TEK INSTRUCTION MANUAL

Part No. 070-2650-00
Product Group 3N

620 MONITOR
WITH OPTIONS

Tektronix
COMMITTED TO EXCELLENCE

TEK INSTRUCTION VOLUME 2

Part No. 070-2650-00
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Please Check for
CHANGE INFORMATION
at the Rear of This Manual

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COMMITTED TO EXCELLENCE

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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 SUMMARY

The general safety information in this part of the summary is for use by both operating and servicing personnel. Specific warnings and cautions will be found throughout the manual where they apply, but may not appear in this summary.

TERMS

IN THIS MANUAL

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

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

AS MARKED ON EQUIPMENT

CAUTION indicates a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property including the equipment itself.

DANGER indicates a personal injury hazard immediately accessible as one reads the marking.

SYMBOLS

IN THIS MANUAL

This symbol indicates where applicable cautionary or other information is to be found.

AS MARKED ON EQUIPMENT

DANGER—High voltage.

Protective ground (earth) terminal.

ATTENTION—refer to manual.

WARNINGS

POWER SOURCE

This product is intended to operate from a power source that will not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

GROUNDING THE PRODUCT

This product is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle before connecting to the product input or output terminals. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

USE THE PROPER POWER CORD

Use only the power cord and connector specified for your product. Use only a power cord that is in good condition.

For detailed information on power cords and connectors, see Tables 3-1 and 3-2 in the Installation section.

Refer cord and connector changes to qualified service personnel.

USE THE PROPER FUSE

To avoid fire hazard, use only the fuse specified in the parts list for your product, and which is identical in type, voltage rating, and current rating.

Refer fuse replacement to qualified service personnel.

DO NOT OPERATE IN EXPLOSIVE ATMOSPHERES

To avoid explosion, do not operate this product in an atmosphere of explosive gases unless it has been specifically certified for such operation.

DO NOT REMOVE COVERS OR PANELS

To avoid personal injury, do not remove the product covers or panels. Do not operate the product without the covers and panels properly installed.

MEDICAL-DENTAL APPLICATIONS

Do not use the amplifier INPUTs for direct patient connection. Signal currents at these connectors, as well as leakage currents, may exceed values considered nonhazardous 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 excessive 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, National Electrical Code, paragraphs 517-120 through 517-122.

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 is securely grounded, refer to qualifed service personnel.

LIMIT INPUT SIGNAL VOLTAGE

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

SERVICING SAFETY SUMMARY

FOR QUALIFIED SERVICE PERSONNEL ONLY

Refer also to the preceding Operators Safety Summary

DO NOT SERVICE ALONE

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

USE CARE WHEN SERVICING WITH POWER ON

Dangerous voltages exist at several points in this product. To avoid personal injury, do not touch exposed connections and components while power is on.

Disconnect power before removing protective panels, soldering, or replacing components.

POWER SOURCE

This product is intended to operate from a power source that will not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the ground conductor in the power cord is essential for safe operation.

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.

DISCONNECT INSTRUMENT POWER

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

EXERCISE CARE WHEN OPERATING INSTRUMENT WITHOUT 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.

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.

CRT IMPLOSION SHIELD

Do not operate the instrument without the proper implosion shield installed.

SILICONE GREASE HANDLING

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

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 internal 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.

EXERCISE CARE WHEN CHECKING DIODES

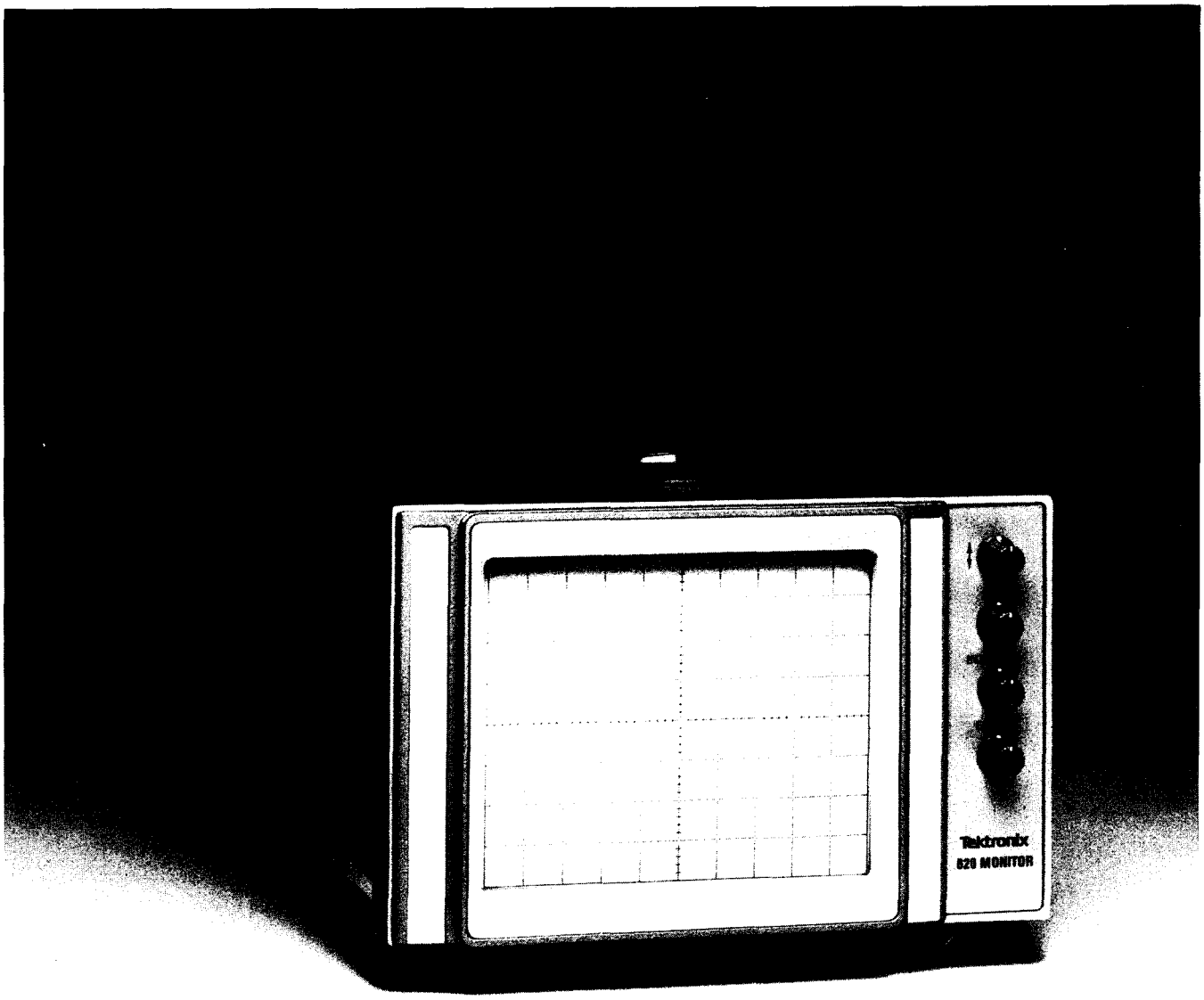
When checking diodes, do not use an ohmmeter setting that has a high internal current, since high currents may damage the diodes under test.

USE PROPER CLEANING AGENTS

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

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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620 FEATURES

The 620 Monitor is a general purpose X-Y display monitor providing a clear, bright display of analog data on a large screen area. This instrument is designed for display applications as in ultrasonic detection systems, volume and vibration analysis, auger probes, and biophysical systems. The 620 Monitor may also be used to provide displays of alphanumeric and graphic information from computers and other data transmission systems. (Monitor is shown with Option 23 installed.)

GENERAL INFORMATION

INTRODUCTION

OPERATORS MANUAL

The Operators Manual contains information necessary to effectively operate the 620 Monitor and is divided into three sections: Section 1 provides a basic description of the 620 with instrument accessories and specifications. Section 2 contains operating information for the instrument. Available options for the 620 Monitor are listed in Section 3 of the manual.

INSTRUCTION MANUAL

The Instruction Manual provides both operating and servicing information for the 620 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 list and schematic diagrams, comply with the American National Standards Institute Y1.1-1972 publication. The parts lists are computer printouts and use computer-supplied abbreviations. Available options for the 620 Monitor are listed in section 7 of the Instruction Manual.

INSTRUMENT DESCRIPTION

The 620 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 hazards, 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 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 rear-panel Z INPUT connector.

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

CLEANING

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.

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, (2) The instrument must be operating in an ambient temperature between 0° and +50° C 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	Adjustable from approximately 0.8 V, or less, to at least 1.2 V full scale. (Set at the factory for 1 V, within 2%, for 8 divisions of deflection.)
Horizontal	Adjustable from approximately 0.8 V, or less, to at least 1.2 V full scale. (Set at the factory for 1 V, within 2%, for 8 divisions of deflection.)
Polarity	
Y INPUT	Positive signal applied deflects beam up; negative signal deflects beam down.
X INPUT	Positive signal applied deflects beam to the right; negative signal deflects beam to the left.
Settling Time	Spot must reach new writing position, within 0.05 cm, within 1.0 microsecond from deflection from any on-screen position.
Bandwidth (With 80% Full-Screen Reference Signal)	Dc to at least 2 MHz at -3 dB point.
Rise Time	175 ns or less.
Position Range	Spot may be positioned anywhere on screen with no signal input.
Position Stability	0.1 cm, or less, of drift per hour after 20 minute warm-up. Not more than 0.2 cm drift in 24 hours.
Input Resistance and Capacitance	1 Megohm, within 1%, paralleled by less than 47 pF.
Maximum Nondestructive Input Voltage	+25 V or -25 V (dc plus peak ac).
Crosstalk between X and Y Amplifiers at 1 MHz	0.05 cm, or less, on the undriven channel with the input terminated in less than 50 ohms and the other channel at full-screen deflection.
Linearity	Less than 5% error in any 2-division segment of the display.
Phase Difference DC to 500 kHz	1 degree or less between X and Y amplifiers. X and Y amplifier gain must be set for the same deflection factor (V/div).

TABLE 1-1 (CONT.)
Electrical Characteristics

Characteristic	Performance Requirement
Z-AXIS AMPLIFIER	
Input Voltage	With input Neg/Pos Selecting Straps in "P" position, +1 V applied results in full display intensity with INTENSITY control at about midrange, and -1 V applied results in cutoff with INTENSITY control fully on.
Useful Frequency Range	Dc to at least 5 MHz at -3 dB point.
Rise Time	70 ns or less.
Input Resistance and Capacitance	1 Megohm, within 1%, paralleled by less than 47 pF.
Maximum Nondestructive Input Voltage	+25 V or -25 V (dc plus peak ac) with crt beam positioned off screen.
TTL Input Voltage (Option 25)	
HI	+2.4 V to +5 V dc.
LO	0 V to +0.8 V dc.
Blanking	Input voltage level to produce blanking is selectable by internal modification. Blanking or unblanking can be produced from a HI input.
CATHODE-RAY TUBE DISPLAY	
Screen Area	10 × 12 cm.
Option 1 Graticule	Internal 8 × 10 divisions (1.22 cm/div).
Quality Area	Center 7 × 9 divisions.
Geometry (Within Graticule Area)	Bowing or tilt 0.1 division or less.
Orthogonality (Within Graticule Area)	90° within 1°.
Accelerating Potential	Approximately 12 kV.
Phosphor	P31 standard, P7 with Option 76.
Deflection	Electrostatic.
Brightness	Light output is at least 30 fL. Measured with the screen flooded by a 60 Hz refresh rate raster, 300 horizontal lines.
Spot Size 1	0.038 cm (0.015") or less, at 0.5 microamperes beam current. Measured within quality area with shrinking raster method.
Spot Size 2	0.051 cm (0.020") or less at 25 fL. Measured within the quality area with shrinking raster method.
POWER SOURCE	
LO Line Voltage Range	
Lo (110 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 1-1 (CONT.)
Electrical Characteristics

Characteristic	Performance Requirement
HI Line Voltage Range	
Lo (220 (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	26 W, 0.27 A, at 120 V ac, 60 Hz.
Fuse Data	
Lo Line Voltage Range (F42)	0.3 A Slow Blow.
Hi Line Voltage Range (F42)	0.15 A Slow Blow.
Hi Voltage Oscillator (A2F226)	1.5 A Fast Blow.
+15 V DC Unregulated (A2F227)	0.3 A Slow Blow.
DC Supply Fuse (Options 20 and 31 only, A2F225)	1.5 A Slow Blow.
DC Input Power (Options 20 and 31 only)	
DC Input Required	+17.0 to +25.0 V dc, including any ripple excursion.
Maximum Operating Current	1.0 Amperes.
Maximum Allowable Input Ripple	2 V ac, peak-to-peak.

TABLE 1-2
Environmental Characteristics

Characteristic	Information
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 12.6 km (50,000 ft.).
Humidity	To 95% relative humidity at 40° C.
Vibration	
Operating and Nonoperating	Standard: Tested to MIL-T-28800B SECT 4.5.5.3.1 Type 2, Class 5, Style E and F. Exception: Tested to 3.8 g's. Rackmount: Installed in a rackmount kit with the instrument complete and operating, vibration frequency swept from 10 to 40 to 10 Hz at 1 minute per sweep. Vibrate 15 minutes in each of the three major axes at 0.25 mm (0.010 inch total displacement). Held 10 minutes at any major resonance, or if none, at 40 Hz. Total time 54 minutes.

TABLE 1-2 (CONT.)
Environmental Characteristics

Characteristic	Information
Shock	
Nonoperating	Standard: Tested to MIL-T-28800B SECT 4.5.5.4.1 Type 2, Class 5, Style E and F. Exception: Tested to 60 g's. Rackmount: Not specified when mounted in a rackmount kit.
Transportation	Qualified under National Safe Transit Committee Test Procedure 1A, Category II.

TABLE 1-3
Physical Characteristics

Characteristic	Information
Net Weight	
Standard	11 lb 4 oz.
Option 20	9 lb 5 oz.
Overall Dimensions	See Figure 1-1.

STANDARD ACCESSORIES

1 ea ..... Operators Manual
1 ea ..... Instruction Manual
1 ea ..... External Lined Graticule (8 × 10 division)

For more detailed information, refer to the tabbed Accessories page at the rear of the 620 Instruction Manual.

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 be contacted, complete instrument type and serial number, and a description of the service required.

Save and reuse the package in which your 620 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.

5. Mark the address of the Tektronix Service Center and your return address on the carton in one or more prominent locations.

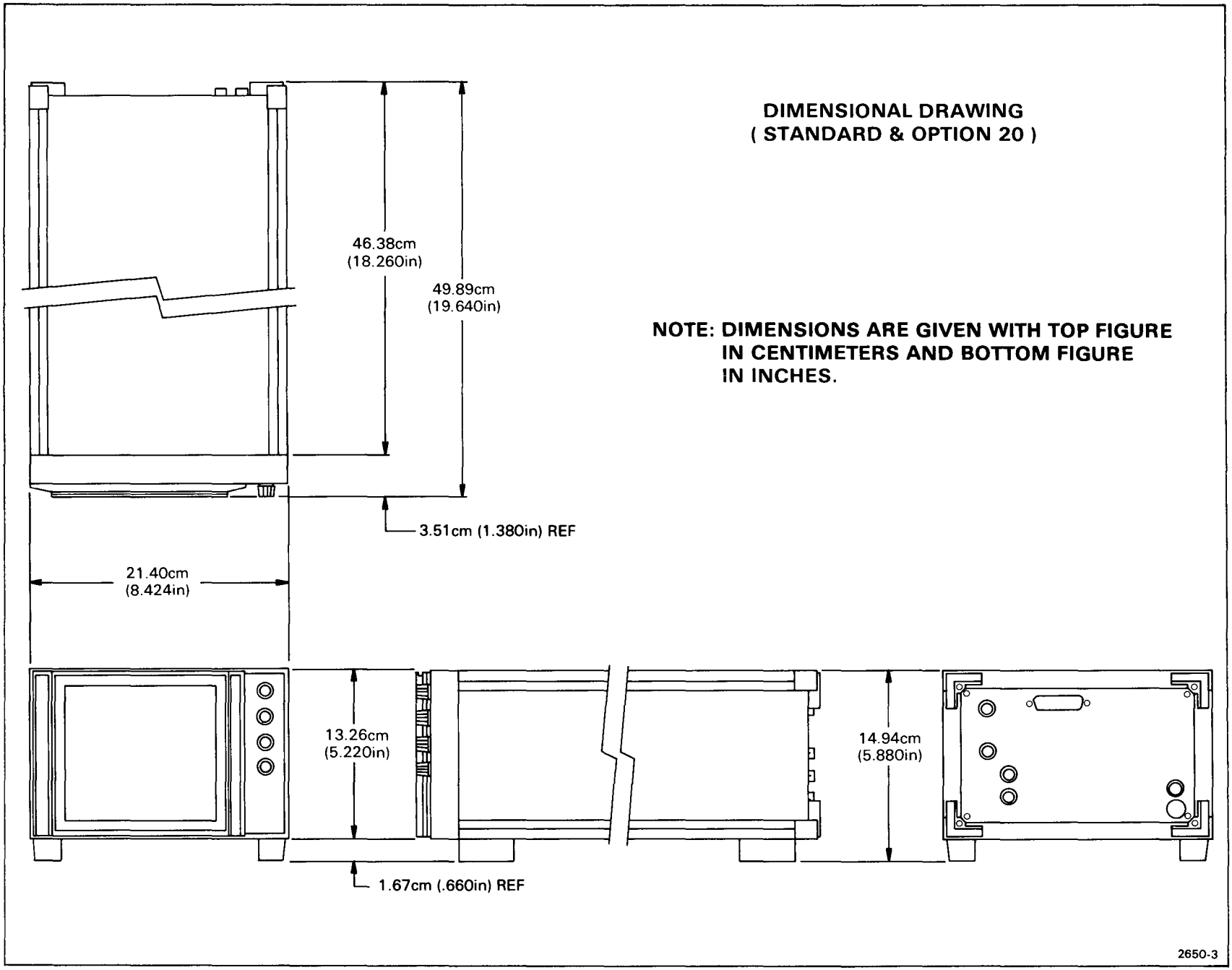


Figure 1-1. 620 Dimensional drawing.

OPERATING INSTRUCTIONS

AMBIENT TEMPERATURE CONSIDERATIONS

This instrument can be operated where the ambient air temperature is between 0° and +50° C, and can be stored in ambient temperatures between -40° and +70° C. After being stored in temperatures beyond the 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 620 is mounted in a rack with other equipment, do not allow the temperature surrounding the Monitor to exceed +50° C. Additional clearance or forced ventilation methods (fan) may be necessary to maintain ambient temperatures below +50° C. The reliability and performance of the 620 will be affected if the ventilation holes in the protective panels are obstructed or if the 620 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 620 Monitor are located on the front and rear panels of the instrument. To make full use of the capabilities of the 620, 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 OPERATING INFORMATION

SIGNAL CONNECTORS

The bnc connectors on the rear panel of the standard 620 Monitor are provided for application of input signals to the vertical (Y) and horizontal (X) Deflection Amplifiers for display on the crt, and to the Z-Axis Amplifier to control the display intensity. An additional bnc connector is provided on 620 Option 25 Monitors to allow application of TTL-compatible input voltages to blank the display.

The 620 Option 10 Monitor also provides a 25-pin Alternate Input connector on the rear panel for direct connections to the Deflection and Z-Axis Amplifiers from a remote location. See Alternate Input Connector (Option 10) for additional details.

INPUT ATTENUATION AND IMPEDANCE

The input circuits of all amplifiers in the standard 620 Monitor present a high impedance to the applied signal. However, the Deflection and Z-Axis Amplifiers can be modified to provide a range of input attenuation and impedance. The desired input attenuation should be set by qualified service personnel only.

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 620 Monitor is achieved when the input signal amplitude to the X and Y INPUT is no greater than that sufficient to provide full-screen deflection.

WARNING

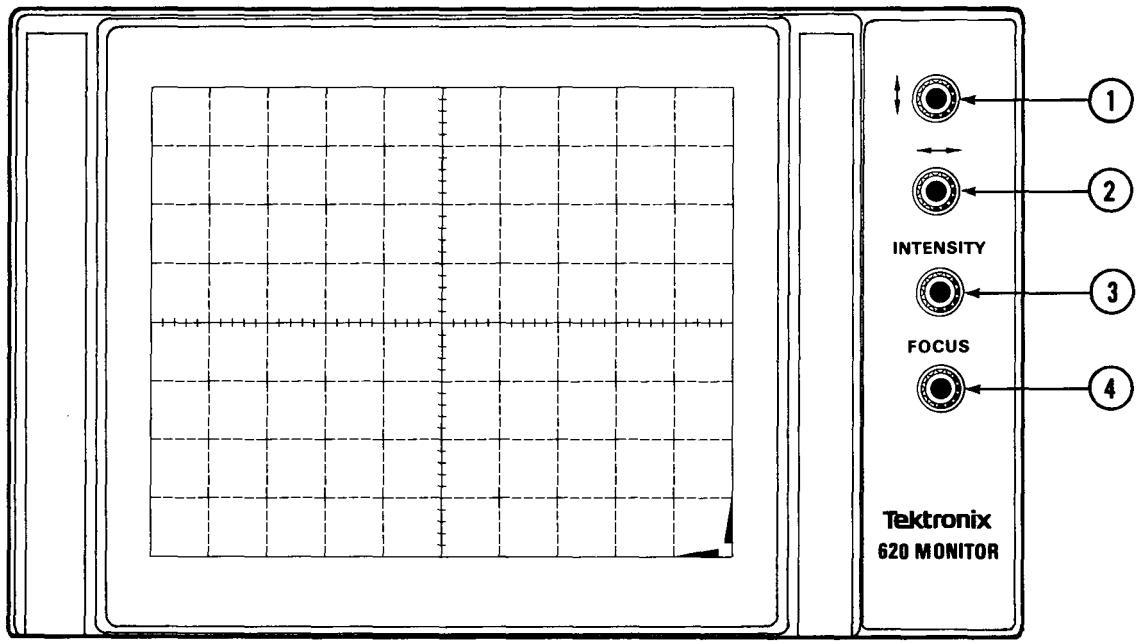
To avoid electric shock hazard, do not apply input signals of more than 25 volts (dc plus peak ac).

