HOT TIP

SOLID STATE

DEC. 1977



Williams® ELECTRONICS
A SUBSIDIARY OF
THE SEEBURG CORPORATION OF DELAWARE

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477 HOT TIP
SOLID STATE
FLIPPER GAME

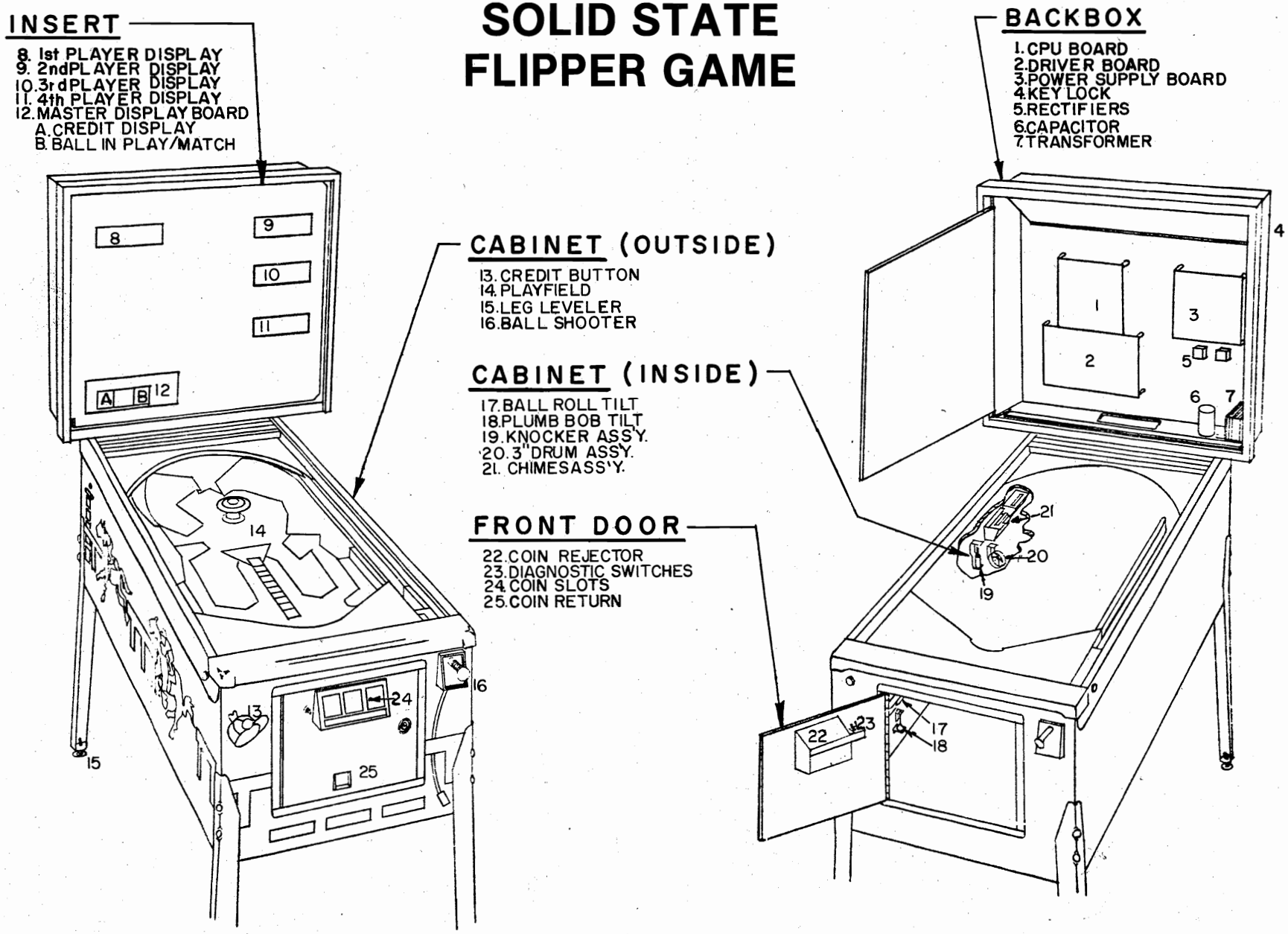


Figure 1

Hot Tip
Section 1
Installation

The initial set up and assembly of the solid state HOT TIP is identical to mechanical pinballs.

First, remove the backbox and cabinet from their respective shipping cartons. Set up the cabinet and mount the legs. Reach into the large hole in the backbox and pull out the power cord and place it in the slot provided. Do not plug machine in at this time.

Next, remove the red shipping block from insert door and place the assembled backbox on the pedestal. Do not pull up any of the other cables from the cabinet at this time.

Note that the back box has a metal bracket protruding from the square bottom hole. This bracket engages a similar bracket on the cabinet pedestal to prevent the backbox from tipping forward while the insert door is open.

Open the insert door by sliding the door latch (located at right) to the left. Install the backbox mounting bolts securely. Level the machine from side to side and front to back by adjusting the leg levelers.

There are five harnesses that must be interconnected next. Three of the harnesses are from the playfield and two are from the cabinet. The connectors are size and color coded and mate wires of the same color together, except in the case of the power line to the transformer connector, where the colors do not match. Connect the black plug to the black connector first. Then interconnect the remaining four connectors. DO NOT intermix the white connector and black plug even though they are the same size.

Next, connect the braided ground strap to the backbox shield liner by fastening it under the wing nut located just in front of the rectangular bottom hole in the backbox.

Then check the connectors to make sure that none of the wire terminations have come loose or were pushed out. Reseat any loose wires by pushing in on the wire terminations.

Also push on all the connectors that are attached to the CPU Board (Figure 1 - No. 1) to make sure they are firmly seated. Then push on all the connectors that are attached to the Driver Board (Figure 1 - No. 2) to make sure they are firmly seated. Also push on all the connectors that are attached to the Power Supply Board (Figure 1 - No. 3). Then check the connectors on both bridge rectifiers (Figure 1 - No. 5) and the filter capacitor (Figure 1 - No. 6).

Also check and push on all the connectors that are attached to the Master Display Board (Figure 1 - No. 12) and the connectors that leave the Master Display Board and go off to the four individual player displays (Figure 1 - No. 8,9,10,11). Finally, check and push on the connector which interconnects the coin door mechanism to the cabinet harness.

After all the connectors have been checked as outlined above, gently press on the integrated circuit (IC) packages that are socketed on the CPU and Driver Boards. (See Figure 2). DO NOT remove any of the IC packages from their sockets. Also check that the batteries are still securely mounted to the CPU Board. DO NOT REMOVE THE BATTERIES! If the batteries are removed with power off the game will go to default values for all the options and particular changes will have to be restored manually before the game can be put on location. The batteries are all installed with the positive (+) end up. Battery life is about the same as shelf life or about one year. When it is time to replace the batteries, remove the batteries while the game is ON or the game will go to default values.

Check that all cables are clear of moving parts. Check for any wires that may have come disconnected. Check switches for loose solder or other foreign material that may have come loose in shipment. Check wires on coils for proper soldering. Check that fuses on the Power Supply Board are secure. Check adjustment of the four tilt switches: Playfield Shake on bottom of playfield, Super Slam on front door, Plumb bob tilt on left side of cabinet near front door and Ball Roll tilt above the Plumb bob. Refer to Section 8 for specific mechanical adjustments for each of these tilt switches.

Before plugging the machine in, also check that the AC line fuse is secure in its holder. Install the ball in the roll tilt and also install the captive ball on the playfield by removing one nut holding the retainer, swing it out of the way, insert the ball and swing it back into place. Replace the nut.

This machine MUST BE PLUGGED INTO A PROPERLY GROUNDED OUTLET TO PREVENT SHOCK HAZARD and to insure PROPER GAME OPERATION. DO NOT use a "cheater plug" to defeat the ground pin. DO NOT cut off the ground pin. The line voltage MUST agree with that on the shipping carton or serious damage to the machine will occur when it is plugged in.

The game is now ready to plug in and check out. Lower the playfield and close the insert door. Plug the game in and flip the power switch located near the right front cabinet leg on. The game will come on and should come up in the game over mode.

The game over mode is indicated by player scores reading zero, player one up light flashing, game over lights lit. The high score to date will alternate with player one score only. Flippers will be inoperative and the general illumination lamps will be lit. The game can now be checked out by play, or diagnostics can be run (See Section 5), or game option adjustments can be made (See Section 3).

HOT TIP SOLID STATE
SOCKETED COMPONENTS

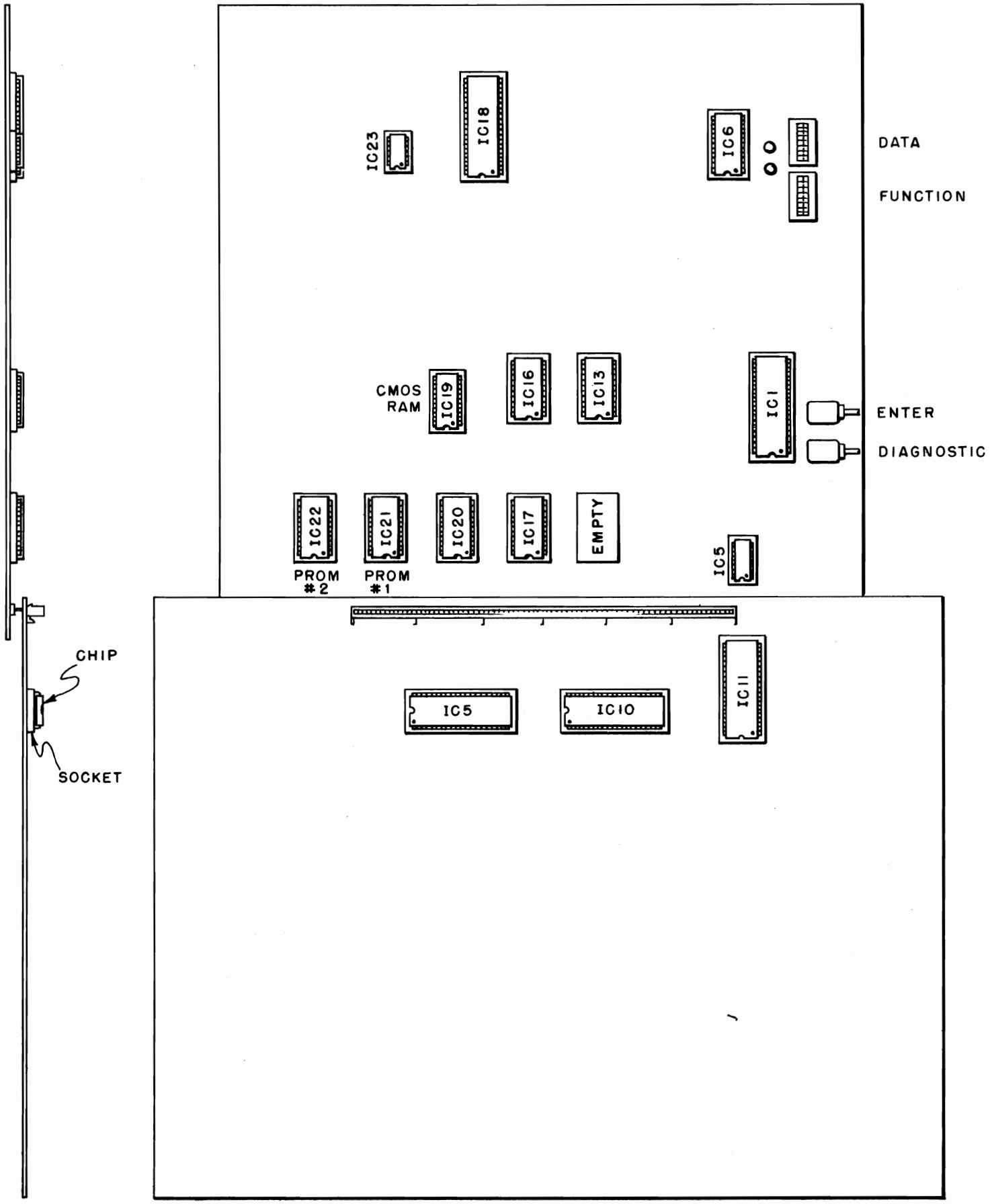


Figure 2

If the game comes up in the diagnostic mode, the ball in play display will show 04 (Figure 1 - No. 12B) and the credit display will show 01 (Figure 1- No. 12A). This indicates that either the batteries were removed or came loose during shipment. The game status has returned to factory default settings, and some values will probably have to be restored according to the procedure outlined in Section 3.

If the game does not light up or does not come up in game over or diagnostic mode, refer to troubleshooting Section 6.

Section 2
General Game Operation and Scoring

Place ball into playfield by outhole. When machine is turned on it will come on in the game over mode. Player 1 up light will be flashing. All player scores will be zero and Player 1 score will alternate from zero to High Score to Date. Game over lights will be lit.

Insert coin into machine. The machine should accept coins and post credits. The knocker will sound for each credit. Pressing the credit button on the cabinet front will cause the outhole kicker to serve the ball, the credit display will be reduced by one, the number of players light will show one, the William Tell Overture tune will be played and the ball in play display will show 01. Pressing the credit button at any time before the ball in play display shows 02 will allow additional players and change the number of players light and reduce the credits by one for each additional player.

Player one up light will flash until the ball makes the first switch or bumper. If the first switch made is the switch inside the spinner lane the machine will tilt out that players ball. The lights surrounding the top eject hole will alternate until the first switch is made. The bonus value is set at 1000 points and the HOT-TIP targets score 10 points. The jet bumper scores 100 points. Side rebound switches score 500 points. The captive ball switch scores 100 points and the captive ball target scores 1000 or 3000 points if lit. The top rebound switches score 10 points and advance the top ejector lights. The rebound switch below H O T targets scores 10 points. The advance bonus switch scores 1000 points and advances bonus. The lane switches score 1000 points. The outside lane switches score 1000 point and award the special when lit. The ejectors score 500 points and advance the bonus or other score features when lit.

Scoring all H O T - T I P targets the first time lights the first horseshoe and also the Double Bonus* if not already lit. It also lights spinner bonus light, resets all HOT TIP targets, makes the targets worth 100 points and scores 5000 points.

Scoring all H O T - T I P targets the second time lights second horseshoe. It resets HOT TIP targets, makes the targets worth 1000 points and scores 5000 points. The extra ball* lights by the left ejector hole.

Scoring all H O T - T I P targets the third time lights third horseshoe and resets all HOT TIP targets. The targets remain at 1000 points. An additional 5000 points is added to the score and the special* light is lit. Making the outhole lane switch with that light on awards replay credit.

Extra balls* won during the course of the game are played immediately after the player's regular ball enters the outhole.

When the ball enters the outhole, the bonus score is added, the HOT TIP targets are reset, and the ball is ejected. The player up light flashes to indicate the next player. The bonus score is reset to 1000 points and all other scoring is set to normal.

After the last ball is played, the match digits appear where the ball in play digits were. If match occurs an extra credit* will be given. The game over tune "Good Night Ladies" will play and the game over lights will light. The high score to date will alternate with the winning player's score only and the winning player's player up light will flash.

If a player's score exceeds the current high score to date, three* credits will be awarded and the game will play "1812 Overture" and the high score light will remain lit.

