Macintosh Color Display

Specifications

Macintosh Color Display

Characteristics

Picture Tube	14-in. diagonal (11.5-in. viewable image) Trinitron CRT with high-contrast glass .26-mm aperture grille pitch
Screen Resolution	640x480 70 dpi
Scan Rates	Horizontal scan rate: 35.0 KHz Vertical refresh rate: 66.7 Hz
Active Video Display Area	9.3 in. by 6.9 in. (235 mm by 176 mm)

Input Signals	Red, green, and blue analog signals Separate synchronization, negative-going TTL

Controls and Ports

User Controls	Front panel: brightness and contrast controls, power switch

Physical and Electrical

Power Supply

Universal power supply
Voltage: 90–270 VAC
Frequency: 47–63 Hz
Power: 37 W normal, 55 W maximum

Fuse Protection

Internal power-line fuse protection (qualified service technician is required to replace the fuse)

Size and Weight

Height: 13 in. (330 mm)
Width: 13.5 in. (344 mm)
Depth: 15.5 in. (394 mm)
Weight: 24 lb. 14 oz. (11.3 kg), including video and power cables

Warm-Up Time	20 minutes required to meet all specifications

Operating Environment

Temperature	50°–95°F (10°–40°C)
Humidity	95% maximum, noncondensing

Troubleshooting

Macintosh Color Display

General

The Symptom Charts included in this chapter will help you diagnose specific symptoms related to your product. Because cures are listed on the charts in the order of most likely solution, try the first cure first. Verify whether or not the product continues to exhibit the symptom. If the symptom persists, try the next cure. (Note: If you have replaced a module, reinstall the original module before you proceed to the next cure.)

If you are not sure what the problem is, or if the Symptom Charts do not resolve the problem, refer to the Flowchart for the product family.

For additional assistance, contact Apple Technical Support.

Symptom Charts

No Raster

No raster, LED off	1 Check power cable connections and power switch. 2 Check all connections on main board. 3 Replace blown fuse. 4 Replace main board.
No raster, LED on, CRT filament on	1 Adjust contrast and brightness knobs. 2 Connect known-good monitor and verify that built-in video signal or video card is working properly. 3 Check all connections on main board. Make sure video connector is secure and wires are inside plastic connector. 4 Perform video adjustments. Refer to “Video” in Adjustments chapter. 5 Replace main board. 6 Replace CRT.

Geometry

Raster too short, tall, narrow, or wide	1 Adjust vertical or horizontal size controls. Refer to “Geometry” in Adjustments chapter. 2 Replace main board.
Raster not centered	1 Move unit away from monitors, fluorescent lights, or other electrical equipment. 2 Adjust vertical or horizontal center controls. Refer to “Geometry” in Adjustments chapter. 3 Replace main board.
Horizontal linearity bad (size of text differs at sides of screen)	Replace main board.

Geometry (Continued)

Vertical linearity bad (size of text differs at top vs. bottom of screen)	Replace main board.
Abnormal or distorted raster	1 Move unit away from monitors, fluorescent lights, or other electrical equipment. 2 Perform geometry adjustments. Refer to “Geometry” in Adjustments chapter. 3 Replace main board. 4 Replace CRT (rarely required).

Geometry (Continued)

Entire raster is tilted	1 Move unit away from monitors, fluorescent lights, or other electrical equipment. 2 Perform geometry adjustments. Refer to “Geometry” in Adjustments chapter. 3 Perform yoke adjustments. Refer to “Yoke” in Adjustments chapter. 4 Replace main board.

Synchronization

Picture breaks into diagonal lines	1 Connect known-good monitor and verify that built-in video signal or video card is working properly. 2 Replace main board.
Picture rolls vertically	1 Connect known-good monitor and verify that built-in video signal or video card is working properly. 2 Replace main board.
Picture breaks and rolls horizontally	1 Connect known-good monitor and verify that built-in video signal or video card is working properly. 2 Replace main board.

Synchronization (Continued)

Black raster with single vertical or horizontal line	1 Replace main board. 2 Replace CRT.

Video

Raster too dark, too bright, or washed out	1 Adjust external contrast and brightness controls. 2 Connect known-good monitor and verify that built-in video signal or video card is working properly. 3 Perform video adjustments. Refer to “Video” in Adjustments chapter. 4 Replace main board. 5 Replace CRT (rarely required).
Out of focus	1 Perform focus adjustment. Refer to “Video” in Adjustments chapter. 2 Replace main board. 3 Adjust focus controls to their limits. If bad focus remains on one part of display, replace CRT.

Video (Continued)

Predominant color tint	1 Check video card in computer. 2 Perform video adjustments. Refer to “Video” in Adjustments chapter. 3 Replace main board. 4 Replace CRT (if you cannot eliminate red, green, or blue tint).
Out of convergence (color bleeding out from text or lines)	1 Connect known-good monitor and verify that built-in video signal or video card is working properly. 2 Perform convergence adjustments. Refer to “Video” in Adjustments chapter. 3 Replace main board. 4 Replace CRT.

Miscellaneous

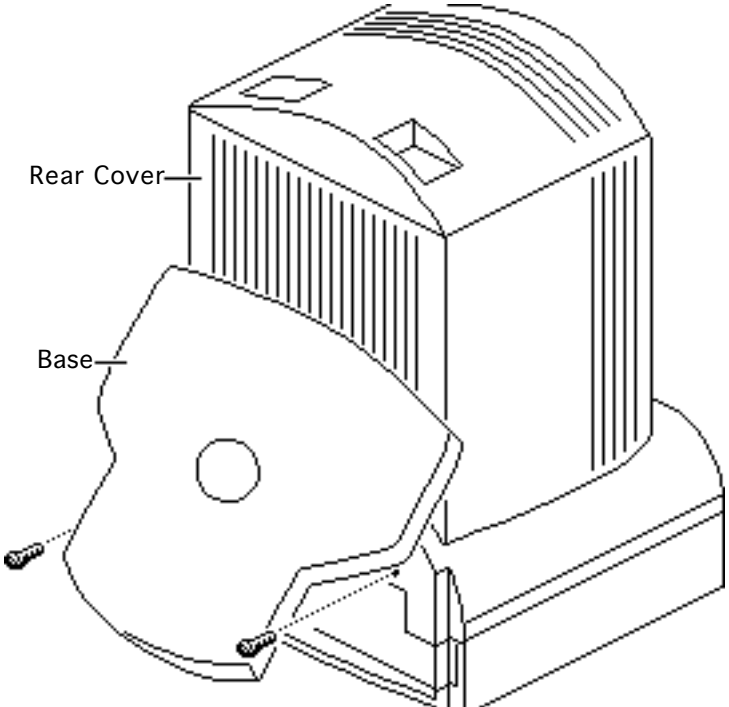
Picture jitters or flashes	1 Move unit away from monitors, fluorescent lights, or other electrical equipment. 2 Check that all ground cables are secure. 3 Replace main board.
Intermittently shuts down	Replace main board.
Flashing or wavy screen	Replace main board.
Black screen spots (burnt phosphors)	Replace CRT.

Miscellaneous (Continued)

Monitor emits high-pitched noise	Replace main board.
Does not degauss	Replace main board.
Erratic or no communication with ADB device	Replace keyboard cable, keyboard, mouse, or other ADB device.
Thin horizontal line on screen	Displays smaller than 15 inches with tron-style CRTs typically have a single horizontal grid wire about one-third of the way from the bottom of the display image. This supporting wire, which is thinner than a human hair, stabilizes the aperture grill against shocks. The line is common to all tron-style displays and is not a screen defect. It cannot be adjusted out or eliminated by repairing or replacing display modules.

Take Apart

Macintosh Color Display

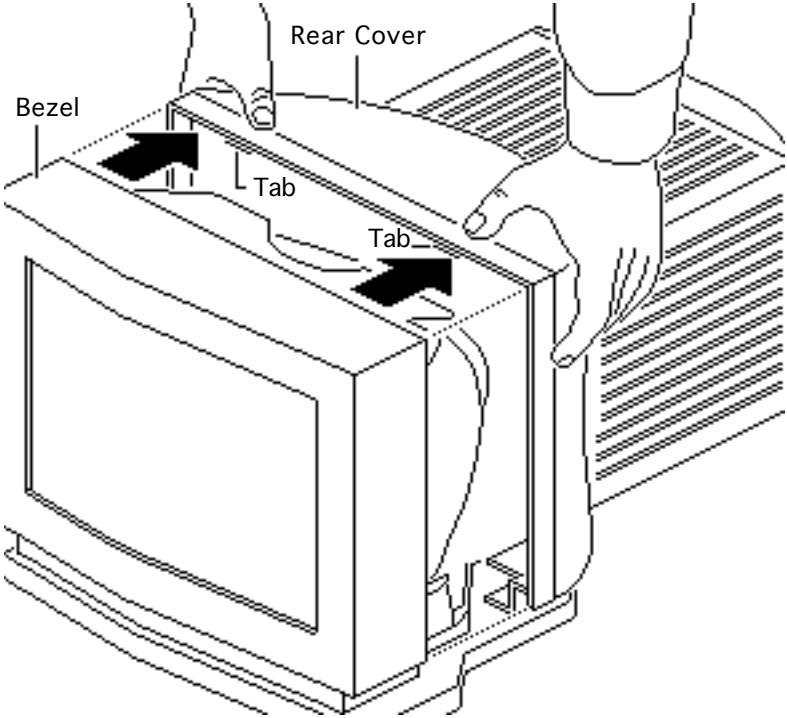


Rear Cover

No preliminary steps are required before you begin this procedure.

1 With the monitor face-down on a protective pad, swivel the base to access the two case screws.

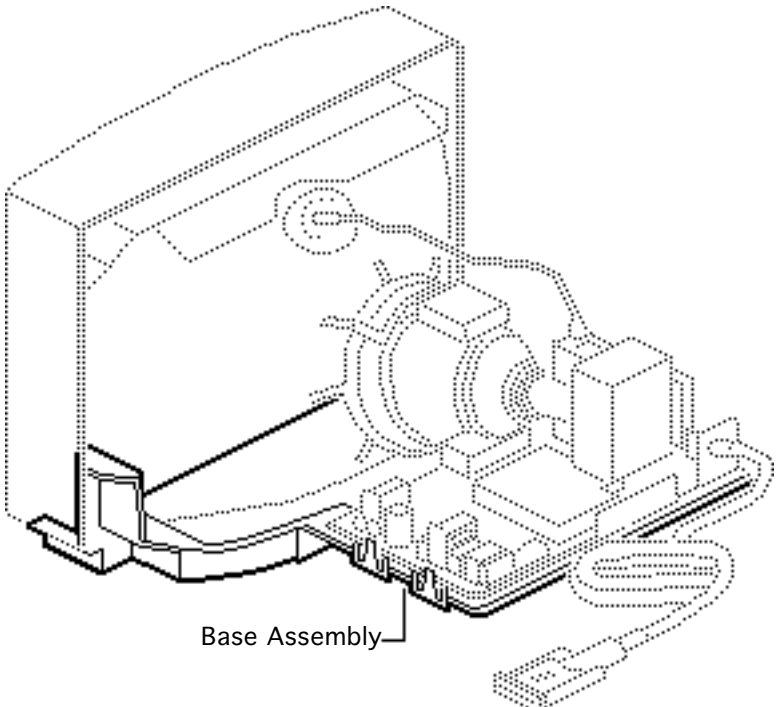
2 Remove the two screws.



3 Set the monitor upright.

4 Press down on the top of the rear cover to release the two tabs from the bezel.

5 Lift the rear cover off the bezel.



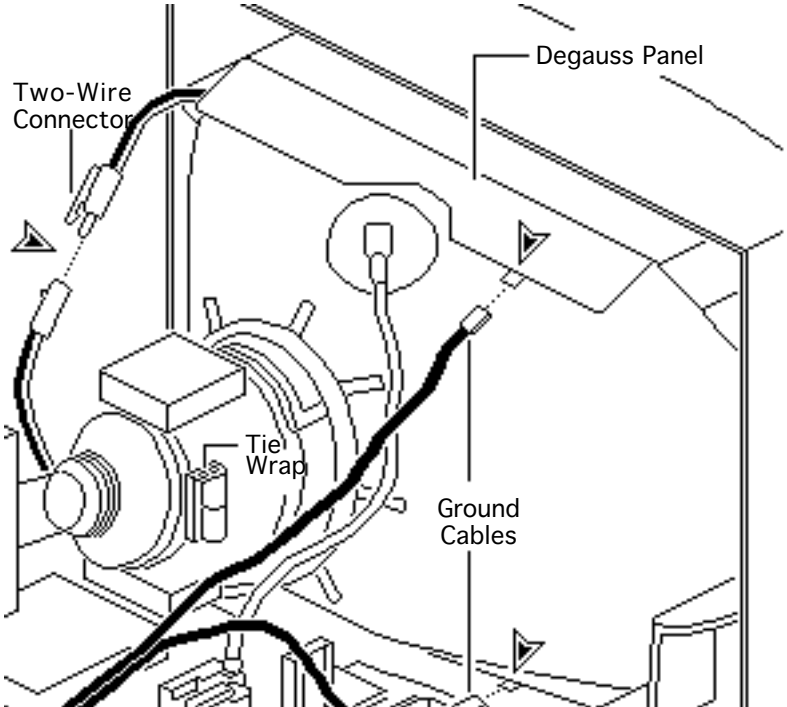
Base Assembly

Before you begin,

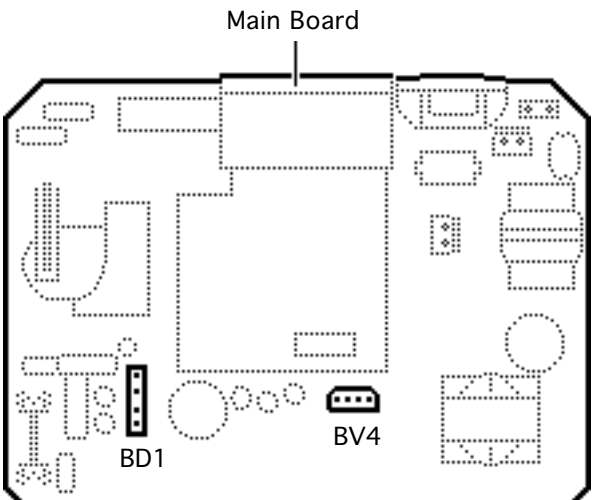
- Remove the rear cover
- Discharge the CRT

Warning: This product contains high voltage and a high-vacuum picture tube. To prevent serious injury, review CRT safety in Bulletins/Safety.

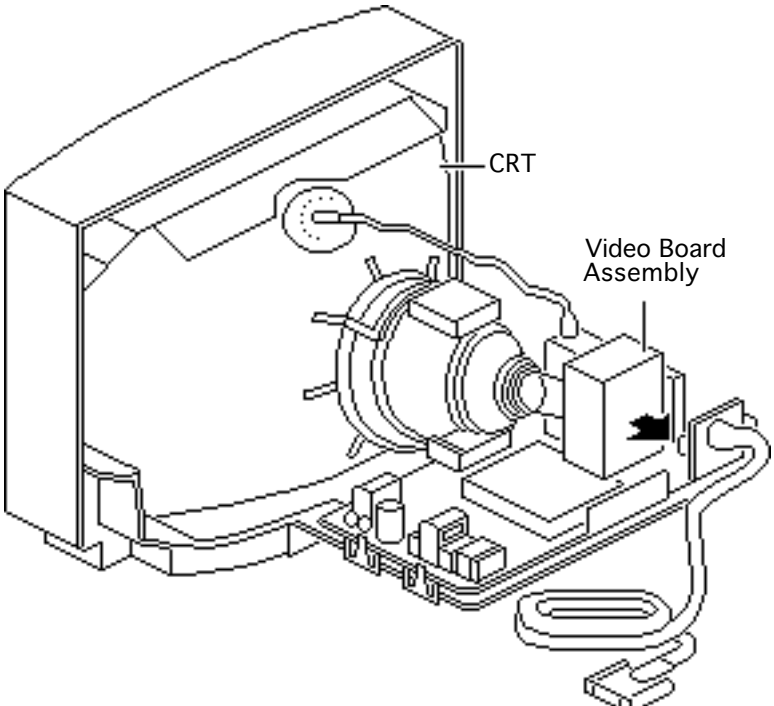
Warning: Never use a grounding wriststrap until after discharging the CRT.



