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GamePlan, inc.

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TLX 20-6098



INSTRUCTION & SERVICE MANUAL

REV. B
NOV. 5 1981

02-30077A

1.0 INTRODUCTION

KAOS is a 19" full color one or two player game that will capture and prolong player interest. It has a joystick for horizontal man movement and jump buttons to allow the player to move his man vertically to different colored levels to intercept (capture) dollars, dodge dragons, or go to the top to get an "ERG" change into a king and slay dragons.

1.1 UNPACKING INSPECTION

To ensure the equipment incurred no damage in shipment, inspect the container prior to acceptance from the carrier. If no immediate cabinet damage is evident, perform the following visual inspection:

1. Open the rear of the game with the appropriate packaged key.
2. Examine each major and electrical component thoroughly for scrapes, broken or missing parts and loose or missing screws.
3. Check for loose cable connectors.
4. Visually verify that all the integrated circuit devices (IC's) plugged into sockets are properly seated and that no IC pins are bent or misaligned.

If you find any damage during this inspection, file a claim with the freight carrier, and send a complete report of the damage to Game Plan Inc.

1.2 INSTALLATION

Planning the location of the game should involve both physical and electrical consideration. Physical considerations concern the placement of the equipment with respect to clearances, AC cable and environmental conditions such as ventilation, temperature, weight support and accessibility (although your game has the durability to endure nearly every type of physical hazard). Electrical considerations include availability of the correct voltage and frequency.

In planning this installation, consideration must also be given to working space required for personnel involved with operation or maintenance of this system.

NOTE: The cabinet must be within six feet of an AC outlet. Be certain that a ground jack or terminal is available at the outlet.

CAUTION: DO NOT remove the AC ground prong from the plug.

- A. Install 4 provided levelers to bottom of cabinet and level cabinet.
- B. The power is controlled by a switch located on top of the cabinet plug into A.C. only 115 volt 60 cycle.

CAUTION:

1. Do not install this game in places directly exposed to sunlight or excessive heat, to prevent rising internal temperatures.
2. High voltage runs the monitor. Therefore only persons familiar with safety measures should make any adjustments.
3. As with any solid state games the power should be turned off before replacing any parts or disconnecting any plugs.
4. Always take boards to distributor for repair, do not attempt to make any repairs with volt-ohmmeter or other test equipment as the internal voltage of such equipment may damage the circuitry.

1.3 PRELIMINARY CHECKOUT PROCEDURE

After properly installing KAOS we suggest checking it's operation in the following procedure:

1. Plug the AC jack into the AC outlet.
2. Allow one to two minutes for CRT to warm up.
3. Observe the TV monitor display to assure the correct attract mode is present on the screen, as explained in Section 2.2.
4. If the KAOS display is incorrect, correct immediately.
5. Insert a quarter into the coin slot.
6. Continue to play the game and verify that all screen images are displayed, once again, described in the Normal Operation procedure.

If repairs are necessary, contact your distributor or Game Plan Inc.

2.0 GAME DESCRIPTION

The following paragraphs describe the video images, sound effects, game strategy.

2.1 RESET MODE

Whenever power is applied the game will start to sequence thru the attract mode (KAOS all stars, KAOS by GAME PLAN, simulated game play)

However, when the slam switch is activated, the game generates a siren blast. This sound alerts the operator, it will even serve to discourage tampering by its psychological effect.

2.2 ATTRACT MODE

After power-up, KAOS automatically cycles thru a sequence of video images that make up the attract mode. This attract mode consists of a listing of the KAOS ALL STARS, the words KAOS by GAME PLAN, with insert coin and a simulated game complete with scoring. This is to show new players how the game plays, and to promote repeat play.

2.3 COIN INPUT MODE

At all times, while power is on, regardless of the game conditions or the operator options, the computer will accept a coin input, generate a unique sound, and increment the coin counter. However, the credits will only be incremented if they are not already at the maximum (10, 20, 30, or 40-operator selectable) and they will be displayed only during the attract modes.

2.4 GAME START MODE

The computer scans the game-start switches only during the attract and game over modes and only then if the credit-count is not zero. When a start-switch is activated, the computer compares the operator selected credit option against the credit-count and ignores the switch if enough credits are not available. If there are sufficient credits, the computer subtracts the price of the selected game, resets the player scores to zero, generates the game-in play (GIP) sound, and displays the GIP message.

2.5 SINGLE PLAYER GAME

The game-play sequence in KAOS consists of 3 or 4 turns (operator selectable) each of which lasts as long as the player can skillfully maneuver his man to avoid destruction while gathering dollars and slaying dragons. When he loses a man either by being eaten by a dragon or by electrocution (hitting the sides on the first three (3) mazes, or falling thru the bottom level), the GIP message reappears (stating whose turn it is, which maze it is, and the point value for the maze) accompanied by the GIP sound, while the computer draws all the colored levels and displays the number of men left (in the upper left hand portion of the screen) with the score. After the last man is lost, the game-over message is displayed.

Assuming a 3 man, 8 \$ per round, game-play begins with player score 000 and 3 men and 8 \$ displayed in the upper left hand portion of the screen. When the computer has finished drawing the various colored levels a man will appear in the middle of the display, (and only 2 will be in the upper left portion of the screen) dollars will then appear and begin moving back and forth along the levels, below whenever they reach an opening in the level they are on, each dollar that appears causes the number of dollars in the upper left portion of the screen to be decreased by 1 thereby showing the remaining number to be captured. The player uses his joystick control to move his man along the various colored levels, to capture these dollars, and increase his score. The player uses his jump button to jump across openings, or to jump up to higher levels or in an attempt to dodge a dragon or when on the top level to grab an "ERG" (become a king for a short while) in order to slay dragons (for increased score).

Whenever a man catches a dollar a distinctive sound is heard and his score is increased. If a dollar should reach the bottom level and falls through an opening, the dollar is immediately transformed into a green dragon, which jumps higher than the man. When the man gets too close to a dragon, he is devoured and the word "URP" is displayed.

When all the dollars in a given round have been captured, the man will appear above the players score while the computer draws a completely different display. Again when the display is completely drawn the man will appear approximately in the middle and one less will be displayed above his score, and play will continue as in the previous round. Note: the game starts with 3 ERGS and 1 additional ERG is awarded either every screen or every 2nd screen (operator selectable).

ERG's when eaten by the man, immediately change the man into a King for a short period of time. While a King the player can continue to collect dollars and also can slay dragons, however, the King is still vulnerable to electrocution by running into the sides (first three (3) mazes), or falling thru the bottom level.

When the man or King is finally destroyed either by a dragon or electrocution, the round is over and the video image returns to the GIP display announcing player (1) up, the MAZE NO. and Score Menu, showing Dollar value, Dragon value, and either Avoid Sides or Wraparound Sides, and displaying the score and the number of remaining men, the computer then generates and displays the maze accompanied by the unique sound.

