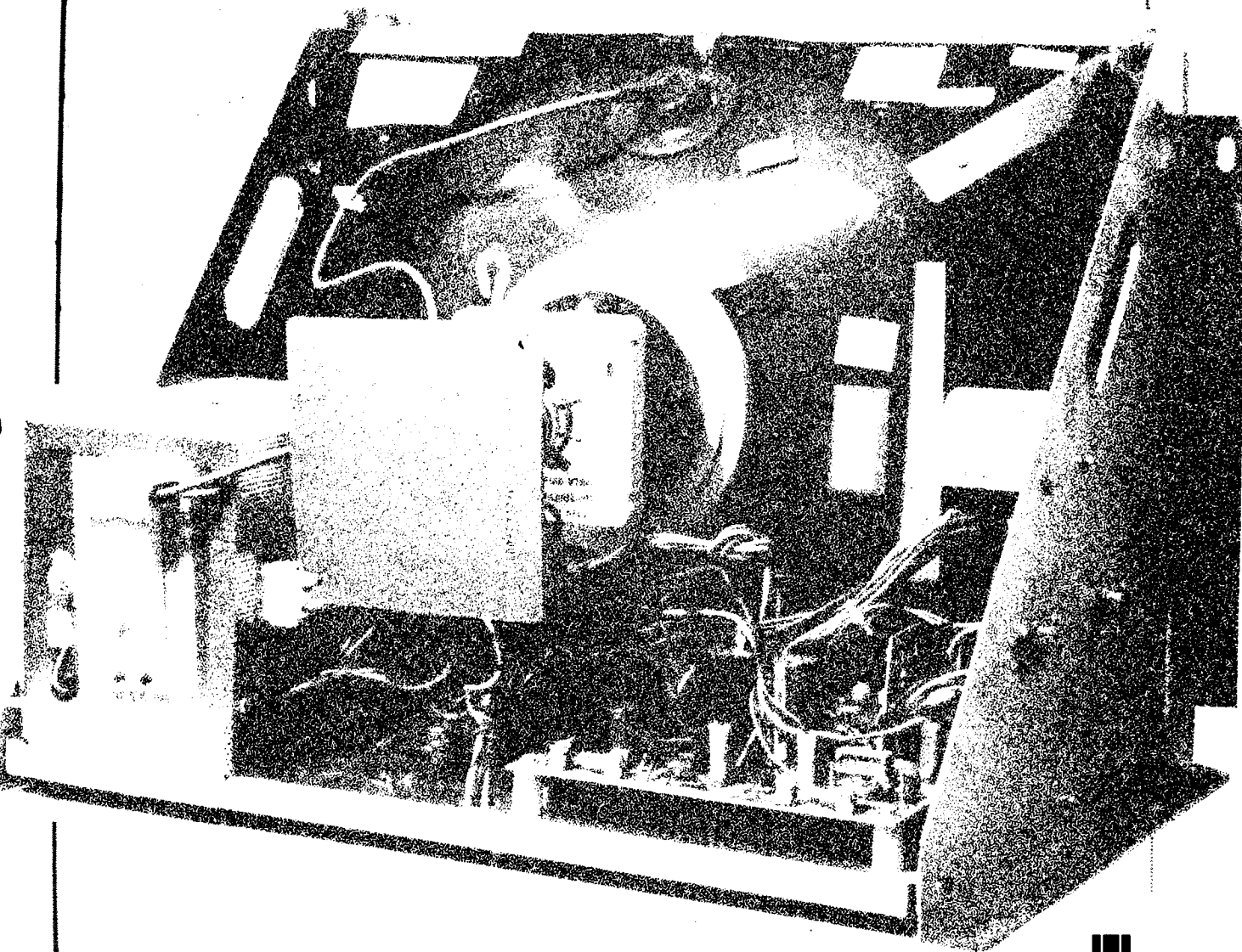


# Wells-Gardner Quadrascan<sup>TM</sup> Color X-Y Display (Atari Part No. 92-053)



## Service Manual

Complete with Schematic and Illustrated Parts Lists



# **Wells-Gardner Quadrascan<sup>TM</sup> Color X-Y Display**

**(Atari Part No. 92-053)**

## **Service Manual**

Complete with Schematic and Illustrated Parts Lists

Display manufactured by Wells-Gardner Electronics Corp.

Chicago, IL 60639 U.S.A.

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# 1 Warnings and Cautions

This Quadrascan™ color X-Y display was designed to Atari specifications and built by Wells-Gardner Electronics Corp. The AC power, color, and X, Y, Z signals are fed to the display through a 15-pin harness connector located next to the right side panel.

*This display differs very little from that used in Atari's black-and-white X-Y video games, such as Asteroids™, Battlezone™ or Red Baron. The only major difference is that it now has three Z amplifiers to control the three color guns. The cathode-ray tube is an off-the-shelf 100° in-line picture tube that is also used in raster-scan displays.*

## A. Before You Start

You should **never attempt** to work on a display chassis if you are not familiar with servicing procedures and precautions necessary for high-voltage equipment. Any television or video display has three sources of possible danger:

- Strong electric shock due to high voltage or unisolated AC line voltages
- X-ray radiation, and
- implosion.

Therefore, please read this chapter carefully.

You should **never attempt** to modify any circuit in this display. You should do service work only after you are thoroughly familiar with all of the warnings and safety measures printed in this chapter.

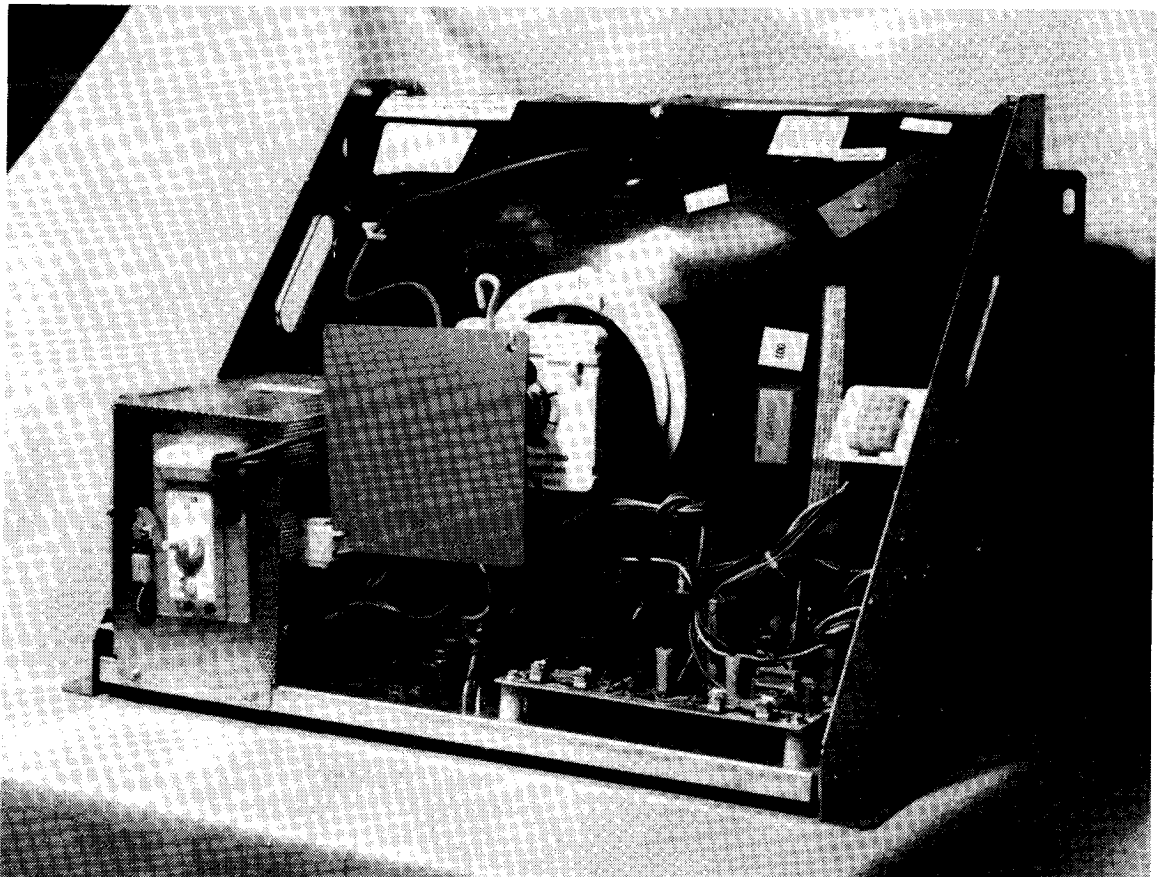


Figure 1 Overview of Display

## WARNINGS

### **High Voltage**

This display contains high voltages capable of delivering lethal quantities of energy. To avoid danger, do not attempt to service the chassis until you have observed all precautions necessary for working on high-voltage equipment.

### **X-Radiation**

This chassis has been designed for minimum X-radiation hazard. However, to avoid possible exposure to soft X-radiation, it is imperative that you **never** modify the high-voltage circuitry.

### **Implosion Hazard**

If you drop the display and the picture tube breaks, **it will implode!** Shattered glass and the yoke can fly 6 feet or more from the implosion. Use care when replacing any display.

## **B. Safety Measures**

Develop good safety habits, so when you're rushed with repair work, you'll still automatically take precautions.

A good practice when working on any display is to first ground the chassis and **use only one hand** when testing circuitry. This will avoid the possibility of carelessly putting one hand on the chassis or ground, and the other on an electrical connection. **Doing so could cause a severe electrical shock.**

If you service this color X-Y display on a test bench, **use only** the power supply that came with the Tempest™ game. (It is called the *Power Supply Assembly for Color X-Y Games*, Atari part no. A037396-xx). You **CANNOT** use standard line voltage or a power supply from a black-and-white X-Y game such as Asteroids™, since the voltages produced by those sources will damage the Wells-Gardner color X-Y display.

To prevent fire or shock hazard, **never expose this display to rain or moisture.** Also check periodically for frayed insulation on wires.

If you need to service the display, observe the original lead dress (routing and length of harness wires). Use extra precaution in the high-voltage circuitry area of the display. Whenever a short circuit occurs, replace those components that indicate they have overheated.

## **C. Picture-Tube Handling**

Use extreme care when handling the picture tube, since rough handling may cause it to implode, due to a vacuum inside. Do not nick or scratch the glass, or subject it to any undue pressure when removing or installing it.

Wear safety goggles and heavy gloves for protection when handling the picture tube. Keep others without safety goggles away. Never lift the tube by its neck.

Discharge the high voltage in the picture tube by shorting the anode connection to chassis ground—**not the cabinet or other mounting parts.** When discharging, go from ground to anode, and use a well-insulated piece of wire.

## **D. Replacing with Proper Components**

It is important for you to maintain the specified values of all components in the high-voltage circuits, and anywhere else in the display that could cause a rise in high voltage, or in operating supply voltages.

The picture tube in this display employs integral implosion protection. For continued safety, replace it with a tube of the same type number. Refer to the parts lists in the back of this manual (Chapter 7), and use **only exact replacement parts**, especially for those parts identified with the  symbol.

## E. Final Testing Before Reinstalling Display

Before installing the color display back in the game, you must check the following:

1. Inspect all harness wiring on the display, and be sure none of it is pinched between the chassis and other metal parts in the display.
2. Replace all protective devices such as insulating fishpaper, compartment covers, and shields.

# 2 Specifications

## A. Inputs

### 1. Input Voltage

25-0-25 VAC RMS center-tapped at nominal line for amplifier.

### 2. Input Voltage Range

+10% to -15%

### 3. Input Power at 50 VAC

150 watts AC (amplifiers at maximum deflection).

### 4. Signal Inputs (at Maximum Deflection)

"X" horizontal: 16 volts P/P ( $\pm 8$  volts).

"Y" vertical: 12 volts P/P ( $\pm 6$  volts).

"Z" beam drive: 4.0 volts maximum brightness, 1.0 volt black level.

### 5. Input Impedance

"X" = 2.5K ohms, "Y" = 2.8K ohms,

"Z" = 1K ohms

## B. Writing Rate

"X" amplifier = .05 inch per microsecond, "Y" amplifier = .0375 inch per microsecond.

## C. Z Bandwidth

5 MHz at -3 dB point.

## D. High Voltage

19.5 KV at  $I_b = 0$ ; adjustable to  $\pm 2\frac{1}{2}\%$ . High-voltage regulation restricted to 2% maximum ( $I_b 0$  to 100 microamps.).