A player has three* chances before the plumb bob tilt tilts the ball in play. The buzzer sounds to warn the player of the first two plumb bob tilts. The third tilts that player's ball. The ball roll and playfield shake tilt switches tilt the ball in play immediately. The super slam tilt on the coin door sets all player scores to zero and returns the game to game over.

If coins are inserted and the maximum* number of credits is exceeded, the credit will be posted correctly but the coin lockout coil will be de-energized until the number of remaining credits is below the maximum.

* These features are adjustable and the procedure is outlined in Section 4.

Test 4 Readout No.	Function Switch	Data Switch	Default Value	This Game
01	01	Replay 1 (Chart 2) 10,000 pts	90,000 (09)	
02	02	Replay 2 (Chart 2) 10,000 pts	140,000 (14)	
03	03	Replay3 (Chart 2) 10,000 pts	200,000 (20)	
04	04	Replay 4 (Chart 2) 10,000 pts	Disabled (*)	
05	05	Maximum Credits (Chart 2)	20	
06	06	Match/Credit/Extra Ball (Chart 1)	00	
		00 - Match ON-Credit award at Replay Points		
		01 - Match ON-Extra ball award at Replay Points		
		04 - Match OFF-Credit award at Replay Points		
		05 - Match OFF-Extra ball award at Replay Points		
07	07	Play (Chart 2)	02	
		01 - Liberal		
		02 - Moderate		
		03 - Conservative		
		04 - No Special, No extra Ball		
08	08	High Score Credits (Chart 2)	03**	
09	12	Lowest coin slot multiplier (Chart 1)	01	
10	13	Middle coin slot multiplier (Chart 1)	01	
11	14	Highest coin slot multiplier (Chart 1)	01	
12	15	Minimum coin units for credit (Chart 1)	00	
13	16	Coin units bonus point (Chart 1)	02	
14	17	Coin units per credit (Chart 1)	01	
15	18	Number of balls (Chart 2)	03	
		03 - Normal play - 3 balls		
		05 - Normal play - 5 balls		
		23 - Extra ball for "special" - 3 balls		
		25 - Extra ball for "special" - 5 balls		
		43 - "Special" awards 10 x value - 3 balls		
		45 - "Special" awards 10 x value - 5 balls		
16	19	Maximum tilts (Chart 2)	03	
17	20	Current number of credits (Chart 2)	00	
18	21	High score to date (Chart 2) 10,000 pts	15	
	22	High score to date (Chart 2) 100 pts	00	
	23	High score to date (Chart 2) 1 pts	00	
19	—	Number of coins through Slot 1	Cannot be set	
20	—	Number of coins through Slot 2	Cannot be set	
21	—	Number of coins through Slot 3	Cannot be set	
22	—	Number of credits payed for	Cannot be set	
23	—	Number of credits won	Cannot be set	

* To disable a replay point turn all data switches ON for that replay function number.

** To disable high score credits turn all data switches OFF for function 08.

TABLE 1A

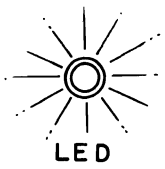
Test 4 Readout No.	Function Switch	Data Switch	Default Value	This Game
01	01	Replay 1 (Chart 2) 10,000 pts	90,000 (09)	
02	02	Replay 2 (Chart 2) 10,000 pts	140,000 (14)	
03	03	Replay 3 (Chart 2) 10,000 pts	200,000 (20)	
04	04	Replay 4 (Chart 2) 10,000 pts	Disabled (*)	
05	05	Maximum Credits (Chart 2)	20	
06	06	Match/Credit/Extra Ball (Chart 1)	00	
		00 - Match ON - Credit award at Replay Points		
		01 - Match ON - Extra ball award at Replay Points		
		04 - Match OFF - Credit award at Replay Points		
		05 - Match OFF - Extra ball award at Replay Points		
07	07	Play (Chart 2)	02	
		01 - Liberal		
		02 - Moderate		
		03 - Conservative		
08	08	High Score Credits (Chart 2)	03**	
09	12	Lowest coin slot multiplier (Chart 1)	01	
10	13	Middle coin slot multiplier (Chart 1)	02	
11	14	Highest coin slot multiplier (Chart 1)	05	
12	15	Minimum coin units for credit (Chart 1)	00	
13	16	Coin units bonus point (Chart 1)	10	
14	17	Coin units per credit (Chart 1)	05	
15	18	Number of balls (Chart 2)	73	
		73 - 3 ball play		
		75 - 5 ball play		
16	19	Maximum tilts (Chart 2)	03	
17	20	Current number of Credits (Chart 2)	00	
18	21	High Score to date (Chart 2) 10,000 pts	15	
	22	High Score to date (Chart 2) 100 pts	00	
	23	High Score to date (Chart 2) 1 pts	00	
19	—	Number of coins through Slot 1	Cannot be set	
20	—	Number of coins through Slot 2	Cannot be set	
21	—	Number of coins through Slot 3	Cannot be set	
22	—	Number of credits payed for	Cannot be set	
23	—	Number of credits won	Cannot be set	

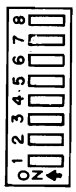
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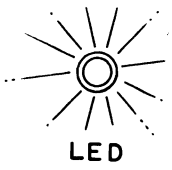
TABLE 1B

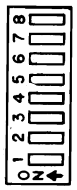
CHART 1





DATA





FUNCTION



ENTER



DIAGNOSTIC

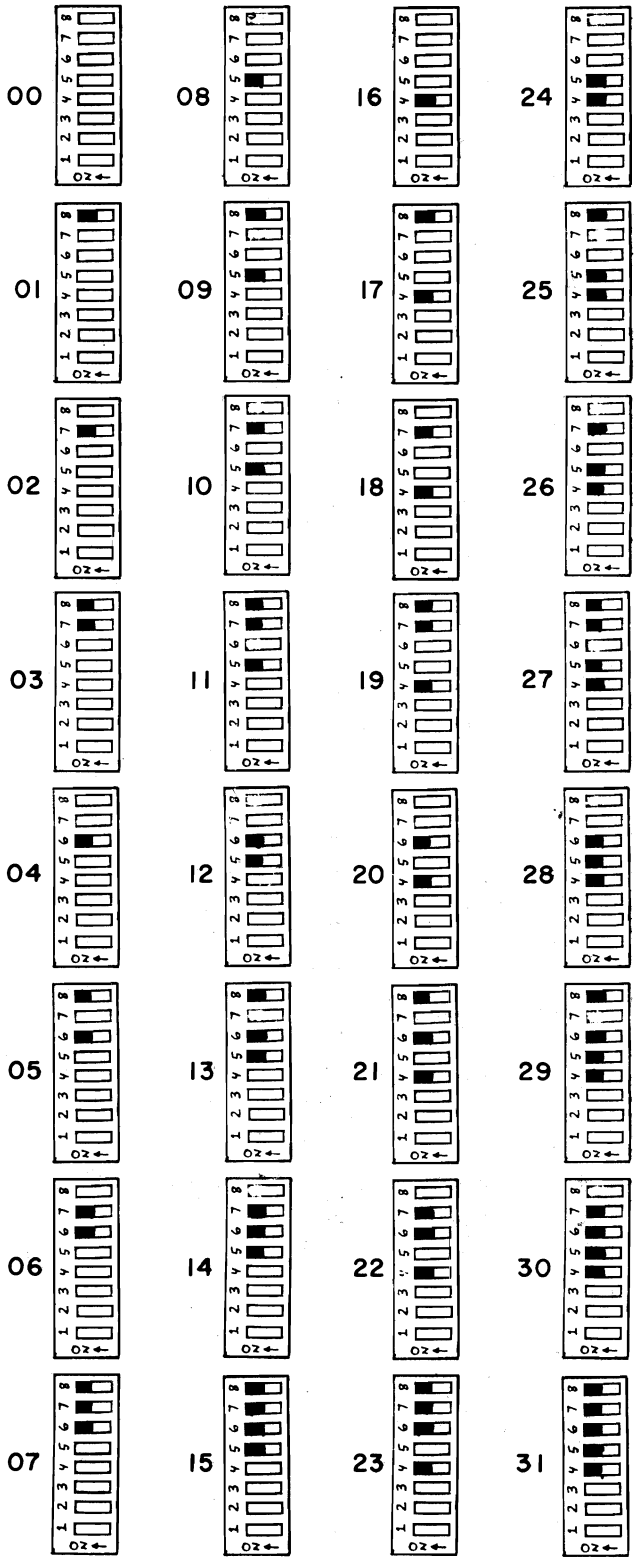
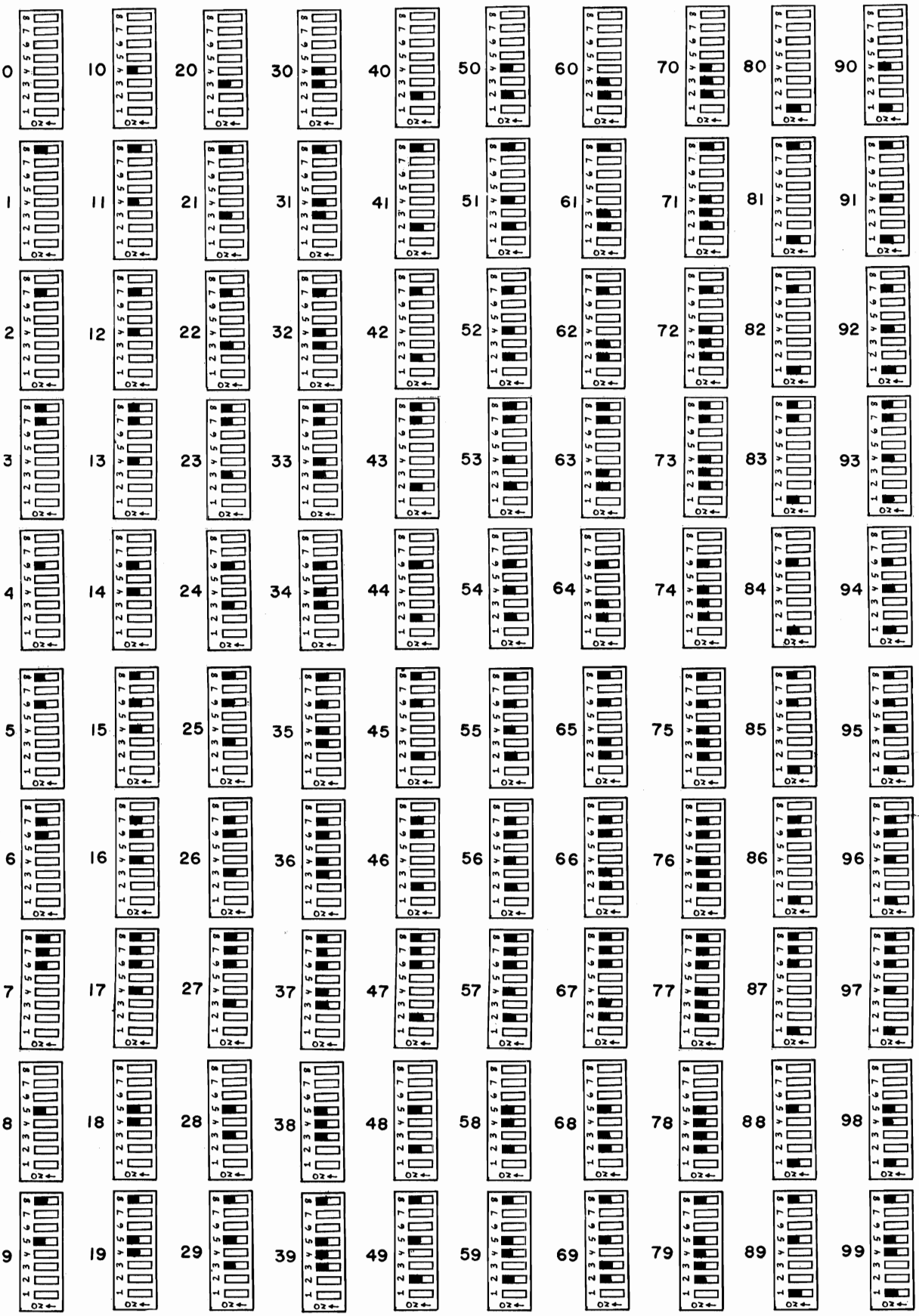


CHART 2


0 10 20 30 40 50 60 70 80 90
1 11 21 31 41 51 61 71 81 91
2 12 22 32 42 52 62 72 82 92
3 13 23 33 43 53 63 73 83 93
4 14 24 34 44 54 64 74 84 94
5 15 25 35 45 55 65 75 85 95
6 16 26 36 46 56 66 76 86 96
7 17 27 37 47 57 67 77 87 97
8 18 28 38 48 58 68 78 88 98
9 19 29 39 49 59 69 79 89 99

Section 3
Game Adjustments

The solid state HOT TIP offers great versatility in customizing the game to the location or operator's requirement. A very simple means of altering factory settings of various replay and other options has been devised. This section outlines the general procedure for making these changes.

Open the insert box door and locate the CPU Board (Figure 1 - No. 1). On the right hand side of the CPU Board there are two 8 position miniature slide switches and below them are two pushbuttons.

Prepare to enter the diagnostic mode by first turning off the machine and then turning it back ON. Then to enter diagnostics, press the lower pushbutton on the CPU Board. The two LED's to the left of the switches will blink twice and go off. If the LED's do not blink twice or stay on continuously, refer to troubleshooting guide in Section 6.

Determine which function is to be changed by looking at Table 1. To change the number of balls per game, for example, is function 18. The game is set up for 3 balls play but can be changed to 5 ball play very easily.

Next, since Function 18 is to be changed, set the BOTTOM switch identically to the switch beside the number 18 in Chart 1. A black mark on Chart 1 next to the switch number indicates that that position of the lower switch is ON (move switch to the left). No black mark indicates that that position switch number should be left OFF (move switch to the right).

The third step is to determine the new data to be entered. In this case Table 1 says to use Chart 2 and to enter 03 or 05 for 3 or 5 ball play. The choice is 5 ball so the TOP switch must be set identically to the switch beside the number 05 in Chart 2. Data numbers may be specified as either Chart 2 or Chart 1 so care must be exercised to use the correct chart or erroneous data may be entered.

Once both the top switch and the bottom switch have been set correctly for the change desired. press the upper pushbutton of the two one time. The two LED's will blink to indicate that the change has been made. If the LED's do not blink when the ENTER pushbutton is depressed, recheck switch settings.

Continue to enter any other changes by checking Table 1 for the correct function number. Use Chart 1 and enter the function number on the lower switch. Then determine the new data desired, and refer to the specified chart for the function. Set the top switch accordingly. Then press the ENTER pushbutton (top pushbutton) once to lock in the new data. Continue to repeat this procedure for all changes.

The functions can be entered in any order. If a mistake is made in setting the data switches, the correct settings can be made and the ENTER button pressed again to enter the new data. Only the last data entered will be retained. If the batteries are removed with power OFF the data must be re-entered manually. There are two ways to verify the data changes entered. One is to turn the machine OFF and then ON again. Then play the machine to see if the new values are correct. A faster method is to use test 4 of the built in diagnostics, and this is described in Section 5 of this manual.

