

**Bally/Midway's**  
**Licensed Games**

---

**Standardized General  
Instructions**

---

*Bally*

**MIDWAY MFG. CO.**

10750 W. Grand Avenue  
Franklin Park, Illinois 60131  
U.S.A.



Phone: (312) 451-1360

Cable Address: MIDCO

Telex No: 72-1596

FORM NO. M051-00132-0000

**WARNING**

**THIS GAME MUST BE GROUNDED. FAILURE TO DO SO MAY RESULT IN DESTRUCTION TO ELECTRONIC COMPONENTS.**

**WARNING:** This equipment generates, uses, and can radiate radio frequency energy and if not used in accordance with the instructions manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a CLASS A computing device pursuant to SUBPART J of PART 15 of FCC RULES, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

ELECTRICAL BULLETIN: FOR ALL APPARATUS COVERED BY THE CANADIAN STANDARDS ASSOCIATION (CSA) STANDARD C22.2 NO. 1, WHICH EMPLOYS A SUPPLY CORD TERMINATED WITH A POLARIZED 2-PRONG ATTACHMENT PLUG.

CAUTION: TO PREVENT ELECTRIC SHOCK DO NOT USE THIS (POLARIZED) PLUG WITH AN EXTENSION CORD, RECEPTACLE OR OTHER OUTLET UNLESS THE BLADES CAN BE FULLY INSERTED TO PREVENT BLADE EXPOSURE.

ATTENTION: POUR PREVENIR CHOCS ELECTRIQUES NE PAS UTILISER CETTE FICHE POLARISEE AVEC UN PROLONGATEUR. UNE PRISE DE COURANT OU UNE AUTRE SORTIE DE COURANT, SAUF SI LES LAMES PEUVENT ETRE INSEREES A FOND SANS EN LAISSER AUCUNE PARTIE A DECOUVERT.

***Bally*/MIDWAY**  
T.M.

*Invites You To Use*

**OUR TOLL FREE NUMBERS FOR  
SERVICE INFORMATION CONCERNING THIS GAME, OR ANY  
OTHER BALLY/MIDWAY™ GAME YOU NOW HAVE ON LOCATION.**

**CALL US FOR PROMPT, COURTEOUS  
ANSWERS TO YOUR PROBLEMS.**

**Continental U.S. 800-323-7182  
Illinois Only 1-800-942-0497**

© COPYRIGHT MCMLXXXIII BY BALLY/MIDWAY CO. ALL RIGHTS RESERVED.

NO PART OF THIS PUBLICATION MAY BE REPRODUCED BY ANY MECHANICAL, PHOTOGRAPHIC, OR ELECTRONIC PROCESS, OR IN THE FORM OF A PHONOGRAPHIC RECORDING, NOR MAY IT BE TRANSMITTED, OR OTHERWISE COPIED FOR PUBLIC OR PRIVATE USE, WITHOUT PERMISSION FROM THE PUBLISHER. THIS MANUAL IS FOR SERVICE USE ONLY, AND NOT FOR GENERAL DISTRIBUTION. FOR PERMISSION REQUESTS, WRITE: MIDWAY MFG. CO., 10750 W. GRAND AVE., FRANKLIN PARK, IL 60131

Printed in U.S.A.

# I. Location and Setup

## INSPECTION

1. Remove the game from its shipping crate.
2. Inspect the entire outside of it for any signs of damage.
  - Any scratches?, dents?, cracks?
  - Any broken controls?
  - Any broken glass or plastic?
  - Just look it over closely and make a note of any signs of damage.
3. Remove the shipping cleats from the bottom of the cabinet.
  - UPRIGHT MODELS ONLY: In order to help prevent easy theft of your game, you may wish to remove the Caster Wheel Assemblies from the bottom of your cabinet at this time.
4. Install the four levelers, one at each corner of the cabinet.
  - Level the cabinet.
5. Open the cabinet and inspect the inside of the game for any signs of damage. See Figure 1-1.
  - Also check to make sure all plug-in connectors on the wire harness are firmly seated.

**NOTE:** ALL connectors or plugs are keyed so they will only go together when all pins are properly lined up.
- Replug any connectors found unplugged. DO NOT FORCE PLUGS ONTO CONNECTORS. DO NOT FORCE PLUGS TOGETHER. If it won't go on easily, assuming the keys are lined up, it either does not belong there or is damaged.
- Make sure all printed circuit boards (P.C.B.'s) are firmly seated in their connectors. See Figure 1-1. These connectors are also keyed. The P.C.B.'s will only go into them one way without being damaged.
- Note the location of the game's serial number. See Figure 1-1.
- Check all major subassemblies to be sure they are mounted securely. These are called out in Figures 1-1 & 1-2.
  - Power supply.
  - Control panel(s).
  - T.V. monitor.
  - Other P.C.B.'s and/or P.C.B. rack, etc.
  - Power supply filter assembly.
  - Transformer board assembly.
6. Make a note of any problems that can't be easily corrected.
7. Call your distributor and/or service man about your problem list.

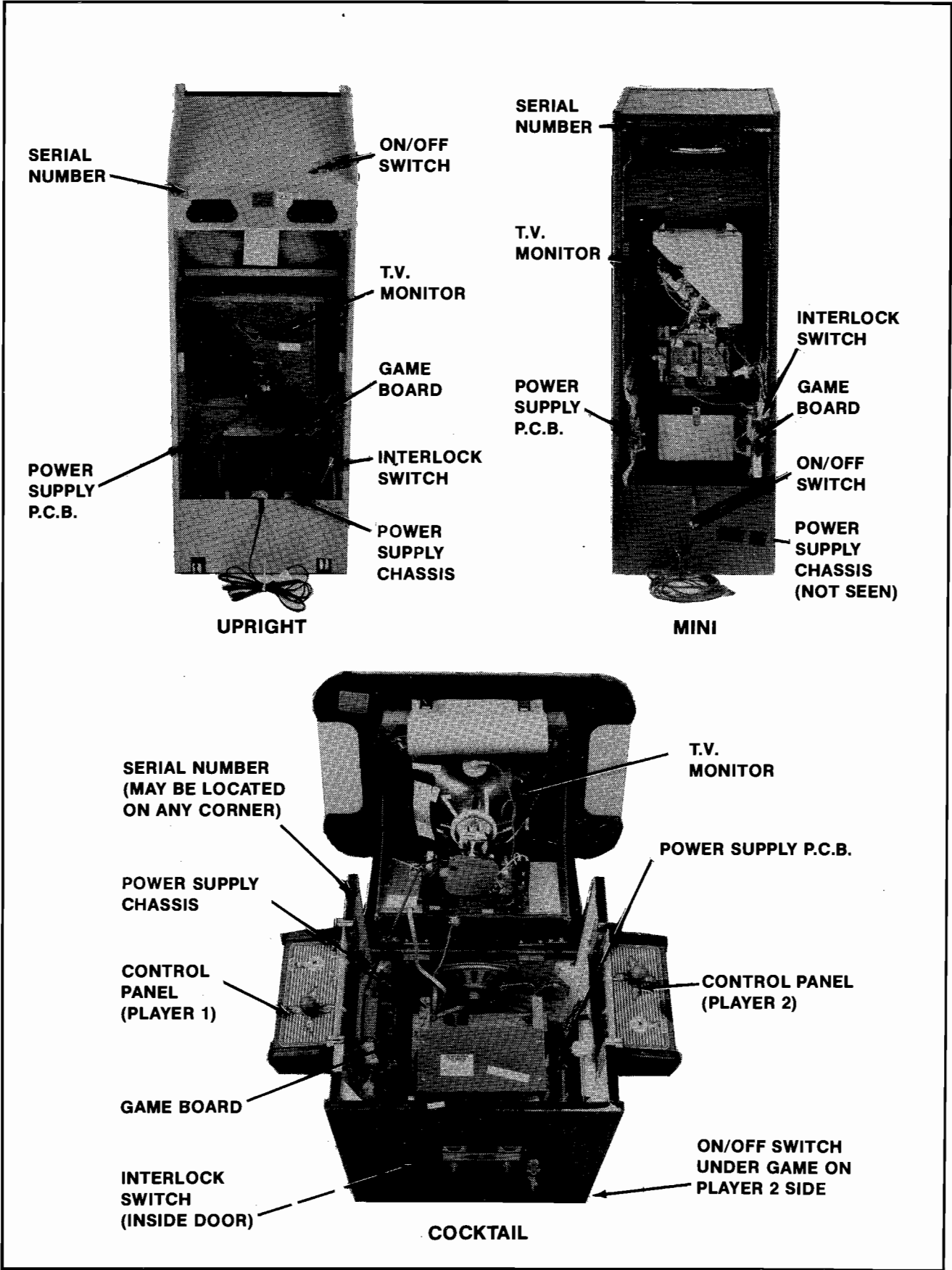


Figure 1-1 Location of Serial No., Interlock Switch, On/Off Switch, and Major Sub-Assemblies

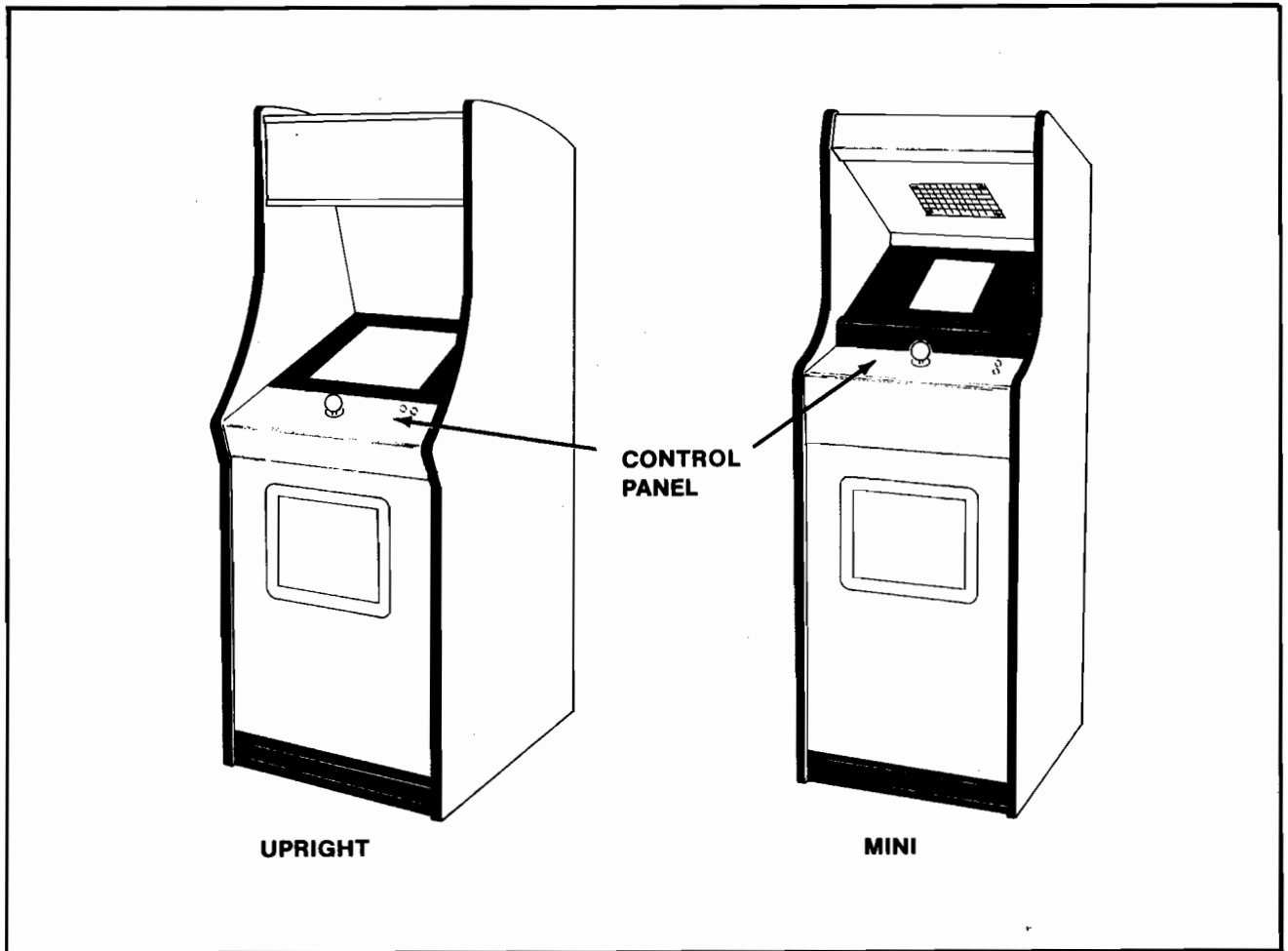


Figure 1-2 Major Sub-Assemblies (cont. from Fig. 1-1)

## INSTALLATION

### 1. Location requirements:

- Power:**  
Domestic 110 V @ 60 Hz  
Foreign 200 V to 240 V @ 50 Hz
- Temperature:** 32° to 100° F (0° to 38° C)
- Humidity:** Not over 95% relative
- Space required:**  
Upright 32" x 25" (81cm x 63cm) APPROX.  
Mini 20" x 24" (50cm x 60cm)  
Cocktail 32" x 22" (81cm x 55cm)
- Game height:**  
Upright 70" (175cm) APPROX.  
Mini 61" (153cm)  
Cocktail 29" (73cm)

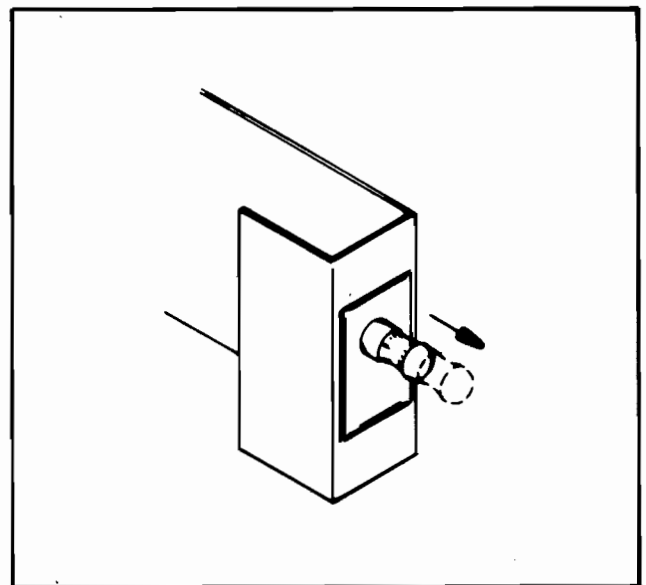


Figure 1-3 Interlock Switch Operation

## 2. Voltage Selection:

Your game is designed to work properly on the line voltage where you are located. Check your line voltage with a meter to determine what its value is. Then check the power input wires to the main power supply transformer on your game to be sure they are connected to taps which correspond to your line voltage value.

If the power input wires to the main power supply transformer are not connected to taps which correspond to your local line voltage, move them to the proper taps.

If the line voltage in your area falls outside the upper or lower limits of the range of inputs covered by the main power supply transformer, **DO NOT PLUG YOUR GAME IN** until you have talked with your distributor and/or service man and obtained a solution to this problem. Otherwise you could damage your game.

## 3. Interlock and power ON/OFF switches. See Figure 1-1.

- To help prevent the possibility of getting an electric shock while working inside the game cabinet, interlock switches have been installed at each cabinet access door (this **DOES NOT** include the coin door in the Upright and Mini models).
- When any access door is opened, the interlock switch installed there turns off all power to the game.
- Check each interlock switch for proper operation.

After checking the line voltage in your area and determining that the input wires to the main power supply transformer of your game are connected properly — or — after obtaining a solution to your over or under voltage problem from your distributor and/or your service man, plug the game into your A.C. wall outlet.

The game ON/OFF switches for all models are located as shown in Figure 1-1. Turn the game on and allow it to warm up a few minutes.

Slowly open each access door to the game (this **does not** include the coin door on the Upright and Mini models).

As the door is opened approximately 1" (2.54cm) the power to the game should go off (the T.V. monitor, all the lights, and all sounds will stop).

If this does not happen, check the interlock switch by this door to see if it has broken loose from its mounting or if it is stuck in the "ON" position.

If the switch is found to be bad, turn the game off, unplug it, and replace the interlock switch. When done, plug the game back into the wall outlet, close the access door, and turn the game back on.

After the game has warmed up, repeat the above interlock switch test.

When the interlock switch is working properly and turns the power to the game off, power may be restored to the game with the access door(s) open. Take hold of the interlock switch plunger and **gently** pull it out to its fully extended position. **THIS IS TO BE USED ONLY FOR SERVICING THE GAME.** See Figure 1-3.

## GAME VOLUME ADJUSTMENT CONTROL. See Figure 1-4.

The volume control pot is located on a P.C. board inside the game cabinet. See Figure 1-4. It may be reached through the coin door on the UPRIGHT models and through the rear access door on the MINI models. On the COCKTAIL TABLE models, you will have to open the table top to reach it.

To make the sounds louder, turn the pot clockwise as you face it (↷).

To make the sounds **less** loud, turn the pot counter-clockwise as you face it (↶).

## OPTION SWITCH SETTINGS

To change the option switch settings, you **DO NOT** have to take the CPU board out of the game. They can be easily reached through the rear access door on the Upright and Mini models. On the Cocktail Table model, you do have to open the table top to reach them.

When changing any options, **ALWAYS** check the results by playing the game to be sure the switches have worked properly and that no switches were accidentally moved that were not meant to be. (These switches are small and this can happen.)

The option switch settings and what they will make the game do are shown in Figure 1-6. See Figure 1-5 for option switch locations.

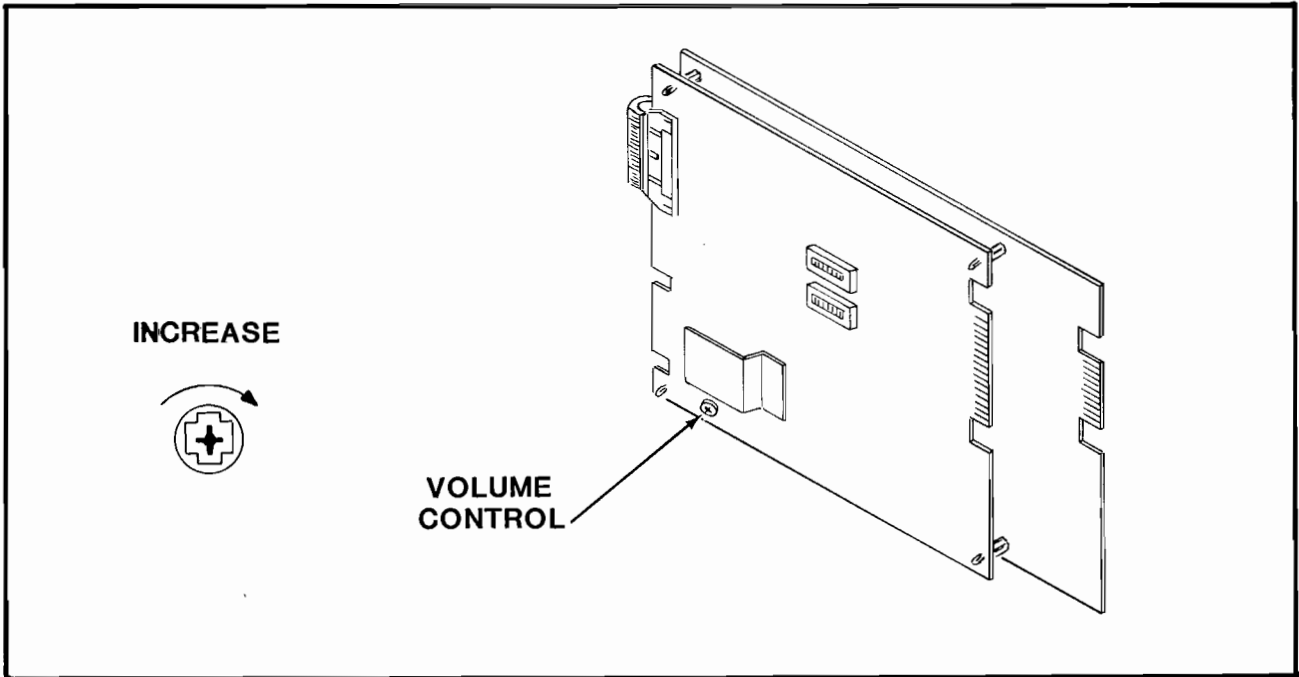


Figure 1-4 Location of Game Volume Adjustment Control

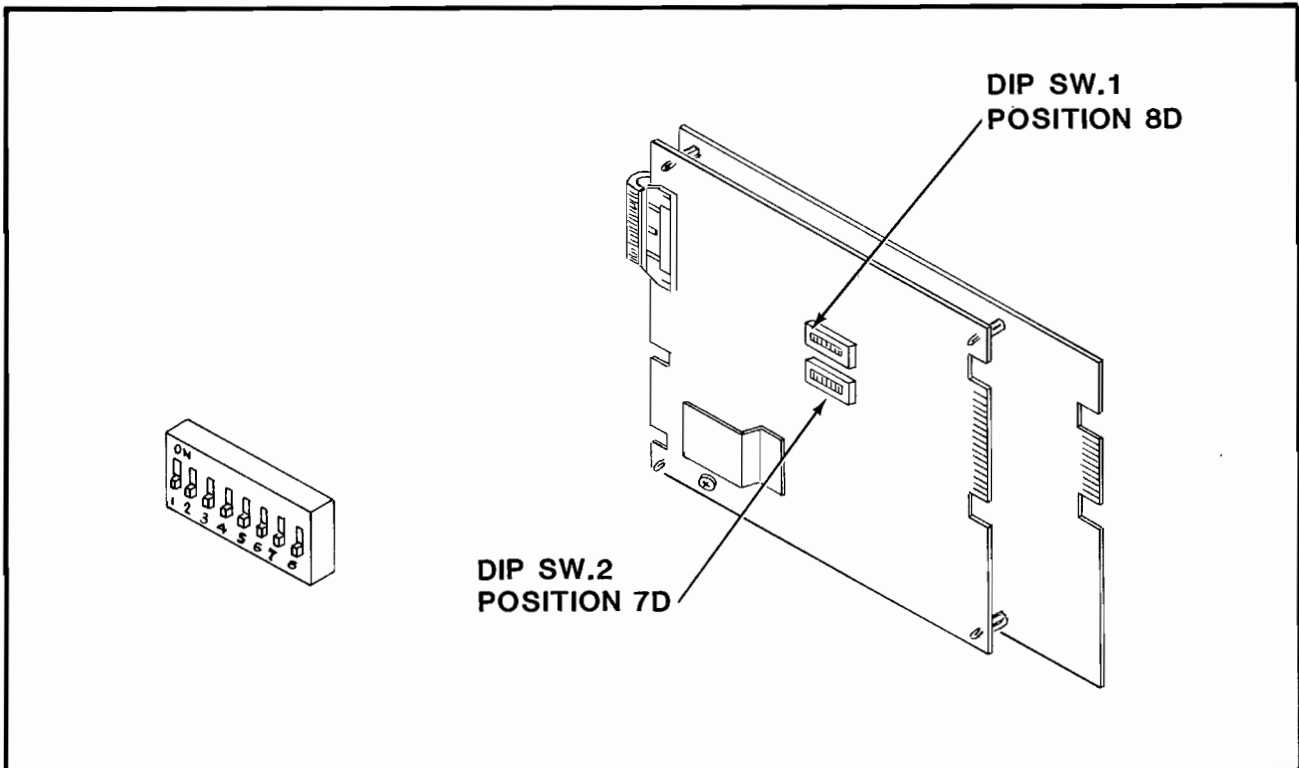


Figure 1-5 Location of Option Switches

B U M P   &   J U M P

O P T I O N   S W I T C H   S E T T I N G S

//////////////////////////////////// DIP SWITCH 8D (SW1) //////////////////////////////////////

**COINS PER CREDIT**

COIN SWITCHES NUMBER 1 AND NUMBER 2		SW#1	SW#2	SW#3	SW#4	SW#5	SW#6	SW#7	SW#8
* 1 - COIN	1 - CREDIT	OFF	OFF						
1 - COIN	2 - CREDITS	ON	OFF						
1 - COIN	3 - CREDITS	OFF	ON						
2 - COINS	1 - CREDIT	ON	ON						

TEST CREDIT BUTTON		SW#1	SW#2	SW#3	SW#4	SW#5	SW#6	SW#7	SW#8
* 1 - COIN	1 - CREDIT			OFF	OFF				
1 - COIN	2 - CREDITS			ON	OFF				
1 - COIN	3 - CREDITS			OFF	ON				
2 - COINS	1 - CREDIT			ON	ON				

**DIAGNOSTICS**

	SW#1	SW#2	SW#3	SW#4	SW#5	SW#6	SW#7	SW#8
* GAME MODE					OFF	OFF		
NORMAL TEST PROCEDURE					ON	OFF		
NO EFFECT					OFF	ON		
VIDEO P.C. BOARD TEST ONLY					ON	ON		

**CABINET DESIGN**

	SW#1	SW#2	SW#3	SW#4	SW#5	SW#6	SW#7	SW#8
UPRIGHT CONTROL PANEL							ON	
COCKTAIL CONTROL PANELS							OFF	
UPRIGHT SCREEN								ON
COCKTAIL SCREEN								OFF

//////////////////////////////////// DIP SWITCH 7D (SW2) //////////////////////////////////////

**NUMBER OF CARS PER GAME**

	SW#1	SW#2	SW#3	SW#4	SW#5	SW#6	SW#7	SW#8
* 3 CARS	OFF					OFF	OFF	OFF
5 CARS	ON							

**BONUS CARS AWARDED EVERY**

	SW#1	SW#2	SW#3	SW#4	SW#5	SW#6	SW#7	SW#8
* 1 CAR EVERY 30,000 POINTS		OFF	OFF			OFF	OFF	OFF
1 CAR EVERY 70,000 POINTS		ON	OFF					
1 CAR <u>ONLY</u> AT 20,000 POINTS		OFF	ON					
1 CAR <u>ONLY</u> AT 30,000 POINTS		ON	ON					

**RACK BONUS**

	SW#1	SW#2	SW#3	SW#4	SW#5	SW#6	SW#7	SW#8
* NORMAL GAME				OFF		OFF	OFF	OFF
CAN CONTINUE GAME FOR ADDITIONAL COINS				ON				

**DIFFICULTY LEVEL OF PLAY**

	SW#1	SW#2	SW#3	SW#4	SW#5	SW#6	SW#7	SW#8
* EASY - COMPETITORS NOT TOO AGGRESSIVE					OFF	OFF	OFF	OFF
HARD - COMPETITORS <u>VERY</u> AGGRESSIVE					ON			

\* INCICATES FACTORY RECOMMENDED SETTINGS.

PART NO. M051-00349-A014

**Figure 1-6 Option Switch Settings**



## II. Maintenance and Repair

Your **NEW** game needs certain types of maintenance to keep it in good working order. **CLEAN**, well **MAINTAINED** games **attract players** and **EARN MORE PROFITS**.

The most important thing for you to remember is to play your game thoroughly **EVERY TIME** you collect money from the coin box. **JUST LOOKING** at your game **WILL NOT** tell you if all its controls and inside parts are working correctly. **ONLY** being familiar with and playing your game will inform you whether or not it is working the way it should.

The second most important thing you should remember is to clean the outside of the game and coin acceptor mechanisms on a regular basis.

### CLEANING

The outside of the game cabinet plus the metal can be cleaned with any non-abrasive household cleaner. However, the front of the T.V. monitor tube and **both sides** of all other glass and plastic on or in the game **MUST** be cleaned with anti-static cleaner **ONLY**. For cleaning the coin acceptors: hot soapy water may be used on the plastic ones and any household cleanser may be used on the metal ones. If you wish, special coin machine cleaners that leave no residue may be purchased from your distributor.

**DO NOT** dry-wipe any of the plastic panels. This is because any dust that was on them can scratch their surfaces. If this has happened, anyone looking through this type of damaged plastic would feel he was looking at the game through a fog. This fogging

damage **CANNOT** be repaired or reversed. The **ONLY** solution is to **replace** the damaged piece of plastic.

### FUSE REPLACEMENT

This game contains several fuses located as shown in Figure 2-1.

#### 1. UPRIGHT MODEL:

As viewed from the back, facing the cabinet, with the rear access door removed; the fuses are located on the Power Chassis and the Power Supply Board Assemblies.

#### 2. MINI MODEL:

As viewed from the back, facing the cabinet, with the rear access door removed; the fuses are located on the Power Chassis and the Power Supply Board Assemblies.

#### 3. COCKTAIL TABLE MODEL:

As viewed from the coin door side of the cabinet, with the monitor tilted open to one side; the fuses are located on the Power Chassis and Power Supply Board Assemblies.

Replace fuses **ONLY** with the type and size listed in the Illustrated Parts Breakdown Section of your game manual.

See the T.V. Monitor Manual (available on request from your Distributor or the Monitor manufacturer) and/or the T.V. Troubleshooting Section of your game manual for information on these fuses.

