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SERVICE BULLETIN
Roms and Rams Self Testing

GAME	SELF TEST SWITCH
GUN FIGHT	None
SEA WOLF	Roms only Switches #6, #7, & #8 to off position
TORNADO BASEBALL	Switch #6 off
MAZE	Switch #4 off
280ZZAP	Switch #3 off & #4 on
CHECK MATE	Switch #8 off
BOOT HILL	Switch #5 off
DOUBLE PLAY	Switch #7 on
ROAD RUNNER	Switch #7 & #8 off
GUIDED MISSILE	Switch #8 on
LAGUNA RACER	Switch #7 off & #8 on
M-4	Switch #5 on
CLOWNS	Switch #8 off
EXTRA INNING	Switch #7 on
SEA WOLF II	Switch #8 off
SPACE WALK	Switch #8 off
DOG PATCH	Switch #6 on
SHUFFLEBOARD	Switch #8 on
BOWLING ALLEY	Switch #8 on
18 WHEELER	Switch #8 on
PHANTOM II	Switch #6 off
SUPER SPEED RACE	Switch #8 off
SPACE INVADERS II	Switch #8 on
GALAXIAN	Slide Switch on
PAC-MAN	Slide Switch on
RALLY X	Slide Switch on
SPACE ENCOUNTERS	Switch #5 off & #6 on
SPACE ZAP	Slide Switch on
GORF	Slide Switch on
WIZARD OF WOR	Slide Switch on
OMEGA RACE	Slide Switch on
GALAGA	Slide Switch on
BOSCONIAN	Slide Switch on
KICKMAN	Slide Switch on
MS PAC-MAN	Slide Switch on
ROBY ROTO	Slide Switch on
TRON	Slide Switch on
SOLOR FOX	Slide Switch on

NOTE: Activate coin door tilt switch to start self test.

Invaders, Blue Shark & Lazarian has no Ram and Rom Test.

ROM & PROM CHART

GAME	4K	8K	16K	32K	64K
GUN FIGHT	8	(3604)	4	(1976)	NO
SEA WOLF	8	(3604)	4	(27581)	2 (9316)
TORNADO BASEBALL	NO		NO		3 (9216)
MAZE	8	(3604)	4	(2708)	2 (9316)
280 ZZZAP	NO		6	(2708)	3 (9316)
CHECKMATE	8	(3604)	4	(2708)	2 (9216)
BOOT HILL	NO		NO		4 (9316)
DOUBLE PLAY	NO		8	(2708)	4 (9316)
ROAD RUNNER	NO		8	(2708)	4 (9316)
GUIDED MISSILE	NO		8	(2708)	4 (9316)
LAGUNA RACER	NO		7	(2708)	4 (9316)
M-4	NO		8	(2708)	4 (9316)
CLOWNS	NO		6	(2708)	NO
(2X) EXTRA INNING	NO		NO		5 (2716)
SEA WOLF II	NO		NO		4 (2716/9316)
SPACE WALK	NO		8	(2708)	NO
(2X) DOG PATCH	NO		NO		4 (2716)
(2X) SHUFFLEBOARD	NO		NO		4 (2716)
ROTATION VIII	NO		NO		4 (2716)
(2X) SPACE INVADER	NO		NO		4 (2716/9316)
(2X) BOWLING ALLEY	NO		NO		5 (2716)
(2X) BLUE SHARK	NO		NO		3 (2716)
(Z80) 18 WHEELER	NO		NO		4
(2XL) PHANTOM II	NO		NO		4+1 (2716)
(Z80) SUPER SPEED RACE	NO		3		2 (2716)
(Z80) SUBMARINE	NO		3		2 (2716)
(2XL) SPACE INVADERS DELUXE	NO		NO		5 (2716/9316)
(2XL) SPACE INVADERS II	NO		NO		6 (2716)
(NAMCO) GALAXIAN	NO		NO		7 (2716/9316)

GAME	8K	16K	32K	64K
EXTRA BASES	NO	8	4	
SPACE ENCOUNTERS	NO	8	NO	
SPACE ZAP	NO	8	4	
GORF	NO	16	8	
PAC-MAN	NO	NO	6	
RALLY X	NO	NO	5	
WIZARD OF WOR	NO	NO	7	
OMEGA RACE	NO	3	4	
GALAGA	NO	NO	9	
KICKMAN	NO	NO	12	4
MS PAC-MAN	NO	1	8	NO
BOSCONIAN	NO	NO	12	NO
ROBY ROTO	NO	NO	10	NO
TRON	NO	NO	3	12
LAZARIAN	NO	13	1	NO
SOLAR FOX	NO	NO	12	4

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SERVICE BULLETIN

GAME (UPRIGHT)	DATE	GAME NUMBER
GUN FIGHT	1975	597
SEAWOLF	1976	596
TOP GUN	1976	603
TORNADO BASEBALL	1976	605
280 ZAP	1976	610
MAZE	1976	611
BOOT HILL	1977	612
CHECKMATE	1977	615
ROAD RUNNER DESERT GUN	1977	618
DOUBLE PLAY	1977	619
LAGUNA RACER	1977	622
GUIDED MISSILE	1977	623
M-4	1977	626
SEAWOLF II	1978	625
CLOWNS	1978	630
SPACE WALK	1978	640
EXTRA INNING	1978	642
SHUFFLEBOARD	1978	643
DOG PATCH	1978	644
BOWLING ALLEY	1979	730
SPACE INVADERS	1979	739

GAME (UPRIGHT)	DATE	GAME NUMBER
PHANTOM II	1979	652
18 WHEELER	1979	653
SUBMARINE	1979	760
SUPER SPEED RACE	1979	762
EXTRA BASES	1980	761
SPACE ENCOUNTERS	1980	645
SPACE INVADERS II	1980	851
SPACE INVADERS DELUXE	1089	852
BLUE SHARK	1980	742
GALAXIAN	1980	866
SPACE ZAP	1980	902
PAC-MAN	1980	902
GORF	1981	873
RALLY X	1981	935
WIZARD OF WOR	1981	961
OMEGA RACE	1981	929
GALAGA	1981	508
KICKMAN	1981	969
MS. PAC-MAN	1982	595
BOSCONIAN	1982	550
ROBY ROTO	1982	530
TRON	1982	628
LAZARIAN	1982	636
SOLAR FOX	1982	982



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SERVICE BULLETIN

GAME (TABLE)	DATE	GAME NUMBER
GUN FIGHT	1975	604
TORNADO BASEBALL	1976	607
MAZE	1976	613
CHECKMATE	1977	617
DOUBLE PLAY	1977	621
ROTATION VIII	1978	627
CLOWNS	1978	634
BOWLING ALLEY	1979	749
SPACE INVADERS	1979	775
SPACE INVADERS II	1980	851
SPACE INVADERS DELUXE	1980	870
GALAXIAN	1980	869
SPACE ZAP	1980	920
EXTRA BASES	1980	889
PAC-MAN	1980	933
GORF	1981	927
RALLY X	1981	936
WIZARD OF WOR	1981	962
OMEGA RACE	1981	930
GALAGA	1981	510
KICKMAN	1981	515
MS. PAC-MAN	1982	599
BOSCONIAN	1982	557
ROBY ROTO	1982	576
TRON	1982	727
LAZARIAN	1982	646
SOLAR FOX	1982	580

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SERVICE BULLETIN

GAME (MINI)	DATE	GAME NUMBER
SPACE ENCOUNTERS	1980	905
SPACE ZAP	1980	908
PAC-MAN	1980	934
GORF	1981	926
RALLY X	1981	937
WIZARD OF WOR	1981	963
OMEGA RACE	1981	931
GALAGA	1981	514
KICKMAN	1981	513
MS. PAC-MAN	1982	602
BOSCONIAN	1982	555
ROBY ROTO	1982	524
TRON	1982	728
LAZARIAN	1982	641
SOLAR FOX	1982	578



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SERVICE BULLETIN

GAME	POWER SUPPLY NUMBER
GUN FIGHT (EARLY MODEL)	PC 80-901
GUN FIGHT TO SPACE ENCOUNTERS 8080 SYSTEM (1975-1980)	PC A082-90400-H000
SEAWOLF II	PC A082-90401-B000
ROTATION VIII	PC A082-90402-E000
SUPER SPEED RACE	PC A082-90401-C000
18 WHEELER	PC A082-90406-B000
SUBMARINE	PC A082-90406-B000
EXTRA BASES	PC A082-90408-D000
SPACE ZAP	PC A082-90411-A000
GORF	PC A082-90411-A000
WIZARD OF WOR	PC A082-90411-A000
RALLY X	PC A084-90414-C935
GALAGA	PC A084-90414-C935
OMEGA RACE	PC A084-90413-D000
KICKMAN	PC A082-90412-B000
TRON	PC A082-90412-B000
LAZARIAN	PC A082-90421-B000



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SERVICE BULLETIN

PART NUMBER	ANTI-CHEAT-DEVICES
A090-00087-0000	COIN CHUTE WITH PIN
A090-00064-0000	ANTI-PENNY DEVICE
0017-00005-0003	METAL ACCEPTOR WITH STRING CUTTER (COIN MECH)
0017-00005-0214	METAL ACCEPTOR WITH STRING CUTTER (COIN ACCEPTORS INC.)
0017-00005-0211	PLASTIC ACCEPTOR WITH ANTI-STRING DEVICE (COIN ACCEPTORS INC.)
A090-00061-0000	ANTI-STRING DEVICE
A090-00061-0100	ANTI-STRING DEVICE-MINI
	ANTI-WIRE CHEAT CLIP
	ANTI-WIRE CHEAT BARRIER

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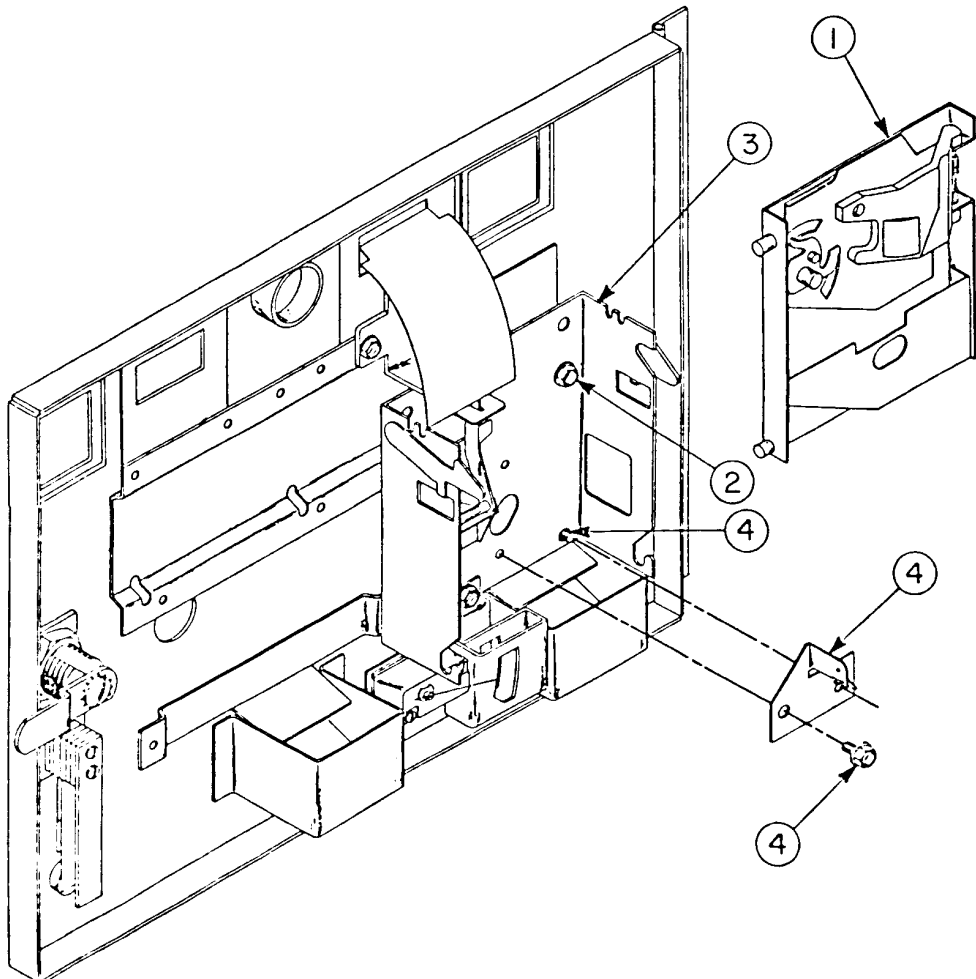
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ANTI-PENNY DEVICE INSTALLATION

A090-00064-0000

1. REMOVE COIN ACCEPTOR FROM BRACKET.
2. REMOVE (3) HEX HEAD SCREWS THAT HOLD BRACKET TO DOOR.
3. REMOVE BRACKET FROM DOOR.
4. INSTALL ANTI-PENNY DEVICE MIDWAY PART NO. A090-00064-0000 USING (2) 6-32 x 5/16 SLOT HEX HEAD SCREWS MIDWAY PART NO. 0017-00101-0555. MOUNT DEVICE WITH 1 SCREW FROM THE FRONT AND 1 SCREW FROM THE BACK OF BRACKET AS SHOWN.
5. SCREW BRACKET BACK TO DOOR AND SNAP COIN ACCEPTOR BACK IN PLACE.



