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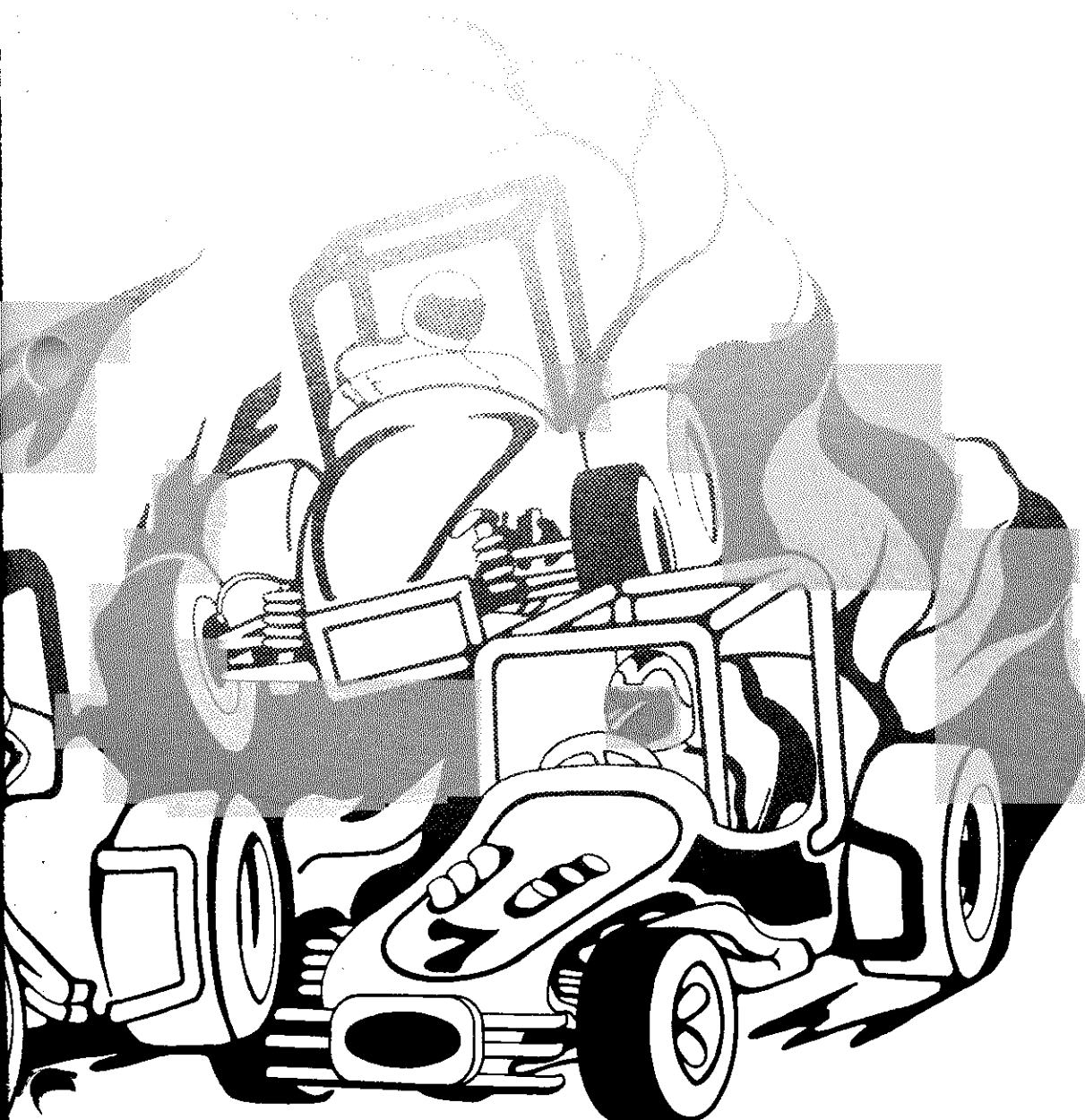
# sprint™ Z

Operation, Maintenance  
and Service Manual



KEE GAMES

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# sprint™ **L**

## Operation, Maintenance and Service Manual

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By the Publications Group, Engineering Department



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# I. INTRODUCTION

## 1.1 PHYSICAL DESCRIPTION OF GAME

Kee Games' Sprint 2 is a one or two player driving game. The game is packaged in its own distinctively-styled upright cabinet that rests directly on the floor. A 23-inch TV monitor is mounted in the top front of the cabinet, with the monitor viewing screen slightly tilted back from vertical. (Drawing number A006205-01, in Section IX of this manual, provides external and sectional views of the game cabinet.) The TV monitor viewing screen is covered with a plexiglas panel.

Player-operated controls are mounted side-by-side directly below the TV monitor viewing screen on the front of the game cabinet. The controls consist of two steering wheels, two four-speed gear shifters, two accelerator foot pedals, and three back-lighted pushbutton switches. The switches are labeled TWO PLAYER START, TRACK SELECT, and ONE PLAYER START. A speaker mounted beneath each steering wheel provides game sound for the car controlled by that player.

Two identical coin mechanisms are mounted on the lower front center of the cabinet, below the steering and shifting controls. Either coin mechanisms can initiate play. The cash box is located behind a locked access door to the coin mechanisms.

## 1.2 SUMMARY OF GAME PLAY

The player's objective is to successfully keep his car in the boundaries of the race track and complete as many laps as possible before the end of game time. A single player operates the white car with the controls on the right side of the cabinet and competes with a black car and two grey cars. The black and grey cars are computer controlled. With two players, the player on the right operates the white car, the player on the left operates the black car, and the two grey cars are computer controlled.

After the proper coins have been inserted in the coin mechanism, the choice of which track to be played must be made. By pressing the TRACK

SELECT pushbutton, the displayed tracks on the TV monitor screen are changed. The tracks become progressively more difficult each time the TRACK SELECT pushbutton is pressed, until the twelfth track is displayed, then the progression begins again from the easiest track.

Once the determination of the desired track is made, a player must press either the ONE PLAYER START or TWO PLAYER START pushbutton (dependent on the number of coins inserted in the coin mechanism). This begins the game play and the game timer starts counting down from 100.

Now with the left hand on the steering wheel, the right hand on the four-speed gear shifter, the right foot on the accelerator foot pedal, and the sound of an idling motor, the player may begin to "drive" his car around the race track.

Acceleration is as in a real car. Start out in anything but first gear and the car accelerates slowly. Start out in first gear and the car accelerates nicely. Once the car is moving, shifting into progressively higher gears increases the speed of the car. If the car goes into a turn too rapidly, the car will go into a driver-controllable skid, with the sound of the skid on that player's speaker. Whenever a player's car comes in contact with any of the other three cars or an oil slick, the car goes into a semi-controllable skid. If a player's car makes contact with the track boundary, a crash sound will be heard and the car will stop.

By passing through check point areas on the track, a score is tallied at the top of the TV monitor screen. There are ten points awarded for the completion of each lap. However, the scoring point locations are not identified on the displayed track.

Thus the outstanding feature of Sprint 2 is that it is a highly competitive game. One player competes with himself and three "computer" controlled cars. Two players compete with themselves, each other, and with two "computer" controlled cars.

## II. SPECIFICATIONS

### 2.1 GENERAL

Cabinet Dimensions:	Height 66 $\frac{1}{4}$ inches, Width 36 inches, Depth 31 inches.
TV Monitor:	Black and white, 23-inch screen, with composite video input.
Coin Mechanisms:	Two identical mechanisms, accept only quarters.
Cash Box:	Removable; located behind locked access door to coin mechanisms.
Power Cord:	Approximately 6 foot long, extending from rear of game cabinet and having grounded three-prong plug for conventional wall outlets.
ON/OFF Switch:	Hidden above the accelerator foot pedal on right side of game cabinet, for owner operator access.
SELF-TEST Switch:	Located at the inside front of game cabinet to the immediate left of coin box.
Lighting:	One 24-inch fluorescent tube for cabinet lighting. One GE #47 lamp for coin mechanism lighting.

### 2.2 ELECTRICAL

Power Requirement:	Uses conventional grounded wall outlet providing 100 volts AC, 60 Hz, single phase, rated at about 200 watts.
Fusing:	All fuses accessible from rear access door of game cabinet; TV monitor has two 3AG 1-amp slow blow, 250 volt fuses and remainder of game is protected by one 3AG 3-amp quick blow, 250 volt fuses, mounted beneath the cover on the Electronics Assembly Tray.

Power Interrupt Switch:

These are safety interlock switches located inside the game cabinet rear access door. They cause the removal of AC power to the game when the access door is opened.

### 2.3 ENVIRONMENTAL

Operating and Storage Temperature Range:	From 32 degrees Fahrenheit to 120 degrees Fahrenheit (Ambient temperature).
Relative Humidity:	Maximum of 80% without condensation.

### 2.4 OWNER/OPERATOR OPTIONS FOR STRUCTURING OF GAME PLAY

Cost:	Free 25¢ for two players 25¢ per player 50¢ per player
Game length:	60 seconds 90 seconds 120 seconds 150 seconds
Extended Play:	None 30% of game length with PRO driving rating.
Miscellaneous:	No oil slicks Oil slicks Only easist track displayed during Attract Mode. Cycling of all twelve tracks during Attract Mode.

### 2.5 ACCESSORIES AVAILABLE ON SEPARATE ORDER

Video Probe:	Order from Atari
Universal Test Fixture:	Order from Atari, catalog no. CTF-1
Universal Test Fixture Sprint 2 Adaptor:	Buffer Board—Order from Atari, catalog no. 005822-01 Diagnostic Test Board—Order from Atari, catalog no. 005840-01

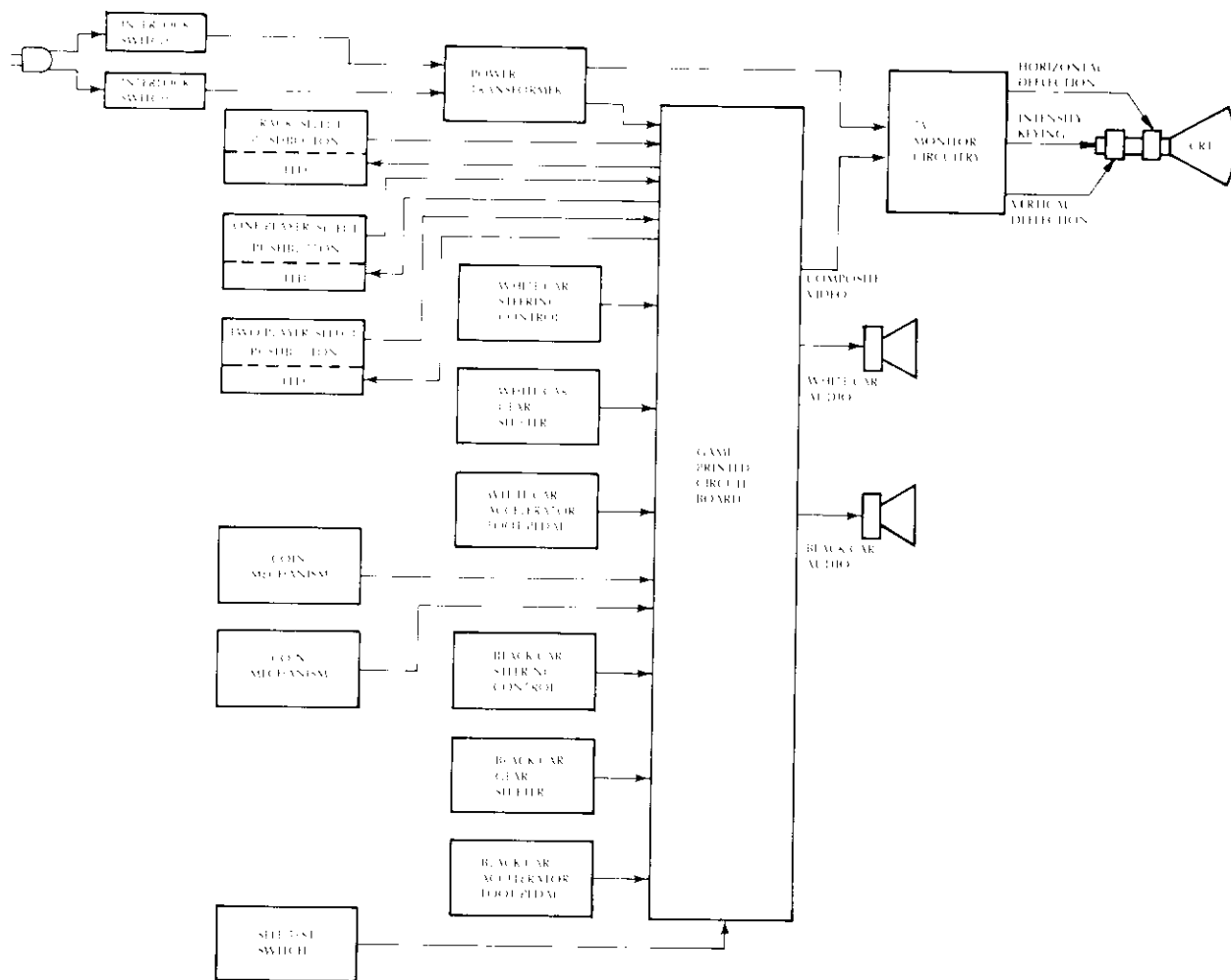


Figure 3-1 Functional Block Diagram of Sprint 2 Game

# III. DESCRIPTION OF OPERATION

## 3.1 FUNCTIONAL DESCRIPTION OF GAME

The block diagram in Figure 3-1 illustrates the major functional parts of the Sprint 2 game. Note that the game printed circuit board (hereafter referred to as PCB) sends a composite video signal to the TV monitor and two separate audio signals to the speakers.

## 3.2 GENERAL INFORMATION

General information about the game in the following subparagraphs provides a background for the Installation Instructions in Section V of this manual, and the description of Game Sequence in paragraph 3.3 of this section.

### 3.2.1 Energizing the Game:

The game is energized by inserting the AC power plug into an active AC wall outlet that provides the specified AC power as listed in Section II, Specifications, of this manual. The Power ON/OFF switch, hidden above the accelerator foot pedal on right side of game cabinet must be set to the "ON" position.

### 3.2.2 TV Monitor:

The game's TV monitor is a self-contained transistorized television monitor. Because the composite video signal sent to the monitor by the control circuitry differs in many respects from the signal derived from commercial TV broadcasts, the picture appearing on the screen is unlike that of a home TV set and the monitor does not produce any sound.

### 3.2.3 TV Monitor Picture:

Normally in black and white video games there are only two video levels, white and black. In Sprint 2 a grey video level is added to represent two programmed race cars. This is accomplished by using the video output summing resistors as a voltage divider during the grey car scans. The results is a decreased video output signal. Since the signal level determines the beam current of the TV monitor CRT, the result is a condition of not full on (white) and not full off (black) but somewhere between the two conditions (grey).

## 3.3 GAME SEQUENCE

### 3.3.1 Operating Modes:

During normal use, Sprint 2 can be described as operating in one of four modes; attract, ready-to-play, play, and freeze. Connecting the power cord to the proper AC source energizes the game and the game will be in the attract mode. The game remains in the attract mode until a coin has been inserted and the coins clear the coin mechanism, then the game goes into the start mode. After the desired track is selected by pressing the TRACK SELECT pushbutton, the play mode is initiated by pressing one of the player start pushbuttons; the game timer will begin counting down from 100 by one-digit increments. When the game timer reaches zero, the game goes into the freeze mode for approximately ten seconds before returning to the attract mode.

### 3.3.2 Attract Mode:

Figure 3-2 illustrates one of the TV monitor displays during the attract mode. During the attract mode, the four cars (one white, one black, and two grey cars) are displayed moving about the tracks as the tracks progressively change from the easiest to the most difficult (see Owner/Operator options, subparagraph 3.3.6 of this section). In this mode, there is no sound. It is normal, while the twelve tracks change, for some of the cars to "cheat" by going through some of the tracks' boundary lines. Across the top of the TV monitor one of the following will be displayed:

1 COIN PER PLAYER  
2 COINS PER PLAYER  
1 COIN PER 2 PLAYERS

### 3.3.3 Start Mode:

Figure 3-3 illustrates the TV monitor display during the start mode before the TRACK SELECT pushbutton is pressed.

The insertion of the proper coins in the coin mechanism initiates the start mode. When the coins clear the coin acceptor, the display will stop the automatic changing of the tracks and the easiest track is displayed and the cars are lined up at the starting line. Pressing the TRACK SELECT pushbutton, as instructed by the TV monitor display, will change the displayed track to the next more difficult track, until



the twelfth track is displayed. Pressing the TRACK SELECT pushbutton while the twelfth track is displayed will begin the cycle over again from the easiest track.

### **3.3.4 Play Mode:**

The play mode is initiated by pressing the ONE PLAYER START or TWO PLAYER START pushbutton. As soon as the appropriate pushbutton is pressed, there will be a motor sound from each of the two speakers. The TV monitor display is the same as the start mode, except as follows; (1) the instruction words PUSH START BUTTON disappear from the bottom of the display; (2) the instruction words PUSH BUTTON TO CHANGE TRACKS disappear from above the track (only if the easiest track is displayed); and (3) the game timer begins counting down from 100. At the time of the initiation of the play mode, the player controls are enabled. As the player or players advance their cars around the track, a score for the player on the right is tallied beneath the word WHITE and a score for the player on the left is tallied under the word BLACK on the TV monitor display. Two points are awarded for passing each of the five checkpoint areas on the track. The five checkpoint areas are not identified on the TV monitor display.

### **3.3.5 Freeze Mode:**

The freeze mode is initiated when the game timer reaches zero (see Owner/Operator Options, subparagraph 3.3.6 of this section). The TV monitor display is the same as in the play mode, except all car motion is "frozen," the words GAME OVER repeatedly appear and disappear across the top of the TV monitor display, and driver rating words GRANNY, ROOKIE, or PRO for each player appear at the bottom of the display. The freeze mode lasts for approximately ten seconds, then the game will go back into the attract mode.

### **3.3.6 Owner/Operator Options:**

Options of the Sprint 2 game are available to the owner/operator for maximum player appeal for each game location. These options are listed in Table 3-1; they are preset for a certain game structure in the manufacturing process. To determine how the switches are set, place the self-test switch, located just inside and to the left of the coin mechanism of the game cabinet, to the ON position. At the end of the self-test sequence, the TV monitor will display the results of the toggle positions of switch assembly SW1, as listed in Table 3-1.

In order to change the toggle positions of the switch assembly, the Sprint 2 PCB must be removed from the RF Shield Box Assembly as described in Section VII, Dissassembly and Assembly, of this manual.

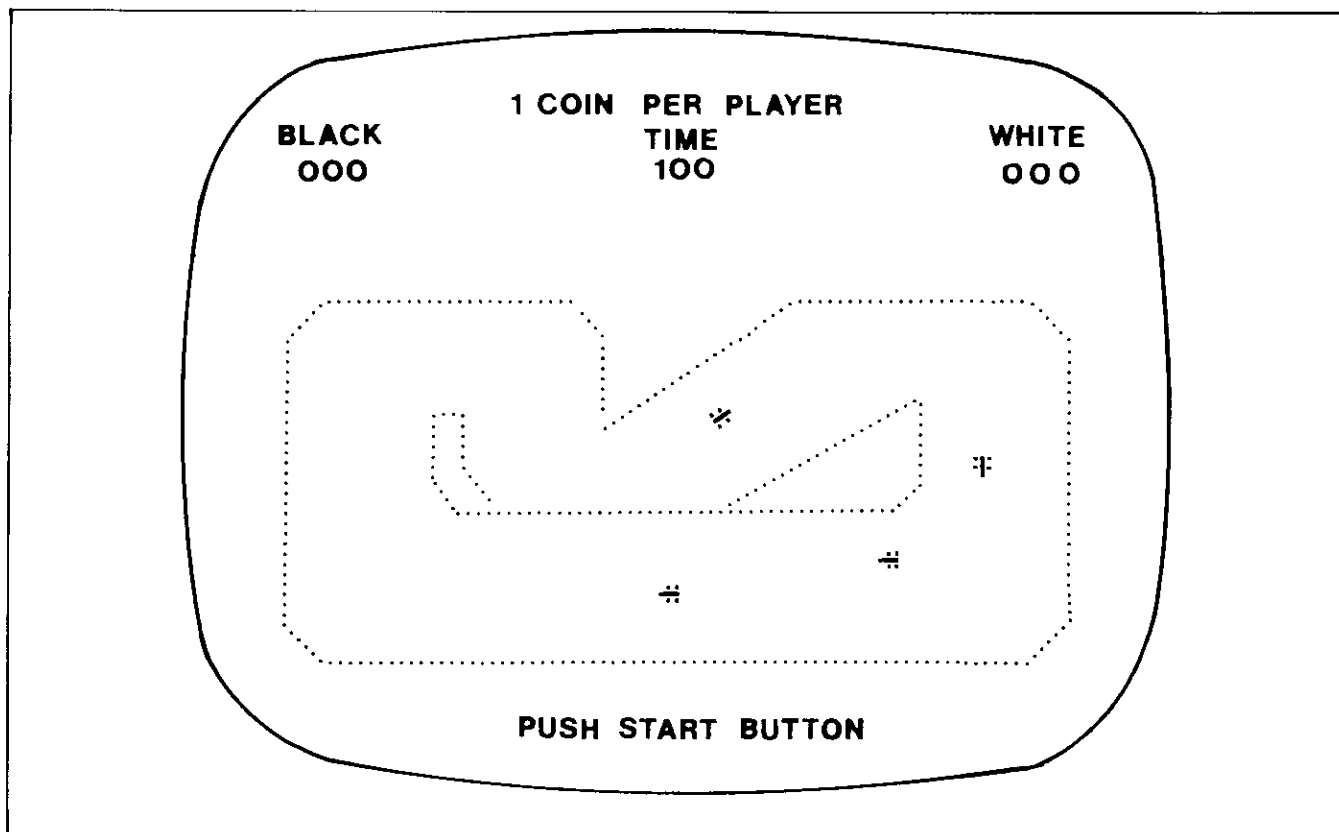


Figure 3-2 Attract Mode Display

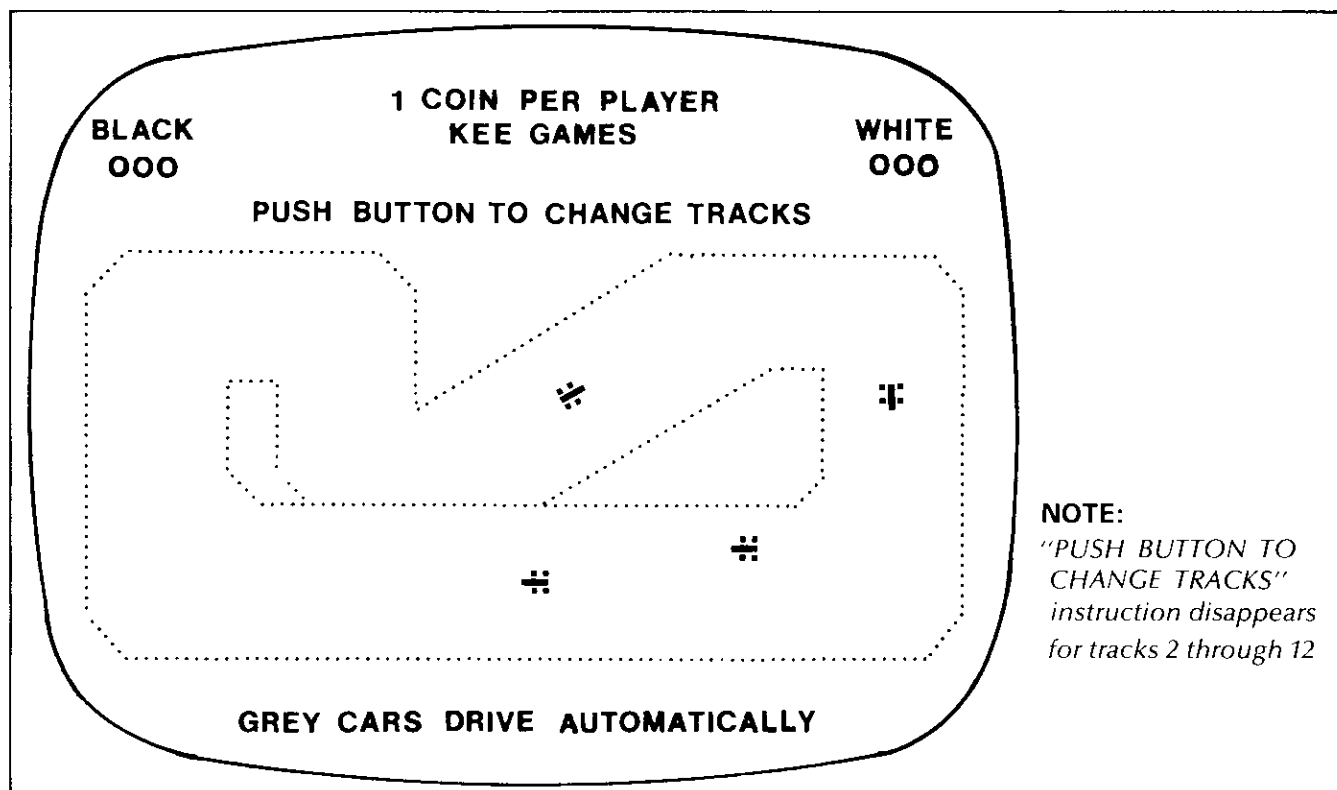


Figure 3-3 Ready-To-Play Mode Display

Table 3-1 Owner/Operator Optional Switch Settings

Switch Assembly SW Toggle Positions								TV Monitor Display	Description
1	2	3	4	5	6	7	8		
On								Oil	oil slicks added to tracks
Off									no oil slicks
	On								displays only easiest track during attract mode
	Off							Cycle	alternately displays all twelve tracks during attract mode
		On	On					1 coin per player	game cost 25¢ per player
		On	Off					2 players per coin	game cost 25¢ for two players
		Off	On					2 coins per player	game cost 50¢ for each player
		Off	Off					Demo	game is free (no attract mode)
				On				Extended play	extended play of 3/10 of time set by toggles 7 and 8, if player obtains pro rating in normal play
				Off					no extended play
					On				this toggle is not used, any position ok
					Off				this toggle is not used, any position ok
						On	On	Time 150	game time equals 150 seconds
						On	Off	Time 120	game time equals 120 seconds
						Off	On	Time 90	game time equals 90 seconds
						Off	Off	Time 60	game time equals 60 seconds

