

SERVICE MANUAL

Color Video Monitor

ZCM-1490



The purpose of this page is to make sure that all service bulletins are entered in this manual. When a service bulletin is received, mark the manual and list the information in the record below.

Record of Field Service Bulletins

SERVICE BULLETIN NUMBER	DATE OF ISSUE	CHANGED PAGE(S)	PURPOSE OF SERVICE BULLETIN	INITIALS

LIMITED RIGHTS LEGEND

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Warnings and Cautions

WARNING

Removing or lifting the ground from the AC power source may present a potentially lethal shock hazard. Do not use an AC two-to-three wire adapter plug with this unit.

WARNING

The CRT anode retains a potentially lethal voltage even when the monitor is turned off. Perform repairs only after the CRT anode has been properly discharged. Refer to Figure 6-1 and the following procedure to discharge the CRT anode:

1. Connect a clip lead or heavy gauge wire to chassis ground.
2. Connect the other end of the lead to the stem of a flat-blade screwdriver that has an insulated handle.
3. Insert the blade of the screwdriver under the rubber insulation that covers the anode lead on the CRT and make contact with the anode terminal. Depending on the amount of charge present on the anode, a distinct snap may be heard as the CRT discharges.

WARNING

The switch mode power supply contains circuits that generate dangerous high frequency, high amplitude, quasi-square wave signals that present a potentially lethal shock hazard. In the ZCM-1490, this circuitry is located on a separate, exposed circuit board located **along** the left side of the monitor when viewed from the back. Do not attempt to service the power supply.

WARNING

To prevent both personal injury and equipment damage, always use an isolation transformer when troubleshooting this monitor.

CAUTION

Under no circumstances should the original design be modified or altered without permission from Zenith Electronics Corporation. All components should be replaced only with types identical to those in the original circuit, and their physical location, wiring, and lead dress must conform to the original layout upon completion of repairs.

CAUTION

Some components contain an X in their reference number. For safety reasons, these components must be replaced only with identical components.

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Chapter 1

Introduction

The Zenith Data Systems ZCM-1490 is a high-resolution analog RGB color video monitor. This monitor incorporates Zenith's patented flat technology CRT. The ZCM-1490 can be used with a computer video source that supplies an analog RGB color signal having a 31.49 kHz horizontal scan frequency. It can also display information in CGA, EGA, MDA, and Hercules video modes provided that the video source supplying the monitor is capable of delivering these modes as analog RGB color signals at a 31.49 kHz scan frequency. The ZCM-1490 is illustrated in Figure 1-1.

Related publications include the *High-Resolution Analog RGB Color Video Monitor User's Guide* (595-3924-1).

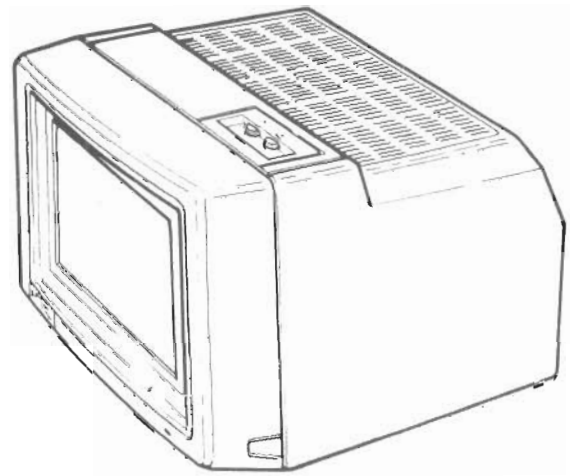


Figure 1-1, ZCM-1490 Color Video Monitor

Specifications

Power input:	90-135/200-265 VAC, 48-62 Hz, switch selectable. Six-foot (1.98 m), 3-wire grounded power cord included.
Video input:	Analog RGB video signal, 0-0.714 V peak-to-peak (1V peak-to-peak maximum), 75 ohm resistive.
Sync input	
Horizontal:	31.49 kHz, ± 1 kHz, positive TTL, 350-line mode, negative TTL, 400-line mode, negative TTL, 480-line mode.
Vertical:	70 Hz, negative TTL, 350-line mode, 70 Hz, positive TTL, 400-line mode, 60 Hz, negative TTL, 480-line mode.
Signal Connector:	15-pin subminiature D-type.

CRT:	Flat technology, 14-inch, 0.31 mm pitch, regular tint, non-glare.
Display area:	10.07 inches (25.6 cm) wide by 7.67 inches (19.5 cm) high (approximate). Display size remains constant with changes in video modes.
Display colors:	Infinite array of displayable colors. (The actual number of displayable colors is limited only by the video source supplying the monitor.)
Characters:	80 characters × 25 rows.
Character block:	8 × 19 (Zenith), 9 × 16 (VGA), 8 × 16 (MCGA), 8 × 14 (EGA), 8 × 16 (CGA, 400-line), 9 × 14 (MDA), 9 × 14 (Hercules).
Active video time	
Horizontal:	25.42 μ s, all modes.
Vertical:	15.4 ms, 640 × 480 (Zenith, VGA), 15.2 ms, 640 × 480 (MCGA), 12.8 ms, 320 × 200 (MCGA), 12.8 ms, 640 × 350 (EGA), 12.8 ms, 320 × 200 (CGA), 12.8 ms, 720 × 350 (MDA), 11.2 ms, 720 × 350 (Hercules).
Inactive video time	
Horizontal:	6.36 μ s, 640 × 480 (Zenith, VGA), 6.35 μ s, 640 × 480 (MCGA), 6.36 μ s, 320 × 200 (MCGA), 6.35 μ s, 640 × 350 (EGA), 6.35 μ s, 320 × 200 (CGA), 6.36 μ s, 720 × 350 (MDA), 6.35 μ s, 720 × 350 (Hercules).

Vertical:	1.44 ms, 640 × 480 (Zenith, VGA), 1.44 ms, 640 × 480 (MCGA), 1.56 ms, 320 × 200 (MCGA), 1.56 ms, 640 × 350 (EGA), 1.56 ms, 320 × 200 (CGA), 1.56 ms, 720 × 350 (MDA), 3.15 ms, 720 × 350 (Hercules).
Resolution:	640 dots × 480 lines (Zenith, VGA), 640 dots × 480 lines (MCGA), 320 dots × 200 lines (MCGA), 640 dots × 350 lines (EGA), 320 dots × 200 lines (CGA), 720 dots × 350 lines (MDA), 720 dots × 350 lines (Hercules).
Misconvergence:	0.68 mm maximum within display area.
User controls:	Power, brightness, contrast, H. CENT (horizontal centering), H. SIZE (horizontal size), V. CENT vertical centering, V. SIZE (vertical size).
Environmental	
Temperature:	0° to 40° C (32° to 104° F) operating, -40° to 60° C (-40° to 140° F) storage.
Humidity:	10% to 90%, (noncondensing) operating, 0% to 95%, (noncondensing) storage.
Altitude:	-1000 to 10,000 feet (-0.3 to 3.05 km) operating, 40,000 feet (12.2 km) maximum (storage).
Dimensions:	14.9 inches (37.9 cm) wide by 12.6 inches (32.0 cm) high by 15.5 inches (39.4 cm) deep.
Weight:	40 lbs (18.1 kg), approximate.

Zenith Data Systems reserves the right to discontinue products and to change specifications at any time without incorporating these changes into products previously sold.

Chapter 2 Installation

This chapter provides basic installation and set-up information for the ZCM-1490 analog color video monitor. If further adjustment or servicing information is required, refer to the appropriate chapters which follow.

Controls and Connections

The various monitor controls and connectors are illustrated in Figures 2-1 and 2-2. Each control and connector is explained individually in the following paragraphs.

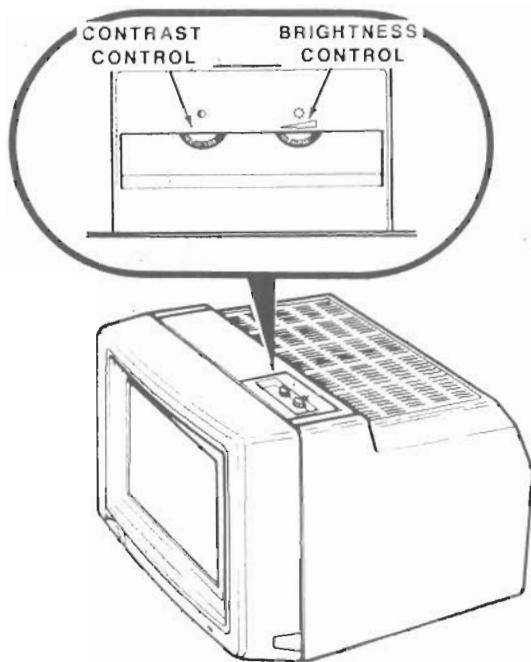


Figure 2-1. ZCM-1490 Front View

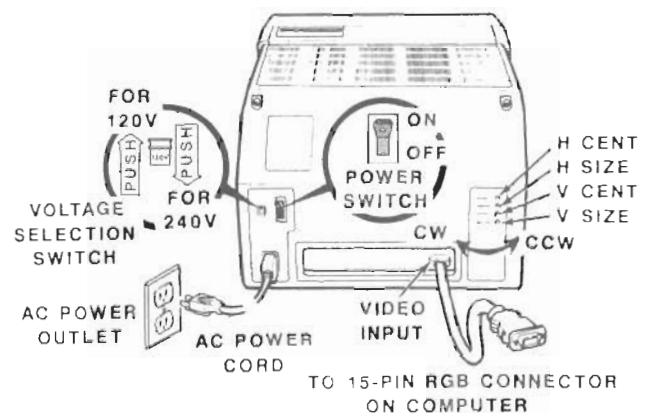


Figure 2-2. ZCM-1490 Rear View

Power — The rocker-type power switch located on the rear panel turns the monitor on or off.

Power-On Indicator — A green LED located on the front panel lights when power is applied to the monitor.

Brightness — The brightness control varies the overall or average intensity of illumination of the display. The average intensity in turn determines the background level in the display.

Contrast — The contrast control varies the difference in intensity between the black and the white areas of the display.

Voltage Selection Switch — The voltage selection switch configures the monitor for operation from the appropriate AC power source.

H. CENT — The horizontal centering control adjusts the left-to-right position of the display within the screen area. To move the display to the left, turn this control counterclockwise. To move the display to the right, turn this control clockwise.

H. SIZE — The horizontal size control adjusts the width of the display within the screen area. To increase the display width, turn this control counterclockwise. To reduce the display width, turn this control clockwise.

V. CENT — The vertical centering control adjusts the top-to-bottom position of the display within the screen area. To move the display upward, turn this control clockwise. To move the display downward, turn this control counterclockwise.

V. SIZE — The vertical size control adjusts the height of the display within the screen area. To increase the display height, turn this control counterclockwise. To reduce the display height, turn this control clockwise.

Power Input Jack — A 3-pin, grounded-type power jack is located on the rear panel.

Power Cord — A 6-foot (1.8 m), 3-wire grounded and shielded power cord supplies power to the monitor.

Video Input Cable — A 3.5-foot (1.05 m) cable, terminated with a 15-pin, subminiature D-type connector, supplies video and sync signals to the monitor. The cable is attached to the monitor and is not

detachable. Figure 2-3 illustrates the connector and Table 1-1 lists its pin configuration.

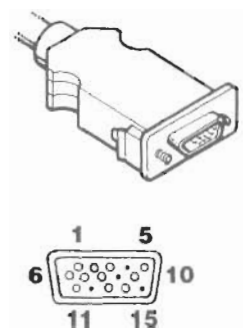


Figure 2-3. Subminiature D-type Connector

Table 2-1. Video Input Cable Pin Functions

PIN NUMBER	FUNCTION
1	Red video input
2	Green video input
3	Blue video input
4	N/C
5	Reserved (test)
6	Red video ground
7	Green video ground
8	Blue video ground
9	N/C
10	Digital/sync ground
11	Reserved (mode)
12	N/C
13	Horizontal sync
14	Vertical sync
15	N/C

Set-Up and Operation

Perform the following steps to set up and operate the monitor.

1. Place the monitor on a flat surface near the computer and near an AC power outlet. Be certain that the ventilation slots in the cabinet are not blocked.
2. Connect the video input cable from the monitor to the computer.
3. Plug the power cord into the monitor and then into an AC outlet. Make sure the voltage selection switch on the rear panel is set to the proper position.

WARNING

Removing or lifting the ground from the AC power source may present a potentially lethal shock hazard. Do not use an AC two-to-three wire adapter plug with this unit.

4. Turn on the computer and the monitor. The front panel power indicator should light.
5. Boot an operating system.
6. When a message is displayed on the monitor, adjust the brightness and contrast controls to obtain a comfortable display.

Initial Tests

To assess the monitor's operation, perform the color bar test and the fill screen test. Both tests are ROM-based.

Color Bar Test

The color bar test displays an array of colors in the form of a bar graph. To display the color bars using a Zenith Data Systems PC-compatible computer:

1. Press the CTRL, ALT, and INS keys in sequence, hold them, and then release them.
2. After the Monitor prompt appears, type C and then press RETURN. Color bars should now be displayed.

Fill Screen Test

The ROM-based keyboard test can be used to set the brightness, contrast, dimensions, focus, convergence, and other qualities of the display to comfortable levels. To perform the fill screen test using a Zenith Data Systems PC-compatible computer:

1. Press the CTRL, ALT, and INS keys in sequence, hold them, and then release them.
2. After the prompt appears on the monitor, type TEST and press RETURN.
3. Select the keyboard test by pressing the 2 key.
4. Press any displayable key to fill the screen with that character. (The capital Z is a good character to display for assessing display characteristics.)

Chapter 3

Disassembly

This chapter contains instructions for both disassembly and reassembly of the monitor. Step-by-step instructions are provided for disassembly. For reassembly, perform the steps in the reverse order unless instructed otherwise. Read each section (and any previous sections referred to) completely before disassembling the monitor.

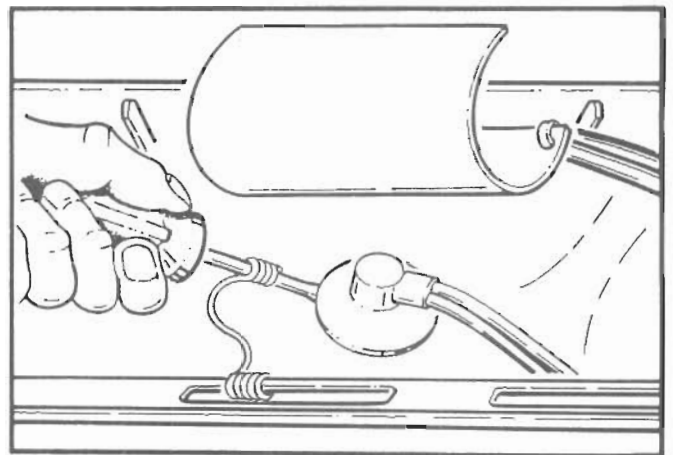
Before proceeding, make sure the power cord and video cable are disconnected. The overall disassembly sequence for this monitor is as follows:

1. Remove the rear cover.
2. Remove the rear chassis panels.
3. Remove the video board.
4. Remove the control board.
5. Remove the PIN board.
6. Remove the fan and bottom panel.
7. Remove the support bracket and shield.
8. Remove the deflection board assembly.
9. Remove the deflection board.
10. Remove the power supply/dynamic focus board assembly.
11. Remove the power supply and dynamic focus boards.
12. Remove the CRT.

WARNING

The CRT anode retains a potentially lethal voltage even when the monitor is turned off. After removing the monitor cover, discharge the CRT anode. Before proceeding with the disassembly. The anode is located at the top of the CRT and is shielded by a white insulating sheet. Refer to Figure 3-1 and the following procedure to discharge the CRT anode:

1. Connect a clip lead or heavy gauge wire to chassis ground.
2. Connect the other end of the lead to the stem of a flat blade screwdriver that has an insulated handle.
3. Insert the blade of the screwdriver under the rubber insulation that covers the anode lead on the CRT and make contact with the anode terminal. Depending on the amount of charge present on the anode, a distinct snap may be heard as the CRT anode discharges.



1. CAREFULLY SLIDE A GROUNDED FLAT SCREWDRIVER TIP UNDER THE LIP OF THE ANODE LEAD.



2. AFTER DISCHARGING THE VOLTAGE, DISCONNECT THE ANODE LEAD FROM THE CRT.

Figure 3-1. CRT Anode Discharging

Rear Cover Removal

The rear cover is secured by eight screws. Two of these screws also secure rubber feet to the bottom of the monitor cover. After disconnecting the power cord and video cable, remove these eight screws as shown in Figure 3-2. Slide the cover away from the monitor, allowing the video cable to pass through the opening in the cover. Tape the screws to the inside of the rear cover and set it aside.

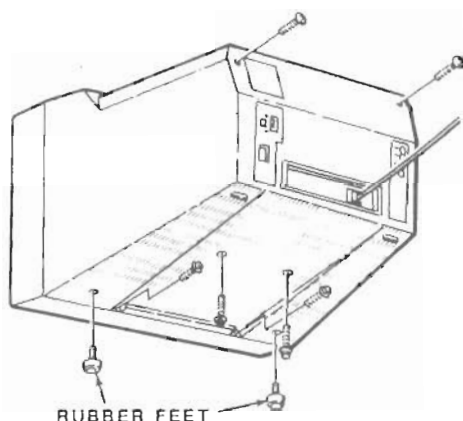


Figure 3-2. Rear Cover Removal

Rear Chassis Panel Removal

Two panels are connected across the back of the monitor chassis. The upper panel adds support to the chassis. The lower panel holds the video cable ground clamp and strain relief. To remove the panels:

1. Refer to Figure 3-3 and remove the four hex screws that secure the upper panel to the chassis side panels. Remove the panel and replace the four screws into the side panels.

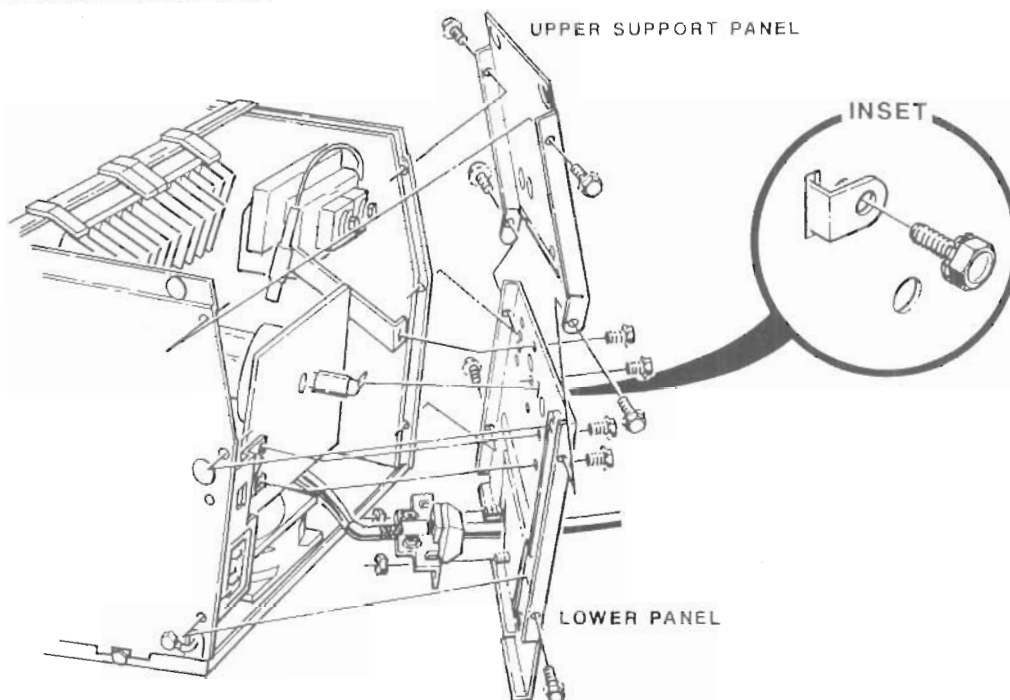


Figure 3-3. Rear Chassis Panel Removal

2. Refer to Figure 3-3 and remove the two hex screws from the bottom sides of the lower panel. Remove the screw that secures the flyback transformer bracket to the lower panel. (In some chassis, all of the high-voltage components are on the deflection board and this bracket may be different than the one shown. Adjust the procedure accordingly.) Refer to the inset of Figure 3-3 and remove the hex screw that secures the ground strap from the video board to the lower panel. Push the ground strap back through the slot in the lower panel and gently pull the lower panel away from the monitor chassis. The video cable is still held to this panel by its ground clamp.
3. Refer to Figure 3-3 and remove the two nuts that secure the video cable ground clamp to the lower panel. Slide the video cable strain relief down and out from the lower panel. It may be necessary to cut the decorative white sheet on the outside of the lower panel to allow the strain relief to slide down and away from the panel.
4. Disconnect the following cables entering the video board: 5R9, 5A9, 5A6, 5R6, 5S6, and 5A1.
5. Disconnect the following cables leaving the video board: 6S5 (to deflection board), 3R5 (to power supply board), and 8R5 (to dynamic focus board).
6. Disconnect the focus lead connector by twisting and pulling apart the plastic socket connector on the lead.
7. Remove the video board.

Video Board Removal

1. Remove the rear chassis panels as described earlier.
2. Refer to Figure 3-4 and loosen the CRT socket clamp screw.
3. Gently wiggle the video board back and away from the CRT neck until the CRT is freed from the socket on the video board. Do not twist the video board while pulling it away from the CRT. To prevent damage to both the video board and the CRT, do not exert excessive force while removing the video board.

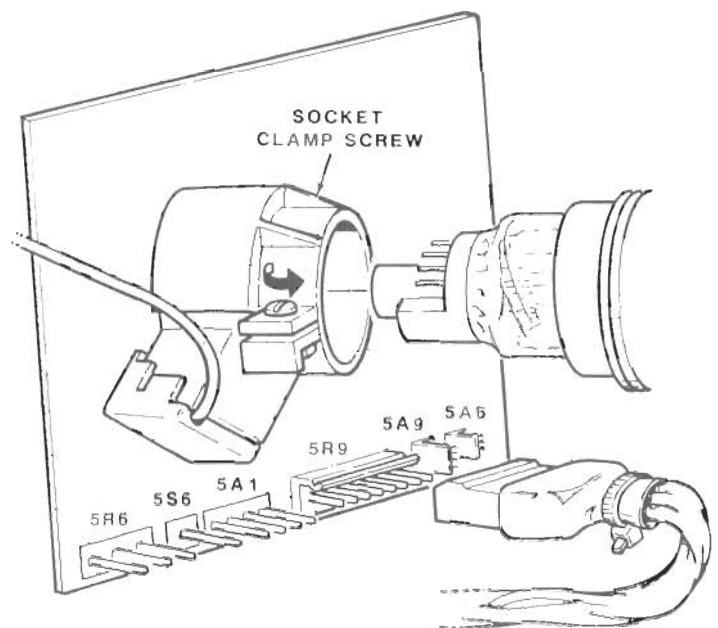


Figure 3-4. Video Board Removal

Control Board Removal

The control board holds the external brightness and contrast controls. To remove the control board:

1. Refer to Figure 3-5 and slide the control board back and up from the tracks that hold it.
2. Disconnect connector 5A1 to the video board and remove the control board.

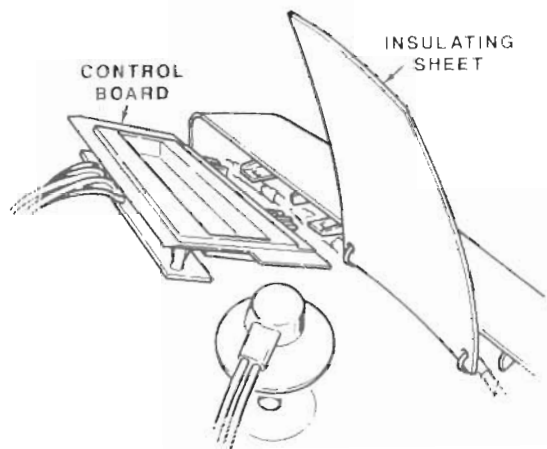


Figure 3-5. Control Board Removal

PIN Board Removal

The PIN board is located at the top front portion of the monitor. It is held in place by two support rails that span the width of the chassis. To remove the PIN board:

1. Loosen the support rails. Refer to Figure 3-6 and remove the two hex screws holding each of the support rails in place.
2. Cut the cable ties indicated in Figure 3-6.
3. Disconnect the following cables entering the PIN board: 8R6, 8V6, and 8U6.
4. Disconnect the following cables leaving the PIN board: 4T8 (to dynamic focus board).
5. Lift the PIN board and support rails out of the monitor. The front support rail is held to the board by plastic standoffs. The rear support rail is screwed to the two heat sinks on the PIN board. Remove the rails as necessary.

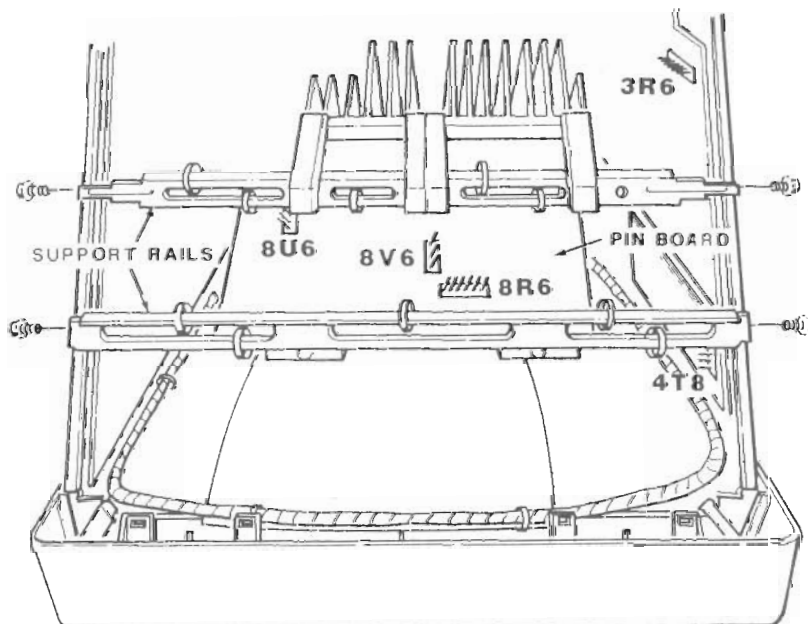


Figure 3-6. PIN Board Removal

Fan and Bottom Panel Removal

A cooling fan is attached to the inside of the bottom panel of the monitor chassis. A portion of the high voltage assembly is also secured to this panel in some chassis. To remove the fan and bottom panel:

1. Carefully set the monitor face down on a soft surface. Be certain that there are no objects that can scratch the surface of the display glass. The glass is treated with a special non-glare OCLI coating that can be damaged by abrasives.
2. Loosen the bottom panel. Refer to Figure 3-7 and remove the four hex screws that secure the bottom panel to each of the side panels.
3. Remove the screw that holds part of the high voltage assembly to the bottom panel. In some units, the high voltage assembly is located entirely on the deflection board, so this step may be unnecessary. Pull the panel out to expose the fan.
4. Refer to Figure 3-7 and remove the three hex screws that secure the fan and air guide to the bottom panel. Remove the fan and disconnect the fan wires from the power supply board (connector 3S8).

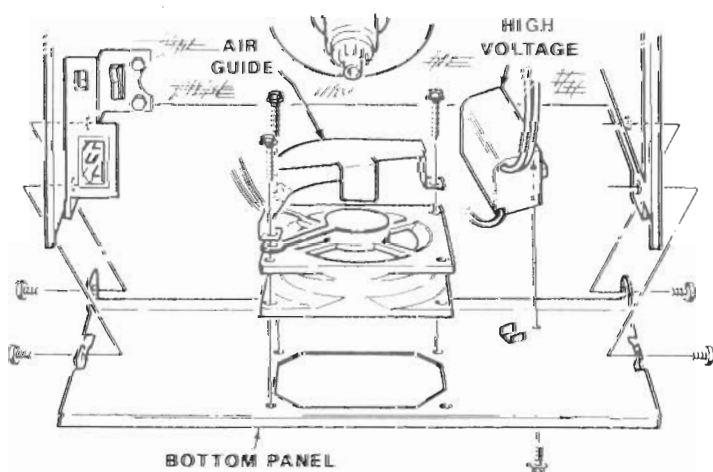


Figure 3-7. Fan and Bottom Panel Removal

Support Bracket and Shield Removal

In addition to the bottom panel, a metal support bracket and wire mesh shield are connected to each of the side panels across the bottom of the chassis. To remove the support bracket and shield:

1. Remove the fan and bottom panel as described earlier.
2. Refer to Figure 3-8 and remove the six hex screws that hold the wire mesh shield in place. Lift the shield away from the support bracket and replace the screws.
3. Refer to Figure 3-8 and remove the two hex screws that secure the support bracket to the side panels. Remove the bracket and replace the screws. After this bracket is removed, the side panels (with the deflection, power supply, and dynamic focus boards attached) will lose most of their support.

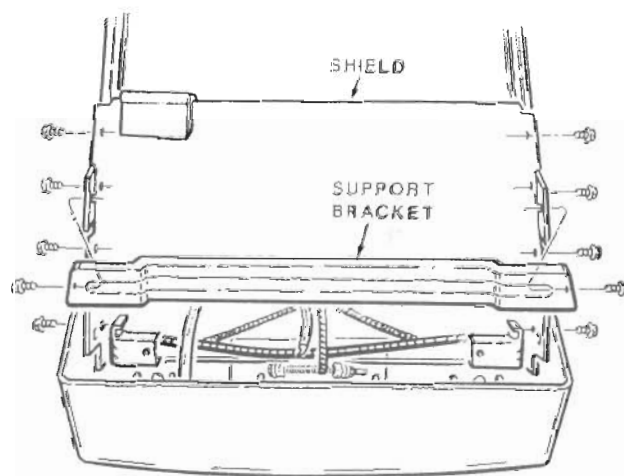


Figure 3-8. Support Bracket and Shield Removal

Deflection Board Assembly Removal

The deflection board assembly consists of the side panel and the deflection board which is secured to the panel. To remove this assembly:

1. Remove the rear chassis panels as described earlier.
2. Remove the video board as described earlier. This step may be omitted for partial disassembly.
3. Remove the control board as described earlier. This step may be omitted for partial disassembly.
4. Remove the PIN board as described earlier. This step may be omitted for partial disassembly.
5. Remove the fan and bottom panel as described earlier.
6. Remove the support bracket and shield as described earlier.
7. Refer to Figure 3-9 and remove the three hex screws that secure the deflection board assembly to the bezel. Note the locations of the ground braid terminals.
8. Disconnect the yoke cable connectors (6R9, 6S9) from the deflection board. Two small

molded plastic dowels support the deflection board assembly. Lift the assembly up and away from the monitor. Replace the hex screws in the bezel.

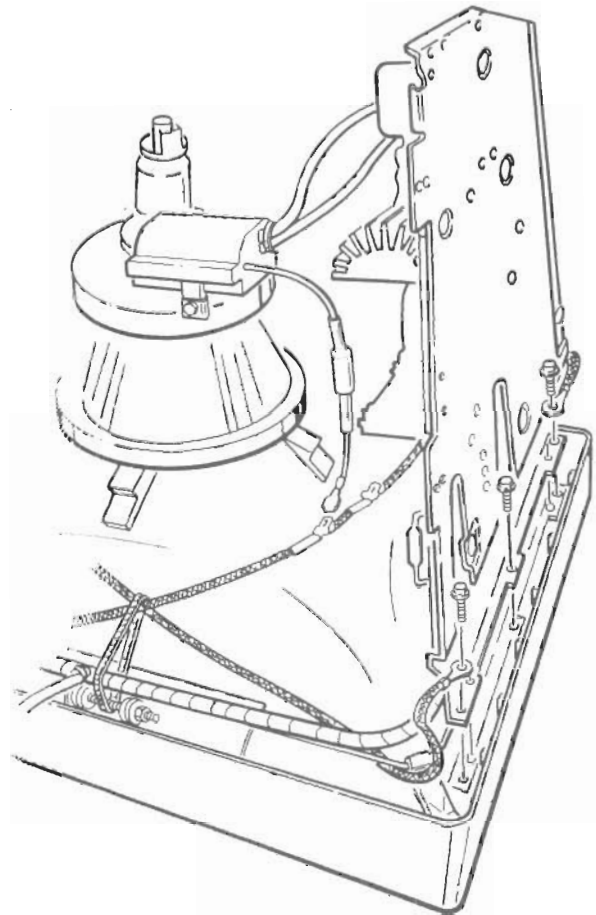


Figure 3-9. Deflection Board Assembly Removal

Deflection Board Removal

The deflection board is attached to the left metal side panel. To remove the deflection board from the side panel:

1. Remove the deflection board assembly as described earlier.
2. Refer to Figure 3-10 and remove the nine hex screws that secure the deflection board to the side panel. Lift the board away from the panel and replace the screws.

