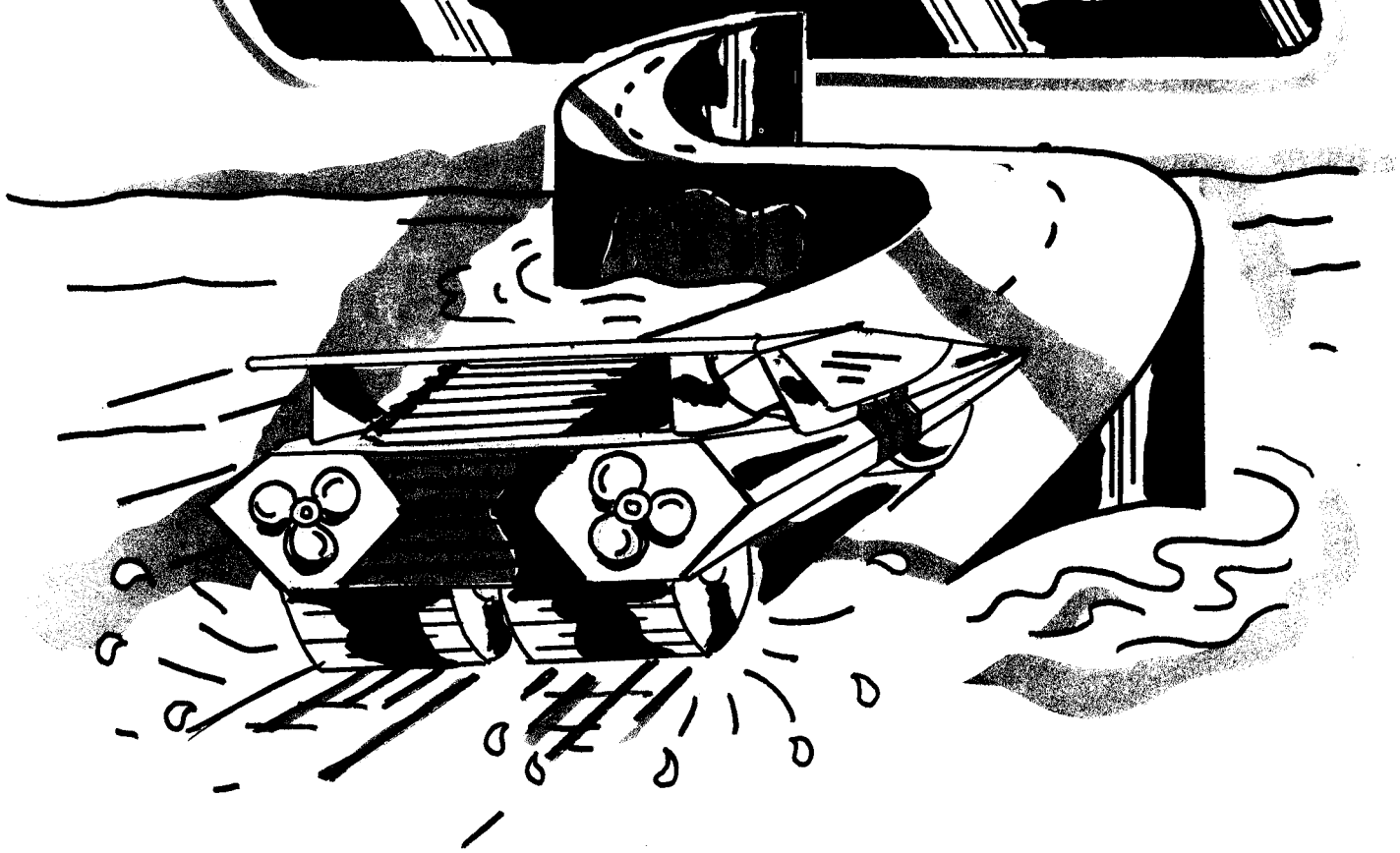
CHANGE LANES

T.M.



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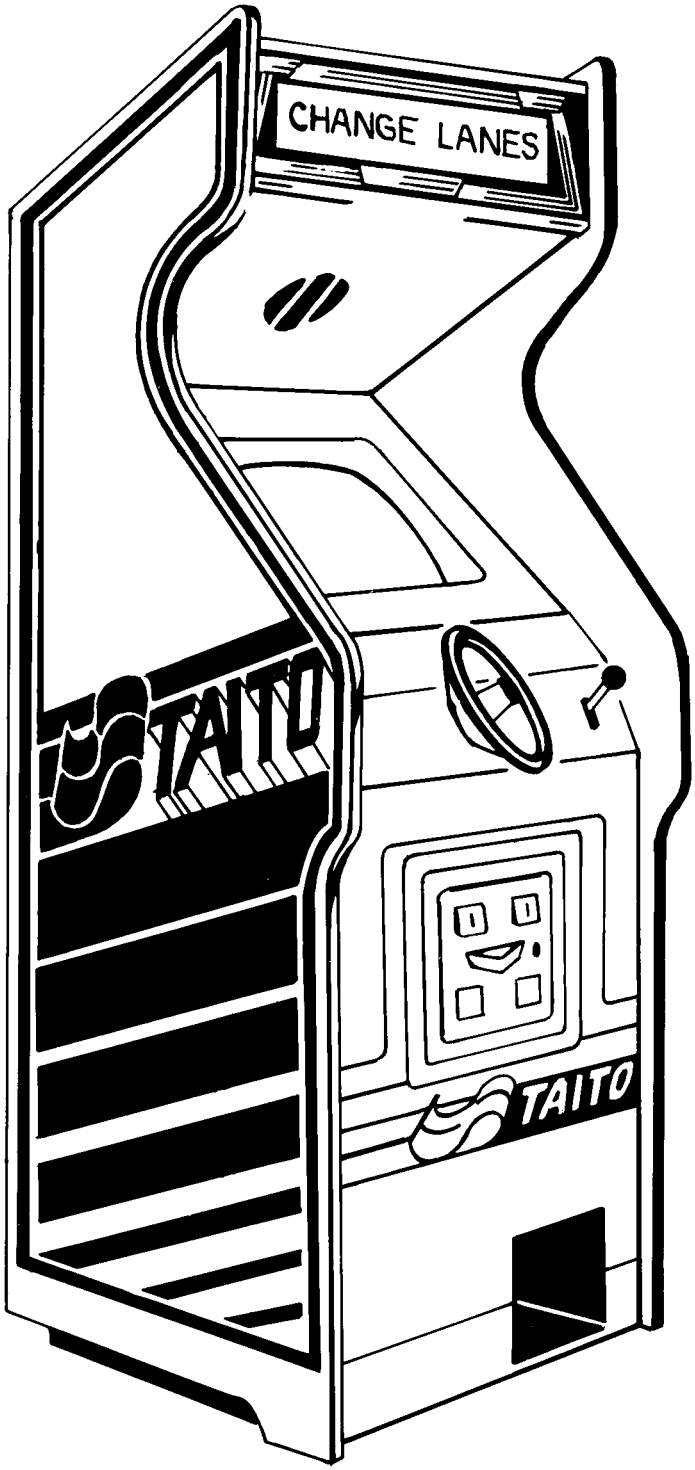
CHANGE LANES
TAITO
TAITO

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"CHANGE LANES"™ UPRIGHT

OPERATION, MAINTENANCE AND SERVICE MANUAL
Complete with Illustrated Parts Catalog

For permission requests, write:
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"CHANGE LANES"™ UPRIGHT

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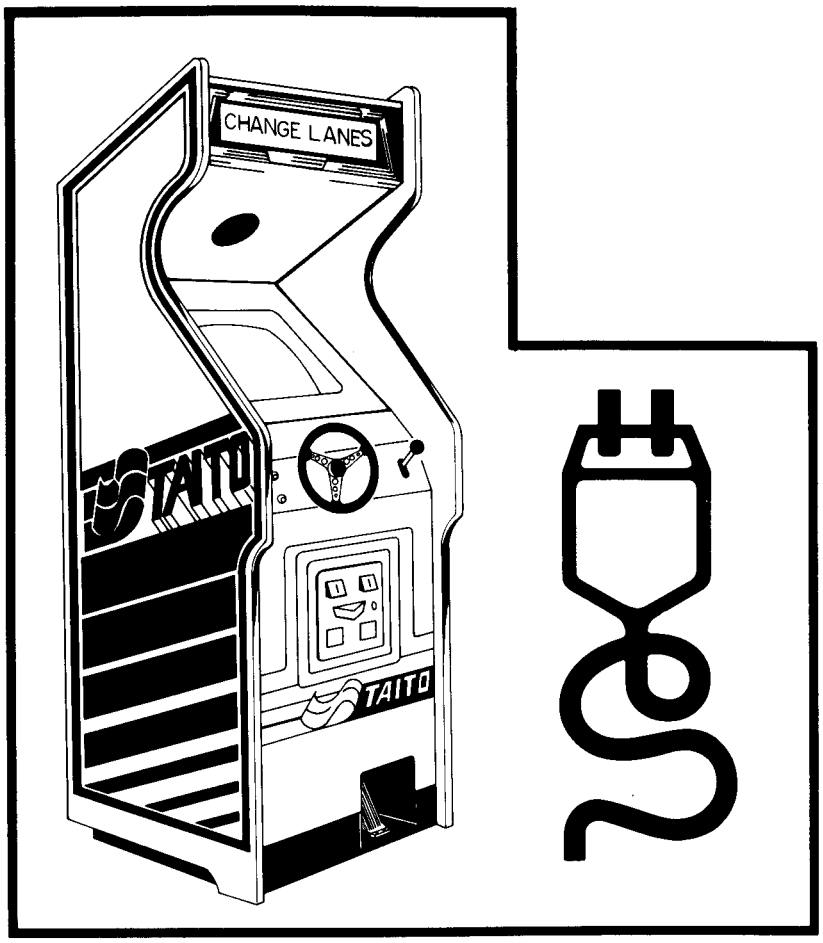


Game Set-Up

1

1. GAME SET-UP

1.1 GAME FEATURES

TAITO AMERICA CORPORATION'S "CHANGE LANES"™ upright game is housed in a highly serviceable cabinet with many added features.

By putting wheels and leg levelers on the cabinet, moving the game from one location to another is made much easier.

A large security designed cash box has been incorporated into the design of this cabinet.

The Control Panel has a polycarbonate overlay, so cigarette marks and mars an easily be wiped clean. This overlay can be replaced if necessary.

The Marquee and Coverglass are made of fully Tempered Glass to minimize breakage.

The Back Service Door houses all the PC Boards for the system making servicing of the game, if needed, much easier.

Lighted Instructions are provided to further enhance the game and attract players, by making the Instructions easier to read.

"CHANGE LANES"™ is also equipped with a new sturdy, reliable steering mechanism designed to take the roughest of handling, which means little or no servicing problems.

"CHANGE LANES"™ also has a Self-Test capability making servicing of the game easier which keeps your game up and running with less down time.

1.2 INTRODUCTION

TAITO AMERICA CORPORATION'S "CHANGE LANES"™ upright game is designed for one or two players.

The object of the game is to get as many points as possible by traveling as fast as possible for as long as possible. The player's vehicle can travel on land or water.

1.2.1 SCREEN DESCRIPTION

The normal "CHANGE LANES"™ screen will be seen as follows:

BONUS AT XXXXXX — which is the score that the player must reach to receive bonus fuel (equivalent to earning a bonus car). After the player reaches this score, bonus fuel is awarded, and a new (higher) bonus level is displayed.

MILES TO GO — This box indicates the number of miles to the next checkpoint. The number will decrement as the player moves forward.

The amount of remaining fuel and the player's speed are indicated by the two gauges on the right side of the screen. When the player earns bonus fuel, it is indicated by fuel pumps appearing in the area below the speed indicator.

The column of numbers on the left-hand edge of the screen indicates all the numbered checkpoints. When a checkpoint is reached, the corresponding checkpoint number in the column is highlighted by the digit turning red and being put on a white background.

1.2.2 Controls

Besides the usual 1 player and 2 player buttons, the "CHANGE LANES"™ control panel has a gearshift lever and a steering wheel. When the gearshift lever is in the up position the player moves forward, and in the down position, the player moves in reverse. The steering wheel controls the left/right motion of the players vehicle.

The accelerator (at the bottom of the cabinet) has 3 speed ranges. When the pedal is all the way up, the vehicle is at low speed, halfway down is medium speed and all the way down is full speed.

1.2.3 ATTRACT MODE

In the attract mode, the game continually runs through it's various features. At the start of the attract mode, the vehicle is driving in the gray lanes and on the the river to reach checkpoint #1. When the checkpoint is reached, the car gets refueled, and the first checkpoint indicator is lit.

The vehicle then proceeds to the next (second) checkpoint by avoiding the pylons. At the second chckpoint, the car again is refueled and the second checkpoint indicator is lit.

On the way to the third checkpoint, the vehicle changes lanes to get to the brown lanes (highest speed lanes). It then drives into the river and reaches the next checkpoint. Note that this checkpoint is just a checkerboard pattern instead of a number. This means that the player did not reach the true checkpoint #3, and therefore does not get a checkpoint bonus. The vehicle will still get refueled, and the third checkpoint indicator will still be lit.

The player then proceeds, on the river, to the fourth checkpoint. On the way, a plane passes over and drops a surface missle which hits and destroys the vehicle.

The attract mode ends by displaying the high score list, including the "Supreme King of the World." Note, the high scores are not permanently saved, so that when the game is powered down or put in self-test mode, the current high scores are lost.

When there are no credits in the machine, the player may read the on screen instructions (4 pages) by pressing the 1 player or 2 player button. The instructions are also displayed when the steering wheel is spun back and forth a couple of times.

1.2.4 PLAY MODE

After the player inserts the required number of tokens/coins, the number of credits bought is displayed in the lower right corner of the screen. The game will continue in the attract mode until the 1 player or 2 player button is pressed.

When the 1 player or 2 player button is pressed, the game begins. The player's vehicle is refueled, the message "Drive to Checkpoint 1 before fuel runs out" is displayed. On the way to the first checkpoint, the player may decide to drive into the river or stay on the road. When the player is driving on river, the blimp overhead will drop boxes worth 5,000 points. If the player hits these boxes with his vehicle, he collects the 5,000 points.

The player should avoid hitting the sides of the roadway, other cars, and the bomb damage, as these will slow him down and cause him to lose bonus points. The true checkpoint 1 is located on the road. When the checkpoint is reached, the vehicle is refueled, and the amount of time the player took to reach the checkpoint is displayed.

The player also earns 100 points for each unit of unused fuel, and the first checkpoint indicator is lit. If the player arrived at the true checkpoint 1, bonus points are awarded according to the players skill:

- "Ace" awards 50,000 points.
- "Great" awards 40,000 points.
- "Good" awards 30,000 points.
- "Fair" awards 20,000 points.

The player then drives to the next checkpoint. A message on the screen tells the player where the next checkpoint is, e.g. "Drive around pylons for checkpoint 2." The player may move into the river or over to other lanes.When the checkpoint is reached, the same sequence of events occur as at the first checkpoint.

In later screens, the plane passing overhead drops surface missles at the player. If the player is hit, the game is over, unless he has earned bonus fuel. If the player does have bonus fuel, he is awarded with another vehicle (at the cost of his bonus fuel), and play continues. While driving on the river, occasional fuel depots will be seen. If the player hits one of them, he gets a free refueling.

On some screens, a green car will appear on the screen. During the time it is on the screen, bonus points are constantly accumulated (shown in the box below the the players score). The points stop accumulating when the player hits some object or the car leaves the screen.

The player continues on in the above manner until all 9 checkpoints have been reached. At the 9th checkpoint, the player must enter his name as "King of the World," after which, the game continues.

HIGH SCORE REGISTRATION

The player can enter three initials if his score is in the top ten high scores. If the player makes it to the ninth checkpoint, he can enter his full name and it will be displayed as "King of the World."

The operator has the option of disabling full name registration completely or reducing it to three letters via DIP switch settings.

1.3 GAME INSPECTION

TAITO AMERICA CORPORATION'S "CHANGE LANES"™ upright game is shipped ready for operation, but a last visual check should be made to insure the game is in good condition. Please verify the following before turning the game on.

- Check the exterior of the game for shipping damage, chips, dents, or broken parts.
- Open the Rear Service Door and check for any interior damage.

- Make sure there isn't any damage to the wiring.
- Check Printed Circuit Boards, making sure there is no damage to the components.
- Check fuses making sure they are firmly in their holders.
- Check for loose foreign objects, especially metal objects which may cause electrical problems.
- Check Plug-in Connectors making sure they are firmly in their sockets.
- Check the Coin Door for any possible damage, especially the switches.

The Video Monitor is properly adjusted before shipping. If there are any adjustments necessary, refer to our Video Monitor Manual (72-00035-001) This Manual contains all the Manufacturers recommendations for adjusting the Video Monitor.

WARNING

The RFI (Radio Frequency Interference) shield (a black plastic shield covering the PCB set) must always be in place when the game is operating to prevent interferences to other radio services.

1.4 PRE-GAME INSTALLATION

The following precautions should be followed when installing the game.

- Avoid rough handling of the game, the picture tube is fragile.
- Install the game on a level surface.
- Avoid installing the game where it may receive excessive sunlight or heat, to protect the game from rising internal temperatures.
- Do not install in a damp or dusty location.
- For a short time after connecting the power to the game, the picture may be temporarily distorted.

The monitor's purity is affected by the earth's magnetic field, causing a variation of color. By turning the game on for 10 or 15 seconds and then off for 20 to 30 minutes the automatic degaussing circuit applies a degaussing field around the edges of the monitor. Doing this several times will correct the problem.

Another way to correct this problem is to purchase a degaussing coil or bulk tape eraser at any electronics store. This will help to immediately demagnetize the Video tube.

If you move the game to another location after degaussing the problem may reappear.

Refer to Monitor Manual (72-00035-001) for details.

1.4.1 POWER REQUIRMENTS

TAITO AMERICA CORPORATION'S "CHANGE LANES"™ game is shipped ready for operation at 120 or 240VAC, 60Hz with a power consumption of approximately 250 Watts.

The following line voltages may be selected:

100VAC ±10% 50/60Hz
120VAC ±10% 50/60Hz
200VAC ±10% 50/60Hz
220VAC ±10% 50/60Hz
240VAC ±10% 50/60Hz

A Voltage Programming Block is located on the primary side of the Transformer to compensate for high/low conditions. (See Figure 1-1).

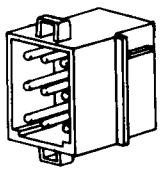


FIGURE 1-1 PROGRAMING PLUG

CAUTION

For safe operation it is recommended the cabinet be grounded. This game is equipped with a three conductor power cable. The third conductor is the ground conductor and when the cable is plugged into an appropriate receptable, the game is grounded. The offset pin on the power cable's three-prong connector is the ground connection.

1.5 POWER ON/OFF SWITCH, SELF TEST SWITCH, VOLUME CONTROL, AND SERVICE OUTLET

To minimize the hazard of electrical shock while servicing the game a Power ON/OFF Switch is provided. One Self Test Switch, two Volume Controls and a Service Outlet have also been provided. (See Figures 5 and 6 for the location of Switches).

1.5.1 POWER ON/OFF SWITCH, INTERLOCK SWITCH

A Power ON/OFF Switch is located in the rear of the game at the top right hand side of the cabinet.

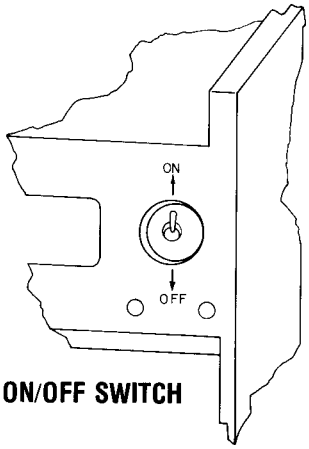


FIGURE 1-2 POWER ON/OFF SWITCH

1.5.2 SELF TEST SWITCH

There is one (1) Self Test Switch which has (2) positions located on the inside of Coin Door (See Figure 1-4). The "CHANGE LANES"™ game is capable of testing itself and provides data to demonstrate that the games circuitry is working properly.* For further information on the Self Test Procedure refer to Figure 1-7 and Section 1.8.

* The free game position puts a credit on the game without increasing the coin counter.

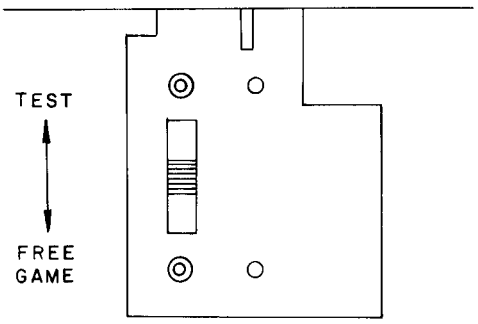


FIGURE 1-3 SELF TEST SWITCH

1.5.3 VOLUME CONTROL SETTING

There are two (2) Volume Controls both are located on the Sound/I.O. Board 08-00109-001. Volume two controls the main overall game sound and Volume one controls the balance between the background and the game volume. We have also included a Volume Control on the inside of the Coin Door. See Figure 1-5 for position. The volume increases when turned clockwise as indicated.

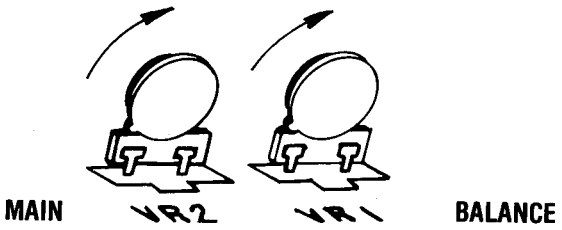


FIGURE 1-4 VOLUME CONTROL SETTINGS

1.5.4 SERVICE OUTLET

A Power Recepatacle has been provided to further aid servicing. The voltage at this receptacle will be the same as the line voltage the game is set at.

1.6 COIN METERS

This game is equipped with a Coin Meter.

1.7 ELECTRONIC COIN ACCEPTORS

This game is equipped with the capability of using 12VDC Electronic Coin Acceptors, such as Third Wave Electronics, Model TW12 or equivalent. Power for these units may be obtained from the Coin Entry Lamp terminals which provide 12VDC.

1.8 TEST & ALIGNMENT PROCEDURE

1.8.1 GENERAL

The Self Test Procedure is performed using the switch located on the inside of the Coin Door.

Pushing the test button on the inside of the Coin Door will cause the game to enter the test mode. Once the test mode is entered, all RAM data will be lost including the high scores and any remaining credits. Pushing any button during the test will cause the machine to leave the test.

These tests are performed in the following order:

- Processor ROM Checksum Test
- RAM test
- Player Control Test & Coin Switch Setup
- Game Mode Setup
- Convergence and Screen Alignment
- Watchdog Test

1.8.2 PROCESSOR ROM CHECKSUM TEST

The five (5) ROM's are tested and the results displayed on the screen with white characters on a black background. If a failure is detected, the failure is highlighted with red characters on a white background. The left most character in the highlighted area identifies the failed ROM.

CHARACTERS	ROM LOCATIONS
0 or 1	U25 - Processor Board
2 or 3	U24 - Processor Board
4 or 5	U23 - Processor Board
6 or 7	U22 - Processor Board
B	U27 - Processor Board

TABLE 1-1 PROCESSOR ROM CHECKSUM TEST

Note! Dip Switch A, Switch 5, if off, will cause the test to loop on memory errors.

1.8.3 RAM TESTS

The five (5) game RAM's are tested and a good/bad indication is put on the screen. Each RAM takes approximately 7 seconds to test. At the end of approximately 35 seconds, any failed RAM will be indicated.

RAM 1	Screen RAM	U31	Processor Board
RAM 2	Processor RAM	U26	Processor Board
RAM 3	Object RAM	U62	Processor Board
RAM 4	River Bed RAM	U109	River Tree Board
RAM 5	Tree RAM	U114	River Tree Board

TABLE 1-2 RAM TEST

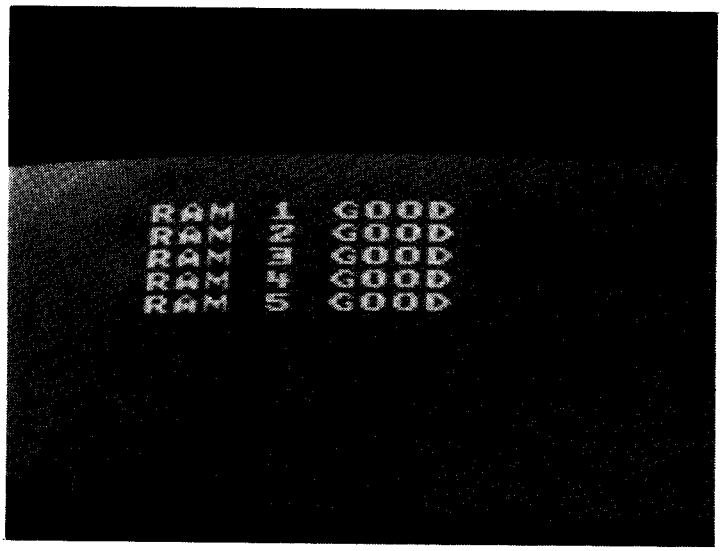


FIGURE 1-5 RAM TEST

Note! Dip Switch A, Switch 5, if off, will cause the test to loop on memory errors.

RAM Tests 2 thru 5 can be by passed by holding closed any of the following switches during the RAM test: Player 1 start, Player 2 start, Free Game, Left coin or Right coin.

1.8.4 CONVERGENCE AND SCREEN ALIGNMENT

The grid of white lines is used to detect and correct any convergence problems in the monitor. They are also used to adjust the size and linearity. Adjust the monitor such that the outside edge of the white border is slightly within the boundaries of the tube. This adjustment is made on the center of the lines that make up the rectangle, the corners of the rectangle will extend beyond the shadow mask.

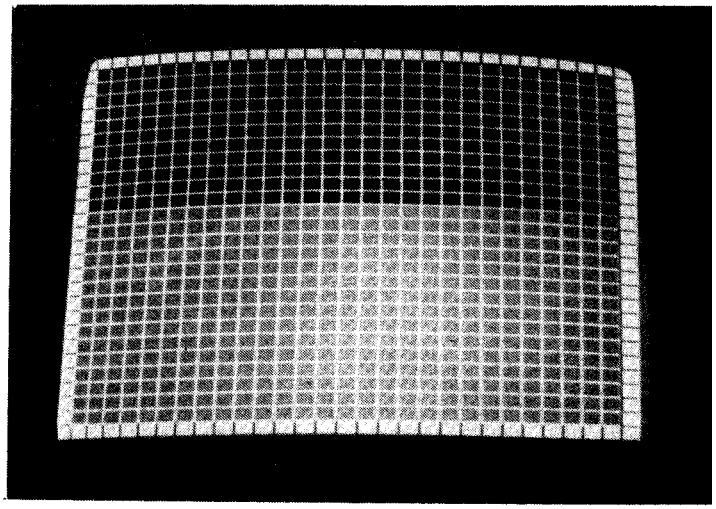


FIGURE 1-6 CONVERGENCE AND SCREEN ALIGNMENT

1.8.5 COLOR ALIGNMENT

The three left vertical color stripes on the screen are blue, green, and red, at minimum intensity. Adjust the red, blue, and green screen controls such that these stripes are just barely visible and of equal intensity. Next, adjust the red and blue drive controls using the next seven stripes as the grey scale.

1.8.6 WATCHDOG TEST

Entering this test puts the processor in a loop waiting for the watchdog reset. This reset should occur within ½ second of entering this test. When the reset occurs, the processor will re-perform the ROM and RAM tests and then enter the attract mode.

1.8.7 PLAYER CONTROLS

STEERING WHEEL The left most digit is the direction indicator, the next digit is the counter. Turn the wheel slowly and observe that the direction indicator remains constant (0 for clockwise, 1 for counter clockwise) and that the counter operates smoothly. Then spin the wheel fast and observe that the direction indicator again remains constant. Any flicker whatsoever means that either the steering wheel mechanism is mechanically misaligned or the optical pickups have deteriorated. (See Figure -).

ACCELERATOR SHIFT — This display indicates the 3 positions of the pedal.

0001 — LOW
0200 — MED
0310 — HIGH

Start 2, Start 1, Free, Left Coin, Right Coin are all indicated next on the screen.

Dip Switch C selects the number of coins required and the number of credits given for the left and the right coin switches. This is also used to put the game in free play mode.

Dip Switch D selects the number of paid credits required to receive a bonus credit. It also selects which coin counter will be used to accumulate the count for each coin slot and the (King of the World) registration.For switch locations refer to Sound I/O Board figure.

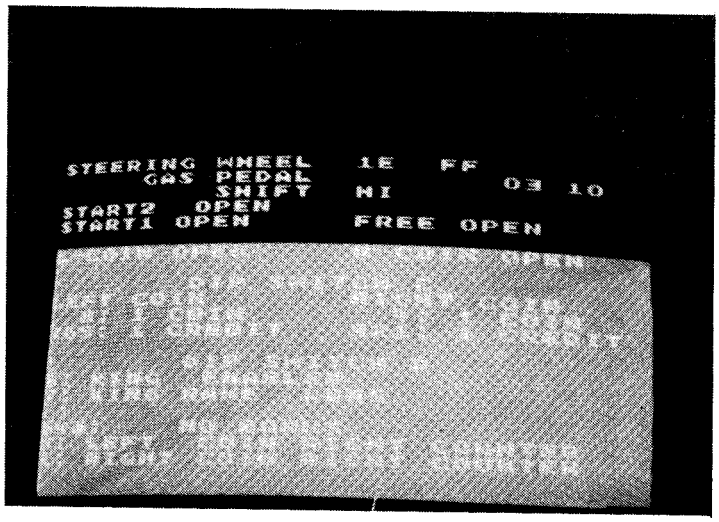


FIGURE 1-7 PLAYER CONTROLS

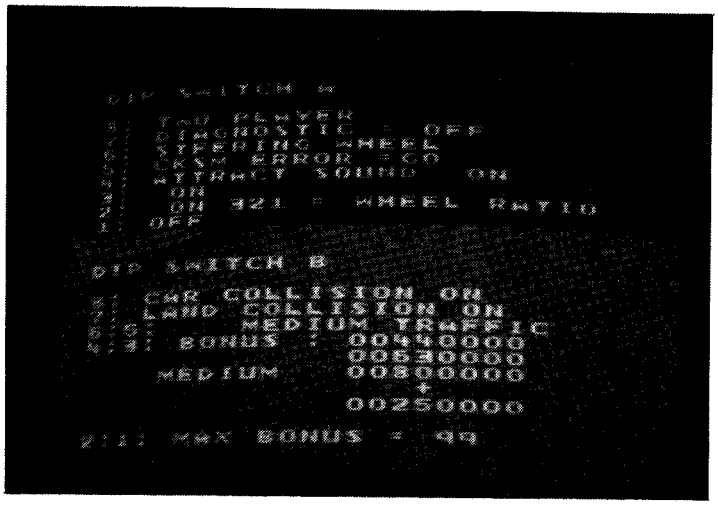


FIGURE 1-8 DIP SWITCH SETTINGS

1.8.8 GAME MODE SETUP

Dip Switches A & B are used to set up the game operating mode.