The following is a brief summary of all game adjustments.

Replay

There are four possible replays awarded from scoring. The default factory settings for the first replay occurs at 90,000 points; the second at 140,000; the third at 200,000; and the fourth is disabled. Replay 1 is function 01. It can be increased or decreased by any multiple of 10,000 points. Table 1 specifies to use Chart 2 for setting the data switch. To establish a replay of 120,000 points instead of 90,000 points a value of 12 (12 x 10,000 = 120,000) must be entered on the data switch, using Chart 2 to set up the top switch and Chart 1 to set up Function 01 in the function switch.

1. If not already in diagnostics, enter diagnostics by pressing the lower pushbutton once.
2. Set up function switch exactly like switch 01 in Chart 1.
3. Set up data switch exactly like switch 12 in Chart 2.
4. Press ENTER button once. The LED's will blink once and the new data is locked in.

To disable the first replay point, turn all data switches ON (move switch to the left). Follow the procedure steps 1 thru 4, except that in step 3 remember to turn all switches ON.

To change or disable replays 2, 3, or 4, enter Function 02, 03, or 04 in step 2 and follow procedure steps 1 thru 4, substituting the new desired value in step 3.

Maximum Credits

Maximum credits is the number of credits that can be entered by putting coins in the machine before the coin lockout coil is released. The default value is 20 credits. Maximum credits is Function 05. It can be set for any value from 01 to 99 using Chart 2 as specified by Table 1. To establish a maximum credits of 10 for example, the function switch would have to be set as 05 and the data switch set to 10 using Chart 2.

1. If not already in diagnostics, enter diagnostics by pressing to lower push-button once.
2. Set up function switch exactly like switch 05 in Chart 1.
3. Set up data switch exactly like switch 10 in Chart 2.
4. Press ENTER button once. The LED's will blink once to indicate that the new data is locked in.

Match/ Credit / Extra Ball

Credits given when a match occurs and extra balls or credits given at replay points can be disabled if desired. Default values give a replay credit for a match. The Credit/Extra Ball is Function 06 and Table 1 specifies to use Chart 1 for the data switch. There are four possible combinations of enabling these two features. Table 1 specifies that for Function 06 Chart 1 is to be used for the data switch values. Table 1 also shows the various possibilities and the value to enter on the data switch.

Data Switch

00 Match ON - Credit award at Replay points
01 Match ON - Extra ball award at Replay points
04 Match OFF - Credit award at Replay points
05 Match OFF - Extra ball award at Replay points

1. If not already in diagnostics, enter diagnostics by pressing the lower pushbutton once.
2. Set up function switch exactly like switch 06 in Chart 1.
3. Set up data switch exactly like switch 00, 01, 04, or 05 in Chart 1.
4. Press ENTER button once. The LED's will blink to indicate that the new data is locked in.

Play

The bonus, extra ball, and special lights are normally lit by making the HOT TIP Targets. Making the H O T - T I P targets light up horseshoe one. Making the H O T - T I P targets a second time lights up horseshoe two. Making the targets a third time lights horseshoe three. There are four modes of play possible.

01 - Liberal
02 - Moderate
03 - Conservative
04 - No Special - No extra ball

When in the Liberal mode - lighting Horseshoe 1 lights both the bonus and extra ball. When in Moderate mode, lighting Horseshoe 1 lights the bonus and lighting Horseshoe 2 lights the extra ball. When in Conservative mode, lighting Horseshoe 1 awards nothing, lighting Horseshoe 2 lights both the bonus and extra ball. In all modes, the only way to light the special is by lighting Horseshoe 3.

Play is function 07 and Table 1 specifies to use Chart 1 to enter the data on the data switch. Table 1 also shows the value to enter for the various modes.

01 - Liberal
02 - Moderate
03 - Conservative
04 - No Special - No Extra Ball

1. If not already in diagnostics, enter diagnostics by pressing the lower pushbutton once.
2. Set up function switch exactly like switch 07 in Chart 1.
3. Set up data switch exactly like switch 01, 02, 03, or 04 in Chart 2.
4. Press ENTER button once. The LED's will blink to indicate that the new data is locked in.

High Score Credits

When the high score to date is exceeded by a player, any number of replay credits may be awarded. The default value is 3 credits. High score credits is Function 08 and Table 1 specifies to use Chart 2 for setting the date switch. In order to disable awarding high score credits, turn OFF all data switches to get a value of zero.

1. If not already in diagnostics, enter diagnostics by pressing the lower pushbutton once.
2. Set up function switch exactly like switch 08 in Chart 1.
3. Set up data switch according to Chart 2 for the number of credits to be awarded. To disable, turn OFF all data switches.
4. Press ENTER pushbutton once. The LED's will blink to indicate that the new data is locked in.

Number of Balls

The number of balls per game is set by default to 3 balls per game. Number of balls is function 18 and Table 1 specifies to use Chart 2. Enter either 03 or 05 on the data switch to get 3 or 5 ball play respectively.

1. If not already in diagnostics, enter diagnostics by pressing lower push-button once.
2. Set up function switch exactly like switch 18 in Chart 1.
3. Set up data switch according to Chart 2 for the number of balls.
4. Press ENTER pushbutton once. The LED's will blink to indicate that the new data is locked in.

Maximum Tilts (Plumb Bob Tilts Only)

The number of plumb bob tilts before forfeiting the ball can be set. Maximum tilt is function 19 and Table 1 says to use Chart 2 for the data switch values. The default value is normally set at 3. Shaking the machine causes the buzzer to sound. The third time the buzzer sounds results in forfeiture of that player's ball. All the other tilts do not have this multiple tilt capability; only the plumb bob tilt. To disable the multiple tilt feature, enter a value of 01.

1. If not already in diagnostics, enter diagnostics by pressing the lower push-button once.
2. Set up function switch exactly like switch 19 in Chart 1.
3. Set up data switch according to Chart 2 for whatever value desired (01 to disable).
4. Press ENTER pushbutton once. The LED's will blink to indicate that the new data is locked in.

Current Credits

The number of credits currently in the machine can be set to any number. Current credits is Function 20 and Table 1 specifies to use Chart 2 for the value to be entered on the data switch. Any number of free credits can be entered in this manner.

1. If not already in diagnostics, enter diagnostics by pressing lower push-button once.
2. Set up function switch exactly like switch 20 in Chart 1.
3. Set up data switch according to Chart 2 for whatever value desired.
4. Press ENTER button once. The LED's will blink to indicate that the new data is locked in.

High Score To Date

The high score to date default value for HOT TIP is 150,000 points. Functions 21, 22, and 23 allow setting the score to any value desired. Function 21 sets up the value of the 100,000 and 10,000 pts digits. Function 22 sets up the value of the 1000 and 100 pts digits. Function 23 sets up the value of the 10 and 1 pts digits. For example, to make the high score to date 235,750 points, Function 21 would have to have its data switch set up for a value of 23. Then Function 22 would have to be set up and its data switch would have to be set for a value of 57. Finally, Function 23 would have to be set up and its data switch value entered as 50. This would result in 23, 57, and 50 being set as the high score to date-235,750. Any value can be entered in this manner.

1. If not already in diagnostics, enter diagnostics by pressing lower push-button once.
2. Set up the function switch exactly like switch 21, 22, or 23 in Chart 1.
3. Set up the data switch for the new value using Chart 2.
4. Press ENTER pushbutton once. The LED's will blink to indicate that the new data is locked in.

Repeat steps 2 thru 4 to change any other of the digit pairs, using the appropriate function number in step 2.

Game Pricing

Six different functions control the various options in setting game pricing. Three pertain to the particular coin door mechanism installed on the game and three pertain to minimum number of coins and the credits awarded for the coins inserted.

The solid state HOT TIP has been designed with versatility in mind. Different coin door mechanisms can be interchanged without extensive rewiring simply by plugging the new coin door mechanism in and changing the six functions.

There are many combinations of coin values and three chute or twin chute coin mechanisms. This explanation will detail how the six functions interrelate and describe sample settings and pricing.

The first step in setting game pricing is to establish the number of coin chutes and the relative value of the coins. Function 12 will pertain to the lowest value coin chute, normally the left chute. Function 13 pertains to the middle value coin chute, normally the center chute. Function 14 pertains to the highest value coin chute, normally the right chute. In the case of a twin chute mechanism, Function 13 would be set to a value of zero.

Next, determine the lowest value single coin, the middle value single coin, and the highest value single coin that can be put into the machine. For example, in a 5, 10, and 25¢ machine the lowest value coin is 5¢, the middle 10¢, and highest coin is 25¢. In a twin quarter chute the lowest and highest value is 25¢ and there is no middle value coin.

Then, reduce all the coin values by dividing each of them by the largest number possible that leaves a remainder of zero. First, try dividing each coin value by 2. If there are any remainders other than zero, try dividing by 3. If there are remainders other than zero, try dividing by 4 etc. until the value of the smallest value coin is reached as the divider.

For example, in a 5, 10, and 25 cent mechanism, 25 ÷ 5 = 5 remainder zero and 10 ÷ 5 = 2 remainder zero. In a 25 cent twin chute mechanism, 25 ÷ 25 = 1 remainder zero. In a 10, 10, and 25 cent mechanism, the largest divider is 5, leaving values of 2, 2, and 5.

These values become the coin slot multipliers and are entered into the machine using Functions 12, 13, and 14. In the examples given above, the 5, 10, and 25 cent machine would have function 12 set to 01, function 13 set to 02, and function 14 set to 05. For the twin quarter chute, function 12 would be set to 01, function 13 set to 00 because there is no center chute, and function 14 set to 01. For 10, 10, 25 mechanisms, function 12 would be set to 02, function 13 set to 02, and function 14 set to 05.

The relative value of all the coins for the coin mechanism has now been established. Next, determine if there is a minimum amount to be entered before giving any credits. For example, the machine can be set to give 3 credits for 50 cents, but no credits until at least 50 cents has been entered. If there is no minimum required, set Function 15 to a value 00. If there is a minimum, divide it by the same divider used to reduce the coin values. For example, in the 5, 10, 25 machine, the divider is 5. If a minimum of 50 cents has to be entered before giving any credits, divide 50 by 5 to get an answer of 10. This will be the value entered on the data switch for function 15. In the twin quarter chute, the divider was 25. When 25 is divided into 50 cents minimum, the answer is 2 so 02 would be the value entered for function 15. For the 10, 10, 25 mechanism, the divider was 5. When 5 is divided into 50 cent minimum, the answer is 10 so the value 10 is entered for Function 15. Any minimum can be established in this manner, so long as the divider used to reduce the coin values goes into the minimum with a remainder of zero. A minimum of 65 cents could not be entered for a 25 cent machine, but could be entered for a 5, 10, 25 cent machine if desired.

The next function to be determined is the number of credits to be given for coins. Again, the values entered in Functions 12, 13, and 14 are used as a guideline. Each coin dropped through the coin chute will award the number of units as set by Functions 12, 13, and 14. If, for example, one credit is to be given for each 25 cents deposited in a 5, 10, 25 machine, the number 05 would be entered as data for function 17. Depositing 5¢ gives 1 unit, 10¢ 2 units, and 25¢, 5 units. Any combination of nickels and dimes would award 1 credit, as would 25 cent pieces. If one credit is to be given for each 50 cents worth of coins deposited in a 5, 10, 25 machine, a value of 10 would be entered as data for function 17.

For the twin chute 25 cent machines, if 2 quarters were required to award 1 credit, a 02 would be entered for data for function 16. If 25 cents awarded 1 credit, a 01 would be entered for data for function 17. To easily determine the data, use the value entered for the lowest coin value and determine how many many lowest value coins must be deposited to award a single credit. Use this number for function 16. (Sample settings are given at the end of this section)

The last function that needs to be determined is the number of bonus credits given for coins (if any). Bonus credits is Function 16 and can be disabled by entering a value of 00.

To determine the bonus credit value, use the value entered for Function 17 as follows: To award a bonus credit for every 2 credit worth of coins, enter double the value of function 17 as the data in function 16. For example, twin quarter chutes: 1 play 25 cents, 3 plays 50 cents. Function 17 would be a 01, so set Function 16 as twice 01, or 02. To award a bonus credit for every 3 credits worth of coins, enter triple the value of function 17 as the data for function 16. For the example cited above, 03 would be entered so that for every 75 cents an extra credit would be given.

Sample Settings

	5,10,25 Coin Door						25, 0, 25 Coin Door					
	Function						Function					
Price	12	13	14	15	17	16	12	13	14	15	17	16
1 Play 25¢	01	02	05	00	05	00	01	00	01	00	01	00
1 Play 25¢ 3 Play 50¢	01	02	05	00	05	10	01	00	01	00	01	02
2 Play 25¢	02	04	10	10	05	00	02	00	02	00	01	00
2 Play 25¢ 5 Play 50¢	02	04	10	10	05	20	02	00	02	02	01	04
3 Play 25¢	03	06	15	15	05	00	03	00	03	00	01	00
3 Play 25¢ 7 Play 50¢	03	06	15	15	05	30	03	00	03	00	01	06
4 Play 25¢	04	08	20	20	05	00	04	00	04	00	01	00
5 Play 25¢	05	10	25	25	05	00	05	00	05	05	01	00
Data Switch												
1 Play 25¢ 3 Play 50¢	01	02	05	00	05	10	01	00	01	00	01	02
1 Play 50¢	01	02	05	00	10	00	01	00	01	00	02	00
1 Play 50¢ 3 Play $1.00	01	02	05	00	10	20	01	00	01	00	02	04
1 Play 75¢	01	02	05	00	05	00	01	00	01	00	03	00
1 Play 75¢ 3 Play $1.50	01	02	05	00	15	30	01	00	01	00	03	06
1 Play $1.00	01	02	05	00	20	00	01	00	01	00	04	00
1 Play $1.00 3 Play $2.00	01	02	05	00	20	40	01	00	01	00	04	08
2 Play $1.00	01	02	05	20	10	00	01	00	01	04	02	00
3 Play $1.00	01	02	05	20	06	00	03	00	03	12	04	00

Section 4
Game Bookkeeping

The game is designed with the operator in mind. There are 5 separate game bookkeeping totals which can be accessed from the coin door. (See Figure 3).