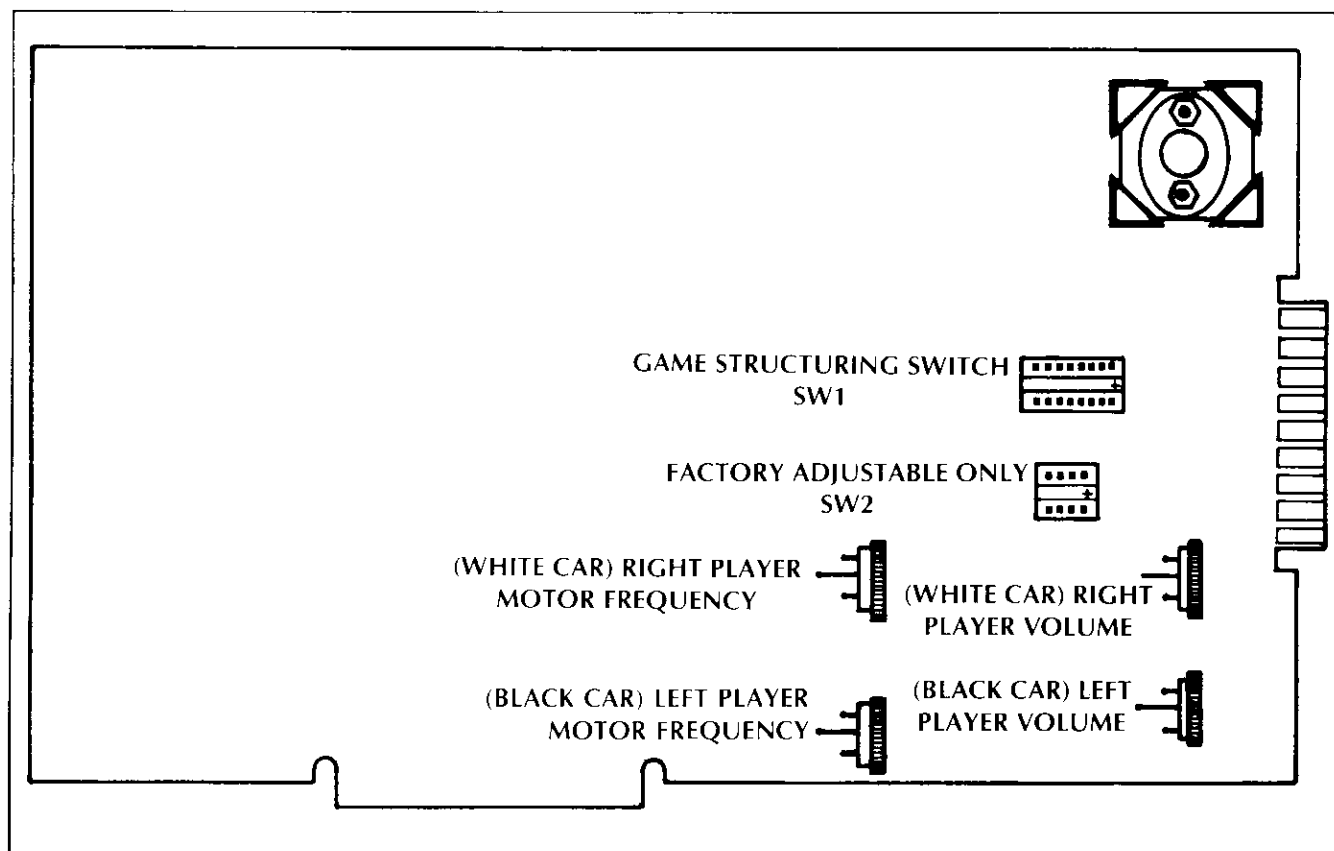


Figure 3-4 Location of Switch SW1 and Volume Controls

# IV. THEORY OF OPERATION

## 4.1 GENERAL COMMENTS

This subsection provides a technical description of the Sprint 2 electronic circuitry. Section IX of this manual contains schematic diagrams, assembly drawings, and parts lists referred to in the following subparagraphs of this section.

On the Sprint 2 PCB schematic diagram, drawing number 005922, the symbol P (appearing at various inputs of the integrated circuits) indicates a connection to +5VDC through one of the pull-up resistors R1, R2, R4, R33, or R38.

For easy reference, the Sprint 2 PCB is divided into 126 sections. These sections are identified by letters A through R (skipping letters G, I, O, and Q because they may be easily confused with numbers 6, 1, and 0 respectively) for the short side of the PCB and numbers 1 through 9 for the long side of the PCB. For example, sheet 1 of 5 of drawing number 005922 illustrates a NAND buffer R9 at the upper left hand corner of the drawing. The component hardware of NAND buffer R9 will be found at coordinates R and 9 on the PCB.

The following circuitry discussion is separated into two sections; the microcomputer circuitry and the game circuitry. Figure 4-1 is a block diagram of the entire Sprint 2 PCB.

## 4.2 COMPONENTS OF THE MICROCOMPUTER SYSTEM

The microcomputer system carries out complex tasks of the game by performing a large number of simple tasks. Control of the system is the primary function of the Microprocessing Unit. The Microprocessing Unit causes the system to perform the desired operations by addressing the Program

Memory for an instruction, reading that instruction, and then executing the simple task dictated by that instruction. Temporary storage of data necessary for the execution of future instructions, such as arithmetic operations, is stored into a Read/Write Memory.

### 4.2.1 Program Memory (Bottom Half of Schematic Sheet 3):

Program Memory consists of read-only memories (ROMs), permanently programmed by Kee Games to execute the Sprint 2 game. This memory has the capability of producing 8 bits of data for each of 8,192 combinations of ones and zeros on the 14 address inputs. In computer terminology, this is stated as a memory size of 8k x 8.

The Sprint 2 game contains one of three combinations of ROM chips to make up the Program Memory, depending on the dash number configuration of the Sprint 2 PCB. These combinations are listed in Table 4-1 and all combinations are illustrated on schematic sheet 3.

Since the data in the Program Memory is a permanent physical configuration of the ROM chips, the data is not lost when power is disconnected from the game or when the chip is removed from its socket. Since the Program consists of read-only memory, the result of an address input can only be the "reading" of data stored in the manufacturing process. It is not possible to "write" in more data.

### 4.2.2 Read/Write Memory (Top Half of Schematic Sheet 3):

Read/Write Memory (RAM) consists of random-access memory, which actually contains eight random-access memories (2102-1s). Data may be stored in the RAM (called "writing" the RAM), then

Table 4-1 ROM Combinations of Program Memory for Sprint 2 PCB Different Configurations

PCB Part No.	Sprint 2 PCB Location																			
	A0	C0	D0	E0	F0	F1	H0	H1	J0	J1	K0	K1	L0	L1	M0	M1	N0	N1	P0	P1
5922-01					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5922-02	X	X											X	X	X	X	X	X	X	X
5922-03	X	X	X	X																

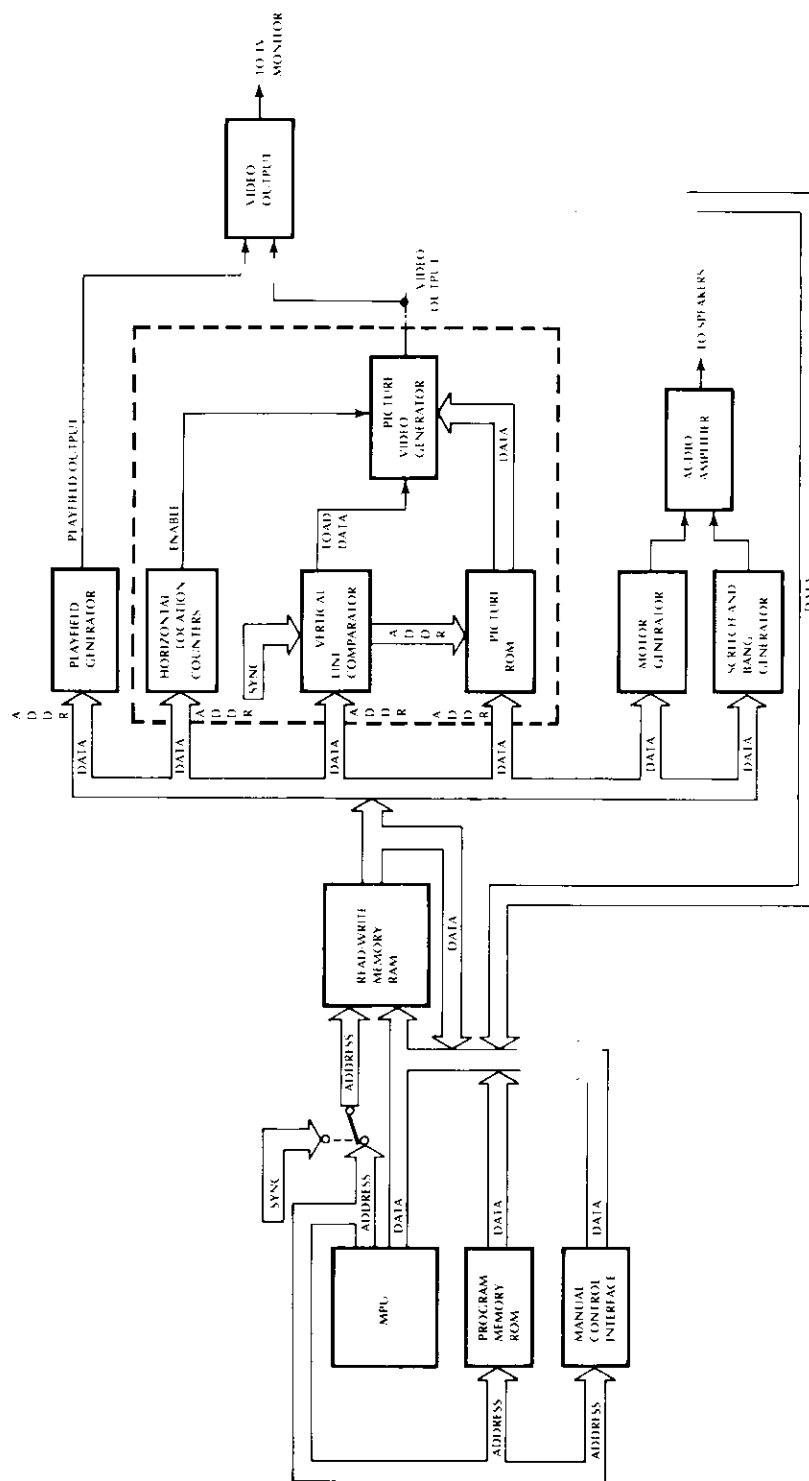


Figure 4-1 Sprint 2 PCB Block Diagram

later recalled (called "reading" the RAM). Memory size of the Read/Write Memory is 1k x 8.

In order to read from the RAM,  $\overline{R/W}$  (pins 3) input of all random-access memories must be at a high logic level; to write into the RAM,  $\overline{R/W}$  must be at a low logic level.

As previously mentioned, data stored in the RAM is for the purpose of performing operations on data as instructed by the Program Memory. Since the RAM is a temporary storage area, removing power from the RAM chips will "erase" all stored data.

#### 4.2.3 Microprocessing Unit:

As mentioned earlier, the controller of the microcomputer is the microprocessor (MPU). From the MPU, a sixteen-bit address bus addresses Program Memory, RAM, and an Address Decoder. An eight-bit bi-directional data bus serves as a path for transferring data from Program Memory and to and from the RAM and other interfacing devices.

#### 4.2.4 Tri-State Devices:

Tri-state devices, such as E5 of schematic sheet 3, are capable of having normal logic output of ones and zeros when disable (pin 1) is at a low logic level. When disable is at a high logic level, the output becomes a high impedance. In other words, when disable is at a high logic level, it is equivalent to completely removing device E5 from the circuit. ROMs and RAMs are also tri-state devices. Each ROM or RAM must be enabled by a certain logic level at its chip-enable input before the device is capable of outputting or inputting data.

### 4.3 THE MICROCOMPUTER SYSTEM

The primary function of the Sprint 2 Microcomputer is to instruct the game circuitry for the proper TV monitor display and audio outputs for corresponding manual inputs.

#### 4.3.1 Program Memory Enable:

With initial power applied to the Sprint 2 PCB, the MPU addresses Program Memory for an instruction by placing a 16-bit code at outputs AB0 through AB15. The address decoder, consisting of ROM E2, one-of-ten decoders D2, F2, and E8, and addressable latch A1, receives the five most significant bits of this address code (address 9 through 13) as an instruction of which part of Program Memory to access. Outputs of one-of-ten decoder F2 enable only the individual ROMs of Program Memory required for the desired instruction.

#### 4.3.2 RAM Enable:

Now, with the Address Decoder addressed for the enabling of the desired Program Memory ROMs, and Program Memory addressed for a data instruction, the MPU receives an 8-bit data instruction from Program Memory on the data bus. If this data instruction includes the storage of information, the MPU addresses the RAM and writes the data into the memory RAMs. The procedure of writing into RAM is enabled by two signals; chip enable CE (pins 13) and  $\overline{R/W}$  (read/write) (pins 3) of the RAM must be at a low logic level. The Address Decoder ROM (E2) receives an address (A9 through A13) and one-of-ten decoder D2 receives a high logic level write signal from the MPU. The results of these signals is a low logic level  $\overline{DISPLAY}$  at the input of multiplexer K2 for a low logic level chip enable CE at pins 13 of the RAM. The MPU also causes the  $\overline{R/W}$  (pins 3) input to the RAM to be pulsed, via the  $\overline{WRITE}$  signal. When this input is pulled to a low logic level, MPU data on the data input to the RAM (pins 11) is stored into the RAM location determined by address inputs A0 through A9.

#### 4.3.3 Phase 1 and Phase 2:

Phase 1 ( $\Phi 1$ ) and phase 2 ( $\Phi 2$ ) are outputs of the MPU and are formed by shaping the pulse of horizontal synchronization pulse 4H by D-type flip-flop A7. The 4H input of A7 (pin 13) is fed twice through the flip-flop at a clock rate of 12.096 MHz. The output of the first flip-flop and the output of the second flip-flop is fed through an OR gate to produce a phase 0 ( $\Phi 0$ ) signal, as illustrated in figure 4-2. The MPU provides an output of  $\Phi 2$  that is exactly like  $\Phi 0$ , except with a slight delay, and an output  $\Phi 1$  that is of an opposite phase of  $\Phi 2$ . Signal  $\Phi 2$  is fed through AND gate N3, which acts as a buffer.

When  $\Phi 1$  is positive, the address and data lines of the MPU change and stabilize for the next output. When  $\Phi 2$  is positive, the MPU addresses memory on the address bus and inputs or outputs data on the data bus. In order to guarantee that the MPU data is written to external devices at the proper time, write enable ( $\overline{WRITE}$ , A7 pin 10) is shaped by NAND gate A8 and D-type flip-flop A7 as illustrated in figure 4-3.

Phase 2 is also used to control the output of RAM Address Multiplexer K2, J2, and H2. The multiplexer acts as a 12-pole-double-throw-switch switched at a rate of  $\Phi 2$ . Again, as previously mentioned, the RAM is addressed by the MPU and data written into it when  $\Phi 2$  is a high logic level. When  $\Phi 2$  is at a low logic level the RAM is addressed by horizontal and vertical synchronization and data is read out of the RAM.

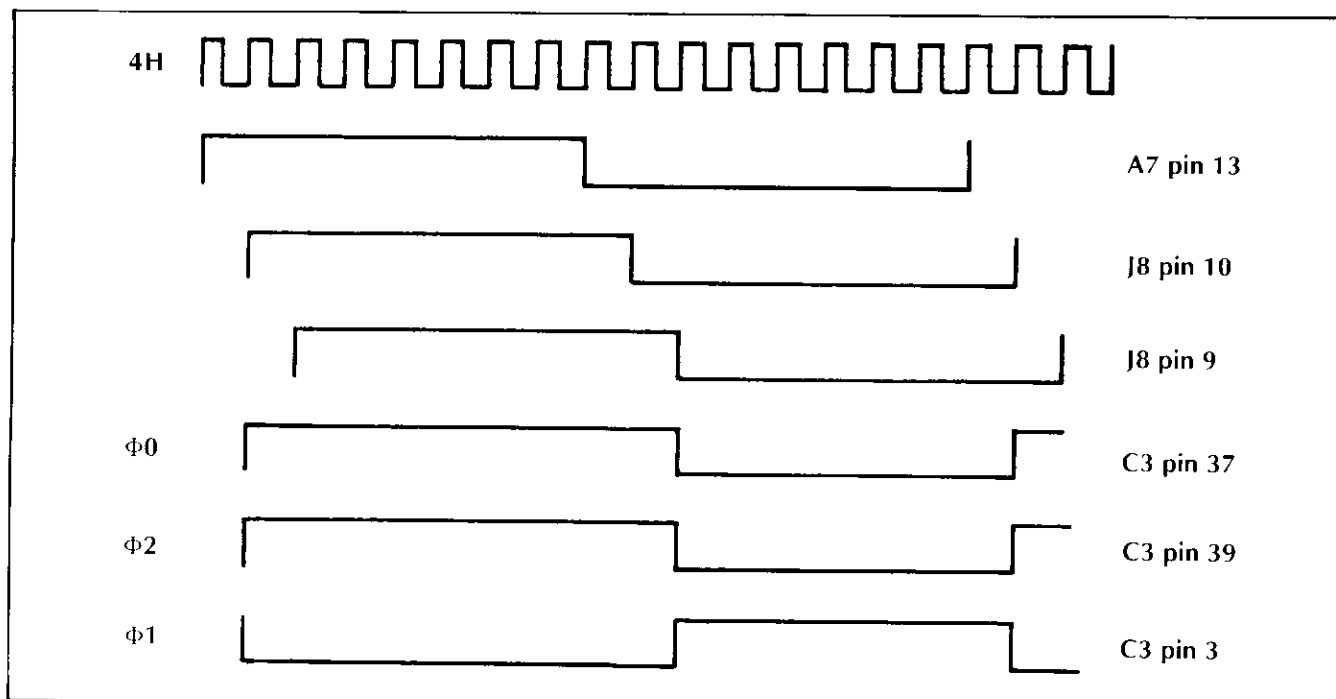


Figure 4-2 Phase 1 and Phase 2 Signal Shaping

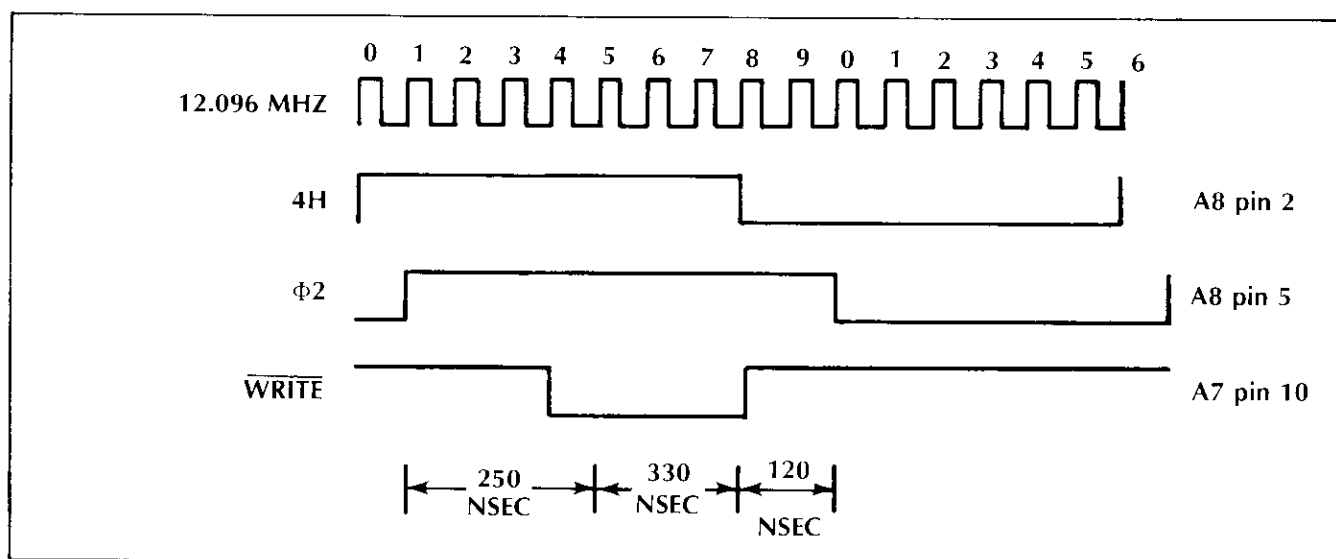


Figure 4-3 RAM Write Enable Signal Shaping

#### 4.3.5 RAM Output:

The RAM has a second data output latch that places the RAM data at the output of D-type flip-flop F5 and L5 with the next rising edge of  $\Phi 2$  (clock input of F5 and L5).