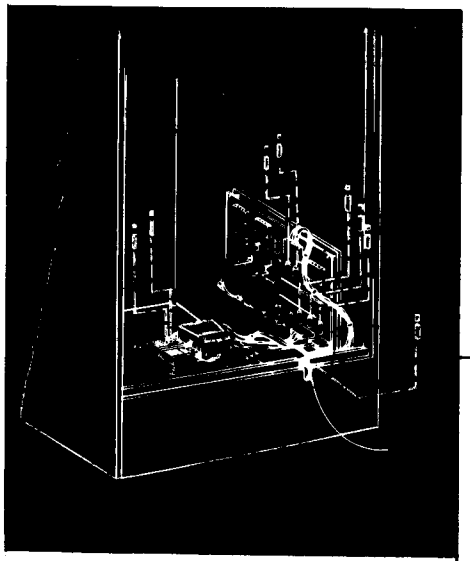
NOTE: The basic playing time is set by selecting the game difficulty which permits the player more or less time to reach the checkpoints after the first one. The actual playing time will depend on the skill of the player. The time permitted to reach the first checkpoint is fixed at 60 seconds.

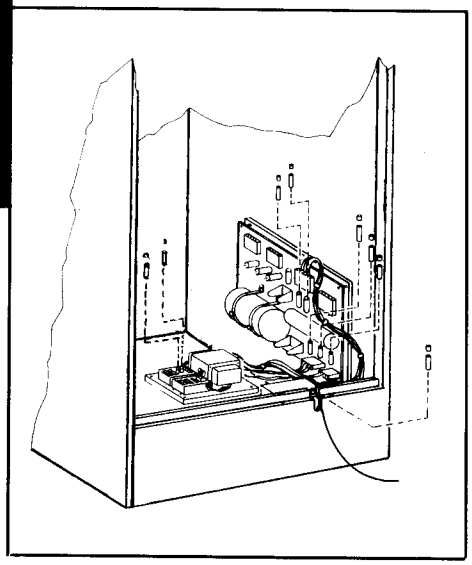
	1	2	3	4	5	6	7	8
Switch A	off	on	on	on	on	on	off	on
Switch B	on	on	on	off	on	off	on	on
Switch C	off	on	on	on	off	on	on	on
Switch D	off	off	on	on	on	on	on	on

TABLE 1-3 FACTORY RECOMMENDED SETTINGS

TABLE 1-4 DIP SWITCH SETTINGS

Switch	1	2	3	4	5	6	7	8
Dip Switch A	**STEERING WHEEL RATIO** OFF ON (Recommended Setting)		ON	ON = Attract Mode = Sound On OFF = Attract Mode = Sound Off	ON = Ignore Memory Failures OFF = Loop On Memory Failures	ON = Steering Wheel OFF = Joy Stick	ON = Diagnostic On OFF = Diagnostic Off	ON = 2 Player Mode OFF = 1 Player Mode
Dip Switch B	**MAX. BONUS FUELS** ON ON = 99 OFF ON = 1 ON OFF = 2 OFF OFF = 3		**GAME DIFFICULTY** ON ON = Real Easy OFF ON = Easy ON OFF = Med. OFF OFF = Hard	**TRAFFIC DIFFICULTY** ON ON = Real Easy OFF ON = Easy ON OFF = Med. OFF OFF = Hard			ON = Land Collisions Enabled OFF = Land Collisions Disabled	ON = Car Collision Enabled OFF = Car Collision Disabled
Dip Switch C	**RIGHT SLOT CREDITS/UNIT** OFF OFF OFF = 7 Credits ON OFF OFF = 6 Credits OFF ON OFF = 5 Credits ON ON OFF = 4 Credits OFF OFF ON = 3 Credits ON OFF ON = 2 Credits OFF ON ON = 1 Credits ON ON ON = Free Play			**RIGHT SLOT COINS/UNIT** ON = 1 Coin/Unit OFF = 2 Coins/Unit	**LEFT SLOT CREDITS/UNIT** OFF OFF OFF = 7 Credits ON OFF OFF = 6 Credits OFF ON OFF = 5 Credits ON ON OFF = 4 Credits OFF OFF ON = 3 Credits ON OFF ON = 2 Credits OFF ON ON = 1 Credits ON ON ON		**LEFT SLOT COINS/UNIT** ON = 1 Coin/Unit OFF = 2 Coins/Unit
Dip Switch D	ON = Right Coin On Left (Top) Counter OFF = Right Coin On Right (Bottom) Counter	ON = Left Coin On Left (Top) Counter OFF = Left Coin On Right (Bottom) Counter	**CREDITS FOR BONUS** OFF OFF OFF = 7 ON OFF OFF = 6 OFF ON OFF = 5 ON ON OFF = 4 OFF OFF ON = 3 ON OFF ON = 2 OFF ON ON = 1 ON ON ON = 0		NOT USED		**"KING OF THE WORLD" NAME** ON = Long Name OFF = 3 Letter Name	ON = Allow Name OFF = No Name





Maintenance

ALL GAMES REQUIRE A CERTAIN AMOUNT OF MAINTENANCE TO KEEP THEM IN GOOD WORKING ORDER. A PERIODIC CHECK OF THE MECHANICAL CONTROLS WOULD BE BENEFICAL TO THE SUCCESS OF YOUR GAME.

2

2. MAINTENANCE AND REPAIR

2.1 CLEANING

The exterior of the game, all metal parts and all plastic parts can be cleaned with a non-abrasive cleanser. Caution should be used when cleaning the glass, a dry cloth can cause scratches and result in a foggy appearance.

2.2 COIN DOOR

The Coin Door used in "CHANGE LANES"™ upright game needs little or no maintenance, See Figure 2-1. If desired, a special coin mechanism cleanser, that leaves no residue, can be obtained from your distributor. Refer to the manufacturers documenation if additional information is needed.

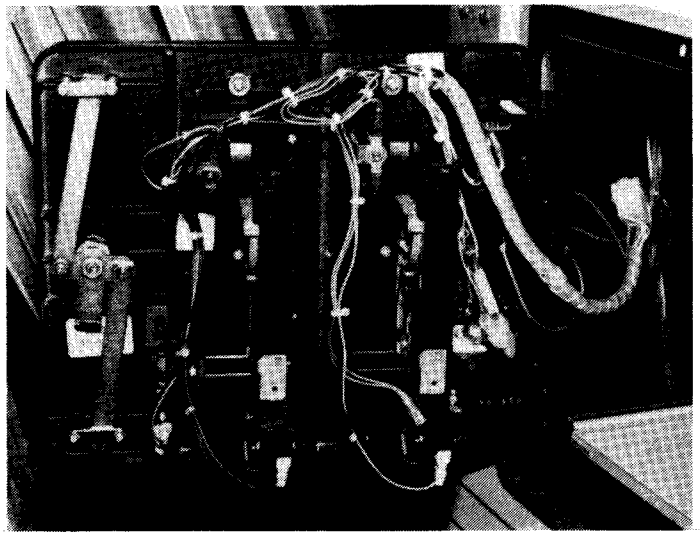


FIGURE 2-1 COIN DOOR

2.3 FUSE REPLACEMENT

This game contains eight (8) fuses. Seven (7) of these fuses can be found on the Power Supply Assembly, five (5) are on the PCB and two (2) are on the Power Supply Bracket. One (1) is located at the bracket where the AC line cord comes into the cabinet. See Figure 2-2 for location of these fuses.

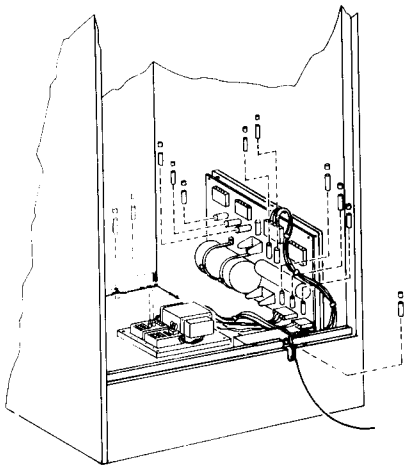


FIGURE 2-2 FUSE REPLACEMENT

2.4 MONITOR REMOVAL

If you need to remove the Video Monitor, follow the instructions listed below:

CAUTION

It is recommended the game be left disconnected for at least one hour before removing the Video Monitor. This will probably discharge the Video tube but EXTREME CAUTION is still necessary.

- Disconnect the power from the line voltage.
- Disconnect the monitor cable connector.
- Remove the wire cable clamps.
- Take out the two rear side bolts, one on each side of the cabinet and lower monitor to a horizontal position.
- Remove the four (4) monitor mounting bolts and disconnect the green ground wire.
- Slide the Monitor out by pulling the monitor toward you.

CAUTION

Use EXTREME CAUTION and do not touch electrical parts of the Monitor Yoke area with your hands or with any metal object in your hands! High voltages may exist in any Monitor, even with power disconnected.

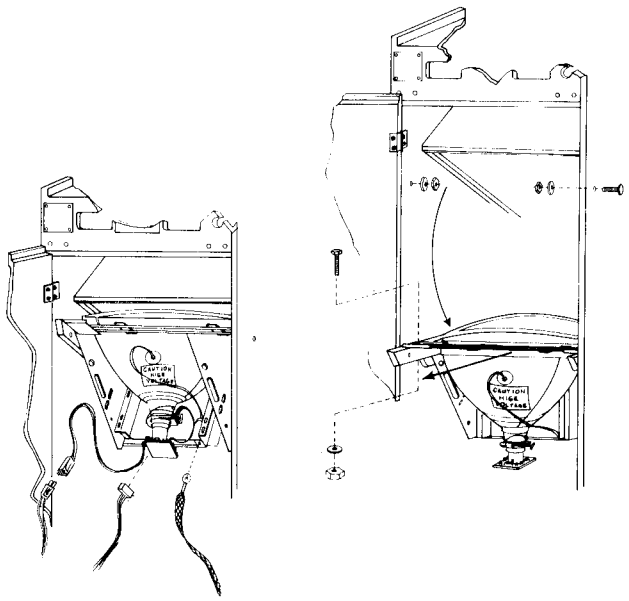


FIGURE 2-3 MONITOR REMOVAL

The monitor's purity is affected by the earth's magnetic field, causing a variation of color. By turning the game on for 10 or 15 seconds and then off for 20 to 30 minutes the automatic degaussing circuit applies a degaussing field around the edges of the monitor, doing this several times will correct the problem.

Another way to correct this problem is to purchase a bulk tape eraser at any electronics store, this will help to immediately demagnetize the video tube.

If you move the game to another location after degaussing the problem may reappear. Refer to Monitor Manual 72-00035-001 for further details.

2.5 COVERGLASS REMOVAL

To remove the coverglass follow the instructions listed below:

- Open the Coin Door.
- Unlock the Control Panel by releasing the two side latches.
- Rotate the Control Panel on its hinges as shown in Figure 2-4.
- Lift the Coverglass out.

The Coverglass can now be easily removed from the front of the game with no screws. To replace the coverglass simply reverse the above procedure.

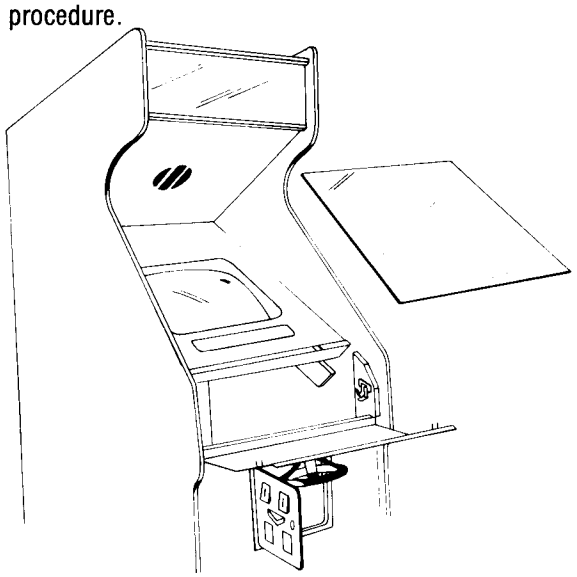


FIGURE 2-4 COVER GLASS REMOVAL

2.6 PRINTED CIRCUIT BOARD REPLACEMENT

You may wish to remove "CHANGE LANES"™ printed circuit board, Sound/IO PCB (08-00109-001), Processor PCB (08-00107-001), and River-Tree PCB (08-00108-001) for servicing. Refer to Figure 2-5.

The "CHANGE LANES"™ Printed Circuit Boards (PCB) are located on the back inside of the rear service door for easy access.

1. Turn the power switch off and disconnect power cord.
2. Open the rear service door. Remove the eleven (11) nuts holding the shield in place. Carefully remove shield for access to the board set.
3. Disconnect the connectors from the boards. Disconnect the ribbon cable connecting the boards by spreading eject latches on the connector.
4. Loosen and turn the Stop Bracket and slide the boards toward you out of the board guides.

WARNING

THIS EQUIPMENT COMPLIES WITH THE REQUIREMENTS OF PART 15 OF FCC RULES FOR A CLASS A COMPUTING DEVICE. OPERATION OF THIS EQUIPMENT IN A RESIDENTIAL AREA MAY CAUSE UNACCEPTABLE INTERFERENCE TO RADIO AND T.V. RECEPTION REQUIRING THE OPERATION TO TAKE WHATEVER STEPS ARE NECESSARY TO CORRECT THE INTERFERENCE.

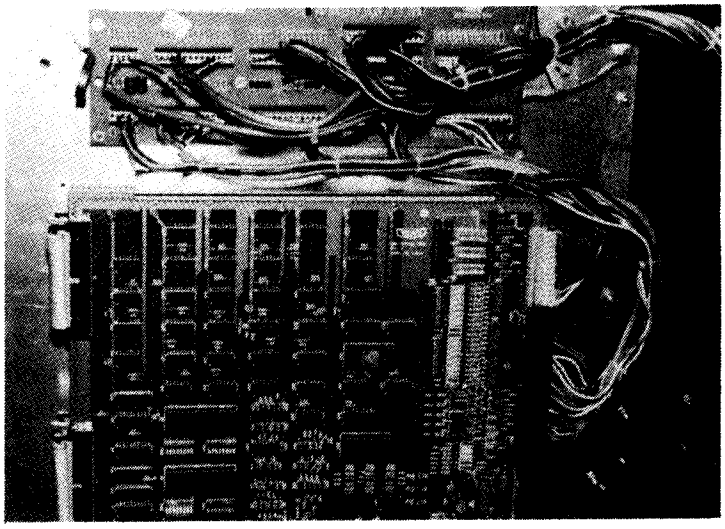


FIGURE 2-5 PRINTED CIRCUIT BOARD

2.7 POWER SUPPLY

The Power Supply produces all the necessary game voltage requirements. Refer to Figure 2-6 while reading the following circuit description.

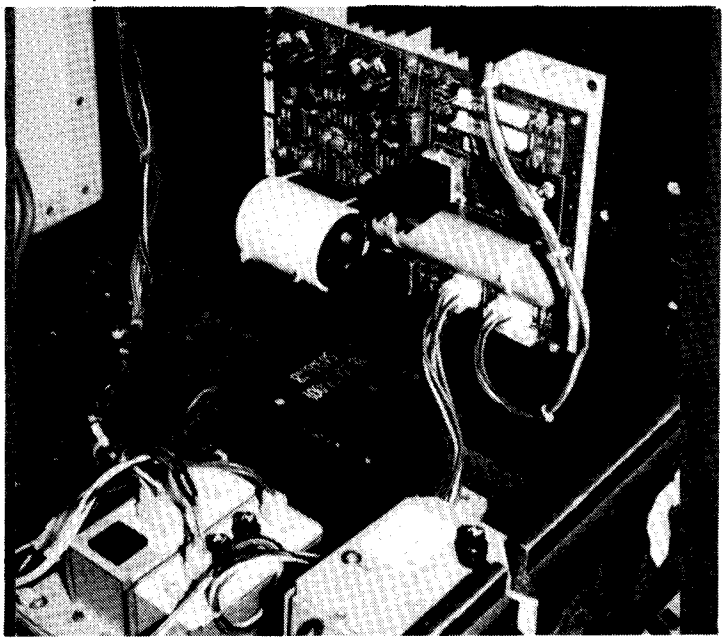


FIGURE 2-6 POWER SUPPLY

2.7.1 AC INPUT

The AC Input is applied to the main Power Supply via the AC Line Cords, Line Filter, Line Fuse, Power Switch and Interlock Switch. Different Line Cord are used for 120V and for 240V. The Line Fuse is located on the Line Cords Assembly near the Strain Relief. A Voltage Programming Block is located on the primary side of the Transformer to compensate for high/low voltage conditions.

The following line voltages may be inserting the appropriate Programming Plug.

Line Voltage		Line Fuse
100 VAC ± 10%	50/60Hz	3 AMP
120 VAC ± 10%	50/60Hz	3 AMP
200 VAC ± 10%	50/60Hz	1.5 AMP
220 VAC ± 10%	50/60Hz	1.5 AMP
240 VAC ± 10%	50/60Hz	1.5 AMP

TABLE 2-1 LINE VOLTAGE

CAUTION

For continous protection against fire hazards, replace only with a fuse of the same type having the same electrical rating.

There are five secondary sources. Three of them go to the Regulator PCB providing one +5VDC, +12VDC, −12VDC, and −5VDC. There is one 6.3VAC and one 120VAC used for the monitor, and in certain models for fluorescent lamp and fan. These secondary fuses are located on the bracket adjacent to the Power Transformer.

Circuit	Secondary Fuse
120VAC	2.0AMP SLO-BLO
6.3VAC	2.5AMP

TABLE 2-2 SECONDARY FUSES

2.7.2 −5VDC AND −12VDC REGULATORS

The AC Input for the negative voltages comes into the Regulator PCB on J1-5 and J1-6 from the transformer. Fuse F3 protects against short circuits. The AC voltage is then full wave rectified by BR3 and filtered by C16. The raw DC is then applied to Reg 1, a three terminal −12V Regulator. The output of this Regualtor is the −12VDC output for the system and is also the input voltage for Reg 2, a −5V Regulator. The output of this Regulator is the −5VDC for the system.

Capacitors C17, C18, C19 are to improve the transient response and stability of the minus voltage regulator. Diodes D8 and D9 provide protection agaists C18 and C19 being shorted through the Regulator.

Resistors R34 and R35 provide current limiting for LED'S 3 and 4 which will light when there is some voltage present at the regulation outputs.

2.7.3 +5VDC REGULATOR

The AC Input for the +5VDC Regulator circuit comes in on J1-1 and J1-2, via F1 into BR1. BR1 full wave rectifies the AC Input. This raw DC is applied to the collectors of (2) series pass transistors, mounted on the Heat Sink Assembly. The regulation is done by U3, which is a voltage regulator whose output controls the gain of Q5, which in turn controls the gain of the series of pass transistors. The emitter of the series pass transistor return to the Regulators PCB and through R11 and R12, which serve to force current sharing between the series pass devices. The voltage at the output of R11 and R12 are the +5VDC for the system. R16 and R18 are voltage set and current foldback adjustments respectively. These are factory adjusted to 5V ± .25V. at 6 AMPS.

Q8, D3 and R20 comprise a SCR-Type Crowbar Circuit which will trigger when the DC output voltages rise above 5.8V. Once the SCR fires, the Power Supply has to be turned off to reset the device. R19 is a current limiter for the voltage indicator LED 1. R16 is used to set the output voltage of the Regulator.

C8, D2, R13 and Q4 delay the start-up of the 5V Regulator to allow the −5VDC Regulator to stabilize first.

2.7.4 +12VDC REGULATOR

This circuit is essentially the same as the 5V Regulator described above. The AC current comes in on J1-3 and J1-4, via fuse F2 into BR2. The AC is rectified by BR2 and filtered by C9. The raw DC is fed to a single series pass transistor on the Heat Sink Assembly and also powers the +12V and +5V Regulator. R28 and R25 are voltage set and current foldback and factory adjusted to 12 Volts ±.25V at 4 AMPS. D7, Q9, and R31 are SCR Crowbar Circuits which trigger at 13VDC output which causes supply to go into shut down to reset power down and then power up again. There is an RC delay as in the 5V circuit to delay the +12V rise time.

2.7.5 RESET CIRCUIT

The reset circuit will output a 2sec active low MRST pulse at J3-14 J4-14 when the power is first turned ON and whenever power fails for more than 35ms.

The reset circuitry is comprised of a Dual Timer (556) and a fullwave type optical coupler across an AC secondary. The output of U1 is the input to one half of the 556 which is configured as a missing pulse detector. C1 and R3 determine the time before the output goes active. This is set for about 35ms. When two or more cycles are missing, the output of the first timer triggers the second timer which drives the MRST low for about 2 seconds. The timer constant for the second timer is set by R4 and C6.

Power on reset is generated by C4, and R39 and D12 on the trigger input of the second timer. Q3 inverts the signal out of the 556 so it is active low. R7 insures MRST is low while the power is rising.

2.7.6 POWER SUPPLY ADJUSTMENTS

VOLTAGE Adjust voltage on +5V and +12V for +5.00V to +5.01V and +12.00V to +12.01V.

CURRENT LIMIT Adjust control (5 I, 12 I) counterclockwise until voltage just changes, then turn control clockwise until voltage goes back to original value. With pointer, mark position of arrow on potentiometer then turn control until beginning of 1st notch is aligned with the pointer. On the controls with the Blue Disk turn approximately 30 degrees.

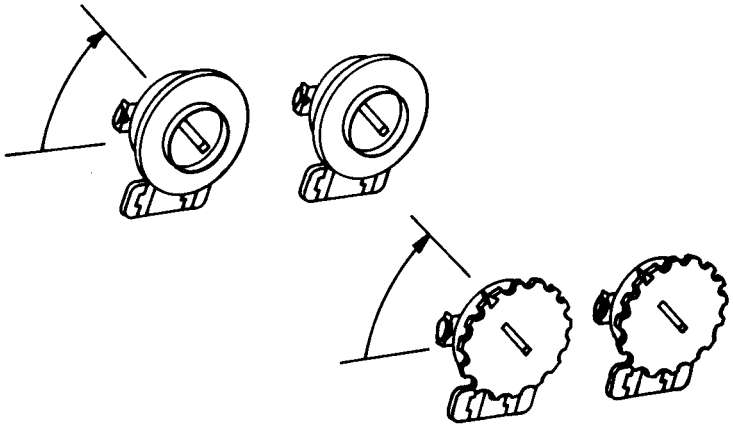
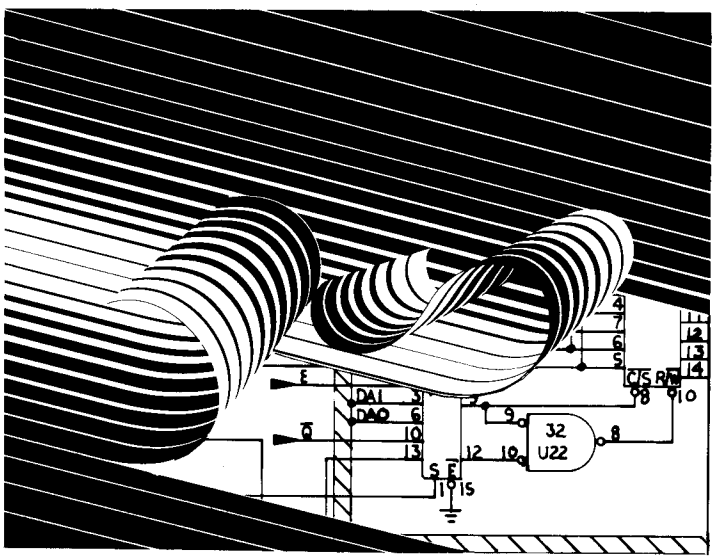


FIGURE 2-7 CURRENT LIMIT ADJUSTMENT

NOTE! If voltage adjustment will not bring voltage up, set current limit adjustment to 1/2 value.



Theory Of Operation

3

THIS SECTION PROVIDES A TECHNICAL DESCRIPTION OF THE "CHANGE LANES"™ GAME. THE GAME ELECTRONICALLY CONSISTS OF PRINTED CIRCUIT BOARDS, POWER SUPPLY, AND SPEAKERS WHICH ARE DESCRIBED IN DETAIL IN THE FOLLOWING TEXT.

3. THEORY OF OPERATION

3.1 GENERAL

The game consists of three boards. The Processor Board, The River-Tree Board, and the Sound/IO Board.

The Processor Board contains the Z80B microprocessor, the program ROM and RAM, the scan counters and sync generator, the screen character generator (OBJ1), the moving object generator (OBJ0), and the watchdog timer.

The River-Tree Board contains a ROM controlled state machine and the math look-up tables for the generation of the size and position of the ground and trees.

The Sound/IO Board contains the sound generators, the voice mixer and output color map, the inputs and outputs for switches and coin counters, and the hardware collision detectors.

3.2 PROCESSOR BOARD

All of the timing signals are generated on this board. The 20MHz master clock is generated by the crystal and inverters U8. It is divided by flip flop U9 to produce a 10MHz and 5MHz clock. The 10MHz clock is used only by flip flop U10 to generate the FASTWRT* signal needed for the OBJ1 generator. The 5MHz clock is used as the main timing signal for the rest of the board. The 5MHz clock is shaped by U8 and Q1 to produce the Z80B clock. The horizontal scan counters U1, U2, U3 are clocked by the 5MHz and produce an active horizontal line of 256 counts (51.2us) and a horizontal blanking of 62 counts (12.4us). It also produces HSYNC, HRESET, 2OD, HRD*, and FASTWRT*. Refer to the Timing Diagrams.

HSYNC is then used to clock the veritcal counters and produce 224 vertical active lines and 38 vertical blank lines. It also produces VSYNC, VSEG1, VSEG0, and the Z80B interrupts. See timing diagram.

The watchdog timer U29 is loaded by any access to the WDOG address E000, and is counted down by VBLANK signals. If for some reason, the processor gets "lost", and stops generating accesses to WDOG, after 8 VBLANK times the Q3 output of U29 will go low and cause a reset at the Z80B.

OBJ1 generator. This circuit generates all of the fixed objects on the screen such as the right hand border and the scores. It also generates the airplane that pulls the sign across the sky. The characters are stored in ROM U46 and are displayed according to the data written into RAM U31 by the processor. Processor access to this RAM is accomplished through multiplexers U19, U20, U21, and buffer U34. Timing for the access is controlled by the flip flops U42 and U41 which generate the mulitplexer control signal and the WAIT 1 signal when the processor accesses the OBJ1 address range (9000-97FF). Two bytes of information are stored for each character position in the RAM. The first is actual character designation which is loaded into latch U33. The second byte contains the horizontal shift position and color group for that character. The horizontal shift data goes to U45 where it is added to the horizontal scan count and produces address information used by the output latches U58, U59 and the MUX U57. The 2 color group bits from U32 and the 2 MUX output bits from U57 form the 4 bit value for this object data and are sent to the video mixer on the Sound/IO Board.

3.3 OBJ0 GENERATOR

This circuit generates all the fixed size moving objects such as the clouds, the city, the blimp and the cars. The characters are stored in ROMs U97, U98, U99 and U100. They are displayed according to the data written to RAM U62 by the processor. Processor access to this RAM is accomplished thru multiplexers U60, U61, U63 and buffer U65. Timing for this access is controlled by the flip flops U64 which generates the MUX control signal and the WAITO signal when the processor accesses the OBJ0 address range (8000-82FF). For each object to be displayed, there are 4 bytes of data stored in the RAM U62. The first is the rotational value and vertical size of the object, the second is the complement of the vertical position of the object, the third is the actual designation of the object, and the fourth is its horizontal position. During each scan line, just after the end of HRESET, the counter U72 and U73 begin sequentially accessing the data in the RAM. The first byte is stored in latch U70. The second byte is subtracted from the current vertical scan count by U80 and U93. The difference is compared with the Vertical size data by U81 and U94 and the results are latched in U95. If these results are such that the currently accessed object is required to appear on the current vertical scan line, then U74 pin 3 will go low and start the object data cycle. Otherwise, the counters U72 and U73 will continue the search. If the data cycle starts, then the third byte of data is loaded into latch U69 as the object identifier, and the fourth byte is loaded into counters U79 and U92 as the horizontal position of the object. Then the flip flops U82 and counter U83 performs a timing cycle whereby the image data in the ROMS is accessed according to the current scan count and rotational bits (VR, HR) and written to the output RAMs U67 or U68. At the end of the timing cycle, the counters U72 and U73 resume the search for objects on this scan line. The output RAMs U67 and U68 are switched on alternate vertical scan lines between outputting data to the video mixer and being available for writes from the data timing cycle. The read or write address is selected by multiplexers U77, U78, U90, U91. As each RAM is read to the screen, it is automatically erased by gates U54 or U55.

0000	7FFF	Processor ROM
8000	86FF	OBJ0 RAM
9000	97FF	OBJ1 RAM
A000	A03F	Color RAM
B000	BFFF	Processor ROM
C000	C7FF	River-Tree RAM
C800	CFFF	River-Tree Status
D000	DFFF	Sound/IO
E000		Watchdog
F000	F7FF	Processor RAM

TABLE 3-1 PROCESSOR ADDRESS MAP

3.4 SOUND I/O BOARD

All of the sounds are generated by two General instruments AY3-8910 sound generator chips U8 and U9. These chips also read the DIP switches. The low frequency sounds are genetated by U9, and shaped by U22. The high frequency sounds are generated by U8 and filtered by components. The balance between the two sound generators is set by VR1 and the overall volume is set by VR2.

The Steering Wheel inputs go to the direction flip flop U33 and the counter U32. The count and direction are read by the processor three U31 approximately every 4 milliseconds. The inputs from the coin door are sent to the encryption processor where they are conditioned before going to the Z80B. All other inputs are read thru multiplexers U45 and U30. Outputs for the coin counters and "yoke-flip" control are generated by U44.

The Video mixer consists of latches U11, U13, U14, U12, U15, flip flops U18, U20, U17 and assorted gates. The gates that monitor the inputs of each of the latches are used to determine if a valid object is present. Of so, then the related object flip flop is set. The outputs of the flip flop go to the priority gates and the existing object with the highest priority is enabled on to the Multiplexed Address bus. The priority is in the following order, Highest to Lowest OBJ1 Tree 0 or Tree 1, OBJ0 River. The priority between TREE 0 and TREE 1 is decided by flip flops U17. Gates U25 and U26 encode the object type into 2 more bits for the Multiplexed Address Bus. The resultant 6 bits on the MA bus go to the output color RAM address inputs. The data outputs of this RAM are used to generate one of 8 levels of intensity for each of the three colors. This RAM is loaded by the processor thru buffer U36 and gate U37.

Hardware collision detection is done by flip flops U42 and U33, and gate U41.

3.5 RIVER-TREE BOARD

The River-Tree Board is comprised of 4 sections; the Input Buffers and River Math generator, the River Video generator, the Tree 0 Video generator, and the Tree 1 Video generator.

The Input Buffers U1, U2, U3 & U4 take in address and timing from the Processor Board and allow data transfer to and from the Processor Board.