1 Cut the tie wrap and disconnect these cables:
- Two ground cables from the degauss panels
- Two-wire (black/white) cable

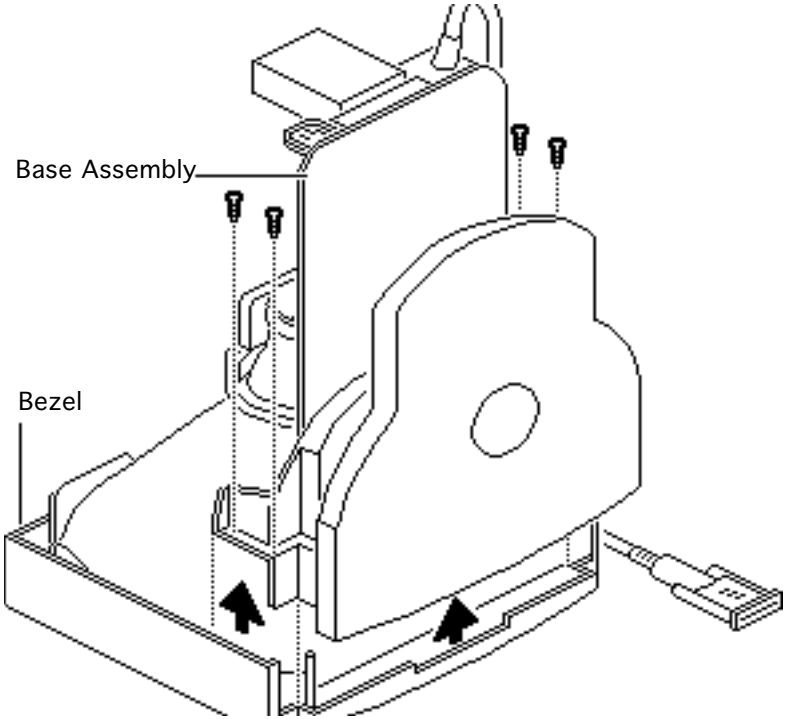


2 Disconnect these cables:
- Yoke cable (4-wire/4-pin) from BD1
- Contrast/brightness cable (4-wire/4-pin) from BV4



Caution: Twisting, bending, or applying force to the video board assembly could damage the neck of the CRT. Be sure to pull the CRT/ video board straight off the CRT.

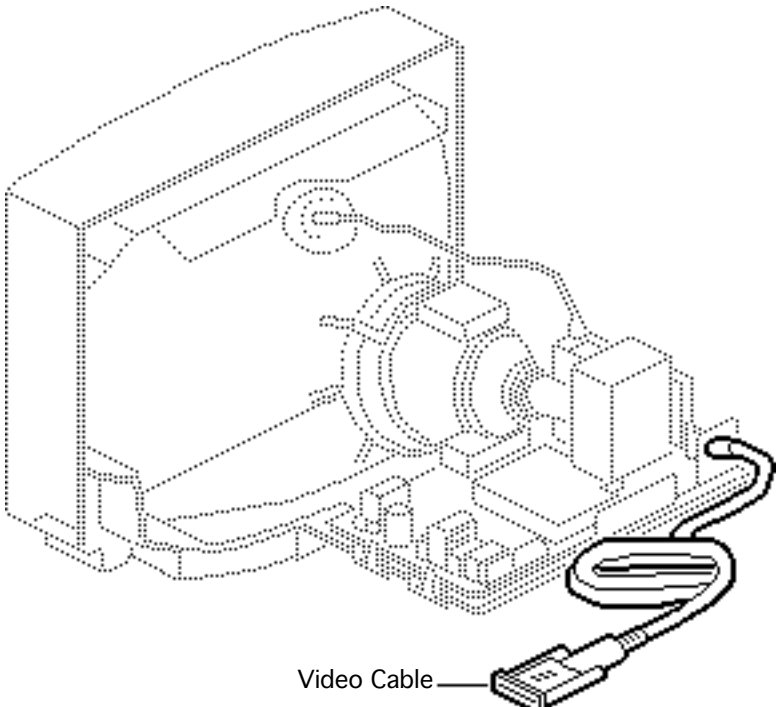
3 Remove the video board assembly from the neck of the CRT.



4 With the monitor face down, remove the four Torx screws that secure the base assembly to the bezel.

5 Lift the base assembly off the bezel.

Replacement Note: The bottom degauss panel remains on the base assembly. If you are replacing the base assembly, remove the bottom degauss panel and reinstall it on the new base assembly.



Video Cable

Before you begin,

- Remove the rear cover
- Discharge the CRT

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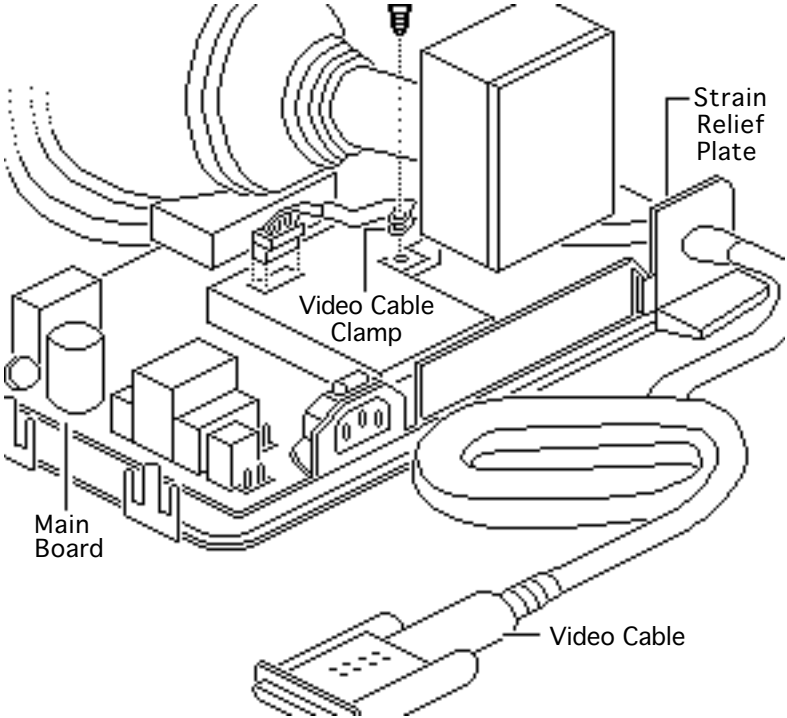
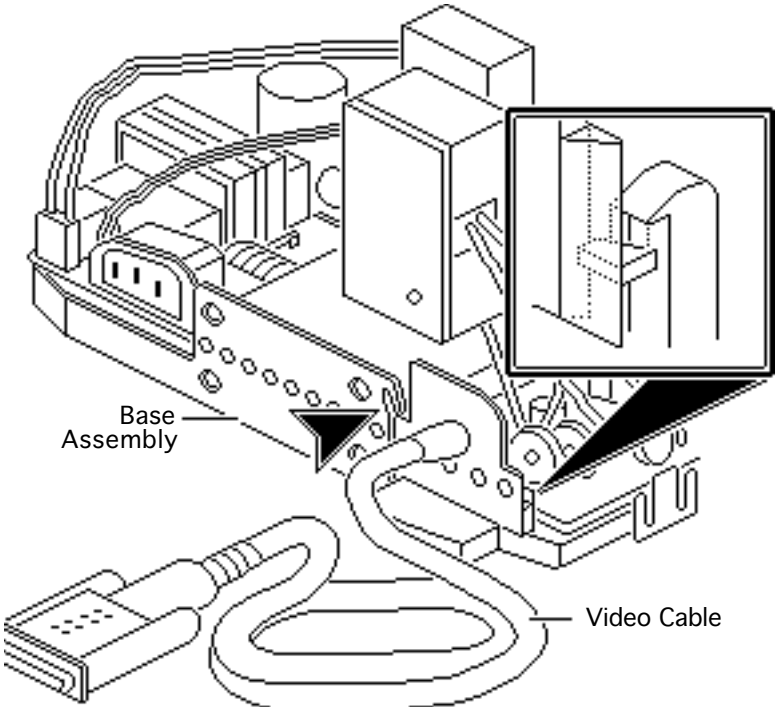
Warning: Never use a grounding wriststrap until after discharging the CRT.



1 Disconnect the video cable from the main board.

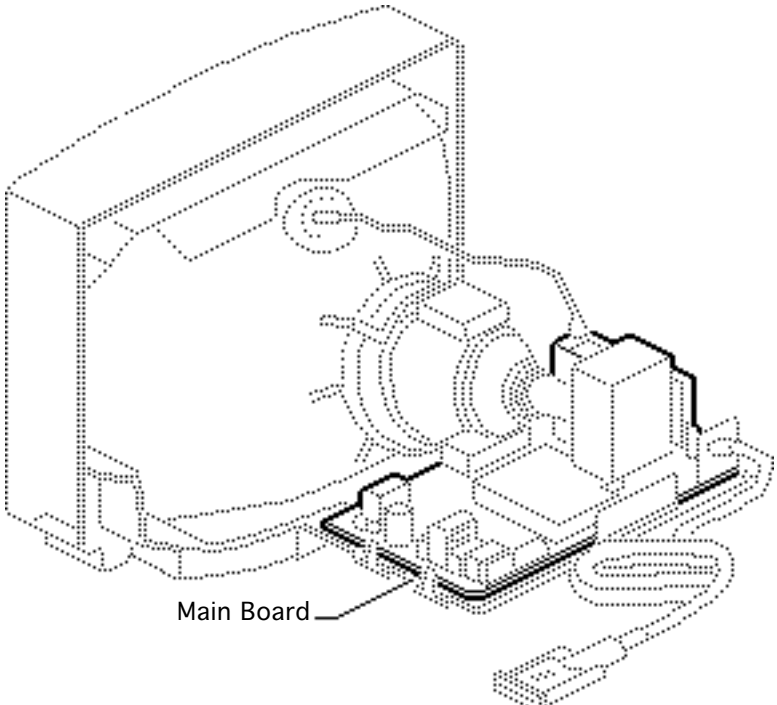
2 Remove the screw that secures the video cable to the main board video housing.

Replacement Note: If you are replacing the video cable, remove the strain relief plate and the video cable clamp and reinstall them on the new video cable.



3 Press back the two plastic latches to release the video cable from the base assembly.

4 Lift out the video cable.



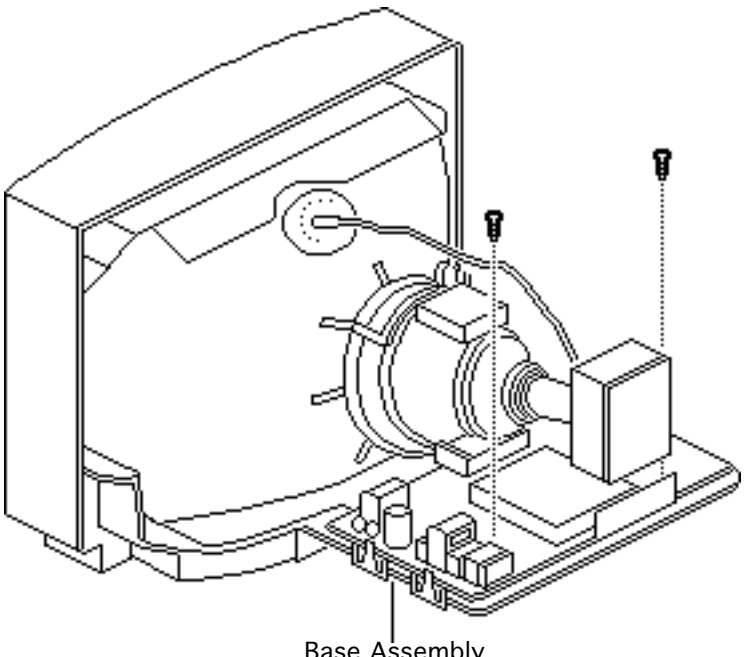
Main Board

Before you begin,

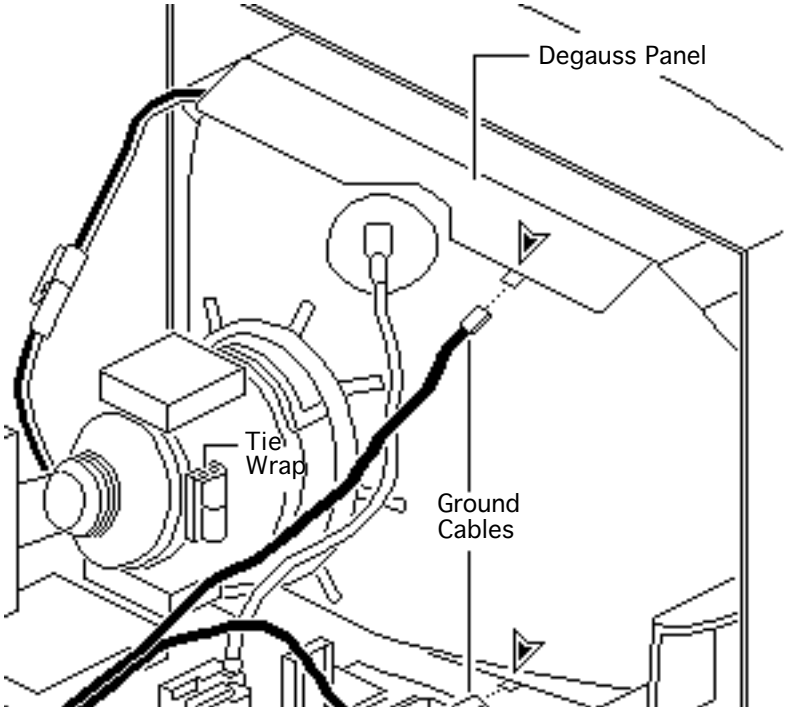
- Remove the rear cover
- Discharge the CRT
- Remove the video cable

Warning: This product contains high voltage and a high-vacuum picture tube. To prevent serious injury, review CRT safety in Bulletins/Safety.

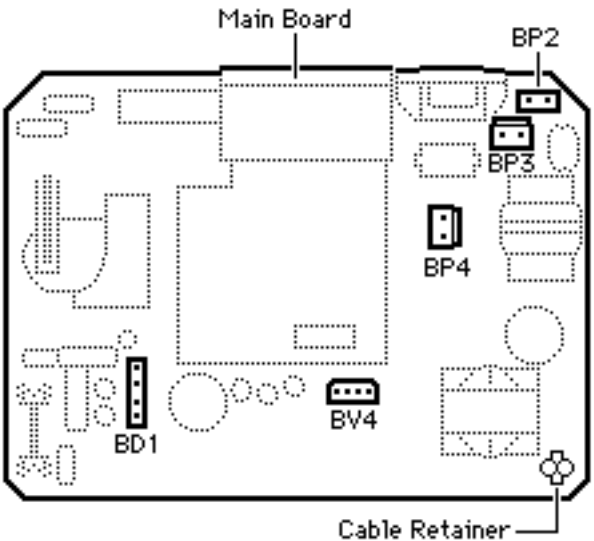
Warning: Never use a grounding wriststrap until after discharging the CRT.



