CAR POLO

**EXIDY
SERVICE
MANUAL**

PART TWO
TECHNICAL DATA

TABLE OF CONTENTS

FIGURES

REMOVAL OF A PLASTIC STEERING CONTROL MODULE

PROCEDURE:

1. Disconnect game from AC power outlet.

2. Open coin door on control module side.

3. Unbolt the four (4) hex through bolts from the underside of the module.

4. Disconnect the harness from the module.

5. Lift the module out and up from the game cabinet.

TO REMOVE P.C.B.

1. Disconnect power to game.

2. Open door to blue car side of cabinet.

3. Remove cash box from blue car side.

4. Remove 2 hex 7/16 bolts located behind cleat at the back of the cash box compartment.

5. Slide foot box out of game. (NOTE: Foot pedal harness is still connected. Caution should be taken to protect this harness.)

6. Facing the P.C.B. mounted on the floor of the cabinet, remove the connectors from the board.

7. Pivot the two metal tabs that secure the P.C.B. in the slotted mount up and out away from the board.

8. Remove the P.C.B. from its mount by sliding it towards you.

REMOVAL OF THE MONITOR
(See Figure 14)

NOTE: Removal of the color monitor from the game cabinet is
accomplished by sliding the monitor out one end of the
cabinet on the wooden side rails. To gain clearance
for the monitor, the top glass bezel assembly and the
blue team plastic steering control module must be re-
moved from the cabinet.

PROCEDURE:

1. Disconnect game from AC power outlet.

2. Open the coin doors at both ends of the cabinet.

3. Remove the glass view plate parts: view plate frame (C),
   view plate gasket (D), glass view plate (E) and bezel (F),
   by unbolting eight (8) through bolts from the top of the
   cabinet.

4. Remove the plastic steering control module (G) from the blue
   team end of the cabinet by unbolting the four hex bolts
   located through the 2 x 2 end blocks under the control box.
   The harness to the module is disconnected and the module is
   lifted out and up from the cabinet.

5. Unbolt the metal monitor bracket and rack from the cabinet
   side rails by removing the two hex through bolts at either
   end of the cabinet rails.

6. Loosen the main harness from the side wall of the monitor on
   the blue team end of the cabinet.

7. Two persons can now slide the monitor out of the cabinet
   through the blue end side of the cabinet.

8. The monitor may be placed on its bottom or back for service.
   CAUTION: The CRT neck is in an exposed position and is pro-
   tected by the monitor rack only when the monitor is placed
   on a flat clean surface.

THEORY OF OPERATION (Figure 1)

CAR POLO is a microprocessor game capable of simultaneous control
of four cars, a ball and a special character (referee) on a color
television screen. In addition, there is a capability of writing
up to 256 alphanumeric characters on the screen.

The microprocessor used in CAR POLO is a MOS TECHNOLOGY 6502, 8
bit microprocessor. For more information on this processor,
refer to MOS TECHNOLOGY PUBLICATION # 6500-10A, MCS 6500 Micro-
computer Family Hardware Manual. It is an inherent characteristic
of this processor that it treats all periferals attached to it as
if they were memory. Therefore, all memory in this system has
been mapped. (See Figure 2, Memory Map). The only random access
memory assigned for use by the game program is the base page
(addresses 0000 - 00FF). The game program uses this memory for
storage of temporary data during the course of a game (example,
car horizontal position). In addition, 256 bytes of random access
memory (addresses 0100 - 01FF) are assigned to the processor for
use as a stack.

The CAR POLO program is just slightly less than four kilobytes
long and exists in prom from addresses F000 to FFC5. The top
eight addresses are used to store the interrupt and reset vectors.

The processor writes alphanumerics on the screen by writing them
into a random access memory at locations 3000 - 30FF. The video
display logic then reads the data out of that ram, converts it to
a video wave-train and displays it on the screen. The format for
an alphanumeric byte is:

MSB   LSB

7	6	5	4	3	2	1	0	Bit
ASCII Character						Color Select.	Function

The coding for the color is as follows:

	BIT	
WHITE	0	0
GREEN	0	1
BLUE	1	0
RED	1	1

Car, ball and special character horizontal and vertical positions
are controlled by writing them into the ram at addresses 4000 -
400F. The functions assigned to each ram location are:

```
4000      Player   1  Horizontal Position
4001      Player   1  Vertical Position
4002      Player   2  Horizontal Position
4003      Player   2  Vertical Position
4004      Player   3  Horizontal Position
4005      Player   3  Vertical Position
4006      Player   4  Horizontal Position
4007      Player   4  Vertical Position
4008      Ball Horizontal Position
4009      Ball Vertical Position
400A      Special Character Horizontal Position
400B      Special Character Vertical Position
400C      Players 1 & 2 Rotation
400D      Players 3 & 4 Rotation
400E      Ball Control Bits
400F      Special Character Bits
```

Once, at the beginning of each frame, the same logic halts the
processor, extracts the data from the position portion of the
ram and uses that data to preload the position counters. It
then loads the rotation data into the rotation ram to be used
in selection of the image to be displayed. The processor is
then allowed to run again.

To display an image the horizontal and vertical positions and the
rotation angle are multiplexed and combined to select the desired
line in the image prom. The data from the prom is then loaded
parallel into the shift register and shifted out serially at the
instant when the image is to appear on the screen.

All of the images, including alphanumerics, are prioritized and
converted into RGB color signals in the video generation circuit-
ry, where, along with combined cync, they are sent to the color
television to be displayed.

The processor detects collisions on the screen by the use of
interrupts. The outputs of the shift registers are anded to-
gether in the interrupt detection and conditioning circuitry.
If this circuitry detects two or more objects in the same place
on the screen at the same time, (example: a car and a car
collision) it sends out a pulse which interrupts the processor.
The processor, at this time, knows that something has occurred,
but doesn't know what. By reading memory location C000, it
receives an eight bit word telling what type of interrupt it was.
It then reads the interrupt data from the following locations:

                    A000   Ball and Border Data

A000   Ball and Goal Data
        Ball and Score Zone Data

A001   Interrupting Car Horizontal Position

A002   Interrupting Car Vertical Position

A003   Which Car Interrupted

A004   Car and Border Data

A005   Car and Ball Data

A006   Car and Goal Data

A007   Game Time Switch Setting

After servicing the interrupt, the processor clears the interrupts
by writing into locations B000 to B007.

B000   Clear Ball and Goal Interrupt

B001   Clear Time Interrupt

B002   Not Used

B003   Clear Car and Car Interrupt

B004   Clear Car and Border Interrupt

B005   Clear Car and Ball Interrupt

B006   Clear Car and Goal Interrupt

Coin drops also generate an interrupt. Which player generated
the coin drop is determined by reading location C000.

The processor interfaces with the outside world with two peri-
pheral interface adaptors. These PIA's are wired to respond to
addresses 5400, 5402, 5800 and 5802. The data which is inter-
faced through these devices is:

PIA # 1 , A Side (5400)