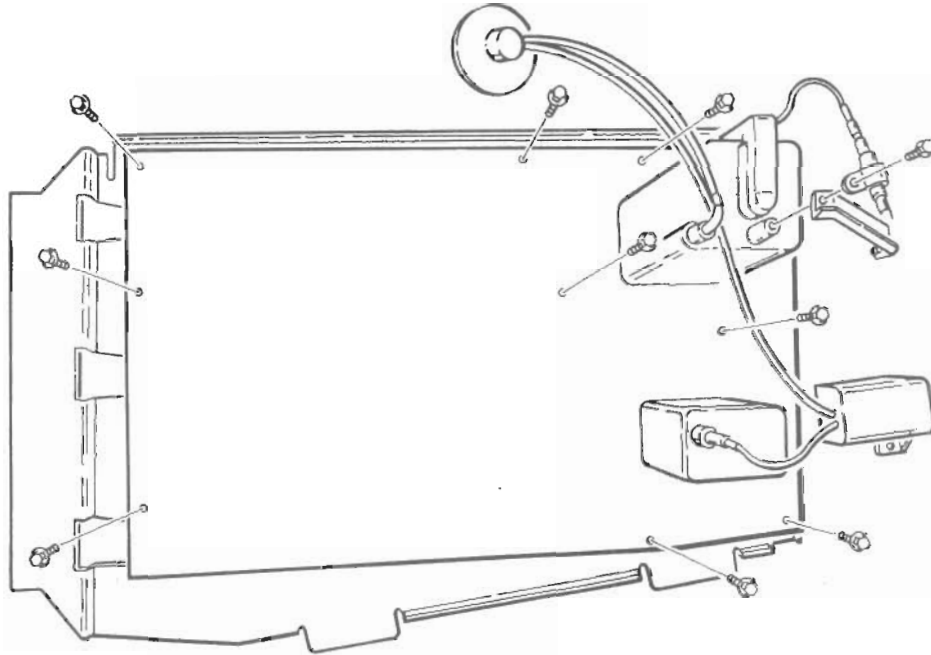


Figure 3-10. Deflection Board Removal

Power Supply/Dynamic Focus Board Assembly Removal

The power supply/dynamic focus board assembly consists of the side panel and the power supply and dynamic focus boards which are secured to the panel. To remove this assembly:

1. Remove the rear chassis panels as described earlier.
2. Remove the video board as described earlier. This step may be omitted for partial disassembly.
3. Remove the control board as described earlier. This step may be omitted for partial disassembly.
4. Remove the PIN board as described earlier. This step may be omitted for partial disassembly.
5. Remove the fan and bottom panel as described earlier.
6. Remove the support bracket and shield as described earlier.
7. Refer to Figure 3-11 and remove the three hex screws that secure the power supply/dynamic focus board assembly to the bezel. Note the locations of the ground braid terminals.

8. Two small molded plastic dowels support the power supply/dynamic focus board assembly. Lift the assembly up and away from the monitor. Replace the hex screws in the bezel.

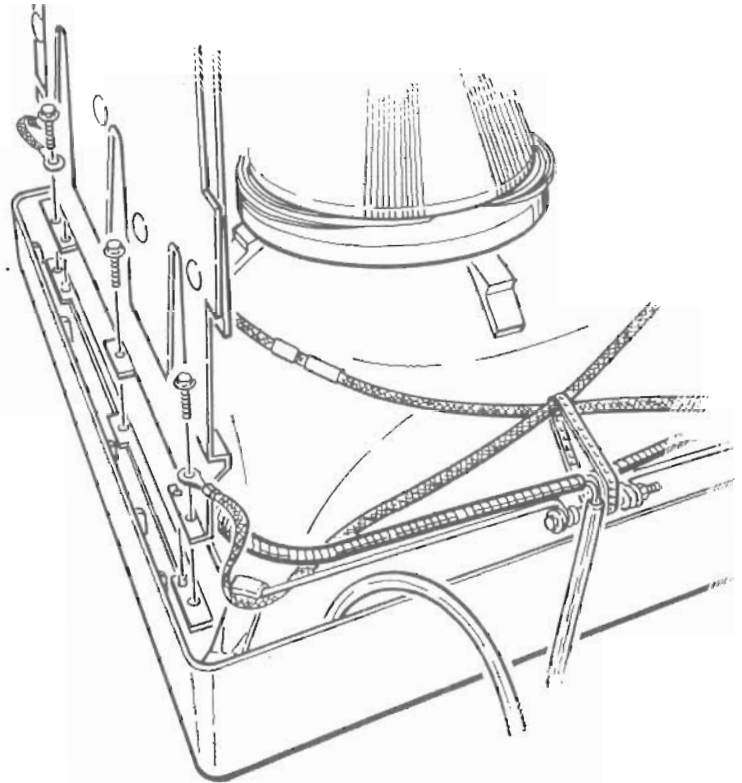


Figure 3-11. Power Supply/Focus Board Assembly Removal

Power Supply and Dynamic Focus Board Removal

The power supply and dynamic focus boards are attached to the right metal side panel. To remove these boards from the side panel:

1. Remove the power supply/dynamic focus board assembly as described earlier.
2. Refer to Figure 3-12 and remove the appropriate hex screws for either the power supply board or the dynamic focus board. Lift the board away from the panel and replace the screws.

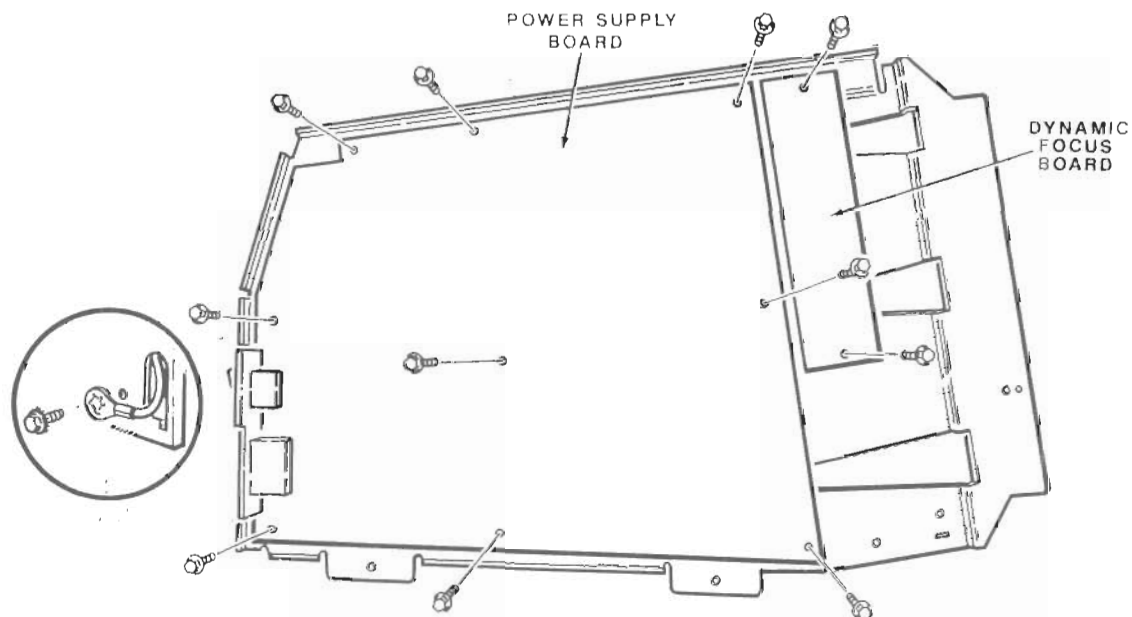


Figure 3-12. Power Supply and Dynamic Focus Board Removal

CRT Lead Dress and Removal

The flat technology CRT is secured by four screws, clamps, and a tensioning ring. A degaussing coil is wrapped around the perimeter of the CRT. A grounding braid is also routed across the back of the CRT.

Refer to Figure 3-13 for the lead dress. To remove the CRT, remove the four hex screws with washers located at the corners of the bezel. Gently lift the CRT away from the bezel. Use Figure 3-13 as a guide when installing a new CRT.

NOTE: The CRT yoke is not replaceable and is considered part of the CRT.

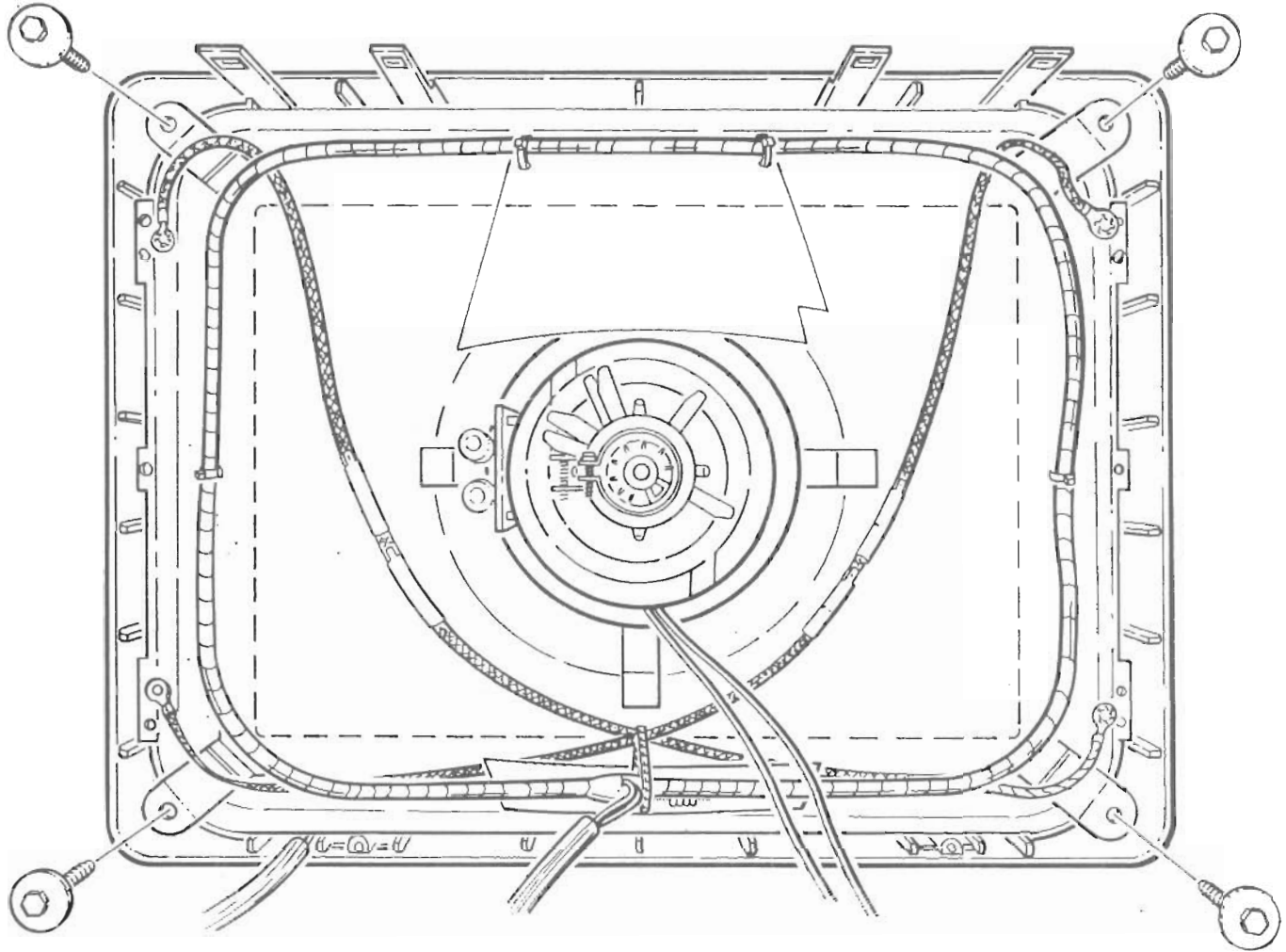


Figure 3-13. CRT Lead Dress and Removal

Chapter 4

Adjustments

This chapter contains instructions for performing the various monitor adjustments. Because these adjustments are performed while the monitor is on, observe proper precautions to avoid personal injury. Specific warnings are included where necessary.

Table 4-1 lists the various adjustment devices and their component numbers. They are arranged according to the circuit board or location where they can be found. Refer to Figures 4-1, 4-2, 4-3, and 4-4 to locate these adjustments on the video output board, the deflection board, and the PIN board, and the dynamic focus board respectively. Specific adjustment procedures follow these figures. If a specific adjustment procedure does not correct a problem, refer to chapters 5 and 6 for additional information.

Table 4-1. Monitor Adjustment Devices

DEVICE	DESCRIPTION
External	
R5401	Contrast (monitor top)
R5403	Brightness (monitor top)
R2148	Vertical centering (rear panel)
R2153	Vertical size (rear panel)
R3402	Horizontal size (rear panel)
R3418	Horizontal centering (rear panel)
Video output board	
R5139	Blue gain
R5154	Red gain
R5316	Red cutoff
R5317	Green cutoff
R5318	Blue cutoff
Deflection board	
R2107	Vertical linearity
R2117	Vertical hold
R2124	Vertical sub-size (480-line)

DEVICE	DESCRIPTION
Deflection board (Cont'd.)	
R2170	Vertical sub-size (400-line)
R2158	Vertical sub-size (350-line)
R3001	Horizontal centering
R3221	High-voltage (optional)
R3238	High-voltage shutdown (optional)
R3415	Horizontal hold
R3420	Horizontal phase
PIN board	
L7401	"W-M" phase
R7012	E-W trap
R7027	E-W level
R7039	E-W phase
R7106	Horizontal size
R7430	N-S trap
R7431	N-S parallelogram
R7433	South phase
R7434	South level
R7435	North phase
R7436	North level
R7454	North "W"
R7456	South "M"
R7460	IC701 trim (optional)
R7540	N-S crossover zero
Dynamic focus board	
R7703	Dynamic focus
Control board	
R5402	Contrast limit
R5404	Brightness limit
Other	
Focus	High-voltage resistor block
G2	High-voltage resistor block



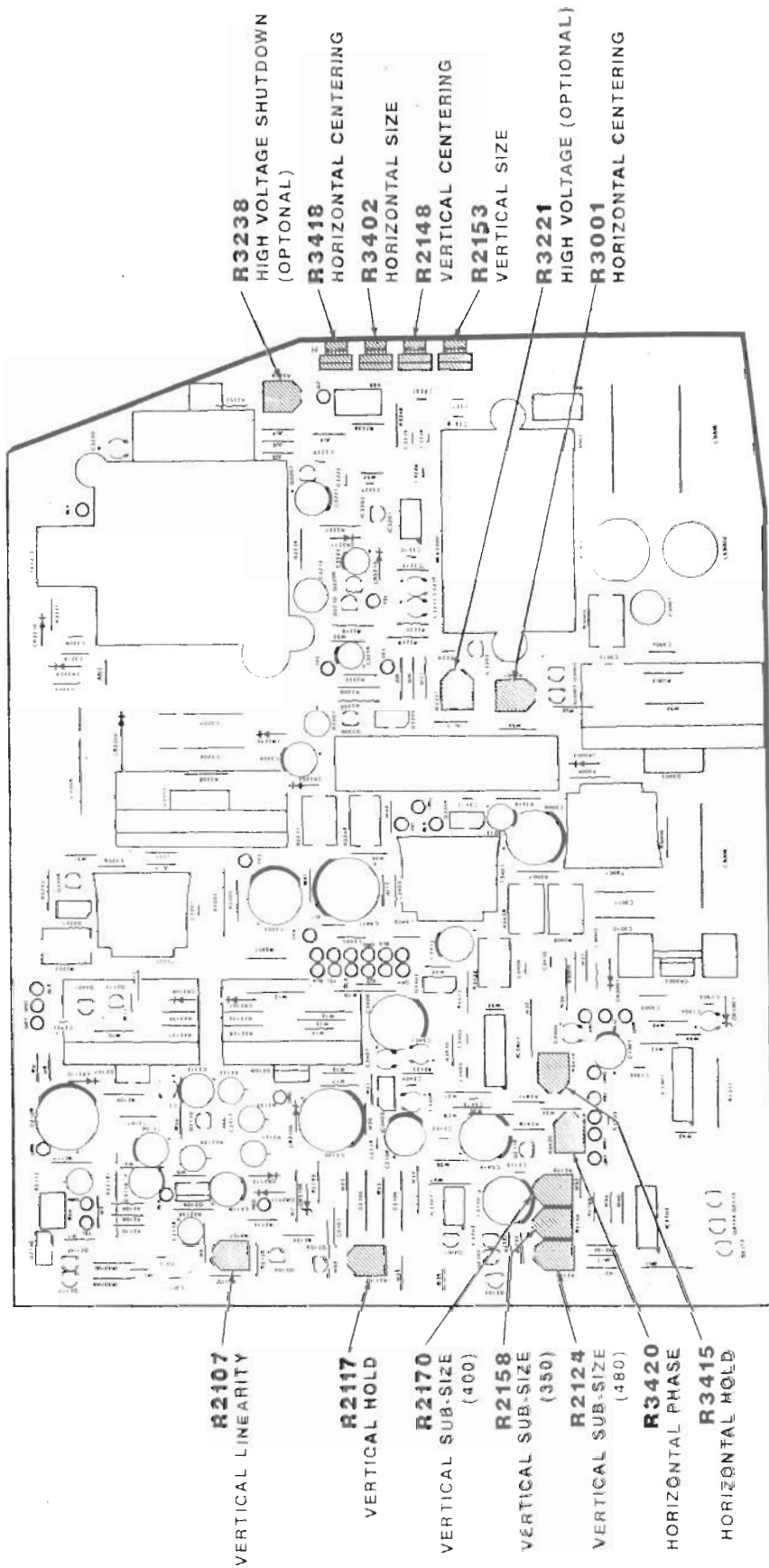


Figure 4-2. Deflection Board Adjustment Locations

Deflection Board Adjustments

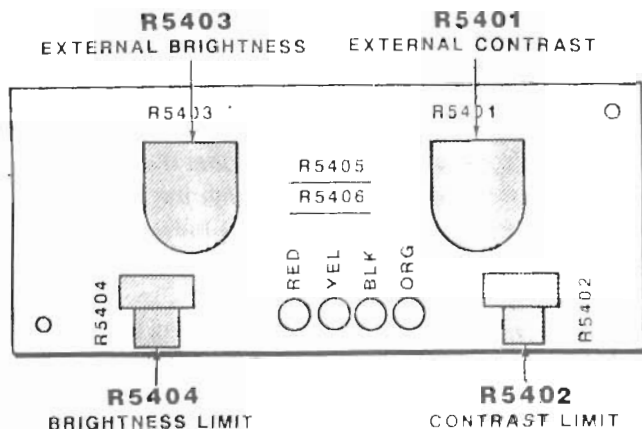


Figure 4-5. Control Board Adjustment Locations

Preparation

Perform the following steps to prepare the monitor for adjustment.

1. Remove the cabinet back to access internal adjustments.
2. Turn the monitor on and allow it to warm up for approximately 30 minutes.
3. Prepare the computer to run disk-based diagnostics (refer to the "Inspection and Preparation" section of Chapter 6 for the procedure). They will be used to generate the test patterns required for specific adjustments. Be certain that the computer is functioning properly by first connecting it to a known good monitor.
4. Read each adjustment procedure completely before performing it.

The following sections contain procedures for performing the various deflection adjustments.

NOTE: Perform these adjustments only if you are certain that the pincushion (PIN) adjustments are satisfactory. Otherwise, proceed to the "Pincushion Adjustments" section and follow the steps indicated there. If the display appears symmetrical and undistorted, it is likely that the pincushion correction circuitry is adjusted properly.

Horizontal Hold

The horizontal hold control (R3415) prevents the display from shifting horizontally and tearing apart in diagonal segments. To adjust the horizontal hold:

1. Adjust R3415 to eliminate horizontal tearing and restore horizontal hold.
2. Verify that the display is stable in all three modes by using software that forces the monitor to operate in each of the three modes.
3. Repeat the procedure until the display is stable in all three modes.

Alternatively, to adjust the horizontal hold:

1. Remove the horizontal sync signal from the deflection board.
2. Adjust R3415 to eliminate horizontal tearing and restore horizontal hold.
3. Re-apply the horizontal sync signal to the deflection board and check for a stable display.

NOTE: The horizontal phase control (R3420) interacts slightly with the horizontal hold control. If horizontal tearing or jittering cannot be completely eliminated by adjusting the horizontal hold control, try adjusting the horizontal phase control to completely stabilize the display.

Horizontal DC Raster Centering

The horizontal DC raster centering control (R3001) sets the left-to-right centering of the raster within the bezel opening. To adjust the horizontal DC raster centering:

1. Turn the G2 control until the raster just appears.
2. Adjust R3001 to center the raster horizontally within the bezel opening.
3. Turn the G2 control until the raster just disappears.

Horizontal Phase

The horizontal phase control (R3420) sets the left-to-right position of the display within the raster area. To adjust the horizontal phase:

1. Use the fill screen test to fill the display area with text.
2. Center the external horizontal centering control (R3418) located on the rear panel.
3. Adjust R3420 to center the display from left to right within the raster area.

Horizontal Size

The horizontal size controls (R3402 and R7106) set the amount of horizontal (left-to-right) raster deflection. To adjust the horizontal size:

1. Use the fill screen test to fill the display area with text.
2. Center the external horizontal size control (R3402) located on the rear panel.
3. Adjust R7106 (located on the PIN board) for a display width of approximately 256 mm \pm 2 mm (10.07 inches).

Vertical Hold

The vertical hold control (R2117) prevents the display from rolling upwards or downwards. To adjust the vertical hold:

1. Adjust R2117 to stabilize the display by turning it first to one extreme and then backing off until the display just stabilizes. Repeat this procedure from the opposite extreme until the display just stabilizes. Set R2117 midway between the two settings that stabilize the display.
2. Verify that the display is stable in all three video modes by using software that forces the monitor to operate in each of the three modes.

Vertical DC Raster Centering

The vertical DC raster centering control (R2148) sets the top-to-bottom centering of the raster within the bezel opening. To adjust the vertical DC raster centering:

1. Use appropriate software to fill the screen in the 480-line mode.
2. Adjust R2148 to center the displayed video vertically within the bezel opening. R2148 should be set within the middle portion of its range when this adjustment is completed.

Vertical Size

The vertical size controls (R2124, R2169, and R2158) set the amount of vertical (top-to-bottom) raster deflection. So that the vertical size remains constant in all three video modes, there are three sub-size adjustments that must be set. To adjust the vertical size, center the external vertical size control and then proceed to the sub-size adjustments for each mode.

To adjust the 480-line mode sub-size:

1. Use appropriate software to fill the screen in the 480-line mode.
2. Adjust sub-size control R2124 for a display height of approximately $195 \text{ mm} \pm 2 \text{ mm}$ (7.67 inches).

To adjust the 400-line mode sub-size:

1. Use appropriate software to fill the screen in the 400-line mode.
2. Adjust sub-size control R2170 for a display height of approximately $195 \text{ mm} \pm 2 \text{ mm}$ (7.67 inches).

To adjust the 350-line mode sub-size:

1. Use appropriate software to fill the screen in the 350-line mode.
2. Adjust sub-size control R2158 for a display height of approximately $195 \text{ mm} \pm 2 \text{ mm}$ (7.67 inches).

Vertical Linearity

The vertical linearity control (R2107) adjusts the vertical scanning for evenly spaced scanning lines on the display. To adjust the vertical linearity:

1. Display a crosshatch pattern. (Use appropriate software to generate this pattern in the 480-line mode.)
2. Adjust R2107 so that the horizontal lines of the crosshatch pattern are evenly spaced from the top to the bottom of the display. The resulting display will show minimal compression, crowding, or expansion of horizontal lines throughout the display.

Focus

The focus control varies the focus voltage to sharpen the display detail. To adjust focus:

1. Display a dot test pattern (refer to the "Inspection and Preparation" section of Chapter 6 for the procedure). Alternatively, perform the fill screen test using the capital Z.
2. Set the external brightness and contrast controls to their detent positions.
3. Adjust the focus control (located on the high-voltage resistor block) for the best overall focus. Check the center, top center, bottom center, left center, and right center areas of the display for good focus.
4. Verify acceptable overall focus using the fill screen test with such characters as @ and #. If the focus is not fairly uniform throughout most of the screen, perform the dynamic focus adjustment.

NOTE: If the G2 control is adjusted after the focus control has been adjusted, it may be necessary to re-adjust the focus control.

Dynamic Focus

The dynamic focus circuitry varies the focus voltage at the horizontal rate so that the voltage at the raster edges is increased and the voltage at the center is decreased. This results in a more uniform overall display focus. To adjust the dynamic focus control (R7703):

1. Display a dot test pattern (refer to the "Inspection and Preparation" section of Chapter 6 for the procedure). Alternatively, perform the fill screen test using the capital Z.
2. Set the external brightness and contrast controls to their detent positions.

3. Adjust R7703 for the best overall focus. Check the center, top center, bottom center, left center, and right center areas of the display for good focus.
4. Verify acceptable overall focus using the fill screen test with such characters as @ and #.
4. Adjust the south level control (R7434) to reduce any PIN distortion at the center of this line. That is, use this control to reduce any bowing in the middle portion of the line.
5. Adjust the north phase control (R7435) to obtain the straightest possible line. Re-adjust the north level control and the north phase control in turn until the straightest line with minimum PIN distortion results.

Pincushion Adjustments

The following sections contain procedures for performing the various pincushion (PIN) correction adjustments. Because this monitor incorporates the new flat technology CRT, these adjustments are considerably more involved than those for a monitor having a conventional CRT.

NOTE: Read this procedure thoroughly before attempting to perform any PIN adjustments. The controls you will be adjusting are interactive; that is, changing one control may make it necessary to go back and change another control until the settings are optimized. For this reason, perform these adjustments in the order in which they are presented.

North-South Pincushion

The north-south (N-S) pincushion adjustments control the symmetry of the top and bottom halves of the display. To adjust the N-S PIN:

1. Display a crosshatch pattern in the 480-line mode.
2. Locate the horizontal line nearest the top of the display.
3. Adjust the north level control (R7436) to reduce any PIN distortion at the center of this line. That is, use this control to reduce any bowing in the middle portion of the line.
4. Adjust the south level control (R7434) to reduce any PIN distortion at the center of this line. That is, use this control to reduce any bowing in the middle portion of the line.
5. Adjust the north phase control (R7435) to obtain the straightest possible line. Re-adjust the north level control and the north phase control in turn until the straightest line with minimum PIN distortion results.
6. Adjust the south phase control (R7433) to obtain the straightest possible line. Re-adjust the south level control and the south phase control in turn until the straightest line with minimum PIN distortion results.
7. Adjust the N-S trap control (R7430) to eliminate trapezoidal distortion in the display. Use the edges of the monitor bezel as references to obtain the most symmetrical display possible.
8. Adjust the N-S parallelogram control (R7431) to eliminate parallelogram distortion in the display. Use the edges of the monitor bezel as references to obtain the most symmetrical display possible.
9. Use appropriate software to fill the screen in the 480-line mode.
10. Adjust the N-S crossover zero control for minimum horizontal line separation across the center of the display. The resulting display should show fairly uniform horizontal line separation throughout the display.
11. Use both the crosshatch pattern and the fill screen test and verify that the N-S adjustments are correct. Repeat steps as needed to obtain the best possible display.

East-West Pincushion

The east-west (E-W) pincushion adjustments control the symmetry of the left and right halves of the display. To adjust the E-W PIN:

1. Display a crosshatch pattern in the 480-line mode.
2. Adjust the E-W level control to reduce PIN distortion in the vertical lines. Use the edges of the monitor bezel as references to obtain the most symmetrical display possible.
3. Adjust the E-W trap control (R7012) to eliminate trapezoidal distortion in the display. Use the edges of the monitor bezel as references to obtain the most symmetrical display possible.
4. Locate the vertical lines nearest the left and right edges of the display.
5. Adjust the E-W phase control (R7039) to obtain the straightest possible vertical lines along the left and right sides of the display.

6. Use both the crosshatch pattern and the fill screen test and verify that the E-W adjustments are correct. Repeat steps as needed to obtain the best possible display.

CRT Cutoff

The cutoff controls (R5316, R5317, and R5318) set the DC level at which the CRT is cut off during blanking and retrace times. The cutoff controls shift the entire waveform viewed at each of the three CRT guns up or down, thereby setting the level of the cutoff pulses (the rectangular pulses in the waveforms of Figure 4-6). Perform this adjustment in a dimly lit area. To adjust the cutoff controls:

1. Use the fill screen test to fill the display area with the capital Z.
2. Set the external contrast control to maximum.
3. Set the external brightness control to minimum.

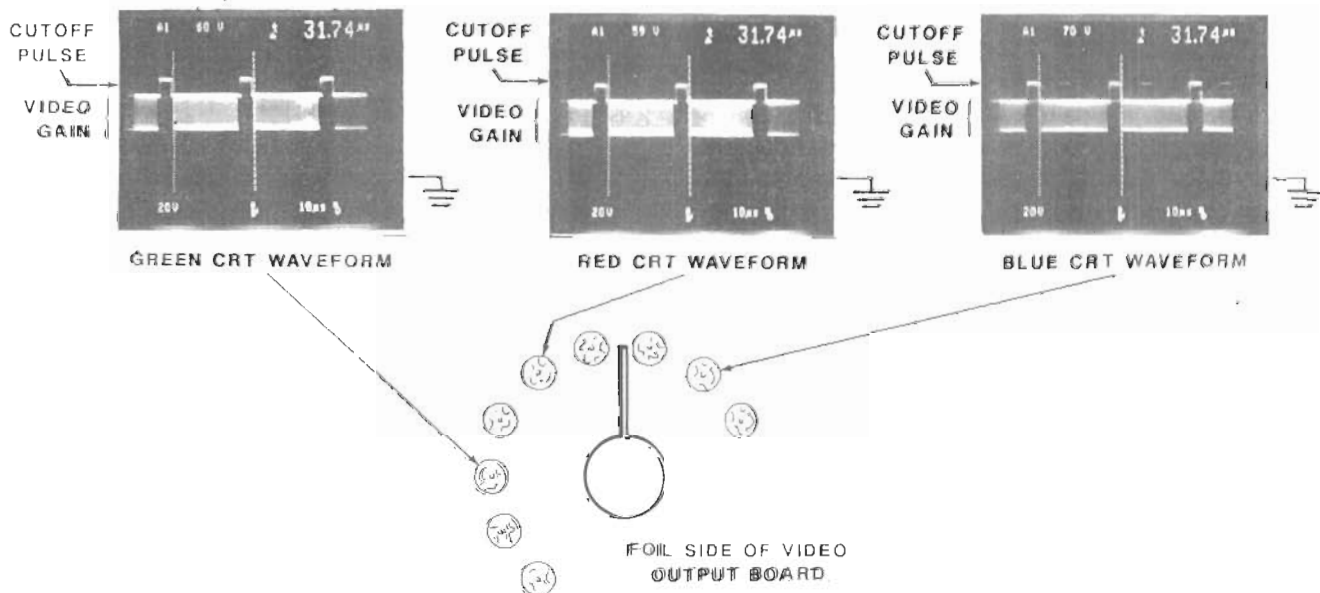


Figure 4-6. CRT Gun Waveforms

4. Set the red and blue gain controls to their mid-range positions.
5. Adjust the G2 control until the raster just appears, then back off until it just disappears.
6. Adjust the red cutoff control (R5316) until a red raster just becomes visible, then back off until it just disappears.
7. Adjust the green cutoff control (R5317) until a green raster just appears, then back off until it just disappears.
8. Adjust the blue cutoff control (R5318) until a blue raster just appears, then back off until it just disappears.
9. Set the external brightness control to maximum and verify that the displayed raster is white. If the display does not appear white, adjust the cutoff controls slightly to eliminate any color cast.
10. Set the external brightness control to its detent position and verify that the display background is black. If the background does not appear black, adjust the G2 control slightly to eliminate any background raster.
11. Set the external brightness and contrast controls to their detent positions and compare the waveforms at the red, green, and blue CRT guns to those pictured in Figure 4-6. They should appear similar.
1. Use the fill screen test to fill the display area with the capital Z.
2. Set the external contrast and brightness controls to maximum.
3. Refer to Figure 4-6 and measure the waveform at the green gun of the CRT. It should be similar to the waveform photograph pictured.
4. Refer to Figure 4-6 and measure the waveform at the red gun of the CRT. The peak-to-peak amplitude of the area labeled "video gain" in the red CRT gun waveform photograph should be equal to the peak-to-peak amplitude of the same area measured at the green gun (approximately 48 V peak-to-peak). Adjust R5154 until the amplitude of this area matches that of the green gun.
5. Refer to Figure 4-6 and measure the waveform at the blue gun of the CRT. The peak-to-peak amplitude of the area labeled "video gain" in the blue CRT gun waveform photograph should be equal to the peak-to-peak amplitude of the same area measured at the green gun (approximately 48 V peak-to-peak). Adjust R5140 until the amplitude of this area matches that of the green gun.
6. Set the external brightness and contrast controls to their detent positions, observe the display, and verify that the displayed characters appear white.

