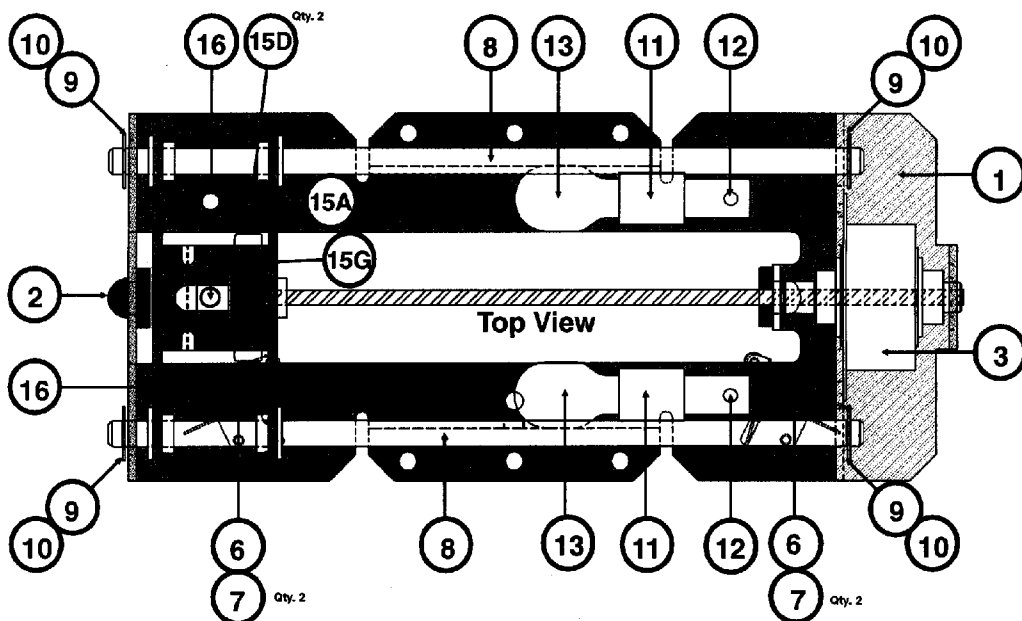
Warrior Bug Assembly, 500-6239-00-59 (Items 1-17) (Part Number Tables on next page)

Side View

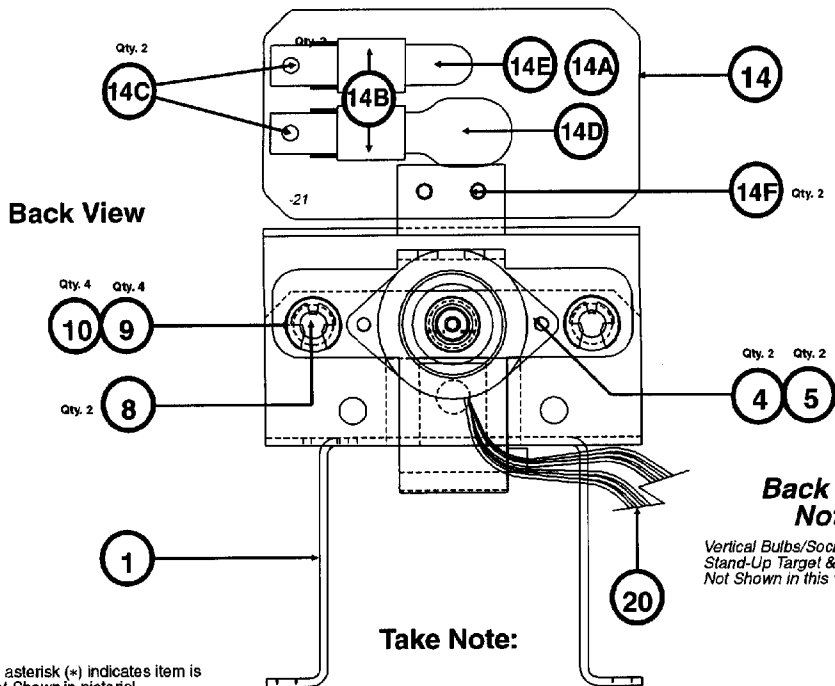


Top View Note:

Vertical Bulbs/Sockets & Screen Plastic, and Target Switch, are Not Shown in this view for clarity.



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

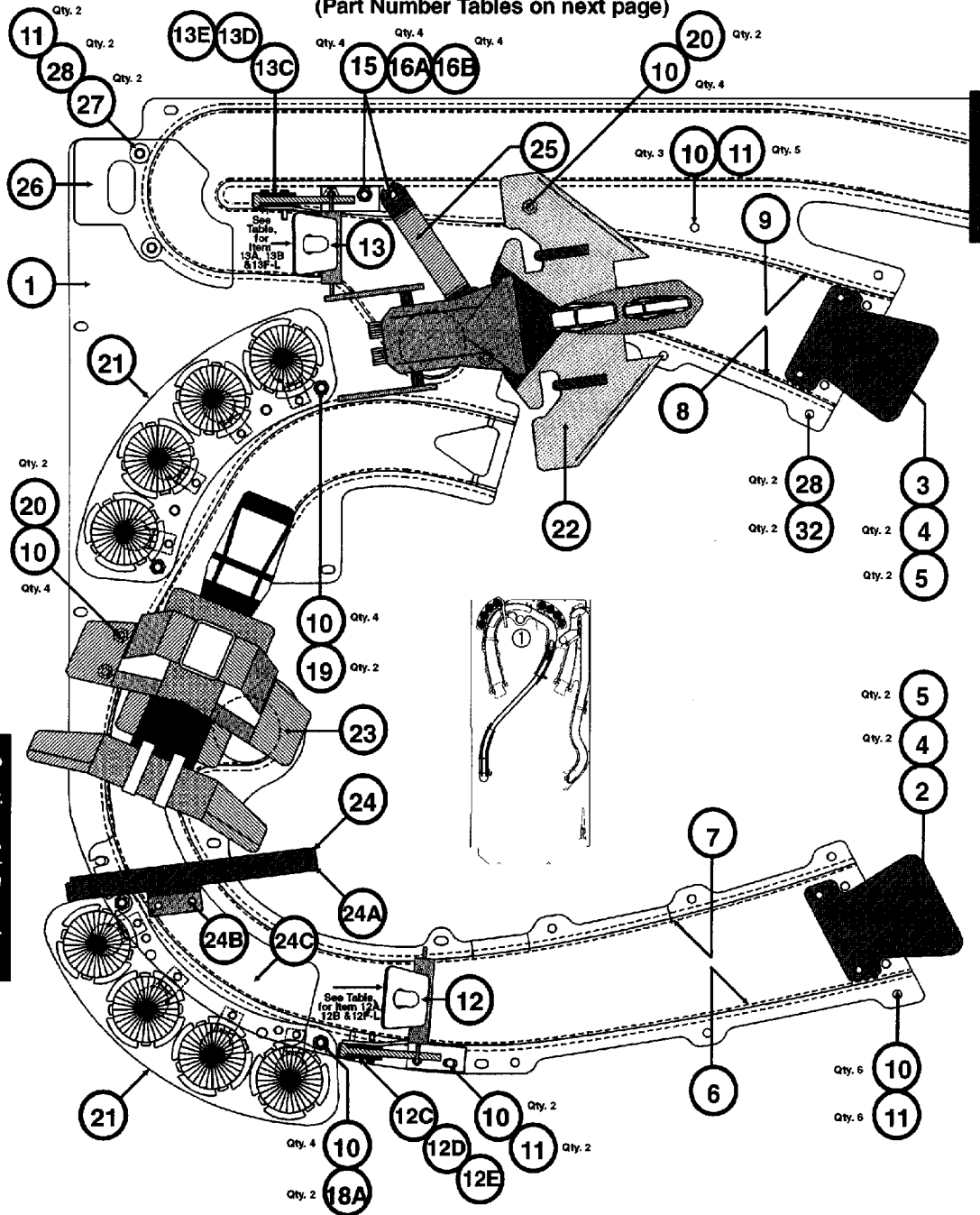


* An asterisk (*) indicates item is Not Shown in pictorial.

- For Item 3, HSI Stepper Motor, see Appendix -F- (bottom of Page 127) for the detailed Motor Specifications.
- 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.
- 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.
- 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.

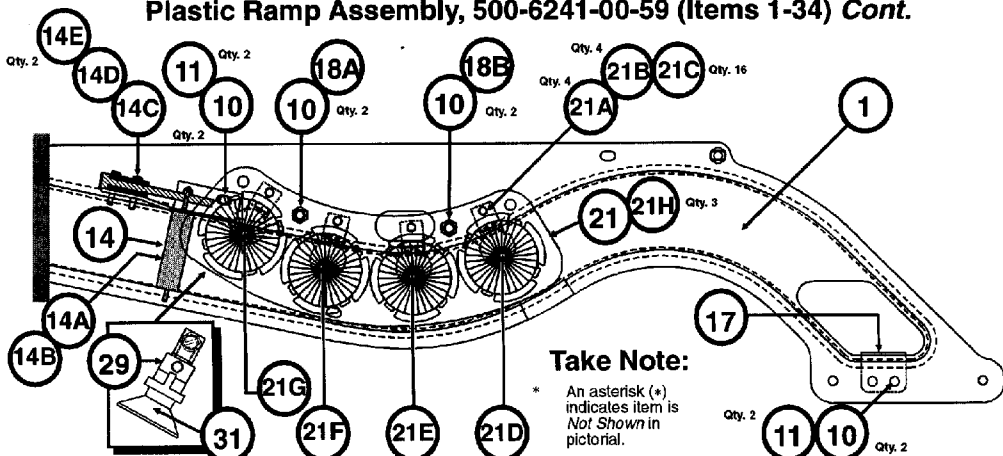
Nº	Individual Part Name	QTY	SPI Part Nº	Nº	Individual Part Name	QTY	SPI Part Nº
1	Warrior Bug Assembly Base	1	535-8152-00	15	Warrior Bug Sub-Assembly	1	515-6775-00-59
2	Rubber Bumper (Grommet)	2	545-5105-00	15A	Carnage Assembly (with Bearings)	1	515-6766-00
3	HSI Stepper Motor Sub-Assembly	1	515-6794-00-59	15B	Warrior Bug Target Sub-Assembly	1	515-6776-08-59
3A	HSI Stepper Motor	1	041-5062-00	NOTE: Item 15B consists of 15B-1, 15B-2 and 15B-3:			
3B	Stepper Motor Shaft, 7"	1	530-5503-00	15B-1	Sw. & Target 1" X 1-1/2" Rect. Whl	1	515-6027-08
3C	7-Pin Connector (CE10F22-07FR.DH)	1	045-5157-07	Item 15B-1 consists of (a)-(d):			
3D	Polarizing Key (PK156D)	1	080-5000-00	(a)	Stack Switch (Radius End)	(1)	180-5133-00
4	#4-40 X 1/2" PPH MS (Sems) Zinc	2	237-5813-00	(b)	Target 1" X 1-1/2" White Plain	(1)	545-5145-08
5	#4-40 Nylon Stop Nut	2	240-5303-00	(c)	Rivet, 1/8" ø X 3/16" Lg.	(1)	249-5001-00
6	Micro Switch (Roller Actuator)	2	180-5119-00	(d)	Washer #6-10 X 5/16" ø X 1/32"	(1)	242-5017-00
7	#2-56 X 3/8" HWH MS (Ser) 3/16" Hd.	4	237-5938-01	15B-2	Switch Back Plate	1	535-6452-00
8	Support Pin, 7.18" Lg.	2	530-5449-02	15B-3	Foam Pad	1	626-5029-00
9	Washer 1/4" ID X 7/16" OD X 1/32"	4	242-5012-00	15C	#6-32 X 3/4" HWH Swage (Serr) Zinc	2	237-5976-06
10	Retaining Ring, 1/4" ø Shaft	4	270-5002-00	15D	#8-32 X 3/8" Soc. Hd. Cap Scr. (Zn)	2	237-5987-00
11	Laydown WB Socket (with notch)	2	077-5026-01	15E	Warrior Bug Toy	1	880-5003-00
12	Rivet, 1/8" ø X 5/32" Lg.	2	249-5009-00	15F	4" Cable Tie (Black)	1	040-5007-00
13	#906 Wedge Base (WB) Bulb	2	165-5004-00	15G	Rubber (Grommet) (used on OPTO PCBs)	1	545-5518-00
14	Screened Plastic (Butylate) -21 Assy.	1	515-6777-21-59	15H*	Cable Wiring Harness	1	036-5429-16-59
14A	Screened Plastic (Butylate) -21	1	830-5926-21	16	Clear Bumper	2	280-5012-00
14B	WB Offset (with Stop-Bracket) Socket	2	077-5029-00	Cable Wiring Harness			
14C	Rivet, 1/8" ø X 5/32" Lg.	2	249-5009-00	17*	Corrugated Tubing 1/2" ø (Black), (12")	2	605-5013-00
14D	#906 Wedge Base (WB) Bulb	1	165-5004-00	Above item covers the Cable Wiring Harness (1.25) on the Warrior Bug Assembly.			
14E	#555 Wedge Base (WB) Bulb	1	165-5002-00	ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY.			
14F	#6-32 X 3/8" HWH Swage (Serr) Zinc	2	237-5976-02	Nº	Associated Part Name	QTY	SPI Part Nº
				17A*	#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)



Section 4 | Drawings

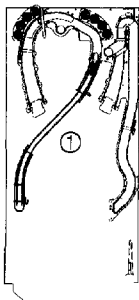
Plastic Ramp Assembly, 500-6241-00-59 (Items 1-34) Cont.



Take Note:

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

Nº	Individual Part Name	QTY	SPI Part Nº	Nº	Individual Part Name	QTY	SPI Part Nº
1	Plastic Ramp (Plain)	1	545-5839-00	15	1/2" X 1/4" Hex Spacer #6-32 Tap.	4	254-5008-03
2	Ramp Flap (Left Entrance)	1	535-8159-00	16A	#6-32 X 1/4" PPH MS (Sems) Zinc	4	232-5200-00
3	Ramp Flap (Right Entrance)	1	535-8160-00	16B	#6-32 X 3/8" PPH MS (Sems) Zinc	4	232-5201-00
4	Rivet, 1/8" x 3/16" Lg.	4	249-5001-00	17	Ramp Protector (Right Exit Hole)	1	535-8167-00
5	Washer 9/64" ID X 5/16" OD X 1/3"	4	242-5017-00	18A	1-1/8" X 1/4" Hex Spacer #6-32 Tap.	3	254-5008-17
6	Ramp Protector (Lt. Entr., Lt. Side)	1	535-8161-01	18B	1" X 1/4" Hex Spacer #6-32 Tap.	1	254-5008-06
7	Ramp Protector (Lt. Entr., Rt. Side)	1	535-8162-01	19	1-1/2" X 1/4" Hex Spacer #6-32 Tap.	2	254-5008-09
8	Ramp Protector (Rt. Entr., Lt. Side)	1	535-8163-01	20	2-1/2" X 1/4" Hex Spacer #6-32 Tap.	4	254-5008-16
9	Ramp Protector (Rt. Entr., Rt. Side)	1	535-8164-02	21	4X Light & Clear Plastic Assembly	3	515-6778-01-59
10	#6-32 X 3/8" PPH MS (Sems) Zinc	35	232-5201-00	ORDERING ABOVE ITEM 21 SUB-ASSY PART NO WILL INCLUDE			
11	#6-32 Nylon Stop Nut	19	240-5005-00	21A	WB Offset (w/Step-Bracket) Socket	4	077-5029-00
12	Gate & Sign Assembly (Enter Left)	1	515-6774-02-59	21B	#906 Wedge Base Bulb	4	165-5004-00
ORDERING ABOVE ITEM 12 SUB-ASSY PART NO WILL INCLUDE				21C	Rivet, 1/8" x 3/16" Lg. and #6 Lock Washer (Riveting)	16	249-5001-00
12A	Gate Bracket	1	535-6303-02	21D	Mini-Mars Light Cover Snap-In Blue	1	560-5030-05
12B	Wire Form	1	535-6304-03	21E	Mini-Mars Light Cover Snap-In Yellow	1	560-5030-06
12C	Micro Switch (Wire Gate)	1	180-5087-00	21F	Mini-Mars Light Cover Snap-In Green	1	560-5030-04
12D	Switch Diode, 1N4001	1	112-5001-00	21G	Mini-Mars Light Cover Snap-In Red	1	560-5030-02
12E	#2-56 X 3/8" HWH MS (Ser) 3/16" Hd. Sign Sub-Assembly (incl. 12F-12K)	2	237-5938-01	21H	Clear Plastic (Dome Mounting Base)	1	830-5927-04
12F	Screened Plastic (Buty) -18 Sign Lt.	1	830-5926-19	21I	FL Lamp F1-F4 Cable Wiring Harness	1	036-5429-09-59
12G	WB Offset (w/Step-Bracket) Socket	1	077-5029-00	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).			
12H	#555 Wedge Base Bulb	1	165-5002-00	22	TAC Fighter Toy	1	880-5001-00
12I	Rivet, 1/8" x 3/16" Lg.	1	249-5001-00	23	Retrieval Ship Toy	1	880-5002-00
12J	#6 Lock Washer	1	246-5000-00	24	Motor Shaft Guard Assembly	1	515-6778-05-59
12K	Rubber Lite Cover Fluor. Orange	1	545-5014-10	ORDERING ABOVE ITEM 24 SUB-ASSY PART NO WILL INCLUDE			
12L	#6 X 3/8" HWH AB (Zinc)	2	234-5000-00	24A	Motor Shaft Guard	1	535-8216-00
12M*	Enter Left Cable Wiring Harness	1	036-5429-02-59	24B	Rivet, 1/8" x 3/16" Lg.	2	249-5001-00
13	Gate & Sign Assembly (Enter Right)	1	515-6774-03-59	24C	Clear Plastic (Butyrate) -05	1	830-5927-05
ORDERING ABOVE ITEM 13 SUB-ASSY PART NO WILL INCLUDE				24D*	#6 X 1/2" PTH A (Zinc)	2	237-5908-00
13A	Gate Bracket	1	535-6303-03	25	1-Way Gate Mounting Bracket	1	535-5269-06
13B	Wire Form	1	535-6304-03	Wire Gate (for above)			
13C	Micro Switch (Wire Gate)	1	180-5087-00	26	Clear Plastic (Butyrate) -03	1	830-5927-03
13D	Switch Diode, 1N4001	1	112-5001-00	27	1/2" X 3/8" Spacer Gray	2	254-5000-01
13E	#2-56 X 3/8" HWH MS (Ser) 3/16" Hd. Sign Sub-Assembly (incl. 13F-13K)	2	237-5938-01	28	#6-32 X 1" PPH MS (Sems) Zinc	4	232-5206-00
13F	Screened Plastic (Buty) -18 Sign Rt.	1	830-5926-18	29	Laydown WB Socket (with notch)	1	077-5026-01
13G	WB Offset (w/Step-Bracket) Socket	1	077-5029-00	30*	#555 Wedge Base Bulb (in Item 31)	1	165-5002-00
13H	#555 Wedge Base Bulb	1	165-5002-00	31	Light Reflector	1	545-5409-01
13I	Rivet, 1/8" x 3/16" Lg.	1	249-5001-00	32	3/8" X 3/8" Spacer Gray	2	254-5000-12
13J	#6 Lock Washer	1	246-5000-00	33*	Clear Plastic Rt. Rmp. Enter Cover	1	830-5927-06
13K	Rubber Lite Cover Fluor. Orange	1	545-5014-10	34*	Ramp Rt. Exit Cable Wiring Harness	1	036-5429-07-59
13L	#6 X 3/8" HWH AB (Zinc)	2	234-5000-00	ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY			
13M*	Enter Right Cable Wiring Harness	1	036-5429-03-59	Nº	Associated Part Name	QTY	SPI Part Nº
14	Gate Assembly (Wire Form Exit)	1	515-6490-01	n/a *	#4 X 5/8" PFH (Black)	4	237-5833-00
ORDERING ABOVE ITEM 14 SUB-ASSY PART NO WILL INCLUDE				Note: Above item secures the Ramp Flaps to the playfield.			
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				



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

Take Note:

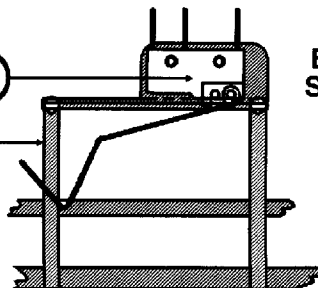
* An asterisk (*) indicates item is *Not Shown* in pictorial.

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

Qty. 2



Enlarged Side View



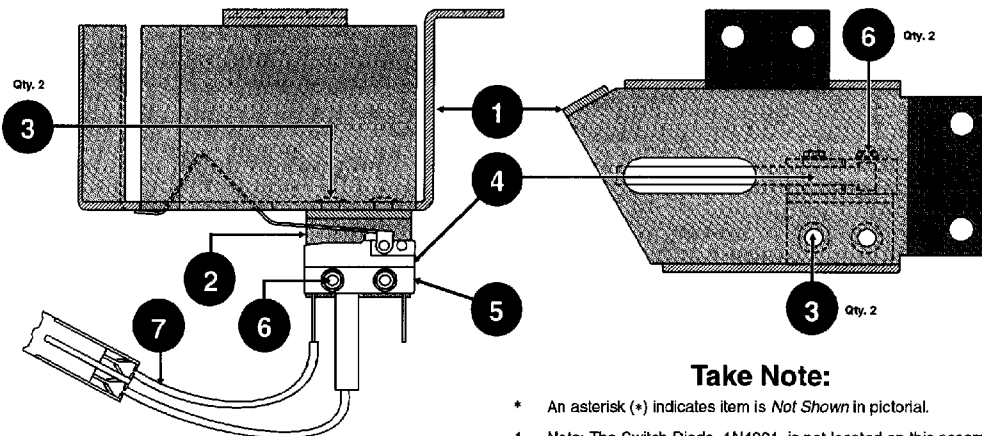
A.P.
A

ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY.

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

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)



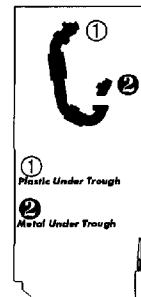
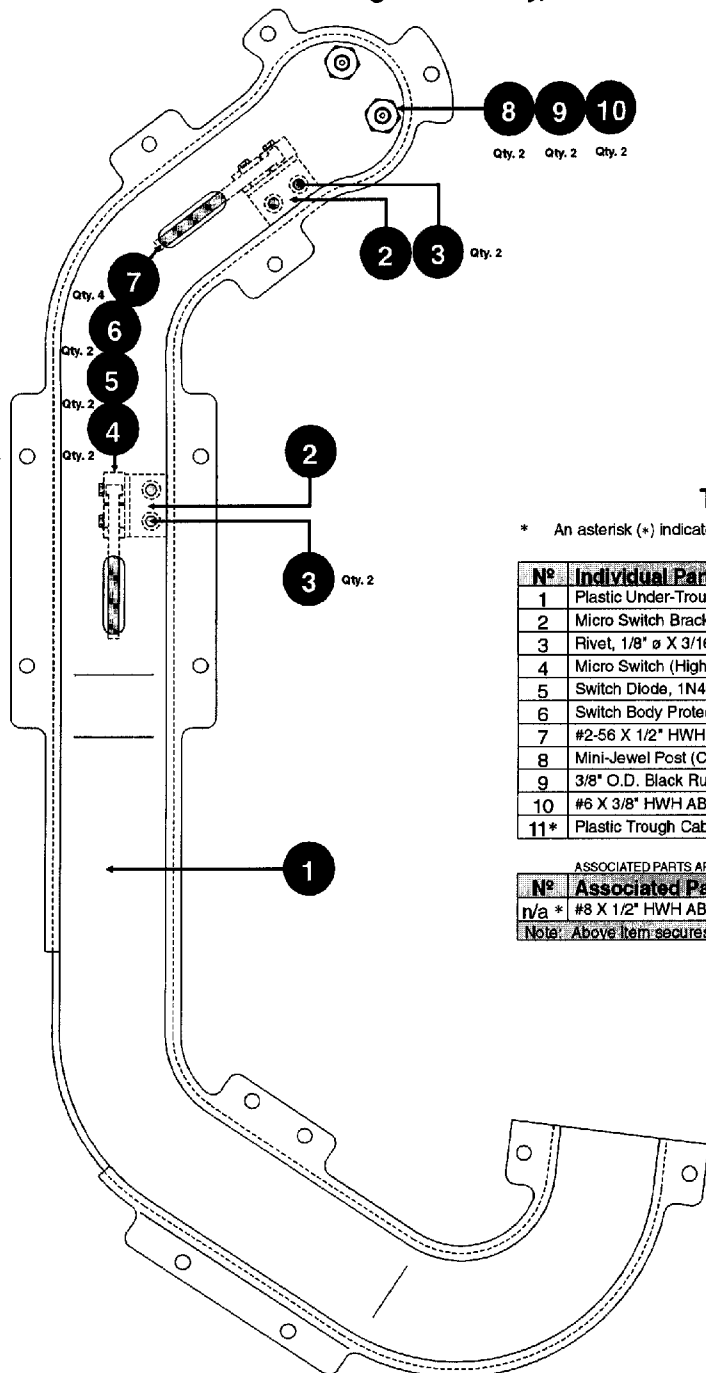
Take Note:

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

- 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	Nº	Individual Part Name	QTY.	SPI Part Nº
1	Metal Under-Trough (Small VUK)	1	535-8157-00	7	Metal Trough Cable Wiring Harness	1	036-5429-04-59
2	Micro Switch Bracket	1	535-7319-05	ASSOCIATED PARTS ARE NOT INCLUDED WITH THE ABOVE ASSEMBLY.			
3	Rivet, 1/8" ø X 5/32" Lg.	2	249-5009-00	Nº	Associated Part Name	QTY.	SPI Part Nº
4	Micro Switch (High Form)	1	180-5057-00	n/a *	#8 X 1/2" HWH AB (Zinc) Blue	4	234-5101-05
5	Switch Body Protect Plate	1	535-6539-00	Note: Above item secures this Metal Under-Trough to the playfield.			
6	#2-56 X 1/2" HWH MS (Ser) 3/16" Hd.	2	237-5937-01				

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:

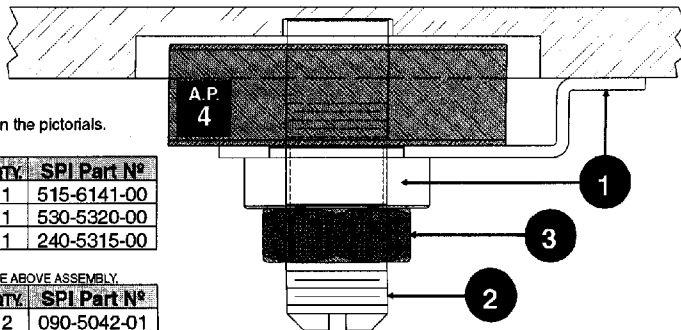
* An asterisk (*) indicates item is *Not Shown* in the pictorials.

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:

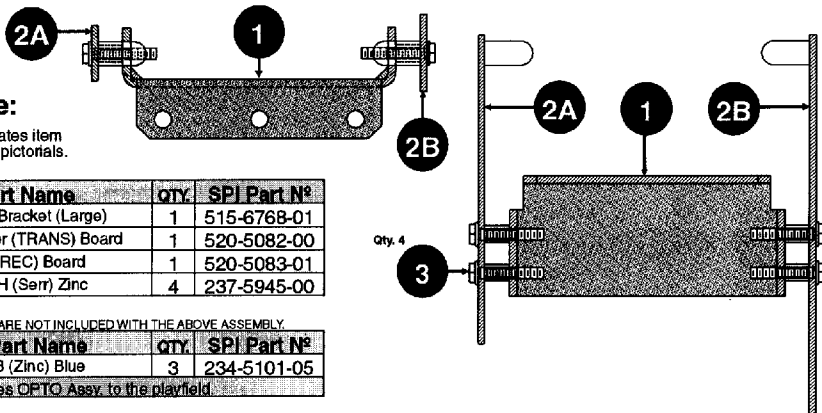
* An asterisk (*) indicates item is *Not Shown* in the pictorials.

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:

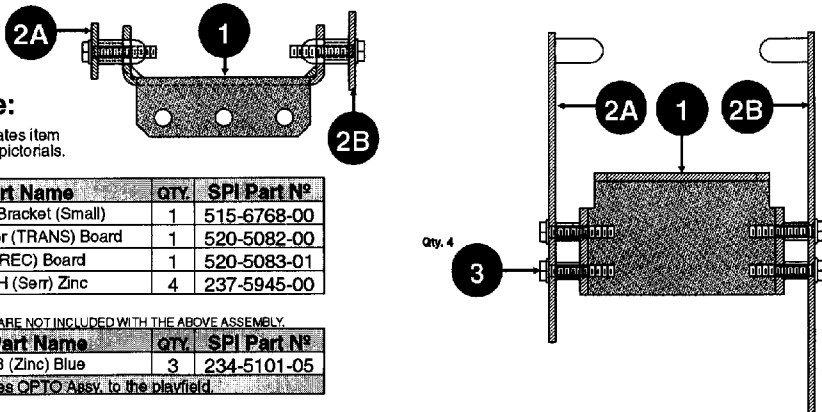
* An asterisk (*) indicates item is *Not Shown* in the pictorials.

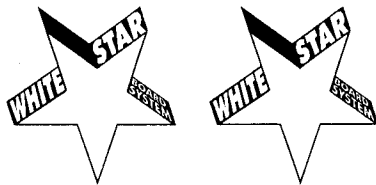
Nº	Individual Part Name	QTY.	SPI Part Nº
1	OPTO Mounting Bracket (Small)	1	515-6768-00
2A	OPTO Transmitter (TRANS) Board	1	520-5082-00
2B	OPTO Receiver (REC) Board	1	520-5083-01
3	#4-40 X 5/8" HWH (Serr) Zinc	4	237-5945-00

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.





Section 5 Schematics & Troubleshooting

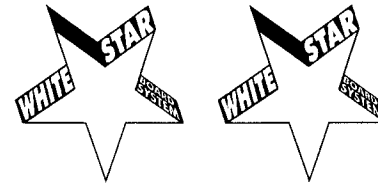


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Use the below **Coils Detailed Chart Table** in conjunction with Sec. 5, Chp. 1, Backbox Board Layout Wiring Diagram and Backbox I/O Power Driver Board Detailed Wiring Diagram (I/O Board Connectors J6, J7, J8 & J9):

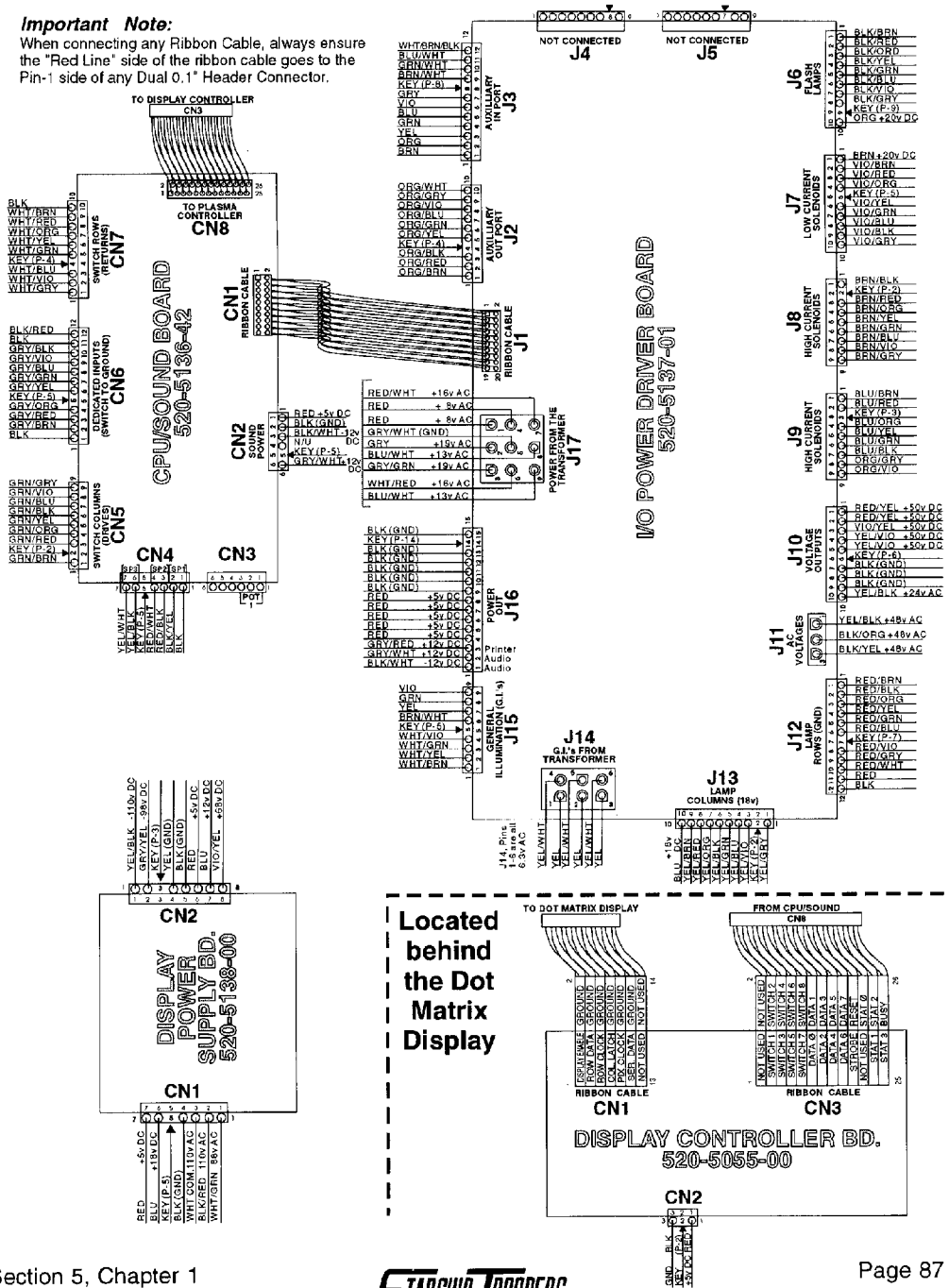
COILS DETAILED CHART TABLE

High Current Coils Group 1		Drive Transistor (D.T.)	Driver Output Board	D.T. Control Line Color	D.T. Control Line Connect	Power Line Color	Power Line Connection	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.	BRN-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 Output Board	D.T. Control Line Color	D.T. Control Line Connect	Power Line Color	Power Line Connection	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 RED-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 RED-YEL	J10-P1/2	50v dc	23-1100 090-5030-00T
Low Current Coils Group 1		Drive Transistor (D.T.)	Driver Output Board	D.T. Control Line Color	D.T. Control Line Connect	Power Line Color	Power Line Connection	Power Voltage	Coil GA/Turn or Bulb Type
17	STEPPER MOTOR #1	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	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	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	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)
Diodo On Terminal Strip (if noted)									
Flash Lamps (FLASH)		Drive Transistor (D.T.)	Driver Output Board	D.T. Control Line Color	D.T. Control Line Connect	Power Line Color	Power Line Connection	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

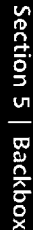
† Note: F5 = 3x #906 Bulb + 1x #89 Bulb

Backbox Board Layout Wiring Diagram

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.

