SERVICE MANUAL

Dual-Frequency Monochrome Video Monitor

ZMM-1470

ZENITH | data systems

NOTE: This preliminary manual is based upon preliminary engineering information. Your monitor may be slightly different from the one represented in this manual.

585-193 860-163

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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

Zenith Data Systems Corporation
St. Joseph, Michigan 49085

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Waveform Photograph Explanations

The waveforms in this manual are photographs taken on a DC-coupled Tektronix 2445, 4-channel, 150 MHz oscilloscope through a 10X probe with 10 MΩ impedance. The oscilloscope automatically compensates for the 10X probe, so the display in Figure A shows the probe input.

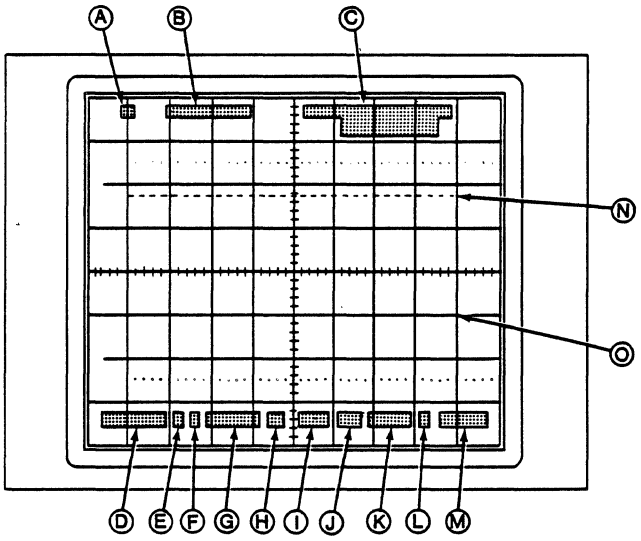

Figure A

OSCILLOSCOPE DISPLAY

A — The letter (A or B) is the oscilloscope trigger that is controlling the display. The trigger source is the second character (Channel 1, 2, 3, or 4).

B — The voltage level at which the scan is triggered, measured in volts (V) or millivolts (mV).

C — One of four possible values: sweep delay time, delta voltage, delta time, or inverse delta time (1/delta time). Delta values are established between the variable reference cursor (dotted line O) and the variable reference cursor (dashed line N). The symbol to the left of the value type indicates delta or delay, while the symbol to the right indicates unit of measurement, based upon either the sweep scale factor (See K and M) or the scale factor (See D, G, I, and J).

D — The channel 1 scale factor in volts (V) or millivolts (mV).

E — Indicates two signals summed together (+).

F — Indicates inverted display (down arrow).

G — The channel 2 scale factor in volts (V) or millivolts (mV).

H — Bandwidth limitation (20 MHz) indicator (BWL).

I — Channel 3 scale factor in volts (V) or millivolts (mV).

J — Channel 4 scale factor in volts (V) or millivolts (mV).

K — A sweep time base in seconds (s), milliseconds (ms), microseconds (μs), or nanoseconds (ns).

L — Holdoff indicator (HO). Holdoff is the amount of time between the end of the sweep and the time that a triggering signal can initiate the next sweep.

M — B-sweep time base in seconds (s), milliseconds (ms), microseconds (μs), or nanoseconds (ns).

N — Data cursor which may be varied either on the vertical axis (illustrated) to measure delta voltage or on the horizontal axis (not illustrated) to measure delta time.

O — Reference cursor which may be varied either on the vertical axis (illustrated) or on the horizontal axis (not illustrated). When in the vertical axis, this cursor indicates ground reference. A ground symbol will be shown on the photograph for exceptions.

YOUR WAVEFORM MAY LOOK DIFFERENT

Differences in oscilloscope probe ground lead length and ground lead positioning may explain why your waveform and the photographs in this manual look different.

Pickup of stray signals add to the test circuit signal, giving a distorted display and wrong peak-to-peak voltage. The stray signal is picked up in the ground lead of the oscilloscope probe. For the least pickup, keep the probe ground lead as short as possible and keep it away from strong magnetic fields.

Both photographs (Figures B and C) below show the same test circuit signal, under the same conditions except for ground lead length and positioning. The photograph taken with the short probe ground lead shows no distortion and correct peak-to-peak voltage. The photograph taken with the long probe ground lead shows distortion and an incorrect peak-to-peak voltage. (Pickup in this case is from the horizontal output transformer of a monochrome monitor).

Also, your waveforms can vary slightly from the photographs in this manual due to bandwidth, input impedance, and other oscilloscope differences, as well as the monitor being different.

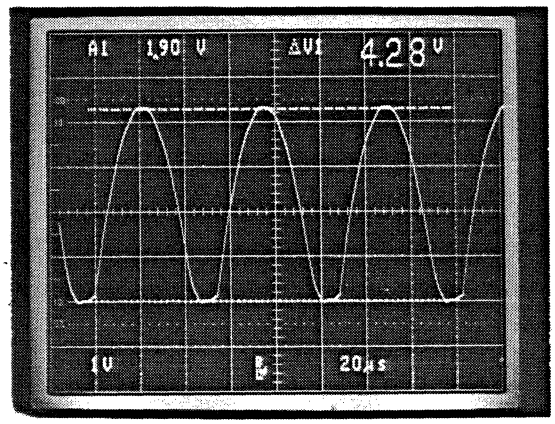

Figure B
Short Ground Lead

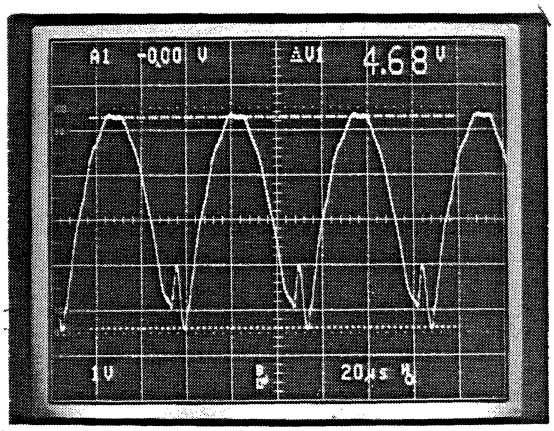

Figure C
Long Ground Lead

WARNINGS and CAUTIONS

IMPORTANT SAFETY NOTICE: 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.

In some instances, redundant circuitry is used for additional circuit protection and X-radiation protection. Special circuits are also used to prevent shock and fire hazard. **These special circuit components contain an X in their reference designator (CX501 is an example). They are to be replaced with identical components only.**

WARNING: No work should be attempted on any part of the chassis by anyone not familiar with Zenith service procedures and precautions. Otherwise, personal injury may result.

WARNING: External isolation transformers should always be used when test equipment is connected to the monitor. This is to reduce a lethal shock hazard, monitor damage, and test equipment damage that could result from the monitor and/or test equipment chassis being connected to different sides of the AC line.

WARNING: Do not operate a monitor with excessive high voltage because the monitor will produce X-rays from the CRT when the high voltage is excessive. Always verify that the high voltage is at the normal level when servicing the unit.

WARNING: Discharge the high voltage at the anode lead of the CRT before attempting service on the high voltage supply or associated circuits. Refer to the servicing section of this manual for detailed instructions.

WARNING: The CRT and the attached CRT board loses support once the back cover is removed. Use extra care when repositioning the monitor. Turn the power off and disconnect the power cord before attempting to reposition the monitor.

WARNING: Handle the cathode-ray tube carefully when you hold, remove, or install it; otherwise implosion and/or personal injury may result.

WARNING: To prevent electrical shock after reassembly, perform an AC leakage test on all exposed metal parts of the monitor. Do not use a line isolation transformer to perform this test.

Any leakage voltage measurement that exceeds 0.75 volts rms (0.5 milliamperes AC) constitutes a potential shock hazard and must be corrected. These voltage and current values are based upon the following test meter circuit (Figure 1) and the following test instructions.

1. Connect the test circuit as shown in Figure 1.
2. With monitor power turned on, measure the leakage voltage between earth ground and an exposed monitor metal part.
3. Repeat the measurement with the meter leads reversed.
4. Repeat steps 2 and 3 until all exposed monitor metal parts are verified to have satisfactory AC leakage levels.

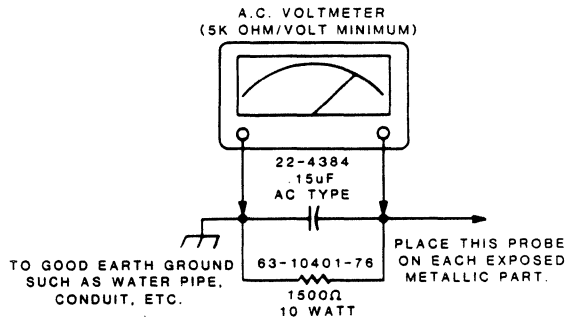

Figure 1
AC Leakage Voltmeter Circuit

WARNING: Unplug the monitor's power cable before cleaning; otherwise, electrical shock and/or personal injury may result.

WARNING: Removing or lifting the ground from the AC power source may present a lethal shock hazard.

CAUTION: The monitor must be located in an area that will provide proper ventilation. Inform the user that the air vents at the bottom, back, and top of the monitor must not be blocked.

CAUTION: Be sure the signal and power cables are unplugged from the computer or other signal and power sources before disassembling the monitor.

CAUTION: Some of the ICs (integrated circuits) used in this unit are electrostatic-sensitive devices. These devices can be damaged by static electricity. When handling any IC, be sure to equalize the static charge before touching the IC, by using a grounding strap.

Contents

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Chapter 1
Characteristics

The ZMM-1470 is a dual-frequency monochrome monitor with a green display.
The monitor has two different operating modes for the two horizontal sweep frequencies. The monitor automatically switches to the correct mode by sensing the frequency of the horizontal sync.

Mode 1 is used with computers such as the Z-100 PC and Z-200 PC series with color graphics capabilities. In mode 1, the computer supplies TTL level RGBI video, positive vertical sync, and a 15.75 kHz horizontal sync inputs.

Mode 2 is used with PC compatible computers that have extended graphics video cards. In this mode, the computer supplies TTL level RGBrgb video, negative vertical sync, and a 21.8 horizontal sync inputs.

The ZMM-1470 monitor can be operated with the following Video cards: Z-309, Z-319, Z-329, Z-409, Z-419, Z-439, Zenith-supplied Extended Graphics Cards, and PC-compatible Enhanced Graphics Adapter cards.