Video Gain

The video gain controls (R5140 and R5154) set the amplitudes of the red and blue CRT drive voltages relative to the green drive voltage. (The green amplifier gain is fixed.) The gain controls shift the "video gain" portions of the CRT gun waveforms in Figure 4-6 up or down. When set properly, all three RGB drive voltages should be the same. To adjust the video gain.

Final Checks

Before returning the monitor to service, perform the following final checks:

1. Perform the AC leakage test as described in Chapter 6.
2. Make sure that all circuit boards and modules are properly installed.

3. Make sure that all connectors are securely installed and that all cables are properly routed to avoid pinching or excessive heat.
4. Make sure that all mounting hardware, barriers, and screws are properly installed.
5. Check the display and verify that the monitor is adjusted and operating properly.
6. Leave the monitor turned on for at least one hour and check for intermittent or thermal problems.

Chapter 5

Circuit Descriptions

This chapter provides descriptions of the major circuits in the ZCM-1490 color video monitor. Use this material in conjunction with the troubleshooting and adjustment information provided elsewhere in this manual.

Refer to the appropriate schematics in Chapter 8 of when reviewing the component level circuit descriptions. Refer to the block diagram in Figure 5-1 when reviewing the overall operation of the monitor. Refer to the waveform photographs in Chapter 8 where

noted. Where appropriate, partial schematics are included within the circuit descriptions for clarity.

Functional Overview

This section provides a brief explanation of the major functional blocks of the monitor. Each of the circuit boards of the monitor is discussed individually. Refer to the block diagram in Figure 5-1 while reading the explanation that follows.

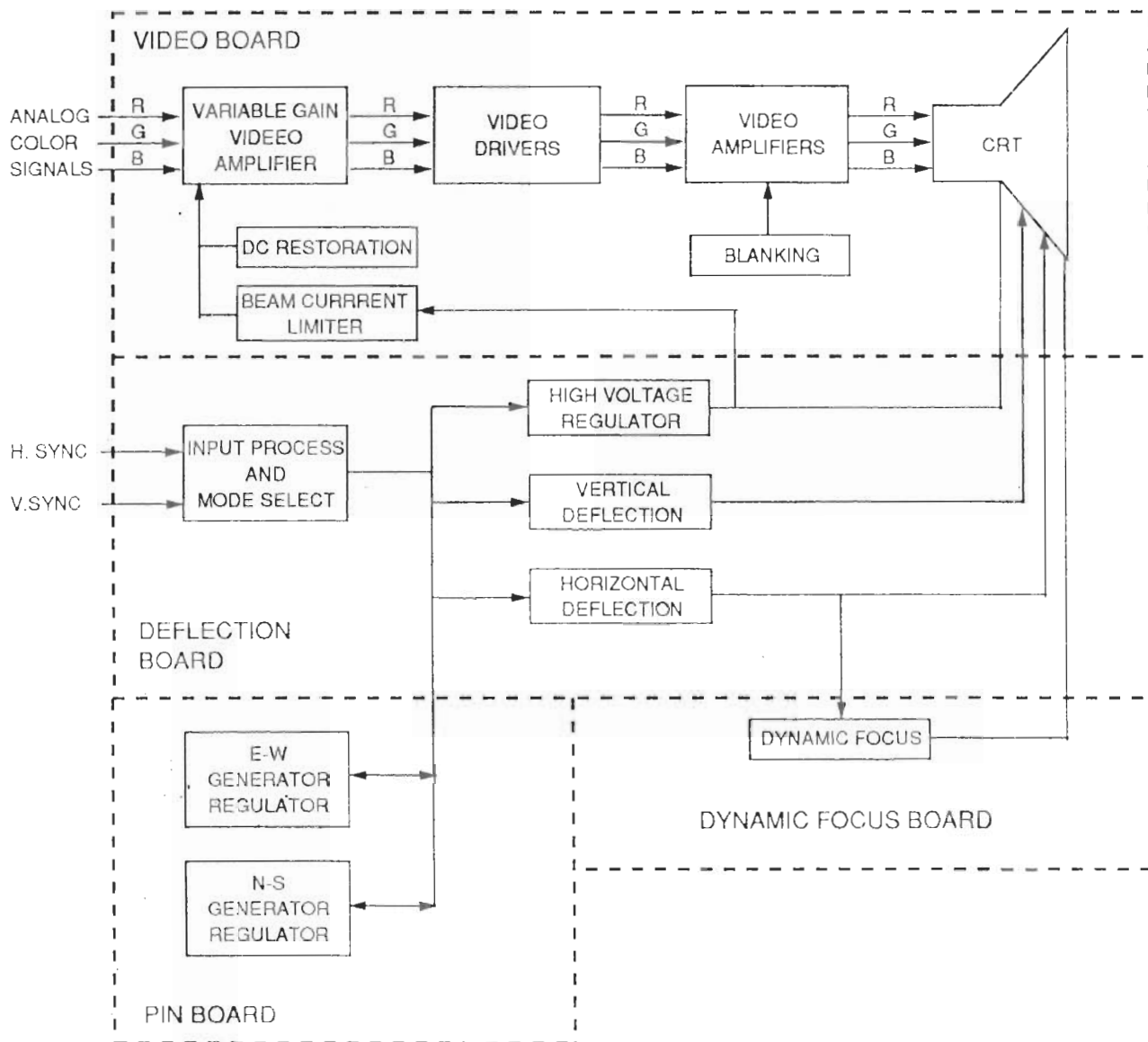


Figure 5-1. ZCM-1490 Block Diagram

The video output module contains RGB amplifiers, brightness and contrast control, automatic brightness limiter, and video blanking circuits. Analog signals containing color information are supplied to the monitor along with horizontal and vertical sync signals. The analog red, green, and blue video inputs are AC-coupled to a variable gain video amplifier. The DC component of the color signals is restored

here. The resulting R,G, and B color signals are applied to video driver and video output stages. The video output amplifiers activate the appropriate red, green, or blue guns of the CRT, allowing information to be displayed. Video blanking for horizontal and vertical retrace acts to shut off the CRT during retrace times.

The monitor deflection module contains the sync processing, high voltage, horizontal and vertical deflection circuitry, and associated feedback paths. Integrated circuits condition the incoming horizontal and vertical sync signals for use by the deflection circuitry. Horizontal deflection amplifiers provide the current required to move the electron beam in the CRT from left to right. Similarly, vertical deflection circuitry provides the current required to move the electron beam from top to bottom. The high voltage needed for the CRT anode is also generated here. Associated feedback-type circuitry includes the anode voltage regulator, pincushion correction, beam current limiting, and blanking pulses.

The FTM/PIN focus board generates the proper waveforms needed to produce a symmetrical display on the CRT. Because this monitor incorporates a flat technology CRT, a much more complex pincushion (PIN) correction circuit is required. Waveforms are generated to correct the display from east to west (E-W) and from north to south (N-S). These correction waveforms are then superimposed upon the horizontal and vertical scanning waveforms to form a symmetrical display.

In most CRTs, the shadow mask is curved to follow the contours of the screen and suspended by springs. This shadow mask may distort with changes in temperature, sacrificing some image quality even under ideal conditions. In the flat technology CRT, the shadow mask is stretched across a frame under extreme tension, resulting in a flat shadow mask that remains flat even with changes in temperature. In addition, the screen itself is perfectly flat. The result is higher resolution and a smaller overall tradeoff between contrast, brightness, and resolution.

Video Input Processing

The red (R), green (G), and blue (B) analog color signals enter the video output module at connector 5R9. These signals are DC-terminated by 75 Ω resistors

R5101, R5102, and R5103. The color signals are then AC-coupled to the video inputs of IC5101 by capacitors C5101, C5102, and C5103.

IC5101 is a three-channel, variable gain video amplifier. A variable DC voltage applied to pin 2 of IC5101 controls the gain of the three channels. The external contrast control acts as a voltage divider to supply this variable voltage at pin 4 of connector 5A1. The integrator formed by R5112 and C5111 helps to smooth the action of the contrast control. The gains of the three channels will track to within about 3% over the range of the contrast control (+8 VDC at maximum contrast to 0 VDC at minimum contrast). The outputs of this gain stage are emitter followers. The characteristic low impedance output of the emitter follower allows for more efficient signal transfer to the following amplifier stages. The gain-controlled video signals appear at pins 12 (R), 15 (G), and 18 (B) of IC5101.

IC5101 also contains an automatic brightness limiter (ABL) circuit. A voltage sample proportional to the average CRT anode current from the deflection board is applied to pin 1 of IC5101. As the average anode current increases, the voltage at pin 1 decreases. The ABL circuit is designed so that as the average anode current exceeds 750 μ A, the gain of the video signal is decreased. The resulting negative feedback loop limits the maximum average anode current to 750 μ A. This circuit is also referred to as a beam current limiter.

Video Amplifiers

After the analog video input signals are processed by IC5101, they are further amplified before being applied to the color guns of the CRT. This amplification occurs in three stages, each of which is discussed individually in the following sections. In addition, the DC component of the color signals is restored here. Cutoff, retrace suppression, and black level circuit descriptions are also included here.

Circuit descriptions for the three video amplifiers are written with reference to the green video amplifier circuits. The red and blue amplifiers function identically. Refer to the partial schematic of Figure 5-2 while reading these circuit descriptions.

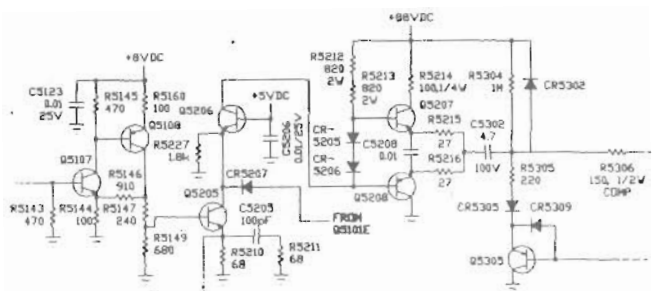


Figure 5-2. Video Amplifier Section (Green)

Video Drivers

The gain-controlled green video signal leaving IC5101 at pin 15 is coupled to the resistor attenuator formed by R5117, R5134, and R5143. C5116 provides some high-frequency peaking for the video signal.

The video signal is then applied to a two-stage, direct-coupled, non-inverting amplifier formed by Q5107 and Q5108. The gain of the green channel is fixed by resistor R5147. In the red and blue channels, potentiometers set the gain (R5156 for red and R5139 for blue) relative to the green channel. The red and blue channel gains can be varied approximately 25% around the green gain.

Cascode Output Amplifier

The video signal is applied to the cascode output amplifier formed by transistors Q5205 and Q5206.

The cascode arrangement allows high gain and wide bandwidth. The amplified video signal appears at the collector of Q5206 across load resistors R5212 and R5213. An emitter peaking network consisting of C5205, C5214, R5209, and R5211 provides frequency compensation for the cascode amplifier.

DC Restoration

As noted earlier, the incoming analog color signals are AC-coupled to the inputs of IC5101. The DC-component of the video signal is then restored as follows. During the horizontal and vertical retrace interval, the voltage at the emitter of Q5205 is sampled by the RC network formed by R5209 and C5214. At this time, the video signal is at black level and the clamp pulse at pin 1 of the 5R6 connector is active-high. This sampled voltage is fed back to pin 14 of IC5101 and compared to a reference voltage developed at pin 13 of IC5101. This reference voltage is used by all three channels in the same manner.

A push-pull current source at the output of the comparator within IC5101 charges or discharges hold capacitor C5105 depending on the magnitude and polarity of the difference between the sampled voltage and the reference voltage. The voltage developed across the hold capacitor C5105 controls the DC bias of the gain-controlled video output at pin 15 of IC5101. During the active clamp pulse time, the DC restoration feedback loop is gated on and the DC bias is set such that the black level emitter voltage of Q5205 equals the reference voltage at pin 13 of IC5101. During the video time, the DC restoration feedback loop is gated off and the voltage across the hold capacitor supplies the required DC bias until the next clamp pulse arrives. In this manner, the AC-coupled video signal applied to the input of IC5101 is DC-restored and an accurate and stable bias is supplied to the cascode output amplifier.

Class AB Output Stage

The amplified video signal at the collector of output transistor Q5206 is applied to a pair of emitter followers (Q5207 and Q5208). Diodes CR5205 and CR5206 force the complementary pair to operate in a class AB mode, thereby reducing crossover distortion as compared to class B operation. This stage isolates the cathode capacitance from the collector of output transistor Q5206 and provides a low-impedance drive for the cathode clamp. (Isolating the cathode capacitance is necessary to mitigate the effect of excess capacitive reactance. Because capacitive reactance is inversely proportional to frequency, it can reduce the load impedance seen by the output amplifier, thereby reducing the gain of the amplifier.) The output of this stage is AC-coupled to the CRT cathode (the green gun) by C5302.

Cutoff

After the output is AC-coupled to the CRT cathode, the DC component is restored by the gated clamp circuit formed by transistors Q5304, Q5305, and their associated circuitry. A positive TTL-level composite blanking pulse is applied to IC5102, where it is buffered and appears at pin 3. This signal is applied to the base of Q5304. With a positive-going pulse at its base, Q5304 produces a negative-going pulse at its collector. This pulse appears at the base of Q5305 after passing through the green cutoff adjustment (R5317). The Q5305 emitter is coupled to the CRT cathode through CR5305 and R5305. Thus, the cathode is forced to the peak level of the gate pulse at the anode of CR5305 during blanking time. The cutoff control determines the DC operating point of the cathode by setting the clamping level.

Retrace Line Prevention

In addition to the video blanking circuitry, a retrace suppressor circuit is included so that the retrace lines produced during flyback do not appear on the screen. A buffered composite blanking pulse from pin 11 of IC5102 is applied to the base of Q5101. The output of this emitter-follower stage is applied to diodes CR5203, CR5207, and CR5211. In the pres-

ence of a pulse, these diodes conduct, thereby steering current away from the cascode output amplifier transistors and shutting them off. This causes a positive blanking pulse to be superimposed onto the cathode video signal during retrace times, thereby preventing a retrace line from being displayed. In addition, this action provides a pedestal for the cutoff circuit clamp.

Black Level

A black level control establishes the difference between black picture information and blanking pulses in the video signal. A buffered blanking pulse from pin 8 of IC5102 is coupled to the variable pedestal generator circuit formed by Q5102, Q5104, and associated circuitry. The output of this generator appears at the emitter of Q5104. During blanking time, a fixed voltage of 7.3 VDC appears at the emitter. During trace time, this voltage is variable, based on the DC voltage applied to the base of Q5102. The external brightness control is a voltage divider supplying this voltage during trace time. The range of the supplied voltage is 7.3 VDC to 5.3 VDC. The resulting pedestal voltage at the emitter of Q5104 is summed to the three video outputs of IC5101.

Sync Input Processing

The horizontal and vertical sync input processing circuitry includes sync input buffering, mode (horizontal scan line) selection, and sync waveform conditioning circuits. In addition, horizontal and vertical size, phase, and hold controls are located here.

Mode Selection

The ZCM-1490 can operate in one of three video modes. In mode 1 (350 scan lines), the monitor can produce an EGA-type display. In mode 2 (400 scan lines), the monitor can produce a CGA-type display (double-scanned). In mode 3 (480 scan lines), the monitor can produce a VGA-type display. In all three modes, the video source supplying the monitor must be a 31.49 kHz analog RGB signal.

The mode of operation is determined by the polarity of the incoming horizontal and vertical sync signals. Table 5-1 lists the required sync polarities for each of the three video modes.

Table 5-1. Mode Selection

	Mode 1 (350 line)	Mode 2 (400 line)	Mode 3 (480 line)
Horizontal sync polarity	(+)	(-)	(-)
Vertical sync polarity	(-)	(+)	(-)

Sync input PROM IC1301 produces mode select signals at pins 4 (mode 1), 3 (mode 2), and 5 (mode 3) based on the incoming sync signal polarities as outlined in Table 5-1.

Regardless of the polarity of the incoming sync signals, the polarity of the horizontal sync signal leaving IC1301 at pin 2 is always positive, while the polarity of the vertical sync signal leaving IC1301 at pin 1 is always negative. The vertical sync signal is applied to the base of transistor Q2116 and appears as a positive sync signal at the collector. The horizontal sync signal is applied to the sync processor, IC3401.

Vertical Processing and Controls

The vertical sync signal at the collector of Q2116 is coupled to the noninverting input of IC2101 at pin 3 through the differentiator formed by CR2122, R2101, and C2103. IC2101 and Q2101 form an oscillator stage. C2101 and R2102 determine the oscillator time constant. IC2101 acts as a comparator with positive feedback, while Q2101 is an emitter follower whose voltage follows that of the output of comparator IC2101 at pin 1. As the output of the comparator changes state from low to high, Q2101 is activated and charges C2115 through CR2102 and R2102. At the same time, the threshold voltage at the noninverting comparator input (pin 3) rises as determined by R2117, R2116, and R2115. C2101 continues to charge until its voltage exceeds that of pin 3,

at which point the comparator output becomes low and the capacitor discharges. The vertical hold control (R2117) controls the threshold voltage at pin 3, thereby changing the free-running frequency of the oscillator.

The external vertical size control (R2153), along with vertical sub-size controls R2158 (mode 1), R2170 (mode 2), and R2124 (mode 3), establish the height of the display. IC2102, Q2102, and Q2105 form a precision current sink that discharges C2105 and C2106 at a linear rate. The sub-size controls determine the discharge current of the circuit, while IC2102 maintains a constant voltage. Thus, as the resistance of the sub-size control is changed, the emitter current of Q2102 changes, as does the collector current. The change in collector current changes the slope of the discharge for capacitors C2105 and C2106, thereby increasing or decreasing the amplitude of the ramp signal.

Transistors Q2103 and Q2104 form a PNP darlington emitter follower pair that acts as a buffer to transform the high-impedance signal at C2105 and C2106 to a lower impedance at R2107. The vertical linearity control (R2107) determines the amount of vertical ramp signal feedback to the junction of C2105 and C2106. This feedback improves the linearity of the sawtooth rise.

Horizontal Controls

IC3401 and its associated circuitry conditions the horizontal sync signal for use by the horizontal deflection and high voltage circuits. The horizontal sync pulses are applied to pins 8 and 9. The processed output appears at pin 3. The customer horizontal phase control (R3418) and the internal horizontal phase control (R3420) interact with the phase detector circuitry to determine the position of the display within the raster area. The horizontal hold control (R3415) adjusts the horizontal oscillator frequency. The horizontal size control (R3402) interacts with the PIN board circuitry to set the horizontal display width.

Horizontal Deflection

The horizontal deflection circuitry is responsible for generating the scanning current needed in the horizontal deflection coils to fill the width of the raster. Three main stages are involved here: the horizontal driver, horizontal output, and pincushion (PIN) correction circuits. Because the ZCM-1490 employs a flat technology CRT, the PIN circuitry is more elaborate than in previous monitors. The PIN circuitry is described in a separate section.

Horizontal Driver

Transistor Q3403 is the horizontal deflection driver. This driver acts as a buffer or isolation stage to prevent the horizontal output circuit from changing the oscillator frequency. The horizontal oscillator output voltage is applied to the base of Q3403. The output of this stage, taken at the collector, is applied to the interstage transformer (TX3401). R3428 and C3409 dampen the primary of TX3401. The transformer steps down the B+ voltage supplied through R3429 to match the low-impedance drive of Q3003. C3009, R3007, and R3009 shape the resulting base drive waveform for Q3003.

Horizontal Output

Transistor Q3003 is the horizontal output transistor. Refer to the following parts of Figure 5-3 while reading this circuit description. Figure 5-3a shows the output voltage waveform at R3009. The corresponding amplifier current in Figure 5-3b shows that Q3003 is cut off during retrace plus a part of the trace at the left side of the raster. Diode CR3003 conducts during this time, producing part of the trace at the left side of the raster and reducing the average amplifier current (thus increasing efficiency). Figure 5-3c illustrates this damper current. Combining Figures 5-3b and 5-3c yields the sawtooth current needed for a complete trace from left to right, as shown in Figure 5-3d.

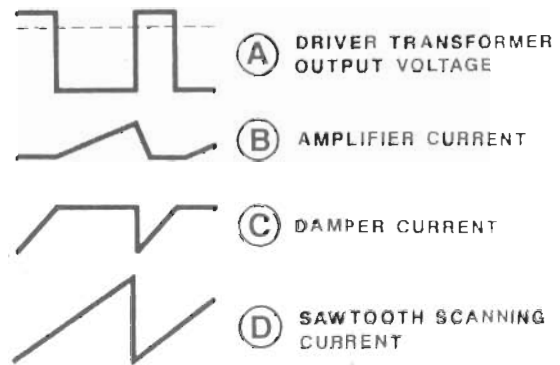


Figure 5-3. Horizontal Output Amplifier Waveforms

Q3003 and CR3003 are the essential parts required for horizontal deflection. Q3003 is the horizontal power amplifier while CR3003 is a damper diode used to increase efficiency. Immediately after flyback, CR3003 is forward-biased by the negative voltage stored in retrace capacitor C3008. CR3003 rectifies the stored energy of the yoke and the core of T3001, thereby recharging capacitors C3006 and C3007. Damping is needed because the oscillations produce white vertical bars at the left side of the raster.

In summary, the resulting current waveshape is related to horizontal scanning as follows:

1. Damped current produces the left side of a trace.
2. As the damped current diminishes and the output stage begins to conduct, the beam is at the center.
3. Current from the output amplifier produces the remainder of the trace.

Series linearity coil LX3002 provides a varying inductance with changing yoke current, resulting in improved linearity. R3003 and C3004 prevent ringing in the coil which might occur with fast changes in signal.

Horizontal Centering

The horizontal centering control (R3001) electrically centers the display from left to right within the raster area. R3001, Q3001, and Q3002 form a voltage divider. Electrical centering is accomplished by supplying direct current through the horizontal deflection coil.

Control Grid Voltage

The G1 control grid voltage is developed from the horizontal output applied to transformer T3001. The output is rectified by diode CR3002 and then regulated at approximately -40 VDC by CR3004.

Anode Voltage

The high voltage required by the anode is developed from the horizontal oscillator output. This signal is applied to the base of driver Q3201 and then to transformer TX3201. The signal from the secondary of TX3201 is in turn applied to anode voltage driver transistor Q3202, which feeds the flyback transformer (TX3202) to produce the required high voltage. The high-voltage output of TX3202 is rectified before being applied to the anode. The focus and G2 voltages are derived at the high-voltage resistor block. The focus control determines the voltage on the last grid of the CRT, thereby regulating the spot size of the beam in order to produce sharp scanning lines.

Anode Voltage Regulator

The anode high voltage is dynamically regulated by IC3201, Q3205, Q3206, Q3203, Q3202, and their associated circuitry. The anode voltage is sensed through a voltage divider and applied to the non-inverting input of IC3201. A reference voltage is established at the inverting input of IC3201 by IC3202 and R3221 (or the associated resistors and jumpers). IC3201 is a difference amplifier which drives Q3205

and feedback voltages at its input terminals. Q3205 drives regulating transistors Q3204 and in turn, Q3205. Q3206 provides additional feedback to insure a stable regulated output voltage from this stage. CR3205, CR3206, CR3216, and CR3217 are protection diodes that limit input transients to IC3201.

High Voltage Shutdown

The high voltage shutdown circuitry disables the horizontal drive input to the anode voltage circuitry when the anode voltage exceeds a certain limit set by circuit parameters. When the shutdown circuit is activated, the collector of Q3207 is held at a DC voltage by emitter resistor R3228. This voltage, appropriately divided by R3232 and R3233, activates Q3208. The horizontal sync pulses at the collector of Q3208 are directed to ground when this transistor is switched on, thereby disabling the base drive to Q3201 and shutting down the high voltage circuitry.

Q3209 senses the CRT anode current at the secondary of the high voltage transformer. If excessive beam current is being drawn, the cathode of CR3207 is forced negative, thereby turning Q3207 on. R3253-R3256 control the high voltage shutdown point by adjusting the shutdown threshold voltage of IC5203. As the sensed voltage at R3230 becomes negative enough to turn Q3207 on, the high voltage shutdown occurs.

Automatic Brightness Limiter

The automatic brightness limiter is a feedback circuit that limits the maximum CRT anode current. The current is sampled at the secondary of the high voltage transformer through transistor Q3210. This sample is passed on to connector 5S6 on the video module. R5111 and C5119 average this signal and apply it to pin 1 of IC5101. As the average anode current exceeds 750 μ A, the gain of the video amplifiers is decreased to limit the maximum anode current.

Vertical Deflection

The vertical deflection circuitry is responsible for generating the scanning current needed in the vertical deflection coils to fill the raster from top to bottom. The vertical sawtooth waveform is sensed by R2127 and applied to IC2101 pin 6. A sample of the vertical output is also fed back to this IC. Diodes CR2114 and CR2115 limit the swing of the signal input applied to IC2101. The output of this IC is applied to driver transistor Q2106.

The output at the collector of Q2106 is applied to the input of the complementary-symmetry amplifier formed by Q2107 and Q2108. Note that Q2107 is a PNP-type transistor, while Q2108 is an NPN-type. The complementary-symmetry, or push-pull action of these two transistors occurs as follows. For a positive-going sawtooth at the base of Q2106, a negative-going drive is applied at the base of Q2107, increasing its collector current. The same negative-going drive applied at the base of Q2108 reduces the forward voltage at the base, resulting in less collector current for this NPN transistor.

Similarly, when a negative-going sawtooth is applied to the base of driver Q2106, a positive-going drive is applied at the base of Q2108, increasing its collector current. In a like manner, less collector current results in Q2107.

Diodes CR2107 and CR2108 set the crossover bias and determine the time that both Q2107 and Q2108 will be active during the middle portion of the sawtooth.

To quicken the vertical retrace action, a "boosted" voltage is generated for retrace. As the yoke voltage rises, Q2110 senses the rise in voltage at its base and activates. This in turn activates retrace switch transistor Q2109. During the scan time prior to

retrace, C2119 in the emitter circuit of Q2109 charges to about +72 V through RX2139, RX2138, and CR2112. When Q2109 is activated at the start of retrace, the stored voltage at C2119 is applied to the collector of Q2108. At this point, Q2108 is conducting and the voltage is transferred to the yoke. The "boosted" voltage causes retrace to occur much faster than it otherwise would.

Diode CR2109 couples +16 VDC to the collector of Q2108 during scan time; during retrace time, it is reverse-biased as the boosted voltage is applied. CR2113 protects the base-emitter junction of Q2109 against reverse-bias damage. CR2114 and CR2115 protect IC2101 from static discharge at the inputs.

Capacitor C2112 performs two functions. First, it increases the load impedance in the collector circuit of Q2106. Because the output circuit may produce crossover distortion with large signals, a large amount of feedback is incorporated to compensate for this. To accommodate this feedback, more gain is required. C2112 supplies positive feedback, increasing the load impedance presented to driver Q2106, and thereby increasing the gain. Second, C2112 maintains Q2108 in a conducting state at all times. This is necessary because large positive peaks in the signal can cut Q2108 off by placing the base and emitter at the power supply potential. The voltage stored across C2112 while the circuit is idling keeps Q2108 conducting at all times.

Vertical Centering

The vertical centering control (R2148) electrically centers the display from top to bottom within the raster area. R2148, Q2111, and Q2112 form a voltage divider. Electrical centering is accomplished by supplying direct current through the vertical deflection coils.

Blanking Pulses

The composite blanking pulse signal is generated from the vertical and horizontal flyback pulses. Transistors Q2117, Q3401, and associated circuitry produce these blanking pulses. Refer to Figure 5-4. The vertical pulse is AC-coupled to the blanking circuit by C2118. Zener diode CR2116 limits this pulse to 5.6 V. The pulse is applied to the base of Q2117, activating it and, in turn, bringing the base of Q3401 to ground. With Q3401 now off, +5 V appears at the collector for the duration of the vertical blanking interval.

Similarly, the -70 V horizontal flyback pulse is AC-coupled by C3413 to the base of Q3401. A negative pulse shuts off Q3401, resulting in a +5 V blanking pulse at the collector for the duration of the horizontal blanking interval.

Diode CR3404 conducts during the retrace portion of the horizontal flyback pulse to prevent reverse-bias damage to Q2117 and Q3401. During the trace portion of the horizontal flyback pulse, CR3404 conducts and holds the collector of Q3401 low. Thus, a composite blanking pulse appears at the collector of Q3401.

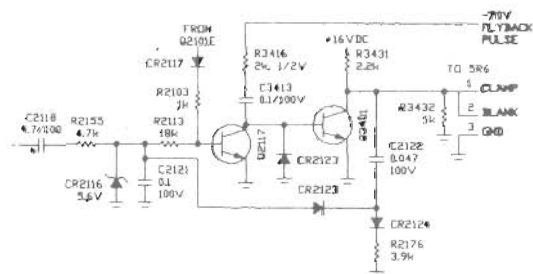


Figure 5-4. Blanking Pulse Circuit

Pincushion Correction

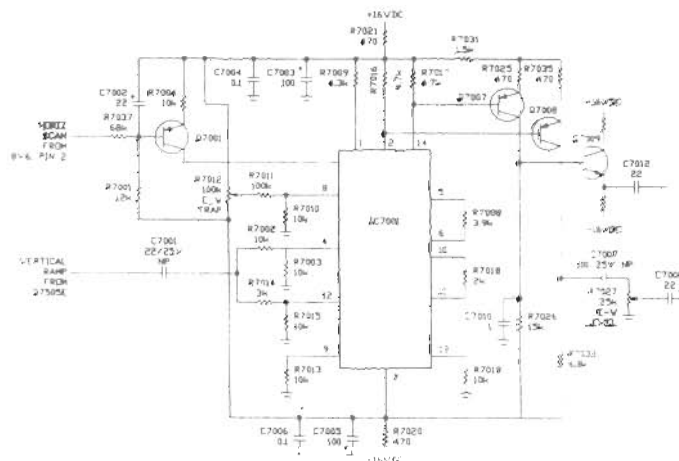
As noted earlier, this monitor incorporates the new flat technology CRT. Because this is a perfectly flat display, a more complex pincushion (PIN) correction must be performed to produce a geometrically correct display. The PIN circuitry can be broken into four functional blocks: an east-west waveform generator, an east-west regulator, a north-south waveform gen-

erator, and a north-south output circuit. Each block is explained individually in the following sections.

East-West Waveform Generator

The east-west (E-W) waveform generator produces the PIN correction waveform for the left and right sides of the display. The resulting waveform modulates the B+ voltage supplied to the horizontal deflection circuitry at the vertical scan rate. In this way, the left and right sides of the display can be corrected as the beam deflects vertically.

