Tektronix®

624 MONITOR
WITH OPTIONS

SERVICE MANUAL

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624 MONITOR
WITH OPTIONS

SERVICE MANUAL

Tektronix, Inc.
P.O. Box 500
Beaverton, Oregon 97077

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PRODUCT GROUP 6

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WARNING

This equipment generates, uses, and can radiate radio frequency energy and may cause interference to radio communications if not installed and used in accordance with the instruction manual. It has been tested and found to comply with the limits for Class B computing devices pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when this equipment is operated in a commercial environment. Operation in a residential area is likely to cause interference in which case the users at their own expense must take whatever measures may be required to correct the interference.

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WARNING

THE REMAINING PORTION OF THIS TABLE OF CONTENTS LISTS THE SERVICING INSTRUCTIONS. THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRICAL SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CALLED OUT IN THE OPERATING INSTRUCTIONS UNLESS QUALIFIED TO DO SO.

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LIST OF ILLUSTRATIONS

The illustrations in section 9 are located near their associated diagrams on the foldout page.

LIST OF TABLES

OPERATORS SAFETY INFORMATION

The following general safety information applies to all operators and service personnel. Specific warnings will be found throughout the manual where they apply and should be followed in each instance.

WARNING statements identify conditions or practices which could result in personal injury or loss of life.

CAUTION statements identify conditions or practices which could result in damage to the equipment or other property.

The word **DANGER** on the equipment identifies areas of immediate hazard which could result in personal injury or loss of life.

The following safety symbols may appear on the equipment:


CAUTION—Refer to manual


DANGER—High voltage


Protective ground (earth) terminal

Other warning symbols where they apply.

WARNING

AC POWER SOURCE AND CONNECTION

This instrument operates from a single-phase power source and has a three-wire power cord with a two-pole, three-terminal grounding-type connector. The voltage to ground (earth) from either pole of the power source must not exceed the maximum rated operating voltage, 250 volts.

Before making connection to the power source, a qualified service person should verify that the instrument is set to match the voltage of the power source and has a suitable two-pole, three-terminal grounding-type connector.

GROUNDING THE INSTRUMENT

This instrument is safety class 1 equipment (IEC designation). Safety class 1 equipment has a 3-wire power cord with a 3-contact plug for connection to the power source and to protective ground. The plug protective-ground contact connects (through the cord protective-grounding conductor) to the accessible metal parts of the equipment. For electric-shock protection, insert this plug into a socket outlet that has a securely grounded protective-ground contact.*

For medical-dental applications (to assure grounding integrity) the hospital-grade input plug must be inserted only into a mating hospital-grade receptacle with a grounding contact.

"To confirm that the socket-outlet ground contact is securely grounded, refer to qualified service personnel."

*IEC: International Electrotechnical Commission

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MEDICAL-DENTAL APPLIATIONS

Do not use the amplifier INPUTs for direct patient connection. Signal currents at these connectors, as well as leakage currents, may exceed values considered non-hazardous for direct patient connection.

Although this instrument is not to be used for direct patient connection, interconnecting this Monitor with other equipment can result in application of excess current to the patient. It is extremely important that the equipment be interconnected in accordance with NFPA 76B-T, Tentative Standard for the Safe Use of Electricity in Patient Care Areas of Health Care Facilities, section 3038, "Signal Transmission Between Appliances". Also refer to NFPA 70-1978, National Electrical Code, paragraphs 517-120 through 517-122.

Do not operate this instrument in the presence of flammable gases or anesthetics. Explosion can result from operation in such an environment.

USE THE PROPER FUSE

Refer fuse replacement to qualified service personnel only. To avoid electric shock and fire hazard, use only the fuse specified in the parts list for your instrument and which is identical in the following respects.

A. Type—Slow blow, fast blow, etc.

B. Voltage rating—250 V, etc.

C. Current rating.

DO NOT REMOVE PROTECTIVE COVERS

High-voltage is present inside the instrument. To avoid electric shock, operating personnel must not remove protective covers. Component replacement and internal adjustments must be made by qualified service personnel only.

LIMIT INPUT SIGNAL VOLTAGE

To avoid potential electric-shock hazard, do not apply input signals of greater than 25 volts (dc + peak ac).

CAUTION

EXERCISE CARE WITH INTENSITY LEVEL

Exercise care in establishing the correct display intensity; a high-amplitude Z-Axis input signal, combined with an excessively high settling of the INTENSITY control, may damage the crt phosphor. Therefore, set the INTENSITY control for just enough display intensity for good visibility.

SERVICE SAFETY INFORMATION

FOR QUALIFIED SERVICE PERSONNEL ONLY

The following are safety precautions which appear on the servicing information sections of this manual. This Service Safety Information is for qualified service personnel only and is in addition to the Operators Safety Information given previously.

WARNING

DO NOT SERVICE ALONE

Do not attempt internal service or adjustment of this instrument unless another person, capable of rendering first aid and resuscitation, is present.

AC POWER SOURCE AND CONNECTION

This instrument operates from a single-phase power source and has a three-wire power cord with a two-pole, three-terminal grounding-type connector. The voltage to ground (earth) from either pole of the power source must not exceed the maximum rated operating voltage, 250 volts.

Before making connection to the power source, verify that the instrument is set to match the voltage of the power source and has a suitable two-pole, three-terminal grounding-type connector.

EXERCISE CARE WHEN OPERATING INSTRUMENT WITHOUT PROTECTIVE COVERS

Dangerous potentials exist at several points throughout this instrument. When the instrument is operated without protective covers, do not touch exposed connections or components.

DISCONNECT INSTRUMENT POWER

To avoid electric shock, disconnect the Monitor from the power source before removing protective panels, soldering, or replacing components.

CRT HANDLING

Use care when handling a crt. Breakage of the crt causes a high-velocity scattering of glass fragments (implosion). Protective clothing and safety glasses should be worn. Avoid striking the crt on any object which might cause it to crack or implode. When storing a crt, place it in a protective carton or set it face down in a protected location on a smooth surface with a soft mat under the faceplate.

SILICONE GREASE HANDLING

Handle silicone grease with care. Avoid getting the silicone grease in your eyes. Wash hands thoroughly after use.

CAUTION

APPLY PROPER LINE VOLTAGE

To prevent damage to the instrument, always check the line-voltage information recorded on the rear panel before applying power to the instrument. Incorrect placement of the line-voltage selector plug may damage the instrument. Verify correct placement of the line-voltage selector plug.

AVOID EXCESSIVE MOISTURE

Circuit boards and components must be dry before applying power to prevent damage from electrical arcing.

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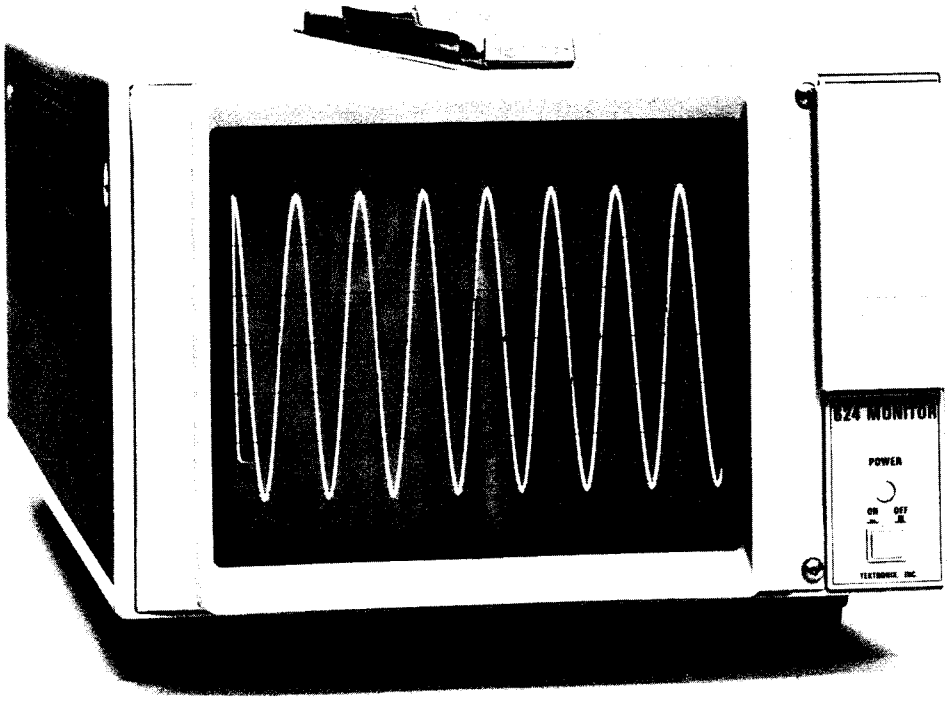
EXERCISE CARE WHEN CHECKING DIODES

When checking diodes, do not use an ohmmeter scale that has a high internal current, since high currents may damage the diodes under test.

USE PROPER CLEANING AGENTS

Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Use a non-residue type of cleaner, preferably isopropyl alcohol, totally denatured ethyl alcohol, or TP35. Before using any other type of cleaner, consult your Tektronix Service Center or representative.



2531-1

624 FEATURES

The 624 Monitor is a general purpose, high-brightness, X-Y display monitor providing a bright display of analog data on a large screen area. This instrument is designed for display application as in ultrasonic detection systems, electron microscope systems, volume and vibration analysis, and medical biophysical systems. The 624 Monitor may also be used to provide displays of alphanumeric and graphic information from computers and other data transmission system. (Monitor is shown with Option 23.)

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GENERAL INFORMATION

INTRODUCTION

OPERATORS MANUAL

The Operators Manual contains information necessary to effectively operate the 624 Monitor and is divided into three sections: Section 1 provides a basic description of the 624 with instrument specifications and accessories. Section 2 contains operating information for the instrument. Available options for the 624 Monitor are listed in section 3 of the manual.

INSTRUCTION MANUAL

The Instruction Manual provides both operating and servicing information for the 624 Monitor. The Instruction Manual is divided into ten sections. Operating information is covered in the first two sections; servicing information for use by qualified service personnel is contained in the remaining eight sections of the manual. Schematic diagrams are located at the rear of the manual and can be unfolded for reference while reading other parts of the manual. The reference designators and symbols used on the schematics are defined on the first page of the Diagrams and Circuit Board Illustrations section. Abbreviations used in the manuals, except those in the parts lists and schematic diagrams, comply with the American National Institute Y1.1-1972 publication. The parts lists are computer printouts and use computer-supplied abbreviations. Available options for the 624 Monitor are listed in section 7 of the Instruction Manual.

INSTRUMENT DESCRIPTION

The 624 Monitor is a compact, solid-state instrument providing accurate displays of information from the X, Y, and Z signal inputs.

WARNING

High voltage is present inside the instrument. To avoid electric shock, operating personnel must not remove protective instrument covers. Component replacement and internal adjustments must be made by qualified service personnel only.

Vertical and horizontal signals to be displayed on the crt are supplied to the Deflection Amplifiers through the appropriate X and Y INPUT connectors. The Deflection Amplifiers process the input signals and provide push-pull outputs to drive the deflection plates of the crt. Both Deflection Amplifiers contain position and gain controls.

The Z-Axis Amplifier controls the display intensity by providing a voltage to drive the crt control grid. Input signals are applied to the Z INPUT connector.

The High-Voltage and Low-Voltage Power Supplies provide all the voltages necessary for operation of this instrument.

SPECIFICATION

The electrical specifications listed in Table 1-1 apply when the following conditions are met: (1) The instrument must have been adjusted at an ambient temperature between +15° and +25° C (+59° and +77° F), (2) the instrument must be operating in an ambient temperature between 0° and +50° C (+32° and +122° F) and (3) the instrument must have been operating for at least 20 minutes.

TABLE 1-1
Electrical Characteristics

Characteristic	Performance Requirement
VERTICAL AND HORIZONTAL AMPLIFIERS	
Deflection Factor	
Vertical (Y)	Adjustable from 0.5 V or less to at least 2.5 V full scale. Nominally set for 1 V, within 2%, for 8 divisions of deflection.
Option 22	An internal 5:1 attenuator extends the deflection factor range to at least 12.5 V full scale.
Horizontal (X)	Adjustable from 0.5 V or less to at least 2.5 V full scale. Nominally set for 1 V, within 2%, for 8 divisions of deflection.
Option 22	An internal 5:1 attenuator extends the deflection factor range to at least 12.5 V full scale.
Attenuators (Option 22)	Deflection factor reduced five times within 3%, with 5:1 attenuation.
Polarity	
+ INPUTs	Positive signal applied to + input deflects beam up or to the right; negative signal deflects beam down or to the left.
- INPUTs (Option 21)	Positive signal applied to - input deflects beam down or to the left; negative signal deflects beam up or to the right.
Settling Time	Spot must reach new writing position with 0.05 cm within 0.5 μs from any on-screen position.
Bandwidth (With 80% Full-Screen Reference Signal)	DC to at least 3 MHz at -3 dB point.
Rise Time	116 ns or less.
Common-Mode Rejection (Option 21)	
DC to 100 kHz	
1X Attenuation	At least 100:1 for signals of ±5 V or less.
5X Attenuation (Option 22)	At least 50:1 for signals of ±25 V or less.
100 kHz to 1 MHz	
1X Attenuation	At least 50:1 for signals of ±5 V or less.
5X Attenuation (Option 22)	At least 20:1 for signals of ±25 V or less.
Phase Difference (DC to 1.0 MHz)	1° or less between X and Y amplifiers. X and Y amplifier gain must be set for the same deflection factor (V/div).
Position Stability	0.5 mm, or less, of drift per hour after 20-minute warm-up.
Gain Stability	1% or less of drift after 20-minute warm-up.

TABLE 1-1 (CONT.)
Electrical Characteristics

Characteristic	Performance Requirement
Displayed Noise (Tangetially Measured)	0.05 mm or less, with all inputs terminated in 1 kΩ or less.
Input RC (ALL INPUTs)	1 MΩ, within 1%, paralleled by 60 pF or less.
Option 26 (ALL INPUTs)	50 Ω, within 1%, paralleled by 60 pF or less.
Maximum Nondestructive Input Voltage (Fault Condition Only)	+100 V or -100 V (dc + peak ac).
Position Range	Spot may be positioned anywhere on screen with no signal input.
Dynamic Range	At least 1.5 screen diameters from center screen.
Crosstalk Between X and Y Amplifiers	
At 500 kHz	0.25 mm, or less, of deflection on the grounded channel (X or Y) with a 1 V signal applied on the other channel (Y or X).
At 3 MHz	0.38 mm, or less, of deflection on the grounded channel (X or Y) with a 1 V signal applied on the other channel (Y or X).

OPTION 4 SWEEP SYSTEM

Sweep Range	100 ms/div to 1 μs/div, in decade steps.
Sweep Accuracy Over Center Eight Divisions	Within 3% (VARIABLE fully clockwise).
Sweep Length	Adjustable to at least 10.5 div.
Linearity of Any Two Division Portion Within Center Eight Divisions	Within 6%, except for first 5% of total sweep length.
VARIABLE (Uncalibrated)	Provides continuously variable sweep rates between calibrated settings. Decreases each sweep rate setting by at least 10:1. Extends slowest sweep rate to at least 1 s/div.
Triggering Sensitivity (With Repetitive Signals)	At least 0.5 div vertical deflection from dc to 2 MHz.

Z-AXIS AMPLIFIER

Useful Input Voltage Range (+Z INPUT)	Adjustable. With Z Gain at maximum, no more than +1 V will provide full intensity. With Z Gain at minimum, at least +5 V is required to produce full intensity. (-1 V input signal cuts off visible intensity.)
Useful Frequency Range	DC to at least 5 MHz at -3 dB point.
Rise Time	70 ns or less.
Noise	No visible intensity modulation with Z INPUT terminated into 1 kΩ or less.
Common-Mode Rejection (Option 21)	
DC to 100 kHz	At least 100:1 with input signals to ±5 V at any setting of Z Gain.
100 kHz to 1 MHz	At least 50:1 with input signals to ±5 V at any setting of Z Gain.

TABLE 1-1 (CONT.)
Electrical Characteristics

Characteristic	Performance Requirement
Input RC (Both INPUTs)	1 MΩ, within 1%, paralleled by 60 pF or less.
Option 26 (Both INPUTs)	50 Ω, within 1%, paralleled by 60 pF or less.
Maximum Nondestructive Input Voltage (Fault Condition Only)	+100 V or -100 V (dc + peak ac) with crt beam positioned off the viewing area.
Crosstalk Between Z-Axis Amplifier and X or Y Amplifier	
DC to 500 kHz	0.25 mm or less, with X and Y INPUTs grounded and a 1 V signal applied to the Z-Axis Amplifier. (Z Gain set for maximum.)
500 kHz to 5 MHz	0.38 mm or less, with X and Y INPUTs grounded and a 1 V signal applied to the Z-Axis Amplifier. (Z Gain set at minimum.)
TTL Input Voltage (Option 25)	
HI	+2.4 V to +5 V dc.
LO	0 V to +0.8 V dc.
Unblanking (Option 25)	Input voltage level to produce unblanking is internally selectable. With selector in NEG position, a LO input produces unblanking; with selector in POS position, a HI input produces unblanking.

CATHODE-RAY TUBE DISPLAY

Usable Screen Area	9.6 X 12 centimers.
Quality Area	9 X 11 centimeters.
Option 1 Graticule	Internal, unlighted, 8 X 10 divisions (1.22 cm/div).
Geometry (Within Graticule Area)	Bowing or tilt is 0.1 division or less.
Orthogonality (Within Graticule Area)	90° within 0.7 °.
Accelerating Potential	Approximately 18 kV.
Deflection	Electrostatic.
Phosphor	P31 standard.
Option 40	P39.
Option 74	P4.
Option 76	P7.
Option 78	P11.
Brightness	Light output is at least 240 cd/m^2 (40 fL) with a 0.33 mm, or less, centered spot size. Measured with quality area flooded by a 60 Hz refresh rate raster, 308 horizontal lines.
Uniformity	Light output in quality area does not vary more than 20% at moderate intensity 34 cd/m^2 (10 fL). Measured with quality area flooded by a 60 Hz refresh raster, 320 horizontal lines.

TABLE 1-1 (CONT.)
Electrical Characteristics

Characteristic	Performance Requirement
Spot Size	
#1	0.31 cm (12 mils) or less, anywhere inside the quality area. Measured with shrinking raster method at 170 cd/m^2 (30 fL) brightness and full-screen raster, 60 Hz refresh rate.
#2	0.028 cm (11 mils) or less, at 0.5 μA of beam current. Measured with shrinking raster method.
Resolution	Spot size does not vary more than 20% over the quality area, at a constant intensity.

POWER SOURCE

Line Voltage (ac, rms)	
Low Range, P951	
Low (100 V ac)	90 to 110 V ac.
Med (110 V ac)	99 to 121 V ac.
Hi (120 V ac)	108 to 132 V ac.
High Range, P952	
Low (200 V ac)	180 to 220 V ac.
Med (220 V ac)	198 to 242 V ac.
Hi (240 V ac)	216 to 250 V ac.
Line Frequency	48 to 440 Hz.
Maximum Power Consumption (120 V ac, 60 Hz)	61 Watts, 0.7 Ampere.
Option 20 Input Power	
+20 V DC Input	+17.0 to +26.0 V dc, including any ripple excursions.
-20 V DC Input	-17.0 to -26.0 V dc, including any ripple excursions.
Option 20 Maximum Operating Current	
+20 V DC Input	2.2 Amperes.
-20 V DC Input	0.3 Ampere.
Option 20 Maximum Allowable Input Ripple	2 V ac, peak-to-peak.
Option 20 Shutdown-Voltage	
+20 V DC Input	+26 V to no greater than +29.5 V dc.
-20 V DC Input	-26 V to no greater than -29.5 V dc.
Option 20 Maximum Nondestructive Input Voltage	
+20 V DC Input	+40 V dc.
-20 V DC Input	-40 V dc.

TABLE 1-2
Environmental Characteristics

Characteristic	Information
NOTE *This instrument will meet the electrical characteristics given in the Performance Requirement column of Table 1-1 over the following environmental limits.*	
Temperature	
Operating	0° to +50°C (+32° to +122°F).
Nonoperating	-40° to +70°C (-40° to +158°F).
Altitude	
Operating	To 4.6 km (15,000 ft).
Nonoperating	To 15.2 km (50,000 ft).
Humidity	To 95% at 40°C.
Transportation	Qualified under National Safe Transit Committee Test Procedure 1A, Category II.

TABLE 1-3
Physical Characteristics

Characteristic	Information
Net Weight	About 8.2 kg (18 pounds).
Overall Dimensions	See Figure 1-1.

STANDARD ACCESSORIES

1 ea ..... Operators Manual

1 ea ..... Instruction Manual

1 ea ..... Lined Crt Implosion Shield (8 X 10 division graticule)

For more detailed information, refer to tabbed Accessories page in the 624 Instruction Manual.

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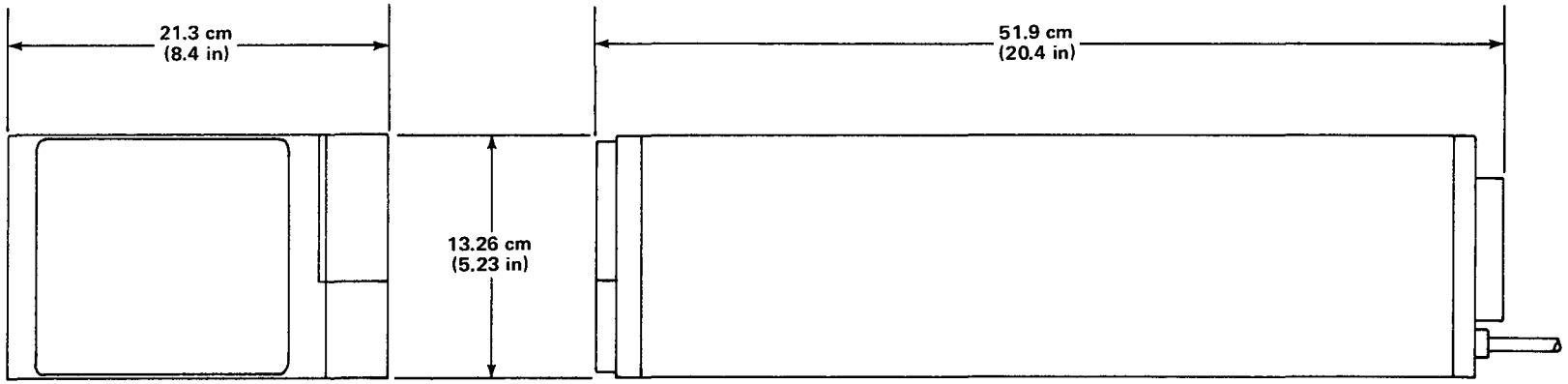
OVERALL DIMENSIONS
(MEASURED AT MAXIMUM POINTS)



NOTE: DIMENSIONS ARE GIVEN WITH TOP FIGURE IN CENTIMETERS AND BOTTOM FIGURE IN INCHES.

REFER TO DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS FOR A DETAILED DIMENSIONAL DRAWING.

2305-5

Figure 1-1. 624 Overall dimensional drawing.

INSTRUMENT PACKAGING

If the instrument is to be shipped to a Tektronix Service Center for service or repair, attach a tag showing the following: Owner (with address) and the name of an individual at your firm who can description of the service required.

Save and re-use the package in which your 624 Monitor was shipped to you. If the original packaging is unfit for use or is not available, repackage the instrument as follows:

1. Obtain a corrugated-cardboard carton with a 275 pound test strength, and having inside dimensions of no less than six inches more than the instrument dimensions; this allows for cushioning.

2. Surround the instrument with polyethylene sheeting to protect the finish.

3. Cushion the instrument on all sides by tightly packing dunnage or urethane foam between the carton and the instrument, allowing three inches on all sides.

4. Seal the carton with shipping tape or with an industrial stapler.

OPERATING INSTRUCTIONS

AMBIENT TEMPERATURE CONSIDERATIONS

This instrument can be operated where the ambient air temperature is between 0° and +50° C (+32° and +122° F), and can be stored in ambient temperatures between -40° and +70° C (-40° and +158° F). After being stored in temperatures beyond the above operating limits, allow the chassis temperature to return to within the operating limits before applying power. Allowing the Monitor to operate at an ambient temperature substantially higher than that specified may result in poor reliability as well as inaccurate performance.

When the 624 is mounted in a rack with other equipment, it is important that the temperature surrounding the Monitor does not exceed +50° C. Additional clearance or forced ventilation methods (fan) may be needed to maintain ambient temperatures below +50°C. Reliabiity and performance of the 624 will be affected if the ventilation holes in the protective panels are obstructed, or if the 624 is operated at an ambient temperature higher than +50° C Other environments and mounting configurations may require additional cooling measures.

CONTROLS AND CONNECTORS

Controls and connectors necessary for operation of the 624 Monitor are located on the front and rear panels of the instrument. To make full use of the capabilities of this instrument, the operator should be familiar with the function and use of each external control and connector. The front-panel controls are shown and described in Figure 2-1. Brief descriptions of the rear-panel controls and connectors are given in Figures 2-2 and 2-3.

DETAILED OPERATION INFORMATION

SIGNAL CONNECTORS

BNC connectors are provided on the rear panel of the instrument for application of input signals to the Vertical (Y) and Horizontal (X) Amplifiers for display on the crt, and to the Z-Axis Amplifier to control display intensity. Amplifiers of the standard 624 Monitor are designed for single-ended operation, while those of the 624 Option 21 Monitor are designed to provide differential operation. The Option 21 Monitor is shipped from the factory prepared for single-ended operation with a grounding cap connected to the -INPUT (inverting input) of each axis. For differential operation, remove the grounding cap and apply the input signals to the BNC connectors of the appropriate axis. An additional BNC connector is provided on 624 Option 25 Monitors to allow application of TTL-compatible input voltages to unblank the display.

INPUT ATTENUATION AND IMPEDANCE

The Vertical (Y) and Horizontal (X) Amplifier input circuits of the 624 Option 22 Monitor include a selectable 1X or 5X attenuator, which is set for 1X attenuation when shipped from the factory. The standard 624 Monitor is designed for 1X operation. The Z-Axis Amplifiers can be modified to provide a range of input impedance and attenuation. The desired input attenuation should be set by qualified service personnel only.

The input circuits of all amplifiers in the standard 624 Monitor present a high impedance to the applied input signal. The Option 26 Monitors, however, have been modified to present a 50-ohm input impedance to the applied input signal.

INPUT SIGNAL REQUIREMENTS

The horizontal (X) and vertical (Y) deflection factors are set at the factory to one volt for eight divisions of deflection on each axis. Thus, as shipped, the input signal required for each division of deflection is 0.125 volt.

The best transient response from the 624 Monitor is achieved when the input signal amplitude to the vertical or horizontal INPUT is no greater than that sufficient to provide full-screen deflection.

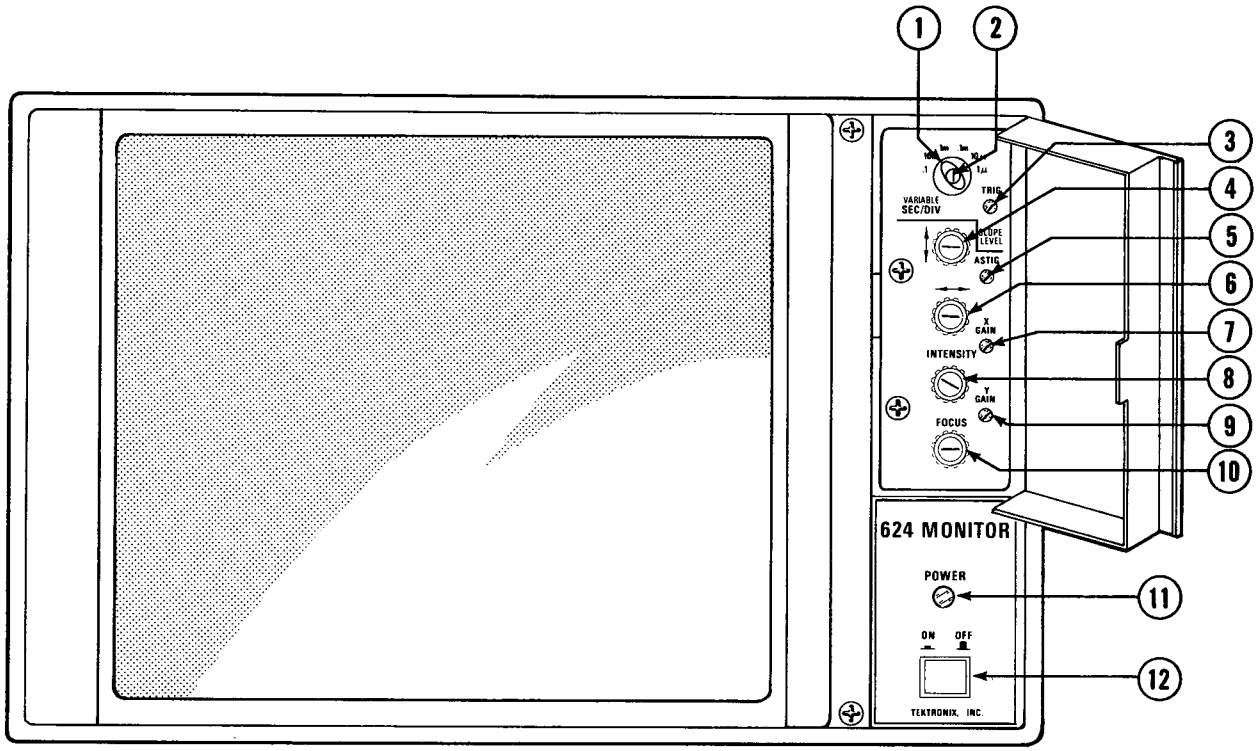
WARNING

To avoid electric shock hazard, do not apply input signals of more than 25 volts (dc plus peak ac). Should fault conditions occur however, the instrument is protected for application of input signals up to 100 volts (dc plus peak ac).

With no signals applied to the Z INPUT, the intensity of the display is controlled only by the front-panel INTENSITY control. To control the display intensity with an externally applied signal, set the INTENSITY control to about midrange, and apply the input signal to the Z INPUT connector.

CAUTION

Exercise care in establishing the correct display intensity; a high-amplitude Z-Axis input signal, combined with an excessively high setting of the INTENSITY control, may damage the crt phosphor.



(1) **SEC/DIV (Option 4 Only)**—Selects one of six calibrated sweep rates between 0.1 second/division and 1 microsecond/division in decade steps. (VARIABLE must be fully clockwise for the indicated sweep rate.)

(2) **VARIABLE (Option 4 Only)**—Screwdriver adjustment, concentric with the SEC/DIV switch, which provides contiuously variable sweep rates between the calibrated steps. Extends the sweep rate range to 1 second/division.

(3) **TRIG SLOPE/LEVEL (Option 4 Only)**— Screwdriver adjustment to select the slope and level of the vertical signal from which the sweep is triggered.

(4) **Vertical (↕) Position**—Positions the crt beam in the Y axis.

(5) **ASTIG**—Screwdriver adjustment to be used in conjunction with the FOCUS control to provide a well-defined display.

(6) **Horizontal (↔) Position**—Positions the crt beam in the X axis.

(7) **X GAIN**—Provides an adjustable amplification factor for full-screen horizontal deflection of at least 0.5 volt to 2.5 volts. (X Gain is an internal control for Option 27 instruments.)

(8) **INTENSITY**—Controls brightness of the crt display and is the offset control for the Z-Axis.

(9) **Y GAIN**—Provides an adjustable amplification factor for full-screen vertical deflection of at least 0.5 volt to 2.5 volts. (Y Gain is an internal control for Option 27 instruments.)

(10) **FOCUS**—Provides adjustment to obtain a well-defined display.

(11) **POWER (Indicator)**—Illuminates when instrument is on.

(12) **ON/OFF**—Controls power to the Monitor. Instrument is on when pushbutton is in.

2531-2

Figure 2-1. Front-panel controls and indicators.

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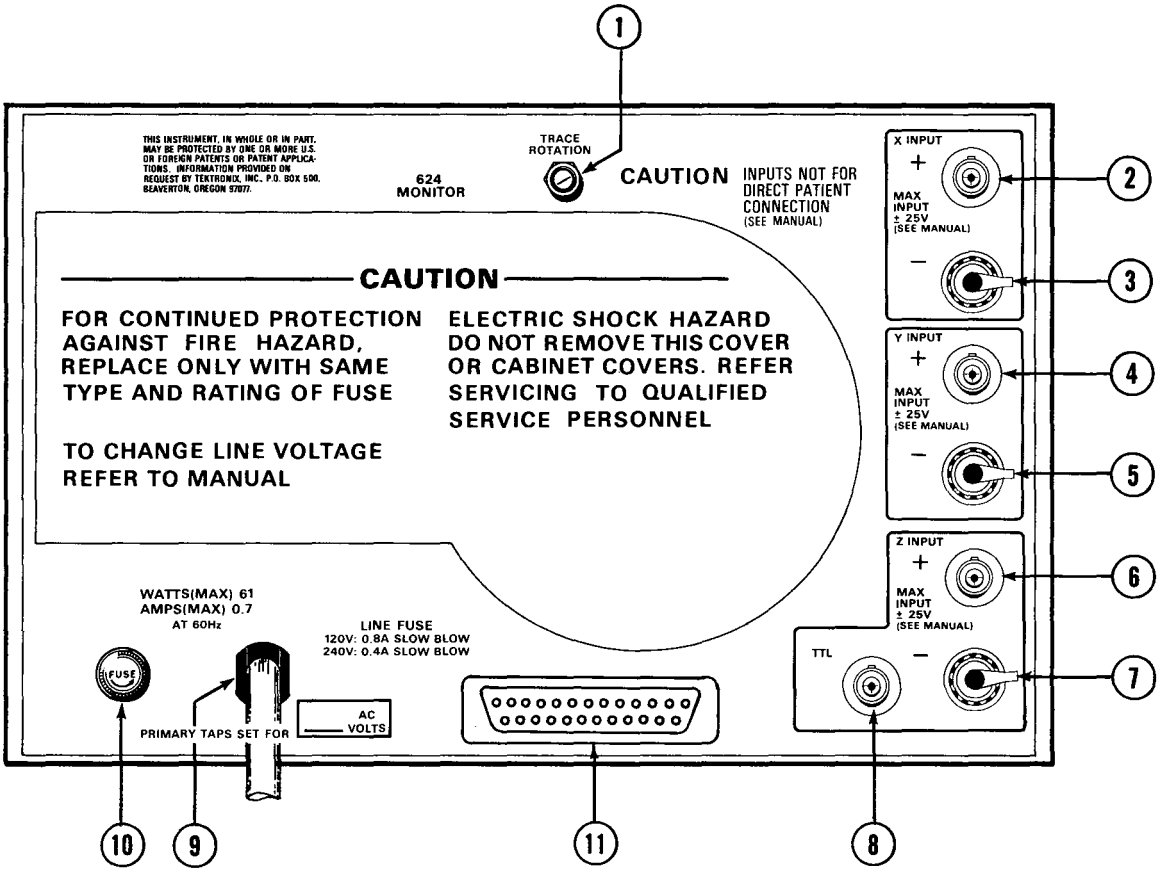


(1) **TRACE ROTATION**—Adjustment to align the trace with the horizontal axis.

(2) **+X INPUT**—BNC input connector to allow application of input signals. A positive signal applied deflects beam to the right; a negative signal deflects beam to the left.

(3) **-X INPUT (Option 21 Only)**—BNC input connector with grounding cap. A positive signal deflects beam to the left; a negative signal deflects beam to the right.

(4) **+Y INPUT**—BNC input connector. A positive signal applied deflects beam up; a negative signal deflects beam down.

(5) **-Y INPUT (Option 21 Only)**—BNC input connector with grounding cap. A positive signal applied deflects beam down; a negative signal deflects beam up.

(6) **+Z INPUT**—BNC input connector. A positive signal applied provides a linear function to increase display brightness; a negative signal decreases display brightness.

(7) **-Z INPUT (Option 21 Only)**—BNC input connector with grounding cap. A positive signal applied provides a linear function to decrease display brightness; a negative signal increases display brightness.

(8) **TTL Z INPUT (Option 25 Only)**—BNC input connector to allow application of TTL-compatible voltages to unblank the crt display.

(9) **Power Cord**—Allows connection to the ac power source to operate the instrument. (Power cord is deleted on Option 20 instruments; see Figure 2531-4.)*

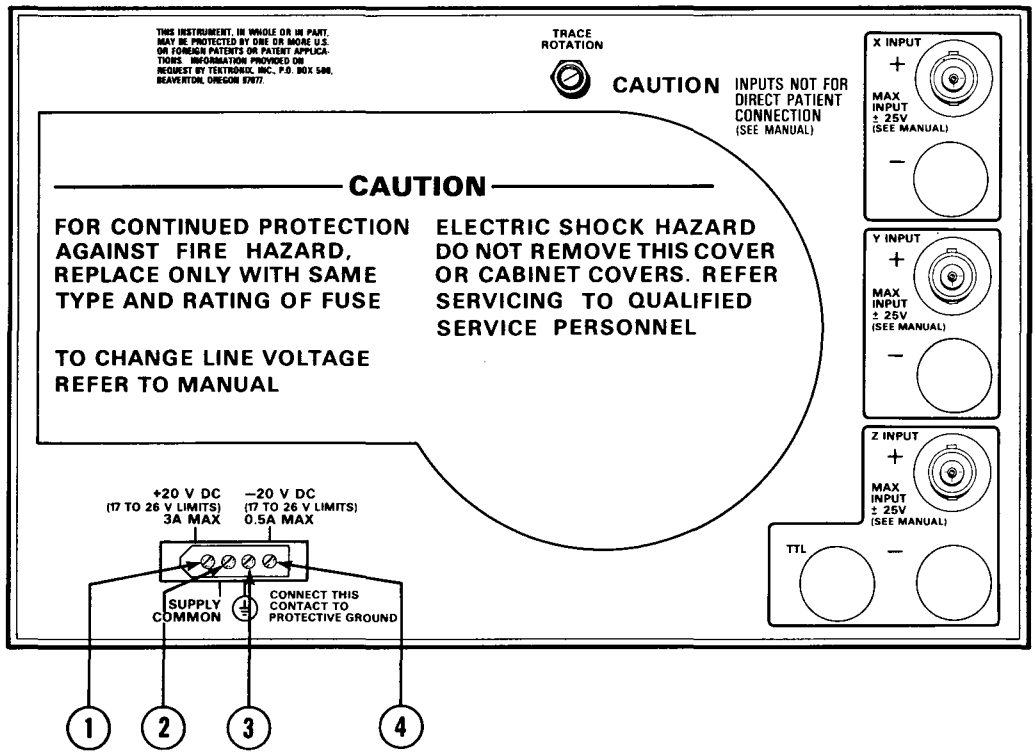
(10) **LINE FUSE**—120 V: 0.8 A SLOW; 220 V: 0.6 A SLOW. (Line fuse is internal for Option 6 instruments and deleted for Option 20 instruments.)*

(11) **ALTERNATE INPUT CONNECTOR (Option 10 Only)**—25-pin input connector to provide an alternate means of connecting input signals to the +X, +Y, and +Z Amplifiers. If your instrument includes Option 25 (TTL Z INPUT), connections are also made for applying TTL Blanking via the connector.

*Refer qualified service personnel to the servicing information section of the 624 Instruction Manual for further information.

2531-3A

Figure 2-2. Rear-panel controls and connectors.



The Option 20 Power-Input Connector allows application of dc voltages and ground to operate the instrument. All pins must be properly connected for instrument operation. Refer qualified service personnel to the servicing information sections of the 624 Instruction Manual for further information.

(1) **+20 V DC**— Input voltage from +17 to +26 V dc, 3 A maximum, will provide proper regulation of the instrument.

(2) **Supply Common**—To be connected to the supply common of the units supplying the power.

(3) **Protective Ground**—To be connected to protective ground of the units supplying the power.

(4) **-20 V DC**—Input voltage from -17 to -26 V dc, 0.5 A maximum, will provide proper regulation of the instrument.

2531-4

Figure 2-3. Option 20 Rear-panel Power-Input connector.

The input signal required for maximum display intensity, through the +Z INPUT connector, is set at the factory for +1 volt, or less. The input signal required to visually cut off the display intensity is set at the factory for -1 volt, or less. The best transient response of the Z-Axis Amplifier is achieved when the input signal is the minimum required to provide the desired intensity change.

An additional BNC connector is provided on the rear panel of the 624 Option 25 Monitors for application of TTL-compatible input voltages to unblank the crt display. (Crt unblanking = visual display.) The input voltage level necessary to produce unblanking is internally selectable, and should be set by qualified service personnel only.

With the internal Unblanking Level Selector in the NEG position, a TTL LO level (0 V to +0.8 V dc) applied to the TTL Z INPUT connector will unblank the display and allow the INTENSITY control and +Z INPUT (and -Z INPUT with Option HI level (+2.4 V to +5 V dc), or no applied voltage, will blank the display. With the Unblanking Level Selector in the POS position, a HI level applied will unblank the display.

OPTION 4 SWEEP INFORMATION

The SEC/DIV switch provides six calibrated sweep rates from 0.1 second to 1 microsecond/division in decade steps (VARIABLE control in the fully clockwise position). The VARIABLE control provides uncalibrated, continuously variable sweep rates between calibrated settings of the SEC/DIV switch.

When making time measurements using the graticule, the area between the second and tenth vertical lines provides the most linear measurement. (See Fig. 2-4.) Therefore, the first and last divisions of the display should not be used for making accurate time measurements. Position the start of the display to be measured to the second vertical line. Then set the SEC/DIV switch so that the end of the display measurement section falls between the second and the tenth vertical line.

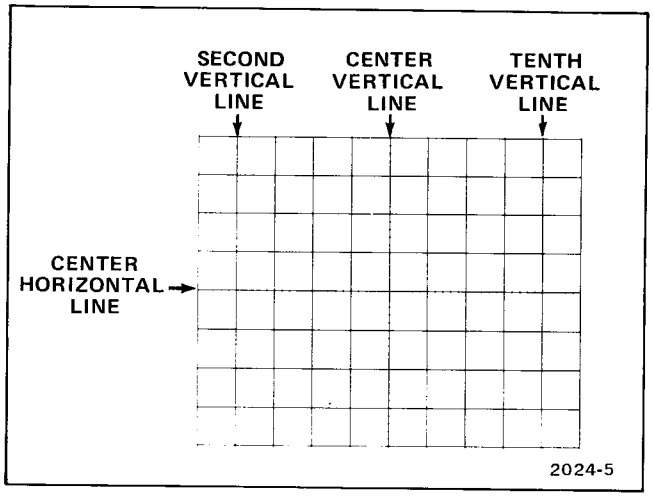


Figure 2-4. Definition of Measurement lines on the 624 graticule.

FUNCTIONAL CHECK

Functional Check procedures are located in the servicing information sections of the 624 Instruction Manual for use by qualified service personnel only. These procedures have not been made available to the operator because of internal controls and selectors which affect the functions of certain operating controls.

WARNING

High-voltage is present inside the instrument. To avoid electric shock, operating personnel must not remove protective instrument covers. Internal adjustments and switch position settings must be made by qualified service personnel only.

INSTALLATION

OPERATING POWER INFORMATION

This instrument (except for the Option 20 version) can be operated from either a 120-volt or 220-volt nominal line-voltage source, 48 to 440 hertz. In addition, three regulating ranges are provided for each nominal line-voltage source.

CAUTION

To prevent damage to the instrument, always check the line-voltage information recorded on the rear panel before applying power to the instrument.

NOTE

Option 20 power requirements are given later in this section.

POWER CORD INFORMATION

WARNING

The 624 Monitor (excluding the Option 20 version) is intended to be operated from a single-phase earth-referenced power source having one current-carrying conductor (the Neutral Conductor) near earth potential. Operation from power sources where both current-carrying conductors are live with respect to earth (such as phase-to-phase on a three-wire system) is not recommended, since only the Line conductor has over-current (fuse) protection within the instrument.

This instrument has a three-wire power cord with a polarized two-pole, three-terminal plug for connection to the power source and safety-earth. The safety-earth terminal of the plug is directly connected to the instrument frame. For electric-shock protection, insert this plug only in a mating outlet with a safety-earth contact.

Do not defeat the grounding connection. Any interruption of the grounding connection can create an electric-shock hazard. Before making external connections to the 624, always ground the instrument first by connecting the power cord to a properly mated power outlet.

TABLE 3-1
Power-Cord Conductor Identification

Conductor	Color	Alternate Color
Line	Brown	Black
Neutral	Light Blue*	White
Safety Earth	Green/Yellow	Green/Yellow

*Tinned copper conductor.

The power-cord plug required depends upon the ac input voltage and the country in which the instrument is to be used. Should you require a power-cord plug other than that supplied with your instrument, refer to the standards listed in Table 3-2.

TABLE 3-2
Location of Power-Cord Configuration Information

Nominal Line Voltage	Reference Standards
120 V AC	[1]ANSI C73.11
	[2]NEMA 5-15P (Hospital Grade)
220 V AC	ANSI C73.20
	[3]AS C112
	[4]BS 1363
	[5]CEE 7, sheets IV, VI and VII
	NEMA 6-15-P

[1]ANSI—American National Standards Institute

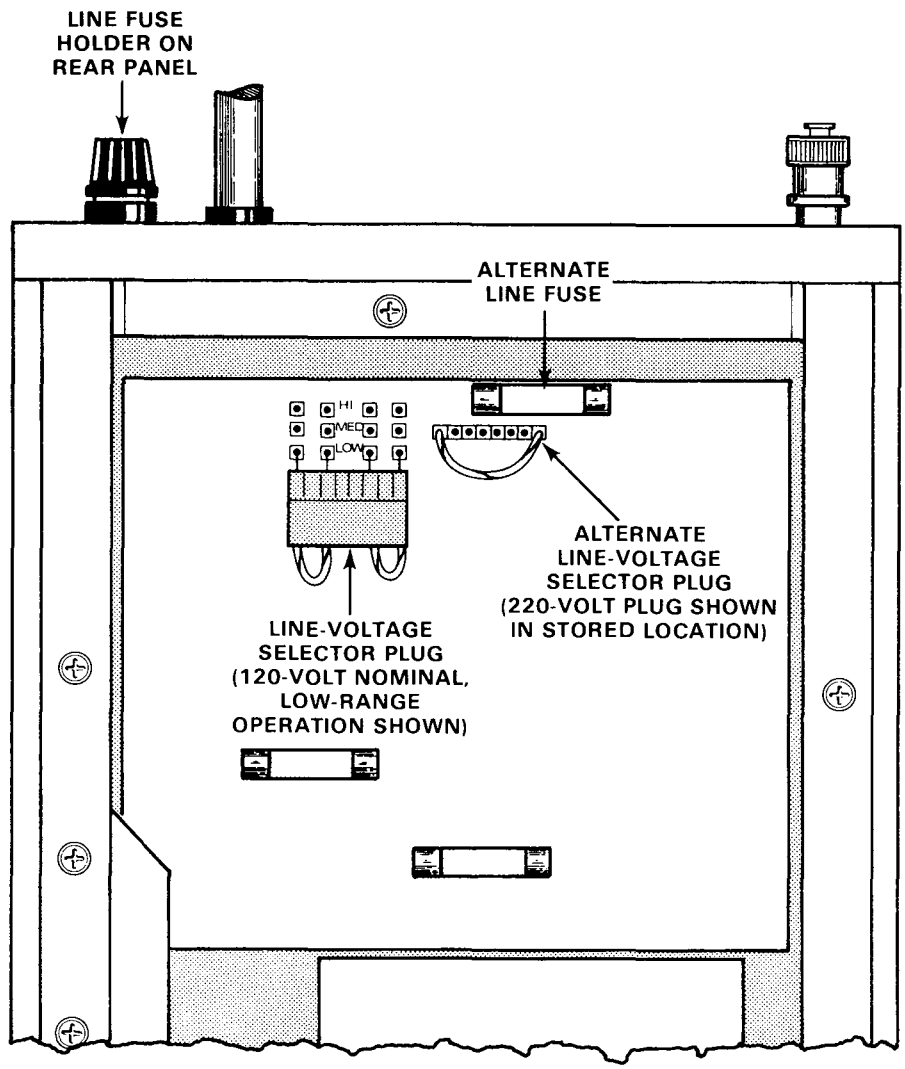
[2]NEMA—National Electrical Manufacturer's Association

[3]AS—Standards Association of Australia

[4]BS—British Standards Institute

[5]CEE—International Commission on Rules for the Approval of Electrical Equipment

For medical-dental applications, use NEMA 5-15-P (Hospital Grade) plug for 120-volt operation, or NEMA 6-15-P plug for 220-volt operation.



Regulating Ranges

Line-Voltage Selector Position	Regulating Range and Fuse Data	
	120 Volts (Nominal)	220 Volts (Nominal)
LO	90 V ac to 110 V ac	180 V ac to 220 V ac
MED	99 V ac to 121 V ac	198 V ac to 242 V ac
HI	108 V ac to 132 V ac	216 V ac to 250 V ac
Line Fuse Data	0.8 A slow-blowing type	0.6 A slow-blowing type

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Figure 3-1. Location of line-voltage selector plugs, regulating-range pins, and line fuse.

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LINE-VOLTAGE AND REGULATING-RANGE SELECTION

CAUTION

Damage to the instrument may result from incorrect placement of the line-voltage selector plug.

To select the correct nominal line voltage and regulating range, proceed as follows:

NOTE

This information does not apply to the Option 20 Monitor.

1. Disconnect the instrument from the power source.

2. Insert the proper line-voltage selector plug (the brown plug for 120-volt operation or the red plug for 220-volt operation) on the line-voltage selector pins (located on the Low-Voltage Power Supply board) labeled for the desired nominal line-voltage range. Refer to Figure 3-1 for location and additional information.

3. Remove the line fuse from the fuse holder and check for the correct rating. Replace it with one having the correct rating, if necessary. Refer to Figure 3-1 for fuse information and location.

NOTE

An alternate line fuse, intended for the line-voltage source for which the Monitor was not set when shipped from the factory, is clipped to the Low-Voltage Power Supply board (see Fig. 3-1).

4. Change the nominal line-voltage information recorded on the 624 rear panel. Use a non-abrasive eraser to remove previous data, and mark on the new data with a permanent marking pen.

5. Apply power to the Monitor.

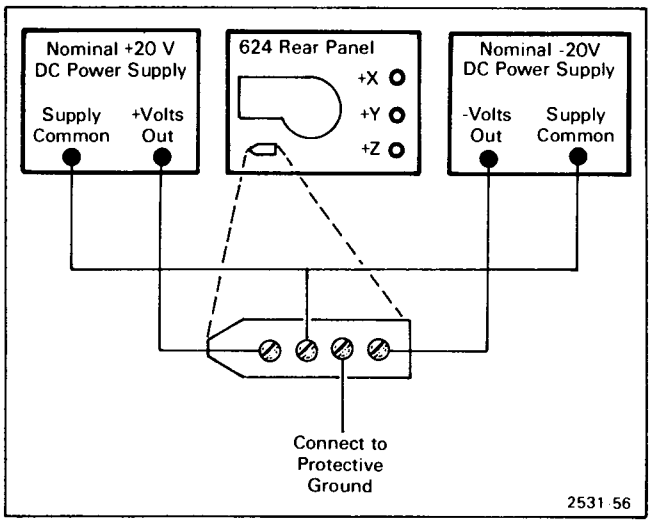

Figure 3-2. Proper application of power to the 624 Option 20 Monitor.

OPTION 20 POWER REQUIREMENTS

The Option 20 Monitor does not have a line fuse or a power cord and will operate only with the correct dc power applied to the rear-panel power-input connector. Apply the following (See Fig. 3-2):

+20 V dc (pin 1).....+17 to +26 V dc, 2.2 A maximum.*

Supply Common (pin 2).....Connect to supply common of unit(s) supplying the power.

Protective Ground (pin 3).....Connect to protective ground of the unit(s) supplying the power.

-20 V dc (pin 4).....-17 to -26 V dc, 0.3 A maximum.*

***When the Monitor is turned on, the inital current drain may exceed the limits given above.**

Fuse protection is provided on the +20 V DC and -20 V DC inputs. See Figure 3-3 for location and rating of the Option 20 input fuses.

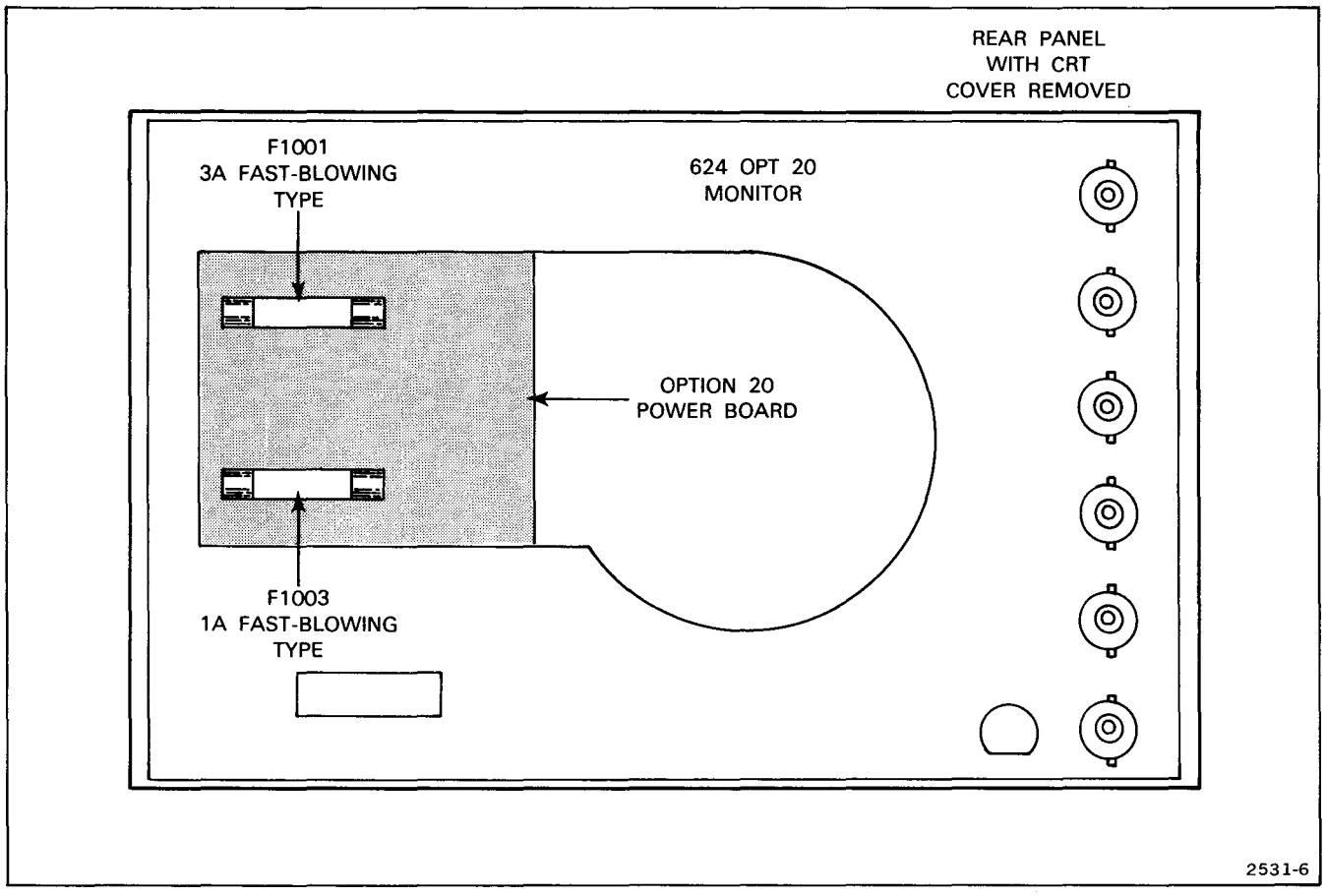

Figure 3-3. Location and rating of Option 20 input fuses.

INSTALLATION IN PATIENT-CARE FACILITIES

WARNING

Do not use the amplifier INPUTS for direct-patient connection. Signal currents at these connectors, as well as leakage currents, may exceed values considered non-hazardous for direct-patient connection.

Although this Monitor is not to be connected directly to a patient, interconnecting this Monitor to other equipment can result in the application of excessive current to a patient. It is extremely important that the interconnection is made in accordance with NFPA 76B-T, Tentative Standard for the Safe Use of Electricity in Patient Care Areas of Health Care Facilities, section 3038, "Signal Transmission Between Appliances".

Among the situations involving the above-mentioned patient hazard is one in which two or more pieces of interconnected equipment are grounded at locations remote from one another. The standard mentioned in the preceding warning describes both this hazard and the appropriate corrective measures.

X AND Y INPUT ATTENUATION SELECTION

WARNING

To avoid electric shock, always turn the instrument OFF before changing the settings of the X or Y Attenuators.

The Horizontal (X) and Vertical (Y) Amplifiers of the 624 Option 22 instrument include selectable 1:1 or 5:1 step attenuators in both the + and—sides of the input circuits. These attenuators extend the deflection factor range of the appropriate amplifier to at least 12.5 volts for full-screen deflection. To maintain proper response of the

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amplifier, set both attenuators to the same position. Refer to the Internal Control and Selector Locations foldout page in Section 9, Diagrams and Circuit Board Illustrations, for the position settings and locations of the attenuator switches.

Z INPUT ATTENUATION

CAUTION

Exercise care in establishing the correct display intensity; a high-amplitude Z-Axis input signal, combined with an excessively high setting of the INTENSITY control, may damage the crt phosphor.

The Z-Axis Amplifier of the standard 624 Monitor is shipped from the factory with 1X input attenuation and 1 megohm input impedance. Option 26 Monitors present an input impedance of 50 Ω; however, the attenuation and input impedance can be modified to suit a specific application. Holes in the Z-Axis Amplifier board, allow components to be changed. Figure 3-4 illustrates the method used to modify input attenuation and input impedance of the +Z INPUT. Refer to the Internal Control and Selector Locations foldout page in Section 9, Diagrams and Circuit Board Illustrations, for location of the Z-Axis attenuation components. Refer to your Tektronix Field Office or representative for additional information.

RACKMOUNTING INFORMATION

The 624 can be operated in a standard 19-inch instrument rack with front and rear holes that conform to universal hole spacing. Kits are available to convert eht 624 from the cabinet to a rackmounted configuration, and vice versa. Complete instructions are included in the kits. A brief description of each available conversion kit is given here. Consult your Tektronix Field Office or representative for additional information.

The standard 624 Monitor is shipped from the factory without protective covers. To assure operator safety, these Monitors should either be installed within equipment cabinets, as provided in original equipment manufacturer's systems, or be provided with protective covers (Option 23 or Option 28). When the Monitor is installed in a system or rackmounted, be sure that the ambient temperature does not exceed +50°C.

CAUTION

Reliability and performance of the 624 will be affected if the ventilation holes in the protective panels are obstructed, or if operated at an ambient temperature higher than +50°C. Forced ventilation methods may be needed.

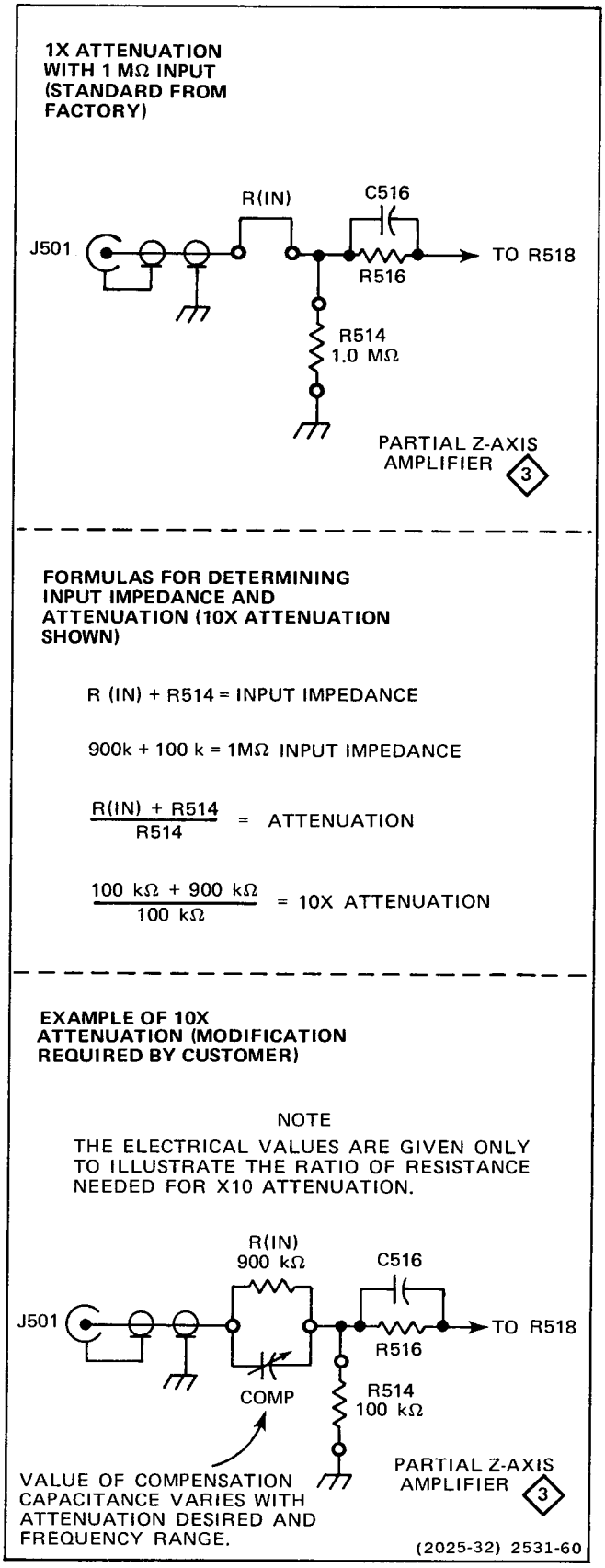

Figure 3-4. Typical method for modifying Z-Axis input impedance and attenuation.

CABINET-TO-RACKMOUNT CONVERSION

TEKTRONIX PART 040-0600-00. Mounts two 624 Monitors side-by-side in a standard 19-inch wide rack. The kit comes equipped with a slide-out assembly and includes the securing hardware. Complete rackmounting instructions are included in each kit.

TEKTRONIX PART 040-0601-00. Mounts one 624 Monitor in a standard 19-inch wide rack. The kit is equipped with a slide-out assembly, securing hardware, and a blank front panel to cover the second instrument opening in the rack. Complete rackmounting instructions are included in each kit.

TEKTRONIX PART 040-0624-00. Converts one TM 503 Power Module and one 624 Monitor to mount side-by-side in a standard 19-inch wide instrument rack. The kit includes slide-out assembly and securing hardware. Complete rackmounting instructions are included with each kit.

RACKMOUNT-TO-CABINET CONVERSION

TEKTRONIX PART 040-0602-00. Converts one 624 Monitor from a rackmount configuration to a cabinet configuration. Complete instructions are included in each kit.

INSTRUMENT DIMENSIONS

A drawing showing the major dimensions of the 624 is shown in Figure 1-1 (General Information section). Further details and tolerances are shown on the Detailed Dimensional Drawing foldout page in Section 9, Diagrams and Circuit Board Illustrations.

FUNCTIONAL CHECK

The following procedures are provided to aid in obtaining a display on the 624 Monitor and may be used as a check of basic instrument operation or to verify proper operation for incoming inspection. Only instrument functions, and not measurement quantities or specifications, are checked in these procedures. Therefore, a minimum amount of test equipment is required.

BEFORE YOU BEGIN:

1. Determine which Options have been installed in your instrument.

2. Determine which of the listed test equipment is required to check your Monitor.

3. Refer to the Change Information at the rear of this manual for any modifications which may affect the Functional Check procedures.

TEST EQUIPMENT REQUIRED

The following test equipment was used as a basis to write the Functional Check procedures. Other test equipment, which meets these requirements, may be substituted. When other equipment is substituted, the control settings or setup may need to be altered. The test equipment listed here is required to check functions of the standard 624 Monitor as well as those of available electrical Options.

1. Power Module

   Description: Tektronix TM 500-series power module with one or more plug-in compartments.

   Type Used: TEKTRONIX TM 501 (used with the FG 503 Function Generator).

2. Function Generator

   Description: Frequency range, one hertz to 50 kilohertz; output amplitude, one volt to five volts (peak-to-peak) into open circuit; waveform output, sine and square waves.

   Type Used: TEKTRONIX FG 503 Function Generator (used with TM 501 Power Module).

3. Cables (2 required)

   Description: Length, 42 inches (1 required). 18 inches (1 required); connectors, BNC.

   Type Used: Type RG-58/U, 50-ohm coaxial, Tektronix Part 012-0057-01 (42 inch), Tektronix Part 012-0076-00 (18 inch).

4. T Connector

Description: Connectors, BNC-to-BNC.

Type Used: BNC-to-BNC T connector, Tektronix Part 103-0030-00.

5. 50-Ohm Termination[1]

Description: Impedance, 50 ohms; connectors, BNC.

Type Used: Tektronix Part 011-0049-00.

[1]**50-ohm termination is not used when checking the Option 26 Monitor.**

PRELIMINARY SET UP

1. Install the function generator in the power module and turn on the power module.

2. Install the lined implosion shield (provided with your instrument) over the crt display area.

3. Connect the 624 to a suitable power source.

4. Open the access door on the front panel and set the controls as follows:

SEC/DIV (Option 4 Only)	1 ms
VARIABLE (Option 4 Only)	Fully clockwise
TRIG SLOPE/LEVEL (Option 4 Only)	As desired
Vertical Position	Midrange
Horizontal Position	Midrange
ASTIG	As set
X GAIN	Midrange
Y GAIN	Midrange
INTENSITY	Fully counterclockwise
FOCUS	As desired
ON/OFF	ON (pushbutton in)

5. Set the applicable internal controls and selectors as follows: (Refer to the Internal Controls and Selectors Location foldout page in Section 9, Diagrams and Circuit Board Illustrations.)

XY-YT (Option 4 Only)	XY (Rear position)
Trig Mode (Option 4 Only)	Auto (rear)
+Y Atten (Option 22 Only)	1X (up position)
-Y Atten (Option 22 Only)	1X (up)
+X Atten (Option 22 Only)	1X (up)
Unblanking Level Selector (Option 25 Only)	POS
Y GAIN (Option 27 Only)	Midrange
X GAIN (Option 27 Only)	Midrange

6. Allow at least one minute for the instrument to warm up.

7. Proceed to the Functional Check procedures.

DISPLAY FUNCTIONS

1. Perform the Preliminary Set Up procedure.

2. As you slowly turn the INTENSITY control clockwise, notice that at approximately midrange a spot will appear on the crt. The brightness will increase as the control is further rotated.

CAUTION

A high intensity level combined with a stationary spot will damage the crt phosphor. Therefore, set the INTENSITY control to the minimum necessary for good visibility.

3. Adjust the FOCUS and ASTIG controls for a sharp, well-defined spot.

4. Rotate the Vertical Position control and notice that the spot can be positioned off the crt display area at the top and bottom. Return the spot to center screen.

5. Rotate the Horizontal Position control and notice that the spot can be positioned off the display area to the left and right. Return the spot to center screen.

6. Connect a 2-volt (peak-to-peak), 50-kilohertz sine wave from the function generator to the +X INPUT connector via the 50-ohm termination and 42-inch cable. For Option 26 Monitors: Do not use the 50-ohm termination in this setup.

7. Position the trace to the center horizontal graticule line with the Vertical Position control. Check that the rear-panel TRACE ROTATION control will align the trace with the center horizontal graticule line.

X AND Y DEFLECTION FUNCTIONS

1. Perform the Preliminary Set Up procedure.

2. Connect a 1-volt (peak-to-peak), 50-kilohertz sine wave from the function generator to the +X INPUT connector via a 50-ohm termination and 42-inch cable. For Option 26 Monitors: Do not use the 50-ohm termination in this setup.

3. Turn the X GAIN control fully clockwise and check for at least 10 divisions of horizontal deflection.

4. For Option 22 Monitors: Set the X GAIN control for exactly 10 divisions of deflection. Set the +X Atten (S310) to the 5X (down) position. Check for 2 divisions of horizontal deflection, within 3%. Return the +X Atten to 1X.

5. For Option 21 Monitors: Remove the grounding cap from the -X INPUT. Disconnect the signal from the +X INPUT and apply it to the -X INPUT. Place the grounding cap on the +X INPUT and, with the X GAIN control fully clockwise, check for at least 10 divisions of horizontal deflection.

6. For Option 21 & 22 Monitors: Set the X GAIN control for exactly 10 divisions of deflection. Set the -X Atten (S410) to the 5X (down) position. Check for 2 divisions of horizontal deflection, within 3%. Return the -X Atten to 1X.

7. Disconnect the signal from the X INPUT and apply it to the +Y INPUT. Turn the Y GAIN fully clockwise and check for at least 8 divisions of vertical deflection.

8. For Option 22 Monitors: Set the Y GAIN control for exactly 8 divisions of deflection. Set the +Y Atten (S110) to the 5X (down) position. Check for 1.6 divisions of vertical deflection, within 3%. Return the +Y Atten to 1X.

9. For Option 21 Monitors: Remove the grounding cap from the -Y INPUT. Disconnect the signal from the +Y INPUT and apply it to the -Y INPUT. Place the grounding cap on the +Y INPUT and, with the Y GAIN control fully clockwise, check for at least 8 divisions of vertical deflection.

10. For Option 21 & 22 Monitors: Set the Y GAIN control for exactly 8 divisions of deflection. Set the -Y Atten (S210) to the 5X (down) position. Check for 1.6 divisions of vertical deflection within 3%. Return the -Y Atten to 1X.

11. Set the function generator for a 5-volt (peak-to-peak), 50-kilohertz sine-wave output.

12. Turn the Y GAIN control fully counterclockwise and check for less than 8 divisions of vertical deflection.

13. For Option 21 Monitors: Remove the grounding cap from the +Y INPUT. Disconnect the signal from the -Y INPUT and apply it to the +Y INPUT. Place the grounding cap on the -Y INPUT and, with the Y GAIN control fully counterclockwise, check for less than 8 divisions of vertical deflection.

14. For Option 21 Monitors: Disconnect the signal from the Y INPUT and apply it to the -X INPUT. Turn the X GAIN control fully counterclockwise and check for less than 10 divisions of horizontal deflection.

15. For Option 21 Monitors: Remove the grounding cap from the +X INPUT. Disconnect the signal from the -X INPUT and apply it to the +X INPUT. Place the grounding cap on the -X INPUT and, with the X GAIN control fully counterclockwise, check for less than 10 divisions of horizontal deflection.

16. For Monitors Without Option 21: Disconnect the signal from the Y INPUT and apply it to the X INPUT. Set the X Gain control fully counterclockwise and check for less than 10 divisions of horizontal deflection.

NOTE

The following steps of this procedure apply only to 624 Monitors equipped with Option 22. For all other 624 Monitors, proceed to check the Z-Axis Functions.

17. Set the Option 22 Attenuators (S110, S210, S310, and S410) to the 5X (down) position.

18. Set the function generator for a 12.5-volt (peak-to-peak), 50-kilohertz sine-wave output. Remove the 50-ohm termination from the set up (does not apply to Option 26 Monitors). With the X GAIN control fully counterclockwise, check for less than 10 divisions of horizontal deflection.

19. For Option 21 Monitors: Remove the grounding cap from the -X INPUT. Disconnect the signal from the +X INPUT and apply it to the -X INPUT. Place the grounding cap on the +X INPUT and, with the X GAIN control fully counterclockwise, check for less than 10 divisions of horizontal deflection.

20. Disconnect the signal from the X INPUT and apply it to the +Y INPUT. With the Y GAIN control fully counterclockwise, check for less than 8 divisions of vertical deflection.

