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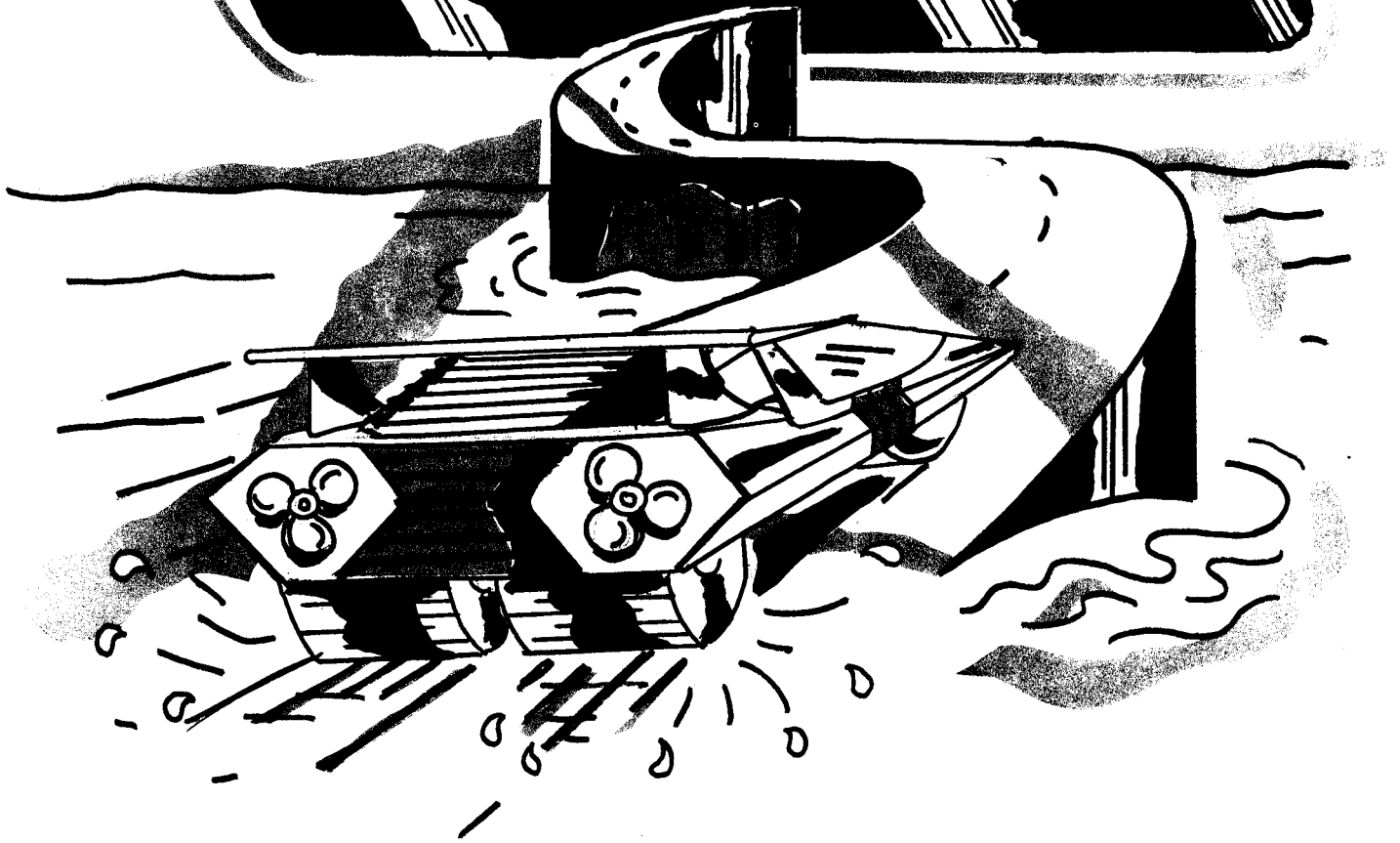
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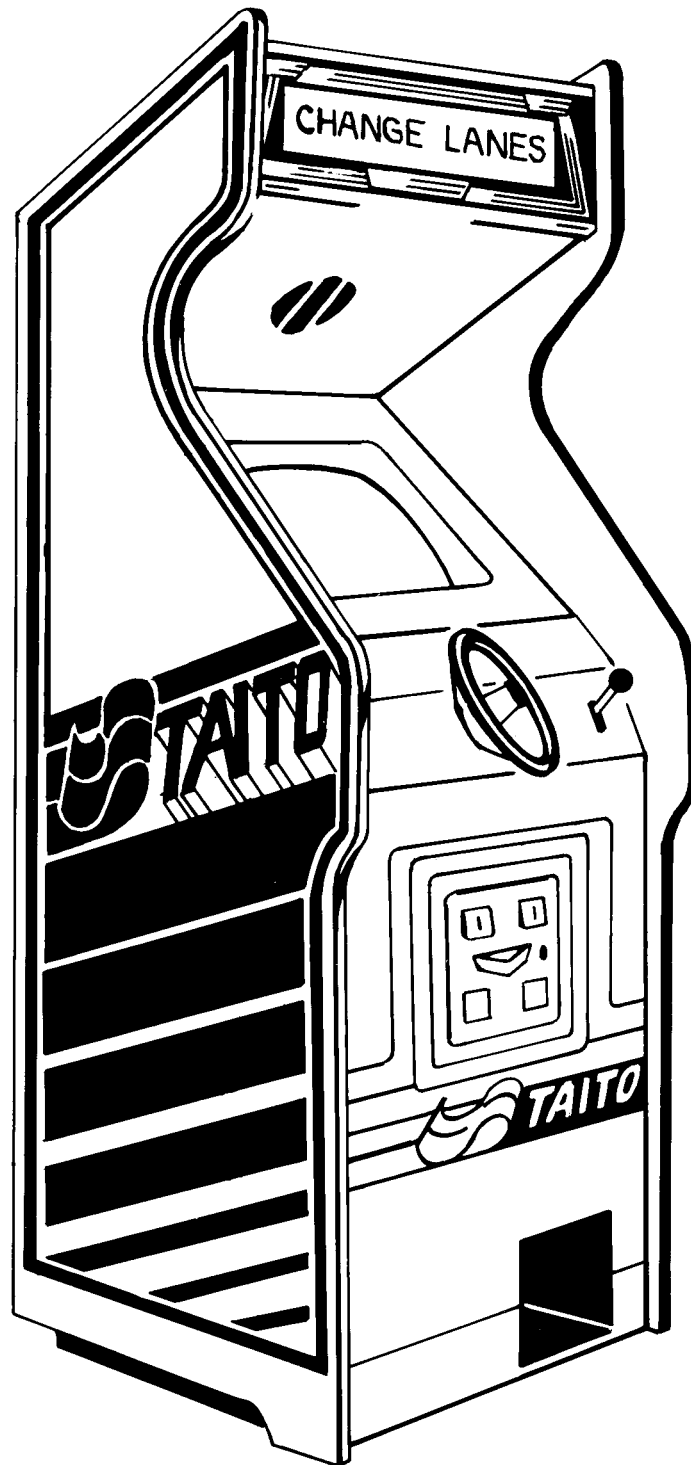


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# CHANGERS LANES

T.M.







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

**“CHANGE LANES”™ UPRIGHT**

OPERATION, MAINTENANCE AND SERVICE MANUAL  
Complete with Illustrated Parts Catalog

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1256 Estes Avenue  
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# **“CHANGE LANES”™ UPRIGHT**

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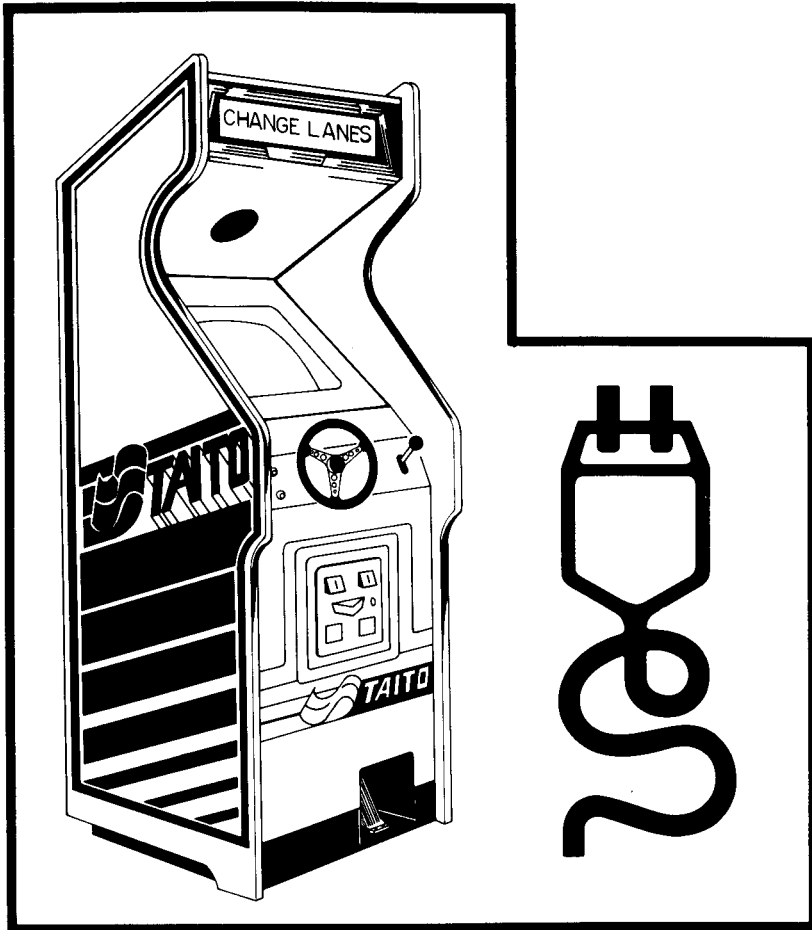
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# Game Set-Up

# 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 are easily 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 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 checkpoint, 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 missile 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 missiles 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 REQUIREMENTS

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  $\pm 10\%$  50/60Hz  
120VAC  $\pm 10\%$  50/60Hz  
200VAC  $\pm 10\%$  50/60Hz  
220VAC  $\pm 10\%$  50/60Hz  
240VAC  $\pm 10\%$  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).