The E-W waveform generator produces three waveforms which are then combined to form the final E-W PIN correction waveform. A parabolic waveform is generated to correct parabolic distortion at the left and right sides of the raster. A ramp waveform at the vertical scan rate is added to the parabola to correct trapezoidal distortion at the left and right sides of the raster. A sine wave at the vertical scan rate is generated and added to the parabola to correct phase errors in this waveform. Refer to Figure 5-5.



Pin 4 of IC7001 is the Y(+) multiplier input, pin 8 is the Y(-) multiplier input, pin 9 is the X(+) multiplier input, and pin 12 is the X(-) multiplier input. Each of these inputs is biased and balanced by a corresponding resistor: R7003 for pin 4, R7010 for pin 8, R7013 for pin 9, and R7015 for pin 12. When the inputs are balanced, a vertical ramp applied to both pins 4 and 12 will produce a parabola at the output of the multiplier.

A ramp waveform at the vertical scan rate is added to the parabola to correct trapezoidal distortion at the left and right sides of the raster. To add the ramp to the parabola, the bias of the (balanced) inputs of multiplier IC7001 is offset. When the bias is offset, a portion of one of the input signals is present at the output of the multiplier. In this manner, the vertical ramp is "added" to the parabolic waveform. The input bias is offset by R7011 and R7012, the E-W trap (trapezoid) control. R7012 adjusts the amount of offset to obtain the desired amplitude and polarity of the vertical ramp to be added to the parabolic waveform.

The outputs of multiplier IC7001 are applied to the differential amplifier formed by transistors Q7007 and Q7008. The output from pin 2(+) is applied to the base of Q7008. The output of Q7008 is coupled to the E-W level control (R7027) by C7007. R7027 controls the amplitude of the parabolic waveform. The signal from the E-W level control is coupled to the E-W regulator.

The multiplier output from pin 14(-) is applied to the base of Q7007. The output of Q7007 (a parabolic waveform) is integrated by C7010 to form a sine wave. This is the sine wave mentioned earlier that is added to the parabolic waveform to correct phase errors. The sine wave is buffered by Q7009 and applied to the E-W phase control (R7039). The signal from the E-W phase control is applied to the E-W regulator.

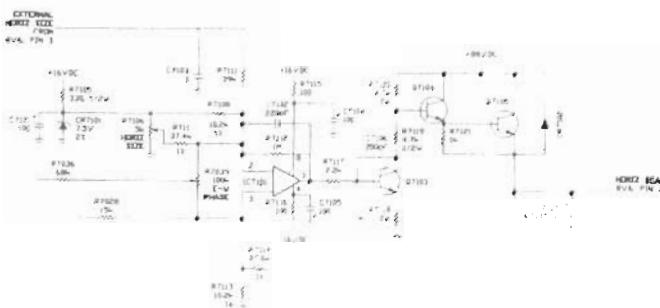
The E-W waveform generator must also produce the proper correction waveform regardless of changes in horizontal and vertical display sizes. A vertical size change is automatically compensated for because the vertical ramp amplitude determines the vertical display size. Thus, a larger ramp at the input of the multiplier circuit results in a correspondingly larger output. To compensate for a change in the horizontal

display size, the B+ voltage supplied to the horizontal deflection circuitry is sampled and used to adjust the correction waveform accordingly.

The B+ voltage at pin 2 of connector 8V6 is scaled and filtered by R7037, R7001, and C7002. Transistor Q7001 compares the resulting signal to a fixed voltage of about 12V (sensed by R7004). The output of this transistor is applied to the K (multiplication constant) input (pin 3) of IC7001. As the sampled B+ voltage changes at the base of Q7001, the current applied to the K input of IC7001 changes. Because the output of the multiplier circuit is KXY (a constant times the X and Y inputs), the K factor corrects the resulting parabolic waveform as the horizontal size changes. In this manner, changes in either the horizontal or vertical size are compensated for.

East-West Regulator

The E-W regulator determines how much of the E-W correction waveform is imposed onto the horizontal scan voltage. It also supplies the current (with the correction waveform) to the horizontal deflection circuitry. Refer to Figure 5-6.



IC7101. As the E-W phase control is offset from its midpoint, a part of the sine wave signal appears at the output of IC7101.

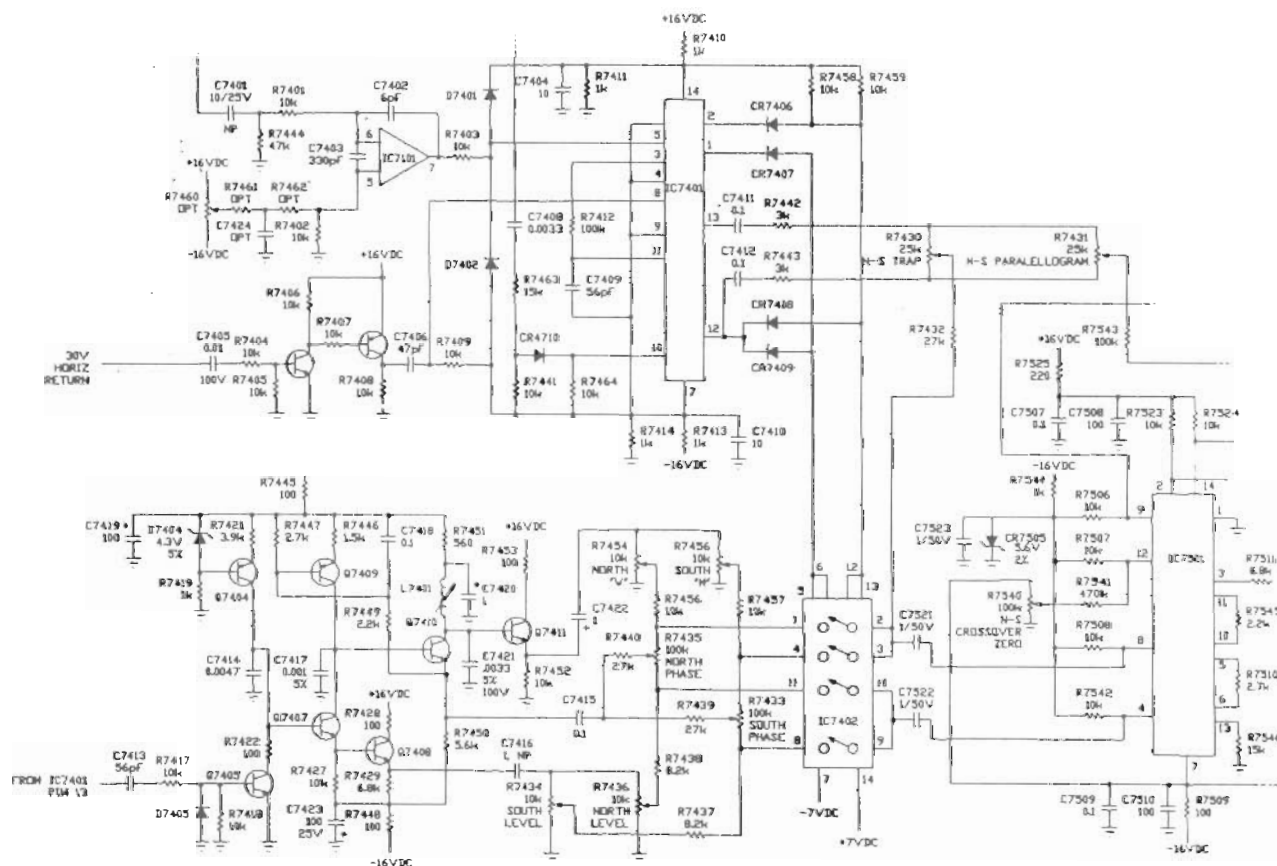
A sample of the output voltage of the E-W regulator is also applied to IC7101 through the divider formed by R7113 and R7114. A reference voltage generated by CR7101 is divided by R7106 and applied as to IC7101. R7106 is the main horizontal size control. Altering the reference voltage supplied to IC7101 by this control alters the horizontal size. The external horizontal size control (R3402, located on the deflection board) also alters this reference voltage, but with a limited range. IC7101 combines these signals to produce an E-W PIN correction waveform at its output (pin 1).

The E-W correction waveform is inverted and buffered by transistor Q7103. Q7104 provides current gain for the E-W pass regulator transistor. The pass

regulator transistor (Q7105) passes the current to the horizontal deflection circuit and drops the voltage. In this manner, the E-W PIN correction waveform is superimposed onto the horizontal scan voltage.

North-South Waveform Generator

The north-south (N-S) waveform generator produces the PIN correction waveform for the top and bottom of the display. The resulting waveform modulates the vertical ramp at the horizontal rate. The purpose is to increase the vertical deflection at the top center and bottom center of the display. In addition, as the electron beam approaches the center of the screen (from the top), the correction waveform must diminish, then reverse phase and increase again as the electron beam moves toward the bottom of the screen. Refer to Figure 5-7.



The 30V horizontal retrace pulse at pin 1 of connector 8V6 is coupled to a signal-shaping circuit formed by transistors Q7402 and Q7401. The resulting signal at the collector of Q7401 is a pulse with a fast rising edge and a delayed, slow falling edge. This shaped pulse is differentiated by C7406 and R7409 and applied to the set input (pin 8) of IC7401, a dual D-type flip-flop. This half of IC7401 is configured as a one-shot multivibrator. (A one-shot multivibrator converts an input pulse of short duration to an output pulse of longer duration.) An RC network formed by R7412 and C7409 delays the clock input signal to pin 11 of IC7401 by approximately 4 μ S. This delay in effect sets the duration of the output pulse. Thus, when the shaped pulse from Q7401 is applied to the set input, output Q2 at pin 13 becomes logic high. The RC network samples this logic high output, delays it by about 4 μ S, and applies it to the clock input (pin 11). When the clock input goes high, the signal at the D input (pin 9) causes Q2 to go low. C7408, R7463, and R7441 differentiate the vertical retrace pulse. CR7410 and R7464 sense this and apply it to the reset input of flip-flop IC7401, thereby resetting the flip-flop at the start of each vertical frame. This prevents flip-flop "latchup" caused by static discharge.

The Q2 signal at pin 13 of IC7401 is coupled to transistor Q7405. This transistor, along with C7414, Q7404, and D7404, forms a horizontal ramp generator. C7414 is charged by the current source formed by Q7404, D7404, and associated components. A pulse at the base of Q7405 causes this transistor to conduct, thereby discharging C7414. The horizontal ramp is formed in this manner. This ramp is buffered by transistors Q7407 and Q7408 and coupled to the south level (R7434) and north level (R7436) controls.

A parabolic waveform is also generated to correct north and south phase. Transistor Q7407 is a modulated current sink for the parabola generator. This transistor, along with C7417 and Q7409, forms a parabola generator. C7417 is charged by the current source formed by Q7409 and associated components. The modulated signal at the base of Q7407 causes this transistor to conduct, thereby discharging C7417. To stabilize the DC bias point of C7417, the current source (Q7409) is DC-modulated by feed-

back from Q7410. The parabolic waveform is formed in this manner. This waveform is buffered by Q7410 and coupled to the south phase (R7433) and north phase (R7435) controls.

Q7410 also acts as a current sink for the resonant circuit formed by C7421 and L7401. A sinewave at twice the horizontal frequency is present at C7421. L7401 adjusts the phase of this sinewave. Q7411 buffers the sinewave for the North "W" (R7454) and South "M" (R7456) controls.

IC7402 is a CMOS switch activated by the appropriate signals from the Q outputs of IC7401. The switches within IC7402 are configured (by external connections) as single pole double throw switches. In this way, the proper set of controls (either north or south) is connected to the following stages based on which half of the raster is being scanned (either the top or bottom). Diodes CR7406 and CR7407 activate the CMOS switches based on the Q1 and not-Q1 signals from IC7401, pins 2 and 1 respectively. Diodes CR7408 and CR7409 open both sets of switches during horizontal retrace time based on the not-Q2 signal from IC7401, pin 12.

The processed horizontal rate signals, routed through IC7402 from previous stages, are applied to the carrier inputs of a balanced modulator-demodulator (IC7501). (A balanced modulator-demodulator forms an output voltage which is a product of an input signal and a carrier.) IC7501 and its associated circuitry modulate the horizontal rate signal (the carrier) with a vertical ramp (the input signal) such that as the beam approaches the center of the screen (from the top), the amplitude of the signal decreases to zero. As the beam crosses the center of the screen, the amplitude again begins to increase, but the phase is now reversed for scanning the bottom half of the screen. The vertical ramp is coupled to IC7501 through C7501 from buffer transistor Q7505. The north-south crossover zero control (R7450) adjusts the crossover point where the horizontal signal amplitude is reduced to zero and the phase reverses. Bias for IC7501 is supplied by Q7502 and Q7503 as a function of the horizontal scan voltage. The gain of this stage is set by R7510 and R7545.

North-South Output

The N-S output circuit provides the current to modulate the vertical ramp at the horizontal rate. Refer to Figure 5-8. The output of IC7501 is coupled to operational amplifier IC7502. The positive polarity output (pin 6) is applied to the noninverting input of IC7502 and the negative polarity output (pin 12) is applied to the inverting input. The signal from the N-S parallelogram control (R7431) is also added to the noninverting input through R7543. IC7502 provides gain to drive op-amp IC7503. Power amplifier IC7503 in turn drives step-up transformer T7501.

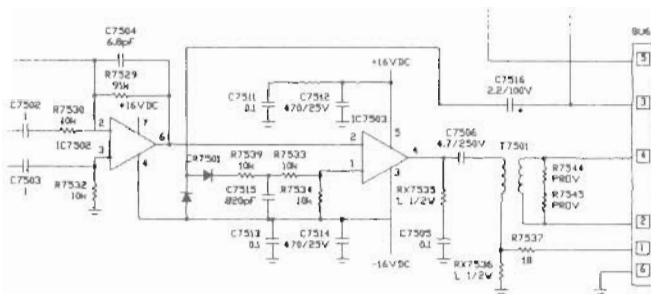


Figure 5-8. N-S Output

The secondary of T7501 is in effect in parallel with the vertical yoke and the N-S pincushion correction waveform is thus imposed onto the vertical output. Although the secondary of T7501 is in series with the vertical yoke, the output of the vertical scan is at AC ground compared to the horizontal rate signal, and the yoke coupling capacitor and resistor present a low impedance.] Thus, T7501 is in effect in parallel with the vertical yoke.

Dynamic Focus

The dynamic focus circuitry varies the focus voltage at the horizontal rate so that the voltage at the raster edges is increased and the voltage at the center is decreased. The horizontal rate waveform is applied to the base of Q7701. R7703 controls the amplitude of the signal applied to the dynamic focus circuit. Q7701 and Q7703 amplify the incoming waveform. T7701 steps up the resulting waveform to generate the 500V p-p focus voltage.

Degaussing Coil

Degaussing refers to demagnetizing the iron and steel parts of the picture tube, in particular the steel shadow mask and frame within the CRT. This is necessary because a steady magnetic field magnetizes these parts and affects the beam register on the color phosphors, resulting in poor purity.

A degaussing coil is wrapped around the CRT and controlled by a positive temperature coefficient thermistor in the power supply. When the monitor is first turned on, current flows through the thermistor and activates the degaussing coil. As the thermistor heats up, its resistance becomes very high and the degaussing coil is deactivated. The thermistor can require up to 30 minutes to cool and reset before the degaussing coil can be reactivated.

Chapter 6

Troubleshooting

This chapter provides information on troubleshooting the ZCM-1490 color video monitor. Enough information is included to assist in diagnosing most faults to the major component level.

General troubleshooting information is included in the beginning sections of this chapter. Read these sections before proceeding. They contain important safety guidelines, initial tests and diagnostics, and other important information.

Following this general information is a series of troubleshooting flowcharts. These charts are designed to assist in diagnosing faults to the major component level when used with the schematics and waveform photographs in Chapter 8. Always begin with the General Troubleshooting Chart. This chart will direct you to an adjustment or to a more detailed chart.

Waveform photographs and schematics are located in Chapter 8. Refer to these as directed when troubleshooting or performing adjustments. Read the "Troubleshooting Charts" section in this chapter and "Waveform Explanations" in Chapter 8 before using the waveform photographs.

Voltage and resistance measurement tables are included after the troubleshooting charts. Use these tables when specific circuits are suspected or when the monitor cannot be turned on for tests.

In the ZCM-1490, measurements on the deflection board cannot be made safely while the monitor is on. To gain access to this board, it must be removed from the monitor chassis. With the exception of a few

specific test points, this board must be serviced by first identifying the symptom and then using the resistance measurement tables to isolate the faulty components. Use the troubleshooting charts to begin by identifying possible problem areas.

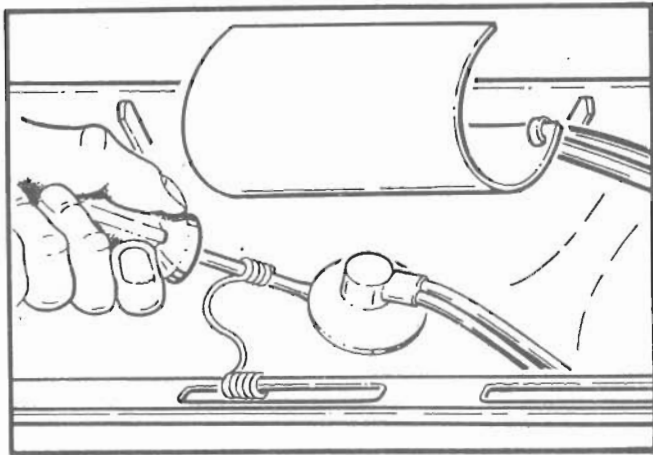
Safety Guidelines

Read the following safety notes carefully before attempting to troubleshoot or service this monitor.

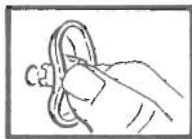
WARNING

The CRT anode retains a potentially lethal voltage even when the monitor is turned off. Perform repairs only after the CRT anode has been properly discharged. Refer to Figure 6-1 and the following procedure to discharge the CRT anode:

1. Connect a clip lead or heavy gauge wire to chassis ground.
2. Connect the other end of the lead to the stem of a flat blade screwdriver that has an insulated handle.
3. Insert the blade of the screwdriver under the rubber insulation that covers the anode lead on the CRT and make contact with the anode terminal. Depending on the amount of charge present on the anode, a distinct snap may be heard as the CRT discharges.



1. CAREFULLY SLIDE A GROUNDED FLAT SCREWDRIVER TIP UNDER THE LIP OF THE ANODE LEAD.



2. AFTER DISCHARGING THE VOLTAGE, DISCONNECT THE ANODE LEAD FROM THE CRT.

Figure 6-1. CRT Anode Discharging

WARNING

The switch mode power supply contains circuits that generate dangerous high frequency, high amplitude, quasi-square wave signals that present a potentially lethal shock hazard. In the ZCM-1490, this circuitry is located on a separate, exposed circuit board located along the left side of the monitor when viewed from the back. Do not attempt to service the power supply.

WARNING

To prevent both personal injury and equipment damage, always use an isolation transformer when troubleshooting this monitor.

CAUTION

Under no circumstances should the original design be modified or altered without per-

mission from Zenith Electronics Corporation. All components should be replaced only with types identical to those in the original circuit, and their physical location, wiring, and lead dress must conform to the original layout upon completion of repairs.

AC Leakage Test

Repair and reassembly of the monitor can inadvertently result in the loss of electrical isolation between the AC power wires and the exposed metal parts of the monitor. If this isolation is lost or significantly reduced, electrical shock can result.

Any AC voltage leak that exceeds 0.75 V rms (0.5 mA) constitutes a potential shock hazard and must be corrected. To prevent electrical shock after reassembly, perform an AC leakage test on all exposed metal parts of the monitor using the following procedure (do not use an isolation transformer during this test):

1. Construct an AC leakage voltmeter circuit as shown in Figure 6-2 using the following parts:
 - An AC voltmeter with an internal impedance of 5 K Ω or more. The overall range of the meter is not critical but the 0 to 0.75 V range must be easy to read accurately.
 - An AC-type 0.15 μ F capacitor.
 - A 1500 Ω , 10 watt resistor.
2. Connect one side of the test circuit to a good earth ground, such as a water pipe, and the other side to an exposed metal part of the monitor.
3. With the monitor turned on, measure the voltage leak between the earth ground and the monitor. Verify that any AC leakage is less than 0.75 V rms (0.5 mA).
4. Reverse the meter leads and repeat the measurement.

5. Repeat steps 3 and 4 until all exposed metal parts are verified to have AC leakage levels less than 0.75 V rms (0.5 mA).

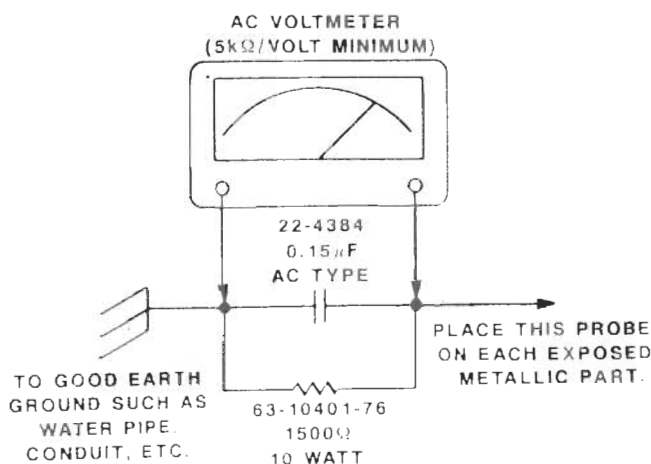


Figure 6-2. AC Leakage Voltmeter Circuit

Suggested Tools and Equipment

The following tools and supplies are recommended for servicing the monitor:

- Flat-blade screwdrivers
- Philips screwdrivers
- Hex drivers
- Plastic alignment tools
- Diagonal cutters
- Wire strippers
- Long nose pliers
- Soldering iron, 25 to 40 watt
- Solder, 60/40
- Desoldering braid
- Plastic cable ties.

The following equipment is recommended for troubleshooting the monitor as described in this chapter:

- Z-100 or Z-200 Series PC-compatible computer or equivalent
- Disk-based diagnostics (CB-5063-28)

- Z-449 31.49 kHz analog video card or equivalent
- Oscilloscope — DC to 100 MHz, dual trace, triggered sweep (Tektronix Model 2235 or equivalent)
- Oscilloscope probe — low capacitance, 4 ns rise time (Heath Model PKW-105 or equivalent)
- Digital voltmeter — high-impedance input, 0 to 1000 V, 0 to 1 megohm (Heath Model SM-2215 or equivalent)
- High-voltage probe — 0 to 40 KV (Heath Model IM-5215 or equivalent)
- Isolation transformer.

Inspection and Preparation

Before turning the monitor on, inspect the power cord, video cable, and all connectors for damaged insulation or loose prongs. Inspect the exterior of the monitor for signs of damage. If physical damage is evident, remove the cabinet back and inspect further before proceeding.

If these preliminary checks do not indicate a problem, proceed as follows:

1. Connect the video cable from the monitor to the computer.
2. Turn the computer and monitor on. Observe the display for faults and refer to the troubleshooting charts in this chapter only after reading the remaining procedures in this section.
3. Allow the monitor to warm up for approximately 30 minutes, unless a fault diagnosed in step 2 prevents this.
4. Perform the ROM-based color bar test and other tests as necessary. The instructions for performing these tests are included here for convenience.

Color Bar Test

The ROM-based color bar test can be used to set the display brightness and contrast to comfortable levels. To display the color bars using a Zenith Data Systems PC-compatible computer:

1. Press the CTRL, ALT, and INS keys in sequence, hold them, and then release them.
2. After the Monitor prompt appears, press C and then press RETURN.
3. Color bars, in the form of a gray scale, should now be displayed.

Use this test in conjunction with the troubleshooting charts at the end of this chapter.

Fill Screen Test

The ROM-based keyboard test can be used to set the brightness, contrast, focus, and dimensions of the display to comfortable levels. This test fills the screen with any character entered from the keyboard. To perform the fill screen test:

1. Press the CTRL, ALT, and INS keys in sequence, hold them, and then release them.
2. After the Monitor prompt appears, type TEST and then press RETURN.
3. Select the keyboard test.
4. Press any displayable key to fill the screen with that character. (The capital Z is a good character to display for assessing display characteristics.)

Disk-Based Diagnostics

The disk-based diagnostics can be used to generate test patterns that may be helpful when performing

display adjustments. The diagnostics are menu-driven. A general procedure for using the diagnostics follows. For further information about the disk-based diagnostics, refer to the documentation supplied with the disk.

1. Boot the disk-based diagnostics.
2. Use the arrow keys to select the computer configuration you are using.
3. Select NO when prompted for the fast test.
4. The diagnostic menu will now be displayed. Use the arrow keys to choose the single test, and then use the arrow keys to choose the video diagnostic menu.
5. The video diagnostic menu will now be displayed. Use the arrow keys to choose the single test, and then use the arrow keys to choose the video patterns. Finally, use the arrow keys to select the coarse grid or the focus pattern as needed.

Cleaning Procedure

CAUTION

Unplug the monitor before cleaning. Be sure that the monitor is completely dry before plugging in the unit.

Clean the cabinet with a lint-free cloth, lightly dampened with a mild cleaning solution. Do not spray liquids directly on the monitor or use a wet, saturated cloth.

Clean the screen with a good quality, non-abrasive glass cleaner. The display glass of the ZCM-1490 is treated with an OCLI HEA coating to reduce glare. Fingerprints and smudges are more noticeable with this coating. Glass cleaners containing isopropyl alcohol are effective in removing these marks.

Surface Mount Component Replacement

This monitor incorporates surface mount technology on many of the circuit boards. To replace a surface mount component:

1. Unsolder the defective component. Use a desoldering braid and a low-wattage soldering iron with a fine tip to remove the solder from the component tabs. Be careful not to form solder bridges with nearby surface mount components.
2. Remove the defective component. The surface mount components are held in place by a small drop of non-conductive cement. Either heat the cement or gently break the component away and remove it.
3. Position the new component. Use a drop of non-conductive cement to hold the component in place on the circuit board. Alternatively, rest the circuit board horizontally and position the new component.
4. Solder the new component. Use a low-wattage soldering iron with a fine tip and solder the new component in place. Be careful not to form solder bridges with nearby surface mount components.

Troubleshooting Charts

This section contains a series of troubleshooting charts designed to assist in diagnosing faults to the major component level. Use these charts with the schematics and waveform photographs included in Chapter 8. The charts emphasize AC signal analysis and monitor adjustments. Refer to the next section in this chapter for DC voltage and resistance measurements.

Refer to the appropriate schematic as you work through the steps of a troubleshooting chart. While these charts are designed to assist in diagnosing faults, they cannot substitute for the information contained in the schematics.

As noted earlier, measurements on the deflection board cannot be made safely while the monitor is on. With the exception of a few specific test points, this board must be serviced by first identifying the symptom and then using the resistance measurement charts to isolate the suspect components. Use the troubleshooting charts to begin to identify possible problem areas.

Always begin with the General Troubleshooting Chart. This chart will then direct you to check a particular item, to perform an adjustment, or to consult a more detailed chart. The charts are:

- General troubleshooting chart
- Video board troubleshooting chart
- Deflection troubleshooting chart
- PIN Board Troubleshooting Chart
- Power Supply Troubleshooting Chart

The waveform photographs in Chapter 8 are numbered and labeled with a brief identifying note. When a block in a troubleshooting chart directs you to check a waveform, the number of that waveform photograph appears in a circle. The same waveform photograph number appears as a circled number on the schematics in Chapter 8.

Sometimes a particular block of a troubleshooting chart requires additional explanation. In this case, a number is placed in the lower left corner of the troubleshooting block. This number refers you to the notes on the charts. Always read these notes before performing a step.