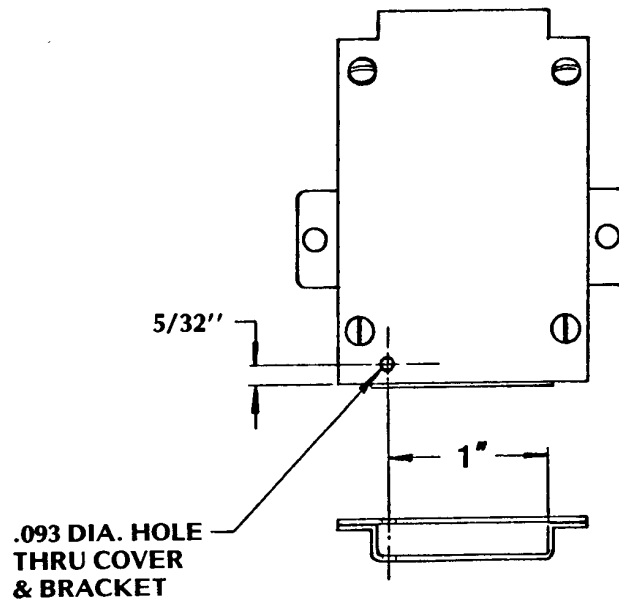
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ANTI-CHEAT COIN CHUTE REWORK



1. DRILL .093 DIA. HOLE THRU COVER AND BRACKET AS SHOWN.
2. REMOVE BURRS FROM EDGES OF HOLE AFTER DRILLING.
3. INSERT 1/16" DIA. COTTER PIN.
4. PIN MUST MOVE FREELY.
5. OBJECT IS TO KICK PENNY TO THE RIGHT AND SLOW IT DOWN.
6. MAKE SURE QUARTER WILL PASS THROUGH AFTER COTTER PIN IS INSERTED.

Bally

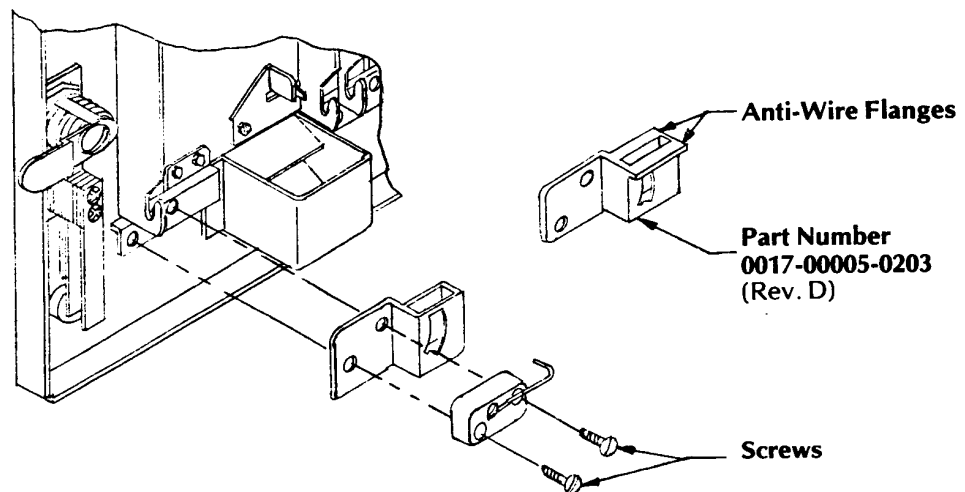
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ANTI-WIRE COIN SWITCH GUIDE

Part No. 0017-00005-0203



1. TURN POWER OFF TO THE GAME.
2. Open the coin door and locate the microswitch at the bottom of the coin acceptor mechanism. See above Figure.
3. Remove the two indicated screws which secure the microswitch and the coin guide to the bracket on the coin door and set them aside.
4. Remove and discard the old coin guide, replacing it with the new ANTI-WIRE COIN GUIDE provided in your kit.
5. Install the new ANTI-WIRE COIN GUIDE and the old microswitch to the bracket on the coin door with the screws you removed in Step 3 above. They should be positioned as shown in the above Figure.
6. Repeat this procedure for the remaining coin acceptor coin guide(s).
7. Turn the power to the game back on and run the game Self-Test.
8. Take the game out of Self-Test and drop some coins through each coin acceptor to make sure they are all working properly.
9. Close and lock the coin door.

EXTNAME: COIN-SWITCH (R)P: (ANTI-WIRE) 01

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July 6, 1982

SERVICE BULLETIN

GAME: LAZARIAN

SUBJECT: NEW MEDIUM POWER SUPPLY WITH BATTERY
MEMORY OPTION (A082-90421-B000)

1. This medium universal power supply can be used in past and future games.
2. The medium power supply can replace the A084-90411-A000 in Space Zap, Gorf, Wizard of Wor and Roby Roto (Triple Supply System).
3. The medium universal power supply can also replace A084-90411-C935 in Rally X, Galaga and Bosconian (Single Supply System).
4. Call the Midway Service Department for any additional information.

Andy Ducay
Service Manager

AD/dd



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July 6, 1982

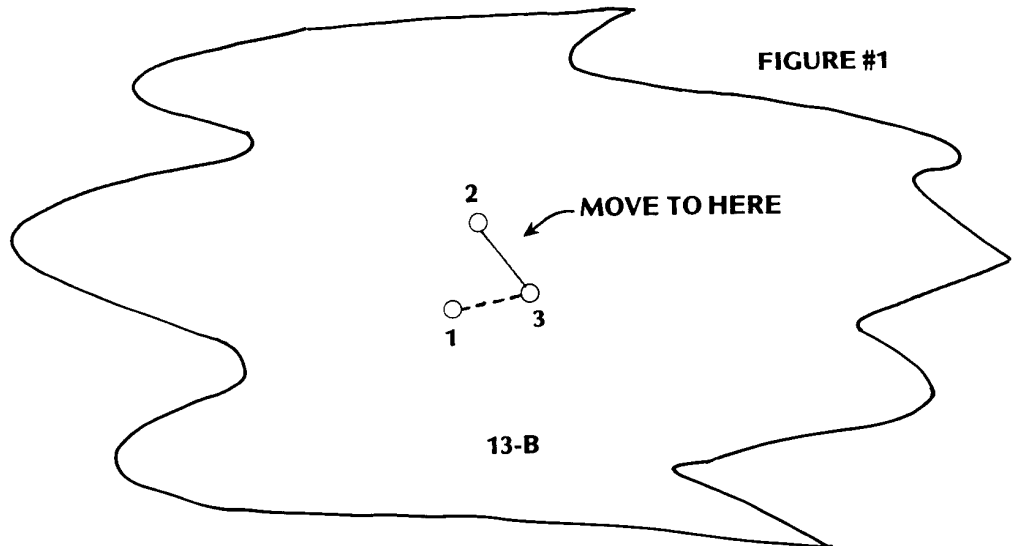
SERVICE BULLETIN

GAME: LAZARIAN (SERIAL NO. 101 to 500).

SUBJECT: LOCK UP CONDITION ON POWER OFF & ON

MODIFICATION

1. Enable the watchdog circuit by moving the jumper wire near location 13-B from position 1 & 3 to position 2 & 3. (See Figure #1).



Andy Ducay
Service Manager

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May 20, 1982

SERVICE BULLETIN

GAME: TRON

SUBJECT: LINE FUSE

MODIFICATION

1. Change the 2.5 amp Slo-Blo line fuse to a 3 amp Slo-Blo fuse.
2. This will prevent the line fuse from blowing on power up.

Andy Ducay
Service Manager

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June 28, 1982

SERVICE BULLETIN

GAME: TRON (SERIAL NUMBER 101-1200)

SUBJECT: CONTROL ASSEMBLY

CONDITION: LOOSE ACTUATING PIN

MODIFICATION

1. Add a flat washer, a periphery washer and a roller as shown in Figure #1.
2. Check out mechanically.

NOTES :

1. TORQUE ACTUATING PIN TO 75 in/lbs \pm 10%
IT IS SUGGESTED TO USE A LOCTITE COMPOUND.
2. A LIGHT GREASE (0017-00008-0087) MUST BE
PUT BETWEEN THE ACTUATING PIN & ROLLER

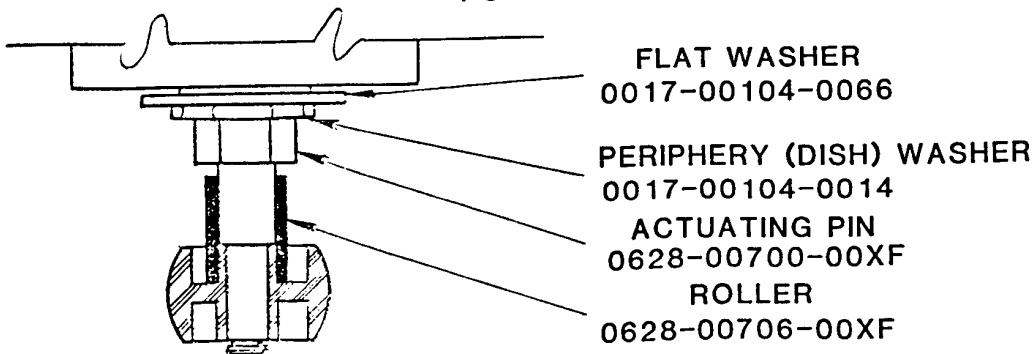


FIGURE #1

Andy Ducay
Service Manager

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May 20, 1982

SERVICE BULLETIN

GAMES: TRON & KICKMAN
SUBJECT: OBJECTIONAL HUM IN SOUND
MODIFICATION: POWER SUPPLY (A082-90412-C000)

1. Cut jumper wire J-4 on power supply (next to the fuse).
2. Check game electrically.

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Service Manager

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April 30, 1982

SERVICE BULLETIN

GAMES: MS. PAC-MAN & GALAGA

SUBJECT: WAVY OR DISTORTED VIDEO WITH STATIC FILTER BOARD

MODIFICATION

1. Remove yellow ground strap from transformer leg and secure it to the line filter assembly mounting screw (metal case is earth ground).
2. Check for loose ground straps.