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.

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.



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

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

(3) **INTENSITY**—Controls brightness of the crt display and is the affect control for the Z-Axis Input.

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

2650-11

Figure 2-1. 620 Monitor front panel controls.

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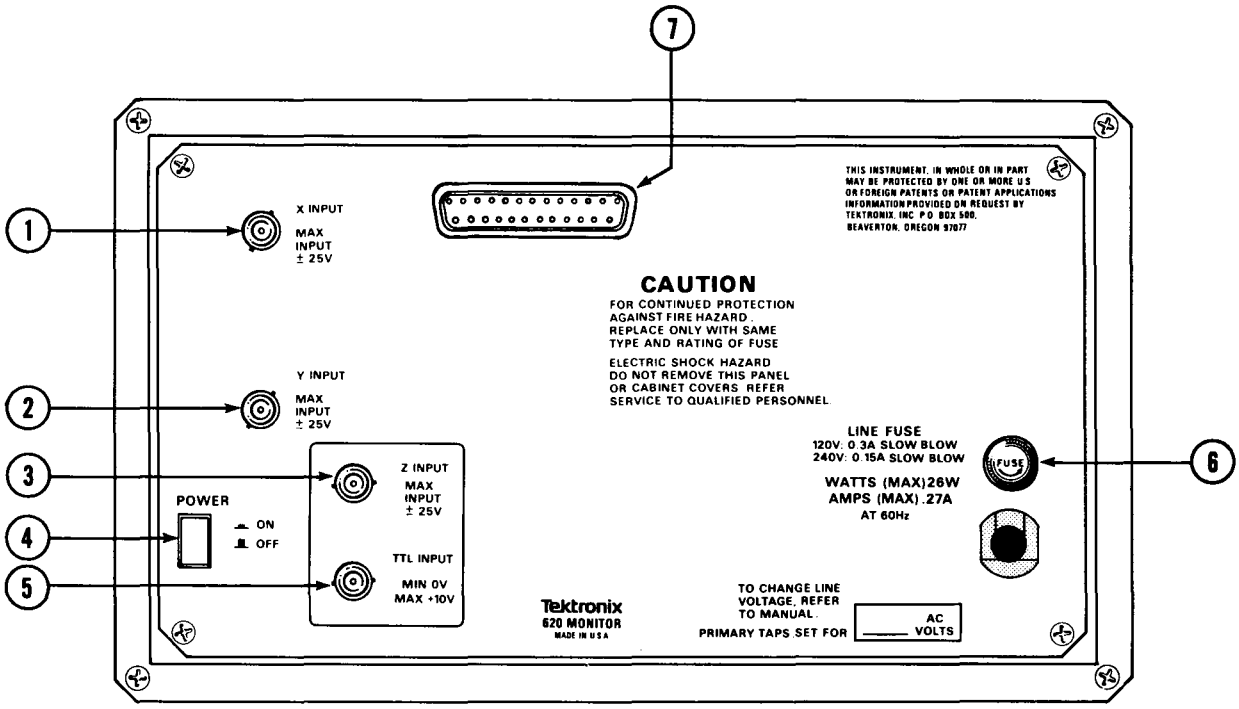

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(1) **X-INPUT**—BNC input connector allows application of input signals. A positive signal applied deflects the beam to the right; a negative signal deflects the beam to the left.

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

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

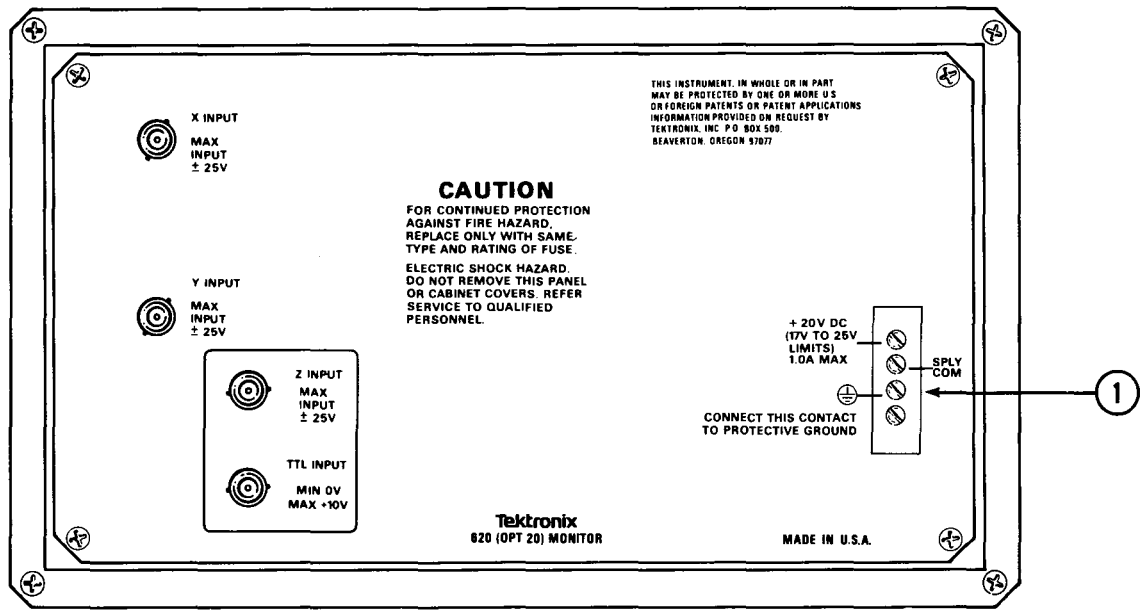
(4) **POWER**—Controls power to the Monitor. Instrument is on when pushbutton is in. Option 20 deletes power switch.

(5) **TTL (Option 25 only)**—Provides a means to connect an external TTL zero level for screen blanking.

(6) **LINE FUSE**—120 V, 0.3 A slow blow, or 240 V, 0.15 A slow blow (use 3AG 250 V fuse).

(7) **ALTERNATE INPUT (Option 10 only)**—Multi-pin connector provides for remote control of the X, Y, and Z axis signals, and TTL unblanking (Option 25 only).

Figure 2-2. 620 Monitor rear panel controls and connectors. (See Fig. 2-3 for Option 20 rear panel.)



(1) **POWER**—DC Power Input Connector, nominal +20 V DC (+17 V to +25 V DC).

Figure 2-3. 620 Monitor Option 20 rear-panel connectors.

INPUT SIGNAL REQUIREMENTS (CONT.)

An additional bnc connector is provided on the rear panel of the 620 Option 25 Monitor for applications of TTL-compatible input voltages to blank the crt display. The input voltage level necessary to produce blanking is internally selectable, and should be set by qualified service personnel only.

With the internal Option 25 selectors in the HI = Blank position, a TTl HI level (+2.4 to +5 V dc) applied to the TTL INPUT connector will blank the display, and a TTL LO level (0 to +0.8 V dc) will unblank the display and allow the INTENSITY control and Z INPUT to control the display brightness. With the selectors in the HI = Unblank position, a HI level applied will unblank the display.

ALTERNATE INPUT CONNECTOR (OPTION 10)

The Alternate Input connector, located on the rear panel of 620 Option 10 Monitor, provides direct connections to the inputs of the Deflection and Z-Axis Amplifiers from a remote location. Signal requirements are the same as for the bnc inputs. See Figure 2-4 for additional details.

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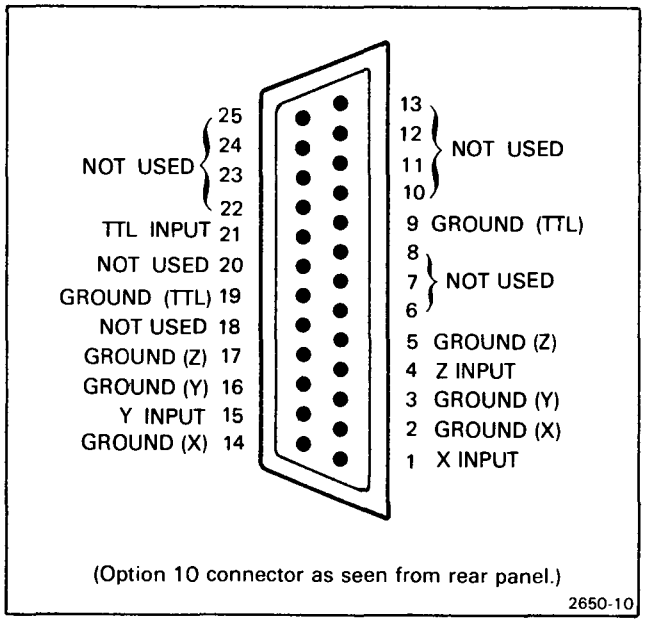


Figure 2-4. Alternate input connector data for Option 10.

CHECKOUT PROCEDURES

The Checkout Procedures are located in the servicing information sections of the 620 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 hazards, operating personnel must not remove protective instrument covers. Internal adjustments and modifications must be made by qualified service personnel only.

WARNING

THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO. REFER TO OPERATORS SAFETY SUMMARY AND SERVICE SAFETY SUMMARY PRIOR TO PERFORMING ANY SERVICE.

INSTALLATION

OPERATING POWER INFORMATION

This instrument (except for the Option 20 and Option 31 versions) 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 and Option 31 power requirements are given later in this section.

POWER CORD INFORMATION

WARNING

The 620 Monitor (excluding the Option 20 and Option 31 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 620, 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

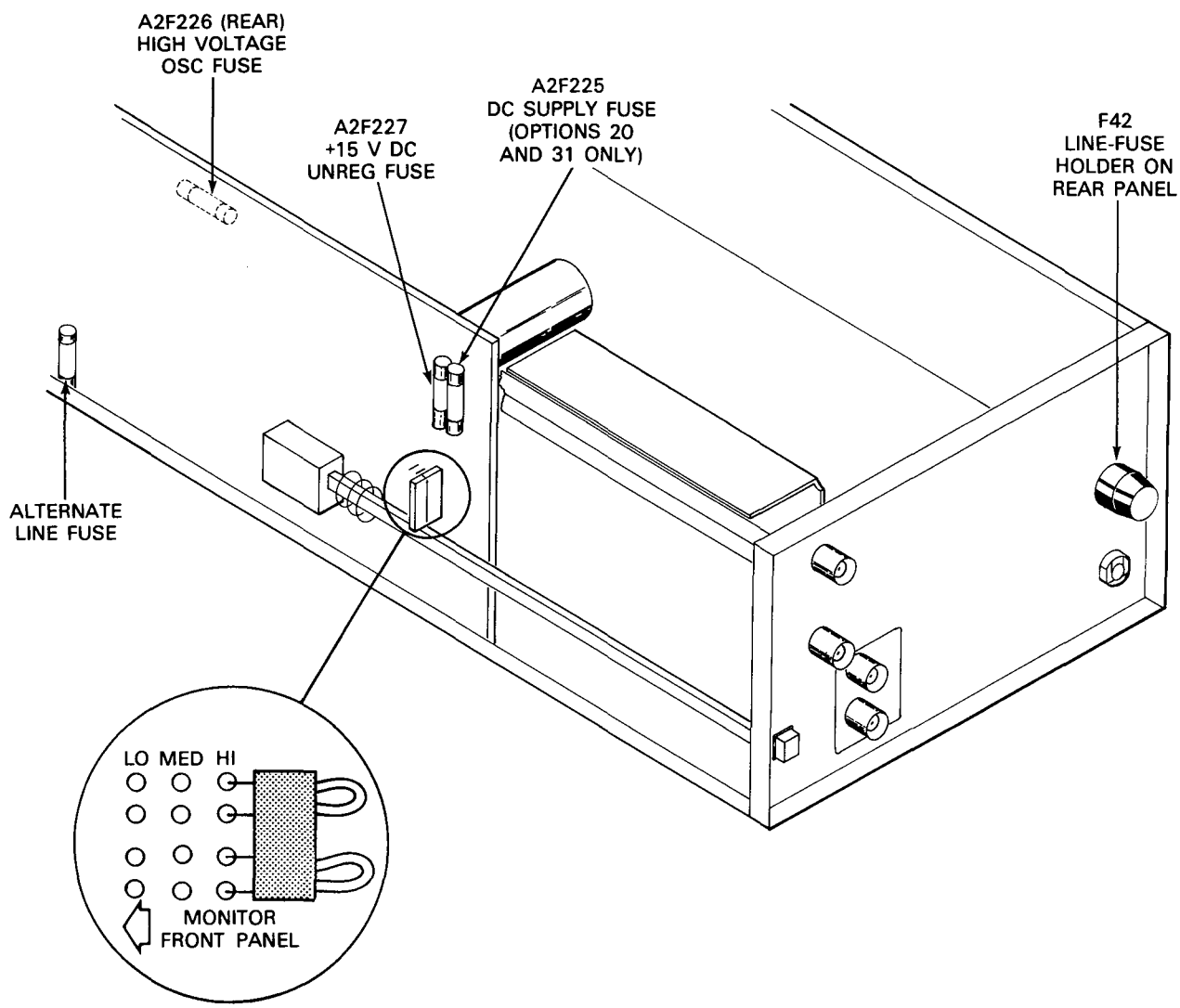
[2]NEMA—National Electrical Manufacturer's Association

[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	
	110 Volts (Nominal)	220 Volts (Nominal)
LO	90 to 110 V ac	180 to 220 V ac
MED	99 to 121 V ac	198 to 242 V ac
HI	108 to 132 V ac	216 to 250 V ac
Line-Fuse Data	0.3 A slow-blow	0.15 A slow-blow
High-Voltage Osc Fuse	1.5 A fast-blow	
+15 V dc Unreg Fuse	0.3 A fast-blow	
DC Supply Fuse (Options 20 and 31 Only)	1.5 A slow-blow	

2650-13A

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

LINE-VOLTAGE AND REGULATING-RANGE SELECTION

CAUTION

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

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

NOTE

This information does not apply to the Option 20 and Option 31 instrument.

1. Disconnect the Monitor from the power source.

2. Remove the High Voltage shield.

3. 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 Power Supply board) labeled for the desired nominal line-voltage range. Refer to Figure 3-1 for location and additional information.

4. 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 Power Supply board (see Fig. 3-1).

5. Replace the High Voltage shield.

6. Change the nominal line-voltage information recorded on the 620 rear panel, if necessary. Use a non-abrasive eraser to remove previous data, and mark on the new data with a permanent marking pen.

7. Apply power to the 620.

OPTION 20 AND OPTION 31 POWER REQUIREMENTS

The Option 20 and Option 31 Monitors do not have line fuses or power cords and will operate only with the correct dc power applied to the proper connector. The Option 20 power-input connector is located on the rear panel (See Fig. 2-3). Power for Option 31 Monitor is applied directly to the Power Supply board (see Fig. 3-2 and 3-3). Apply the following:

+20 V dc pin ..... +17 to +25 V dc, 1 A max.*

Supply Common pin ..... Connect to supply common of unit supplying power.

Protective Ground pin ..... Connect to protective ground of unit supplying power (Option 20 only).

*When the Monitor is turned on, the initial current drain may exceed 1 ampere.

Fuse protection is provided on the +20 V dc input line. See Figure 3-1 for location and rating of this fuse.

OPTION 31 POWER AND SIGNAL INPUTS

All power and signal connections to the 620 Option 31 Monitor are made directly to the circuit boards. Pins are provided on the Deflection/Z-Axis board for application of the X, Y and Z INPUT signals. See Figure 3-3 for the location of these input pins.

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 nonhazardous 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.

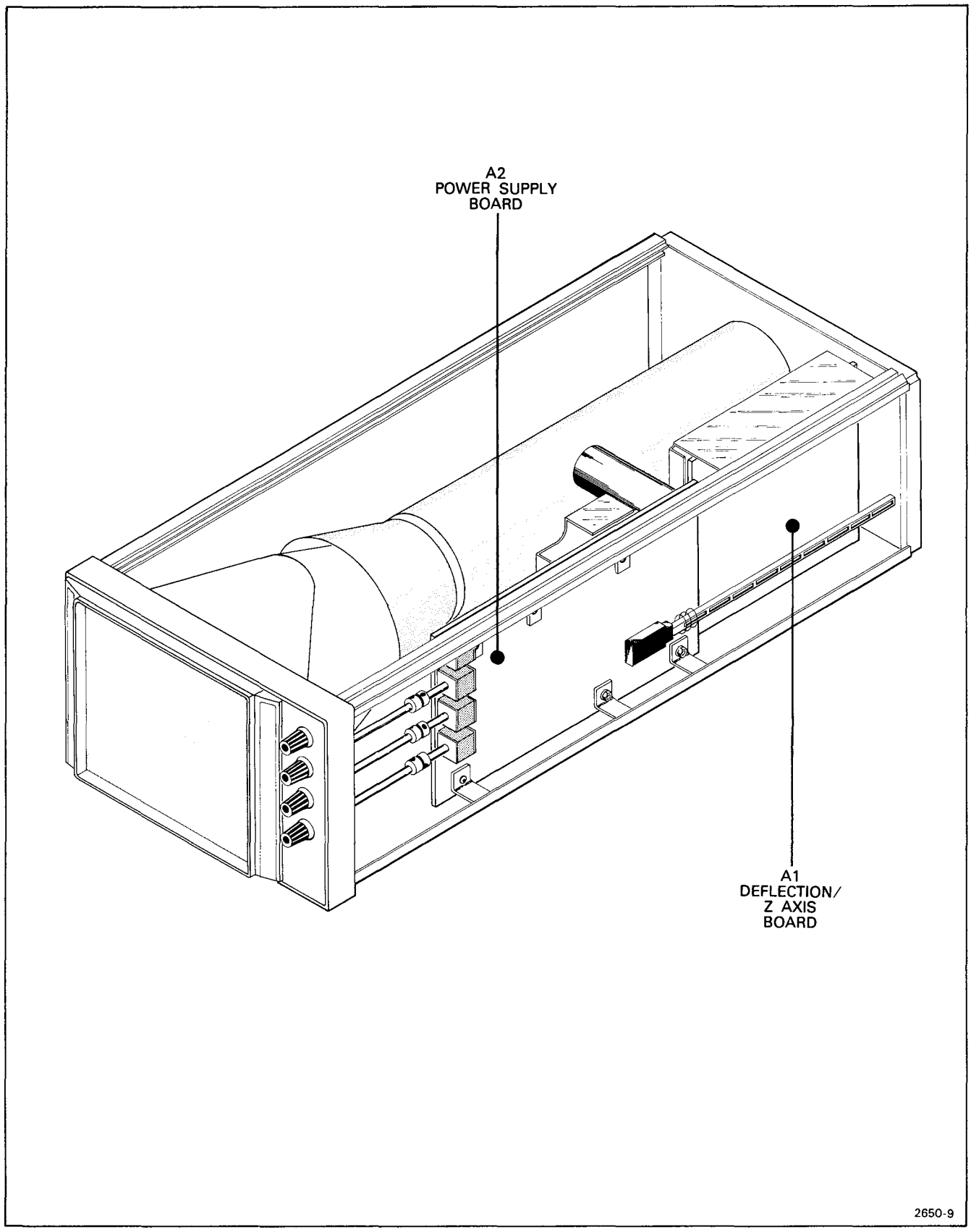
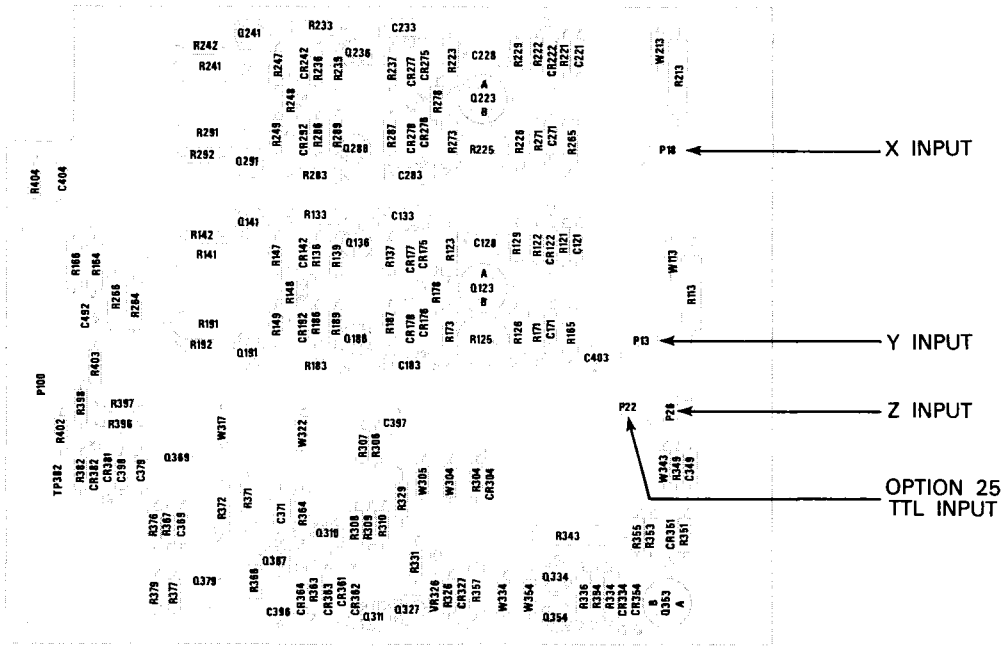
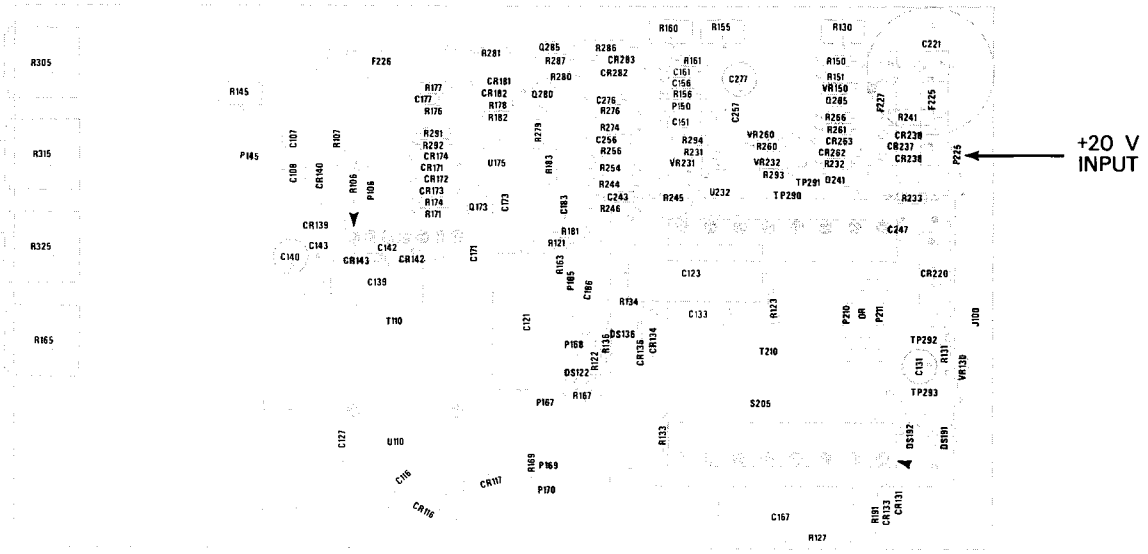


Figure 3-2. Circuit board locations.