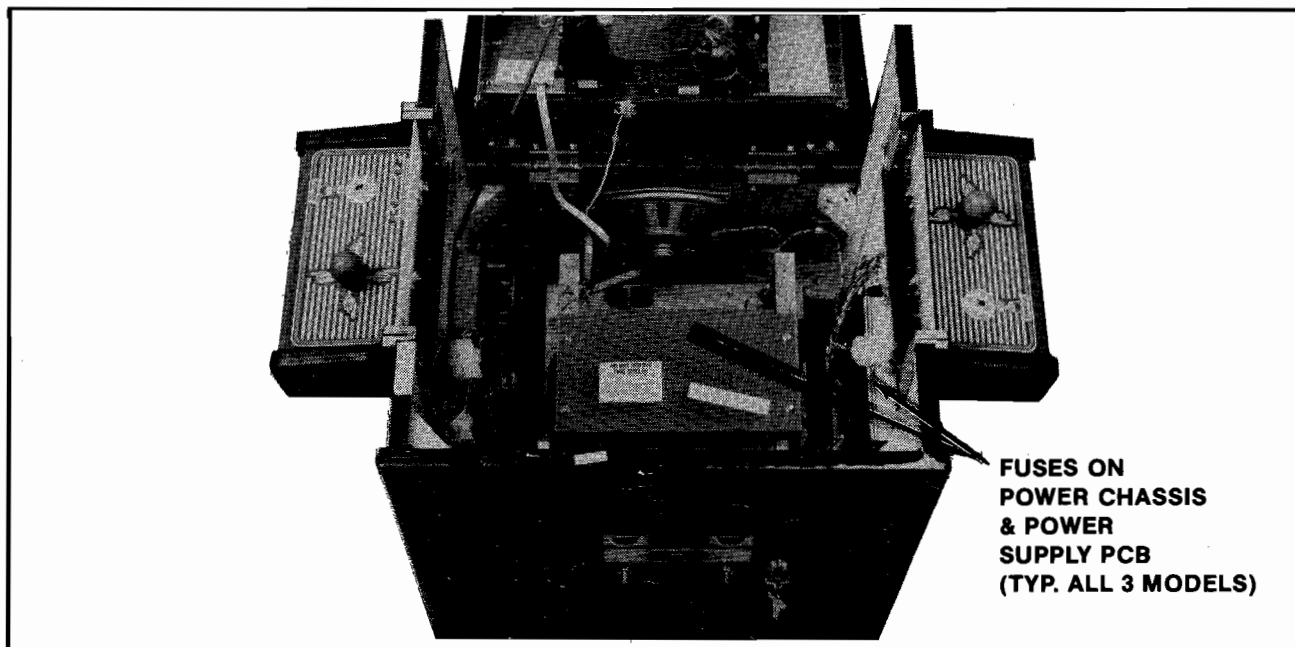


Figure 2-1 Location of Fuses

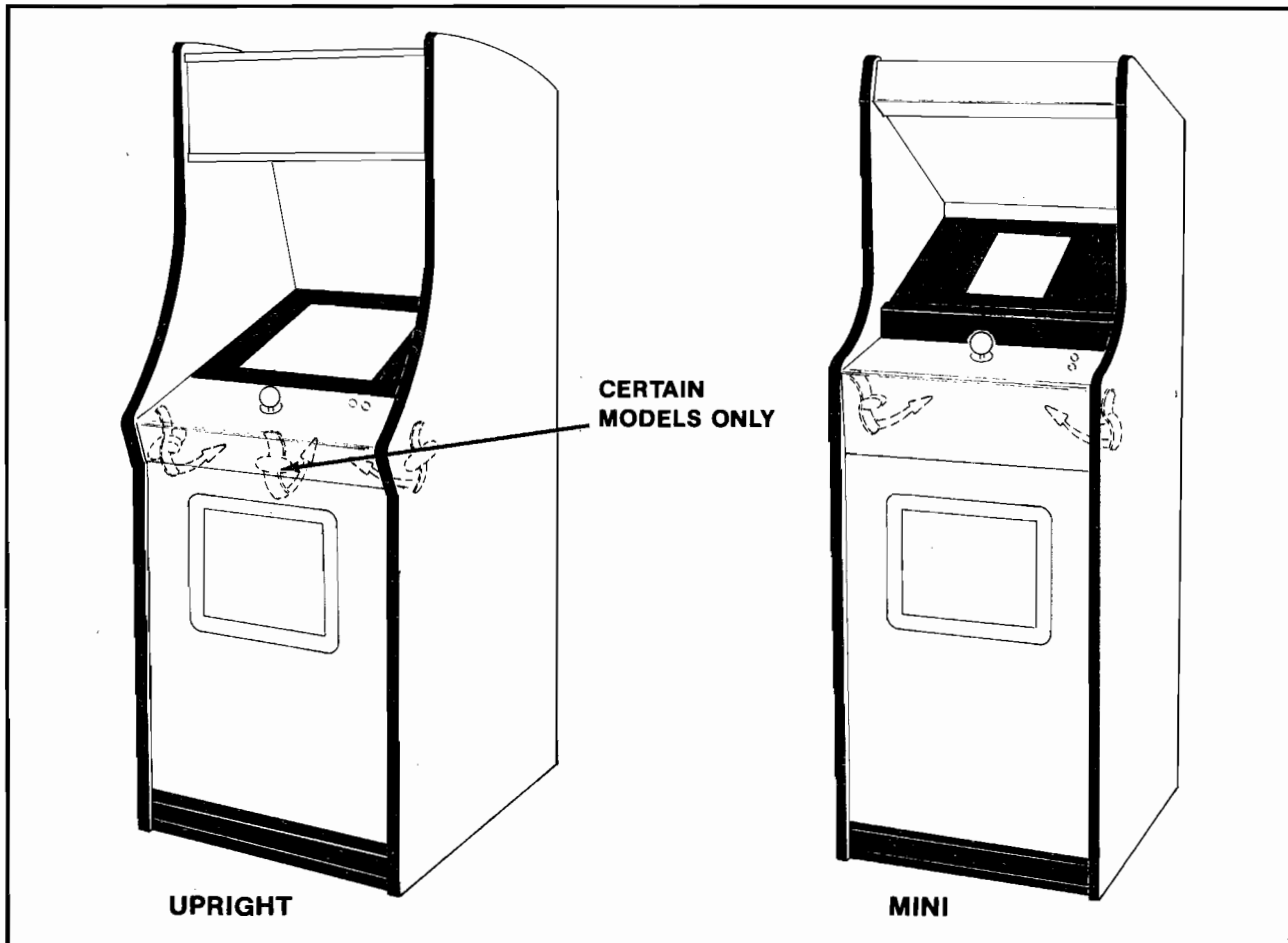
**OPENING THE CONTROL PANEL.** See Figure 2-2.

**1. UPRIGHT MODEL:**

- The control panel is held in place by two or three latches. See Figure 2-2.  
They are spring loaded to provide constant positive pressure on their latch plates.  
They can be reached through the coin door **AFTER turning power to the game off.**  
To release the latches, lift up and toward the front center of the control panel.  
Once they are released, unhook them from their latch plates.
- To remove the control panel:  
Raise it up and tilt it toward you until you can see the cable behind it.  
Cradling the control panel between yourself and the cabinet, disconnect it from its cabling and nylon retaining strap.  
The control panel is now free and can be removed.
- To reinstall the control panel, reverse this procedure.

**2. MINI MODEL:**

- The control panel is held in place by two latches. See Figure 2-2.  
They are spring loaded to provide constant positive pressure on their latch plates.  
They can be reached through the coin door **AFTER turning power to the game off.**  
To release the latches, lift up and toward the center of the control panel.  
Once they are released, unhook them from their latch plates.
- To remove the control panel:  
Raise it up and tilt it toward you until you can see the cable behind it.  
Cradling the control panel between yourself and the cabinet, disconnect it from its cabling and nylon retaining strap.  
The control panel is now free and can be removed.
- To reinstall the control panel, reverse this procedure.



**Figure 2-2 Opening the Control Panel — Upright & Mini**

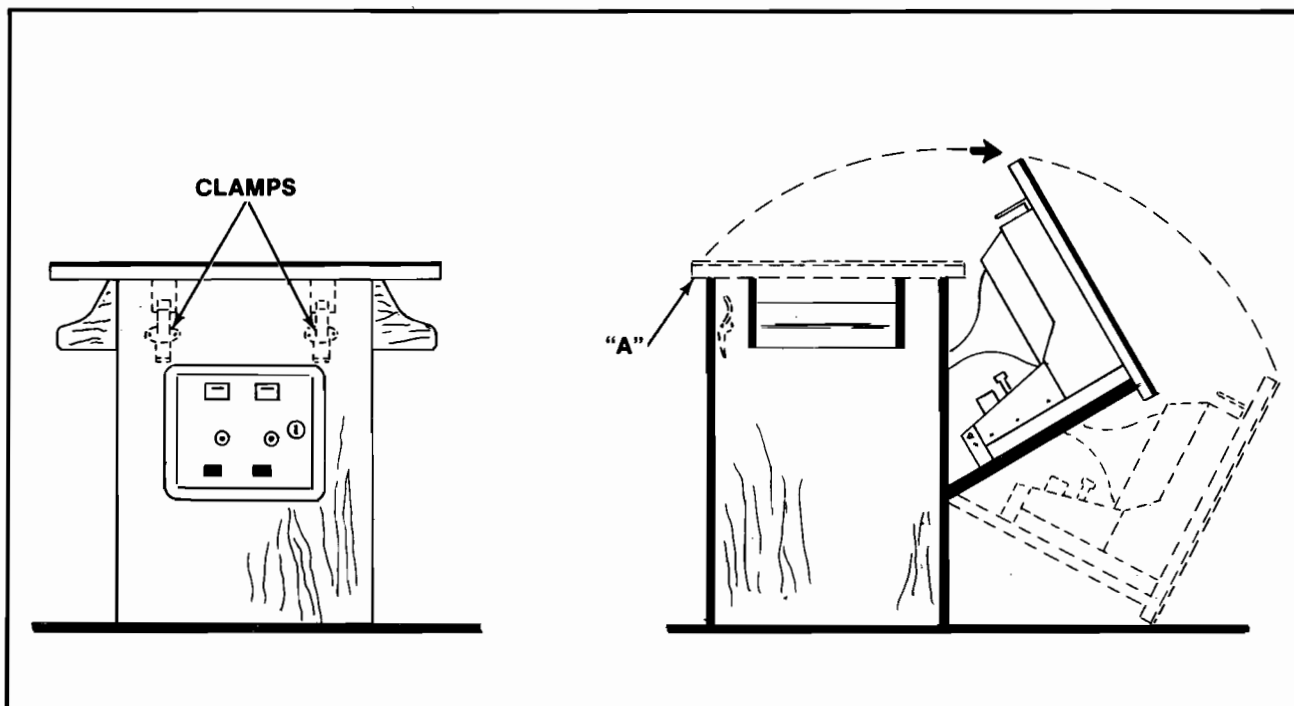


Figure 2-3 Opening the Cocktail Game

### 3. COCKTAIL TABLE MODEL:

- Each control panel is held in place by several screws, two on the inside of the cabinet and three along the outside bottom edge of the control panel.

**Turn power to the game off.**

Open the coin box door and release the two latches indicated in Figure 2-3.

**CAUTION: The right hand latch is very close to the HIGH VOLTAGE on the monitor.**

Once they're released, unhook them from their latch plates.

Grasp the table top at "A" and open it as indicated in Figure 2-3.

**CAUTION: Due to the weight of the monitor, EXTREME CARE MUST be taken when opening the cabinet.**

Remove the screws which secure the control panel in place. See Figure 2-4.

- To remove the control panel(s):  
Disconnect it from its cabling.  
The control panel is now free and can be removed.
- To reinstall the control panel, reverse this procedure.

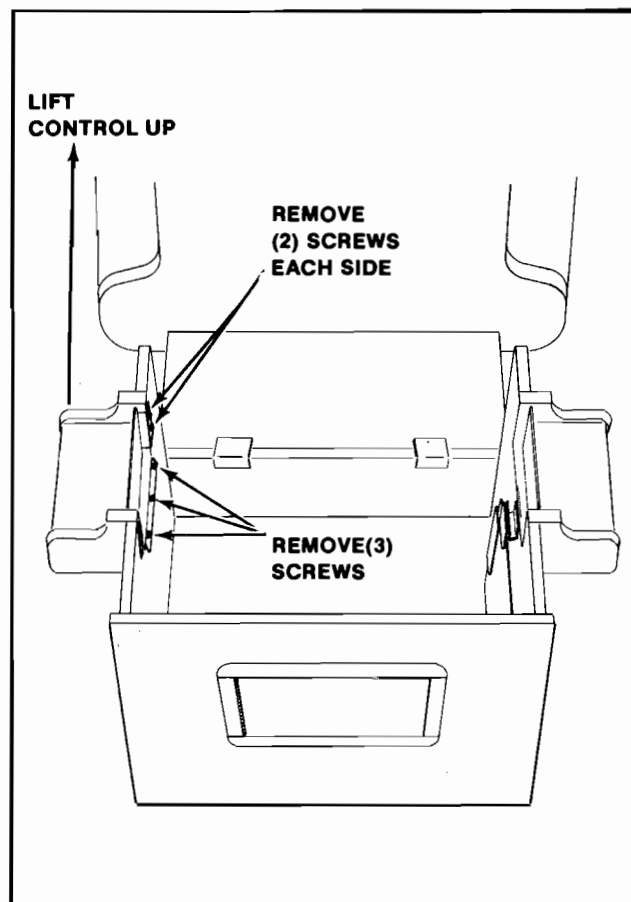


Figure 2-4 Removing the Control Panel — Cocktail

## REMOVAL OF THE MAIN-DISPLAY-GLASS AND/OR THE T.V. BEZEL ASSEMBLY

### 1. UPRIGHT MODEL: See Figure 2-5.

**NOTE:** In order to do this, the control panel **MUST** be removed first. See the "Mini Model" procedure.

- Turn the power to the game off and remove the control panel.
- Certain models only: Remove the screws which secure the glass clamping plate and lift it out.
- This frees the main-display-glass so it can be lifted up.
- By putting your finger in the hole in the middle of the main-display-glass support, you can lift it up and out.
- Loosen the screws which secure the T.V. bezel-glass-clamps in place. Move the clamps to the side and the bezel glass may be removed. Remove the above mentioned screws and the bezel with four bezel-glass-clamps may be removed.
- To reinstall the T.V. bezel assembly and the main-display-glass, reverse this procedure.

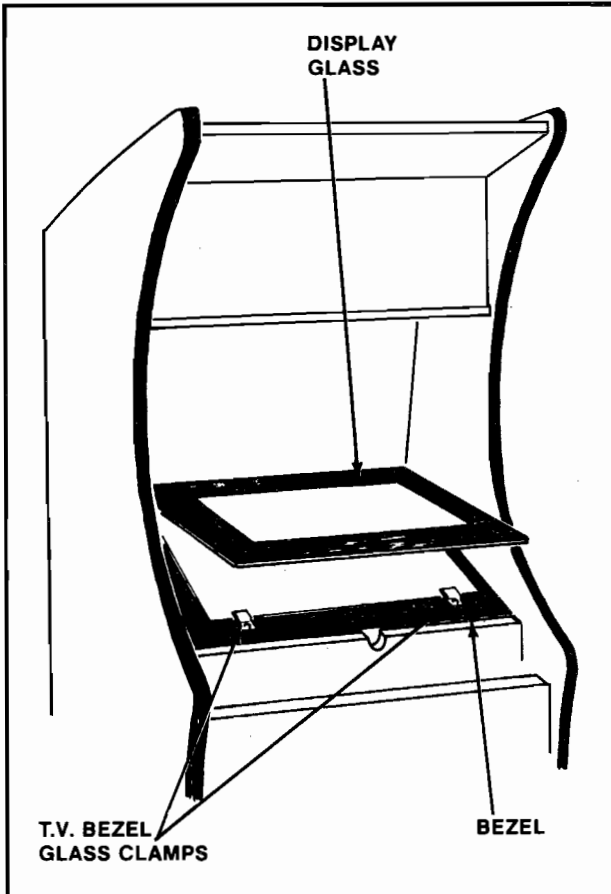


Figure 2-5 Removing the Main Display Glass & T.V. Bezel — Upright

### 2. MINI MODEL: See Figure 2-6.

**NOTE:** In order to do this, the control panel **MUST** be removed first. See the "Mini Model" procedure.

- Turn the power off to the game and remove the control panel.
- Remove the screws which secure the glass clamping plate.
- Lift out the glass clamping plate. This frees the main-display-glass so it can be lifted up.
- By putting your finger in the hole in the middle of the main-display-glass support, you can lift it up and out.
- Remove the screws which secure the T.V. bezel assembly and lift it out.

**NOTE:** Use the hole in the center of the main-display-glass support to grasp it.

- Reverse this procedure to reinstall the T.V. bezel assembly and the main-display-glass.

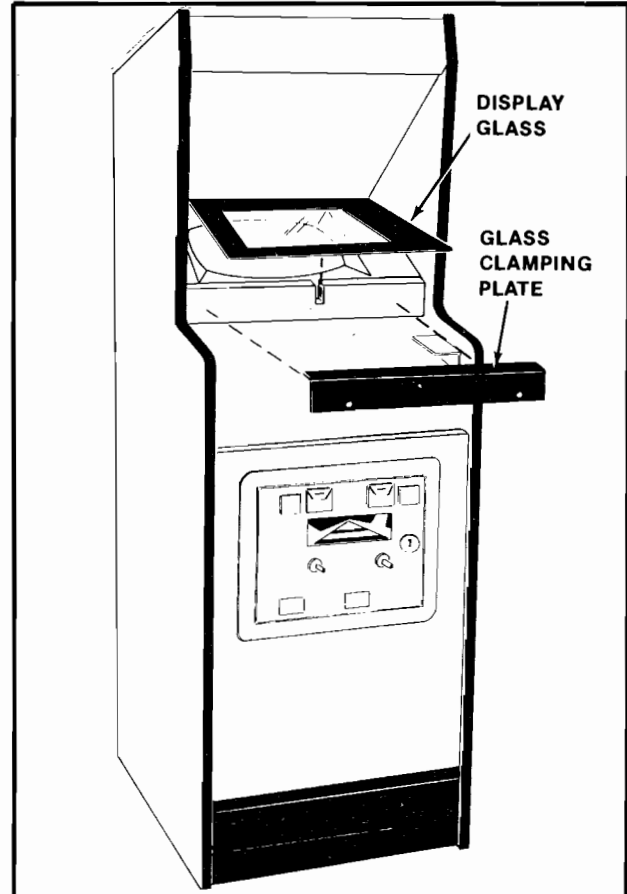


Figure 2-6 Removing the Main Display Glass & T.V. Bezel — Mini

### 3. COCKTAIL TABLE MODEL: See Figure 2-7.

**NOTE:** This may be done with the table top in the open or the closed position. If you decide to open the table top, **TURN THE POWER TO THE GAME OFF FIRST.**

- Remove the screws which secure the table top glass clamps in place.
- Remove the table top glass.
- Loosen the screws which secure the T.V. bezel-glass-clamps in place. Move the clamps to the side and the bezel glass may be removed. Remove the screws which secure the bezel assembly to the table top and the bezel with four bezel-glass-clamps may be removed.
- To reinstall the T.V. bezel assembly and the table top glass, simply reverse this procedure.

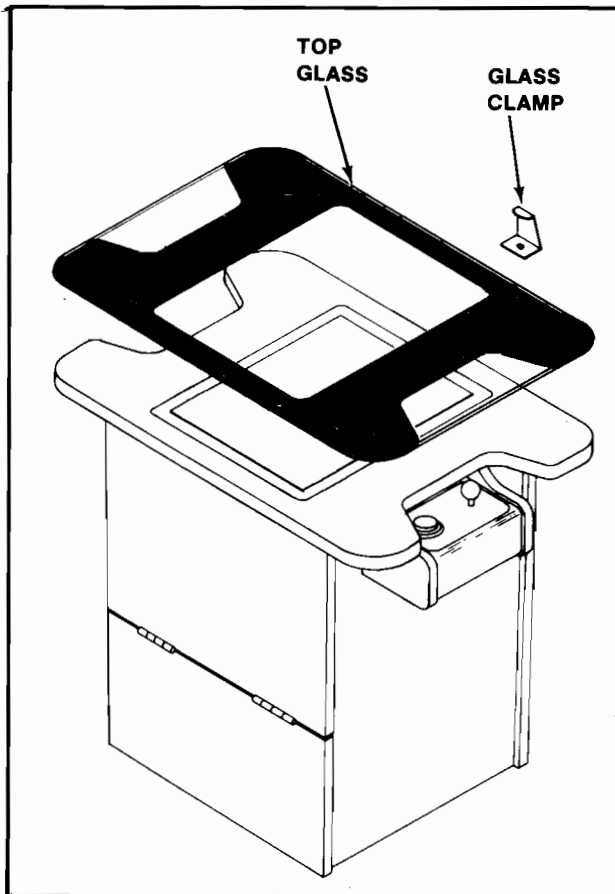


Figure 2-7 Removing the Top Glass & T.V. Bezel — Cocktail

## T.V. MONITOR REPLACEMENT

**CAUTION:** High voltages may exist in any television unit, even with the power disconnected. Use **EXTREME CAUTION** and do not touch electrical parts or the T.V. yoke area with your hands or with metal objects held in your hands!

In addition, **BE SURE TO USE HEAVY GLOVES** when handling the monitor. You could cut your hands on the metal T.V. chassis without such protection.

**DANGER:** The T.V. monitor **DOES NOT** contain an isolation transformer on its chassis (it is mounted instead on the floor of the cabinet). When servicing the monitor on a test bench, **YOU MUST ISOLATE THE MONITOR FROM AC VOLTAGE WITH AN ISOLATION TRANSFORMER.**

### 1. UPRIGHT MODEL: See Figure 2-8.

- Turn power off to the game.
- Open the rear access door.
- Completely disconnect the T.V. monitor from all its cabling. **DON'T FORGET THE CHASSIS GROUND WIRE.**

Before removing the T.V. monitor, the main-display-glass and bezel **MUST** be removed. See above "Upright Model" procedure.

With the removal of only four bolts, the T.V. monitor and its mounting channels will be loose.

The monitor mounting channels slide on top of and against two metal guides mounted to the cabinet's right and left sides. The monitor is removed by sliding it out the back of the cabinet. See Figure 2-8.

- To reinstall the T.V. monitor, reverse this procedure.
- After replacing the T.V. monitor, be sure to run the game Self-Test.

### 2. MINI MODEL: See Figure 2-9.

- Turn the power off to the game.
- Open the rear access door.
- Completely disconnect the T.V. monitor from all its cabling. **DON'T FORGET THE CHASSIS GROUND WIRE.**

Before removing the T.V. monitor, the main-display-glass and bezel **MUST** be removed. See above "Mini Model" procedure.

With the removal of only four bolts, the T.V. monitor will be loose.

**CAUTION:** **BE SURE** to support the T.V. monitor from the rear while removing the four bolts so it will not fall out of the cabinet.

The monitor is removed by supporting it and pulling straight back as shown in Figure 2-9.

- To reinstall the T.V. monitor, reverse this procedure.

After replacing the T.V. monitor, be sure to run the game Self-Test.

**3. COCKTAIL TABLE MODEL:** See Figure 2-11.

- Turn the power off to the game.
- Open the coin box door and release the two latches indicated in Figure 2-10.

**CAUTION: The right hand latch is very close to the HIGH VOLTAGE on the monitor.**

- Once the latches are released, unhook them from their latch plates.
- Grasp the table top at "A" and open it as indicated in Figure 2-10.

**CAUTION: due to the weight of the monitor, EXTREME CARE MUST be taken when opening the cabinet.**

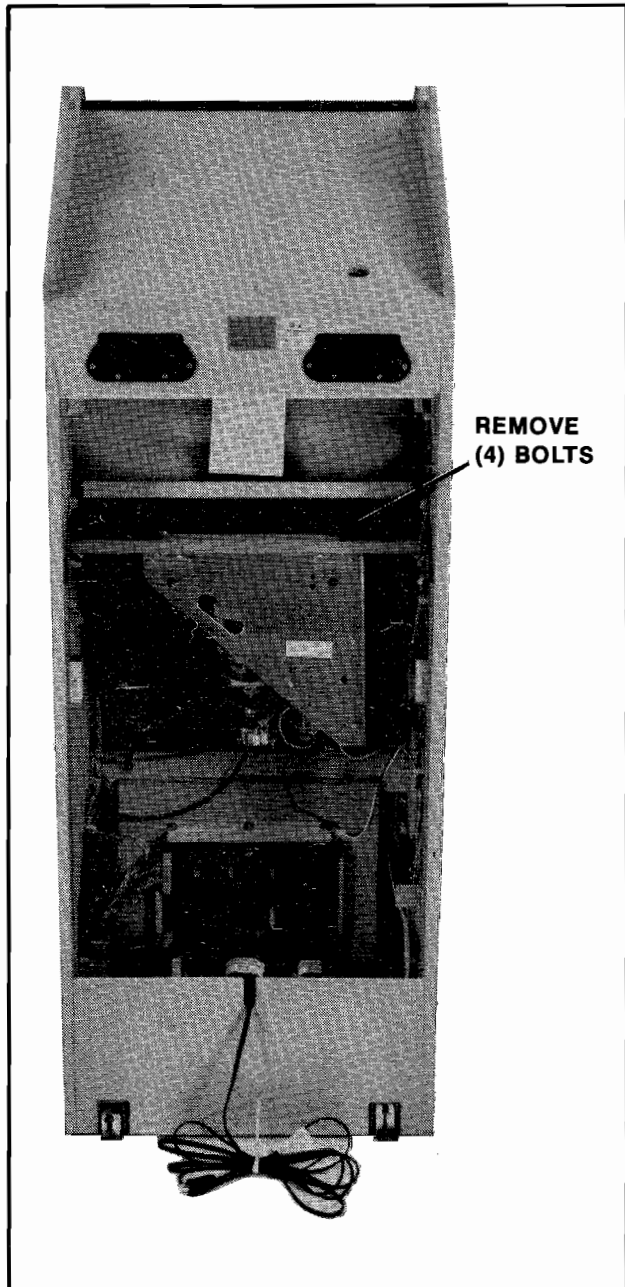


Figure 2-8 Removing the Monitor — Upright

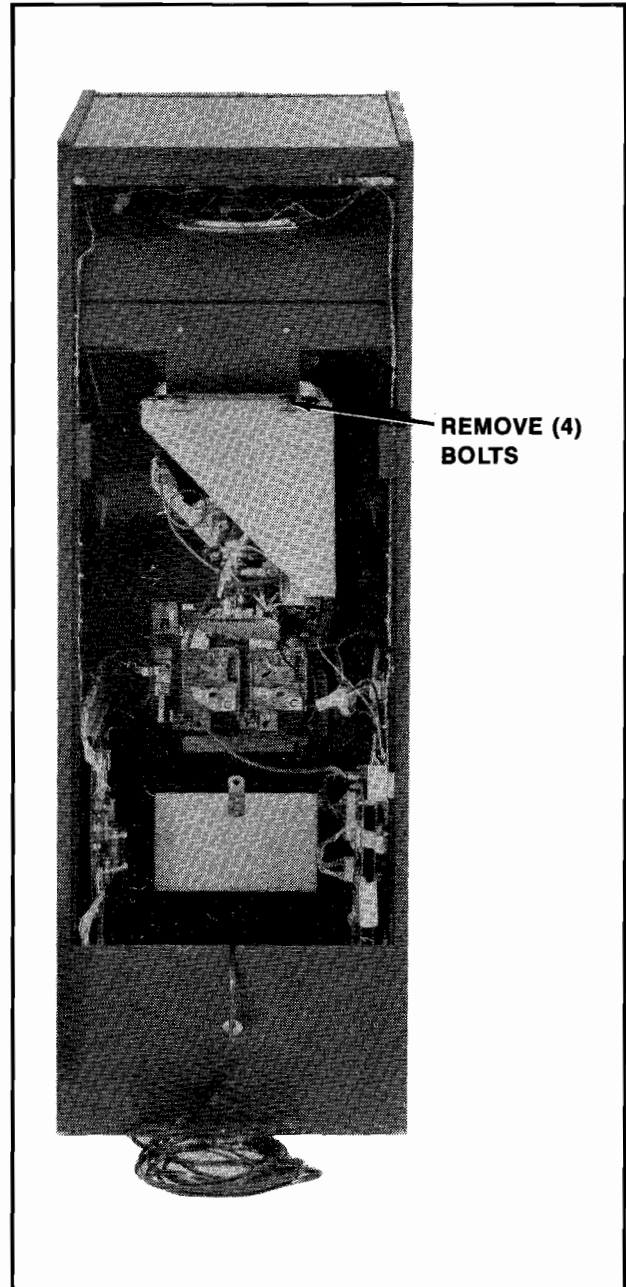


Figure 2-9 Removing the Monitor — Mini

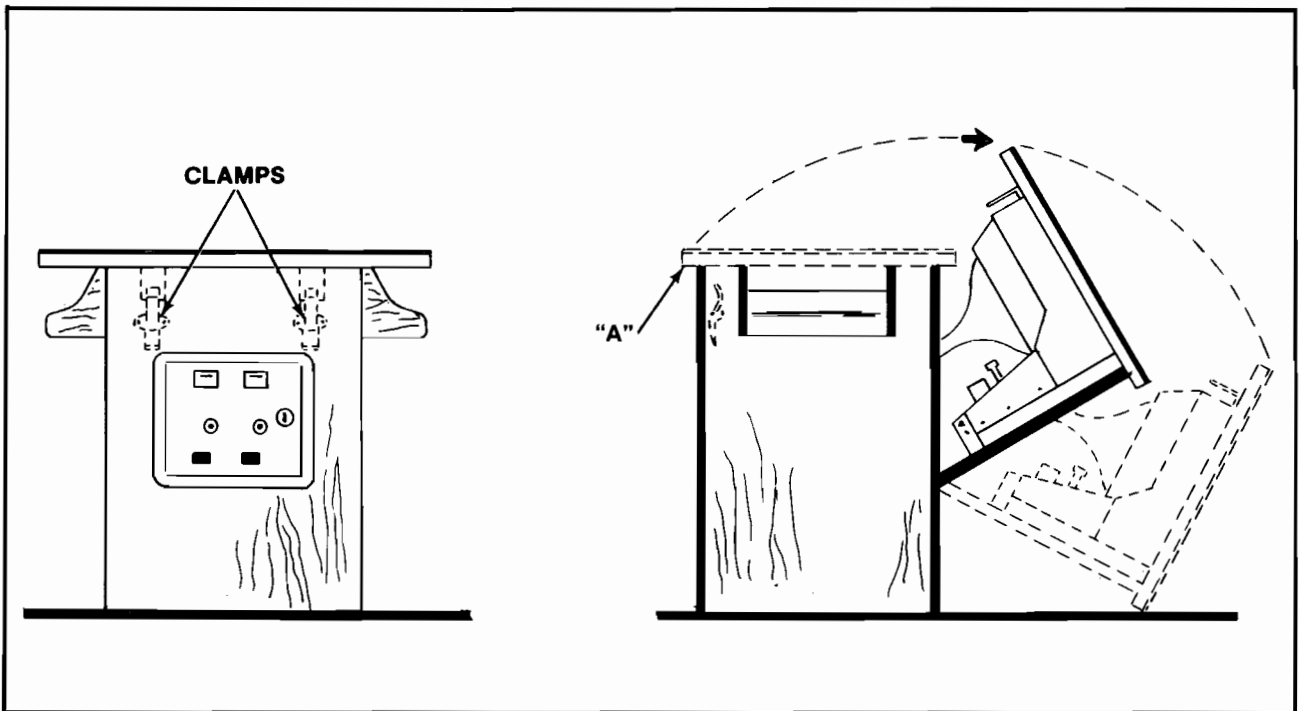


Figure 2-10 Opening the Cocktail Game

- Remove the screws which hold the table top glass clamps in place.
- Remove the table top glass.
- Lift out the T.V. bezel assembly.
- Completely disconnect the T.V. monitor from all its cabling. **DON'T FORGET THE CHASSIS GROUND WIRE.**
- Remove the screws holding the T.V. monitor chassis to the "L" by the door hinge(s). See Figure 2-11.
- Close the Cocktail Table and re-latch it.
- Remove the screws which secure the T.V. monitor mounting brackets to the edges of the slot cut in the table top. See Figure 2-11.
- Pry up the end of each monitor mounting bracket with a screwdriver or similar tool until you can grasp them both.
- Lift the T.V. monitor straight up and out of the table top being **VERY CAREFUL** not to bump the neck of the picture tube.
- To reinstall the T.V. monitor assembly, reverse this procedure.
- Be sure to check the clearance of the "L" brackets **BEFORE** setting the monitor into the table top.
- After replacing the T.V. monitor, be sure to run the game Self-Test.