1 Using a Torx screwdriver, remove the two mounting screws that secure the main board to the base assembly.

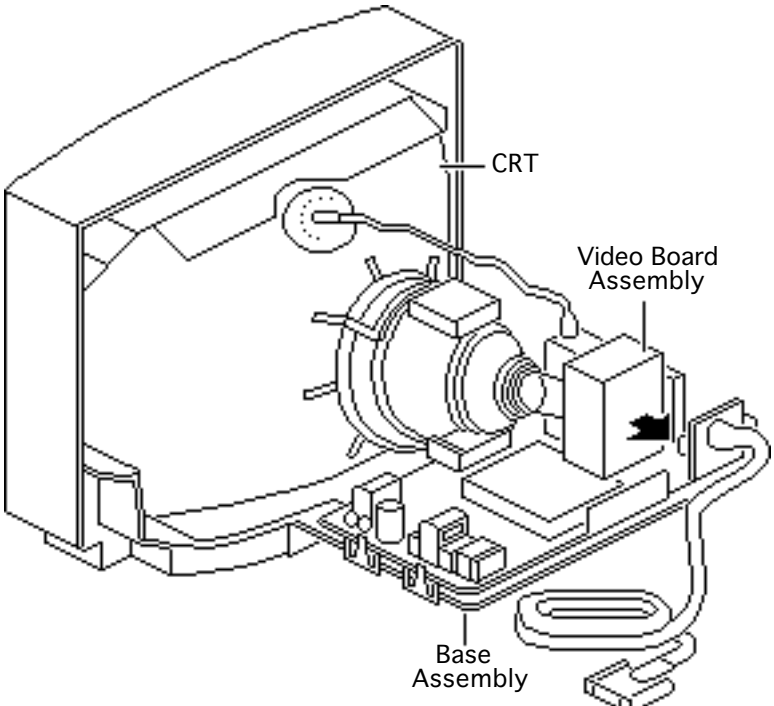


2 Cut the tie wrap and disconnect the two ground cables from the degauss panels.



3 Disconnect the following cables from the main board:
- LED cable from BP4
- On/off cable from BP3
- Degauss cable from BP2
- CRT cable from BD1
- Contrast/brightness cable from BV4

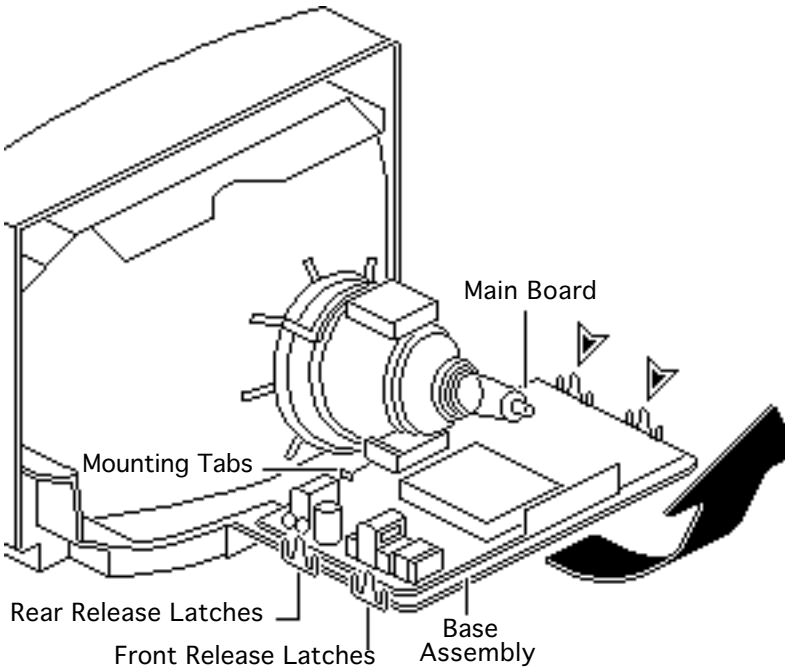
4 Remove the wires from the cable retainer.



Replacement Note: If you are replacing the main board, remove the cable retainer and reinstall it on the new board.

5 **Caution:** Twisting, bending, or applying force to the video board assembly could damage the neck of the CRT. Be sure to pull the CRT/video board straight off the CRT.

Remove the video board assembly from the neck of the CRT.

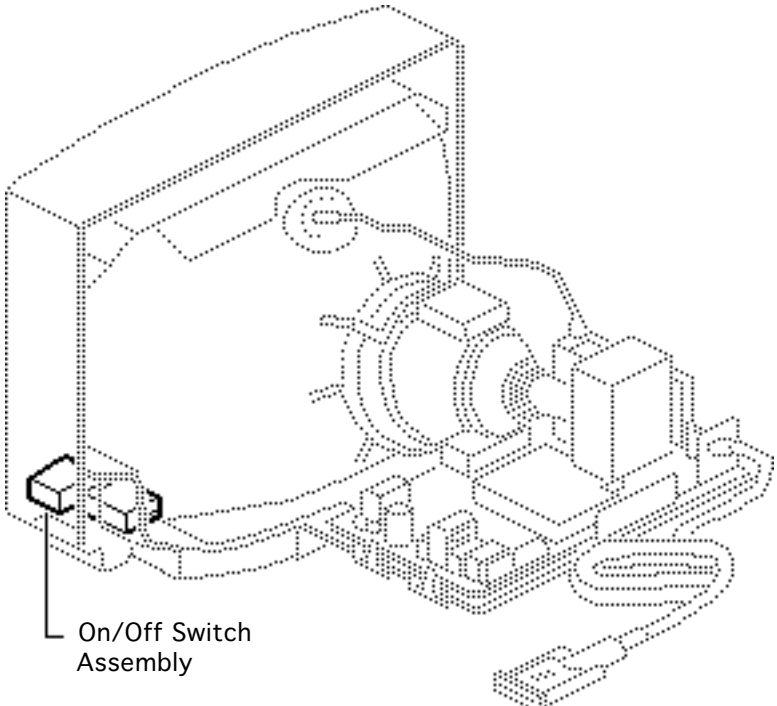


6 Push out the two front release latches and lift the main board slightly.

7 Push out the two rear release latches. Lift up and slide the main board back to clear the mounting tabs.

8 Remove the board from the base assembly.

Replacement Note: Perform the cutoff adjustment whenever you replace the main board. See “Video” in the Adjustments chapter.



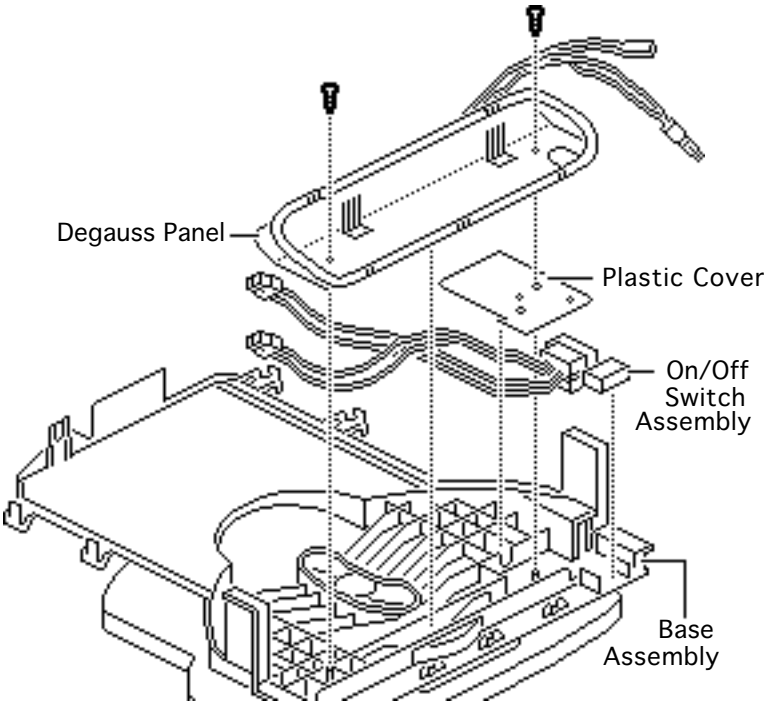
On/Off Switch Assembly

Before you begin,

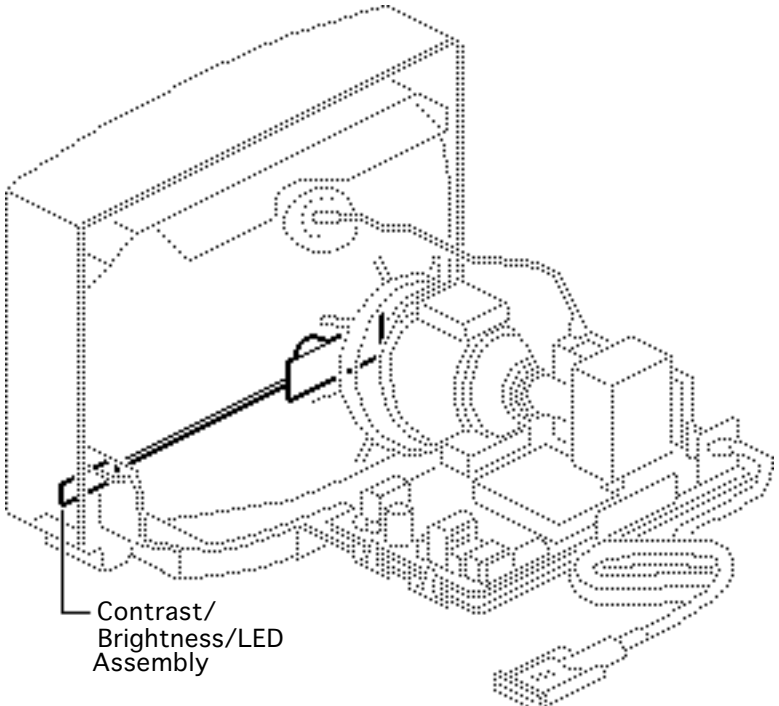
- Remove the rear cover
- Discharge the CRT
- Remove the base assembly

Warning: This product contains high voltage and a high-vacuum picture tube. To prevent serious injury, review CRT safety in Bulletins/Safety.

Warning: Never use a grounding wriststrap until after discharging the CRT.



1. Using a Torx screwdriver, remove the two mounting screws and the degauss panel from the base assembly.
2. Remove the plastic cover.
3. Lift the on/off switch assembly out of the base.

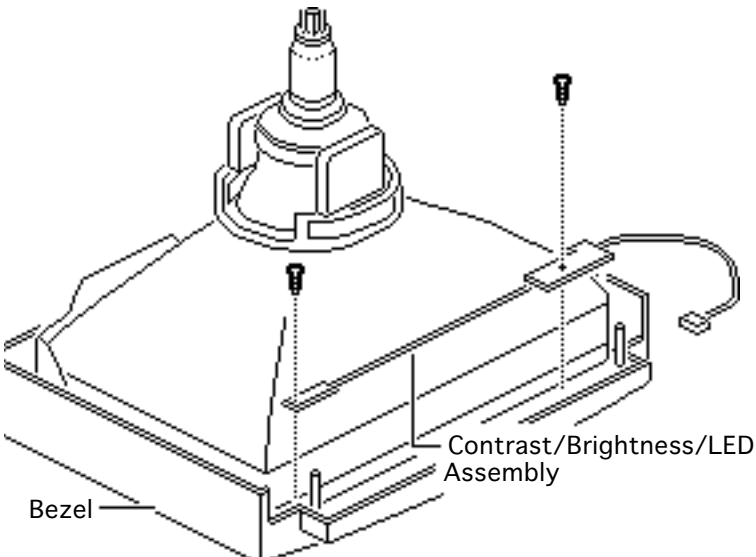


Contrast/ Brightness/LED Assembly

Before you begin,

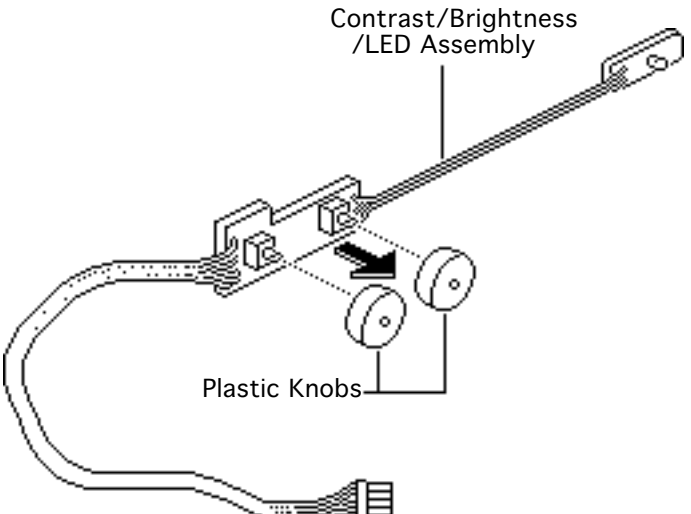
- Remove the rear cover
- Discharge the CRT
- Remove the base assembly

Warning: This product contains high voltage and a high-vacuum picture tube. To prevent serious injury, review CRT safety in Bulletins/Safety.

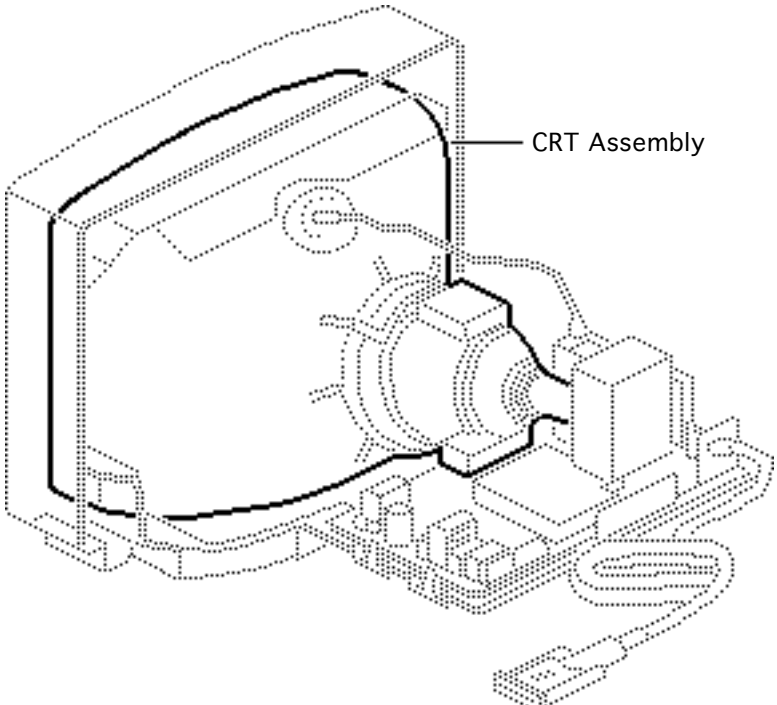


⚠**Warning:** Never use a grounding wriststrap until after discharging the CRT.

Using a Torx screwdriver, remove the two mounting screws and lift the contrast/brightness/LED assembly from the bezel.



Replacement Note: If you are replacing the contrast/brightness/LED assembly, remove the plastic knobs and reinstall them on the new contrast/brightness/LED assembly.



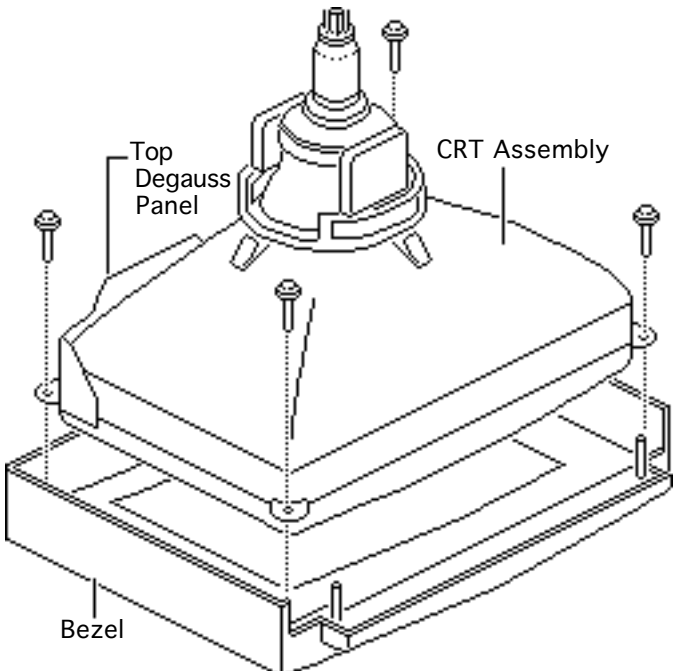
CRT Assembly

Before you begin,

- Remove the rear cover
- Discharge the CRT
- Remove the base assembly

Warning: This product contains high voltage and a high-vacuum picture tube. To prevent serious injury, review CRT safety in Bulletins/Safety.

