Bally
MIDWAY·SENTE
MANUFACTURING COMPANY

SERVICE BULLETIN BOOK – 1987

BALLY-MIDWAY-SENTE
SERVICE BULLETIN BOOK 1987

April 2, 1985

S E R V I C E   B U L L E T I N

GAME: STRIKES AND SPARES SHUFFLE ALLEY

SUBJECT: P.C. BOARD INTERCHANGEABILITY

The following P.C. Boards have been used before in Bally Midway games.

P.C. BOARD	INTERCHANGEABLE WITH
70VA Power Supply (A082-90421-B000)	Robby Roto (Must be a "B" version)
70VA Power Chassis (A945-00036-0002)	Burger Time, Super Pac-Man & other 70VA games
High Voltage P.C. (A084-91701-A000)	10 Pin Deluxe Shuffle Alley
5 MHz CPU (P.C. A084-91490-H010)	Tapper, Root Beer, Timber & Discs of Tron

NOTE - The Sound & I/O P.C. A084-91795-BB37, Puck Sensor P.C. A084-91796-AB37 and Lamp Driver P,C. A084-91797-BB37 are new and are only used in Strikes and Spares.

The 5 MHz CPU P.C. A080-91490-H010 connector J-5, J-6 and J-7 are not used in Strikes and Spares.

Andy Ducay
Technical Service Manager

AD/dd

June 18, 1985

S E R V I C E   B U L L E T I N

GAME: DEMOLITION DERBY (4-Player)

SUBJECT: INTERMITTENT LOSS OF AUDIO DUE TO STATIC CONDITION

MODIFICATION

   1. Make the following change to the Turbo Cheap Squeak Board
       (PC A084-91779-A000).

   2. See Figure #1 & #2.

Andy Ducay
Technical Service Manager

AD/dd
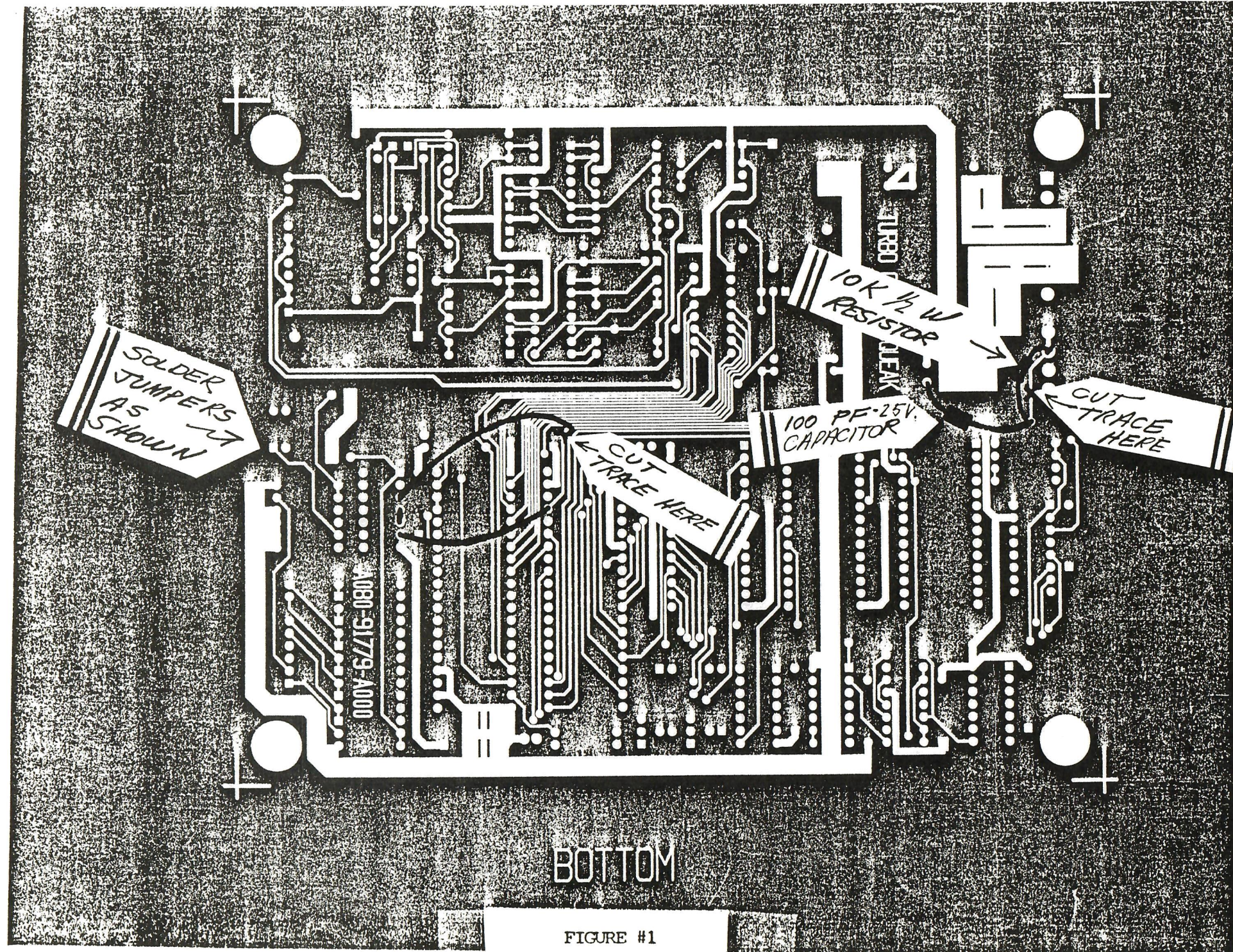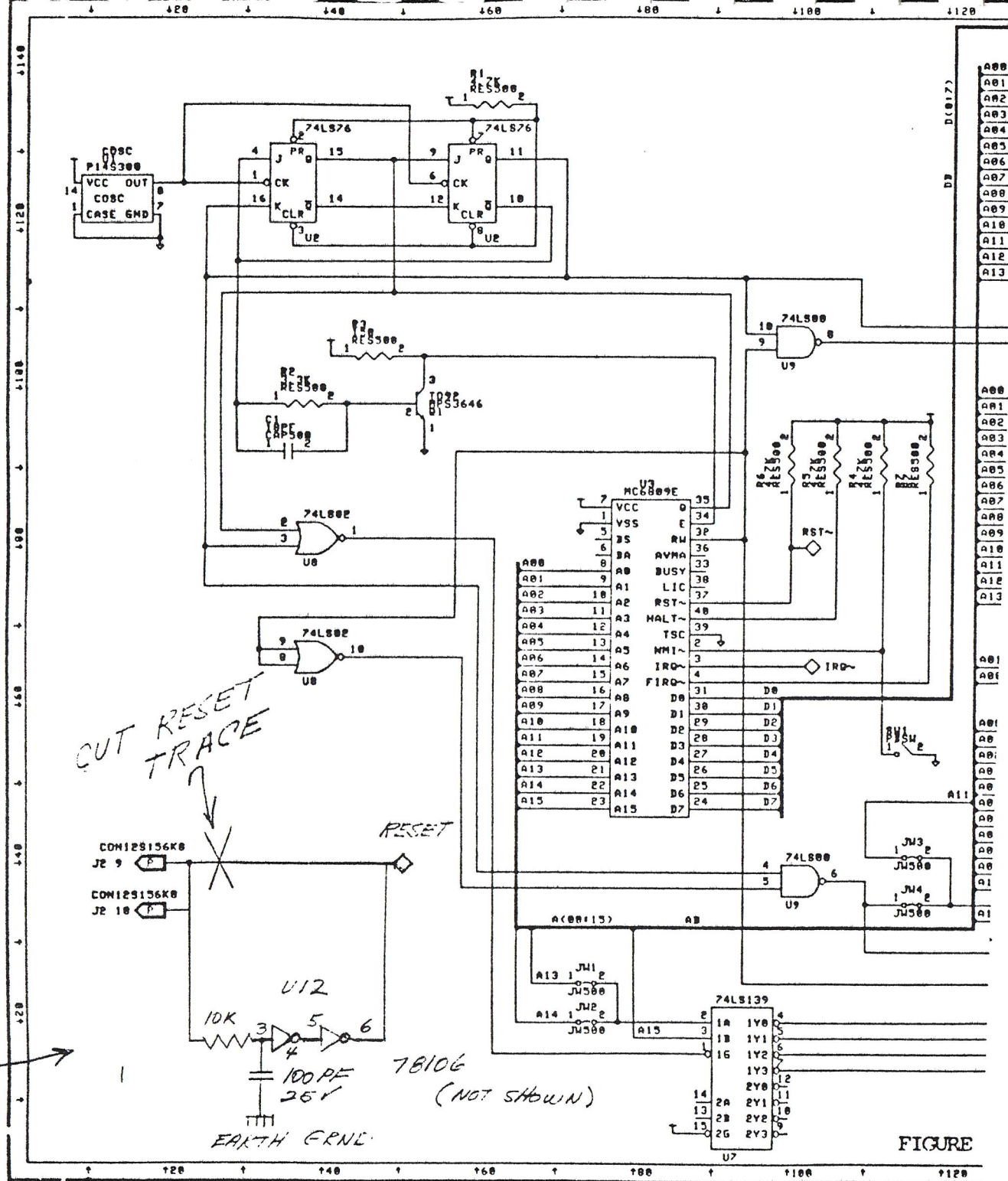
FIGURE #1

FIGURE

October 11, 1985

SERVICE BULLETIN

GAME: DEMOLITION DERBY (2 & 4 Player)

SUBJECT: OPTICAL ENCODER DELUXE (A084-91794-A000)

1.   The Optical Encoder Deluxe is interchangeble between either
     the 2 player or 4 player games.

2.   If used in a Demo Derby 2 player U.R. make sure jumper JWl is
     installed.

3.   In a 4 player model JWl must be removed.

GM/dc

April 24, 1985

S E R V I C E   B U L L E T I N

GAME: DEMOLITION DERBY (4 Player)

SUBJECT: ROM CHANGE (Location 1C on CPU Board)

1. An error has been detected in the Demolition Derby coins/credit switch settings.

2. When trying to set the game for either 2 coins – 1 play or 1 coin – 2 plays, no matter what the dip switches are set for, the game will always give 1 coin – 1 credit.

3. Any game with Serial Numbers 101 to 350 may exhibit this fault.

4. If you find it necessary to utilize these settings (2 coins – 1 play or 1 coin – 2 plays) a corrected EPROM is available and would have to be installed in Position 1C on the CPU Board.

Gregory S. McKay
Field Service Technician

GSM/dd

6

April 12, 1985

S E R V I C E   B U L L E T I N

GAME: DEMOLITION DERBY (4-Player, Serial Nos. 101 to 350)

SUBJECT: ROM CHANGE (Location 1C on CPU Board)

1. An error has been detected in the Demolition Derby Coins/Credit
    Switch Setting.

2. Any Demolition Derby shipped from Bally Midway prior to April 12, 1985
    will need an updated ROM.

3. The Bally Midway Parts Department will supply the EPROM at no charge.

4. Any additional EPROMS required will be on a charge basis.

Gregory S. McKay
Field Service Technician

GSM/dd

Bally MIDWAY MFG. CO.

January 10, 1986

S E R V I C E   B U L L E T I N

GAME: "Jumpshot"

SUBJECT: OPTION SWITCH SETTINGS

1. Errors have been detected in the switch settings for
    JUMPSHOT. Please disregard the option switch setting
    information (M051-00E18-A007) located on Page 5 of
    your JUMPSHOT field conversion kit instruction manual.

2. Refer instead to the option switch setting information
    (M051-00E18-B007) attached to this bulletin.

3. Keep this information in your JUMPSHOT field conversion
    kit manual for future reference.

Greg McKay
Field Service Representative
Bally Midway Mfg. Co.

GM/dlm

enc.

JUMP SHOT

OPTION SWITCH SETTINGS

// GAME TIME //

	SW#1	SW#2	SW#3	SW#4	SW#5	SW#6	SW#7	SW#8
2 MINUTES TOTAL GAME TIME	ON	ON						
4 MINUTES TOTAL GAME TIME	OFF	ON						
2 MINUTES TOTAL GAME TIME	ON	OFF						
3 MINUTES TOTAL GAME TIME	*OFF	OFF						

// PLAYER SELECTION //

PLAYER 1	BLACK				ON			
	WHITE				*OFF			
PLAYER 2	BLACK					ON		
	WHITE					*OFF		

// METHOD OF PLAY //

FREE PLAY							ON	
NORMAL PLAY							*OFF	

1 PLAYER PER 1 CREDIT								ON
1 OR 2 PLAYERS PER 1 CREDIT								*OFF

// SPECIAL FUNCTIONS //

FREEZE VIDEO (MONITOR PRESENTATION STOPS MOVING)								ON
GAME OPERATES NORMALLY								*OFF

* INDICATES FACTORY RECOMMENDED SETTINGS	PART NO. M051-00E18-B007

January 24, 1986

S E R V I C E   B U L L E T I N

GAME: "Jump Shot"

SYMPTON: Possible intermittant game reset

CURE: Game Board I.C. Chip 8B, 74LS368, should be a Texas
           Instrument. Any other manufacture may result in
           reset problem.

NOTE: When Converting from Pac Man, Ms. Pac Man or Pac Man
           Plus upright.

Ed Schmidt
Assistant Field Service Manager

ES/dlm

MAX RPM U.R. - 2 PLAYER
Calibration Procedure

CALIBRATION PROCEDURE FOR STEERING WHEEL ASSEMBLY

1. Select player input in Test Mode.

2. Center (left or right) players steering wheel.

3. Locate (left or right) players potentiometer on the Reflective Sensor Control P.C.B.

4. Adjust for a reading of 128 $\pm$5 on screen.

CALIBRATION PROCEDURE FOR A GAS PEDAL ASSEMBLY

1. Select player input in Test Mode.

2. Locate (left or right) players potentiometer on the Reflective Sensor Control P.C.B.

3. Adjust for a reading of 235 to 240 on screen.

4. Depress gas pedal all the way down and a reading of 10 or less should be observed.

POTENTIOMETER ASSIGNMENTS ON REFLECTIVE SENSOR CONTROL P.C.B.

Potentiometer	VR1	=	Right Gas Pedal
Potentiometer	VR2	=	Left Gas Pedal
Potentiometer	VR3	=	Left Steering
Potentiometer	VR4	=	Right Steering

M051-00C75-A010

Bally **MIDWAY** _MFG. CO._

October 10, 1986

S E R V I C E   B U L L E T I N

GAME: **RAMPAGE U.R.**

SUBJECT: Option Switch Settings

Your **RAMPAGE** manual Option Switch Settings on Page 1-6 refer to the initial production run only. Should you find the settings in the manual do not work in your game, refer to the Option Switch Settings listed below.

This program was changed only to provide European operators with multiple coin options. You can easily identify this program as "V.3 (Version 3)" in self test.

R A M P A G E U. R.
O P T I O N   S W I T C H   S E T T I N G S

/////////////////////// SWITCH NO. 2 - AT A13 - LOCATED ON MONOBOARD ///////////////////////

DURING GAME PLAY:	SW#1	SW#2	SW#3	SW#4	SW#5	SW#6	SW#7	SW#8	SW#9	SW#10 NOT USED
DIFFICULTY LEVEL 1 FACTORY SETTING	OFF	OFF								
DIFFICULTY LEVEL 0-EASY	ON	OFF								
DIFFICULTY LEVEL 2-ADVANCED	OFF	ON								
* SCORE OPTION - ON			OFF							
SCORE OPTION - OFF			ON							
COIN CHUTE 1: 1 COIN / 1 CREDIT				OFF						
2 COINS/ 1 CREDIT				ON						
COIN CHUTE 2: 1 COIN / 1 CREDIT					OFF	OFF	OFF			
1 COIN / 2 CREDITS					ON	OFF	OFF			
1 COIN / 3 CREDITS					OFF	ON	OFF			
1 COIN / 4 CREDITS					ON	ON	OFF			
1 COIN / 5 CREDITS					OFF	OFF	ON			
1 COIN / 6 CREDITS					ON	OFF	ON			
2 COINS/ 1 CREDIT					OFF	ON	ON			
3 COINS/ 1 CREDIT					ON	ON	ON			
GAME PLAY ** RACK ADVANCE								OFF		
								ON		
NORMAL VIDEO									OFF	
FREEZE VIDEO									ON	

* ALLOWS PLAYER TO RETAIN POINT TOTAL WHEN HE "BUYS BACK IN" WITHIN A FIXED TIME LIMIT.