## E. Controls

Factory-adjusted controls: high-voltage adjustment and Z tracking. Operator-adjustable controls: focus and brightness.

## F. Operating Temperature and Humidity

Ambient (in the game cabinet) humidity: 0 to 90% non-condensing.

Ambient temperature: 0 to 55° C. (32 to 131° F.).

# 3 Adjustable Controls

**Remember to observe the precautions regarding high voltages when you make adjustments on this display!**

To make the following adjustments, keep the game in the attract or play mode. Note that before you adjust the brightness, the display should be turned on for at least 5 minutes.

Refer to Figure 2 for brightness (labeled *SCREEN*) and focus control locations.

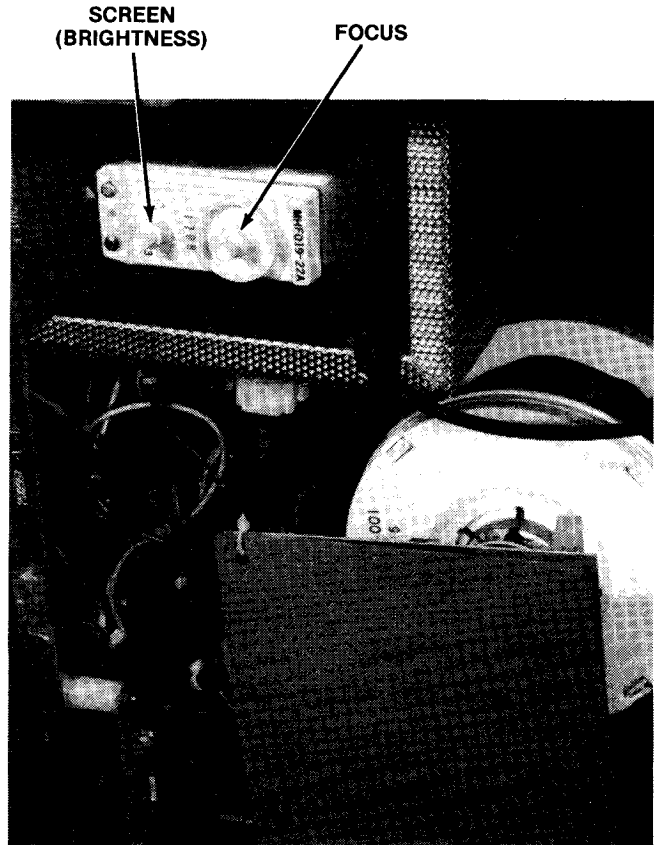
## A. Brightness

Exercise caution when adjusting the brightness control. Adjusting the brightness too high will not only cause retrace lines to become visible, but may also cause phosphor burn. Too low a brightness causes some of the objects displayed to become dark and obscured.

If you are using this display in the Tempest™ game and wish to adjust the brightness level, select self-test screen #5. Turn the control until only five of the lines are visible (the longest is the dimmest). Too much brightness causes the sixth line to become visible. Too little brightness causes the fifth line to disappear.

## B. Focus

This control changes the sharpness of the screen image. Select the Tempest self-test screen #1. Turn the focus control until you get the optimum screen sharpness possible, then turn it counterclockwise (as viewed from the back of the display). Your goal is best character appearance without appreciable fuzziness.



**Figure 2 Adjustable Controls on High-Voltage "Cage"**

---

# 4 Replacement of Major Assemblies

*Tools Required to Replace all Assemblies Covered in This Chapter: 7/16-inch and 1/4-inch hex socket wrenches, and a Phillips-head torque wrench.*

## A. Picture-Tube Replacement

Be sure to first unplug the 15-pin power and color-signal connector. Remove display assembly from game as described in Chapter 2 of the game manual.



1. Discharge the high voltage from the tube. Remove the large high-voltage connector (anode wire) near the top of the picture tube. Unplug the neck board at rear of picture tube.
2. Unplug the 5-pin connector on the Deflection PCB.
3. Using a  $\frac{1}{16}$ -inch hex socket wrench, remove the four screws that hold the picture tube in the steel frame. Carefully remove the tube by pulling it out toward the front.
4. **Important:** Note that after replacing a picture tube you will have to re-converge the picture, re-adjust the purity, and readjust the grey-level tracking. These adjustment procedures are covered in Chapter 5 of this manual.

## B. Yoke Replacement

First unplug the 15-pin power and color-signal connector. Remove the display assembly from the game.

1. Discharge the high voltage from the tube. Unplug the Neck PCB at rear of picture tube.
2. With a  $\frac{1}{4}$ -inch hex socket wrench and your fingers, loosen the screws that tighten the two neck clamps around the picture-tube neck.
3. Now slide the magnet assembly, then the yoke assembly off the end of the picture tube.
4. **Important:** Note that after replacing a yoke, you will have to re-converge the picture, and readjust the purity. These adjustment procedures are covered in Chapter 5 of this manual.

## C. High-Voltage PCB Replacement

First unplug the power and color-signal connector. Remove the display assembly from the game.

1. Discharge the high voltage from the tube. Remove the large connector at top of picture tube. Then disengage the anode wire from its white holder on the purity shield.
2. Unplug the neck board at rear of picture tube.
3. Unplug the white, 3-pin harness connector on the side of the high-voltage cage. Also unplug the red, 8-pin harness connector just below the 3-pin connector.

4. Using a  $\frac{1}{4}$ -inch hex socket wrench, remove the 5 screws holding down the high-voltage protection cage. Do not remove the screws that hold together the side and bottom panels of the display chassis.
5. To remove the PCB from the cage, turn the cage upside down. Remove the two sheet-metal screws inside that secure the PCB. Slide the PCB at an angle out of its slots in the cage.
6. When replacing the high-voltage transformer, be sure to check the picture for correct sharpness and brightness. If it's not correct, adjust the *FOCUS* or *SCREEN* knobs on the rear of the display. Note that after replacing the high-voltage PCB, you will have to readjust the high voltage control. This adjustment procedure is covered in Chapter 6 of this manual.

## D. Power Transistor Replacement

When replacing any of the power transistors, observe the following precautions:

1. Hold the insulated transistor socket in its proper location. It is not "captive" or mounted onto the metal chassis; instead, the transistor's mounting screws secure the socket.
2. Apply silicone grease evenly to both sides of the mica insulator when replacing an output transistor.
3. Make sure the transistor mounting screws are tight before applying power to the display. This insures proper cooling and electrical connections. Use a Phillips torque wrench and torque the mounting screws 7 to 10 inch-lbs.—**no more**. Excessive pressure will strip the threads, causing a poor electrical and mechanical connection.

## E. Deflection PCB

This board is secured by mounting screws and a retaining bracket. Three plastic spacers ("stand-offs") and four plastic mounting posts underneath the board keep it away from and shorting out with the metal chassis.

Use a  $\frac{1}{4}$ -inch hex socket wrench to remove the two rear screws. Then slide the board out towards the rear of the chassis. The harness has sufficient slack so you can service the board when it is removed from its mounting position. All plugs are keyed, so improper connection would be difficult—if not impossible.

# 5 Purity, Convergence and Tracking Adjustments

**Remember to observe the precautions regarding high voltages when you make any adjustments on this display.**

All the adjustments to be made in this chapter can be done while the display is mounted within the game. Allow at least 15 minutes for the display to warm up completely before attempting the adjustments.

## A. Purity Adjustments

Enter the self-test mode and advance the screens until the horizontal and vertical crosshatch pattern appears. Then rotate the encoder wheel on the control panel of the game until only the green pattern appears. (Refer to the Tempest™ manual, TM-190, Figure 6, Part 2 for more information.)

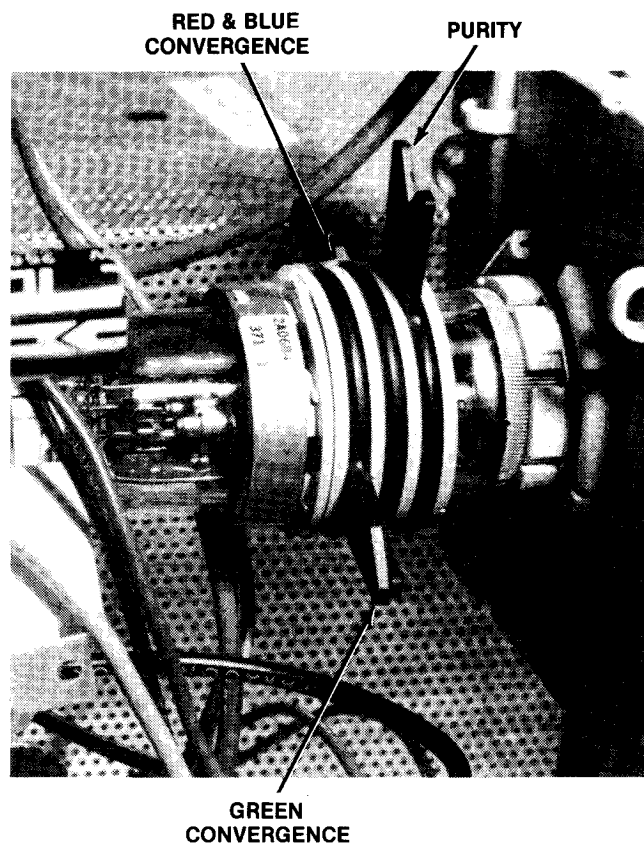
Check the red, green and blue testpoints on the Main (Analog Vector-Generator) PCB with an oscilloscope or voltmeter to make sure that only the green signal is being sent to the display.

Loosen the yoke-retaining clamp so that the yoke can move. Slide the yoke toward the back. Remove any glue that may be holding the purity ring magnets in place, and rotate one or both purity rings in a line so that they face opposite directions from each other.

Slowly slide the yoke toward the front of the CRT until the pattern displayed is an overall pure green. Tighten the yoke retaining clamp lightly, making any slight physical adjustments to the yoke to maintain a pure green pattern. Rotate the yoke to level the pattern on the face of the CRT.

Turn the encoder wheel to the red and blue patterns, and slightly readjust the yoke for a uniform and pure pattern for each color. Tighten the yoke-retaining clamp to prevent yoke shift or rotation.

To make fine adjustments to the purity, turn the purity magnets for the best overall purity of each color. Reglue the purity magnets with a small amount of glue.



**Figure 3 Adjustable Magnets on Display Neck**

## B. Static Convergence Adjustments (Center Area)

Put the game into the self-test mode and advance the screen through the patterns until the horizontal and vertical checkerboard pattern is displayed.

If you are using this display in a Tempest™ game, turn the encoder wheel on the control panel of the game until only the red and blue lines are displayed. Adjust the tabs on the center pair of adjusting magnets so that the red and blue lines are superimposed on each other. (Do this at the center of the screen.)

Turn the encoder wheel on the control panel until red, green and blue lines are displayed. Adjust the tabs on the pair of magnetic rings closest to the Neck PCB, so that the green line is superimposed on the red and blue lines. (Do this at the center of the screen.)

## C. Tracking Adjustments (on Neck PCB)

### 1. Preliminary

Go into self-test mode and display screen #5 (seven groups of colored bars of various intensities.)

Next, turn all potentiometers on the Neck PCB to the full clockwise position. Turn the brightness control to a level that clearly displays the fifth line from the right of the center group of lines. If the sixth line from the right is visible, reduce the brightness. If the fifth line from the right is not clearly visible, increase the brightness.

### 2. Bias Adjustments

Adjust the red, green, and blue bias potentiometers until the fifth line from the right is pure white. These pots are labeled R BIAS, G BIAS and B BIAS; see Figure 4.