Specifications

CRT	14 inches diagonal, P-31 green, nonglare, dark tint.
Monochrome Capabilities	8-level or 16-level gray scale.
Characters	80 × 25 (8 × 8 or 9 × 14 character cell in mode 1 or 8 × 14 character cell mode 2).
Resolution	640 horizontal pixels × 200 or 350 scan lines in mode 1. 320 × 200, 640 × 200, 720 × 350 in mode 1. 640 horizontal pixels × 350 scan lines in mode 2.
Active Area (Nominal)	8.785 × 7.028 inches (11.25 inches diagonal minimum).
Vertical Refresh	60 Hz.
Dot Clock Rate	14 MHz in mode 1. 16.25 MHz in mode 2.
Horizontal Blanking	19 μS in mode 1. 6.5 μS in mode 2.

Vertical Blanking	2.4 – 4 mS in mode 1. 0.75 mS in mode 2.
Horizontal Scan Frequency	15.75 kHz in mode 1. 21.85 kHz in mode 2.
Vertical Scan Frequency	60 Hz.
Inputs	TTL level. RGBI, +H sync, +V sync in mode 1. RGBrgb, +H sync, –V sync in mode 2.
Connector	9-pin D type attached to the monitor.
Power Source	98 – 132/208 – 262 VAC, 48 – 62 Hz.
User Controls	On/Off, Contrast, Brightness.
Operating Environment	32° to 104°F (0° to 40°C)
Storage Environment	14° to 140°F (–10° to +60°C)
Relative Humidity	20 to 80% (noncondensing).
Size	10 × 11 × 12.5 inches (254 × 294 × 322 mm).
Shipping Weight	24 lbs (11.8 kg).

Controls Indicators and Cables

The following is a description of the controls, indicators and cables of the video monitor. Refer to Figure 1-1 for their location.

Power switch — This 2-position switch turns the monitor on and off.

Power indicator — Lights when power is supplied to the monitor and power switch is turned on.

Brightness (outer dial) — Adjusts the intensity of the entire display.

Contrast (inner dial) — Varies the difference between the non-intensified shades and the intensified shades.

Caution: Avoid setting the contrast and brightness controls for an excessively bright display. A bright, fixed pattern, if displayed for long periods of time, may permanently imprint the pattern on the CRT.

Size switch — Adjusts the width of the display. During mode 2 operation, it may be necessary to decrease the width of the display so that all of the displayed data can be seen. Figure 1-2 shows the location of the size switch.

Refer to Figure 1-3 for the location of the power cord and video cable connector.

Video input cable — Transmits the video signal from the computer to the monitor.

Power connector — Supplies AC power to the monitor.

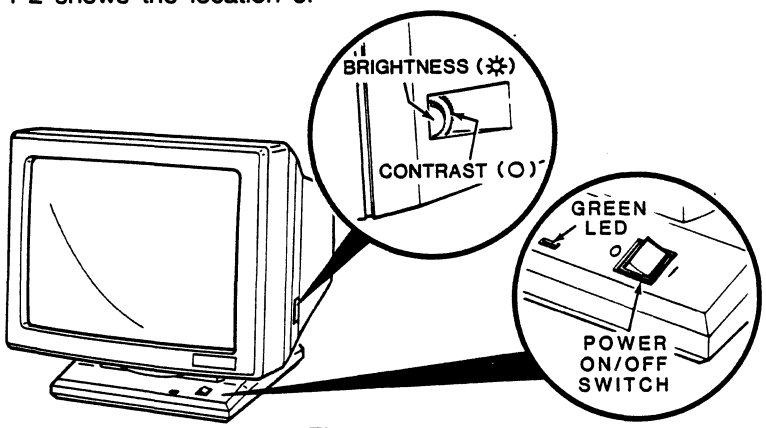

Figure 1-1
Control Locations

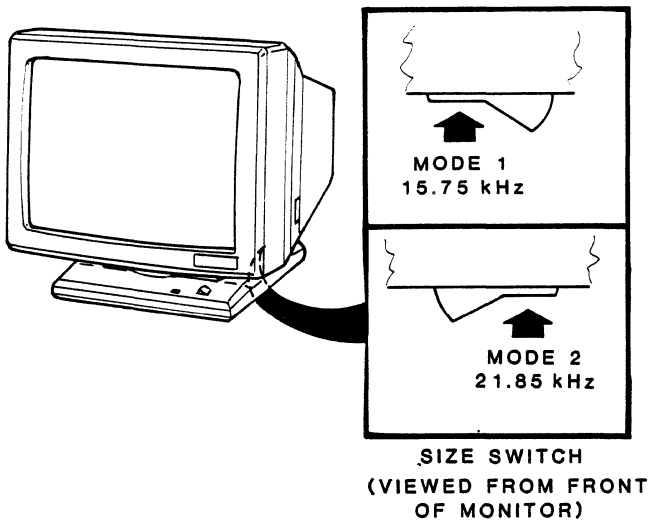

Figure 1-2
Size Switch

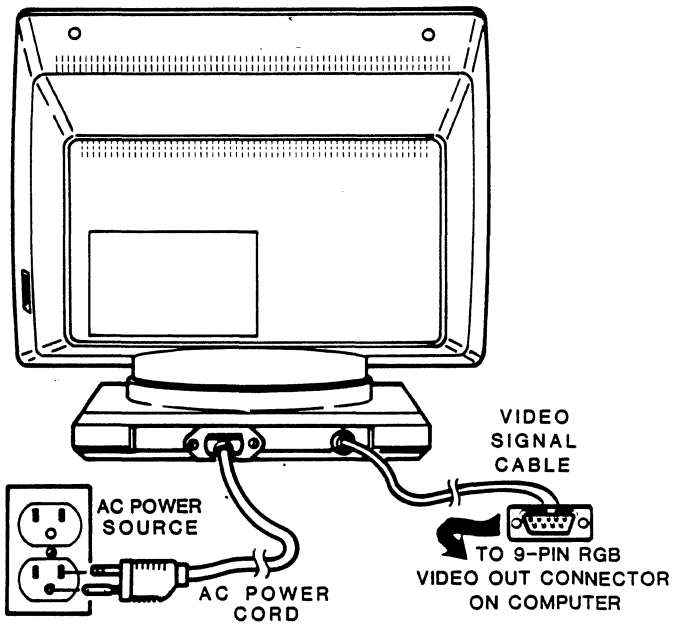

Figure 1-3
Power Cord and Cable Connectors

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Chapter 2
Installation

This chapter discusses basic installation of the monitor. It includes the setup procedure and performance test for the monitor.

1. Place the monitor on a horizontal surface that is near the computer and near AC power. The monitor must be located in an area that will provide proper ventilation and allow airflow through the unit. Verify that the vents on the top and bottom of the monitor are free from obstruction.

2. Connect the video monitor signal cable to the computer.

3. Connect the power cable to the monitor and then to the correct AC power source. Verify that the power source corresponds to the monitor's power requirements.

Warning: Removing or lifting the ground from the AC power source may present a lethal shock hazard.

4. Turn on the computer and the monitor. The power indicator on the front of the monitor should light.

5. Perform the color bar test or the fill screen test to adjust the brightness and contrast to the desired levels. If further adjustments are required, refer to Chapter 4, "Servicing."

NOTE: Changes in room lighting or repositioning the monitor screen may require resetting the brightness and contrast controls.

Color Bar Test

The color bar test displays an 8- or 16-level gray scale as a bar graph. If the monitor is to be used with a PC-compatible computer, display the PC color bar from the ROM. Display the color bar with a Z-100 PC series computer as follows:

1. Press the **CTRL, ALT,** and **INS** keys simultaneously to display the monitor prompt.

2. Enter **C** and press **RETURN** to call up the color bar display.

3. Proceed to the fill screen test.

NOTE: Not all video cards are capable of providing the RGBI video signals to the monitor. If the intensity bit is not used, only eight colors will be displayed.

The BASIC program in Listing 2-1 may also be used to generate a color bar pattern when used with a computer that has RGB color capabilities.

Listing 2-1
BASIC Color Bar Program

```
10 REM clear screen
20 CLS
30 REM produce color bar
40 LINE (0,0)-(79,106),0,BF
50 LINE (80,0)-(159,106),1,BF
60 LINE (160,0)-(239,106),4,BF
70 LINE (240,0)-(319,106),5,BF
80 LINE (320,0)-(399,106),2,BF
90 LINE (400,0)-(479,106),3,BF
100 LINE (480,0)-(599,106),6,BF
110 LINE (560,0)-(639,106),7,BF
120 REM label bars
130 LOCATE 13,5
140 PRINT TAB (5); "BLACK"; TAB (15);"BLUE"; TAB (25);"RED";
150 PRINT TAB (35);"MAGENTA"; TAB (45);"GREEN"; TAB (55);"CYAN";
160 PRINT TAB (65);"YELLOW";TAB (75);"WHITE
170 REM end of program
180 END
```

Fill Screen Test

The fill screen test will fill the screen with any character entered from the keyboard. If a Z-100 PC computer is being used, fill the screen as follows:

1. Press the **CTRL, ALT,** and **INS** keys simultaneously to display the monitor prompt.

2. Type **TEST** and press **RETURN** to enter the TEST menu.

3. Select the Keyboard Test by pressing the **2** key.

4. Choose any character to fill the screen by pressing the corresponding key. The capital Z is recommended.

5. Check to see if the screen is filled with the character and if the width and height of the display are correct. Refer to the specifications for dimensions.

6. After setting the desired controls, press the **DELETE** key to return to the test menu.

7. Press the **5** key to return to the monitor prompt.

The BASIC program shown in Listing 2-2 may also be used to fill the screen with any character as follows:

1. Prepare the computer for the BASIC program operation.

2. Enter the program shown in Listing 2-2.

3. Run the program by typing **RUN** and pressing the **RETURN** key. The screen will be filled with the letter Z or any other character inserted in line 20.

4. To end the program, press the CTRL and BREAK keys at the same time.

Listing 2-2
BASIC Program to Fill the Screen

```
10 FOR I = 1 TO 2000
20 PRINT "Z";
30 NEXT I
40 GO TO 40
50 END
```

Video Cable Interface

The video cable is fixed to the monitor on one end and supplied with a D-type 9-pin connector on the other. Figure 2-1 illustrates the connector and Table 2-1 list the connector signals.