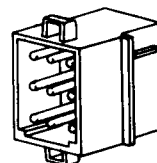


FIGURE 1-1 PROGRAMING PLUG

#### 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.

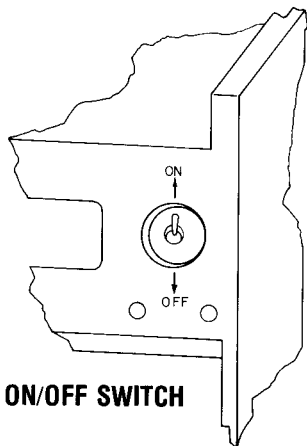


FIGURE 1-2 POWER ON/OFF SWITCH

### 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.

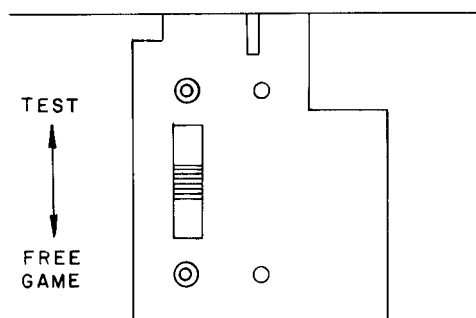


FIGURE 1-3 SELF TEST SWITCH

### 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.

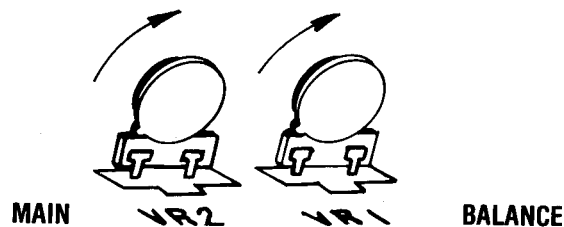


FIGURE 1-4 VOLUME CONTROL SETTINGS

### 1.5.4 SERVICE OUTLET

A Power Receptacle 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

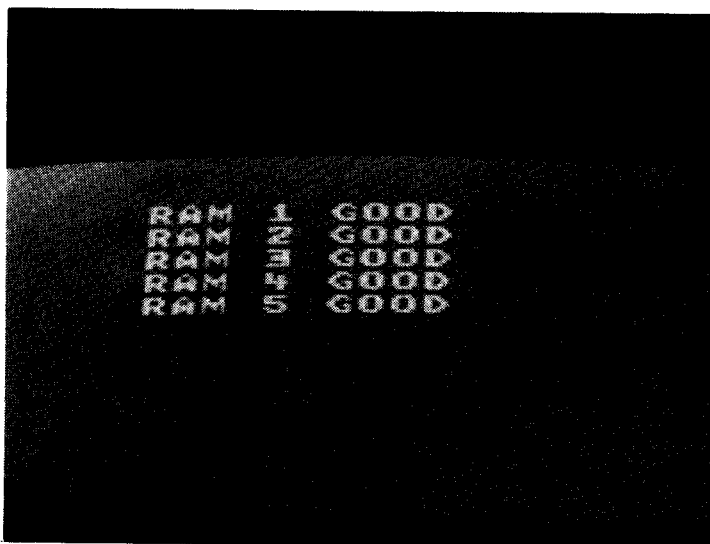


FIGURE 1-5 RAM TEST

**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.

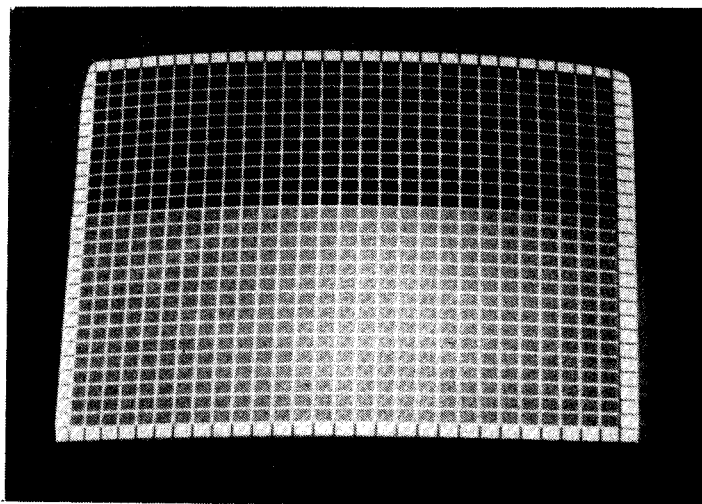


FIGURE 1-6 CONVERGENCE AND SCREEN ALIGNMENT

### 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.

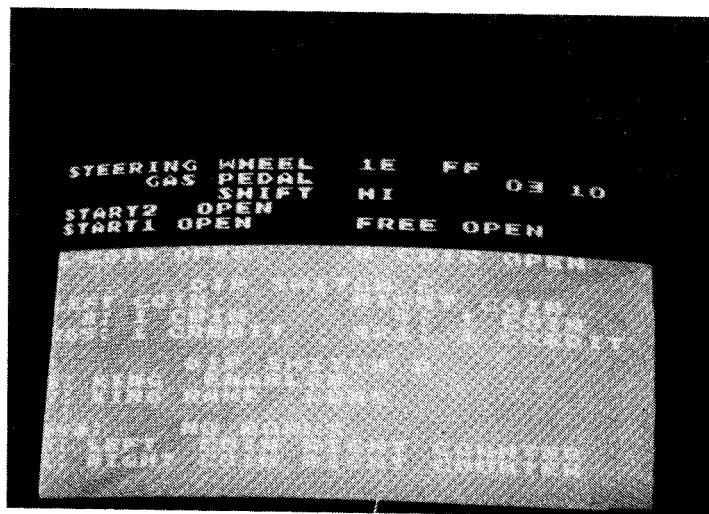


FIGURE 1-7 PLAYER CONTROLS

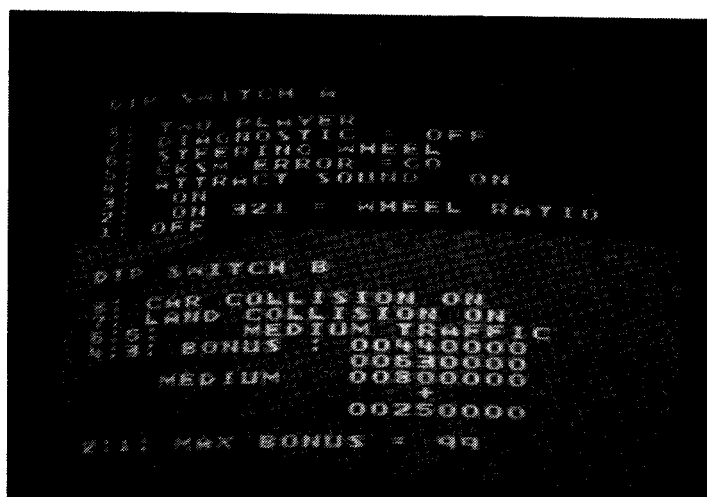


FIGURE 1-8 DIP SWITCH SETTINGS

### 1.8.8 GAME MODE SETUP

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

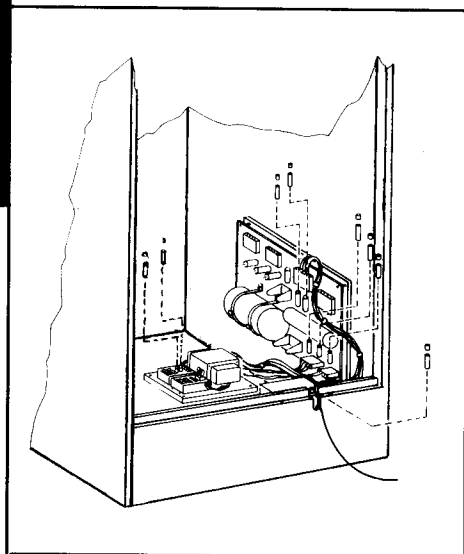
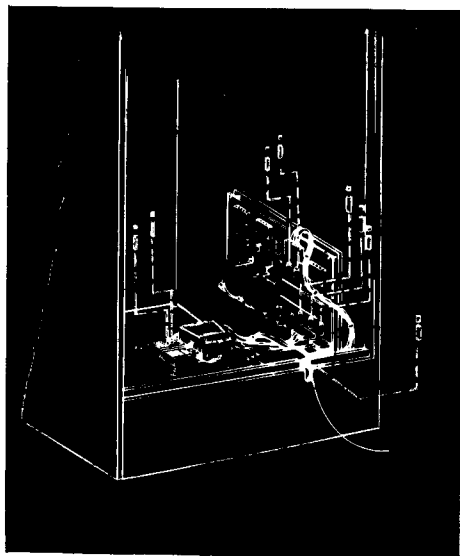
**NOTE:** The basic playing time is set by selecting the game difficulty which permits the player more or less time to reach the checkpoints after the first one. The actual playing time will depend on the skill of the player. The time permitted to reach the first checkpoint is fixed at 60 seconds.

|          | 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                                                          |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|-----------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|
| <b>Dip Switch A</b> | OFF<br><br>ON                                                                                                                                                                      | <b>STEERING WHEEL RATIO</b><br>ON<br>(Recommended Setting)                        |                                                                                                              | ON = Attract Mode = Sound On<br>OFF = Attract Mode = Sound Off | ON = Ignore Memory Failures<br>OFF = Loop On Memory Failures                                                                                                                      | ON = Steering Wheel<br>OFF = Joy Stick | ON = Diagnostic On<br>OFF = Diagnostic Off                                                                      | ON = 2 Player Mode<br>OFF = 1 Player Mode                  |
| <b>Dip Switch B</b> | <b>MAX. BONUS FUELS</b><br>ON = 99<br>OFF = 1<br>ON = 2<br>OFF = 3                                                                                                                 |                                                                                   | <b>GAME DIFFICULTY</b><br>ON = Real Easy<br>OFF = Easy<br>ON = Med.<br>OFF = Hard                            |                                                                | <b>TRAFFIC DIFFICULTY</b><br>ON = Real Easy<br>OFF = Easy<br>ON = Med.<br>OFF = Hard                                                                                              |                                        | ON = Land Collisions Enabled<br>OFF = Land Collisions Disabled                                                  | ON = Car Collision Enabled<br>OFF = Car Collision Disabled |
| <b>Dip Switch C</b> | <b>RIGHT SLOT CREDITS/UNIT</b><br>OFF = 7 Credits<br>ON = 6 Credits<br>OFF = 5 Credits<br>ON = 4 Credits<br>OFF = 3 Credits<br>ON = 2 Credits<br>OFF = 1 Credits<br>ON = Free Play |                                                                                   | <b>RIGHT SLOT COINS/UNIT</b><br>ON = 1 Coin/Unit<br>OFF = 2 Coins/Unit                                       |                                                                | <b>LEFT SLOT CREDITS/UNIT</b><br>OFF = 7 Credits<br>ON = 6 Credits<br>OFF = 5 Credits<br>ON = 4 Credits<br>OFF = 3 Credits<br>ON = 2 Credits<br>OFF = 1 Credits<br>ON = 1 Credits |                                        | <b>LEFT SLOT COINS/UNIT</b><br>ON = 1 Coin/Unit<br>OFF = 2 Coins/Unit                                           |                                                            |
| <b>Dip Switch D</b> | ON = Right Coin On Left (Top) Counter<br>OFF = Right Coin On Right (Bottom) Counter                                                                                                | ON = Left Coin On Left (Top) Counter<br>OFF = Left Coin On Right (Bottom) Counter | <b>CREDITS FOR BONUS</b><br>OFF = 7<br>ON = 6<br>OFF = 5<br>ON = 4<br>OFF = 3<br>ON = 2<br>OFF = 1<br>ON = 0 |                                                                | NOT USED                                                                                                                                                                          |                                        | <b>"KING OF THE WORLD"</b><br>NAME<br>ON = Long Name<br>OFF = 3 Letter Name<br>ON = Allow Name<br>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 BENEFICIAL 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 documentation if additional information is needed.

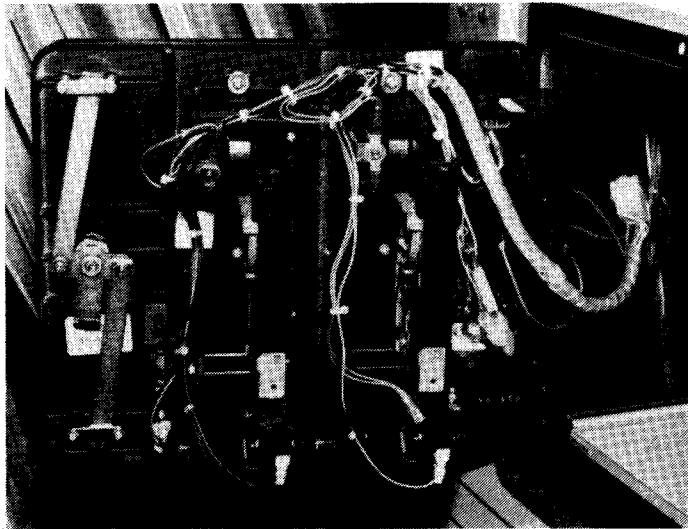


FIGURE 2-1 COIN DOOR

### 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.

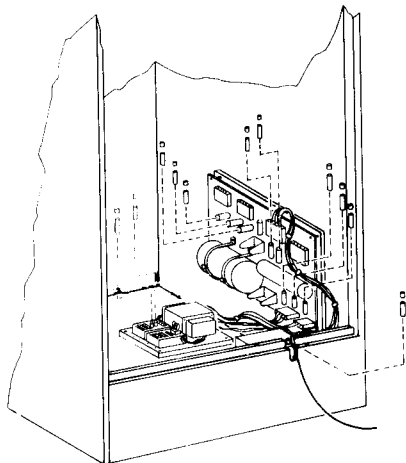


FIGURE 2-2 FUSE REPLACEMENT

### 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.

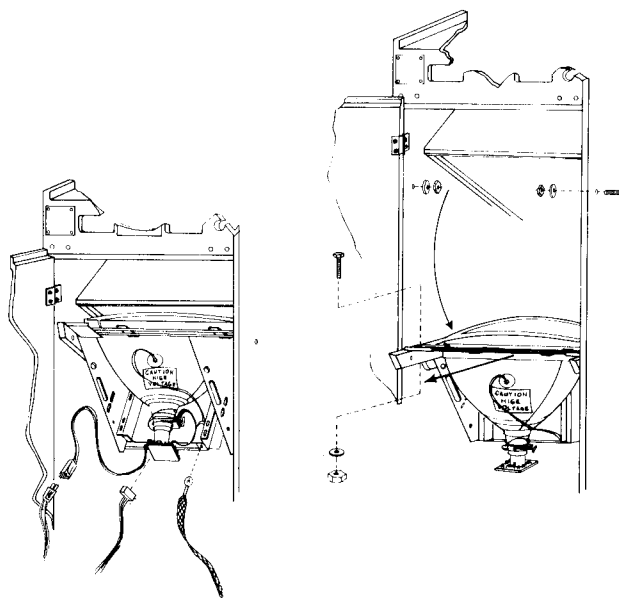


FIGURE 2-3 MONITOR REMOVAL

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.

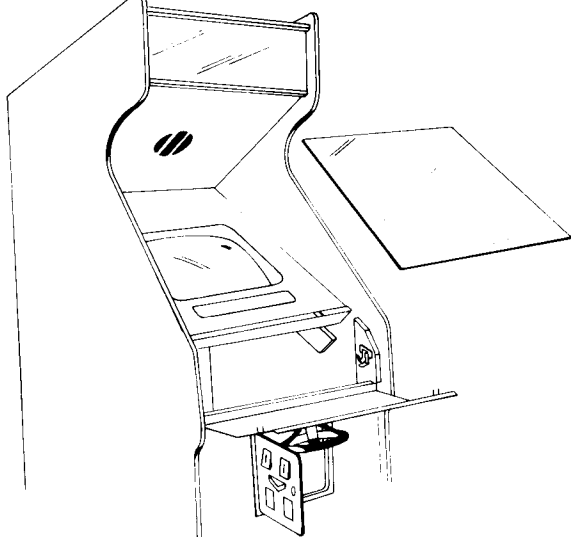


FIGURE 2-4 COVER GLASS REMOVAL

## 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.

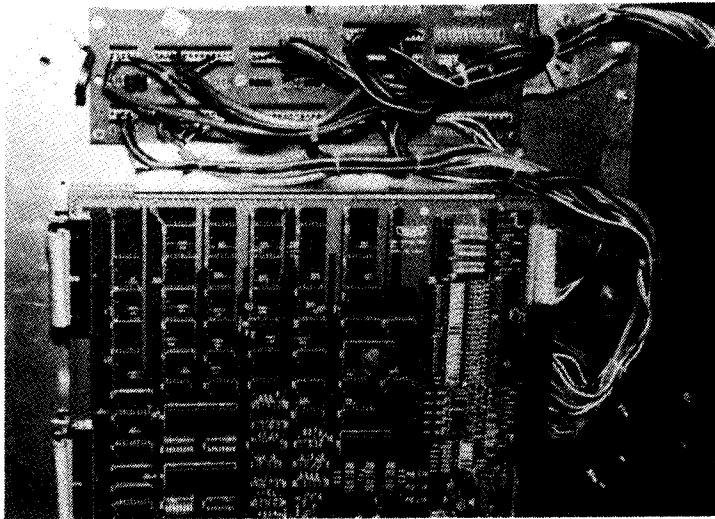


FIGURE 2-5 PRINTED CIRCUIT BOARD

## 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.

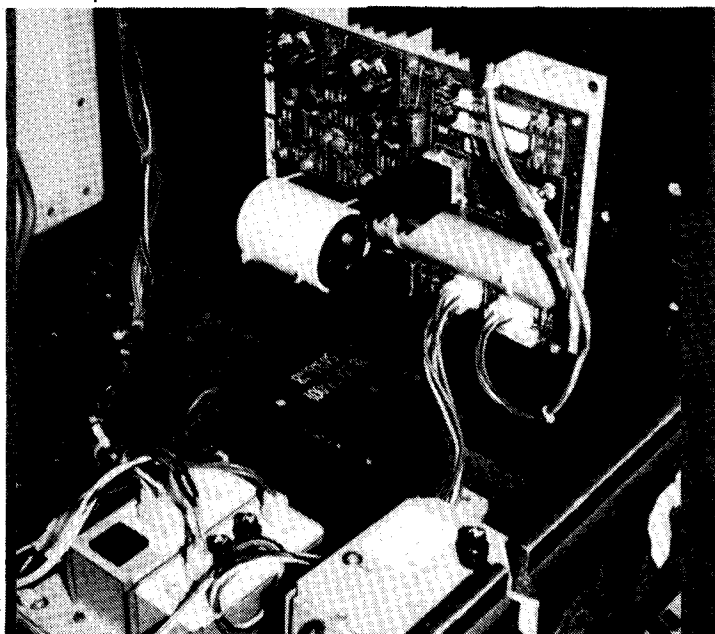


FIGURE 2-6 POWER SUPPLY

### 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 $\pm$ 10% | 50/60Hz | 3 AMP     |
| 120 VAC $\pm$ 10% | 50/60Hz | 3 AMP     |
| 200 VAC $\pm$ 10% | 50/60Hz | 1.5 AMP   |
| 220 VAC $\pm$ 10% | 50/60Hz | 1.5 AMP   |
| 240 VAC $\pm$ 10% | 50/60Hz | 1.5 AMP   |

TABLE 2-1 LINE VOLTAGE

### CAUTION

For continuous 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 Regulator 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 against 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  $5V \pm .25V$ . 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  $\pm .25V$  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.

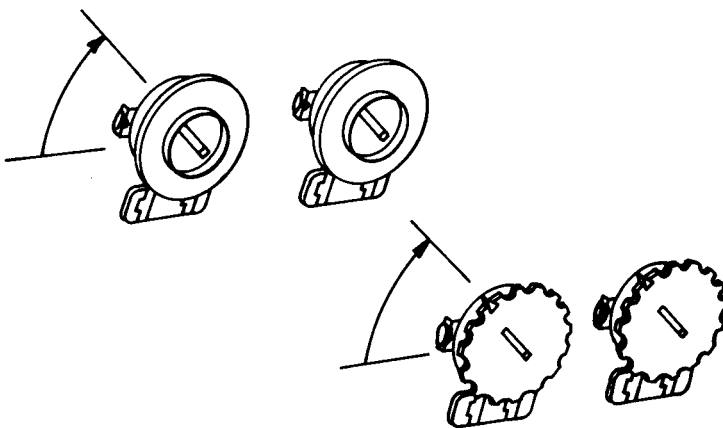
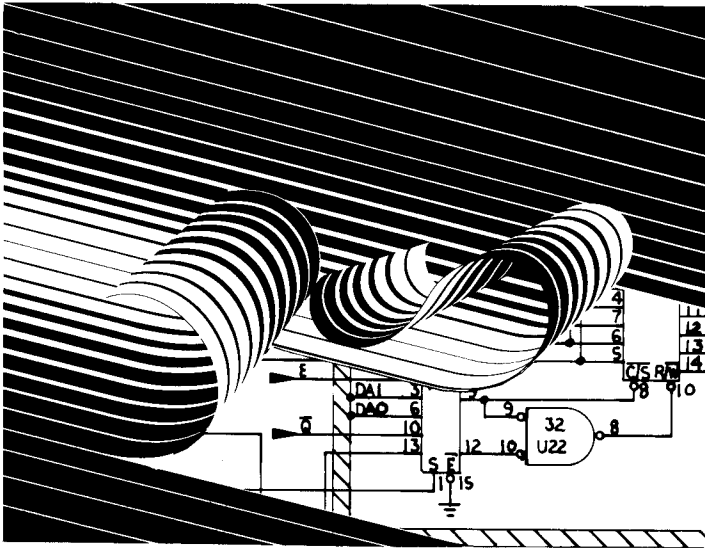


FIGURE 2-7 CURRENT LIMIT ADJUSTMENT

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



# Theory Of Operation

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

### 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, 20D, HRD\*, and FASTWRT\*. Refer to the Timing Diagrams.

HSYNC is then used to clock the vertical 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 multiplexer 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 WAIT0 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 generated 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. If 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 of 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 & U127. 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.