2.5 cont. SINGLE PLAYER GAME

During play there are various number of dollars working their way to the bottom level and a various number of dragons (3 max.) in search of the man. However, there is always a set number of dollars per round (8, 12, operator selectable) the dollars on the first display are worth 100 pts. each and the dragons they become 300 pts. each. The dollars on each following display are worth more and the dragons these dollars become are worth three times (3x) the value of the dollar.

After each group of dollars' (8, 12) is collected or dragons slain, an entire different display of colored levels is shown. Each succeeding display is somewhat faster and completely unique. At the beginning of the game, the action is rather moderate to allow players an opportunity to develop a feel for the game.

Any dollars left at the end of a round will reappear at the beginning of the next round.

All of these features combine to make KAOS challenging for the player and profitable for the operator.

2.6 TWO-PLAYER MODE

The play of KAOS in a two-player game is identical to single-play with the players alternating turns. On the Upright Version, the players use one common set of controls. On the cocktail version there are two sets of controls on opposite sides of the table. The computer activates control alternately between 1 and 2 and flip-flops the screen image so that it is oriented to the player in control.

The GIP message, which appears after each turn, clearly indicates which player is up this allows time for the players to position themselves at the controls, but is brief enough to avoid unnecessary "dead-time".

2.7 GAME OVER MODE

After the players have lost their last man, the game over message is displayed and the attract mode begins. If there are credits left or a coin is inserted, the attract mode will be interrupted by pressing the start button.

3.0 COMPUTER SYSTEM

The KAOS Computer System consists of 2 printed circuit assemblies which perform the functions illustrated in Figure I. A self-contained switching regulated power supply provides reliable DC voltages to enhance the overall computer system reliability.

The Game Computer Board controls the game sequence, image generation, system-level diagnostics (accessed by test - EPROM and switch) audio and peripheral interface; thus keeping interconnections to a minimum.

The Video Computer Board contains the display RAM and timing circuits to interface with any standard RGB raster-scan color monitor. The Video Computer also contains unique input timing circuits which permit vector graphic writing to the video RAM.

3.1 POWER SUPPLY

The computer system power is provided by a high efficiency, very reliable, switching-regulated, power supply. It eliminates the hot, bulky transformers required by old-fashioned supplies and the high efficiency permits it to run cool at extreme of input line voltage variations.

The computer system uses -5, +5, and +12 VDC. The primary power is +5 VDC for the TTL and MOS devices. The ROM's can be either triple-voltage or single-voltage. The dynamic video RAM's use all 3 voltages. The audio amplifier uses +12 VDC. The coin door lamps and meters use +5 VDC.

DC voltage distribution from the power supply to the four circuit boards is multiply-redundant to enhance reliability. Each voltage is carried by two wires to each board. All four power connectors are identical, are keyed, and are symmetrical, so that only intentional abuse could result in faulty power connections. Each of the three voltages is current-limited by the supply to provide protection against short-circuits.

3.2 GAME COMPUTER

The Game Computer uses a 6502 central processor in a conventional computer architecture containing ROM, RAM, and I/O ports (FIG. 2). The computer clock uses a standard 4.00 megahertz crystal which is divided by 4 to provide a CPU clock of 1 megahertz.

The computer contains a unique power-on reset circuit which requires a positive feedback response from the computer to disable the reset circuit. Therefore, an initial power-on software program must successfully complete a specific set of operations or else the circuit continuously resets the computer. This technique assures that the computer is operating properly before continuing but does not require the software overhead of "watchdog" circuits.

Conventional TTL address decoding generates signals to select one of eight (8) ROM's or two (2) RAM's. Program and image storage is provided by eight (8) -4K x 3 - 2732 E PROM's. Computer scratch-pad RAM is either two (2) 1 K x 4 - 2114's or two (2) 256 x 4 - 2101's.

Port 1 provides an 8-Bit video data byte on port 1A and a 4-Bit video control address on Port 1B to write data into the video RAM. In addition, port 2B receives video timing signals which are used to synchronize the game program with the video display.

Interface Portion uses port 2A and 2B to create a 6 x 8 switch matrix for scanning up to 48 switches. Two (2) columns of the matrix are used to scan two 8-position DIP switches providing operator options. The remaining switches provide signals for driving coin meters and other peripheral devices. In addition, Port 2 is linked to the power-on reset circuit so that the computer can enable or disable the reset signal.

Audio Section of the board transmits game sounds thru Port 3.