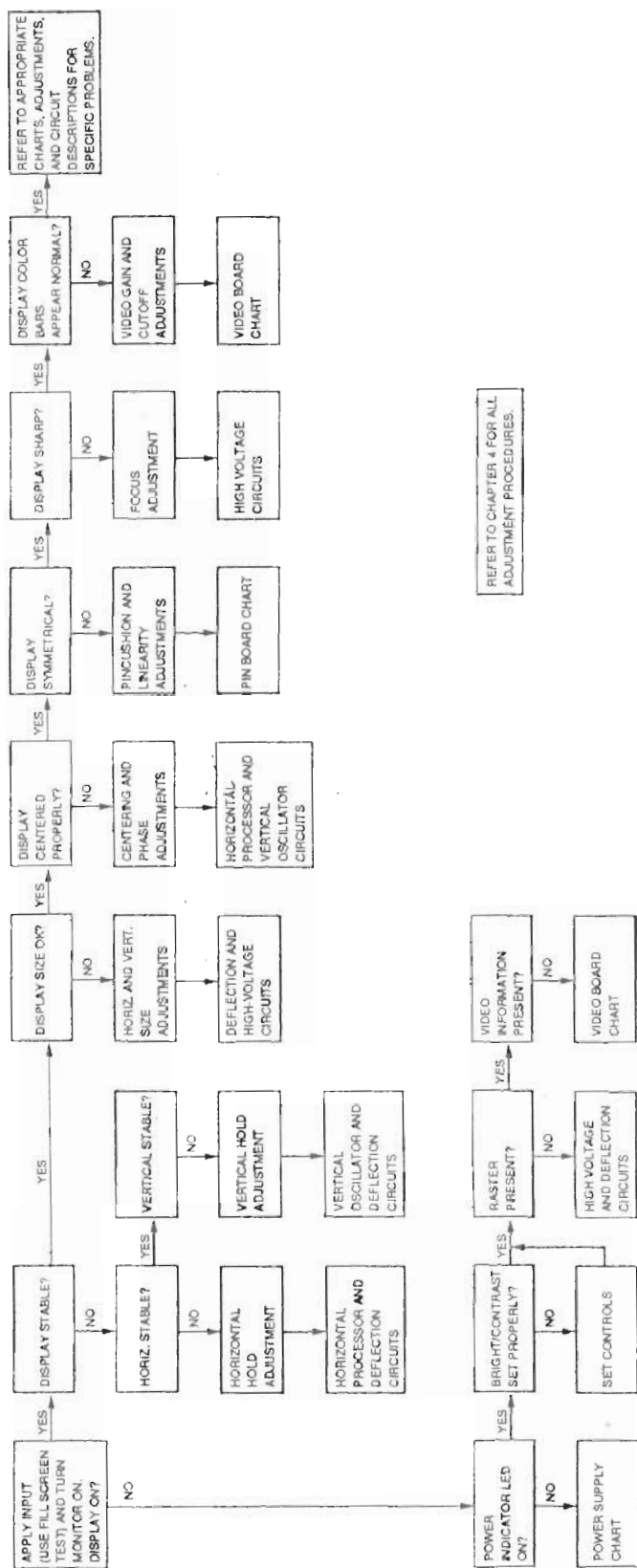


Figure 6-3. General Troubleshooting Chart

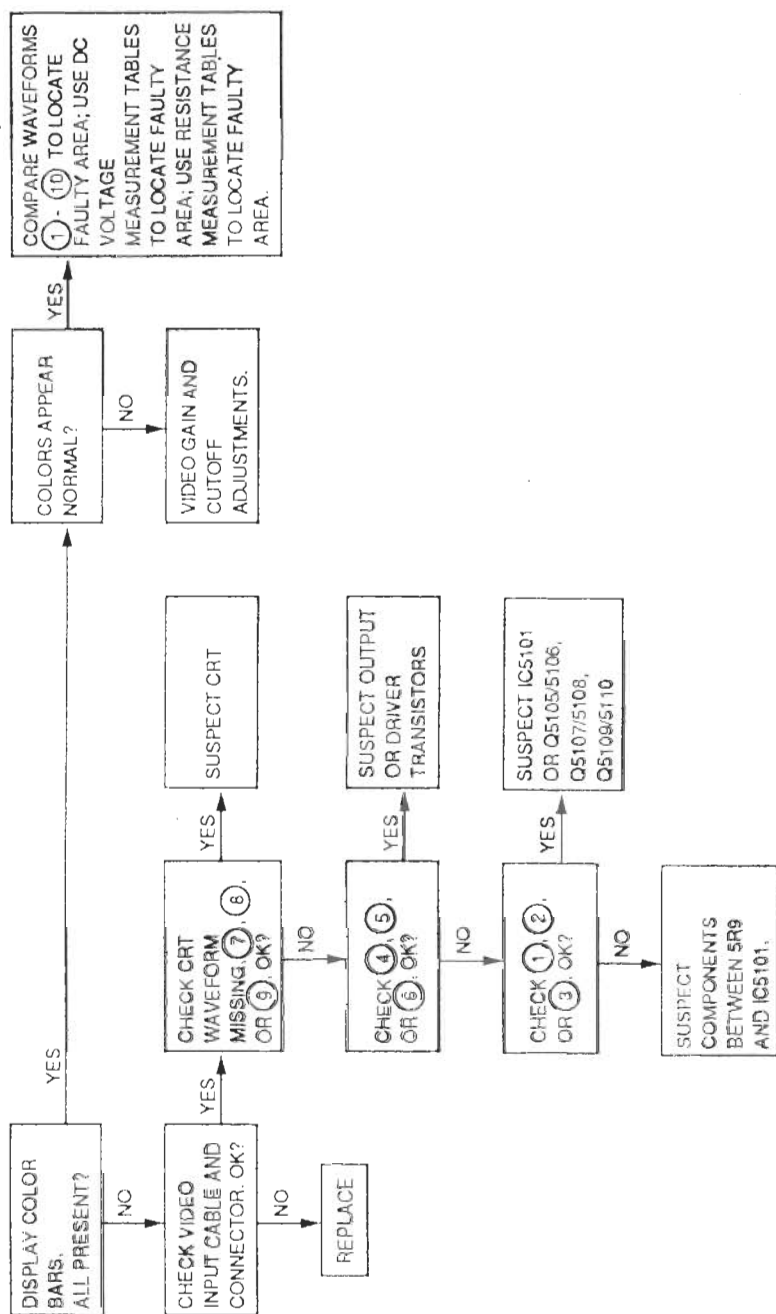
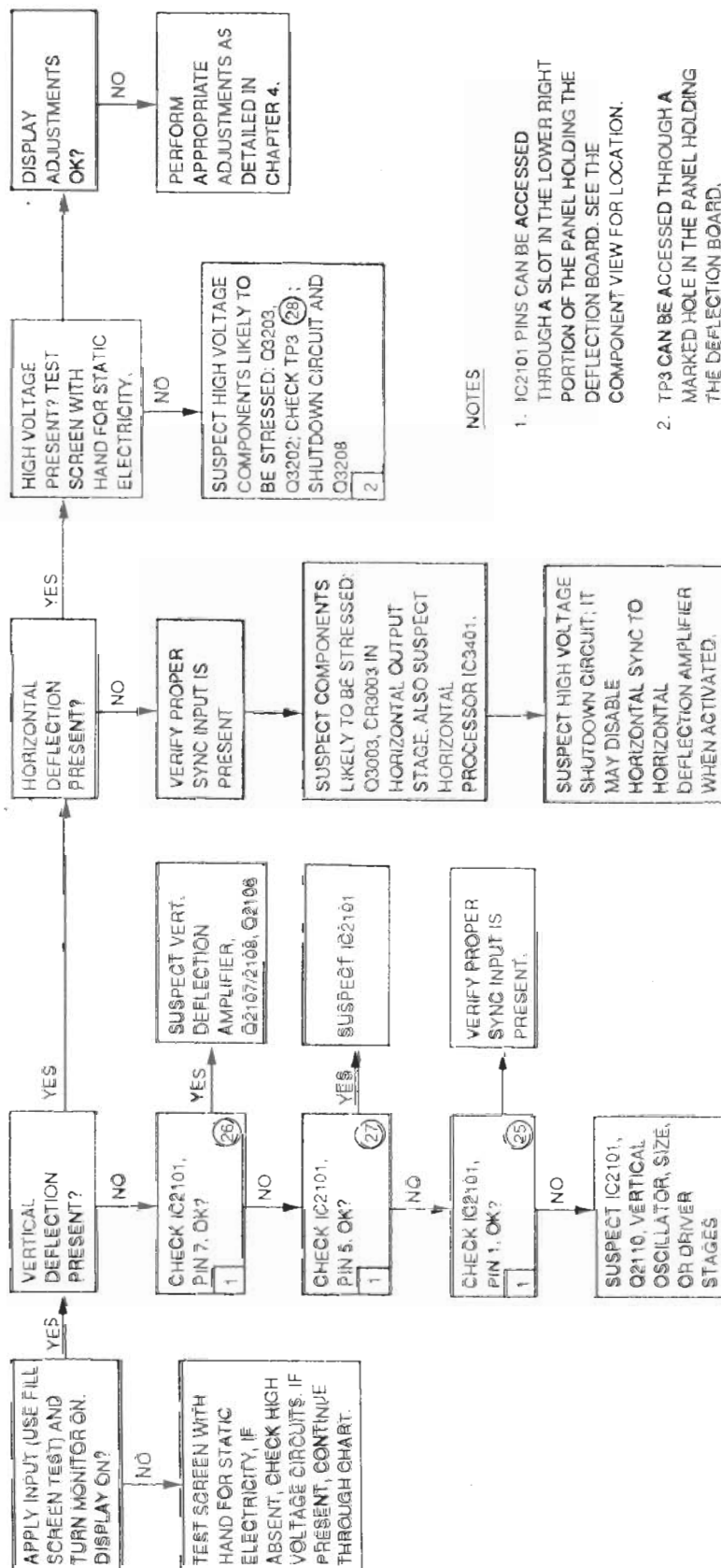


Figure 6-4. Video Board Troubleshooting Chart

THIS CHART CAN ONLY ASSIST IN DIAGNOSING FAULTY CIRCUIT AREAS BY SYMPTOM. WAVEFORM MEASUREMENTS CANNOT BE MADE SAFELY WHILE THE MONITOR IS ON. TO BE SERVICED, THIS BOARD MUST BE REMOVED FROM THE MONITOR. USE THE RESISTANCE MEASUREMENT TABLES TO IDENTIFY FAULTY COMPONENTS AFTER A FAULTY CIRCUIT AREA IS IDENTIFIED.



NOTES

1. IC2101 PINS CAN BE ACCESSED THROUGH A SLOT IN THE LOWER RIGHT PORTION OF THE PANEL HOLDING THE DEFLECTION BOARD. SEE THE COMPONENT VIEW FOR LOCATION.
2. TP3 CAN BE ACCESSED THROUGH A MARKED HOLE IN THE PANEL HOLDING THE DEFLECTION BOARD.

Figure 6-5. Deflection Board Troubleshooting Chart

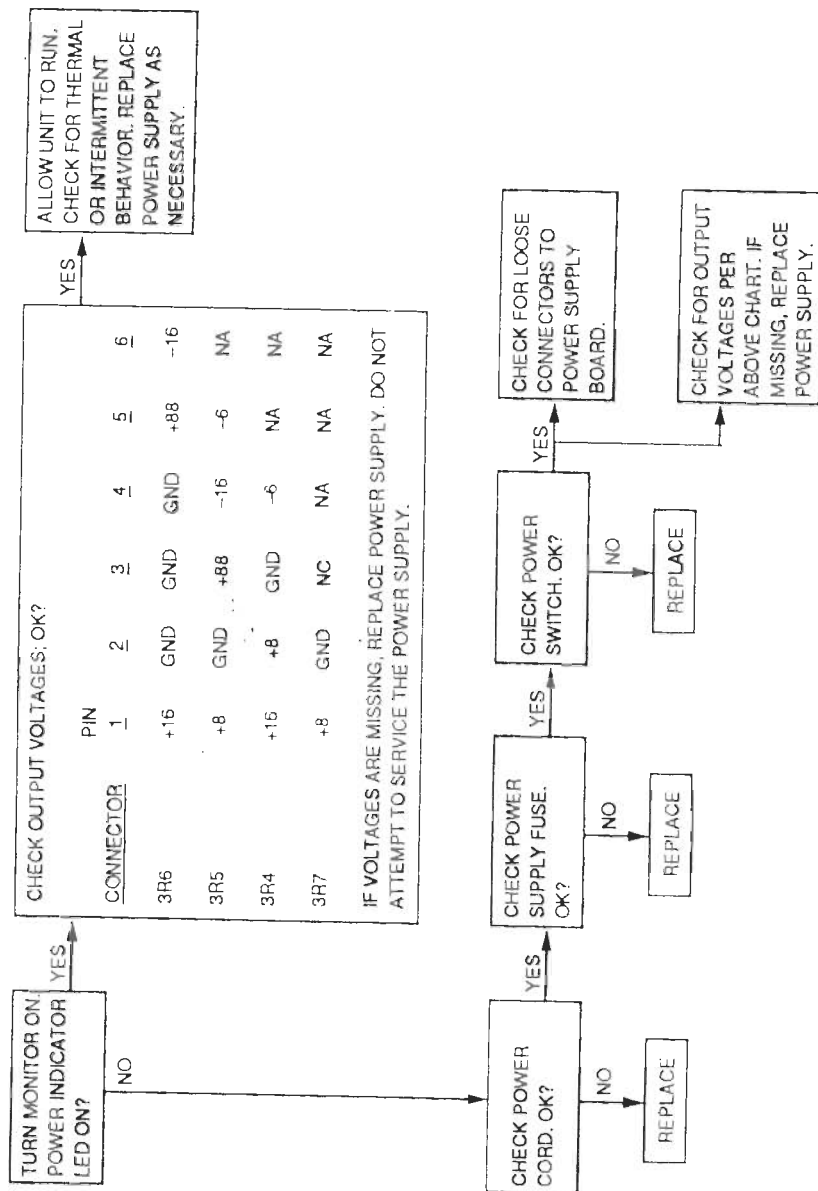


Figure 6-7. Power Supply Troubleshooting Chart

Resistance Measurements

This section contains the measured resistance to chassis ground for a number of the active devices in the monitor. The measurements were made using a Heath by Fluke SM-77 digital volt-ohm meter. Verify these values with the monitor off and the power cord disconnected. Use these measurements to locate faulty components in the circuitry. A (+) symbol after the value indicates a charging action with an increasing meter reading; a (-) symbol after a value indicates a charging action with a decreasing meter reading.

Table 6-1. PIN Board Transistor Resistance Measurements

DEVICE	EMITTER	BASE	COLLECTOR
Q7001	10.8k Ω	11.6k Ω	3.26M Ω
Q7007	2600 Ω (+)	5.46k Ω	15.7k Ω
Q7008	2600 Ω (+)	5.38k Ω	6k Ω (+)
Q7009	10k Ω (+)	15.7k Ω	200 Ω (+)
Q7401	150k Ω (+)	20.3k Ω	10.1k Ω
Q7402	0 Ω	10k Ω	10.3k Ω
Q7404	4.21k Ω	994 Ω	3.35M Ω
Q7405	0 Ω	1673 Ω	3.31M Ω
Q7407	10.6k Ω	3.3M Ω	3.13M Ω
Q7408	7.42k Ω	10.6k Ω	200 Ω (+)
Q7409	1825 Ω	2230 Ω	3.14M Ω
Q7410	2845 Ω	3.14M Ω	880 Ω
Q7411	10k Ω	850 Ω (+)	200 Ω (+)
Q7502	8.62k Ω	0 Ω	1500 Ω (+)
Q7503	8.62k Ω	11.9k Ω	3.35M Ω
Q7505	1445 Ω	1023 Ω	326 Ω

Table 6-2. PIN Board IC Resistance Measurements

PIN	IC7001	IC7101	IC7401	IC7402	IC7501	IC7502
1	3.96k Ω	1M Ω	4M Ω	9.26k Ω	0 Ω	36.5k Ω
2	5.37k Ω	6.7k Ω	4M Ω	3.4M Ω	10.5k Ω	3.5M Ω
3	3.24M Ω	8.3k Ω	3.9M Ω	3.4M Ω	3.3M Ω	10k Ω

Table 6-2 (continued). PIN Board IC Resistance Measurements

PIN	IC7001	IC7101	IC7401	IC7402	IC7501	IC7502
4	7k Ω	700 Ω (-)	600 Ω (+)	9.3k Ω	11.4k Ω	600 Ω (-)
5	12.3M Ω	10.1k Ω	1.3M Ω	10.5k Ω	11.9M Ω	36.4k Ω
6	12.3M Ω	56 Ω	600 Ω (+)	10.5k Ω	11.9M Ω	3.6M Ω
7	800 Ω (+)	1.34M Ω	600 Ω (+)	600 Ω (+)	600 Ω (-)	100 Ω (+)
8	9.29k Ω	200 Ω (+)	10.6k Ω	11k Ω	11.4k Ω	I
9	10k Ω	-	600 Ω (+)	3.5M Ω	11.5k Ω	-
10	I	-	10.7k Ω	3.5M Ω	I	-
11	I	-	4M Ω	10.9k Ω	I	-
12	7k Ω	-	4M Ω	10.6k Ω	11.2k Ω	-
13	10.1k Ω	-	3.9M Ω	10.6k Ω	15.3k Ω	-
14	5.43k Ω	-	560 Ω	550 Ω	10.5k Ω	-

Table 6-3. Video Board Transistor Resistance Measurements

DEVICE	EMITTER	BASE	COLLECTOR
Q5101(SM)	3.3k Ω	12.3k Ω	655 Ω
Q5102(SM)	1280 Ω	1722 Ω	3.36k Ω
Q5104(SM)	1258 Ω	3.36k Ω	655 Ω
Q5105(SM)	95.3 Ω	432 Ω	1120 Ω
Q5106(SM)	755 Ω	1120 Ω	480 Ω
Q5107(SM)	94.8 Ω	430 Ω	1120 Ω
Q5108(SM)	756 Ω	1120 Ω	484 Ω
Q5109(SM)	96 Ω	430 Ω	1126 Ω
Q5110(SM)	756 Ω	1126 Ω	478 Ω
Q5201	67.4 Ω	441 Ω	I
Q5202	I	953 Ω	I
Q5203	3.5M Ω (+)	5k Ω (-)	2900 Ω (-)
Q5204	3.5M Ω (+)	0.1 Ω	I
Q5205	67.7 Ω	442 Ω	I
Q5206	I	954 Ω	I
Q5207	2.2M Ω (+)	5k Ω (-)	2900 Ω (-)
Q5208	3.5M Ω (+)	0.1 Ω	I
Q5209	67.6 Ω	453 Ω	I
Q5210	I	954 Ω	I
Q5211	3.3M Ω (+)	5k Ω (-)	2900 Ω (+)
Q5212	3.5M Ω (+)	0.1 Ω	I
Q5301	3.5M Ω	3.8k Ω	0.1 Ω
Q5302	3.47M Ω	5k Ω (-)	0.1 Ω
Q5303	3.45M Ω	5k Ω (-)	0.1 Ω
Q5304	130 Ω	3.12M Ω	7.67k Ω

Table 6-4. Video Board IC Resistance Measurements

PIN	IC5101	IC5102
1	11.7k Ω	848 Ω
2	1312 Ω	0.2 Ω
3	10.3k Ω	3.1M Ω
4	4.36M Ω	835 Ω
5	10.3k Ω	835 Ω
6	4.35M Ω	I
7	639 Ω	0.3 Ω
8	10.2k Ω	1.46M Ω
9	4.35M Ω	849 Ω
10	0.3 Ω	0.2 Ω
11	1068 Ω	3M Ω (+)
12	1433 Ω	849 Ω
13	661 Ω	0.2 Ω
14	1058 Ω	835 Ω
15	1427 Ω	
16	655 Ω	
17	1068 Ω	
18	1430 Ω	
19	1698 Ω	
20	0.2 Ω	

Table 6-5. Deflection Board Transistor Resistance Measurements

DEVICE	EMITTER	BASE	COLLECTOR
Q2101	13k Ω (-)	3.54M Ω	100 Ω (\pm)
Q2102	3.29M Ω	5.11k Ω	120k Ω
Q2103	11k Ω (+)	121.7k Ω	0.8M(-)
Q2104	1000 Ω (+)	11.1k Ω	15k Ω (-)
Q2105	1000 Ω (\pm)	5.1k Ω	999 Ω
Q2107	400 Ω (+)	I	0.3 Ω
Q2108	400 Ω (+)	1.06M Ω (+)	4M Ω (+)
Q2110	179.2 Ω	2213 Ω	17M Ω (+)
Q2111	1000 Ω (+)	1000 Ω (\pm)	100 Ω (\pm)
Q2112	1000 Ω (+)	1090(+)	0.1 Ω
Q2113	2100 Ω (+)	0.3 Ω	1.44M Ω (-)
Q2114	2100 Ω (+)	0.3 Ω	1.44M Ω (-)
Q2115	2100 Ω (+)	0.5 Ω	1.5M Ω (-)
Q2116	0.3 Ω	630 Ω (+)	5.1k Ω (+)
Q3001	1.59M Ω (+)	1000 Ω (\pm)	100 Ω (\pm)

Table 6-5 (continued). Deflection Board Transistor Resistance Measurements

DEVICE	EMITTER	BASE	COLLECTOR
Q3002	1.8M Ω (+)	1000 Ω (+)	2500 Ω (-)
Q3003	0.1 Ω	1.7 Ω	1M Ω (+)
Q3202	0.3 Ω	1.9 Ω	4M Ω (+)
Q3203	1M Ω (+)	1M Ω (+)	1.15M Ω (+)
Q3205	1025 Ω	1.02M Ω	0.5M Ω (+)
Q3206	6k Ω (+)	2.85M Ω	2.8M Ω (+)
Q3207	1600 Ω (+)	59.1k Ω	15.55k Ω
Q3208	0.3 Ω	2881 Ω	2.6M Ω (+)
Q3209	4.2M Ω (+)	0.3 Ω	I
Q3210	4.1M Ω (+)	0.3 Ω	I
Q3403	0.2 Ω	6.43k Ω	0.5M Ω (+)

NOTE: These measurements were taken with the deflection board removed and disconnected from the rest of the monitor.

Table 6-6. Deflection Board IC Resistance Measurements

PIN	IC1301	IC2101	IC2103	IC3201	IC3401
1	500 Ω (+)	3.68M Ω	3.4M Ω	39.5k Ω (-)	1600 Ω (-)
2	600 Ω (+)	95k Ω (+)	55k Ω (+)	10.7k Ω (+)	550 Ω (+)
3	700 Ω (+)	14k Ω (+)	73k Ω (+)	0.322M Ω	4.65 \times Ω
4	600 Ω (+)	200k Ω (-)	3.39M Ω	22k Ω (-)	10.8 \times Ω (+)
5	700 Ω (+)	24.6k Ω (+)	19k Ω (+)	40k Ω (-)	61.6 \times Ω
6	I	23.8k Ω (+)	200k Ω (-)	1.02M Ω	13.12k Ω
7	I	2.22M Ω	200k Ω (-)	180 Ω (\pm)	4.09 \times Ω
8	0.3 Ω	100k Ω (\pm)	200k Ω (-)	I	6.3k Ω (+)
9	I	-	200k Ω (-)	-	6.3k Ω (+)
10	744 Ω	-	70k Ω (-)	-	9.65 \times Ω
11	338 Ω	-	3.38M Ω	-	0.3 Ω
12	745 Ω	-	19k Ω (+)	-	0.4 Ω
13	336 Ω	-	19k Ω (+)	-	109 \times Ω
14	0.3 Ω	-	0.6 Ω	-	4.49M Ω
15	0.3 Ω	-	-	-	8.04 \times Ω
16	200 Ω (\pm)	-	-	-	0.3 Ω

NOTE: These measurements were taken with the deflection board removed and disconnected from the rest of the monitor.

Table 6-7. Dynamic Focus Board Transistor Resistance Measurements

DEVICE	EMITTER	BASE	COLLECTOR
Q7701	2156Ω	8.01kΩ	11.78kΩ
Q7702	1995Ω	11.78kΩ	51.3kΩ
Q7703	1003Ω	1994Ω	51.3kΩ

NOTE: These measurements were taken with the PIN board removed and disconnected from the rest of the monitor.

Table 6-8. PIN Board Transistor Voltage Measurements

DEVICE	EMITTER	BASE	COLLECTOR
Q7001	1.19V	0.61V	-10.6V
Q7007	8.73V	8.13V	0.87V
Q7008	8.41V	7.81V	-1.38V
Q7009	0.315V	0.93V	16.6V
Q7401	16.6V	16.29V	7.81V
Q7402	0.019V	-1.84V	13.6V
Q7411	12.5V	13.13V	16.7V
Q7502	0.58V	0.019V	-15.0V
Q7503	-0.64V	0.052V	-7.65V
Q7505	-0.5V	0.114V	15.08V

Table 6-9. PIN Board IC Voltage Measurements

PIN	IC7001	IC7501
1	5.45V	0.019V
2	7.86V	6.27V
3	-10.63V	-14.8V
4	0.03V	0V

Table 6-9 (continued). PIN Board IC Voltage Measurements

PIN	IC7001	IC7501
5	-1.37V	-7.02V
6	-1.33V	0V
7	-11.9V	-16.05V
8	0.041V	-5.65V
9	0.002V	-5.65V
10	-1.37V	-7.02V
11	-1.36V	-7.06V
12	0.003V	-5.69V
13	-10.67V	0V
14	8.18V	6.39V

Table 6-10. Video Board Transistor Voltage Measurements

DEVICE	EMITTER	BASE	COLLECTOR
Q5201	0.80V	1.55V	4.50V
Q5202	4.50V	4.94V	73.0V
Q5203	73.9V	74.4V	88.7V
Q5204	73.7V	0V	73.1V
Q5205	0.805V	1.52V	4.48V
Q5206	4.48V	4.94V	72.9V
Q5207	73.7V	74.2V	88.8V
Q5208	73.5V	72.8V	0.001V
Q5209	0.80V	1.53V	4.48V
Q5210	4.48V	4.94V	73.1V
Q5211	73.8V	74.4V	88.9V
Q5212	73.7V	0.01V	73.2V
Q5301	85.5V	85.5V	0.001V
Q5302	85.5V	85.6V	0.001V
Q5303	85.5V	85.6V	0.001V
Q5304	0.60V	0.814V	72.0V

Chapter 7

Parts List

This chapter contains the replacement parts lists for the ZCM-1490 color video monitor.

CAUTION

Some components contain an X in their reference number. For safety reasons, these components must be replaced only with identical components.

Table 7-1. Designated Components Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Capacitors		
C1301	022-07860-09A	100 μ F, 20%, 25V, electrolytic
C1302	022-08003-02A	0.1 μ F, 5%, 50V, ceramic chip
C1303	022-08003-02A	0.1 μ F, 5%, 50V, ceramic chip
C1304	022-07859-05A	10 μ F, 20%, 16V, electrolytic
C2101	022-07702-24	0.1 μ F, 2%, 100V, polypropylene
C2103	022-07773	0.001 μ F, 5%, 100V, polyester
C2104	022-07860-12	470 μ F, 20%, 25V, electrolytic
C2105	022-07702-30	0.33 μ F, 2%, 100V, polypropylene
C2106	022-07702-30	0.33 μ F, 2%, 100V, polypropylene
C2107	022-07704-28	0.22 μ F, 10%, 100V, polypropylene
C2108	022-07860-09A	100 μ F, 20%, 25V, electrolytic
C2109	022-07860-15	3300 μ F, 20%, 25V, electrolytic
C2110	022-07860-12	470 μ F, 20%, 25V, electrolytic

Table 7-1 (continued). Designated Components Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Capacitors (continued)		
C2111	022-07773-04	0.0022 μ F, 5%, 100V, polyester
C2112	022-07862-07A	33 μ F, 20%, 50V, electrolytic
C2113	022-07864A	0.47 μ F, 20%, 100V, electrolytic
C2114	022-08003-02A	0.1 μ F, 5%, 50V, ceramic chip
C2115	022-08003-02A	0.1 μ F, 5%, 50V, ceramic chip
C2116	022-07860-09A	100 μ F, 20%, 25V, electrolytic
C2117	022-07786C	1000pF, 10%, 500V, ceramic disc
C2118	022-07864-04A	4.7 μ F, 20%, 100V, electrolytic
C2119	022-07864-06	22 μ F, 20%, 100V, electrolytic
C2120	022-07860-15	3300 μ F, 20%, 25V, electrolytic
C2121	022-07773-24	0.1 μ F, 5%, 100V, polyester
C2122	022-07773-20	0.047 μ F, 5%, 100V, polyester
C3001	022-07405-06	22 μ F, 20%, 25V, NP electrolytic
C3002	022-05704	180pF, \pm 10%, 3000V, ceramic disc
C3003	022-02670	0.0033 μ F, \pm 10%, 500V, cer. disc
C3004	022-07244	0.0015 μ F, \pm 5%, 500V, ceramic disc
C3006	022-07683-05	0.047 μ F, 5%, 200V, polypropylene
C3007	022-07683-05	0.047 μ F, 5%, 200V, polypropylene

**Table 7-1 (continued). Designated Components
Parts List**

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Capacitors (continued)		
C3008	022-07672-10	0.011 μ F, 5%, 1600V, polypropylene
C3009	022-07860-13	1000 μ F, 20%, 25V, electrolytic
C3010	022-07876-20	0.47 μ F, 5%, 250V, polyester
C3011	022-07876-20	0.47 μ F, 5%, 250V, polyester
C3012	022-07864-04A	4.7 μ F, 20%, 100V, electrolytic
C3013	022-07773-24	0.1 μ F, 5%, 100V, polyester
C3201	022-07773-24	0.1 μ F, 5%, 100V, polyester
C3202	022-07242	0.0018 μ F, \pm 10%, 500V, ceramic disc
C3203	022-07860-13	1000 μ F, 20%, 25V, electrolytic
C3204	022-07672-30	0.0215 μ F, 5%, 1600V, polypropylene
C3205	022-05704	180pF, \pm 10%, 3000V, ceramic disc
C3206	022-07786-10C	470pF, 10%, 500V, ceramic disc
C3207	022-07876-20	0.47 μ F, 5%, 250V, polyester
C3208	022-07876-20	0.47 μ F, 5%, 250V, polyester
C3209	022-07860-09A	100 μ F, 20%, 25V, electrolytic
C3210	022-07773-24	0.1 μ F, 5%, 100V, polyester
C3211	022-07864-04A	4.7 μ F, 20%, 100V, electrolytic
C3212	022-07864-04A	4.7 μ F, 20%, 100V, electrolytic
C3214	022-07860-09A	100 μ F, 20%, 25V, electrolytic
C3216	022-07773-15	0.018 μ F, 5%, 100V, polyester
C3217	022-07773-16	0.022 μ F, 5%, 100V, polyester

**Table 7-1 (continued). Designated Components
Parts List**

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Capacitors (continued)		
C3218	022-07405-05	10 μ F, \pm 20%, 35V, NP electrolytic
C3219	022-07242	0.0018 μ F, \pm 10%, 500V, ceramic disc
C3220	022-07862-01A	1 μ F, 20%, 50V, electrolytic
C3221	022-07860-09A	100 μ F, 20%, 25V, electrolytic
C3222	022-07958-57	2400pF, 5%, 100V, ceramic chip
C3224	022-07864-04A	4.7 μ F, 20%, 100V, electrolytic
C3225	022-07774-12	0.01 μ F, 10%, 100V, polyester
C3226	022-07621-27B	51pF, 5%, 50V, ceramic disc
C3227	022-07621-34B	100pF, 5%, 50V, ceramic disc
C3228	022-07621-27B	51pF, 5%, 50V, ceramic disc
C3229	022-08003-02A	0.1 μ F, 5%, 50V, ceramic chip
C3401	022-07864-04A	4.7 μ F, 20%, 100V, electrolytic
C3402	022-07774-12	0.01 μ F, 10%, 100V, polyester
C3403	022-07958-57	2400pF, 5%, 100V, ceramic chip
C3404	022-07862-02A	2.2 μ F, 20%, 50V, electrolytic
C3405	022-08003-02A	0.1 μ F, 5%, 50V, ceramic chip
C3406	022-07860-05A	10 μ F, 20%, 25V, electrolytic
C3407	022-07862-01A	1 μ F, 20%, 50V, electrolytic
C3408	022-07860-13	1000 μ F, 20%, 25V, electrolytic
C3409	022-07786-16C	1800pF, 10%, 500V, ceramic disc
C3410	022-07773-26	0.15 μ F, 5%, 100V, polyester
C3411	022-07909	47 μ F, \pm 50/-10%, 200V, electrolytic

Table 7-1 (continued). Designated Components Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Capacitors (continued)		
C3412	022-07860-09A	100 μ F, 20%, 25V, electrolytic
C3413	022-07773-24	0.1 μ F, 5%, 100V, polyester
C3415	022-08003-02A	0.1 μ F, 5%, 50V, ceramic chip
C5101	022-07862-04A	4.7 μ F, 20%, 50V, electrolytic
C5102	022-07862-04A	4.7 μ F, 20%, 50V, electrolytic
C5103	022-07862-04A	4.7 μ F, 20%, 50V, electrolytic
C5104	022-08039-01A	6800pF, 20%, 25V, ceramic, tubular, leadless
C5105	022-08039-01A	6800pF, 20%, 25V, ceramic, tubular, leadless
C5106	022-08039-01A	6800pF, 20%, 25V, ceramic, tubular, leadless
C5108	022-07991A	2200pF, 10%, 16V, ceramic, tubular, leadless
C5109	022-07860-05A	10 μ F, 20%, 25V, electrolytic
C5110	022-08016A	10 μ F, 20%, 16V, NP electrolytic
C5111	022-07860-06A	22 μ F, 20%, 25V, electrolytic
C5112	022-08039-03A	10000pF, 20%, 25V, ceramic, tubular, leadless
C5114	022-07860-06A	22 μ F, 20%, 25V, electrolytic
C5115	022-07985-23A	6pF, \pm 0.5pF, 50V, ceramic, tubular, leadless
C5116	022-07985-23A	6pF, \pm 0.5pF, 50V, ceramic, tubular, leadless
C5117	022-07985-23A	6pF, \pm 0.5pF, 50V, ceramic, tubular, leadless
C5118	022-07984-15A	1000pF, 10%, 50V, ceramic, tubular, leadless
C5119	022-07860-05A	10 μ F, 20%, 25V, electrolytic
C5120	022-07860-06A	22 μ F, 20%, 25V, electrolytic

Table 7-1 (continued). Designated Components Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Capacitors (continued)		
C5121	022-07860-05A	10 μ F, 20%, 25V, electrolytic
C5122	022-08039-03A	10000pF, 20%, 25V, ceramic, tubular, leadless
C5124	022-08039-03A	10000pF, 20%, 25V, ceramic, tubular, leadless
C5125	022-07859-09A	100 μ F, 20%, 16V, electrolytic
C5201	022-08036-36A	100pF, 5%, 50V, ceramic, tubular, leadless
C5202	022-08039-03A	10000pF, 20%, 25V, ceramic, tubular, leadless
C5203	022-04948	1000pF, GMV, 500V, ceramic disc
C5204	022-08039-03A	10000pF, 20%, 25V, ceramic, tubular, leadless
C5205	022-08036-36A	100pF, 5%, 50V, ceramic, tubular, leadless
C5206	022-08039-03A	10000pF, 20%, 25V, ceramic, tubular, leadless
C5207	022-04948	1000pF, GMV, 500V, ceramic disc
C5208	022-08039-03A	10000pF, 20%, 25V, ceramic, tubular, leadless
C5209	022-08036-36A	100pF, 5%, 50V, ceramic, tubular, leadless
C5210	022-08039-03A	10000pF, 20%, 25V, ceramic, tubular, leadless
C5211	022-04948	1000pF, GMV, 500V, ceramic disc
C5212	022-08039-03A	10000pF, 20%, 25V, ceramic, tubular, leadless
C5213	022-07984-03A	100pF, 10%, 50V, ceramic, tubular, leadless
C5214	022-07984-03A	100pF, 10%, 50V, ceramic, tubular, leadless
C5215	022-07984-03A	100pF, 10%, 50V, ceramic, tubular, leadless
C5301	022-07864-04A	4.7 μ F, 20%, 100V, electrolytic
C5302	022-07864-04A	4.7 μ F, 20%, 100V, electrolytic