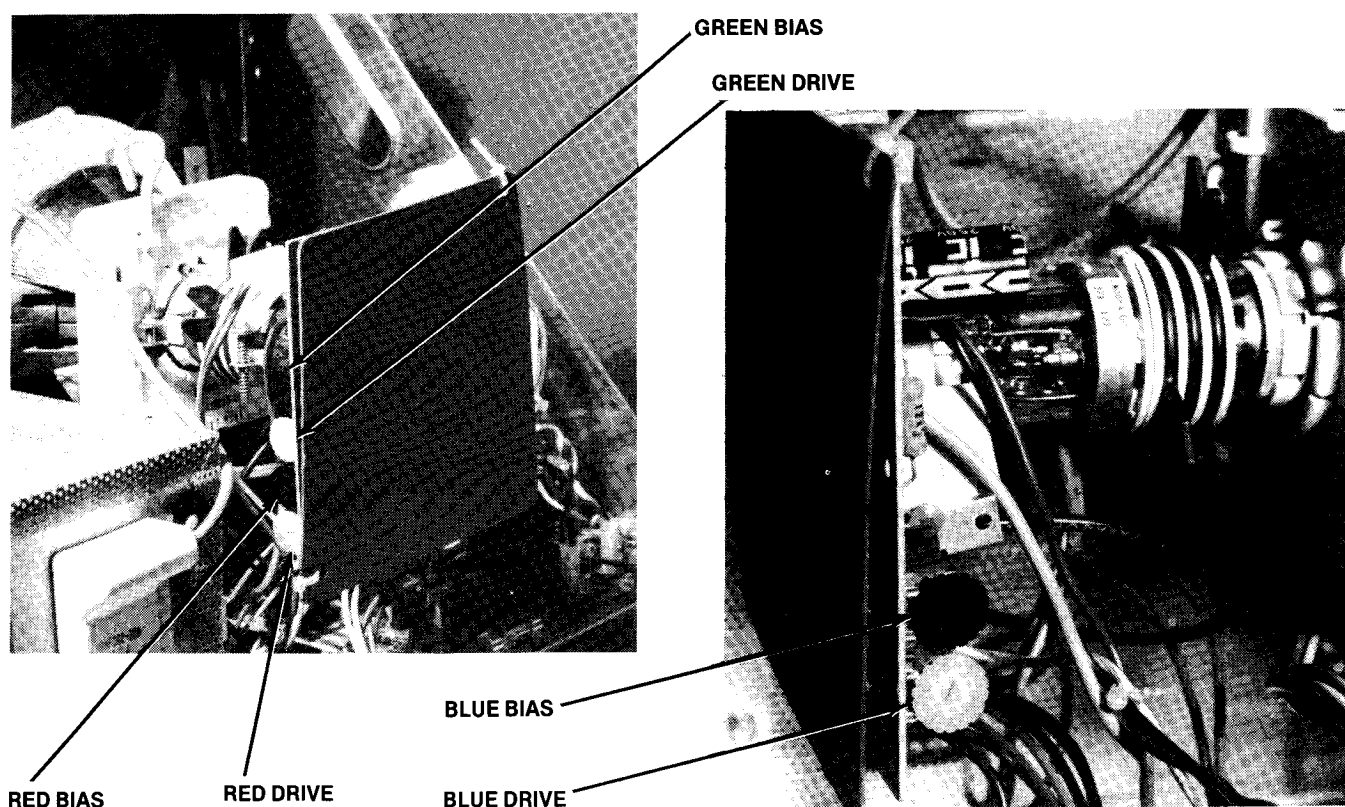


Figure 4 Adjustable Controls on Neck PCB

### 3. Drive Adjustments

Adjust the red, green and blue drive potentiometers until the first line on the right is pure white. Drive potentiometers are marked as follows on the neck board: R DRIVE, G DRIVE and B DRIVE; see Figure 4. Repeat step 2 if the fifth line from the right is no longer pure white.

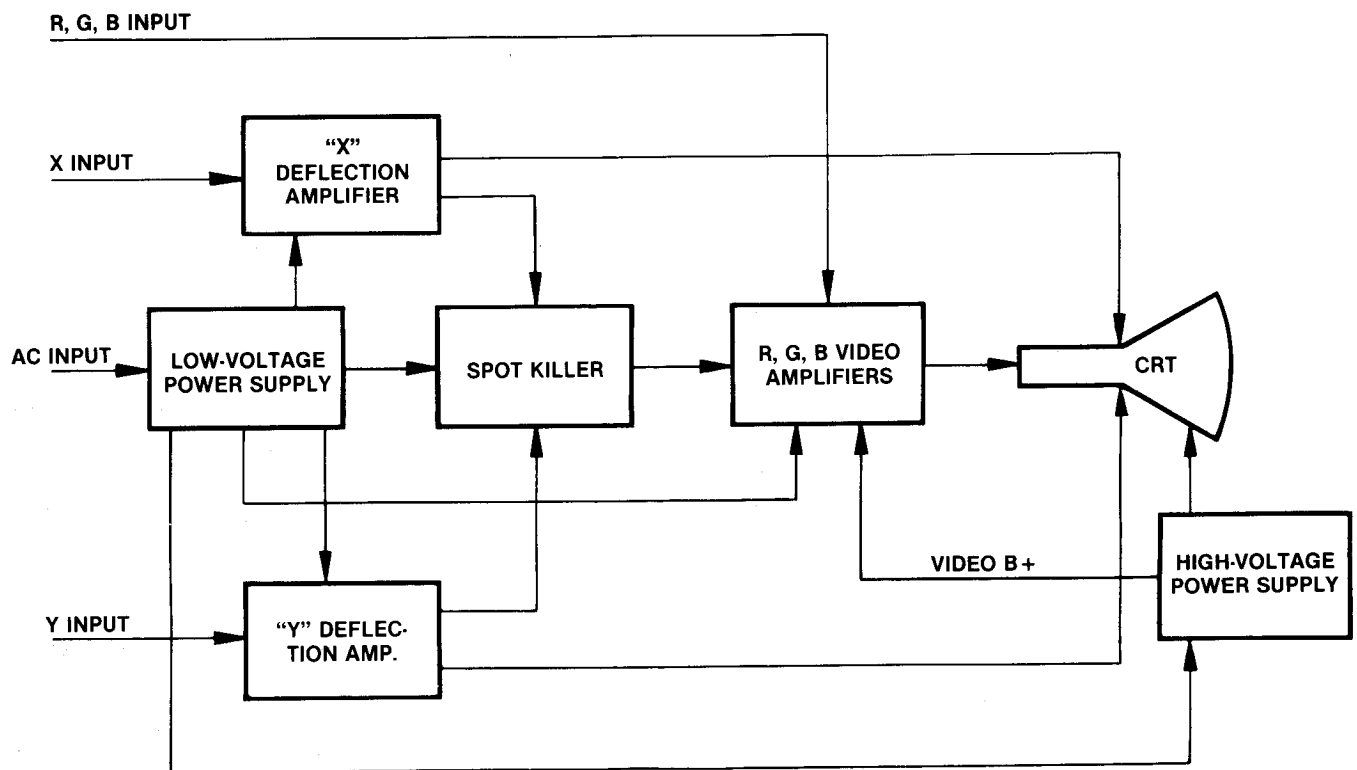


Figure 5 Display Block Diagram

# 6 Details of Operation

## A. Low Voltage Power Supply

The input voltage of 48 VAC from the game power supply enters through fuses F100 and F101. Diodes D100 through D104 from a rectifier bridge that converts the AC input into an unfiltered DC. Capacitors C100 and C101 form the first stage of filtering. Resistors R102 and R103 and capacitors C102 and C103 form two low-pass filters which help filter out AC ripple. Transistors Q100 through Q103 form an active filter that provides the stable, filtered DC voltages.

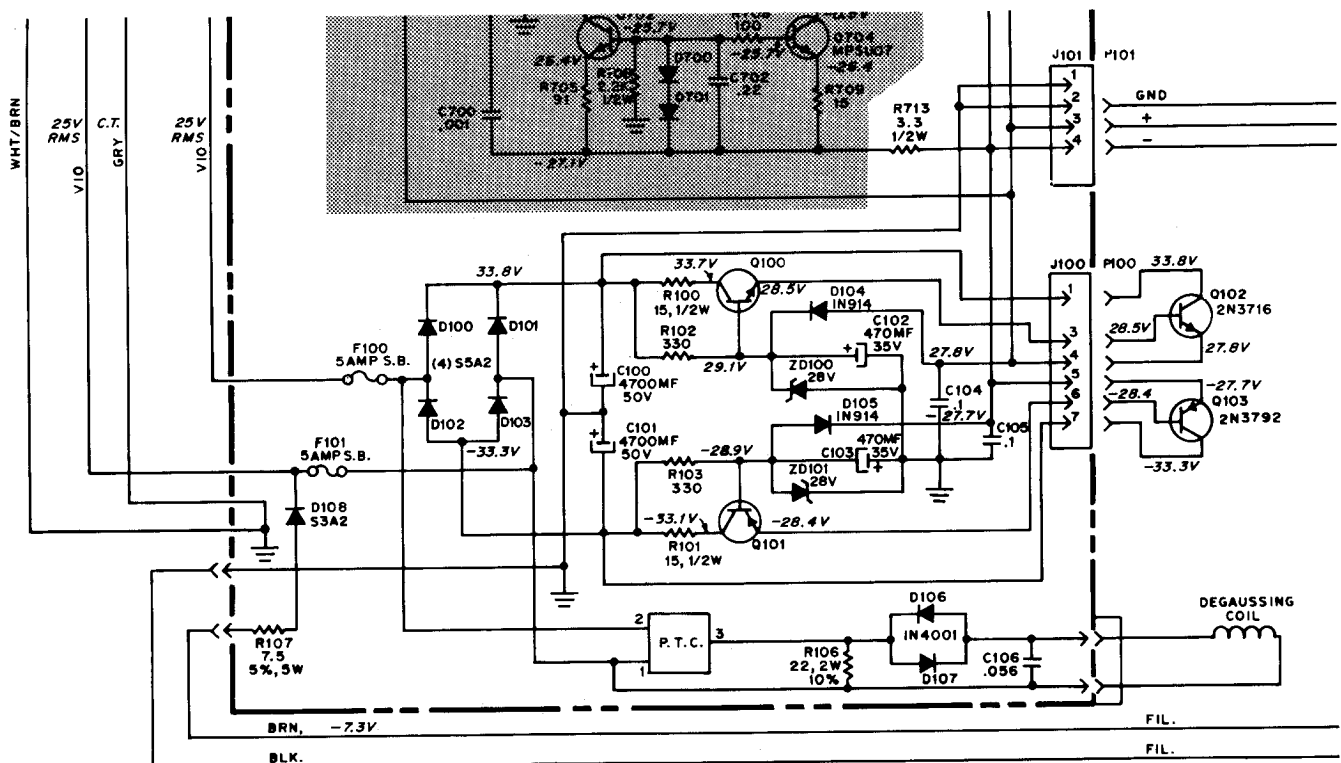
The degaussing coil operates when power is first applied to the display, when the P.T.C. (positive temperature coefficient) thermistor is cool. Diodes

D106 and D107 form a protective barrier from any residual current that might enter the degaussing coil during normal game play.

The output voltages from the low-voltage power supply should be as follows:

- J101 pin 2: ground
- J101 pin 3: + 25 volts
- J101 pin 4: - 25 volts

The picture-tube filament voltage is taken from the front end of the low-voltage power supply through D108 and R107.



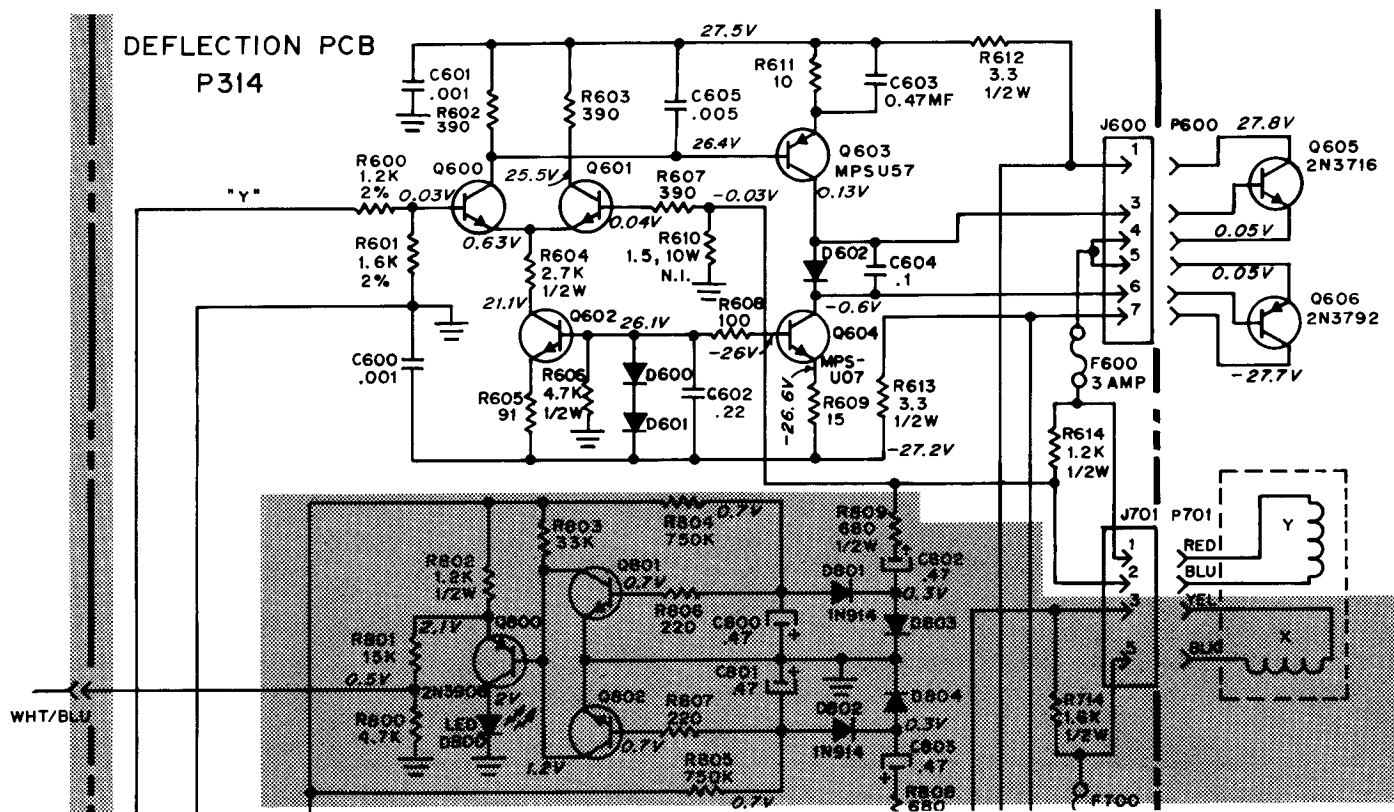


Figure 7 Schematic Diagram of Y Amplifier

## B. X and Y Amplifiers

Both the X and Y amplifiers are nearly identical. For this reason only the Y amplifier is described.