** SERVICE BUTTON ADVANCES RACK

FACTORY SETTING - ALL LOGIC SWITCHES SET IN THE "OFF" POSITION   PART NO. M051-00E36-C007

Ed Schmidt
Asst. Field Service Manager

ES:bjn

S E R V I C E   B U L L E T I N

November 12,1986

GAME: RAMPAGE UPRIGHT

SUBJECT: CONDOR SWITCHING POWER SUPPLY

Two versions of the Condor Power Supply were used during
the Rampage production run. Although either supply will
work in your game, the information listed below will help
you to understand the difference between them and insure
that they are properly connected to your game.

Failure to properly connect your respective power supply
can result in game damage.

	Version A	Version B
Bally Midway Part No.	0017-0003-0543	0017-0003-0609
Condor Part No. on PCB	02-30379-0001	02-30485-0001
Connector and No. of Pins	JI,5 J2,20	JI,20
Used with Adapter Cable	No	Yes

NOTE: Games shipped with the version 'B' power supply
included an adapter cable. When replacing a version 'B'
with a version 'A' power supply, DO NOT use the original
adapter cable.

FIELD SERVICE DEPARTMENT

S E R V I C E   B U L L E T I N

January 13, 1987

SUBJECT: CONDOR POWER SUPPLY (#SP1016)

We have found that on Bally Midway video games, we are operating the Condor Power Supply at just under the minimum load required for proper operation. Because of this, when turning on a game, the Condor Power Supply may oscillate on and off.

To correct this situation, change resistor R9 to a 750 ohm 1/4 watt. R9 is located under the heatsink for Q2. It is necessary to remove Q2 and the heatsink to change R9.

Also, please note that we have put a ninety (90) day warranty on the Condor Power Supply.

Greg McKay
Field Service Representative

GM/jmm

Bally SENTE SERVICE ™

October 11, 1985

SENTE SERVICE BULLETIN

GAME: STOCKER

SUBJECT: OPTION SWITCH SETTINGS

An error has been detected in the Stocker Field Conversion Kit instruction package.

Please refer to the following switch settings when changing your options:

G1

1	2	3	4	5	6	7	8	
XX	XX	XX	XX	XX	XX	OFF		* Normal
XX	XX	XX	XX	XX	XX	ON		3 Tickets Ends Game
XX	XX	XX	XX	XX	XX		OFF	No Attract Music
XX	XX	XX	XX	XX	XX		ON	* Music in Attract

H1

1	2	3	4	5	6	7	8	
ON	ON							FREE PLAY
OFF	ON							* 1 COIN/1 CREDIT
ON	OFF							1 COIN/2 CREDITS
OFF	OFF							2 COINS/1 CREDIT
		ON	ON	ON				* No Bonus Coins
		OFF	ON	ON				2 Coins Adds 1 Bonus Coin
		ON	OFF	ON				3 Coins Adds 1 Bonus Coin
		OFF	OFF	ON				4 Coins Adds 1 Bonus Coin
		ON	ON	OFF				4 Coins Adds 2 Bonus Coins
		OFF	ON	OFF				5 Coins Adds 1 Bonus Coin
		ON	OFF	OFF				5 Coins Adds 2 Bonus Coins
		OFF	OFF	OFF				5 Coins Adds 3 Bonus Coins
					ON			* Left Coin Mech x 1
					OFF			Left Coin Mech x 2
						ON	ON	* Right Coin Mech x 1
						OFF	ON	Right Coin Mech x 4
						ON	OFF	Right Coin Mech x 5
						OFF	OFF	Right Coin Mech x 6

* = recommended settings

October 11, 1985

SENTE SERVICE BULLETIN

GAME: SAC 1 and COCKTAIL CABINETS

SUBJECT: ALL CONVERSTION KITS WITH CONTROL PANELS THAT USE
           TRACKBALLS

IF there seems to be an obstruction by the trackball assembly
when installing the control panel, follow these steps:

1. Turn control panel over and take off 4 nuts holding the
    trackball P.C. (006-8004-10) to the trackball assembly.

2. Lift P.C. off studs and rotate the trackball P.C. 90
    degrees.

3. Replace P.C. on studs and secure again with nuts.

GM/dc

Bally SENTE SERVICE ™

SERVICE BULLETIN

KIT: SAC MAN FIELD CONVERSION

SUBJECT: GALAXIAN POSITIVE SYNC MODIFICATION

PROBLEM: Some earlier GALAXIAN U.R. games have a negative sync and the
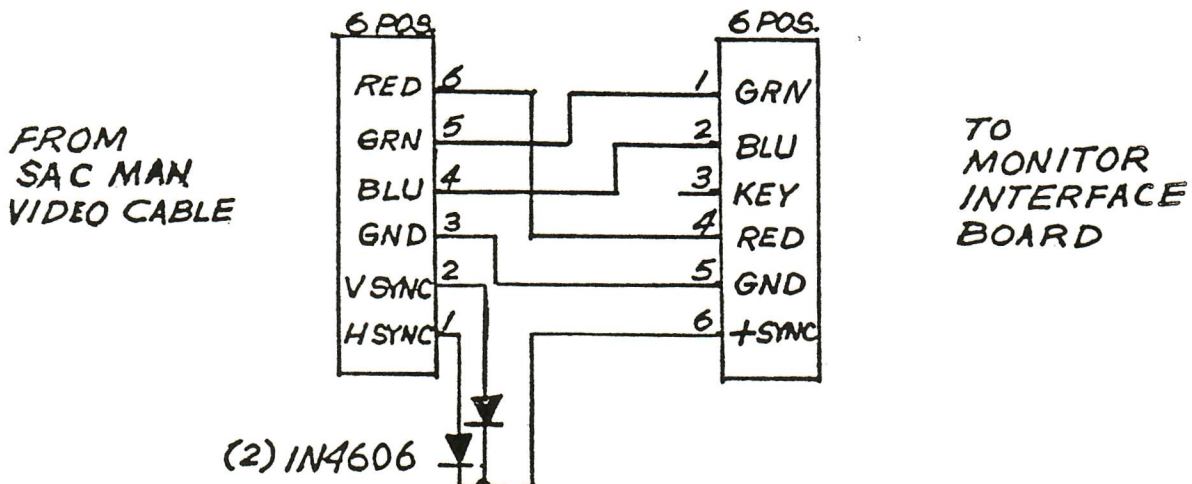   SAC MAN kit requires a positive sync.

SOLUTION: Make the following respective modifications:

   RE: Wells-Gardner Monitor Interface P.C. boards; P302, P297
        and 294 for positive sync.

MONITOR INTERFACE BOARD MODIFICATION PROCEDURE

1. Remove TR203 and install a jumper from the base to the collector
   board positions.

2. Remove R210 resistor and install a jumper across the resistor
   board positions.

3. Remove R207 and R208.

4. Install a 10K OHM, 1/2 Watt Resistor from the collector board
   position of TR203 to ground.

5. Construct an adaptor cable using Fig. #1 as a reference and
   install cable.

FIG. #1

FROM SAC MAN VIDEO CABLE

6 POS.			6 POS.
RED	6	1	GRN
GRN	5	2	BLU
BLU	4	3	KEY
GND	3	4	RED
V SYNC	2	5	GND
H SYNC	1	6	+SYNC

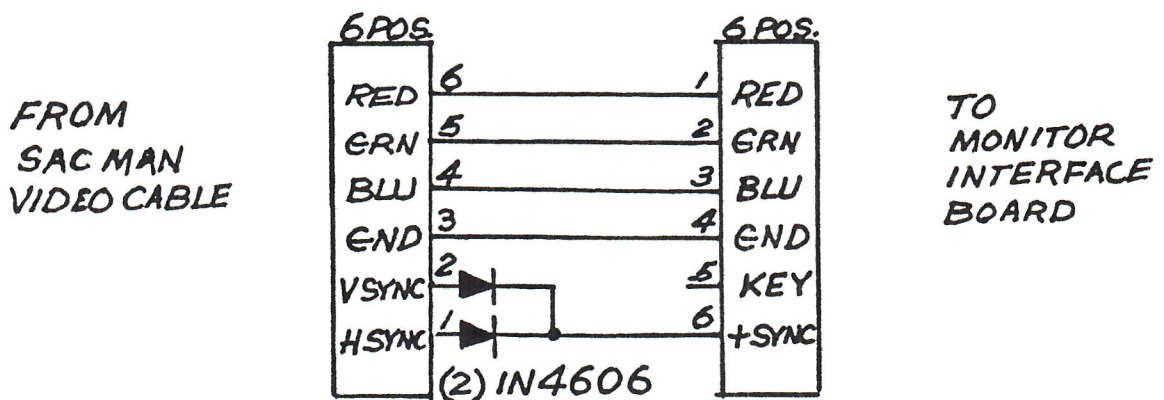TO MONITOR INTERFACE BOARD

(2) IN4606

March 24, 1986
SERVICE BULLETIN

RE: Wells-Gardner Monitor Interface P.C. Boards 298 and P307
      for positive sync.

MONITOR INTERFACE BOARD MODIFICATION PROCEDURE

1. Remove 1K OHM resistor located in X201 and install a jumper
    across 1K OHM resistor positions.

2. Remove transistor near R217.
    NOTE: This transistor is not identified on the P.C. Board.

3. Install a jumper from the base of J202 to Pin 10.

4. Remove the diode on the solder side of the P.C. Board located
    from the collector of J202 to Pin 10.

5. Construct an adaptor cable using Fig. #2 as a reference and
    install cable.

FIG #2

FROM
SAC MAN
VIDEO CABLE

6 POS

RED	6
GRN	5
BLU	4
GND	3
VSYNC	2
HSYNC	1

(2) IN4606

6 POS.

1	RED
2	GRN
3	BLU
4	GND
5	KEY
6	+SYNC

TO
MONITOR
INTERFACE
BOARD

Ed Schmidt
Assistant Field Service Manager

ES/dlm

18

Bally SENTE SERVICE ™

April 10, 1986

S E R V I C E   B U L L E T I N

RE: NAME THAT TUNE TEST PROCEDURE

Due to the size of the Game Program, the standard test procedure for Bally Sente games could not be incorporated into this game. This does not mean that tests are not available, only that they are not obvious to the operator.

PROCEDURE:

To enter the test mode, flip the test switch to the on position. The screen displays the message, "Please Stand By". During this time the sound board is being tested and will display an error message if it finds a problem. It will then display:

> "THE NUMBER OF SONGS"
> "THE NUMBER OF CATAGORIES"
> "THE NUMBER OF BID TOPICS"

Pressing the "Player One" start button, displays the song 0000 (in hexadecimal).

Pressing the "Player Two" #1 button, increments the tune selection to song 0001. Holding in this button will cause the displayed songs to rapidly scan forward.

Operating the "Player One" #1 button works in the same manner scanning the tune selection in the opposite direction.

Once a song is selected, press "Player One" start button to activate the tune. This will execute the entire portion of that song stored in memory provided no other push buttons are operated. For a nine note rendition of the same song without cords or background, press "Player Two" start button.

To continue with the test, just use "Player One" or "Player Two" #1 button to make your next selection and repeat the procedure. To exit the test, return the test switch to the off position and after a short pause the game should return to the attract mode.

If you should encounter any problems, please contact Bally Sente service at 1-800-323-7182.

April 10, 1986

S E R V I C E   B U L L E T I N

RE: BALLY SENTE MAIN FRAME MASTER CABLE MODIFICATION

The following modification **MUST** be performed on all Sente main frame cables that work in conjunction with the NAME THAT TUNE conversion kit.

Failure to make this modification may result in garbage on screen or the picture may freeze intermittantly.

Each NAME THAT TUNE kit contains a "master cable kit", which includes two wires for installation into your respective Bally Sente main frame cable.

The purpose of this cable modification is to replace the regulated +12 V.D.C. with unregulated +12 V.D.C. to your respective main frame cable. This change will provide a +12 V.D.C. unregulated buss line to the NAME THAT TUNE control panel, player one and player two lamps.

As current production of Sac IB main frame units already include this cable modification, no work will be required on your part. However, Bally Sente main frame units manufactured prior to "this" cable change must be modified for proper NAME THAT TUNE game operation. This includes: Sac I, Sac IA, Sac IB (made prior to cable modification), Sac Man and the cocktail main frame.

A quick way to determine if the cable modification has been made is to look at the Power Supply connector P19 at pins 10 and 11. If a GREEN-WHITE wire is connnected to pin 10 and a GREEN-RED wire is connected to pin 11, the modification has been installed. See Figure "A"

If not, then the master cable assembly must be modified, using the NAME THAT TUNE master cable kit as follows:

A. Cut the GREEN-WHITE or GREEN wire at location "K" of cable connector P7 (22 position). Then strip "this" wire for later use with wire nut. Please cut as close as possible to the connector.

B. Connect the cable kit GREEN-WHITE wire from the Power Supply connector P19, Pin 10, to the GREEN-WHITE or GREEN wire you cut at location "K" of cable connector P7. After both wires are stripped and joined together, install the wire nut provided in the cable kit.
   NOTE: Do Not install cable ties now. Also Do Not connect the kit wire to position "K".

C. Cut the GREEN-RED or GREEN wire at location "L" of cable connector P7. Then strip "this" wire for later use with wire nut. Please cut as close as possible to the connector.

D. Connect the cable kit GREEN-RED wire from the Power Supply connector P19, PIN 11, to the GREEN-RED or GREEN wire you cut at location "L" of cable connector P7. After both wires are stripped and joined together, install the wire nut provided in the cable kit.
   NOTE: Do Not connect the kit wire to position "L".

FIGURE 'A'
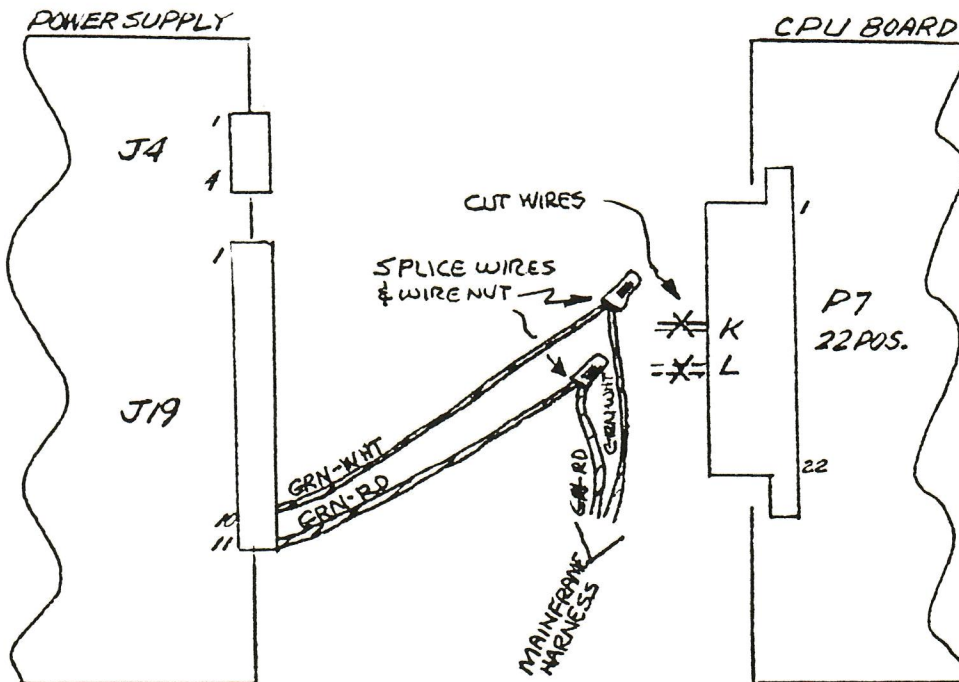
E. Install cable ties.