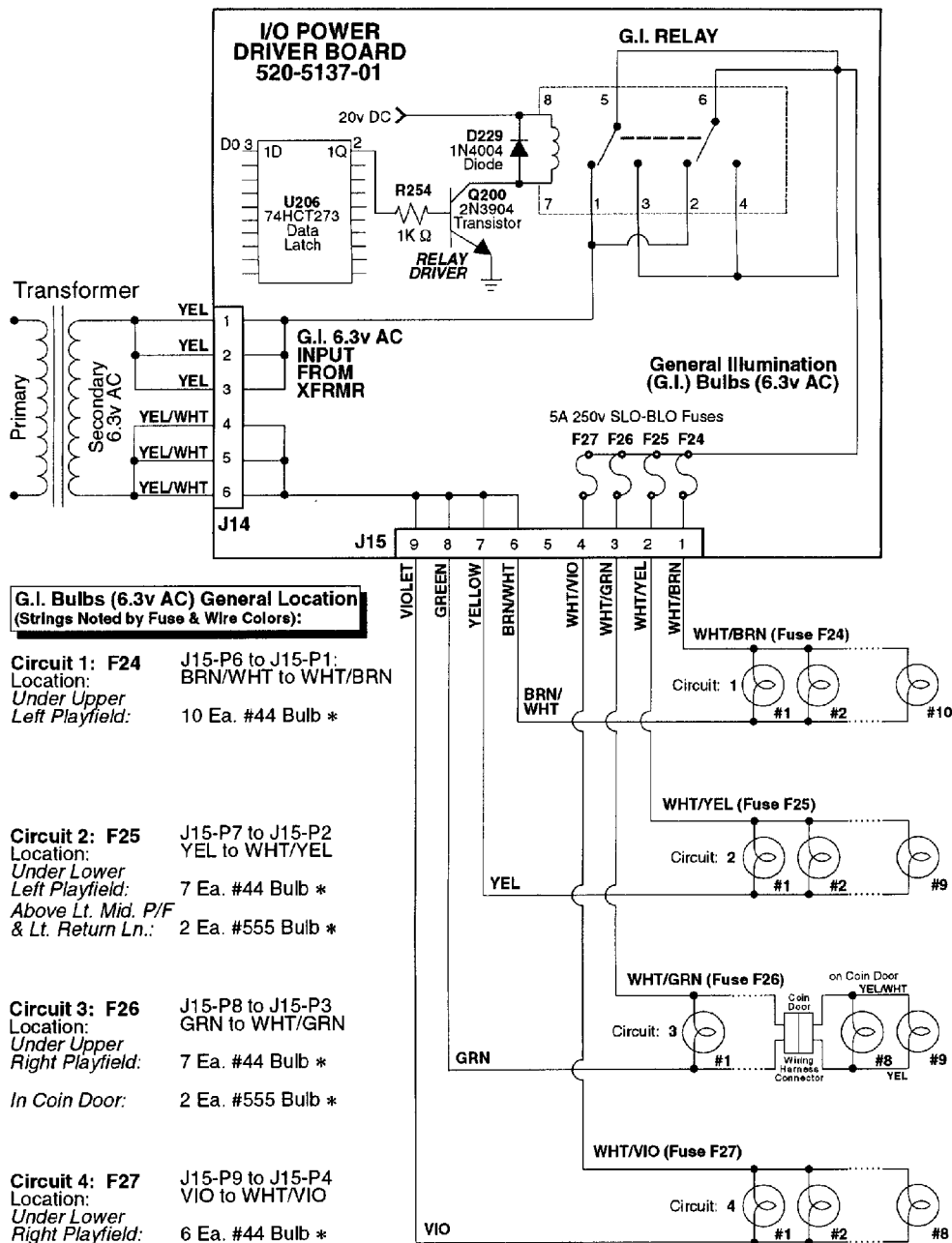


STARSHIP
TROOPERS™



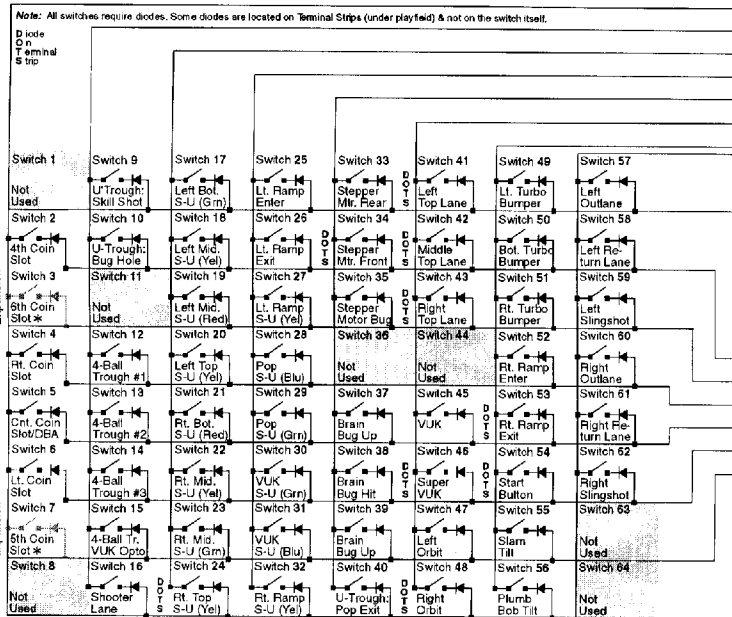
Playfield Wiring

General Illumination Circuit Detailed Wiring Diagram



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

Playfield Switch Wiring Diagram



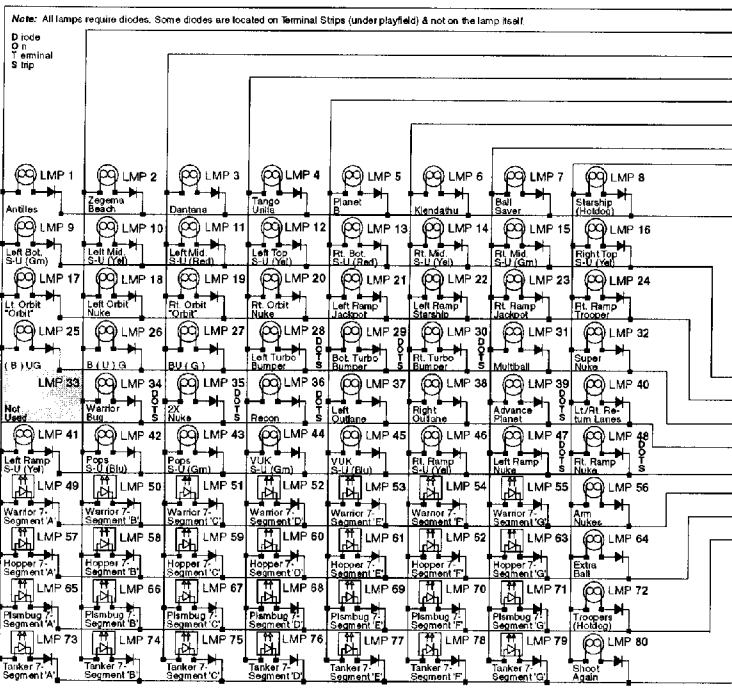
CPU/Snd. Bd. CN5-

GRN/BRN	1	Sw. Drive 1: Q1
GRN/RED	3	Sw. Drive 2: Q2
GRN/ORG	4	Sw. Drive 3: Q3
GRN/YEL	5	Sw. Drive 4: Q4
GRN/BLK	6	Sw. Drive 5: Q5
GRN/BLU	7	Sw. Drive 6: Q6
GRN/VIO	8	Sw. Drive 7: Q7
GRN/GRY	9	Sw. Drive 8: Q8

CPU/Snd. Bd. CN7-

WHT/BRN	9	Sw. Return 1: U400
WHT/RED	8	Sw. Return 2: U400
WHT/ORG	7	Sw. Return 3: U400
WHT/YEL	6	Sw. Return 4: U400
WHT/GRN	5	Sw. Return 5: U401
WHT/BLU	4	Sw. Return 6: U401
WHT/VIO	3	Sw. Return 7: U401
WHT/GRY	2	Sw. Return 8: U401

Playfield Lamp Wiring Diagram

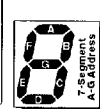


I/O Bd. J13-

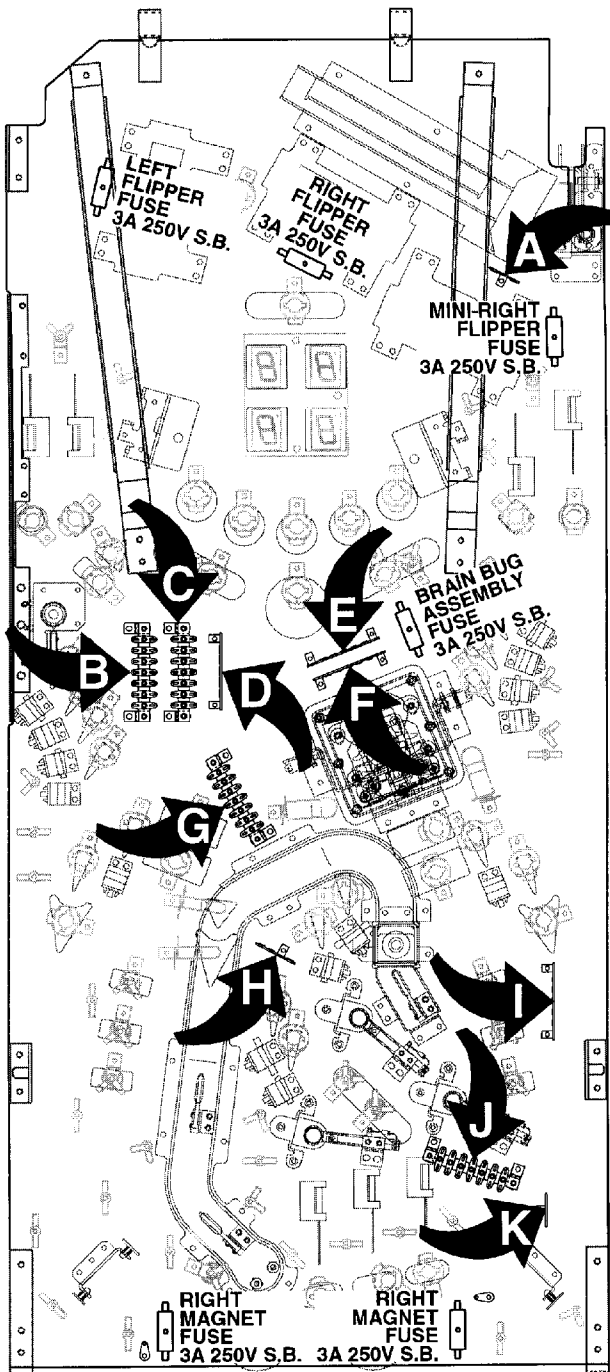
YEL/BRN	9	Lamp Drive 1: U17
YEL/RED	8	Lamp Drive 2: U16
YEL/ORG	7	Lamp Drive 3: U15
YEL/BLK	6	Lamp Drive 4: U14
YEL/GRN	5	Lamp Drive 5: U13
YEL/BLU	4	Lamp Drive 6: U12
YEL/VIO	3	Lamp Drive 7: U11
YEL/GRY	1	Lamp Drive 8: U10

I/O Bd. J12-

RED/BRN	1	Lamp Return 1: Q33
RED/BLK	2	Lamp Return 2: Q34
RED/ORG	3	Lamp Return 3: Q35
RED/YEL	4	Lamp Return 4: Q36
RED/GRN	5	Lamp Return 5: Q37
RED/BLU	6	Lamp Return 6: Q38
RED/VIO	7	Lamp Return 7: Q39
RED/GRY	8	Lamp Return 8: Q40
RED/WHT	9	Lamp Return 9: Q41
RED	10	Lamp Return 10: Q42



Playfield Diode Terminal Strip & Fuse Descriptions & Locations



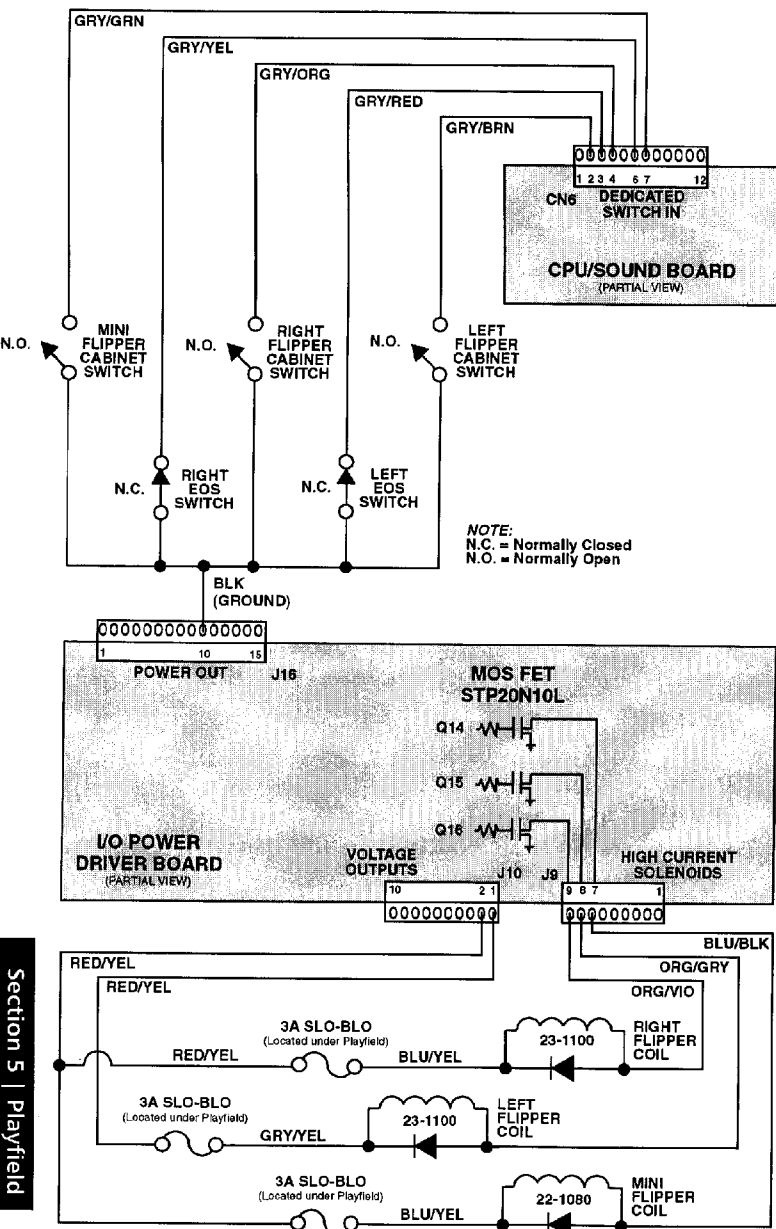
All switches, lamps, coils require diodes. The diodes not physically located on the switch, lamp or coil are located on Terminal Strips under the playfield. The Switch & Lamp Matrix Grids also note which switch or lamp has a diode on a Terminal Strip (noted by "DOTS" meaning "Diode on Terminal Strip"). 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
C	1N4001	Lamp 39	ORG
	112-5001-00	Adv. Planet	RED/GRN
	1N4001	Lamp 47	BLU
	112-5001-00	Lt. Ramp	RED/BLU
	1N4001	Lamp 48	ORG/BLU
	112-5001-00	Rt. Ramp	RED/BLU
D	1N4001	Lamp 34	ORG/GRN
	112-5001-00	Warrior Bug	RED/GRN
	1N4001	Switch 45	ORG/GRN
	112-5001-00	VUK	WHT/GRN
E & F	1N4001	Switch 38	ORG/WHT
	112-5001-00	Brain Bug	WHT/BLU
	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
G	1N4004	Coil 18	GRN
	112-5003-00	Step. Mtr. 2	VIO/RED
	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
H	1N4001	Switch 35	ORG/BLK
	112-5001-00	S. Mtr. Bug	WHT/ORG
	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
K	112-5001-00	Right Pop	YEL/BLU
	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.