Table 7-1 (continued). Designated Components Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Capacitors (continued)		
C5303	022-07864-04A	4.7 μ F, 20%, 100V, electrolytic
C5305	022-07961-11	10 μ F, 20%, 160V, electrolytic
C7001	022-07405-06	22 μ F, 10%, 25V, NP electrolytic
C7002	022-07860-06A	22 μ F, 20%, 25V, electrolytic
C7003	022-07860-09A	100 μ F, 20%, 25V, electrolytic
C7004	022-07774-24	0.1 μ F, 10%, 100V, polyester
C7005	022-07860-09A	100 μ F, 20%, 25V, electrolytic
C7006	022-07774-24	0.1 μ F, 10%, 100V, polyester
C7007	022-07405-09	100 μ F, \pm 20%, 25V, NP electrolytic
C7008	022-07860-06A	22 μ F, 20%, 25V, electrolytic
C7010	022-07862-01A	1 μ F, 20%, 50V, electrolytic
C7012	022-07405-06	22 μ F, 10%, 25V, NP electrolytic
C7101	022-07860-09A	100 μ F, 20%, 25V, electrolytic
C7102	022-07613-04C	220pF, 10%, 50V, ceramic disc
C7103	022-07862-01A	1 μ F, 20%, 50V, electrolytic
C7104	022-07860-09A	100 μ F, 20%, 25V, electrolytic
C7105	022-07860-09A	100 μ F, 20%, 25V, electrolytic
C7106	022-05719	200pF, \pm 5%, 500V, ceramic disc
C7107	022-07864-04A	4.7 μ F, 20%, 100V, electrolytic
C7401	022-07405-05	10 μ F, \pm 20%, 25V, NP electrolytic
C7402	022-07621-06B	6pF, \pm 0.25pF, 50V, ceramic disc
C7403	022-07613-06C	330pF, 10%, 50V, ceramic disc

Table 7-1 (continued). Designated Components Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Capacitors (continued)		
C7404	022-07860-05A	10 μ F, 20%, 25V, electrolytic
C7405	022-07774-12	0.01 μ F, 10%, 100V, polyester
C7406	022-07621-26B	47pF, 5%, 50V, ceramic disc
C7408	022-07773-06	0.0033 μ F, 5%, 100V, polyester
C7409	022-07621-28B	56pF, 5%, 50V, ceramic disc
C7410	022-07860-05A	10 μ F, 20%, 25V, electrolytic
C7411	022-07773-24	0.1 μ F, 5%, 100V, polyester
C7412	022-07773-24	0.1 μ F, 5%, 100V, polyester
C7413	022-07621-42B	220pF, 5%, 50V, ceramic disc
C7414	022-07773-08	0.0047 μ F, 5%, 100V, polyester
C7415	022-07773-24	0.1 μ F, 5%, 100V, polyester
C7416	022-07407-01	1 μ F, \pm 20%, 50V, NP electrolytic
C7417	022-07958-48	1000pF, 5%, 100V, ceramic chip
C7418	022-07773-24	0.1 μ F, 5%, 100V, polyester
C7419	022-07860-09A	100 μ F, 20%, 25V, electrolytic
C7420	022-07862-01A	1 μ F, 20%, 50V, electrolytic
C7421	022-07958-60	3300pF, 5%, 100V, ceramic chip
C7422	022-07862-01A	1 μ F, 20%, 50V, electrolytic
C7423	022-07860-09A	100 μ F, 20%, 25V, electrolytic
C7501	022-07860-06A	22 μ F, 20%, 25V, electrolytic
C7502	022-07862-01A	1 μ F, 20%, 50V, electrolytic
C7503	022-07862-01A	1 μ F, 20%, 50V, electrolytic
C7504	022-07743-10	6.8pF, 10%, 50V, ceramic, tubular

Table 7-1 (continued). Designated Components Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Capacitors (continued)		
C7505	022-07773-24	0.1 μ F, 5%, 100V, polyester
C7506	022-08001-04	4.7 μ F, 10%, 250V, polyester
C7507	022-07773-24	0.1 μ F, 5%, 100V, polyester
C7508	022-07860-09A	100 μ F, 20%, 25V, electrolytic
C7509	022-07773-24	0.1 μ F, 5%, 100V, polyester
C7510	022-07860-09A	100 μ F, 20%, 25V, electrolytic
C7511	022-07773-24	0.1 μ F, 5%, 100V, polyester
C7512	022-07860-12	470 μ F, 20%, 25V, electrolytic
C7513	022-07773-24	0.1 μ F, 5%, 100V, polyester
C7514	022-07860-12	470 μ F, 20%, 25V, electrolytic
C7515	022-07613-11C	820pF, 10%, 50V, ceramic disc
C7516	022-07864-02A	2.2 μ F, 20%, 100V, electrolytic
C7517	022-08015-01A	22 μ F, 20%, 25V, NP electrolytic
C7518	022-07613	100pF, 10%, 50V, ceramic disc
C7519	022-08039-03A	10000pF, 20%, 25V, ceramic, tubular, leadless
C7520	022-07407-01	1 μ F, \pm 20%, 50V, NP electrolytic
C7521	022-07862-01A	1 μ F, 20%, 50V, electrolytic
C7522	022-07862-01A	1 μ F, 20%, 50V, electrolytic
C7523	022-07862-01A	1 μ F, 20%, 50V, electrolytic
C7701	022-07773-28	0.22 μ F, 5%, 100V, polyester
C7702	022-07773-24	0.1 μ F, 5%, 100V, polyester
C7703	022-07773-28	0.22 μ F, 5%, 100V, polyester

Table 7-1 (continued). Designated Components Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Diodes		
CR1301	103-00301-05A	Zener, 5.1V, 1W
CR1302	103-00398A	Si, general, tubular, leadless
CR1303	103-00398A	Si, general, tubular, leadless
CR1304	103-00398A	Si, general, tubular, leadless
CR1305	103-00398A	Si, general, tubular, leadless
CR1306	103-00398A	Si, general, tubular, leadless
CR1307	103-00398A	Si, general, tubular, leadless
CR1308	103-00398A	Si, general, tubular, leadless
CR1309	103-00398A	Si, general, tubular, leadless
CR2101	103-00398A	Si, general, tubular, leadless
CR2102	103-00398A	Si, general, tubular, leadless
CR2103	103-00398A	Si, general, tubular, leadless
CR2104	103-00398A	Si, general, tubular, leadless
CR2105	103-00398A	Si, general, tubular, leadless
CR2106	103-00301-16A	Zener, 12V, 1W
CR2107	103-00142-01	Si, general
CR2108	103-00142-01	Si, general
CR2109	103-00344-02A	General
CR2110	103-00344-02A	General
CR2111	103-00344-02A	General
CR2112	103-00344-02A	General
CR2113	103-00398A	Si, general, tubular, leadless
CR2114	103-00398A	Si, general, tubular, leadless
CR2115	103-00398A	Si, general, tubular, leadless

**Table 7-1 (continued). Designated Components
Parts List**

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Diodes (continued)		
CR2116	103-00399-11A	Zener, 5.6V, 0.5W, tubular leadless
CR2117	103-00398A	Si, general, tubular, leadless
CR2119	103-00398A	Si, general, tubular, leadless
CR2120	103-00398A	Si, general, tubular, leadless
CR2121	103-00398A	Si, general, tubular, leadless
CR2122	103-00398A	Si, general, tubular, leadless
CR2123	103-00398A	Si, general, tubular, leadless
CR2124	103-00398A	Si, general, tubular, leadless
CR3001	103-00344-06A	General
CR3002	103-00344-06A	General
CR3003	103-00431	Si, high frequency
	114-01325-03	Screw, 4-24 x 0.312, hex head
CR3004	103-00399-38A	Zener, 39V, 0.5W, tubular leadless
CR3201	103-00398A	Si, general, tubular, leadless
CR3203	103-00344-06A	General
CR3204	103-00254-01	Si, general
CR3205	103-00398A	Si, general, tubular, leadless
CR3206	103-00398A	Si, general, tubular, leadless
CR3207	103-00398A	Si, general, tubular, leadless
CR3208	103-00398A	Si, general, tubular, leadless
CR3209	103-00398A	Si, general, tubular, leadless
CR3210	103-00344-06A	General
CR3211	103-00254-01	Si, general
CR3212	103-00254-01	Si, general
CR3213	103-00398A	Si, general, tubular, leadless

**Table 7-1 (continued). Designated Components
Parts List**

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Diodes (continued)		
CR3214	103-00398A	Si, general, tubular, leadless
CR3215	103-00344-02A	General
CR3216	103-00398A	Si, general, tubular, leadless
CR3217	103-00398A	Si, general, tubular, leadless
CR3401	103-00398A	Si, general, tubular, leadless
CR3404	103-00398A	Si, general, tubular, leadless
CR5101	103-00399-10A	Zener, 5.1V, 0.5W, tubular leadless
CR5102	103-00398A	Si, general, tubular, leadless
CR5104	103-00398A	Si, general, tubular, leadless
CR5105	103-00399-10A	Zener, 5.1V, 0.5W, tubular leadless
CR5201	103-00398A	Si, general, tubular, leadless
CR5202	103-00398A	Si, general, tubular, leadless
CR5203	103-00398A	Si, general, tubular, leadless
CR5204	103-00399-10A	Zener, 5.1V, 0.5W, tubular leadless
CR5205	103-00398A	Si, general, tubular, leadless
CR5206	103-00398A	Si, general, tubular, leadless
CR5207	103-00398A	Si, general, tubular, leadless
CR5209	103-00398A	Si, general, tubular, leadless
CR5210	103-00398A	Si, general, tubular, leadless
CR5211	103-00398A	Si, general, tubular, leadless
CR5301	103-00415-02A	Si, general
CR5302	103-00415-02A	Si, general
CR5303	103-00415-02A	Si, general

Table 7-1 (continued). Designated Components Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Diodes (continued)		
CR5304	103-00415-02A	Si, general
CR5305	103-00415-02A	Si, general
CR5306	103-00415-02A	Si, general
CR5307	103-00415-02A	Si, general
CR5308	103-00398A	Si, general, tubular, leadless
CR5309	103-00398A	Si, general, tubular, leadless
CR5310	103-00398A	Si, general, tubular, leadless
CR7101	103-00336-15A	Zener, 7.5V, 0.5W
CR7102	103-00254-01	Si, general
CR7406	103-00142-01	Si, general
CR7407	103-00142-01	Si, general
CR7408	103-00142-01	Si, general
CR7409	103-00142-01	Si, general
CR7410	103-00142-01	Si, general
CR7501	103-00142-01	Si, general
CR7502	103-00142-01	Si, general
CR7504	103-00308	Zener, 12V, 0.5W
CR7505	103-00279-11A	Zener, 5.6V, 0.5W
D7401	103-00142-01	Si, general
D7402	103-00142-01	Si, general
D7404	103-00279-08A	Zener, 4.3V, 0.5W
D7405	103-00142-01	Si, general

Integrated Circuits

IC1301	A-15305-01	Programmable IC
IC2101	221-00240	Dual wideband op-amp
IC2102	221-00265	Adjustable shunt regulator
IC2103	221-00173	Quad switch
IC3201	221-00438	JFET input op-amp
IC3202	221-00265	Adjustable shunt regulator
IC3203	221-00265	Adjustable shunt regulator
IC3401	221-00440	Horizontal processor
IC3402	221-00166-04	Regulator, 12V, 500mA, linear
IC5101	221-00397	RGB video processor, ANALOG input

Table 7-1 (continued). Designated Components Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Integrated Circuits (continued)		
IC5102	221-00318-03	Quad, 2-input exclusive-OR gate
IC7001	221-C0309	Four-quadrant multiplier (contract assembly only)
IC7101	221-00240	Dual wideband op-amp
IC7401	221-00146	Dual D-type flip-flop
IC7402	221-00173	Quad switch
IC7501	221-C0309	Four-quadrant multiplier (contract assembly only)
IC7502	221-00438	JFET input op-amp
IC7503	221-00504	4 Amp linear driver

Inductors

L3401	020-03831	Coil, RFC filter
L3402	020-03831	Coil, RFC filter
L7401	020-03849A	Coil, RFC, tunable
L7701	020-03931A	Coil, RFC
LX3001	020-04233	Coil, RFC, tunable, centering choke
LX3002	064-00519-02	Eyelet, rolled flange
	020-04279	Coil, linearity

Transistors

Q2101	121-01040	NPN, Si
Q2102	121-00975A	NPN, Si
Q2103	121-00973A	PNP, Si
Q2104	121-00973A	PNP, Si
Q2105	121-00975A	NPN, Si
Q2106	121-01037-01	NPN, Si
Q2107	121-01188	PNP, Si, power, 2A
	114-01325-03	Screw, 4-24 x 0.312, hex head
Q2108	121-01187	NPN, Si, power, 2A
	114-01325-03	Screw, 4-24 x 0.312, hex head
Q2109	121-01188	PNP, Si, power, 2A
Q2110	121-01063A	NPN, Si
Q2111	121-01035A	NPN, Si
Q2112	121-01036A	PNP, Si

**Table 7-1 (continued). Designated Components
Parts List**

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Transistors (continued)		
Q2113	121-00973A	PNP, Si
Q2114	121-00973A	PNP, Si
Q2115	121-00973A	PNP, Si
Q2116	121-00975A	NPN, Si
Q2117	121-00975A	NPN, Si
Q3001	121-01035A	NPN, Si
Q3002	121-01036A	PNP, Si
Q3003	121-01198	NPN, Si, horizontal output
	114-01325-03	Screw, 4-24 x 0.312, hex head
Q3201	121-01037-01	NPN, Si
Q3202	121-01199	NPN, Si
Q3203	121-01204	NPN, Si, power, 10A
	114-01115-04	Screw, 6-20 x 0.375, hex head
Q3204	121-01037-01	NPN, Si
Q3205	121-01037-01	NPN, Si
Q3206	121-00895A	NPN, Si
Q3207	121-00973A	PNP, Si
Q3208	121-00895A	NPN, Si
Q3209	121-01063A	NPN, Si
Q3210	121-00895A	NPN, Si
Q3401	121-01096A	NPN, Si
Q3403	121-01037-01	NPN, Si
Q5101	121-01130A	NPN, Si, chip
Q5102	121-01139A	NPN, Si
Q5104	121-01130A	NPN, Si, chip
Q5105	121-01139A	NPN, Si
Q5106	121-01127-01A	PNP, Si
Q5107	121-01139A	NPN, Si
Q5108	121-01127-01A	PNP, Si
Q5109	121-01139A	NPN, Si
Q5110	121-01127-01A	PNP, Si
Q5201	121-01096A	NPN, Si
Q5201E	149-00555-16	Core, ferrite bead
Q5202	121-01156-01	NPN, Si
Q5203	121-01170A	NPN, Si, 150V, 50mA
Q5204	121-01186A	PNP, Si, high voltage
Q5205	121-01096A	NPN, Si
Q5205E	149-00555-16	Core, ferrite bead

**Table 7-1 (continued). Designated Components
Parts List**

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Transistors (continued)		
Q5206	121-01156-01	NPN, Si
Q5207	121-01170A	NPN, Si, 150V, 50mA
Q5208	121-01186A	PNP, Si, high voltage
Q5209	121-01096A	NPN, Si
Q5209E	149-00555-16	Core, ferrite bead
Q5210	121-01156-01	NPN, Si
Q5211	121-01170A	NPN, Si, 150V, 50mA
Q5212	121-01186A	PNP, Si, high voltage
Q5301	121-01059A	PNP, Si
Q5302	121-01059A	PNP, Si
Q5303	121-01059A	PNP, Si
Q5304	121-01063A	NPN, Si
Q7001	121-00973A	PNP, Si
Q7007	121-00973A	PNP, Si
Q7008	121-00973A	PNP, Si
Q7009	121-00895A	NPN, Si
Q7103	121-01037-01	NPN, Si
Q7104	121-01037-01	NPN, Si
Q7105	121-01072-01	NPN, Si
Q7401	121-00973A	PNP, Si
Q7402	121-00895A	NPN, Si
Q7404	121-00973A	PNP, Si
Q7405	121-00895A	NPN, Si
Q7407	121-00895A	NPN, Si
Q7408	121-00895A	NPN, Si
Q7409	121-00973A	PNP, Si
Q7410	121-00895A	NPN, Si
Q7411	121-00895A	NPN, Si
Q7502	121-00973A	PNP, Si
Q7503	121-00973A	PNP, Si
Q7505	121-00895A	NPN, Si
Q7701	121-01063A	NPN, Si
Q7702	121-01063A	NPN, Si
Resistors		
R1301	063-11020-58A	240Ω, 5%, 1/4W, film, tubular, leadless
R1302	063-11020-58A	240Ω, 5%, 1/4W, film, tubular, leadless

Table 7-1 (continued). Designated Components Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Resistors (continued)		
R1303	063-11020-66A	510 Ω , 5%, 1/4W, film, tubular, leadless
R1304	063-11020-66A	510 Ω , 5%, 1/4W, film, tubular, leadless
R1307	063-11020-65A	470 Ω , 5%, 1/4W, film, tubular, leadless
R1308	063-11020-65A	470 Ω , 5%, 1/4W, film, tubular, leadless
R1309	063-11020-65A	470 Ω , 5%, 1/4W, film, tubular, leadless
R1310	063-11020-65A	470 Ω , 5%, 1/4W, film, tubular, leadless
R1311	063-10836-48 086-00836	100 Ω , 5%, 2W, film Terminal, male
R1312	063-11020-49A	100 Ω , 5%, 1/4W, film, tubular, leadless
R1313	063-11020-49A	100 Ω , 5%, 1/4W, film, tubular, leadless
R1314	063-11020A	0 Ω , 5%, 1/4W, film, tubular, leadless
R1315	063-11020A	0 Ω , 5%, 1/4W, film, tubular, leadless
R2101	063-11021-35A	390k Ω , 5%, 1/4W, film, tubular, leadless
R2102	063-11021-21A	100k Ω , 5%, 1/4W, film, tubular, leadless
R2103	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless
R2104	063-11020-23A	120k Ω , 5%, 1/4W, film, tubular, leadless
R2105	063-11020-99A	12k Ω , 5%, 1/4W, film, tubular, leadless
R2106	063-10936-46	2.67k Ω , 1%, 1/4W, film
R2107	063-10651-22	Control, rotary trimmer
R2108	063-10934-10	124 Ω , 1%, 1/4W, film
R2109	063-10243-08	2.2 Ω , 5%, 1/2W, film
R2110	063-10936-33	2.05k Ω , 1%, 1/4W, film
R2111	063-10243-62	390 Ω , 5%, 1/2W, film
R2112	063-10422-24 086-00836 194-01987	1 Ω , 10%, 2W, wirewound Terminal, male Spacer, ceramic tube
R2113	063-11021-03A	18k Ω , 5%, 1/4W, film, tubular, leadless

Table 7-1 (continued). Designated Components Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Resistors (continued)		
R2114	063-10236-05	24k Ω , 5%, 1/4W, film
R2115	063-11021-21A	100k Ω , 5%, 1/4W, film, tubular, leadless
R2116	063-11020-93A	6.8k Ω , 5%, 1/4W, film, tubular, leadless
R2117	063-10651-11	Control, rotary trimmer
R2118	063-11020-81A	2.2k Ω , 5%, 1/4W, film, tubular, leadless
R2119	063-11020-36A	30 Ω , 5%, 1/4W, film, tubular, leadless
R2120	063-11020-61A	330 Ω , 5%, 1/4W, film, tubular, leadless
R2121	063-11020-57A	220 Ω , 5%, 1/4W, film, tubular, leadless
R2122	063-11020-90A	5.1k Ω , 5%, 1/4W, film, tubular, leadless
R2123	063-10938-69	41.2k Ω , 1%, 1/4W, film
R2124	063-11052-08	Control, rotary trimmer, black
R2125	063-10934-99	732 Ω , 1%, 1/4W, film
R2126	063-10934-86	562 Ω , 1%, 1/4W, film
R2127	063-11021-06A	24k Ω , 5%, 1/4W, film, tubular, leadless
R2128	063-11021-53A	2.2M Ω , 5%, 1/4W, film, tubular, leadless
R2129	063-11020-77A	1.5k Ω , 5%, 1/4W, film, tubular, leadless
R2131	063-10836-70 086-00836 194-01987	820 Ω , 5%, 2W, film Terminal, male Spacer, ceramic tube
R2132	063-10836-68 086-00836 194-01987	680 Ω , 5%, 2W, film Terminal, male Spacer, ceramic tube
R2133	063-10836-70 086-00836 194-01987	820 Ω , 5%, 2W, film Terminal, male Spacer, ceramic tube
R2140	063-11020-69A	4.7k Ω , 5%, 1/4W, film, tubular, leadless
R2141	063-11020-81A	2.2k Ω , 5%, 1/4W, film, tubular, leadless
R2142	063-11020-55A	180 Ω , 5%, 1/4W, film, tubular, leadless

Table 7-1 (continued). Designated Components Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Resistors (continued)		
R2143	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless
R2144	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R2145	063-10243-48	100 Ω , 5%, 1/2W, film
R2146	063-11020-49A	100 Ω , 5%, 1/4W, film, tubular, leadless
R2147	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless
R2148	063-10854-13	Control, rotary, trimmer
R2152	063-10940-27	180k Ω , 1%, 1/4W, film
R2153	063-11005	Control, rotary, trimmer
R2154	063-11020-49A	100 Ω , 5%, 1/4W, film, tubular, leadless
R2155	063-11020-89A	4.7k Ω , 5%, 1/4W, film, tubular, leadless
R2157	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R2158	063-11052-08	Control, rotary, trimmer, black
R2159	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless
R2160	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless
R2161	063-11020-65A	470 Ω , 5%, 1/4W, film, tubular, leadless
R2162	063-11020-77A	1.5k Ω , 5%, 1/4W, film, tubular, leadless
R2163	063-11021-03A	18k Ω , 5%, 1/4W, film, tubular, leadless
R2164	063-11021-03A	18k Ω , 5%, 1/4W, film, tubular, leadless
R2165	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless
R2166	063-11021-03A	18k Ω , 5%, 1/4W, film, tubular, leadless
R2167	063-11020-77A	1.5k Ω , 5%, 1/4W, film, tubular, leadless
R2168	063-11020-77A	1.5k Ω , 5%, 1/4W, film, tubular, leadless
R2169	063-10936-71	4.3k Ω , 1%, 1/4W, film
R2170	063-11052-08	Control, rotary, trimmer, black

Table 7-1 (continued). Designated Components Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Resistors (continued)		
R2171	063-10938-26	17.8k Ω , 1%, 1/4W, film
R2172	063-11020-89A	4.7k Ω , 5%, 1/4W, film, tubular, leadless
R2173	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless
R2174	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless
R2175	063-10235-72	1k Ω , 5%, 1/4W, film
R2176	063-11020-87A	3.9k Ω , 5%, 1/4W, film, tubular, leadless
R3001	063-10651-30	Control, rotary, trimmer
R3002	063-10840-51	130 Ω , 5%, 3W, film
	012-08568-03	Metal stamping bracket, resistor support
	194-01987	Spacer, ceramic tube
R3003	063-10243-62	390 Ω , 5%, 1/2W, film
R3005	063-10243	1 Ω , 5%, 1/2W, film
R3006	063-10243-24	10 Ω , 5%, 1/2W, film
R3007	063-10243-06	1.8 Ω , 5%, 1/2W, film
R3008	063-10442-56	22 Ω , 5%, 5W, wirewound
	012-08568-03	Metal stamping bracket, resistor support
	194-01987	Spacer, ceramic tube
R3009	063-10243-32	22 Ω , 5%, 1/2W, film
R3010	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R3011	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless
R3201	063-10243-82	2.7k Ω , 5%, 1/2W, film
R3202	063-10836-76	1.5k Ω , 5%, 2W, film
	086-00836	Terminal, male
R3203	063-10840-86	3.9k Ω , 5%, 3W, film
	012-08568-03	Metal stamping bracket, resistor support
	194-01987	Spacer, ceramic tube
R3204	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless
R3205	063-10243-08	2.2 Ω , 5%, 1/2W, film
R3206	063-10243-32	22 Ω , 5%, 1/2W, film
R3207	063-10836-88	4.7k Ω , 5%, 2W, film
	086-00836	Terminal, male
	194-01987	Spacer, ceramic tube

Table 7-1 (continued). Designated Components Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Resistors (continued)		
R3208	063-10243-88	4.7k Ω , 5%, 1/2W, film
R3209	063-10243-72	1k Ω , 5%, 1/2W, film
R3210	063-11020-89A	4.7k Ω , 5%, 1/4W, film, tubular, leadless
R3211	063-10444-42	5.6 Ω , 10%, 5W, wirewound
	012-08568-03	Metal stamping bracket, resistor support
	194-01987	Spacer, ceramic tube
R3212	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless
R3214	063-11020-81A	2.2k Ω , 5%, 1/4W, film, tubular, leadless
R3215	063-11021-45A	1M Ω , 5%, 1/4W, film
R3216	063-11020-49A	100 Ω , 5%, 1/4W, film, tubular, leadless
R3217	063-11020-49A	100 Ω , 5%, 1/4W, film, tubular, leadless
R3218	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R3219	063-10243-66	560 Ω , 5%, 1/2W, film
R3220	063-10938-23	16.5k Ω , 1%, 1/4W, film
R3222	063-10936-71	4.3k Ω , 1%, 1/4W, film
R3223	063-11021-21A	100k Ω , 5%, 1/4W, film, tubular, leadless
R3224	063-10828-84A	3.3k Ω , 5%, 1/2W, film
R3225	063-11020-83A	2.7k Ω , 5%, 1/4W, film, tubular, leadless
R3226	063-11021-15A	56k Ω , 5%, 1/4W, film, tubular, leadless
R3227	063-10243-72	1k Ω , 5%, 1/2W, film
R3228	063-11020-84A	3k Ω , 5%, 1/4W, film, tubular, leadless
R3229	063-11020-99A	12k Ω , 5%, 1/4W, film, tubular, leadless
R3230	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless
R3231	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless
R3232	063-11020-91A	5.6k Ω , 5%, 1/4W, film, tubular, leadless
R3233	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless

Table 7-1 (continued). Designated Components Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Resistors (continued)		
R3234	063-11021-15A	56k Ω , 5%, 1/4W, film, tubular, leadless
R3237	063-10938-42	24.3k Ω , 1%, 1/4W, film
R3238	063-10651-22	Control, rotary trimmer
R3239	063-10936-33	2.05k Ω , 1%, 1/4W, film
R3240	063-11021-15A	56k Ω , 5%, 1/4W, film, tubular, leadless
R3241	063-11020-83A	2.7k Ω , 5%, 1/4W, film, tubular, leadless
R3242	063-10243-84	3.3k Ω , 5%, 1/2W, film
R3243	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R3244	063-10840-48	100 Ω , 5%, 3W, film
	012-08568-03	Metal stamping bracket, resistor support
	194-01987	Spacer, ceramic tube
R3245	063-11021-21A	100k Ω , 5%, 1/4W, film, tubular, leadless
R3246	063-11021-14A	51k Ω , 5%, 1/4W, film
R3248	063-07799	2.2k Ω , 10%, 1/2W, carbon composition
R3249	063-10243-48	100 Ω , 5%, 1/2W, film
R3250	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless
R3252	063-10936-53	3.01k Ω , 1%, 1/4W, film
R3253	063-11020-55A	180 Ω , 5%, 1/4W, film, tubular, leadless
R3254	063-11020-55A	180 Ω , 5%, 1/4W, film, tubular, leadless
R3255	063-11020-55A	180 Ω , 5%, 1/4W, film, tubular, leadless
R3256	063-11020-55A	180 Ω , 5%, 1/4W, film, tubular, leadless
R3257	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless
R3258	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless
R3401	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R3402	063-10854-07	Control, rotary trimmer
R3403	063-11021-11A	39k Ω , 5%, 1/4W, film, tubular, leadless

Table 7-1 (continued). Designated Components Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Resistors (continued)		
R3404	063-11020-91A	5.6k Ω , 5%, 1/4W, film, tubular, leadless
R3405	063-11020-91A	5.6k Ω , 5%, 1/4W, film, tubular, leadless
R3406	063-11021-13A	47k Ω , 5%, 1/4W, film, tubular, leadless
R3407	063-11020-75A	1.2k Ω , 5%, 1/4W, film, tubular, leadless
R3408	063-11021-29A	220k Ω , 5%, 1/4W, film, tubular, leadless
R3409	063-11021-21A	100k Ω , 5%, 1/4W, film, tubular, leadless
R3410	063-10937-13	9.76k Ω , 1%, 1/4W, film
R3411	063-10938-64	37.4k Ω , 1%, 1/4W, film
R3414	063-11021-17A	68k Ω , 5%, 1/4W, film, tubular, leadless
R3415	063-10651-11	Control, rotary, trimmer
R3416	063-10243-79	2k Ω , 5%, 1/2W, film
R3417	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R3418	063-10854-10	Control, rotary, trimmer
R3419	063-10235-96	10k Ω , 5%, 1/4W, film
R3420	063-10651-13	Control, rotary, trimmer
R3421	063-11021-16A	62k Ω , 5%, 1/4W, film, tubular, leadless
R3422	063-10235-60	330 Ω , 5%, 1/4W, film
R3427	063-11020-79A	1.8k Ω , 5%, 1/4W, film, tubular, leadless
R3428	063-10840-82	2.7k Ω , 5%, 3W, film
	012-08568-03	Metal stamping bracket, resistor support
	194-01987	Spacer, ceramic tube
R3429	063-10840-51	130 Ω , 5%, 3W, film
	012-08568-03	Metal stamping bracket, resistor support
	194-01987	Spacer, ceramic tube
R3430	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R3431	063-11020-81A	2.2k Ω , 5%, 1/4W, film, tubular, leadless
R3432	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless

Table 7-1 (continued). Designated Components Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Resistors (continued)		
R5101	063-11020-46A	75 Ω , 5%, 1/4W, film, tubular, leadless
R5102	063-11020-46A	75 Ω , 5%, 1/4W, film, tubular, leadless
R5103	063-11020-46A	75 Ω , 5%, 1/4W, film, tubular, leadless
R5104	063-10979-70A	10k Ω , 5%, 1/8W, film, tubular, leadless
R5105	063-10979-70A	10k Ω , 5%, 1/8W, film, tubular, leadless
R5106	063-10979-70A	10k Ω , 5%, 1/8W, film, tubular, leadless
R5107	063-10979-32A	220 Ω , 5%, 1/8W, film, tubular, leadless
R5108	063-10979-32A	220 Ω , 5%, 1/8W, film, tubular, leadless
R5109	063-10979-32A	220 Ω , 5%, 1/8W, film, tubular, leadless
R5110	063-10836-56	220 Ω , 5%, 2W, film
	194-01987	Spacer, ceramic tube
R5111	063-10979-68A	8.2k Ω , 5%, 1/8W, film, tubular, leadless
R5112	063-10979-32A	220 Ω , 5%, 1/8W, film, tubular, leadless
R5113	063-10979-83A	39k Ω , 5%, 1/8W, film, tubular, leadless
R5115	063-10979-47A	1k Ω , 5%, 1/8W, film, tubular, leadless
R5116	063-10979-47A	1k Ω , 5%, 1/8W, film, tubular, leadless
R5117	063-10979-47A	1k Ω , 5%, 1/8W, film, tubular, leadless
R5118	063-10979-47A	1k Ω , 5%, 1/8W, film, tubular, leadless
R5119	063-10979-78A	22k Ω , 5%, 1/8W, film, tubular, leadless
R5120	063-10979-80A	27k Ω , 5%, 1/8W, film, tubular, leadless
R5121	063-10979-59A	3.3k Ω , 5%, 1/8W, film, tubular, leadless
R5122	063-10979-89A	68k Ω , 5%, 1/8W, film, tubular, leadless

