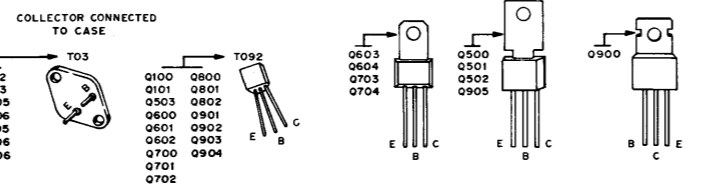


GENERAL NOTES:
 1. RESISTANCE VALUES IN OHMS OR KΩ MUST BE MEASURED WITH 10% TOLERANCE. RESISTANCE VALUES IN MΩ OR Ω MUST BE MEASURED WITH 5% TOLERANCE.
 2. CAPACITANCE VALUES OF 100 PICO OR LESS IN MICROFARADS, SHOULD BE IN PICOFARAD UNITS OTHERWISE NOTED.
 3. * 0.000 AND 0.0000 ARE NOT ON H.V.P.C.B.
 4. ALL D.C. VOLTAGES MUST BE MEASURED FROM POINT INDICATED TO GROUND UNLESS A DIFFERENT REFERENCE POINT IS SPECIFIED. VOLTAGES ARE MEASURED WITH NO SIGNAL INPUT AND CONTROLS ARE IN A NORMAL OFF POSITION.
 5. USE A LOGIC PROBE WHEN MEASURING SIGNALS OR FOCUS VOLTAGE.
 6. 2200Ω-100 USES (BARCODED) DOT SCREEN DOUSE IN SERIES WITH PROTECTIVE 150Ω RESISTOR IN EARLY PRODUCTION MODELS.
 7. USE A LOGIC PROBE WHEN MEASURING SIGNALS OR FOCUS VOLTAGE.



Components identified by shading have special characteristics important to safety and should be replaced only with identical types.

**Self-Test Procedure Part 1
Operator Information Display**

The information below is displayed on the screen if you set the self-test switch to on during the attract mode. Look at the displayed numbers for SECONDS ON and SECONDS PLAYED. If these numbers run together vertically, make adjustments to the X and Y outputs of the game PCB.

To continue with self-test, rotate the control knob until the message FOR SELF TEST PRESS FIRE AND SUPERZAPPER appears on the monitor. Then press both FIRE and SUPERZAPPER. To end the operator information display, set self-test switch to off.

To erase High Score Table:
 1. Turn control knob until top line reads PRESS FIRE AND START 2 TO ZERO HIGH SCORES.
 2. Press both FIRE and START 2.
 3. The word ERASING appears and blinks on the screen until the entire table is erased. Wait until the word ERASING disappears before continuing with other tests.

To erase Game Times:
 1. Turn control knob until top line reads PRESS FIRE AND START 1 TO ZERO TIMES.
 2. Press both FIRE and START 1.
 3. The word ERASING appears and blinks on the screen until the entire table is erased. Wait until the word ERASING disappears before continuing with other tests.

Self-Test Procedure Part 2

Instruction Test Passes Test Fails

1. Set self-test switch to on (see Figure 5). Press RESET on the PCB, or power game to off, then turn power off and on again.
 After about 5 seconds, the monitor displays the picture below. No sounds are produced.
RAM FAILURE is indicated by a sequence of 1 to 12 tones and an R displayed in top half of screen. You will hear a short low tone and see a short flash on the LED start pushbutton for each good RAM chip, and a long high tone accompanied by a long pulse on the start pushbutton for a failing RAM chip. The test stops with the first failing RAM. To restart the sequence, press RESET on the PCB, or power game to off, then turn power off and on again. Identify the bad RAM chip with the table below. Example: four short low tones followed by a long high tone indicates failure of RAM at location M3.

Long High Tone	Bad RAM Chip Location	on Analog Vector-Generator PCB
1st	R2	
2nd	P2	
3rd	R4	
4th	P4	
5th	M3	
6th	M4	
7th	L3	
8th	L4	
9th	K3	
10th	K4	
11th	J3	
12th	J4	

ROM FAILURE is indicated by a vertical pair of hexadecimal numbers on the top of the screen. The top number indicates the location of the failing ROM(s). Ignore the bottom hexadecimal number in the pair. Identify the bad ROM with the table immediately below.

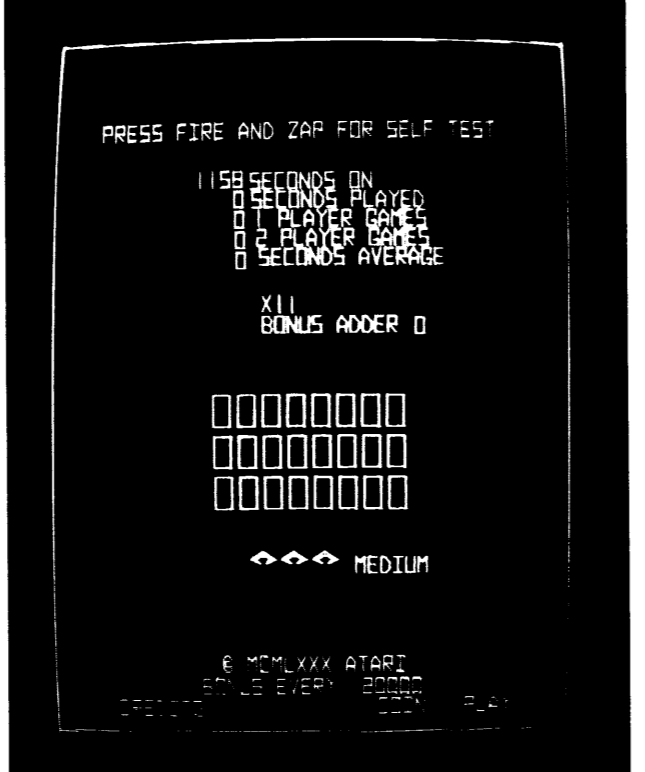
Displayed No.	Bad ROM Chip Location	PCB Location
B	R1	
A	P1	
9	M/N1	
8	L/M1	Analog Vector-Generator PCB
7	K1	
6	J1	
5	H1	
4	F1	
3	E1	
2	D1	
1	R3	
0	N/P3*	

EAROM, Audio and Math Box Failure are indicated by a single letter in the center of the display. Identify the failure with the table below.

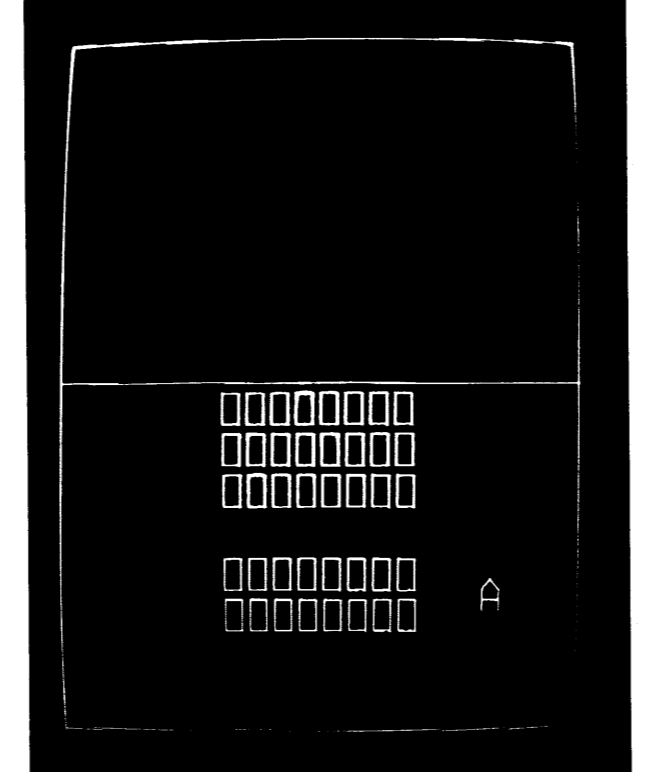
Displayed Letter	Failure	PCB Location
E	EAROM	C3 (Aux. PCB)
P	Audio 1	B/C2 (Aux. PCB)
Q	Audio 2	C/D2 (Aux. PCB)
R	RAM	See RAM test above
M	Math Box**	

* If this ROM is bad, you will hear a continuous low tone, and the program may be unable to display a screen image.
 ** Math-box failure is explained in TM-195, Tempest Troubleshooting Guide.