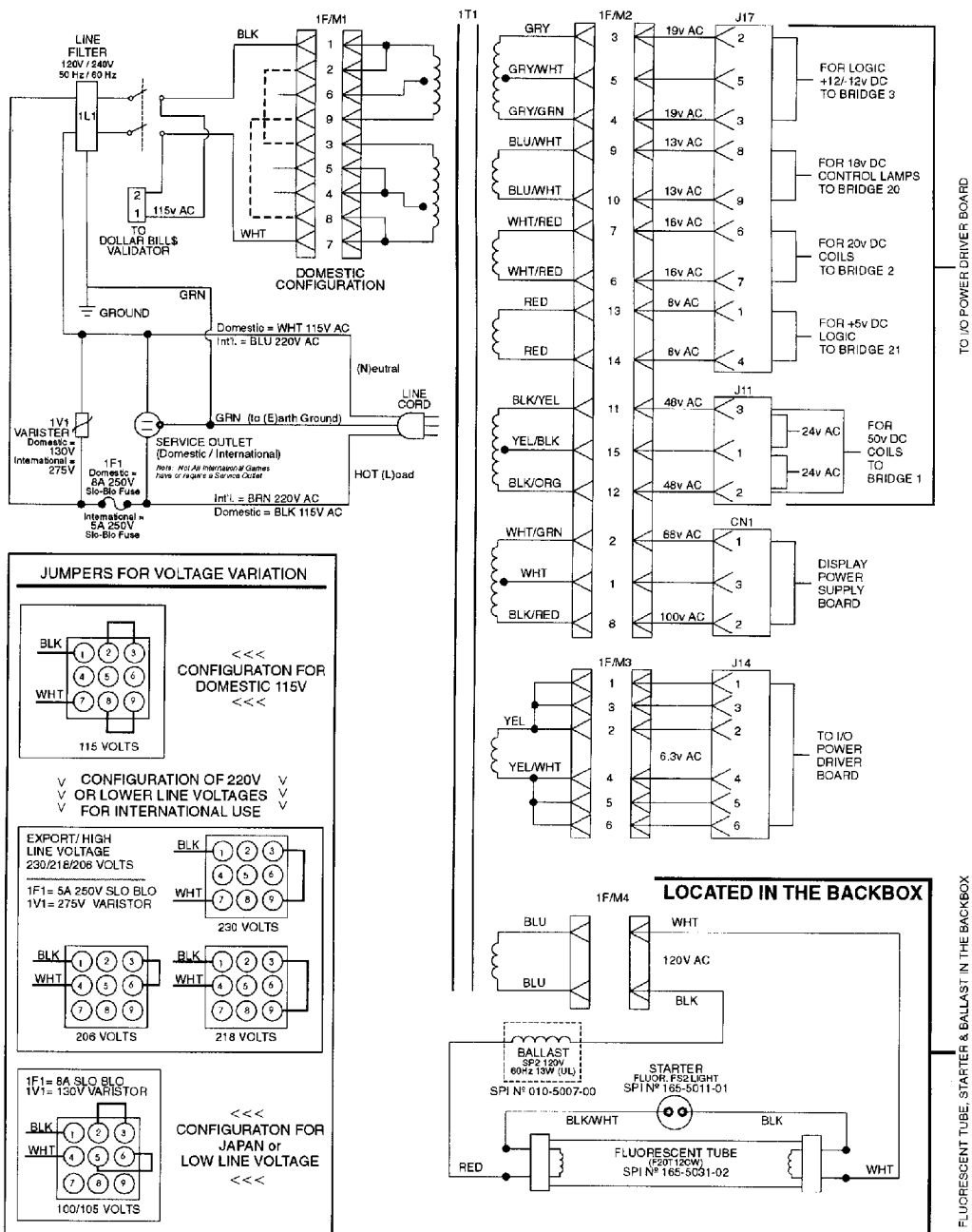
Technical Overview

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 msec for the duration of the hold cycle.

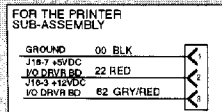
The **E.O.S. (End-Of-Stroke) Switch** serves the same function as before as it prevents foldback when the player has the flipper energized to capture balls. The **E.O.S. Switch** is a normally closed switch which opens approximately a 1/16" when the flipper is energized. The **Game CPU** will detect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



Section 5 | Cabinet

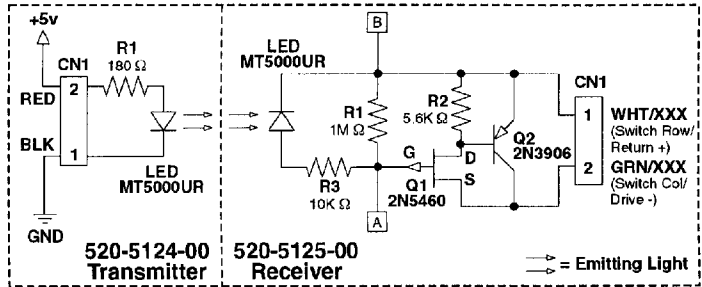


Printed Circuit Boards (PCBs)

Trough Up-Kicker OPTO Boards Theory of Operation & Schematic

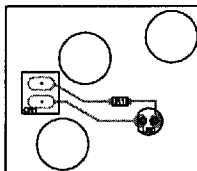
As light from the Transmitter falls on the **Receiver LED**, it generates a Positive Bias Voltage (0.7v to 1.5v) which is applied to the gate of **Q1**, turning **Q1** off. When **Q1** is held off, no current flows through **Q2**'s Base, the transistor is off acting as an **OPEN SWITCH**.

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**.



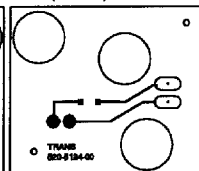
Trough Up-Kicker OPTO Boards Component Layout & Parts

Component Side (Green)



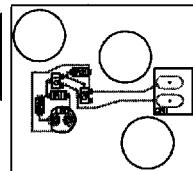
520-5124-00 (TRANS)

Solder / Component Side (Green)



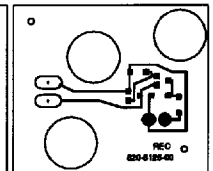
Note:
CN1 (on both boards) =
Pin-1 RED (+5v)
Pin-2 BLK (GND)

Component Side (Green)

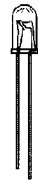


520-5125-00 (REC)

Solder / Component Side (Green)



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.

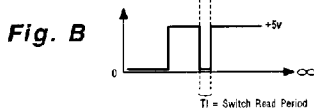
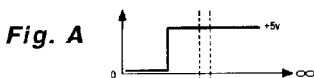
OPTO Troubleshooting

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):



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.

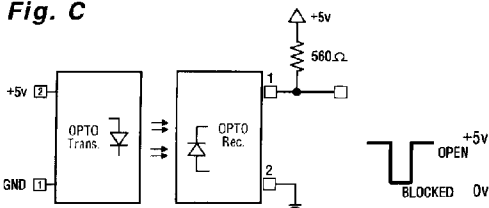
OPTO Troubleshooting Continued Next Page.

OPTO Troubleshooting Continued

3. Bench Test (See Fig. C):

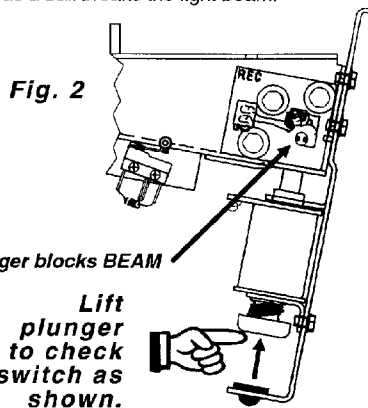
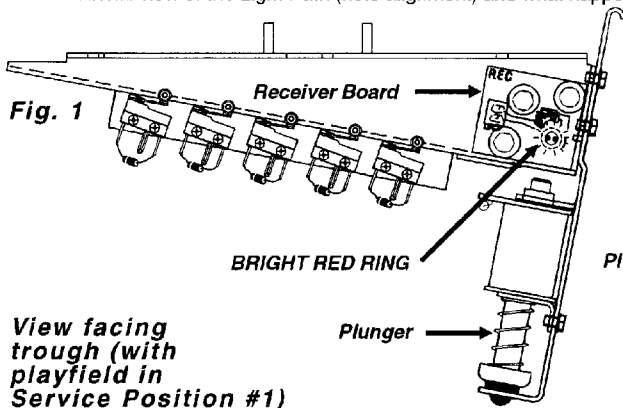
Disconnect the OPTO Transmitter / Receiver Board from the circuit. Connect one side of a 560Ω Pull-up Resistor to **Pin-1** of the OPTO Receiver Bd. and the other side of the resistor to a 5v DC source. Connect **Pin-2** to GND. Connect a +5v DC source to **Pin-1** of the Transmitter & GND to **Pin-2**. 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.



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

IMPORTANT

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

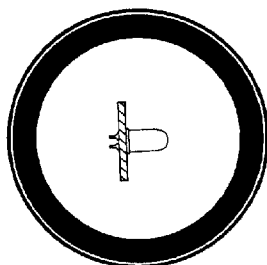


Fig. 4a
Correct Position

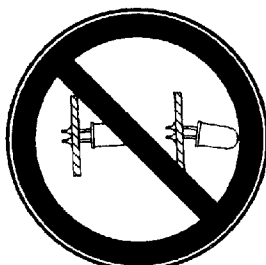
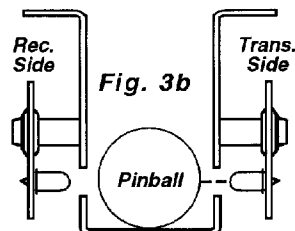
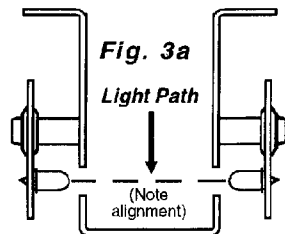
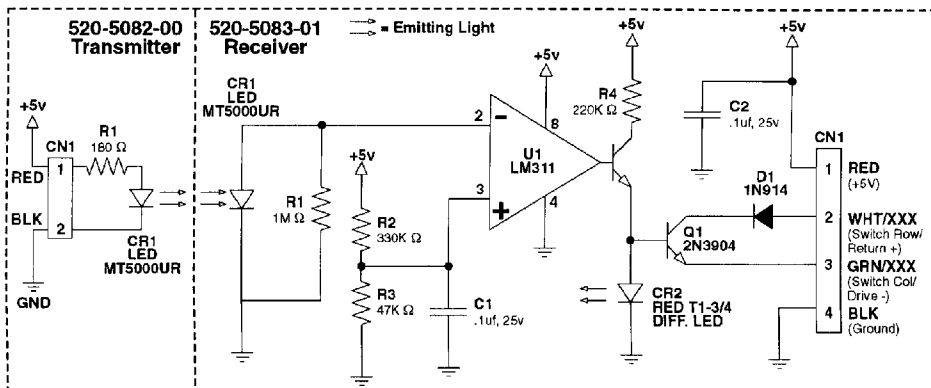


Fig. 4b
Incorrect Position

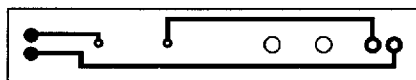


Playfield Sw. OPTO "Long-Hop" Boards Theory of Operation & Schematic

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.

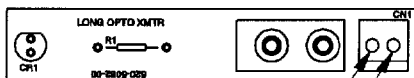


Playfield Switch OPTO "Long-Hop" Boards Component Layout & Parts



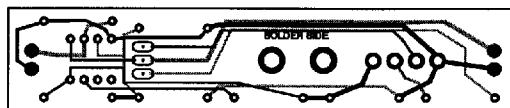
520-5082-00 (TRANS)

Solder Side (Green)



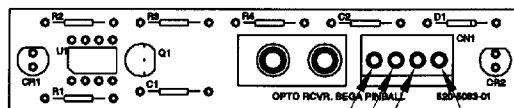
Component Side (Beige)

Pin-1 RED (+5v)
Pin-2 BLK (GROUND)
CN1



Solder Side (Green)

520-5083-01 (REC)



Component Side (Beige)

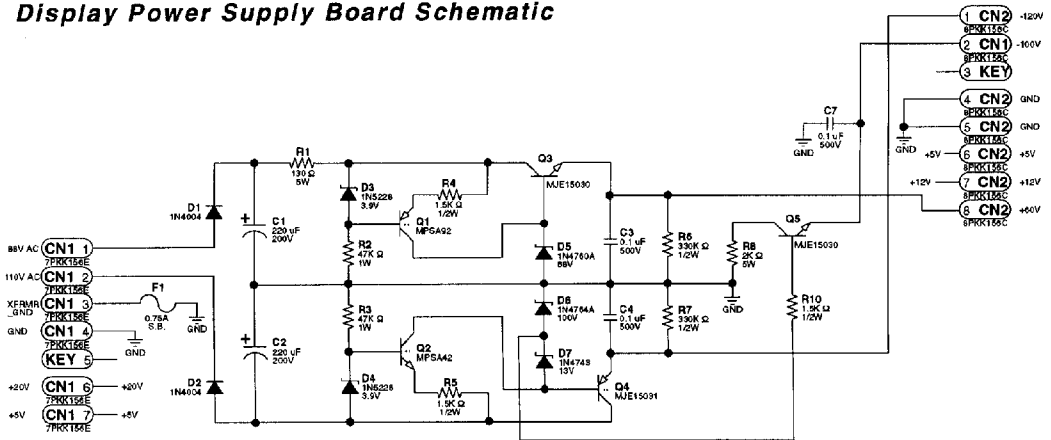
Pin-3 GRN/XXX (Sw. Drive « - »)
Pin-2 WHT/XXX (Sw. Return « + »)
Pin-1 RED (+5v)
Pin-4 BLK (GROUND)
CN1

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).