Table 7-1 (continued). Designated Components Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Resistors (continued)		
R5123	063-10979-28A	150Ω, 5%, 1/8W, film, tubular, leadless
R5124	063-11020-55A	180Ω, 5%, 1/4W, film, tubular, leadless
R5126	063-10979-57A	2.7kΩ, 5%, 1/8W, film, tubular, leadless
R5130	063-10979-50A	1.3kΩ, 5%, 1/8W, film, tubular, leadless
R5131	063-10979-57A	2.7kΩ, 5%, 1/8W, film, tubular, leadless
R5132	063-10979-24A	100Ω, 5%, 1/8W, film, tubular, leadless
R5133	063-10979-59A	3.3kΩ, 5%, 1/8W, film, tubular, leadless
R5134	063-10979-59A	3.3kΩ, 5%, 1/8W, film, tubular, leadless
R5135	063-10979-59A	3.3kΩ, 5%, 1/8W, film, tubular, leadless
R5136	063-10979-39A	470Ω, 5%, 1/8W, film, tubular, leadless
R5137	063-10979-24A	100Ω, 5%, 1/8W, film, tubular, leadless
R5138	063-10979-39A	470Ω, 5%, 1/8W, film, tubular, leadless
R5139	063-10979-46A	910Ω, 5%, 1/8W, film, tubular, leadless
R5140	063-10651-28	Control, rotary, trimmer
R5142	063-10979-39A	470Ω, 5%, 1/8W, film, tubular, leadless
R5143	063-10979-39A	470Ω, 5%, 1/8W, film, tubular, leadless
R5144	063-10979-24A	100Ω, 5%, 1/8W, film, tubular, leadless
R5145	063-10979-39A	470Ω, 5%, 1/8W, film, tubular, leadless
R5146	063-10979-46A	910Ω, 5%, 1/8W, film, tubular, leadless
R5147	063-10979-33A	240Ω, 5%, 1/8W, film, tubular, leadless
R5149	063-10979-43A	680Ω, 5%, 1/8W, film, tubular, leadless
R5150	063-10979-39A	470Ω, 5%, 1/8W, film, tubular, leadless

Table 7-1 (continued). Designated Components Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Resistors (continued)		
R5151	063-10979-24A	100Ω, 5%, 1/8W, film, tubular, leadless
R5152	063-10979-39A	470Ω, 5%, 1/8W, film, tubular, leadless
R5153	063-10979-46A	910Ω, 5%, 1/8W, film, tubular, leadless
R5154	063-10651-28	Control, rotary, trimmer
R5156	063-10979-39A	470Ω, 5%, 1/8W, film, tubular, leadless
R5157	063-10979-70A	10kΩ, 5%, 1/8W, film, tubular, leadless
R5158	063-10979-81A	30kΩ, 5%, 1/8W, film, tubular, leadless
R5159	063-10979-24A	100Ω, 5%, 1/8W, film, tubular, leadless
R5160	063-10979-24A	100Ω, 5%, 1/8W, film, tubular, leadless
R5161	063-10979-24A	100Ω, 5%, 1/8W, film, tubular, leadless
R5162	063-10979-81A	30kΩ, 5%, 1/8W, film, tubular, leadless
R5201	063-10979-47A	1kΩ, 5%, 1/8W, film, tubular, leadless
R5202	063-11020-45A	68Ω, 5%, 1/4W, film, tubular, leadless
R5203	063-10979-20A	68Ω, 5%, 1/8W, film, tubular, leadless
R5204	063-10836-70	820Ω, 5%, 3W, film
	086-00836	Terminal, male
	194-01987	Spacer, ceramic tube
R5205	063-10836-70	820Ω, 5%, 3W, film
	086-00836	Terminal, male
	194-01987	Spacer, ceramic tube
R5206	063-11020-45A	100Ω, 5%, 1/4W, film, tubular, leadless
R5207	063-11020-35A	27Ω, 5%, 1/4W, film, tubular, leadless
R5208	063-11020-35A	27Ω, 5%, 1/4W, film, tubular, leadless
R5209	063-10979-47A	1kΩ, 5%, 1/8W, film, tubular, leadless

Table 7-1 (continued). Designated Components Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Resistors (continued)		
R5210	063-11020-45A	68Ω, 5%, 1/4W, film, tubular, leadless
	086-00836	Terminal, male
R5211	063-10979-20A	68Ω, 5%, 1/8W, film, tubular, leadless
R5212	063-10836-70	820Ω, 5%, 3W, film
	086-00836	Terminal, male
	194-01987	Spacer, ceramic tube
R5213	063-10836-70	820Ω, 5%, 3W, film
	086-00836	Terminal, male
	194-01987	Spacer, ceramic tube
R5214	063-11020-49A	100Ω, 5%, 1/4W, film, tubular, leadless
R5215	063-11020-35A	27Ω, 5%, 1/4W, film, tubular, leadless
R5216	063-11020-35A	27Ω, 5%, 1/4W, film, tubular, leadless
R5217	063-10979-47A	1kΩ, 5%, 1/8W, film, tubular, leadless
R5218	063-11020-45A	68Ω, 5%, 1/4W, film, tubular, leadless
R5219	063-10979-20A	68Ω, 5%, 1/8W, film, tubular, leadless
R5220	063-10836-70	820Ω, 5%, 3W, film
	086-00836	Terminal, male
	194-01987	Spacer, ceramic tube
R5221	063-10836-70	820Ω, 5%, 3W, film
	086-00836	Terminal, male
	194-01987	Spacer, ceramic tube
R5222	063-11020-49A	100Ω, 5%, 1/4W, film, tubular, leadless
R5223	063-11020-35A	27Ω, 5%, 1/4W, film, tubular, leadless
R5224	063-11020-35A	27Ω, 5%, 1/4W, film, tubular, leadless
R5225	063-10979-35A	300Ω, 5%, 1/8W, film, tubular, leadless
R5301	063-10980-16A	1.0MΩ, 5%, 1/8W, film, tubular, leadless
R5302	063-10979-32A	220Ω, 5%, 1/8W, film, tubular, leadless
R5303	063-07749	150Ω, 5%, 1/2W, carbon composition

Table 7-1 (continued). Designated Components Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Resistors (continued)		
R5304	063-10980-16A	1.0MΩ, 5%, 1/8W, film, tubular, leadless
R5305	063-10979-32A	220Ω, 5%, 1/8W, film, tubular, leadless
R5306	063-07749	150Ω, 5%, 1/2W, carbon composition
R5307	063-10980-16A	1.0MΩ, 5%, 1/8W, film, tubular, leadless
R5308	063-10979-32A	220Ω, 5%, 1/8W, film, tubular, leadless
R5309	063-07749	150Ω, 5%, 1/2W, carbon composition
R5310	063-07799	2.2kΩ, 10%, 1/2W, carbon composition
R5311	063-07799	2.2kΩ, 10%, 1/2W, carbon composition
R5314	063-10979-27A	130Ω, 5%, 1/8W, film, tubular, leadless
R5315	063-10243-80	2.2kΩ, 5%, 1/2W, film
R5316	063-10651-30	Control, rotary, trimmer
R5317	063-10651-30	Control, rotary, trimmer
R5318	063-10651-30	Control, rotary, trimmer
R5319	063-10243-72	1kΩ, 5%, 1/2W, film
R5320	063-11020-01A	1Ω, 5%, 1/4W, film, tubular, leadless
R5401	063-10764-03	Control, rotary, single
R5402	063-10854-04	Control, rotary, trimmer
R5403	063-10764-03	Control, rotary, single
R5404	063-10854-12	Control, rotary, trimmer
R5405	063-10235-86	3.9kΩ, 5%, 1/4W, film
R5406	063-10235-86	3.9kΩ, 5%, 1/4W, film
R5407	063-10235-67	620Ω, 5%, 1/4W, film
R7001	063-11020-99A	12kΩ, 5%, 1/4W, film, tubular, leadless
R7002	063-11020-97A	10kΩ, 5%, 1/4W, film, tubular, leadless
R7003	063-11020-97A	10kΩ, 5%, 1/4W, film, tubular, leadless
R7004	063-11020-97A	10kΩ, 5%, 1/4W, film, tubular, leadless
R7008	063-11020-87A	3.9kΩ, 5%, 1/4W, film, tubular, leadless

**Table 7-1 (continued). Designated Components
Parts List**

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Resistors (continued)		
R7010	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7011	063-11021-21A	100k Ω , 5%, 1/4W, film, tubular, leadless
R7012	063-10857-17	Control, rotary, trimmer
R7013	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7014	063-11020-84A	3k Ω , 5%, 1/4W, film, tubular, leadless
R7015	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7016	063-11020-89A	4.7k Ω , 5%, 1/4W, film, tubular, leadless
R7017	063-11020-89A	4.7k Ω , 5%, 1/4W, film, tubular, leadless
R7018	063-11020-80A	2k Ω , 5%, 1/4W, film, tubular, leadless
R7019	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7020	063-11020-65A	470 Ω , 5%, 1/4W, film, tubular, leadless
R7021	063-11020-65A	470 Ω , 5%, 1/4W, film, tubular, leadless
R7025	063-11020-65A	470 Ω , 5%, 1/4W, film, tubular, leadless
R7026	063-11021-01A	15k Ω , 5%, 1/4W, film, tubular, leadless
R7027	063-10857-14	Control, rotary, trimmer
R7028	063-11021-01A	15k Ω , 5%, 1/4W, film, tubular, leadless
R7030	063-10235-48	100 Ω , 5%, 1/4W, film
R7031	063-11020-77A	1.5k Ω , 5%, 1/4W, film, tubular, leadless
R7033	063-11020-93A	6.8k Ω , 5%, 1/4W, film, tubular, leadless
R7034	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7035	063-11020-65A	470 Ω , 5%, 1/4W, film, tubular, leadless
R7036	063-11021-17A	68k Ω , 5%, 1/4W, film, tubular, leadless
R7037	063-11021-17A	68k Ω , 5%, 1/4W, film, tubular, leadless

**Table 7-1 (continued). Designated Components
Parts List**

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Resistors (continued)		
R7039	063-10857-17	Control, rotary, trimmer
R7105	063-10243-60	330 Ω , 5%, 1/2W, film
R7106	063-10857-11	Control, rotary, trimmer
R7108	063-10938-01	10.2k Ω , 1%, 1/4W, film
R7110	063-10938-48	27.4k Ω , 1%, 1/4W, film
R7111	063-10236-10	39k Ω , 5%, 1/4W, film
R7112	063-11021-45A	1M Ω , 5%, 1/4W, film, tubular, leadless
R7113	063-10937-13	9.76k Ω , 1%, 1/4W, film
R7114	063-10940	100k Ω , 1%, 1/4W, film
R7115	063-11020-49A	100 Ω , 5%, 1/4W, film, tubular, leadless
R7116	063-11020-49A	100 Ω , 5%, 1/4W, film, tubular, leadless
R7117	063-11020-81A	2.2k Ω , 5%, 1/4W, film, tubular, leadless
R7118	063-10243-72	1k Ω , 5%, 1/2W, film
R7119	063-10243-88	4.7k Ω , 5%, 1/2W, film
R7120	063-10836-88	4.7k Ω , 5%, 2W, film
	086-00836	Terminal, male
R7121	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless
R7401	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7402	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7403	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7404	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7405	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7406	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7407	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7408	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7409	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7410	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless

Table 7-1 (continued). Designated Components Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Resistors (continued)		
R7411	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless
R7412	063-11021-21A	100k Ω , 5%, 1/4W, film, tubular, leadless
R7413	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless
R7414	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless
R7417	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless
R7418	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7419	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless
R7421	063-11020-87A	3.9k Ω , 5%, 1/4W, film, tubular, leadless
R7422	063-11020-49A	100 Ω , 5%, 1/4W, film, tubular, leadless
R7427	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7428	063-11020-49A	100 Ω , 5%, 1/4W, film, tubular, leadless
R7429	063-11020-93A	6.8k Ω , 5%, 1/4W, film, tubular, leadless
R7430	063-10857-14	Control, rotary, trimmer
R7431	063-10857-14	Control, rotary, trimmer
R7432	063-11021-07A	27k Ω , 5%, 1/4W, film, tubular, leadless
R7433	063-10857-17	Control, rotary, trimmer
R7434	063-10857-12	Control, rotary, trimmer
R7435	063-10857-17	Control, rotary, trimmer
R7436	063-10857-12	Control, rotary, trimmer
R7437	063-11020-95A	8.2k Ω , 5%, 1/4W, film, tubular, leadless
R7438	063-11020-95A	8.2k Ω , 5%, 1/4W, film, tubular, leadless
R7439	063-11021-07A	27k Ω , 5%, 1/4W, film, tubular, leadless
R7440	063-11021-07A	27k Ω , 5%, 1/4W, film, tubular, leadless
R7441	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless

Table 7-1 (continued). Designated Components Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Resistors (continued)		
R7442	063-11020-84A	3k Ω , 5%, 1/4W, film, tubular, leadless
R7443	063-11020-84A	3k Ω , 5%, 1/4W, film, tubular, leadless
R7444	063-10236-12	47k Ω , 5%, 1/4W, film
R7445	063-11020-49A	100 Ω , 5%, 1/4W, film, tubular, leadless
R7446	063-11020-77A	1.5k Ω , 5%, 1/4W, film, tubular, leadless
R7447	063-11020-83A	2.7k Ω , 5%, 1/4W, film, tubular, leadless
R7448	063-11020-49A	100 Ω , 5%, 1/4W, film, tubular, leadless
R7449	063-11020-81A	2.2k Ω , 5%, 1/4W, film, tubular, leadless
R7450	063-11020-91A	5.6k Ω , 5%, 1/4W, film, tubular, leadless
R7451	063-11020-67A	560 Ω , 5%, 1/4W, film, tubular, leadless
R7452	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7453	063-11020-49A	100 Ω , 5%, 1/4W, film, tubular, leadless
R7454	063-10857-12	Control, rotary, trimmer
R7455	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7456	063-10857-12	Control, rotary, trimmer
R7457	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7458	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7459	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7463	063-11021-01A	15k Ω , 5%, 1/4W, film, tubular, leadless
R7464	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7465	063-10235-72	1k Ω , 5%, 1/4W, film
R7501	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless
R7506	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless

Table 7-1 (continued). Designated Components Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Resistors (continued)		
R7507	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7508	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7509	063-11020-49A	100 Ω , 5%, 1/4W, film, tubular, leadless
R7510	063-11020-83A	2.7k Ω , 5%, 1/4W, film, tubular, leadless
R7511	063-11020-93A	6.8k Ω , 5%, 1/4W, film, tubular, leadless
R7512	063-10533-35	2k Ω , 1%, 1/4W, film
R7513	063-10533-35	2k Ω , 1%, 1/4W, film
R7514	063-10533-18	6190 Ω , 1%, 1/4W, film
R7515	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless
R7516	063-10938-96	68.1k Ω , 1%, 1/4W, film
R7517	063-10938-07	11.8k Ω , 1%, 1/4W, film
R7518	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless
R7523	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7524	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7525	063-11020-57A	220 Ω , 5%, 1/4W, film, tubular, leadless
R7529	063-11021-20A	91k Ω , 5%, 1/4W, film, tubular, leadless
R7530	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7532	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7533	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7534	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7537	063-11020-31A	18 Ω , 5%, 1/4W, film, tubular, leadless
R7538	063-11020-49A	100 Ω , 5%, 1/4W, film, tubular, leadless
R7539	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless

Table 7-1 (continued). Designated Components Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Resistors (continued)		
R7540	063-10857-17	Control, rotary, trimmer
R7541	063-11021-37A	470k Ω , 5%, 1/4W, film, tubular, leadless
R7542	063-11020-97A	10k Ω , 5%, 1/4W, film, tubular, leadless
R7543	063-11021-21A	100k Ω , 5%, 1/4W, film, tubular, leadless
R7544	063-11020-73A	1k Ω , 5%, 1/4W, film, tubular, leadless
R7545	063-11020-81A	2.2k Ω , 5%, 1/4W, film, tubular, leadless
R7546	063-11021-01A	15k Ω , 5%, 1/4W, film, tubular, leadless
R7701	063-10235-88	4.7k Ω , 5%, 1/4W, film
R7702	063-10235-94	8.2k Ω , 5%, 1/4W, film
R7703	063-10651-18	Control, rotary, trimmer
R7704	063-10236-30	270k Ω , 5%, 1/4W, film
R7705	063-10235-80	2.2k Ω , 5%, 1/4W, film
R7706	063-10236-13	51k Ω , 5%, 1/4W, film
R7707	063-10243-96	10k Ω , 5%, 1/2W, film
R7708	063-10442-96	1k Ω , 5%, 5W, wirewound
R7709	063-07785	1k Ω , 10%, 1/2W, carbon composition
R7710	063-10235-96	10k Ω , 5%, 1/4W, film
R7711	063-10235-72	1k Ω , 5%, 1/4W, film
RX2134	063-10565	1 Ω , 5%, 1/2W, film
RX2135	063-10565	1 Ω , 5%, 1/2W, film
RX2136	063-10565	1 Ω , 5%, 1/2W, film
RX2137	063-10565	1 Ω , 5%, 1/2W, film
RX2138	063-10565-08	2.2 Ω , 5%, 1/2W, film
RX2139	063-10836-60	330 Ω , 5%, 2W, film
	086-00836	Terminal, male
	194-01987	Spacer, ceramic tube
RX2149	063-10565-36	33 Ω , 5%, 1/2W, film
RX2150	063-10565-36	33 Ω , 5%, 1/2W, film
RX2151	063-10840-51	130 Ω , 5%, 3W, film
	086-00836	Terminal, male
RX7535	063-10565	1 Ω , 5%, 1/2W, film
RX7536	063-10565	1 Ω , 5%, 1/2W, film

Table 7-1 (continued). Designated Components Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
Transformers		
T3001	095-04040	Transformer, hybrid scan choke with secondary
T3401	095-03904-01	Transformer, driver
T7501	095-04048	Transformer, pincushion
T7701	095-04049-01	Transformer, dynamic focus
TX3201	095-03753	Transformer, horizontal driver

Table 7-2. Miscellaneous Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
N/A	009-00688	Module, Video Output
N/A	009-00695-01	Module, PIN/Focus
N/A	009-00712-01	Module, Deflection
N/A	009-00740	Module, Dynamic Focus
N/A	011-00355	Power cord, 3-conductor, shielded
N/A	012-09446	Transistor locator, molded plastic
N/A	012-09520-01	Metal bracket, CRT mounting
N/A	012-09521-02	Metal bracket, right side
N/A	012-09522-02	Metal bracket, left side
N/A	014-11812-03	Cabinet front, molded plastic
N/A	014-11813-01	Cabinet rear, molded plastic
N/A	020-04240-32	Coil, degausser
N/A	022-07523-01B	Capacitor, 0.01 μ F, \pm 20%, 2000V, ceramic disc
N/A	022-07859-13	Capacitor, 1000 μ F, 20%, 16V, electrolytic
N/A	030-01284	Name plate
N/A	046-10445-01	Knob, thumbwheel, rotary
N/A	050-01645-03	5R9/5A9 connector and cable assembly

Table 7-2 (continued). Miscellaneous Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
N/A	050-01654-01	5S6 connector and cable assembly
N/A	050-01656-01	5R6 connector and cable assembly
N/A	050-01657-01	6S5 connector and cable assembly
N/A	050-01659-02	8V6 connector and cable assembly
N/A	050-01662-02	5A6 connector and cable assembly
N/A	050-01674	5A1 connector and cable assembly
N/A	050-01675-01	8R5 connector and cable assembly
N/A	050-01758	8U6 connector and cable assembly
N/A	050-01769	3R6 connector and cable assembly
N/A	050-01770	8R6 connector and cable assembly
N/A	050-01772	3R5 connector and cable assembly
N/A	050-01783	4T8 connector and cable assembly
N/A	054-00250-05	Nut, machine, 6-32 x 0.312AF x 0.109THK, ZD hex
N/A	054-00347	Nut, machine, 6-32 x 0.312AF x 0.109THK, ZF hex with washer
N/A	054-00347-01	Nut, machine, 6-32 x 0.312AF x 0.114THK, ZD hex with washer
N/A	054-00348-01	Nut, machine, 8-32 x 0.344AF x 0.130THK, ZD hex with washer
N/A	054-00349	Nut, machine, 10-32 x 0.375AF x 0.125 THK ZN hex with washer
N/A	054-00952-01	Nut, machine, 4-40 x 0.250AF x 0.093THK BX hex
N/A	054-00952-04	Nut, machine, 4-40 x 0.250AF x 0.093THK ZD hex

Table 7-2 (continued). Miscellaneous Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
N/A	063-11020-85A	Resistor, 3.3k Ω , 5%, 1/4W, film, tubular, leadless
N/A	074-00291	Screen, ventilating
N/A	082-00275-18	Strap, ground, insulated
N/A	082-00371-01	Strap, CRT retaining
N/A	095-04072-01	Transformer, high voltage
N/A	101-07941	Label, X-ray safety notice
N/A	101-08051	Label, shock hazard
N/A	101-08068	Label, warning or caution, electric shock
N/A	101-08102	Label, UL information
N/A	103-00385-05	Diode, visible LED, rectangular, green
N/A	112-01093-03	Screw, thread forming, 4-40 \times 0.250, type C, ZD pan head, phillips
N/A	112-01160-02	Screw, thread forming, 8-18 \times 0.437, type B, black oxide, pan head, phillips, cabinet rear top
N/A	112-01689-03	Screw, machine, 4-40 \times 0.625 ZD, pan head, phillips
N/A	112-01697-07	Screw, machine, 4-40 \times 0.375 ZN, pan head, phillips
N/A	112-01724-01	Screw, machine, 6-32 \times 1.250 ZD, pan head, phillips
N/A	112-01865	Screw, thread forming, 6-20 \times 0.437, type B, cadmium pan head, phillips, two bumpers to foot brackets
N/A	112-02280-01	Screw, thread forming, 8-18 \times 0.375, type B, black oxide, flat head, phillips, four insulators to o p crossbrace rear
N/A	112-02556	Screw, machine, 6-32 \times 0.500 ZD, pan head, phillips
N/A	114-00549-01	Screw, machine, 10-32 \times 2.125 ZD \times 0.312AF, hex head with washer

Table 7-2 (continued). Miscellaneous Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
N/A	114-00894-02	Screw, thread forming, 8-18 \times 0.5 TP B, ZD 0.250 AF, hex washer head, insulators to heatsink FTM module
N/A	114-00984-03	Screw, thread forming, 6-20 \times 0.625 type B, 0.250 AF, hex washer head
N/A	114-01100-01	Screw, thread forming, 8-18 \times 0.750 type B, 1/4AF, hex head with washer, two cabinet rear to cabinet front bottom
N/A	114-01108	Screw, thread cut, 620 \times 0.375 type BT, ZN 1/4AF, hex washer head, 9 to side bracket, 2 to rear bracket, 2 foot support bracket to side
N/A	114-01108-01	Screw, thread cut, 6-20 \times 0.375 type BT, ZD 250AF, hex washer head, deflection module to side brackets
N/A	114-01190-01	Screw, thread forming, 8-18 \times 0.625 type AB, ZD 0.250AF, hex washer head
N/A	114-01261	Screw, thread forming, 8-18 \times 0.500 type AB, ZD 250AF, hex head with washer
N/A	114-01274	Screw, thread forming, 8-18 \times 0.625 type AB, bronze 1/4AF, hex head with washer
N/A	114-01325-03	Screw, thread forming, 4-24 \times 0.312 type B, ZD 0.187AF, hex washer head
N/A	114-01379-03	Screw, thread forming, 8-10 \times 0.500 hi-riser, ZD 0.250AF, hex washer head
N/A	114-01393-01	Screw, thread cut, 8-10 \times 0.625 hi-riser, 0.250AF, hex washer head, frame to front

Table 7-2 (continued). Miscellaneous Parts List

REFERENCE NUMBER	ZENITH PART NUMBER	DESCRIPTION
N/A	114-01399	Screw, thread forming, 6-20 × 1.25 type B, bronze, hex washer head, fan and deflector to fan mounting bracket
N/A	114-01403	Screw, machine, 4-40 × 0.250 BX, 0.187AF, hex washer head
N/A	114-01463-01	Screw, thread cut, 10-8 × 1.000 hi-riser, 1/4AF, hex head with washer, CRT bosses
N/A	114-01470-02	Screw, machine, 8-32 × 0.500, 0.250AF, ZD hex head, phillips, I/O cable clamp
N/A	114-01483-01	Screw, thread forming, 6-32 × 0.310 type B, ZN 0.250AF, hex head with washer, contact spring to power supply bracket
N/A	114-01483-03	Screw, thread forming, 6-32 × 0.310 type B, ZD 0.250AF, hex head with washer, contact spring to power supply bracket
N/A	141-00227-03	Fan, 12 VDC
N/A	152-00343-01	Wedge, rubber, CRT retainer

Table 7-3 Heath Parts List

HEATH PART NUMBER	DESCRIPTION
234-954	CRT and yoke assembly
234-955	Power supply
234-956	Video output module
234-957	PIN/focus module
234-958	Deflection module
234-959	Dynamic focus module
234-971	Fan, 12 VDC
234-972	Cabinet, front and nameplate
234-973	Cabinet, rear
234-974	LED and cable assembly
234-975	Carton assembly, ZCM-1490

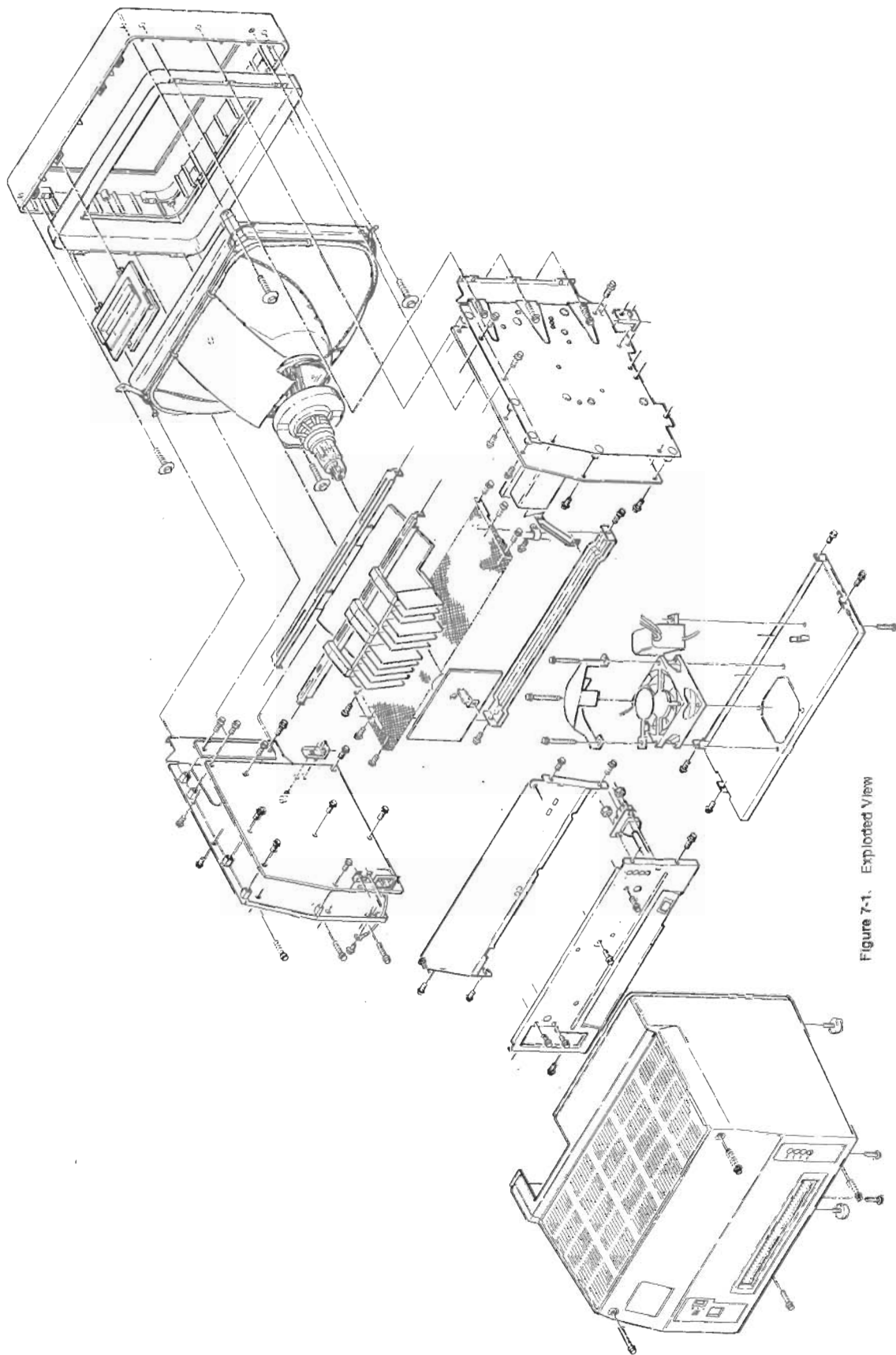


Figure 7-1. Exploded View

Chapter 8

Schematics and Waveforms

This chapter contains schematics, waveforms, and component views for the ZCM-1490 color video monitor. Where appropriate, test points are designated on the schematics and component views by a circled number that refers to a corresponding waveform photograph.

Waveform Explanation

This chapter contains all waveform photographs referred to throughout the manual. Figure 8-1 and the notes that follow it explain the waveform display window and oscilloscope settings. All waveforms were taken with the external brightness and contrast controls set to their detent position. The fill screen test with the capital Z was displayed.

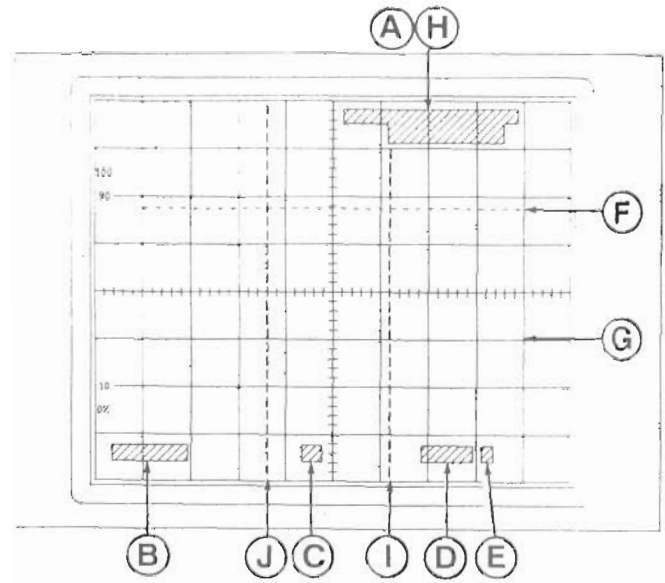
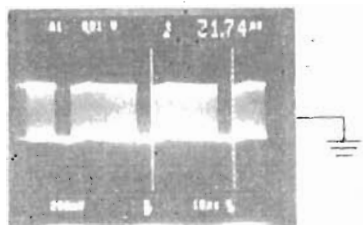


Figure 8-1. Oscilloscope Display Information

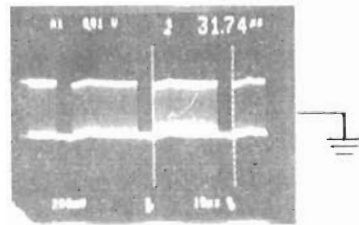
Each waveform photograph is numbered and labeled with a brief identifying note. The waveforms were taken using a Tektronix Model 2445 150 MHz oscilloscope. Your waveforms may be slightly different due to differences in test equipment, monitors, etc. These waveform photographs should serve as a guide for troubleshooting and servicing.

- (A) The delta voltage established between the variable reference cursor (dotted line G) and the variable data cursor (dotted line F). This value, when displayed, indicates the peak-to-peak voltage of the waveform.
- (B) The channel 1 scale factor (volts/division).
- (C) 20 MHz bandwidth limitation indicator.
- (D) Sweep time base (seconds/division).

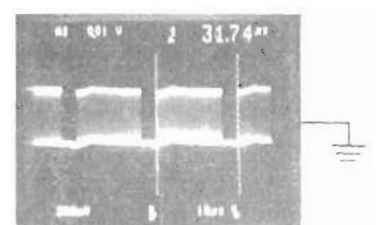
- (E) Holdoff indicator (holdoff refers to the amount of time between the end of the sweep and the time that a triggering signal can initiate the next sweep).
- (F) Data cursor that can be varied on the vertical axis to provide a reference for the delta voltage.
- (G) Data cursor that can be varied on the vertical axis to provide a reference for the delta voltage.
- (H) The delta time established between the variable reference cursor (dotted line J) and the variable data cursor (dotted line I). This value, when displayed, indicates the period of the waveform.
- (I) Data cursor that can be varied on the horizontal axis to provide a reference for the delta time.
- (J) Data cursor that can be varied on the horizontal axis to provide a reference for the delta time.