#### 4.4 MICROCOMPUTER WATCH DOG

Watch dog is an external monitoring system that resets the Program Execution back to its initial

instructions, if the program execution memory deviates from its intended sequence. This is accomplished by a watch dog statement (address code), incorporated in Program Memory, that results in a TIMER RESET pulse at the output of the Address Decoder. This reset pulse must occur before decade counter C6, 7 reaches the count of eight. Therefore if the Program Memory is functioning properly, a TIMER RESET pulse occurs within every eight frames of video.

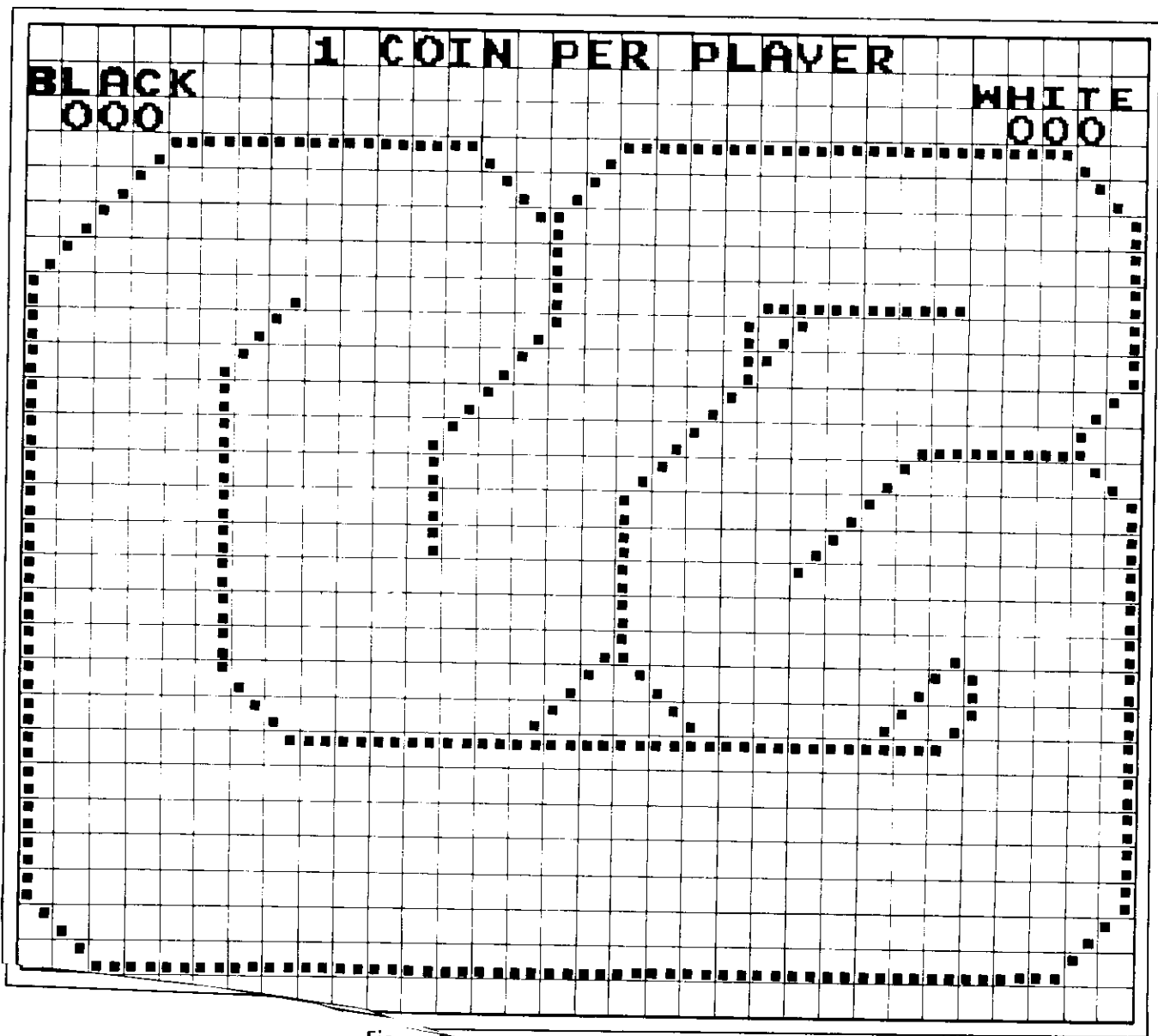


Figure 4-4

#### 4.5 COMPONENTS OF SPRINT 2 GAME CIRCUITRY

The game circuitry receives game instructions from the microcomputer and responds with the proper video and audio output. Manual controls of the game circuitry provide control information and data input to the microcomputer.

##### 4.5.1 System Clock and Sync Generator (Top of Schematic Sheet 1):

The crystal-controlled-clock generates a 12.096 MHz clock frequency that is used to produce all of the operating frequencies of the game. Insert 1, supplied with this manual, illustrates the horizontal and vertical sync synchronization waveforms. Note that 9-bit binary counter (R8, P8, and N8) counts

##### Field Display

from 128 to 512, accomplished by tying bit 128H (pin 5 of N8), to a pull-up resistor. Also note that the output of PROM M2 (programmable read only Memory programmed by Key Games) is connected to the sync output as illustrated by insert 1.

The horizontal and vertical synchronization signals are used to produce a TV monitor raster made up of 262 horizontal lines at a horizontal frequency of 15,750 Hz (256H). Synchronized with line 224 is a vertical blanking pulse that occurs for the duration of 38 more horizontal scans, resulting in the total number of 262 lines per frame.



#### 4.5.2 Playfield Generator (Left Bottom of Schematic Sheet 1):

The Playfield Generator generates both the playfield and all alpha-numeric video for the TV monitor display. This is accomplished by the playfield ROM (consisting of ROMs P4 and R4 for a memory size of 512 x 8), shift register R3, and binary counter R2.

As illustrated in figure 4-4, the TV monitor display is made up of thirty-two horizontal by twenty-eight vertical grid sections. For each grid section, there is a byte of data (one byte equals eight bits D0 through D7) in the microcomputer RAM. During the  $\Phi 2$  cycle, the RAM is addressed by the MPU, at which time the desired byte of data is transferred from Program Memory to the data input of the RAM. Then, during the  $\Phi 1$  cycle, the horizontal and vertical synchronization signals can access each of these bytes of data as that particular grid is to be displayed. The RAM then outputs six bits of data (DISPLAY 0 through DISPLAY 5) that address any of the sixty-four different alpha-numerics and playfield characters stored in the Playfield ROM.

The Playfield ROM is programmed by Kee Games to provide eight bits of data for each of 512 addresses. The least significant addresses are from vertical synchronization 1V, 2V, and 4V and the 504 most significant addresses are DISPLAY 0 through DISPLAY 5 from the microcomputer RAM. For each of the 512 addresses, there is one of sixty-four grid pictures, each being eight scan lines high.

The top of figure 4-5 illustrates the letter "C" as it would be "traced" on the TV monitor display. The RAM would provide one six-bit address to the Playfield ROM for the letter, while vertical synchronization 1V, 2V, and 4V would complement the RAM address for each of the horizontal scan lines. The bottom of figure 4-5 illustrates the output of shift register R3 for each horizontal scan line.

Note the letter "C" in grid section horizontal 11, vertical 1. In order to generate this character in this location, the microcomputer RAM would output a data code at the time this part of the display is being scanned. This six-bit code (DISPLAY 0 through DISPLAY 5) would contain the Playfield ROM address for the letter "C." Vertical synchronization 1V, 2V, and 4V would determine which of the eight lines of the character was being scanned at that time.

Shift register R3 then loads the actual playfield or alpha/numeric data from the playfield ROM and shifts it out in serial video (R3 pin 13).

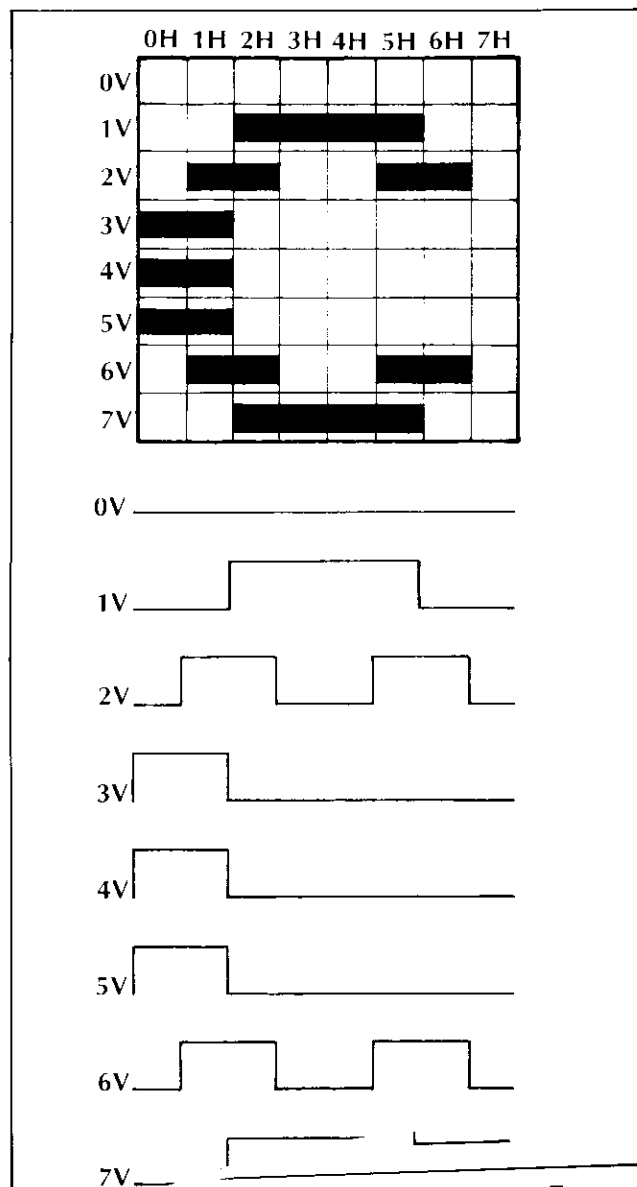


Figure 4-5 Playfield Generator Character Trace

Binary counter R2 latches data DISPLAY 7, from the microcomputer RAM. This results in the selection of white playfield video if DISPLAY 7 is a high logic level or black playfield video if DISPLAY 7 is a low logic level. In actuality, only some alpha/numerics and all oil slicks are represented in black video, while all of the racetrack boundary (playfield) is represented in white video.

Binary counter R2 is also used to produce the COMP SYNC\*, COMP BLANK\*, and a 256H\* signal that are all delayed one character's width from their original timing. This delay is used to center the playfield on the monitor's horizontal scan.

#### 4.5.3 Motion Generator (All of Schematic Sheet 2):

The motion generator generates the video for the four cars, which are the only moving objects of the Sprint 2 game. The car picture ROM (consisting of ROMs J6 and K6, for a memory size of 512 x 8) is programmed by Kee Games to provide sixteen bits of data for each of the eight lines of each of the thirty-two different states of rotation of a car.

The microcomputer RAM provides three words (bytes) of data for the display of each car picture. The first byte determines the vertical location of the car, the second determines the proper rotation picture of the car, and the third determines the horizontal location of the car. The accessing of these bytes of RAM data is done during the horizontal blanking period (256H).

Vertical position data is received by Vertical Line Comparator M4 and L4. Take for example, the data code for a car to be displayed beginning on line 120. The RAM byte data code of 01111000 would be loaded into the comparator. When the vertical line comparator reaches the count of 01111000, and 8H, 64H, 256H, and  $\Phi 2$  are all at a high logic level, the conditions are met for a low logic level at the output of NAND gate N4 (pin 8). One  $\Phi 2$  clock pulse later, a low logic level appears at the Q3 (pin 7) output of latch L5 (clock input for L5 is located on schematic sheet 3). This initiates the eight vertical load pulses as illustrated in Insert 1, supplied with this manual.

The RAM byte data code that controls car rotation is capable of addressing any of thirty-two different car pictures. The five bits of data code necessary for this (DISPLAY 3 through DISPLAY 7) are from ROM J6 and K6. The output of the Car Picture ROM (input address A2, and A3) complement the rotation data code by determining which of the eight lines of the car is being described by the ROM data output, and whether it is the first half (right) or second half (left) of the car to be displayed. When  $\Phi 2$  is a high logic level, the video data output (VID 0 through VID 7) from the Car Picture ROM is timed with load vertical pulse LDVxB. Load vertical pulse LDVxB enables shift register M7 (K7, H7, or E7) to load the video data from the Car Picture ROM. This data is for the right half of the car.

When  $\Phi 2$  is a low logic level, the video data output (VID 0 through VID 7) from the Car Picture ROM is timed with load vertical pulse LDVxA. Load vertical pulse LDVxA enables shift register N7 (L7, J7, or F7)

to load the video data from the Car Picture ROM. This data is for the left half of the car.

Now to review, the Motion generator has received a RAM data code for where the car is to be displayed vertically and a RAM data code for the proper picture of the car. The final instruction needed is for the horizontal placement of the car. The RAM byte that determines this is received by the car horizontal location counter.

The car horizontal location counter R5 and R6 (P5 and P6, N5 and N6, or M5 and M6) is loaded each horizontal line by a load horizontal pulse LDHx as illustrated in Insert 1, supplied with this manual. The counter is preset to a given count by the RAM data code (DISPLAY 0 through DISPLAY 7) during horizontal blanking. At the end of horizontal blanking, 256H goes to a high logic level, and the counter is enabled to begin counting up at a clock rate of six MHz.

#### 4.5.4 Video Output (Schematic Sheet 1):

The Video Output circuit receives all video signals and gates them together through summing resistors R48, R49, and R50. Cars 3 and 4, the grey cars, are gated through a parallel path to produce a positive signal through resistor R50 and a negative signal through R49. The summed result is between a full ON condition (white) and a full OFF condition (black) which is a grey level of the TV monitor display.

#### 4.5.5 Car/Playfield Comparator (Top Center of Schematic Sheet 5):

The Car/Playfield Comparator is a network of logic gates that gate together the three video outputs of the Motion Generator and the two video outputs of the Playfield Generator. Table 4-2 produces the seven possible conditions that would cause a high logic level to appear on data lines D6 and D7 of the data bus. The microcomputer MPU recognizes an output from the Car/Playfield Comparator as an address to the Address Decoder for a cause tri-state devices E5 and F5 to output. This allows the output of the Car Playfield Comparator to be transferred onto the MPU data bus.

When the MPU receives the data that a skid (high logic level on data line D6) or crash (high logic level on data line D7) condition exists, Program Memory instructs the MPU to cause the appropriate response to be displayed on the TV monitor display, and then to clear the Car/Playfield Comparator. This is done by the MPU outputting an address that is

decoded to cause a low logic level COLLISION RESET 1 and/or COLLISION RESET 2. The Collision

Reset signals reset latch H6 of the Car/Playfield Comparator.

**Table 4-2 Conditions of Car/Playfield Data Output**

Car/Playfield Comparator Conditions	Data Line Output
Car 1 equals Car 2	D6
Car 1 equals Car 3 or 4	D6
Car 2 equals Car 3 or 4	D6
Car 1 equals Black Playfield (oil)	D6
Car 2 equals Black Playfield (oil)	D6
Car 1 equals White Playfield (track boundary)	D7
Car 2 equals White Playfield (track boundary)	D7

#### 4.5.6 Manual Control Interface (Left Side of Schematic Sheet 5):

The main component of the Manual Control Interface is multiplexer M8. This component acts as a two-pole four-position switch, operated by address lines ADR6 and ADR7 from the microcomputer MPU. Table 4-3 lists the input/output relationship of multiplexer M8 with the given Address inputs. Multiplexer M8 interfaces three different sources of information as follows; 1) coin information; 2) steering information; and 3) switch information. All information is received by the microcomputer MPU when the MPU addresses the Address Decoder for a low logic level SWITCH signal that enables tri-state device K5 for a data output on the D6 and D7 data lines.

Coin information is a matter of storing in the microcomputer RAM the number of times a low logic level pulse appears on the data lines, when the appropriate address input of multiplexer M8 is being addressed. The microcomputer MPU only "looks" for coin pulses during the attract mode.

Steering information is "looked" for by the microcomputer MPU during the play mode. The steering printed circuit assembly consists of two light

light sensitive transistors. A toothed cylinder, that is turned by the steering wheel, is inserted between the light emitting diodes and the transistors, and interrupts the light from the diodes. When the steering wheel is turned, two pulses appear at the output of the steering printed circuit assembly that differ in phase. As illustrated in figure 4-6, when the wheel is turned to the right, the A output pulse leads the B output pulse. When the wheel is turned to the left the A output pulse lags the B output pulse. The inverse of the two pulses are applied to the D and clock inputs of two D-type flip-flops (see schematic). The microcomputer MPU recognizes that a steering maneuver has been made when a low logic level appears on data line D7. The MPU then "looks" at data line D6 and determines from the logic level (high or low) if "Steering A" input is leading or lagging "Steering B" input. Once the MPU has processed a steering maneuver, the MPU then outputs an address that is decoded by the Address Decoder and results in a low logic level STEERING RESET for the steering signal.

Switch information is received by multiplexer M8 at inputs 1CO and 2CO. The microcomputer MPU addresses Decoders F9, H9, and J9 to determine if a switch is opened or closed. If closed a low

**Table 4-3 Operation of Multiplexer M8 with Given Input Address**

Address Logic Level		Output	
ADR6	ADR7	1Y (D7)	2Y (D6)
L	L	1C0	2C0
L	H	1C1	2C1
H	L	1C2	2C2
H	H	1C3	2C3

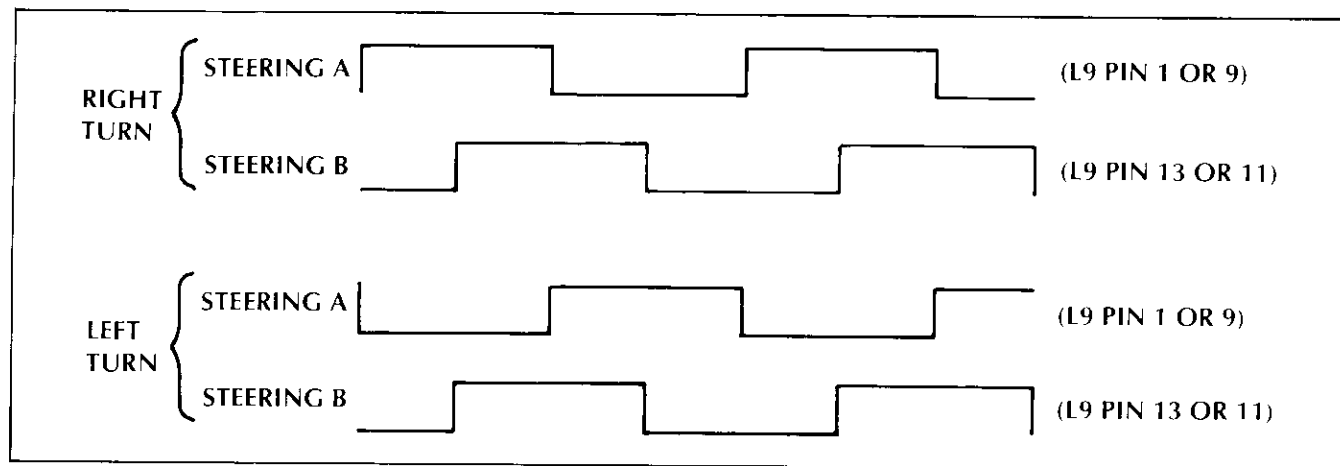


Figure 4-6 Steering Printed Circuit Assembly Output Pulses

Table 4-4 Addresses of Switch Positions for MPU Data Line D6 D7 Input

	0	1	2	3	4	5	6	0	1	2	3	4	5	6	0	1	2	3
ADR0	L	H	L	H	L	H	L	L	H	L	H	L	H	L	L	H	L	H
ADR1	L	L	H	H	L	L	H	L	L	H	H	L	L	H	L	L	H	H
ADR2	L	L	L	L	H	H	H	L	L	L	L	H	H	H	X	X	X	X
ADR3	H	H	H	H	H	H	H	H	H	H	H	H	H	H	L	L	L	L
ADR4	H	H	H	H	H	H	H	L	L	L	L	L	L	L	H	H	H	H
ADR5	L	L	L	L	L	L	L	H	H	H	H	H	H	H	X	X	X	X
multiplexer M8 input 1CO (D7)	1S11	1S22	2ND1	2ND2	3RD1	3RD2		GAS1	GAS2	SELF TEST		START 1	START 2	TRACK SEL	OIL SLICK	MODE 1	EXT PLAY	TIME 1
multiplexer M8 input 2CO (D6)															TRK CYC	MODE 0	SPARE	TIME 0

NOTE: X indicates a condition of either high or low

logic level pulse will result for the given address as listed in table 4-4.

#### 4.5.7 Motor Generator (Top Right of Schematic Sheet 5):

The key to the Motor Generator is the operation of transistor Q1 in conjunction with timer D7,8. Timer D7,8 operates as an oscillator with output frequency dependent upon the resistive charge path of capacitor C22.

Varying the collector to emitter resistive value of transistor Q1, varies the combined resistive charge path of capacitor C22 through transistor Q1 and resistors R21 and R23 in parallel with resistor R22. As the combined resistive value decreases, the output frequency of the timer increases. Variable resistor R23 makes it possible for the technician to adjust the frequency for a desirable motor idle sound.

The conductance of transistor Q1 is varied by grounding any combination of voltage divider resistors R5, R6, R7, and R8. The combinations of these resistors are determined by data, from the micro-computer RAM, applied to the input of Latch D4. Table 4-5 lists the approximate voltages at the base of transistor Q1 (or Q2) for the fifteen different address inputs. These addresses cause a latch condition of Latch D4 only if a low level logic MOTOR 1 signal enables Latch D4.