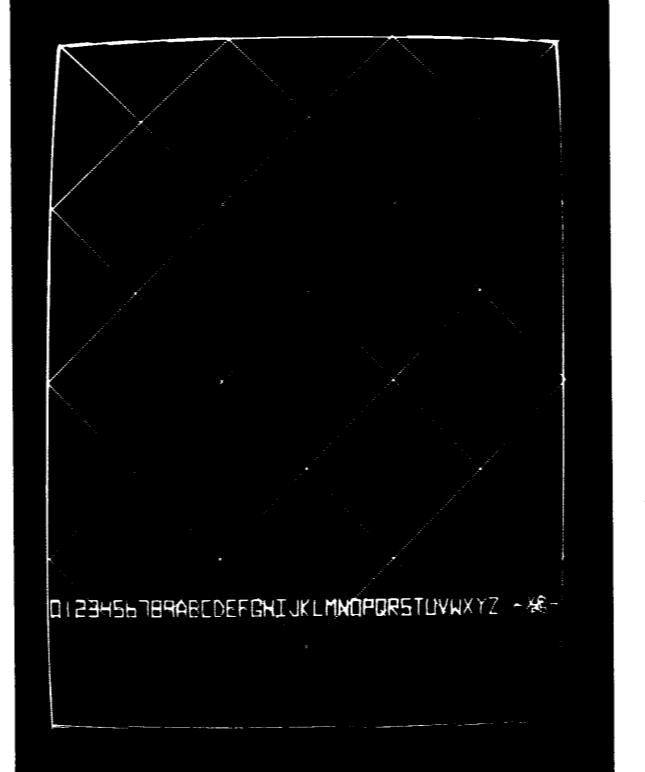
Self-Test Screens



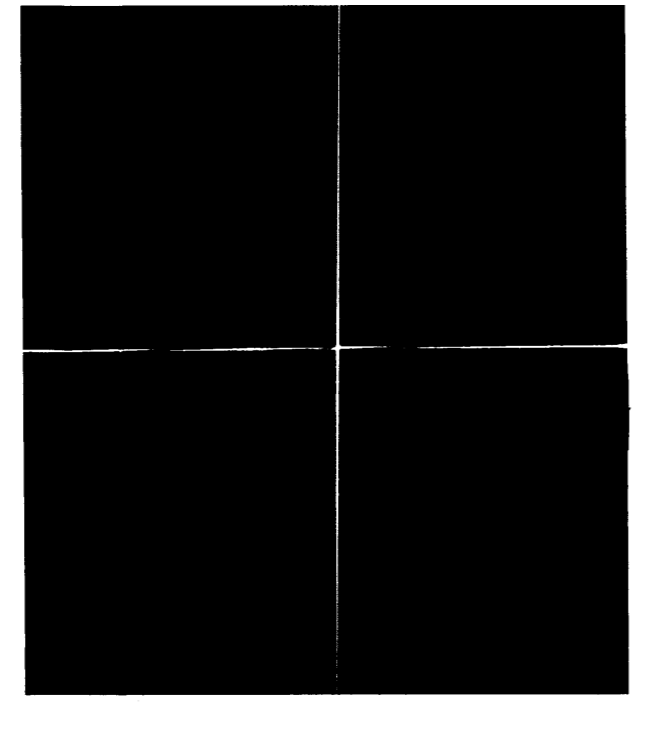
Screen #1



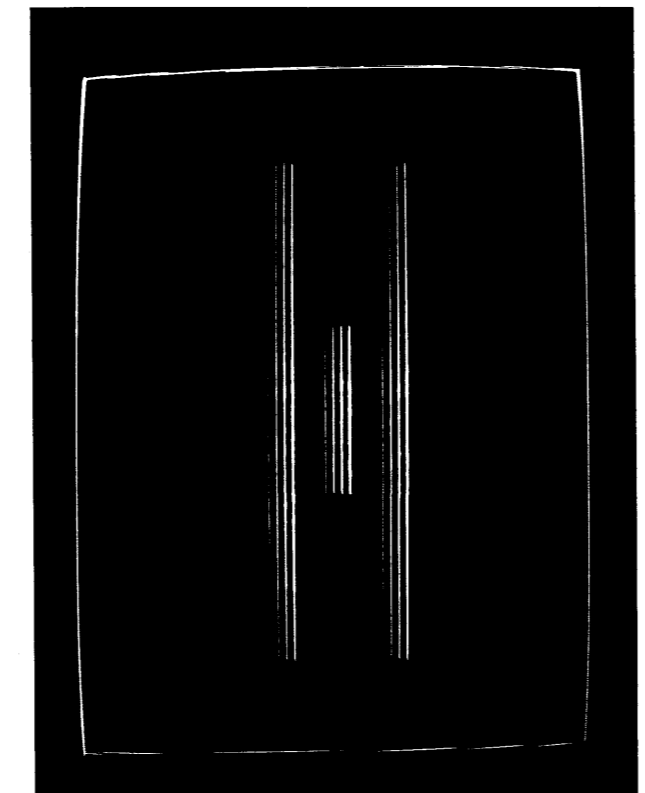
Screen #2



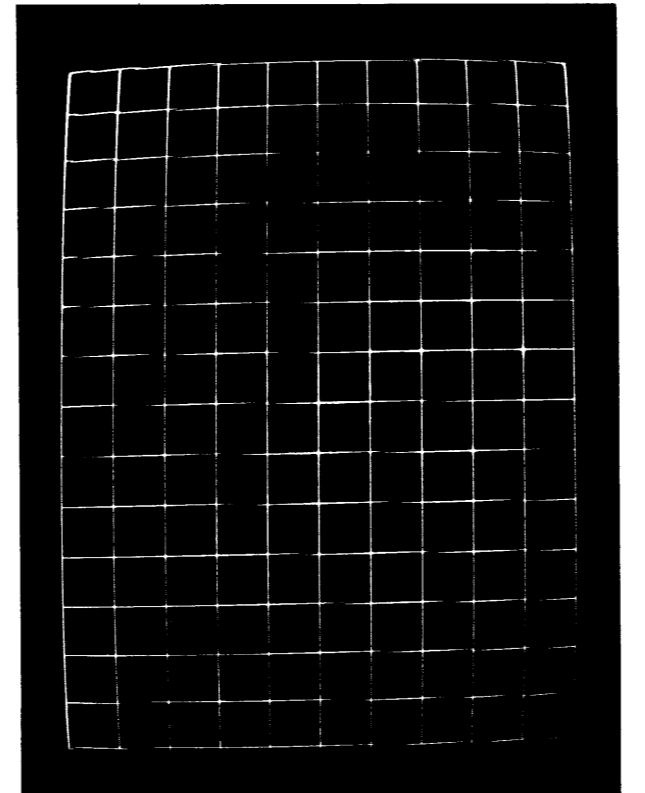
Screen #3



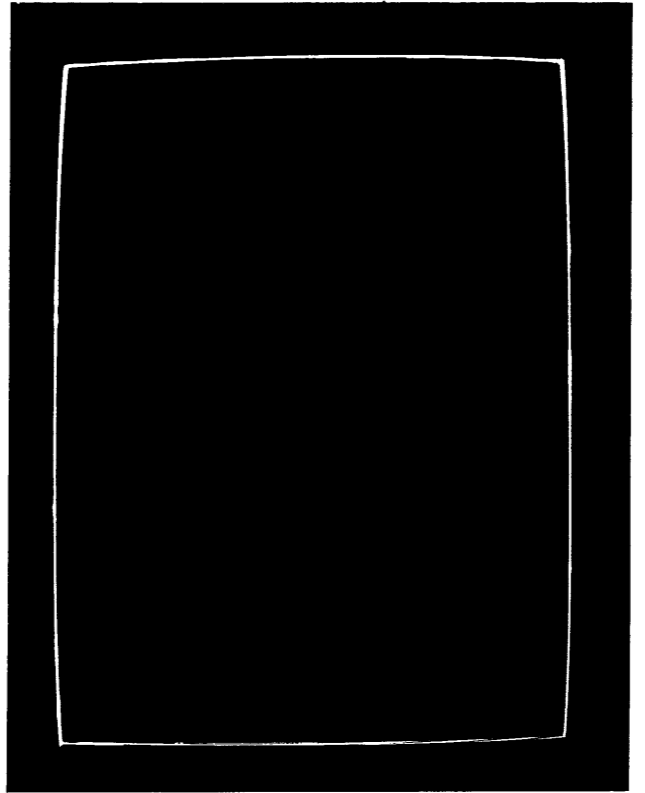
Screen #4



Screen #5



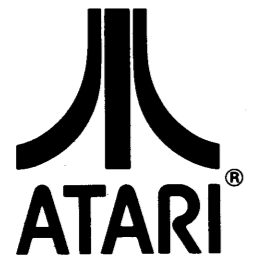
Screen #6



Screen #7

- 2. Activate start, fire, Superzap, SLAM, and coin switches.*
As switch activates, you'll hear a beep and 0 changes to 1 on the screen.
- 3. Rotate encoder wheel clockwise and counterclockwise.
The right hexadecimal number on the screen will increase with counter clockwise motion, and decrease with clockwise motion.
- 4. Observe the white frame around the outside of the screen.
Each frame corner should be within 1/2-inch of each monitor bezel corner.
- 5. Activate SLAM switch.
A white cross hatch pattern appears. A character set appears at the bottom of the screen.
- 6. Activate SLAM switch.
Horizontal and vertical lines cross in the center of the screen displaying a large "plus" sign. Audio I/O 1 and 2 alternate to produce four tones.
- 7. Activate SLAM switch.
Tests purple, cyan, yellow, white, green, blue, and red for color and intensity. Displays seven groups of vertical lines, each with right line the brightest and left line the dimmest.
- 8. Activate SLAM switch.
A checkerboard pattern touches the sides and corners of the monitor. Rotate the control knob to change color.
- 9. Activate SLAM switch.
A white frame is displayed on the screen.
- 10. When satisfied with test, set self-test switch to off position.

* Activate coin switches by inserting at least one coin in each coin slot. You will not trip the coin counters as long as you are in self-test.



