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Galaxian

INSERT COIN.

SELECT ONE OR TWO PLAYERS.

CONTROL LEVER MOVES DEFENSE SHIP RIGHT OR LEFT.

TO FIRE MISSILE, PRESS BUTTON.

ATTACKING ALIEN SHIPS SCORE HIGHER THAN SHIPS IN CONVOY.

SCORING



IN CONVOY	30	40	50	60
IN ATTACK	60	80	100	300

INSTRUCTIONS

INSERT COIN.

SELECT ONE OR TWO PLAYERS.

CONTROL LEVER MOVES DEFENSE SHIP RIGHT OR LEFT.

TO FIRE MISSILE, PRESS BUTTON.

ATTACKING ALIEN SHIPS SCORE HIGHER THAN SHIPS IN CONVOY.

SCORING

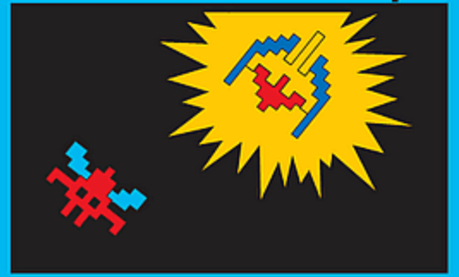


IN CONYOY:	30	40	50	60
ATTACKING:	60	80	100	?

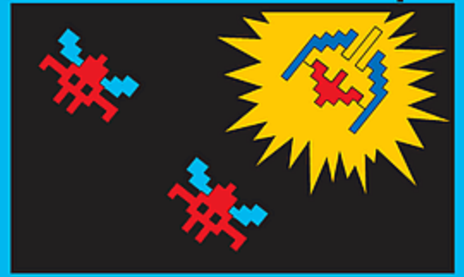
FLAGSHIP ATTACK 150 pts.



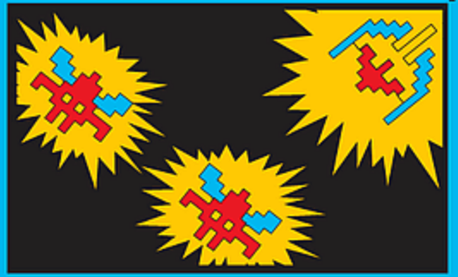
WITH 1 ESCORT 200 pts.



WITH 2 ESCORTS 300 pts.



WITH FLAGSHIP LAST 800 pts.



GAME NO. 866
FEBRUARY, 1980

MIDWAY'S

Galaxian

PARTS AND OPERATING MANUAL



MIDWAY MFG. CO.
A BALLY COMPANY
10750 WEST GRAND AVENUE
FRANKLIN PARK, ILLINOIS 60131
U.S.A.

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WARNING

THIS GAME MUST BE GROUNDED. FAILURE TO DO SO MAY RESULT IN DESTRUCTION TO ELECTRONIC COMPONENTS.

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GENERAL INSTRUCTIONS FOR "GALAXIAN"

INSTALLATION

1. Remove shipping cleats located on bottom of cabinet.
2. Install four (4) provided leg levelers to bottom of cabinet and level cabinet.
3. The power is controlled by a switch located on top of the cabinet. Additional taps have been provided on the transformer to compensate for fluctuating line voltage

LINE VOLTAGE SAFETY SWITCH

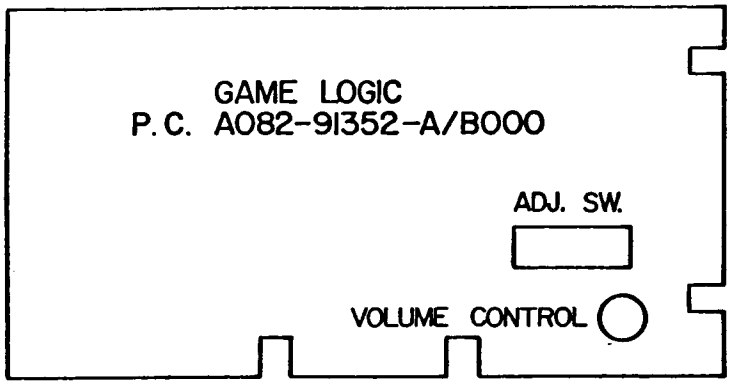
A line voltage safety switch has been provided for your protection. It is located on the right rear side of the cabinet in the back door area. When the back door is removed, it opens the circuit to the line voltage. To restore power (when servicing), pull switch fully out.

VOLUME CONTROL

The volume control pot is located on the Game Logic Board (P.C. A082-91352-A000). This pot controls the volume of all sounds and may be varied as desired by rotating pot control.

ADJUSTMENT SWITCHES

Located on Game Logic Board (P.C. A082-91352-A000) and may be adjusted as indicated on separate instruction card in back box area.



TO REMOVE CONTROL PANEL AND MONITOR DISPLAY GLASS

1. Open coin door.
2. Release two (2) clamps located below Control Panel on each side of cabinet.
3. Disconnect control panel jack.
4. Remove control panel.
5. Remove monitor display glass.

CREDIT PUSH BUTTON SWITCH

Located in cash box area and is readily accessible by opening coin door. This switch is provided as a test aid and awards one credit without advancing coin meter.

TEST SLIDE SWITCH

Located in cash box area and is readily accessible by opening coin door. When placed in "on" position this switch initiates test mode.

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 Galaxip 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 Ram" – 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.

M051-00866-A012

MONITOR ADJUSTMENTS

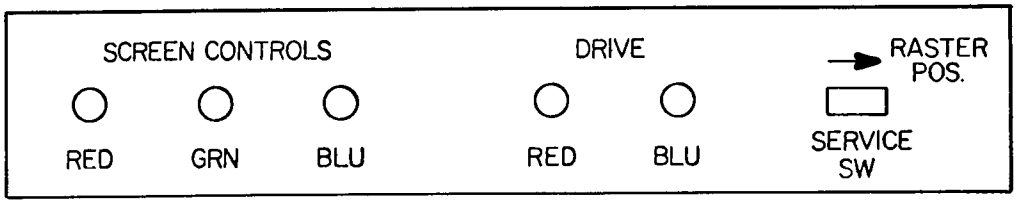
Degaussing:

All monitors are equipped with an automatic degaussing circuit which effecitvely demagnetizes the picture tube each time the monitor is turned on. The degaussing circuit will operate automatically each time the game is turned on after having been off for at least five (5) minutes. The degaussing is confined to the picture tube since the coils are mounted on the ferrous tube shield. Should any part of the chassis of cabinet become magnetized, it will be necessary to degauss the affected area by means of a manual degaussing coil. Move the coil slowly around the parts to be demagnetized, then slowly withdraw the degaussing coil for a distance of six (6) feet before disconnecting the coil from the A.C. power supply.

Purity Adjustments:

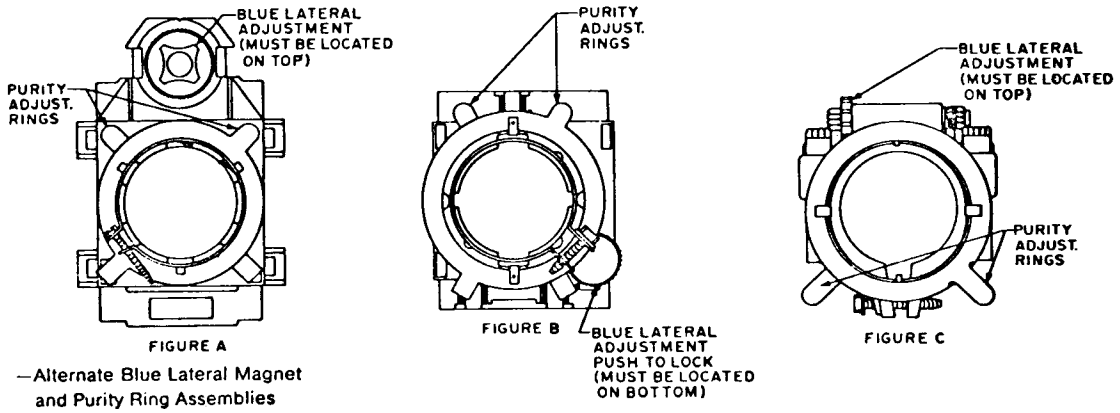
If degaussing fails to improve bad color, check for purity as follows. Position monitor to be facing

either north or south. Purity adjustments are most accurate while observing RED FIELD ONLY. Remove the interface printed circuit connector at the monitor. Turn BLUE and GREEN screen controls (shown below) fully counterclockwise.



To obtain RED field, place service switch in RASTER position. Next, adjust the RED screen control to sufficient brightness to observe purity.

Loosen the yoke and slide the yoke back against the convergence coils assembly. Adjust for a uniform RED area in the center of the screen by spreading or rotating the purity magnet assembly located on the BLUE lateral magnet housing assembly.



—Alternate Blue Lateral Magnet and Purity Ring Assemblies

Spreading the tube increases the magnet strength and moves beams in a radial direction. Rotating the purity magnets moves beams in a circular path.

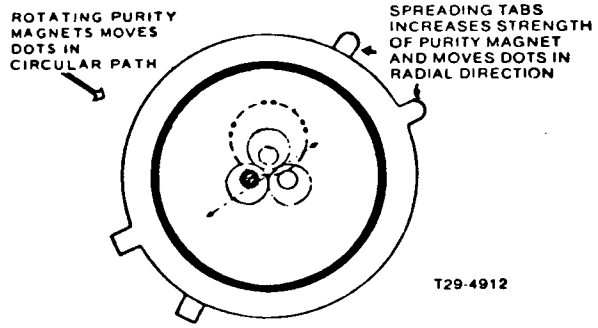


Figure 4.—Center Landing Adjustments

After purity has been attained, slide yoke toward the picture tube bell while observing entire screen. Position yoke for the best overall RED screen and tighten yoke. Preactivate BLUE and GREEN guns and observe all three beams. If the screen is not a uniform white, repeat purity adjustments. Place service switch in NORMAL position and reconnect interface connector at monitor.

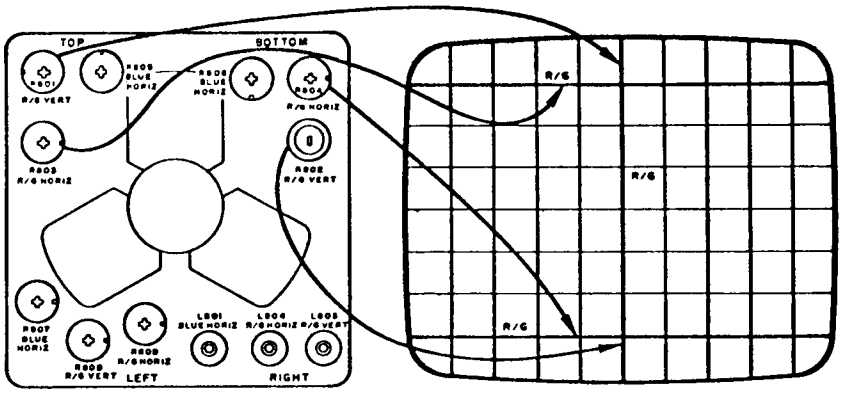
CONVERGENCE ADJUSTMENTS:

Before performing convergence adjustments, the monitor must be preheated for at least five (5) minutes. The convergence service switch is located to the right of the cash box and is accessed by opening coin door. Turn this switch momentarily "ON" then "OFF". When the crosshatch pattern appears on the screen, turn the service switch back to the "ON" position. The crosshatch pattern will now remain on the screen.

Converge the monitor as follows:

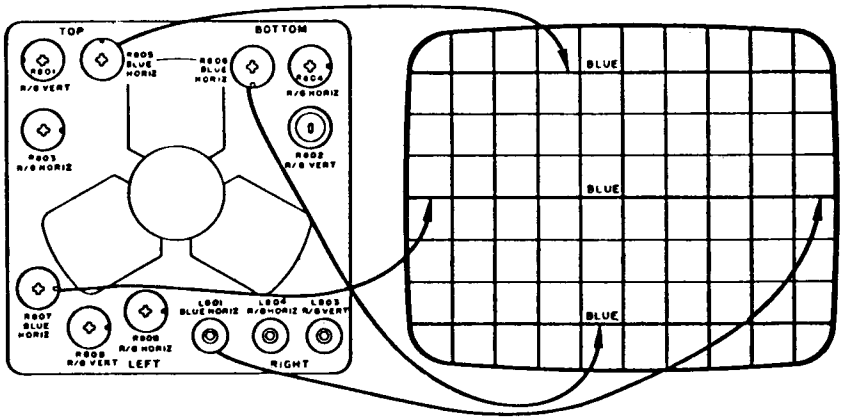
CONVERGENCE

1. Use either crosshatch or dot pattern for center convergence.
2. Converge center of screen with red, green and blue magnet and the blue lateral magnet.
3. Adjust R801 and R802 for convergence (parallelism) of R/G vertical center line.
4. Readjust center convergence if necessary.
5. Adjust R804 to converge bottom R/G horizontal lines and R803 to converge top R/G horizontal lines at center line of screen.
6. Adjust R807 and L801 for straight horizontal blue center line.
7. Adjust R806 and R805 for uniform displacement of blue horizontal lines along center vertical lines.
8. Converge blue horizontal lines with R/G horizontal lines by adjusting the blue convergence magnet. Adjust red and green magnets if necessary.
9. Repeat steps 6 through 8 if necessary.
10. Adjust alternately L803 and R809 for right and left side convergence of R/G vertical lines.
11. Adjust alternately L804 and R808 for convergence of R/G horizontal center line.
12. Converge center of screen and repeat steps 10 and 11 if necessary.
13. Minor touch-up adjustments may be made using the appropriate controls.



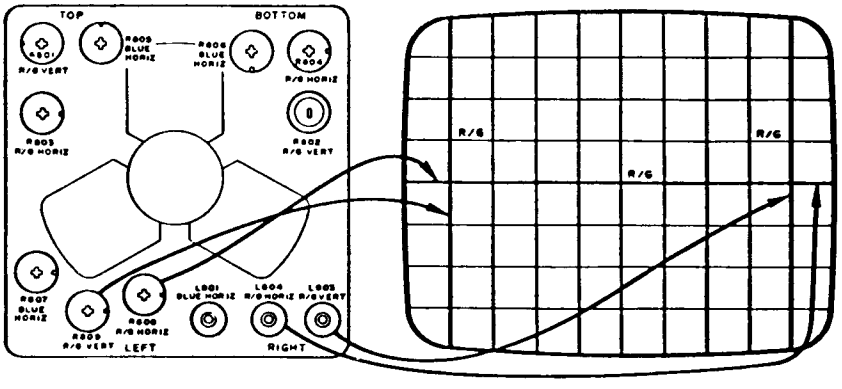
STEPS 3 AND 5 ADJUSTMENTS

Figure 8.—Effect of R801, R804, R803 and R802 Adjustment



STEPS 6 AND 7 ADJUSTMENTS

Figure 9.—Effect of R807, L801, R806 and R805 Adjustment



STEPS 10 AND 11 ADJUSTMENTS

Figure 10.—Effect of L803, R809, L804 and R808 Adjustment

When monitor is satisfactorily converged, return service switch to "OFF" position, (game mode).

SWITCH ADJUSTMENTS

PROGRAM NO. 1

METHOD OF PLAY	SW. 1	SW. 2
1 COIN = 1 PLAY	OFF	OFF
2 COINS = 1 PLAY	ON	OFF
1 COIN = 2 PLAYS	OFF	ON
FREE PLAY	ON	ON

BONUS GALAXIP	SW. 3	SW. 4
NO BONUS GALAXIP	OFF	OFF
BONUS GALAXIP AT 4000 PTS.	ON	OFF
BONUS GALAXIP AT 5000 PTS.	OFF	ON
BONUS GALAXIP AT 7000 PTS.	ON	ON

NUMBER OF GALAXIP PER GAME	SW. 5
3 GALAXIP PER GAME	OFF
5 GALAXIP PER GAME	ON

M051-00866-A006

PROGRAM NO. 2

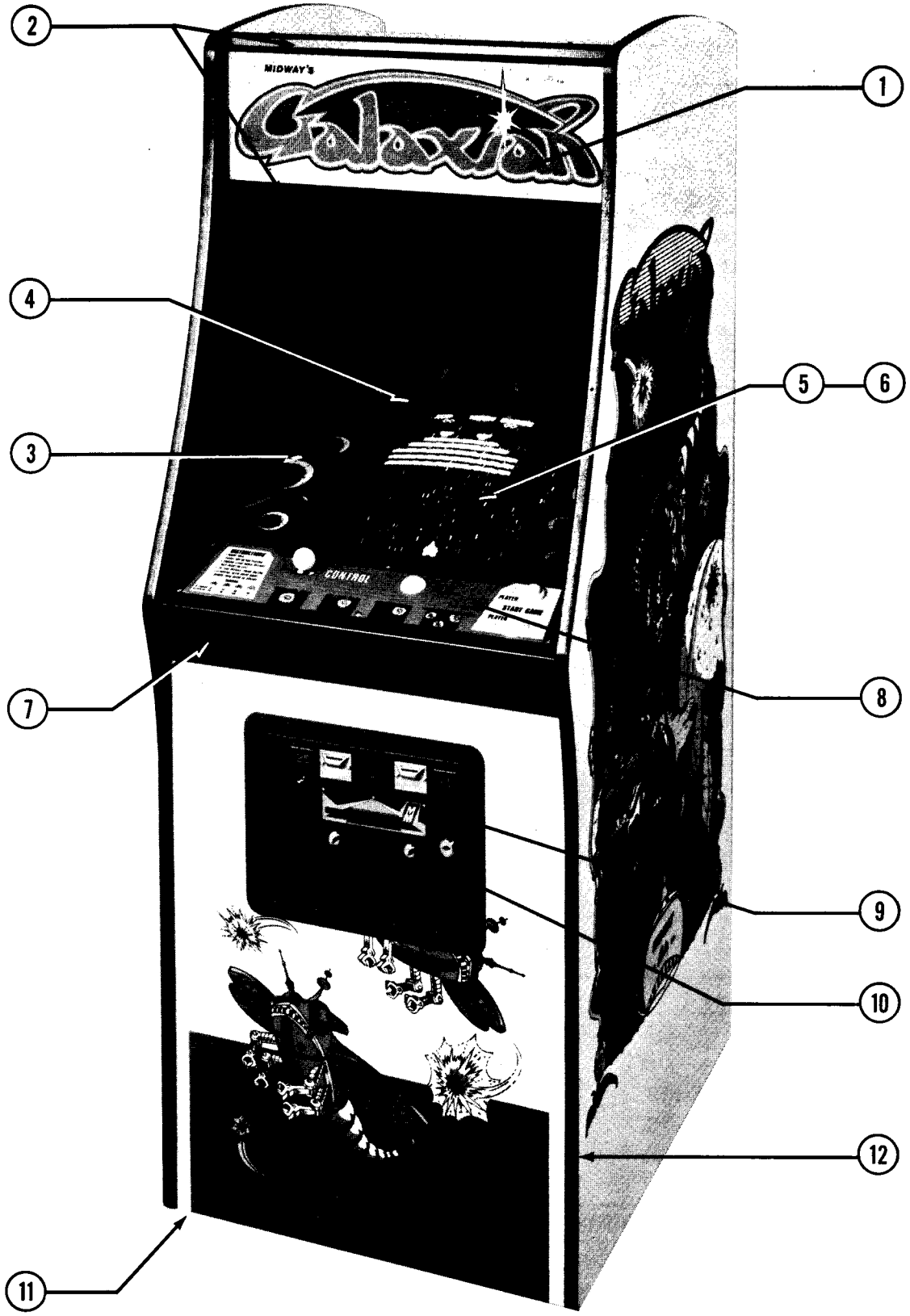
METHOD OF PLAY	SW. 1	SW. 2
1 COIN = 1 PLAY	OFF	OFF
2 COINS = 1 PLAY	ON	OFF
1 COIN = 2 PLAYS	OFF	ON
FREE PLAY	ON	ON

BONUS GALAXIP	SW. 3	SW. 4
NO BONUS GALAXIP	OFF	OFF
BONUS GALAXIP AT 3000 PTS.	ON	OFF
BONUS GALAXIP AT 4000 PTS.	OFF	ON
BONUS GALAXIP AT 5000 PTS.	ON	ON

NUMBER OF GALAXIP PER GAME	SW. 5
2 GALAXIP PER GAME	OFF
3 GALAXIP PER GAME	ON

M051-00866-A005

NO. 866 – GALAXIAN – FRONT PICTURE



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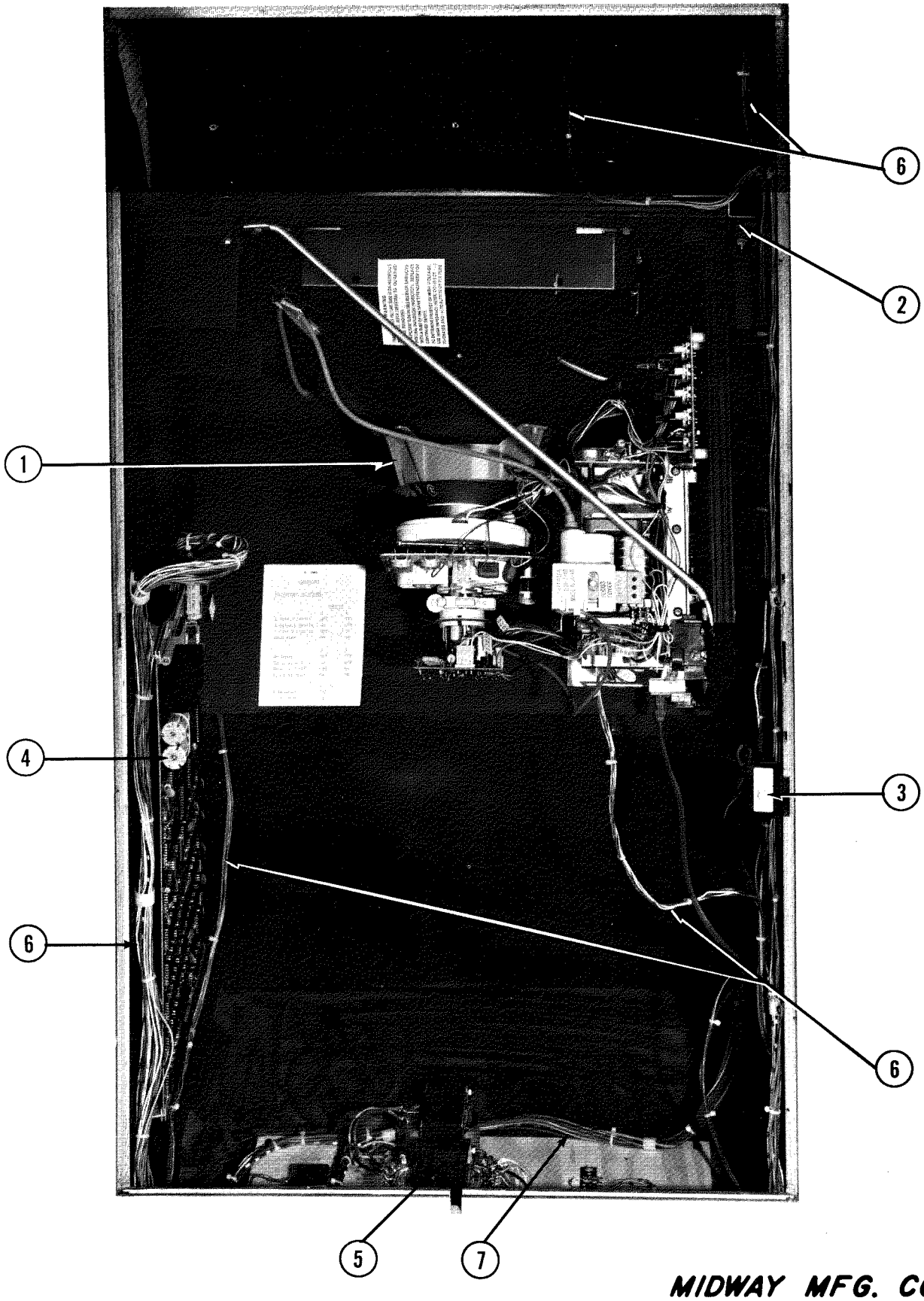
NO. 866 – GALAXIAN – FRONT PICTURE

ORDER BY PART NUMBER ONLY

ITEM	PART Nº	DESCRIPTION
1	0866-00901-0000	UPPER DISPLAY PLEXI - 23" x 9" x 3/16"
2	0866-00103-00XF	PLEXI RETAINING BRKT. (2 REQ'D.)
3	0866-00900-0000	MAIN DISPLAY PLEXI - 2-1/8" x 23" x 3/16"
	M052-00050-0005	SPONGE RUBBER TAPE - 1/4 x 23" LG.
4	0866-00904-0000	T.V. BEZEL
5	0851-00904-0000	DISPLAY PLEXI (SMOKED) - 17-3/8" x 14"
	M052-00090-0001	DOUBLE COATED TAPE - 1/2 x 17" LG.
6	0017-00003-0294	19" COLOR MONITOR - COMPLETE
7	0866-00902-00XF	CONTROL SHELF OVERLAY
	0017-00101-0639	#8 - 32 x 1-1/4 CARRIAGE BOLTS (6 REQ'D.)
	0017-00104-0022	#8 WASHER (6 REQ'D.)
	0017-00103-0061	#8 - 32 HEX NUT W/SEMS. (6 REQ'D.)
	0017-00101-0775	#6 x 1/2 PHIL. PAN HD. SCREW (2 REQ'D.)
8	0866-00903-0000	DECORATIVE CONTROL PANEL
9	A090-00020-2001	DOUBLE ENTRY COIN DOOR ASSY.
	A090-00057-0000	COIN DOOR COUNTER METER ASSY.
10	0090-00002-02GR	COIN DOOR FRAME
	0017-00101-0555	#6 - 32 x 5/16 HEX HD. S.M.S. (3 REQ'D.) (MOUNTS COIN DOOR TO FRAME)
11	0017-00102-0048	LEG LEVELERS (4 REQ'D.)
	0017-00103-0026	LEG LEVELER NUTS (4 REQ'D.)
12	0098-00900-0200	T-MOLDING - GREEN
		NOT SHOWN LIST
	0017-00003-0187	6" x 9" SPEAKER - 8OHM, 9W.
	0017-00009-0393	BLACK SPEAKER GRILL W/4, 1-1/2" SCREWS
	0017-00009-0033	LATCH CLAMP (2 REQ'D.)
	0603-00131-0000	STRIKE (2 REQ'D.)
	0586-00036-0000	ON-OFF SWITCH
	0567-00106-0100	SWITCH MTG. PLATE
	0017-00101-0025	#8 x 1/2 SLOT. HEX HD. WD. SCR. (4 REQ'D.)
	A866-00036-0000	TEST SWITCH & BKT. ASSY.