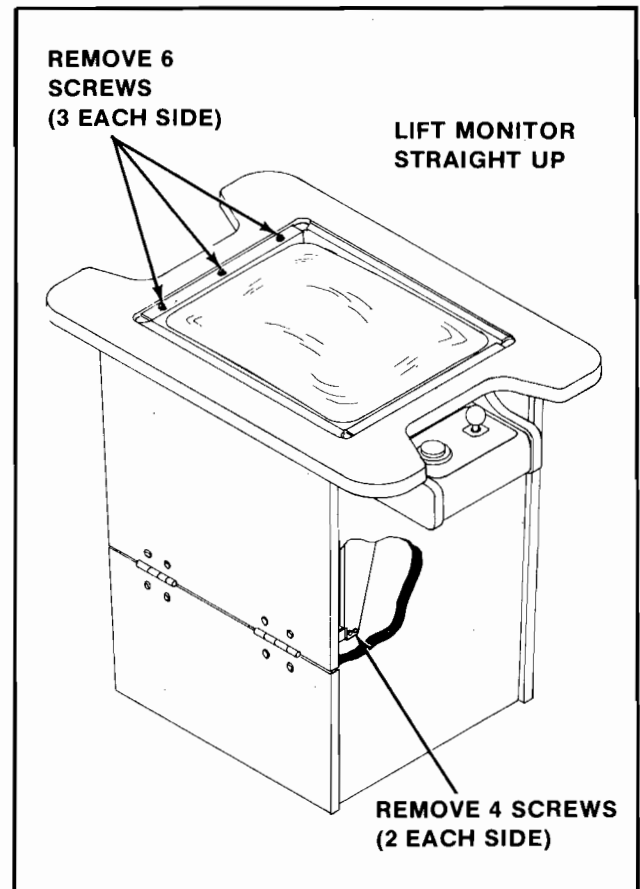


Figure 2-11 Removing the Monitor — Cocktail

## PRINTED CIRCUIT BOARD (P.C.B.) REPLACEMENT

### 1. UPRIGHT MODEL: See Figure 2-12.

- Turn the power to the game off.
- Unlock and open the rear access door (game board) and the coin door (sound board).
- Disconnect the game board from all its cabling.
- Disconnect the sound board from all its cabling.
- Remove the indicated P.C.B. supports and lift the above P.C.B.'s out the cabinet.

- Disconnect the power supply board from all its cabling, remove the P.C.B. supports indicated in Figure 2-12, and slide it out the back of the cabinet.

- To reinstall the above P.C.B.'s, reverse this procedure.

**NOTE:** P.C.B.'s are all keyed and will **ONLY** fit into their connectors one way without forcing them. The plugs on the cable harness which connect it to the P.C.B.'s are also keyed and will **ONLY** go onto their connectors one way without forcing them.

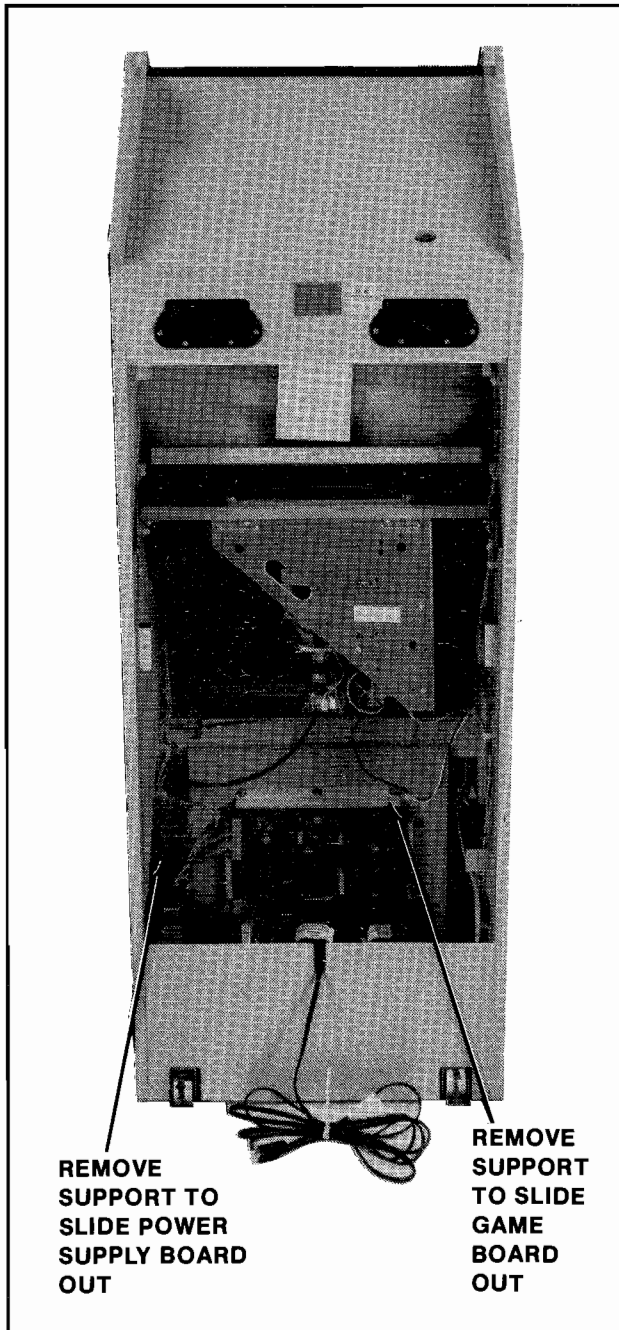


Figure 2-12 Removing P.C.B.'s — Upright

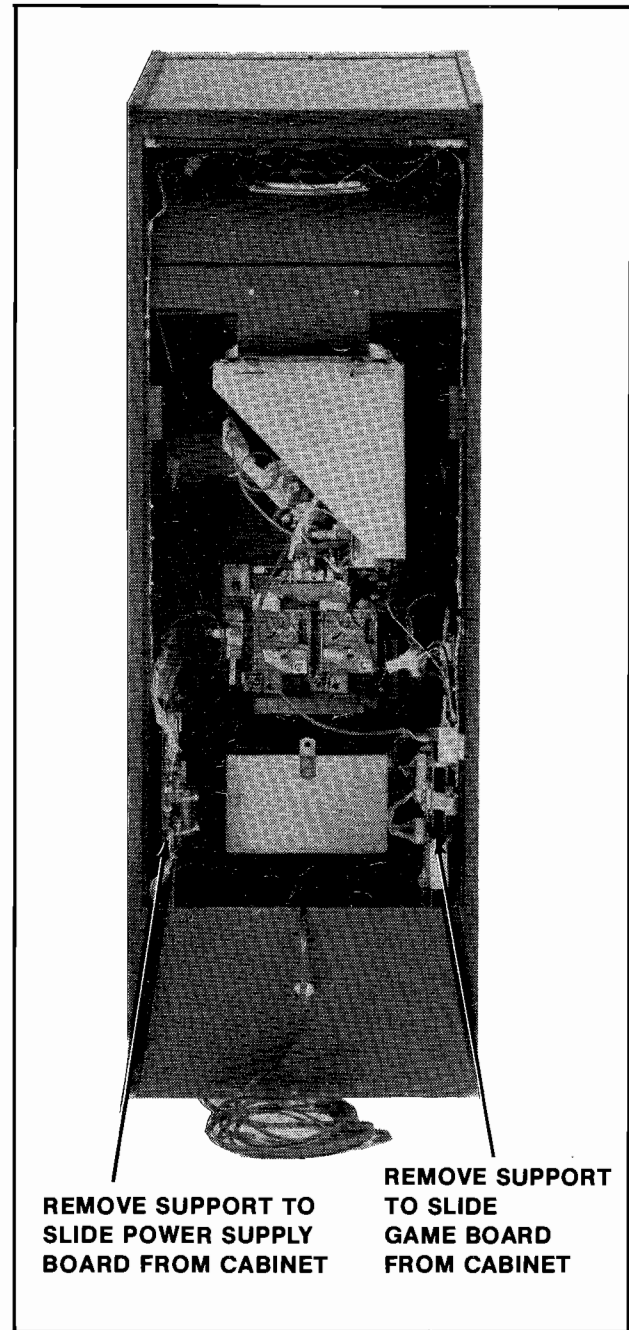


Figure 2-13 Removing P.C.B.'s — Mini



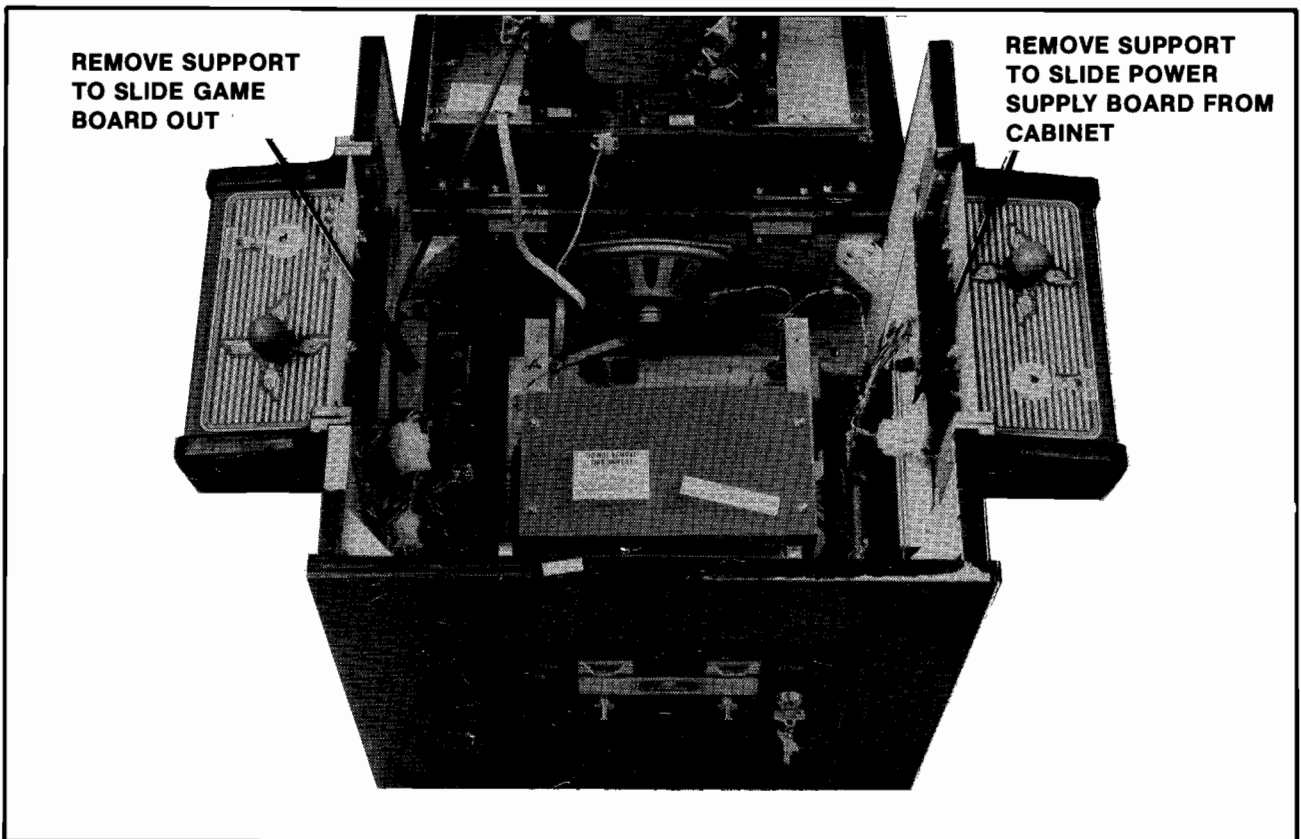


Figure 2-14 Removing P.C.B.'s — Cocktail

**2. MINI MODEL:** See Figure 2-13.

- Turn the power off to the game.
- Unlock and open the rear access door.
- Disconnect the game board from all its cabling.
- Disconnect the sound board from all its cabling.
- Remove the indicated P.C.B. supports and lift the above P.C.B.'s out of the cabinet.
- Disconnect the power supply board from its cabling, remove the P.C.B. supports indicated in Figure 2-13, and slide it out the back of the cabinet.
- To reinstall the above P.C.B.'s, reverse this procedure.

**3. COCKTAIL TABLE MODEL:** See Figure 2-14.

- Turn the power off to the game.
- Open the cabinet:  
Open the coin box door and release the two latches indicated in Figure 2-10.

**CAUTION:** The right hand latch is very close to the HIGH VOLTAGE on the monitor.

Once they're released, unhook them from their latch plates.

- Grasp the table top at "A" and open it as indicated in Figure 2-10.

**CAUTION:** Due to the weight of the monitor, EXTREME CARE MUST be taken when opening the cabinet.

- To remove the power supply board. See Figure 2-14.  
Disconnect it from all its cabling.  
Remove the two smallest P.C.B. supports.  
Once these are removed, the power supply can be lifted out the top of the cabinet.  
To reinstall the power supply board, reverse this procedure.
- To remove the game and Sound boards. See Figure 2-14.  
Disconnect the game board from all its cabling.  
Disconnect the sound board from all its cabling.
- Remove the indicated P.C.B. supports and lift the above P.C.B.'s out of the cabinet.  
To reinstall the game and sound boards, reverse this procedure.

## OPENING THE ATTRACTION PANEL:

### 1. UPRIGHT MODEL: See Figure 2-15.

- Turn the power to the game off.
- Opening the attraction panel:  
Remove the screws which secure the top bracket in place. (They are on its top side.) See Figure 2-15.  
Remove the top bracket and slide up the attraction panel. This exposes the attraction panel fluorescent light tube and its mounting bracket assembly.  
To reinstall the attraction panel, reverse this procedure.
- The fluorescent light tube may be replaced at this time. BE CAREFUL NOT TO DROP IT.

**WARNING:** If you drop a fluorescent tube and it breaks, IT WILL IMplode! Shattered glass can fly six (6) feet or more from the implosion. Use care when replacing any fluorescent tube.

- Replacing the fluorescent light tube starter. See Figure 2-16.  
**Be sure the power to the game has been turned off.**  
Grasp the starter (it is on the back of the mounting bracket), give it a quarter turn, and remove it from its socket.  
To replace the fluorescent light tube starter, reverse this procedure.
- Replacement of the fluorescent tube mounting bracket assembly.  
**Be sure the power is off to the game.**  
Disconnect it from its power cable.  
Remove the screws which secure it and gently slide it out the front of the cabinet, being careful not to catch its power cable on anything.  
To reinstall the fluorescent tube mounting bracket assembly, reverse this procedure.
- Replacing the speaker.  
**Be sure the power is off to the game.**  
Remove the attraction panel and disconnect the speaker from its cabling.  
Remove the nuts and bolts which secure the speaker and speaker grill in place and set them and the speaker grill aside.  
Once the bolts which secure the speaker in place are removed, the speaker may be removed through the opening where the attraction panel was.  
Reverse this procedure to reinstall the speaker.

### 2. MINI MODEL: See Figure 2-17.

- Turn the power off to the game.
- Remove the screws from the top and bottom of the formed attraction panel.
- Remove the formed attraction panel by pulling it straight away from the cabinet. This exposes the attraction panel light bulbs and their mounting board.

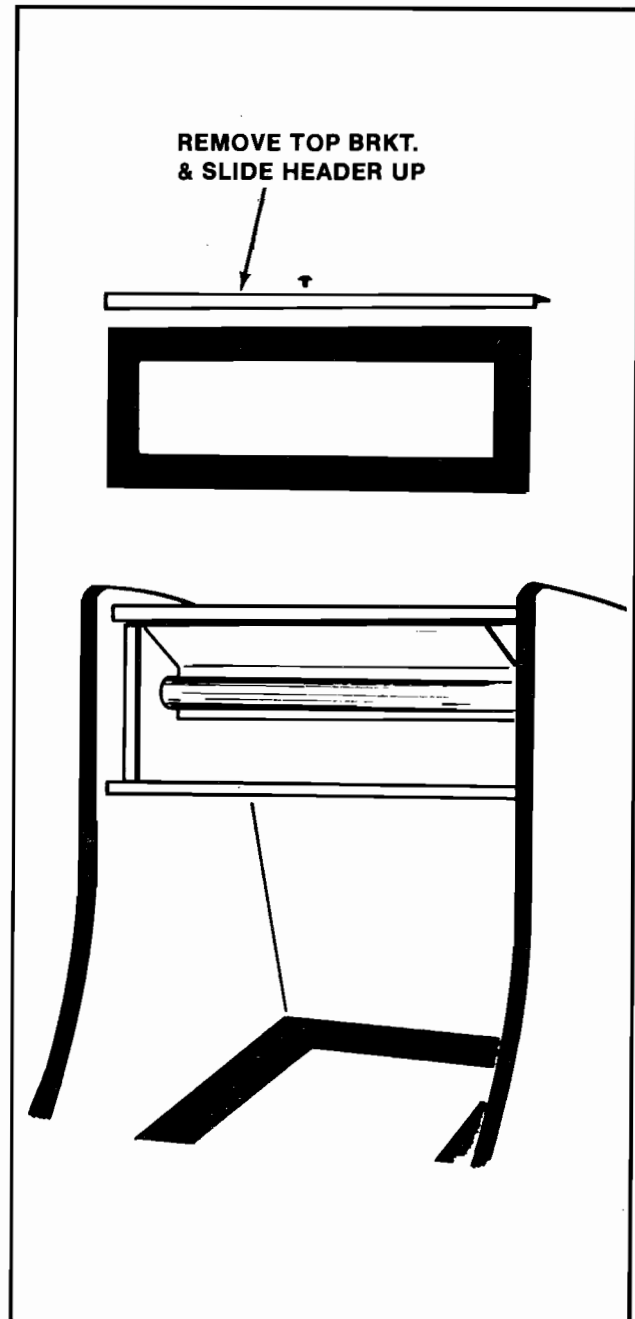


Figure 2-15 Opening the Attraction Panel — Upright

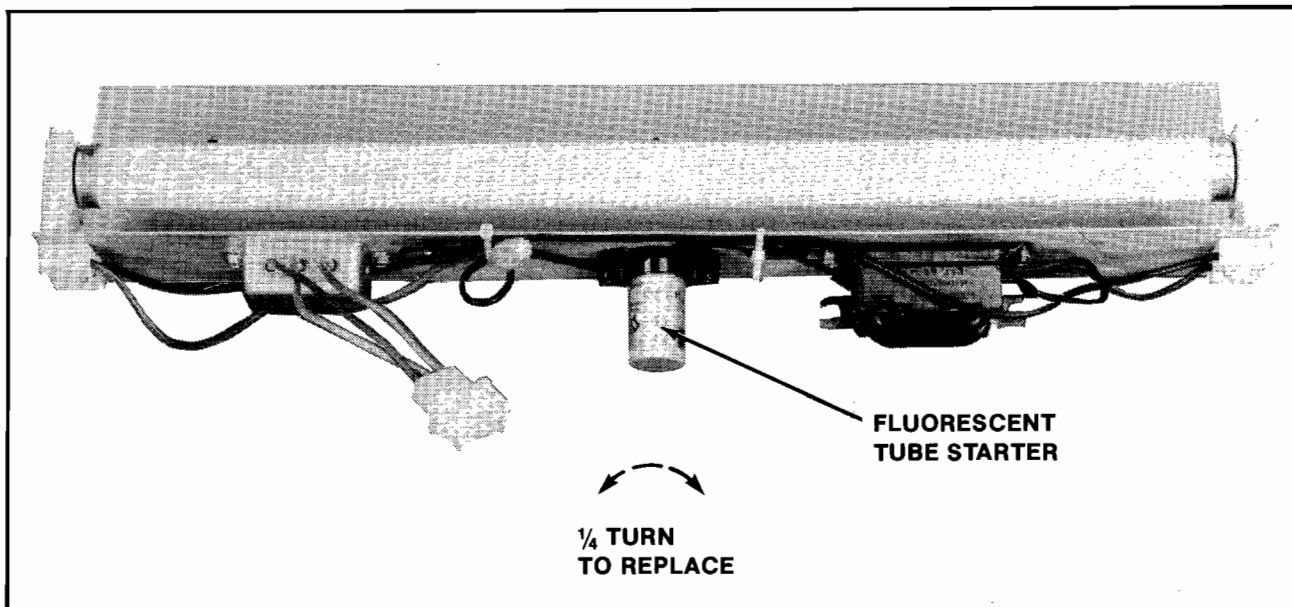


Figure 2-16 Replacing Fluorescent Tube Starter

- To service the light bulbs and their mounting board:

Turn the power to the game back on so you can see which bulbs are burnt out.

Mark the burnt out bulbs and **turn the power to the game back off again.**

To replace the burnt out bulbs, grasp them gently and pull straight out.

The new bulbs are gently pushed into the empty sockets.

To completely replace the light bulb mounting board:

Open the cabinet rear access door and unplug the mounting board from its power cable.

Remove the screws that hold the mounting board to the cabinet.

Gently slide the mounting board out the front of the cabinet being careful not to catch its cable on anything.

To reinstall the above removed items, reverse this procedure.

- To replace the speaker.

**Be sure the power is off to the game.**

Disconnect the speaker from its cabling.

Remove the nuts and bolts securing the speaker.

Slide the speaker out through the rear access door.

To reinstall the speaker, simply reverse this procedure.

### 3. THE COCKTAIL MODE HAS NO BACK-LIT ATTRACTION PANEL.

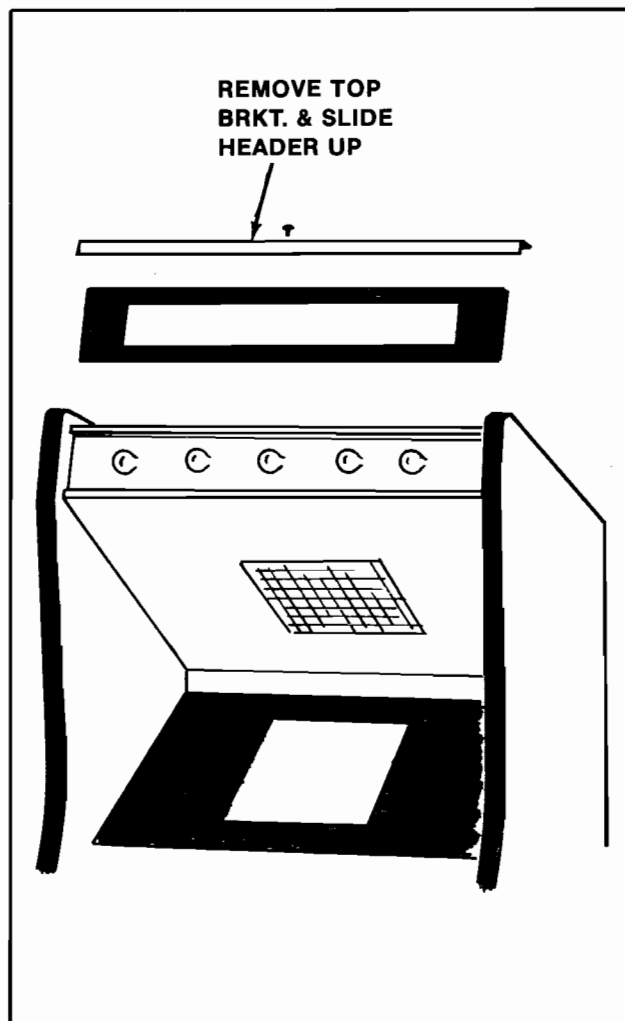


Figure 2-17 Opening the Attraction Panel — Mini

# III. Technical Troubleshooting

## Introduction

The most common problems occur in harness components such as the coin acceptor, player controls, interconnecting wiring, etc. The TV monitor and PCB computer cause their share of problems too, but not as much as the harness and its component parts. TV monitor troubleshooting will not be covered here because it is covered in that section of this manual.

As you already know, the PCB computer is a complex device with a number of different circuits. Some circuits remain basically the same among games, but overall there are a great many differences between them. PCB troubleshooting procedures, therefore, can be lengthy and will differ greatly among games. However, some basic Z-80 CPU information is involved in this section.

## General Suggestions

The first step in any troubleshooting procedure is correctly identifying the malfunction's symptoms. This includes not only the circuits or features malfunctioning, but also those still operational. A carefully trained eye will pick up other clues as well. For instance, a game in which the computer functions fail completely just after money was collected may have a quarter shorting the PCB traces. Often, an experienced troubleshooter will be able to spot the cause of the problem even before opening the cabinet.

After all the clues are carefully considered, the possible malfunctioning areas can be narrowed down to one or two good suspects. Those areas can be examined by a process of elimination until the cause of the malfunction is discovered.

## Harness Component Troubleshooting

Typical problems falling in this category are coin and credit problems, power problems and failure of individual features.

### NO GAME CREDIT

For example, your prospective player inserts his quarter and is not awarded a game. The first item to check is if the quarter is returned. If the quarter is returned, the malfunction most certainly lies in the coin acceptor itself. First, use a set of test coins (both old and new) to ascertain that the player's coin is not undersize or underweight. If your test coins are also returned, coin acceptor servicing is indicated. Generally, the cause of this particular problem is a maladjusted magnet gate. Normally, this will mean slightly closing the magnet gate a little by turning the adjusting screw out a bit (see section on coin acceptor for more details).

If the quarter is not returned and there is no game credit, the cause of the malfunction may be in one of several areas. First try operating the coin return button; if the coin is returned, the problem is most likely in the magnet gate. Enlarge the gap according to the coin acceptor service procedures. If this does not cure the problem, remove the coin acceptor, clean it and perform the major adjustment procedure.

If the trapped coin is not returned when the wiper lever is actuated, you may have an acceptor jammed by a slug, gummed up with beer, a jammed coin chute, or mechanical failure of the acceptor mechanism. In this case, first check for the slug that will generally be trapped against the magnet. If so, simply remove the slug and test the acceptor. If the chute is blocked, remove the acceptor and remove the jammed coins. If there is actual failure of the acceptor, remove the unit and repair as indicated in the coin acceptor service procedures.

If the coin is making its way through the acceptor (that is, falling into the coin box), yet there is still no game credit, you either have a mechanical failure of the coin switch or electrical failure of the coin and credit circuits. The first place to begin is by checking the coin switch. Most of these switches are the make/break variety of micro switch, which is checked by testing for continuity between the NO, NC, and C terminals. When not actuated, the NC and C terminals should be continuous and the NO terminal open. When operated, the NO and C terminals should close and the NC should be open. If the coin switch checks out, examine the connections to the terminals to make sure there is good contact. If necessary, use the continuity tester and check from the terminal lug on the switch to the associated PCB trace. This will tell you if there is a continuous line all the way to the credit circuit.

If the coin switch wires do not check out, the problem is in the computer — most likely in the coin and credit circuitry.

If you do get game credit when a coin is deposited, but the game will not start when the start switch is pressed, you may have a problem in the start switch, the interconnecting wiring or in the computer. First check the switch. If the switch is OK, proceed to check the wiring. Again, make sure you go from the terminal lug on the switch to the PCB trace. This way, you will check the terminal contact as well as PCB edge connector contact. If the wiring is continuous, proceed to check the PCB credit circuit. If not, check each section of the wiring, until the discontinuity is located. If the wiring is OK, the problem must lie in the computer.

## Transformer and Line Voltage Problems

Your machine must have the correct line voltage to operate properly. If the line voltage drops too low, a circuit in the computer will disable game credit. The point at which the computer will fail to work will vary some from game to game, but no game will work on line voltage that drops below 105 VAC.

Low line voltage may have many causes. Line voltage normally fluctuates a certain amount during the day as the total usage varies. Peak usage times occur mainly at dawn or dusk, so if your machine's malfunction seems to be related to the time of day, this may be a factor. A large load connected to the same line as the game (such as a large air conditioner or other device with an exceptionally large motor) may drop the line voltage significantly when starting up. This drop can result in an intermittent credit problem. In addition, poor connections in the location wiring, plug, or line cord may also cause a significant drop in power. Cold solder joints in the game's harness, especially in areas like the transformer connections, interlock switch, or fuse block, may also produce the same results, although probably on a more permanent basis.