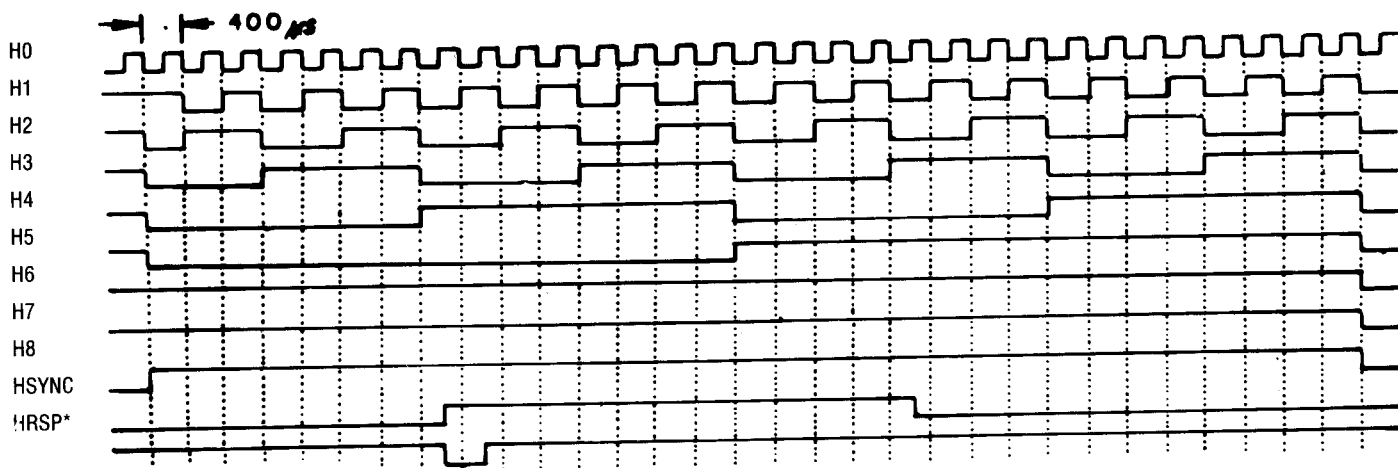
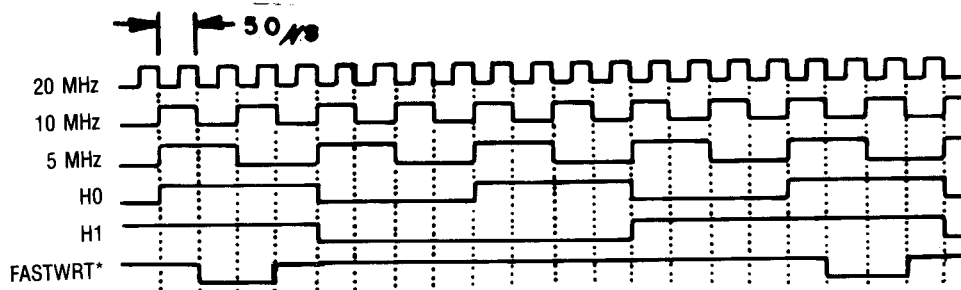
### 3.6 STATE MACHINE OPERATION

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.

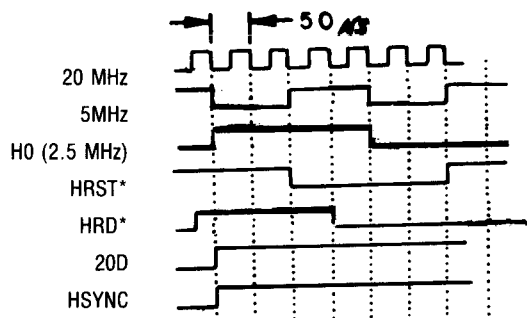
# PROCESSOR CLOCKS

FIGURE 3-1

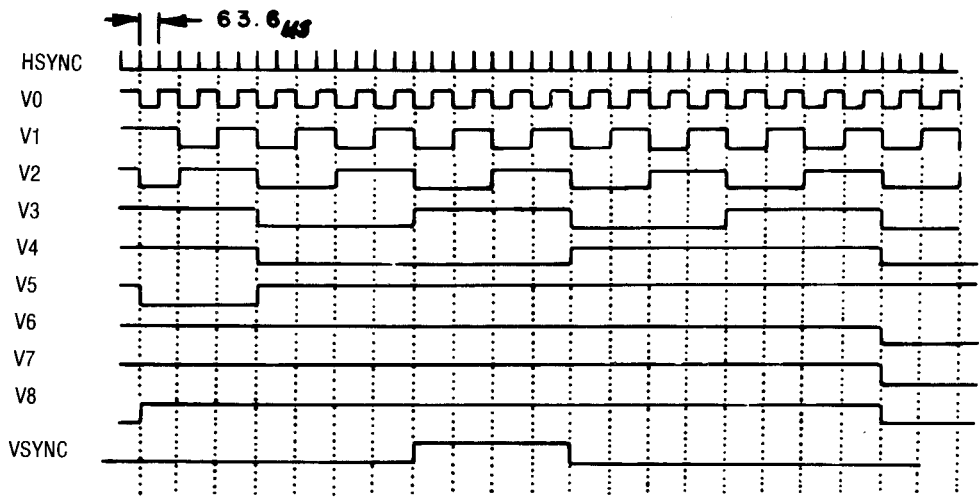
## HORIZONTAL BLANKING TIMING



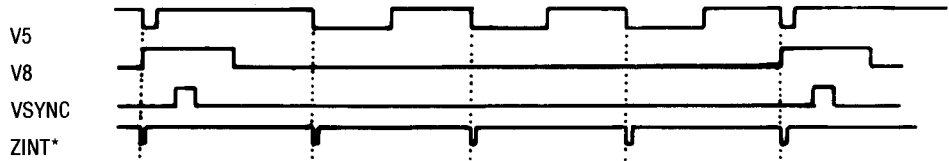
## DELAYED CLOCK TIMING



**VERTICAL BLANKING TIMING**



**PROCESSOR INTERRUPT TIMING**



**STATE MACHINE DATA DEFINITION**  
**TABLE 3-2**

| State | Bits |   |   |   |   |   |   |   | Hex | Source | Dest. | Description                                                         |
|-------|------|---|---|---|---|---|---|---|-----|--------|-------|---------------------------------------------------------------------|
|       | 7    | 6 | 5 | 4 | 3 | 2 | 1 | 0 |     |        |       |                                                                     |
| 0     | 0    | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0D  | ROM    | Adder | NOOP - Data From ROM                                                |
| 1     | 0    | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0F  | 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 | 0F  | 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 | 0D  | ROM    | Adder | HBUMPO - From ROM4-To Adder-To RAM4                                 |
| A     | 0    | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 6D  | RAM    | Adder | HPO50 - 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 | 0D  | 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 | 0D  | 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 | VBUMPO - 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)<br>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**

|    | <b>RAM CONTENTS</b> | <b>ROM CONTENTS</b> |
|----|---------------------|---------------------|
| 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 vertical 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 | H4 (U1-14) = F979 |
| H1 (U2-13) = 6U6U | H5 (U1-13) = 2HH3 |
| H2 (U2-12) = 49C6 | H6 (U1-12) = 9330 |
| H3 (U2-11) = H90C | H7 (U1-11) = 313U |
|                   | H8 (U3-6) = U57C  |

|                   |                   |
|-------------------|-------------------|
| V0 (U5-14) = 61HF | V4 (U6-14) = PFHH |
| V1 (U5-13) = 846C | V5 (U6-13) = 2408 |
| V2 (U5-12) = H6P5 | V6 (U6-12) = F6F5 |
| V3 (U5-11) = HH31 | 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 | A 8 = HC89 |
| A1 = 5555 | A 9 = 2H70 |
| A2 = CCCC | A10 = HPP0 |
| A3 = 7F7F | A11 = 1293 |

A4 = 5H21

A12 = HAP7

A5 = 0AFA

A6 = UPFH

A7 = 52F8

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 eeproms, 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                      U89-12 = 3F39  
U89-5 = UP6F                      U89-15 = 0002  
U89-6 = 005F                      U89-16 = U8UF  
U89-9 = 148C                      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 eeprom:

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- 6 = C87F  
U59-2 = 59A4                      U59- 7 = 6H45  
U59-3 = U569                      U59- 8 = 0PAP  
U59-4 = UP6F                      U59-10 = 59A4  
U59-5 = 4F50

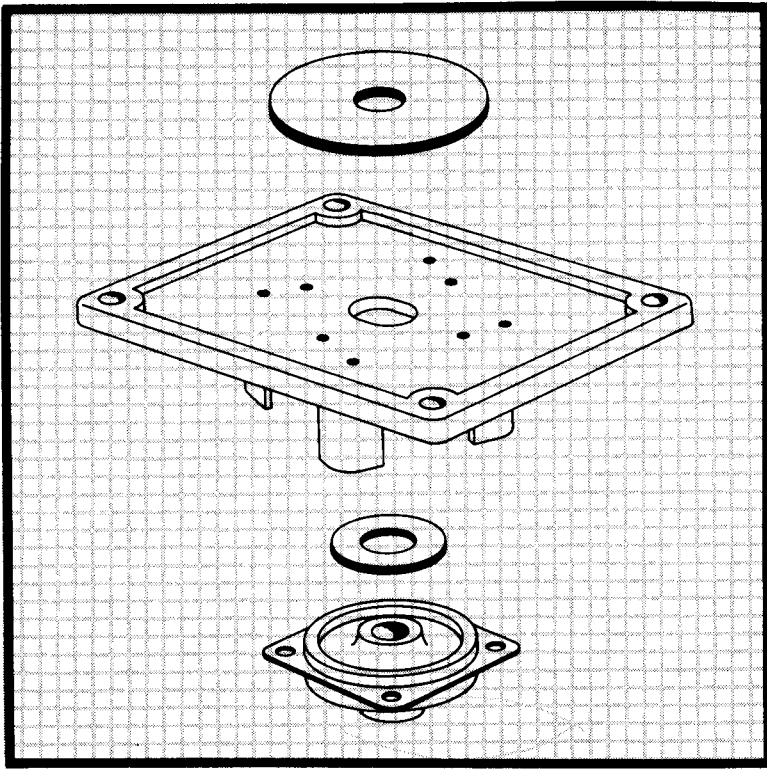
Math eeprom data and address signals (U44)

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

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



# **Illustration & Parts Lists**

# **4**

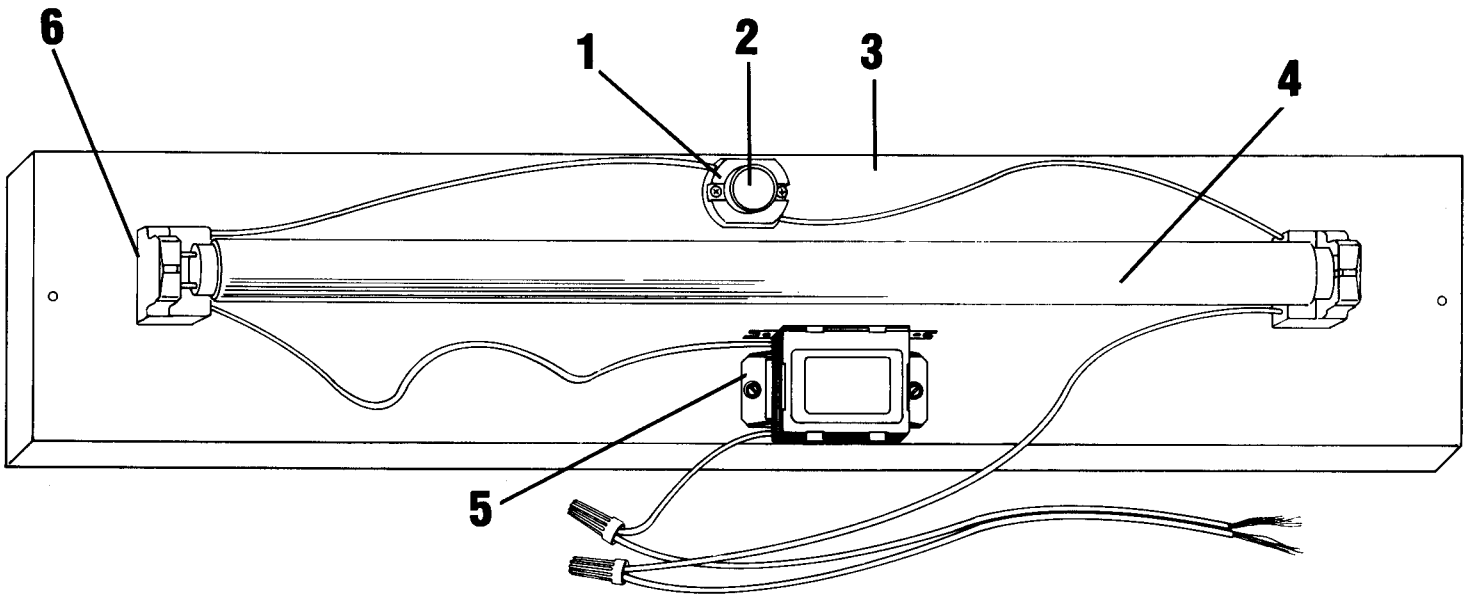
**FLUORESCENT PANEL  
(07-00273-001)**

**FIGURE 1**

| <b>ITEM</b> | <b>TAITO<br/>PART NO.</b> | <b>DESCRIPTION</b>          |
|-------------|---------------------------|-----------------------------|
| 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**