    Bit 0   Coin Counter Output
    Bit 1   Player 4 Crash (to Audio)

```
        Bit 2    Player 3 Crash (to Audio)
        Bit 3    Clear Steering Wheel Logic
        Bit 4    Player 2 Crash (to Audio)
        Bit 5    Score Pulse (to Audio)
        Bit 6    Player 1 Crash (to Audio)
        Bit 7    Ball Hit Pulse (to Audio)

PIA # 1, B Side (5402)

        Bit 0    Strobe Speed Bits Out (to Audio)
        Bit 1    Speed Bit 0 Out (to Audio)
        Bit 2    Speed Bit 1 Out (to Audio)
        Bit 3    Speed Bit 2 Out (to Audio)
        Bit 4    Speed Bit 0 In (From Foot Pedals)
        Bit 5    Speed Bit 1 In (From Foot Pedals)
        Bit 6    Select Foot Pedal Assembly Output 0
        Bit 7    Select Foot Pedal Assembly Output 1

PIA # 2, A Side (5800)

        Bit 0    Player 4    Steering Input (Left or Right)
        Bit 1    Player 3    Steering Input (Left or Right)
        Bit 2    Player 2    Steering Input (Left or Right)
        Bit 3    Player 1    Steering Input (Left or Right)
        Bit 4    Player 4    Forward/Reverse Input
        Bit 5    Player 3    Forward/Reverse Input
        Bit 6    Player 2    Forward/Reverse Input
        Bit 7    Player 1    Forward/Reverse Input

PIA # 1, B Side (5802)

        Bit 0    Player 4    Active Output (to Audio)
        Bit 1    Player 3    Active Output (to Audio)
        Bit 2    Player 2    Active Output (to Audio)
        Bit 3    Player 1    Active Output (to Audio)
        Bit 4    Player 4    Steering Input (Wheel Moving)
        Bit 5    Player 3    Steering Input (Wheel Moving)
        Bit 6    Player 2    Steering Input (Wheel Moving)
        Bit 7    Player 1    Steering Input (Wheel Moving)
```
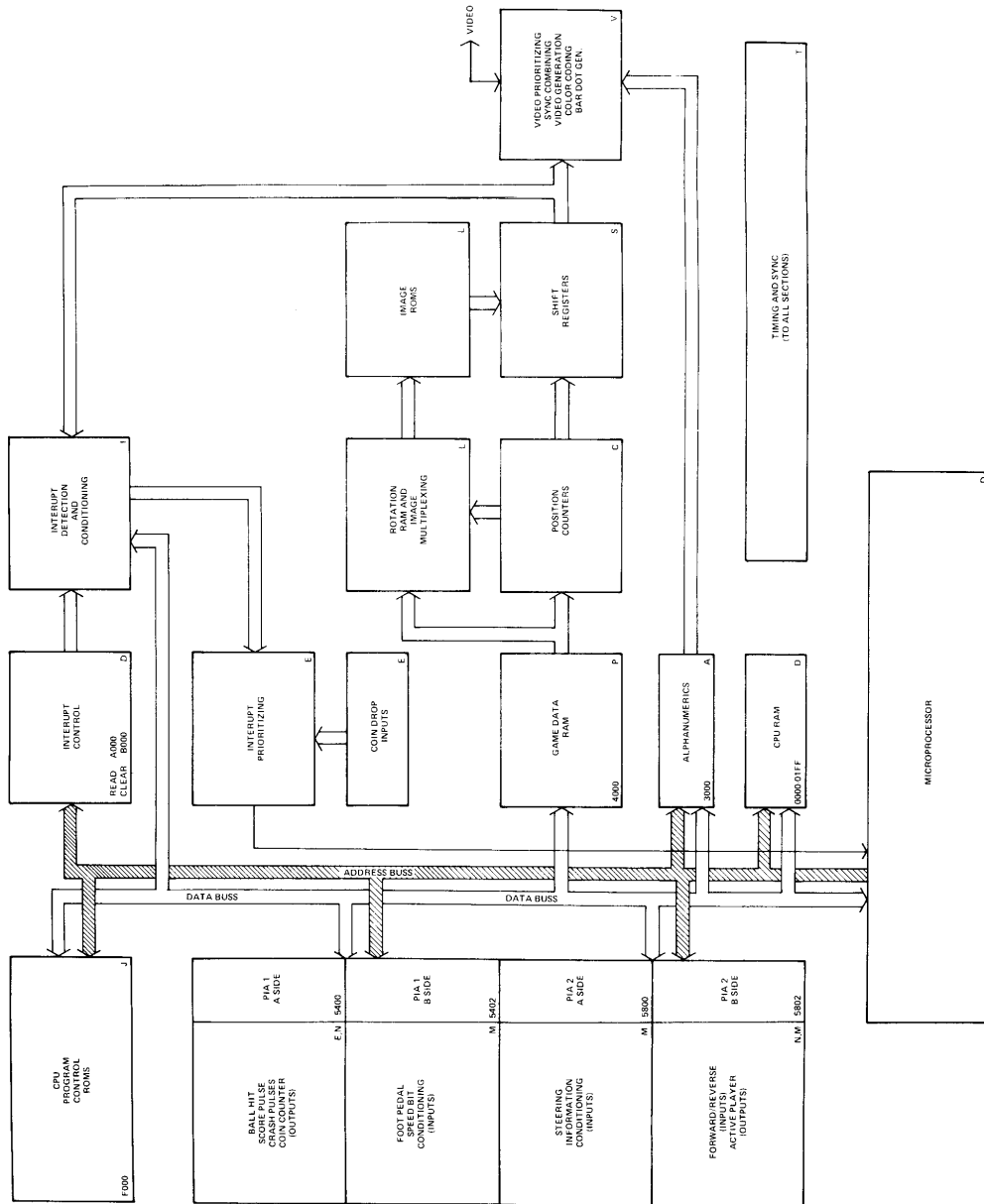
FIGURE 13. LOGIC BOARD BLOCK DIAGRAM

FFFF	FFF8 - FFFF Interrupt Vectors
F000	F000 - FFC8 Game Program
EFFF	
E000	Not Used
DFFF	
D000	Not Used
CFFF	
C000	C000 Read Interrupt Vector
BFFF	
B000	B000 - B00F = Clear Interrupt Data
AFFF	
A000	A000 - A00F = Read Interrupt Data
9FFF	
9000	Not Used
8FFF	
8000	Not Used
7FFF	
7000	Not Used
6FFF	
6000	Not Used
5FFF	
5000	5800 = PIA2A 5802 = PIA2B
4FFF	5400 = PIA1A 5402 = PIA1B
4000	4000 - 400F Game Data
3FFF	
3000	3000 - 30FF Alphanumerics
2FFF	
2000	Not Used
1FFF	
1000	Not Used
0FFF	
0000	0100 - 01FF = Stack
	0000 - 00FF = Base Page

CAR POLO

SCHEMATIC

DIAGRAMS

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10

DEVICE TYPE

LOCATION ON PC BOARD

PIN NUMBER

74

8C

LOCATION (MAY APPEAR BELOW SYMBOL)

2T

Ø4

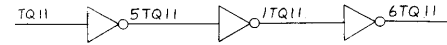**DEVICE TYPE** (ALL ZEROS ARE CANCELLED "Ø")

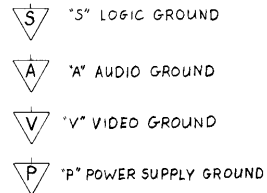1.2K — RESISTOR VALUE

R3 — COMPONENT NUMBER
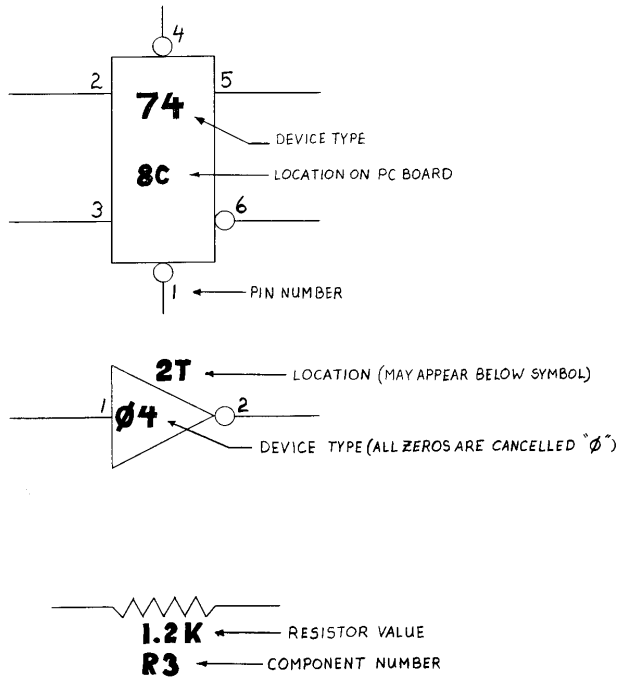
NOTES:

1. ALL DEVICES EXCEPT FOR; 533, 8T95, 8T28, 2111, 6331, 652Ø, 21Ø1, LM 38Ø, RØ3 2513, 334Ø, AND NE566 ARE 7400 SERIES TTL, THE 74 PREFIX DOES NOT APPEAR IN THE SCHEMATC DRAWINGS.

2. CLOCK SIGNALS:

TQ11 — 5TQ11 — 1TQ11 — 6TQ11

5TQ11
— FREQUENCEY OF CLOCK
— DESIGNTES SIGNAL AS CLOCK
— ORIGINATING PAGE
— INDICATES PHASE OF CLOCK, ORIGINAL CLOCK WILL BE LABLED AS TQ--, THE FIRST INVERTION WILL BE 5TQ--, THE SECOND WILL BE 1TQ--, SO THAT IN PHASE CLOCKS WILL 1, 2, 3, ETC., AND CLOCKS 180° OUT OF PHASE WILL BE 5, 6, 7, ETC.
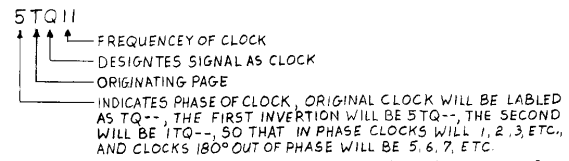
3. GROUND SYMBOLS, THERE ARE FOUR SYMBOLS USED IN CAR POLO;

S — "S" LOGIC GROUND

A — "A" AUDIO GROUND

V — "V" VIDEO GROUND

P — "P" POWER SUPPLY GROUND

4. LETTERS THAT APPEAR BETWEEN BRACKETS, ⟨ ⟩, DENOTE TO WHICH PAGES THAT SIGNAL GOES. HENCE A SIGNAL THAT APPEARS THUS :,

TSCB ⟨AIJP⟩
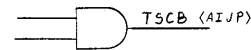
WOULD GO TO THE A, I, J, AND P PAGES. SIGNALS THAT ORIGNATE AND TERMINATE ON THE SAME PAGE.