F. Check out electrically.

G. Any problems or questions call Bally Sente Service at our toll-free number 1-800-323-7182.

Ed Schmidt
Asst. Field Service Manager

ES/dlm

21

April 23, 1984

S E R V I C E   B U L L E T I N

GAME: KINGS OF STEEL

SUBJECT: UNIQUE PARTS LIST

The following is a unique parts list for game number #390 Kings of Steel.

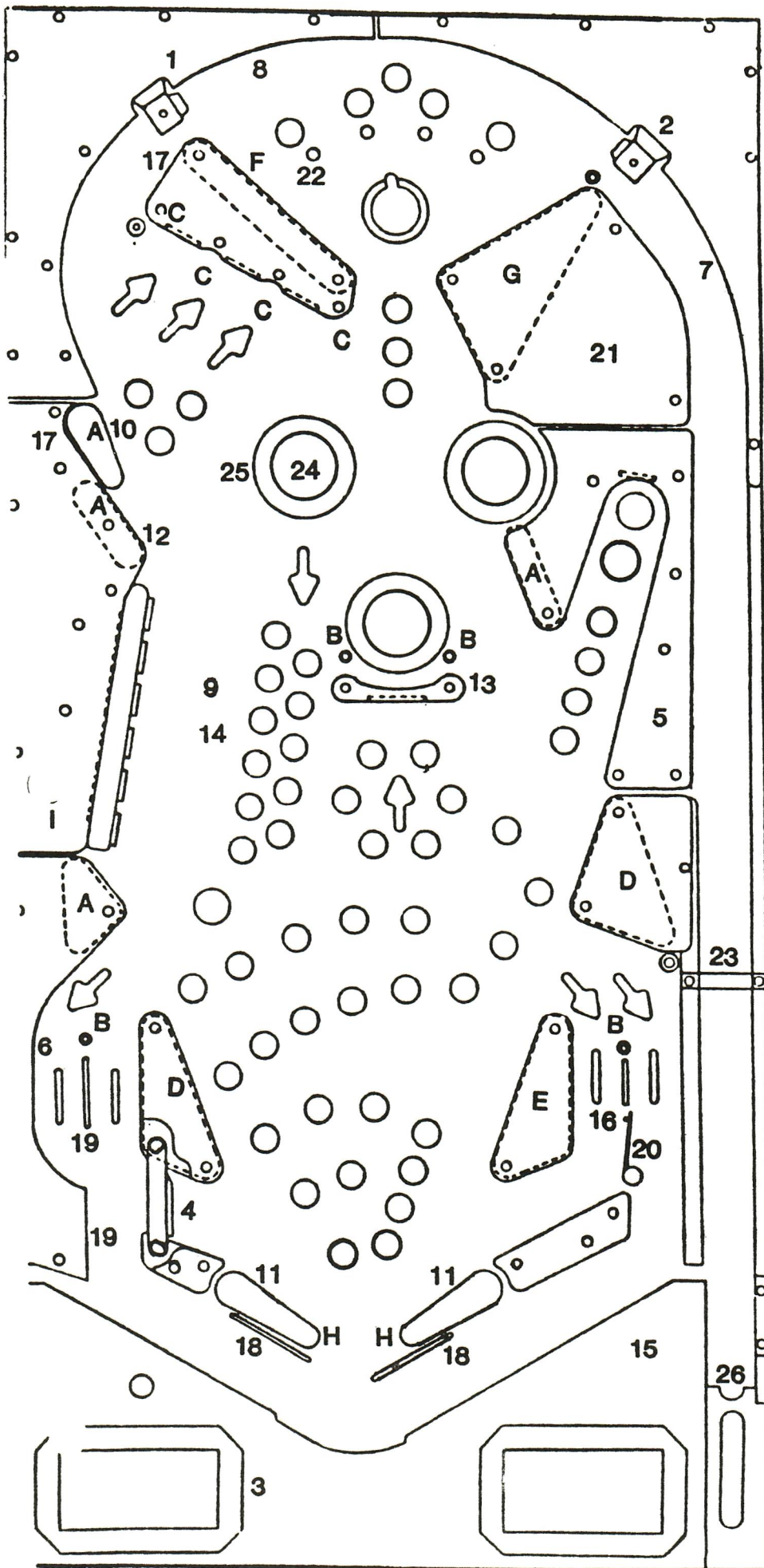| DESCRIPTION	BALLY MIDWAY PART NUMBER
10 Drop Target	A390-11
Jack Drop Target (2)	A390-12
Queen Drop Target (3)	A390-13
Back Glass	A390-42

Attached is a complete listing of the playfield top and bottom parts.

Pete Gustafson
Field Service Technician

PG/dd

attach.

page 1 of 2

23

RUBBER PARTS

Dimensions are inside diameters. Numbers in parenthesis indicate quantity used, if in excess of one.

A.	17-41-643	1"	(5)
B.	17-41-633	Bumper	(6)
C.	17-41-641	Post	(4)
D.	17-41-645	2"	(2)
E.	17-41-646	2½"	
F.	17-41-647	3"	
G.	17-41-648	3½"	
H.	17-41-682	Flipper	(2)
I.	17-41-689	Rubber Nut	(30)

PANEL TOP PARTS

1. Left Ball Gate Assy.........................A360-22
2. Right Ball Gate Assy........................A360-23
3. Top Mounted Ball Kicker Assy. (Outhole).....A360-234
4. Ball Gate and Wire Assy.....................A371-40
5. Plastics and Bushing Assy...................A390-16
6. Ball Guide Assy.............................A390-18
7. Ball Guide Assy.............................A390-19
8. Ball Guide Assy.............................A390-20
9. Playfield Screened and Pierced..............A390-504-XF
10. Mini Flipper and Shaft......................A391-52-100
11. White Flipper and Shaft (2).................A967-31
12. 1" Red Post (11)............................17-42-588
13. 1 3/16" Red Post (19).......................17-42-596
14. Mylar Overlay...............................331-903
15. Bottom Arch.................................391-105
16. 1 1/8" Ball Guide...........................360-175-3200
17. 1 1/4" Ball Guide (2).......................360-175-4600
18. 2 3/8" Buffer Wire (2)......................360-175-5300
19. 1 3/4" Ball Guide (2).......................360-175-8400
20. Free Ball Gate..............................390-110-XF
21. Screened Plastics...........................390-901-XF
22. Rollover Buttons (4)........................390-906
23. Shooter Lane Hood...........................A967-107-XF
24. Thumper Bumper Cap (3)......................A390-39
25. Thumper Bumper Collar (3)...................17-42-403
26. Shooter Gauge...............................391-106

WHEN ORDERING PART, SPECIFY PART NO. AND NAME OF GAME

#0390 Kings of Steel

◯ INDICATES SWITCH ASSEMBLY IDENTIFICATION NUMBERS.

▢ INDICATES SOLENOID IDENTIFICATION NUMBERS.

△ INDICATES ASSEMBLY IDENTIFICATION NUMBERS.
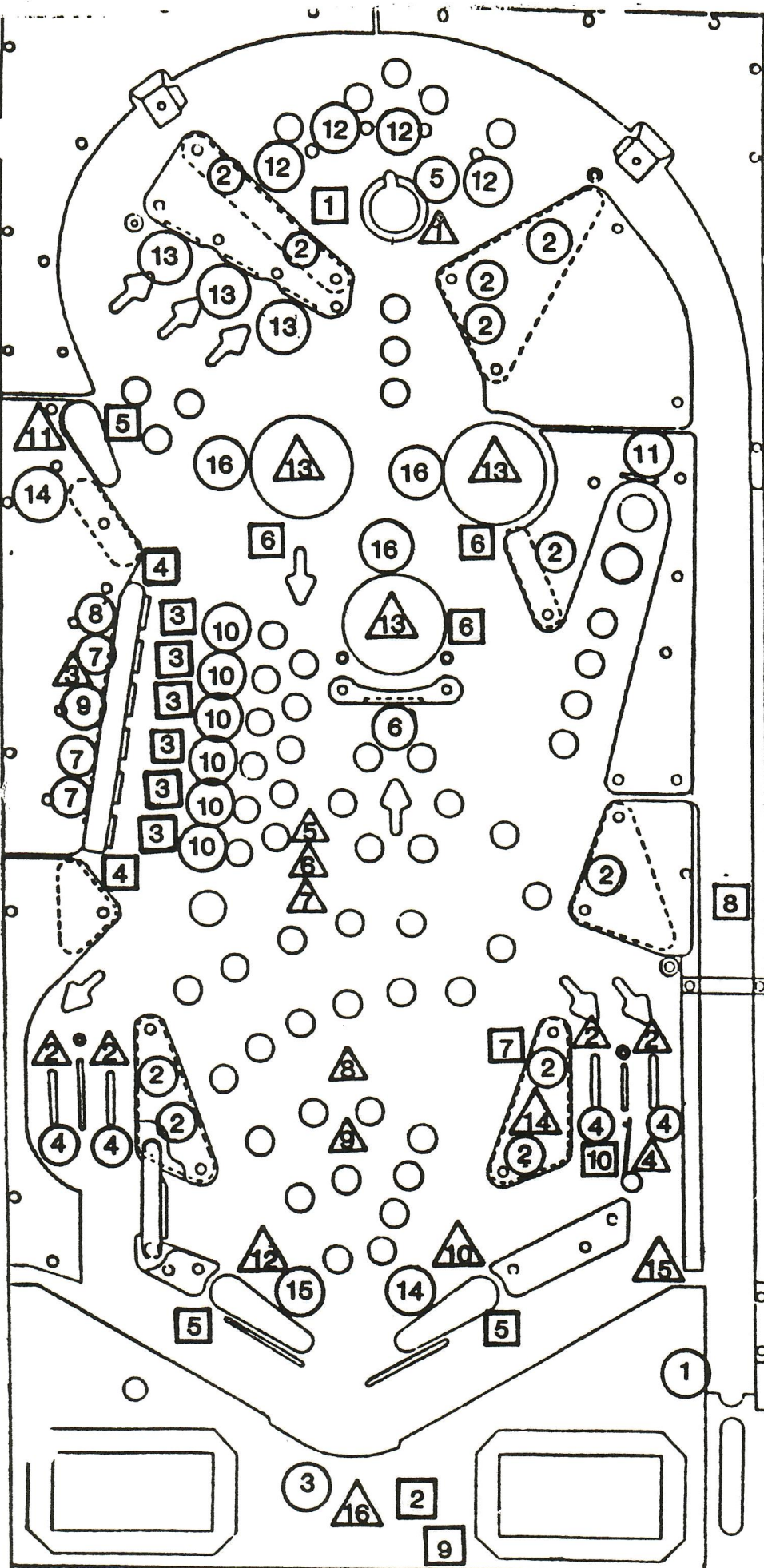
WHEN ORDERING PART, SPECIFY PART NO. AND NAME OF GAME

page 1 of 2

25

SWITCH ASSEMBLY IDENTIFICATION PART NUMBERS

1. Playfield Tilt...A360-57
2. General Rebound (11)......................................A360-69
3. Outhole..A360-55
4. Rollover Switch (4).......................................A360-61
5. Saucer...A967-75
6. Square Red Target..A390-14
7. White Targets Behind Drop Targets (3)..................A365-27-109
8. Top White Target Behind Drop Targets..................A365-27-200
9. Red Target Behind Drop Targets.........................A365-28-200
10. Drop Targets (6)..A360-62
11. White Target..A360-261
12. Rollover Button (4).....................................A390-22
13. Blue Target (6)...A391-41
14. Upper Left & Right Flipper End of Stroke Switch (2)..A360-77
15. Lower Left Flipper End of Stroke Switch.............A360-67
16. Thumper Bumper (3)......................................A967-74

SOLENOID IDENTIFICATION PART NUMBERS

1. Saucer...A360-211
2. Outhole..A360-44
3. Drop Target Memory Coils (6)...........................A360-210
4. Drop Target Reset Coils (2)............................A967-77
5. Flippers (3)..A360-45
6. Thumper Bumpers (3).....................................A360-44
7. Sling Shot..A967-46
8. Knocker...A360-46
9. Coin Lock Out...A360-208
10. Free Gate...A390-27

ASSEMBLY IDENTIFICATION NUMBERS
PLAYFIELD BOTTOM PARTS

1. Saucer...A331-34
2. Rollover Wire Form (4)..................................A360-216
3. Six Drop Target and Memory Coil Assy...................A390-25
4. Free Gate Relay...A390-32
5. Upper Feature Lamp Board W/Sockets.....................A390-36
6. Upper Feature Lamp Board W/O Sockets.............A084-91704-A390
7. Feature and Bonus Board Lamp Sockets (43)...........17-31-29
8. Bonus Board W/Sockets...................................A390-37
9. Bonus Board W/O Sockets.........................A084-91703-B390
10. Right Flipper...A391-53-100
11. Upper Left Flipper......................................A391-53-200
12. Lower Left Flipper......................................A391-54-200
13. Thumper Bumper (3)......................................A967-53
14. Sling Shot..A967-59
15. One Position Fuse Clip..................................720-1-100
16. Outhole Wire Actuator...................................A360-217

WHEN ORDERING PART, SPECIFY PART NO. AND NAME OF GAME

July 11, 1984

S E R V I C E   B U L L E T I N

GAME: BLACK PYRAMID

SUBJECT: ATTRACT MODE SOUND & CORRECTION ON PAGE SEVEN (7)
            OF THE GAME MANUAL

In order to shut off the attract mode sound, Dip Switch
No. #30 on the MPU Board must be turned off. Please add
this information to Page 7 of your game manual.

Also, on Page 7 the last switch setting for the Left Lane
Extra Ball Build Up Adjustment (SW#7 ON SW#8 ON 50K) should
read 'Most Liberal'.

Pete Gustafson
Field Service Technician

PG/dd

October 18, 1984

S E R V I C E   B U L L E T I N

GAME: SPY HUNTER PINBALL

SUBJECT: NUMBER OF GAMES REPLAYS PER GAME ADJUSTMENT

Please add Switch No. 29 information to page seven (7)
of your game manual.

LIBERAL	SW. 29 ON	All replays earned will be collected
CONSERVATIVE	SW. 29 OFF	Only 1 replay per player per game

Switch No. #29 should be checked before placing your Spy
Hunter Pinball game on location.

Pete Gustafson
Field Service Technician

PG/dd

Bally MIDWAY MFG. CO.

February 21, 1985

S E R V I C E   B U L L E T I N

GAME: SPY HUNTER

SUBJECT: FLIPPER ASSEMBLY MANUFACTURING PART CHANGES, ASE-1587 SERIES

1. The Spring Washer (Part No. 0017-00104-0073) has been removed. See Drawing Below, Ref: 'A'.

2. Flipper Stop Bracket (Part Nos. 0360-00152-01XF, left; 0360-00152-02XF, right). The bracket hole diameter has been enlarged by .007, from .375 $^{+.003}_{-.000}$ to .382 ±.002. See Drawing Below, Ref: 'B'.