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Service Manager

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May 19, 1982

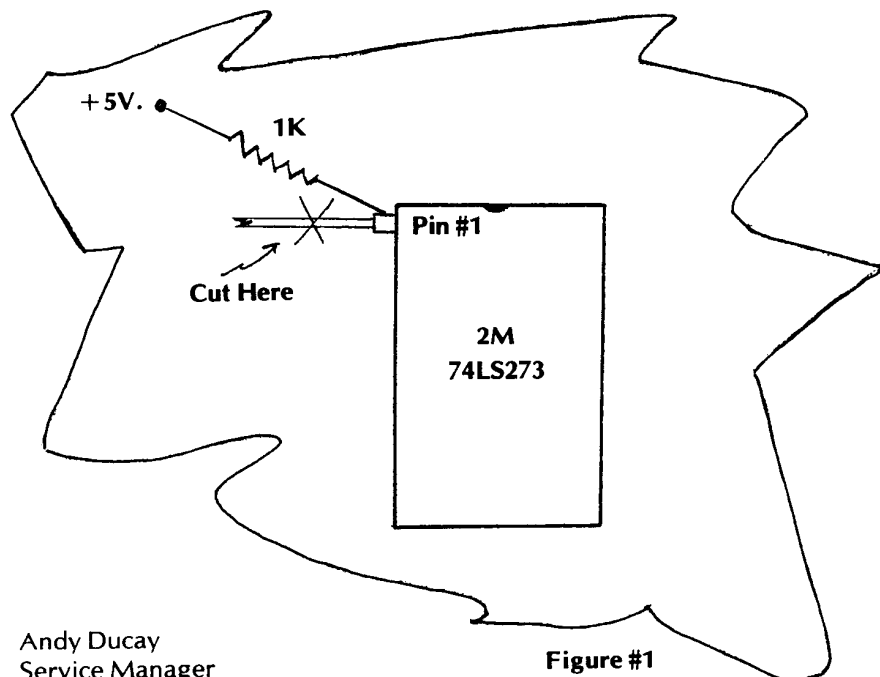
SERVICE BULLETIN

GAME: PAC-MAN & MS. PAC-MAN

SUBJECT: INTERMITTENT LOSS OF SOUND (STATIC)

MODIFICATION

1. Cut trace to pin #1 of 2M (74LS273).
2. Solder 1K resistor from +5VDC to pin #1 of IC 2M. (See Figure #1).



Andy Ducay
Service Manager

Figure #1

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June 9, 1982

SERVICE BULLETIN

GAMES: ROBY ROTO, MS. PAC-MAN & GALAGA

SUBJECT: COIN METERS (COUNTER)

MODIFICATION

1. The 1N4004 clamping diode is now soldered across the meter coil in the meter. (A090-00057-0000).
2. When replacing the coin meter use a meter with a diode to prevent logic board damage.
3. In earlier games the diode was located on a terminal strip by the transformer.

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Service Manager

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February 15, 1982

SERVICE BULLETIN

GAME: MS. PAC-MAN

SUBJECT: MS. PAC-MAN MAIN LOGIC BOARD
(PC A082-91375-B000)

1. The main "Ms. Pac-Man" logic board is the same logic board as in Pac-Man.
2. There are two minor changes:
 - A. Character Proms at 5E and 5F are Ms. Pac-Man type.
 - B. The Z80 is removed and inserted into Ms. Pac-Man auxiliary board (PC A084-91415-B617).

NOTE - All Ms. Pac-Man will be shipped with static filter boards.

Andy Ducay
Service Manager

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January 13, 1982

SERVICE BULLETIN

GAMES: KICK (KICKMAN) & TRON

SUBJECT: NEW FEATURES

1. Fluorscent lamp (display).
2. Battery memory (holds high score).
3. Bookkeeping mode.
4. Twenty-four (24) different sounds.
5. New and easy diagnostic (self-test).
6. Front panel programing of coin play, bonus, etc.
7. Metal cash box compartment.
8. New three (3) card logic system (Z80 system).
9. Heavy duty power supply (7.5 amps.).
10. Skill level adjustment.

Andy Ducay
Service Manager

AD/dd

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January 12, 1982

SERVICE BULLETIN

GAME: KICK

SUBJECT: THE NAME "KICK" WILL BE CHANGED TO "KICKMAN"
AS OF SERIAL NUMBER - (U/R #1600, C/T #650 & MINI #126)

1. The Kick game CPU and video board Proms must not mix with Kickman Proms, CPU and video boards.
2. The sound and I & O board Proms are not effected by the name change.
3. I repeat, check for proper Proms in Kick and Kickman.

NOTE - The cocktail game glass will be the Kick type but as of serial number #650 the proms will be Kickman.

Andy Ducay
Service Manager

AD/dd

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January 4, 1982

SERVICE BULLETIN

GAME: KICK

SUBJECT: KICK BUTTON LIGHT BULBS

1. The Kick button must use a 12V lamp to prevent an overheating condition (wedge base type GE #194 or 161).
2. Do not use a 6V bulb because the bulb heat will damage the plastic button.

Andy Ducay
Service Manager

AD/dd

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February 3, 1982

SERVICE BULLETIN

GAME: KICK OR KICKMAN

SUBJECT: CAPACITOR CP34 ON SOUND I/O BOARD
(A082-90908-G000)

1. Capacitor CP34 on the Sound I/O Board has been inserted with polarity reversed due to incorrect labeling on the P.C. Board. This can cause a loss of +5VDC when CP34 finally breaks down.
2. Remove capacitor CP34 or reverse its polarity on the Sound I/O Board.

Bob Norton
Service Technician

BN/dd

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January 4, 1982

SERVICE BULLETIN

GAME: KICK

SUBJECT: RAM/ROM TEST SWITCH LOCATION

1. The ram/rom test switch is located to the right of the cash box (below the volume control).
2. Some games have a test switch under the coin counter which is not used.
3. The switch under the coin counter is not wired and should be removed.

Andy Ducay
Service Manager

AD/dd

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January 6, 1982

SERVICE BULLETIN

GAME: KICK AND KICKMAN

SUBJECT: EPROM IDENTIFICATION

1. All EPROMS will have a colored label and a Midway part number.
2. When ordering an EPROM, specify the part number and the color of the label.

Bob Norton
Service Technician

BN/dd



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January 7, 1982

SERVICE BULLETIN

GAME: KICK

SUBJECT: PROM LOCATION IDENTIFICATION ON VIDEO BOARD
(A082-91399-E000)

CODE (UPRIGHT)	LOCATION
3000 A	E1
3100 B	D1
3200 C	BC1
3300 D	A1

CODE (MINI & COCKTAIL)	LOCATION
2600 A	E1
2700 B	D1
2800 C	BC1
2900 D	A1

Andy Ducay
Service Manager

AD/dd

Bally

MIDWAY MFG. CO.

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Telephone (312) 451-9200



January 13, 1982

SERVICE BULLETIN

GAME: KICK (KICKMAN)

SUBJECT: SPEAKERS (TWO)

1. For proper speaker balance, use two 4 ohm speakers.
2. Using 8 ohm speakers will cause a loss in volume.
3. Mixing a 4 ohm and an 8 ohm will cause one channel to be louder than the other.
4. The master volume control (located to the right of the cash box) will control the volume of all the sounds.

Andy Ducay
Service Manager

AD/dd

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January 4, 1982

SERVICE BULLETIN

GAME: KICK

SUBJECT: UPRIGHT, MINI AND COCKTAIL LOGIC BOARDS

1. The logic boards can be interchanged between Mini and Cocktail games (check switch #7 for proper setting).
2. In upright games, due to a mirror, the Proms have been programmed for a mirror image.
3. Upright logic boards cannot be used in Mini or Cocktail games unless the Proms on video and CPU boards are replaced with Mini - Cocktail type.

Andy Ducay
Service Manager

AD/dd

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February 8, 1982

SERVICE BULLETIN

GAME: KICK

SUBJECT: INTERCHANGING LOGIC BOARDS BETWEEN THE
UPRIGHT, COCKTAIL & MINI MODELS

- I. Mini cocktail boards are the same, the only difference is the dip switch setting of SW1 (located on the sound I/O board).
 - A. SW1 switch #7 ON for mini, OFF for cocktail.

- II. To install cocktail or mini boards in an upright game.
 - A. SW1 switch #7 to the ON position.
 - B. Reverse vertical yoke wires.
 1. Using an Electrohome monitor, reverse the brown & gray wires on yoke.
 2. Using Wells-Gardner, reverse the green & yellow wires.

- III. Installing upright boards in a mini game.
 - A. No switch change is needed.
 - B. Reverse vertical yoke wires.

- IV. Upright boards in a cocktail game are not interchangeable, I repeat, are not interchangeable.

Kevin Moeller
Service Technician

KM/dd

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February 19, 1982

SERVICE BULLETIN

GAMES: KICKMAN & TRON

SUBJECT: VIDEO LOCK UP CONDITION & LOSS OF COIN DOOR LITES

1. When the audio and coin door lites fuse (2 amp.) blows, it will cause a video lock up condition (12VDC).
2. This lock up condition is due to the AC sync. and power reset circuits on the power supply (PC A082-90412-B000) which uses 12VDC.

Andy Ducay
Service Manager

AD/dd

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April 30, 1982

SERVICE BULLETIN

GAME: GALAGA

SUBJECT: GAME GOES INTO RAM/ROM TEST OR LOCK-UP
WHILE PLAYING

1. Check for a 4 MHz Z80-A CPU at position 4M of the CPU board.
2. Adjust for +5.2VDC. The easiest place to check this voltage is across the capacitor labeled C-1 which is located on the upper left hand corner of the CPU board.
3. On the power supply, solder a jumper to pin 3 from pin 2 of IC SG3532.
4. If not already modified, change 4E & 4J to the 4 MHz Z80-A type CPU. Also change IC 5B to a 74107 (Texas Instruments) and finally clip out the 33pf capacitor labeled CX-1. This capacitor is found either soldered on chip 5B or, on newer boards, it is located next to IC 5A.

Andy Ducay
Service Manager

AD/dd

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June 15, 1982

SERVICE BULLETIN

GAME: GALAGA

SUBJECT: LOSS OF BASE SHIP

1. Occasionally the game may subtract one of the player's base ships even though the player has not lost in battle.
2. To prevent this condition, change the 74LS259 at location 3C on the Galaga CPU Board (P.C. A084-91404-E508). Use Texas Instruments components only.

Bob Norton
Assistant Service Manager
and Field Technician

BN/dd



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January 5, 1982

SERVICE BULLETIN

GAME: GALAGA

SUBJECT: PROM LOCATION IDENTIFICATION (2732)

CODE (CPU)	LOCATION
3200 A	3N
3300 B	3M
3400 C	3L
3500 D	3K
3600 E	3J
3700 G	3E

CODE (VIDEO)	LOCATION
2600 J	4L
2700 K	4F
2800 L	4D

Andy Ducay
Service Manager

AD/dd

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November 11, 1981

SERVICE BULLETIN

GAME: GALAGA

SUBJECT: LOGIC BOARD IC REPLACEMENT (7400 SERIES)

1. When replacing a defective IC, use only Texas Instrument type (Ti).
2. If other manufacturers IC's are used it can cause timing problems.
3. Check enclosed IC list regarding which are involved.

Andy Ducay
Service Manager

AD/dd

Bally

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July 17, 1981

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

GAME: OMEGA RACE

SUBJECT: NEW FEATURES

1. Vector X-Y monitor (Electrohome).
2. Special X-Y and computer motherboard.
(PC A084-90007-E929)
3. Powerful audio sounds controlled by and additional Z80 on game board.
(PC A084-91372-D000).
4. Filter unit and 9 amp. power supply.
(PC A084-90413-D000).
5. Heavy duty AC transformers (two - MT88 & MT89A).
6. Fluorescent lamps (two).
7. Revised encoder and lite up push buttons.
8. Self-test for rom, ram, switches and monitor alignment.

Andy Ducay
Service Manager

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September 16, 1981

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

GAME: OMEGA RACE (UPRIGHT & MINI)

SUBJECT: WRONG DIP SWITCH SETTING CAUSING SECOND
 PLAYER CONTROLS TO BE INOPERATIVE

CHECK THE FOLLOWING:

1. Dip switch #2 Daughter Board (PC A084-91372-929) must have switch 8 in the ON position for all controls to function properly.
2. Dip switch #2 is located in position C-6.
3. Switch 8 is in the OFF position only in the cocktail table models.

Andy Duca
Service Manager

AD/dd

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July 17, 1981

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

GAME: OMEGA RACE

SUBJECT: DOOR KEYS

1. The #1350 door key will be replaced starting with Omega Race and the new key number will be #1355 (Part No. 0017-00005-0213).
2. In the near future eventually all games will be using the #1355 key.

Andy Ducay
Service Manager

AD/dd



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MIDWAYS



— ROM/RAM CHECK LIST AND MOTHER BOARD LOCATION COORDINATES

*	P	ROM 1	OK	-----	M-7
	P	ROM 2	OK	-----	L-7
	P	ROM 3	OK	-----	K-7
	P	ROM 4	OK	-----	J-7
	P	RAM 1	OK	-----	S-3 and/or S-2
	P	RAM 2	OK	-----	R-3 and/or (R/S)-2
	P	RAM 3	OK	-----	P-3 and/or (P/R)-2
	BBU	RAM	OK	-----	S-4
**	V	RAM 1	OK	-----	H-1 and/or (M/N)-1
	V	RAM 2	OK	-----	J-1 and/or (L/M)-1
	V	RAM 3	OK	-----	L-1 and/or (K/L)-1
	V	RAM 4	OK	-----	(J/K)-1 and/or (N/P)-1
	V	ROM 1	OK	-----	E-1
	V	ROM 2	OK	-----	F-1
	*	If completely bad, no picture and no "BEEP" sound.			
	**	If completely bad, no picture.			