21. For Option 21 Monitors: Remove the grounding cap from the -Y INPUT. Disconnect the signal from the +Y INPUT and apply it to the -Y INPUT. Place the grounding cap on the +Y INPUT and, with the Y GAIN control fully counterclockwise, check for less than 8 divisions of vertical deflection.

22. Disconnect the function generator.

Z-AXIS FUNCTIONS

1. Perform the Preliminary Set Up procedure.

2. Set the X GAIN and Y GAIN controls to midrange. Adjust the INTENSITY control for a barely-visible spot.

3. Connect a 2-volt (peak-to-peak), 50-kilohertz sine wave from the function generator to the +X INPUT and +Z INPUT connectors via the 50-ohm termination, 42-inch cable, BNC T connector, and the 18-inch cable. Option 26 Monitors: Do not use the 50-ohm termination in this setup.

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4. Check that the right end of the crt display becomes bright, and that the left end disappears.

5. For Option 21 Monitors: Remove the grounding cap from the -Z INPUT. Disconnect the signal from the +Z INPUT and apply it to the -Z INPUT. Place the grounding cap on the +Z INPUT and check that the left end of the crt display becomes bright, and that the right end disappears.

6. Disconnect the function generator.

NOTE

The following steps of this procedure apply only to 624 Monitors equipped with Option 25.

7. Set the INTENSITY and FOCUS controls for a moderately bright, defocused spot.

8. Connect a +5-volt (with respect to ground), 1-hertz square wave from the function generator to the TTL Z INPUT via the 42-inch cable.

9. Check that the defocused spot periodically disappears.

10. Turn off the Monitor and move P550, Unblanking Level Selector, to the NEG position.

11. Turn ON the Monitor and check that the defocused spot periodically disappears.

12. Disconnect the function generator.

OPTION 4 SWEEP FUNCTIONS

1. Perform the Preliminary Set Up procedure.

2. Set the internal XY-YT switch (S434) to the YT (forward) position. Adjust the INTENSITY control for a visible trace.

3. Connect a 1-volt, 1-kilohertz squarewave signal from the function generator to the Y INPUT connector via a 42-inch BNC cable and 50-ohm termination. For Option 26 Monitors: Do not use the 50-ohm termination in this setup.

4. Adjust the TRIG SLOPE/LEVEL control for a stable display.

5. Check the display for one complete cycle per division. If necessary, adjust the front-panel SWP CAL screwdriver adjustment for one complete cycle per division over the center 8 graticule divisions.

6. Turn the VARIABLE control fully counterclockwise and note that the displayed sweep rate changes to at least the next slower SEC/DIV switch setting (i.e., 10 milliseconds/division...10 cycles/division).

7. Set the internal Trig Mode switch (S1140) to the Norm position. Adjust the TRIG SLOPE/LEVEL control for a stable display.

8. Disconnect the function generator and check for no display.

OPTION 10 ALTERNATE INPUT CONNECTOR WIRING

Wiring connections for the Alternate Input connector (J900) are shown in Fig. 3-5. A mating male plug connector is supplied as a standard accessory with instruments equipped with Option 10.

All interconnection wiring should be done by a qualified service technician.

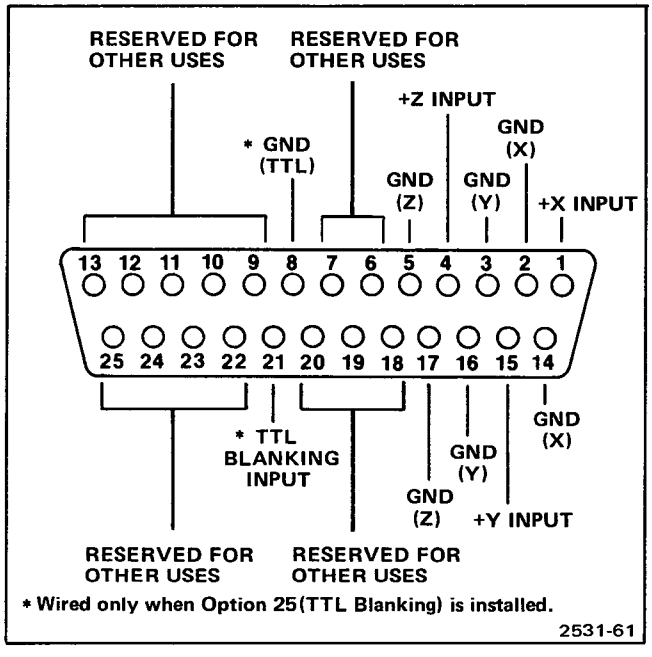

Figure 3-5. Alternate Input connector (J900) as seen from the rear panel.

This completes the Functional Check for the 624 Monitor.

THEORY OF OPERATION

This section of the manual describes the circuitry in the 624 Monitor. The description begins with a discussion of the instrument using the block diagram on Figure 4-1, and then continues in detail, showing the relationships between the stages in each major circuit. Schematics of all major circuits are given in Section 9, Diagrams and Circuit Board Illustrations. Stages are outlined on the schematics with wide shaded lines; the stage names are in shaded boxes. Refer to these schematics throughout the following discussions for specific electrical values and relationships.

BLOCK DIAGRAM

The following discussion is provided to aid in understanding the overall concept of the 624 before the individual circuits are discussed in detail. A basic block diagram is shown in Figure 4-1.

Vertical and horizontal signals to be displayed on the crt are supplied to the Deflection Amplifiers through the appropriate Y and X INPUT connectors.

The Deflection Amplifiers process the input signals and provide push-pull outputs to drive the deflection plates of the crt. Both Deflection Amplifiers contain position and gain controls.

The Z-Axis Amplifier controls the display intensity by providing a voltage to drive the crt control grid. Input signals are applied to the Z INPUT connector.

The Option 4 Sweep circuit produces a positive-going sawtooth voltage, which is amplified by the Horizontal (X) Amplifier to provide sweep deflection in the crt. The level of the vertical signal from which triggering occurs is determined by the TRIG SLOPE/LEVEL control. The Sweep circuit also produces an unblanking gate signal coincident with the sawtooth waveform. This gate signal unblanks the crt to permit display presentation.

The High-Voltage and Low-Voltage Power Supplies provide all the voltages necessary for operation of this instrument.

DETAILED CIRCUIT OPERATION

Complete schematic diagrams are provided in Section 9, Diagrams and Circuit Board Illustrations. The numbers inside the diamond after a heading in the following discussions refer to the schematic diagram for that circuit. The schematic diagrams contain wide shaded borders around the major stages of the circuits to conveniently locate the components mentioned in the following discussions. The name of each stage is given in a shaded box on the diagram, and as sub-headings in the discussion of that schematic diagram.

VERTICAL (Y) DEFLECTION AMPLIFIER ◇1◇

The Vertical (Y) Deflection Amplifier processes the Y input signals and provides final amplification to drive the vertical deflection plates of the crt. A schematic diagram of the Vertical (Y) Deflection Amplifier is shown on Diagram 1. A detailed block diagram, showing each major stage of the Vertical (Y) Deflection Amplifier, is superimposed on the schematic with wide shaded lines to conveniently locate the components mentioned here. The stage names (given as sub-headings in the following discussion) can be found in the shaded boxes on Diagram 1.

Y PREAMPLIFIER

Signals to be displayed are applied to the Y INPUT, BNC connector J101. For instruments equipped with Option 21, differential signals can be applied to both J101 and J201, -Y INPUT. Option 22 provides an internal switch for each input, S110-S210, to allow either 1X or 5X attenuation of the input signal before it is applied to the Y Preamplifier. The 5X position of each attenuator is a frequency-compensated voltage divider. These step attenuators are set in the 1X position when shipped from the factory. For optimum response of the amplifier, both attenuators should be set in the same position.

Two identical, noninverting operational amplifiers, Q120A-Q130 and Q120B-Q230, form the Y Preamplifier. In the standard instrument with a single-ended input, this stage operates as a paraphase amplifier; in Option 21 Monitors with differential inputs, it operates as a differential amplifier. In either case, however, a push-pull signal is produced at the collectors of Q130 and Q230.

A matched pair of field-effect transistors, Q120A and Q120B, provide high input impedance and temperature stability. Excessively large negative-going signals are diode-clamped at the FET gates to protect Q120A and

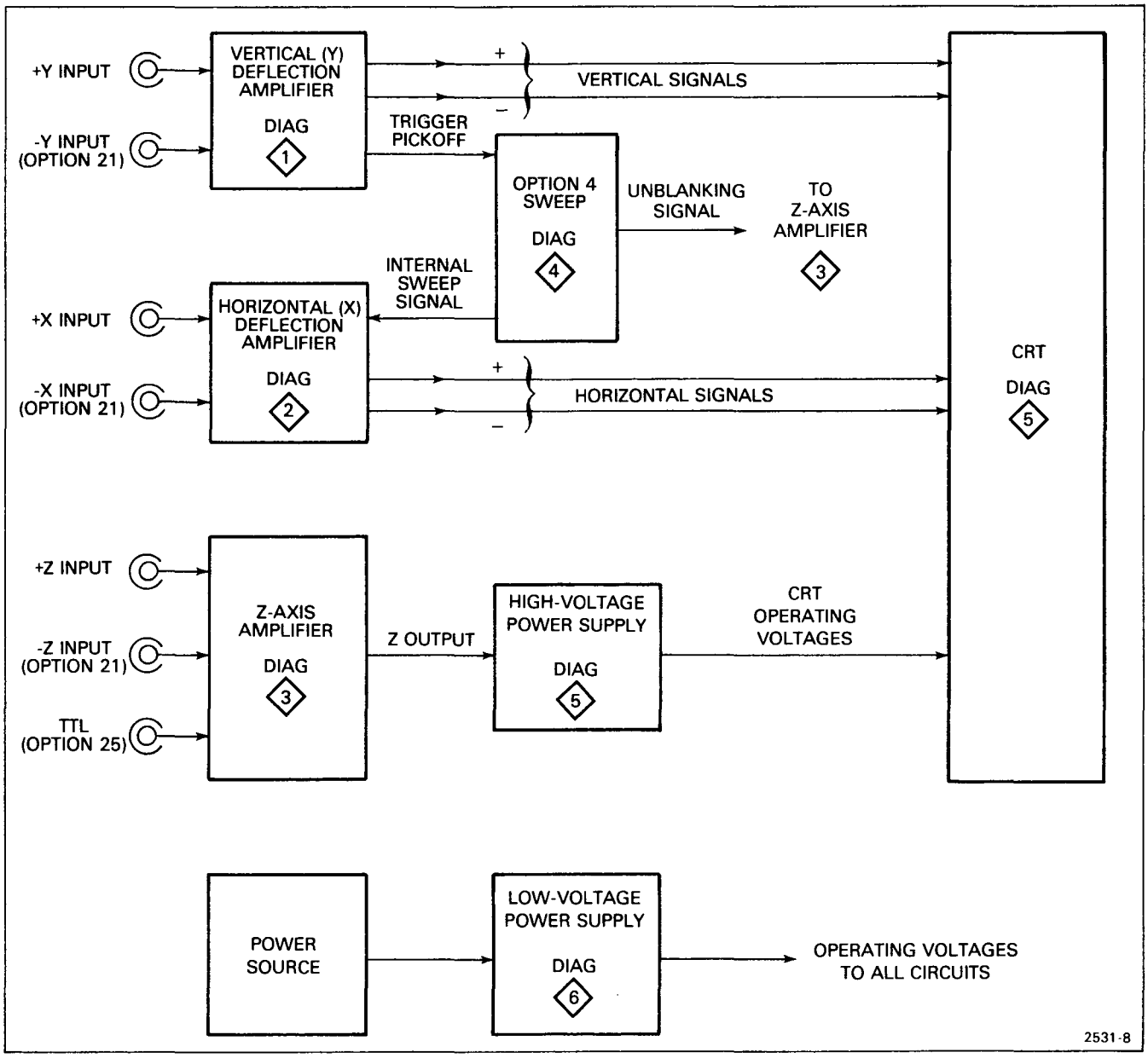

Figure 4-1. 624 Block Diagram.

Q120B. The Y GAIN control, R125, allows setting the crt full-screen deflection from 0.5 volt, or less, to at least 2.5 volts. This control is set at the factory for 8 divisions of deflection with a 1-volt input signal applied. Variable capacitor C122 provides adjustment for high gain phasing.

VERTICAL POSITIONING

Vertical positioning is provided by front-panel control R147, through the current sources of Q140-Q240. The push-pull signals from the Y Preamplifier are applied to the Y Output Amplifier after being offset by this stage. Variable capacitor C138 provides the dominate phasing adjustment.

OPTION 4 TRIGGER PICKOFF

The trigger signal, including the vertical position voltage, is taken from the collector of Q130 in the Y Preamplifier for use by the Option 4 Sweep Circuit. Transistor Q134 provides offset voltage before the trigger signal is sent to the Sweep (Option 4) circuit (Diagram 4).

Y OUTPUT AMPLIFIER

The Y Output Amplifier provides final amplification for the vertical (Y) signals before thay are applied to the crt, and consists of two identical and noninverting

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operational amplifiers connected in a differential configuration. High-frequency compensation is provided by C153.

+Y signals from the Y Preamplifier are amplified and inverted by Q160; -Y signals are amplified and inverted by Q260. Diodes CR163-CR164-CR263-CR264 prevent overdriving the Y Output Amplifier by limiting the signals at the collectors of Q160-Q260 to within about 2 volts of each other. The signals are then applied to the cascode amplifiers of Q176-Q174 and Q276-Q274. The cascode amplifiers again invert the signals and provide the final amplification before the signals are applied to the crt. Feedback is provided through R178-C178 for the +Y signal, and through R278-C278 for the -Y signal.

HORIZONTAL (X) DEFLECTION AMPLIFIER ②

The Horizontal (X) Deflection Amplifier processes the X input signal and provides final amplification to drive the horizontal deflection plates of the crt. A schematic diagram of the Horizontal (X) Deflection Amplifier is shown on Diagram 2. A detailed block diagram, showing each major stage of the Horizontal (X) Deflection Amplifier, is superimposed on the schematic with wide shaded lines to conveniently locate the components mentioned here. The stage names (given as sub-headings in the following discussion) can be found in the shaded boxes on Diagram 2.

X PREAMPLIFIER

Signals to be displayed are applied to the X INPUT, BNC connector J301. For instruments equipped with Option 21, differential signals can be applied to both J301 and J401, -X INPUT. Option 22 provides an internal switch for each input, S310-S410, to allow either 1X or 5X attenuation of the input signal before it is applied to the X Preamplifier. The 5X position of each attenuator is a frequency-compensated voltage divider. These step attenuators are set in the 1X position when shipped from the factory. For optimum response of the amplifier, both attenuators should be set in the same position.

Two identical, noninverting operational amplifiers, Q320A-Q330 and Q320B-Q430, form the X Preamplifier. In the standard instrument with a single-ended input, this stage operates as a paraphase amplifier; in Option 21 Monitors with differential inputs, it operates as a differential amplifier. In either case, however, a push-pull signal is produced at the collectors of Q330 and Q430.

A matched pair of field-effect transistors, Q320A and Q320B, provide high input impedance and temperature stability. Excessively large negative-going signals are diode-clamped at the FET gates to protect Q320A and Q320B. The X GAIN control, R325, allows setting the crt full-screen deflection from 0.5 volt, or less, to at least 2.5 volts. This control is set at the factory for 8 divisions of deflection with a 1-volt input signal applied.

HORIZONTAL POSITIONING

Horizontal positioning is provided by front-panel control R347, through the current sources of Q340-Q440. The push-pull signal from the X Preamplifier, or the sawtooth signal from the Sweep (Option 4) circuit, is applied to the X Output Amplifier after being offset by this stage. Internal switch S434 determines the operating mode of the Option 4 Monitor.

X OUTPUT AMPLIFIER

The X Output Amplifier provides final amplification for the horizontal (X) signals before they are applied to the crt, and consists of two identical and noninverting operational amplifiers connected in a differential configuration. Highfrequency compensation is provided by C353.

+X signals from the X Preamplifier are amplified and inverted by Q360; -X signals are amplified and inverted by Q460. Diodes CR363-CR364-CR463-CR464 prevent overdriving the X Output Amplifer by limiting the signals at the collectors of Q360-Q460 to within about 2 volts of each other. The signals are then applied to the cascode amplifiers of Q376-Q374 and Q476-Q474. The cascode amplifiers again invert the signals and provide the final amplification before the signals are applied to the crt. Feedback is provided through R378-C378 for the +X signal, and through R478-C478 for the -X signal.

Z-AXIS AMPLIFIER ③

The Z-Axis Amplifier circuit provides the drive signal to control the crt intensity. A schematic diagram of the Z-Axis Amplifier is shown on Diagram 3 at the rear of this manual. A detailed block diagram showing each major stage is superimposed on the schematic diagram with wide shaded lines. The stage names (given as sub-headings in the following discussion) can be found in the shaded boxes on Diagram 3.

Z-AXIS PREAMPLIFIER

Single-ended input signals are applied to the Z INPUT, BNC connector J501, in the standard instrument; for Option 21 Monitors, differential signals can be applied to both J501 and J601, -Z INPUT. Provisions have been made on both input lines to permit installation of attenuating resistors (see Z-Axis Input Attenuation Selection in Section 3, Installation).

The Z Preamplifier employs a matched pair of FETs to provide high input impedance and temperature stability. Two identical operational amplifiers, Q520A-Q530-Q534 and Q520B-Q630-Q634, which operate as a paraphase amplifier in the standard instrument (single-ended input) or as a differential amplifier in Option 21 Monitors, form the basic Z Preamplifier. Excessively large negative-going input signals are clamped by diodes CR518 and CR618 before application to the gates of Q520A and Q520B. A single-ended output is produced at the collector of Q534 which is in phase with signals applied to the Option 21 -Z

INPUT, and opposite in phase with signals applied to the +Z INPUT. Maximum crt intensity is obtained by applying from 1 to 5 volts to the Z-axis INPUTS, as controlled by the setting of the Z Gain adjustment R525.

UNBLANKING CIRCUIT

Option 25 Unblanking

Input signals applied to the Option 25 rear-panel TTL input connector, J551, may be either a TTL LO level (0 to +0.8 volts) or a TTL HI level (+2.4 to +5 volts). Determination of the TTL level necessary to provide unblanking of the crt is made by the Unblanking Level Selector, P550. With P550 in the POS position an applied HI will unblank the display and an applied LO will blank the display; with P550 in the NEG position a HI will blank the display and a LO will unblank the display. With no signal applied to the TTL input connector, an internal pull-up circuit in U550A will set the input to a HI level.

With a HI applied to pin 1 of U550A and P550 in the POS position, U550A produces a LO which is inverted by U550B and applied to pin 9 of U550C. NAND gate U550C produces a LO at pin 8 which turns off Q558 and turns on Q545. Q545 of the Intensity and Limiter stage provides a signal to the Z Output Amplifier resulting in an unblanked display. With a HI applied to pin 1 of U550A and P550 in the NEG position, inverter U550B is bypassed, which places a LO at pin 9 of U550C. The HI at pin 8 turns on Q558 and turns off Q545. With no signal applied to the Z Output Amplifier, from Q545, the display is blanked.

Option 4 Unblanking

The positive-going Unblanking Gate from the Sweep (Option 4) circuit is applied to pin 10 of NOR gate U550C, producing a LO level at pin 8. This LO turns Q558 off and turns Q545 on resulting in an unblanked crt display.

INTENSITY AND LIMITER

Front-panel INTENSITY control R544 offsets the Z Preamplifier output signal to vary the display intensity. Diode CR541 and transistor Q545 prevent overdriving the Z Output Amplifier by limiting the signal at the emitter of Q545 to within about 1 volt of ground.

Z OUTPUT AMPLIFIER

The Z Output Amplifier is an inverting operational amplifier consisting of Q562-Q590-Q570-Q580. The feedback network consists of R591 and C591. Variable capacitor C591, in conjunction with R560, provides a means of adjusting the amplifiers high-frequency response. The signals from Q545 are buffered by Q562 and coupled to the bases of Q590-Q580-Q570. Transistors Q580 and Q590 are connected as a collector-coupled complementary amplifier to provide a fast, linear output signal to the crt control grid. Transistor Q570 conducts only when large negative-going transient signals are present at the emitter of Q562. The Z Output signal is applied to the crt control grid, through the Control Grid DC Restorer network shown on Diagram 5, to control the crt beam intensity.

SWEEP (OPTION 4) ④

The Option 4 Sweep circuit produces a positive-going sawtooth voltage, which is amplified by the Horizontal (X) Amplifier, to provide sweep deflection in the crt. The Sweep circuit also produces an unblanking gate signal coincident with the sawtooth waveform to unblank the crt and permit display presentation. A schematic diagram of the Sweep circuit is shown on Diagram 4. A detailed block diagram showing each major stage of this circuit is superimposed on the schematic diagram with wide shaded lines. The stage names (given as sub-headings in the following discussion) can be found in the shaded boxes on Diagram 4.

TRIGGER AND SWEEP GENERATOR

The Trigger and Sweep Generator stage produces a positive-going sawtooth voltage that is amplified by the Horizontal (X) Amplifier to provide sweep deflection in the crt. Six sweep rates are provided: 0.1 second through 1 microsecond in decade steps. A negative-going gate is produced at the same time the sawtooth is produced to unblank the crt.

The Trigger and Sweep Generator is made up of Tektronix-manufactured integrated circuit U1140 and the associated discrete components. U1140 contains the trigger generator, the sweep-gating circuit, and an operational amplifier to form the basis of a Miller integrator. Power is applied to pins 7 and 12 to establish the operating levels within the device. An internal reference zener diode provides 6.4 volts between pins 8 and 9 for operation of external controls; pin 8 provides a potential which is two diode junctions above the negative voltage at pin 12.

The timing components are selected by S1150, SEC/DIV, which permits one of six nominal sweep rates to be chosen. Front-panel VARIABLE, R1147, varies the timing current for a continuously variable sweep rate.

Pins 10, 11, 13, and 14 are associated with the Trigger Generator portion of U1140. The triggering signal from the Vertical (Y) Amplifier is applied to a field-effect transistor input at pin 13 through Q1110 and R1114. Potentiometer R1130, TRIG SLOPE/LEVEL, at pin 14 controls the internal comparators that determine the level and slope at which the internal Schmitt multivibrator changes state, initiating the sweep trigger. Capacitor C1143 at pin 11 determines the trigger-pulse width.

With S1140 in the Norm position, -8.2 volts is applied to pin 10 to hold the bright-baseline auto circuit inactive. In this mode, when the triggering signal is lost, a sweep cannot be produced. When S1140, Trig Mode, is set to Auto, the -8.2 volts is disconnected to permit a freerunning sweep, or bright baseline, to be produced. Pin 10 moves positive as C1140 charges; this positive potential replaces the incoming trigger signal. A new sweep will be initiated immediately following the sweep hold-off time. However, with S1140 in the Auto position,

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any incoming trigger signal will discharge C1140. If the signal is occuring at a rate greater than about 20 Hz, C1140 will be held below the auto-trigger level to permit a triggered sweep to be produced.

Pins 1 through 6, and pin 16, are associated with the Sweep Generator portion of U1140. Upon receipt of a trigger from the Trigger Generator, the sweep gate turns on. While the gate is on, CR1150 is turned off by a high logic level at pin 2, allowing the current through external R_t components R1151 and R1148 to be switched to timing capacitors C1156 and C1159. Pin 5 is the null point of the internal operational amplifier. Thus, the nearly constant timing current charges the capacitors linearly, producing a linear, negative-going sawtooth voltage at pin 4. When the sawtooth reaches a level determined by R1134, Sweep Length, the sweep terminates. At this point the sweep gate turns off, turning on CR1150 and quickly discharging the timing capacitors. A short-duration trigger lockout period (to allow the sweep generator to reset and stabilize) is provided by C1122 and C1120 at pin 3.

SAWTOOTH AMPLIFIER

Transistor Q1180 provides inverting amplification of the sweep sawtooth from pin 4 of U1140 to an amplitude suitable to meet the sensitivity requirements of the Horizontal (X) Amplifier. A positive-going sawtooth is produced at the collector of Q1180. Zener diode VR434 (in the Horizontal Deflection Amplifier) shifts the sawtooth voltage about 10 volts positive. Swp Cal R1185 permits calibrating the sweep to the crt graticule.

UNBLANKING GATE OUTPUT AMPLIFIER

The negative-going gate produced during a sweep (at pin 16 of U1140) is level shifted and buffered by Q1160 and Q1170. The positive-going gate produced at the collector of Q1170 is applied to U550C in the Z-Axis Amplifier to unblank the crt during the sweep.

HIGH-VOLTAGE POWER SUPPLY ⑤

The High-Voltage Power Supply provides the voltage levels and control circuits necessary for operation of the cathode-ray tube (crt). A schematic diagram of the High-Voltage Power Supply is shown on Diagram 5. A detailed block diagram, showing each major stage of this circuit, is superimposed on the schematic diagram with wide shaded lines. The stage names (given as sub-headings in the following discussion) can be found in the shaded boxes on Diagram 5.

HIGH-VOLTAGE OSCILLATOR

A repetitive, sinusoidal signal is produced by a regenerative feedback oscillator in the primary of T850 and induced into the secondary. Current drive for the primary winding is furnished by Q816-Q810-Q814. The conduction of the High-Voltage Oscillator transistors is controlled by the output voltage of the Error Amplifier.

CATHODE SUPPLY

The Cathode Supply voltage, -3500 volts, is produced by voltage doubler C852-CR852-CR853. It is then filtered by C854, R856, and C858, before being applied to the crt cathode (pin 2 of V950). The Cathode Supply is regulated by the Error Amplifier.

ERROR AMPLIFIER

Regulation of the Cathode Supply voltage is accomplished by applying a sample of the -3500 volts, from voltage divider R920A-R920B, to the positive input (pin 3) of U832. If the output level of the Cathode Supply exceeds the normal -3500 volts (becomes more negative), the voltage at pin 3 of U832 goes negative from its quiescent zero-volt level. This results in a reduced output voltage from U832. A lower potential from the Error Amplifier reduces the conduction of the High-Voltage Oscillator, resulting in a smaller peak-to-peak amplitude of the signal in the secondary of T850 and returning the Cathode supply to -3500 volts.

CURRENT LIMITER

Transistor Q826 protects the High-Voltage Oscillator transistors if excess current is demanded from the secondary of T850, due to a short circuit or abnormal load, by limiting the maximum current drawn by the High-Voltage Oscillator.

CONTROL-GRID DC RESTORER

The Control-Grid DC Restorer couples the dc and low-frequency components of the Z-Axis Amplifier output signal to the crt control grid (pin 3 of V950). This allows the Z-Axis Amplifier to control the crt beam intensity. The potential difference between the Z-Axis Amplifier output level and the crt control grid (about -3600 volts) prohibits direct coupling.

The Control-Grid DC Restorer is actually a cathode-referenced bias supply for the crt control grid. Quiescently, its output voltage is more negative than the crt cathode by an amount determined by the Z-Axis Amplifier output level and the setting of the Crt Bias adjustment, R862. (The cutoff voltage at the crt control grid is typically about 85 volts more negative than the crt cathode level.)

NOTE

A simplified diagram of the Control-Grid DC Restorer is shown in Figure 4-2. The voltages given on this diagram are idealized levels and will not necessarily be the same as those found in the actual instrument.

The Control-Grid DC Restorer is divided into two sections for ease of explanation. The first section can be considered a modulator at low-voltage potentials, and the remaining section as a demodulator at high-voltage potentials (see Fig. 4-2).

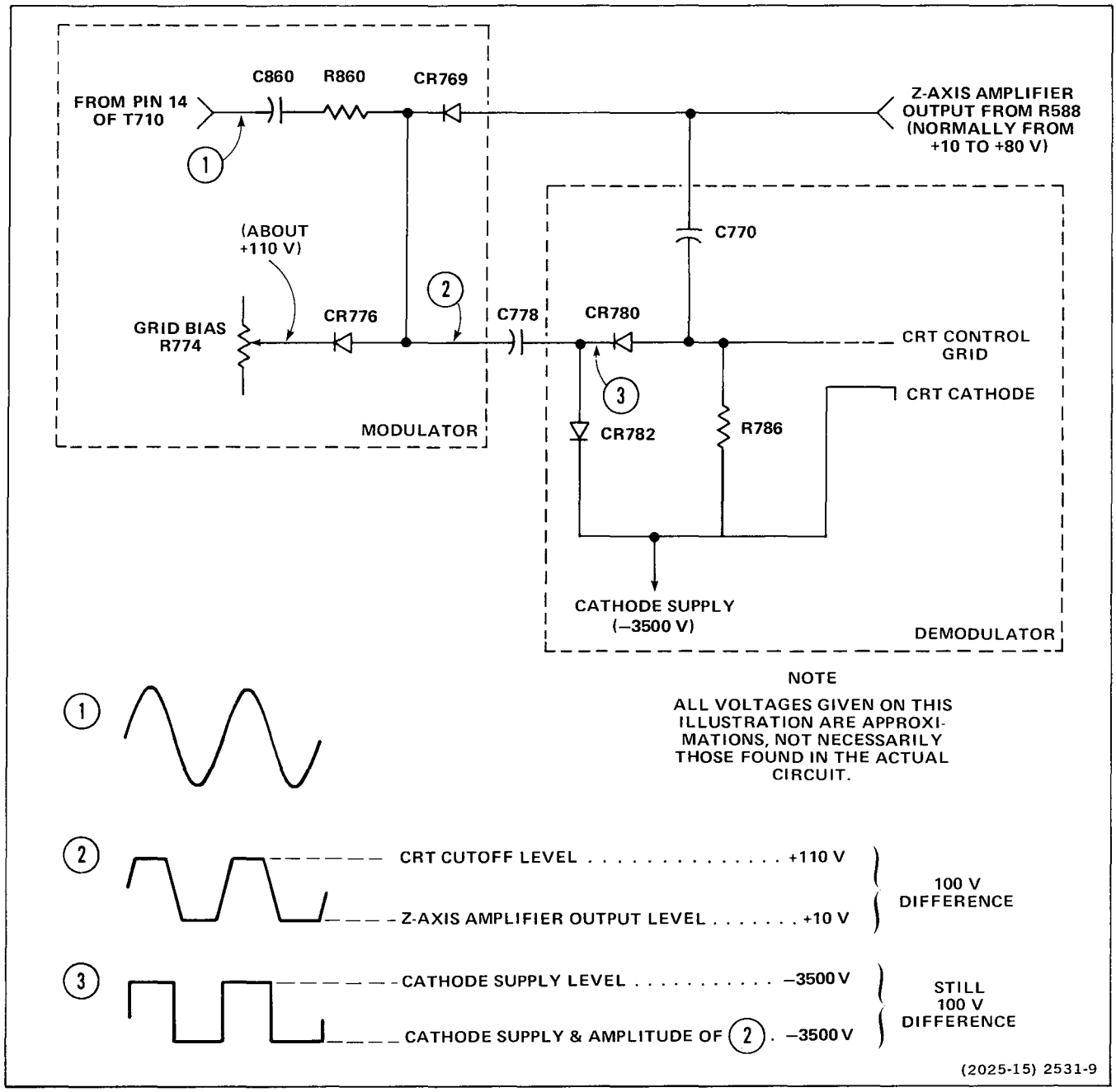


Figure 4-2. Simplified diagram of Control-Grid DC Restorer.

Modulator

When the secondary winding output of T850 (pin 10) swings positive, C872 charges through R860 and C860 to a voltage level determined by the setting of the Crt Bias adjustment, R862. At this voltage level (approximately 85 volts), diode CR872 conducts, preventing any additional increase in the positive voltage across C872. When the secondary-winding output swings negative, diode CR872 turns off. Then CR860 conducts and clamps the negative excursion at C872 to the voltage level of the Z-Axis Amplifier output. The result is a square-wave output from the Modulator; the output amplitude is determined by the difference between the Z-Axis Amplifier output level and the Crt Bias adjustment setting. (See waveform 2 on Fig. 4-2.) This square wave is coupled through C872 to the Demodulator.

Demodulator

The Demodulator rectifies the signal from the Modulator and references it to the crt Cathode Supply level. The positive swing of waveform 3, Figure 4-2, is limited by CR874 to the level of the Cathode Supply; the negative excursion is coupled through CR876 to C879. Quiescently, C879 will charge to about -3500 volts through R876. After repetitive cycles from C872, C879 will charge to the negative level of waveform 3. Capacitor C879 filters the output of the demodulator, and also provides a path for the high-frequency portions of the Z-Axis Amplifier output signal to be coupled to the crt control grid.

The remainder of the components not shown on the simplified diagram in Figure 4-2 provide circuit protection in the event of a high-voltage arc or other malfunction.

+100-VOLT REGULATED SUPPLY

The ac voltage from pin 2 of T850 is half-wave rectified by CR888 to provide unregulated power for the +100-Volt Regulated Supply. Filtering is provided by C889, L889, and C890.

The regulator for this supply is a feedback amplifier system. Current to the load is delivered by series-pass transistor Q897, which is located in the output side of the supply. The supply voltage is established by the drop across R900-R910. The feedback through this network is compared to the reference level (ground) established at pin 2 of U905. Any variation in output voltage of the supply (due to ripple, change of current through the load, etc.), is immediately transmitted through error amplifier U905 through the emitter of Q910, to the base of Q897. This changes the conduction of Q897 and nullifies the original output variation.

Transistor Q896 protects the +100-volt series regulator (Q897) if excess current is demanded from the supply (due to a short circuit or similar malfunction in the output of the supply). This excess current turns on Q896. The resulting current through Q896 reduces the conduction of Q897 to limit the supply current to a safe level.

CRT INTERCONNECTS

The ASTIG screwdriver adjustment, R841, which is used in conjunction with the front-panel FOCUS control (R844) to provide a well-defined display, varies the positive level on the astigmatism element of the crt. Geometry adjustment R943 varies the positive level on the geometry element to control the overall geometry of the display. TRACE ROTATION adjustment R949 controls the current through L980 to provide adjustment of the display alignmment.

LOW-VOLTAGE POWER SUPPLY ⑥

The Low-Voltage Power Supply provides the operating power for the Monitor. Electronic regulation is used to provide stable, low-ripple output voltages. A schematic diagram of the Low-Voltage Power Supply is shown on Diagram 6 at the rear of this manual. A detailed block diagram, showing each major stage of this circuit, is superimposed on the schematic with wide shaded lines. The stage names (given as sub-heading in the following discussion) can be found in the shaded blocks on Diagram 6.

POWER INPUT

Power is applied to the primary of transformer T950 through fuse F950, thermal cutout S960, ON/OFF switch S950, and Line-Voltage Selector plug P951 or P952. The Line-Voltage Selector plugs allow changing the primary winding taps of T950 to meet different line-voltage and regulating range requirements. Line fuse F950 should be changed for each nominal line voltage (current rating of fuse for 220-volt operation must be 0.4 A slow-blowing type; for 120-volt operation the current rating of the fuse must be 0.8 A slow-blowing type).

Thermal cutout S960 provides thermal protection for this instrument. If the internal temperature of the instrument exceeds a safe operating level, S960 opens to interrupt the applied power. When the temperature returns to a safe level, S960 automatically closes to reapply the power.

RECTIFIER AND FILTER

A full-wave bridge circuit, composed of CR951-CR952-CR953-CR954 rectifies the ac voltage from the secondary of T950. Filtering is provided by C951 and C952.

+18-VOLT UNREGULATED SUPPLY

The +18-Volt Unregulated Supply provides unregulated power for the high-voltage transformer (T850) on Diagram 5. Fuse F951 provides circuit protection in the event of an overload.

+15-VOLT REGULATED SUPPLY

The +15-Volt Regulated Supply, in addition to providing power to circuitry throughout the instrument, provides a reference-voltage source to establish the operating level for the feedback regulator of the -15-volt Regulated Supply. The regulator for the +15-Volt Regulated Supply is a feedback amplifier system that operates between ground and the +18-Volt Unregulated Supply. Current to the load is delivered by series-pass transistor Q955, which is located in the output side of the supply. The supply voltage is established by the drop across resistive-divider network R959-R958-R957. The feedback through this network is compared to the reference level established at the base of Q965 by the voltage drop across VR968. Any variation in output voltage of the supply (due to ripple, change of current through the load, etc.), is immediately transmitted to the base of Q955 and nullified by a change in Q955 conduction, maintaining a steady output.

The output of the supply is set to exactly +15 volts by adjustment of R958, the +15-V Adjust.

Transistor Q970 protects the +15-volt series regulator (Q955) if excess current is demanded from this supply. Essentially, all current from this supply flows through R954. When excess current is demanded from the +15-volt series regulator, due to a short circuit or similar malfunction at the output of this supply, the voltage drop across R954 increases enough to turn on Q970. The resulting current through Q970 reduces the conduction of Q955 to limit the supply current to a safe level. Fuse F953 provides circuit protection in the event of an overload or regulator malfunction.

-15-VOLT REGULATED SUPPLY

The regulator for the -15-Volt Regulated Supply consists of series-pass transistor Q976 and error amplifier Q987-Q944-Q981. This is a feedback amplifier system similar to that just described for the +15-Volt Regulated Supply.

The center of resistive-divider network R978-R979 is set by the error amplifier to be zero volts, with respect to ground, during normal operation. Any variation in output from the -15-Volt Regulated Supply is coupled to the error amplifier, which changes the bias of the -15-volt series regulator (Q976). This change in bias, and resulting change in conduction of the regulator, nullifies the output variation to maintain a steady level from the supply.

Diode CR993 protects the -15-volt series regulator (Q976) if excess current is demanded from this supply. Essentially, all current from this supply flows through R975. When excess current is demanded from the -15-volt series regulator, due to a short circuit or similar malfunction at the output of this supply, the voltage drop across R975 increases enough to forward bias CR993. This increases the conduction of Q994, which then reduces the conduction of Q976 to limit the supply current to a safe level. Fuse F955 provides circuit protection in the event of an overload or regulator malfunction.

DC POWER SUPPLY OPTION 20 ⑦

The DC Power Supply of the 624 Option 20 Monitor replaces the Power Input stage shown on the Low-Voltage Power Supply, Diagram 6. A schematic diagram of the DC Power Supply is shown on Diagram 7 at the rear of this manual. A detailed block diagram, showing each major stage of this circuit, is superimposed on the schematic with wide shaded lines. The stage names (given as sub-headings in the following discussion) can be found in the shaded blocks on Diagram 7.

DC POWER INPUT

The DC Power Input circuit replaces the Power Input stage which is shown on the Low-Voltage Power Supply schematic. The rear-panel Input-Power Connector (P1000) allows application of +20 V dc, -20 V dc, supply common, and protective ground for operation of the 624 Option 20 instrument. Circuit protection is provided by fuses F1001 and F1003.

Thermal cutout S960 provides thermal protection for the instrument. If the internal temperature exceeds a safe operating level, S960 opens to interrupt the applied power. When the temperature returns to a safe level, S960 automatically closes to reapply the power through ON/OFF switch S950.

SHUTDOWN PROTECTION (SN B010863 and up)

The Shut Down Protection stage is provided to protect the instrument if excessive voltage is applied to pins 1 or 4 of the Power-Input Connector. With the proper voltages (17 to 26 V dc) applied to P1000, components Q1075-Q1076-Q1025-Q1021-VR1020-VR1057 are conducting and Q1056-Q1017-Q1015-VR1055-VR1015 are not conducting. If pin 4 of the Power-Input Connector crosses the shut down threshold (between -26 V and -29.5 V dc), zener diode VR1055 will conduct. This turns Q1056 on and Q1076-Q1075 off, resulting in instrument shut down. If pin 1 of P1000 crosses the shut down threshold (between 26 V and 29.5 V dc), zener diode VR1015 will conduct. This turns on Q1017-Q1015, and turns off Q1021-Q1025-VR1020. This also results in instrument shut down.

SHUTDOWN PROTECTION (SN B010100 through B010862)

The Shutdown Protection stage is provided to protect the instrument if excessive voltage is applied to pins 1 or 4 of the Power-Input Connector. With the proper voltages (17 to 26 V dc) applied to P1000, components Q1075-Q1025-Q1021-VR1020 are conducting and Q1056-Q1015-VR1055-VR1015 are not conducting. If pin 4 of the Power-Input Connector crosses the shutdown threshold (between -26 V and -29.5 V dc), zener diode VR1055 will conduct. This turns Q1056 on and Q1075 off, resulting in instrument shutdown. If pin 1 of P1000 crosses the shutdown threshold (between +26 V and +29.5 V dc), zener diode VR1015 will conduct. This turns on Q1015, and turns off Q1021-Q1025-VR1020. This also results in instrument shutdown.

CABLING ⑧

Diagram 8 at the rear of this manual shows the interconnections between circuit board assemblies and all electrical chassis-mounted components and connectors. The Cabling diagram is intended as an aid to troubleshooting and instrument repair.

MAINTENANCE

This section of the manual contains information for performing preventive maintenance, troubleshooting, and corrective maintenance for the 624 Monitor.

PREVENTIVE MAINTENANCE

Preventive maintenance, when performed on a regular basis, can prevent instrument breakdown and may improve the reliability of the instrument. The severity of the environment to which the instrument is subjected will determine the frequency of maintenance. A convenient time to perform preventive maintenance is preceding electrical adjustment of the instrument.

CLEANING

The 624 Monitor should be cleaned as often as operating conditions require. Accumulation of dirt in the instrument can cause overheating and component breakdown. Dust on components acts as an insulating blanket which prevents efficient heat dissipation, and also provides an electrical conduction path which may result in instrument failure. Cabinet panels will provide some protection against dust in the interior of the instrument.

CAUTION

Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Use a non-residue type of cleaner, preferably isopropyl alcohol, total denatured ethyl alcohol, or TP35. Before using any other type of cleaner, consult your Tektronix Service Center.

EXTERIOR

Loose dust accumulated on the outside of the instrument can be removed with a soft cloth or small brush. The brush is particularly useful for dislodging dirt on and around the front-panel controls. Dirt which remains can be removed with a soft cloth dampened in a mild detergent and water solution. Abrasive cleaners should not be used.

CRT

Clean the crt faceplate with a soft, lint-free cloth dampened with denatured alcohol.

INTERIOR

Cleaning the interior of the instrument should only be occasionally necessary. The best way to clean the interior is to blow off the accumulated dust with dry, low-velocity air (approximately 5 lb/in^2). Remove any dirt which remains with a soft brush or a cloth dampened with a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces, or for cleaning more delicate circuit components.

CAUTION

Circuit boards and components must be dry before applying power to the instrument to prevent damage from electrical arcing.

The high-voltage circuits should receive special attention. Excessive dust in this area may cause high-voltage arcing and result in improper instrument operation.

VISUAL INSPECTION

The 624 Monitor should be inspected occasionally for such defects as broken connections, improperly seated semiconductors, damaged or improperly installed circuit boards, and heat-damaged parts. The corrective procedure for most visible defects is obvious; however, particular care must be taken if heat-damaged parts are found. Overheating usually indicates other trouble in the instrument; therefore, the cause of overheating must be corrected to prevent recurrence of the damage.

SEMICONDUCTOR CHECKS

Periodic checks of semiconductors are not recommended. The best check of semiconductor performance is actual operation in the instrument. More details on semiconductors are given under Troubleshooting later in this section.

PERIODIC ELECTRICAL ADJUSTMENT

To ensure accurate measurements, check the electrial adjustment of this instrument after each 1000 hours of operation, or every six months if used infrequently. In addition, replacement of components may necessitate adjustment of the affected circuits. Complete adjustment instructions are given in Section 6, Performance Check and Calibration. This procedure can be helpful in localizing certain troubles in the instrument, and in some cases, may correct them.

TROUBLESHOOTING

The following information is provided to facilitate troubleshooting of the 624 Monitor. Information contained in other sections of this manual should be used in conjunction with the following data to aid in locating a defective component. An understanding of the circuit operation is helpful in locating troubles. See Section 4, Theory of Operation, for this information.

TROUBLESHOOTING AIDS

DIAGRAMS

Complete schematic diagrams are given on the foldout pages in Section 9, Diagrams and Circuit Board Illustrations. The component number and electrical value of each component in this instrument are shown on these diagrams. (See the first page of the Diagrams and Circuit Board Illustrations section for definitions of the reference designators and symbols used to identify components in this instrument.) Important voltages and numbered waveform test points are also shown on the diagrams. Important waveforms, and the numbered test points where they were obtained, are located adja-to each diagram. The portions of circuits mounted on circuit boards are enclosed with heavy solid black lines. Each schematic diagram is divided into functional stage blocks, as indicated by the wide shaded lines. These functional blocks are described in detail in Section 4, Theory of Operation.

CIRCUIT BOARD ILLUSTRATIONS

To aid in locating circuit boards, a circuit board location illustration appears on the back of the foldout page facing the schematic diagram. In addition, an illustration of the circuit board is included here, with the physical location of the components and waveform test points that appear on the schematic diagram identified. Each circuit board illustration is arranged in a grid locator with an index to facilitate rapid location of components contained in the schematic diagrams.

TROUBLESHOOTING CHART

A troubleshooting chart is given in Section 9, Diagrams and Circuit Board Illustrations, to aid in locating a defective circuit. The shaded blocks of the Troubleshooting Chart indicate stages which may cause the indicated malfunction. The stage names given in shaded blocks correspond directly to the names given in the functional stage blocks of the schematic diagrams. The circuits are discussed in detail in Section 4, Theory of Operation.

TEST POINT AND ADJUSTMENT LOCATIONS

To aid in locating test points and adjustable components called out in the Performance Check and Calibration procedures, a Test Point and Adjustment Locations foldout page is provided in Section 9, Diagrams and Circuit Board Illustrations.

INTERNAL CONTROL AND SELECTOR LOCATIONS

To aid in locating internal controls and selectors called out in the Functional Check, Performance Check, and Calibration procedures, an Internal Control and Selector Locations foldout page is provided in Section 9, Diagrams and Circuit Board Illustrations.

COLOR CODE

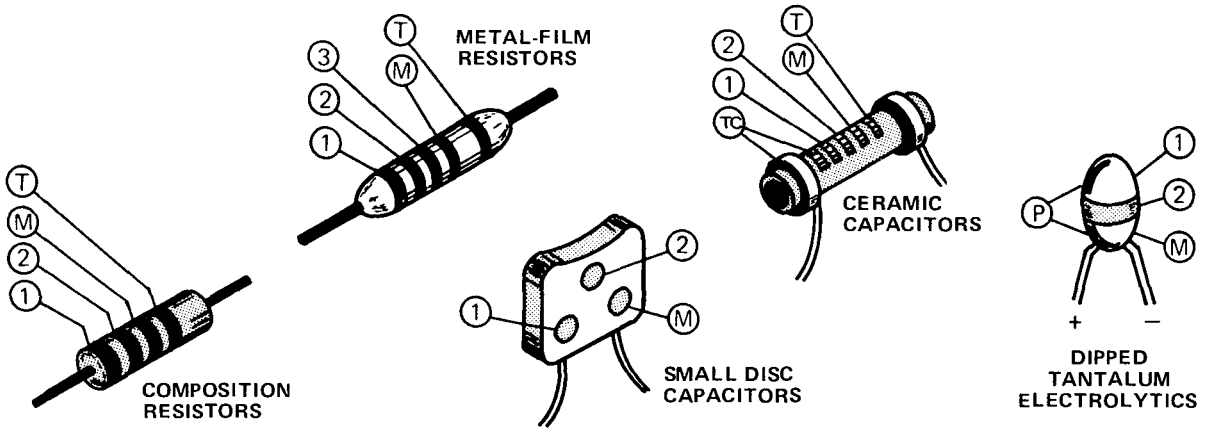
(1) (2) AND (3) - 1st, 2nd, AND 3rd SIGNIFICANT FIGS.

(M) - MULTIPLIER; (T) - TOLERANCE;

(TC) - TEMPERATURE COEFFICIENT.

(T) AND/OR (TC) COLOR CODE MAY NOT BE PRESENT ON SOME CAPACITORS;

(P) - POSITIVE (+) POLARITY AND VOLTAGE RATING.



COLOR	SIGNIFICANT FIGURES	RESISTORS		CAPACITORS			DIPPED TANTALUM VOLTAGE RATING
		MULTIPLIER (OHMS)	TOLERANCE	MULTIPLIER (pF)	TOLERANCE		
					OVER 10pF	UNDER 10pF	
BLACK	0	1	---	1	±20%	± 2pF	4VDC
BROWN	1	10	±1%	10	±1%	±0.1pF	6VDC
RED	2	10^2 or 100	±2%	10^2or 100	±2%	---	10VDC
ORANGE	3	10^3or 1 K	±3%	10^3 or 1000	±3%	---	15VDC
YELLOW	4	10^4 or 10K	±4%	10^4 or 10,000	+100% –0%	---	20VDC
GREEN	5	10^5 or 100 K	±1/2%	10^5or 100,000	±5%	±0.5pF	25VDC
BLUE	6	10^6 or 1 M	±1/4%	10^6 or 1,000,000	---	---	35VDC
VIOLET	7	---	±1/10%	10^7 or 10,000,000	---	---	50VDC
GRAY	8	---	---	10^{-2} or 0.01	+80% –20%	±0.25pF	---
WHITE	9	---	---	10^{-1} or 0.1	±10%	±1pF	3VDC
GOLD	---	10^{-1} or 0.1	±5%	---	---	---	---
SILVER	---	10^{-2} or 0.01	±10%	---	---	---	---
NONE	---	---	±20%	---	±10%	±1pF	---

(1862-74) 1866-57

Figure 5-1. Color code for resistors and capacitors.

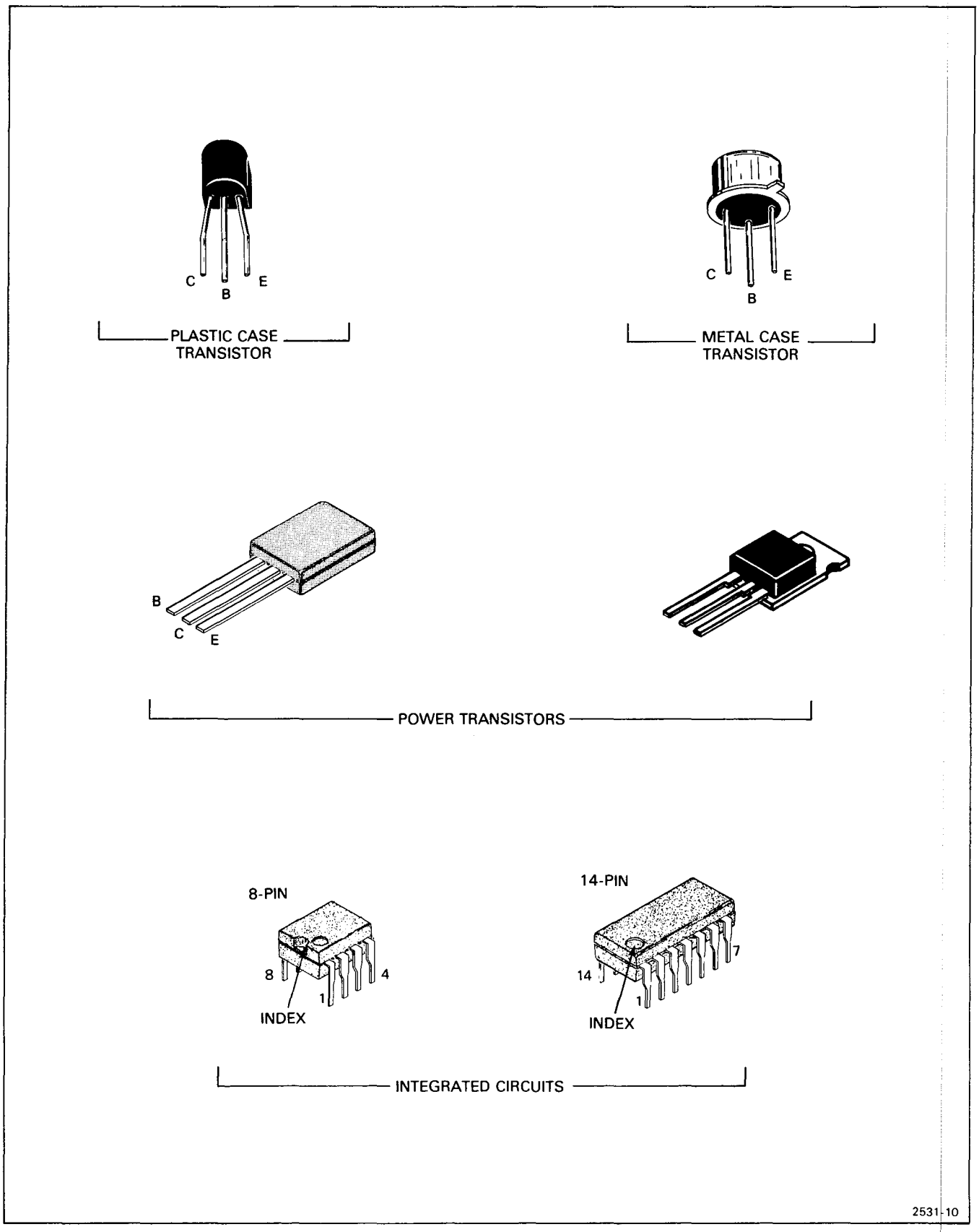


Figure 5-2. Semiconductor lead configurations.

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COMPONENT COLOR CODING

This instrument contains brown composition resistors, some metal-film resistors and some wire-wound resistors. The resistance values of wire-wound resistors are usually printed on the component body. The resistance values of composition resistors and metal-film resistors are color coded on the components using the EIA color code (some metal-film resistors may have the value printed on the body). The color code is read starting with the stripe nearest the end of the resistor. Composition resistors have four stripes, which consist of two significant figures, a multiplier, and a tolerance value (see Fig. 5-1). Metal film resistors have five stripes consisting of three significant figures, a multiplier, and a tolerance value.

The values of common disc capacitors and small electrolytics are marked on the side of the component body. The white ceramic and epoxy-coated tantalum capacitors used in the instrument are color coded using a modified EIA code (see Fig. 5-1). Axial capacitors either have the value printed on the body or use the modified EIA code.

The cathode end of glass-encased diodes is indicated by a stripe, a series of stripes, or a dot. The cathode and anode ends of metal-encased diodes can be identified by the diode symbol marked on the body.

SEMICONDUCTOR LEAD CONFIGURATIONS

Figure 5-2 shows the lead configurations of semiconductors used in the 624 Monitor.

MULTI-CONNECTOR HOLDERS

The multi-connector holders are keyed with two triangles, one on the holder and one on the circuit board. When a connection is made perpendicular to a circuit board surface, the orientation of the triangle on the end-lead multi-pin connector holder is determined by the placement of the multi-pin connector index (see Fig. 5-3).

TROUBLESHOOTING EQUIPMENT

The following equipment, in addition to that listed in the Performance Check and Adjustment section, is useful for troubleshooting the 624 Monitor:

Semiconductor Tester

Description: Dynamic-type tester.

Purpose: To test the semiconductors used in this instrument.

Recommended Type: TEKTRONIX Type 576 or equivalent.

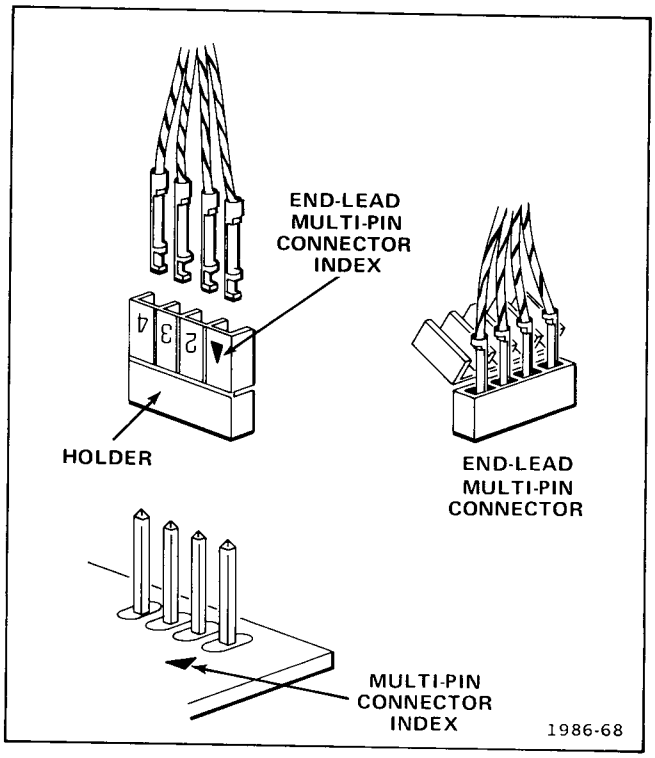

Figure 5-3. Orientation of Multi-connector holders.

Multimeter

Description: Ten megohm input impedance and 0 to 300 volts range, ac and dc; ohmmeter, 0 to 50 megohms. Accuracy, within 3%. Test probes must be insulated to prevent accidental shorting.

Test Oscilloscope

Description: Frequency response, dc to three megahertz minimum (to five megahertz for troubleshooting the Z-Axis Amplifier); deflection factor, one millivolt/division to five volts/division. A 10X, ten megohm voltage probe should be used to reduce circuit loading for voltage measurements.

Purpose: To check operating waveforms.

TROUBLESHOOTING TECHNIQUES

This troubleshooting procedure is arranged in an order that checks the simple trouble possibilities before proceeding with extensive troubleshooting. The first few checks assure proper connection, operation, and adjustment. If the trouble is located by these checks, the remaining steps aid in locating the defective component. When the defective component is located, replace it using the replacement procedure given under Component Replacement in this section.

1. CHECK CONTROL SETTINGS

Incorrect control settings can indicate a trouble that does not exist. If there is any question about the correct function or operation of any control on the 624, refer to Section 2, Operating Instructions.

2. CHECK ASSOCIATED EQUIPMENT

Before proceeding with troubleshooting, check that the equipment used with this instrument is operating correctly. Also, check that the input signals are properly connected and that the interconnecting cables are not defective. Check the power source voltage.

WARNING

Although this Monitor is not to be connected to a patient, interconnecting this Monitor to other equipment can result in the application of excessive current to a patient. It is extremely important that the interconnection is made in accordance with NFPA 76B-T, Tentative Standard for the Safe Use of Electricity in Patient Care Areas of Health Care Facilities, section 3038, "Signal Transmission Between Appliances".

3. VISUAL CHECK

Visually check that portion of the instrument in which the trouble is located. Many troubles can be found by visible indications, such as unsoldered connections, broken wires, damaged circuit boards and damaged components.

4. CHECK INSTRUMENT ADJUSTMENT

Check the electrical adjustment of this instrument, or of the affected circuit if the trouble appears in one circuit. The apparent trouble may only be a result of misadjustment. Complete adjustment instructions are given in Section 6, Performance Check and Calibration.

5. ISOLATE TROUBLE TO A CIRCUIT

To isolate trouble to a particular circuit, note the trouble symptom. The symptom often identifies the circuit in which the trouble is located. When trouble symptoms appear in more than one circuit, check the affected circuits by taking voltage and waveform readings.

Incorrect operation of all circuits often indicates trouble in the power supplies. Check first for the correct output voltage of the individual supplies. A defective component elsewhere in the instrument can appear as a power-supply trouble and may also affect the operation of other circuits. Table 5-1 lists the output voltage range and typical ripple of the power supplies in this instrument. These voltages are measured between the power-supply test points and ground (see the Test Point and Adjustment Locations foldout page in Section 9, Diagrams and Circuit Board Illustrations, for test point locations). If the power-supply voltage and ripple is within the listed range, the supply can be assumed to be working correctly. If outside the range, the supply may be misadjusted or operating incorrectly. Use the procedure given in Section 6, Performance Check and Calibration, to adjust the power supplies.

Figure 9-10 in Section 9, Diagrams and Circuit Board Illustrations, provides a guide for locating a defective circuit. Start at the top left of the Troubleshooting Chart and perform the checks given across the top of the chart until the indicated results are not found. Then proceed to further checks, or the circuit in which trouble is suspected, as listed underneath the step. The shaded blocks of the Troubleshooting Chart indicate circuit stages that may cause the malfunction, and correspond directly to the functional blocks on the schematic diagrams. The circuits listed are discussed in detail in Section 4, Theory of Operation. After the defective circuit has been located, proceed with steps 6 and 7 of Troubleshooting Techniques to isolate the defective component.

TABLE 5-1
Power Supply Output Voltage

Power Supply	Test Point	Output Voltage Range	Typical Ripple (peak-to-peak)
-15 V	-15 V TP	-14.7 V to -15.3 V	2 mV or less
+15 V	+15 V TP	+14.6 V to +15.04 V	2 mV or less
+100 V	+100 V TP	+97 V to +103 V	50 mV or less

6. CHECK VOLTAGES AND WAVEFORMS

Often the defective component can be located by checking for the correct voltages or waveforms in the circuit. Typical voltages and waveforms are given in Section 9, Diagrams and Circuit Board Illustrations.

NOTE

Voltages and waveforms given in Section 9, Diagrams and Circuit Board Illustrations, are not absolute and may vary slightly between 624 Monitors. To obtain operating conditions similar to those used to make these readings, see the appropriate schematic.

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7. CHECK INDIVIDUAL COMPONENTS

The following procedures describe methods of checking individual components in the 624 Monitor. Components which are soldered in place are best checked by first disconnecting one end. This isolates the measurement from the effects of surrounding circuitry.

WARNING

To avoid electric shock, always disconnect the Monitor from the power source before replacing components.

Fuses

Check for open fuses by checking the continuity with an ohmmeter. The location and rating of power-supply fuses is shown in Figure 5-4.

Transistors

A good check of transistor operation is actual performance under operating conditions. A transistor can most effectively be checked by substituting a new component for it (or one which has been checked previously). However, be sure that circuit conditions are not such that a replacement transistor might also be damaged. If substitute transistors are not available, use a dynamic tester. Static-type testers are not recommended, since they do not check operation under simulated operating conditions.

Integrated Circuits

Integrated circuits can be checked with a voltmeter, test oscilloscope, or by direct substitution. A good understanding of the circuit operation is essential when troubleshooting circuits using integrated circuits. In addition, operating waveforms, logic levels, and other operating information for the integrated circuits are given in Section 4, Theory of Operation, and Section 9, Diagrams and Circuit Board Illustrations. Use care when

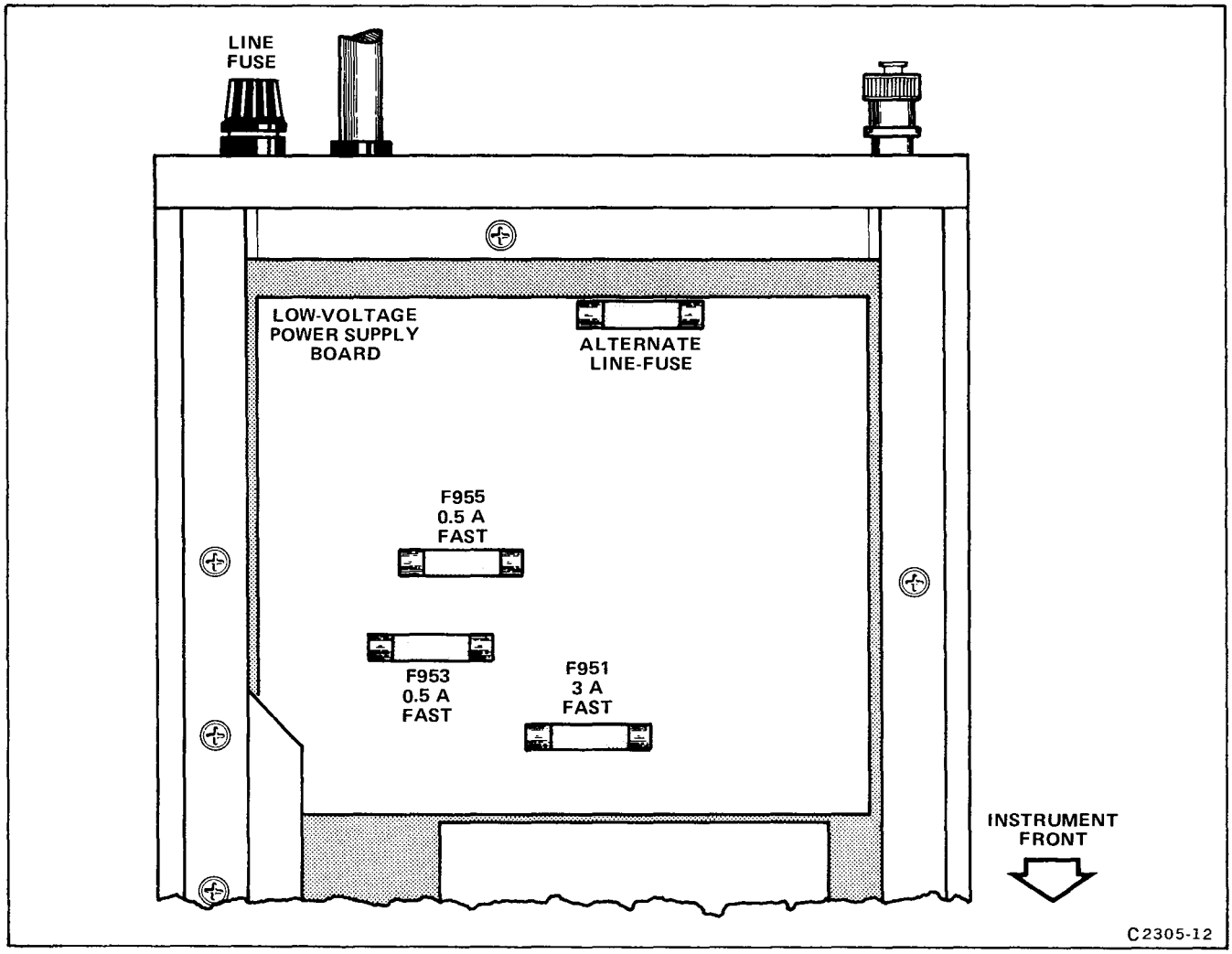

Figure 5-4. Location and rating of power supply fuses.

checking voltages and waveforms around the integrated circuits so that adjacent leads are not shorted together. A convenient means of clipping a test probe to the in-line multi-pin integrated circuits is with an integrated-circuit test clip. This device also doubles as an integrated-circuit extraction tool.

Diodes

A diode can be checked for an open or shorted condition by measuring the resistance between terminals with an ohmmeter scale having a low internal source current, such as the R X 1K scale. The resistance should be very high in one direction and very low when the meter leads are reversed.

CAUTION

When checking diodes, do not use an ohmmeter scale that has a high internal current, since high currents may damage the diodes under test.

Resistors

Check the resistors with an ohmmeter. Resistor tolerance is given in Section 8, Replaceable Electrical Parts. Normally, resistors do not need to be replaced unless the measured value varies widely from the specified value.

Capacitors

A leaky or shorted capacitor can best be detected by checking resistance with an ohmmeter on the highest scale. Do not exceed the voltage rating of the capacitor. The resistance reading should be high after initial charge of the capacitor. An open capacitor can best be detected with a capacitance meter or by checking if the capacitor passes ac signals.

8. REPAIR AND READJUST THE CIRCUIT

If any defective parts are located, follow the replacement procedures given under Component Replacement in this section. Check the performance of any circuit that has been repaired or that has had any electrical components replaced. Adjustment of the circuit may be necessary.

CORRECTIVE MAINTENANCE

Corrective maintenance consists of component replacement and instrument repair. Special techniques required to replace components in the 624 Monitor are given here.

OBTAINING REPLACEMENT PARTS

STANDARD PARTS

All electrical and mechanical part replacements can be obtained through your local Tektronix Field Office or representative. However, many of the standard electronic components can be obtained locally in less time than is required to order them from Tektronix, Inc. Before ordering or purchasing replacement parts, check the parts list for value, tolerance, rating, and description.

NOTE

When selecting replacement parts, remember that the physical size and shape of a component may affect its performance in the instrument. All replacement parts should be direct replacements unless you know that a different component will not adversly affect instrument performance.

SPECIAL PARTS

Some components of the 624 are manufactured or selected by Tektronix, Inc. to meet specific performance requirements. Most of the mechanical parts used in this instrument have been manufactured by Tektronix, Inc. Order all special parts directly from your local Tektronix Field Office or representative.

ORDERING PARTS

When ordering replacement parts from Tektronix, Inc., include the following information:

1. Instrument type.

2. Instrument serial number.

3. A description of the part (if electrical, include the circuit number).

4. Tektronix part number.

SOLDERING TECHNIQUES

WARNING

To avoid electric shock, disconnect the Monitor from the power source before soldering.

The reliability and accuracy of this instrument can be maintained only if proper soldering techniques are used when repairing or replacing parts. General soldering techniques which apply to maintenance of any precision

electronic equipment should be used when working on this instrument. Use only 60/40 resin-core, electric-grade solder. The choice of soldering iron is determined by the repair to be made. When soldering on circuit boards or small wiring, use only a 15-watt, pencil-type soldering iron. A higher wattage soldering iron can cause the etched circuit wiring to separate from the board base material and melt the insulation from small wiring. Always keep the soldering-iron tip properly tinned to ensure the best heat transfer to the solder joint. Apply only enough heat to remove the component or to make a good solder joint. To protect heat-sensitive components, hold the component lead with a pair of long-nose pliers between the component body and the solder joint. Use a solder-removing wick to remove excess solder from connections or to clean circuit board pads.

The following technique should be used to replace a component on any of the circuit boards in this instrument. Most components can be replaced without removing the board(s) from the instrument.

1. Touch the soldering iron to the lead at the solder connection. Never place the iron directly on the board, as this may damage the board.

2. Melt a small amount of solder onto the component lead connection. This replaces the flux, which may have been removed during instrument cleaning, and facilitates removal of the component.

3. Grip the component lead with a pair of long-nose pliers. When the solder begins to flow, gently pull the component lead from the board. If unable to separate the lead from the board, try removing the other end of the component.

NOTE

Some components are difficult to remove from the circuit board due to a bend placed in each lead during machine insertion of the component. The purpose of the bent leads is to hold the component in position during a flow-solder manufacturing process which solders all components at once. To make removal of machine inserted components easier, straighten the leads of the component on the back of the circuit board using a small screwdriver or pliers, while heating the soldered connection.

4. Bend the leads of the replacement component to fit the holes in the circuit board. If the component is replaced while the board is mounted in the instrument, cut the leads so they will just protrude through the board. Insert the leads into the holes in the board so that the component is firmly seated against the board, or as originally positioned.

5. Touch the iron to the connection and apply enough solder to make a firm solder joint.

6. Cut off any excess lead protruding through the board (if not clipped in step 4).

7. Clean the area around the solder connection with a flux-removing solvent. Be careful not to remove information printed on the circuit board.

COMPONENT REMOVAL AND REPLACEMENT

WARNING

To avoid electric shock, always disconnect the Monitor from the power source before replacing components.

The exploded-view drawings associated with the Replaceable Mechanical Parts list (located at the rear of this manual) may be helpful in the removal or disassembly of individual components or sub-assemblies.

CATHODE-RAY TUBE REMOVAL

Remove the cathode-ray tube (crt) as follows (see Fig. 5-5):

WARNING

Use care when handling a crt. Breakage of the crt causes a high-velocity scattering of glass fragments (implosion). Protective clothing and safety glasses should be worn. Avoid striking the crt on any object which might cause it to crack or implode. When storing a crt, place it in a protective carton or set it face down in a protected location on a smooth surface with a soft mat under the faceplate.

1. Remove the bezel assembly and snap-in implosion shield with graticule by removing the 2 bezel securing screws on the front of the instrument.