Drawing Package Supplement to

Tempest™

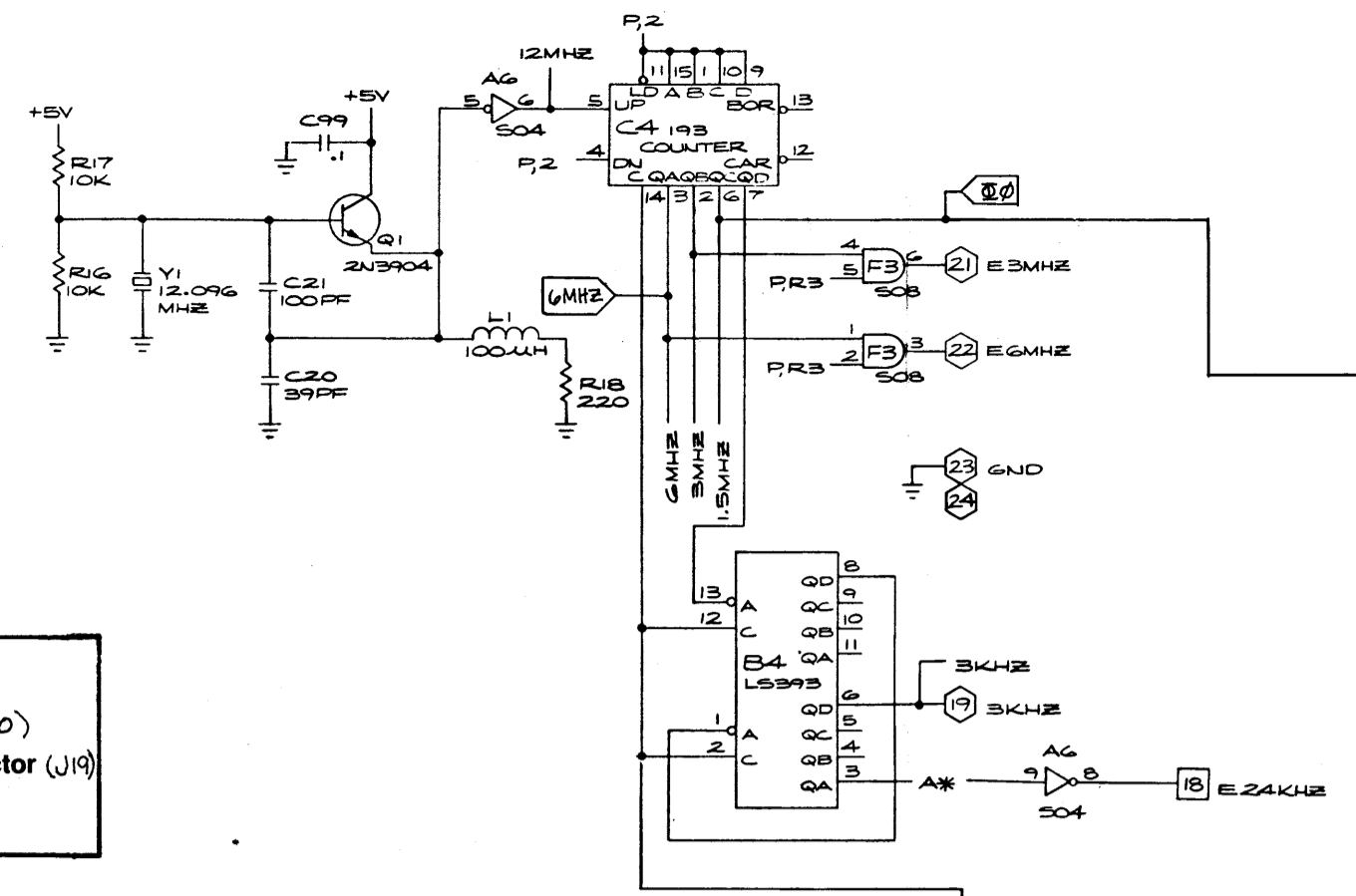
Operation, Maintenance, and Service Manual

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Contents of this Drawing Package

Self-Test Screens Self-Test Procedure 19-In. Wells-Gardner Color X-Y Monitor Sheet 1, Side A
 Color X-Y Power Supply Regulator/Audio II PCB Sheet 1, Side B
 Tempest Upright Wiring Diagram Coin Door Sheet 1, Side B
 Microprocessor Address Decoder Power Input Clock IRQ Counter Memory Map Sheet 2, Side A
 Power Reset and Watchdog Counter ROM Memory RAM Memory
 X-Y Outputs Coin Counter and Video Invert Outputs Sheet 2, Side B
 Coin Door and Option Switch Inputs Color Outputs
 Vector Generator: Program Counter RAM ROM Data Shifter Sheet 3, Side A
 Data Buffer Address Selector Vector Timer State Machine
 Auxiliary PCB: Power Inputs Address Decoder Math Box Sheet 3, Side B
 High Score Memory Player Inputs and Audio Output

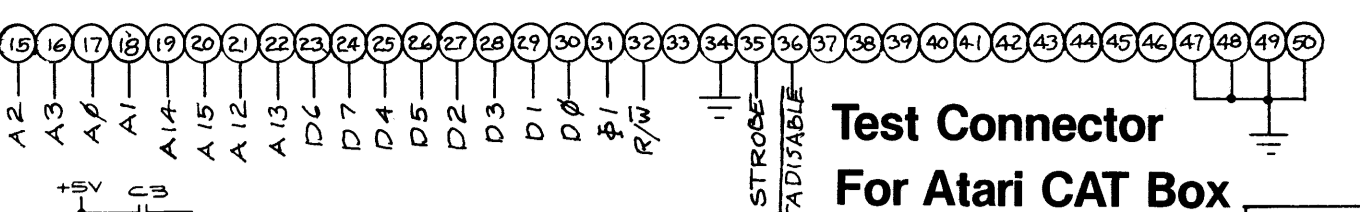
Clock Circuit



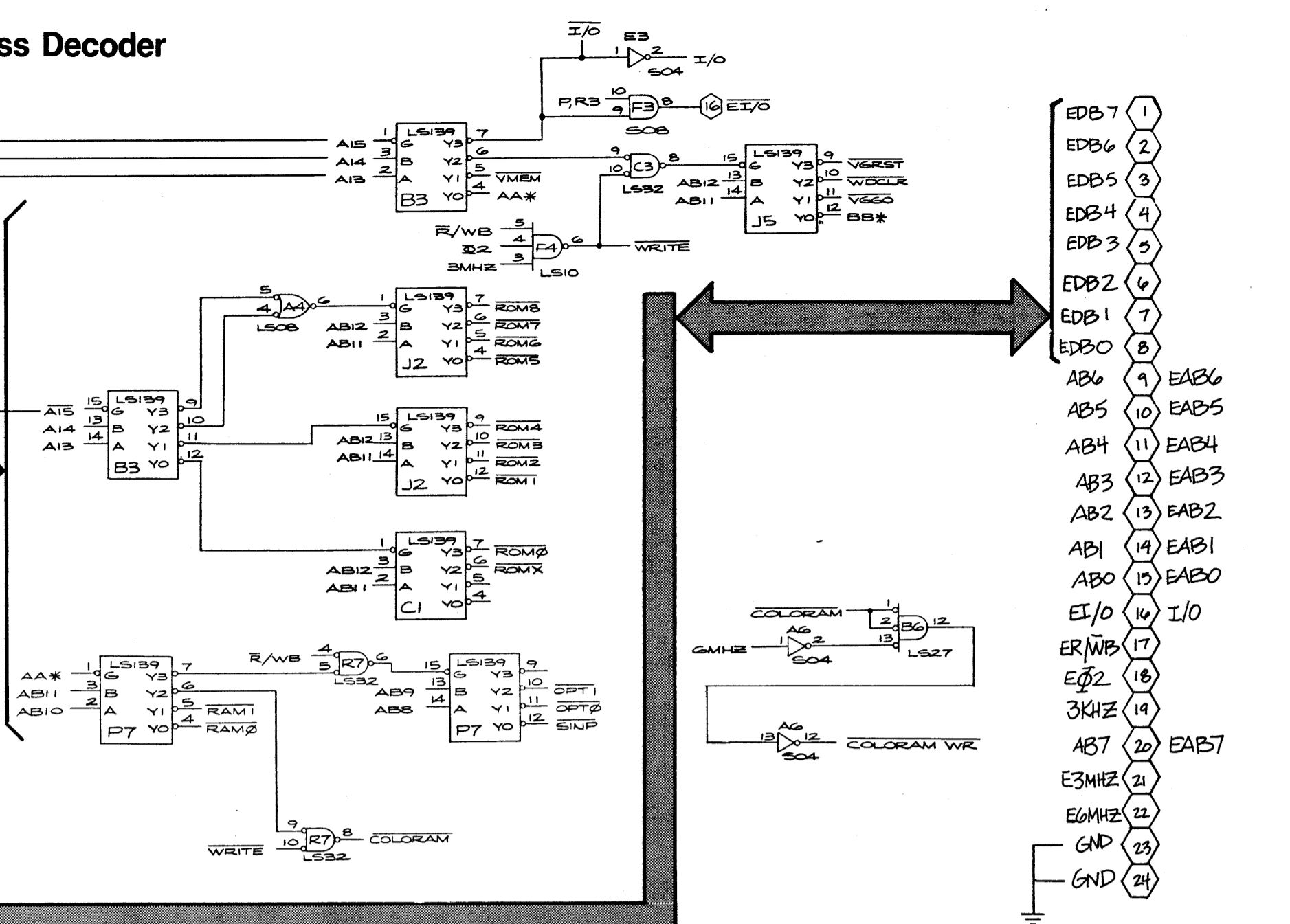
NOTE
 □ Indicates Edge Connector (J20)
 ○ Indicates Interconnect Connector (J10)
 △ Indicates Test Point