For instance: if the 7th and the 12th chips down from the top are found to be bad, they would look like this (P RAM 3 NG) and (V RAM 4 NG). In the above case, the "BEEPING" sequence would be as follows:

**7 "BEEPS",
PAUSE (2 to 5 seconds),
THEN 12 MORE "BEEPS",
LONGER PAUSE (10 to 15 seconds),
THEN REPEATS ABOVE SEQUENCE.**

NOTE: In addition to the "BEEPING", the game will also flash its 1 and 2 credit LED lit push buttons at you in sequence with the "BEEPS" - 7 "BEEPS", 7 "flashes" - 12 more "BEEPS", 12 more "flashes" - and so on.

These "BEEPING" and "FLASHING" sequences are repeated until the game is turned off and the bad chip(s) are replaced or until the Self-Test switch is turned off.

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October 8, 1981

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

GAME: PAC-MAN & OMEGA RACE (UPRIGHT MODELS)

SUBJECT: PARTS & OPERATING MANUAL

1. New location for storing the Parts & Operating Manuals.
2. Starting October, 1981 all upright games will have the Parts & Operating Manuals stapled on the inside of the back door (in a plastic envelope).

Andy Ducay
Service Manager

AD/dd

Bally

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June 11, 1981

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

GAME: WIZARD OF WOR

SUBJECT: NEW FEATURES

1. Wizard of Wor allows you to service the entire electronic system (with the exception of the video monitor) from the front of the cabinet. (upright only).
2. Wizard of Wor features lighted coin slots.
3. Wizard of Wor is equipped with wheels on the back of the cabinet for ease of movement.
4. Wizard of Wor is a talking video game that uses three speakers for improved sound.
5. Wizard of Wor features Midway's positive approach to increase price of play at the player's option. A single coin gives a player the standard number of Warriors, two coins for two players. If additional Warriors are desired, 2 coins will give 1 player twice as many Warriors plus an additional bonus Warrior. Four coins will give 2 players twice as many Warriors plus an additional bonus Warrior for each player.
6. New service outlet.
7. Fluorescent lamp fixture.
8. Wizard of Wor copyrighted and trademarked in accordance with the U.S. copyright laws. Midway will protect its proprietary rights against any infringers of Wizard of Wor.

ANDY DUCAY
SERVICE MANAGER

AD/dd

Bally

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October 8, 1981

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

GAME: WIZARD OF WOR

**SUBJECT: MIXING ROMS (9332) & PROMS (2532) ON
 MEMORY BOARD (PC A082-91397-0000)**

1. Roms and Proms can now be mixed (no strapping change).
2. The strapping is only altered when all Roms and Proms are used.

Andy Ducay
Service Manager

AD/dd

Bally

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June 11, 1981

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

GAME: RALLY X

SUBJECT: RAM TEST MESSAGE CODE

1. The position of rams given in our Ram Test Message on page 6 of the Parts and Operating Manual is incorrect.
2. The correct Ram Test Message Code is shown in figure #1.
3. Each of the 2114 Rams are checked during the Ram Test and when any irregularity is found a test message (e.g. Ram 0L) is displayed and the test series stops. If there is no irregularities in the rams the sound and switch test begins.
4. The Ram Test is only for the 2114 Rams.

ANDY DUCAY
SERVICE MANAGER

AD/dd

FIGURE #1

Test Message	Position of RAM on PCB
RAM 0L	6C
RAM 0H	6A
RAM 1L	6D
RAM 1H	6B
RAM 2L	6K
RAM 2H	6J
RAM 3L	6L
RAM 3H	6H
RAM 4L	6M
RAM 4H	6F
RAM 5L	6N
RAM 5H	6E



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SERVICE BULLETIN

GAME: GORF

SUBJECT: NEW 6 CARD Z-80 SYSTEM USING A CARD RACK

GAME CARD (PC A084-90708-A873)
I&O CUSTOM CHIP (TWO)
TALKING CHIP - SC-01

ROM & RAM CARD (A082-91364-A000)
DOMESTIC & FOREIGN (A082-91374-A000)
RAMS 2114
ROMS 9316 OR 9332

CPU CARD (A082-91354-E000)
Z80 CPU
ADDRESS CUSTOM CHIP
DATA CUSTOM CHIP
CRYSTAL 14,318

RAM CARD (A082-91356-0000)
TWO RAM CARDS
16 RAM EACH (M4027)

PATTERN CARD (PC 082-91355-C000)
SHIFTS INFORMATION AT A FASTER RATE

POWER SUPPLY (PC 082-90411-A000)
SAME AS SPACE ZAP

NOTE: ALL PC CARDS EDGE CONNECTORS ARE GOLD PLATED.

Andy Ducay
Service Manager

Bally

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June 17, 1981

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

GAME: GORF

SUBJECT: MISSION SELF TEST (PROGRAM TWO ONLY)

1. Missions can be played in self test out of sequence in the following manner:
 - A. Coin Game.
 - B. Press one player button.
 - C. Move self test switch to test position.
 - D. Press one player button to select mission to be tested (played).
 - E. Release one player button and play mission selected.
 - F. Press one player button again to select other missions if bases are not destroyed.
 - G. Move self test switch to off position for normal play.

NOTE -In upright games the new program will test the rating lites by flashing each lite in sequence when in self test.

Andy Ducay
Service Manager

AD/dd

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April 27, 1981

SERVICE BULLETIN

GAME: GORF

SUBJECT: ROM PROGRAM CHANGE

1. Rom program number two is now in all Gorf games which will make the game harder to play after the 5th mission.
2. The roms will not be interchangeable between program number one and two.
3. The rom code and board location of program number one and two roms. See the code and location chart.
4. The rom location on domestic and foreign rom/ram boards are different.

ANDY DUCAY
SERVICE MANAGER

AD/dd



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ROM CODE AND LOCATION CHART

**Domestic Rom/Ram Board
PC A082-91364-A000**

PROGRAM NUMBER ONE

<u>ROM CODE</u>	<u>LOCATION</u>
M873A-0850	x-1
M873B-0850	x-3
M873C-0850	x-5
M873D-0850	x-7
M873E-0850	x-11
M873F-0850	x-13
M873G-0850	x-15
M873H-0850	x-17

**Foreign Rom/Ram Board
PC A082-91374-A000**

<u>ROM CODE</u>	<u>LOCATION</u>
M873A-0850	x-1
M873B-0850	x-2
M873C-0850	x-3
M873D-0850	x-4
M873E-0850	x-5
M873F-0850	x-6
M873G-0850	x-7
M873H-0850	x-8



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ROM CODE AND LOCATION CHART
Domestic Rom/Ram Board
PC A082-91364-A000

PROGRAM NUMBER TWO

ROM CODE	LOCATION
873-109AXR-AXSD	x-1
873-109AXR-BXSD	x-3
873-109AXR-CXSD	x-5
873-109AXR-DXSD	x-7
873-109AXR-EXSD	x-11
873-109AXR-FXSD	x-13
873-109AXR-GXSD	x-15
873-109AXR-HXSD	x-17

Foreign Rom/Ram Board
PC A082-91374-A000

ROM CODE	LOCATION
873-109AXR-AXSD	x-1
873-109AXR-BXSD	x-2
873-109AXR-CXSD	x-3
873-109AXR-DXSD	x-4
873-109AXR-EXSD	x-5
873-109AXR-FXSD	x-6
873-109AXR-GXSD	x-7
873-109AXR-HXSD	x-8

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April 3, 1981

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

GAME: GORF

**SUBJECT: ALLEN KEY 1/8" TAMPER PROOF WRENCH
(0017-00009-0484)**

The operator can not service the control grip without this special wrench.

Enclosed, please find a spare tamper proof wrench.

**ANDY DUCAY
SERVICE MANAGER**

AD/pc

Bally

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September 16, 1981

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

GAME: PAC-MAN, RALLY X AND GALAXIAN

SUBJECT: FREE GAMES HITTING COIN DOOR

MODIFICATION AS FOLLOWS:

1. Remove the capacitor from coin switch or switches.
2. As of 9-10-81 all Pac-Man shipped will have the capacitors removed.
3. When the capacitors are removed, check for proper coin switch wire adjustment to prevent loss of coins.

Andy Ducay
Service Manager

AD/dd

Bally

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March 30, 1981

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

GAME: PAC-MAN, RALLY X, & GORF

SUBJECT: ANTI-STATIC CLEANER APPLICATION

When a game has a plexiglas front glass and or tinted Plexiglas T.V. tube overlay, anti-static cleaner must be used.

When using any anti-static cleaner, both surfaces of the Plexiglas must be sprayed and cleaned individually. Also, as a new policy, we will be using this same anti-static cleaner to clean the C.R.T. This is most important since this is the prime source of static discharge.

In the past we have been using a anti-static cleaner called K-Lux. We will continue using this product until the stock has been depleted. We will then begin using a new product called Merix Anti-Static No. 79 Concentrate (0017-00008-0091). This concentrate must be diluted 1:10 - 1 part concentrate; 10 parts H₂O.

Please read caution label before using.

ANDY DUCAY
SERVICE MANAGER

AD/pc

Bally

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April 9, 1981

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

GAME: PAC-MAN, RALLY X & GORF

SUBJECT: NEW BACK DOOR, #350 & #1355 KEYS

Some Pac-Man, Rally X & Gorf will have the new Illinois locks with #350 keys.

Extra Illinois locks with #350 keys can now be ordered from our parts department.

All operators must order locks and keys from their local distributor.

ANDY DUCAY
SERVICE MANAGER

AD/pc

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March 30, 1981

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

GAME: PAC-MAN (UPRIGHT & MINI)
SUBJECT: CREDIT MULTIPLIER
 BYPASS JACK PC# A080-9109-A000

The credit unit bypass jack is not needed when a credit multiplier unit is used.
PC# A082-01348-C000.

The credit multiplier is for foreign games, for additional credits.

When the credit multiplier is missing the coin jack must be inserted to the
credit bypass jack for proper coin operation.

ANDY DUCAY
SERVICE MANAGER

AD/pc

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May 15, 1981

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

GAME: PAC-MAN & RALLY X

SUBJECT: BRIGHTNESS ADJUSTMENT
 WELLS GARDNER COLOR MONITOR (K4604 - 4)

1. To set the brightness level on a Wells Gardner Color Monitor, use the Black Level Control located on the interface PC Board.
2. Location of the Black Level Control can be found by following the logic board video cable which will be connected to the Interface PC Board.
3. Do not alter the screen control on the neck board, this can distort the picture when used as a brightness control.

ANDY DUCAY
SERVICE MANAGER

AD/dd

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11-13-80

SERVICE BULLETIN

GAME: PAC-MAN

SUBJECT: DIP SWITCH SETTING (7 & 8)

1. Switches 7 & 8 must be in the off position for proper game operation.
2. When switch #7 is on, a test of all racks is possible.
3. When switch #8 is on, the picture will lock up.
4. The above information will be added to all switch setting cards.

Andy Ducay
Service Manager

AD/pr



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January 8, 1981

SERVICE BULLETIN

GAME: PAC-MAN

SUBJECT: ROM-RAM TEST

BAD ROM LOCATION CODE

DISPLAY	LOCATION
M-Rom-0	6E
M-Rom-1	6F
M-Rom-2	6H
M-Rom-3	6J

BAD RAM LOCATION CODE

DISPLAY	LOCATION
Bad V Ram-0	4K
Bad V Ram-1	4N
Bad C Ram-0	4L
Bad C Ram-1	4P
Bad W Ram-0	4M
Bad W Ram-1	4R

ANDY DUCAY
SERVICE MANAGER

AD/pc



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SERVICE BULLETIN

November 19, 1980

GAME: SPACE ZAP, GORF & WIZARD OF WOR

SUBJECT: Card Rack System Test Equipment

To aid board repair the following test cards are available.

1. A Ram Test card to locate a bad Ram. A082-91516-A000.
2. A Card Rack Test card which is used with the Ram Test Card and will also test the pattern card. A082-91517-A000.
3. Order test cards from Midway's Parts Department.

Andy Ducay
Service Manager

AD/dc



MIDWAY MFG. CO.