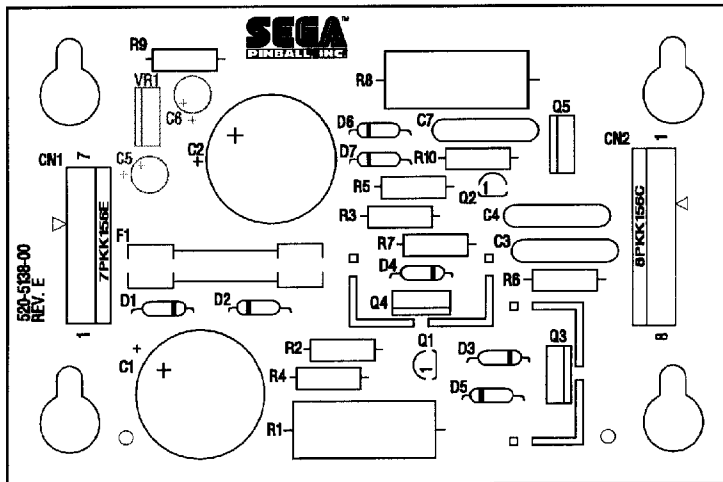
ITEM	QTY	PART NUMBER	REF-DESIGNATOR	DESCRIPTION
A	1	520-5083-01	OPTO Receiver Board	Complete PCB Assembly
1	1	165-5100-00	CR1	LED MT5000UR (Ultra Bright Red)
2	1	165-5099-00	CR2	LED T1-3/4 RED DIFFUSER
3	1	112-5014-00	D1	1N914, Diode
4	1	121-5013-00	R1	1M Ω 1/4W Res., 5%
5	1	121-5037-00	R2	330K Ω 1/4W 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.
9	1	100-5025-00	U1	LM311
10	1	110-0069-00	Q1	2N3904, Transistor
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)



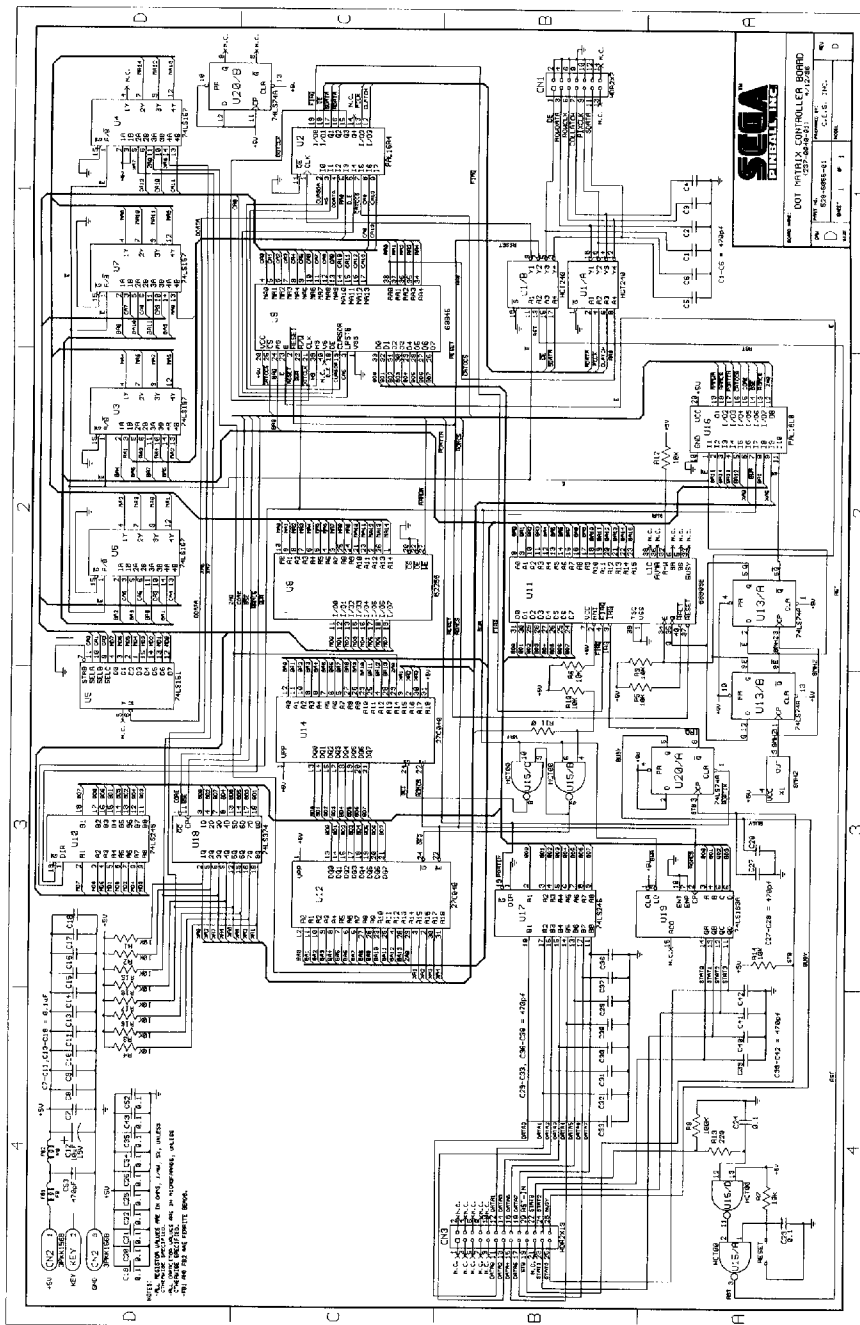
Display Power Supply Board Schematic



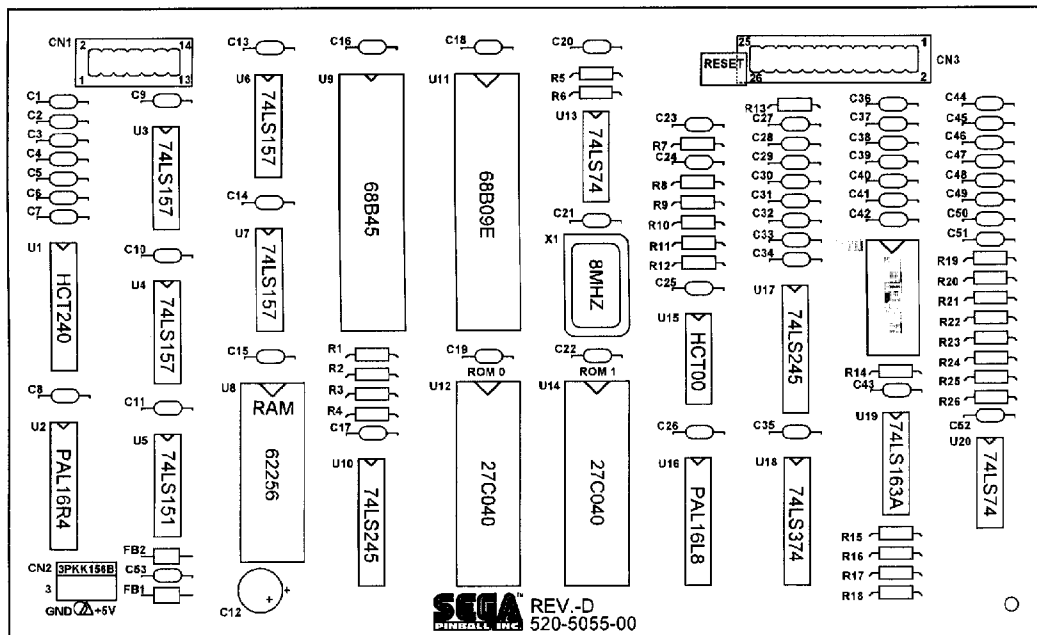
Display Power Supply Board Component Layout & Parts



ITEM	QTY	PART NUMBER	REF-DESIGNATOR	DESCRIPTION (NS = Not Stuffed)
1	1	520-5138-00	Display Power Supply Board	Complete PCB Assembly
2	1	200-5000-17	F1	3/4A (0.75A) S.B. Fuse
3	2	535-5000-11	Q3, Q4	Heatsinks - AAVID #563002
4	2	125-5044-00	C1, C2	220uF, 250v, Radial Lytic Cap.
5	4	121-5038-00	R4, R5, R9, R10	1.5K Ω 1/2W Res. (R9: NS)
6	2	121-5059-00	R6, R7	330K Ω 1/2W Res.
7	2	121-5060-00	R2, R3	47K Ω 1W Res.
8	1	121-5061-00	R8	130 Ω 5W Res.
9	2	121-5062-00	R1	2K Ω 5W Res.
10	1	112-0053-00	D3, D4	1N5228, 3.9v, Diode
11	1	112-0061-00	D5	1N4760A, 68v, Diode
12	1	112-0049-00A	D6	1N4764A, 100v, Diode
13	1	112-0061-00	D7	1N4743, 13v, Diode
14	1	110-0100-00	Q1	MPSA92, Transistor
15	3	110-0082-00	Q2	MPSA42, Transistor
16	1	125-5035-00	C3, C4, C7	0.1uF, 500v, Ceramic Disk Cap.
17	1	110-0103-00	Q4	MJE15031, Transistor
18	2	110-0101-00	Q3, Q5	MJE15030, Transistor
19	0	125-5003-00	C5, C6	22uF, 25v, Rad. Lytic Cap. (C5, C6: NS)
20	0	124-5003-00	VR1	7812CT (VR1: NS)
21	1	045-5015-06	DN2	8PKK156 (PIN3=KEY)
22	2	112-5003-00	D1, D2	1N4004, Diode
23	1	045-5015-07	CN1	7PKK156E (PIN5=KEY)
24	2	240-5008-00	Q3, Q4	6/32 KEPS Nut
25	2	237-5501-00	Q3, Q4	6/32 X 3/8" PPH Screw
26	2	205-0004-00	F1	Fuse Clips



Display Controller Board Component Layout & Parts



ITEM	QTY	PART NUMBER	REF-DESIGNATOR	DESCRIPTION (NS = Not Stuffed)
1	1	520-5055-00	Display Controller Board	Complete PCB Assembly
2	2	077-5217-00	U12, U14	32-Pin, IC Dip Socket
3	1	100-0397-00	U8	32K X 8 Static RAM (62256L-10PC)
4	1	100-0189-01	U11	68B09E
5	1	100-0233-00	U9	68B45
6	1	100-0351-00	U15	74HC100
7	1	100-5001-00	U5	74HCT240
8	4	100-0046-00	U3, U4, U6, U7	74LS151
9	1	100-0049-00	U19	74LS157
10	2	100-0058-00	U7, U10	74LS163A
11	1	100-0064-00	U18	74LS245
12	2	100-0037-00	U13, U20	74LS374
13	1	965-0107-00	U16 - ORANGE DOT	74LS74
14	1	965-0108-00	U2 - ORANGE DOT	PAL16L8 (15CN), (Programmed)
15	23	125-5031-00	C7>C11, C13>C26, C34, C35, C43, C52	- ORANGE DOT
16	1	121-5051-00	R8	PAL16R4 (25CN), (Programmed)
17	15	121-5051-00	R1>R7, R9, R10, R12, R14>R18	- ORANGE DOT
18	1	121-5014-00	R13	1uF (104), Axial Cer. Cap
19	0	n/a	R19>R26	100K Ω 1/4W C.F. Res. 5%
20	21	125-5028-00	C1>C6, C27>C33, C36>C42, C44>C51, C53	10K Ω 1/4W Res. 5%
21	2	n/a	FB1, FB2	220 Ω 1/4W C.F. Res. 5% (R19>R26: NS)
22	1	125-5015-00	C12	470pF, (471), Axial Cap (C44>C51: NS)
23	1	045-5015-26	CN3	Ferrite Bead (2743001182)
24	1	045-5015-03	CN2	100uF, 25v, Cap. (Radial Elec.)
25	1	045-5015-02	CN1	13-Pin, Dual Row .1" HDR Conn.
26	1	140-0013-00	X1	3-Pin, KK-156 Conn. (540445-3)
27	0	Not Used	SW1	7-Pin, Dual Row .1" Hdr. Conn.
28	1 (See Pg. DR. 6 Table)		U12 U14 (ROM 0)	8Mhz Clock Oscillator (SW1: NS) 4MB ROM (U14: NS)

I/O Power Driver Board Theory of Operation

5V Supply:

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

+5 +12 +50V +18V +20V LED Indicators:

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

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

Reset Circuitry:

The I/O will reset in three cases:

1. The CPU is in reset. The CPU's reset signal is fed into the I/O through connector J1 and forces the I/O into reset.
2. The 5V supply has fallen 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.

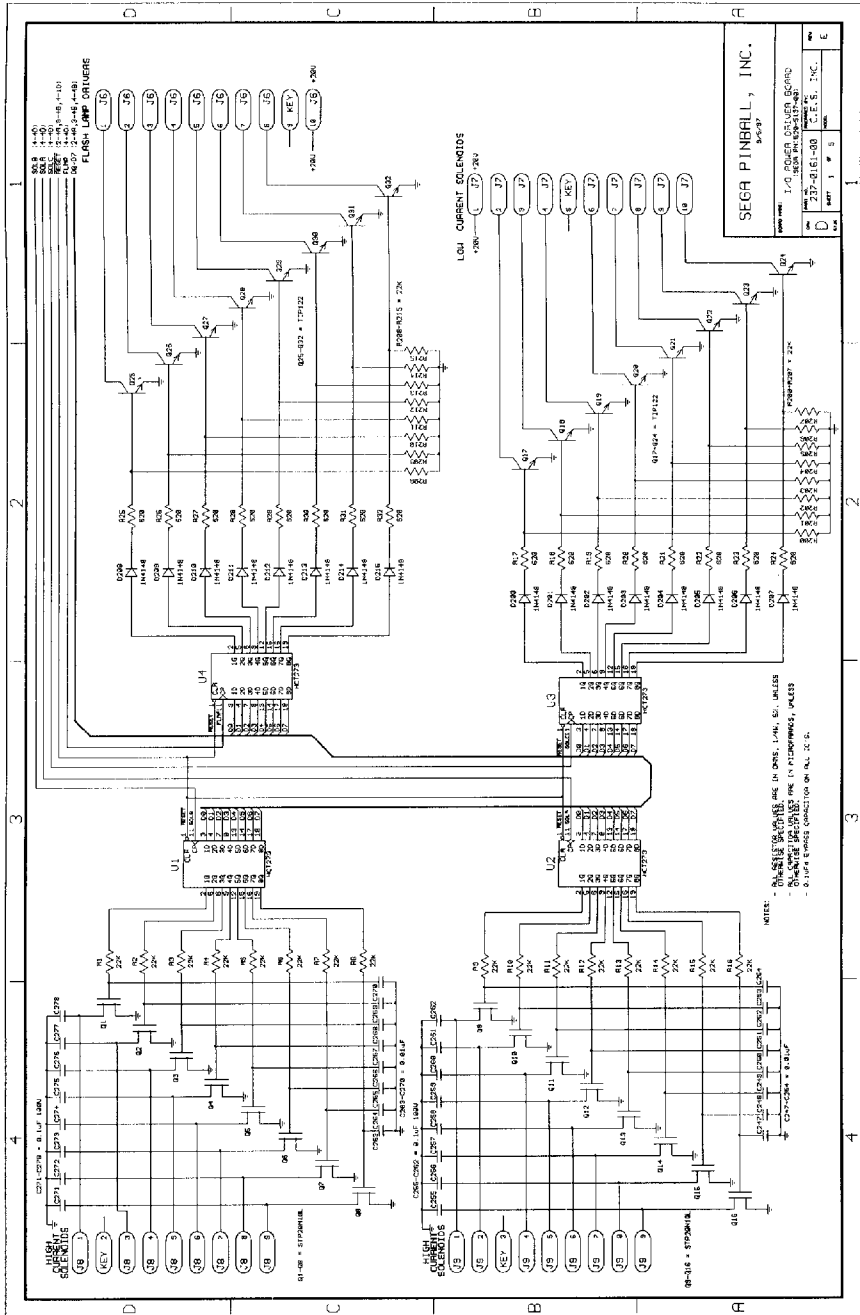
J3 8 CMOS Inputs general purpose inputs.

