

# SERVICE MANUAL

## Color Video Monitor with Touch Control

ZVM-133-TC



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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

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St. Joseph, Michigan 49085

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# Chapter 1

## Characteristics

### Description

The ZVM-133-TC is a high-resolution color monitor with touch control. RGBI input signals are used for the display and RS-232C output signals supply the touch control information.

Touch control makes application programs easier and faster to use. The touch control logic board communicates with the computer, making the usual keyboard operations unnecessary. Operator training time and skill level are significantly reduced. The touch control operator places a finger at a specific screen location and the touch control logic board identifies the location for the software in the computer.

The ZVM-133-TC is designed to be used with Z-100 Series and Z-100 PC Series computers.

**NOTE:** The Z-319 video card must be installed in the Z-100 PC Series computers.

### Controls, Indicators, and Connectors

Refer to Figures 1-1, 1-2, 4-2, 4-3, and 4-4 for locations of the following controls, indicators, and connectors.

#### Front Panel

- Power Switch
- Power Indicator
- Brightness
- Contrast
- Green/White Switch

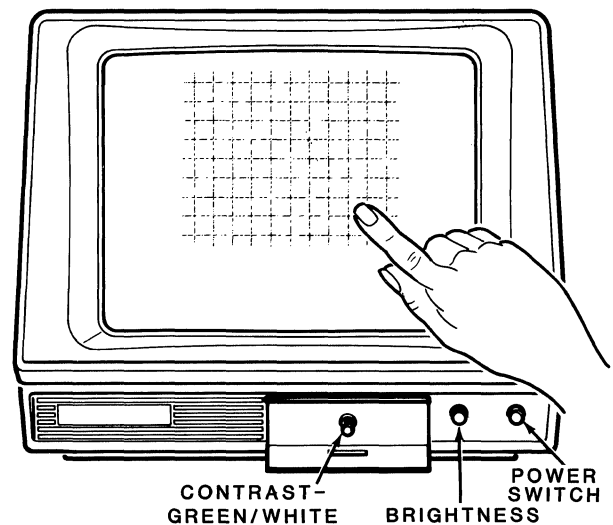
#### Internal

- Red LED Touch Indicator
- Horizontal Centering
- Width
- Vertical Centering
- Height

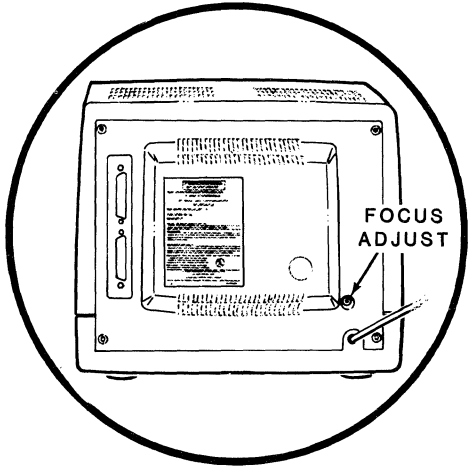
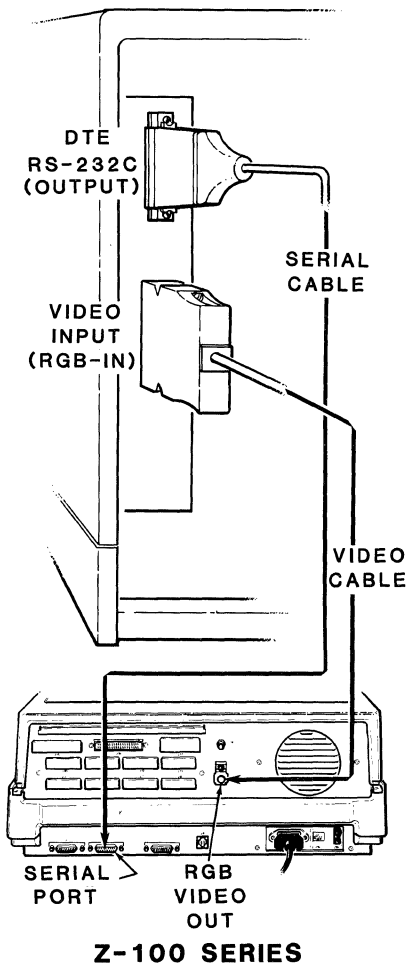
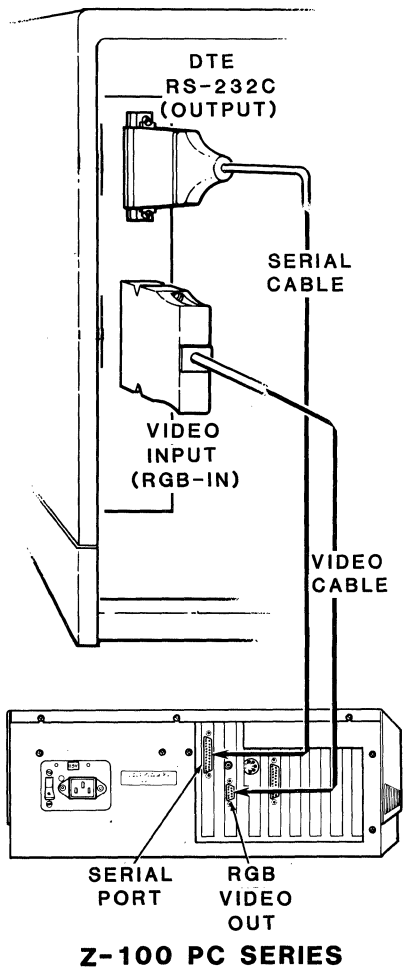
- G1
- G2
- RGB Cutoff
- RGB Drive
- Horizontal Oscillator
- +95 Volts
- Width Selection
- Sensitivity (Touch Control)

#### Rear Panel

- Focus
- Video Input connector
- DTE (output) connector



**Figure 1-1**  
*Monitor Front View*



**Figure 1-2**  
*Monitor Rear View*

## Specifications

### General

Electrical Power .....	105 – 130 VAC 60 Hz, 1.36 A.
Height .....	13.75" (350 mm).
Width .....	15.25" (390 mm).
Depth .....	15.25" (390 mm).
Weight .....	38 pounds (17.2 kg).

### Monitor

CRT .....	13" (330 mm) diagonal.
Phosphor .....	P-22 pigmented phosphor color.
Pixel resolution .....	640 dots (RGB), 250 dots.
Text capacity .....	25 lines of 80 characters.
Video resolution .....	640 pixels horizontal by 240 lines (non-interlaced), or by 480 lines (interlaced).

Video bandwidth .....	20 MHz.
Rise time .....	40 nanoseconds.
Horizontal frequency .....	15.7 – 16.8 kHz.
Vertical frequency .....	57 – 62 Hz.
Inputs .....	DB-25 type connector. RGBI signals — TTL level digital positive. Horizontal sync — TTL positive or negative. Vertical sync — TTL positive or negative. IBM intensity — TTL level digital positive.

### Touch Control

Sync input .....	Horizontal sync — TTL positive or negative.
Microprocessor clock .....	6.0 MHz.
Touch output .....	DB-25 type connector. RS-232C serial data. 110 — 9600 baud (factory set to 4800). (Factory set to 8-bit and zero parity.)

Touch area .....	16 × 16 cells in a 7.5" × 7.5" square centered on the CRT.
Touch resolution .....	32 × 32 infrared detector matrix. 0.295" horizontal. 0.295" vertical.
Touch data format .....	Message format will be 8 characters: <SOH>XxxYyy<CR> xx and yy are the ASCII representation of the number 00 through 15. Leading zeros will not be suppressed. The upper left corner of the screen is: X = 00, Y = 00 Logic Board X = 1, Y = 16 Plato Program

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# Chapter 2

## Installation

See Touch Control Performance Test and Touch Control Alignment and Checkout in the Servicing chapter.

1. Connect the cables as shown in Figure 1-2.
2. Select green or color:
  - If the monitor is to be used only for monochrome text display, select green by pushing in the Green/White switch.
  - If the monitor is to be used for graphics display or text and color display, select color by pulling out the Green/White switch.
3. Turn on the computer and video monitor. The power indicator on the front of the video monitor should light.
4. After the monitor has warmed up, adjust the brightness control for the desired display brightness.
5. If the monitor is to be used with a Zenith personal computer, display the color bar from the ROM. Adjust the Contrast control so that the eight bars on the right side of the display have the desired color intensity.



# Chapter 3

## Circuit Descriptions

### Monitor

Refer to the block diagram, schematics, and waveforms starting at Figure 4-8 in Chapter 4.

#### RGB GAIN CONTROL BOARD

The RGB digital signals enter the monitor through the DB-25 input connector, and are then interfaced to the RGB gain control board through connector 8A7. The intensity (I) signal is also interfaced through connector 8A7 if a PC-compatible computer is used.

#### RGB Signal Input

The RGB signals are then applied to hex buffer/driver IC1700. When either the RED or GREEN signals are active (low), they are sent from pins 2 and 4, respectively, to the bases of common collector transistors Q1703 and Q1704. Base current drive for transistor Q1703 (RED) is derived from the +12 VDC supply, through resistor R1712, diode CR1704, and buffer IC1700. Similarly, base drive for Q1704 (GREEN) is derived through resistor R1712, diode CR1703, and buffer IC1700.

When the BLUE signal is active, the base of common emitter transistor Q1709 is driven through resistor R1711 causing the transistor to conduct from emitter to collector. When this occurs, the +12 VDC supply is loaded, and therefore reduces the RED and GREEN signal current drive capability. The gain on each respective signal is therefore equal to each other. The BLUE signal drives the base of Q1705 through pin 6 of buffer IC1700.

#### RGBI Input

When used with an IBM PC-compatible computer, the intensity bit is used to enhance the hue of a particular color by providing additional drive to the displayed color. In this manner, as many as 16 different colors can be displayed.

The intensity bit is applied to pins 1 and 3 of hex buffer/inverter IC1700. When these signals are active, they force the output at pins 8, 10, and 12 of IC1700 low. This 3-bit combination of data goes through diodes CR1707, CR1708, and CR1709 to D/A converter IC1723. The D/A converter processes the data and provides additional drive voltage at pins 8 (RED), 2 (GREEN), and 5 (BLUE). This voltage increases the bias on the bases of common collector transistors Q1706 (RED), Q1707 (GREEN), and Q1708 (BLUE). These RGB output transistors are therefore able to provide higher level RGB signals at their emitters. The signals go to the main board through connector E.

#### MAIN BOARD

The main board generates start-up and operating voltages for itself and for other boards. Also, the RGB drive and cutoff voltages and the horizontal and vertical drive voltages are generated by the main board. See the following detailed description.

#### Start-up and Operating Voltages

Line voltage is supplied to the main board through connector 3R8. The AC voltage is then routed through fuse FX3201 and an LCI (line conducted interference) choke. The LCI choke, in conjunction with capacitors CX3250 and CX3258 prevent noise generated within the monitor from being fed back into the AC line. The power switch is located across pins 2 and 3 of connector 3S8.

## Degaussing Circuit

Since externally generated magnetic forces can cause the mask inside the CRT to become magnetized, the CRT is automatically degaussed each time the monitor is switched on.

Degaussing is accomplished by passing AC current through the degaussing coil wrapped around the CRT. The average value of the AC current is zero and therefore does not allow residual magnetism to remain on the mask of the CRT.

The degaussing coil is connected to the main board by connector 3T8. A positive temperature coefficient thermistor (R3245) controls AC current flow through the degaussing coil. When monitor power is turned on, a high AC current will flow from one side of the AC line through the degaussing coil, diode CR3210 or CR3211, and through thermistor R3245 to the other side of the AC line. This high AC current demagnetizes the mask and then quickly drops to a value of near zero due to the heating and subsequent high resistance of R3245.

## Power Supplies

When the power switch is closed, AC voltage is applied to the main board. The AC voltage goes to a simple bridge rectifier comprised of diodes CR3231 – CR3234. The output of this bridge rectifier circuit acts as a source for the other power supplies.

**WARNING:** The bridge rectifier circuit is referenced to chassis ground and is not isolated from the AC power with a built-in isolation transformer. Therefore, an external isolation transformer should always be used whenever the monitor is serviced to prevent injury and damage to the monitor and/or test equipment.

## + 150 VDC Supply

When monitor power is first turned on, the first power supply to develop output voltage is the +150 VDC supply. This is the B+ power for the H.O.T. (horizontal output transistor) located on the high voltage and horizontal sweep assembly.

Several oscillators must be operating before additional power supplies will operate. For example, the horizontal oscillator must be operating and driving the H.O.T. before high voltage can be generated.

## + 26 VDC Supply

Transformer T3201 located on the main board is used as a start-up transformer to provide the necessary voltage to get the horizontal oscillator operating. AC current from the secondary winding of T3201 is rectified by diode CR3224. Only the positive alternations through CR3224 produce voltage as the negative alternations are shunted to ground by CR3219. This half-wave rectifier circuit supplies +26 VDC to the sync processor IC3401. An oscillator within the sync processor then begins to operate, sending the horizontal drive signal to pin 5 of IC3401.

## + 12 VDC Supply

The regulated +12 VDC supply is derived from the +26 VDC supply and is used to power most of the transistors found on the main board. Transistor Q3200 is the active regulator whose emitter supplies +12.7 VDC. Current flow through CR3205 produces a proportional voltage drop across the voltage divider comprised of resistors R3203 and R3202. The base of transistor Q3201 is connected to the middle of the voltage divider and therefore detects changes in output voltage

at the emitter of Q3200. If the output voltage decreases, the current through R3203 and R3202 decreases and therefore the voltage at the base of Q3201 decreases. When this occurs, conduction through Q3201 decreases effectively raising the voltage at the base of Q3200. Regulator Q3200 is driven harder, thereby increasing its output voltage and current delivering capability.

If the output voltage rises above +12 VDC, the current through resistors R3203 and R3202 increases and causes the voltage at the base of Q3201 to increase. This transistor is forced to conduct harder which lowers the voltage at the base of Q3200, and therefore its output voltage at the emitter.

### **RGB Drive and Cutoff Voltages**

The RGB signals are processed by the RGB gain control board and are then interfaced to the main board through connector E.

The RED signal is supplied to the base circuit of emitter follower transistor Q2501. During its quiescent state, the base of Q2501 is biased to approximately +11.3 volts as determined by the voltage divider comprised of resistors R2501 and R2502.

When an active-low RED signal drives the base of Q2501, the emitter of Q2501 reproduces the signal and drives the base of Q2502 through potentiometer R2506. This potentiometer establishes the bias voltage at the base of Q2502 and therefore is used to vary the RED signal drive. The RED signal cutoff voltage is adjusted by potentiometer R2505 which is located in the emitter circuit of Q2502.

The collector of Q2502 conducts the inverted RED signal to the base of emitter follower transistor Q2507 which drives the signal through resistor R2550 to pin 4 of connector A.

The BLUE and GREEN signal drive circuits function in exactly the same way as the RED signal circuits.

### **Vertical Sync**

The sync processor adjusts the vertical signal with respect to the horizontal signal, to provide properly synchronized CRT scan.

With either positive or negative vertical sync, the signal is supplied from pin 2 of connector E to the base of common emitter transistor Q3401. The inverted signal at the base of Q3401 goes to the base of common emitter Q3402 and is then applied to pin 28 of the sync processor.

### **Horizontal Sync**

The sync processor adjusts the horizontal signal with respect to the vertical signal to provide properly synchronized CRT scan.

With either positive or negative horizontal sync, the signal is supplied from pin 1 of connector E to the base of common emitter transistor Q3403. The inverted signal at the collector of Q3403 goes to the base of emitter follower Q3404. The signal is then supplied to pin 27 of sync processor IC3401.

### **Horizontal and Vertical Drive Outputs**

The sync processor, IC3401 contains horizontal oscillators, horizontal automatic phase control (APC), horizontal output driver, vertical oscillator, and vertical output driver.

The vertical output of IC3401 (pin 14) drives a stacked pair of transistors (Q2101 and Q2102) for vertical scan generation. This vertical drive output goes to connector 3G3 to supply the sweep assembly.

The horizontal output of IC3401 (pin 15) also is routed through connector 3G3 to the sweep assembly. This horizontal drive signal will drive the H.O.T. on the sweep assembly.

## **HIGH VOLTAGE and HORIZONTAL SWEEP BOARD**

This board will be referred to as the sweep board in the following text. The horizontal drive signal originates in the main board, enters the sweep board at connector 3G3, goes to the forward driver transistor Q3206 and reverse driver transistor Q3209, and then to transformer T3205. The output of T3205 goes to the H.O.T. through connector 3R3 with the H.O.T. output going to the sweep board through the same 3R3. From connector 3R3, the H.O.T. output goes to the width step board through connector 3S3. The H.O.T. output also goes to the horizontal output transformer TX3204 where the following voltages are generated; CRT filament, focus, G2, +170 V(P-P), 60 V(P-P), and video B+.

The vertical output which originates in the main board, goes to the yoke through the sweep board after passing through connectors 3G3 and 2A3.

## **WIDTH STEP BOARD**

The horizontal sweep goes to the width step board before reaching the horizontal windings of the yoke. Coarse width selection is made at this board by placement of P1 and P2 jumpers as explained in Alignments and Adjustments in Chapter 4.

## **VIDEO OUTPUT BOARD**

All outputs of this board go to the CRT socket which is on this board. The RED, GREEN, and BLUE signals from the main board enter at connector 5A2 and go to transistors Q5102, Q5103, and Q5101 to drive the CRT. The following voltages are supplied by the sweep board:

- The CRT filament voltage
- G2 voltage to connector 5X3
- Focus voltage through a pigtail connector to the CRT

The +120 VDC transistor supply voltage along with G2 and BASE voltage are supplied to the video output board by the main board.

# **Touch Control**

## **LOGIC BOARD**

Refer to the block diagram, schematics, and waveforms in the Servicing chapter.

## **Bipolar $\pm 12$ VDC Power Supply**

The bridge rectifier, consisting of diodes CR701 – CR704, is supplied AC voltage from transformer TX701 at pins 5 and 7 of connector J5. Capacitor C701 charges and develops approximately +18 VDC at pin 1 of IC701 and capacitor C702 develops –18 VDC at pin 1 of IC702.

This full-wave rectification allows capacitors C701 and C702 to maintain +18 VDC and –18 VDC respectively, at the inputs to regulators IC701 and IC702. Capacitors C704 and C705 shunt high frequency oscillations to ground and capacitors C706 – C709 filter the output of each regulator.

## **+5 VDC Power Supply**

Diodes CR705 and CR706 rectify the 20 VAC from transformer TX701 to pins 4 and 6 of J5. Capacitors C710 and C711 charge to approximately 15 VDC. Capacitor C712 prevents high frequency oscillations at the input of regulator IC703. The +5 VDC regulated output at pin 5 of IC703 is filtered by capacitors C714 and C715.

## Reset

When power is initially applied to the monitor, Q701 is off until the +5 VDC is present. The resulting low on the reset line (TP3) initializes microprocessor IC101. When the +5 VDC supply reaches approximately 4.5 volts, Q701 conducts to reverse bias CR707. Capacitor C716 then holds the reset line high by charging to 5 VDC through a pull-up resistor within IC101. The RC time constant allows logic circuits to reach 5 VDC before the RES\* signal becomes inactive.

If the +5 VDC supply drops to approximately 4.5 volts, Q701 will turn off. The reset line is therefore driven low resetting microprocessor IC101. This circuit resets the microprocessor if brownouts occur.

## Timing

A 6.0 MHz oscillator provides control and synchronization signals to microprocessor IC101 at pins 2 and 3. The timing signals enable internal registers, buffers, and control logic to function.

## Microprocessor

IC101 is an 8-bit 8749 microprocessor containing an EPROM. Microprocessor IC101 is clocked by a 6.0 MHz oscillator to control internal register and buffer operation. IC101 also initiates a sequential strobe which drives a matrix of IR (infrared) LEDs located within the front bezel assembly of the monitor. The projected infrared beams allow IC101 to sense the presence and location of a finger placed against the face of the CRT.

The strobe is implemented over the DB7 – DB0 bus and is triggered by the horizontal synchronization signals of the monitor. The infrared beams projected across the face of the CRT define X-Y coordinates

which IC101 uses to interpret a particular location on the CRT display. The microprocessor strobes each IR LED approximately every 400 microseconds ( $\mu$ s) and reads its testable input each time a strobe occurs. If a finger breaks a set of X-Y infrared beams, the testable input is driven low. IC101 then logs the data bytes which drove the IR LEDs corresponding to that particular X-Y location and uses them to execute an instruction contained within firmware.

## Main CPU Interface

When data for an X-Y coordinate is established, the microprocessor communicates with the main CPU by means of serial data transmission from the monitor output connector J8. The transmission is directed through ports P25, P26, and P27. When microprocessor IC101 wants to communicate with the main CPU, a RTS (request to send) signal is issued. The signal is buffered and inverted by NAND gate IC102, pin 6, and is then transmitted through inductor L102, to the monitor output connector J8 at pin 4. L102 filters the signal and suppresses radiation while diodes CR103 and CR104 shunt any developed back EMF.

In response to the RTS signal, the main CPU issues a CTS (clear to send) signal, interfaced through pin 5 of connector J8 to pin 38 of microprocessor IC101. This signal is also filtered and suppressed for radiation by inductor L103, and diodes CR105 and CR106 protect pin 13 of buffer/inverter IC103.

Upon receipt of the CTS signal, microprocessor IC101 begins to transmit serial data (SOUT) to the main CPU through pin 3 of buffer/inverter IC102 and inductor L101. The transmission is interfaced to the main CPU through pin 2 of connector J8. The SOUT signal is filtered and radiation suppressed by inductor L101. Diodes CR101 and CR102 protect against developed back EMF.

## Strobe Synchronization

The horizontal sync signal triggers the strobe which sequentially illuminates the IR LEDs. If positive sync is configured, the rising edge of the signal triggers the strobe and if negative sync is configured, the falling edge triggers the strobe. There are 32 IR LEDs mounted across the vertical plane (left side), and 32 across the horizontal plane (bottom) of the front bezel assembly. Each of 64 distinct bytes of data decode and drive each one of the IR LEDs.

With respect to the front bezel, the strobes occur in a counter clockwise direction beginning with the vertical plane, followed by the horizontal plane. The horizontal synchronization signals are supplied to the logic board from pin 1 (negative sync) and pin 2 (positive sync) of monitor input connector J7.

If positive horizontal synchronization is configured, the signal goes to pin 12 of IC106. Diodes CR112 and CR113 limit the signal to  $-0.7$  to  $+5.7$  volts. Pin 11 of IC106 is held high by pull-up resistor R120. On each high-to-low transition of the positive sync pulse, IC106 sends a  $10\ \mu\text{s}$  pulse to pin 39 of microprocessor IC101.

If negative horizontal synchronization is configured, the signal goes to pin 11 of IC106. Pin 12 is held low by R121 which is connected to ground. On each low-to-high transition of the negative sync pulse, IC106 sends a  $10\ \mu\text{s}$  pulse to pin 39 of microprocessor IC101.