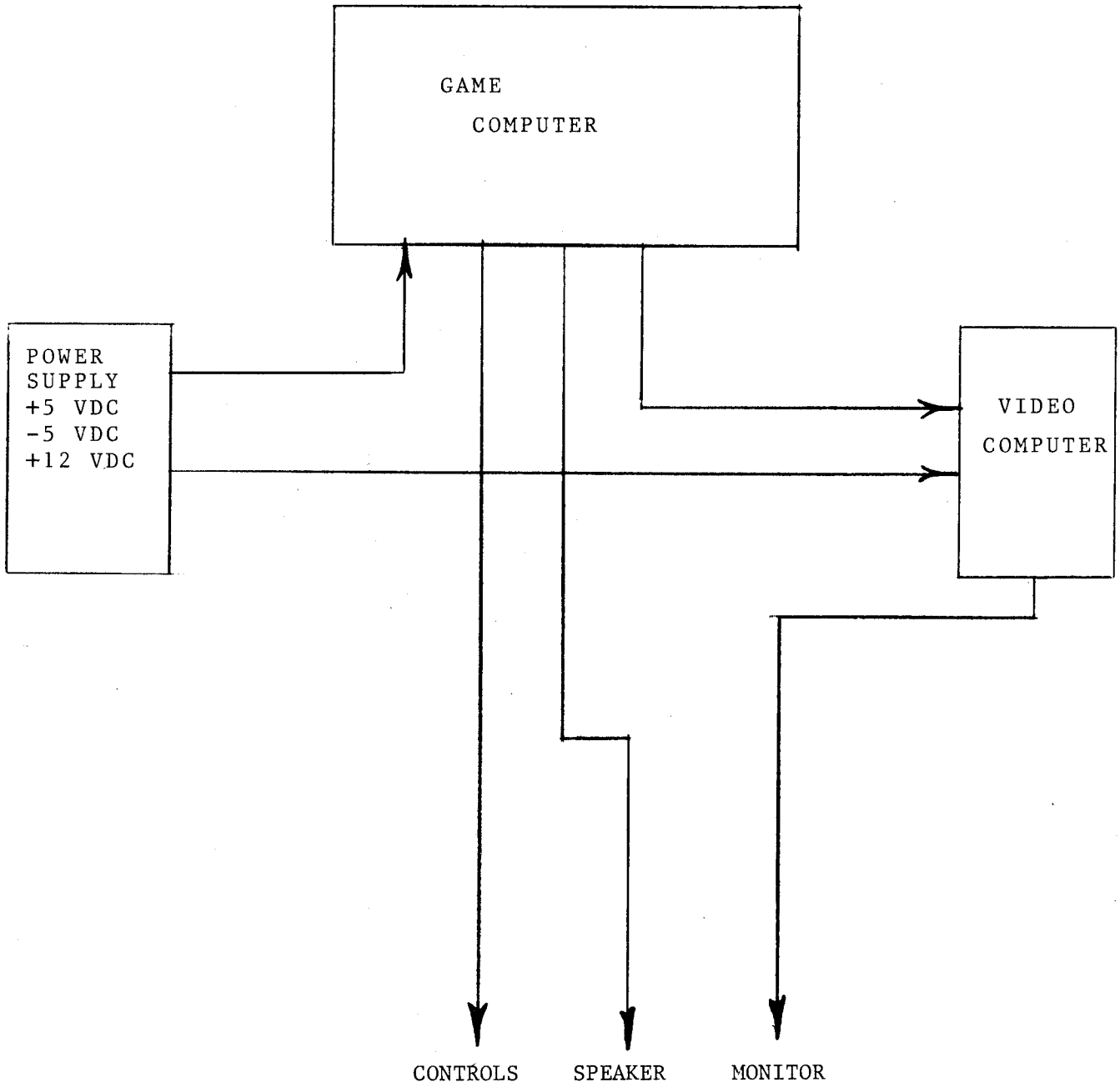


FIG - I

GAME BLOCK DIAGRAM

3.2.1 PERIPHERAL INTERFACE PORTION

The Peripheral Interface Portion provides buffers and drivers for protective isolation of the electronics. Up to 32 switches can be handled by 4 columns of a switch matrix, as illustrated in figure 3. Each switch is "diode-isolated" to provide "n-key rollover". The potential problems of ghost-switches is also eliminated by putting all critical, non-player-accessable switches in a single column.

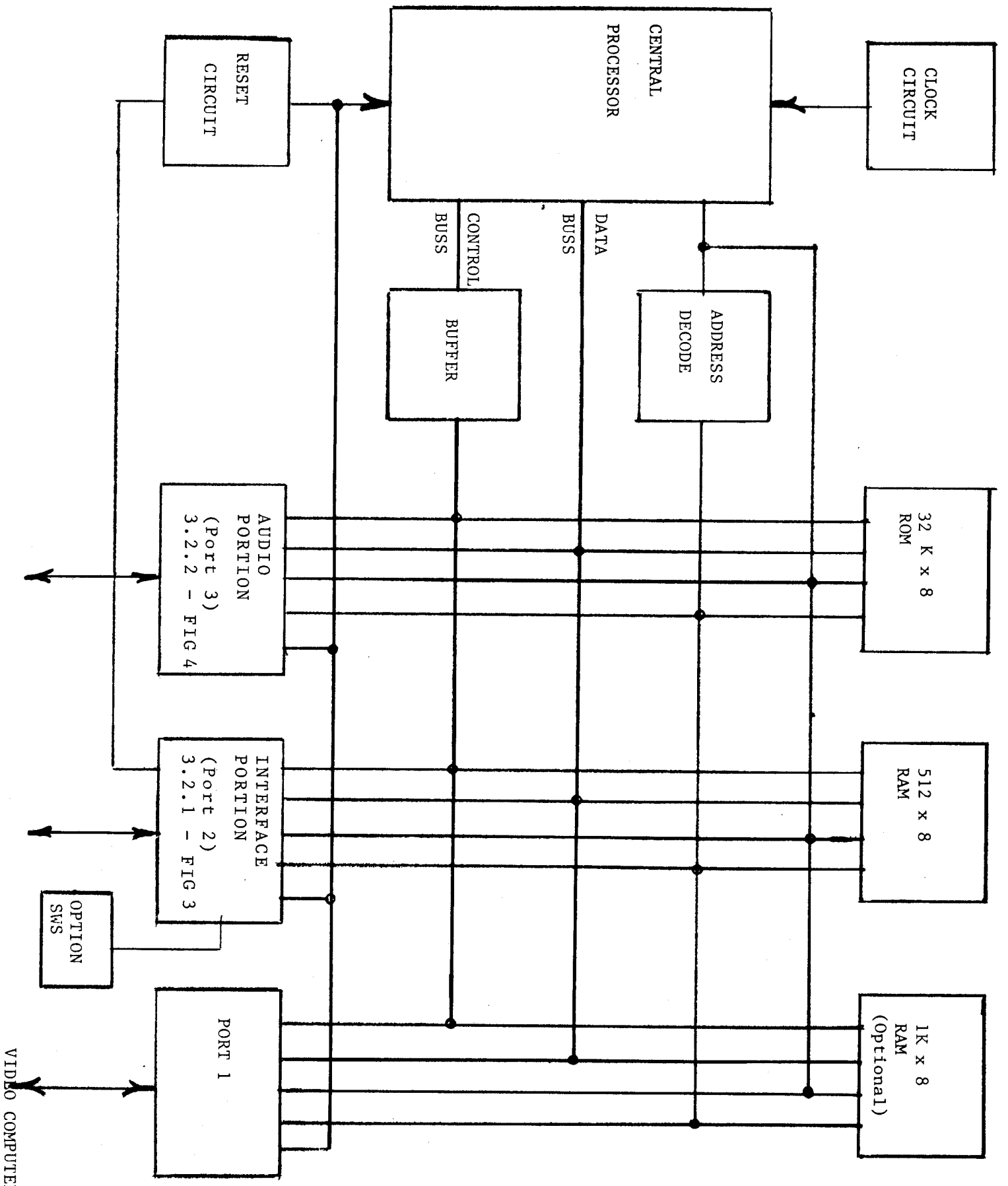


FIG. 2
BLOCK DIAGRAM COMPUTER BOARD

VIDEO COMPUTER (FIG 5)