To derive a realistic car motor sound, the output of Timer D7,8 is divided into three separate frequencies by Divider D8, then summed by resistors R42, R43, and R44. A divide by three signal at QB (pin 11) output of D8 is applied to summing resistor R42. Outputs QB and QD (pin 8) are also applied to Exclusive OR Gate C7 to provide a divide by twelve signal at the QA (pin 12) output of D8, which is applied to summing resistor R42.

**Table 4-5 Approximate Base Voltage of Transistor Q1 or Q2 for Given Address**

Address					Base Voltage of Transistor Q1 or Q2
	DISPLAY 0	DISPLAY 1	DISPLAY 2	DISPLAY 3	
0	L	L	L	L	5.00 VDC
1	H	L	L	L	4.25 VDC
2	L	H	L	L	4.08 VDC
3	H	H	L	L	3.95 VDC
4	L	L	H	L	3.77 VDC
5	H	L	H	L	3.65 VDC
6	L	H	H	L	3.52 VDC
7	H	H	H	L	3.42 VDC
8	L	L	L	H	3.22 VDC
9	H	L	L	H	3.13 VDC
10	L	H	L	H	3.03 VDC
11	H	H	L	H	2.95 VDC
12	L	L	H	H	2.84 VDC
13	H	L	H	H	2.77 VDC
14	L	H	H	H	2.69 VDC
15	H	H	H	H	2.62 VDC

#### 4.5.8 Bang and Screech Generator (Right Bottom of Schematic Sheet 5):

The heart of the Bang and Screech Generator is noise generator B7, D7. Shift Registers B7 and D7 are connected in a manner to produce random noise at the QH (pin 13) output of B7.

Bang is the result of data from the microcomputer RAM, which is used to gate varying amounts of random noise through to the audio amplifier. By starting with a binary data code of 1111 (DISPLAY 3 through DISPLAY 0), then rapidly stepping the data code down to 0000, results in gating noise from noise generator B7, D7 through a resistive value of 550 ohms (R24, R25, R26, and R27 in parallel), to 8.2k ohms, for a data code of 0001, and infinity, for a data

code of 0000. The result is an envelope of sound from full ON to full OFF.

Screech sound is produced by processing the output of the random noise generator with a type of hysteresis feedback loop, via schmitt-trigger inverter A5 (7414) and 100 ohm resistors R17 and R18), and then gating this processed noise with SKID 1 or SKID 2.

#### 4.5.9 Audio Output (Bottom Center of Schematic Sheet 5):

The summed signals of the Motor Generators, and Bang and Screech Generator are applied to one leg of a 5k ohm potentiometer. Varying the wiper position of the potentiometer varies the signal input of Audio Amplifier B9 or D9. The output of the Audio Amplifiers are connected to an eight-ohm speaker for each car.

#### 4.6 SELF-TEST FEATURE

A self-test feature is provided in the Sprint 2 game and is activated by merely setting the self-test switch, located just inside and to the left of the coin mechanism access door, to the ON position. This feature provides on-the-spot testing to a level of approximately 70% of the Sprint 2 game. Circuitry that is tested is the microcomputer MPU, RAM, motion circuitry Program Memory, game switches, and pushbutton light emitting diodes (LEDs).

By addressing the RAM, writing the RAM with all possible combinations of data, then reading the RAM, the self-test thoroughly tests the individual random access memory chips and the MPU itself.

By performing a check sum of all the data bits of the Program Memory, the self-test detects any error of the Program Memory.

Operation of all game switches is checked by the self-test operator, by listening for a screech audio output as the operator activates each switch.

Backlighting of each pushbutton is activated for a visual check by the self-test operator.

# V. INSTALLATION INSTRUCTIONS

## 5.1 UNPACKING INSTRUCTIONS

### 5.1.1 Examination for Shipping Damage:

Before shipment from the factory, components and sub-assemblies of each game are carefully checked for proper operation. However, during shipment some adjustments may have changed or parts may have been damaged. Upon initial removal of the game from the shipping container, first examine the exterior of the cabinet. Then open the rear access panel and also examine the interior. Any shipping damage such as a dented, cracked or broken cabinet, sub-assemblies broken loose, etc., should be reported immediately to the shipper and to Atari, Inc.

### 5.1.2 Mechanical Inspection:

After determining that the game has been received in good condition, carefully inspect the interior parts and verify the following:

- (a) All plug-in connectors are firmly seated.
- (b) The fuses are all seated in their holders
- (c) No loose foreign objects are present (especially metal objects which could cause electrical short circuits)
- (d) No harness wires have become disconnected or pulled loose.

Be sure *all* major assemblies have been checked: game PCB, the transformer and other components on the electronics tray assembly, the two coin mechanisms, the speakers, all player controls and the TV monitor chassis.

Do not go on to the remaining paragraphs in this section until the above mechanical inspection has been thoroughly performed.

## 5.2 VERIFYING OPERATION OF INTERLOCK SWITCHES

Interlock switches are located inside the rear access door and are there to prevent accidental shock of anyone who has reason to stick a hand inside the cabinet. The function of these switches is to remove all power that goes into the game when the rear access door is open. These switches are mechanically aligned by Kee Games, but it is impor-

tant that they are checked to insure the proper operation after shipping.

After the completion of subparagraph 5.1.2 plug the AC Power Cord into the appropriate AC Power Source, set the "Power ON/OFF" switch to ON position. Within approximately 30 seconds, there shall be a raster display on the TV monitor. Verify operation of interlock switches as follows:

1. Unlock and completely open rear access door. This will result in the picture of the TV monitor screen to disappear.
2. Press switch plunger for one of the interlock switches and hold for at least ten seconds. If TV monitor picture comes on, replace the other interlock switch.
3. Repeat step 2 with the other interlock switch.
4. Check that both interlock switches are aligned in a manner that when the rear access door is opened the interlock switches will disengage.

Do not go on to the remaining subparagraphs in this section until the operation of the interlock switches has been satisfactorily verified.

## 5.3 OPERATION OF SELF-TEST FEATURE

### 5.3.1 Activating the Self-Test Feature:

To activate the self-test feature, unlock and open the coin mechanism door and set the self-test switch, located inside and to the left of the coin mechanism door, to the ON position.

### 5.3.2 Self-Test Procedure:

The response of activating the self-test feature is as follows:

(a) *RAM Test:* The TV monitor shall "flash" alpha-numerics on the viewing screen, while an audio "hash" sound comes from the speakers. During the time the TV monitor is flashing pictures of alpha-numerics, a rotating car appears in the lower right-hand corner of the viewing screen, and moves diagonally across the screen toward the upper left-hand corner of the screen. When the car reaches the upper left-hand corner of the screen, the RAM test is completed.

If there is a RAM failure, the TV monitor display will freeze, with the alpha or numeric displayed on the TV monitor that is associated with the particular data code that failed the RAM test.

If the RAM test determines that all RAMs are OK, the self-test feature will automatically begin the ROM test.

*(b) ROM Test:* The ROM test will have no visual effect on the viewing screen, if all ROMs test results are satisfactory. Therefore, the self-test operator just sees a visual representation of the game structuring in white characters at the top of the TV monitor viewing screen. If a ROM is not operating properly, black numbers will appear in the center of the TV monitor viewing screen. Table 4-1 lists the ROMs of the Sprint 2 PCB for the black numbers on the TV monitor display. If all ROMs are OK, there will not be any black numbers in the center of the TV monitor display.

*(c) Switch Test:* Perform the following steps. For each step, there will be an audio screech sound from the game cabinet speakers. Absence of the audio screech sound is an indication that the associated switch circuitry is not functioning properly.

1. Set gear shifter on left-hand side of game cabinet in 4th-gear position and set right-side gear shifter in the 1st-gear position.
2. Set right side gear shifter in 2nd-gear position.
3. Set same gear shifter in 3rd-gear position.

4. Set same gear shifter in 4th-gear position (there should be no screech sound), then step on accelerator foot pedal on right-hand side of game cabinet.
5. Set gear shifter on left-hand side of game cabinet in 1st-gear position.
6. Set same gear shifter in 2nd-gear position.
7. Set same gear shifter in 3rd-gear position.
8. Set same gear shifter in 4th-gear position (there should be no screech sound), then step on accelerator foot pedal on left-hand side of game cabinet.
9. Press One Player Start pushbutton.
10. Press Track Select Pushbutton.
11. Press Two Player Start pushbutton.
12. Unlock and open coin mechanism door. (No sound produced)
13. Trip left coin acceptor.
14. Trip right coin acceptor.

*(d) Lamp Test:* Light emitting diodes for One Player Start, Track Select, and Two Player Start shall be lighted.

## 5.4 OPTIONAL GAME STRUCTURING

At the end of the RAM test, when the self-test switch is in the ON position, game structuring is displayed in white alpha-numerics at the top of the TV monitor viewing screen. In order to determine the meaning of this display, refer to subparagraph 3.3.6 of Section III of this manual.

## VI. MAINTENANCE AND ADJUSTMENTS

### 6.1 ROUTINE MAINTENANCE

Due to its solid-state electronic circuitry, this Kee game should require very little maintenance and only occasional adjustment.

Game cabinets and glass may be cleaned with any non-abrasive household cleaner. If desired, special coin machine cleaners which leave no residue can be obtained from distributors.

#### NOTE

*The TV monitor is accessible only from inside the game cabinet and these adjustments have to be done while the game is energized. Therefore only persons familiar with safety measures and repair procedures on electrical equipment should perform them.*

### 6.2 ADJUSTMENTS ON TV MONITOR

The TV monitor need be adjusted *only* when the picture is distorted, or if the contrast or brightness seem out of adjustment.

The monitor's adjustments function like those of a conventional commercial television set, except that the volume adjustment has no effect. Instead the game produces its sound in a speaker separate from the TV monitor. Figure 6-1 shows the location

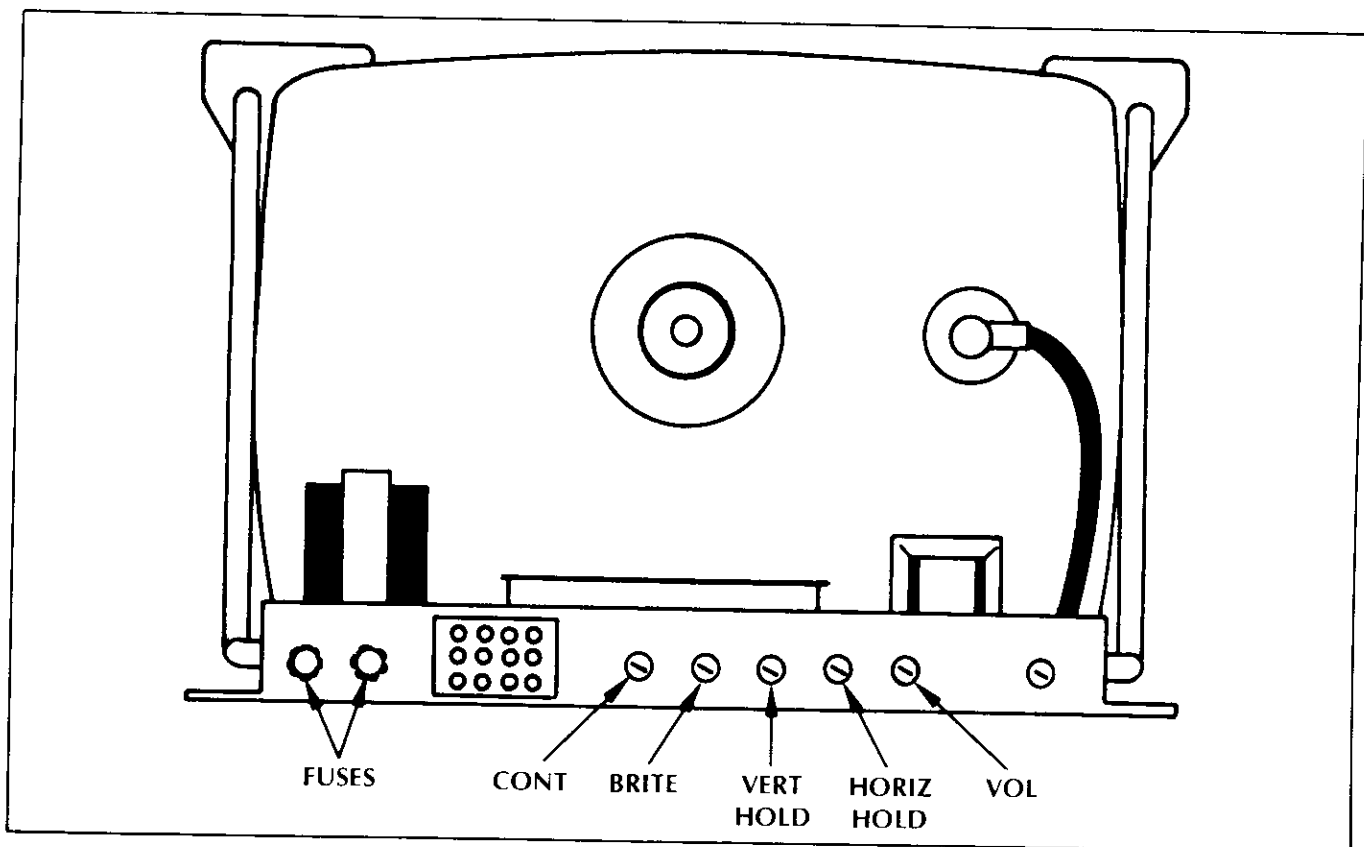


Figure 6-1 Location of Adjustments on TV Chassis



of the adjustments on the rear of the chassis. When making the adjustments follow these general guidelines:

**BRITE (Brightness)**—Perform this adjustment before the contrast. Adjust so that the white lines covering the screen just barely disappear, when the brightness is turned up.

**CONT (Contrast)**—Adjust so that the images are as bright as possible against the dark background without being blurred.

**HORIZ HOLD (Horizontal Hold)**—Adjust if the picture is slightly off-center horizontally, if the images appear warped, or if the picture is broken up into a series of diagonal lines. Adjust for a stable, centered picture.

**VERT HOLD (Vertical Hold)**—This needs adjustment only if the picture appears to be rolling up or down the screen. Adjust for a stable, centered picture.

## VII. DISASSEMBLY AND ASSEMBLY

### 7.1 GENERAL INFORMATION

The following procedures are supplemented by Exploded Diagram, figure 7-1A and B, and by parts list and drawing A006205-01 located in Section IX of this manual. All capitalized component terms are directly referenced to the parts list.

When working inside the rear access door, always check to make sure that the two interlocking switches are not in the defeat position or stuck in the ON position.

### 7.2 REMOVING AND INSTALLING THE SPRINT 2 PCB

- (a) Unlock and open rear access door.
- (b) Locate R.F. Shield Box Assembly immediately inside the rear access door. It is an aluminum box with many small holes. On one end of the box is a printed circuit board with an edge connector coming from the edge of the board. This printed circuit board is the R.F. Shield Assembly (PCB).
- (c) Remove five pan head phillips screws from each of the long sides (total of ten screws) of the R.F. Shield Assembly (PCB).
- (d) Carefully lift the R.F. Shield Assembly (PCB) upward while pulling the Sprint II PC Board Assembly straight out of the R.F. Shield Box Assembly.
- (e) To install the Sprint 2 PC Board Assembly, follow preceding steps (a) through (d) in the reverse order. DO NOT FORCE OR BEND THE PRINTED CIRCUIT BOARDS. BEFORE INSTALLING INTO THE R.F. SHIELD BOX ASSEMBLY, ALWAYS INSPECT THE TWO PRINTED CIRCUIT BOARDS FOR PHYSICAL DAMAGE.

### 7.3 REMOVING AND INSTALLING THE TV MONITOR

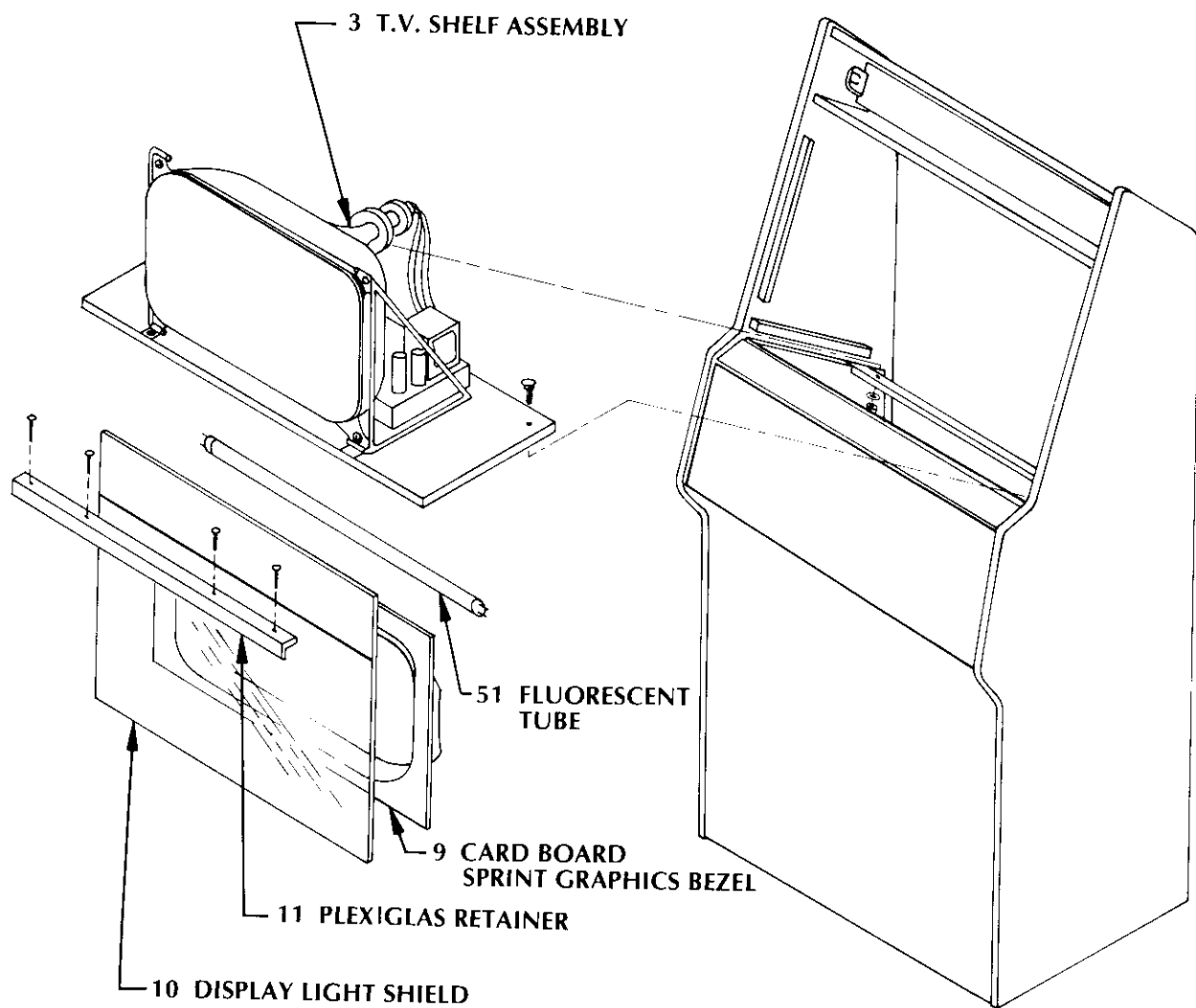
- (a) Unlock and open rear access door.
- (b) Unplug the 12-pin Molex connector from the chassis of the TV monitor.
- (c) With a  $\frac{3}{8}$ -inch wrench, remove two  $\frac{1}{4}$ -20

Machine Hexagonal Nuts, two #10 Split-Lock Washers, and two #10 Flat Washers from underneath the bottom rear sides of the wood T.V. Shelf Assembly.

- (d) Remove two #10-24 x 1.25-inch Carriage Bolts from the top rear of the wood TV Shelf Assembly.
- (e) With a  $\frac{1}{8}$ -inch hex wrench, remove four 1-inch #10-32 Button Head Socket Cap Screws from the top front edge of the game cabinet.
- (f) Remove the black Plexiglas Retainer, then the plexiglas Display Light Shield
- (g) Carefully remove the Card Board Sprint Graphics Bezel.
- (h) Slowly and carefully, slide the TV Shelf Assembly up and out of the game cabinet.
- (i) To install the TV Shelf Assembly into the game cabinet, follow the preceding steps (a) through (h) in the reverse order. Before installing the TV Shelf Assembly, make sure the aluminum foil around the front edge of the wooden base of the TV Shelf Assembly is not damaged. If damaged, replace.

### 7.4 REPLACING THE STEERING BOARD PCB

- (a) Unlock and open rear access door.
- (b) Unplug 10-pin Molex connector from the steering board PCB.
- (c) With a  $\frac{7}{16}$ -inch wrench, remove self locking hex nut and  $\frac{1}{4}$ -inch internal tooth star-lock washer from the steering wheel axis screw, while a helper holds the steering wheel at the front of the game cabinet.
- (d) Remove black plastic edge-toothed wheel.
- (e) Remove steering board PCB by removing two  $\frac{1}{2}$ -inch #2-56 pan head Phillips screws.
- (f) To install steering board PCB, follow preceding steps (a) through (e) in the reverse order. Before installing the steering board PCB, make sure there is a sufficient amount of silicone lubricant on the inner hole.