The River Math generator functions as follows:

During Vertical Reset (V8* from U4/16) the slope address counters U33 and U34 are loaded with the horizon value from U19. When Vertical Reset ends, the counters start incrementing on positive edges of HRD*(U4/5). These counters address the slope ROM, U44 which provides horizontal and vertical size data to the River source bus.

A high speed state machine also synchronized to HRD*(U73, U87, U88, U89, U101, U102, U103, U104, U115, U116 U117, U118 & U119) directs this data to the River Video generator. The actions of this state machine are shown below.

Each of the generators is comprised of a Math Train and an image output section. The first description is for the River generator.

The Math Train consists of a 4 bit wide path from the data RAM U59 thru the adder (U60, U75 & U61) thru the address latches and counters (U62, U77, U76, U91 & U92) to the horizontal size generator (U106, U107, U121 & U122). At each CLKTRAIN2 (U104/8) the 4 bit data packets are moved one location down the train. The train is fed by either the slope MUX U45, the adder MUX U61, or the data RAM U59. This data is accepted by the adder input U60 or the address train input U62. The data is also written back into the data RAM U59. The data RAM serves as an accumulator, providing storage from one scan line to the next, of the inputs to and the results of the math process. The function of this math process is to add the size data from the slope ROM to the position data in the data RAM and put it to the address train. The initial values of position are loaded into the River data RAM U59 during vertical reset thru MUX U57, U58 and data buffer U47. This initial value is the position of the River at the lower right corner or the screen. The details of this process are shown in the state machine table.

This Math process is run during horizontal reset on every scan line. At the end of each process (the beginning of each scan line), the serial train of address latches and counters will contain the vertical and horizontal addresses of the River Video to be displayed. The horizontal address counter is clocked by the horizontal size generator output U122/5. The frequency of the size generator is determined by the value loaded into U106 during the math process. This value is the start value used by counters U107 & U121. These counters count up until they reach FF'hex and are then reloaded by U42/11 with the start value. If the LSB of the start value (U106/19) is high, then flip flop U122/9 will cause the counters to skip 1 clock every other time it reloads. This allows an apparent 40 MHz resolution in horizontal size with only a 20 MHz clock.

The resultant addresses now go to the image output generator. The MSB's of the vertical and horizontal addresses go to the image locator RAM U109 to select the image cell (16 lines by 8 pixels) to be displayed. This data along with the LSB's of the addresses goes to the image ROM U111 and output shifters U126 & 112. Each pixel is 4 bits deep. The result of this math process is to make the image of each successive scan line (starting from the bottom of the screen) smaller and smaller so as to create the illusion of depth and perspective in the ground terrain.

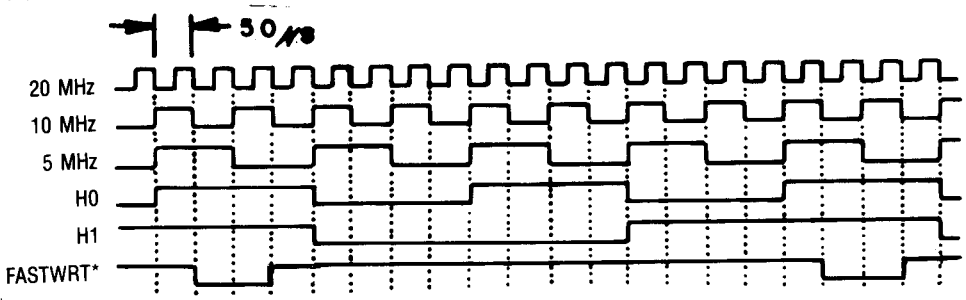
The tree generators (Tree 0 is described here) operate the same as the River generator until a tree start pixel (all 0) is detected by gate U52 and flip flop U56. At this time, Tree on is set (U29/5) and the River source bus is disconnected from the tree generator (U63/1). The tree generator continues to function but no new position or size data is received from the river source bus. Position and size data is now taken from the tree data RAM U79 which contains the values last received from the river source bus. The result of freezing the incremental size values is that the image outputs will be clocked at the fixed rate of the ground terrain at the time of the tree was detected. This makes the tree appear vertical and also forces it to track the ground terrain motion.

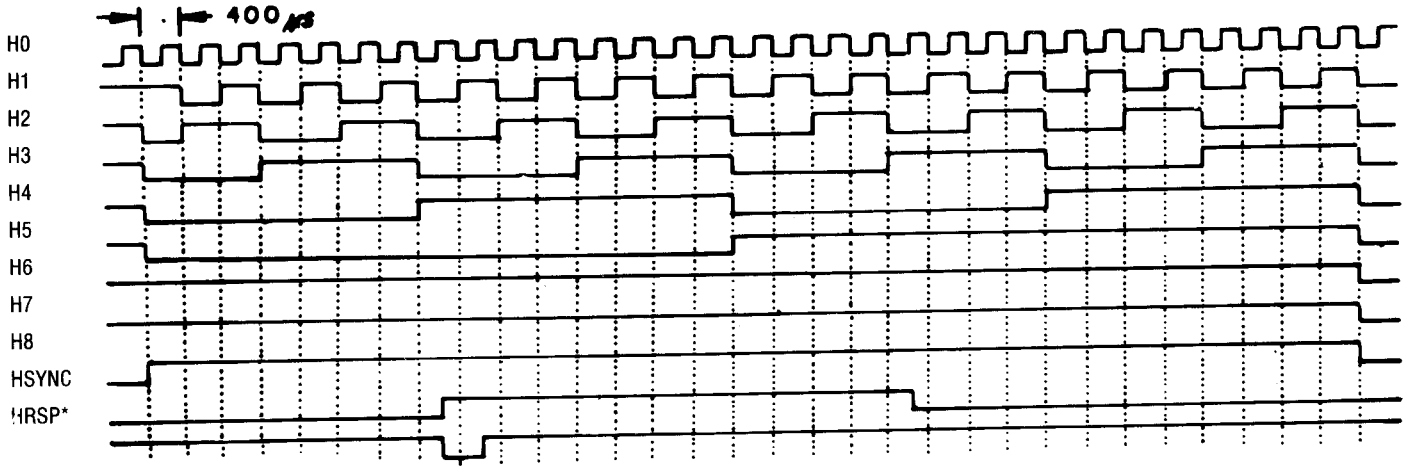
3.6 STATE MACHINE OPERATION

The State Machine is controlled by counters U101 & U87. These counters are clocked by 20D (U115/6). This is a 20MHz clock that is disabled while HRD* is low. Flip flop U102/8 resynchronizes HRD* to 20D and allows the state machine to start. The state machine counters provide the timing for the basic math clock (U105/2) and the address for the state ROM U88. When the counters reach maximum, U105/3 goes low. After a delay of 2 clocks, U119/5 goes low which allows U102/8 to clock low. This ends the state machine cycle. At this time, counter U116 is enabled and it allows a burst of 16 10MHz clocks to go to the math train. This is needed to flush any remaining invalid data from the image outputs. While the state machine is on, the data from the state ROM is latched in U89. This data controls the generation of the various clocks and enables in the various sections of the math train. The details of this operation are shown in the table below.

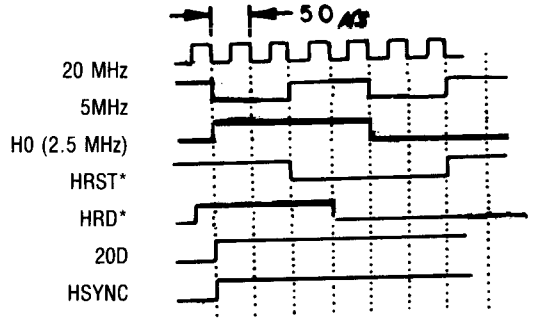
PROCESSOR CLOCKS
FIGURE 3-1

HORIZONTAL BLANKING TIMING

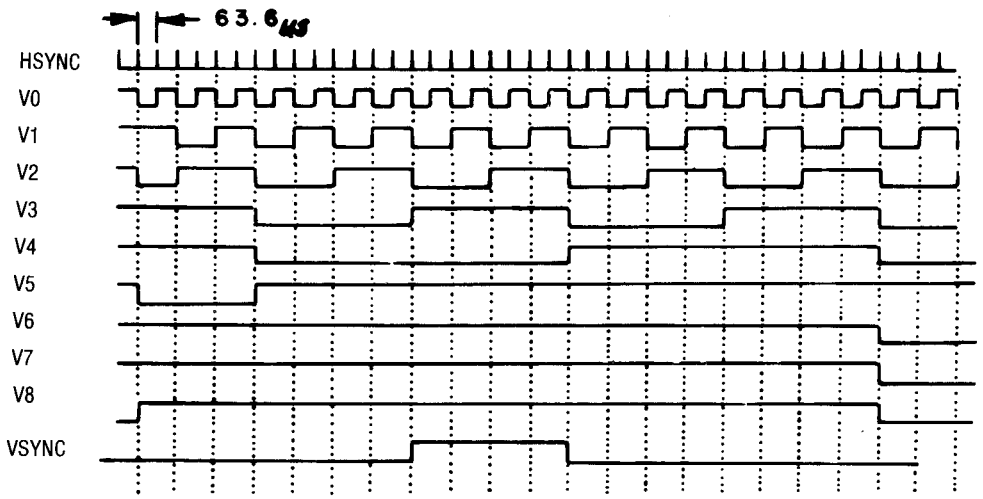




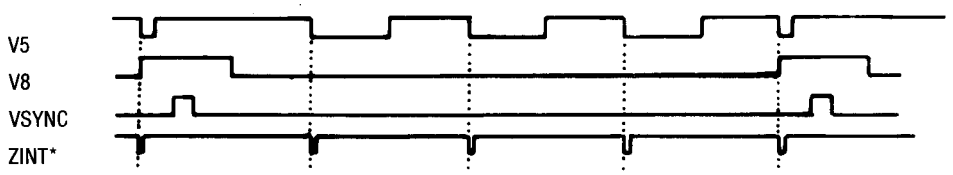
DELAYED CLOCK TIMING



VERTICAL BLANKING TIMING



PROCESSOR INTERRUPT TIMING



STATE MACHINE DATA DEFINITION
TABLE 3-2

State	Bits 7	6	5	4	3	2	1	0	Hex	Source	Dest.	Description
0	0	0	0	0	1	1	0	1	OD	ROM	Adder	NOOP - Data From ROM
1	0	0	0	0	1	1	1	1	OF	ROM	Train	LSB Clock Offset - From ROM0-To Train-To RAM0
2	0	1	0	0	1	1	0	1	4D	RAM	Adder	NOOP - Clock ROM Addr Counter
3	0	0	1	0	1	1	1	1	2F	ROM	Train	MSBClock Offset-From ROM1-To Train-To RAM1
4	1	1	0	0	1	1	0	1	CD	RAM	Adder	NOOP - Clock ROM Addr Ctr-Clock RAM Addr Ctr
5	0	0	0	0	1	1	1	1	OF	ROM	Train	LSB Clock Freq-From ROM2-To Train-To RAM2
6	0	1	0	0	1	1	0	1	4D	RAM	Adder	NOOP - Clock ROM Addr Counter
7	0	0	1	0	1	1	1	1	2F	ROM	Train	MSB Clock Freq-From ROM3-To Train-To RAM3
8	1	1	0	0	0	1	0	1	C5	RAM	Adder	NOOP - Clock ROM ADDR Ctr-Clock RAM Addr Ctr-Clear Carry
9	0	0	0	0	1	1	0	1	OD	ROM	Adder	HBUMP0 - From ROM4-To Adder-To RAM4
A	0	1	1	0	1	1	0	1	6D	RAM	Adder	HP050 - From RAM5-To Adder-To RAM5-Clock ROM Addr Ctr
B	1	1	1	0	1	1	1	0	EE	Adder	Train	HPOS0 - From Adder-To Train-To RAM5-Clock Carry-Clock RAM Addr
C	0	0	0	0	1	1	0	1	OD	ROM	Adder	HBUMP1 - From ROM5-To Adder-To RAM6
D	0	1	1	0	1	1	0	1	6D	RAM	Adder	HPOS1 - From ROM7-To Adder-To RAM7-Clock ROM Addr Counter
E	1	1	1	0	1	1	1	0	EE	Adder	Train	HPOS1 - From Adder-To Train-To RAM7-Clock Carry-Clock RAM Addr Ctr
F	0	0	0	0	1	1	0	1	OD	ROM	Adder	HBUMP2 - From ROM6-To Adder-To RAM8
10	0	1	1	0	1	1	0	1	6D	RAM	Adder	HPOS2 - From RAM9-To Adder-To RAM9-Clock ROM Addr Counter
11	1	1	1	0	1	1	1	0	EE	Adder	Train	HPOS2 - From Adder-To Train-To RAM9 Clock Carry-Clock RAM Addr Ctr
12	1	0	0	0	1	1	0	1	8D	ROM	Adder	NOOP-Clock RAM Addr Ctr
13	0	1	0	0	1	1	0	1	4D	RAM	Adder	NOOP-Clock RAM Addr Ctr
14	0	0	0	0	0	0	0	1	01	ROM	Adder	VBUMP0 - From ROM8-To Adder-To RAMC-Clear Carry
15	0	1	1	0	1	0	0	1	69	RAM	Adder	VPOS0 - From RAMD-To Adder-To RAMD-Clock ROM Addr Ctr
16	1	1	1	0	1	0	1	0	EA	Adder	Train	VPOS0 - From Adder-To Train-To RAMD-Clock RAM Addr Ctr
17	0	0	0	0	1	0	0	1	09	ROM	Adder	VBUMP1 - From ROM9-To Adder-To RAME
18	0	1	1	0	1	0	0	1	69	RAM	Adder	VPOS1 - From RAMF-To Adder-To RAMF-Clock ROM Addr Ctr
19	1	1	1	0	1	0	1	0	EA	Adder	Train	VPOS1 - From Adder-To Train-To RAMF-Clock Carry-Clock RAM Addr Ctr
1A	0	0	0	1	1	0	0	1	19	ROM	Adder	VBUMP2 - From ROMA-To Adder-To RAM10-Load HOSC From Train
1B	0	1	1	0	1	0	0	1	69	RAM	Adder	VPOS2 - From RAM11-To Adder-To RAM11-Clock ROM Addr Ctr
1C	1	1	1	0	1	0	1	0	EA	Adder	Train	VPOS2 - From Adder-To Train-To RAM11-Clock Carry-Clock RAM Addr Ctr
1D	0	0	0	0	1	0	0	1	09	ROM	Adder	VBUMP3 - From ROMB-To Adder-To RAM12
1E	0	1	1	0	1	0	0	1	69	RAM	Adder	VPOS3 - From RAM13-To Adder-To RAM13-Clock ROM Addr Ctr
1F	1	1	1	0	1	0	1	0	EA	Adder	Train	VPOS3 - From Adder-To Train-To RAM13-Clock Carry-Clock RAM Addr

STATE MACHINE BIT DEFINITION
TABLE 3-3

Bit 0	RAM Address Counter Enable
Bit 1	Data Select (1 = RAM Value, 0 = ROM Value) Also Clock ROM Addr Ctr When Leaving ROM Mode
Bit 2	RAM Address 0
Bit 3	1 = Load Horizontal OSC
Bit 4	0 = Clear the Carry
Bit 5	1 = H Process, 0 = V Process
Bit 6	1= Destination is Train, 0 = Destination Is Adder
Bit 7	1 = Source is Memory, 0 = Source Is Adder

STATE MACHINE MEMORY DEFINITION
TABLE 3-4

	RAM CONTENTS	ROM CONTENTS
0	LSB Clock Offset	LSB Clock Offset
1	MSB Clock Offset	MSB Clock Offset
2	LSB Clock FREQ	LSB Clock FREQ
3	MSB Clock FREQ	MSB Clock FREQ
4	HBUMP0	HBUMP0
5	HPOS0*	HBUMP1
6	HBUMP1	HBUMP2
7	HPOS1*	HBUMP3
8	HBUMP2	VBUMP0
9	HPOS2*	VBUMP1
A	HBUMP3	VBUMP2
B	HPOS3*	VBUMP3
C	VBUMP0	
D	VPOS0*	
E	VBUMP1	
F	VPOS1*	
10	VBUMP2	
11	VPOS2*	
12	VBUMP3	
13	VPOS3*	

*Loaded from preload section of River RAM (A5=0).
These values represent the lower right corner of the screen.
Note that HBUMP3 and HPOS3 are not used by the hardware, they are in the ROM and RAM to simplify the software process.

TROUBLESHOOTING "CHANGE LANES™" with Signature Analysis (SA)

Equipment required: Signature Analyzer (e.g. HP5004A)
NOP fixture for Z80B (e.g. Kurz-Kasch NOPZ80)

The "CHANGE LANES" PCB set can be broken down into two main parts for the purpose of troubleshooting. The first is the hardwired timing generators (horizontal and vertical scan counters) and the second is the processor and associated logic. Since much of the processor activity is based on inputs from the timing generators, they would be a good place to start looking for trouble.

All the timing is derived from a 20 MHz oscillator located on the processor PCB. This signal (20 Mhz) is divided by four (5 Mhz) and used to drive the horizontal and verical scan counters. By the way, a signal name followed by an * denotes an active low signal. These show up on the schematic as signal names with a bar over them.

Horizontal and vertical scan counter signatures:

Setup — CLK = 5M (UB-12), rising edge
START = STOP = V8 (U3-10), rising edge

Logic hi = F9A0

H0 (U2-14) = 8PF0
H1 (U2-13) = 6U6U
H2 (U2-12) = 49C6
H3 (U2-11) = H90C
H4 (U1-14) = F979
H5 (U1-13) = 2HH3
H6 (U1-12) = 9330
H7 (U1-11) = 313U
H8 (U3-6) = U57C

V0 (U5-14) = 61HF
V1 (U5-13) = 846C
V2 (U5-12) = H6P5
V3 (U5-11) = HH31
V4 (U6-14) = PFHH
V5 (U6-13) = 2408
V6 (U6-12) = F6F5
V7 (U6-11) = A19U
V8 (U3-10) = 3911
V8* (U3-9) = U0C1

VSYNC (U17- 5) = ICA3
HSYNC (U18- 6) = 7CFH
VSEG1 (U 4- 8) = A01U
VSEG0 (U 4-11) = 6P5A
HRST* (U49-4) = FCF3

Note that many of these signals are used on the other two PCBs, and these signatures are valid on those boards as well.

If these signals are ok, the next step is to check the processor address and data busses. To do this, remove U38 (the Z80B) and replace it with a NOP fixture.

SA Setup: CLK = RD* (U38-21), falling edge.
START = STOP = A15 (U38-5), falling edge.

Logic hi = 0001

A0 = UUUU
A1 = 5555
A2 = CCCC
A3 = 7F7F
A4 = 5H21
A5 = 0AFA
A6 = UPFH
A7 = 52F8
A8 = HC89
A9 = 2H70
A10 = HPP0
A11 = 1293
A12 = HAP7

U25-20 (CS*) = 4P0A
U24-20 (CS*) = 12U3
U23-20 (CS*) = PC01
U22-20 (CS*) = F2A6

Note, the address bus is also present on the other PCBs.
Next, the data bus check. These signatures reflect the integrity of data bus and the four program eproms, U22-U25.

SA setup: CLK = RD* (U38-21), rising edge
START = A15, falling edge
STOP = A15, rising edge (note we're only testing 0000H - 7FFFH).

Logic hi 755U.

D0 = 96F9
D1 = H31C
D2 = 9UF7
D3 = P965

OBJECT 1 CIRCUITS CHECK.

Object 1 circuits generate the lettering (see Theory of Operation) on the screen. If the game is put into self test, the first thing to come up is the checksum screen. All this lettering is generated by the object 1 circuits, and since the screen doesn't change with time, it is useful for generating some stable signatures.

SA setup: Game displaying "checksum" screen
CLK = 5M (U8-12), rising edge
START = STOP = V8 (U3-10), rising edge

Logic hi = F9A0

Object 1 EPROM (U46) address inputs:

U46-1 = 463A
U46-2 = 463A
U46-3 = 463A
U46-4 = 463A
U46-5 = 463A
U46-6 = 463A
U46-7 = 463A
U46-8 = 463A

Object 1 EPROM data outputs:

U46- 9 = 49U3
U46-10 = 209P
U46-11 = H3H3
U46-13 = P0HA

Outputs of Object 1 mux (U57)

U57-3 = HHP0
U57-4 = 0A75
U57-5 = P39C
U57-6 = 2C37
U57-7 = 0217

Note — the OBJ 1 data can be traced further on the Sound/IO PCB.

The further adventures of OBJ 1 signals . . .(on the Sound/IO PCB).

SA setup: set the game display (via self test) to the color bar screen.
CLK = U11-7 (OBJ 1 CLK), rising edge
START = V8*, rising edge
STOP = V8*, falling edge

Logic hi = U0C1

D0 (U11-14) = 4P43
D1 (U11-13) = 4A12
D2 (U11-12) = 8A83
D3 (U11-11) = A006
U 4- 8 = AUAH
U18- 6 = 2U8P
U25-12 = HU3U
U 4- 6 = HU3U
EN1 (U26-8) = 2U8P
EN2 (U26-3) = U0C1
MA4 (U35-2) = 0000
MA5 (U35-3) = HU3U

With the same setup

HS (U36-13) = 6129
CB*(U43-13) = 046C
H1 (U8-22) = 0PA5
River-Tree PCB SA.

Much of the River & Tree display circuitry is driven by the state machine, U88 (see Theory of Operation). The timing signals generated here are used in several places on the board.

SA setup: CLK = U115-2, falling edge
START = STOP = U105-2, rising edge

Logic hi = UFP6.

Latched outputs of state machine:

U89-2 = UF6P
U89-5 = UP6F
U89-6 = 005F
U89-9 = 148C
U89-12 = 3F39
U89-15 = 0002
U89-16 = U8UF
U89-19 = 0088

Outputs of River address bus counter:

U73-14 = 0U2F
U73-13 = 82H0
U73-12 = 007F
U73-11 = 83HF

Outputs of first counter for math eprom:

U18 -14 = 2C28
U18 -13 = 18HC
U18 -12 = 8433
U18 -11 = 83F0

U119- 5 = 7HAF

Move the SA CLK to U104-8 (CLKTRAIN2),set CLK, START, & STOP for falling edge.

Logic hi = 59A4

U59 address inputs:

U59-1 = 0000
U59-2 = 59A4
U59-3 = U569
U59-4 = UP6F
U59-5 = 4F50
U59- 6 = C87F
U59- 7 = 6H45
U59- 8 = OPAP
U59-10 = 59A4

Math eprom data and address signals (U44)

SA setup: CLK = U4-5, rising edge
START = V8*, falling edge
STOP = V8*, rising edge
Game set on "checksum" screen

Logic hi = 5456

U44- 1 = 2A2C
U44- 2 = 2A2C
U44- 3 = 2A2C
U44- 4 = 2A2C
U44- 5 = 2A2C
U44- 6 = 0000
U44- 7 = 0000
U44- 8 = 0000
U44- 9 = 0000
U44-10 = 5456
U44-11 = 7P7H
U44-13 = 5456
U44-14 = 2A2C
U44-15 = 2A2C
U44-16 = 2A2C
U44-17 = 5456
U44-23 = 2A2C

U45- 4 = 0000
U45- 7 = 5456
U45- 9 = 5456
U45-12 = 7P7H

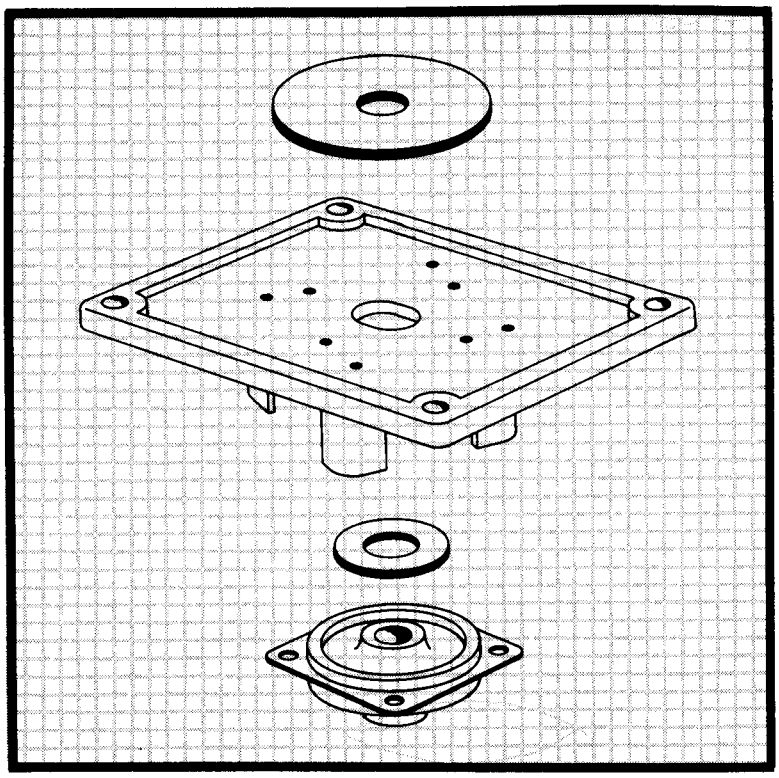


Illustration & Parts Lists

4

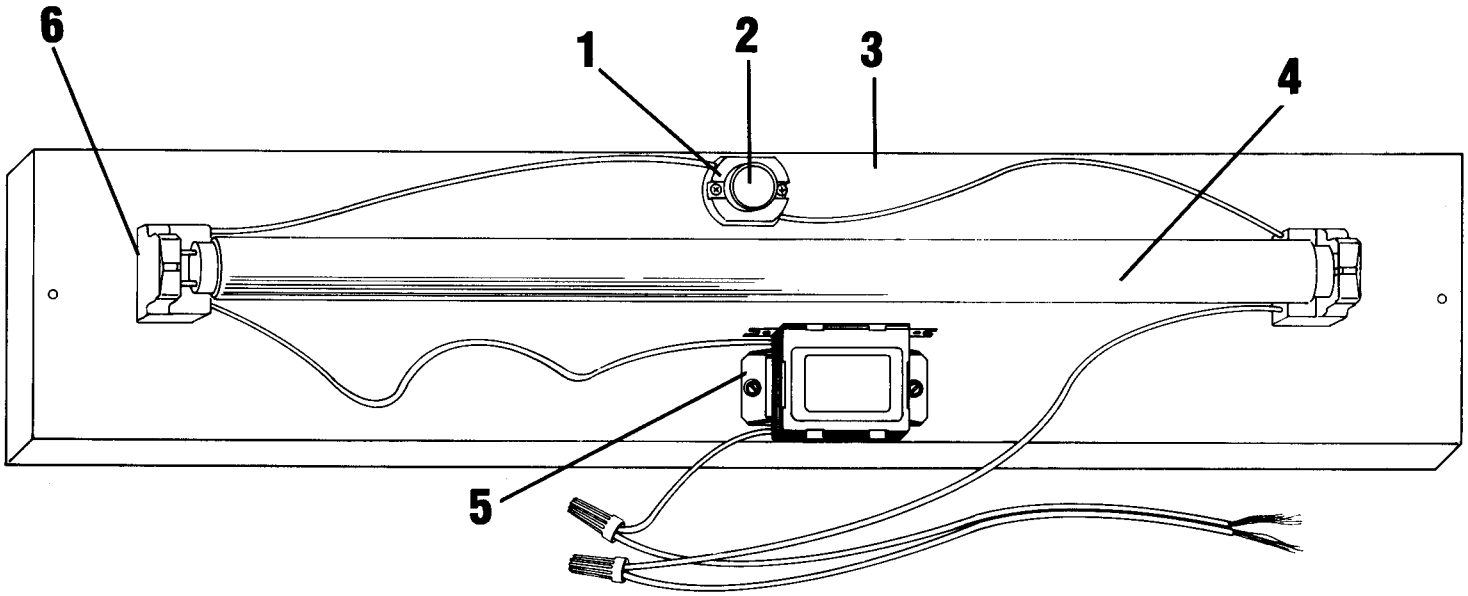
FLUORESCENT PANEL
(07-00273-001)

FIGURE 1

ITEM	TAITO PART NO.	DESCRIPTION
1	26-00005-001	Starter Socket, Fluorescent
2	29-00003-001	Switch Starter, Fluorescent
3	42-00147-001	Light Panel, C.L.
4	27-00001-001	Lamp, Fluorescent 15W
5	18-00002-001	Ballast Transformer 120V
6	26-00004-001	Lamp Socket, Fluorescent

FLUORESCENT PANEL
(07-00273-001)

FIGURE 1



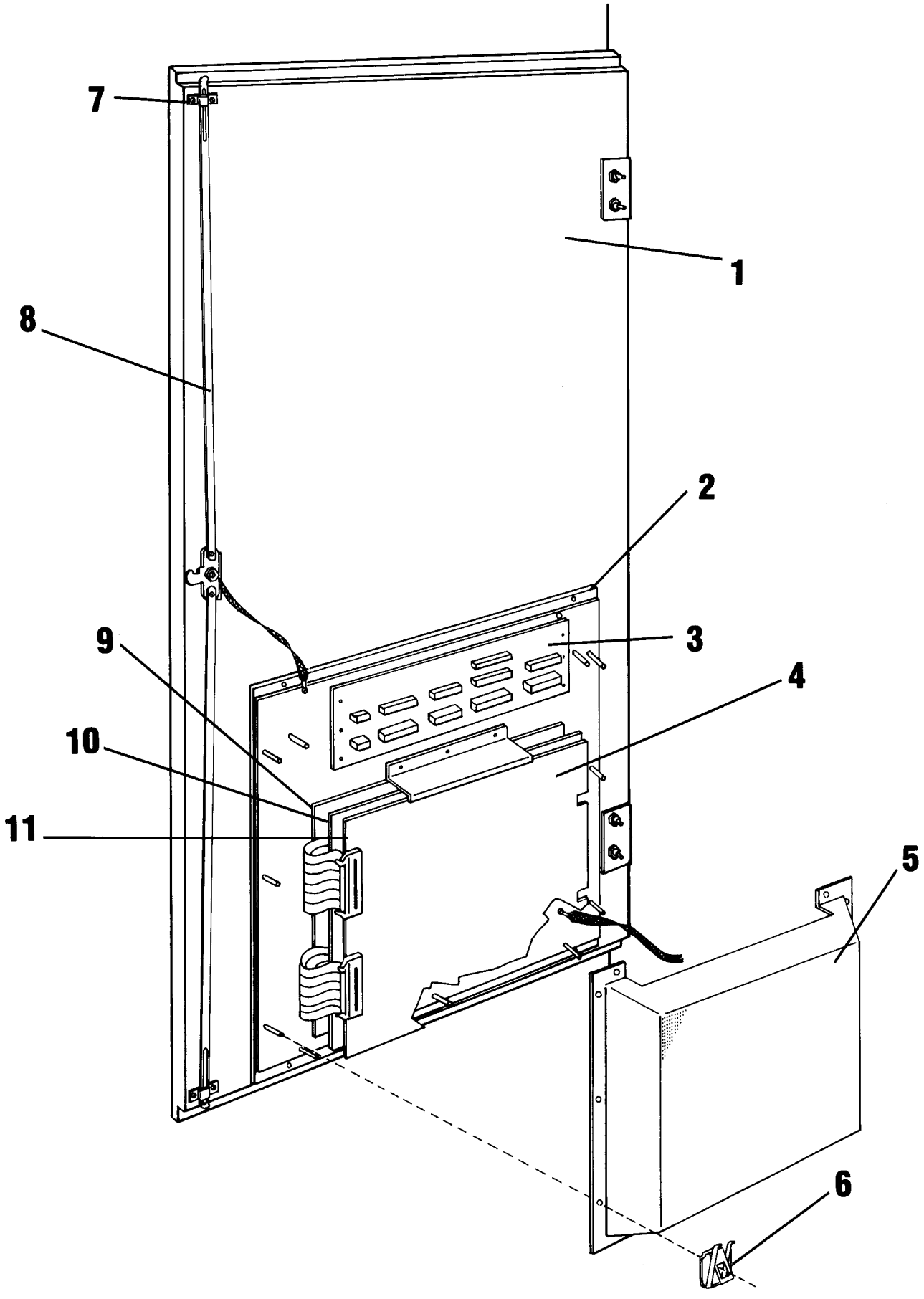
BACK DOOR

FIGURE 2

ITEM	TAITO PART NO.	DESCRIPTION
1	42-00148-001	Back Door
2	61-00300-001	Ground Plate
3	08-00114-001	Filter Bd. Assy.
4	08-00113-001	PCB Set C.L.
5	63-00140-001	Shield EMI/RFI
6	59-00057-001	Speed Nut
7	61-00221-001	Bracket, Lock Rod L-1
8	61-00246-001	Lock Rod Assy L-1
9	08-00107-001	Processor PCB
10	08-00108-001	River-Tree PCB
11	08-00109-001	Sound / I/O