The Y deflection signal from the game board is applied to the base circuit of transistor Q600. Transistors Q600 and Q601 form a differential amplifier. Transistor Q602 is a constant current source providing current to the differential amplifier.

Transistor Q603 is the driver transistor that provides current to the emitter-follower transistors Q605 and Q606. Transistor Q604 is a constant current source that provides current to the driver transistor Q603. Fuse F600 can open in case of circuit failure, protecting the deflection coil in the yoke from damage.

## C. Z Amplifiers (Red, Green, and Blue)

Since the red, green and blue amplifiers are identical, only the blue amplifier will be described.

Transistor Q502 is a common emitter amplifier used to provide gain for the blue intensity signal. Resistor R509 is the blue drive pot which determines the amount of gain in the blue amplifier. Resistor R513 is the blue bias pot which determines the cut-off characteristics of the blue amplifier. The output of the Z amplifiers bias the cathodes of the three electron guns within the picture tube.

Transistor Q503 is biased by a voltage from the spot killer. When transistor Q503 is cut off, the collector of Q503 rises to the zener voltage of ZD500 (+4.3V). This allows the emitter of transistor Q502 to rise in voltage, which disables the blue signal from the picture tube.

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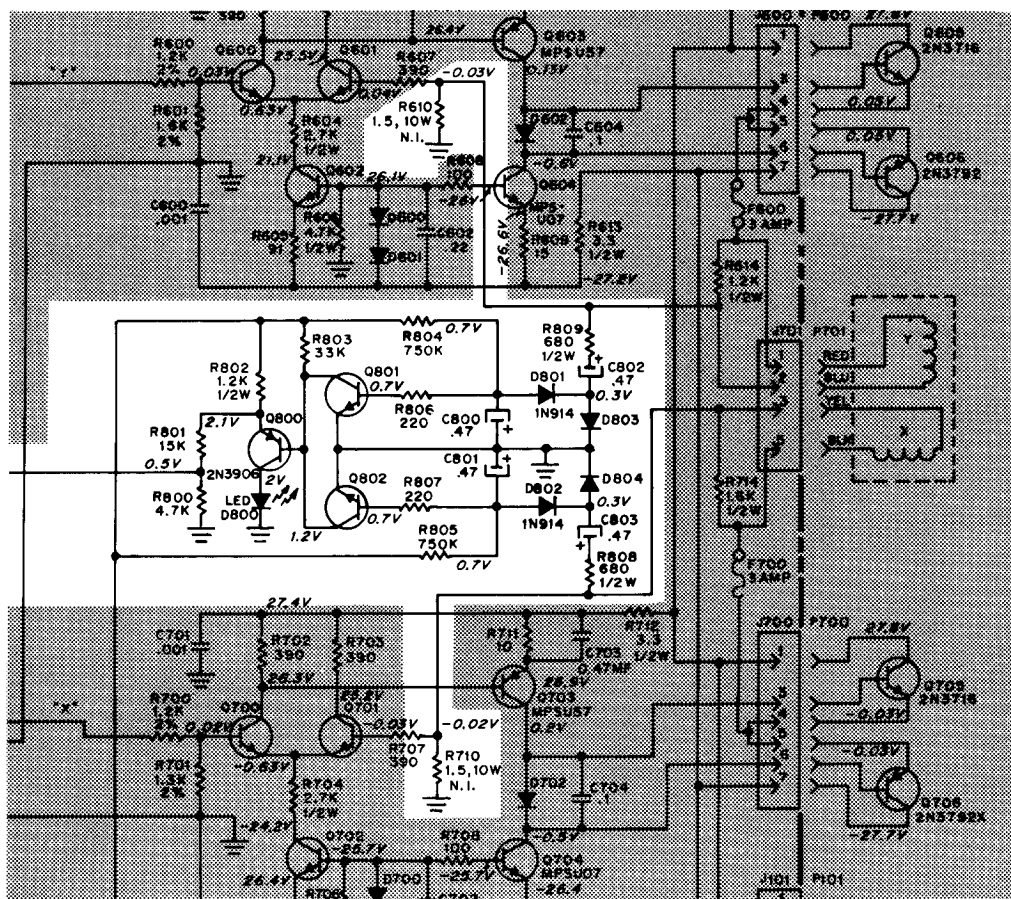
## D. Spot Killer Circuitry

The purpose of the spot killer is to turn off the video intensity amplifiers when deflection is not occurring. Failure of the spot killer can cause the phosphor coating on the picture tube to become burned.

The two signal input voltages to the spot killer are taken from resistors R610 and R710 in the X and Y deflection circuits. Diodes D801 through D804 and capacitors C800 through C803 form two separate

voltage doublers. The outputs of the voltage doublers are applied to the bases of transistor Q801 and Q802.

When either of the deflection amplifiers is not driving current through the deflection coils, then either transistor Q801 or Q802 becomes biased so that it conducts, which turns on transistor Q800 and the LED D800 in its collector circuit. When transistor Q800 is conducting, then transistor Q503 in the Neck PCB is cut off, forcing the red, green and blue amplifiers to turn off their electron beams.



### Figure 9 Schematic Diagram of Spot Killer Circuitry



## E. High Voltage Power Supply

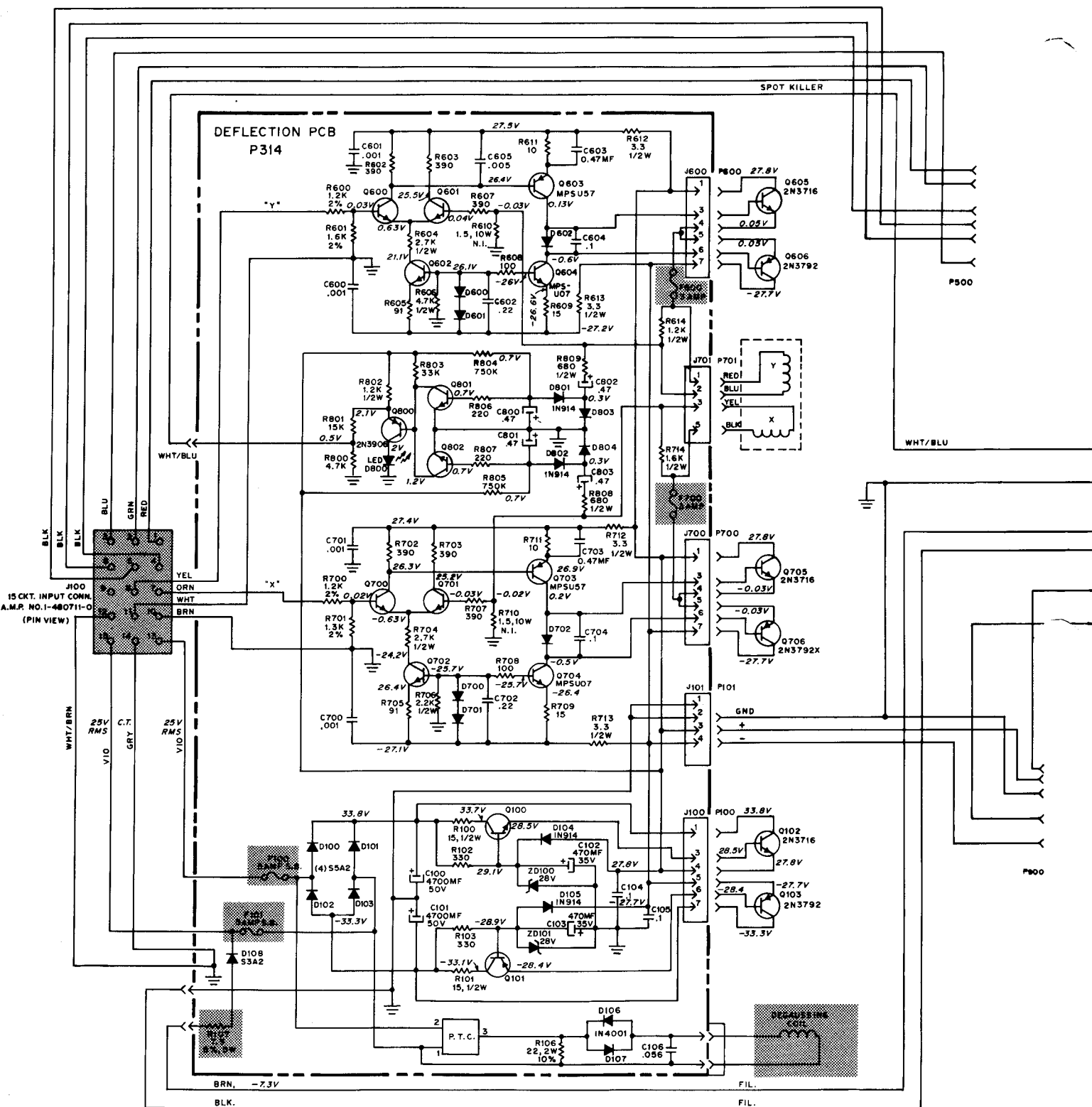
At no time is the high-voltage PCB to be serviced while power is applied. An extremely high voltage is present within this circuit. Output of the high-voltage power supply is over 19,000 volts.

high-voltage step-up transformer T900. The output of the secondary windings is applied to the picture tube at the focus and intensity grids and the 19.5-KV anode.

Diode D901 allows capacitor C910 to charge to +180 volts during the discharge of the primary's magnetic field. Transistors Q900 through Q903 are error amplifiers that regulate the +180 volt video B+. Pot R918 provides an adjustment to the video B+ and hence the high voltage.

To adjust the high voltage, you will need a high-voltage probe, a voltmeter, and an insulated screwdriver tipped adjustment tool. Turn off power to the display. Connect the high-voltage probe to the voltmeter, and insert the tip of the probe under the high-voltage anode rubber shield.

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## GENERAL NOTES

1. Resistance values in ohms,  $\frac{1}{4}$  watt,  $\pm 5\%$ , unless otherwise noted. K = 1,000, M = 1,000,000
2. Capacitance value of 1 or less is in microFarads, above 1 in picoFarads, unless otherwise noted.
3. \* Q900 and Q906 are not in High-Voltage PCB.
4. All D.C. voltages are  $\pm 10\%$  measured from point indicated to ground, using a high-impedance meter. Voltages are measured with no signal input and controls are in a normal operating position.
5. Circled numbers indicate location of waveform reading.
6. ZD100-101 uses (66X0040-007) zener diode in series with (340X2331-934) 330-ohm resistor in early production models.
7. Use a 1,000:1 probe when measuring G2 (screen) or focus voltage.

Components identified by shading have special characteristics important to safety and should be replaced only with identical types.