Indicates same reference number in parts list A006205-01, Section IX

Figure 7-1A Exploded Diagram, Front View

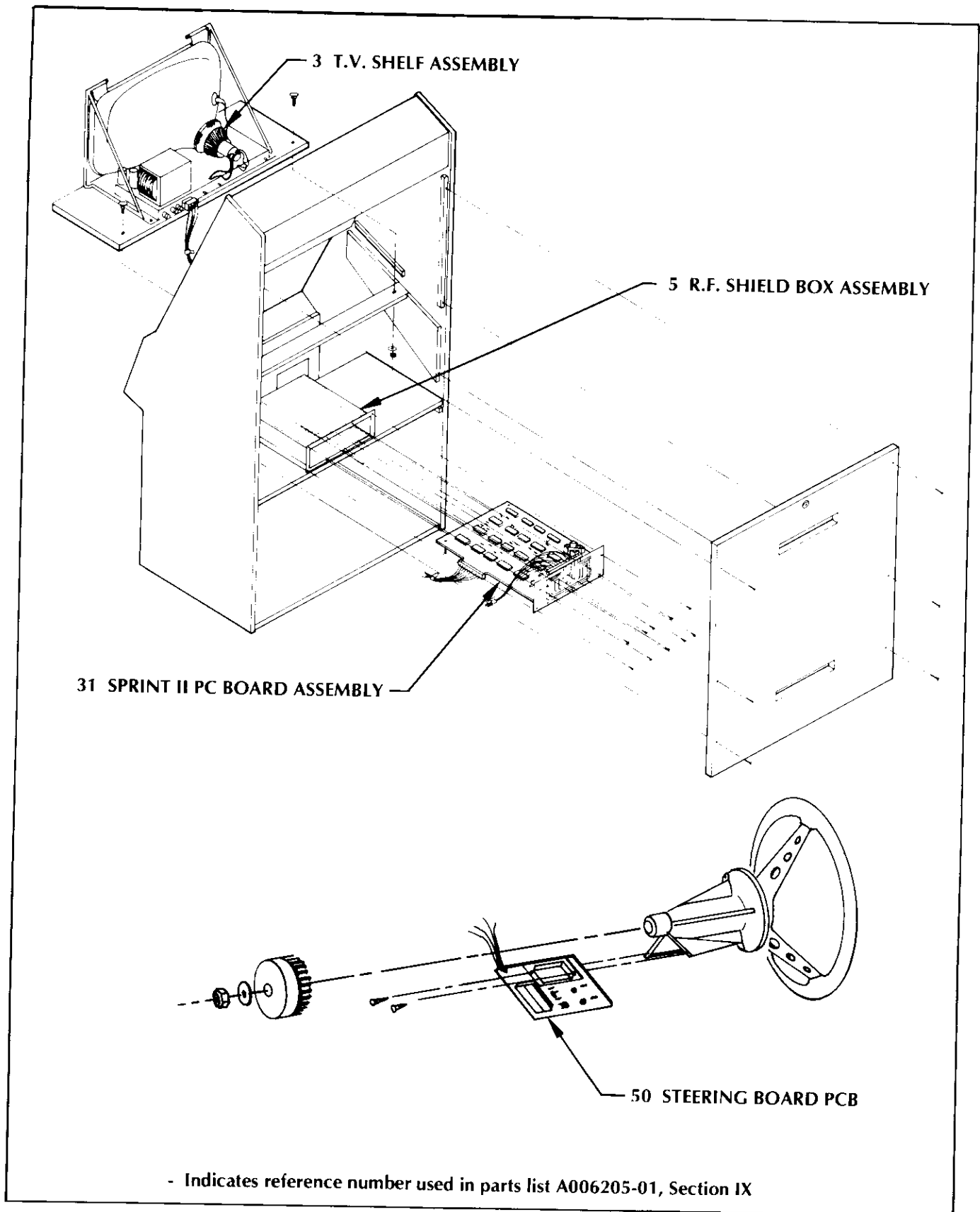


Figure 7-1B Exploded Diagram, Rear View

## 7.5 REPLACING FLUORESCENT TUBE

- (a) With a  $\frac{1}{8}$ -inch hex wrench, remove four 1-inch #10-32 Button Head Socket Cap Screws from the top front edge of the game cabinet.
- (b) Remove the black Plexiglas Retainer, then remove the Plexiglas Display Light Shield.
- (c) Remove fluorescent tube.
- (d) Replace Plexiglas Display Light Shield, making sure Card Board Sprint Graphics Bezel is properly seated.
- (e) Attach plexiglas screen with plexiglas retainer and four button head screws.

# VIII. TROUBLESHOOTING AND REPAIR

## 8.1 GENERAL PROCEDURE

### NOTE

*This section describes troubleshooting procedures in detail sufficient for a person with moderate technical ability to understand. However, for those interested in gaining more information on video game technology, especially the electronics, we recommend reading the **Video Game Operator's Handbook**, manual no. TM-043. This book is available from Atari, Inc., attn. Customer Service Dept., 2175 Martin Avenue, Santa Clara, CA 95050 for \$5.00 each, or from your distributor.*

### 8.1.1 Identifying the Trouble Area:

The first troubleshooting step should be to note all observable trouble symptoms. Examples of symptoms are: depositing a coin produces no game response, no sound coming out of the speaker at any time, no picture on the TV screen. At the same time also note the game features that still work. A systematic way of checking game operation is to perform the functional check given in Section V of this manual. Carefully train your eye to pick up all clues; by doing this an experienced troubleshooter can often spot the cause of a trouble even before he opens the cabinet.

Keeping these observations in mind, use the understanding of game operation gained from Section III, Description of Operation and Section IX, Schematics. Next narrow down the suspected cause of the trouble to a specific area or areas of the game: coin mechanism, TV monitor, harness or front panel controls (switches, lamps, speakers), electronics tray, printed circuit board or power cord. Be careful not to overlook possible trouble areas that may seem too obvious: a power cord plug that has worked loose from the wall outlet and is no longer fully seated in the receptacle, power ON/OFF set to the OFF position, or a rear panel access door that is not fully closed (thus causing the interrupt switch to block the AC power path to the game).

### 8.1.2 Locating the Trouble Cause:

Once a problem has been narrowed down to one or more areas, the next step is to perform various tests and measurements to isolate a specific cause of the trouble. Remember that sometimes a very complicated problem, such as erratic game operation, can be traced to a simple cause—the printed circuit board not being properly seated in its edge connector. Start with the most suspect area and trace backwards from the point where the trouble is first observable, using a process of elimination to eventually locate the faulty component, connection, etc. For example, if no sound is audible during game play, first check for a signal at the speaker leads. If no signal is present there, go back to the printed circuit board. If there is still no signal, then systematically check back through the various components of the sound generation circuit.

Substitution of parts is a legitimate and easy way to isolate the cause. For instance, if the PCB is the suspected trouble area, remove it and substitute a known-to-be-good PCB. Then check for correct game operation. Similarly, to check the TV monitor, connect the game to a known-to-be-good monitor. The harness can often be checked by substitution also. Substitute both a known-to-be-good PCB and TV monitor. If the trouble still persists, the harness must be at fault.

The test equipment for use in troubleshooting is discussed in paragraph 8.2.

### 8.1.3 Correcting the Trouble Cause:

In practice, the steps required to correct troubles can range from simple adjustments (correctly seating the PCB in its edge connector, changing the setting on a potentiometer, adjusting the picture controls on the TV monitor) to repair of loose connections and replacement of defective parts. Extreme care should be exercised when removing integrated circuit devices and discrete components. Use a 40-watt maximum soldering iron with a small tip designed especially for IC work. To remove an IC device, follow this procedure:

Clip all leads and lift the IC package out, leaving two rows of leads. Then remove

leads individually with a soldering iron and needle-nose pliers. Finally, evacuate the holes with a solder sucker. Afterwards clean the area thoroughly, using an approved PCB cleaning solution to remove any traces of flux and dirt. Alcohol will do in a pinch, if necessary.

The microprocessor, read-only memories, and random-access memories are removed by simply pulling them out of their sockets. When placing them into their sockets, make certain they are placed in the correct socket.

Insert the new IC device using an IC insertion tool, making sure that the reference notch is oriented correctly and that the device's leads are not bent during insertion into the board. Afterwards, be sure to solder each lead on *both* sides of the PCB, using as little solder as possible. After soldering, clean the area thoroughly to remove the flux.

Observe the same removal and insertion procedures when replacing discrete components. Trim the leads as close as possible and be sure to orient diodes and capacitors correctly.

#### 8.1.4 Verifying Correct Game Operation:

After locating and correcting the cause of a trouble, re-energize the game and perform a final check by placing the game in the self-test function, then check for correct operation during game play. Doing this will verify that your troubleshooting was correct. If the game operation is still not correct, go back and double-check your work. Make sure that any replaced components were installed correctly. If this was done properly, then start the troubleshooting steps over again. Keep in mind that there may be more than one trouble at a time, and that correcting one trouble can sometimes bring previously undetectable troubles to light.

This verification is especially important when the original trouble had been intermittent, that is, was not happening all the time.

## 8.2 TEST EQUIPMENT

Electronic troubleshooting of a video game essentially consists of checking for the presence of various signals and of examining their condition. A signal can be thought of as acting like a "messenger" that carries instructions from one unit or circuit to another. Many different types of signals are produced in a video game, and for this reason several unusual and perhaps unfamiliar types of test

instruments are used during troubleshooting. Each instrument has its own set of advantages and disadvantages for examining a given type of signal, and both the depth of the intended troubleshooting capability and budget will determine what instruments will be needed. Some instruments are basic and essential, no matter what size of service facility, while other optional instruments are desirable because they make troubleshooting easier and quicker.

### 8.2.1 Basic Test Equipment:

(a) *The Video Probe.* This is a simple but invaluable instrument having two leads—a test-clip lead and a test-probe lead. During troubleshooting of video signals the test-clip lead is left connected to the game side of the video coupling capacitor. On the Sprint 2 this point is the junction of summing resistors R48 through R50 on the PCB. When the test-probe lead is then connected to any video developmental signal, that signal will be coupled to the video signal going to the TV monitor and a video probe picture will appear on the TV screen. The shape and other characteristics of this picture will give information about the signal being probed. The video probe is suited for troubleshooting synchronization and image signals, but will not be useful for extremely fast signals (such as the clock) or for very slow analog or digital signals.

A video probe can be constructed in a few minutes from these common electrical components: a length of 20 AWG (American Wire Gauge) rubber-coated wire, a 4.7K-ohm, 1/4-watt carbon resistor, and two test leads. For the leads, use a single Mouser test clip (Mouser #131C301 or 302) attached to one end of the wire, and a test prod containing the resistor on the other.

To assemble the video probe, proceed as follows: Remove the cap from the test clip and strip 3/16 inch off each end of the wire. Solder one end to the post in the test clip, thread the other end through the hole in the cap, and snap on the cap. Next unscrew the plastic body of the test prod from the point and trim both leads of the resistor to a 3/16-inch length. Solder one resistor lead to the inside of the point. Thread the other end of the wire through the hole in the body and solder it to the other resistor lead; screw the body back onto the point.

(b) *The Logic Probe.* This is a test instrument designed for fast verification of digital IC outputs. It is small, convenient to carry, easy to read, and rela-

tively inexpensive. The logic probe derives its power from the system under test; it has two power leads, one for connection to ground and the other to +5 volts DC. When the logic probe's tip is held against a digital signal point, three colored lamps in the tip will indicate the signal's condition or state, as follows:

- The red lamp lit indicates a high or logic level 1 (for TTL components, this is +2.4 to +5 volts)
- The white lamp lit indicates a low or logic level 0 (for TTL components, this is 0 to +0.8 volt)
- The blue lamp lit indicates that the signal is changing states
- No lamps lit indicate the grey region between 0 and 1 (for TTL this is between +0.8 and +2.4 volts)

A circuit shorted to ground will illuminate the white lamp and an open circuit will illuminate the red lamp.

The logic probe is readily available from electronic supply sources; a commercial model found satisfactory is the Kurz-Kasch model LP 520.

(c) *The Logic Pulser.* This test instrument is similar in size and shape to the logic probe, and it also derives its power from the system under test. When the logic pulser's tip is held against a digital signal point, the source and sink capabilities of the pulser override any IC output and the point is driven to the opposite logic level. If the point that the logic pulser is held against is low, pressing the switch on the side of the pulser will introduce a high pulse. Conversely, pulsing a high line will pull that line low momentarily.

During troubleshooting the logic pulser allows stimulation of in-circuit ICs with a shaped digital pulse. For example, a certain feature of the game may not be working and you suspect that a circuit is not receiving the necessary signal. Use the pulser to imitate that signal: if the circuit begins working, you have proved that the signal was in fact missing and you can begin tracking it down. This technique is very similar to jumping coils in electromechanical games such as pinball machines.

In addition to the regular "pulse" button, there is another switch mounted on the logic pulser. When this switch is set in the "rep" mode, the instrument pulses the digital signal point at a 5-Hz rate or 5 times per second. This extremely low rate is slow enough to allow watching events initiated by the pulser. Counter outputs, for example, are more

easily observed when the counter is pulsed or clocked at this rate.

The logic pulser is also readily available from electronic supply sources; a commercial model found satisfactory is the Kurz-Kasch model HL 583.

(d) *Oscilloscope.* The most versatile test instrument, and also the most expensive, is the oscilloscope. The high-speed TTL integrated circuits used in video games produce fast-rise-time signals. The oscilloscope should have a 50-MHz bandwidth, dual trace and dual time base capability. These latter features allow examination of both input and output signals simultaneously, so that precise timing relationships can be checked. The oscilloscope should also have provision for internal or external sync.

Of the newer, solid-state oscilloscopes, a satisfactory model is the Tektronix 465.

(e) *VOM or Volt-Ohmmeter.* This common measuring instrument is extremely useful in video game troubleshooting. It can be used to check line voltage, transformer secondary windings, continuity, resistance, power supply voltages, and to some extent used for measurements in the analog circuitry.

One commercial model found satisfactory is the Simpson 260.

### 8.2.2 Optional Test Equipment:

(a) *The Logic Comparator.* This test instrument's main benefit is that it can be used to check the functioning of an integrated circuit device while the device is still in place on the printed circuit board. The logic comparator performs the check by comparing the suspect ICs functioning with that of an identical-type reference IC mounted in the instrument itself. Suppose that the functioning of a type-74195 device on the PCB is suspected to be defective. First insert a program card with a known-to-be-good 74195 into the logic comparator, and then clip the comparator test leads onto the leads of the suspect device. If there are any logic state differences between the reference IC and the suspect IC under test, then an LED on the logic comparator will light up to indicate which output is not functioning correctly. Once a defective IC has been located, it should be replaced.

Logic comparators are readily available from electronic supply sources.



(b) *Atari Universal Test Fixture.* In situations where a large number of video games are being serviced, investment in the Universal Test Fixture will be justified. This item of test equipment forms a test station for troubleshooting printed circuit boards after they have been removed from the game cabinet. The Universal Test Fixture has a full set of controls for operating the game and also has its own TV monitor. The game's PCB is plugged into an edge connector mounted on the side of the Fixture; with this arrangement the PCB is positioned in a convenient way for connecting probes and other test instruments.

A program card inserted into a receptacle in the top of Fixture takes the place of the game's interconnect wires. The program card thus sets up the Fixture for each particular game; the game's name is clearly printed on the program card itself.

With the Universal Test Fixture the method of troubleshooting via substitution of known-to-be-good parts is made fast and convenient. For example, suppose that the TV picture in a game is completely broken up and you want to determine whether the game or monitor is causing the problem. Remove the PCB and plug it into the Fixture's edge connector, and also insert the correct program card for that game. If the picture on the Fixture's monitor is correct, then you know that the problem lies in the game's monitor.

### 8.3 SPECIFIC TROUBLESHOOTING INFORMATION

The following subparagraphs give additional troubleshooting information about certain areas of the Flyball game.

#### 8.3.1 Coin Mechanism:

If a player inserts a coin and the game does not respond, first check the coin mechanism. If pressing the coin rejector button forces the rejector mechanism to return the coin, then examine the coin to make sure that it is genuine. If it is, then use a set of your own test coins (which should include both very new and very old, worn coins) to determine whether or not the player's coin is undersize or underweight. If your test coins are also returned, this indicates that servicing of the coin acceptor portion of the coin mechanism is called for. Generally the cause of this particular problem is an improperly adjusted magnet gate.

Inside the coin mechanism a magnet is used to test the metallic composition of the coin. Highly

magnetic coins, such as those made of steel or iron, will be retained by the magnet and can be returned by actuating the wiper operating lever. Coins having comparatively high magnetic properties will be slowed down by the magnet, and will drop off the end of the rail short of the "accept" entrance and be returned. Coins having little or no magnetic properties, such as brass or zinc coins, will pass through the magnetic field so fast that they will overshoot the "accept" entrance and be returned.

A magnetic gate adjusted with too large a gap may pass both genuine and counterfeit coins. An adjustment with too small a gap can lead to rejection of some or even all coins. Over a period of time, the screw that adjusts the magnet gate has a tendency to work loose, resulting in a gradual narrowing of the gate. At first, only the thickest (i.e., newest) coins are rejected. As time passes, more and more coins are rejected until finally player complaints lead to the calling of the game repairman.

If pressing the coin rejector button does not cause the coin to be returned, and if the game still does not respond, then check the coin mechanism to see if the coin is jammed inside.

If you are certain that the coin is genuine, and that the coin passes through the coin mechanism and into the cash box, then the lack of game response is probably due to some kind of electrical trouble. Check for signals at the electrical contacts of the coin mechanism before moving on to the harness and other parts of the circuitry.

#### 8.3.2 TV Monitor:

The TV monitor is a self-contained unit housed in its own chassis. A trouble's cause may be narrowed down to the monitor—either by the substitution method using a known-to-be-good monitor, or by verifying presence of AC power to the monitor power supply and presence of the *correct* composite video signal. The entire monitor can then be removed from the game cabinet. Doing this facilitates troubleshooting steps, because all monitor components will then be accessible.

A schematic diagram of the monitor circuitry is included in Section IX of this manual. After disconnecting and removing the monitor from the game, standard TV troubleshooting techniques are adequate for locating causes of trouble. Additional servicing information is available from the monitor manufacturer (Motorola).

## IX. SCHEMATICS, DRAWINGS, AND PARTS LISTS

NUMBER	TITLE
A006205-01	Parts List and Drawing Final Assembly
A006206-01	Drawing Control Panel Assembly
A005925	Drawing Electronics Tray Assembly
A006285-01	Parts List and Drawing R.F. Shield Assembly (PCB)
A005922-01	Parts List, Drawing, and Schematic Sprint II PC Board Assembly
A000607	Parts List, Drawing, and Schematic Steering Printed Circuit Assembly
A006278-01	Schematic Harness
(none)	Schematic Motorola Model XM 701-10 TV Monitor

SPRINT II



ASSEMBLY TITLE

FINAL ASSEMBLY

P/LA006205-01

## PARTS LIST SPECIFICATION

Page 1 of 2

Drawn

FINAL ASSY

Checked

Mech. Eng.

Proj. Eng.

Elec. Eng

REV.

B

Rev.	Description	Date	Apprv.	Rev.	Description	Date	Apprv.
1	PRE PROD REL	7/29/76					
2	Pre Prod Rel						
A	PROD REL	10/1/76					
B	Rev per ECN 3090	10/8/76					


Item	Part Number	Qty.	DESCRIPTION
1	A006214-02	1	Cabinet Assembly with Graphics
2	A006206-01	1	Control Panel Assembly
3	A005667-01	1	T.V. Shelf Assembly
4	A005925-02	1	Electronics Tray Assembly
5	A005912-01	REF	R.F. Shield Box Assembly
6	A003637-1 1	1	Coin Door Assembly
7	A005495-02	1	24" Fluorescent Fixture Assembly
8	A006284-01	2	Single Foot Pedal Assembly
9	006211-01	1	Bezel, Card Board Sprint Graphics
10	006210-01	1	Shield, Display Light (Silkscreen)
11	005665-01	2	Plex Retainers
12	001638-01	2	Panel MTG. Bracket
13	005419-01	2	Speaker Grill
14	73-77004	8	Rivets, 3/16" O.D. x .68" Lg. .250-.500 Grip
15	72-6612	2	Screws, Sm #6 x 3/4 Lg. Phil Pan Hd.
16	48-001	2	8" Speaker
17	82-1824	8	Wood Screw, #8 x 1.50" Lg, Flat Hd Phil
18	A005410-02	1	Rear Door Assy, with Lock
19	A006285-01	1	R.F. Shield Assy (P.C.B.)
20	75-5124B	6	Bolt, Carriage, 10-24 x 1.50" Lg. Black
21	75-010S	14	#10 Washer, Flat
22	75-040	12	#10 Washer, Split-Lock
23	75-911S	12	#10-24 Nut, Hex
24	75-5520N	2	Bolt, Carriage #10-20 x 1.25" Lg.
25	75-015S	6	Washer, Flat, 1/4"
26	75-045	6	Washer, Split Lock, 1/4"
27	75-915S	4	Nut, Machine Hexagon, 1/4-20
28	75-99090006	7	Well Nut, Blind Hole Fastener 10-32
29	82-8016	8	Screw, Button Hd. Socket Cap, 10-32 x 1.00" Lg.
30	72-6812	14	Screw, Self-Tapping #8 x 3/4 Lg., Phil, Pan Hd.
31	A005922-01	1	P.C. Board Assembly, Sprint II (17.50)
32	005233-01	1	Rear Door Seal
33	75-5132N	2	Bolt, Carriage, #10-24 x 2.00 Lg.
34	68-001	2	Interlock Switch, A.C. Power
35	000268-01	2	Interlock Switch Bracket
36	72-6608	16	Screw, SM., Pan Hd., Phil., #6 x 1/2" Lg.
37	TM-078	1	Technical Manual
38	A 00593C-XX	1	Shipping Container
39	72-6808	1	Screw, SM. #8 x 1/2 Lg Phil Pan Hd.