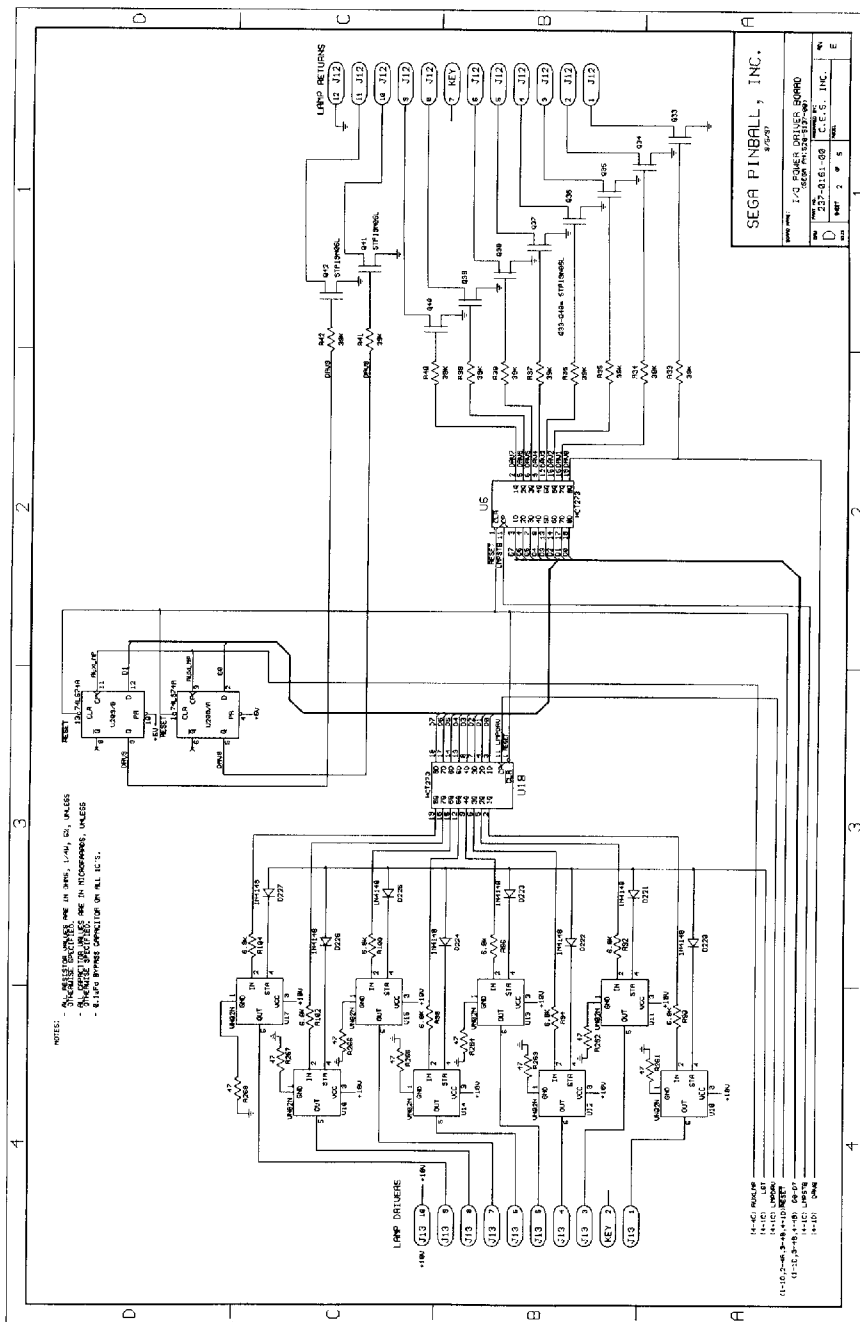
Lamp Matrix:

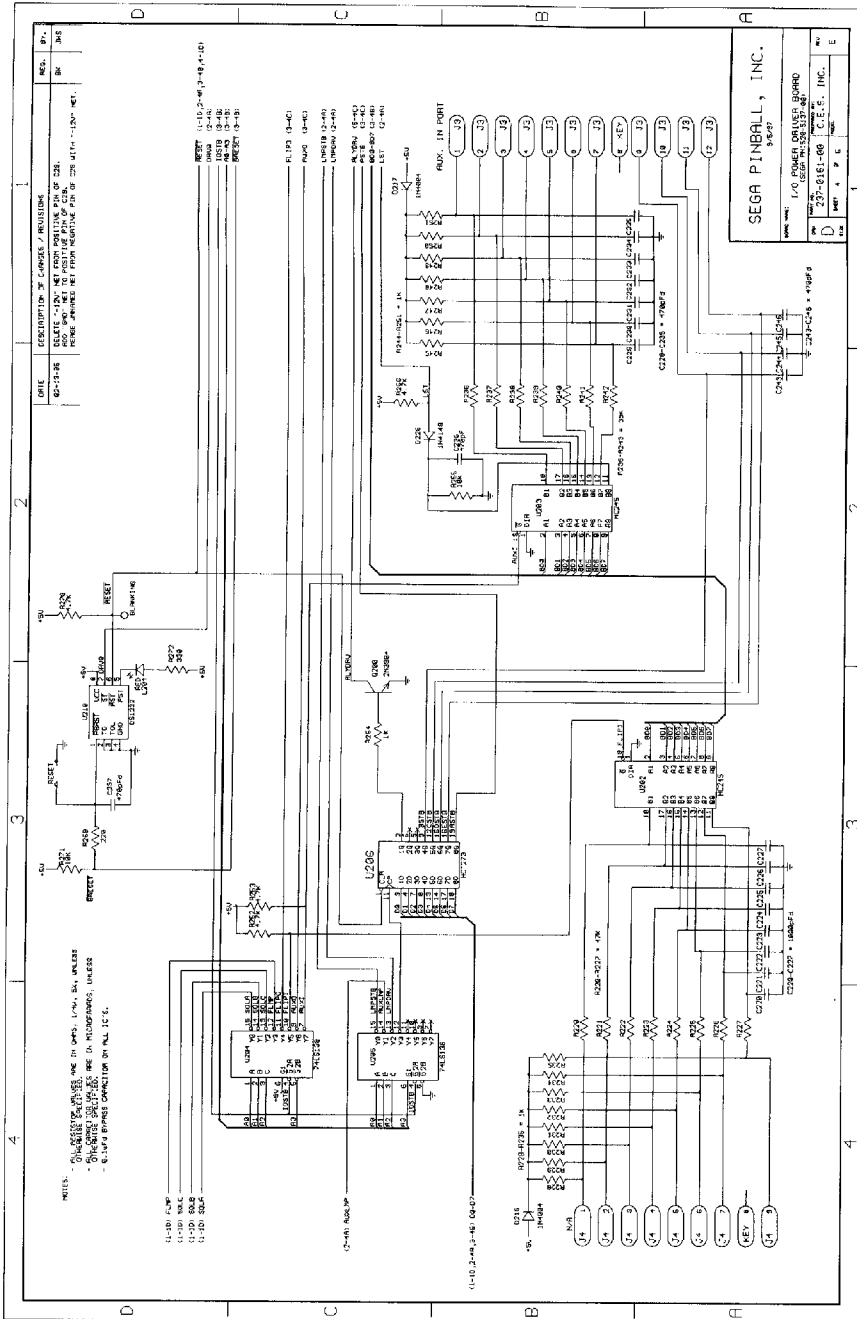
J12 has 10 low side drivers for the lamp strobes which consist of 19N06L MOSFETS. Only one lamp strobe should be low at any time. Again the scanning of the lamp strobes keeps the I/O from resetting. J13 has 8 high side drivers with each having a status indicator. All the status indicators are logically '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.

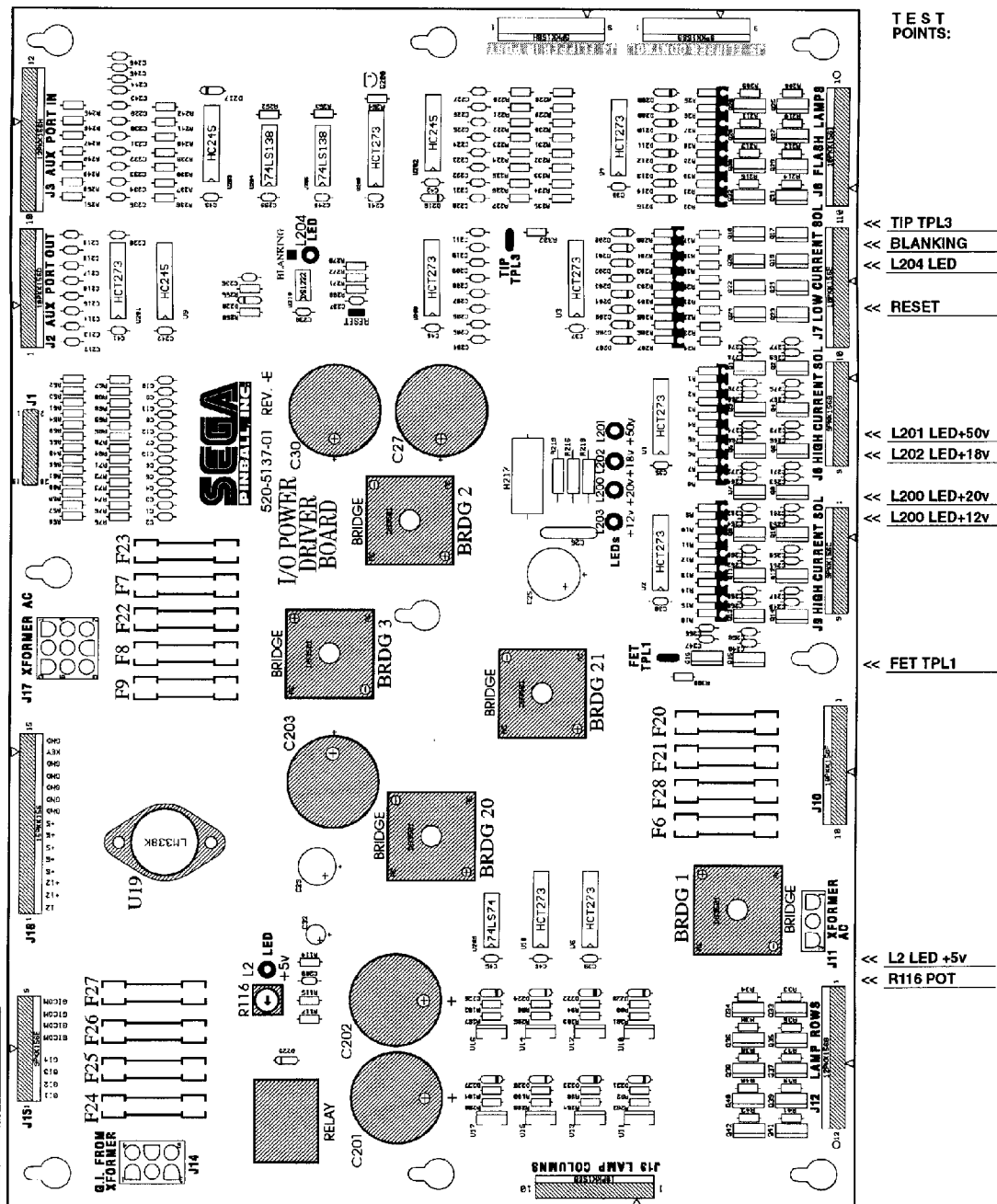






SEGA PINBALL, INC.
5500
237-6161-000 C.E.S. INC.

I/O Power Driver Board Component Layout



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 S.T.P. 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	6	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	74HC1273 (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 S.T.P. 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	TP1, 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 U211 and 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 68B09E (U6) reads in this data and handles the interfacing to the BSMT.

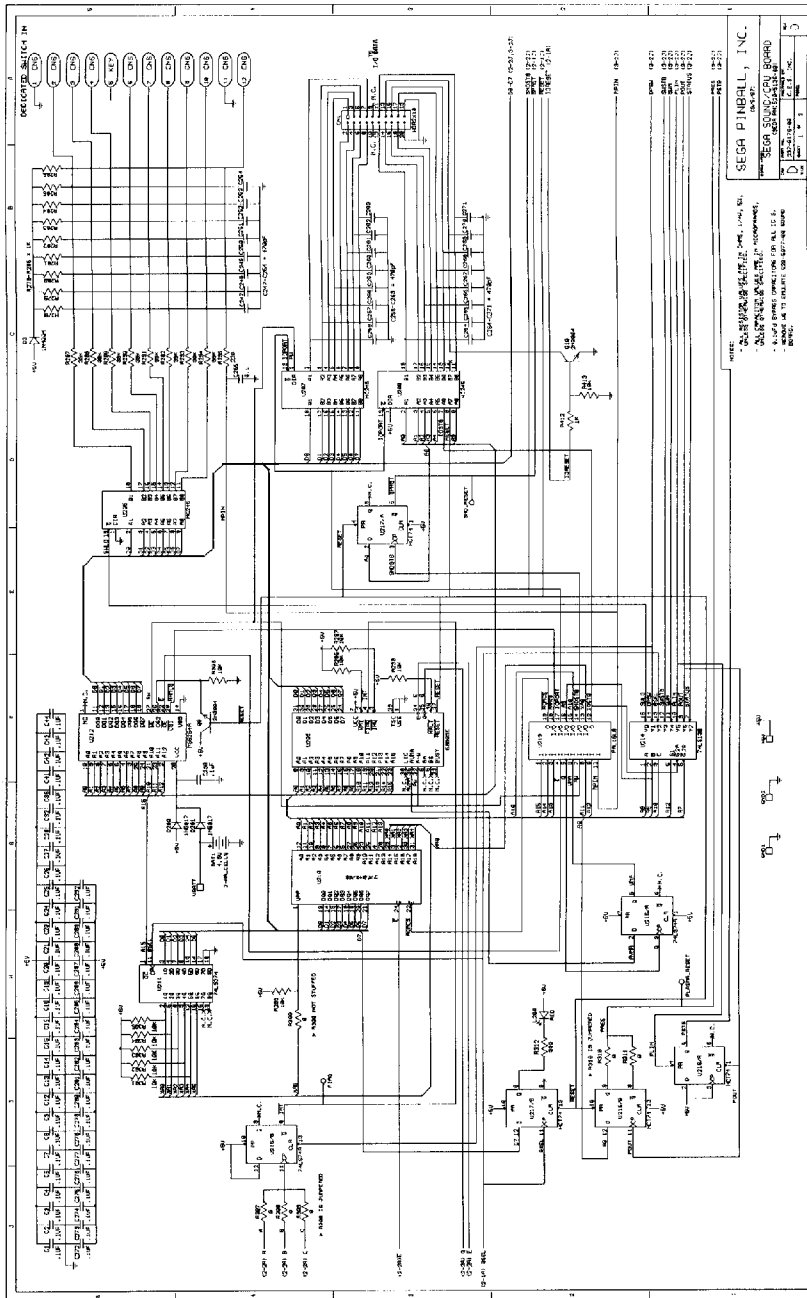
Other Test Points:

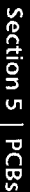
E & Q - The CPU signals for both 68B09E processors. Should be at 2Mhz with Q leading E by 500 nsec.

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

SND-FIRQ - The sound sections CPU interrupt.

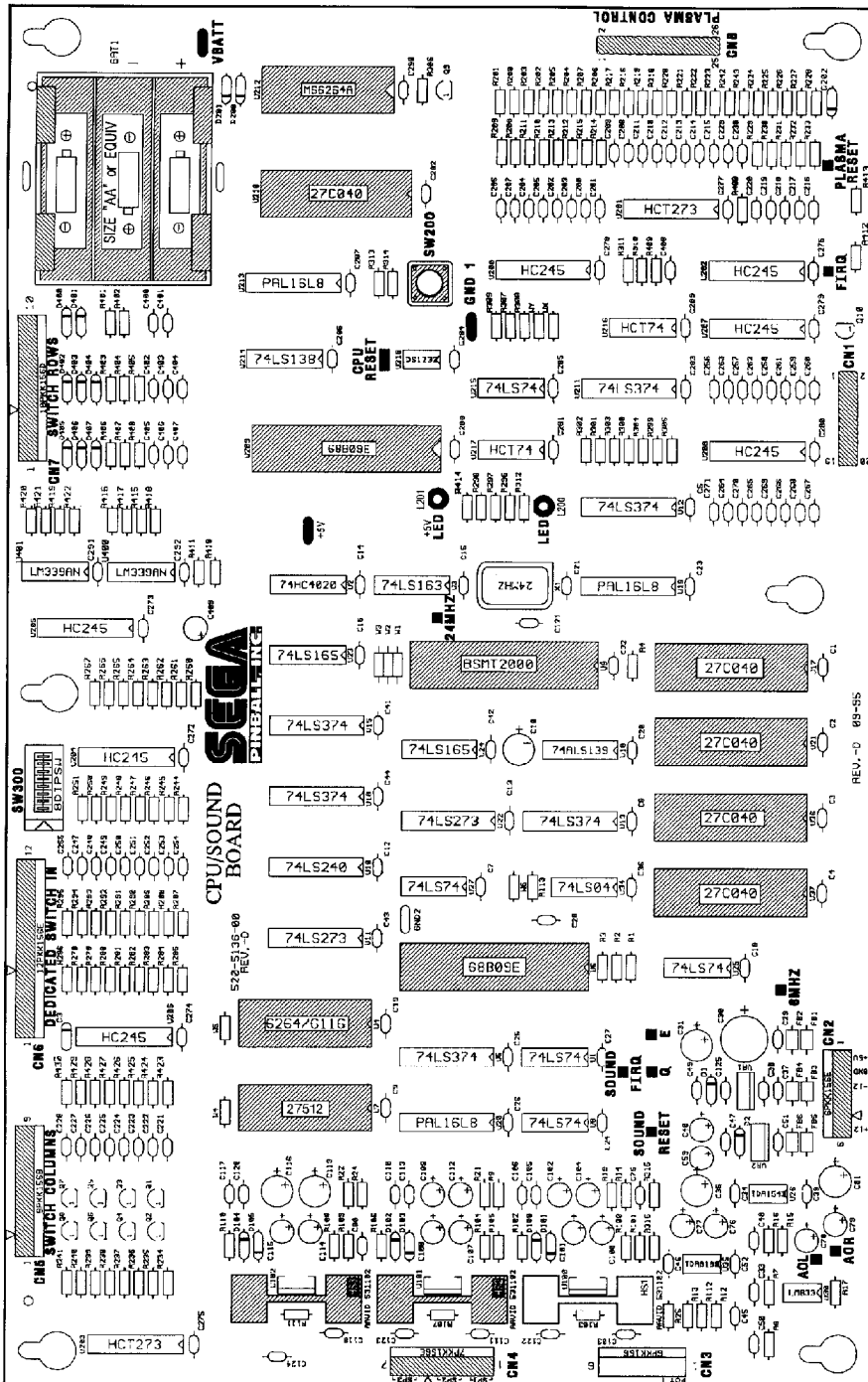
6Mhz - This clock is generated internally on the BSMT and is used for shifting the data samples into the DAC.