A1—DEFLECTION/Z AXIS BOARD



A2—POWER SUPPLY BOARD

2650-30

Figure 3-3. Location of input signal connectors in the 620 Monitor, Option 31.

INPUT ATTENUATION

WARNING

To avoid electric-shock hazards, always turn the instrument OFF before modifying the instrument.

The Deflection and Z-Axis Amplifiers of the 620 Monitor are shipped from the factory with 1X input attenuation and 1-megohm input impedance; however, these can be modified to suit a specific application. Conversion information for modifying the input attenuation and impedance is illustrated in figures 3-4 and 3-5. Refer to Soldering Techniques in Section 5, Maintenance, for proper component installation and substitution. Contact your Tektronix Field Office or representative for additional information.

RACKMOUNTING INFORMATION

The 620 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 the 620 from the cabinet to a rackmounted configuration. 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.

CAUTION

Reliability and performance of the 620 will be affected if the ventilation holes in the protective panels are obstructed, or if the 620 is operated in an ambient temperature higher than +50° C. Forced ventilation methods may be needed.

CABINET-TO-RACKMOUNT CONVERSION

Single Monitor Mounting

The Tektronix cabinet-to-rack conversion kit Part 016-0404-00 provides the necessary hardware to mount one 620 Monitor in a standard 19-inch wide instrument rack. The kit is equipped with a slide-out assembly, protective covers, securing hardware, and a blank front panel to cover the second instrument opening in the rack. Complete rackmounting instructions are included in each kit. (This kit cannot be ordered with Option 6, 23, or 28.)

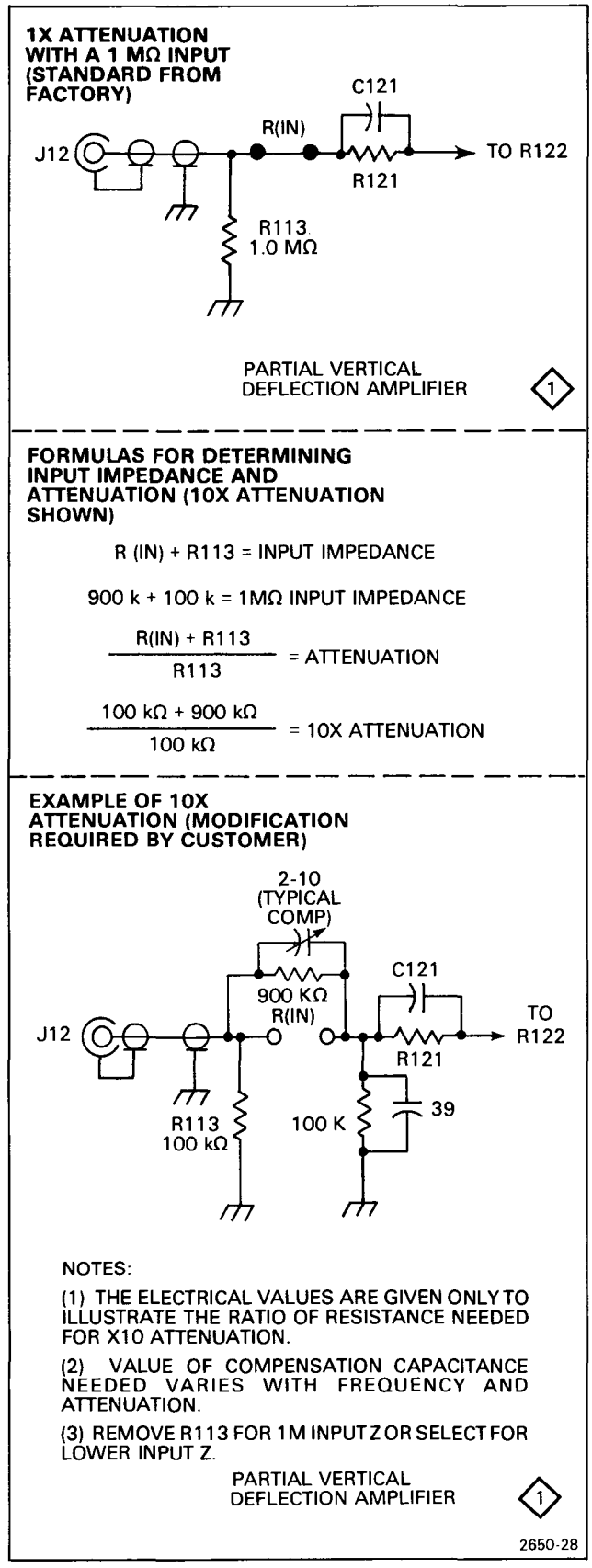


Figure 3-4. Typical method for modifying Y-Axis input attenuation and impedance.

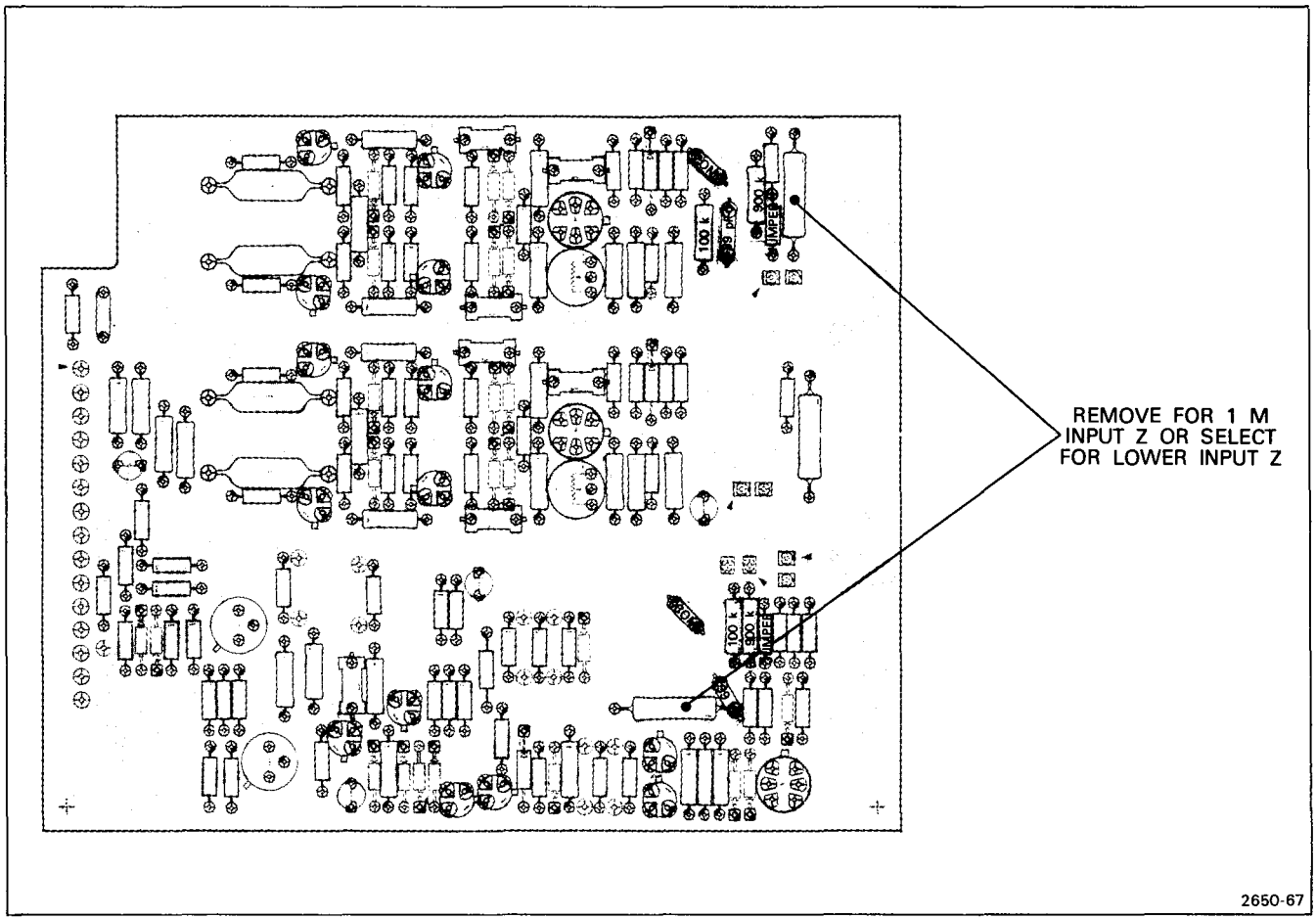


Figure 3-5. Component placement for modifying input attenuation and impedance. (X-Axis and Z-Axis shown X10)

Double Monitor Mounting

The Tektronix cabinet-to-rack conversion kit Part 016-0405-00 provides the necessary hardware to mount two 620 Monitors side by side in a standard 19-inch wide instrument rack. The kit includes slide-out assembly, protective covers, and securing hardware for both Monitors. Complete rackmounting instructions are included with each kit. (This kit cannot be ordered with Options 6, 23, 28, or 31.)

INSTRUMENT DIMENSIONS

A drawing showing the major dimensions of the standard 620 Monitor is shown in Figure 1-1 in the General Information section. Further details and tolerances are shown on the Detailed Dimensional Drawing foldout page in Section 9, Diagrams and Circuit Board Illustrations.

CHECKOUT PROCEDURES

The Checkout Procedures are provided to aid in obtaining a display on the 620 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 Checkout Procedures.

TEST EQUIPMENT REQUIRED

The following test equipment was used as a basis to write the Checkout Procedures. Other test equipment, which meets these requirements, may be substituted. When other equipment is substituted, the control settings or setups may need to be altered. The test equipment listed here is required to check functions of the standard 620 Monitor as well as those of available electrical Options.

1. 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).

2. Power Module

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

Type Used: TEKTRONIX TM 500 (used with the FG 503 Function Generator).

3. Cables[1] (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[1]

Description: Connectors, bnc-to-bnc.

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

5. 50-Ohm Termination

Description: Impedance, 50-ohms; connectors, bnc.

Type Used: Tektronix Part 011-0049-01.

[1] **Not used when checking the Option 31 Monitor.**

PRELIMINARY SETUP

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

2. Install the lined graticule (provided with your instrument) over the crt display area. For instructions or installation of graticule, See Section 6, Callibration.

3. Connect the 620 to a suitable power source.

4. Set the front-panel controls as follows:

Vertical Position ..... Midrange

Horizontal Position ..... Midrange

INTENSITY ..... Fully counterclockwise

FOCUS ..... As desired

5. Check and record the positions of the Neg/Pos Selecting Straps (A1W317, A1W322, A1W334 and A1W354). (The Selecting Strap placement is shown on the Internal Control and Selector Locations foldout page, Section 9, Diagrams and Circuit Board Illustrations.)

6. Turn the Monitor ON and allow at least one minute for the instrument to warm up.

7. Proceed to the following procedures.

DISPLAY FUNCTIONS

1. Perform the Preliminary Setup procedure.

2. As you slowly rotate 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 control for a sharp, well-defined spot.

4. Rotate the Vertical Position control and notice that the spot can be positioned off the crt viewing 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 viewing area to the left and right. Return the spot to center screen.

DEFLECTION FUNCTIONS

1. Perform the Preliminary Setup procedure.

2. Connect a 2-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.

NOTE

For Option 31 Monitors, all signal connections should be made as described in Option 31 Inputs earlier in this section. (See Fig. 3-3.)

3. Check for horizontal deflection.

4. Disconnect the signal from the X INPUT and apply it to the Y INPUT. Check for vertical deflection.

5. For Option 10 Monitors:

   a. Remove the signal from the Y INPUT and apply it to pin 1 of the Alternate Input connector. Check for horizontal deflection. (See Fig. 2-4.)

   b. Remove the signal from pin 1 and apply it to pin 15. Check for vertical deflection.

6. Disconnect the function generator.

Z-AXIS FUNCTIONS

1. Perform the Preliminary Setup procedure.

2. Adjust the INTENSITY control for a barely visible spot.

3. For Monitors with the Neg/Pos Selecting Straps in the Positive position:

   a. 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.

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

4. For Monitors with the Neg/Pos Selecting Straps in the Negative position:

   a. 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.

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

5. For Option 10 Monitors with Neg/Pos Selecting Straps in the Positive position:

   a. Remove the signal from the X and Z INPUT connectors and apply it to pins 1 and 4 of the Alternate Input connector.

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

6. For Option 10 Monitors with Neg/Pos Selecting Straps in the Negative position:

   a. Remove the signal from the X and Z INPUT connectors and apply it to pins 1 and 4 of the Alternate Input connector.

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

7. Disconnect the function generator.

OPTION 25 TTL Z-AXIS FUNCTIONS

1. Perform the Preliminary Setup procedure.

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

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

4. Check that the defocused spot periodically disappears.

5. Disconnect the function generator.

THEORY OF OPERATION

This section of the manual describes the circuitry in the 620 Monitor. The description begins with a discussion of the instrument using the block diagram in 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 620 Monitor 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 rear-panel Z INPUT connector.

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 number inside the diamond preceding 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.

◇1 DEFLECTION AMPLIFIERS

The Vertical (Y) and Horizontal (X) Deflection Amplifiers convert single-ended input signals to push-pull outputs suitable to drive the deflection plates of the crt. A schematic diagram of the Deflection Amplifiers is shown on diagram 1.

VERTICAL DEFLECTION AMPLIFIER

The Vertical (Y) Deflection Amplifier consists mainly of two noninverting operational amplifiers, A1Q123A-A1Q136-A1Q141 and A1Q123B-A1Q186-A1Q191, provide amplified push-pull signals to drive the vertical deflection plates of the crt.

Signals to be displayed on the crt are applied to the Y INPUT bnc connector J12, or to J13 in the 620 Option 31 Monitor. A matched dual field-effect transistor (A1Q123A and A1Q123B) provides high input impedance and temperature stability. Excessively large negative-going signals are diode-clamped by A1CR122 at the gate of A1Q123A to protect the FET. The Y Gain control, A1R125, allows setting the crt full-screen deflection sensitivity. This control is set at the factory for 8 divisions of deflection with a 1 volt input signal applied. Provisions have been made for the addition of an attenuating resistor (in place of A1W113) if signals much larger than the nominal 1 volt are to be applied to the input. See Figure 3-4 in the Installation section.

Front-panel control A1R305 provides vertical positioning by setting the bias at the gate of A1Q123B.

The push-pull signals from A1Q123A and A1Q123B are held to within about 1.4 volts of each other by diodes A1CR175, A1CR176, A1CR177, and A1CR178 to improve overdrive recovery of the amplifier. The signals are then applied to emitter-followers A1Q136 and A1Q186 which provide drive for the output transistors. Transistors A1Q141 and A1Q191 provide final amplification of the vertical signals before they are applied to the crt deflection plates. Quiescently, the output voltage (with the crt beam positioned to center screen) is about -26 volts. Feedback is provided by A1R133-A1C133 and A1R183-A1C183. High-frequency compensation is provided by A1R129-A1C128.

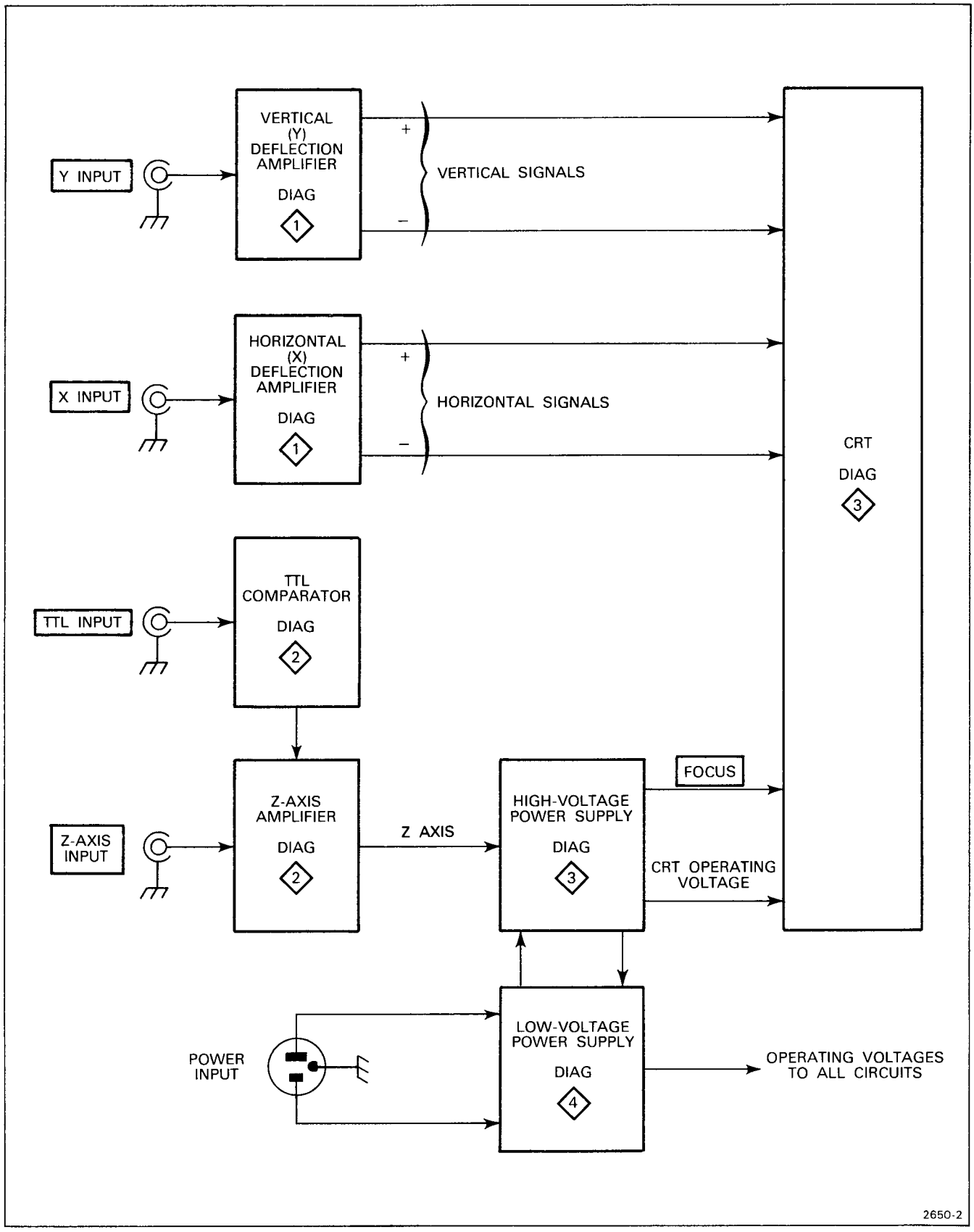


Figure 4-1. 620 Block diagram.

HORIZONTAL DEFLECTION AMPLIFIER

The Horizontal (X) Deflection Amplifier consists mainly of two noninverting operational amplifiers, A1Q223A-A1Q236-A1Q241 and A1Q223B-A1Q286-A1Q291, which provide amplified push-pull signals to drive the horizontal deflection plates of the crt.

Signals to be displayed on the crt are applied to the X INPUT, bnc connector J17, or to J18 in the Option 31 620 Monitor. A matched dual field-effect transistor (A1Q223A and A1Q223B) provides high input impedance and temperature stability. Excessively large negative-going signals are diode-clamped by A1CR222 at the gate of A1Q223A to protect the FET. The X Gain control, A1R225, allows setting the crt full-screen deflection sensitivity. This control is set at the factory for 8 divisions of deflection with a 1 volt input signal applied. Provisions have been made for the addition of an attenuating resistor (in place of A1W213) if signals much larger than the nominal 1 volt are to be applied to the input.

Front-panel control A1R315 provides horizontal positioning by setting the bias at the gate of A1Q223B.

The push-pull signals from A1Q223A and A1Q223B are held to within 1.4 volts of each other by diodes A1CR275, A1CR276, A1CR277, and A1CR278 to improve overdrive recovery of the amplifier. The signals are then applied to emitter-followers A1Q236 and A1Q286 which provide drive for the output transistors. Transistors A1Q241 and A1Q291 provide final amplification of the horizontal signals before they are applied to the crt deflection plates. Quiescently, the output voltage (with the crt beam centered) is about -26 volts. Feedback is provided by A1R223-A1C223 and A1R283-A1C283. High-frequency compensation is provided by A1R229-A1C228.

Z-AXIS AMPLIFIER

The Z-Axis Amplifier provides the drive signal to control the crt intensity. A schematic diagram of the Z-Axis Amplifier is shown on diagram 2 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 2.