15

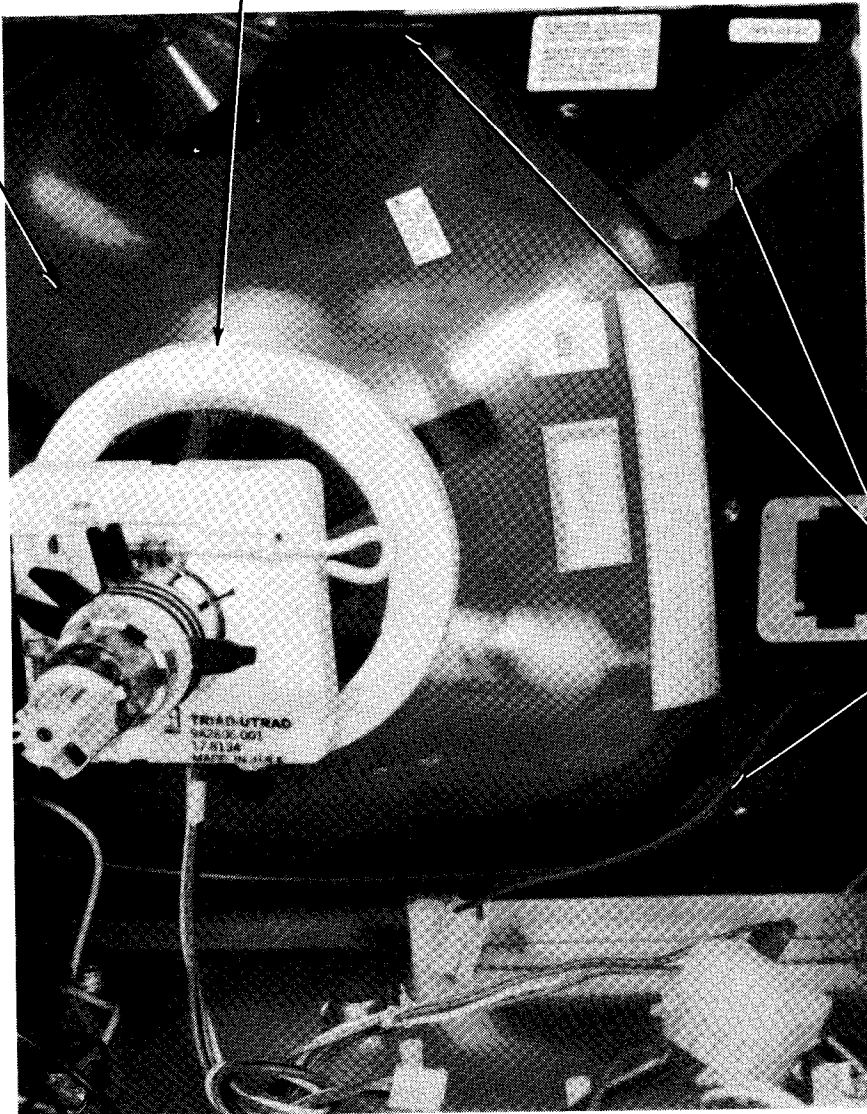
# 7 Illustrated Parts List

This chapter provides you with the necessary information for ordering replacement parts for your 19-inch Wells-Gardner Quadrascan™ color X-Y display. Please note that, for simplicity, **common hardware has been deleted** from these parts lists. This includes screws, nuts, washers, bolts, etc.

When ordering parts from your distributor, give the Atari part number, part name, applicable figure number of this manual, and serial number of your display. This will help to avoid confusion and mistakes in your order. We hope the results will be less downtime and more profit from your game.

PICTURE TUBE

DEFLECTION  
YOKE



PURITY SHIELD/  
DEGAUSSING ASSY.

Figure 12 Display Assembly  
92-053 C

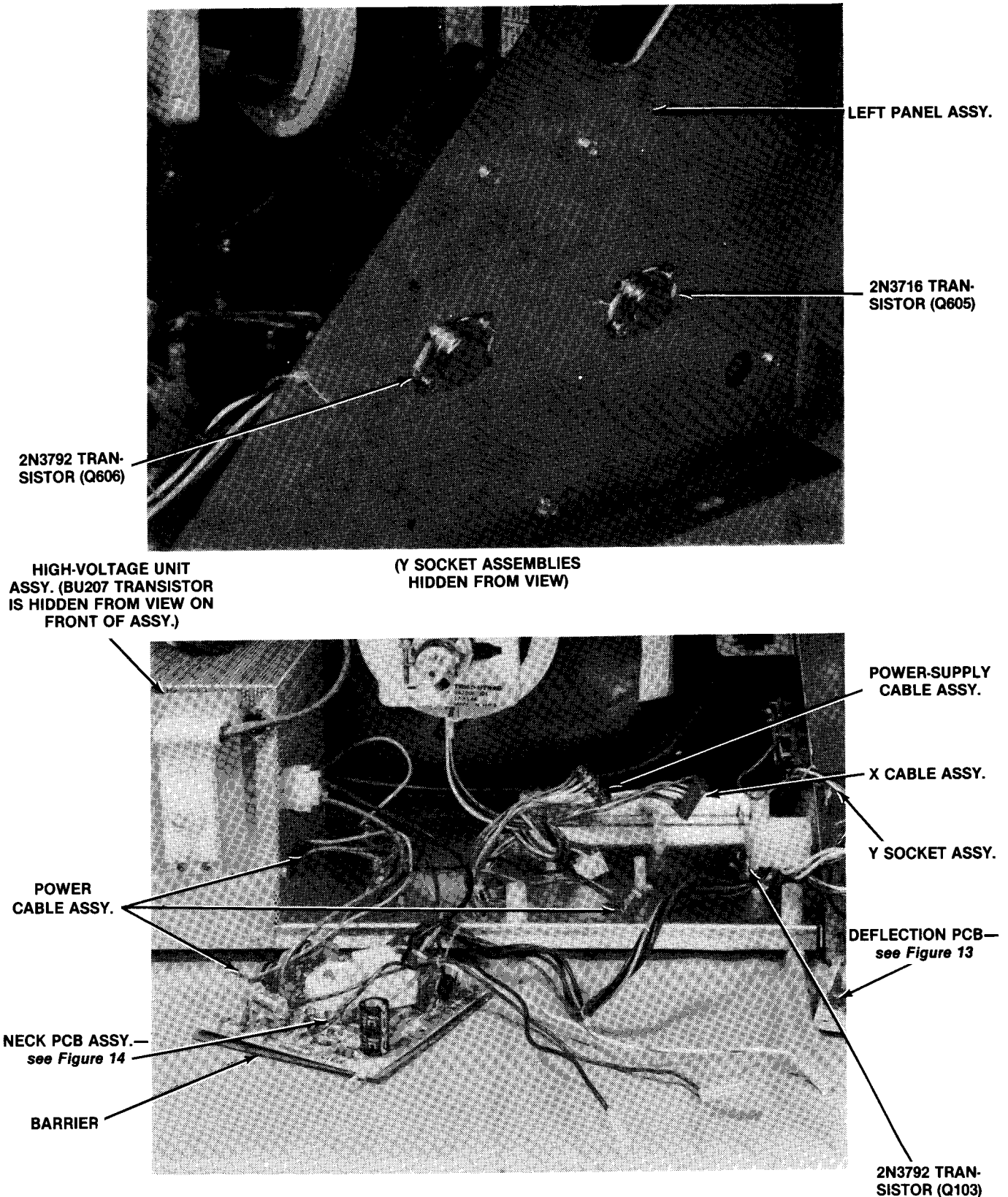
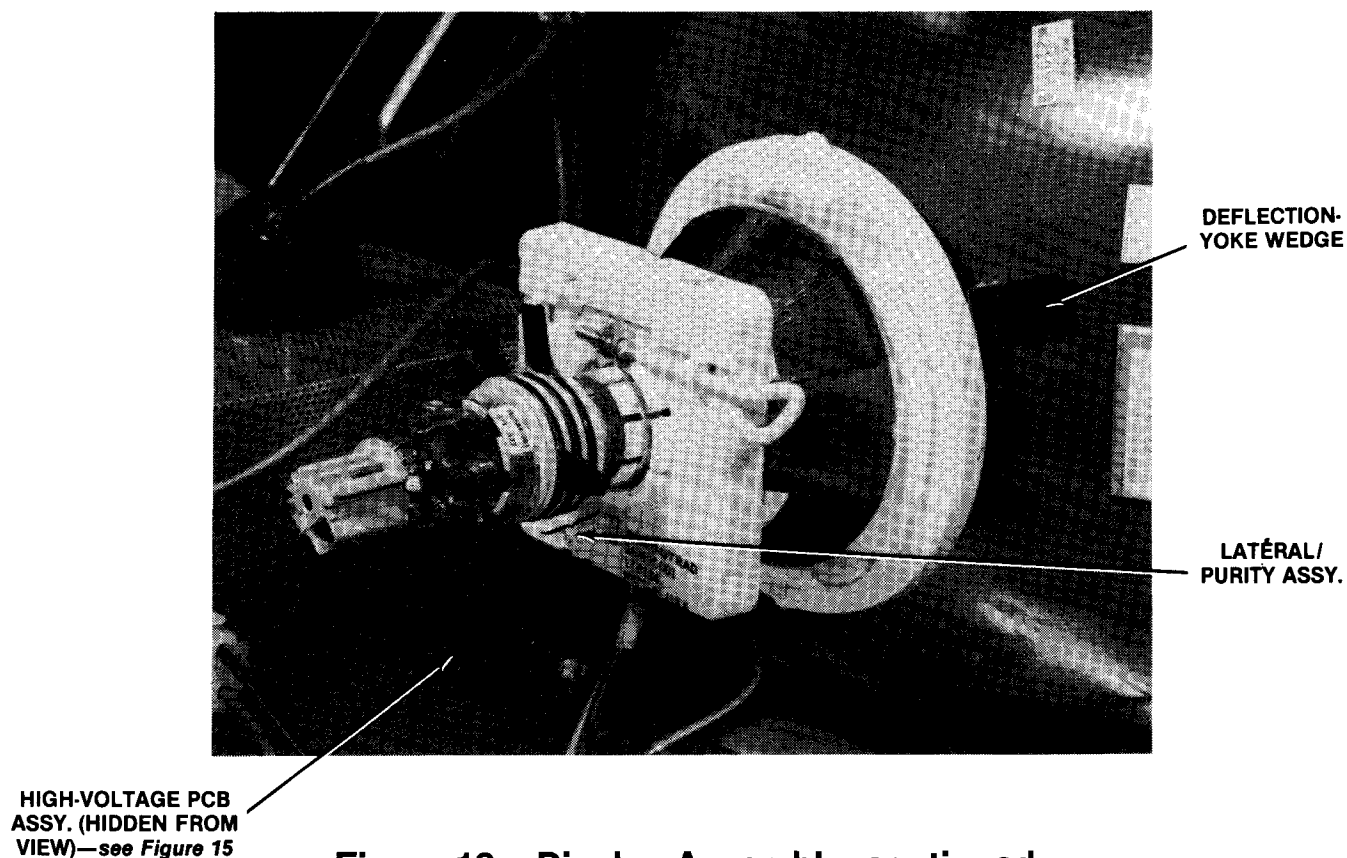
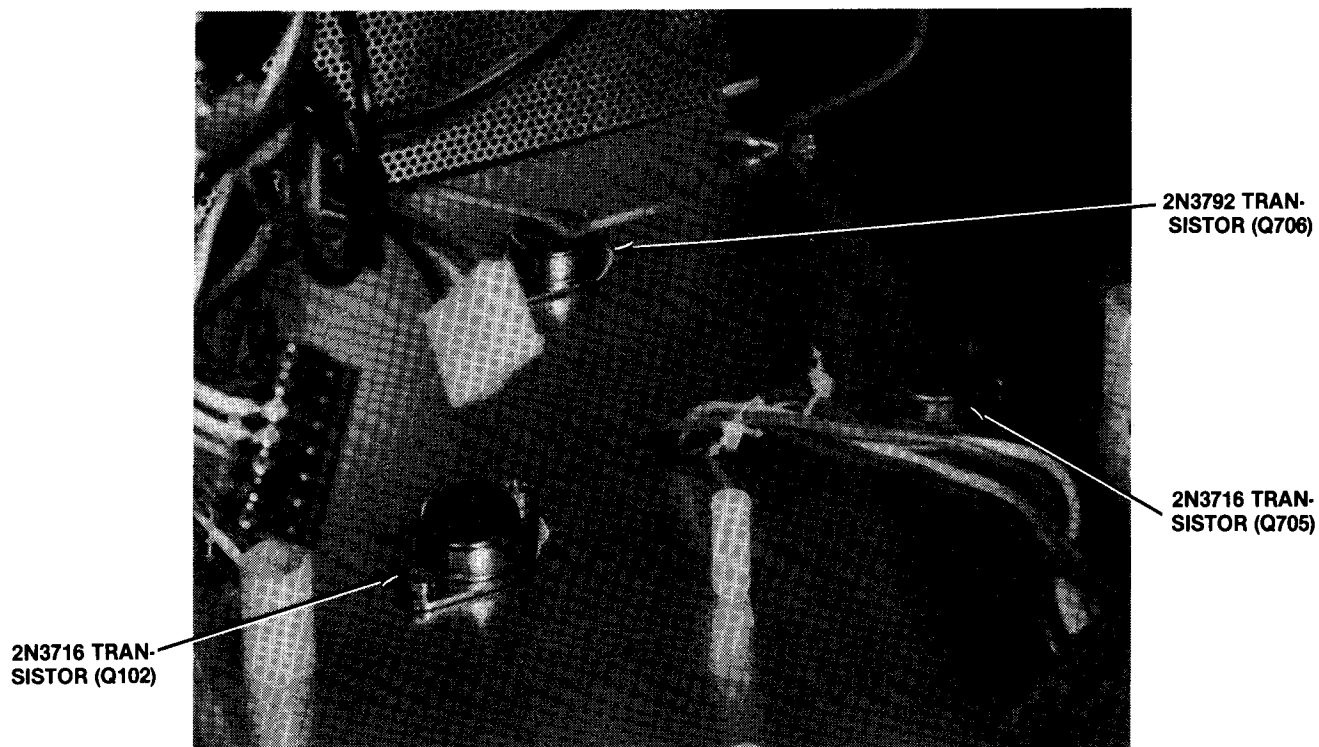