CPU/Sound Board Component Layout

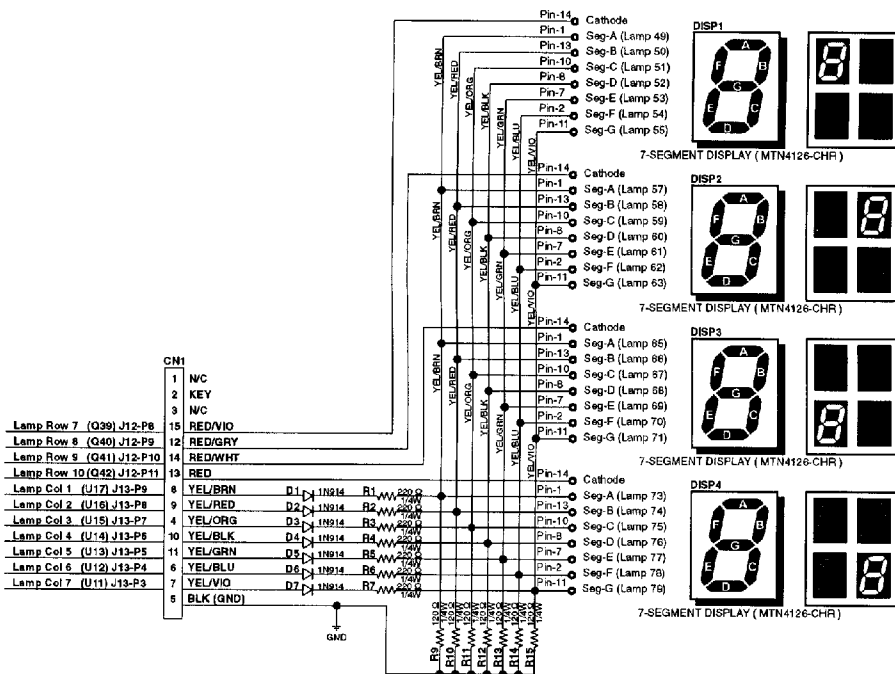


- TEST POINTS:
- VBATT
 - PLASMA RESET
 - FIRQ
 - SW200
 - GROUND 1
 - CPU RESET
 - L201 LED+5v
 - L200 LED
 - +5v
 - 24 Mhz
 - 6 Mhz
 - E
 - SOUND FIRQ
 - Q
 - SOUND RESET
 - AOR
 - AOL

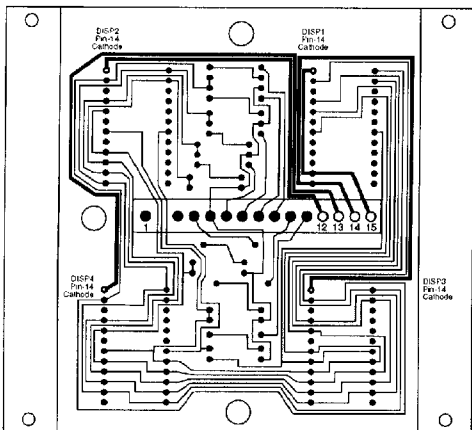
CPU/Sound Board Parts

ITEM	QTY	PART NUMBER	REF-DESIGNATOR	DESCRIPTION (NS = Not Stuffed)
1	1	520-5136-00	CPU/Sound Board	Complete PCB Assembly
2	1	124-5001-00	VR2	7805 +5v Regulator
3	5	121-5051-00	R12, R13, R19, R21, R22, R24	100K Ω 1/4W Res. (R19; NS)
4	2	121-5009-00	R103, R107, R111	1K Ω 1/4W Res. (R103; NS)
5	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.
6	5	121-5023-00	R9, R14, R100, R102, R104, R106, R110	(R200>R207, R409, R413; NS)
7	20	121-5009-00	R15, R8, R234>R241, R278>R286, R412	22K Ω 1/4W Res. (R100, R102; NS)
8	1	121-5043-00	R16, R17, R25, R112	1K Ω 1/4W Res.
9	4	121-5018-00	R101, R105, R109	2.2K Ω 1/4W Res.
10	9	121-5045-00	R108, R287>R294	1.5K Ω 1/4W Res.
11	1	121-5036-00	R312	470K Ω 1/4W Res. (R101; NS)
12	12	n/a	R300, R308>R311, R313>R316, WX, WY	39K Ω Res.
13	15	121-5033-00	R208>R215, R229>R33, R414>R422	330 Ω 1/4W Res.
14	11	121-5021-00	R216>R223, R242, R243, R400	0 Ω Jumper Wire (24ga.)
15	16	121-5047-00	R401>R408, R423>R430	220K Ω 1/4W Res. (R208>R215; NS)
16	2	121-5048-00	R410, R411	4.7K Ω 1/4W Res.
17	1	100-0049-00	U3	560 Ω 1/4W Res.
18	1	(See Pg. DR. 8 Table)	U7	3.3K Ω 1/4W Res.
19	1	045-5015-07	CN4	74LS163
20	1	Not Used	HESET	27512 EPROM
21	1	(See Pg. DR. 9 Table)	U17, U21, U36, U37, U210	7PKK156 (PIN5=KEY)
22	39	100-5008-00	U23, U24	Do Not Stuff
23	1	125-5017-00	C76>C79	27C040 EPROM
24	4	125-5020-00	C40, C59, C101, C108, C115	74LS165
25	2	125-5017-00	C100, C107, C114	10uF 25v, Radial Lytic Cap.
26	22	125-5015-00	C102, C104, C109, C112	22uF 25v, Radial Lytic Cap. (C101; NS)
27	1	125-5014-00	C409	10uF 35v, Radial Lytic Cap. (C100; NS)
28	1	100-5016-00	U35	100uF 25v, Rad. Ltc. Cap. (C102, C104; NS)
29	1	125-5037-00	C30	22uF 16v, Radial Lytic Cap.
30	1	100-0027-00	U34	TDA1899
31	1	100-0043-00	U18	1000uF 16v, Radial Lytic Cap.
32	6	100-0064-00	U5, U12, U13, U15, U16, U211	74LS04
33	1	100-0249-00	U2	74ALS139
34	1	100-0149-00	U10	74LS374
35	6	n/a	W1>W6	74HC4020
36	22	125-5012-00	C31, C81	74LS240
37	1	125-5017-00	C10, C35	0 Ω Jumper Wire (24ga.)
38	22	125-5019-00	C116, C119	470uF 25v, Radial Lytic Cap.
39	1	045-5015-06	CN2	10uF 16v, Radial Tant. Cap.
40	1	140-0011-00	X1	220uF 25v, Radial Lytic Cap.
41	1	105-0116-00	U9	6PKK156 (PIN 5=KEY)
42a	1	965-0136-00	U19 - YELLOW DOT	24MHz
42b	1	965-0137-00	U20 - WHITE DOT	BSMT2000
42c	1	965-6504-00	U213 - BLUE DOT	PAL16L8 (Programmed) - YELLOW DOT
43	35	100-0037-00	U1, U8, U25, U27, U215	PAL16L8 (Programmed) - WHITE DOT
44	1	125-5043-00	C29, C37, C51	PAL16L8 (Programmed) - BLUE DOT
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	74LS74
46	1	125-5038-00	C121	0.001uF (102), Cap.
47	4	125-5039-00	C48, C50, C75, C80	0.1uF (104), Axial Cer. Cap.
48	39	125-5028-00	C200>C220, C229, C230, C247>C254, C256>C271	(C102, C103, C105, C106; NS)
49	8	125-5029-00	C221>C228, C408	100pF (101), Cap.
50	1	045-5015-06	CN3	0.0022uF (222), Cap.
51	1	100-0375-00	U30	470pF (471), Cer. Cap. (C200>C207; NS)
52	2	100-0022-00	U22, U11	0.01uF (103), Cap. (C408; NS)
53	2	112-5003-00	D1>D3, D100>D105	6PKK156
54	1	112-5008-00	D200, D201	LM833
55	18	112-0054-00	D202, D400>D407	74LS273
56	1	124-5002-00	VR1	1N4004, Diode (D100, D101; NS)
57	2	100-5016-20	U100>U102	1N5817, Diode
58	1	100-5018-00	U26	1N4148, Diode (D202; NS)
59	1	n/a	SW200	7905 -5v Regulator
60	1	165-5099-00	L200	TDA2030V (U100; NS)
61	1	165-5099-00	L201	TDA1543
62	2	100-5015-00	U216, U217	B3F4000
63	1	100-0148-00	U214	LED T1-3/4 DIFFUSER LED
64	1	105-0046-00	U212	LED T1-3/4 DIFFUSER LED
65	1	100-0189-01	U19, U209	HCT74
66	1	545-5685-00	BAT-1 BATTERY HOLDER	74LS138
67	1	045-5015-01	CN1	MS6264A
68	10	n/a	6MHZ AOR Q AOL 24MHZ	68B09E
69	10	110-0069-00	Q1>Q10	3-AA CELLS 4.5v
70	1	045-5013-00	CN5	20-Pin, 0.1 HEADER
71	2	100-5019-00	U201, U203	Test Points - NS
72	6	100-0338-00	U200, U202, U204>U208	2N3904, Transistor
73	1	100-5023-00	U218	9PKK156 (PIN 2=KEY)
74	1	045-5015-26	CN8	74HCT273
75	1	045-5014-01	CN7	74HC245 (U200; NS)
76	4	n/a	VBATT +5V GND1, GND2	DS1232
77	1	045-5015-00	CN6	26-Pin, 0.1 HEADER
78	1	181-5002-00	SW300	12PKK156 (PIN 4=KEY)
79	2	100-0377-00	U400, U401	Test Point Wire (24ga.) Loops
80	1	105-0052-05	U4	12PKK156 (PIN 5=KEY)
81	3	535-5000-10	U100>U102	5-Pin, Dip Switch
82	2	077-5209-00	U6, U9, U209	LM339AM
83	6	077-5217-00	U17, U21, U36, U37, U210	6116 RAM
84	3	077-5208-00	U4, U7, U212	AAV/D 531102
				40-Pin, IC Socket
				32-Pin, IC Socket
				28-Pin, IC Dip Socket

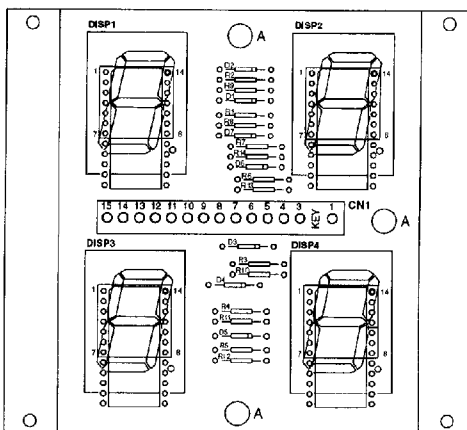
4X 7-Segment Display Board Schematic



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
1	1	520-5166-00	4X 7-Segment Display Bd.
2	7	121-5014-00	R1>R7
3	7	121-5030-00	R8>R14
4	4	112-5014-00	D1>D7
5	4	165-5040-00	DISP1, DISP2, DISP3, DISP4
6	4	045-5166-24	DISP1, DISP2, DISP3, DISP4
7	1	045-5161-15	CN1

DESCRIPTION

Complete PCB Assembly
220 Ω 1/4W Res.
120 Ω 1/4W Res.
1N914, Diode
1" 7-Seg. Red Disp (MTN4126-CHR)
24-Pin Socket, .6" W X .3" H (SPC SP-242T)
15X1 Reverse-Mount .156" Hdr.

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 ...describes the EPROM with its chip size, the Sega Pinball Inc. Part N^o,
 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 N^o, Sega Pinball Inc. Part N^o,
 NTE N^o, ECG N^o, Radio Shack Part N^o (If applicable) and RCA Part N^o (If
 applicable).
- **Appendix C, CPU Jumper Table 121**
 ...provides the Game Manufactured Date and Manual Part N^o, the CPU version,
 the ROM Position, and the Jumpers Installed and Removed.
- **Appendix D, Board Type Table.....122-123**
 ...provides Part N^o 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
 Table124-125**
 ...provides the Coils used with Part N^o and Gauge-Turns (of the coil).
- **Appendix F, Motor Specification Table126-127**
 ...provides all the Motor information used on the games (Motor Type,
 Function and Part N^o).
- **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 pictorial 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 pictorial 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 N°	Ver.	Loc.	Raw Part N°
Laser War					
CPU	(256K)	965-0004-00		C5	960-5007-00
Sound (old)	(256K)	965-0005-00		J6	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		8F	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)	965-0057-00	A1-7	C5	960-5007-00
Voice 1	(1M)	965-0058-00		F7	960-5009-00
Voice 2	(1M)	965-0059-00		F5	960-5009-00
Sound	(256K)	965-0060-00		F4	960-5007-00
Display	(512K)	965-0060-00		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)	965-0068-00	A1.06	C5	960-5007-00
Voice 1	(2M)	965-0069-00		U17	960-5010-00
Voice 2	(1M)	965-0070-00		U21	960-5009-00
Sound	(256K)	965-0071-00		U7	960-5007-00
Display	(1M)	965-0071-00	A1.06	U8	960-5009-00

EPROM	Chip Size	Part N°	Ver.	Loc.	Raw Part N°
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		U8	960-5009-00
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	960-5010-00
Voice 3	(4M)	965-0167-00		U36	960-5017-00
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	960-5010-00
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	960-5010-00
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

Table continued on the next page.

Appendix — A —
Pinball Game Firmware Table

APPENDIX A

Pinball Game Firmware Table

EPROM	Chip Size	Part N°	Ver.	Loc.	Raw Part N°
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 N°	Ver.	Loc.	Raw Part N°
Apollo 13					
CPU / Sound Board:		520-5136-00 (Stereo)			
Game ROM (1M)		965-0208-00	A5.01	U210	960-5009-00
			\$09FF		
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	ROM 0	960-5015-00
			\$B92B		
Golden Eye					
CPU / Sound Board:		520-5136-00 (Stereo)			
Game ROM (1M)		965-0214-42	A4.04	U210	960-5009-00
			\$3FFF		
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	ROM 0	960-5015-00
			\$F6ED		
Twister					
CPU / Sound Board:		520-5136-10 (Mono)			
Game ROM (1M)		965-0219-41	A4.05	U210	960-5009-00
			\$E9FF		
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	ROM 0	960-5015-00
			\$FD01		
ID4: Independence Day					
CPU / Sound Board:		520-5136-10 (Mono)			
Game ROM (1M)		965-0224-45	A2.02	U210	960-5009-00
			\$3CFF		
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	ROM 0	960-5015-00
			\$ABF7		
ROM	Chip Size	Part N°	Ver.	Loc.	Raw Part N°
Space Jam					
CPU / Sound Board:		520-5136-10 (Mono)			
Game ROM (1M)		965-0229-43	A3.00	U210	960-5009-00
			\$E8FF		
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	ROM 0	960-5015-00
			\$Q057		
The Star Wars Trilogy - Special Edition (S.E.)					
CPU / Sound Board:		520-5136-10 (Mono)			
Game ROM (1M)		965-0235-56	A4.03	U210	960-5009-00
			\$E8FF		
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	ROM 0	960-5015-00
			\$8817		
The Lost World: Jurassic Park					
CPU / Sound Board:		520-5136-10 (Mono)			
Game ROM (1M)		965-0240-53	A2.01	U210	960-5009-00
			\$C2FF		
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	ROM 0	960-5015-00
			\$7F45		
The X-Files					
CPU / Sound Board:		520-5136-10 (Mono)			
Game ROM (1M)		965-0245-46	A3.02	U210	960-5009-00
			\$DFFF		
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	ROM 0	960-5015-00
			\$68D0		
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		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

Table Notes:
 * Game Firmware can be updated after the production run. This table is accurate as of the printing of this manual. To see if any changes occurred, the next game manual will include updates.
 The version listed is USA. If there is a question of what version number any particular ROM is and the next game manual is not available, call our technical support department.