Warning: Never use a grounding wriststrap until after discharging the CRT.

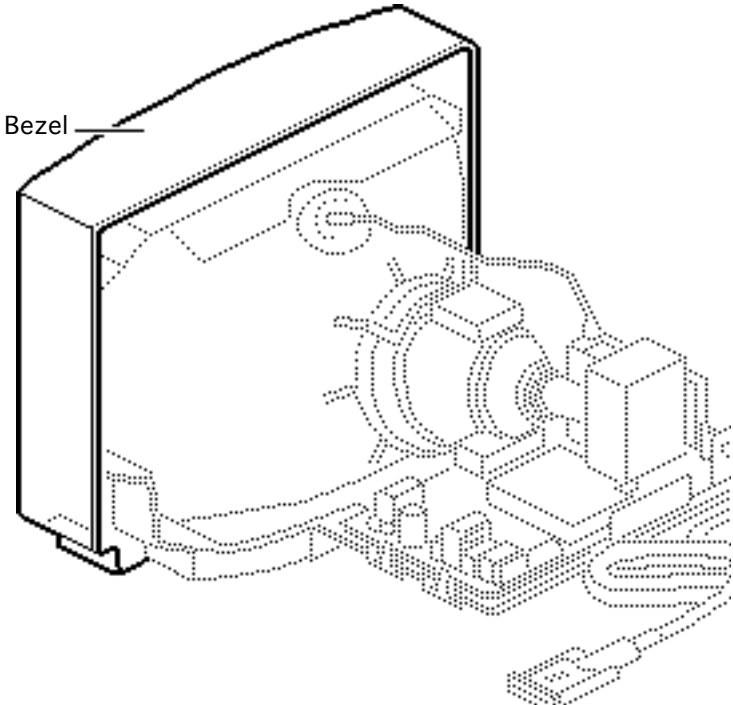


1 Remove the four screws that secure the CRT assembly to the bezel.

2 Carefully lift the CRT assembly out of the bezel.

Replacement Note: The top degauss panel remains on the CRT. The bottom degauss panel remains on the base assembly. If you are replacing the CRT, remove the top degauss panel and reinstall it on the new CRT.

Replacement Note:
Perform the cutoff adjustment whenever you replace the CRT assembly. See “Video” in the Adjustments chapter.



Bezel

Before you begin,

- Remove the rear cover
- Discharge the CRT
- Remove the base assembly
- Remove the CRT assembly

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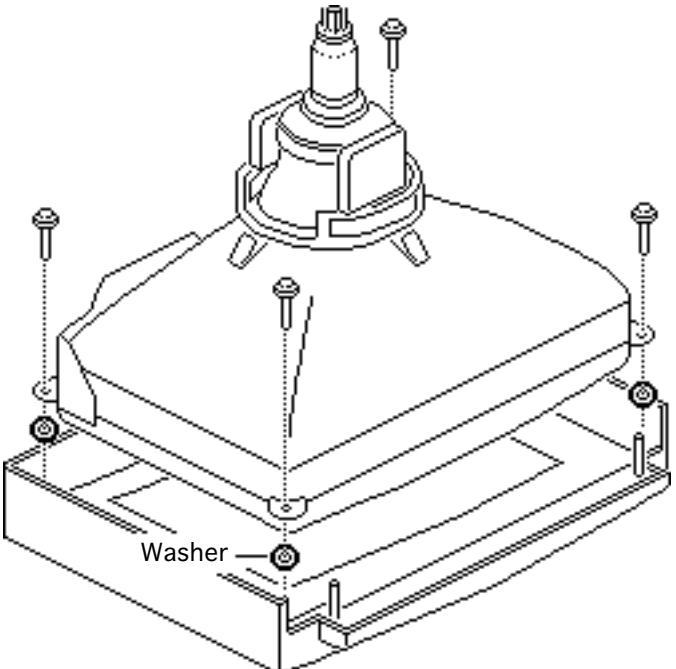
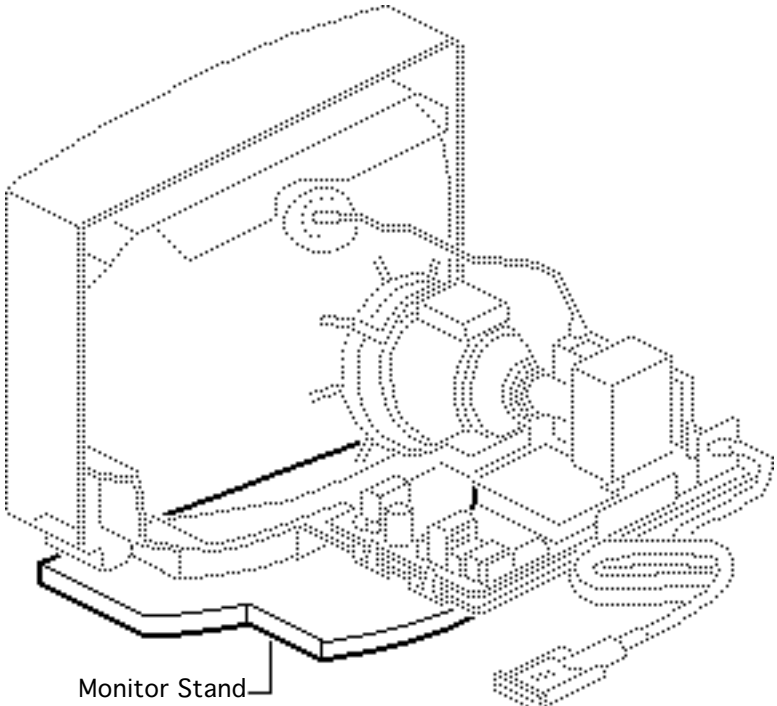
Warning: Never use a grounding wriststrap until after discharging the CRT.



Lift the CRT off of the bezel.

Replacement Note: Install the four washers included with the new bezel.



Monitor Stand

Before you begin,

- Remove the rear cover
- Discharge the CRT
- Remove the base assembly
- Remove the main board
- Remove the CRT assembly
- Remove the bezel

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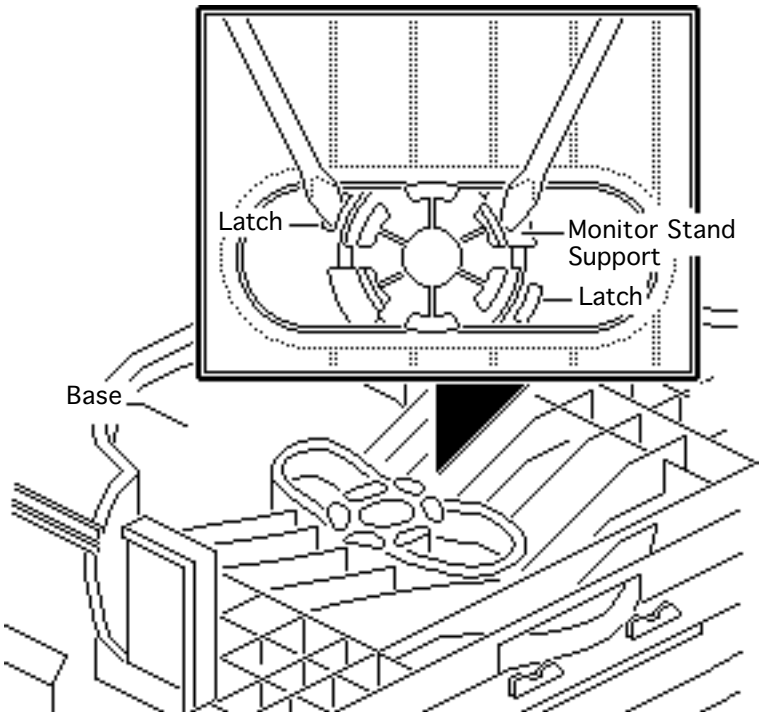
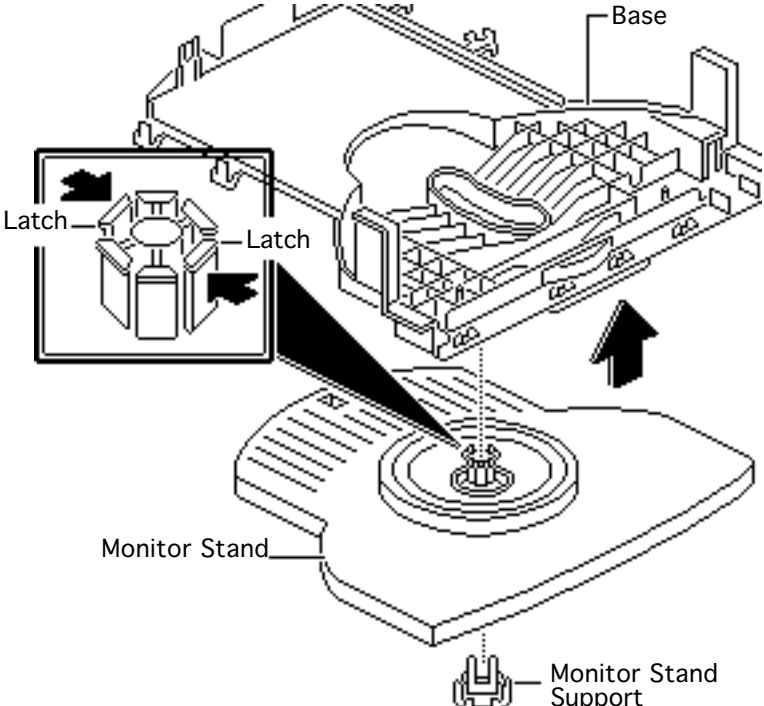


Warning: Never use a grounding wriststrap until after discharging the CRT.

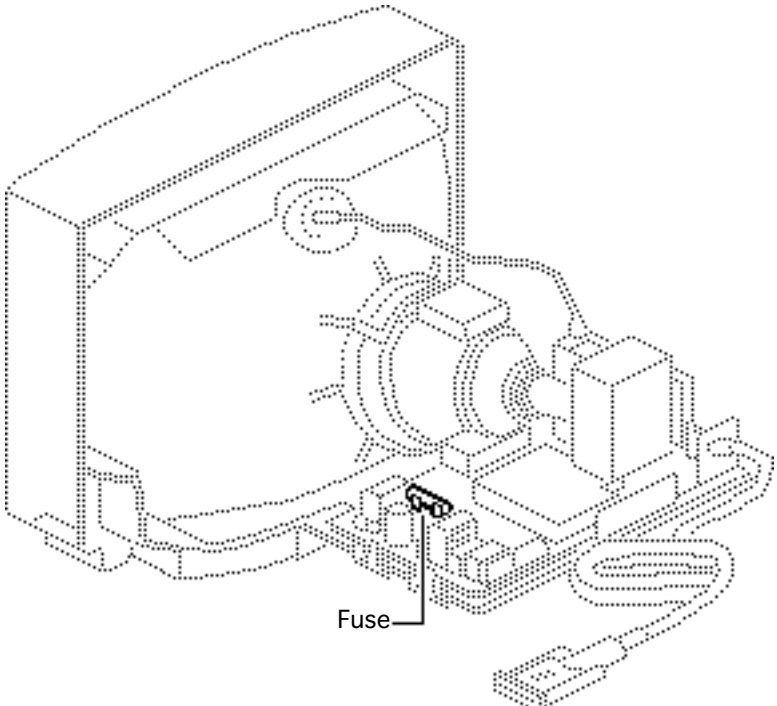
1. Using two screwdrivers, push the two latches to the center of the monitor stand and press down on the monitor stand support.
2. Swivel the base to access the two remaining latches and repeat the first step.



3 Remove the monitor stand support.

Replacement Note: If you are replacing the monitor stand, reinstall the support onto the new monitor stand.

4 Push in the two latches and remove the monitor stand from the base.



Fuse

Before you begin,

- Remove the rear cover
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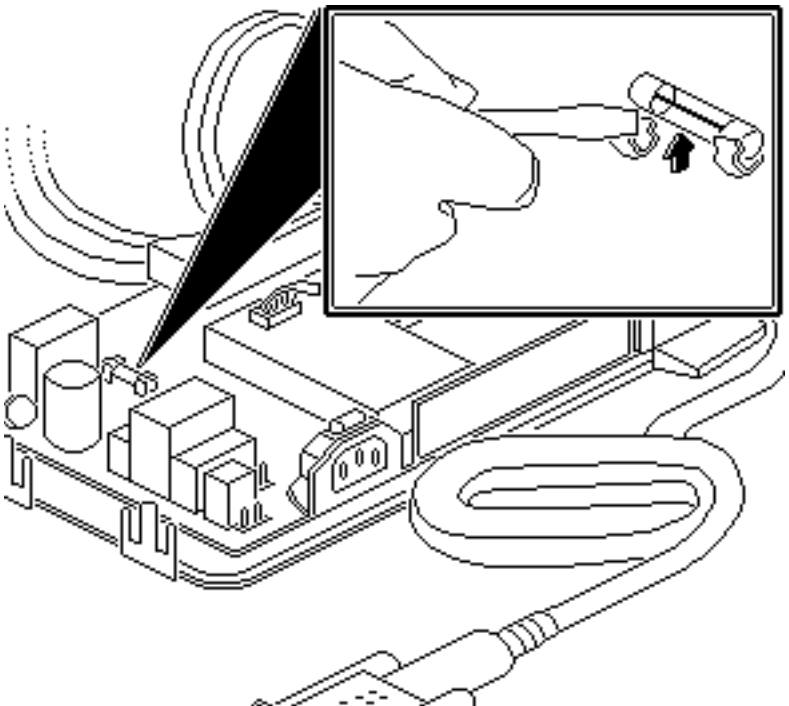
Warning: Never use a grounding wriststrap until after discharging the CRT.



Using a small, long-stemmed screwdriver, pry up one end of the fuse and remove it from the main board.

Adjustments

Macintosh Color Display

Geometry

Before you begin, remove the rear cover.