NO. 866 – GALAXIAN – OPENED BACK PICTURE



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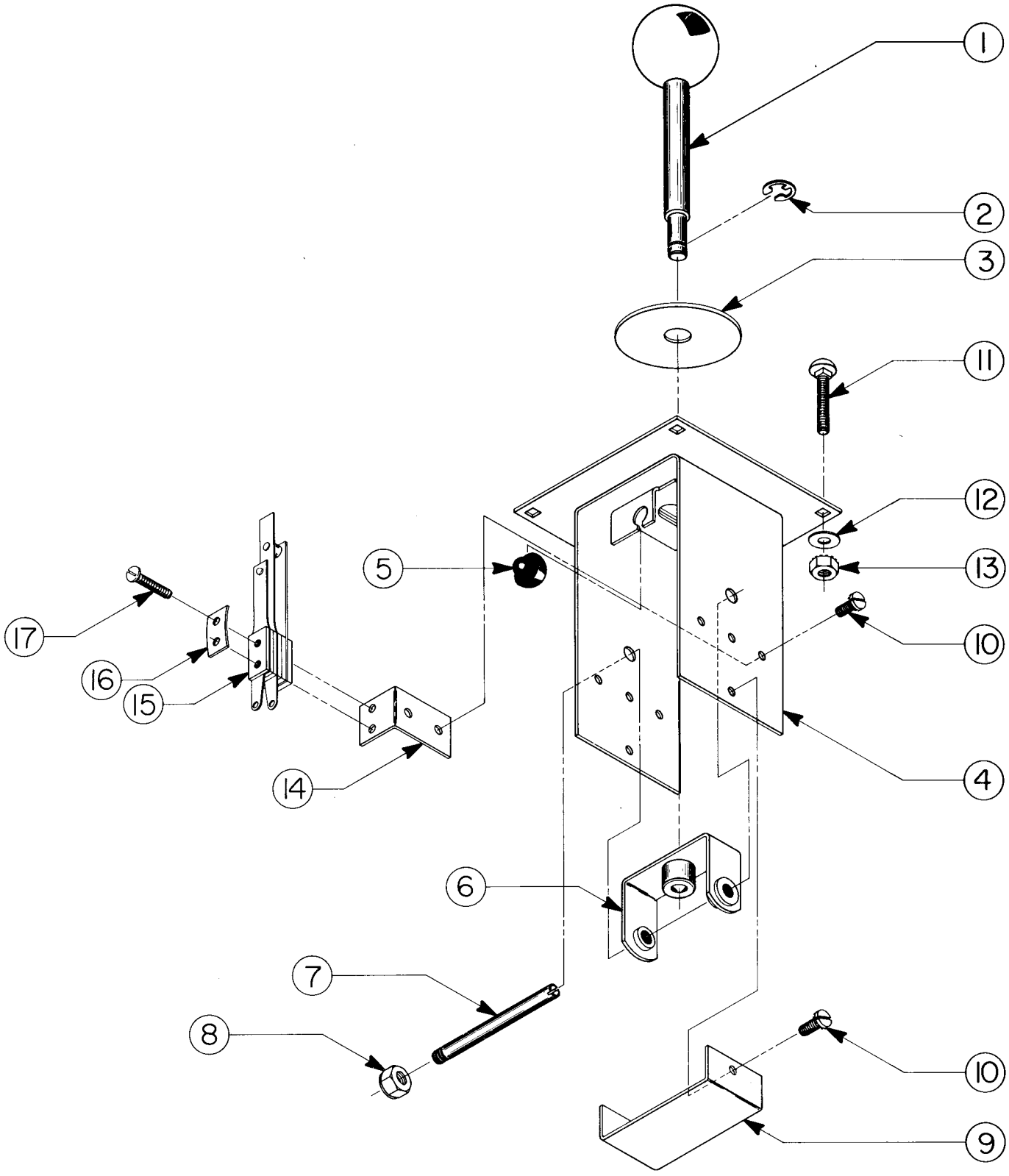
NO. 866 – GALAXIAN – OPENED BACK PICTURE

ORDER BY PART NUMBER ONLY

ITEM	PART Nº	DESCRIPTION
1	0017-00003-0294	19" COLOR MONITOR & CHASSIS - COMPLETE
2	0866-00109-0000	MONITOR MTG. BRKT.
	0017-00101-0115	#8 - 32 x 2" HEX MACH. SCREW (5 REQ'D.)
	0017-00101-0639	#8 - 32 x 1-1/4 CARRIAGE BOLT
	0017-00101-0628	#8 - 32 x 3/4 CARRIAGE BOLT (4 REQ'D.)
	0017-00104-0022	#8 WASHER (10 REQ'D.)
	0017-00103-0061	#8 - 32 HEX NUT SEMS. (10 REQ'D.)
3	A866-00035-00XF	INTERLOCK SW. BRKT. ASSY.
	0017-00032-0071	INTERLOCK SWITCH
4	A082-91352-A866	GAME LOGIC BOARD ASSY.
	0624-00902-0600	P.C. SUPPORT BRKT. - 17" (2 REQ'D.)
	0624-00902-0300	P.C. SUPPORT BRKT. - 2-1/2" (2 REQ'D.)
5	A866-00048-0000	TRANSFORMER BOARD ASSY.
6	A866-00054-0000	LOW VOLTAGE CABLE ASSY.
7	A866-00051-0000	POWER CABLE ASSY. - HIGH VOLTAGE
	A866-00053-0000	COIN DOOR CABLE ASSY. - NOT SHOWN
	A866-00052-0000	CONTROL PANEL CABLE ASSY. - NOT SHOWN
		ADDITIONAL PARTS LIST
	A084-91353-A866	MEMORY BOARD ASSEMBLY
	A097-00001-0000	LOCK ASSY. - BACK DOOR
	0618-00117-0000	VENT SCREEN (2 REQ'D.)
	A623-00110-0000	COIN BOX ASSY.
	A623-00013-0000	COIN BOX COVER ASSY.
	A624-00001-0000	COIN BOX GUIDE BRKT. ASSY.
	0624-00101-0000	COIN BOX GUIDE BRKT.
	0017-00101-0628	#8 - 32 x 3/4 CARRIAGE BOLT (4 REQ'D.)
	0017-00104-0022	#8 STL. WASHER (4 REQ'D.)
	0017-00103-0061	#8 - 32 LOCK NUT SEMS. (4 REQ'D.)
	0866-00905-0000	FISHPAPER SHIELD 4 IN. SQ.
	0017-00009-0419	PIN EXTRACTOR TOOL (PIN POPPER)

NO. 866 – GALAXIAN – CONTROL ASSEMBLY



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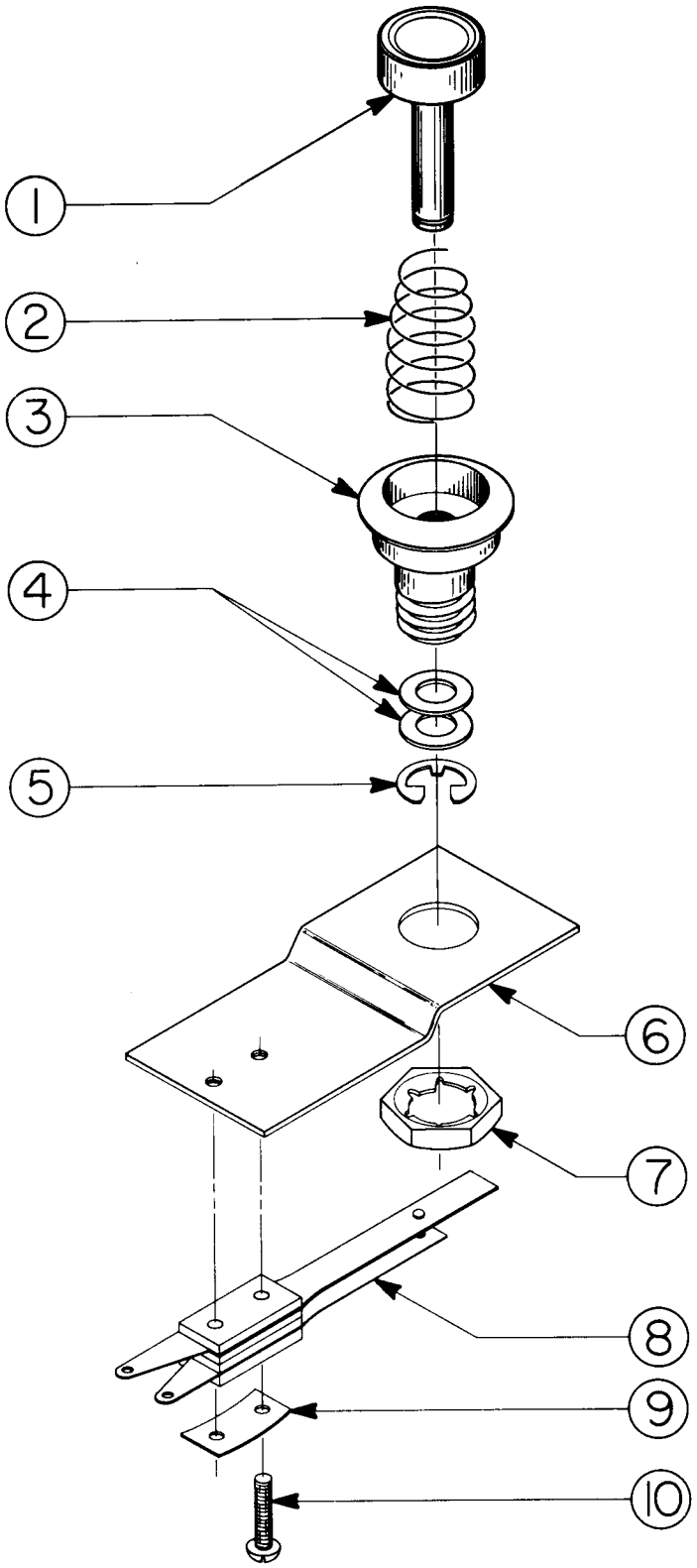
NO. 866 – GALAXIAN – CONTROL ASSEMBLY

ORDER BY PART NUMBER ONLY

ITEM	PART Nº	DESCRIPTION
1	A866-00028-0000	HANDLE ASSEMBLY
2	0017-00100-0025	"E"-RING
3	0852-00106-0000	PLATE - FOLLOWER
4	A852-00014-00XF	CONTROL SW. BRKT. & TOP PLÀTE ASSY.
5	0017-00041-0616	RUBBER BUMPER (2 REQ'D.)
6	A866-00027-0000	PIVOT BRKT. HUB & BEARING ASSY.
7	0852-00701-00XF	PIVOT ROD
8	0017-00103-0011	#10 - 32 LOCK NUT
9	0852-00101-00XF	BRACE MAIN BRKT.
10	0017-00101-0553	#6 - 32 x 1/4 SLT. PAN HD. M.S. (6 REQ'D.)
11	0017-00101-0637	#8 - 32 x 1" CARRIAGE BOLTS (4 REQ'D.)
12	0017-00104-0022	#8 STL. WASHER (4 REQ'D.)
13	0017-00103-0061	#8 - 32 HEX LOCKNUT SEMS. (4 REQ'D.)
14	0852-00103-00XF	SWITCH BRACKET (2 REQ'D.)
15	A852-00016-0000	SWITCH ASSY. (2 REQ'D.)
16	0020-00202-0000	SWITCH PLATE (2 REQ'D.)
17	0017-00101-0737	#5 - 40 x 5/8 PAN HD. M.S. (4 REQ'D.)

NO. 866 – GALAXIAN – PUSH BUTTON ASSY.

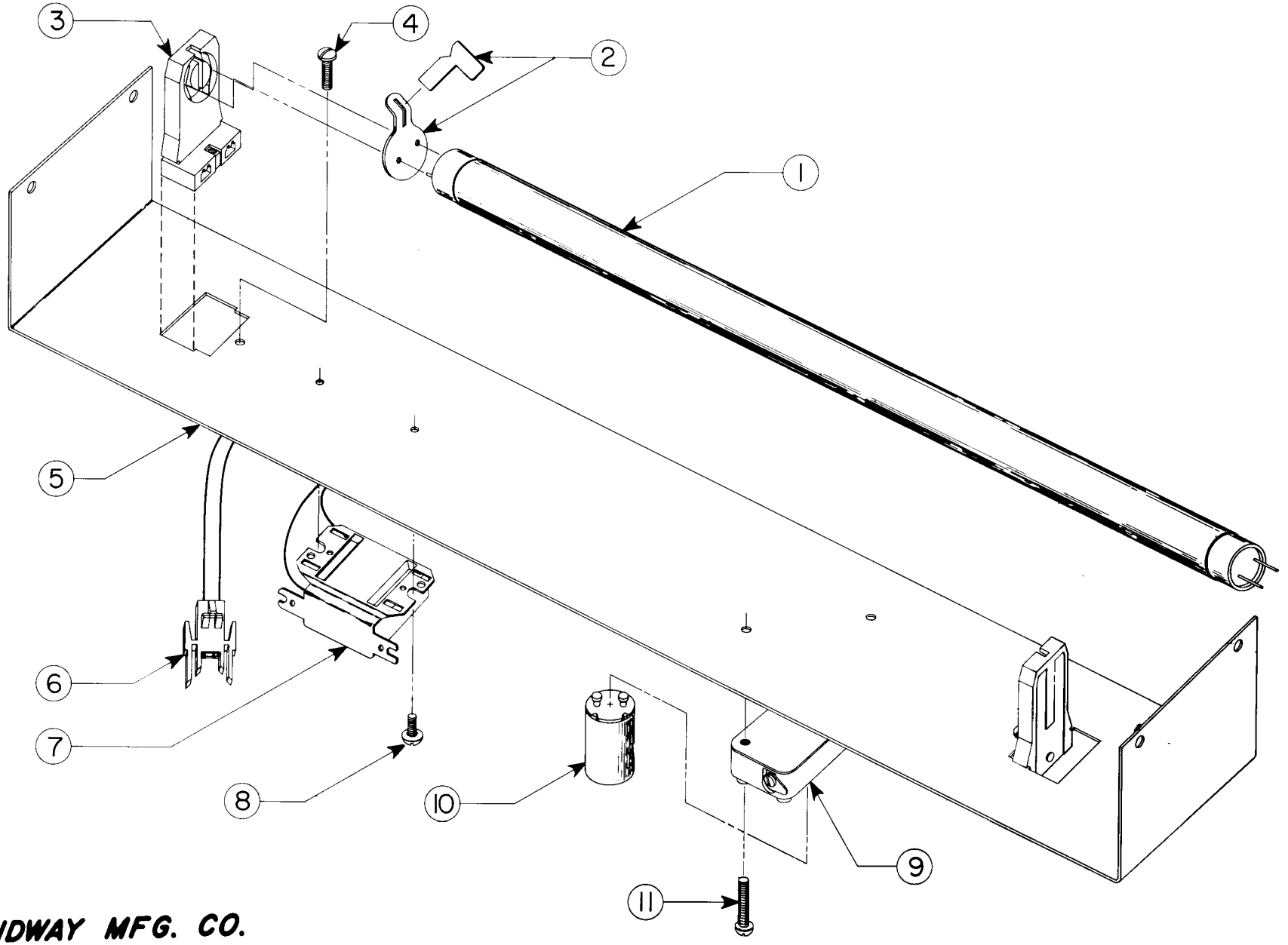


NO. 866 – GALAXIAN – PUSH BUTTON ASSY.

ORDER BY PART NUMBER ONLY

ITEM	PART Nº	DESCRIPTION
1	0017-00009-0384	BUTTON
2	0010-00593-0000	SPRING
3	0017-00009-0376	BUTTON HOUSING
4	0017-00104-0028	FLAT WASHER (2 REQ'D.)
5	0017-00100-0025	E-RING
	A739-00012-0000	PUSH BUTTON ASSY. (FIRST 5 ITEMS)
6	0586-00107-0000	MOUNTING BRKT.
7	0017-00103-0054	PAL NUT
8	A739-00016-0000	SWITCH ASSY.
9	0020-00202-0000	SWITCH PLATE
10	0017-00101-0526	#5 - 40 x 9/16 PHIL. HD. M.S. (2 REQ'D.)

NO. 866 – GALAXIAN – FLUORESCENT FIXTURE ASSEMBLY OR INCANDESCENT LIGHT ASSEMBLY



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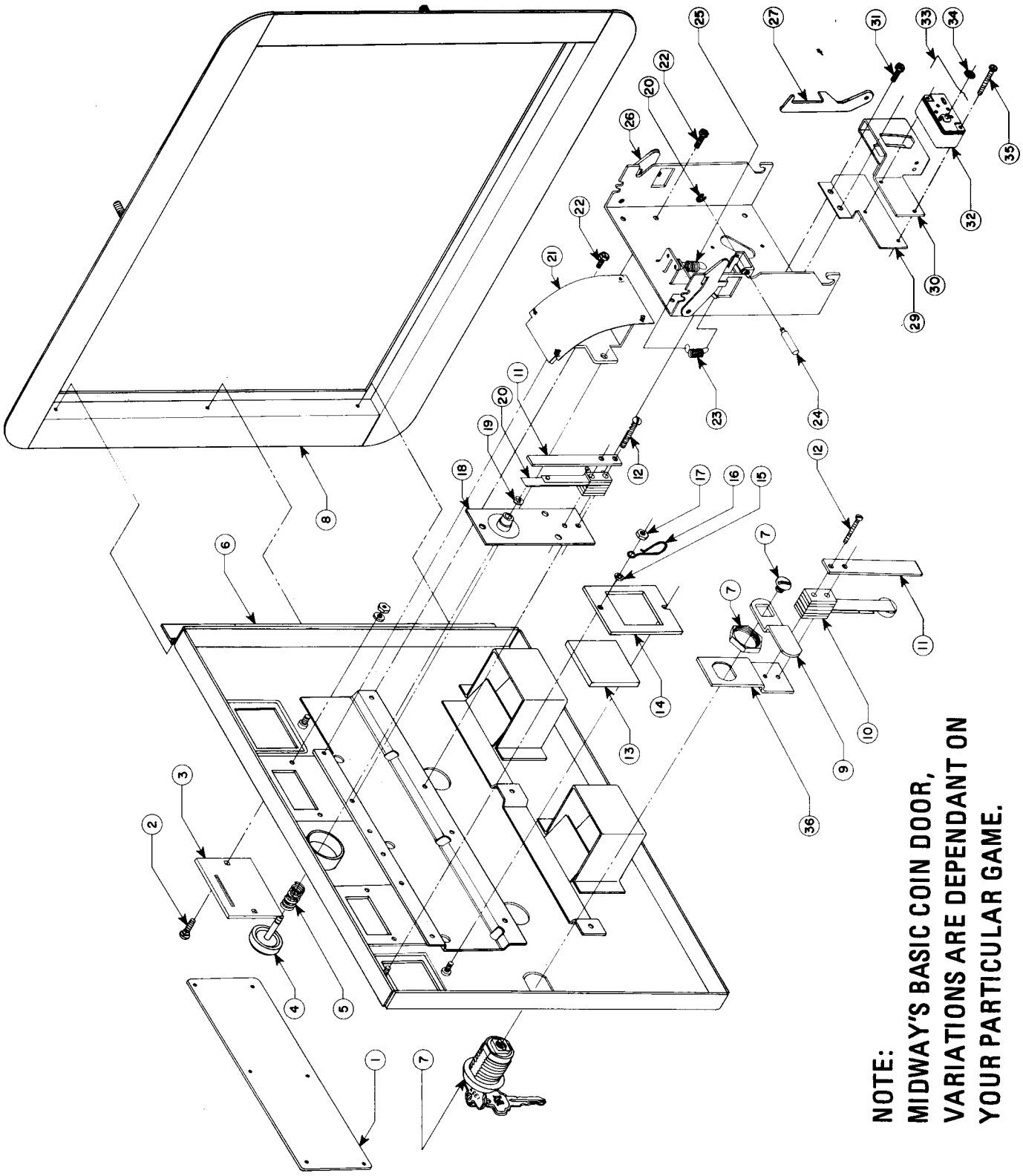
NO. 866 – GALAXIAN – FLUORESCENT FIXTURE ASSEMBLY OR INCANDESCENT LIGHT ASSEMBLY

ORDER BY PART NUMBER ONLY

ITEM	PART Nº	DESCRIPTION
1	0017-00003-0043	18 IN. FLUORESCENT LAMP - COOL WHITE
2	0017-00021-0005	FLUORESCENT LOCKS (2 REQ'D.)
3	0017-00031-0036	FLUORESCENT SOCKET (2 REQ'D.)
4	0017-00101-0573	#6 - 32 x 1/2 SLT. RND. HD. M.S. (2 REQ'D.)
5	0866-00108-0000	FLUORESCENT BRKT. ASSY.
6	0017-00021-0096	2 PIN SOCKET CONNECTOR
7	0017-00003-0026	BALLAST
8	0017-00101-0593	#8 - 32 x 1/4 SLT. PAN HD. M.S. (2 REQ'D.)
9	0017-00021-0079	STARTER HOLDER
10	0017-00003-0019	STARTER
11	0017-00101-0528	#5 - 40 x 3/4 R.H.M.S. (2 REQ'D.)
	A866-00039-0000	FLUORESCENT CABLE ASSY. - NOT SHOWN
		INCANDESCENT LIGHT ASSEMBLY
		USED AFTER GAME NO. 3,000
	0866-00113-0000	SOCKET MTG. BRKT. (2 REQ'D)
	0017-00003-0135	LAMP SOCKET (2 REQ'D.)
	0017-00003-0309	LAMP 12V., 25W. (2 REQ'D.)
	0017-00101-0626	#8 - 32 x 3/4 SLT. PAN HD. M.S. (4 REQ'D.)
	0017-00103-0061	#8 - 32 HEX NUT W/SEMS. (4 REQ'D.)

NO. 866 – GALAXIAN – FRONT DOOR ASSY.



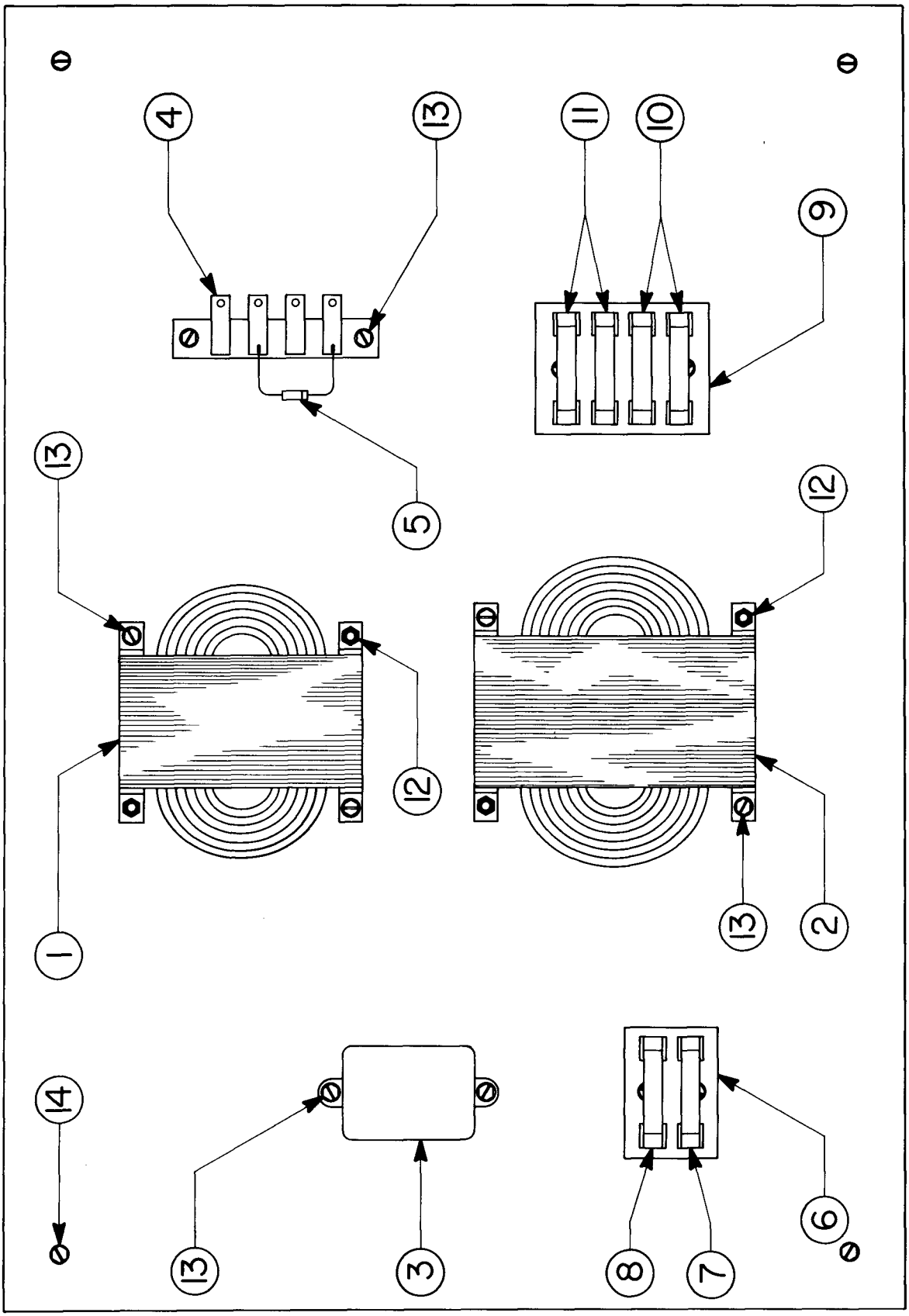
NOTE:
MIDWAY'S BASIC COIN DOOR,
VARIATIONS ARE DEPENDANT ON
YOUR PARTICULAR GAME.

NO. 866 – GALAXIAN – FRONT DOOR ASSY.

ORDER BY PART NUMBER ONLY

ITEM	PART Nº	DESCRIPTION
1	0090-00902-0000	DRESS PLATE
	0090-00902-0100	DRESS PLATE (W/O PRESS BUTTON TO START GAME)
2	0017-00101-0552	#6 - 32 x 1/4 CARRIAGE BOLT (2)
3	0090-00117-03XF	COIN ENTRY PLATE (25¢)
4	0090-00906-0000	PLASTIC START BUTTON
5	0010-00007-0000	COMPRESSION SPRING
6	0090-00013-0200	DOOR ASSY. DOUBLE ENTRY
7	0017-00005-0050	DOOR LOCK & KEY WITH SCREW & NUT
8	0090-00002-02BR	DOUBLE DOOR FRAME
9	0017-00005-0041	421 N.S. CAM
10	0090-00901-0000	DOOR SWITCH
11	0090-00126-01XF	SWITCH BACKUP PLATE
12	0017-00101-0528	#5 - 40 x 3/4" LNG. M.S.
13	0090-00903-0040	25¢ WINDOW
14	0090-00143-0000	COIN PLEX RETAINER
15	0017-00104-0002	SPLIT LOCK WASHER
16	0017-00007-0019	KEY HOOK
17	0017-00103-0005	#6 - 32 HEX NUT
18	0090-00010-0000	SW. PLATE & OILLITE ASSY.
19	0017-00100-0018	"E" RING
20	0090-00131-0000	SWITCH
21	0090-00104-0000	TOP & BTM. COIN CHUT W/BRKT. ASSY.
22	0017-00101-0598	#8 - 32 x 5/16 SCREW
23	0010-00181-0100	SPRING
24	0090-00129-00XF	PIVOT POST
25	0010-00134-0000	SPRING
26	0090-00008-0000	ACCEPTOR FRAME ASSY.
27	0093-00155-00XF	REJECTOR LEVER
28	0017-00100-0012	"E" RING
29	0093-00151-00XF	COIN GUIDE MTG. BRACKET
30	0090-00005-0000	COIN GUIDE ASSY.
31	0017-00101-0555	#6 - 32 x 5/16 SCREW
32	0017-00005-0039	COIN SWITCH
33	0010-00557-2500	TRIP WIRE
34	0017-00007-0132	PUSH-ON RING (BIK)
35	0017-00101-0507	#4 - 36 x 3/4 SCREW
36	0090-00128-00XF	SWITCH BRKT. - DOOR TILT
	A090-00061-0000	ANTI-STRING DEVICE ASSY. - OPTIONAL (REPLACES ITEM 30)
	A090-00064-0000	ANTI-PENNY DEVICE ASSY. - OPTIONAL

NO. 866 – GALAXIAN – TRANSFORMER BOARD ASSEMBLY



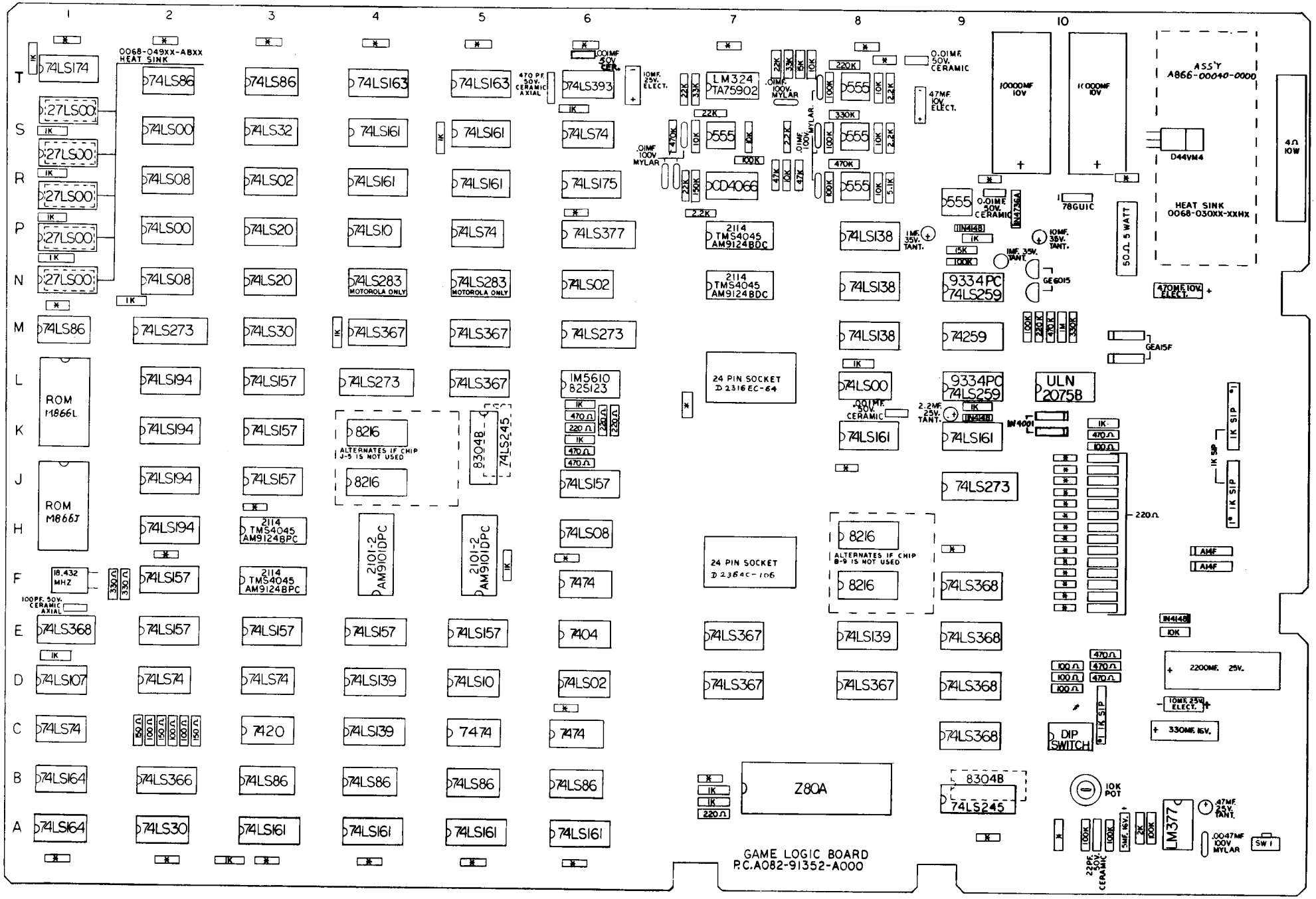
NO. 866 – GALAXIAN – TRANSFORMER BOARD ASSEMBLY

ORDER BY PART NUMBER ONLY

ITEM	PART Nº	DESCRIPTION
1	MT00-00082-0000	TRANSFORMER - 115 VOLT
2	MT00-00081-0000	TRANSFORMER - 240 VOLT
3	0017-00003-0114	NOISE FILTER
4	A031-00002-0000	TERMINAL STRIP ASSY.
5	0064-030XX-XXPX	IN4004 400 V. DIODE
6	0720-00001-0200	2 POSITION FUSE CLIP
7	0017-00003-0103	FUSE 1A. SLO-BLO
8	0017-00003-0261	FUSE 1.5A. SLO-BLO
9	0720-00001-0400	4 POSITION FUSE CLIP
10	0017-00003-0169	FUSE 5A. (2 REQ'D.)
11	0017-00003-0001	FUSE 1A. (2 REQ'D.)
12	0017-00101-0637	#8 - 32 x 1-1/4 CARRIAGE BOLT (4 REQ'D.)
	0017-00103-0008	#8 - 32 HEX NUT (4 REQ'D.)
13	0017-00101-0014	#6 x 1/2 SLT. HEX HD. WD. SCR. (12 REQ'D.)
14	0017-00101-0018	#6 x 3/4 SLT. HEX HD. WD. SCR. (4 REQ'D.)
	A866-00049-0000	LINE CORD ASSY. - NOT SHOWN

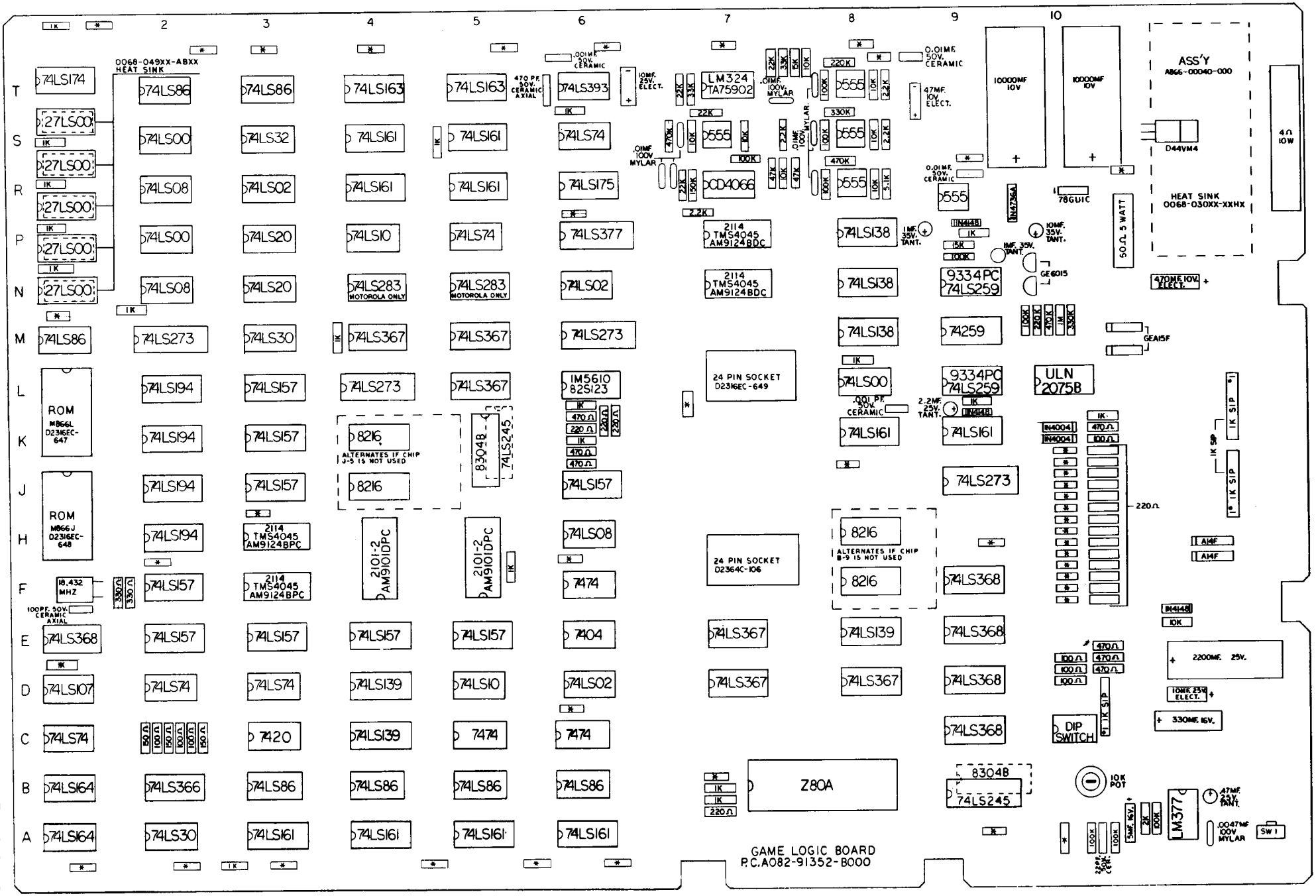
COMPONENT LAYOUT PART NO. M051-00866-A002

* INDICATES 0.1MF. 50V. AXIAL LEAD CERAMIC CAP.