Microprocessor

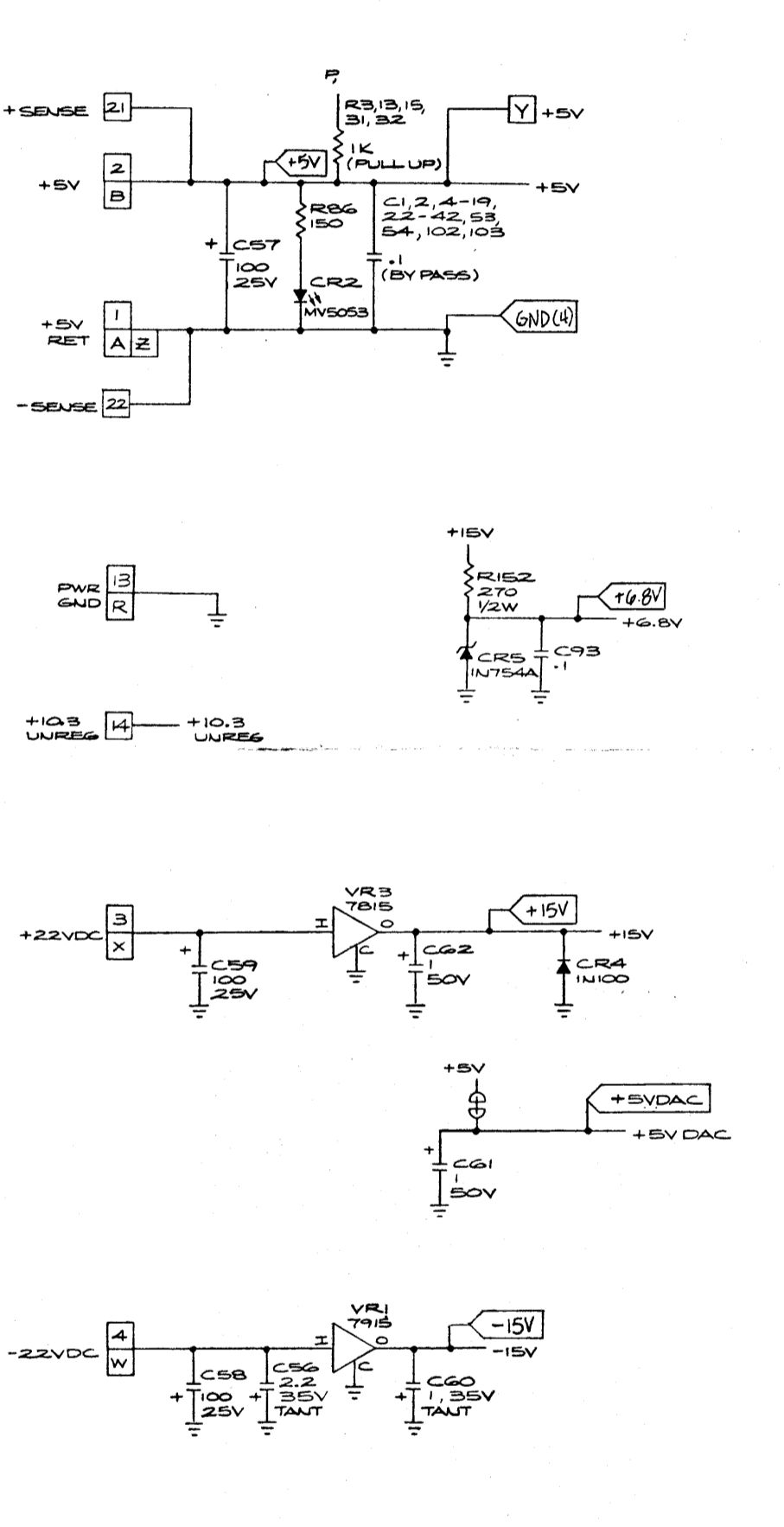
NOTE:
 The MPU in this game operates at a frequency of 1.5 MHz. Therefore the MPU chip must be 6502A. The 6502's maximum frequency is 1 MHz and is not compatible with this game.