CARPOLO
ALPHA NUMERIC DISPLAY:
8 LINES OF 32 EACH AND COLOR
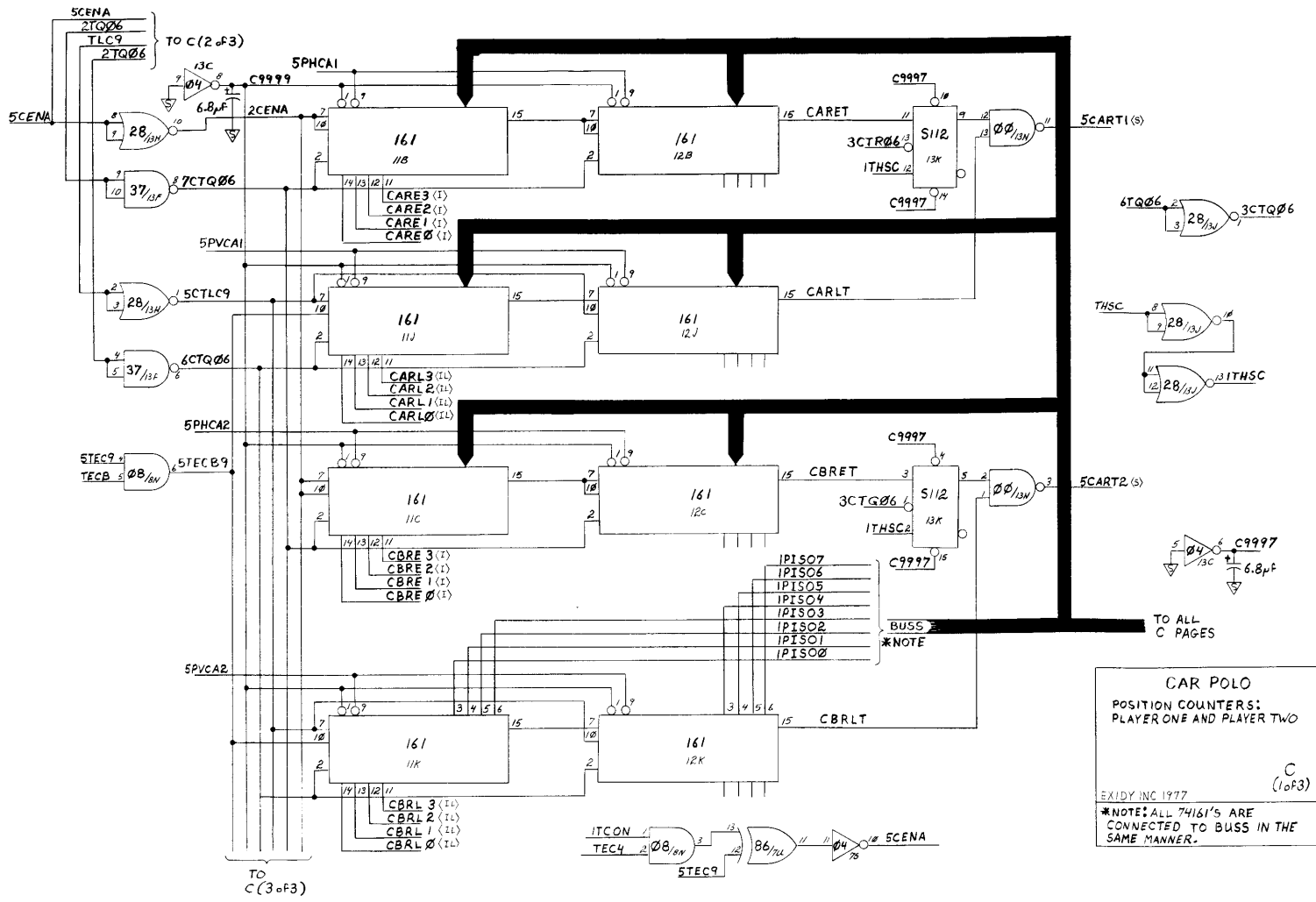
EXIDY INC 1977   A.

CAR POLO

POSITION COUNTERS:
PLAYER ONE AND PLAYER TWO

C
(1 of 3)

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*NOTE: ALL 74161'S ARE
CONNECTED TO BUSS IN THE
SAME MANNER.

CAR POLO

POSITION COUNTERS:
PLAYER THREE AND
PLAYER FOUR

EXIDY INC 1977

C
(2 of 3)

*NOTE: ALL 74161'S ARE
CONNECTED AS ARE ON BOTTOM
OF PAGE
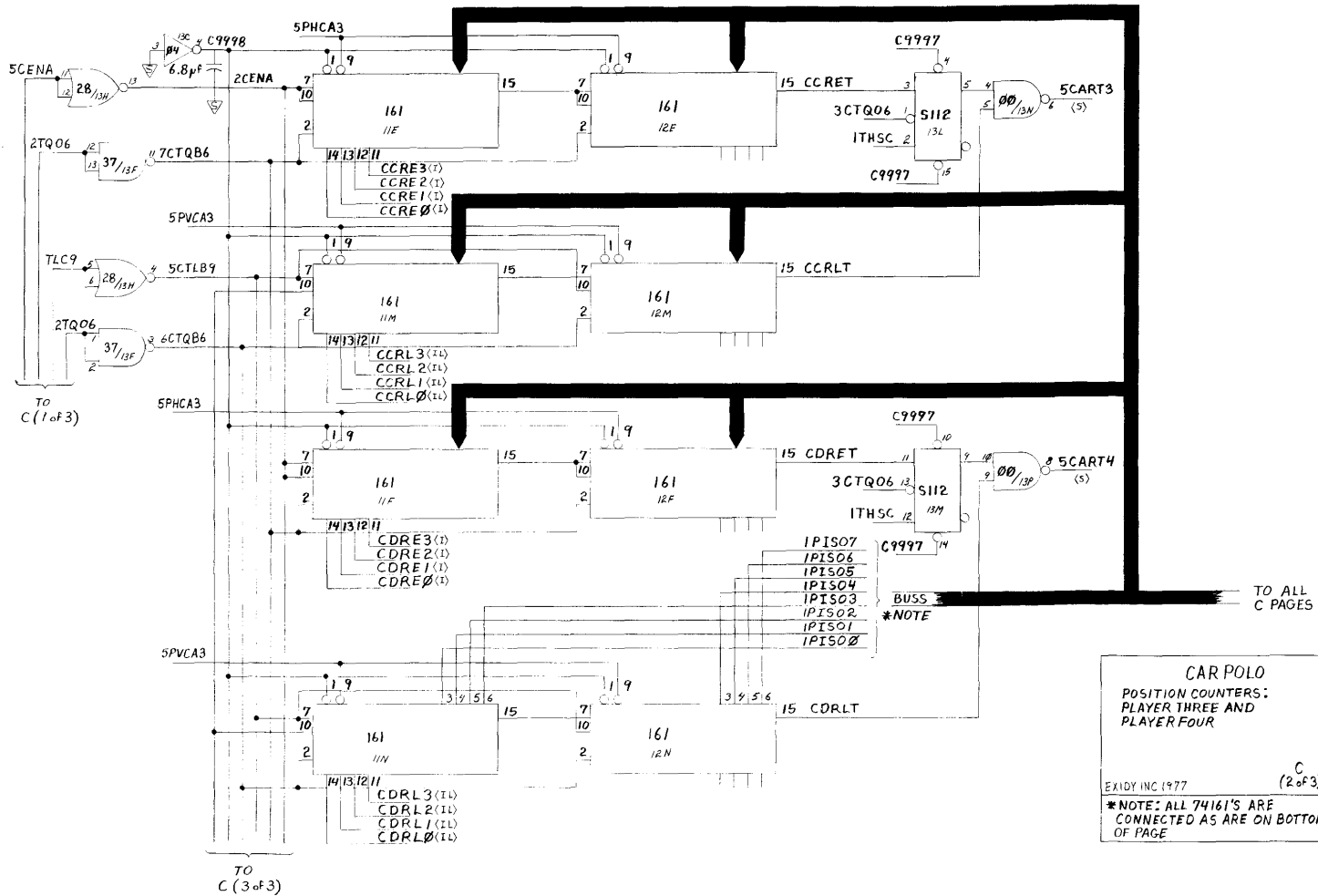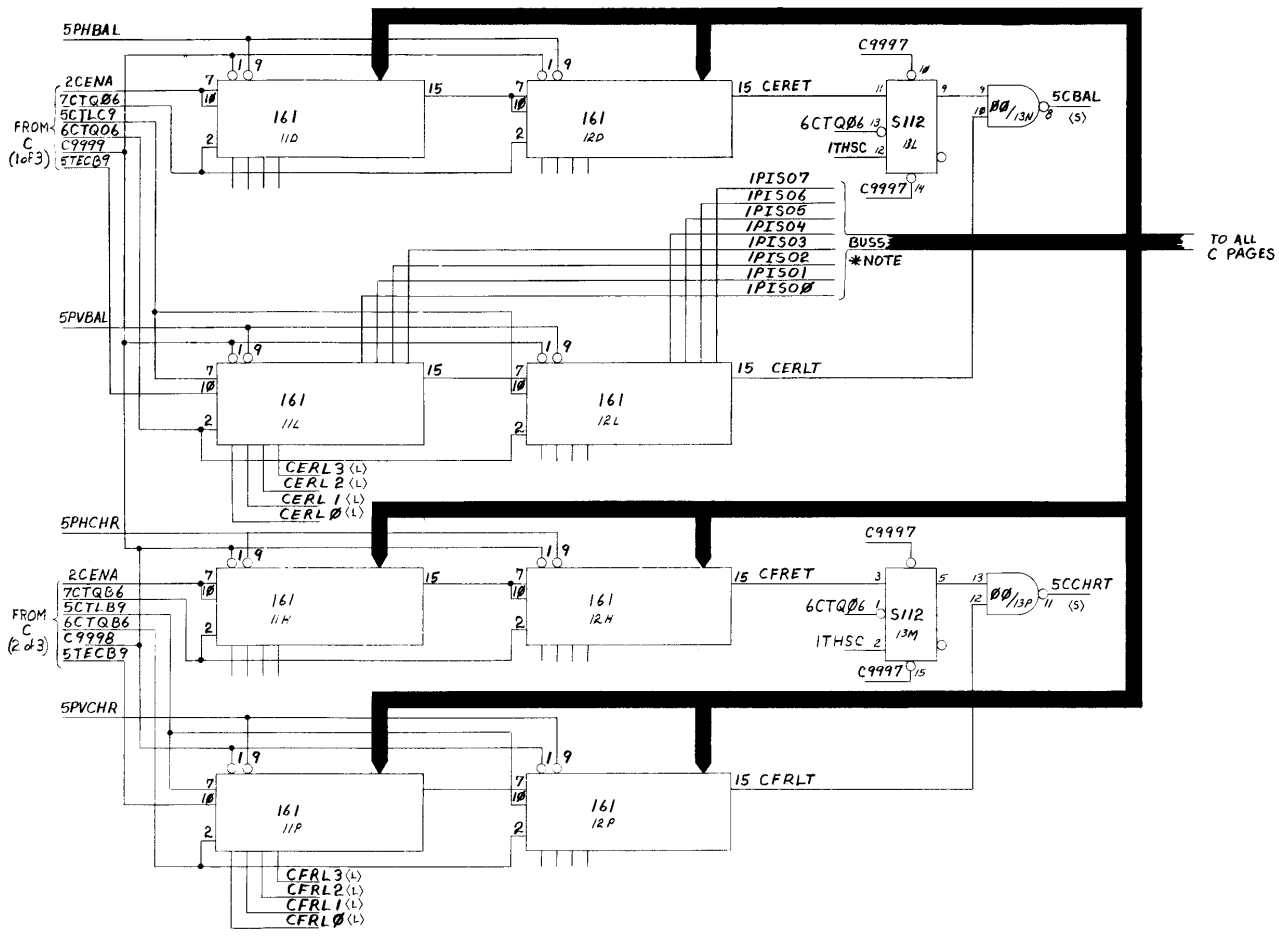
CAR POLO
POSITION COUNTERS:
BALL AND CHARACTER