2. Remove any protective side cabinet panels to gain access to the crt leads.

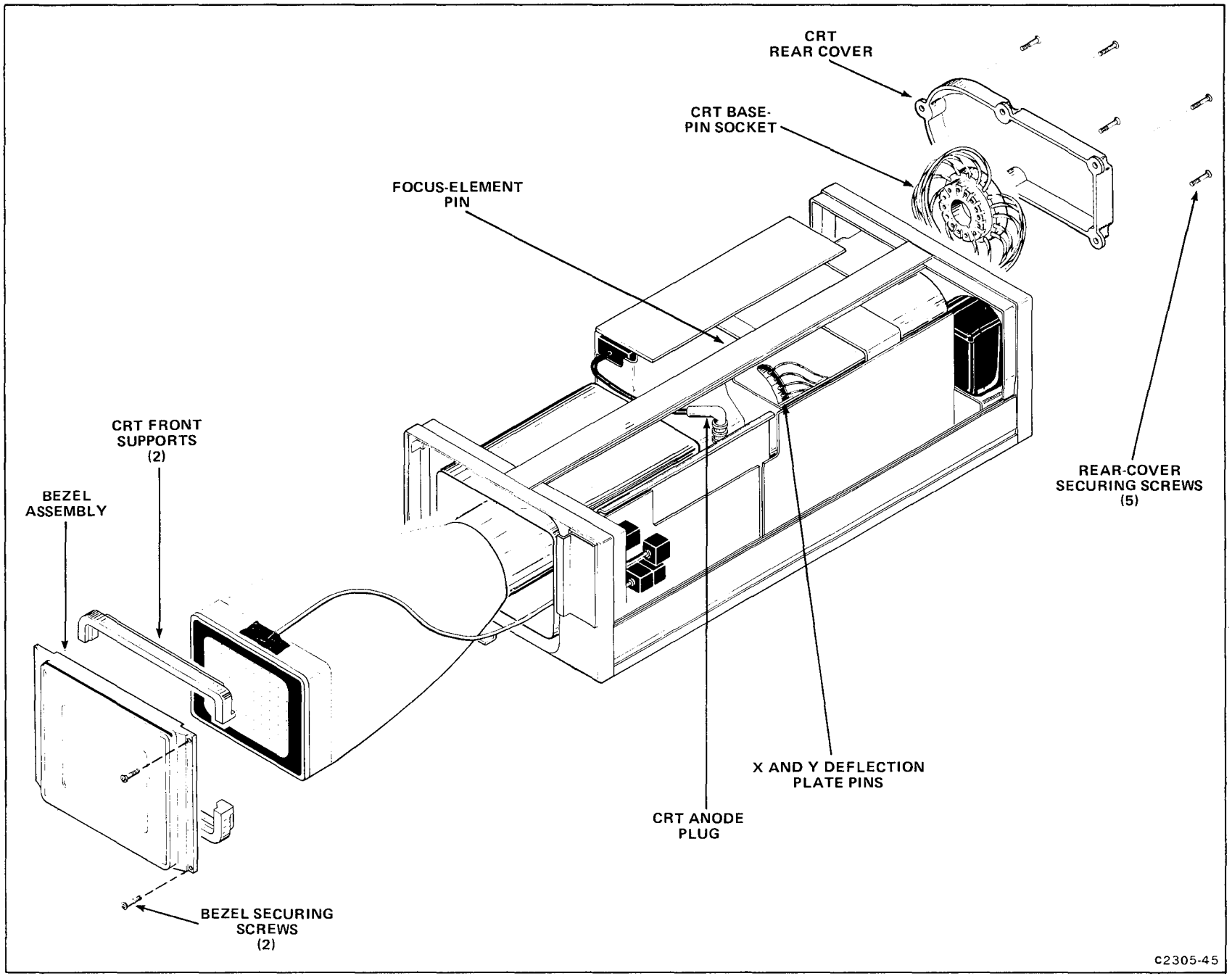

Figure 5-5. Cathode-ray tube (crt) removal and replacement.

3. Disconnect the 4 leads from the crt X and Y deflection plate pins, and the lead from the crt focus-element pin.

NOTE

The red and black leads entering the crt shield from the Low-Voltage Power Supply board and rear-panel TRACE ROTATION control are connected to the display-rotation coil inside the shield. They will not hamper crt removal and need not be disconnected.

4. Disconnect the anode lead from the crt anode plug.

WARNING

To avoid electric shock, always ground the anode lead to the chassis to dissipate any stored charge in the crt.

5. Remove the 5 crt rear-cover securing screws and remove the cover.

6. Remove the crt base-pin socket.

7. With one hand on the front of the instrument, gently push on the crt base to slide the crt forward. The crt front supports will slide out with the crt.

8. Remove the crt front supports and gently pull the crt out from the front of the instrument while guiding the crt anode plug through the hole in the crt shield.

CATHODE-RAY TUBE REPLACEMENT

Replace the cathode-ray tube (crt) as follows (see Fig. 5-5):

1. Press the crt front supports into the front-panel recesses.

2. Insert the neck of the crt part way into the shield.

3. Feed the crt anode plug through the hole in the shield, and fully insert the crt into the shield.

4. Connect the crt anode plug to the mating jack.

5. Mount and fasten the bezel and implosion shield to the front panel with the 2 bezel securing screws.

6. Place the crt base-pin socket onto the crt base pins and replace the rear cover.

7. Connect the 4 leads to the proper X and Y deflection pins, and the lead to the crt focus-element pin.

NOTE

The replacement crt will require that the Monitor be readjusted. Refer to Section 6, Performance Check and Calibration.

CIRCUIT BOARDS

If a circuit board is damaged beyond repair, the entire assembly, including all soldered-on components, can be replaced. Part numbers for the completely wired boards are given in Section 8, Replaceable Electrical Parts.

A1 Deflection Amplifier And A2 Z-Axis Amplifier Boards

Remove and replace the Deflection Amplifier and Z-Axis Amplifier boards as follows (see Fig. 5-6):

NOTE

When disconnecting wires from a circuit board, always tag the wire and the corresponding connection point on the circuit board.

1. Remove the seven screws shown in Figure 5-6.

2. Disconnect all cables from the Deflection and Z-Axis Amplifier boards.

3. Disconnect the deflection leads from the crt neck pins.

4. Remove both circuit boards as an assembly by pulling the Deflection Amplifier board up to disengage the inter-board connector, and pulling both boards towards the rear of the instrument until the controls clear the front panel.

5. To separate the two boards, pull them apart until the inter-board connector disengages.

6. Reverse this procedure to reassemble.

A3 Option 4 Sweep Board

Remove the Option 4 Sweep board as follows:

NOTE

When disconnecting wires from a circuit board, always tag the wire and the corresponding connection point on the circuit board.

1. Disconnect all wires connected to the component side of the board.

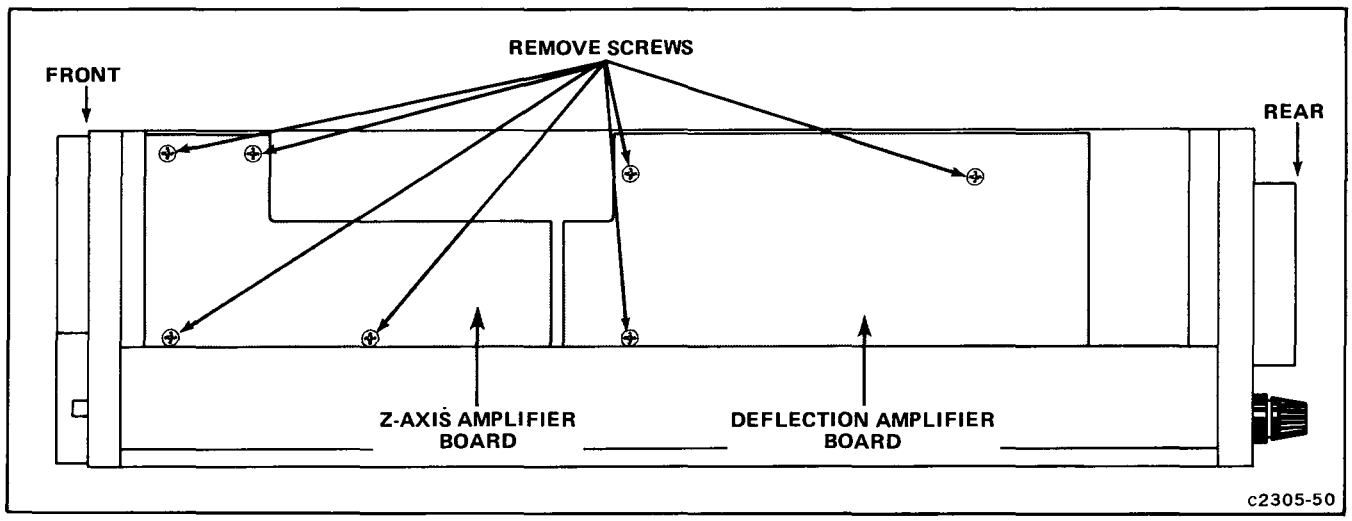

Figure 5-6. Location of screws securing A1 Deflection Amplifier and A2 Z-Axis Amplifier boards.

2. Remove the four screws holding the board to the chassis.

3. Slide the board toward the rear of the instrument to free the frontpanel Sweep controls.

4. Lift the board out of the instrument. Do not force or bend the circuit board.

5. To replace the board, reverse the order of removal.

A5 Low-Voltage Power Supply Board

Remove the Low-Voltage Power Supply board as follows (see Fig. 5-7):

NOTE

When disconnecting wires from a circuit board, always tag the wire and the corresponding connection point on the circuit board.

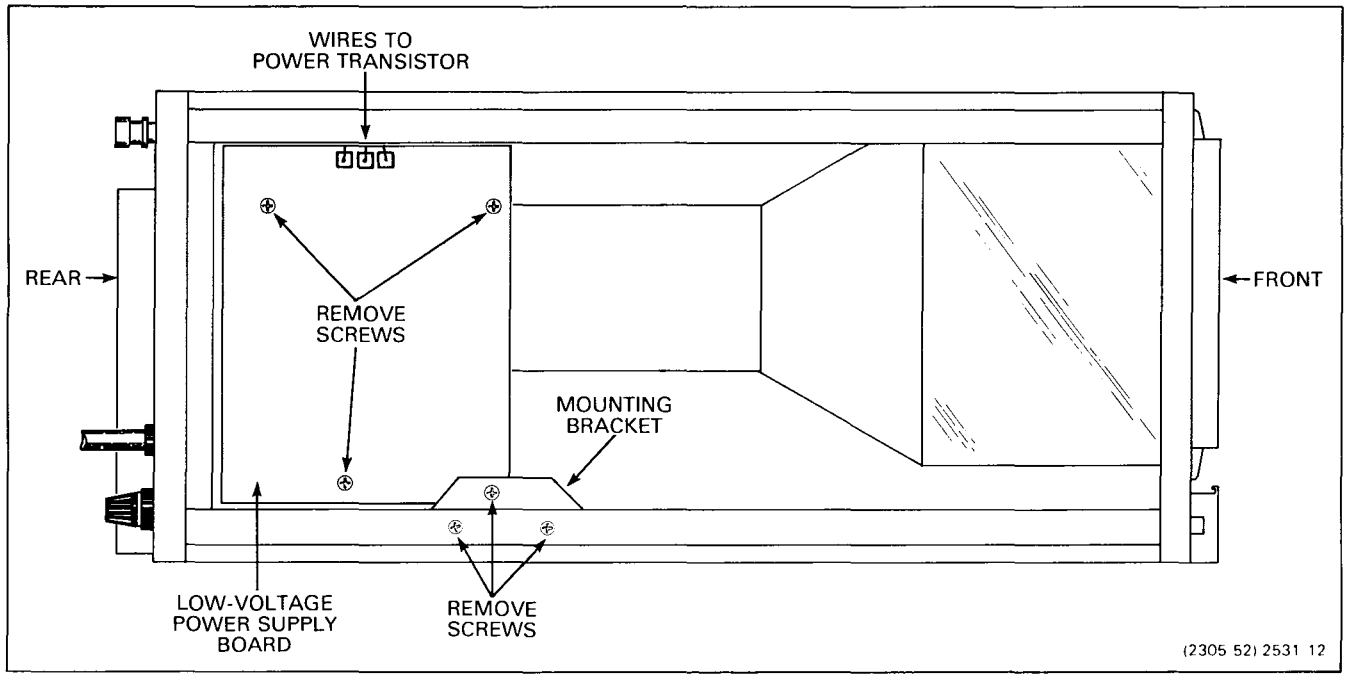

Figure 5-7. Location of screws securing A5 Low-Voltage Power Supply board.

1. Unsolder the wires to the power transistor (Q816), noting the position and orientation of each wire (see Fig. 5-7).

2. Remove the six screws shown in Figure 5-7. Remove the mounting bracket.

3. Remove the two spring clips holding the power transistors to the heatsink.

4. Extend the Low-Voltage Power Supply board from the chassis as far as possible and unsolder all remaining wires from the board, noting the position of each wire.

5. Reverse this procedure to reassemble.

A4 High-Voltage Power Supply Board

Remove the High-Voltage Power Supply board as follows (see Fig. 5-8):

NOTE

When disconnecting wires from a circuit board, always tag the wire and the corresponding connection point on the circuit board.

1. Remove the 2 screws securing the high-voltage shield to the top of the chassis and remove the shield.

2. Disconnect the crt anode lead from the high-voltage multiplier (see Fig. 5-8).

WARNING

To avoid electric shock always ground the anode lead to the chassis to dissipate any stored charge remaining in the crt.

3. Disconnect the focus-element lead from the crt neck pin.

4. Disconnect all plug-on cables from the front and back of the board, noting their positions and orientation.

5. Remove the three screws shown in Figure 5-8.

6. Pull the circuit board up (toward the top of the instrument) to disengage the inter-board connector at the bottom of the board.

7. Reverse this procedure to reassemble, being careful to align the inter-board connector to the pins on the Low-Voltage Power Supply board.

SEMICONDUCTORS

Semiconductors should not be replaced unless actually defective. If removed from their sockets during routine maintenance, return them to their original sockets. Unnecessary replacement of semiconductors may affect the adjustment of the instrument. When semiconductors are replaced, check the operation of circuits which may be affected.

WARNING

Always disconnect the Monitor from the power source before replacing components to avoid electrical-shock hazard.

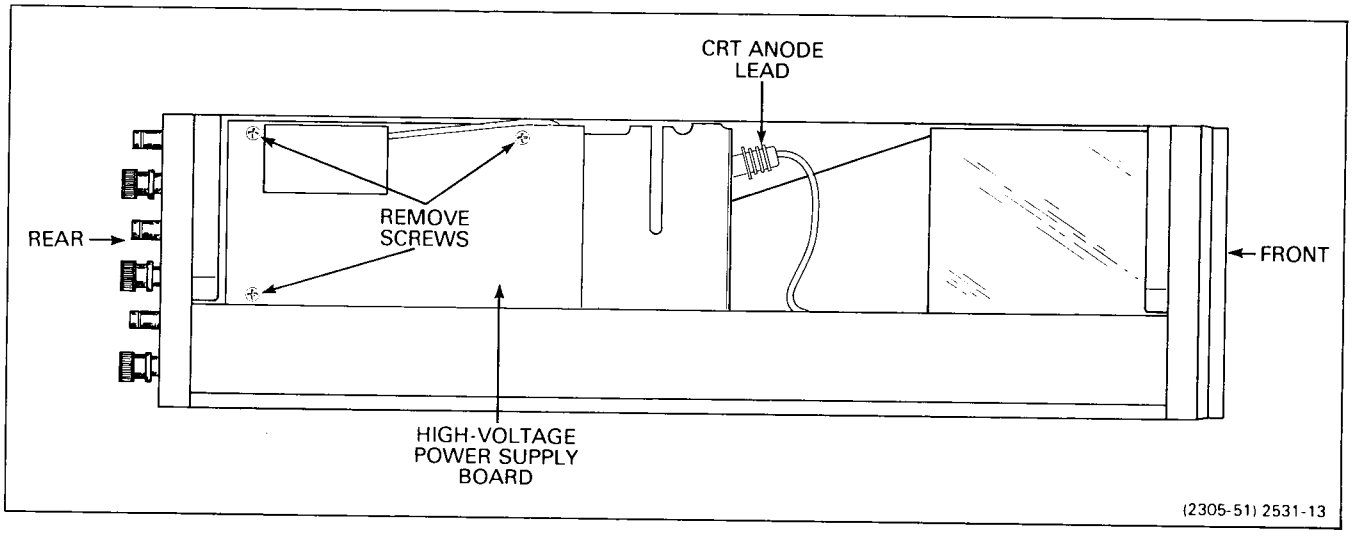

Figure 5-8. Location of screws securing A4 High-Voltage Power Supply board.

Replacement semiconductors should be of the original type or a direct replacement. Lead configurations of the semiconductors used in this instrument are shown in Figure 5-2. Some plastic case transistors have lead configurations which do not agree with those shown. If a replacement transistor is made by a different manufacturer than the original, check the manufacturer's basing diagram for correct basing. All transistor sockets in the 624 are wired for the standard basing as used for metal-cased transistors. When removing soldered-in transistors, use a solder-removing wick to remove the solder from the circuit board pads. Transistors which have heat radiators or are mounted on the chassis use silicone grease to increase heat transfer. Replace the silicone grease on both sides of the insulator plate and on the metal tab, if the transistor has one, when replacing these transistors.

WARNING

Handle silicone grease with care. Avoid getting silicone grease in your eyes. Wash hands thoroughly after use.

CIRCUIT-BOARD PIN REPLACEMENT

A circuit-board pin replacement kit, including necessary tools, instructions, and replacement pins with attached spare ferrules, is available from Tektronix, Inc. Order Tektronix Part 040-0542-00.

To replace a damaged pin, first disconnect any pin connectors. Then unsolder (see Soldering Techniques) the damaged pin and pull it from the board with a pair of pliers, leaving the ferrule (see Fig. 5-9) in the hole if possible. If the ferrule remains in the circuit board, remove the spare ferrule from the replacement pin and press the new pin into the hole in the circuit board. If the ferrule is removed with the damaged pin, clean out the hole using a solder-removing wick and a scribe. Then press the replacement pin, with attached spare ferrule, into the hole. Position the replacement pin in the same manner as the original pin had been. Solder the pin to the circuit board on each side of the circuit board. If the original pin was bent at an angle to mate with a connector, carefully bend the new pin to the same angle. Replace the pin connector.

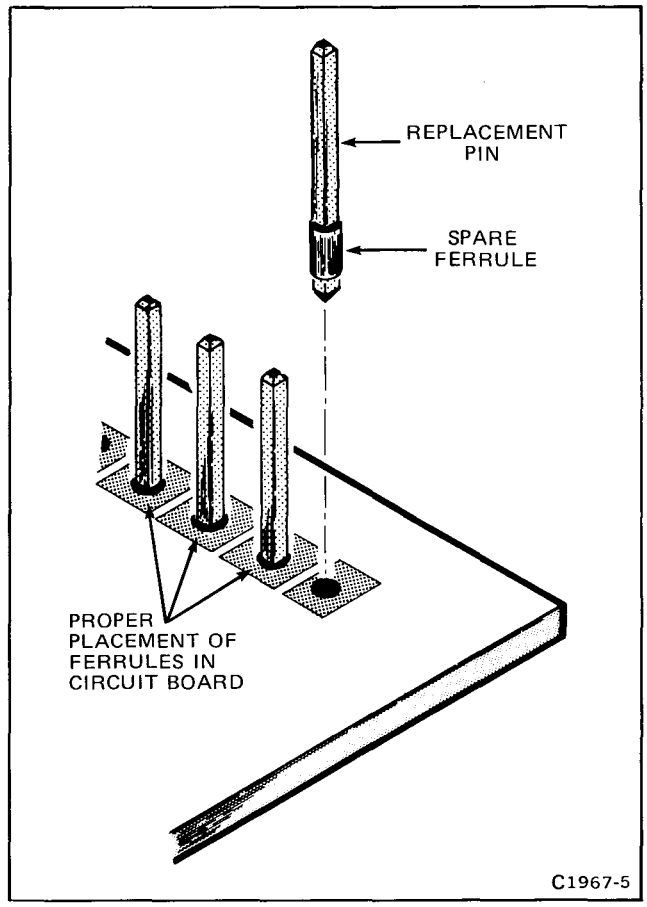

Figure 5-9. Exploded view of circuit board pin and ferrule.

END-LEAD PIN CONNECTORS

The pin connectors used to connect the wires to the interconnecting pins are clamped to the ends of the associated leads. To remove or replace damaged end-lead pin connectors, remove the old pin connector from the end of the lead and clamp the replacement connector to the lead.

Some of the pin connectors are grouped and mounted in a plastic holder; the overall result is that these connectors are removed and installed as a multi-pin connector (see Troubleshooting Aids). If the individual end-lead pin connectors are removed from the plastic holder, note the order of the individual wires for correct replacement in the holder.

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PERFORMANCE CHECK AND CALIBRATION

This section provides information necessary to: (1) Verify that this instrument meets the electrical specifications in Section 1, General Information, (2) verify that all controls function properly, and (3) perform all internal adjustments. The Part I Performance Check procedure checks the electrical specifications listed in section 1 without making any internal adjustments. The Part II Calibration procedure provides a complete sequential check of instrument performance concurrent with a complete sequential adjustment of internal controls. A separate Functional Check procedure, in the Installation section of this manual, can be used to check only the functions of the front- and rear-panel controls and connectors.

PRELIMINARY INFORMATION

USING THESE PROCEDURES

Both the Part I Performance Check and Part II Calibration procedures are divided into functional block subsections (e.g., A. Power Supply, B. Crt Circuit, etc.). The order in which the subsections and steps (A1, A2, B1, B2, etc.) appear in each procedure is the recommended sequence for accomplishing a performance check or calibration of the instrument. Subsections within either procedure can be performed independently, as can each step within any subsection. Refer to Partial Procedures for specific instructions on performing either a partial Performance Check or a partial Calibration.

All functional block subsections begin with a list of required test equipment, followed by instructions for **Before You Begin** and the list of Preliminary Control Settings for that subsection (e.g., Power Supply Preliminary Control Settings, Crt Circuit Preliminary Control Settings, etc.). Each step contains separate Setup Conditions which, if applicable, include the instrument control settings, an illustrated test setup, and test equipment control settings. The instrument and test equipment control settings listed in the step Setup Conditions may include additional settings, changes from the previous step, or changes to the Preliminary Control Settings. This is necessary to accommodate those who wish to perform partial procedures. The illustrated test setup in the Setup Conditions shows all test equipment needed to perform the step, as well as the setup necessary to begin the step instructions.

Partial Procedures

Part I Performance Check. To perform a partial Performance Check procedure, first determine which electrical specifications are to be checked. Table 6-1, Performance Check and Calibration Summary, lists the applicable electrical specifications from Section 1, General Information, and provides references to the step(s) in which the performance requirements are checked. The Performance Check Index, at the start of Part I Performance Check, provides a convenient means for locating the desired subsections and steps. For example: If the vertical amplifier had been repaired and a performance check was considered necessary, use the Performance Check and Calibration Summary table to locate the applicable specifications affected by the repair, and the step title of Part I Performance Check in which those performance requirements are checked. Then use the Performance Check Index to locate the Vertical (Y) Amplifier subsection and the step and page number of the applicable step(s).

Any step of a subsection can be performed separately by following the instructions given below.

1. Locate the desired subsection and applicable steps (e.g., B1, B2, B4, etc.) with the Performance Check and Calibration Summary table and the Performance Check Index.

2. Perform the Performance Check Power Up Sequence at the start of Part I Performance Check, and the instructions under **Before You Begin** and Preliminary Control Settings at the beginning of the subsection.

3. Perform the Setup Conditions instructions for the desired step. Disregard any control settings which are the same as those under Preliminary Control Settings.

4. Proceed with the lettered instructions (e.g., a, b, c, etc.).

NOTE

If the steps performed are consecutive, it is not necessary to repeat the Preliminary Control Settings after the first step. However, when a step is skipped, the Preliminary Control Settings must be performed again.

Part II Calibration. Although each step in the Part II Calibration procedure can be performed independently, we recommend that the entire subsection be performed if any adjustments are made. Table 6-1, Performance Check and Calibration Summary, lists the electrical specifications from Section 1, General Information, and provides references to the step(s) in which the performance requirements are checked and applicable adjustments are made. The Calibration Index, at the start of Part II Calibration, provides a convenient means for locating the desired subsections and steps. For example: If the A5 Low-Voltage Power Supply board had been replaced, use the Performance Check and Calibration Summary table to locate the applicable specifications affected by the repair, and the step title(s) of Part II Calibration in which those performance requirements are checked or adjusted. Then use the Calibration Index to locate the Power Supply subsection and the step and page number of the applicable step(s).

A heading system is provided to readily identify the steps (A1, A2, B1, B2, etc.) that contain performance check and/or adjustment instructions. For example, if CHECK appears in the title of a step, a performance requirement listed in the Specifications is checked. If ADJUST appears as the first word in the title, the step concerns one or more internal adjustments. And if CHECK/ADJUST appears in the title, the step involves one or more performance requirement checks and adjustments.

The alphabetical instructions under each step (a, b, c, etc.) may contain CHECK, EXAMINE, ADJUST, or INTERACTION as the first word of the instruction. These terms are defined as follows:

1. **CHECK**—indicates that the instruction accomplishes a performance requirement check.

2. **EXAMINE**—usually precedes an ADJUST instruction and describes how to determine whether the adjustment is necessary.

3. **ADJUST**—describes which adjustment to make and the desired result. We recommend that adjustments not be made if a previous CHECK or EXAMINE instruction indicates that no adjustment is necessary.

4. **INTERACTION**—indicates that the adjustment described in the preceding instruction interacts with other circuits. The nature of the interaction is described and reference is made to the step(s) affected.

ADJUSTMENT INTERVAL

To maintain instrument accuracy, check the performance of the 624 every 1000 hours of operation, or every 6 months if used infrequently. Before complete adjustment, thoroughly clean and inspect this instrument as outlined in Section 5, Maintenance.

TEKTRONIX FIELD SERVICE

Tektronix Field Service Centers and the Factory Service Center provide instrument repair and adjustment services. Contact your Tektronix Field Office or representative for further information.

TABLE 6-1

Performance Check Summary

Characteristic	Performance Requirement	Performance Check Procedure Title	Calibration Procedure Title
	VERTICAL (Y) AMPLIFIER		
Deflection Factor	Adjustable from 0.5 V or to at least 2.5 V full scale. Nominally set for 1 V, within 2%, for 8 divisions of deflection.	D1. Check Y Gain.	D3. Check/Adjust Y Gain (R125).
Option 22	An internal 5:1 attenuator extends the deflection factor range to at least 12.5 V full scale.	Does not normally require customer verification. However, the extended deflection factor can be verified with the "Functional Check" procedure in Section 3, Installation.	
Attenuators (Option 22)	Deflection factor reduced five times within 3%, with 5:1 attenuation.	Does not normally require customer verification. However, the attenuator accuracy can be verified with the "Functional Check" procedure in Section 3, Installation.	

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TABLE 6-1 (CONT.)

Performance Check and Calibration Summary

Characteristic	Performance Requirement	Performance Check Procedure Title	Calibration Procedure Title
Polarity		Does not normally require customer verification. Satisfactory operation is substantiated by other tests throughout the procedures.	
+Y INPUT	Positive signal applied deflects beam up; negative signal applied deflects beam down.		
-Y INPUT (Option 21)	Positive signal applied deflects beam down; negative signal applied deflects beam up.		
Settling Time	Spot must reach new writing position within 0.05 cm within 0.5 μs from any on-screen position.	D4. Check Vertical Settling Time.	D6. Check Vertical Settling Time
Bandwidth (With 80% Full-Screen Reference Signal)	Dc to at least 3 MHz at -3 dB point.	D5. Check Vertical Bandwidth	D1. Adjust Option 22 Y Attenuation Compensation (C110 and C210). D2. Adjust Vertical (Y) Compensation (C153). D7. Check Vertical Bandwidth.
Common-Mode Rejection (Option 21)		D3. Check Option 21 Vertical Common-Mode Rejection.	D5. Check Option 21 Vertical Common-Mode Rejection.
DC to 100 kHz			
1X Attenuation	At least 100:1 for signals of ±5 V or less.		
5X Attenuation (Option 22)	At least 50:1 for signals of ±25 V or less.		
100 kHz to 1 MHz			
1X Attenuation	At least 50:1 for signals of ±5 V or less.		
5X Attenuation (Option 22)	At least 20:1 for signals of ±25 V or less.		
Risetime	116 ns or less.	Does not normally require customer verification. However, risetime can be calculated from the Vertical Bandwidth.	
Phase Difference (DC to 1.0 MHz)	1° or less between X and Y amplifiers. X and Y amplifier gain must be set for the same deflection factor (V/div).	D2. Check Phasing.	D4. Check/Adjust Phasing (C122 and C138).
Position Stability	0.5 mm, or less, of drift per hour after 20-minute warmup.	Does not normally require customer verification.	

TABLE 6-1 (CONT.)

Performance Check and Calibration Summary

Characteristics	Performance Requirement	Performance Check Procedure Title	Calibration Procedure Title
Gain Stability	1% or less of drift after 20-minute warmup.	Does not normally require customer verification.	
Displayed Noise (Measured Tangetially)	0.05 mm or less, with all inputs terminated in 1 kΩ or less.	Does not normally require customer verification.	
Input RC	1 MΩ, within 1%, paralleled by 60 pF or less.	Does not normally require customer verification. Input resistance and capacitance can be determined with appropriate testing bridge if necessary.	
Option 26	50 Ω, within 1%, paralleled by 60 pF or less.		
Maximum Non-destructive Input Voltage (Fault Condition Only)	+100 V or -100 V (dc + peak ac).	Specification applicable under fault conditions only; therefore this is not a procedural check.	
Position Range	Spot may be positioned anywhere on screen with no signal input.	D6. Check Vertical Positioning.	D8. Check Vertical Positioning.
Dynamic Range	At least 1.5 screen diameters from center screen.	Does not normally require customer verification.	
Crosstalk Between X and Y Amplifiers		Does not normally require customer verification. However, crosstalk can be determined as follows: Terminate undriven channel (X or Y) input into 50 ohms or less, and drive the other channel (Y or X) with a 1-volt, 500 kHz (3 MHz) sinewave. With the display centered, observe no more than 0.25 mm deflection in the undriven channel.	
At 500 kHz	0.25 mm, or less, of deflection on the grounded channel (X or Y) with a 1V signal applied on the other channel (Y or X).		
At 3 MHz	0.38 mm, or less, of deflection on grounded channel (X or Y) with a 1 V signal applied on the other channel (Y or X).		
HORIZONTAL (X) AMPLIFIER			
Deflection Factor	Adjustable from 0.5 V or less to at least 2.5 V full scale. Nominally set for 1 V, within 2%, for 8 divisions of deflection.	C1. Check X Gain.	C3. Check/Adjust X Gain (R325).
Option 22	An internal 5:1 attenuator extends the deflection factor range to at least 12.5 V full scale.	Does not normally require customer verification. However, the extended deflection factor can be verified with the "Functional Check" procedure in Section 3, Installation.	

TABLE 6-1 (CONT.)

Performance Check and Calibration Summary

Characteristics	Performance Requirement	Performance Check Procedure Title	Calibration Procedure Title
Attenuators (Option 22)	Deflection factor reduced five times within 3%, with 5:1 attenuation.	Does not normally require customer verification. However, the attenuator accuracy can be verified with the "Functional Check" procedure in Section 3, Installation.	
Polarity		Does not normally require customer verification. Satisfactory operation is substantiated by other tests throughout the procedure.	
+X INPUT	Positive signal applied deflects beam to the right; negative signal deflects beam to the left.		
-X INPUT (Option 21)	Positive signal applied deflects beam to the left; negative signal deflects beam to the right.		
Settling Time	Spot must reach new writing position within 0.05 cm within 0.5 μs from any on-screen position.	C3. Check Horizontal Settling Time.	C5. Check Horizontal Settling Time.
Bandwidth (With 80% Full-Screen Reference Signal)	Dc to at least 3 MHz at -3 dB point.	C4. Check Horizontal Bandwidth.	C1. Adjust Option 22 X Attenuator Compensation (C310 and C410). C2. Adjust Horizontal (X) Compensation (C353). C6. Check Horizontal Bandwidth.
Risetime	116 ns or less.	Does not normally require customer verification. However, risetime can be calculated from the Horizontal Bandwidth.	
Common-Mode Rejection (Option 21)		C2. Check Option 21 Horizontal Common-Mode Rejection.	C4. Check Option 21 Horizontal Common-Mode Rejection.
DC to 100 kHz			
1X Attenuation	At least 100:1 for signals of ±5 V or less.		
5X Attenuation (Option 22)	At least 50:1 for signals of ±25 V or less.		
100 kHz to 1 MHz			
1X Attenuation	At least 50:1 for signals of ±5 V or less.		
5X Attenuation (Option 22)	At least 20:1 for signals of ±25 V or less.		
Position Stability	0.5 mm, or less, of drift per hour after 20-minute warmup.	Does not normally require customer verification.	
Gain Stability	1% or less of drift after 20-minute warmup.	Does not normally require customer verification.	

TABLE 6-1 (CONT.)

Performance Check and Calibration Summary

Characteristic	Performance Requirement	Performance Check Procedure Title	Calibration Procedure Title
Displayed Noise (Tangetially Measured)	0.05 mm or less, with all inputs terminated in 1 k or less.	Does not normally require customer verification.	
Input RC	1 MΩ, within 1%, paralleled by 60 pF or less.	Does not normally require customer verification. Input resistance and capacitance can be determined with appropriate testing bridge if necessary.	
Option 26	50 Ω, within 1% paralleled by 60 pF or less.		
Maximum Non-destructive Input (Fault Condition Only)	+100 V or -100 V (dc + peak ac).	Specification applicable under fault conditions only; therefore this is not a procedural check.	
Position Range	Spot may be positioned anywhere on screen with no signal input.	C5. Check Horizontal Positioning.	C7. Check Horizontal Positioning.
Dynamic Range	At least 1.5 screen diameters from center screen.	Does not normally require customer verification.	
Crosstalk Between X and Y Amplifiers		Does not normally require customer verification. However, crosstalk can be determined as follows Terminate undriven channel (X and Y) input into 50 ohms or less, and drive the other channel (X or Y) with a 1-volt, 500 kHz (3 MHz) sinewave. With the display centered, observe no more than 0.25 mm deflection in the undriven axis (Y or X).	
At 50 kHz	0.25 mm, or less, of deflection on the grounded channel (X or Y) with a 1 V signal applied on the other channel (Y or X).		
At 3 MHz	0.38 mm, or less, of deflection on the grounded channel (X or Y) with a 1 V signal applied on the other channel (Y or X).		

OPTION 4 SWEEP SYSTEM

Sweep Range	100 ms/div to 1 μs/div, in decade steps.	Does not normally require customer verification. Satisfactory operation is substantiated by other tests throughout the procedure.	
Sweep Accuracy Over Center Eight Divisions	Within 3% (VARIABLE fully clockwise).	F3. Check Sweep Timing.	F3. Check/Adjust Sweep Timing (R1185).
Sweep Length	Adjustable to at least 10.5 div.	F1. Check Sweep Length.	F1. Check/Adjust Sweep Length (R1134).

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TABLE 6-1 (CONT.)

Performance Check and Calibration Summary

Characteristics	Performance Requirement	Performance Check Procedure Title	Calibration Procedure Title
Linearity of Any Two Division Portion Within Center Eight Divisions	Within 6%, except for first 5% of total sweep length.	F4. Check Sweep Linearity.	F4. Check Sweep Linearity.
VARIABLE (Uncalibrated)	Provides continuously variable sweep rates between calibrated settings. Decreases each sweep rate setting by at least 10:1. Extends slowest sweep rate to at least 1 s/div.	F5. Check Variable Time/Division.	F5. Check Variable Time/Division.
Triggering Sensitivity (With Repetitive Signals)	At least 0.5 div. vertical deflection from dc to 2 MHz.	F2. Check Trigger	F2. Check Trigger

Z-AXIS AMPLIFIER

Useful Input Voltage Range (+Z INPUT)	Adjustable. With Z Gain at maximum, no more than +1 V will provide full intensity. With Z Gain at minimum, at least +5 V is required to produce full intensity. (-1 V input signal cuts off visible intensity).	E1. Check Z Gain.	E1. Check/Adjust Z Gain (R525).
Useful Frequency Range	Dc to at least 5 MHz at -3 dB point.	E2. Check Z-Axis Bandwidth.	E2. Adjust Z-Axis Compensation (R560 and C591). E3. Check Z-Axis Bandwidth.
Risetime	70 ns or less.	Does not normally require customer verification. However, risetime can be calculated from the Z-Axis Bandwidth.	
Noise	No visible intensity modulation with Z INPUT terminated into 1 kΩ or less.	Does not normally require customer verification.	
Common-Mode Rejection (Option 21)		E3. Check Option 21 Z-Axis Common-Mode Rejection.	E4. Check Option 21 Z-Axis Common-Mode Rejection.
DC to 100 kHz	At least 100:1 with input signals to ±5 V at any setting of Z Gain.		
100 kHz to 1 MHz	At least 50:1 with input signals to ±5 V at any setting of Z Gain		

TABLE 6-1 (CONT.)

Performance Check and Calibration Summary

Characteristic	Performance Requirement	Performance Check Procedure Title	Calibration Procedure Title
Input RC	1 MΩ, within 1%, paralleled by 60 pF or less.	Does not normally require customer verification. Input resistance and capacitance can be determined with the appropriate testing bridge if necessary.	
Option 26	50 Ω, within 1% paralleled by 60 pF or less.		
Maximum Non-destructive Input Voltage (Fault Condition Only)	+100 V or -100 V (dc + peak ac) with crt beam positioned off the viewing area.	Specification applicable under fault conditions only; therefore this is not a procedural check.	
Crosstalk Between Z-Axis Amplifier and X or Y Amplifier		Does not normally require customer verification.	
DC to 500 kHz	0.25 mm or less, with X and Y INPUTS grounded and a 1 V signal applied to the Z-Axis Amplifier. (Z Gain set for maximum).		
500 kHz to 5 MHz	0.38 mm or less, with X and Y INPUTS grounded and a 1 V signal applied to the Z-Axis Amplifier. (Z Gain set at minimum.)		
TTL Input Voltage (Option 25)		Does not normally require customer verification.	
HI	+2.4 V to +5 V dc.		
LO	0 V to +0.8 V dc.		
Unblanking (Option 25)	Input voltage level to produce unblanking is internally selectable. With selector in NEG position, a LO input produces unblanking; with selector in POS position, a HI input produces unblanking.	E4. Check Option 25 Z-Axis Unblanking.	E5. Check Option 25 Z-Axis Unblanking.

CATHODE-RAY TUBE DISPLAY

Usable Screen Area	9.6 × 12 centimeters.	Does not normally require customer verification.	
Quality Area	9 × 11 centimeters.	Does not normally require customer verification.	
Option 1 Graticule	Internal, unlighted, 8 × 10 divisions (1.22 cm/div).	Does not normally require customer verification. To determine if your instrument is equipped with Option 1, check the inside of the front-panel access door.	
Geometry (Within Graticule Area)	Bowing or tilt is 0.1 division or less.	B2. Check Geometry.	B4. Check/Adjust Geometry (R943).
Orthogonality (Within Graticule Area)	90° within 0.7°.	B1. Check Orthogonality.	B3. Check Orthogonality.

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TABLE 6-1 (CONT.)

Performance Check and Calibration Summary

Characteristic	Performance Requirement	Performance Check Procedure Title	Calibration Procedure Title
Accelerating Potential	Approximately 18 kV.	Does not normally require customer verification.	
Deflection	Electrostatic.	Does not normally require customer verification.	
Phosphor	P31 (Standard).	Does not normally require customer verification. To determine if an Optional phosphor is in your Monitor, check the inside of the front-panel access door.	
Option 74	P4.		
Option 76	P7.		
Option 78	P11.		
Option 40	P39.		
Brightness	Light output is at least 240 dc/m^2 (40 fL) with a 0.33 mm, or less, centered spot size. Measured with quality area flooded by a 60 Hz refresh rate raster, 308 horizontal lines.	Does not normally require customer verification.	
Uniformity	Light output in quality area does not vary more than 20% at moderate intensity 34 dc/m^2 (20 fL). Measured with quality area flooded by a 60 Hz refresh raster, 320 horizontal lines.	Does not normally require customer verification.	
Spot Size		Does not normally require customer verification.	
#1	0.31 cm or less, anywhere inside the quality area. Measured with shrinking raster method at 170 cd/m^2 (30 fL) brightness and full-screen raster, 60 HZ refresh rate.		
#2	0.26 cm or less, at 0.5 μA lb. Measured with shrinking raster method.		
Resolution	Spot size does not vary more than 20% over the quality area, at a constant intensity.	Does not normally require customer verification.	

POWER SOURCE

Line Voltage (ac, rms)		Does not normally require customer verification.	
Low Range, P951			
Low (100 V ac)	90 to 110 V ac.		
Med (110 V ac)	99 to 121 V ac.		
Hi (120 V ac)	108 to 132 V ac.		

TABLE 6-1 (CONT.)

Performance Check and Calibration Summary

Characteristic	Performance Requirement	Performance Check Procedure Title	Calibration Procedure Title
High Range, P952			
Low (200 V ac)	180 to 220 V ac.		
Med (220 V ac)	198 to 242 V ac.		
Hi (240 V ac)	216 to 250 V ac.		
Line Frequency	48 to 440 Hz.	Does not normally require customer verification.	
Maximum Power Consumption (120 V ac, 60 Hz)	61 Watts, 0.7 Ampere.	Does not normally require customer verification.	
Option 20 Input Power		A1. Check Option 20 Regulation and Shutdown.	A3. Check Option 20 Regulation and Shutdown Threshold.
+20 V DC Input	+17.0 to +26.0 V dc, including any ripple excursions.		
-20 V DC Input	-17.0 to -26.0 V dc, including any ripple excursions.		
Option 20 Maximum Operating Current		Does not normally require customer verification.	
+20 V DC Input	2.2 Amperes.		
-20 V DC Input	0.3 Ampere.		
Option 20 Maximum Allowable Input Ripple	2 V ac, peak-to-peak.	Does not normally require customer verification.	
Option 20 Shutdown-Voltage		A1. Check Option 20 Regulation and Shutdown.	A3. Check Option 20 Regulation and Shutdown.
+20 V DC Input	+26 V to no greater than +29.5 V dc.		
-20 V DC Input	-20 V to no greater than -29.5 V dc.		
Option 20 Maximum Nondestructive Input Voltage		Specification applicable under fault conditions only; therefore this is not a procedural check.	
+20 V DC Input	+40 V dc.		
-20 V DC Input	-40 V dc.		

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TEST EQUIPMENT REQUIRED

The test equipment listed in Table 6-2 is required for a complete Performance Check and Calibration of this instrument. The specifications for test equipment, given in Table 6-2, are the minimum required to meet the Performance Requirements. Detailed operating instructions for test equipment are omitted in these procedures. Refer to the test equipment instruction manual if more information is needed.

If only a Performance Check is to be performed, not all of the listed test equipment is required. Items used only for calibration are indicated by footnote 1. The remaining pieces of equipment are common to both procedures.

SPECIAL FIXTURES

Special fixtures are used only where they facilitate instrument adjustment. These fixtures are available from Tektronix, Inc. Order by part number from Tektronix Field Offices or representatives.

TEST EQUIPMENT ALTERNATIVES

All of the listed test equipment is required to completely calibrate this instrument. However, complete checking or adjusting may not always be necessary or desirable. You may be satisfied with checking only selected characteristics, thereby reducing the amount of test equipment actually required.

The Performance Check and Calibration procedures are based on the first item of equipment given as an example. When other equipment is substituted, control settings or setups may need to be altered. If the exact item of equipment given as an example in Table 6-2 is not available, first check the specifications column carefully to see if any other equipment might suffice. Then check the Purpose column to see what this item is used for. If used for a check or adjustment that is of little or no importance for your measurement requirements, the item and corresponding step(s) can be deleted.

TABLE 6-2

Test Equipment

Description	Minimum Specifications	Purpose	Examples of Applicable Test Equipment
1. Precision dc voltmeter [1] (with test leads)	Measurement range, -15 to +100 V; measurement accuracy, within 0.1%.	Adjust +15 V supply. Check low-voltage supplies. Adjust CRT Bias.	a. TEKTRONIX DM 502A Option 02 Digital Multi-Meter (operates in TM 500-Series Power Module).
2. Dc voltmeter [1] (with test leads)	Measurement range, -3564 to -3636 V.	Adjust High-Voltage Supply	a. Triplet Model 630-NA. b. Simpson Model 262.
3. Function generator	Waveshapes, sine and square; frequency range, 1 Hz to 2 MHz; amplitude, 5 V to 20 V (P-P) into an open circuit.	Check common-mode rejection of the vertical, horizontal, and Z-axis amplifiers in the Option 21 instrument. Check Z-axis unblanking in the Option 25 instrument. Check triggering in the Option 4 instrument.	a. TEKTRONIX FG 503 Function Generator (operates in TM 500-Series Power Module).
4. Ramp generator	Ramp duration, 5 ms to 10 μs within 3%; ramp 1 MΩ; external trigger input, compatible with square-wave generator trigger output; gate output, 1 to 3 V into 1 MΩ.	Adjust gain and compensation of the vertical, hori- Check vertical and horizontal settling time, bandwidth and positioning. Check Z-axis and common-mode rejection (Option 21). Adjust trace rotation and geometry. Check orthogonality.	a. TEKTRONIX RG 501 Ramp Generator (operates in TM 500-Series Power Module).
5. Square-wave	Frequency range, 1 kHz to 100 kHz; amplitude, 0.5 to 1 V when terminated compatible with ramp generator external trigger input.	Adjust gain and compensation of the vertical, horizontal and Z-axis amplifiers. Check vertical and horizontal settling time.	a. TEKTRONIX PG 506 Calibration Generator (operates in TM 500-Series Power Module).

[1]Used for calibration only; NOT used for performance check.

TABLE 6-2 (CONT.)

Test Equipment

Description	Minimum Specifications	Purpose	Examples of Applicable Test Equipment
6. Sine-wave generator	Frequency range, 1 MHz to at least 5 MHz; reference frequency, 50 kHz; amplitude, 0.5 to 5 V when terminated into 50 Ω; amplitude accuracy, constant within 5% of reference as output frequency changes	Check bandwidth of the vertical, horizontal, and Z-axis amplifiers. Check and adjust phasing between the vertical and horizontal amplifiers.	a. TEKTRONIX SG 503 Leveled Sine-Wave Generator (operates in TM 500-Series Power Module).
7. Time-mark generator (required for Option 4 Monitors only)	Marker output, 1 μs to 0.1 s; accuracy, within 1%.	Check and adjust sweep timing, and check variable time/division in the Option 4 instrument.	a. TEKTRONIX TG 501 Time Mark Generator (operates in TM 500-Series Power Module).
8. Test oscilloscope (with 10X probe)	Bandwidth, dc to at least 50 MHz; deflection factor, 0.1 to 10 V/div within 2%; sweep rate, 5 μs/div to 0.5 μ/div.	Adjust gain and compensation of Z-axis amplifier. Check Z-axis bandwidth and Option 21 common-mode rejection.	a. TEKTRONIX 5440 Oscilloscope with 5A45 Amplifier, 5B40 Time Base, and P6105 1-meter probe. b. TEKTRONIX 7603 Oscilloscope with 7A15A Amplifier, 7B50A Time Base, and P6053B 3.5-foot probe. c. Refer to the Tektronix catalog for compatible oscilloscope system.
9. Dual-input coupler	BNC connectors.	Check common-mode rejection of the vertical, horizontal, and Z-axis amplifiers in the Option 21 instrument. Check and adjust phasing between the vertical and horizontal amplifiers.	a. Tektronix 067-0525-01 Calibration Fixture.
10. 50-ohm termination (Not required for Option 26 Monitors; 2 required for all other model Monitors)	Impedance, 50 Ω within 2%, BNC connectors.	Adjust gain and compensation, and check bandwidth and common-mode rejection of the vertical, horizontal, and Z-axis amplifiers. Check vertical and horizontal settling time. Check and adjust phasing between the vertical and horizontal amplifiers.	a. Tektronix part 011-0049-01.
11. 50-ohm cables (4 required)	Impedance, 50 Ω; length 42 inches; connectors, BNC.	Provide signal interconnection.	a. Tektronix part 012-0057-01.
12. Screwdriver[1]	3-inch shaft, 3/32-inch bit.	Adjust variable resistors.	a. Xcelite R3323.
13. Low-capacitance screwdriver [1]	3-3/4 inch shaft.	Adjust variable capacitors.	a. Tektronix part 003-0675-00.
14. Nominal +20 V dc power supply (required for Option 20 Monitors only)	Output voltage range, +17.0 to +29.5 volts; output current at least 3 amperes.	Supply positive voltage to operate the Option 20 instrument. Check regulation over input voltage range. Check shutdown threshold.	a. Power Mate Corp. Model BPE 34E.

[1]Used for calibration only; NOT used for performance check.

TABLE 6-2 (CONT.)

Test Equipment

Description	Minimum Specifications	Purpose	Examples of Applicable Test Equipment
15. Nominal -20 V dc power supply (required for Option 20 Monitors only)	Output voltage range, -17.0 to -29.5 volts; output current at least 0.5 ampere.	Supply negative voltage to operate the Option 20 instrument. Check regulation over input voltage range. Check shutdown threshold.	a. Power Mate Corp. Model BP 34C.

[1]Used for calibration only; NOT used for performance check.

PART 1 — PERFORMANCE CHECK

The following procedure is intended to be used for incoming inspection to determine the acceptability of newly purchased or recently recalibrated instruments, and is primarily concerned with those portions of the instrument essential to measurement accuracy and the correct operation. See Preliminary Information, at the beginning of this section, for information on performing a partial Performance Check procedure.

PERFORMANCE CHECK PROCEDURE INDEX

PERFORMANCE CHECK POWER-UP SEQUENCE

NOTE

The performance of this instrument can be checked at any ambient temperature from 0° to +50°C unless otherwise stated.

1. Check that the internal Line Voltage Selector plug has been set for the correct input line voltage (see Section 3, Installation).

NOTE

For Option 20 Monitors: Connect your instrument to the DC Power Supplies as shown in Figure 6-1.

2. Check that the crt has an 8 X 10 division graticule over the display area.

3. Remove any cabinet panels to gain access to the internal controls and test points.

4. Check the crt cover on the rear panel to determine which Options have been installed in your Monitor.

5. Connect the power cord to a suitable line voltage source. Push in the ON/OFF pushbutton and allow at least 20 minutes warmup before proceeding.

CAUTION

Do not allow a high-intensity dot to remain stationary on the crt. The crt phosphor could be permanently damaged.

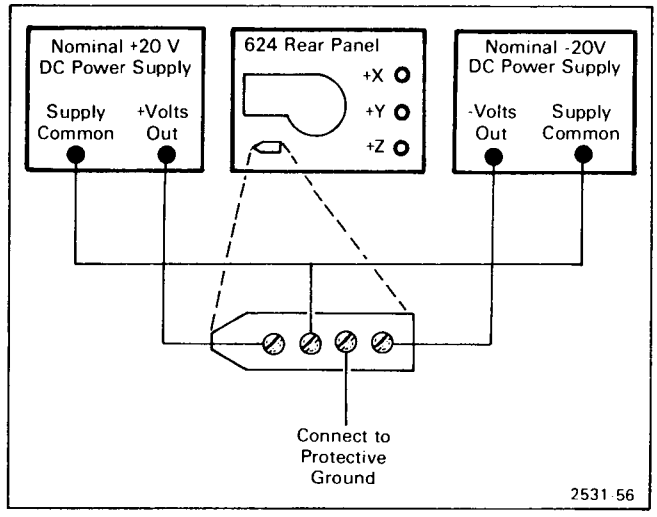


Figure 6-1. Proper application of power to the 624 Option 20 Monitor.

A. OPTION 20 POWER SUPPLY

Equipment Required:

1. Nominal +20 V dc power supply
2. Nominal -20 V dc power supply
3. Precision dc voltmeter

BEFORE YOU BEGIN:

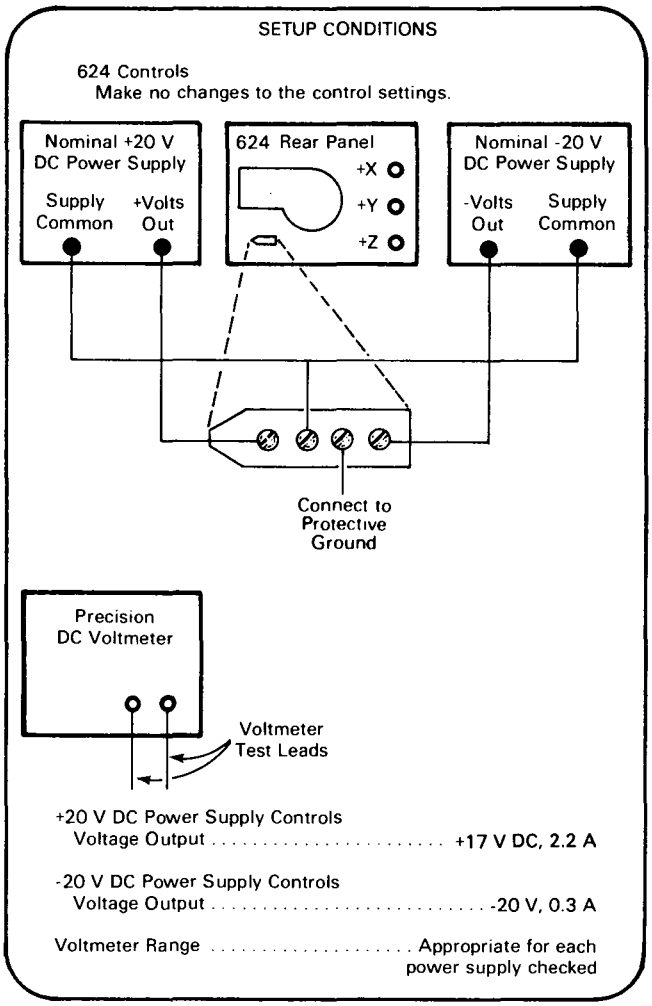
(1) Perform the Performance Check Power-Up Sequence.

(2) Refer to Section 7, Instrument Options, and the Change Information at the rear of this manual for any modifications which may affect this procedure.

(3) See the Test Point and Adjustment Locations foldout page, and the Internal Control and Selector Locations foldout page in Section 9, Diagrams and Circuit Board Illustrations.

OPTION 20 POWER SUPPLY PRELIMINARY CONTROL SETTINGS:

INTENSITY ..... Fully counterclockwise



A1. CHECK OPTION 20 REGULATION AND SHUTDOWN THRESHOLD

SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Option 20 Power Supply Preliminary Control Settings, then proceed with the following instructions.

a. Table 6-3 lists the low-voltage supplies in this instrument. Connect the precision dc voltmeter between the appropriate test point and ground.

b. **CHECK**—The voltmeter for a reading within the voltage range given in Table 6-3 for the appropriate supply.

TABLE 6-3
Low-Voltage Supply Accuracy

Supply (dc)	Voltage Range
-15 V	-14.7 V to -15.3 V
+15 V	+14.96 V to +15.04 V
+100 V	+97 V to +103 V

c. Set the +20 V dc power supply output voltage to +26 volts.

d. **CHECK**—The voltmeter for a reading within the voltage range given in Table 6-3 for the appropriate supply.

e. Set the +20 V dc power supply output voltage to +20 volts. Set the -20 V dc power supply output voltage to -17 volts.

f. **CHECK**—The voltmeter for a reading within the voltage range given in Table 6-3 for the appropriate supply.

g. Set the -20 V dc power supply output voltage to -26 volts.

h. **CHECK**—The voltmeter for a reading within the voltage range given in Table 6-3 for the appropriate supply.

i. Connect the precision dc voltmeter between the +15 V test point and ground.

j. **CHECK**—That the Monitor will shutdown, producing a voltmeter reading of 0 volts, as the -20 V dc power supply output voltage is increased from -26 volts to no greater than -29.5 volts.

k. Set the -20 V dc power supply output voltage to -20 volts.

l. **CHECK**—That the Monitor will shutdown, producing a voltmeter reading of 0 volts, as the +20 V dc power supply output voltage is increased from +26 volts to no greater than +29.5 volts.

m. Return the +20 V dc power supply output to +20 volts.

B. CRT CIRCUIT

Equipment Required:

1. Ramp generator

2. 50-ohm cable (1 required)

BEFORE YOU BEGIN:

(1) Perform the Performance Check Power-Up Sequence.

(2) Refer to Section 7, Instrument Options, and the Change Information at the rear of this manual for any modifications which may affect this procedure.

(3) See the Test Point and Adjustment Locations foldout page, and the Internal Control and Selector Locations foldout page in Section 9, Diagrams and Circuit Board Illustrations.

CRT CIRCUIT PRELIMINARY CONTROL SETTINGS:

CAUTION

Do not allow a high-intensity dot to remain stationary on the crt. The crt phosphor could be permanently damaged.

Vertical and Horizontal Position ..... Midrange
INTENSITY ..... Visible display
FOCUS ..... Well-defined display
XY-YT (Option 4 Internal Selector) ..... XY (rear)
+X Atten (Option 22 Internal Selector) ..... 1X (up)
-X Atten (Option 22 Internal Selector) ..... 1X (up)

NOTE

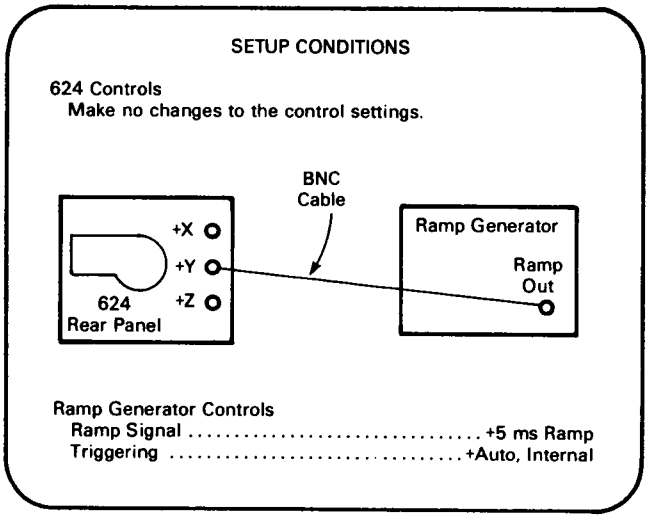
Always place terminations or grounding caps on all INPUTs to which signals are not applied.

B1. CHECK ORTHOGONALITY

SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Crt Circuit Preliminary Control Settings, then proceed with the following instructions.



a. Position the start of the horizontal trace to the center vertical graticule line.

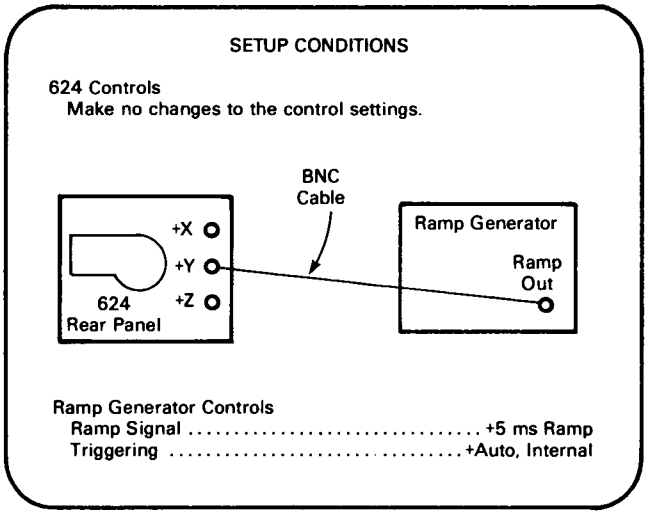
b. **CHECK**—That the vertical trace is aligned with the center vertical graticule line at the top and bottom of the graticule, within 0.1 division.

B2. CHECK GEOMETRY

SETUP CONDITIONS

NOTE

For a partial procedure, first perform the CRT Circuit Preliminary Control Settings, then proceed with the following instructions.



a. Position the vertical trace to the left edge of the graticule and then to the right.

b. **CHECK**—Vertical trace for 0.1 division, or less, of bowing or tilt at the left and right edge of the graticule.

c. Disconnect the ramp generator from the +Y INPUT and connect it to the +X INPUT. Horizontally center the display on the graticule.

d. Position the horizontal trace to the top edge of the graticule and then to the bottom edge.

e. **CHECK**—Horizontal trace for 0.1 division, or less, of bowing or tilt at the top and bottom of the graticule.

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C. HORIZONTAL (X) AMPLIFIER

Equipment Required:

1. Function generator
2. Ramp generator
3. Sine-wave generator
4. Square-wave generator
5. Dual-input coupler
6. 50-ohm cables (4 required)
7. 50-ohm termination (2 required)

BEFORE YOU BEGIN:

(1) Perform the Performance Check Power-Up Sequence.

(2) Refer to Section 7, Instrument Options, and the Change Information at the rear of this manual for any modifications which may affect this procedure.

(3) See the Test Point and Adjustment Locations foldout page, and the Internal Control and Selector Locations foldout page in Section 9, Diagrams and Circuit Board Illustrations.

HORIZONTAL PRELIMINARY CONTROL SETTINGS:

Vertical and Horizontal Position ..... Midrange
Y GAIN ..... Midrange
INTENSITY ..... Visible display
FOCUS ..... Well-defined display
XY-YT (Option 4 Internal Selector) ..... XY (rear)
+Y Atten (Option 22 Internal Selector) ..... 1X (up)
-Y Atten (Option 22 Internal Selector) ..... 1X (up)

NOTE

Always place terminations or grounding caps on all INPUTs to which signals are not applied.

C1. CHECK X GAIN

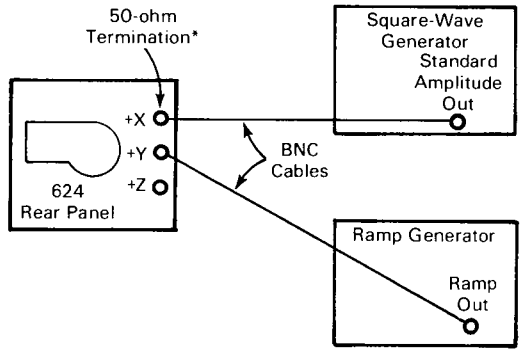
SETUP CONDITIONS

NOTE

X GAIN can be set to provide 10 divisions of horizontal deflection with any input signal voltage from +0.5 to +2.5 volts. However, when doing a complete Performance Check procedure the X GAIN must be set to provide 8 divisions of deflection with a 1-volt input signal. See step C3. CHECK/ADJUST X GAIN (R325) in Part II—Calibration for the procedure to set the X GAIN. For a partial Performance Check procedure, first perform the Horizontal Preliminary Control Settings, then proceed with the following instructions.

SETUP CONDITIONS

624 Controls
X GAIN ..... Fully clockwise



Square-Wave Generator Controls
Amplitude ..... Set to provide 0.5 Volt input signal to the Monitor.

Ramp-Generator Controls
Ramp Signal ..... +20 μs Ramp
Triggering ..... +Auto, Internal

*For Option 26 Monitors: Remove the 50-ohm termination from the test setup.

a. **CHECK**—The crt for a horizontal display of 8 divisions, within 2%. (Position as necessary.)

b. Set X GAIN fully counterclockwise.

c. Set the square-wave generator amplitude for +2.5 volts to the Monitor.

d. **CHECK**—The crt for a horizontal display of 8 divisions, within 2%. (Position as necessary.)

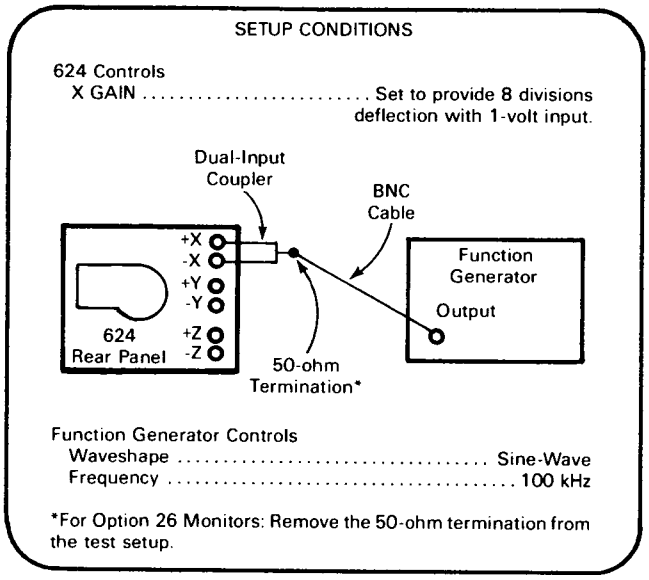
e. Return the X GAIN setting to provide 8 divisions of deflection with 1 volt input. (Refer to step C3 in Part II.)

C2. CHECK OPTION 21 HORIZONTAL COMMON-MODE REJECTION

SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Horizontal Preliminary Control Settings, then proceed with the following instructions.



a. Set the function generator amplitude for a 10-volt (peak-to-peak) input signal to the Monitor.

b. **CHECK**—Crt display for 0.8 divisions, or less, of free-running horizontal display. (Position as necessary.)

c. Set the output frequency of the function generator to 1 megahertz.

d. **CHECK**—Crt display for 1.6 divisions, or less, of free-running horizontal display. (Position as necessary.)

NOTE

Perform the remaining parts of this step only if your instrument is equipped with both Option 21 and Option 22.

e. Turn OFF power to the 624. Then, set S310 (+X Atten) and S410 (-X Atten) to the 5X (down) position. Press front-panel ON/OFF pushbutton to apply power to the 624.

f. Set the function generator amplitude for a 20-volt (peak-to-peak) input signal to the Monitor.

g. **CHECK**—Crt display for 0.3 division, or less, of free-running horizontal display. (Position as necessary.)

h. Set the function generator output frequency to 100 kHz.

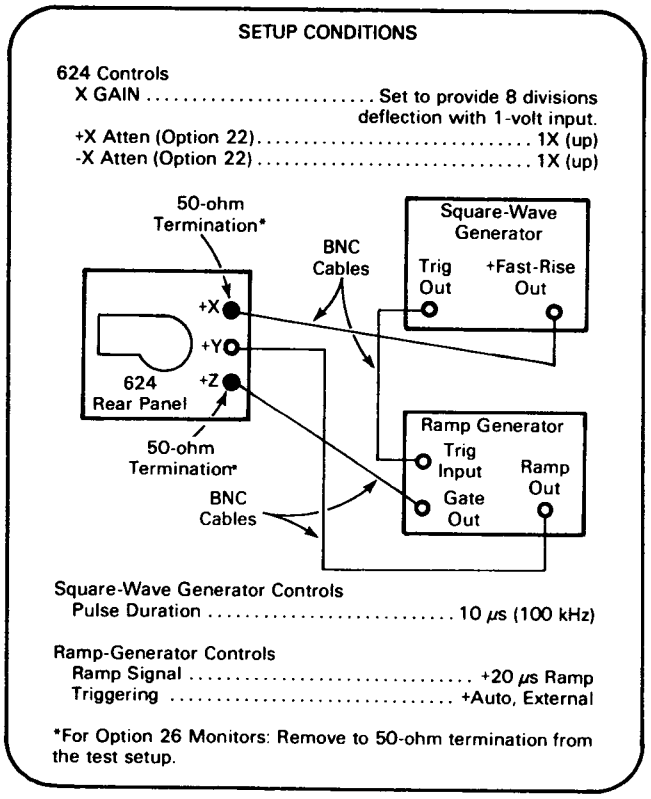
i. **CHECK**—Crt display for 0.8 division, or less, of free-running horizontal display. (Position as necessary.)

C3. CHECK HORIZONTAL SETTLING TIME

SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Horizontal Preliminary Control Settings, then proceed with the following instructions.



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a. Set the ramp generator amplitude for exactly 8 divisions of vertical display. (Position as necessary.)

b. Set the square-wave generator amplitude for 8 divisions of horizontal display, and set the repetition rate to display approximately 1 cycle.

c. **CHECK**—That the time required for the leading edge of the square wave to travel from the zero percent level (see Fig. 6-2) to within 0.50 millimeters (about one trace width) of the 100 percent level is 500 nanoseconds (0.625 division) or less.

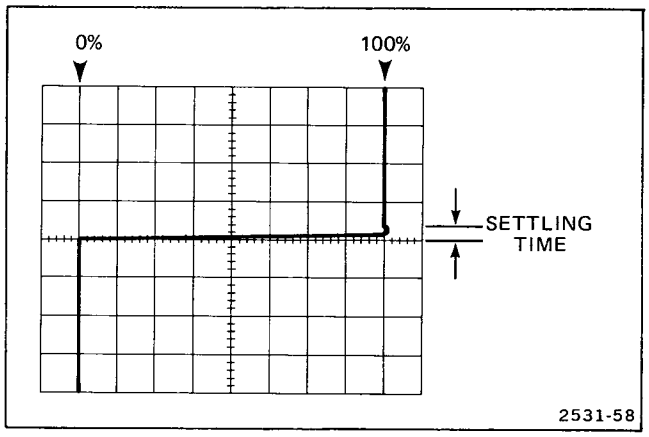


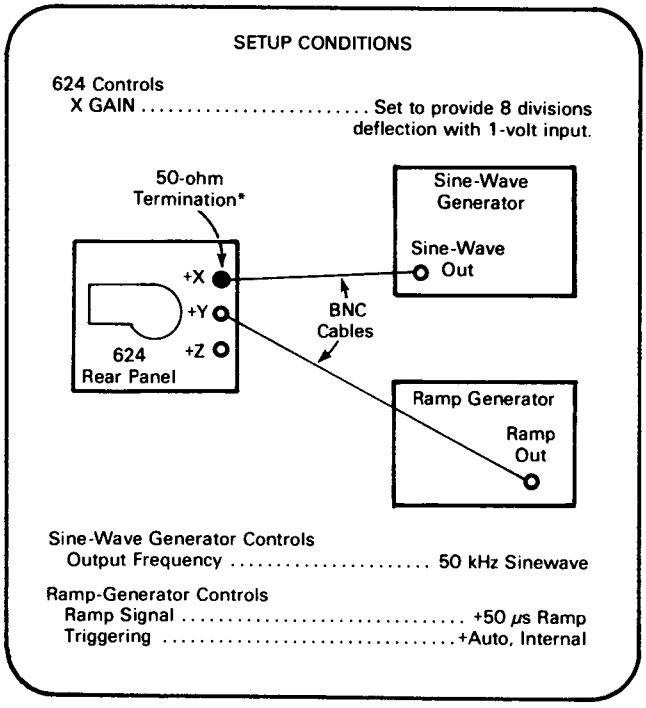
Figure 6-2. Typical crt display for horizontal settling-time measurement.

C4. CHECK HORIZONTAL BANDWIDTH

SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Horizontal Preliminary Control Settings, then proceed with the following instructions.



a. Set the ramp generator amplitude for more than 8 divisions of vertical deflection.

b. Set the sine-wave generator amplitude for 8 divisions of horizontal deflection.

c. Slowly increase the sine-wave generator output frequency until the display's horizontal amplitude is 5.7 divisions.

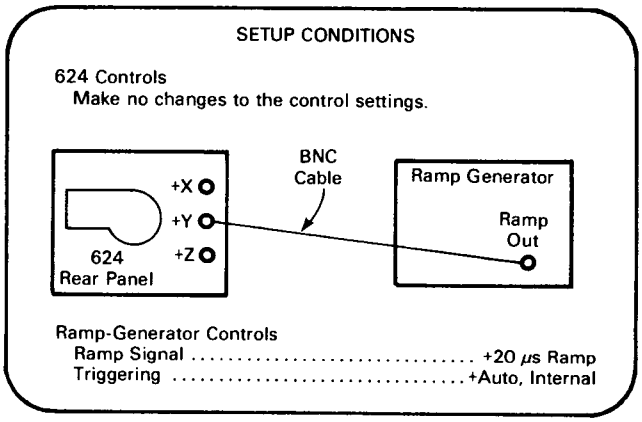
d. **CHECK**—That the sine-wave generator output frequency is at least 3 megahertz.