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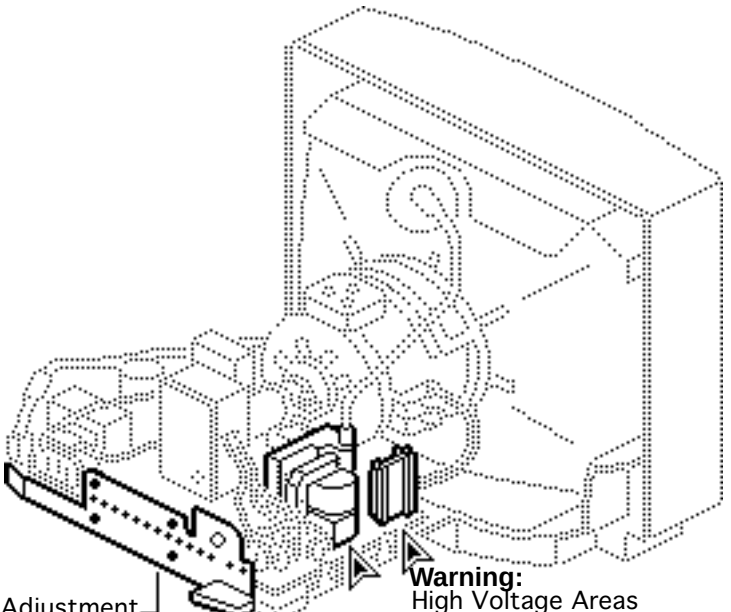
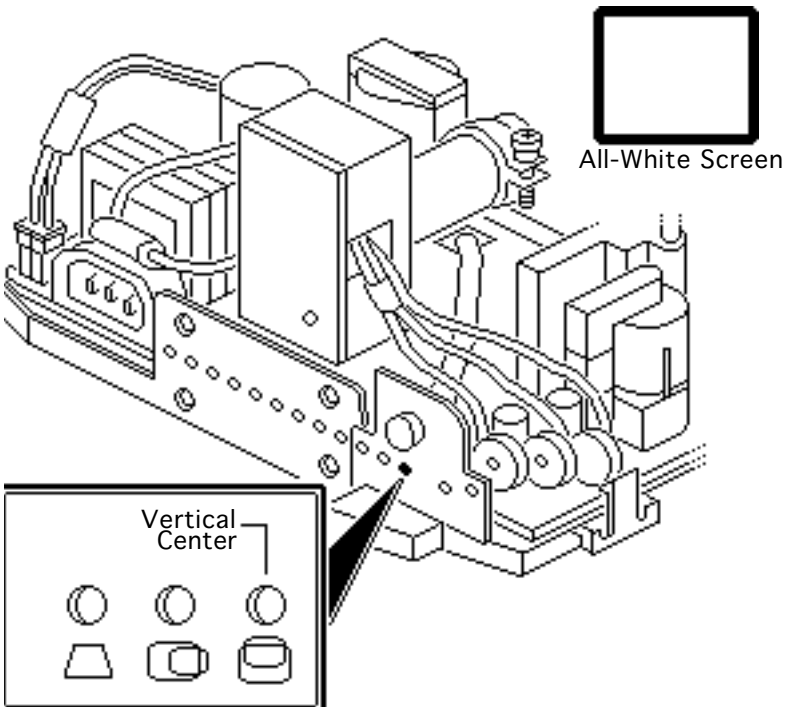


Note: The controls on this monitor require a small hex-head plastic tool to make adjustments. If the tool is long, it will be too flexible, which will make fine adjustments difficult. Use a short hex-head plastic tool to minimize flexing.

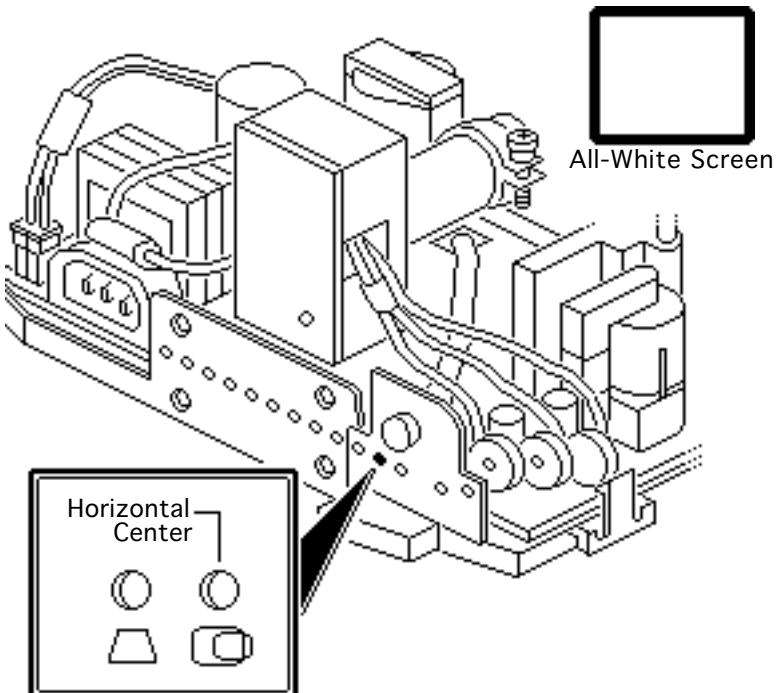
Warning: Do not use metal alignment tools—they are a shock hazard.



Vertical Center

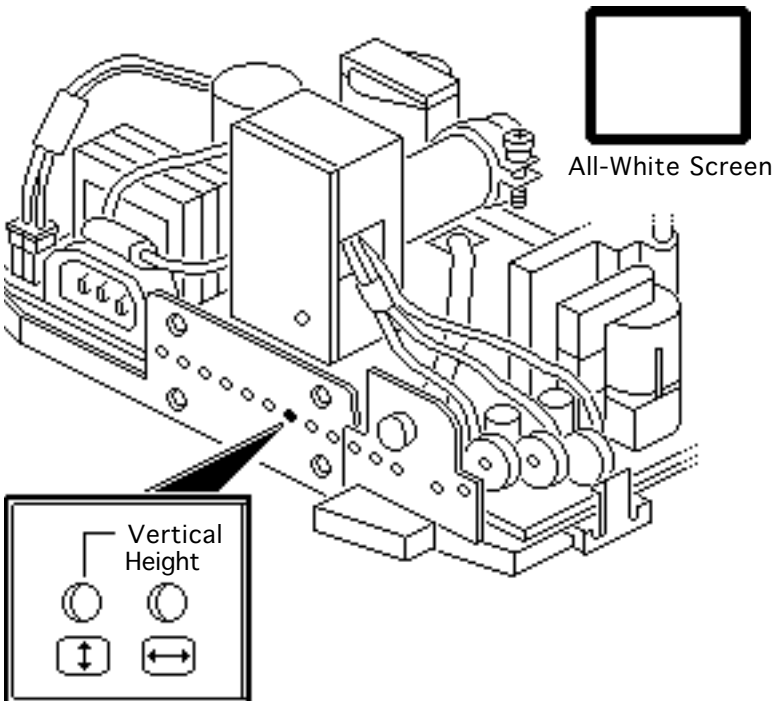
1 Use Display Service Utility to display the All-White Screen test pattern.

2 Using a hex-head plastic adjustment tool, adjust the vertical center control until the raster is centered (top to bottom) in the display area.



Horizontal Center

Using a hex-head plastic adjustment tool, adjust the horizontal center control until the raster is centered (side to side) in the display area.



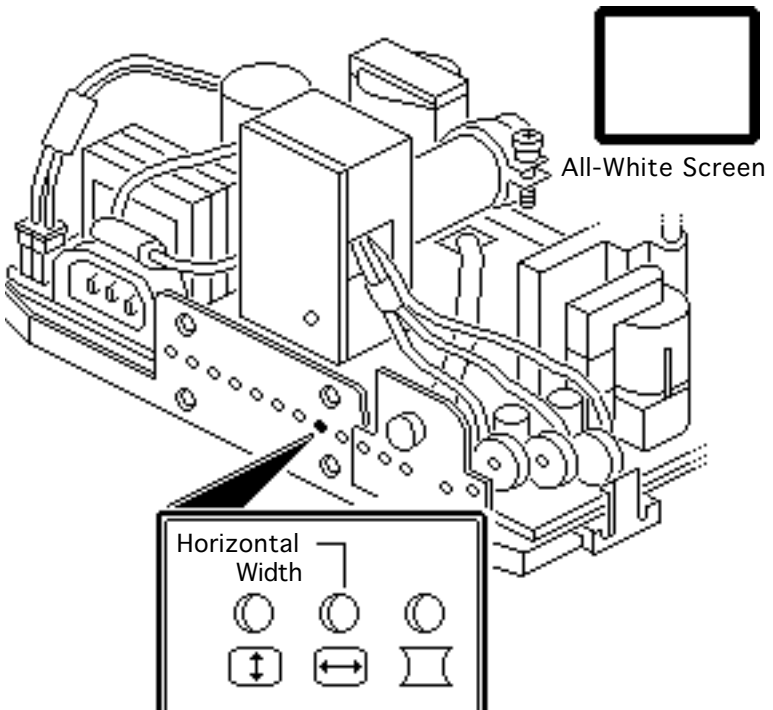
Vertical Size

1 Using a hex-head plastic adjustment tool, adjust the vertical height control until the raster height is 7 in. (± 1/8 in.) or 176 mm (± 2 mm).

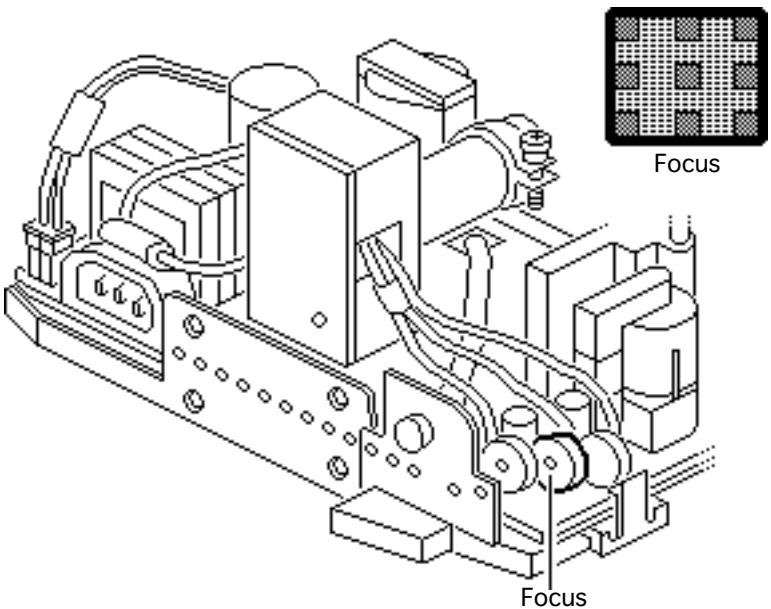
2 Verify this height. If it is off, repeat the vertical size adjustment and, if necessary, the vertical center adjustment.

Horizontal Size

Note: Due to video features and timing differences across the Apple line of Macintosh computers, the width of the raster/image area on the Macintosh Color Display may vary up to 3/16 in. at each side of the display. Perform the horizontal size adjustment to set the display to its proper width.



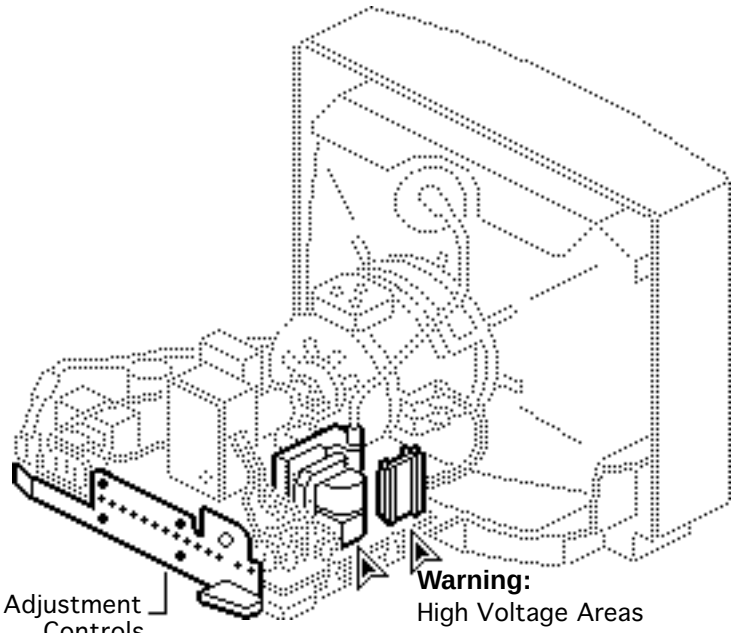
Using a hex-head plastic adjustment tool, adjust the horizontal width control until the raster is 9 1/4 in. (± 1/8 in.) or 235 mm (± 2 mm).



Focus

1 Use Display Service Utility to display the Focus test pattern.

2 Using a hex-head plastic adjustment tool, adjust the focus control until the Focus test pattern is as clear as possible.

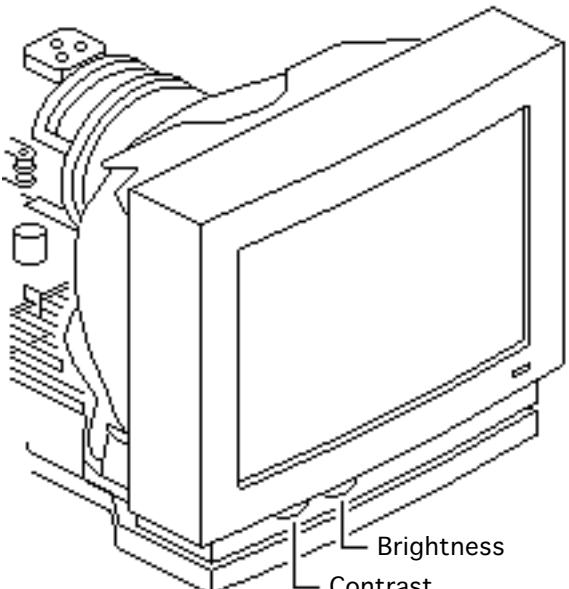


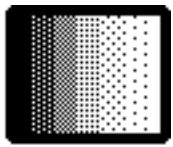
Video

Before you begin, remove the rear cover.

⚠**Warning:** This product contains high voltage and a high-vacuum picture tube. To prevent serious injury, review CRT safety in Bulletins/Safety.

Note: Perform the cutoff adjustment prior to adjusting the white balance.



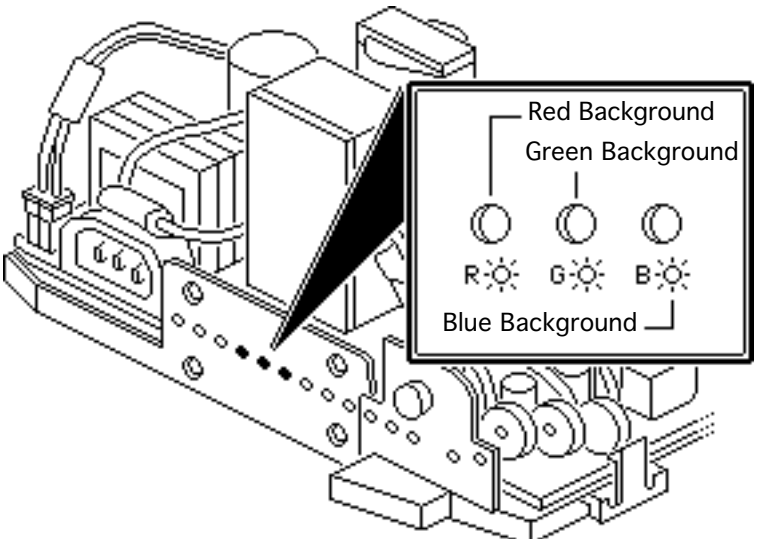

Gray Bars

Cutoff

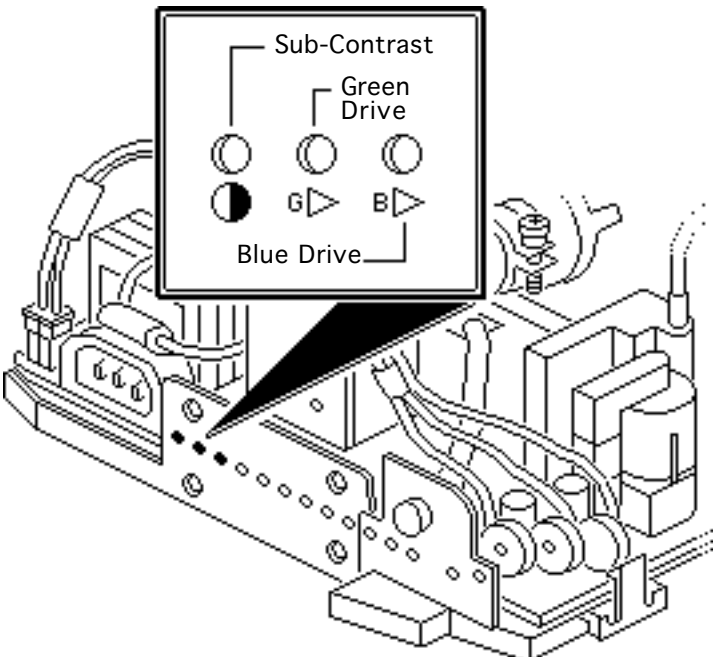
Note: Perform the cutoff adjustment after the monitor has been on for at least 10 minutes.