EXIDY INC 1977

C
(3 of 3)

*NOTE: ALL 74161'S ARE
CONNECTED TO BUSS
THE SAME.

CAR POLO
1. PROCESSOR
2. PIA'S
3. ADDRESS DECODING

D.

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15

CAR POLO
1. COIN DROP LATCHES
2. COIN DROP COUNTER
3. INTERUPT PRIORITIES
4. TIME INTERUPT

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E

*NOTE: DIP SWITCH
**NOTE: R 2,3,4,5,6, AND R7
ARE 1.2K

CAR POLO
1. CAR + CAR
2. CAR + BALL
3. CAR + BORDER
4. CAR + GOAL
5. BALL + BORDER
6. BALL + GOAL
7. BALL + SCORE

I.

6C — 6341 74S-474

Left	Pin		Pin	Right
DADD 8	23		17	DATA 7
DADD 7	1		16	DATA 6
DADD 6	2		15	DATA 5
DADD 5	3		14	DATA 4
DADD 4	4		13	DATA 3
DADD 3	5		11	DATA 2
DADD 2	6		10	DATA 1
DADD 1	7		9	DATA 0
DADD 0	8			
5DCDF	21			
DADD 11	20			
5DADD10	19			
5DADD9	18			

6D — 6341 74S-474

Left	Pin		Pin	Right
DADD 8	23		17	DATA 7
DADD 7	1		16	DATA 6
DADD 6	2		15	DATA 5
DADD 5	3		14	DATA 4
DADD 4	4		13	DATA 3
DADD 3	5		11	DATA 2
DADD 2	6		10	DATA 1
DADD 1	7		9	DATA 0
DADD 0	8			
5DCDF	21			
DADD 11	20			
5DADD10	19			
DADD9	18			

6E — 6341 74S-474

Left	Pin		Pin	Right
DADD 8	23		17	DATA 7
DADD 7	1		16	DATA 6
DADD 6	2		15	DATA 5
DADD 5	3		14	DATA 4
DADD 4	4		13	DATA 3
DADD 3	5		11	DATA 2
DADD 2	6		10	DATA 1
DADD 1	7		9	DATA 0
DADD 0	8			
5DCDF	21			
DADD 11	20			
DADD10	19			
5DADD9	18			

6F — 6341 74S-474

Left	Pin		Pin	Right
DADD 8	23		17	DATA 7
DADD 7	1		16	DATA 6
DADD 6	2		15	DATA 5
DADD 5	3		14	DATA 4
DADD 4	4		13	DATA 3
DADD 3	5		11	DATA 2
DADD 2	6		10	DATA 1
DADD 1	7		9	DATA 0
DADD 0	8			
5DCDF	21			
DADD 11	20			
DADD10	19			
DADD9	18			

6H — 6341 74S-474

Left	Pin		Pin	Right
DADD 8	23		17	DATA 7
DADD 7	1		16	DATA 6
DADD 6	2		15	DATA 5
DADD 5	3		14	DATA 4
DADD 4	4		13	DATA 3
DADD 3	5		11	DATA 2
DADD 2	6		10	DATA 1
DADD 1	7		9	DATA 0
DADD 0	8			
5DCDF	21			
5DADD11	20			
5DADD10	19			
5DADD9	18			

6K — 6341 74S-474

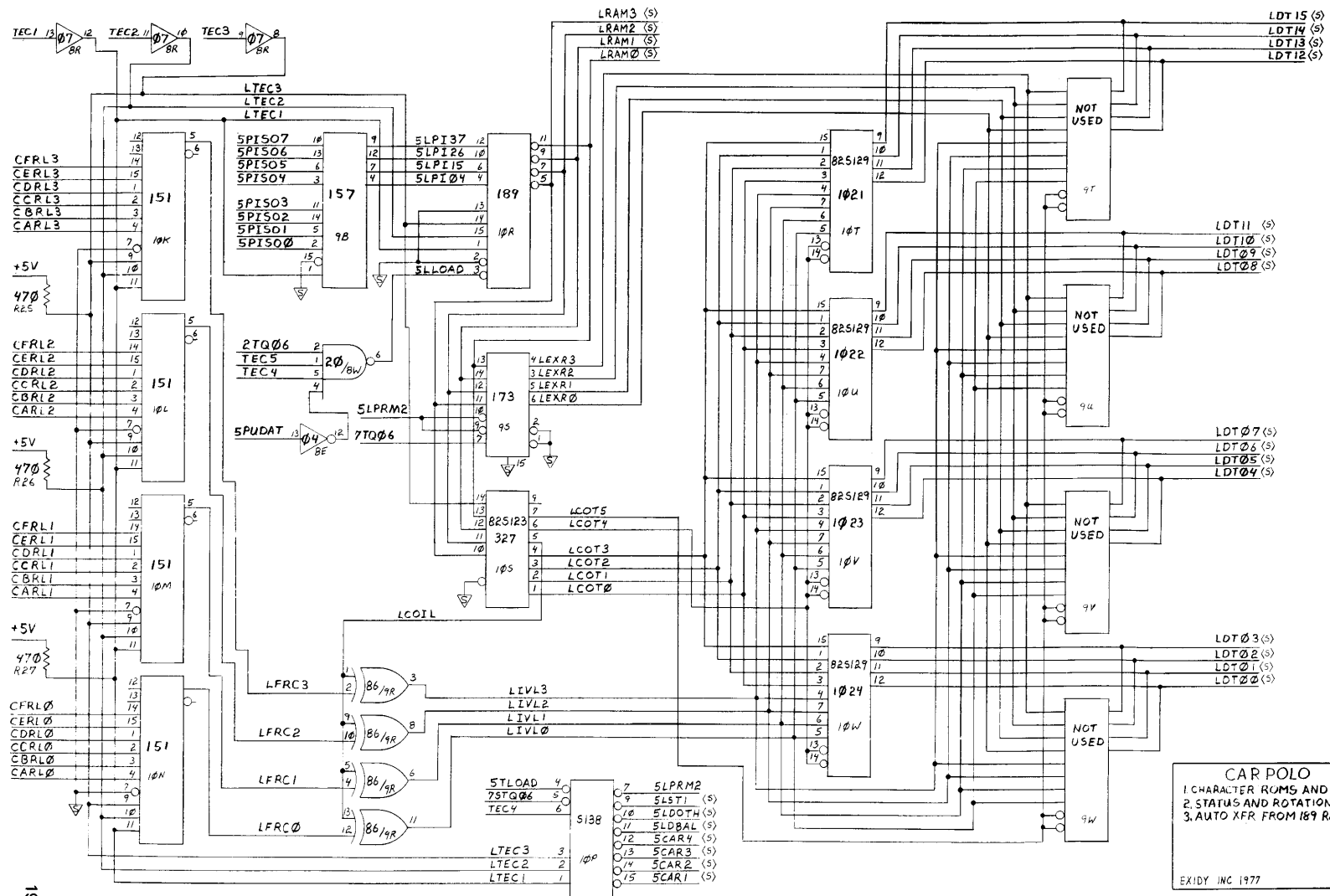| Left	Pin		Pin	Right
DADD 8	23		17	DATA 7
DADD 7	1		16	DATA 6
DADD 6	2		15	DATA 5
DADD 5	3		14	DATA 4
DADD 4	4		13	DATA 3
DADD 3	5		11	DATA 2
DADD 2	6		10	DATA 1
DADD 1	7		9	DATA 0
DADD 0	8			
5DCDF	21			
5DADD11	20			
5DADD10	19			
DADD9	18			