C5. CHECK HORIZONTAL POSITIONING

SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Horizontal Preliminary Control Settings, then proceed with the following instructions.



a. **CHECK**—Rotate the Horizontal Position Control and check that the vertical trace can be positioned horizontally anywhere in the graticule area.

D. VERTICAL (Y) AMPLIFIER

Equipment Required:

1. Function generator
2. Ramp generator
3. Sine-wave generator
4. Square-wave generator
5. Dual-input coupler
6. 50-ohm cables (4 required)
7. 50-ohm terminations (2 required)

BEFORE YOU BEGIN:

(1) Perform the Performance Check Power-Up Sequence.

(2) Refer to Section 7, Instrument Options, and the Change Information at the rear of this manual for any modifications which may affect this procedure.

(3) See the Test Point and Adjustment Locations foldout page, and the Internal Control and Selector Locations foldout page in Section 9, Diagrams and Circuit Board Illustrations.

VERTICAL PRELIMINARY CONTROL SETTINGS:

Vertical and Horizontal Position ..... Midrange
INTENSITY ..... Visible display
X GAIN ..... Midrange
FOCUS ..... Well-defined display
XY-YT (Option 4 Internal Selector) ..... XY (rear)
+X Atten (Option 22 Internal Selector) ..... 1X (up)
-X Atten (Option 22 Internal Selector) ..... 1X (up)

D1. CHECK Y GAIN

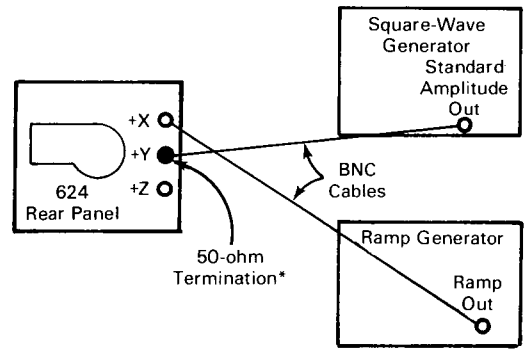
SETUP CONDITIONS

NOTE

Y GAIN can be set to provide 8 divisions of vertical deflection with any input signal voltage from +0.5 to +2.5 volts. However, when doing a complete Performance Check procedure the Y GAIN must be set to provide 8 divisions of deflection with a 1-volt input signal. See step D3. CHECK/ADJUST Y GAIN (R125) in Part II—Calibration for the procedure to set the Y GAIN. For a partial Performance Check procedure, first perform the Vertical Preliminary Control Settings, then proceed with the following instructions.

SETUP CONDITIONS

624 Controls
Y GAIN ..... Fully clockwise



Square-Wave Generator Controls
Amplitude ..... Set to provide 0.5-volt input signal to the Monitor.

Ramp-Generator Controls
Ramp Signal ..... +20 μs Ramp
Triggering ..... +Auto, Internal

*For Option 26 Monitors: Remove the 50-ohm termination from the test setup.

a. **CHECK**—The crt for a vertical display of 8 divisions, within 2%. (Position as necessary.)

b. Set the Y GAIN fully counterclockwise.

c. Set the square-wave generator amplitude for +2.5 volts to the Monitor.

d. **CHECK**—The crt for a vertical display of less than 8 divisions, (Position as necessary.)

e. Return the Y GAIN setting to provide 8 divisions of deflection with 1 volt input. (Refer to step D3 in Part II.)

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D2. CHECK PHASING

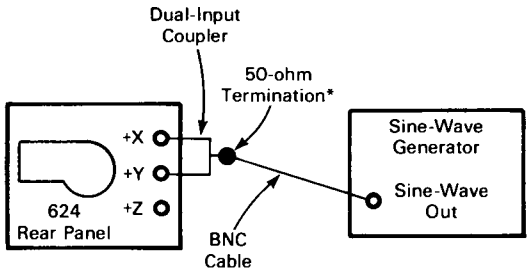
SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Vertical Preliminary Control Settings, then proceed with the following instructions.

SETUP CONDITIONS

624 Controls
X GAIN and Y GAIN ..... Set to provide 8 divisions deflection with 1-volt input.



Sine-Wave Generator Controls
Output Frequency ..... 1 MHz

*For Option 26 Monitors: Remove the 50-ohm termination from the test setup.

a. Set the sine-wave generator amplitude to provide a 1-volt input signal to the Monitor.

b. Position the display as shown in Figure 6-3.

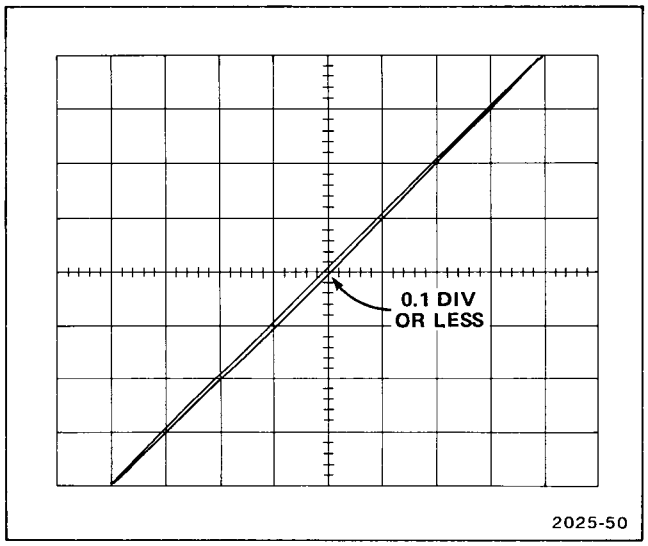


Figure 6-3. Typical horizontal and vertical phase difference display.

c. **CHECK**—That the diameter of the displayed ellipse, measured vertically at the center of the graticule, is 0.1 division or less (see Fig. 6-3).

D3. CHECK OPTION 21 VERTICAL COMMON-MODE REJECTION

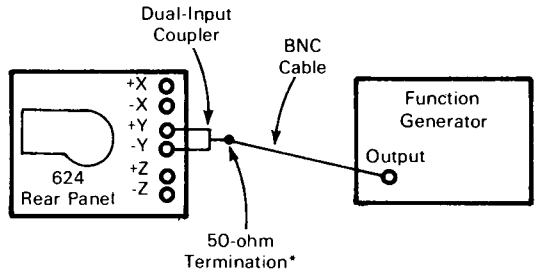
SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Vertical Preliminary Control Settings, then proceed with the following instructions.

SETUP CONDITIONS

624 Controls
Y GAIN ..... Set to provide 8 divisions deflection with 1-volt input.



Function Generator Controls
Waveshape ..... Sine-Wave
Frequency ..... 100 kHz

*For Option 26 Monitors: Remove the 50-ohm termination from the test setup.

a. Set the function generator amplitude for a 10-volt (peak-to-peak) input signal to the Monitor.

b. **CHECK**—Crt display for 0.8 division, or less, of free-running vertical display. (Position as necessary.)

c. Set the output frequency of the function generator to 1 megahertz.

d. **CHECK**—Crt display for 1.6 divisions, or less, of free-running vertical display. (Position as necessary.)

NOTE

Perform the remaining parts of this step only if your instrument is equipped with both Option 21 and Option 22.

e. Turn OFF power to the 624. Then, set S110 (+Y Atten) and S210 (-Y Atten) to the 5X (down) position. Press front-panel ON/OFF pushbutton to apply power to the 624.

f. Set the function generator amplitude for a 20-volt (peak-to-peak) input signal to the Monitor

g. **CHECK**—Crt display for 0.3 division, or less, of free-running vertical display. (Position as necessary.)

h. Set the function generator output frequency to 100 kHz.

i. **CHECK**—Crt display for 0.8 division, or less, of free-running vertical display. (Position as necessary.)

D4. CHECK VERTICAL SETTLING TIME

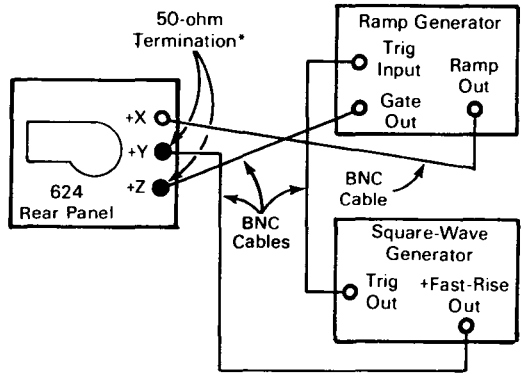
SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Vertical Preliminary Control Settings, then proceed with the following instructions.

SETUP CONDITIONS

624 Controls
+Y Atten (Option 22) ..... 1X (up)
-Y Atten (Option 22) ..... 1X (up)
Y GAIN ..... Set to provide 8 divisions deflection with 1-volt input.



Ramp-Generator Controls
Ramp Signal ..... +10 μs Ramp
Triggering ..... +Auto, External

Square-Wave Generator
Pulse Duration ..... 10 μs (100 kHz)

*For Option 26 Monitors: Remove the 50-ohm termination from the test setup.

a. Set the ramp-generator amplitude for exactly 10 divisions of trace length. (Position as necessary.)

b. Set the square-wave generator amplitude for 8 divisions of vertical display and set the repetition rate to display approximately 1 cycle.

c. **CHECK**—That the time required for the leading edge of the square wave to travel from the zero percent level (see Fig. 6-4) to within 0.50 millimeters (about one trace width) of the 100 percent level is 500 nanoseconds (0.50 division) or less.

D5. CHECK VERTICAL BANDWIDTH

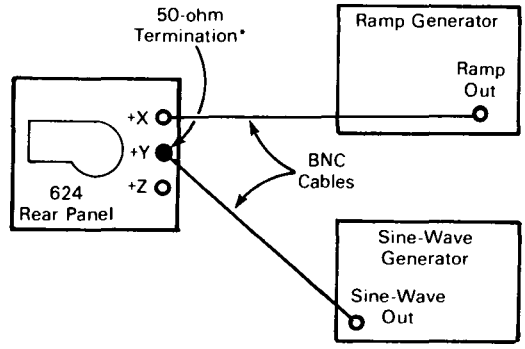
SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Vertical Preliminary Control Settings, then proceed with the following instructions.

SETUP CONDITIONS

624 Controls
Y GAIN ..... Set to provide 8 divisions deflection with 1-volt input.



Ramp-Generator Controls
Ramp Signal ..... +50 μs Ramp
Triggering ..... +Auto, Internal

Sine-Wave Generator Controls
Output Frequency ..... 50 kHz

*For Option 26 Monitors: Remove the 50-ohm termination from the test setup.

a. Set the ramp generator amplitude for more than 10 divisions of horizontal deflection.

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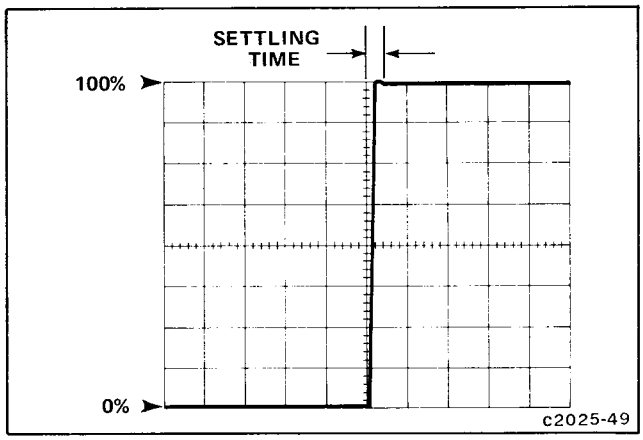


Figure 6-4. Typical crt display for vertical settling-time measurement.

b. Set the sine-wave generator amplitude for 6.4 divisions of vertical deflection.

c. Slowly increase the sine-wave generator output frequency until the display amplitude is 4.5 divisions.

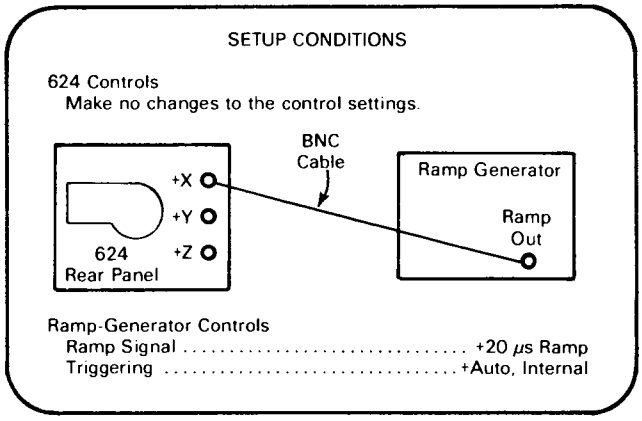
d. **CHECK**—That the sine-wave generator output frequency is at least 3 megahertz.

D6. CHECK VERTICAL POSITIONING

SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Vertical Preliminary Control Settings, then proceed with the following instructions.



a. **CHECK**—Rotate the Vertical Position control and check that the horizontal trace can be positioned vertically anywhere in the graticule area.

E. Z-AXIS AMPLIFIER

Equipment Required:

1. Function generator
2. Ramp generator
3. Sine-wave generator
4. Square-wave generator
5. Test oscilloscope
6. Dual-input coupler
7. 50-ohm cables (2 required)
8. 50-ohm termination (1 required)

BEFORE YOU BEGIN:

(1) Perform the Performance Check Power-Up Sequence.

(2) Refer to Section 7, Instrument Options, and the Change Information at the rear of this manual for any modifications which may affect this procedure.

(3) See the Test Point and Adjustment Locations foldout page, and the Internal Control and Selector Locations foldout page in Section 9, Diagrams and Circuit Board Illustrations.

Z-AXIS PRELIMINARY CONTROL SETTINGS:

Vertical and Horizontal Position ..... Midrange
INTENSITY ..... Visible display
FOCUS ..... Well-defined display

NOTE

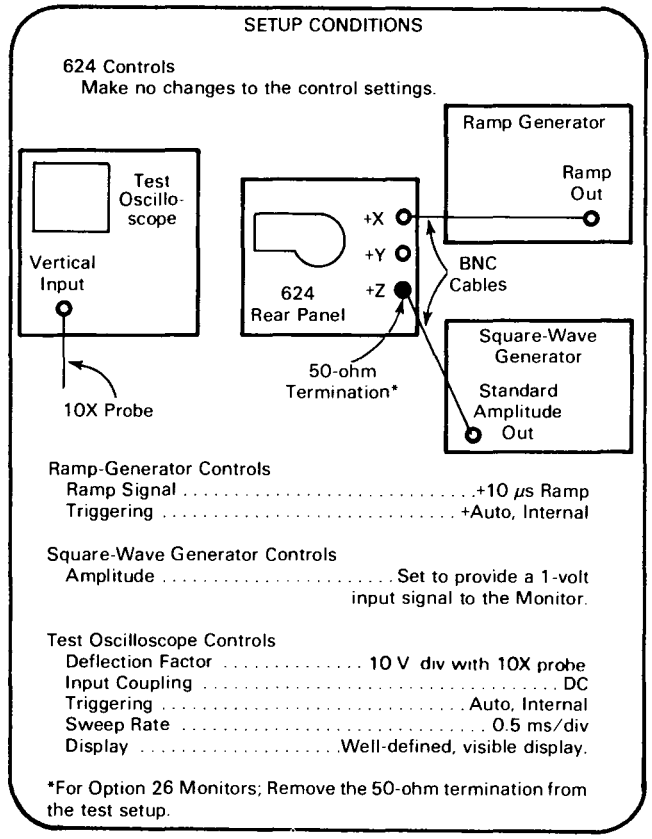
Always place terminations or grounding caps on all INPUTs to which signals are not applied.

E1. CHECK Z GAIN

SETUP CONDITIONS

NOTE

Z GAIN can be set to provide full intensity with any input signal voltage from +1 to +5 volts. However, when doing a complete Performance Check procedure the Z GAIN must be set to provide full intensity with a 1-volt input signal. See step E1. CHECK/ADJUST Z GAIN (R525) in Part II—Calibration for the procedure to set the Z GAIN. For a partial Performance Check procedure, first perform the Z-Axis Preliminary Control Settings, then proceed with the following instructions.



a. Set the square-wave generator amplitude for a 1-volt input signal to the Monitor.

b. Connect a 10X probe from the test oscilloscope vertical input to TP590. Set the 624 INTENSITY control for a 10-volt base level of the square wave displayed on the test oscilloscope.

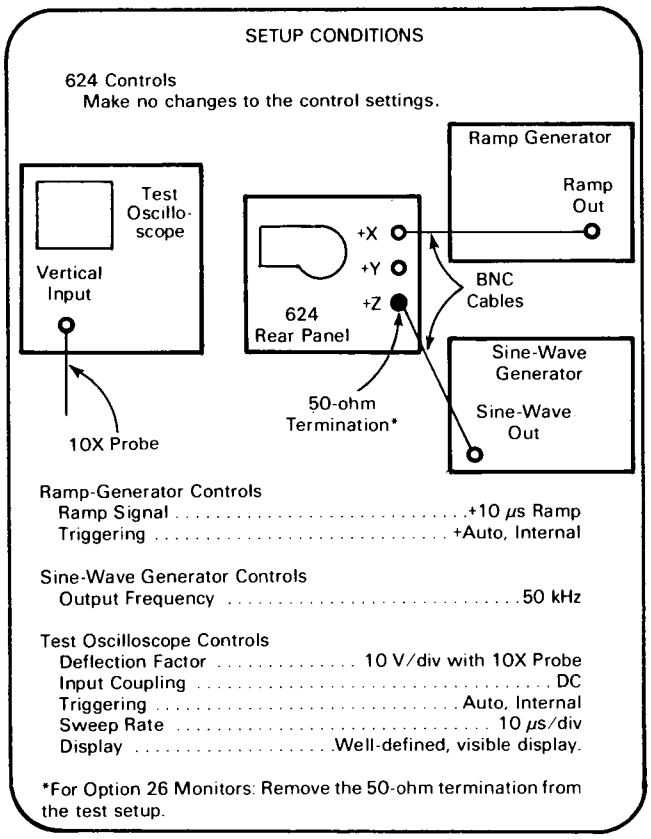
c. **CHECK**—That the amplitude of the square wave displayed on the test oscilloscope is at least 60 volts. (Position as necessary.)

E2. CHECK Z-AXIS AMPLIFIER BANDWIDTH

SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Z-Axis Preliminary Control Settings, then proceed with the following instructions.



a. Connect a 10X probe from the test oscilloscope vertical input to TP590.

b. Set the 624 INTENSITY control and the sine-wave generator amplitude for a 6-division (from 10 V dc to 70 V dc) display on the test oscilloscope. (Make sure that no clipping occurs on the test oscilloscope display.)

c. Slowly increase the sine-wave generator output frequency until the display amplitude is 4.2 divisions on the test oscilloscope.

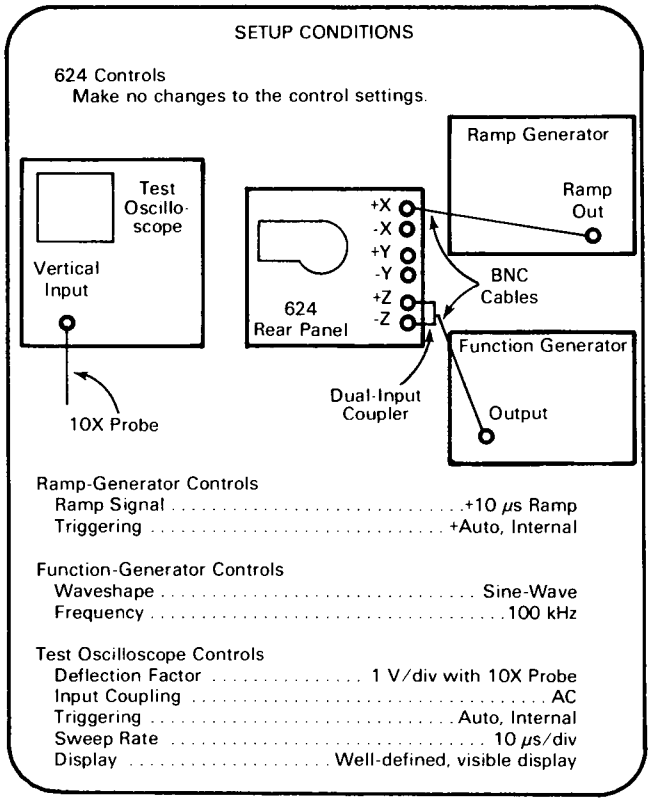
d. **CHECK**—That the sine-wave generator output frequency is at least 5 megahertz.

E3. CHECK OPTION 21 Z-AXIS COMMON-MODE REJECTION

SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Z-Axis Preliminary Control Settings, then proceed with the following instructions.



a. Set the function generator amplitude for a 5-volt input signal to the Monitor.

b. Connect a 10X probe from the test oscilloscope vertical input to TP590.

c. **CHECK**—The test oscilloscope display for 7 divisions (7 volts) or less.

d. Set the function generator output frequency to 1 megahertz and the test oscilloscope vertical deflection factor to 2 V/div (with 10X probe).

e. **CHECK**—The test oscilloscope display for 7 divisions (14 volts) or less.

E4. CHECK OPTION 25 Z-AXIS UNBLANKING

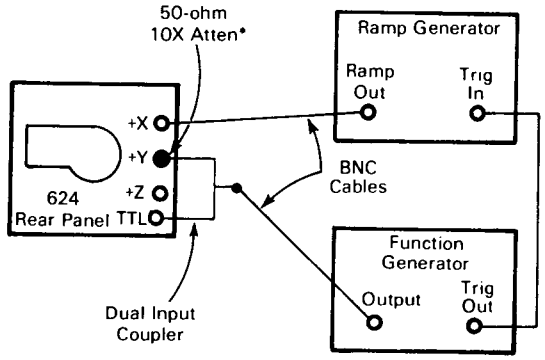
SETUP CONDITIONS

NOTE

For a partial procedure, Control Settings, then proceed with the following instructions.

SETUP CONDITIONS

624 Controls
INTENSITY ..... Visible display



Function-Generator Controls
Waveshape ..... Square-Wave
Frequency ..... 50 kHz
Amplitude ..... +2.5 V referenced to ground

Ramp-Generator Controls
Ramp Signal ..... +10 μs Ramp
Triggering ..... +Auto, External

*For Option 26 Monitors: Remove the 50-ohm termination from the test setup.

a. **CHECK**—That the defocused dot periodically disappears.

b. Turn OFF the 624. Change the setting of P550 (Unblanking Level Selector) and turn ON the 624.

c. **CHECK**—That the defocused dot periodically disappears.

@

F. OPTION 4 SWEEP GENERATOR

Equipment Required:

1. Function generator
2. Time-mark generator
3. 50-ohm cable (1 required)
4. 50-ohm termination (1 required)

BEFORE YOU BEGIN:

(1) Perform the Performance Check Power-Up Sequence.

(2) Refer to Section 7, Instrument Options, and the Change Information at the rear of the manual for any modifications which may affect this procedure.

(3) See the Test point and Adjustment Locations foldout page, and the Internal Control and Selector Locations foldout page in Section 9, Diagrams and Circuit Board Illustrations.

OPTION 4 SWEEP PRELIMINARY CONTROL SETTINGS:

SEC/DIV (Option 4) ..... 1 μs/div
VARIABLE (Option 4) ..... Fully clockwise (calibrated)
INTENSITY ..... Visible display
FOCUS ..... Well-defined display
XY-YT (Option 4 Internal Selector) ..... YT (forward)
Trig Mode (Option 4 Internal Selector) ..... Auto (rear)

F1. CHECK SWEEP LENGTH

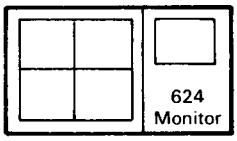
SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Option 4 Sweep Preliminary Control Settings, then proceed with the following instructions.

SETUP CONDITIONS

624 Controls
Make no changes to the control settings.



No external signals are connected to the 624 Monitor.

a. **CHECK**—That the sweep length is at least 10.5 divisions. (Position as necessary.)

F2. CHECK TRIGGER SLOPE/LEVEL

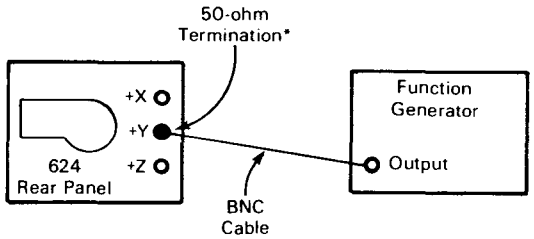
SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Option 4 Sweep Preliminary Control Settings, then proceed with the following instructions.

SETUP CONDITIONS

624 Controls
Make no changes to the control settings.



Function-Generator Controls
Waveshape ..... Sine-Wave
Frequency ..... 2 MHz

*For Option 26 Monitors: Remove the 50-ohm termination from the test setup.

a. Set the function generator amplitude for a 0.5-division display.

b. **CHECK**—For a stable display. (Rotate the TRIG SLOPE/LEVEL control as necesary.)

c. **CHECK**—That the display is free-running with the TRIG SLOPE/LEVEL control fully clockwise and fully counterclockwise.

d. Set the Trig Mode switch (S1140) to Norm.

e. **CHECK**—That the stable display is obtained by rotating the TRIG SLOPE/LEVEL control.

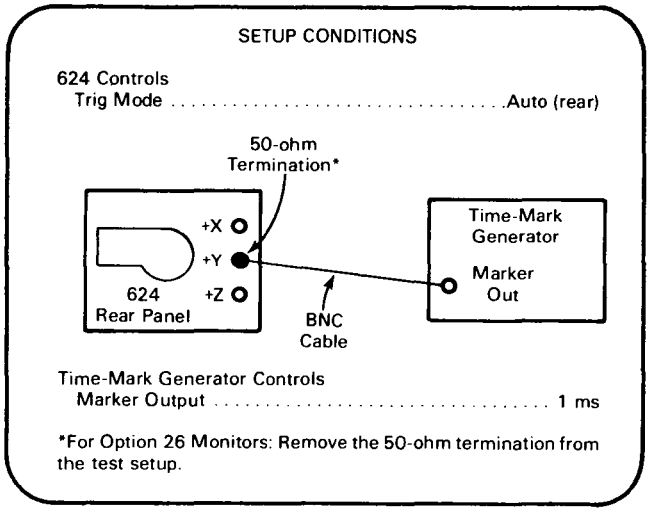
f. **CHECK**—For no display when the TRIG SLOPE/LEVEL control is set fully clockwise and fully counterclockwise.

F3. CHECK SWEEP TIMING

SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Option 4 Sweep Preliminary Control Settings, then proceed with the following instructions.



a. Set the time-mark generator amplitude for a 2- to 6-division display.

b. Position the first time marker to the left edge of the graticule.

c. **CHECK**—That the distance between the second and tenth time markers is 8 divisions, within 0.24 division (3%).

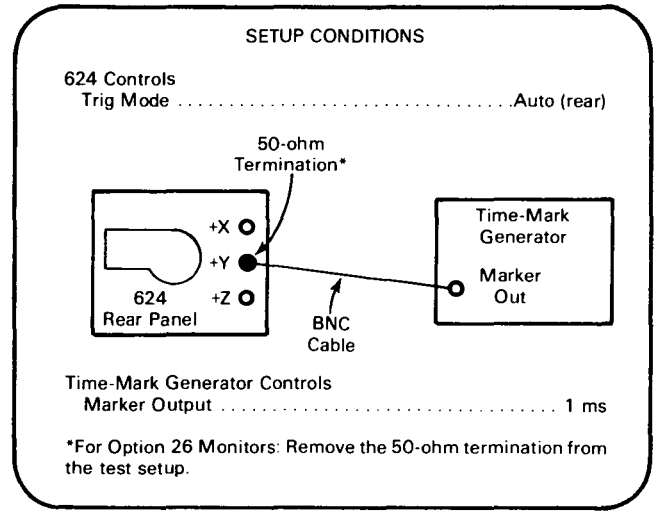
d. **CHECK**—Remaining positions of the SEC/DIV switch with time markers that correspond to each switch position. The distance between the second and tenth time markers at each SEC/DIV switch position should be 8 divisions, within 0.24 division (3%).

F4. CHECK SWEEP LINEARITY

SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Option 4 Sweep Preliminary Control Settings, then proceed with the following instructions.



a. Set the time-mark generator amplitude for a 2- to 6-division display.

b. Position the second time marker to the second vertical graticule line.

c. **CHECK**—That the distance between any 3 time marks, between the 2nd and 10th vertical graticule lines, is 2 divisions within 0.12 division (6%).

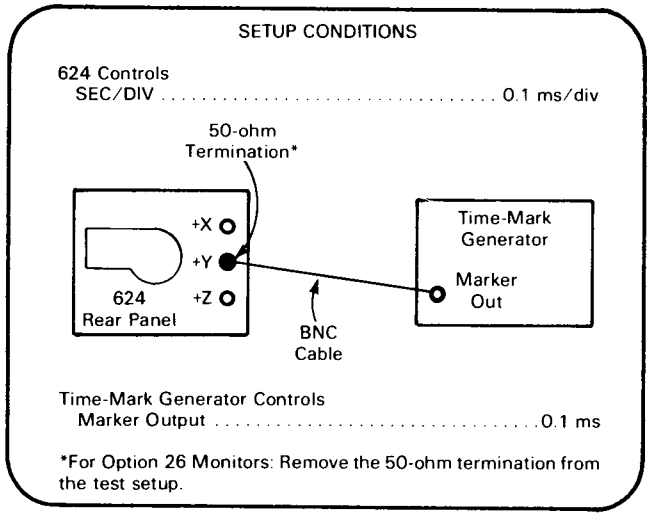
@

F5. CHECK VARIABLE TIME/DIVISION

SETUP CONDITIONS

NOTE

For a partial procedure first perform the Option 4 Sweep Preliminary Control Settings, then proceed with the following instructions.



a. Position the display for 1 time marker per division.

b. Set the VARIABLE control fully counterclockwise.

c. Set the SEC/DIV switch to 1 ms.

d. **CHECK**—For at least 1 time marker per division.

PART II — CALIBRATION

The following procedure returns the 624 Monitor to correct admustment and provides a complete sequential check of instrument performance concurrent with the adjustments. Although each step in this procedure can be performed independently, we recommend that the entire subsection (e.g., A. Power Supplies, B. Crt Circuit, etc.) be performed if any adjustments are made. See Preliminary Information, at the beginning of this section, for further information.

CALIBRATION PROCEDURE INDEX

CALIBRATION POWER-UP SEQUENCE

NOTE

The performance of this instrument can be checked at any ambient temperature from 0° to +50° C unless otherwise stated. Adjustments must be performed at an ambient temperature from +15° to +25° C for specified accuracies.

1. Check that the internal Line Voltage Selector plug has been set for the correct input line voltage (see Section 3, Installation).

NOTE

For Option 20 Monitors: Connect your instrument to the DC Power Supplies as shown in Figure 6-5.

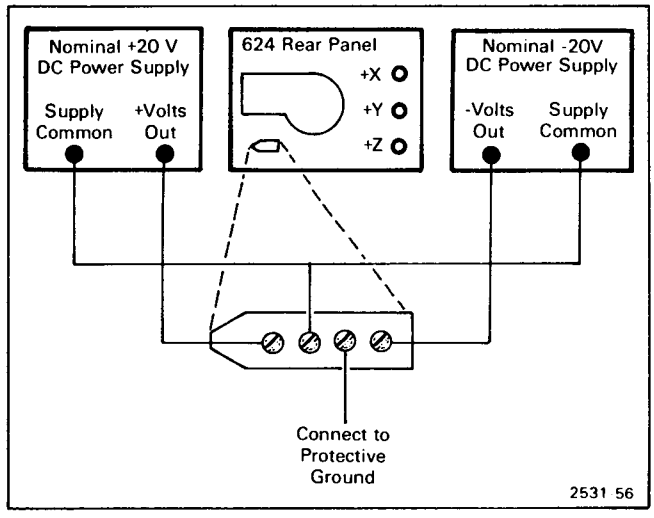


Figure 6-5. Proper application of power to the 624 Option 20 Monitor.

2. Check that the crt has an 8 X 10 division graticule over the display area.

3. Remove any cabinet panels to gain access to the internal controls and test points.

4. Check the crt cover on the rear panel to determine which Options have been installed in your Monitor.

5. Connect the power cord to a suitable line voltage source. Push in the ON/OFF pushbutton and allow at least 20 minutes warmup before proceeding.

CAUTION

Do not allow a high-intensity dot to remain stationary on the crt. The crt phosphor could be permanently damage.

A. POWER SUPPLY

Equipment Required:

1. Dc voltmeter
2. Precision dc voltmeter
3. Nominal +20 V DC power supply (Option 20 only)
4. Nominal -20 V DC power supply (Option 20 only)

BEFORE YOU BEGIN:

(1) Perform the Calibration Power-Up Sequence.

(2) Refer to Section 7, Instrument Options, and the Change Information at the rear of this manual for any modifications which may affect this procedure.

(3) See the Test Point and Adjustment Locations foldout page, and the Internal Control and Selector Locations foldout page in Section 9, Diagrams and Circuit Board Illustrations.

POWER SUPPLY PRELIMINARY CONTROL SETTINGS:

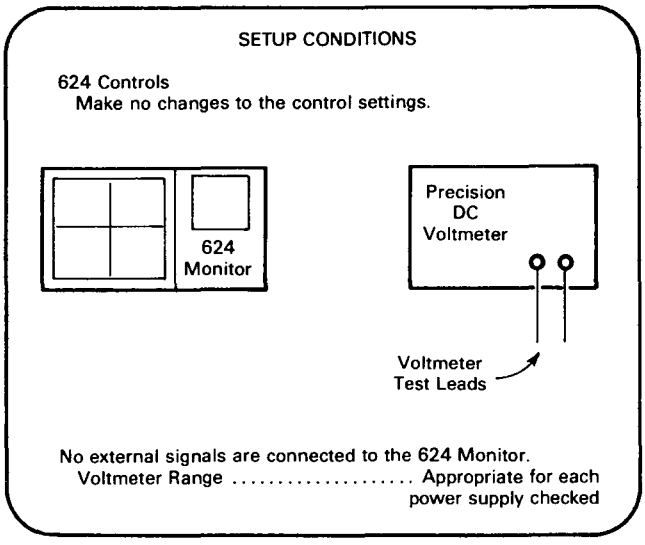
Vertical and Horizontal Position ..... Midrange
INTENSITY ..... Fully Counterclockwise

A1. ADJUST +15-VOLT SUPPLY (R958)

SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Power Supply Preliminary Control Settings, then proceed with the following instructions.



a. Table 6-4 lists the low-voltage supplies in this instrument. Connect the precision dc voltmeter between the appropriate test point and ground.

TABLE 6-4
Low-Voltage Supply Accuracy

Supply (dc)	Voltage Range
-15 V	-14.7 V to -15.3 V
+15 V	+14.96 V to +15.04 V
+100 V	+97 V to +103 V

b. **EXAMINE**—The voltmeter for a reading within the voltage range given in Table 6-4 for the appropriate supply.

c. **ADJUST**—R958 (+15 V Adj) for a voltmeter reading of +15.00 volts.

d. **INTERACTION**—If any of the low-voltage supplies in Table 6-4 are out of tolerance, re-examine the adjustment of the +15 Volt Supply in part b and the High-Voltage Supply in step A.

A2. ADJUST HIGH-VOLTAGE SUPPLY (R918)

WARNING

Turn off the instrument when connecting and disconnecting the dc voltmeter. Potentially dangerous voltage exists at several points on the High-Voltage Power Supply board and crt socket.

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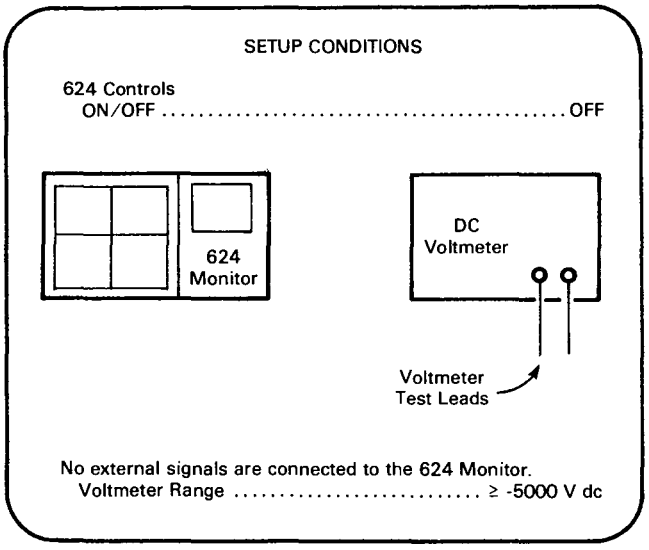
SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Power Supply Preliminary Control Settings, then proceed with the following instructions.



a. Remove the rear crt cover (5 screws) from the rear panel. Then remove the crt socket cover.

b. Connect the dc voltmeter (set for at least -5000 dc volts full scale) between pin 2 of the crt socket (second pin clockwise from the socket index) and ground.

c. Push in the front-panel ON/OFF pushbutton.

d. **EXAMINE**—The voltmeter for a reading between --3564 volts and -3636 volts.

e. **ADJUST**—R918 (HV Adj) for exactly -3500 volts.

f. Turn off the instrument and disconnect the voltmeter. Replace the crt socket cover and the rear crt cover.

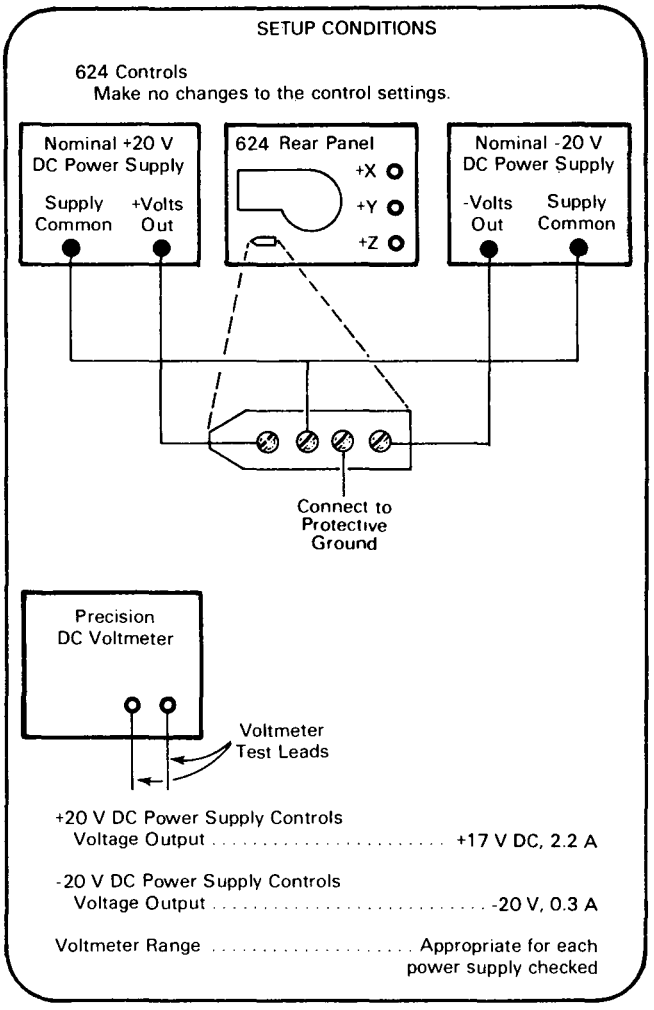
g. **INTERACTION**—Readjustment of R918 (HV Adj) and R958 (+15 V Adj) may be necessary to bring all power supplies within their specified tolerances. The setting of R918 affects both the High-Voltage Supply and the +100 Volt Supply; the setting of R958 affects both the +15 Volt Supply and the -15 Volt Supply. Repeating step A1 is necessary if R918 is readjusted.

A3. CHECK OPTION 20 REGULATION AND SHUTDOWN THRESHOLD

SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Power Supply Preliminary Control Settings, then proceed with the following instructions.



a. Turn ON the 624 Monitor.

b. Table 6-4 lists the low-voltage supplies in this instrument. Connect the precision dc voltmeter between the appropriate test point and ground.

c. **CHECK**—The voltmeter for a reading within the voltage range given in Table 6-4 for the appropriate supply.

d. Set the +20 V dc power supply output voltage for +26 volts.

e. **CHECK**—The voltmeter for a reading within the voltage range given in Table 6-4 for the appropriate supply.

f. Set the +20 V dc power supply output voltage for +20 volts. Set the -20 V dc power supply output voltage for -17 volts.

g. **CHECK**—The voltmeter for a reading within the voltage range given in Table 6-4 for the appropriate supply.

h. Set the -20 V dc power supply voltage for -26 volts.

i. **CHECK**—The voltmeter for a reading within the voltage range given in Table 6-4 for the appropriate supply.

j. Connect the precision dc voltmeter between the +15 V test point and ground.

k. **CHECK**—That the Monitor will shutdown, producing a voltmeter reading of 0 volts, as the -20 V dc power supply output voltage is increased from -26 volts to no greater than -29.5 volts.

l. Set the -20 V dc power supply output voltage to -20 volts.

m. **CHECK**—That the Monitor will shutdown, producing a voltmeter reading of 0 volts, as the +20 V dc power supply output voltage is increased from +26 volts to no greater than +29.5 volts.

n. Return the +20 V dc power supply output voltage to +20 volts.

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B. CRT CIRCUIT

Equipment Required:

1. Precision dc voltmeter
2. Ramp generator
3. 50-ohm cable (1 required)

BEFORE YOU BEGIN:

(1) Perform the Calibration Power-Up Sequence.

(2) Refer to Section 7, Instrument Options, and the Change Information at the rear of this manual for any modifications which may affect this procedure.

(3) See the Test Point and Adjustment Locations foldout page, and the Internal Control and Selector Locations foldout page in Section 9, Diagrams and Circuit Board Illustrations.

CRT CIRCUIT PRELIMINARY CONTROL SETTINGS:

CAUTION

Do not allow a high-intensity dot to remain stationary on the crt. The crt phosphor could be permanently damaged.

Vertical and Horizontal Position ..... Midrange
INTENSITY ..... Visible display
FOCUS ..... Well-defined display
XY-YT (Option 4 Internal Selector ..... XY (rear)
+X Atten (Option 22 Internal Selector) ..... 1X (up)
-X Atten (Option 22 Internal Selector) ..... 1X (up)

NOTE

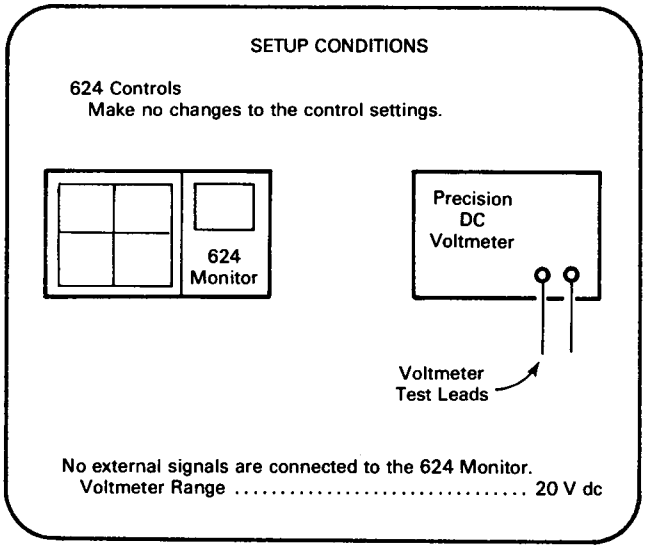
Always place terminations or grounding caps on all INPUTs to which signals are not applied.

B1. ADJUST CRT BIAS (R862)

SETUP CONDITIONS

NOTE

For a partial procedure, first perform the CRT Circuit Preliminary Control Settings, then proceed with the following instructions.



a. Position the sharply-focused dot near graticule center.

b. Connect the precision dc voltmeter between TP590 and ground.

c. Slowly set the INTENSITY control for a voltmeter reading of about 10 volts dc. Disconnect the precision dc voltmeter.

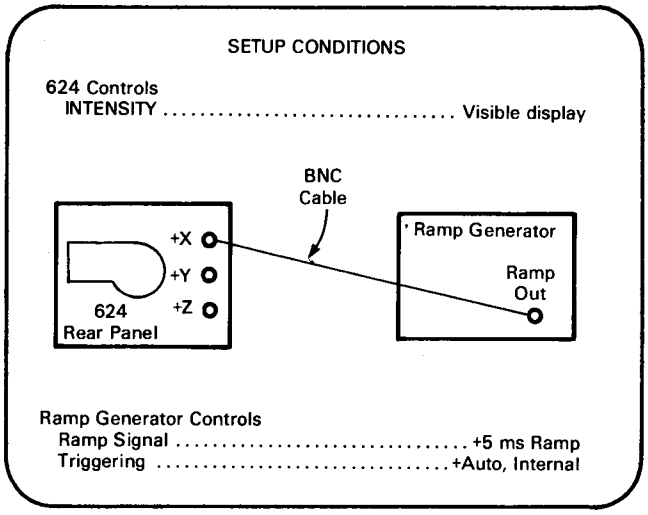
d. **ADJUST**—R862 (CRT Bias) until the dot just appears.

B2. ADJUST TRACE ROTATION (R949)

SETUP CONDITIONS

NOTE

For a partial procedure, first perform the CRT Circuit Preliminary Control Settings, then proceed with the following instructions.



a. Set the ramp-generator amplitude for a 10-division horizontal trace on the crt.

b. Vertically position the trace to the center horizontal graticule line.

c. **EXAMINE**—The trace for alignment with the center horizontal graticule line.

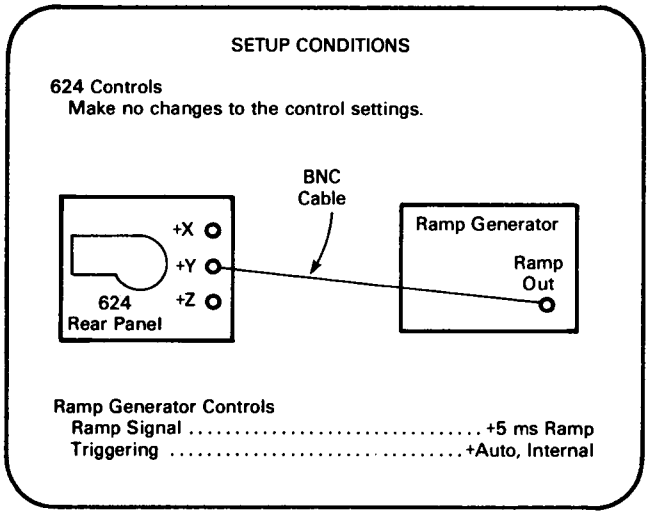
d. **ADJUST**—R949 (rear-panel TRACE ROTATION) to align the trace with the center horizontal graticule line.

B3. CHECK ORTHOGONALITY

SETUP CONDITIONS

NOTE

For a partial procedure, first perform the CRT Circuit Preliminary Control Settings, then proceed with the following instructions.



a. Horizontally position the start of the trace to the center vertical graticule line.

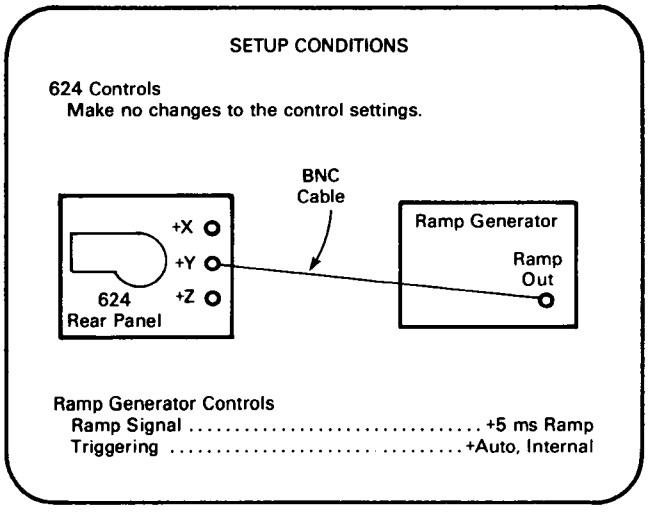
b. **CHECK**—That the vertical trace is aligned with the center vertical graticule line at the top and bottom of the graticule, within 0.1 division.

B4. CHECK/ADJUST GEOMETRY (R943)

SETUP CONDITIONS

NOTE

For a partial procedure, first perform the CRT Circuit Preliminary Control Settings, then proceed with the following instructions.



a. Position the vertical trace to the left edge of the graticule and then to the right.

b. **CHECK**—Vertical trace for 0.1 division or less of bowing or tilt at the left and right edge of the graticule.

c. **ADJUST**—R943 (Geometry) for a minimum bowing or tilt of the vertical trace at the left and right edges of the graticule.

d. Disconnect the ramp generator from the +Y INPUT and connect it to the +X INPUT. Horizontally center the display on the graticule.

e. Position the horizontal trace to the top edge of the graticule and then to the bottom edge.

f. **CHECK**—Horizontal trace for 0.1 division or less of bowing or tilt at the top and bottom of the graticule.

g. **INTERACTION**—If necessary, readjust R943 (Geometry) for minimum bowing or tilt at the top and bottom of the graticule. Then, repeat step B3. Check Orthogonality, and B4 Check/Adjust Geometry (R943) until optimum geometry is achieved.

B5. ADJUST ASTIGMATISM (R841)

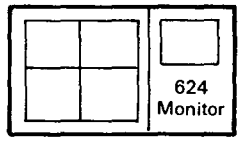
SETUP CONDITIONS

NOTE

For a partial procedure, first perform the CRT Circuit Preliminary Control Settings, then proceed with the following instructions.

SETUP CONDITIONS

624 Controls
FOCUS ..... Fully counterclockwise



No external signals are connected to the Monitor.

a. Position the dot display near graticule center.

b. **EXAMINE**—The dot display for a defocused, round dot.

c. **ADJUST**—R841 (front-panel ASTIG) for a symmetrically round dot.

C. HORIZONTAL (X) AMPLIFIER

Equipment Required:

1. Function generator
2. Ramp generator
3. Sine-wave generator
4. Square-wave generator
5. Dual-input coupler
6. 50-ohm cables (4 required)
7. 50-ohm terminations (2 required)

BEFORE YOU BEGIN:

(1) Perform the Calibration Power-Up Sequence.

(2) Refer to Section 7, Instrument Options, and the Change Information at the rear of this manual for any modifications which may affect this procedure.

(3) See the Test Point and Adjustment Locations foldout page, and the Internal Control and Selector Locations foldout page in Section 9, Diagrams and Circuit board Illustrations.

HORIZONTAL PRELIMINARY CONTROL SETTINGS:

Vertical and Horizontal Position ..... Midrange
INTENSITY ..... Visible display
X GAIN ..... Midrange
FOCUS ..... Well-defined display
XY-YT (Option 4 Internal Selector) ..... XY (rear)
+X Atten (Option 22 Internal Selector) ..... 1X (up)
-X Atten (Option 22 Internal Selector) ..... 1X (up)

NOTE

Always place terminations or grounding caps on all INPUTs to which signals are not applied.

C1. ADJUST OPTION 22 X ATTENUATION COMPENSATION (C310 and C410)

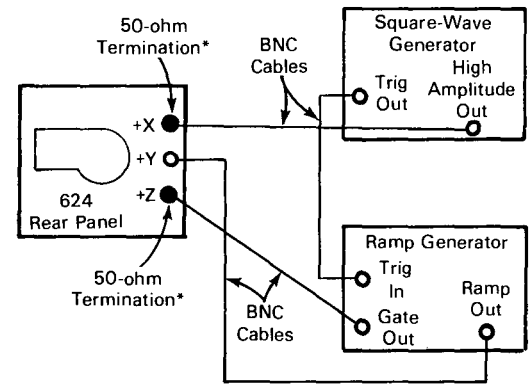
SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Horizontal Preliminary Control Settings, then proceed with the following instructions.

SETUP CONDITIONS

624 Controls
+X Atten ..... 5X (down)
-X Atten ..... 5X (down)



Square-Wave Generator Controls
Pulse Duration ..... 1 ms (1 kHz)

Ramp-Generator Controls
Ramp Signal ..... +1 ms Ramp
Triggering ..... +Auto, External

*For Option 26 Monitors: Remove the 50-ohm termination from the test setup.

a. Set the ramp-generator frequency and amplitude controls to display about 3 cycles of square-wave display over 8 divisions. (Position as necessary.)

b. Set the square-wave generator amplitude and 624 X GAIN for an 8-division horizontal display. (Position as necessary.)

c. **EXAMINE**—The display for a fast rising edge without overshoot.

d. **ADJUST**—C310 (+X Atten Comp), using a low-capacitance screwdriver, for optimum square corner.

NOTE

Perform the remaining parts of this step only if your instrument is equipped with both Option 21 and Option 22.

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e. Disconnect the square-wave generator signal from the +X INPUT and connect it to the -X INPUT. Place the grounding cap on the +X INPUT.

f. **EXAMINE**—The display for a fast rising edge without overshoot. (Position as necessary.)

g. **ADJUST**—C410 (-X Atten Comp), using a low-capacitance screwdriver, for optimum square corner.

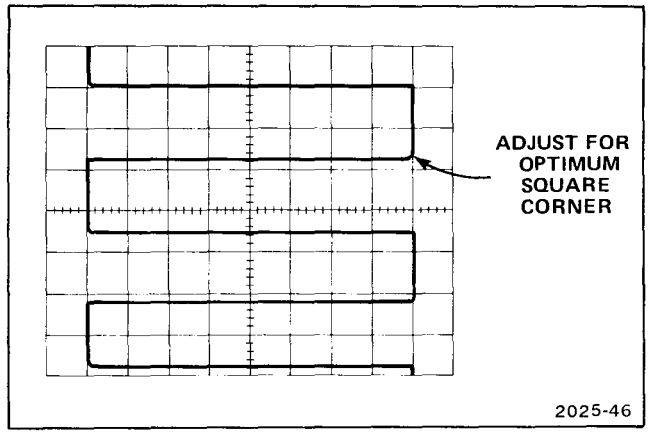


Figure 6-6. Typical crt display for adjustment of horizontal (X) compensation.

C2. ADJUST HORIZONTAL (X) COMPENSATION (C353)

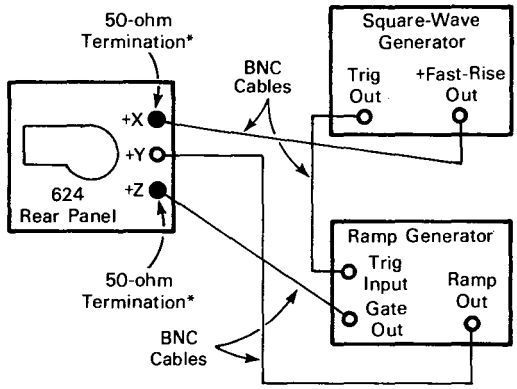
SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Horizontal Preliminary Control Settings, then proceed with the following instructions.

SETUP CONDITIONS

624 Controls
X GAIN ..... Fully clockwise
+X Atten (Option 22) ..... 1X (up)
-X Atten (Option 22) ..... 1X (up)



Square-Wave Generator Controls
Pulse Duration ..... 10 μs (100 kHz)

Ramp Generator Controls
Ramp Signal ..... +20 μs Ramp
Triggering ..... +Auto, External

*For Option 26 Monitors: Remove the 50-ohm termination from the test setup.

a. Set the ramp-generator amplitude control for just over 8 divisions of vertical deflection. (Position as necessary.)

b. Set the square-wave generator amplitude for an 8-division display. (Position as necessary.)

c. **EXAMINE**—The display for optimum rising edge and square corner.

d. **ADJUST**—C353 (HF Adj), using a low-capacitance screwdriver, for a fast rising edge without overshoot. (See Fig. 6-6.)

e. **INTERACTION**—Changing the adjustment of C353 may affect the checks in steps C5 and C6.

C3. CHECK/ADJUST X GAIN (R325)

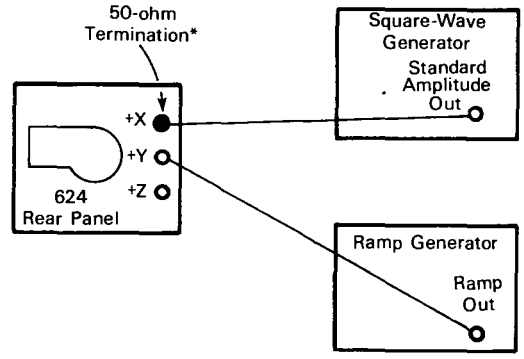
SETUP CONDITIONS

NOTE

The X GAIN (R325) in this procedure is set to provide 8 divisions of horizontal deflection from a 1-volt input signal. This procedure can be altered for any voltage, from +0.5 to +2.5 volts for 10 divisions, to obtain the desired sensitivity. However, when doing a complete Calibration procedure the X GAIN must be set as specified in the following procedure. For a partial procedure, first perform the Horizontal Preliminary Control Settings, then proceed with the following instructions.

SETUP CONDITIONS

624 Controls
Make no changes to the control settings.



Square-Wave Generator Controls
Amplitude ..... Set to provide a 1-volt input signal to the Monitor

Ramp-Generator Controls
Ramp Signal ..... +20 μs Ramp
Triggering ..... +Auto, Internal

*For Option 26 Monitors: Remove the 50-ohm termination from the test setup.

a. **CHECK**—The crt for a horizontal display of 8 divisions, within 2%. (Position as necessary.)

b. **ADJUST**—R325 (X GAIN) for an 8-division horizontal display.

C4. CHECK OPTION 21 HORIZONTAL COMMON-MODE REJECTION

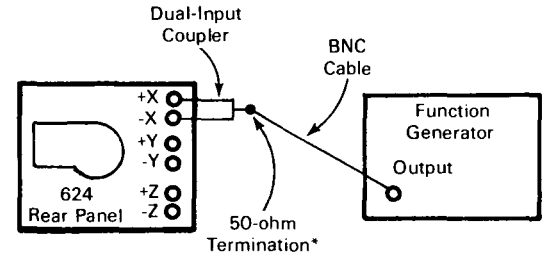
SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Horizontal Preliminary Control Settings, then proceed with the following intructions.

SETUP CONDITIONS

624 Controls
X GAIN ..... Set to provide 8 divisions deflection with 1-volt input.



Function Generator Controls
Waveshape ..... Sine-Wave
Frequency ..... 100 kHz

*For Option 26 Monitors: Remove the 50-ohm termination from the test setup.

a. Set the function generator amplitude for a 10-volt (peak-to-peak) input signal to the Monitor.

b. **CHECK**—Crt display for 0.8 division, or less, of free-running horizontal display. (Position as necessary.)

c. Set the output frequency of the function generator to 1 megahertz.

d. **CHECK**—Crt display for 1.6 divisions, or less, of free-running horizontal display. (Position as necessary.)

NOTE

Perform the remaining parts of this step only if your instrument is equipped with both Option 21 and Option 22.

e. Turn OFF power to the 624. Then, set S310 (+X Atten) and S410 (-X Atten) to the 5X (down) position. Press front-panel ON/OFF pushbutton to apply power to the 624.

f. Set the function generator amplitude for a 20-volt (peak-to-peak) input signal to the Monitor.

g. **CHECK**—Crt display for 0.3 division, or less, of free-running horizontal display. (Position as necessary.)

h. Set the function generator output frequency to 100 kHz.

i. **CHECK**—Crt display for 0.8 division, or less, of free-running horizontal display. (Position as necessary.)

@

C5. CHECK HORIZONTAL SETTLING TIME

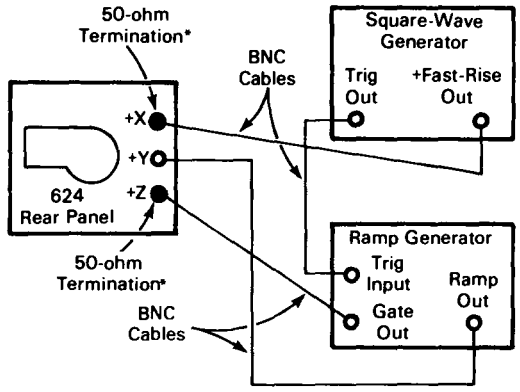
SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Horizontal Preliminary Control Settings, then proceed with the following instructions.

SETUP CONDITIONS

624 Controls
X GAIN ..... Set to provide 8 divisions deflection with 1-volt input.
+X Atten (Option 22) ..... 1X (up)
-X Atten (Option 22) ..... 1X (up)



Square-Wave Generator Controls
Pulse Duration ..... 10 μs (100 kHz)

Ramp-Generator Controls
Ramp Signal ..... +20 μs Ramp
Triggering ..... +Auto, External

*For Option 26 Monitors: Remove to 50-ohm termination from the test setup.

a. Set the ramp-generator amplitude for exactly 8 divisions of vertical display. (Position as necessary.)

b. Set the square-wave generator amplitude for 8 divisions of horizontal display, and set the repetition rate to display approximately 1 cycle.

c. **CHECK**—That the time required for the leading edge of the square wave to travel from the zero percent level (see Fig. 6-7) to within 0.50 millimeters (about one trace width) of the 100 percent level is 500 nanoseconds (0.625 division) or less.

d. **INTERACTION**—If the check requirements in part c cannot be met, repeat step C2.

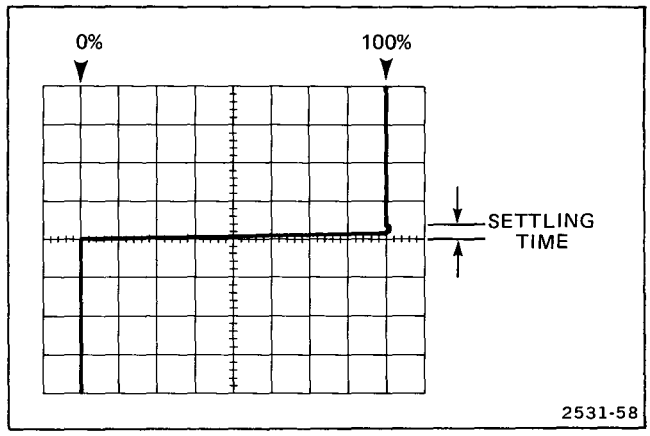


Figure 6-7. Typical crt display for horizontal settling-time measurement.

C6. CHECK HORIZONTAL BANDWIDTH

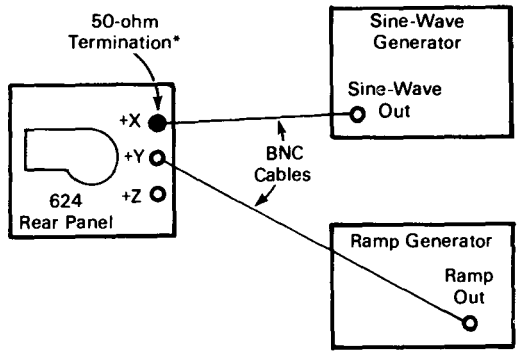
SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Horizontal Preliminary Control Settings, then proceed with the following instructions.

SETUP CONDITIONS

624 Controls
X GAIN ..... Set to provide 8 divisions deflection with 1-volt input.



Sine-Wave Generator Controls
Output Frequency ..... 50 kHz Sinewave

Ramp-Generator Controls
Ramp Signal ..... +50 μs Ramp
Triggering ..... +Auto, Internal

a. Set the ramp-generator amplitude for more than 8 divisions of vertical deflection.

b. Set the sine-wave generator amplitude for 8 divisions of horizontal deflection.

c. Slowly increase the sine-wave generator output frequency until the display's horizontal amplitude is 5.7 divisions.

d. **CHECK**—That the sine-wave generator output frequency is at least 3 megahertz.

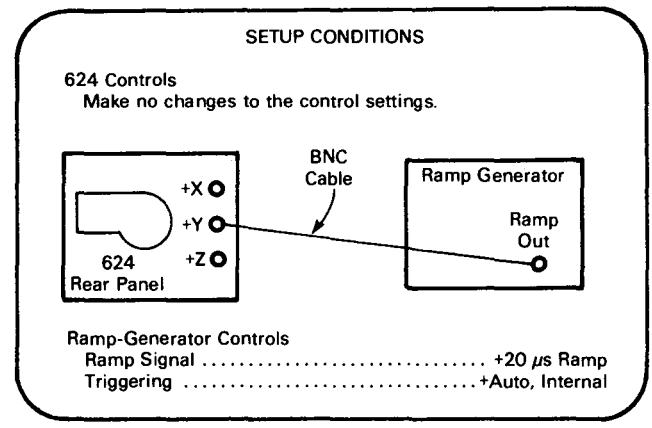
e. **INTERACTION**—If the check requirement in part d cannot be met, repeat step C2.

C7. CHECK HORIZONTAL POSITIONING

SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Horizontal Preliminary Control Settings, then proceed with the following instructions.



a. **CHECK**—Rotate the Horizontal Position Control and check that the vertical trace can be positioned horizontally anywhere in the graticule area.

D. VERTICAL (Y) AMPLIFIER

Equipment Required:

1. Function generator
2. Ramp generator
3. Sine-wave generator
4. Square-wave generator
5. Dual-input coupler
6. 50-ohm cables (4 required)
7. 50-ohm termination (2 required)

BEFORE YOU BEGIN:

(1) Perform the Calibration Power-Up Sequence.

(2) Refer to Section 7, Instrument Options, and the Change Information at the rear of this manual for any modifications which may affect this procedure.

(3) See the Test Point and Adjustment Locations foldout page, and the Internal Control and Selector Locations foldout page in Section 9, Diagrams and Circuit Board Illustrations.

VERTICAL PRELIMINARY CONTROL SETTINGS:

Vertical and Horizontal Position ..... Midrange
Y GAIN ..... Midrange
INTENSITY ..... Visible display
FOCUS ..... Well-defined display
XY-YT (Option 4 Internal Selector) ..... XY (rear)
+Y Atten (Option 22 Internal Selector) ..... 1X (up)
-Y Atten (Option 22 Internal Selector) ..... 1X (up)

NOTE

Always place terminations or grounding caps on all INPUTs to which signals are not applied.

D1. ADJUST OPTION 22 Y ATTENUATION COMPENSATION (C110 and C210)

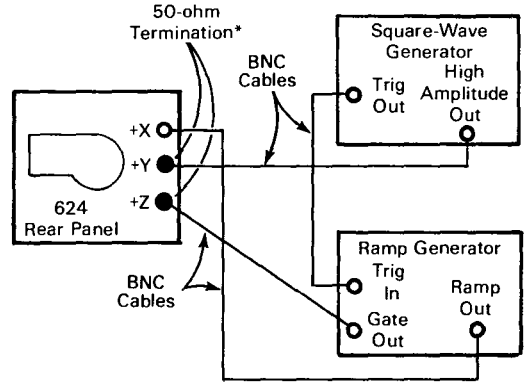
SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Vertical Preliminary Control Settings, then proceed with the following instructions.

SETUP CONDITIONS

624 Controls
+Y Atten ..... 5X (down)
-Y Atten ..... 5X (down)



Square-Wave Generator Controls
Pulse Duration ..... 1 ms (1 kHz)

Ramp Generator Controls
Ramp Signal ..... +1 ms Ramp
Triggering ..... +Auto, External

*For Option 26 Monitors: Remove the 50-ohm termination from the test setup.

a. Set the ramp-generator frequency and amplitude controls to display about 3 cycles of square-wave over 8 divisions. (Position as necessary.)

b. Set the square-wave generator amplitude and 624 Y GAIN for an 8-division vertical display. (Position as necessary.)

c. **EXAMINE**—The display for a fast rising edge without overshoot.

d. **ADJUST**—C110 (+Y Atten Comp), using a low-capacitance screwdriver, for optimum square corner.

NOTE

Perform the remaining parts of this step only if your instrument is equipped with both Option 21 and Option 22.

e. Disconnect the square-wave generator signal from the +Y INPUT and connect it to the -Y INPUT. Place the grounding cap on the +Y INPUT.

f. **EXAMINE**—The display for a fast rising edge without overshoot. (Position as necessary.)

g. **ADJUST**—C210 (-Y Atten Comp), using a low-capacitance screwdriver, for optimum square corner.

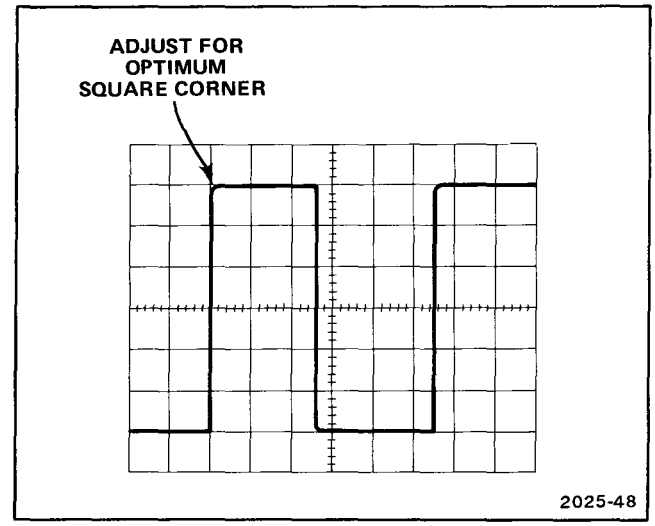


Figure 6-8. Typical crt display for adjutment of vertical (Y) compensation.

D2. ADJUST VERTICAL (Y) COMPENSATION (C153)

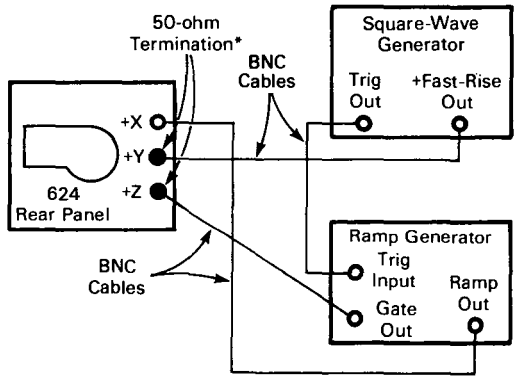
SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Vertical Preliminary Control Settings, then proceed with the folowing instrutions.

SETUP CONDITIONS

624 Controls
Y GAIN ..... Fully Clockwise
+Y Atten (Option 22) ..... 1X (up)
-Y Atten (Option 22) ..... 1X (up)



Square-Wave Generator Controls
Pulse Duration ..... 10 μs (100 kHz)

Ramp-Generator Controls
Ramp Signal ..... +20 μs Ramp
Triggering ..... +Auto, External

*For Option 26 Monitor: Remove the 50-ohm termination from the test setup.

a. Set the ramp-generator amplitude control for just over 10 divisions of horizontal deflection. (Position as necessary.)

b. Set the square-wave generator amplitude for a 6-division vertical display. (Position as necessary.)

c. **EXAMINE**—The display for optimum rising edge and square wave.

d. **ADJUST**—C153 (HF Adj), using a low-capacitance screwdriver, for a fast rising edge without overshoot. (See Fig. 6-8).

D3. CHECK/ADJUST Y GAIN (R125)

SETUP CONDITIONS

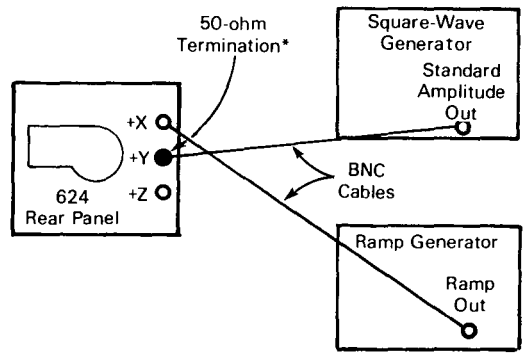
NOTE

The Y GAIN (R125) in this procedure is set to provide 8 divisions of deflection from a 1-volt input signal. This procedure can be altered for any voltage, from +0.5 to +2.5 volts, for the desired sensitivity. However, when doing a complete Calibration procedure the Y GAIN must be set as specified in the following procedure. For a partial procedure, first perform the Vertical Preliminary Control Settings, then proceed with the following instructions.