These pulses synchronize the IR LED strobe sequence.

## Infrared LED Strobe Sequence

To implement the strobe, sequential data bytes decode which of the IR LEDs to illuminate in the vertical plane, and then the LEDs in the horizontal plane. Each byte

of data is placed onto the DB7 – DB0 bus and is also temporarily stored in a register within the microprocessor. When data on the bus is valid, port P16 goes low providing the chip enable signal to pin 1 of IC108. The low at port 16 also forces the output of NAND gate IC105 high. Pin 2 of inverter IC104 inverts the signal and enables IC106. Microprocessor IC101 then outputs an active write (WR\*) pulse. The low-to-high transition on the lagging edge of the pulse causes octal flip-flop IC108 to latch the status of data on the DB7 - DB0 bus to its Q outputs.

The active write cycle also produces a high at pin 6 of IC106. This high enables each of the inputs of NAND gates IC109 and IC110 to conduct the latched output of IC108. This output enables one set of 8 IR LEDs. By holding the cathodes of each set of IR LEDs low, each anode can then be selectively strobed, causing each of the 8 IR LEDs to be sequentially illuminated. Data on the DB7 – DB0 bus is used to strobe the anodes of the enabled group of IR LEDs through buffer/driver IC107.

After an IR LED is decoded and strobed within the vertical plane, IC101 checks for the presence of a finger on the CRT by reading the status of its testable input at pin 1. If a finger intersects the infrared projection a low appears at the testable input. The microprocessor then retains the byte stored in its internal register corresponding to that particular location as the X coordinate data.

The microprocessor then decodes and strobes each IR LED within the horizontal plane. When the testable input is driven low by the placement of a finger on the CRT, the microprocessor retains the data byte stored in its internal register corresponding to that particular location as the Y coordinate data.

With X-Y coordinates established, the microprocessor interprets where the finger has been placed on the screen. The microprocessor uses the X-Y coordinate data bytes to execute an instruction contained within



firmware, and then serially communicates with the main CPU.

## Infrared Detection

When one's finger is placed at some point on the face of the CRT, the finger must pass through the lattice established by the projected infrared beams. That point within the infrared lattice where the finger is placed causes the IR beams to be broken.

Refer to Figure 3-1 for the following discussion.

As beams are projected across the face of the CRT, an infrared receptacle referred to as a light pipe assembly collects the beams and conducts them to a single focal point at its base. The infrared detector mounted to the base of the light pipe assembly, conducts when struck by an infrared beam and inputs a signal to an amplifier and comparator circuit on the logic board. If a finger breaks the beam, the detector does not conduct and the output of the comparator circuit indicates to the microprocessor that a finger has been placed on the screen. The microprocessor then logs the data bytes corresponding to that location on the CRT. There is one light pipe assembly and detector set for vertical and another set for horizontal.

As a point on the lattice is intersected by a finger, the output of the vertical and horizontal detectors are interrupted once for each strobe. These signals go to the logic board at connectors J3 and J4 which are wired directly in parallel. Since the vertical and horizontal strobing is sequential, the detected signals do not appear at the same time, allowing one amplifier to be time-shared.

C204 couples the signals to the base of common emitter amplifier Q201 which inverts and amplifies them

with a gain of approximately 40. The signals are then coupled to the high impedance input at the base of common emitter transistor Q203. The signal is then buffered by Q204 and coupled to the base of Q205 through capacitor C210. Q204 increases the gain by 40 again and finally supplies the signal to the inverting input (pin 8) of operational amplifier IC201.

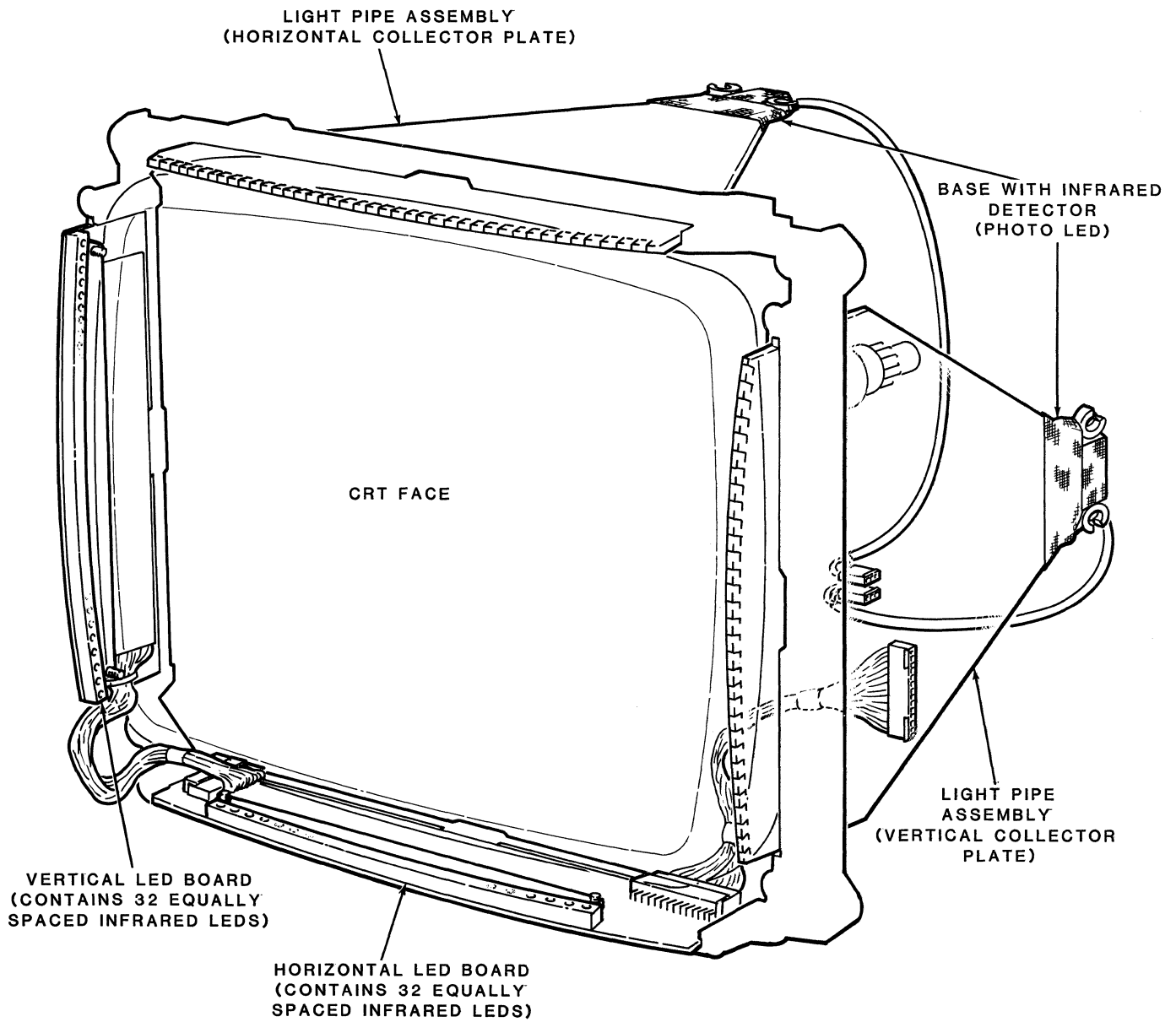
## Digital Infrared Detection Automatic Gain Control

Infrared detectors cause the output at pin 14 of IC201 to pulse low when a finger is placed on the screen. In order to assure that increased room lighting or sunlight do not produce erroneous outputs, the microprocessor continually adjusts the sensitivity of comparator IC201. IC101 scans the output at pin 14 of the voltage comparator each time an IR LED is strobed. If no signal is output, IC101 decreases the reference voltage at the noninverting input (pin 9) of IC201 through a 4-bit digital to analog conversion circuit.

The noninverting input at pin 9 of IC201 is connected to a voltage divider consisting of R101 and R106. The microprocessor can force the voltage at this point to any of 16 values in the range 3 to 8 volts (see waveform E and A in Figure 4-24).

## LED Drive

When the microprocessor is about to transmit data to the main CPU, LED CR109 on the logic board is lit. CR109 will stay lit until the main CPU is ready to receive. Pin 8 of IC105 is driven high and the high is inverted at pin 12 of IC104 to drive CR109 through current-limiting resistor R124.



**Figure 3-1**  
*Light Pipe Assembly*

## Safety and Service Guidelines

**WARNING:** Part of this monitor contains a **Hot Chassis**. The line voltage is applied across a bridge rectifier which is referenced to the hot (AC) ground. **Use an isolation transformer when you are working on this monitor.**

**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 the monitor power turned off and disconnected, discharge the high voltage anode lead at the CRT using a jumper lead connected between the chassis and a screwdriver (see Figure 6-1). Failure to comply could result in severe shock and/or personal injury.

**WARNING:** Do not operate the monitor with excessive high voltage any longer than necessary or the monitor may produce X-rays from the CRT.

Excessive high voltage will produce X-rays from the CRT; always verify that the voltage is at normal levels when servicing the monitor.

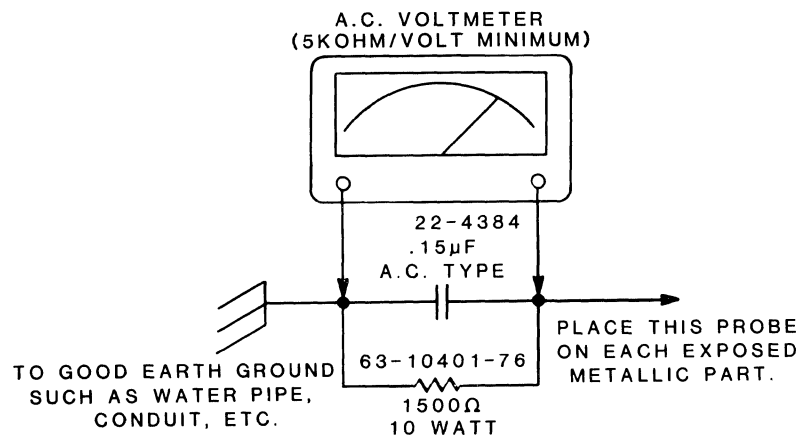
**WARNING:** Carefully handle the cathode-ray tube when you hold, remove, or install it; otherwise, implosion and/or injury may result.

**NOTE:** Under no circumstances should the original design be modified or altered without permission from Zenith Electronics Corporation.

## 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.



**Figure 4-1**  
*AC Leakage Voltmeter Circuit*

**WARNING:** Any leakage voltage measurement that exceeds 0.75 volts rms (0.5 milliamperes AC) constitutes a potential shock hazard and must be corrected.

**CAUTION:** Some of the ICs used in the monitor are electrostatic-sensitive devices. These circuits can be damaged by static electricity. When handling any IC, use a wrist grounding strap or be sure to equalize the static charge before touching the IC.

## Other Precautions

- Be sure that all components are positioned in such a manner as to avoid the possibility of short circuits.
- Inspect and correct all soldered connections for cold solder joints, frayed leads, damaged insulation, splashed solder, or sharp points.
- Never release a repaired product to a customer unless all protective devices, such as insulators, barriers, cover shields, strain reliefs, etc., have been installed.
- Remove all loose material from inside the monitor after servicing.
- Follow the original lead layout, dress, lengths, and tension.
- Replace all components with exact Zenith Data Systems replacement parts.

## Suggested Tools and Supplies

- 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-331-6
- Desoldering braid, HE-490-185
- Cable ties, HE-354-7
- Lint-free cloths

## Test Equipment

- Oscilloscope — DC to 100 MHz, dual trace, triggered sweep. Tektronix Model 465, or equivalent.
- Logic probe — Capable of detecting 10 nanoseconds single pulses, and indicating logic one, logic zero, and high impedance states. Heath Model IT-7410, or equivalent.
- Digital voltmeter — High impedance input, zero to 1000 volts, zero to one megohm. Heath Model SM-2215, or equivalent.
- Variable power supply — Zero to 120 VAC rms, 3 amps Heath Model IM-5210, 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-5210, or equivalent.
- Isolation transformer.
- Test IC Assembly — A-14136 (used for troubleshooting the touch control system).

## Troubleshooting

Use the following inspection to determine possible causes of monitor failures.

- Verify proper computer operation.
  - Check monitor controls for proper response and settings.
  - Unplug the signal and power cables from the monitor and check for burnt insulation, broken wires, or loose prongs on plugs.
  - Check the AC receptacle (wall outlet) for proper supply voltage.
  - Check all cabling and internal circuit board plugs for proper electrical connections. Refer to the applicable block diagram and component location illustrations for cable connector assignments.
  - Check monitor adjustments as explained at the end of this chapter.
  - Check all circuit boards for broken or burnt components or for darkened areas or other signs of component overheating.
  - Verify that the Green/White switch is in the correct position.
- When power is applied, check the CRT for glowing filament.
  - When power is applied, check for high voltage by placing the back of the hand near the face of the CRT.

**Table 4-1**  
General Troubleshooting

PROBLEM	POSSIBLE CAUSE
Dead monitor	No power at source Power cord Fuse Connector 3R8 Connector 3S8 Power switch
No display	RGB cable 95 volt supply
No color	Green/White switch Software produces monochrome display
Green color only	Green/White switch Software produces green display
Out of focus	Focus control
Raster displayed with no signal	G2 control set too high
Display does not fit on CRT	P1, P2 on the sweep board Width control 95 volt adjustment

## Monitor Fault Isolation Procedures

Have the monitor sync-locked to a signal, if possible, before starting this procedure.

Always reference the DVM or oscilloscope to DC (cold) ground unless instructed otherwise.

A 10X probe is recommended for use with the oscilloscope.

1. With a DVM, measure the voltage at pin 2 of connector 3V3 on the main board (see Figure 4-11).

If +150 VDC is present, proceed to step 2.

If +150 VDC is not present, replace the main board.

2. With a DVM, measure the voltage at pin 2 of connector 3F3 on the main board.

If the voltage is from +4.5 VDC to +12 VDC, proceed to step 3.

If the voltage is less than +4.5 VDC, replace the main board.

3. With a DVM, measure the voltage at pin 2 of connector 3D3 on the main board.

If the voltage is from +12 VDC to +26 VDC, proceed to step 4.

If the voltage is more than +26 volts, replace the main board.

4. With a DVM, measure the voltage at pin 2 of connector 3G3 on the main board. A value of +0.3 VDC should be observed. Observe this point with an oscilloscope and verify the presence of horizontal drive pulses.

If the pulses are present, proceed to step 5.

If the pulses are not present, replace the main board.

5. With an oscilloscope, measure the supply voltages at connector 3D3 on the main board. The voltages should be:

Pin 1	170 volts peak-to-peak
Pin 2	+26 volts DC
Pin 3	Ground
Pin 5	60 volts peak-to-peak
Pin 6	140 volts peak-to-peak

If all voltages are correct, proceed to step 6.

If any voltage is not correct, replace the sweep assembly.

6. Use a high voltage probe to verify the presence of 26 kV on the CRT anode lead.

If +26 kV is present, proceed to step 7.

If +26 kV is not present, replace the sweep assembly.

7. Apply a white field on the entire CRT. This can be done with a video source or, with a Z-100 or Z-100 PC computer, by using the Z-BASIC or GW-BASIC command:

```
PAIN(0,0),,7
```

Disconnect 5A2 connector from the video output board and measure for the following voltages at the cable connector:

Pin 2 (BLUE)	+ 3.5 VDC to + 4.5 VDC
Pin 3 (GREEN)	+ 3.5 VDC to + 4.5 VDC
Pin 4 (RED)	+ 3.5 VDC to + 4.5 VDC

If the voltages are within range, proceed to step 8. If any voltage is not within range, replace the main board.

8. Refer to Monitor Alignments and Adjustments in this chapter to be sure that all alignments and adjustments have been made.

9. If the monitor still has a problem, the CRT or video output board may be defective.

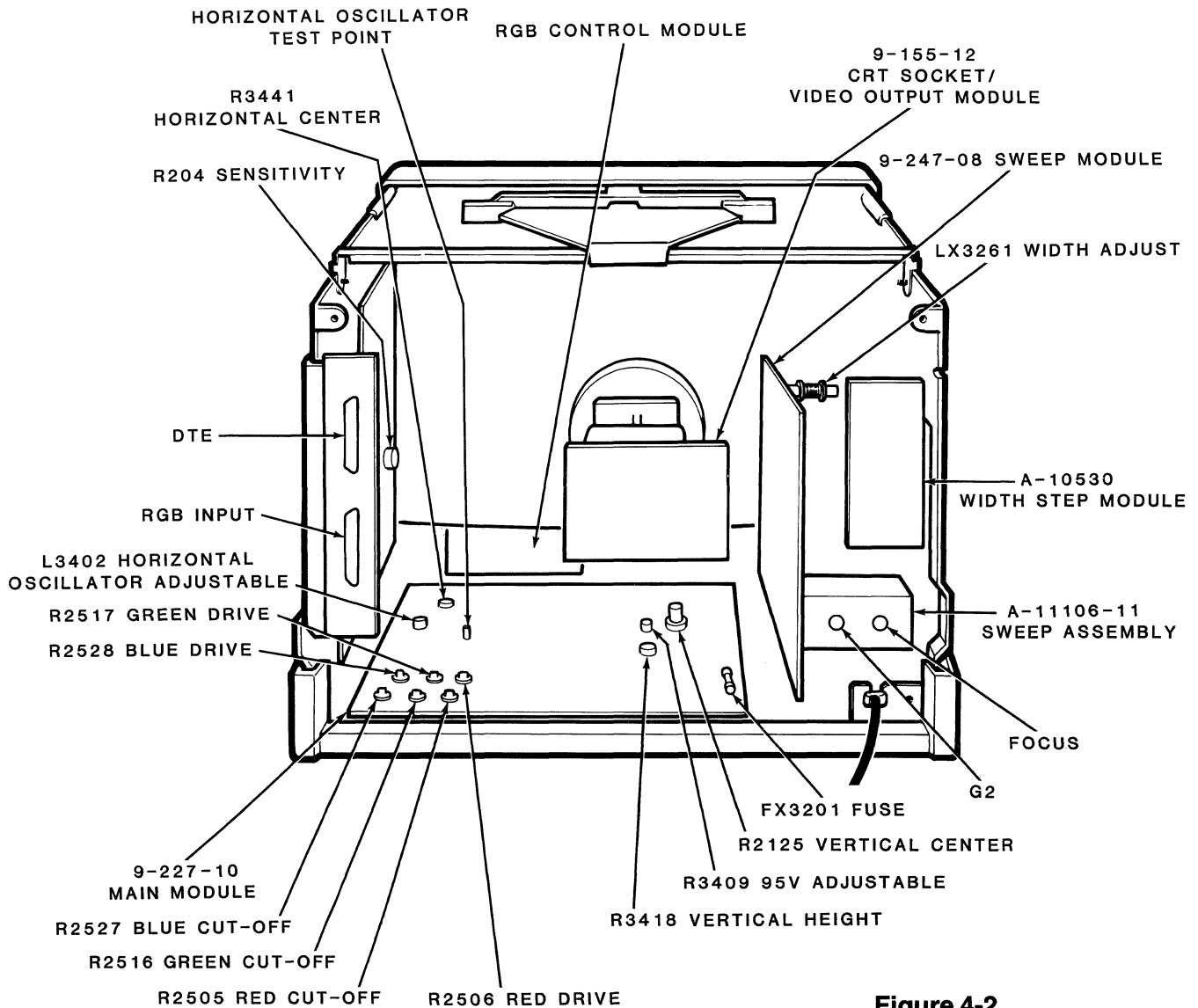
## **Monitor Alignments and Adjustments**

Instructions for the alignment and adjustment of the main board, the sweep assembly boards, and the audio/video sync board are provided in the following text.

If convergence is necessary, refer to the CRT Maintenance manual for Zenith Data System monitors, 860-168.

**IMPORTANT SAFETY NOTICE**

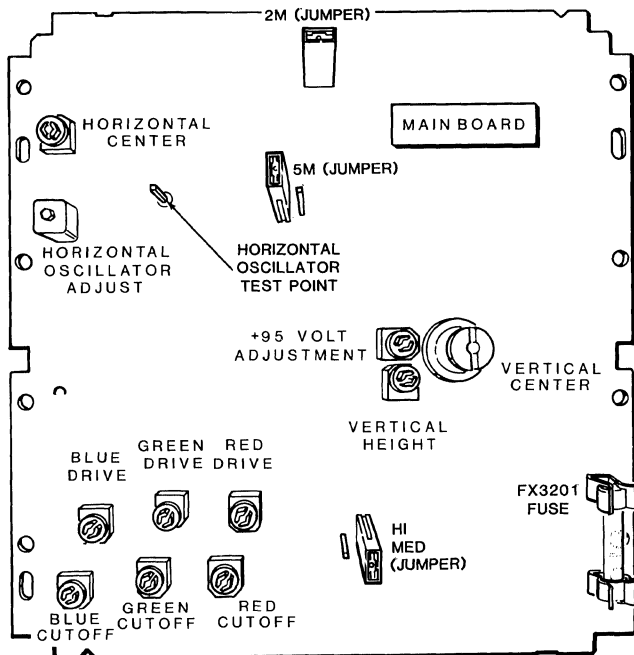
FOR X-RADIATION, FIRE OR SHOCK HAZARD PREVENTION, CERTAIN SPECIAL OR REDUNDANT PARTS ARE USED. USE ONLY EXACT REPLACEMENTS. DO NOT ALTER THE CIRCUIT OR DEFEAT THE FUSES. FAILURE TO COMPLY MAY BE UNLAWFUL.



**Figure 4-2**  
*Adjustments — Monitor Rear View*



## MAIN BOARD ADJUSTMENTS



**Figure 4-3**  
*Main Board Adjustments*

## RGB Cutoff and G2 Adjustments

These adjustments should be made in a darkened room.

1. Turn each control (R2506-RED, R2516-GREEN, and R2527-BLUE) fully counterclockwise.
2. Adjust G2 on the sweep board (see Figure 4-4) until the raster just appears.
3. Adjust each cutoff control until a gray raster appears.
4. Readjust G2 until the raster just disappears.

## RGB Drive Adjustments

Apply a white field on the entire CRT. This can be done with a video source or, with a Z-100 or Z-100 PC computer, by using the Z-BASIC or GW-BASIC command:

```
PAINT(0,0),,7
```

Observe the screen closely and see if any red, green, or blue tints are present. Adjust the appropriate drive (R2506-RED, R2517-GREEN, R2528-BLUE) until the tint disappears.

## Vertical Height and Vertical Center Adjustments

These controls (R3418-height and R2125-vertical centering) should be adjusted under low-light conditions.

1. Turn the G2 control clockwise until a raster appears.
2. Adjust these two controls so that the top and bottom of the raster are 1/2-inch from the edges of the CRT.
3. Turn the G2 control counterclockwise until the raster just disappears.