Sometimes location owners (especially in bars) replace light switches with dimmer rheostats, and the game is sometimes on the same line. Obviously, the voltage available to the game is going to drop dramatically when the dimmer is turned.

In any case, the way to check for correct line voltage is with your VOM. Set the VOM to 250 VAC and stick the probes in the wall receptacle. If it's OK here, check the transformer primary connections. If you do not get 117 VAC, examine the solder joints on the transformer, fuse block, and interlock switch. If you do get 117 VAC, the problem must be either in the transformer, harness connections, or in the PCB power supply.

If you suspect the transformer, check its secondaries with the VOM set to 50 VAC and correlate the readings with the legend on the side of the transformer. The transformer must also be correctly grounded, so check the ground potential as well, especially if there is a hum bar rolling up or down the TV screen.

## HARNESS PROBLEMS

Other harness problems include blowing fuses and malfunctioning controls. The repeating blown-fuse problem can sometimes be quite exasperating to solve, for short circuits have the tendency to occur in areas almost impossible to find. First, try inserting a new fuse, as old fuses age and blow without cause. If the new one also blows, you definitely have a short.

The best way to approach this problem is by turning the power off and disconnecting devices that may be causing the problem, such as the TV, transformer, and PCB. Disconnect the devices by pulling off their connectors, but do not allow them to touch. If necessary, insulate them with small pieces of electrical tape. Then, connect your VOM across the terminals of the fuse block (all electrical power shut off), and set it to one of the resistance scales. This will save blowing a fuse each time you want to check the circuit.

If the VOM reveals that disconnecting the devices removed the short, reconnect the devices one by one until the short returns. The last device connected is the one that is at fault. If the VOM reads a short even after the devices are disconnected, the fault must lie in the harness itself, and only patient exploration will reveal its location. First, carefully examine all the wiring, looking for terminals that may be touching, metal objects such as coins shorting connections or burned insulation. If necessary, use the VOM to check each suspected wire.

## MALFUNCTIONING CONTROLS

One of the most common problems here is a bad potentiometer. Typically, a bad pot will cause the image to jump as it reaches a certain point. The only cure for this one is to install a new pot.

If a feature that is operated by a switch (for example, joysticks, foot pedals, control panel buttons) does not operate at all, check the switch with a VOM or continuity tester to verify its operation. If the switch does not check out, replace it. If the switch is OK, you should suspect the input to the switch from the PCB. In this case, get out the harness and logic schematics and check to see what kind of input it is. In many cases, the input will be +5 VDC. If so, use the VOM to check its presence. Normally, the switch is used to pull a +5 VDC line LOW to GND or to pull a LOW line HIGH. If the PCB output is missing, check the wire length from the PCB. If you find the signal at the PCB trace, the wire length or connection is at fault. If not, begin exploring the PCB using the logic schematics.

# A Glossary of Microprocessor Terms

**MICROPROCESSOR** — one or several microcircuits that perform the function of a computer's CPU. Sections of the circuit have arithmetic and comparative functions that perform computations and executive instructions.

**CPU** — central-processing unit. A computing system's "brain", whose arithmetic, control and logic elements direct functions and perform computations. The microprocessor section of a microcomputer is on one chip or several chips.

**PROM** — programmable read-only memory. User permanently sets binary on-off bits in each cell by selectively fusing or not fusing electrical links. Non-erasable. Used for low-volume applications.

**EPROM** — erasable, programmable, read-only memory. Can be erased by ultraviolet light bath, then reprogrammed. Frequently used during design and

development to get programs debugged, then replaced by ROM for mass production.

**ROM** — read-only memory. The program, or binary on-off bit pattern, is set into ROM during manufacture, usually as part of the last metal layer put onto the chip. Nonerasable. Typical ROM's contain up to 16,000 bits of data to serve as the microprocessor's basic instructions.

**RAM** — random-access memory. Stores binary bits as electrical charges in transistor memory cells. Can be read or modified through the CPU. Stores input instructions and results. Erased when power is turned off.

**LSI** — large scale integration. Formation of hundreds or thousands of so-called gate circuits on semiconductor chips. Very large scale integration (VLS) involves microcircuits with the greatest component density.

**MOS** — metal-oxide semiconductor. A layered construction technique for integrated circuits that achieves high component densities. Variations in MOS chip structures create circuits with speed and low-power requirements, or other advantages (static will damage a MOS chip).

# IV. Coin Door Maintenance

**SPECIAL NOTE:** If you have any questions about the coin acceptors in your game(s), please feel free to contact their manufacturers. Each manufacturer's name is **PROMINENTLY** imprinted on every acceptor mechanism.

Metal mechanisms only:  
**COIN MECHANISMS, INC.**  
817 Industrial Drive  
Elmhurst, IL 60126  
Phone (312) 279-9150

Metal and Plastic mechanisms:  
**COINCO COIN ACCEPTORS, INC.**  
860 Eagle Drive  
Bensenville, IL 60106  
Phone (312) 766-6781

## COIN DOOR MAINTENANCE

### METAL COIN ACCEPTOR MECHANISMS

Periodically, the metal coin acceptor mechanism(s) must be removed from the coin door and cleaned.

1. **Make sure the power to the game is off.**
2. Unlock and open the coin door.

3. Remove the coin acceptor mechanism as shown in Figure 4-1.

- Push down on the two spring loaded latches.
- While holding the latches down, pull the top of the coin acceptor mechanism toward you.
- Release the latches and lift out the coin acceptor mechanism.

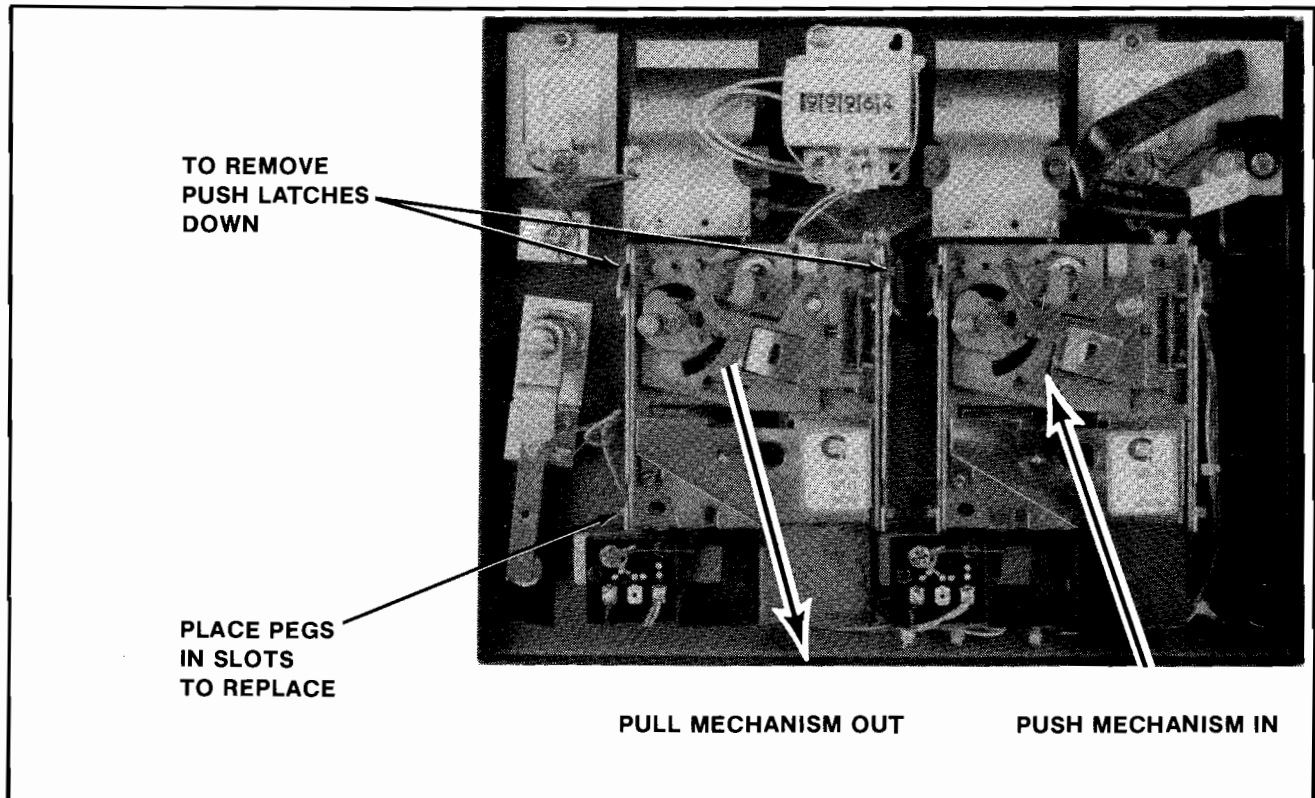


Figure 4-1 Removing & Replacing the Coin Acceptor

4. Clean the magnet of all foreign particles. See Figure 4-2.
  - This may be accomplished by swinging the gate open as shown in the above figure.
5. Remove the cradles and undersize levers and clean the bushings. (A pipe cleaner makes a good bushing cleaner.)
  - Also clean the pivot pin.
6. Whenever needed, the coin acceptor should be cleaned with hot water and cleanser in the following manner:
  - Place the coin acceptor in boiling water for about ten minutes.

**CAUTION: BE CAREFUL NOT TO BURN YOURSELF.**

- Next, use a brush and kitchen cleaner to remove all remaining foreign matter from the unit.
- Rinse the coin acceptor in clean boiling water.
- Dry the coin acceptor thoroughly by using filtered compressed air to blow it dry.

**NOTE:** The reason we recommend using boiling water is that it evaporates faster than cold water and speeds drying time.

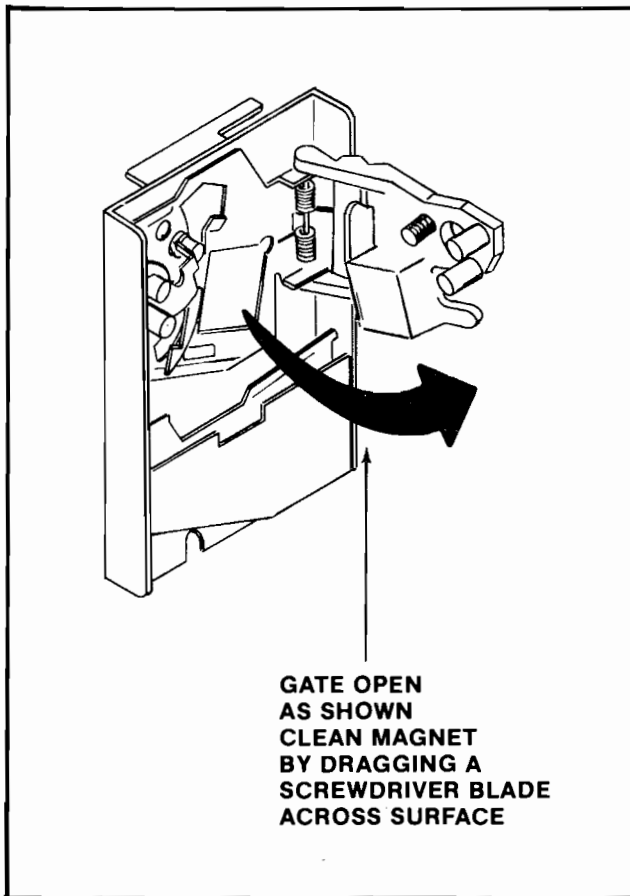


Figure 4-2 Cleaning the Metal Coin Acceptor

7. To lubricate the coin acceptor:
  - Use **ONLY** powdered graphite and put it **ONLY** on the moving parts of the coin acceptor. These parts are called out in Figure 4-3.
  - Be extremely careful to keep the powdered graphite away from paths that are traveled by the coins.

— WARNING —  
**DO NOT USE OIL  
TO LUBRICATE THE  
COIN ACCEPTOR.**

8. Check the coin chute for obstructions such as: paper, gum, etc.
9. Reinstall the coin acceptor to the coin door. See Figure 4-1.
  - Place the two pegs at the coin acceptor's base into their retaining slots.
  - Now push the top of the coin acceptor toward the coin door until it snaps in place and is held there by the two spring loaded latches.
10. Close and lock the coin door.

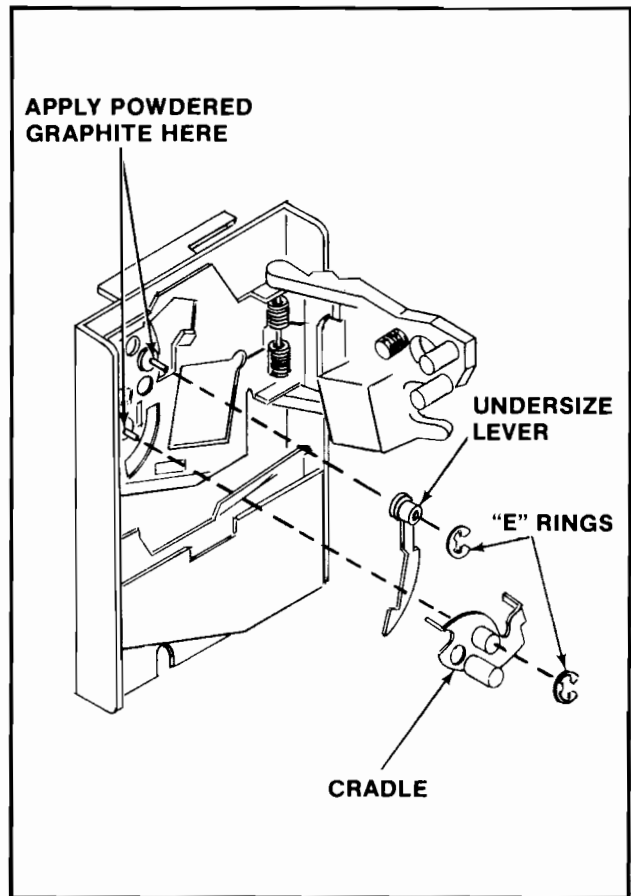


Figure 4-3 Lubricating the Metal Coin Acceptor



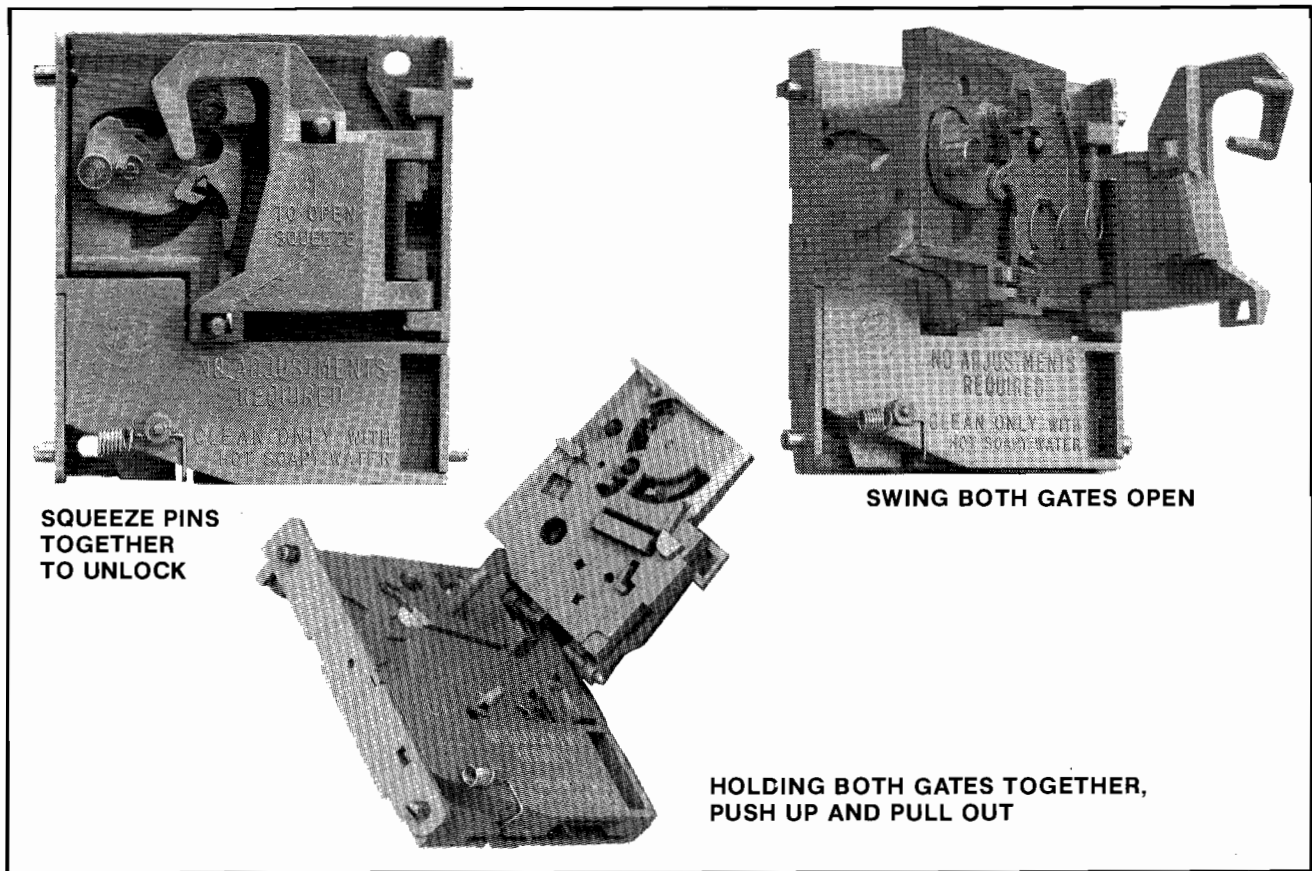


Figure 4-4 Opening the Plastic Coin Acceptor

### PLASTIC COIN ACCEPTOR MECHANISMS

The plastic coin acceptor mechanism(s) must be removed periodically from the coin door and cleaned.

**1. Make sure the power to the game is off.**

2. Unlock and open the coin door.

3. Remove the coin acceptor mechanism(s) as shown in Figure 4-1.

- Push down on the two spring loaded latches.
- While holding the latches down, pull the top of the acceptor mechanism toward you.
- Release the latches and lift out the mechanism.

4. Squeeze the two pins indicated in Figure 4-4 together to open the mechanism and break it down into its three basic parts.

- Clean the mechanism in hot soapy water. It never rusts.
- Rinse the mechanism in clean hot water and allow it to dry.

Reassemble the mechanism (it never needs lubrication).

5. Check the coin chute for obstructions such as: paper, gum, etc.

6. Reinstall the coin acceptor to the coin door. See Figure 4-5.

Place the two pegs at the coin acceptor's base into their retaining slots.

Now push the top of the coin acceptor toward the coin door until it snaps in place and is held there by the two spring loaded latches.

7. Close and lock the coin door.

**NOTE:** See Figure 4-6 for instructions on how to set the plastic coin acceptor mechanisms to either accept or reject Canadian quarters.

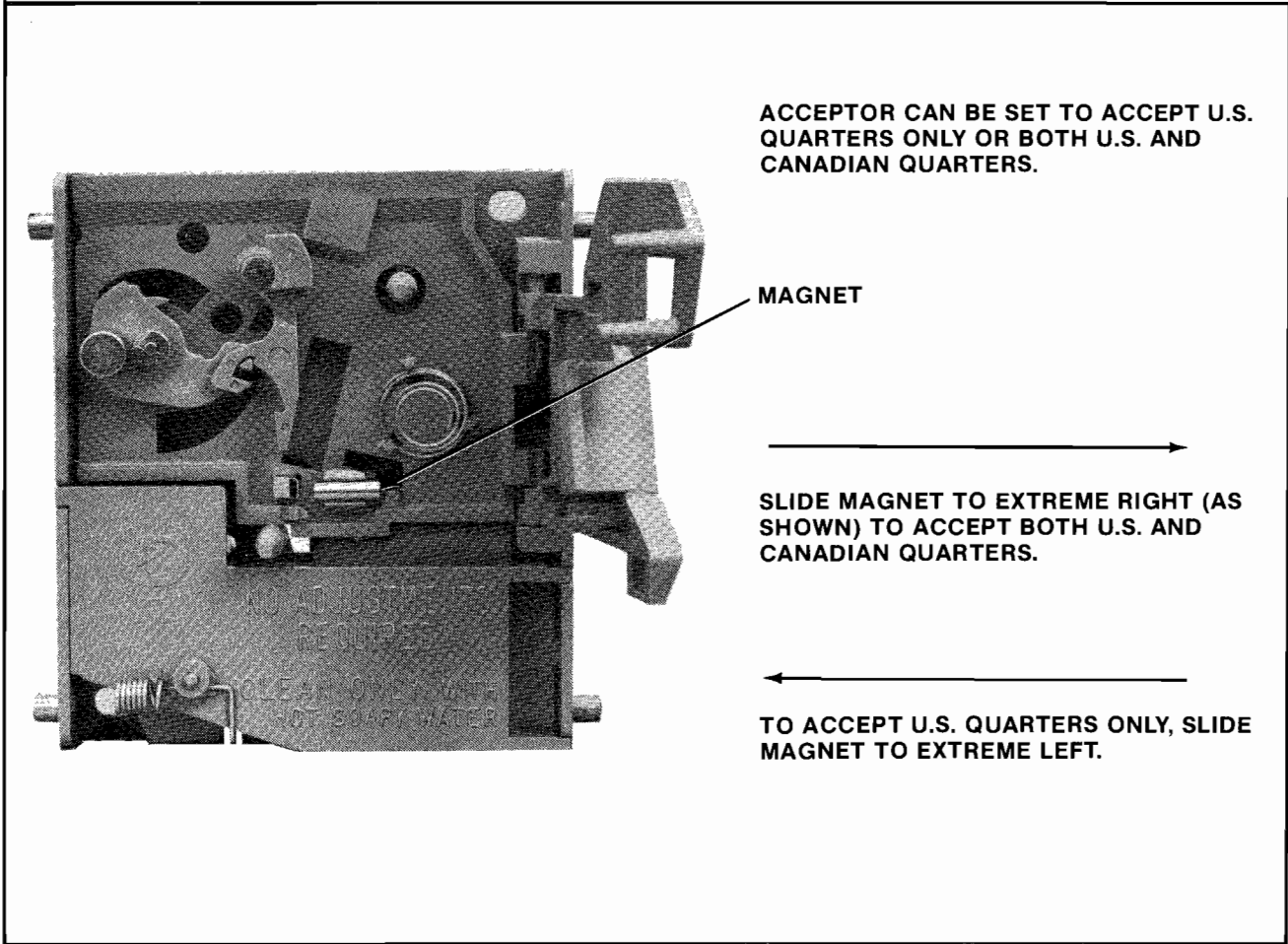


Figure 4-5 Changing the Plastic Coin Acceptor to Accept American or Canadian Quarters

# V. T.V. Monitor Manual

## PLEASE NOTE:

THE INFORMATION CONTAINED IN THIS SECTION IS TOLD IN AN EASY TO UNDERSTAND MANNER AND IS INTENDED TO AID THOSE WITHOUT AN ELECTRONICS DEGREE IN TROUBLESHOOTING AND REPAIRING THEIR GAMES T.V. MONITOR.

IF YOU READ THROUGH THIS SECTION AND STILL HAVE QUESTIONS, PLEASE CONTACT YOUR DISTRIBUTOR OR MIDWAY MANUFACTURING COMPANY AT THE TOLL FREE NUMBER PROVIDED WITH YOUR GAMES PAPERS.

**OUR STAFF AND OUR DISTRIBUTORS STAND READY TO HELP YOU!**

**THANK YOU**

## **Introduction:** (How to use this section of your manual.)

This section has been designed to simply familiarize you with one of the more mystical components in your game — the T.V. monitor. If you are an electronics technician who is quite knowledgeable on the subject, you may decide to just go to the schematics and start troubleshooting the defective monitor. But if you are like most people, a monitor is a T.V. set, and that means a complex doo-dad that means big buck repairs. This isn't necessarily so. This section of the manual will acquaint you with the monitor and could just help you repair it if you feel adventurous enough to give it a try. If you have any knowledge of electronics, especially the use of a voltmeter, the repairs you can make are astonishing. Just keep in mind that **ELECTRICITY CAN BE VERY DANGEROUS, SO BE CAREFUL!!**

If you want to understand how a monitor works, just read the "THEORY OF OPERATION" subsection. If you wish, you can follow along with the schematics. The information is presented in a very basic manner but a more complete treatment of the subject can be found in the technical sections of bookstores.

If you want to attempt to repair your monitor, it would be a good idea to read this whole section beginning to end before starting. **Pay attention to all warnings**

**and take them seriously.** The more equipment you have the better, but a low cost Volt-Ohm-Milliameter can often do the trick. Here are the steps to take:

1. Find the symptom that matches the problems your monitor has in the "SYMPTOM — DIAGNOSIS" subsection. The diagnosis tells the circuit or area the problem may be in and possibly even the actual component causing it.
2. Once you have the circuit that is causing the trouble, read the "TROUBLESHOOTING" subsection to learn the procedure for finding the bad part.
3. Next, go to the schematic section and find the schematic that matches your monitor. It may be helpful to read the "DIFFERENCES BETWEEN MONITORS" subsection if you are unsure of which monitor you have. Use the schematic to see what parts are in the offending circuit.

That really is all there is to it. Just remember that there are some bizarre or rare symptoms not covered, or that a monitor may have two or more different problems that only a genius, the experienced, or an experienced genius can figure out. But be patient, follow safety precautions, and remember that there is also literature available from the monitor companies through your distributor or from Bally Midway Manufacturing Company on request. (There is a toll free number on the back side of the front cover of this manual.)

# Symptom Diagnosis

- 1. Insufficient width or height:**
  - A. Horizontal line (due to VERTICAL CIRCUIT DEFECT).
    - Bad yoke.
    - Bad vertical output section.
    - Open fusible resistor in vertical section.
    - Bad height control.
    - Bad flyback.
  - B. Vertical line (due to HORIZONTAL CIRCUIT DEFECT).
    - Bad yoke.
    - Open width coil.
    - Open part in horizontal output section.
- 2. Picture spread out too far or crushed in certain areas:**
  - A. Horizontal or vertical output transistor.
  - B. Bad Component in output circuitry.
  - C. Vertical linearity or damper control needs adjustment.
- 3. Line too close with black spacing:**
  - A. Problem in vertical section causing poor linearity.
- 4. Poor focus and convergence:**
  - A. Bad high voltage transformer ("flyback") or control.
  - B. Focus voltage wire not connected to neck-board terminal.
- 5. Colors missing; check:**
  - A. Interface color transistors.
  - B. Color output transistors.
  - C. Cracked printed circuit board (neck Board).
  - D. Color circuits.
  - E. Video input jack.
  - F. Defective picture tube.
- 6. Picture not bright enough:**
  - A. Weak emission from picture tube.
- 7. Silvery effect in white areas; check:**
  - A. Beam current transistors.
  - B. Weak picture tube emission.
- 8. Too much brightness with retrace lines; check:**
  - A. Beam limiter transistors.
  - B. Brightness and/or color blanking control set too high.
- 9. Increasing brightness causes an increase in size and poor focus.**
  - A. Weak high voltage rectifier or regulation (high voltage unit).
  - B. Bad component in monitor's power supply.
- 10. Small picture and/or poor focus:**
  - A. Low B+ voltage (power supply trouble).
- 11. Vertical rolling:**
  - A. Vertical oscillator in the IC, vertical sync transistor, or circuit.
  - B. No sync from logic board.
  - C. Three pin sync. jack is loose or plugged in wrong.
- 12. Horizontal line across center:**
  - A. Vertical output circuit is dead (see symptom No. 1. A.).
  - B. Vertical oscillator is not putting out the right wave form.
- 13. Picture bends:**
  - A. Horizontal sync needs adjusting.
  - B. Magnetic or electromagnetic interference.
- 14. Flashing picture, visible retrace lines:**
  - A. Broken neck board.
  - B. Internal short circuit in the picture tube (arcing).
- 15. Unsymmetrical picture or sides of picture:**
  - A. Defective yoke.
- 16. No brightness, power supply operating — No high voltage for the picture tube; check:**
  - A. Horizontal oscillator.
  - B. Horizontal amplifier and output.
  - C. Flyback transformer (high voltage unit).
- 17. No brightness, high voltage present; check:**
  - A. Heater voltage to the tube at the neck board.
  - B. Screen-grid voltage for the tube.
  - C. Focus voltage.
  - D. Grid to cathode picture tube bias.
- 18. No high voltage; check:**
  - A. For AC input to the "flyback".
  - B. Horizontal deflection stages.
  - C. Flyback transformer.
  - D. Yoke.
  - E. Power supply.
- 19. No horizontal and vertical hold; check:**
  - A. Sync transistors and circuit.
  - B. Wires and jack from logic board to the monitor.
- 20. Wavy picture — (power supply defect); check:**
  - A. Transistors, diodes, electrolytic capacitors in the power supply.

**21. Moving bars in picture:**

- A. Ground connector off between monitor and logic boards.
- B. Defect in the power supply (see wavy picture symptom).

**22. Washed out picture (see picture not bright enough):**

- A. Check video signal at the cathode pins with an oscilloscope. If there is about 80 volts peak to peak, the picture tube has weak emission.

**23. Monitor won't turn on:**

- A. Problem in the power supply: Check fuse, transistors, open fusible resistor.
- B. Shorted horizontal output transistor.

- C. Defective high voltage disabling circuit.
- D. Crack(s) somewhere on main chassis board.

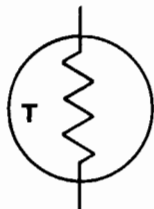
**24. Can't adjust purity or convergence:**

- A. Use a degausser to demagnetize the picture tube carefully following your degausser's instructions.
- B. Picture tube defective.
- C. Nearby equipment is electromagnetically interfering.
- D. The poles of the earth are pulling off the purity — see "A" above.
- E. Poor focus or width of picture.
- F. Make sure you have the correct CRT number for that brand of monitor.