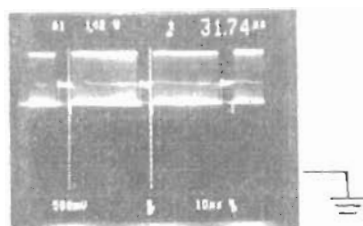
1. IC5101, PIN 3



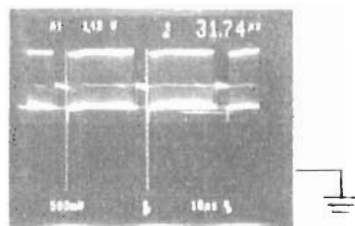
2. IC5101, PIN 5



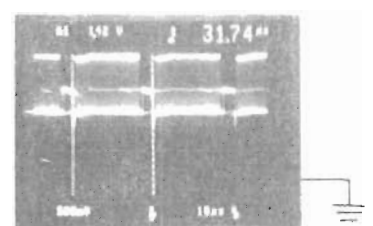
3. IC5101, PIN 8



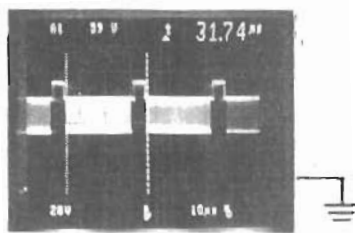
4. Q5201 BASE



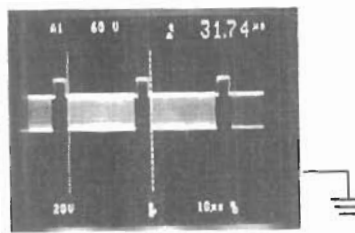
5. Q5205 BASE



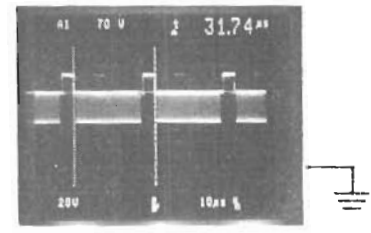
6. Q5209 BASE



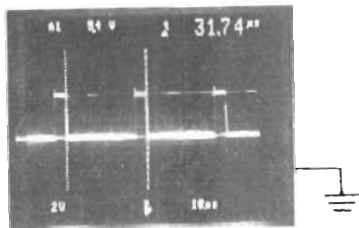
7. CRT RED



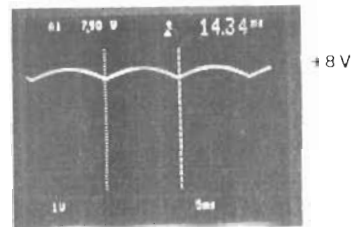
8. CRT GREEN



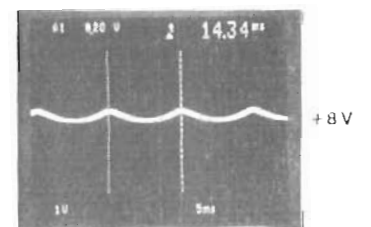
9. CRT BLUE



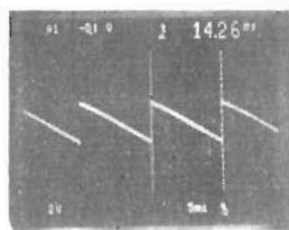
10. Q5101 EMITTER



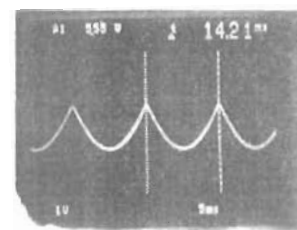
11. IC7001, PIN 2



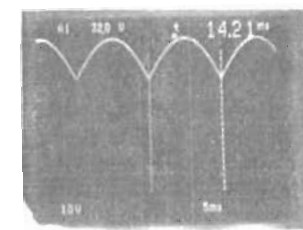
12. IC7001, PIN 14



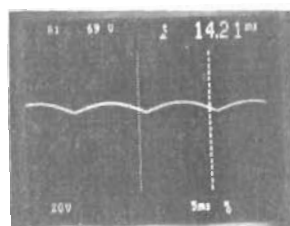
13. 8U6, PIN 5 (Q7505 BASE)



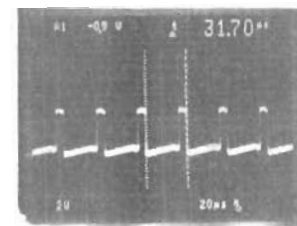
14. IC7101, PIN 1



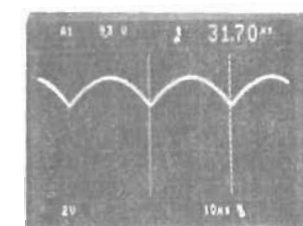
15. Q7103 COLLECTOR



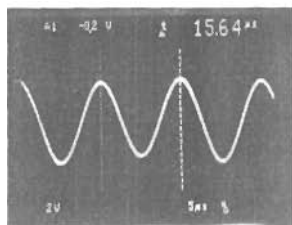
16. Q7105 EMITTER



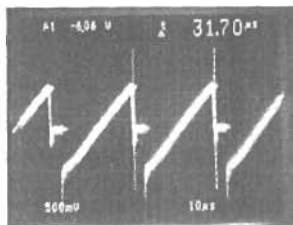
17. Q7402 BASE



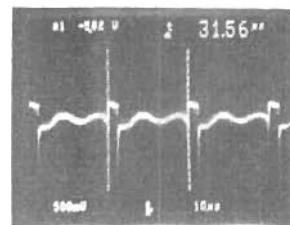
18. Q7410 BASE



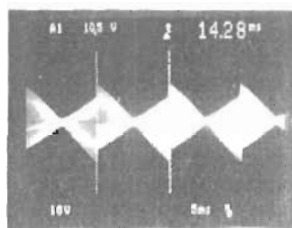
19. TP1, PIN BOARD



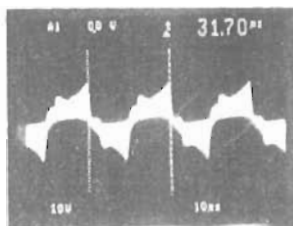
20. IC7501, PIN 4



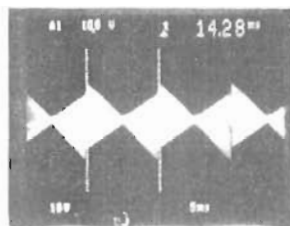
21. IC7501, PIN 8



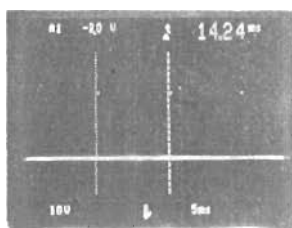
22. IC7502, PIN 6 (ENVELOPE)



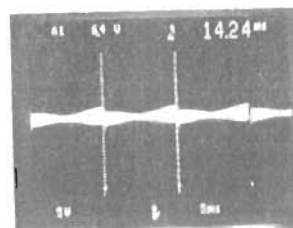
23. IC7502, PIN 6 (CARRIER)



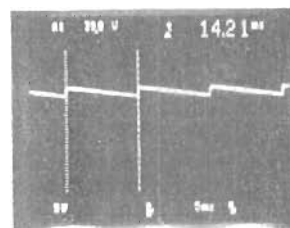
24. IC7503, PIN 4 (ENVELOPE)



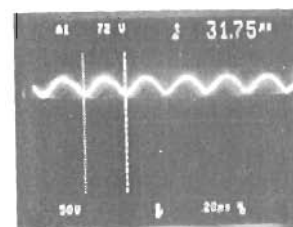
25. IC2101, PIN 1



26. IC2101, PIN 7



27. IC2101, PIN 5



28. TP3, DEFLECTION BOARD



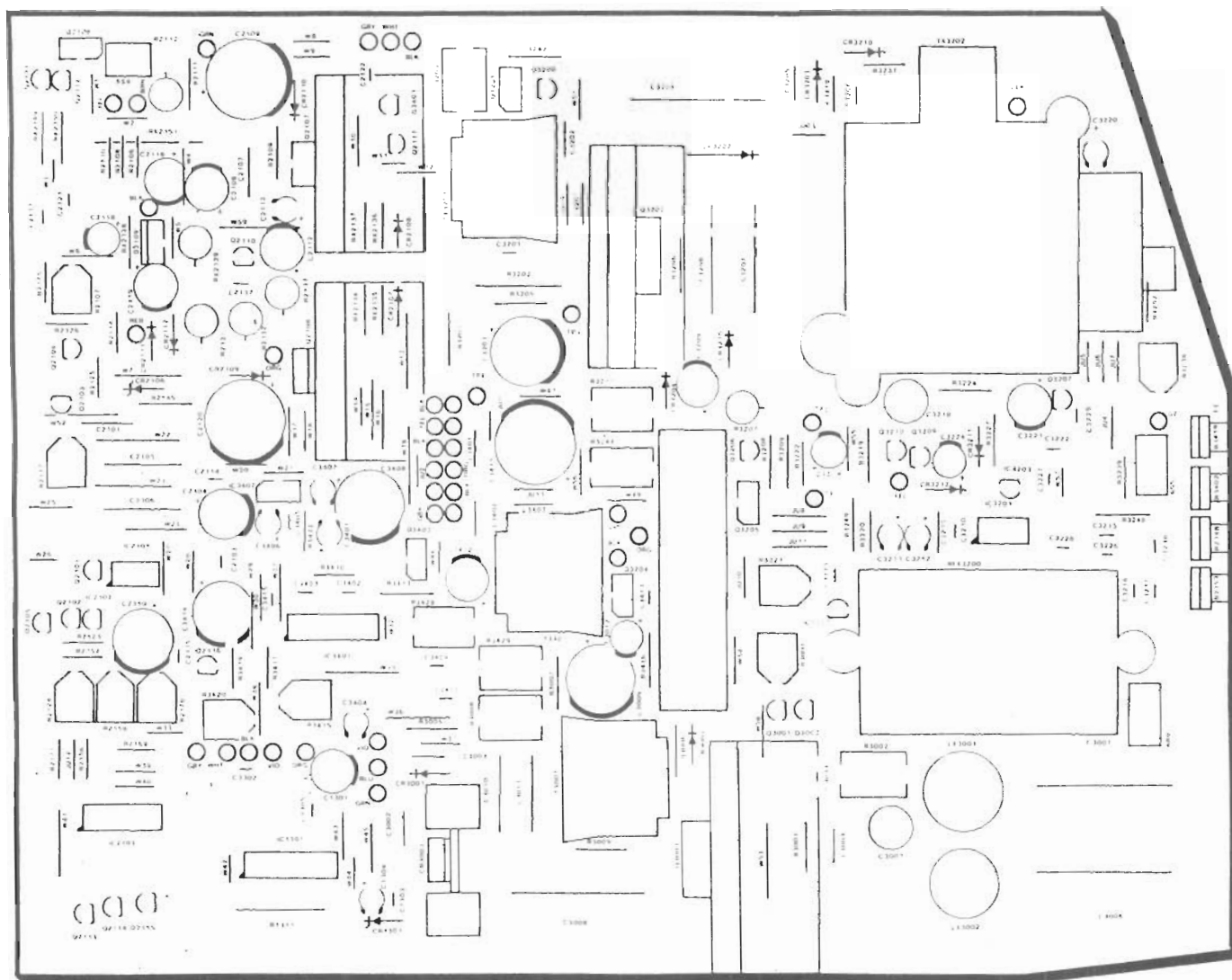


Figure 8-5. Deflection Board Component View (Component Side)

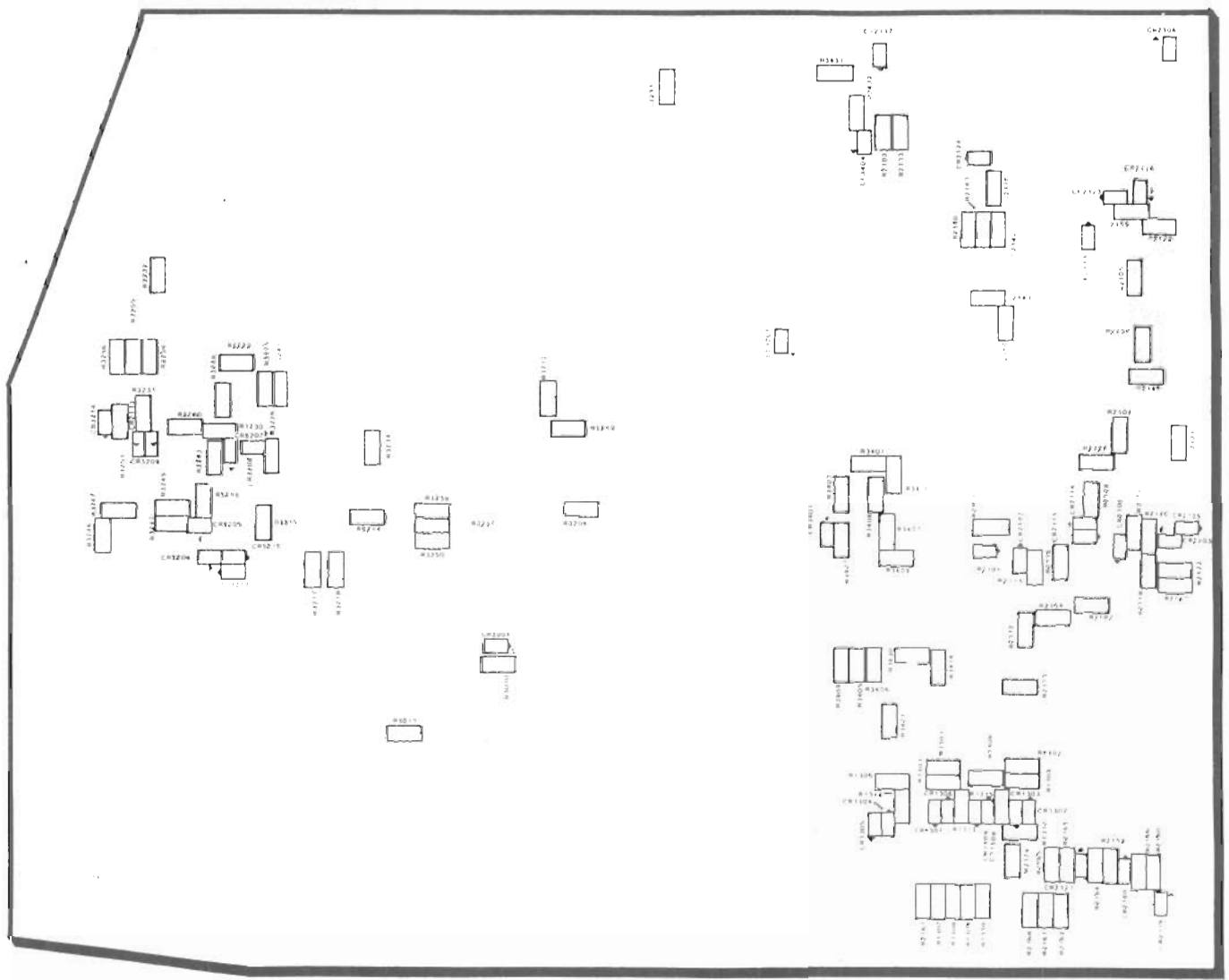


Figure 8-6. Deflection Board Component View (Foil Side)

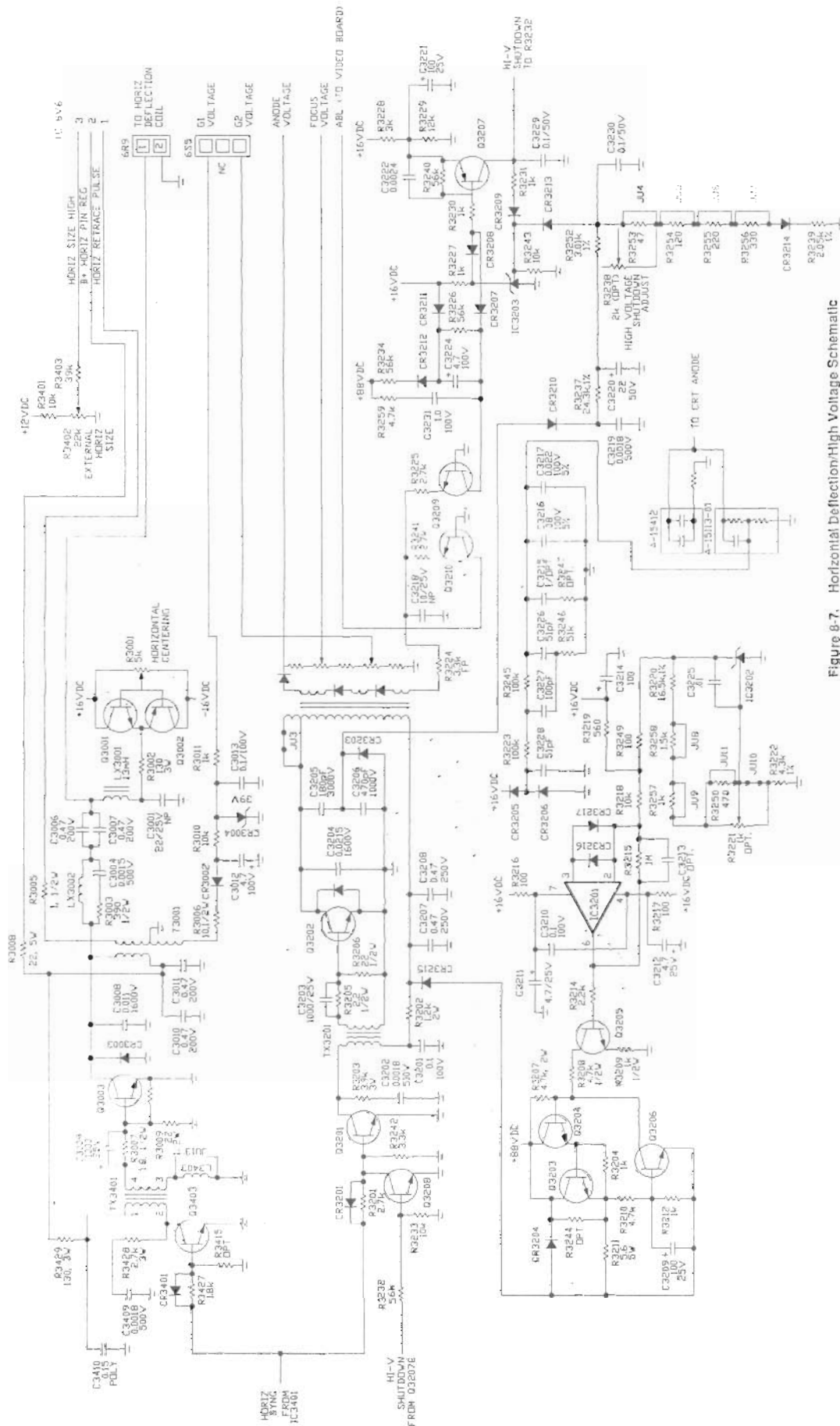


Figure 8-7. Horizontal Deflection/High Voltage Schematic

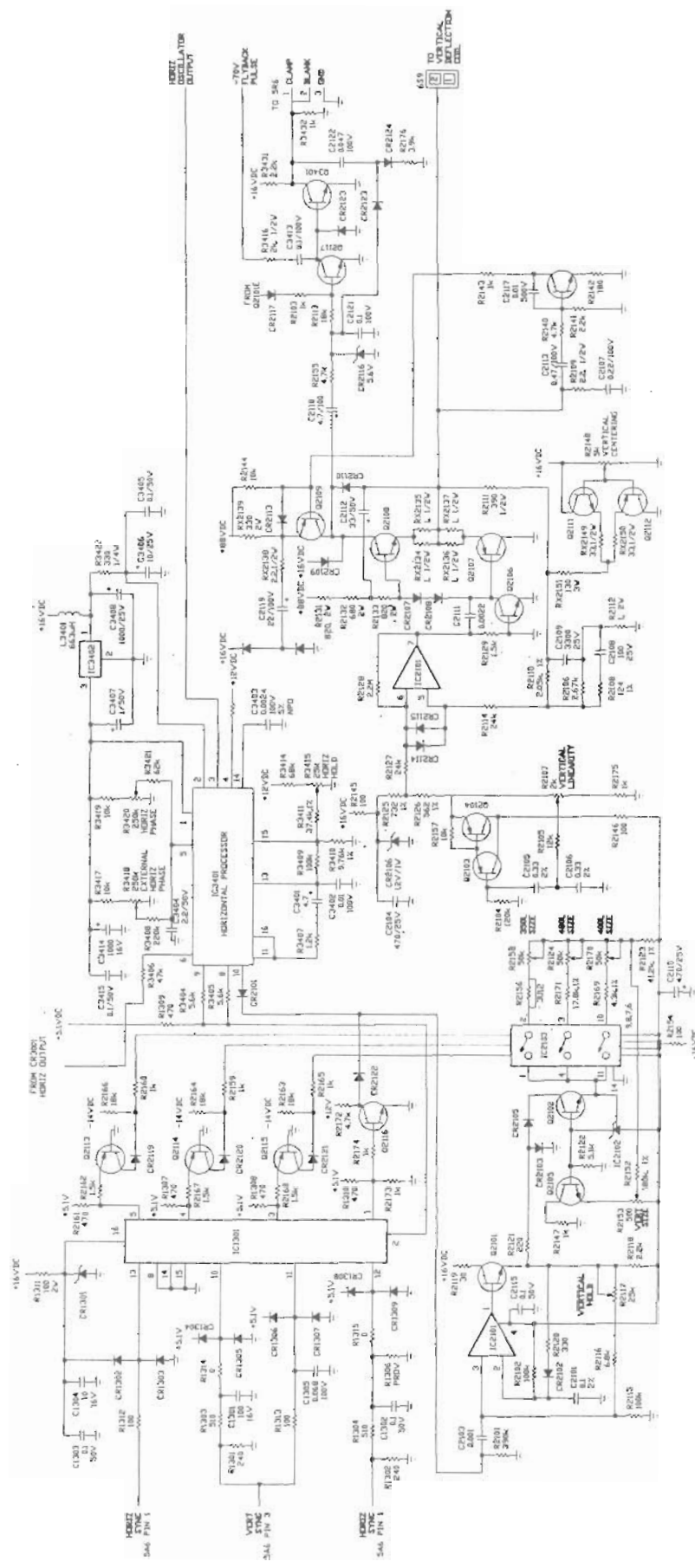


Figure 8-8. Vertical Deflection/Mode Selection Schematic



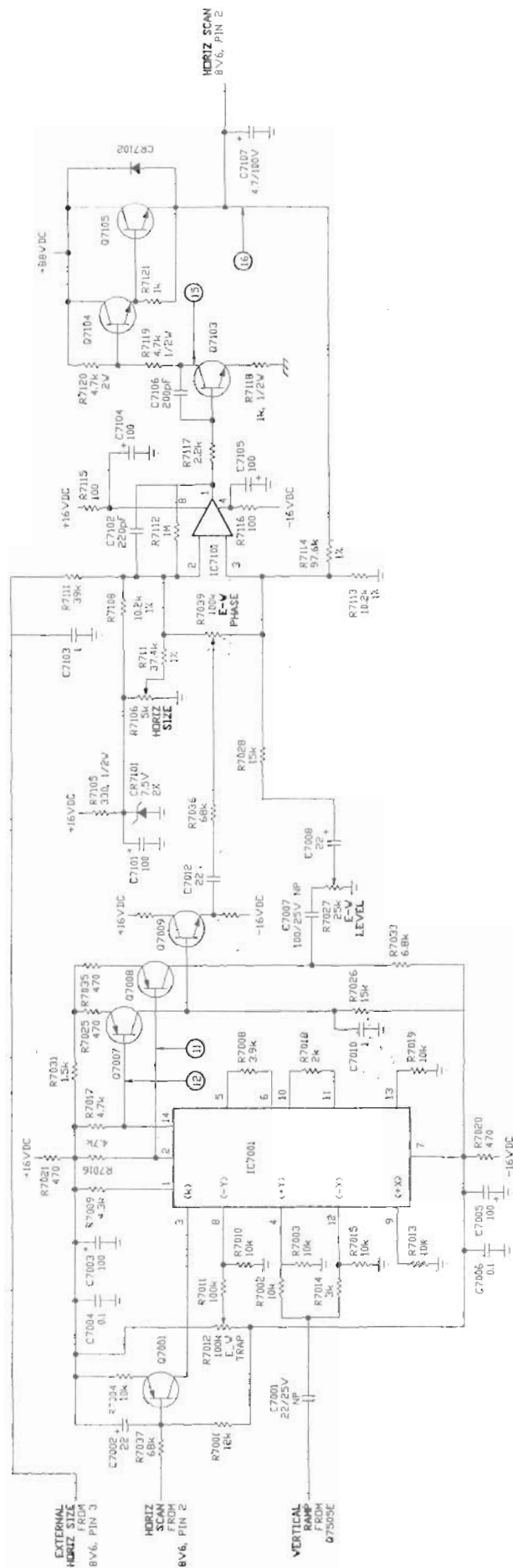


Figure 8-11. E-W Generator/Regulator Schematic

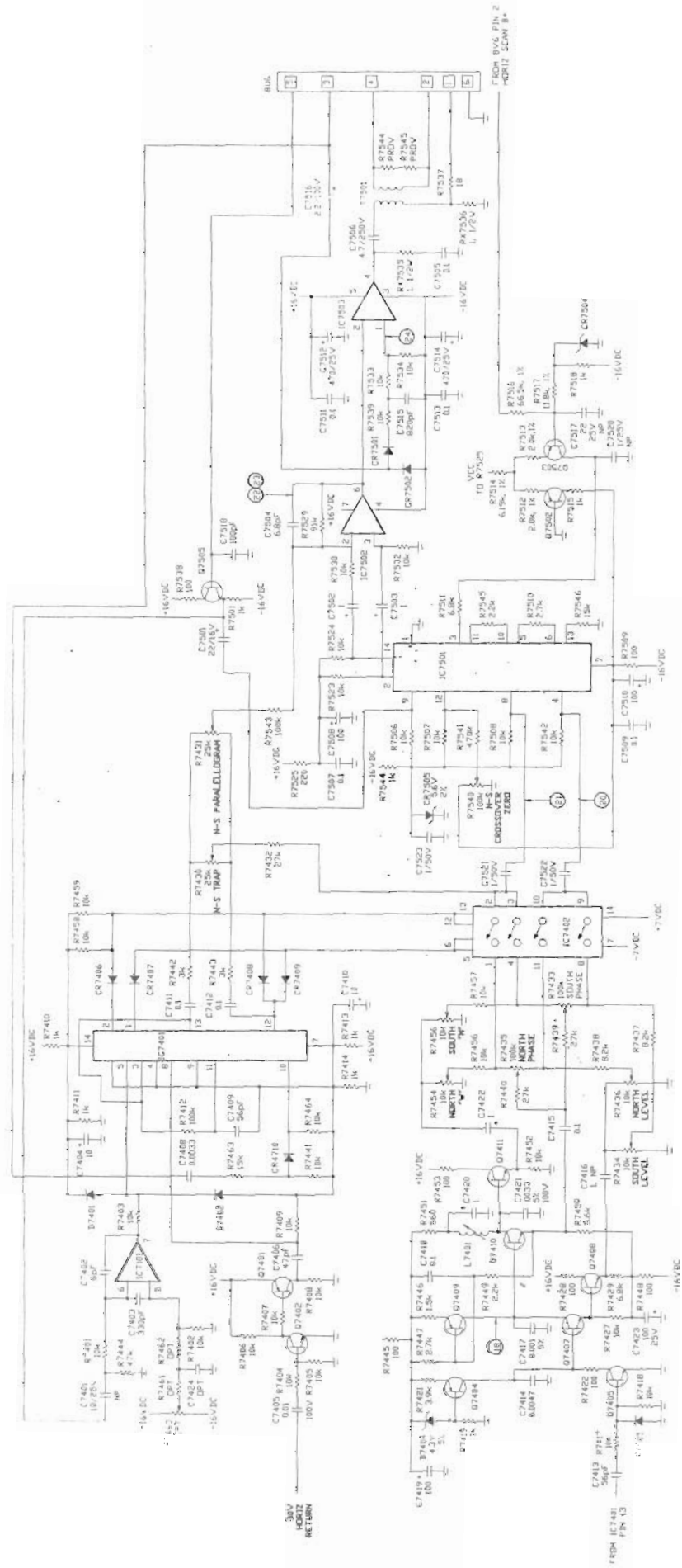


Figure 8-12. N-S Generator Output Schematic

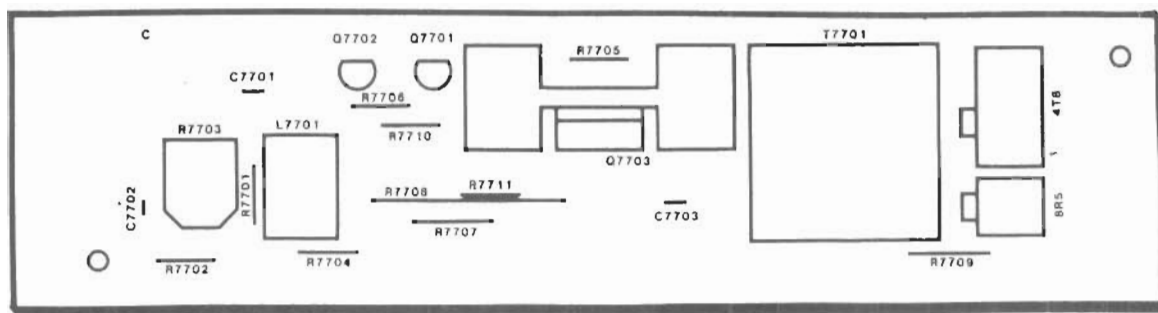


Figure 8-13. Dynamic Focus Board Component View

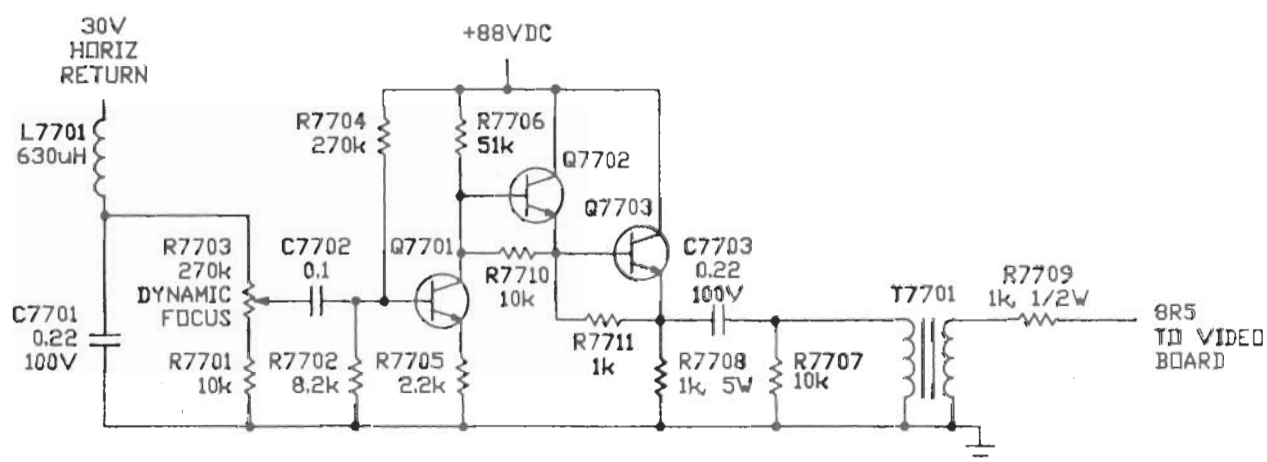


Figure 8-14. Dynamic Focus Schematic

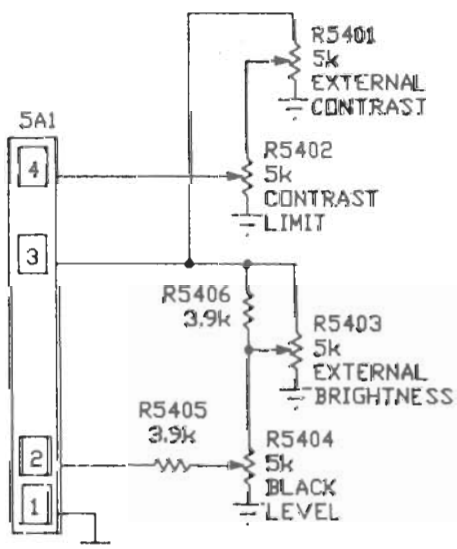


Figure 8-15. Control Board Schematic