## Horizontal Width and Horizontal Center Adjustments

Horizontal centering control R3441 (located on the main board) and horizontal width LX3261 (located on the sweep board) should be adjusted under low-light conditions (see Figure 4-3).

**NOTE:** Width selection must be made before attempting these adjustments.

1. Turn the G2 control (located on the sweep board) clockwise until a raster appears.

2. 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. Turn the G2 control counterclockwise until the raster just disappears.

### Horizontal Oscillator Adjustment

The horizontal oscillator control L3402 (located on the main board) is for oscillator frequency adjustment.

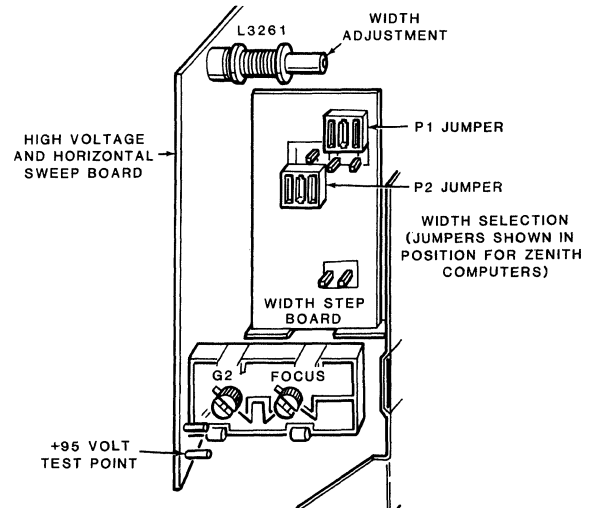
1. Disable the automatic phase control (APC) by jumpering +12 VDC to pin 27 of the sync processor IC3401.
2. Adjust L3402 for an oscillator frequency of 15,734 Hz.
3. Remove the jumper from +12 VDC and pin 27 of IC3401.

### +95 Volt Adjustment

The +95 volt (B+) adjustment is located on the main board. The test point is located on the sweep board (see Figure 4-4).

1. Connect the monitor to the AC line through an isolation transformer.
2. Connect the ground lead of the voltmeter to the hot AC ground.
3. Connect the hot lead of the voltmeter to the +95 volt test point.
4. Adjust the 95-volt control for 95 volts.

## SWEEP ASSEMBLY ADJUSTMENTS



**Figure 4-4**  
*High Voltage and Sweep Board/Width Step Board Adjustments*

### Focus Adjustment

With a video source connected to the monitor, adjust the focus control for the clearest (sharpest) display. The focus control is located on the sweep board (see Figures 1-2, 4-2, and 4-4).

### Width Selection

**NOTE:** This selection must be made before attempting width adjustment.

Coarse width is controlled with jumpers P1 and P2. For Zenith computers, P1 should be in the upper-vertical position and P2 should be in the lower-vertical position.

With P1 and P2 in the lower-vertical position, the width of the display is much wider than can be used on a Zenith computer.

With P1 in the lower-vertical position and P2 in the upper-vertical position, the display is narrower and will not fill the screen when used on a Zenith computer.

## Monitor Performance Tests

A Z-100 Series, Z-100 PC Series, or equivalent computer is required for these tests.

### FILL THE SCREEN TEST

The screen can be filled by using the Monitor ROM.

1. Turn on the computer.
2. Z-100: When the hand prompt appears (you may have to defeat the autoboot by pressing the ESC key during the autoboot sequence to get this), press the **T** key to obtain the test menu from the Monitor ROM. If the test menu does not appear and the computer beeps, then the Monitor ROM is an early version and does not contain the test routines. In this situation, use the BASIC program.  
  
Z-100 PC: Press the **CTRL**, **ALT**, and **INS** keys and then enter TEST and press **RETURN**.
3. Select the Keyboard Test by pressing the **2** key.
4. Choose any character to fill the screen by pressing it. The capital Z is recommended.
5. Check to see if the screen is filled with the test character and if the width and height of the display are correct.
6. Make any necessary adjustments (see Monitor Alignments and Adjustments in this chapter).

7. When you are finished using the display, press the **DELETE** key to return to the test menu.
8. Press the **5** key to return to the hand prompt.

### COLOR BAR TEST

The pattern will be eight different colors from the RGB output connector of a Z-100 with color capability or a gray scale (eight shades of a single color) from the composite output connector of a Z-100 Low-Profile Computer with color capability. A Z-100 that does not have color capability will not produce a color bar or gray scale. Instead, one side of the screen will be dark and the other side will be light.

Use the color bar to determine if any of the color adjustments have to be made (see Monitor Alignments and Adjustments in this chapter).

1. Turn on the computer.
2. Z-100: When the hand prompt appears, press **C** to obtain the color bar pattern. If the color bar pattern does not appear, then the Monitor ROM is an early version and the BASIC program in Listing 1 will have to be used.

**NOTE:** The autoboot may have to be defeated by pressing the ESC key during the autoboot sequence to get the color bar pattern.)

Z-100 PC: Press the **CTRL**, **ALT**, and **INS** keys simultaneously. Press the **C** key and then the **RETURN** key.

3. The hand prompt will continue to be seen at the bottom of the color bar.
4. When the necessary adjustments have been made, press the **DELETE** key to return to the test menu.

## BASIC PROGRAM

The program in Listing 4-1 can be used to produce a color bar pattern on a Z-100 with the color option.

1. Turn on the computer.
2. Boot Z-DOS and start Z-BASIC.
3. Enter and run the BASIC program in Listing 4-1.

### Listing 4-1. BASIC Color Bar Program

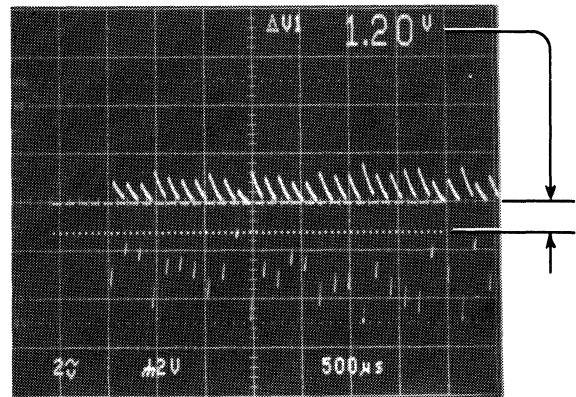
```
10 REM clear screen
20 CLS
30 REM produce color bar
40 LINE(0,0)-(79,106),0,BF
50 LINE(80,0)-(159,106),1,BF
60 LINE(160,0)-(239,106),4,BF
70 LINE(240,0)-(319,106),5,BF
80 LINE(320,0)-(399,106),2,BF
90 LINE(400,0)-(479,106),3,BF
100 LINE(480,0)-(599,106),6,BF
110 LINE(560,0)-(639,106),7,BF
120 REM 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
```

## Touch Control Sensitivity Adjustment

Perform this procedure before you attempt fault isolation and also after you repair the touch control system. Refer to Figures 4-23, 4-24, and 4-25.

1. Display the PLATO TOUCH Grid from the touch control system.

2. Set S101 (See Figure 4-23 for location) switch 6 off (away from the board).
3. Connect an oscilloscope to TP1 on the logic board and observe the pulses that result from the infrared LED strobe. (Set the oscilloscope to 500  $\mu$ s/Div. and 2V/Div. See Figure 4-5).
4. Turn R204 sensitivity to the counterclockwise stop (maximum sensitivity). The negative peaks of the pulses should be "bright", indicating saturation.
5. Turn R204 slowly clockwise to bring the pulses out of saturation (back off from the negative peaks).
6. Check the amplitude of the weakest pulse (See Figure 4-5). If this pulse is less than 1.2 volts peak-to-peak, adjust R204 until it is 1.2 volts peak-to-peak.



**Figure 4-5**  
*LED Strobe Pulses (TP1)*

7. Reset S101 switches for operation, 2 and 3 off (away from the board) and all other switches on (toward the board).

## Touch Control Fault Isolation Procedure

Use the following procedure if the touch control screen on the monitor fails and the computer does not beep.

1. Set R204 sensitivity according to the Touch Control Sensitivity Adjustment procedure before starting fault isolation. If the touch control circuits are not functioning well enough to allow sensitivity setting, proceed to step 2.
2. Connect the monitor and the computer as shown in Figure 1-2.
3. Boot the PLATO Diagnostic disk into the computer and display the PLATO TOUCH grid. The CB-5063-28 Diagnostic package also can be used to display the PLATO TOUCH grid (early copies of the diagnostic package may not have this feature).
4. Touch each square in a diagonal line starting at the upper-left corner to the bottom-right corner.  
  
If there is no response when you touch a square, disconnect the power and signal cables from the monitor and remove the back and top covers.
5. Reconnect the cables as shown in Figure 1-2 and display the PLATO TOUCH grid on the monitor.
6. Locate the red LED (CR109) on the logic board (see Figure 4-23).
7. Observe CR109 while you touch a square. If CR109 flashes each time you touch a square, valid touches are being detected, indicating any problem may be in the data cable to the computer or in the computer (software). Check the cable by replacing it with a good cable.
8. If CR109 does not flash, check the following power supplies on the logic board. Replace the Power Supply Assembly if the indicated voltages are not present.

+ 5 VDC	TP4	(Common connection of R116 and R117)
+ 12 VDC	TP5	(Cathode of CR107)
- 12 VDC	TP6	(Anode of CR106)
9. If the power supplies are satisfactory, check for proper horizontal sync pulse waveforms as follows:
  - a. Connect an oscilloscope to display waveforms **X** and **D** according to Figure 4-24.
  - b. Replace IC106 if the waveform is not correct at pin 39 of IC101.
10. If CR109 still fails to flash, check for a 6 MHz sine wave at pins 2 and 3 of IC101. Replace crystal Y101 if the sine wave is not present.
11. If the horizontal sync pulse waveforms and IC101 are satisfactory, check for an oscilloscope indication of pulses at TP1 on the logic board. See Figure 4-24, waveform **A**, and proceed as follows:
  - a. Turn off (up) switch 6 of S101 on the logic board.
  - b. Replace IC101 on the logic board with Test IC Assembly A-14136.
  - c. Turn the monitor off, then back on.
  - d. CR109 (Red LED) should be flashing.

- e. If it is not, check for pulses at the following locations and in the order shown. If pulses are not present, replace the logic board or troubleshoot the components in parentheses. Pin 35 of IC101 (IC101), Pin 8 of IC105 (IC102, IC105, C107, C108, R123), and pin 12 of IC104 (IC104).
  - f. Check for continuity of R124 and CR109 to make sure that they are functional.
 

If all these checks are satisfactory and CR109 is still not flashing, the problem may be in the reset circuit.
  - g. Test the reset circuit by momentarily grounding TP3 and then connecting it to the +5 VDC supply (See Figure 4-23). If this causes CR109 to flash, troubleshoot the components associated with Q107, the reset transistor.
12. If CR109 is flashing but the monitor fails to respond when you touch the screen, connect an oscilloscope to L101 (either end) and look for waveform G in Figure 4-24 (See Figure 4-24 for oscilloscope settings).
  13. If waveform G is not correct, test IC102 pins 2 and 3. This gate inverts the input signal. Replace IC102 if necessary.
  14. If waveform G is correct, keep the oscilloscope on L101 and connect another oscilloscope channel to L102 (either end). Look for waveform G and F of Figure 4-24 (See Figure 4-24 for oscilloscope settings).
  15. If waveforms G and F are not correct, test IC102 pins 4, 5, and 6. This gate inverts the input signal (pin 4) at the output (pin 6). Pin 5 adds drive to the circuit and it should be "high." Replace IC102 if necessary.
  16. If waveforms G and F are correct, keep the oscilloscope connected to L101 and connect the other channel to the junction of R101, R106, and pin 9 of IC201 (Point E on the schematic). Look for Z and E waveforms of Figure 4-24 (See Figure 4-24 Z and E for oscilloscope settings).
  17. If waveforms Z and E are not correct, test IC104 pins 3 to 6 and 8 to 11. IC104 buffers and inverts the input signals. Replace IC104 if necessary.
  18. If waveforms Z and E are correct, proceed to step 19. If the preceding has caused CR109 to start flashing, the problem is in Q701 or one of its associated circuit components.
  19. If CR109 is flashing but the monitor still fails to respond when you touch the screen, connect an oscilloscope and attempt to display waveforms B and A as shown in Figure 4-24.
 

If pulses are not observed, replace the logic board or IC104, IC106, IC108, and IC109.
  20. Check the horizontal and vertical collector plates as follows:
    - a. Set the oscilloscope to 100 mV/Div AC.
    - b. Turn the logic board sensitivity (R204) fully counterclockwise. This is a maximum gain and it should cause an increase in noise amplitude (see Figures 4-2 and 4-23).
    - c. Place a lit incandescent light bulb (40 to 100 watts) several inches from the top left corner of the face of the CRT to induce a 60 Hz signal into the horizontal circuit from the infrared output of the bulb.
 

If the horizontal collector assembly is good, the oscilloscope will display a 60 Hz sine wave.

- d. Check the vertical collector the same way you checked the horizontal collector, except place the incandescent light bulb a few inches from the bottom right corner of the face of the CRT.
- e. If no signal is observed, check J3 and J4 for good connections.
- f. If the signal is observed from one detector, but not the other, replace the collector plate assembly that has no signal output.

**NOTE:** Both vertical and horizontal circuits must be operating before the touch control will respond to any touching.

- 21. If both collector plates fail the bulb test, the problem is most likely in the amplifier. Test the amplifier as follows:
  - a. Remove the logic board from the monitor, remove the top shield from the amplifier, and reconnect all logic board cable connectors.
  - b. Measure the amplifier transistor voltages. They should be the values shown below. If the values are not within 5% tolerance, replace the logic board. The ratios of the voltages between the base, collector, and emitter of each transistor must be as shown.

**Table 4-2**  
Logic Board Transistor Voltages

TRANSISTOR DESIGNATION	VOLTS DC		
	BASE	EMITTER	COLLECTOR
Q201	6.0	5.4	6.6
Q203	3.5	2.9	8.2
Q204	8.2	7.6	12.0
Q205	3.5	2.9	8.2

- c. Set R204 (sensitivity) to mid-range and induce a sine wave (10MHz, 10 mVpp) to pin 1 of the J3 connector. Check Q201 and Q203 collector voltages. The voltages should be 100 mVpp at Q201 and between 2 and 3 Vpp at Q203.
- 22. If the amplifier is satisfactory, check the collectors as follows:
  - a. With the monitor turned off, disconnect the collector plate cable from the logic board, and connect a DC voltmeter between pins 1 and 3 of the cable connector.
  - b. Position the monitor for the most room light to reach the collector plate that is under test (upside down for the horizontal collector plate and vertical collector plate side down for the vertical collector plate).
  - c. Record the DC Voltmeter reading with room light striking the the collector plate assembly and then block off the complete front of the monitor and record the meter reading again. The meter reading should change by a factor of 2 or more. With the room light blocked, the meter reading should be 20 mV or less. Readings with room light on the collector assembly will vary depending upon the type and intensity of the light. An example is, 150 mV with high intensity fluorescent room lighting.
  - d. Repeat this test for the other collector.
- 23. After repair, remove the test IC, install an operational IC101, and set S101 switches for operation, 2 and 3 off (away from the board) and all other switches on (toward the board).
- 24. Readjust the R204 sensitivity according to the Touch Control Sensitivity Adjustment procedure.

## Touch Control Alignment and Checkout

The touch grid displayed is for the 32 × 32 (all LEDs strobed) Monitor mode. This requires the 595-4177 (30-1166) plastic touch grid which has a 16 × 16 square pattern in a 7.5" × 7.5" area. Switch 5 of Logic Board switch S101 is factory set to on (32 × 32 mode).

### LOGIC BOARD DIP SWITCH S101

These switches are initially set for 4800 baud rate, no parity, and a 32 × 32 mode (matrix). See Figure 4-23 for the location of S101.

Switch positions = 0 for ON and 1 for OFF.  
 ON is down (toward the board).  
 OFF is up (away from the board).

**Table 4-3**  
S101 Settings

FUNCTION		SWITCH POSITIONS					
		1	2	3	4	5	6
BAUD RATE	110	ON	ON	ON			
	150	OFF	ON	ON			
	300	ON	OFF	ON			
	600	OFF	OFF	ON			
	1200	ON	ON	OFF			
	2400	OFF	ON	OFF			
	4800	ON	OFF	OFF			
PARITY	Zero parity and 8 bits					ON	
	Even parity and 7 bits					OFF	
MODE (MATRIX)	32 × 32						ON
TEST	Normal						ON
	Test						OFF

**NOTE:** This procedure requires the PLATO Diagnostic program in a Z-150 PC Series or Z-160 PC Series computer with a Z-319 video card installed. The CB-5063-28 Diagnostic Package also can be used to display the Touch Grid (except for early diagnostic packages).

**NOTE:** The object of this alignment is to achieve proper response of the touch control when any one of the squares of the **displayed grid** is touched. The plastic grid is used for coarse alignment and the displayed grid may be different at the completion of alignment. Proper response is indicated by an alternating display of 0 and X in the square touched with changes to only adjacent squares allowable.

1. Use tape to attach the plastic grid (30-1166) to the screen, aligning it with the the small dots at the centers of the top, bottom, left, and right sides of the CRT (see Figures 4-5 and 4-6).
2. Connect the computer and the ZVM-133-TC monitor as shown in Figure 1-2 and turn power on for both units.
3. Install the PLATO Diagnostic disk which will automatically boot.
4. Display the PLATO Touch Grid.
5. Adjust the horizontal center so that the displayed grid is centered with the plastic grid.
6. Adjust the horizontal width so that the right and left sides of the displayed grid conform to the plastic grid.
7. Repeat steps 3 and 4 as necessary, to get the displayed and plastic grids to conform horizontally.
8. Adjust vertical centering so that the displayed grid is centered with the plastic grid.



9. Adjust vertical size so that the top and bottom of the displayed grid coincide with the plastic grid.
10. Repeat 8 and 9 as necessary to get the displayed and plastic grids to coincide vertically.
11. Remove the plastic grid.
12. Turn the monitor power on and off to reset parameters.
13. Check for horizontal accuracy while touching squares with a 0.3 inch device. If there is a response for squares to the right or left of the one touched, adjust horizontal centering and width for better accuracy.

**NOTE:** It is acceptable for adjacent squares to be activated when a square is touched after final video alignment.

14. Check for vertical accuracy while touching squares with a 0.3 inch device. If there is a response to squares above or below the one touched, adjust vertical centering and vertical size for better accuracy.

## Touch Control Performance Test

**NOTE:** This procedure requires the PLATO Diagnostic program in a Z-150 PC Series or Z-160 PC Series computer with a Z-319 video card installed.

The CB-5063-28 Diagnostic Package also can be used to display the Touch Grid (except for early diagnostic packages).

1. Connect the computer and the ZVM-133-TC monitor as shown in Figure 1-2 and turn power on for both units.
2. Install the PLATO Diagnostic disk which will automatically boot.
3. Display the PLATO Touch Grid.
4. Select any square on the CRT and note its coordinates.
5. Point to the selected square by placing a 0.3" diameter pointer on the face of the CRT:
  - An audible beep should be heard.
  - An 0 should be displayed in the center of the selected square.
  - The X-axis and Y-axis coordinates, for the square being touched, should be indicated in the left-hand bottom corner of the CRT.
  - An X or a 0 may be displayed in a directly adjacent square; above, below, right, or left of the touched square.

**NOTE:** The display alternates between X and O when a square is repeatedly touched.

6. Touch other squares on the display including the edges and corners and check for proper responses as indicated in step 5.

## 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 and with a mild cleaning solution; do not spray liquids directly on the monitor, or use a wet, saturated cloth.
- Clean the monitor's screen with a good quality glass cleaner.
- Be sure that the monitor is completely dry before applying electrical power.

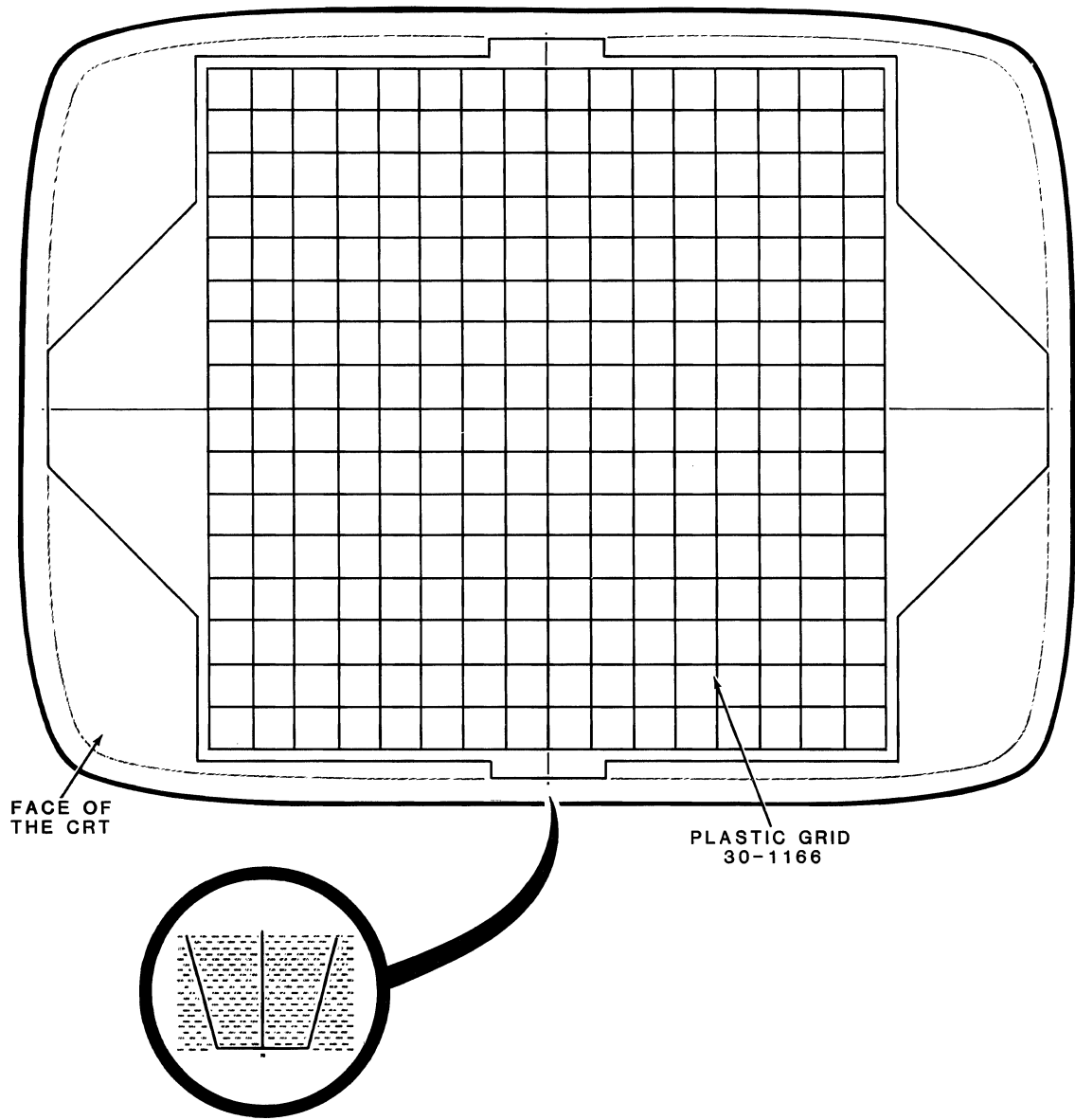
## Servicing Diagrams

Use the following block diagrams to locate schematics while tracing signal and power circuits during troubleshooting.