3. The Flipper End of Stroke contact material has been changed from Silver Cadmium to Tungsten. See Drawing Below, Ref: "C".
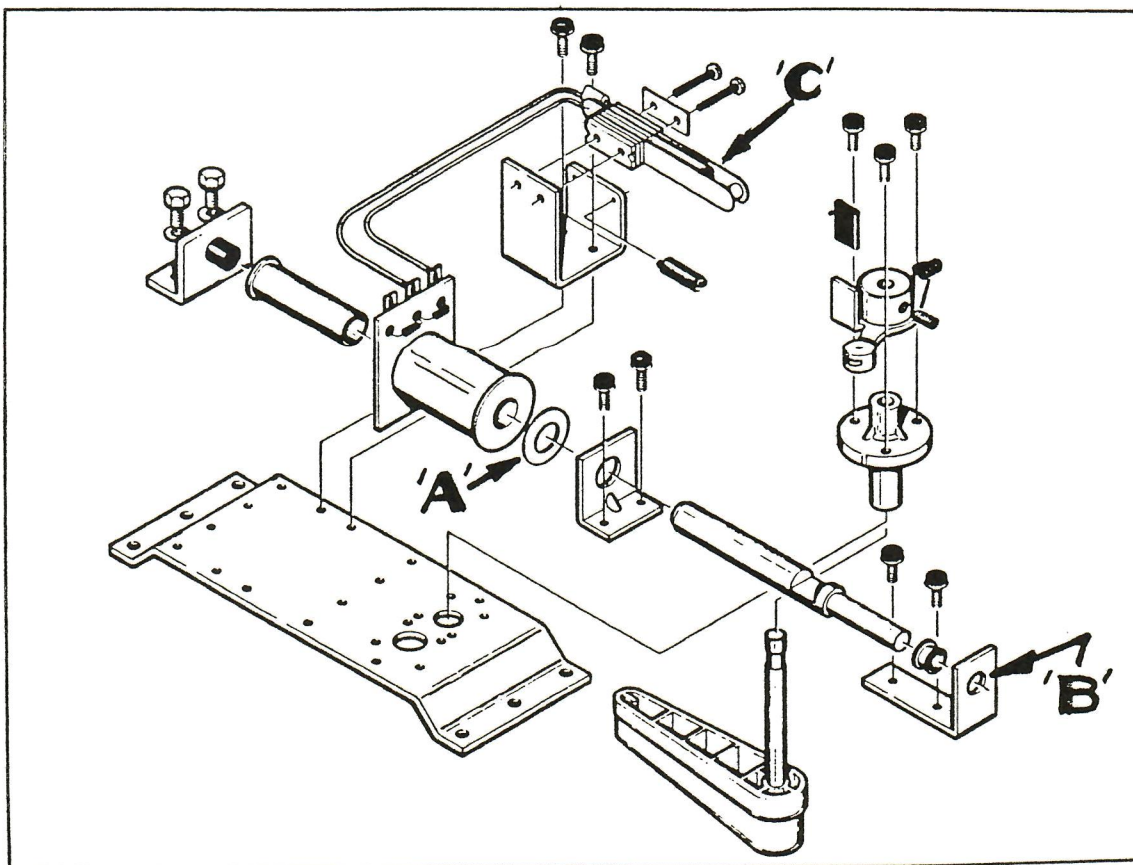
Changes 'A' and 'B' were made to reduce the possibility of the flipper assembly plunger from binding. If you are presently experiencing a binding problem, please make the appropriate changes.

January 23, 1985

S E R V I C E   B U L L E T I N

GAME: FIREBALL CLASSIC & SPY HUNTER (PINBALL)
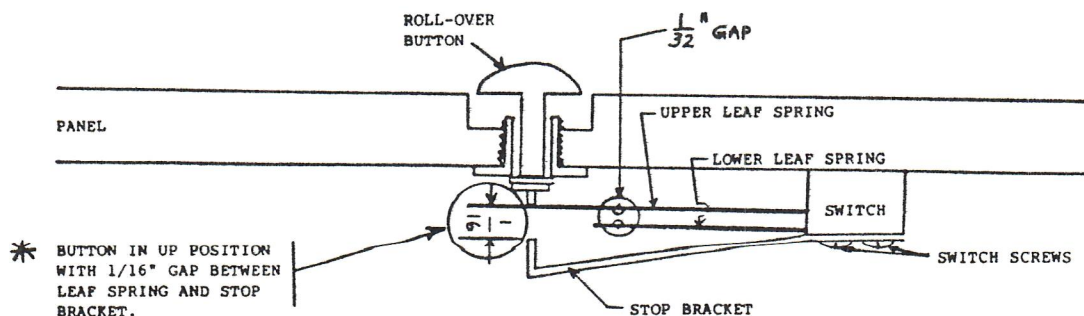
SUBJECT: ROLL-OVER BUTTON ADJUSTMENT PROCEDURE

POTENTIAL PROBLEM: If the R.O. Button is out of adjustment the game
                      ball can trap between the R.O. Button and the play-
                      field.

SOLUTION: Adjust R.O. Button as shown in the drawing below.

ROLL-OVER BUTTON GAME LOCATION

Fireball Classic — (8) Surrounding spinning rubber pad
Spy Hunter   — (9) Weapons warehouse area

PROCEDURE:

A) CHECK SWITCH SCREWS FOR TIGHTNESS.
B) MAKE SURE UPPER LEAF SPRING (ON SWITCH)
    CONTACTS ROLL-OVER BUTTON STEM (UPWARD PRESSURE)
C) INSERT GAUGE.
D) ADJUST STOP BRACKET FOR 1/16" GAP. REMOVE GAUGE.
E) ADJUST LOWER LEAF SPRING FOR SWITCH CONTACT (1/32"GAP
    BETWEEN CONTACTS)

NOTE: TEST ADJUSTMENT WITH BALL ON TOP OF PLAYFIELD - BALL
      MUST ACTUATE SWITCH (IF NOT - MODIFY UPWARD PRESSURE
      - STEP B - AND RE-ADJUST).

Ed Schmidt
Asst. Technical Service Manager

ES/dd

January 24, 1985

S E R V I C E   B U L L E T I N

GAME: FIREBALL CLASSIC (Game Serial Numbers 101 thru 700)

SUBJECT: ODIN AND WOTAN EJECT SAUCER TABS ADJUSTMENT

POTENTIAL PROBLEM: A game ball can trap between a saucer captive ball and the edge of the Wotan and/or Otin saucer.
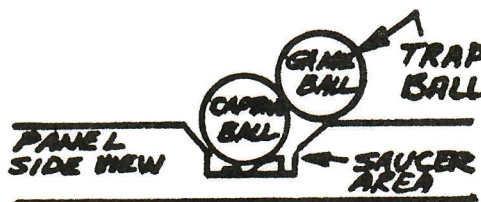
SOLUTION: To prevent a potential ball trap, spread the two eject saucer tabs apart as shown in the drawing below.
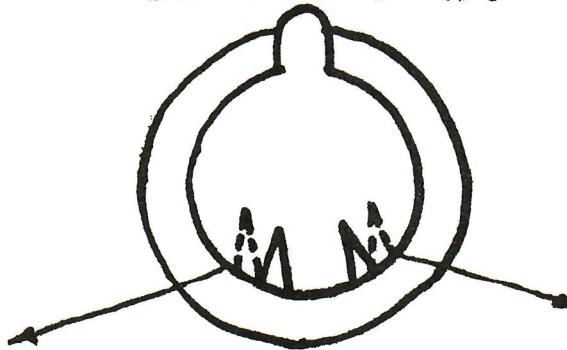
Left Eject Saucer: Ball should exit to right flipper

Right Eject Saucer: Ball should exit to free ball gate lane

Ed Schmidt
Asst. Technical Service Manager

ES/dd

February 21, 1985

S E R V I C E   B U L L E T I N

GAME: FIREBALL CLASSIC PRELIMINARY MANUAL, OWNER/OPERATORS SECTION
              (M051-00A40-A012)

SUBJECT: GAME OVER ATTRACT SOUND ADJUSTMENT

Please add the following information on Page 7A:

GAME OVER ATTRACT ADJUSTMENT

SW. 30 ON   ATTRACT SOUND ON

SW. 30 OFF   ATTRACT SOUND OFF

Ed Schmidt
Asst. Technical Service Manager

ES/dd

February 18, 1985

S E R V I C E   B U L L E T I N

GAME: FIREBALL CLASSIC PINBALL

SUBJECT: MANUAL CHANGES – PRELIMINARY OWNER/OPERATORS SECTION (M051-00A40-A012)

Please make the following changes in the above mentioned manual:

1. Attached you will find a copy of the corrected 'GAME FEATURE OPTIONS', Page 7A. Insert this page in your manual. 7A deletes and replaces the original 'GAME FEATURE OPTIONS' information on Page 7.

2. Attached you will find a copy of the 'RECOMMENDED SWITCH SETTINGS FOR 3 AND 5 BALL', Page 12A. Insert this page in your manual. 12A deletes and replaces the original 'RECOMMENDED SWITCH SETTINGS' information on Page 12.

3. Page 6, MATCH FEATURE reads:

MATCH		SWITCH 28	
ON	ON	OFF	OFF

    Change to read:

MATCH	SWITCH 28
ON	ON
OFF	OFF

ATTACHMENTS

1. GAME FEATURE OPTIONS, Page 7A.

2. RECOMMENDED SWITCH SETTINGS FOR 3 AND 5 BALL, Page 12A.

Ed Schmidt
Asst. Technical Service Manager

ES/dd

attach.

TEST SEQUENCE

This is the order in which the MPU Tester tests the various components and functions of the MPU board. This sequence of tests is completely automatic. When an error code is displayed, the Tester will go to the next test in the sequence when the 'Test' button is activated. Note that certain PIA and Memory errors cause one or two of the following tests to be bypassed.

	ERROR CODE		COMPONENT OR FUNCTION TESTED
1.	U7	=	U18 - 6802 Internal RAM
2.	U8	=	U6 - 5114 C-MOS RAM
3.	FF		No memory detected in U8-U13 sockets. If this error is detected, the tester bypasses the memory tests and goes to the PIA tests.

Error codes for type '02' - A084-91638-D000 MPU board memory tests/

5C00] 5800] 5400] 5000*] 1C00] 1800] 1400] 1000]	Refer to 'New MPU Memory Map' table to determine component tested. e.g.; if 5C00 is the error code displayed and the MPU board memory is implemented with a 2732 Prom, U8 is the component that failed the test. If a 9332 ROM was used, U8 is still the component that failed.

4.	1006	U17 - B Control Register (If the error code is displayed, next test is #7.)
5.	1005	U17 - B Data Direction Register (Next test is #7.)
6.	1004	U17 - B Peripheral Data Register
7.	1003	U17 - A Control Register (Next Test is #10.)
8.	1002	U17 - A Data Direction Register (Next Test is #10.)
9.	1001	U17 - A Peripheral Data Register
10.	1106	U16 - B Control Register (Next Test is #13.)
11.	1105	U16 - B Data Direction Register (Next Test is #13.)
12.	1104	U16 - B Peripheral Data Register

*If this error code is displayed no other memory chips are tested. Tester proceeds to PIA tests.

	ERROR CODE	COMPONENT OR FUNCTION TESTED
13.	1103	U16 - A Control Register (Next Test is #16.)
14.	1102	U16 - A Data Direction Register (Next Test is #16.)
15.	1101	U16 - A Peripheral Data Register
16.	10	U19 - Display IRQ Timer Stuck high or low
17.	20	U19 - Display IRQ Timer timing error
18.	30	U1 & U17 - 'Zero Crossing' error
19.	J2-1 thru J2-5 J3-2, J3-3	U17 & outputs at connector pins.
20.	J3-9 thru J3-16	U17 & outputs at connector pins.
21.	J1-1 thru J1-7	U16 & outputs at connector pins.
22.	J4-1 thru J4-8	U16 & outputs at connector pins.
23.	J1-20 thru J1-24 J1-10	U17 & U20 & outputs at connector pins.
24.	J1-25 thru J1-28	U17 & outputs at connector pins.
25.	J1-12 thru J1-19	U17 & outputs at connector pins.
26.	J1-11	U17, Pin 19 & output at connector pin.
27.	J1-8	U16, Pin 29 & output at connector pin.
28.	J1-10	U17, Pin 39, U14, U19 & output at connector pin.
29.	50	U18, Pin 4, IRQ Line stuck high (flashing LED indicates IRQ stuck low)
30.	S01 thru S32	Dip switches S1 thru S32, all switches closed.
31.	CP1 thru CP4 CP43	CP1=D44, CP2=D43, CP3=D42, CP4=D41 & CP43=D45 (open, short or reversal)
32.	J3-1	U17, Pin 40 & input at connector pin.
33.	J5-32	U16, Pin 18 & input at connector pin.
34.	J4-10	U16, Pin 19 & output at connector pin.
35.	9999	End of Test.

	Configuration	Address Space
U12	2532 PROM	⌈ $1,000 - $17FF
	or 9332 ROM	⌊ $5,000 - $57FF
U8	9732 PROM	⌈ $1,800 - $1FFF
	or 9332 ROM	⌊ $5,800 - $5FFF

Bally **MIDWAY** MFG. CO.
_____

June 3, 1985

S E R V I C E   B U L L E T I N

GAME: CYBERNAUT Pinball Machine, M.P.U. Board (6802)
        Game Serial Numbers 100-612

C4 CAPACITOR

POTENTIAL   Game may not power up or may power up and go into game reset
PROBLEM: after a brief period of time. This problem will be due to a wrong
            size capacitor in position, C4, which will have a .01 uf rating.

SOLUTION: Remove C4, .01 uf capacitor and replace with a 4.7 uf, 25 V.,
            TANTALUM capacitor.

            Also, the game manual, M.P.U. schematic M051-00114-D077, C4 capacitor
            reads .01 uf and should be changed to read 4.7 uf TANTALUM.

PARTS: The Bally Midway Parts Department will ship a like amount of 4.7 uf
            TANTALUM capacitors at no charge to cover the amount of games shipped
            to each distributor for game serial numbers 100-612.

D1 DIODE

POTENTIAL   On games using B1-PHASE switch illumination, D1 (IN4148 DIODE) should
PROBLEM: be in the zero crossing circuit with R16, 2K resistor removed. In all
            other games, R16 should be present with D1 removed.

            CYBERNAUT uses the R16, 2K resistor, therefore D1 DIODE must be
            removed. On game serial numbers 100-612, the D1 DIODE may have been
            installed on some of the 6802 M.P.U. boards. D1 DIODE in circuit may
            cause a problem in the zero crossing detector circuitry, especially on
            components R4, 2K resistor and/or U1, 4049B.

SOLUTION: Please remove the D1 DIODE.

Ed Schmidt
Assistant Technical Service Manager

ES/af

May 6, 1986

<u>S E R V I C E   B U L L E T I N</u>

GAMES: "8 BALL CHAMP, BEAT THE CLOCK AND LADY LUCK"

SUBJECT: Manual error. Test point 2 and test point 4 are
                reversed

ACTION: Please correct respective game manual as follows:

                * Test point 2 changed to read test point 4
                * Test point 4 changed to read test point 2

<u>OPERATING GAME MANUAL REFERENCE</u>

            * 8 Ball Champ;   Page 3-14, Sheet 2 of 7
            * Beat The Clock; Page 3-14, Sheet 2 of 7
            * Lady Luck;   Page 2-14, Sheet 2 of 7

Ed Schmidt
Asst. Field Service Manager

ES/dlm

December 26, 1985

S E R V I C E   B U L L E T I N

GAME: "Beat The Clock"

SUBJECT: MANUAL ERROR CORRECTIONS AND ADDITIONS

Please make the following game manual corrections:

PAGE #	READS	CHANGE TO READ
3-16	REF: Sheet 1 of 2 NOTE: coil I.D. incorrect.	Replace with sheet 1 of 2 attached. NOTE: coil I.D. corrected.
3-16	REF: Sheet 2 of 2 Strobe #5 reads: CJ4-2 I4 reads: CJ4-5	Strobe #5 should read: CJ4-1 I4 should read: CJ4-6
3-17	Controller BD-C, J5 Pin 15	Add: SJ1-8

Ed Schmidt
Asst. Field Service Manager
Bally Midway Mfg. Co.