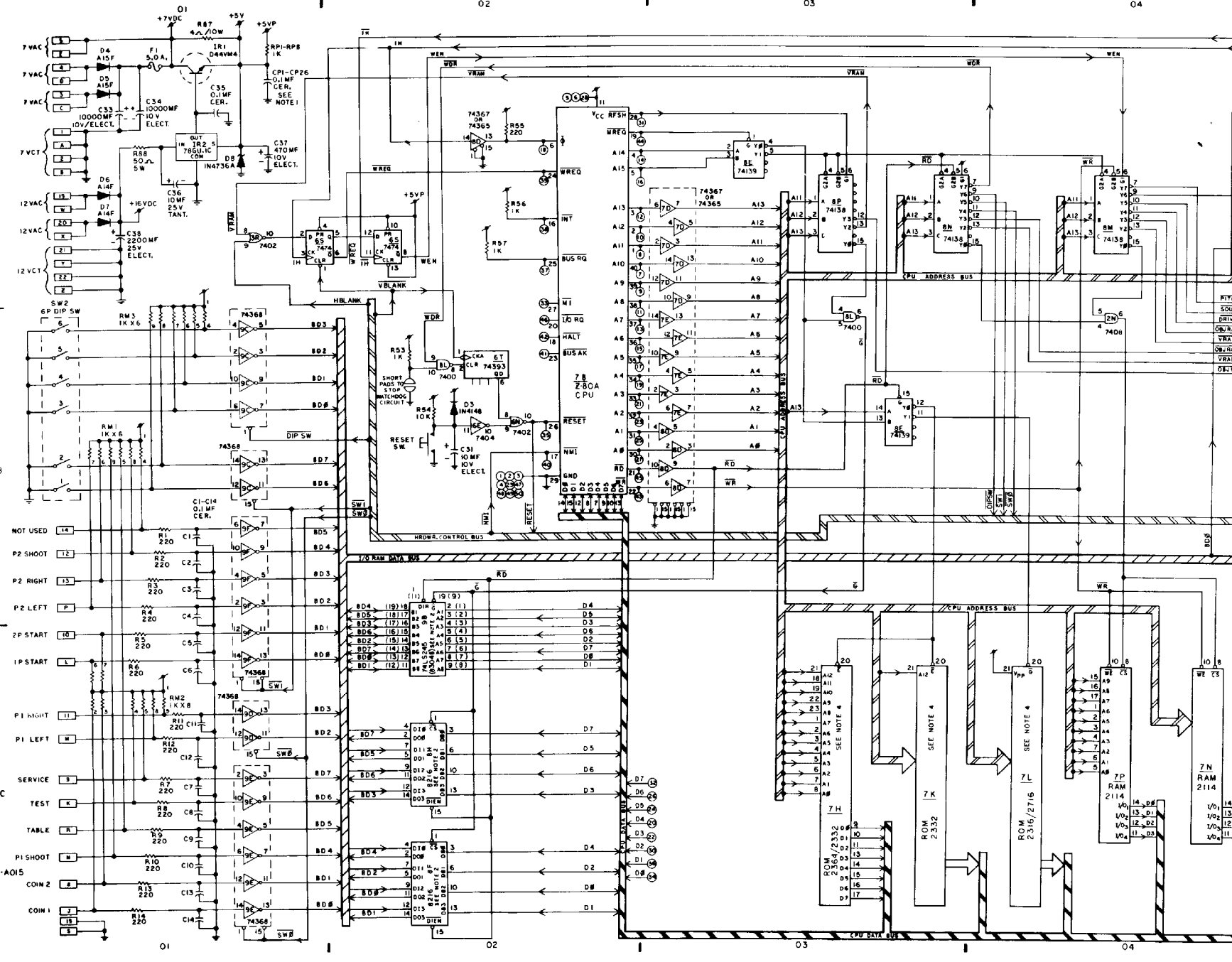


COMPONENT LAYOUT PART NO. M051-00866-B002

* INDICATES 0.1MF. 50V. AXIAL LEAD CERAMIC CAP



PAGE 21



NOTES:

1. 8 PULL-UP RESISTORS AND 26 DECOUPLING CAPACITORS ARE DISTRIBUTED OVER THE P.C. BOARD ASS'Y.
2. ONLY 1 PC 74LS245, OR 1 PC 8304B, OR 2 PC 8216 ARE USED (AND STUFFED) FOR BI-DIRECTIONAL DRIVERS (1 BYTE OF DATA).
3. SAME AS NOTE 2.
4. SUBSTITUTION FOR THESE ROM'S IS MEMORY BRD. ASS'Y A084 - 91353 - A866

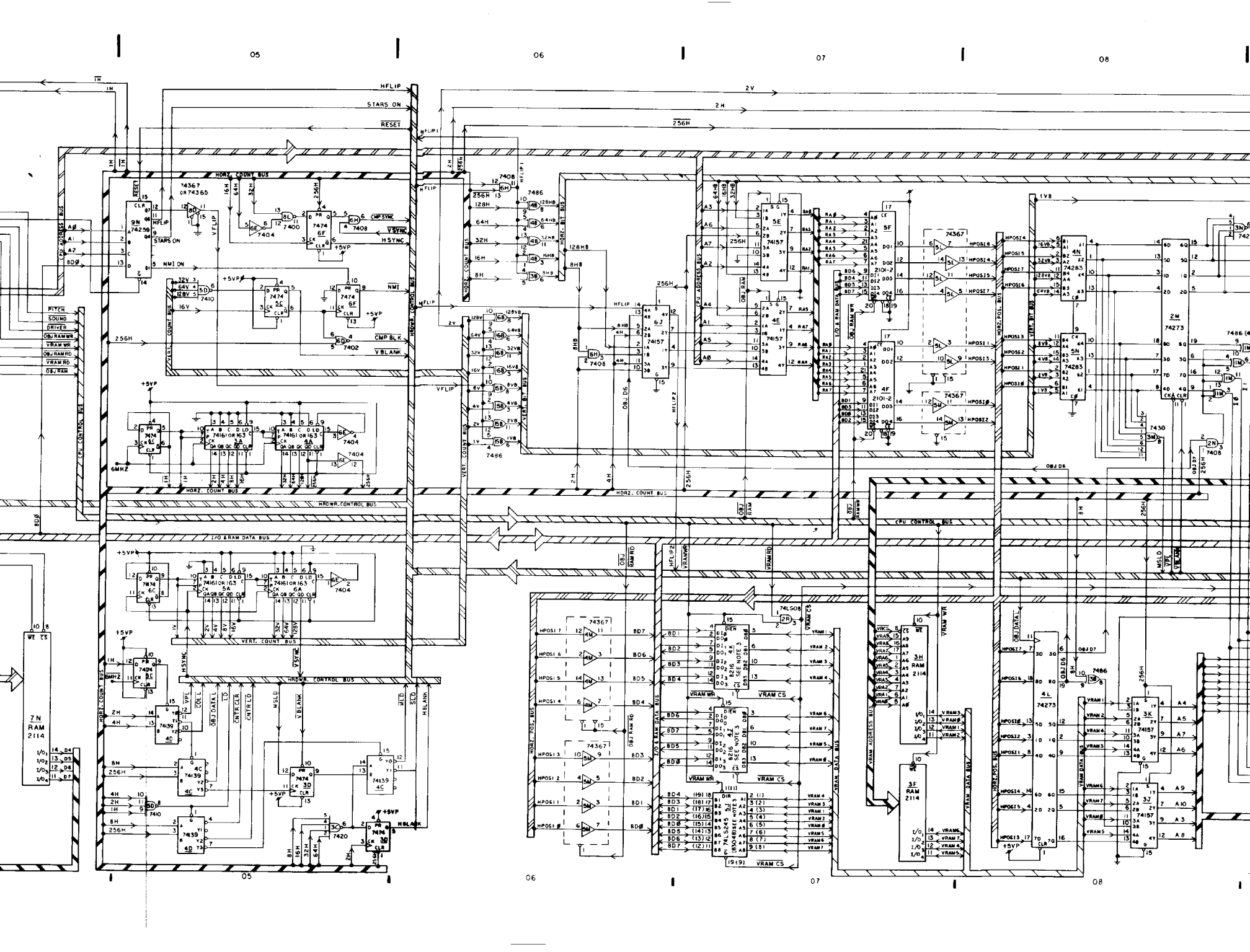
↑ INDICATES +5V

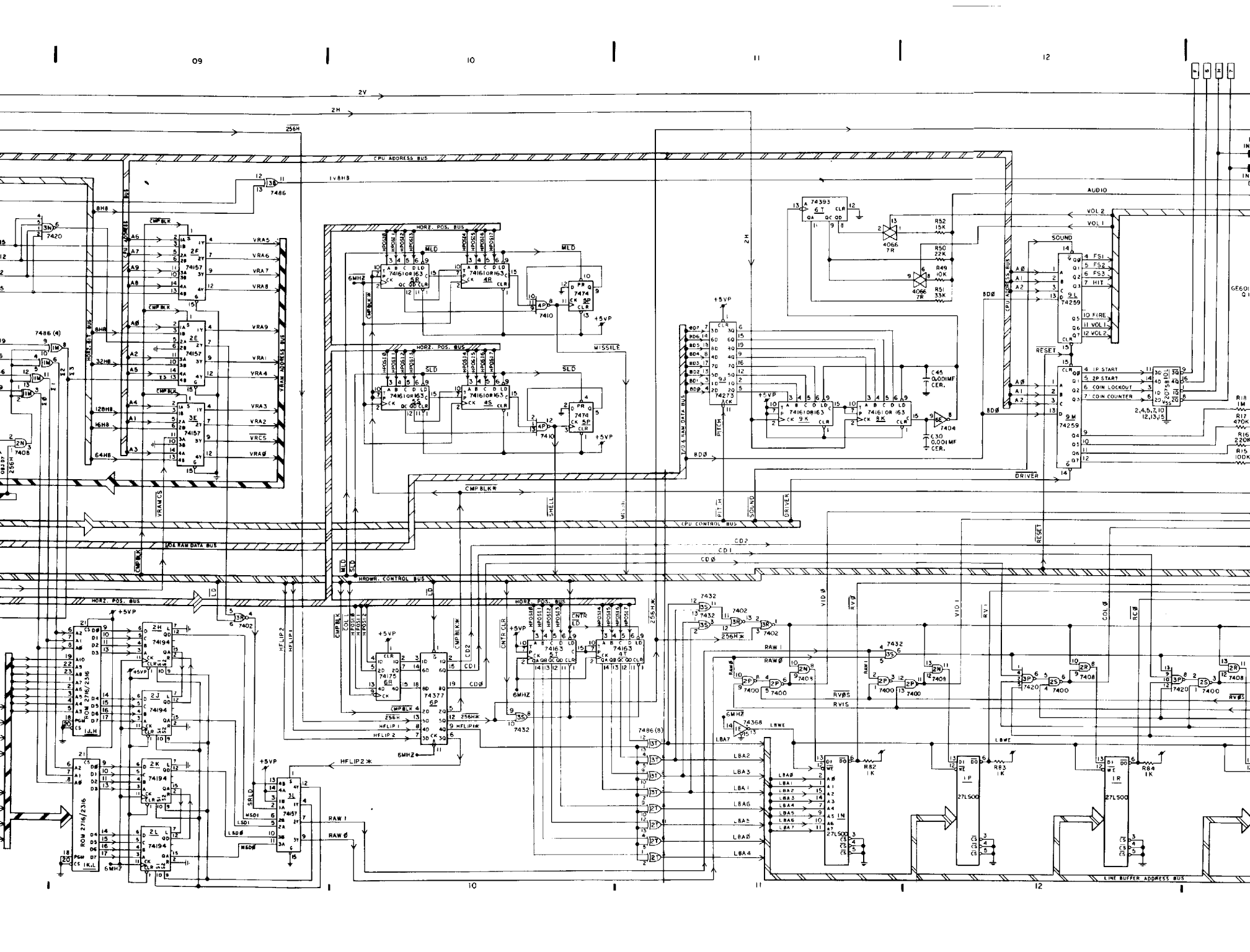
REV.	DESC.	DATE
B	ALL 0.1MF CER. CAP → AX. LEAD	4-20-80

MIDWAY MFG. CO.
FRANKLIN PARK, ILL.

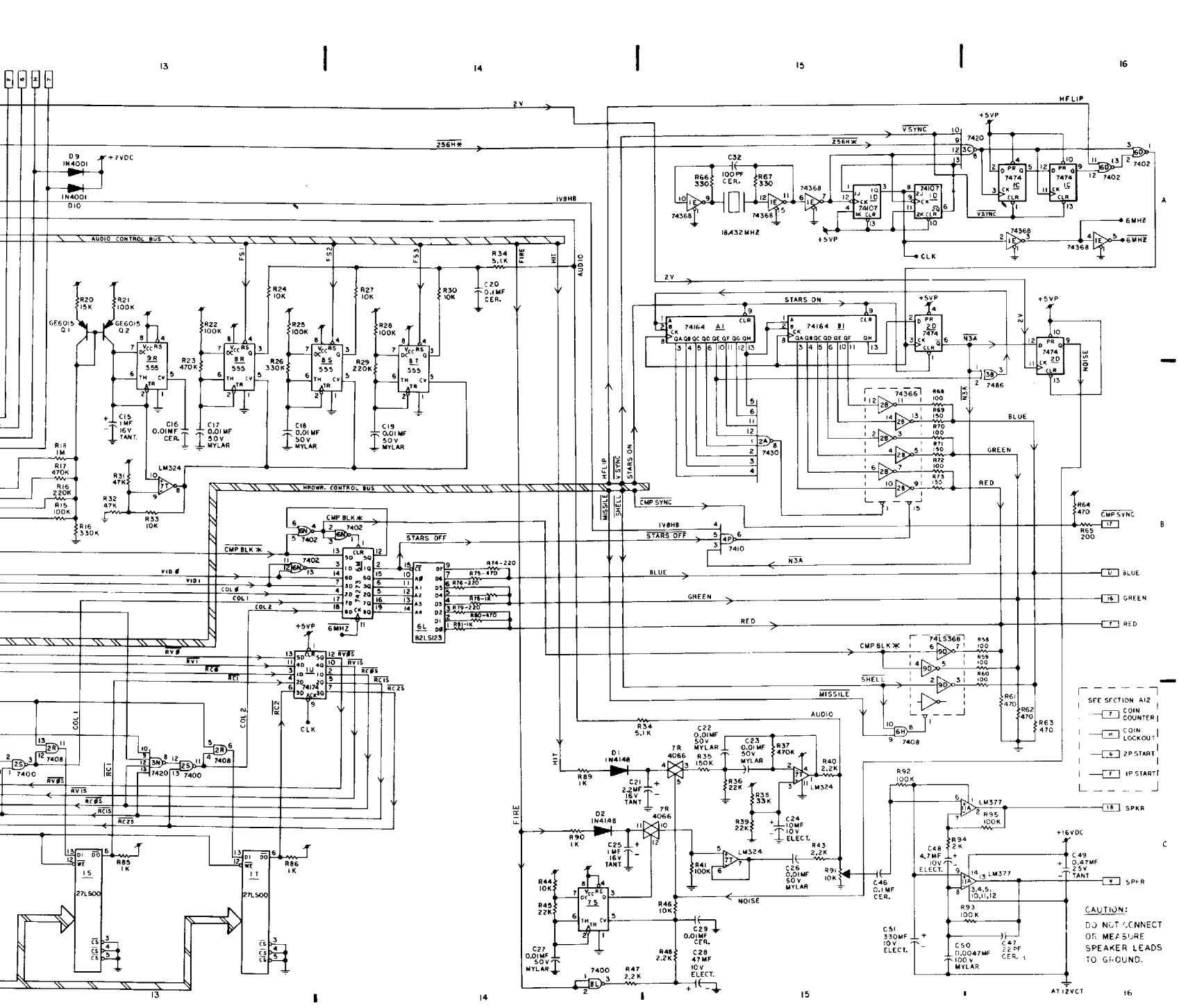
DRN. G. RIZZO	CHD.
DATE JAN. 1980	NO. REQ'D 1
USED ON GALAXIAN	
DESC. LOGIC BOARD CIRCUITRY	
PART NO. A082-91352-A/B000	

LOGIC SCHEMATIC PART NO. M051-00866-A015


05
06
07
08
HFLIP
STARS ON
RESET
2V
2H
256H
HORZ. COUNT BUS
HRDWR. CONTROL BUS
CPU CONTROL BUS
I/O & RAM DATA BUS
VERT. COUNT BUS
CPU ADDRESS BUS
HORZ. POS. BUS
VRAM ADDRESS BUS
VRAM DATA BUS
OBJ RAM
6MHZ
NMI ON
CMP SYNC
HSYNC
VSYNC
CMP BLK
VBLANK
NMI
+5VP
7N RAM 2114
3H RAM 2114
3F RAM 2114



09
10
11
12
2V
2H
256H
CPU ADDRESS BUS
1V8H8
7486
7420
HORZ. POS. BUS
MLD
SLD
MISSILE
74161OR163
74174
74157
74273
74393
4066
74259
74194
74377
74163
74175
74368
7410
7404
7402
7432
7400
7408
7420
7486 (4)
7408
ROM 2716/2316
VRAM ADDRESS BUS
VRAM CS
I/O & RAM DATA BUS
HRDWR. CONTROL BUS
CPU CONTROL BUS
CMP BLK*
SHELL
PITCH
SOUND
DRIVER
RESET
AUDIO
VOL 2
VOL 1
SOUND
FS1
FS2
FS3
HIT
FIRE
1P START
2P START
COIN LOCKOUT
COIN COUNTER
C45 0.001MF CER.
C30 0.001MF CER.
HFLIP 1
HFLIP 2
HFLIP2*
RAW 1
RAW Ø
RVØS
RV1S
LBWE
LBA2
LBA3
LBA1
LBA6
LBA5
LBAØ
LBA4
LINE BUFFER ADDRESS BUS
27LS00



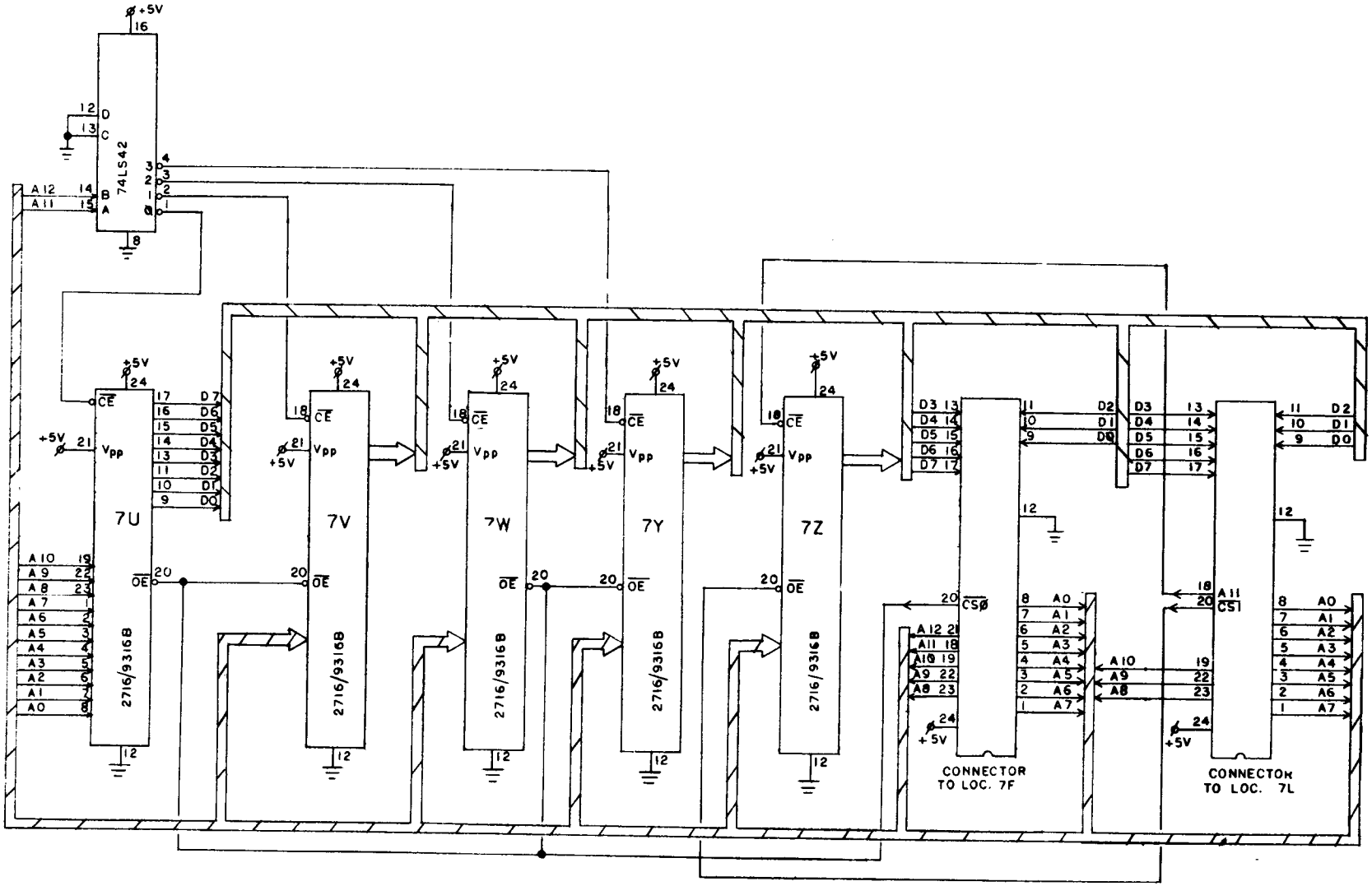
AUDIO CONTROL BUS
HROWR. CONTROL BUS
HFLIP
VSYNC
STARS ON
STARS OFF
CMP SYNC
CMP BLK
BLUE
GREEN
RED
MISSILE
SHELL
AUDIO
FIRE
HIT
NOISE
SPKR
SEE SECTION A12
COIN COUNTER
COIN LOCKOUT
2P START
1P START
CAUTION:
DO NOT CONNECT OR MEASURE SPEAKER LEADS TO GROUND.

GALAXIAN LOGIC BOARD

CHIP NUMBER	FUNCTION
74LS00	Quad Two Input Nand
74LS02	Quad Two Input Nor
7404	Hex Inverter
74LS08	Quad Two Input And
74LS10	Triple Three Input Nand
74LS20	Dual Four Input Nand
74LS30	Eight Input Nand
74LS32	Quad Two Input Or
74LS74	Dual "D" Flip – Flop
74LS86	Quad Two Input Exclusive Or
74LS107	Dual "JK" Flip – Flop
74LS138	Three to Eight Line Decoder
74LS139	Dual Two to Flour Line Decoder
74LS157	Quad Two Input Multiplexer
74LS161	Four Bit Counter
74LS163	Four Bit Counter
74LS164	Eight Bit Shift Register
74LS174	Hex "D" Flip – Flop
74LS175	Quad "D" Flip – Flop
74LS194	Eight Bit Shift Register
74LS259	Eight Big Addressable Latch
74LS273	Octal "D" Flip – Flop
74LS823	Four Bit Binary Adder
74LS245	Octal Bus Transceiver
74LS366	Hex Bus Driver – Inverting
74LS367	Hex Bus Driver
74LS368	Hex Bus Driver – Inverting
74LS377	Octal "D" Flip – Flop

GALAXIAN LOGIC BOARD

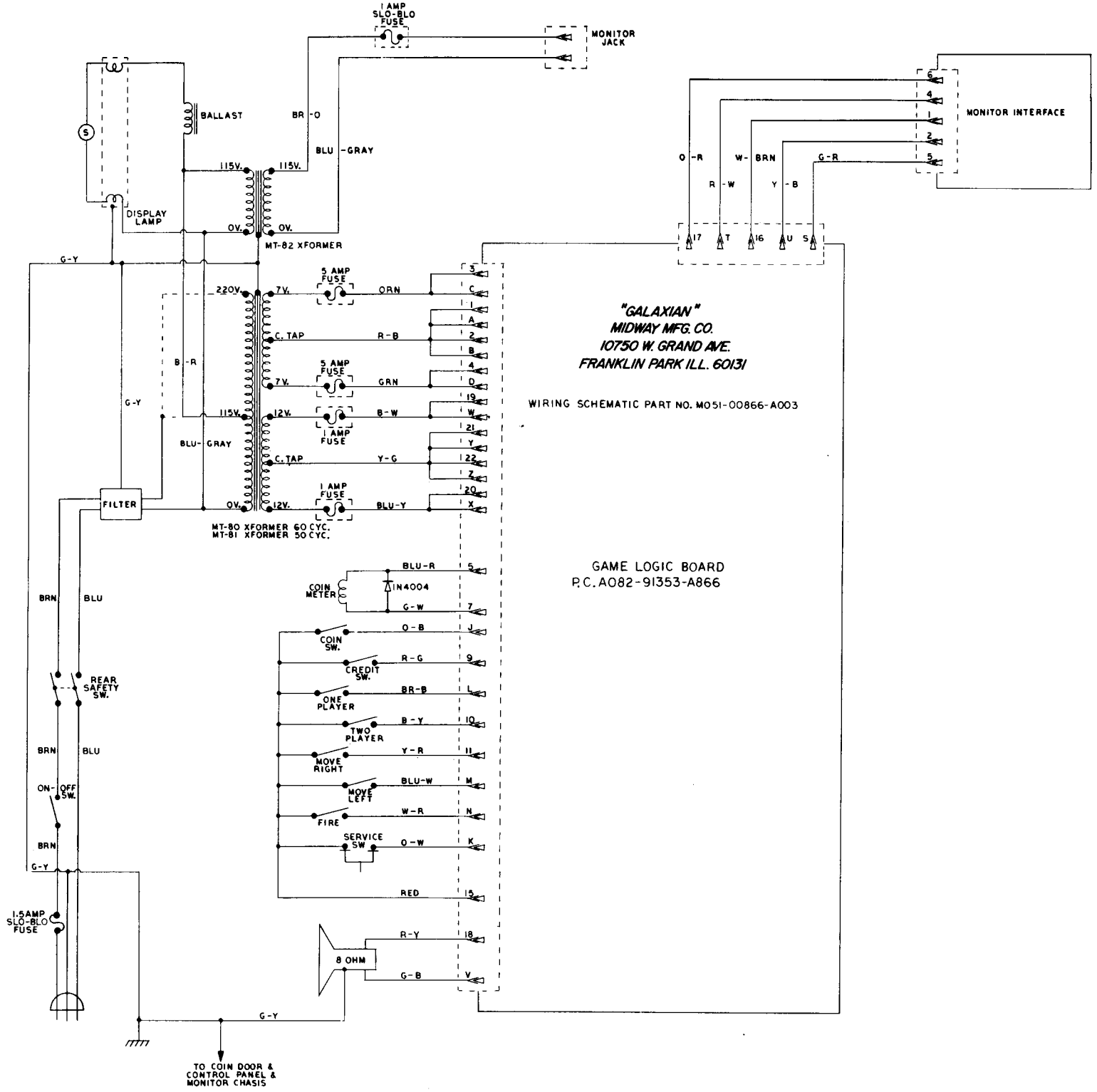
CHIP NUMBER	FUNCTION
74LS393	Dual Four Bit Binary Counter
27LS00	Ram
2114	Ram
TMS4045	Ram
AM9124	Ram
2102-2	Ram
AM9101	Ram
8304	Bus Driver – Bidirectional
8216	Bus Driver – Bidirectional
LM324	Quad Operational Amp
555	Timer
LM377	Audio Amp
Z80	CPU
2716	Prom – 16K
1M5610	Prom
78GUIC	Voltage Regulator
ULN2075	Quad Buffer
18.432	X-TAL
CD4066	Quad Electronic Switch
D44VM4	Transistor
GE6015	Transistor
MC14066	Quad Electronic Switch
GEA15F	Diode – Rectifier
A14F	Diode – Rectifier
IN4148	Diode – Rectifier
IN4736A	Diode – Zener
D2316EC	16K Rom
D2364C	64K Rom