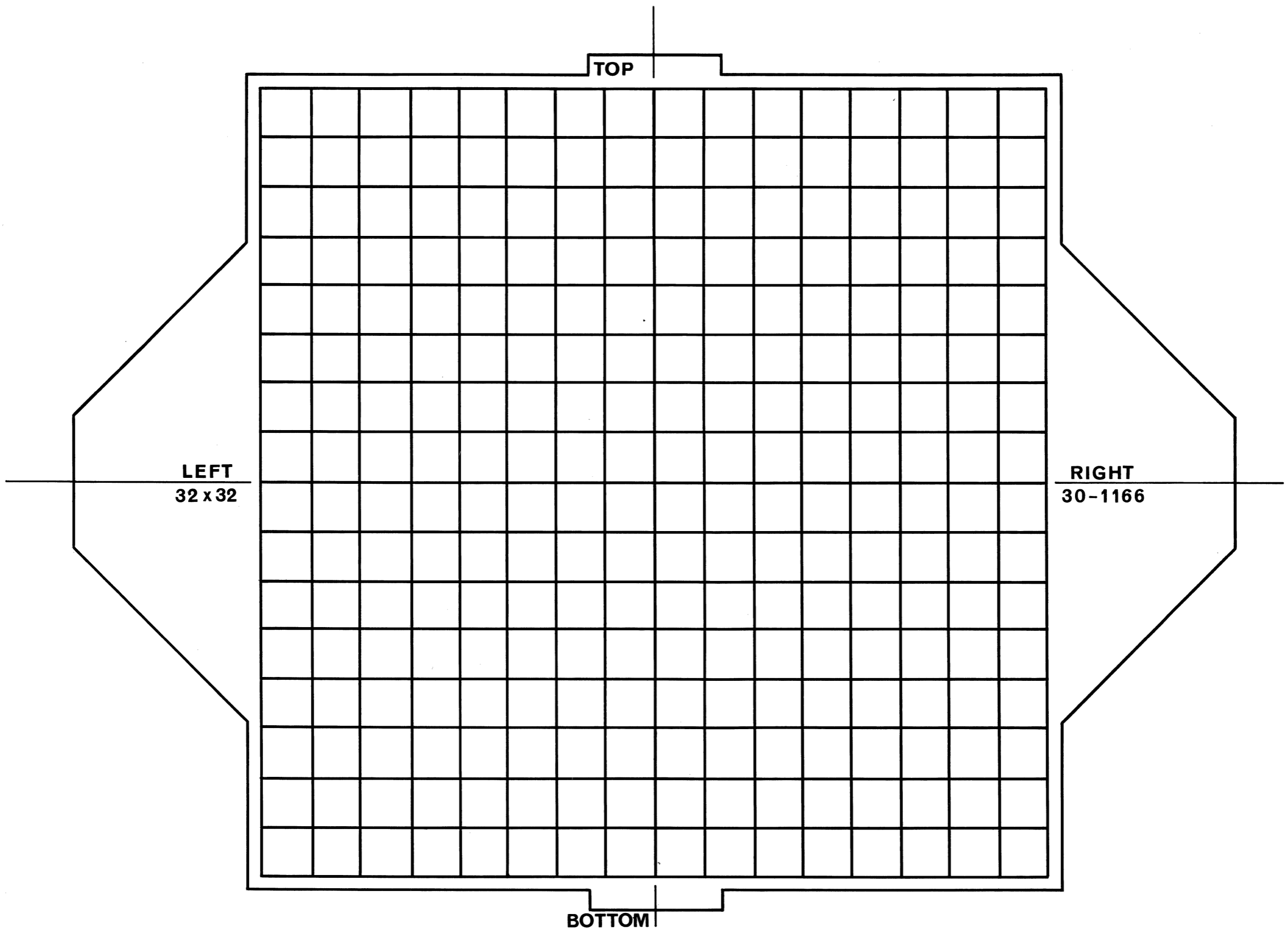
Waveform representations are provided with adjacent schematic and component location drawings. The source location of waveforms are shown on both schematic and component location drawing.

A Z-160 PC Series computer was used to supply the RGB and composite 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.

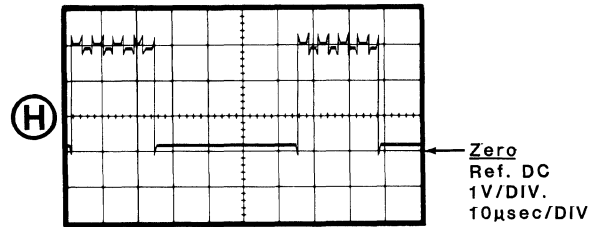
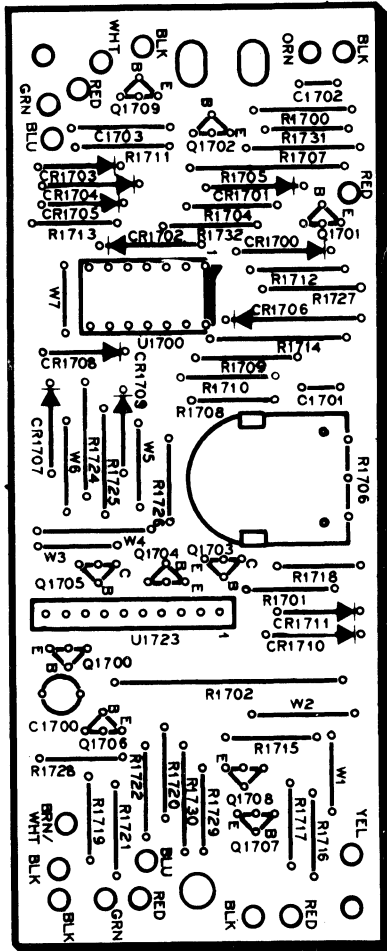


**Figure 4-6**  
*Installation of Plastic Grid*

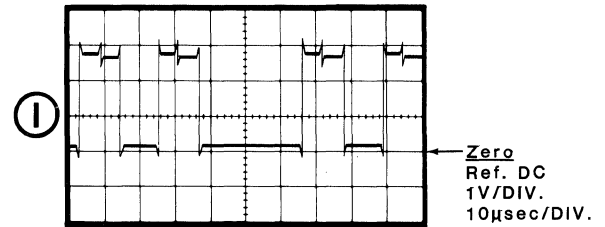


**Figure 4-7**  
595-4177 (30-1166) Plastic Grid  
Overlay (full-size)



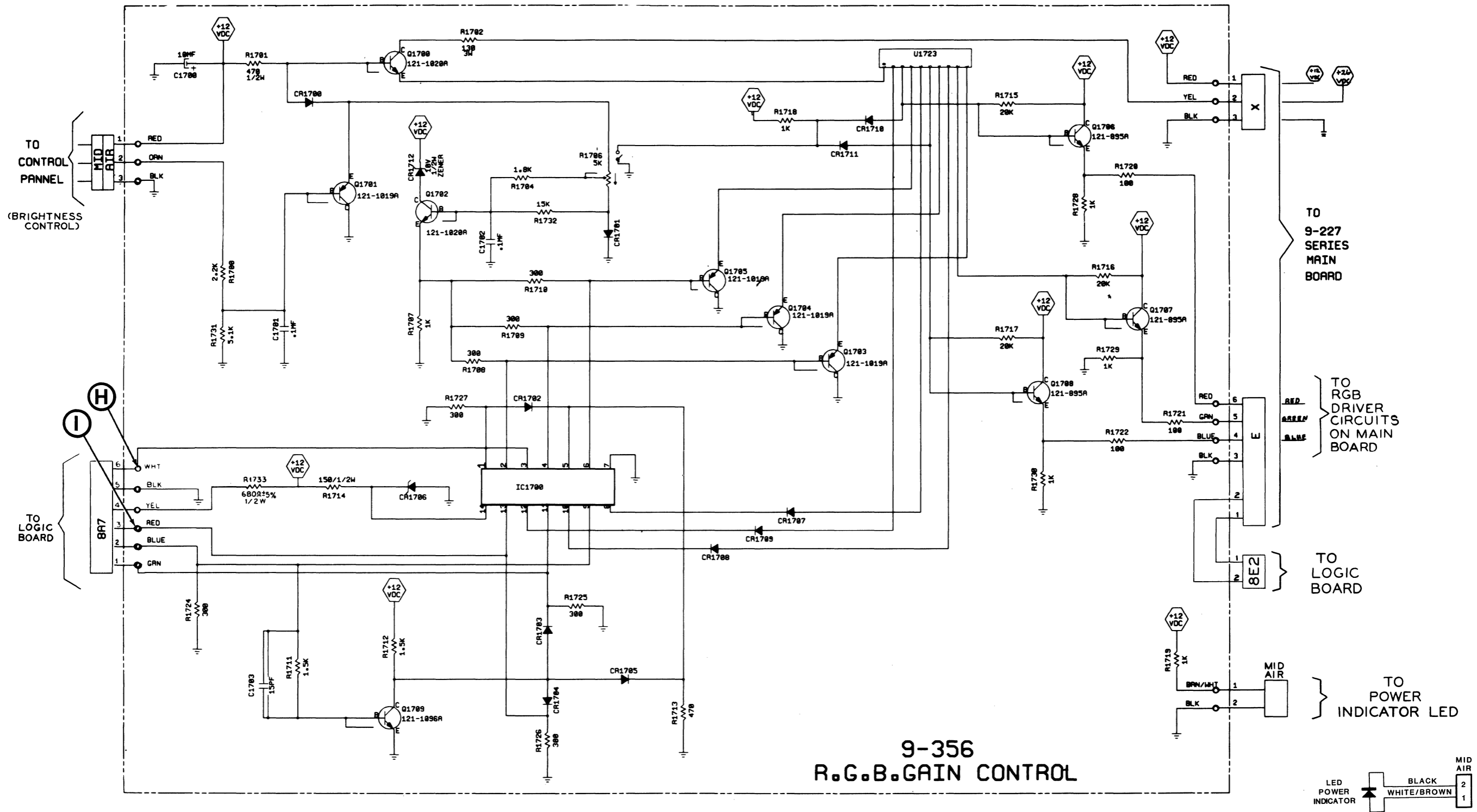


Connector 8A7, Pin 6  
Intensity Input From Computer  
(RGB input)



Connector 8A7, Pin 3  
RED Signal From Computer  
(RGB input)

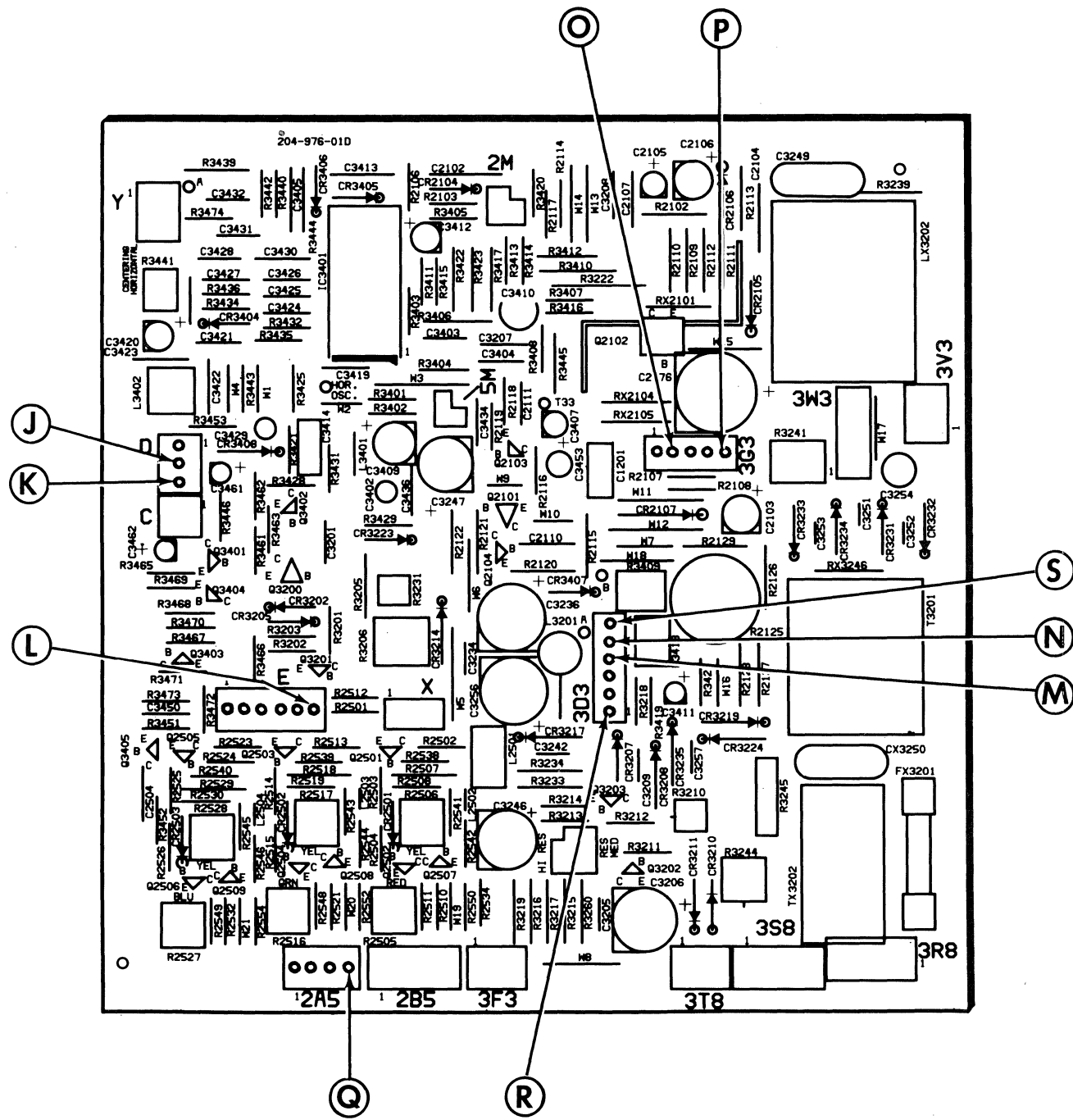
**Figure 4-9**  
*RGB Gain Control Board Component  
Location and Waveforms*



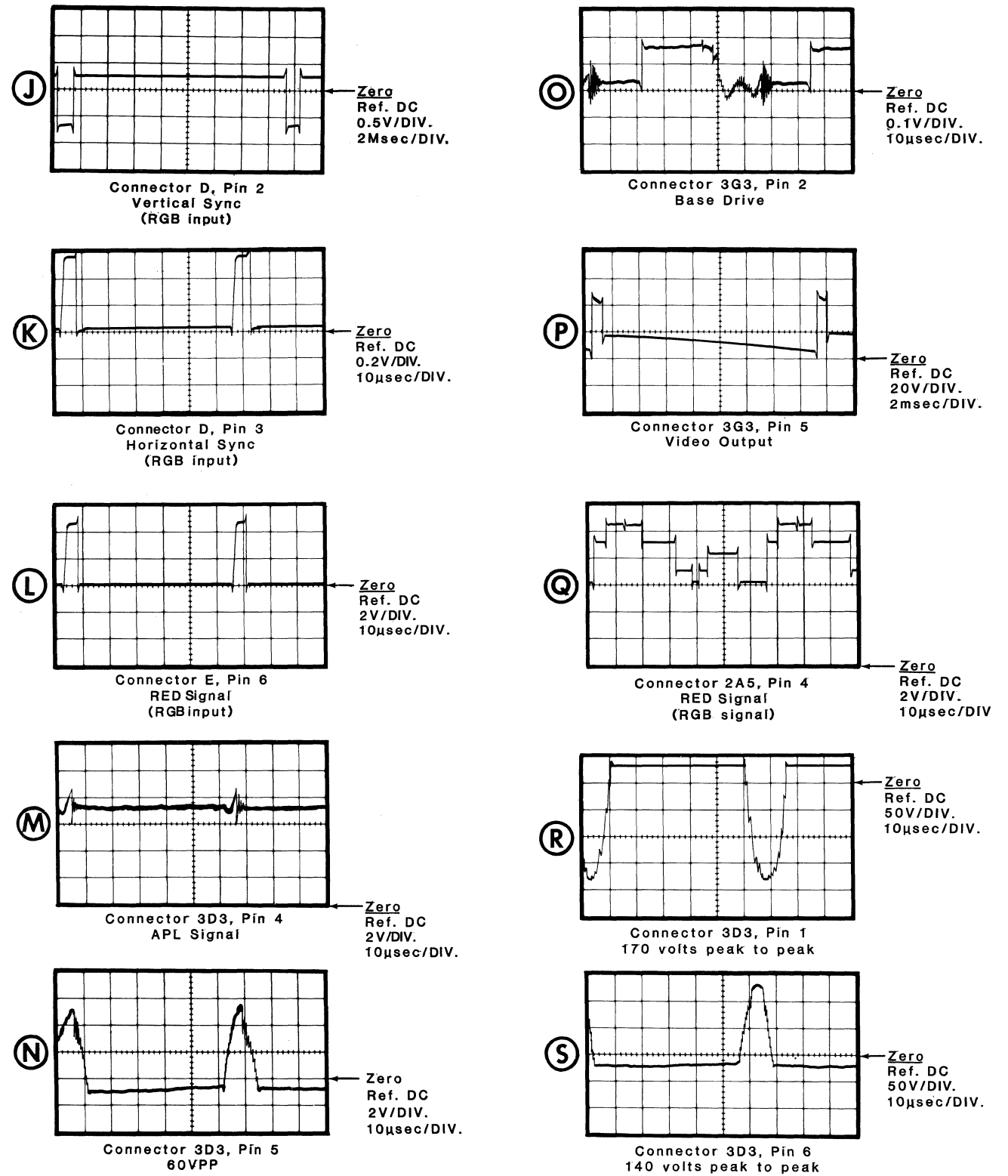
NOTES:  
 1. RESISTORS ARE 1/4 WATT, 5 PERCENT TOLERANCE UNLESS OTHERWISE SPECIFIED.  
 2. CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.

NOTES: (VALUE TAGS WITH SPECIAL MEANINGS)  
 A. P/L = SEE PARTS LIST FOR APPLICABLE USAGE.  
 B. JUMPER = JUMPER WIRE USED INSTEAD OF NORMAL PART  
 C. PROV = PROVISION FOR A PHYSICAL PART IN THE LAYOUT ONLY.