3.2.2 AUDIO COMPUTER

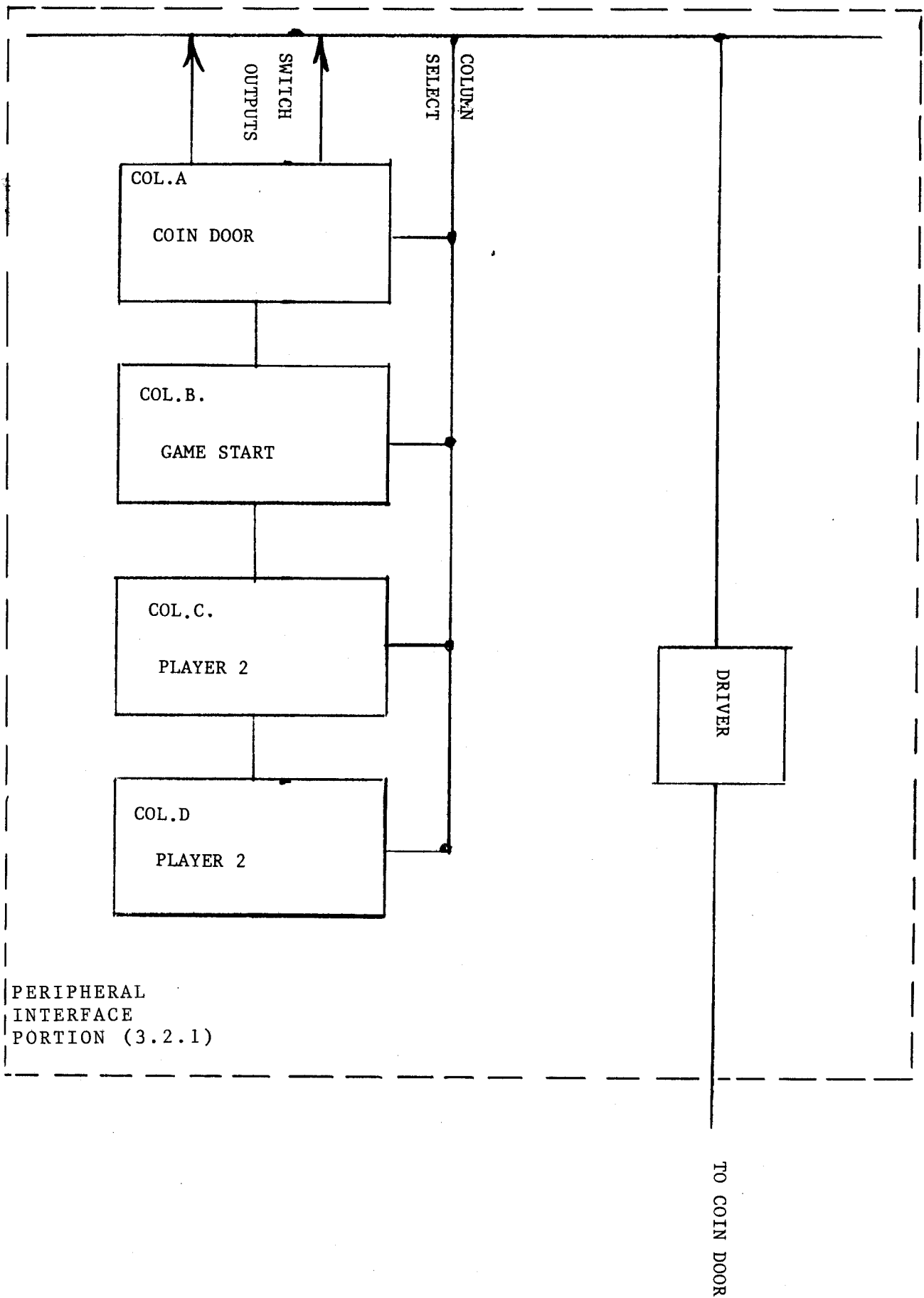
The Audio Computer also uses a 6502 central processor chip as illustrated in figure 4 and it also uses a standard TV color-burst crystal to generate a computer clock slightly less than 900 kilohertz. However, Port 5 uses a 6532 which provides dual 8-Bit bi-directional data-bus buffers plus 128 bytes of RAM. Program storage is provided by a single 2K x 8, 2716 EPROM or 2316 ROM.

The small amount of RAM and ROM is sufficient for this system because of the use of a unique programmable sound generator chip (AY-3-8910 PSG). This device contains 3 sets of tone generators, a pseudo-noise generator, and 3 channels with a variety of amplitude controls—all under stored-program control. In addition, the PSG contains two 8-Bit ports which are used to read two DIP switches that can be used to manually program the PSG for test purposes.

Access to the Audio Computer is through Port 5A which interrupts the processor when a sound-request is made. The computer stores the sound request data-byte and then re-transmits it on Port 5B. Thus the Game Computer can verify that a requested sound has been processed and, if this verification is not received, force a reset of the Audio Computer.

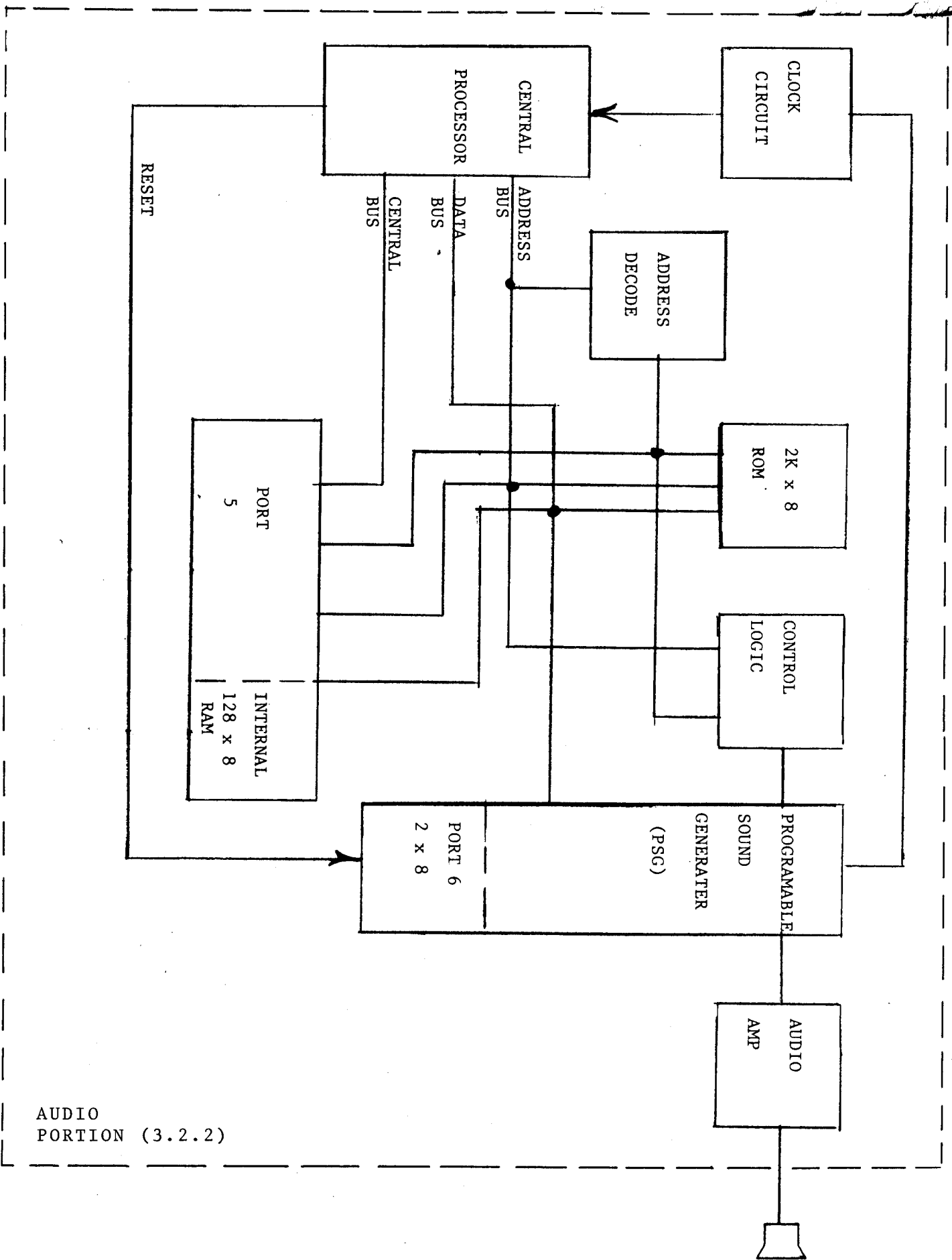
The 3 audio channel outputs of the PSG are amplified by an industry-standard, reliable LM 380. The amplifier operates with regulated 12 VDC which provides sufficient audio volume for noisy arcades, and yet is only 60% of the rated voltage to provide another margin of reliability.