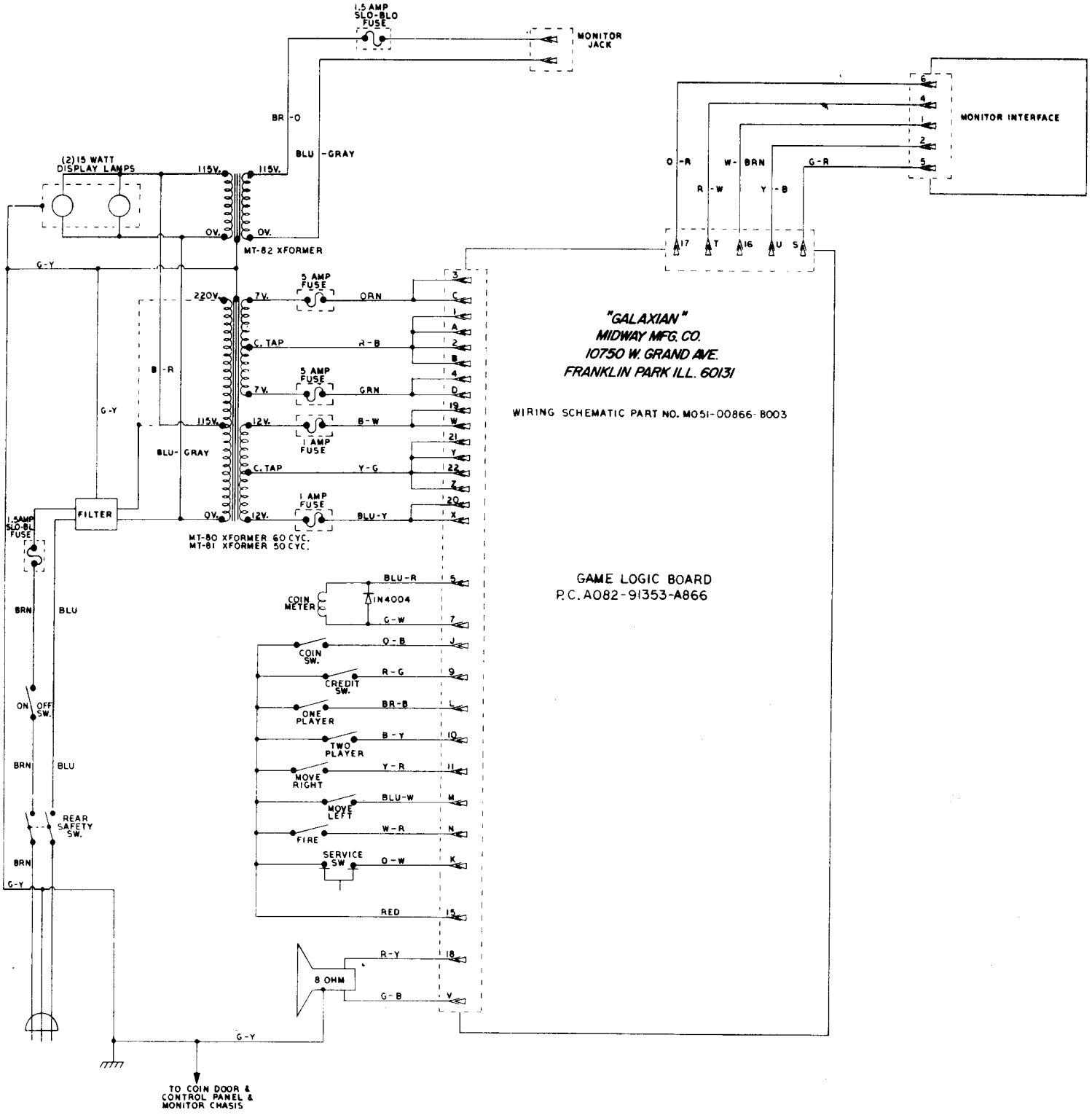


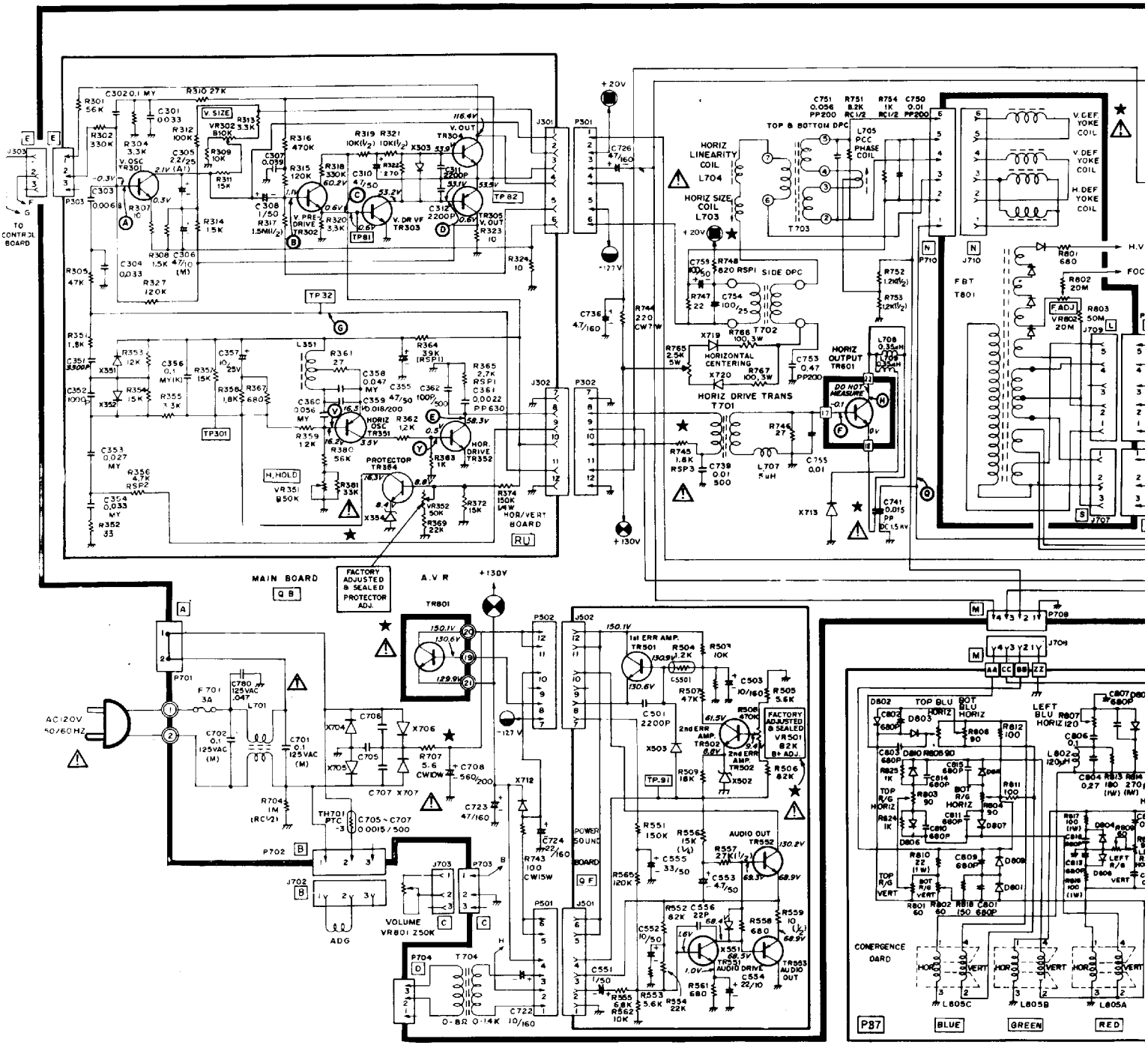
MEMORY LOGIC SCHEMATIC
PART NO. M051-00866-A004

DO NOT SCALE DWG.	HEAT TREAT	SCALE	USED ON GALAXIAN	MIDWAY MFG. CO. FRANKLIN PK. ILL.
DIM. TOLERANCES UNLESS SPECIFIED	DRN.	MAT'L.	NO. REQ'D 1	MEMORY BOARD CIRCUIT
CONCENTRICITY T.I.R. .003 FRACTIONAL ±1/64 DECIMAL ±.005 HOLE DIA. +.003 -.000	CKD. L.O	FINISH	DATE Dec. 13 '79	PART NO. A082-91353-A866

REVISIONS


1 AMP SLO-BLO FUSE
MONITOR JACK
MONITOR INTERFACE
BALLAST
BR -O
BLU -GRAY
115V.
0V.
DISPLAY LAMP
MT-82 XFORMER
G-Y
220V.
7V.
5 AMP FUSE
ORN
C. TAP
R-B
GRN
12V.
B-W
Y-G
BLU-Y
B-R
BLU-GRAY
FILTER
MT-80 XFORMER 60 CYC.
MT-81 XFORMER 50 CYC.
"GALAXIAN"
MIDWAY MFG. CO.
10750 W. GRAND AVE.
FRANKLIN PARK ILL. 60131
WIRING SCHEMATIC PART NO. M051-00866-A003
GAME LOGIC BOARD
P.C. A082-91353-A866
COIN METER
IN4004
BLU-R
G-W
COIN SW.
O-B
CREDIT SW.
R-G
ONE PLAYER
BR-B
TWO PLAYER
B-Y
MOVE RIGHT
Y-R
MOVE LEFT
BLU-W
FIRE
W-R
SERVICE SW
O-W
RED
8 OHM
R-Y
G-B
BRN
BLU
REAR SAFETY SW.
ON-OFF SW.
1.5AMP SLO-BLO FUSE
TO COIN DOOR & CONTROL PANEL & MONITOR CHASIS
O-R
W-BRN
G-R
R-W
Y-B


1.5 AMP SLO-BLO FUSE
MONITOR JACK
MONITOR INTERFACE
BR-O
BLU-GRAY
(2) 15 WATT DISPLAY LAMPS
115V.
0V.
MT-82 XFORMER
O-R
W-BRN
G-R
R-W
Y-B
17
T
16
U
S
G-Y
220V.
7V.
5 AMP FUSE
ORN
C. TAP
R-B
GRN
12V.
B-W
1 AMP FUSE
Y-G
BLU-Y
B-R
FILTER
1.5AMP SLO-BL FUSE
MT-80 XFORMER 60 CYC.
MT-81 XFORMER 50 CYC.
"GALAXIAN"
MIDWAY MFG. CO.
10750 W. GRAND AVE.
FRANKLIN PARK ILL. 60131
WIRING SCHEMATIC PART NO. M051-00866-B003
GAME LOGIC BOARD
P.C. A082-91353-A866
BRN
BLU
ON OFF SW.
REAR SAFETY SW.
COIN METER
1N4004
BLU-R
G-W
COIN SW.
O-B
CREDIT SW.
R-G
ONE PLAYER
BR-B
TWO PLAYER
B-Y
MOVE RIGHT
Y-R
MOVE LEFT
BLU-W
FIRE
W-R
SERVICE SW
O-W
RED
8 OHM
R-Y
G-B
TO COIN DOOR & CONTROL PANEL & MONITOR CHASIS


MAIN BOARD
Q B
FACTORY ADJUSTED & SEALED PROTECTOR ADJ.
A.V.R
+130V
+20V
-127V
AC120V 50/60HZ
F 701 3A
TR801
TR301
TR302
TR303
TR304
TR305
TR306
TR307
TR308
TR309
TR310
TR311
TR312
TR313
TR314
TR315
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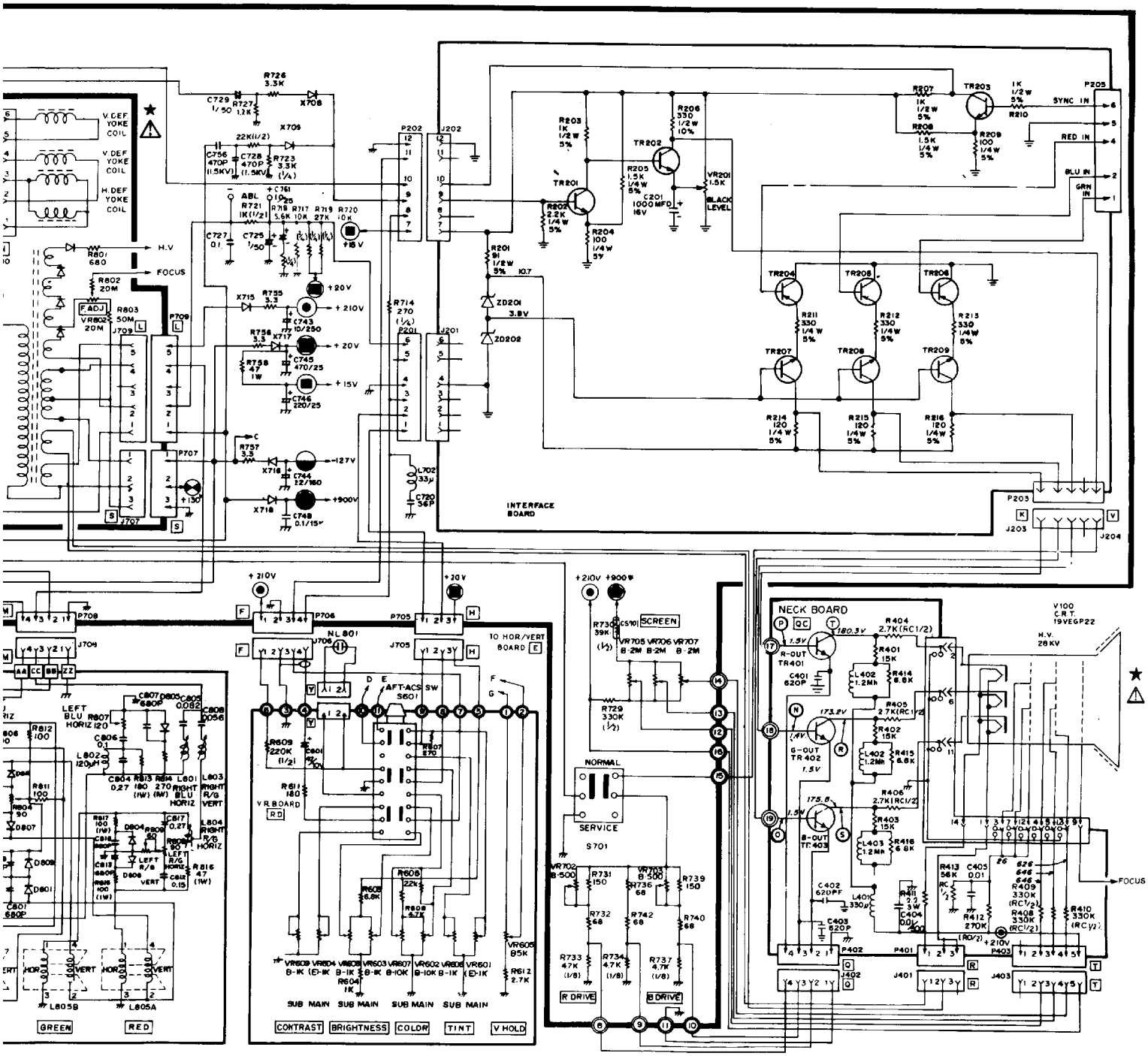
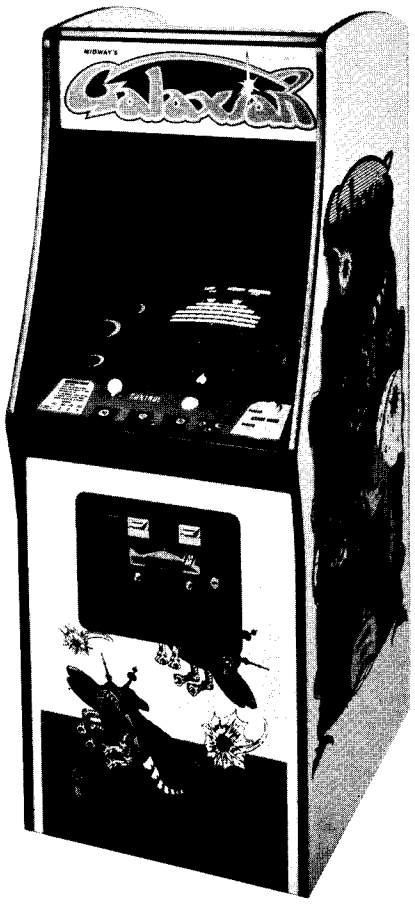
TR339
TR340
TR341


INTERFACE BOARD
NECK BOARD
V100 C.R.T. 19VEGP22
H.V. 28KV
SUB MAIN
SUB MAIN
SUB MAIN
SUB MAIN
CONTRAST
BRIGHTNESS
COLOR
TINT
V HOLD
GREEN
RED
SCREEN
FOCUS
R DRIVE
B DRIVE
SERVICE
NORMAL
SYNC IN
RED IN
BLU IN
GRN IN
BLACK LEVEL
H.V
FOCUS
+210V
+900V
+20V
+15V
-27V
+150V
+18V

MIDWAY'S

Galaxian

TROUBLE SHOOTING LOGIC BOARD
PART I



PHONE
(312) 451-1360

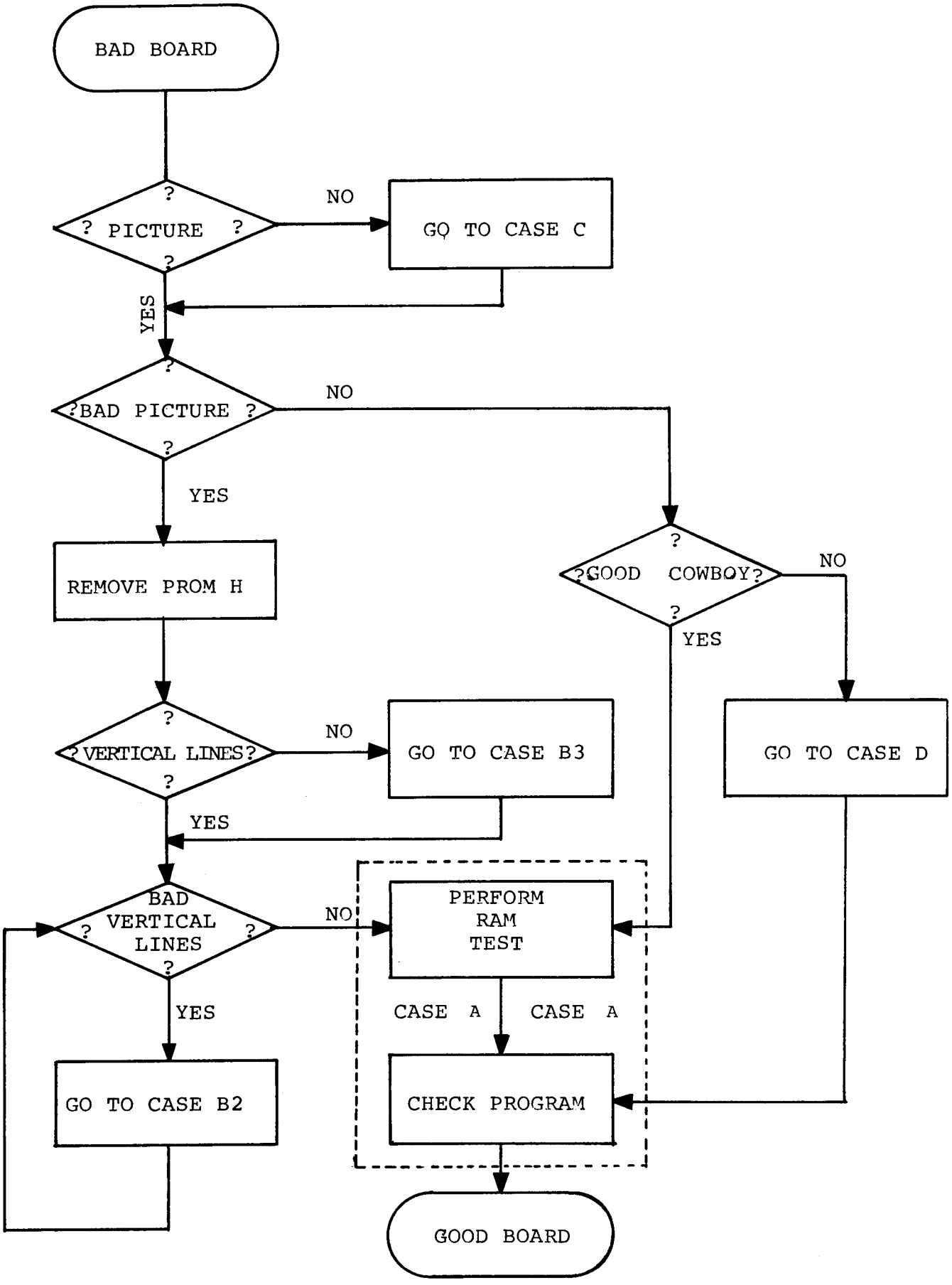
MIDWAY MFG. CO.
A BALLY COMPANY
10750 WEST GRAND AVENUE
FRANKLIN PARK, ILLINOIS 60131
U.S.A.

PHONE
TOLL FREE
800-323-7182

FORM-00216-8008

FLOW CHART OF TROUBLESHOOTING

PROCEDURE



Galaxian

GALAXIAN, Midway's new space wars video game, features a full color monitor and is available in a 1 or 2 player upright or cocktail table model.

The player, controlling the Galaxian defenders of the Earth, must destroy a convoy of aliens that are equally determined to annihilate him by firing missiles. The defender must protect himself without the aid of barricades. He must shoot down not only alien army regulars, but also out-maneuver and destroy enemy fighter escort ships that peel off from the main body of the alien squadron at random.

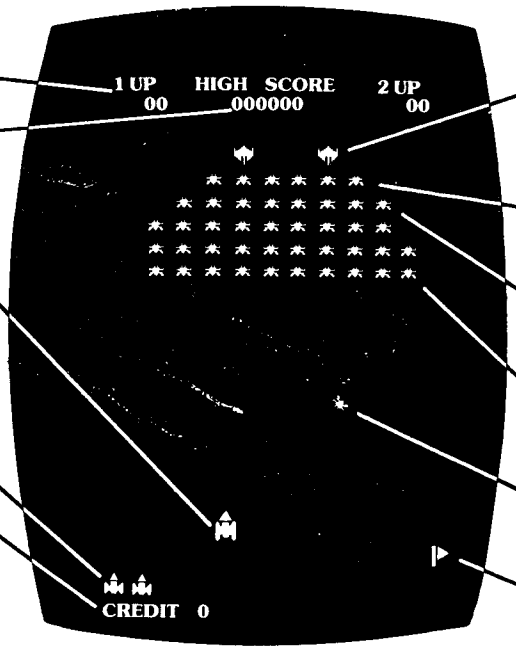
Score:
1 or 2 player. Maximum score: 999,990.

High Score:
Retained and displayed up to 6 digits.

Defender Galax Ship:
Moves freely across bottom of monitor firing missiles at aliens.

Reserve Galax Ships:
Number of player-up remaining ships clearly indicated.

Credit Line:
Maximum 9 credits per player.



ALIEN SHIPS' POINTS:

Flagship: 60 points each. 150, 200, 300 and 800 bonus points when hit while attacking.

Red Alien: 50 points each. 100 bonus points for hits while attacking.

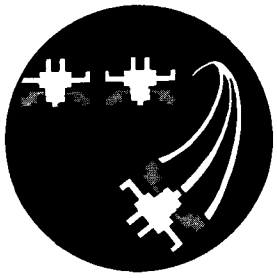
Purple Alien: 40 points each. 80 bonus points for hits when attacking.

Green Alien: 30 points each. 60 bonus points when attacking.

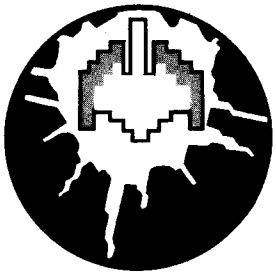
Alien Attacker Ships:
Double score for each ship shot down.

Flag: One awarded for each convoy destroyed.

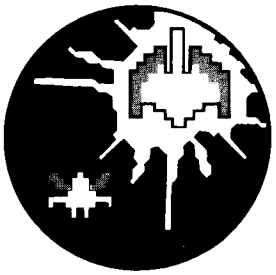
BONUS POINTS:



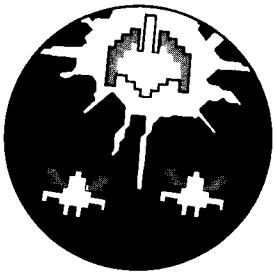
Double Points:
For lone green alien attacking at random.



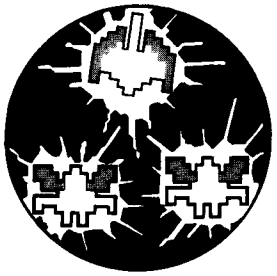
150 Points:
For hitting lone attacking flagship.



200 Points:
For hitting attacking flagship with single escort.



300 Points:
For hitting attacking flagship with two escorts.



Special 800 Points:
For destroying fighter escort and flagship. (Escort ships must be hit first.)

MIDWAY MFG. CO.
A BALLY COMPANY
10750 West Grand Avenue
Franklin Park, IL 60131
Phone: (312) 451-1360

DISTRIBUTED BY:

Printed in U.S.A.

GALAXIAN

TROUBLE SHOOTING LOGIC BOARD PC A082-91352-B000

****

1. CHECK +5VDC AT CPU AND ROMS.
2. 6MHZ CLOCK FREQUENCY AT PIN #5-E1 AND 3MHZ AT PIN #6 OF CPU.
3. RESET LINE PIN #26 OF CPU NORMALLY HIGH AND GOES LOW WITH RESET.
4. CHECK RAM AND ROM TEST FOR BAD RAM OR ROM. IF TV SHOWS A BAD ROM MAKE SURE PROGRAM CARD IS SEATED PROPERLY.
5. ROM TEST WILL NOT TEST THE CHARACTER ROMS AT L-1 & H-1 (REPLACE).
6. WHEN CHARACTER ROMS ARE REMOVED THE TV SCREEN WILL SHOW HORIZONTAL BARS.
7. REMOVE PROGRAM PC A082-91353-A866 AND TV SCREEN SHOULD HAVE GARBAGE WITH RESET LINE PULSING.
8. CHECK ALL ADDRESS AND DATA LINES COLOR ROM 6-L & 1-N.
9. CHECK ALL ADDRESS AND DATA LINES CPU (Z80).
10. CHECK ALL ADDRESS AND DATA LINES L-1 & H -1.
11. GAME WILL PLAY WITHOUT CHARACTER ROMS WITH LOSS OF VISUAL EFFECT.
12. PROCEED TO TROUBLE SHOOTING LOGIC BOARD PART II MANUAL.
13. GOOD LUCK

GALAXIAN

Trouble Shooting
PC A082-91352 Logic Board
[Total 122 Chips]

NOTE: All I.C. trouble shooting information is with the I.C. removed from circuit.

POSITION	CHIP	POSSIBLE TROUBLE
1-A	74LS164	No Stars - No Explosion - High pitch Missile sound.
2-A	74LS30	No Stars.
3-A	74LS161	Diagonal lines on screen - Effects Horizontal Count.
4-A	74LS161	Blank Screen - Effects Horizontal Count.
5-A	74LS161	Thin vertical lines on screen - Effects vertical count.
6-A	74LS161	Blank Screen - Effects vertical count.
11-A	LM377	No Sound.
1-B	74LS64	No Stars - No Explosion - High Pitch Missile sound.
2-B	74LS366	No Stars.
3-B	74LS86	Double Image - Distorted characters.
4-B	74LS86	Vertical rows of Flags & Invaders - The word credit appears up and down left side of screen.
5-B	74LS86	Letters & Numbers missing - Distorted Invaders & Ram Rom Test - Star OK.
6-B	74LS86	Blank screen Ram - Rom test distorted - Stars OK.
7&8-B	Z80A	Screen covered with Distorted Letters & Numbers.
9-B	74C245 74LS245 8304	Continuous Sound - Screen Total Garbage - Stars OK.
1-C	74LS74	Stars Move in wrong direction (up).
3-C	7420	No Explosion - High Pitch Missile Sound - All words wrong Sequence.
4-C	74LS139	All Diving objects are numbers. (21 & 30)
5-C	7474	Blank Screen - Effects Vertical & Horizontal Blanking.
6-C	7474	Large squares on screen (Eight) - High Pitch sound continuous.
9-C	74LS 368	Free Play - Effects Dip Switch.

GALAXIAN

Trouble Shooting
PC A082-91352 Logic Board.
(Continued)

POSITION	CHIP	POSSIBLE TROUBLE
1-D	74LS107	Blank Screen Effects Clock.
2-D	74LS74	No Stars - No Explosion - High pitch Missile sound.
3-D	74LS74	Flashing Letters - Numbers - No Stars.
4-D	74LS139	Blank Screen - Distorted Ram Rom Test - Stars OK.
5-D	74LS10	Blank Screen - Effects Vertical & Horizontal Blanking.
6-D	74LS02	Distorted video entire screen - Effects Clock.
7-D	74LS367	Letters - Numbers - Garbage entire screen - Effects Addresses.
8-D	74LS367	Letters - Numbers Garbage entire screen - High Pitch sound continuous.
9-D	74LS368	No control players Glaxship moves to left - No Shells - No Missile.
1-E	74LS368	Blank Screen - Effects Clock.
2-E	74LS157	Blank Screen - Effects Vertical Ram Address.
3-E	74LS157	Effects Rom & Ram Test - Test flashes over & over.
4-E	74LS157	Runs Rom & Ram test continuous.
5-E	7404	Runs Rom & Ram Test continuous.
6-E	74LS139	Blank Screen - Effects Horizontal & Vertical Count.
7-E	74LS367	Letters - Numbers & Garbage on Screen High Pitch Sound.
8-E	74LS139	Same as 7E
9-E	74LS368	Stays in Ram Rom Test.
2-F	74LS157	Screen flashes Letters - Numbers & Garbage.
3-F	2114(Ram)	Screen covered with dot pattern.
4-H&F	2101(Ram)	Bad Ram #3.
5-H&F	2101(Ram)	Bad Ram #3.
6-F	7474	High Pitch Tones - Horizontal lines on screen.
8-F	8216	Same as 9B.

GALAXIAN

Trouble Shooting
PC A082-91352 Logic Board
(Continued)

POSITION	CHIP	POSSIBLE TROUBLE
9-F	74LS368	Game starts with coin - will not select 2 player game - continuous tone in switch test.
1-H&J	2716(Prom)	Game plays - Color Horizontal Bars - Invaders all red - Diving objects square.
2-H	74LS194	Game Plays - Distorted characters Effect Character Prom.
3-H	2114(Ram)	All zeros on screen.
6-H	74LS08	Game Plays - Flips Picture - Distroted Invaders & Galaxip.
8-H	8216	Same as 9B.
2-J	74LS194	Game Plays - Effects Character Prom.
3-J	74LS157	Game Plays - Letters & Numbers(EC &A8) - Invaders all letters (EC) - Hi-Score Distorted - Effects addresses of Character Prom.
4-J	8216	Same as 5-J.
5-J	74LS245 74C245 8304	Letters and Numbers entire screen.
6-J	74LS157	Game Plays - Fast diving invaders - All words are backwards - Distorted invaders.
9-J	74273	Game Plays Effects Tone Generator - No Start, Dive, Coin tones Etc..
1-K&L	2716(Prom)	Same as 1-H&J with different colors.
2-K	74LS194	Game Plays - Horizontal lines across screen - Distorted invaders.
3-K	74LS157	Game Plays - Zeros & Letters on screen Diving Invaders Distorted.
4-K	8216	Same as 5-J.
5-K	74LS245 8304	Same as 5-J.
8-K	74LS161	Game Plays - Effects Tone Generator - No coin, start, dive Invader Hit Tones Etc..
9-K	74LS161	Same as 8-K.