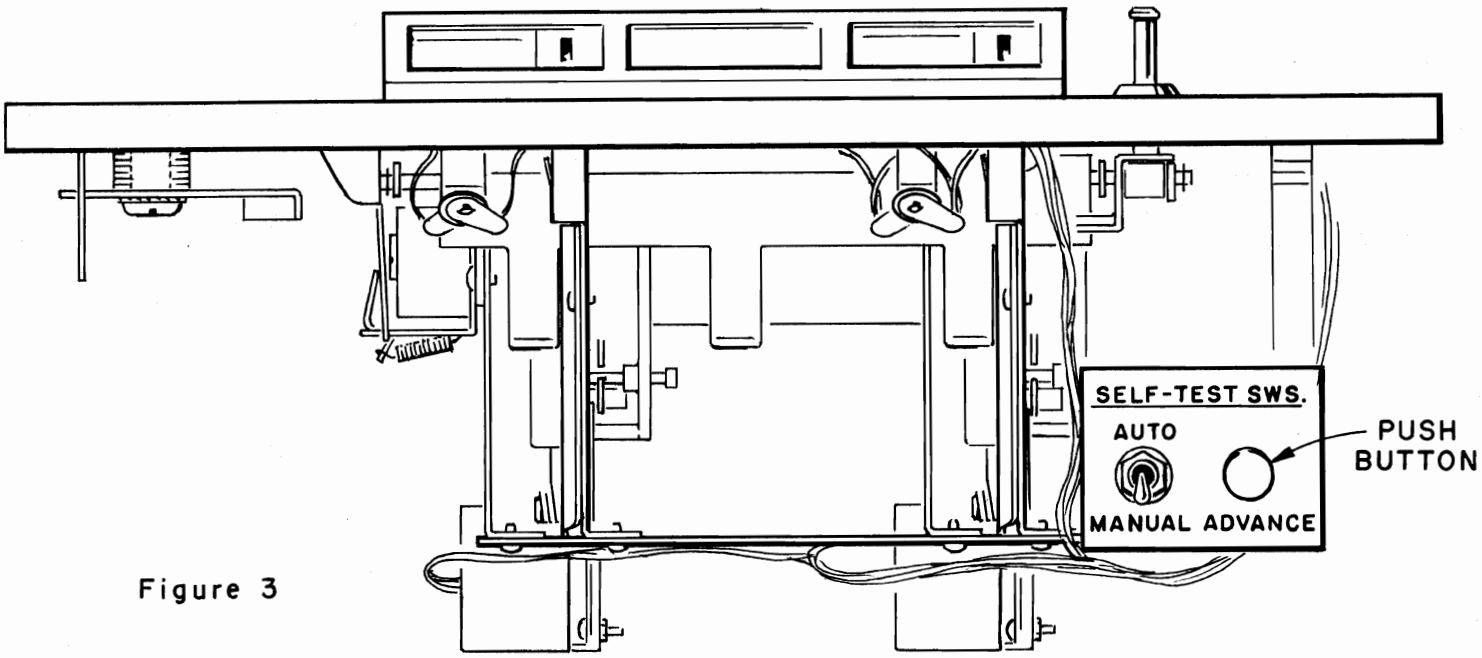


Figure 3

With the game in the game over mode, place the coin door diagnostic switch in the manual position. Then press the advance switch once. This immediately enters the diagnostic at test 4, subtest 18. This displays the current high score to date in the Player 1 display. Press the advance switch again and this advances the diagnostic to test 4, subtest 19. This displays the number of coins through Slot 1. Press the advance switch again to go to subtest 20, which displays the number of coins through Slot 2. Press the advance switch again to go to subtest 21, which displays the number of coins through Slot 3.

There are two additional bookkeeping entries which are again accessed by pressing the advance switch. Test 4, subtest 22 displays the number of credits paid for. Pressing the advance switch again advances to subtest 23, which displays the number of credits won.

To return to game over after reading out the bookkeeping totals, place the AUTO/MANUAL switch to AUTO and press ADVANCE once. This will return the game to game over.

Test 04	Subtest 18	High Score to Date
	19	Number of Coins - Slot 1
	20	Number of Coins - Slot 2
	21	Number of Coins - Slot 3
	22	Number of Credits paid
	23	Number of Credits won

The bookkeeping totals are not resettable to zero, therefore a log similar to Figure 4 is recommended. If there is no coin slot # 2, the number displayed is of no significance and should be ignored.

GAME_____ SERIAL NUMBER_____

Date	Collected			Totals to Date			Credits			High Score To Date	Initial
	Slot 1	Slot 2	Slot 3	Slot 1	Slot 2	Slot 3	Paid	Free	%		

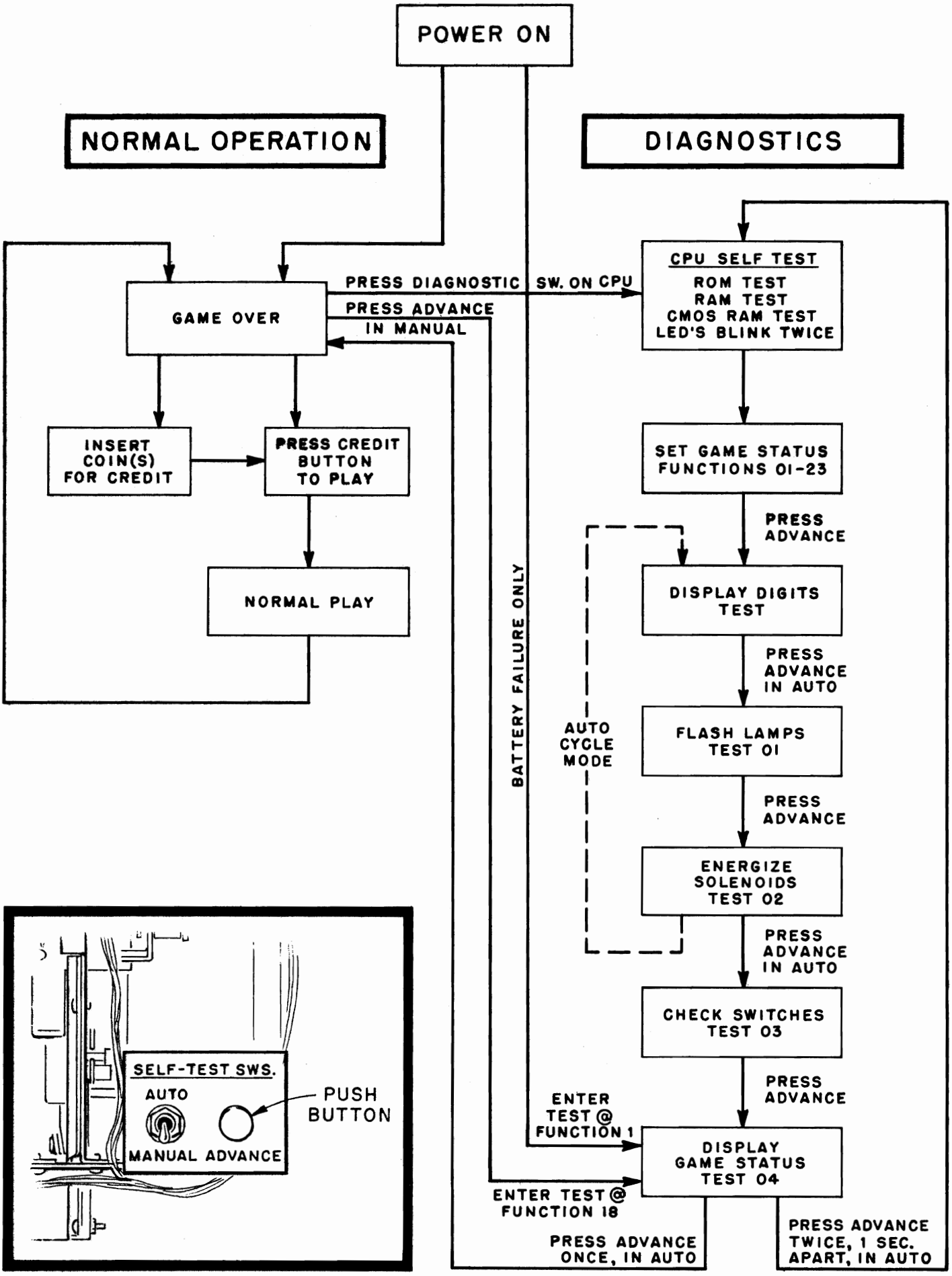

POWER ON
NORMAL OPERATION
DIAGNOSTICS
GAME OVER
PRESS DIAGNOSTIC SW. ON CPU
PRESS ADVANCE IN MANUAL
INSERT COIN(S) FOR CREDIT
PRESS CREDIT BUTTON TO PLAY
NORMAL PLAY
CPU SELF TEST
ROM TEST
RAM TEST
CMOS RAM TEST
LED'S BLINK TWICE
SET GAME STATUS FUNCTIONS 01-23
PRESS ADVANCE
DISPLAY DIGITS TEST
PRESS ADVANCE IN AUTO
FLASH LAMPS TEST 01
PRESS ADVANCE
ENERGIZE SOLENOIDS TEST 02
PRESS ADVANCE IN AUTO
CHECK SWITCHES TEST 03
PRESS ADVANCE
DISPLAY GAME STATUS TEST 04
AUTO CYCLE MODE
BATTERY FAILURE ONLY
ENTER TEST @ FUNCTION 1
ENTER TEST @ FUNCTION 18
PRESS ADVANCE ONCE, IN AUTO
PRESS ADVANCE TWICE, 1 SEC. APART, IN AUTO
SELF-TEST SWS.
AUTO
MANUAL ADVANCE
PUSH BUTTON

Figure 5

Section 5
Built In Diagnostics

The built in diagnostics were designed for ease of operation and thoroughness. The diagnostics have been organized in such a way as to allow individual testing of different areas in the machine. These areas include:

a) CPU Board Self - Test
b) Game status change
c) Display digits test*
d) Lamps (test 01)
e) Solenoids (test 02)*
f) Switches (test 03)*
g) Game status display (test 04)*

* There are specific subtests in these tests. The different ways to enter the diagnostics and normal game operation are shown in Figure 5. There is also an auto cycle test which will be discussed later.

DIAGNOSTIC SWITCHES

There are three switches which are used to control the operation of the diagnostics:

1. Diagnostic switch (lower pushbutton on CPU)
2. Auto/Manual (inside coin door)
3. Advance switch (inside coin door)

Pressing the Diagnostic switch on the CPU Board initiates the diagnostics and causes the CPU to perform three self tests automatically:

1. ROM/PROM test
2. RAM test
3. CMOS RAM test

If any errors are detected, the two LED's on the CPU Board will light to indicate the specific failure. If all three tests pass successfully, the two LED's will blink twice and then go off. The diagnostics will then be in GAME STATUS CHANGE.

CPU BOARD SELF TESTS
ROM/PROM TEST

The ROM/PROM test specifically checks the contents of CPU Board IC 17, IC 20, IC 21, IC 22 to see if the information in the ROM's and the field PROMS is correct. If the information is incorrect, the bottom LED will light up and the top LED will be OFF on the CPU Board.


OFF ROM/PROM failure
ON

RAM TEST

The RAM test specifically checks the ability of the RAM IC's 13 and IC 16 to retain information correctly. If the information is not retained correctly, the CPU Board top LED will light up and the bottom LED will be OFF.



RAM failure

CMOS RAM TEST

The CMOS RAM test specifically checks the ability of the CMOS RAM IC 19 to retain information correctly. If the information is not retained correctly, both LED's will light up and stay ON on the CPU Board.



CMOS RAM failure

GAME STATUS CHANGE

Following the successful completion of the CPU Board self tests, the two LED's blink twice and the diagnostic program enters the game status change area. This is the only time that changes can be entered as outlined in Section 3 of this manual. Replay points, maximum credits, match features, etc. can be changed ONLY during this portion of the diagnostics. Any changes made to the data will not be displayed until the game status display (test 04) described later. After making all game status changes (if any), press the ADVANCE pushbutton once to go to the digits test.

NOTE: This section of the diagnostic is the only section where ALL player and master display digits are turned OFF. No digits show on the displays until the next section of the diagnostics is entered by pressing the ADVANCE pushbutton on the coin door.

DISPLAY DIGITS TEST

This test is controlled by the two switches mounted on the coin door. If the AUTO/MANUAL switch is in the AUTO position, the digits on the display will alternate from 0 to 1 etc to 9 and back to 0, 1, etc. This will continue until the ADVANCE pushbutton is pressed.

If the AUTO/MANUAL switch is in the MANUAL position when entering the test, the digit displays will show all zeros and will remain at zero until the ADVANCE is pressed. This will change all the displays to all 1's. Pressing ADVANCE again will change the display to all 2's etc.

Each time the ADVANCE pushbutton is pressed the digits will change. Returning the AUTO/MANUAL switch to the AUTO position will cause the digits to start cycling automatically. To regain manual control, place the AUTO/MANUAL switch to the MANUAL position and press the ADVANCE pushbutton. To exit this test and proceed to the LAMP Test (Test 01), place the AUTO/MANUAL switch to the AUTO position and press the ADVANCE pushbutton once. All the displays will clear. The match digits will display 01 to indicate test 01 and the diagnostic will go to the lamp test.

LAMP TEST - TEST 01

This test causes all multiplexed lamps to blink on and off. The AUTO/MANUAL switch has no effect in this test. All lamps will continue to blink until the ADVANCE pushbutton is pressed. This causes the diagnostic to proceed directly to the Solenoid Test (Test 02). Note that the general illumination lamps do not blink on and off during this or at any other time.

SOLENOID TEST - TEST 02

When this test is entered the match digits will display 02 to indicate test 02. This test is controlled by the AUTO/MANUAL switch and the ADVANCE pushbutton.

This test is designed to pulse each solenoid for 15 milliseconds. The credit display will indicate the number of the solenoid being pulsed. Refer to Chart 3 for the solenoid identification list. Note that for HOT TIP the solenoids numbered 06, 07, 08, 20, 21, 22 are not used. Also note that 15 milliseconds is too short a pulse duration to actuate the coin lockout coil and it is insufficient to raise lowered drop targets.

If the AUTO/MANUAL switch is in the AUTO position when this test is entered, the test will automatically sequence from solenoid 01 to 02 to 03 etc. to 22 and back to 01, 02, 03 etc. This will continue until either the ADVANCE pushbutton is pressed to go on to the next test or the AUTO/MANUAL switch placed to the MANUAL position and the ADVANCE pushbutton pressed, causing the test to cycle only the solenoid where the pause occurred.

If the AUTO/MANUAL switch is in the MANUAL position when this test is entered, the test will operate solenoid 01 repeatedly until the ADVANCE pushbutton is pressed. Then the solenoid 02 will be operated repeatedly until the ADVANCE pushbutton is again pressed. Placing the AUTO/MANUAL switch to the AUTO position at any time will cause automatic sequencing to resume. When the ADVANCE pushbutton is pressed with the AUTO/MANUAL switch in the AUTO position, the diagnostics will advance to the SWITCH TEST.

Chart 3
HOT TIP Solenoid List

01	Top Eject
02	"TIP" Eject
03	"HOT" Eject
04	Left Eject

05	Ball Release
06	Not Used
07	Not Used
08	Not Used
09	10 Point Chime (Large)
10	100 Point Chime (Medium - Large)
11	1000 Point Chime (Medium - Small)
12	10,000 Point Chime (Small)
13	Noise Drum
14	Credit Knocker
15	Buzzer
16	Coin Lockout*
17	Jet Bumper
18	Right Kicker
19	Left Kicker
20	Not Used
21	Not Used
22	Not Used

* NOTE: 15 msec is not long enough to energize this coil.

SWITCH TEST - TEST 03

When this test is entered the match digits will display 03 to indicate test 03. The position of the AUTO/MANUAL switch has no effect on the operation of this test.

After entering this test, the credit display will display up to four switches on the playfield that are closed or stuck. After this listing is complete only the last switch closed will be indicated. If NO switches are closed when this test is entered the credit display will be blank.

All switches can be checked by closing the switch manually and observing that the switch number appears in the credit display. To exit this section of the diagnostics, press the ADVANCE pushbutton to go to the display game status test 04.