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Telephone (312) 451-9200



December 11, 1980

SERVICE BULLETIN

GAME: SPACE ENCOUNTERS

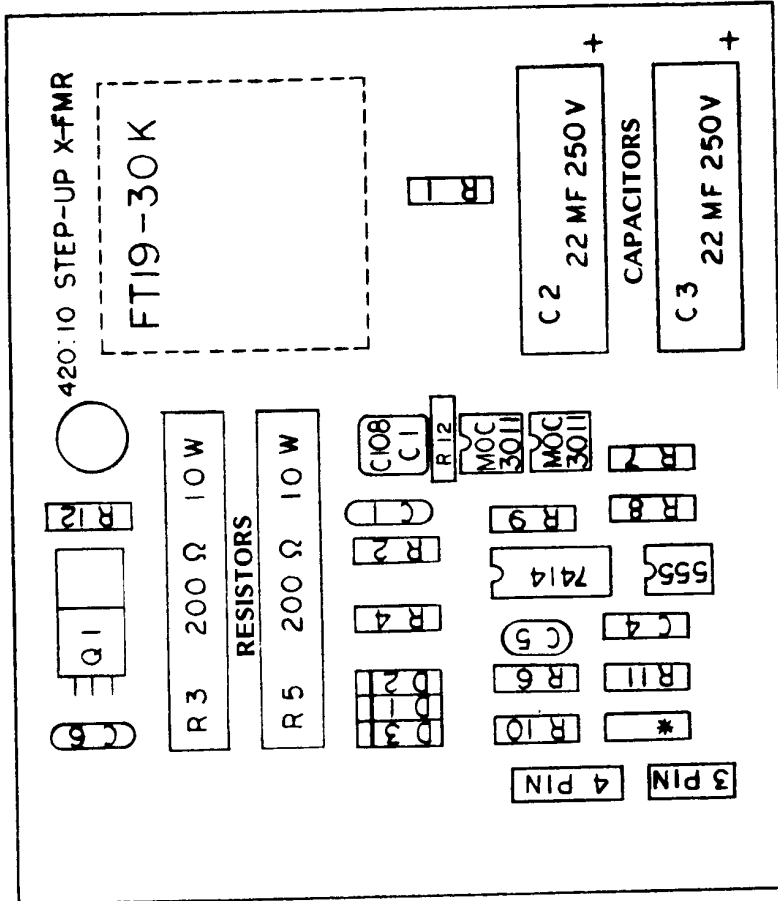
SUBJECT: Strobe unit PC A084-91359-B645
Serial No. 101 to 3700

MODIFICATION: (see figure #1)

1. Change resistor R3 and R5 to one of the following values.
 1. 300 ohms, 20 watts. 10%.
 2. 310 ohms, 20 watts. 10%.
2. Capacitor C-2 and C-3 should be 22MF., 250 V.
3. Check electrically.

ANDY DUCAY
SERVICE MANAGER

FIGURE 1



NOTE

- D 1 2 3 IN 4004
- * .1 MF AX. CER.
- C 1 0.1 MF 200V MYLAR
- C 4 .01 MF AX. CER.
- C 5 .1 MF 100V MYLAR
- C 6 0.01 MF 250V MYLAR
- R 1 1 M
- R 2 10 K
- R 4 180 K
- R 6 820 Ω
- R 7 220 Ω
- R 8 1.6 M
- R 9 1 K
- R 10 330 Ω
- R 11 220 Ω
- R 12 180 Ω
- Q 1 SC141D

REVISIONS	

USED ON SPACE ENCOUNTER		MIDWAY MFG. CO.	
NO. REQ'D 1 PER		FRANKLIN PK. ILL.	
SCALE		PART NO.	
ASSEMBLY DRAWING		A084-91359-B645	
STROBE AND LIGHT P.C.			
DO NOT SCALE DWG.	HEAT TREAT	MAT'L.	FINISH
DIM. TOLERANCES UNLESS SPECIFIED	DRN. <i>CL</i>		
CONCENTRICITY T.I.R.: .003			
FRACTIONAL: 1/64 CKD.			
DECIMAL: .005			
HOLE DIA.: +.002-.000	DATE 7/3/80		

Bally

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October 28, 1980

SERVICE BULLETIN

GAME: Space Encounter Upright and Mini

SUBJECT: GAME BOARD PC A084-90700-645

The upright game board IC located at G-5 (74163) is not needed and the 5 pin connector at F-1 is not used (connector "D").

The mini game board must have an IC located at G-5 (74163) and the monitor interface cable jack at F-1 (connector "D").

Andy Ducay
Service Manager

AD/cm

Bally

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SERVICE BULLETIN

GAME: Space Encounters

SUBJECT: Angle Encoders

1. Due to a shortage of Encoders some games will have 25K pots. (two)
2. For proper operation of pots a A/G converter. PC A082-91377-B000 has been added.
3. The A/G Converter PC is mounted under the control panel.
4. Refer to instruction adjustment for proper pot alignment.

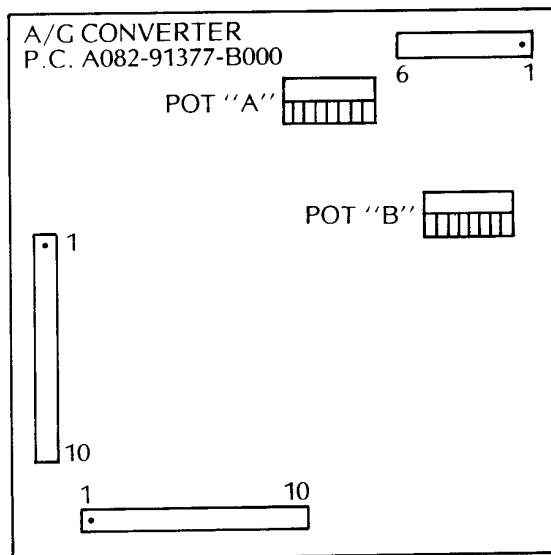
Andy Ducay
Service Manager

AD/dc

SPACE ENCOUNTERS U.R. AND MINI

INSTRUCTIONS TO ADJUST CONTROL PANEL: "B" VERSION

1. Place adjustment switch (5) "OFF" and (6) "ON".
2. Press trigger button, located on steering control to set test mode.
3. On P.C. board A082-91377-B000, rotate Pot A clockwise and Pot B counter-clockwise.
4. Push steering control forward, rotate vertical pot until defense ship is in its' furthest position. Back off pot until ship starts to come back down. Tighten set screw.
5. Put steering control in its' furthest out position. Rotate Pot A until defense ship stops in lower part of viewing area.
6. Put steering control all the way to the left.
7. Turn horizontal pot until defense ship is to the left side of the tunnel.
8. Tighten set screw.
9. Turn control to the right and adjust Pot B until the defense ship reaches the right side of the tunnel.



Bally

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SERVICE BULLETIN

GAME: Space Encounters

SUBJECT: Power Supply PC0080-00904H

Condition:

The power supply +5 voltage may shut down in certain games due to an overload. The 0.18 5 watt resistor tolerance will affect the +5 volts. shut down.

Modification:

1. Replace the 0.18 resistor with another 10% tolerance type (better tolerance).
2. Replace the 0.18 resistor with a 5% tolerance if available.
3. Parallel a 1.5 1 watt resistor across the 0.18 resistor (rear side).
4. Check game electrically.

Note: This power supply overload only occurs in Space Encounters.

Andy Ducay
Service Manager

AD/cm

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April 29, 1980

SERVICE BULLETIN

GAME: GALAXIAN & PAC-MAN

SUBJECT: Static Condition Causing A False
Ram and Rom Test.

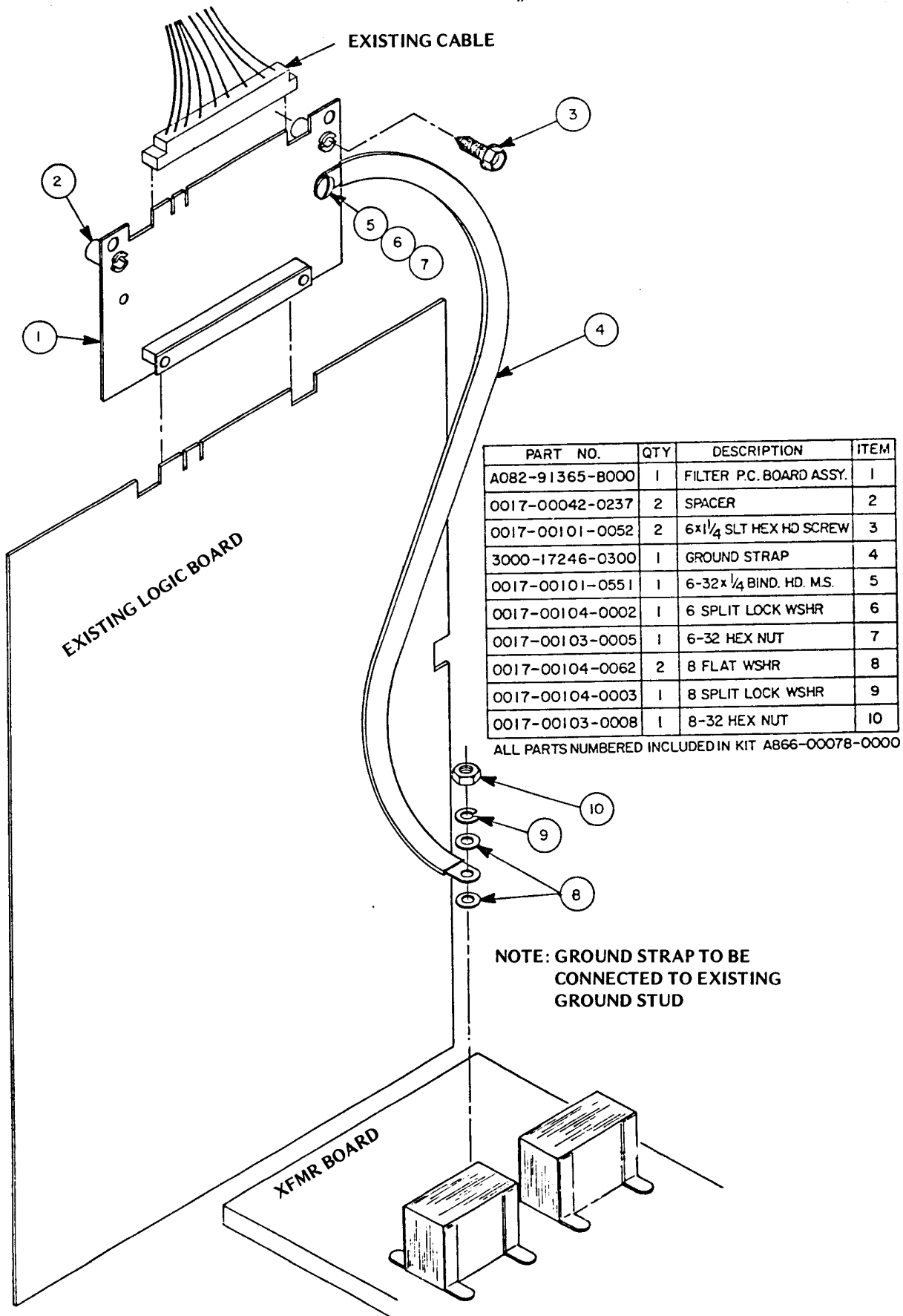
MODIFICATION:

1. Order from the Midway Parts Department an Anti-Static Kit PC A866-00078-0000 and install as shown in instruction diagram. (Fig. #1)
2. Check game out electrically.

Andy Ducay
Service Manager

ANTI-STATIC INSTALLATION INSTRUCTIONS FOR GALAXIAN

FIGURE #1





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February 11, 1980

SERVICE BULLETIN

GAME: Galaxian

GAME BOARD TEST

If game board is good, the following information will be displayed on the screen:

- OK
- Coin Adjustment Setting
- Bonus Adjustment Setting
- No. of Galixip Per Game Setting

RAM/ROM TEST

If any of the Rams or Roms are faulty, the following information will be displayed on the screen:

- "Bad Ram 1" – indicates bad Ram at location 7N or 7P.
- "Bad Ram 2" – indicates bad Ram at location 3F or 3H.
- "Bad Ram 3" – indicates bad Ram at location 4FH or 5FH.
- "Bad Rom" – indicates bad Rom on memory board.