GALAXIAN

Trouble Shooting
PC A082-91354 Logic Board.
(Continued)

POSITION	CHIP	POSSIBLE TROUBLE
2-L	74LS194	Game Plays - Effects Character Prom - Characters wrong place on screen - Vertical Roll.
3-L	74LS157	Game Plays - Effects Character Prom - Horizontal bars across screen.
4-L	74LS273	Game Plays - Diving objects distorted - Effects Horizontal Position.
5-L	74LS367	Stays in Ram - Rom Test - Garbage in test.
6-L	82S123(Color Rom)	Game Plays - No Invaders - No diving objects - No Letters & Numbers. Sound, Stars, Shells, Missile OK.
8-L	74LS00	Horizontal lines - Continuous Sound.
9-L	74LS259	Effects Tone Generator - No Explosion - Wrong Tones all other sounds - Back-ground sound in game over.
10-L	ULN2075B	Game Plays - 2 player game 2nd player fails to fire missile & move L&R. No Meter Pulse.
1-M	74LS86	Game Plays - Diving objects are Blocks, Invaders are Blocks - Letters & Numbers are Blocks Missile Shells and Stars are OK.
2-M	74LS273	Game Plays - No Invaders - Diving objects - Letters & Numbers. Missile - Shells - Stars, Audio OK.
3-M	74LS30	Game Plays - No Missile - No Shells.
4-M	74LS367	Defective Ram - Rom Test runs continuous.
5-M	74LS367	Same as 4-M.
6-M	74LS273	Game Plays - No Invaders - Letters - Numbers - Galaxips. Effects color Rom 6-L. Stars - Missile - Shells OK.
8-M	74LS138	Continuous Tone sound - Bit & Bytes cover entire screen.
9-M	74259	Game Plays - Effects Tone Generator - Alters Background Sound - No Meter Pulse.
1-N	27LS00(Ram)	Game Plays - Diving Objects Distorted - Colors Missing.
2-N	74LS08	Blank Screen - Effects Ram select 7-P & 7N.

GALAXIAN

Trouble Shooting
PC A082-91352 Logic Board.
(Continued)

POSITION	CHIP	POSSIBLE TROUBLE
3-N	74S20	Game Plays - 3 Rows of Invaders Missing(Dots) Numbers & Letters are yellow - No Diving Objects Effects Color 2.
4-N	74LS283	Defective Ram Rom Test - A row of Numbers at bottom of screen. (20) Invaders appear lower screen - Stars OK.
5-N	74LS283	Defective Ram Rom Test - Horizontal squares appear - Stars OK.
6-N	74LS02	Stars only - Stars move up screen -Effects color Rom 6-L.
7-N	2114(Ram)	Bad Rom #1.
8-N	74LS138	Bad Rom #1 - Effects Dip Switch & Controls.
9-N	74LS259	Defective Ram - Rom Test - Stars move jerky up screen.
1-P	27LS00(Ram)	Game Plays - Diving objects distorted with missing colors.
2-P	74LS00	Game Plays - Invaders all red - Letters & Numbers are are Red & Green Effects Video O & I.
3-P	74LS20	Game Plays - Top 3 rows of invaders are dots - Diving objects groups of 3 are distorted. Effects color O&I.
4-P	74S10	No Missile - No Shells - Game Plays.
5-P	74LS74	Game Plays - Missile Horizontal yellow line - Diving objects white Horizontal lines with Multiple dots.
6-P	74LS377	Game Plays - All letters & Numbers are upside down - No diving objects - Distorted invaders - Stars move slowly & are too many.
7-P	2114(Ram)	Bad Ram #1.
8-P	74LS138	Flashes Bad Ram #1 & Letters over entire screen.
1-R	27LS00(Ram)	Game Plays - Group of 3 diving objects wrong color.
2-R	74LS08	Defective Ram - Rom Test - Entire screen letters - Numbers & Garbage.
3-R	74LS02	Blank Screen - Effects the five 27LS00 Rams.
4-R	74161	Game Plays - No Missile.
5-R	74161	Same as 4-R.

GALAXIAN

Trouble Shooting
PC A082-91352 Logic Board.
(Continued)

POSITION	CHIP	POSSIBLE TROUBLE
6-R	74175	Game plays - Invaders - Diving Objects - Letters - Numbers wrong color.
7-R	CD4066	Game Plays - No Missile Sound - No Explosion Sound - Effects all Generator Tones. (High Pitch).
8-R	555	Game Plays - Effects background Sound.
9-R	555	Game Plays - Effects Background sound which is a steady tone.
1-S	27LS00(Ram)	Game Plays - Effects diving objects color.
2-S	74LS00	Game Plays - Diving Objects - Invaders Letters & Number wrong color.
3-S	74LS32	Game Plays - Diving Objects - Invaders change colors.
4-S	74S161	Game Plays - No Shells.
5-S	74S161	Game Plays - No Shells.
6-S	74S74	Garbage entire screen - No Colors Continuous Tone Sound.
7-S	555	Game Plays - No Missile Sound.
8-S	555	Game Plays - Effects Background Sound wrong pitch.
1-T	27LS00(Ram)	Game Plays - Diving Objects are white dots.
2-T	74LS86	Game Plays - Horizontal Lines on Invaders hit - Diving Objects Horizontal lines - Flashing Horizontal lines in Ram - Rom Test.
3-T	74LS86	Game Plays - 16 Horizontal lines across screen - Lines change in thickness when playing.
4-T	74LS163	Games Plays - Diving Object appears at top of screen - Explosion appears at top of screen.
5-T	74LS163	Game Plays - Same as 4-T.
6-T	74LS393	Defective Ram - Rom Test - Screen total garbage. Effects Watchdog.
7-T	LM324	Game Plays - No Explosion - No Missile Sound - Effects Background Sound.
8-T	555	Game Plays- Effects Background Sound.
1-U	74LS174	Game Plays - Diving Objects Missing.

GALAXIAN

Trouble Shooting
PC A082-91352 Logic Board.
(Continued)

ADDITIONAL DEVICES

POSITION	
1-F	Crystal (18,432).
1R-1	+5VDC Regulator 78GV.IC
1R-2	Pass Transistor D44VM4 (Tip 31)
7-K & 7-L	Memory Board PC - 082 - 91353 - A866
Note:	Loose or Missing Memory Board Screen will be total Garbage.
	The 74LS42 Decoder IC on Memory Board is Rom Select.

NOTES

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GALAXIAN LOGIC BOARD

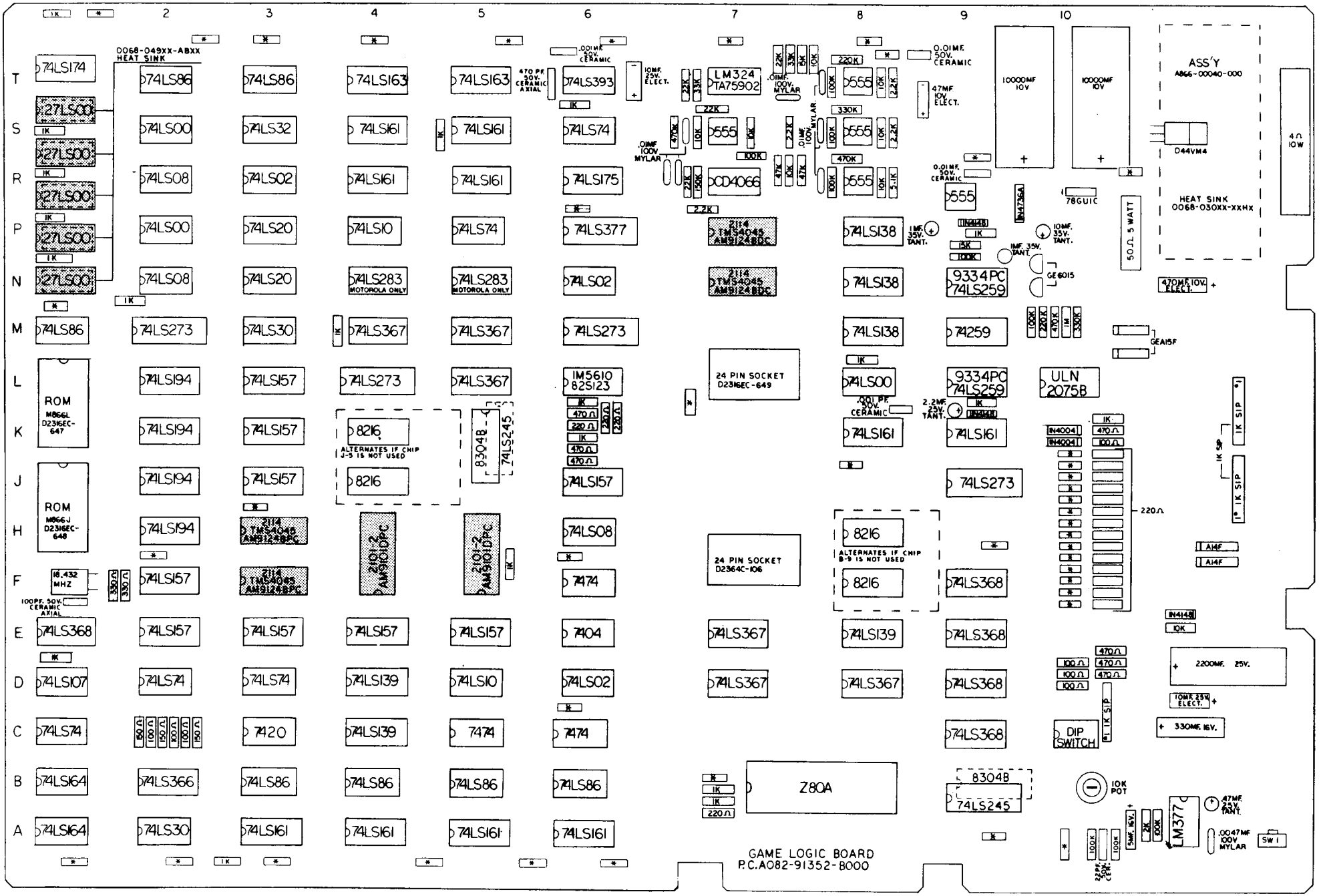
CHIP NUMBER	FUNCTION
74LS00	Quad Two Input Nand
74LS02	Quad Two Input Nor
7404	Hex Inverter
74LS08	Quad Two Input And
74LS10	Triple Three Input Nand
74LS20	Dual Four Input Nand
74LS30	Eight Input Nand
74LS32	Quad Two Input Or
74LS74	Dual "D" Flip-Flop
74LS86	Quad Two Input Exclusive Or
74Ls107	Dual "JK" Flip-Flop
75LS138	Three to Eight Line Decoder
74LS139	Dual Two to Four Line Decoder
74LS157	Quad Two Input Multiplexer
74LS161	Four Bit Counter
74LS163	Four Bit Counter
74LS164	Eight Bit Shift Register
74LS174	Hex "D" Flip-Flop
74LS175	Quad "D" Flip-Flop
74LS194	Eight Bit Shift Register
74LS259	Eight Bit Addressable Latch
74LS273	Octal "D" Flip-Flop
74LS283	Four Bit Binary Adder
74LS245	Octal Bus Transceiver
74LS366	Hex Bus Driver-Inverting
74LS367	Hex Bus Driver
74LS368	Hex Bus Driver - Inverting
74LS377	Octal "D" Flip-Flop

GALAXIAN LOGIC BOARD

CHIP NUMBER	FUNCTION
74LS393	Dual Four Bit Binary Counter
27LS00	Ram
2114	Ram
TMS4045	Ram
AM9124	Ram
2101-2	Ram
AM9101	Ram
8304	Bus Driver - Bidirectional
8216	Bus Driver - Bidirectional
LM324	Quad Operational Amp
555	Timer
LM377-1877	Audio Amp
Z80	CPU
2716	Prom - 16K
1M5610	Prom
78GUIC	Voltage Regulator
ULN2075	Quad Buffer
18.432	X-TAL
CD4066	Quad Electronic Switch
D44VM4	Transistor
GE6015	Transistor
MC14066	Quad Electronic Switch
GEA15F	Diode - Rectifier
A14F	Diode - Rectifier
IN4148	Diode - Rectifier
IN4736A	Diode - Zener
D2316EC 2716 & 9316	16K Rom - Prom
D2364C	64K Rom

COMPONENT LAYOUT PART NO. M051-00866-8002

* INDICATES 0.1MF. 50V. AXIAL LEAD CERAMIC CAP



NOTES

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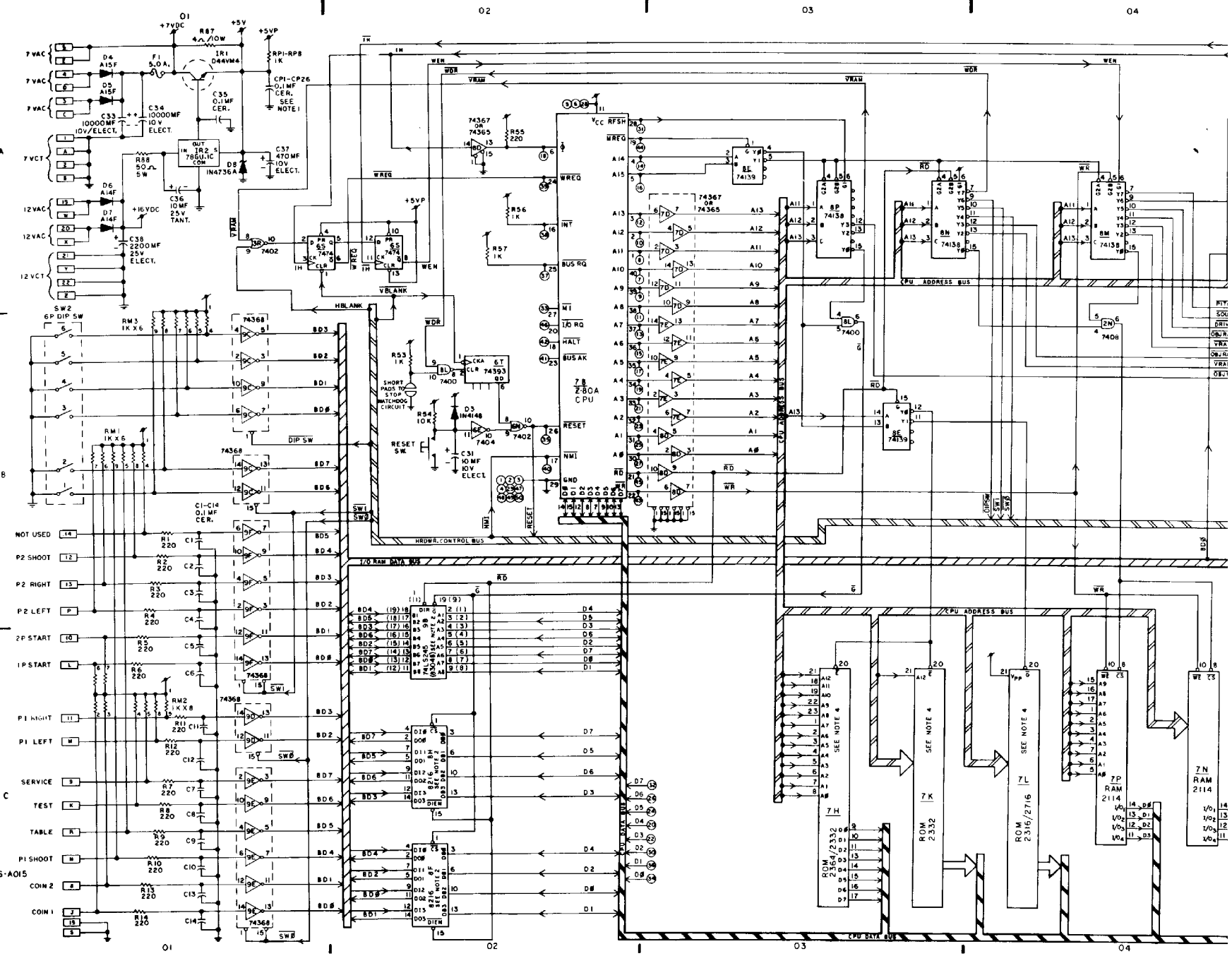
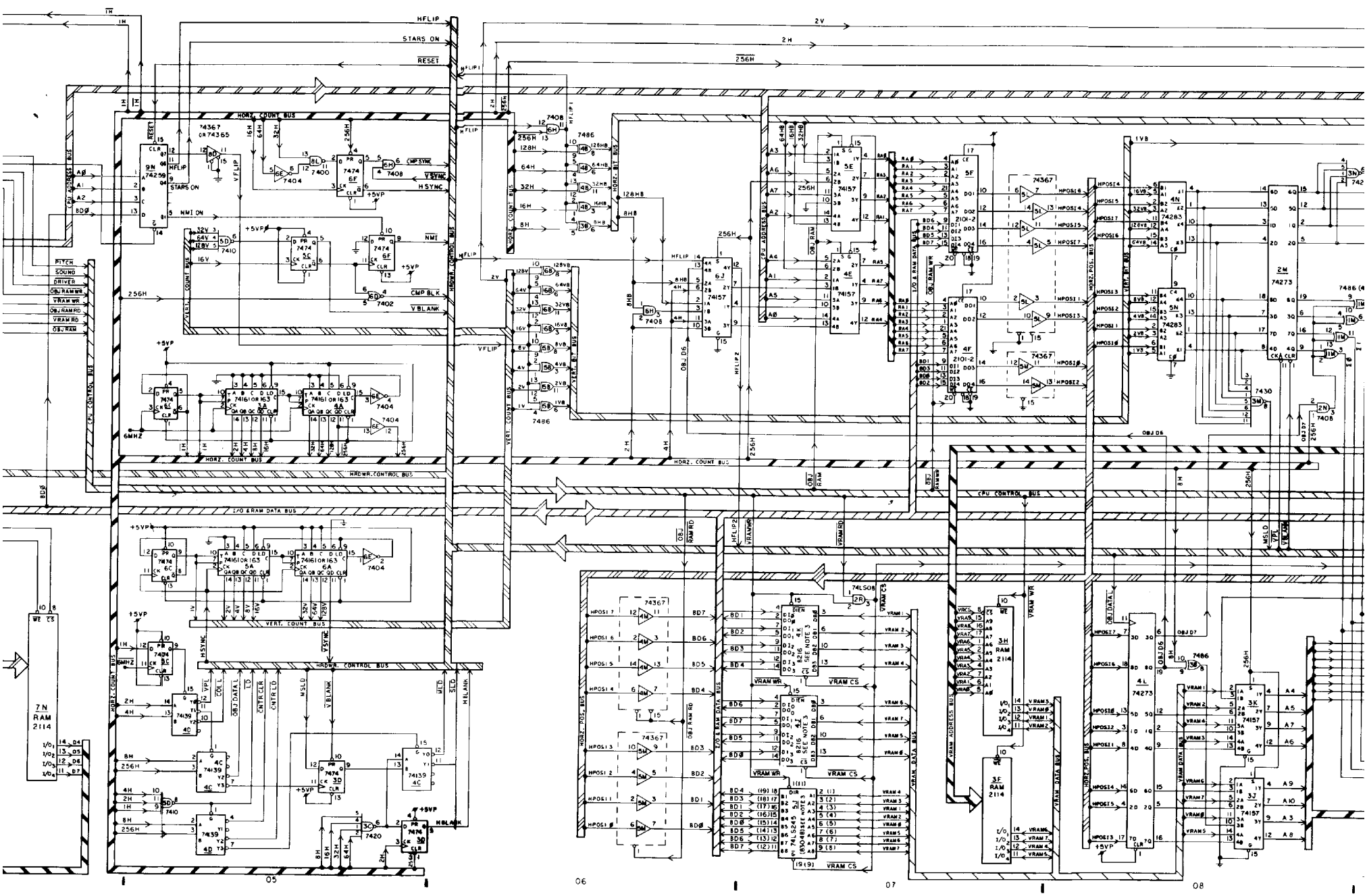
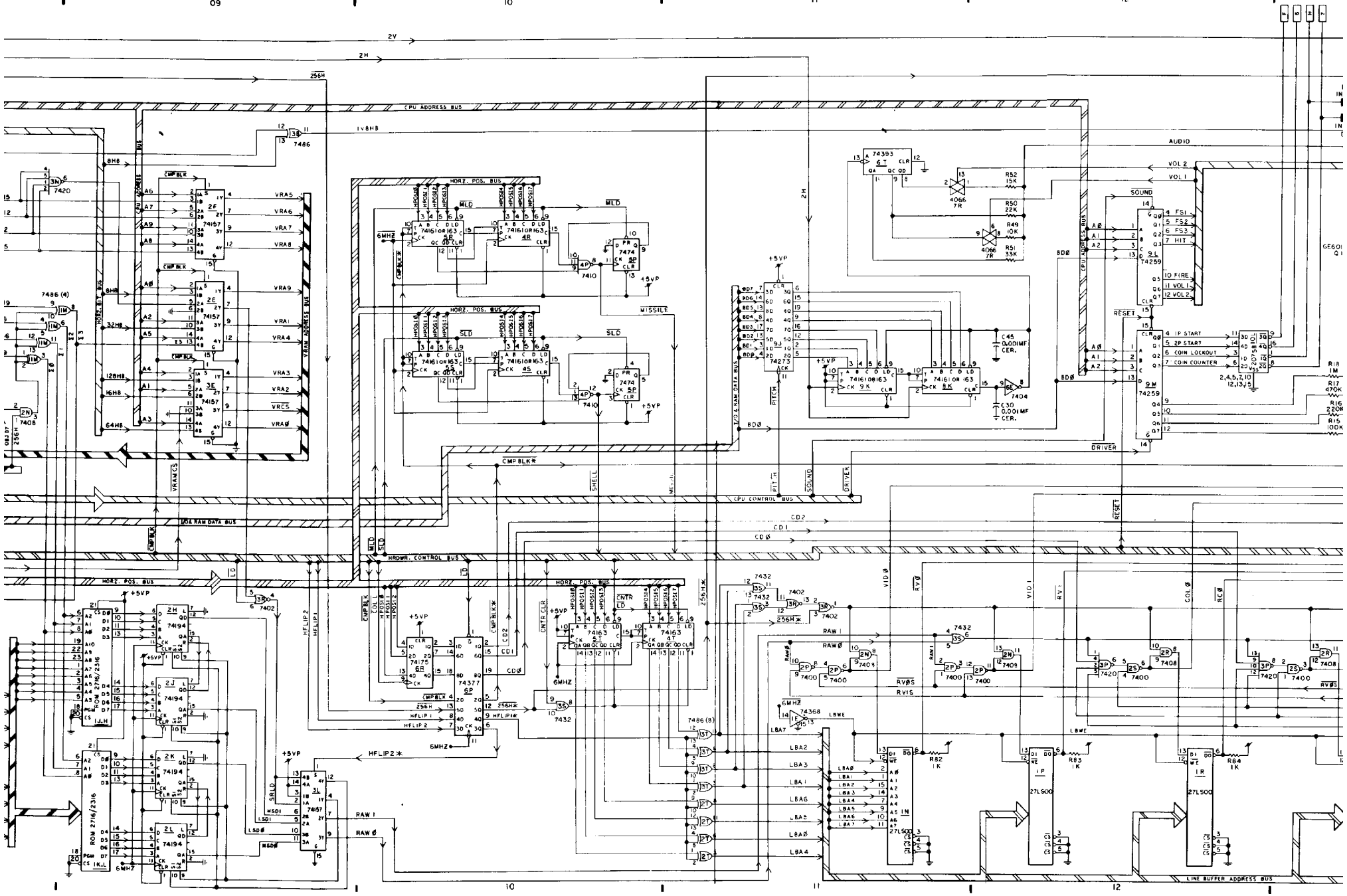
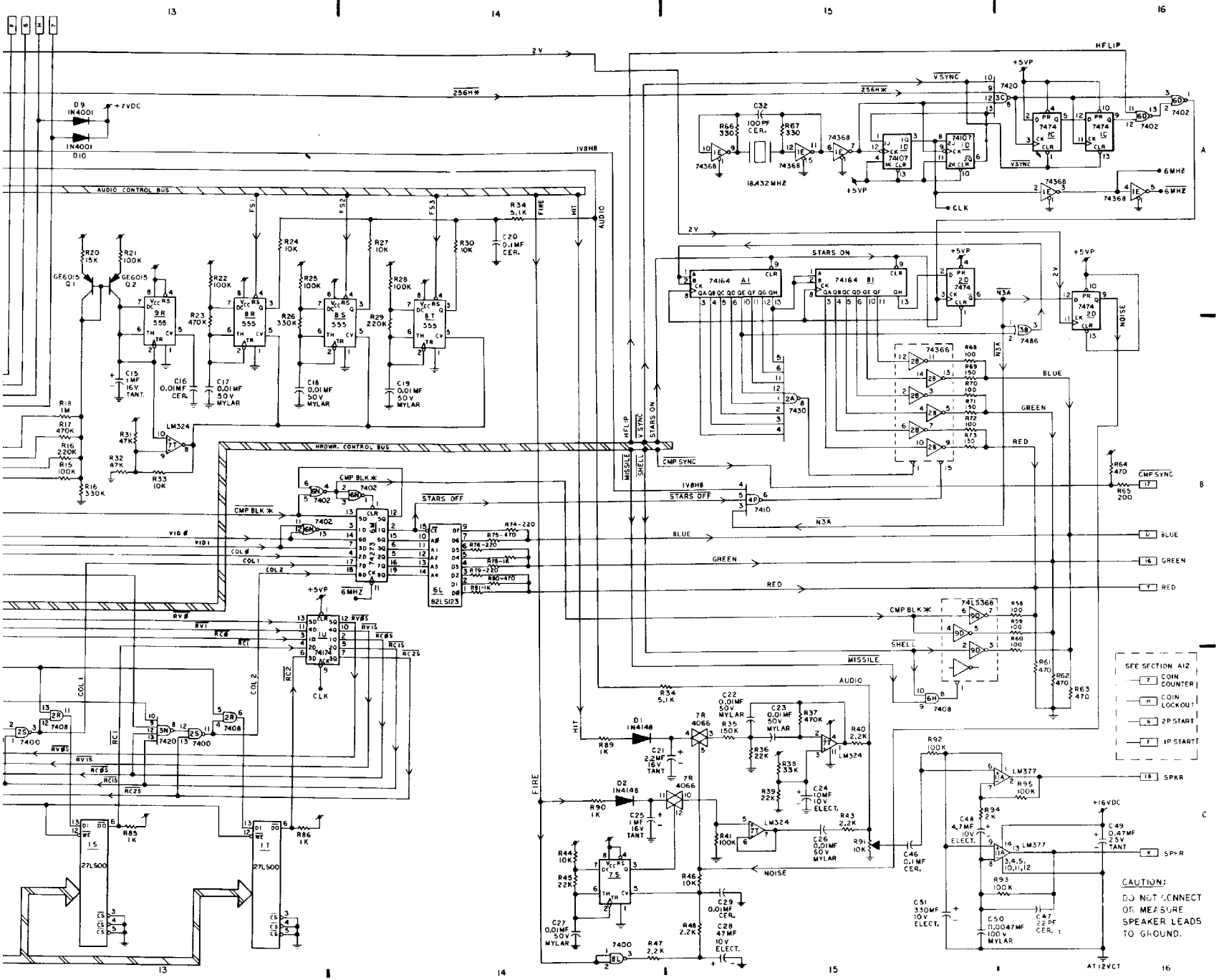

NOTES:
1. 8 PULL-UP RESISTORS AND 26 DECOUPLING CAPACITORS ARE DISTRIBUTED OVER THE P.C. BOARD ASS'Y.
2. ONLY 1 PC 74LS245, OR 1 PC 83048, OR 2 PC 8216 ARE USED (AND STUFFED) FOR BI-DIRECTIONAL DRIVERS (1 BYTE OF DATA).
3. SAME AS NOTE 2.
4. SUBSTITUTION FOR THESE ROM'S IS MEMORY BRD. ASS'Y A084 - 91353 - A866
5. INDICATES +5V
MIDWAY MFG. CO.
FRANKLIN PARK, ILL.
DRN. G. RIZZO
DATE JAN, 1980
USED ON GALAXIAN
DESC. LOGIC BOARD CIRCUITRY
PART NO. A082 - 91352 - A/B000
LOGIC SCHEMATIC PART NO. M051-00866-A015
CPU ADDRESS BUS
CPU DATA BUS
I/O R/W DATA BUS
HRDWR. CONTROL BUS
7B Z-80A CPU
7H ROM 2364/2332
7K ROM 2332
7L ROM 2316/2716
7P RAM 2114
7N RAM 2114


05
06
07
08
HFLIP
STARS ON
RESET
2V
2H
256H
HORZ. COUNT BUS
CPU ADDRESS BUS
CPU CONTROL BUS
I/O & RAM DATA BUS
HRDWR. CONTROL BUS
VERT. COUNT BUS
HORZ. POS. BUS
VRAM ADDRESS BUS
VRAM DATA BUS
VERT. BIT BUS
HORZ. BIT BUS
HORZ. CONTROL BUS
VFLIP
NMI ON
NMI
CMP BLK
CMP SYNC
VSYNC
HSYNC
VBLANK
6MHZ
PITCH
SOUND
DRIVER
OBJ RAM WR
VRAM WR
OBJ RAM RD
VRAM RD
OBJ RAM
7N RAM 2114
3H RAM 2114
3F RAM 2114
2M 74273
4L 74273
4N 74283
5N 74283
3K 74157
3J 74157
5E 74157
5F 74157
6J 74157
4F 2101-2
4E 2101-2
SEE NOTE 3
SEE NOTE 4



09
10
11
12
2V
2H
256H
CPU ADDRESS BUS
1V8H8
7486
7420
8H8
32H8
16H8
64H8
128H8
HORZ. BIT BUS
VRAM ADDRESS BUS
VRA5
VRA6
VRA7
VRA8
VRA9
VRA1
VRA4
VRA3
VRA2
VRCS
VRAØ
74157
HORZ. POS. BUS
MLD
SLD
6MHZ
7474
7410
+5VP
MISSILE
74273
PITCH
C45 0.001MF CER.
C30 0.001MF CER.
7404
74393
4066
R52 15K
R50 22K
R49 10K
R51 33K
AUDIO
VOL 2
VOL 1
SOUND
74259
FS1
FS2
FS3
HIT
10 FIRE
11 VOL 1
12 VOL 2
RESET
1P START
2P START
COIN LOCKOUT
COIN COUNTER
DRIVER
R18 1M
R17 470K
R16 220K
R15 100K
CMPBLK*
SHELL
CPU CONTROL BUS
I/O & RAM DATA BUS
HRDWR. CONTROL BUS
CD2
CD1
CDØ
ROM 2716/2316
74194
74175
74377
74163
74368
7432
7402
7400
7408
7420
RAW 1
RAWØ
RVØS
RV1S
LBWE
LBA7
LBA2
LBA3
LBA1
LBA6
LBA5
LBAØ
LBA4
27LS00
R82 1K
R83 1K
R84 1K
LINE BUFFER ADDRESS BUS
HFLIP2*
HFLIP1



13
14
15
16
AUDIO CONTROL BUS
HRDWR. CONTROL BUS
HFLIP
VSYNC
STARS ON
STARS OFF
CMP SYNC
CMP BLK
MISSILE
SHELL
AUDIO
FIRE
HIT
NOISE
BLUE
GREEN
RED
SPKR
+5VP
+7VDC
+16VDC
AT 12VCT
18.432 MHZ
6MHZ
SEE SECTION A12
COIN COUNTER
COIN LOCKOUT
2P START
1P START
CAUTION:
DO NOT CONNECT OR MEASURE SPEAKER LEADS TO GROUND.