Figure 12 Display Assembly, continued  
92-053 C



**Figure 12 Display Assembly, continued**  
92-053 C

## Figure 12 Display Assembly, continued Parts List

Components identified by ▲ have special characteristics important to safety and should be replaced only with identical types.

| Atari Part No. | Description (Reference Designations in Bold)                                                                                                                                                                                           |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 99-130416      | Type-2N3716 Transistor ( <b>Q102, 705</b> )                                                                                                                                                                                            |
| 99-130417      | Type-2N3792 Transistor ( <b>Q103, 706</b> )                                                                                                                                                                                            |
| 99-130468      | X Cable Assembly Assembly consists of: 99-130422—7-Crct. Housing and 99-130481—Key Plug                                                                                                                                                |
| 99-130469      | Power-Supply Cable Assembly Assembly consists of: 99-130427—7-Circuit Header Connector and 99-130481—Key Plug                                                                                                                          |
| 99-130470      | Left Panel Assembly Assembly consists of: 99-130416—Type-2N3716 Transistor ( <b>Q605</b> ), 99-130417—Type-2N3792 Transistor ( <b>Q606</b> ), and 99-130483—Y Socket Assy.                                                             |
| 99-130471      | ▲ Purity Shield/Degaussing Assembly Assembly consists of: 99-130484—Riveted Purity Shield Assy., 99-130485—Degaussing Coil Assy., 99-130486—AMP Connector, and 99-130488—DAG Spring Assy.                                              |
| 99-130472      | ▲ Type-19VLUP22 Picture Tube                                                                                                                                                                                                           |
| 99-130473      | ▲ High-Voltage Unit Assembly Assembly consists of: 99-130446—Type-BU409 Transistor, 99-130490—High-Voltage PCB Assy. (see Figure 15), 99-130491—Focus/G2 Lead Assy., 99-130492—Ground Lead Assy., and 99-130122—Type-BU207 Transistor. |
| 99-130474      | Deflection PCB Assembly—see Figure 13                                                                                                                                                                                                  |
| 99-130475      | Power Cable Assembly Assembly consists of: 99-130493—#22 8-Circuit Connector, 99-130494—#22 5-Circuit Connector, 99-130495—AMP Pin Receptacle, and 99-130496—AMP Connector.                                                            |
| 99-130476      | Deflection Yoke                                                                                                                                                                                                                        |
| 99-130477      | Deflection-Yoke Wedge                                                                                                                                                                                                                  |
| 99-130478      | Lateral/Purity Assembly                                                                                                                                                                                                                |
| 99-130479      | Neck PCB Assembly—see Figure 14                                                                                                                                                                                                        |
| 99-130480      | Barrier for Neck PCB                                                                                                                                                                                                                   |
| 99-130483      | Y Socket Assembly Assembly consists of: 99-130422—#22 7-Circuit Connector Receptacle, 99-130497—Transistor Socket, and 99-130481—Key Plug                                                                                              |
| 99-130489      | Riveted High-Voltage Assembly (includes sheet-metal housing, bracket, and 2 rivets)                                                                                                                                                    |
| 99-130491      | Focus/G2 Lead Assembly                                                                                                                                                                                                                 |
| 99-130492      | Ground Lead Assembly                                                                                                                                                                                                                   |

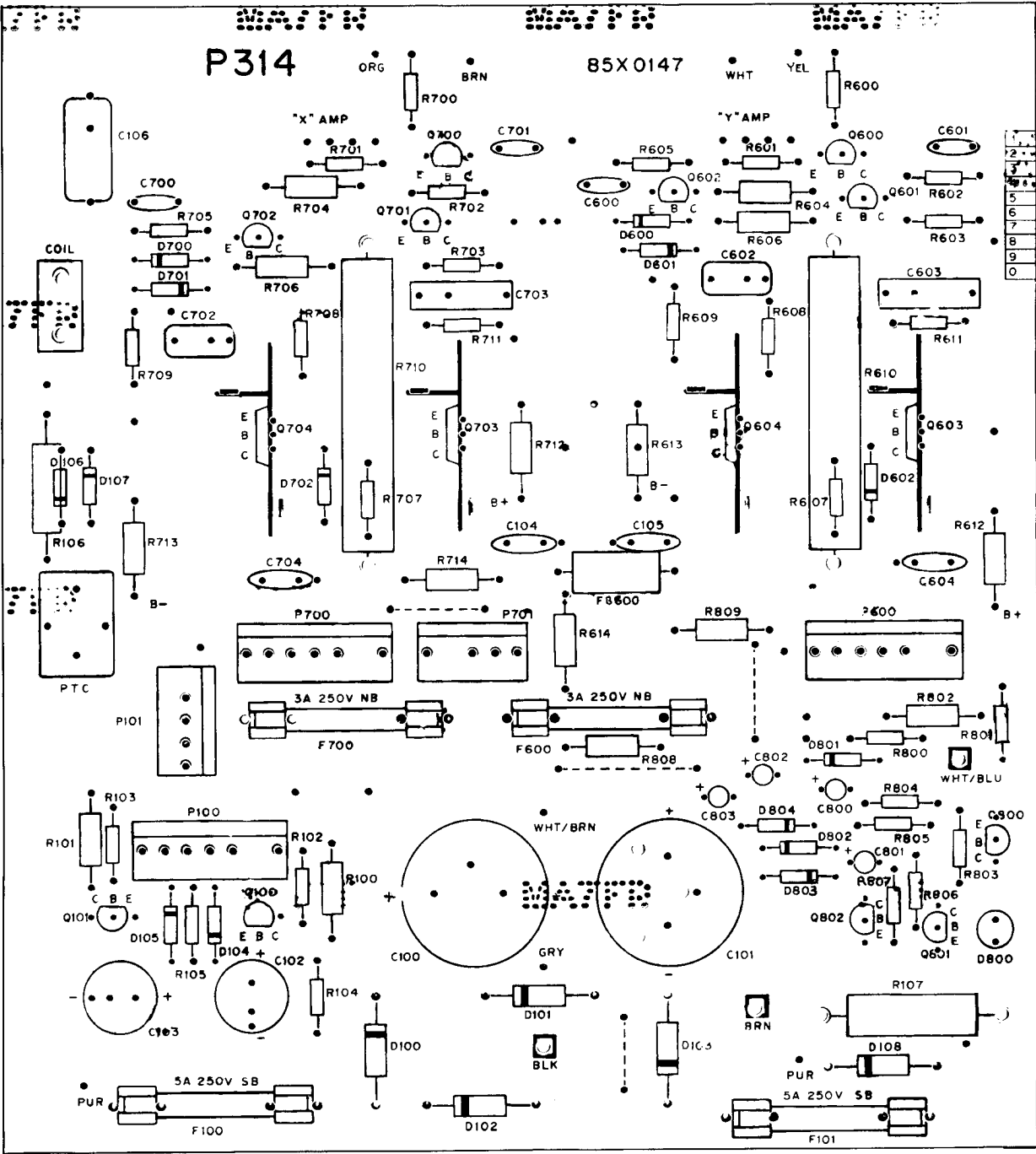


Figure 13 Deflection PCB Assembly  
99-130474 C



## Figure 13 Deflection PCB Assembly, continued Parts List

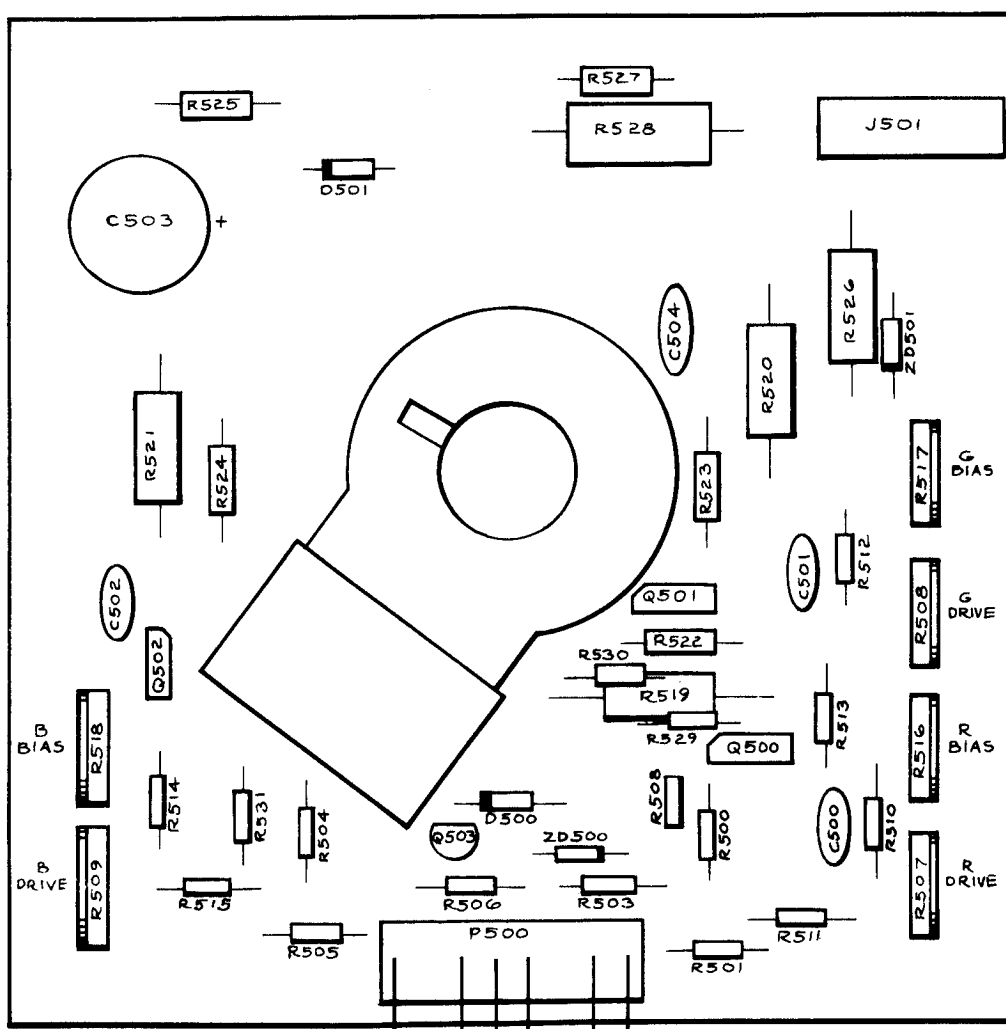
Components identified by ▲ have special characteristics important to safety and should be replaced only with identical types.