1 Use Display Service Utility to display the Gray Bars test pattern.

2 Set the contrast control to maximum (clockwise) and the brightness control to the center (detent) position.



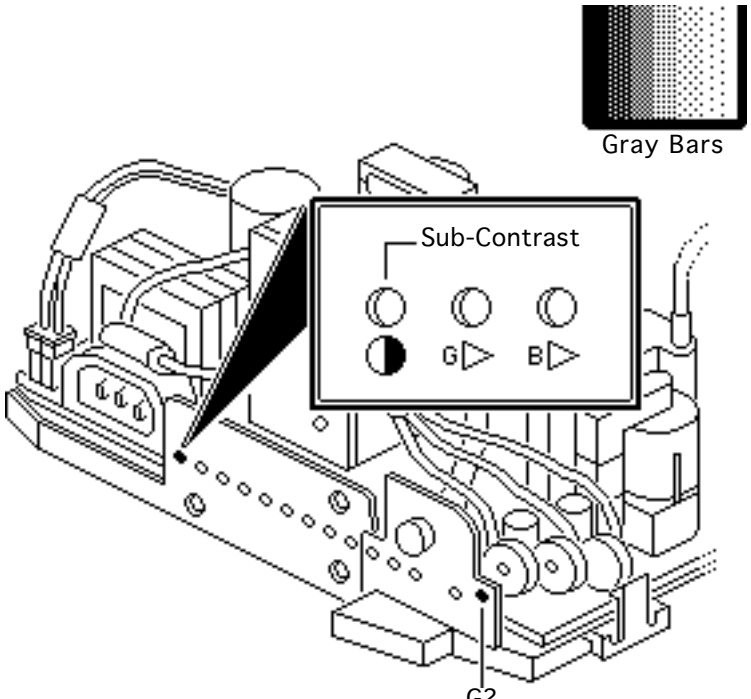
3 Using a hex-head plastic adjustment tool, set the red, green, and blue background controls to the full counterclockwise positions.



Note: To set the green and blue drive controls to their 3/4 position, turn the controls to their full clockwise position and then turn back 1/4 turn counterclockwise.

4 Set the green and blue drive controls clockwise to their 3/4 position.

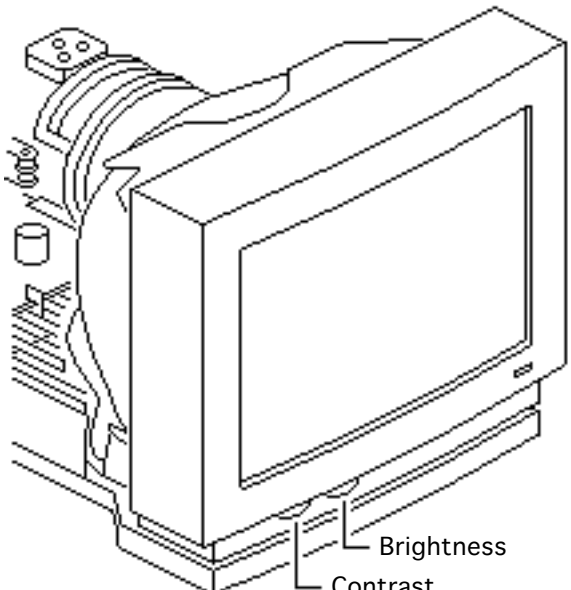
5 Set the sub-contrast control to its full clockwise position.

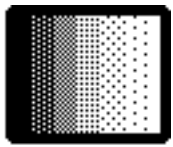


6 Using a hex-head plastic adjustment tool, adjust G2 until the first bar in the test pattern is completely black and the second bar is barely visible.

7 Set the sub-contrast control to the center position.

Replacement Note: Perform the cutoff adjustment whenever you replace the CRT assembly or the main board.



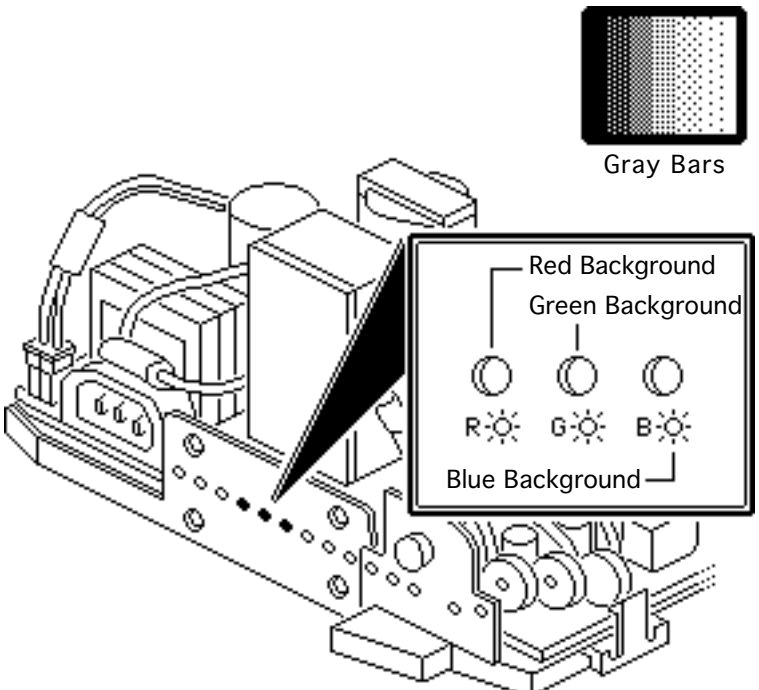


Gray Bars

White Balance

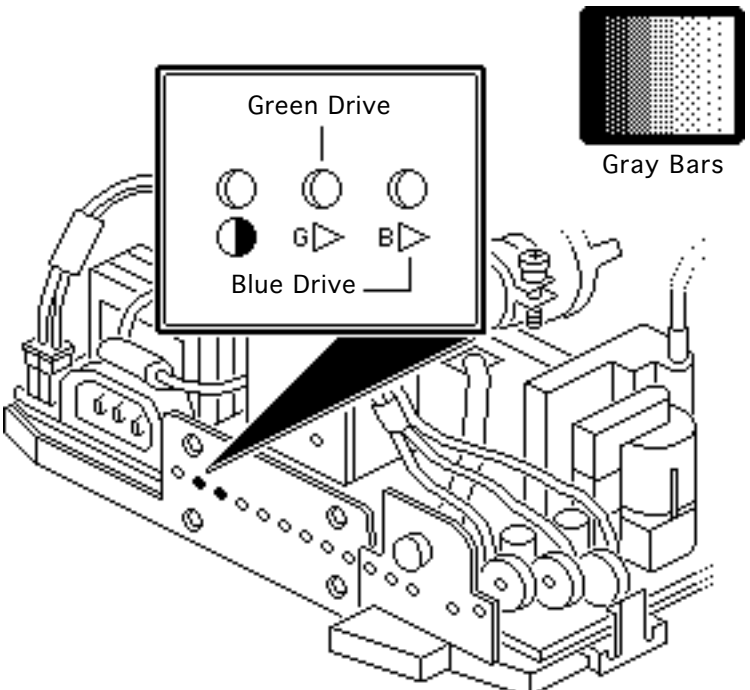
Note: Perform the white balance adjustment after the monitor has been on for at least 10 minutes.

1. Use Display Service Utility to display the Gray Bars test pattern.
2. Set the contrast control (clockwise) to maximum and the brightness control to the center (detent) position.



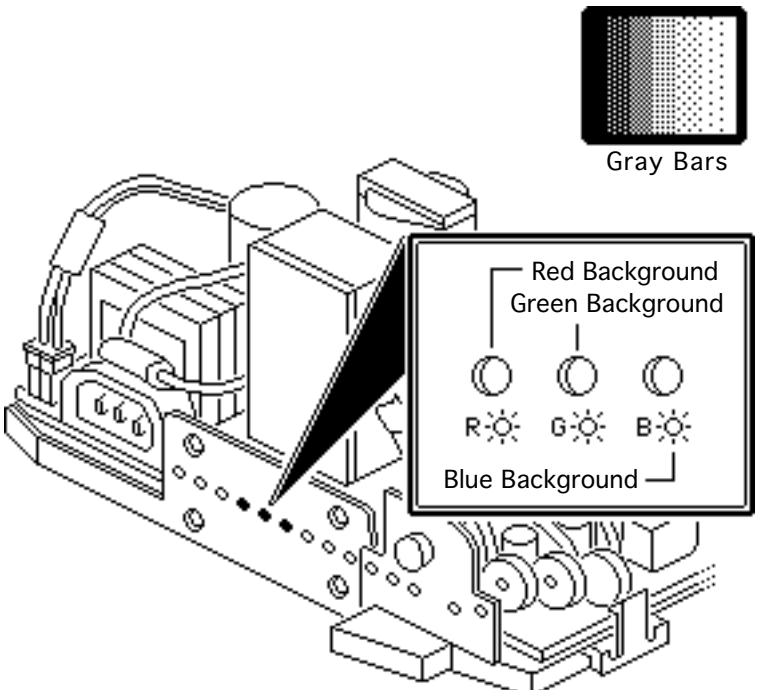
3 Note the predominant color.

4 Using a hex-head plastic adjustment tool, alternately adjust the red, green, and blue background controls until there is no predominant color in the four darkest bars.

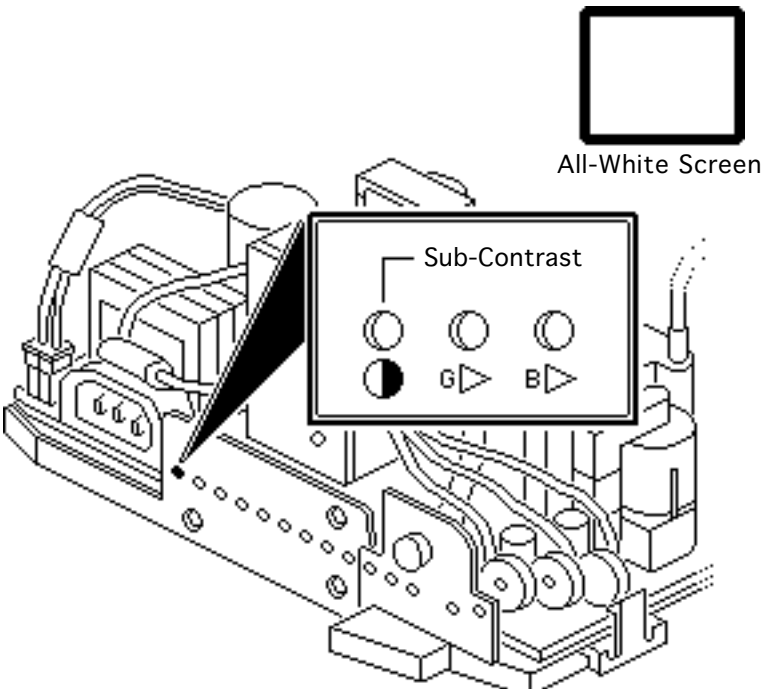


Note: The darkest bar must remain completely black throughout the rest of the procedure. If you notice a predominant color in the darkest bar, readjust the appropriate background control.

5 If necessary, adjust the blue and green drive controls until there is no predominant color in the four brightest bars.

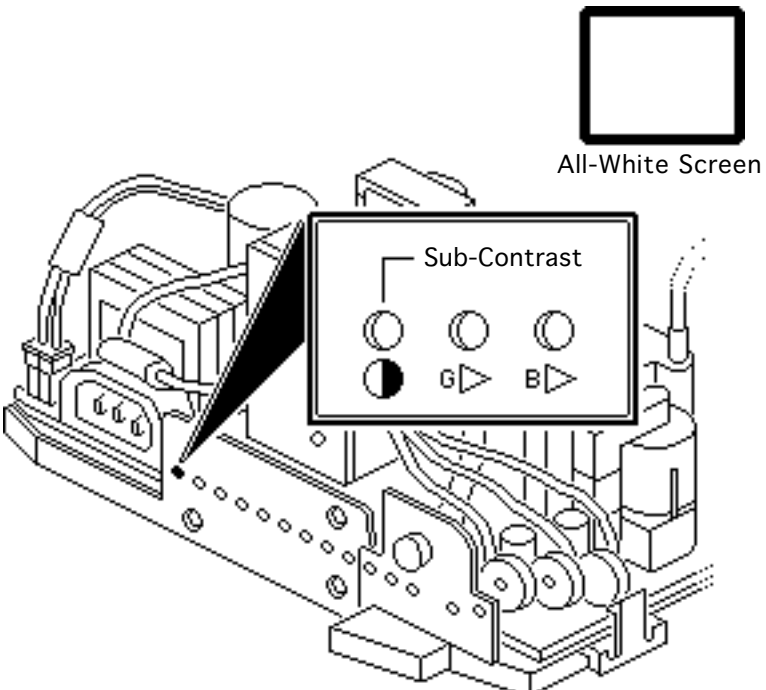


6 Check the four darkest bars, and if necessary, adjust the red, green, and blue background controls until there is no predominant color.



Important: Readings from light meter models R77, L-248, and 246 differ. Please note which meter you are using before making adjustments. (See “Light Meter Setup.”)

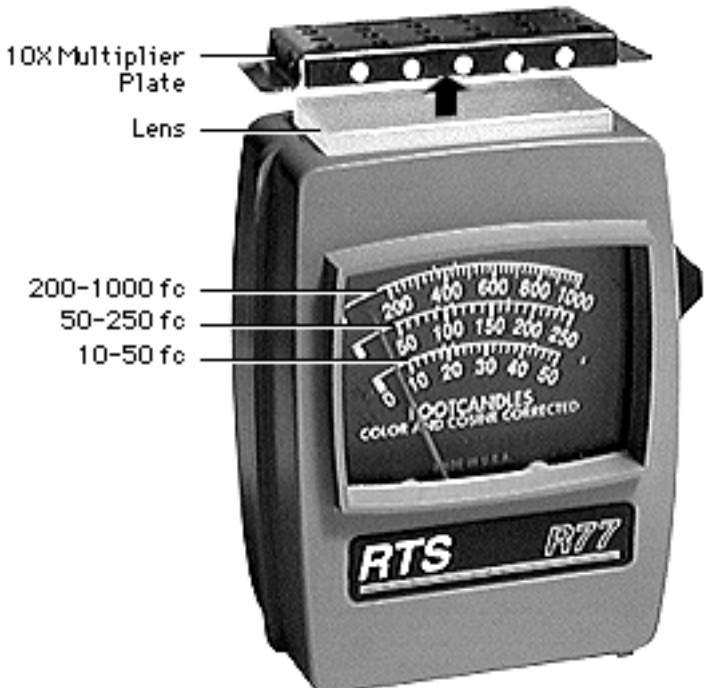
7 Using Display Service Utility, display the All-White Screen test pattern.



8 Using the light meter and a two-inch plastic screwdriver, adjust the sub-contrast control until you get 30 foot lamberts (± 3 foot lamberts), which on the light meter is

- Model R77: 23 on the bottom scale
- Model L-248: middle of the 10 scale
- Model 246: 23 on the red scale

Important: Over time, light meter tolerances can vary. If you doubt your meter's accuracy, verify the readings with a known-good light meter or photometer.



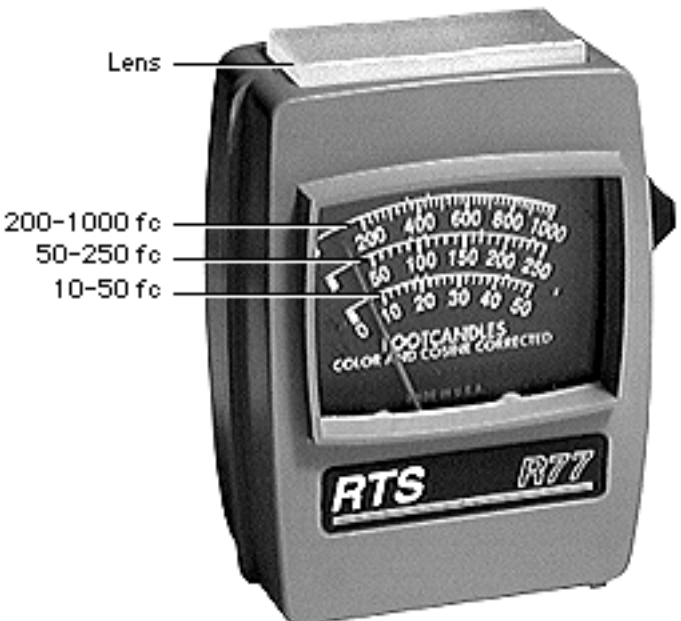
Light Meter Setup

This topic covers setup for three light meter models: R77, L-248, and 246. Model R77 (Apple part number 076-0310) is the newest model available.