MIDWAY'S

Galaxian

TROUBLE SHOOTING LOGIC BOARD
PART II



PHONE
(312) 451-1360

MIDWAY MFG. CO.
A BALLY COMPANY
10750 WEST GRAND AVENUE
FRANKLIN PARK, ILLINOIS 60131
U.S.A.

PHONE
TOLL FREE
800-323-7183

FORM 00214-8008

Galaxian

GALAXIAN, Midway's new space wars video game, features a full color monitor and is available in a 1 or 2 player upright or cocktail table model.

The player, controlling the Galaxian defenders of the Earth, must destroy a convoy of aliens that are equally determined to annihilate him by firing missiles. The defender must protect himself without the aid of barricades. He must shoot down not only alien army regulars, but also out-maneuver and destroy enemy fighter escort ships that peel off from the main body of the alien squadron at random.

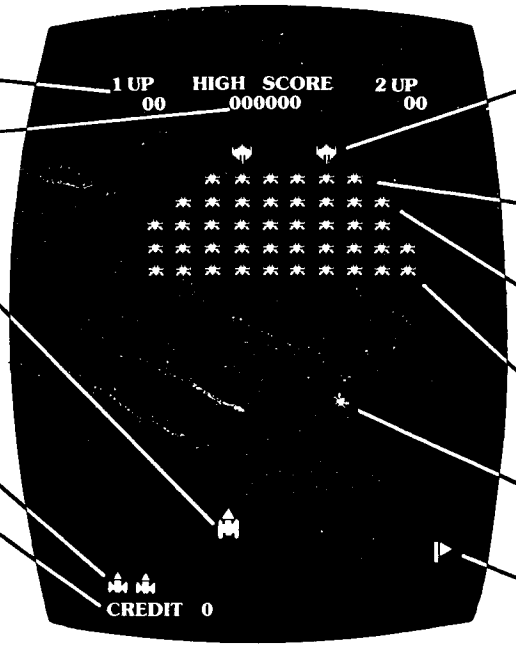
Score:
1 or 2 player. Maximum score: 999,990.

High Score:
Retained and displayed up to 6 digits.

Defender Galax Ship:
Moves freely across bottom of monitor firing missiles at aliens.

Reserve Galax Ships:
Number of player-up remaining ships clearly indicated.

Credit Line:
Maximum 9 credits per player.



ALIEN SHIPS' POINTS:

Flagship: 60 points each. 150, 200, 300 and 800 bonus points when hit while attacking.

Red Alien: 50 points each. 100 bonus points for hits while attacking.

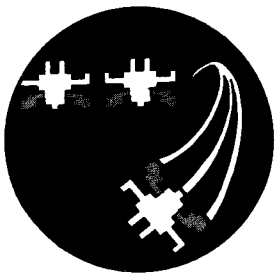
Purple Alien: 40 points each. 80 bonus points for hits when attacking.

Green Alien: 30 points each. 60 bonus points when attacking.

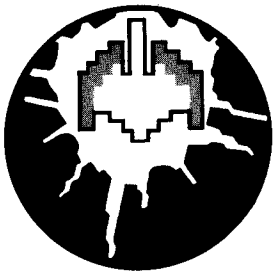
Alien Attacker Ships:
Double score for each ship shot down.

Flag: One awarded for each convoy destroyed.

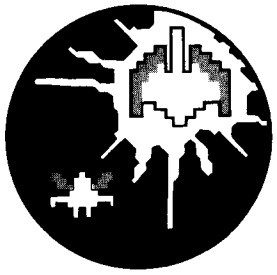
BONUS POINTS:



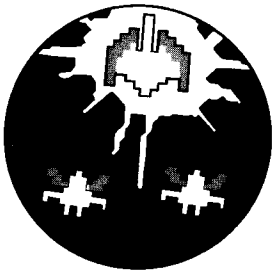
Double Points:
For lone green alien attacking at random.



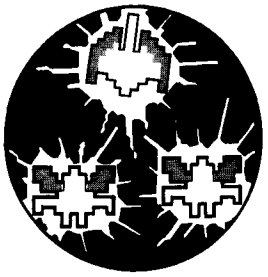
150 Points:
For hitting lone attacking flagship.



200 Points:
For hitting attacking flagship with single escort.



300 Points:
For hitting attacking flagship with two escorts.



Special 800 Points:
For destroying fighter escort and flagship. (Escort ships must be hit first.)

MIDWAY MFG. CO.
A BALLY COMPANY
10750 West Grand Avenue
Franklin Park, IL 60131
Phone: (312) 451-1360

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INTRODUCTION

Midway's new game, Galaxian, promises to be one of the hottest new games on the market today. As with any high production product, there will be a need for servicing from time to time. Therefore, since necessity is the mother of invention, this manual is being written to satisfy that need and to simplify troubleshooting.

The game itself is a highly complex system, but with a few basic tools all but the most difficult problems can be solved. This manual will show you how to track down the most common problems and show you how to fix them. It does not in any way explain how the board works, as that could conceivably run into volumes of text.

So use this manual to its fullest potential, GOOD LUCK!

NOTES

THIS SPACE IS PROVIDED FOR PERSONAL NOTES

ASSUMPTION

It is assumed throughout this manual that the board in question was once a working board; that is, there are no shorts, open lines or wrong parts. However, there may be isolated cases where such a condition occured during normal use. These conditions, although rare, will be discussed where appropriate.

It is also assumed that the service person has the following:

1) AVOM or facsimile
2) A double clip lead ie, a jumper cable
3) A''Video Probe'' assembled as follows

VIDEO PROBE ASSEMBLY

1) Use a piece of insulated stranded wire AWG 16 or smaller.
2) Solder a 470 ohm resistor to one end and tape the connection for insulation.
3) Solder a miniature clip to the other end and tape as in step 2.
4) Check completed video probe for solidarty.

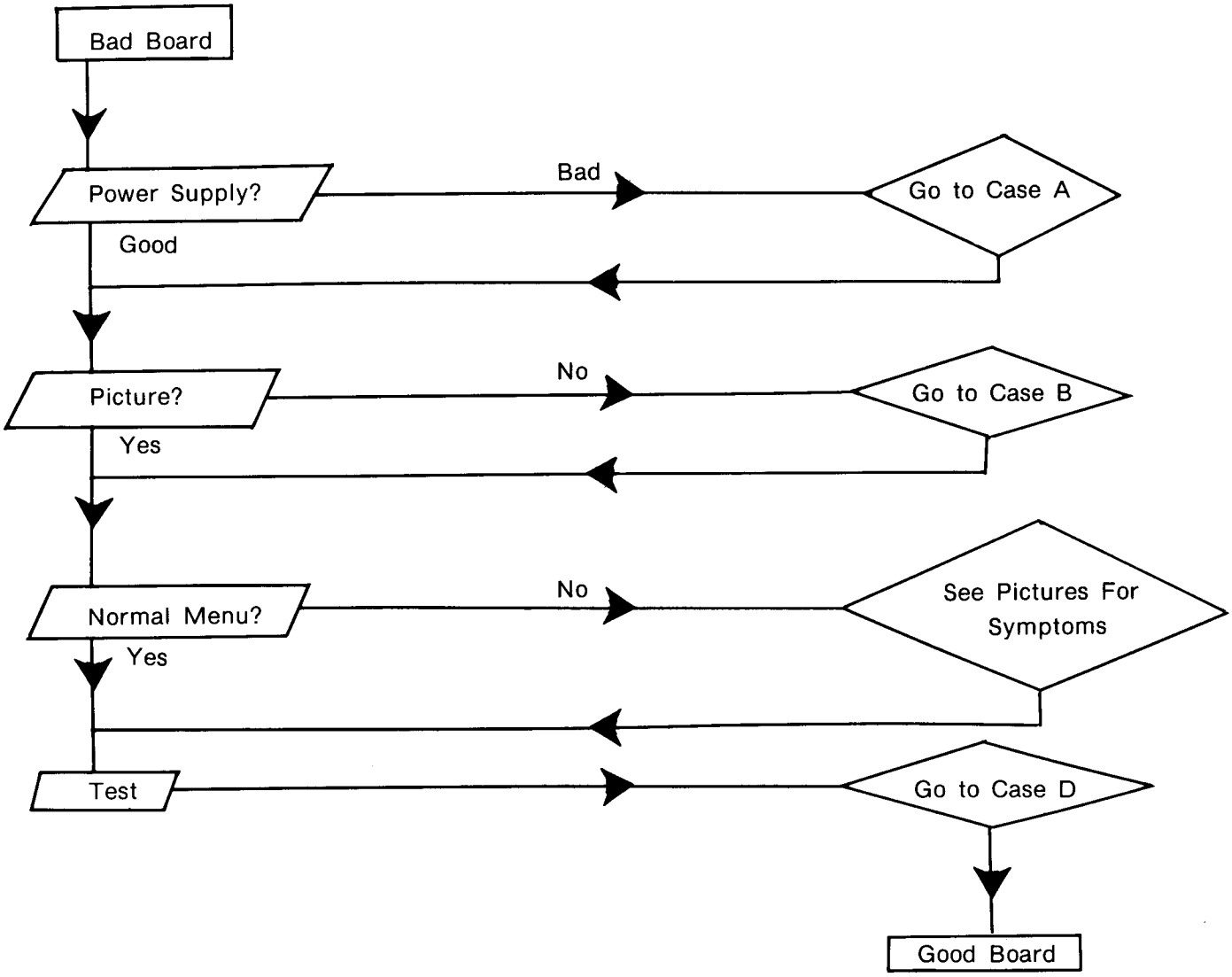
VIDEO PROBE USE

1) Connect clip of video probe to R59 between R62 and ground.
2) Test probe by touching resistor lead on probe to +5v.
3) A bright green block should be seen in the middle of the screen surrounded by a dimmer green boarder.
4) Probe is now functioning and ready to use.

It should be mentioned here that the video probe, although useful in many cases, is not a replacement for a 50Mhz oscilloscope. Whereas, it will show the presence or absence of certain signals, it will not always detect wrong signals without a little practice in identifying the wrong ones.

Therefore, if possible, it is recommended that you check the signals shown here before the board fails, to familiarize yourself with the proper responses to signals of your own video probe.

FLOW CHART OF TROUBLESHOOTING PROCEDURE



CASE A-BAD POWER SUPPLY

The power supply on the Galaxian game board is relatively simple to troubleshoot and repair.

1) Disconnect the +5v jumper located next to the two A14F diodes D6 & D7.
2) With the power off, check both sets of diodes with an ohm-meter for short or open condition. If a diode is found to be faulty, replace it.

3) If diodes check out, check the two 10,000uf capacitors for shorts to ground.

If the board is OK up to here, the problem is probably with the D44VM4 and the UA78GU1C. Replace both if found to be faulty. Turn the power on and measure +7v from one side of the jumper to ground. If +7v is not measured, replace the 1N4736 (D8) zener diode. Reconnect the jumper and turn on the power. The board should be functioning properly.

CASE B-NO VIDEO

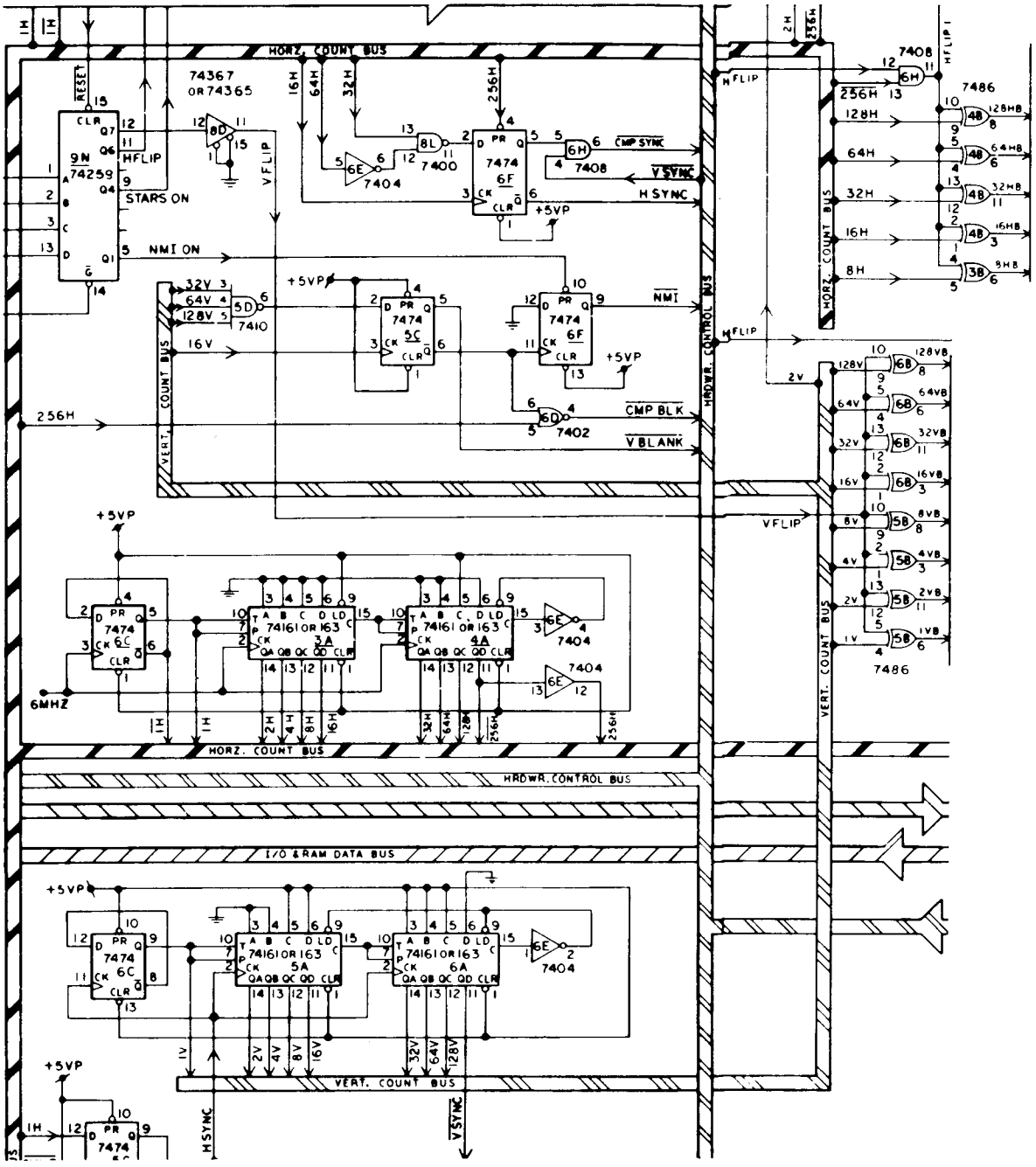
In the case of no video, it is assumed that the board was once a working board, the power supply is working, there are no stars or "garbage" on the screen

First, with the video probe previously described, check the 74LS161's located at 3A,4A,5A, and 6A. You should observe horizontal lines on the pins of 3A and 4A that become more numerous and thinner as the probe is moved from pin 11 to pin 14 on each chip. If there are none on 3A, replace the 18 Mhz crystal and after that the 74368 at 1E. On pins 11 to 14 5A and 6A, you should see vertical lines in the same fashion as 3A and, 4A. See ILLUSTRATIONS chapter.

If the lines do not appear on any of the output pins on 3A,4A,5A, & 6A cut the pin and check with Video Probe. The lines will appear if the 74LS161 is good. If the lines are missing change the 74LS161.

If these chips are found to be OK, the next step is to check the Xor gates located at 3B, 4B, 5B, and 6B. This is done in the same manner as the 74LS161's just discussed. Figure 1 shows the entire section with the Xor gates on the outputs. The inputs of these chips should resemble the outputs. If they do not, cut the pin and check the line and the pin. If the pin is OK, reconnect the first pin cut, then cut any pin connected to that line until the line looks right again. Replace faulty part.

FIG.1. SECTION SHOWING 1C 74I6Is & 7486s



If the problem hasn't been remedied by this time, it may be a difficult and involved one. See ILLUSTRATIONS of video probe data for CPU ADDRESS and DATA , and compare them with your findings. Also, try replacing the memory board and CPU to be sure they are not the cause of the problem.

CASE C-BAD MENU

The "MENU" in the case of Galaxian may also be called the "Shill" or "Attract" mode. That is, the game "plays itself" to attract players. It starts with "1 UP" and "High Score" at the top with "00" under each. "GAME OVER" appears on the lower 1/3 of the screen and "CREDIT O" in the lower left corner. It then prints the Galaxian's mission and score advance table with the "CHARGER" scores flashing. Then it plays a short game and repeats.

Many of the problems present in the game, except sound, can be observed and/or repaired in this mode. See other sections for specific problems and solutions.

CASE D-TEST

SEE PARTS AND OPERATION INSTRUCTION MANUAL SUPPLIED WITH GAME FOR COMPLETE TEST PROCEDURE

This section deals with the switches on the front panel and coin switches.

If any switches (left, right, fire, etc.) fail to work or emit a game noise during test mode, procede as follows:

1) Clean contacts on faulty switch with a stiff pen eraser.
2) With an ohm meter, check the wire from the switch to the game board for continuity.
3) Check the corresponding resistor and .1uf capacitor for proper value.
4) If the capacitor proves to be faulty, replace it.
5) If there is no problem here, change the corresponding 74LS368, according to Fig. 2. The sounds corresponding to switches are given in table 1.

TABLE 1—SOUNDS & SWITCHES

SWITCH	
Left-right	Alien hit
Fire	Missle sound
Player 1-2 start	Yellow attacker hit
Coin 1-2	Coin sound

FIG. #2 SECTION SHOWING 74368s

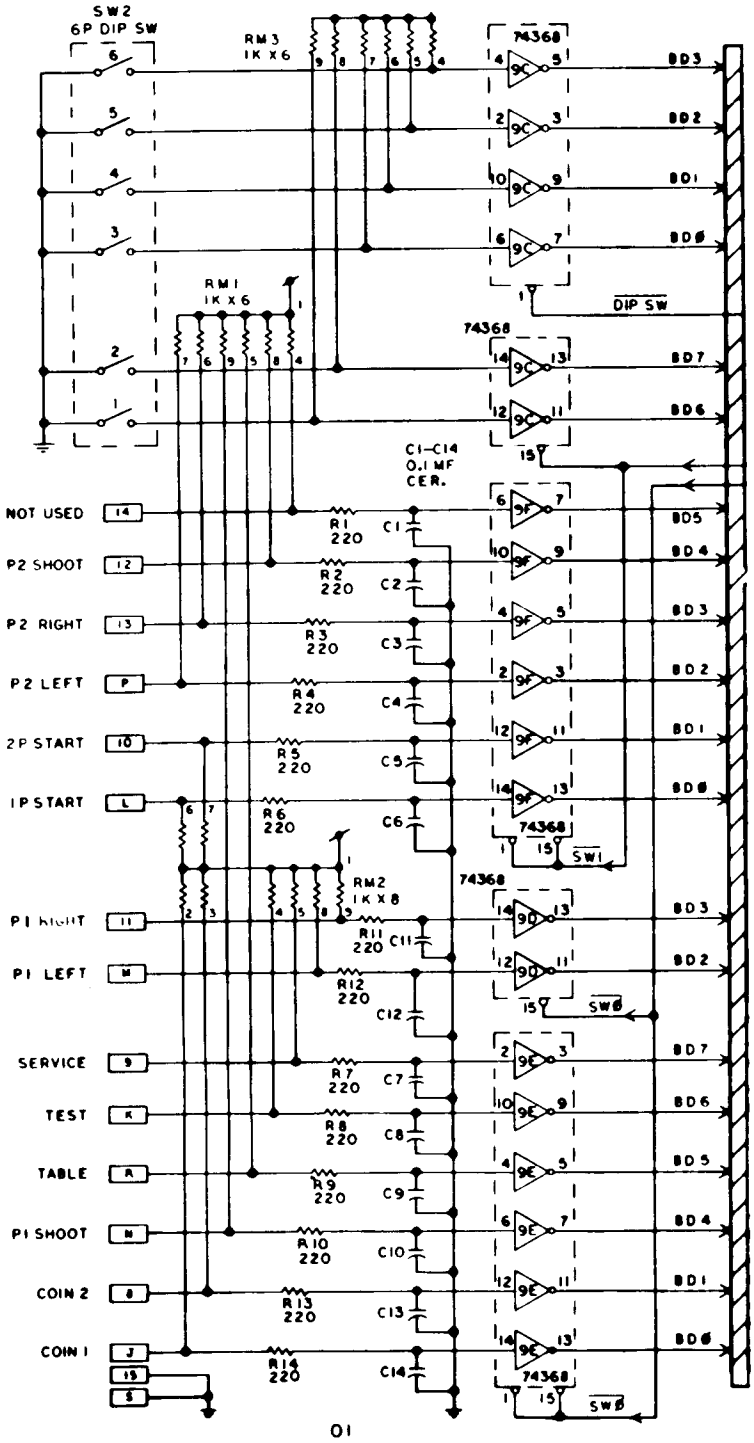


FIG. #2

CASE D1-SOUND

There should be very few sound problems, but if encountered they are easy to fix using an ohm meter and a jumper to +5v. Most often the problems will be no sound, distorted sound and/or hum. In all cases, replace the .1uf capacitor located next to the LM 377 at 11A. If this doesn't clear it up, replace the LM377 and its heat sink. (.1uf capacitor C46)

All but two of the sounds can be checked in the test mode. The sounds not tested are explosion and background noise (rack movement).

BAD EXPLOSION

To check the explosion in the test mode use a jumper to +5v and touch pin 7 of IC9L. This will cause the sound to remain on until the board is reset or placed in the game mode. If no explosion sounds, touch the anode side of D1 with the jumper. If explosion does sound, check R89 for continuity. If found to be faulty, replace it. If good, replace D1. If still no explosion, place video probe on one side of R40. "Noisy" or "dancing" green bars should be seen on the side away from pin 1 of IC7T. If not, replace LM 324 at 7T.

BACKGROUND NOISE (RACK MOVEMENT)

The background noises can be checked individually in the test mode by touching the +5v jumper to pin 4 of IC's NE555 at 8R, 8S and 8T. If any one is bad or missing, replace C17, C18, or C19 respectively. If this doesn't work, replace faulty NE555. If all sounds are present but don't oscillate, replace both Q1 and Q2, GE6015 transistors.

FIRE

The fire or missle sound if missing, can usually be fixed by replacing C26, or .01uf mylar capacitor. If not, place video probe on pin 5 of IC7T, press fire button twice rapidly and hold it in. Check screen for faint "DANCING" lines. If they are on pin 5 and not brighter on pins 6 and 7, replace bad LM 324.

OTHER SOUNDS

All other sounds are generated by the IC74LS273 at 9J, the two IC74LS161's at 8K and 9K, and the IC74LS393 at 6T as seen in figure 3. Most often these will be indicated if the sounds are "jumbled." There may be a "hissing" noise in the sound which is usually remedied by changing the 470uf capacitor, C37, next to the power supply.

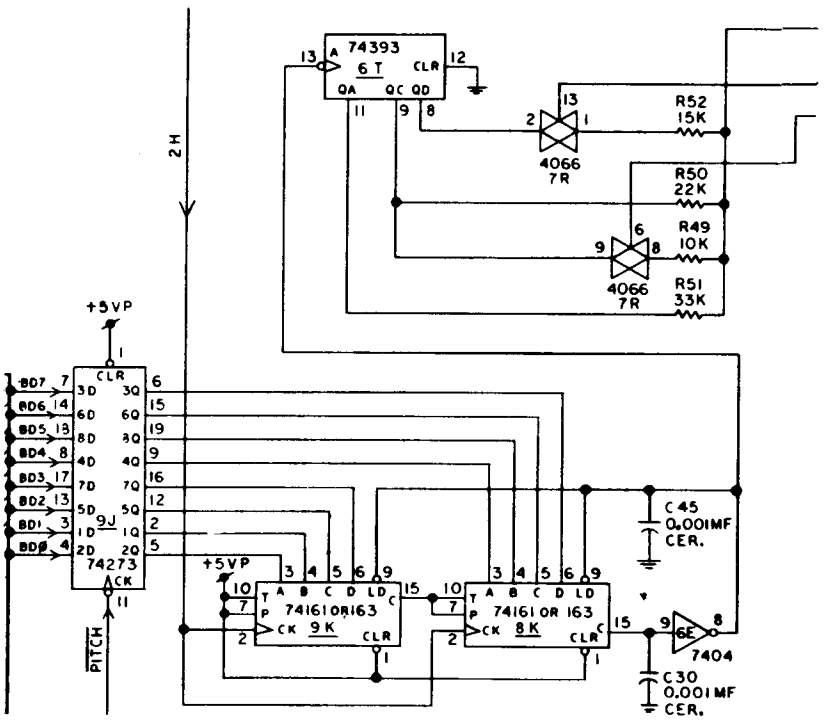
OTHER SOUNDS (CON'T)

To troubleshoot the sounds generated by 9J, 8K, and 9K, check the outputs of 9J with the video probe. When normal, an output will display a solid green block in the middle of the screen. When a switch is closed, it will flash off and on. This is true of all outputs from 9J.

If any one output does not flash, cut the pin and check the pin and the line. If the pin produces a flashing box, change the corresponding IC74LS161. If not, 9J is bad and should be replaced.

Only one output is used from the IC74LS161's, eg pin 15. If nothing is flashing on pin 15 of 8K, check pin 15 of 9K and replace 9K if found to be faulty. When all is normal up to pin 8 of 6E, and the sound is still not good, check pins 6 and 13 of 7R. When normal, pin 6 should slightly dimm the color when using the video probe. Pin 13 should put a solid green block on the screen for the duration of the sound, then dim the color. If this is not the case, cut the pin and check the line. If found to be OK, check the pin on the IC74LS259 at 9L. If the pin on 9L is OK, replace the bad 4066 at 7R. If the pin is bad, replace the bad IC74LS259 at 9L.

FIG. #3 SECTION SHOWING 74161s, 74393 & 74273



NOTES

THIS SPACE IS PROVIDED FOR PERSONAL NOTES

ILLUSTRATIONS

This chapter deals with some symptoms of bad video and shows some of the typical responses of the video probe.

Figure 1 shows the MENU with the reset button held in. You will notice the lack of stars and "charger" point values. The missing stars are normal with the reset button held in. Since the "charger" points flash on and off, they are missing only because the button was pushed when they were off.

Figures 2 through 16 show the 8 basic types of data as seen by the video probe. As can be seen in Fig. 2, 3 and 4, the VB signals start out wide and few and get thinner and more numerous as the probe is moved from pi 12 to 14 of IC5A and IC6A. The above description applies to Figures 6, 7, and 8, substituting HB signals with VB signals and IC3A and IC4A with IC's· 5A and 6A.

Figure 9 shows a typical output of the IC74LS273 located at 2M. When the game is running in the shill mode, you will notice the movement of the green bars with the rack and the Galaxip. Depending upon the output selected, the bars will be of different sizes.

Figure 10 shows a typical output of one of the outputs of the IC74LS283's located at 4N and 5N. As can be seen in the schematic, their outputs go to the inputs of the IC74LS273 at 2M and are changed to resemble the outputs shown in Fig. 9.

Figure 11 shows a typical H-Position signal. These should all look about the same but flicker at different rates.

VRAM DATA, as seen in Figure 12 will put isolated squares and rectangles on different parts of the screen. All but the one seen on pin 12 of 3F will put green squares on the screen and leave the background normal. Pin 12 of 3F will make the background green and put blank squares on the screen.

BD DATA is shown in Fig. 13. These should look similar to each other.

Figures 14 and 15 show CPU ADDRESS lines of different frequencies. You shouldn't have to check these very often, but it may help to see what they look like. This holds true for Fig. 16 as well.

VIDEO ILLUSTRATIONS

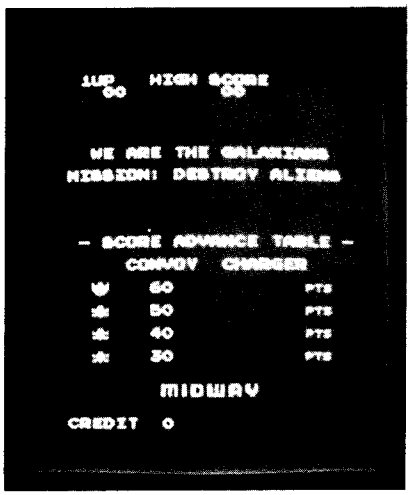


Fig. 1 Normal Menu with reset button held in.

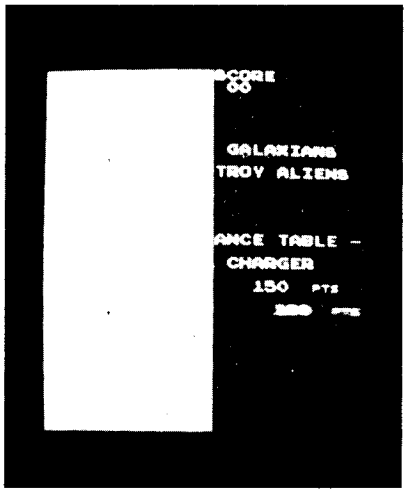


Fig. 2 Normal VB as seen with the video probe on pin 12 of IC6A

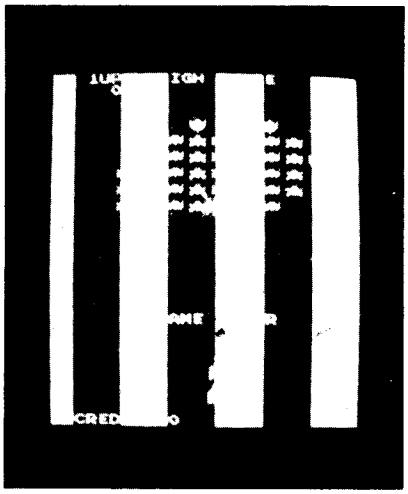


Fig. 3 Normal VB as seen with the video probe on pin 14 of IC6A.

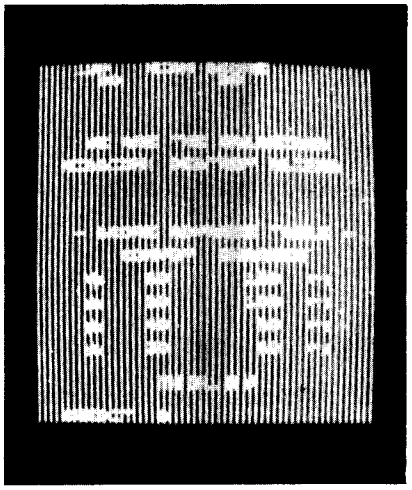


Fig. 4 Normal VB as seen with video probe on pin 14 of IC5A

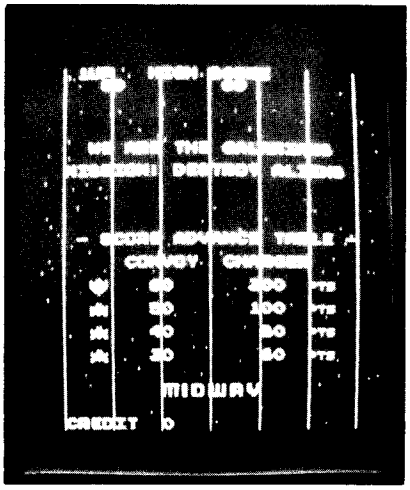


Fig. 5 Normal enable of VB counters as seen with video probe on pin 15 of IC5A and pin 10 of IC6A.