*NOTE: Early models were not equipped with memory boards. In these models, "Bad Rom" indicates bad Rom at location 7F or 7H.

CONTROL PANEL and COIN SWITCH TEST

To verify operation of any switch, close switch in question. If the switch is operating properly, a game sound will emit when closure is made.

CAUTION: Be sure to return test switch to game mode when all tests are completed.

Andy Ducay
Service Manager

AD/jk



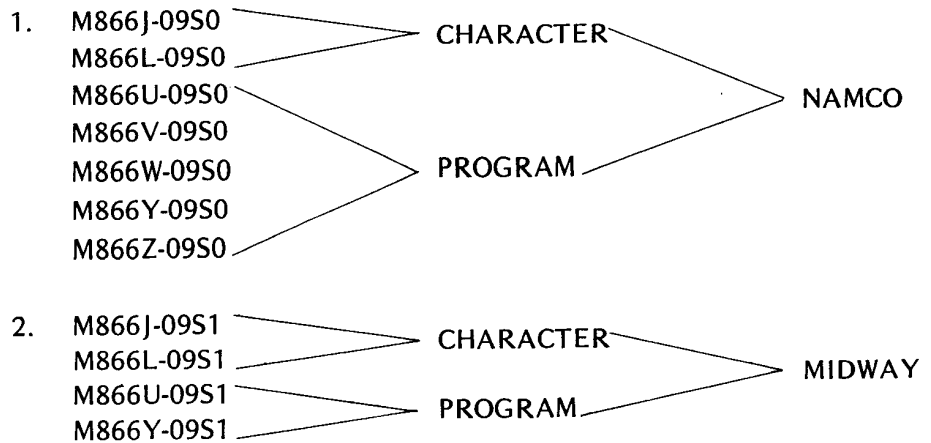
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GALAXIAN LOGIC BOARD
SERVICE BULLETIN

There are two (2) versions of the Galaxian Program. They are:



The Midway Roms and the Namco Roms CHARACTER CANNOT be mixed. It will result in the super-imposing of the names in the attract mode of the game.

However the Midway and Namco Program can be mixed with one exception and that is the locations U & Y. If you use one you'll have to use the other or you'll get a BAD ROM read-out.



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May 6, 1980

SERVICE BULLETIN

GAME: Galaxian (As of Serial No. 11,500)
SUBJECT: Rom program identification (3rd Program)

1. The 3rd program change has new Bonus Values. (see Figure #1).
2. New program identification (Game, Location and Program).
 - M866 - U - 09S2
 - M866 - V - 09S2
 - M866 - W - 09S2
 - M866 - Y - 09S2
 - M866 - Z - 09S2
3. The 1st program version 09S0 and 2nd program version 09S1 can not mix with 3rd program 09S2.
4. The 1st and 2nd program has 2716 Proms and also 2716 Proms mixed with 9316 Roms.
5. If additional clarification is needed please call the service department.
6. New Program Bonus Values are as follows (Figure #1).

	SW. 3	SW. 4
Bonus Galaxip at 7000 pts.	OFF	ON
Bonus Galaxip at 10,000 pts.	ON	OFF
Bonus Galaxip at 12,000 pts.	OFF	ON
Bonus Galaxip at 20,000 pts.	ON	OFF

Andy Ducay
Service Manager



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November 7, 1980

SERVICE BULLETIN

SUBJECT: MONITOR'S MIDWAY GAMES

MANUFACTURE	MODEL NO.	GAME
WELLS GARDNER	19K4500 (19'')	GALAXIAN UPRIGHT
WELLS GARDNER	19K4601 (19'')	GALAXIAN UPRIGHT & COCKTAIL
ELECTROHOME	G02 (25'')	GALAXIAN UPRIGHT
ELECTROHOME	G07-901 & 904	UPRIGHT & COCKTAIL
ELECTROHOME	V-17 (15'')	SPACE ZAP, SPACE ENCOUNTERS MINI
WELLS GARDNER	V1001 (19'')	SOACE ZAP & SPACE ENCOUNTERS
MOTOROLA	M-500 (19'')	SPACE ZAP & SPACE ENCOUNTERS
ELECTROHOME	G07 (13'')	PAC-MAN, GORF & RALLY-X
WELLS GARDNER	(19'') (XY)	OMEGA RACE
ELECTROHOME	G05 (19'') (XY)	OMEGA RACE
ELECTROHOME	G05 (13'')	OMEGA RACE
WELLS GARDNER	19K4900 (19'')	MS. PAC-MAN
WELLS GARDNER	13K4800 (13'')	MS. PAC-MAN

Andy Ducay
Service Manager

AD/dd



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January 12, 1982

SERVICE BULLETIN

GAME: ALL GAMES WITH 19" COLOR MONITORS

SUBJECT: CRT REPLACEMENTS

Reviewing the difference in 19" in-line CRT's with internal degaussing shield versus exterior degaussing shield with CRT manufacturers and with vendors (Electrohome and Wells-Gardner). It was found that the CRT with internal degaussing shield can be used as a replacement in a monitor with an external shield with no need to modify the monitor in any manner.

This being the case, it is recommended that you purchase only 19" in-line color CRT's with internal shields for replacement purposes. This will simplify our stocking requirement as well as reduce possible replacement errors.

Any of the below listed 19" in-line CRT's with internal degaussing shield can be used as a substitute for each other:

19VMNP22	(RCA)
19VMJP22	(Rauland)
510UJB22	(Hitachi)

Any of the above CRT's can also be used as a substitute for below listed CRT's, designed to be used with external degaussing shield:

19VJTP22	(RCA)
19VMBP22	(Rauland)
19VMAP22	(Vendor not known)
MV19VLGP22	(Vendor not known)

Andy Ducay
Service Manager

AD/dd



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SERVICE BULLETIN

GAME: GALAXIAN, PAC-MAN & GORF

SUBJECT: Electrohome 19" Color Monitor

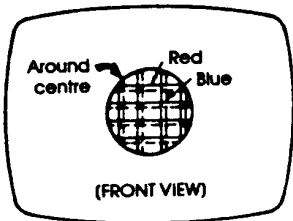
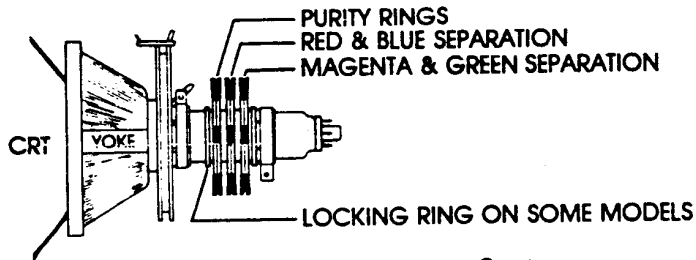
Static convergence (in the center of the monitor) is achieved by manipulating four magnets located on the neck of the CRT nearest the base of the tube. The middle pair of rings adjust the red and blue crosshatch. The rear pair of rings adjusts the blue/red to the green crosshatch lines. Dynamic Convergence is handled by tilting the yoke up, down, left and right, then securing it with wedges. Refer to the game schematic for Diagnostic Tests that generate crosshatch and background colors.

- A. Tilt the yoke up, down, left and right to achieve convergence around the edges. Secure with one temporary wedge.
- B. Rotate the center rings to adjust the red and blue separation.
- C. Rotate the rear rings to adjust the magenta (red-blue) and green separation; when best results are obtained, seal the rings with nail polish.
- D. Remove the temporary wedge from the yoke. Tilt the yoke again to adjust the edges of the screen for minimum separation and insert three new wedges. These should have adhesive added to hold them permanently.

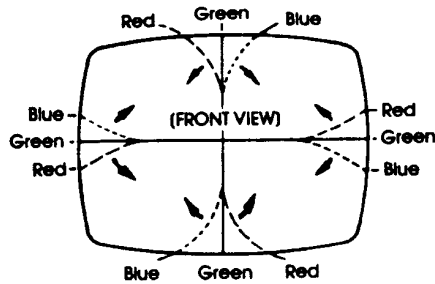
See figure #1.

Andy Ducay
Service Manager

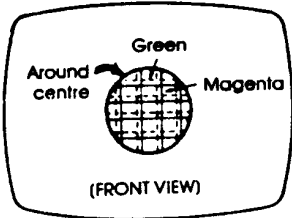
FIGURE 1



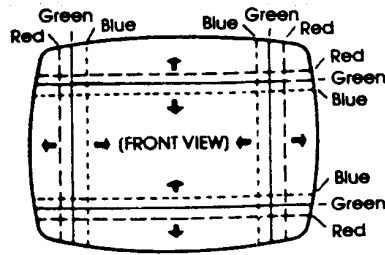
Let the red and blue lines come in line by turning two 4-pole magnets.



Tilting the yoke upward will move the lines as shown with the arrows.



Let the green and magenta lines come in line by turning two 6-pole magnets.



Tilting the yoke to the right will move the lines as shown with the arrows.

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SERVICE BULLETIN

GAME: GALAXIAN

1. Proper video cable wire sequence for interface PC, Wells Gardner color monitor 19K4500. (See Figure #1)

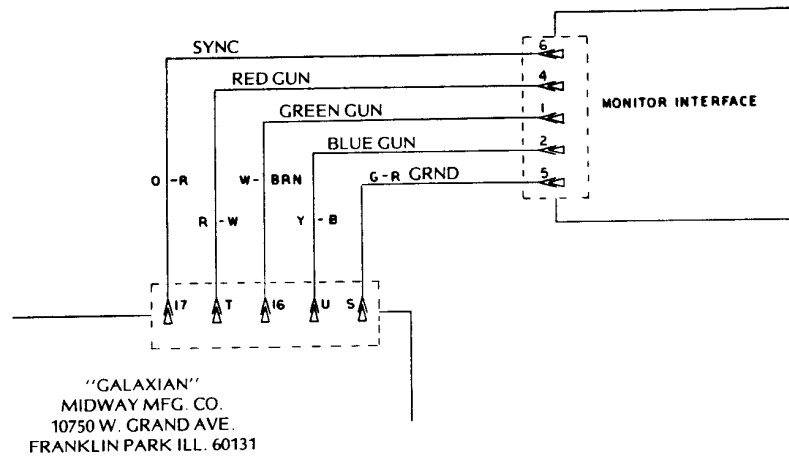


Figure #1

NOTE: The 19K4500 is used only in upright games.

2. Proper video cable wire sequence for interface PC, Wells Gardner color monitor 19K4601. (Upright) (See Figure #2).

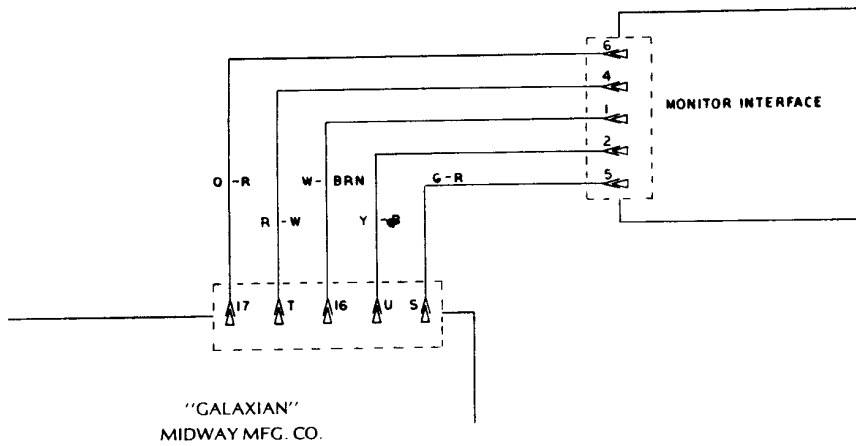
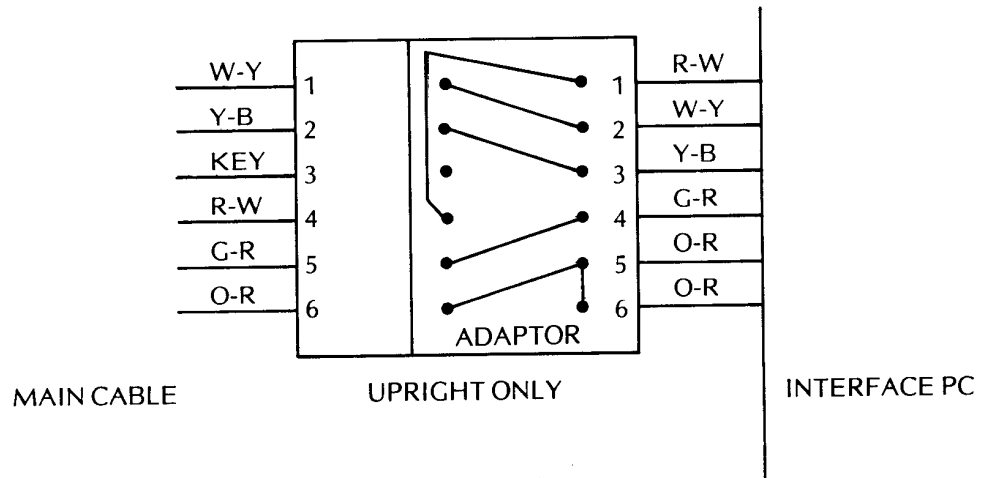


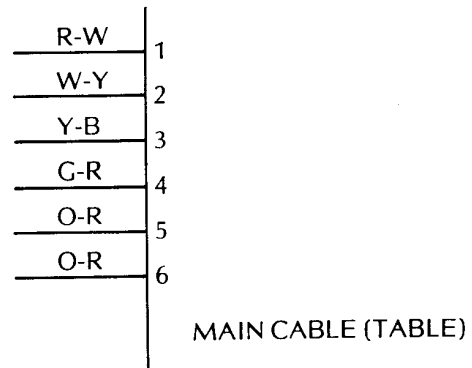
Figure #2

NOTE: The cocktail table main cable is wired for the Electrohome monitor and must be altered when installing a Wells Gardner monitor. (Same wire sequence as above).