BACK DOOR

FIGURE 2



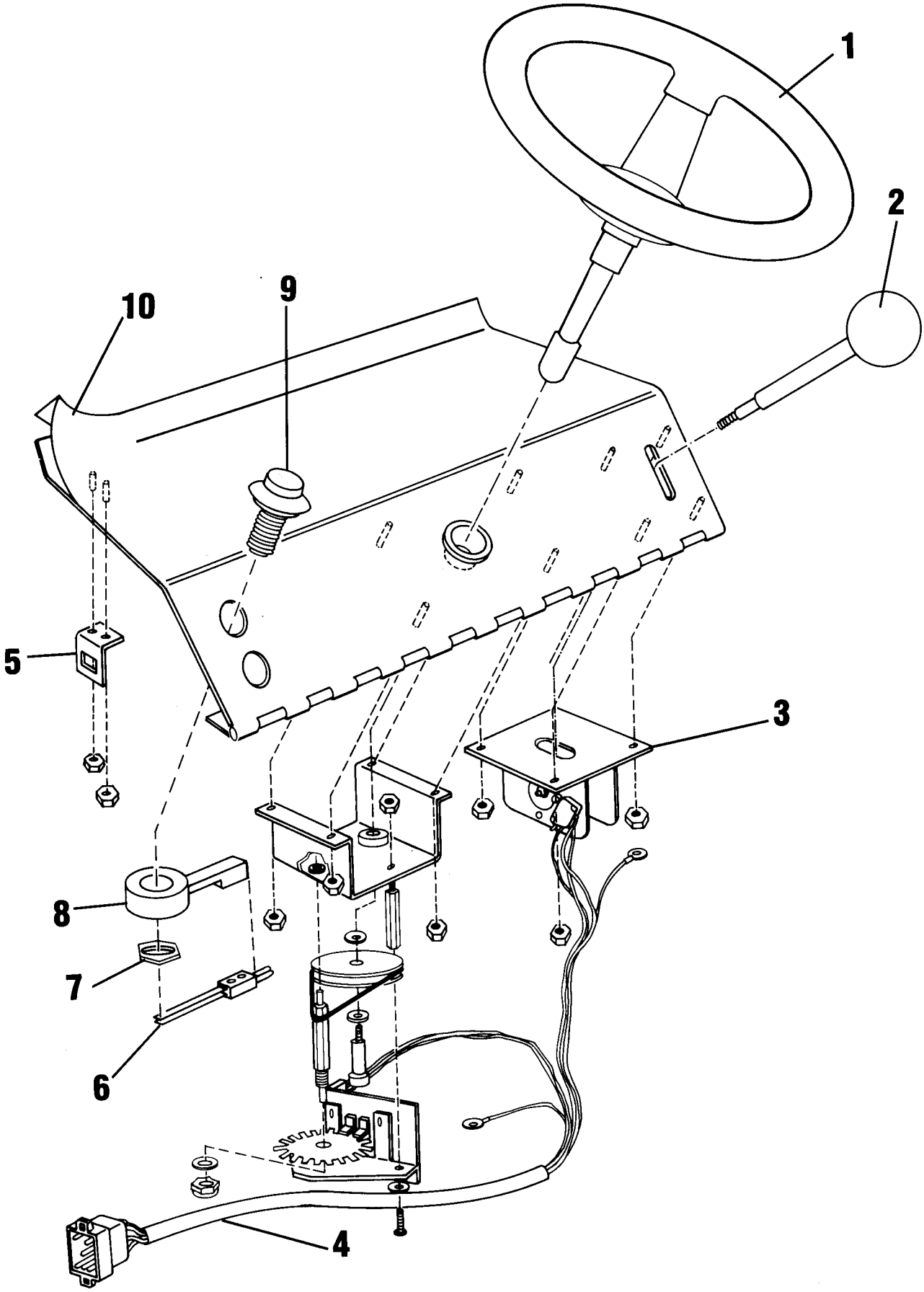
CONTROL PANEL

FIGURE 3

ITEM	TAITO PART NO.	DESCRIPTION
1	63-00139-001	Steering Wheel
2	63-00141-001	Shift Ball & Shaft
3	07-00259-001	Shift Assembly
4	09-00269-001	Harness
5	61-00015-001	Strike Hook
6	29-00016-001	Leaf Switch
7	54-07001-008	Nut Stamped ⅝-11
8	63-00025-001	Switch Support
9	63-00024-001	Push Button Short White
10	63-00132-001	Lexan Overlay

CONTROL PANEL

FIGURE 3



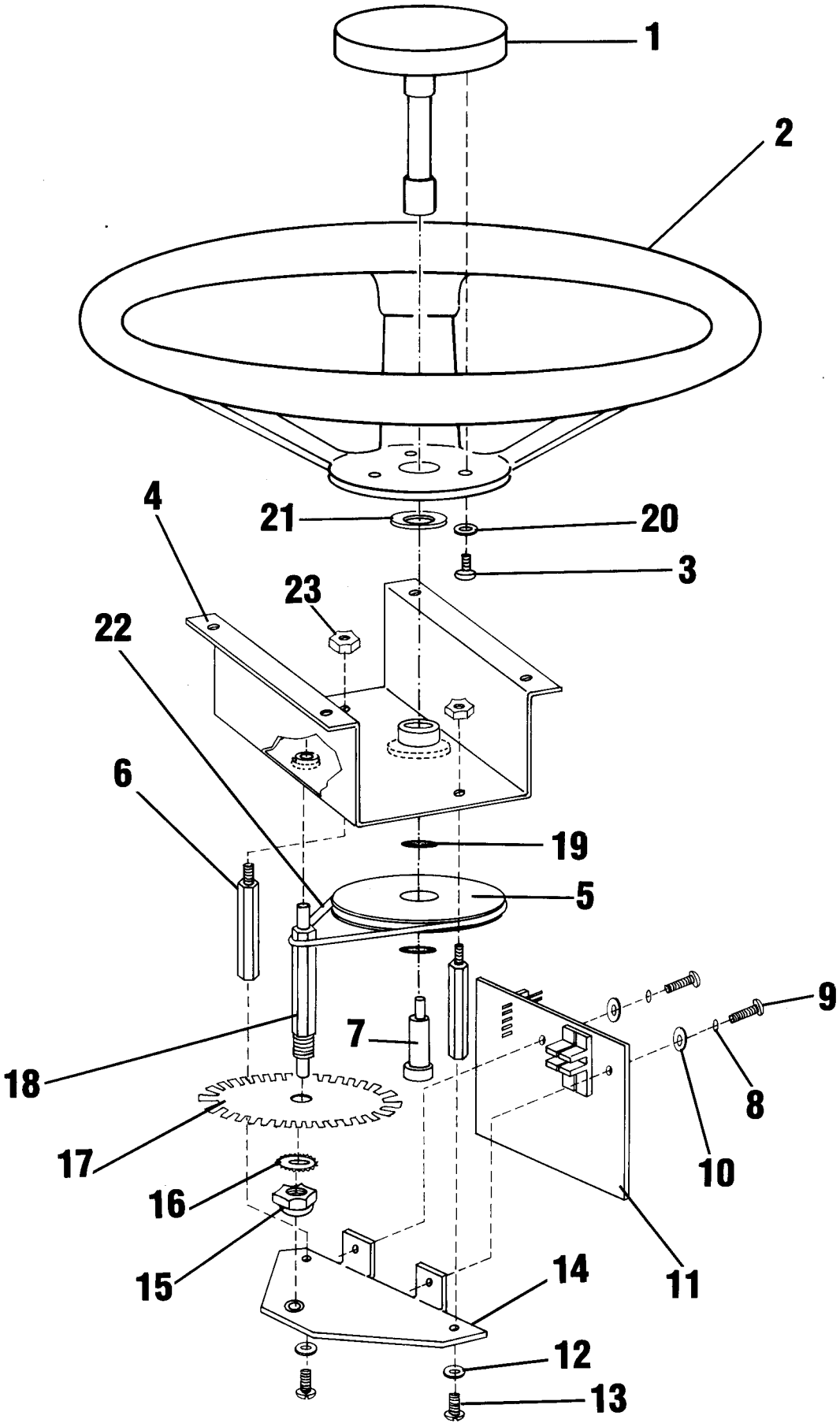
STEERING WHEEL ASSEMBLY

FIGURE 4

ITEM	TAITO PART NO.	DESCRIPTION
1	61-00299-001	Drive Shaft
2	63-00139-001	Steering Wheel
3	51-02024-104	#10-24 Screws
4	61-00303-001	Bracket
5	63-00150-001	Pulley
6	59-00058-001	Standoff
7	51-00014-001	Shoulder Screw
8	55-02001-001	Lockwasher # split
9	51-02011-002	Screw #4-40 x ¼ Hex Wshr. Hd.
10	55-01001-001	Flat Washer #4
11	08-00121-001	Optocoupler P.C. Assy.
12	55-02002-001	Lockwasher #4 Split
13	51-02012-004	Screw #6-32 x ⅜ Hex Wshr. Hd.
14	61-00267-001	Mounting Bracket
15	54-03007-001	Locknut ⅜-16 Nylon Insert
16	55-03007-001	Lockwasher ⅜ External
17	61-00266-001	Interrupter Wheel
18	61-00308-001	Drive Shaft
19	55-00001-002	Lockwasher ¼ Internal
20	55-02004-001	Lockwasher #10 Split
21	55-01008-001	Washer 1" O.D. x ½ I.D. x 14GA
22	62-00007-001	"O" Ring
23	54-00002-001	Nut #6-32 Kepsnut

STEERING WHEEL ASSEMBLY

FIGURE 4



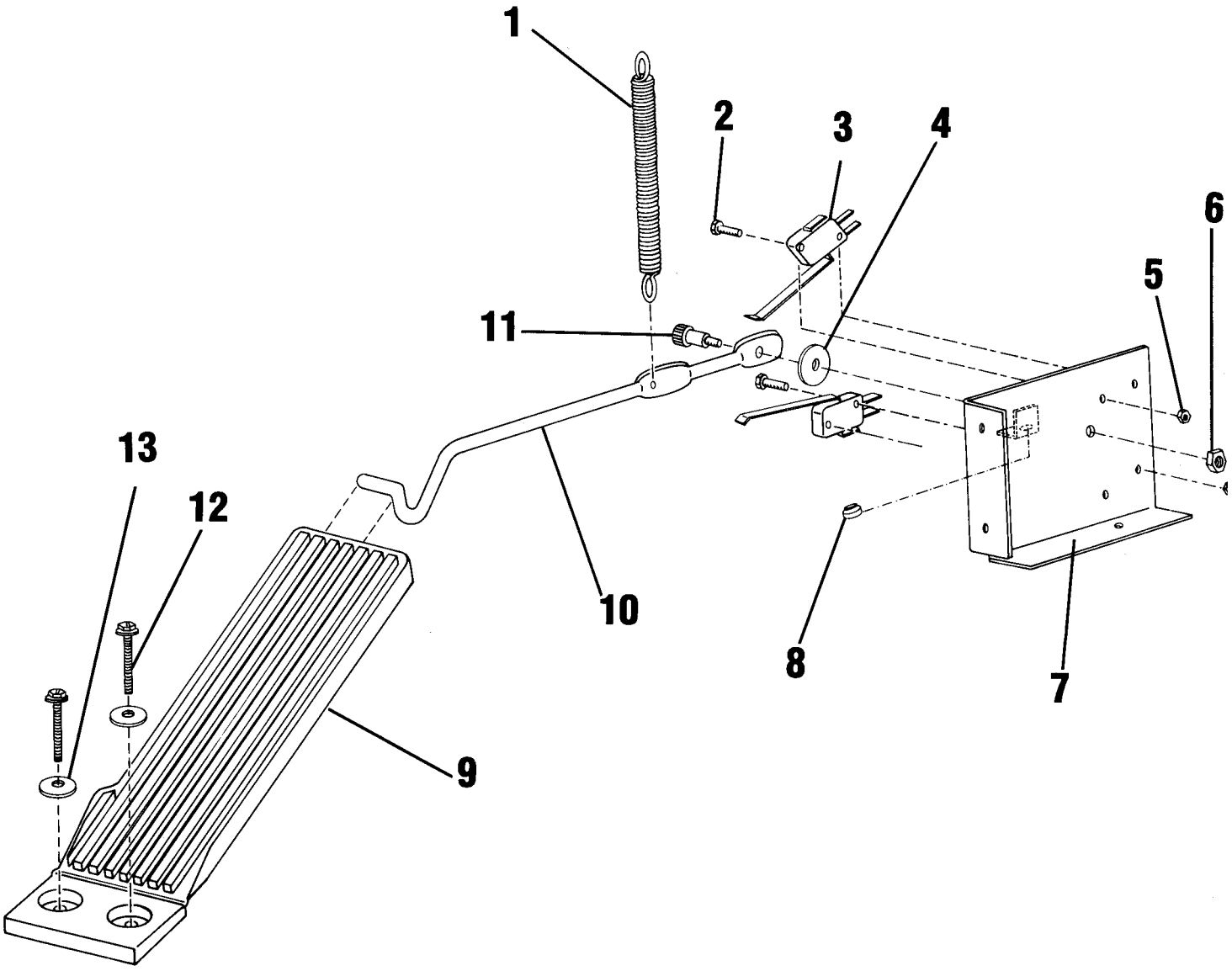
ACCELERATOR ASSEMBLY

FIGURE 5

ITEM	TAITO PART NO.	DESCRIPTION
1	58-00008-001	Extension Spring
2	51-02011-009	Screw 4-40 x ¾
3	29-00040-002	Switch
4	55-00002-001	Washer Nylon C.L.
5	54-02001-001	Keps Nut 4-40
6	54-02004-001	Keps Nut #10-24
7	61-00288-001	Accelerator Switch Plate
8	62-00008-001	Rubber Bumper
9	63-00151-001	Accelerator Pedal
10	61-00287-001	Pedal Lever
11	51-00013-001	Shoulder Screw
12	51-02014-001	#10-24 x 1" Screw
13	55-01004-001	#10 x ½ OD Washer

ACCELERATOR ASSEMBLY

FIGURE 5



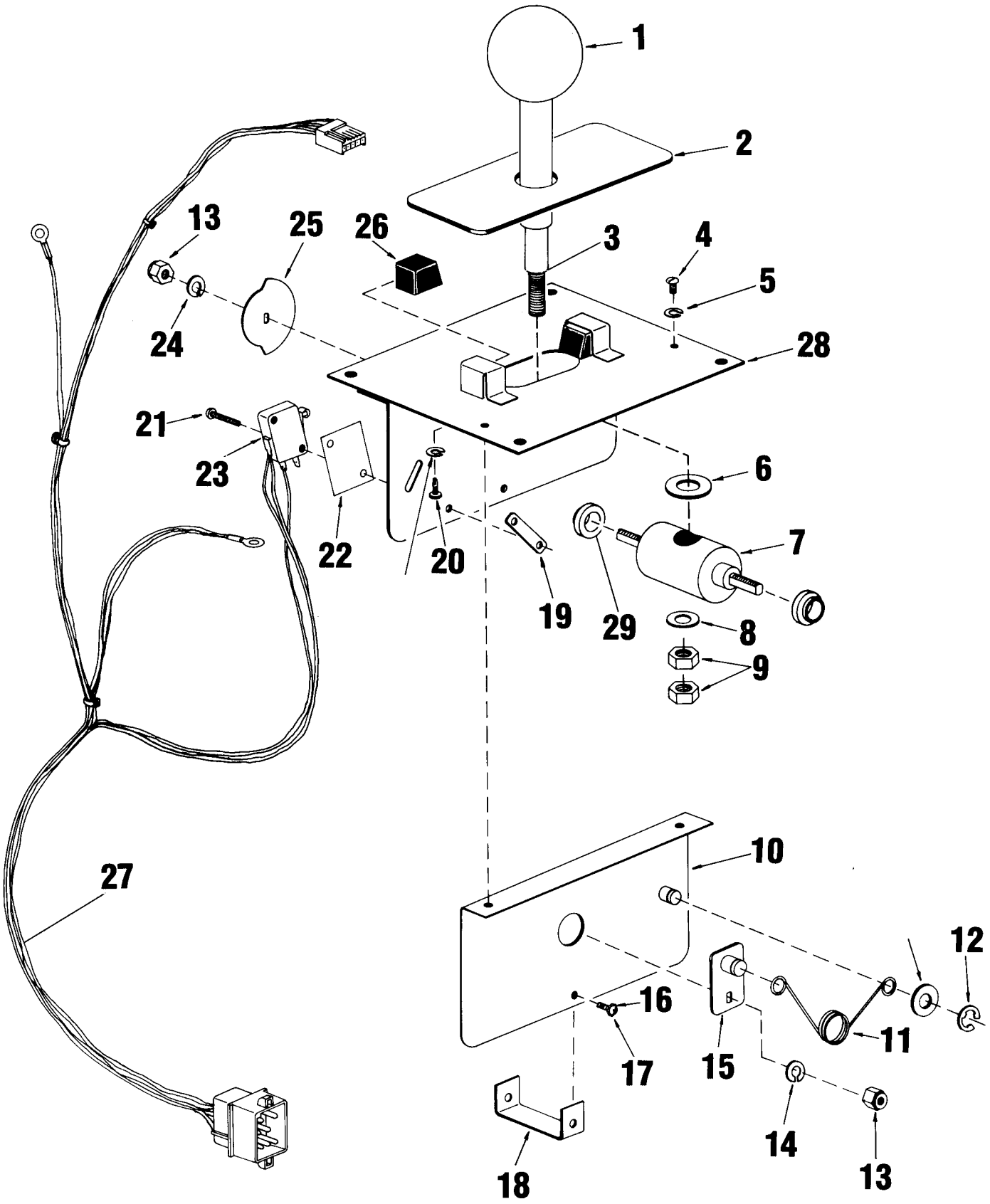
SHIFT LEVER ASSEMBLY

FIGURE 6

ITEM	TAITO PART NO.	DESCRIPTION
1	99-F90-00288A	Shift Knob
2	99-F90-00557A	Mask
3	99-E10-00380A	Lever
4	99-P06-00021A	Pan Hd Screw M3 x 6
5	99-P30-00004A	Lock Washer 3M
6	99-P27-00010A	Plain Washer 8M
7	99-E10-00385A	Center Shaft
8	99-P27-00009A	Plain Washer 6M
9	99-P26-00011A	Flange Nut M6
10	99-E30-01470A	Shift Bracket (A)
11	99-E40-00090A	Spring
12	99-P32-00007A	E-Ring ETWJ-4
13	99-P21-00002A	Self Locking Nut
14	99-P29-00008A	Spring Washer
15	99-F10-00381A	Guide Arm
16	99-P21-00002A	Self Locking Nut
17	99-P06-00021A	Pan Hd Screw M3 x 6
18	99-E30-01459A	Spacer
19	99-E30-00153A	Nut Plate
20	99-P15-00032A	Pan Hd Screw Self Tap
21	99-P43-00026A	Bind Hd Screw M3 x 16
22	99-F90-00150A	Insulator V-type
23	99-C02-00083A	Micro Switch AH7155660
24	99-P29-00008A	Spring Washer 5M
25	99-F30-01434A	Cam
26	99-F90-00553A	Rubber Bumper
27	09-00255-001	Wiring Harness
28	99-E90-00419A	Shift Bracket (B)
29	99-E10-00386A	Oilite Bush

SHIFT LEVER ASSEMBLY

FIGURE 6



COIN DOOR

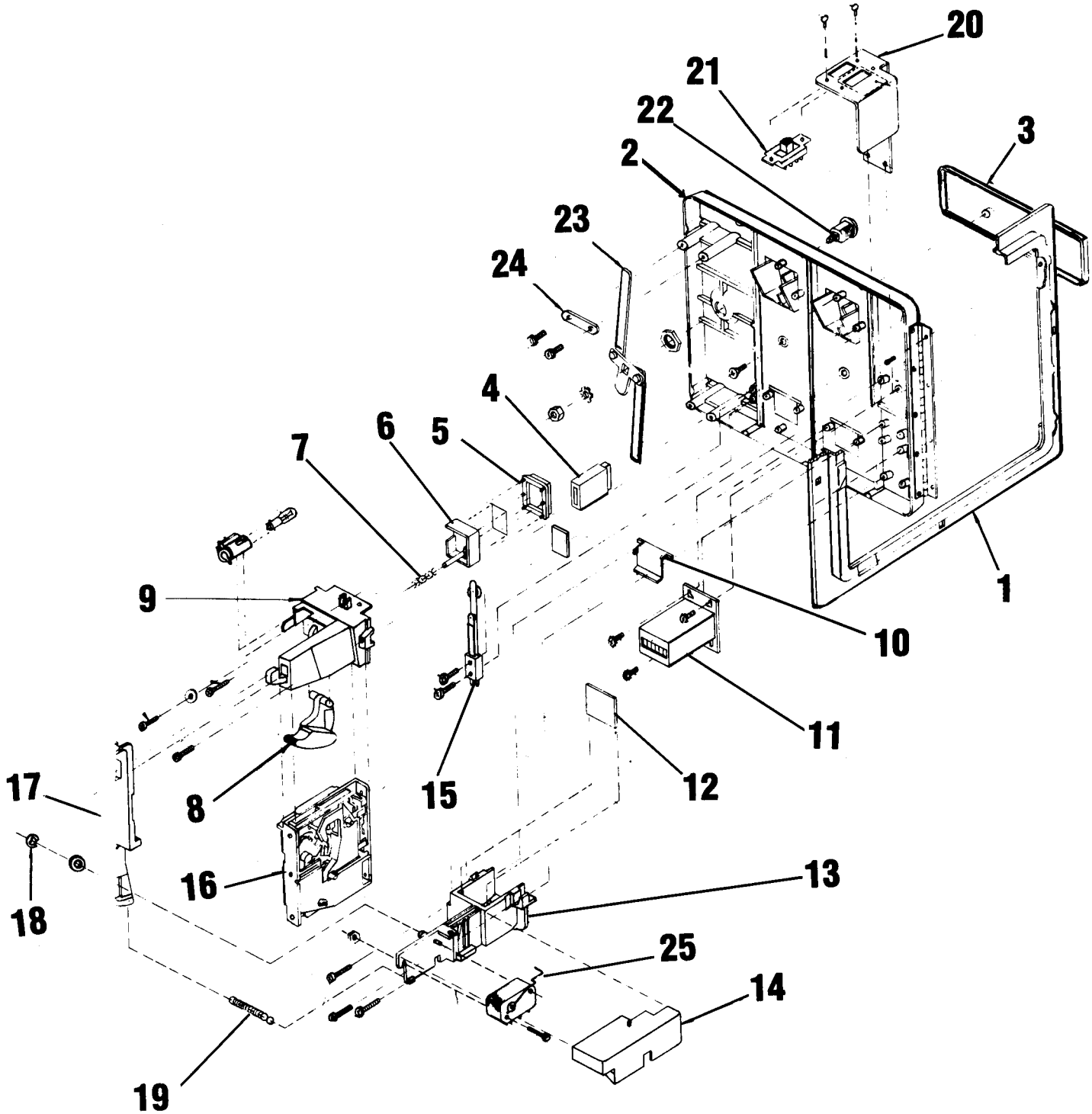
FIGURE 7

ITEM	TAITO PART NO.	DESCRIPTION	REFERENCE
1	61-00270-001	Door Frame	15-8039
2	61-00271-001	Door	15-8038
3	61-00273-001	Taito Name Plate	15-8115
4	63-00124-001	Coin Entry Slot	15-8074
5	63-00125-001	Push Button Cover	15-8072
6	63-00126-001	Push Button	15-8071
7	58-00007-001	Compression Spring	30-7722
8	63-00127-001	Reject Lever	15-8084
9	61-00274-001	Coin Chute	15-8075
10	63-00128-001	Coin Return Door	15-8083
11	33-00002-001	Coin Counter 12 V.A.C.	31-4550
12	61-00276-001	Guard	15-8092
13	23-00003-001	Coil Assortment	15-8091
14	63-00130-001	Switch Cover	15-8043
15	29-00036-001	Slam Switch	15-1255
16	59-00055-001	Plastic 25¢ Coin Acceptor	31-4014
17	63-00131-001	Coin Acceptor Retainer	15-8086
18	59-00020-025	¼" "E" Ring	30-0731
19	58-00008-001	Extension Spring	30-7372
20	61-00277-001	Service Switch Bracket (Switchcraft No. 46311 Mar.)	15-8030
21	29-00037-001	Service Switch	23-1339
22	07-00242-001	Lock ⅝" Assembly	34-1855
23	07-00243-001	Lock Cam Assembly	55-2909
24	61-00278-001	Lock Cam Plate	55-2909
25	61-00279-001	Wire Form (Coin Switch)	23-1348
26 *	09-00258-001	Door Cable Assembly	15-0868

* Not Shown

COIN DOOR

FIGURE 7



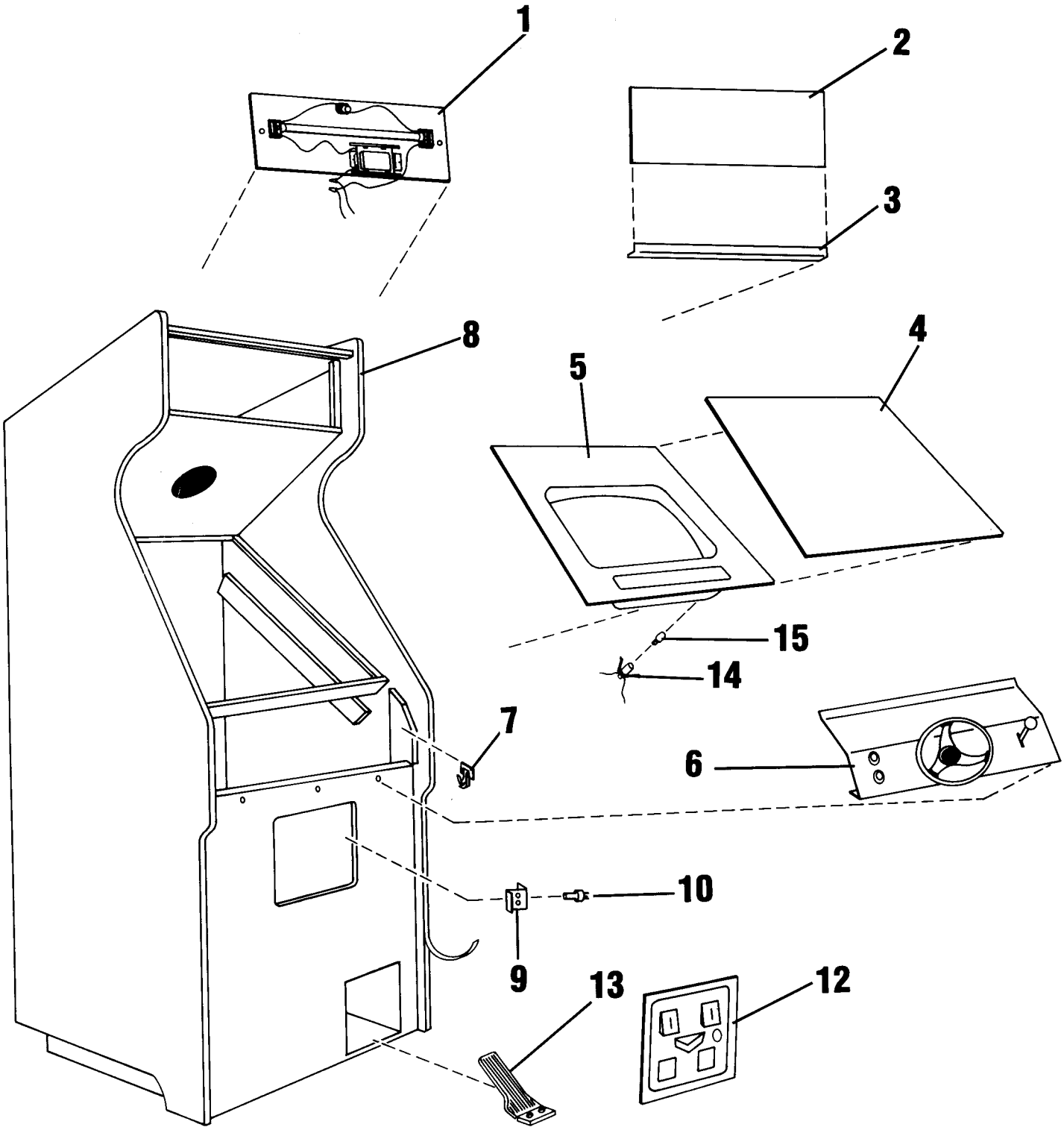
CABINET ASSEMBLY FRONT VIEW

FIGURE 8

ITEM	TAITO PART NO.	DESCRIPTION
1	07-00273-001	Light Panel Assembly
2	47-00019-001	Marquee
3	61-00249-001	Marquee Mounting Bracket
4	47-00021-001	Coverglass
5	63-00089-001	Shroud
6	07-00256-001	Control Panel Assembly
7	59-00008-001	Clamp Latching
8	41-00022-001	Cabinet
9	61-00212-001	Volume Control Bracket
10	11-60002-502	Volume Control
*	61-00277-001	Switch Bracket
*	29-00037-001	Slide, Center Return Switch
12	07-00276-001	Coin Door
13	63-00151-001	Accelerator Pedal
14	27-00006-001	#47 Bulb
15	26-00008-001	Socket Lamp