ES/dlm

+43 VDC (62)

NOTE 2.   NOTE 2.   NOTE 2.   1A SLO-BLO

RIGHT FLIPPER   UPPER RIGHT FLIPPER   LEFT FLIPPER

OUTHOLE

RIGHT BUMPER   RIDDLE BUMPER   LEFT BUMPER   RIGHT BLING SHOT   LEFT BLING SHOT

1-6 B.T. RESET   RIDDLE B.T. RESET   RIGHT SAUCER

8.9VAC

GENERAL ILLUM.

RETURN

COLOR CODE

1= RED   6= BROWN
2= BLUE   7= ORANGE
3= YELLOW   8= BLACK
4= GREEN   9= GRAY
5= WHITE   0= NO COLOR

NOTES:
V CAPORUSSO

BALLY MIDWAY MFG. CO.

BEAT THE CLOCK PLAYFIELD

SHEET 1 OF 2   REV

NOTES:
1. COIL & LAMP DIODES ARE 1N4004
2. GERMANY ONLY-CAPACITOR .01MF 2500V

TIME 60 — J13-2 — 70
TIME 120 — J13-13 — 27
2X
LEFT RETLANE — J13-5 — 30
3X
RIGHT RETLANE — J13-3 — 95
5X
TIMER (T) — J13-12 — 86
RIGHT LANE 2X
TIMER (I) — J13-10 — 87
RIGHT LANE 3X
TIMER (R) — J13-4 — 79
RIGHT LANE 5X
TIMER (E) — J13-11 — 78
RIGHT LANE 40K
TIMER (R) — J13-07 — 94
RIGHT LANE SPECIAL
TIME 00 — J11-13 — 61
TIME 10 — J11-3 — 29
RIGHT START — J12-2 — 29
TIME 10 — J11-14 — 73
LEFT START — J12-18 — 73
TIME 20 — J11-9 — 10
LEFT OUTLANE — J12-8 — 10
TIME 20 — J11-2 — 23
RIGHT OUTLANE — J12-3 — 23
TIME 30 — J11-15 — 90
ADD 8 SEC — J12-11 — 90
TIME 30 — J11-7 — 91
COLLECT BONUS — J12-9 — 91
TIME 40 — J11-1 — 15
LANE (A) — J12-4 — 15
TIME 45 — J12-17 — 34
LANE (B) — J13-1 — 34
TIME 50 — J12-18 — 48
LANE (C) — J12-8 — 48
TIME 55 — J12-16 — 14
LANE (D) — J13-6 — 14
CLOCK STOPPER — J11-4 — 79
TIME 04 — J12-1
TIME 08 — J11-18 — 58

91 — J10-1 — STOP(S)
94 — J10-7 — EXTRA BALL
STOP(T)
71 — J10-16 — MATCH
STOP(O)
49 — J10-2 — CREDIT
STOP(P)
62 — J10-8 — DIP
BTG 90K
97 — J10-17 — HIGH SCORE
BTG 100K
95 — J10-3 — GAME OVER
BTG 150K
38 — J10-9 — TILT
BTG SPECIAL
96 — J10-18 — BONUS 5K
SAUCER 10K
41 — J10-4 — BONUS 10K
SAUCER 20K
42 — J10-11 — BONUS 15K
SAUCER 30K
18 — J10-19 — BONUS 20K
SAUCER 40K
68 — J10-5 — BONUS 25K
SAUCER 50K
34 — J10-12 — BONUS 30K
SAUCER 100K
36 — J10-14 — BONUS 35K
SAUCER SPECIAL
21 — J10-6 — BONUS 40K
SAUCER 10 SEC
57 — J10-10 — BONUS 45K
91 — J10-13 — BONUS 50K
67 — J11-0 — BONUS 100K
93 — J11-16 — BONUS 200K
12 — J11-5 — DOUBLE SCORE
TIME 01
48 — J11-12 — TRIPLE SCORE
TIME 02
19 — J11-11 — CLOCK RUNNING
TIME 03

68 — A2J1-7
90 — CJ6-0
90 — CJ6-9
02 — CJ9-0
01 — CJ8-7
90 — CJ6-4
75 — CJ6-3
87 — CJ6-2
74 — CJ6-1
87 — CJ9-2
75 — CJ9-3
74 — CJ9-4
18 — PJ1-9
72 — PJ1-11
41 — PJ1-8
92 — PJ1-6

B9 PHASE
BA PHASE
PJ1-18 — VIO-R
PJ1-2 OR 3 — 36
VIO-R — PJ1-12
36 — PJ1-2/PJ1-3
B9 PHASE
BA PHASE

December 26, 1985

S E R V I C E   B U L L E T I N

SUBJECT: Beat the Clock and Future Pinball Games

SYMPTON: The control board L.E.D. flashes 8 times but game
fails to power up.

CAUSE: The utility portion of the program contained in U3 has
been modified for purposes of internal testing,
starting with game #300 of BEAT THE CLOCK.

CURE: A 100K ohm 1/4 watt resister has been connected from
the +5 volt buss to pin 12 of U1 (the 6803 CPU).

NOTE: This resistor addition has been made on all control
boards containing the updated program and must be made
when converting an earlier game (i.e. Eight Ball Champ)
to any newer game.

Arnie Aastad
Field Service Manager
Bally Midway Mfg. Co.

AA/dlm

September 15, 1986

S E R V I C E   B U L L E T I N

GAME: Beat The Clock

SUBJECT: Parts and Operating Manual Correction

REF: Inside of back cover "CONTROL BOARD" jumper information.

        JW8 reads "IN"; Change to read "OUT"
        JW9 reads "OUT"; Change to read "IN"

NOTE: JW9 provides an extra switch strobe, ST5 for use in the
        playfield matrix of BEAT THE CLOCK.

Ed Schmidt
Asst. Field Service Manager

ES/dlm

Bally **MIDWAY** *MFG. CO.*

June 26, 1986

<u>S E R V I C E   B U L L E T I N</u>

SUBJECT: Circlite-Mister 8" 22 Watt
           Fluorescent Lamp Assembly

USED ON: Motordome and Future Bally Midway
           Pinball Machines

Remove the above circular lamp from inside of back box before
transporting game cabinet.

This same information is on a label affixed to the top of the
cash box cover.

Please know that this circular lamp is a common part and is
available at most electrical outlet stores.

Lamp Part Number: "General Electric" FC8T9-WW
                  (Warm White - Rapid Start)

Ed Schmidt
Asst. Field Service Manager

ES/dlm

June 26, 1986

S E R V I C E   B U L L E T I N

GAME: "Motordome"

SUBJECT: MANUAL ERROR CORRECTIONS

OPERATING MANUAL GAME #OE14, FM. #OE14-00300-0100

PAGE #	SHEET	DESCRIPTION	CHANGE TO READ
2-18	1 of 1	Motordome Cabinet Diagram	"Not Used (For Future Use)" Is changed to read: "Right Flipper Button"
			"Right Flipper Button" Is changed to read: "Not Used (For Future Use)"
2-18	1 of 2	Motordome Playfield Diagram	The "1.5A SLO-BLO" fuse Is changed to read: "1A SLO-BLO"
			The left, middle & right gate coils are drawn common to the 30 (yellow 18 AWG) + 43 V.D.C. buss wire.
			These coils should be drawn common to the 60 (brown 18 AWG) + 43 V.D.C. buss wire.

PARTS MANUAL GAME #OE14, FM #OE14-00300-0200

PAGE #	ITEM #	READS:
29A	32	"OE14-00101-0000, Right-Platform Support."
		Change to read:
		"OE14-00102-0000, Left-Platform Support."

Ed Schmidt
Asst. Field Service Manager

ES/dlm

June 26, 1986

S E R V I C E   B U L L E T I N

GAME: "Motordome"

SUBJECT: MANUAL ERROR CORRECTIONS

OPERATING MANUAL GAME #OE14, FM. #OE14-00300-0100

PAGE #	SHEET	DESCRIPTION	CHANGE TO READ
2-18	1 of 1	Motordome Cabinet Diagram	"Not Used (For Future Use)" Is changed to read: "Right Flipper Button" "Right Flipper Button" Is changed to read: "Not Used (For Future Use)"
2-18	1 of 2	Motordome Playfield Diagram	The "1.5A SLO-BLO" fuse Is changed to read: "1A SLO-BLO" The left, middle & right gate coils are drawn common to the 30 (yellow 18 AWG) + 43 V.D.C. buss wire. These coils should be drawn common to the 60 (brown 18 AWG) + 43 V.D.C. buss wire.

PARTS MANUAL GAME #OE14, FM #OE14-00300-0200

PAGE #	ITEM #	READS:
29A	32	"OE14-00101-0000, Right-Platform Support." Change to read: "OE14-00102-0000, Left-Platform Support."

Ed Schmidt
Asst. Field Service Manager

ES/dlm

August 11, 1986

S E R V I C E   B U L L E T I N

SUBJECT: Manual Error Correction

RE: 6803 Pinbal Power Module Schematic
                Drawing A084-91785-D000

                C6 and C7 read .1 UF
                Change to read .01 UF

GAME MANUALS
INVOLVED: "8 Ball Champ"
                "Beat The Clock"
                "Lady Luck"
                "Motordome"
                "Black Belt"

Ed Schmidt
Asst. Field Service Manager

ES/dlm

November 14,1986

Dear Distributor:

Due to problems that sometimes occur on the Brite-Lite
Circuits of Motordome, we are providing a field kit for
each of the games you received.

This kit contains a resistor to limit the inrush current
when the bulbs are turned on, as well as a lower value
fuse to protect the circuit should any irregularities
occur.

The kit takes only a few minutes to install and we
strongly recommend each of the Motordomes be updated to
insure game reliability.

Thank you for your cooperation.

Sincerely,

BALLY MIDWAY MFG. CO.

Arnold N. Aarstad

AA/jm

68 — PJ1-7   +43 VDC (60)   BROWN WIRE

NOTE 2.   NOTE 2.   NOTE 2.   NOTE 2.

1.5 A
SLOW BLOW

RIGHT
FLIPPER   UPPER
RIGHT
FLIPPER   LEFT
FLIPPER   UPPER
LEFT FLIPPER

90 — CJ6-9   91   75   NOTE 1
95 — CJ6-8   RIGHT FLIPPER   OUTHOLE
50 — CJ9-0   LEFT FLIPPER

4 OHM
5 WATT

ORANGE WIRE

24 — CJ9-10
27 — CJ8-7
35 — CJ6-4
34 — CJ6-3
32 — CJ6-2
31 — CJ6-1

LEFT
THUMPER
BUMPER   MIDDLE
THUMPER
BUMPER   RIGHT
THUMPER
BUMPER   LEFT
SLING
SHOT   RIGHT
SLING
SHOT   SEE NOTE 3
RIGHT
GATE

3/4 A
SLOW BLOW

59 — CJ9-11
511 — CJ9-9
51 — CJ9-1
25 — CJ8-6
311 — CJ6-7
36 — CJ6-5

SINGLE
DROP TARGET   MIDDLE
GATE   LEFT
SAUCER   RIGHT
SAUCER   LEFT
GATE   KNOCKER

+43VDC

SEE NOTE 3   SEE NOTE 3

70 — PJ1-9   6.3VAC   TOP BRITE LITES
                                 L   L   L
                   GENERAL
                   ILLUM.   MIDL. BRITE LITES
                                 L   L   L
40 — PJ1-6   RETURN

                            LEFT BRITE LITES
52 — CJ9-2   L   L   L
53 — CJ9-3
54 — CJ9-4   RIGHT BRITE LITES   RED/BLACK WIRE
56 — CJ9-6   L   L   L

GE 0912 (12V) BULBS

COLOR CODE

1 ← RED   6 ← BROWN
2 ← BLUE   7 ← ORANGE
3 ← YELLOW   8 ← BLACK
4 ← GREEN   9 ← GRAY
5 ← WHITE   0 ← NO COLOR
             11 ← VIOLET

NOTES: BALLY MIDWAY MFG. CO.

D. STERN
10/27/86   MOTORDOME
            BRIGHT LIGHT MODIFICATION

SHEET 1 OF 1   REV

September 15, 1986

S E R V I C E   B U L L E T I N

GAME: Black Belt Pinball Machine and Future Games

SUBJECT: Self-Percentaging

Bally Midway is introducing a "Self-Percentaging" feature with
BLACK BELT pinball machine.

Please insert the attached "Self-Percentaging" procedure into
your BLACK BELT operating manual. Also, add the catagories "Self
Percent", "Target Percent" and "Threshold 1 Percent" under
"Threshold 1" in the "Percent Options" portion of your operating
manual on Page 1-3.

Thank You.

Ed Schmidt
Asst. Field Service Manager

ES/dlm

enc.

S E L F - P E R C E N T A G I N G

1.) The term Self-Percentaging refers to the game's ability to automatic-
ally adjust the score level of Threshold 1 to attain a desired replay
percentage, also known as the TARGET PERCENT. (see article #8)

2.) Self-Percentaging also applies to extra balls, when used instead of
replays.

3.) Initially, a minimum of 200 games must be played before the Self-
Percentaging Process goes into effect. It then monitors the current
replay percentage of Threshold 1 ONLY and makes an adjustment, if
necessary, every 50 games.

4.) The Self-Percentaging Process will automatically adjust the score level
of Threshold 1 ONLY. It makes NO adjustments to OTHER "Award" features
in the game.

5.) Located within the "PERCENT OPTIONS" category of your game's test mode
are the following registers:
* THRESHOLD 1
* SELF PERCENT
* TARGET PERCENT
* THRESHOLD 1 PERCENT
Each of these registers are explained in detail further in this text.

6.) To set or check the current score level of Threshold 1:
A.) "Step through" your game's test mode, using the "A" or "B"
button on the keypad, until you reach a category titled:
"PERCENT OPTIONS".
B.) Press the "ENTER" button to select this category.
C.) The first register displayed will be THRESHOLD 1.

THRESHOLD 1 –   This register displays the current score level
of the 1st Replay Threshold. Enter any value
from 0 to 9,999,999 to set the desired score
level.

7.) To activate the Self-Percentaging Process:
A.) "Step through" your game's test mode, using the "A" or "B"
button on the keypad, until you reach a category titled
"PERCENT OPTIONS".
B.) Press the "ENTER" button to select this category.
C.) Again, use the "A" button to "step through" until you reach a
register titled: "SELF PERCENT".

SELF PERCENT –   This register displays whether the Self-
Percentaging Process is OFF or ON.
Enter "0" to turn OFF or "1" to turn ON.

8.) To adjust the desired Replay Percentage for Threshold 1:
A.) "Step through" your game's test mode, using the "A" or "B"
button on the keypad, until you reach a category titled
"PERCENT OPTIONS".

B.) Press the "ENTER" button to select this category.
C.) Again, use the "A" button to "step through" until you reach a register titled: "TARGET PERCENT".

TARGET PERCENT –   This register displays the desired percentage of replays to be awarded for reaching Threshold 1. For example, if you want Threshold 1 to award a replay in 15% of the games played, you would press keys "1", "5" and then "ENTER". This register will then display "15%" as your goal or "TARGET PERCENT".

NOTE: This register automatically defaults to a factory setting of "10%", when the "FACTORY RESET" register is enabled.

9.) The TOTAL Replay Percentage will be 10% or 15% higher with the addition of Match, Special and High Score To Date credits.

10.) To manually check the current replay percentage of Threshold 1 ONLY:
A.) "Step through" your game's test mode, using the "A" or "B" button on the keypad, until you reach a category titled "PERCENT OPTIONS".
B.) Press the "ENTER" button to select this category.
C.) Again, use the "A" button to "step through" until you reach a register titled: "THRESHOLD 1 PERCENT".

THRESHOLD 1 PERCENT –   The figure displayed in this register is the actual percentage of replays awarded for reaching Threshold 1. Progress of the Self-Percentaging Process may be monitored by comparing the current value displayed in this register with the "TARGET PERCENT".