| <i>Atari Part No.</i> | <i>Description (Reference Designations in Bold)</i>                                                                                    |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| 99-130076             | 2.2K Ohm, $\pm 5\%$ , $\frac{1}{2}$ W Resistor ( <b>R606, 706</b> )                                                                    |
| 99-130128             | Type-2N3906 PNP Transistor ( <b>Q800</b> )                                                                                             |
| 99-130130             | Type-MPSA06 NPN Transistor ( <b>Q100</b> )                                                                                             |
| 99-130134             | Type-MPSA56 PNP Transistor ( <b>Q101</b> )                                                                                             |
| 99-130351             | 100 Ohm, $\pm 5\%$ , $\frac{1}{4}$ W Resistor ( <b>R608, 708</b> )                                                                     |
| 99-130354             | 330 Ohm, $\pm 5\%$ , $\frac{1}{4}$ W Resistor ( <b>R102, 103</b> )                                                                     |
| 99-130366             | 3.3 Ohm, $\pm 5\%$ , $\frac{1}{2}$ W Resistor ( <b>R612, 613</b> )                                                                     |
| 99-130369             | 33K Ohm, $\pm 5\%$ , $\frac{1}{4}$ W Resistor ( <b>R803</b> )                                                                          |
| 99-130385             | 220 Ohm, $\pm 5\%$ , $\frac{1}{4}$ W Resistor ( <b>R806, 807</b> )                                                                     |
| 99-130389             | 91 Ohm, $\pm 5\%$ , $\frac{1}{4}$ W Resistor ( <b>R605, 705</b> )                                                                      |
| 99-130400             | .1 uf Radial-Lead Ceramic-Disc 50V Capacitor ( <b>C604, 704</b> )                                                                      |
| 99-130401             | .47 uf Aluminum Electrolytic Fixed Axial-Lead 35V Capacitor ( <b>C800, 801</b> )                                                       |
| 99-130405             | .22 uf 50V Capacitor ( <b>C602, 702</b> )                                                                                              |
| 99-130407             | Type-S3A2 Diode ( <b>D108</b> )                                                                                                        |
| 99-130408             | Type-1N914B Diode ( <b>D104, 105, 600, 601, 700, 701, 801-804</b> )                                                                    |
| 99-130409             | Light-Emitting Diode ( <b>D800</b> )                                                                                                   |
| 99-130411             | Type-1N4001 Diode ( <b>D106, 107, 602, 702</b> )                                                                                       |
| 99-130412             | Type-TPS98 NPN Transistor ( <b>Q600-602</b> )                                                                                          |
| 99-130414             | PNP Transistor Assembly ( <b>Q603, 703</b> ) <i>Assembly consists of: 99-130564—PNP Transistor, and 99-130563—Heat Sink</i>            |
| 99-130415             | NPN Transistor Assembly ( <b>Q604, 704</b> ) <i>Assembly consists of: 99-130562—NPN Transistor, and 99-130563—Heat Sink</i>            |
| 99-130418             | ▲ 5-Amp. Slow-Blow Fuse ( <b>F100, F101</b> )                                                                                          |
| 99-130427             | 7-Circuit Header Connector ( <b>P600, 700</b> )                                                                                        |
| 99-130429             | 5-Circuit Header Connector ( <b>P101, 701</b> )                                                                                        |
| 99-130527             | ▲ 7.5 Ohm, $\pm 5\%$ , 5W Resistor ( <b>R107</b> )                                                                                     |
| 99-130547             | 1.5 Ohm, $\pm 5\%$ , 10W Resistor ( <b>R610, 710</b> )                                                                                 |
| 99-130548             | Type-S5A2 Diode ( <b>D100-103</b> )                                                                                                    |
| 99-130549             | 22 Ohm, $\pm 10\%$ , 2W Resistor ( <b>R106</b> )                                                                                       |
| 99-130550             | Positive-Temperature-Coefficient Thermistor                                                                                            |
| 99-130551             | Fuse Clip                                                                                                                              |
| 99-130552             | ▲ 3-Amp. Normal-Blow Fuse ( <b>F600, F700</b> )                                                                                        |
| 99-130553             | .001 uf, $\pm 20\%$ , Type-Z5F Capacitor ( <b>C600, 601</b> )                                                                          |
| 99-130554             | .47 uf 100V Capacitor ( <b>C603, 703</b> )                                                                                             |
| 99-130555             | 4700 uf Aluminum Electrolytic Fixed Axial-Lead 50V Capacitor ( <b>C100, 101</b> )                                                      |
| 99-130556             | 470 uf Aluminum Electrolytic Fixed Axial-Lead 35V Capacitor ( <b>C102, 103</b> )                                                       |
| 99-130557             | .056 uf, $\pm 10\%$ , 400V Capacitor ( <b>C106</b> )                                                                                   |
| 99-130558             | Ferrite Bead ( <b>FB600</b> )                                                                                                          |
| 99-130559             | #20 Gauge Bare Wire                                                                                                                    |
| 99-130560             | Purple Lead Assembly                                                                                                                   |
| 99-130561             | ▲ 15-Circuit Connector Assembly <i>Assembly consists of: 99-130565—15-Circuit Connector, and 99-130493—#22 Gauge 8-Circuit Housing</i> |
| 99-130577             | 15 Ohm, $\pm 5\%$ , $\frac{1}{2}$ W Resistor ( <b>R100, 101</b> )                                                                      |
| 99-130587             | 1.2K Ohm, $\pm 2\%$ , $\frac{1}{4}$ W Resistor ( <b>R600, 700</b> )                                                                    |

[Continued on next page]

# Figure 13 Deflection PCB Assembly, continued Parts List

| Atari Part No. | Description (Reference Designations in Bold)                        |
|----------------|---------------------------------------------------------------------|
| 99-130588      | 1.6K Ohm, $\pm 2\%$ , $\frac{1}{4}$ W Resistor ( <b>R601</b> )      |
| 99-130589      | 1.3K Ohm, $\pm 2\%$ , $\frac{1}{4}$ W Resistor ( <b>R701</b> )      |
| 99-130590      | 390 Ohm, $\pm 5\%$ , $\frac{1}{4}$ W Resistor ( <b>R602, 603</b> )  |
| 99-130591      | 10 Ohm, $\pm 5\%$ , $\frac{1}{4}$ W Resistor ( <b>R611, 711</b> )   |
| 99-130592      | 15 Ohm, $\pm 5\%$ , $\frac{1}{4}$ W Resistor ( <b>R609, 709</b> )   |
| 99-130593      | 15K Ohm, $\pm 5\%$ , $\frac{1}{4}$ W Resistor ( <b>R801</b> )       |
| 99-130594      | 750K Ohm, $\pm 5\%$ , $\frac{1}{4}$ W Resistor ( <b>R804, 805</b> ) |
| 99-130595      | 2.7K Ohm, $\pm 5\%$ , $\frac{1}{2}$ W Resistor ( <b>R604, 704</b> ) |
| 99-130596      | 1.2K Ohm, $\pm 5\%$ , $\frac{1}{2}$ W Resistor ( <b>R614, 802</b> ) |
| 99-130597      | 1.6K Ohm, $\pm 5\%$ , $\frac{1}{2}$ W Resistor ( <b>R714</b> )      |
| 99-130598      | 680 Ohm, $\pm 5\%$ , $\frac{1}{2}$ W Resistor ( <b>R808, 809</b> )  |
| 99-130599      | 28V, $\pm 5\%$ , 1W Zener Diode ( <b>ZD100, 101</b> )               |

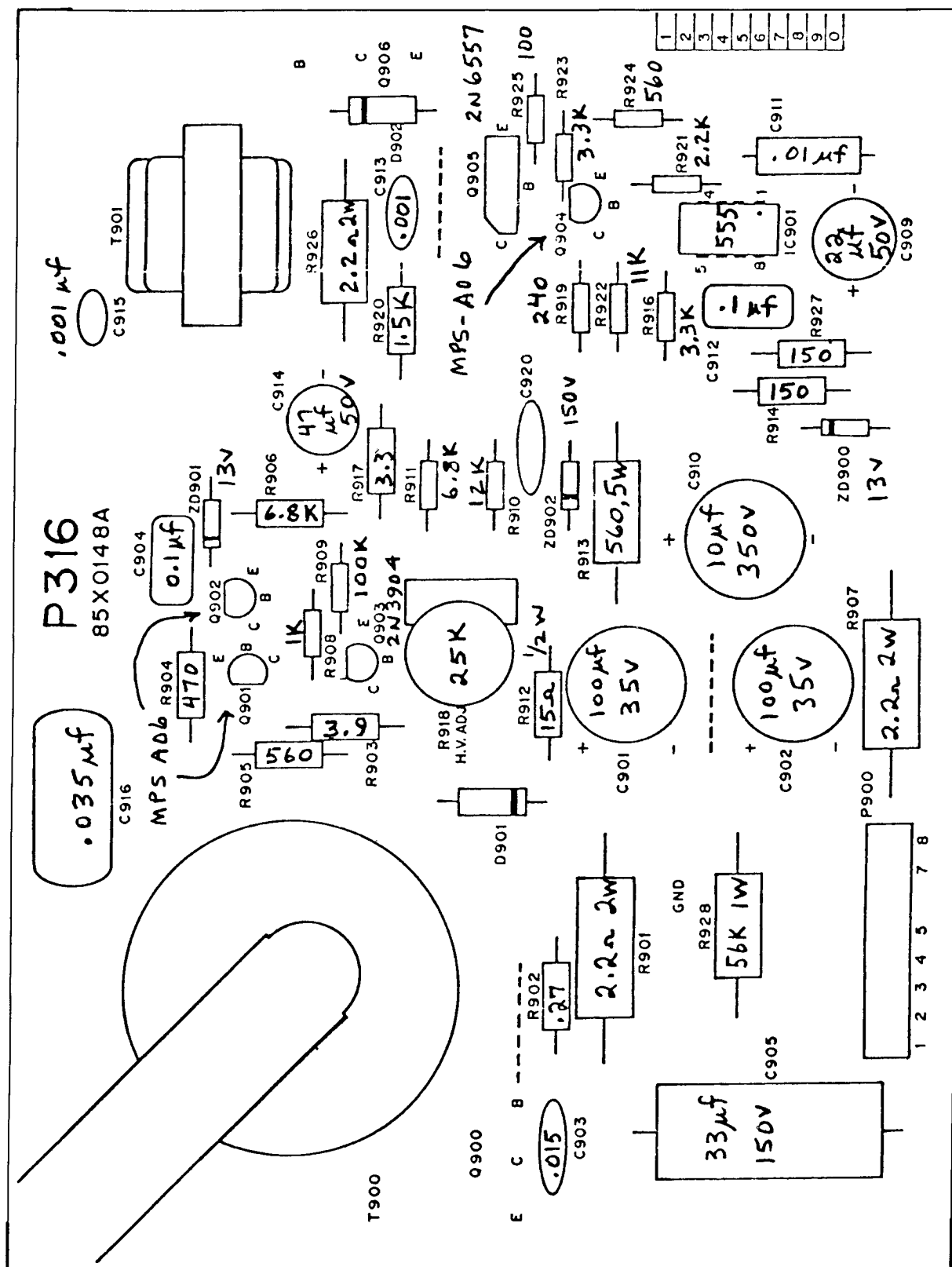


## Figure 14 Neck PCB Assembly 99-130479 C

## Figure 14 Neck PCB Assembly, continued Parts List

Components identified by ▲ have special characteristics important to safety and should be replaced only with identical types.