6L — 6341 74S-474

Left	Pin		Pin	Right
DADD 8	23		17	DATA 7
DADD 7	1		16	DATA 6
DADD 6	2		15	DATA 5
DADD 5	3		14	DATA 4
DADD 4	4		13	DATA 3
DADD 3	5		11	DATA 2
DADD 2	6		10	DATA 1
DADD 1	7		9	DATA 0
DADD 0	8			
5DCDF	21			
5DADD11	20			
DADD10	19			
5DADD9	18			

6N — 6341 74S-474

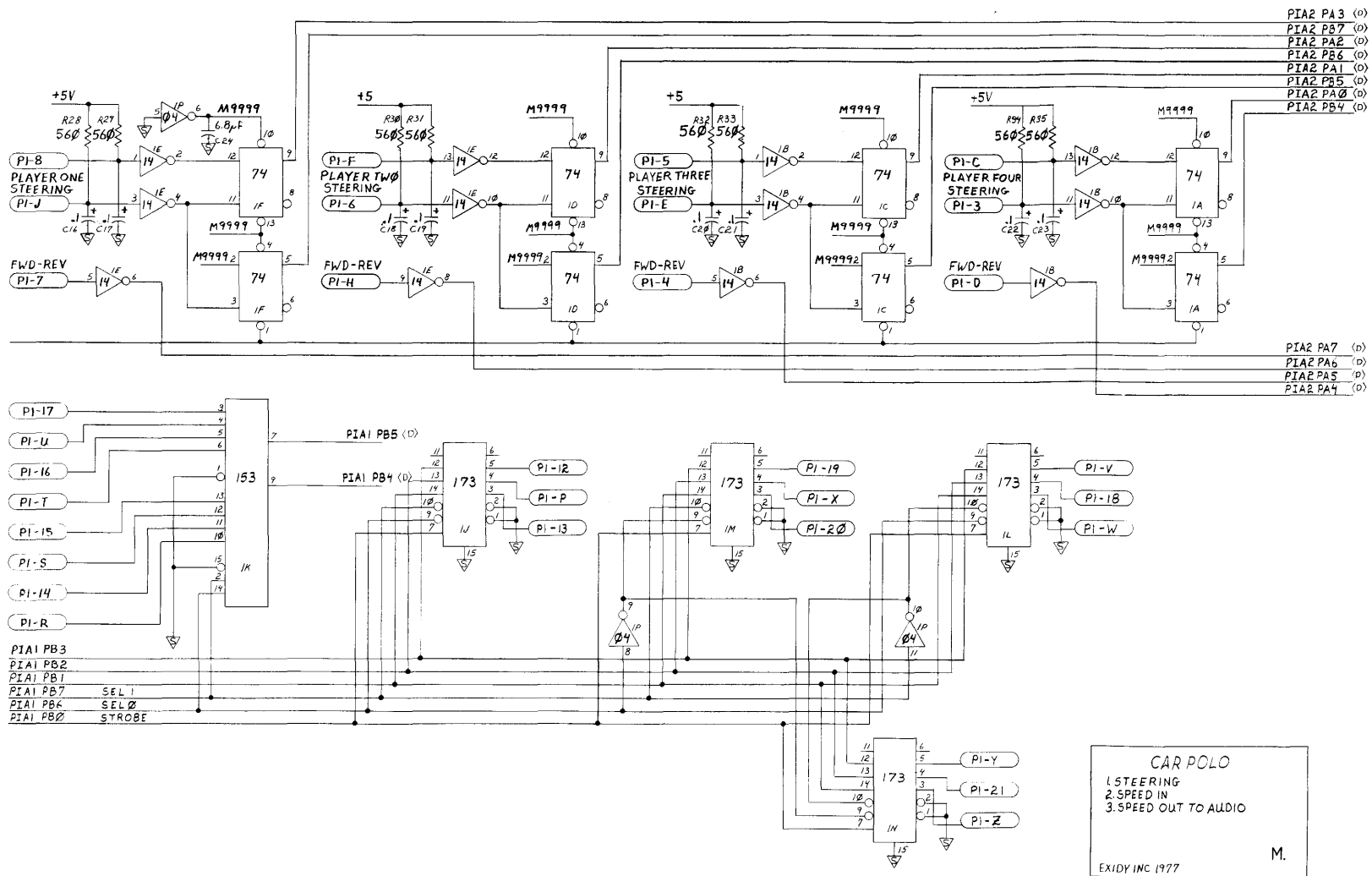| Left	Pin		Pin	Right
DADD 8	23		17	DATA 7
DADD 7	1		16	DATA 6
DADD 6	2		15	DATA 5
DADD 5	3		14	DATA 4
DADD 4	4		13	DATA 3
DADD 3	5		11	DATA 2
DADD 2	6		10	DATA 1
DADD 1	7		9	DATA 0
DADD 0	8			
5DCDF	21			
5DADD11	20			
DADD10	19			
DADD9	18			

DADD11 1 — 8L 04 — 2 5DADD 11

DADD10 3 — 8L 04 — 4 5DADD10
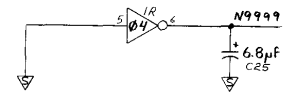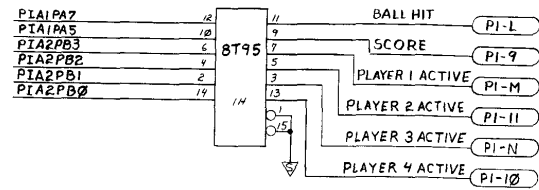
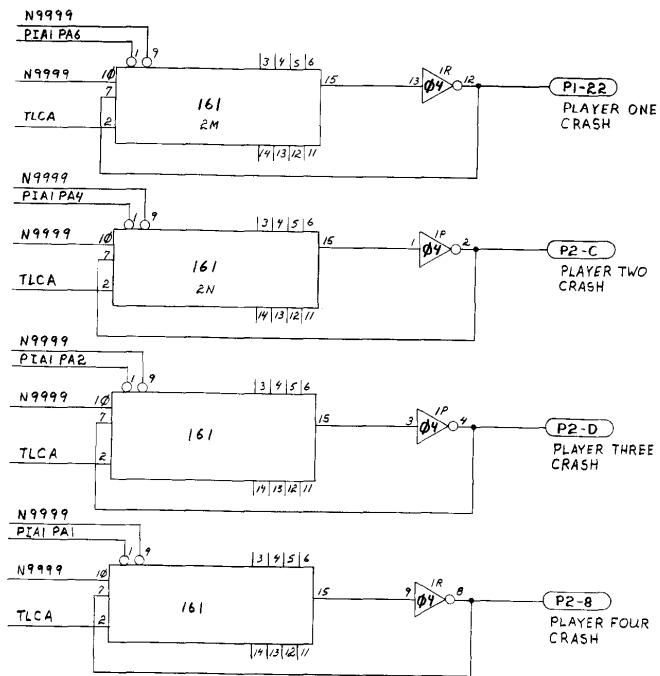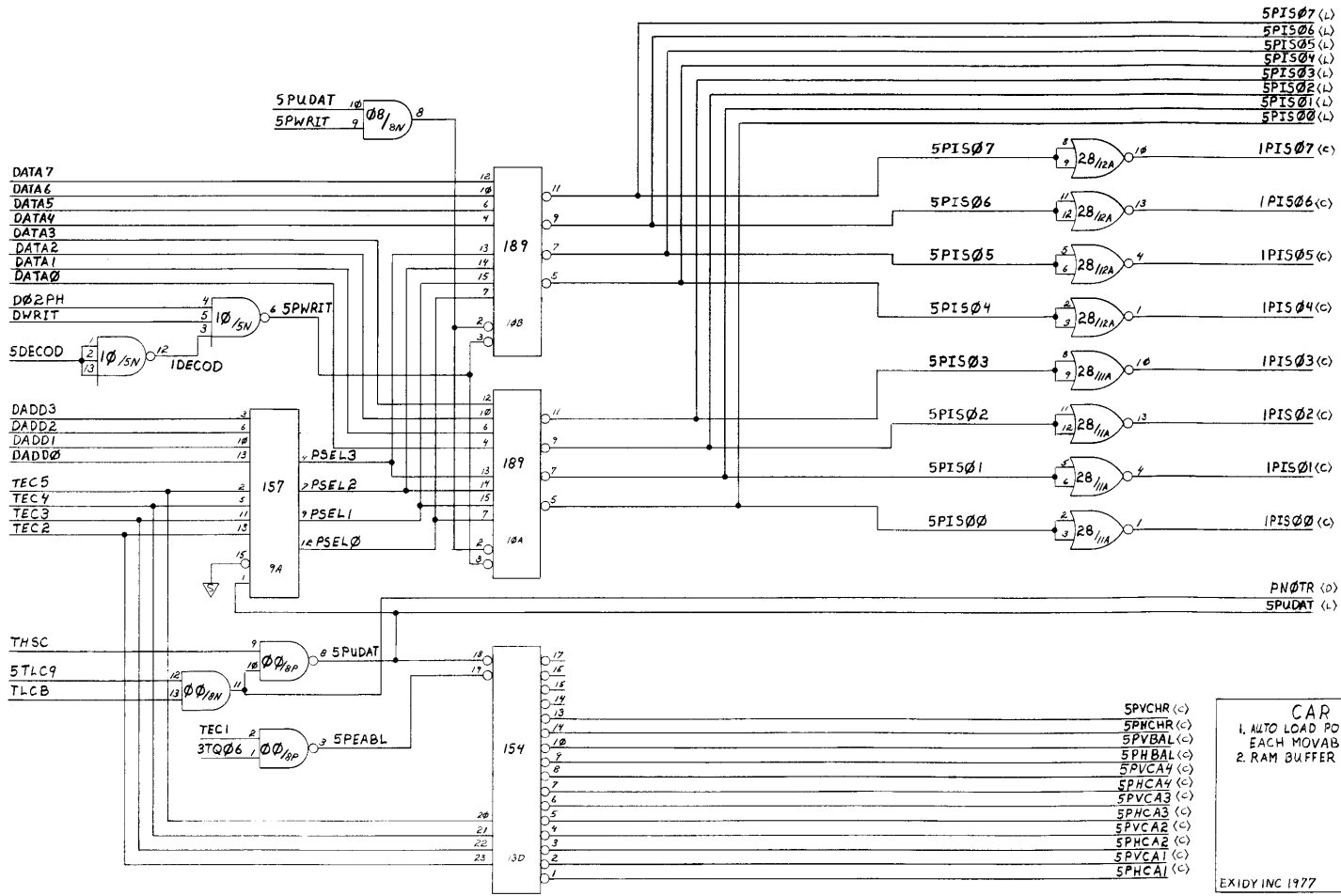DADD9 5 — 8L 04 — 6 5DADD9