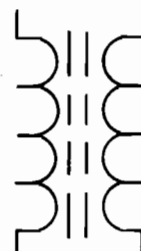
---

---

## Guide To Schematic Symbols



**THERMISTOR**  
(POLARITY DOESN'T MATTER)



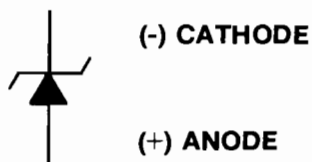
**IRON CORE TRANSFORMER**  
(SUCH AS A FLYBACK)



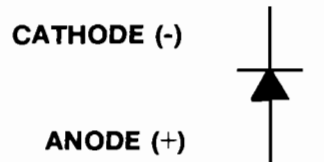
**INDUCTOR, COIL, CHOKE**  
(POLARITY DOESN'T MATTER)



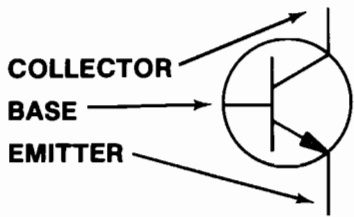
**FUSE**  
(POLARITY DOESN'T MATTER)



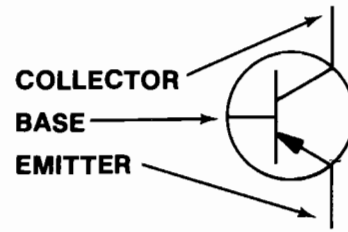
**ZENER DIODE**



**DIODE**



**NPN TRANSISTOR**



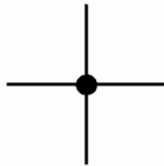
**PNP TRANSISTOR**



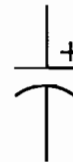
**VARIABLE RESISTOR, POT, CONTROL**  
(POLARITY DOESN'T MATTER)



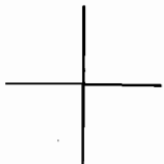
**RESISTOR**  
(POLARITY DOESN'T MATTER)



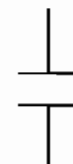
**LINES ARE CONNECTED**



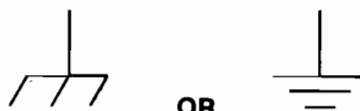
**ELECTROLYTIC CAPACITOR**



**LINES ARE NOT CONNECTED**



**CAPACITOR**  
(POLARITY DOESN'T MATTER)



**OR**  
**GROUND**

# Troubleshooting

Troubleshooting monitors requires experience, patience, **and luck**. The first step is to match the symptom the monitor displays to the diagnosis next to it in the "SYMPTOM-DIAGNOSIS" subsection. This will pinpoint the circuit the problem is probably in, and often the parts to check. Next, the circuit should be visually inspected to see if there are any parts broken, burned, or if something is there that shouldn't be, like a loose screw, etc. Some parts go bad before others and should be checked first. In fact, following is the general order in which parts usually go bad:

1. Semiconductors (like transistors, diodes, and integrated circuits).
2. Fusible resistors.
3. Electrolytic capacitors.
4. Resistors.
5. Capacitors and coils.

Always remember that a monitor can bite like a snake. Even when it is turned off, capacitors hold voltage and will discharge it to you should you be touching chassis ground. The picture tube or CRT, itself, is a giant capacitor, so avoid the flyback anode plug hole. With the monitor on, the power supply circuit and/or the flyback, which puts out at least 23,000 volts, **CAN BE KILLERS!!** Avoid handling power transistors (usually output transistors) or ICs, yoke terminals, and other high power components when the monitor is on.

## **WARNING: That picture tube is a bomb!**

When it breaks, first it implodes, then it explodes. Large pieces of glass have been known to fly in excess of 20 feet in all directions. **DO NOT** carry it by the long, thin neck. Discharge its voltage to ground by shorting the anode hole to ground. Use a plastic handled screwdriver, connect one end of a wire with an alligator clip at each end to chassis ground and the other end to the metal shaft of the screwdriver. Using **ONE HAND ONLY** (put the other in your pocket) and touching **ONLY** the plastic handle of the screwdriver (**DO NOT TOUCH THE METAL SHAFT**) stick the blade of the screwdriver into the anode hole.

**IMPORTANT!** The side brackets of the monitor are chassis ground as is the aquadag, the picture tube's dark conductive coating. **BUT**, on the ZENITH MONITOR there are metallic mounting parts which **ARE NOT** chassis ground. Discharging the CRT to these will damage the monitor!

Be prepared for a fairly loud pop and a flash. The longer the monitor has been turned off, the smaller the pop and dimmer the flash. But **BE CAREFUL**, picture tubes will hold a very healthy charge for at least **a week** if not longer. Even after you've discharged it once, it may still carry a residual charge. It's better to be too careful than dead, which is why electronic equipment always carries stickers referring servicing to qualified personnel. Handle the side with the viewing screen against your chest when changing it. **ALWAYS** wear safety goggles when handling the picture tube.

To maintain the safety and performance of the monitor, always use exact replacement parts. For instance, the wrong components in the power supply can cause a fire, or the wrong color transistor may give a funny color to the picture. Service your monitor on a nonconductive firm table like wood, **NOT METAL**, and take off all of your jewelry just in case. With all this in mind, you are ready to begin troubleshooting.

Observe the picture carefully. Try to vary the appropriate control that would most likely affect your particular symptom. For example, if there is poor brightness or no picture, try turning up the brightness or contrast control. If the controls have no effect at all, chances are there is trouble with the control itself, the circuit it controls, or a nearby circuit that may be upsetting voltages. Go to the list of symptoms and determine with the schematic where the bad circuit is.

### **CAUTION:**

**Keep in mind that capacitors hold a charge as can the picture tube (for at least a week and usually longer), and could shock you.**

First, check for obvious visual defects such as broken or frayed wires, solder where it is not supposed to be, missing components, burned components, or cracked printed circuit boards. If everything looks good up to this point, make sure that diodes, electrolytic capacitors, and transistors have their leads connected in the right polarity as shown on the schematic and the circuit board.

Turn on the power and measure the voltages at the leads of the active devices such as tubes, transistors, or integrated circuits. Any voltage that does not come within at least 10% to 15% of the voltage specified on the schematic indicates either a problem with that device or a component connected with it in the circuit. The next step is to use the ohmmeter to narrow down the field of possible offenders.

To test a transistor, one lead of the ohmmeter is placed on the base; and the other lead placed just on the emitter, then on the collector. A normal transistor will read either high resistance (infinite), or little resistance (400 to 900 ohms), depending on the polarity of this type transistor. Then the leads should be switched, one remaining on the base, and the other switched from the emitter to the collector. Now the opposite condition should result: the resistance should be infinite if it was lower when the other lead was on the base. Consistently infinite readings indicate an open, and a short is demonstrated by 0-30 ohms on most of these test readings. Finally, place one lead on the collector, then the other on the emitter. No matter which lead is used, there should be infinite resistance. Any lower reading, such as 50 ohms (which is typical on a bad transistor), indicates a short.

This all sounds pretty confusing, but a little experience on a good transistor will make you an expert in no time. Usually, the lowest ohmmeter setting is used for testing transistors. Once in a great while a transistor may check out good on this test, but may actually be "leaky" or break down only on higher voltages. If in doubt, change it. It is also wise to check the transistor out of the circuit just in case some component in the circuit is affecting the ohmmeter reading.

A diode is tested like a transistor except it only has two leads. Again, there should be high resistance one

way and little resistance the other. If it tests bad, take one lead out of the circuit in case some component is messing up the ohmmeter reading.

**NOTE: DO NOT** leave soldering equipment on the leads too long since all semiconductors, especially integrated circuits, are easily destroyed by heat.

Without special equipment, integrated circuits are checked by verifying the proper DC voltage on the pins and the correct AC wave form using an oscilloscope. **BE CAREFUL:** Shorting their pins can easily destroy them.

Resistors are checked with an ohmmeter and should usually be within ten percent of the value stated on them and on the schematic. You may have to desolder one lead from the printed circuit board. If you wreck the foil on the board, carefully solder a small wire over the break to reconnect the conductive foil.

Capacitors are tricky. Their resistance goes up when checked with an ohmmeter which shows a charging action. As they suck up current from the meter, the voltage goes up and so does the resistance. If you are sure a particular circuit is giving you a problem and everything else checks out O.K., Electrolytic capacitors are prime suspects. Substitute a new one and keep your fingers crossed.

---

## Theory of Operation

To understand what goes on inside the monitor, large general groups of circuits will be examined instead of laboriously analyzing the branches and small circuits that make up these groups. This will help avoid confusion and aid in a basic, concrete, knowledge of what makes up a monitor.

### THE POWER SUPPLY —

The AC going to the monitor from the game transformer is just like the voltage and current from your wall outlet. It jumps up and down going positive and negative sixty times a second. But a monitor needs nice, smooth DC; direct current, not alternating. So diodes chop up the AC and a big electrolytic capacitor filters it out to make it even smoother. Since the monitor is a big piece of electronic equipment, with many circuits demanding a lot of power from the power supply, there are also zener diodes and transistors to help maintain a nice, constant, smooth voltage so that the monitor circuits don't jump around. And this is what happens when you see a wavy picture. There is AC creeping

through the power supply, so it must be malfunctioning. If the voltage from the power supply is too low, the other circuits will be starved for power and you may see a small, wavy picture, or none at all.

Some circuits receive voltages that are higher than what the power supply should put out. But they come from the flyback transformer which will be discussed later.

### THE INTERFACE SECTION OF THE CHASSIS —

The interface section of the chassis is fairly easy to identify. It is right by the place where the video jack(s) from the logic board(s) plug into. There are sets of transistors that receive the separate red, green, blue, and sync information from the cables that come from the logic boards. The circuits jack up the voltage and match impedances, or in other words, prepare the logic board outputs for the circuits that will really amplify them for the output devices such as the yoke in the case of the sync, or the picture tube that shows the colors.



An interesting aside is that our sync is composite negative sync. That means two things:

1. The sync is a negative going wave form.
2. There are two pulses going at different speeds over the same wire:
  - a. Vertical wave forms at 60 times per second (or Hertz) and
  - b. Horizontal wave forms at about 15,750 times per second (Hz).

The sync is amplified by a sync amplifier transistor and sent on its way to the oscillators. The sync or timing information will be explained along with the oscillator shortly.

The color information is sent via wires to the neck board where the main amplification occurs. This will also be discussed later.

## VERTICAL AND HORIZONTAL DEFLECTION—

After the sync signal is amplified by the sync amp, it goes to two different sections, the vertical and horizontal circuits. Basically, the sync signals are for timing so the picture doesn't mess up since it is assembled like an orderly jigsaw puzzle, but so fast that you can't see the electron beams for each color painting the picture on the screen. This will all become clear soon. For now, we will follow the 60 cycle component of the sync as it goes on its journey to the deflection yoke.

The 60 cycle pulse goes to the vertical oscillator to make sure this circuit goes back and forth (or oscillates) at 60 times a second. Without this pulse keeping the circuit at the correct speed, it may get lazy and oscillate at 58 cycles or lower, or get ambitious and oscillate at 62 cycles or higher. At the wrong speed, the picture will start to roll up or down.

A Wells Gardner 13" (K4806) or 19" (K4906, K4956) color monitor uses an integrated circuit for its sync section. An Electrohome 13" or 19" color monitor uses an integrated circuit IC501 for its sync section. The Zenith monitor (CD19MXRF06) also uses an IC for the sync processing. Wells Gardner uses HA11423, Electrohome uses HA11244, and Zenith uses 221-175 (their part number). **These ARE NOT interchangeable!** The idea is all the same. The output to the vertical amplifying transistors for all monitors must form a sawtooth wave form, sort of like a bunch of pyramids, racing through the yoke's vertical coils at 60 times a second.

Along the way to the output transistors, the 60 cycle pulse is shaped and amplified to do the job: the yoke magnetically pushes the electron beam to fill the screen out sideways looking at the screen with the greatest length going up and down. Or viewing the screen sitting like a home television set, the amplified vertical output fills the screen up and down. Watching a monitor like this, seeing only a horizontal line means a problem with the vertical coils of the yoke or

anything from the vertical output section on back to the oscillator.

The horizontal section is very similar with a few exceptions. The horizontal wave shape is more like a square and has a frequency of 15,750 cycles a second. Both Wells Gardner and Electrohome use the other side of their respective integrated circuits for the horizontal circuitry. If the oscillator isn't going at the correct speed, the picture may move sideways, start to slant, or tear up with slanted thin figures. With both the vertical and horizontal of all monitors, there are variable resistors that change the speed of the oscillators up and down. This way you have controls that can make the correct frequencies to keep the electronic jigsaw puzzle nicely locked in place. If you're driving in a car and next to you someone else is driving their car at exactly the same speed, it will appear that they are not moving. And this is why the sync frequency and the oscillator's frequency must match, so the picture doesn't appear to move.

The correct wave form is shaped and amplified in the circuitry just like in the vertical section. But the horizontal output transistor is a large power transistor and not only serves to give current to the horizontal yoke windings, it also feeds the flyback transformer.

## THE FLYBACK TRANSFORMER (OR HIGH VOLTAGE UNIT) —

The picture tube needs high voltage to light up, and the power supply can't meet this demand. The flyback transformer receives current alternating at about 15,750 times per second from the horizontal output transistor. The "flyback" jacks up its input voltage and puts out a higher voltage alternating at the same speed. But, in your "flyback" there are diodes that chop up the alternating voltage to make it a smooth DC output just like in the power supply. This is what goes through that thick red wire to your picture tube. **THIS AREA HAS ABOUT 24,000 VOLTS ON IT AND IT CAN KILL YOU!!**

The "flyback" may be dangerous, but it is also generous. It has extra output windings which give voltage to the heater pins of the picture tube, voltage for the vertical deflection circuits, and picture tube screen-grid voltage. So in a way, the high voltage "flyback" is like a second power supply.

## COLOR CIRCUITS —

The color circuits are pretty straight forward. The signals go into the interface section where some amplification and impedance matching occurs. These circuits are pretty sparse and simple. Each color just has two transistors and a diode with some resistors and capacitors. From here, the AC color signal is sent by wires to the neck board.

The color output circuits are on the neck board. The color signals going to the transistors are controlled by two variable resistors called drive controls. There are only two, one for the red and one for the green on

Wells Gardner and Electrohome monitors. Zenith monitors have all three: red, blue and green.

The Wells Gardner and Electrohome monitor have another variable resistor in their emitter part of their color output transistors. These "cutoff controls" vary the amount of A.C. signal that the transistor amplifies and sends to the cathodes of the picture tube. The Zenith monitor has its cutoff controls in the interface section to vary the amount of signal going to the output transistors. The more signal, the more color.

If you think this is confusing, here is another little hitch. The Electrohome and Zenith monitors both have the actual A.C. picture information signal going through the emitters of the color output transistors. The Wells Gardner has the A.C. signal going to the base of the transistors. The blanking and beam limiting signals which come from the blanking and beam limiting transistors in the interface section go into the color output transistor base in the Electrohome and Zenith monitors, but enters into the emitter of the Wells Gardner monitor's color output transistor. Should you feel adventurous enough to look at this signal on an oscilloscope, it should look like a square.

The beam limiter helps control the brightness level, and the blanking transistor rapidly turns the picture tube on and off so that retrace lines don't show up on the screen. By turning up the brightness on a good monitor, these four to six retrace lines can be seen slanting diagonally across the picture.

## PROTECTION CIRCUIT —

To protect the high voltage section against voltages that are too high coming from the power supply which could cause X-rays to be emitted from the "flyback", a circuit senses the higher power supply voltage and turns off the horizontal oscillator. Since the horizontal oscillator doesn't work, the horizontal output transistor has nothing to feed the "flyback" which in turn has nothing to feed the picture tube. The monitor will be silent, have no picture, and will appear to be off. **But don't be fooled.** There is still that excessive amount of voltage coming from the power supply. To find out, check at pin two of Wells Gardner's IC501 and emitter of X04 for the Electrohome monitor. Check the 95 volt test point (located near the "flyback") for the Zenith monitor. Here are the voltages you should receive:

Wells Gardner	=	130VDC
Electrohome	=	120VDC
Zenith	=	95VDC

The best place to measure this voltage on an Electrohome monitor is at a pin marked B1 on the chassis. This is because a 13 inch color Electrohome monitor, The G07-FB0 or G07-902, has an integrated circuit and very little else in the power supply. Still, there should be 120VDC at B1.

## THE PICTURE TUBE (OR CRT) —

**ATTENTION!** For information on picture tube replacement types, go to the last section, "PICTURE TUBE INTERCHANGEABILITY".

The picture tube or CRT is an output device. In other words, the end result of the circuit's work is displayed by this part. Actually, the output of other circuits is in the neck of the picture tube.

First, there is the heater. The heater boils off electrons from the cathodes so that they (the electrons) shoot up to the screen to excite the phosphors so that the three phosphors emit three colors of light.

The cathodes are next, and again they emit electrons to turn on the tube phosphors, making it glow. A defective cathode may cause the particular color it handles to be missing.

Next come the grids. The first grid is grounded. The following grid is the screen grid which receives about 300VDC depending on the brightness setting. The next grid closest to the picture tube screen is the focus grid which gets about one fifth the amount of voltage that is applied to the picture tube anode.

After jetting from the cathode through all these grids, the electrons speed through a mask, a sheet of material with tiny holes, and then excite the tiny dots of phosphor in the inside surface of the picture tube screen. The green electron gun (or cathode and circuitry) spits out electrons which head for the green phosphors only. The same goes for the red and blue guns. The way the phosphor light blends determines the color seen. Should these electron beams become too intense, they may burn the phosphor. With the monitor off, this can be seen as a dark permanent image of the video information on the tube screen.

---

---

## Differences Between Monitors

The easiest way to identify the brand of monitor you are working with is to find the manufacturer's name or model number printed on the chassis or chassis base. But what if the monitor was in a Texas dust storm or buried in volcanic ash and this information is no longer there? Fear not! Each monitor has its own peculiarities and the following should help to identify them:

The **ELECTROHOME** G07-904 (19") and G07-902 (13") have their horizontal and vertical processing IC hidden under a silver can. A shiny metal top behind the "VERTICAL HEIGHT" and "HORIZONTAL FREQUENCY" control prove this is an Electrohome monitor.

The **WELLS GARDNER** K4906 (19") and K4806 (13") have their horizontal and vertical processing IC out in the open directly behind the "VERTICAL HOLD" control.

The **ZENITH** C019MXRF06 (19") monitor has its horizontal and vertical processing IC way in back by the picture tube. The monitor also has large white cables going from the main board to the neck board.

**K4906 (1st TYPE)** — This monitor's identifying tags have **BLACK** ink printed on a white background. There is **NO** Vertical Damping Control. (This Control would be next to the Vertical Hold Control but this area is jumpered with a small wire instead.

**K4906 (2nd TYPE)** — This monitor's identifying tags have **RED** ink printed on a white background. There **IS** a Vertical Damping Control next to the Vertical Hold Control. The Damping Control provides a few more lines on the top of the monitor screen (monitor viewed as a normal T.V. would be) for any video game that may need these lines to fit the picture on the screen. Moving the Control may distort the top part of your picture (or the side, depending on the game and how the monitor is mounted) so go ahead and move it if you are having this type of problem. To accommodate this new feature, there are a few circuit changes.

ONE MAJOR DIFFERENCE BETWEEN THESE TWO VERSIONS OF THE K4906 IS THE YOKE. They look the same but notice the part numbers:

K4906 **WITHOUT** the Damper Control: 2021111201

K4906 **WITH** the Damper Control: 2021111258

Since the companies like to change part numbers at the drop of a hat, the best thing to do is to request whatever part number is written on your yoke. If you should get the wrong yoke, the results will be:

Picture distortion.

Excessive brightness.

Too much or too little vertical picture size.

## CONTROLS YOU MAY NOT TOUCH

Basically, on the Electrohome monitor, you can move any control you want **EXCEPT** for the B1 control. This sets the power supply voltage (ideally at 120 VDC) and is located right behind VERTICAL HOLD. The 13" Electrohome **DOES NOT** have this control. It may also be wise not to move the VERTICAL LINEARITY since this distorts the picture and is hard to reset perfectly. If you do move it, turn on the Cross Hatch Test Pattern of your game and try to get the squares to the point where they are equal in size by readjusting this Linearity Control.

On the Wells Gardner monitor, brightness is adjusted by the "BLACK LEVEL" Control which is right next to the Horizontal Frequency Control. Under the Focus Control is the "SCREEN" Control which you **DO NOT** touch. Yes, this control does adjust the brightness,

but it is used to set the CRT bias and is adjusted at the factory. When Wells Gardner sets it, they mark the position with a black mark on the knob. If you move it, be sure to realign the mark and THEN set the BLACK LEVEL Control to the brightness you desire. So, other than the SCREEN control, you may adjust any of the controls.

The Zenith monitor has a 95 volt adjustment control. It is green and located behind the jack labeled 3D3. To discourage you from moving it, Zenith has placed a little glue on top of this control.

---

---

## Parts Interchangeability

Some parts can be interchanged on all of the monitors. Here are the rules:

1. You **CAN** swap any resistor between monitors that has the same resistance, wattage rating, and tolerance.
2. You **CAN** swap any capacitor between monitors that has the same capacitance and voltage rating.
3. You **CAN** swap many of the parts between the 19" and the 13" versions of each manufacturer's monitor. **BUT**, be certain to compare the manufacturers' part numbers to be positive the parts you want to interchange are identical. **BE SURE** you have read the section DIFFERENCES BETWEEN MONITORS which was covered earlier.
4. You **MAY BE ABLE** to swap picture tubes between monitors. In the past you could swap any picture tube, but due to rampant engineering changes and new monitor models being introduced, you would need a computer to keep track of what could be swapped. For more information on this subject, go to "PICTURE TUBE INTERCHANGEABILITY".
5. You **CANNOT** change any part that is a **safety part**, one that is shaded in gray on the schematic; it **MUST** be **IDENTICAL** to the original. **To do otherwise IS DANGEROUS.** For instance, the 13 inch Electrohome (G07-902) monitor "flyback" looks identical to the 19 inch Electrohome (G07-904) monitor "flyback". In fact, there is even a 19 inch Electrohome (G07-905) monitor (which is an obsolete model) with a similar looking "flyback". **NONE OF THESE ARE INTERCHANGEABLE!!**
6. You **CAN** change any of the parts between the G07-904 and G07-907. They're essentially the same monitor except that the G07-907 has a vertically mounted picture tube.

If there is any doubt about what parts can be swapped between each manufacturer's 19 inch and 13 inch models, compare the manufacturer's part number between each one. If they match up, they are the same part.

---

# Picture Tube Interchangeability

## 13" MONITORS

There are currently two 13" monitors being used: the Wells Gardner K4806 and the Electrohome G07-902. The picture tubes used are NOT interchangeable. The pins on the neck of the CRT will not fit in the socket should you use the wrong CRT.

Here is a chart for all the 13" color monitors Bally Midway uses.

ELECTROHOME	G07-902	—	370ESB22
WELLS GARDNER	K4806	—	370KSB22

The factory recommended CRT type could change in the future for one reason or another, but the listed picture tubes will work. As a matter of fact, you can call another picture tube company to see if they have a replacement number to recommend...but caveat emptor — let the buyer beware.

## 19" MONITORS

Here it gets a little tricky. All of the picture tubes will fit no matter which is used. But if you use the wrong one, you will have problems with purity and/or dynamic convergence.

Purity trouble means that the color won't be true. If you turn up the color control for one color, instead of seeing that solid color it will show blotches or blobs of other colors on the screen.

Trouble with dynamic convergence means that there will be color fringing around solid lines at the edges of the screen.

The only way to ensure that you avoid these problems is to get the right picture tube or the right substitute.

Here is a list of the 19" monitors and the **CORRECT** CRT numbers.

### **ALL ELECTROHOME G07-904 —**

19VMNP22 RCA  
19VMJP22 RAULAND  
510UJB22 HITACHI

### **WELLS GARDNER K4906 —**

19VLTP22 RCA  
19VMLP22 ZENITH  
19VMKP22 PHILLIPS




### **ZENITH CD19MXRF06 —**

19VMLP22 ZENITH  
19VLTP22 RCA  
19VMKP22 PHILLIPS

# 19" COLOR MONITOR SCHEMATIC DIAGRAM

## MODELS 19K4901, 19K4906, 19K4951, 19K4956

Power Supply Voltage and Symbols

Symbol	Voltage	Operating Circuit
	15V	Vert. Osc. Sync Blanking CRT Cut-Off
	130V	Horiz. Osc. Horz. Drive Horz. Output Vert. Output
	175V	Video Output

**SERVICE TECHNICIAN WARNING**  
**X-RAY RADIATION PRECAUTION:**

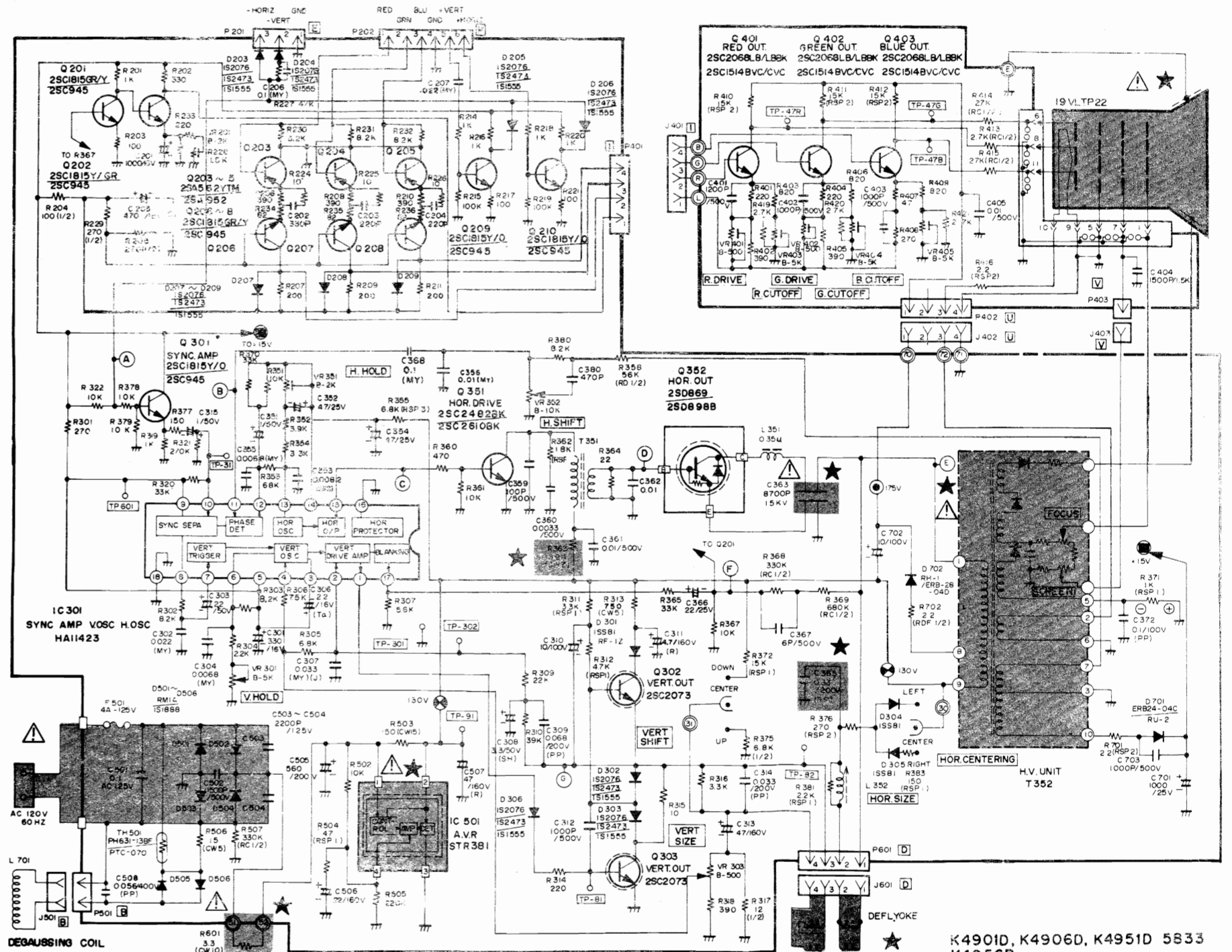
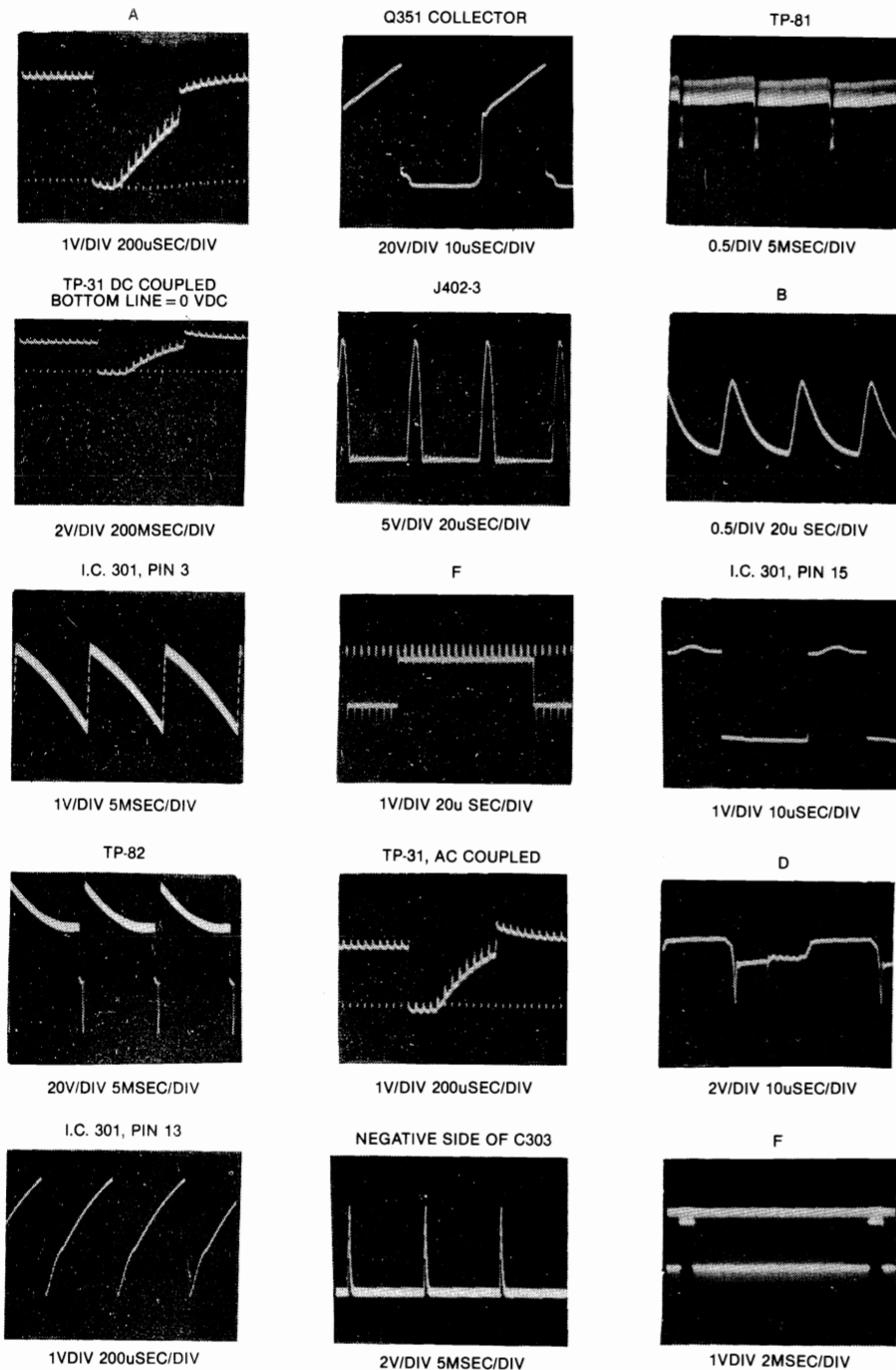
THIS PRODUCT CONTAINS CRITICAL ELECTRICAL AND MECHANICAL PARTS ESSENTIAL FOR X-RAY RADIATION PROTECTION. FOR REPLACEMENT PURPOSES, USE ONLY TYPE PARTS SHOWN IN THE PARTS LIST.