@

SETUP CONDITIONS

624 Controls
Make no changes to the control settings.



Square-Wave Generator Controls
Amplitude ..... Set to provide a 1-volt input signal to the Monitor.

Ramp-Generator Controls
Ramp Signal ..... +20 μs Ramp
Triggering ..... +Auto, Internal

*For Option 26 Monitors: Remove the 50-ohm termination from the test setup.

a. **CHECK**—The crt for a vertical display of 8 divisions, within 2%. (Position as necessary.)

b. **ADJUST**—R125 (Y GAIN) for an 8-division vertical display.

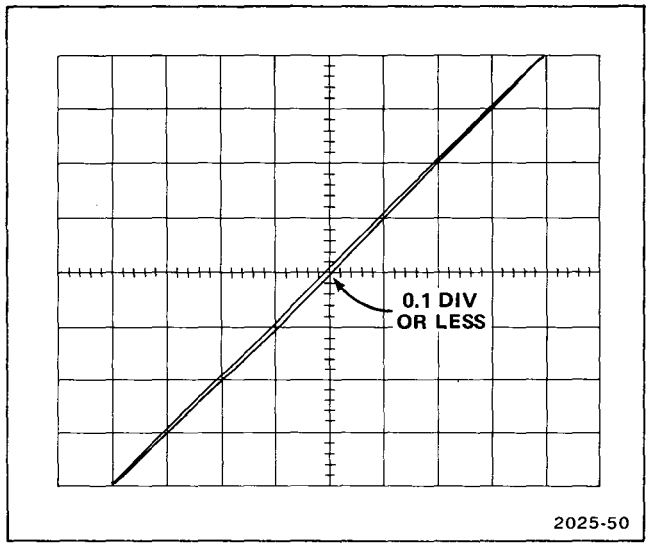


Figure 6-9. Typical horizontal and vertical phase difference display.

D4. CHECK/ADJUST PHASING (C122 and C138)

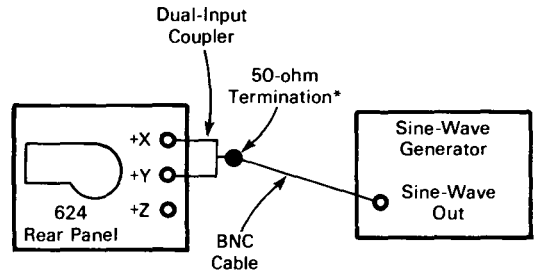
SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Vertical Preliminary Control Settings, then proceed with the following instructions.

SETUP CONDITIONS

624 Controls
X GAIN and Y GAIN ..... Set to provide 8 divisions deflection with 1-volt input.



Sine-Wave Generator Controls
Output Frequency ..... 1 MHz

*For Option 26 Monitors: Remove the 50-ohm termination from the test setup.

a. Set the sine-wave generator amplitude to provide a 1-volt input signal to the Monitor.

b. Position the display as shown in Figure 6-9.

c. **CHECK**—That the diameter of the displayed ellipse, measured vertically at the center of the graticule, is 0.1 division or less (see Fig. 6-9.)

d. **ADJUST**—C138 (Phasing) and C122 (High-Gain Phasing). With X GAIN and Y GAIN controls set for 8 divisions with a +2.5 volt input, and using a low-capacitance screwdriver, adjust C138 to close the phasing loop. Then, with X GAIN and Y GAIN set for 8 divisions with a +0.5 volt input, adjust C122 to close the phasing loop.

e. Reset X GAIN and Y GAIN to provide 8 divisions of deflection from a 1-volt input signal. See steps C3 and D3.

f. **INTERACTION**—Changing the adjustment of C122 or C138 may affect step D2.

D5. CHECK OPTION 21 VERTICAL COMMON-MODE REJECTION

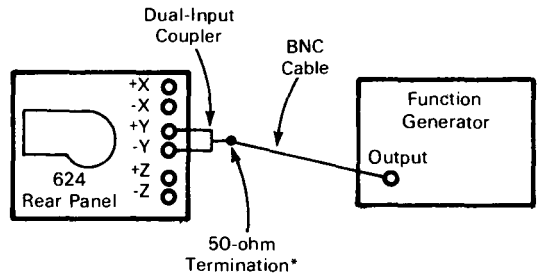
SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Vertical Preliminary Control Settings, then proceed with the following instruction.

SETUP CONDITIONS

624 Controls
Y GAIN ..... Set to provide 8 divisions deflection with 1-volt input.



Function Generator Controls
Waveshape ..... Sine-Wave
Frequency ..... 100 kHz

*For Option 26 Monitors: Remove the 50-ohm termination from the test setup.

a. Set the function generator amplitude for a 10-volt (peak-to-peak) input signal to the Monitor.

b. **CHECK**—Crt display for 0.8 division, or less, of free-running vertical display. (Position as necessary.)

c. Set the output frequency of the function generator to 1 megahertz.

d. **CHECK**—Crt display for 1.6 divisions, or less, of free-running vertical display. (Position as necessary.)

NOTE

Perform the remaining parts of this step only if your instrument is equipped with both Option 21 and Option 22.

e. Turn OFF power to the 624. Then, set S110 (+Y Atten) and S210 (-Y Atten) to the 5X (down) position. Press front-panel ON/OFF pushbutton to apply power to the 624.

f. Set the function generator amplitude for a 20-volt (peak-to-peak) input signal to the Monitor.

g. **CHECK**—Crt display for 0.3 division, or less, of free-running vertical display. (Position as necessary.)

h. Set the function generator output frequency to 100 kHz.

i. **CHECK**—Crt display for 0.8 division, or less, of free-running vertical display. (Position as necessary.)

D6. CHECK VERTICAL SETTLING TIME

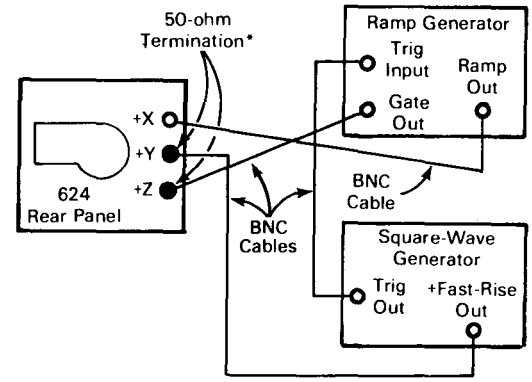
SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Vertical Preliminary Control Settings, then proceed with the following instructions.

SETUP CONDITIONS

624 Controls
+Y Atten (Option 22) ..... 1X (up)
-Y Atten (Option 22) ..... 1X (up)
Y GAIN ..... Set to provide 8 divisions deflection with 1-volt input.



Ramp-Generator Controls
Ramp Signal ..... +10 μs Ramp
Triggering ..... +Auto, External

Square-Wave Generator
Pulse Duration ..... 10 μs (100 kHz)

*For Option 26 Monitors: Remove the 50-ohm termination from the test setup.

a. Set the ramp-generator amplitude for exactly 10 divisions of trace length. (Position as necessary.)

b. Set the square-wave generator amplitude for 8 divisions of vertical display and set the repetition rate to display approximately 1 cycle.

c. **CHECK**—That the time required for the leading edge of the square wave to travel from the zero percent level (see Fig. 6-10) to within 0.50 millimeters (about one trace width) of the 100 percent level is 500 nanoseconds (0.50 division) or less.

d. **INTERACTION**—If the check requirements in part c cannot be met, repeat step D2.

D7. CHECK VERTICAL BANDWIDTH

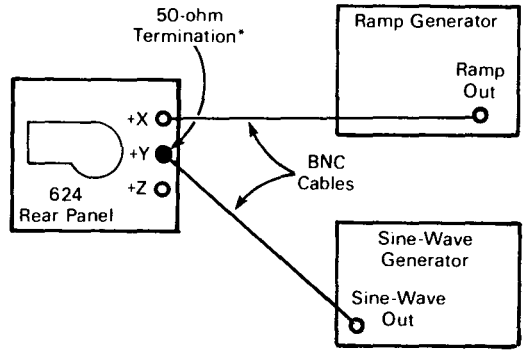
SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Vertical Preliminary Control Settings, then proceed with the following instructions.

SETUP CONDITIONS

624 Controls
Y GAIN ..... Set to provide 8 divisions deflection with 1-volt input.



Ramp-Generator Controls
Ramp Signal ..... +50 μs Ramp
Triggering ..... +Auto, Internal

Sine-Wave Generator Controls
Output Frequency ..... 50 kHz

*For Option 26 Monitors: Remove the 50-ohm termination from the test setup.

a. Set the ramp-generator amplitude for more than 10 divisions of horizontal deflection.

b. Set the sine-wave generator amplitude for 6.4 divisions of vertical deflection.

c. Slowly increase the sine-wave generator output frequency until the display amplitude is 4.5 divisions.

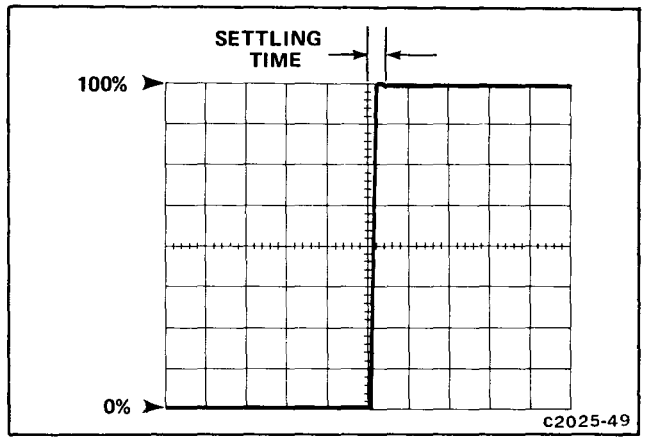


Figure 6-10. Typical crt display for vertical settling-time measurement.

d. **CHECK**—That the sine-wave generator output frequency is at least 3 megahertz.

e. **INTERACTION**—If the check requirement in part d cannot be met, repeat step D2.

D8. CHECK VERTICAL POSITIONING

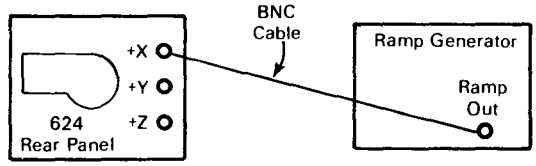
SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Vertical Preliminary Control Settings, then proceed with the following instructions.

SETUP CONDITIONS

624 Controls
Make no changes to the control settings.



Ramp-Generator Controls
Ramp Signal ..... +20 μs Ramp
Triggering ..... +Auto, Internal

a. **CHECK**—Rotate the Vertical Position control and check that the horizontal trace can be positioned vertically anywhere in the graticule area.

E. Z-AXIS AMPLIFIER

Equipment Required:

1. Function generator
2. Ramp generator
3. Sine-wave generator
4. Square-wave generator
5. Test oscilloscope
6. Dual-input coupler
7. 50-ohm cables (2 required)
8. 50-ohm termination

BEFORE YOU BEGIN:

(1) Perform the Calibration Power-Up Sequence.

(2) Refer to Section 7, Instrument Options, and the Change Information at the rear of this manual for any modifications which may affect this procedure.

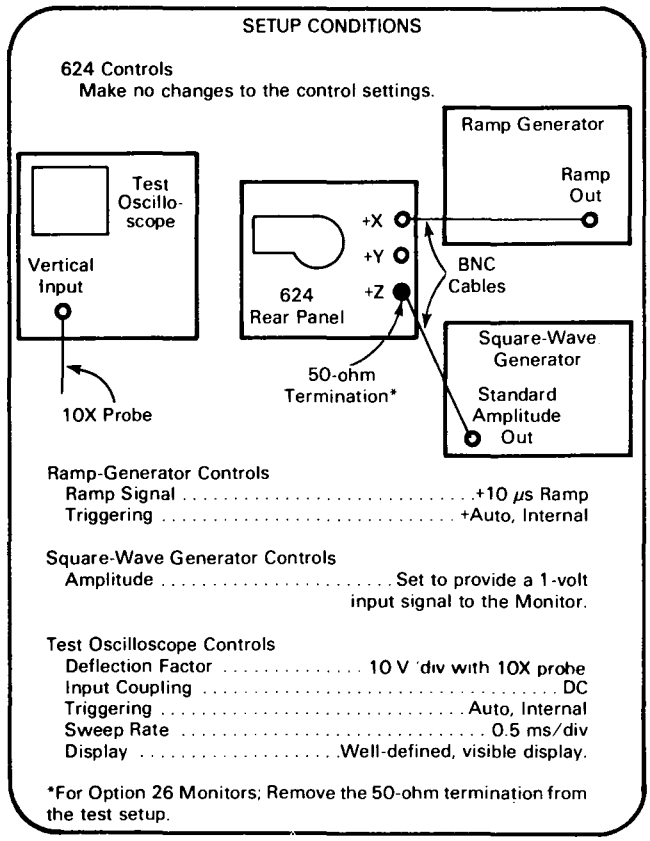
(3) See the Test Point and Adjustment Locations foldout page, and the Internal Control and Selector Locations foldout page in Section 9, Diagrams and Circuit Board Illustrations.

Z-AXIS PRELIMINARY CONTROL SETTINGS:

Vertical and Horizontal Position ..... Midrange
INTENSITY ..... Visible display
FOCUS ..... Well-defined display

NOTE

Always place terminations or grounding caps on all INPUTs to which signals are not applied.



E1. CHECK/ADJUST Z GAIN (R525)

SETUP CONDITIONS

NOTE

The following procedure sets the Z Gain for full intensity from a 1-volt input signal. This procedure can be altered for any voltage, from +1 volt to +5 volts, to provide the desired intensity control. However, for a complete Calibration procedure the Z Gain must be set as specified in the following procedure. For a partial procedure, first perform the Z-Axis Preliminary Control Settings, then proceed with the following instructions.

a. Set the square-wave generator amplitude for a 1-volt input signal to the Monitor.

b. Connect a 10X probe from the test oscilloscope vertical input to TP590. Set the 624 INTENSITY control for a 10-volt base level of the square wave displayed on the test oscilloscope.

c. **CHECK**—That the amplitude of the square wave displayed on the test oscilloscope is at least 60 volts. (Position as necessary.)

d. **ADJUST**—R525 (Z Gain) so that the amplitude of the square wave displayed on the test oscilloscope is 60 volts.

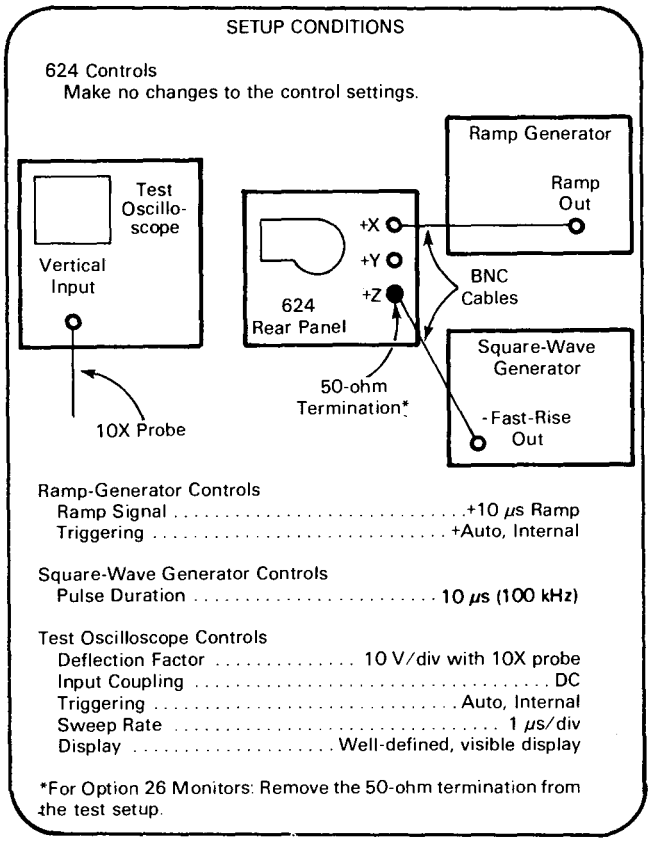
@

E2. ADJUST Z-AXIS COMPENSATION (R560 and C591)

SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Z-Axis Preliminary Control Settings, then proceed with the following instructions.



a. Connect a 10X probe from the test oscilloscope vertical input to TP590.

b. Set the 624 INTENSITY control and square-wave generator amplitude for 6 divisions amplitude (from 10 volts to 70 volts) as indicated on the test oscilloscope.

c. **EXAMINE**—The square wave displayed on the test oscilloscope for optimum front corner and minimum abberations.

d. **ADJUST**—Preset R560 (HF Adj) and C591 (HF Adj) to midrange. Adjust R560 for minimum abberations and C591 for optimum front corner. (Use a low-range capacitance screwdriver when adjusting C591.)

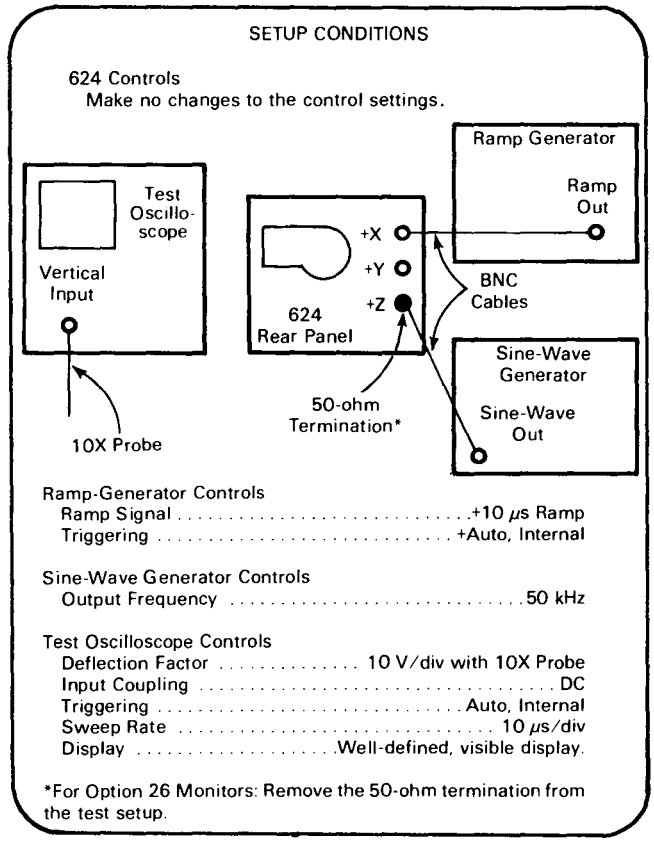
e. **INTERACTION**—R560 and C591 will interact; repeat adjustments in part d for optimum square corner and minimum abberrations. Changing the adjustment of R560 or C591 may affect the check in step E3.

E3. CHECK Z-AXIS AMPLIFIER BANDWIDTH

SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Z-Axis Preliminary Control Settings, then proceed with the following instructions.



a. Connect a 10X probe from the test oscilloscope vertical input to TP590.

b. Set the 624 INTENSITY control and the sine-wave generator amplitude for a 6-division (10 volts to 70 volts dc) display on the test oscilloscope. (Make sure that no clipping occurs on the test oscilloscope display.)

c. Slowly increase the sine-wave generator output frequency until the display amplitude is 4.2 divisions on the test oscilloscope.

d. **CHECK**—That the sine-wave generator output frequency is at least 5 megahertz.

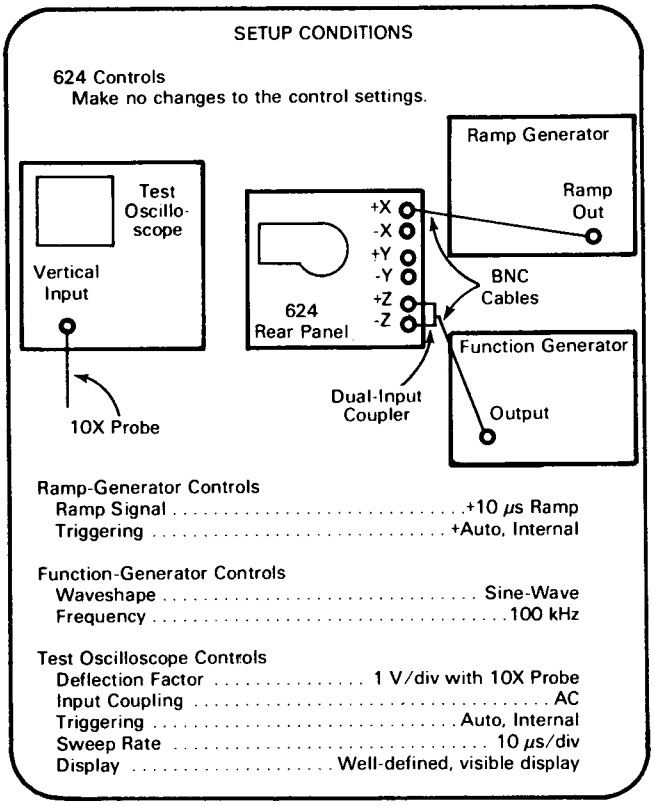
e. **INTERACTION**—If the check requirement in part d cannot be met, repeat the adjustments in step E2.

E4. CHECK OPTION 21 Z-AXIS COMMON-MODE REJECTION

SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Z-Axis Preliminary Control Settings, then proceed with the following instructions.



a. Set the function generator amplitude for a 5-volt input signal to the Monitor.

b. Connect a 10X probe from the test oscilloscope vertical input to TP590. Set the test oscilloscope for ac input coupling and the deflection factor to 1 volt/division (with 10X probe).

c. **CHECK**—Test oscilloscope display for 7 divisions (7 volts) or less.

d. Set the function generator output frequency to 1 megahertz and the test oscilloscope vertical deflection factor to 2 V/div (with 10X probe).

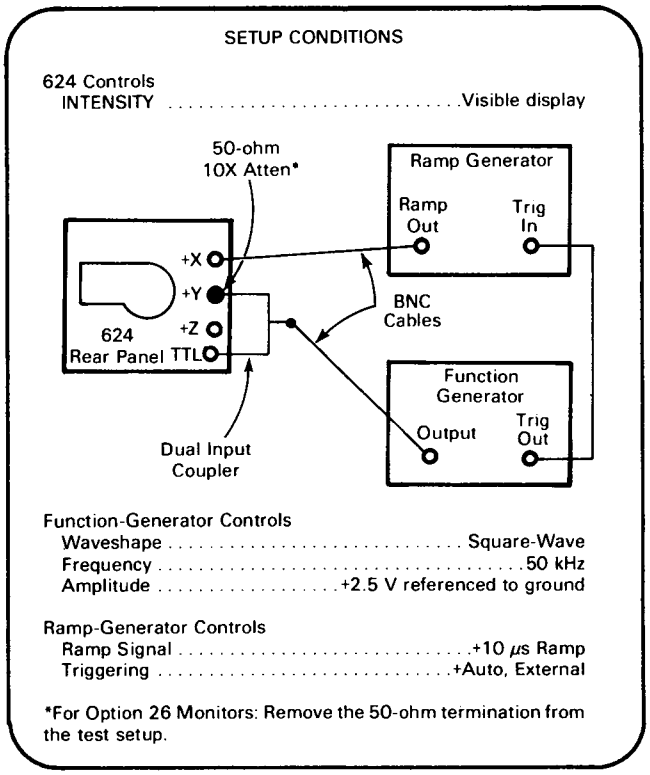
e. **CHECK**—Test oscilloscope display for 7 divisions (14 volts) or less.

E5. CHECK OPTION 25 Z-AXIS UNBLANKING

SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Z-Axis Preliminary Control Settings, then proceed with the following instructions.



a. Turn off the 624. Remove P550 (Unblanking Level Selector) and turn on the 624.

b. **CHECK**—That the full square-wave is visible.

c. Turn off the 624. Connect P550 to the NEG position. Turn on the 624.

d. **CHECK**—That only the negative portion of the squarewave is displayed on the screen.

e. Turn off the 624. Change the setting of P550 to the POS position. Turn on the 624.

f. **CHECK**—That only the positive portion of the squarewave is displayed on the screen. The Unblanking Level Selector plug (P550) should remain in the POS position for normal Monitor operation.

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F. OPTION 4 SWEEP GENERATOR

Equipment Required:

1. Function generator
2. Time-mark generator
3. 50-ohm cable (1 required)
4. 50-ohm termination (1 required)

BEFORE YOU BEGIN:

(1) Perform the Calibration Power-Up Sequence.

(2) Refer to Section 7, Instrument Options, and the Change Information at the rear of this manual for any modifications which may affect this procedure.

(3) See the Test Point and Adjustment Locations foldout page, and the Internal Control and Selector Locations foldout page in Section 9, Diagrams and Circuit Board Illustrations.

OPTION 4 SWEEP PRELIMINARY CONTROL SETTINGS:

Vertical and Horizontal Position ..... Midrange
INTENSITY ..... Visible display
FOCUS ..... Well-defined display
XY-YT (Option 4 Internal Selector) ..... YT (forward)
Trig Mode (Option 4 Internal Selector) ..... Auto (rear)
SEC/DIV (Option 4) ..... 1 μs/div
VARIABLE (Option 4) ..... Fully clockwise (calibrated)

F1. CHECK/ADJUST SWEEP LENGTH (R1134)

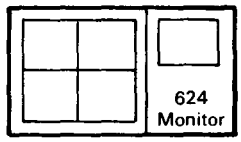
SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Option 4 Sweep Preliminary Control Settings, then proceed with the following instructions.

SETUP CONDITIONS

624 Controls
Make no changes to the control settings.



No external signals are connected to the 624 Monitor.

a. **CHECK**—That the sweep length is at least 10.5 divisions. (Position as necessary.)

b. **ADJUST**—R1134 (Sweep Length) for a sweep length of 10.5 divisions.

F2. CHECK TRIGGER SLOPE/LEVEL

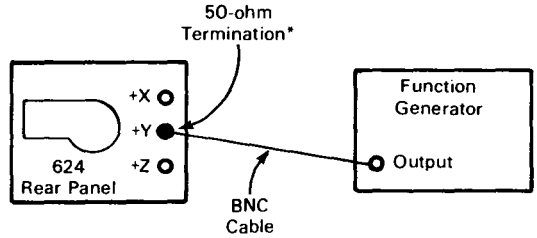
SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Option 4 Sweep Preliminary Control Settings, then proceed with the following instructions.

SETUP CONDITIONS

624 Controls
Make no changes to the control settings.



Function-Generator Controls
Waveshape ..... Sine-Wave
Frequency ..... 2 MHz

*For Option 26 Monitors: Remove the 50-ohm termination from the test setup.

a. Set the function generator amplitude for a 0.5-division display.

b. **CHECK**—For a stable display. (Rotate the TRIG SLOPE/LEVEL control as necessary.)

c. **CHECK**—That the display is free-running with the TRIG SLOPE/LEVEL control fully clockwise and fully counterclockwise.

d. Set the Trig Mode switch (S1140) to Norm (forward position).

e. **CHECK**—That a stable display is obtained by rotating the TRIG SLOPE/LEVEL control.

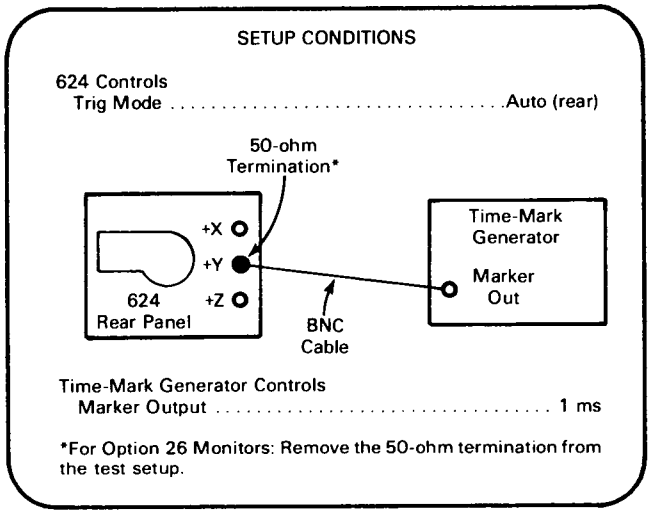
f. **CHECK**—For no display when the TRIG SLOPE/LEVEL control is set fully clockwise and fully counterclockwise.

F3. CHECK/ADJUST SWEEP TIMING (R1185)

SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Option 4 Sweep Preliminary Control Settings, then proceed with the following instructions.



a. Set the time-mark generator amplitude for a 2- to 6-division display.

b. Position the first time marker to the left edge of the graticule.

c. **CHECK**—That the distance between the second and tenth time markers is 8 divisions, within 0.24 division (3%).

d. **ADJUST**—R1185 (Swp Cal) so that the second and tenth time markers are exactly 8 divisions apart.

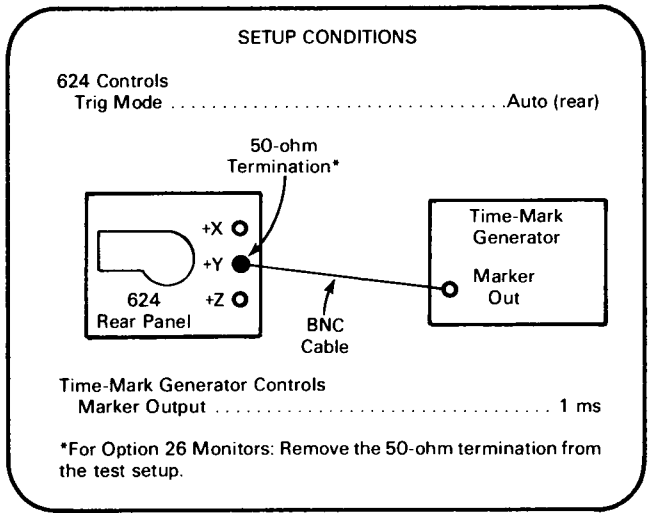
e. **CHECK**—Remaining positions of the SEC/DIV switch with time markers that correspond to each switch position. The distance between the second and tenth time markers at each SEC/DIV switch position should be 8 divisions, within 0.24 division (3%).

F4. CHECK SWEEP LINEARITY

SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Option 4 Sweep Preliminary Control Settings, then proceed with the following instructions.



a. Set the time-mark generator amplitude for a 2- to 6-division display.

b. Position the second time marker to the second vertical graticule line.

c. **CHECK**—That the distance between any 3 time marks, between the 2nd and 10th vertical graticule lines, is 2 divisions within 0.12 division (6%).

F5. CHECK VARIABLE TIME/DIVISION

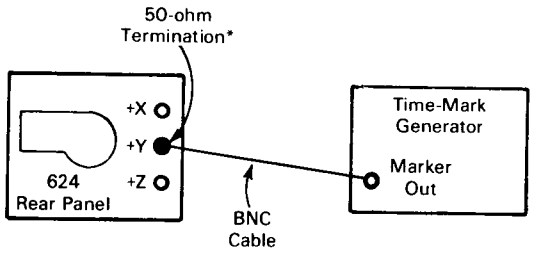
SETUP CONDITIONS

NOTE

For a partial procedure, first perform the Option 4 Sweep Preliminary Control Settings, then proceed with the following instructions.

SETUP CONDITIONS

624 Controls
SEC/DIV . . . . . 0.1 ms/div



Time-Mark Generator Controls
Marker Output . . . . . .0.1 ms

*For Option 26 Monitors: Remove the 50-ohm termination from the test setup.

a. Position the display for 1 time marker per division.

b. Set the front-panel VARIABLE control fully counterclockwise.

c. Set the SEC/DIV switch to 1 ms.

d. **CHECK**—For at least 1 time marker per graticule division.

INSTRUMENT OPTIONS

Your instrument may be equipped with one or more instrument options. A brief description of each available option is given in the following discussion. Refer to Table 7-1 for location of option information. For further information on instrument options, see your Tektronix Catalog or contact your Tektronix Field Office. Check the crt cover on the rear panel to determine which options are in your Monitor.

OPTION 1

An internal, unlighted graticule of 8 X 10 divisions is included on the crt faceplate.

OPTION 4

Includes an internal X-axis sweep circuit with selectable sweep rates from 0.1 second/division to 1 microsecond/division. Internal switches select X-Y or Y-T modes of operation (cannot be ordered with Option 27).

OPTION 6

Listed as Professional Medical Equipment by Underwriters Laboratories, Inc. Modifications include warnings required for medical equipment, a hospital grade cord and plug cap, an internal line fuse, a carrying handle, protective panels, and feet. (Cannot be ordered with Option 20, Option 23, or Option 28.)

OPTION 9

Certified as a recognized component, Professional Medical Equipment, by Underwriters Laboratories, Inc.

OPTION 10

Includes a 25-pin Alternate Input connector, mounted on the rear panel of the instrument. The Alternate Input connector provides direct connections to the non-inverting (positive) inputs of the Horizontal (+X), Vertical (+Y), and +Z Amplifiers. Signal sensitivity at the connector is the same as the standard bnc +X, +Y, and +Z INPUTs. If the instrument includes Option 25 (TTL Blanking), connections for TTL Blanking are also made via the Alternate Input connector. A matching male plug is provided to permit connections to the inputs from a remote location.

OPTION 20

The line fuse and power cord are removed from the rear panel of the instrument. The Monitor requires +20 V and -20 V dc (unregulated) to operate.

OPTION 21

Includes differential INPUT connectors on the rear panel for the Horizontal (X), Vertical (Y), and Z-Axis Amplifiers.

OPTION 22

Includes internal 1:1 or 5:1 switchable input attenuators in the Horizontal (X) and Vertical (Y) Amplifiers.

OPTION 23

Includes a carrying handle, protective cabinet panels, and feet. (Cannot be ordered with Option 28.)

OPTION 25

Modifies the Z-Axis Amplifier and rear panel to include an external TTL unblanking input.

OPTION 26

Modifies the input impedance of the Horizontal (X), Vertical (Y), and Z-Axis Amplifiers to 50 ohms.

OPTION 27

Deletes the X GAIN and Y GAIN controls from the front panel. X Gain and Y Gain are provided as internal adjustments (cannot be ordered with Option 4).

OPTION 28

Includes protective cabinet panels. (Cannot be ordered with Option 23.)

OPTION 29

Includes a metal crt bezel.

OPTION 40

Uses P39 phosphor in the crt.

OPTION 74

Uses P4 phosphor in the crt.

OPTION 76

Uses P7 phosphor in the crt.

OPTION 78

Uses P11 phosphor in the crt.

TABLE 7-1
Option Information Locator

Instrument Option	Manual Section	Location of Information
Option 1 (Internal CRT Graticule)	1 General Information	Specification Description of graticule is given in Table 1-1.
Option 4 (Internal Sweep System)	1 General Information	Specification Table 1-1 contains the electrical characteristics of the sweep circuit.
	2 Operating Instructions	Controls and Connectors Figure 2-1 depicts and describes the sweep circuit controls.
		Detailed Operating Information Includes basic information for making time measurements.
	3 Installation	Functional Check Includes procedure for checking functions of sweep controls.
	4 Theory of Operation	Detailed Circuit Operation Includes circuit description of the sweep system.
	5 Maintenance	Component Removal and Replacement Includes procedure for removing and replacing the Sweep circuit board.

TABLE 7-1 (CONT.)
Option Information Locator

Instrument Option	Manual Section	Location of Information
Option 4 (cont.)	6 Performance Check and Calibration	Preliminary Information Table 6-1 lists the electrical characteristics of the sweep system and gives references to the appropriate steps in the Performance Check and Calibration procedures.
		Part I—Performance Check Includes procedures for doing a Performance Check of the Sweep System.
		Part II—Calibration Includes procedures for calibrating the Sweep system.
	7 Instrument Options	Instrument Options Includes a brief description of the sweep system.
		Option 4 Provides a mechanical parts list and an exploded-view drawing of the Option 4.
	8 Replaceable Electrical Parts	Provides an electrical parts list for the Option 4 instrument.
	9 Diagrams and Circuit Board Illustrations	Provides block diagram; component, adjustment, test point, internal control and selector locations; a troubleshooting chart; and the schematic for the Option 4 instrument.
Option 6 (Meets Underwriters' Laboratory 544 Medical and Dental Equipment requirements)	7 Instrument Options	Instrument Options Includes a brief description of the UL listed instruments.
		Option 6 Provides a mechanical parts list and an exploded-view drawing of the Option 6
Option 9 (Certified as a recognized component, Professional Medical Equipment, by Underwriters' Laboratories)	7 Instrument Options	All information is contained in this section.
Option 10 (Alternate Input Connector)	2 Operating Instructions	Controls and Connectors Figure 2-2 depicts and describes the Alternate Input (Option 10) connector.
	3 Installation	Alternate Input Connector (Option 10) Provides connection details for the Alternate Input connector.

TABLE 7-1 (CONT.)
Option Information Locator

Instrument Option	Manual Section	Location of Information
Option 10 (cont.)	7 Instrument Options	Instrument Options Provides a brief description of Option 10.
		Option 10 Provides a mechanical parts list and exploded view drawing of Option 10.
	9 Diagrams and Circuit Board Illustrations	Provides a block diagram and schematic diagrams for the Option 10 instrument
Option 20 (Deletes AC Power Input Circuit)	1 General Information	Specification Table 1-1 contains the power specifications for the Option 20 instrument.
	3 Installation	Operating Power Information Describes the external power required by the Option 20 instrument.
	4 Theory of Operation	Detailed Circuit Operation Includes block diagram and schematic information.
	6 Performance Check and Calibration	Preliminary Information Table 6-1 lists Performance Check and Calibration procedures for the Option 20 instrument.
		Part I—Performance Check Contains performance check procedures for the Option 20 power supply.
		Part II—Calibration Contains Performance Check procedures for the Option 20 power supply.
	7 Instrument Options	Instrument Options Includes a brief description of Option 20.
		Option 20 Provides a mechanical parts list and an exploded-view drawing of the Option 20.
	8 Replaceable Electrical Parts	Provides an electrical parts list for the Option 20 instrument.
	9 Diagrams and Circuit Board Illustrations	Provides a block diagram, schematic diagram 7, and circuit board illustration for Option 20.
Option 21 (Includes differential INPUT connectors on the X, Y, and Z axis)	1 General Information	Specification Table 1-1 contains electrical characteristics for the Option 21 instrument.

TABLE 7-1 (CONT.)
Option Information Locator

Instrument Option	Manual Section	Location of Information
Option 21 (cont.)	2 Operating Instructions	Controls and Connectors Figure 2-2 depicts and describes the differential Input connectors.
		Detailed Operating Information Contains differential operating information.
	3 Installation	Functional Check Provides a functional check procedure for the Option 21 instrument.
	4 Theory of Operation	X, Y, and Z Preamplifier Discusses the operation of the Option 21 instrument.
	6 Performance Check and Calibration	Preliminary Information Table 6-1 lists performance checks and calibration procedures for the Option 21 instrument.
		Part I—Performance Check Contains procedures for checking the Option 21 instrument.
		Part II—Calibration Contains procedures for checking the Option 21 instrument.
	7 Instrument Options	Instrument Options Includes a brief description of Option 21.
		Option 21 Provides a mechanical parts list and an exploded-view drawing of the Option 21.
	9 Diagrams and Circuit Board Illustrations	Option 21 differential Input connectors are shown on schematic diagrams 1, 2, and 3.
Option 22 (Includes Switchable attenuators in the X and Y Amplifiers)	1 General Information	Specification Table 1-1 contains the electrical characteristics of the Option 22 instrument.
	2 Operating Instructions	Input Attenuation and Impedance Provides a brief description of the Option 22 attenuators.
	3 Installation	X and Y Input Attenuation Selection Provides general information for setting the the Option 22 attenuators.
		Functional Check Includes procedures for checking functions of the Option 22 attenuators.
	4 Theory of Operation	X and Y Preamplifier Provides circuit description of Option 22.

TABLE 7-1 (CONT.)
Option Information Locator

Instrument Option	Manual Section	Location of Information
Option 22 (cont.)	7 Instrument Options	Instrument Options Provides a brief description of Option 22.
	8 Replaceable Electrical Parts	Provides an electrical parts list for the Option 22 instrument.
	9 Diagrams and Circuit Board Illustrations	Option 22 attenuators are shown on schematic diagrams 1 and 2.
Option 23 (Includes carrying handle, panels, and feet)	7 Instrument Options	Instrument Options Includes a brief description of Option 23.
	8 Replaceable Electrical Parts	Provides electrical parts list for the Option 25 instrument.
	9 Diagrams and Circuit Board Illustrations	Option 25 TTL unblanking circuit is shown on schematic 3.
		Option 23 Provides a mechanical parts list and an exploded-view drawing of Option 23.
Option 25 (TTL unblanking)	1 General Information	Specification Table 1-1 contains the electrical characteristics of the TTL unblanking.
	2 Operating Instructions	Controls and Connectors Figure 2-2 depicts and describes the Option 25 TTL unblanking connector.
		Detailed Operating Information Describes TTL input signal requirements.
	3 Installation	Functional Check Includes procedure for checking function of external TTL unblanking.
	4 Theory of Operation	Z-Axis Amplifier Includes circuit description of Option 25 Unblanking circuit.
	6 Performance Check and Calibration	Preliminary Information Table 6-1 lists performance checks and calibration procedures for the Option 25 instrument.
		Part I—Performance Check Contains procedures for checking the Option 25 instrument.
		Part II—Calibration Contains procedures for checking the Option 25 instrument.

TABLE 7-1 (CONT.)
Option Information Locator

Instrument Option	Manual Section	Location of Information
Option 25 (cont.)	7 Instrument Options	Instrument Options Provides a brief description of Option 25.
		Option 25 Provides a mechanical parts list and an exploded-view drawing of the Option 25.
Option 26 (50 Ω Input Impedance)	1 General Information	Specification Table 1-1 contains the electrical characteristics of the Option 26 instrument.
	2 Operating Instruction	Input Attenuation and Impedance Provides a brief description of Option 26 input impedance.
	3 Installation	Functional Check Provides functional check procedures for the Option 26 instrument.
	6 Performance Check and Calibration	All Setup Conditions include special instructions for the Option 26 instrument, if applicable.
	7 Instrument Options	Provides a brief description of Option 26.
	8 Replaceable Electrical Parts	Provides an electrical parts list for the Option 26 instrument.
	9 Diagrams and Circuit Board Illustrations	Option 26 input resistors are shown on schematics 1, 2, and 3.
Option 27 (X and Y GAIN controls are removed from the front panel)	7 Instrument Options	Instrument Options Provides a brief description of Option 27.
Option 28 (Provides Protective panels)	7 Instrument Options	Instrument Options Provides a brief description of Option 28.
		Option 28 Provides a mechanical parts list and an exploded-view drawing for Option 28.
Option 29 (Provides a Metal CRT Bezel)	7 Instrument Options	Instrument Options Provides a brief description of Option 29.

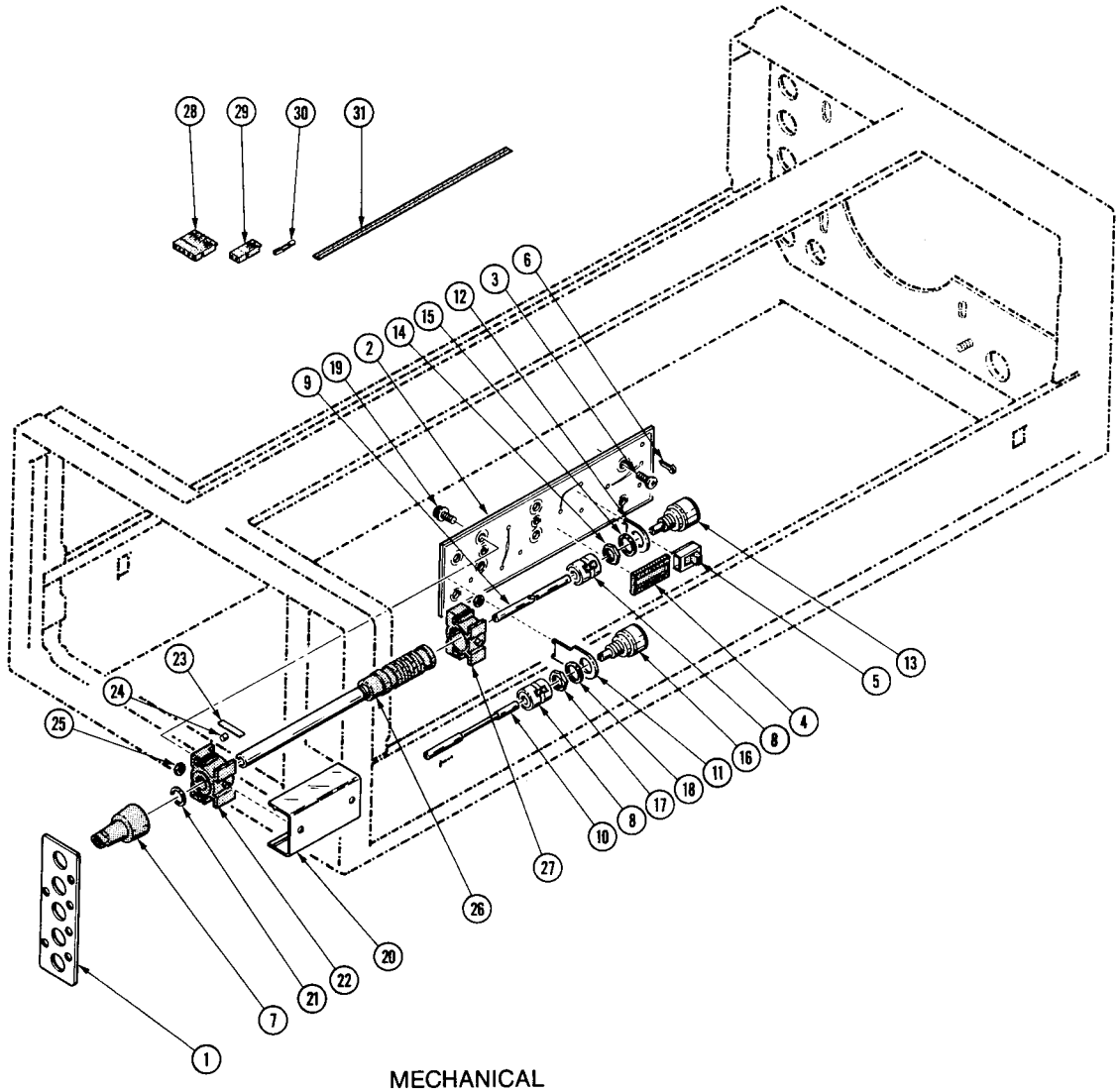
TABLE 7-1 (CONT.)
Option Information Locator

Instrument Option	Manual Section	Location of Information
Option 40 (P39 Phosphor)	1 General Information	Specification Table 1-1 describes Option 40.
	7 Instrument Options	Instrument Options Provides a brief description of Option 40.
	8 Replaceable Electrical Parts	Lists replacement information for the Option 40 crt.
Option 74 (P4 Phoshpor)	1 General Information	Specification Table 1-1 describes Option 74.
	7 Instrument Options	Instrument Options Provides a brief description of Option 74
	8 Replaceable Electrical Parts	Lists replacement information for the Option 74 crt.
Option 76 (P7 Phosphor)	1 General Information	Specification Table 1-1 describes Option 76.
	7 Instrument Options	Instrument Options Provides a brief description of Option 76.
	8 Replaceable Electrical Parts	Lists replacement information for the Option 76 crt.
Option 78 (P11 Phosphor)	1 General Information	Specification Table 1-1 describes Option 78.
	7 Instrument Options	Instrument Options Provides a brief description of Option 78.
	8 Replaceable Electrical Parts	Lists replacement information for the Option 78 crt.

OPTION 4

Includes an internal X-Axis sweep circuit with selectable sweep rates from 0.1 second/division to 1 microsecond/division. Internal switches select X-Y or Y-T modes of operation (cannot be ordered with Option 27).

OPTION 4



MECHANICAL

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
-1	333-2495-00			1		PANEL,FRONT:	80009	333-2495-00
-2	----- -----			1		CRT BOARD ASSY:SWEEP OPTION(SEE A3 REPL)		
						(ATTACHING PARTS)		
-3	211-0008-00			4		SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
						- - - * - - -		
	----- -----			-		CRT BD ASSY INCLUDES:		
-4	136-0260-00			1		. SOCKET,PLUG-IN:16 CONTACT,RECT SHAPE	71785	133-51-92-008
-5	----- -----			1		. SWITCH,SLIDE:(SEE S1140 REPL)		
-6	214-0579-00			1		. TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-7	366-1369-00			1		. KNOB:GRAY	80009	366-1369-00
-8	376-0051-01			2		. CPLG,SHAFT,FLEX:0.127 ID X 0.375 OD	80009	376-0051-01
	----- -----			-		. . EACH COUPLER INCLUDES:		
	213-0048-00			4		. . SETSCREW:4-40 X 0.125 INCH,HEX SOC STL	74445	OBD
	354-0251-00			2		. . RING,COUPLING:0.251 ID X 0.375 INCH OD,AL	80009	354-0251-00
	376-0049-01			1		. . CPLG,SHAFT,FLEX:0.127 ID X 0.375 OD,PP	80009	376-0049-01
-9	384-0284-00			1		. EXTENSION SHAFT:5.688 INCH LONG	80009	384-0284-00
-10	384-1156-00			1		. EXTENSION SHAFT:2.20 INCH LONG	80009	384-1156-00
-11	386-2351-00			1		. PL,VAR RES MTG:HORIZ CKT BD	80009	386-2351-00
-12	387-0794-00			1		. PLATE,CMPNT MTG:VAR RESISTOR,BRASS	80009	387-0794-00

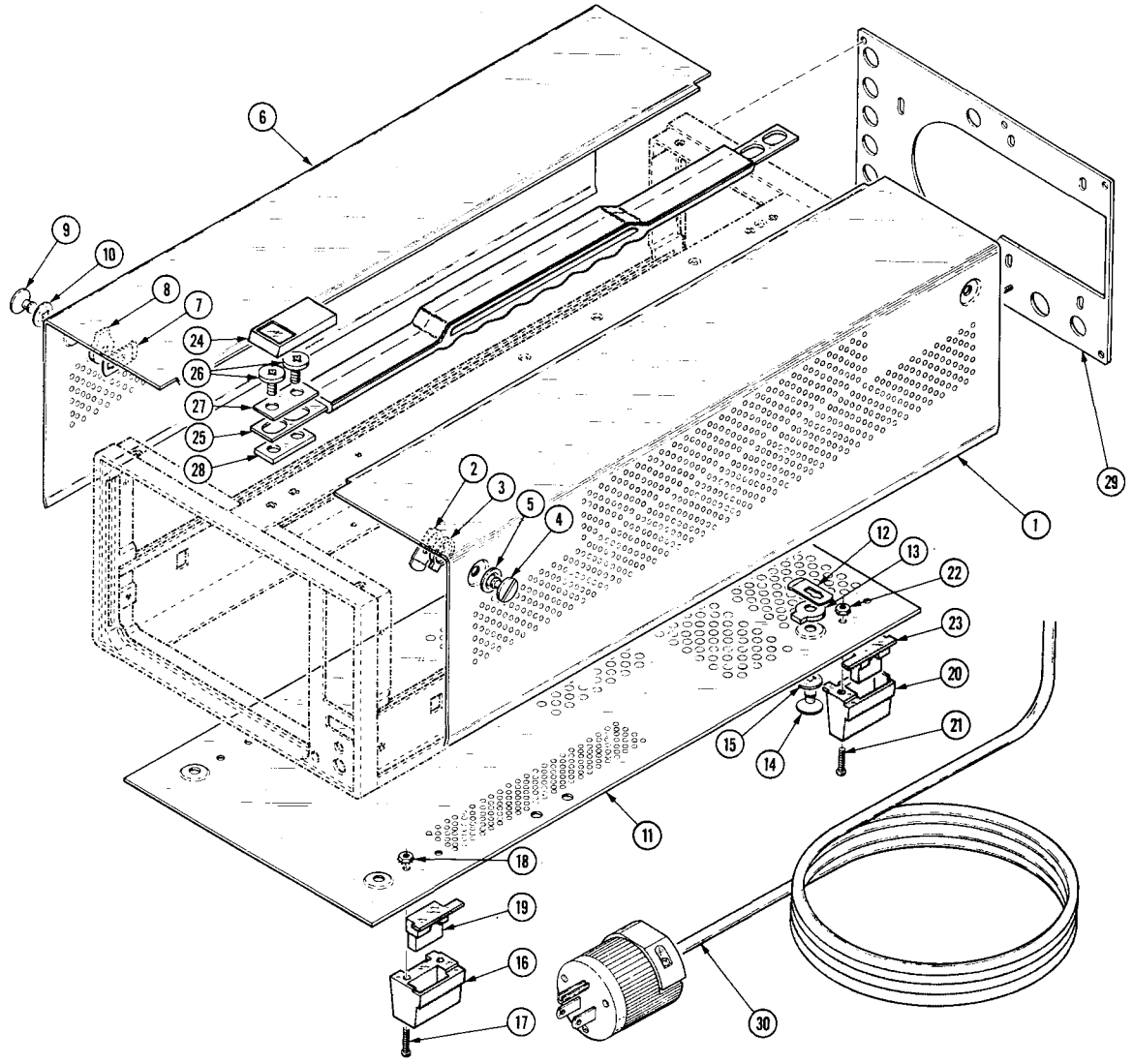
OPTION 4

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
-13	----- -----			1		. RES.,VAR:(SEE R1130 REPL)		
						(ATTACHING PARTS)		
-14	210-0583-00			1		. NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-15	210-0940-00			1		. WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
						- - - * - - -		
-16	----- -----			1		. RES.,VAR:(SEE R1147 REPL)		
						(ATTACHING PARTS)		
-17	210-0583-00			1		. NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-18	210-0940-00			1		. WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
						- - - * - - -		
	----- -----			1		. ACTR ASSY,CAM S:(SEE S1150 REPL)		
						(ATTACHING PARTS)		
-19	211-0116-00	B010100	B021457	4		. SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
	211-0292-00	B021458		4		. SCR,ASSEM WSHR:4-40 X 0.29,BRS NI PL	78189	OBD
						- - - * - - -		
	----- -----			-		. . ACTR ASSY,CAM S INCLUDES:		
-20	200-1441-00			1		. . COVER,CAM SW.:7 ELEMENTS	80009	200-1441-00
-21	354-0219-00			1		. . RING,RETAINING:FOR 0.25 INCH SHAFT	79136	5103-25-MD-R
-22	401-0155-00			1		. . BEARING,CAM SW:FRONT	80009	401-0155-00
-23	214-1704-01			1		. . SPRING,FLAT:CAM SW DETENT,0.008 INCH THK	80009	214-1704-01
-24	214-1127-00			1		. . ROLLER,DETENT:0.125 DIA X 0.125,SST	80009	214-1127-00
-25	210-0406-00			4		. . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
-26	105-0388-00			1		. . ACTUATOR,CAM SW:	80009	105-0388-00
-27	401-0156-00			1		. . BEARING,CAM SW:REAR	80009	401-0156-00
	198-4047-00			1		WIRE SET,ELEC:	80009	198-4047-00
-28	352-0163-00			1		. CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0163-00
-29	352-0169-02			1		. CONN BODY,PL,EL:2 WIRE RED	80009	352-0169-00
-30	131-0707-00			6		. CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	47439
-31	175-0825-00			1		. WIRE,ELECTRICAL:2 WIRE RIBBON	80009	175-0825-00

OPTION 6

Listed as Professional Medical Equipment by Underwriters Laboratories, Inc. Modifications include warnings required for medical equipment, a hospital grade cord and plug cap, an internal line fuse, a carrying handle, protective panels, and feet. (Cannot be ordered with Option 20, Option 23, or Option 28.)

OPTION 6



MECHANICAL

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
-1	390-0543-00			1		CAB.SIDE,MON:	80009	390-0543-00
	214-0816-00			2		. FASTENER,PAWL:	80009	214-0816-00
-2	386-1151-00			2		. . CLAMP,RIM CLENC:SPG STL CD PL	80009	386-1151-00
-3	386-0227-00			2		. . STOP,CLP,RIM CL:ACETAL	80009	386-0227-00
-4	214-0603-01			2		. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-5	214-0604-00			2		. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-6	390-0543-00			1		CAB.SIDE,MON:	80009	390-0543-00
	214-0816-00			2		. FASTENER,PAWL:	80009	214-0816-00
-7	386-1151-00			2		. . CLAMP,RIM CLENC:SPG STL CD PL	80009	386-1151-00
-8	386-0227-00			2		. . STOP,CLP,RIM CL:ACETAL	80009	386-0227-00
-9	214-0603-01			2		. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-10	214-0604-00			2		. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
	348-0275-00			1		. . FLIPSTAND,CAB.:	80009	348-0275-00
-11	390-0523-00			1		. . COVER,SCOPE:BOTTOM	80009	390-0523-00
	214-0816-00			4		. FASTENER,PAWL:	80009	214-0816-00
-12	386-1151-00			4		. . CLAMP,RIM CLENC:SPG STL CD PL	80009	386-1151-00
-13	386-0227-00			4		. . STOP,CLP,RIM CL:ACETAL	80009	386-0227-00

OPTION 6

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
-14	214-0603-01			4		. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-15	214-0604-00			4		. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-16	348-0074-00			2		. HINGE BLOCK,STA:R FR,L REAR,BLACK ACETAL	80009	348-0074-00
						(ATTACHING PARTS)		
-17	211-0532-00			4		. SCREW,MACHINE:6-32 X 0.75 INCH,FILH STL	83385	OBD
-18	210-0457-00			4		. NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	OBD
						- - - * - - -		
-19	348-0207-00			2		. FOOT,CABINET:RIGHT FRONT AND LEFT REAR	80009	348-0207-00
-20	348-0073-00			2		. HINGE BLOCK,STA:L FR,R REAR,BLACK ACETAL	80009	348-0073-00
						(ATTACHING PARTS)		
-21	211-0532-00			4		. SCREW,MACHINE:6-32 X 0.75 INCH,FILH STL	83385	OBD
-22	210-0457-00			4		. NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	OBD
						- - - * - - -		
-23	348-0208-00			2		. FOOT,CABINET:LEFT FRONT AND RIGHT REAR	80009	348-0208-00
-24	200-0728-00			2		. COV,HANDLE END:	80009	200-0728-00
-25	367-0116-00			1		. HANDLE,CARRYING:	12136	OBD
						(ATTACHING PARTS)		
-26	212-0597-00			4		. SCREW,MACHINE:10-32 X 0.50 INCH,STL	93907	OBD
-27	386-1624-00			2		PLATE,HDL RTNG:STAINLESS STEEL	80009	386-1624-00
-28	386-1283-00			2		PLATE,HDL MTG:FRONT	80009	386-1283-00
						- - - * - - -		
	200-1218-00			1		RTNR,CRT SCALE:6.814 X 5.125,NYLON	80009	200-1218-00
-29	333-2350-03			1		PANEL,REAR:	80009	333-2350-03
	334-3408-00			1		MARKER,IDENT:MARKED CAUTION	80009	334-3408-00
-30	161-0121-00			1		CABLE ASSY,PWR,:3,18 AWG,115V,96.0 L	80009	161-0121-00

OPTION 10

Includes a 25-pin Alternate Input connector on the rear panel for the +X, +Y, and +Z Amplifiers. If the instrument includes Option 25 (TTL Z INPUT), connections for TTL Blanking are also included.

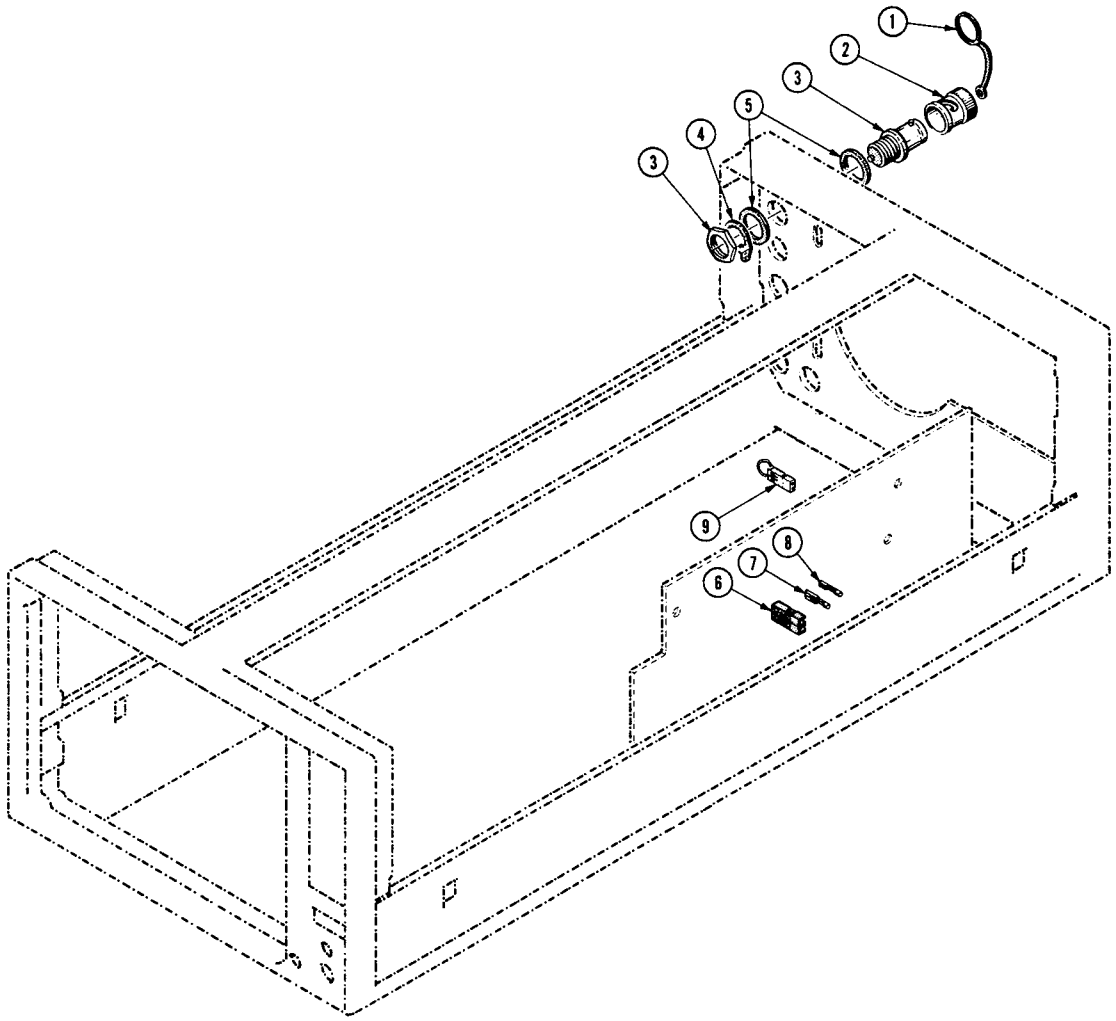
OPTION 20

The line fuse and power cord are removed from the rear panel of the instrument. The Monitor requires +20V and -20V dc (unregulated) to operate.

OPTION 21

Includes differential INPUT connectors on the rear panel for the Horizontal (X), Vertical (Y), and Z-Axis Amplifiers.

OPTION 21



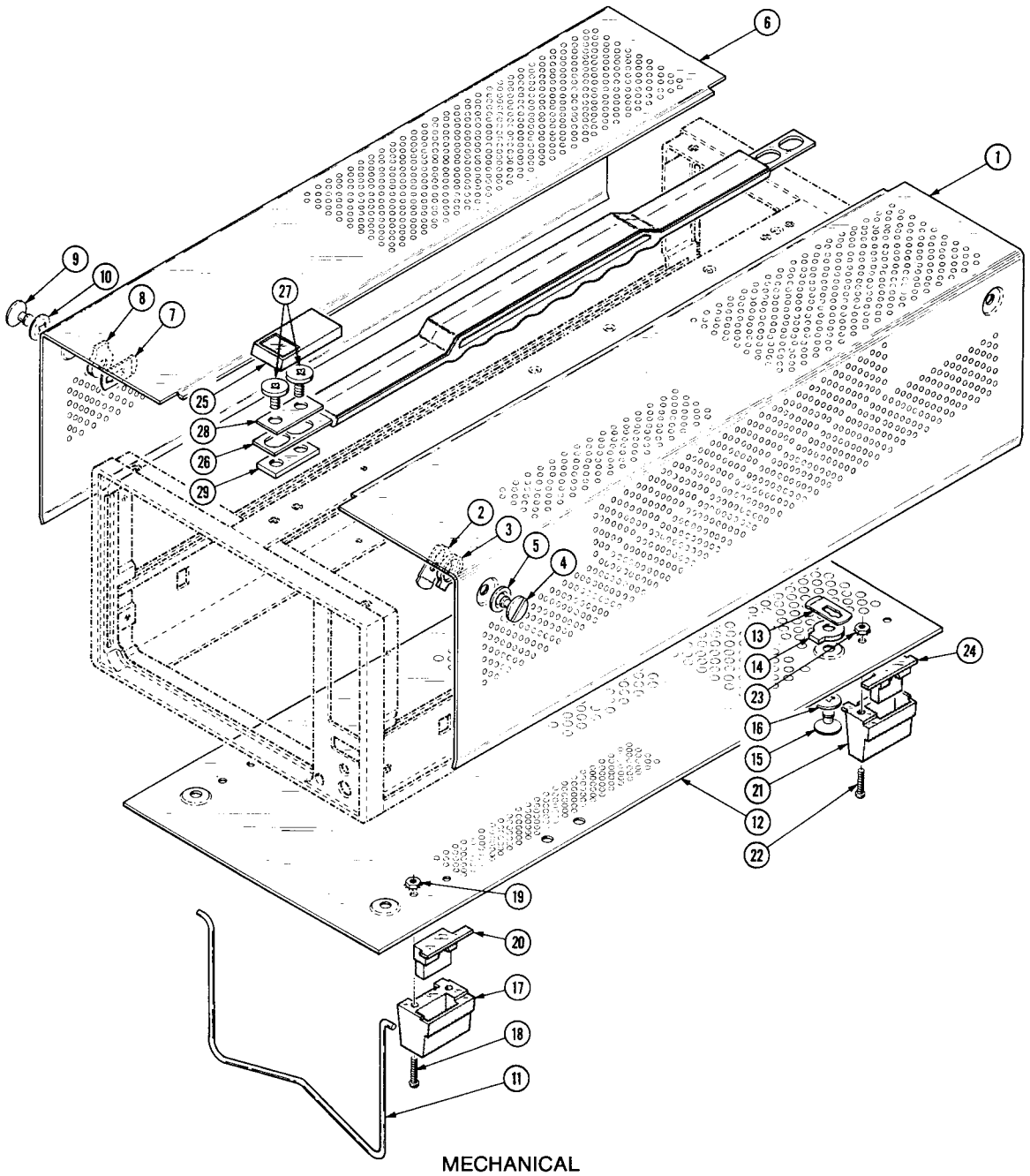
MECHANICAL

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
-1	346-0045-00			3		STRAP,CONN COV:BNC ONE END,POLYPROPYLENE	80009	346-0045-00
-2	200-0991-00			3		COV,ELEC CONN:BNC ,W/CTR GND	77820	2096-5
-3	131-0955-00			3		CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
-4	210-0255-00			3		TERMINAL,LUG:0.391" ID INT TOOTH	80009	210-0255-00
-5	342-0117-00			6		INSULATOR,BSHG:0.375 ID X 0.065 L,DELRIN	80009	342-0117-00
	198-3780-00			1		WIRE SET,ELEC:	80009	198-3780-00
-6	352-0198-00			3		. HLDR,TERM CONN:2 WIRE BLACK	80009	352-0198-00
-7	131-0792-00			3		. CONNECTOR,TERM:18-20 AWG,CU BE GOLD PL	22526	46221
-8	131-0621-00			3		. CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	46231

OPTION 23

Includes a carrying handle, protective cabinet panels, and feet. (Cannot be ordered with Option 28.)

OPTION 23



MECHANICAL

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
-1	390-0270-00			1		COVER,MONITOR:LEFT	80009	390-0270-00
	214-0816-00			2		. FASTENER,PAWL:	80009	214-0816-00
-2	386-1151-00			2		. . CLAMP,RIM CLENC:SPG STL CD PL	80009	386-1151-00
-3	386-0227-00			2		. . STOP,CLP,RIM CL:ACETAL	80009	386-0227-00
-4	214-0603-01			2		. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-5	214-0604-00			2		. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-6	390-0244-00			1		COVER,MONITOR:RIGHT	80009	390-0244-00
	214-0816-00			2		. FASTENER,PAWL:	80009	214-0816-00
-7	386-1151-00			2		. . CLAMP,RIM CLENC:SPG STL CD PL	80009	386-1151-00
-8	386-0227-00			2		. . STOP,CLP,RIM CL:ACETAL	80009	386-0227-00
-9	214-0603-01			2		. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-10	214-0604-00			2		. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00

OPTION 23

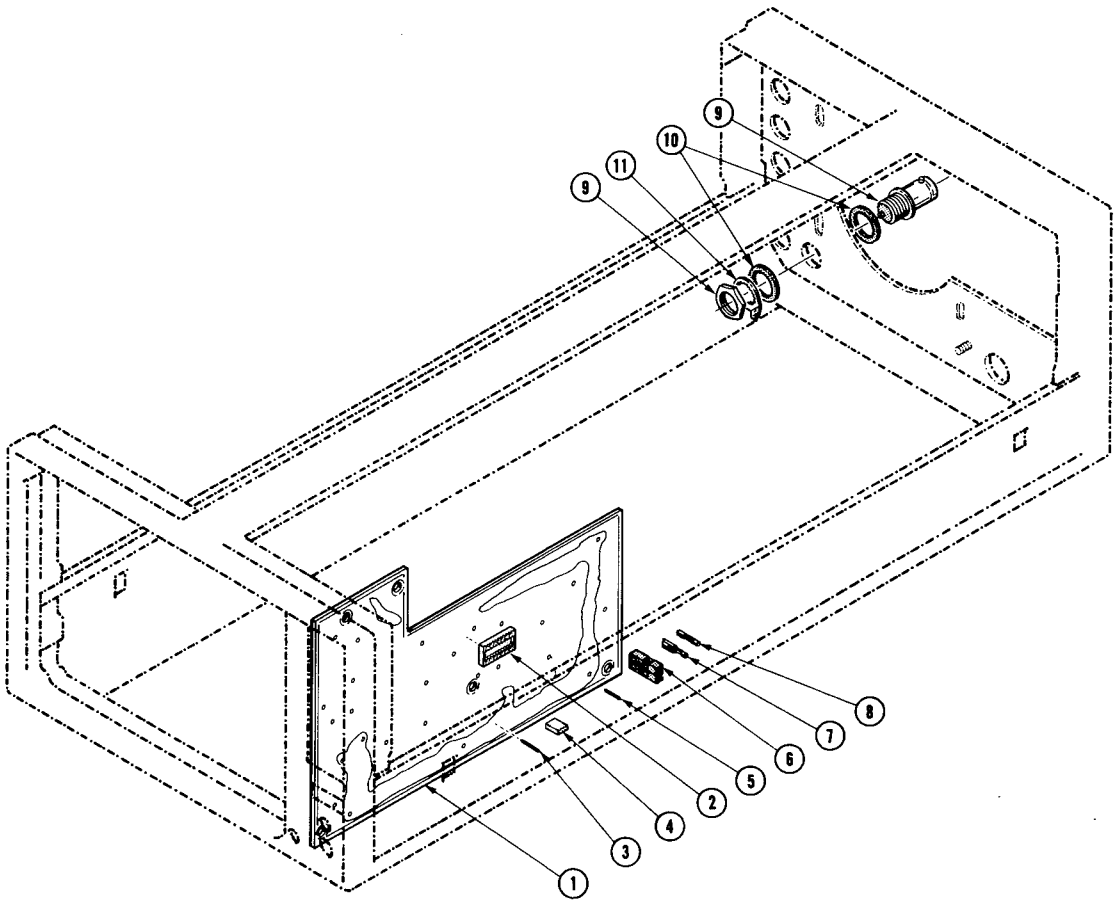
MECHANICAL

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
-11	348-0275-00			1		. . FLIPSTAND,CAB.:	80009	348-0275-00
-12	390-0280-00			1		. . COVER,SCOPE:BOTTOM	80009	390-0280-00
	214-0816-00			4		. FASTENER,PAWL:	80009	214-0816-00
-13	386-1151-00			4		. . CLAMP,RIM CLENC:SPG STL CD PL	80009	386-1151-00
-14	386-0227-00			4		. . STOP,CLP,RIM CL:ACETAL	80009	386-0227-00
-15	214-0603-01			4		. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-16	214-0604-00			4		. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-17	348-0074-00			2		. HINGE BLOCK,STA:R FR,L REAR,BLACK ACETAL	80009	348-0074-00
						(ATTACHING PARTS)		
-18	211-0532-00			4		. SCREW,MACHINE:6-32 X 0.75 INCH,FILH STL	83385	OBD
-19	210-0457-00			4		. NUT,PL,ASSEM WA:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-20	348-0207-00			2		. FOOT,CABINET:RIGHT FRONT AND LEFT REAR	80009	348-0207-00
-21	348-0073-00			2		. HINGE BLOCK,STA:L FR,R REAR,BLACK ACETAL	80009	348-0073-00
						(ATTACHING PARTS)		
-22	211-0532-00			4		. SCREW,MACHINE:6-32 X 0.75 INCH,FILH STL	83385	OBD
-23	210-0457-00			4		. NUT,PL,ASSEM WA:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-24	348-0208-00			2		. FOOT,CABINET:LEFT FRONT AND RIGHT REAR	80009	348-0208-00
-25	200-0728-00			2		. COV,HANDLE END:	80009	200-0728-00
-26	367-0116-00			1		. HANDLE,CARRYING:	12136	OBD
						(ATTACHING PARTS)		
-27	212-0597-00			4		. SCREW,MACHINE:10-32 X 0.50 INCH,STL	93907	OBD
-28	386-1624-00			2		. PLATE,HDL RTNG:STAINLESS STEEL	80009	386-1624-00
-29	386-1283-00			2		. PLATE,HDL MTG:FRONT	80009	386-1283-00
						- - - * - - -		

OPTION 25

Modifies the Z-Axis Amplifier and rear panel to include an external TTL unblanking input.