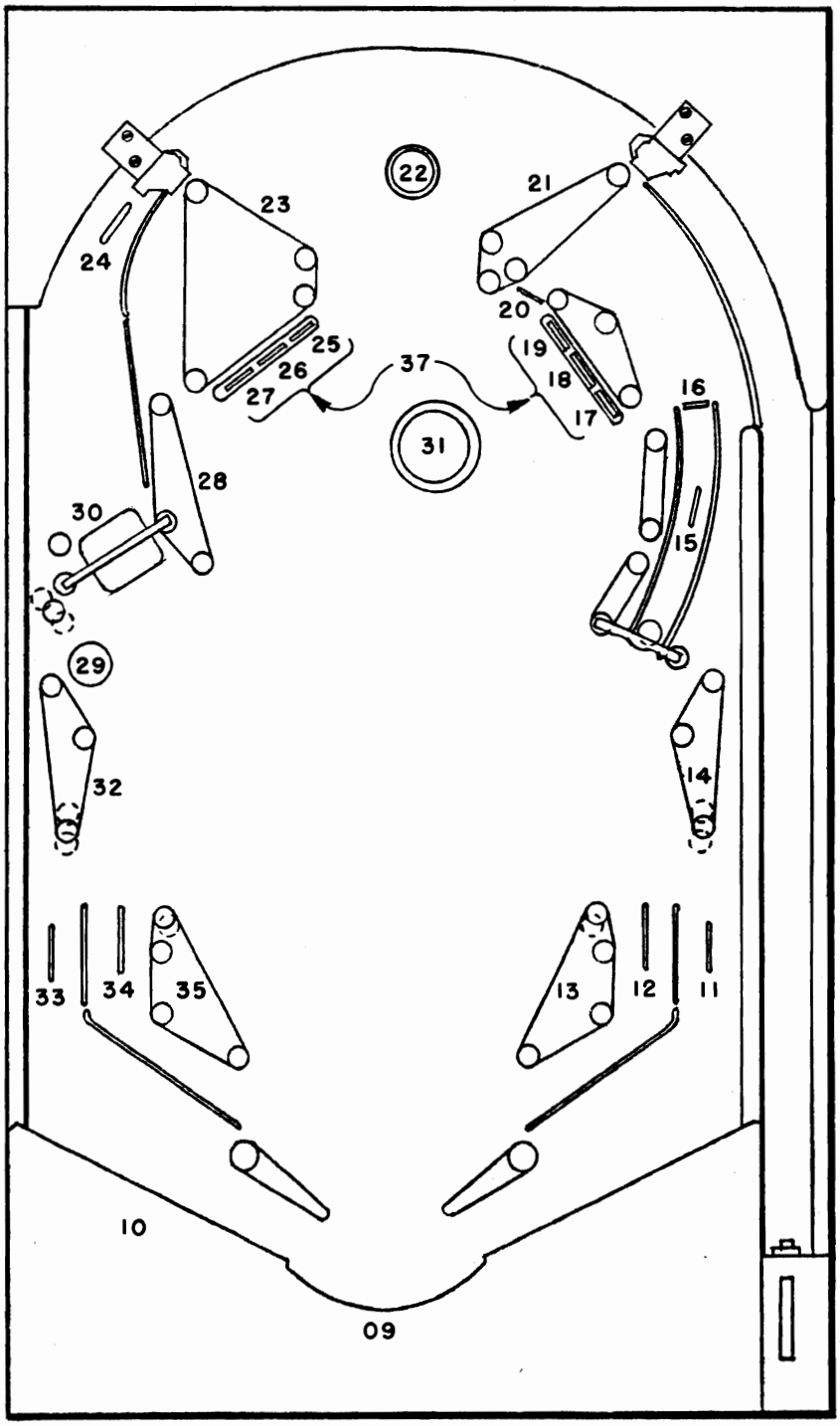
Refer to Chart 4 for the description and location of all switches in the HOT TIP playfield. Note that switches 01 thru 08 are not on the playfield itself and that switch 37 is closed only as a result of all H O T - T I P targets down.

DISPLAY GAME STATUS - TEST 04

When this test is entered, the match digits will display 04 to indicate test 04. This test displays on Player 1 display the current game status for the 18 functions that can be changed according to Section 3 in this manual and for the 5 bookkeeping totals which can be accessed as described in Section 4. Changes to the game status CANNOT be made at this time! To make changes the diagnostics must be in the Game Status Change section of the diagnostics as previously explained.

CHART 4

"HOT TIP" SOLID STATE PLAYFIELD SWITCHES



"HOT TIP" SWITCH LIST

01	Plumb Bob Tilt	IN BOTTOM CABINET
02	Ball Roll Tilt	
03	Credit Button	
04	Right Coin Switch	
05	Center Coin Switch	
06	Left Coin Switch	
07	Slam Tilt	
08	Not used	
09	Outhole	
10	Playfield Tilt	
11	Bottom Outside Right Rollover	
12	Bottom Inside Right Rollover	
13	Right Kicker Score	
14	Lower Right Stand-up	
15	Captive Ball Rollover	
16	Captive Ball Target	
17	Right "TIP" Target	
18	Center "TIP" Target	
19	Left "TIP" Target	
20	Advance Bonus Target	
21	Top Right Stand-up	
22	Top Eject	
23	Top Left Stand-up	
24	Top Left Rollover	
25	Right "HOT" Target	
26	Center "HOT" Target	
27	Left "HOT" Target	
28	Middle Left Stand-up	
29	Left Eject	
30	Spinning Target	
31	Jet Bumper Score	
32	Lower Left Stand-up	
33	Bottom Outside Left Rollover	
34	Bottom Inside Left Rollover	
35	Left Kicker Score	
36	Not used	
37	"HOT-TIP" Target Series	

When this test is entered, if the AUTO/MANUAL switch is in the AUTO position the test will sequentially display the game status data values on the Player 1 display and the function number on the credit display and continue cycling until the ADVANCE pushbutton is pressed. If the ADVANCE pushbutton is pressed once, the diagnostics will end and the game will go to the GAME OVER mode. If the ADVANCE pushbutton is pressed once and then after a 1 second pause pressed a second time, the diagnostics will start all over again with the CPU Self Tests and then go to Game Status Change section of the diagnostics.

If the AUTO/MANUAL switch is in the MANUAL position when the test is entered, the credit display will show 01, Player 1 display the value of whatever is function 01, and will remain that way until the ADVANCE pushbutton is pressed, at which time the value for function 02 will be display on Player 1 display and 02 will display in the credit display. Each time the ADVANCE pushbutton is pressed, the credit display will increment by 1 until 23 is reached then it will return to 01. This will continue until the AUTO/MANUAL switch is returned to the AUTO position and the ADVANCE pushbutton pressed once or twice as described above. Note that for test 4 function numbers 8 thru 14, values above 09 will not be displayed correctly. Refer to Table 1A and 1B for an explanation of the values read out during this test.

AUTO CYCLE MODE

As an aid in diagnosing intermittent problems or as a means to let the machine cycle itself through portions of the diagnostics, provision was made for the AUTO CYCLE MODE. This mode will sequence through the digit display test, go to test 01 and flash the lamps 128 times then go to test 02 and energize each solenoid then digit test, test 01, etc. This can be allowed to run indefinitely or until the ADVANCE pushbutton is pressed to regain control of the diagnostics.

To enter the AUTO CYCLE MODE:

1. Turn game OFF then turn game ON.
2. Press the diagnostic pushbutton on the CPU Board to enter diagnostics.
3. Set the data and function switches as follows:
   DATA SWITCH (TOP SWITCH) - Turn all switches OFF.
   FUNCTION SWITCH (BOTTOM SWITCH) - Turn all switches OFF then turn ON only switch 1.
4. Press ENTER pushbutton on CPU Board. The two LED's will blink to accept the data.
5. Place the AUTO/MANUAL switch to AUTO.
6. Press ADVANCE pushbutton ONCE. The AUTO CYCLE MODE will begin and continue until the ADVANCE pushbutton is pushed again to regain manual control of the diagnostics or the machine is turned OFF.

Section 6
Troubleshooting Charts

This section, along with the diagnostics, allows the operator to locate any problems to the specific area responsible for the problem. A more specific troubleshooting manual for component level repair is also available.

If the game exhibits a specific problem with

Lamp	-	See Section 6A
Switch	-	See Section 6B
Solenoid	-	See Section 6C
Master Display	-	See Section 6D
Player Display	-	See Section 6E
Game Operation	-	See Section 6F

If the game does not play at all or blows fuses - see Section 6G

If the game plays intermittently - See Section 6H

If the game come on in diagnostic test 04, subtest 01 - See Section 6I

Section 6A - Place Diagnostics in Test 01

Lamp Troubleshooting Chart

1 LAMP

Always OFF

1. Check Bulb
2. Check Diode (Observe Polarity
3. Check wiring (broken wires)

Glows DIM

1. Check Bulb (correct # bulb)
2. Check Diode (Observe Polarity)
3. Check wiring (shorted wires)

Always ON

1. Check Diode (Observe Polarity)
2. Check wiring (shorted wires)

4-8 LAMPS

Always OFF

1. Check wiring (broken wires)
2. Check Connectors (2J5, 2J7)
3. Replace Driver Board

Glows DIM

1. Check wiring (broken wires)
2. Check Diodes
3. Check Connectors (2J5, 2J7)
4. Replace Driver Board

Always ON

1. Check wiring (shorted wires)
2. Check Diodes
3. Check Connectors (2J5, 2J7)
4. Replace Driver Board

ALL LAMPS

Always OFF

1. Check fuse 3F3on Power Supply
2. Check for + 18 VDC on fuse 3F3 to ground
3. Check Connector 3J4
4. Check Connector 8P 2/8J2
5. Check wiring (Broken or shorts)
6. Replace Driver Board

Glows DIM

1. Check line voltage
2. Check for + 18VDC on fuse 3F3 to ground

GENERAL ILLUMI.

Always ON

Normal Condition

Always OFF

1. Check fuse 3F4 on Power Supply
2. Check for +6.3 VAC
3. Check Connectors (3J3)
4. Check Connectors 9P1 and 8P2/8J2
5. Check wiring (broken or short)

Glows DIM

1. Check line voltage

All lamps are N44 or equivalent

All diodes are IN4001 or equivalent

Section 6B - Place Diagnostics in Test 03

Switch Troubleshooting Chart

1 SWITCH

Always Actuated

1. Check contacts
2. Check shorted wires

Never Actuates

1. Check adjustment
2. Check broken wires
3. Check for open diode by jumpering across diode and actuating.

4-8 SWITCHES

Always Actuated

1. Check adjustments
2. Check shorted wires on playfield or to 2J2, 2J3
3. Replace Driver Board

Never Actuated

1. Check adjustment
2. Check broken wires on playfield or 2J2, 2J3
3. Check plug 8P1/8J1 for broken wires or pushed out pins
4. Replace Driver Board

Switch Closure Displays Multiple Switch Numbers

1. Check adjustments
2. Check shorted wires on playfield or to 2J2, 2J3
3. Replace Driver Board

Switch Displays Incorrect No.

1. Check correct switch chart for game and check adjustment
2. Incorrect wiring on playfield 2J2, 2J3, or 8P1/8J1
3. Check Connector keying

ALL SWITCHES

1. Check adjustments
2. Check Connectors 2J2, 2J3, are not exchanged
3. Replace Driver Board

Section 6C - Place Diagnostics in Test 02

Solenoid Troubleshooting Chart

1 SOLENOID

Never Actuates

1. Check solenoid Chart to verify number correct and in use
2. Broken wire to solenoid
3. Shorted diode across solenoid
4. Shorted/burned out solenoid
5. Open driver for that solenoid - replace Driver Board

Always Actuated

1. Shorted wire for that solenoid
2. Shorted driver for that solenoid on Driver Board - replace Driver Board

ALL SOLENOIDS

Never Actuated

1. Check for + 28VDC on Power Supply fuse 3F2 to ground
2. Check fuse 3F2 on Power Supply
3. Check Connectors 3J3 and 3J4 on Power Supply
4. Check Connector 2J9, 2J10, 2J11, 2J12 for broken/shorted wires.
5. Replace Driver Board

FLIPPERS

FLIPPER INOPERATIVE

1. Switch contacts on flipper button open or out of adjustment
2. Check Connectors from switch to back box to driver board
3. Shorted diode across coil

FLIPPER WEAK

1. Switch contacts on flipper button out of adjustment or pitted contacts.
2. End of stroke switch on solenoid not adjusted properly
3. Check connections on solenoid and check for bind

Section 6D-Place Diagnostics in Display Digits Test

Master Display Troubleshooting Chart

NO DISPLAY

1. Check -300VDC, - 100VDC, +100VDC & fuse 3F1 on Power Supply
2. Check connectors 3J5, 4J7, 4J5, 1J3, 1J5, 1J6, 1J7
3. Check for +100VDC and -100VDC on connector 4J7 - replace Power Supply Board if voltage incorrect
4. Replace Master Display Board.

INCORRECT DISPLAY

1. Check -300VDC, +100VDC- 100VDC at 4J7
2. Check for broken or shorted wires on 4J5, 4J6, 1J5, 1J6, 1J7
3. Replace Master Display Board

Section 6E- Place Diagnostics in Display Digits Test

Player Display Troubleshooting Chart

1 PLAYER DISPLAY INCORRECT/OFF

1. Check correct location of connector from Master Display Board.
2. Replace Player Display - if still incorrect, replace MASTER DISPLAY

2-4 PLAYER DISPLAYS INCORRECT/OFF

1. Check correct location of connectors from Master Display Board
2. Check voltage -300VDC, +100VDC and - 100VDC on connector 4J7
3. If voltages are correct - replace MASTER DISPLAY

USE EXTREME CAUTION WHEN MEASURING HIGH VOLTAGES!!!

Section 6F - Game Operation Troubleshooting

Put game in game over mode. Manually play game to verify problem. Go to diagnostic mode and read out functions by stepping through test 04. Review the game adjustments to verify that they are what is desired. Review game operation (Section 2).

Section 6G - Troubleshooting an inoperative machine or a machine that blows fuses.

Machine Inoperative

1. Remove plug from wall outlet and measure wall voltage.
2. With machine unplugged, check the line fuse, line cord, and ON/OFF switch with an Ohmmeter for continuity.
3. Check for any loose connections on line filter, ON/OFF switch.
4. Check that power connector to transformer is securely connected.
5. Check all fuses on power supply board.
6. Plug machine in, turn on and check voltage on power supply board fuses.