A volume control is located on the Computer Board. Individual game sound volumes are programmed to balance the overall audio effect.



PERIPHERAL
INTERFACE
PORTION (3.2.1)

FIG. 3
PERIPHERAL INTERFACE (BLOCK DIAGRAM)



AUDIO PORTION (3.2.2)

FIG. 4
AUDIO COMPUTER (BLOCK DIAGRAM)

3.3 VIDEO COMPUTER

The Video System uses a RAM intensive, dot-oriented technique. What this means is that the circuit board contains sufficient memory to store an entire CRT screen image and that each bit in this RAM array can be individually addressed.

The large memory array is comprised of low-cost MOS dynamic RAM's which are ideally suited for video display. The repetitive reading of the memory for raster scan display automatically takes care of the refresh timing required to retain dynamic memory. On the other hand, dynamic RAM's are notoriously unreliable (by digital computer standards) but occasional bit errors are tolerable (in fact, often invisible) on a CRT screen. Some systems use part of the video RAM for computer scratch-pad but the video computer appears to the game computer as a "write-only" device.

As illustrated in figure 5, the Video Computer contains 3 separate RAM arrays for each of the 3 spectral primary colors; red, green, and blue. Two independent sets of counters generate read and write addresses that access the 3 arrays in parallel to generate color dots (pixels). The read-address counters perform the dual function of generating horizontal and vertical timing signals for synchronization of the CRT monitor and the Game Computer image generation.

The write-address counters are parallel-load, up,-down devices which provide 2 modes of writing to the display memory. In the first mode, the write-counters can be loaded with a 8-bit X-address and an 8-bit Y-address to locate the beginning of a line vector. The second mode involves incrementing or decrementing the counters to move the write-address along a desired vector. Each time a write-address is changed, the Video Computer automatically writes the specified color bits into that RAM location.

A Write-request to the Video computer is non-synchronous so timing buffers interface the read and write functions. In addition, the timing buffers generate "wait" signals to let the Game Computer know when each write operation is completed.

The 8-bit X-Y addressing generates a 256 x 256 screen image (256 dots per line and 256 lines per game screen). This symmetrical display combined with the vector graphic writing technique provides simple software control of the screen image orientation. Thus the system provides switch selection to use vertical or horizontal monitors, inverted screen for cocktail flipflop of 2-player games, and reversed images for mirrored games.