OPTION 25



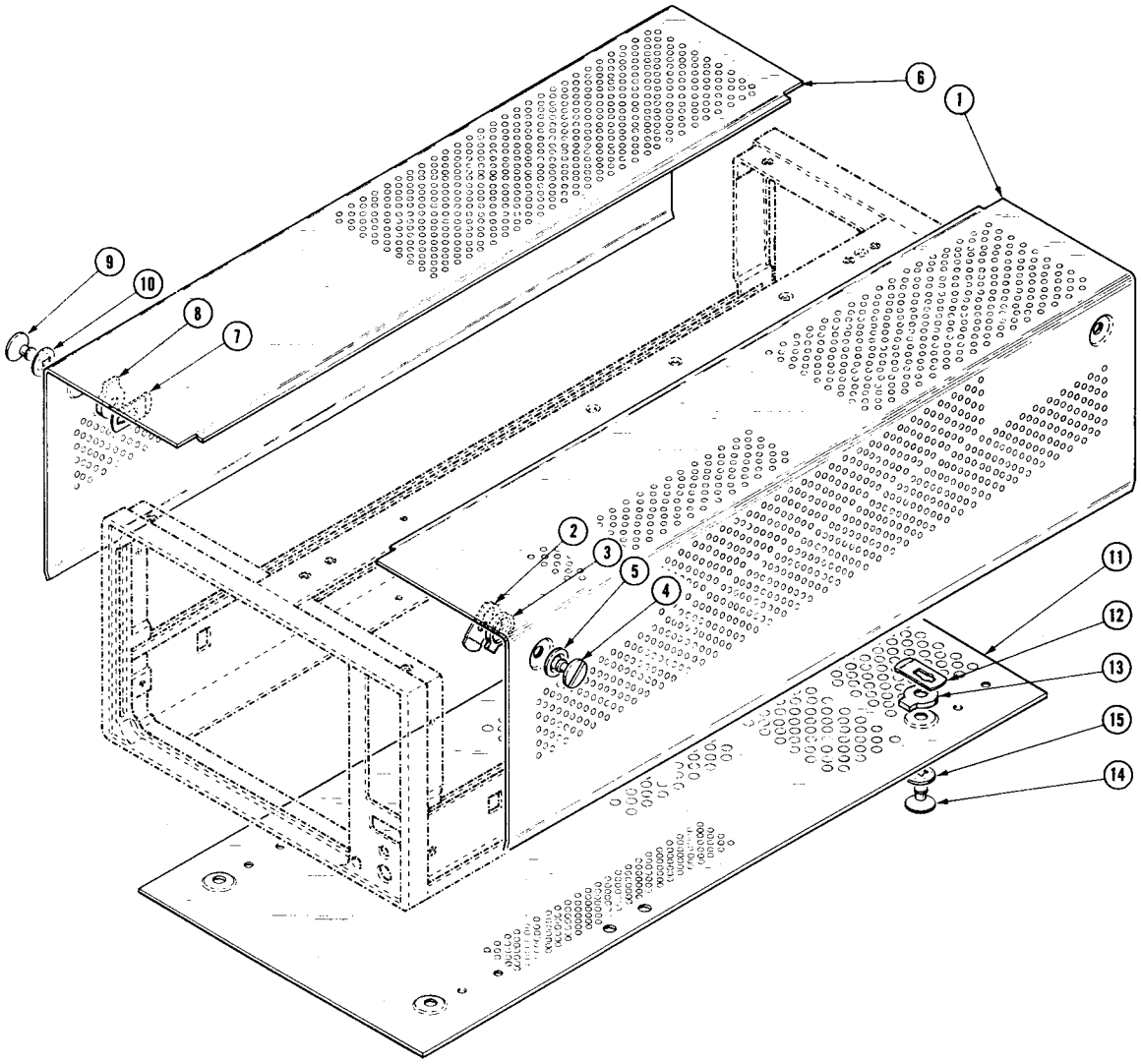
MECHANICAL

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
-1	----- -----			1		CKT BOARD ASSY:(SEE A2 REPL)		
-2	136-0269-02			1		. SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW CLE	73803	CS9002-14
-3	131-0608-00			3		. TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-4	131-0993-00			1		. BUS,CONDUCTOR:2 WIRE BLACK	00779	850100-01
-5	131-0589-00			2		. TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
	198-3781-00			1		WIRE SET,ELEC:	80009	198-3781-00
-6	352-0198-00			1		. HLDR,TERM CONN:2 WIRE BLACK	80009	352-0198-00
-7	131-0621-00			2		. CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	46231
-8	131-0792-00			2		. CONNECTOR,TERM:18-20 AWG,CU BE GOLD PL	22526	46221
-9	131-0955-00			1		CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
-10	342-0117-00			2		INSULATOR,BSHG:0.375 ID X 0.065 L,DELRIN	80009	342-0117-00
-11	210-0255-00			1		TERMINAL,LUG:0.391 ID,LOCKING,BRS CD PL	80009	210-0255-00

OPTION 28

Includes protective cabinet panels. (Cannot be ordered with Option 23.)

OPTION 28



MECHANICAL

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
-1	390-0270-00			1		COVER,MONITOR:LEFT	80009	390-0270-00
	214-0816-00			2		. FASTENER,PAWL:	80009	214-0816-00
-2	386-1151-00			2		. . CLAMP,RIM CLENC:SPG STL CD PL	80009	386-1151-00
-3	386-0227-00			2		. . STOP,CLP,RIM CL:ACETAL	80009	386-0227-00
-4	214-0603-01			2		. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-5	214-0604-00			2		. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-6	390-0244-00			1		. . COVER,MONITOR:RIGHT	80009	390-0244-00
	214-0816-00			2		. FASTENER,PAWL:	80009	214-0816-00
-7	386-1151-00			2		. . CLAMP,RIM CLENC:SPG STL CD PL	80009	386-1151-00
-8	386-0227-00			2		. . STOP,CLP,RIM CL:ACETAL	80009	386-0227-00
-9	214-0603-01			2		. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-10	214-0604-00			2		. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-11	390-0281-00			1		. . COVER,SCOPE:BOTTOM	80009	390-0281-00
-12	386-1151-00			4		. CLAMP,RIM CLENC:SPG STL CD PL	80009	386-1151-00
-13	386-0227-00			4		. STOP,CLP,RIM CL:ACETAL	80009	386-0227-00
-14	214-0603-01			4		. PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-15	214-0604-00			4		. WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

ACTR	ACTUATOR	PLSTC	PLASTIC
ASSY	ASSEMBLY	QTZ	QUARTZ
CAP	CAPACITOR	RECP	RECEPTACLE
CER	CERAMIC	RES	RESISTOR
CKT	CIRCUIT	RF	RADIO FREQUENCY
COMP	COMPOSITION	SEL	SELECTED
CONN	CONNECTOR	SEMICOND	SEMICONDUCTOR
ELCTLT	ELECTROLYTIC	SENS	SENSITIVE
ELEC	ELECTRICAL	VAR	VARIABLE
INCAND	INCANDESCENT	WW	WIREWOUND
LED	LIGHT EMITTING DIODE	XFMR	TRANSFORMER
NONWIR	NON WIREWOUND	XTAL	CRYSTAL

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
00213	NYTRONICS, COMPONENTS GROUP, INC., SUBSIDIARY OF NYTRONICS, INC.	ORANGE STREET	DARLINGTON, SC 29532
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
02735	RCA CORPORATION, SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
03508	GENERAL ELECTRIC COMPANY, SEMI-CONDUCTOR PRODUCTS DEPARTMENT	ELECTRONICS PARK	SYRACUSE, NY 13201
03888	KDI PYROFILM CORPORATION	60 S JEFFERSON ROAD	WHIPPANY, NJ 07981
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867, 19TH AVE. SOUTH	MYRTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
05397	UNION CARBIDE CORPORATION, MATERIALS SYSTEMS DIVISION	11901 MADISON AVENUE	CLEVELAND, OH 44101
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
10389	CHICAGO SWITCH, INC.	2035 WABANSIA AVE.	CHICAGO, IL 60647
11237	CTS KEENE, INC.	3230 RIVERSIDE AVE.	PASO ROBLES, CA 93446
13511	AMPHENOL CARDRE DIV., BUNKER RAMO CORP.		LOS GATOS, CA 95030
14099	SEMTECH CORP.	652 MITCHELL RD.	NEWBURY PARK, CA 91320
14193	CAL-R, INC.	1601 OLYMPIC BLVD.	SANTA MONICA, CA 90404
14433	ITT SEMICONDUCTORS	3301 ELECTRONICS WAY P O BOX 3049	WEST PALM BEACH, FL 33402
14552	MICRO SEMICONDUCTOR CORP.	2830 E FAIRVIEW ST.	SANTA ANA, CA 92704
14752	ELECTRO CUBE INC.	1710 S. DEL MAR AVE.	SAN GABRIEL, CA 91776
15238	ITT SEMICONDUCTORS, A DIVISION OF INTER NATIONAL TELEPHONE AND TELEGRAPH CORP.	P.O. BOX 168, 500 BROADWAY	LAWRENCE, MA 01841
24546	CORNING GLASS WORKS, ELECTRONIC COMPONENTS DIVISION	550 HIGH STREET	BRADFORD, PA 16701
27014	NATIONAL SEMICONDUCTOR CORP.	2900 SEMICONDUCTOR DR.	SANTA CLARA, CA 95051
27264	MOLEX PRODUCTS CO.	5224 KATRINE AVE.	DOWNERS GROVE, IL 60515
31918	IEE/SCHADOW INC.	8081 WALLACE ROAD	EDEN PRAIRIE, MN 55343
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
50437	RELIANCE STEEL PRODUCTS COMPANY	3700 WALNUT STREET	MCKEESPORT, PA 15132
51406	MURATA CORPORATION OF AMERICA	2 WESTCHESTER PLAZA	ELMSFORD, NY 10523
51642	CENTRE ENGINEERING INC.	2820 E COLLEGE AVENUE	STATE COLLEGE, PA 16801
52306	HIGH VOLTAGE DEVICES, INC.	7485 AVENUE 304	VISALIA, CA 93277
53944	ELT INC., GLOW LITE DIVISION	BOX 698	PAULS VALLEY, OK 73075
54473	MATSUSHITA ELECTRIC, CORP. OF AMERICA	1 PANASONIC WAY	SECAUCUS, NJ 07094
56289	SPRAGUE ELECTRIC CO.	87 MARSHALL ST.	NORTH ADAMS, MA 01247
57668	R-OHM CORP.	16931 MILLIKEN AVE.	IRVINE, CA 92713
59660	TUSONIX INC.	2155 N FORBES BLVD	TUCSON, AZ 85705
59821	CENTRALAB INC SUB NORTH AMERICAN PHILIPS CORP	7158 MERCHANT AVE	EL PASO, TX 79915
63743	WARD LEONARD ELECTRIC CO., INC.	31 SOUTH ST.	MOUNT VERNON, NY 10550
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
73803	TEXAS INSTRUMENTS, INC., METALLURGICAL MATERIALS DIV.	34 FOREST STREET	ATTLEBORO, MA 02703
74276	SIGNALITE DIV., GENERAL INSTRUMENT CORP.	1933 HECK AVE.	NEPTUNE, NJ 07753
74970	JOHNSON, E. F., CO.	299 10TH AVE. S. W.	WASECA, MN 56093
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
80031	ELECTRA-MIDLAND CORP., MEPCO DIV.	22 COLUMBIA ROAD	MORRISTOWN, NJ 07960
82389	SWITCHCRAFT, INC.	5555 N. ELSTON AVE.	CHICAGO, IL 60630
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	3029 E. WASHINGTON STREET P. O. BOX 372	INDIANAPOLIS, IN 46206
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-5607-00			CKT BOARD ASSY:DEFLECTION	80009	670-5607-00
A2	670-5606-00			CKT BOARD ASSY:Z AXIS & CONTROL	80009	670-5606-00
A3	670-5763-00			CKT BOARD ASSY:SWEEP OPTION	80009	670-5763-00
A3	----- -----			(OPTION 04 ONLY)		
A4	670-5610-00	B010100	B010532	CKT BOARD ASSY:HIGH VOLTAGE	80009	670-5610-00
A4	670-5610-01	B010533	B019999	CKT BOARD ASSY:HIGH VOLTAGE	80009	670-5610-01
A4	670-5610-02	B020000		CKT BOARD ASSY:HIGH VOLTAGE	80009	670-5610-02
A5	670-5214-01	B010100	B010962	CKT BOARD ASSY:LOW VOLTAGE POWER SUPPLY	80009	670-5214-01
A5	670-5214-03	B010963	B019999	CKT BOARD ASSY:LOW VOLTAGE POWER SUPPLY	80009	670-5214-03
A5	670-5214-04	B020000		CKT BOARD ASSY:LOW VOLTAGE POWER SUPPLY	80009	670-5214-04
A6	670-5459-00	B010100	B010862	CKT BOARD ASSY:DC INPUT	80009	670-5459-00
A6	----- -----			(OPTION 20 ONLY)		
A6	670-5459-01	B010863		CKT BOARD ASSY:DC INPUT	80009	670-5459-01
A6	----- -----			(A6, OPTION 20 ONLY)		
C110	281-0153-00			CAP.,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-005
C110	----- -----			(C110, OPTION 22 ONLY)		
C112	281-0510-00			CAP.,FXD,CER DI:22PF,+/-4.4PF,500V	59660	301-000C0G0220M
C112	----- -----			(C112, OPTION 22 ONLY)		
C116	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	SA201C103KAA
C122	281-0205-00			CAP.,VAR,PLSTC:5.5-65PF,100V	80031	2810C5R565QJ02F0
C123	281-0759-00			CAP.,FXD,CER DI:22PF,10%,100V	72982	8035D9AADC1G220K
C132	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	SA201C103KAA
C138	281-0202-00			CAP.,VAR,PLSTC:1.5-5.5PF,100V	80031	2807C1R406MM02F
C142	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	SA201C103KAA
C153	281-0202-00			CAP.,VAR,PLSTC:1.5-5.5PF,100V	80031	2807C1R406MM02F
C154	281-0604-00			CAP.,FXD,CER DI:2.2PF,+/-0.25PF,500V	04222	7001-C0J-2R2C
C172	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	SA201C103KAA
C178	281-0661-00			CAP.,FXD,CER DI:0.8PF,+/-0.1PF,500V	04222	7001-COK-OR8B
C194	290-0766-00			CAP.,FXD,ELCTLT:2.2UF,+50-10%,160V	54473	ECEA2CS2R2
C196	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C197	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	SA201C103KAA
C198	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C210	281-0153-00			CAP.,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-005
C210	----- -----			(C210, OPTION 22 ONLY)		
C212	281-0510-00			CAP.,FXD,CER DI:22PF,+/-4.4PF,500V	59660	301-000C0G0220M
C212	----- -----			(C212, OPTION 22 ONLY)		
C216	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	SA201C103KAA
C242	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	SA201C103KAA
C244	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	SA201C103KAA
C272	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	SA201C103KAA
C278	281-0661-00			CAP.,FXD,CER DI:0.8PF,+/-0.1PF,500V	04222	7001-COK-OR8B
C310	281-0153-00			CAP.,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-005
C310	----- -----			(C310, OPTION 22 ONLY)		
C312	281-0510-00			CAP.,FXD,CER DI:22PF,+/-4.4PF,500V	59660	301-000C0G0220M
C312	----- -----			(C312, OPTION 22 ONLY)		
C316	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	SA201C103KAA
C323	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	04222	GA101A470KAA
C332	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	SA201C103KAA
C338	281-0627-00			CAP.,FXD,CER DI:1PF,+/-0.25PF,500V	04222	77001-C0K-1R0C
C342	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	SA201C103KAA
C353	281-0202-00			CAP.,VAR,PLSTC:1.5-5.5PF,100V	80031	2807C1R406MM02F
C354	281-0604-00			CAP.,FXD,CER DI:2.2PF,+/-0.25PF,500V	04222	7001-C0J-2R2C
C372	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	SA201C103KAA

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C378	281-0661-00			CAP.,FXD,CER DI:0.8PF,+/-0.1PF,500V	04222	7001-COK-OR8B
C394	290-0766-00			CAP.,FXD,ELCTLT:2.2UF,+50-10%,160V	54473	ECEA2CS2R2
C396	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C397	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	SA201C103KAA
C398	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C410	281-0153-00			CAP.,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-005
C410	----- -----			(C410, OPTION 22 ONLY)		
C412	281-0510-00			CAP.,FXD,CER DI:22PF,+/-4.4PF,500V	59660	301-000C0G0220M
C412	----- -----			(C412, OPTION 22 ONLY)		
C416	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	SA201C103KAA
C442	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	SA201C103KAA
C444	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	SA201C103KAA
C472	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	SA201C103KAA
C478	281-0661-00			CAP.,FXD,CER DI:0.8PF,+/-0.1PF,500V	04222	7001-COK-OR8B
C516	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	SA201C103KAA
C523	281-0562-00			CAP.,FXD,CER DI:39PF,10%,500V	59660	301-000U2J0390K
C530	281-0593-00			CAP.,FXD,CER DI:3.9PF,10%,500V	04222	7001-C0J-3R9C
C531	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C538	281-0811-00			CAP.,FXD,CER DI:10PF,10%,100V	72982	8035D2AADC1G100K
C560	281-0518-00			CAP.,FXD,CER DI:47PF,+/-9.4PF,500V	59660	301-000U2J0470M
C564	281-0814-00			CAP.,FXD,CER DI:100PF,10%,100V	04222	GC70-1-A101K
C570	283-0057-00			CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	2C20Z5U104Z200B
C574	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	SA201C103KAA
C580	283-0057-00			CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	2C20Z5U104Z200B
C587	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	SA201C103KAA
C591	281-0064-00			CAP.,VAR,PLSTC:0.25-1.5PF,600V	74970	273-0001-101
C616	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	SA201C103KAA
C630	281-0544-00			CAP.,FXD,CER DI:5.6PF,10%,500V	04222	7001-COH-5R6D
C650	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C660	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C660	----- -----			(C660, OPTION 4 AND OPTION 25 ONLY)		
C811	290-0527-00	B020000		CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C816	290-0719-00			CAP.,FXD,ELCTLT:47UF,20%,25V	56289	196D476X0025TE3
C818	290-0719-00			CAP.,FXD,ELCTLT:47UF,20%,25V	56289	196D476X0025TE3
C819	290-0529-00			CAP.,FXD,ELCTLT:47UF,20%,20V	05397	T362C476M020AS
C823	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	56289	273C11
C824	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	56289	273C11
C830	290-0721-00			CAP.,FXD,ELCTLT:100UF,20%,20V	56289	196D107X0020TE3
C831	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C832	283-0134-00	B010100	B019999	CAP.,FXD,CER DI:0.47UF,+80-20%,50V	72982	8131N087Z5U0474Z
C832	290-0534-00	B020000		CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C834	283-0341-00			CAP.,FXD,CER DI:0.047UF,10%,100V	72982	8121N153X7R0473K
C837	283-0067-00	B010100	B019999	CAP.,FXD,CER DI:0.001UF,10%,200V	59660	835-515-Z5D0102K
C837	281-0786-00	B020000		CAP.,FXD,CER DI:150PF,10%,100V	51642	G1710100NP0151K
C852	283-0034-00			CAP.,FXD,CER DI:0.005UF,20%,4000V	51406	DHR23Z5V502M4KV
C854	285-1138-00			CAP.,FXD,PLSTC:0.01UF,10%,8000V	56289	430P558
C858	285-1138-00	B010100	B019999	CAP.,FXD,PLSTC:0.01UF,10%,8000V	56289	430P558
C858	285-1193-00	B020000		CAP.,FXD,MTLZD:0.033UF,10%,6000V		
C860	281-0513-00			CAP.,FXD,CER DI:27PF,+/-5.4PF,500V	59660	301-055P2G0270M
C869	290-0758-00			CAP.,FXD,ELCTLT:2.2UF,+50-10%,160V	56289	502D227
C872	283-0300-00			CAP.,FXD,CER DI:0.001UF,+80-20%,10,000V	59660	3910BA303X5T0102
C879	285-1138-00			CAP.,FXD,PLSTC:0.01UF,10%,8000V	56289	430P558
C888	285-1082-00			CAP.,FXD,PLSTC:0.47UF,20%,200V	14752	230B1C474
C889	290-0164-00			CAP.,FXD,ELCTLT:1UF,+50-10%,150V	56289	500D105F150BA7

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C890	290-0164-00			CAP.,FXD,ELCTLT:1UF,+50-10%,150V	56289	500D105F150BA7
C894	283-0057-00			CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	2C20Z5U104Z200B
C897	281-0580-00			CAP.,FXD,CER DI:470PF,10%,500V	04222	7001-1374
C899	283-0057-00			CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	2C20Z5U104Z200B
C900	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	SDDH66J103Z
C920	283-0300-00			CAP.,FXD,CER DI:0.001UF,+80-20%,10,000V	59660	3910BA303X5T0102
C921	283-0013-00			CAP.,FXD,CER DI:0.01UF,+100-0%,1000V	59660	818-602ZSUO103P
C938	283-0341-00			CAP.,FXD,CER DI:0.047UF,10%,100V	72982	8121N153X7R0473K
C943	283-0341-00			CAP.,FXD,CER DI:0.047UF,10%,100V	72982	8121N153X7R0473K
C946	283-0341-00			CAP.,FXD,CER DI:0.047UF,10%,100V	72982	8121N153X7R0473K
C950	290-0818-00			CAP.,FXD,ELCTLT:390UF,+100-10%,40V	56289	672D397H040DS5C
C951	290-0506-00			CAP.,FXD,ELCTLT:9600UF,+100-10%,25V	56289	68D10471
C952	290-0583-00			CAP.,FXD,ELCTLT:3000UF,+100-10%,35V	56289	68D10490
C954	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L
C959	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	SDDH66J103Z
C961	281-0580-00			CAP.,FXD,CER DI:470PF,10%,500V	04222	7001-1374
C965	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C976	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L
C978	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	SDDH66J103Z
C983	281-0549-00			CAP.,FXD,CER DI:68PF,10%,500V	59660	301-000U2J0680K
C994	281-0580-00			CAP.,FXD,CER DI:470PF,10%,500V	04222	7001-1374
C1018	281-0775-00	B010863		CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
C1018	----- -----			(OPTION 20 ONLY)		
C1020	290-0529-00	B010863		CAP.,FXD,ELCTLT:47UF,20%,20V	05397	T362C476M020AS
C1020	----- -----			(OPTION 20 ONLY)		
C1056	281-0775-00	B010863		CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
C1056	----- -----			(OPTION 20 ONLY)		
C1057	290-0512-00	B010863		CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
C1057	----- -----			(OPTION 20 ONLY)		
C1120	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C1120	----- -----			(C1120, OPTION 4 ONLY)		
C1122	283-0041-00			CAP.,FXD,CER DI:0.0033UF,5%,500V	59660	841-542B332J
C1122	----- -----			(C1122, OPTION 4 ONLY)		
C1138	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C1138	----- -----			(C1138, OPTION 4 ONLY)		
C1140	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C1140	----- -----			(C1140, OPTION 4 ONLY)		
C1143	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	04222	GA101A470KAA
C1143	----- -----			(C1143, OPTION 4 ONLY)		
C1156	295-0159-00			CAP SET,MATCHED:1UF,0.01UF,0.001UF	80009	295-0159-00
C1156	----- -----			(C1156, OPTION 4 ONLY)		
C1157	295-0159-00			CAP SET,MATCHED:1UF,0.01UF,0.001UF	80009	295-0159-00
C1157	----- -----			(C1157, OPTION 4 ONLY)		
C1159	295-0159-00			CAP SET,MATCHED:1UF,0.01UF,0.001UF	80009	295-0159-00
C1159	----- -----			(C1159, OPTION 4 ONLY)		
C1164	281-0792-00			CAP.,FXD,CER DI:82PF,10%,100V	72982	8035D2AADC0G820K
C1164	----- -----			(C1164, OPTION 4 ONLY)		
C1170	281-0786-00			CAP.,FXD,CER DI:150PF,10%,100V	51642	G1710100NP0151K
C1170	----- -----			(C1170, OPTION 4 ONLY)		
C1190	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C1190	----- -----			(C1190, OPTION 4 ONLY)		
C1192	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C1192	----- -----			(C1192, OPTION 4 ONLY)		
C1195	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C1195	----- -----			(C1195, OPTION 4 ONLY)		

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C1197	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C1197	----- -----			(C1197, OPTION 4 ONLY)		
CR118	152-0246-00			SEMICOND DEVICE:SW,SI,40V,200MA	03508	DE140
CR130	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR156	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR163	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR164	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR174	152-0574-00			SEMICOND DEVICE:SILICON,120V,0.15A	14433	WG1308
CR218	152-0246-00			SEMICOND DEVICE:SW,SI,40V,200MA	03508	DE140
CR230	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR263	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR264	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR274	152-0574-00			SEMICOND DEVICE:SILICON,120V,0.15A	14433	WG1308
CR318	152-0246-00			SEMICOND DEVICE:SW,SI,40V,200MA	03508	DE140
CR330	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR356	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR363	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR364	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR374	152-0574-00			SEMICOND DEVICE:SILICON,120V,0.15A	14433	WG1308
CR418	152-0246-00			SEMICOND DEVICE:SW,SI,40V,200MA	03508	DE140
CR430	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR463	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR464	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR474	152-0574-00			SEMICOND DEVICE:SILICON,120V,0.15A	14433	WG1308
CR518	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR540	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR541	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR550	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR550	----- -----			(CR550, OPTION 25 ONLY)		
CR551	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR551	----- -----			(CR551, OPTION 25 ONLY)		
CR564	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR573	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR585	152-0574-00			SEMICOND DEVICE:SILICON,120V,0.15A	14433	WG1308
CR618	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR810	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR816	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR818	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR820	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR822	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR823	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR824	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR825	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR826	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR830	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR831	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR832	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR833	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR852	152-0429-00			SEMICOND DEVICE:SILICON,5000V,10MA	14099	SA3282
CR853	152-0429-00			SEMICOND DEVICE:SILICON,5000V,10MA	14099	SA3282
CR860	152-0242-00			SEMICOND DEVICE:SILICON,225V,200MA	07263	FDH5004
CR868	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012

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CR869	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
CR872	152-0242-00			SEMICOND DEVICE:SILICON,225V,200MA	07263	FDH5004
CR874	152-0242-00			SEMICOND DEVICE:SILICON,225V,200MA	07263	FDH5004
CR876	152-0242-00			SEMICOND DEVICE:SILICON,225V,200MA	07263	FDH5004
CR888	152-0400-00			SEMICOND DEVICE:SILICON,400V,1A	80009	152-0400-00
CR889	152-0400-00			SEMICOND DEVICE:SILICON,400V,1A	80009	152-0400-00
CR890	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
CR891	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
CR903	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR904	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR938	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR943	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR951	152-0198-00			SEMICOND DEVICE:SILICON,200V,3A	03508	1N5624
CR952	152-0198-00			SEMICOND DEVICE:SILICON,200V,3A	03508	1N5624
CR953	152-0198-00			SEMICOND DEVICE:SILICON,200V,3A	03508	1N5624
CR954	152-0198-00			SEMICOND DEVICE:SILICON,200V,3A	03508	1N5624
CR955	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	14433	LG4016
CR957	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	14433	LG4016
CR962	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR972	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
CR976	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	14433	LG4016
CR978	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	14433	LG4016
CR981	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR993	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR1010	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	14433	LG4016
CR1010	---- -----			(CR1010, OPTION 20 ONLY		
CR1050	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	14433	LG4016
CR1050	---- ----			(CR1050, OPTION 20 ONLY)		
CR1150	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1150	---- ----			(CR1150, OPTION 4 ONLY)		
CR1186	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1186	---- ----			(CR1186, OPTION 4 ONLY)		
DS512	150-1017-00			LT EMITTING DIO:GREEN,550NM,55MA MAX	50437	LSM-16L-100
DS920	150-0111-00			LAMP,GLOW:NEON,1.2MA	53944	A1B-3
E856	119-0181-00			ARSR,ELEC SURGE:230V,GAS FILLED	74276	CG230L
E876	119-0181-00			ARSR,ELEC SURGE:230V,GAS FILLED	74276	CG230L
E878	119-0181-00			ARSR,ELEC SURGE:230V,GAS FILLED	74276	CG230L
F950	159-0018-00			FUSE,CARTRIDGE:3AG,0.8A,250V,SLOW-BLOW	71400	MDL 8/10
F950	159-0031-00			FUSE,CARTRIDGE:3AG,0.4A,250V,SLOW-BLOW	71400	MDL 4/10
F950	---- ----			(F950, ALTERNATE)		
F951	159-0015-00	B010100	B010962	FUSE,CARTRIDGE:3AG,3A,250V,0.65 SEC	71400	AGC 3
F951	159-0021-00	B010963		FUSE,CARTRIDGE:3AG,2A,250V,FAST-BLOW	71400	AGC 2
F953	159-0025-00			FUSE,CARTRIDGE:3AG,0.5A,250V,FAST-BLOW	71400	AGC 1/2
F955	159-0025-00			FUSE,CARTRIDGE:3AG,0.5A,250V,FAST-BLOW	71400	AGC 1/2
F1001	159-0015-00			FUSE,CARTRIDGE:3AG,3A,250V,0.65 SEC	71400	AGC 3
F1001	---- ----			(F1001, OPTION 20 ONLY)		
F1003	159-0022-00			FUSE,CARTRIDGE:3AG,1A,250V,FAST-BLOW	71400	AGC 1
F1003	---- ----			(F1003, OPTION 20 ONLY)		
J100	131-1782-00			CONN,RCPT,ELEC:RT ANGLE,12 FEM,0.045 SQ	27264	09-52-3121
J101	131-0955-00			CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279

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J301	131-0955-00			CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
J500	131-1782-00			CONN,RCPT,ELEC:RT ANGLE,12 FEM,0.045 SQ	27264	09-52-3121
J501	131-0955-00			CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
J800	131-2077-00			TERM.,FEEDTHRU:CKT CARD,RT ANGLE,15 FEMALE	27264	09-52-3151
L889	108-0155-00			COIL,RF:FIXED,1MH	80009	108-0155-00
L951	108-0337-00			COIL,RF:25UH	80009	108-0337-00
Q120	151-1054-00			TRANSISTOR:SILICON,JFE,N-CHANNEL,DUAL	80009	151-1054-00
Q130	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q134	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q134	----- -----			(Q134, OPTION 4 ONLY)		
Q140	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q150	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q160	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q174	151-0615-00	B010100	B021078	TRANSISTOR:SILICON,NPN	04713	SDS358K
Q174	151-0615-01	B021079		TRANSISTOR:2N6558,SCREENED	80009	151-0615-01
Q176	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS652	04713	SPS8801
Q230	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q240	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q260	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q274	151-0615-00	B010100	B021078	TRANSISTOR:SILICON,NPN	04713	SDS358K
Q274	151-0615-01	B021079		TRANSISTOR:2N6558,SCREENED	80009	151-0615-01
Q276	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS652	04713	SPS8801
Q320	151-1054-00			TRANSISTOR:SILICON,JFE,N-CHANNEL,DUAL	80009	151-1054-00
Q330	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q340	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q350	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q360	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q374	151-0615-00	B010100	B021078	TRANSISTOR:SILICON,NPN	04713	SDS358K
Q374	151-0615-01	B021079		TRANSISTOR:2N6558,SCREENED	80009	151-0615-01
Q376	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS652	04713	SPS8801
Q430	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q440	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q460	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q474	151-0615-00	B010100	B021078	TRANSISTOR:SILICON,NPN	04713	SDS358K
Q474	151-0615-01	B021079		TRANSISTOR:2N6558,SCREENED	80009	151-0615-01
Q476	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS652	04713	SPS8801
Q520	151-1042-00			SEMICOND DVC SE:MATCHED PAIR FET	01295	SKA5390
Q530	151-0216-00			TRANSISTOR:SILICON,PNP	04713	SPS8803
Q534	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q545	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q558	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q558	----- -----			(Q558, OPTION 4 AND OPTION 25 ONLY)		
Q562	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q570	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q580	151-0406-00	B010100	B021078	TRANSISTOR:SILICON,PNP	04713	OBD
Q580	151-0406-02	B021079		TRANSISTOR:SGC7282,SCREENED	04713	ST1264H
Q590	151-0407-00	B010100	B021078	TRANSISTOR:SILICON,NPN	04713	SS2456
Q590	151-0407-01	B021079		TRANSISTOR:SILICON,NPN	80009	151-0407-01
Q630	151-0216-00			TRANSISTOR:SILICON,PNP	04713	SPS8803
Q634	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q810	151-0136-00			TRANSISTOR:SILICON,NPN	02735	35495
Q814	151-0134-00			TRANSISTOR:SILICON,PNP	80009	151-0134-00

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Q816	151-0349-00	B010100	B021078	TRANSISTOR:SILICON,NPN,SEL FROM MJE280	04713	SJE924
Q816	151-0349-05	B021079		TRANSISTOR:SILICON,NPN,SCREENED	80009	151-0349-05
Q826	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q864	151-0444-00			TRANSISTOR:SILICON,NPN	04713	SPS797
Q896	151-0350-00			TRANSISTOR:SILICON,PNP	04713	SPS6700
Q899	151-0647-00			TRANSISTOR:SILICON,PNP	04713	SJE795
Q910	151-0444-00			TRANSISTOR:SILICON,NPN	04713	SPS797
Q955	151-0405-00	B010100	B021078	TRANSISTOR:SILICON,NPN,SEL FROM MJE800	04713	SJE943
Q955	151-0405-04	B021079		TRANSISTOR:SILICON,NPN,SCREENED	80009	151-0405-04
Q962	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q965	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q970	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q976	151-0405-00	B010100	B021078	TRANSISTOR:SILICON,NPN,SEL FROM MJE800	04713	SJE943
Q976	151-0405-04	B021079		TRANSISTOR:SILICON,NPN,SCREENED	80009	151-0405-04
Q981	151-0350-00			TRANSISTOR:SILICON,PNP	04713	SPS6700
Q987	151-0350-00			TRANSISTOR:SILICON,PNP	04713	SPS6700
Q994	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q1015	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q1015	---- ----			(Q1015, OPTION 20 ONLY)		
Q1017	151-0188-00	B010863		TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q1017	---- ----			(Q1017, OPTION 20 ONLY)		
Q1021	151-0478-00			TRANSISTOR:SILICON,NPN	04713	SJE410
Q1021	---- ----			(Q1021, OPTION 20 ONLY)		
Q1025	151-0482-00	B010100	B010682	TRANSISTOR:SILICON,PNP	80009	151-0482-00
Q1025	---- ----			(Q1025, OPTION 20 ONLY)		
Q1025	151-0625-00	B010683	B010862	TRANSISTOR:SILICON,PNP	03508	D45H11
Q1025	---- ----			(Q1025, OPTION 20 ONLY)		
Q1025	151-0616-00	B010863		TRANSISTOR:SILICON,PNP	04713	SJE377
Q1025	---- ----			(Q1025, OPTION 20 ONLY)		
Q1056	151-0190-00	B010100	B010862	TRANSISTOR:SILICON,NPN	07263	S032677
Q1056	---- ----			(Q1056, OPTION 20 ONLY)		
Q1056	151-0301-00	B010863		TRANSISTOR:SILICON,PNP	27014	2N2907A
Q1056	---- ----			(Q1056, OPTION 20 ONLY)		
Q1075	151-0478-00			TRANSISTOR:SILICON,NPN	04713	SJE410
Q1075	---- ----			(Q1075, OPTION 20 ONLY)		
Q1076	151-0301-00	B010863		TRANSISTOR:SILICON,PNP	27014	2N2907A
Q1076	---- ----			(Q1076, OPTION 20 ONLY)		
Q1110	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q1110	---- ----			(Q1110, OPTION 4 ONLY)		
Q1150	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
Q1150	---- ----			(Q1150, OPTION 4 ONLY)		
Q1160	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q1160	---- ----			(Q1160, OPTION 4 ONLY)		
Q1170	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q1170	---- ----			(Q1170, OPTION 4 ONLY)		
Q1180	151-0342-00			TRANSISTOR:SILICON,PNP	07263	S035928
Q1180	---- ----			(Q1180, OPTION 4 ONLY)		
R105	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R105	---- ----			(R105, OPTION 22 ONLY)		
R110	321-0891-00			RES.,FXD,FILM:800K OHM,1%,0.125W	91637	MFF1816G80002F
R110	---- ----			(R110, OPTION 22 ONLY)		
R112	321-0423-00			RES.,FXD,FILM:249K OHM,1%,0.125W	91637	MFF1816G24902F
R112	---- ----			(R112, OPTION 22 ONLY)		

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R114	321-0481-00			RES.,FXD,FILM:1M OHM,1%,0.125W	24546	NA4D1004F
R116	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R118	315-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	01121	CB1325
R120	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R123	321-0118-00			RES.,FXD,FILM:165 OHM,1%,0.125W	91637	MFF1816G165R0F
R124	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R125	311-2001-00			RES.,VAR,NONWIR:PNL,2.5K OHM,20%,0.5W	01121	73M4G04L252T
R130	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R132	315-0161-00			RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
R133	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R134	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R134	----- -----			(R134, OPTION 4 ONLY)		
R135	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R135	----- -----			(R135, OPTION 4 ONLY)		
R136	321-0265-00			RES.,FXD,FILM:5.62K OHM,1%,0.125W	91637	MFF1816G56200F
R136	----- -----			(R136, OPTION 4 ONLY)		
R142	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R144	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R147	311-1958-00			RES.,VAR,NONWIR:PANEL,1K OHM,10%,0.50W	01121	WP1G032S102UZ
R149	321-0213-00			RES.,FXD,FILM:1.62K OHM,1%,0.125W	91637	MFF1816G16200F
R150	321-0175-00			RES.,FXD,FILM:649 OHM,1%,0.125W	91637	MFF1816G649R0F
R151	321-0231-00			RES.,FXD,FILM:2.49K OHM,1%,0.125W	91637	MFF1816G24900F
R153	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
R154	315-0684-00			RES.,FXD,CMPSN:680K OHM,5%,0.25W	01121	CB6845
R155	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R156	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R160	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R172	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R173	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R174	308-0348-00			RES.,FXD,WW:3.32K OHM,1%,3W	91637	RS2B-B33200F
R176	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R178	323-0347-00			RES.,FXD,FILM:40.2K OHM,1%,0.50W	75042	CECT0-4022F
R194	315-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R196	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R197	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R198	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R210	321-0891-00			RES.,FXD,FILM:800K OHM,1%,0.125W	91637	MFF1816G80002F
R210	----- -----			(R210, OPTION 22 ONLY)		
R212	321-0423-00			RES.,FXD,FILM:249K OHM,1%,0.125W	91637	MFF1816G24902F
R212	----- -----			(R212, OPTION 22 ONLY)		
R214	321-0481-00			RES.,FXD,FILM:1M OHM,1%,0.125W	24546	NA4D1004F
R216	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R218	315-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	01121	CB1325
R220	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R224	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R230	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R233	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R242	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R244	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R251	321-0231-00			RES.,FXD,FILM:2.49K OHM,1%,0.125W	91637	MFF1816G24900F
R260	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R272	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R273	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R274	308-0348-00			RES.,FXD,WW:3.32K OHM,1%,3W	91637	RS2B-B33200F

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R276	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R277	308-0507-00			RES.,FXD,WW:1K OHM,1%,3W	91637	RS2B-B10000F
R278	323-0347-00			RES.,FXD,FILM:40.2K OHM,1%,0.50W	75042	CECT0-4022F
R305	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R310	321-0891-00			RES.,FXD,FILM:800K OHM,1%,0.125W	91637	MFF1816G80002F
R310	----- -----			(R310, OPTION 22 ONLY)		
R312	321-0423-00			RES.,FXD,FILM:249K OHM,1%,0.125W	91637	MFF1816G24902F
R312	----- -----			(R312, OPTION 22 ONLY)		
R314	321-0481-00			RES.,FXD,FILM:1M OHM,1%,0.125W	24546	NA4D1004F
R316	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R318	315-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	01121	CB1325
R320	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R323	321-0118-00			RES.,FXD,FILM:165 OHM,1%,0.125W	91637	MFF1816G165R0F
R324	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R325	311-2001-00			RES.,VAR,NONWIR:PNL,2.5K OHM,20%,0.5W	01121	73M4G04L252T
R330	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R332	315-0161-00			RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
R333	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R342	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R344	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R347	311-1958-00			RES.,VAR,NONWIR:PANEL,1K OHM,10%,0.50W	01121	WP1G032S102UZ
R349	321-0213-00			RES.,FXD,FILM:1.62K OHM,1%,0.125W	91637	MFF1816G16200F
R350	321-0175-00			RES.,FXD,FILM:649 OHM,1%,0.125W	91637	MFF1816G649R0F
R351	321-0231-00			RES.,FXD,FILM:2.49K OHM,1%,0.125W	91637	MFF1816G24900F
R353	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
R354	315-0684-00			RES.,FXD,CMPSN:680K OHM,5%,0.25W	01121	CB6845
R355	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R356	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R360	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R361	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R372	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R373	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R374	308-0348-00			RES.,FXD,WW:3.32K OHM,1%,3W	91637	RS2B-B33200F
R376	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R378	323-0347-00			RES.,FXD,FILM:40.2K OHM,1%,0.50W	75042	CECT0-4022F
R394	315-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R396	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R397	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R398	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R410	321-0891-00			RES.,FXD,FILM:800K OHM,1%,0.125W	91637	MFF1816G80002F
R410	----- -----			(R410, OPTION 22 ONLY)		
R412	321-0423-00			RES.,FXD,FILM:249K OHM,1%,0.125W	91637	MFF1816G24902F
R412	----- -----			(R412, OPTION 22 ONLY)		
R414	321-0481-00			RES.,FXD,FILM:1M OHM,1%,0.125W	24546	NA4D1004F
R416	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R418	315-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	01121	CB1325
R420	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R424	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R430	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R433	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R435	315-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	01121	CB1325
R435	----- -----			(R435, OPTION 4 ONLY)		
R436	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R436	----- -----			(R436, OPTION 4 ONLY)		

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R442	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R444	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R451	321-0231-00			RES.,FXD,FILM:2.49K OHM,1%,0.125W	91637	MFF1816G24900F
R460	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R461	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R472	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R473	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R474	308-0348-00			RES.,FXD,WW:3.32K OHM,1%,3W	91637	RS2B-B33200F
R476	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R477	308-0507-00			RES.,FXD,WW:1K OHM,1%,3W	91637	RS2B-B10000F
R478	323-0347-00			RES.,FXD,FILM:40.2K OHM,1%,0.50W	75042	CECT0-4022F
R512	301-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.50W	01121	EB3615
R514	321-0481-00			RES.,FXD,FILM:1M OHM,1%,0.125W	24546	NA4D1004F
R516	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R518	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R520	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R523	321-0120-00			RES.,FXD,FILM:174 OHM,1%,0.125W	91637	MFF1816G174R0F
R525	311-1563-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	73138	91-85-0
R530	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R534	321-0218-00			RES.,FXD,FILM:1.82K OHM,1%,0.125W	91637	MFF1816G18200F
R538	315-0184-00			RES.,FXD,CMPSN:180K OHM,5%,0.25W	01121	CB1845
R539	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R540	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R543	321-0183-00			RES.,FXD,FILM:787 OHM,1%,0.125W	91637	MFF1816G787R0F
R544	311-1958-00			RES.,VAR,NONWIR:PANEL,1K OHM,10%,0.50W	01121	WP1G032S102UZ
R545	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R546	315-0200-00			RES.,FXD,CMPSN:20 OHM,5%,0.25W	01121	CB2005
R548	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R551	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R551	----- -----			(R551, OPTION 4 AND OPTION 25 ONLY)		
R552	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R552	----- -----			(R552, OPTION 25 ONLY)		
R553	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R553	----- -----			(R553, OPTION 4 AND OPTION 25 ONLY)		
R554	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R555	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R556	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R557	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	01121	CB8235
R560	311-1563-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	73138	91-85-0
R564	315-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R570	315-0160-00			RES.,FXD,CMPSN:16 OHM,5%,0.25W	01121	CB1605
R572	315-0124-00			RES.,FXD,CMPSN:120K OHM,5%,0.25W	01121	CB1245
R573	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R580	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R582	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R584	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R587	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R590	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R591	323-0303-00			RES.,FXD,FILM:14K OHM,1%,0.50W	75042	CECT0-1402F
R614	321-0481-00			RES.,FXD,FILM:1M OHM,1%,0.125W	24546	NA4D1004F
R616	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R618	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R620	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R630	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025

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R634	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R639	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R650	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R651	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R652	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R810	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R811	307-0051-00	B010100	B019999	RES.,FXD,CMPSN:2.7 OHM,5%,0.50W	01121	EB27G5
R811	301-0330-00	B020000		RES.,FXD,CMPSN:33 OHM,5%,0.50W	01121	EB3305
R812	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R814	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R816	308-0679-00			RES.,FXD,WW:0.51 OHM,5%,2W	75042	BWH-R5100J
R818	308-0679-00			RES.,FXD,WW:0.51 OHM,5%,2W	75042	BWH-R5100J
R819	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R820	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R822	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R824	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R826	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R830	315-0162-00			RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	01121	CB1625
R831	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R832	315-0223-00	B010100	B019999	RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R832	315-0104-00	B020000		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R833	315-0821-00	B010100	B019999	RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R833	315-0222-00	B020000		RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R834	315-0221-00	B010100	B019999	RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R834	315-0101-00	B020000		RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R836	315-0364-00	B010100	B019999	RES.,FXD,CMPSN:360K OHM,5%,0.25W	01121	CB3645
R836	315-0226-00	B020000		RES.,FXD,CMPSN:22M OHM,5%,0.25W	01121	CB2265
R837	315-0273-00	B010100	B019999	RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R837	---- ----			(REFER TO W837)		
R839	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R841	311-1960-00			RES.,VAR,NONWIR:PANEL,50K OHM,20%,0.75W	01121	73U1G148L503M
R844	311-1959-00			RES.,VAR,NONWIR:PANEL,5M OHM,20%,0.50W	01121	WP1G032S505MZ
R850	307-0051-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.50W	01121	EB27G5
R854	301-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.50W	01121	EB4705
R856	301-0163-00	B010100	B019999	RES.,FXD,CMPSN:16K OHM,5%,0.50W	01121	EB1635
R856	301-0822-00	B020000		RES.,FXD,CMPSN:8.2K OHM,5%,0.50W	01121	EB8225
R858	301-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.50W	01121	EB4705
R860	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R862	311-1229-00			RES.,VAR,NONWIR:15K OHM,20%,0.50W	32997	3386F-T04-153
R864	321-0344-00			RES.,FXD,FILM:37.4K OHM,1%,0.125W	91637	MFF1816G37401F
R865	301-0123-00	B010100	B010532	RES.,FXD,CMPSN:12K OHM,5%,0.50W	01121	EB1235
R865	301-0822-00	B010533		RES.,FXD,CMPSN:8.2K OHM,5%,0.50W	01121	EB8225
R866	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R867	321-0376-00	B010100	B010532	RES.,FXD,FILM:80.6K OHM,1%,0.125W	91637	MFF1816G80601F
R867	321-0382-00	B010533		RES.,FXD,FILM:93.1K OHM,1%,0.125W	91637	MFF1816G93101F
R868	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R872	301-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.50W	01121	EB4725
R874	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R876	315-0226-00			RES.,FXD,CMPSN:22M OHM,5%,0.25W	01121	CB2265
R878	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R879	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R880	301-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.50W	01121	EB2215
R890	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R893	303-0330-00			RES.,FXD,CMPSN:33 OHM,5%,1W	01121	GB3305

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R895	307-0057-00			RES.,FXD,CMPSN:5.1 OHM,5%,0.50W	01121	EB51G5
R896	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R897	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R898	308-0127-00			RES.,FXD,WW:2.5K OHM,5%,5W	91637	CW5-25000J
R900	323-0385-00			RES.,FXD,FILM:100K OHM,1%,0.50W	75042	CECT0-1003F
R901	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
R902	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R903	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R904	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R905	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R907	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R910	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R911	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R917	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R918	311-1563-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	73138	91-85-0
R919	321-0277-00			RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R920	307-0572-00			RES NTWK,FXD FI:HIGH VOLTAGE DIVIDER	80009	307-0572-00
R921	315-0824-00			RES.,FXD,CMPSN:820K OHM,5%,0.25W	01121	CB8245
R937	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R939	316-0471-00			RES.,FXD,CMPSN:470 OHM,10%,0.25W	01121	CB4711
R942	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R943	311-1556-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	73138	91-78-0
R944	316-0471-00			RES.,FXD,CMPSN:470 OHM,10%,0.25W	01121	CB4711
R946	316-0471-00			RES.,FXD,CMPSN:470 OHM,10%,0.25W	01121	CB4711
R947	301-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.50W	01121	EB1015
R949	311-1484-00			RES.,VAR,NONWIR:PNL,2.5K OHM,1W	01121	11M110
R954	308-0767-00			RES.,FXD,WW:1.1 OHM,5%,1W	75042	BW20-1R100J
R955	308-0079-00			RES.,FXD,WW:117 OHM,5%,5W	91637	RS5-K117R0J
R957	321-0232-00			RES.,FXD,FILM:2.55K OHM,1%,0.125W	91637	MFF1816G25500F
R958	311-1564-00			RES.,VAR,NONWIR:TRMR,500 OHM,0.5W	73138	91-86-0
R959	321-0213-00			RES.,FXD,FILM:1.62K OHM,1%,0.125W	91637	MFF1816G16200F
R961	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R962	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R963	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R965	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R967	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R968	321-0184-00			RES.,FXD,FILM:806 OHM,1%,0.125W	91637	MFF1816G806R0F
R970	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R972	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R973	301-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.50W	01121	EB3035
R975	308-0686-00			RES.,FXD,WW:2.2 OHM,5%,2W	75042	BWH-2R200J
R976	308-0079-00			RES.,FXD,WW:117 OHM,5%,5W	91637	RS5-K117R0J
R978	321-0779-03			RES.,FXD,FILM:7.020K OHM,0.25%,0.125W	91637	MFF1816D70200C
R979	321-0274-00			RES.,FXD,FILM:6.98K OHM,1%,0.125W	91637	MFF1816G69800F
R981	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R983	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R985	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R987	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R988	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R990	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R991	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R993	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R994	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R995	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035

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R1015	315-0681-00	B010100	B010862	RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R1015	----- -----			(R1015, OPTION 20 ONLY)		
R1015	301-0392-00	B010863		RES.,FXD,CMPSN:3.9K OHM,5%,0.50W	01121	EB3925
R1015	----- -----			(R1015, OPTION 20 ONLY)		
R1016	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R1016	----- -----			(R1016, OPTION 20 ONLY)		
R1017	315-0222-00	B010863		RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R1017	----- -----			(R1017, OPTION 20 ONLY)		
R1018	315-0681-00	B010863		RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R1018	----- -----			(R1018, OPTION 20 ONLY)		
R1020	308-0298-00			RES.,FXD,WW:560 OHM,5%,3W	91637	CW2B-B560R0J
R1020	----- -----			(R1020, OPTION 20 ONLY)		
R1021	308-0078-00	B010100	B010682	RES.,FXD,WW:70 OHM,5%,5W	63743	7686
R1021	----- -----			(R1021, OPTION 20 ONLY)		
R1021	308-0218-00	B010683	B010862	RES.,FXD,WW:150 OHM,5%,3W	00213	1240S-150-5
R1021	----- -----			(R1021, OPTION 20 ONLY)		
R1021	308-0078-00	B010863		RES.,FXD,WW:70 OHM,5%,5W	63743	7686
R1021	----- -----			(R1021, OPTION 20 ONLY)		
R1025	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R1025	----- -----			(R1025, OPTION 20 ONLY)		
R1055	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R1055	----- -----			(R1055, OPTION 20 ONLY)		
R1056	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R1056	----- -----			(R1056, OPTION 20 ONLY)		
R1075	308-0298-00	B010100	B010862	RES.,FXD,WW:560 OHM,5%,3W	91637	CW2B-B560R0J
R1075	----- -----			(R1075, OPTION 20 ONLY)		
R1075	308-0076-00	B010863		RES.,FXD,WW:300 OHM,5%,3W	14193	SA30300 OHM 5%
R1075	----- -----			(R1075, OPTION 20 ONLY)		
R1076	315-0332-00	B010863		RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R1076	----- -----			(R1076, OPTION 20 ONLY)		
R1110	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R1110	----- -----			(R1110, OPTION 4 ONLY)		
R1112	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R1112	----- -----			(R1112, OPTION 4 ONLY)		
R1114	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R1114	----- -----			(R1114, OPTION 4 ONLY)		
R1116	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R1116	----- -----			(R1116, OPTION 4 ONLY)		
R1122	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R1122	----- -----			(R1122, OPTION 4 ONLY)		
R1123	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R1123	----- -----			(R1123, OPTION 4 ONLY)		
R1125	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R1125	----- -----			(R1125, OPTION 4 ONLY)		
R1130	311-0949-00			RES.,VAR,NONWIR:2K OHM,10%,0.50W	01121	WA1G040S202UA
R1130	----- -----			(R1130, OPTION 4 ONLY)		
R1134	311-0607-00			RES.,VAR,NONWIR:10K OHM,10%,0.50W	73138	82-25-2
R1134	----- -----			(R1134, OPTION 4 ONLY)		
R1140	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R1140	----- -----			(R1140, OPTION 4 ONLY)		
R1147	311-0443-00			RES.,VAR,NONWIR:2.5K OHM,20%,0.75W	11237	300SF-41330
R1147	----- -----			(R1147, OPTION 4 ONLY)		
R1148	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R1148	----- -----			(R1148, OPTION 4 ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R1151	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W	91637	MFF1816G49901F
R1151	----- -----			(R1151, OPTION 4 ONLY)		
R1153	321-0452-00			RES.,FXD,FILM:499K OHM,1%,0.125W	91637	MFF1816G49902F
R1153	----- -----			(R1153, OPTION 4 ONLY)		
R1155	307-0381-00			RES.,FXD,FILM:4.99M OHM,1%,0.5W	03888	FLYZ 4.99M+/-1%
R1155	----- -----			(R1155, OPTION 4 ONLY)		
R1162	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R1162	----- -----			(R1162, OPTION 4 ONLY)		
R1164	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R1164	----- -----			(R1164, OPTION 4 ONLY)		
R1165	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R1165	----- -----			(R1165, OPTION 4 ONLY)		
R1180	321-0251-00			RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R1180	----- -----			(R1180, OPTION 4 ONLY)		
R1182	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R1182	----- -----			(R1182, OPTION 4 ONLY)		
R1183	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R1183	----- -----			(R1183, OPTION 4 ONLY)		
R1184	311-1261-00			RES.,VAR,NONWIR:500 OHM,10%,0.50W	32997	3329P-L58-501
R1184	----- -----			(R1184, OPTION 4 ONLY)		
R1186	321-0251-00			RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R1186	----- -----			(R1186, OPTION 4 ONLY)		
R1192	301-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.50W	01121	EB2415
R1192	----- -----			(R1192, OPTION 4 ONLY)		
R1197	301-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.50W	01121	EB2415
R1197	----- -----			(R1197, OPTION 4 ONLY)		
S110	260-1811-00			SWITCH,SLIDE:DPDT,0.5 A,125VAC-DC	82389	C5B206L2
S110	----- -----			(S110, OPTION 22 ONLY)		
S210	260-1811-00			SWITCH,SLIDE:DPDT,0.5 A,125VAC-DC	82389	C5B206L2
S210	----- -----			(S210, OPTION 22 ONLY)		
S310	260-1811-00			SWITCH,SLIDE:DPDT,0.5 A,125VAC-DC	82389	C5B206L2
S310	----- -----			(S310, OPTION 22 ONLY)		
S410	260-1811-00			SWITCH,SLIDE:DPDT,0.5 A,125VAC-DC	82389	C5B206L2
S410	----- -----			(S410, OPTION 22 ONLY)		
S434	260-1811-00			SWITCH,SLIDE:DPDT,0.5 A,125VAC-DC	82389	C5B206L2
S950	260-0413-00			SW,THERMOSTATIC:10A,240V	73803	20700L63-253
S960	260-1849-02	B010100	B021864	SWITCH,PUSH:DPDT,4A,250VAC,W/BRACKET	80009	260-1849-02
S960	260-2047-00	B021865		SWITCH,PUSH:DPST,4A,250V	31918	601805
S1140	260-0960-01			SWITCH,SLIDE:0.5A,120VDC,CKT BD MT	10389	23-021-043
S1140	----- -----			(S1140, OPTION 4 ONLY)		
S1150	105-0389-00			ACTR ASSY,CAM S:TIMING	80009	105-0389-00
S1150	----- -----			(S1150, OPTION 4 ONLY)		
T950	120-1133-00			XFMR,PWR,STPDN:	80009	120-1133-00
T850	120-1187-00			XFMR,PWR,SDN & SU:HIGH VOLTAGE	80009	120-1187-00
U550	156-0382-02			MICROCIRCUIT,DI:QUAD 2-INP NAND GATE	01295	SN74LS00
U550	----- -----			(U550, OPTION 4 AND OPTION 25 ONLY)		
U832	156-0067-00	B010100	B021109	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	01295	MICROA741CP
U832	156-0067-01	B021110		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER,CHK	80009	156-0067-01
U885	152-0703-00			SEMICOND DEVICE:HV MULTR,SI,7.5KVAC,15KVDC	52306	CMX426
U905	156-0067-00	B010100	B021109	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	01295	MICROA741CP
U905	156-0067-01	B021110		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER,CHK	80009	156-0067-01

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
U1140	155-0055-00			MICROCIRCUIT,LI:MONOLITHIC,TRIG AND SWEEP	80009	155-0055-00
U1140	----- -----			(U1140, OPTION 4 ONLY)		
V950	154-0787-00			ELECTRON TUBE:CRT,T6080-31,W/0 GRATICULE	80009	154-0787-00
V950	154-0787-03	B021200		ELECTRON TUBE:CRT,T6080-07,W/O GRATICULE	80009	154-0787-03
V950	----- -----			(OPTION 76 ONLY)		
V950	154-0787-04	B021200		ELECTRON TUBE:CRT,T6080-11,W/O GRATICULE	80009	154-0787-04
V950	----- -----			(OPTION 78 ONLY)		
V950	154-0787-39			ELECTRON TUBE:CRT,T6080-39,W/O GRATICULE	80009	154-0787-39
V950	----- -----			(OPTION 40 ONLY)		
V950	154-0786-00			ELECTRON TUBE:CRT,T6080-30-1,W/GRATICULE	80009	154-0786-00
V950	----- -----			(OPTION 1 ONLY)		
V950	154-0786-03	B021200		ELECTRON TUBE:CRT,T6080-07-1,W/GRATICULE	80009	154-0786-03
V950	----- -----			(OPTION 1,76 ONLY)		
V950	154-0786-39			ELECTRON TUBE:CRT,T6080-39-1,W/GRATICULE	80009	154-0786-39
V950	----- -----			(OPTION 1,40 ONLY)		
VR434	152-0149-00			SEMICOND DEVICE:ZENER,0.4W,10V,5%	04713	SZG35009K3
VR434	----- -----			(VR434, OPTION 4 ONLY)		
VR530	152-0226-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	14552	TD3810980
VR540	152-0280-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	80009	152-0280-00
VR583	152-0282-00			SEMICOND DEVICE:ZENER,0.4W,30V,5%	14552	1N972B
VR584	152-0282-00			SEMICOND DEVICE:ZENER,0.4W,30V,5%	14552	1N972B
VR660	152-0149-00			SEMICOND DEVICE:ZENER,0.4W,10V,5%	04713	SZG35009K3
VR660	----- -----			(VR660, OPTION 4 AND OPTION 25 ONLY)		
VR819	152-0243-00			SEMICOND DEVICE:ZENER,0.4W,15V,5%	14552	TD3810983
VR822	152-0282-00			SEMICOND DEVICE:ZENER,0.4W,30V,5%	14552	1N972B
VR938	152-0241-00			SEMICOND DEVICE:ZENER,0.4W,33V,5%	04713	SZG35009K5
VR968	152-0212-00			SEMICOND DEVICE:ZENER,0.5W,9V,5%	04713	SZ50646RL
VR1015	152-0147-00			SEMICOND DEVICE:ZENER,0.4W,27V,5%	04713	SZ50622KRL
VR1015	----- -----			(VR1015, OPTION 20 ONLY)		
VR1020	152-0520-00			SEMICOND DEVICE:ZENER,1W,12V,5%	15238	Z6033
VR1020	----- -----			(VR1020, OPTION 20 ONLY)		
VR1055	152-0147-00			SEMICOND DEVICE:ZENER,0.4W,27V,5%	04713	SZ50622KRL
VR1055	----- -----			(VR1055, OPTION 20 ONLY)		
VR1057	290-0512-00	B010863		CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
VR1057	----- -----			(VR1057, OPTION 20 ONLY)		
VR1192	152-0217-00			SEMICOND DEVICE:ZENER,0.4W,8.2V,5%	04713	SZG20
VR1192	----- -----			(VR1192, OPTION 4 ONLY)		
VR1197	152-0217-00			SEMICOND DEVICE:ZENER,0.4W,8.2V,5%	04713	SZG20
VR1197	----- -----			(VR1197, OPTION 4 ONLY)		
W837	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
W837	----- -----			(LOCATED AT R837)		

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

Electrical components shown on the diagrams are in the following units unless noted otherwise:

Capacitors = Values one or greater are in picofarads (pF). Values less than one are in microfarads (μF).

Resistors = Ohms (Ω).

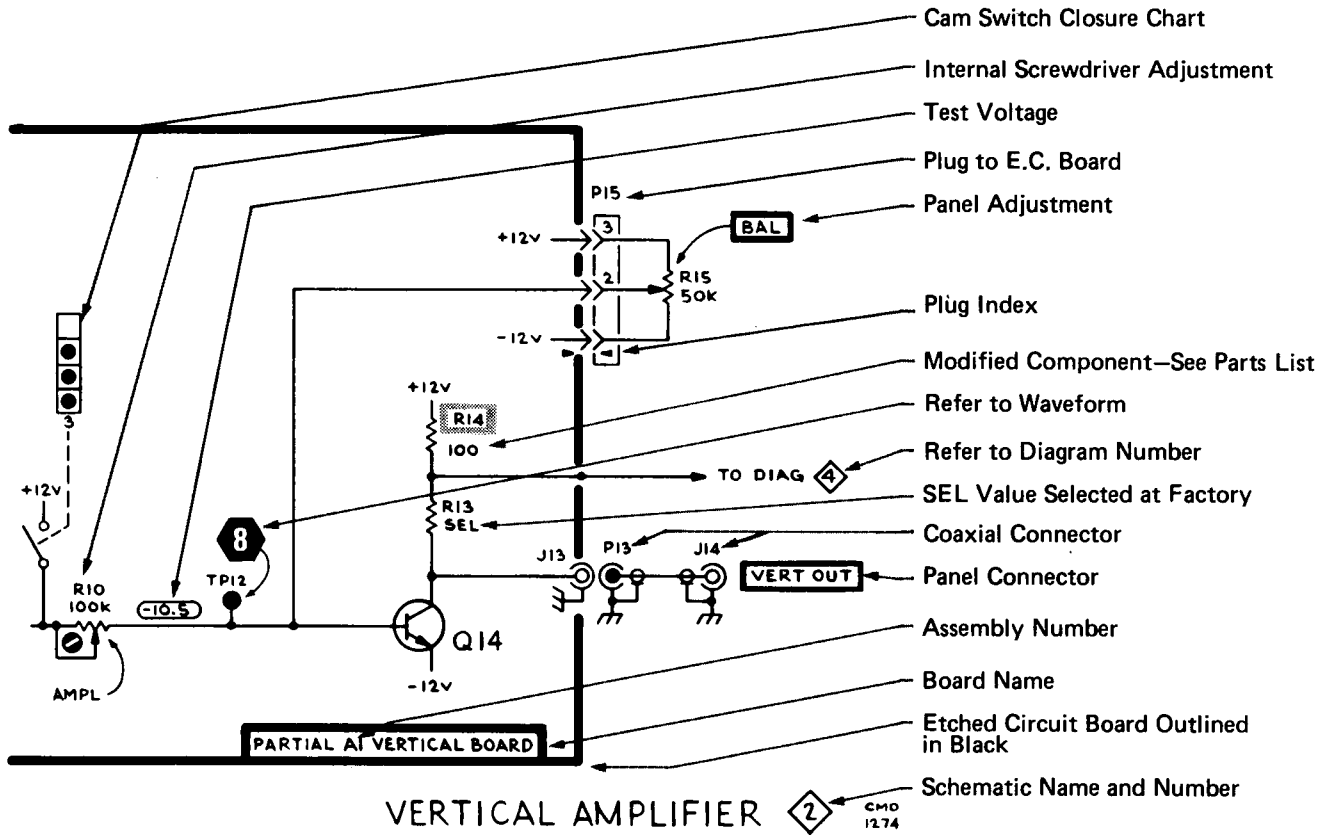
Symbols used on the diagrams are based on ANSI Standard Y32.2-1975.

Logic symbology is based on ANSI Y32.14-1973 in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

A	Assembly, separable or repairable (circuit board, etc.)	H	Heat dissipating device (heat sink, heat radiator, etc.)	RT	Thermistor
AT	Attenuator, fixed or variable	HR	Heater	S	Switch
B	Motor	HY	Hybrid circuit	T	Transformer
BT	Battery	J	Connector, stationary portion	TC	Thermocouple
C	Capacitor, fixed or variable	K	Relay	TP	Test point
CB	Circuit breaker	L	Inductor, fixed or variable	U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
CR	Diode, signal or rectifier	LR	Inductor/resistor combination	V	Electron tube
DL	Delay line	M	Meter	VR	Voltage regulator (zener diode, etc.)
DS	Indicating device (lamp)	P	Connector, movable portion	Y	Crystal
E	Spark Gap	Q	Transistor or silicon-controlled rectifier	Z	Phase shifter
F	Fuse	R	Resistor, fixed or variable		
FL	Filter				

The following special symbols are used on the diagrams:



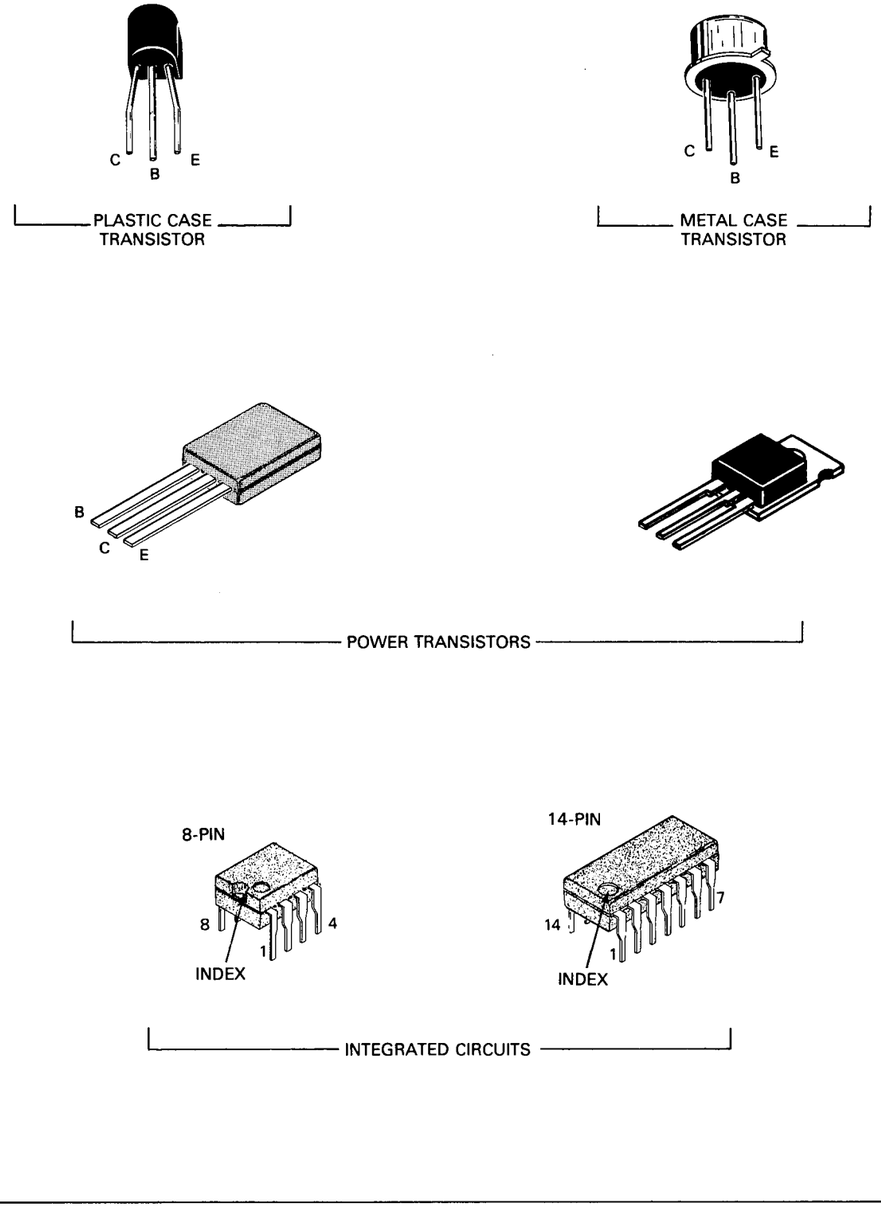


Figure 9-1. Semiconductor lead configurations.