Table 2-1
Video Connector Signals

PIN NO.	MODE 1	MODE 2
1	Ground.	Ground.
2	Ground.	R'.
3	R.	R.
4	G.	G.
5	B.	B.
6	Intensity.	G'.
7	Monochrome Video*	B'.
8	Horizontal Sync.	Horizontal Sync.
9	Vertical Sync.	Vertical Sync.

NOTE: Secondary red (R'), green (G'), and blue (B') signals are indicated by the lower case r, g, and b throughout this manual.

* Present, but not used in this monitor.

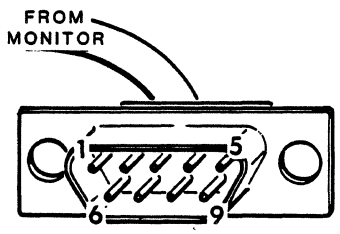

Figure 2-1
Video Cable Connector

Chapter 3
Circuit Descriptions

This chapter provides circuit descriptions of the major components of the monitor. A general theory of operation is provided as an introduction to each section. Refer to the block diagram in Figure 3-1 and the schematic in Chapter 4, while reading the following material.

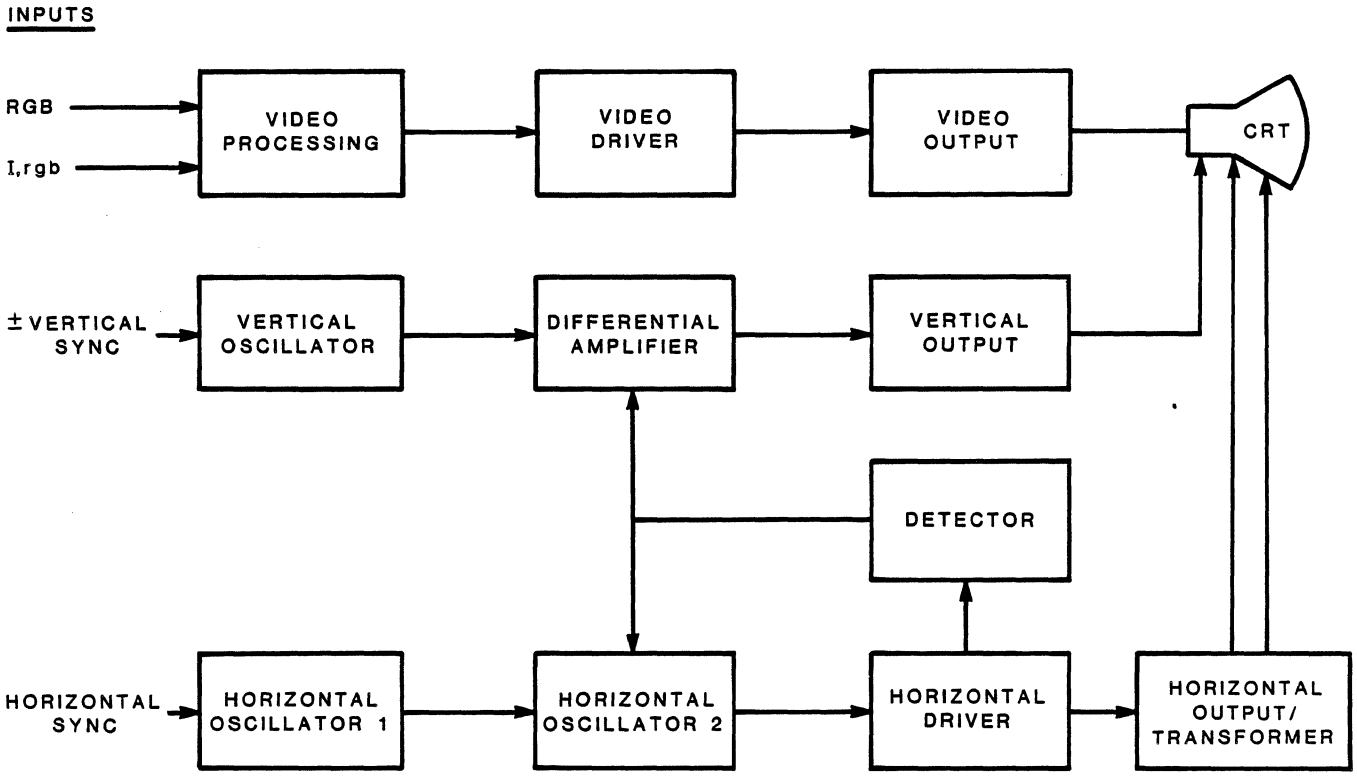

Figure 3-1
Block Diagram

Video Input Processing

The inputs are all TTL level, digital signals supplied by the computer. These signals are listed in Table 3-1.

Table 3-1
Input Signals

PIN	MODE 1	MODE 2
1	Shield Ground	Shield Ground
2	Signal Ground	R' – Secondary Red
3	R – Primary Red	R – Primary Red
4	G – Primary Green	G – Primary Green
5	B – Primary Blue	B – Primary Blue
6	Intensity	G' – Secondary Green
7	Monochrome Video*	B' – Secondary Blue
8	Horizontal Sync (15.75 kHz)	Horizontal Sync (21.85 kHz)
9	Vertical Sync	Vertical Sync

NOTE: Secondary red (R'), green (G'), and blue (B') signals are indicated by the lower case r, g, and b throughout this manual.

* Present, but not used by this monitor.

In mode 1, the RGB (red, green, and blue) signals contain the primary video information. These signals will produce an 8-level gray scale that will range from black to white. The I (intensity) bit will highlight the 8 RGB inputs to provide an additional 2 levels of gray for each RGB input. In this manner, as many as 16 levels of gray can be displayed.

In mode 2, the RGB inputs contain the primary video information but the highlighting information is contained in the secondary inputs r, g, and b. These three bits of data are ORed together to form the intensity bit. When any of the r, g, or b inputs are high, it will produce the same video level as if the I bit was high in mode 1. This process will provide a 16-level gray scale. The input signal combinations required to generate these video levels for both modes are listed in Table 3-2.

Table 3-2
Video Levels

VIDEO LEVEL	MODE 1 R G B I	MODE 2 R G B r g b
Black	0 0 0 0	0 0 0 0 0 0
Gray	0 0 0 1	0 0 0 0 0 1
		0 0 0 0 1 0
		0 0 0 0 1 1
		0 0 0 1 0 0
		0 0 0 1 0 1
		0 0 0 1 1 0
		0 0 0 1 1 1
Gray 1	0 0 1 0	0 0 1 0 0 0
Intense Gray 1	0 0 1 1	0 0 1 0 0 1
		0 0 1 0 1 0
		0 0 1 0 1 1
		0 0 1 1 0 0
		0 0 1 1 0 1
		0 0 1 1 1 0
		0 0 1 1 1 1
Gray 2	0 1 0 0	0 1 0 0 0 0
Intense Gray 2	0 1 0 1	0 1 0 0 0 1
		0 1 0 0 1 0
		0 1 0 0 1 1
		0 1 0 1 0 0
		0 1 0 1 0 1
		0 1 0 1 1 0
		0 1 0 1 1 1
Gray 3	0 1 1 0	0 1 1 0 0 0
Intense Gray 3	0 1 1 1	0 1 1 0 0 1
		0 1 1 0 1 0
		0 1 1 0 1 1
		0 1 1 1 0 0
		0 1 1 1 0 1
		0 1 1 1 1 0
		0 1 1 1 1 1
Gray 4	1 0 0 0	0 0 0 0.0 0
Intense Gray 4	1 0 0 1	0 0 0 0 0 1
		0 0 0 0 1 0
		0 0 0 0 1 1
		0 0 0 1 0 0
		0 0 0 1 0 1
		0 0 0 1 1 0
		0.0 0 1 1 1

Table 3-2 (Cont'd)
Video Levels

VIDEO LEVEL	MODE 1 R G B I	MODE 2 R G B r g b
Gray 5	1 0 1 0	1 0 1 0 0 0
Intense Gray 5	1 0 1 1	1 0 1 0 0 1
		1 0 1 0 1 0
		1 0 1 0 1 1
		1 0 1 1 0 0
		1 0 1 1 0 1
		1 0 1 1 1 0
		1 0 1 1 1 1
Gray 6	1 1 0 0	1 1 0 0 0 0
Intense Gray 6	1 1 0 1	1 1 0 0 0 1
		1 1 0 0 1 0
		1 1 0 0 1 1
		1 1 0 1 0 0
		1 1 0 1 0 1
		1 1 0 1 1 0
		1 1 0 1 1 1
White	1 1 1 0	1 1 1 0 0 0
Intense White	1 1 1 1	1 1 1 0 0 1
		1 1 1 0 1 0
		1 1 1 0 1 1
		1 1 1 1 0 0
		1 1 1 1 0 1
		1 1 1 1 1 0
		1 1 1 1 1 1

0 = No signal.
1 = Signal active.

The RGB signals enter the board at connector J201. The I, V sync, and H sync signals are also input through this connector.

The RGB signals go to IC101, a buffer/driver. Each signal passes through a current limiting resistor and is then tied together with the intensity bit. Notice that the R signal is passed through the least amount of resistance. This bit is considered to the be the MSB (most significant bit) and provides the most drive to produce the higher video levels. The I signal is also input to IC101 and the output is connected to the video signal. When I is high it will add to the drive of the video signal. The I signal is also applied to IC102, an inverter. The output is connected to the contrast control and then to the intensity signal. When I is high, the output of the inverter is low and the contrast control input is added to the intensity signal. When I is low, the output of the inverter is high, and the setting of the contrast control does not affect the video signal.

In mode 2, the r, g, and b signals are ORed together. This signal then performs the same as the I signal in mode 1.

Once the video information is decoded, the video signal is applied to the base of Q402, the video driver. This transistor controls the emitter bias of Q401, the video output. The video driver is also controlled by Q404 that provides the horizontal blanking pulses. Q404 can raise the emitter voltage of the video driver to prevent the video signals from being output to the video output transistor during horizontal retrace. The vertical blanking pulses are developed by Q308 and input to the video output transistor that will turn off the video output during vertical retrace. The output of Q401 drives the cathode of the CRT.

Spot Burn Protection

When the monitor is turned off, the filament of the CRT is still hot and capable of emitting electrons. With a high potential still on the face of the CRT, it is possible that a beam of electrons could be attracted to one particular area of the screen. If this occurs, the phosphor on the screen may be burned, leaving a spot that is visible at all times.

To prevent spot burn, capacitor C401 is charged while the monitor is turned on. When the monitor is turned off, Q401 is off, preventing C401 from discharging. This holds the cathode at a positive potential, attracting electrons from the filament.