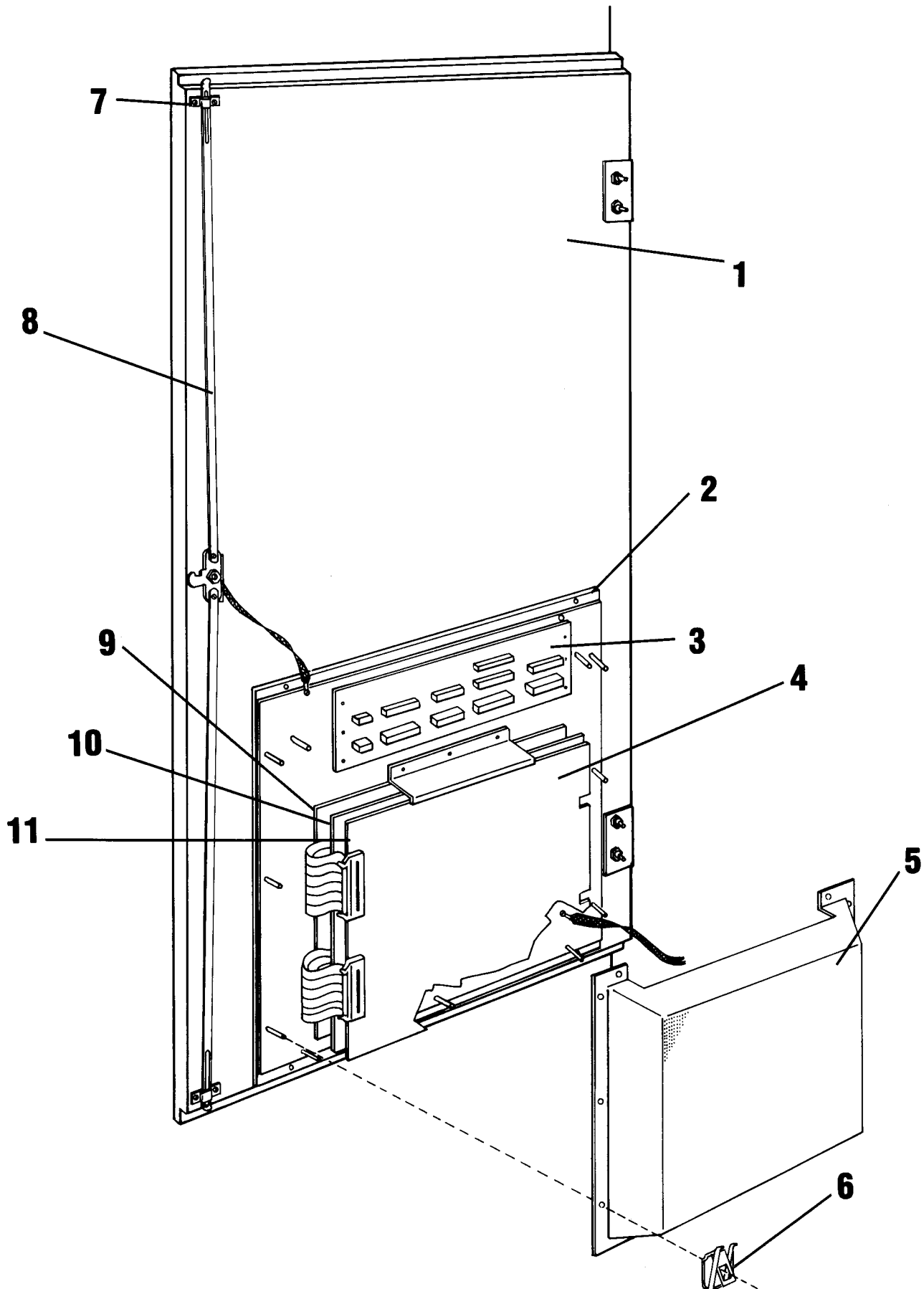
## BACK DOOR

FIGURE 2

| ITEM | TAITO<br>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



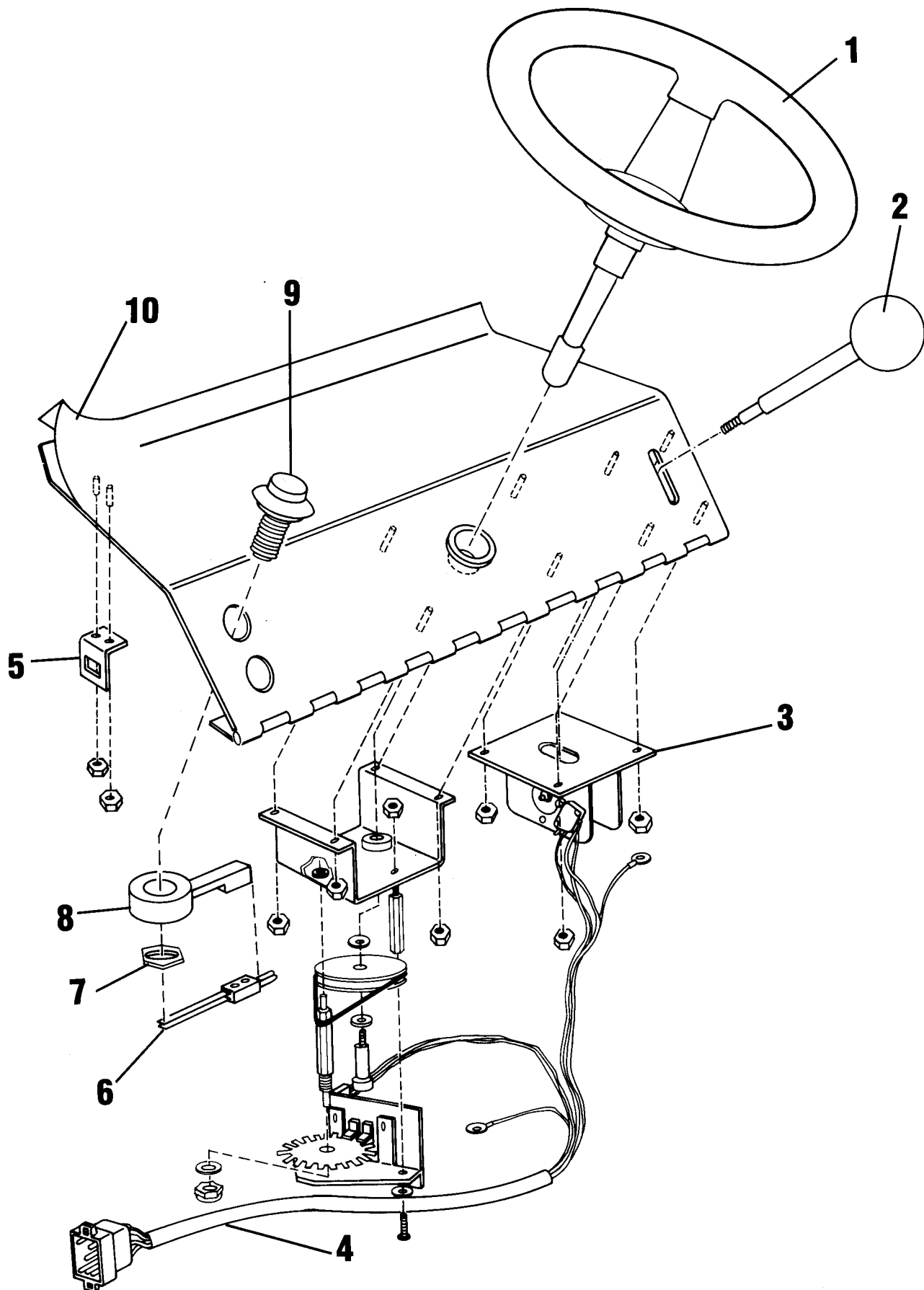
## CONTROL PANEL

FIGURE 3

| ITEM | TAITO<br>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 $\frac{5}{8}$ -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

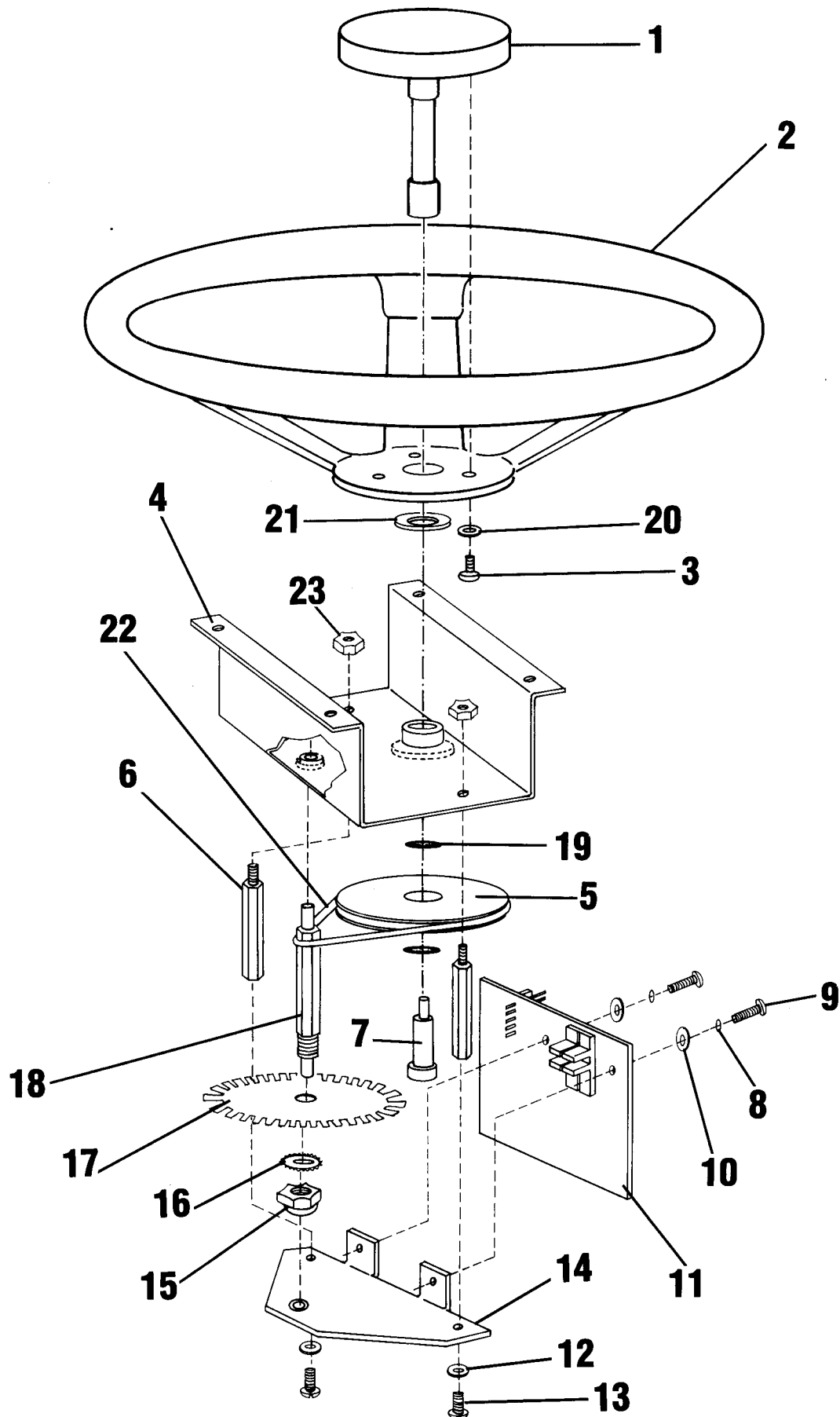


**STEERING WHEEL ASSEMBLY****FIGURE 4**

| ITEM | TAITO<br>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 ¾ Hex Wshr. Hd.  |
| 14   | 61-00267-001      | Mounting Bracket               |
| 15   | 54-03007-001      | Locknut ¾-16 Nylon Insert      |
| 16   | 55-03007-001      | Lockwasher ¾ 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