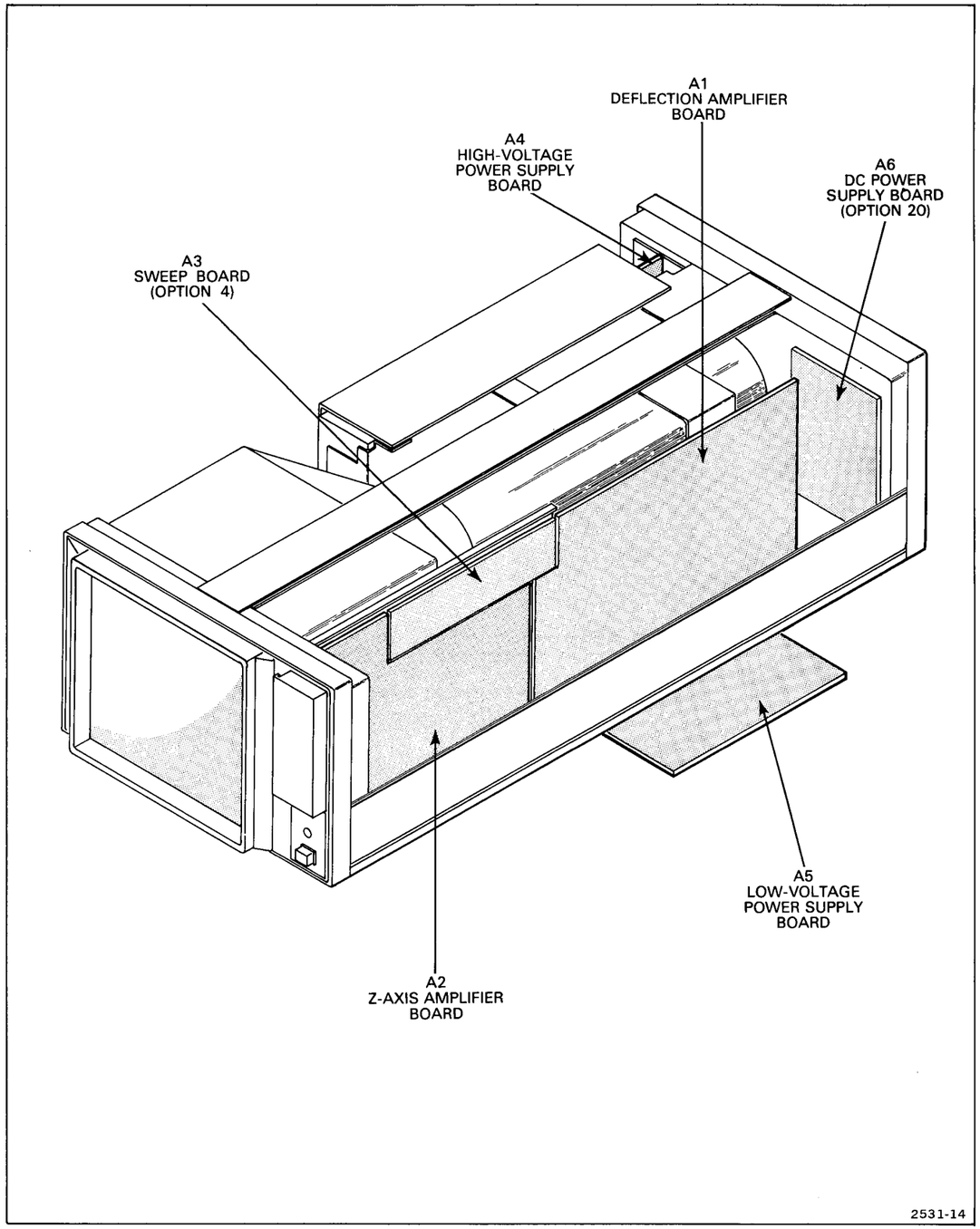


Figure 9-2. Circuit board locations.

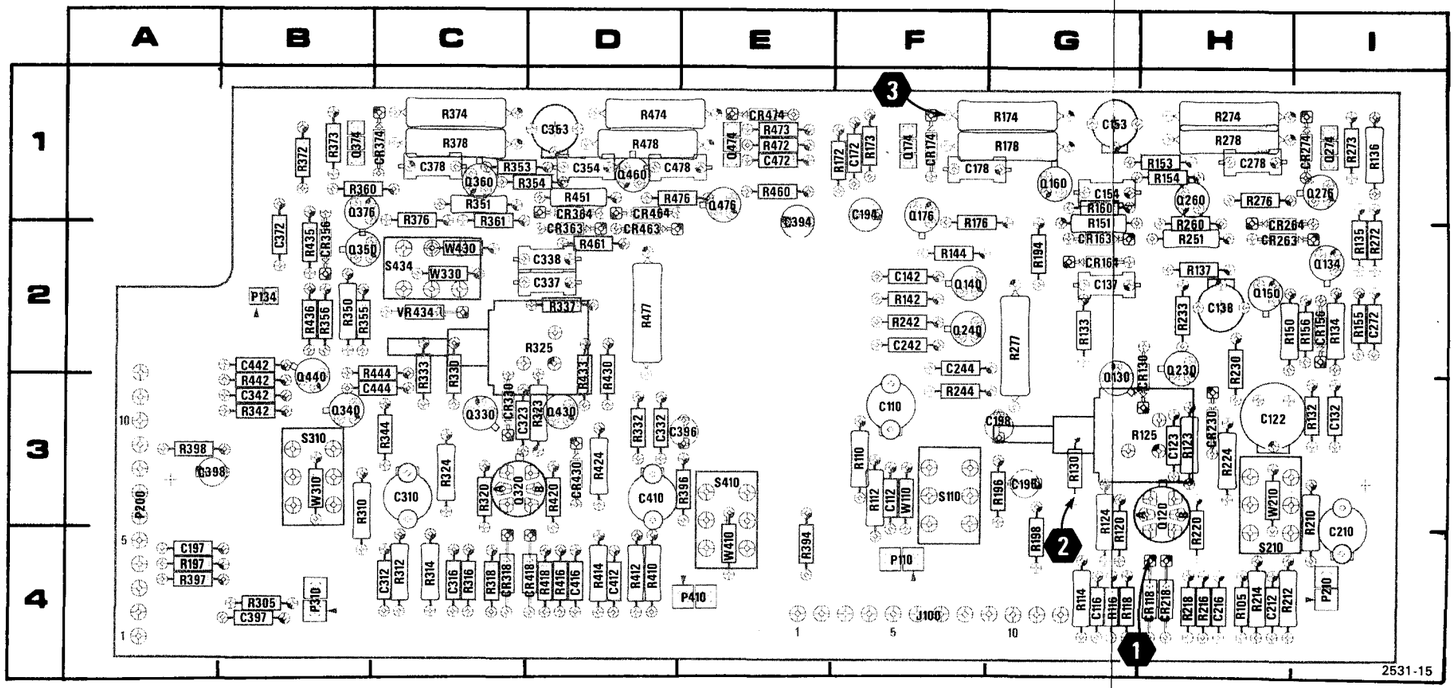
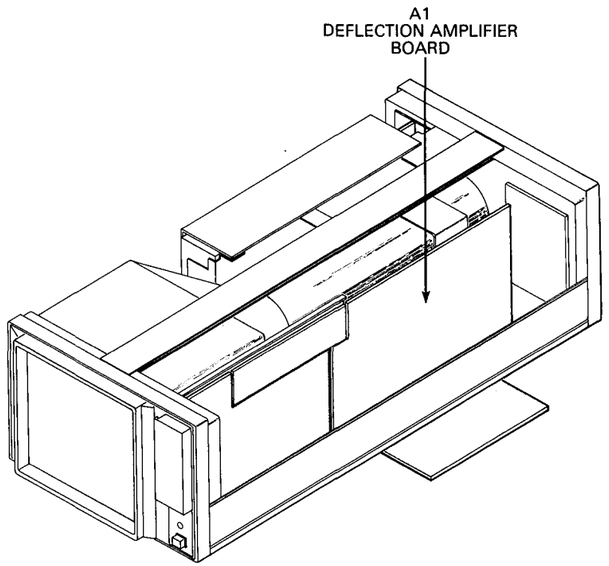


Figure 9-3. A1—Vertical (Y) Amplifier component and waveform test point locations.



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CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C110	3F	CR118	4H	Q350	2B	R214	4H	R394	4E
C112	3F	CR130	2H	Q360	1C	R215	4H	R396	3D
C116	4G	CR156	2I	Q374	1B	R216	4H	R397	4A
C122	3H	CR163	2G	Q376	1B	R218	4H	R398	3A
C123	3H	CR164	2G	Q430	3D	R220	3H	R410	4D
C132	3I	CR174	1F	Q440	3B	R224	3H	R412	4D
C137	2G	CR218	4H	Q460	1D	R230	2H	R414	4D
C138	2H	CR230	3H	Q474	1E	R233	2H	R415	4D
C142	2F	CR263	2H	Q476	1E	R242	2F	R416	4D
C153	1G	CR264	1H			R244	3F	R418	4D
C154	1G	CR274	1I	R105	4H	R251	2H	R420	3D
C172	1F	CR318	4C	R110	3F	R260	1H	R424	3D
C178	1F	CR330	3C	R112	3F	R272	2I	R430	2D
C194	1F	CR356	2B	R114	4G	R273	1I	R433	2D
C196	3G	CR363	2D	R115	4G	R274	1H	R435	2B
C197	4A	CR364	1D	R116	4G	R276	1H	R436	2B
C198	3G	CR374	1C	R118	4G	R277	2G	R442	3B
C210	3I	CR418	4D	R120	3G	R278	1H	R444	3B
C212	4H	CR430	3D	R123	3H	R305	4B	R451	1D
C216	4H	CR463	2D	R124	4H	R310	3B	R460	1E
C242	2F	CR464	1D	R125	3H	R312	4C	R461	2D
C244	2F	CR474	1E	R130	3G	R314	4C	R472	1E
C272	2I			R132	3I	R315	4C	R473	1E
C278	1H	J100	4F	R133	2G	R316	4C	R474	1D
C310	3C			R134	2I	R318	4C	R476	1D
C312	4C	P110	4F	R135	2I	R320	3C	R477	2D
C316	4C	P200	3A	R136	1I	R323	3D	R478	1D
C323	3C	P210	4I	R142	2F	R324	3C		
C332	3D	P310	4B	R144	2F	R325	2D	S110	3F
C338	2D	P410	4E	R150	2I	R330	3C	S210	4H
C342	3B			R151	1G	R332	3D	S310	3B
C353	1D	Q120	3H	R153	1H	R333	3C	S410	3E
C354	1D	Q130	3G	R154	1H	R342	3B	S434	2C
C372	2B	Q134	2I	R155	2I	R344	3C		
C378	1C	Q140	2F	R156	2I	R350	2B	VR434	2C
C394	1E	Q150	2H	R160	1G	R351	1C		
C396	3D	Q160	1G	R172	1F	R353	1C	W110	3F
C397	4B	Q174	1F	R173	1F	R354	1C	W210	3H
C398	3A	Q176	1F	R174	1G	R355	2B	W310	3B
C410	3D	Q230	2H	R176	1F	R356	2B	W330	2C
C412	4D	Q240	2F	R178	1G	R360	1B	W410	4E
C416	4D	Q260	1H	R194	2G	R361	1C	W430	2C
C442	2B	Q274	1I	R196	3G	R372	1B		
C444	3B	Q276	1I	R197	4A	R373	1B		
C472	1E	Q320	3C	R198	4G	R374	1C		
C478	1D	Q330	3C	R210	3I	R376	1C		
		Q340	3B	R212	4H	R378	1C		

Assembly	Location of Complete or Partial Board on Diagrams
A1—Deflection Amplifier Board	Diag. 1 2 5 8
A2—Z-Axis Amplifier Board	Diag. 1 2 3 5 8
A3—Sweep Board	Diag. 4 8
A4—High Voltage Power Supply Board	Diag. 5 8
A5—Low Voltage Power Supply Board	Diag. 5 6 7 8
A6—Option 20 Power Supply Board	Diag. 7 8

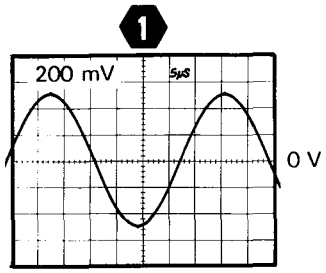
VOLTAGE AND WAVEFORM CONDITIONS

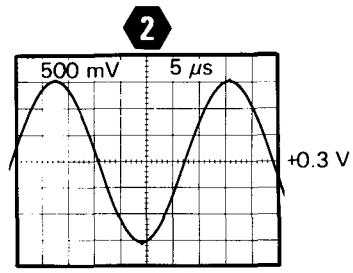
NOTE

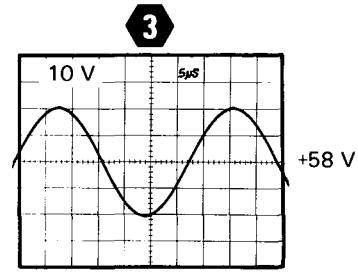
The test equipment used to obtain the voltages and waveforms is listed in Table 6-2, Test Equipment.

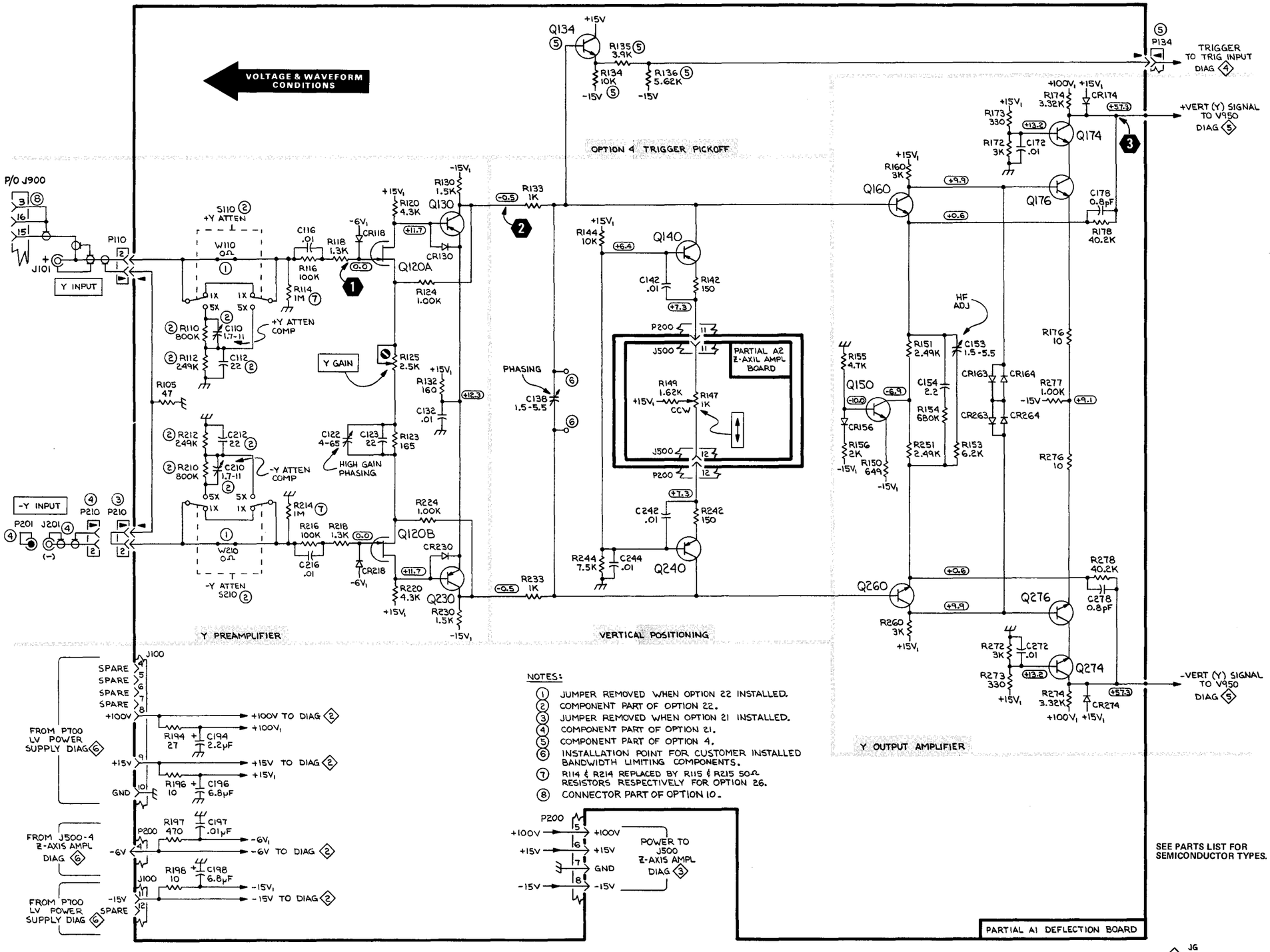
Voltage Conditions. The dc voltages indicated on the schematic diagrams were obtained with a digital multimeter and with no test signal input. The 624 INTENSITY and Position controls were set for a barely visible spot positioned at near center screen.

Waveform Conditions. The following waveforms were monitored with a test oscilloscope and a 10X probe. A 1-volt peak-to-peak 50-kilohertz, sinewave was applied to the 624 +Y input connector with the vertical position control centered. The Y GAIN control was adjusted to provide 8 divisions of deflection with a 1-volt input. Test oscilloscope deflection factor and sweep rate settings appear on the waveform illustrations.









REV. A, APR 1979

VERTICAL (Y) DEFLECTION AMPLIFIER ◇1 JG

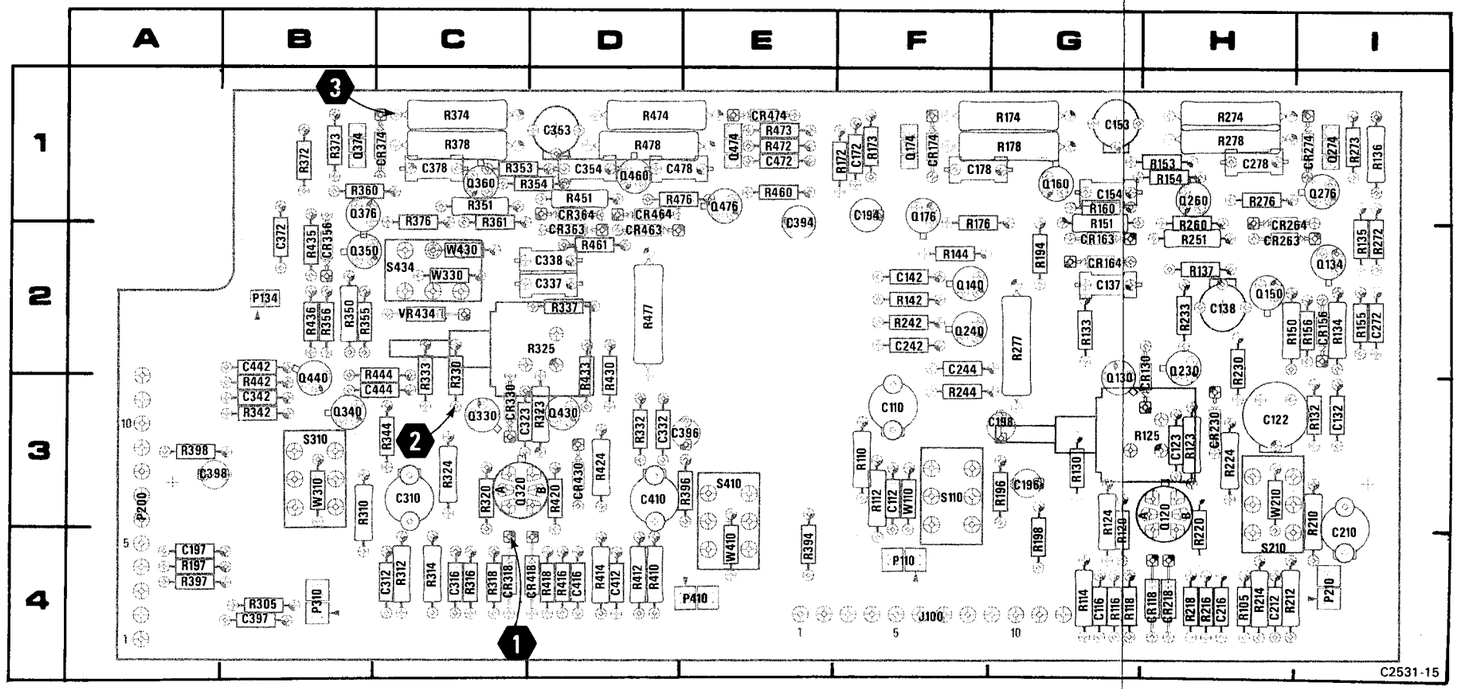
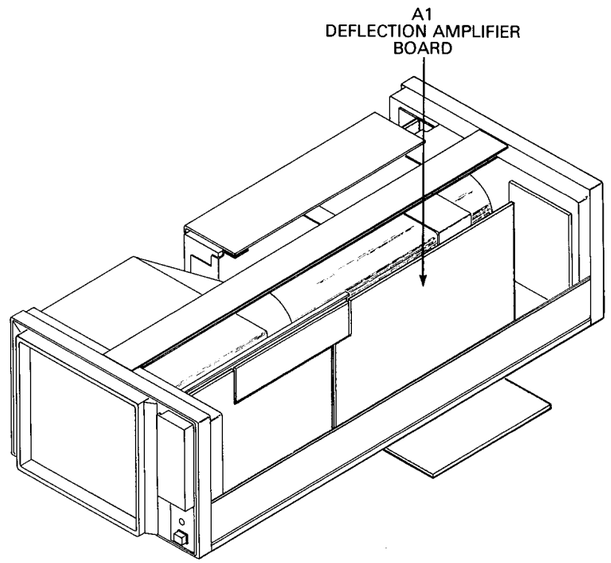


Figure 9-4. A1—Horizontal (X) Amplifier component and waveform test point locations.



CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C110	3F	CR118	4H	Q350	2B	R214	4H	R394	4E
C112	3F	CR130	2H	Q360	1C	R215	4H	R396	3D
C116	4G	CR156	2I	Q374	1B	R216	4H	R397	4A
C122	3H	CR163	2G	Q376	1B	R218	4H	R398	3A
C123	3H	CR164	2G	Q430	3D	R220	3H	R410	4D
C132	3I	CR174	1F	Q440	3B	R224	3H	R412	4D
C137	2G	CR218	4H	Q460	1D	R230	2H	R414	4D
C138	2H	CR230	3H	Q474	1E	R233	2H	R415	4D
C142	2F	CR263	2H	Q476	1E	R242	2F	R416	4D
C153	1G	CR264	1H			R244	3F	R418	4D
C154	1G	CR274	1I	R105	4H	R251	2H	R420	3D
C172	1F	CR318	4C	R110	3F	R260	1H	R424	3D
C178	1F	CR330	3C	R112	3F	R272	2I	R430	2D
C194	1F	CR356	2B	R114	4G	R273	1I	R433	2D
C196	3G	CR363	2D	R115	4G	R274	1H	R435	2B
C197	4A	CR364	1D	R116	4G	R276	1H	R436	2B
C198	3G	CR374	1C	R118	4G	R277	2G	R442	3B
C210	3I	CR418	4D	R120	3G	R278	1H	R444	3B
C212	4H	CR430	3D	R123	3H	R305	4B	R451	1D
C216	4H	CR463	2D	R124	4H	R310	3B	R460	1E
C242	2F	CR464	1D	R125	3H	R312	4C	R461	2D
C244	2F	CR474	1E	R130	3G	R314	4C	R472	1E
C272	2I			R132	3I	R315	4C	R473	1E
C278	1H	J100	4F	R133	2G	R316	4C	R474	1D
C310	3C			R134	2I	R318	4C	R476	1D
C312	4C	P110	4F	R135	2I	R320	3C	R477	2D
C316	4C	P200	3A	R136	1I	R323	3D	R478	1D
C323	3C	P210	4I	R142	2F	R324	3C		
C332	3D	P310	4B	R144	2F	R325	2D	S110	3F
C338	2D	P410	4E	R150	2I	R330	3C	S210	4H
C342	3B			R151	1G	R332	3D	S310	3B
C353	1D	Q120	3H	R153	1H	R333	3C	S410	3E
C354	1D	Q130	3G	R154	1H	R342	3B	S434	2C
C372	2B	Q134	2I	R155	2I	R344	3C		
C378	1C	Q140	2F	R156	2I	R350	2B	VR434	2C
C394	1E	Q150	2H	R160	1G	R351	1C		
C396	3D	Q160	1G	R172	1F	R353	1C	W110	3F
C397	4B	Q174	1F	R173	1F	R354	1C	W210	3H
C398	3A	Q176	1F	R174	1G	R355	2B	W310	3B
C410	3D	Q230	2H	R176	1F	R356	2B	W330	2C
C412	4D	Q240	2F	R178	1G	R360	1B	W410	4E
C416	4D	Q260	1H	R194	2G	R361	1C	W430	2C
C442	2B	Q274	1I	R196	3G	R372	1B		
C444	3B	Q276	1I	R197	4A	R373	1B		
C472	1E	Q320	3C	R198	4G	R374	1C		
C478	1D	Q330	3C	R210	3I	R376	1C		
		Q340	3B	R212	4H	R378	1C		

Assembly	Location of Complete or Partial Board on Diagrams
A1—Deflection Amplifier Board	Diag. 1 2 5 8
A2—Z-Axis Amplifier Board	Diag. 1 2 3 5 8
A3—Sweep Board	Diag. 4 8
A4—High Voltage Power Supply Board	Diag. 5 8
A5—Low Voltage Power Supply Board	Diag. 5 6 7 8
A6—Option 20 Power Supply Board	Diag. 7 8

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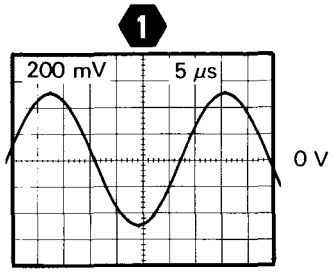
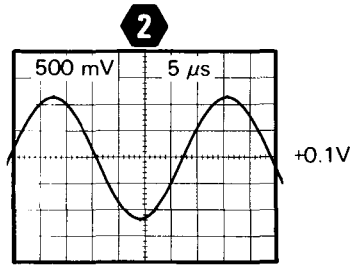
VOLTAGE AND WAVEFORM CONDITIONS

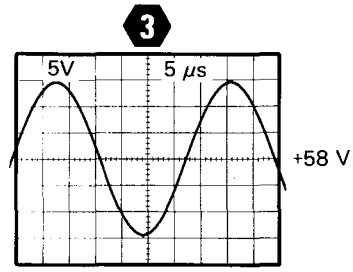
The test equipment used to obtain the voltages and waveforms is listed in Table 6-2, Test Equipment.

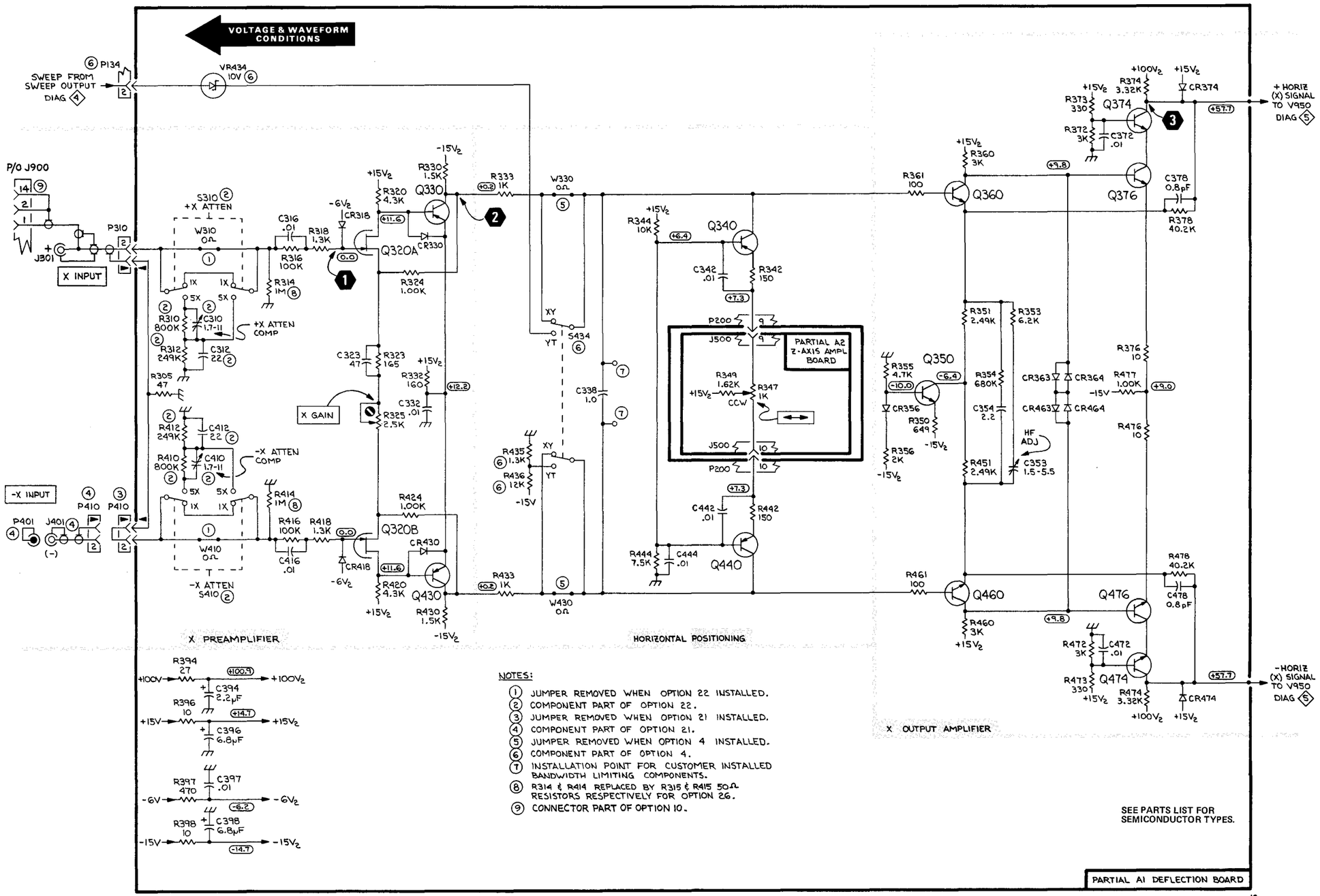
Voltage Conditions. The dc voltages indicated on the schematic diagrams were obtained with a digital multimeter and with no test signal input. The 624 INTENSITY and Position controls were set for a barely visible spot positioned at near center screen.

Waveform Conditions. The following waveforms were monitored with a test oscilloscope and a 10X probe. A 1-volt peak-to-peak, 50-kilohertz, sinewave was applied to the 624 +X input connector with the vertical position control centered. The X GAIN control was adjusted to provide 8 divisions of deflection with a 1-volt input. Test oscilloscope deflection factor and sweep rate settings appear on the waveform illustrations.









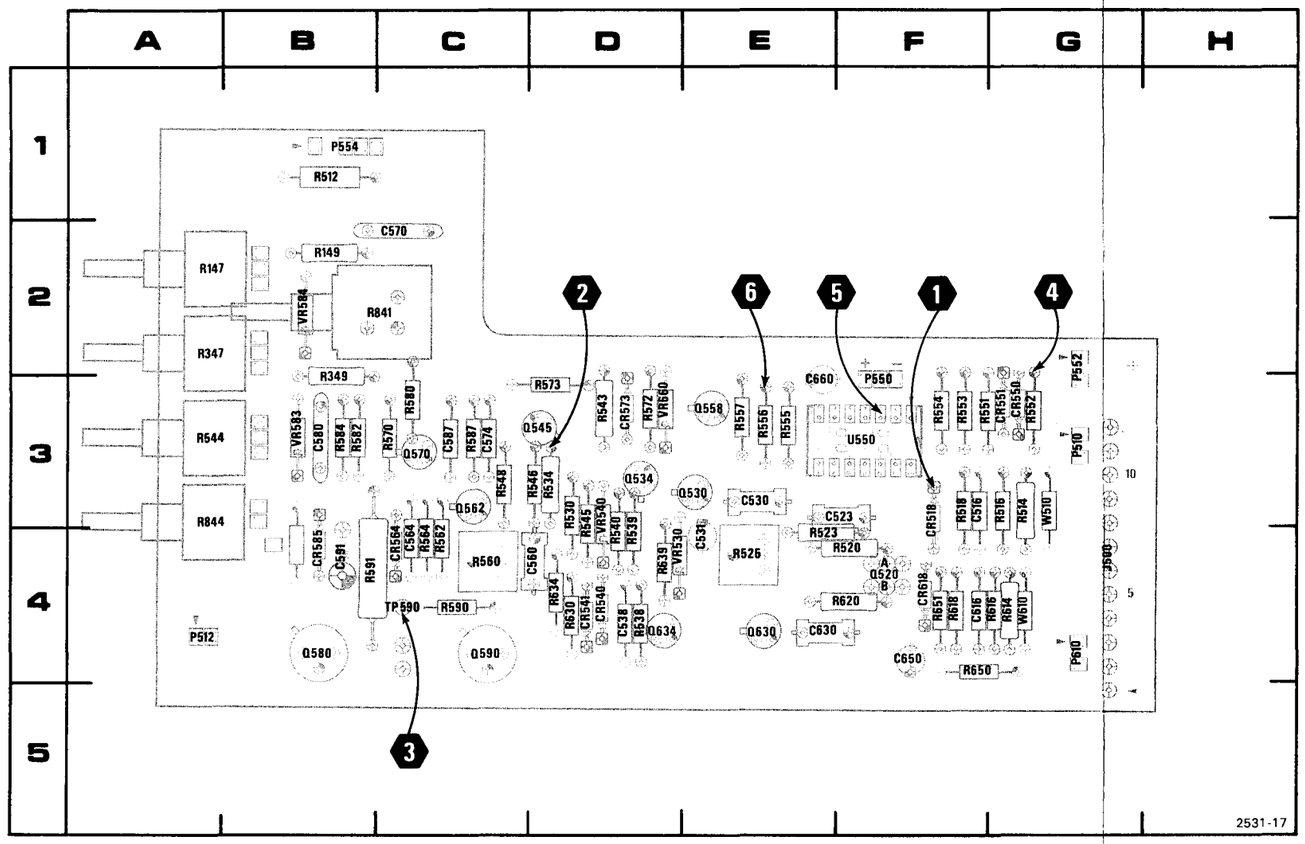
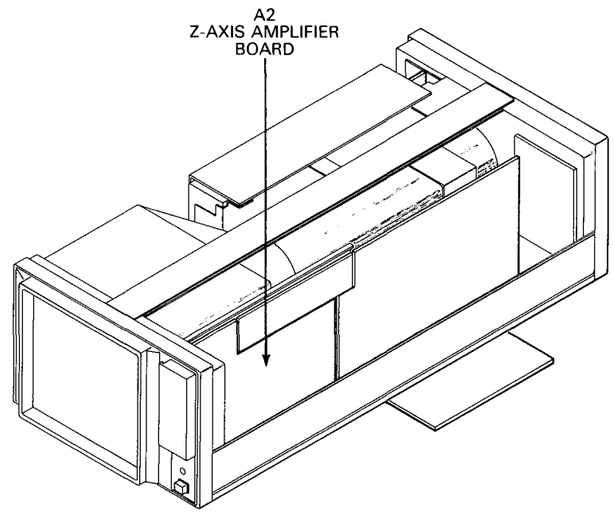


Figure 9-5. A2—Z-Axis Amplifier component and waveform test point locations.

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C516	3E	CR573	3D	Q634	4D	R548	3C	R618	4E
C523	3E	CR585	4B			R551	3E	R620	4E
C530	3E	CR618	4E	R147	2A	R552	3G	R630	4D
C531	4E			R149	2B	R553	3E	R634	4D
C538	4D	J500	4G	R347	2A	R554	3E	R639	4D
C560	4D			R349	2B	R555	3E	R650	4E
C564	4C	P510	3G	R512	1B	R556	3E	R651	4E
C570	2C	P512	4A	R514	3G	R557	3E	R841	2B
C574	3C	P550	3E	R515	3G	R560	4C	R844	3A
C580	3B	P552	3G	R516	3G	R562	4C		
C587	3C	P554	1B	R518	3E	R564	4C	TP590	4C
C591	4B	P610	4G	R520	4E	R570	3C		
C616	4E			R523	4E	R572	3D	U550	3E
C630	4E	Q520	4E	R525	4E	R573	3D		
C650	4E	Q530	3E	R530	3D	R580	3C	VR530	4D
C660	3E	Q534	3D	R534	3D	R582	3B	VR540	3D
		Q545	3D	R538	4D	R584	3B	VR583	3B
CR518	3E	Q558	3E	R539	3D	R587	3C	VR584	2B
CR540	4D	Q562	3C	R540	3D	R590	4C	VR660	3D
CR541	4D	Q570	3C	R543	3D	R591	4B		
CR550	3G	Q580	4B	R544	3A	R614	4G	W510	3G
CR551	3G	Q590	4C	R545	3D	R615	4G	W610	4G
CR564	4C	Q630	4E	R546	3D	R616	4G		

Assembly	Location of Complete or Partial Board on Diagrams
A1—Deflection Amplifier Board	Diag. 1 2 5 8
A2—Z-Axis Amplifier Board	Diag. 1 2 3 5 8
A3—Sweep Board	Diag. 4 8
A4—High Voltage Power Supply Board	Diag. 5 8
A5—Low Voltage Power Supply Board	Diag. 5 6 7 8
A6—Option 20 Power Supply Board	Diag. 7 8



VOLTAGE AND WAVEFORM CONDITIONS

NOTE

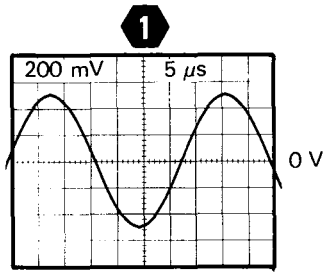
The test equipment used to obtain the voltages and waveforms is listed in Table 6-2, Test Equipment

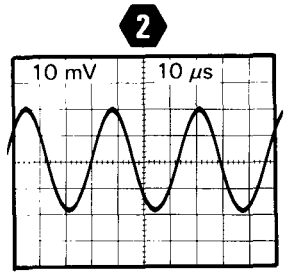
Voltage Conditions. The dc voltages indicated on the schematic diagrams were obtained with a digital multimeter and with no test signal input. The 624 INTENSITY and Position controls were set for a barely visible spot positioned at near center screen.

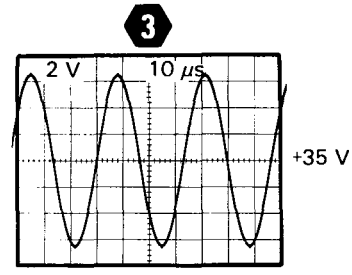
Waveform Conditions. The following waveforms were monitored with a test oscilloscope and a 10X probe. A 1-volt peak-to-peak, 50-kilohertz, sinewave was applied to the 624 +Z input connector with the displayed spot positioned off screen (to prevent burning the crt phosphor). The INTENSITY control was set for approximately +35 volts dc as monitored at the Z-Axis Amplifier output TP590. Test oscilloscope deflection factor and sweep rate settings appear on the waveform illustrations.

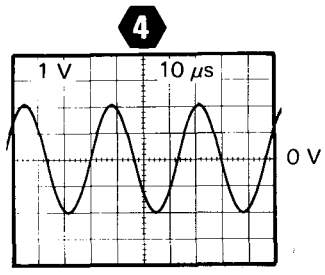
Option 25 (TTL)
Voltage Conditions. The TTL connector should be open (no connections). P550 (Unblanking Level Selector) in the POS position.

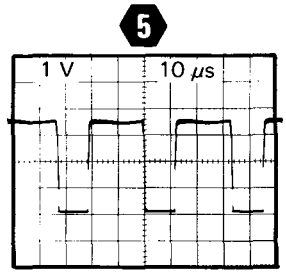
Waveform Conditions. The following waveforms were monitored with a test oscilloscope and a 10X probe. A 4-volt peak-to-peak, 50-kilohertz, sinewave was applied to the 624 TTL input connector with the displayed spot positioned off the screen (to prevent burning the crt phosphor).

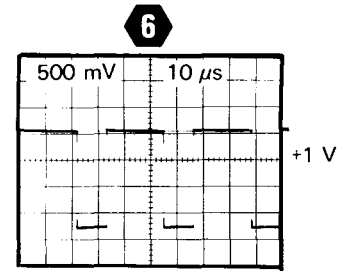












VOLTAGE & WAVEFORM CONDITIONS

UNBLANKING CIRCUIT

TYPE	+5V	GND
74LS00	14	7

UNBLANKING LEVEL SELECTOR

P550 POS NEG

P/O J900

J551 TTL

P552

CR550 CR551

R551 10K R552 240 R553 10K R554 10K R555 2K R556 2.4K R557 82K

U550A 74LS00 4,5

U550B 74LS00

U550C 74LS00

Q558

P554

UNBLANKING FROM P1100-4 DIAG 4

P/O J900

J501 Z INPUT

P510

W510 0Ω

C516 .01 R516 100K R514 1M

R518 3.9K CR518 -6V

Q520A

R520 1.00K C530 3.9

Q534

R530 2K R534 1.82K

Q530

R539 180 C538 10 R538 180K

C523 39 R523 174

VR530 5.1V C531 1μF

Z GAIN R525 1.0K

P601 J601 PG10 PG10 -Z INPUT

RG14 1M RG16 100K RG18 3.9K CG16 .01 CR618 -6V W610 0Ω

Q520B

RG39 180

Q630 Q634

RG20 1.00K CG30 5.6 RG30 2K RG34 1.8K

Z-AXIS PREAMPLIFIER

VR540 6.2V R540 100K CR540 R543 787 R544 1K INTENSITY

R545 100K R548 10 CR541 Q545 R546 20

INTENSITY AND LIMITER

Q562 R560 1K C560 47 HF ADJ R562 910

R572 120K CR573 R573 560

Q570 R570 16 R580 3.6K C580 0.1

C574 .01 R582 47K R587 100 C587 .01 R584 750 CR585

Q580

VR583 30V VR584 30V

Q590 R564 27 C564 100 CR564 C591 0.25-1.5 HF ADJ R591 14.0K

R590 22 TP590

Z OUTPUT TO P860 DIAG 5

Z OUTPUT AMPLIFIER

NOTES:

1. COMPONENT PART OF OPTION 4.
2. COMPONENT PART OF OPTION 25.
3. JUMPER REMOVED WHEN OPTION 21 INSTALLED.
4. COMPONENT PART OF OPTION 21.
5. R514 & RG14 REPLACED BY R515 & RG15 50Ω RESISTORS RESPECTIVELY FOR OPTION 26.
6. CONNECTOR PART OF OPTION 10.
7. CONNECTOR WIRED IN ONLY WHEN OPTION 10 & 25 INSTALLED.

POWER FROM P200 DEFL BOARD DIAG 1

J500 +100V C570 0.1 +15V GND -15V

VR660 10V +5V C660 1μF

R650 5.6K CG50 1μF R651 8.2K

R512 360 P512 DS512 POWER

J500 -6V TO P200-4 DEFLECTION BOARD DIAG 1

SPARE GND POWER TO SWEEP BOARD DIAG 4

P554

PARTIAL A2 Z-AXIS AMPLIFIER BOARD

SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

Z-AXIS AMPLIFIER 3 JG

REV. A, APR 1979

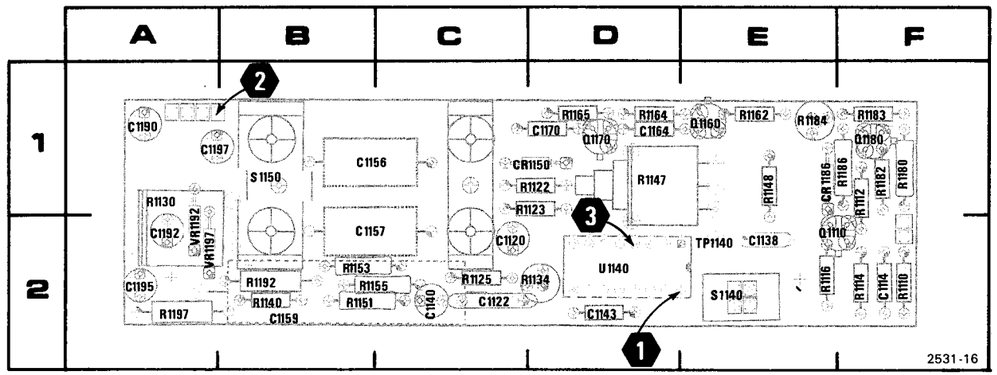


Figure 9-6. A3—Sweep (Option 4) component and waveform test point locations.

CKT NO	GRID COORD	CKT NO	GRID COORD
C1114	2F	R1125	2C
C1120	2C	R1130	1A
C1122	2C	R1134	2D
C1138	2E	R1140	2B
C1140	2C	R1147	1D
C1143	2D	R1148	1E
C1156	1B	R1151	2B
C1157	2B	R1153	2B
C1159	2B	R1155	2B
C1164	1D	R1162	1E
C1170	1D	R1164	1D
C1190	1A	R1165	1D
C1192	2A	R1180	1F
C1195	2A	R1182	1F
C1197	1A	R1183	1F
		R1184	1E
CR1150	1D	R1186	1F
CR1186	1E	R1192	2B
		R1197	2A
Q1110	2E		
Q1160	1E	S1140	2E
Q1170	1D	S1150	1B
Q1180	1F		
		TP1140	2E
R1110	2F		
R1112	1F	U1140	2D
R1114	2F		
R1116	2E	VR1192	2A
R1122	1D	VR1197	2A
R1123	1D		

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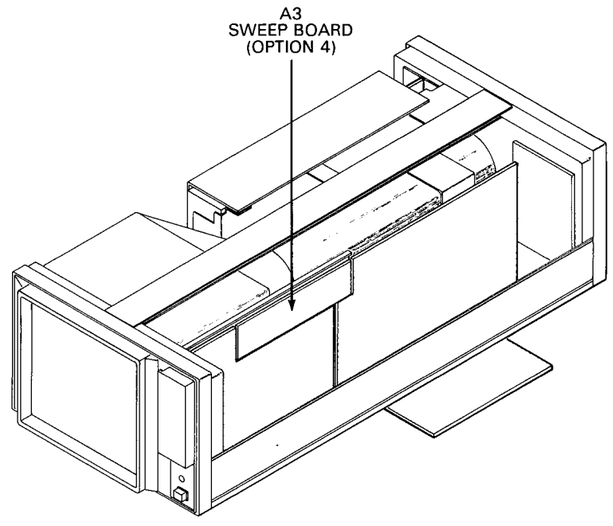
Assembly	Location of Complete or Partial Board on Diagrams
A1—Deflection Amplifier Board	Diag. 1 2 5 8
A2—Z-Axis Amplifier Board	Diag. 1 2 3 5 8
A3—Sweep Board	Diag. 4 8
A4—High Voltage Power Supply Board	Diag. 5 8
A5—Low Voltage Power Supply Board	Diag. 5 6 7 8
A6—Option 20 Power Supply Board	Diag. 7 8



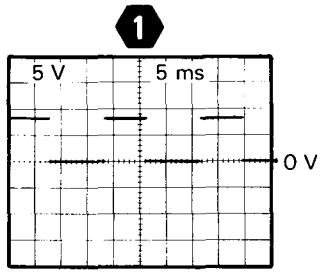
VOLTAGE AND WAVEFORM CONDITIONS

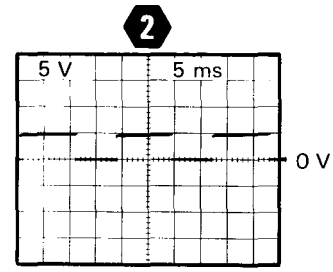
NOTE

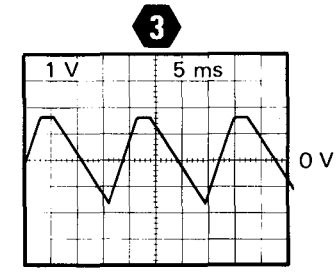
The test equipment used to obtain the voltages and waveforms is listed in Table 6-2, Test Equipment.

Voltage Conditions. The dc voltages indicated on the schematic diagrams were obtained with a digital multimeter and with no test signal input. The 624 SEC/DIV switch is set at 1 ms, and the YT-XY switch is set to the YT (forward) position. Set trace to screen horizontal center.

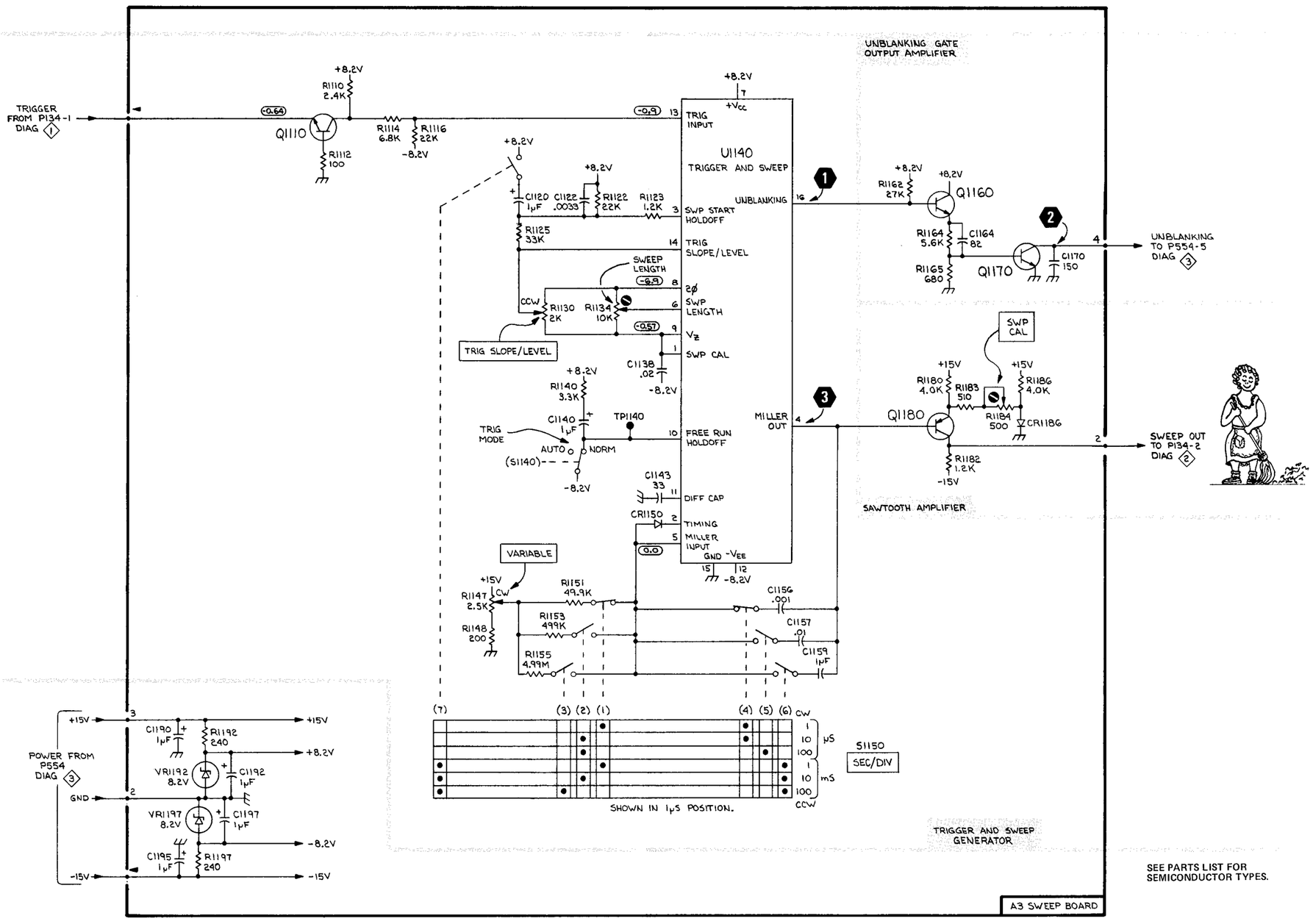
Waveform Conditions. The following waveforms were monitored with a test oscilloscope and a 10X probe, with no signal input. The 624 controls were set same as those for Voltage Conditions. Test oscilloscope deflection factor and sweep rate settings appear on the waveform illustrations.







VOLTAGE & WAVEFORM CONDITIONS



SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

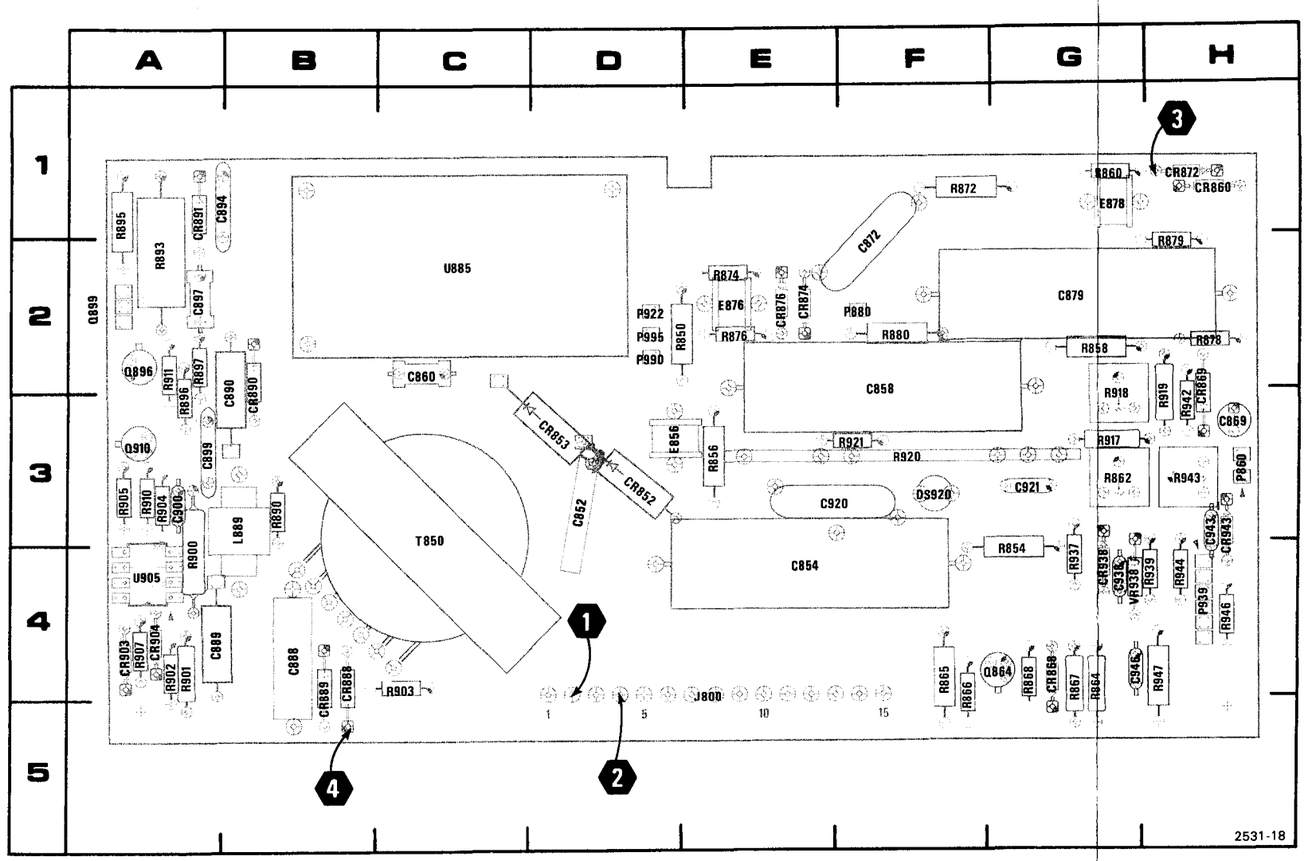
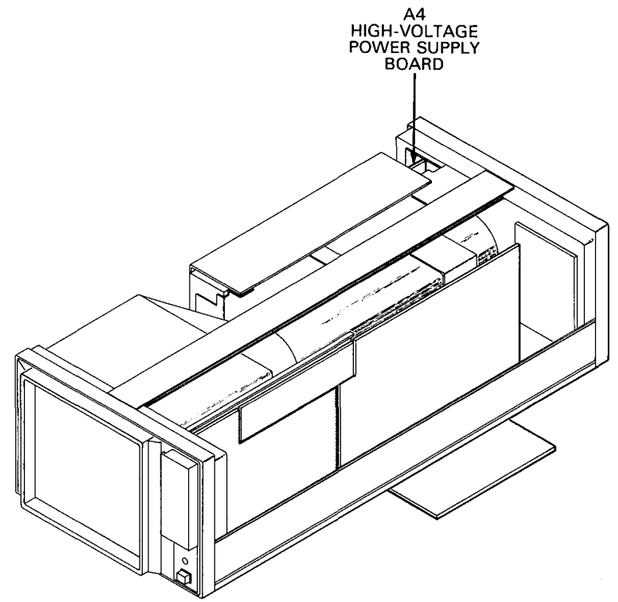


Figure 9-7. A4—High-Voltage Power Supply component and waveform test point locations.

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C852	3D	CR868	4G	P860	3H	R868	4G	R919	2H
C854	4E	CR869	2H	P880	2F	R872	1F	R920	3F
C858	2F	CR872	1H	P899	2A	R874	2E	R921	3F
C860	2C	CR874	2E	P922	2D	R876	2E	R937	4G
C869	3H	CR876	2E	P939	4H	R878	2H	R939	4H
C872	2F	CR888	4B	P990	2D	R879	2H	R942	2H
C879	2G	CR889	4B	P995	2D	R880	2F	R943	3H
C888	4B	CR890	2B			R890	3B	R944	4H
C889	4A	CR891	1A	Q864	4G	R893	2A	R946	4H
C890	2B	CR903	4A	Q896	2A	R895	1A	R947	4H
C894	1A	CR904	4A	Q899	2A	R896	3A		
C897	2A	CR938	4G	Q910	3A	R897	2A	T850	3C
C899	3A	CR943	3H			R900	4A		
C900	3A			R850	2D	R901	4A	U885	2C
C920	3E	DS920	3F	R854	4G	R902	4A	U905	4A
C921	3G			R856	3E	R903	4C		
C938	4G	E856	3D	R858	2G	R904	3A	VR938	4G
C943	3H	E876	2E	R860	1G	R905	3A		
C946	4G	E878	1G	R862	3G	R907	4A		
				R864	4G	R910	3A		
CR852	3D	J800	4E	R865	4F	R911	2A		
CR853	3D			R866	4F	R917	3G		
CR860	1H	L889	3B	R867	4G	R918	3G		

Assembly	Location of Complete or Partial Board on Diagrams
A1—Deflection Amplifier Board	Diag. 1 2 5 8
A2—Z-Axis Amplifier Board	Diag. 1 2 3 5 8
A3—Sweep Board	Diag. 4 8
A4—High Voltage Power Supply Board	Diag. 5 8
A5—Low Voltage Power Supply Board	Diag. 5 6 7 8
A6—Option 20 Power Supply Board	Diag. 7 8



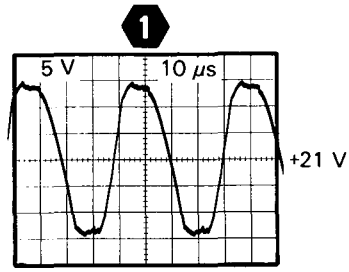
VOLTAGE AND WAVEFORM CONDITIONS

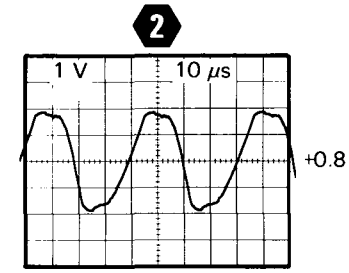
NOTE

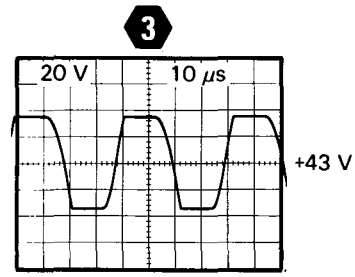
The test equipment used to obtain the voltages and waveforms is listed in Table 6-2, Test Equipment.

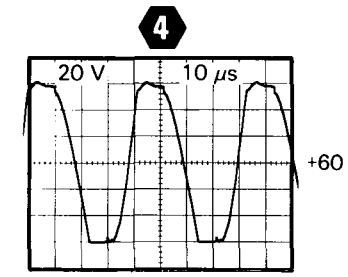
Voltage Conditions. The dc voltages indicated on the schematic diagrams were obtained with a digital multimeter and with no test signal input. The 624 INTENSITY and Position controls were set for a barely visible spot positioned at near center screen.

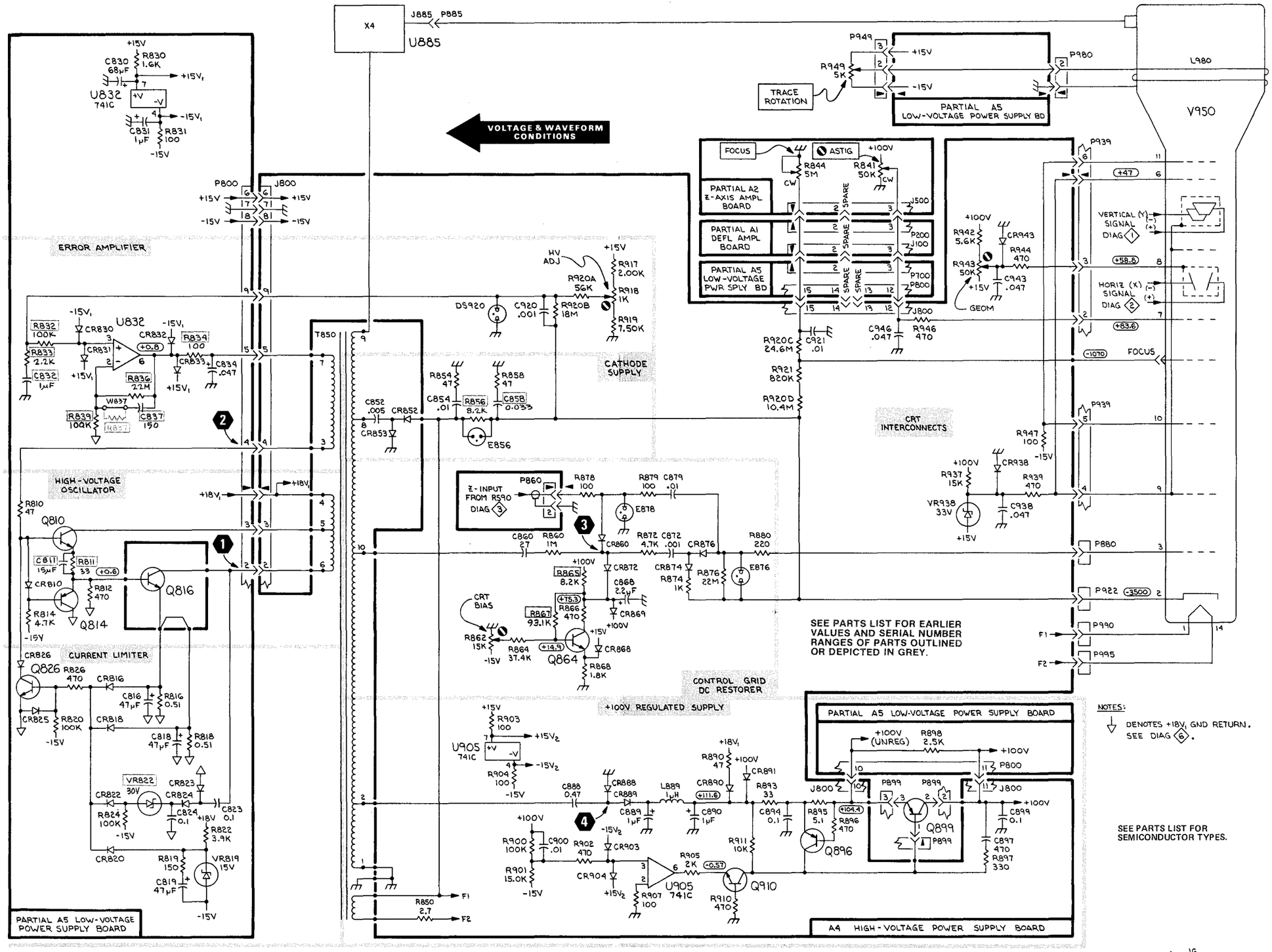
Waveform Conditions. The following waveforms were monitored with a test oscilloscope and a 10X probe. No input was applied to the 624; the display is a barely visible spot positioned at near center screen. Test oscilloscope deflection factor and sweep rate settings appear on the waveform illustrations.











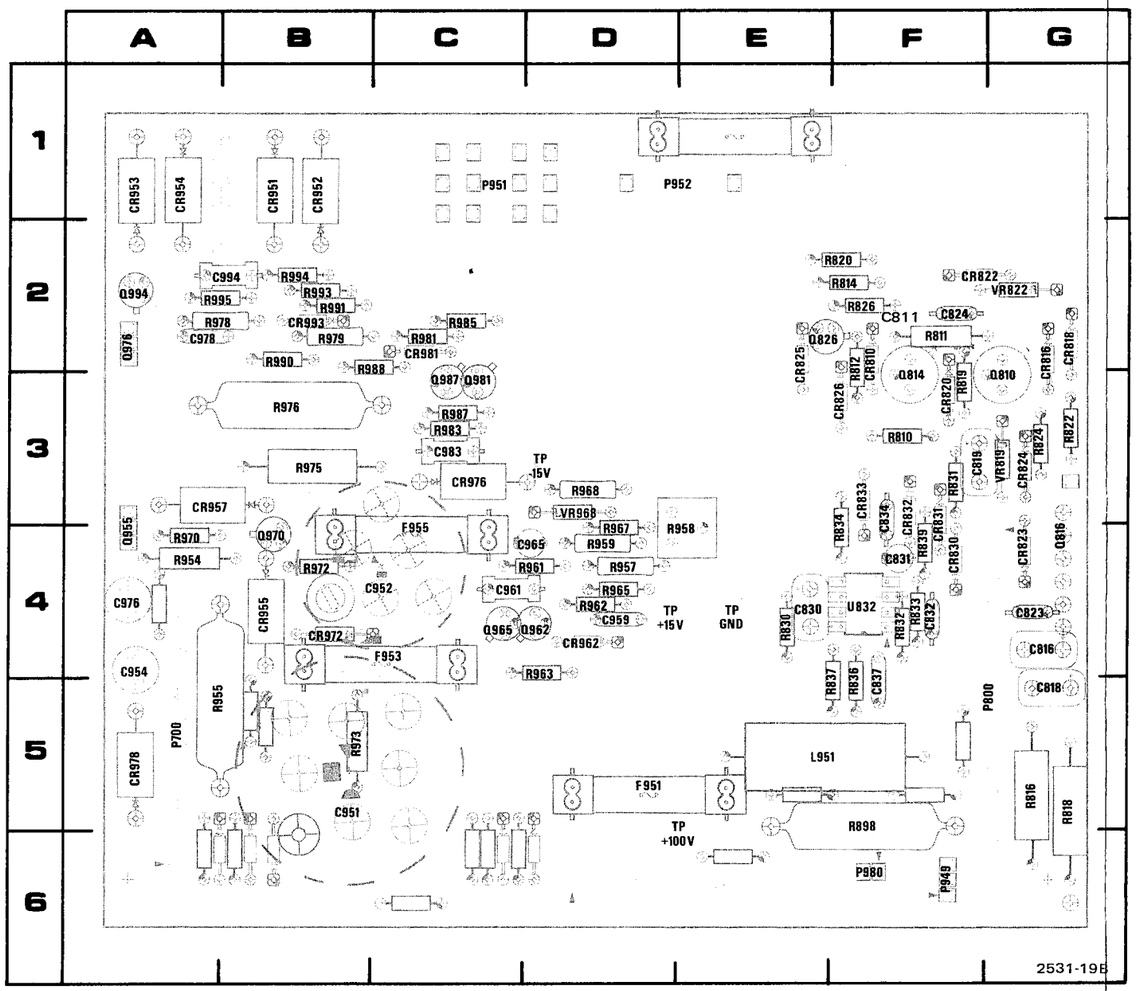


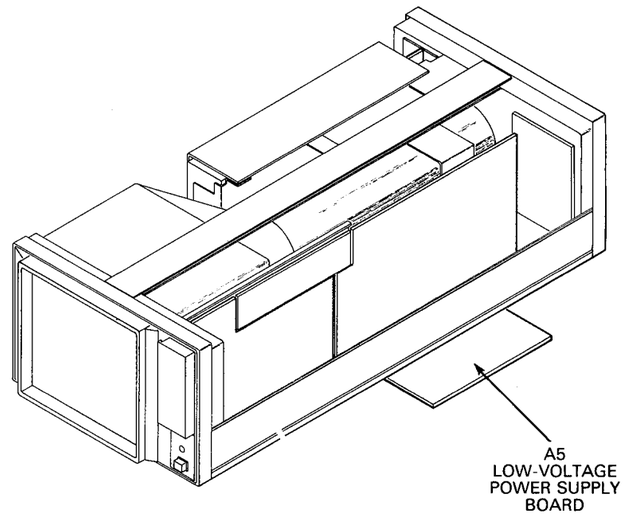
Figure 9-8. A5—Low-Voltage Power Supply component locations.

Assembly	Location of Complete or Partial Board on Diagrams
A1—Deflection Amplifier Board	Diag. ① ② ⑤ ⑧
A2—Z-Axis Amplifier Board	Diag. ① ② ③ ⑤ ⑧
A3—Sweep Board	Diag. ④ ⑧
A4—High Voltage Power Supply Board	Diag. ⑤ ⑧
A5—Low Voltage Power Supply Board	Diag. ⑤ ⑥ ⑦ ⑧
A6—Option 20 Power Supply Board	Diag. ⑦ ⑧

REV, JUN 1981

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C811*	2F	CR820	3F	P608	6F	R814	2F	R973	5B
C816	4G	CR822	2F	P700	5A	R816	5G	R975	3B
C818	5G	CR823	4G	P710	6E	R818	5G	R976	3B
C819	3F	CR824	3G	P800	5F	R819	3F	R978	2A
C823	4G	CR825	2E	P949	6F	R820	2F	R979	2B
C824	2F	CR826	3F	P951	1C	R822	3G	R981	2C
C830	4E	CR830	4F	P952	1E	R824	3G	R983	3C
C831	4F	CR831	3F	P980	6F	R826	2F	R985	2C
C832	4F	CR832	3F			R830	4E	R987	3C
C834	3F	CR833	3F	Q810	3G	R831	3F	R988	2B
C837	5F	CR951	1B	Q814	3F	R832	4F	R990	2B
C951	5B	CR952	1B	Q816	4G	R833	4F	R991	2B
C952	4C	CR953	1A	Q826	2E	R834	3F	R993	2B
C954	4A	CR954	1A	Q955	4A	R836	5F	R994	2B
C959	4D	CR955	4B	Q962	4D	R837*	5E	R995	2A
C961	4C	CR957	3A	Q965	4C	R839	4F		
C965	4C	CR962	4D	Q970	4B	R898	5F	TP GND	4E
C976	4A	CR972	4B	Q976	2A	R954	4A	TP+100V	6D
C978	2A	CR976	3C	Q981	3C	R955	5A	TP+15V	4D
C983	3C	CR978	5A	Q987	3C	R957	4D		
C994	2B	CR981	2C	Q994	2A	R958	4E	U832	4F
		CR993	2B			R959	4D		
						R961	4C	VR819	3G
		F950	1E			R962	4D	VR822	2G
		F951	5D			R963	4D	VR968	3D
		F953	4C			R965	4D		
CR810	2F	F955	3C			R967	4D		
CR816	2G			R810	3F	R968	3D		
CR818	2G	L951	5E	R811	2F	R970	4A		
CR818	2G			R812	2F	R972	4B		

*See Parts List for serial number ranges.