CABINET ASSEMBLY FRONT VIEW

FIGURE 8



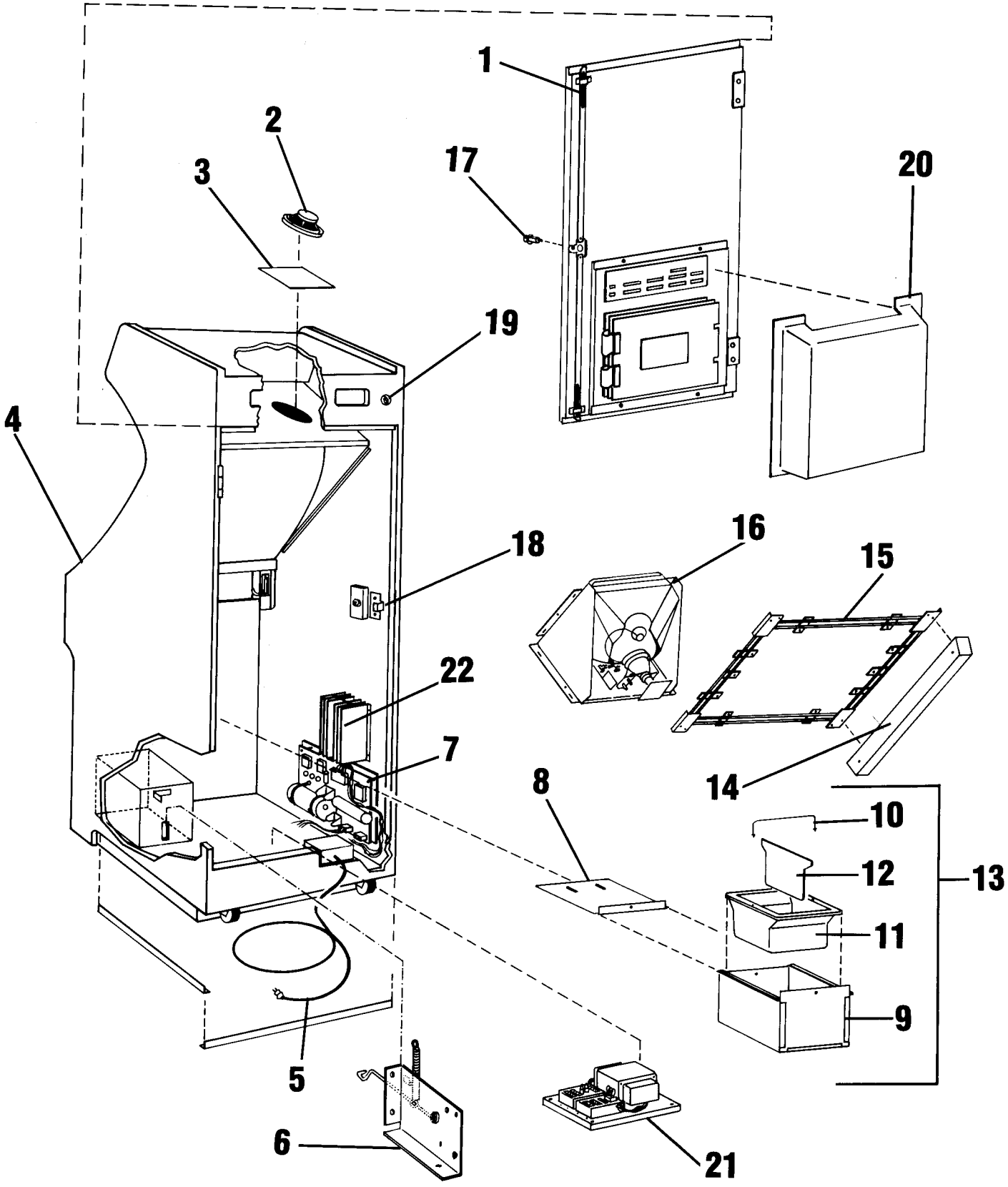
CABINET ASSEMBLY REAR VIEW

FIGURE 9

ITEM	TAITO PART NO.	DESCRIPTION
1	61-00221-001	Lock Rod Bracket
2	07-00083-002	Speaker Assembly
3	61-00038-001	Speaker Grill
4	41-00022-001	Finished Cabinet
5	07M00042-001	A/C Line Cord Assembly
6	07-00258-001	Accelerator Assembly
7	07-00275-001	Regulator Assembly
8	61C00054-001	Cash Box Lid
9	61D00060-001	Cash Box
10	61B00039-001	Cash Tray Handle
11	63R00010-001	Cash Tray Only
12	63-00019-001	Cash Tray Separator
13	07M00054-001	Cash Tray Assembly
14	42C00013-001	Monitor Support Cleat
15	61D00208-011	Monitor Bracket
16	31-00016-001	19" Monitor
17	04-00037-001	Lock Assembly
18	61-00210-001	Latch
19	29-00023-001	Power On-Off Switch
20	63-00140-001	Shield
21	07-00274-001	Transformer Assembly
22	07-00041-001	Heat Sink Assembly

CABINET ASSEMBLY REAR VIEW

FIGURE 9



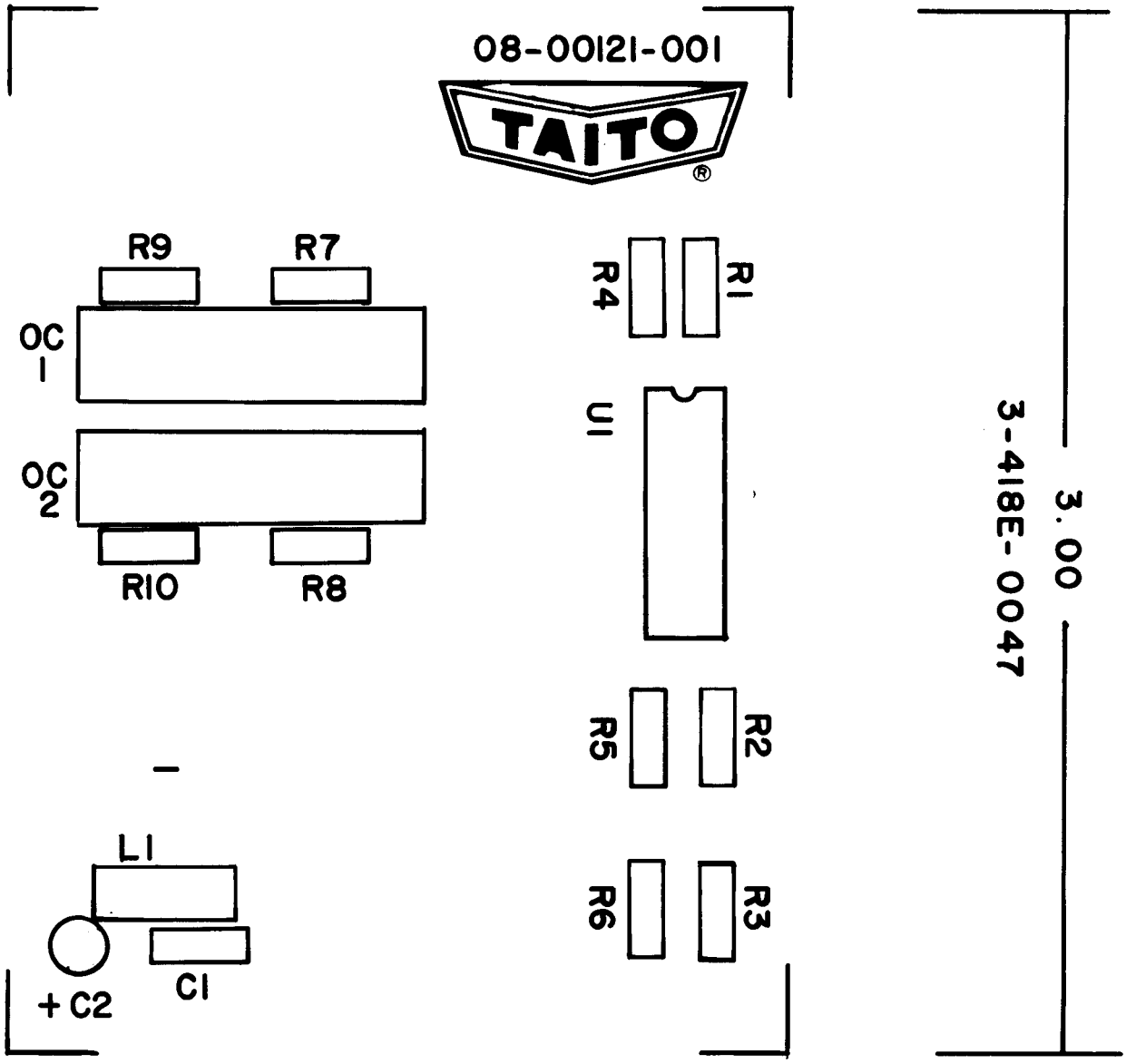
OPTOCOUPLER

FIGURE 10

ITEM	TAITO PART NO.	DESCRIPTION
U1	15-53900-001	LM3900
OC1	15-60010-001	Optocoupler
OC2	15-60010-001	Optocoupler
C1	12-10001-471	470 pf
C2	12-30001-475	4.7 uf tant.
R1	11-00001-513	51K
R2	11-00001-333	33K
R3	11-00001-821	820
R4	11-00001-513	51K
R5	11-00001-333	33K
R6	11-00001-821	820
R7	11-00001-105	1M
R8	11-00001-105	1M
R9	11-00001-241	240
R10	11-00001-241	240
L1	17-00001-001	Ferrite Bead
J1	25-00002-005	5 Pin Connector (mounted on solder side)

OPTOCOUPLER

FIGURE 10



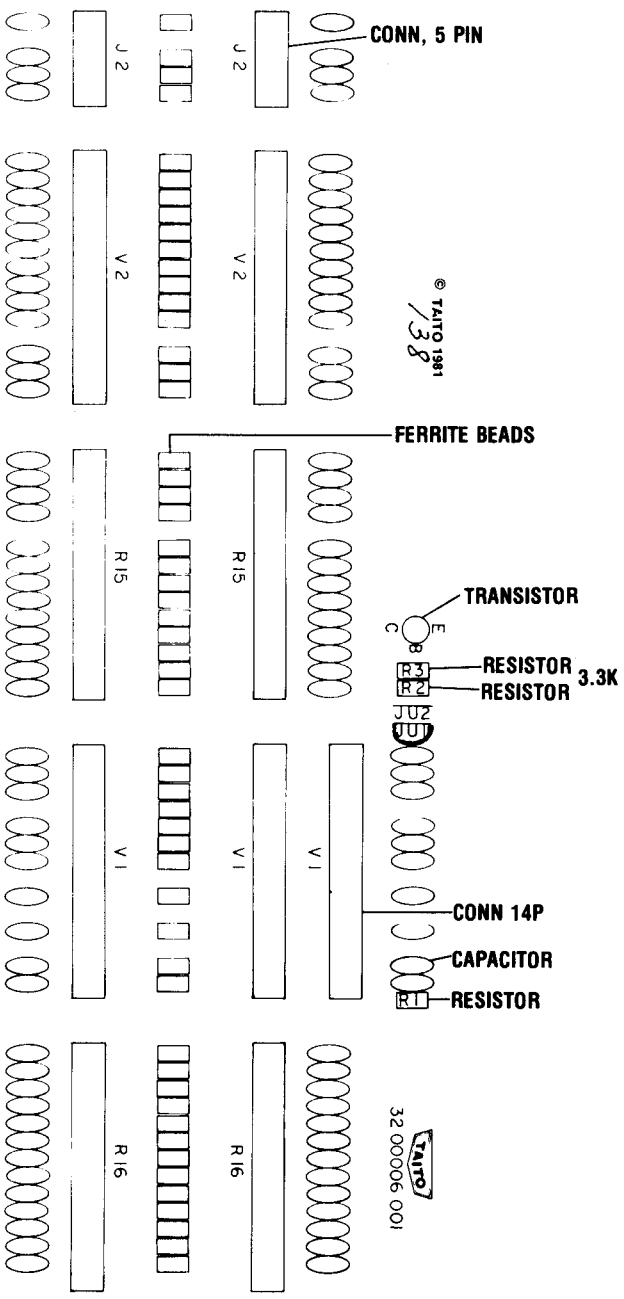
FILTER BOARD

FIGURE 11

ITEM	TAITO PART NO.	DESCRIPTION	QUANTITY
1	12-10003-471	Cap, 470pf ± 10% Axial Lead	74
2	17-00001-001	Ferrite Bead Assembly	12
3	25-00002-014	Connector 14P	9
4	25-00002-005	Connector 5P	2
5	14-23904-001	Transistor NPN 2N3904	1
6	11-00001-102	Resistor 1K ohm ¼W	1
7	11-00001-332	Resistor 3.3 ohm ¼W	2
8	63B00068-001	Stand Off	6
9	17-00002-001	Ferrite Bead Assembly	6
10	17-10001-001	Inductor, 10μH	24

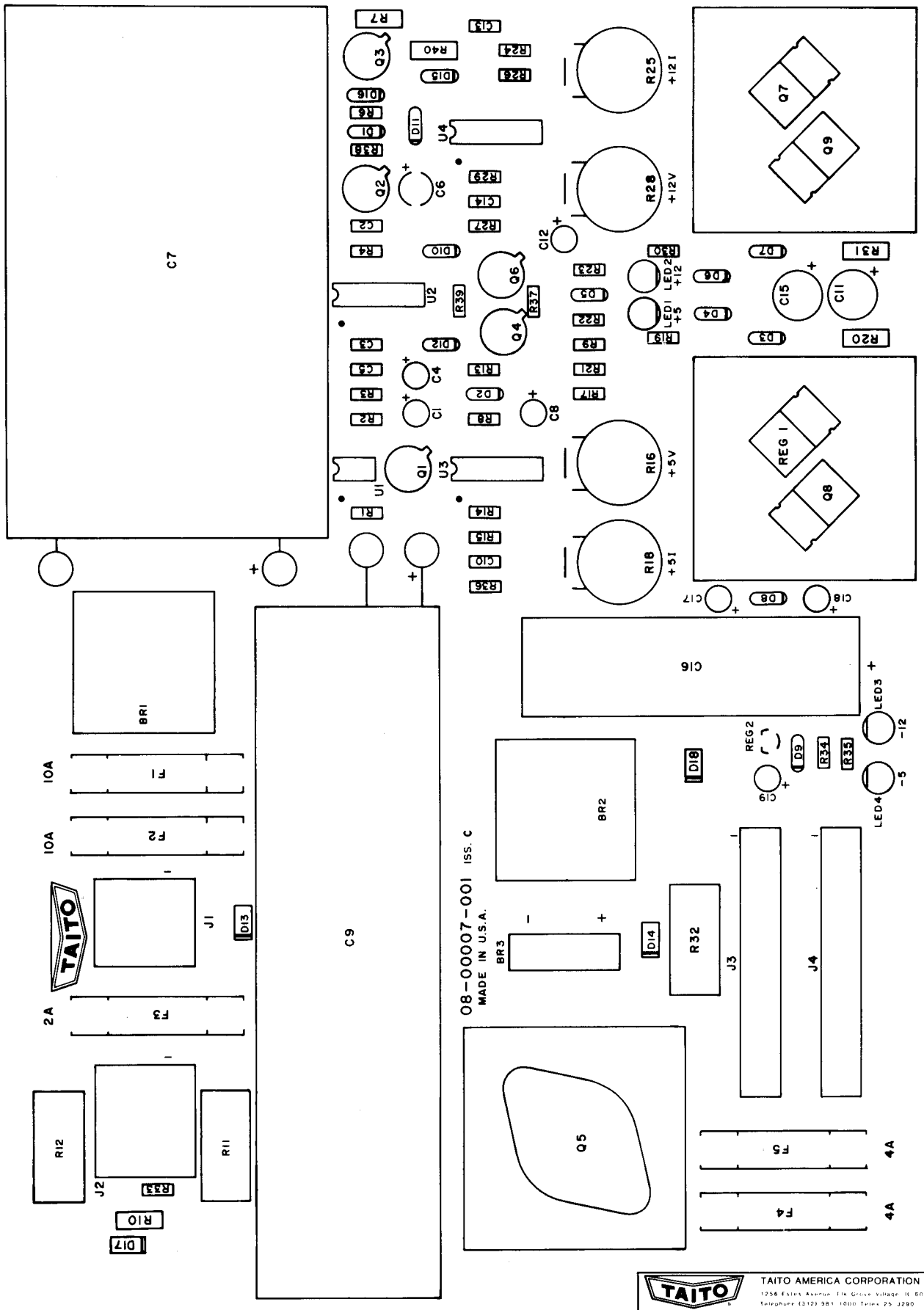
FILTER BOARD

FIGURE 11



POWER SUPPLY COMPONENT LAYOUT

FIGURE 12



TAITO AMERICA CORPORATION
1256 Estes Avenue, Elk Grove Village, IL 60007
Telephone (312) 981-1000 Telex 25-3290

UNLESS OTHERWISE SPECIFIED

DIM TOL	FRACT	MM
.X	±	±
.XX		
.XXX		
ANG		

DRAWN BY | DATE | STATE
APPROVED BY | DATE

DESCRIPTION

FRONT LINE™
Power Supply Board Layout

SIZE | DRAWING NUMBER | SHEET

POWER SUPPLY

FIGURE 12

SYM	TAITO PART NO.	DESCRIPTION
R1	11-00001-102	Resistor 1.0K 5% ¼W 5%
R2	11-00001-512	Resistor 5.1K ¼W 5%
R3	11-00001-183	Resistor 18K ¼W 5%
R4	11-00001-224	Resistor 220K ¼W 5%
R5	11-00001-020	Resistor 2ohm ¼W ± 5%
R6	11-00001-222	Resistor 2.2K ¼W 5%
R7	11-10001-101	Resistor 100K ¼W 5%
R8	11-00001-102	Resistor 10K ¼W 5%
R9	11-00001-472	Resistor 4.7K ¼W 5%
R10	11-10001-101	Resistor 100K ½W 5%
R11	11-30001-015	Resistor .15 4W 5%
R12	11-30001-015	Resistor .15 4W 5%
R13	11-00001-472	Resistor 4.7K ¼W 5%
R14	11-00001-222	Resistor 2.2K ¼W 5%
R15	11-00001-222	Resistor 2.2K ¼W 5%
R16	11-60001-252	Pot 2.5K ¼W 20%
R17	11-00001-222	Resistor 2.2K ¼W 5%
R18	11-60001-102	Pot 1.0K ¼W 20%
R19	11-00001-511	Resistor 510K ¼W 5%
R20	11-10001-470	Resistor 47K ½W 5%
R21	11-00001-162	Resistor 1.6K ¼W 5%
R22	11-00001-103	Resistor 10K ¼W 5%
R23	11-00001-472	Resistor 4.7K ¼W 34
R24	11-00001-222	Resistor 2.2K ¼W 5%
R25	11-60001-102	Pot 1.0K ¼W 5%
R26	11-00001-472	Resistor 470K ¼W 5%
R27	11-00001-222	Resistor 2.2K ¼W 5%
R28	11-60001-252	Pot 2.5K ¼W 20%
R29	11-00001-472	Resistor 4.7K ¼W 5%
R30	11-00001-122	Resistor 1.2K ¼W 5%
R31	11-10001-470	Resistor 47K ¼W 5%
R32	11-30001-015	Resistor .15K 4W 5%
R33	11-00001-222	Resistor 2.2K ¼W 5%
R34	11-00001-122	Resistor 1.2K ¼W 5%
R35	11-00001-511	Resistor 510 ¼W 5%
R36	11-00001-222	Resistor 2.2K ¼W 5%
R37	11-00001-104	Resistor 100K
R38	11-00001-103	Resistor 10K ¼W 5%
R39	11-00001-224	Resistor 220L ¼W 5%
C1	12-30001-225	Capacitor, Tantalum 2.2uf 25V
C2	12-10004-103	Capacitor, Ceramic .01uf
C3	12-10004-103	Capacitor, Ceramic .01uf
C4	12-30001-105	Capacitor, Tantalum 1.uf 35V

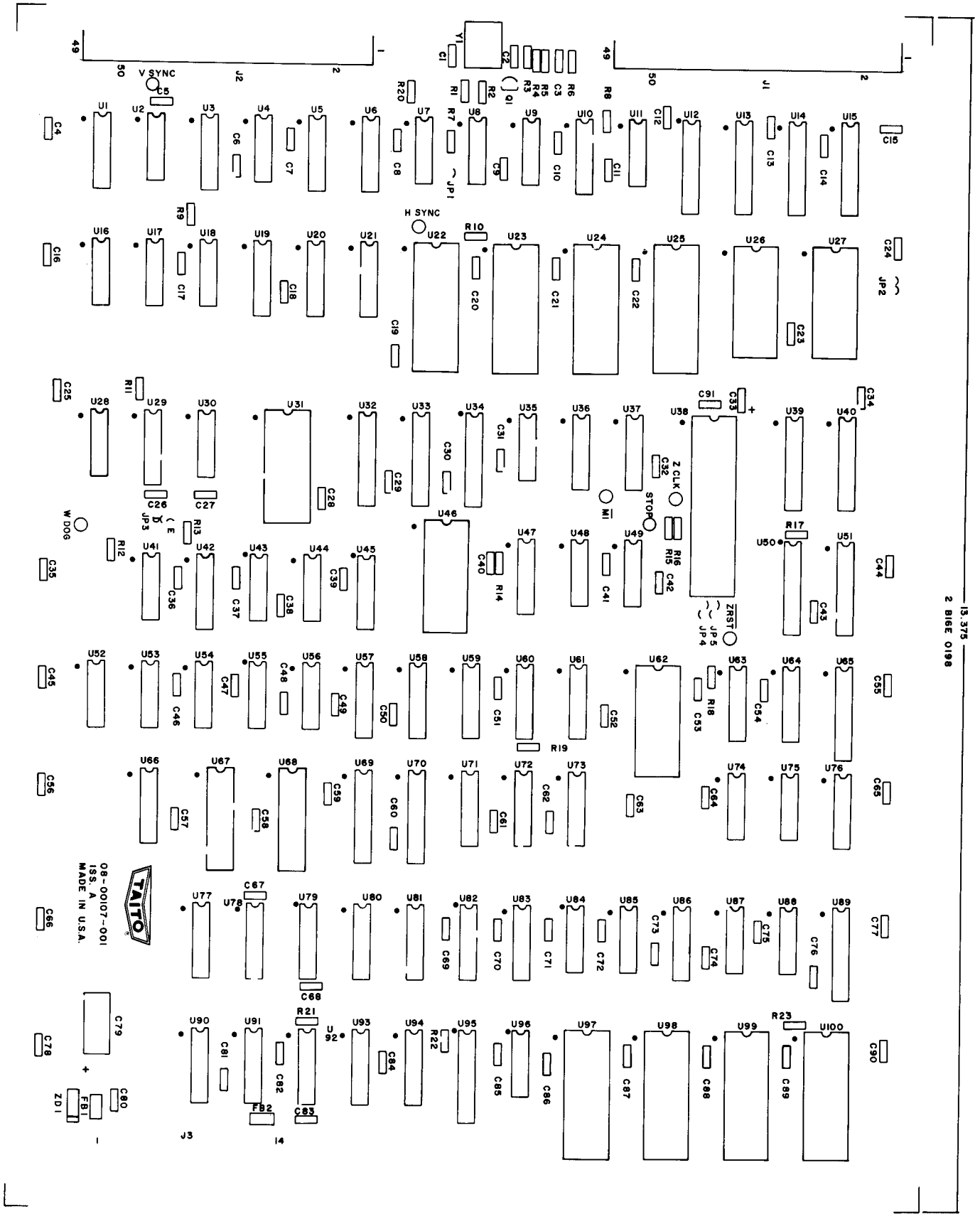
SYM	TAITO PART NO.	DESCRIPTION
C5	12-10001-102	Capacitor, .001uf
C6	12-30001-106	Capacitor, Tantalum 10uf
C7	12-20003-509	Capacitor, Electrolytic 50,000uf
C8	12-30001-105	Capacitor, Tantalum 1.uf 35V
C9	12-20003-209	Capacitor, Electrolytic 20,000uf
C10	12-10001-332	Capacitor, Ceramic .0033uf
C11	12-30001-476	Capacitor, Tantalum 47uf
C12	12-30001-105	Capacitor, Tantalum 1.uf 35V
C13	12-10004-103	Capacitor, Ceramic .01uf
C14	12-10001-102	Capacitor, .001uf
C15	12-30001-476	Capacitor, Tantalum 47uf
C16	12-20002-108	Capacitor, Electrolytic 1,000uf
C17	12-30001-225	Capacitor, Tantalum 2.2uf 25V
C18	12-30001-225	Capacitor, Tantalum 2.2uf 25V
C19	12-30001-105	Capacitor, Tantalum 1.uf 35V
F1	24-00003-010	10A Fuse
F2	24-00003-010	10A Fuse
F3	24-00003-003	Fuse, 2A
F4	24-00003-004	Fuse, 4A
F5	24-00003-004	Fuse, 4A
BR1	13-00100-025	Diode Bridge 25A, 100V
BR2	13-00100-012	Diode Bridge 12A, 100V
BR3	13-00100-002	Diode Bridge 2A, 100V
D1	13-14002-001	Diode IN4002
D2	13-14002-001	Diode IN4002
D3	13-10752-001	Diode, Zener IN4002
D4	13-14002-001	Diode IN4002
D5	13-14002-001	Diode IN4002
D6	13-14002-001	Diode IN4002
D7	13-10964-001	Diode, Zener IN4002
D8	13-14002-001	Diode IN4002
D9	13-14002-001	Diode IN4002
D10	13-14002-001	Diode IN4002
D11	13-14002-001	Diode IN4002
D12	13-14002-001	Diode IN4002
D13	13-16276-001	Transorb (IN6276)
D14	13-16281-001	Transorb (IN6281)
D15	13-14002-001	Diode IN4002
D16	13-14002-001	Diode IN4002
D17	13-16267-001	Transorb (IN6267)
LED1	13-00001-001	LED (Red)
LED2	13-00001-001	LED (Red)
LED3	13-00001-001	LED (Red)
LED4	13-00001-001	LED (Red)

POWER SUPPLY

FIGURE 12

SYM	TAITO PART NO.	DESCRIPTION
U1	15-62500-001	Opto Coupler H11AA2
U2	15-50556-001	Timer (Dual) 556
U3	15-50723-001	Voltage Regulator 723
U4	15-50723-001	Voltage Regualtor 723
REG1	15-57912-001	Voltage Regualtor 7912
REG2	15-57905-001	Voltage Regualtor 79L05
Q1	14-22905-001	Transistor 2N2905
Q2	14-22905-001	Transistor 2N2905
Q3	14-22905-001	Transistor 2N2905
Q4	14-22905-001	Transistor 2N2905
Q5	14-23055-001	Transistor 2N3055
Q6	14-22905-001	Transistor 2N2905
Q7	14-20030-001	Transistor TIP-30A
Q8	14-26401-001	SCR 2N6401
Q9	14-26401-001	SCR 2N6401
J1	25-00022-006	Connector, 1-380999-0 6Pin
J2	25-00022-008	Connector, 350212-1 8Pin
J3	25-00002-014	Connector, 09-60-1141 14Pin
J4	25-00002-014	Connector, 09-60-1140 14Pin
	24-10001-001	Fuse Clips
	30-00220-002	Heat Sink Dual To-220
	30-00003-001	Heat Sink Single To-3

PROCESSOR BOARD COMPONENT LAYOUT
FIGURE 13



PROCESSOR BOARD

FIGURE 13

ITEM	TAITO PART NO.	DESCRIPTION
U1	15-70163-001	74S163 4 Bit Counter
U2	15-70163-001	74S163 4 Bit Counter
U3	15-20109-001	74LS109 Dual JK Flip Flop
U4	15-20008-001	74LS08 Quad 2 Input AND
U5	15-70163-001	74S163 4 Bit Counter
U6	15-70163-001	74S163 4 Bit Counter
U7	15-20086-001	74LS86 Quad 2 Input EXCL
U8	15-70004-001	74S04 Hex Inverter
U9	15-70114-001	74S114 Dual JK FF
U10	15-70112-001	74S112 Dual JK FF
U11	15-70008-001	74S08 Quad 2 Input AND Gate
U12	15-20244-001	74LS244 Qctal Buffer
U13	15-20245-001	74LS245 Bus Transciever Octal
U14	15-20244-001	74LS244 Octal Buffer
U15	15-20244-001	74LS244 Octal Buffer
U16	15-20002-001	74LS02 Quad 2 Input NOR
U17	15-20074-001	74LS74 Flip Flop Dual D
U18	15-20074-001	74LS74 Flip Flop Dual D
U19	15-20157-001	74LS157 Mux Quad 2 Input
U20	15-20157-001	74LS157 Mux Quad 2 Input
U21	15-20157-001	74LS157 Mux Quad 2 Input
U22	16-00026-001	EPROM Change Lanes
U23	16-00026-002	EPROM Change Lanes
U24	16-00026-003	EPROM Change Lanes
U25	16-00026-004	EPROM Change Lanes
U26	15-10013-001	RAM, Static NMOS 2KX8 200NS
U27	16-00026-005	EPROM Change Lanes
U28	15-20074-001	74LS74 Flip Flop Dual D
U29	15-20193-001	74LS193 4 Bit I/O Control
U30	15-20004-001	74LS04 Inverter Hex
U31	15-10013-001	RAM, Static NMOS 2KX8 200NS
U32	15-20377-001	74LS377 Octal D FF
U33	15-20377-001	74LS377 Octal D FF
U34	15-20245-001	74LS245 Bus Transciever Octal
U35	15-20021-001	74LS21 Dual 4 Input-AND
U36	15-20138-001	74LS138 Decoder 1 of 8
U37	15-20139-001	74LS139 Dual Decoder, 1 of 4
U38	15-00015-001	Z80B Microprocessor
U39	15-20244-001	74LS244 Octal Buffer
U40	15-20244-001	74LS244 Octal Buffer
U41	15-20074-001	74LS74 Flip Flop Dual D
U42	15-20175-001	74LS175 Quad Flip Flop
U43	15-20032-001	74LS32 Quad 2 Input OR
U44	15-20004-001	74LS04 Inverter Hex
U45	15-20283-001	74LS283 4 Bit Binary ADD
U46	16-00026-006	PROM Change Lanes
U47	15-20112-001	74LS112 Dual JK FF
U48	15-20032-001	74LS32 Quad 2 Input DR