3. Proper video cable wire sequence for interface PC, Electrohome 19'' color monitor G07 - 901 & 905 (upright & cocktail table). (See Figure #3)



- NOTE: 1. The adaptor Jack PC A080 - 91106 is used in upright games for proper wire sequence.
2. The cocktail table wire sequence if for the Electrohome Monitor.



- Proper video cable wire sequence for interface PC, Electrohome color monitor. G02- 25 inch (upright). (See Figure #4)

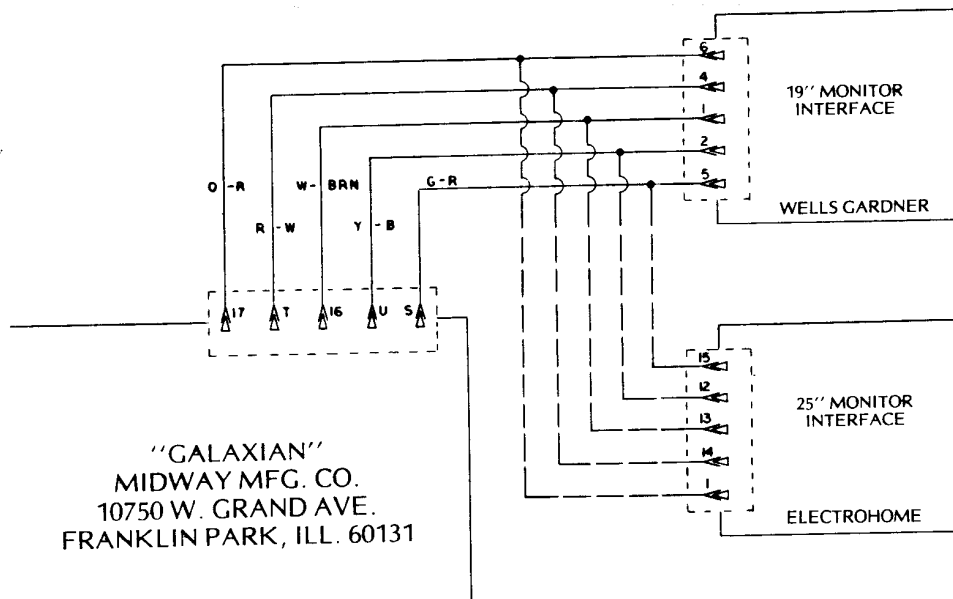


Figure #4

NOTE: Due to cable changes and other modifications the 25 inch color monitor must be used.

5. Proper video cable wire sequence for interface PC, Electrohome color monitor G07 CB0 - 904. (upright & cocktail table). (See Figure #5)

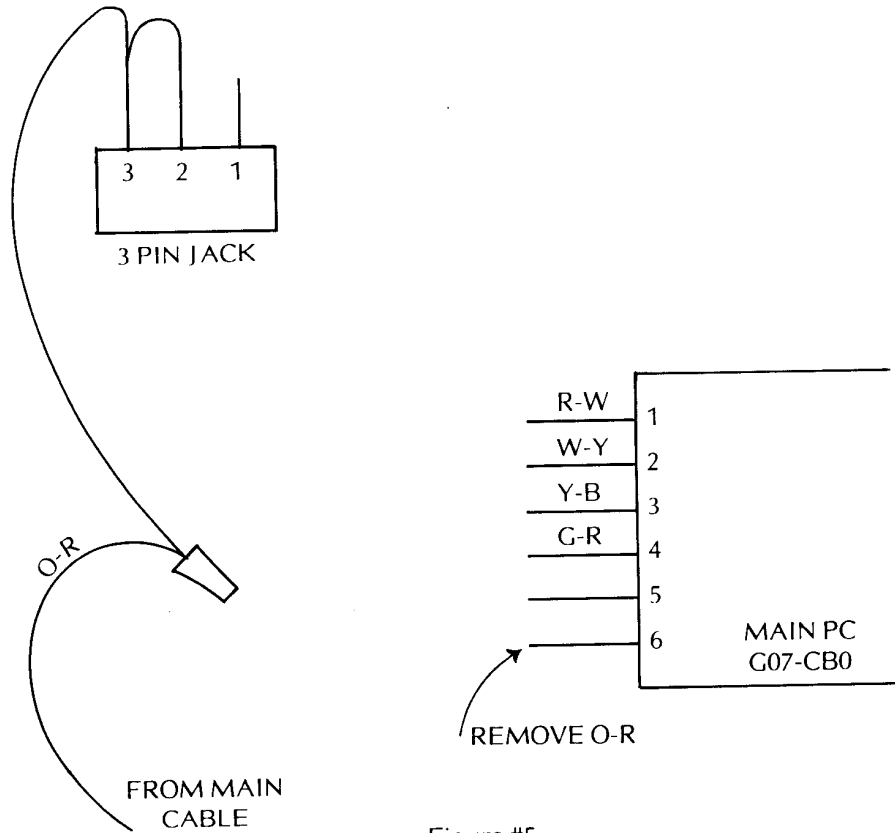


Figure #5

- NOTE:
1. The adaptor jack PCA080 - 91106 is used to eliminate wire changes in upright games.
 2. Not used in cocktail table games. (PCA080 - 91106).
 3. The orange - red must go to 3 pin jack as shown.

Andy Ducay
Service Manager

AD/dc



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SERVICE BULLETIN

GAME: PAC-MAN, GORF AND RALLY-X

1. PROPER VIDEO CABLE WIRE SEQUENCE FOR WELLS GARDNER COLOR MONITOR 19K4606
SEE FIGURE #1

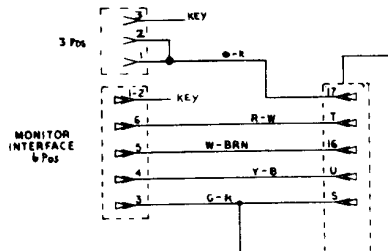


FIGURE #1

NOTE: PAC-MAN, GORF AND RALLY-X UPRIGHT GAMES CAN USE 19" ELECTROHOME OR WELLS GARDNER COLOR MONITORS.

MINI GAMES CAN USE THE G07-13 ELECTROHOME COLOR MONITOR.

ANDY DUCAY
SERVICE MANAGER



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SERVICE BULLETIN

GAME: PAC-MAN, GORF AND RALLY-X

1. PROPER VIDEO CABLE WIRE SEQUENCE FOR ELECTROHOME 19" COLOR MONITOR G07-CB0

SEE FIGURE #1

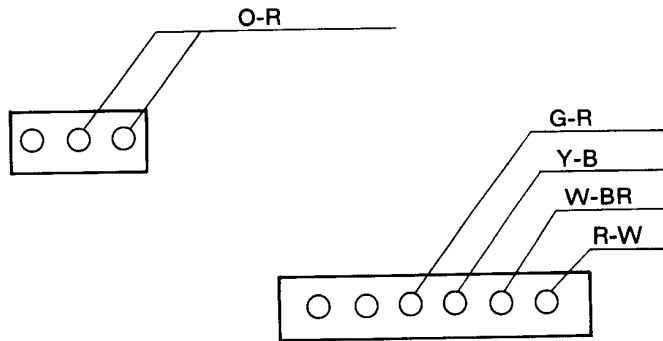


FIGURE #1

NOTE: PAC-MAN, GORF AND RALLY-X COCKTAIL TABLES USE ONLY ELECTROHOME MONITORS G07-CB0.

ANDY DUCAY
SERVICE MANAGER

Bally

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April 14, 1980

SERVICE BULLETIN

GAME: Galaxian

SUBJECT: Wells Gardner 19 inch Color Monitor

The four controls contrast, brightness, color and tint are not used. These controls are located in the upper right side of the monitor panel.

The brightness control is located on the interface P.C. Board. (85-X0134-001)

Andy Ducay
Service Manager

Bally

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May 6, 1982

SERVICE BULLETIN

GAMES: MS. PAC-MAN, KICKMAN & GALAGA

SUBJECT: WELLS-GARDNER COLOR MONITOR (19K4900 & 13K4800).

CONDITION

Loss of vertical deflection (white line down center of screen).

REMEDY

Check C313 (47/160V) capacitor for loose solder connection.

Kevin Moeller
Service Technician

KM/dd

Bally

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May 16, 1980

SERVICE BULLETIN

GAME: SPACE INVADERS DELUXE

SUBJECT: PROMS AND ROMS

1. Due to a supply problem the Invader program may be all 2716 Proms or all 9316 Roms.
2. On occasion the Invader program will be a mixture 2716 Proms (single supply) and 9316 Roms. The 2716 Proms will have pin #21 cut with a jumper wire between pin #21 and pin #24.
3. When all 2716 Proms are single supply type the Mother Board Strapping is different from 9316 and 2716 multiple type.

Andy Ducay
Service Manager

AD/dc



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February 13, 1980

SERVICE BULLETIN

GAME: Space Invaders

CONDITION: Garbage Lines In Video and Extra Credit

POSSIBLE REMEDY

1. Check game board for proper RRC capacitor grounding. (P.C. A804-90700-D739).
2. Clean game board edge connector and inspect Mother board 72 pin connector.
3. Measure +5, +12 and -5 voltages at edge connector of Mother board. Adjust voltages using pots on Power Supply.
4. Replace possible heat sensitive TI-8080 CPU with 7919 date code.
5. Add a Cor-Com line filter. (0017-00003-0114)
6. Inspect soldering of bit shifters on game board. (25S10 or 74151)

Andy Ducay
Service Manager

AD:jk



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May 14, 1979

SERVICE BULLETIN

GAME: Space Invaders Upright and
Cocktail Table

SUBJECT: Dip Switch Settings, Game Logic
Board (PC-A084-90700-739)

1. Upright Games
 - A. Switches 5, 6, 7 and 8 must be in on position.
2. Cocktail Table
 - A. Switches 5, 6, 7 and 8 must be in off position.

Andy Ducay
Service Manager

AD:jk



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SERVICE BULLETIN

GAME: SEA WOLF II, EXTRA BASES, SPACE ZAP, GORF & WIZARD

SUBJECT: Custom chip identification (I/O, Address, and Data)

The following numbers will identify the special custom chips used in Seawolf II mother board (PC 084-90002-B-625):

I/O2720 or 0066-117XX

Address2719 or 0066-115XX

Data 2721 or 0066-116XX or 2860

Andrew Ducay
Service Manager

AD/r
07/10/79

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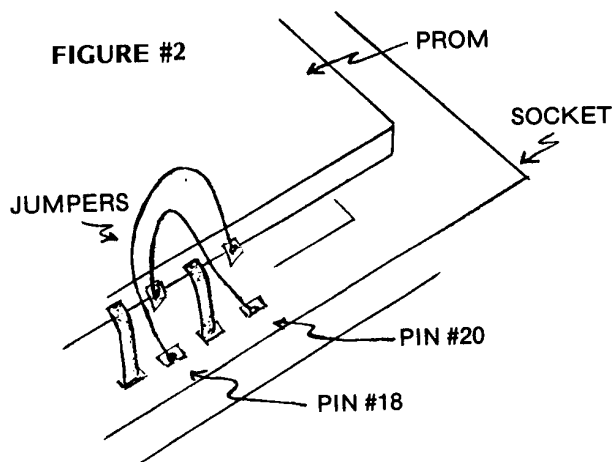


October 13, 1980

SERVICE BULLETIN

GAME: SEA WOLF I. 280Z. GUIDED MISSILE, LAGUNA RACER
SUBJECT: 8516 & 2716 Prom Strapping Information (16K)

1. Refer to figure #1 for proper strapping of jumpers and capacitor removing or relocating.
2. Cut pins #18 and #20 of each prom and jumper as shown in figure #2.
3. Check electrically.