APPENDIX B

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

Table No	Type	Source Number	SEGA PINBALL™	NTE®	ECG®	Radio Shack®	RCA®
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
3	Diode	1N4736 6.8v 1w	112-5007-00	-----	-----	-----	-----
	TRANSISTORS - TYPE FET, NPN, PNP AND/OR SCR						
	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	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	5C	J4 J6a J7a	J5 J6 J7b	29. Apollo 13	NOV 85 780-5044-00	—	U210	n/a	n/a
2. Secret Service	MAR 88 780-5002-00	2	5B, 5C	J4	J5	30. Golden Eye	FEB 96 780-5042-00	—	U210	n/a	n/a
3. Torpedo Alley	AUG 88 780-5003-00	2	5B, 5C	J4	J5	31. Twister	APR 96 780-5041-00	—	U210	n/a	n/a
4. Time Machine	DEC 88 780-5004-00	2	5B, 5C	J4	J5	32. ID4: Independence Day	JUL 96 780-5045-00	—	U210	n/a	n/a
5. Playboy 35th Anniversary	MAY 89 780-5005-00	2	5B, 5C	J4	J5	33. Space Jam	OCT 96 780-5043-00	—	U210	n/a	n/a
6. ABC Monday Night Football	SEP 89 780-5007-00	2	5B, 5C	J4	J5	34. The Star Wars Trilogy - S.E.	FEB 97 780-5056-00	—	U210	n/a	n/a
7. Robocop	NOV 89 780-5006-00	2	5B, 5C	J4	J5	35. The Lost World: J.P.	JUN 97 780-5053-00	—	U210	n/a	n/a
8. Phantom of the Opera	JAN 90 780-5008-00	2	5B, 5C	J4	J5	36. The X-Files	AUG 97 780-5046-00	—	U210	n/a	n/a
9. Back to the Future	JUN 90 780-5009-00	3	5B, 5C	J4	J5	37. Starship Troopers	NOV 97 780-5059-00	—	U210	n/a	n/a
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						

† 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		<i>initial:</i> 520-5002-00 <i>replaced with:</i> 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		520-5002-02	520-5000-00	520-5014-01 7 Digit Alpha/Numeric Combined
Torpedo Alley		520-5002-02	520-5000-00	520-5014-01 7 Digit Alpha/Numeric Combined
Time Machine		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	5C	J4, J6a, J7a	J5, J6, J7b
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

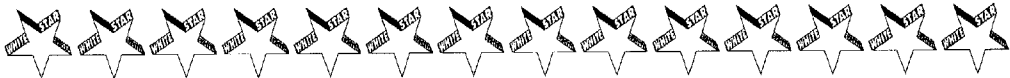
Game Name	Flipper	Sound	Power Supply	Display X-Digit
Laser War	2-Flipper Board Not Required	<i>Initial:</i> 520-5002-00 <i>replaced with:</i> 520-5002-02 520-5002-01 was not used.	520-5000-00	Master: 520-5004-00 plus: 7 Digit Alpha/Numeric 520-5005-00 (Qty. 2) 7 Digit Numeric 520-5006-00 (Qty. 2) 4 Digit 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 Trilogy - 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					FLIPPER COILS				
GA-TURNS	Res. (Ω)	SPI PART N°	GA-TURNS	Res. (Ω)	SPI PART N°	GAUGE-TURNS	Res. (Ω)	COLOR	SPI PART N°
20-400	1.0 Ω	090-5021-00	24-940 †	5.5 Ω	090-5036-00T	21-900 †	not available	RED	090-5020-10T
22-500	1.7 Ω	090-5017-00			090-5036-00B	22-750/30-2600 ‡	2.6 / 92.0 Ω	N/A	090-5011-00
22-600	2.2 Ω	090-5023-00	25-1240	9.3 Ω	090-5034-00	22-900 †	3.4 Ω	YEL	090-5020-20T
23-700	3.1 Ω	090-5022-00	26-1200 †	10.3 Ω	090-5044-00T	22-1080 †	4.3 Ω	YEL/GRN	090-5032-00T
23-750	3.4 Ω	090-5019-00			090-5044-00B				090-5032-00B
23-800 †	3.6 Ω	090-5001-00T	27-1300	14.2 Ω	090-5003-00	23-620/30-2600 ‡	2.4 / 75.0 Ω	N/A	090-5006-00
		090-5001-00B	27-1400	14.7 Ω	090-5015-00	23-700/30-2600 ‡	3.0 / 83.5 Ω	N/A	090-5013-00
23-840	4.0 Ω	090-5005-00	27-1500	16.3 Ω	090-5004-00T	23-800/30-2600 ‡	2.8 / 90.5 Ω	N/A	090-5012-00
23-1200	7.1 Ω	090-5008-00			090-5004-00B	23-900	3.8 Ω	GRN	090-5020-30
23 1/2-765	3.6 Ω	090-5037-03	28-1050	11.5 Ω	090-5046-00	23-1100	5.1 Ω	ORG	090-5030-00
24-900	5.0 Ω	090-5002-00	29-2000	33.6 Ω	090-5016-00	24-1570	9.5 Ω	N/A	090-5025-00
NOTE: Ohm values may vary +/- .03Ω depending on meter calibration.						25-1800	13.8 Ω	BLU/GRN	090-5041-00

† Coil Part N°s 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 N°
22-650	4.3 Ω	090-5042-00

MINI-COILS		
GA-TURNS	Res. (Ω)	SPI PART N°
31-1500	52.0 Ω	090-5054-00
32-1800	50.2 Ω	090-5031-00

LUGLESS COILS		
GA-TURNS	Res. (Ω)	SPI PART N°
23-800	3.6 Ω	090-5053-00

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

Flipper Coil Table ‡ ††

GAME NAME	N° of Flippers	LOWER FLIPPERS		UPPER FLIPPERS	
		SPI N° / Gauge-Turns / Color		SPI N° / 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		UPPER FLIPPERS	
		SPI N° / Gauge-Turns / Color		SPI N° / 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 N°s ending with a "T" signifies the Diode is on the top of the lug (on the coil-winding side);
Coil Part N°s ending with a "B" signifies the Diode is on the bottom of the lugs.

APPENDIX F

Motor Specification Table

Game Name	Function	Specifications	Part N°
Laser War	No motors were used on the games listed on the shaded lines.		
Secret Service			
Torpedo Alley			
Time Machine			
Playboy 35th Anniversary			
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	Neil 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	Tomblone 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 №
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 (Tomado 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	515-6794-00-59

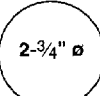
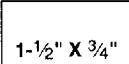
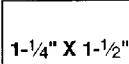
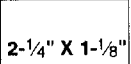
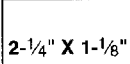
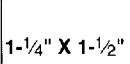
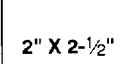
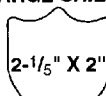
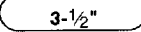
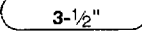
APPENDIX G

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

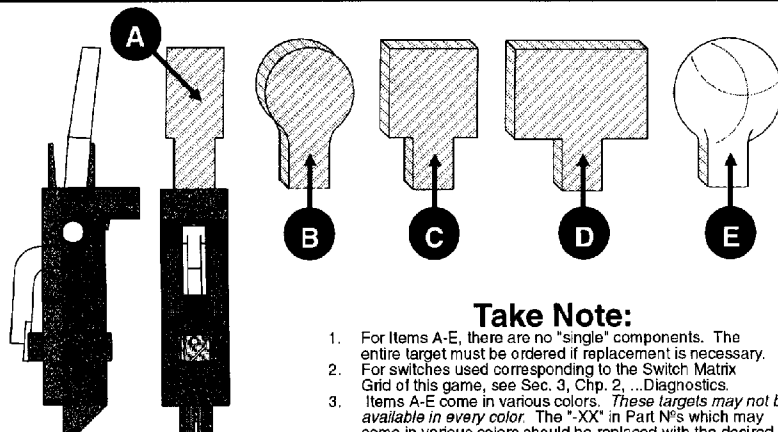
Note: The shapes and sizes shown above are not to scale. Some shapes may no longer be available in every color.

Instructions:

Parts which may come in various colors (i.e. targets, some posts, playfield inserts, etc.) end in a 2-digit N^o which correspond to the color of that part. The "-XX" in Part N^os which may come in various colors should be replaced with the desired 2-Digit N^o corresponding to the color desired. *Not all colors may be available.*

P L A S T I C P A R T C O L O R C H A R T									
N ^o	Color	N ^o	Color	N ^o	Color	N ^o	Color	N ^o	Color
-00	Black	-03	Amber	-06	Yellow	-09	Purple	-12	Fluor. Blue
-01	Clear	-04	Green	-07	Orange	-10	Fluor. Orange	-13	Teal Green
-02	Red	-05	Blue	-08	White	-11	Fluor. Green	-14	Gray
								-15	Luminescent
								-16	Gold

APPENDIX I Stand-Up Targets

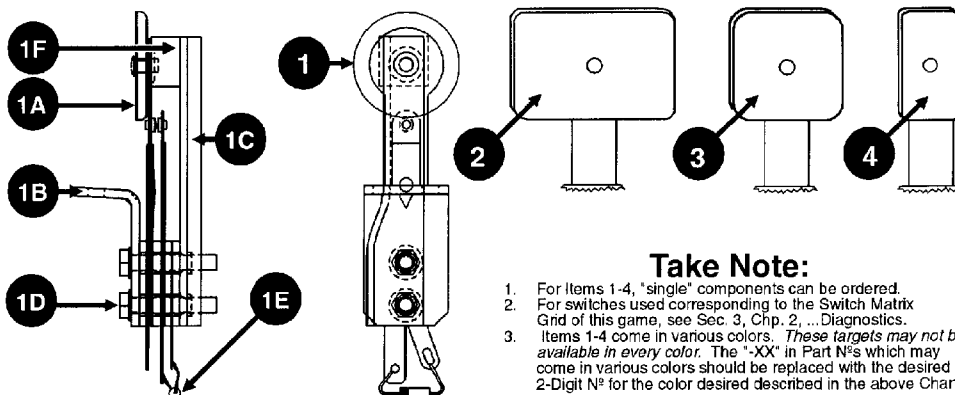


PLASTIC PART COLOR CHART	
Nº	Color
-00	Black
-01	Clear
-02	Red
-03	Amber
-04	Green
-05	Blue
-06	Yellow
-07	Orange
-08	White
-09	Purple
-10	Fluor. Orange
-11	Fluor. Green
-12	Fluor. Blue
-13	Teal Green
-14	Gray
-15	Luminescent
-16	Gold

Take Note:

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

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



Take Note:

- For Items 1-4, "single" components can be ordered.
- For switches used corresponding to the Switch Matrix Grid of this game, see Sec. 3, Chp. 2, ...Diagnostics.
- Items 1-4 come in various colors. *These targets may not be available in every color.* The "-XX" in Part N's which may come in various colors should be replaced with the desired 2-Digit N° for the color desired described in the above Chart.

Nº	Stand-Up (Flat) Target Name	Part Nº	Nº	Stand-Up (Flat) Target Name	Part Nº
1	1" Round Stand-Up Target Assy.	500-5835-XX	3	1" Sq. Stand-Up Target Assy.	500-5232-XX
ORDERING ABOVE (ITEM 1) ASSY. PART Nº WILL INCLUDE:			ORDERING ABOVE (ITEM 3) ASSY. PART Nº WILL INCLUDE:		
1A†	Switch & Target Assy. 1" Round	515-5966-XX	3A†	Sw. & Target Assy. 1" Square	515-5162-XX
1B	Mounting Bracket	535-6896-00	Items 3B-F are identical to 1B-F		
1C	Switch Back Plate	535-6452-00	Same as 1B-F		
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 (545-5145-XX).			† 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 (545-5145-XX).		
2	1" X 1½" Stand-Up Rect. Target Assy.	500-5321-XX	4	Narrow Stand-Up Target Assy.	500-5835-XX
ORDERING ABOVE (ITEM 2) ASSY. PART Nº WILL INCLUDE:			ORDERING ABOVE (ITEM 4) ASSY. PART Nº WILL INCLUDE:		
2A†	Sw. & Target Assy. 1" X 1½" Rect.	515-6027-XX	4A†	Sw. & Target Assy. Narrow	515-5967-XX
Items 2B-F are identical to 1B-F			Items 4B-F are identical to 1B-F		
† 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 (545-5145-XX).			† 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).		

Item 2 Table Note continued in the next column.

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) Alternating Current.

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. CN5-P3).

CT (Abbreviation) Center.

DC (Abbreviation) Direct Current.

DT (Abbreviation) Drop Target(s).

DOTS (Acronym) Diode On Terminal Strip.

EB (Abbreviation) Extra Ball.

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

EPROM (Acronym) Erasable Programmable Read Only Memory. Can be erased using UV Light and re-programmed.

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

EOS (Acronym) End-Of-Stroke (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) Integrated Circuit (As in after 24-Pin IC).

ID or I.D. (Acronym) Inside Dimension.

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) Light Emitting Diode.

Loop [Shot] Continuously up a ramp and back to the flipper.

Lwr. (Abbreviation) Lower.

Orbit [Shot] From the left or right flipper around the back rail of the playfield back to the flipper.

MB (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 N° or # (Abbreviation) Number

NPF (Acronym) No Problem Found.

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-P3).

PCB (Acronym) Printed Circuit Board

P/F (Abbreviation) Playfield.

PIA LED (Acronym) Peripheral Interface Adapter Light Emitting Diode. 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) Random Access Memory. 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) Read Only Memory. 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) Vertical Up-Kicker (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

[illegible]

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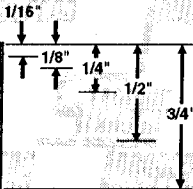


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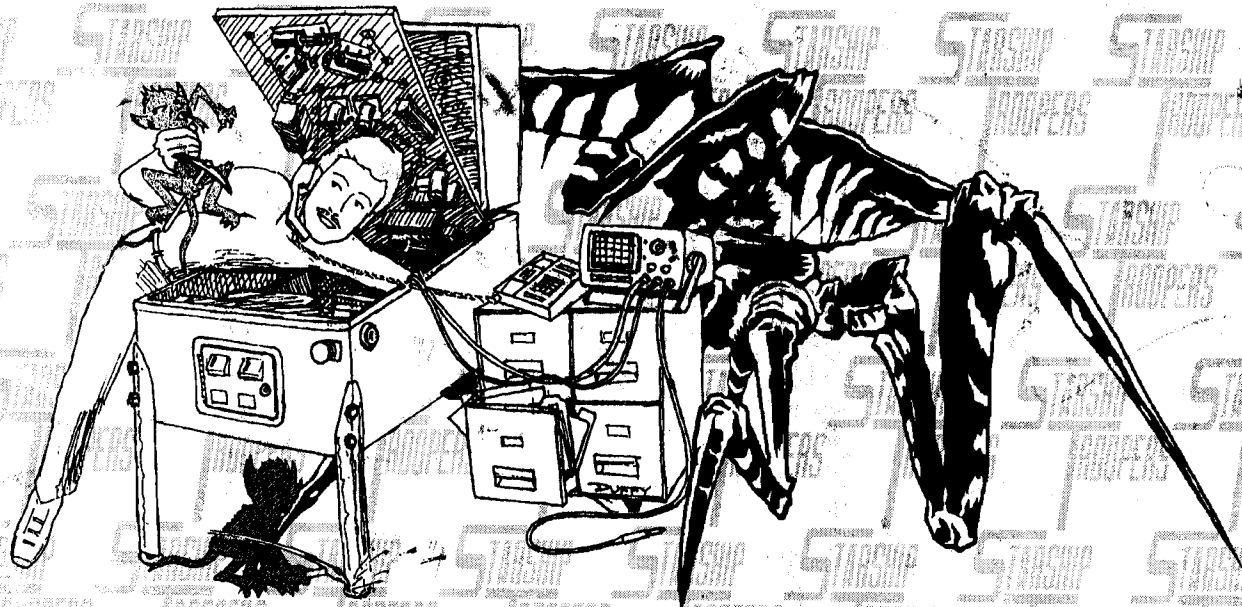


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Inch fractions defined:



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



STARSHIP TROOPERS

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