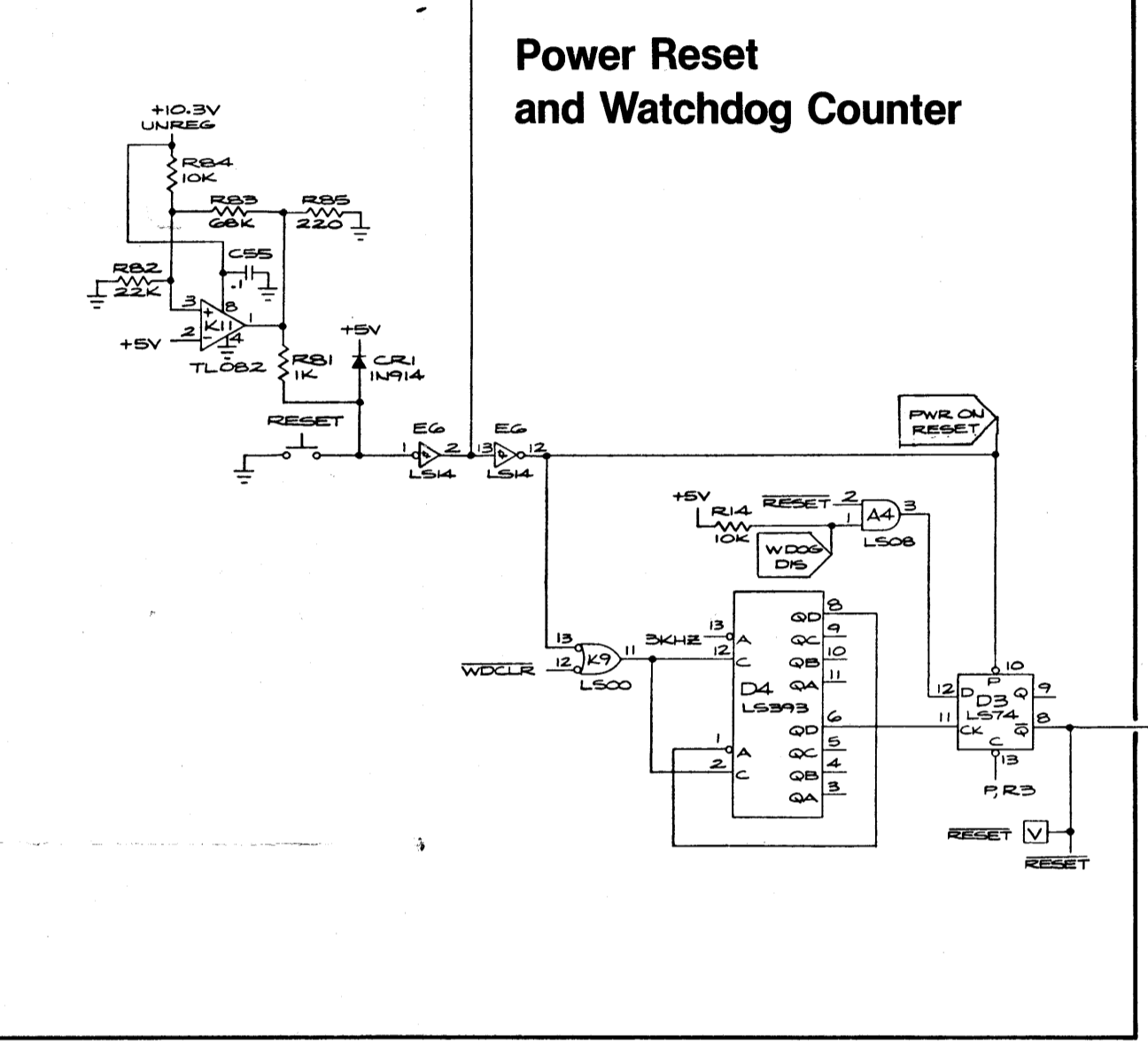
Address Decoder



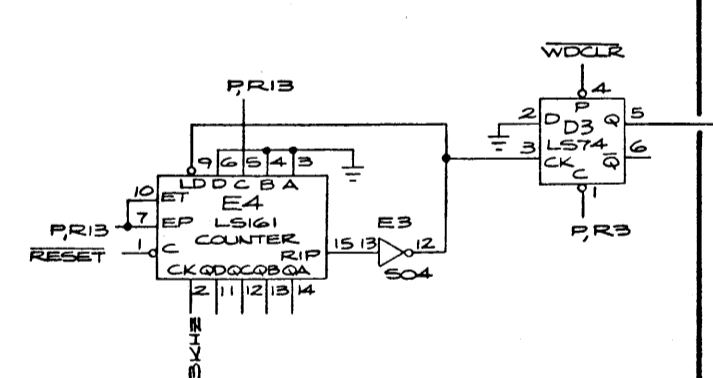
Power Inputs



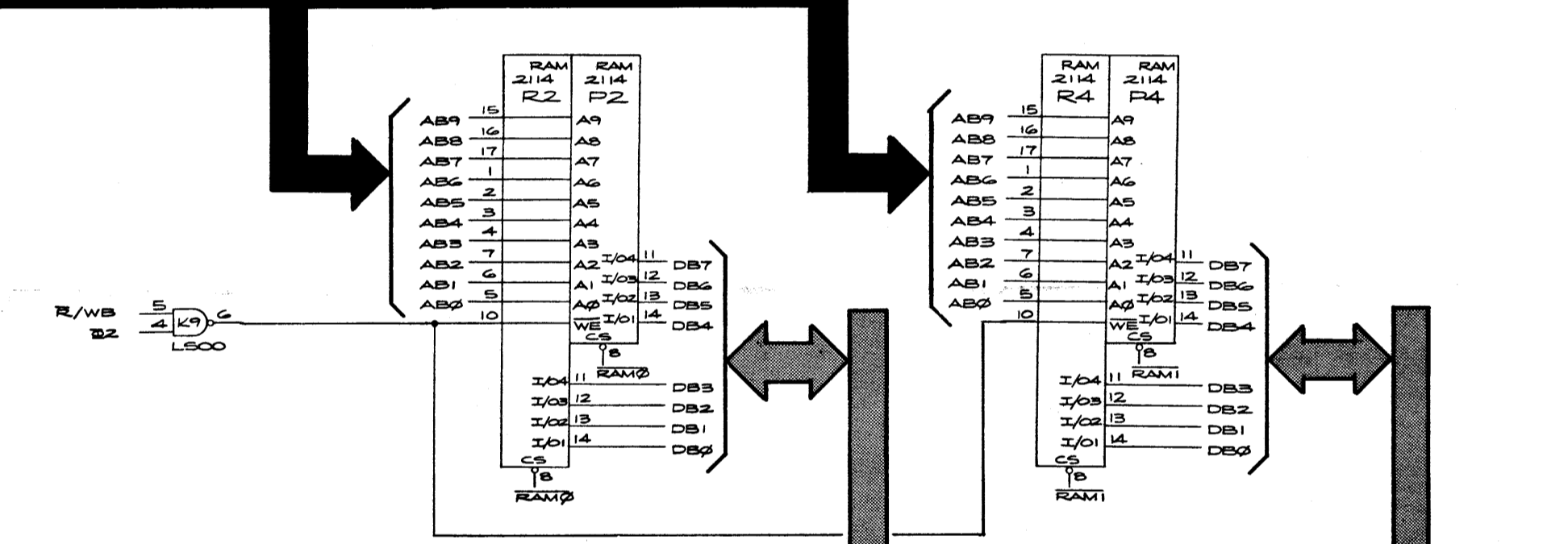
Power Reset and Watchdog Counter



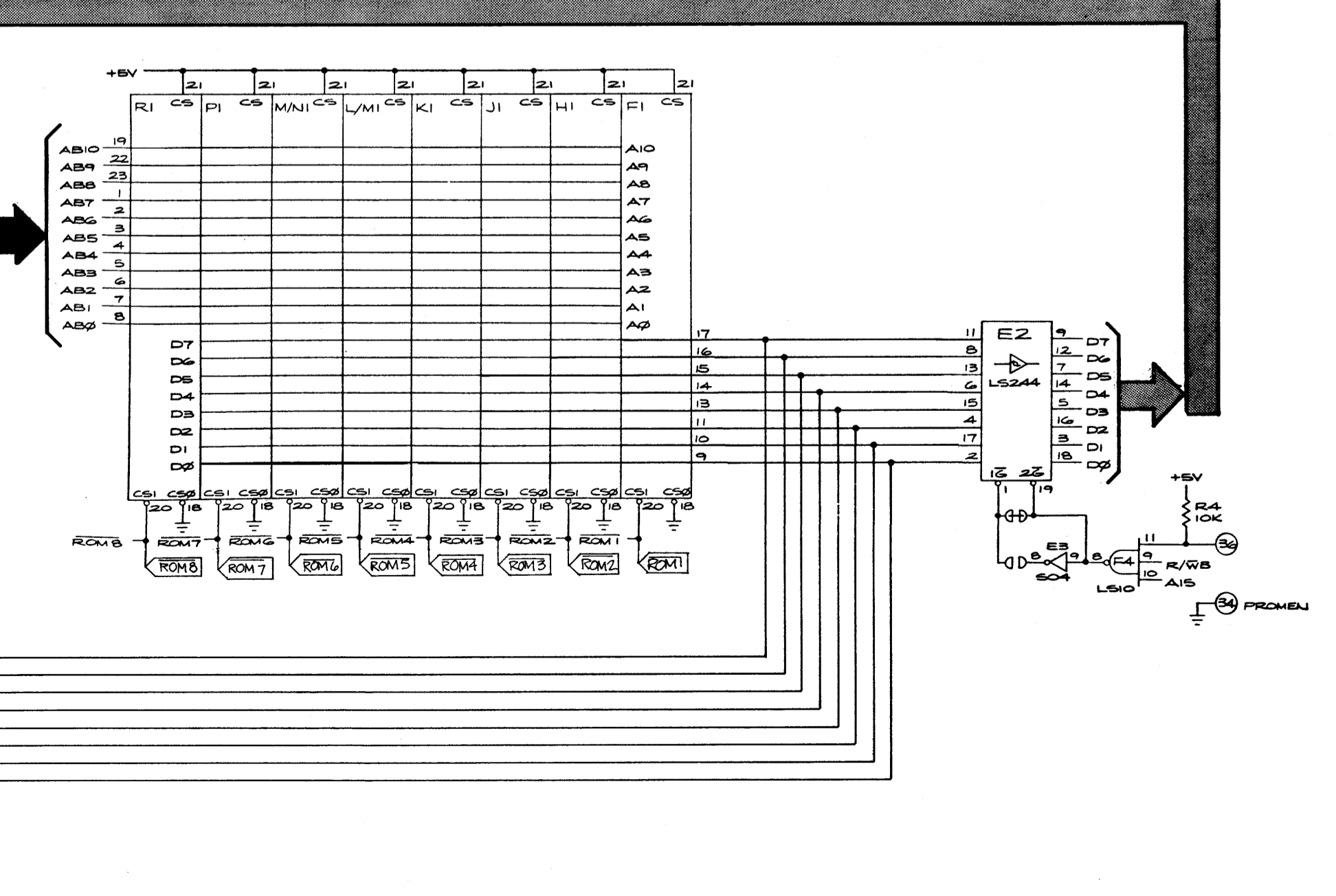
IRQ Counter



RAM Memory



ROM Memory

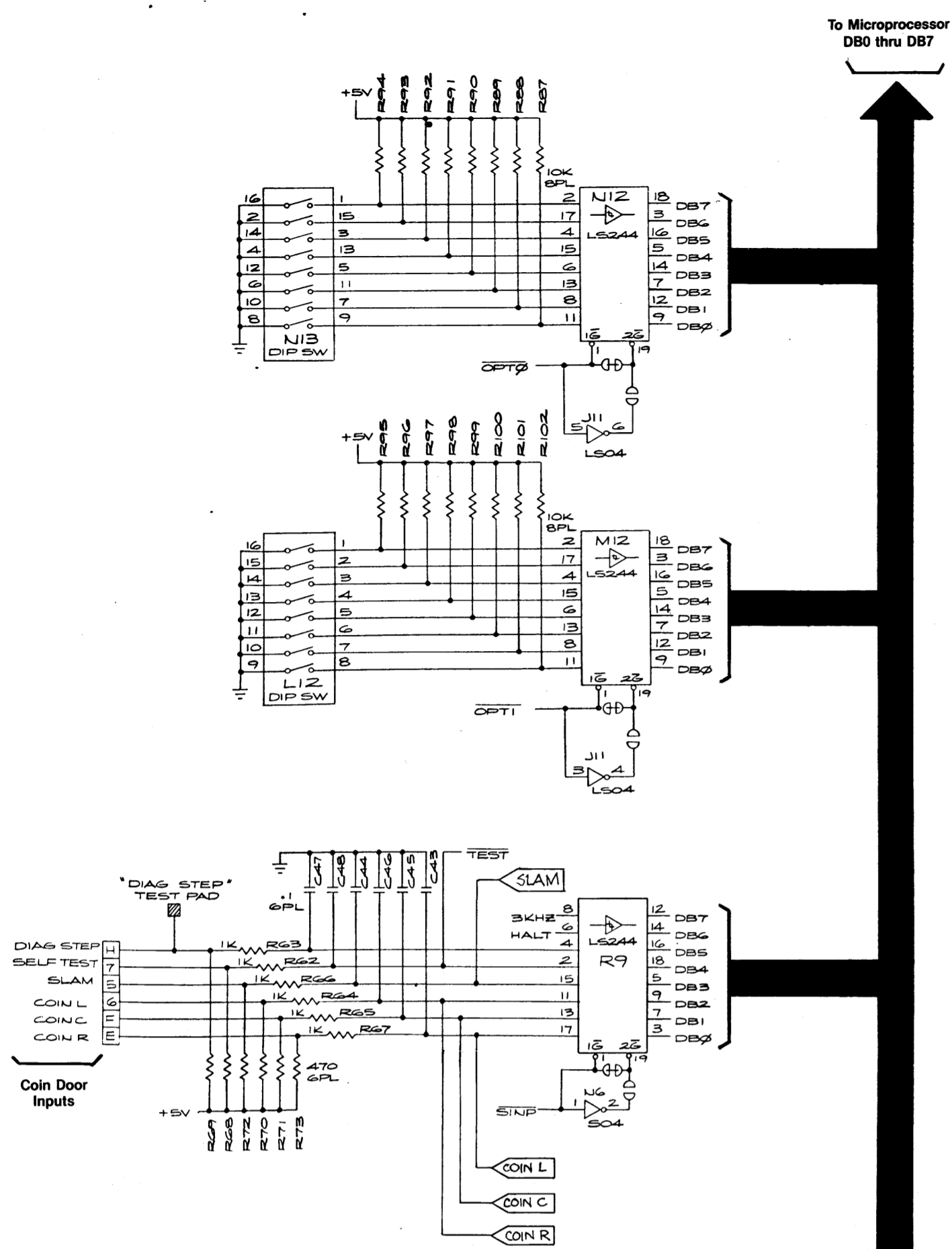


- Analog Vector-Generator PCB
- Microprocessor
- Address Decoding
- Power Input
- Clock
- IRQ Counter
- Power Reset and Watchdog Counter
- ROM Memory
- RAM Memory
- Memory Map