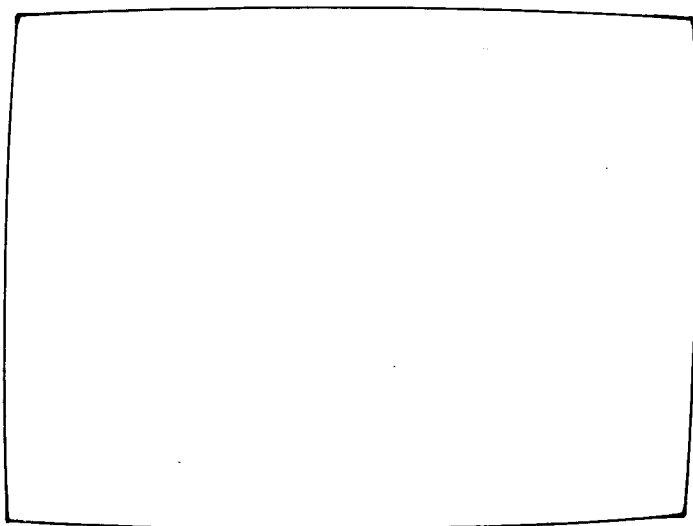
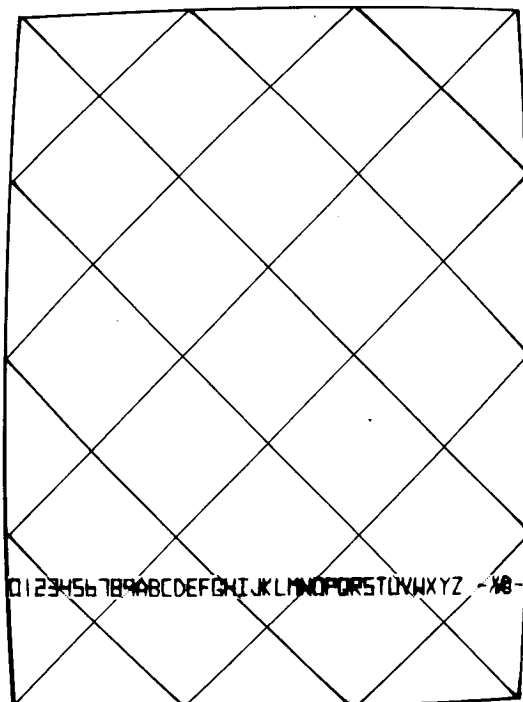
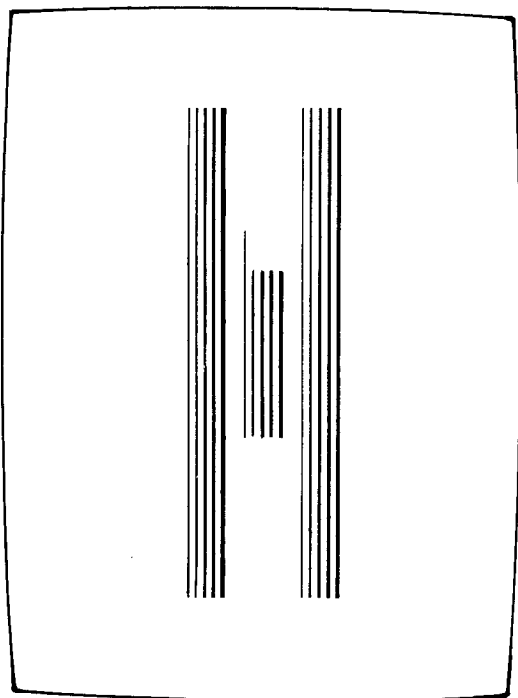
| <i>Atari Part No.</i> | <i>Description (Reference Designations in Bold)</i>                                                                                           |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| 99-130034             | 470 pf, $\pm 10\%$ , Type-Z5F Radial-Lead Ceramic-Disc Capacitor <b>(C500-502)</b>                                                            |
| 99-130111             | 470 Ohm, $\pm 5\%$ , $\frac{1}{2}$ W Resistor <b>(R527)</b>                                                                                   |
| 99-130129             | Type-D40P3 NPN Transistor <b>(Q500-502)</b>                                                                                                   |
| 99-130380             | 470 Ohm, $\pm 5\%$ , $\frac{1}{4}$ W Resistor <b>(R500, 502, 504)</b>                                                                         |
| 99-130392             | 1K Ohm, $\pm 5\%$ , $\frac{1}{4}$ W Resistor <b>(R501, 503, 505)</b>                                                                          |
| 99-130408             | Type-1N914B Diode <b>(D500)</b>                                                                                                               |
| 99-130410             | 250V Diode <b>(D501)</b>                                                                                                                      |
| 99-130413             | Type-2N3904 NPN Transistor <b>(Q503)</b>                                                                                                      |
| 99-130525             | 12K Ohm, $\pm 5\%$ , 2W Resistor <b>(R519-521)</b>                                                                                            |
| 99-130526             | 510 Ohm, $\pm 5\%$ , 1W Resistor <b>(R526)</b>                                                                                                |
| 99-130527             | ▲ 7.5 Ohm, $\pm 5\%$ , 5W Resistor <b>(R528)</b>                                                                                              |
| 99-130528             | 100 pf, $\pm 10\%$ , Radial-Lead Ceramic-Disc 2KV Capacitor <b>(C504)</b>                                                                     |
| 99-130529             | 33 uf Aluminum Electrolytic Fixed Axial-Lead 250V Capacitor <b>(C503)</b>                                                                     |
| 99-130530             | 300 Ohm Clear Control <b>(R507-509)</b>                                                                                                       |
| 99-130531             | 15K Ohm Black Control <b>(R516-518)</b>                                                                                                       |
| 99-130532             | ▲ Picture-Tube Socket                                                                                                                         |
| 99-130533             | 8-Circuit Right-Angle Header Connector                                                                                                        |
| 99-130534             | Black Wire Assembly <i>Assembly consists of: 99-130495—Pin Receptacle and 99-130540—1-Circuit Housing</i>                                     |
| 99-130535             | Brown Wire Assembly <i>Assembly consists of: 99-130495—Pin Receptacle and 99-130540—1-Circuit Housing</i>                                     |
| 99-130536             | White/Blue Wire Assembly <i>Assembly consists of: 99-130495—Pin Receptable and 99-130540—1-Circuit Housing</i>                                |
| 99-130537             | Ground Wire Assembly                                                                                                                          |
| 99-130538             | ▲ Focus and Red Wire Assembly <i>Assembly consists of: 99-130541—Focus Wire Assy., 99-130542—Red Wire Assy., and 99-130543—3-Circuit Plug</i> |
| 99-130539             | SG Lead Assembly                                                                                                                              |
| 99-130575             | 13V, $\pm 5\%$ , 1W Zener Diode <b>(ZD501)</b>                                                                                                |
| 99-130578             | 12K Ohm, $\pm 5\%$ , $\frac{1}{4}$ W Resistor <b>(R529-531)</b>                                                                               |
| 99-130581             | 10K Ohm, $\pm 5\%$ , $\frac{1}{4}$ W Resistor <b>(R506)</b>                                                                                   |
| 99-130582             | 300 Ohm, $\pm 5\%$ , $\frac{1}{4}$ W Resistor <b>(R511, 513, 515)</b>                                                                         |
| 99-130583             | 2.7K Ohm, $\pm 10\%$ , $\frac{1}{2}$ W Resistor <b>(R522-524)</b>                                                                             |
| 99-130584             | 3.3 MegOhm, $\pm 10\%$ , $\frac{1}{2}$ W Resistor <b>(R525)</b>                                                                               |
| 99-130585             | 4.3V, $\pm 5\%$ , $\frac{1}{2}$ W Zener Diode <b>(ZD500)</b>                                                                                  |
| 99-130586             | 4.7K Ohm, $\pm 5\%$ , $\frac{1}{4}$ W Resistor <b>(R510, 512, 514)</b>                                                                        |



**Figure 15 High-Voltage PCB Assembly**  
**99-130490 C**

## Figure 15 High-Voltage PCB Assembly Parts List

| Atari Part No. | Description (Reference Designations in Bold)                                                                              |
|----------------|---------------------------------------------------------------------------------------------------------------------------|
| 99-130007      | 33 uf Aluminum Electrolytic Fixed Axial-Lead 150V Capacitor (C905)                                                        |
| 99-130008      | 47 uf Aluminum Electrolytic Fixed Axial-Lead 50V Capacitor (C914)                                                         |
| 99-130021      | 1000 pf, $\pm 10\%$ , Radial-Lead Ceramic-Disc 500V Capacitor (C915)                                                      |
| 99-130028      | .1 uf, $\pm 20\%$ , Radial-Lead Epoxy-Dipped 100V Mylar Capacitor (C904)                                                  |
| 99-130049      | Horizontal Driver Transformer (T901)                                                                                      |
| 99-130087      | 1.5K Ohm, $\pm 5\%$ , $\frac{1}{2}W$ Resistor (R920)                                                                      |
| 99-130089      | 2.2 Ohm, $\pm 5\%$ , 2W Resistor (R901, 907, 926)                                                                         |
| 99-130094      | 150 Ohm, $\pm 5\%$ , $\frac{1}{2}W$ Resistor (R914, 927)                                                                  |
| 99-130111      | 470 Ohm, $\pm 5\%$ , $\frac{1}{2}W$ Resistor (R904)                                                                       |
| 99-130115      | 3.9 Ohm, $\pm 5\%$ , $\frac{1}{2}W$ Resistor (R903)                                                                       |
| 99-130130      | Type-MPSA06 NPN Transistor (Q901, 902, 904)                                                                               |
| 99-130132      | Type-2N6557 Horizontal Driver Transistor (Q905)                                                                           |
| 99-130351      | 100 Ohm, $\pm 5\%$ , $\frac{1}{4}W$ Resistor (R925)                                                                       |
| 99-130366      | 3.3 Ohm, $\pm 5\%$ , $\frac{1}{2}W$ Resistor (R917)                                                                       |
| 99-130373      | 2.2K Ohm, $\pm 5\%$ , $\frac{1}{4}W$ Resistor (R921)                                                                      |
| 99-130376      | 6.8K Ohm, $\pm 5\%$ , $\frac{1}{2}W$ Resistor (R906)                                                                      |
| 99-130377      | 100K Ohm, $\pm 5\%$ , $\frac{1}{4}W$ Resistor (R909)                                                                      |
| 99-130392      | 1K Ohm, $\pm 5\%$ , $\frac{1}{4}W$ Resistor (R908)                                                                        |
| 99-130444      | .015 uf Radial-Lead Ceramic-Disc 100V Capacitor (C903)                                                                    |
| 99-130448      | Silicon Diode (D901, 902)                                                                                                 |
| 99-130507      | 25K Trim Pot (R918)                                                                                                       |
| 99-130508      | 56K Ohm, $\pm 5\%$ , 1W Resistor (R928)                                                                                   |
| 99-130509      | Transistor (Q903)                                                                                                         |
| 99-130510      | Type-NE555P Integrated Circuit Timer Clock (IC901)                                                                        |
| 99-130511      | 100 uf Aluminum Electrolytic Fixed Axial-Lead 35V Capacitor (C901, 902)                                                   |
| 99-130512      | 22 uf Aluminum Electrolytic Fixed Axial-Lead 50V Capacitor (C909)                                                         |
| 99-130514      | .01 uf Polypropylene Capacitor (C911)                                                                                     |
| 99-130515      | .1 uf, $\pm 5\%$ , Radial-Lead Epoxy-Dipped 100V Mylar Capacitor (C912)                                                   |
| 99-130516      | High-Voltage Transformer (T900)                                                                                           |
| 99-130517      | 3-Circuit Transistor Lead Assembly <i>Assembly consists of: 99-130521—Terminal, and 99-130522—Power-Transistor Socket</i> |
| 99-130518      | Type-TO3 Transistor Lead Assembly <i>Assembly consists of: 99-130497—Transistor Socket, and miscellaneous wires</i>       |
| 99-130519      | 8-Circuit Right-Angle Header Connector (P900)                                                                             |
| 99-130520      | 68 pf Capacitor (C920)                                                                                                    |
| 99-130553      | .001 uf, $\pm 20\%$ , Type-Z5F Capacitor (C913)                                                                           |
| 99-130567      | 10 uf Aluminum Electrolytic Fixed Axial-Lead 300V Capacitor (C919)                                                        |
| 99-130568      | 560 Ohm, $\pm 10\%$ , 5W Resistor (R913)                                                                                  |
| 99-130569      | .035 uf, $\pm 5\%$ , 400V Polypropylene Capacitor (C916)                                                                  |
| 99-130570      | 560 Ohm, $\pm 5\%$ , $\frac{1}{2}W$ Resistor (R905)                                                                       |
| 99-130571      | 11K Ohm, $\pm 5\%$ , $\frac{1}{4}W$ Resistor (R922)                                                                       |
| 99-130572      | 3.3K Ohm, $\pm 5\%$ , $\frac{1}{4}W$ Resistor (R916, 923)                                                                 |
| 99-130573      | 240 Ohm, $\pm 5\%$ , $\frac{1}{4}W$ Resistor (R919)                                                                       |
| 99-130574      | 560 Ohm, $\pm 5\%$ , $\frac{1}{4}W$ Resistor (R924)                                                                       |
| 99-130575      | 13V, $\pm 5\%$ , 1W Zener Diode (ZD900, 901)                                                                              |
| 99-130576      | 150V, $\pm 5\%$ , 1W Zener Diode (ZD902)                                                                                  |
| 99-130577      | 15 Ohm, $\pm 5\%$ , $\frac{1}{2}W$ Resistor (R912)                                                                        |
| 99-130578      | 12K Ohm, $\pm 5\%$ , $\frac{1}{4}W$ Resistor (R910)                                                                       |
| 99-130579      | .27 Ohm, $\pm 10\%$ , $\frac{1}{2}W$ Resistor (R902)                                                                      |
| 99-130580      | 6.8K Ohm, $\pm 5\%$ , $\frac{1}{4}W$ Resistor (R911)                                                                      |



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