Z PREAMPLIFIER

Single-ended input signals are applied to the Z INPUT, bnc connector J25, or to J26 in the 620 Option 31 Monitor. A matched dual FET (A1Q353A and A1Q353B) provides high input impedance and temperature stability. Excessively large negative-going signals are diode-clamped by A1CR351 at the gate of A1Q353A to protect the FET. Provisions have been made for the addition of an attenuating resistor (in place of A1W343) if signals much larger than the nominal 1 volt are to be applied to the input.

FET A1Q353A functions as a source follower, with source current provided by A1Q353B. The output of A1Q353 is applied to the base of A1Q354. Front-panel INTENSITY control A1R325 sets the voltage at the base of A1Q334. Transistors A1Q334-A1Q354 are connected in a differential configuration, however only one output is applied to A1Q327 because of the input selecting straps (A1W317-A1W322-A1W334-A1354). With the input selecting straps connected to the P terminals as shown on diagram 2, a positive input signal will increase the display intensity. When these straps are connected to the N terminals, a negative input signal will increase the display intensity. But in either case, rotating the INTENSITY control clockwise will increase display brightness. See Figure 4-2.

The Z-Axis signal at the base of A1Q354 is amplified by either A1Q354 or A1Q334, depending upon the position of the input selecting straps, and applied across common-base transistor A1Q327.

LIMITER

Diodes A1CR361-A1CR362-A1CR363-A1CR364 act to limit the output signal from the Z Preamplifier to within about 1 volt of ground. This maintains the Z Output Amplifier in the active state and prevents saturation of the amplifier transistors.

Z OUTPUT AMPLIFIER

The Z Output Amplifier is a current driven operational amplifier consisting of active components A1Q367-A1Q369-A1Q379. Feedback for the amplifier is provided by A1R372-A1R371-A1C371. Components A1CR381-A1CR382-A1R382 provide voltage-surge protection in the event of a high-voltage malfunction. The Z-Axis output signal is applied to the crt control grid through the Control Grid DC Restorer network (shown on diagram 3) to control the crt beam intensity.

TTL INPUT COMPARATOR (OPTION 25)

The TTL Input Comparator (A1Q310-A1Q311) processes the signal applied to the rear-panel TTL INPUT, bnc connector J21 (or J22 in the 620 Option 31 Monitor) and, depending upon the voltage level, either blanks or unblanks the crt beam.

Wire straps A1W304 and A1W305 allow selection of the input logic polarity necessary to blank (turn crt beam off) or unblank (turn crt beam on); see Figure 4-2. With A1W304 and A1W305 in the HI = Blank position, a TTL HI input signal (between +2.4 V and +5 V) will blank the crt, and a TTL LO input signal (between +0.8 V and 0 V) will unblank the crt. The opposite levels will blank and unblank the crt when the wire straps are in the HI = Unblank position.

With A1W304 and A1W305 in the HI = Blank position as shown on the schematic, input signals are applied to the base of A1Q311, and the base of A1Q310 is connected to a reference level. A TTL LO input will cause current to flow into the Z Output Amplifier, via A1Q311 to unblank the crt. A TTL HI will turn off A1Q311, resulting in a blanked crt.

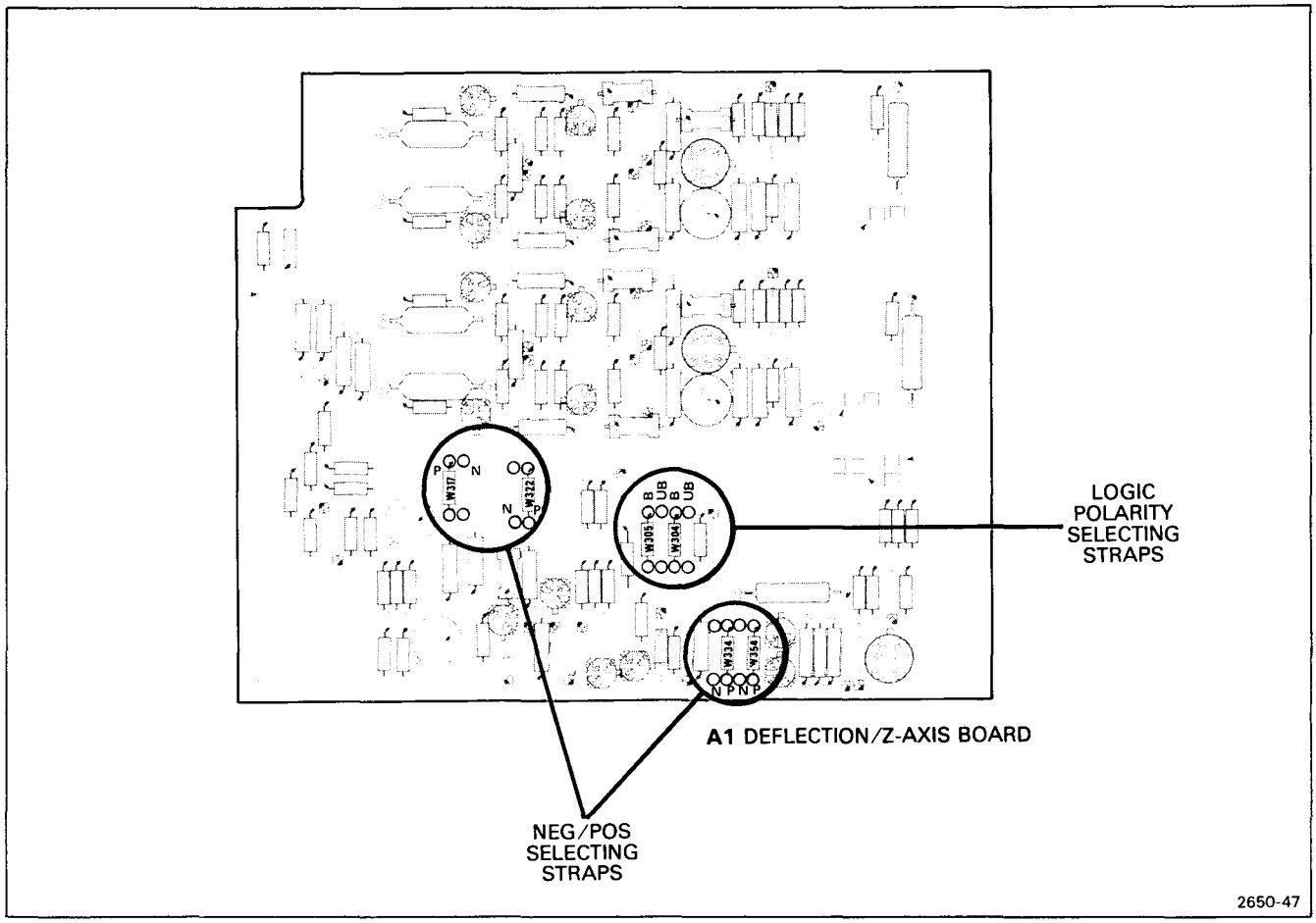


Figure 4-2. Locations of logic polarity selecting straps (Option 25) and Z Preamplifier neg/pos selecting straps.

With A1W304 and A1W305 in the HI = Unblank position, the base of A1Q311 is connected to the reference and input signals are applied to the base of A1Q310.

3

HIGH-VOLTAGE POWER SUPPLY

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 3 at the rear of this manual. A detailed block diagram, showing each major stage of the 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 3.

HIGH-VOLTAGE OSCILLATOR

A repetitive, sinusoidal signal is produced by a regenerative feedback oscillator in the primary of A2T110 and induced into the secondary. Current drive for the primary winding is supplied by Q35. The conduction of Q35 is controlled by the output voltage of the Error Amplifier.

CATHODE SUPPLY

The Cathode Supply, -2250 volts, is produced by voltage doubler A2C116-A2CR116-A2CR117. This voltage is then filtered by A2C121-A2R122-A2C123 before being applied to the crt cathode (pin 2 of V39). 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 -2250 volts, from voltage divider A2R163C-A2R163D-A2R183 to the positive input (pin 3) of A2U175A. If the output level of the Cathode Supply exceeds the normal -2250 volts (becomes more negative), the voltage at pin 3 of A2U175A goes negative from its quiescent zero-volt level. This results in the output voltage from A2U175A becoming more negative, which in turn controls A2Q173. A more negative potential from the Error Amplifier reduces conduction of the High-Voltage Oscillator, resulting in a smaller peak-to-peak amplitude of the signal in the secondary of A2T110 and returning the Cathode Supply to -2250 volts.

@

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 V39). 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 -2250 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 (A2R130), in conjunction with A2VR130 and A2C131. (The cutoff voltage at the crt control grid is typically about 65 volts more negative than the crt cathode level.)

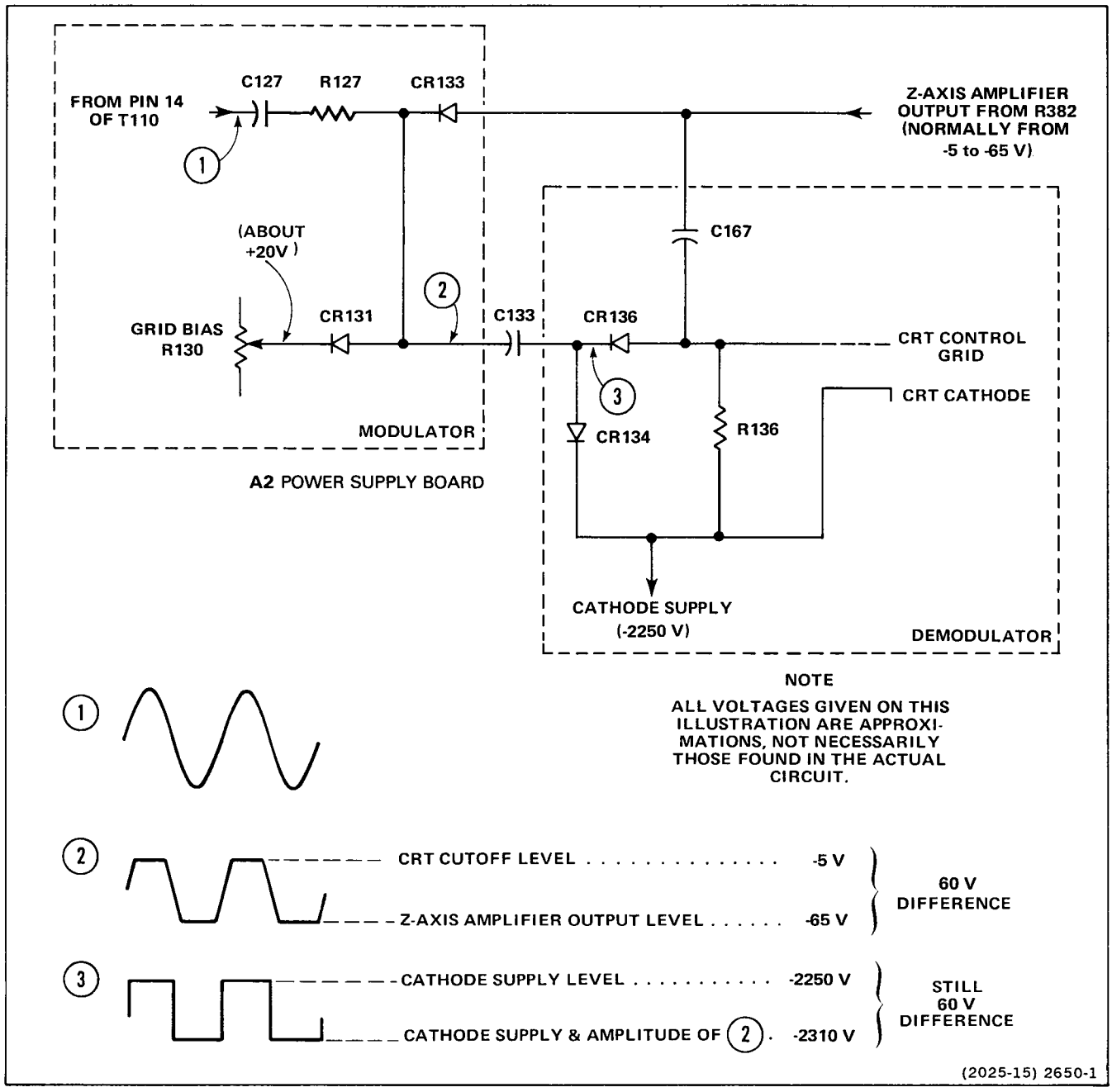


Figure 4-3. Simplified diagram of Control-Grid DC Restorer.

NOTE

A simplified diagram of the Control-Grid DC Restorer is shown in Figure 4-3. 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. 4-3).

Modulator

When the secondary winding output of A2T110 (pin 10) swings positive, A2C133 charges through A2C127 and A2R127 to a voltage level determined by the setting of the Crt Bias adjustment, in conjunction with A2VR130 and A2C131. At this voltage level (approximately 65 volts), diode A2CR131 conducts, preventing any additional increase in the positive voltage across A2C133. When the secondary winding swings negative, diode A2CR131 turns off. Then A2CR133 conducts and clamps the negative excursion at A2C133 to the voltage level of the Z-Axis Amplifier output level and the Crt Bias adjustment setting. (See waveform 2 in Fig. 4-3). This square wave is coupled through A2C133 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 4-3, is limited by A2CR134 to the level of the Cathode Supply; the negative excursion is coupled through A2CR136 to A2C167. Quiescently, A2C167 will charge to about -2250 volts through A2R136. After repetitive cycles from A2C133, A2C167 will charge to the negative level of waveform 3. Capacitor A2C167 holds the voltage constant at the crt control grid, and also provides a path for the ac 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 4-3 provide circuit protection in the event of a high-voltage arc or other malfunction.

UNREGULATED POWER SUPPLY

The -75 volts unregulated is produced by voltage doubler A2C139-A2CR139-A2CR140. It is then filtered by A2C140, before being applied to the -70 Volt Regulated Supply (diagram 4).

The -20 volts unregulated is produced by voltage doubler A2C142-A2CR142-A2CR143. It is then filtered by A2C143 before being applied to the -15 Volt Regulated Supply (diagram 4).

CRT INTERCONNECTS

The Astig screwdriver adjustment, A2R160, which is used in conjunction with the front-panel FOCUS control (A2R165) to provide a well-defined display, varies the negative level on the astigmatism element of the crt.

The Geom screwdriver adjustment, A2R155, varies the negative level on the geometry element to control the overall geometry of the display.

The voltage divider A2VR150-A2R150 provides approximately -33 volts dc for additional crt elements.

4 LOW-VOLTAGE POWER SUPPLY

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 4 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 4.

POWER INPUT

Power is applied to the primary of transformer A2T210 through fuse F42, thermal cutout S43, ON/OFF switch A2S206, and Line-Voltage Selector plug A2P210 or A2P211. The Line-Voltage Selector plugs allow changing the primary winding taps of A2T210 to meet different line-voltage and regulating-range requirements. Line fuse F42 should be changed for each nominal line voltage (current rating of fuse for 220-volt operation must be 0.15 A slow-blow type; for 120 volt operation the current rating of the fuse must be 0.3 A slow-blow type).

Thermal cutout S43 provides thermal protection for this instrument. If the internal temperature of the instrument exceeds a safe operating level, S43 opens to interrupt the applied power. When the temperature returns to a safe level S43 automatically closes to re-apply the power.

RECTIFIER AND FILTER

A full-wave bridge circuit (A2CR220) rectifies the ac voltage from the secondary of A2T210. Filtering is provided by A2C221.

+20 VOLT UNREGULATED SUPPLY

The +20 Volt Unregulated Supply provides unregulated power for the high-voltage transformer (A2T110) on diagram 3. Fuse A2F226 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 and -70 Volt Regulated Supply. The regulator for the +15 Volt Regulated Supply is a feedback amplifier system that operates between ground and the +20 Volt Unregulated Supply. Current to the load is delivered by series-pass transistor A2Q241, which is located in the output side of the supply. The supply voltage is established by the drop across resistive-divider network A2R244-A2R245-A2R246. The feedback through this network is compared to the reference level established at the input of A2U232A (pin 2) by the voltage drop across A2VR231. 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 A2Q241 and nullified by a change in A2Q241 conduction, maintaining a steady output.

The series regulator, A2Q241, is protected against excessive current demand by a network consisting of A2CR236-A2CR237-A2CR238-A2R241. Essentially, all current from this supply flows through A2R241. 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 A2R241 increases enough to forward-bias A2CR236, A2CR237, and A2CR238, which in turn reduces the conduction of A2Q241 to limit the supply current to a safe level. Fuse A2F227 provides additional circuit protection in the event of a regulator malfunction.

The output of the supply is set to exactly +15 volts by adjustment of A2R245, the +15 V Adj.

-15 VOLT REGULATED SUPPLY

The regulator for -15 Volt Regulated Supply consists of series-pass transistor A2Q265 with A2U232B being the control amplifier. Unregulated -20 volts, from which the regulator operates, comes from the High-Voltage transformer A2T110, shown on diagram 3. This is a feedback amplifier system similar to that just described for the +15 Volt Regulated Supply.

-70 VOLT REGULATED SUPPLY

The regulator for -70 Volt Regulated Supply consists of series-pass transistor A2Q285 with A2U175B being the control amplifier. Unregulated -75 volts, from which the regulator operates, comes from the High-Voltage transformer A2T110, shown on diagram 3.

This is a feedback amplifier system similar to those of +15 and -15 Volt Regulated Supply. The only difference is the use of a level shifting transistor (A2Q280) rather than a level shifting Zener diode.

MAINTENANCE

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

PREVENTIVE MAINTENANCE

Preventive maintenance, when performed on a regular basis, can prevent or forestall 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 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 nonresidue type of cleaner, preferably isopropyl alcohol or total denatured ethyl alcohol. 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/sq. in.). 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 Monitor should be inspected occasionally for such defects as broken connections, improperly seated semiconductors, damaged 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, 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 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 adjacent 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 Adjustment and Performance Check procedures, a "Test Point and Adjustment Locations" foldout page is provided in Section 9, Diagrams and Circuit Board Illustrations.

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 Monitor.

COLOR CODE

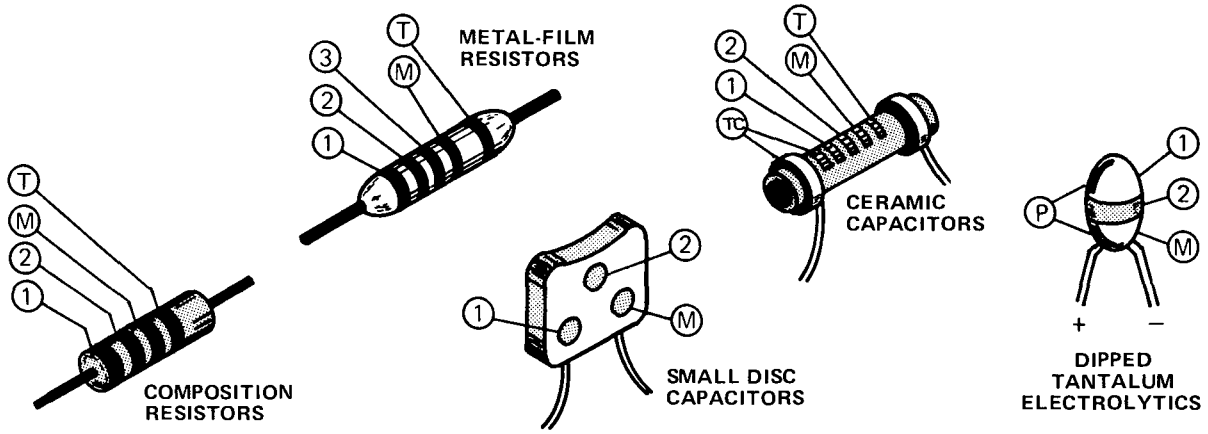
(1) (2) AND (3) - 1st, 2nd, AND 3rd SIGNIFICANT FIGS.

(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	---

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

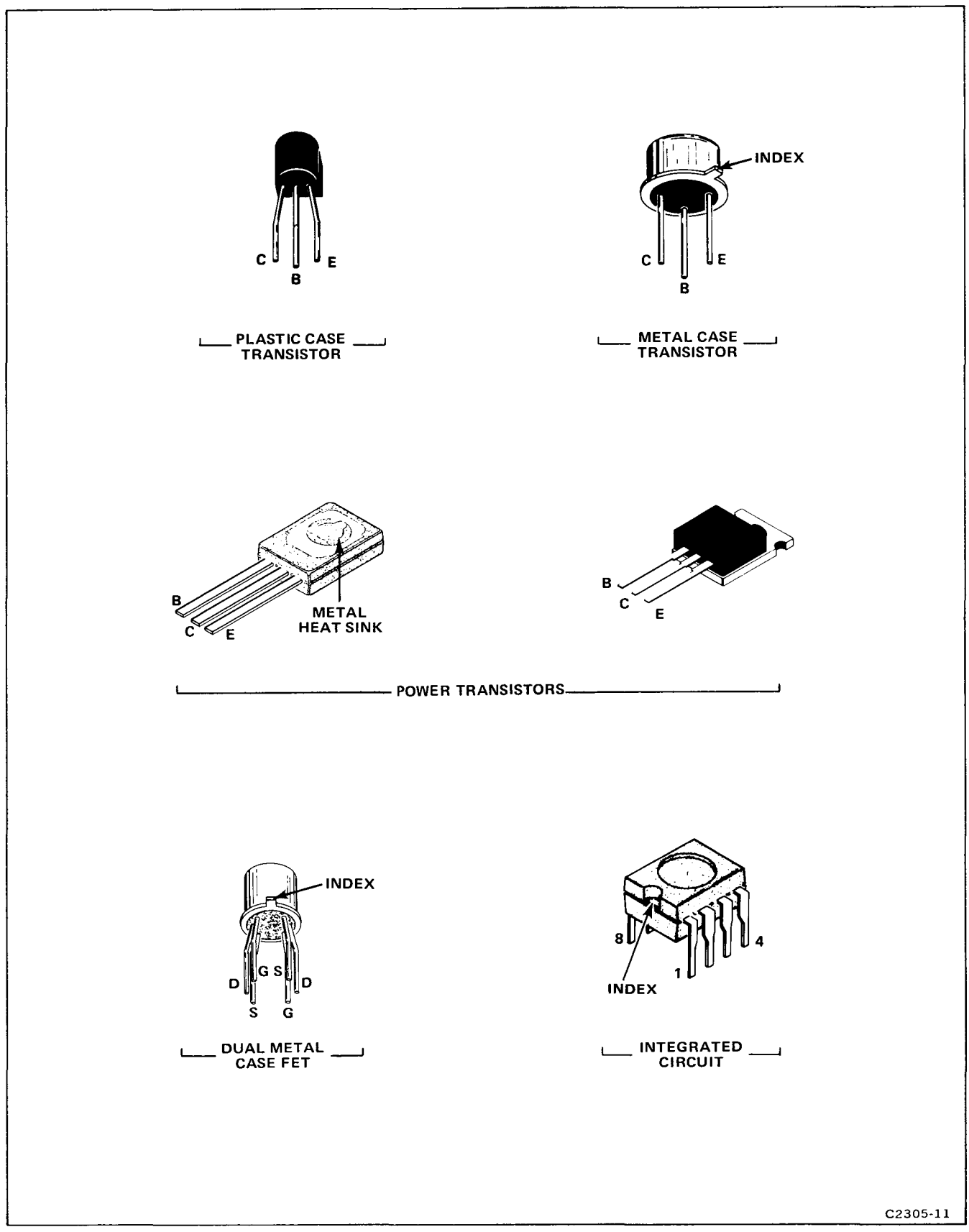

Figure 5-2. Semiconductor lead configurations.