HEXA-DECIMAL ADDRESS		R/W	D7	D6	D5	D4	D3	D2	D1	D0	FUNCTION
0000-7FFF	R/W	D	D	D	D	D	D	D	D	D	Program RAM (2K)
0800-080F	W										Color RAM
0C00	R									D	Right Coin Switch
0C00	R									D	Center Coin Switch
0C00	R									D	Left Coin Switch
0C00	R									D	Slam Switch
0C00	R									D	Self-Test Switch
0C00	R									D	Diag. Step Switch
0C00	R									D	HALT
0C00	R	D									3KHz
0D00	R	D	D	D	D	D	D	D	D	D	Option Switch Inputs
0E00	R	D	D	D	D	D	D	D	D	D	Option Switch Inputs
2000-2FFF	R/W	D	D	D	D	D	D	D	D	D	Vector RAM (4K)
3000-3FFF	R	D	D	D	D	D	D	D	D	D	Vector RAM (4K)
4000	W									D	Right Coin Counter
4000	W									D	Center Coin Counter
4000	W									D	Video Invert X
4000	W									D	Video Invert Y
4800	W									D	VG GO

HEXA-DECIMAL ADDRESS		R/W	D7	D6	D5	D4	D3	D2	D1	D0	FUNCTION
5000	W										WD CLEAR
5800	W										VG Reset
6000-603F	W	D	D	D	D	D	D	D	D	D	EAROM Write
6040	W	D	D	D	D	D	D	D	D	D	EAROM Control
6040	R	D	D	D	D	D	D	D	D	D	Math Box Status
6050	R	D	D	D	D	D	D	D	D	D	EAROM Read
6060	R	D	D	D	D	D	D	D	D	D	Math Box Read
6070	R	D	D	D	D	D	D	D	D	D	Math Box Read
6080-609F	W	D	D	D	D	D	D	D	D	D	Math Box Start
60C0-60CF	R/W	D	D	D	D	D	D	D	D	D	Custom Audio Chip 1
60D0-60DF	R/W	D	D	D	D	D	D	D	D	D	Custom Audio Chip 2
60E0	R									D	One Player Start
60E0	R									D	Two Player Start
60E0	R									D	FLIP
9000-9FFF	R	D	D	D	D	D	D	D	D	D	Program ROM (20K)