**CAUTION: FOR CONTINUED SAFETY, REPLACE SAFETY CRITICAL COMPONENTS ONLY WITH MANUFACTURER'S RECOMMENDED PARTS.**  
**AVERTISSEMENT: POUR MAINTENIR LE DEGRE DE SECURITE DE L'APPAREIL NE REMPLACER LES COMPOSANTS DONT LE FONCTIONNEMENT EST CRITIQUE POUR LA SECURITE QUE PAR DES PIECES RECOMMANDEES PAR LE FABRICANT.**

**OSCILLOSCOPE WAVEFORM PATTERN**

The waveforms shown are as observed on the wide band oscilloscope with the monitor turned to a reasonably strong signal and a normal picture. The voltages shown on each waveform are the approximate peak amplitudes.

If the waveforms are observed on the oscilloscope with a poor high frequency response, the corner of the pulses will tend to be more rounded than those shown and the amplitude of any high frequency pulse will tend to be less.



K4901D, K4906D, K4951D 5833  
K4956B

## REPLACEMENT PARTS LIST

This monitor contains circuits and components included specifically for safety purposes.

For continued protection no changes should be made to the original design, and components shown in shaded areas of schematic, or **▲** on parts list should be replaced with exact factory replacement parts.

The use of substitute parts may create a shock, fire, radiation or other hazard. Service should be performed by qualified personnel only.

## MAIN BOARD

Ref. No.	Part No.	Description	Ref. No.	Part No.	Description
<b>RESISTORS</b>					
R201	203X6500-645	1K Ohm, 5%, 1/4W Carbon	R369	203X5602-329	680K Ohm, 5%, 1/2W Comp.
R202	203X6500-523	30 Ohm, 5%, 1/4W Carbon	R370	203X6501-002	33K Ohm, 5%, 1/4W Carbon
R203	203X6500-405	100 Ohm, 5%, 1/4W Carbon	R371	203X9014-584	1K Ohm, 5%, 1W Metal Oxide
R204	203X6700-327	100 Ohm, 5%, 1/2W Carbon	R372	203X9101-119	12K Ohm, 5%, 1W Metal Oxide
R205	203X6700-421	270 Ohm, 5%, 1/2W Carbon	R375	203X6700-763	6.8K Ohm, 5%, 1/2W Carbon
R206	203X6500-540	390 Ohm, 5%, 1/4W Carbon	R376	203X9104-404	270 Ohm, 5%, 2W Metal Oxide
R207	340X2201-934	200 Ohm, 5%, 1/4W Carbon	R377	203X6500-447	150 Ohm, 5%, 1/4W Carbon
R208	203X6500-540	390 Ohm, 5%, 1/4W Carbon	R378	203X6500-886	10K Ohm, 5%, 1/4W Carbon
R209	340X2201-934	200 Ohm, 5%, 1/4W Carbon	R379	203X6500-886	10K Ohm, 5%, 1/4W Carbon
R210	203X6500-540	390 Ohm, 5%, 1/4W Carbon	R380	203X6500-865	8.2K Ohm, 5%, 1/4W Carbon
R211	340X2201-934	200 Ohm, 5%, 1/4W Carbon	R381	203X6500-724	2.2K Ohm, 5%, 1W Metal Oxide
R214	203X6500-645	1K Ohm, 5%, 1/4W Carbon	R383	203X9014-387	150 Ohm, 5%, 1W Metal Oxide
R215	203X6501-126	100K Ohm, 5%, 1/4W Carbon	R502	203X6500-886	10K Ohm, 5%, 1/4W Carbon
R216	203X6500-645	1K Ohm, 5%, 1/4W Carbon	R503	204X1700-535	150 Ohm, 5%, 15W Metal Oxide
R217	203X6500-405	100 Ohm, 5%, 1/4W Carbon	R504	203X9014-267	47 Ohm, 5%, 1W Metal Oxide
R218	203X6500-645	1K Ohm, 5%, 1/4W Carbon	R505	203X6501-209	2.2K Ohm, 5%, 1/4W Carbon
R219	203X6501-126	100K Ohm, 5%, 1/4W Carbon	R506	203X9104-105	15 Ohm, 5%, 2W Metal Oxide
R220	203X6500-645	1K Ohm, 5%, 1/4W Carbon	R507	203X5602-185	330K Ohm, 5%, 1/2W Comp.
R221	203X6500-405	100 Ohm, 5%, 1/4W Carbon	▲ R601	204X1625-058	3.3 Ohm, 5%, 10W WW
R222	203X6500-762	3.3 Ohm, 5%, 1/4W Carbon	R701	203X9105-141	2.2 Ohm, 5%, 2W Metal Oxide
R224	203X6500-169	10 Ohm, 5%, 1/4W Carbon	R702	203X6206-441	2.2 Ohm, 5%, 1/2W Carbon
R225	203X6500-169	10 Ohm, 5%, 1/4W Carbon	VR201	204X2070-072	2K Ohm-B Semi-Fixed
R226	203X6500-169	10 Ohm, 5%, 1/4W Carbon	VR301	204X2070-084	5K Ohm-B Semi-Fixed
R227	203X6501-044	47K Ohm, 5%, 1/4W Carbon	VR303	204X2070-055	500 Ohm-B Semi-Fixed
R228	203X6500-645	1K Ohm, 5%, 1/4W Carbon	VR351	204X2070-072	2K Ohm-B Semi-Fixed
R229	203X6700-421	270 Ohm, 5%, 1/2W Carbon	VR352	204X2070-072	2K Ohm-B Semi-Fixed
R230	203X6500-863	8.2K Ohm, 5%, 1/2W Comp.	<b>CAPACITORS</b>		
R231	203X6500-863	8.2K Ohm, 5%, 1/2W Comp.	C201	203X0014-088	1000 uF, 16V, Electrolytic
R232	203X6500-863	8.2K Ohm, 5%, 1/2W Comp.	C202	202X7200-064	330 pF, 500V, Ceramic
R233	203X6500-468	180 Ohm, 5%, 1/4W Carbon	C203	202X7200-043	220 pF, 500V, Ceramic
R234	340X2820-934	82 Ohm, 5%, 1/4W Carbon	C204	202X7200-043	220 pF, 500V, Ceramic
R235	340X2820-934	82 Ohm, 5%, 1/4W Carbon	C205	203X0014-076	470 uF, 16V, Electrolytic
R236	340X2820-934	82 Ohm, 5%, 1/4W Carbon	C206	203X1810-149	0.1 uF, 125V Mylar
R301	203X6500-508	270 Ohm, 5%, 1/4W Carbon	C207	349X2232-109	.022 uF, 100V Mylar
R302	203X6500-863	8.2K Ohm, 5%, 1/4W Carbon	C301	203X0014-065	330 uF, 50V Electrolytic
R303	203X6500-863	8.2K Ohm, 5%, 1/4W Carbon	C302	203X1600-563	0.033 uF, 50V Mylar
R304	203X6500-724	2.2K Ohm, 5%, 1/4W Carbon	C303	203X0629-037	3.3 uF, 50V Electrolytic
R305	203X6500-842	6.8K Ohm, 5%, 1/4W Carbon	C304	203X1600-366	0.068 pF, 50V Mylar
R306	203X6003-201	7.5K Ohm, 2%, 1/4W Carbon	C306	203X0412-012	2.2 uF, 16V Tantal
R307	203X6500-825	5.6K Ohm, 5%, 1/4W Carbon	C307	203X1600-634	0.033 uF, 50V Mylar
R309	203X6500-965	22K Ohm, 5%, 1/4W Carbon	C308	203X0025-174	3.3 uF, 50V Electrolytic
R310	203X6500-988	39K Ohm, 5%, 1/4W Carbon	C309	203X1207-100	0.068 uF, 100V PP
R311	203X6500-762	3.3K Ohm, 5%, 1/4W Carbon	C310	203X0629-061	10 uF, 100V Electrolytic
R312	203X9014-741	4.7K Ohm, 5%, 1/4W Carbon	C311	203X0041-025	10 uF, 160V Electrolytic
R313	204X1450-537	1K Ohm, 5%, 5W Carbon	C312	202X7050-248	1000 pF, 500V Ceramic
R314	203X6500-481	220 Ohm, 5%, 1/4W Carbon	C313	203X0040-052	47 uF, 160V Electrolytic
R315	203X6500-169	10 Ohm, 5%, 1/4W Carbon	C314	203X1201-265	0.033 uF, 200V PP
R316	203X6500-762	3.3K Ohm, 5%, 1/4W Carbon	C315	203X0629-023	1 uF, 50V Electrolytic
R317	203X6700-107	12 Ohm, 5%, 1/2W Carbon	C351	203X0629-023	1 uF, 50V Electrolytic
R318	203X6500-540	390 Ohm, 5%, 1/4W Carbon	C352	203X0619-045	47 uF, 25V Electrolytic
R319	203X6500-645	1K Ohm, 5%, 1/4W Carbon	C353	203X1190-015	0.0082 pF, 50V Mylar-PP
R320	203X6501-002	33K Ohm, 5%, 1/4W Carbon	C354	203X0619-045	47 uF, 25V Electrolytic
R321	203X6501-224	270K Ohm, 5%, 1/2W Carbon	C355	203X1600-366	0.0068 pF, 50V Mylar
R322	203X6500-886	10K Ohm, 5%, 1/4W Carbon	C356	202X7050-483	0.01 uF, 500V Ceramic
R351	203X6500-886	10K Ohm, 5%, 1/4W Carbon	C359	202X8065-606	100 pF, 500V Ceramic
R352	203X6500-785	3.9K Ohm, 5%, 1/4W Carbon	C360	202X7050-366	0.0033 pF, 500V Ceramic
R353	203X6501-086	68K Ohm, 5%, 1/4W Carbon	C361	202X7050-483	0.01 uF, 500V Ceramic
R354	203X6500-762	3.3K Ohm, 5%, 1/4W Carbon	C362	202X7203-032	0.01 uF, 50V Ceramic
R355	203X9205-143	6.8K Ohm, 5%, 3W Metal Oxide	▲ C363	203X1270-911	8700 pF, 1.5 KV PP
R358	203X5601-878	56K Ohm, 5%, 1/2W Carbon	★ C365	203X1201-265	0.33 uF, 200V PP
R360	203X6500-561	470 Ohm, 5%, 1/4W Carbon	C366	203X0019-026	22 uF, 25V Electrolytic
R361	203X6500-886	10K Ohm, 5%, 1/4W Carbon	C367	202X8065-162	6 pF, 500V Ceramic
R362	203X9014-645	1.8K Ohm, 5%, 1W Metal Oxide	C368	202X7203-032	0.01 uF, 50V Ceramic
★ R363	204X1527-751	3.9K Ohm, 5%, 7W Metal Oxide	C372	203X1207-125	0.1 uF, 100V PP
R364	203X6500-246	22 Ohm, 5%, 1/4W Carbon			
R365	203X6501-002	33K Ohm, 5%, 1/4W Carbon			
R367	203X6500-886	10K Ohm, 5%, 1/4W Carbon			
R368	203X5602-185	330K Ohm, 5%, 1/2W Comp.			

## MAIN BOARD (CONT.)

Ref. No.	Part No.	Description	Ref. No.	Part No.	Description
<b>CAPACITORS (CONT.)</b>					
C380	202X7200-087	470 uF, 500V Ceramic	Q206	200X3181-523	Transistor (NPN) 2SC1815GR
▲ C501	203X1810-149	0.1 uF, 125V Mylar	Q207	200X3181-523	Transistor (NPN) 2SC1815GR
▲ C502	202X7050-282	1500 pF, 500V Ceramic	Q208	200X3181-523	Transistor (NPN) 2SC1815GR
▲ C503	202X7810-214	2200 pF, 125V Ceramic	Q209	200X3181-523	Transistor (NPN) 2SC1851GR
▲ C504	202X7810-214	2200 pF, 125V Ceramic	Q210	200X3181-523	Transistor (NPN) 2SC1851GR
C505	203X0010-075	560 uF, 200V Electrolytic	Q301	200X3181-523	Transistor (NPN) 2SC1851GR
C506	203X0010-034	22 uF, 160V Electrolytic	Q302	200X3207-306	Transistor (NPN) 2SC2073LBGL2
C507	203X0041-057	47 uF, 160V Electrolytic	Q303	200X3207-306	Transistor (NPN) 2SC2073LBGL2
C701	203X0019-092	1000 uF, 25V Electrolytic	Q351	200X3248-217	Transistor (NPN) 2SC2482BK
C702	203X0634-061	10 uF, 100V Electrolytic	Q352	200X4589-802	Transistor (NPN) 2SD898B
C703	202X7050-248	1000 pF, 500V Ceramic	IC301	200X2300-033	IC HA11423
			▲ IC501	200X2600-183	IC STR381

## SEMICONDUCTORS

D203	201X2010-159	Diode, IS2076-27
D204	201X2010-159	Diode, IS2076-27
D205	201X2010-159	Diode, IS2076-27
D206	201X2010-159	Diode, IS2076-27
D207	201X2010-159	Diode, IS2076-27
D208	201X2010-159	Diode, IS2076-27
D209	201X2010-159	Diode, IS2076-27
D301	201X2010-165	Diode, ISS81
D302	201X2010-159	Diode, IS2076-27
D303	201X2010-159	Diode, IS2076-27
D304	201X2120-009	Diode, RH-IV
D305	201X2120-009	Diode, RH-IV
D306	201X2010-159	Diode, IS2076-27
▲ D501	201X3120-216	Diode, RM-1AV
▲ D502	201X3120-216	Diode, RM-1AV
▲ D503	201X3120-216	Diode, RM-1AV
▲ D504	201X3120-216	Diode, RM-1AV
D505	201X3120-216	Diode, RM-1AV
D506	201X3120-216	Diode, RM-1AV
D701	201X2130-234	Diode, RU-2V
D702	201X2120-009	Diode, RH-IV
Q201	200X3181-523	Transistor (NPN) 2SC1815GR
Q202	200X3181-523	Transistor (NPN) 2SC1815GR
Q203	200X4056-260	Transistor (PNP) 2SA562-Y-TM
Q204	200X4056-260	Transistor (PNP) 2SA562-Y-TM
Q205	200X4056-260	Transistor (PNP) 2SA562-Y-TM

## SEMICONDUCTORS (CONT.)

Q206	200X3181-523	Transistor (NPN) 2SC1815GR
Q207	200X3181-523	Transistor (NPN) 2SC1815GR
Q208	200X3181-523	Transistor (NPN) 2SC1815GR
Q209	200X3181-523	Transistor (NPN) 2SC1851GR
Q210	200X3181-523	Transistor (NPN) 2SC1851GR
Q301	200X3181-523	Transistor (NPN) 2SC1851GR
Q302	200X3207-306	Transistor (NPN) 2SC2073LBGL2
Q303	200X3207-306	Transistor (NPN) 2SC2073LBGL2
Q351	200X3248-217	Transistor (NPN) 2SC2482BK
Q352	200X4589-802	Transistor (NPN) 2SD898B
IC301	200X2300-033	IC HA11423
▲ IC501	200X2600-183	IC STR381

## TRANSFORMERS & COILS

L351	201X4710-134	Coil, (RF Choke)
L352	201X5000-083	Coil, Horiz. Size
L701	611X0004-007	Coil, Adg.
T351	202X1300-080	Transformer, Hor. Drive
▲ T352	200X9720-301	HV-Unit M-11

## MISCELLANEOUS

▲ F501	204X7120-073	Fuse, 4 Amp. 125V
J402	206X5008-632	Recep W Wire 3P-M-BG
P201	204X9600-466	Plug, PWB 3P-J
P202	204X9601-477	Plug, PWB 6P-Q
P401	204X9600-298	Plug, PWB 4P-B
P501	204X9600-249	Plug, PWB 2P-B
P601	204X9600-304	Plug, PWB 4P-C
TH501	201X0100-112	Thermistor

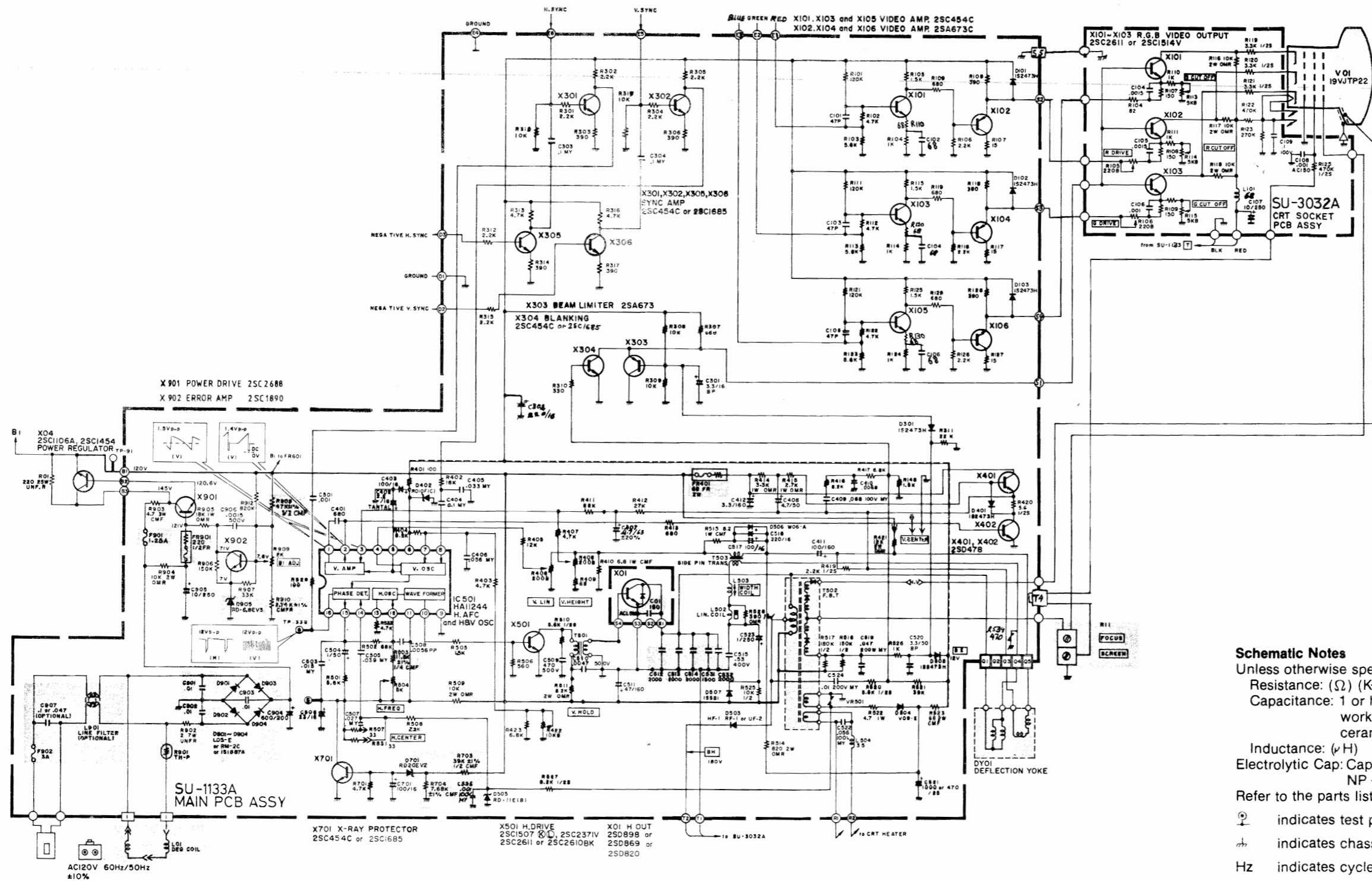
## FINAL ASSEMBLY PARTS

▲ 88X0138-506	19VLT22 Pix Tube
205X9800-158	Lateral/Purity Assembly
▲ 202X1111-201	Yoke Deflection
204X9301-255	CRT Socket
291X5004-262	Automatic Degaussing Coil Unit

## NECK BOARD

### RESISTORS

R401	203X6000-729	220 Ohm, 5% 1/4W Carbon
R402	203X6500-540	390 Ohm, 5% 1/4W Carbon
R403	203X6000-661	820 Ohm, 5% 1/4W Carbon
R404	203X6000-729	220 Ohm, 5% 1/4W Carbon
R405	203X6500-540	390 Ohm, 5% 1/4W Carbon
R406	203X6000-661	820 Ohm, 5% 1/4W Carbon
R407	203X6000-729	470 Ohm, 5% 1/4W Carbon
R408	203X6000-998	270 Ohm, 5% 1/4W Carbon
R409	203X6000-661	820 Ohm, 5% 1/4W Carbon



**Schematic Notes**  
 Unless otherwise specified  
 Resistance: (Ω) (K→KΩ, M→MΩ), 1/4 (W) carbon resistor  
 Capacitance: 1 or higher → (pF), less than 1 → (μF)  
 working voltage → 50 (V)  
 ceramic capacitor  
 Inductance: (μH)  
 Electrolytic Cap: Capacitance Value (μF)/working voltage (V),  
 NP → non-polar (or bipolar) electrolytic cap.  
 Refer to the parts list for additional component information.  
 ⊕ indicates test point connection  
 ⊕ indicates chassis ground unless otherwise specified  
 Hz indicates cycles per second  
 For **safety** purposes (and continuing reliability)  
 ⚠ replace all components marked with safety symbol with  
 identical type.  
 NOTE: FR → fusible resistor

00-4147-04  
 G07-CB0

Parts identification on circuit boards:  
 e.g. SU1126A (R107 = R1107)  
 SU3030A (R113 = R3113)

## REPLACEMENT PARTS LIST - ELECTROHOME 19" MONITOR

Components identified by the  $\Delta$  symbol in the PARTS LIST and on the Schematic have special characteristics important to safety.

DO NOT degrade the safety of the set through improper servicing.

### Abbreviations for Resistors and Capacitors

Resistor		Capacitor	
C R	: Carbon Resistor	C Cap.	: Ceramic Capacitor
Comp. R	: Composition Resistor	M Cap.	: Mylar Capacitor
OM R	: Oxide Metal Film Resistor	E Cap.	: Electrolytic Capacitor
V R	: Variable Resistor	BP E Cap.	: Bi-Polar (or Non-Polar) Electrolytic Capacitor
MF R	: Metal Film Resistor	MM Cap.	: Metalized Mylar Capacitor
CMF R	: Coating Metal Film Resistor	PP Cap.	: Polypropylene Capacitor
UNF R	: Nonflammable Resistor	MPP Cap.	: Metalized PP Capacitor
F R	: Fusible Resistor	PS Cap.	: Polystyrol Capacitor
		Tan. Cap.	: Tantal Capacitor

NOTE: When ordering replacement parts please specify the part number as shown in this list including part name, and model number. Complete information will help expedite the order.

Use of substitute replacement parts which do not have the same safety characteristics as specified, may create shock, fire or other hazards. For maximum reliability and performance, all parts should be replaced by those having identical specifications.

### SERVICE REPLACEMENT PARTS LIST

Symbol	Description	Part Number
	Main P.C.B. Ass'y	SU-1133A
	CRT Socket P.C.B. Ass'y	SU-3032A
	Purity Shield Ass'y	07-220083-03

### Outside of the P.C.B. Ass'y

Symbol	Description	Part Number
$\Delta$	Picture Tube 19"	17-7198-03
$\Delta$	Deflection Yoke	A29779-D = 21-141-01
$\Delta$	PC Magnet	A75034-B = 29-32-01
$\Delta$	Flyback Transf.	A29951-B
$\Delta$	HVR	A46600-A
R05	UNF Resistor 220 $\Omega$ , 25W K	QRF258K-221
C04	C Capacitor 150pF, AC1.5KV	QCZ0101-005
X01	Si. Transistor	2SD870
X02	Si. Transistor	2SC1106A
SC	Screw #8- $\frac{3}{8}$	31-610818-06
SC	Screw $\frac{1}{4}$ x $\frac{3}{4}$ Pix Tube Mtg. (4)	31-601418-12
WA	Pyramidal Lock Washer (4)	33-255-01
	Nut Retainer, Pix Tube Mtg. (4)	33-494-01
	Clip — P.C.B. Support	33-629-02
	Standoff	33-670-010R-02
	Wire Terminal (Gnd. Strap)	34-228-03
	Terminal Lug (Gnd.)	34-33-04
	Groundstrap Assy.	34-574-02
	Grounding Spring	35-212-03
	Wire Hook (Gnd. Strap)	35-3053-02
	Purity Shield Holddown Clamp	35-2348-01
	Support Brkt. RH	35-3890-01
	Support Brkt. LH	35-3890-02
	Chassis Base	38-449-02
	Yoke Wedge (3)	39-1233-01

### Purity Shield Ass'y. Parts List

Symbol	Description	Part Number
D911, D912	Degaussing Coil	21-1007-30
	Rectifier 1 Amp 600V (2)	28-22-27
	Pin Terminal (2)	34-708-01
	Pin Terminal Housing	34-709-01
	Purity Shield (2 pcs.)	35-3847-01
	Purity Shield (2 pcs.)	35-3847-02
C911	Capacitor 100nF 10% 400V	48-171544-62
R921	Resistor, Wirewound 33 $\Omega$ , 4W	42-113301-03
	Fire Retardent Term. Strip 4 Lug	34-492-09

### CRT Socket P.C.B. Ass'y (SU-3032A) Parts List

Resistors	Description	Part Number
R3105	V R 200	QVZ3234-022
R3106	V R 200	QVZ3234-022
R3113	V R 5K	QVZ3234-053
R3114	V R 5K	QVZ3234-053
R3115	V R 5K	QVZ3234-053
R3116	OM R 10K $\Omega$ 2W J	QRG029J-103
R3117	OM R 10K $\Omega$ 2W J	QRG029J-103
R3118	OM R 10K $\Omega$ 2W J	QRG029J-103
R3119	Comp. R 3.3K $\Omega$ $\frac{1}{2}$ W K	QRZ0039-332
R3120	Comp. R 3.3K $\Omega$ $\frac{1}{2}$ W K	QRZ0039-332
C3121	Comp. R 3.3K $\Omega$ $\frac{1}{2}$ W K	QRZ0039-332

### Capacitors

Symbol	Description	Part Number
C3107	E Cap. 10uF 250V A	QEW53EA-106
C3108	C Cap. 1000pF DC1400V P	QCZ9001-102M

### Coils

Symbol	Description	Part Number
L3101	Peaking Coil	QQL043K-101



**Semiconductors**

Symbol	Description	Part Number
X3101	Si. Transistor	2SC1514VC
X3102	Si. Transistor	2SC1514VC
X3103	Si. Transistor	2SC1514VC

**Miscellaneous**

Symbol	Description	Part Number
△	△CRT Socket	A76068

**Main PCB Ass'y (SU-1133A) Parts List****Resistors**

Symbol	Description	Part Number
R1406	V R 200Ω	QVZ3230-002
R1408	V R 200Ω	QVZ3230-002
R1410	CMF R 6.8Ω1W J	QRX019J-6R8
R1414	OM R 3.3KΩ1W J	QRG019J-332
R1415	OM R 2.7KΩ1W J	QRG019J-272
R1421	OM R 12KΩ2W J	QRG026J-123Z
R1422	V R 10KΩ	QVZ3230-014
△FR1401	△F R 68Ω2W K	QRH024K-680M
△R1503	△CMF R 11.8KΩ¼W +1%	QRV142F-1182
R1504	V R 5KΩ	QVZ3230-053
R1509	OM R 10KΩ2W J	QRG026J-103Z
R1512	OM R 8.2KΩ2W J	QRG026J-822Z
R1514	OM R 820Ω2W J	QRG026J-821Z
R1515	CMF R 8.2Ω1W J	QRX019J-8R2
R1522	CMF R 4.7Ω1W J	QRX019J-4R7
R1523	OM R 68Ω2W J	QRG026J-680Z
R1528	OM R 390Ω1W J	QRG019J-391
R1534	ZN R	ERZ-C05ZK471
VR1501	ZN R	ERZ-C05DK271
△R1703	△CMF R 39Ω½W +1%	QRV122F-3902
△R1704	△CMF R 7.68KΩ¼W +1%	QRV142F-7681
△R1901	△Posistor	A75414
R1902	UNF R 2Ω7W K	QRF076K-2R0
R1903	CMF R 4.7Ω3W J	QRX039J-4R7
R1904	OM R 10KΩ2W J	QRG026J-103Z
R1905	OM R 18KΩ1W J	QRG019J-183
△Q1908	△CMF R 47Ω½W +1%	QRV122F-470Z
△R1909	V R 2KΩ	QVP5A0B-023E
R1910	△CMF R 2.74KΩ¼W +1%	QRV142F-2741
△FR1901	△F R 220Ω½W K	QRH124K-221M

**Capacitors**

Symbol	Description	Part Number
C1301	BPE Cap. 3.3uF 50V A	QEN61HA-335Z
C1402	Tan. Cap. 2.2uF 16V K	QEE51CK-225B
C1407	E Cap. 4.7uF 6.3V A	QEW51JA-475
C1411	E Cap. 100uF 160V A	QEW52CA-107
C1412	E Cap. 3.3uF 160V A	QEW52CA-335
C1508	PP Cap. 5600uF 50V J	QFP31HJ-562
△C1512	△PP Cap. 2000pF DC1500V J	QFZ0082-202
△C1513	△PP Cap. 2000pF DC1500V J	QFZ0082-202
△C1514	△PP Cap. 2000pF DC1500V J	QFZ0082-202
C1515	PP Cap. 0.53uF DC1200V J	QFZ0067-534
C1520	BPE Cap. 3.3uF 50V A	QEN61HA-335Z
C1523	E Cap. 1uF 160V A	QEW62CA-105Z
C1524	M Cap. 0.1uF 200V K	QFM720K-104M
△C1531	△PP Cap. 2000pF DC1500V J	QFZ0082-202
△C1532	△PP Cap. 1500pF DC1500V J	QFZ0082-152
C1904	E Cap.	QEY0034-001
C1905	E Cap. 10uF 250V A	QEW52EA-106

**Coils****Symbol**

L1502  
L1503  
L1504

**Description**

Linearity Coil  
Width Coil  
Heater Choke

**Part Number**

A39835  
C30380-A  
C30445-A

**Transformers****Symbol**

T1501  
T1503

**Description**

Hor. Drive Transf.  
Side Pin Transf.