Machine Blows Fuse

1. Wall fuse or circuit breaker blows -
   a) Disconnect wall plug.
   b) Disconnect connector from line filter to transformer.
   c) Check line cord with Ohmmeter for shorts.
   d) Check varistor and line filter for shorts.
   e) Plug cord in wall and see if wall fuse still blows - if yes, disconnect whatever else is on same wall plug circuit and recheck items (c) and (d) above.
2. Machine fuse blows -
   a) Check for correct fuse rating.
   b) Check varistor, line filter, line cord for shorts.
   c) Disconnect connector from line filter to transformer and try another fuse.
   d) If fuse still blows, do item a, b, c again.
   e) If fuse does not blow, disconnect 3P1 and 3P2 plugs from the power supply board and reconnect plug from line filter to transformer.
   f) If fuse blows, check transformer and both lamp and solenoid rectifiers for shorts.
   g) If fuse does not blow, plug in 3P2 and 3P1 then try again. If fuse now blows, disconnect 3P3, 3P4, 3P5, 3P6, and try another fuse. If fuse still blows replace POWER SUPPLY.
   h) If fuse doesn't blow, hook up 3P3, 3P4, 3P5, and 3P6 one at a time. If fuse blows when any one is plugged in, look for burned out solenoid, dead shorts, etc.

3. Individual Power Supply Fuse Blows

a) Disconnect load from portion of the power supply that blows the fuse by disconnecting the appropriate plug.

1. 3F1 (-300VDC) disconnect 3P5
2. 3F2 (+28VDC) disconnect 3P4, 3P3
3. 3F3 (+18VDC) disconnect 3P4
4. 3F4 (6.3VAC) disconnect 3P3
5. 3F5 (+5VDC) disconnect 3P6

b) If fuse still blows, replace POWER SUPPLY.

c) If fuse does not blow, check for shorts in wiring, burned out solenoids, etc.

Section 6H - Game plays intermittently.

This usually indicates a power supply or CPU board problem. Check the +5DVC and the unregulated +5VDC on the CPU board and on the power supply. If the voltage is correct, attempt to run the CPU self tests in the diagnostics. (See Section 5) If the CPUself tests fail, remove the DRIVER BOARD and attempt to run the CPU self tests again. If the diagnostics now run, replace the DRIVER BOARD. Otherwise, replace the CPU Board.

Section 6I - Game repeatedly comes on in diagnostic test 04, subtest 01

This indicates that there has been either a battery failure or a CPU board failure. Measure the voltage across the batteries. If the voltage is below 3.0VDC, replace the batteries with Power ON and make any necessary game status changes if required. If the voltage is above 3.0VDC, run the CPU Self Test diagnostics. If CMOS RAM test fails, replace the CPU Board.

Section 7
Interconnection Charts

The following interconnection charts are used to identify the color and pin number of all the wires for all the components and typical wiring sketches for each type of circuit.

The following conventions are used throughout -

1. 1J1 is connector J1 on board 1.
   3J6 is connector J6 on board 3.
2. J designations refer to the male part of plug.
   P designations refer to the female part of plug.
3. The prefix numbers are as follows:

   1. CPU Board
   2. Driver Board
   3. Power Supply Board
   4. Master Display Board
   5. Slave Display Board
   6. Back Box Miscellaneous
   7. Cabinet
   8. Playfield
   9. Insert Box

Refer to Figures 6, 7, 8 and 9 for the lamps matrix, the switch matrix, solenoid matrix and connector identification.



TYPICAL WIRING

	1 YEL-BRN	2 YEL-RED	3 YEL-ORG	4 YEL-BLK	5 YEL-GRN	6 YEL-BLU	7 YEL-VIO	8 YEL-GRY
RED-BRN 1			SAME PLAYER SHOOTS AGAIN (PLAYFIELD)	EJECT 1000		2000		#1 PLAYER UP
RED-BLK 2			LEFT SPECIAL	EJECT LITES CAPTIVE BALL		3000	1 CAN PLAY	#2 PLAYER UP
RED-ORN 3		DOUBLE BONUS	EXTRA BALL	EJECT 500		4000	2 CAN PLAY	#3 PLAYER UP
RED-YEL 4		# 1 HORSESHOE	SPINNER 100	EJECT DOUBLES BONUS		5000	3 CAN PLAY	#4 PLAYER UP
RED-GRN 5		#2 HORSESHOE	"HOT" 1000	EJECT 500		6000	4 CAN PLAY	TILT
RED-BLU 6		#3 HORSESHOE	"HOT" 100			7000	MATCH	GAME OVER
RED-VIO 7		CAPTIVE BALL 3000	"TIP" 1000		10,000	8000	BALL IN PLAY	SAME PLAYER SHOOTS AGAIN (BACK BOX)
RED-GRY 8		RIGHT SPECIAL	"TIP" 100		1,000	9000	CREDITS (PLAYFIELD)	HIGH SCORE

FIGURE 6 - LIGHTS

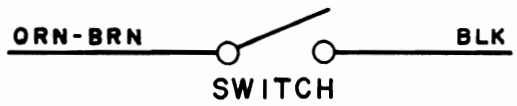
(BY WHITE) GREEN

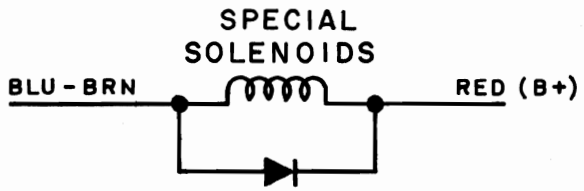
TYPICAL WIRING

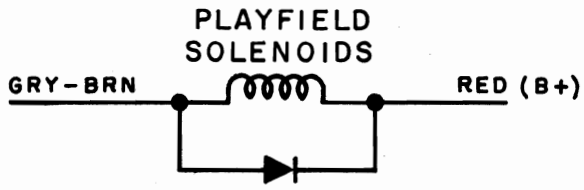
	1 GRN-BRN	2 GRN-RED	3 GRN-ORG	4 GRN-YEL	5 GRN-BLK	6 GRN-BLU	7 GRN-VIO	8 GRN-GRY
WHT-BRN 1	PLUMB TILT 1	BALL RETURN 9	RIGHT "TIP" TARGET 17	RIGHT "HOT" TARGET 25	BOTTOM L.R.O. SPECIAL 1000 33	41	49	57
WHT-RED 2	BALL ROLL TILT 2	PLAYFIELD TILT 10	CENTER "TIP" TARGET 18	CENTER "HOT" TARGET 26	INSIDE BOTTOM L.R.O. 1000 34	42	50	58
WHT-ORG 3	CREDIT BUTTON 3	BOTTOM R.R.O. SPECIAL 1000 11	LEFT "TIP" TARGET 19	LEFT "HOT" TARGET 27	L. KICKER 10 PT. SW. 35	43	51	59
WHT-YEL 4	25¢ SWITCH 4	INSIDE BOTTOM R.R.O. 1000 12	TOP ADVANCE BONUS TARGET 20	L. TOP STAND-UP SW. 10 28	36	44	52	60
WHT-GRN 5	10¢ SWITCH 5	R. KICKER 10 PT. SW. 13	R. TOP STAND-UP SW. 10 21	L. EJECT SW. 29	"HOT-TIP" SERIES 37	45	53	61
WHT-BLU 6	5¢ SWITCH 6	R. STAND-UP SW. 500 14	TOP EJECT SW. 22	SPINNING TARGET SW. 30	38	46	54	62
WHT-VIO 7	SLAM TILT 7	CAPTIVE BALL R.O. SW. 15	L. TOP STAND-UP SW. 10 23	JET BUMPER SW. 31	39	47	55	63
WHT-GRY 8	8	CAPTIVE BALL TARGET 16	L. TOP ROLLOVER SW. 24	L. STAND-UP SW. 500 32	40	48	56	64

FIGURE 7- VITCH

TYPICAL WIRING







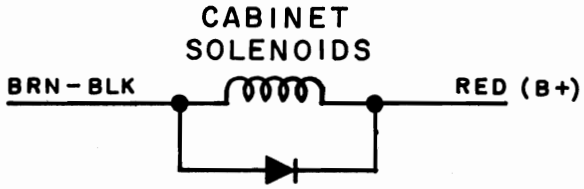


Figure 8

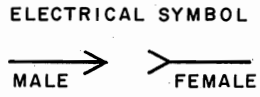
SPECIAL SOLENOIDS

SWITCH → ORN-BRN	
COIL → BLU-BRN	18 RIGHT KICKER
ORN-RED	
BLU-RED	17 JET BUMPER
ORN-BLK	
BLU-ORN	19 LEFT KICKER
ORN-YEL	
BLU-YEL	not used
ORN-GRN	
BLU-GRN	not used
ORN-BLUE	
BLUE-BLK	not used
ORN-VIO	
BLU-VIO	RIGHT FLIPPER
ORN-GRY	
BLU-GRY	LEFT FLIPPER

SOLENOIDS

PLAYFIELD	CABINET
GRY-BRN	BRN-BLK
1 TOP EJECT	9 10 POINT CHIME
GRAY-RED	BRN-RED
2 "TIP" RESET	10 100 POINT CHIME
GRAY-ORN	BRN-ORN
3 "HOT" RESET	11 1000 POINT CHIME
GRY-YEL	BRN-YEL
4 LEFT EJECT	12 10,000 POINT CHIME
GRY-GRN	BRN-GRN
5 BALL RELEASE	13 NOISE DRUM
GRAY-BLUE	BRN-BLUE
6 not used	14 CREDIT KNOCKER
GRAY-VIO	BRN-VIO
7 not used	15 BUZZER
GRAY-BLK	BRN-GRAY
8 not used	16 COIN LOCKOUT

CONNECTOR LEGEND



MALE
1 PIN

WHITE HOUSING
5A-9124

TERM. NO. 5A-9078



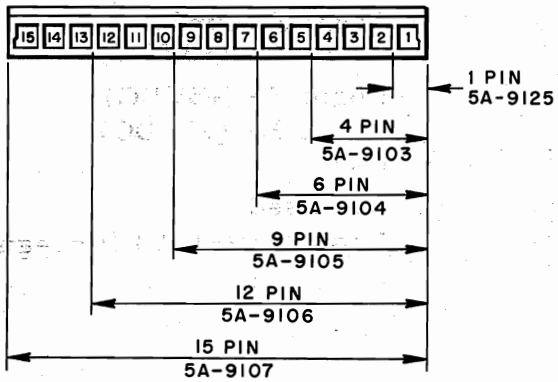


FEMALE
1 PIN

WHITE HOUSING
5A-9125

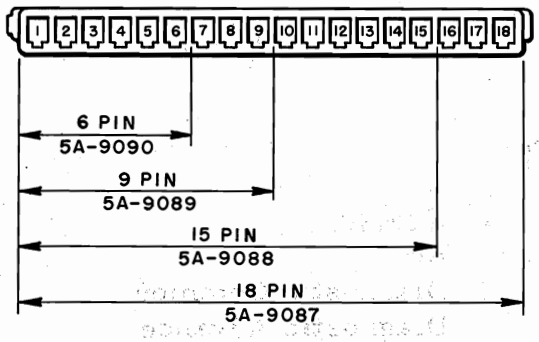
TERM. NO. 5A-9079

FEMALE



TERMINAL NO. 5A-9076

FEMALE

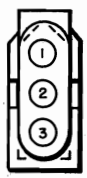


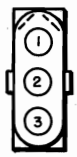
TERMINAL NO. 5A-9077

MALE
3 PIN

WHITE HOUSING
5A-9111

TERM. NO. 5A-9080



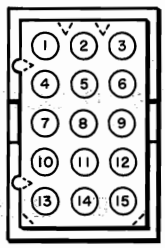


FEMALE
3 PIN

WHITE HOUSING
5A-9110

TERM. NO. 5A-9081

MALE
15 PIN

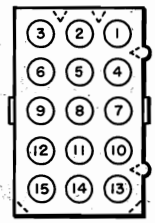


WHITE HOUSING
5A-9093

BLACK HOUSING
5A-9095

TERM. NO. 5A-9078

FEMALE
15 PIN

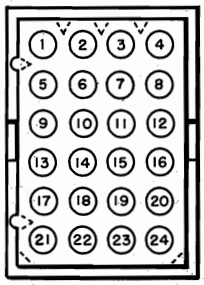


WHITE HOUSING
5A-9094

BLACK HOUSING
5A-9096

TERM. NO. 5A-9079

MALE
24 PIN

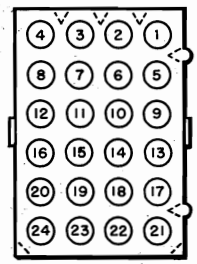


WHITE HOUSING
5A-9097

BLACK HOUSING
5A-9099

TERM. NO. 5A-9078

FEMALE
24 PIN

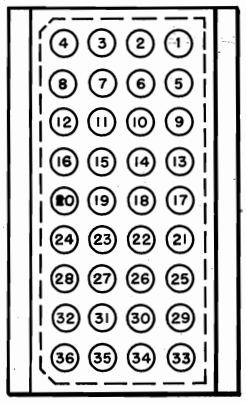


WHITE HOUSING
5A-9098

BLACK HOUSING
5A-9100

TERM. NO. 5A-9079

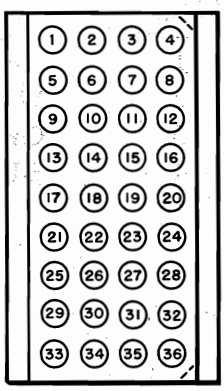
MALE
36 PIN



WHITE HOUSING
5A-9101

TERM. NO. 5A-9101

FEMALE
36 PIN



WHITE HOUSING
5A-9102

TERM. NO. 5A-9102

FIGURE 9

1 J 1 - INTERBOARD CONNECTOR

1P2 - LOGIC POWER BUS INPUT

Pin	Wire Color	Function
1	Black	Logic Ground
2	Black	Logic Ground
3	Black	Logic Ground
4	Gray	Logic B+ (+5VDC)
5	Gray	Logic B+ (+5VDC)
6	Gray	Logic B+ (+5VDC)
7	Key	Key
8	N/C	Not Used
9	Gray-White	Logic B+ (+12V) (Unregulated)

1P3 - DISPLAY BLANKING

Pin	Wire Color	Function
1	N/C	Not Used
2	N/C	Not Used
3	Key	Key
4	Blue-White	Display Blanking

1P4 - DIAGNOSTIC SWITCH INPUTS

Pin	Wire Color	Function
1	Key	Key
2	White	Diagnostic Common
3	Green	Diagnostic Advance
4	Blue	Diagnostic Auto/Man.