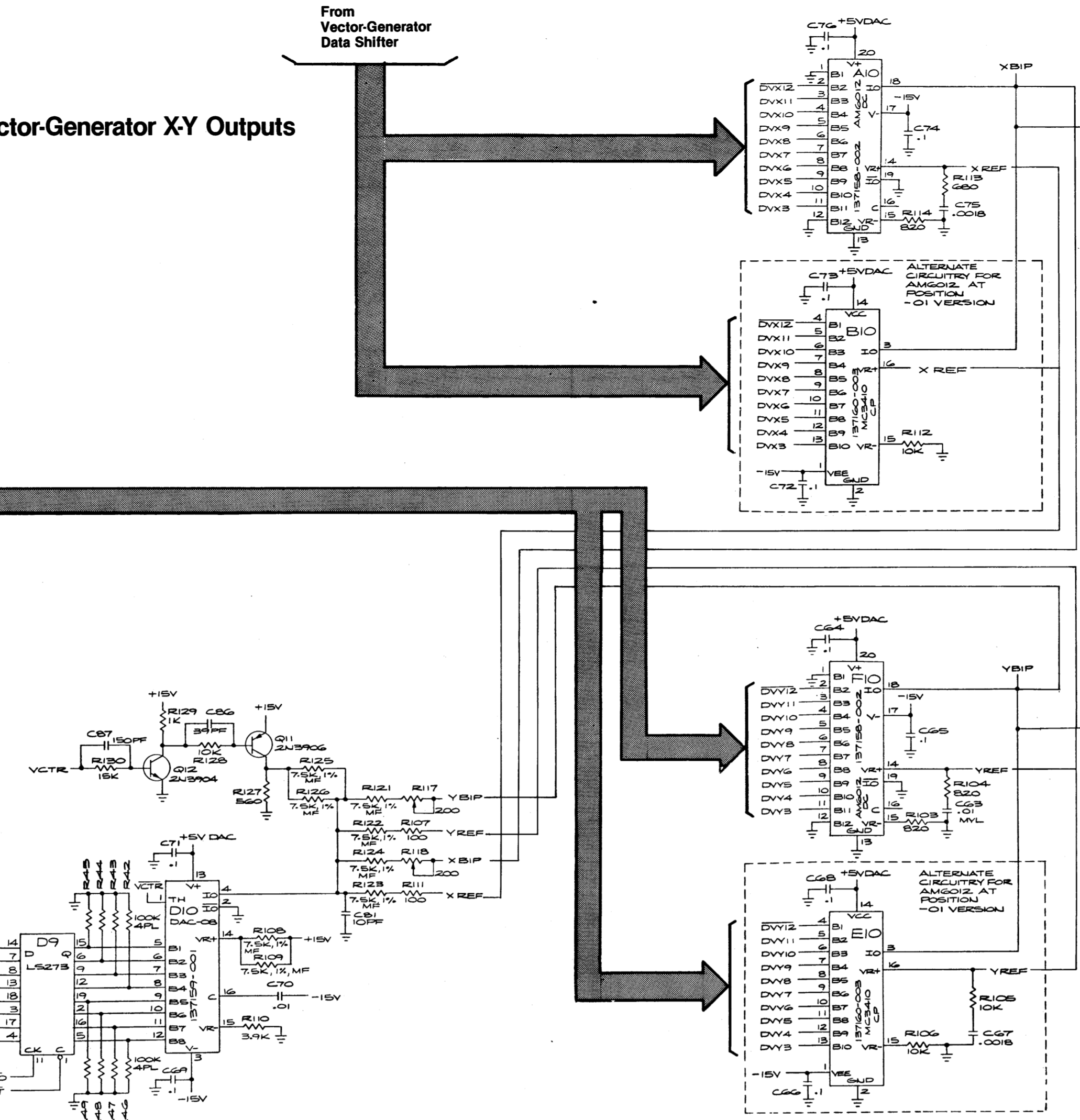
Coin Door and Option Switch Inputs



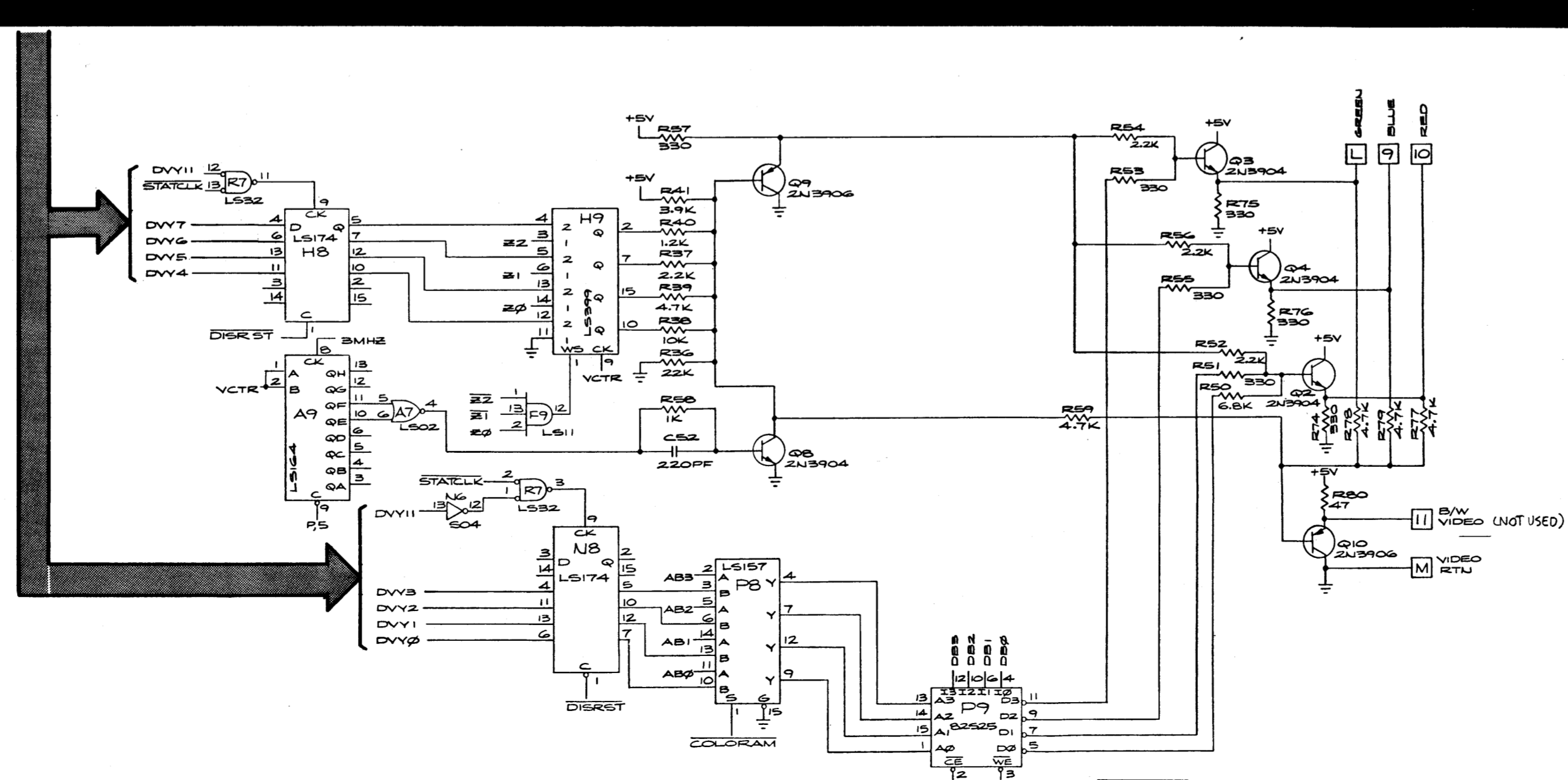
To Microprocessor DB0 thru DB7

From Vector-Generator Data Shifter

Analog Vector-Generator X-Y Outputs



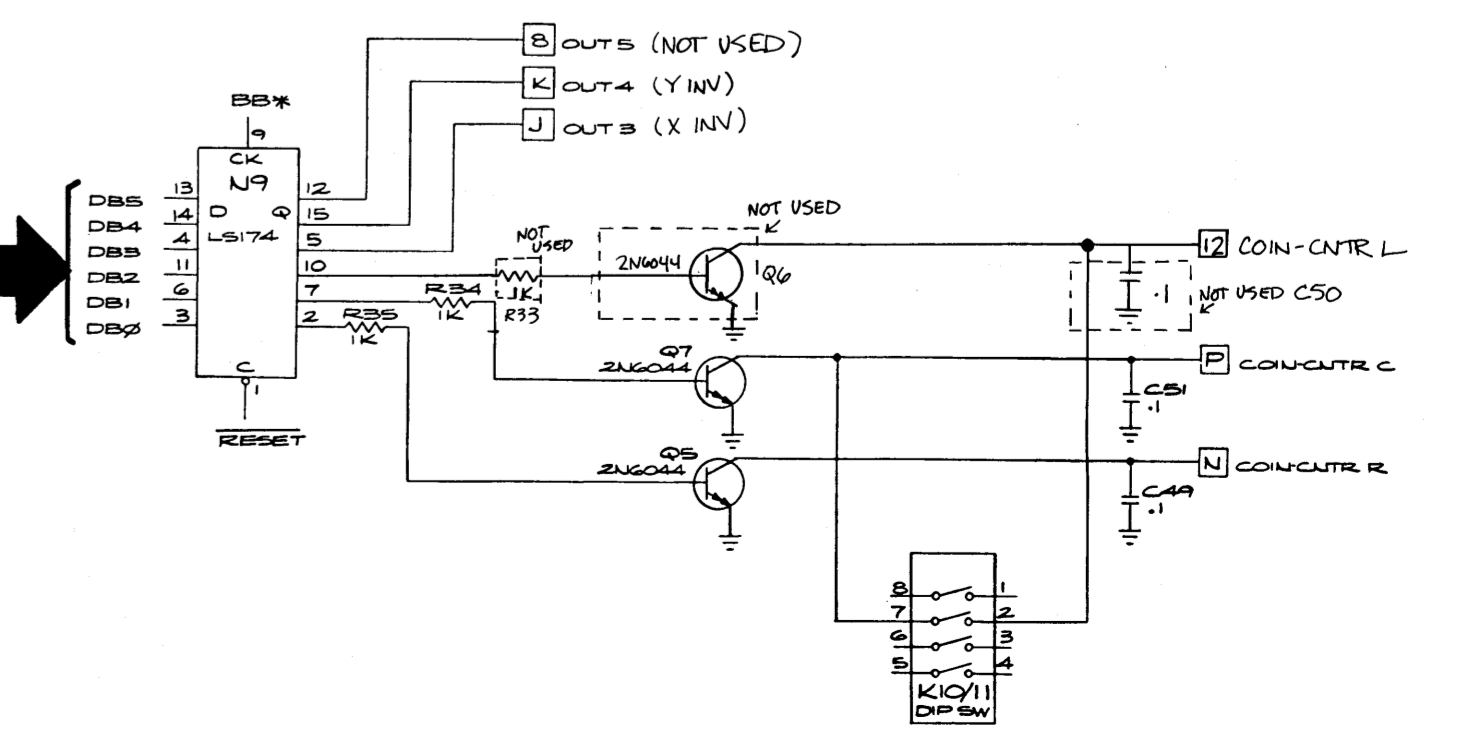
Analog Vector-Generator Color Outputs



- #### Adjusting Video Pots
- If you replace the Tempest™ Analog Vector-Generator PCB (Main PCB) or the monitor, you may have to make the following adjustments:
1. Enter self-test and advance screen to diagonal crosshatch pattern.
 2. Adjust "CENTER" pots: Adjust X-CENTER (R147) and Y-CENTER (R167) so that the crosshatch pattern is located at the middle of the screen.
 3. Adjust "SIZE" pots: Adjust X-SIZE (R150) and Y-SIZE (R168) so that the crosshatch pattern exactly covers the whole visible screen.
 4. Adjust the "BIP" pots: Adjust the X-BIP (R118) and Y-BIP (R117) so that the corners of the diagonal lines rest exactly on the sides of the outer rectangle.
 5. Adjust the "LIN" pots: Adjust the X-LINEAR (R169) and Y-LINEAR (R165) so that the diagonal lines are straight. Since the "LIN" pots change the size of the displayed picture on the screen, you may have to readjust the "SIZE" pots in order to get the correct adjustment.

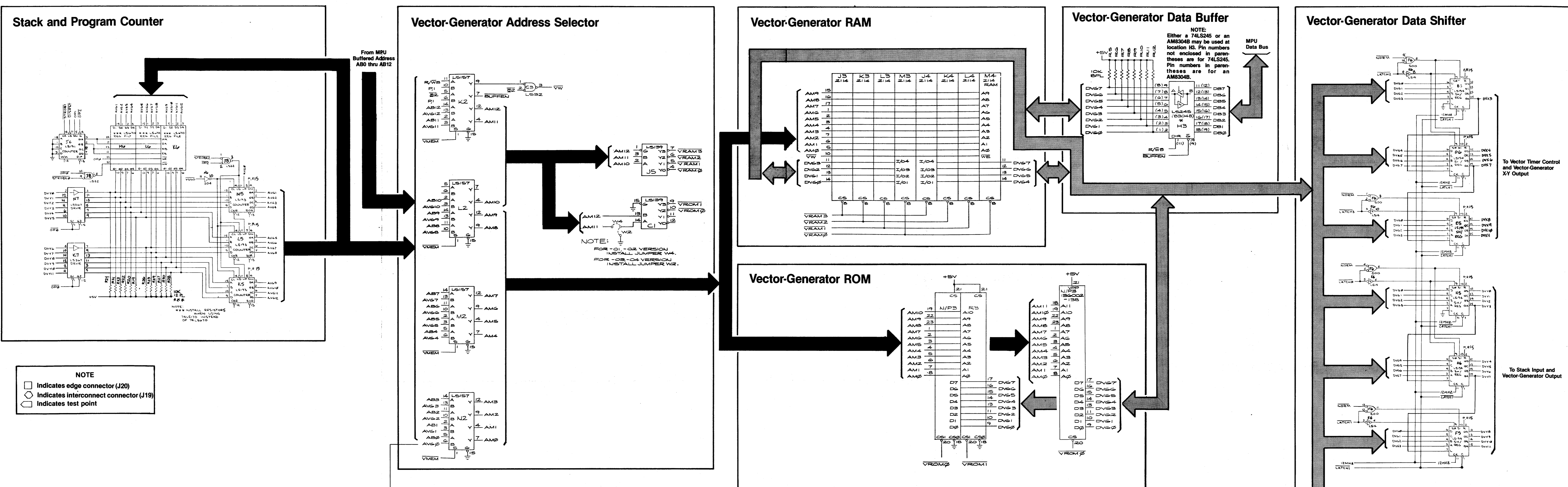


Coin Counter and Video Invert Outputs



Analog Vector-Generator PCB
Coin Door and Option Switch Inputs
X-Y Outputs
Color Outputs
Coin Counter and Video Invert Outputs
Section of 037383-01 & -02B

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NOTE

- Indicates edge connector (J20)
- Indicates interconnect connector (J19)
- ◇ Indicates test point