VIDEO ILLUSTRATIONS

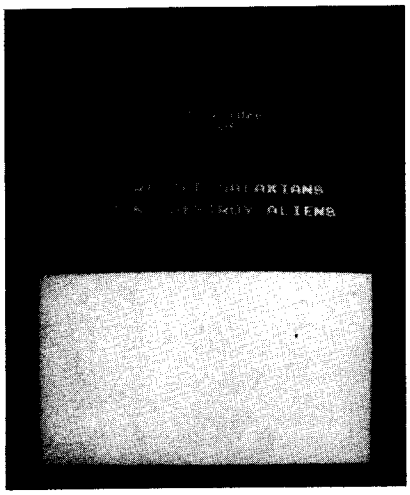


Fig. 6 Normal HB as seen with video probe on pin 12 of IC4A.

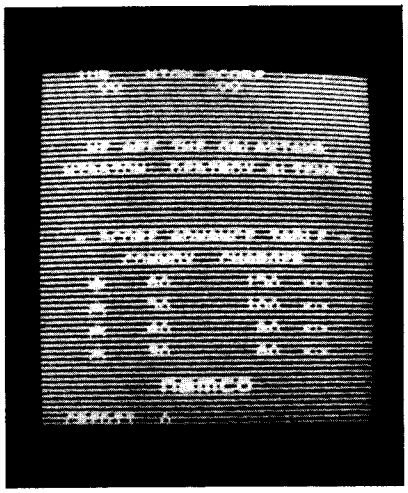


Fig. 7 Normal HB as seen with video probe on pin 14 of IC3A.

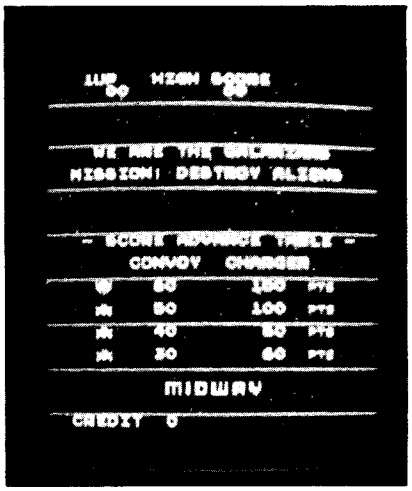


Fig. 8 Normal enable signal for HB counters as seen with video probe on pin 15 of IC3A and pin 10 of Fig. 4A.

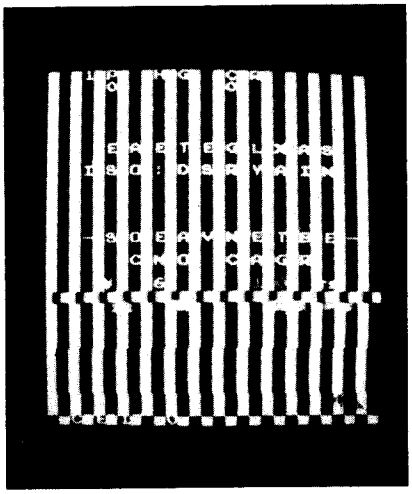


Fig. 9 Normal output of 74LS273 pin 19 of IC2M.

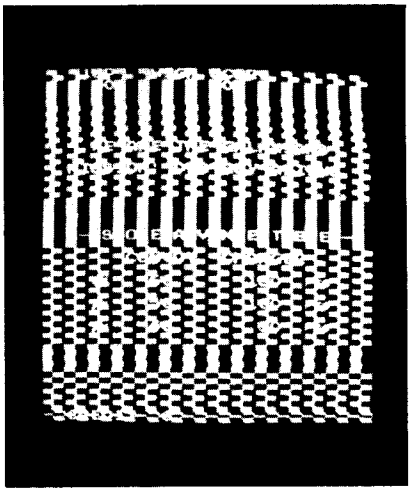


Fig. 10 Normal output of 74LS283 pin 10 of IC5N

VIDEO ILLUSTRATIONS

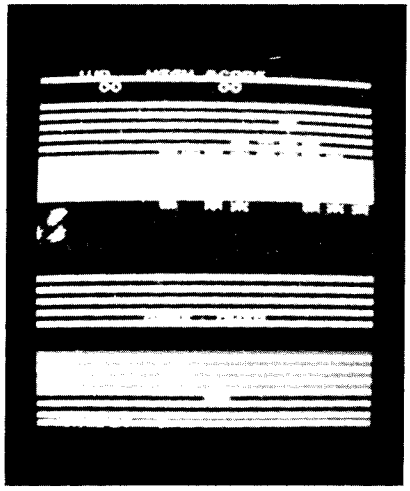


Fig. 11 Typical H POSI. data as seen with the video probe.

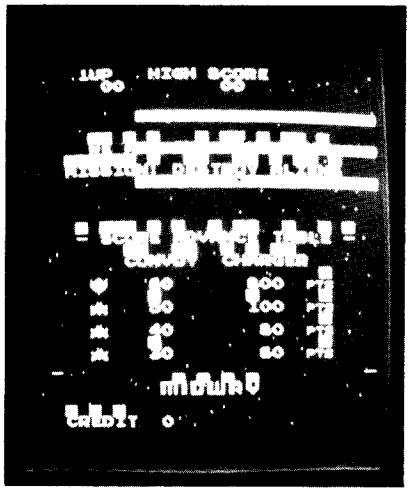


Fig. 12 Typical Vram data.

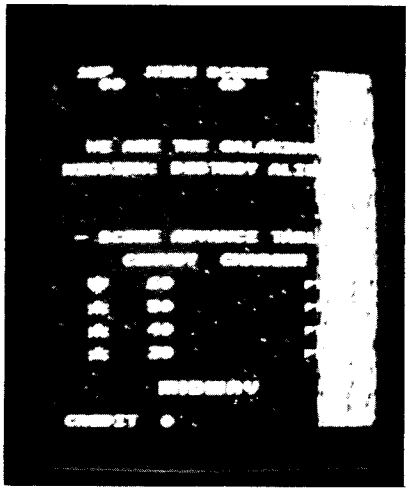


Fig. 13 Typical BD data.

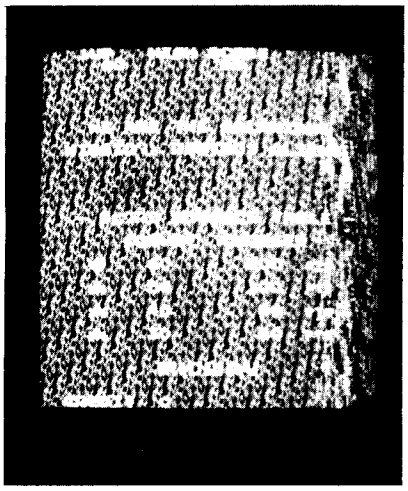


Fig. 14 Typical CPU address signal.

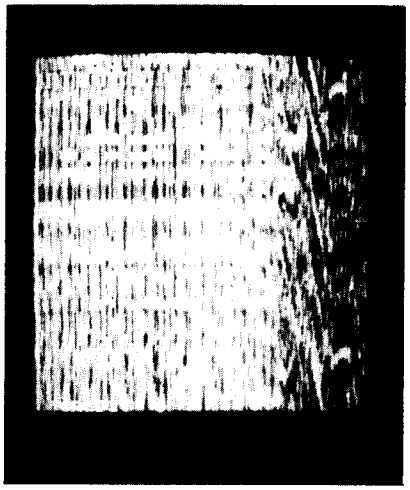


Fig. 15 another type of CPU address.

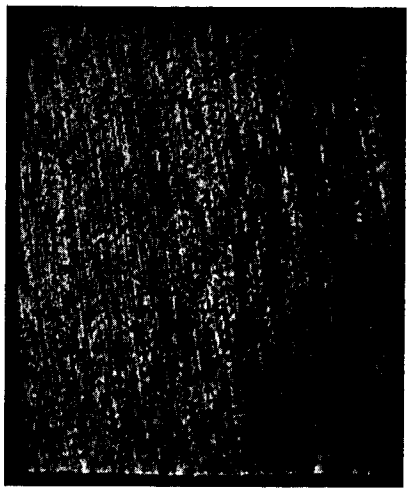


Fig. 16 Typical CPU data.

VIDEO ILLUSTRATIONS

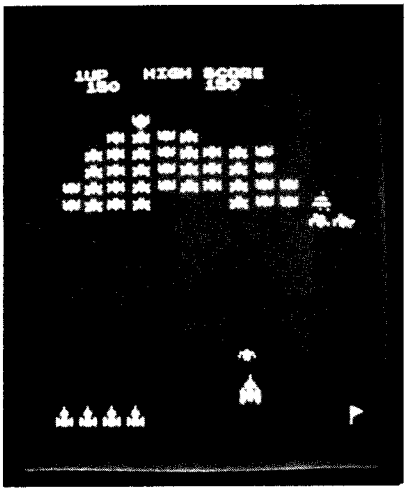


Fig. 17 Missing address on attack Ram. Note - the lines and distortion on divers. (27LS00)

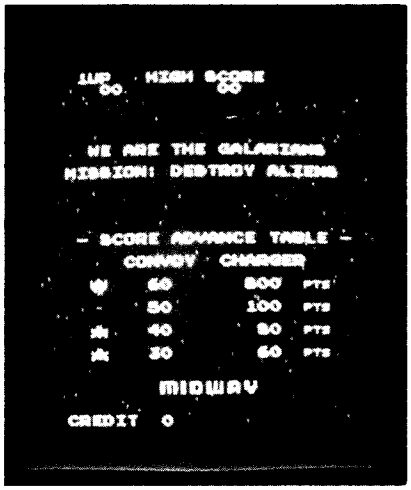


Fig. 18 Bad attack Ram 1S.

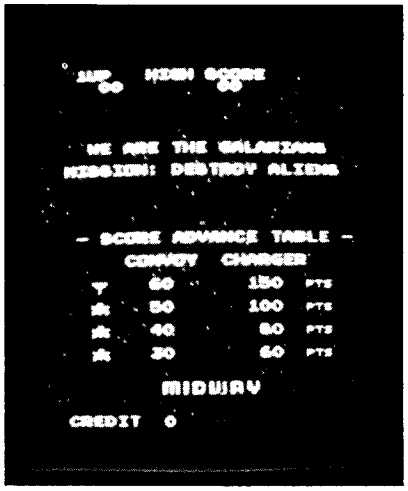


Fig. 19 Bad attack Ram 1R.

Figure 17 shows what usually happens when an attack Ram goes bad. When the aliens dive, there may be colored or just black lines through the attackers. When lines appear, it is a symptom of a missing address line within the Ram. Therefore, the bad line may not appear to be bad when viewed with the video probe.

TROUBLE SHOOTING BAD ATTACK RAMS IS DONE AS FOLLOWS:

1) Connect jumper cable to +5v.
2) Touch Pin 6 of each attack Ram and watch divers.
3) You will notice one attacker disappears or all attackers look distorted.
4) Whichever Ram makes the lines go away when touched to +5v is the defective Ram.
5) If socketed, double check by pulling out suspected Ram.
6) Replace if found to be faulty.

Figures 18 and 19 also show symptoms of a bad attack Ram. They also show what happens when the technique listed above is used for 2 of the attack Rams. See No. 3 Above.

Figure 20 shows a typical reaction to a bad output from IC4L, a 74LS273. When the attackers dive, they may turn into many different and definitely wrong characters such as parts of an explosion, red Galaxip or numbers and letters as shown here.

Figures 21 and 22 illustrate symptoms of a bad RAM 3 (IC2101 at 4F and 5F). This problem is probably the most common one you will come across. It can be described as "Breaking Up" of all movement in the rack and Galaxip. Figure 21 best shows what happens when IC5F is bad. Note the wrong letters and the small line next to the moving alien (to the right of the "30"). Figure 22 shows the "Breaking Up" of video. This usually points to IC4F, however, both IC2101's can cause either symptom.

Sometimes a bad IC2101 is indicated if the shells from the Galaxip flicker when an attacker is in the air. Also, when a shell is fired and the "High Score" moves rapidly to the right.

Other symptoms of a bad RAM 3 include, parts of aliens missing, distorted aliens after warm up, flickering aliens, distorted letters, distortion on explosion and "BAD RAM 3" on screen. If these RAMS are in sockets and any of these symptoms appear, replace the RAMS one at a time until it is cleared up. If it proves not to be a bad RAM and the motion is still breaking up, use the video probe in the following manner:

1) Place probe on the outputs of the IC74LS273 located at 2M.
2) Push reset button and wait for screen to clear.
3) Observe the motion and watch for any inconsistency of motion.
4) When inconsistency of motion is found, check the input for the same inconsistency.
5) If the input is OK, replace the IC74LS273.
6) If the input is bad, replace the corresponding IC74LS283 at 4N or 5N according to the schematic.

Figure 23 is an extreme case of bad RAM 2 ie missing pin 13 at IC 3F. Usually the board will just read, "BAD RAM 2" on the screen. If this is the case, replace IC2114's at 3F and 3H, or 9B & 5J.

Figure 24 shows a rare case of no sync. Proceed as follows:

1) Follow the line back from R65 to pin 6 of IC6H for breaks.
2) If none, clean contacts on board with a stiff pen eraser.

If that doesn't work, replace IC6H.

Figure 25 shows an input to the RAMS at 3F and 3H. It looks like fig. 9 except for the Address visible along the bottom. It is an output from a 74LS157 multiplexer located at 3E. This IC "adds" the outputs from the 74LS273 at 2M and CPU ADDRESS to supply "VRA" Address to the IC2114 RAMS at 3F and 3H.

VIDEO ILLUSTRATIONS

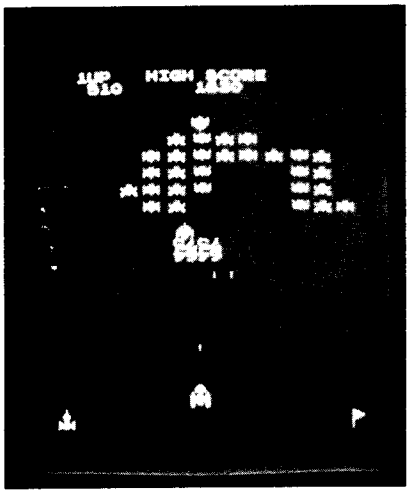


Fig. 20 Typical of bad output on IC4L.

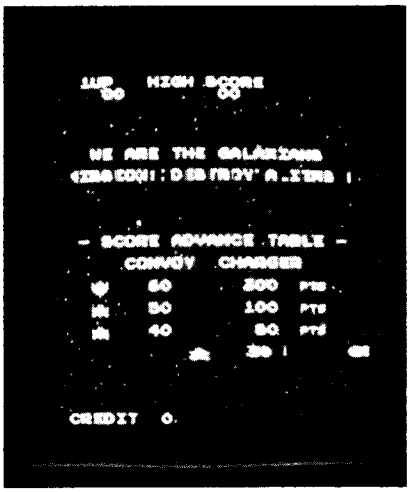


Fig. 21 Typical symptom of a bad RAM 3.

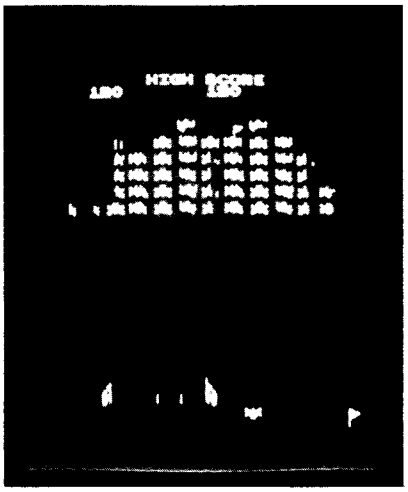


Fig. 22 Typical symptom of a bad RAM 3.

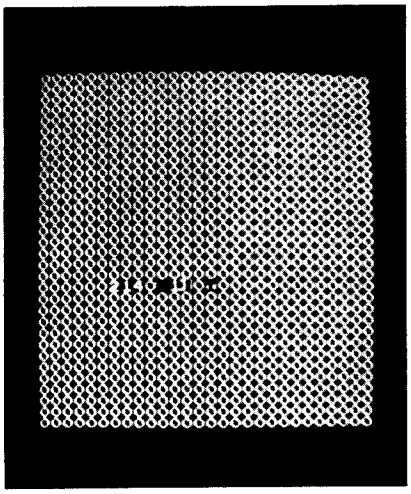


Fig. 23 Bad RAM 2

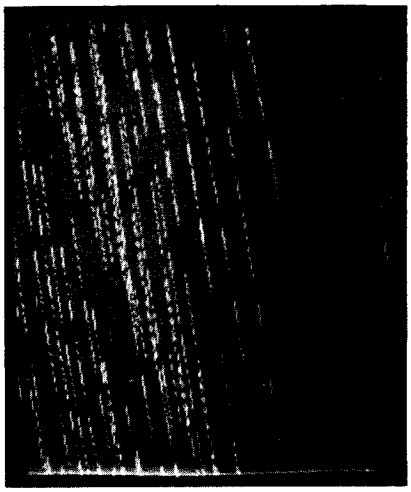


Fig. 24 No SYNC

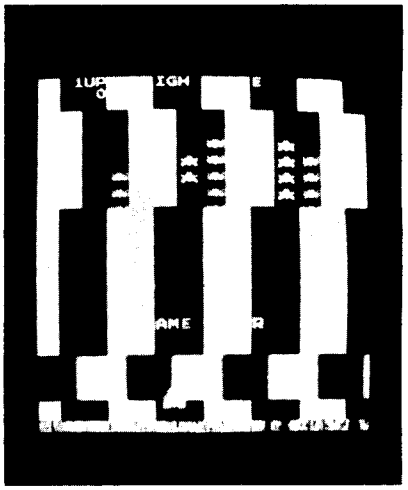


Fig. 25 Showing output data from IC5N and CPU address being multiplexed at pin 7 IC2F.

APPENDIX

QUICK REFERENCE OF PROBLEMS + SOLUTIONS

SYMPTOM	POSSIBLE SOLUTION	LOCATION
No Video	Power Supply	
Aliens Break Up*	2101	4F/5F
Picture Breaks Up	2101	4F/5F
Galaxip, Letters Break Up	2101	4F/5F
Stars Flash or are Missing	74LS164	1A/1B
Blows Fuses	Power Supply	
Lines in Picture (Colored or Black)	27LS00, 93411, 82516+	1N-1T
Lines through Attackers	27LS00, 93411, 82516+	1N-1T
Bad Ram 2 on Screen	74C245**	9B/5J**
Bad Rom on Screen	Rom Card	7F-7L
Tilts Itself (Resets)	Rom Card	7F-7L
Garbage on Screen	Rom Card	7F-7L
No Sound	1877,.1 uf Cap. (LM 377)	11A, C26

The table above shows some of the most common problems and probable trouble areas. Use this table for quick fixes and reference to problem areas only.

* SEE ILLUSTRATIONS

+ All the same type of part located at 1N-1T with heat sinks glued on.

**74C245 is a Bi-Directional bus driver. Some boards have 2-8216's as bus drivers. In this case, the problem probably lies somewhere else.

GALAXIAN LOGIC BOARD

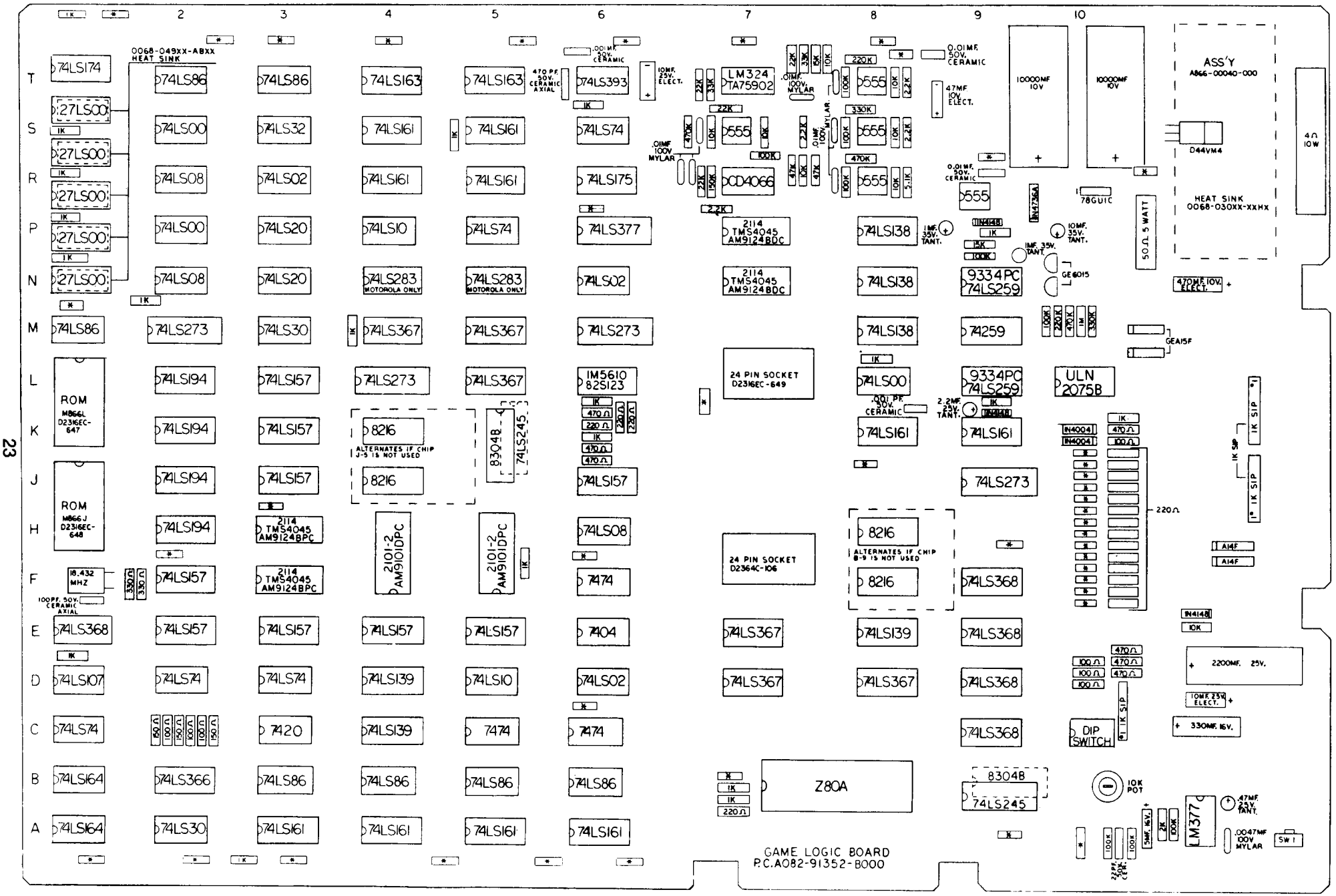
CHIP NUMBER	FUNCTION
74LS00	Quad Two Input Nand
74LS02	Quad Two Input Nor
7404	Hex Inverter
74LS08	Quad Two Input And
74LS10	Triple Three Input Nand
74LS20	Dual Four Input Nand
74LS30	Eight Input Nand
74LS32	Quad Two Input Or
74LS74	Dual "D"Flip-Flop
74LS86	Quad Two Input Exclusive Or
74LS107	Dual "JK" Flip-Flop
74LS138	Three to Eight Line Decoder
74LS139	Dual Two to Four Line Decoder
74LS157	Quad Two Input Multiplexer
74LS161	Four Bit Counter
74LS163	Four Bit Counter
74LS164	Eight Bit Shift Register
74LS174	Hex "D"Flip-Flop
74LS175	Quad"D" Flip-Flop
74LS194	Eight Bit Shift Register
74LS259	Eight Bit Addressable Latch
74LS273	Octal "D" Flip-Flop
74LS283	Four Bit Binary Adder
74LS245	Octal Bus Transceiver
74LS366	Hex Bus Driver-Inverting
74LS367	Hex Bus Driver
74LS368	Hex Bus Driver-Inverting
74LS377	Octal "D" Flipflop

GALAXIAN LOGIC BOARD

CHIP NUMBER	FUNCTION
74LS393	Dual Four Bit Binary Counter
27LS00	Ram
2114	Ram
TMS4045	Ram
AM9124	Ram
2101-2	Ram
AM9101	Ram
8304	Bus Driver-Bidirectional
8216	Bus Driver-Bidirectional
LM324	Quad Operational Amp
555	Timer
LM377-1877	Audio Amp
Z80	CPU
2716	Prom-16K
1M5610-82LS123	Prom
78GUIC	Voltage Regulator
ULN2075	Quad Buffer
18.432	X-TAL
CD4066	Quad Electronic Switch
D44VM4 TIP-31	Transistor
GE6015	Transistor
MC14066	Quad Electronic Switch
GEA15F	Diode-Rectifier
A14F	Diode-Rectifier
IN4148	Diode-Rectifier
IN4736A	Diode-Zener
D2316EC-9316	16K Rom
D2364C	64K Rom

COMPONENT LAYOUT PART NO. M051-00866-B002

* INDICATES 0.1MF. 50V. AXIAL LEAD CERAMIC CAP



Logic Terms

PC A082-91352-B000

A	Address
Audio	Common line for all sounds except Explosion
Blue	Color
Green	Color
Red	Color
BD	Bidirectional Data
CMP SYNC	Composite Sync
CMP BLK	Composite Blanking
COL	Color
CS	Chip Select
CNTR CL	Counter Clear
CLR	Clear
CD	Color Data
Driver	Enable low sounds
D	Data
DIP SW	Switches on Logic Board
FS	Frequency Select
DI	Data In

GALAXIAN

Logic Terms

PC A082 - 91352 - B000

HIT	Explosion Sound
FIRE	Missile Sound
G	Gate (chip enable)
HPOS	Horizontal position
HFLIP	Horizontal Video flip
LBWE	Line Buffer write enable
LBA	Line Buffer Address
LSD	Least Significant Bit.
LD	Load
MLD	Missile Load
MSD	Most Significant Bit
MSLD	Missile Shell Load Data
MHZ	Megahertz
Missile	Player's Missile
NMION	Non Maskable interrupt on.
Noise	Sound noise for Missile and Explosion.
I&O	Input and Output
Pitch	Load High Pitch Sounds
PGM	Program
OBJ RAM WR	Object Ram Write
OBJ RAM RD	Object Ram Read
OBJ RAM	Object Ram

GALAXIAN

Logic Terms

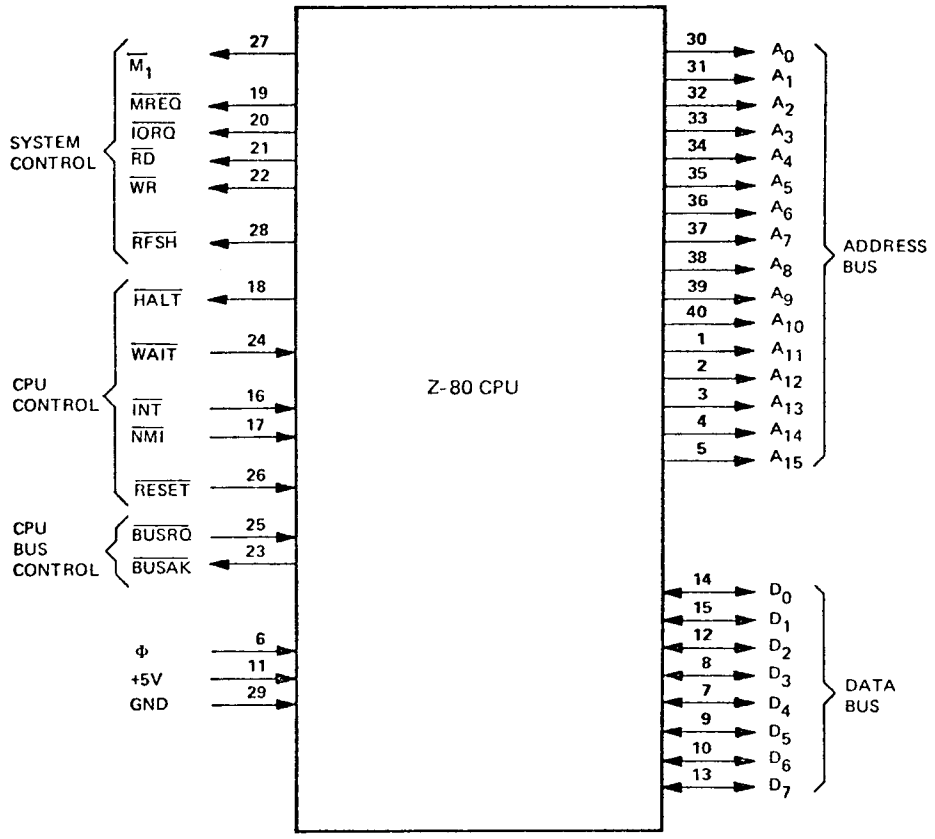
PC A082-91352-B000

RAM RD	RamRead
Reset	Clears Memory
RA	Ram Address
RC	Raw Color
RV	Raw Video
RAW	Raw (Data)
RVIS	Raw Video Select High
RVOS	Raw Video Select Low
SLD	Shell Load
Sound	Enable all Sounds
Shell	Invader Shell
Stars	Video Stars
VPL	Vertical Position Load
VID	Video
VRA	Vertical Ram Address
VRCS	Vertical Ram Chip Select
VRAM	Vertical Ram Chip Select
VRAM RD	Vertical Ram Read
VRAM WR	Vertical Ram Write
V Blank	Vertical Blanking
V SYNC	Vertical Sync

H SYNC	Horizontal Sync
V RAM CS	Vertical Ram Chip Select
VOL	Volume
WE	Write Enable
WDR	Watchdog Driver
WEN	Write Enable
WREQ	Write Request Write Enable

Z-80 CPU PIN DESCRIPTION

The Z-80 CPU is packaged in an industry standard 40 pin Dual In-Line Package. The I/O pins are shown in figure 3.0-1 and the function of each is described below.