1P5 - MASTER DISPLAY BCD OUTPUTS

Pin	Wire Color	Function
1	Blue-Yellow	Display BCD D1
2	Blue-Orange	Display BCD C1
3	Blue-Red	Display BCD B1
4	Blue-Brown	Display BCD A1
5	Blue-Gray	Display BCD D2
6	Key	Key
7	Blue-Violet	Display BCD C2
8	Blue-Black	Display BCD B2
9	Blue-Green	Display BCD A2

1P6 - MASTER DISPLAY STROBE OUTPUTS

Pin	Wire Color	Function
1	Violet-Gray	Display Strobe # 16
2	Violet-Black	Display Strobe # 15
3	Violet-Blue	Display Strobe # 14
4	Violet-Green	Display Strobe # 13
5	Violet-Yellow	Display Strobe # 12
6	Violet-Orange	Display Strobe # 11
7	Key	Key
8	Violet-Red	Display Strobe # 10
9	Violet-Brown	Display Strobe # 9

1P7 - MASTER DISPLAY STROBE OUTPUTS

Pin	Wire Color	Function
1	Brown-Gray	Display Strobe # 8
2	Brown-Violet	Display Strobe # 7
3	Brown-Blue	Display Strobe # 6
4	Brown-Green	Display Strobe # 5
5	Brown-Yellow	Display Strobe # 4
6	Brown-Orange	Display Strobe # 3
7	Brown-Red	Display Strobe # 2
8	Key	Key
9	Brown-Black	Display Strobe # 1

2P1 - INTERBOARD CONNECTOR

2P2 - SWITCH STROBE DRIVE

Pin	Wire Color	Function
1	N/C	Not Used
2	N/C	Not Used
3	N/C	Not Used
4	Key	Key
5	Green-Black	Switch Strobe # 5
6	Green-Yellow	Switch Strobe # 4
7	Green-Orange	Switch Strobe # 3
8	Green-Red	Switch Strobe # 2
9	Green-Brown	Switch Strobe # 1

2P3 - SWITCH ROW INPUTS

Pin	Wire Color	Function
1	White-Gray	Switch Return # 8
2	Key	Key
3	White-Violet	Switch Return # 7
4	White-Blue	Switch Return # 6
5	White-Green	Switch Return # 5
6	White-Yellow	Switch Return # 4
7	White-Orange	Switch Return # 3
8	White-Red	Switch Return # 2
9	White-Brown	Switch Return # 1

2P4 - LAMP POWER BUS

Pin	Wire Color	Function
1	Blue	Lamp B+
2	Blue	Lamp B+
3	Key	Key
4	Blue	Lamp B+
5	Blue	Lamp B+
6	N/C	Not Used
7	Blue	Lamp B+
8	Blue	Lamp B+
9	Blue	Lamp B+

2P5 - LAMP COLUMN DRIVE

Pin	Wire Color	Function
1	Yellow-Violet	Lamp Column # 7
2	Yellow-Gray	Lamp Column # 8
3	Yellow-Green	Lamp Column # 5
4	Key	Key
5	Yellow-Blue	Lamp Column # 6
6	Yellow-Orange	Lamp Column # 3
7	Yellow-Black	Lamp Column # 4
8	N/C	Not Used
9	Yellow-Red	Lamp Column # 2

2P6 - LAMP GROUNDS

Pin	Wire Color	Function
1	Black	Lamp Ground
2	Key	Key
3	Black	Lamp Ground
4	Black	Lamp Ground
5	N/C	Not Used
6	Black	Lamp Ground
7	Black	Lamp Ground
8	Black	Lamp Ground
9	Black	Lamp Ground

2P7 - LAMP ROW DRIVE

Pin	Wire Color	Function
1	Red-Brown	Lamp Row # 1
2	Red-Black	Lamp Row # 2
3	Red-Orange	Lamp Row # 3
4	Red-Yellow	Lamp Row # 4
5	Red-Green	Lamp Row # 5
6	Red-Blue	Lamp Row # 6
7	Key	Key
8	Red-Gray	Lamp Row # 8
9	Red-Violet	Lamp Row # 7

2P8 - LOGIC POWER BUS INPUT

Pin	Wire Color	Function
1	Black	Logic Ground
2	Black	Logic Ground
3	Black	Logic Ground
4	Black	Logic Ground
5	Key	Key
6	Gray	Logic B+ (+5 VDC)
7	Gray	Logic B+ (+5 VDC)
8	Gray	Logic B+ (+5 VDC)
9	Gray	Logic B+ (+5 VDC)

2P9 - CABINET SOLENOIDS DRIVE

Pin	Wire Color	Function	
1	Brown-Orange	Coil # 11	1000 Point Chime
2	Brown-Yellow	Coil # 12	10,000 Point Chime
3	Brown-Green	Coil # 13	Noise Unit
4	Brown-Blue	Coil # 14	Knocker
5	Brown-Violet	Coil # 15	Buzzer
6	Brown-Gray	Coil # 16	Coin Lockout
7	Brown-Red	Coil # 10	100 Point Chime
8	Key	Key	
9	Brown-Black	Coil # 9	10 Point Chime

2P10 - SOLENOID GROUNDS

Pin	Wire Color	Function
1	Black	Solenoid Ground
2	Black	Solenoid Ground
3	Black	Solenoid Ground
4	Black	Solenoid Ground
5	Key	Key
6	N/C	Not Used
7	Black	Solenoid Ground
8	Black	Solenoid Ground
9	Black	Solenoid Ground

DRIVER BOARD

2P11 - PLAYFIELD SOLENOIDS DRIVE

Pin	Wire Color	Function	
1	N/C	Not Used	
2	N/C	Not Used	
3	N/C	Not Used	
4	Gray-Brown	Coil # 1	Top Eject
5	Gray-Red	Coil # 2	"TIP" Reset
6	Key	Key	
7	Gray-Orange	Coil # 3	"HOT" Reset
8	Gray-Yellow	Coil # 4	Left Eject
9	Gray-Green	Coil # 5	Ball Release

2P12 - SPECIAL SOLENOIDS DRIVE

Pin	Wire Color	Function
1	Orange-Violet	Right Flipper Enable
2	Orange-Gray	Left Flipper Enable
3	Blue-Orange	Left Kicker Coil
4	Blue-Red	Jet Bumper Coil
5	Key	Key
6	N/C	Not Used
7	Blue-Brown	Right Kicker Coil
8	N/C	Not Used
9	N/C	Not Used

2P13 - SPECIAL SWITCH INPUTS

Pin	Wire Color	Function
1	Key	Key
2	Orange-Black	Left Kicker Switch
3	Orange-Red	Jet Bumper Switch
4	N/C	Not Used
5	Orange-Brown	Right Kicker Switch
6	N/C	Not Used
7	N/C	Not Used
8	N/C	Not Used
9	N/C	Not Used

3P1 - POWER BUS INPUTS

Pin	Wire Color	Function
1	Violet	Lamps (+18 VDC)
2	Orange	Solenoids (+28 VDC)
3	Yellow	6.3 VAC
4	White	90 VAC
5	N/C	Not Used
6	Yellow	6.3 VAC
7	N/C	Not Used
8	N/C	Not Used
9	White	90 VAC
10	Gray	18.7 VAC C.T.
11	Gray	18.7 VAC C.T.
12	Gray White	18.7 VAC C.T.

3P2 - POWER BUS INPUTS

Pin	Wire Color	Function
1	Black	Lamp Rect -
2	N/C	Not Used
3	N/C	Not Used
4	Black	Solenoid Rect -
5	N/C	Not Used
6	N/C	Not Used

3P3 - DISPLAY LAMPS & SOLENOID POWER BUS

Pin	Wire Color	Function
1	Yellow-White	6.3 VAC Display Lamps
2	Yellow-White	6.3 VAC Display Lamps
3	Black	Ground
4	Yellow	6.3 VAC Display Lamps
5	Yellow	6.3 VAC Display Lamps
6	Red	Solenoid B+ (+28 VDC)
7	Red	Solenoid B+ (+28 VDC)
8	N/C	Not Used
9	Key	Key

3P4- LAMP & SOLENOID POWER BUS

Pin	WireColor	Function
1	Black	Ground
2	Black	Ground
3	Black	Ground
4	Black	Ground
5	Blue	Lamp B+ (+16 VDC)
6	Blue	Lamp B+ (+16 VDC)
7	Blue	Lamp B+ (+16 VDC)
8	Blue	Lamp B+ (+16 VDC)
9	Black	Ground
10	Black	Ground
11	Black	Ground
12	Black	Ground

3P5 - DISPLAY POWER BUS

Pin	Wire Color	Function
1	Black	Ground
2	White-Black	-300 VDC
3	Orange	-100 VDC
4	Brown	+100 VDC
5	N/C Key	Not Used
6	Gray	Logic B+ (+5 VDC)

3P6 - LOGIC POWER BUS

Pin	Wire Color	Function
1	N/C	Not Used
2	N/C	Not Used
3	N/C	Not Used
4	N/C	Not Used
5	Key	Key
6	Gray-White	Logic + (+12V. Un-regulated)
7	Gray	Logic B+ (+5V.)
8	Gray	Logic B+ (+5V.)
9	Gray	Logic B+ (+5V.)
10	Gray	Logic B+ (+5V.)
11	Black	Ground
12	Black	Ground
13	Black	Ground
14	Black	Ground
15	Black	Ground

4P1 - MASTER DISPLAY PLAYER # 1

Pin	Wire Color	Function
1	Brown-Black -2	Units
2	Brown-Red-2	10's
3	Brown-Orange-2	100's
4	Brown-Yellow-2	1,000's
5	Brown-Green-2	10,000's
6	N/C	Key
7	Brown-Blue-2	100,000's
8	Brown-1	a
9	Red-1	b
10	Blue-1	f
11	Violet	g Segments
12	Orange-1	c
13	Green-1	e
14	Yellow-1	d
15	White-Black	Keep Alive

4P2 - MASTER DISPLAY PLAYER # 2

Pin	Wire Color	Function
1	White-Black	Keep Alive
2	Red-Black-1	Units
3	Red-Brown-1	10's
4	Red-Orange-1	100's
5	Red-Yellow-1	1000's
6	Yellow-1	d
7	Green-1	e Segments
8	Orange-1	c
9	N/C	Key
10	Violet	g
11	Blue-1	f
12	Red-1	b
13	Brown-1	a
14	Red-Green-1	10,000's
15	Red-Blue-1	100,000's

MASTER DISPLAY

4P3 - MASTER DISPLAY PLAYER # 3

Pin	Wire Color	Function
1	White-Black	Keep Alive
2	Orange-Yellow-1	100's
3	Orange-Green-1	1000's
4	N/C	Key
5	Orange-Blue-1	10,000's
6	Orange-Violet-1	100,000's
7	Orange-Red-1	10's
8	Orange-Brown-1	Units
9	Brown-2	a
10	Red-2	b
11	Blue-2	f Segments
12	Violet-1	g
13	Orange-2	c
14	Green-2	e
15	Yellow-2	d

4P4 - MASTER DISPLAY PLAYER # 4

Pin	Wire Color	Function
1	Yellow-2	d
2	Green-2	e
3	Orange-2	c
4	Violet-1	g
5	Blue-2	f
6	Red-2	b
7	Brown-2	a
8	Yellow-Brown-1	Units
9	Yellow-Red-1	10's
10	Yellow-Orange-1	100's
11	N/C	Key
12	Yellow-Green-1	1000's
13	Yellow-Blue-1	10,000's
14	Yellow-Violet-1	100,000's
15	White-Black	Keep Alive

4P5- MASTER DISPLAY STROBE INPUTS

Pin	Wire Color	Function
1	N/C	Not Used
2	Brown-Gray-1	Strobe # 8
3	Brown-Violet-1	Strobe # 7
4	Violet-Gray	Strobe # 16
5	Violet-Black	Strobe # 15
6	Brown-Black-1	Strobe # 1
7	Brown-Red-1	Strobe # 2
8	Brown-Orange-1	Strobe # 3
9	Brown-Yellow-1	Strobe # 4
10	Brown-Green-1	Strobe # 5
11	Brown-Blue-1	Strobe # 6
12	Violet-Red	Strobe # 10
13	Violet-Orange	Strobe # 11
14	Violet-Blue	Strobe # 14
15	Violet-Brown	Strobe # 9
16	Violet-Green	Strobe # 13
17	Violet-Yellow	Strobe # 12
18	N/C	Not Used

4P6 - MASTER DISPLAY BCD INPUTS

Pin	Wire Color	Function
1	Blue-Red-1	B1
2	Blue-Orange-1	C1
3	Blue-White	Blanking
4	Blue-Yellow-1	D1
5	Blue-Brown-1	A1
6	Blue-Black-1	B2
7	Blue-Violet-1	C2
8	Blue-Gray-1	D2
9	Blue-Green-1	A2

4P7- MASTER DISPLAY POWER INPUTS

Pin	Wire Color	Function
1	White-Black	Keep Alive - 300 VDC
2	Brown	+100 VDC
3	Gray	Logic B+ +5VDC
4	N/C	Not Used
5	Black	Ground
6	Orange	-100 VDC

5P1 - PLAYER #1 SLAVE DISPLAY

Pin	Wire Color	Function
1	Blue-1	f
2	Violet	g
3	Brown-Blue-2	100,000's
4	Green-1	e
5	Yellow-1	d
6	Brown-Green-2	10,000's
7	Brown-Yellow-2	1,000's
8	N/C	Not Used
9	Jumper to Pin 3	
10	White-Black	Keep Alive
11	Brown-Orange-2	100's
12	Brown-Red-2	10's
13	N/C	Key
14	Orange-1	c
15	Brown-Black-2	Units
16	Red-1	b
17	Brown-1	a
18	N/C	Not Used

5P2- PLAYER #2 SLAVE DISPLAY

Pin	Wire Color	Function
1	Blue-1	f
2	Violet	g
3	Red-Blue-1	100,000's
4	Green-1	e
5	Yellow-1	d
6	Red-Green-1	10,000's
7	Red-Yellow-1	1,000's
8	N/C	Not Used
9	Jumper to Pin 3	
10	White-Black	Keep Alive
11	Red-Orange-1	100's
12	Red-Brown-1	10's
13	N/C	Key
14	Orange-1	c
15	Red-Black-1	Units
16	Red-1	b
17	Brown-1	a
18	N/C	Not Used

5P3 - PLAYER # 3 SLAVE DISPLAY

Pin	Wire Color	Function
1	Blue-2	f
2	Violet-1	g
3	Orange-Violet-1	100,000's
4	Green-2	e
5	Yellow-2	d
6	Orange-Blue-1	10,000's
7	Orange-Green-1	1,000's
8	N/C	Not Used
9	Jumper to Pin 3	
10	White-Black	Keep Alive
11	Orange-Yellow-1	100's
12	Orange-Red-1	10's
13	N/C	Key
14	Orange -2	c
15	Orange-Brown-1	Units
16	Red-2	b
17	Brown-2	a
18	N/C	Not Used

5P4 - PLAYER # 4 SLAVE DISPLAY

Pin	Wire Color	Function
1	Blue-2	f
2	Violet -1	g
3	Yellow-Violet-1	100,000's
4	Green-2	e
5	Yellow-2	d
6	Yellow-Blue-1	10,000's
7	Yellow-Green-1	1,000's
8	N/C	Not Used
9	Jumper to Pin 3	
10	White-Black	Keep Alive
11	Yellow-Orange-1	100's
12	Yellow-Red-1	10's
13	N/C	Key
14	Orange-2	c
15	Yellow-Brown-1	Units
16	Red-2	b
17	Brown-2	a
18	N/C	Not Used

6P1/6J1 SWITCHED AC INPUT

Pin	Color	Function
1	White-Red	AC
2	N/C	
3	White-Red	AC

CABINET

7P1/7J1 - CABINET SOLENOIDS & SWITCHED (White 36 Pin)