Model R77

The R77 light meter is capable of reading luminance from 10 to 1,000 footcandles (fc).

Before you begin, remove the 10X multiplier plate

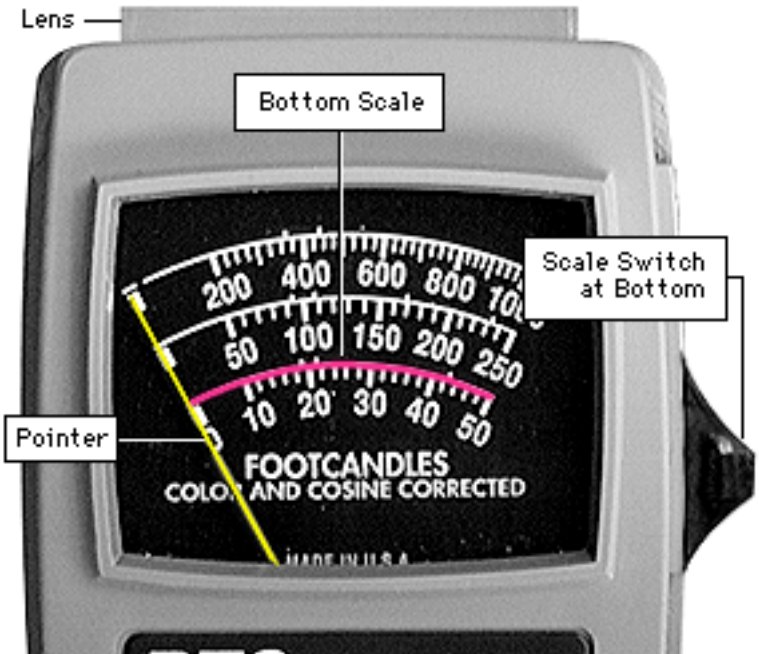


from the lens.

Three scales are shown on the light meter:

- 200-1000 fc
- 50-250 fc
- 10-50 fc

Because display screen luminance typically ranges from 10 to 50 fc, take readings from the bottom scale only.



To measure a display screen's luminance,

1 Set the scale switch to the bottom position (to set up the 10-50 fc scale).

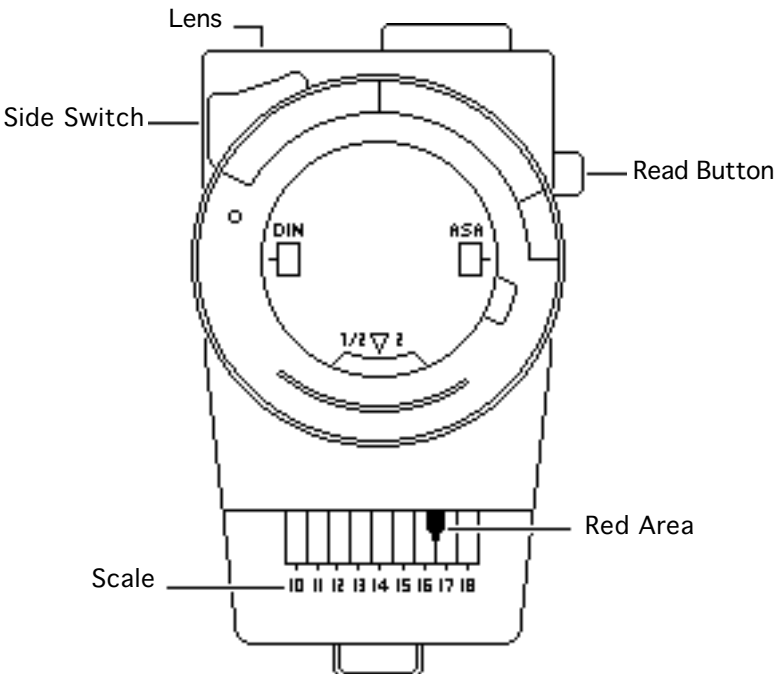
2 Place the lens against the middle of the screen and read the bottom scale.

Note: When the light meter is not in use, slide the scale switch to its top position, and store the meter in its protective case.

Important: If you suspect the light meter is giving false

readings, verify the readings with a known-good light meter or photometer. Also check the age of the R77 light meter by its four-digit manufacturing date stamp (such as 0398 for March 1998).

Caution: Dropping the meter can permanently damage its accuracy. A shock-damaged meter might read incorrectly or its pointer may not drop to zero.



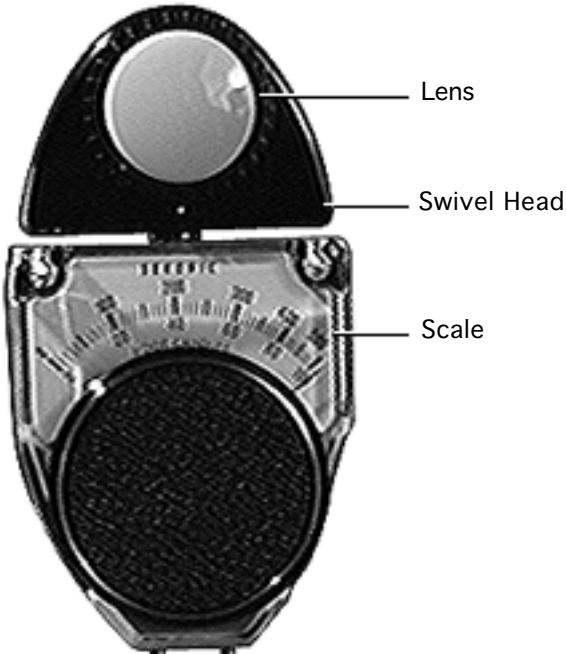
Model L-248

1 Press the red button on the back of the light meter. If the reading is out of the red area, replace the battery.

2 Move the side switch to its upper position so that the scale reads 10 through 18.

3 Uncover the lens of the meter.

4 Place the lens against the middle of the screen and press the read button to read the scale.



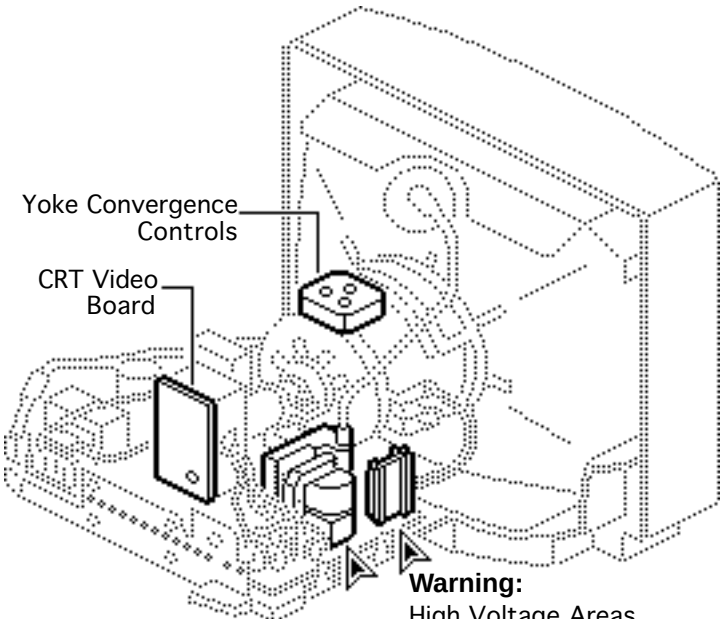
Model 246

1 Remove the metal slide, if installed, from the top of the light meter.

2 Install the white lens with the red dot.

3 Rotate the swivel head so the lens of the meter faces the monitor.

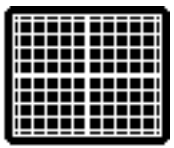
4 Place the lens against the middle of the screen and read the scale.



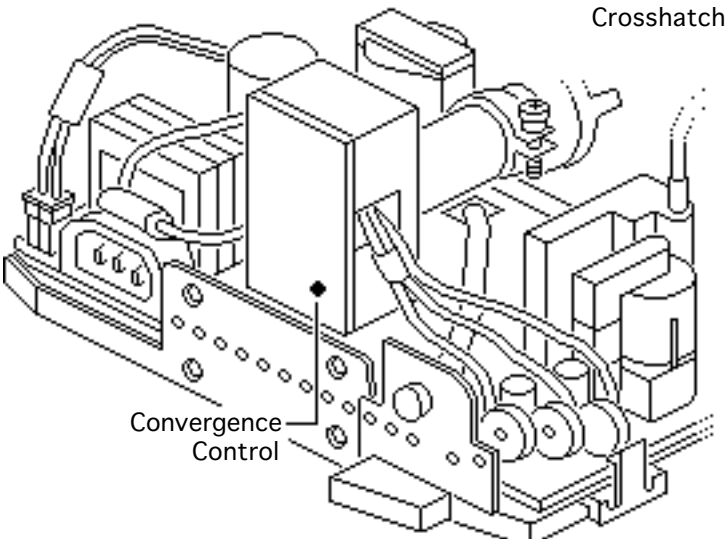
Convergence

Before you begin, remove the rear cover.

⚠**Warning:** This product contains high voltage and a high-vacuum picture tube. To prevent serious injury, review CRT safety in Bulletins/Safety.

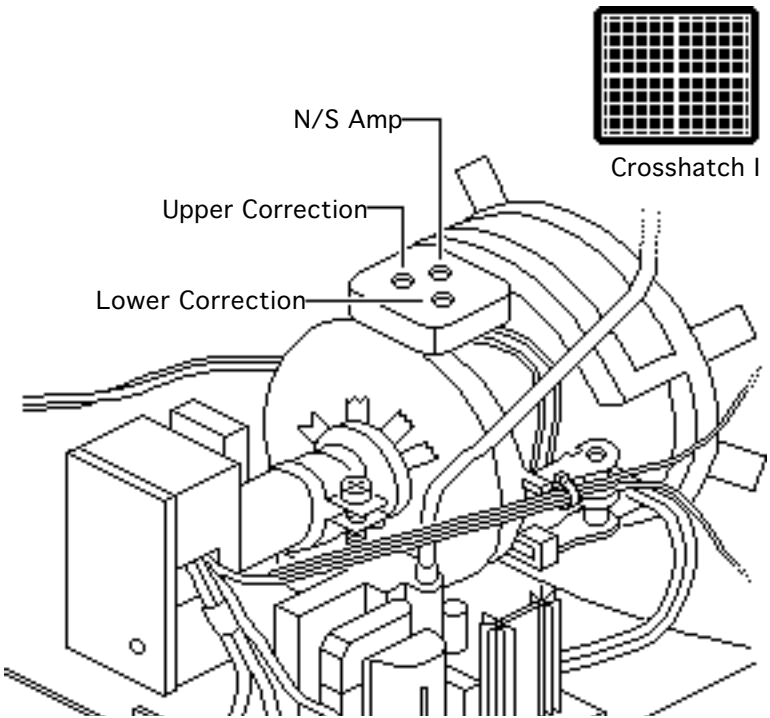


Crosshatch I



1 Use Display Service Utility to display the Crosshatch I test pattern.

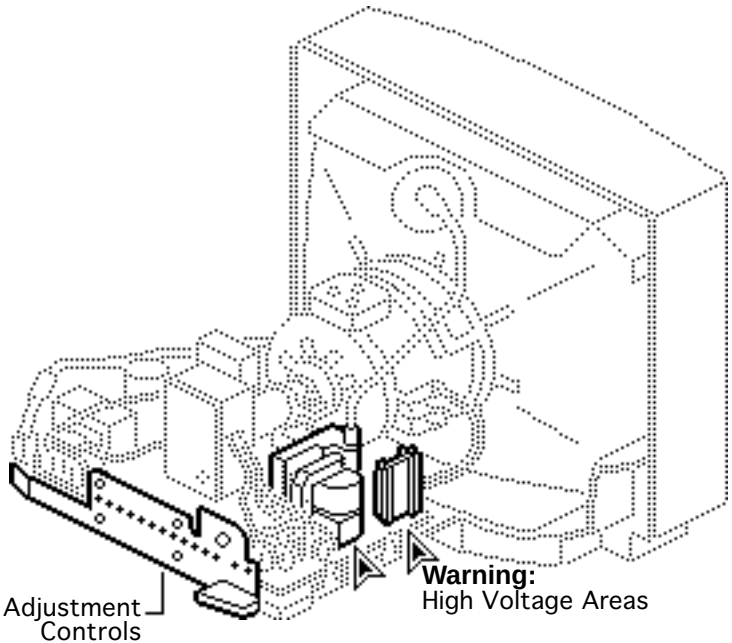
2 Using a hex-head plastic adjustment tool, adjust the convergence control on the CRT video board for best overall convergence.



3 Using a hex-head plastic adjustment tool, adjust the N/S amp control for best convergence of horizontal lines at the top and bottom of the screen.

4 Adjust the lower correction control for best convergence of vertical lines at the bottom of the screen.

5 Adjust the upper correction control for best convergence of vertical lines at the top of the screen.

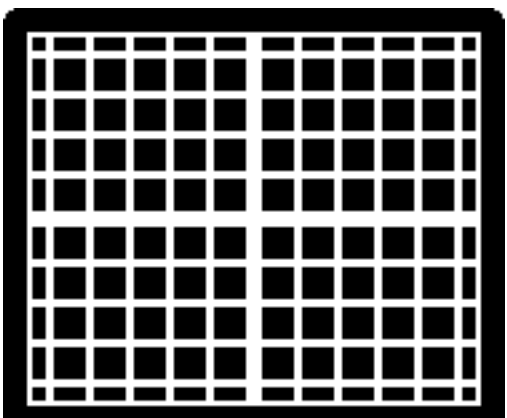


Geometric Distortion

Before you begin, remove the rear cover.

Warning: This product contains high voltage and a high-vacuum picture tube. To prevent serious injury, review CRT safety in Bulletins/Safety.

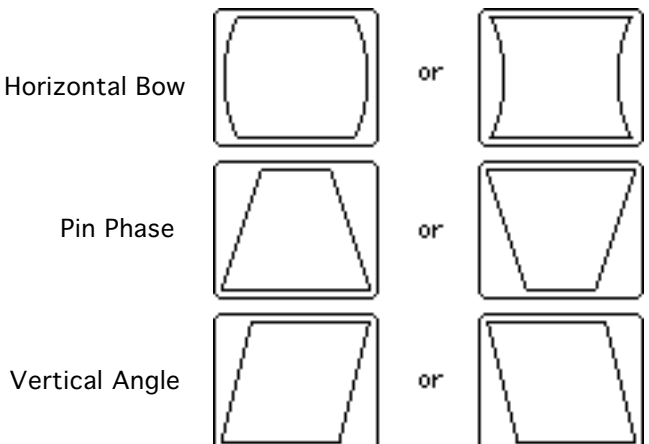
Note: Perform the following geometric adjustments only if your attempts to adjust raster distortions with the external geometry controls do not produce the results you wanted.