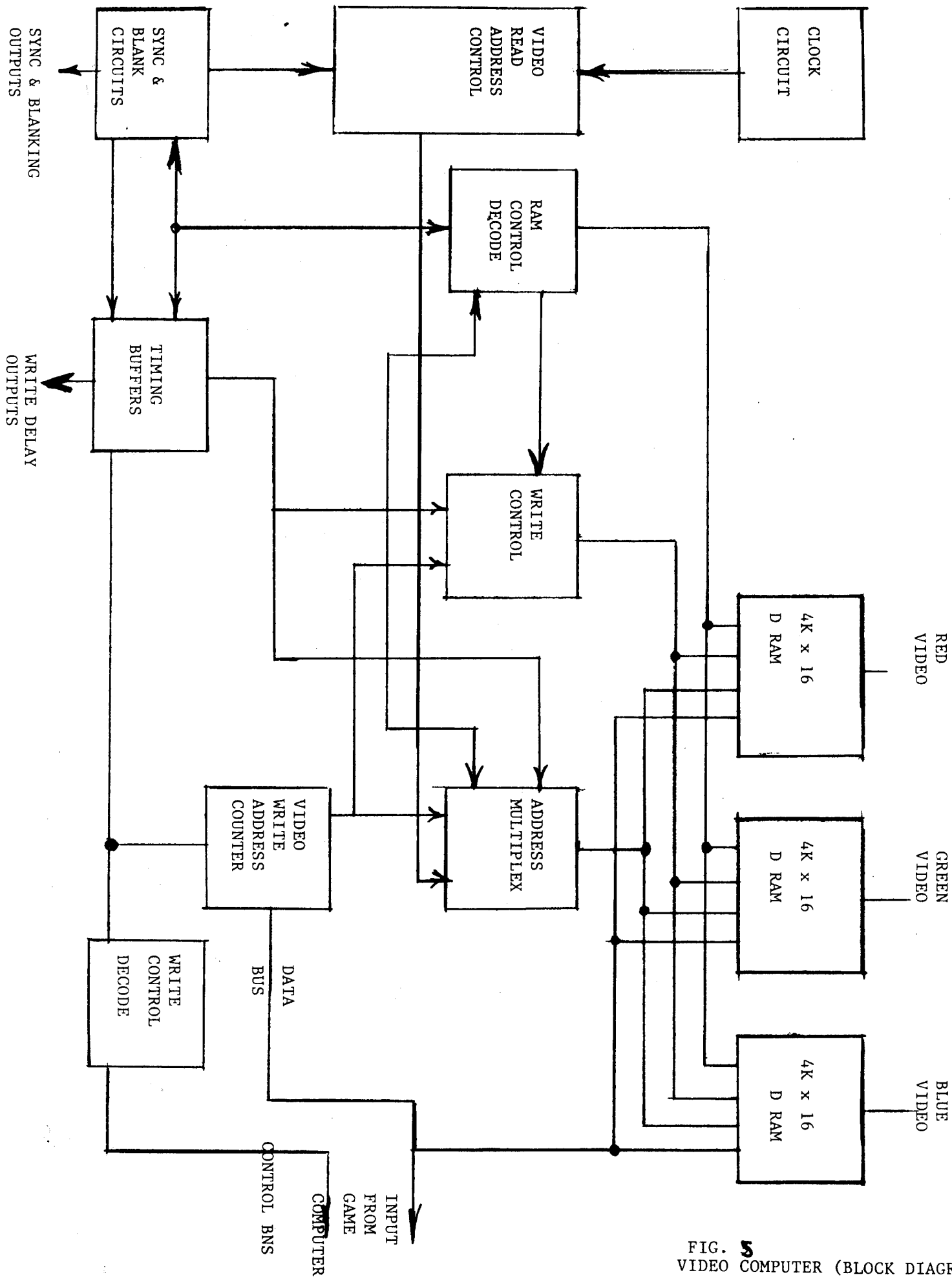


FIG. 5
VIDEO COMPUTER (BLOCK DIAGRAM)

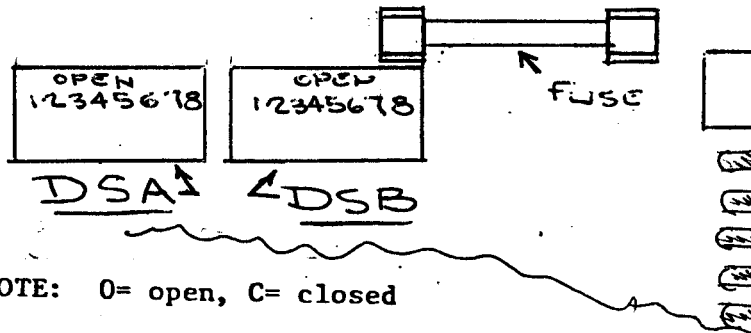
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Oct. 28, 1981

4.0 OPERATOR OPTIONS

Dip Switch settings for KAOS,



DSA:

NOTE: 0= open, C= closed

coins
(1-4)

1	2	3	4	credits/coin
0	0	0	0	3/2
C	0	0	0	1/1
0	C	0	0	2/1
C	C	0	0	3/1
0	0	C	0	4/1
C	0	C	0	5/1
0	C	C	0	6/1
C	C	C	0	7/1
0	0	0	C	8/1
C	0	0	C	9/1
0	C	0	C	10/1
C	C	0	C	11/1
0	0	C	C	12/1
C	0	C	C	13/1
0	C	C	C	14/1
C	C	C	C	1/2

Sound Attract Mode

5 OFF-No sound during attract mode
 ON- sound during, attract mode

max credits
(6-7)

6	7	max credits
0	0	10
C	0	20
0	C	30
C	C	40

free play
(8)

8	
0	normal
C	free play

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DSB

Number of men
 (1)

1 num of men	
0	3
C	4

Speed
 (2)

2 Speed	
0	fast at start
C	slow at start

Bonus Men
 (3&4)

3 4 Bonus men		
0	0	No bonus
C	0	10,000 (1)
0	C	10K, 30K(2)
C	C	10K, 30K 60K (3)

Number of \$
 (5)

5 num of \$	
0	8
C	12

Bonus erg
 (6)

6 Erg awarded	
0	every other screen
C	every screen

Not used
 (7)

Cocktail/Upright
 (8)

8 Game style	
0	upright
C	cocktail

EXAMPLE:

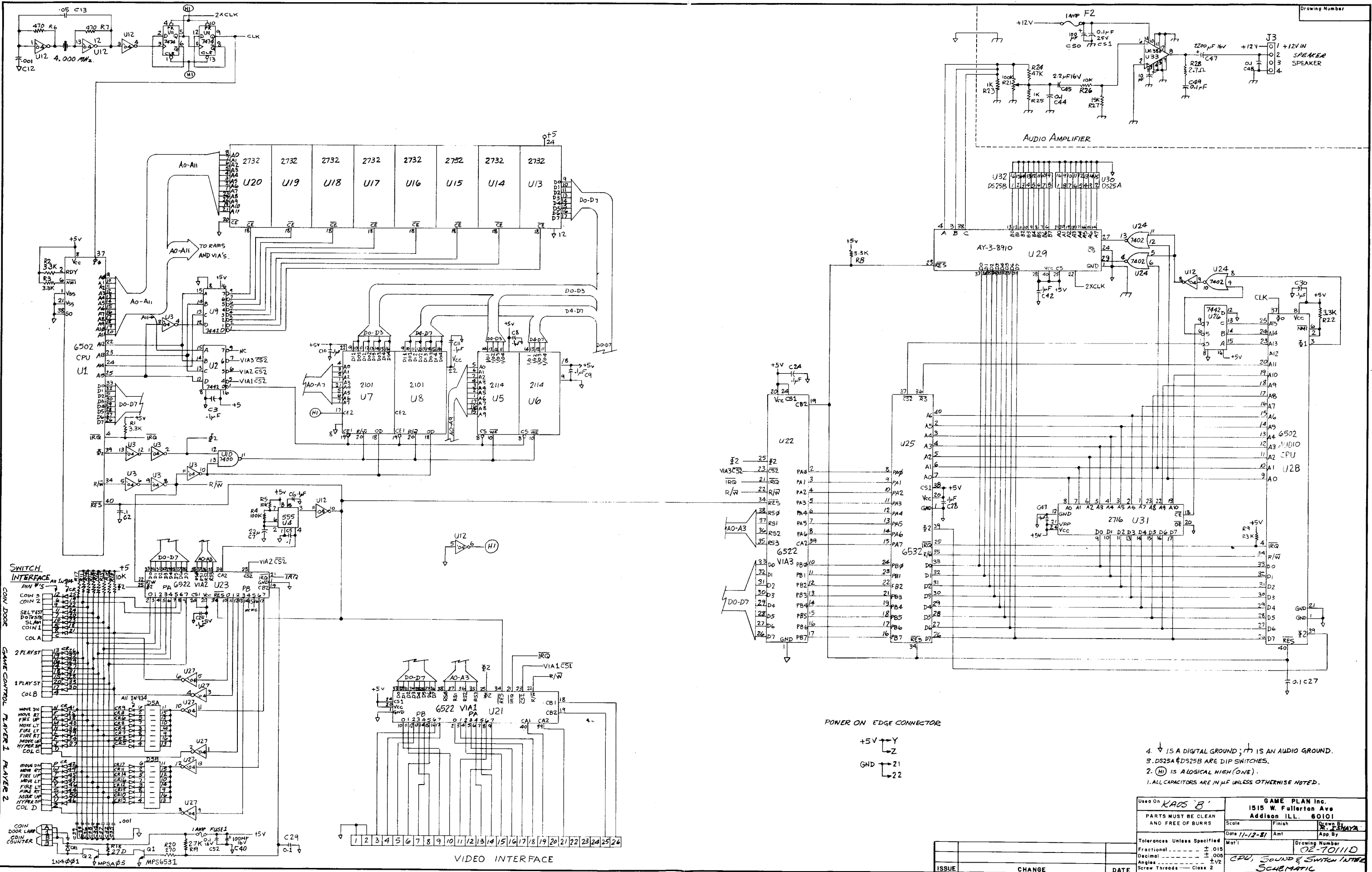
DSA

1	2	3	4	5	6	7	8
C	0	0	0	C	0	0	0

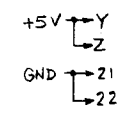
DBS

1	2	3	4	5	6	7	8
0	C	C	C	0	C	0	0

1 play per coin, sound during attract mode, 10 max, credits not freeplay, 3 men, slow speed, 3 bonus men 8 \$, bonus erg every screen upright.

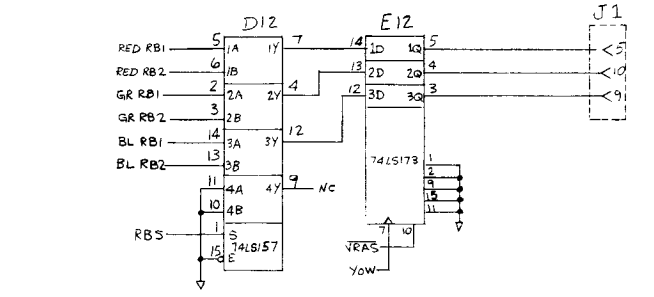
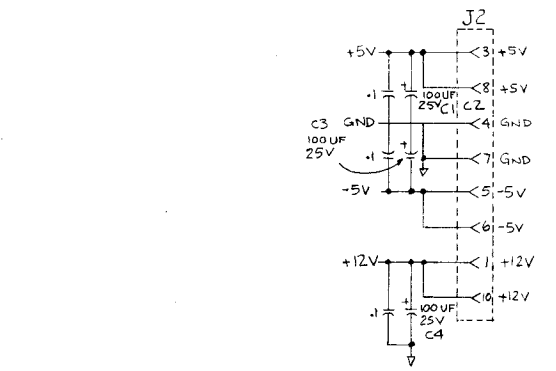
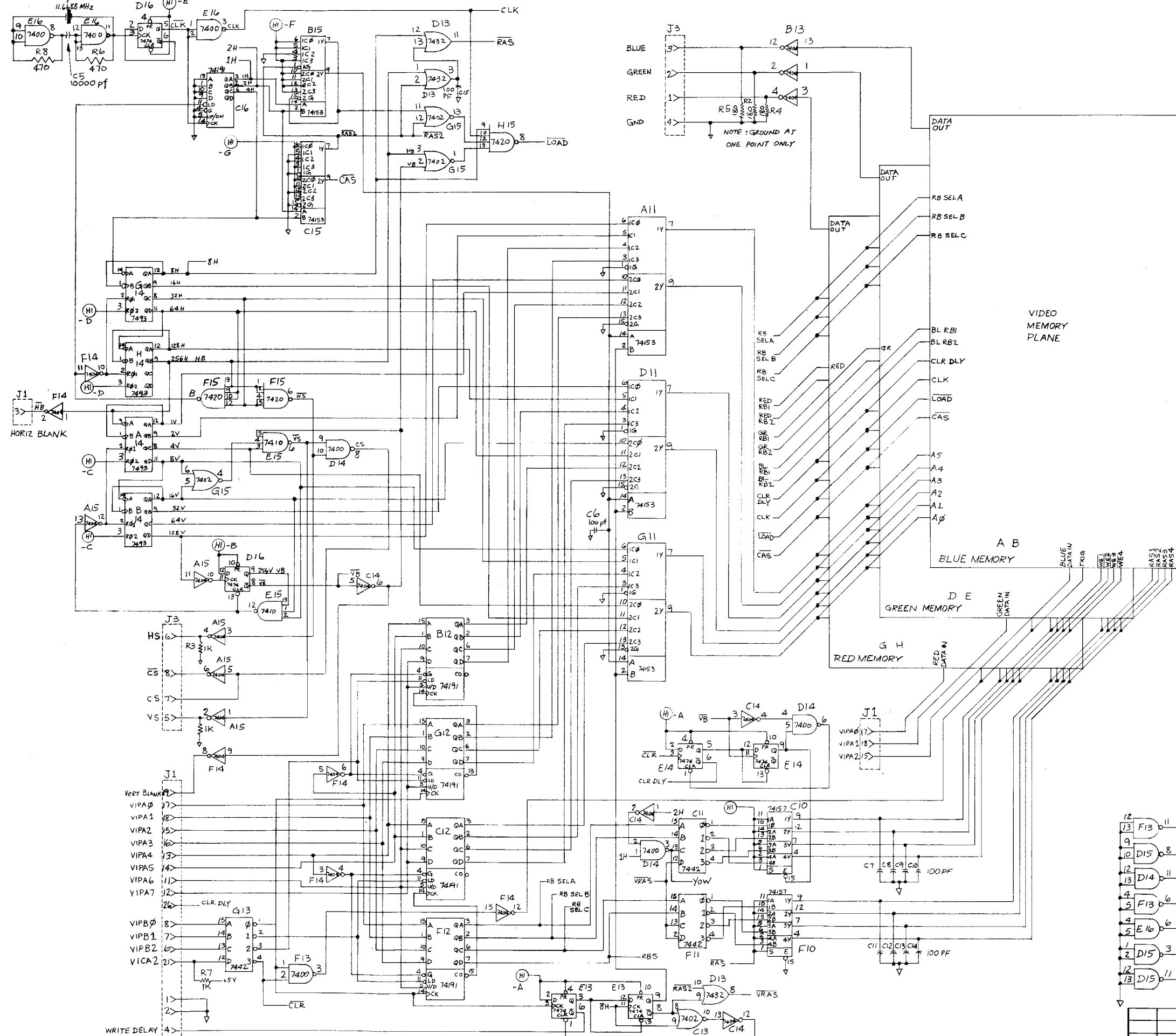


POWER ON EDGE CONNECTOR



- 4. ↓ IS A DIGITAL GROUND; (H) IS AN AUDIO GROUND.
- 5. DS25A & DS25B ARE DIP SWITCHES.
- 2. (H) IS A LOGICAL HIGH (ONE).
- 1. ALL CAPACITORS ARE IN nF UNLESS OTHERWISE NOTED.