Vertical Circuit

The vertical circuitry produces the vertical scan signal from the vertical sync input. The vertical scan signal controls the vertical motion of the beam in the CRT. The vertical scan frequency operates between 48 – 62 Hz.

In mode 1, the vertical sync pulse has a positive polarity; and in mode 2, it has a negative polarity. The signal is DC coupled to the first stage, the oscillators, by C301. The signal is then shaped by C302. This removes the DC components and shapes the waveform so that the polarity of the sync input does not affect the operation of the circuitry.

Transistors Q301 and Q302 form a free-running oscillator. The sync signal is input to the oscillator and locks the oscillator into the proper scan frequency. The oscillator output charges C303 to produce the sawtooth waveform. The DC bias point of the sawtooth waveform is determined by the voltage at C304. The amplitude and vertical size is determined by two different reference circuits depending on the mode of operation. In mode 1, R311, R312, R335, and R336 control the amplitude. In mode 2, R330 and R320 control the amplitude. A signal is generated from the detector circuitry and applied to Q312 that determines which circuitry is used. In mode 1, Q312 is on and shorts out R330 and R320. This leaves R311 and R312 as the reference. In mode 2, Q312 is off and R330 and 320 are connected in parallel with R311 and R312. The sawtooth waveform is then applied to Q303, the differential amplifier.

The differential amplifier is used for phase control and linear correction. It compares the sawtooth input with the waveform from the vertical yoke. C316, the yoke coupling capacitor, is used for s-shaping the waveform. This rounds off the peaks of the waveform to compensate for the round surface of the CRT. Other wave-shaping components include R317, R316, C307, and C309. This signal is summed with the yoke current sample from R331 and fed back to the differential amplifier.

The output of the differential amplifier controls the vertical driver. The vertical driver amplifies the sawtooth waveform and applies it to the two vertical output transistors, Q306 and Q307. The output transistors drives the vertical yoke, TX202 and the vertical retrace transistor, Q308.

Horizontal Scan

The computer supplies the monitor with two different horizontal sync frequencies depending on the mode of operation. Mode 1 is 15.75 kHz and mode 2 is 21.85 kHz. The horizontal sync pulse is a positive polarity and operates at TTL levels.

The sync pulse is used to trigger the first stage oscillator made up of transistors Q101 and Q104. These transistors are configured as a common collector multivibrator that will oscillate at the frequency of the incoming sync pulse. The output of this stage is taken from the collector of Q104 and is coupled to the second stage oscillator by C106. The second stage oscillator is also a common collector multivibrator made up of Q106 and Q107. The output of this stage is taken from the collector of Q107 and drives Q108, driver 1. Q108 inverts the signal and drives Q102, driver 2.

Horizontal Output

The signal from the horizontal output driver, Q102 is coupled to the base of Q103, the HOT (horizontal output transistor), through transformer TX101. Q103 controls the current in the primary winding of the horizontal output transformer, TX102, that switches scan current in the horizontal deflection yoke, TX202B, for right side scan. The current through the yoke establishes the magnetic field necessary to deflect the electron beam along a horizontal plane. CX118 and the yoke inductance provide a resonant retrace pulse that resets the beam to the left side of the screen. Diode CR104 provides the current for scan to the left side of the screen. The width coil, LX101, and linearity coil, LX102, place an inductive reactance in series with the deflection coil. This provides the correct horizontal size of raster on the screen. CX117 and associated components provide the S-shaping of the waveform to compensate for the curvature of the CRT.

Detector

The detector monitors the horizontal scan frequency to determine which mode the computer is operating in. The output then signals circuits in the monitor as to which mode is being used. The horizontal signal is sampled at the collector of the HOT and applied to the base of Q116. The emitter supplies the drive for the output of the detector circuit. This can be adjusted by R143.

Power Supply

The power supply provides regulated voltages used by the various circuits within the monitor. This is a self-regulating power supply that allows the monitor to operate between the ranges of 98-132 VAC and 208-262 VAC at 48-62 Hz.

WARNING: The power supply contains dangerous high voltages that may cause serious injury. This power supply is not considered user serviceable.

The power supply is also a proprietary item and should be returned to the manufacturer for service.

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Chapter 4
Servicing

The following service procedures provide information on how to adjust, align and troubleshoot the monitor. These procedures are intended to be used with the schematics, component views, and waveforms found at the end of this chapter. Review the following safety guidelines before beginning service, and perform the final checks at the end of this chapter after repairing the unit.

Safety Guidelines

WARNING: No work should be attempted on any part of the chassis by anyone not familiar with Zenith service procedures and precautions; otherwise personal injury may result.

WARNING: With monitor power turned off and disconnected, discharge the high voltage anode lead at the CRT using a jumper lead connected between the chassis and screwdriver as illustrated in Figure 6-1.

WARNING: Operation of the CRT at voltages higher than 28 KV may produce X-rays. Always verify that the voltage is at normal levels when servicing the monitor. Do not operate the monitor with excessive high voltage any longer than necessary to locate the cause of the excessive voltage.

WARNING: Carefully handle the CRT when holding, removing, or installing it; otherwise, implosion and/or personal injury may result.

CAUTION: Many integrated circuits are electrostatic-sensitive and can be damaged by static electricity if they are handled improperly. Once an IC or board is removed from its protective foam packing, envelope, or computer, do not lay the IC or board down or let go of it until it is installed in the unit. When bending the leads of an IC, hold the IC in one hand and place the other hand on the work surface before touching the IC to the work surface. This will equalize the static electricity between the work surface, you, and the IC.

WARNING: 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.

AC Leakage Test

To prevent electrical shock after reassembly, perform an AC leakage test on all exposed metal parts of the monitor. Do not use an isolation transformer to perform this test.

1. Connect the test circuit as shown in Figure 4-1.
2. With the monitor turned on, measure the leakage voltage between earth ground and an exposed monitor metal part.
3. Repeat the measurement with the meter leads reversed.
4. Repeat steps 2 and 3 until all exposed metal parts are verified to have satisfactory AC leakage levels.

WARNING: An isolation transformer must be used during troubleshooting to prevent personal injury and/or damage to the monitor or test equipment.

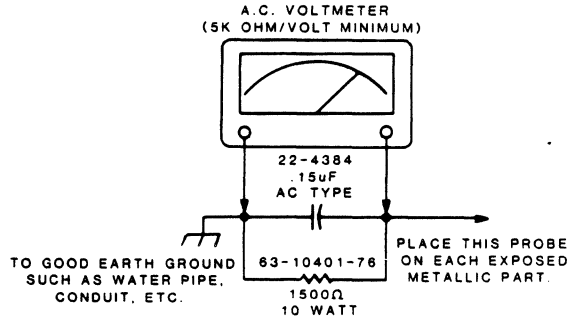


Figure 4-1
AC Leakage Voltmeter Circuit

Suggested Equipment and Supplies

TOOLS AND SUPPLIES

The following items are recommended to be at hand when servicing the monitor.

- 1/4-inch nut driver.
- Flat-blade screwdriver, 1/4-inch blade.
- Phillips screwdriver, No. 1 tip.
- Phillips screwdriver, No. 2 tip.
- Diagonal cutters.
- Wire strippers.
- Long-nose pliers.
- Desoldering tool.
- Soldering iron, 25 to 40 watts.
- Solder, 60/40, HE-490-185.
- Desoldering braid, HE-354-59.
- Lint-free cloths.
- Z-100 PC or equivalent.
- Diagnostic disk, CB-5063-28

TEST EQUIPMENT

The following items are recommended to troubleshoot the monitor to the board level. The test equipment specification should meet or exceed those listed after each item.

- Oscilloscope — DC to 100 MHz, dual trace triggered sweep. Tektronix Model 2235, or equivalent.
- Digital voltmeter — High impedance input, zero to 1000 volts, zero to 1 megohm. Heath Model SM-2215, or equivalent.
- Low capacitance oscilloscope probe — Input capacitance adjustable from 15 pF to 50 pF, 4 ns rise time. Heath Model PKW-105, or equivalent.
- High voltage probe — Zero to 40 kV. Heath Model IM-5215, or equivalent.
- Isolation transformer.

Inspection and Troubleshooting

Use the following procedures to determine possible external causes of monitor failure.

- Verify proper computer operation and compatibility.
- Check monitor controls for proper response and settings. Refer to the "Adjustments" section in this chapter if necessary.
- Check the signal and power cables for proper connection. Inspect these cables for burnt insulation, broken wires, or loose prongs on the plugs.
- Check the AC power source for proper operating voltage.
- Verify that the power supply selector switch is in the proper position.

If the previous inspection did not reveal the cause of monitor failure, refer to Table 4-1. This table will help to identify the problem area and suggest the most likely cause. A board or module will be recommended for further investigation. The checkout procedure for each board or module follows after Table 4-1.

Table 4-1
Fault Isolation

PROBLEM	POSSIBLE CAUSE	ITEM TO CHECK
Dead monitor, power LED is not lit.	No power.	Power source. Power cord. Power switch. Power supply. Fuse.
No raster, power LED is lit.	High-voltage or horizontal circuits.	High-voltage to anode. Main board. Power supply. CRT.
No display.	No video.	Computer output. Brightness or contrast. Video cable. CRT socket board.
No vertical deflection.	Vertical circuitry.	Main board. Deflection yoke.
Poor horizontal linearity.	Horizontal circuitry.	Horizontal linearity adjustment. Main board.
Narrow picture.	Horizontal circuitry.	Width adjustment. Main board.
Out of focus.	High-voltage circuitry.	Focus adjustment. CRT socket board. Main board.
Insufficient brightness.	Video circuitry.	Brightness or contrast. CRT socket board. Main board.

Checkout Procedure

The following procedure is in a question-and-answer form, with a yes or no answer derived from most steps.

When the answer to the question is a yes, the YES column will indicate which step to proceed to. If the answer is a no, the NO column will indicate which step to proceed to. See step 1 for an example.

When a dash (—) is listed in the column, the fault has been identified and/or corrected, or no action is required. In these cases the text will indicate which step to proceed to in order to retest the fault area. See step 1b for an example.