MULTI-PIN CONNECTOR HOLDERS

The multi-pin 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).

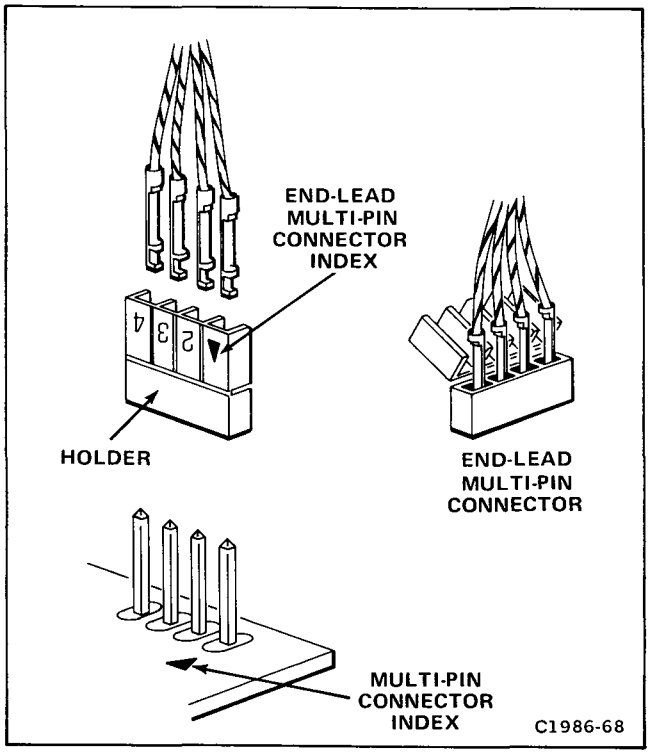

Figure 5-3. Orientation of multi-pin connector holders.

TROUBLESHOOTING EQUIPMENT

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

Semiconductor Tester

Description: Dynamic-type tester.

Purpose: To test the semiconductors used in this instrument.

Recommended Type: TEKTRONIX Type 576 or equivalent.

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 twenty-five megahertz minimum; 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, 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, 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 is within the listed range, the supply can be assumed to be working correctly.

TABLE 5-1
Power Supply Output Voltage

Power Supply	Test Point	Output Voltage Range	Typical Ripple (P-P)
+15 V	A2TP291	+14.96 V to +15.04 V	10 mV or less
-15 V	A2TP292	-14.7 V to -15.3 V	10 mV or less
-70 V	A2TP293	-67.9 V to -72.1 V	20 mV or less
GND	A2TP290		

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 Monitors. To obtain operating conditions similar to those used to make these readings, see the appropriate schematic.

7. CHECK INDIVIDUAL COMPONENTS

The following procedures describe methods of checking individual components in the 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 removing components.

Fuses

Check for open fuses by checking the continuity with an ohmmeter. The location and rating of power-supply fuses is shown in the Installation section, Figure 3-1.

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

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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 set on a 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 Monitor are given here.

OBTAINING REPLACEMENT PARTS

Most electrical and mechanical parts can be obtained through your local Tektronix field office or representative. However, you should be able to obtain many of the standard electronic components from a local commercial source in your area. Before you purchase or order a part from a source other than Tektronix, Inc., please check the electrical parts list for the proper value, rating, tolerance and description.

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, if crt, also include all data on crt tag).

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. 5-4):

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 protective cabinet panels (if so equipped) to gain access to the crt leads.

2. Disconnect the anode lead from the high-voltage multiplier.

WARNING

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

3. Disconnect the four leads to the X and Y deflection plate pins and the harmonica (A2P145) that supplies the trace rotation coil.

4. Remove the opening covers to gain access to the bezel and crt clamp screws.

5. Loosen the crt clamp screws and remove the bezel.

6. Remove the two mounting screws that support the rear of the crt shield.

7. With one hand on the front of the instrument, gently push on the rear of the crt to slide the crt forward.

8. Remove the crt base-pin socket.

9. Gently pull the crt out the front of the instrument while guiding the crt anode plug and the trace rotation plug.

10. Remove the crt shield.

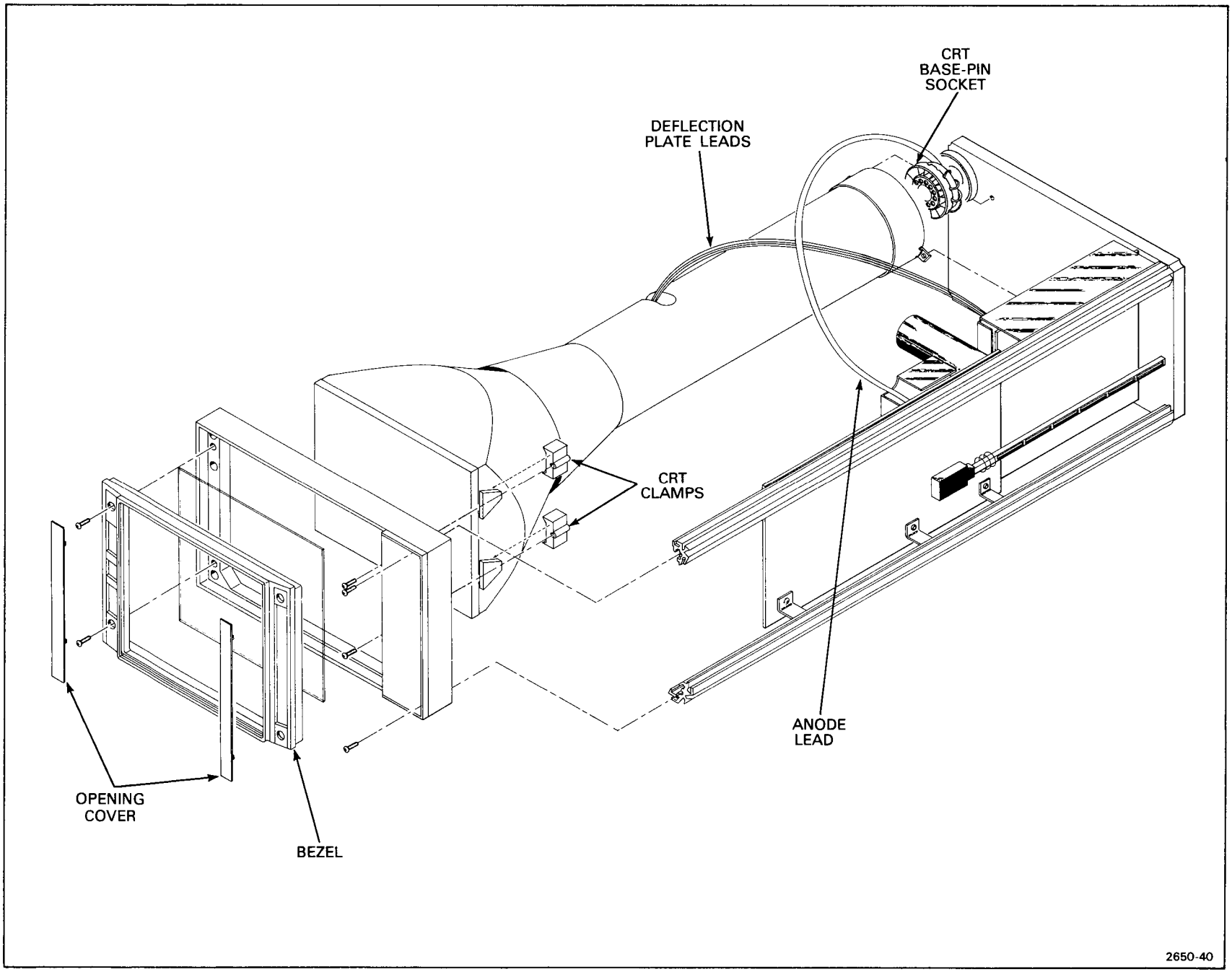

Figure 5-4. Crt removal.

CATHODE-RAY TUBE REPLACEMENT

Replace the cathode-ray tube (crt) as follows (see Fig. 5-4).

1. Install the crt shield.

2. Insert the crt part way into the instrument.

3. Place the crt base-pin socket onto the crt base pins.

4. Mount the crt shield to the rear panel. Leave the mounting screws loose.

5. Mount and fasten the bezel and implosion shield to the front panel with the 4 bezel securing screws.

6. Tighten the 4 crt clamp screws to 8 in. lbs. and replace the opening covers.

7. Tighten the two crt shield mounting screws on the rear panel.

8. Connect the four leads to the X and Y deflection plate pins and the harmonica (A2P145) that supplies the trace rotation coil.

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

NOTE

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

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.

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 may have lead configurations which do not agree with those shown. If a replacement transistor is made by other than the original manufacturer, check the manufacturer's basing diagram for correct basing. All transistor sockets 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 040-0542-01.

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. 5-5) in the hole if

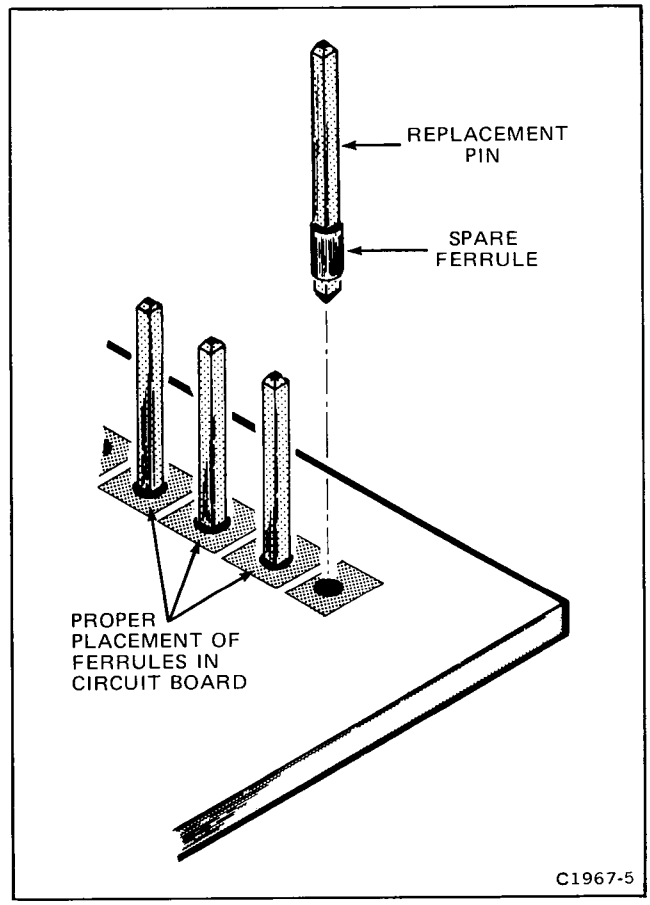

Figure 5-5. Exploded view of circuit-board pin and ferrule.

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.

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.

CIRCUIT BOARD REPLACEMENT

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/Z-AXIS BOARD

1. Unplug X and Y deflection pins.

2. Remove rear panel (see Fig. 5-6).

3. Remove mounting screws (see Fig. 5-7).

4. Unplug the circuit board from the interboard connector.

5. Reverse the removal procedure to replace the board.

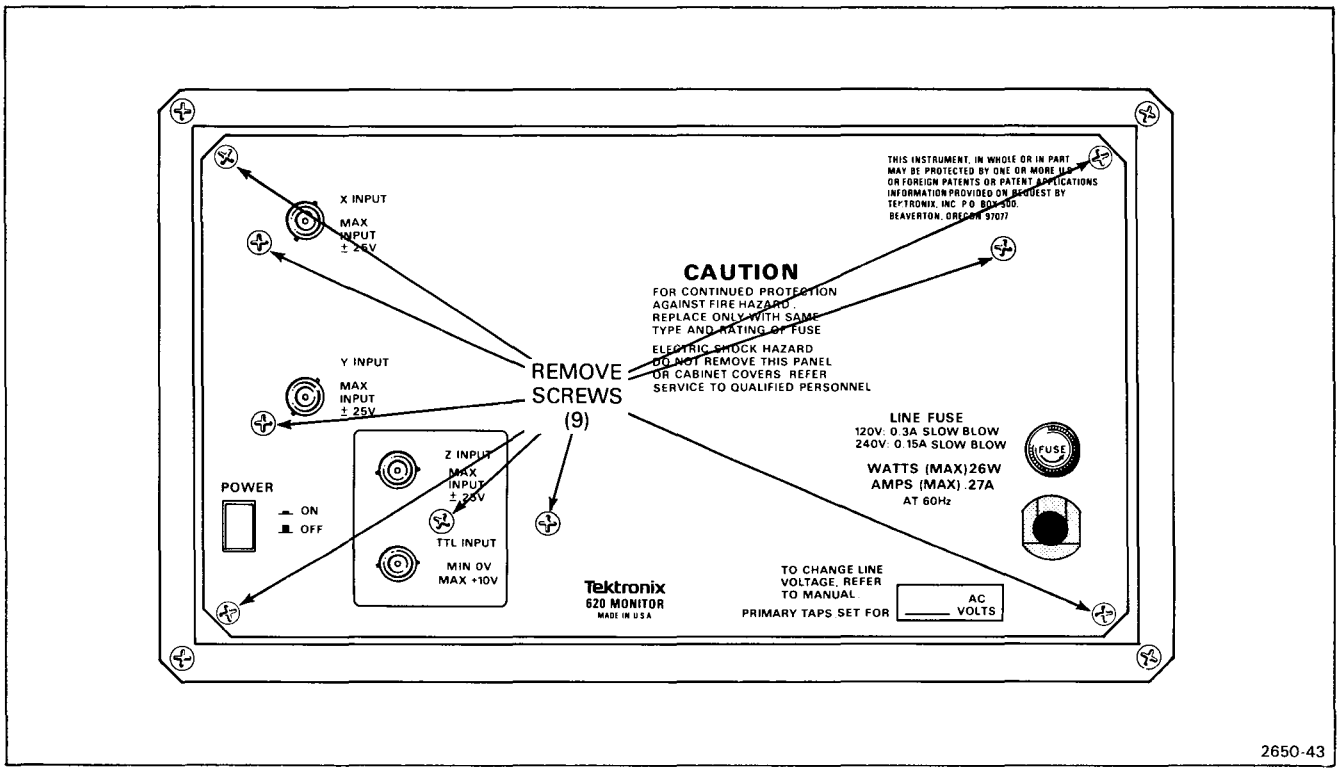

Figure 5-6. Screw locations for rear panel removal.

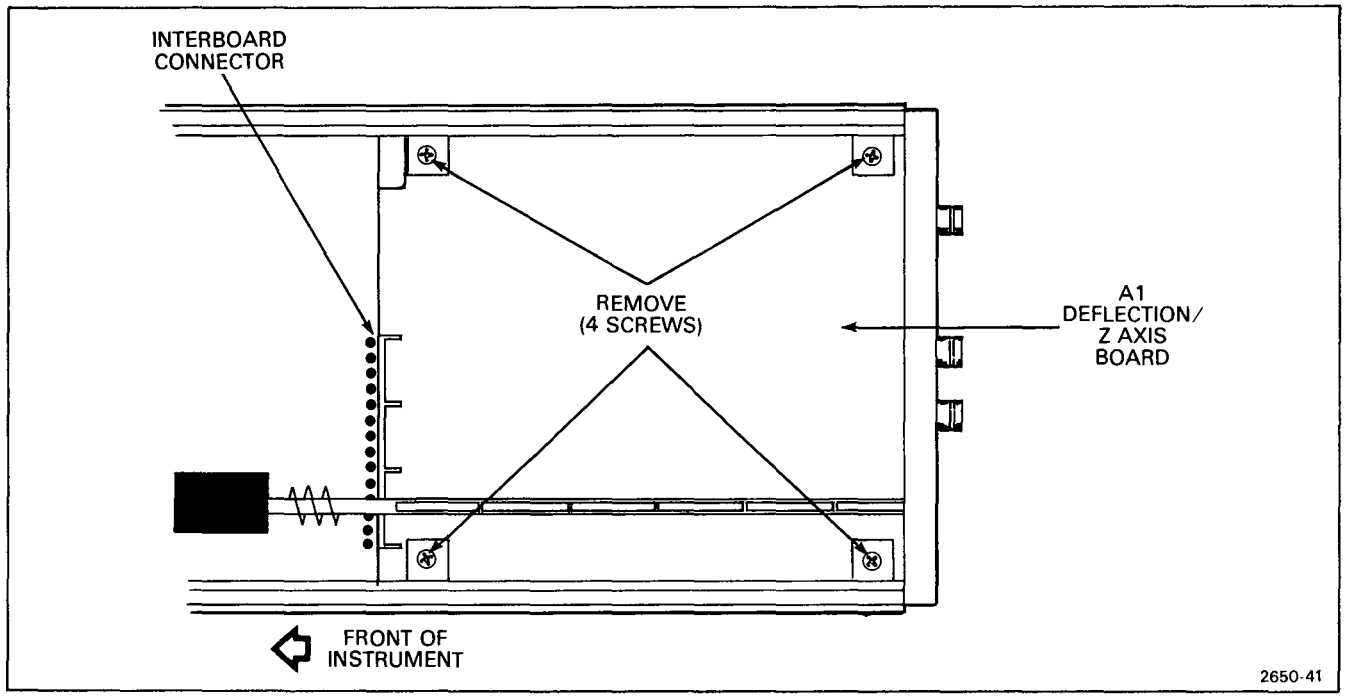

Figure 5-7. A1-Deflection/Z-Axis board removal.

A2 POWER SUPPLY BOARD

1. Follow the procedure for the Deflection/Z-Axis board removal, then proceed with the following instructions.

2. Remove the high voltage shield and mounting hardware shown in Figure 5-8.

3. Loosen the set screws from one end of each of the four flex couplings.

4. Disconnect the extension shaft from the power switch.

5. Unplug the crt base-pin socket, anode lead, trace rotation coil (A2P145), the High Voltage Oscillator (A2P106) and power connector (P42).

6. Remove the crt shield. This provides the proper clearance to remove the board.

7. Reverse the removal procedure to replace the board.

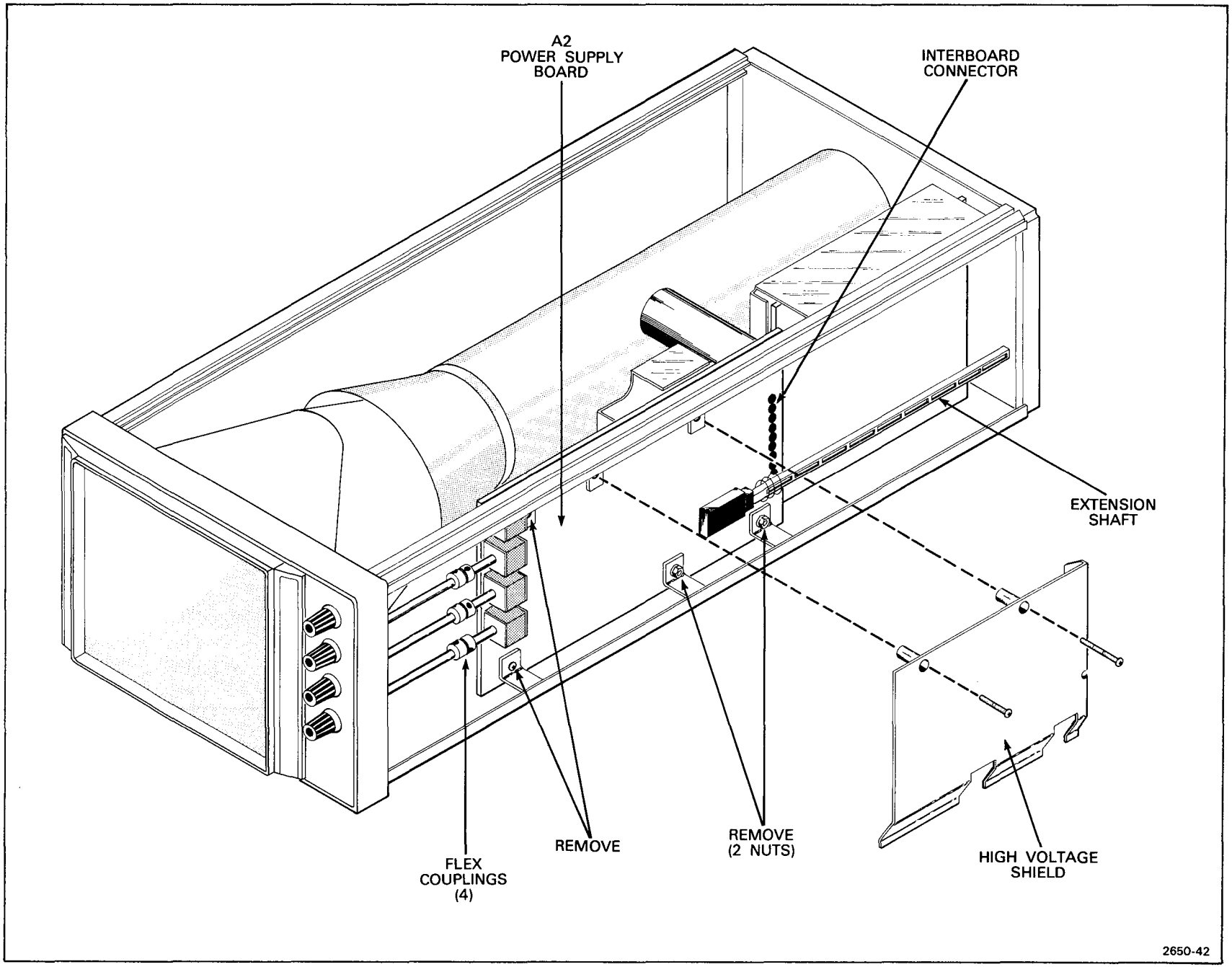

Figure 5-8. A2 Power Supply board removal.