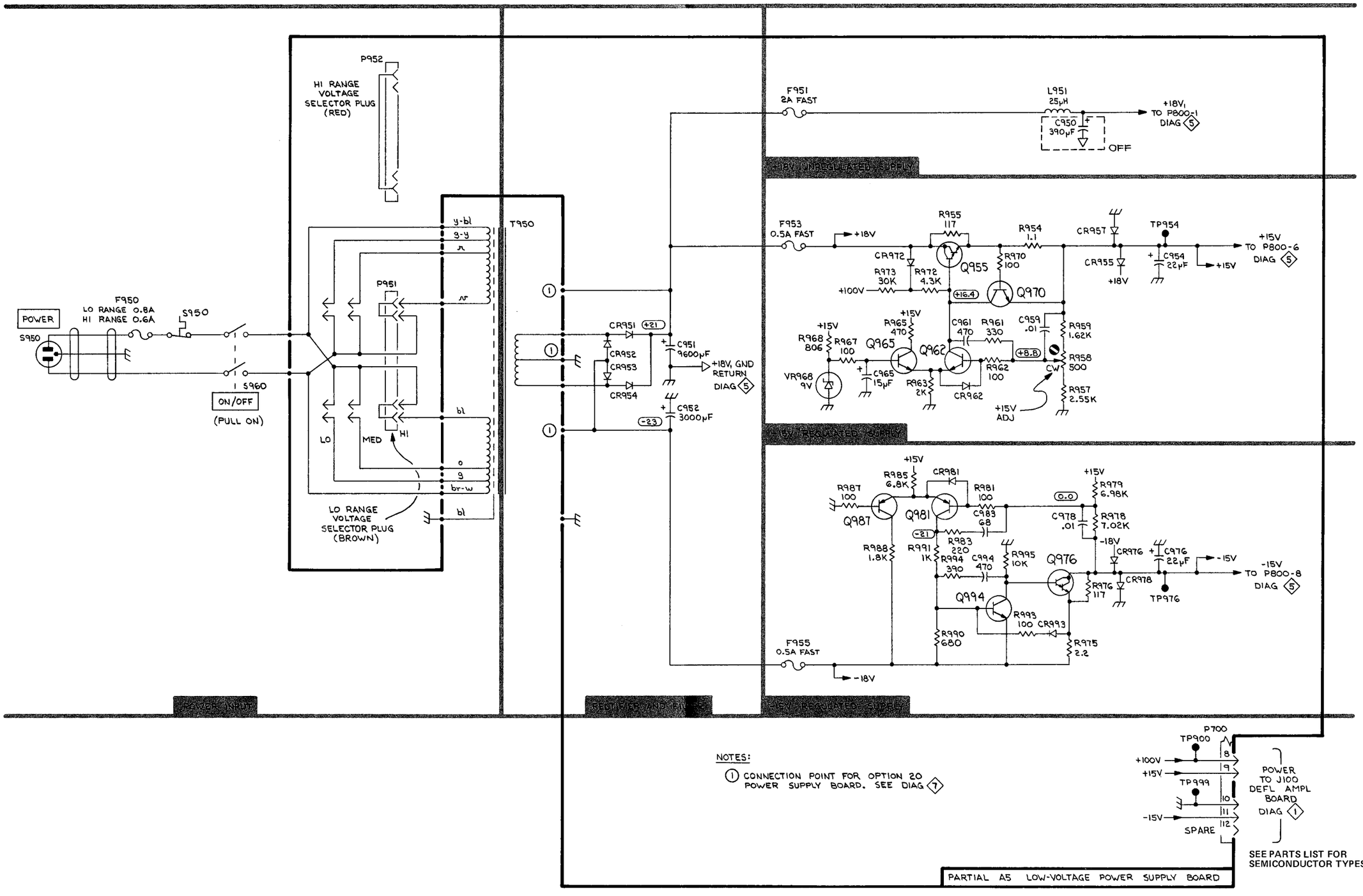


VOLTAGE CONDITIONS

NOTE

The test equipment used to obtain the voltages is listed in Table 6-2, Test Equipment.

Voltage Conditions. The dc voltages indicated on the schematic diagrams were obtained with a digital multimeter and with no test signal input. The 624 INTENSITY and Position controls were set for a barely visible spot positioned at near center screen.



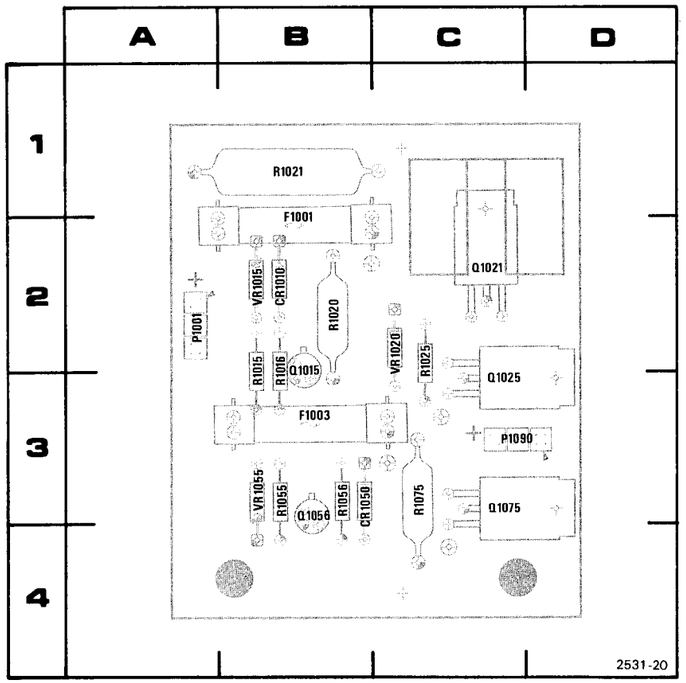
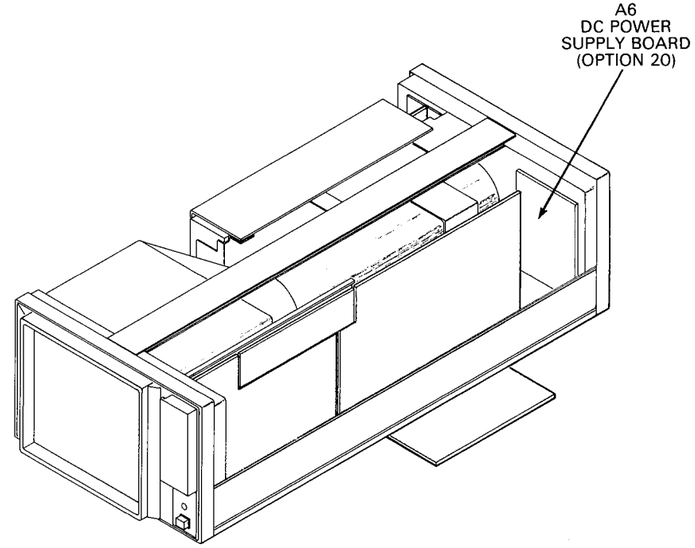


Figure 9-9. A6—DC Power Supply (Option 20) component locations.

CKT NO	GRID COORD	CKT NO	GRID COORD
CR1010	2B	R1015	2B
CR1050	3B	R1016	2B
		R1020	2B
F1001	2B	R1021	1B
F1003	3B	R1025	2C
		R1055	3B
P1001	2A	R1056	3B
P1090	3C	R1075	3C
Q1015	2B	VR1015	2B
Q1021	2C	VR1020	2C
Q1025	3C	VR1055	3B
Q1056	3B		
Q1075	3C		

@

Assembly	Location of Complete or Partial Board on Diagrams
A1—Deflection Amplifier Board	Diag. 1 2 5 8
A2—Z-Axis Amplifier Board	Diag. 1 2 3 5 8
A3—Sweep Board	Diag. 4 8
A4—High Voltage Power Supply Board	Diag. 5 8
A5—Low Voltage Power Supply Board	Diag. 5 6 7 8
A6—Option 20 Power Supply Board	Diag. 7 8

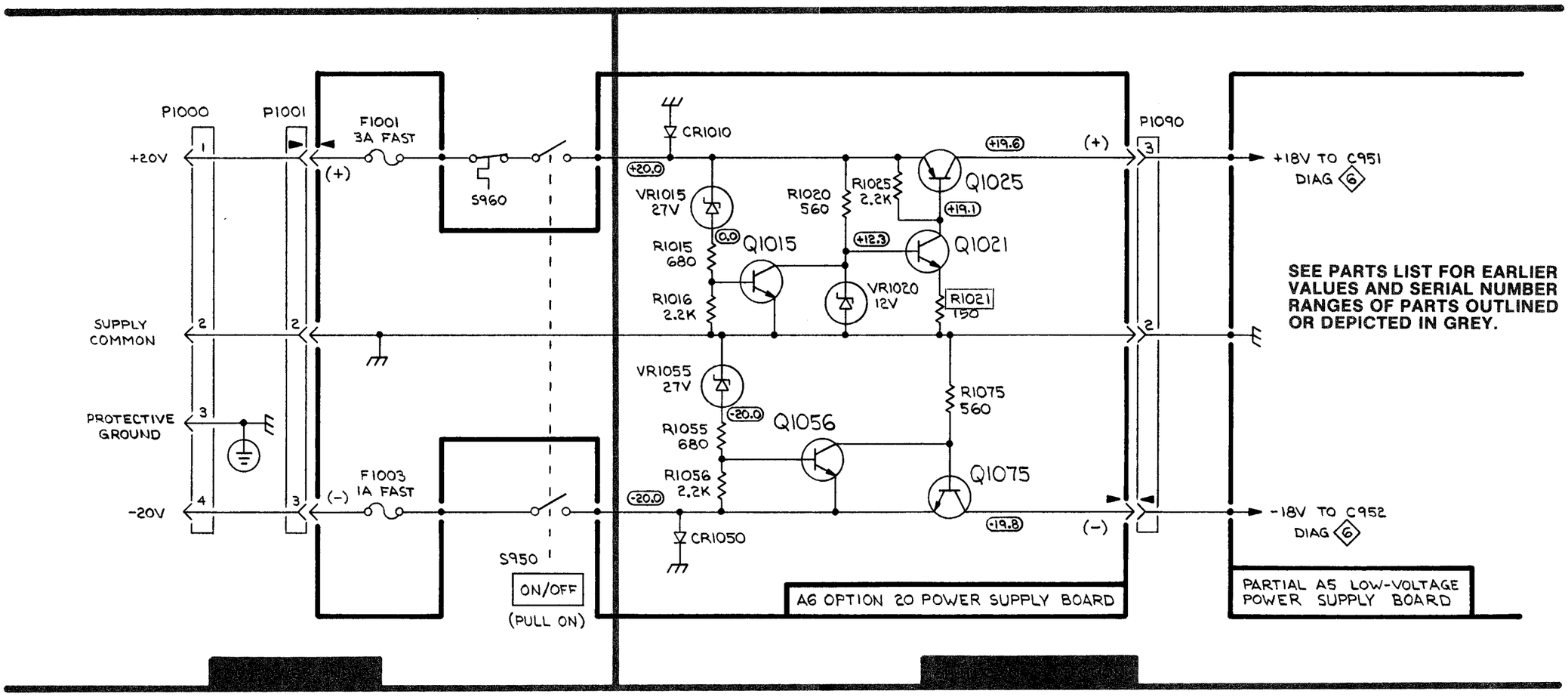


VOLTAGE CONDITIONS

NOTE

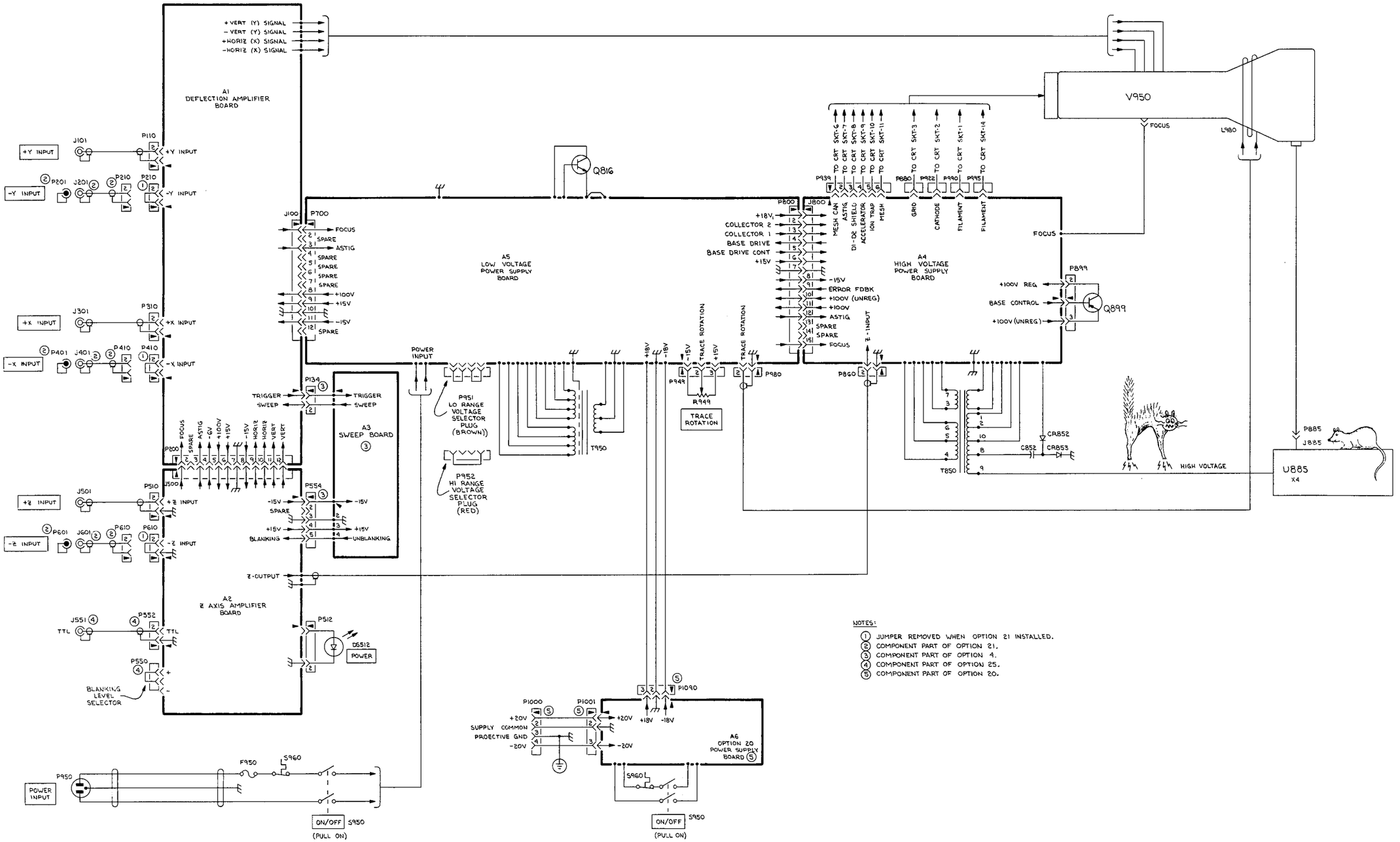
The test equipment used to obtain the voltages is listed in Table 6-2, Test Equipment.

Voltage Conditions. The dc voltags indicated on the schematic diagrams were obtained with a digital multimeter and with no test signal input. The 624 INTENSITY and Position controls were set for a barely visible spot positioned at near center screen.



SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.

SEE PARTS LIST FOR SEMICONDUCTOR TYPES.



NOTES:

1. JUMPER REMOVED WHEN OPTION 21 INSTALLED.
2. COMPONENT PART OF OPTION 21.
3. COMPONENT PART OF OPTION 4.
4. COMPONENT PART OF OPTION 25.
5. COMPONENT PART OF OPTION 20.

624 TROUBLESHOOTING CHART:

1. Before you begin the Troubleshooting Chart, check the rear panel c

For 624 Option 4 instruments
XY-XT switch to XY positio

2. Beginning at the top left block of the chart, proceed with the instructi indicated by the solid arrows, until the instrument does not perform a

3. Then follow the dashed arrows, as the symptom indicates, until a m which may be the cause of the malfunction, and corresponds directly

4. Refer to the numbered schematic diagram indicated in the shaded schematics to aid in troubleshooting. Typical waveforms, and the condit the schematic. Located on the back of the foldout page facing the sch circuit, or major portion of the circuit is on. In addition, an illustration of components and waveform test points.

5. If additional understanding the circuit or stage is required, refer to the on the schematic diagrams are repeated as sub-headings in section 4,

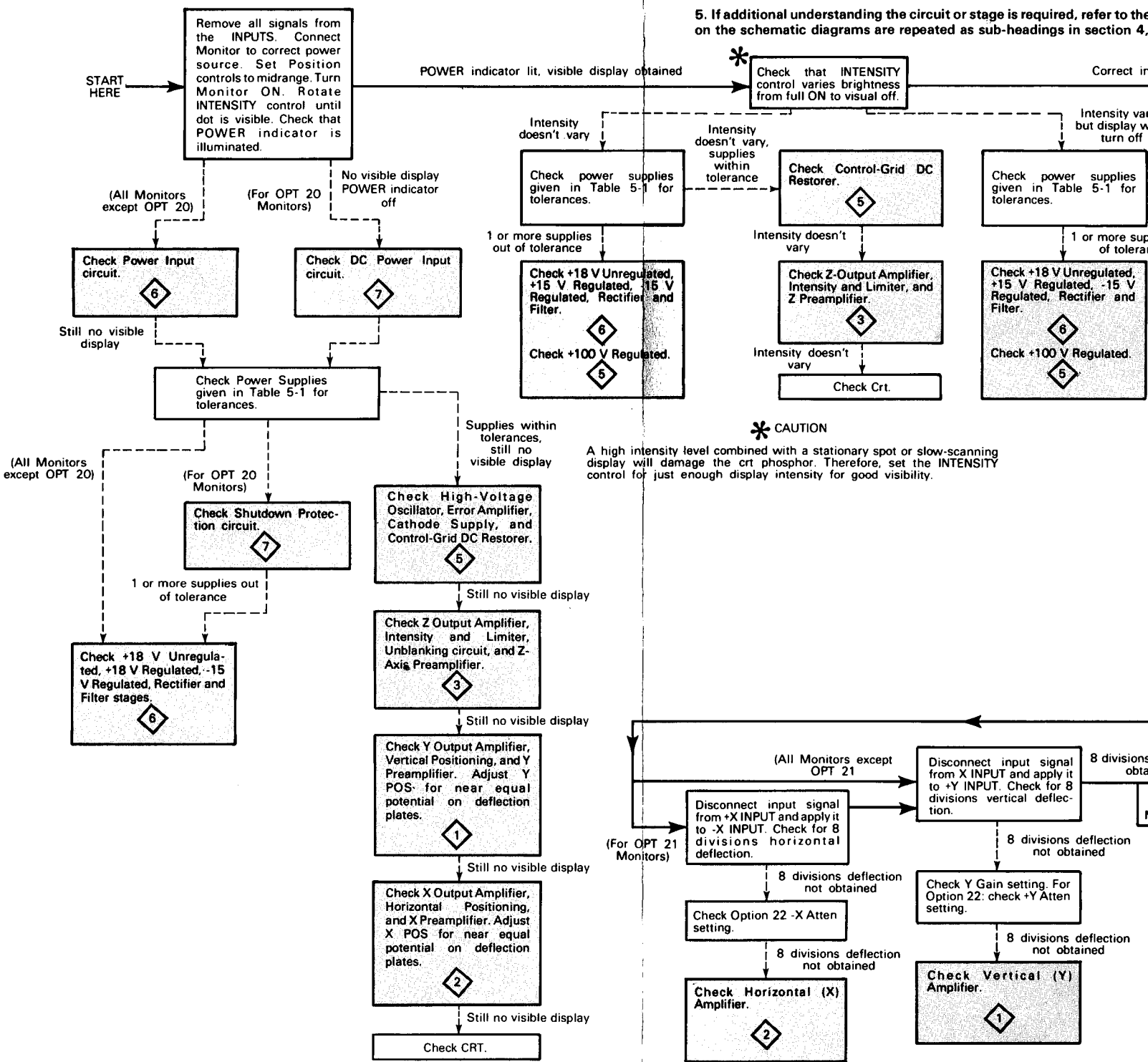


Figure 9-10. 6

anel crt cover to determine which Options have been installed in your monitor.

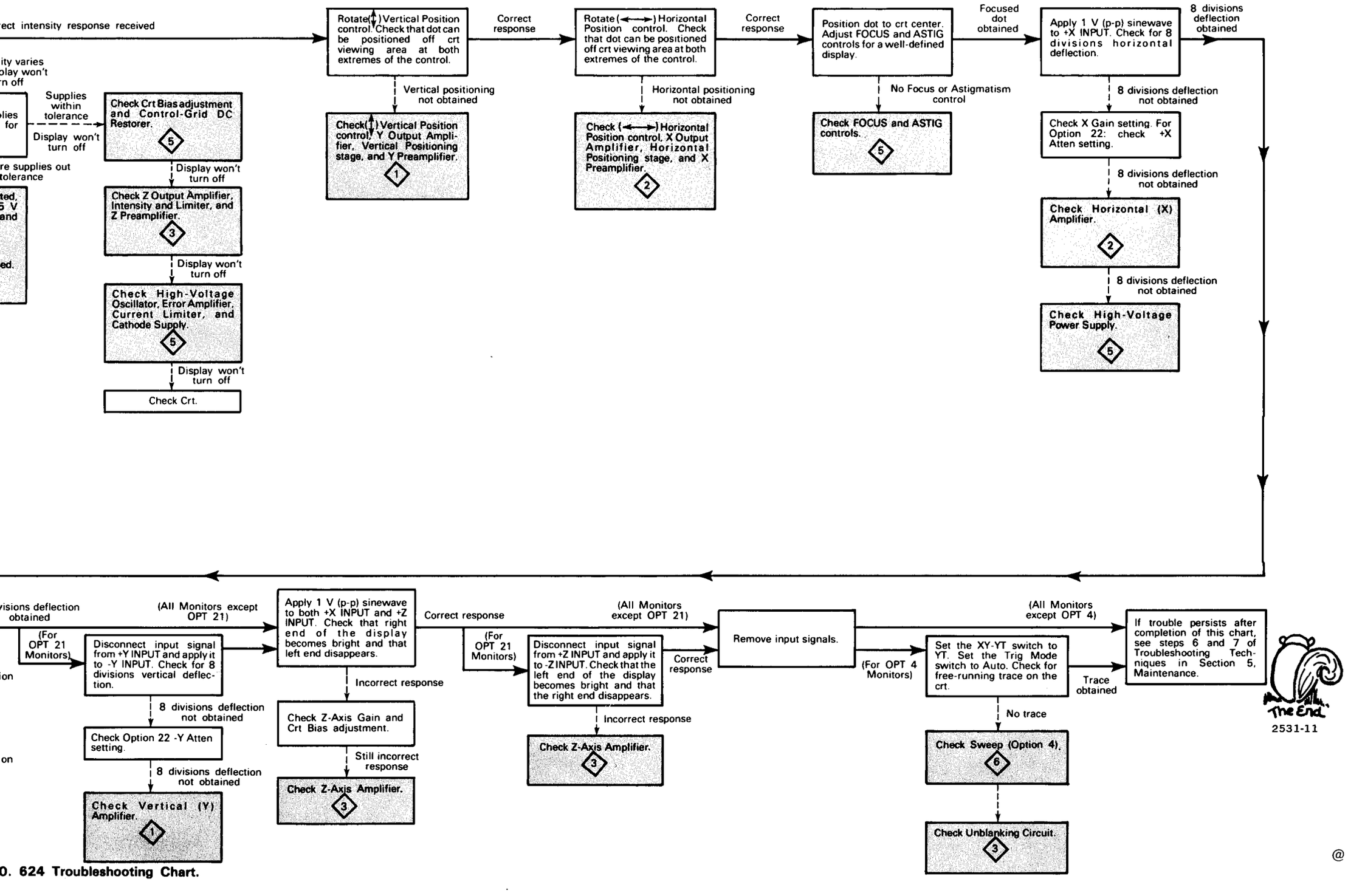
NOTE
nents, disconnect the sweep (by setting the osition) before beginning this procedure.

tructions, appropriate for your particular instrument (e.g., For Option 20 Monitors) as orm as indicated.

l a malfunction is located. Each shaded block in this chart indicates a circuit or stage ectly to the circuit or stage names given on the schematic diagram.

aded box. Important voltages and numbered waveform test points are given on the onditions under which the voltages and waveforms were taken, are located adjacent to e schematic is an illustration of the 624 showing the location of the board which the on of that circuit board is included here, identifying the physical location of the circuit

to the Theory of Operation, Section 4. The circuit or stage names given in this chart and on 4, where they are discussed in detail.



0. 624 Troubleshooting Chart.

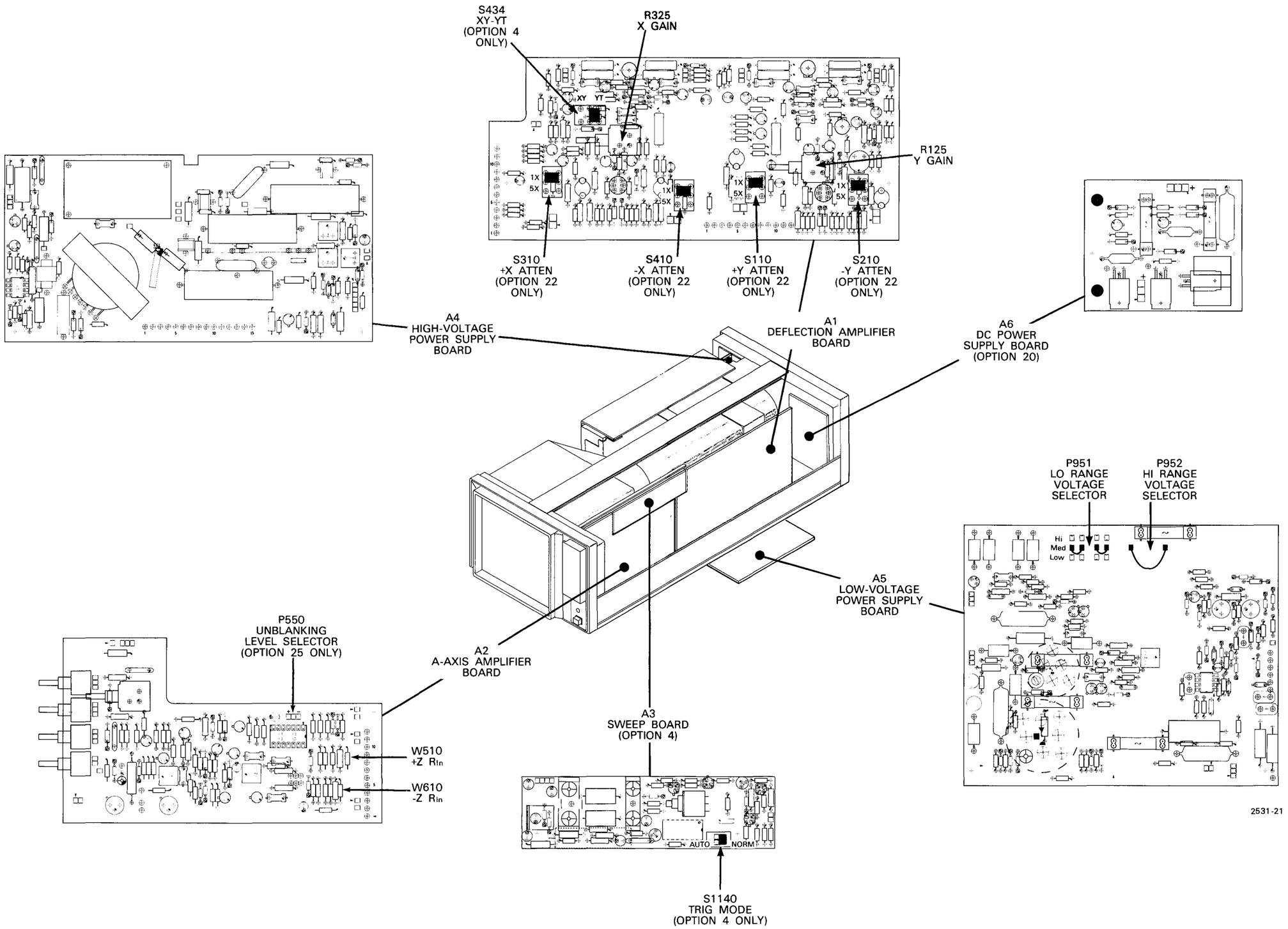


Figure 9-11. Internal controls and selector locations.

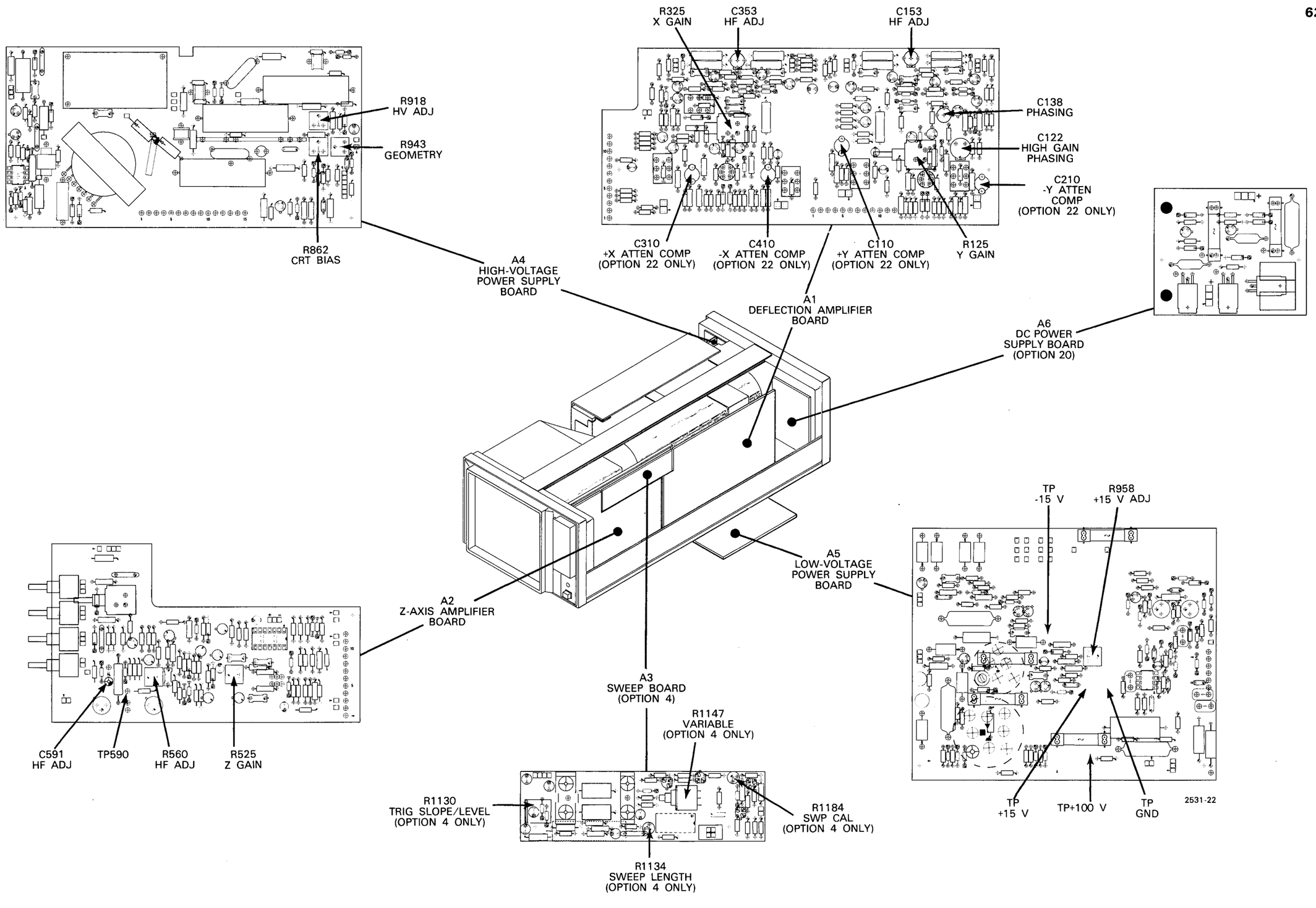
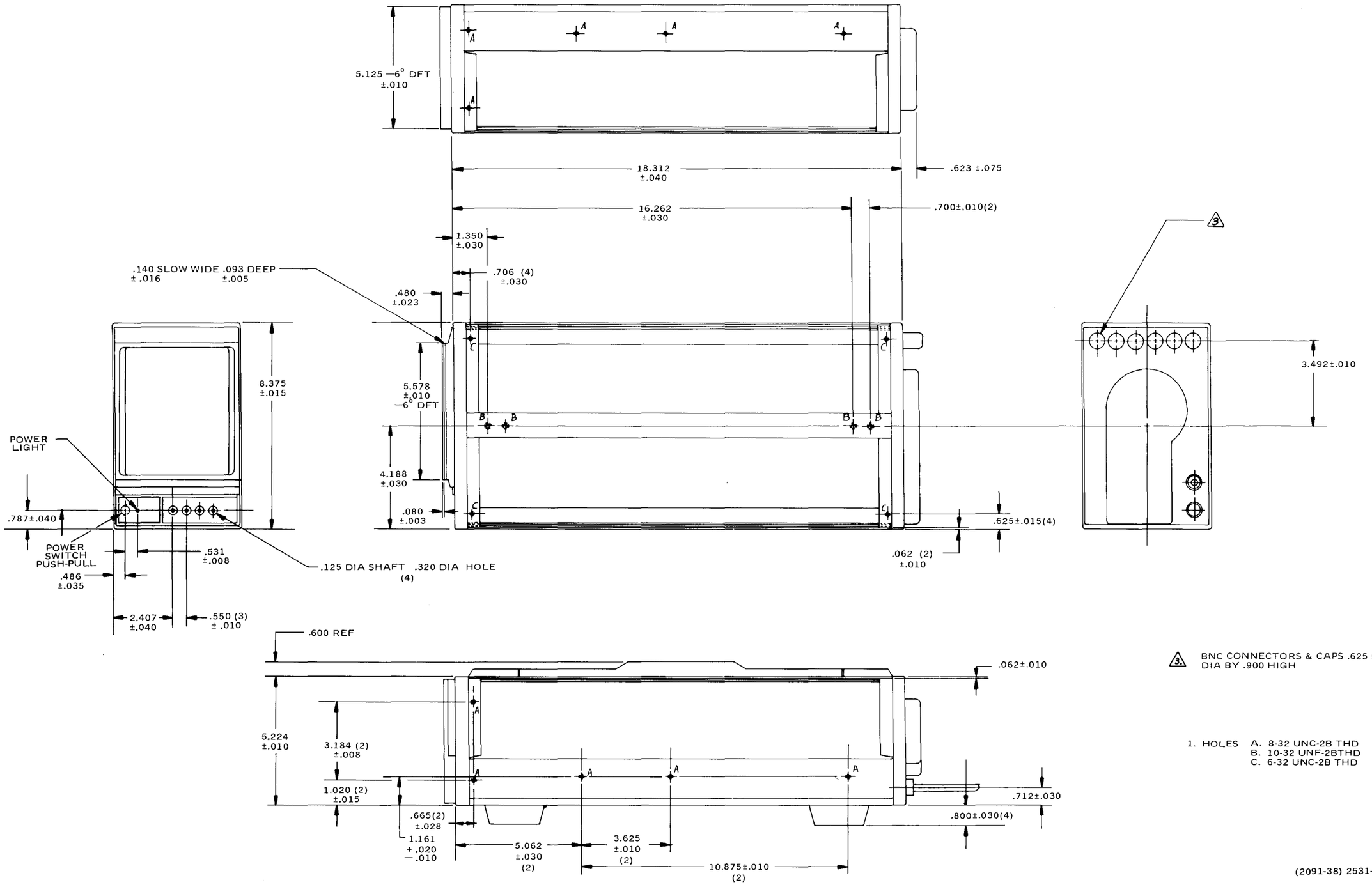


Figure 9-12. Test point and adjustment locations.



3. BNC CONNECTORS & CAPS .625 MAX DIA BY .900 HIGH

1. HOLES A. 8-32 UNC-2B THD
B. 10-32 UNF-2BTHD
C. 6-32 UNC-2B THD

(2091-38) 2531-23

Figure 9-13. Detailed dimensional drawing.

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REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the description column.

1 2 3 4 5 Name & Description

Assembly and/or Component
Attaching parts for Assembly and/or Component
- - - * - - -
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
- - - * - - -
Parts of Detail Part
Attaching parts for Parts of Detail Part
- - - * - - -

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. The separation symbol - - - * - - - indicates the end of attaching parts.

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

"	INCH
#	NUMBER SIZE
ACTR	ACTUATOR
ADPTR	ADAPTER
ALIGN	ALIGNMENT
AL	ALUMINUM
ASSEM	ASSEMBLED
ASSY	ASSEMBLY
ATTEN	ATTENUATOR
AWG	AMERICAN WIRE GAGE
BD	BOARD
BRKT	BRACKET
BRS	BRASS
BRZ	BRONZE
BSHG	BUSHING
CAB	CABINET
CAP	CAPACITOR
CER	CERAMIC
CHAS	CHASSIS
CKT	CIRCUIT
COMP	COMPOSITION
CONN	CONNECTOR
COV	COVER
CPLG	COUPLING
CRT	CATHODE RAY TUBE
DEG	DEGREE
DWR	DRAWER
ELCTRN	ELECTRON
ELEC	ELECTRICAL
ELCTLT	ELECTROLYTIC
ELEM	ELEMENT
EPL	ELECTRICAL PARTS LIST
EQPT	EQUIPMENT
EXT	EXTERNAL
FIL	FILLISTER HEAD
FLEX	FLEXIBLE
FLH	FLAT HEAD
FLTR	FILTER
FR	FRAME or FRONT
FSTNR	FASTENER
FT	FOOT
FXD	FIXED
GSKT	GASKET
HDL	HANDLE
HEX	HEXAGON
HEX HD	HEXAGONAL HEAD
HEX SOC	HEXAGONAL SOCKET
HLCPS	HELICAL COMPRESSION
HLEXT	HELICAL EXTENSION
HV	HIGH VOLTAGE
IC	INTEGRATED CIRCUIT
ID	INSIDE DIAMETER
IDENT	IDENTIFICATION
IMPLR	IMPELLER
IN	INCH
INCAND	INCANDESCENT
INSUL	INSULATOR
INTL	INTERNAL
LPHLDR	LAMPHOLDER
MACH	MACHINE
MECH	MECHANICAL
MTG	MOUNTING
NIP	NIPPLE
NON WIRE	NOT WIRE WOUND
OBD	ORDER BY DESCRIPTION
OD	OUTSIDE DIAMETER
OVH	OVAL HEAD
PH BRZ	PHOSPHOR BRONZE
PL	PLAIN or PLATE
PLSTC	PLASTIC
PN	PART NUMBER
PNH	PAN HEAD
PWR	POWER
RCPT	RECEPTACLE
RES	RESISTOR
RGD	RIGID
RLF	RELIEF
RTNR	RETAINER
SCH	SOCKET HEAD
SCOPE	OSCILLOSCOPE
SCR	SCREW
SE	SINGLE END
SECT	SECTION
SEMICOND	SEMICONDUCTOR
SHLD	SHIELD
SHLDR	SHOULDERED
SKT	SOCKET
SL	SLIDE
SLFLKG	SELF-LOCKING
SLVG	SLEEVING
SPR	SPRING
SQ	SQUARE
SST	STAINLESS STEEL
STL	STEEL
SW	SWITCH
T	TUBE
TERM	TERMINAL
THD	THREAD
THK	THICK
TNSN	TENSION
TPG	TAPPING
TRH	TRUSS HEAD
V	VOLTAGE
VAR	VARIABLE
W/	WITH
WSHR	WASHER
XFMR	TRANSFORMER
XSTR	TRANSISTOR

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000BH	FAB-TEK	17 SUGAR HALLOW ROAD	DANBURY, CT 06810
000BK	STAUFFER SUPPLY	105 SE TAYLOR	PORTLAND, OR 97214
000CP	AIMSCO	4024 22ND AVE. WEST	SEATTLE, WA 98199
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
05820	WAKEFIELD ENGINEERING, INC.	AUDUBON ROAD	WAKEFIELD, MA 01880
06776	ROBINSON NUGENT INC.	800 E. 8TH ST., BOX 470	NEW ALBANY, IN 47150
08261	SPECTRA-STRIP CORP.	7100 LAMPSON AVE.	GARDEN GROVE, CA 92642
12136	PHILADELPHIA HANDLE COMPANY, INC.	1643 HADDON AVENUE	CAMDEN, NJ 08103
12327	FREEWAY CORPORATION	9301 ALLEN DRIVE	CLEVELAND, OH 44125
13103	THERMALLOY COMPANY, INC.	2021 W VALLEY VIEW LANE P O BOX 34829	DALLAS, TX 75234
13511	AMPHENOL CARDRE DIV., BUNKER RAMO CORP.		LOS GATOS, CA 95030
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
27264	MOLEX PRODUCTS CO.	5224 KATRINE AVE.	DOWNERS GROVE, IL 60515
28520	HEYMAN MFG. CO.	147 N. MICHIGAN AVE.	KENILWORTH, NJ 07033
57668	R-OHM CORP.	16931 MILLIKEN AVE.	IRVINE, CA 92713
70485	ATLANTIC INDIA RUBBER WORKS, INC.	571 W. POLK ST.	CHICAGO, IL 60607
71785	TRW, CINCH CONNECTORS	1501 MORSE AVENUE	ELK GROVE VILLAGE, IL 60007
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
73803	TEXAS INSTRUMENTS, INC., METALLURGICAL MATERIALS DIV.	34 FOREST STREET	ATTLEBORO, MA 02703
74445	HOLO-KROME CO.	31 BROOK ST. WEST	HARTFORD, CT 06110
75915	LITTELFUSE, INC.	800 E. NORTHWEST HWY	DES PLAINES, IL 60016
77820	BENDIX CORP., THE, ELECTRICAL COMPONENTS DIVISION	SHERMAN AVE.	SIDNEY, NY 13838
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
79136	WALDES, KOHINOOR, INC.	47-16 AUSTEL PLACE	LONG ISLAND CITY, NY 11101
79807	WROUGHT WASHER MFG. CO.	2100 S. O BAY ST.	MILWAUKEE, WI 53207
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
85471	BOYD, A. B., CO.	2527 GRANT AVENUE	SAN LEANDRO, CA 94579
93907	TEXTRON INC. CAMCAR DIV	600 18TH AVE	ROCKFORD, IL 61101
95987	WECKESSER CO., INC.	4444 WEST IRVING PARK RD.	CHICAGO, IL 60641
S3629	PANEL COMPONENTS CORP.	2015 SECOND ST.	BERKELEY, CA 94170

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-1	200-1218-00			1		RTNR,CRT SCALE:6.814 X 5.125,NYLON	80009	200-1218-00
	200-2148-01			1		RTNR,CRT SCALE:ALUMINUM	80009	200-2148-01
	----- -----			-		(OPTION 29 ONLY)		
						**********(ATTACHING PARTS)**********		
-2	211-0188-00			2		SCREW,MACHINE:4-40 X 0.30 INCH,SST	83385	OBD
						**********(END ATTACHING PARTS)**********		
-3	337-2126-01			1		SHL,IMPLOSION:W/BLACK BORDER	80009	337-2126-01
	378-0704-00	B021200		1		FILTER,LT,CRT:AMBER,5.52 X 4.51 X 0.03	80009	378-0704-00
	----- -----			-		(OPTION 76 ONLY)		
-4	386-3824-00			2		SUPPORT,CRT:FRONT	80009	386-3824-00
-5	108-0889-00			1		COIL,TUBE DEFL:TRACE ROTATOR	80009	108-0889-00
-6	337-2490-00			1		SHIELD,CRT:FRONT	80009	337-2490-00
						**********(ATTACHING PARTS)**********		
-7	211-0587-00			1		SCREW,MACHINE:6-32 X 0.188 INCH,HSB	80009	211-0587-00
						**********(END ATTACHING PARTS)**********		
	131-2187-00			1		CONTACT,ELEC:PHOSPHOR BRONZE	80009	131-2187-00
	358-0566-00			2		INSULATOR,BSHG:0.625 ID X 0.406 THK,NYLON	28520	SB-812-10
	334-1379-00			1		LABEL:CRT,ADHESIVE BACK	80009	334-1379-00
-8	366-1257-00			1		PUSH BUTTON:GRAY PLASTIC	80009	366-1257-00
-9	426-0681-00			1		FR,PUSH BUTTON:GRAY PLASTIC	80009	426-0681-00
-10	333-2347-01			1		PANEL,FRONT:	80009	333-2347-01
						**********(ATTACHING PARTS)**********		
-11	210-0586-00			1		NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	OBD
-12	210-0949-00			1		WASHER,FLAT:0.141 ID X 0.50 INCH OD,BRS	12327	OBD
						**********(END ATTACHING PARTS)**********		
-13	200-2128-00			1		DOOR,ACCESS PNL:	80009	200-2128-00
-14	333-2334-00			1		PANEL,FRONT:	80009	333-2334-00
	333-2412-01			1		PANEL,FRONT:	80009	333-2412-01
	----- -----			-		(OPTION 27 ONLY)		
						**********(ATTACHING PARTS)**********		
-15	211-0008-00			2		SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
						**********(END ATTACHING PARTS)**********		
-16	----- -----			1		LAMP,LEC:(SEE DS512 REPL)		
-17	386-2067-02			1		SUBPANEL,FRONT:	80009	386-2067-02
-18	----- -----			1		SWITCH,PUSH:(SEE S960 REPL)		
						**********(ATTACHING PARTS)**********		
-19	211-0022-00			2		SCREW,MACHINE:2-56 X 0.188 INCH,PNH STL	83385	OBD
-20	210-0053-00			2		WASHER,LOCK:INTL,0.092 ID X 0.175"OD,S	83385	OBD
-21	211-0087-01			2		SCREW,MACHINE:2-56 X 0.188,FLH 82 DEG,STL	83385	OBD
						**********(END ATTACHING PARTS)**********		
-22	361-0861-00			2		SPACER,SLEEVE:0.36 L X 0.09 ID,ALUMINUM	80009	361-0861-00
-23	200-1308-01			1		COVER,CRT,REAR:	80009	200-1308-01
						**********(ATTACHING PARTS)**********		
-24	211-0097-00			5		SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
						**********(END ATTACHING PARTS)**********		
-25	----- -----			1		TRANSFORMER:(SEE T950 REPL)		
						**********(ATTACHING PARTS)**********		
-26	212-0100-00			4		SCREW,MACHINE:8-32 X 0.625 INCH,HEX.HD,ST	83385	OBD
-27	210-0804-00			4		WASHER,FLAT:0.17 ID X 0.375 INCH OD,STL	12327	OBD
-28	210-0458-00			4		NUT,PL,ASSEM WA:8-32 X 0.344 INCH,STL	83385	OBD
						**********(END ATTACHING PARTS)**********		
-29	407-2017-00			2		BRACKET,XFMR:ALUMINUM	80009	407-2017-00
-30	342-0028-00			2		INSULATOR,PLATE:0.600 W X 1.700 INCH LONG	80009	342-0028-00
-31	161-0017-09			1		CABLE ASSY,PWR,:3,18 AWG,125V,96.0 L	80009	161-0017-09
-32	179-2571-00			1		WIRING HARNESS,:POWER	80009	179-2571-00
-33	358-0529-00			1		BSHG,STRAIN RLF:FOR 0.3-0.36 OD CABLE,STR	28520	207 (UL 6P3-4)
-34	352-0076-00	B010100	B021972	1		FUSEHOLDER:W/HARDWARE	75915	342012-L
	204-0833-00	B021973		1		BODY,FUSEHOLDER:3AG & 5 X 20MM FUSES	S3629	031.1653(MDLFEU)
-35	214-2076-00			1		NUT,PLAIN,HEX.:HEX	75915	903012
-36	210-0873-00			1		WASHER,NONMETAL:0.5 ID X 0.688 INCH OD,NPR	70485	OBD
-36.1	200-2264-00	B021973		1		CAP.,FUSEHOLDER:3AG FUSES	S3629	FEK 031 1666
-37	----- -----			3		CONN,RCPT:(SEE J101,J301 & J501 REPL)		
-38	342-0117-00			6		INSULATOR,BSHG:0.375 ID X 0.065 L,DELRIN	80009	342-0117-00
-39	210-0255-00			3		TERMINAL,LUG:0.391 ID,LOCKING,BRS CD PL	80009	210-0255-00
-40	214-2668-00			4		PLUG,HOLE:0.497 DIA,PLASTIC	80009	214-2668-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-41	----- -----			1		RES.,VAR,NONWIR:(SEE R949 REPL)		
						**********(ATTACHING PARTS)**********		
-42	210-0583-00			1		NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-43	210-0940-00			1		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
						**********(END ATTACHING PARTS)**********		
-44	210-0202-00			1		TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED	78189	2104-06-00-2520N
						**********(ATTACHING PARTS)**********		
-45	210-0457-00			1		NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	OBD
						**********(END ATTACHING PARTS)**********		
-46	200-0865-00			1		COVER,MTG HOLE:2.164 X 0.53,AL	80009	200-0865-00
						**********(ATTACHING PARTS)**********		
-47	211-0097-00			2		SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
						**********(END ATTACHING PARTS)**********		
-48	210-0586-00			2		NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	OBD
-49	333-2350-01			1		PANEL,REAR:	80009	333-2350-01
						**********(ATTACHING PARTS)**********		
-50	211-0507-00			4		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
-51	220-0419-00			2		NUT,PLAIN,SQ:6-32 X 0.312 INCH,STL	83385	OBD
-52	210-0006-00			2		WASHER,LOCK:#6 INTL,0.018 THK,STL CD PL	78189	1206-00-00-0541C
						**********(END ATTACHING PARTS)**********		
-53	220-0809-00			2		NUT BLOCK:0.85 X 0.95,(1)6-32 THRU	80009	220-0809-00
						**********(ATTACHING PARTS)**********		
-54	211-0538-00			2		SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH ST	83385	OBD
	211-0507-00			2		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
						**********(END ATTACHING PARTS)**********		
-55	343-0659-00			2		CLAMP,LOOP:0.375 DIA,STEEL CAD PLATE	000CP	OBD
						**********(ATTACHING PARTS)**********		
-56	211-0538-00			2		SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH ST	83385	OBD
-57	210-0457-00			2		NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	OBD
						**********(END ATTACHING PARTS)**********		
-58	166-0603-00			1		GND,METAL,RIGID:14.0 L X 0.319 ID,AL	80009	166-0603-00
-59	366-1564-00			4		KNOB:GRAY PLASTIC,PRESS MT	80009	366-1564-00
-60	384-1112-04			1		EXTENSION SHAFT:9.03 L X 0.188 OD,PLASTIC	80009	384-1112-04
-61	376-0029-00			1		CPLG,SHAFT,RGD:0.128 ID X 0.312 OD X 0.5"L	80009	376-0029-00
-62	384-1112-03			1		EXTENSION SHAFT:12.98 L X 0.188 OD,PLASTIC	80009	384-1112-03
-63	376-0029-00			1		CPLG,SHAFT,RGD:0.128 ID X 0.312 OD X 0.5"L	80009	376-0029-00
-64	----- -----			1		CKT BOARD ASSY:Z-AXIS/CONTROL(SEE A2 REPL)		
						**********(ATTACHING PARTS)**********		
-65	211-0008-00			4		SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
						**********(END ATTACHING PARTS)**********		
	----- -----			-		CKT BOARD ASSY INCLUDES:		
-66	----- -----			3		.RES.,VAR NONWIR:(SEE R147,347,547 REPL)		
						.**********(ATTACHING PARTS)**********		
	210-0583-00			3		.NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
	210-0046-00			3		.WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	78189	1214-05-00-0541C
						.**********(END ATTACHING PARTS)**********		
-67	----- -----			1		.RES.,VAR NONWIR:(SEE R844 REPL)		
						.**********(ATTACHING PARTS)**********		
-68	210-0583-00			1		.NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-69	210-0046-00			1		.WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	78189	1214-05-00-0541C
						.**********(END ATTACHING PARTS)**********		
-70	407-1999-00			1		.BRACKET,CMPNT:BRASS	80009	407-1999-00
-71	214-0579-00			1		.TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-72	131-0608-00			2		.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-73	131-1334-00			1		.BUS CONDUCTOR:	80009	131-1334-00
-74	131-0589-00			4		.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-75	136-0252-07			6		.SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-76	----- -----			1		.RES.,VAR NONWIR:(SEE R841 REPL)		
						.**********(ATTACHING PARTS)**********		
-77	210-0583-00			1		.NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-78	210-0046-00			1		.WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	78189	1214-05-00-0541C
						.**********(END ATTACHING PARTS)**********		
-79	386-3786-00			1		.PLATE,VAR RES:BRASS	80009	386-3786-00
-80	214-1291-00			2		.HEAT SINK,ELEC:XSTR,0.72 OD X 0.375"H	05820	207SB
-80.1	342-0324-00	B021006		2		.INSULATOR,DISC:TO-5 TRANSISTOR	13103	7717-5N-BLUE

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-81	131-0566-00			3		.BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
-82	131-1782-00			1		.CONN,RCPT,ELEC:RT ANGLE,12 FEM,0.045 SQ	27264	09-52-3121
-83	214-0973-00			1		.HEAT SINK,ELEC:0.28 X 0.18 OVAL X 0.187"H	80009	214-0973-00
-84	----- -----			1		CKT BOARD ASSY:DEFLECTION(SEE A1 REPL)		
						**********(ATTACHING PARTS)**********		
-85	211-0008-00			3		SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
						**********(END ATTACHING PARTS)*********		
	----- -----			-		CKT BOARD ASSY INCLUDES:		
-86	131-2079-00			1		.CONN,RCPT,ELEC:FD.THRU,12 MALE,TIN PLATED	27264	09-67-1124
-87	131-0566-00			6		.BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
-88	131-0589-00			8		.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-89	136-0252-07			12		.SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-90	131-1782-00			1		.CONN,RCPT,ELEC:RT ANGLE,12 FEM,0.045 SQ	27264	09-52-3121
-91	131-1334-00			2		.BUS CONDUCTOR:	80009	131-1334-00
	366-1564-00			2		.KNOB:GRAY PLASTIC,PRESS MT	80009	366-1564-00
	----- -----			-		.(OPTION 27 ONLY)		
-92	----- -----			2		.RES.,VAR NONWIR:(SEE R125,R325 REPL)		
						.*******(ATTACHING PARTS FOR EACH)********		
-93	210-0583-00			1		.NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-94	210-0046-00			1		.WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	78189	1214-05-00-0541C
						.**********(END ATTACHING PARTS)**********		
-95	386-3786-00			2		.PLATE,VAR RES:BRASS	80009	386-3786-00
-96	337-2456-00			1		.SHIELD,ELEC:DEFLECTION	80009	337-2456-00
	198-3981-00	B010100	B021280	1		.WIRE SET,ELEC:	80009	198-3981-00
	198-3981-01	B021281		1		.WIRE SET,ELEC:	80009	198-3981-01
-97	131-1963-00	B010100	B021280	4		..TERM.,QIK DISC.:FOR 0.038 DIA CRT PIN	00779	42428-9
	131-2525-00	B021281		4		..CONN,PLUG,ELEC:CRT,22-26 AWG	06776	PS40-101
-97.1	343-0854-00	B021281		4		..STRAIN RLF,TERM:CKT BOARD,22-26 AWG	27264	16-02-0034
-98	334-2359-00			1		MARKER,IDENT:WARNING	80009	334-2359-00
-99	386-3837-00			1		SUPPORT,CKT BD:	80009	386-3837-00
						**********(ATTACHING PARTS)**********		
-100	211-0101-00			3		SCREW,MACHINE:4-40 X 0.25,100 DEG,FLH STL	83385	OBD
-101	129-0273-00			1		POST,ELEC-MECH:0.625 X 0.188 INCH OD	80009	129-0273-00
-102	211-0008-00			1		SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
-103	211-0038-00			2		SCREW,MACHINE:4-40 X 0.312,FLH,100 DEG	83385	OBD
						**********(END ATTACHING PARTS)*********		
-104	----- -----			1		CKT BOARD ASSY:LV PWR SPLY(SEE A5 REPL)		
						**********(ATTACHING PARTS)**********		
	211-0008-00			2		SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
						**********(END ATTACHING PARTS)*********		
	----- -----			-		CKT BOARD ASSY INLCUDES:		
-105	344-0236-00			2		.CLIP,SPR TNSN:	80009	344-0236-00
-106	342-0082-00			2		.INSULATOR,PLATE:0.52 SQ X 0.015 INCH THK,	80009	342-0082-00
-107	407-2000-00			1		.BRACKET,ANGLE:POWER SUPPLY,ALUMINUM	80009	407-2000-00
						.**********(ATTACHING PARTS)**********		
-108	211-0008-00			1		.SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
						.**********(END ATTACHING PARTS)**********		
-109	131-1782-00	B010100	B010100	1		.CONN,RCPT,ELEC:RT ANGLE,12 FEM,0.045 SQ	27264	09-52-3121
-110	131-0566-00			8		.BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
	131-0566-00	B020000		1		.BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
-111	136-0514-00			1		.SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
-112	344-0154-00			8		.CLIP,ELECTRICAL:FUSE,CKT BD MT	80009	344-0154-00
-113	131-0608-00			19		.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-114	131-1783-00			1		.CONN,RCPT,ELEC:FD-THRU,12 MALE,TIN PLATED	27264	09-64-1123
-115	214-0579-00			4		.TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-116	131-1896-00			1		.LINK,TERM. CONN:8,22 AWG,1.5 L	80009	131-1896-00
-117	131-1895-00			1		.LINK,TERM. CONN:8,22 AWG,1.5 L	80009	131-1895-00
-118	131-2078-00			1		.TERM.,FEEDTHRU:15 PIN,INSULATED,0.045 RND	27264	09-64-1151
	334-3711-00	B020963		1		.MARKER,IDNET:MKD 2.0A FAST	80009	334-3711-00
-119	342-0414-00			1		INSULATOR,SW:POWER	80009	342-0414-00
-120	334-3185-00			2		MARKER,IDENT:MARKED DANGER UP TO 100V	80009	334-3185-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-121	441-1393-00			1	CHASSIS,MONITOR:CONTROL & L.V. POWER	80009	441-1393-00
					**********(ATTACHING PARTS)**********		
-122	211-0538-00			2	.SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH ST	83385	OBD
-123	210-0457-00			2	.NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	OBD
-124	211-0025-00			1	.SCREW,MACHINE:4-40 X 0.375 100 DEG,FLH ST	83385	OBD
	211-0008-00			1	.SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
-125	210-0586-00			1	.NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	OBD
					.**********(END ATTACHING PARTS)**********		
-126	343-0006-00			1	.CLAMP,LOOP:0.50 INCH DIAMETER,PLSTC	95987	1-2-6B
					.**********(ATTACHING PARTS)**********		
-127	211-0510-00			1	.SCREW,MACHINE:6-32 X 0.375,PNH,STL,CD PL	83385	OBD
-128	210-0863-00			1	.WSHR,LOOP CLAMP:0.187 ID U/W 0.5 W CLP,ST	95987	C191
					.**********(END ATTACHING PARTS)**********		
-129	200-0616-01	B010100	B010648	1	COV,ELECTRON TU:	80009	200-0616-01
	200-0616-02	B0101649		1	COVER,CRT SKT:	80009	200-0616-02
	136-0690-00			1	SKT,PL-IN ELEK:	80009	136-0690-00
-130	136-0202-04			1	.SKT,PL-IN ELEK:ELECTRON TUBE,14 CONT	80009	136-0202-04
-131	131-0621-00			4	.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	46231
-132	131-0707-00			6	.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
-133	352-0164-01			1	.CONN BODY,PL,EL:6 WIRE BROWN	80009	352-0164-01
	334-2363-00			1	MARKER INDENT:WARNING,DANGER,HV	80009	334-2363-00
-134	407-0931-00			1	BRKT,CRT SHIELD:REAR,POLYAMIDE	80009	407-0931-00
					**********(ATTACHING PARTS)**********		
-135	211-0007-00			3	SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
-136	210-0586-00			3	NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	OBD
-137	210-0004-00			3	WASHER,LOCK:#4 INTL,0.015 THK,STL CD PL	000BK	OBD
-138	129-0260-00			3	POST,ELEC-MECH:0.255 HEX X 0.500 INCH L	80009	129-0260-00
-139	210-0802-00			3	WASHER,FLAT:0.15 ID X 0.312 INCH OD	12327	OBD
					**********(END ATTACHING PARTS)**********		
-140	348-0145-00			1	GROMMET,PLASTIC:U-SHP,1.0 X 0.42 INCH	80009	348-0145-00
-141	348-0090-00			4	PAD,CUSHIONING:2.03 X 0.69 X 0.312	85471	OBD
-142	337-2455-00			1	SHIELD SECT,CRT:REAR	80009	337-2455-00
-143	337-2563-00			1	SHIELD,ELEC:HIGH VOLTAGE	80009	337-2563-00
-144	342-0329-00			1	.INSULATION,FILM:HV SHIELD,3.15 W X 4.15 L	80009	342-0329-00
					**********(ATTACHING PARTS)**********		
-145	211-0008-00			3	SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
					**********(END ATTACHING PARTS)**********		
-146	343-0521-00			1	CLAMP,XSTR:750 WIDE W(2) 4-40 THD HOLE	80009	343-0521-00
					**********(ATTACHING PARTS)**********		
-147	211-0102-00			1	SCREW,MACHINE:4-40 X 0.500",FLH,STL	83385	OBD
-148	342-0082-00			2	INSULATOR,PLATE:0.52 SQ X 0.015 INCH THK,A	80009	342-0082-00
	334-3186-00			1	MARKER,IDENT:MARKED DANGER UP TO 4.5KV	80009	334-3186-00
-149	----- -----			1	CKT BOARD ASSY:HV(SEE A4 REPL)		
					**********(ATTACHING PARTS)**********		
-150	211-0008-00			3	SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
					**********(END ATTACHING PARTS)**********		
	----- -----			-	CKT BOARD ASSY INCLUDES:		
-151	136-0514-00			1	.SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
-152	131-0589-00			6	.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-153	131-0608-00			6	.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-154	131-2077-00			1	.TERM.,FEEDTHRU:CKT CARD,RT ANGLE,15 FEMAL	27264	09-52-3151
	175-2840-00	B021006		1	.LEAD ASSY,ELEC:3,26 AWG,1.5 L & 1,24 AWG	80009	175-2840-00
154.1	131-1815-00			3	..CONTACT,ELEC:22-30 AWG,FEMALE,BRASS	27264	08-56-0110
	131-1963-00	B021006	B021280	1	..TERM.,QIK DISC.:FOR 0.038 DIA CRT PIN	00779	42428-9
154.2	131-2525-00	B021281		1	..CONN,PLUG,ELEC:CRT,22-26 AWG	06776	PS40-101
154.3	343-0854-00	B021281		1	..STRAIN RLF,TERM:CKT BOARD,22-26 AWG	27264	16-02-0034
154.4	204-0678-00			1	..CONN BODY,PL,EL:FOR 3 FEMALE CONTACTS	27264	10-17-2032
-155	344-0236-00			1	CLIP,SPR TNSN:	80009	344-0236-00
-156	342-0082-00			1	INSULATOR,PLATE:0.52 SQ X 0.015 INCH THK,A	80009	342-0082-00
-157	----- -----			1	SW,THERMOSTATIC:(SEE S950 REPL)		
					**********(ATTACHING PARTS)**********		
-158	210-0586-00	B010100	B010124	2	NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	OBD
	210-0586-00	B010125		1	NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	OBD
	129-0323-00	B010125		1	POST,ELEC-MECH:HEX,0.25 X 1 INCH LONG	80009	129-0323-00
	210-0004-00	B010125		1	WASHER,LOCK:#4 INTL,0.015 THK,STL CD PL	000BK	OBD
					**********(END ATTACHING PARTS)**********		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-159	441-1392-00	B010100	B021144	1	CHASSIS,MONITOR:HIGH VOLTAGE	80009	441-1392-00
	441-1392-01	B021145		1	CHASSIS,MONITOR:HIGH VOLTAGE	80009	441-1392-01
-160	342-0402-00			1	.INSULATOR,FILM:HIGH VOLTAGE	80009	342-0402-00
					**********(ATTACHING PARTS)**********		
-161	211-0008-00			1	SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
-162	210-0003-00			1	WASHER,LOCK:EXT,0.123 ID X 0.245" OD,ST	78189	1104-00-00-0541C
	211-0038-00			1	SCREW,MACHINE:4-40 X 0.312,FLH,100 DEG	83385	OBD
	210-0457-00			1	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	OBD
	211-0538-00			1	SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH ST	83385	OBD
-163	211-0025-00			2	SCREW,MACHINE:4-40 X 0.375 100 DEG,FLH ST	83385	OBD
-164	210-0586-00			2	NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	OBD
					**********(END ATTACHING PARTS)*********		
-165	426-1441-00			1	FRAME,MONITOR:	80009	426-1441-00
	198-3714-00			1	WIRE SET,ELEC:	80009	198-3714-00
-166	131-0707-00			2	.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
	131-0621-00			3	.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	46231
	131-0792-00			3	.CONNECTOR,TERM:18-20 AWG,CU BE GOLD PL	22526	46221
-167	352-0169-00			1	.HLDR,TERM CONN:2 WIRE BLACK	80009	352-0169-00
-168	352-0161-00			1	.HLDR,TERM CONN:3 WIRE,BLACK	80009	352-0161-00
	352-0198-00			3	.HLDR,TERM CONN:2 WIRE BLACK	80009	352-0198-00
-169	175-0825-00			FT	.WIRE,ELECTRICAL:2 WIRE RIBBON	80009	175-0825-00
-170	175-0826-00			FT	.WIRE,ELECTRICAL:3 WIRE RIBBON	80009	175-0826-00
	198-3982-00			1	WIRE SET,ELEC:	80009	198-3982-00
	131-0622-00			1	.CONTACT,ELEC:0.577"L,28-32 AWG WIRE	22526	46241
	131-0792-00			1	.CONNECTOR,TERM:18-20 AWG,CU BE GOLD PL	22526	46221
	131-1815-00	B010100	B021005	3	.CONTACT,ELEC:22-30 AWG,FEMALE,BRASS	27264	08-56-0110
	131-1963-00	B010100	B021005	1	.TERM.,QIK DISC.:FOR 0.038 DIA CRT PIN	00779	42428-9
	175-0862-00			FT	.WIRE,ELECTRICAL:3 WIRE RIBBON	08261	SS-0322-1910610C
	204-0678-00	B010100	B021005	1	.CONN BODY,PL,EL:FOR 3 FEMALE CONTACTS	27264	10-17-2032
	352-0198-00			1	.HLDR,TERM CONN:2 WIRE BLACK	80009	352-0198-00
	198-4090-00	B010168		1	WIRE SET,ELEC:	80009	198-4090-00
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	334-3379-00	B010392		1	MARKER,IDENT:MARKED GROUND SYMBOL	80009	334-3379-00

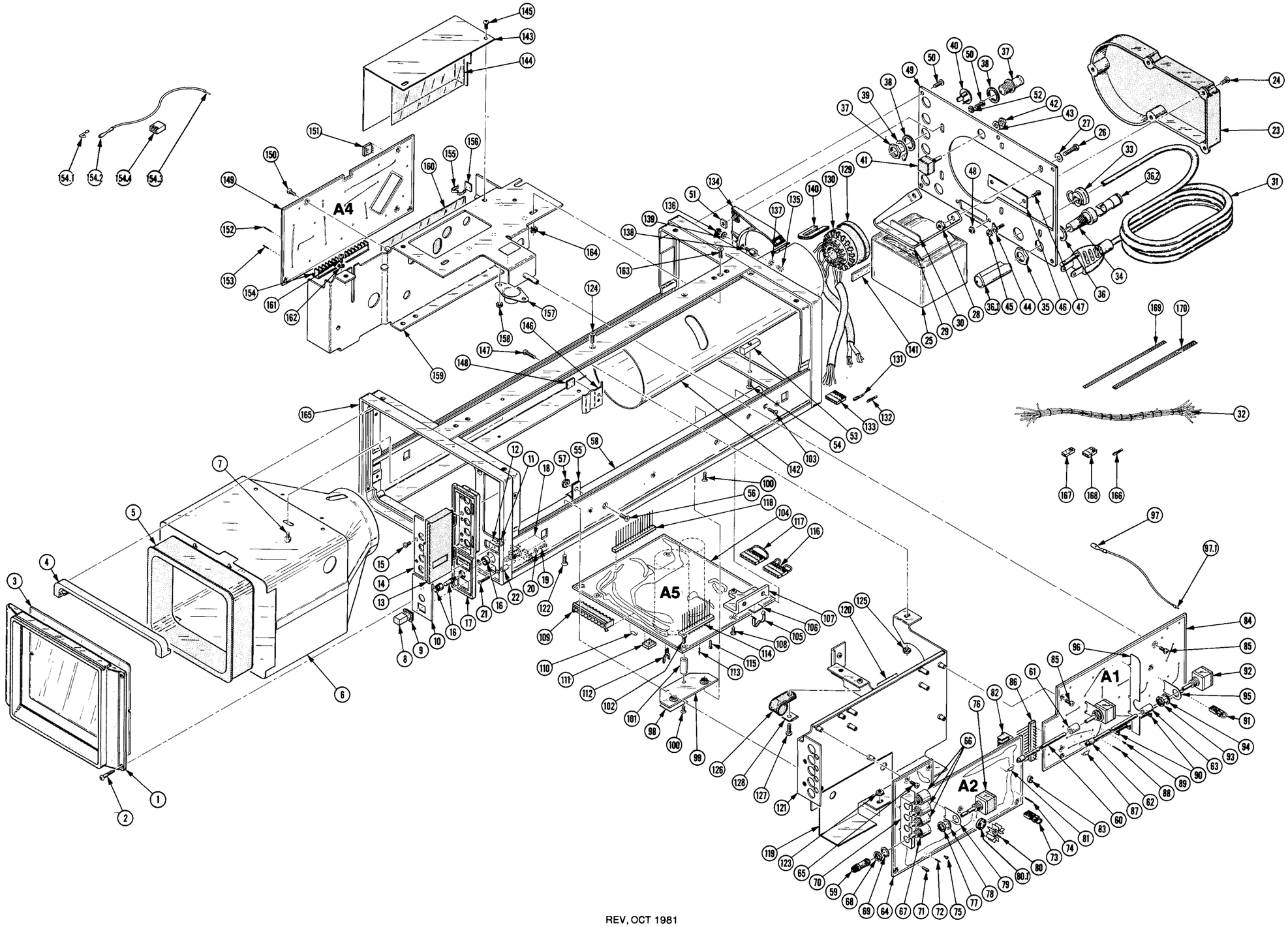

FIG. 1 EXPLODED

ACCESSORIES

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
	070-2530-00			1		MANUAL,TECH:OPERATORS	80009	070-2530-00
	070-2531-00			1		MANUAL,TECH:INSTRUCTION	80009	070-2531-00
	337-2126-02			1		SHLD,IMPLOSION:GRATICULE	80009	337-2126-02