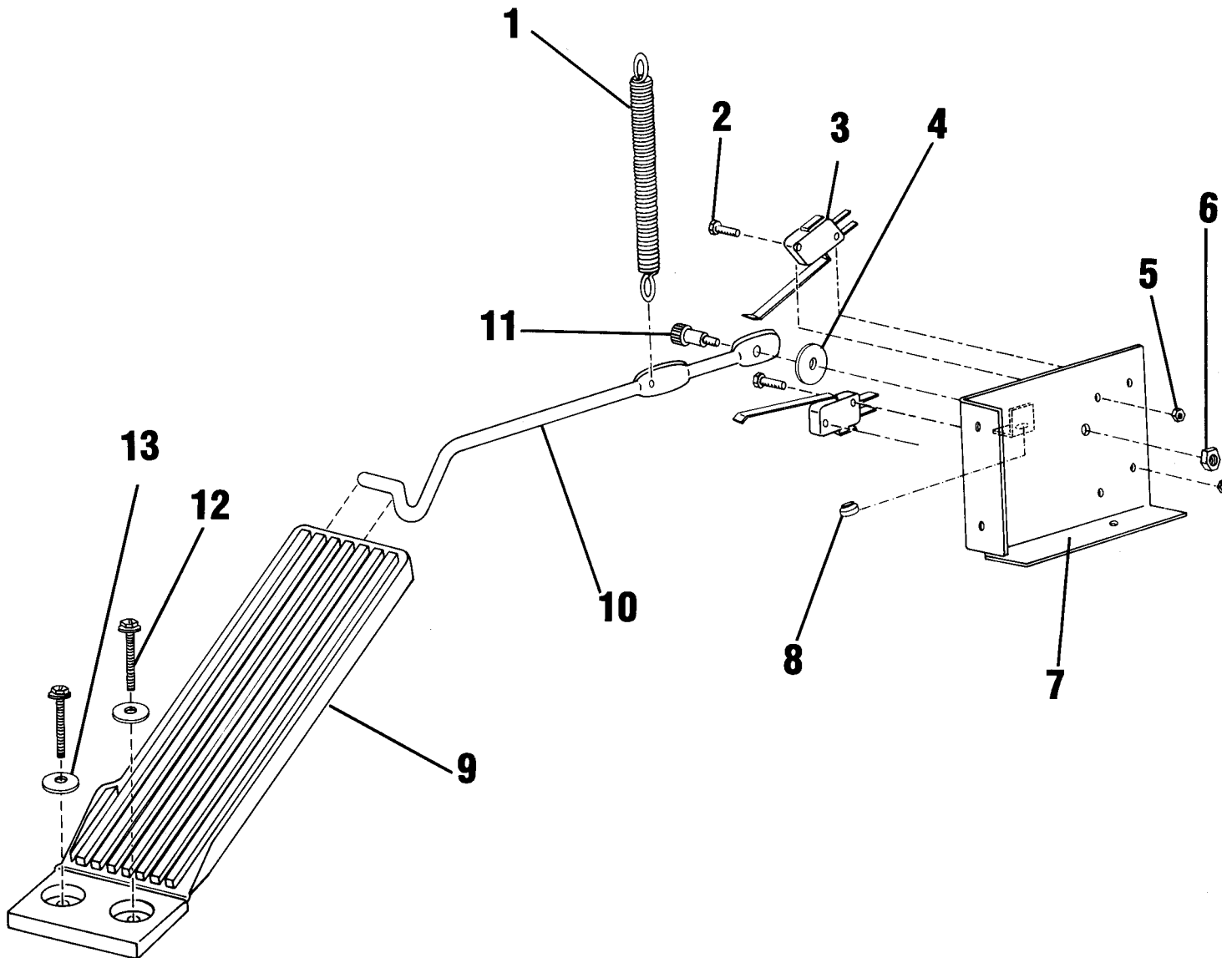
## ACCELERATOR ASSEMBLY

FIGURE 5

| ITEM | TAITO<br>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

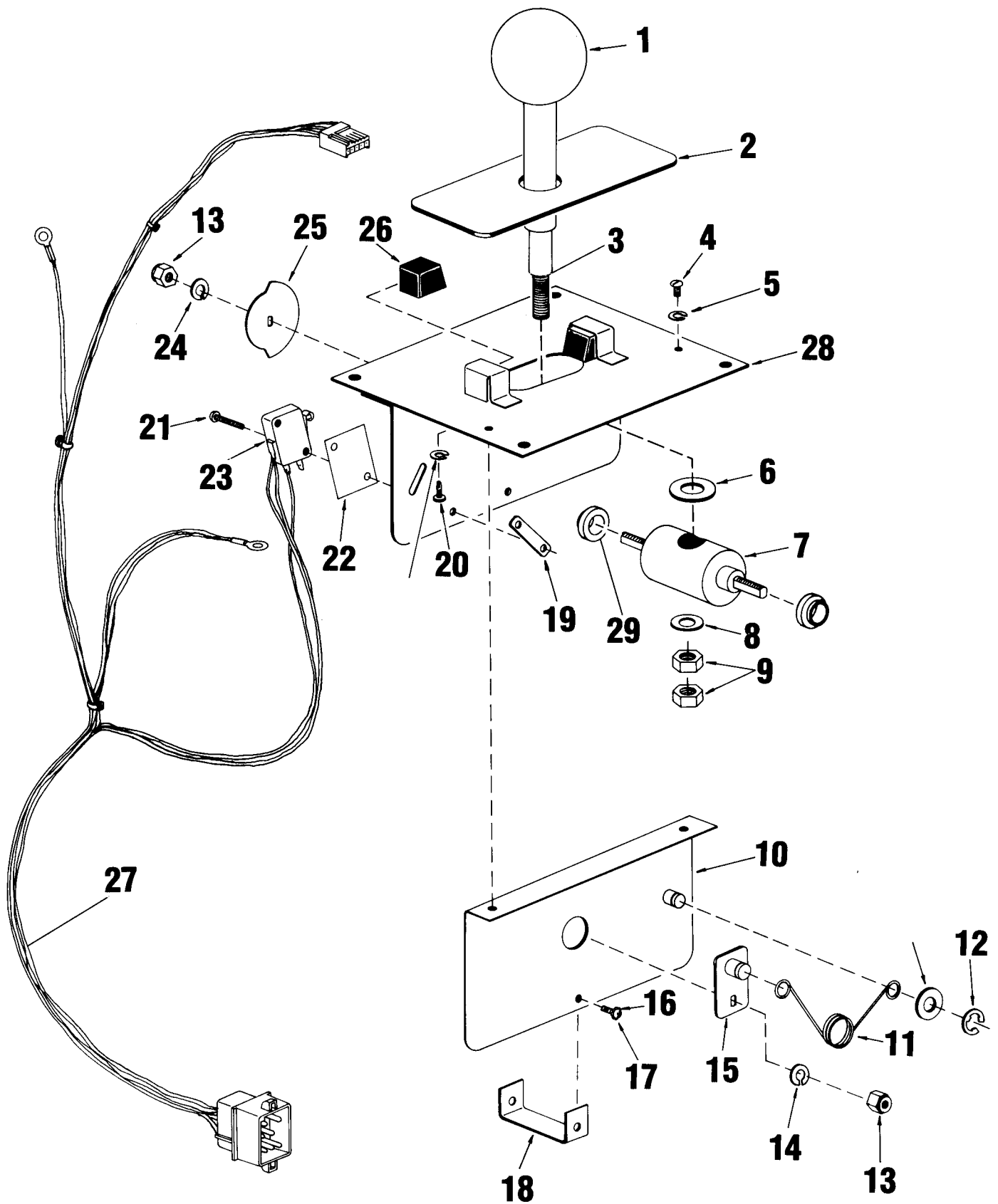


**SHIFT LEVER ASSEMBLY****FIGURE 6**

| ITEM | TAITO<br>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



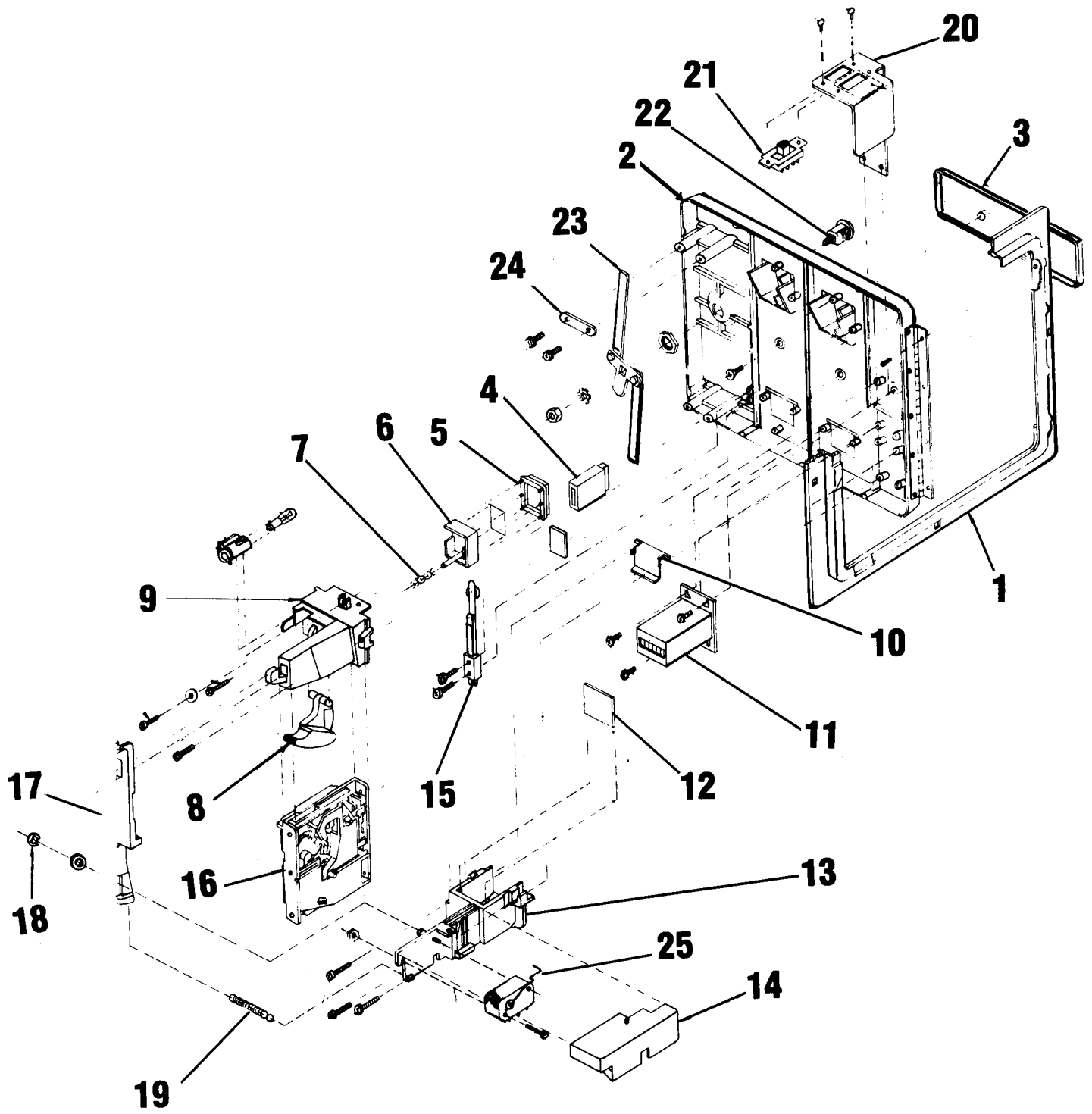
**COIN DOOR****FIGURE 7**

| ITEM | TAITO<br>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

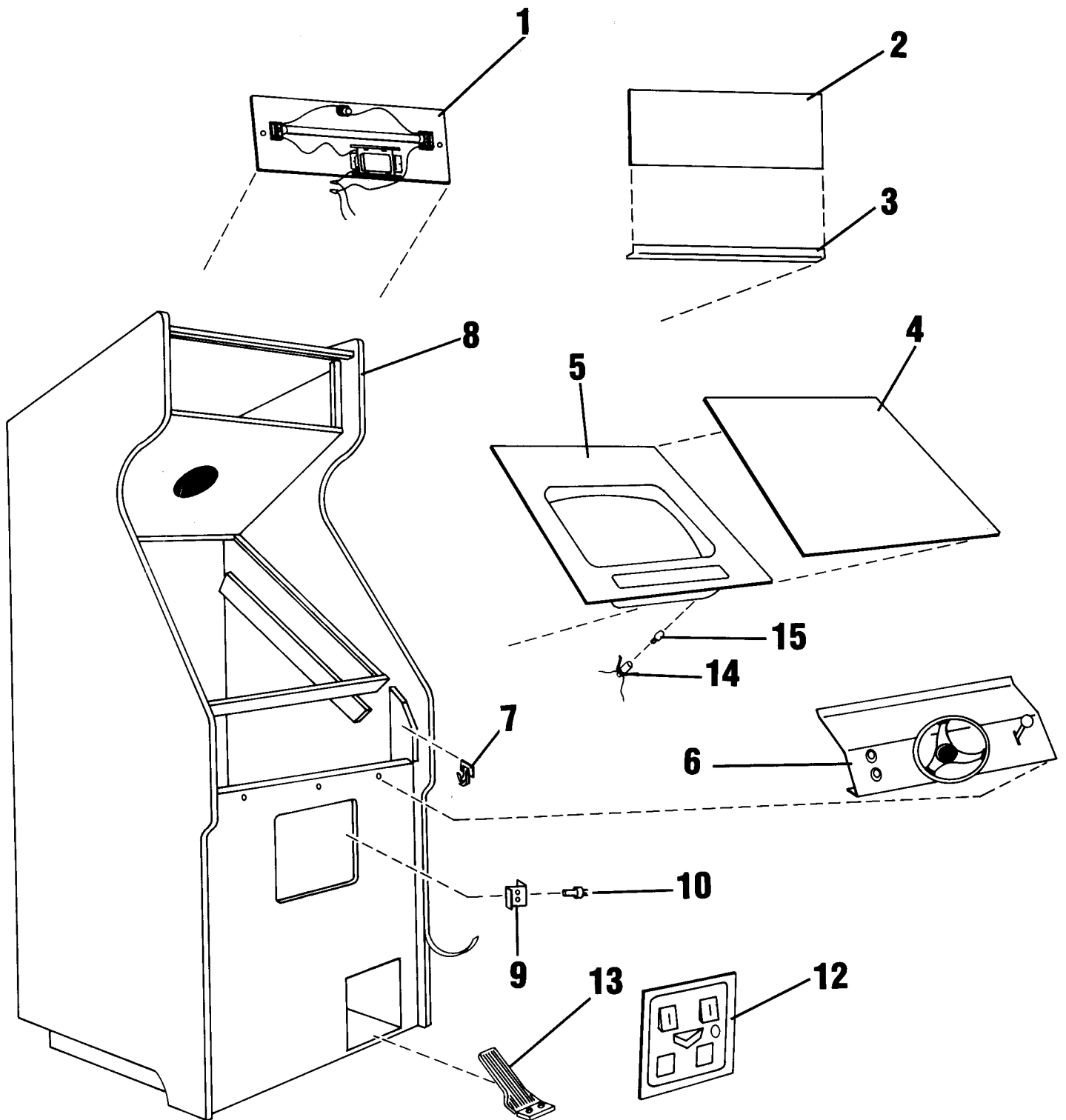


**CABINET ASSEMBLY FRONT VIEW****FIGURE 8**

| ITEM | TAITO<br>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

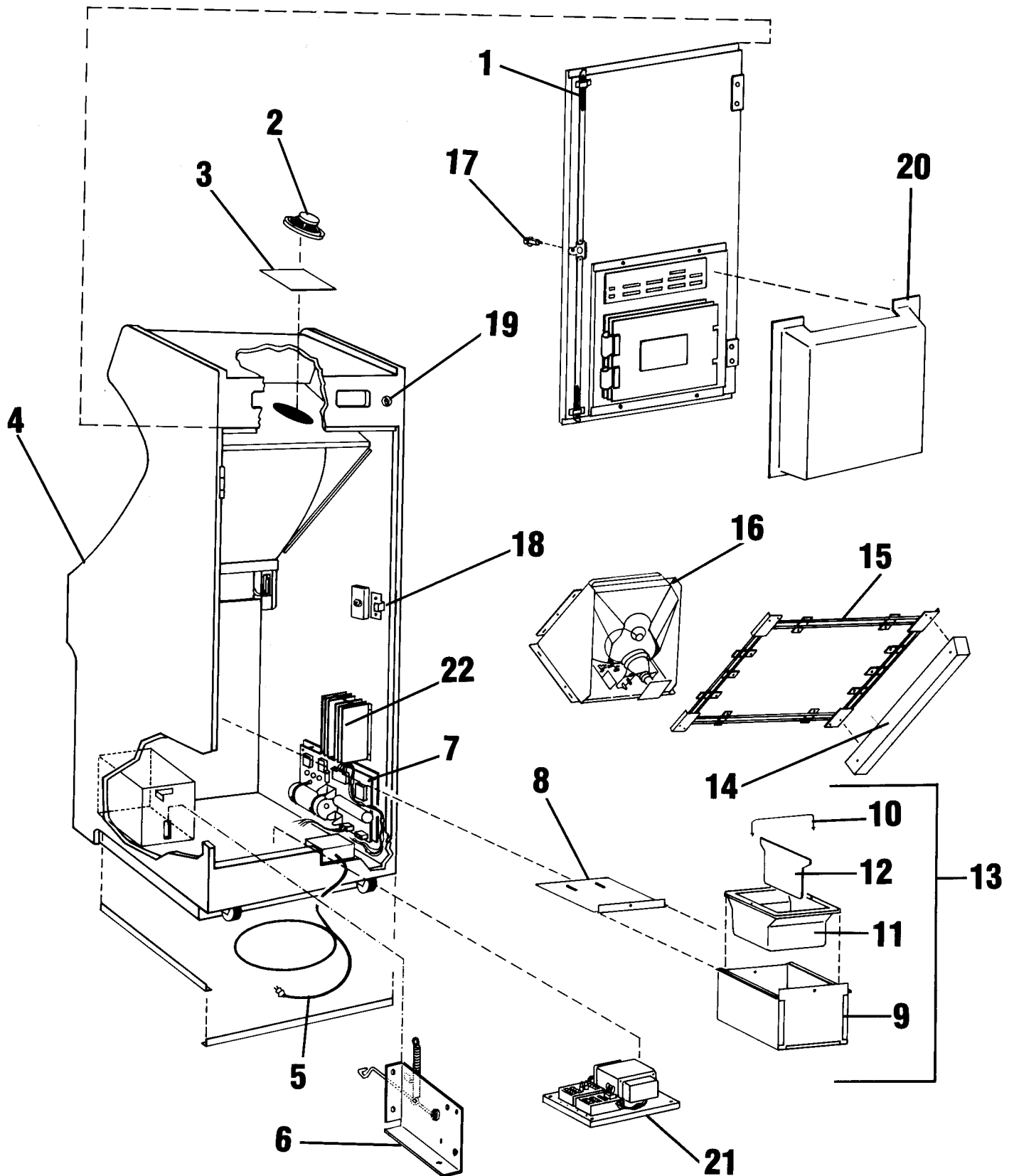


**CABINET ASSEMBLY REAR VIEW****FIGURE 9**

| <b>ITEM</b> | <b>TAITO<br/>PART NO.</b> | <b>DESCRIPTION</b>     |
|-------------|---------------------------|------------------------|
| 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