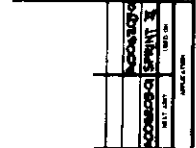


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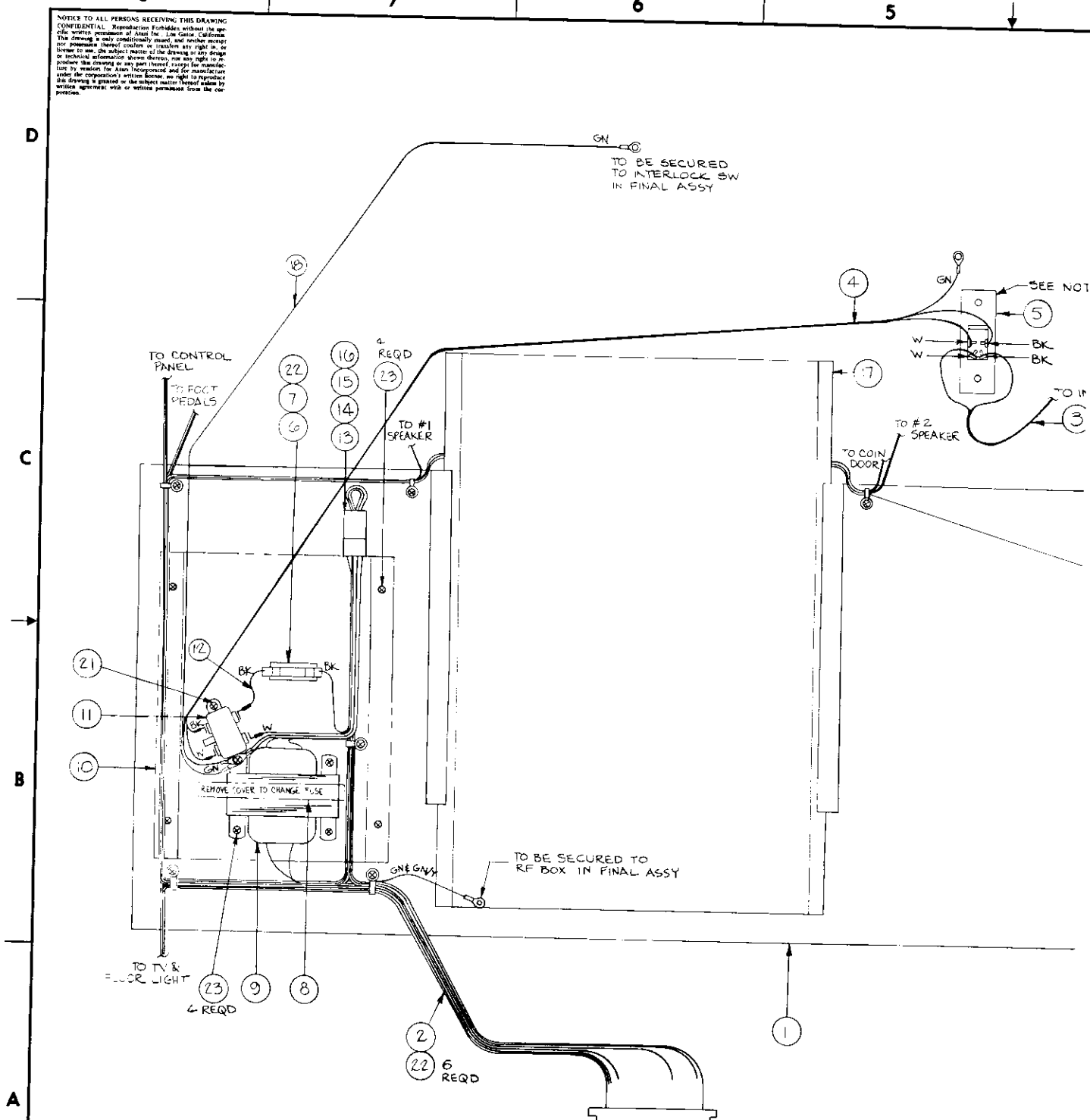
Page 2 of 2

Item	Part Number	Qty.	DESCRIPTION
40	75-935	2	Wing-Nut, 1/4 - 20
41	75-931	1	WingNut, #10-24
42	78-6601216	A/R	Alum Foil (Approx. 6 inches) 1" wide
43			
44	A006222-02	1	Strain Relief Power Cord Assy.
45	A006278-01	1	Harness Schematic
46	72-6610	12	Screw, Sm. #6 x 5/8 Lg. Phl. Pan Hd.
47	78-25001	1	Screw Down Tie-Wrap
48	006305-01	1	Printed Poly Bag
49	006319-01	1	Copyright Decal

NAME <input type="checkbox"/> COMPANY <input type="checkbox"/> ADDRESS <input type="checkbox"/> PHONE NO. <input type="checkbox"/> FAX NO. <input type="checkbox"/> E-MAIL <input type="checkbox"/>	DO NOT BE ABLE DRAWING.		1 YEAR WARRANTY 1 YEAR FREE SERVICE 1 YEAR FREE RETURN
SEE PL ADDRESS ON		CONTROL PANEL ASSY	1 YEAR WARRANTY 1 YEAR FREE SERVICE 1 YEAR FREE RETURN

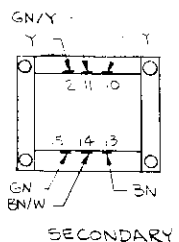
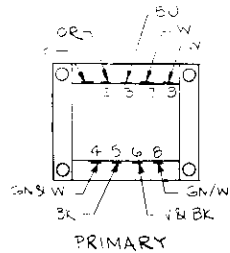
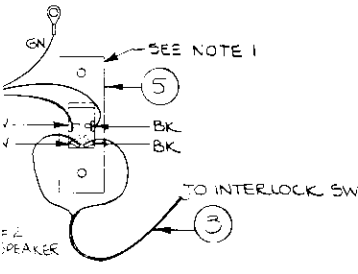


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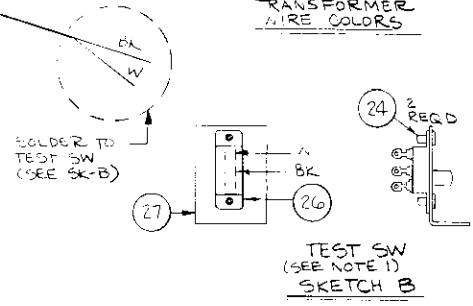
BISHOP GRAPHICS/ACCUPRESS  
REORDER NO. A-6610

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REVISIONS				
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A		PROD REL		
D		REV PER ECN 3089		



TRANSFORMER  
WIRE COLORS



OUTSTANDING ECNs	

AD05664-01	
AD06205-01	
AD06205-01	SPRINT II
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON:	
ANGLES = A1°	C = .1
SURFACE FINISH	XX = A .03
	XXX = A .010
MATERIAL	DO NOT SCALE DRAWING
SEE P/L	DRAWN BY DATE
	CHECKED
	ENGINEER
	PROJECT ENGINEER

ATARI INCORPORATED 14600 Winchester Boulevard Los Gatos, California 95030	
TITLE SPRINT II ELECTRONICS TRAY ASSEMBLY	
SIZE D	DRAWING NO. A005925-XX
SCALE 1:2	REV 3
SHEET 1 OF 1	

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**G.K.**

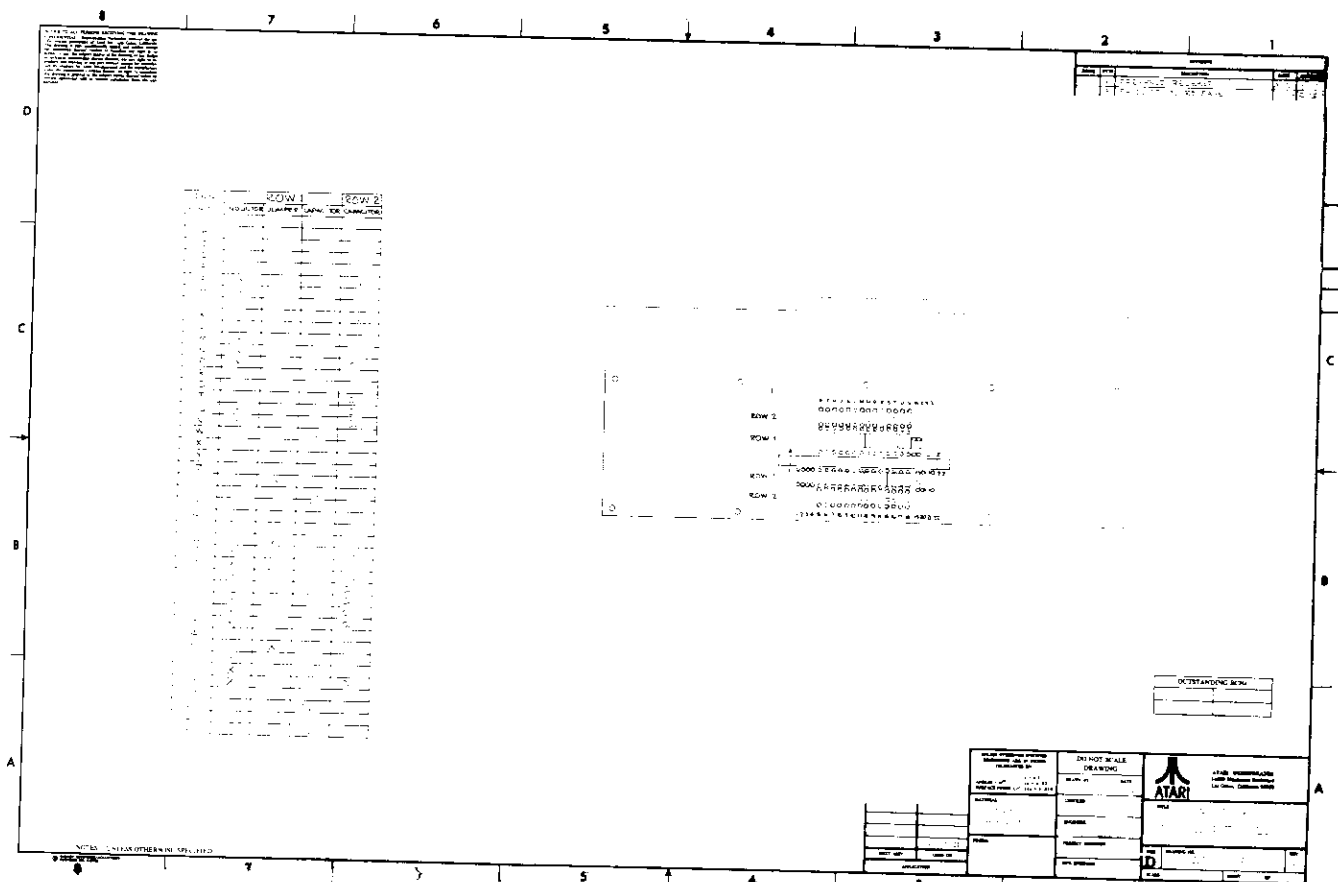
ASSY, SPRINT II R.F. SHIELD BD. P/L A006285-01

Page 1 of 1

REV.  
A

[illegible]

Item	Part Number	Qty.	DESCRIPTION
1	005491-01	1	P.C. BOARD
2	79-517222	1	CONNECTOR, 44 PIN P.C. MOUNT
3	41-3003	18	INDUCTOR, 100uh
4	27-250104	32	CAP, CER DISC, 0.1uf 25V
5	52-002	5	Jumper, .4 Center
6	52-003	3	Jumper, .6 Center





ASSEMBLY TITLE	SPRINT II P.C. ASSY.	P/L	A005922-01
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PARTS LIST SPECIFICATION	Page 1 of 6
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Drawn		
Checked	Mech. Eng.	
Proj. Eng.	Elec. Eng.	Rev.
	Mfg. Eng.	A

Rev.	Description	Date	Apprv.	Rev.	Description	Date	Apprv.
1	PRE PROD.	8/3/76					
A	PRODUCTION REL.	10/1/76					

Item	Part Number	Qty.	Description
1	005923-01	1	SPRINT P.C. BOARD
2	10-5101	5	RES., CARBON, 5%, 1/4W, 100 OHM R17,18,35,37,32
3	10-5102	10	" " " " 1K OHM R1,2,4,19,20,26,33,38,50,68
4	10-5103	19	" " " " 10K OHM R3,21,28, ,39-44,54-61,63,64
5	10-5105	2	" " " " 1M OHM R6,11
6	10-5182	2	" " " " 1.8K OHM R48,49
7	10-5222	3	" " " " 2.2K OHM R15,16,25
8	10-5224	2	" " " " 220K OHM R8,13
9	10-5225	2	" " " " 2.2M OHM R5,10
10	10-5331	21	" " " " 330 OHM R 45,46,51-53,69-83,86
11	10-5333	2	" " " " 33K OHM R62,65
12	10-5335	2	" " " " 3.3M OHM R22,29
13	10-5392	1	" " " " 3.9K OHM R24
14			
15	10-5474	2	" " " " 470K OHM R7,12
16	10-5683	2	" " " " 68K OHM R9,14
17	10-5822	1	" " " " 8.2K OHM R27
18	19-809W2P0	1	RES., WIREWOUND, 20W, 2 OHM R47
19	19-315502	2	TRIMPOT, 5K OHM R66,67
20	19-315254	2	TRIMPOT, 250K OHM R23,R30
21	10-5221	1	RES., CARBON, 5%, 1/4W, 220 OHM R84
22	10-5270	1	" " " " 27 OHM R85
23			
24			

## PARTS LIST SPECIFICATION

Page 2 of 6

Item	Part Number	Qty.	Description
25	21-101103	2	CAP., MYLAR, .01uf 100V C22,23
26			
27			
28			
29	24-160808	2	CAP., ELECTROLYTIC, 8000uf, 16V C65,66
30	24-25016	4	" " 10uf, 25V C17,18,24,25
31	24-250108	2	" " 1000uf, 25V C49,50
32	24-250227	1	" " 220uf, 25V C12
33	24-250478	1	" " 4700uf, 25V C67
34			
35	27-250102	2	CAP., CERAMIC DISC, .001uf, 25V C55,62
36	27-250103	8	" " " .01uf, 25V C28,30,57,64,44-47
37	27-250104	42	" " " .1uf, 25V C1-4,13-16,19-26,27,29,31-36,41-43,48,51,52,54,56,58,59,61,63,68,69,6-11,39,70
38			
39			
40	28-101101	2	CAP., DIPPED MICA, 100pf, 100V C37,38
41	28-101221	2	" " " 220pf, 100V C53,60
42			
43			
44			
45			
46	31-A14F	2	DIODE, A14,F CR6,7
47	31-MR501	2	" MR501 CR4,5
48	31-IN914	3	" IN914 CR1,2,3
49			
50			
51	33-2N3644	2	TRANSISTOR, 2N3644 Q1,Q2
52			
53			
54			
55			
56			
57	37-7400	2	INTEGRATED CIRCUIT, 7400 F8,D0

## PARTS LIST SPECIFICATION

Page 3 of 6

Item	Part Number	Qty.	Description		
58	37-7402	1	INTEGRATED CIRCUIT, 7402	P2	
59	37-7404	6	" " 7404	E3,E4,H5,J5,L6,N9	
60	37-7408	5	" " 7408	B2,C2,N3,C5,A6	
61	37-7410	1	" " 7410	R7	
62	37-7414	2	" " 7414	A5,L9	
63	37-7420	1	" " 7420	A8	
64	37-7430	1	" " 7430	N4	
65	37-7432	5	" " 7432	A2,L2,P3,F6,J8	
66	37-7437	1	" " 7437	R9	
67	37-7474	3	" " 7474	R1,L8,M9	
68	37-74S74	1	" " 74S74	R8	
69	37-7475	3	" " 7475	B4,C4,D4	
70	37-7483	2	" " 7483	L4,M4	
71	37-7486	1	" " 7486	C7	
72	37-7490	1	" " 7490	C6/7	
73	37-7492	2	" " 7492	B8,D8	
74	37-9312	2	" " 9312	F9,H9	
75	37-74153	1	" " 74153	M8	
76	37-74156	1	" " 74156	J9	
77	37-74LS163	8	" " 74LS163 74164	M5,N5,P5,Q5 B7,D7	
78	37-74165	8	" " 74165	E7,F7,H7,J7, K7,L7,M7,N7	
80	37-74166	1	" " 74166	R3	
81	37-74174	3	" " 74174	F5,L5,A7	
82	37-74175	1	" " 74175	N2	
83	37-74279	1	" " 74279	H6	
84	37-9301	5	" " 9301	D2,F2,P7,E8,K8	
85	37-9316	5	" " 9316	R2,L3,M3,N8,P8	
86	37-9322	3	" " 9322	H2,J2,K2	
87	37-9334	1	" " 9334	H8	
88	37-555	2	" " 555	B7/8,D7/8	
89	37-74367	3	" " 74367	E5,K5,E6	
90	37-21L02A	8	" " 21L02A	F3,H3,J3,K3, F4,H4,J4,K4	
91	37-LM323	1	REGULATOR LM323		
92	37-TDA1004	2	OP-AMP TDA1004	B9,D9	

## PARTS LIST SPECIFICATION

Page 4 of 6

Item	Part Number	Qty.	Description
93			
94			
95			
96			
97	62-001	1	SWITCH, SPST, MOMENTARY SW3
98	66-114P1T	1	SWITCH, SPST, x4, DIP SW2
99	66-118P1T	1	SWITCH, SPST, x8, DIP SW1
100			
101			
102			
103	72-1608C	2	SCREWS, PAN HD., PHIL., 6-32 x 1/2 LG, CRES
104	75-016	2	WASHER, FLAT #6
105	75-056	2	WASHER, LOCK, INT STAR, #6
106	75-916C	2	NUT, HEX, #6-32 CRES
107			
108			
109	78-06001	1	HEATSINK, (LM323)
110	78-06009	2	HEATSINK, (TDA1004)
111	78-13016	A/R	CEMENT, (TDA1004 HEATSINK)
112	78-16005	1	SILPAD (LM323)
114			
115			
116			
117A	79-42518	16	SOCKET 18 PIN, LOW INSERTION PO,HQ,JO,KO,LO,MO, (USED ON -01 BOARDS ONLY) NO,PO,F1,H1,J1,K1, L1,M1,N1,P1
117B	79-42518	8	SOCKET 18 PIN, LOW INSERTION LO,L1,MO,M1,NO,N1, (USED ON -02 BOARDS ONLY) PO,P1
117C			NOT USED ON -03 BOARDS
118A			NOT USED ON -01 BOARDS
118B	79-42524	2	SOCKET, 24 PIN, LOW INSERTION AO,CO (USED ON -02 BOARDS ONLY)
118C	79-42524	4	SOCKET, 24 PIN, LOW INSERTION AO,DO,EO (USED ON -03 BOARDS ONLY)

## PARTS LIST SPECIFICATION

Page 5 of 6

Item	Part Number	Qty.	Description
119	79-42540	1	SOCKET, 40 PIN, LOW INSERTION C3
120			
121			
122			
123	90-102	1	CRYSTAL, 12.096MHZ Y1
124			
125			
126			
127	006380-01	1	SPRINT II PROGRAM PROM 1 L1 (NOT USED ON -03 BOARDS)
128	006381-01	1	SPRINT II PROGRAM PROM 2 L0
129	006382-01	1	" " " " 3 M1
130	006383-01	1	" " " " 4 M0
131	006384-01	1	" " " " 5 N1
132	006385-01	1	" " " " 6 N0
133	006386-01	1	" " " " 7 P1
134	006387-01	1	" " " " 8 P0
135			
136			
137	006388-01	1	SPRINT II RACE TRACK PROM 2 P0
138	006389-01	1	" " " " 3 H1
140	006391-01	1	" " " " 4 H0
141	006392-01	1	" " " " 5 J1
142	006393-01	1	" " " " 6 J0
143	006394-01	1	" " " " 7 K1
144	006395-01	1	" " " " 8 K0
145			
146			
147	006396-01	1	SPRINT II CHARACTER PROM LSB P4
148	006397-01	1	" " " " MSB R4
149			
150			
151	006398-01	1	SPRINT II RACE CAR PROM LSB K6
152	006399-01	1	" " " " MSB J6
153			
154			