Used On KAOS 'B'		GAME PLAN Inc. 1515 W. Fullerton Ave Addison ILL. 60101	
PARTS MUST BE CLEAN AND FREE OF BURRS		Scale	Finish
		Date 11-12-81	App. By
Tolerances Unless Specified		Drawing Number	
Fractional	± 0.05	02-701110	
Decimal	± 0.005	CPU, SOUND & SWITCH INTFR	
Angles	± 1/2°	SCHEMATIC	
Screw Threads	Class 2		
ISSUE	CHANGE	DATE	



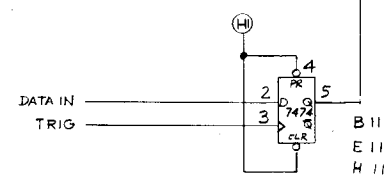
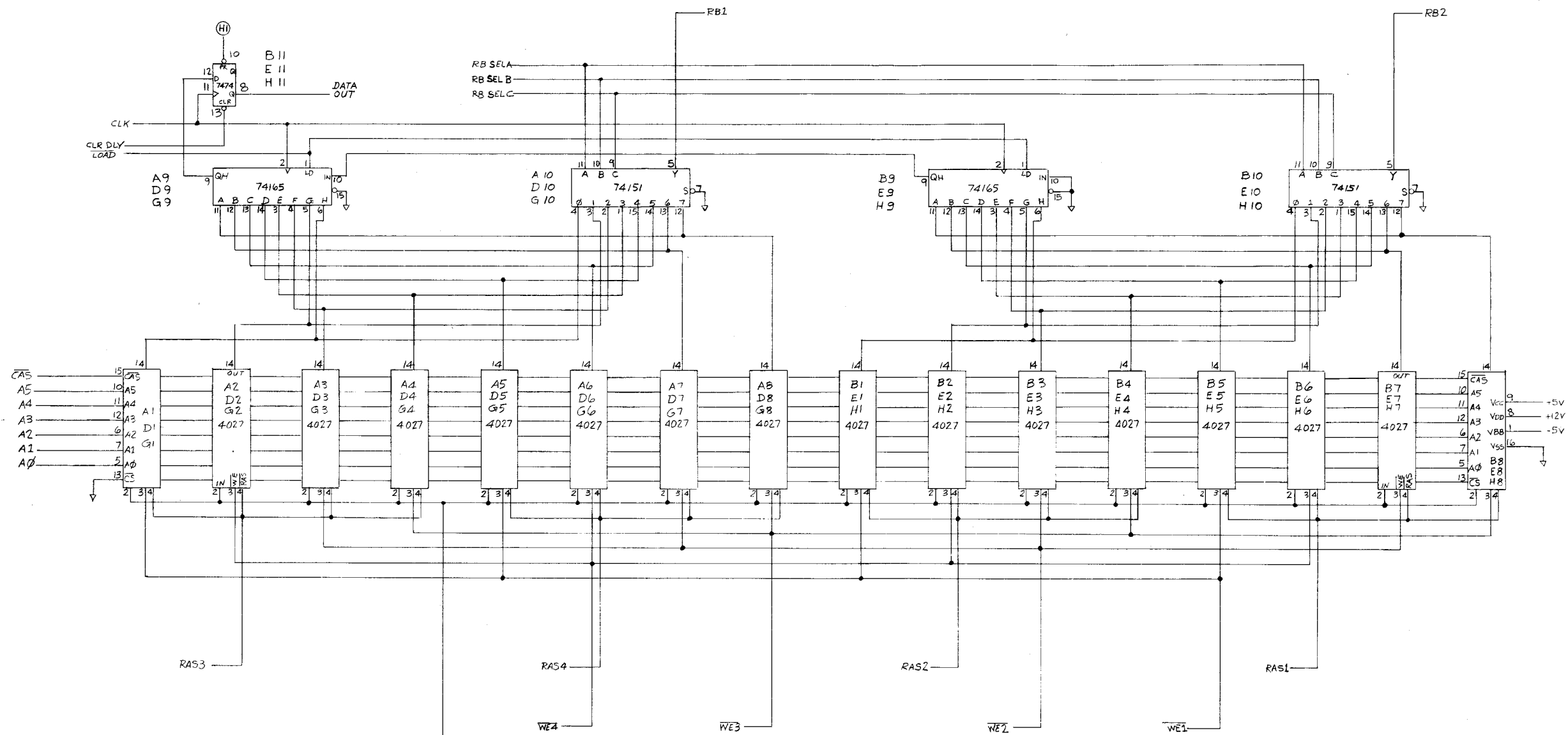
- 12 (H) - A
- 9 (H) - B
- 10 (H) - C
- 13 (H) - D
- 4 (H) - E
- 5 (H) - F
- 1 (H) - G
- 12 (H) - G

NOTE: (H) IS A LOGICAL HIGH (ONE).

SHT 1 OF 2

Used On KA03 B		GAME PLAN Inc. 1515 W. Fullerton Ave Addison ILL. 60101	
PARTS MUST BE CLEAN AND FREE OF BURRS	Scale	Finish	Drawn By R. ZHAYTA
Tolerances Unless Specified	Date 11-13-81	Am't	App. By
Fractional ----- ± 0.15	Drawing Number 02-70110D		
Decimal ----- ± 0.05	VIDEO BOARD SCHEMATIC		1 OF 2
Angles ----- ± 1/2			
Screw Threads ----- Class 2			

ISSUE	CHANGE	DATE



DEVICE TABLE	
TYPE	REF DESIGNATION
7400	D14 D15 E16 F13
7402	G15 C1
7404	A15 B13 C14 F14
7410	E15
7420	F15 H15
7432	D13
7442	C11 F11 G13
7474	B11 E11 H11 E13 E14 D16
7493	A14 B14 G14 H14
74LS151	A10 D10 G10 B10 E10 H10
74153	A11 D11 G11 B11 C15
74157	C10 F10
74LS157	D12
74165	A9 D9 G9 B9 E9 H9
74LS173	E12
74191	B12 C12 F12 G12
4027 RAM	A1-A8 B1-B8 D1-D8 E1-E8 G1-G8 H1-H8

NOTE: (H) IS A LOGICAL HIGH(ONE).

SHT 2 OF 2

Used On	GAME PLAN Inc. 1515 W. Fullerton Ave Addison ILL. 60101		
PARTS MUST BE CLEAN AND FREE OF BURRS	Scale	Finish	Drawn By
	Date 11-10-81	App. Amt	App. By
Tolerances Unless Specified	Drawing Number		
Fractional ± .015	32-73110		
Decimal ± .005	VIDEO BOARD SCHEMATIC		
Angles ± 1/2			
Screw Threads — Class 2			

ISSUE	CHANGE	DATE