Z-80 PIN CONFIGURATION
FIGURE 3.0-1

LOGIC TERMS Z-80 SYSTEM

ADD	Address
AUDIN	Audio In
BUSAK	Bus Acknowledge
BUSRO	Bus Request
BUZOFF	External Control
B-Y	Blue Minus Video
BYTE	Has Four Pixels
CE	Chip Select
CAS	Column Address Strobe
CASEN	CAS Enable
D-O	Data Out
D-1	Data In
DATEN	Data Enable
I or Q	Input-Output Request
HD	Horizontal Drive (63.5 us)
INT	Interrupt Request
I & O	Input-Output Signals
LTCHDA	Latch Data
LITE PEN	Interrupt Control
MD	Memory Data
MA	Memory Address
M1	Machine Cycle One
MREQ	Memory Request
MUXD	Multiplex Data
MC	Mirco Cycle Control
MENEN	Memory Enable

LOGIC TERMS Z-80 SYSTEM

NMI	Non Maskable Interrupt
OG	Phi-G Clock
PX	Monitor Picture Clock
PIXEL	Smallest spot on color monitor screen with information
RAS	Row Address Strobe
RFSH	Refresh
RAMSEL	Ram Select
RD	Memory Read
R-Y	Red Minus Video
SYSEN	System Enable
SI	Signal In
SO	Signal Out
VD	Vertical Drive (16.6 MS)
VIDOT	Video Out
WE	Write
WRTCL	Write Control
WR	Memory Write

RESET	Normally high
	an active low
	resets the Z-80

CABLE – MIDCO
TELEX NO. 72-1596

MIDWAY MFG. CO.
A BALLY COMPANY
10750 W. GRAND AVENUE • FRANKLIN PARK, ILL. 60131

PHONE: AREA CODE 312 451-1360
CHICAGO PHONE: 992-2250

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 7,000 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

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PHONE: AREA CODE 312 451-1360
CHICAGO PHONE: 992-2250

SERVICE BULLETIN

GALAXIAN LOGIC BOARD

****

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

They are:

1. M866J - 09S0
   M866L - 09S0
   M866U - 09S0
   M866V - 09S0
   M866W - 09S0
   M866Y - 09S0
   M866Z - 09S0

   → CHARACTER / PROGRAM → NAMCO

2. M866J - 09S1
   M866L - 09S1
   M866U - 09S1
   M866Y - 09S1

   → CHARACTER / PROGRAM → MIDWAY

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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TELEX NO. 72-1596

MIDWAY MFG. CO.
A BALLY COMPANY
10750 W. GRAND AVENUE • FRANKLIN PARK, ILL. 60131

PHONE: AREA CODE 312 451-1360
CHICAGO PHONE: 992-2250

SERVICE BULLETIN

GAME: GALAXIAN

TEST SLIDE SWITCH

Located in cash box area and is readily accessible by opening coin door. When placed in "on" position this switch initiates test mode.

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 Galaxip 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.

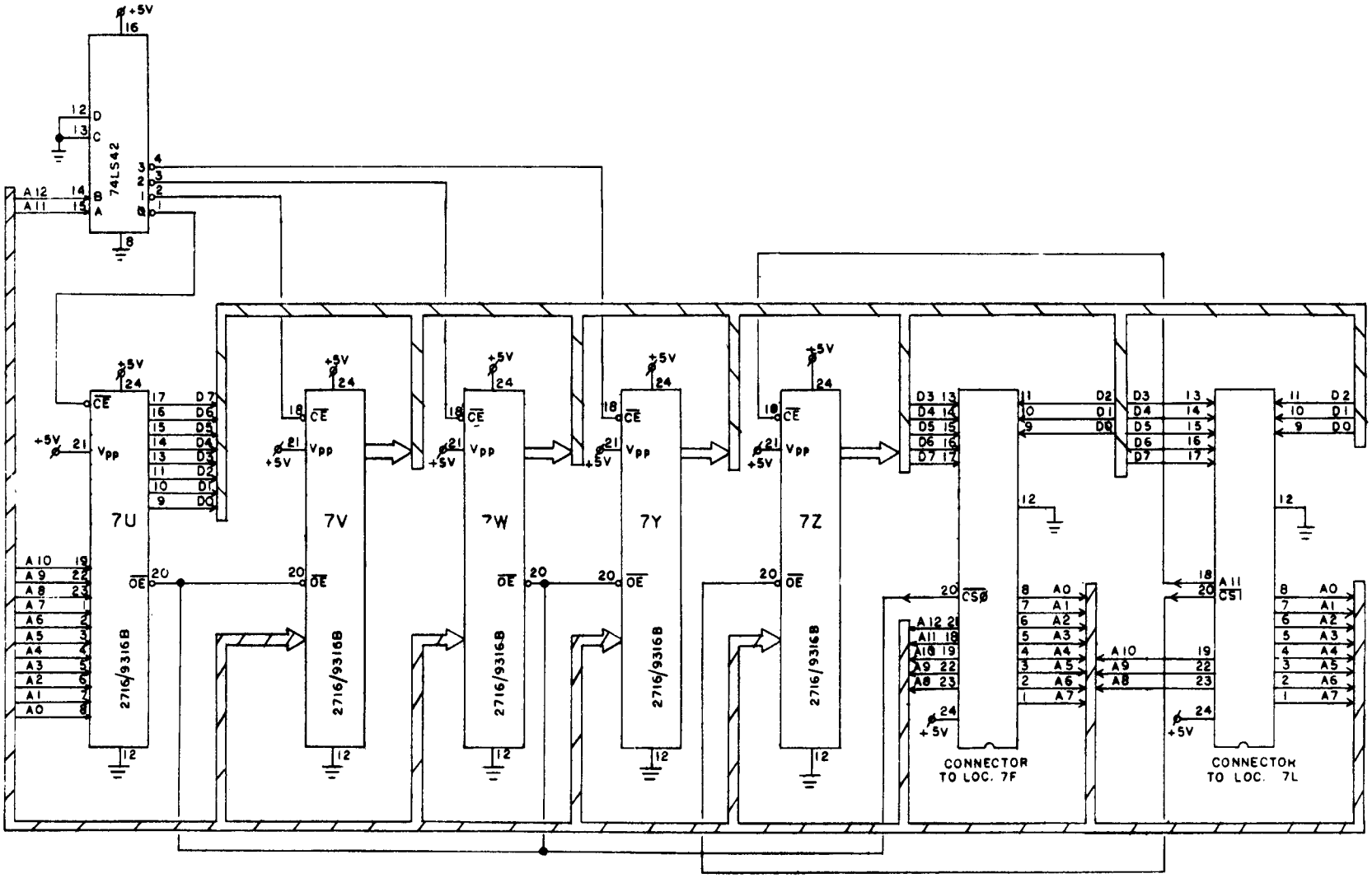
"Bad Ram" — indicates bad Rom on memory board.

*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

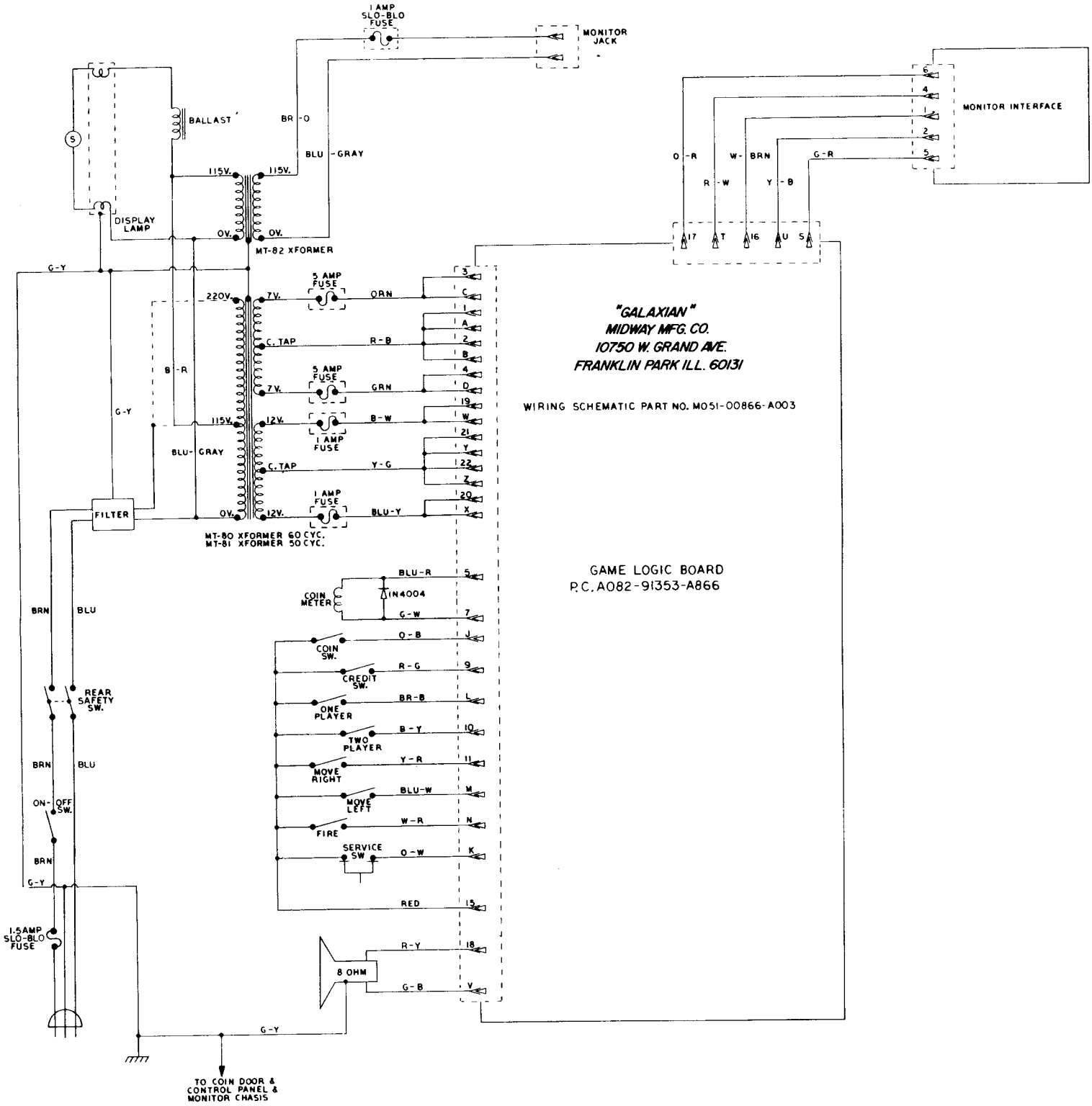
To verify operation of any switch, close switch in question. If the switch is operating properly, a game sound will emit when closure is made.

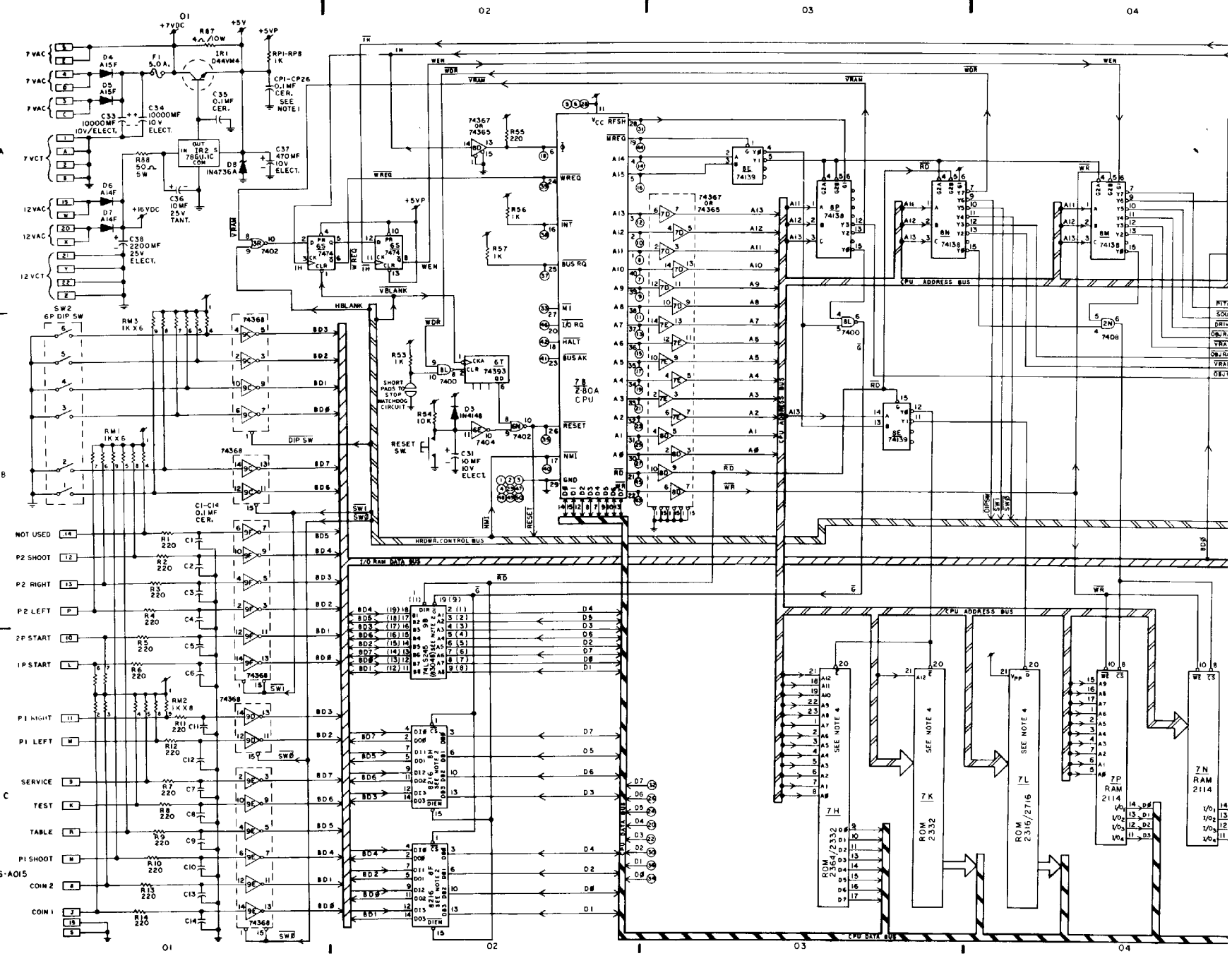
CAUTION: Be sure to return test switch to game mode when all tests are completed.

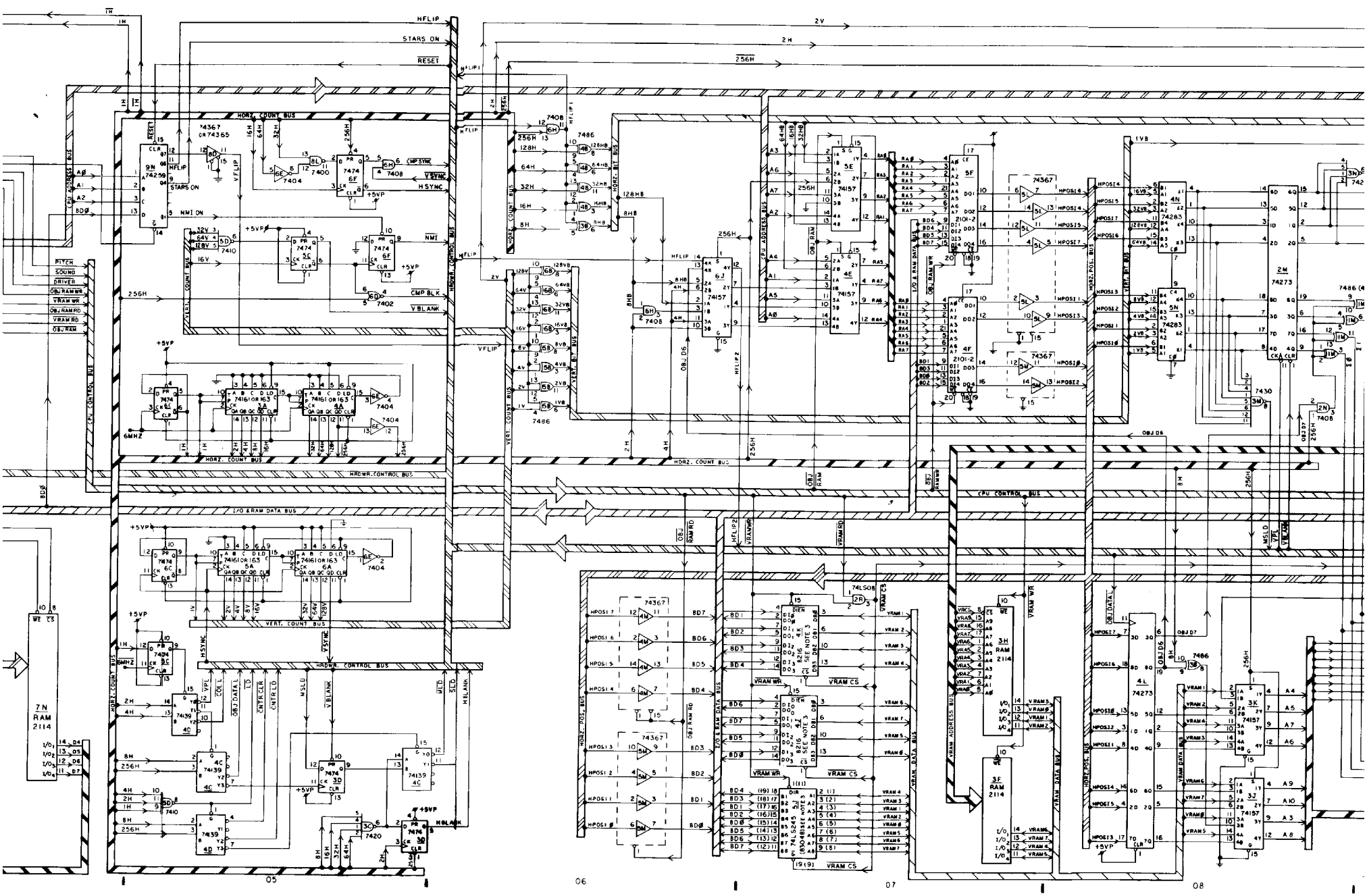


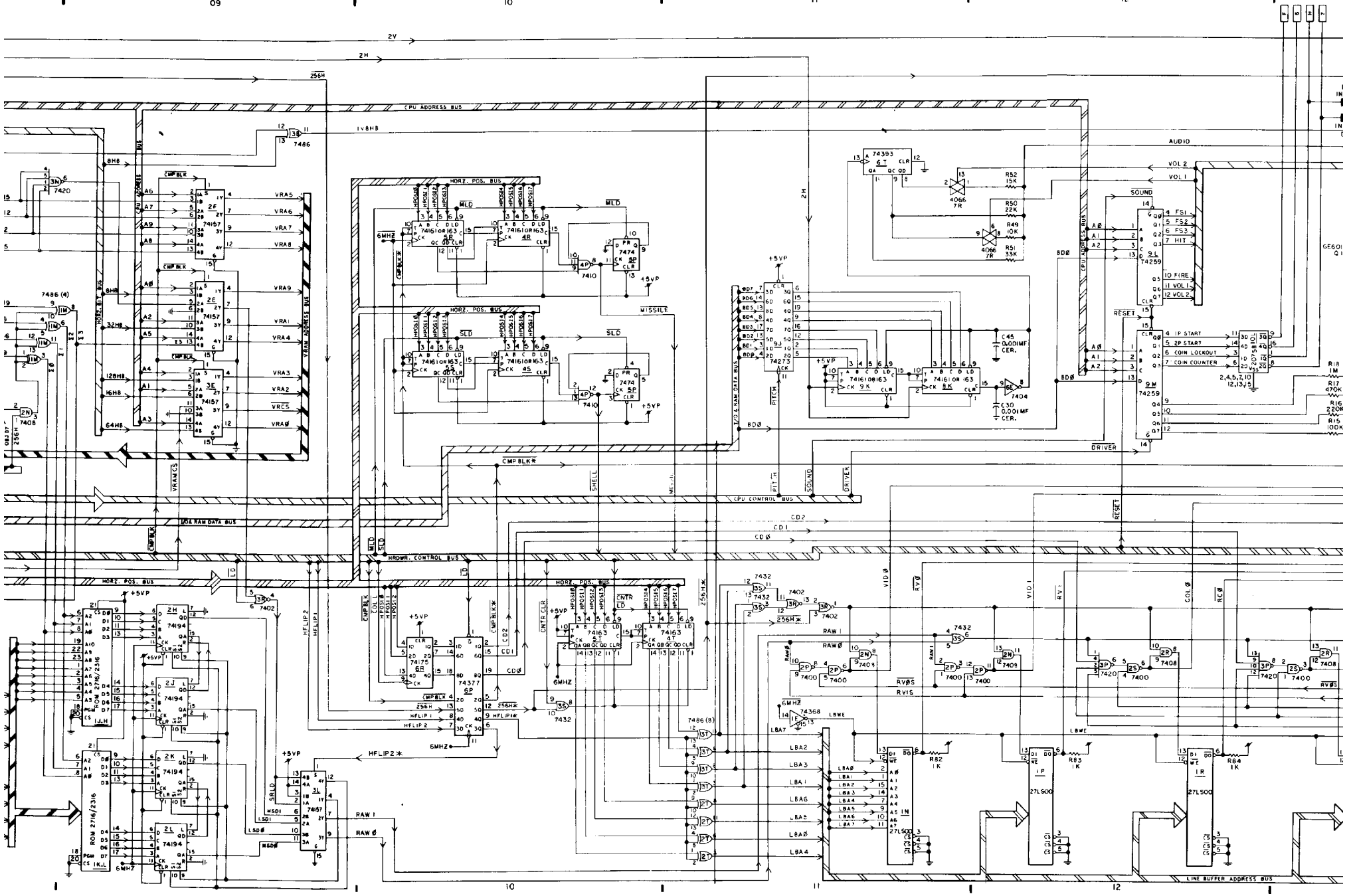
MEMORY LOGIC SCHEMATIC
PART NO. M051-00866-A004

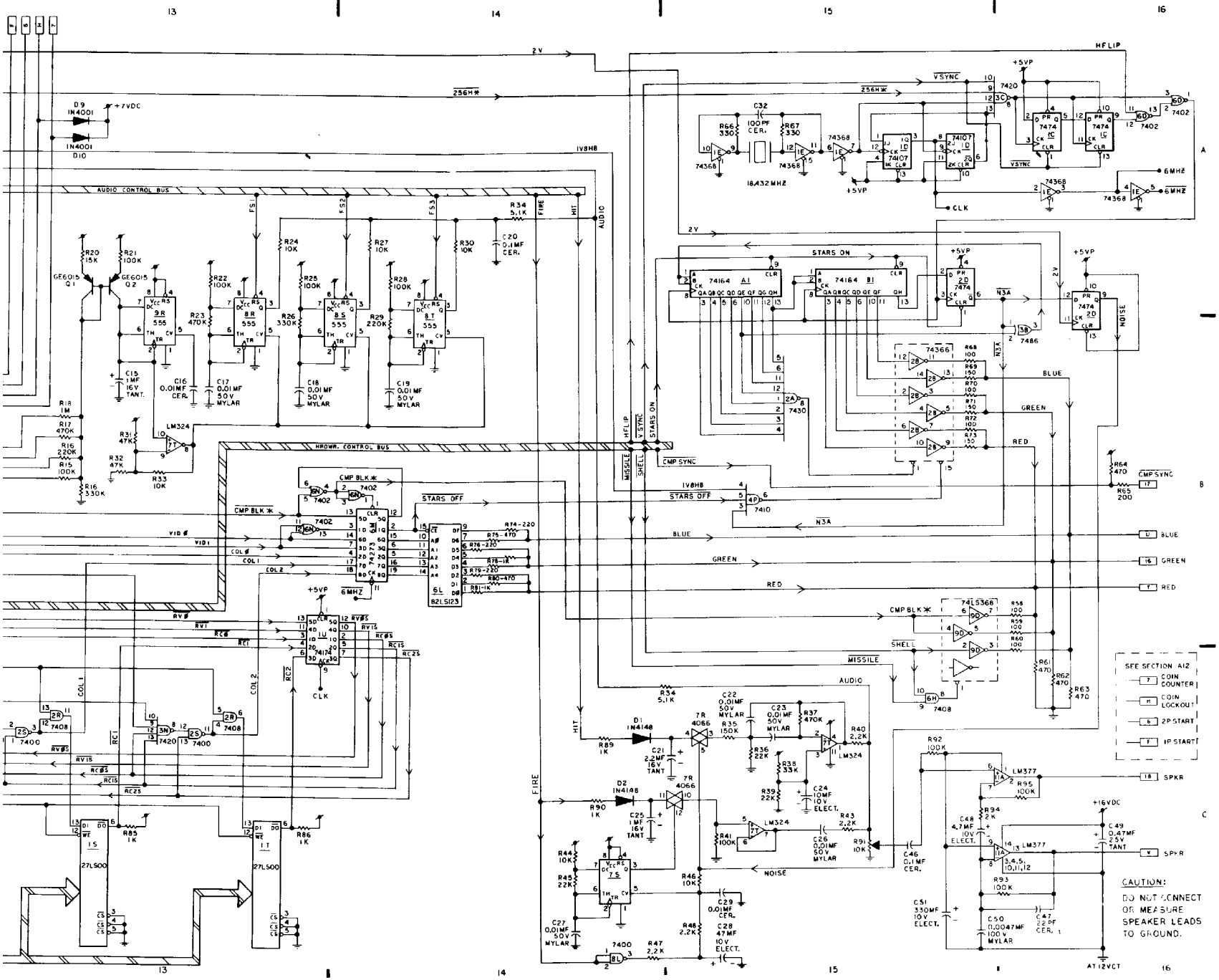
REVISIONS				
DO NOT SCALE DWG.	HEAT TREAT	SCALE	USED ON GALAXIAN	MIDWAY MFG. CO. FRANKLIN PK. ILL.
DIM. TOLERANCES UNLESS SPECIFIED	DRN. DH	MAT'L.	NO. REQ'D 1	MEMORY BOARD CIRCUIT
	CKD. L.D	FINISH	DATE Dec. 12 '79	PART NO. A082-91353-A866


1 AMP SLO-BLO FUSE
MONITOR JACK
MONITOR INTERFACE
BALLAST
BR-O
BLU-GRAY
115V.
0V.
DISPLAY LAMP
MT-82 XFORMER
G-Y
220V.
7V.
5 AMP FUSE
ORN
C. TAP
R-B
GRN
12V.
B-W
1 AMP FUSE
Y-G
BLU-Y
B-R
BLU-GRAY
FILTER
MT-80 XFORMER 60 CYC.
MT-81 XFORMER 50 CYC.
O-R
W-BRN
G-R
R-W
Y-B
"GALAXIAN"
MIDWAY MFG. CO.
10750 W. GRAND AVE.
FRANKLIN PARK ILL. 60131
WIRING SCHEMATIC PART NO. M051-00866-A003
GAME LOGIC BOARD
P.C. A082-91353-A866
COIN METER
1N4004
BLU-R
G-W
COIN SW.
CREDIT SW.
ONE PLAYER
TWO PLAYER
MOVE RIGHT
MOVE LEFT
FIRE
SERVICE SW
O-B
R-G
BR-B
B-Y
Y-R
BLU-W
W-R
O-W
RED
8 OHM
R-Y
G-B
BRN
BLU
REAR SAFETY SW.
ON-OFF SW.
1.5 AMP SLO-BLO FUSE
TO COIN DOOR & CONTROL PANEL & MONITOR CHASIS


NOTES:
1. 8 PULL-UP RESISTORS AND 26 DECOUPLING CAPACITORS ARE DISTRIBUTED OVER THE P.C. BOARD ASS'Y.
2. ONLY 1 PC 74LS245, OR 1 PC 83048, OR 2 PC 8216 ARE USED (AND STUFFED) FOR BI-DIRECTIONAL DRIVERS (1 BYTE OF DATA).
3. SAME AS NOTE 2.
4. SUBSTITUTION FOR THESE ROM'S IS MEMORY BRD. ASS'Y A084 - 91353 - A866
5. INDICATES +5V
MIDWAY MFG. CO.
FRANKLIN PARK, ILL.
DRN. G. RIZZO
DATE JAN, 1980
USED ON GALAXIAN
DESC. LOGIC BOARD CIRCUITRY
PART NO. A082 - 91352 - A/B000
LOGIC SCHEMATIC PART NO. M051-00866-A015
CPU ADDRESS BUS
CPU DATA BUS
I/O R/W DATA BUS
HRDWR. CONTROL BUS
7B Z-80A CPU
7H ROM 2364/2332
7K ROM 2332
7L ROM 2316/2716
7P RAM 2114
7N RAM 2114


05
06
07
08
HFLIP
STARS ON
RESET
2V
2H
256H
HORZ. COUNT BUS
CPU ADDRESS BUS
CPU CONTROL BUS
I/O & RAM DATA BUS
HRDWR. CONTROL BUS
VERT. COUNT BUS
HORZ. POS. BUS
VRAM ADDRESS BUS
VRAM DATA BUS
VERT. BIT BUS
HORZ. BIT BUS
HORZ. CONTROL BUS
VFLIP
NMI ON
NMI
CMP BLK
CMP SYNC
VSYNC
HSYNC
VBLANK
6MHZ
PITCH
SOUND
DRIVER
OBJ RAM WR
VRAM WR
OBJ RAM RD
VRAM RD
OBJ RAM
7N RAM 2114
3H RAM 2114
3F RAM 2114
2M 74273
4L 74273
4N 74283
5N 74283
3K 74157
3J 74157
5E 74157
5F 74157
6J 74157
4F 2101-2
4E 2101-2
SEE NOTE 3
SEE NOTE 4


09
10
11
12
CPU ADDRESS BUS
HORZ. POS. BUS
HRDWR. CONTROL BUS
CPU CONTROL BUS
LINE BUFFER ADDRESS BUS
AUDIO
SOUND
RESET
DRIVER
MISSILE
SHELL
PITCH
VRAM ADDRESS BUS
HORZ. BIT BUS
ROM 2716/2316
74157
74194
74175
74377
74163
74273
74393
74259
74368
27LS00
7486
7420
7408
7402
7432
7400
7404
7410
7474
4066
7R
R52 15K
R50 22K
R49 10K
R51 33K
C45 0.001MF CER.
C30 0.001MF CER.
R18 1M
R17 470K
R16 220K
R15 100K
R82 1K
R83 1K
R84 1K
6MHZ
+5VP
2V
2H
256H
1V8H8
8H8
32H8
128H8
16H8
64H8
VRA5
VRA6
VRA7
VRA8
VRA9
VRA1
VRA4
VRA3
VRA2
VRCS
VRAØ
VRAMCS
CMPBLK
HFLIP1
HFLIP2
HFLIP2*
CNTR CLR
CD2
CD1
CDØ
RAW1
RAWØ
RVØS
RVIS
LBWE
LBA7
LBA2
LBA3
LBA1
LBA6
LBA5
LBAØ
LBA4
VIDØ
RVØ
VID1
RV1
COLØ
RCØ
VOL 2
VOL 1
FS1
FS2
FS3
HIT
10 FIRE
11 VOL 1
12 VOL 2
1P START
2P START
COIN LOCKOUT
COIN COUNTER
2,4,5,7,10
12,13,15



AUDIO CONTROL BUS
HRDWR. CONTROL BUS
HFLIP
VSYNC
STARS ON
STARS OFF
CMP SYNC
CMP BLK
MISSILE
SHELL
AUDIO
FIRE
HIT
NOISE
BLUE
GREEN
RED
SPKR
SEE SECTION A12
COIN COUNTER
COIN LOCKOUT
2P START
1P START
CAUTION:
DO NOT CONNECT OR MEASURE SPEAKER LEADS TO GROUND.