Crosshatch I

1 Use Display Service Utility to display the Crosshatch I test pattern.

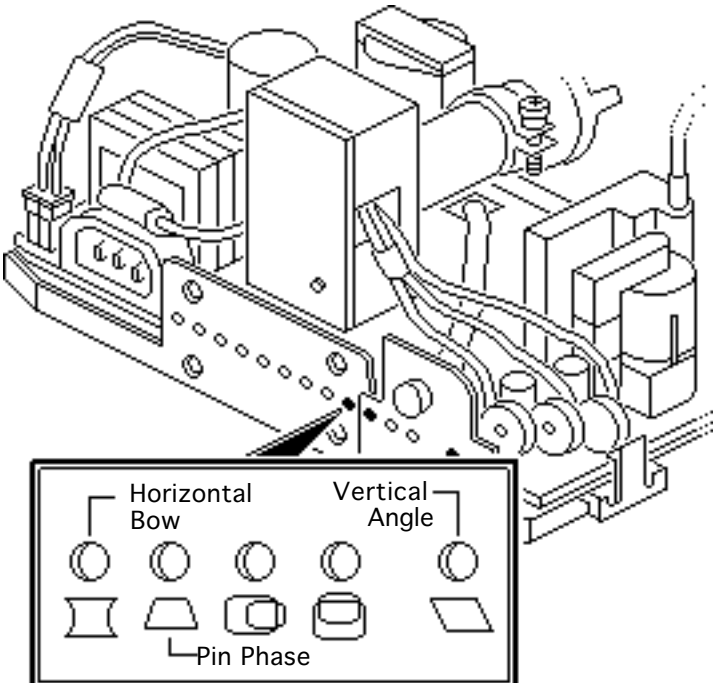
2 Verify that the boxes on the top row are the same size as the boxes on the bottom row, and the boxes on the left side are the same size as the boxes on the right side.



Warning: The entire yoke assembly has very high voltage. To prevent electrical shock, do not touch the yoke assembly, the anode wire, or the yoke wires.

3 To determine which control to adjust, compare the display with the distortions shown.

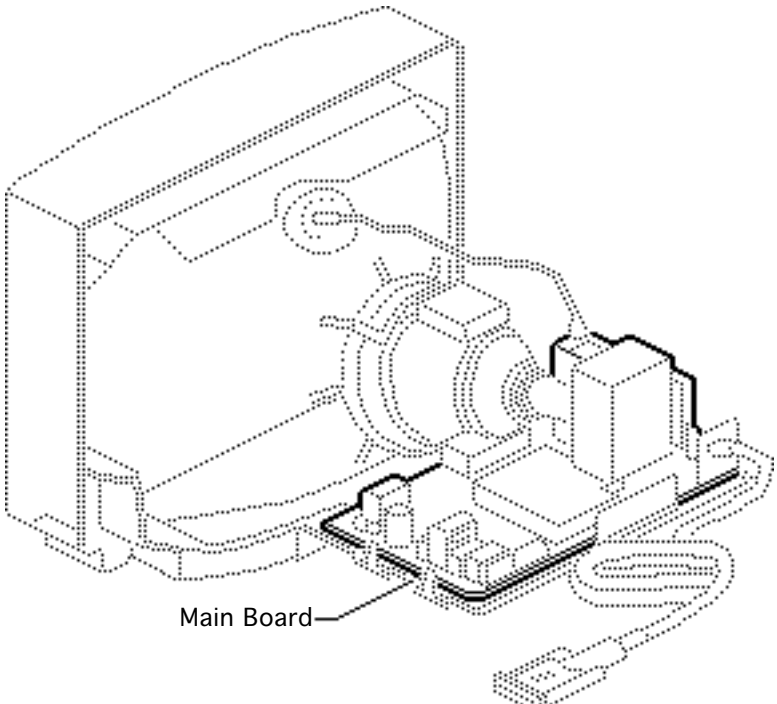
4 Using a hex-head plastic adjustment tool, adjust the control (see next page for control locations).



5 Using a hex-head plastic adjustment tool, adjust the control that is appropriate for the distortion.

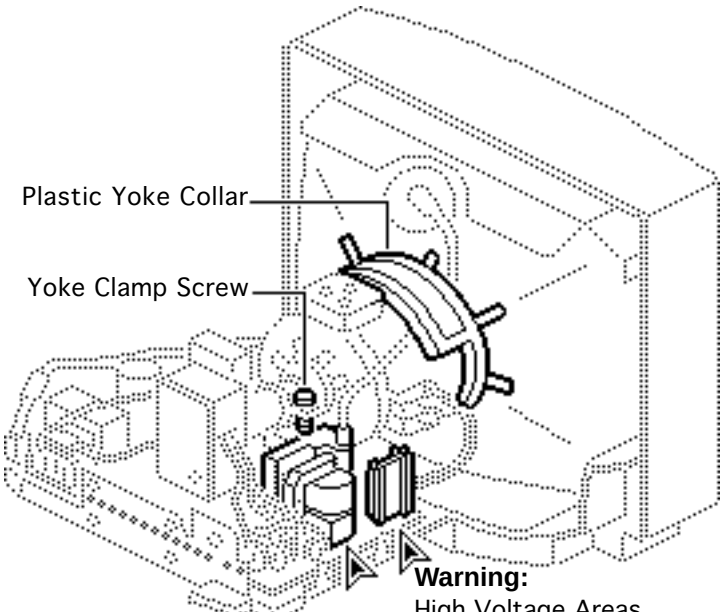
Note: If the display is so distorted that you can't tell which adjustments to make, perform the adjustments in the following sequence:

- Pin Phase
- Vertical Angle
- Horizontal Bow



6 If the display is still distorted, repeat the vertical angle and pin phase adjustments.

7 If you can't correct the distortion, replace the main board. See "Main Board" in the Take Apart chapter.



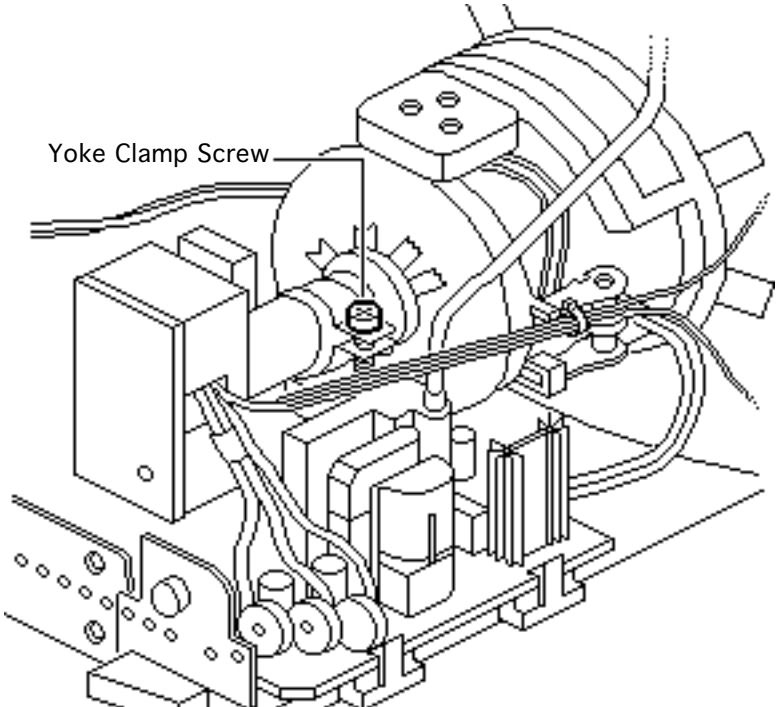
Yoke

Before you begin, remove the rear cover.

⚠**Warning:** This product contains high voltage and a high-vacuum picture tube. To prevent serious injury, review CRT safety in Bulletins/Safety.

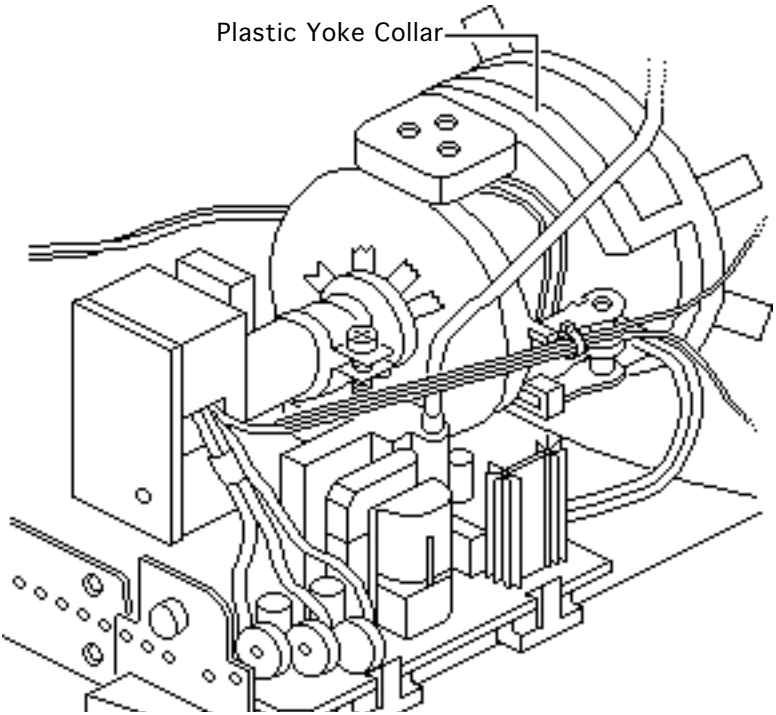
⚠**Warning:** Because you must make yoke adjustments from the rear of the computer, use a mirror to view the computer screen. Do not reach around the computer to make adjustments.

Note: If you replace the CRT, you will probably need to adjust the yoke.

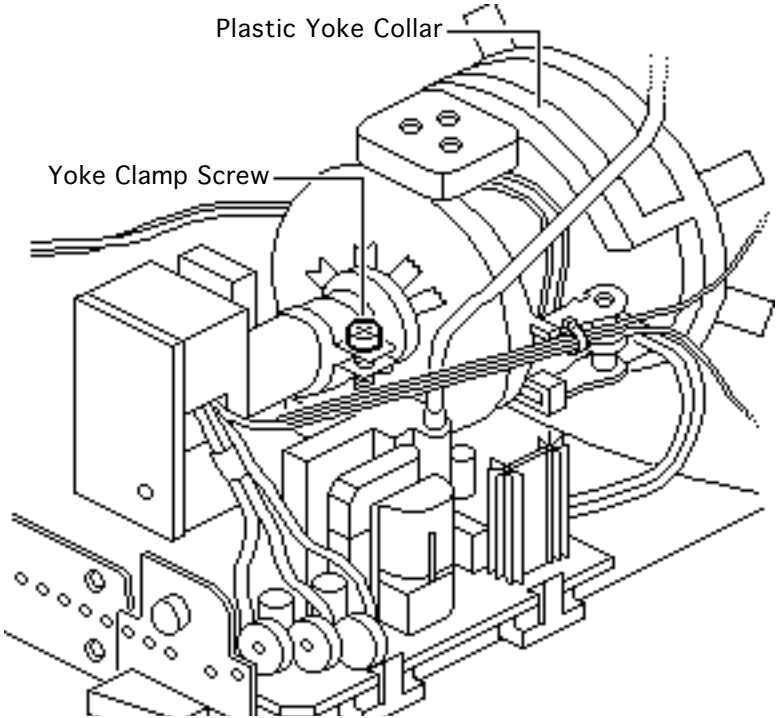


1 Using an insulated Phillips screwdriver, loosen the yoke clamp screw two or three turns.

2 Switch on the computer.



3 With one hand, grasp the plastic yoke collar and rotate it until the top and bottom edges of the picture are parallel with the top and bottom of the bezel.



4 Switch off and unplug the computer.

5 Discharge the CRT.

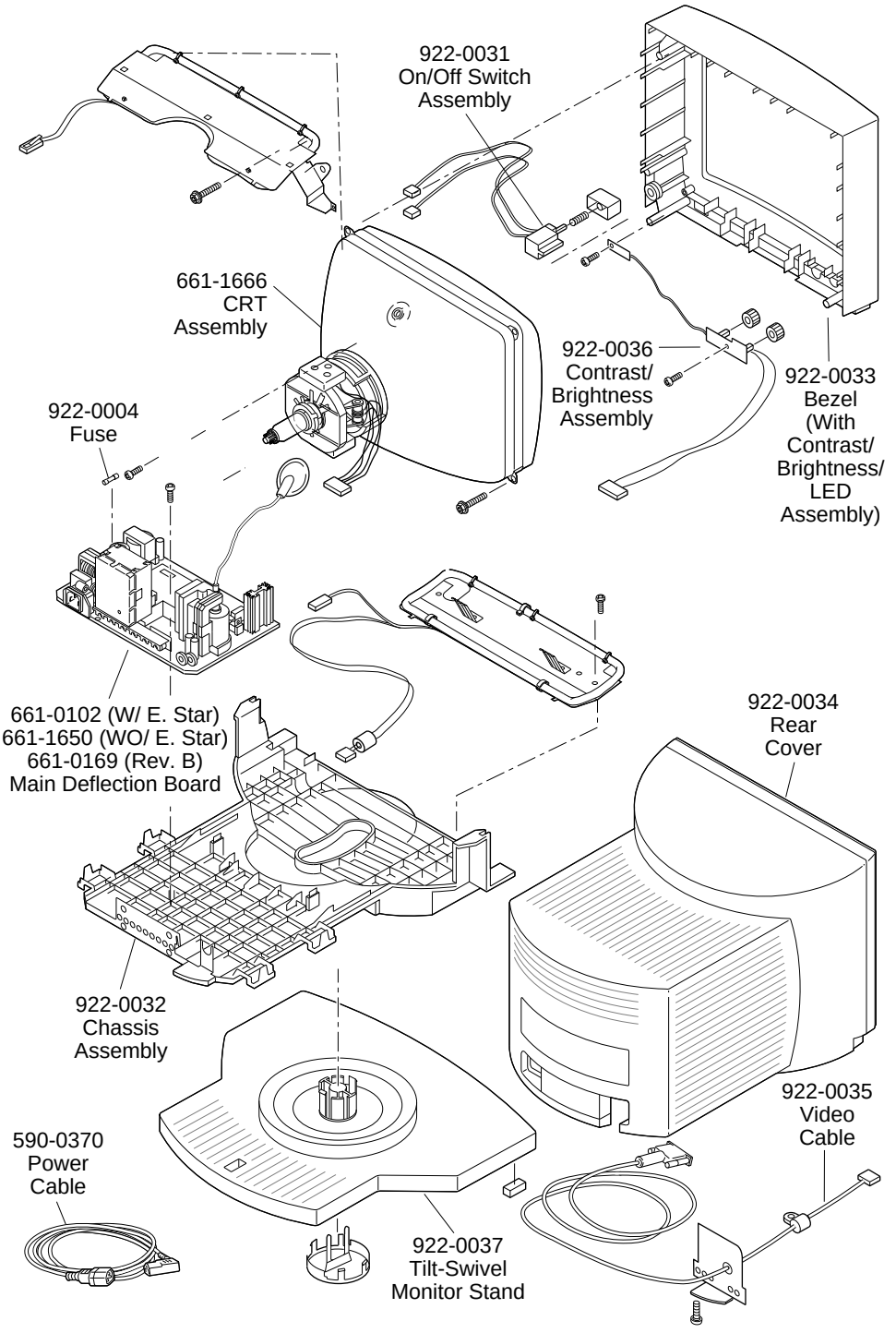
6 Hold the plastic yoke collar in position and carefully tighten the yoke clamp screw so that the collar cannot slip. Do not overtighten the screw.

7 Replace the rear cover and switch on the computer.

8 Verify that the top and bottom edges of the picture are parallel with the top and bottom of the bezel.

Exploded View

Macintosh Color Display


922-0031
On/Off Switch
Assembly
661-1666
CRT
Assembly
922-0036
Contrast/
Brightness
Assembly
922-0033
Bezel
(With
Contrast/
Brightness/
LED
Assembly)
922-0004
Fuse
661-0102 (W/ E. Star)
661-1650 (WO/ E. Star)
661-0169 (Rev. B)
Main Deflection Board
922-0034
Rear
Cover
922-0032
Chassis
Assembly
922-0035
Video
Cable
590-0370
Power
Cable
922-0037
Tilt-Swivel
Monitor Stand