CAR POLO

MEMORY

J

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CAR POLO
1. CHARACTER ROMS AND MPXING
2. STATUS AND ROTATION
3. AUTO XFR FROM 189 RAMS

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L

CAR POLO

1. STEERING
2. SPEED IN
3. SPEED OUT TO AUDIO

M.

EXIDY INC 1977

N9999
PIAI PA6
N9999
TLCA
161
2M
3 4 5 6
15
13 1R 04 12
P1-22
PLAYER ONE CRASH
1 9
10
7
2
14 13 12 11

N9999
PIAI PA4
N9999
TLCA
161
2N
3 4 5 6
15
1 1P 04 2
P2-C
PLAYER TWO CRASH
1 9
10
7
2
14 13 12 11

N9999
PIAI PA2
N9999
TLCA
161
3 4 5 6
15
3 1P 04 4
P2-D
PLAYER THREE CRASH
1 9
10
7
2
14 13 12 11

N9999
PIAI PA1
N9999
TLCA
161
3 4 5 6
15
9 1R 04 8
P2-8
PLAYER FOUR CRASH
1 9
10
7
2
14 13 12 11

PIAIPA7   12
PIAIPA5   10
PIA2PB3   6
PIA2PB2   4
PIA2PB1   2
PIA2PBØ   14

8T95
1H

11   BALL HIT   P1-L
9   SCORE   P1-9
7
5   PLAYER 1 ACTIVE   P1-M
3
13   PLAYER 2 ACTIVE   P1-11
      PLAYER 3 ACTIVE   P1-N
15
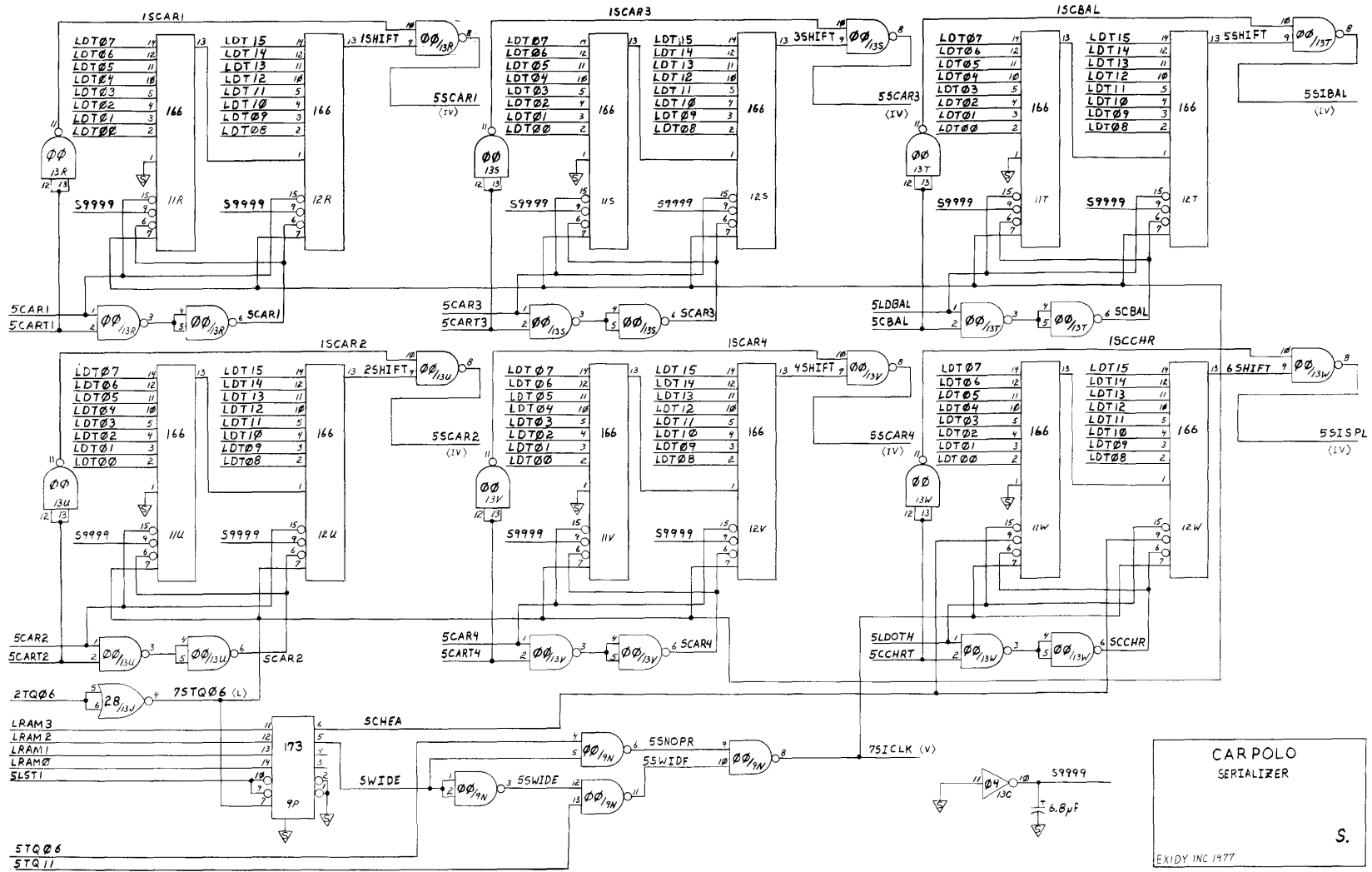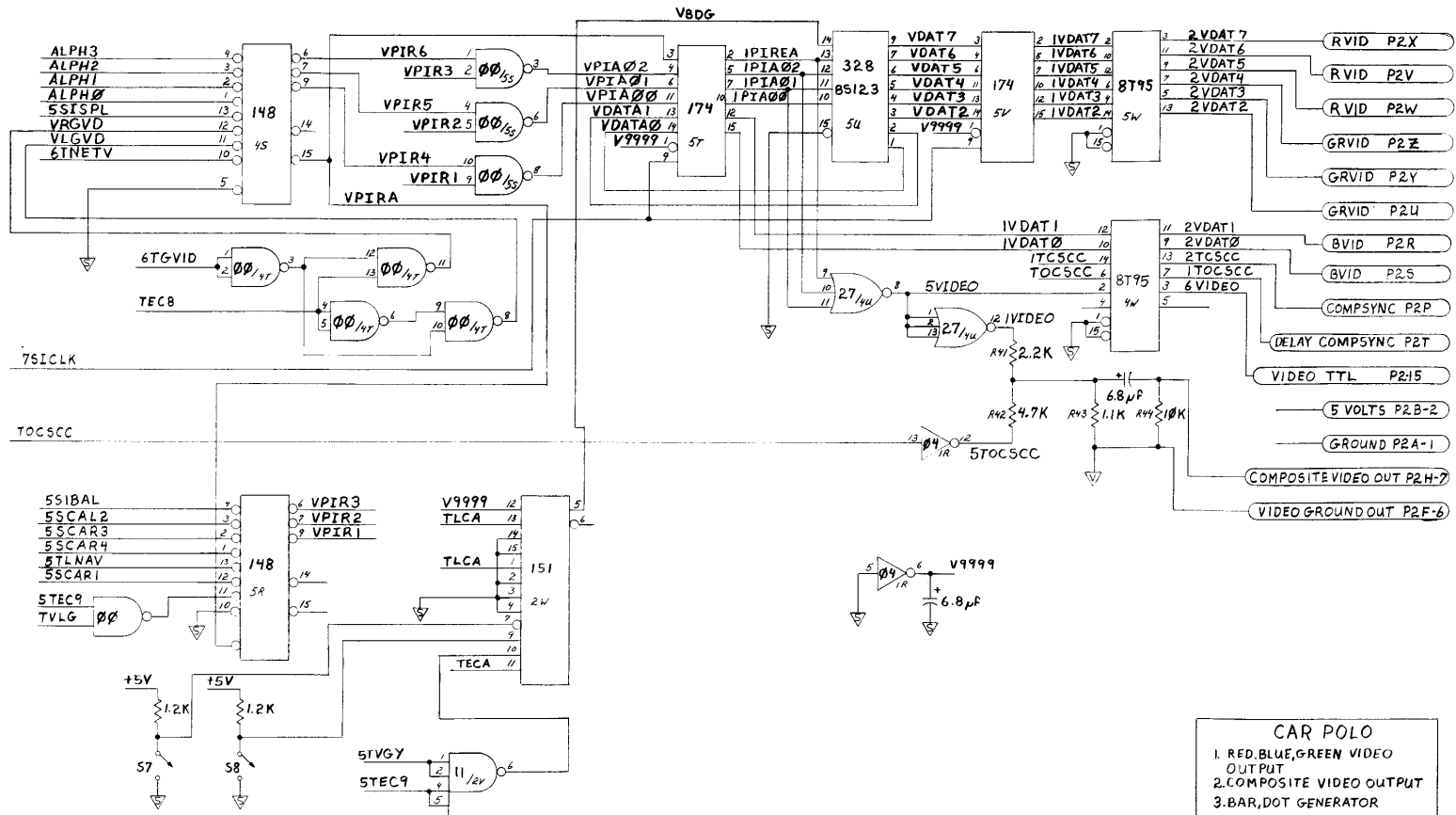   PLAYER 4 ACTIVE   P1-10