CALIBRATION

This section provides procedures for calibrating this instrument. These procedures are designed to compare the performance of this instrument with other measurement instruments of known accuracy to detect, correlate, or eliminate by adjustment, any variation from the electrical specification. These procedures also verify that the controls function properly.

This section is divided into two parts: Part I—Performance Check, is provided for those who wish to verify that this instrument meets the applicable electrical specification in section 1 without making internal adjustments. Part II—Adjustment and performance Check, provides a complete calibration procedure that includes adjustments and performance checks in addition to verifying that the controls function properly. The procedures in Part I and Part II are written so that the entire instrument or any major circuit or part of a circuit can be checked or adjusted.

Table 6-1, Calibration Procedure Electives, lists the choices available and instructions for performing complete or partial calibration procedures. Also refer to page 6-2, Using These Procedures, for more detailed information.

TABLE 6-1
Calibration Procedure Electives

Electives	Procedure
Functional Check	Perform Power-Up Sequence in Part II—Adjustment and Performance Check. Then proceed sequentially through subsections (A, B, C, etc.) to end. If a functional check only is desired, perform the Checkout Procedures in section 3.
Performance Check Only	Perform Power-Up Sequence in Part I—Performance Check. Then proceed sequentially through subsections (A, B, C, etc.) to end.
Complete Calibration (Part II—Adjustment and Performance Check)	Perform Power-Up Sequence in Part II—Adjustment and Performance Check. Then proceed sequentially through subsections (A, B, C, etc.) to end.
Partial Part I—Performance Check or Part II—Adjustment and Performance Check by Subsection (A, B, C, etc.)	Perform Power-Up Sequence for Part I—Performance Check or Part II—Adjustment and Performance Check. Perform **Before You Begin** and Preliminary Control Settings instructions for the desired subsection. Then proceed sequentially through the procedures in the desired subsection.
Partial Part I—Performance Check or Part II—Adjustment and Performance Check by Step (A1, A2, B1, B2, etc.) Within a Subsection (A, B, C, etc.)	Perform Power-Up Sequence for Part I—Performance Check or Part II—Adjustment and Performance Check. Perform **Before You Begin** and Preliminary Control Settings instructions for subsection (A, B, C, etc.) containing the desired step (A1, A2, B1, B2, etc.). Then proceed through the instructions (a, b, c, etc.) in the desired step. **NOTE** *Although a partial adjustment procedure may be done, we recommend that the entire subsection procedure be performed if any adjustments are made.*

USING THESE PROCEDURES

These procedures are divided into subsections by major functional circuits (e.g., A. Option 20 Power Supply, B. CRT Circuit, etc.). The order in which the subsections and procedures appear is the recommended sequence for a complete performance check or calibration of the instrument.

Each step contains the Setup Conditions which, if applicable, include control settings for this instrument, a test setup illustration, and test equipment control settings. The Setup Conditions are written so that, if desired, each subsection (A, B, C, etc.) or step (A1, A2, B1, B2, etc.) can be performed separately.

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 is the first word in the title of a step, an electrical specification is checked. If ADJUST is the first word in the title, the step concerns one or more internal adjustments. If EXAMINE is the first word in the step title, the step concerns measurement limits that indicate whether the instrument is operating properly; these limits are not to be interpreted as electrical specifications.

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 the instruction accomplishes an electrical specification check. Each electrical specification checked is listed in Table 6-2, Performance Check Summary (see the following Performance Check Summary discussion for more information).

2. **EXAMINE**—usually precedes an ADJUST instruction and indicates that the instruction determines whether adjustment is necessary. If no ADJUST instruction appears in the same step, the EXAMINE instruction concerns measurement limits that do not have a related adjustment. Measurement limits following the word EXAMINE are not to be interpreted as electrical specifications. They are provided as indicators of a properly functioning instrument and to aid in the adjustment process.

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.

PERFORMANCE CHECK SUMMARY

Table 6-2, Performance Check Summary, lists the electrical specifications that are checked in Part I and Part II of this section. Table 6-2 is intended to provide a convenient means for locating the procedures in Part I and Part II that check and/or adjust the instrument to meet the applicable electrical specifications. For example: If A2 Power Supply board had been repaired or replaced, use Table 6-2 to locate the electrical specifications affected by the repair or replacement. Then, note the title of the procedure in Part I or Part II in which those specifications are checked and/or adjusted. Use the index provided at the front of Part I and Part II to determine the page number of the desired procedures.

TABLE 6-2
Performance Check Summary

Characteristic	Performance Requirement	Part I Performance Check Procedure Title	Part II Adjustment and Performance Check Procedure Title
VERTICAL (Y) AMPLIFIER			
Deflection Factor	Adjustable from 0.8 V or to at least 1.2 V full scale. Nominally set for 1 V, within 2%, for 8 divisions of deflection.	D1. Check Y Gain.	D1. Check/Adjust Y Gain (A1R125).
Polarity		Does not normally require customer verification. Satisfactory operation is verified by other tests throughout the procedures.	
Y INPUT	Positive signal applied deflects beam up; negative signal applied deflects beam down.		

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TABLE 6-2 (CONT.)
Performance Check Summary

Characteristic	Performance Requirement	Part I Performance Check Procedure Title	Part II Adjustment and Performance Check Procedure Title
Settling Time	Spot must reach new writing position within 0.05 cm, within 1.0 μs from any on-screen position.	D2. Check Vertical Settling Time.	D2. Check Vertical Settling Time.
Bandwidth (With 80% Full-Screen Reference Signal)	Dc to at least 2 MHz at -3 dB point.	D3. Check Vertical Bandwidth.	D3. Check Vertical Bandwidth.
Risetime	175 ns or less.	Does not normally require customer verification. However, risetime can be calculated from the Vertical Bandwidth.	
Position Stability	0.1 cm, or less, of drift per hour after 20-minute warmup. Not more than 0.2 cm drift in 24 hours.	Does not normally require customer verification.	
Input RC	1 MΩ, within 1%, paralleled by 47 pF or less.	Does not normally require customer verification. Input resistance and capacitance can be determined with appropriate testing bridge if necessary.	
Maximum Non-destructive Input voltage (Fault Condition Only)	+25 V or -25 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.	D4. Check Vertical Positioning.	D4. Check Vertical Positioning.
Crosstalk Between X and Y Amplifiers	0.05 cm, or less, on the undriven channel with the input terminated in less than 50 Ω and the other channel at full-screen deflection.	Does not normally require customer verification. However, crosstalk can be determined as follows: Terminate undriven channel (X or Y) input into 50 Ω and drive the other channel with a 1 volt 1 MHz sinewave. With the display centered, observe no more than 0.05 division deflection in the undriven channel.	
Linearity	Less than 5% error in any 2-division segment of the display.	D5. Check Vertical Deflection Linearity.	D5. Check Vertical Deflection Linearity.

HORIZONTAL (X) AMPLIFIER

Deflection Factor	Adjustable from 0.8 V or less to at least 1.2 V full scale. Nominally set for 1 V, within 2%, for 8 divisions of deflection.	C1. Check X Gain.	C1. Check/Adjust X Gain (A1R225).
Polarity X INPUT	Positive signal applied deflects beam to the right; negative signal deflects beam to the left.	Does not normally require customer verification. Satisfactory operation is verified by other tests throughout the procedure.	

TABLE 6-2 (CONT.)
Performance Check Summary

Characteristic	Performance Requirement	Part I Performance Check Procedure Title	Part II Adjustment and Performance Check Procedure Title
Phase Difference (DC to 500 kHz)	1° or less between X and Y amplifiers. X and Y amplifier gain must be set for the same deflection factor (V/div).	C2. Check Phasing.	C2. Check/Adjust Phasing (A1C293).
Settling Time	Spot must reach new writing position within 0.05 cm, within 1.0 μs from any on-screen position.	C3. Check Horizontal Settling Time.	C3. Check Horizontal Settling Time.
Bandwidth (With 80% Full-Screen Reference Signal)	Dc to at least 2 MHz at -3 dB point.	C4. Check Horizontal Bandwidth.	C4. Check Horizontal Bandwidth.
Risetime	175 ns or less.	Does not normally require customer verification. However, risetime can be calculated from the Horizontal Bandwidth.	
Position Stability	0.1 cm or less, of drift per hour after 20-minute warmup. Not more than 0.2 cm drift in 24 hours.	Does not normally require customer verification.	
Maximum Non-destructive Input (Fault Condition Only)	+25 V or -25 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.	C5. Check Horizontal Positioning.
Crosstalk Between X and Y Amplifiers (At 1 MHz)	0.05 cm or less, on the undriven channel with the input terminated in less than 50 Ω and the other channel at full-screen deflection.	Does not normally require customer verification. However, crosstalk can be determined as follows: Terminate undriven channel (X or Y) input into 50 Ω and drive the other channel with a 1 volt 1 MHz sinewave. With the display centered, observe no more than 0.05 division deflection in the undriven channel.	
Linearity	Less than 5% error in any 2-division segment of the display.	C6. Check Horizontal Deflection Linearity.	C6. Check Horizontal Deflection Linearity.

Z-AXIS AMPLIFIER

Useful Input Voltage Range (Z INPUT)	With input selecting straps in 'P' position, +1 V applied results in full display intensity with INTENSITY control at about midrange, and -1 V applied results in cut-off display with INTENSITY control fully on.	Does not normally require customer verification. Satisfactory operation is sustained by other tests throughout the procedures.	
Useful Frequency Range	Dc to at least 5 MHz at -3 dB point	E1. Check Z-Axis Bandwidth.	E1. Check Z-Axis Bandwidth.

TABLE 6-2 (CONT.)
Performance Check Summary

Characteristic	Performance Requirement	Part I Performance Check Procedure Title	Part II Adjustment and Performance Check Procedure Title
Risetime	70 ns or less.	Does not normally require customer verification. However, risetime can be calculated from the Z-Axis Bandwidth.	
Input RC	1 MΩ, within 1%, paralleled by 47 pF or less.	Does not normally require customer verification. Input resistance and capacitance can be determined with the appropriate testing bridge if necessary.	
Maximum Non-destructive Input voltage (Fault Condition Only)	+25 V or -25 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.	
TTL Input Voltage (Option 25)		Does not normally require customer verification.	
HI Logic Level	+2.4 V to +5 V dc.		
LO Logic Level	0 V to +0.8 V dc.		
Unblanking (Option 25)	Input voltage level to produce unblanking is internally selectable.	E2. Check Option 25 Z-Axis Unblanking.	E2. Check Option 25 Z-Axis Unblanking.

CATHODE-RAY TUBE DISPLAY

Usable Screen Area	10 × 12 centimeters.	Does not normally require customer verification.	
Quality Area	Center 7 × 9 divisions.	Does not normally require customer verification.	
Geometry (Within Graticule Area)	Bowing or tilt is 0.1 division or less.	B2. Check Geometry.	B4. Check/Adjust Geometry (A2R155).
Orthogonality (Within Graticule Area)	90° within 1°.	B1. Check Orthogonality.	B3. Check Orthogonality.
Accelerating Potential	Approximately 12 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 rear panel.	
Brightness	Light output is at least 30 fL. Measured with quality area flooded by a 60 Hz refresh rate raster, 300 horizontal lines.	Does not normally require customer verification.	
Spot Size 1	0.038 cm (0.015") or less, at 0.5 μA beam current. Measured within quality area with shrinking raster method.	Does not normally require customer verification.	

TABLE 6-2 (CONT.)
Performance Check Summary

Characteristic	Performance Requirement	Part I Performance Check Procedure Title	Part II Adjustment and Performance Check Procedure Title
Spot Size 2	0.051 cm (0.020") or less at 25 fL measured within the quality area with the shrinking raster method.	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 rear panel.	
POWER SOURCE			
Line Voltage (ac, rms)		Does not normally require customer verification.	
Low Range			
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			
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)	26 watts, 0.27 A	Does not normally require customer verification.	
Option 20 Input Power		A1. Check Option 20 Regulation.	A3. Check Option 20 Regulation.
+20 V DC Input	+17.0 to +25 V dc, including any ripple excursions.		

ADJUSTMENT INTERVAL

To maintain instrument accuracy, check the performance of the 620 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.

TEST EQUIPMENT REQUIRED

The test equipment listed in Table 6-3 is required for a complete Adjustment and Performance Check of this instrument. If only Part I—Performance Check is to be performed, the items required for Part II—Adjustment and Performance Check are not required and are indicated by footnote 1. The remaining test equipment is common to both procedures.

The specifications for test equipment, given in Table 6-3, 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.

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 Calibration procedures in Part I and Part II 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 6-3 is not available, first check the Minimum 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 performance check or adjustment that is of little or no importance for your measurement requirements, the item and corresponding step(s) can be deleted.

TABLE 6-3
Test Equipment

Description	Minimum Specifications	Purpose	Examples of Applicable Test Equipment
1. Precision dc voltmeter[1] (with test leads)	Measurement range, +25 V to -72.1 V, measurement accuracy, within 0.1%.	Adjust +15 V supply. Check low-voltage supplies. Check crt bias.	a. TEKTRONIX DM 501A Option 02 Digital Multi-Meter (operates in TM 500-Series Power Module).
2. Dc voltmeter[1] (with test leads)	Measurement range, -2250 to -2295 V.	Check high-voltage supply.	a. Triplett Model 630-NA.
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 Z-axis unblanking in the Option 25 instrument.	a. TEKTRONIX FG 503 Function Generator (operates in TM 500-Series Power Module).
4. Ramp generator	Ramp duration, 1 ms to 50 μs within 3%; ramp amplitude, 0.5 to 2 V into 1 MΩ; external trigger input, compatible with square-wave generator output; gate output, 1 to 3 V into 1 MΩ.	Check vertical and horizontal settling time, bandwidth and positioning. Check Z-axis, adjust trace rotation and geometry. Check orthogonality.	a. TEKTRONIX RG 501 Ramp Generator (operates in TM 500-Series Power Module).
5. Square-wave generator	Frequency range, 1 kHz to 100 kHz; amplitude, 0.5 to 2.5 V when terminated compatibly with ramp generator external trigger input.	Adjust gain of the vertical and horizontal amplifiers. Check vertical and horizontal settling time.	a. TEKTRONIX PG 506 Calibration Generator (operates in TM 500-Series Power Module).
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 amplitude at reference frequency as output frequency changes.	Check bandwidth of the vertical, horizontal and Z-axis amplifiers. Check phasing between the vertical and horizontal amplifiers. Check vertical and horizontal deflection linearity.	a. TEKTRONIX SG 503 Leveled Sine-wave Generator (operates in TM 500-Series Power Module).

[1] **Used for Part II—Adjustment and Performance Check only; NOT used for Part I—Performance Check.**

TABLE 6-3 (CONT.)
Test Equipment

Description	Minimum Specifications	Purpose	Examples of Applicable Test Equipment
7. Test oscilloscope (with 10X probe)	Bandwidth, dc to at least 50 MHz; deflection factor 0.1 to 10 V/div within 2%; sweep rate, 10 μs/div.	Check Z-axis bandwidth.	a. TEKTRONIX 5440 Oscilloscope with 5A45 Amplifier, 5B40 Time Base, and P6105 2-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.
8. Dual-input coupler	Connectors, bnc.	Check phasing and Z-axis unblanking.	a. Tektronix 067-0525-01 Calibration Fixture
9. 50 Ω termination (2 required)	Impedance, 50 Ω within 2%; connectors, bnc.	Adjust gain and compensation, and check bandwidth of the vertical, horizontal, and Z-axis amplifiers. Check vertical and horizontal settling time. Check phasing between the vertical and horizontal amplifiers.	a. Tektronix part 011-0049-01.
10. 50 Ω cable (4 required)	Impedance, 50 Ω; length 42 inches; connectors, bnc.	Provide signal interconnection.	a. Tektronix part 012-0057-01.
11. Screwdriver[1]	3-inch shaft, 3/32-inch bit.	Adjust variable resistors.	a. Xcelite R3323.
12. Nominal +20 V dc power supply with test leads (required for Option 20 and 31 Monitors only)	Output voltage range, +17.0 to +25 V; output current at least 3 amperes.	Supply positive voltage to operate the Option 20 instrument. Check regulation over input voltage range. Check shutdown.	a. Power Mate Corp. Model BPE 34E.
13. 50 Ω 10X Attenuator (Option 25 only)	Impedance, 50 Ω; attenuation accuracy, within 2%, connectors, bnc.	Attenuates Y input in Option 25 Z-axis unblanking check.	a. Tektronix part 011-0059-02.

[1] **Used for Part II—Adjustment and Performance Check only; NOT used for Part I—Performance Check.**

PART I—PERFORMANCE CHECK

The following procedure (Part I—Performance Check) verifies electrical specifications without removing instrument covers or making internal adjustments. All tolerances given are as specified in the Specification tables (section 1) in this manual.

Part II—Adjustment and Performance Check provides the information necessary to: (1) verify that the instrument meets the electrical specifications, (2) verify that the controls function properly, and (3) perform all internal adjustments.

A separate Operators Checkout Procedure is provided in the Operators Manual for familiarization with the instrument and also to verify that the controls function properly.

See Table 6-1, Calibration Procedure Electives, at the beginning of this section, for information on performing a Partial Part I—Performance Check procedure.

INDEX TO PERFORMANCE CHECK PROCEDURE

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. Remove the High Voltage shield. See Figure 5-8 in Section 5, Maintenance.

WARNING

Extreme caution must be used when operating the 620 with the High Voltage Shield removed due to the line voltage and high voltage potentials present.

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

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

NOTE

Install the calibration graticule as follows (see Fig. 6-1):

a. Remove the flexible frame mask.

b. Position the graticule against the crt.

c. Exert minimum pressure at the edges of the graticule till it snaps in.

d. Snap in the flexible frame mask.

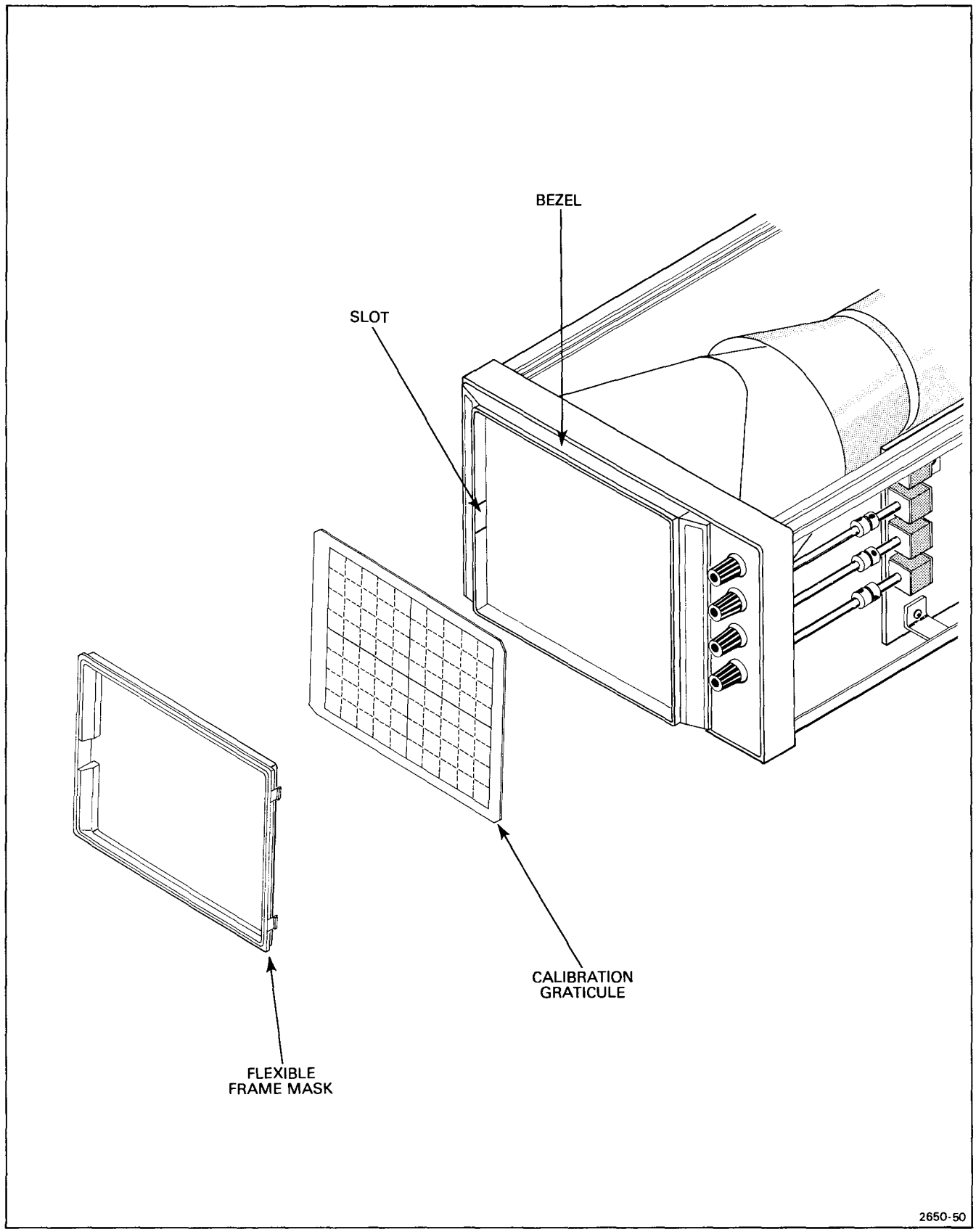


Figure 6-1. Calibration graticule installation.