Step 1: Power Supply

STEP	PROCEDURE	YES	NO
1	Switch on the power switch. Does the power LED light?	2	1a
1a	Is the power cord plugged into a operating outlet?	1c	1b
1b	Switch off the power switch, plug the power cord into an operating outlet and return to step 1.	—	—
1c	Remove the rear cover. Switch the power switch on. Using a DVM, measure the output voltages at each pin of each connector of the power supply. Are there voltages present?	1f	1d
1d	Switch off the power switch, and disconnect the power cord from the power outlet. Remove the power supply and its cover. Locate fuse F3401. Is the fuse blown?	1e	1f
1e	Replace the fuse and return to step 1.	—	—
1f	Check to see if any output is shorted by using a DVM to measure the resistance of each of the loads of the power supply. Do any outputs read 0 ohms?	1g	
1g	Replace the power supply and return to step 1.	—	—

Step 2: CRT Socket Board

STEP	PROCEDURE	YES	NO
2	Switch the monitor on. Is a raster present?	2a	3
2a	Display a color bar pattern. Is the gray scale present?	3	2b
2b	Adjust the brightness and contrast controls. Is the gray scale present now?	3	2c
2c	Use an oscilloscope to check the video signals at the input connector. Compare the waveforms with the one shown in Figure 4-2. Are the waveforms correct?	2f	2d

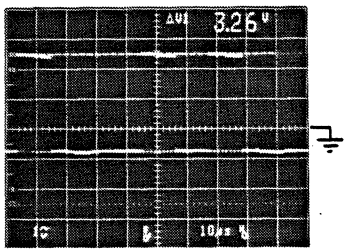
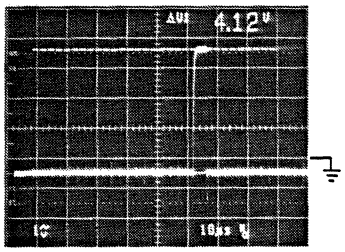


Figure 4-2
Video Input Signals

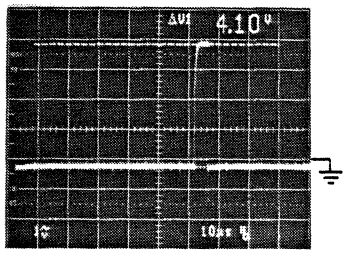
2d	Verify correct computer operation. Use a different source to generate the color bar pattern. Are the waveforms present now?	2	2e
2e	Replace the video signal cable and return to step 2.	—	—
2f	Replace the CRT socket board and return to step 2.	—	—

Step 3: Main Board

STEP	PROCEDURE	YES	NO
3	Use an oscilloscope to check the horizontal and vertical sync signals at the input connector. Compare these waveforms with the ones in Figure 4-3. Are these signals correct?	3c	3a



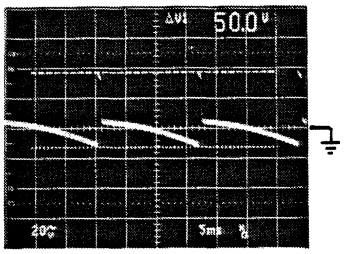
VERTICAL SYNC



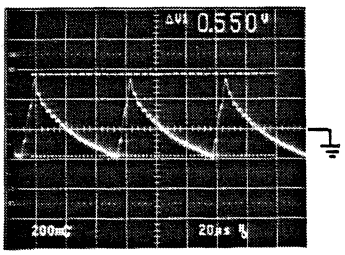
HORIZONTAL SYNC

Figure 4-3
Sync Inputs

STEP	PROCEDURE	YES	NO
3a	Verify correct computer operation. Use a different source to generate the sync signals. Are the waveforms present now?	3b	3c
3b	Replace the computer and return to step 2.	—	—
3c	Replace the video signal cable and return to step 2.	—	—
3d	Use an oscilloscope to check the sawtooth waveform to the vertical yoke. Compare this waveform with the one shown in Figure 4-4. Is this waveform correct?	3e	3g
3e	Use an oscilloscope to check the waveform at the horizontal yoke. Compare this waveform with the one shown in Figure 4-4. Is this waveform correct?	3f	3g



VERTICAL



HORIZONTAL

Figure 4-4
Yoke Waveforms

STEP	PROCEDURE	YES	NO
3f	Use a high-voltage probe to measure the voltage at the anode of the CRT. Does this voltage approximately equal 12.7 kV?	—	3g
3g	Replace the main board and return to step 4.	—	—

Adjustments

Instructions for setting the various monitor adjustments are contained in the following text. If necessary, convergence procedures are covered in the "CRT Maintenance Manual for Zenith Data Systems Monitors." This manual is available by ordering part number 860-168.

Setup

To prepare the monitor for adjustment, perform the following procedure.

1. Turn the monitor ON and allow it to warmup for 3 minutes.

2. Remove the rear cover to access the internal adjustments, if required.

3. Prepare the computer to run the disk-based diagnostics, as these will used for several adjustments.

4. Verify correct computer operation with a known good monitor.

Scan Regulator

1. Set the computer for mode 1 operation.
2. Using an oscilloscope, observe the output of point B at the junction of CR308, R177, and R138. Adjust the scan regulator until the output is low.
3. Set the computer for mode 2 operation.
4. Using an oscilloscope, observe the output of point B at the junction of CR308, R177, and R138. Adjust the scan regulator until the output is low.
5. Repeat the previous steps 1-4 until the proper output is obtained for each mode of operation.

Height

1. Set the computer for mode 1 operation.
2. Use the master height control (R312) to adjust the height of the raster.
3. Set the computer for mode 2 operation.
4. Use the high scan height control (R320) to realign the height of the raster.

Width and Centering

These controls should be adjusted under low-light conditions.

1. Set the computer for mode 1 operation.
2. Use the horizontal width control (LX101) to adjust the width of the raster and the master video centering control (R103) to shift the raster right or left. Adjust these two controls so that the raster is 1/4-inch from the left and 3/8-inch from the right CRT edges.
3. Set the computer for mode 2 operation.
4. Use the high scan video centering control (R155) to realign the raster to the right or left.

Linearity

This control adjusts the shape of the image displayed on the screen.

1. Boot the diagnostics disk in the computer. Select the video test patterns and then select the alignment grid.
2. Use the horizontal linearity control (LX102) to adjust the horizontal lines to a level position.

Focus

1. Boot the diagnostics disk in the computer. Select the video test patterns and then select the focus pattern.
2. Adjust the focus control (R148) for the clearest, sharpest display.

Final Checks

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

1. Perform the AC leakage test as described at the beginning of this chapter.
2. Make sure that all circuit boards and modules are properly installed.
3. Make sure that all connectors are securely installed and the 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 to see if the monitor is adjusted properly.
6. Leave the monitor turned on for an hour to check for thermal or intermittent problems.

Cleaning Procedure

WARNING: Be sure that the monitor's power cable is unplugged before cleaning.

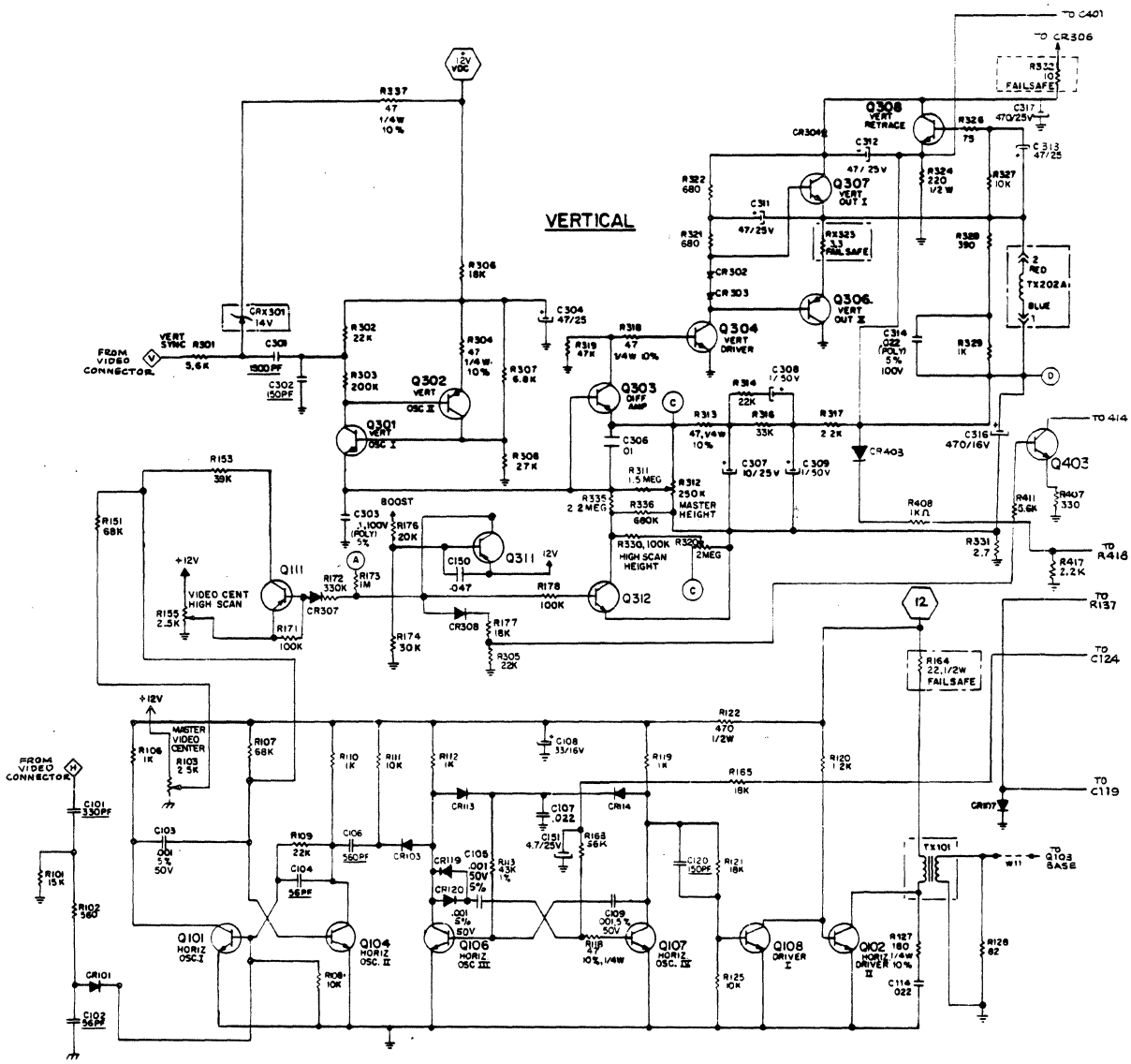
- Clean the cabinet with a lint-free cloth, lightly dampened with a mild cleaning solution. **Do not** spray liquids directly on the monitor or use a wet, saturated cloth.
- Clean the screen with a good quality glass cleaner.
- Be sure that the monitor is completely dry before applying electric power.