Pin	Color	Function
1	Yellow	6.3 VAC Display Lamps
2	Yellow-White	6.3 VAC Display Lamps
3	Red	Solenoid B+
4	White	Diagnostic Common
5	Green	Diagnostic Advance
6	Blue	Diagnostic Auto/Man.
7	Orange-Violet	Right Flipper Switch
8	Blue-Violet	Right Flipper Switch
9	Orange-Gray	Left Flipper Switch
10	Blue-Gray	Left Flipper Switch
11	Brown-Black	Coil # 9 10 Point Chime
12	Brown-Red	Coil # 10 100 Point Chime
13	Brown-Orange	Coil # 11 1000 Point Chime
14	Brown-Yellow	Coil # 12 10,000 Point Chime
15	Brown-Green	Coil # 13 Noise Unit
16	Brown-Blue	Coil # 14 Knocker
17	Brown-Violet	Coil # 15 Buzzer
18	Brown-Gray	Coil # 16 Coin Lockout
19	Green-Brown	Switch Column # 1
20	N/C	Not Used
21	White-Brown	Switch Row # 1
22	White-Red	Switch Row # 2
23	White-Orange	Switch Row # 3
24	White-Yellow	Switch Row # 4
25	White-Green	Switch Row # 5
26	White-Blue	Switch Row # 6
27	White-Violet	Switch Row # 7
28-36	N/C	Not Used

7P2/7J2 CABINET SWITCHES & DISPLAY LAMPS (White)
(15 Pin)

Pin	Color	Function
1	Yellow	6.3 VAC Display Lamps
2	Yellow-White	6.3 VAC Display Lamps
3	Red	Coil B+
4	Brown-Gray	Coil # 16 Coin Lockout
5	N/C	Not Used
6	Green-Brown	Switch Column # 1
7	N/C	Not Used
8	White-Yellow	Switch Row # 4
9	White-Green	Switch Row # 5
10	White-Blue	Switch Row # 6
11	White-Violet	Switch Row # 7
12	N/C	Not Used
13	White	Diagnostic Common
14	Green	Advance
15	Blue	Auto/Manual

8P1/8J1- PLAYFIELD SWITCHES (White)
(15 Pin)

Pin	Color	Function
1	Green-Red	Switch Column # 2
2	Green-Orange	Switch Column # 3
3	Green-Yellow	Switch Column # 4
4	Green-Black	Switch Column # 5
5	N/C	Not Used
6	N/C	Not Used
7	N/C	Not Used
8	White-Brown	Switch Row # 1
9	White-Red	Switch Row # 2
10	White-Orange	Switch Row # 3
11	White-Yellow	Switch Row # 4
12	White-Green	Switch Row # 5
13	White-Blue	Switch Row # 6
14	White-Violet	Switch Row # 7
15	White-Gray	Switch Row # 8

8P2/8J2- PLAYFIELD LAMPS (White)
(24 Pin)

Pin	Color	Function
1	Yellow	6.3 VAC Display Lamps
2	Yellow-White	6.3 VAC Display Lamps
3	N/C	Not Used
4	Yellow-Red	Lamp Column # 2
5	Yellow-Orange	Lamp Column # 3
6	Yellow-Black	Lamp Column # 4
7	Yellow-Green	Lamp Column # 5
8	Yellow-Blue	Lamp Column # 6
9	Yellow-Violet	Lamp Column # 7
10	N/C	Not Used
11	Red-Brown	Lamp Row # 1
12	Red-Black	Lamp Row # 2
13	Red-Orange	Lamp Row # 3
14	Red-Yellow	Lamp Row # 4
15	Red-Green	Lamp Row # 5
16	Red-Blue	Lamp Row # 6
17	Red-Violet	Lamp Row # 7
18	Red-Gray	Lamp Row # 8
19-24	N/C	Not Used

PLAYFIELD

8P3/8J3 - PLAYFIELD SOLENOIDS, SPECIAL SWITCHES (Black) (24 Pin)

Pin	Color	Function
1	Red	Coil B+
2	Black	Ground (Special Switch Common)
3	Blue-Violet	Right Flipper Coil
4	Blue-Gray	Left Flipper Coil
5	Orange-Brown	Right Kicker Switch
6	Orange-Red	Jet Bumper Switch
7	Orange-Black	Left Kicker Switch
8	N/C	Not Used
9	N/C	Not Used
10	N/C	Not Used
11	Blue-Brown	Right Kicker Coil
12	Blue-Red	Jet Bumper Coil
13	Blue-Orange	Left Kicker Coil
14	N/C	Not Used
15	N/C	Not Used
16	N/C	Not Used
17	Gray-Brown	Coil # 1 Top Eject
18	Gray-Red	Coil # 2 "TIP" Reset
19	Gray-Orange	Coil # 3 "HOT" Reset
20	Gray-Yellow	Coil # 4 Left Eject
21	Gray-Green	Coil # 5 Ball Release
22	N/C	Not Used
23	N/C	Not Used
24	N/C	Not Used

INSERT BOX

9P1/9J1 - INSERT DOOR LAMP CONNECTOR (Black) (15 Pin)

Pin	Color	Function
1	Yellow	6.3 VAC Display Lamps
2	Yellow-White	6.3 VAC Display Lamps
3	N/C	Not Used
4	N/C	Not Used
5	N/C	Not Used
6	Yellow-Violet	Lamp Column # 7
7	Yellow-Gray	Lamp Column # 8
8	Red-Brown	Lamp Row # 1
9	Red-Black	Lamp Row # 2
10	Red-Orange	Lamp Row # 3
11	Red-Yellow	Lamp Row # 4
12	Red-Green	Lamp Row # 5
13	Red-Blue	Lamp Row # 6
14	Red-Violet	Lamp Row # 7
15	Red-Gray	Lamp Row # 8

Section 8
Mechanical Adjustments

Switches

There are different types of switches used throughout the game. The switch blades are made of a highly conductive spring type metal in various lengths, thickness, and form. Each switch is designed to satisfy specific operation conditions such as bounce, current carrying capacity, speed of operation, etc. Therefore it is important to replace a blade with another of the same kind. When adjusting blades, never kink or bend sharply, as this causes fatigue which leads to fractures. Adjust blades with a sweeping, bowing motion, with a switch adjusting tool or duck bill pliers.

When switch adjustments are called for, before forming blades on any machine, check that the screws holding the switch stacks are down very tight. This is recommended because plastic spacers in the switch stacks will occasionally shrink by drying out causing a poor adjustment.

With the exception of a few instances, all blade type switches should have at least 1/32 inch between the contact points and should follow thru for at least 1/32 inch beyond the point at which the contacts close. This follow thru action provides a wiping motion between the contacts keeping them clean and insuring good contact between the points.

To adjust blade type switches properly, first adjust the actuating blade (usually, the longer one) with relation to the part that it contacts. Then set the gap and follow thru by adjusting the other blade.

Switch Contacts

With the exception of flipper button and end of stroke switches, all blade switch contacts are gold-plated and must NOT be burnished or filed. To clean the contacts, close them on a clean piece of paper (e.g. business card) and wipe gently until the contacts are clean.

For the flipper button switches, remove tarnish by filing with a contact file and then burnishing. Do the same for the flipper end-of-stroke switch contacts.

DO NOT file or burnish any other contacts.

Severely pitted contacts should be replaced as an assembly. Switch contacts should only be adjusted when they cause a malfunction or do not score properly.

Roll-Over Lane Switches

Playfield lane switches are operated by a roll-over wire form which is actuated by the ball. Before the switch is adjusted, the wire should be centered in the playfield slot. The long blade closest to the playfield should be adjusted to hold the wire form up. Check this condition with the playfield down. Then, with the playfield up, adjust the short blade for 1/16 inch clearance. Depress the wire form to its maximum depression with the ball and check for 1/32 inch follow thru. To prevent switch vibration a back-up blade is used. It should be parallel and just barely in contact with the short blade.

Flipper

Flippers are controlled by the flipper push buttons to either side of the cabinet. The flipper coil consists of two windings: A pull-in winding and a lighter gauge hold-in winding. The hold-in winding is normally bypassed by a closed switch.

The pull-in winding produces a strong stroke. However, if this winding were to remain energized by the player it would overheat. To reduce this high current, the hold winding is put in series with the pull-in winding by opening the end-of-stroke switch.

This switch should be adjusted so that the long blade is moved by the flipper pawl assembly for about the last 1/8 inch of movement. With the plunger completely depressed manually, the short blade should be adjusted for a 3/32 inch gap and 1/32 inch follow thru.

NEVER LUBRICATE THE PLUNGER. The only lubrication required is the link assembly with the special coin machine lubricant.

Weak or sluggish flipper action can be due to dirty or improperly adjusted contact points, worn out coil sleeve, loose or broken bushing, incorrect coil or shorted diodes, worn out fiber links, weak or broken return spring, loose coil between the retaining bracket and coil stop, or loose screws. Check all of the above to correct.

Plumb Bob Tilt

The plumb bob tilt can be made more sensititive by raising the plumb bob on the shaft. It can also be made less sensitive by lowering the bob on the shaft.

Super Slam Tilt

The super slam tilt on the coin door is adjustable. The normal adjustment is contacts open 1/32 inch.

Playfield Tilt

The playfield tilt is adjustable by forming the switch contacts. Closing the gap will make the tile more sensitive.

Roll Tilt

The roll tilt in the cabinet box can be raised (more sensitive) or lowered (less sensitive) at the front pivot slot.

Section 9

Spare Parts

The parts used on the solid state HOT TIP are standard Williams parts. Refer to the accompanying sketch for identification of various playfield parts and adjustments.

Playfield Care

The playfield on this machine has an improved finish with excellent wearing properties. DO NOT clean the board with water, water soap solutions, or harsh abrasives. Avoid using steel wool, kitchen cleansers, or abrasive hand soap. Water will weaken the adhering of the paint to the board and abrasives shorten the board life.

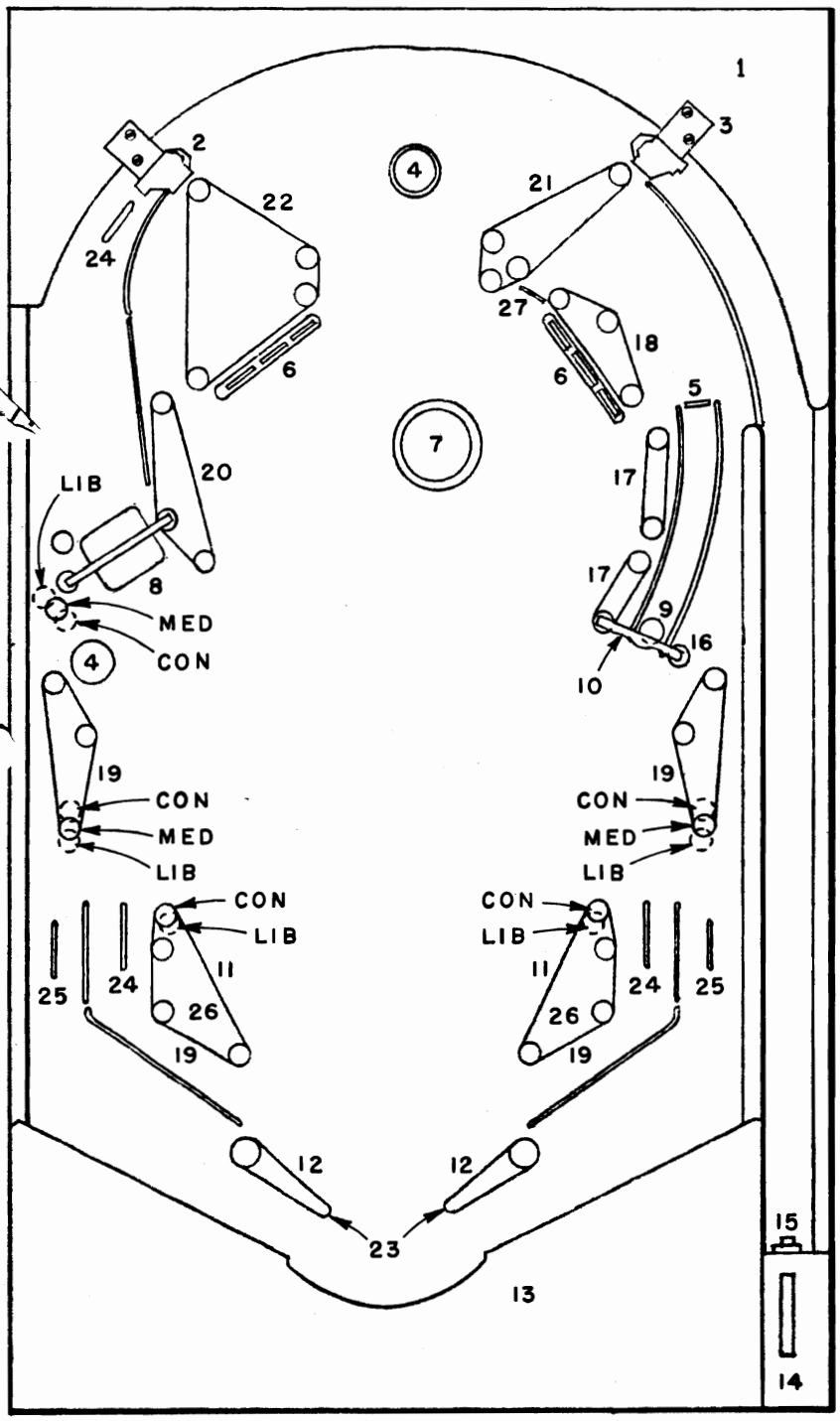
A wax base cleaner with negligible abrasive qualities used lightly, but frequently, will extend board life to its full capabilities.

Backglass Removal

Unlock the key lock (Figure 1, - No. 4) then lift the glass up and out.

477 HOT TIP

PLAYFIELD PARTS



	PART NO.	DESCRIPTION	QTY.
1.	1C-2852-474	TOP ARCH	1
2.	A-4817-L	LEFT BALL GATE	1
3.	A-4817-R	RIGHT BALL GATE	1
4.	B-7472-1R	EJECT HOLE ASSY	2
5.	A-7902	STAND UP TARGET ASSY	1
6.	D-7931-3	DROP TARGET BANK ASSY	2
7.	B-7894	JET BUMPER ASSY	1
8.	B-7875	SPINNING TARGET ASSY	1
9.	20A-6500	CAPTIVE BALL	1
10.	23A-6538	CAPTIVE BALL RETAINER	1
11.	B-7573	KICKER ASSY	2
12.	B-7060-L&R	FLIPPER ASSY	2
13.	D-7473	BOTTOM ARCH	1
14.	1B-3573	SHOOTER GAUGE	1
15.	23A-6327	BALL SHOOTER TIP	1
16.	23A-6300	RUBBER RING 5/16" L.D.	3
17.	23A-6304	RUBBER RING 1-1/2 I.D.	2
18.	23A-6305	RUBBER RING 2" I.D.	1
19.	23A-6306	RUBBER RING 2-3/8 I.D.	4
20.	23A-6307	RUBBER RING 2-7/8 I.D.	1
21.	23A-6308	RUBBER RING 3-3/8 I.D.	1
22.	23A-6309	RUBBER RING 3-7/8 I.D.	1
23.	23A-6519	FLIPPER RUBBER	2
24.	A-5844-6	ROLLOVER WIRE ASSY	3
25.	A-5844-9	ROLLOVER WIRE ASSY	2
26.	30C-474	PLAYFIELD PLASTICS (SET OF 7)	1
27.	A-7983	STAND UP TARGET ASSY	1

ABBREVIATIONS:

CON - CONSERVATIVE
MED - MEDIUM
LIB - LIBERAL