**Figure 4-10**  
*RGB Gain Control Board Schematic*

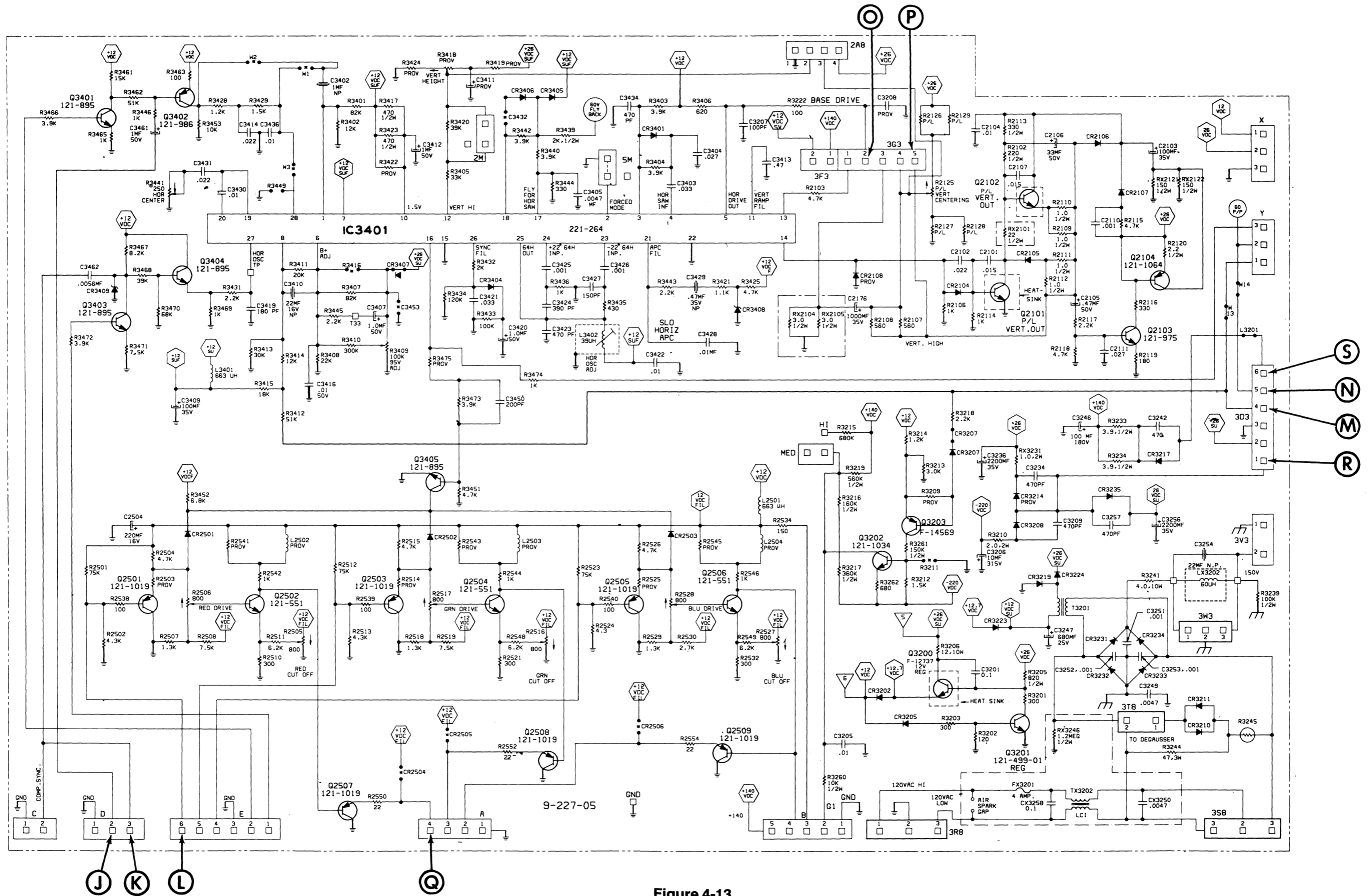


**Figure 4-11**  
Main Board Component Location



**Figure 4-12**  
Main Board Waveforms

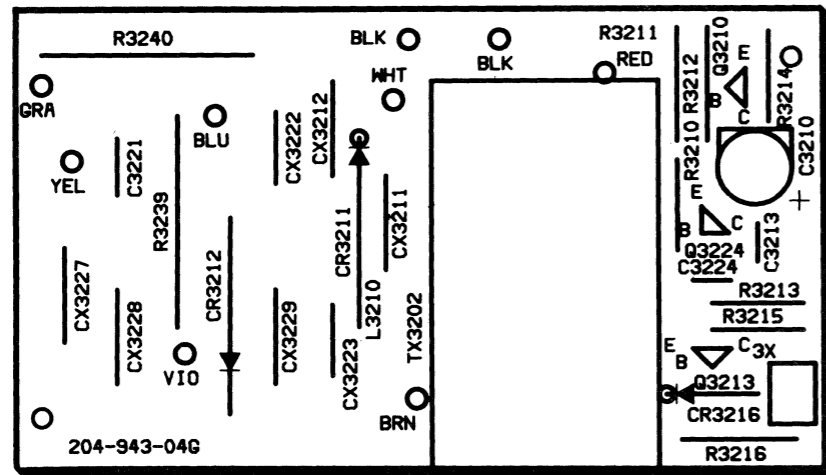




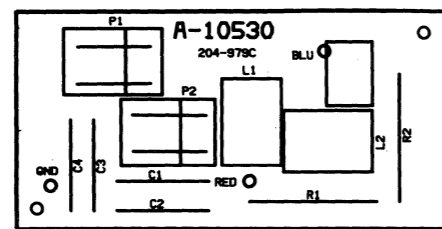
**Figure 4-13**  
Main Board Schematic



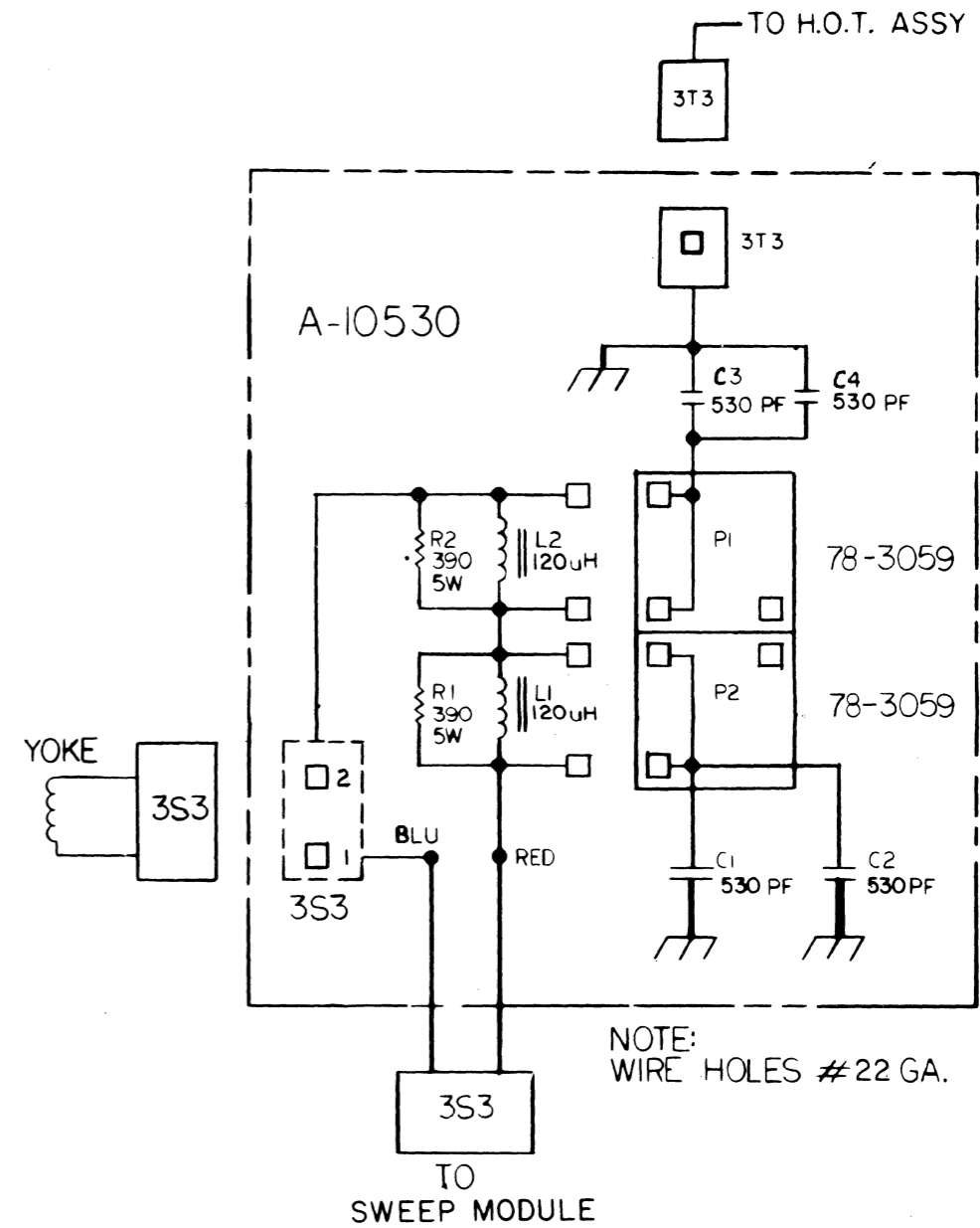




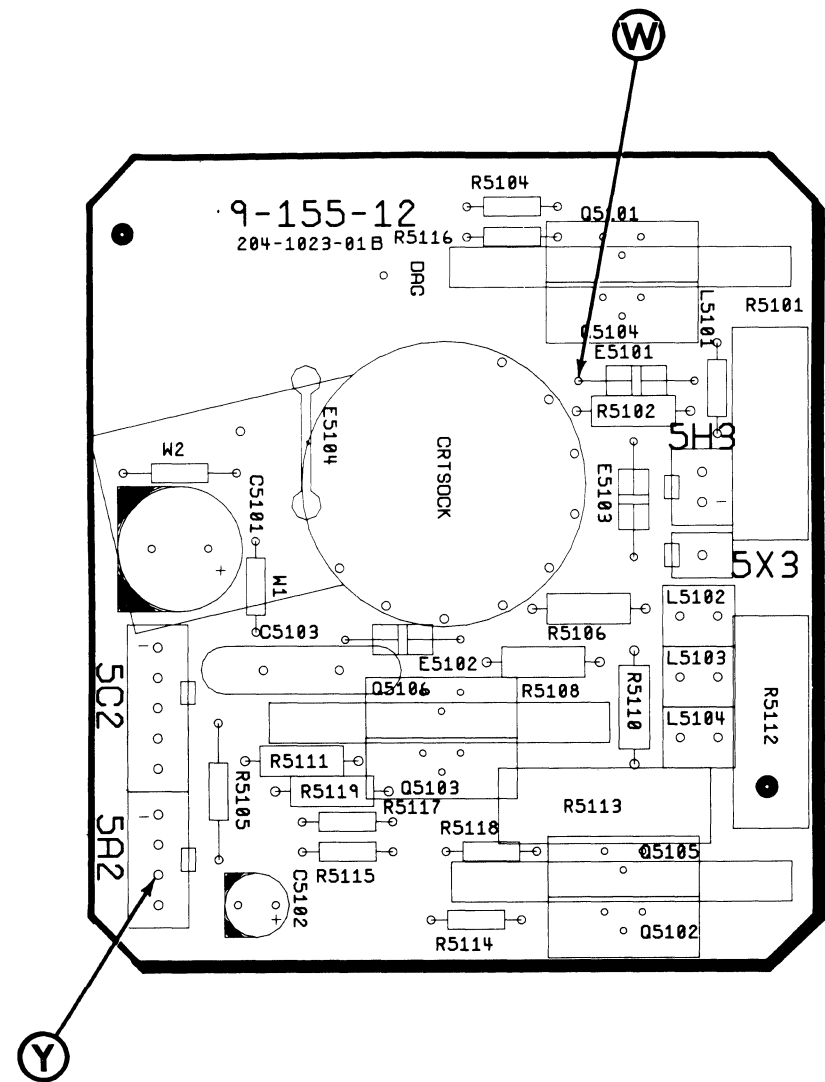
**Figure 4-17**  
High Voltage Power Supply Component Location



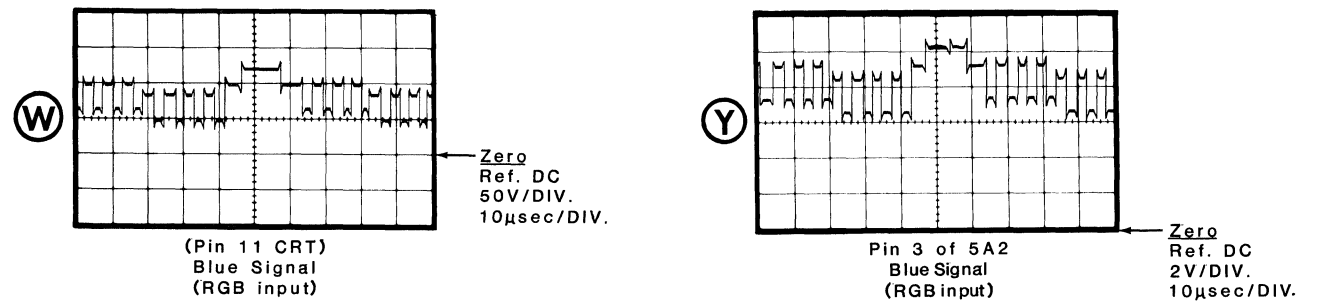
**Figure 4-18**  
Width Step Board Component Location



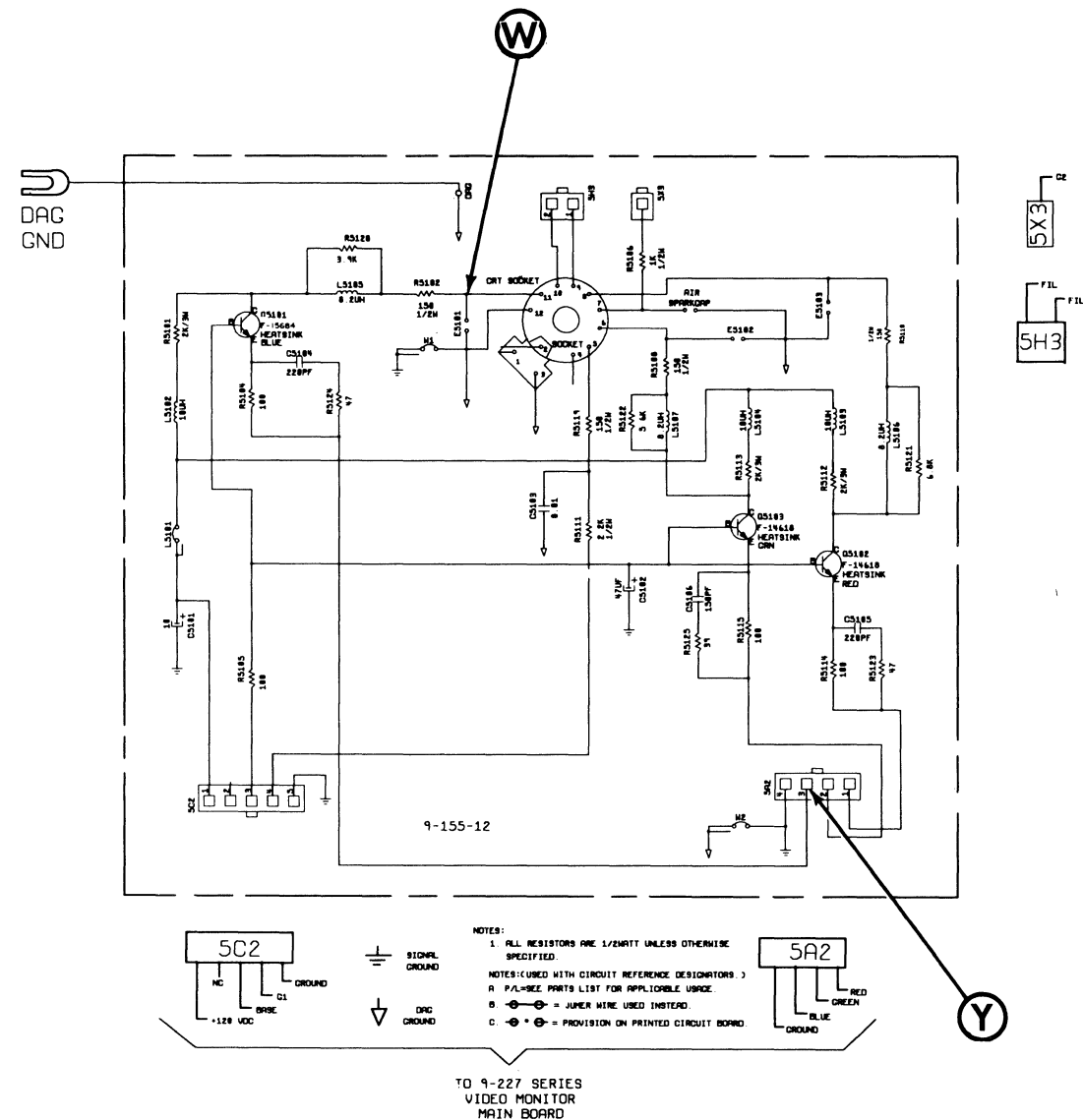
**Figure 4-19**  
Width Step Board Schematic



**Figure 4-20**  
Video Output Board Component Location



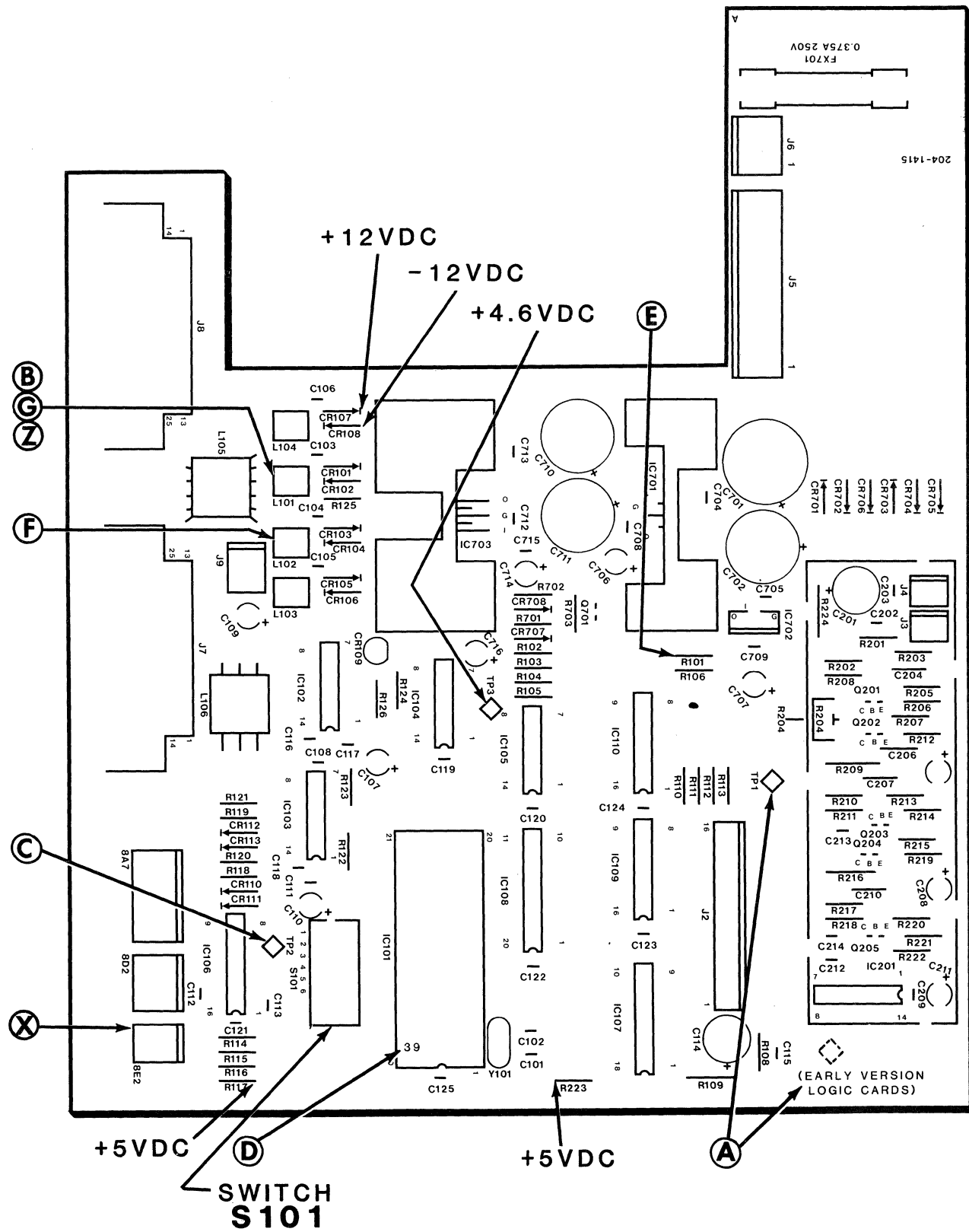
**Figure 4-21**  
Video Output Board Waveforms



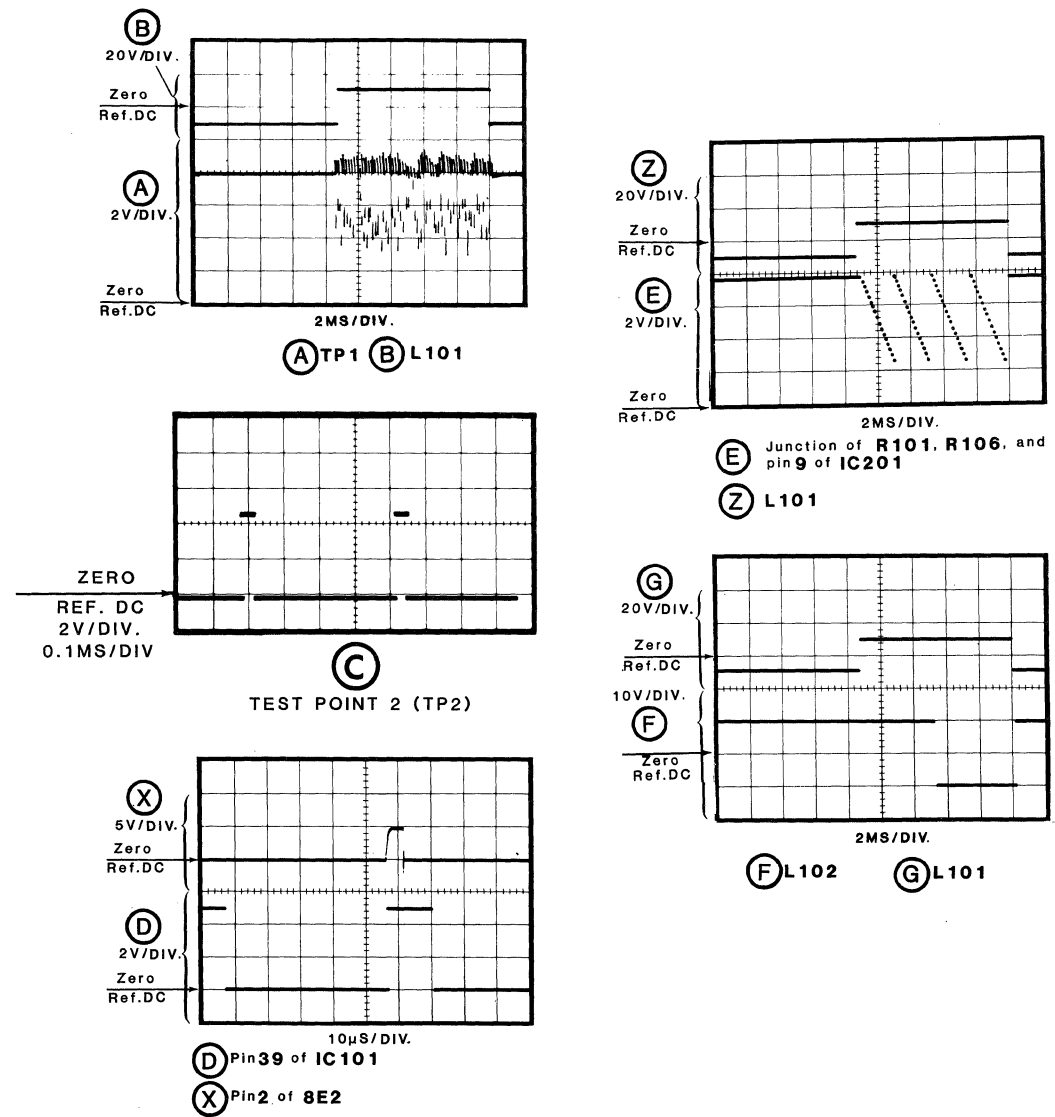
**NOTES:**  
 1. ALL RESISTORS ARE 1/2WATT UNLESS OTHERWISE SPECIFIED.  
 NOTES: CIRCLED WITH CIRCUIT REFERENCE DESIGNATORS.  
 A. P.A.M.C.E. PARTS LIST FOR APPLICABLE USAGE.  
 B. = SUPER WIRE USED INSTEAD.  
 C. = PROVISION ON PRINTED CIRCUIT BOARD.

TO 9-227 SERIES  
VIDEO MONITOR  
MAIN BOARD

**Figure 4-22**  
Video Output Board Schematic



**Figure 4-23**  
Logic Board Component Location



NOTE: J9 PIN 2 WAS USED FOR GROUND REFERENCE FOR ALL WAVEFORM REPRESENTATIONS.