5 1R 04 6   N9999
+ 6.8µF
C28

CAR POLO
1. CRASH PULSE EXTENDERS
2. AUDIO SIGNAL BUFFERS

N

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21

22

CAR POLO
1. AUTO LOAD POSITION OF
   EACH MOVABLE OBJECT
2. RAM BUFFER

P.

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CAR POLO
SERIALIZER

EXIDY INC 1977

S.

23

CAR POLO
MASTER TIMING

EXIDY INC 1977

ALPH3
ALPH2
ALPH1
ALPH0
5SISPL
VRGVD
VLGVD
6TNETV

148
4S

VPIR6
VPIR3 2 Ø0/5S
VPIR5
VPIR25 Ø0/5S
VPIR4
VPIR1 Ø0/5S
VPIRA

V8DG

VPIAØ2
VPIAØ1
VPIAØØ
VDAT1
VDATAØ
V9999

174
5T

1PIREA
1PIAØ2
1PIAØ1
1PIAØØ

328
8S123
5U

VDAT7
VDAT6
VDAT5
VDAT4
VDAT3
VDAT2
V9999

174
5V

1VDAT7
1VDAT6
1VDAT5
1VDAT4
1VDAT3
1VDAT2

8T95
5W

2VDAT7
2VDAT6
2VDAT5
2VDAT4
2VDAT3
2VDAT2

RVID P2X
RVID P2V
RVID P2W
GRVID P2Z
GRVID P2Y
GRVID P2U
BVID P2R
BVID P2S
COMPSYNC P2P
DELAY COMPSYNC P2T
VIDEO TTL P2-15
5 VOLTS P2B-2
GROUND P2A-1
COMPOSITE VIDEO OUT P2H-7
VIDEO GROUND OUT P2F-6

6TGVID Ø0/4T   Ø0/4T
TEC8   Ø0/4T   Ø0/4T
7SICLK
TOCSCC

1VDAT1
1VDAT0
1TCSCC
TOCSCC

27/4U
5VIDEO
27/4U 1VIDEO
R41 2.2K

8T95
4W

2VDAT1
2VDAT0
2TCSCC
1TOCSCC
6VIDEO

R42 4.7K
6.8µF
R43 1.1K R44 10K

Ø4/1R
5TOCSCC

5SIBAL
5SCAL2
5SCAR3
5SCAR4
5TLNAV
5SCAR1
5TEC9
TVLG Ø0

148
5R

VPIR3
VPIR2
VPIR1

V9999
TLCA
TLCA
TECA

151
2W

Ø4/1R V9999
6.8µF

+5V 1.2K
+5V 1.2K
S7
S8

5TVGY
5TEC9 11/2V

CAR POLO
1. RED,BLUE,GREEN VIDEO OUTPUT
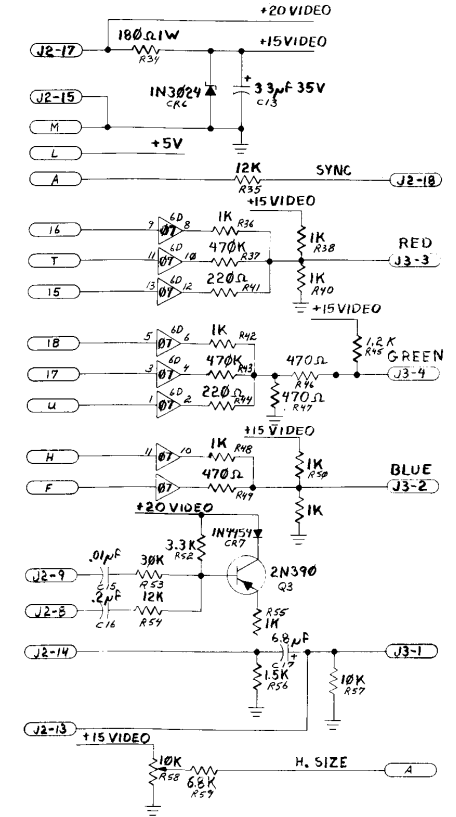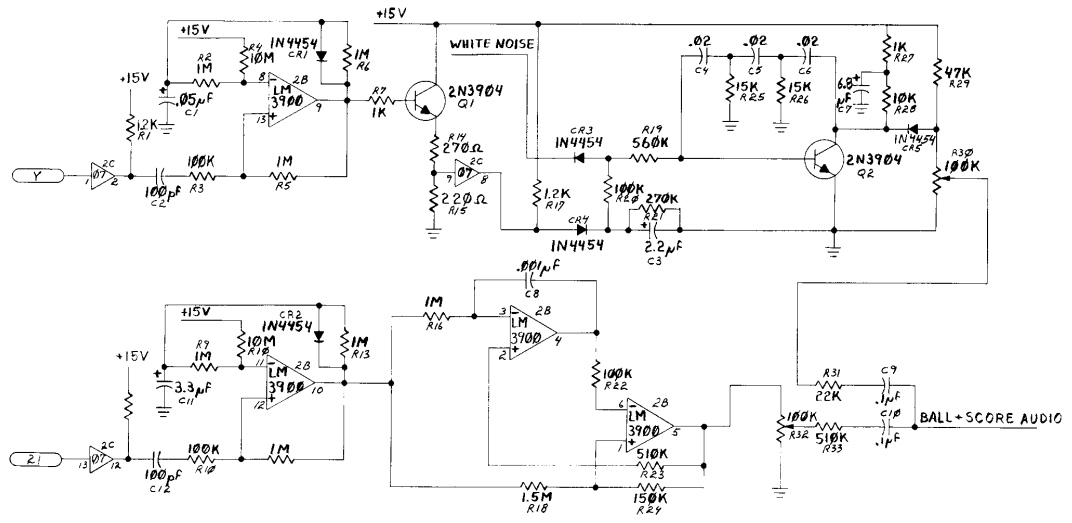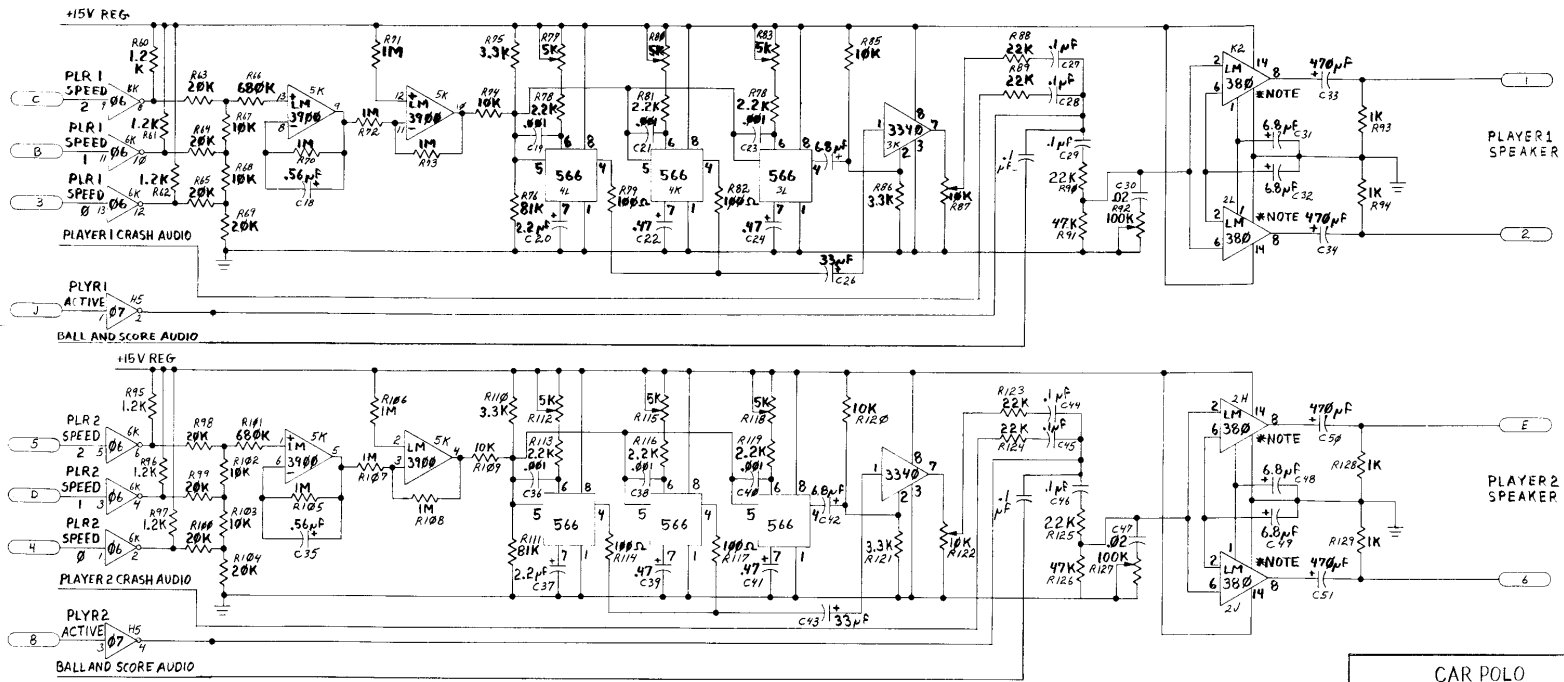2. COMPOSITE VIDEO OUTPUT
3. BAR,DOT GENERATOR
V.
EXIDY INC 1977