ITEM	TAITO PART NO.	DESCRIPTION
U49	15-20004-001	74LS04 Inverter Hex
U50	15-20244-001	74LS244 Octal Buffer
U51	15-20245-001	74LS245 Bus Transceiver
U52	15-70008-001	74S08 Quad 2 Input AND Gate
U53	15-70051-001	74S51 Dual AND-OR Invert
U54	15-20032-001	74LS32 Quad 2 Input OR
U55	15-20032-001	74LS32 Quad 2 Input OR
U56	15-70020-001	74S20 Dual 4-Input NAND
U57	15-20153-001	74LS153 Multiplexer Dual
U58	15-20670-001	74LS670 4x4 Register File
U59	15-20670-001	74LS670 4x4 Register File
U60	15-20157-001	74LS157 Mux Quad 2 Input
U61	15-20157-001	74LS157 Mux Quad 2 Input
U62	15-10013-001	RAM, Static NMOS 2KX8 200NS
U63	15-20157-001	74LS157 Mux Quad 2 Input
U64	15-20175-001	74LS175 Quad Flip Flop
U65	15-20245-001	74LS245 Bus Transceiver
U66	15-20175-001	74LS175 Quad Flip Flop
U67	15-10020-001	256X4 RAM
U68	15-10020-001	256X4 RAM
U69	15-20377-001	74LS377 Octal D FF
U70	15-20377-001	74LS377 Octal D FF
U71	15-20139-001	74LS139 Dual Decoder
U72	15-20161-001	74LS161 Counter 4 Bit Preset
U73	15-20161-001	74LS161 Counter 4 Bit Preset
U74	15-20000-001	74LS00 Quad 2 Input NAND
U75	15-20032-001	74LS32 Quad 2 Input OR
U76	15-20157-001	74LS157 Mux Quad 2 Input
U77	15-20157-001	74LS157 Mux Quad 2 Input
U78	15-20157-001	74LS157 Mux Quad 2 Input
U79	15-20161-001	74LS161 Counter 4 Bit Preset
U80	15-20283-001	74LS283 4 Bit Binary Add
U81	15-20085-001	74LS85 4 Bit Comparator
U82	15-20175-001	74LS175 Quad Flip Flop
U83	15-20169-001	74LS169 UP/DN Counter
U84	15-20000-001	74LS00 Quad 2 Input NAND
U85	15-20000-001	74LS00 Quad 2 Input NAND
U86	15-20109-001	74LS109 JK FF
U87	15-20086-001	74LS86 Quad 2 Input X OR
U88	15-20000-001	74LS00 Quad 2 Input NAND
U89	15-20377-001	74LS377 Octal D FF
U90	15-20157-001	74LS157 Mux Quad 2 Input
U91	15-20157-001	74LS157 Mux Quad 2 Input
U92	15-20161-001	74LS161 Counter 4 Bit Preset
U93	15-20283-001	74LS283 4 Bit Binary Add
U94	15-20085-001	74LS85 4 Bit Comparator
U95	15-20377-001	74LS377 Octal D FF
U96	15-20086-001	74LS86 Quad 2 Input X OR

PROCESSOR BOARD

FIGURE 13

ITEM	TAITO PART NO.	DESCRIPTION
U97	16-00026-007	2764-3 E-PROM Change Lanes
U98	16-00026-008	2764-3 E-PROM Change Lanes
U99	16-00026-009	2764-3 E-PROM Change Lanes
U100	16-00026-010	2764-3 E-PROM Change Lanes
Q1	14-23906-001	Trans 2N3906
FB1	17-00001-001	Ferrite Bead
FB2	17-00001-001	Ferrite Bead
Y1	19-00003-001	Crystal 20.000 MHz
C1	12-10003-101	Cap, Disc 100pf 10% NPO
C2	12-10003-101	Cap, Disc 100pf 10% NPO
C3	12-10003-330	Cap, 33pf
C4	12-10002-104	Cap, Cer .1uf 50V
C5	12-10002-104	Cap, Cer .1uf 50V
C6	12-10002-104	Cap, Cer .1uf 50V
C7	12-10002-104	Cap, Cer .1uf 50V
C8	12-10002-104	Cap, Cer .1uf 50V
C9	12-10002-104	Cap, Cer .1uf 50V
C11	12-10002-104	Cap, Cer .1uf 50V
C12	12-10002-104	Cap, Cer .1uf 50V
C13	12-10002-104	Cap, Cer .1uf 50V
C14	12-10002-104	Cap, Cer .1uf 50V
C15	12-10002-104	Cap, Cer .1uf 50V
C16	12-10002-104	Cap, Cer .1uf 50V
C17	12-10002-104	Cap, Cer .1uf 50V
C18	12-10002-104	Cap, Cer .1uf 50V
C19	12-10002-104	Cap, Cer .1uf 50V
C20	12-10002-104	Cap, Cer .1uf 50V
C21	12-10002-104	Cap, Cer .1uf 50V
C22	12-10002-104	Cap, Cer .1uf 50V
C23	12-10002-104	Cap, Cer .1uf 50V
C24	12-10002-104	Cap, Cer .1uf 50V
C25	12-10002-104	Cap, Cer .1uf 50V
C26	12-10002-104	Cap, Cer .1uf 50V
C27	12-10002-104	Cap, Cer .1uf 50V
C28	12-10002-104	Cap, Cer .1uf 50V
C29	12-10002-104	Cap, Cer .1uf 50V
C30	12-10002-104	Cap, Cer .1uf 50V
C31	12-10002-104	Cap, Cer .1uf 50V
C32	12-10002-104	Cap, Cer .1uf 50V
C33	12-30001-106	Cap, Tant 10uf 16V
C34	12-10002-104	Cap, Cer .1uf 50V
C35	12-10002-104	Cap, Cer .1uf 50V
C36	12-10002-104	Cap, Cer .1uf 50V
C37	12-10002-104	Cap, Cer .1uf 50V
C38	12-10002-104	Cap, Cer .1uf 50V
C39	12-10002-104	Cap, Cer .1uf 50V
C40	12-10002-104	Cap, Cer .1uf 50V

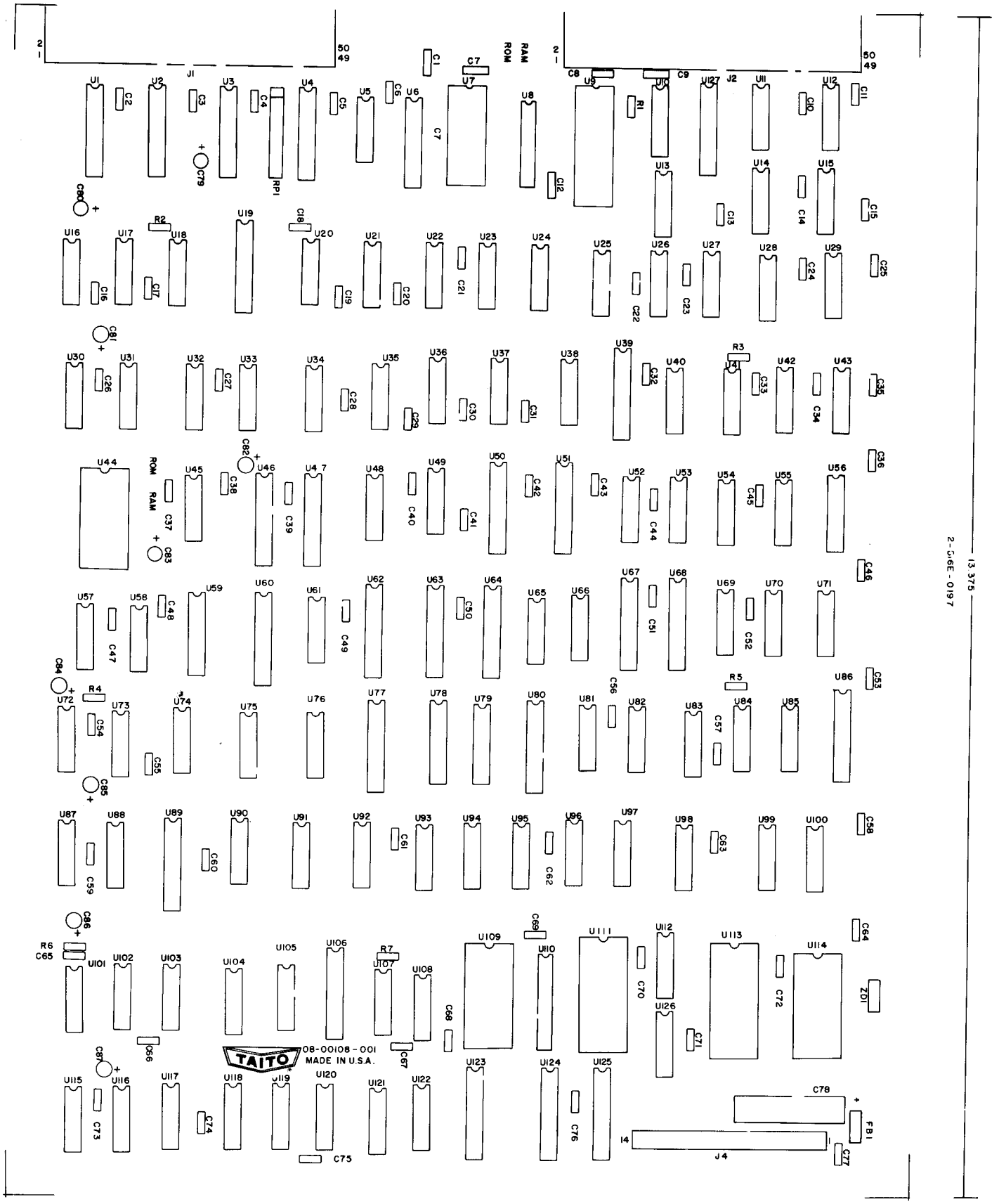
ITEM	TAITO PART NO.	DESCRIPTION
C41	12-10002-104	Cap, Cer .1uf 50V
C42	12-10002-104	Cap, Cer .1uf 50V
C43	12-10002-104	Cap, Cer .1uf 50V
C44	12-10002-104	Cap, Cer .1uf 50V
C45	12-10002-104	Cap, Cer .1uf 50V
C46	12-10002-104	Cap, Cer .1uf 50V
C47	12-10002-104	Cap, Cer .1uf 50V
C48	12-10002-104	Cap, Cer .1uf 50V
C49	12-10002-104	Cap, Cer .1uf 50V
C50	12-10002-104	Cap, Cer .1uf 50V
C51	12-10002-104	Cap, Cer .1uf 50V
C52	12-10002-104	Cap, Cer .1uf 50V
C53	12-10002-104	Cap, Cer .1uf 50V
C54	12-10002-104	Cap, Cer .1uf 50V
C55	12-10002-104	Cap, Cer .1uf 50V
C56	12-10002-104	Cap, Cer .1uf 50V
C57	12-10002-104	Cap, Cer .1uf 50V
C58	12-10002-104	Cap, Cer .1uf 50V
C59	12-10002-104	Cap, Cer .1uf 50V
C60	12-10002-104	Cap, Cer .1uf 50V
C61	12-10002-104	Cap, Cer .1uf 50V
C62	12-10002-104	Cap, Cer .1uf 50V
C63	12-10002-104	Cap, Cer .1uf 50V
C64	12-10002-104	Cap, Cer .1uf 50V
C65	12-10002-104	Cap, Cer .1uf 50V
C66	12-10002-104	Cap, Cer .1uf 50V
C67	12-10002-104	Cap, Cer .1uf 50V
C68	12-10002-104	Cap, Cer .1uf 50V
C69	12-10002-104	Cap, Cer .1uf 50V
C70	12-10002-104	Cap, Cer .1uf 50V
C71	12-10002-104	Cap, Cer .1uf 50V
C72	12-10002-104	Cap, Cer .1uf 50V
C73	12-10002-104	Cap, Cer .1uf 50V
C74	12-10002-104	Cap, Cer .1uf 50V
C75	12-10002-104	Cap, Cer .1uf 50V
C76	12-10002-104	Cap, Cer .1uf 50V
C77	12-10002-104	Cap, Cer .1uf 50V
C78	12-10002-104	Cap, Cer .1uf 50V
C79	12-20001-107	Cap, Elect 16V 100uf
C80	12-10001-471	Cap 470pf 50V 10% X7R AXL
C81	12-10002-104	Cap, Cer .1uf 50V
C82	12-10002-104	Cap, Cer .1uf 50V
C83	12-10001-471	Cap, 470pf 50V 10% X7R AXL
C84	12-10002-104	Cap, Cer .1uf 50V
C85	12-10002-104	Cap, Cer .1uf 50V
C86	12-10002-104	Cap, Cer .1uf 50V
C87	12-10002-104	Cap, Cer .1uf 50V
C88	12-10002-104	Cap, Cer .1uf 50V

PROCESSOR BOARD

FIGURE 13

ITEM	TAITO PART NO.	DESCRIPTION
C89	12-10002-104	Cap, Cer .1uf 50V
C90	12-10002-104	Cap, Cer .1uf 50V
C91	12-10002-104	Cap, Cer .1uf 50V
R1	11-00001-102	Resistor 1 K ohm ¼w ± 5%
R2	11-00001-102	Resistor 1 K ohm ¼w ± 5%
R3	11-00001-101	Resistor 680 ohm ¼w ± 5%
R4	11-00001-221	Resistor 220 ohm ¼w ± 5%
R5	11-00001-220	Resistor 22 ohm
R6	11-00001-122	Resistor 1.2K ohm ¼w ± 5%
R7	11-00001-102	Resistor 1K ohm ¼w ± 5%
R8	11-00001-102	Resistor 1K ohm ¼w ± 5%
R9	11-00001-102	Resistor 1K ohm ¼w ± 5%
R10	11-00001-102	Resistor 1K ohm ¼w ± 5%
R11	11-00001-102	Resistor 1K ohm ¼w ± 5%
R12	11-00001-472	Resistor 4.7K ohm ¼w ± 5%
R13	11-00001-102	Resistor 1K ohm ¼w ± 5%
R14	11-00001-102	Resistor 1K ohm ¼w ± 5%
R15	11-00001-472	Res 4,700 ohm ¼w ± 5%
R16	11-00001-472	Res 4,700 ohm ¼w ± 5%
R17	11-00001-102	Resistor 1K ohm ¼w ± 5%
R18	11-00001-102	Resistor 1K ohm ¼w ± 5%
R19	11-00001-102	Resistor 1K ohm ¼w ± 5%
R20	11-00001-681	Resistor 680 ohm ¼w ± 5%
R21	11-00001-102	Resistor 1K ohm ¼w ± 5%
R22	11-00001-102	Resistor 1K ohm ¼w ± 5%
R23	11-00001-102	Resistor 1K ohm ¼w ± 5%
TP1	59-00021-001	Test Point Turret Type
TP2	59-00021-001	Test Point Turret Type
TP3	59-00021-001	Test Point Turret Type
TP4	59-00021-001	Test Point Turret Type
TP5	59-00021-001	Test Point Turret Type
TP6	59-00021-001	Test Point Turret Type
TP7	59-00021-001	Test Point Turret Type
	26-00001-022	Socket Dip 22 Pin
	26-00001-024	Socket Dip 24 Pin
	26-00001-028	Socket Dip 28 Pin
	26-00001-040	Socket Dip 40 Pin
	25-00001-101	Conn Header Horz 50 Pin
	25-00002-114	Conn 14 Pin Rt. Angle

RIVER-TREE PCB COMPONENT LAYOUT
FIGURE 14



RIVER-TREE PCB

FIGURE 14

ITEM	TAITO PART NO.	DESCRIPTION
C1	12-10002-104	Cap, Cer .1uf 50V
C2	12-10002-104	Cap, Cer .1uf 50V
C3	12-10002-104	Cap, Cer .1uf 50V
C4	12-10002-104	Cap, Cer .1uf 50V
C5	12-10002-104	Cap, Cer .1uf 50V
C6	12-10002-104	Cap, Cer .1uf 50V
C7	12-10002-104	Cap, Cer .1uf 50V
C8	12-10002-104	Cap, Cer .1uf 50V
C9	12-10002-104	Cap, Cer .1uf 50V
C10	12-10002-104	Cap, Cer .1uf 50V
C11	12-10002-104	Cap, Cer .1uf 50V
C12	12-10002-104	Cap, Cer .1uf 50V
C13	12-10002-104	Cap, Cer .1uf 50V
C14	12-10002-104	Cap, Cer .1uf 50V
C15	12-10002-104	Cap, Cer .1uf 50V
C16	12-10002-104	Cap, Cer .1uf 50V
C17	12-10002-104	Cap, Cer .1uf 50V
C18	12-10002-104	Cap, Cer .1uf 50V
C19	12-10002-104	Cap, Cer .1uf 50V
C20	12-10002-104	Cap, Cer .1uf 50V
C21	12-10002-104	Cap, Cer .1uf 50V
C22	12-10002-104	Cap, Cer .1uf 50V
C23	12-10002-104	Cap, Cer .1uf 50V
C24	12-10002-104	Cap, Cer .1uf 50V
C25	12-10002-104	Cap, Cer .1uf 50V
C26	12-10002-104	Cap, Cer .1uf 50V
C27	12-10002-104	Cap, Cer .1uf 50V
C28	12-10002-104	Cap, Cer .1uf 50V
C29	12-10002-104	Cap, Cer .1uf 50V
C30	12-10002-104	Cap, Cer .1uf 50V
C31	12-10002-104	Cap, Cer .1uf 50V
C32	12-10002-104	Cap, Cer .1uf 50V
C33	12-10002-104	Cap, Cer .1uf 50V
C34	12-10002-104	Cap, Cer .1uf 50V
C35	12-10002-104	Cap, Cer .1uf 50V
C36	12-10002-104	Cap, Cer .1uf 50V
C37	12-10002-104	Cap, Cer .1uf 50V
C38	12-10002-104	Cap, Cer .1uf 50V
C39	12-10002-104	Cap, Cer .1uf 50V
C40	12-10002-104	Cap, Cer .1uf 50V
C41	12-10002-104	Cap, Cer .1uf 50V
C42	12-10002-104	Cap, Cer .1uf 50V
C43	12-10002-104	Cap, Cer .1uf 50V
C44	12-10002-104	Cap, Cer .1uf 50V
C45	12-10002-104	Cap, Cer .1uf 50V
C46	12-10002-104	Cap, Cer .1uf 50V
C47	12-10002-104	Cap, Cer .1uf 50V
C48	12-10002-104	Cap, Cer .1uf 50V

ITEM	TAITO PART NO.	DESCRIPTION
C49	12-10002-104	Cap, Cer .1uf 50V
C50	12-10002-104	Cap, Cer .1uf 50V
C51	12-10002-104	Cap, Cer .1uf 50V
C52	12-10002-104	Cap, Cer .1uf 50V
C53	12-10002-104	Cap, Cer .1uf 50V
C54	12-10002-104	Cap, Cer .1uf 50V
C55	12-10002-104	Cap, Cer .1uf 50V
C56	12-10002-104	Cap, Cer .1uf 50V
C57	12-10002-104	Cap, Cer .1uf 50V
C58	12-10002-104	Cap, Cer .1uf 50V
C50	12-10002-104	Cap, Cer .1uf 50V
C60	12-10002-104	Cap, Cer .1uf 50V
C61	12-10002-104	Cap, Cer .1uf 50V
C62	12-10002-104	Cap, Cer .1uf 50V
C63	12-10002-104	Cap, Cer .1uf 50V
C64	12-10002-104	Cap, Cer .1uf 50V
C65	12-10002-104	Cap, Cer .1uf 50V
C66	12-10002-104	Cap, Cer .1uf 50V
C67	12-10002-104	Cap, Cer .1uf 50V
C68	12-10002-104	Cap, Cer .1uf 50V
C69	12-10002-104	Cap, Cer .1uf 50V
C70	12-10002-104	Cap, Cer .1uf 50V
C71	12-10002-104	Cap, Cer .1uf 50V
C72	12-10002-104	Cap, Cer .1uf 50V
C73	12-10002-104	Cap, Cer .1uf 50V
C74	12-10002-104	Cap, Cer .1uf 50V
C75	12-10002-104	Cap, Cer .1uf 50V
C76	12-10002-104	Cap, Cer .1uf 50V
C77	12-10001-471	470pf Cap, 50V 10% X7R AXL
C78	12-20001-107	100uf Cap, Elect 16V 100uf
C79	12-30001-475	Cap, Tant. 4.7uf 16v
C80	12-30001-475	Cap, Tant. 4.7uf 16v
C81	12-30001-475	Cap, Tant. 4.7uf 16v
C82	12-30001-475	Cap, Tant. 4.7uf 16v
C83	12-30001-475	Cap, Tant. 4.7uf 16v
C84	12-30001-475	Cap, Tant. 4.7uf 16v
C85	12-30001-475	Cap, Tant. 4.7uf 16v
C86	12-30001-475	Cap, Tant. 4.7uf 16v
C87	12-30001-475	Cap, Tant. 4.7uf 16v
R1	11-00001-102	1K-Ohm Resistor ¼w ± 5%
R2	11-00001-102	1K-Ohm Resistor ¼w ± 5%
R3	11-00001-102	1K-Ohm Resistor ¼w ± 5%
R4	11-00001-102	1K-Ohm Resistor ¼w ± 5%
R5	11-00001-102	1K-Ohm Resistor ¼w ± 5%
R6	11-00001-102	1K-Ohm Resistor ¼w ± 5%
R7	11-00001-102	1K-Ohm Resistor ¼w ± 5%
U1	15-20244-001	74LS244 Octal Buffer
U2	15-20244-001	74LS244 Octal Buffer

RIVER-TREE PCB

FIGURE 14

ITEM	TAITO PART NO.	DESCRIPTION
U3	15-20245-001	74LS245 Bus Transceiver
U4	15-20244-001	74LS244 Octal Buffer
U5	15-20174-001	74LS174 Hex F/F
U6	15-20245-001	74LS245 Bus Transceiver Octal
U7	16-00026-011	2732A (250ns) Change Lanes
U8	15-20003-001	74LS377 Octal D FF
U9	16-20026-012	2764 (250ns) Change Lanes
U10	15-20195-001	74LS195 4 Bit Shift Register
U11	15-70074-001	74S74 Dual D FF
U12	15-70008-001	74S08 Quad 2 Input AND Gate
U13	15-20195-001	74LS195 4 Bit Shift Register
U14	15-70010-001	74S10 3 Input NAND TTL
U15	15-20051-001	74LS51 Dual AND-OR-INVERT
U16	15-20138-001	74LS138 Decoder 1 of 8
U17	15-20174-001	74LS174 Hex F/F
U18	15-20161-001	74LS161 Counter 4 Bit Preset
U19	15-20273-001	74LS273 Register 8 Bit
U20	15-20000-001	74LS00 Quad 2 Input NAND
U21	15-20138-001	74LS138 Decoder 1 of 8
U22	15-20257-001	74LS257 IC Multiplexer
U23	15-20257-001	74LS257 IC Multiplexer
U24	15-20257-001	74LS257 IC Multiplexer
U25	15-20032-001	74LS32 Quad 2 Input OR
U26	15-20260-001	74LS260 Dual 5 - Input NOR
U27	15-20020-001	74LS20 Dual 4 Input NAND
U28	15-20112-001	74LS112 Dual JK FF
U29	15-20074-001	74LS74 Flip Flop Dual D
U30	15-20157-001	74LS157 Multi Quad 2 Input
U31	15-20157-001	74LS157 Multi Quad 2 Input
U32	15-20157-001	74LS157 Multi Quad 2 Input
U33	15-20161-001	74LS161 Cntr 4 Bit Preset
U34	15-20161-001	74LS161 Cntr 4 Bit Preset
U35	15-20074-001	74LS74 Flip Flop Dual D
U36	15-20161-001	74161 Counter 4 Bit Preset
U37	15-20161-001	74161 Counter 4 Bit Preset
U38	15-20161-001	74LS161 Counter 4 Bit Preset
U39	15-20377-001	Octal D FF
U40	15-27163-001	74LS163 4 Bit Counter
U41	15-27163-001	74LS163 4 Bit Counter
U42	15-70008-001	74S08 Quad 2 Input & Gate
U43	15-70000-001	74S00 Quad 2 Input NAND
U44	16-00026-013	EPROM Change Lanes
U45	15-20257-001	74LS257 IC Multiplexer
U46	15-20245-001	74LS245 Bus Transceiver Octal
U47	15-20245-001	74LS245 Bus Transceiver Octal
U48	15-20032-001	74LS32 Quad 2 Input OR
U49	15-20257-001	74LS257 IC Multiplexer
U50	15-20377-001	74LS377 Octal D FF

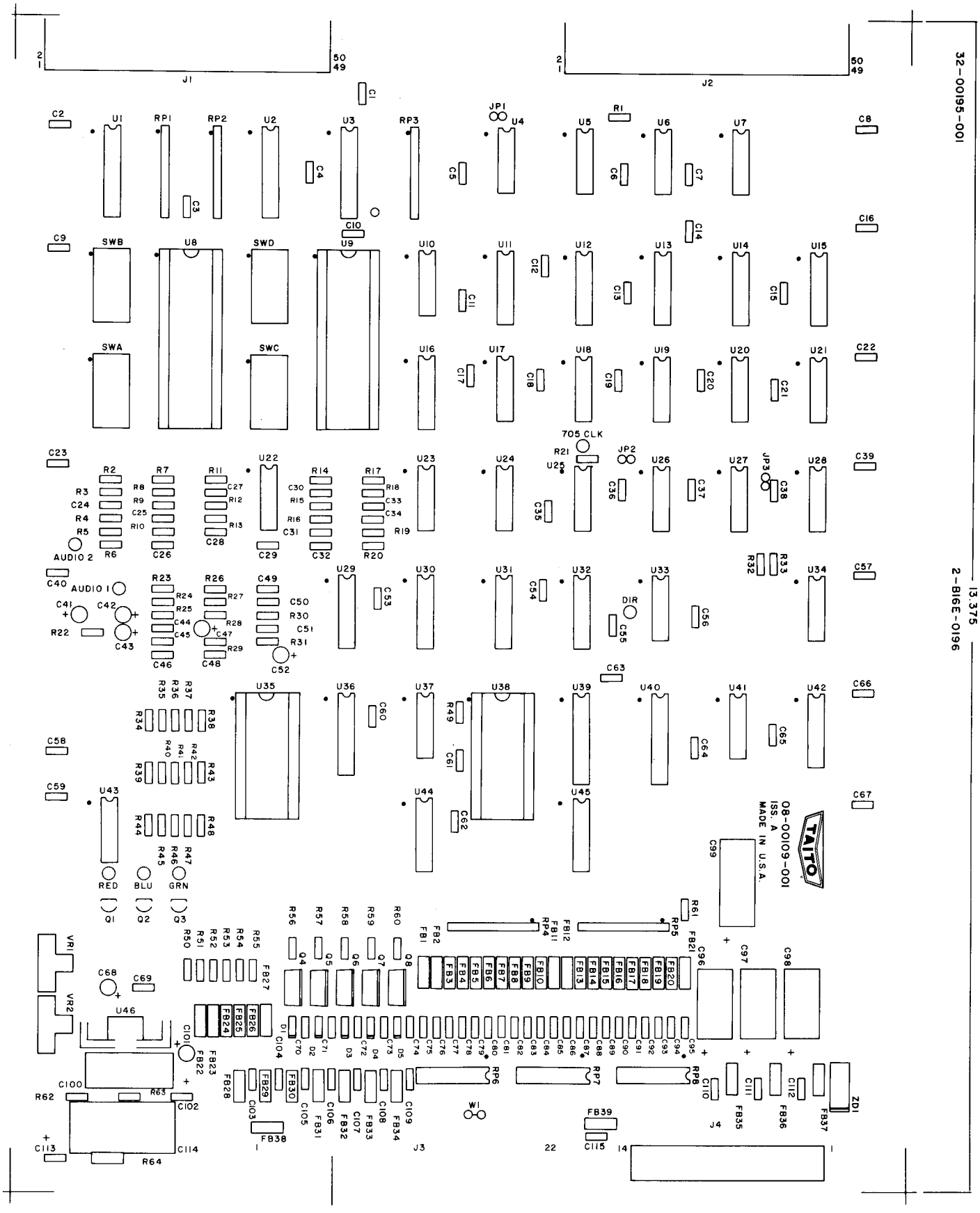
ITEM	TAITO PART NO.	DESCRIPTION
U51	15-20377-001	74LS377 Octal D FF
U52	15-20260-001	74LS260 Dual 5-Input NOR
U53	15-20020-001	74LS20 Dual 4 Input NAND
U54	15-20195-001	74LS195 4 Bit Shift Register
U55	15-20195-001	74LS195 4 Bit Shift Register
U56	15-20112-001	74LS112 Dual JK FF
U57	15-20157-001	74LS157 Multi Quad 2 Input
U58	15-20157-001	74LS157 Multi Quad 2 Input
U59	15-10003-002	2114 (120NS) 1K X 4 SRAM 120NS
U60	15-20377-001	74LS377 Octal D FF
U61	15-20257-001	74LS257 IC Multiplexer
U62	15-20377-001	74LS377 Octal D FF
U63	15-20244-001	74LS244 Octal Buffer
U64	15-20377-001	74LS377 Octal D FF
U65	15-20283-001	74LS283 4-Bit Binary ADD
U66	15-20000-001	74LS00 Quad 2 Input NAND
U67	15-20377-001	74LS377 Octal D FF
U68	15-20377-001	74LS377 Octal D FF
U69	15-20161-001	74LS161 Cntr 4 Bit Preset
U70	15-20161-001	74LS161 Cntr 4 Bit Preset
U71	15-20161-001	74LS161 Cntr 4 Bit Preset
U72	15-70008-001	74S08 Quad 2 Input AND Gate
U73	15-20161-001	74LS161 Cntr 4 Bit Preset
U74	15-70051-001	74S51 Dual AND/OR/INVRT Gate
U75	15-20283-001	74LS283 4 Bit Binary ADD
U76	15-20161-001	74LS161 Counter 4 Bit Preset
U77	15-20377-001	74LS377 Octal D FF
U78	15-10003-001	2114 (120ns) RAM
U79	15-10003-001	2114 (120ns) RAM
U80	15-20377-001	74LS377 Octal D FF
U81	15-20283-001	74LS283 4 Bit Binary ADD
U82	15-20257-001	74LS257 IC Multiplexer
U83	15-70010-001	74S10 3 Input NAND TTL
U84	15-70163-001	74S163 4 Bit Counter
U85	15-70163-001	74S163 4 Bit Counter
U86	15-20377-001	74LS377 Octal D FF
U87	15-20163-001	74LS163 4 Bit Counter
U88	16-00026-014	Programmed ROM
U89	15-20273-001	74LS273 Register 8 Bit
U90	15-20074-001	74LS74 Flip Flop Dual D
U91	15-20161-001	74LS161 Cntr 4 Bit Preset
U92	15-20161-001	74LS161 Cntr 4 Bit Preset
U93	15-20157-001	74LS157 Multi Quad 2 Input
U94	15-20157-001	74LS157 Multi Quad 2 Input
U95	15-20157-001	74LS157 Multi Quad 2 Input
U96	15-20074-001	74LS74 Flip Flop Dual D
U97	15-70074-001	74S74 Dual D FF
U98	15-20157-001	74LS157 Multi Quad 2 Input