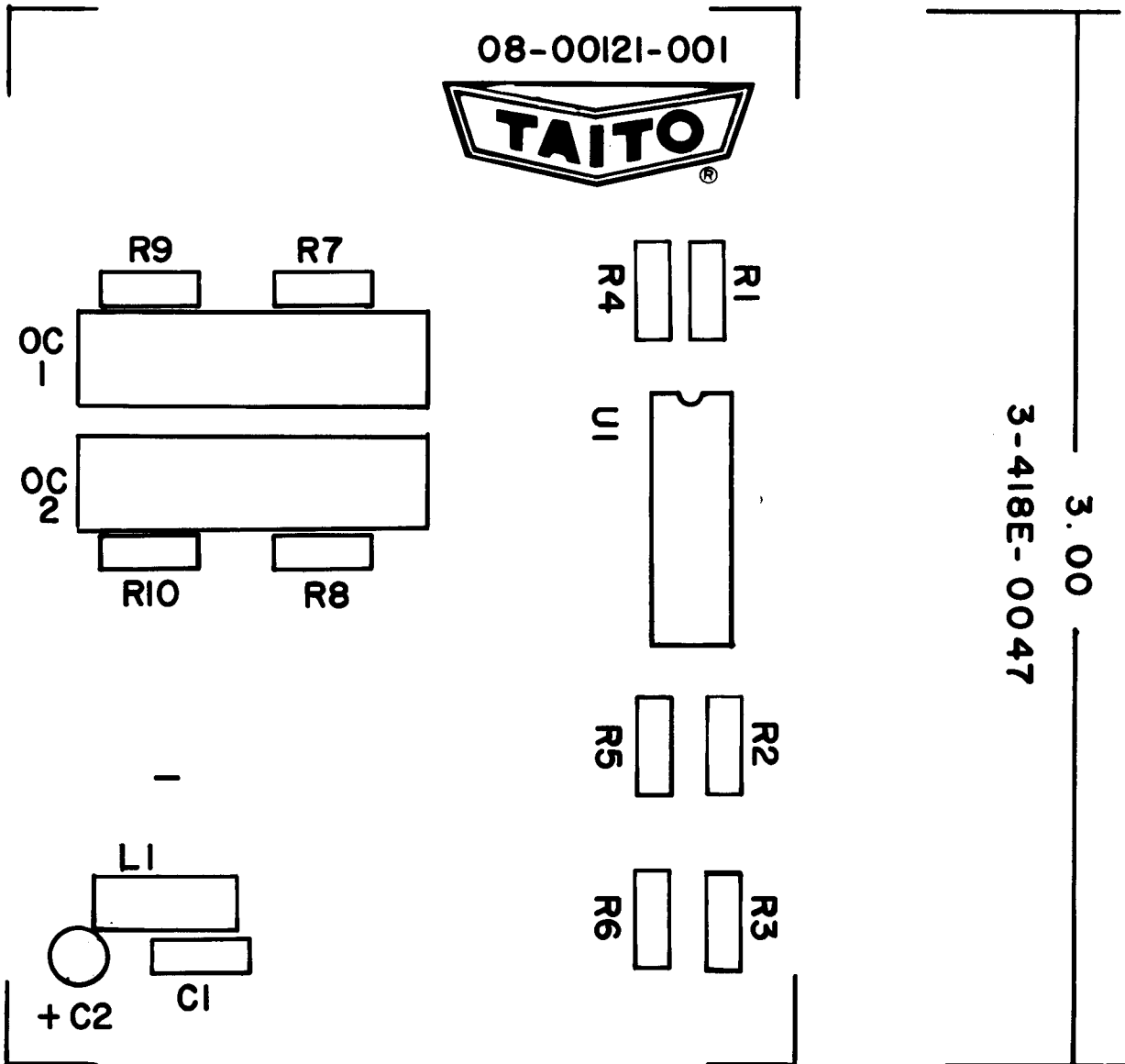


**OPTOCOUPLER****FIGURE 10**

| ITEM | TAITO<br>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) |

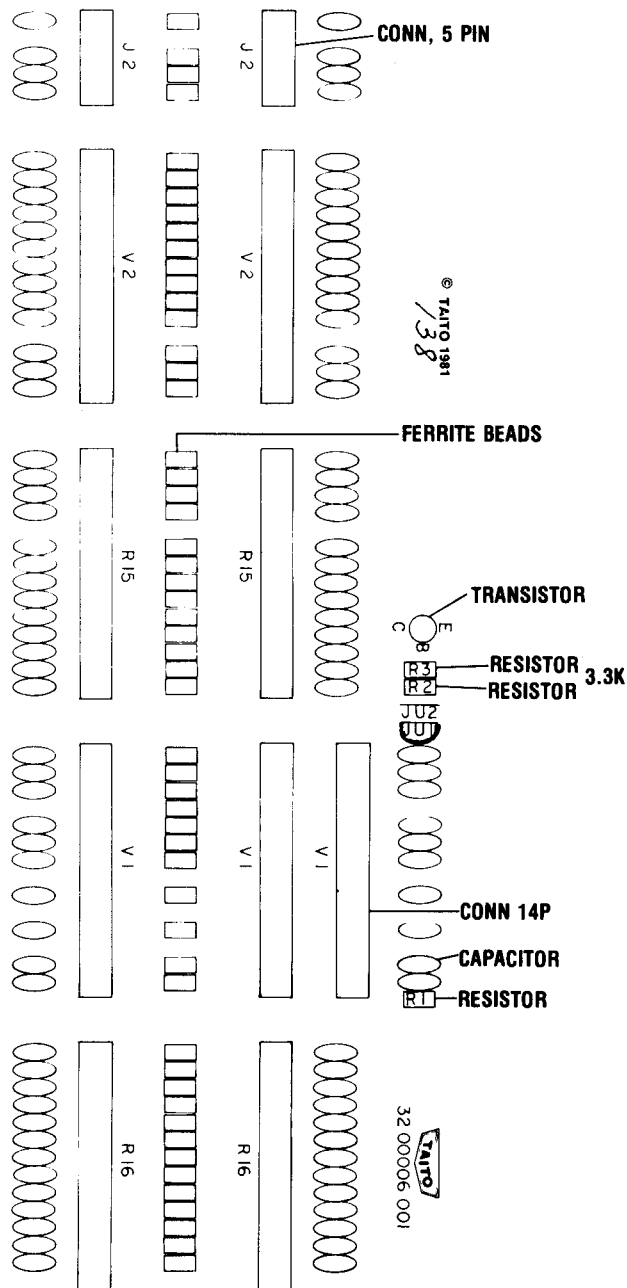
# OPTOCOUPLER

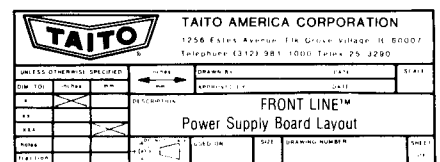
FIGURE 10



**FILTER BOARD****FIGURE 11**

| ITEM | TAITO<br>PART NO. | DESCRIPTION                      | QUANTITY |
|------|-------------------|----------------------------------|----------|
| 1    | 12-10003-471      | Cap, 470pf $\pm$ 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 $\frac{1}{4}$ W  | 1        |
| 7    | 11-00001-332      | Resistor 3.3 ohm $\frac{1}{4}$ W | 2        |
| 8    | 63B00068-001      | Stand Off                        | 6        |
| 9    | 17-00002-001      | Ferrite Bead Assembly            | 6        |
| 10   | 17-10001-001      | Inductor, 10 $\mu$ H             | 24       |

**FIGURE 11**

**FIGURE 12**

# 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  |

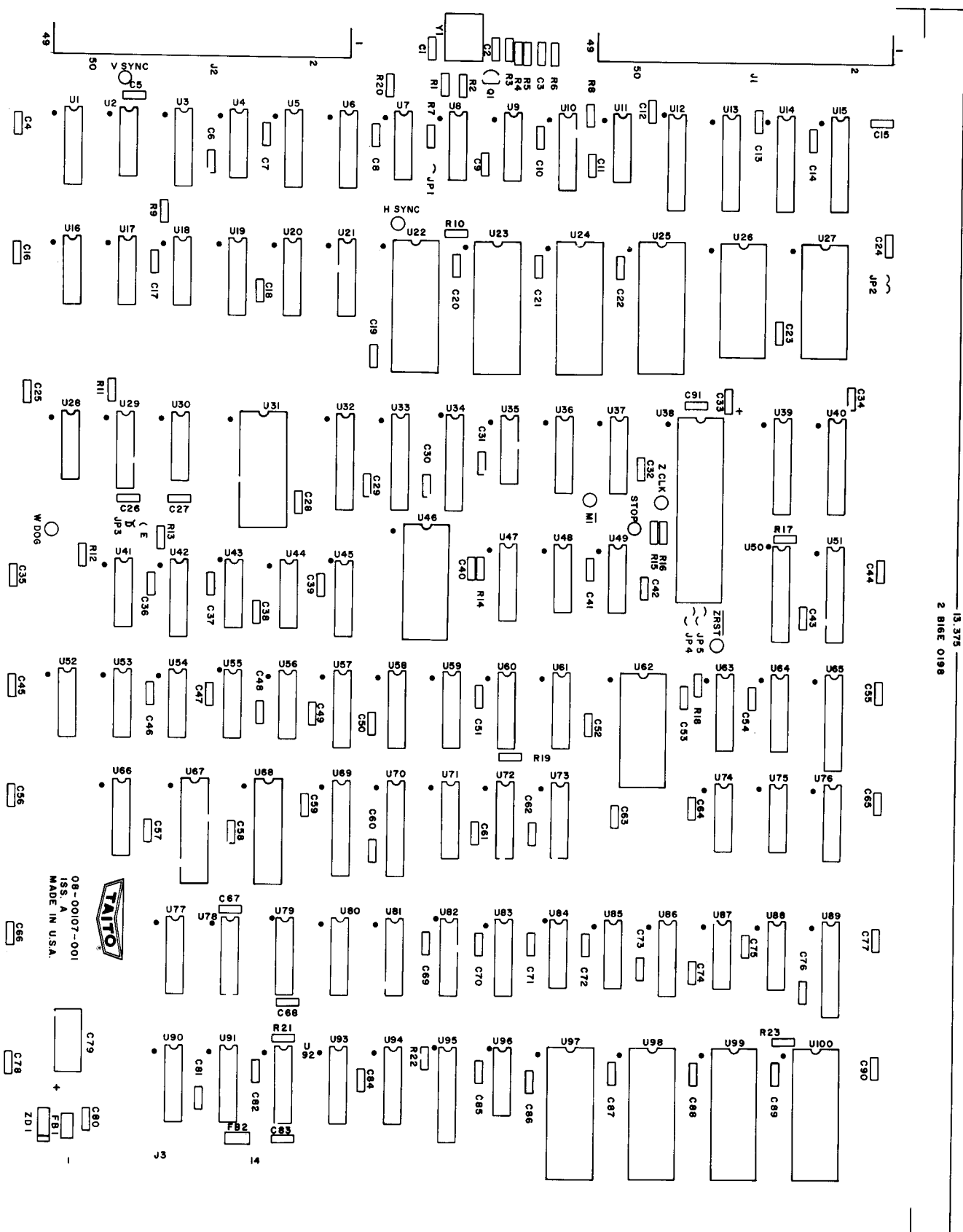
| SYM  | TAITO PART NO. | DESCRIPTION                      |
|------|----------------|----------------------------------|
| C5   | 12-10001-102   | Capacitor, .001uf                |
| C6   | 12-30001-106   | Capacitor, Tantalum 10uf         |
| C7   | 12-20003-509   | Capacitor, Electrolytic 50,000uf |
| 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<br>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 Octal Buffer          |
| U13  | 15-20245-001   | 74LS245 Bus Transceiver 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 Transceiver 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<br>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 $\frac{1}{4}w \pm 5\%$  |
| R2   | 11-00001-102      | Resistor 1 K ohm $\frac{1}{4}w \pm 5\%$  |
| R3   | 11-00001-101      | Resistor 680 ohm $\frac{1}{4}w \pm 5\%$  |
| R4   | 11-00001-221      | Resistor 220 ohm $\frac{1}{4}w \pm 5\%$  |
| R5   | 11-00001-220      | Resistor 22 ohm                          |
| R6   | 11-00001-122      | Resistor 1.2K ohm $\frac{1}{4}w \pm 5\%$ |
| R7   | 11-00001-102      | Resistor 1K ohm $\frac{1}{4}w \pm 5\%$   |
| R8   | 11-00001-102      | Resistor 1K ohm $\frac{1}{4}w \pm 5\%$   |
| R9   | 11-00001-102      | Resistor 1K ohm $\frac{1}{4}w \pm 5\%$   |
| R10  | 11-00001-102      | Resistor 1K ohm $\frac{1}{4}w \pm 5\%$   |
| R11  | 11-00001-102      | Resistor 1K ohm $\frac{1}{4}w \pm 5\%$   |
| R12  | 11-00001-472      | Resistor 4.7K ohm $\frac{1}{4}w \pm 5\%$ |
| R13  | 11-00001-102      | Resistor 1K ohm $\frac{1}{4}w \pm 5\%$   |
| R14  | 11-00001-102      | Resistor 1K ohm $\frac{1}{4}w \pm 5\%$   |
| R15  | 11-00001-472      | Res 4,700 ohm $\frac{1}{4}w \pm 5\%$     |
| R16  | 11-00001-472      | Res 4,700 ohm $\frac{1}{4}w \pm 5\%$     |
| R17  | 11-00001-102      | Resistor 1K ohm $\frac{1}{4}w \pm 5\%$   |
| R18  | 11-00001-102      | Resistor 1K ohm $\frac{1}{4}w \pm 5\%$   |
| R19  | 11-00001-102      | Resistor 1K ohm $\frac{1}{4}w \pm 5\%$   |
| R20  | 11-00001-681      | Resistor 680 ohm $\frac{1}{4}w \pm 5\%$  |
| R21  | 11-00001-102      | Resistor 1K ohm $\frac{1}{4}w \pm 5\%$   |
| R22  | 11-00001-102      | Resistor 1K ohm $\frac{1}{4}w \pm 5\%$   |
| R23  | 11-00001-102      | Resistor 1K ohm $\frac{1}{4}w \pm 5\%$   |
| 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                    |

**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             |
| 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  | 12-10001-471   | 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 1/4w $\pm$ 5% |
| R2   | 11-00001-102   | 1K-Ohm Resistor 1/4w $\pm$ 5% |
| R3   | 11-00001-102   | 1K-Ohm Resistor 1/4w $\pm$ 5% |
| R4   | 11-00001-102   | 1K-Ohm Resistor 1/4w $\pm$ 5% |
| R5   | 11-00001-102   | 1K-Ohm Resistor 1/4w $\pm$ 5% |
| R6   | 11-00001-102   | 1K-Ohm Resistor 1/4w $\pm$ 5% |
| R7   | 11-00001-102   | 1K-Ohm Resistor 1/4w $\pm$ 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            |

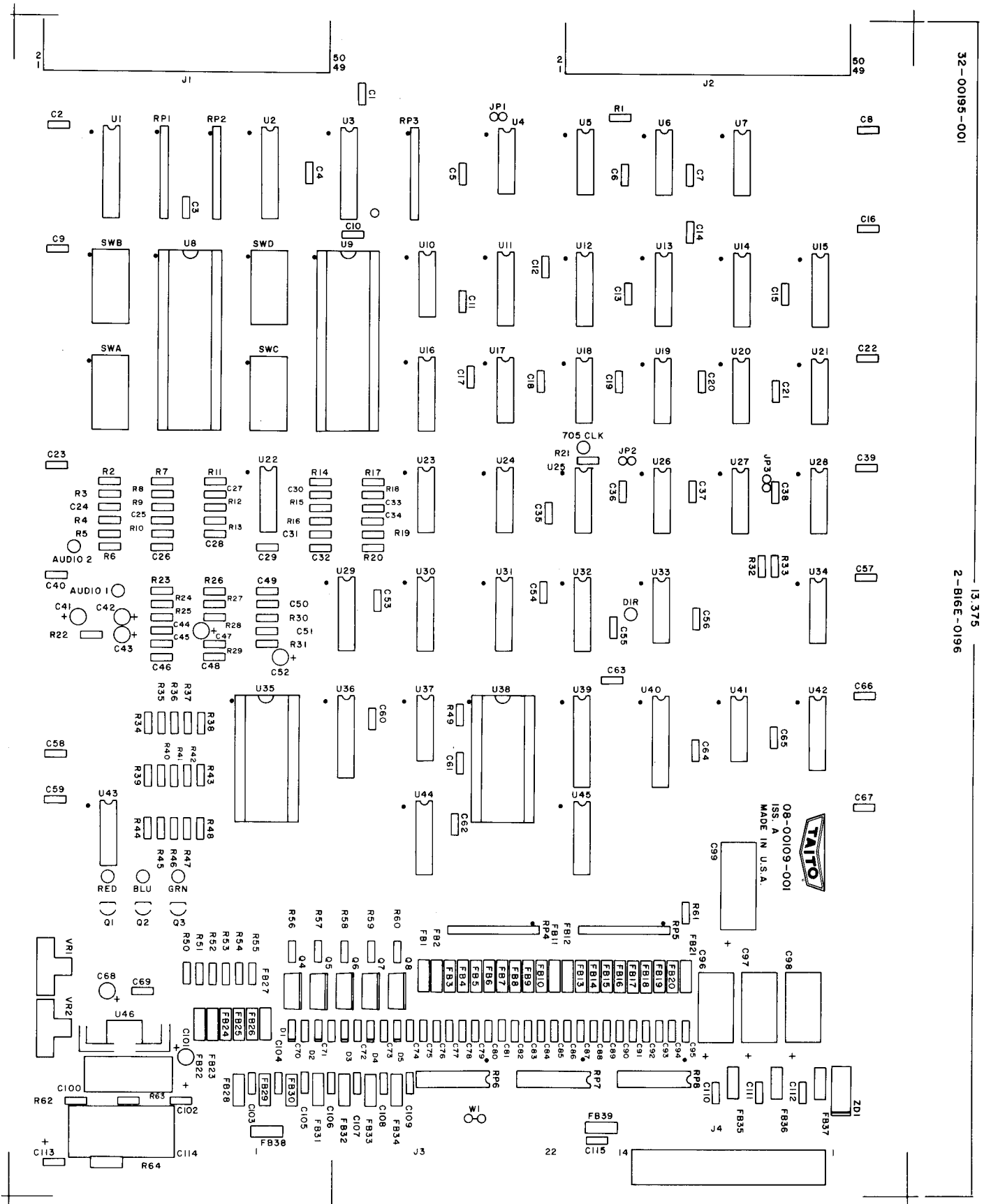
| ITEM | TAITO PART NO. | DESCRIPTION                    |
|------|----------------|--------------------------------|
| U51  | 15-20377-001   | 74LS377 Octal D FF             |
| U52  | 15-20260-001   | 74LS260 Dual 5-Input NOR       |
| U53  | 15-20020-001   | 74LS20 Dual 4 Input NAND       |
| U54  | 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<br>PART NO. | DESCRIPTION                                 |
|------|-------------------|---------------------------------------------|
| U99  | 15-20157-001      | 74LS157 Multi Quad 2 Input                  |
| U100 | 15-20157-001      | 74LS157 Multi 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<br>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<br>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 Addressable 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<br>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