CAR POLO
1. G.E. TV INTERFACE
2. BALL AUDIO
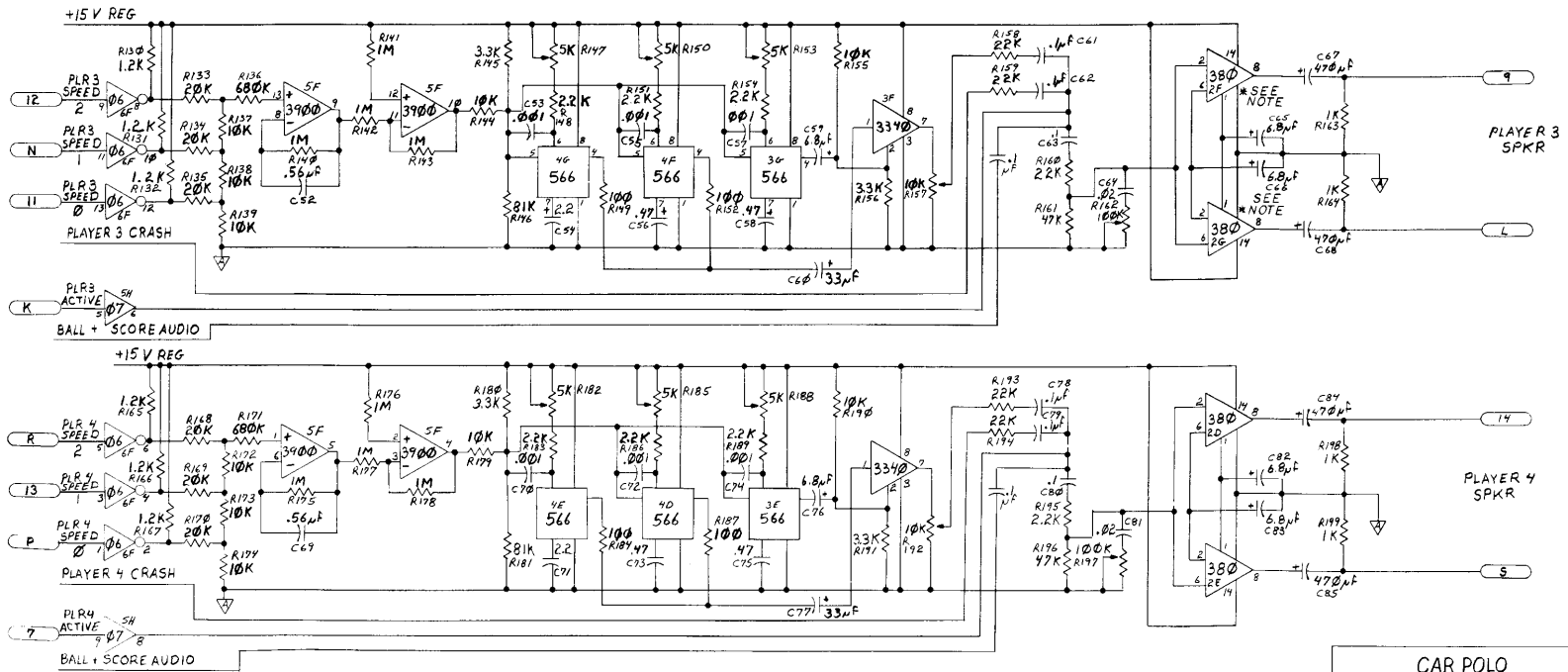3. SCORE AUDIO

EXIDY INC 1977   W.

CAR POLO

1. MOTOR NOISE GENERATION
2. AUDIO SUMMING
3. AUDIO AMPLIFIERS

EXIDY INC 1977
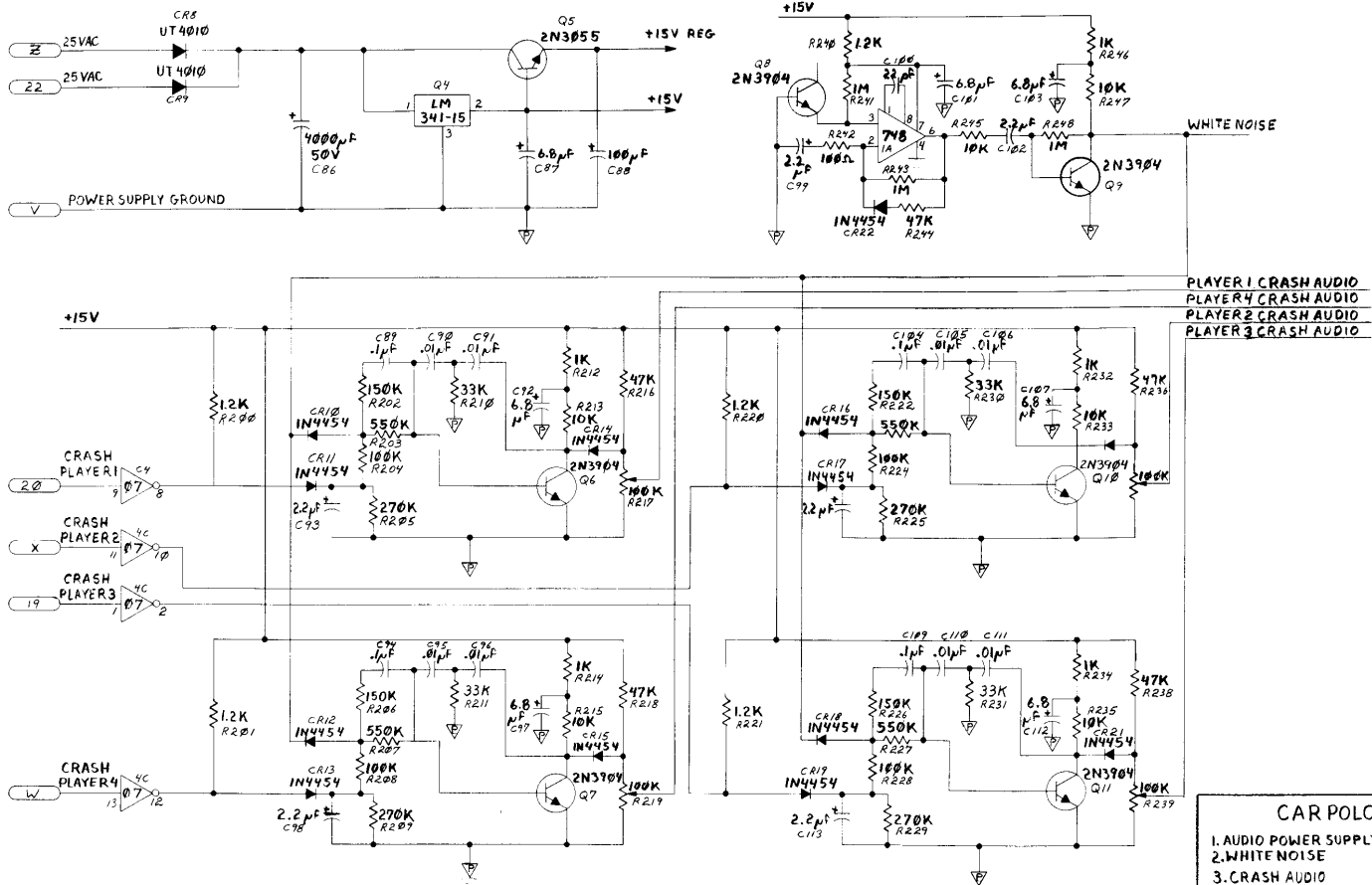
X.

*NOTE: PINS 3,4,5,9,10,11,12,+13 ARE ALL TIED TOGETHER

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CAR POLO
1. MOTOR NOISE GENERATION
2. AUDIO SUMMING
3. AUDIO AMPS

Y.

EXIDY INC 1977

NOTE: PINS 3,4,5,9,10,11,+13
ARE ARE ALL TIED TO GROUND

CAR POLO

1. AUDIO POWER SUPPLY
2. WHITE NOISE
3. CRASH AUDIO

Z.