Servicing Diagrams

Schematic and component location drawings are provided in this section. The source location of waveforms referenced in the text are shown on both schematic and component location drawings.

A Z-150 PC computer was used to supply the RGB signals for generating the waveforms.

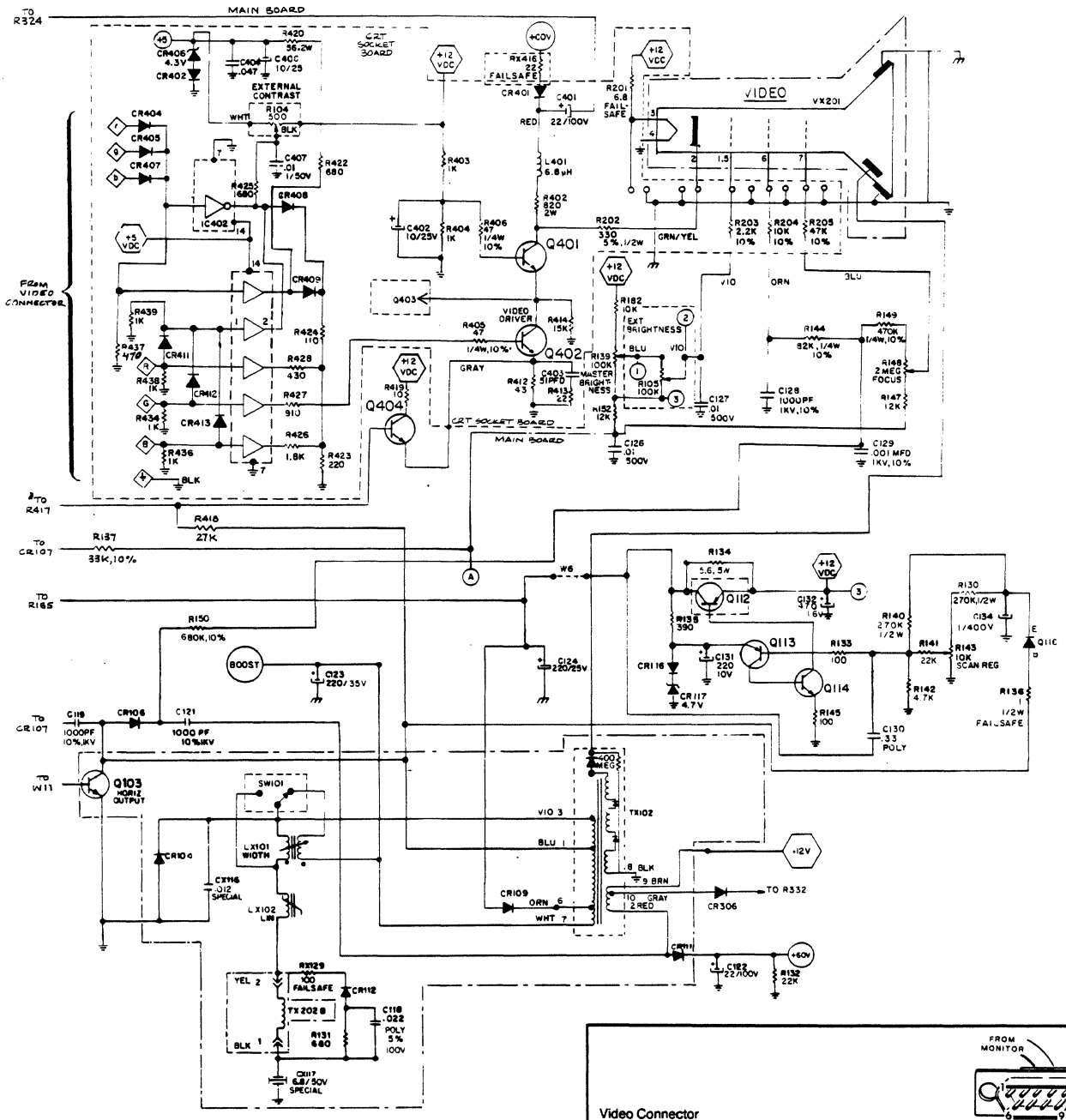
NOTE: Some input and output waveforms for some boards are taken from the adjacent boards because test points having the same signal are more accessible there.



INPUT		OUTPUT
98–132 VAC 48–62 Hz	MULTIMODE SWITCHMODE POWER SUPPLY ASSEMBLY	+12 VDC

NOTES:
- OBSERVE ALL WARNINGS ON THE SWITCHMODE POWER SUPPLY ASSEMBLY
- ADJUST TO +12 ±0.5 VDC

Figure 4-5 Part 1
Monitor Schematic



Video Connector			
Pin No.	SIGNAL NAME/FUNCTION 15.75kHz (Mode 1)	21.85 kHz (Mode 2)	Schematic Location
1	Shield Ground (GND)	Ground (GND)	
2	Unused/Reserved	Secondary Red (r)	
3	Primary Red (R)	Primary Red (R)	
4	Primary Green (G)	Primary Green (G)	
5	Primary Blue (B)	Primary Blue (B)	
6	Intensity (I)	Secondary Green	
7	Unused/Reserved	Secondary Blue	
8	Horizontal Sync (H Sync)	Horizontal Sync	
9	Vertical Sync (V Sync)	Vertical Sync	

Figure 4-5 Part 2
Monitor Schematic

PRELIMINARY COPY

Chapter 5
Disassembly/Reassembly

This section, along with Figure 6-1, provides instructions for both disassembling and reassembling the monitor. The step-by-step instructions are written for disassembly. For reassembly, perform the steps in the reverse order except when instructed otherwise. The number that is enclosed in parentheses, is the reference number from the parts list and exploded view in Chapter 6.

WARNING: Be sure the signal and power cables are unplugged from the computer or other signal or power sources before disassembling the monitor.

Normally, the disassembly sequence will be:

1. Remove the back cover (130).
2. Remove the CRT socket board (125).
3. Remove the main board (180).
4. Remove the power supply assembly (150).
5. Remove the cathode-ray tube (10).

Note: Some of the assemblies can be removed independently of the others, see each procedure.

Back Cover (130)

WARNING; The CRT and the attached CRT board lose support once the back cover (130) is removed, so be very careful if you reposition the monitor. Turn the power off and unplug the power cord before you reposition the monitor.

1. Switch off monitor power and unplug the power cord.
2. Disconnect the video cable connector from the computer.
3. Remove the two phillips head screws (135) that secure the back cover to the front of the monitor at the top corners.
4. Remove the two slotted screws (136) that secure the back cover at the bottom front corners of the monitor.
5. Carefully slide the back cover (130) from the monitor.

CRT Socket Board (125)

1. Remove the back cover (130).
2. Loosen the clamp that secures the CRT board (125) to the neck of the CRT (10).
3. Cut the cable ties (35) that secure the wires leading to the CRT board (125).
4. Use one hand to raise the neck of the CRT and carefully slide the CRT board to the rear until the CRT pins are disengaged and the clamp is free from the CRT.
5. Disconnect the 8-pin signal cable connector at the CRT socket board.
6. Disconnect the ground lead from the CRT ground contact.

   The CRT socket board can be inspected and repaired at this point. Wires have to be unsoldered in order to free the CRT socket board from the main board and from the brightness/contrast control.

Main Board (80)

1. Remove the back cover (130).
2. Discharge the high voltage, and disconnect the high voltage lead from the CRT.

WARNING: Discharge the high voltage at the anode lead of the CRT using a jumper lead connected between the chassis and a screwdriver. Otherwise, shock or injury may result. Refer to the inset of Figure 6-1.

3. Remove the CRT socket board.
4. Remove the main board guide from the back of the monitor by removing the 1/4-inch screw that secures it.

5. Reposition the main board to provide access to the connectors.

6. Remove the nut that secures the video cable shield to the main board.

7. Free the 2-wire power supply cable by sliding the separate connectors from the main board at the + 12VDC (red wire) and ground (blue wire) pins.

8. Disconnect the horizontal yoke cable connector (black and yellow wires).

9. Disconnect the vertical yoke cable connector (red and blue wires).

10. Disconnect the mid-air connector from the horizontal output transformer.

11. Remove the main board front bracket and the brightness/contrast control.

12. Record the color of the wires connected to the Size switch and then remove the wires by pulling the cable terminals from the switch pins.

NOTE: These wires must be installed in their original positions during reassembly.

The main board is free from the monitor and can be inspected and repaired. Wires have to be unsoldered in order to free the main board from the CRT socket board and from the brightness/contrast control.

Power Supply Assembly (150)

1. Remove the back cover (130).

2. Discharge the high voltage and disconnect the high voltage lead from the CRT.

WARNING: Discharge the high voltage at the anode lead of the CRT using a jumper lead connected between the chassis and a screwdriver. Otherwise, shock or injury may result. Refer to the inset of Figure 6-1.

3. Remove the CRT socket board.

4. Remove the horizontal transformer from the top of the power supply assembly by removing the two screws from the top of the transformer bracket.

5. Remove the screws that secure the cable clamp and ground wire at the top rear of the power supply assembly.

6. Pull the power cable female connectors (black wire and red wire) free from the main board.

7. Disconnect the two connectors at the rear of the power supply assembly.

8. Remove the power supply assembly from the monitor by removing the two screws that secure it to the cabinet bottom.

CRT (10)

1. Remove the rear cover (130).

2. Remove the CRT socket board (125).

3. Remove the main board.

4. Remove the power supply assembly.

5. Place the monitor face-down on a soft surface.

6. Discharge the high voltage, and disconnect the high voltage lead from the CRT.

WARNING: Discharge the high voltage at the anode lead of the CRT using a jumper lead connected between the chassis and a screwdriver. Otherwise, shock or injury may result. Refer to the inset of Figure 6-1.

7. Loosen the yoke clamp and remove the yoke (30) from the CRT (10).

8. Remove all the screws that secure the CRT (10) to the front panel (5) and lift out the CRT.

Chapter 6
Parts List

CAUTION: Some of the ICs (integrated circuits) used in this unit are electrostatic-sensitive devices. When handling any IC, use a wrist ground strap or be sure to equalize the static charge before touching the IC.

IMPORTANT SAFETY NOTICE: Under no circumstances should the original design be modified or altered without permission from Zenith Electronics Corporation. Replace all components only with types identical to those in the original circuit. Also, their physical location, wiring, and lead dress must conform to the original layout when you complete repairs.