11.) The size of adjustment, made by the Self-Percentaging Process to the score level of Threshold 1, is determined by the current difference between the "TARGET PERCENT" (entered by the operator) and the actual percentage of replays awarded for reaching Threshold 1.
* A difference of 10% or more will result in a 10% adjustment.
* A difference equal to or greater than 5%, but less than 10%, will result in a 5% adjustment.
* A difference less than 5% will result in a 1% adjustment.

12.) To check the current score level of Threshold 1, refer to article #6.

13.) When the "CLEAR BOOKKEEPING" register is enabled, the Self-Percentaging Process is reinitiated.

SELF PERCENT   Enter "0" or "1"; "0" disables Self-Percentaging
                                Process, "1" enables Self Percentaging Process.

TARGET PERCENT   Enter desired percentage of replays awarded for
                                reaching Threshold 1.

THRESHOLD 1 PERCENT   Displays actual percentage of replays awarded for
                                reaching Threshold 1.

THRESHOLD 2   Enter 0 through 9,999,999; sets award level and
                                display.

THRESHOLD 3   Enter 0 through 9,999,999; sets award level and
                                display

HIGHEST SCORE   Enter 0 through 9,999,999; sets the High Score replay
                                level and display.

January 29, 1987

Dear Distributor:

Due to problems that sometimes occur on the Brite-Lite Circuits
of BLACK BELT, we are providing a field kit for each of the games
you received.

This kit contains a resistor to limit the inrush current when the
bulbs are turned on, as well as a lower value fuse to protect the
circuit should any irregularities occur.

The kit takes only a few minutes to install and we strongly
recommend each of the BLACK BELTS be updated to insure game
reliability.

Thank you for your copperation.

Sincerely,

BALLY MIDWAY MFG. CO.

Arnold R. Aarstad
Field Service Manager

ANA/dlm

enc.

+43 VDC (68)

48 — PJ1-9

NOTE 2. RIGHT FLIPPER
NOTE 2. UPPER RIGHT FLIPPER
NOTE 2. LEFT FLIPPER
NOTE 2. UPPER LEFT FLIPPER

1A SLO-BLO
10

98 — CJ6-8
95 — CJ6-9
90
95
RIGHT FLIPPER END OF STROKE
LEFT FLIPPER E.O.S.

NOTE 1 OUTHOLE

58 — CJ9-8
24 — CJ9-10
311 — CJ6-7
35 — CJ6-4
34 — CJ6-3
32 — CJ6-2
31 — CJ6-1

SEE NOTE 3

LEFT THUMPER BUMPER
RIGHT THUMPER BUMPER
LEFT SLING SHOT
RIGHT SLING SHOT
LEFT GATE
RIGHT GATE

82

C PART OF RELAY ON SOLENOID EXPANDER

LEFT SAUCER
MIDDLE SAUCER
RT BT
LT BT
RIGHT KICK BACK

3/4 AMP SLO-BLO
B= KIT

4 OHM 5 WATT

36 — CJ6-5
59 — CJ9-11
27 — CJ8-7
25 — CJ8-6
51 — CJ9-1
52 — CJ9-2
53 — CJ9-3
56 — CJ9-4
54 — CJ9-6

MAN BRIGHT LIGHTS
SUN BRIGHT LIGHTS
RIGHT BRIGHT LIGHTS
TOP LEFT LIGHTS
TOP RIGHT LIGHTS
BACK RIGHT LITES
BACK LEFT LIGHTS
81

+43VDC

KNOCKER

43 — PJ1-11   6.3VAC
20 — PJ1-6   RETURN   GENERAL ILLUM.

GE 8912 (12V) BULBS

NOTES:
W. STONE
1/21/87

BALLY MIDWAY MFG. CO.
BLACK BELT
PLAYFIELD DIAGRAM
(WITH WIRING MOD.)
M051-00E52-A013
SHEET 1 OF 1   REV

NOTES:
1. COIL & LAMP DIODES ARE 1N4004
2. GERMANY ONLY-CAPACITOR .01MF 8500V

COLOR CODE
1→ RED
2→ BLUE
3→ YELLOW
4→ GREEN
5→ WHITE
6→ BROWN
7→ ORANGE
8→ BLACK
9→ GRAY
0→ NO COLOR
11→ VIOLET

METER SPECIAL — CJ10-9 — 26
L. CALF
METER 50K — CJ10-3 — 14
LEFT KNEE
METER 25K — CJ10-17 — 41
L. THIGH
METER 10K — CJ10-8 — 25
R. THIGH
METER 8K — CJ10-2 — 13
R. KNEE
METER 6K — CJ10-16 — 38
R. CALF
METER 4K — CJ10-7 — 24
L. OUTLANE
METER 2K — CJ10-1 — 12
R. OUTLANE
SOLND EXPANDER — CJ10-6 — 21
TOP "G" — CJ10-14 — 37
CENTER XBALL
TOP "F" — CJ10-12 — 32
FLASH 6
TOP "E" — CJ10-5 — 18
FLASH 5
TOP "D" — CJ10-19 — 45
FLASH 4
TOP "C" — CJ10-11 — 31
FLASH 3
TOP "B" — CJ10-4 — 15
FLASH 2
TOP "A" — CJ10-18 — 43
FLASH 1
— CJ11-4 — 61
BONUS 8K
— CJ11-11 — 71
BONUS 7K
— CJ11-12 — 72
BONUS 6K
— CJ11-6 — 62
BONUS 5K
BODY SHOT — CJ11-16 — 78
BONUS 4K
— CJ11-8 — 64
BONUS 3K

PHASE B
PHASE A
PJ1-12 — 88
PJ1-2 — 10

36 — CJ10-13 — 28
BONUS 2K
20 — CJ10-10
8PSA
BONUS 1K
63 — CJ11-7
LEFT H.D.
L. OPEN GATE
75 — CJ11-15
LEFT SIDE
R. OPEN GATE
58 — CJ11-2
LEFT 10K
BONUS 50K
67 — CJ11-9
LEFT ARROW
BONUS 40K
74 — CJ11-14
RIGHT XBALL
BONUS 30K
59 — CJ11-3
RIGHT SIDE
BONUS 20K
68 — CJ11-10
RIGHT 10K
BONUS 10K
73 — CJ11-13
RIGHT ARROW
BONUS 9K
84 — CJ13-3
L. RETURN LANE
5X
86 — CJ13-5
R. RETURN LANE
4X
97 — CJ13-13
KARATE "E"
3X
83 — CJ13-2
KARATE "T"
2X
87 — CJ13-6
KARATE "A"
BLACK BELT
93 — CJ13-8
KARATE "R"
BLUE BELT
81 — CJ13-1
KARATE "A"
GREEN BELT
48 — CJ11-1
KARATE "K"
YELLOW BELT
91 — CJ13-7
REG R. LEG
R. SAU ARROW
95 — CJ13-11
REG R. SIDE
COLLECT BONUS
35 — CJ13-4
REG BODY
H.D. LOW
94 — CJ13-10
REG L. SIDE
READY
96 — CJ13-12
REG L. LEG
READY ARROW

88 — PJ1-12
10 — PJ1-2

PHASE B
PHASE A

S E R V I C E   B U L L E T I N

January 5, 1987

GAME: Strange Science Pinball Machine

SUBJECT: Feature Operation and Scoring Manual Information

* *

Attached please find the above listed information (pages 1-15 to
1-20), which should be included in your STRANGE SCIENCE Operating
Manual, Form No. OE35-00300-0100.

This information was not included in the game manual at the time
it was originally released for production.

Ed Schmidt
Ed Schmidt
Assistant Field Service Manager

Encl.

ES/jmm

XIV. STRANGE SCIENCE FEATURE OPERATION AND SCORING

1. BUBBLE BONUS FEATURE

Two Bubble Bonus switches are in this game. One rollover switch is located on the left side of the playfield and the other rollover switch is located in the Shooter Lane on the right side. The Bubble Bonus Value Lights flash sequencially at a constant rate from 5,000 points to 10,000 points to 20,000 points to a maximum of 50,000 points. When the ball makes the rollover switch, the moving value freezes and is awarded. At the start of each ball, a skill shot is scored by trying to make the Shooter Lane's Bubble Bonus switch when its' value is 50,000 points.

2. PARTICLE SEPARATOR & BONUS MULTIPLIER FEATURES

In the Particle Separator tray are three holes which correspond to the letters "L-A-B" (in the back board) and the three lanes below (on the playfield). Each hole has a wire-actuated switch. Each lane has a rollover switch. One of the letters is lit when the ball falls through the hole or rolls through the lane corresponding to that letter. The push button below the right flipper push button on the cabinet allows you to shift lit letter(s) in "L-A-B" to the right. This provides you with Hole Change and Lane Change while attempting to spell "L-A-B" (making any combination of holes and lanes).

At the start of each ball:

1. The Particle Separator flashes two upper Collect Spark Bonus Lights.
2. The Particle Separator is made when the ball closes any of the three hole switches scoring the Collect Spark Bonus (see Spark Bonus Feature). Lighting a letter awards 5,000 points and also 3,000 points are awarded to the Bonus.
3. By initially making the flashing Particle Separator, both the Anti-gravity and it's Collect Spark Bonus Light flash. Completing the flashing Anti-gravity (see Anti-gravity Feature) in turn flashes the Particle Separator again and also flashes the Particle Separator's left Collect Spark Bonus Light.

When it is not flashing, making the Particle Separator awards 10,000 points and adds 3,000 points to the Bonus.

When the ball makes a hole switch or lane switch, "L-A-B" letters score:

1. 5,000 points for lighting the first or second letter in "L-A-B".
2. 1,000 points for a letter already lit.
3. 10,000 points for spelling "L-A-B".

Spelling "L-A-B" also advances the Bonus Multiplier 2X through 6X.

3. ANTI-GRAVITY, EXTRA BALL, & SPECIAL FEATURES

Completing the Anti-gravity shot requires making both the entrance switch and exit switch within three seconds. If flashing, completion of the Anti-gravity awards its flashing Collect Spark Bonus and also adds 5,000 points to the Bonus. If not flashing, completion of the Anti-gravity awards 10,000 points and also adds 1,000 points to the Bonus.

Making the entrance switch alone awards 1,000 points. Making the exit switch alone awards 1,000 points with an additional 1,000 points for each Voltage Level Light lit (see Atomic Generator Feature) and also adds 1,000 points to the Bonus. The exit switch can be made by a direct shot up the center of the game without involving the entrance switch.

The following features are earned by completing the Anti-gravity a certain number of times:

# OF COMPLETIONS REQUIRED	FEATURES EARNED
Every Time	Collect Bonus Light activated
2 Times	Hold Bonus Light activated
3 Times (adjustable)	Extra Ball Light activated
4 Times (adjustable)	Extra Ball awarded
5 Times (adjustable)	Special Light activated

* REGISTER "Award Count" controls the number of times on the Anti-gravity (when lit) required to activate the Extra Ball Light, to award the Extra Ball, and to activate the Special Light.

EXTRA BALL LIGHT	EXTRA BALL	SPECIAL LIGHT	ENTER
6 Times	7 Times	8 Times	0
5 Times	6 Times	7 Times	1
4 Times	5 Times	6 Times	2
3 Times	4 Times	5 Times	3

4. ATOM SMASHER, PLAYFIELD VALUE MULTIPLIER, & TIMED EXTRA BALL FEATURES

Up to five balls can be loaded into the Atom Smasher through its rear entrance by using the top Flipper. Every ball loaded collects the upper left Collect Spark Bonus. As the first ball is loaded, a pair of ball stop pins spring up at the Atom Smasher's front entrance to hold the ball on the ramp.

1-16

One or more balls loaded can be released as follows:

1. Balls stored can be released one at a time by "smashing" the ball in play into the leading held ball at the Atom Smasher's front entrance. This knocks one held ball up the ramp and out across a pair of guide wires from the left side to the right side of the playfield awarding the Collect Spark Bonus and resulting in Multiball play. If, during this type of multiball play, there are remaining stored balls in the Atom Smasher and a ball is loaded through its' rear entrance, the stored balls are released when the ball stop pins are pulled down. When no balls are loaded, a ball can pass through the front entrance and up the ramp. This is the same as "smashing" a ball out and collects the Spark Bonus. "Smashing" a ball out of the Atom Smasher also lights the Extra Ball Light (on a timer which is adjustable) located near the Anti-gravity.

2. When the fifth ball is loaded, the ball stop pins are pulled down and all five balls are released for multiball play awarding 120,000 points. As a result, the ball stop pins will always remain pulled down during this second type of multiball play and every ball loaded will automatically be released.

3. Awards for releasing balls stored in the Atom Smasher are:

# OF BALLS RELEASED	AWARD
2	30,000 points
3	60,000 points
4	90,000 points
5	120,000 points

The Playfield Value Multiplier increases with the number of balls in play at any one time:

# OF BALLS IN PLAY	PLAYFIELD VALUE MULTIPLIER
2	3X
3	6X
4	9X
5	12X

* REGISTER "Extra Ball Timer" controls the length of time the Extra Ball Light flashes after being activated.

LENGTH OF TIME	ENTER
8 seconds	0
16 seconds	1
32 seconds	2

1-17

68

5. "S-T-R-A-N-G-E S-C-I-E-N-C-E", SPARK BONUS, & TIMED SPECIAL FEATURES

Located on either side of the center playfield area are three stand up bullseye targets: left side - "S-T-R-A-N-G-E" lights, right side - "S-C-I-E-N-C-E" lights. When the game begins, one light is on in "S-T-R-A-N-G-E" and one light is on in "S-C-I-E-N-C-E". Each of these lights sweep downwards. The sweep rate is controlled by the "Voltage Level" of the Atomic Generator (see Atomic Generator Feature). The three bullseyes are connected to the center three letters of each word. When a bullseye is hit the corresponding light lights if it was off, and then instantly begins sweeping too. Spelling "S-T-R-A-N-G-E" (or "S-C-I-E-N-C-E") awards 10,000 points. Lighting a letter awards 5,000 points and adds 1,000 points to the Bonus. Hitting a lit letter awards 1,000 points and adds 1,000 points to the Bonus.

Spelling "S-T-R-A-N-G-E S-C-I-E-N-C-E" completely earns the following:

1. The Power Saver is activated (see Power Saver Feature).
2. The Spark Bonus Value is advanced starting from 25,000 points to 50,000 points to a maximum of 75,000 points. This value is reset to 25,000 points for each new ball. The Spark Bonus turns into a moving value during multiball.
3. In the right Outlane a timed Special light is lit (adjustable).

A letter in "S-T-R-A-N-G-E S-C-I-E-N-C-E" is spotted each time.

1. The Anti-gravity is completed by making the entrance switch and exit switch within three seconds.
2. The Particle Separator is made by closing one of its hole switches. Also, one extra letter in "S-T-R-A-N-G-E S-C-I-E-N-C-E" is spotted whenever a letter in "L-A-B" is lit (See Particle Separator Feature).
3. A ball is loaded into the Atom Smasher (see Atom Smasher Feature).

* REGISTER "Special Timer" controls the length of time the Special Light flashes after being activated.

LENGTH OF TIME	ENTER
8 seconds	0
16 seconds	1
32 seconds	2
Until end of current ball	3

1-18

6. ATOMIC GENERATOR FEATURE

The Atomic Generator area consists of three Thumper Bumpers ("Atomic Generators") and nine Voltage Level Lights ("Volt Meter"). Each time a Thumper Bumper is hit 1,000 points is awarded. Thirteen hits advance the Voltage level to the next light. The Voltage Level Lights range from 100 volts to 900 volts. The Voltage Level is carried over from ball to ball. The Voltage Level Value times ten is awarded each time the Anti-gravity exit switch is made. The Voltage Level controls the sweep rate of the lights on the playfield. The faster the lights sweep, the easier it is to spell "S-T-R-A-N-G-E S-C-I-E-N-C-E". Each Voltage Level has a different background sound.