**Part Number**

A46022-BM  
C39050-A

**Semiconductors****Symbol**

IC1501

**Description**

IC

**Part Number**

HA11244

X1101

Si. Transistor

2SC1685(R)

X1102

Si. Transistor

2SA673(C)

X1103

Si. Transistor

2SC1685(R)

X1104

Si. Transistor

2SA673(C)

X1105

Si. Transistor

2SC1685(R)

X1106

Si. Transistor

2SA673(C)

X1301

Si. Transistor

2SC1685(R)

X1302

Si. Transistor

2SC1685(R)

X1303

Si. Transistor

2SA673(C)

X1304

Si. Transistor

2SC1685(R)

X1305

Si. Transistor

2SC1685(R)

X1401

Si. Transistor

2SD478

X1402

Si. Transistor

2SD478

X1501

Si. Transistor

2SC2610BK

X1901

Si. Transistor

2SC2688 (K.L.M.)

X1902

Si. Transistor

2SC1890A (E.F.)

D1101

Si. Diode

W06A

D1102

Si. Diode

W06A

D1103

Si. Diode

W06A

D1301

Si. Diode

1SZ473H

D1401

Si. Diode

1SZ473H

D1402

Zener Diode

RD10F(C)

D1503

Si. Diode

HF-1

D1504

Si. Diode

V09E

D1505

Zener Diode

RD11E(B)

D1506

Si. Diode

W06A

D1507

Si. Diode

1SS81

D1508

Si. Diode

1SZ473H

△D1701

△Zener Diode

RD20EV2

△D1901

△Si. Diode

1S1887A

△D1902

△Si. Diode

1S1887A

△D1903

△Si. Diode

1S1887A

△D1904

△Si. Diode

1S1887A

△D1905

△Zener Diode

RD6.8EV3

**Miscellaneous****Symbol**

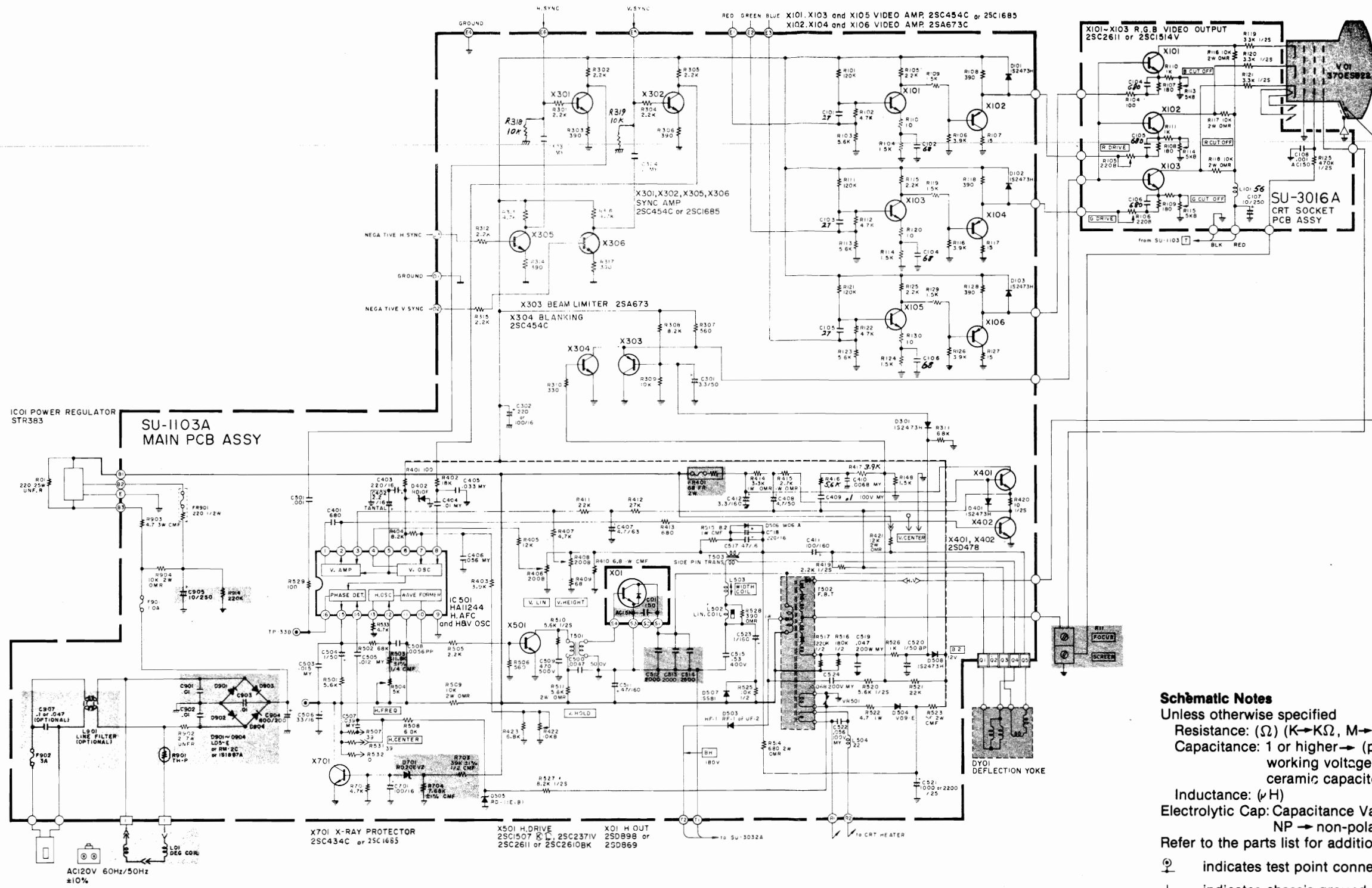
△F1901  
△F1902

**Description**

△Fuse 1.25A  
△UL Fuse 3A

**Part Number**

QMF53U1-1R25S  
QMF66U1-3R0S



**Schematic Notes**

- Unless otherwise specified
- Resistance: ( $\Omega$ ) (K $\rightarrow$ K $\Omega$ , M $\rightarrow$ M $\Omega$ ), 1/4 (W) carbon resistor
- Capacitance: 1 or higher  $\rightarrow$  (pF), less than 1  $\rightarrow$  ( $\mu$ F)
- working voltage  $\rightarrow$  50 (V)
- ceramic capacitor
- Inductance: ( $\mu$ H)
- Electrolytic Cap: Capacitance Value ( $\mu$ F)/working voltage (V), NP  $\rightarrow$  non-polar (or bipolar) electrolytic cap.
- Refer to the parts list for additional component information.
- $\oplus$  indicates test point connection
- $\perp$  indicates chassis ground unless otherwise specified
- Hz indicates cycles per second
- For **safety** purposes (and continuing reliability)
- $\triangle$  replace all components marked with safety symbol with identical type.
- NOTE: FR  $\rightarrow$  fusible resistor ( $\text{---}\text{---}$ )

G07-FBO  
00-4147-03

## REPLACEMENT PARTS LIST - ELECTROHOME 13" MONITOR

Components identified by the  $\Delta$  symbol in the PARTS LIST and on the Schematic have special characteristics important to safety.

DO NOT degrade the safety of the set through improper servicing.

### Abbreviations for Resistors and Capacitors

Resistor		Capacitor	
C R	: Carbon Resistor	C Cap.	: Ceramic Capacitor
Comp. R	: Composition Resistor	M Cap	: Mylar Capacitor
OM R	: Oxide Metal Film Resistor	E Cap.	: Electrolytic Capacitor
V R	: Variable Resistor	BP E Cap.	: Bi-Polar (or Non-Polar) Electrolytic Capacitor
MF R	: Metal Film Resistor	MM Cap.	: Metalized Mylar Capacitor
CMF R	: Coating Metal Film Resistor	PP Cap.	: Polypropylene Capacitor
UNF R	: Nonflammable Resistor	MPP Cap.	: Metalized PP Capacitor
F R	: Fusible Resistor	PS Cap	: Polystyrol Capacitor
		Tan. Cap.	: Tantal Capacitor

NOTE: When ordering replacement parts please specify the part number as shown in this list including part name, and model number. Complete information will help expedite the order.

Use of substitute replacement parts which do not have the same safety characteristics as specified, may create shock, fire or other hazards. For maximum reliability and performance, all parts should be replaced by those having identical specifications.

Symbol	Description	Part Number
	Main P.C.B. Ass'y	SU-1103A
	CRT Socket P.C.B. Ass'y	SU-3016A
<b>Outside of the P.C.B. Ass'y</b>		
Symbol	Description	Part Number
$\Delta$ V01	$\Delta$ Picture Tube	370ESB22(E)
$\Delta$ DY01	$\Delta$ Deflection Yoke	C29123-V
	PC Magnet	A76366-A
	Wedge	C30006
	$\Delta$ Flyback Transf.	A19183-A
	$\Delta$ Focus V R	A46606-A
$\Delta$ R11	UNF Resistor 220 $\Omega$ , 25W. K	QRF258K-221
$\Delta$ R05		QCZ0101-005
$\Delta$ C04	$\Delta$ C Capacitor 150 pF, AC1.5KV	2SD869
X01	Si. Transistor	STR383
IC01	IC Regulator	21-1007-31
L01	Degaussing Coil	34-708-01
	Degaussing Coil Pin Terminal (2)	34-709-01
	Degaussing Coil Pin Terminal Housing	34-697-04
	Groundstrap Ass'y.	34-228-03
	Groundstrap Wire Terminal	35-3560-01
	Groundstrap Spring (2)	35-3919-01
BR	Support Bracket RH	35-3919-02
BR	Support Bracket LH	31-631018-08
SC	SCREW 10- $\frac{1}{2}$ Pix Tube Mtg. (4)	33-255-01
WA	Pyramidal Lockwasher (4)	33-629-02
	Clip P.C.B. Support (2)	34-33-04
	Ground Lug	38-452-01
CH	Chassis Base	

## Main P.C.B. Ass'y (SU-1103A) Parts List

### Resistors

Symbol	Description	Part Number
R1406	V R 200 $\Omega$	QVZ3230-022
R1408	V R 200 $\Omega$	QVZ3230-022
R1410	CMF R 6.8 $\Omega$ 1W J	QRX019J-6R8
R1414	OM R 3.3K $\Omega$ 1W J	QRG019J-332
R1415	OM R 2.7K $\Omega$ 1W J	QRG019J-272
R1421	OM R 12K $\Omega$ 2W J	QRG029J-123
R1422	V R 10K $\Omega$	QVZ3224-014H
$\Delta$ FR1401	$\Delta$ F R 68 $\Omega$ 2W K	QRH024K-680M
$\Delta$ R1503	$\Delta$ CMF R 11.8K $\Omega$ $\frac{1}{2}$ W +1%	QRV142F-1182
R1504	V R 5K $\Omega$	QVZ3230-053
R1509	OM R 10K $\Omega$ 2W J	QRG029J-103
R1511	OM R 5.6K $\Omega$ 2W J	QRG029J-562
R1514	OM R 680 $\Omega$ 2W J	QRG029J-681
R1515	CMF R 8.2 $\Omega$ 1W J	QRX019J-8R2
R1522	CMF R 4.7 $\Omega$ 1W J	QRX019J-4R7
R1523	OM R 56 $\Omega$ 2W J	ORG029J-560
R1528	OM R 390 $\Omega$ 1W J	ORG019J-391
R1534	ZN R	ERZ-C05ZK471
VR1501	ZN R	ERZ-C05DK271
$\Delta$ R1703	$\Delta$ CMF R 39K $\Omega$ $\frac{1}{2}$ W +1%	QRV122F-3902
$\Delta$ R1704	$\Delta$ CMF R 7.68K $\Omega$ $\frac{1}{2}$ W +1%	QRV142F-7681
$\Delta$ R1901	$\Delta$ Posistor	A75414
R1902	UNF R 2 $\Omega$ 7W K	QRF076K-2R0
R1903	CMF R 5.6 $\Omega$ 3W J	QRX039J-5R6
R1904	OM R 10K $\Omega$ 2W J	QRG026J-103Z
$\Delta$ FR1901	$\Delta$ F R 220 $\Omega$ $\frac{1}{2}$ W K	QRH124K-221M

### Capacitors

Symbol	Description	Part Number
C1402	Tan. Cap. 2.2uF 16V K	QEE51CK-225B
C1411	E Cap. 100uF 160V A	QEW52CA-107
C1412	E Cap. 3.3uF 160V A	QEW52CA-335
C1508	PP Cap. 5600pF 50V J	QFP31HJ-562
C1511	E Cap. 47uF 160V A	QEW52CA-476S
$\Delta$ C1512	$\Delta$ PP Cap. 2000pF DC1500V J	QFZ0082-202
$\Delta$ C1513	$\Delta$ PP Cap. 2000pF DC1500V J	QFZ0082-202
$\Delta$ C1514	$\Delta$ PP Cap. 2500pF DC1500V J	QFZ0082-252
C1515	PP Cap. 0.53uF DC1200V K	QFZ0067-534
C1520	BPE Cap. 1uF 50V A	QEN61HA-105Z
C1524	M Cap. 0.1uF 200V K	QFM72DK-682M
C1904	E Cap.	QEY0034-001
C1905	E Cap. 10uF 250V A	QEW52EA-106
$\Delta$ C1907	$\Delta$ MM Cap. 0.1uF AC150V Z	QFZ9008-104

### Coils

Symbol	Description	Part Number
L1501	Peaking Coil	A75360-6
L1502	Liniarty Coil	A39934
L1503	Width Coil	C30380-A
L1504	Heater Choke	C30333-A
L1901	Line Filter	A39475-J

### Transformers

Symbol	Description	Part Number
T1501	Hor. Drive Transf.	A46022-BM
T1503	Side Pin Transf.	C39050-A

<b>Semiconductors</b>		
<b>Symbol</b>	<b>Description</b>	<b>Part Number</b>
IC1501	I.C.	HA11244
X1101	Si. Transistor	2SC1685(R)
X1102	Si. Transistor	2SA673(C)
X1103	Si. Transistor	2SC1685(R)
X1104	Si. Transistor	2SA673(C)
X1105	Si. Transistor	2SC1685(R)
X1106	Si. Transistor	2SA673(C)
X1301	Si. Transistor	2SC1685(R)
X1302	Si. Transistor	2SC1685(R)
X1303	Si. Transistor	2SA673(C)
X1304	Si. Transistor	2SC1685(R)
X1305	Si. Transistor	2SC1685(R)
X1401	Si. Transistor	2SD478
X1402	Si. Transistor	2SD478
X1501	Si. Transistor	2SC2610BK
X1701	Si. Transistor	2SC1685(P-S)
D1101	Si. Diode	W06A
D1102	Si. Diode	W06A
D1103	Si. Diode	W06A
D1301	Si. Diode	1S2473H
D1401	Si. Diode	1S2473H
D1402	Zener Diode	RD10F(C)
D1503	Si. Diode	HF-1
D1504	Si. Diode	V09E
D1505	Zener Diode	RD11E(B)
D1506	Si. Diode	W06A
D1507	Si. Diode	1SS81
D1508	Si. Diode	1S2473H
△D1701	△Zener Diode	RD20EV2
△D1901	△Si. Diode	1S1887A
△D1902	△Si. Diode	1S1887A
△D1903	△Si. Diode	1S1887A
△D1904	△Si. Diode	1S1887A
<b>Miscellaneous</b>		
<b>Symbol</b>	<b>Description</b>	<b>Part Number</b>
△F1901	△Fuse 1A	QMF53U1-1R0S
△F1902	△UL Fuse 3A	QMF66U1-3R0S

## CRT Socket P.C.B. Ass'y (SU-3016A) Parts List

### Resistors

Symbol	Description	Part Number
R3105	V R 200 $\Omega$	QVZ3234-022
R3106	V R 200 $\Omega$	QVZ3234-022
R3113	V R 5K $\Omega$	QVZ3234-053
R3114	V R 5K $\Omega$	QVZ3234-053
R3115	V R 5K $\Omega$	QVZ3234-053
R3116	OM R 10K $\Omega$ 2W J	QRG029J-103
R3117	OM R 10K $\Omega$ 2W J	QRG029J-103
R3118	OM R 10K $\Omega$ 2W J	QRG029J-103
R3119	Comp. R 3.3K $\Omega$ ½W K	QRZ0039-332
R3120	Comp. R 3.3K $\Omega$ ½W K	QRZ0039-332
R3121	Comp. R 3.3K $\Omega$ ½W K	QRZ0039-332

### Capacitors

Symbol	Description	Part Number
C3107	E Cap. 10 $\mu$ F 250V A	QEW52EA-106
C3108	C Cap. 1000pF DC1400V P	QCZ9001-102M

### Coils

Symbol	Description	Part Number
L3101	Peaking coil	QQL043K-101

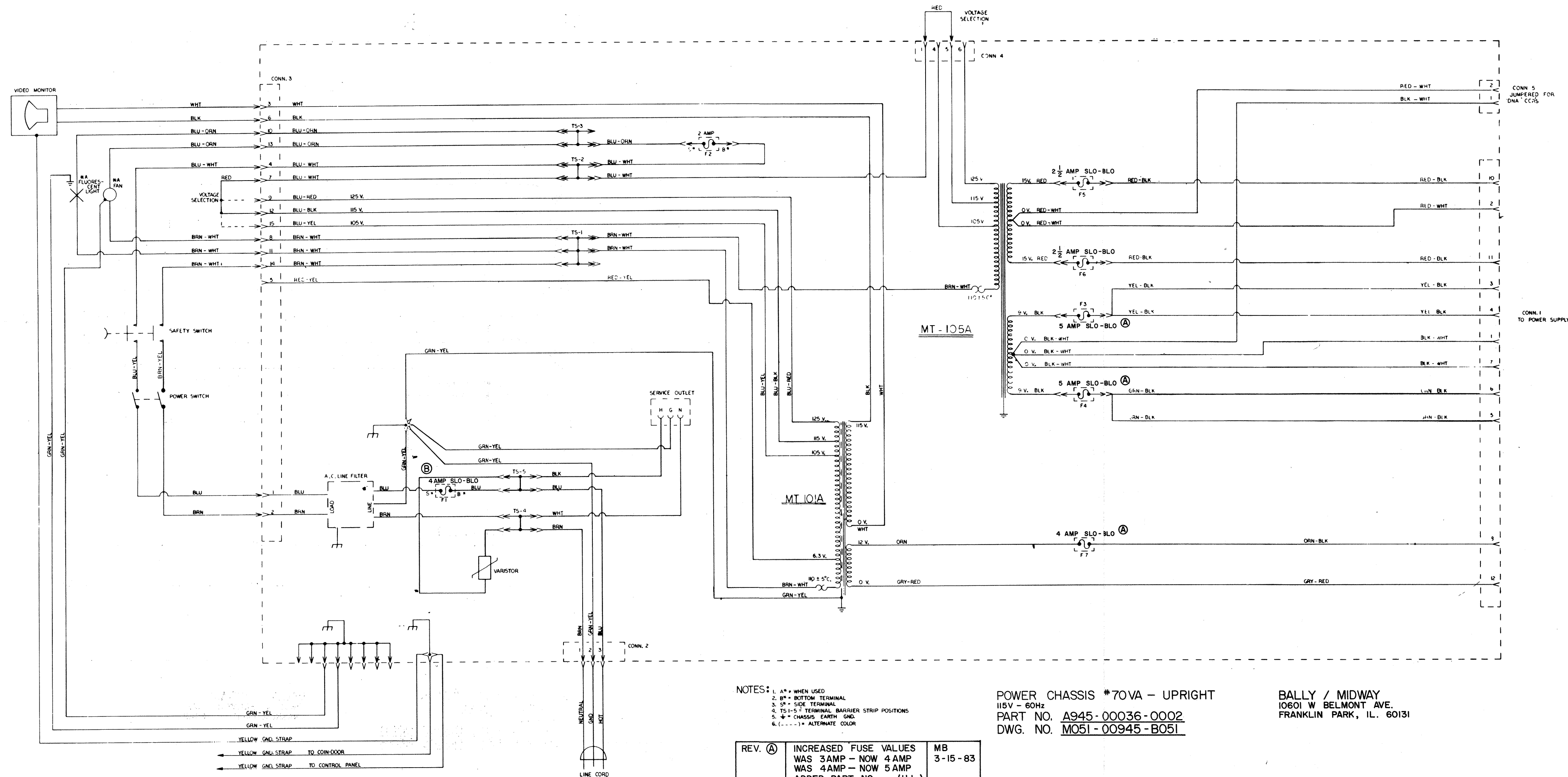
### Semiconductors

Symbol	Description	Part Number
X3101	Si. Transistor	2SC2611
X3102	Si. Transistor	2SC2611
X3103	Si. Transistor	2SC2611

### Miscellaneous

Symbol	Description	Part Number
△	△ CRT Socket	A75522

## **IX Schematics and Wiring Diagrams**



NOTES:

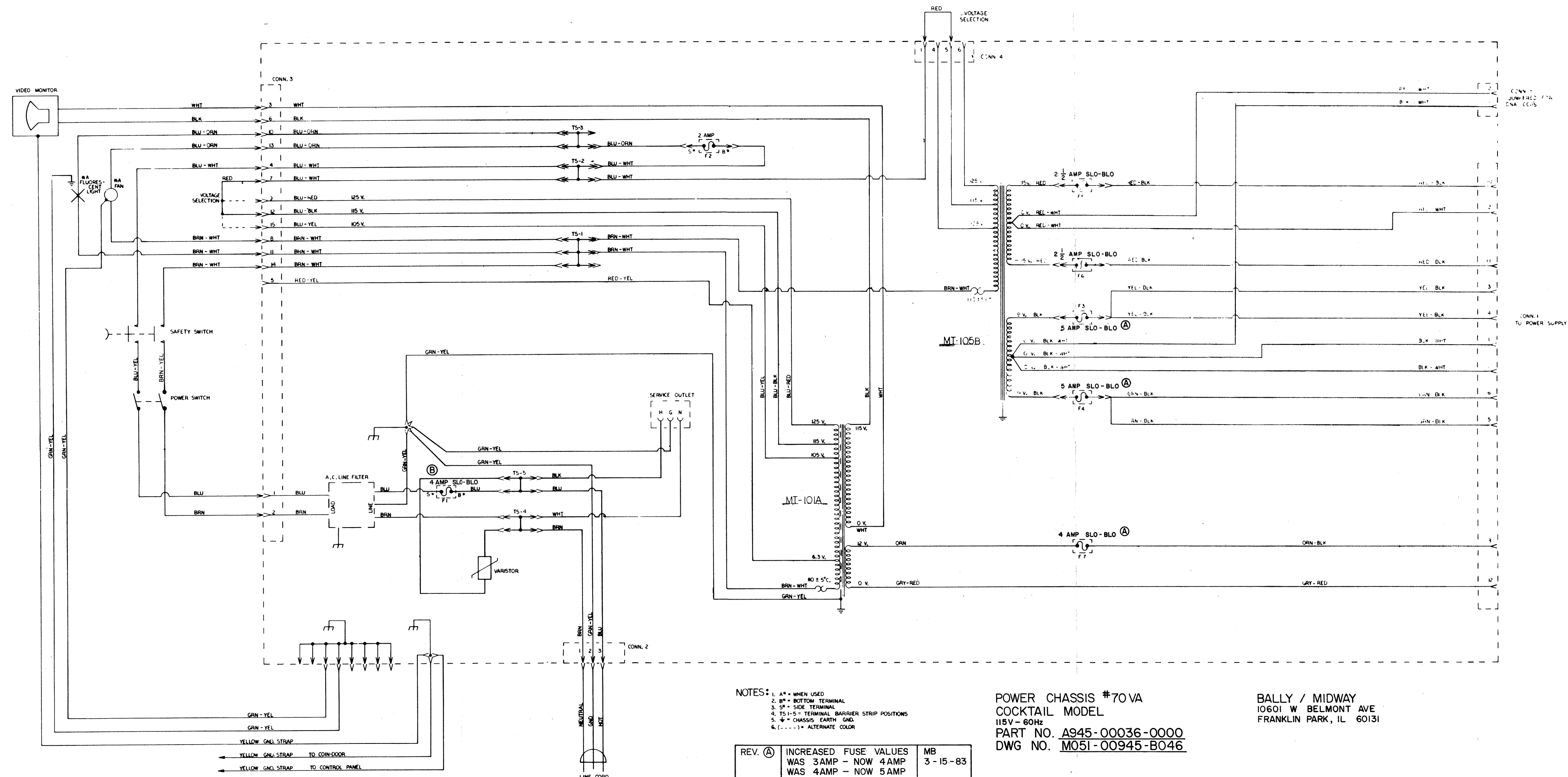
1. A\* - WHEN USED
2. B\* - BOTTOM TERMINAL
3. S\* - SIDE TERMINAL
4. TS-1-5 - TERMINAL BARRIER STRIP POSITIONS
5. + - CHASSIS EARTH GND.
6. (---) - ALTERNATE COLOR

POWER CHASSIS #70VA - UPRIGHT  
 115V - 60Hz  
 PART NO. A945-00036-0002  
 DWG. NO. M051-00945-B051

BALLY / MIDWAY  
 10601 W BELMONT AVE.  
 FRANKLIN PARK, IL. 60131

REV. (A)	INCREASED FUSE VALUES WAS 3 AMP - NOW 4 AMP WAS 4 AMP - NOW 5 AMP ADDED PART NO. (U.L.)	MB 3-15-83
REV. (B)	INCREASED FUSE VALUE WAS 3 AMP - NOW 4 AMP	MB 3-24-83