**Figure 4-24**  
Logic Board Waveforms

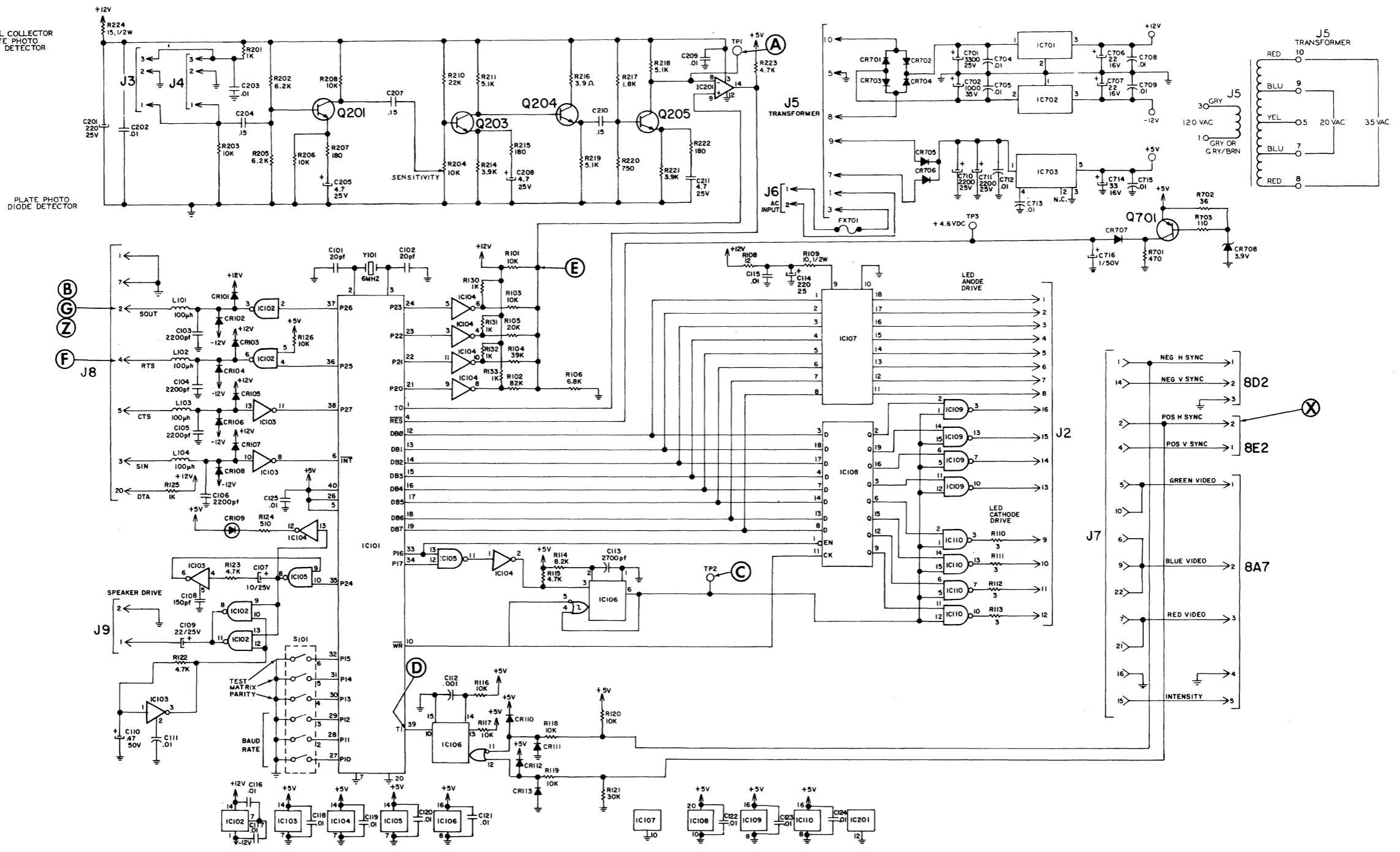
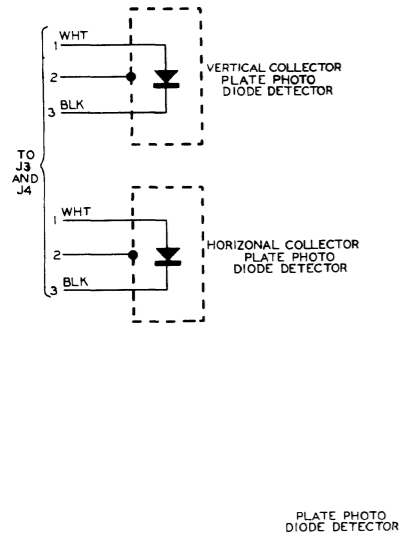
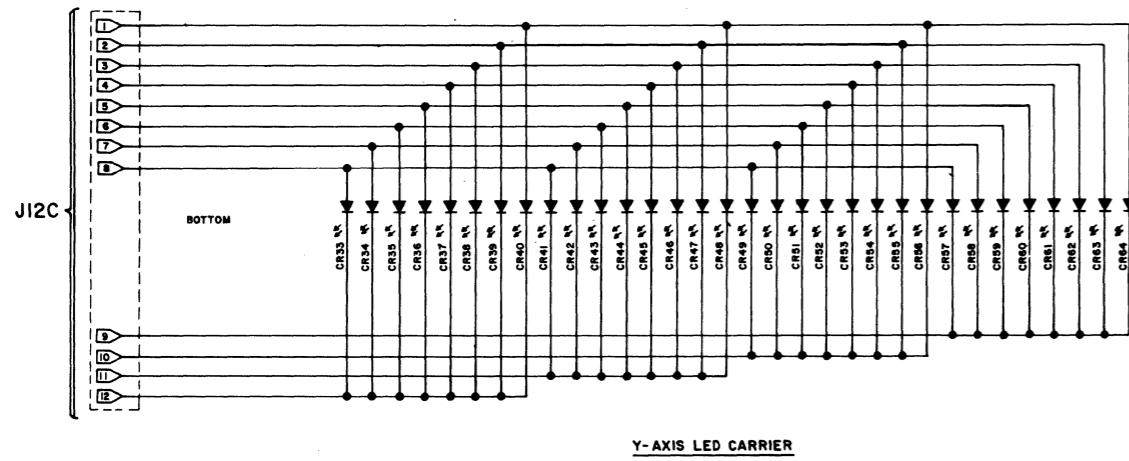
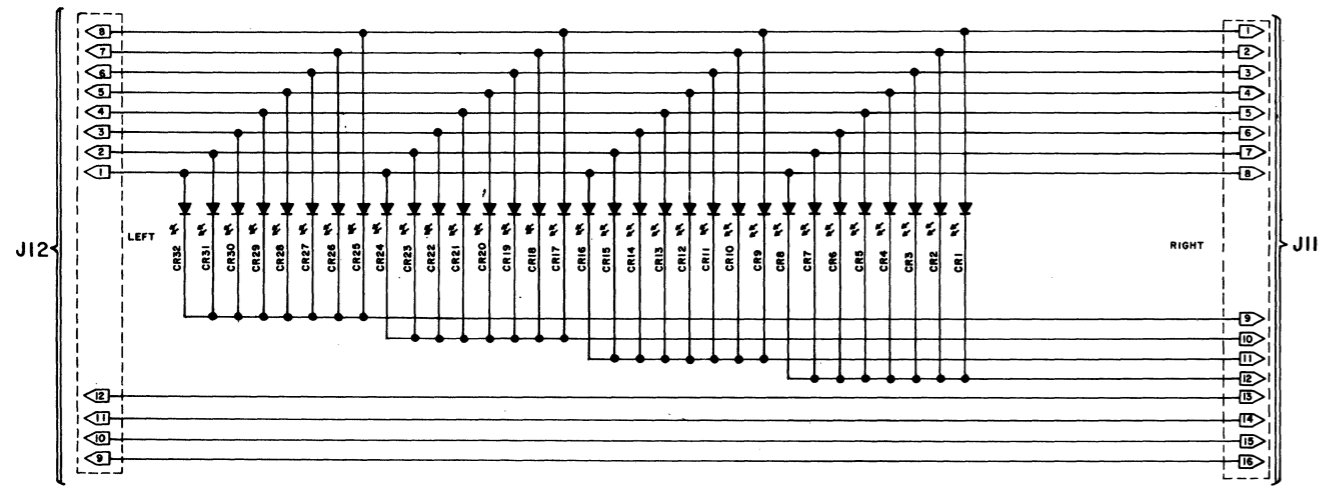


Figure 4-25  
Logic Board Schematic

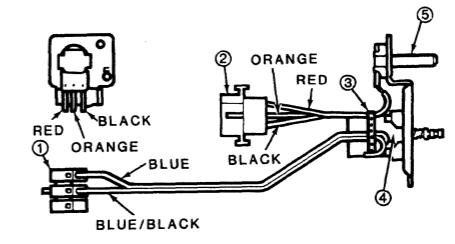


Y-AXIS LED CARRIER



X-AXIS LED CARRIER

Figure 4-26  
X-Axis and Y-Axis LED Carrier Schematic



DESCRIPTION	QTY.	ITEM PART NUMBER	ITEM
CONROL ROTARY, SINGLE	1	O63-10770-17	⑤
SWITCH PUSH BUTTON, LOCKING	1	O85-01559-02	④
STRAP CABLE TIE	1	O19-00733-07	③
CONNECTOR & CABLE ASSY	1	O50-00481	②
CABLE & HOUSING ASSY	1	A-10150-05	①

Figure 4-27  
Primary Control Board Component Location

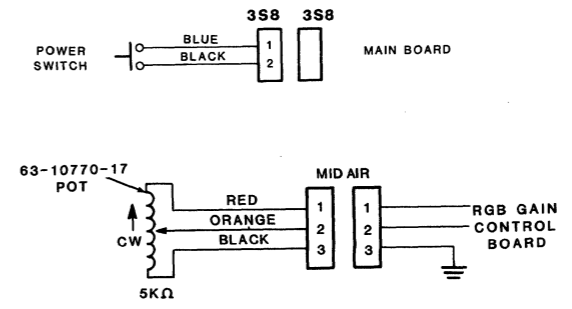


Figure 4-28  
Primary Control Board Schematic



# Disassembly/Reassembly

This chapter along with Figure 6-1, provides instructions to both disassemble and reassemble the monitor. Except for the CRT, the step-by-step instructions are written for disassembly. For reassembly, perform steps in the reverse order except when instructed to do otherwise. Replace all cut cable ties during reassembly.

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

## Back Cover (10)

1. Disconnect the power and signal cables from the rear of the monitor.
2. Remove the four screws (05) from the back cover (10) and pull the cover back and away from the monitor.

## Top Cover (20)

1. Remove the back cover (10).
2. Remove the two screws (15) from the bottom of the cabinet and lift the top cover (20) up and toward the rear of the monitor.

## Video Output Board (70)

1. Carefully remove the video output board from the neck of the CRT and disconnect cable connectors 5A2, 5C2, 5X3, and 5H3.
2. Disconnect the focus lead by twisting the halves of the connector and pulling them apart.

3. Disconnect the gray grounding wire from the CRT ground contact (100).

## Cabinet Front (150)

1. Remove the back cover (10).
2. Remove the top cover (20).
3. Disconnect the primary control cable connectors from the other boards.
4. Disconnect the RGB gain control board cables from the other boards.
5. Disconnect the degaussing cable connector from the main board.
6. Remove the four screws (168) which secure the cabinet front (150) and bring the cabinet front forward and away from the monitor.

## Primary Control Board (125)

1. Remove the cabinet front (150).
2. Cut the cable tie (167) which holds the power LED cable to the brightness control cable.
3. Remove the two screws (120) securing the primary control board and remove the control board from the cabinet front.

**NOTE:** The control knobs do not have to be removed because they will fit through the openings in the front of the cabinet.

## RGB Gain Control Board (135)

1. Remove the cabinet front (150).
2. Disconnect the cables from the primary control board and power LED.
3. Remove the two screws (130) securing the RGB gain control board and remove the board from the cabinet front.

**NOTE:** The control knobs do not have to be removed because they will fit through the openings in the front of the cabinet.

## Main Board (85)

The main board is mounted on two plastic guides that are bolted to the chassis.

1. Spring the retaining clips to free the board from the two plastic guides (80 and 82).
2. Disconnect all cables from the board (85) and lift it out of the cabinet.

**NOTE:** The board may be secured to the plastic guides with screws also. These screws would have to be removed.

## High Voltage and Horizontal Sweep Assembly (77)

1. Remove the cabinet back (10).
2. Remove the cabinet top (20).

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

**WARNING:** Discharge the high voltage at the anode lead to 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.

4. Remove the four screws (75) holding the board to the chassis and disconnect all remaining cables from the assembly.

## CRT Disassembly (105)

**NOTE:** CRT replacement is not recommended for field service because the touch control realignment is critical and difficult.

**NOTE:** CRT is replaceable as CRT, yoke, and beam bender assembly only. This eliminates field service purity and convergence adjustments. If impurities appear, check the degaussing circuit.

1. Remove the cabinet back (10).
2. Remove the cabinet front (20).
3. Discharge the high voltage and disconnect the high voltage lead from the CRT (105).

**WARNING:** Discharge the high voltage at the anode lead to 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.

4. Cut the tie which holds the high voltage lead to the corner of the CRT.

5. Disconnect the video output board from the CRT.
6. Disconnect the ground lead which connects the clamp on the neck of the CRT to the CRT ground contact (100).
7. Disconnect the yoke cable connectors.
8. Disconnect the primary control cable connectors from the monarch logic board and the main board.
9. Disconnect the secondary control cable connectors from the monarch logic board and the main board.
10. Remove the four screws (168) which secure the cabinet front to the right and left chassis CRT mounting plates (151 and 152) and remove the cabinet front.
11. Remove the two screws (169) which secure the horizontal collector plate (157) to the bracket at the top center of the crossbrace (30).
12. Remove the two screws (169) which secure the vertical collector plate (156) to the right chassis mounting plate (151).
13. Remove the four nuts (171) and four flat washers (172) which secure the plastic holder (162) to the front of the CRT and slide the holder forward away from the monitor.
14. Remove the four spacers (163) from the four stud bolts (164) at the corners of the CRT.
15. Place the monitor face down on a soft horizontal surface.
16. Disconnect the video output board ground wire from the CRT contact ground.
17. Disconnect the degaussing cable connector from the main board.

18. Remove the four stud bolts (164) and star washers (165), and flat washers (166) from the four front corners of the CRT.
19. Carefully lift the monitor away from the CRT.

## CRT Reassembly (105)

**NOTE:** Touch Control Alignment and Checkout in the Servicing chapter should be read before attempting this procedure.

1. Place the CRT face down on a soft horizontal surface.
2. Position the monitor, face down, directly over the CRT with the CRT ground contact in alignment with the top corner of the monitor.
3. Use the stud bolts (164), flat washers (166), and star washers (165) to secure the CRT to the right and left CRT mounting plates.
4. Reposition the monitor so it is top side up.
5. Install spacers (163) over the stud bolts (164).
6. Carefully install the plastic holder (162) over the stud bolts and secure the CRT with the flat washers (172) and nuts (171).
7. Install the logic board and the video output board.
8. Reconnect all cables between the cabinet front and the monitor. Lean the cabinet front in a face down position, away from the CRT.
9. Use tape to attach the 16 × 16 line plastic grid (30-1165) to the face of the CRT, aligning it with the small dots at the centers of the top, bottom, and sides of the CRT (see Figures 4-5 and 4-6).

10. Reconnect the monitor power and signal cables(see Figure 1-2).
11. Use the PLATO Diagnostic disk in the computer to display the PLATO Touch Grid.
12. Check for alignment between the plastic grid and the display. Rotational and off-square misalignment must be mechanically corrected which may require removing the plastic holder (162) to allow access to the stud bolts (164).
13. Touch squares and check for proper response. (See Touch Control Alignment and Checkout in the Servicing chapter.)

**NOTE:** Failure of the touch control to respond to touching squares in the outside rows is an indication of extreme misalignment. Resetting of horizontal centering, vertical centering, height, and width may be necessary.

This failure may also be caused by misalignment between an LED board and its collector plate. The design of the rigid plastic holder (162) with its positive mechanical mounting for the LED boards and collector plates, reduces the frequency of these misalignments.

14. Remove the plastic grid and install the cabinet front.
  15. Check for horizontal accuracy while touching squares with a 0.3 inch device. If there is a response to the squares to the right or left of the square touched, adjust horizontal centering and width for better accuracy.
- NOTE:** It is acceptable for adjacent squares to be activated when a square is touched after final video alignment.
16. Check for vertical accuracy while touching squares with a 0.3 inch device. If there is a response to squares above or below the square touched, adjust vertical centering and vertical height for better accuracy.

## Logic Board (65)

1. Remove the back cover (10) and the top cover (20).
2. Unplug the video output board from the CRT.
3. Disconnect all cables from the logic board except J3 and J4 detector cables.
4. Remove the two screws (178) which secure the board stand-offs (173) to the right chassis CRT mounting plate (151).
5. Push the plastic board support (174) toward the board and out of the hole in the right chassis CRT mounting plate.
6. Remove the two screws (35) which secure the input panel assembly (40) to the right chassis CRT mounting plate.
7. Remove the four stand-offs (175) which secure the DTE and video input connectors to the input panel.
8. Remove the two screws (176) which secure the logic board to the input panel.
9. Move the logic board toward the center of the monitor until it is beyond the transformer (177) and then bring it toward the rear to allow access to the detector connectors J3 and J4.
10. Carefully peel back the copper foil to expose connectors J3 and J4.
11. Disconnect the cable connectors J3 and J4 and remove the logic board from the monitor.

**NOTE:** The detector cables can be interchanged at the logic board connectors J3 and J4 as these connectors are wired in parallel on the board.

## LED Boards and Collector Plates

1. Remove the back cover (10).
2. Remove the top cover (20).
3. Remove the four screws (168) which secure the cabinet front to the right and left chassis CRT mounting plates.
4. Pull the cabinet front forward to the point where it is held by the cables only and then lean it face down, away from the CRT.
5. Remove the specific LED board or collector plate.

### Horizontal (top) Collector Plate (157)

- a. Disconnect the cable connector from the logic board.
- b. Remove the four screws (169) which secure the collector plate at the top of the monitor.
- c. Carefully bring the collector plate forward and out of the plastic holder (162).

**NOTE:** Observe the placement of insulators (181) and spacers (179) and install them in the same place during reassembly.

### Vertical (side) Collector Plate (156)

- a. Remove the logic board (65).
- b. Remove the two screws (180) which secure the collector plate at the front of the CRT.

- c. Remove the two screws (169) which secure the collector plate to the right chassis CRT mounting plate.
- d. Carefully bring the collector plate forward and out of the plastic holder (162).

**NOTE:** Observe the placement of insulator (181) and install it in the same place during reassembly.

### Horizontal (bottom) LED Board (159)

- a. Remove the two screws (180) which secure the board at the face of the CRT.
- b. Carefully pull the board forward away from the CRT and disconnect the board connector from the logic board.
- c. Disconnect the connector from the cable to the vertical (side) LED board (160).

**NOTE:** During reassembly, make sure that the board is slid straight back, all the way into its retaining slot, and tightened securely to maintain touch control alignment.

### Vertical (side) LED Board (160)

- a. Remove the vertical LED board.
- b. Remove the two screws (180) which secure the board at the face of the CRT.
- c. Slide the board out of its retaining slot.

**NOTE:** During reassembly, make sure that the board is slid straight back, all the way into its retaining slot, and tightened securely to maintain touch control alignment.



# Chapter 6 Parts List

All part numbers in this manual are identified in the following tables of parts lists: Table 6-1: Monitor Major Assemblies, Table 6-2: Cable Assemblies, and Table 6-3 through Table 6-10 board and assembly components.

**CAUTION:** Some of the ICs used in this unit are electrostatic-sensitive devices. These devices can be damaged by static electricity. 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. 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 circuits are incorporated for additional protection and X-radiation protection. Special circuits are also used to prevent shock and fire hazard. These special circuit components, which 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 list, N/A refers to "Not Assigned" parts for which there is no replacement part number assigned.

Assemblies identified by part numbers which start with the letter F are not available at this assembly level.

Table 6-1 identifies the monitor major assemblies and provides their part numbers (see Figure 6-1).

**Table 6-1:  
Monitor Major Assembly Parts List**

REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
05	114-1207	Screw, back cover, 8-18 × .625 hex head
10	14-11514-03	Back cover
15	112-2262-05	Screw, cover glue block, 8-18 × 1.250 phillips
20	14-11649	Top cover
25	114-802-01	Screw, cross brace, 8-18 × .375 hex head
30	12-8298	Cross brace
35	114-1100-01	Screw to input panel
40	N/A	Input panel assembly
65	A-13336	Logic board
70	9-155-12	Video output board
74	12-8130	Width board mounting bracket
75	114-1270	Screw, high voltage and horizontal sweep board
76	114-984	Screw, width board to bracket
77	9-247-08	High voltage and horizontal sweep board
78	A-10530	Width step board
79	114-802	Screw, bracket for width step board
80	12-8228	Main board left-mounting guide
82	12-8228	Main board right-mounting guide

**Table 6-1 (continued):  
Monitor Major Assembly Parts List**

REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
85	9-227-10	Main board
90	19-733-04	Cable tie
91	19-733-09	Cable tie
92	A-11104	Degaussing coil and cable assembly
100	127-226-01	Contact, CRT ground
105	A-11161-04	CRT, yoke, and beam bender assembly
120	114-1402	Primary control board screws
125	A-13360	Primary control board and switch assembly
N/A	A-08846	Knob assembly ON/OFF
N/A	46-10335	Knob
126	A-10675	LED, cable, and housing
N/A	19-1000	Clip, LED mounting
130	114-1402	RGB gain control board screws
135	9-356	RGB gain control board
140	114-1393	Screw, chassis
141	N/A	Insulating standoffs
145	12-8415	Bottom plate
145	12-8416	Perforated bottom plate
146	A-11847	Power cable
146	50-347	Power cable assembly
147	125-198-07	Power cable strain relief
N/A	114-1425-01	Screw, AC line, ground to frame
150	14-11647	Cabinet front
N/A	114-1402	Screw, cabinet front to right and left CRT plate
151	12-8214-10	Right chassis mounting plate
152	12-8214-11	Left CRT chassis mounting plate
155	14-11515-01	Cabinet bottom
156	A-13242	Vertical (side) collector plate
157	A-13243	Horizontal (top) collector plate
158	192-00744	Lens, IR Filter
159	A-13337	Horizontal diode board
160	A-13338	Vertical diode board
N/A	103-C0002	Infrared diodes (part of diode boards)
162	012-08829	Molded plastic bracket, LED support
163	N/A	Spacer
164	N/A	Stud bolt
165	N/A	Star washer
166	N/A	Flat washer
167	N/A	Cable tie
168	N/A	Screw
169	N/A	Screw
170	N/A	Screw
171	N/A	Nut
172	N/A	Flat washer
173	N/A	Standoff, logic board



**Table 6-1 (continued):  
Monitor Major Assembly Parts List**

REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
174	N/A	Plastic support, logic board
175	N/A	Standoff
176	N/A	Screw
177	95-03624-01	Power transformer (TX701), logic board
178	N/A	Screw
179	N/A	Spacer
180	N/A	Screw
181	N/A	Insulator, collector plates
182	N/A	Screw
183	N/A	Screw
184	A-13244	Diode and cable assembly (part of collector plates A-13242 and A-13243)
N/A	162-00012-01	Photo diode (part of A-13244)
185	54-01054	Spring nut
186	N/A	Star washer
187	N/A	Screw
188	N/A	Bracket, horizontal collector plate
189	N/A	Cable tie, twisted
N/A	24-02899-02	Secondary control cover
N/A	30-01053-02	Secondary control overlay
N/A	166-00265	Rubber feet
N/A	30-01107-02	Control Data logo
N/A	A-10632-03	High voltage power supply
N/A	136-00123-15	.375A slo-blo fuse FX710 (logic board)
N/A	136-00113-23	4A fuse FX320 (main board)

Table 6-2 identifies interconnecting monitor cables and provides their part numbers.