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

5. Check the rear panel to determine which Options have been installed in your Monitor.

6. Connect the instrument to a power source which meets the voltage and frequency requirements marked on the instrument rear panel.

NOTE

For Option 20 and 31 Monitors: Connect your instrument to the dc power supplies as shown in Figure 6-2.

7. Push in the OFF/ON pushbutton (rear-panel) 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.

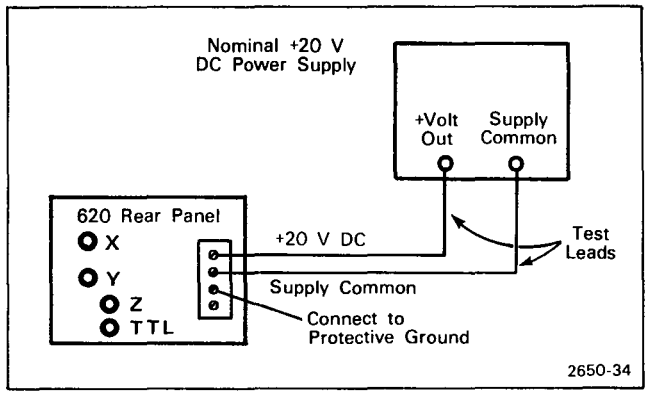


Figure 6-2. 620 Monitor Option 20 power supply connectors.

A. OPTION 20 POWER SUPPLY

Equipment Required: (Numbers correspond to those listed in Table 6-3, Test Equipment.

1. Precision dc voltmeter

12. Nominal +20 V dc power supply

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.

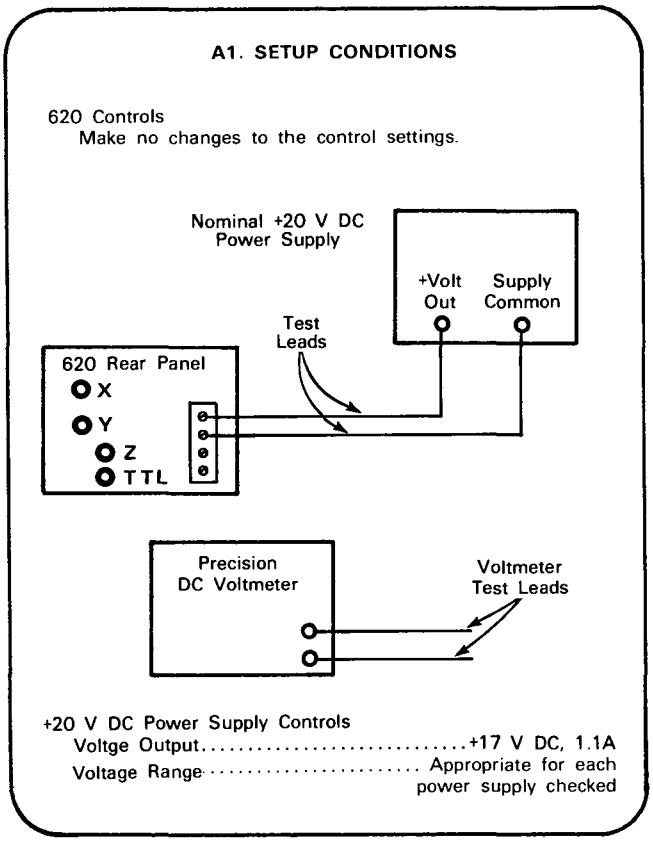
OPTION 20 POWER SUPPLY PRELIMINARY CONTROL SETTINGS:

620 Monitor
INTENSITY ..... Fully counterclockwise

A1. CHECK OPTION 20 REGULATION

NOTE

For a partial procedure, first perform the Option 20 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.

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

c. Set the +20 V dc power supply output voltage to +25 volts.

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

@

e. 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 6-4 for the appropriate supply.

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

TABLE 6-4
Low-Voltage Supply Accuracy

Supply (dc)	Voltage Range
+15 V	+14.96 V to +15.04 V
-15 V	-14.7 V to -15.3 V
-70 V	-67.9 V to -72.1 V

B. CRT CIRCUIT

Equipment Required: (Numbers correspond to those listed in Table 6-3, Test Equipment.)

4. Ramp generator

10. 50-ohm bnc 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.

620 Monitor
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.

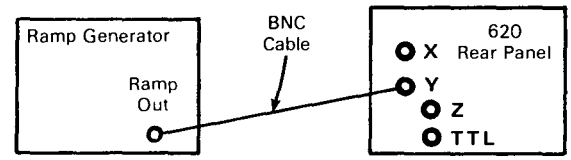
B1. CHECK ORTHOGONALITY

NOTE

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

B1. SETUP CONDITIONS

620 Controls
Make no changes to the control settings.



Ramp Generator Controls
Ramp Signal ..... +5 ms Ramp
Triggering ..... +Auto, Internal

a. Set the ramp generator amplitude for a 10-division vertical trace on the crt (position as necessary).

b. Position the start of the vertical trace to the bottom horizontal graticule line.

c. **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.

@

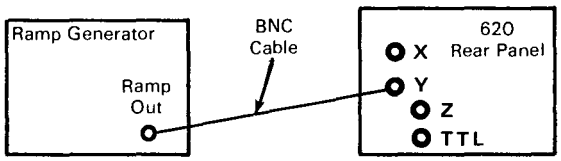
B2. CHECK GEOMETRY

NOTE

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

B2. SETUP CONDITIONS

620 Controls
Make no changes to the control settings.



Ramp Generator Controls
Ramp Signal ..... +5 ms Ramp
Triggering ..... +Auto, Internal

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. 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.

C. HORIZONTAL (X) AMPLIFIER

Equipment Required: (Numbers correspond to those listed in Table 6-3, Test Equipment.)

4. Ramp generator
5. Square-wave generator
6. Sine-wave generator
8. Dual-input coupler
9. 50-ohm termination (2 required)
10. 50-ohm bnc cable (4 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:

620 Monitor
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.

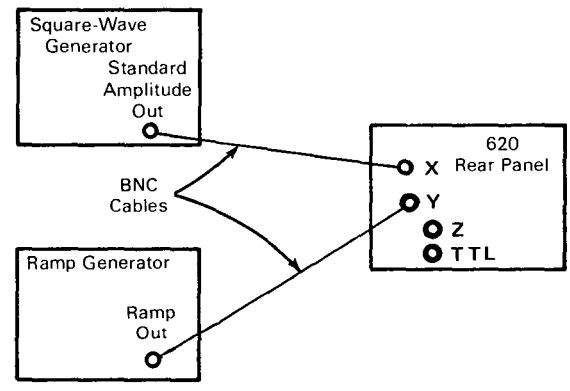
C1. CHECK X GAIN

NOTE

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

C1. SETUP CONDITIONS

620 Controls
X Gain ..... Fully clockwise



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

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

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

NOTE

X Gain can be set to provide 8 divisions of horizontal deflection with any input signal voltage from approximately +0.8 to +1.2 volts. However, when performing 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 C1. Check/Adjust X Gain (A1R225) in Part II—Adjustment and Performance Check, for the procedure to set the X Gain.

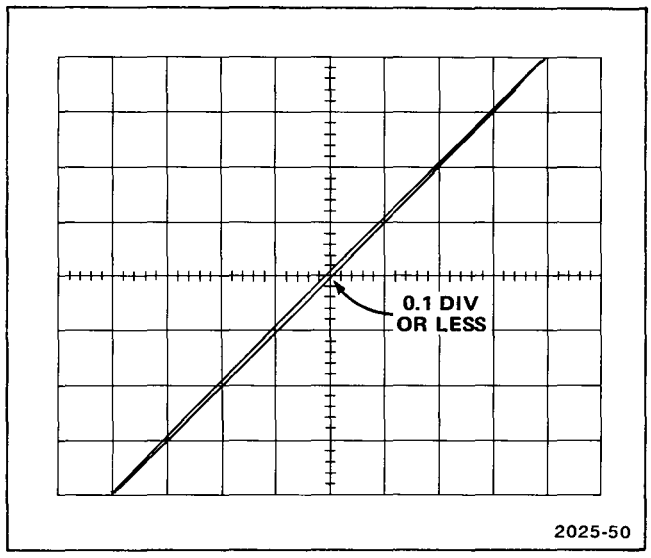


Figure 6-3. Typical horizontal and vertical phase difference display.

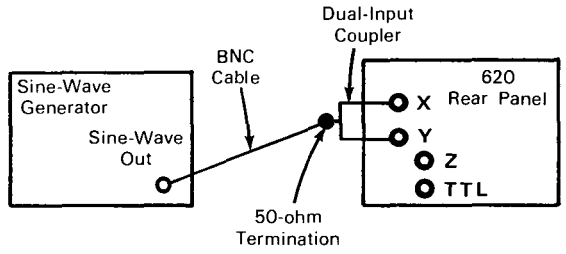
C2. CHECK PHASING

NOTE

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

C2. SETUP CONDITIONS

620 Controls
X Gain and Y Gain ..... Set to provide 8 divisions deflection with 1-volt input. (See steps C1 and D1 in Part II—Adjustment and Performance Check)



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

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.

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).

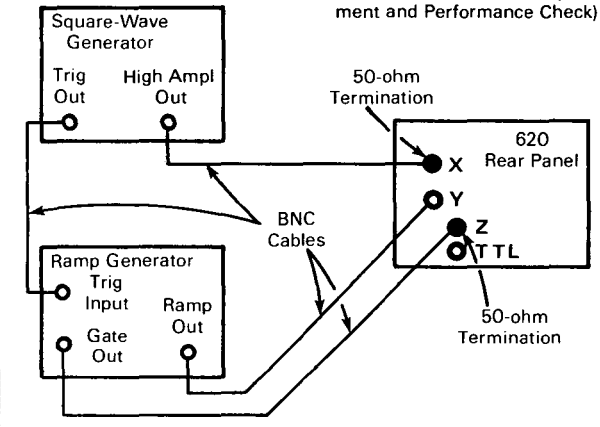
C3. CHECK HORIZONTAL SETTLING TIME

NOTE

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

C3. SETUP CONDITIONS

620 Controls
X Gain ..... Set to provide 8 divisions deflection with 1-volt input (See Step C1 in Part II—Adjustment and Performance Check)



Square-Wave Generator Controls
Pulse Duration ..... 10 μs (100 kHz)
Ramp-Generator Controls
Ramp Signal ..... +20 μs Ramp
Triggering ..... +Auto, External

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

b. Set the square-wave generator amplitude for 10 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. 6-4) to within 0.50 millimeters (about one trace width) of the 100 percent level is 1 μsec (0.8 division) or less.

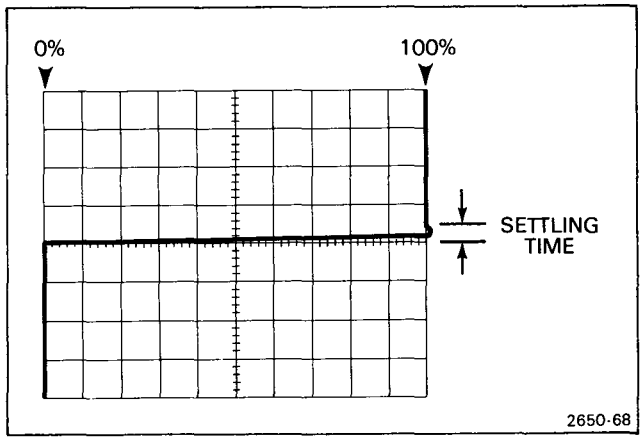
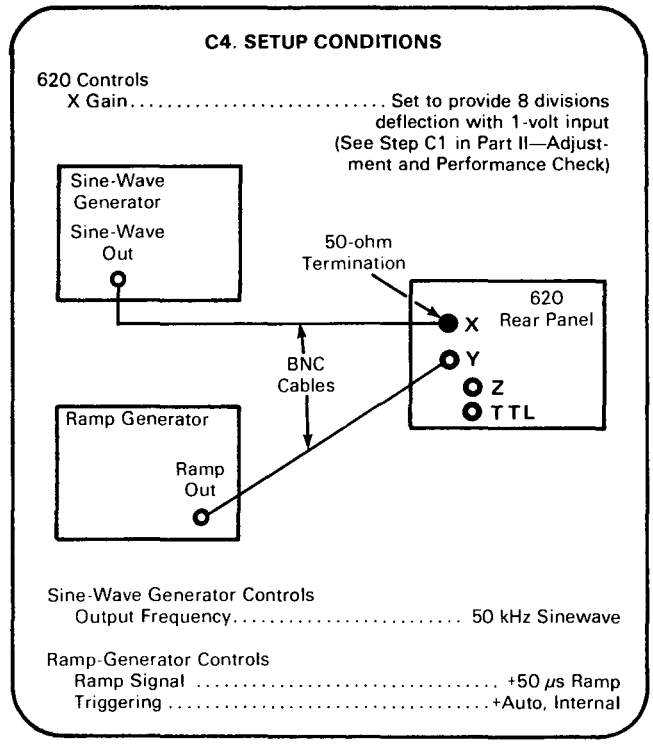


Figure 6-4. Typical crt display for horizontal settling-time measurement (settling time includes corner distortion).



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 2 megahertz.

C4. CHECK HORIZONTAL BANDWIDTH

NOTE

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

C5. CHECK HORIZONTAL POSITIONING

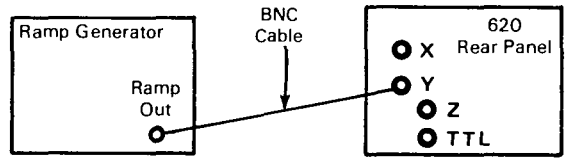
NOTE

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

@

C5. SETUP CONDITIONS

620 Controls
Make no changes to the control settings.



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

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

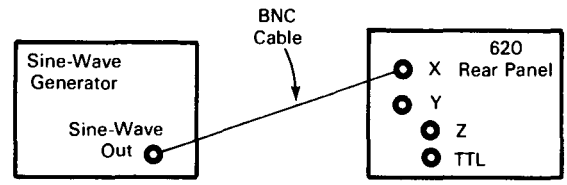
C6. CHECK HORIZONTAL DEFLECTION LINEARITY

NOTE

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

C6. SETUP CONDITIONS

62C Controls
Make no changes to control settings.



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

a. Set the sine-wave generator amplitude for a 2 division display centered horizontally on the graticule.

b. Horizontally position the trace to the left and then to the right of the graticule and check for 2 divisions within 5 percent (1.9 to 2.1 divisions) over the display area.

D. VERTICAL (Y) AMPLIFIER

Equipment Required: (Numbers correspond to those listed in Table 6-3, Test Equipment.)

4. Ramp generator
5. Square-wave generator
6. Sine-wave generator
8. Dual-input coupler
9. 50-ohm termination (2 required)
10. 50-ohm bnc cable (4 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 (Y) AMPLIFIER PRELIMINARY CONTROL SETTINGS:

620 Monitor
Vertical and Horizontal
Positioning ..... Midrange
INTENSITY ..... Visible display
FOCUS ..... Well-defined display

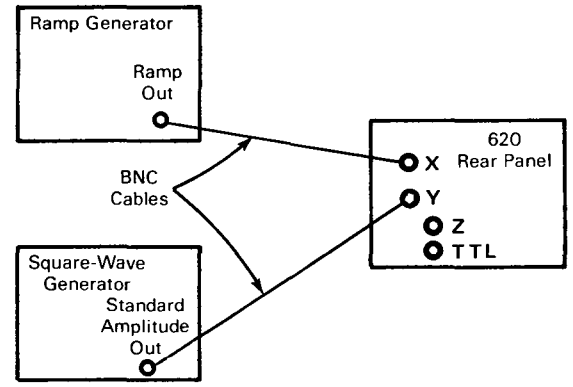
D1. CHECK Y GAIN

NOTE

For a partial Performance Check procedure, first perform the Vertical (Y) Amplifier Preliminary Control Settings, then proceed with the following instructions.

D1. SETUP CONDITIONS

620 Controls
Y Gain ..... Fully clockwise



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

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

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

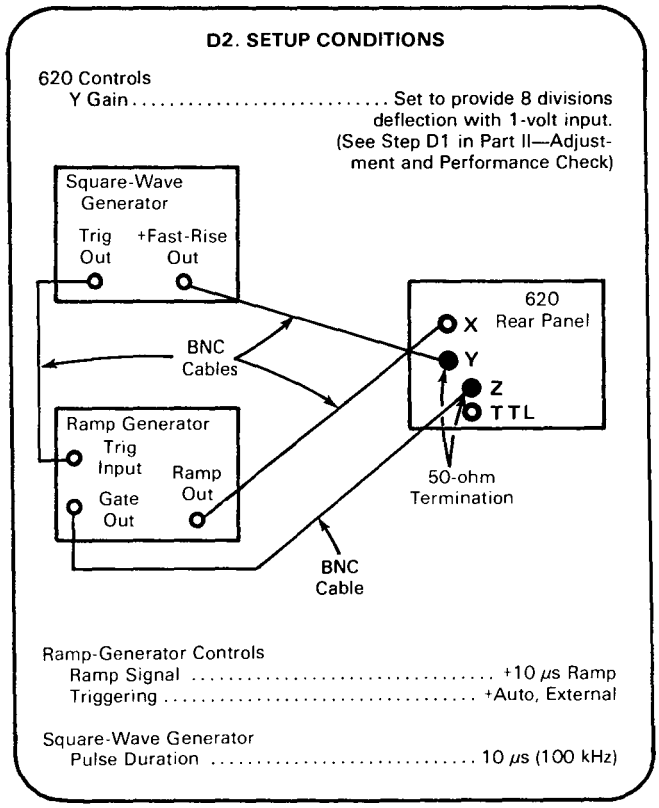
NOTE

The Y Gain can be set to provide 8 divisions of vertical deflection with any input signal voltage from approximately +0.8 to +1.2 volts. However, when performing 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 D1. Check/Adjust Y Gain (A1R125) in Part II—Adjustment and Performance Check for the procedure to set the Y Gain.

D2. CHECK VERTICAL SETTLING TIME

NOTE

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



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. 6-5) to within 0.50 millimeters (about one trace width) of the 100 percent level is 1 μsec (1.0 division) or less.

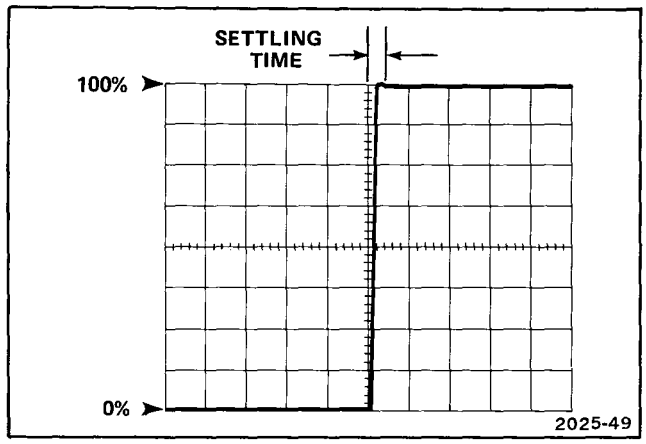
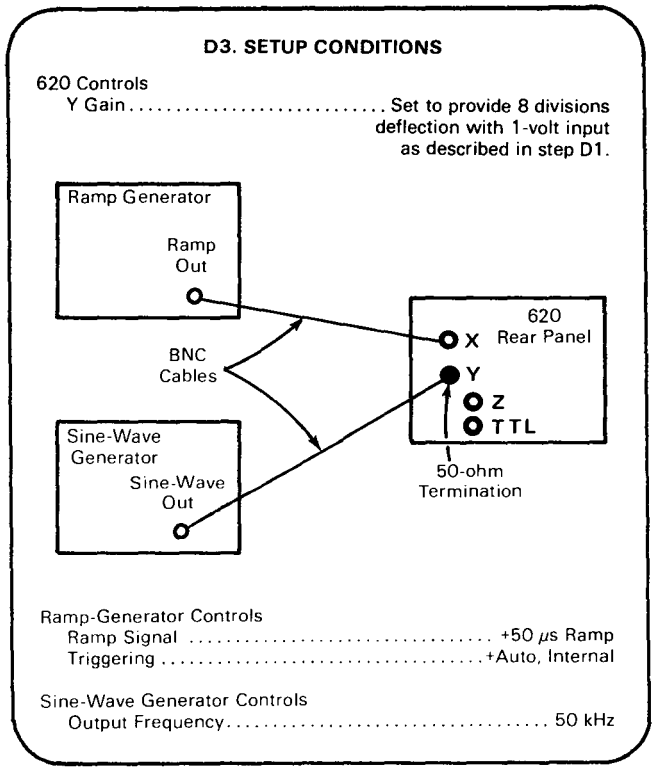


Figure 6-5. Typical crt display for vertical settling time measurement (settling time includes corner distortion).

D3. CHECK VERTICAL BANDWIDTH

NOTE

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



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.