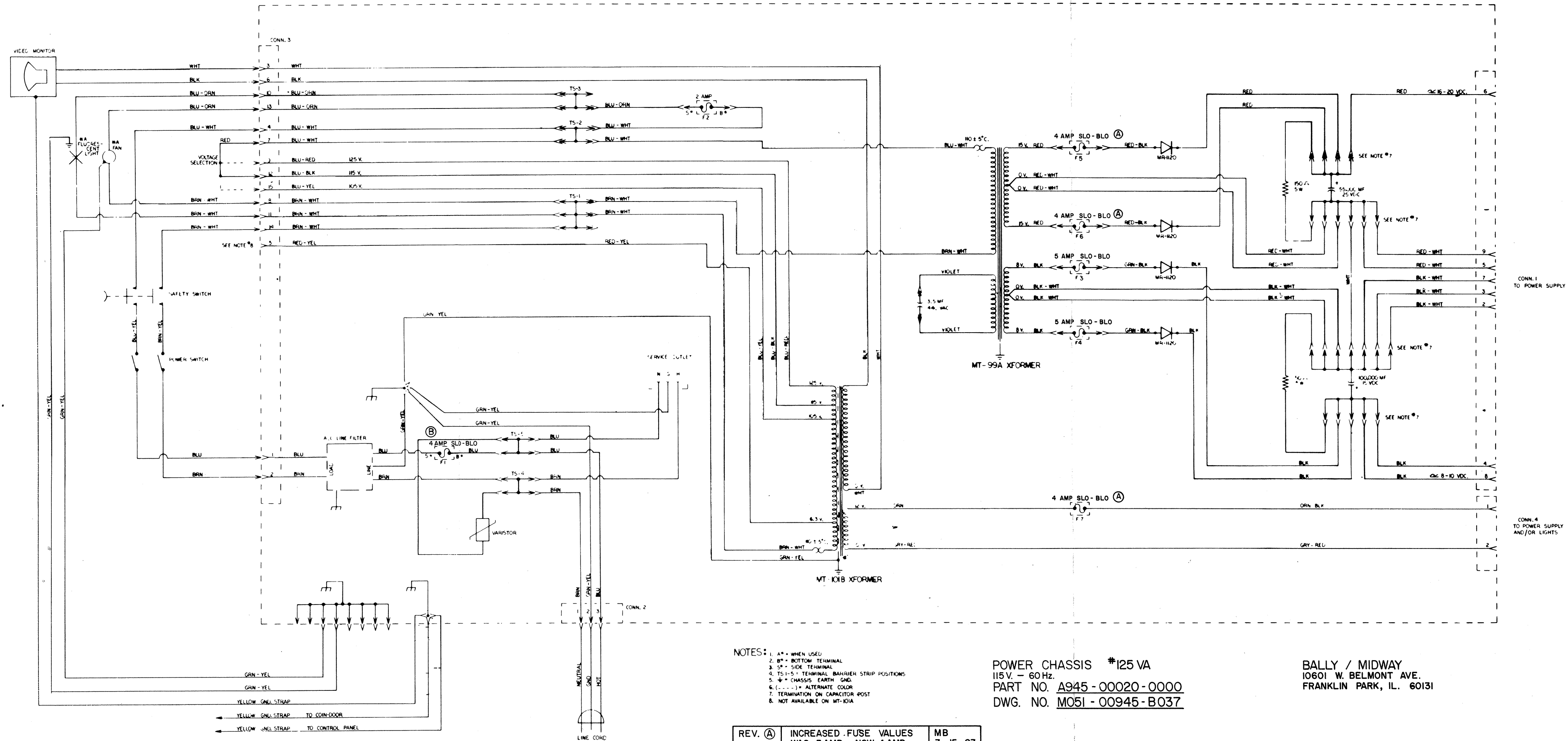


- NOTES:
1. A\* = WHEN USED
  2. B\* = BOTTOM TERMINAL
  3. S\* = SIDE TERMINAL
  4. TS 1-5 = TERMINAL BARRIER STRIP POSITIONS
  5. \* = CHASSIS EARTH GND
  6. (...) = ALTERNATE COLOR

REV. (A)	INCREASED FUSE VALUES WAS 3 AMP - NOW 4 AMP WAS 4 AMP - NOW 5 AMP ADDED PART NO. (U.L.)	MB 3-15-83
REV. (B)	INCREASED FUSE VALUE WAS 3 AMP - NOW 4 AMP	MB 3-24-83

POWER CHASSIS #70 VA  
 COCKTAIL MODEL  
 115V - 60Hz  
 PART NO. A945-00036-0000  
 DWG NO. M051-00945-B046

BALLY / MIDWAY  
 10601 W BELMONT AVE  
 FRANKLIN PARK, IL 60131



- NOTES:
1. A\* - WHEN USED
  2. B\* - BOTTOM TERMINAL
  3. S\* - SIDE TERMINAL
  4. TS1-S\* - TERMINAL BARRIER STRIP POSITIONS
  5. + - CHASSIS EARTH GND
  6. (---) - ALTERNATE COLOR
  7. TERMINATION ON CAPACITOR POST
  8. NOT AVAILABLE ON MT-101A

POWER CHASSIS #125 VA  
 115V. - 60HZ.  
 PART NO. A945-00020-0000  
 DWG. NO. M051-00945-B037

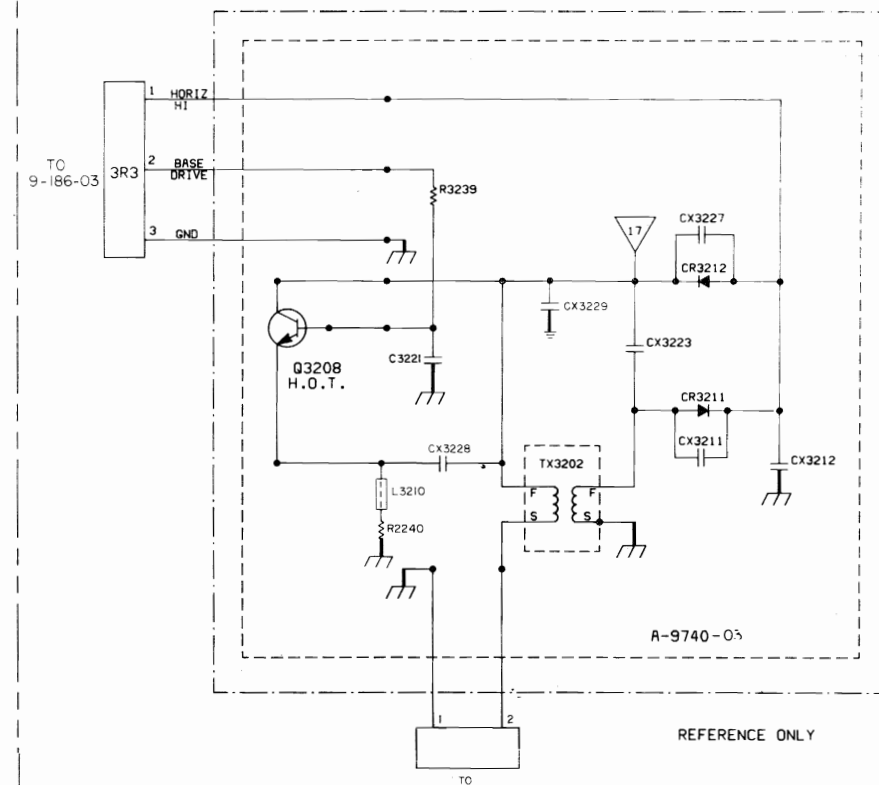
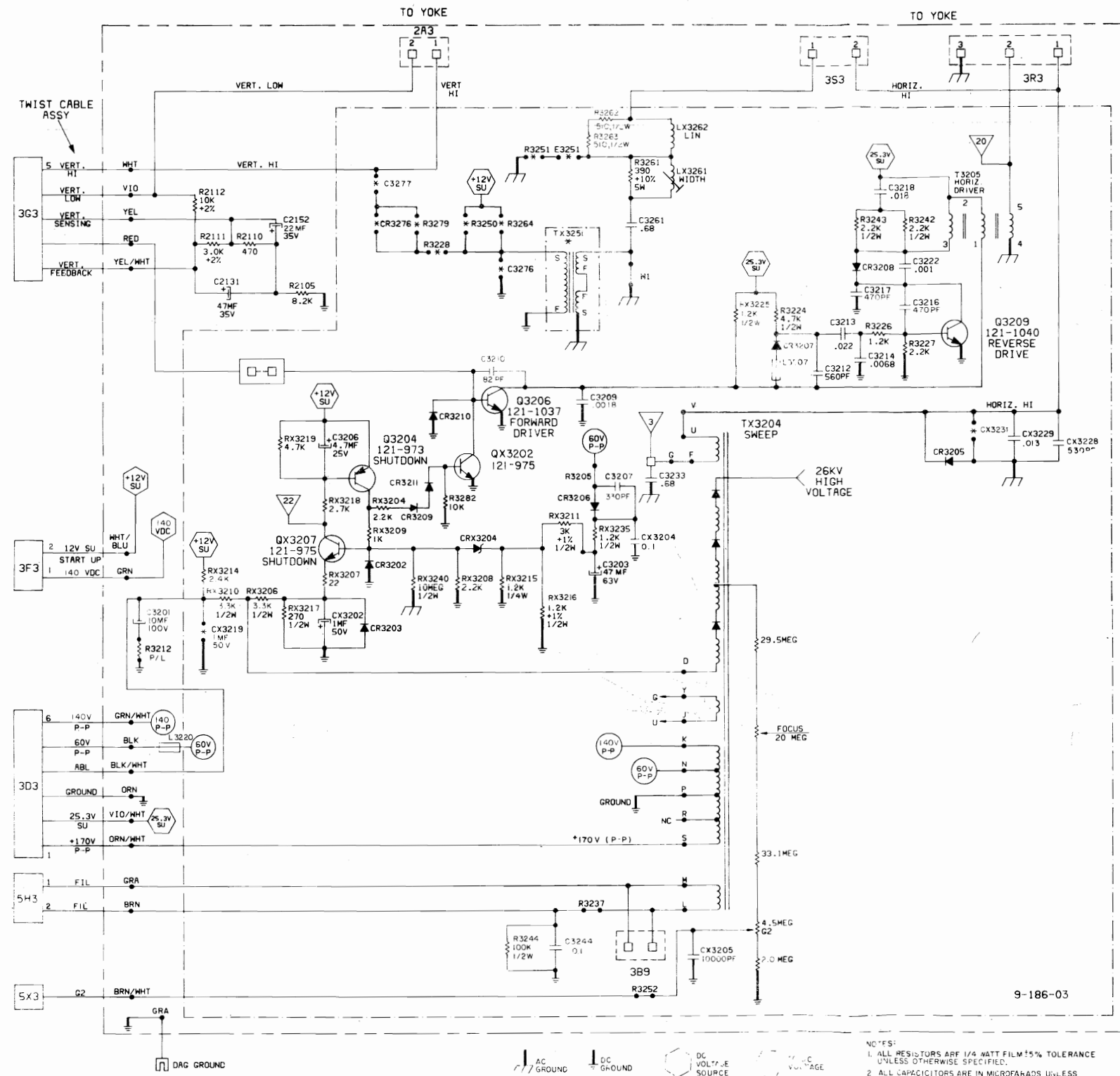
BALLY / MIDWAY  
 10601 W. BELMONT AVE.  
 FRANKLIN PARK, IL. 60131

REV. A	INCREASED FUSE VALUES WAS 3 AMP - NOW 4 AMP ADDED PART NO. (U.L.)	MB 3-15-83
REV. B	INCREASED FUSE VALUE WAS 3AMP - NOW 4AMP	MB 3-24-83

CONN. 1 TO POWER SUPPLY

CONN. 4 TO POWER SUPPLY AND/OR LIGHTS

YELLOW GND STRAP TO COIN-DOOR  
 YELLOW GND STRAP TO CONTROL PANEL

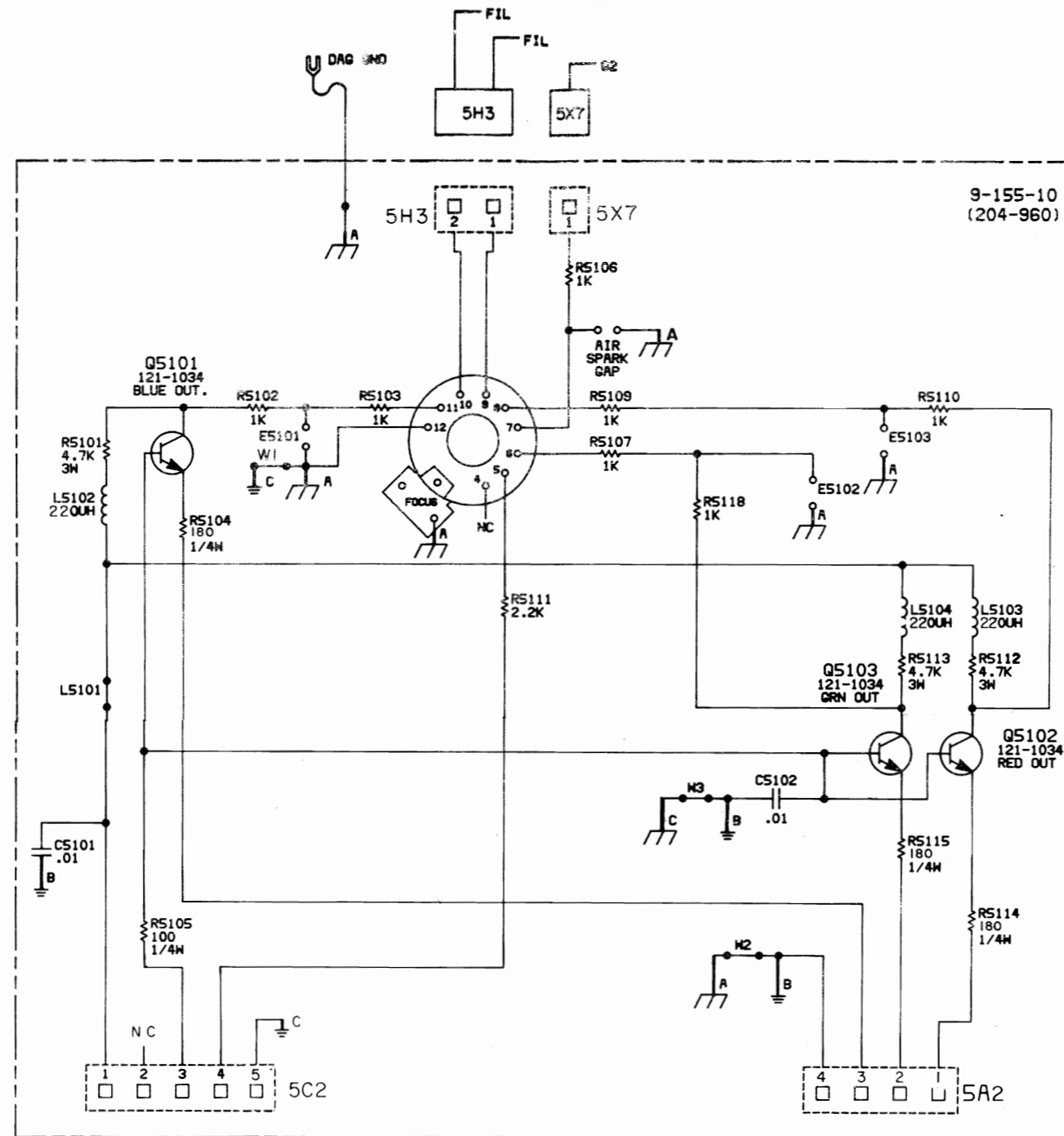


**SCHEMATIC FOR**  
**9-186-03**  
**SWEEP BOARD**  
**RGB COLOR MONITOR**

ZENITH RADIO CORP. CHICAGO, ILL.	ISSUE <b>B</b>	<b>9-186</b>
--	-------------------	--------------

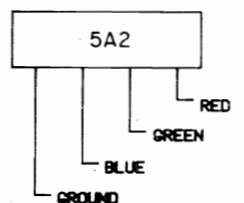
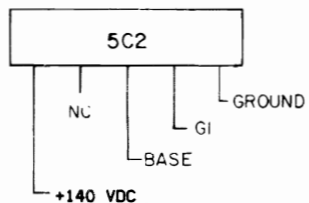
**M051-00087-A021**

NOTES: (USED WITH CIRCUIT REFERENCE DESIGNATORS)  
 A. P/L - SEE PARTS LIST FOR APPLICABLE USAGE.  
 R. -●-●- JUMPER WIRE USED INSTEAD.  
 C. -●-●- PROVISION ON PRINTED CIRCUIT BOARD.



9-155-10  
(204-960)

.156 CENTERS



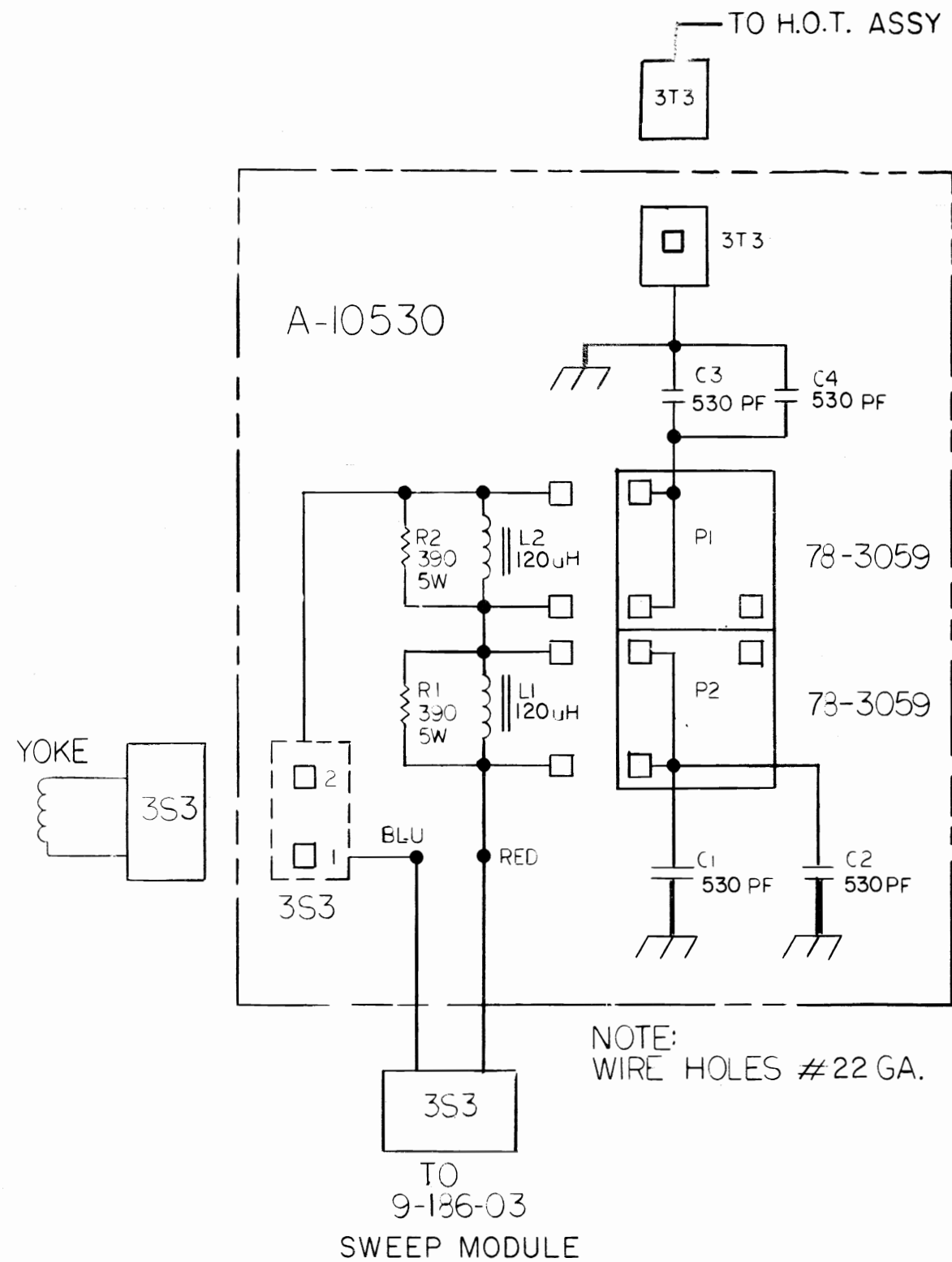
NOTE:  
1. ALL RESISTORS ARE 1/2WATT UNLESS OTHERWISE SPECIFIED.

NOTES: (USED WITH CIRCUIT REFERENCE DESIGNATORS)  
A. P/L = SEE PARTS LIST FOR APPLICABLE USAGE.  
B. —●—●— = JUMPER WIRE USED INSTEAD.  
C. —●—●— = PROVISION ON PRINTED CIRCUIT BOARD.



M051-00087-A022

SCHEMATIC FOR 9-155-10 RGB COLOR MONITOR CRT SOCKET BOARD		
ZENITH RADIO CORP. CHICAGO, ILL.	ISSUE	9-155



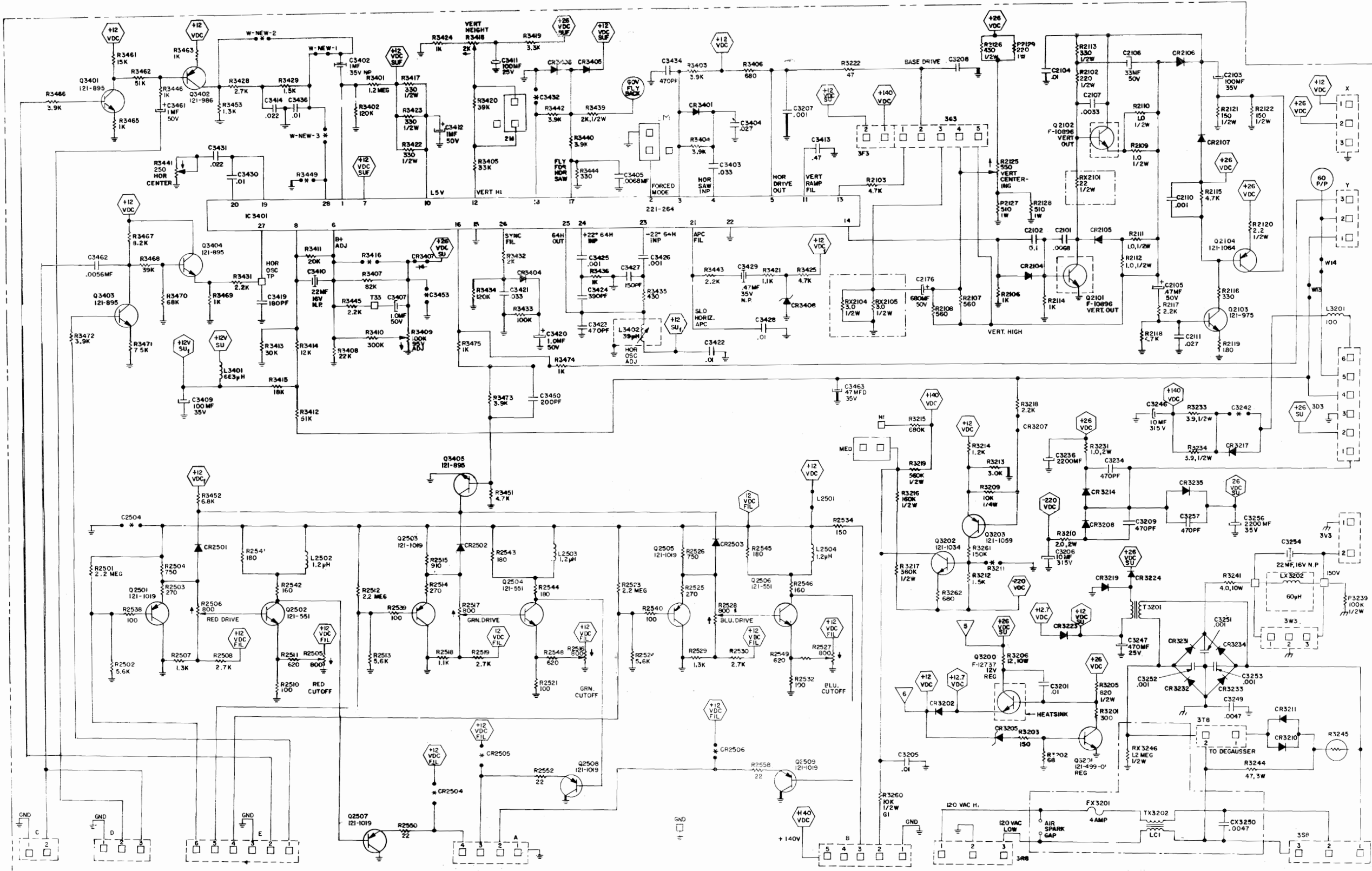
M051-00087-A023

SCHEMATIC  
FOR A-10530  
WIDTH STEP ASSY.

ZENITH  
RADIO CORP.  
CHICAGO, ILL.

ISSUE  
B

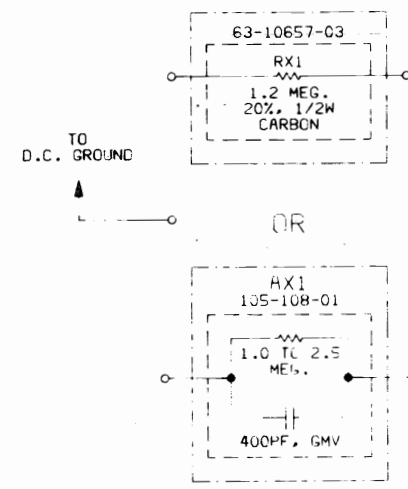
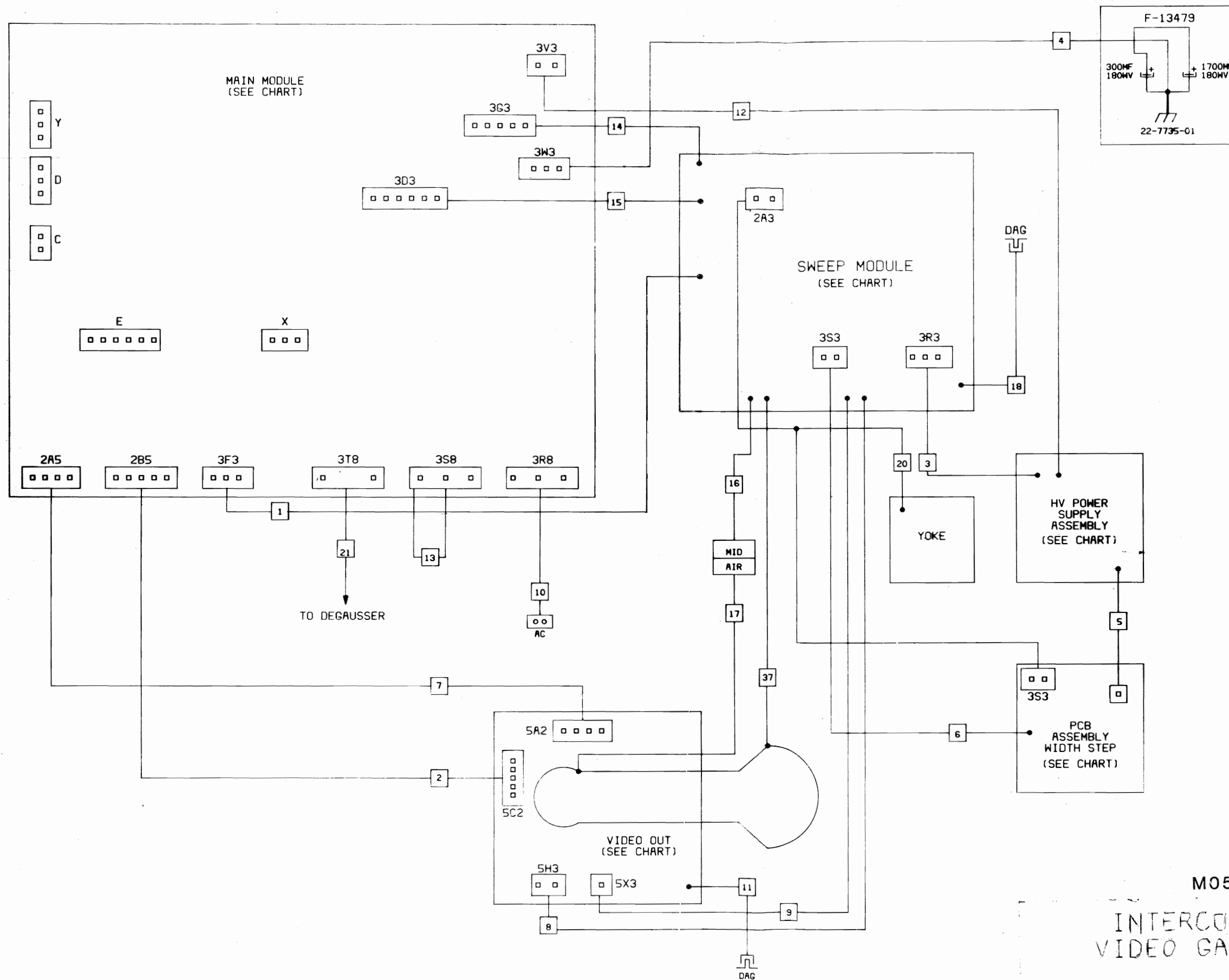
A-10530



SCHEMATIC FOR  
9-227-01  
RGB COLOR MONITOR  
(MAIN BOARD)

**ZENITH  
RADIO CORP. C**      9-227  
CHICAGO, ILL.

M051-00087-A024



**IMPORTANT SAFETY NOTICE**

WHEN SERVICING THIS CHASSIS, UNDER NO CIRCUMSTANCES SHOULD THE ORIGINAL DESIGN BE MODIFIED OR ALTERED WITHOUT PERMISSION FROM THE ZENITH RADIO CORPORATION. ALL COMPONENTS SHOULD BE REPLACED ONLY WITH TYPES IDENTICAL TO THOSE IN THE ORIGINAL CIRCUIT, AND THEIR PHYSICAL LOCATION, WIRING AND LEAD DRESS MUST CONFORM TO ORIGINAL LAYOUT UPON COMPLETION OF REPAIRS.

SPECIAL CIRCUITS ARE ALSO USED TO PREVENT SHOCK AND FIRE HAZARD. THESE AREAS ARE SHADED ON THE SCHEMATIC FOR EASY IDENTIFICATION. THE LETTER "X" INCLUDED IN THE ITEM NUMBER DESIGNATES SPECIAL FAILSAFE COMPONENTS IN THESE AREAS WHICH ARE REQUIRED TO MAINTAIN SAFE PERFORMANCE. NO LEVIATIONS ARE ALLOWED WITHOUT PRIOR APPROVAL BY THE PRODUCT SAFETY ENGINEERING DEPARTMENT.

THIS CIRCUIT DIAGRAM MAY OCCASIONALLY DIFFER FROM THE ACTUAL CIRCUIT USED. THIS WAY, IMPLEMENTATION OF THE LATEST SAFETY AND PERFORMANCE IMPROVEMENT CHANGES INTO THE SET IS NOT DELAYED UNTIL THE NEW SERVICE LITERATURE IS PRINTED.

M051-00087-A025

INTERCONNECT FOR VIDEO GAME MONITOR

ZENITH RADIO CORP. CHICAGO, ILL.

ISSUE

22-7735-01