**Table 6-2:**  
Cable Assemblies Parts List

CABLE IDENTIFIER	ZDS PART NUMBER	DESCRIPTION
2A5 – 5A2	A-9882-01	
2B5/5C2	A-9882-08	
2B5 5C2	A-9882-17	
3D3	A-9919-26	
3F3	A-9913-29	
3G3	A-9917	
	A-10080	includes housing
3S3	A-9941-11	
3T3	A-9939-24	
3R3	A-9943-10	
3V3	A-9941-23	
3W3	A-9943-07	includes capacitor (22-7735-01)
5H3	A-9911-58	
5X3	A-9939-18	

Table 6-3 identifies A-13336 Logic Board components and provides their part numbers (see Figure 4-23).

**Table 6-3:**  
A-13336 Parts List

CIRCUIT DESCRIPTION	ZDS PART NUMBER	DESCRIPTION
<b>Capacitors</b>		
C101	22-7619-17	20 pF disc
C102	22-7619-17	20 pF disc
C103		
through		
C106	22-7776-04	0.0022 $\mu$ F polyester

**Table 6-3 (continued):**  
A-13336 Parts List

CIRCUIT DESCRIPTION	ZDS PART NUMBER	DESCRIPTION
C107	22-7860-05	10 $\mu$ F electrolytic
C108	22-7613-02	150 pF disc
C109	22-7860-06	22 $\mu$ F electrolytic
C110	22-7390-02	0.47 $\mu$ F electrolytic
C111	22-7615-06	0.01 $\mu$ F disc
C112	22-7773	0.001 $\mu$ F polyester
C113	22-7773-05	0.0027 $\mu$ F polyester
C114	22-7860-10	220 $\mu$ F electrolytic
C115		
through		
C125	22-7615-06	0.01 $\mu$ F disc
C201	22-7860-10	220 $\mu$ F electrolytic
C202	22-7615-06	0.01 $\mu$ F disc
C203	22-7615-06	0.01 $\mu$ F disc
C204	22-7738-26	0.15 $\mu$ F polyester
C205	22-07860-04	4.7 $\mu$ F electrolytic
C207	22-7738-26	0.15 $\mu$ F polyester
C208	22-7860-04	4.7 $\mu$ F electrolytic
C209	22-7615-06	0.01 $\mu$ F disc
C210	22-7738-26	0.15 $\mu$ F disc
C211	22-7860-04	4.7 $\mu$ F electrolytic
C701	22-7860-15	3300 $\mu$ F electrolytic
C702	22-7861-13	1000 $\mu$ F electrolytic
C704	22-7615-04	0.01 $\mu$ F disc
C705	22-7615-04	0.01 $\mu$ F disc
C706	22-7859-06	22 $\mu$ F electrolytic
C707	22-7859-06	22 $\mu$ F electrolytic
C708	22-7615-06	0.01 $\mu$ F disc
C709	22-7615-06	0.01 $\mu$ F disc
C710	22-7860-14	2200 $\mu$ F electrolytic
C711	22-7860-14	2200 $\mu$ F electrolytic
C712	22-7615-06	0.01 $\mu$ F disc
C713	22-7615-06	0.01 $\mu$ F disc

**Table 6-3 (continued):**  
A-13336 Parts List

CIRCUIT DESCRIPTION	ZDS PART NUMBER	DESCRIPTION
C714	22-7859-07	33 $\mu$ F electrolytic
C715	22-7615-06	0.01 $\mu$ F disc
C716	22-7862-01	1 $\mu$ F electrolytic
C717	22-7859-06	22 $\mu$ F electrolytic
<b>Diodes</b>		
CR101 through CR108 CR109	103-142-01 103-327	
CR110 through CR113	103-142-01	
CR701 through CR706	103-315-06	
CR707 CR708	103-23-01 103-279-07	
<b>Fuse</b>		
FX701	136-123-15	0.375 amp, SLO BLO, 250 volt
<b>Integrated Circuits</b>		
IC101 IC102 IC103	221-C17 221-331 221-332	Microprocessor
IC104 IC105 IC106	221-274-01 221-318 221-228	
IC107 IC108 IC109 IC110	221-362 221-C10-01 221-358 221-358	

**Table 6-3 (continued):**  
A-13336 Parts List

CIRCUIT DESCRIPTION	ZDS PART NUMBER	DESCRIPTION
IC201	221-121	
IC701 IC702 IC703	221-213-04 221-192 221-392	+ 12 V regulator - 12 V regulator + 5 V regulator
<b>Inductors</b>		
L101 through L104	20-3887-24	RFC coil, 100 mH
<b>Connectors</b>		
J1 J2 J3 J4	78-3015-08 58-425-09 58-425 58-425	Socket 16 position 3 position 3 position
J5 J6 J7 J8	83-9013-21 83-9013-06 78-3232 58-466	Terminal strip, male, 10 position Terminal strip, male, 2 position 25 position 25 position
J9 J11 J11C J12 J12C	83-9013-03 58-364-59 50-962 58-364-58 50-961	Terminal strip, male 16 pin, 90 deg., (part of A-13337) Cable, 16 pin (part of model) 12 pin, 90 deg., (part of A13337) Cable, 12 pin, (part of A-13338)
8A7 8D2 8E2	83-9013-11 83-9013-07 83-9013-03	Terminal strip, male, 5 position Terminal strip, 3 position Terminal strip, male
<b>Transistors</b>		
Q201 through Q205	121-1040	
Q701	121-699	

**Table 6-3 (continued):**  
A-13336 Parts List

CIRCUIT DESCRIPTION	ZDS PART NUMBER	DESCRIPTION
<b>Resistors</b>		
R101	63-10235-96	10 k $\Omega$ , 1/4 watt, 5%
R103	63-10235-96	10 k $\Omega$ , 1/4 watt, 5%
R104	63-10236-10	39 k $\Omega$ , 1/4 watt, 5%
R105	63-10236-03	20 k $\Omega$ , 1/4 watt, 5%
R106	63-10235-92	6.8 k $\Omega$ , 1/4 watt, 5%
R108	63-10235-26	12 $\Omega$ , 1/4 watt, 5%
R109	63-10234-24	10 $\Omega$ , 1/2 watt, 5%
R110 through R113	63-10235-11	3 $\Omega$ , 1/4 watt, 5%
R114	63-10235-94	8.2 k $\Omega$ , 1/4 watt, 5%
R115	63-10235-88	4.7 k $\Omega$ , 1/4 watt, 5%
R116 through R120	63-10235-96	10 k $\Omega$ , 1/4 watt, 5%
R121	63-10236-07	30 k $\Omega$ , 1/4 watt, 5%
R122	63-10235-88	4.7 k $\Omega$ , 1/4 watt, 5%
R123	63-10235-88	4.7 k $\Omega$ , 1/4 watt, 5%
R124	63-10235-65	510 $\Omega$ , 1/4 watt, 5%
R125	63-10235-72	1 k $\Omega$ , 1/4 watt, 5%
R126	63-10235-96	10 k $\Omega$ , 1/4 watt, 5%
R130 through R133	63-10235-72	1 k $\Omega$ , 1/4 watt, 5%
R201	63-10235-72	1 k $\Omega$ , 1/4 watt, 5%
R202	63-10235-91	6.2 k $\Omega$ , 1/4 watt, 5%
R203	63-10235-96	10 k $\Omega$ , 1/4 watt, 5%

**Table 6-3 (continued):**  
A-13336 Parts List

CIRCUIT DESCRIPTION	ZDS PART NUMBER	DESCRIPTION
R204	63-10854-06	10 k $\Omega$ , control
R206	63-10235-96	10 k $\Omega$ , 1/4 watt, 5%
R207	63-10235-54	180 $\Omega$ , 1/4 watt, 5%
R208	63-10235-96	10 k $\Omega$ , 1/4 watt, 5%
R210	63-10236-04	2.2 $\Omega$ , 1/4 watt, 5%
R211	63-10235-89	5.1 k $\Omega$ , 1/4 watt, 5%
R214	63-10235-86	3.5 k $\Omega$ , 1/4 watt, 5%
R215	63-10235-54	180 $\Omega$ , 1/4 watt, 5%
R216	63-10235-14	3.9 $\Omega$ 1/4 watt, 5%
R217	63-10235-78	1.8 k $\Omega$ , 1/4 watt, 5%
R218	63-10235-89	5.1 k $\Omega$ , 1/4 watt, 5%
R219	63-10235-89	5.1 k $\Omega$ , 1/4 watt, 5%
R220	63-10235-69	750 $\Omega$ , 1/4 watt, 5%
R221	63-10235-86	3.9 k $\Omega$ , 1/4 watt, 5%
R222	63-10235-54	180 $\Omega$ , 1/4 watt, 5%
R223	63-10235-88	4.7 k $\Omega$ , 1/4 watt, 5%
R224	63-10243-28	15 $\Omega$ , 1/2 watt, 5%
R701	63-10235-64	470 $\Omega$ , 1/4 watt, 5%
R702	63-10235-37	36 $\Omega$ , 1/4 watt, 5%
R703	63-10235-49	110 $\Omega$ , 1/4 watt, 5%
<b>Switches</b>		
SW101	85-1650-06	DIP, side actuated
<b>Crystal</b>		
Y101	224-59 6	MHz quartz crystal

Table 6-4 identifies 9-227-07 Main Board components and provides their part numbers (see Figure 4-11).

**Table 6-4 (continued):**  
9-227-07 Parts List

**Table 6-4:**  
9-227-07 Parts List

CIRCUIT REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
<b>Capacitors</b>		
C2101	22-7775-10	.0068 $\mu$ F polyester
C2102	22-7774-16	.022 $\mu$ F polyester
C2103	22-7861-09	100 $\mu$ F electrolytic
C2104	22-7613-24	.01 $\mu$ F disc
C2105	22-7862	.47 $\mu$ F electrolytic
C2106	22-7862-07	33 $\mu$ F electrolytic
C2107	22-7774-14	.015 $\mu$ F polyester
C2110	22-7742-10	.001 $\mu$ F polyester
C2111	22-7774-17	.027 $\mu$ F polyester
C2176	22-7861-13	1000 $\mu$ F electrolytic
C2501	22-7621-42	220 pF disc
C2502	22-7621-42	220 pF disc
C2503	22-7621-42	220 pF disc
C2504	22-7859-10	220 $\mu$ F electrolytic
C3201	22-7775-24	0.1 $\mu$ F polyester
C3204	22-7603	4.7 $\mu$ F electrolytic
C3205	22-3512	.01 $\mu$ F disc
C3206	22-7603-01	10 $\mu$ F electrolytic
C3207	22-7742-10	.001 $\mu$ F axial
C3208	22-7742-10	.001 $\mu$ F axial
C3209	22-7395	470 pF disc
CX3230	Provision for 22-07431-01	
C3234	22-7395	470 pF disc
C3236	22-7861-14	2200 $\mu$ F electrolytic
C3242	22-7395	470 pF disc
C3246	22-7832-10	100 $\mu$ F electrolytic
C3247	22-7860-29	680 $\mu$ F electrolytic
C3249	22-7431-06	.0047 $\mu$ F disc
C3250	22-7431-06	.0047 $\mu$ F disc
C3251	22-7811-	.001 $\mu$ F disc
C3252	22-7811-	.001 $\mu$ F disc

CIRCUIT REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
C3253	22-7811-	.001 $\mu$ F disc
C3254	22-7900-01	22 $\mu$ F NP electrolytic
C3256	22-7861-14	2200 $\mu$ F electrolytic
CX3258	22-5854	0.1 $\mu$ F
C3257	22-7395	470 pF disc
C3401	22-7613-24	.01 $\mu$ F disc
C3402	22-7406-01	1.0 $\mu$ F electrolytic
C3403	22-7773-18	.033 $\mu$ F polyester
C3404	22-7773-17	.027 $\mu$ F polyester
C3405	22-7775-08	.0068 $\mu$ F polyester
C3407	22-7862-10	1 $\mu$ F electrolytic
C3409	22-7861-09	100 $\mu$ F electrolytic
C3410	22-7404-06	22 $\mu$ F electrolytic
C3411	22-7860-09	100 $\mu$ F electrolytic
C3412	22-7862-01	1 $\mu$ F electrolytic
C3413	22-7562-32	.47 $\mu$ F polyester
C3414	22-7774-16	.022 $\mu$ F polyester
C3416	22-7802-07	.01 $\mu$ F axial
C3419	22-7751-39	180 pF axial
C3420	22-7862-01	1 $\mu$ F electrolytic
C3421	22-7773-18	.033 $\mu$ F polyester
C3422	22-7613-24	.01 $\mu$ F disc
C3423	22-7613-08	470 pF disc
C3424	22-7742-05	390 pF axial
C3425	22-7742-10	.001 $\mu$ F axial
C3426	22-7742-10	.001 $\mu$ F axial
C3427	22-7647-35	150 pF axial
C3428	22-7774-12	.01 $\mu$ F polyester
C3429	22-7406	.47 $\mu$ F electrolytic
C3430	22-7613-24	.01 $\mu$ F disc
C3431	22-7774-16	.022 $\mu$ F polyester
C3434	22-7742-06	470 pF axial
C3435	22-7613-24	.01 $\mu$ F disc
C3436	22-7774-12	.01 $\mu$ F polyester
C3450	22-7619-41	200 pF disc
C3461	22-7862-01	1 $\mu$ F electrolytic
C3462	22-7774-09	.0056 $\mu$ F polyester

**Table 6-4 (continued):**  
9-227-07 Parts List

CIRCUIT REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
<b>Chokes</b>		
L2501	20-3831	Coil, peaking, 663 $\mu$ H
L2502	20-3887-01	Coil, peaking, 1.2 $\mu$ H
L2503	20-3887-01	Coil, peaking, 1.2 $\mu$ H
L2504	20-3887-01	Coil, peaking, 1.2 $\mu$ H
L3201	91-2053	Wire, 22 guage
LX3202	95-3501-01	Transformer, 60 $\mu$ H
L3401	20-3831	Coil, peaking, 663 $\mu$ H
L3402	20-4026	Coil, tunable, 39 $\mu$ H
<b>Connectors</b>		
A	86-799	Connector pins (4)
B	86-799	Connector pins (4)
C	83-9239-02	Terminal strip, 2-pos.
D	83-9239-04	Terminal strip, 3-pos.
D	58-436-01	Terminal strip, 3-pos.
E	83-9230-03	Terminal strip, 6-pos.
E	58-363-02	Terminal strip, 6-pos.
X	86-799	Connector pins (3)
Y	86-799	Connector pins (3)
3D3	86-799	Connector pins (6)
3F3	86-799	Connector pins (2)
3G3	86-799	Connector pins (5)
3R8	86-799	Connector pins (3)
3S8	86-799	Connector pins (3)
3T8	86-799	Connector pins (2)
2A8	A-9915-62	Housing/Terminal Assy
3V3	86-799	Connector pins (2)
3W3	86-799	Connector pins (3)
2M	78-3065	Connector, 2M, 2-pos.
5M	78-3056	Connector, 5M, 2-pos.
MED-HIGH-RES	78-3056	Connector, 2-pos.

**Table 6-4 (continued):**  
9-227-07 Parts List

CIRCUIT REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
<b>Diodes</b>		
CR2104	103-142-01	Low voltage
CR2105	103-254-01	Low voltage
CR2106	103-254-01	Low voltage
CR2107	103-254-01	Low voltage
CR2108	103-279-14	Low voltage
CR2501	103-142-02	Low voltage
CR2502	103-142-01	Low voltage
CR2503	103-142-02	Low voltage
CR2504	Provision for 103-254-01	
CR2505	Provision for 103-254-01	
CR2506	Provision for 103-254-01	
CR2507	103-142-01	Low voltage
CR2508	103-142-01	Low voltage
CR2509	103-142-01	Low voltage
CR2510	103-142-01	Low voltage
CR2511	103-142-01	Low voltage
CR2512	103-142-01	Low voltage
CR3202	103-330	Low voltage
CR3205	103-309-01	Zener, 10 volt
CR3206	103-254-01	Low voltage
CR3207	103-254-01	Low voltage
CR3208	103-326	Low voltage
CR3210	103-254-01	Low voltage
CR3211	103-254-01	Low voltage
CR3214	103-326	Low voltage
CR3217	103-377-04	Low voltage
CR3219	103-330	Low voltage
CR3223	103-330	Low voltage
CR3224	103-330	Low voltage
CR3231	103-315-06	
CR3232	103-315-06	
CR3233	103-315-06	
CR3234	103-315-06	
CR3235	103-284	Low voltage

**Table 6-4 (continued):**  
9-227-07 Parts List

CIRCUIT REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
CR3401	103-142-01	Low voltage
CR3404	103-142-01	Low voltage
CR3405	103-142-01	Low voltage
CR3406	103-142-01	Low voltage
CR3408	103-279-14	Zener, 6.8 volt
CR3409	103-279-19	Zener, 10 volt
<b>Fuses</b>		
FX3202		Wire, 22 gauge
FX3201	136-113-23	Fuse, 4 amp, FB
<b>Integrated Circuits</b>		
IC3401	78-3014-07	Socket
IC3401	221-264	Horizontal/Vertical
<b>Miscellaneous</b>		
T3201	95-3558-03	Transformer, Start Up
TX3202	95-3439	Transformer, LCI
<b>Transistors</b>		
Q2101	121-1072 19-957-03 126-2028-01	Transistor Clip Heat sink
Q2102	121-1072 19-957-03 126-02028-01	Transistor Clip Heat sink
Q2103	121-975	NPN
Q2104	121-1064	PNP
Q2501	121-1019	PNP
Q2502	121-551	NPN
Q2503	121-1019	PNP
Q2504	121-551	NPN
Q2505	121-1019	PNP

**Table 6-4 (continued):**  
9-227-07 Parts List

CIRCUIT REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
Q2506	121-551	NPN
Q2507	121-1019	PNP
Q2508	121-1019	PNP
Q2509	121-1019	PNP
Q3200	A-12791 19-956-01 121-966-02 126-2029-02	Assembly Clip Transistor Heat sink
Q3201	121-499-01	NPN
Q3202	121-1034	NPN
Q3203	121-1059	PNP
Q3204	121-986	Transistor
Q3401	121-895	NPN
Q3402	121-896	PNP
Q3403	121-895	NPN
Q3404	121-895	NPN
Q3405	121-895	NPN
<b>Resistors</b>		
RX2101	63-10565-32	22 $\Omega$ , film
R2102	63-10243-56	220 $\Omega$ , film
R2103	63-10235-88	4.7 k $\Omega$ , film
RX2104	63-10243-11	3.0 $\Omega$ , film
RX2105	63-10243-11	3.0 $\Omega$ , film
R2106	63-10235-72	1.0 k $\Omega$ , film
R2107	63-10235-66	560 $\Omega$ , film
R2108	63-10235-66	560 $\Omega$ , film
R2109	63-10565	1.0 $\Omega$ , film
R2110	63-10565	1.0 $\Omega$ , film
R2111	63-10565	1.0 $\Omega$ , film
R2112	63-10565	1.0 $\Omega$ , film
R2113	63-10243-60	330 $\Omega$ , film
R2114	63-10235-72	1 k $\Omega$ , film
R2115	63-10235-88	4.7 k $\Omega$ , film
R2116	63-10235-60	330 $\Omega$ , film
R2117	63-10235-80	2.2 k $\Omega$ , film
R2118	63-10235-88	4.7 k $\Omega$ , film
R2119	63-10235-54	180 $\Omega$ , film

**Table 6-4 (continued):**  
9-227-07 Parts List

CIRCUIT REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
R2120	63-10565-08	2.2 Ω, film
R2121	63-10828-52	150 Ω, film
R2122	63-10828-52	150 Ω, film
R2125	63-9023-02	Control
R2126	63-10243-63	430 Ω, film
R2127	63-10832-65	510 Ω, carbon
R2128	63-10832-65	510 Ω, carbon
R2129	63-10832-56	220 Ω, carbon
R2411	63-10235-67	620 Ω, film
R2501	63-10236-17	75 KΩ, film
R2502	63-10235-87	4.3 kΩ, film
R2503	63-10235-58	270 Ω, film
R2504	63-10235-88	4.7 kΩ, film
R2505	63-10857-27	800 Ω, control
R2506	63-10857-11	Control
R2507	63-10233-76	1.5 kΩ, film
R2508	63-10233-92	6.8 kΩ, film
R2509	63-10235-80	2.2 kΩ, film
R2510	63-10235-59	300 kΩ, film
R2511	63-10235-91	6.2 kΩ, film
R2512	63-10236-17	75 kΩ, film
R2513	63-10235-87	4.3 kΩ, film
R2514	63-10235-58	270 Ω, film
R2515	63-10235-88	4.7 kΩ, film
R2516	63-10857-25	800 Ω, control
R2517	63-10857-32	Control
R2518	63-10233-76	1.5 kΩ, film
R2519	63-10233-92	6.8 kΩ, film
R2520	63-10235-80	2.2 kΩ, film
R2521	63-10235-59	300 Ω, film
R2522	63-10235-74	1.2 kΩ, film
R2523	63-10236-17	75 kΩ, film
R2524	63-10235-87	4.3 kΩ, film
R2525	63-10235-58	270 Ω, film

**Table 6-4 (continued):**  
9-227-07 Parts List

CIRCUIT REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
R2526	63-10235-88	4.7 kΩ, film
R2527	63-10857-26	800 Ω, control
R2528	63-10857-31	Control
R2529	63-10233-76	1.5 kΩ, film
R2530	63-10233-92	6.8 kΩ, film
R2531	63-10235-80	2.2 kΩ, film
R2532	63-10235-59	300 Ω, film
R2533	63-10235-74	1.2 kΩ, film
R2534	63-10235-52	150 Ω, film
R2535	63-10235-52	150 Ω, film
R2536	63-10235-52	150 Ω, film
R2537	63-10235-52	150 Ω, film
R2538	63-10235-48	100 Ω, film
R2539	63-10235-48	100 Ω, film
R2540	63-10235-48	100 Ω, film
R2541	63-10235-54	180 Ω, film
R2542	63-10235-72	1 kΩ, film
R2543	63-10235-54	180 Ω, film
R2544	63-10235-72	1 kΩ, film
R2545	63-10235-54	180 Ω, film
R2546	63-10235-72	1 kΩ, film
R2548	63-10235-91	6.2 kΩ, film
R2549	63-10235-91	6.2 kΩ, film
R2550	63-10235-32	22 Ω, film
R2552	63-10235-32	22 Ω, film
R2554	63-10235-32	22 Ω, film
R3201	63-10235-59	300 Ω, film
R3202	63-10235-50	120 Ω, film
R3203	63-10235-59	300 Ω, film
R3205	63-7781	820 Ω, film
R3206	63-10460-50	resistor & splice
	93-2104	12 Ω, wirewound
	19-889	Washer
		Clip
R3210	63-10420-31	2.0 Ω, wirewound
R3212	63-10235-76	1.5 kΩ, film