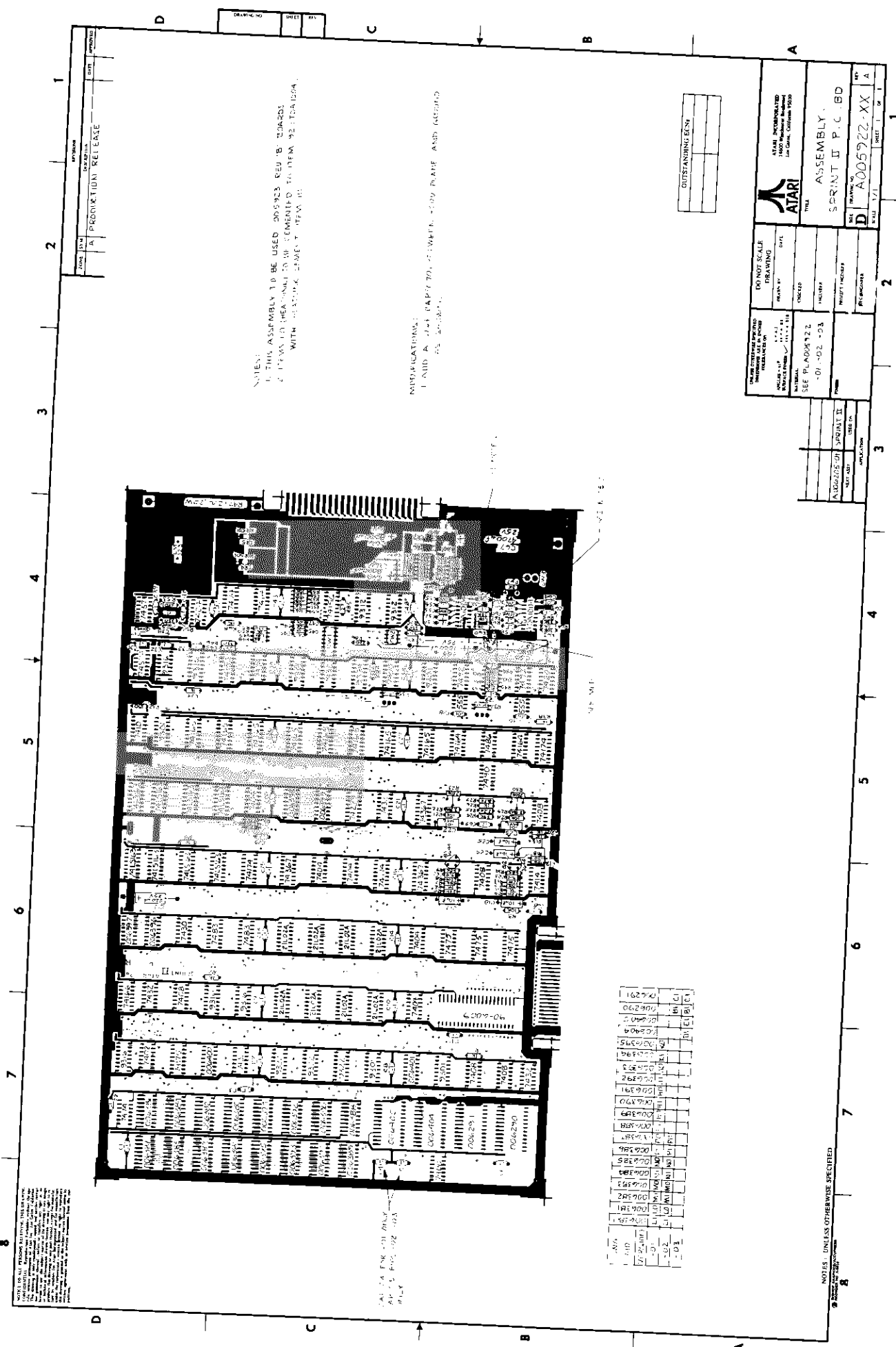
NOT USED ON  
-03 BOARDS

USED ON -01  
BOARDS ONLY

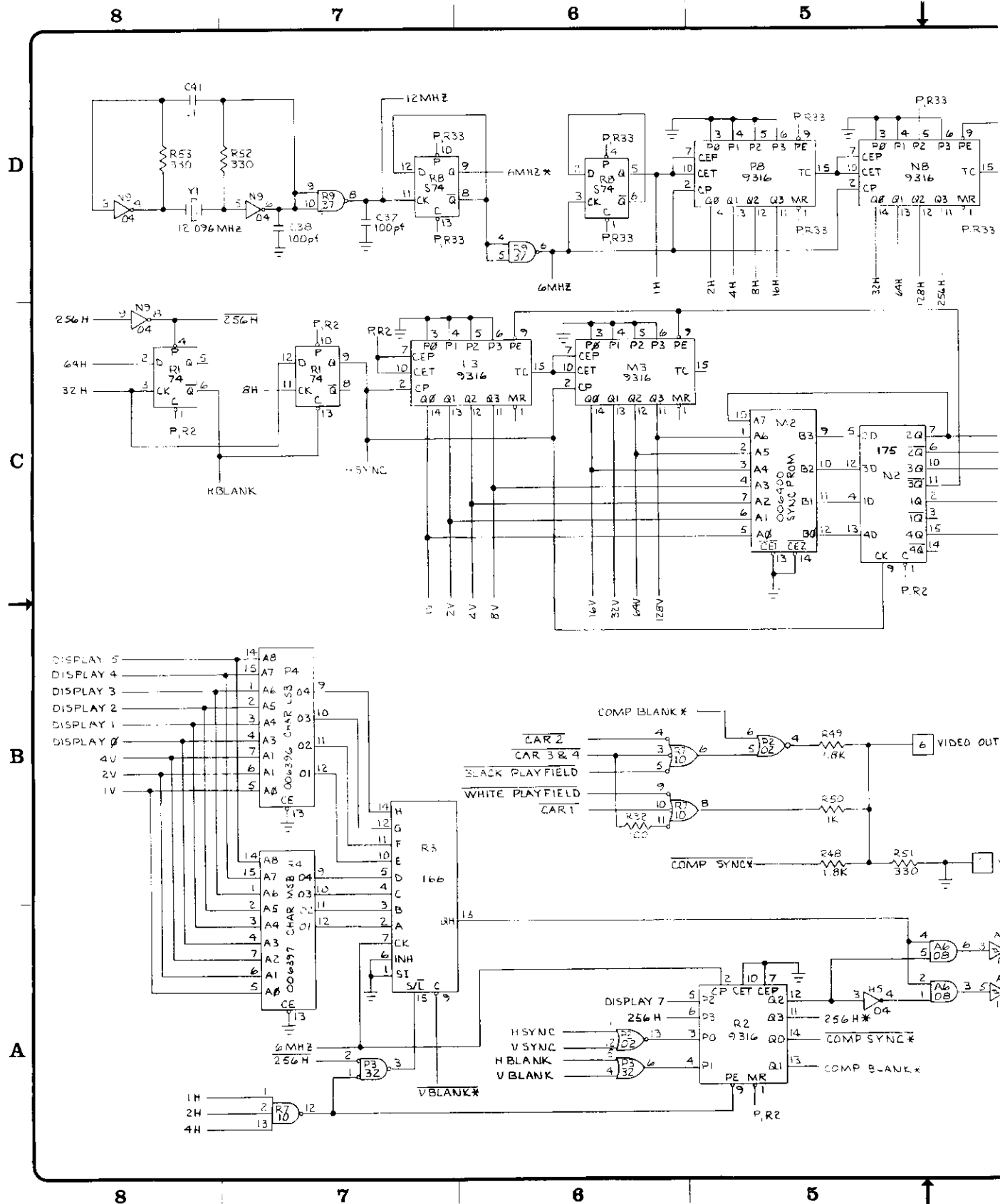
## PARTS LIST SPECIFICATION

Page 6 of 6

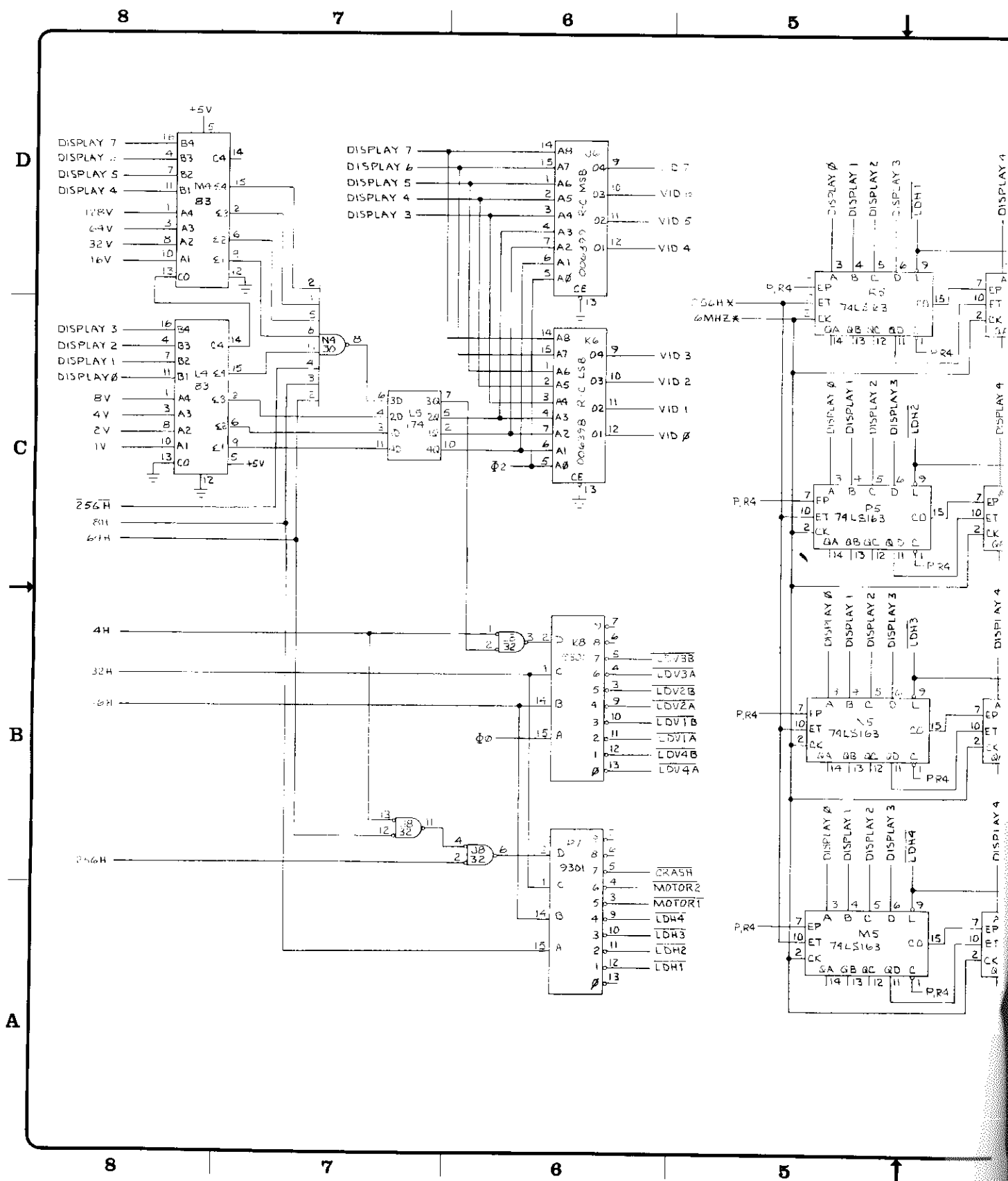
Item	Part Number	Qty.	Description
155	006400-01	1	SPRINT II SYNC PROM M2
156			
157			
158	006401-01	1	SPRINT II ADDRESS DECODE PROM
159			
160			
161	006404-01	1	SPRINT II PROGRAM ROM 1 D1 (USED ON -03 BOARDS ONLY)
162			
163			
164	006405-01	1	SPRINT II PROGRAM ROM 2 E1 (USED ON -03 BOARDS ONLY)
165			
166			
167	006290-01	1	SPRINT II RACE TRACK ROM 1 A1 (USED ON -02 AND -03 BOARDS ONLY)
168			
169			
168	006291-01	1	SPRINT II RACE TRACK ROM 2 C1 (USED ON -02 AND -03 BOARDS ONLY)
169			
169			
169	90-6009	1	INTEGRATED CIRCUIT C3
169			
169			



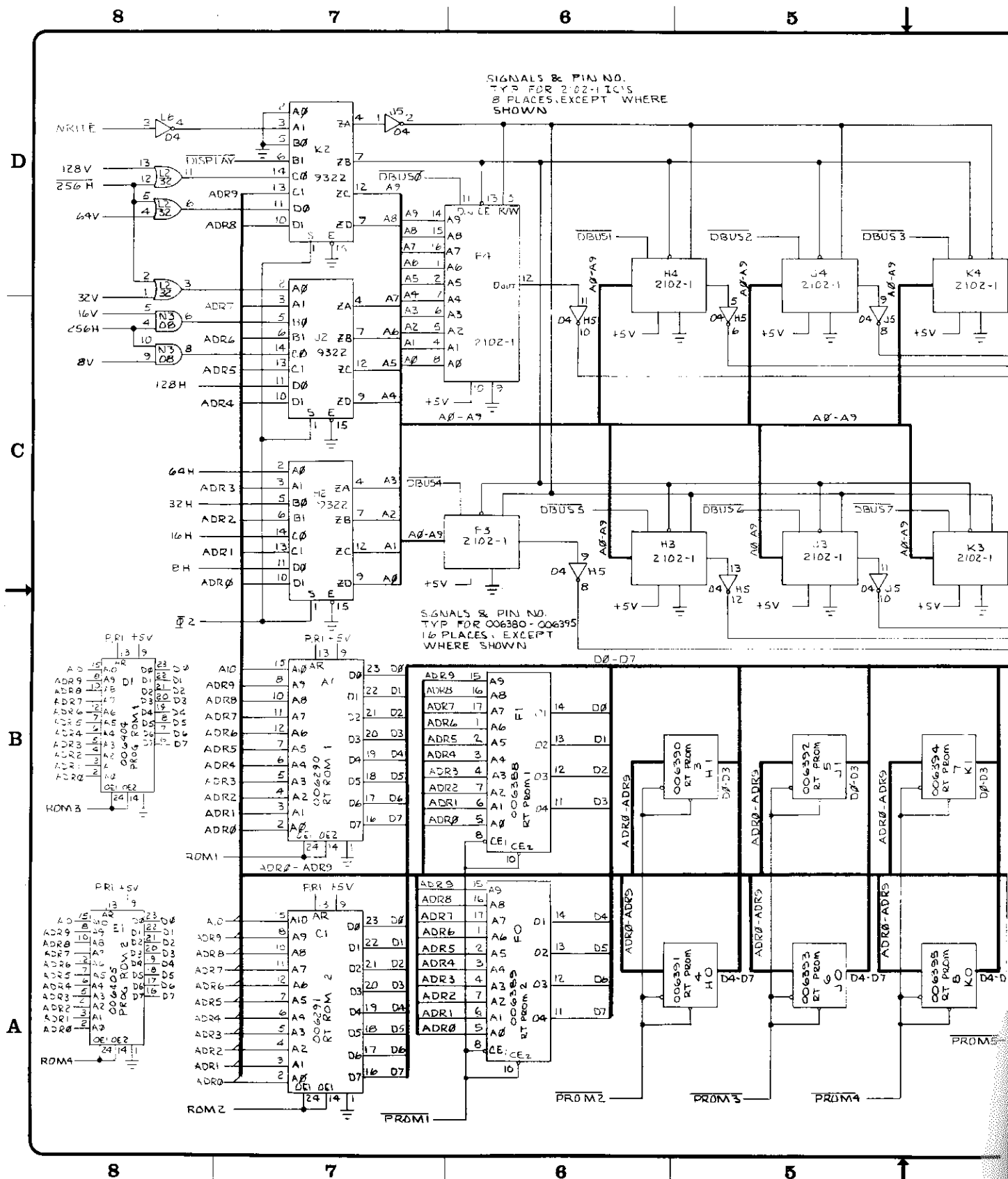


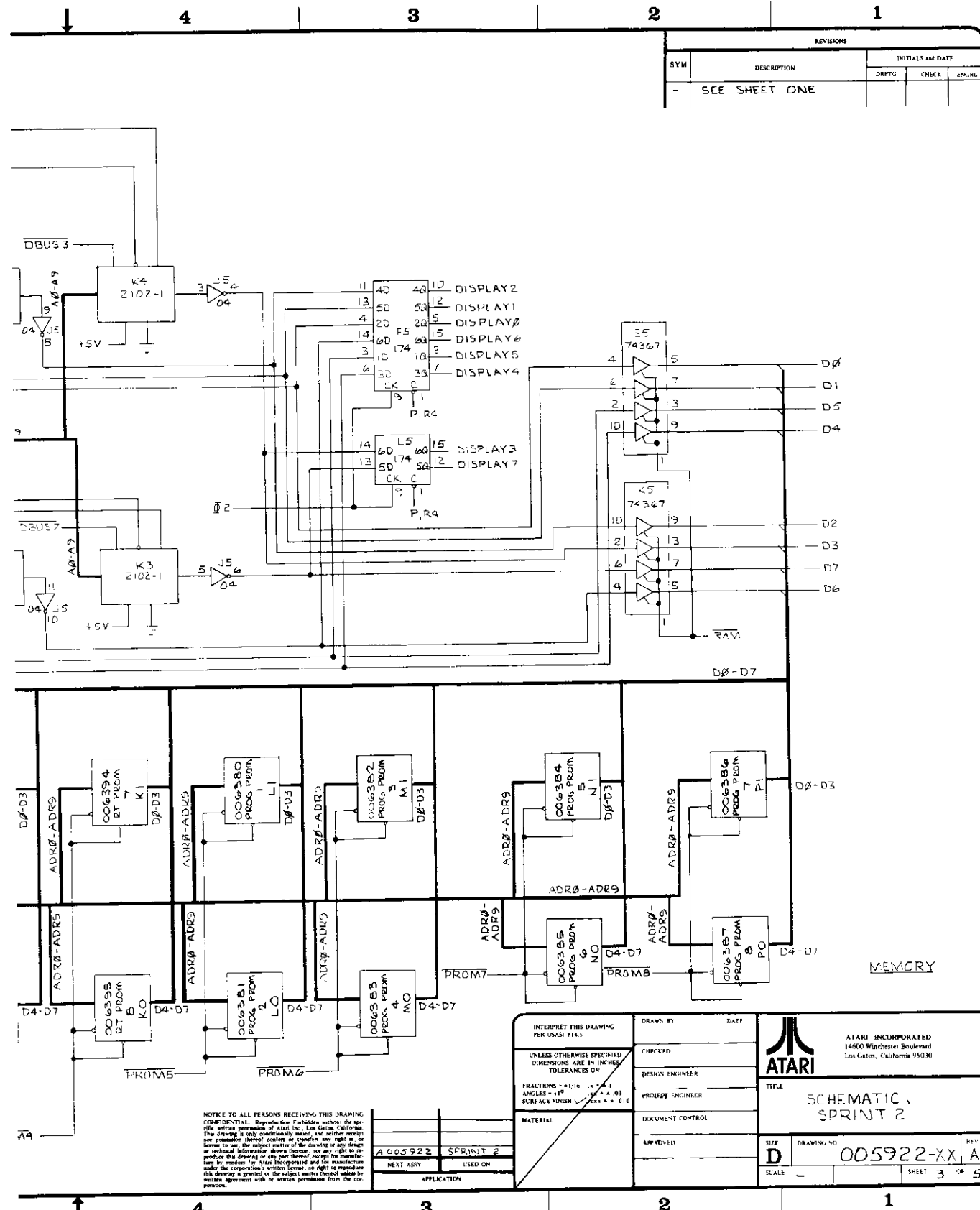












REVISIONS				
SYM	DESCRIPTION	INITIALS AND DATE		
-	SEE SHEET ONE	DRFTG	CHECK	ENGRG

D  
C  
B  
A

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005922	SPRINT 2
NEXT ASSY	USED ON
APPLICATION	

INTERPRET THIS DRAWING PER USAS 114.5		DRAWN BY _____ DATE _____	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON		CHECKED _____	
FRACTIONS - 1/16 - 1/8 - 1/4 - 1/2 - 1		DESIGN ENGINEER _____	
ANGLES - 1° - 5° - 10° - 15° - 30° - 45° - 60° - 90° - 180°		PROCESS ENGINEER _____	
SURFACE FINISH - 0.005 - 0.010		DOCUMENT CONTROL _____	
MATERIAL _____		APPROVED _____	
ATARI		TITLE	
ATARI INCORPORATED 14600 Winchester Boulevard Los Gatos, California 95030		SCHEMATIC, SPRINT 2	
SIZE	DRAWING NO.	REV	
D	005922-XX	A	
SCALE		SHEET	3 OF 5

8

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↓

1 2 3 4 5 6

+5V

Vcc

D

(TEST)

TIMER RESET

SW3

RESET

C3  
90-6009

RESET

C

12MHZ

R/W

Q2

4H

WRITE

4H

B

A

+5V

C11

IN914

16.5 VAC

R16

2.2K

R15

2.2K

C15

.1

GND

E6

74367

D4

D5

D6

D7

SYNC

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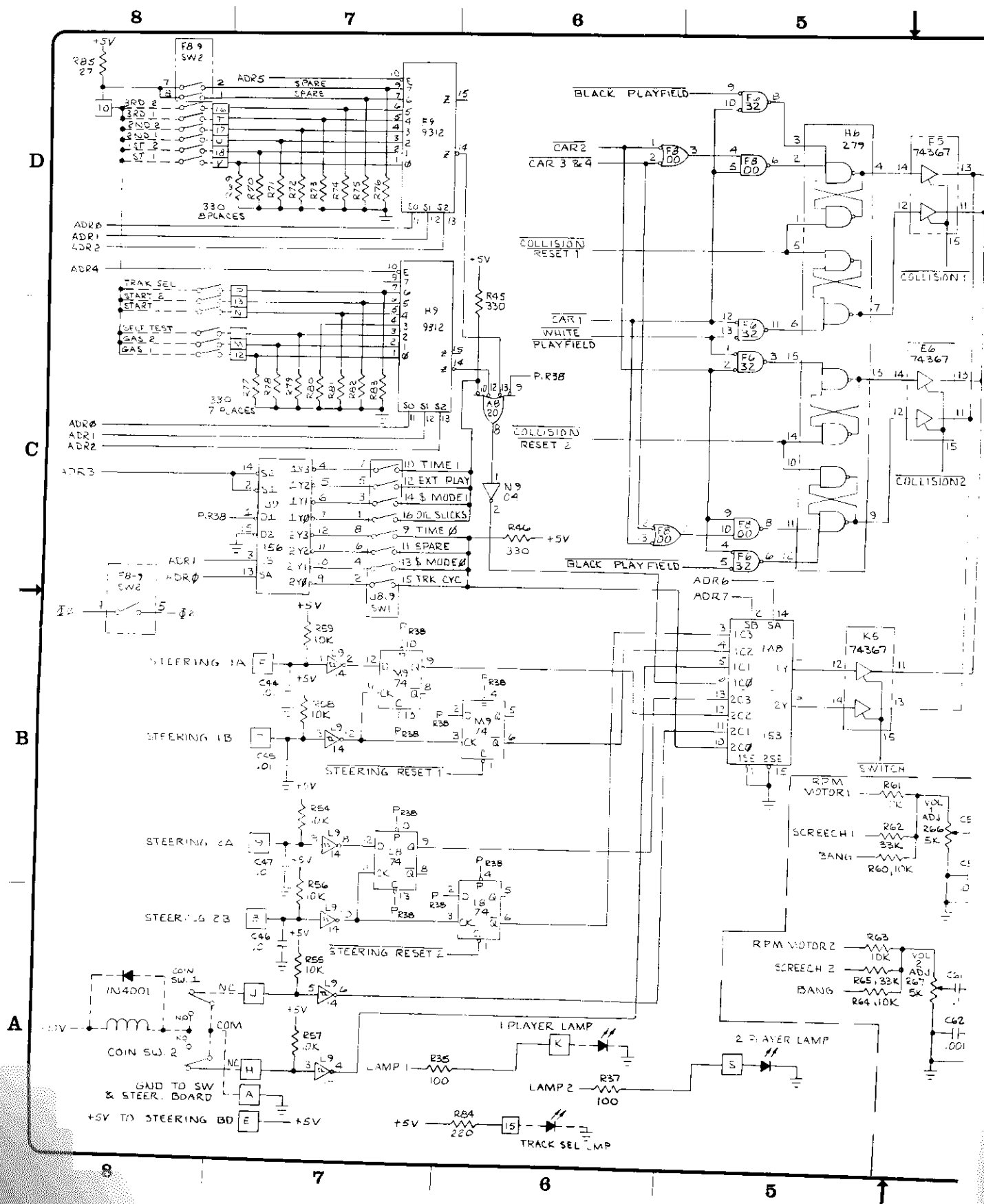
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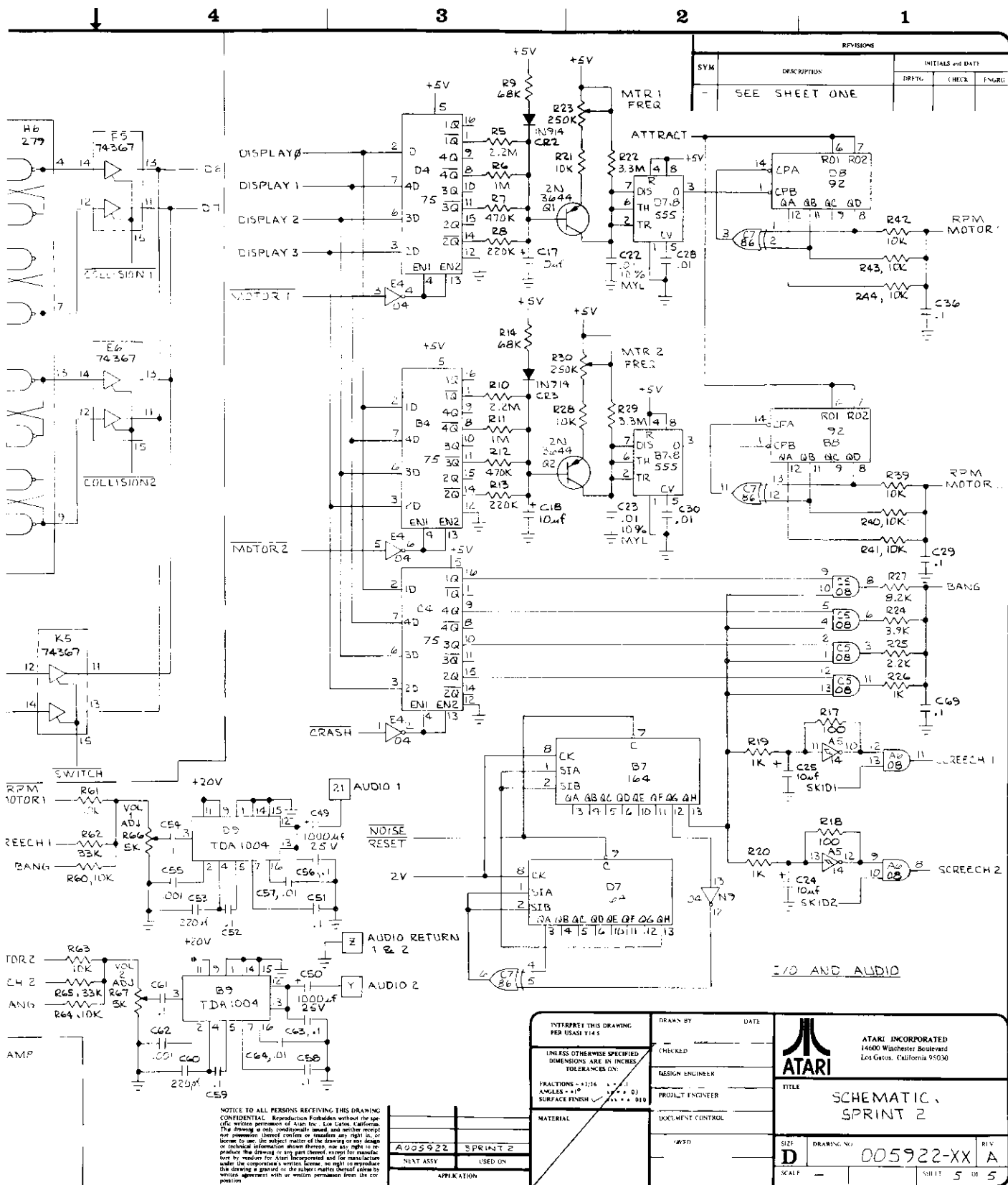
350

351











Job Title RACETRAK STEERING PCB ASSY

Dwg. P/L 000607

# Parts List Specification

sheet 1 of 1

Drawn

Checked

Mech. Eng.