RIVER-TREE PCB

FIGURE 14

ITEM	TAITO PART NO.	DESCRIPTION
U99	15-20157-001	74LS157Multi Quad 2 Input
U100	15-20157-001	74LS157Multi Quad 2 Input
U101	15-70163-001	74S163 4 Bit Counter
U102	15-70074-001	74S74 Dual D FF
U103	15-70000-001	74S00 Quad 2 Input NAND
U104	15-70008-001	74S08 Quad 2 Input AND Gate
U105	15-20000-001	74LS00 Quad 2 Input NAND
U106	15-20377-001	74LS377 Octal D FF
U107	15-70163-001	74S163 4 Bit Counter
U108	15-70010-001	74S10 3 Input NAND TTL
U109	15-10013-001	2128 (150ns) RAM, Static NMOS 2KX8 200NS
U110	15-20377-001	74LS377 Octal D FF
U111	16-00026-015	2764 (250NS) Change Lanes
U112	15-20195-001	74LS195 4 Bit Shift Register
U113	16-00026-016	2764 (250NS) Change Lanes
U114	15-10013-001	2128 (150NS) RAM, Static NMOS 2KX8 200NS
U115	15-70004-001	74S04 Hex Inverter
U116	15-70163-001	74S163 Bit Counter
U117	15-70000-001	74LS00 Quad 2 Input NAND
U118	15-20074-001	74LS74 Flip Flop Dual D
U119	15-70074-001	74S74 Flip Flop Dual D
U120	15-70000-001	74S00 Quad 2 Input NAND
U121	15-70163-001	74S163 4 Bit Counter
U122	15-70074-001	74S74 Dual D FF
U123	15-20245-001	74LS245 Bus Transceiver Octal
U124	15-20245-001	74LS245 Bus Transceiver Octal
U125	15-20377-001	74LS377 Octal D FF
U126	15-20195-001	74LS195 4 Bit Shift Register
U127	15-20244-001	74LS244 Octal Buffer
	26-00001-028	Socket 28 Pin Dip
	26-00001-024	Socket Dip 24 Pin
	26-00001-018	Socket Dip 18 Pin
FB1	17-00001-001	Ferrite Bead

SOUND I/O BOARD COMPONENT LAYOUT
FIGURE 15



SOUND I/O BOARD

FIGURE 14

ITEM	TAITO PART NO.	DESCRIPTION
U1	15-20244-001	74LS244 Octal Buffer
U2	15-20245-001	74LS245 Bus Transceiver Octal
U3	15-20244-001	74LS244 Octal Buffer
U4	15-70020-001	74S20 Dual Input NAND
U5	15-20021-001	74LS21 Dual 4-AND
U6	15-20260-001	74LS260 Dual 5-Input NOR
U7	15-70020-001	74S20 Dual 4-Input NAND
U8	15-60006-001	AY-3-8910 IC Sound Gen
U9	15-60006-001	AY-3-8910 IC Sound Gen
U10	15-20032-001	74LS32 Quad 2 Input OR
U11	15-20173-001	74LS173 4 Bit D Resistor
U12	15-20173-001	74LS173 4 Bit D Resistor
U13	15-20173-001	74LS173 4 Bit D Resistor
U14	15-20173-001	74LS173 4 Bit D Resistor
U15	15-20173-001	74LS173 4 Bit D Resistor
U16	15-20139-001	74LS139 Dual Decoder
U17	15-20074-001	74LS74 Flip Flop Dual D
U18	15-70074-001	74S74 Dual D FF
U19	15-70000-001	74S00 Quad 2 Input NAND
U20	15-70074-001	74S74 Dual D FF
U21	15-20000-001	74LS00 Quad 2 Input NAND
U22	15-50003-001	LM324 IC OP Amp (LM324)
U23	15-20014-001	74LS14 Hex Schmitt Invert
U24	15-20051-001	74LS51 Dual And-or-Invert
U25	15-70010-001	74S10(3) Input NAND TTL
U26	15-70000-001	74S00 Quad 2 Input NAND
U27	15-20000-001	74LS00 Quad 2 Input NAND
U28	15-20260-001	74LS260 Dual 5-Input NOR
U29	15-20139-001	74LS139 Dual Decoder
U30	15-20257-001	74LS257 IC Multiplexer
U31	15-20257-001	74LS257 IC Multiplexer
U32	15-20191-001	74LS191 4 Bit U/D Control
U33	15-20074-001	74LS74 Flip Flop Dual D
U34	15-20074-001	74LS74 Flip Flop Dual D
U35	15-10019-026	93419 64 x 9 RAM
U36	15-20244-001	74LS244 Octal Buffer
U37	15-70051-001	74S51 Dual And-or-Invert
U38	16-00010-026	Programmed Controller
U39	15-20374-001	74LS374 Latch, Octal
U40	15-20374-001	74LS374 Latch, Octal
U41	15-20000-001	74LS00 Quad 2 Input NAND
U42	15-20109-001	74LS109
U43	15-30007-001	7407 Hex Buffer OC
U44	15-20259-001	74LS259 8 Bt Adressable Latch
U45	15-20257-001	74LS257 IC Multiplexer
U46	15-50002-001	Audio Amplifier (2002)
C1	12-10002-104	Cap, Ceramic .1uf 50V
C2	12-10002-104	Cap, Ceramic .1uf 50V

ITEM	TAITO PART NO.	DESCRIPTION
C3	12-10002-104	Cap, Ceramic .1uf 50V
C4	12-10002-104	Cap, Ceramic .1uf 50V
C5	12-10002-104	Cap, Ceramic .1uf 50V
C6	12-10002-104	Cap, Ceramic .1uf 50V
C7	12-10002-104	Cap, Ceramic .1uf 50V
C8	12-10002-104	Cap, Ceramic .1uf 50V
C9	12-10002-104	Cap, Ceramic .1uf 50V
C10	12-10002-104	Cap, Ceramic .1uf 50V
C11	12-10002-104	Cap, Ceramic .1uf 50V
C12	12-10002-104	Cap, Ceramic .1uf 50V
C13	12-10002-104	Cap, Ceramic .1uf 50V
C14	12-10002-104	Cap, Ceramic .1uf 50V
C15	12-10002-104	Cap, Ceramic .1uf 50V
C16	12-10002-104	Cap, Ceramic .1uf 50V
C17	12-10002-104	Cap, Ceramic .1uf 50V
C18	12-10002-104	Cap, Ceramic .1uf 50V
C19	12-10002-104	Cap, Ceramic .1uf 50V
C20	12-10002-104	Cap, Ceramic .1uf 50V
C21	12-10002-104	Cap, Ceramic .1uf 50V
C22	12-10002-104	Cap, Ceramic .1uf 50V
C23	12-10002-104	Cap, Ceramic .1uf 50V
C24	12-10002-104	Cap, Ceramic .1uf 50V
C25	12-10002-104	Cap, Ceramic .1uf 50V
C26	12-10002-103	Cap, Ceramic .01uf 50V 10% CL
C27	12-10002-104	Cap, Ceramic .1uf 50V
C28	12-10002-104	Cap, Ceramic .1uf 50V
C29	12-10002-104	Cap, Ceramic .1uf 50V
C30	12-10002-104	Cap, Ceramic .1uf 50V
C31	12-10002-104	Cap, Ceramic .1uf 50V
C32	12-10002-102	Cap, Ceramic Disc .001uf 50V
C33	12-10002-104	Cap, Ceramic .1uf 50V
C34	12-10002-102	Cap, Ceramic Disc .001uf 50V
C35	12-10002-104	Cap, Ceramic .1uf 50V
C36	12-10002-104	Cap, Ceramic .1uf 50V
C37	12-10002-104	Cap, Ceramic .1uf 50V
C38	12-10002-104	Cap, Ceramic .1uf 50V
C39	12-10002-104	Cap, Ceramic .1uf 50V
C40	12-10002-104	Cap, Ceramic .1uf 50V
C41	12-30001-475	Cap, Tant 4.7uf 16V 20% CL
C42	12-30000-475	Cap, Tant 4.7uf 16V 20% CL
C43	12-30001-475	Cap, Tant 4.7uf 16V 20% CL
C44	12-10002-104	Cap, Ceramic .1uf 50V
C45	12-10002-104	Cap, Ceramic .1uf 50V
C46	12-10002-104	Cap, Ceramic .1uf 50V
C47	12-30001-475	Cap, Tant 4.7uf 16V 20% CL
C48	12-10002-102	Cap, Ceramic .1uf 50V
C49	12-10002-104	Cap, Ceramic .1uf 50V
C50	12-10002-102	Cap, Ceramic .001uf 50V

SOUND I/O BOARD

FIGURE 14

ITEM	TAITO PART NO.	DESCRIPTION
C51	12-10002-104	Cap, Ceramic .1uf 50V
C52	12-30001-475	Cap, Ceramic .1uf 50V
C53	12-10002-104	Cap, Ceramic .1uf 50V
C54	12-10002-104	Cap, Ceramic .1uf 50V
C55	12-10002-104	Cap, Ceramic .1uf 50V
C56	12-10002-104	Cap, Ceramic .1uf 50V
C57	12-10002-104	Cap, Ceramic .1uf 50V
C58	12-10002-104	Cap, Ceramic .1uf 50V
C59	12-10002-104	Cap, Ceramic .1uf 50V
C60	12-10002-104	Cap, Ceramic .1uf 50V
C61	12-10002-104	Cap, Ceramic .1uf 50V
C62	12-10002-104	Cap, Ceramic .1uf 50V
C63	12-10002-104	Cap, Ceramic .1uf 50V
C64	12-10002-104	Cap, Ceramic .1uf 50V
C65	12-10002-104	Cap, Ceramic .1uf 50V
C66	12-10002-104	Cap, Ceramic .1uf 50V
C67	12-10002-104	Cap, Ceramic .1uf 50V
C68	12-30001-475	Cap, Tant 4.7uf 16V 20% CL
C69	12-10002-104	Cap, Ceramic .1uf 50V
C70	12-10001-471	Cap, Ceramic 470pf 50V
C71	12-10001-471	Cap, Ceramic 470pf 50V
C72	12-10001-471	Cap, Ceramic 470pf 50V
C73	12-10001-471	Cap, Ceramic 470pf 50V
C74	12-10001-471	Cap, Ceramic 470pf 50V
C75	12-10001-471	Cap, Ceramic 470pf 50V
C76	12-10001-471	Cap, Ceramic 470pf 50V
C77	12-10001-471	Cap, Ceramic 470pf 50V
C78	12-10001-471	Cap, Ceramic 470pf 50V
C79	12-10001-471	Cap, Ceramic 470pf 50V
C80	12-10001-471	Cap, Ceramic 470pf 50V
C81	12-10001-471	Cap, Ceramic 470pf 50V
C82	12-10001-471	Cap, Ceramic 470pf 50V
C83	12-10001-471	Cap, Ceramic 470pf 50V
C84	12-10001-471	Cap, Ceramic 470pf 50V
C85	12-10001-471	Cap, Ceramic 470pf 50V
C86	12-10001-471	Cap, Ceramic 470pf 50V
C87	12-10001-471	Cap, Ceramic 470pf 50V
C88	12-10001-471	Cap, Ceramic 470pf 50V
C89	12-10001-471	Cap, Ceramic 470pf 50V
C90	12-10001-471	Cap, Ceramic 470pf 50V
C91	12-10001-471	Cap, Ceramic 470pf 50V
C92	12-10001-471	Cap, Ceramic 470pf 50V
C93	12-10001-471	Cap, Ceramic 470pf 50V
C94	12-10001-471	Cap, Ceramic 470pf 50V
C95	12-10001-471	Cap, Ceramic 470pf 50V
C96	12-20001-107	Cap, Elect. 100uf 16V
C97	12-20001-107	Cap, Elect. 100uf 16V
C98	12-20001-107	Cap, Elect. 100uf 16V

ITEM	TAITO PART NO.	DESCRIPTION
C99	Not Used	
C100	12-20001-471	Cap, Elect. 470uf 16V
C101	12-30001-475	Cap, Tant. 4.7uf 16V
C102	12-10001-471	Cap, Ceramic 470pf 50V
C103	12-10001-471	Cap, Ceramic 470pf 50V
C104	12-10001-471	Cap, Ceramic 470pf 50V
C105	12-10001-471	Cap, Ceramic 470pf 50V
C106	12-10001-471	Cap, Ceramic 470pf 50V
C107	12-10001-471	Cap, Ceramic 470pf 50V
C108	12-10001-471	Cap, Ceramic 470pf 50V
C109	12-10001-471	Cap, Ceramic 470pf 50V
C110	12-10001-471	Cap, Ceramic 470pf 50V
C111	12-10001-471	Cap, Ceramic 470pf 50V
C112	12-10001-471	Cap, Ceramic 470pf 50V
C113	12-10002-104	Cap, Ceramic .1uf 50V
C114	12-20001-807	Cap, Elect. 800uf 16V
C115	12-10001-471	Cap, Ceramic 470pf 50V
R1	11-00001-472	4.7K-Ohm ¼W±5%
R2	11-00001-102	1K-Ohm ¼W±5%
R3	11-00001-332	3.3K-Ohm Resistor 22K ¼W±5%
R4	11-00001-223	22K-Ohm ¼W±5%
R5	11-00001-102	1K-Ohm ¼W±5%
R6	11-00001-102	1K-Ohm ¼W±5%
R7	11-00001-102	1K-Ohm ¼W±5%
R8	11-00001-102	1K-Ohm Resistor ¼W±5%
R9	11-00001-223	22K-Ohm Resistor ¼W±5%
R10	11-00001-223	22K-Ohm Resistor ¼W±5%
R11	11-00001-225	2.2M-Ohm Resistor ¼W±5%
R12	11-00001-225	2.2M-Ohm Resistor ¼W±5%
R13	11-00001-223	22K-Ohm Resistor ¼W±5%
R14	11-00001-225	2.2M-Ohm Resistor ¼W±5%
R15	11-00001-104	100K-Ohm Resistor ¼W±5%
R16	11-00001-102	1K-Ohm Resistor ¼W±5%
R17	11-00001-102	1K-Ohm Resistor ¼W±5%
R18	11-00001-104	100K-Ohm Resistor ¼W±5%
R19	11-00001-104	100K-Ohm Resistor ¼W±5%
R20	11-00001-102	1K-Ohm Resistor ¼W±5%
R21	11-00001-472	4.7K-Ohm Resistor ¼W±5%
R22	11-00001-103	10K-Ohm Resistor ¼W±5%
R23	11-00001-472	4.7K-Ohm Resistor ¼W±5%
R25	11-00001-472	4.7K-Ohm Resistor ¼W±5%
R26	11-00001-472	4.7K-Ohm Resistor ¼W±5%
R27	11-00001-472	4.7K-Ohm Resistor ¼W±5%
R28	11-00001-472	4.7K-Ohm Resistor ¼W±5%
R29	11-00001-103	10K-Ohm Resistor ¼W±5%
R30	11-00001-102	1K-Ohm Resistor ¼W±5%
R31	11-00001-102	1K-Ohm Resistor ½W±5%
R32	11-00001-472	4.7K-Ohm Resistor ¼W±5%

SOUND I/O BOARD

FIGURE 14

ITEM	TAITO PART NO.	DESCRIPTION
R33	11-00001-102	1K-Ohm Resistor ¼W±5%
R34	11-00001-222	2.2K-Ohm Resistor ¼W±5%
R35	11-00001-681	680-Ohm Resistor ¼W±5%
R36	11-00001-221	220-Ohm Resistor ¼W±5%
R37	11-00001-471	470-Ohm Resistor ¼W±5%
R38	11-00001-102	1K-Ohm Resistor ¼W±5%
R39	11-00001-222	2.2K-Ohm Resistor ¼W±5%
R40	11-00001-681	680-Ohm Resistor ¼W±5%
R41	11-00001-221	220-Ohm Resistor ¼W±5%
R42	11-00001-471	470-Ohm Resistor ¼W±5%
R43	11-00001-102	1K-Ohm Resistor ¼W±5%
R44	11-00001-222	2.2K-Ohm Resistor ¼W±5%
R45	11-00001-685	680-Ohm Resistor ¼W±5%
R46	11-00001-221	220-Ohm Resistor ¼W±5%
R47	11-00001-471	470-Ohm Resistor ¼W±5%
R48	11-00001-102	1K-Ohm Resistor ¼W±5%
R49	11-00001-472	4.7K-Ohm Resistor ¼W±5%
R50	11-00001-471	470-Ohm Resistor ¼W±5%
R51	11-00001-271	270-Ohm Resistor ¼W±5%
R52	11-00001-271	270-Ohm Resistor ¼W±5%
R53	11-00001-471	470-Ohm Resistor ¼W±5%
R54	11-00001-271	270-Ohm Resistor ¼W±5%
R55	11-00001-471	470-Ohm ¼W±5%
R56	11-00001-471	470-Ohm ¼W±5%
R57	11-00001-471	470-Ohm ¼W±5%
R58	11-00001-471	470-Ohm ¼W±5%
R59	11-00001-471	470-Ohm ¼W±5%
R60	11-00001-471	470-Ohm ¼W±5%
R61	11-00001-562	5.6K-Ohm ¼W±5%
R62	11-00001-020	2.2 ¼W±5%
R63	11-00001-221	220-Ohm ¼W±5%
R64	11-00001-010	1-Ohm ½W±5%
RP1	11-50003-331	330/470-Ohm SIP Resistor Network
RP2	11-50003-331	330/470-Ohm SIP Resistor Network
RP3	11-50003-331	330/470-Ohm SIP Resistor Network
RP4	11-50001-562	5.6K-Ohm SIP Resistor Network
P5	11-50001-562	5.6K-Ohm SIP Resistor Network
RP6	11-50002-471	470-Ohm SIP Resistor Network
RP7	11-50002-471	470-Ohm SIP Resistor Network
RP8	11-50002-471	470-Ohm SIP Resistor Network
SWA	29-00001-008	8 Position Dip Switch
SWB	29-00001-008	8 Position Dip Switch
SWC	29-00001-008	8 Position Dip Switch
SWD	29-00001-008	8 Position Dip Switch
VR1	11-60003-104	Pot, 100K-Ohm
VR2	11-60003-502	Pot, 5K-Ohm

ITEM	TAITO PART NO.	DESCRIPTION
Q1	14-23904-001	2N3904 Transistor
Q2	14-23904-001	2N3904 Transistor
Q3	14-23904-001	2N3904 Transistor
Q4	14-00001-001	TIP120 Transistor
Q5	14-00001-001	TIP120 Transistor
Q6	14-00001-001	TIP120 Transistor
Q7	14-00001-001	TIP120 Transistor
Q8	14-00001-001	TIP120 Transistor
FB2		Jumper Wire
FB3		Jumper Wire
FB4		Jumper Wire
FB5		Jumper Wire
FB6		Jumper Wire
FB7		Jumper Wire
FB8		Jumper Wire
FB9		Jumper Wire
FB10		Jumper Wire
FB13		Jumper Wire
FB14		Jumper Wire
FB15		Jumper Wire
FB16		Jumper Wire
FB22		Jumper Wire
FB23		Jumper Wire
FB24		Jumper Wire
FB25		Jumper Wire
FB27		Jumper Wire
FB28		Jumper Wire
FB29		Jumper Wire
FB33	17-00001-001	Ferrite Bead
FB34	17-00001-001	Ferrite Bead
FB35	17-00001-001	Ferrite Bead
FB36	17-00001-001	Ferrite Bead
FB37	17-00001-001	Ferrite Bead
FB38	17-00001-001	Ferrite Bead
FB39	17-00001-001	Ferrite Bead
D1	13-14001-001	Diode, 1N4001
D2	13-14001-001	Diode, 1N4001
D3	13-14001-001	Diode, 1N4001
D4	13-14001-001	Diode, 1N4001
D5	13-14001-001	Diode, 1N4001
J1	25-00001-101	Conn., 50 Pin Rt Angle
J2	25-00001-101	Conn., 50 Pin Rt Angle
J4	25-00002-114	Conn., 14 Pin Rt Angle
705 CLK	59-00021-001	test point
Audio 1	59-00021-001	test point
Audio 2	59-00021-001	test point

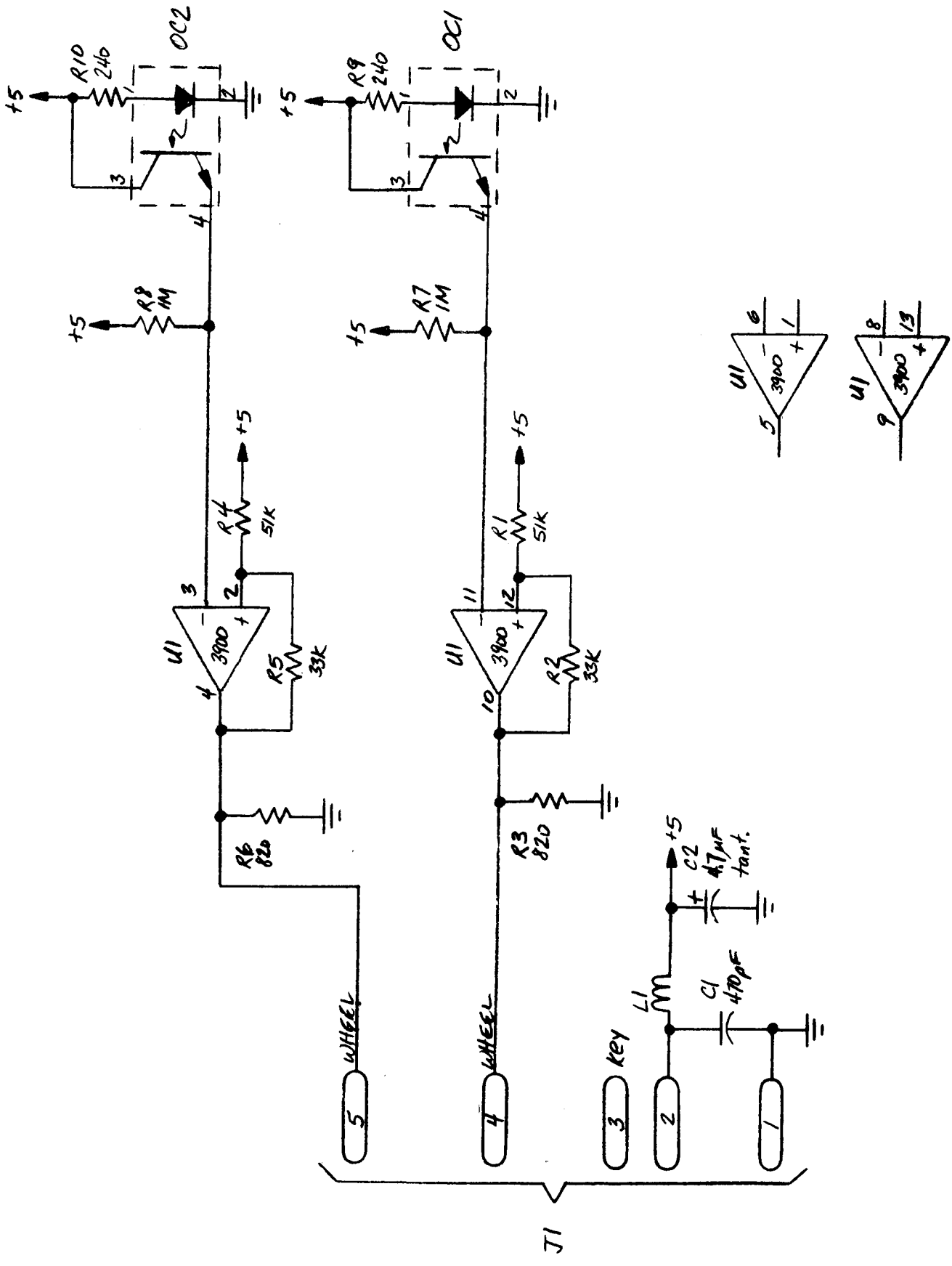
SOUND I/O BOARD

FIGURE 14

ITEM	TAITO PART NO.	DESCRIPTION
Dir	59-00021-001	test point
Red	59-00021-001	test point
Blu	59-00021-001	test point
Grn	59-00021-001	test point

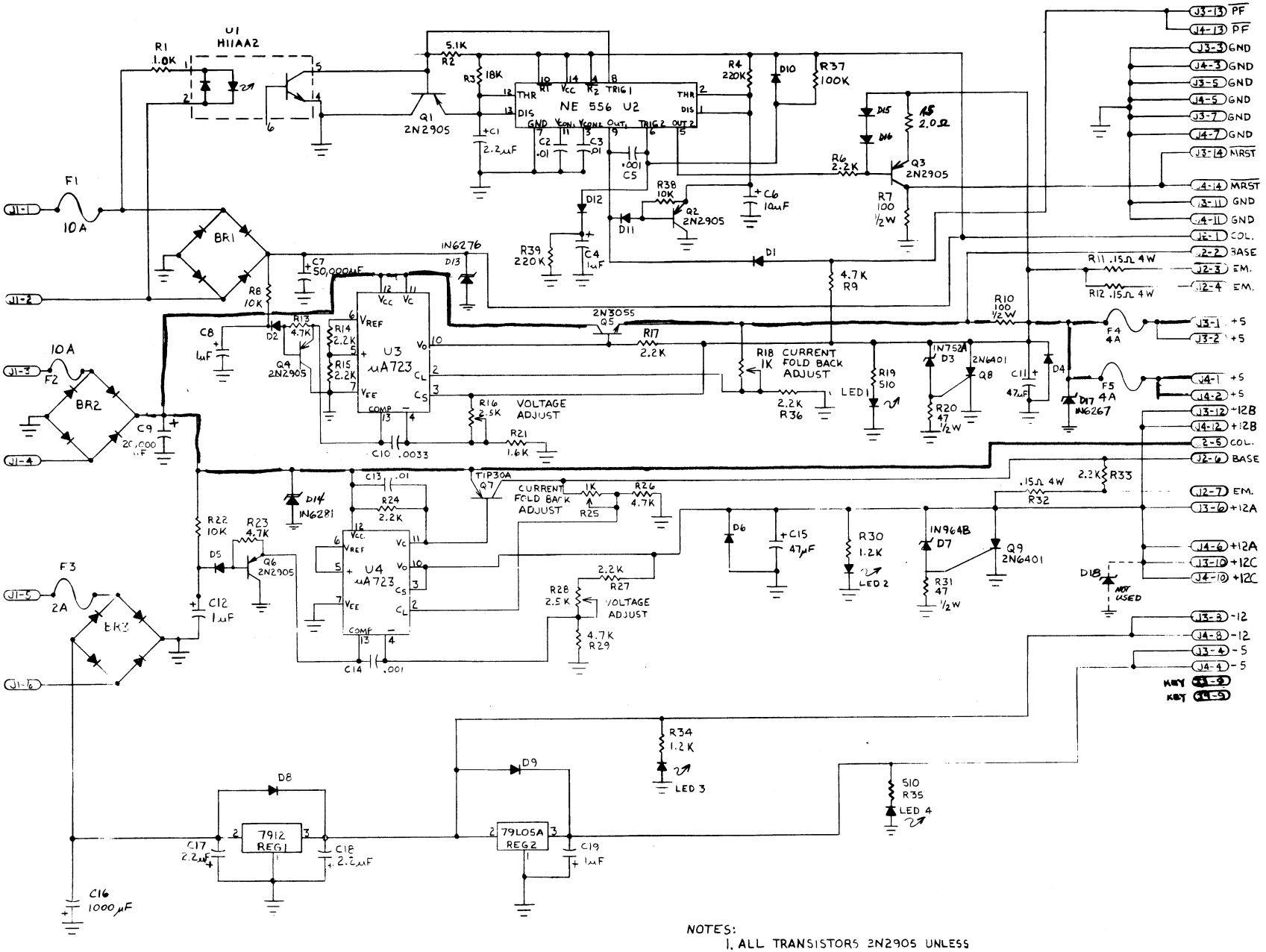
OPTOCOUPLER SCHEMATIC 1 OF 1

FIGURE 16



POWER SUPPLY SCHEMATIC 1 OF 1

FIGURE 17

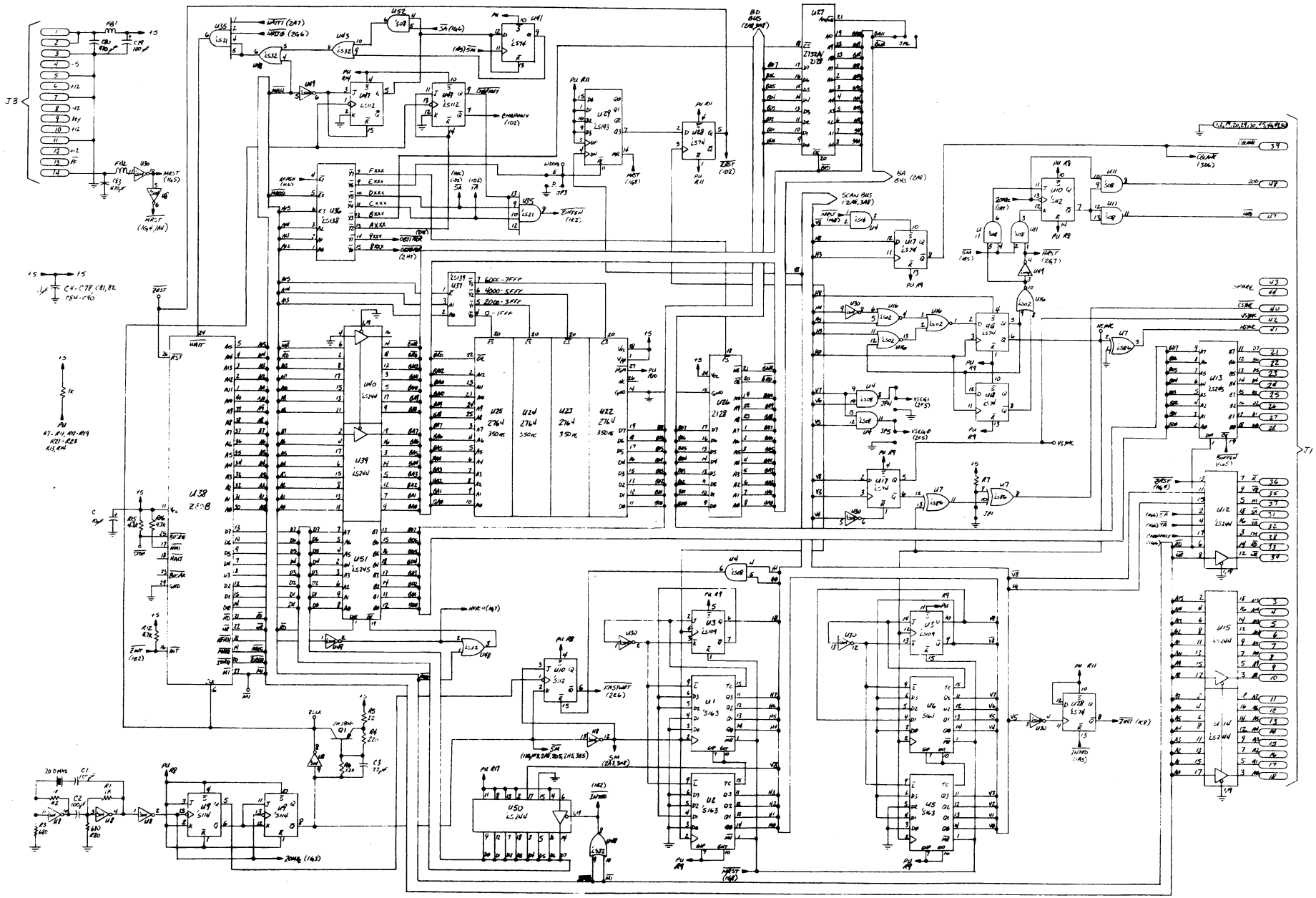


NOTES:

1. ALL TRANSISTORS 2N2905 UNLESS OTHERWISE SPECIFIED
2. ALL DIODES IN4002 UNLESS OTHERWISE SPECIFIED

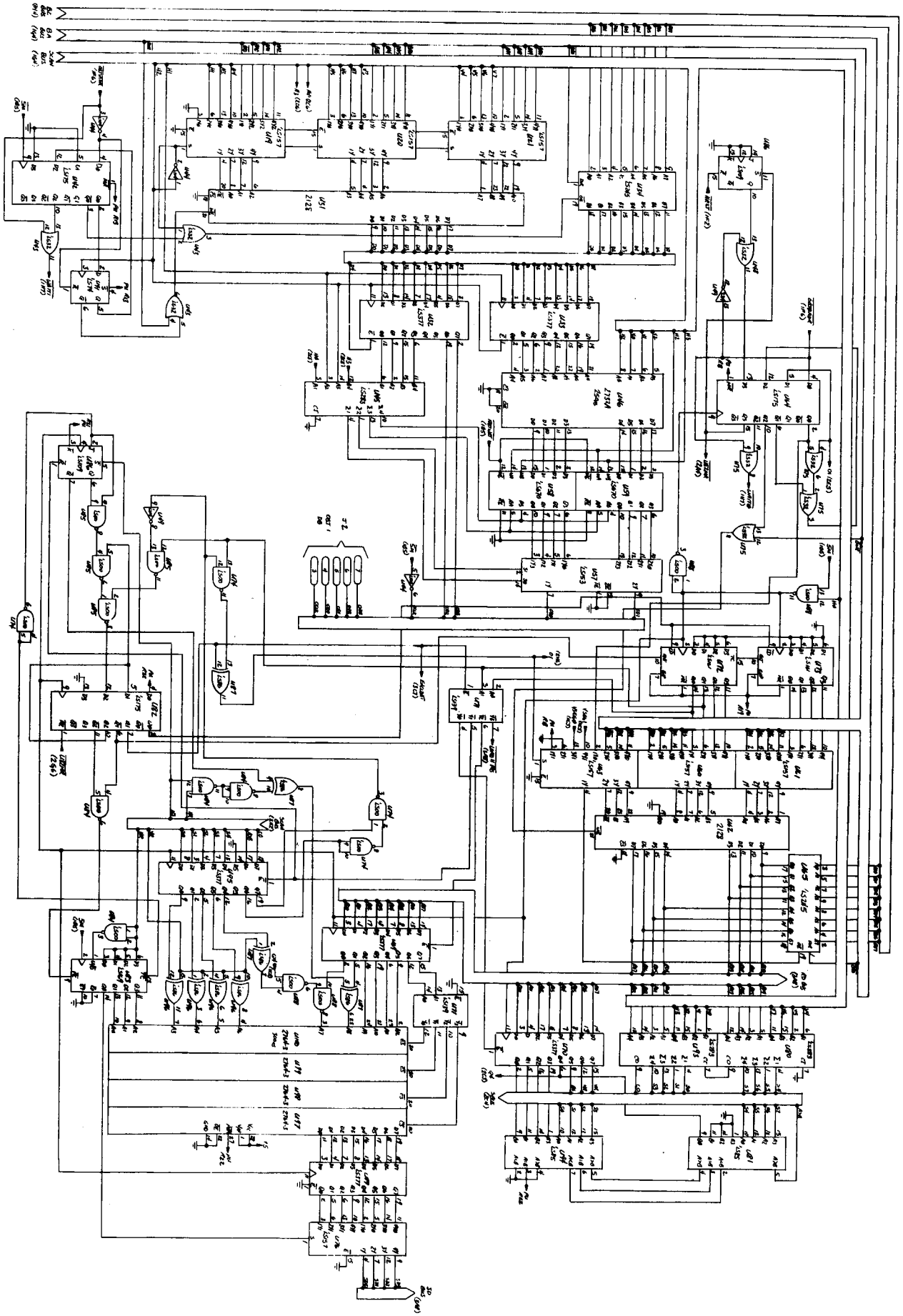
PROCESSOR BOARD SCHEMATIC 1 OF 3

FIGURE 18



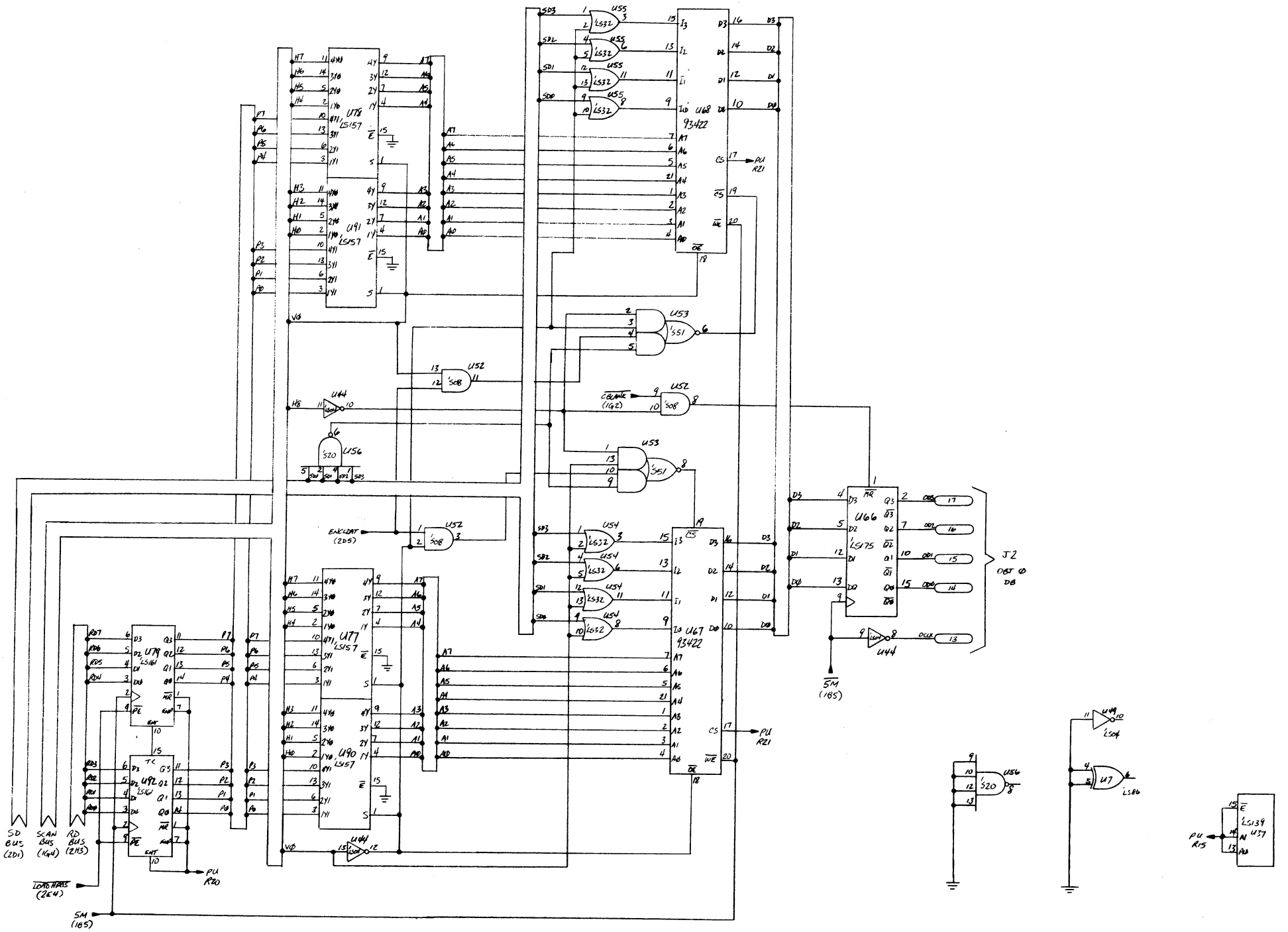
PROCESSOR BOARD SCHEMATIC 2 OF 3

FIGURE 19



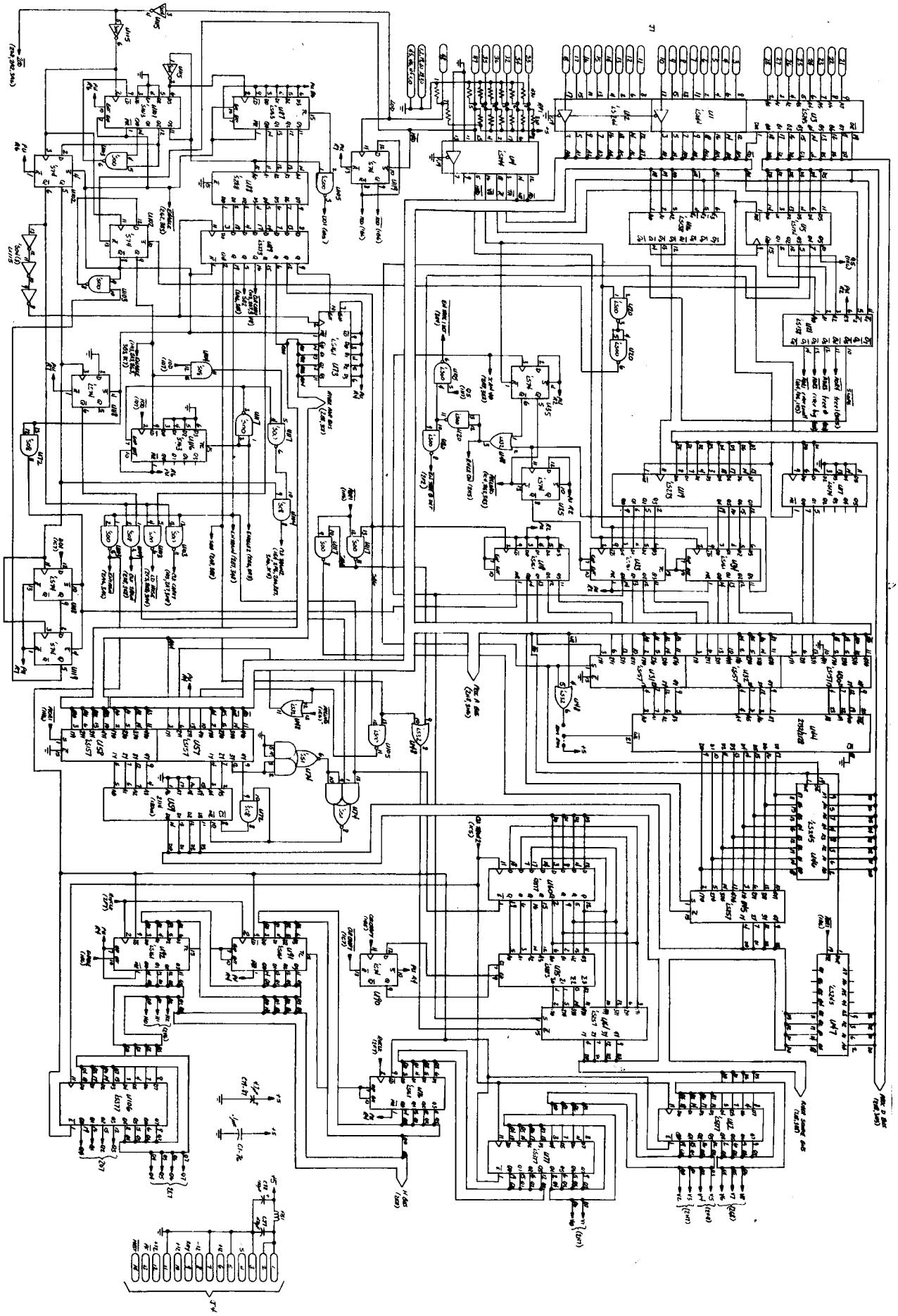
PROCESSOR BOARD SCHEMATIC 3 OF 3

FIGURE 20



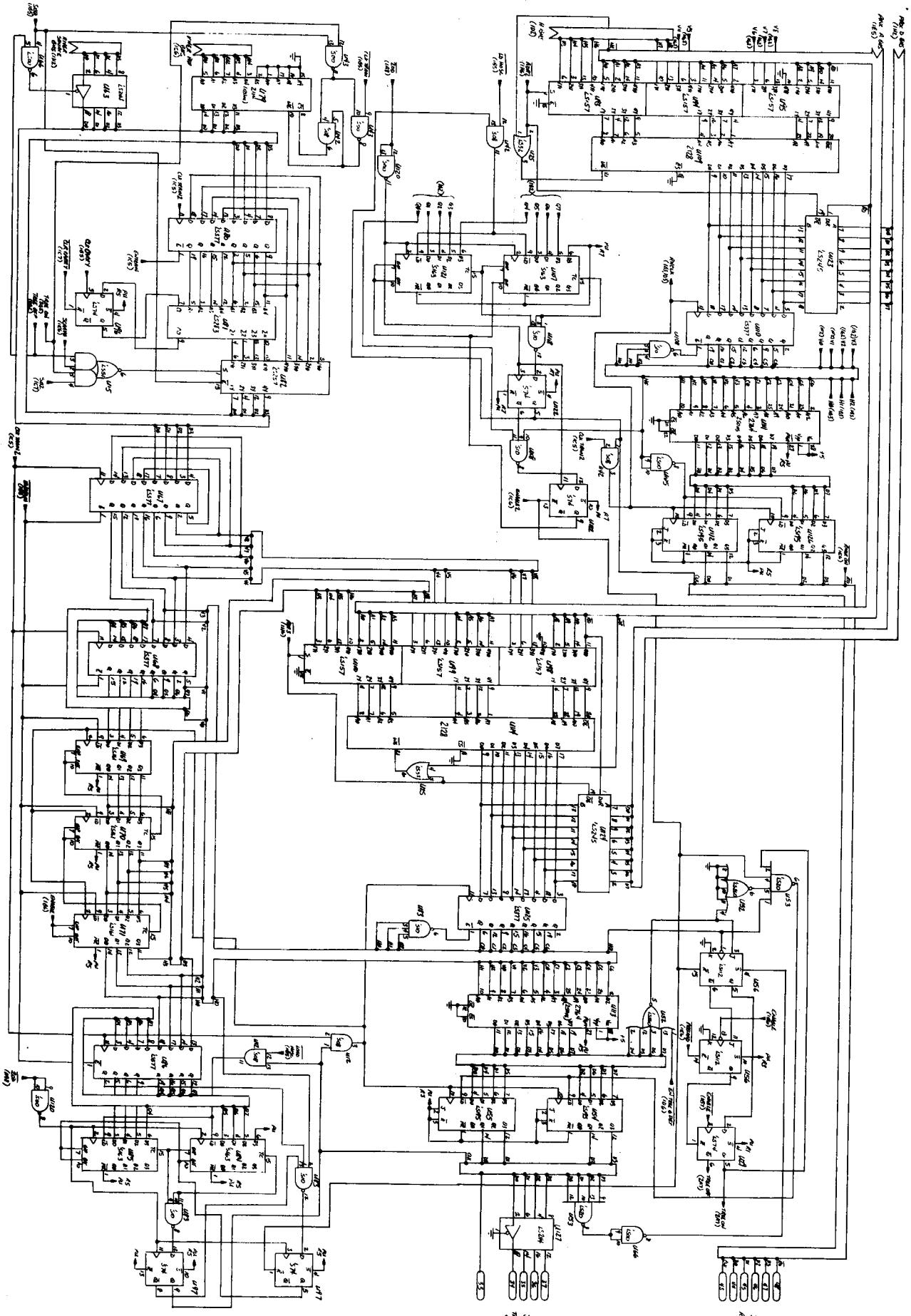
RIVER-TREE PCB SCHEMATIC 1 OF 3

FIGURE 21



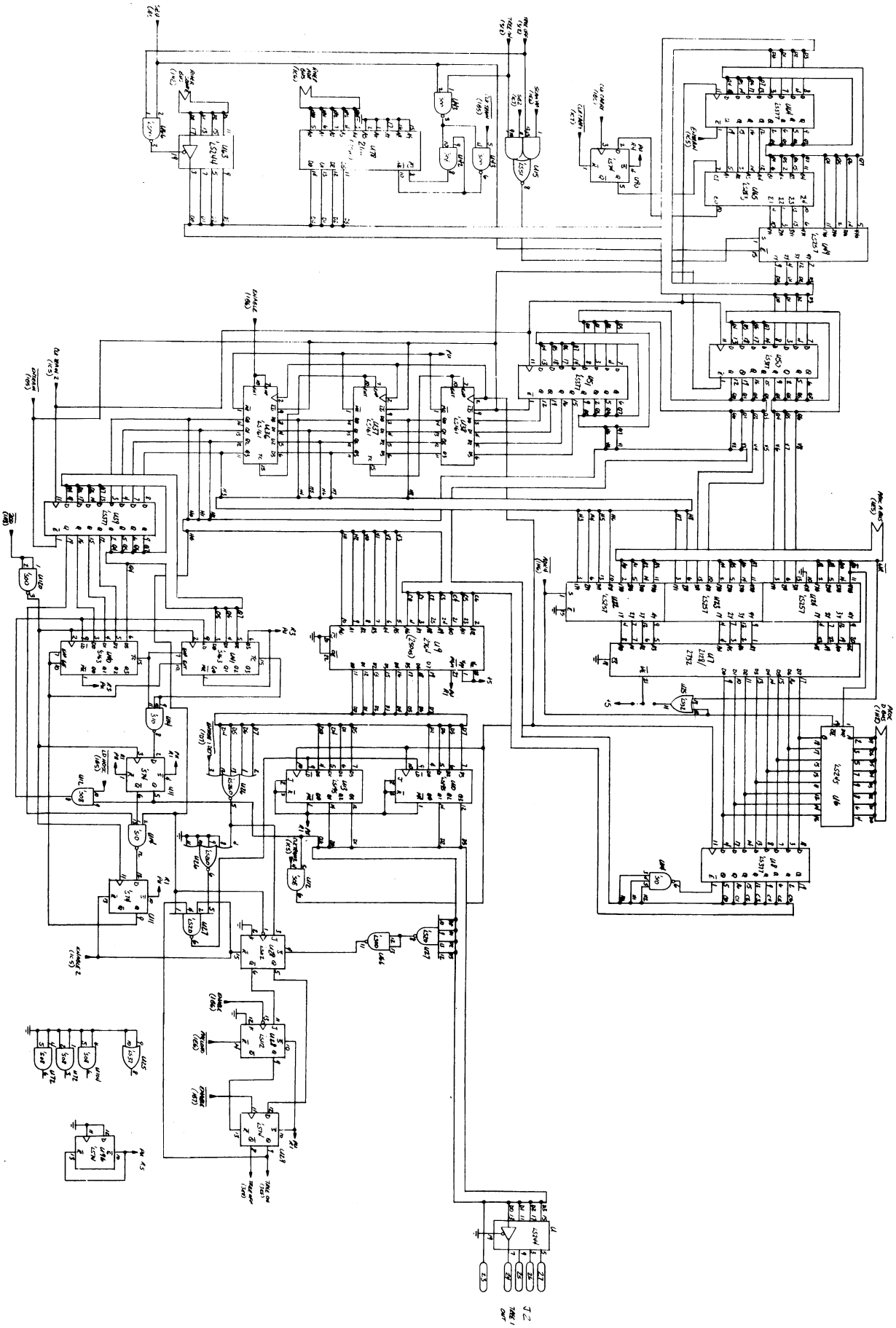
RIVER-TREE PCB SCHEMATIC 2 OF 3

FIGURE 22



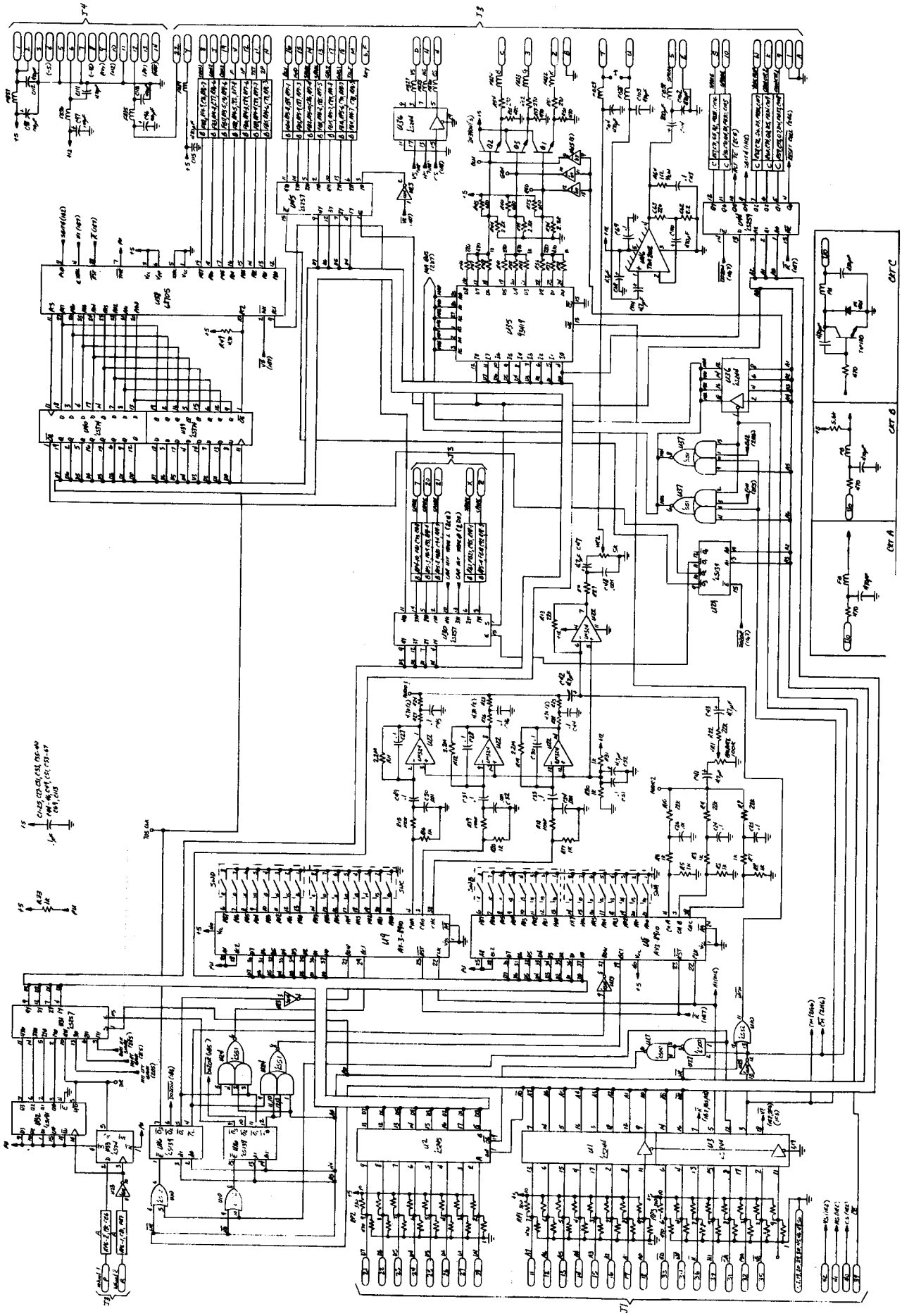
RIVER-TREE PCB SCHEMATIC 3 OF 3

FIGURE 23



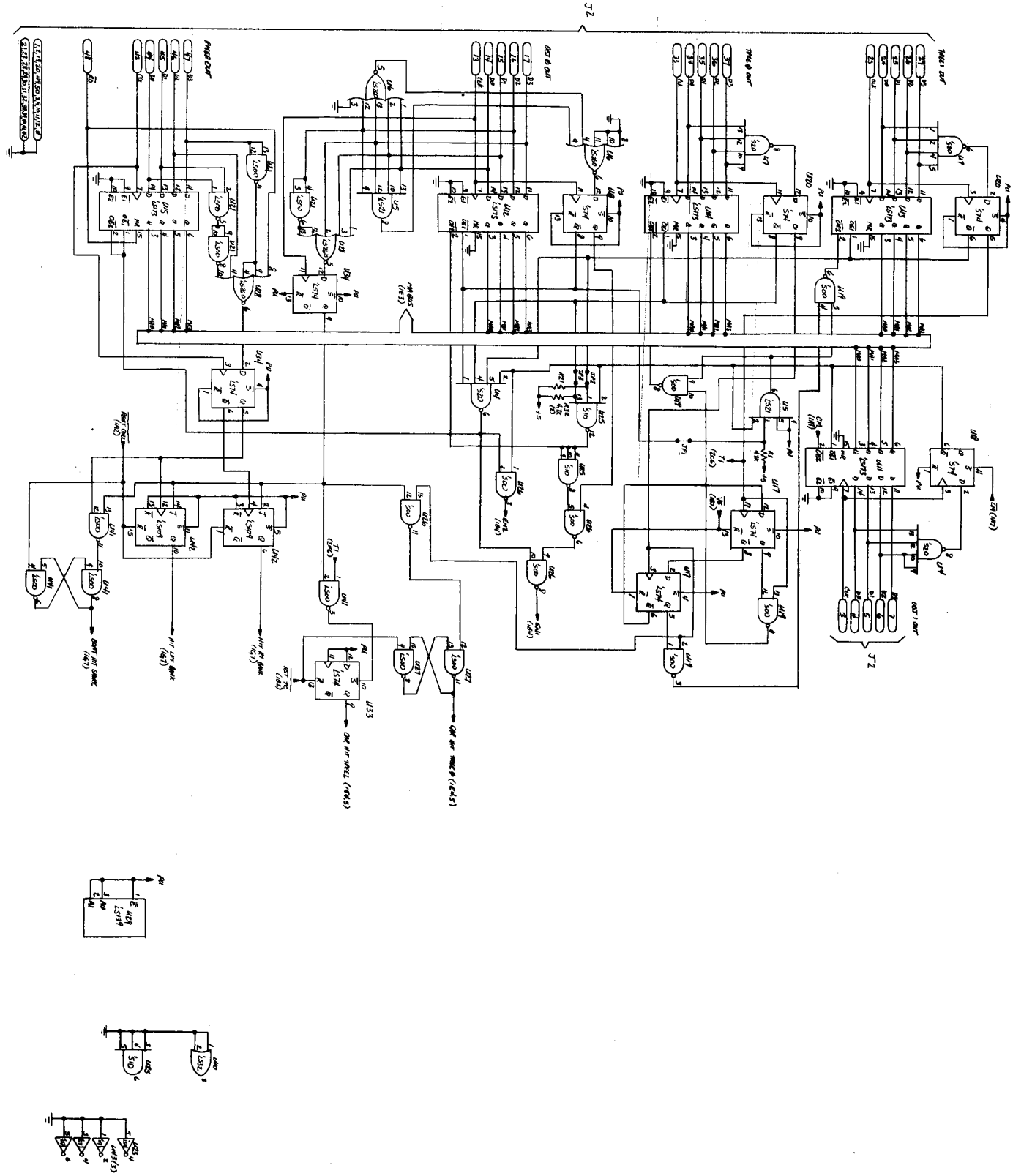
SOUND I/O BOARD SCHEMATIC 1 OF 2

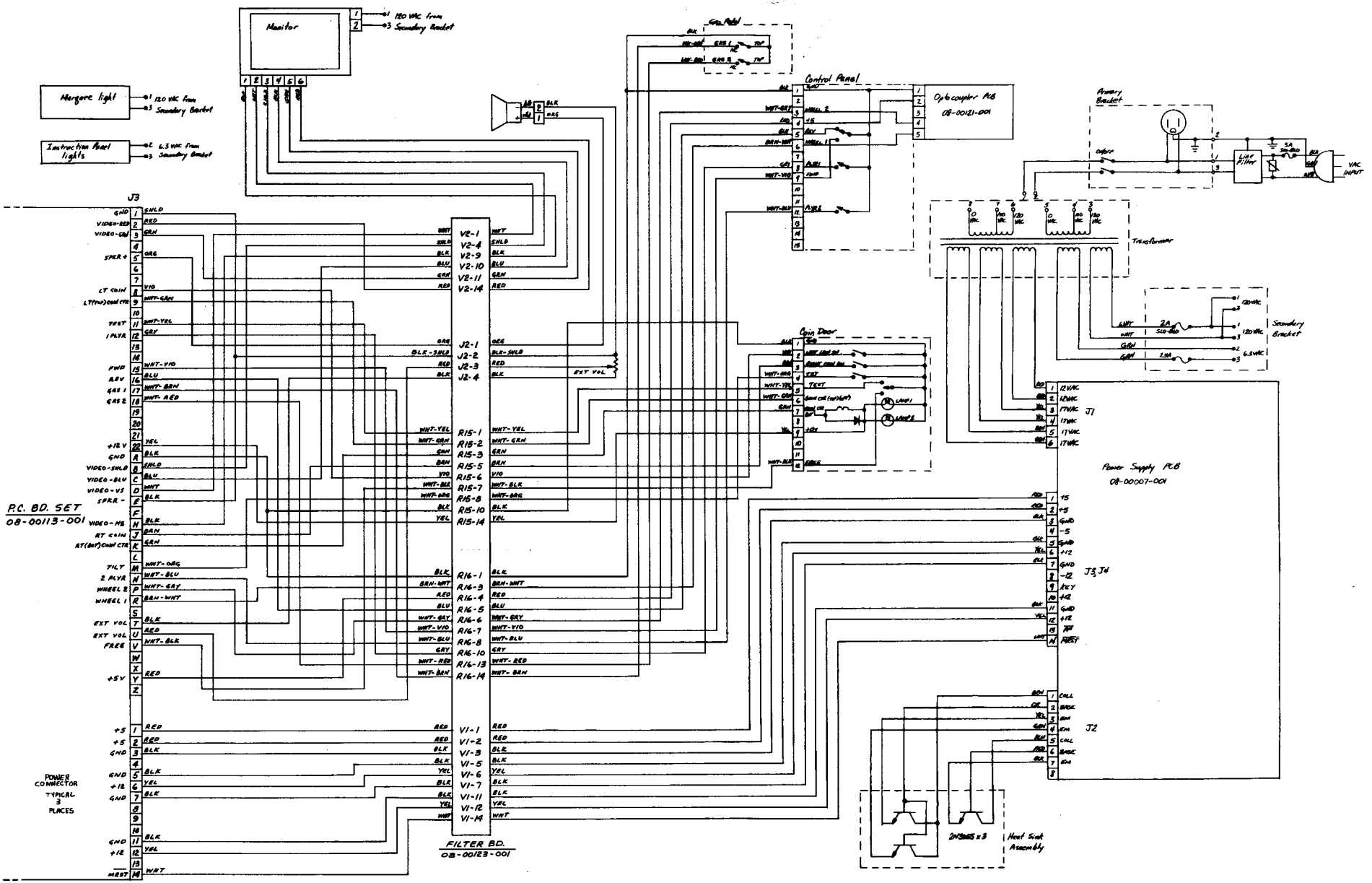
FIGURE 24



SOUND I/O BOARD SCHEMATIC 2 OF 2

FIGURE 25





WIRING DIAGRAM
FIGURE 26