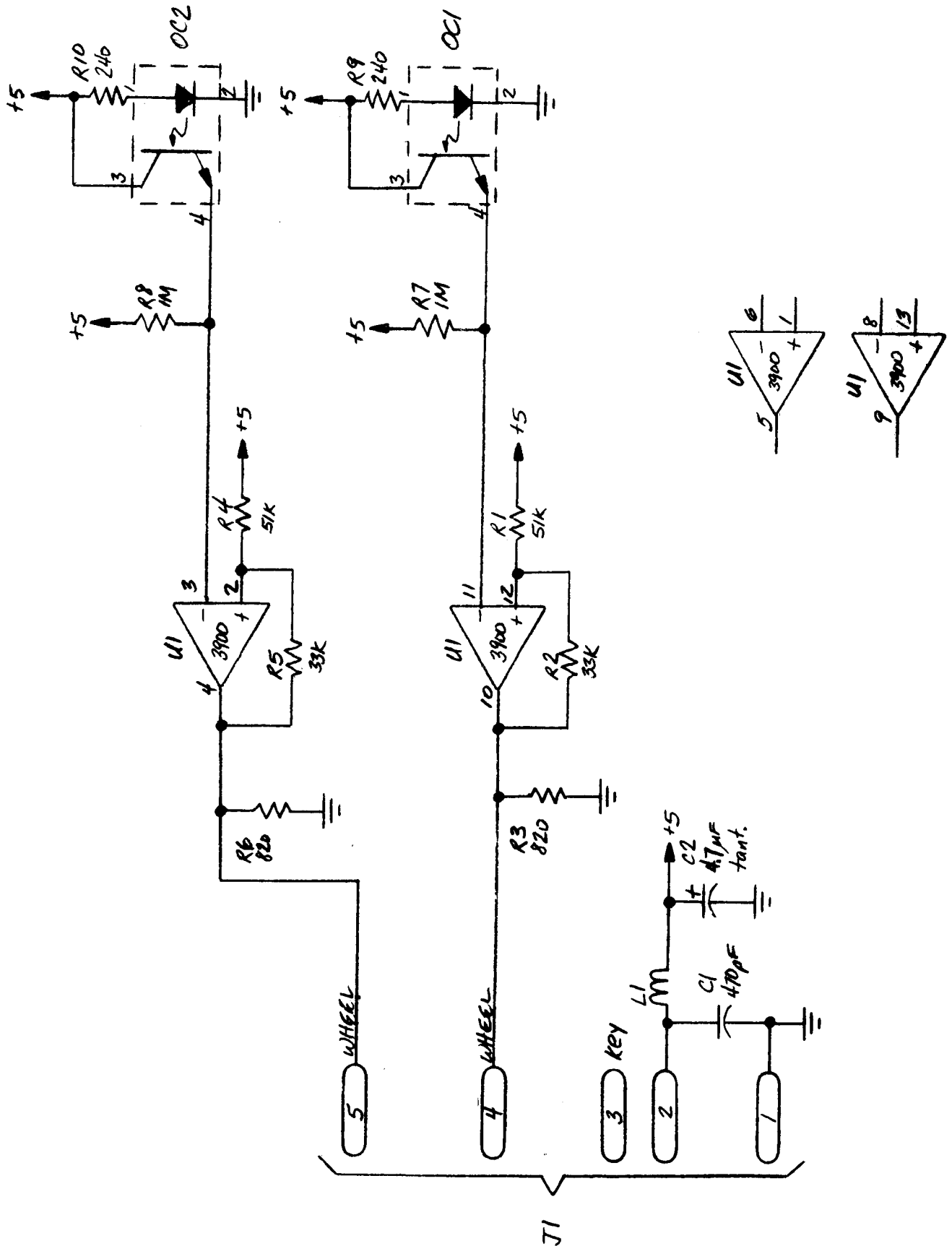


FIGURE 17

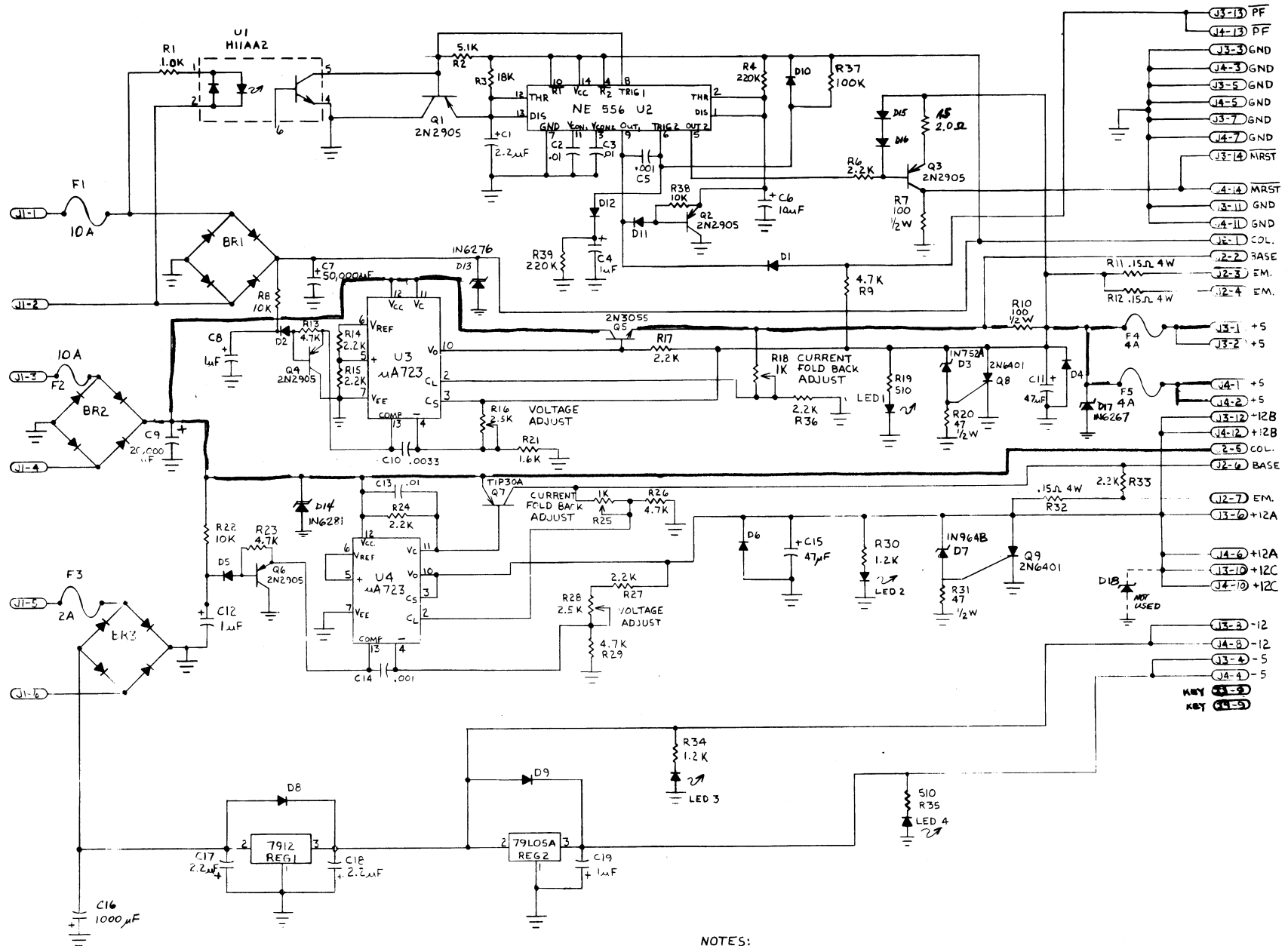


FIGURE 18

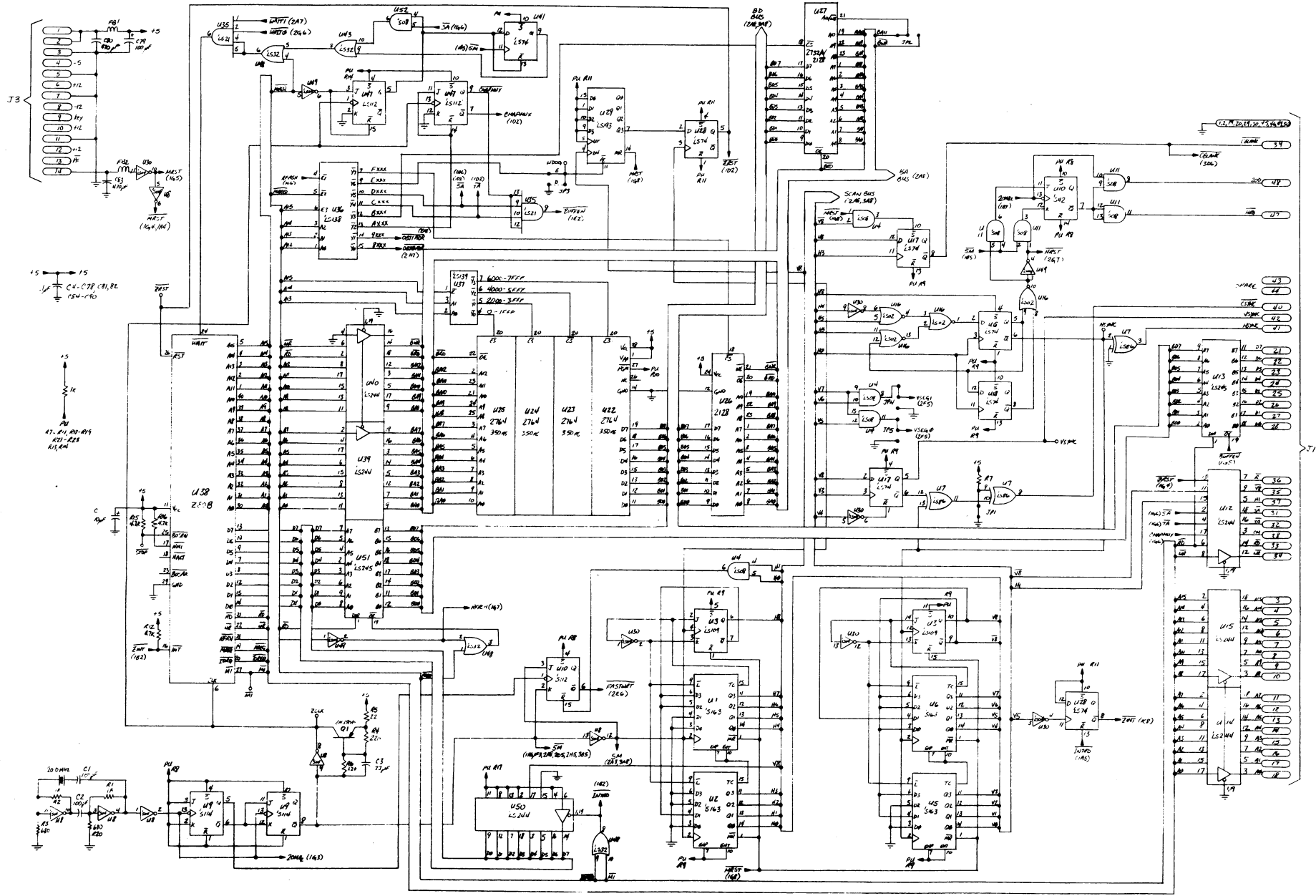
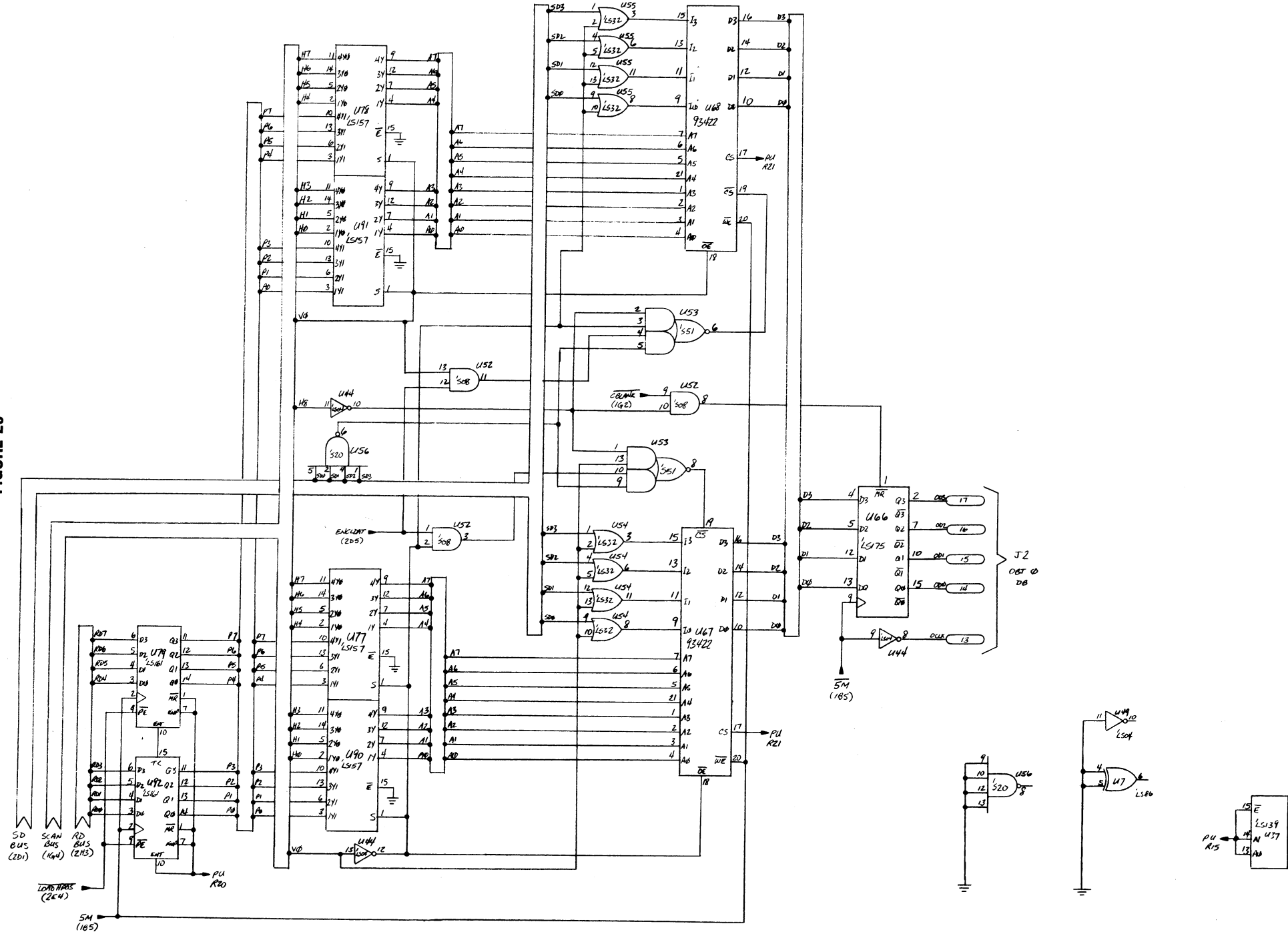