Rev.

Proj. Eng.

Elec. Eng.

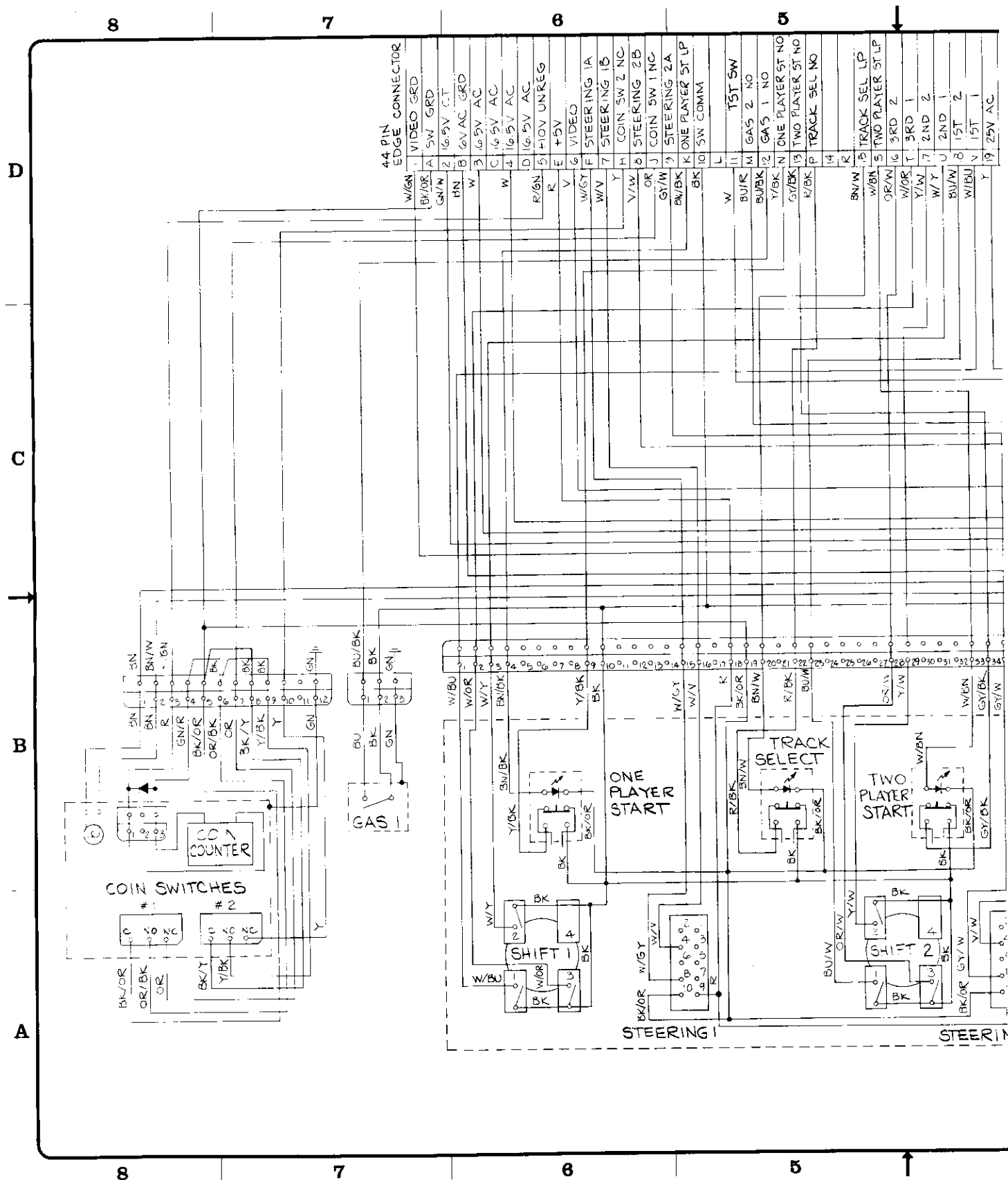
MF

M

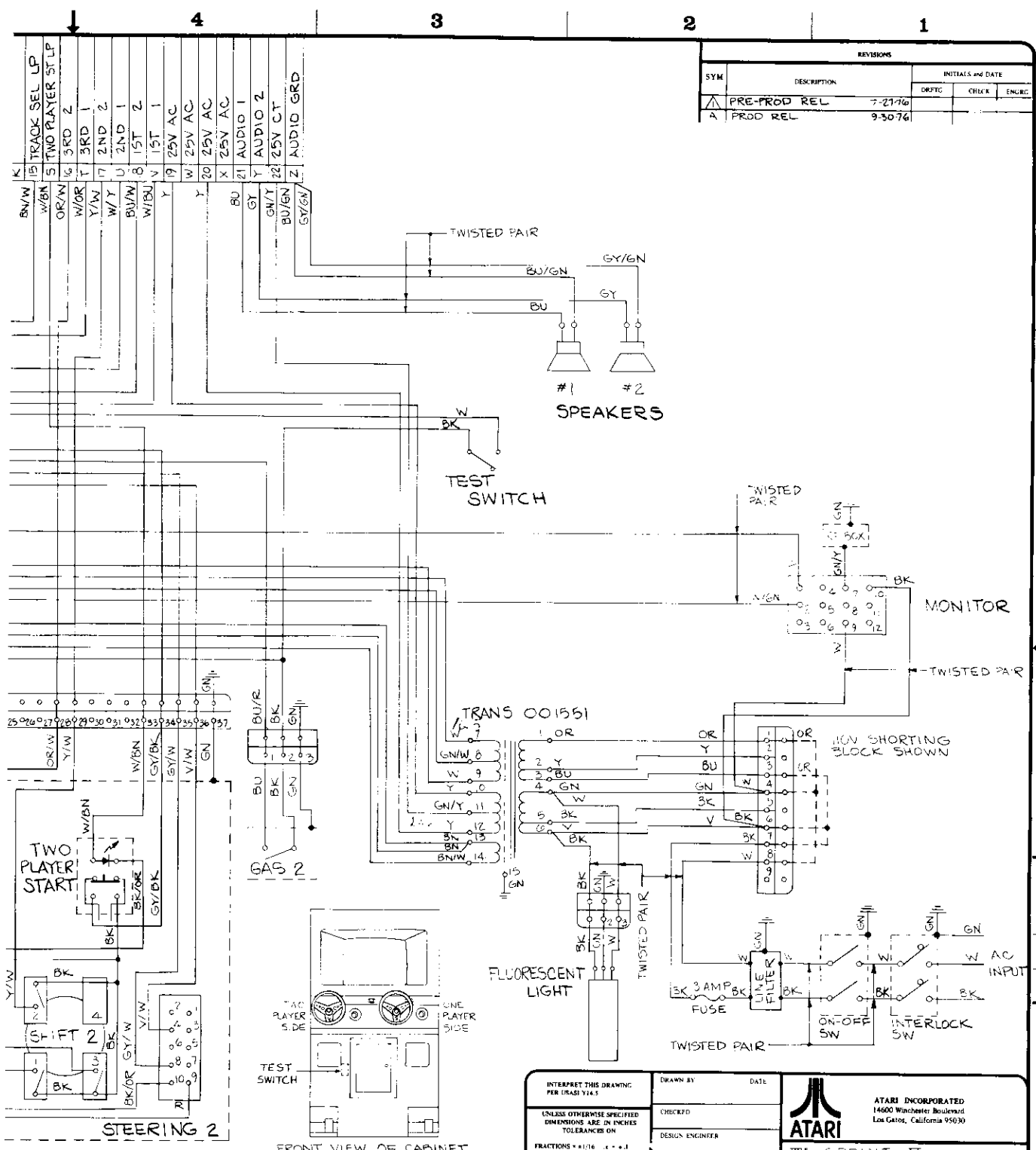
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H	Redesigned				
J	Rev per ECN 397				
K	Rev per ECN 457				
L	Rev per ECN 601				
M	Rev per ECN 1531				

Item	Part. No.	Qty.	Description
1	000614	1	Printed Circuit Board (E)
2	001092	1	Light Mount
3	001151	Ref	Schematic Diagram
4	11750/10-5750	2	Resistor, Comp., 75 ohm, 1/4 watt, 5%
5	11471/10-5471	4	Resistor, Comp, 470 ohm, 1/4 watt, 5%
6	11332/10-5332	2	Resistor, Comp, 3.3Kohm, 1/4 watt, 5%
7	34104 /27-101103	2	Capacitor, Ceramic, .01uf
8	70006/38-2N5777	2	Transistor, 2N 5777 (Photo Darlington)
9	70000/34-2N3643	2	Transistor, 2N 3643
10	71008/38-ME7124	2	Light Emitting Diode, I.R. ME 7124
11			
12			
13			
14	80089 /79-58005	1	Connector, 10 pin, PC Mount, Amp #1-380991
15	72-1212S	1	Screw, Machine, Pan Head Phil, #2-56 x 3/4 Lg.
16	75-042	1	Washer, Split Lock #2
17	75-912S	1	Nut, Hex, #2-56
18	003749	1	Retainer, Led Light Mount





REVISIONS			
SYM	DESCRIPTION	INITIALS AND DATE	
		DRAFT	CHECK
PRE-PROD REL	7-27-76		
A	PROD REL	9-30-76	



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A006205-01	A006205-01
NEXT ASSY	USED ON
APPLICATION	

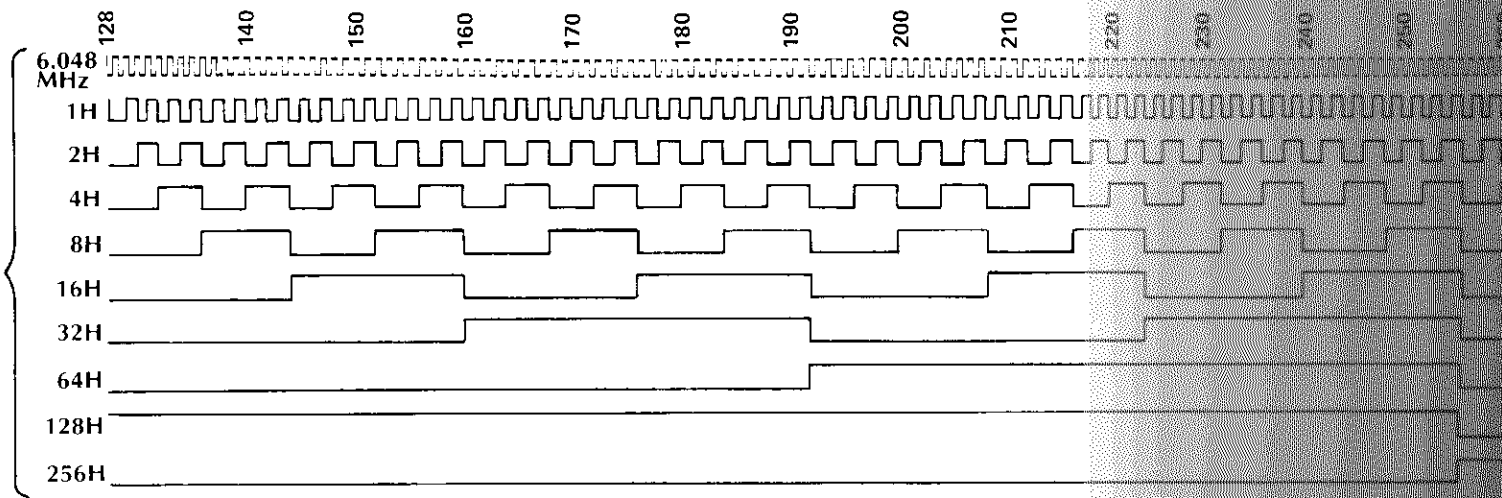
INTERPRET THIS DRAWING PER (RASI) 114.5	DRAWN BY	DATE	 <b>ATARI</b> ATARI INCORPORATED 14600 Winchester Boulevard Los Gatos, California 95030
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON	CHECKED		
FRACTIONS 1/16 1/8 1/4 3/8 1/2 5/8 3/4 7/8 1 1 1/2 2 3 4 5 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112 114 116 118 120 122 124 126 128 130 132 134 136 138 140 142 144 146 148 150 152 154 156 158 160 162 164 166 168 170 172 174 176 178 180 182 184 186 188 190 192 194 196 198 200 202 204 206 208 210 212 214 216 218 220 222 224 226 228 230 232 234 236 238 240 242 244 246 248 250 252 254 256 258 260 262 264 266 268 270 272 274 276 278 280 282 284 286 288 290 292 294 296 298 300 302 304 306 308 310 312 314 316 318 320 322 324 326 328 330 332 334 336 338 340 342 344 346 348 350 352 354 356 358 360 362 364 366 368 370 372 374 376 378 380 382 384 386 388 390 392 394 396 398 400 402 404 406 408 410 412 414 416 418 420 422 424 426 428 430 432 434 436 438 440 442 444 446 448 450 452 454 456 458 460 462 464 466 468 470 472 474 476 478 480 482 484 486 488 490 492 494 496 498 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1800 1802 1804 1806 1808 1810 1812 1814 1816 1818 1820 1822 1824 1826 1828 1830 1832 1834 1836 1838 1840 1842 1844 1846 1848 1850 1852 1854 1856 1858 1860 1862 1864 1866 1868 1870 1872 1874 1876 1878 1880 1882 1884 1886 1888 1890 1892 1894 1896 1898 1900 1902 1904 1906 1908 1910 1912 1914 1916 1918 1920 1922 1924 1926 1928 1930 1932 1934 1936 1938 1940 1942 1944 1946 1948 1950 1952 1954 1956 1958 1960 1962 1964 1966 1968 1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022 2024 2026 2028 2030 2032 2034 2036 2038 2040 2042 2044 2046 2048 2050 2052 2054 2056 2058 2060 2062 2064 2066 2068 2070 2072 2074 2076 2078 2080 2082 2084 2086 2088 2090 2092 2094 2096 2098 2100 2102 2104 2106 2108 2110 2112 2114 2116 2118 2120 2122 2124 2126 2128 2130 2132 2134 2136 2138 2140 2142 2144 2146 2148 2150 2152 2154 2156 2158 2160 2162 2164 2166 2168 2170 2172 2174 2176 2178 2180 2182 2184 2186 2188 2190 2192 2194 2196 2198 2200 2202 2204 2206 2208 2210 2212 2214 2216 2218 2220 2222 2224 2226 2228 2230 2232 2234 2236 2238 2240 2242 2244 2246 2248 2250 2252 2254 2256 2258 2260 2262 2264 2266 2268 2270 2272 2274 2276 2278 2280 2282 2284 2286 2288 2290 2292 2294 2296 2298 2300 2302 2304 2306 2308 2310 2312 2314 2316 2318 2320 2322 2324 2326 2328 2330 2332 2334 2336 2338 2340 2342 2344 2346 2348 2350 2352 2354 2356 2358 2360 2362 2364 2366 2368 2370 2372 2374 2376 2378 2380 2382 2384 2386 2388 2390 2392 2394 2396 2398 2400 2402 2404 2406 2408 2410 2412 2414 2416 2418 2420 2422 2424 2426 2428 2430 2432 2434 2436 2438 2440 2442 2444 2446 2448 2450 2452 2454 2456 2458 2460 2462 2464 2466 2468 2470 2472 2474 2476 2478 2480 2482 2484 2486 2488 2490 2492 2494 2496 2498 2500 2502 2504 2506 2508 2510 2512 2514 2516 2518 2520 2522 2524 2526 2528 2530 2532 2534 2536 2538 2540 2542 2544 2546 2548 2550 2552 2554 2556 2558 2560 2562 2564 2566 2568 2570 2572 2574 2576 2578 2580 2582 2584 2586 2588 2590 2592 2594 2596 2598 2600 2602 2604 2606 2608 2610 2612 2614 2616 2618 2620 2622 2624 2626 2628 2630 2632 2634 2636 2638 2640 2642 2644 2646 2648 2650 2652 2654 2656 2658 2660 2662 2664 2666 2668 2670 2672 2674 2676 2678 2680 2682 2684 2686 2688 2690 2692 2694 2696 2698 2700 2702 2704 2706 2708 2710 2712 2714 2716 2718 2720 2722 2724 2726 2728 2730 2732 2734 2736 2738 2740 2742 2744 2746 2748 2750 2752 2754 2756 2758 2760 2762 2764 2766 2768 2770 2772 2774 2776 2778 2780 2782 2784 2786 2788 2790 2792 2794 2796 2798 2800 2802 2804 2806 2808 2810 2812 2814 2816 2818 2820 2822 2824 2826 2828 2830 2832 2834 2836 2838 2840 2842 2844 2846 2848 2850 2852 2854 2856 2858 2860 2862 2864 2866 2868 2870 2872 2874 2876 2878 2880 2882 2884 2886 2888 2890 2892 2894 2896 2898 2900 2902 2904 2906 2908 2910 2912 2914 2916 2918 2920 2922 2924 2926 2928 2930 2932 2934 2936 2938 2940 2942 2944 2946 2948 2950 2952 2954 2956 2958 2960 2962 2964 2966 2968 2970 2972 2974 2976 2978 2980 2982 2984 2986 2988 2990 2992 2994 2996 2998 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OTES

from 128  
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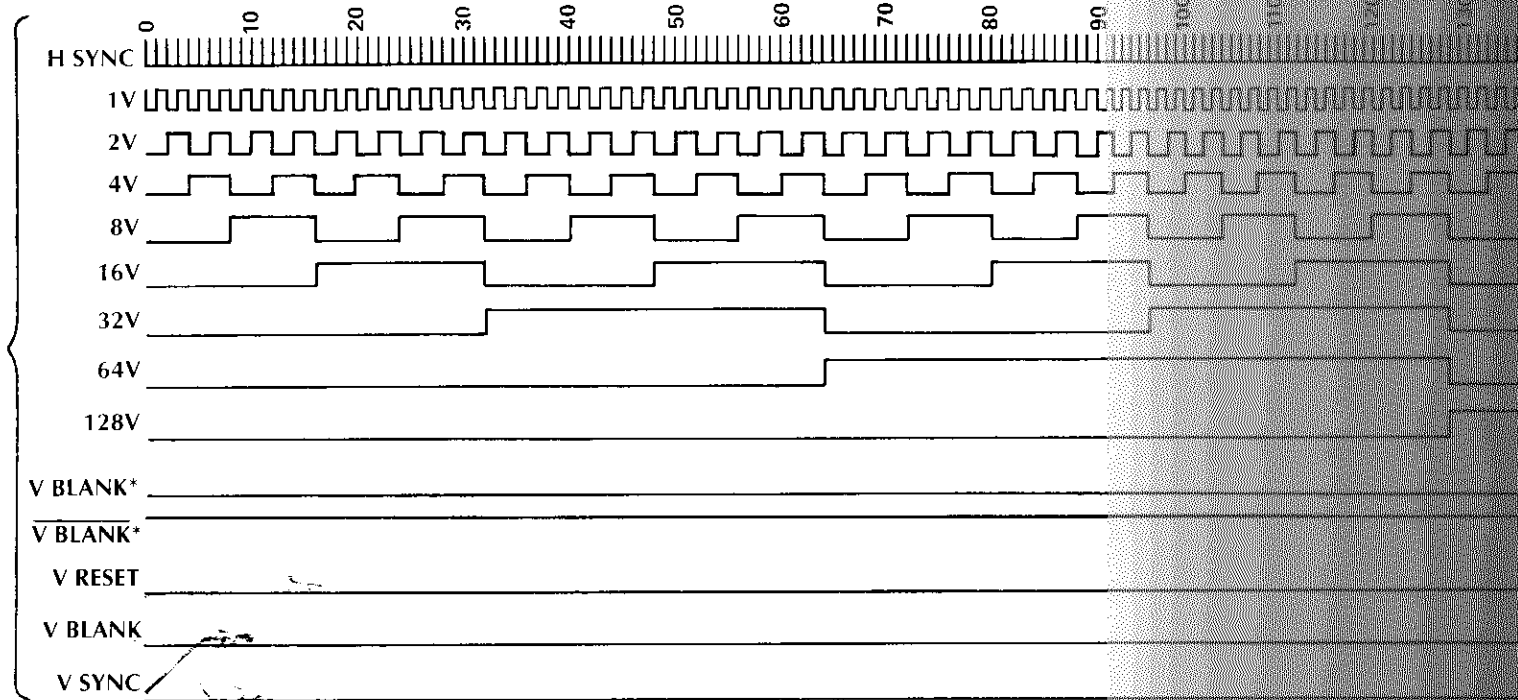
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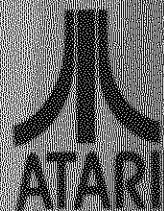
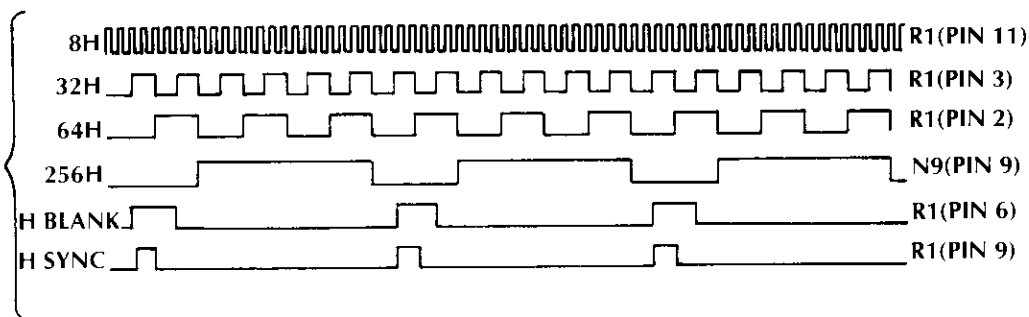
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D-Type



I BLANK

YNC sig-





### HORIZONTAL SYNCHRONIZATION NOTES

9-Bit Binary Counter R8, P8, and N8 counts from 128 to 512, then resets to 128. Results in the following:

$$\frac{6.048 \text{ MHz}}{512 - 128} = 15,750 \text{ Hz} = 256\text{H}$$

Pulse 128H high portion longer than low portion  
Pulse 256 high portion longer than low portion

### VERTICAL SYNCHRONIZATION NOTES

9-Bit Binary Counter R1, L3, and M3 counts from 0 to 262, then resets to 0 when V BLANK\* goes low. Results in the following:

$$\frac{15,750 \text{ Hz}}{262} = 60 \text{ Hz} = \text{V SYNC}$$

ROM M2 utilizes vertical inputs as follows:

1V	= 1V PROM input
2V	= 2V PROM input
4V	= 4V PROM input
8V	= 8V PROM input
16V	= 16V PROM input
64V	= 32V PROM input
128V	= 64V PROM input
V BLANK*	= 128V PROM input

ROM M2 programmed to provide signals to D-Type Flip-Flop N2 outputs as illustrated.

### H BLANK AND H SYNC NOTES

Inputs to D-Type Flip-Flop R1 results in H BLANK signal as illustrated.

Inputs to D-Type Flip-Flop R1 results in H SYNC signal as illustrated.