In some instances, redundant circuitry is used for additional circuit protection and X-radiation protection. Special circuits are also used to prevent shock and fire hazard. **These special circuit components, that contain X in their reference designator, are to be replaced with identical components only.**

NOTE: Unless otherwise specified, all resistors are 1/4-watt, 5% tolerance.

In the following parts lists, N/A refers to "not assigned" parts for which there is no replacement part number assigned or no reference part illustrated.

Table 6-1
Major Assemblies

REFERENCE DESCRIPTION	ZDS PART NUMBER	DESCRIPTION
5	14-11701-05	Cabinet front (plastic)
6	14-11601-10	Cabinet bottom (plastic)
7	N/A	Base pan and cover assembly
10	100-00727-42E	CRT, 14 inch
11	19-01080-04	Clamp, CRT retaining
N/A	19-01090	Clip, CRT top
N/A	19-01090-01	Clip, CRT top
20	127-00277	Ground contact
30	A-08337	Deflection yoke assembly
45	46-10421	Knob, contrast control
46	46-10422	Knob, brightness control
50	149-00464	Magnet, CRT correction
51	149-00464-01	Magnet, CRT correction
80	N/A	Main board assembly
100	11-00357	Line cord, 3-conductor
101	50-00681-04	Video input cable
102	136-00135-10	Fuse (FX501) 1A, 250V, Time Delay
103	95-03877	Sweep transformer, Final Display
104	63-11014-01	Control, dual rotary
125	N/A	CRT socket board
130	14-11604-08	Cabinet rear
135	112-02247-01	Screws for cabinet rear (top)
136	112-02289-08	Screws for cabinet rear (bottom)
150	N/A	Power supply assembly

Table 6-2
Main Board

REFERENCE DESCRIPTION	ZDS PART NUMBER	DESCRIPTION
Capacitors		
C101	22-07742-04	330 pF, ceramic tubular
C102	22-07743-30	56 pF, ceramic tubular
C103	22-07759-02	1000 pF, ceramic disc
C104	22-07743-30	56 pF, ceramic tubular
C105	22-07759-02	1000 pF, ceramic chip
C106	22-07742-07	560 pF, ceramic tubular
C107	22-07615-08	0.022 µF, ceramic disc
C108	22-07859-07	33 µF, electrolytic
C109	22-07759-02	1000 pF, ceramic chip
C114	22-07615-08	0.022 µF, ceramic disc
CX116	22-07798-03	0.018 µF, polyester
CX117	22-07892-04	6.8 µF, electrolytic nonpolarized
C118	22-07773-16	0.022 µF, polyester
C119	22-07811	1000 pF, ceramic disc
C120	22-07742	150 pF, ceramic tubular
C121	22-07811	1000 pF, ceramic disc
C122	22-07864-06	22 µF, electrolytic
C124	22-07860-10	220 µF, electrolytic
C126	22-04905-01	0.01 µF, ceramic disc
C127	22-04905-01	0.01 µF, ceramic disc
C128	22-07811	1000 pF, ceramic disc
C129	22-07811	1000 pF, ceramic disc
C131	22-07858-10	220 µF, electrolytic
C132	22-07859-12	470 µF, electrolytic
C133	22-07859-09	100 µF, electrolytic

Table 6-2 (Cont'd)
Main Board

REFERENCE DESCRIPTION	ZDS PART NUMBER	DESCRIPTION
Capacitors (Cont'd)		
C134	22-07966-05	1 μF, electrolytic
C150	22-07615-10	0.047 μF, ceramic disc
C151	22-07860-04	4.7 μF, electrolytic
C301	22-07742-12	1500 pF, ceramic tubular
C302	22-07742	150 pF, ceramic tubular
C303	22-08004-02	0.1 μF, polyester
C304	22-07860-08	47 μF, electrolytic
C306	22-07614-24	10000 pF, ceramic disc
C307	22-07860-05	10 μF, electrolytic
C308	22-07862-01	1 μF, electrolytic
C309	22-07862-01	1 μF, electrolytic
C311	22-07860-08	47 μF, electrolytic
C312	22-07860-08	47 μF, electrolytic
C313	22-07860-08	47 μF, electrolytic
C314	22-07773-16	0.022 μF, polyester
C316	22-07859-12	470 μF, electrolytic
C317	22-07860-12	470 μF, electrolytic
Diodes		
CR101	103-00142-01	Low voltage general
CR103	103-00142-01	Low voltage general
CR104	103-00339-06	Low voltage general
CR106	103-00323-04	Low voltage general
CR107	103-00295-03	Low voltage general
CR109	103-00339-06	Low voltage general
CR111	103-00323-04	Low voltage general
CR112	103-00323-04	Low voltage general
CR113	103-00142-01	Low voltage general
CR114	103-00142-01	Low voltage general
CR116	103-00142-01	Low voltage general
CR117	103-00279-09	Zener, 4.7 V, 1/2-watt
CR301	103-00279-23	Zener, 14.0 V, 1/2-watt
CR302	103-00142-01	Low voltage general
CR303	103-00142-01	Low voltage general
CR304	103-00254-01	Low voltage general
CR306	103-00323-04	Low voltage general
CR307	103-00142-01	Low voltage general
CR308	103-00142-01	Low voltage general

Table 6-2 (Cont'd)
Main Board

REFERENCE DESCRIPTION	ZDS PART NUMBER	DESCRIPTION
Inductors		
LX101	95-03627	Width control coil
LX102	20-03906	Horizontal Linearity Control coil
Transistors		
Q101	121-00975	NPN transistor
Q102	121-01040	NPN transistor
Q103	121-01070-01	NPN H.O.T. transistor
N/A	126-01844-04	Heat sink for Q103
N/A	19-00984	Clamp for Q103
N/A	114-01409-06	Screw for Q103
Q104	121-00975	NPN transistor
Q106	121-00975	NPN transistor
Q107	121-00975	NPN transistor
Q108	121-01093	NPN transistor
Q111	121-00699	PNP transistor
Q112	121-00994	PNP transistor
N/A	126-02210	Heat sink for Q112
N/A	19-00984	Clamp for Q112
N/A	114-00803-08	Screw for Q112
Q113	121-00699	PNP transistor
Q114	121-00975	NPN transistor
Q116	121-00975	NPN transistor
Q301	121-00975	NPN transistor
Q302	121-00699	PNP transistor
Q303	121-00699	PNP transistor
Q304	121-01040	NPN transistor
Q306	121-01036	PNP transistor
Q307	121-01035	NPN transistor
Q308	121-01040	NPN transistor
Q311	121-00699	PNP transistor
Q312	121-00975	NPN transistor
Q403	121-00699	PNP transistor
Q404	121-00975	NPN transistor

Table 6-2 (Cont'd)
Main Board

REFERENCE DESCRIPTION	ZDS PART NUMBER	DESCRIPTION
Resistors		
R101	63-10236	15 kΩ, 1/4-watt, 5%
R102	63-10235-66	560 Ω, 1/4-watt, 5%
R103 and R155	63-09228-11	Rotary control (Video center/high)
R106	63-10235-72	1 kΩ, 1/4-watt, 5%
R107	63-10236-16	68 kΩ, 1/4-watt, 5%
R108	63-10235-96	10 kΩ, 1/4-watt, 5%
R110	63-10235-72	1 kΩ, 1/4-watt, 5%
R111	63-10235-96	10 kΩ, 1/4-watt, 5%
R112	63-10235-72	1 kΩ, 1/4-watt, 5%
RX113	63-10938-71	43 kΩ, 1/4-watt, 1%
R118	63-10183-40	47 Ω, 1/4-watt, 10%
R119	63-10235-72	1 kΩ, 1/4-watt, 5%
R120	63-10235-74	1.2 kΩ, 1/4-watt, 5%
R121	63-10236-02	18 kΩ, 1/4-watt, 5%
R122	63-10243-64	470 Ω, 1/2-watt, 5%
R125	63-10235-96	10 kΩ, 1/4-watt, 5%
R127	63-10183-54	180 Ω, 1/4-watt, 10%
R128	63-10235-46	82 Ω, 1/4-watt, 5%
RX129	63-10559-48	100 Ω, 1/4-watt, 5%
R130	63-10244-30	270 kΩ, 1/2-watt, 5%
R131	63-10235-68	680 Ω, 1/4-watt, 5%
R132	63-10236-04	22 kΩ, 1/4-watt, 5%
R133	63-10235-48	100 Ω, 1/4-watt, 5%
R134	63-10442-42	5.6 Ω, 5-watt, 5%
N/A	19-00889-01	Clip for R134
R135	63-10235-62	390 Ω, 1/4-watt, 5%
R136	63-10236-03	20 kΩ, 1/4-watt, 5%
R137	63-10184-16	68 kΩ, 1/4-watt, 10%
R139	63-09228-13	100 kΩ, Control (master brightness)
R140	63-10244-30	270 kΩ, 1/2-watt, 5%
R141	63-10236-04	22 kΩ, 1/4-watt, 5%
R142	63-10236-04	22 kΩ, 1/4-watt, 5%
R143	63-09228-12	10 kΩ, Control (scan regulator)
R144	22-10184-18	82 kΩ, 1/4-watt, 10%
R145	63-10235-48	100 Ω, 1/4-watt, 5%
R147	63-10235-98	12 kΩ, 1/4-watt, 5%
R148	63-09228-15	2 mΩ, Control (focus)
R149	63-10184-36	470 kΩ, 1/4-watt, 10%