**Table 6-4 (continued):**  
9-227-07 Parts List

CIRCUIT REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
R3213	63-10235-83	3 kΩ, film
R3214	63-10235-74	1.2 kΩ, film
R3215	63-10244-40	680 kΩ, film
R3216	63-10244-25	160 kΩ, film
R3217	63-10244-33	360 kΩ, film
R3218	63-10235-80	2.2 kΩ, film
R3219	63-10244-38	560 kΩ, film
R3222	63-10235-48	47 Ω, film
RX3231	63-10422-24	1.0 Ω, wirewound
R3233	63-10565-14	3.9 Ω, film
R3234	63-10565-14	3.9 Ω, film
R3239	63-10244-20	100 kΩ, film
R3241	93-2104	Washer
R3241	19-889	Clip
R3244	63-10430-64	47 Ω, wirewound
R3245	63-10710	Thermistor
R3246	63-10657-03	1.2 MΩ
R3260	63-10243-96	10 kΩ, film
R3261	63-10244-24	150 kΩ, film
R3401	63-10236-18	82 kΩ, film
R3402	63-10235-98	82 kΩ, film
R3403	63-10235-86	3.9 kΩ, film
R3404	63-10235-86	3.9 kΩ, film
R3405	63-10236-08	33 kΩ, film
R3406	63-10235-67	620 Ω, film
R3407	63-10236-18	82 kΩ, film
R3408	63-10236-04	22 kΩ, film
R3409	63-10857-17	100 kΩ, control
R3410	63-10236-31	300 kΩ, film
R3411	63-10236-03	20 kΩ, film
R3412	63-10236-13	51 kΩ, film
R3413	63-10236-07	30 kΩ, film
R3414	63-10235-98	12 kΩ, film
R3415	63-10236-02	18 kΩ, film
R3417	63-10243-64	470 Ω, film
R3418	63-10857-08	2 kΩ, control
R3419	63-10235-84	3.3 kΩ, film
R3420	63-10236-10	39 kΩ, film

**Table 6-4 (continued):**  
9-227-07 Parts List

CIRCUIT REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
R3421	63-10235-73	1.1 kΩ, film
R3422	63-10243-64	470 Ω, film
R3423	63-10243-64	470 Ω, film
R3424	63-10235-72	1 kΩ, film
R3425	63-10235-88	4.7 kΩ, film
R3428	63-10235-74	1.2 kΩ, film
R3429	63-10235-76	1.5 kΩ, film
R3431	63-10235-80	2.2 kΩ, film
R3432	63-10235-79	2 kΩ, film
R3433	63-10236-20	100 kΩ, film
R3434	63-10236-22	120 kΩ, film
R3435	63-10235-63	430 Ω, film
R3436	63-10235-72	1.0 kΩ, film
R3439	63-10243-79	2 kΩ, film
R3440	63-10235-86	3.9 kΩ, film
R3441	63-10857-02	250 Ω, control
R3443	63-10235-80	2.2 kΩ, film
R3444	63-10235-60	330 Ω, film
R3445	63-10235-80	2.2 kΩ, film
R3446	63-10235-72	1 kΩ, film
R3451	63-10235-88	4.7 kΩ, film
R3452	63-10235-92	6.8 kΩ, film
R3453	63-10235-96	10 kΩ, film
R3461	63-10236	15 kΩ, film
R3462	63-10236-13	51 kΩ, film
R3465	63-10235-72	1 kΩ, film
R3463	63-10235-48	100 Ω
R3466	63-10235-86	3.9 kΩ, film
R3467	63-10235-94	8.2 kΩ, film
R3468	63-10236-10	39 kΩ, film
R3469	63-10235-72	1 kΩ, film
R3470	63-10236-16	68 kΩ, film
R3471	63-10235-86	3.9 kΩ, film
R3473	63-10235-96	10 kΩ, film
R3474	63-10235-72	1 kΩ, film
R3472	63-10235-86	3.9 kΩ, film
R3475	63-10235-72	1 kΩ, film

Table 6-5 identifies 9-247-08 High Voltage and Horizontal Sweep Board components and identifies their part numbers (see Figure 4-14).

**Table 6-5:**  
9-247-08 Parts List

CIRCUIT REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
<b>Capacitors</b>		
C2131	22-7508	47 $\mu$ F, electrolytic
C2152	22-7508-01	22 $\mu$ F, electrolytic
CX3202	22-7862-01	1 $\mu$ F, electrolytic
C3203	22-7863-08	47 $\mu$ F, electrolytic
CX3204	22-7773-24	0.1 $\mu$ F, polyester
CX3205	22-7523-01	.01 $\mu$ F, disc
C3206	22-7860-04	4.7 $\mu$ F, electrolytic
C3207	22-7786-08	330 pF, disc
C3209	22-7786-16	1800 pF, disc
C3210	22-5995	82 pF, disc
C3211	22-7777-20	.047 $\mu$ F, polyester
C3212	22-7234	560 pF, disc
C3213	22-7775-16	.022 $\mu$ F, polyester
C3214	22-7775-10	.0068 $\mu$ F, polyester
C3216	22-5684	470 pF, disc
C3217	22-5684	470 pF, disc
C3218	22-7774-15	.018 $\mu$ F, polyester
CX3219	22-7708-05	10 $\mu$ F, electrolytic
C3222	22-7742-10	.001 $\mu$ F, axial
CX3228	22-6466	530 pF, ceramic disc
CX3229	22-7672-08	.0165 $\mu$ F, polypropylene
CX3231	22-6466	530 pF, ceramic disc
C3233	22-7128	.68 $\mu$ F, polyester
C3244	22-7566-24	0.1 $\mu$ F, polyester
C3261	22-7683-01	.68 $\mu$ F, polypropylene
C3276	22-7389-04	15 $\mu$ F, electrolytic
C3277	22-7862-09	100 $\mu$ F, electrolytic

**Table 6-5 (continued):**  
9-247-08 Parts List

CIRCUIT REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
<b>Connectors</b>		
3D3	50-218-08	Connector & cable assy
3F3	A-9913-29	Cable w/housing assy
3G3	A-10080	Cable w/housing assy
5H3	A-9911-58	Cable w/housing assy
5X3	A-9939-18	Cable w/housing assy
<b>Miscellaneous</b>		
E3251	52-2240-08	Spark Gap
<b>Diodes</b>		
CR3202	103-142-01	Low voltage
CR3203	103-330	Low voltage
CR3204	103-308	Zener
CR3205	103-305	Damper
CR3206	103-284	Low voltage
CR3207	103-295-01	Diode
CR3208	103-295-01	Low voltage
CR3209	103-142-01	Low voltage
CR3210	103-142-01	Low voltage
CR3211	103-142-01	Low voltage
CR3276	103-254-01	Low voltage
<b>Chokes</b>		
L3200	149-454	Iron core
L3207	149-454	Core, ferrite bead
L3220	149-509-01	Core, ferrite bead
LX3261	20-3976	Coil, width
LX3262	20-4073	Coil, linearity width

**Table 6-5 (continued):**  
9-247-08 Parts List

CIRCUIT REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
<b>Resistors</b>		
R2105	63-10235-94	8.2 k $\Omega$ , film
R2110	63-10235-64	470 $\Omega$ , film
R2111	63-10233-83	3 k $\Omega$ , film
R2122	63-10233-96	10 k $\Omega$ , film
RX3204	63-10235-80	2.2 k $\Omega$ , film
RX3206	63-7816	5.6 k $\Omega$ , carbon
RX3207	63-10235-32	22 $\Omega$ , film
RX3208	63-10235-80	2.2 k $\Omega$ , film
RX3209	63-10235-72	1 k $\Omega$ , film
RX3210	63-7805	3.3 k $\Omega$ , carbon
RX3211	63-10818	3.0 k $\Omega$ , film
RX3213	63-10236-08	33 k $\Omega$ , film
RX3214	63-10233-82	2.7 k $\Omega$ , film
RX3215	63-10236-02	18 k $\Omega$ , film
RX3216	63-10810-06	1.2 k $\Omega$ , film
RX3217	63-7770	470 $\Omega$ , carbon
RX3218	63-10235-82	2.7 k $\Omega$ , film
RX3219	63-10235-88	4.7 k $\Omega$ , film
R3224	63-10243-88	4.7 k $\Omega$ , film
R3225	63-10836-68	680 $\Omega$ , wirewound
R3226	63-10235-74	1.2 k $\Omega$ , film
R3227	63-10235-80	2.2 k $\Omega$ , film
RX3228	63-7757	220 $\Omega$ , carbon
RX3235	63-10810-06	1.2 k $\Omega$ , film
R3237		Wire, 22 gauge
RX3240	63-10657-04	10 M $\Omega$ , carbon

**Table 6-5 (continued):**  
9-247-08 Parts List

CIRCUIT REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
R3242	63-10243-80	2.2 k $\Omega$ , film
R3243	63-10243-80	2.2 k $\Omega$ , film
R3244	63-7868	100 k $\Omega$ , carbon
R3250	63-10243-71	910 $\Omega$ , film
R3251	63-7785	1 k $\Omega$ , carbon
R3252		Wire, 22 gauge
R3261	63-10444-86	390 $\Omega$ , wirewound
R3262	63-10828-65	510 $\Omega$ , film
R3263	63-10828-65	510 $\Omega$ , film
R3264	63-10243-71	910 $\Omega$ , film
R3279	63-7757	220 $\Omega$ , carbon
R3282	63-10235-96	10 k $\Omega$ , film
<b>Transformers</b>		
TX3204	95-3603-01	Sweep
TX3205	95-3344	Horizontal driver
<b>Transistors</b>		
QX3202	121-975	NPN
QX3204	121-973	PNP shutdown
Q3206	121-1037	NPN forward driver
QX3207	121-975	NPN shutdown
Q3209	121-1040	NPN reverse driver

Table 6-6 identifies A-10530 Width Step Board components and provides their part numbers (see Figure 4-18).

**Table 6-6:**  
A-10530 Parts List

CIRCUIT REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
<b>Capacitors</b>		
C1	22-6466	530 pF, ceramic disc
C2	22-6466	530 pF, ceramic disc
C3	22-6466	530 pF, ceramic disc
C4	22-6466	530 pF, ceramic disc
<b>Chokes</b>		
L1	20-4031	120 $\mu$ H
L2	20-4031	120 $\mu$ H
<b>Connectors</b>		
P1	78-3059	4-circuit shunt
P2	78-3059	4-circuit shunt
<b>Resistors</b>		
R1	63-10271	390 $\Omega$ , wirewound
R2	63-10271	390 $\Omega$ , wirewound
<b>Miscellaneous</b>		
3S3	A-9941-11	Cable w/housing assy
	86-799	Terminal pin
	204-979-01	Printed circuit board

Table 6-7 identifies A-11105 Transistor and Bracket Assembly (H.O.T.) components and provides their part numbers.

**Table 6-7:**  
A-11105 Parts List

REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
<b>Transistor</b>		
Q3208	121-01029-01	Transistor
	078-03080-01	Transistor socket
<b>Capacitor</b>		
CX3240	22-7735-01 <sup>1</sup>	1700 $\mu$ F electrolytic
CX3240A	22-7735-01 <sup>1</sup>	300 $\mu$ F electrolytic

<sup>1</sup>One 22-7735-01 contains both CX3240 and CX3240A

Table 6-8 identifies A-10632-03 High Voltage Power Supply Board components and provides their part numbers (see Figure 4-17).

**Table 6-8:**  
A-10632-03 Parts List

REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
<b>Capacitors</b>		
CX3211	022-06466	530 pF, disk
CX3221	022-05688	1000 pF, disk
CX3223	022-07523-01	.01 $\mu$ F, disk
CX3227	022-06466	530 pF, disk
<b>Chokes</b>		
L3210	149-00454	Core, Ferrite bead
<b>Diodes</b>		
CR3212	103-00339-04	Low voltage
CR3221	103-00312	Low voltage
<b>Miscellaneous</b>		
TX-3202	095-03502-02	Regulator
<b>Resistors</b>		
R3239	063-10852	1 $\Omega$ , wirewound
R3240	063-10852-01	.18 $\Omega$ , wirewound

Table 6-9 identifies 9-155-12 Video Output Board components and provides their part numbers (see Figure 4-20).

**Table 6-9:**  
9-155-12 Parts List

CIRCUIT REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
<b>Capacitors</b>		
C5101	22-7603-01	10 $\mu$ F, electrolyte
C5121	22-7708-08	47 $\mu$ F, electrolytic
C5122	22-3512	.01 $\Omega$ F, disc
C5123	22-7742-02	220 pF, tubular
C5124	22-7742-02	220 pF, tubular
C5125	22-7742	150 pF, tubular
<b>Chokes</b>		
L5101		Wire, 22 guage
L5102	20-3907-12	10 $\mu$ H, peaking
L5103	20-3907-12	10 $\mu$ H, peaking
L5104	20-3907-12	10 $\mu$ H, peaking
L5105	20-3907-11	8.2 $\mu$ H, peaking
L5106	20-3907-11	8.2 $\mu$ H, peaking
L5107	20-3907-11	8.2 $\mu$ H, peaking
<b>Connectors</b>		
5A2	86-799	Pin, connector (4)
5X3	86-799	Pin, connector (1)
5C2	86-799	Pin, connector (5)
5H3	86-799	Pin, connector (2)

**Table 6-9 (continued):**  
9-155-12 Parts List

CIRCUIT REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
<b>Resistors</b>		
R5101	63-10840-79	2 k $\Omega$ , film
R5102	63-7750	150 $\Omega$ , carbon
R5104	63-10235-48	100 $\Omega$ , film
R5105	63-10235-48	100 $\Omega$ , film
R5106	63-7785	1 k $\Omega$ , carbon
R5108	66-7750	150 $\Omega$ , carbon
R5110	63-7750	150 $\Omega$ , carbon
R5111	63-7799	2.2 k $\Omega$ , carbon
R5112	63-10840-79	2 k $\Omega$ , film
R5113	63-10840-79	2 k $\Omega$ , film
R5114	63-10235-48	100 $\Omega$ , film
R5115	63-10235-48	100 $\Omega$ , film
R5119	63-7750	150 $\Omega$ , carbon
R5120	63-10235-86	3.9 k $\Omega$ , film
R5121	63-10235-92	6.8 k $\Omega$ , film
R5122	63-10235-90	5.6 k $\Omega$ , film
R5123	63-10235-40	47 $\Omega$ , film
R5124	63-10235-40	47 $\Omega$ , film
R5125	63-10235-38	39 $\Omega$ , film

**Table 6-9 (continued):**  
9-155-12 Parts List

CIRCUIT REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
<b>Transistors</b>		
Q5101	121-01088 126-02112 54-00952 93-02110 114-01437	NPN Heat sync for Q5101 Nut for Q5101 Washer for Q5101 Screw for Q5101
Q5102	121-01088 126-02112 54-00952 93-02110 114-01437	NPN Heat Sync for Q5102 Nut for Q5102 Washer for Q5102 Screw for Q5102
Q5103	121-01088 126-02112 54-00952 93-02110 114-01437	NPN Heat sync for Q5103 Nut for Q5103 Washer for Q5103 Screw for Q5103
<b>Miscellaneous</b>		
W1		22 guage wire
W2		provision, wire, as needed
W3		22 guage wire
CRT	A-11056 78-2993-02	Assembly, PC board and CRTsocket CRT socket
E5101	52-2240-06	Spark gap
E5102	52-2240-06	Spark gap
E5103	52-2240-06	Spark gap
E5104		Air spark gap

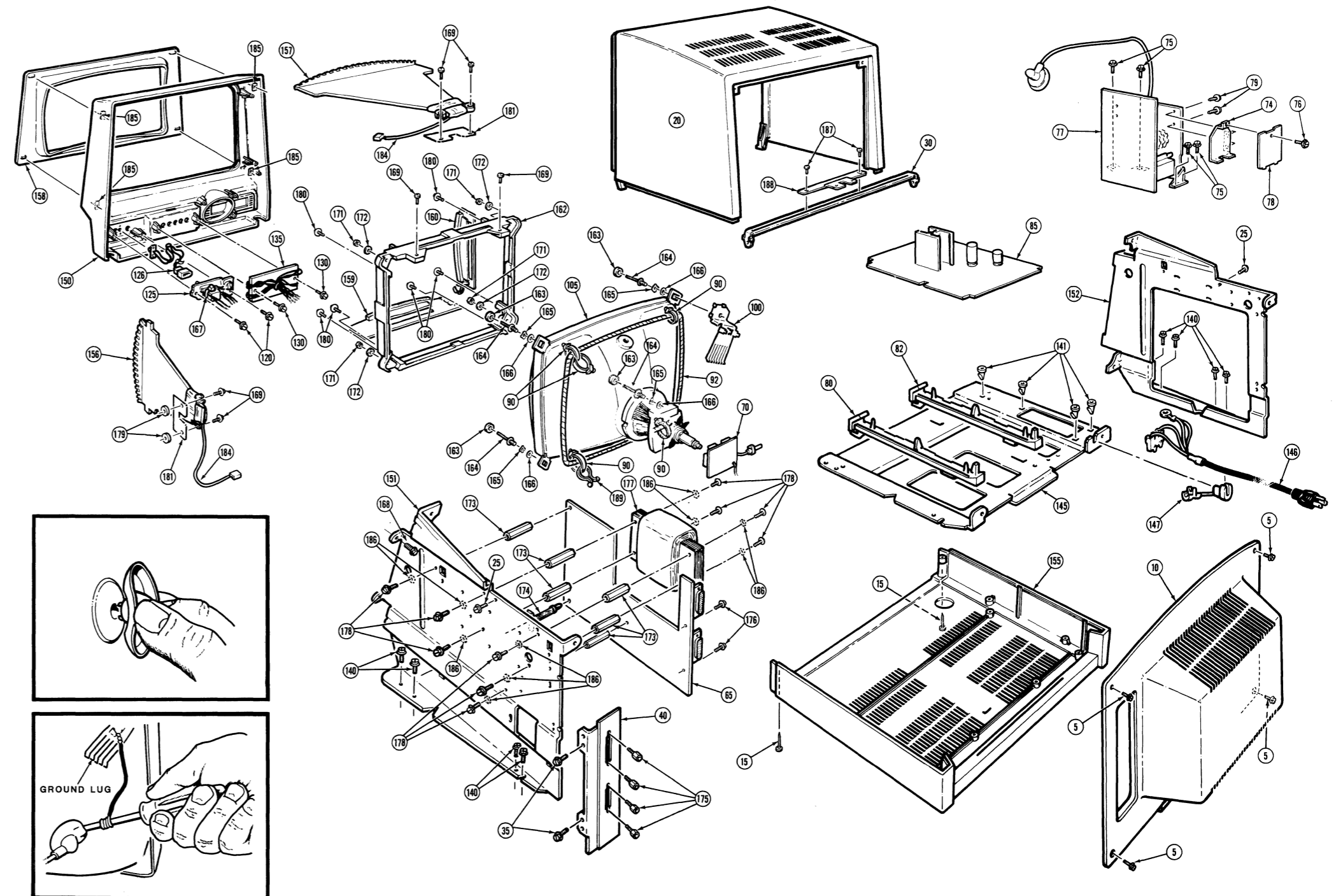
Table 6-10 identifies 9-356 RGB Gain Control Board components and provides their part numbers (see Figure 4-8).

**Table 6-10:**  
9-356 Parts List

CIRCUIT REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
<b>Capacitors</b>		
C1700	22-7860-05	10 $\mu$ F, electrolytic
C1701	22-7773-24	0.1 $\mu$ F, poly
C1702	22-7773-24	0.1 $\mu$ F, poly
C1703	22-7746-16	15 pF, ceramic axial lead
<b>Diodes</b>		
CR1700	103-142-01	Low voltage, silicon
CR1701	103-142-01	Low voltage, silicon
CR1702	103-142-01	Low voltage, silicon
CR1703	103-142-01	Low voltage, silicon
CR1704	103-142-01	Low voltage, silicon
CR1705	103-142-01	Low voltage, silicon
CR1706	103-279-10	Zener, 5.1 volt
CR1707	103-142-01	Low voltage, silicon
CR1708	103-142-01	Low voltage, silicon
CR1709	103-142-01	Low voltage, silicon
CR1710	103-142-01	Low voltage, silicon
CR1711	103-142-01	Low voltage, silicon
<b>Integrated Circuit</b>		
IC1700	221-274	Hex buffer/driver
<b>Resistors</b>		
R1700	63-10235-80	2.2 k $\Omega$ , film
R1701	63-10359-64	470 $\Omega$ , film
R1702	63-10840-51	130 $\Omega$ , film
R1704	63-10235-68	680 $\Omega$ , film
R1705	63-10243-38	39 $\Omega$ , film
R1706	63-10962	control
R1707	63-10235-72	1 k $\Omega$ , film
R1708	63-10235-59	300 $\Omega$ , film

**Table 6-10 (continued):**  
9-356 Parts List

CIRCUIT REFERENCE DESIGNATOR	ZDS PART NUMBER	DESCRIPTION
R1709	63-10235-59	300 $\Omega$ , film
R1710	63-10235-59	300 $\Omega$ , film
R1711	63-10235-76	1.5 k $\Omega$ , film
R1712	63-10235-76	1.5 k $\Omega$ , film
R1713	63-10235-72	1 k $\Omega$ , film
R1714	63-10235-53	180 $\Omega$ , film
R1715	63-10236-03	20 k $\Omega$ , film
R1716	63-10236-03	20 k $\Omega$ , film
R1717	63-10236-03	20 k $\Omega$ , film
R1718	63-10235-72	1 k $\Omega$ , film
R1719	63-10235-72	1 k $\Omega$ , film
R1720	63-10235-48	100 $\Omega$ , film
R1721	63-10235-48	100 $\Omega$ , film
R1722	63-10235-48	100 $\Omega$ , film
R1724	63-10235-59	100 $\Omega$ , film
R1725	63-10235-59	100 $\Omega$ , film
R1726	63-10235-59	100 $\Omega$ , film
R1727	63-10235-59	100 $\Omega$ , film
R1728	63-10235-72	1 k $\Omega$ , film
R1729	63-10235-72	1 k $\Omega$ , film
R1730	63-10235-72	1 k $\Omega$ , film
<b>Transistors</b>		
Q1700	121-1020	NPN
Q1701	121-1019	PNP
Q1702	121-1020	NPN
Q1703	121-1019	PNP
Q1704	121-1019	PNP
Q1705	121-1019	PNP
Q1706	121-895	NPN
Q1707	121-895	NPN
Q1708	121-895	NPN
Q1709	121-1096	NPN
<b>Miscellaneous</b>		
U1729	105-104	Resistance network, thick film



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

**Figure 6-1**  
Exploded View