7. POWER SAVER FEATURE

The Power Saver Feature is initially provided to the first ball (adjustable). When the Power Saver is on, a ball draining through the left Outlane can be saved by pressing the push button below the left Flipper push button on the cabinet. This pulses the Kicker Post at the right moment to knock the ball into the left Flipper Return Lane. After the left Outlane switch is hit, the Power Saver remains on for four seconds.
Spelling "S-T-R-A-N-G-E S-C-I-E-N-C-E" will light the Power Saver if it is off.

* REGISTER "Power Saver" controls the number of new balls to which the Power Saver feature is initially provided.

NEW BALL #	ENTER
None	0
1	1
1 & 2	2
1,2 & 3	3
1 thru 4	4
1 thru 5	5

8. BRAIN TRANSPLANT AND COLLECT BONUS SAUCER FEATURES

The Brain Transplant begins by flashing the left Star Rollover Target when at least 1,000 points of Bonus has been earned (see the Particle Separator feature and the Anti-gravity feature). The left Star Rollover Target scores 130 points when not lit and scores 2,000 points when it's flashing. The Bonus Lights begin to strobe from left to right when the left Star Rollover Target is made. The right Star Rollover Target begins flashing when the Bonus reaches 9,000 points. The right Star Rollover Target scores 130 points when not lit. When it's flashing, making the right Star Rollover Target "completes the Brain Transplant" and collects the Bonus (**not** including the Bonus Multiplier).

The Collect Bonus Saucer awards 5,000 points when not lit. When lit, the Bonus (including the Bonus Multiplier) is awarded.

1-19

70

9. MISCELLANEOUS FEATURES

The left Outlane awards 3,000 points.
The right Outlane awards 20,000 points.
Each Flipper Return Lane awards 5,000 points
Each Sling Shot awards 130 points.
The Rebound awards 230 points.

* REGISTER **"Attract Sound"** enables or disables, when the game is over, the Sound Mode while displaying Hi-score or instructions.

ENABLES SOUND MODE	ENTER
No	0
Yes	1

In Basic Options:

* REGISTER **"Sling Shot"** controls the Sling Shot:

SLING SHOTS: ACTIVE	ENTER
No	0
Yes	1

* REGISTER **"Tilt Warning"** controls the number of Tilt Warnings:

# OF TILT WARNINGS	ENTER
None	0
1	1
2	2
3	3

STRANGE SCIENCE OPERATING MANUAL REVISIONS

On page 1-5, in the "Feature Options" section of "GAME REGISTERS & OPTIONS":

1) The factory setting for the "Power Saver" register is shown as "2". This setting should read as "1".

2) For the "Extra Ball Timer" register, "2=24 sec." should read as "2=32 sec."

3) The factory setting for the "Special Timer" register is shown as "1". This setting should read as "0".

4) For the "Special Timer" register, "2=24 sec." should read as "2=32 sec.".

S E R V I C E   B U L L E T I N

GAME: "STRANGE SCIENCE"

SUBJECT: Multiball Problems

Dear Service Manager:

Maintaining the Bally tradition of the best product support
policy in the industry, we are supplying at no charge a STRANGE
SCIENCE ball trough kit.

The initial shipments will begin immediately to help resolve
multiball problems experienced by some of our customers on
STRANGE SCIENCE.

The kit will consist of several new parts producing a reliable
assembly, but still requiring some use of the small existing
parts on the playfield. Please examine the detailed instructions
before discarding parts from the old assembly.

We thank you for your cooperation and apologize for any
inconvenience you may have encountered.

Sincerely,

Arnold R. Aarstad

Arnold R. Aarstad
Field Service Manager

ARA/dlm

S E R V I C E   B U L L E T I N

May 13, 1987

GAME: "HARDBODY" Pinball

SUBJECT: Ball Escape - Serial Numbers #101 Through #1065

Dear Service Manager:

We have found a ball escape condition on the upper right section
of the playfield by the two star roll over buttons.

We will be sending you a "Fix" consisting of: (1) piece of
plexiglass, (4) standoffs, (4) screws and instructions. We ask
you pass these modifications to all HARDBODY customers on a
no charge basis.

Sorry for any inconvience this might have caused you.

Thank you.

Bally Midway Field Service

GM/dlm

S E R V I C E   B U L L E T I N

GAME: "HARDBODY"

SUBJECT: Ball Escape - Serial Numbers #101 through $1065

1. Refer to Figure 1.

2. Lay plexiglass over position XXX.

3. Put one post at each of the 4 corners using the holes in the plexiglass as guides.

4. Mount plexiglass to the posts and screw into playfield.
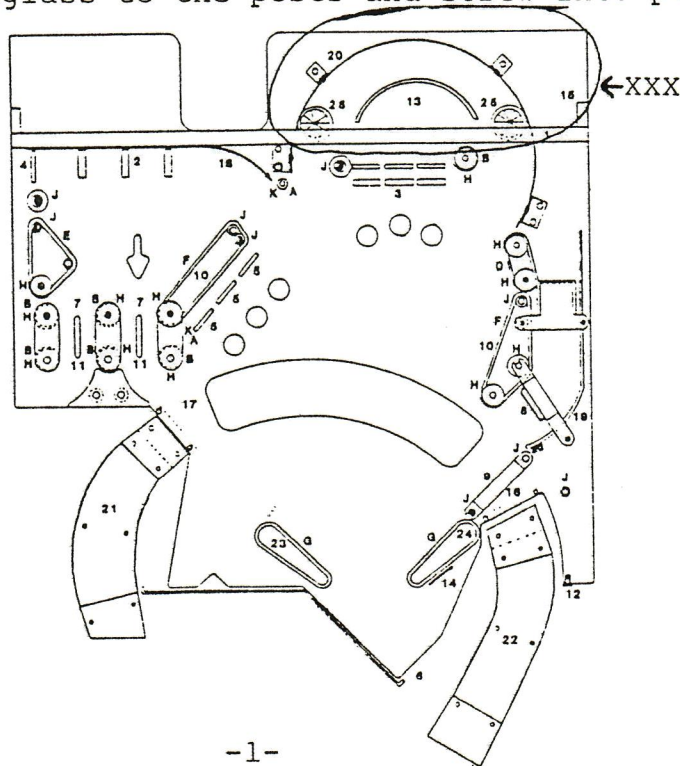
-1-

Bally Midway Field Service

GM/dlm

March 25, 1987

S E R V I C E   B U L L E T I N

GAME: **HARDBODY**   FROM: Greg McKay

SUBJECT: Changing Shooter Lane Hoop (Chrome Hoops Only)

1. Refer to figure 1.

2. Remove 3 Acorn Nuts holding
    butyrate at Position A.

3. Lift off butyrate.

4. Remove 2 Philips type screws
    holding shooter lane hoop
    (Position B).

5. Replace with new hoop
    and reassemble.
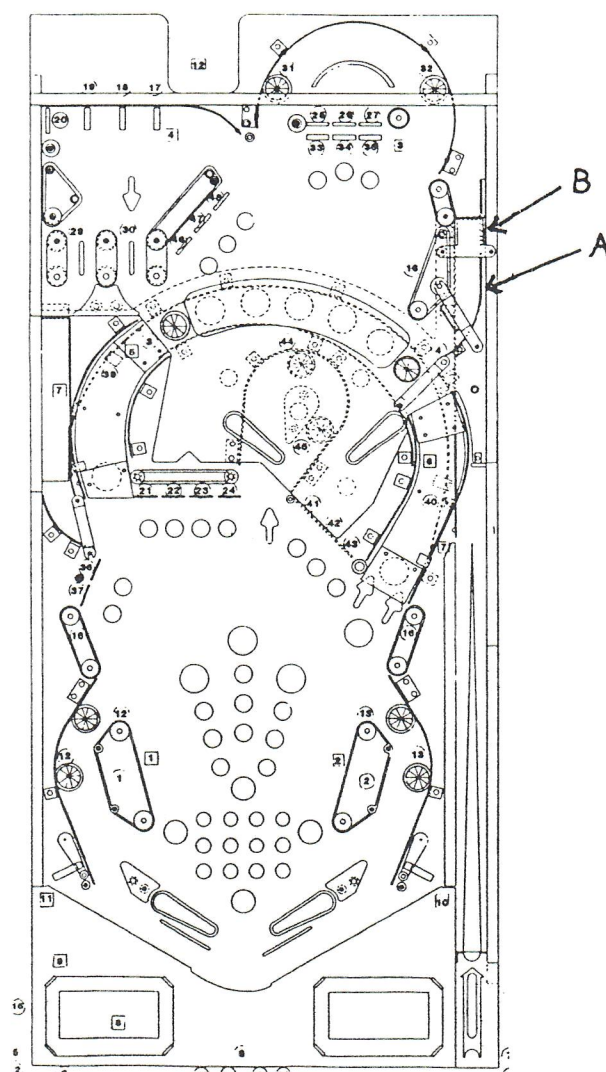
Figure 1

6803 Control Board Theory of Operation

POWER SUPPLIES

The Control Board requires a regulated +5VDC for its logic circuit operation. In addition, the Power Module provides an unregulated +14 to+18VDC, the phase A and phase B voltages (11VAC),and +43VDC to the Control board.The +14 to+18VDC is used in the Valid power detector circuits; the phase A & B voltages are used for the Zero Crossing detector circuits and the +43VDC is required on the board exclusively for the flipper enable relay. Besides supplying these voltages to the Control Board and other sections of the game, the Power module also provides a regulated +190VDC to the displays and 6.3VAC for general illumination.

RESET CIRCUIT

On power up the µP (microprocessor) requires +5VDC+.25VDC be applied for 100 milliseconds before the RESET line is allowed to swing from 0 to +4.8VDC. The RESET circuit on the Control Board works with the unregulated+14 to+18VDC to prevent the RESET line from going high until the +5VDC supply has had time to stabilize after power on. The zener diode D1 and transistors Q2 and Q3 with R2 through R9 form a Valid power detector circuit that monitors the input voltage to the regulator (coming from the Power Module). This regulator requires a minimum of +7.5VDC input before it provides a +5VDC output. When this condition has been met diode D2 allows C1 to charge through R11.This RC time constant provides the initial 100 millisecond delay to allow the µP oscillator to stabilize. The voltage across C1 is monitored by Q4, Q5, D4, D5 and R12 through R16. When it has reached about +2.5VDC the RESET line snaps high to allow the µP to start program execution. In the event the output of D1 drops below +7.5VDC for an instant, the Valid power detector quickly discharges C1 through R9 and D2 to re-prime the RC time constant and insure a correct RESET cycle when power is re-applied.

The RESET signal is applied to the µP (U1) and the PIAs (U7&U8). Through the switch of Q6 it prevents false data from entering the CMOS RAM (U4) during power-up and utilizing D3, R35, U11 & U12 it sets the mode of operation for the microprocesser. The circuitry forces a 010 code on P20, P21, and P22 of the µP during RESET causing it to come up in an internal RAM external ROM, multiplexed address/data mode.

MICROPROCESSOR,BUS DEMUX,ADDRESS DECODE AND PROGRAM ROM

The Control Module uses a single chip microcomputer the MC6803 as its µP (U1). This µP provides two I/O ports,128 bytes of RAM, a multifunction timer and external ROM capibility. A bus cycle begins on the MC6803 with the Address/Data and R/W lines changing to a known state. Shortly after they are stable the Address strobe clock is output. This is used to latch the low order address lines A0-A7 from the AD0-AD7 bus via U6. After the Address strobe goes low the AD0-AD7 lines become the D0-D7 data bus. One half of a bus cycle later the E (enable) clock output goes high. The addressed device on the bus places data on the AD0-AD7 (R/W high) or takes its data from AD0-AD7 (R/W low) during the E clock . The bus cycle terminates when E goes low . Addresses are decoded by U9 & U10 to determine which external bus device the MC6803 is accessing. The E clock is used to qualify the decoding in timing the data transfer. U5 is an octal bus transceiver which controls the direction of data transmission utilizing the R/W line from the processor chip. The program is provided by U2 & U3 ROMs.These 28 pin sites accept a 128Kbit ROM giving the board a maximum of 32Kbytes of program storage.

1. Control Board Self Test:

The Control Board has as part of its program (U2 &U3) a subroutine designed to check the module each time the power is turned on. No action is required on the operator's part to initiate the test. The program causes the MPU chip to test itself, the program contained in integrated circuits U2 & U3, the MPU's internal scratch pad memory, the CMOS memory (U4), the I/O chips (peripheral interface adadaptors-PIAs) U7 & U8, and the display and zero crossing interupt circuits. If the Control Module finds fault during the course of the self-test, it stops at that point in the test and will not allow game play. It should be noted that the early games using this system did not require U2 for game features and therefore the test for that chip was omitted. These games consisted of Eight Ball Champ ,Beat the Clock and Lady Luck.

A) 1st Flash

After reset the Control Module tests its µP and on chip RAM. It attempts to write -then read back all 256 patterns (0000 0000 to 1111 1111) in each of the 128 on-chip locations. If at any point in this test the µP fails to correctly read back a pattern it has written, it is deemed defective and the µP will not allow the game to come up. If the µP completes the test sucessfully, it flashes the LED and procedes to the next test.

B) 2nd Flash

Next the MPU (U1) attempts to test the ROM U2. It does a vertical checksum of the ROM contents and checks for an all ones result. If the computed checksum is not accurate, the part is deemed defective and the µP will not allow game play. If the checksum is 1111 1111 the µP flashes the LED and procedes to the next test.

C) 3rd Flash

An identical test is now performed on ROM U3. It does a vertical checksum of the ROM contents and checks for an all ones result. If the computed checksum is not accurate, the part is deemed defective and the µP will not allow game play. If the checksum is 1111 1111 the µP flashes the LED and procedes to the next test.

D) 4th Flash

The MPU chip accesses the CMOS RAM U4 (read-write memory). It makes a copy of the contents of the first half of U4. This is necessary because U4 is the battery supplied, non- volitile memory location where the bookkeeping functions and game set-up are stored. It then erases the contents of the first byte of U4 (U4 contains 2Kbytes of "scratch pad" memory). It trys to read back the word 0000 0000. If it can be read back , it adds "1" to the previous word (new word , 0000 0001). It continues to write and read until it reads the word 1111 1111. When this has been done successfully, it repeats the process on the next byte and the following bytes thereafter until it completes the test on byte 1024 . It then restores the memory to the first half of the RAM and saves the contents of the second half. It repeats the process for each of the remaining 1024 bytes one byte at a time and then restores the memory to the second half of RAM. If the MPU, at the end of these tests has read back correctly each of the words it has written, the MPU causes the LED to flash the fourth time.

E) 5th Flash

The µP now tests the PIA U8. It tests each of the two full byte port initialization registers with a 256 pattern test (0000 0000 to 1111 1111). It tests each of the two full byte I/O registers, PA0-PA7 and PB0-PB7 with a 256 pattern test. It then tests the CA2 and CB2 ports. These are initialized as outputs then written into to see if they will store a "1" and a "0". When both these ports are found good, the µP flashes the LED and proceeds to the next test.....

F) 6th Flash

The MPU chips repeats the same procedure it did for the fifth flash except this time it checks PIA U7. If no faults are found it procedes to the next test.

G) 7th Flash

The MPU now monitors its internal "clock". This clock is utilized as a Display Interrupt Generator, creating a pulse once every 1.2 milliseconds. If this interrupt pulse is not detected in U1, the Program will not allow game play until the fault is corrected.

Please note: Jumper JW7, when connected, will disable the Display Interrupt Generator in the MPU chip. This option is provided exclusively for troubleshooting with an oscilloscope.

H) 8th Flash

The MPU chip now monitors PIA port CB1 U8. If transitions from high to low are detected the MPU decides that the Phase B Zero Crossing detector is working. It then causes the LED to flash the 8th time.