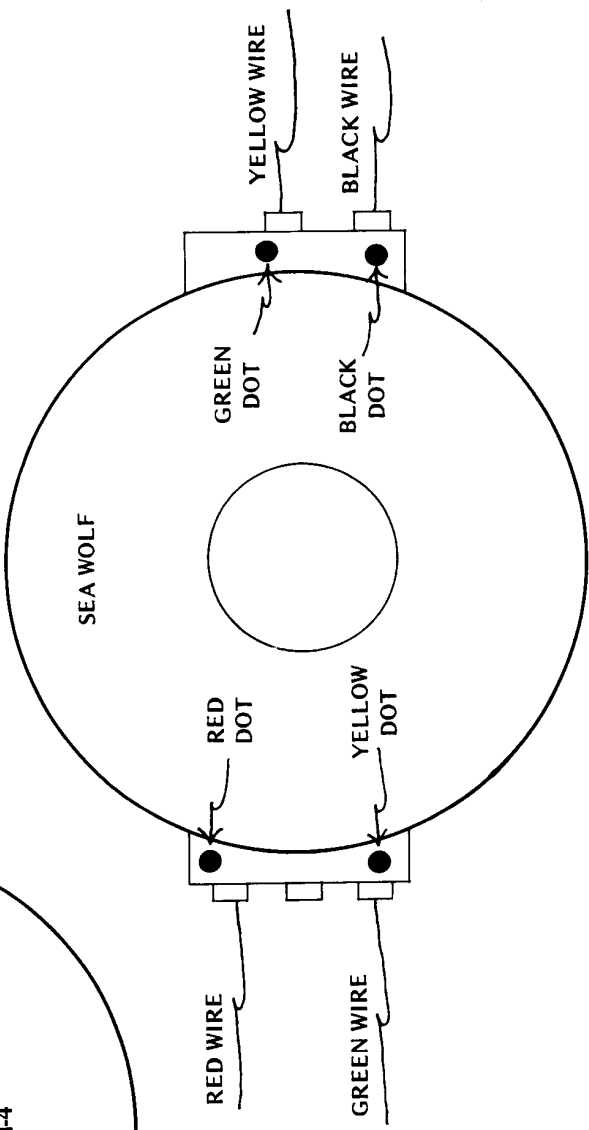
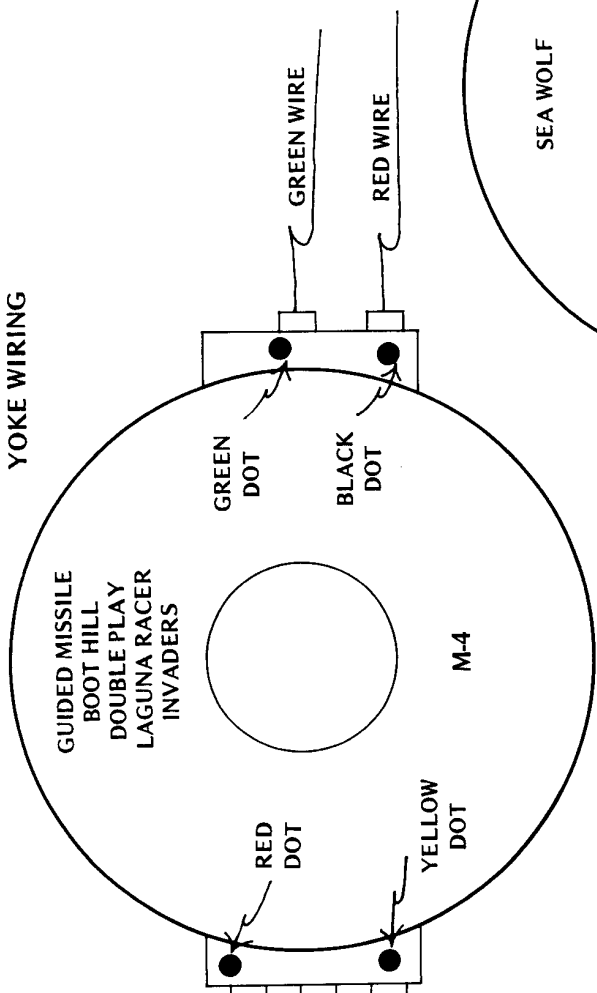
Andy Ducay
Service Manager

REVERSE PIN #18 & 20 AS SHOWN

MOTOROLA MONITOR M 7000-155

YOKE WIRING

NOTE!
 NO CHANGE
 GUN FIGHT
 CHECK MATE
 CLOWNS
 ALL TABLES

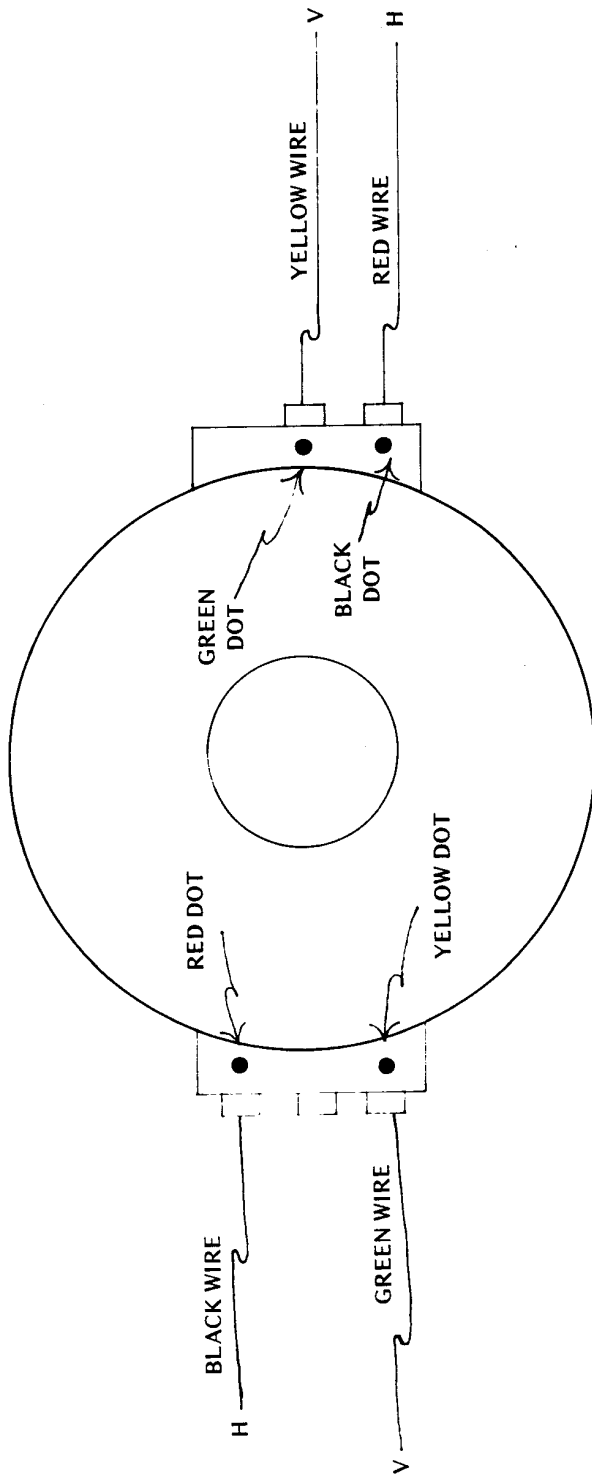


NOTE
 USE SAME WIRE
 SEQUENCE FOR
 ALL TYPE YOKES
 USED IN M 7000-155
 MONITORS.

H
 V

MOTOROLA MONITOR M 7000-155

YOKE WIRING



NOTE
USE SAME WIRE
SEQUENCE FOR
ALL TYPE YOKES
USE IN M 7000-155
MONITORS.

ROAD RUNNER
DESERT GUN

Bally

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MONITOR MANUFACTURERS

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Telephone: (312) 231-4400

Chris Petri, Product Service Manager

WELLS GARDNER ELECTRONICS CORP.
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Telephone: (312) 252-8220

Harry McComb, Service

ELECTROHOME LIMITED
809 Wellington St. N.
Kitchener, Ont. N2G 4J6

Telephone: (519) 744-7111

Tom Van Gink, Program Co-Ordinator

Glossary of Computer Terms

Silicon Valley - The region around Sunnyvale, California (south of San Francisco) is known as the birthplace and present capital of the microprocessor. Fairchild Instrument is considered as the pioneer company in this area with most of their engineers leaving and branching out to form competing companies such as Intel and Zilog.

Hardware - The physical components of a system. i.e. transistors, capacitors, microprocessor, data chip, input-output chip, address chip.

Software - Can be best defined as the program, whether it be resident permanently as a fixed set of instructions as in ROM or input as data by the user.

Bit - A word is one logical unit of information consisting of 4, 8, 12 or 16 bit (a bit is a binary digit, either 1 or 0, high or low). An 8 bit microprocessor requires 8 bits of data and the word size for an 8 bit microprocessor is therefore 8 bits.

Byte - Eight bits are called a byte.

Memory - That part of a system which is used to store both the programs which will execute on the processor, and the data which will be manipulated by the system.

ROM - Read Only Memory is a device that has data permanently entered into it to be output on demand, a fixed set of instructions.

RAM - Random Access Memory is a type of memory in which any byte can be accessed (that is, written into or read from) after any other byte. The random access capability of RAM makes it easier to use, and allows much faster operation.

Address - The position or location of the word within the memory is called its address.

LSI technology - Large Scale Integration technology allows the implementing of 1 to 15,000 transistors on a single chip.

CPU - The CPU (central processing unit) is basically a microprocessor. The CPU is divided into two units, the ALU (arithmetic logical unit) and the CU (control unit). The function of the ALU is to perform arithmetic and logical operations on data passing through it. The CU will sequence the operation of the entire system. The control unit fetches, decodes and executes successive instructions stored in the memory system.

Microprocessor - An LSI component which implements the functions of an arithmetic-logical-unit plus its associated control unit in a single chip.

Register - A fundamental unit inside a microprocessor which is a specialized memory. It can be thought of as a blackboard where data is written so it can be easily accessed and changed. Registers usually contain the data the processor is currently working on. Generally, microprocessors with more registers are more powerful and easier to program to do a given job.

Intel 8080 - First off-shoot of the 8008. This machine inspired the development of most microprocessors today, such as the Motorola 6800, Rockwell PPS8, Signetics 2650, and the Zilog Z-80. The 8080 is a general purpose middle of the road microprocessor. Its instruction set and other characteristics are good examples of microprocessors in general, being neither extremely simplified, nor extremely powerful, nor particularly unusual.

Motorola 6800 - A machine that was introduced as direct competition to the Intel 8080. The 6800 has two apparent advantages to the 8080, it requires only one voltage level to operate as compared to the three needed by the 8080, hence a more simplified power supply is needed. Secondly, the 6800 has an additional two pins.

F-8 (by Fairchild) - This microprocessor is designed for specialized applications where the microprocessor is permanently incorporated as part of a specific piece of equipment unrelated to computing. This microprocessor is known for the large amount of supporting circuitry and devices it needs for operation.

Zilog - Designers of the Z-80. This microprocessor was developed by many of the men who designed the Intel 8080. This device is probably the first case where experienced microprocessor designers, after having seen the results of their work used in practical applications, designed a new general purpose microprocessor.

The Z-80 executes 158 different instructions, which increase to 696 operation codes, compared to 78 instructions and 244 operation codes for the 8080A (the first version of the 8080).