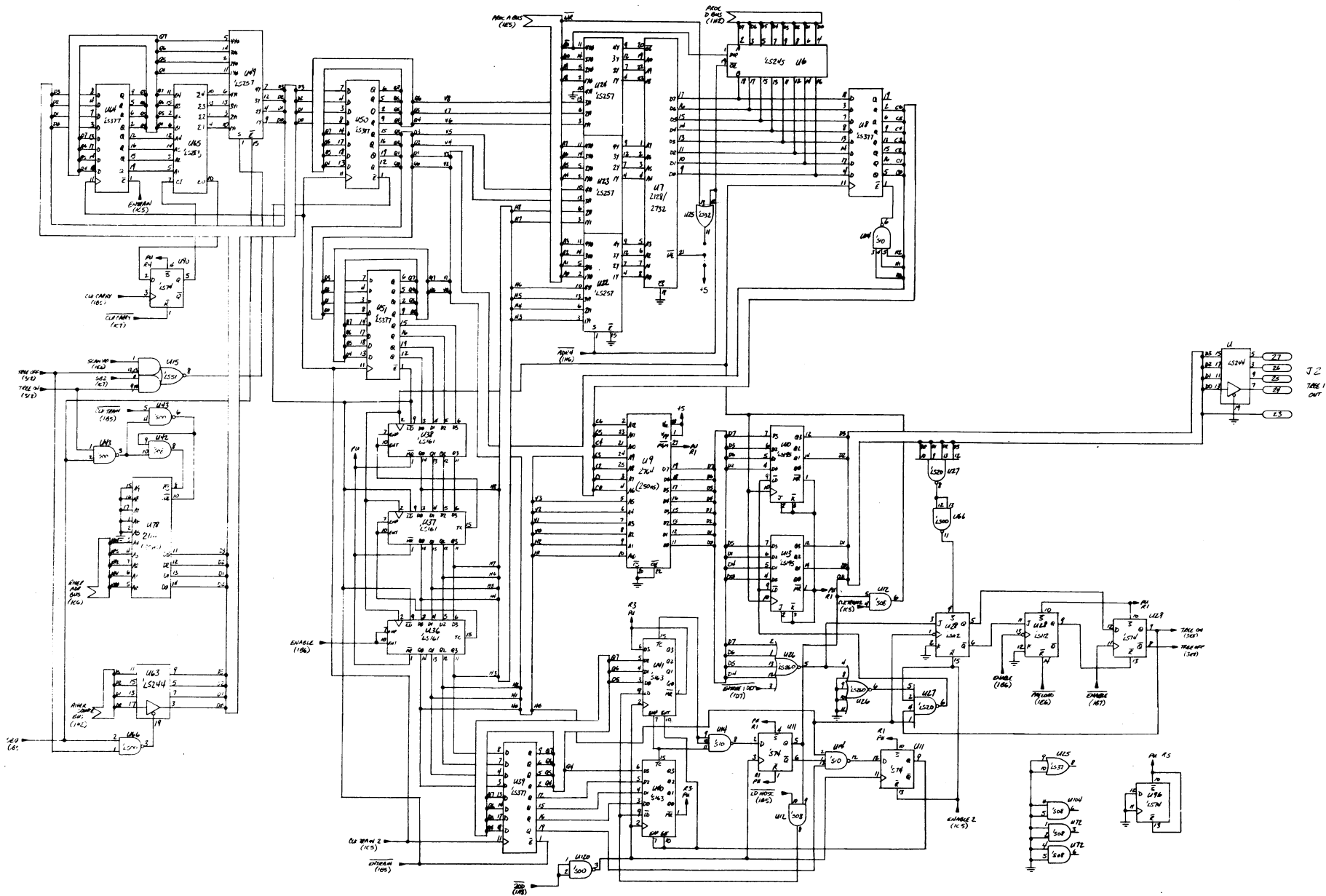
FIGURE 20

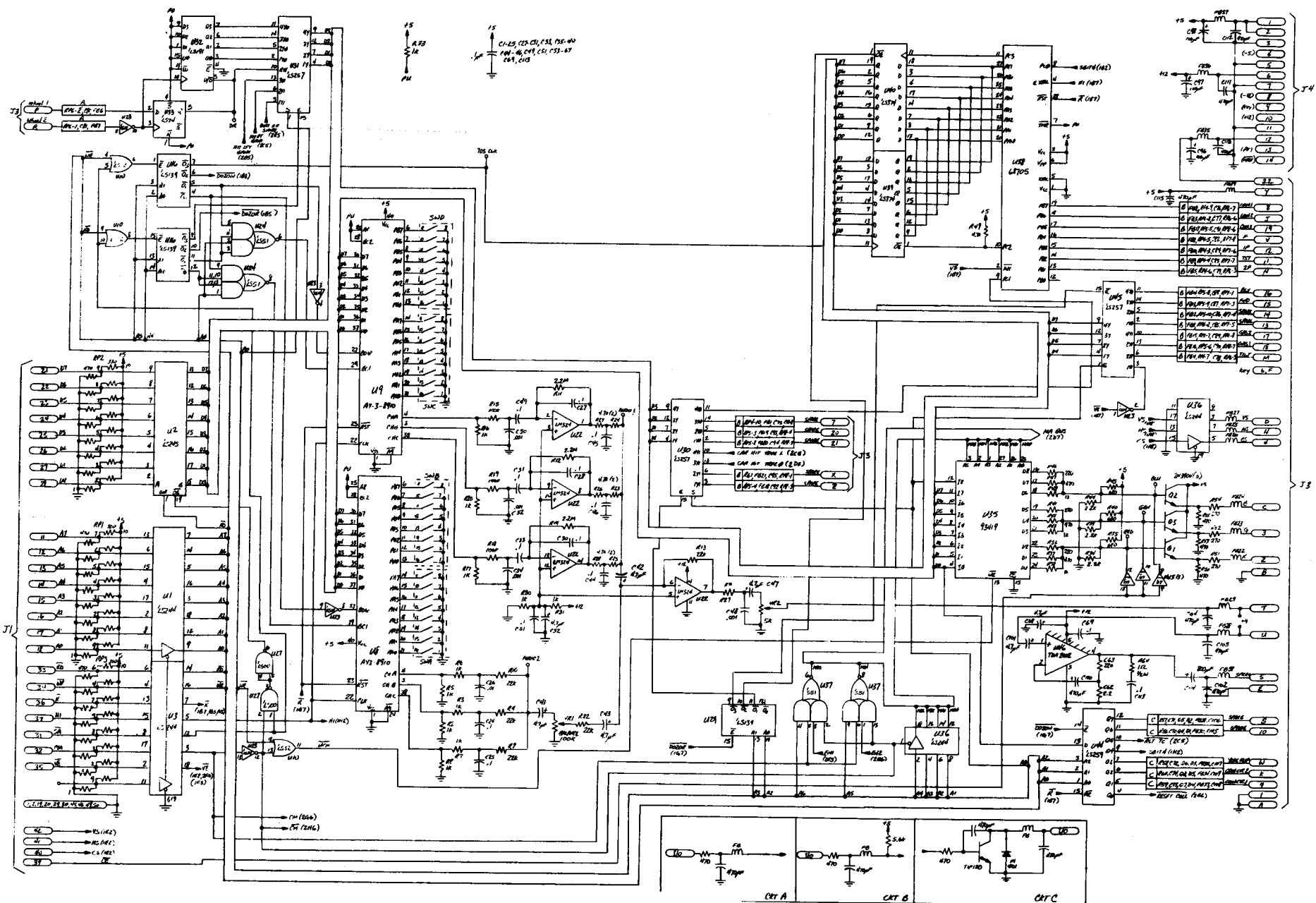


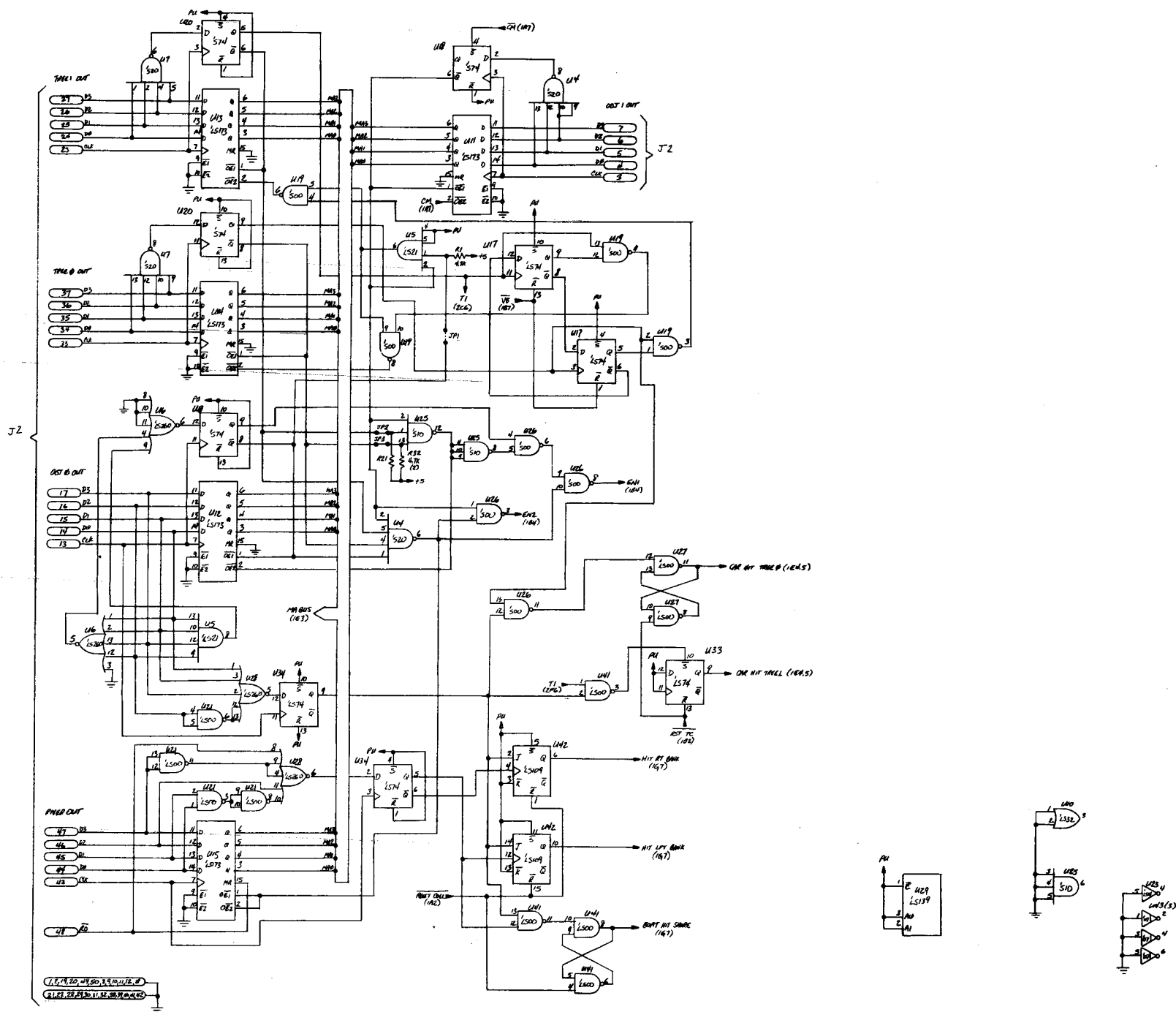


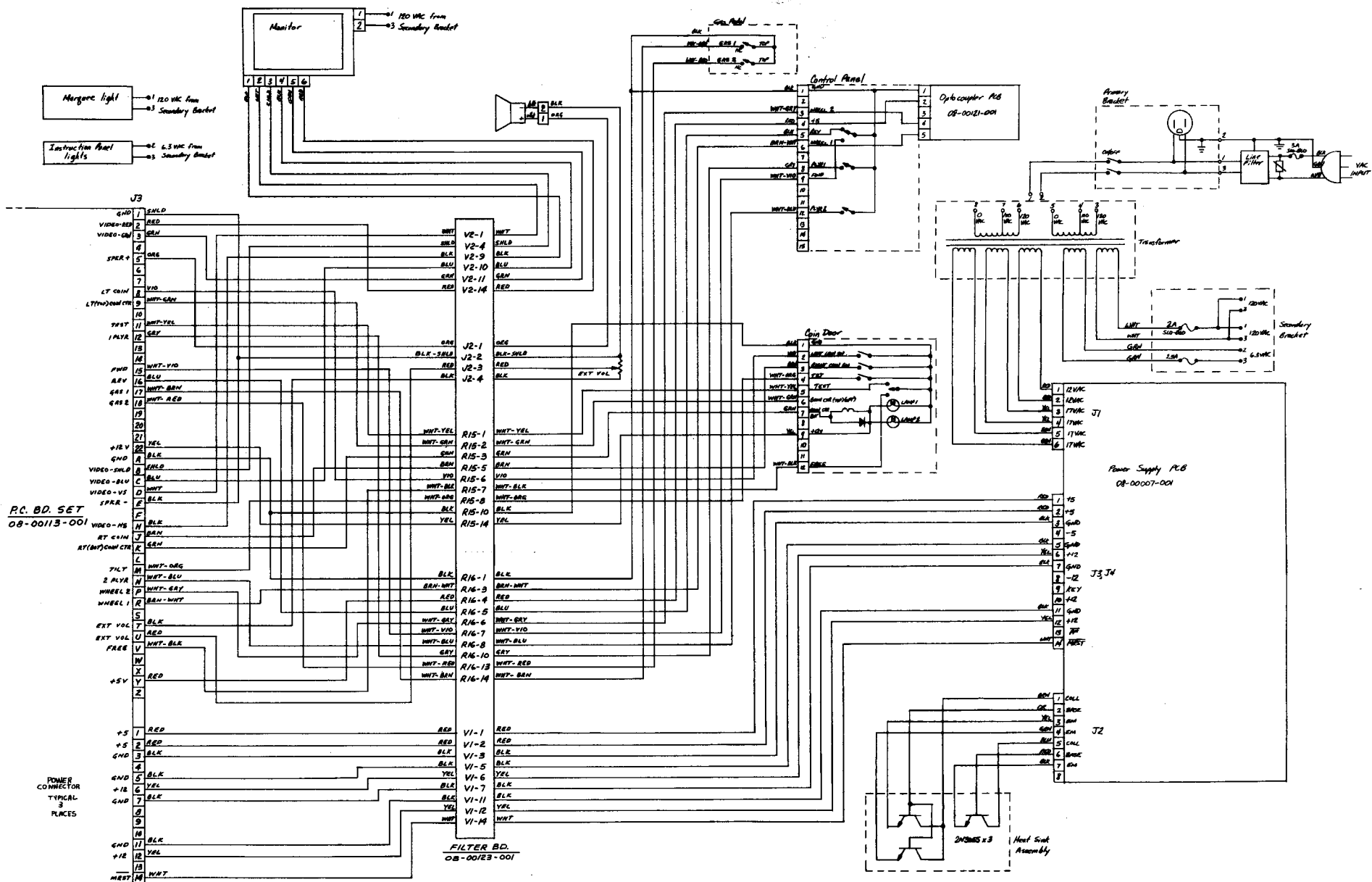


## FIGURE 23









WIRING DIAGRAM  
FIGURE 26