If U12,C15,or D9 fails and the CB1 line is stuck high or low the program will not allow game play until the problem is corrected. It is to be noted that this Zero Crossing input is the Phase B switched illumination supply. If the fuse in that line (F5 on the power module) is blown when the power is turned on, the program will not allow game play until the fault on the Phase B line is corrected.

I) 9th Flash

To complete the power up sequence, the MPU now monitors its P20 port U1 pin 8. If transitions from low to high are detected the MPU decides that the Phase A Zero Crossing detector is working. It Then causes the LED to flash the ninth time.

If U11, U12, C16, or D11 fails and the P20 line is stuck high or low the program will not allow game play until the problem is corrected. This particular line is the Phase A switched illumination supply. If the fuse on that line (F4 on the Power Module) is blown when the power is turned on, the program will not allow game play until the fault on the Phase A line is corrected.

J) Game Initialization

The MPU chip, through the program, now initializes the two PIAs, U7 and U8, assigning to each port its role as either an input or output, as required.

It then verifies the integrety of the CMOS RAM U4 information by checking certain bytes to determine if Battery failure has occured or if possibly the +5VDC supply was interupted during a previous write operation to RAM. Should an error be detected the program sets specific registers to factory default conditions.

The game now enters a selective Stuck Switch test to display to the Operator any switches that may effect normal game operation which should be open but are not. It also Resets Drop targets that may be down and kicks out balls remaining in Saucers from the last time the game was played.

The game now enters an attract mode - flashing lights, showing the score thresholds and current credits on the displays, and monitoring the coin and credit switches for closure.

2. Game Play

After completing the self test, or in between games, the MPU spends approximately 40% of its time monitoring the memory record of the momentary switches on the playfield and in the cabinet. The other time is divided between servicing the display update interrupts and the solenoid, lamp momentary switch scanning, and lamp update interrupts.

A)Normal Mode:

The momentary switches are arranged in a "matrix".The MPU chip, through the program, examines a memory record of the matrix, looking for valid switch closures. If it finds a valid closure, it decodes the address associated with the closure and jumps to the appropiate subroutine.

For example: If the game is in a game over status and the MPU finds that the left coin switch has a valid closure in memory, it jumps to the coin /credit handling routine in the program. This routine reviews the memory record in bookeeping to determine if the maximum credits have been reached. If they have, the coin will not be acknowledged. TheMPU goes back to monitoring the record of switch closures. If the maximum credits have not been reached, the memory record in bookeeping is reviewed to determine how many credits are to be awarded per coin.These credits are added to the credit register in memory.The record of the number of coins through the left chute are increased by one .

The MPU chip, through the program, now returns to its task of monitoring the memory record of valid switch closures, ready to jump to the appropiate subroutines that deal with the player pressing the credit button, etc.

The memory record of valid switch closures is a qualified memory record.The MPU,as discussed under "Interupts", looks at each switch several times before it makes a decision as to whether or not a closure is valid. This multiple-look is a debounce mechanism that prevents the game points on noise pulses or stuck switches. The debounce criteria is: When the MPU chip reviews the history of a switch to determine if a closure is valid, it must see an "open" in the "oldest " record. There must be a "closed" in an "old" record and a "closed" in the current reading. Only when this criteria is satisfied will it make an entry in the memory record of valid closures that a switch is closed.If it saw a "closed", "closed", "closed", the MPU would assume a stuck switch and do nothing ."Open", "closed", "open"or "closed", "open", "open", are likewise rejected.

The momentry switches in the matrix are the "eyes" and "ears" of the MPU.It is only by means of sensing closures, and reacting to valid closures (during normal operation) that the MPU,through the program, knows what to do next.

B) Interrupts:

An interrupt is a signal to the MPU chip to stop what it is doing and do something else.When the MPU senses an interrupt from the PIA-U8,CA1 or CB1 or from the peripheral port on the µP-U1, P20, it completes the instruction it is working on, and makes a memory record of its contents and its place in the program so that it can get back to what it was doing before it jumps to service the interrupt .When the interrupt is completed, control is relinquished to normal operation. The MPU goes to the memory record of its pre-interrupt contents and methodically refills itself. It then goes about its business as if it had never been interupted.

Interrupts are used for two types of activity in the Bally game. The first is the periodic lamp, solenoid, and momentary switch status update U8, CB1 & U1, P20 and the Display update internal to U1.The second is the signal to go into Self-Diagnostic tests U8, CA1.

The periodic interrupts are generated by the Phase A & Phase B Zero Crossing detectors and the Display interrupt generator on the Control module.The former occurs at a rate of 120 times per second or once each power line zero crossing (60 for Phase A and 60 for Phase B). The second occurs internally in U1 at a rate of approximately 830 times per second.

1)Zero Crossing interrupts:120 times per second, or once each 8.3 milliseconds, the MPU chip senses a zero crossing, time delayed by U12 just enough to allow a voltage to appear at the anodes of the silicon controlled rectifiers that drive the feature lamps before that portion of the interrupt routine begins.

Lamps are updated near the zero crossing to minimize the inrush current associated with a cold filament and hence extend their life.DC powered solenoids, likewise, exhibit a far smaller counter EMF, if turned off near a zero crossing. This helps extend the life of the solenoid driver transistors and other circuit components by keeping large voltage spikes out of the system.

At the start of this routine the MPU looks at the contents of several general purpose timers. If it finds them active, it subtracts "one" from their remaining period. In passing thru, it adds "one" to the random number generator used for the "Match feature" (unless the contents are already equal to nine, in which case, it resets the generator to zero). The random number generator, then, counts from 0 to 9, twelve times a second. This makes it virtually impossible to cheat, and truly random.

The MPU examines the status of the *solenoid period counter*. If it is zero, it turns off all momentary solenoids, and branches to the feature lamp update routine. If it is not zero, it subtracts "one" from the contents of the counter. In general, momentary solenoids(thumper bumpers, slingshots, etc.) are energized for 3 zero crossings (26 milliseconds). Saucer kickers are energized longer to make sure the ball clears the saucer.

The MPU next enters the *feature lamp update* part of the program. Their are 90 single bit entries in U4, the CMOS scratch pad memory. 45 bits corresponding to Phase A and 45 Bits corresponding to Phase B. This is utilized to form a memory "picture" (lamp matrix) of the status (on or off) of each feature lamp in the game.

The MPU will now aquire the first 3 bits from memory, combine it with an appropiate half byte address and send this address and data to the lamp decoders via PIA U8, ports PA0 thru PA7. The low order ports carry the first decode address (0000) generated by the MPU chip thru the program. The high order ports, PA5 thru PA7 contain lamp data from the first 3 bits in memory. The address (0000) goes to each of the three "one of sixteen" decoder chips in the lamp driver section via the lines labeled PA00, PA01, PA02, and PA03 . This is the address of the "0" port (pin 11) of each of these chips. The data is routed to the chips by the foil on the printed circuit board, i.e. PA5 goes to U15, PA6 goes to U16 and PA7 goes to U17.

It is to be noted that pin 11 of chip U15 drives SCR Q23, U16 drives SCR Q70, and U17 drives SCR Q55. Conclusion: the first 3 bits in the lamp matrix in memory chip U4 is a picture of the status of the lamps driven by these three SCRs.

The MPU chip, thru its program, now causes the strobe line (CB2, PIA U8) to go high and low, thereby presenting the first 3 bits of update information to the gates of SCRs Q23, Q70, and Q55. A low (0) at the gate leaves the SCR and it's associated lamp "off ",a high (1) turns it "on". When an SCR is turned on it will stay on for the remainder of the supply line alternation (1/120 second) and turn off at the next zero crossing. It will stay off unless the next update again drives the gate high.

The MPU fetches the second 3 bits from memory, generates an address (0001) and repeats the process. It is now addressing the gates of SCR Q24, SCR Q41, and SCR Q56. It causes the strobe to go high and then low, driving the gates of these SCRs and thereby updating their corresponding lamps.

The MPU fetches the third 3 bits from memory, generates an address (0010) etc. It is now addressing the gates of SCR Q25, SCR Q42, and SCR Q57. It repeats the strobe pulse and the appropriate lamps are updated.

Twelve more quick passes thru the subroutine and each of the 45 SCRs in the lamp section are updated. (Note that not all 45 SCRs are necessarily used in a given game.)The SCRs can be thought of as a type of memory or storage .When the MPU updates the SCR, if it is turned on it will stay on for the rest of the cycle (1/60 of a second).

The next step in the lamp update program is to strobe an address (1111) into the chips U15, U16, and U17. This is a "rest" address and frees the PA0 thru PA7 lines for other purposes. This completes the sequence for updating Phase A lamps and now the whole process is repeated for the Phase B lamps.

The majority of lamps in the game each have one lead commoned to an 11VAC line (Phase A or Phase B). In addition each lamp has a blocking diode tied in series with its phase line to preserve the integrety of that phase. Since the common lines are 90 degrees out of phase, the "B"lamps are all off when the "A" lamps are being updated and conversely the "A" lamps are off when the "B" lamp status is renewed. Since these updates occur so rapidly an observer could believe that both lamps appear to be on at the same time. This procedure allows a single SCR to control the state of two lamp circuits, one for each phase.

In games utilizing the Phase C & D lines the same principles apply with the following rules :

The Phase C line corresponds in timing to the Phase A line.

The Phase D line corresponds in timing to the Phase B line.

Each of these phases supply 24VAC for the bright light circuits.

And only the large SCR drivers (MCR 106-1) may be used in firing these lamps.

The last portion of the zero crossing interrupt routine is to read the *momentary switches* and look for valid closures. PIA U8, ports PB0 thru PB7 are initialized as inputs, PA0 thru PA7 as outputs. The MPU chip, thru the program, sends a pulse down the ST4 strobe line. If a switch is closed the pulse will return the corresponding "I" line. The MPU chip examines the past history (in memory) of the switch and if it finds that the switch was "open","closed" and is now "closed", it makes a memory record of the valid closure. The reaction to this valid closure was discussed previously under Normal Mode of operation.

It is to be noted that stuck switches, a "closed", "closed" and currently "closed" condition is ignored and does not result in a memory record of a valid closure. Thus the game ignores stuck switches. Also,noise conditions such as "open", "closed" and currently "open" do not satisfy the valid closure criteria, and are ignored.

The MPU chip sends a strobe pulse down the ST3 line and monitors the "I" line for returns. It repeats the process of evaluating the previous history of the switches from memory and makes a record of any valid closures. The process is repeated for the ST2, ST1 and ST0 lines. At the end of the time period, the entire switch matrix has been scaned and a memory record of the switches previous and current history is filed together with a record of valid switch closures.

It is to be noted that this multiple reading of a switch takes time, i.e., it must be done over several zero crossings before a valid closure can be verified and recorded. This procedure would spoil the response time to hit a thumper bumper or slingshot or any electromechanical device that must react quickly. To overcome this difficulty, a special, quick reaction subroutine exists in the program dealing with "normal operation". This routine takes place immediately after the memory record of valid closures is reviewed. It consists of a review of the previous and current history of *just* the solenoids that require a quick reaction. If an "open", "closed" record is found, the solenoid is energized. No scoring is involved in this routine. The net result is slingshots and thumper bumpers respond "instantaneously". They are not allowed to score until a valid closure is detected later. Because of this quick reaction subroutine, a noise pulse may cause a solenoid to pull (very-very infrequent). However, no points will be added to the players score. If the pull and scoring ever occur for no apparent reason, it is most probably because of improperly adjusted switch contacts.

The diodes in the switch matrix are steering diodes that prevent sneak paths and subsequent false decodes. On Party Animal, for example, if diodes were not used: when the MPU sends the group strobe pulse down the ST1 line, and a coin is dropped through the right coin chute and both bottom and middle drop targets are down the strobe pulse will be returned down the "I1" line. The game will assume that a coin was dropped in both the left and right hand chutes and award the appropriate credits.

The Zero Crossing Interrupt is now completed. The MPU chip goes into memory and replenishes itself with its place in the program and the data it was processing prior to the interrupt. It then begins and continues in the program as if it had never been interrupted.

2)Display Update Interrupt: 830 times per second the MPU senses an internal display update interrupt. The MPU makes a memory record of its contents and then jumps to service the interrupt.

There is also a memory record for each digit on each of the two displays in the CMOS memory, U4. 14 x 2=28 one byte memory locations are reserved for retaining this data. Each byte is capable of storing 256 states, representing all possible combinations of the segments that may be lit. Because many of these combinations would be unintelligible, we use an abbreviated version of an ASCII lookup table to represent the numbers 0 thru 9 and the letters A thru Z. When we refer to this table we are able to extract exactly what bits should be turned on to illuminate the corresponding segments in a particular digit.

The displays in the Bally Pinball are multiplexed. This means that only one digit per display is on at a given point in time. If a picture of the backbox were taken with a high speed camera, the result might show that at the time the shutter opened, the #6 digit was "on" in both display driver modules.

The multiplex rate is fast enough that humans do not see the flicker. The advantage of multiplexing is that it minimizes the number of leads necessary to control the displays. For example without multiplexing you would need 8 leads for each segment on a digit, times 14 digits, times 2 displays equals 224 leads and thats not even including commons or power leads.

The segment data lines (PA10-PA17) for both displays are commoned. The same is true for each of the Binary Digit Select lines (PA04-PA07) and the blanking line. Only a separate display latch strobe line is required for each of the display driver modules. It should also be noted that the comma information is time shared with PA16 & PA17 for Players 1 and 2 and PA14 & PA15 for Players 3 & 4.

The MPU begins the update by determining which digit was updated last. Assume that this was digit #4. The MPU thru the program, adds one to this number and makes a memory record of this fact for future reference. It causes the blanking line to go high and blank the displays. This keeps each digit clean and crisp looking by preventing flicker during the update.

The MPU chip goes into memory and obtains the segment data for the fifth digit, for the Player 3 & 4 Display. It places this information on the PA10 thru PA17 lines and strobes it into U1 on the display module.

The MPU goes back to memory, obtains the segment data for the fifth digit, for the Player 1 & 2 Display. It places this information on the PA10 thru PA17 lines and strobes it into U1 on the Player 1 & 2 display module at the same time sending the Binary digit select for digit #5 into U2 of both displays.

With this process complete, it removes the blanking pulse thereby enabling digit #5 and returns from the interrupt to whatever it was doing previously.

Assume that the MPU chip is to enable digit #5. The Binary Digit select information 0101 (DCBA) is sent to U2 on both displays. When U2 is strobed, the base of level shifter transistor Q11 is made high. This causes the collector of Q11 to drop from a high, positive voltage (+190 volts DC less the leakage current drop across R31, 100k ohms) to the saturation voltage, approximately .3VDC. The voltage across R31 is now approximately 189VDC (190-.3(VCE SAT, Q11)-.7VDC (VBE, Q23).). The collector of Q23, which was clamped to the +80VDC bus, now rises to approximately 189.7 VDC (190-.3(VCE SAT, Q23). Digit #5 is now enabled.

Assume that the fifth digit of the 1st & 2nd Display module is to display the character "H". The MPU chip looks in the ASCII table and obtains the segment data 0111 0110. It then places this information into chip U1 on the display via the PA10 thru PA17 lines. U1, when strobed, latches this input, and as soon as the MPU chip removes the blanking pulse, the bases of transistors Q13, Q2, Q15, Q26 and Q14 are made high by the outputs of U1. The emitter-collector voltage of these transistors, previously at +80VDC due to the blanking pulse, now falls to VCE SAT, approximately +.3VDC. The result is the "b", "c", "e", "f" and "g" segments in the display panel are enabled.

Both of the actions of the previous example result in turning on the character "H" in the 5th digit position on the Player 1 & 2 Display.

It is interesting to note that the 6803 MPU is capable of being interrupted while it is servicing an interrupt. All that is necessary when this happens is for the MPU chip to make a record of where it was in the program and of its contents. It can then jump off and service the interrupt. At the completion of this task, it returns, completes and finally returns to normal operation. An example of this action is a zero crossing interrupt being interrupted by the Display Interrupt Generator.