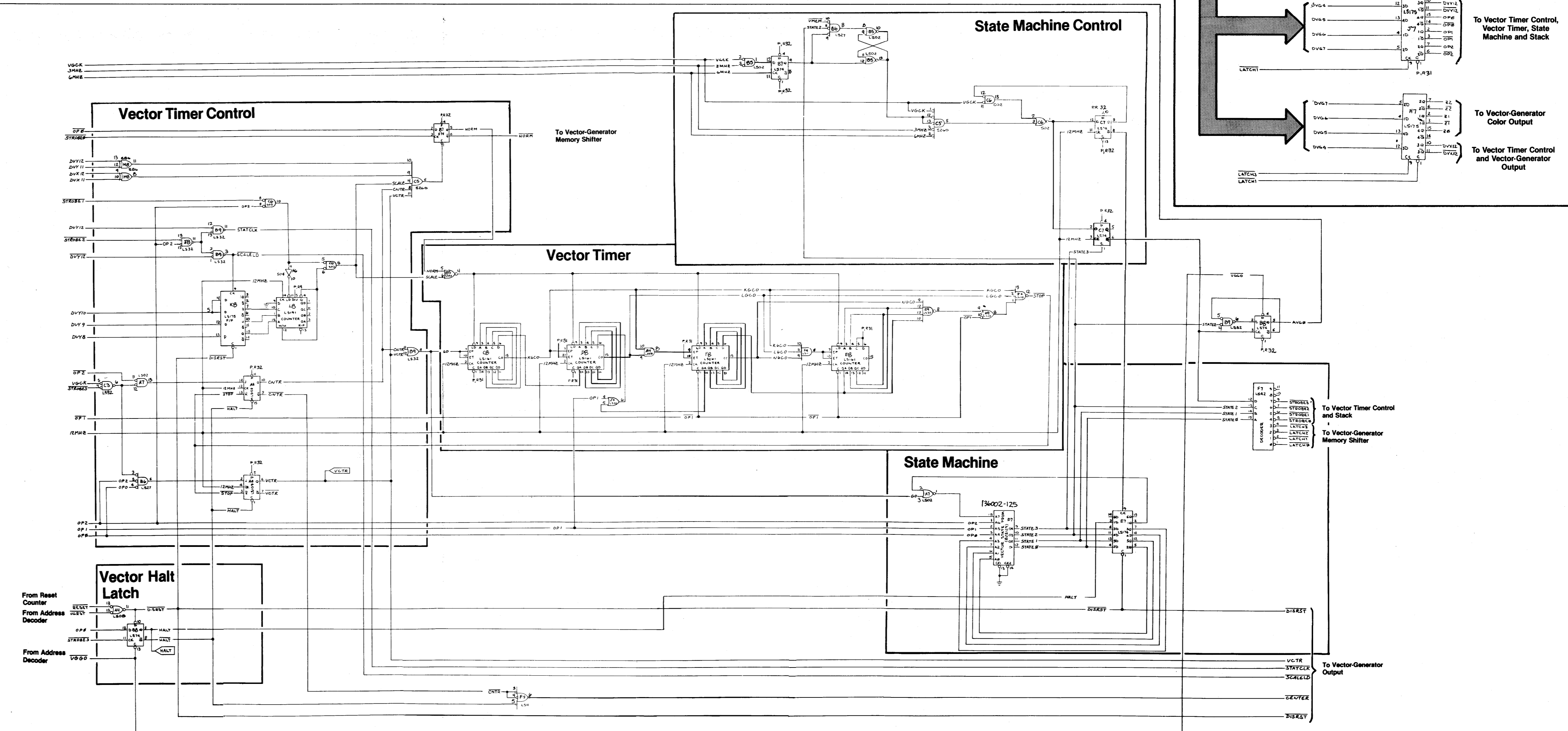


Sheet 3, Side A
Tempest™

- Vector-Generator Program Counter
 - Vector-Generator RAM
 - Vector-Generator ROM
 - Vector-Generator Data Shifter
 - Vector-Generator Data Buffer
 - Vector-Generator Address Selector
 - Vector-Generator Vector Timer
 - Vector-Generator State Machine
- Section of 037383-01 thru -04 C

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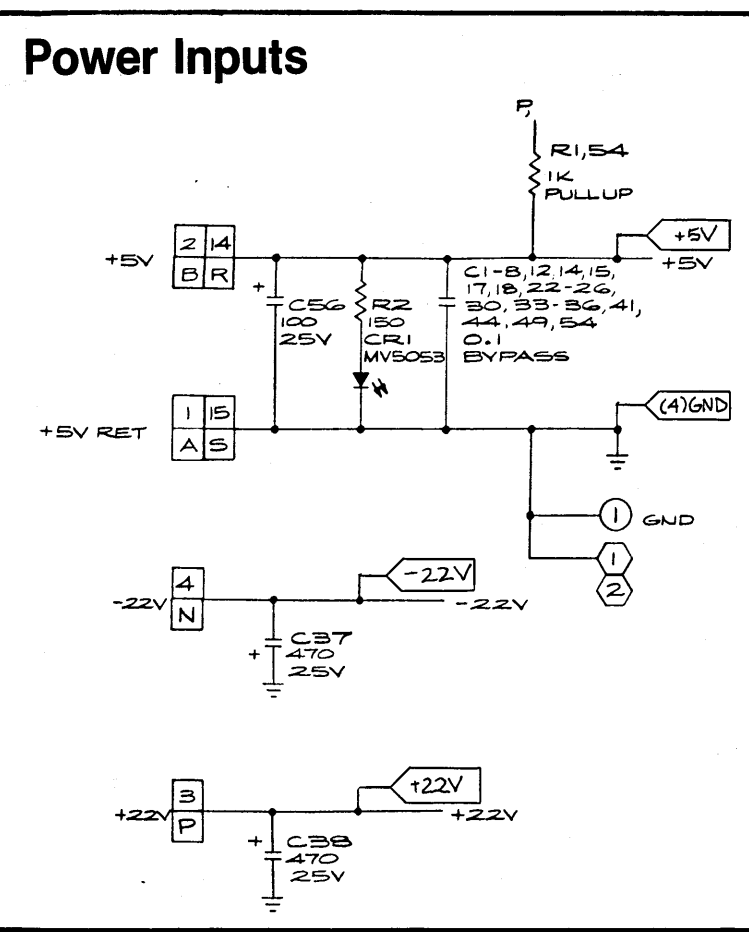
A Warner Communications Company



Auxiliary Board Address Decoder

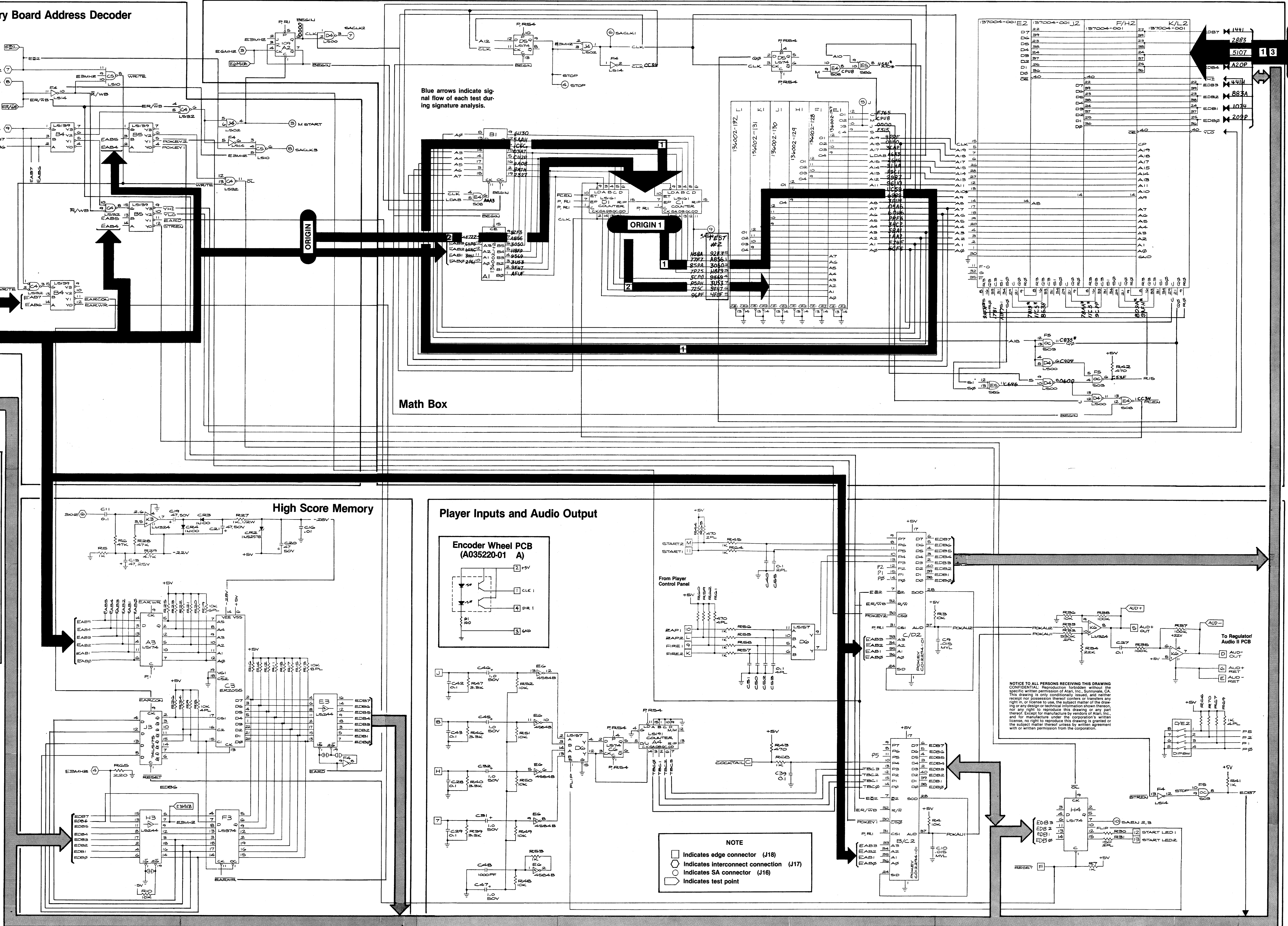
External Address Bus
From Sheet 2 Side A

External Data Bus
From Sheet 2 Side A



ATARI

Sheet 3, Side B
Tempest™
High Score Memory
Auxiliary PCB
Audio Output
Control Panel Input
Math Box
Encoder Wheel
037585-01 B
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Blue arrows indicate signal flow of each test during signature analysis.

ORIGIN

ORIGIN 1

ORIGIN

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