Table 6-2 (Cont'd)
Main Board

REFERENCE DESCRIPTION	ZDS PART NUMBER	DESCRIPTION
Resistors (Cont'd)		
R150	63-10184-40	680 kΩ, 1/4-watt, 10%
R151	63-10236-16	68 kΩ, 1/4-watt, 5%
R152	63-10235-98	12 kΩ, 1/4-watt, 5%
R153	63-10236-10	39 kΩ, 1/4-watt, 5%
R155	(See R103 and R155)	
R163	63-10236-16	68 kΩ, 1/4-watt, 5%
R164	63-10565-32	22 Ω, 1/2-watt, 5%
R171	63-10236-20	100 kΩ, 1/4-watt, 5%
R172	63-10236-32	330 kΩ, 1/4-watt, 5%
R173	63-10236-44	1 mΩ, 1/4-watt, 5%
R174	63-10236-07	30 kΩ, 1/4-watt, 5%
R176	63-10236-03	20 kΩ, 1/4-watt, 5%
R177	63-10236-02	18 kΩ, 1/4-watt, 5%
R178	63-10236-20	100 kΩ, 1/4-watt, 5%
R182	63-10235-96	10 kΩ, 1/4-watt, 5%
R301	63-10235-90	5.6 kΩ, 1/4-watt, 5%
R302	63-10236-04	22 kΩ, 1/4-watt, 5%
R303	63-10236-27	200 kΩ, 1/4-watt, 5%
R304	63-10183-40	47 Ω, 1/4-watt, 10%
R305	63-10236-04	22 kΩ, 1/4-watt, 5%
R306	63-10236-02	18 kΩ, 1/4-watt, 5%
R307	63-10235-92	6.8 kΩ, 1/4-watt, 5%
R308	63-10236-06	27 kΩ, 1/4-watt, 5%
R311	63-10236-48	1.5 mΩ, 1/4-watt, 5%
R312	63-09228-16	250 kΩ, Control (master height)
R313	63-10183-40	47 Ω, 1/4-watt, 10%
R314	63-10236-04	22 kΩ, 1/4-watt, 5%
R316	63-10236-08	33 kΩ, 1/4-watt, 5%
R317	63-10235-80	2.2 kΩ, 1/4-watt, 5%
R318	63-10183-40	47 Ω, 1/4-watt, 10%
R319	63-10236-12	47 kΩ, 1/4-watt, 5%
R320	63-09228-15	2 mΩ, Control (High scan)
R321	63-10235-68	680 Ω, 1/4-watt, 5%
R322	63-10235-68	680 Ω, 1/4-watt, 5%
RX323	63-10559-12	3.3 Ω, 1/4-watt, 5%

Table 6-2 (Cont'd)
Main Board

REFERENCE DESCRIPTION	ZDS PART NUMBER	DESCRIPTION
Resistors (Cont'd)		
R324	63-10243-56	220 Ω, 1/2-watt, 5%
R326	63-10235-45	75 Ω, 1/4-watt, 5%
R327	63-10235-96	10 kΩ, 1/4-watt, 5%
R328	63-10235-62	390 Ω, 1/4-watt, 5%
R329	63-10235-72	1 kΩ, 1/4-watt, 5%
R331	63-10235-10	2.7Ω, 1/4-watt, 5%
RX332	63-10559-24	10 Ω, 1/4-watt, 5%
R335	63-10236-52	2.2 mΩ, 1/4-watt, 5%
R336	63-10236-40	680 kΩ, 1/4-watt, 5%
R407	63-10235-60	330 Ω, 1/4-watt, 5%
R411	63-10235-90	5.6 kΩ, 1/4-watt, 5%
RX416	63-10559-32	22 Ω, 1/4-watt, 5%
R417	63-10235-68	680 Ω, 1/4-watt, 5%
R418	63-10236-10	39 kΩ, 1/4-watt, 5%
R419	63-10235-40	47 Ω, 1/4-watt, 5%
Transformers		
TX101	95-03136	Transformer (Horizontal driver)

Table 6-3
CRT Board

REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
Capacitors		
C401	22-07864-06	22 µF, electrolytic
C402	22-07860-05	10 µF, electrolytic
C403	22-07743-29	51 pF, ceramic tubular
C404	22-07615-10	47000 pF, ceramic disc
C406	22-07860-05	10 µF, electrolytic
C407	22-07613-24	10000 pF, ceramic disc

Table 6-3 (Cont'd)
CRT Board

REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
Diodes		
CR401	103-00254-01	Low voltage general
CR402	103-00142-01	Low voltage general
CR403	103-00142-01	Low voltage general
CR404	103-00142-01	Low voltage general
CR405	103-00142-01	Low voltage general
CR406	103-00279-08	Zener, 4.3 V, 1/2-watt
CR407	103-00142-01	Low voltage general
CR409	103-00142-01	Low voltage general
CR411	103-00142-01	Low voltage general
CR412	103-00142-01	Low voltage general
CR413	103-00142-01	Low voltage general
Integrated Circuits		
IC401	221-00274	Hex buffer/drivers
IC402	221-00274-01	Hex buffer/driver, w/oc HV output
Transistors		
Q401	121-01088	NPN transistor
Q402	121-00895	NPN transistor
Inductors		
L401	20-03907-10	Coil, 6.8 µH
Resistors		
R201	63-10559-20	6.8 Ω, 1/4-watt, 5%
R202	63-07763	3.30 Ω, 1/2-watt, 5%
R203	63-07799	2.2 kΩ, 1/2-watt, 10%
R204	63-07827	10 kΩ, 1/2-watt, 10%
R205	63-07855	47 kΩ, 1/2-watt, 10%

Table 6-3 (Cont'd)
CRT Board

REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
Resistors (Cont'd)		
R402	63-10836-70	820 Ω, 2-watt, 5%
R403	63-10235-72	1 kΩ, 1/4-watt, 5%
R404	63-10235-72	1 kΩ, 1/4-watt, 5%
R405	63-10183-40	47 Ω, 1/4-watt, 10%
R406	63-10183-40	47 Ω, 1/4-watt, 10%
R412	63-10235-39	43 Ω, 1/4-watt, 5%
R413	63-10235-32	22 Ω, 1/4-watt, 5%
R414	63-10236	15 kΩ, 1/4-watt, 5%
R420	63-10836-42	56 Ω, 2-watt, 5%
R422	63-10235-68	680 Ω, 1/4-watt, 5%
R423	63-10235-56	220 Ω, 1/4-watt, 5%
R424	63-10235-49	110 Ω, 1/4-watt, 5%
R425	63-10235-68	680 Ω, 1/4-watt, 5%
R426	63-10235-78	1.8 kΩ, 1/4-watt, 5%
R427	63-10235-71	910 Ω, 1/4-watt, 5%
R428	63-10235-63	430 Ω, 1/4-watt, 5%
R434	63-10235-72	1 kΩ, 1/4-watt, 5%
R436	63-10235-72	1 kΩ, 1/4-watt, 5%
R437	63-10235-72	1 kΩ, 1/4-watt, 5%
R438	63-10235-72	1 kΩ, 1/4-watt, 5%
R439	63-10235-72	1 kΩ, 1/4-watt, 5%
Miscellaneous		
N/A	A-13287	Clamp assembly (deflection yoke)
J401	78-03233	CRT socket

Table 6-4
Base Pan and Cover Assembly

REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
CRX505	103-00385-04	Power indicating LED, green
SW501	85-01687	AC rocker switch
N/A	58-00411-01	AC plug, 3 pin
N/A	50-00681-04	Video input cable

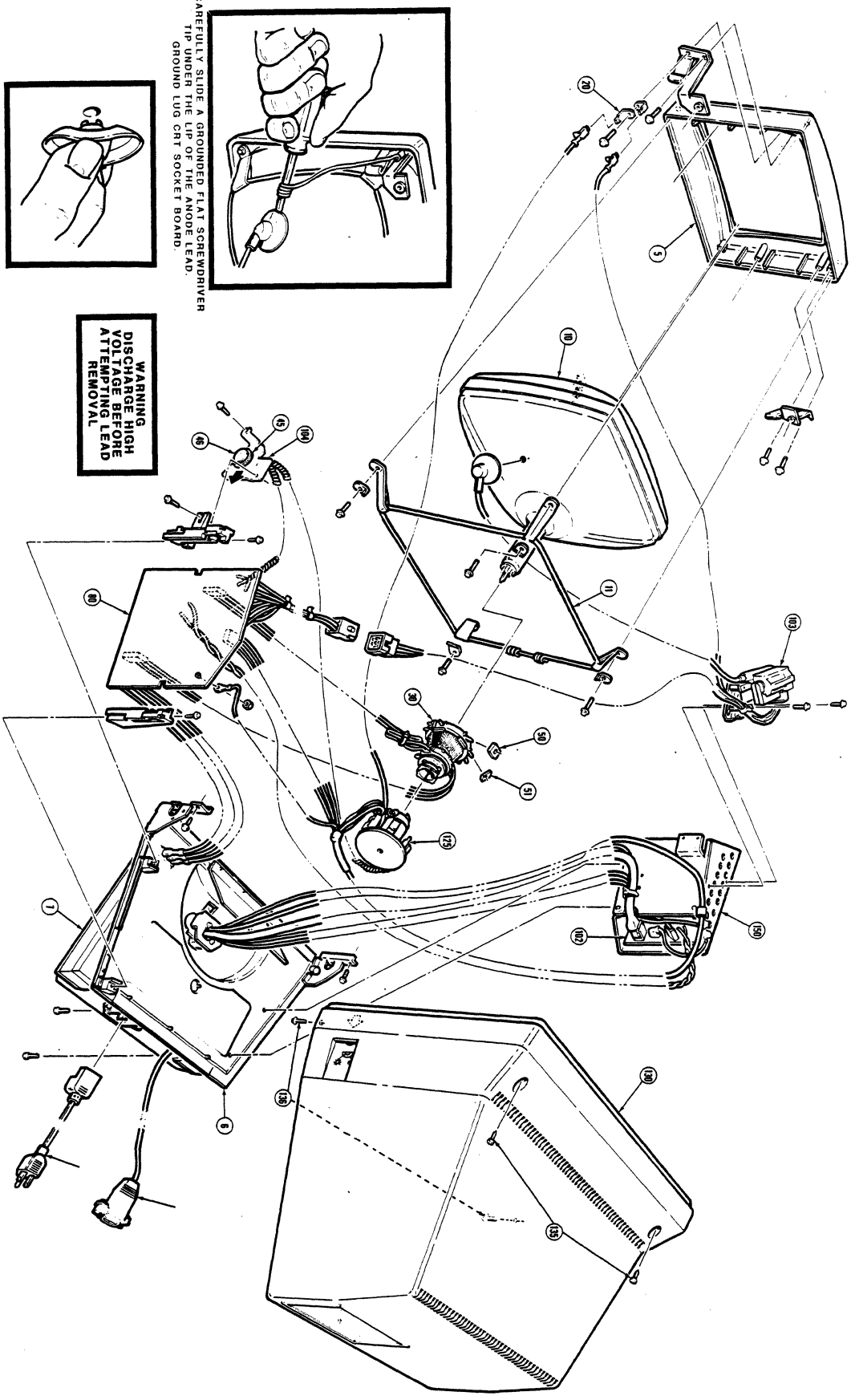


Figure 6-1
Exploded View