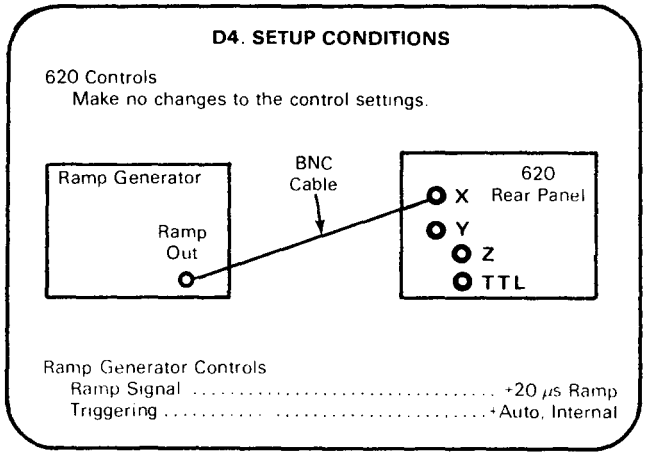
c. Slowly increase the sine-wave generator output frequency until the display amplitude is 4.5 divisions.

d. **CHECK**—That the sine-wave generator output frequency is at least 2 megahertz.

D4. CHECK VERTICAL POSITIONING

NOTE

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

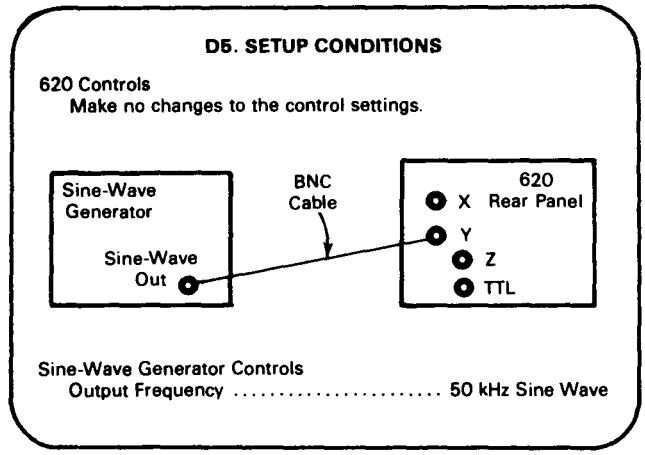


a. **CHECK**—Rotate the Vertical Position control and check that the horizontal trace can be positioned vertically anywhere in the graticule area.

D5. CHECK VERTICAL DEFLECTION LINEARITY

NOTE

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



a. Set the sine-wave generator amplitude for a 2 division vertical display centered vertically on the graticule.

b. **CHECK**—Vertically position the trace to the top and then to the bottom of the graticule and check for 2 divisions within 5 percent (1.9 to 2.1 divisions) over the display area.

E. Z-AXIS AMPLIFIER

Equipment Required: (Numbers correspond to those listed in Table 6-3, Test Equipment.)

3. Function generator
4. Ramp generator
6. Sine-wave generator
7. Test oscilloscope
8. Dual-input coupler
9. 50-ohm termination (1 required)
10. 50-ohm bnc cable (3 required)
13. 50-ohm 10X attenuator

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:

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

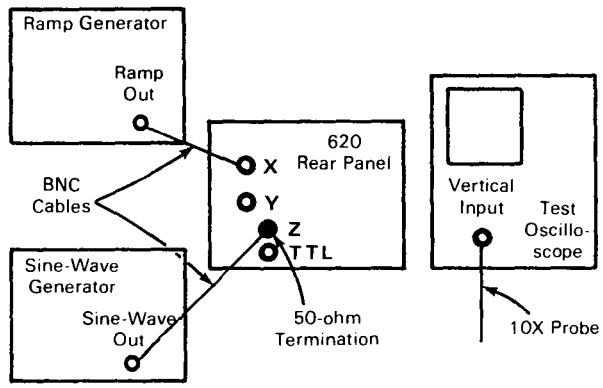
E1. CHECK Z-AXIS AMPLIFIER BANDWIDTH

NOTE

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

E1. SETUP CONDITIONS

620 Controls
Make no changes to the control settings.



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

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

Test Oscilloscope Controls
Deflection Factor ..... 10 V/div with 10X Probe
Input Coupling ..... DC
Triggering ..... Auto, Internal
Sweep Rate ..... 10 μs/div
Display ..... Well-defined visible display

a. Connect a 10X probe from the test oscilloscope vertical input to A1TP382.

b. Set the 620 INTENSITY control and the sine-wave generator amplitude for a 5-division (from -60 V dc to -10 V dc) display on the test oscilloscope. (Make sure that no clipping occurs on the test oscilloscope display.)

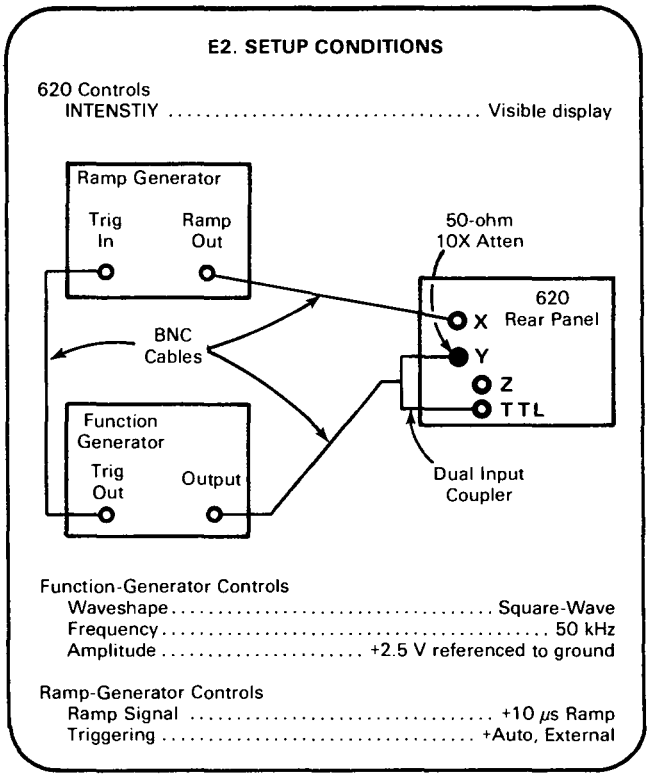
c. Slowly increase the sine-wave generator output frequency until the display amplitude is 3.5 divisions on the test oscilloscope.

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

E2. CHECK OPTION 25 Z-AXIS UNBLANKING

NOTE

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



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

NOTE

Remove the calibration graticule as follows (see Fig. 6-1):

a. Remove the flexible frame mask.

b. Locate a slot at the midpoint of the left edge of the crt bezel.

c. Using the bezel as a fulcrum and a small flat blade screwdriver as a pry, carefully exert pressure against the graticule edge allowing it to bow sufficiently to clear the ridges in the bezel.

d. Snap in the flexible frame mask.

This completes the Performance Check procedure.

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PART II—ADJUSTMENT AND PERFORMANCE CHECK

The following procedure (Part II—Adjustment and Performance Check) provides the information necessary to: (1) verify that the instrument meets the electrical specifications, (2) verify that all controls function properly, and (3) perform all internal adjustments.

Part I—Performance Check verifies electrical specifications without removing instrument covers or making internal adjustments. All tolerances given are as specified in the Specification tables (section 1) in this manual.

A separate Operators Checkout Procedure is provided in the Operating Instructions for familiarization with the instrument and also to verify that all controls, indicators and connectors function properly.

See Table 6-1, Calibration Procedure Electives, at the beginning of this section, for information on performing a Partial Part II—Adjustment and Performance Check procedure.

INDEX TO ADJUSTMENT AND PERFORMANCE CHECK

ADJUSTMENT AND 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. Adjustments must be performed at an ambient temperature from +15° to +25° C for specified accuracies.

1. Remove the High Voltage Shield. See Figure 5-8.

WARNING

Extreme caution must be used when operating the 620 with the High Voltage shield removed due to the line voltage, and high voltage potentials present.

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

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

NOTE

Install the calibration graticule as follows (refer to Fig. 6-1):

a. Remove the flexible frame mask.

b. Position the graticule against the crt.

c. Exert minimum pressure at the edges of the graticule till it snaps in.

d. Snap in the flexible frame mask.

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

5. Check the rear panel to determine which Options have been installed in your Monitor.

6. Connect the instrument to a Power source which meets the voltage and frequency requirements marked on instrument rear panel.

NOTE

For Option 20 and 31 Monitors: Connect your instrument to the dc power supplies as shown in Figure 6-6.

7. Push in the ON/OFF pushbutton (rear panel) 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.

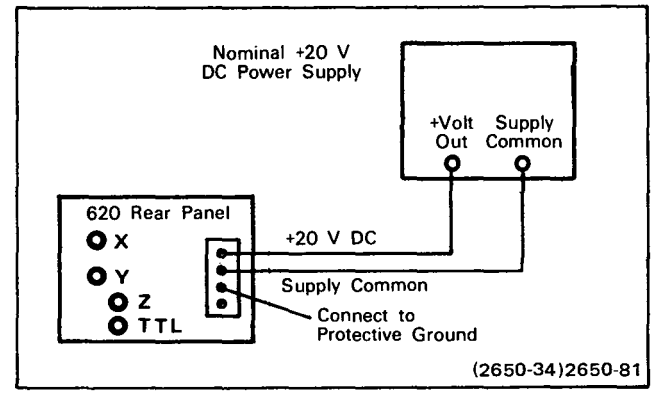


Figure 6-6. 620 Monitor Option 20 power supply connectors.

A. POWER SUPPLY

Equipment Required: (Numbers correspond to those listed in Table 6-3, Test Equipment.)

1. Precision dc voltmeter
2. Dc voltmeter
12. Nominal +20 V dc power supply with test leads (Option 20 and 31 only)

BEFORE YOU BEGIN:

(1) Perform the Adjustment and 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.

POWER SUPPLY PRELIMINARY CONTROL SETTINGS:

620 Monitor
Vertical and Horizontal
Position ..... Midrange
INTENSITY ..... Fully counterclockwise

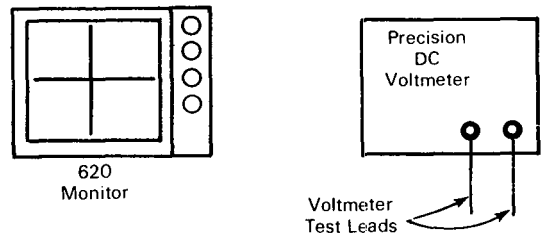
A1. ADJUST +15 VOLT SUPPLY (A2R245)

NOTE

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

A1. SETUP CONDITIONS

620 Controls
Make no changes to the control settings.



No external signals are connected to the 620 Monitor
Voltmeter Range ..... Appropriate for each power supply checked

a. Table 6-5 lists the low-voltage supplies in this instrument. Connect the precision dc voltmeter between the appropriate test point and ground.

TABLE 6-5
Low-Voltage Supply Accuracy

Supply (dc)	Voltage Range
+15 V	+14.96 V to +15.04 V
-15 V	-14.7 V to -15.3 V
-70 V	-67.9 V to -72.1 V

b. **EXAMINE**—The voltmeter for a reading within the voltage range given in Table 6-5 for the appropriate supply.

c. **ADJUST**—A2R245 (+15 V Adj) for a voltmeter reading of +15.00 volts.

d. **EXAMINE**—(-15 V) A2TP292, (-70 V) A2TP293.

e. **INTERACTION**—If any of the low-voltage supplies in Table 6-5 are out of tolerance, reexamine the adjustment of the +15 volt supply in part b.

A2. EXAMINE HIGH-VOLTAGE SUPPLY

WARNING

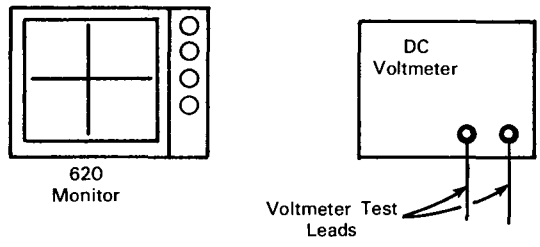
Turn off the instrument when connecting and disconnecting the dc voltmeter. Potentially dangerous voltage exists at several points on the High-Voltage Power Supply board and crt socket.

NOTE

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

A2. SETUP CONDITIONS

620 Controls
ON/OFF ..... OFF



No external signals are connected to the 620 Monitor
Voltmeter Range ..... ≥-2500 V dc

a. Remove the rear panel. See Figure 5-6 in the Maintenance section. Then remove the crt socket cover.

b. Connect the dc voltmeter (set for at least -2500 V dc full scale) between pin 2 of the crt socket (second pin clockwise from the socket index) and ground.

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

d. **EXAMINE**—The voltmeter for a reading between -2205 volts and -2295 volts.

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

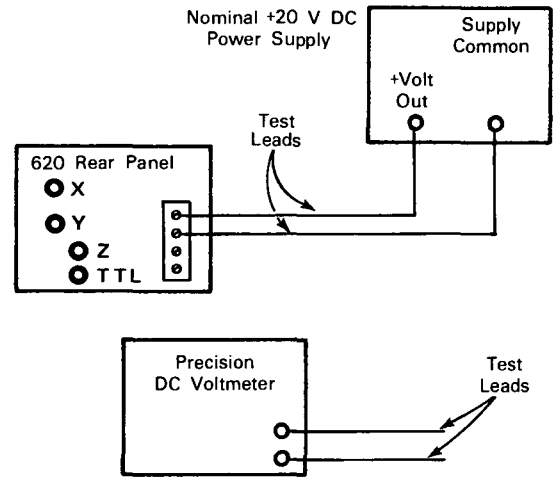
A3. CHECK OPTION 20 REGULATION

NOTE

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

A3. SETUP CONDITIONS

620 Controls
Make no changes to the control settings.



+20 V DC Power Supply Controls
Voltage Output ..... +17 V DC, 1.1 A
Voltage Range ..... Appropriate for each power supply checked

a. Turn ON the 620 Monitor.

b. Table 6-5 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 6-5 for the appropriate supply.

d. Set the +20 V dc power supply output voltage for +25 volts.

e. **CHECK**—The voltmeter for a reading within the voltage range given in Table 6-5 for the appropriate supply.

f. 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 6-5 for the appropriate supply.

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

@

B. CRT CIRCUIT

Equipment Required: (Numbers correspond to those listed in Table 6-3, Test Equipment.)

1. Precision dc voltmeter
4. Ramp generator
10. 50-ohm bnc cable (1 required)

BEFORE YOU BEGIN:

(1) Perform the Adjustment and 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.

620 Monitor
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.

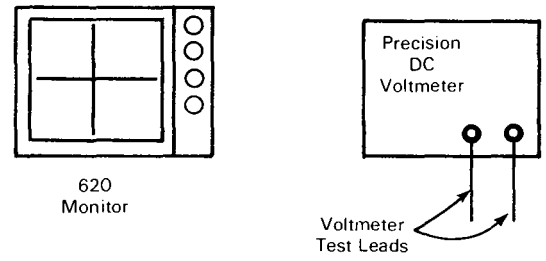
B1. ADJUST CRT BIAS (A2R130)

NOTE

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

B1. SETUP CONDITIONS

620 Controls
Make no changes to the control settings.



No external signals are connected to the 620 Monitor
Voltmeter Range ..... 200 V dc

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

b. Connect the precision dc voltmeter between A1TP382 and ground.

c. Slowly set the INTENSITY control for a voltmeter reading of about -60 volts dc. Disconnect the precision dc voltmeter.

d. **ADJUST**—A2R130 (CRT Bias) until the dot just appears.

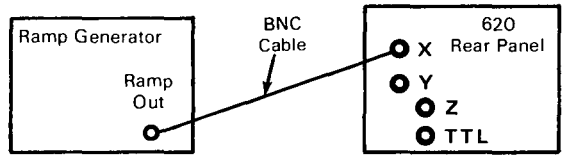
B2. ADJUST TRACE ROTATION (A2R145)

NOTE

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

B2. SETUP CONDITIONS

620 Controls
INTENSITY ..... Visible display



Ramp Generator Controls
Ramp Signal ..... +5 ms Ramp
Triggering ..... +Auto, Internal

a. Set the ramp-generator amplitude for a 10-division horizontal trace on the crt (position as necessary).

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**—A2R145 (Trace Rotate) to align the trace with the center horizontal graticule line.

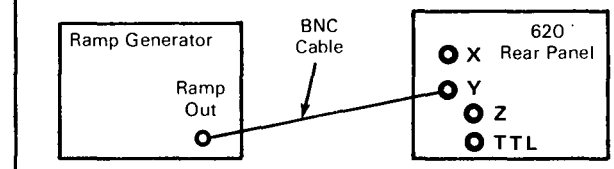
B3. CHECK ORTHOGONALITY

NOTE

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

B3. SETUP CONDITIONS

620 Controls
Make no changes to the control settings.



Ramp Generator Controls
Ramp Signal ..... +5 ms Ramp
Triggering ..... +Auto, Internal

a. Set the ramp generator amplitude for a 10-division vertical trace on the crt (position as necessary).

b. Horizontally position the trace to the center vertical graticule line.

c. **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.

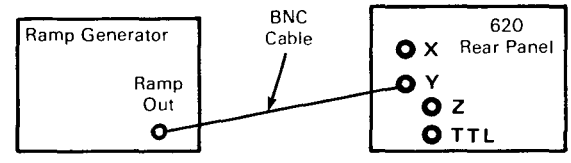
B4. CHECK/ADJUST GEOMETRY (A2R155)

NOTE

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

B4. SETUP CONDITIONS

620 Controls
Make no changes to the control settings.



Ramp Generator Controls
Ramp Signal ..... +5 ms Ramp
Triggering ..... +Auto, Internal

@

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**—A2R155 (Geom) 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 A2R155 (Geom) for minimum bowing or tilt at the top and bottom of the graticule. Then, repeat step B3 Check Orthogonality, and B4 Check/Adjust Geometry (A2R155) until optimum geometry is achieved.

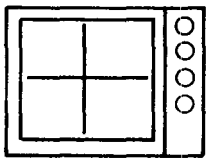
B5. ADJUST ASTIGMATISM (A2R160)

NOTE

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

B5. SETUP CONDITIONS

620 Controls
FOCUS ..... Fully clockwise



620
Monitor

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**—A2R160 (Astig) for a symmetrically round dot.

C. HORIZONTAL (X) AMPLIFIER

Equipment Required: (Numbers correspond to those listed in Table 6-3, Test Equipment.)

4. Ramp generator
5. Square-wave generator
6. Sine-wave generator
8. Dual-input coupler
9. 50-ohm termination (2 required)
10. 50-ohm bnc cable (4 required)

BEFORE YOU BEGIN:

(1) Perform the Adjustment and 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:

620 Monitor
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.

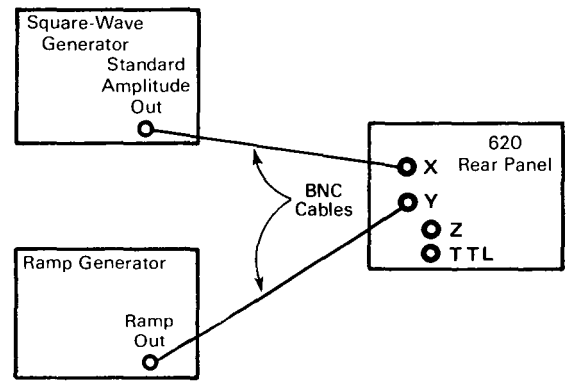
C1. CHECK/ADJUST X GAIN (A1R225)

NOTE

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

C1. SETUP CONDITIONS

620 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

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

@

b. **ADJUST**—A1R225 (X Gain) for an 8-division horizontal display.

NOTE

The X Gain (A1R225) 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 approximately +0.8 to +1.2 volts, to obtain the desired sensitivity. However, when doing a complete Adjustment and Performance Check procedure the X Gain must be set as specified in the preceding procedure.

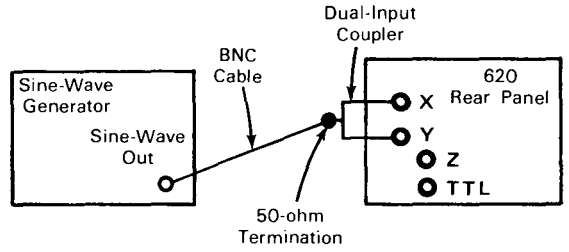
C2. CHECK/ADJUST PHASING (A1C293)

NOTE

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

C2. SETUP CONDITIONS

620 Controls
X Gain and Y Gain ..... Set to provide 8 divisions deflection with 1-volt input. (See Steps C1 and D1 in Part II—Adjustment and Performance Check)



Sine-Wave Generator Controls
Output Frequency ..... 500 KHz

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 6-7.

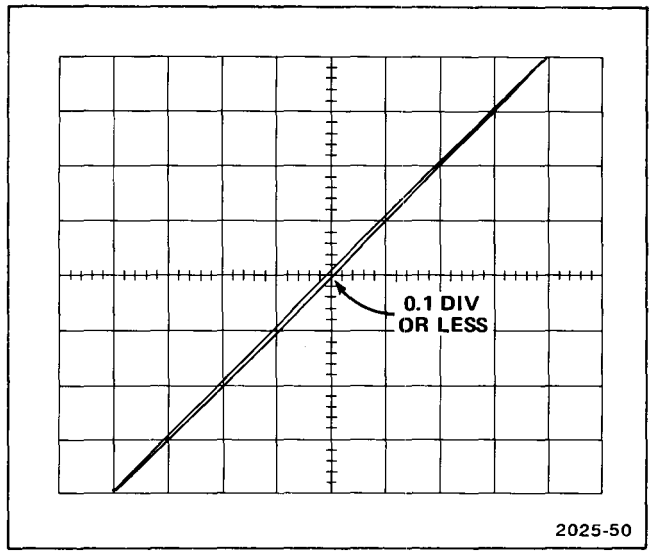


Figure 6-7. Typical horizontal and vertical phase difference display.

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. 6-7).

d. **ADJUST**—A1C293 (Phasing). With X Gain and Y Gain controls set for 8 divisions with a +1.2 volt input, and using a low-capacitance screwdriver, adjust A1C293 to close the phasing loop.

NOTE

In some instruments, the phasing adjustment A1C293 has been moved to the vertical amplifier to obtain proper adjustment. If phasing difficulties occur, the adjustable component may be used in either the horizontal or vertical amplifier.

e. Reset X Gain and Y Gain to provide 8 divisions of deflection from a 1 volt input signal. See steps C1 and D1.

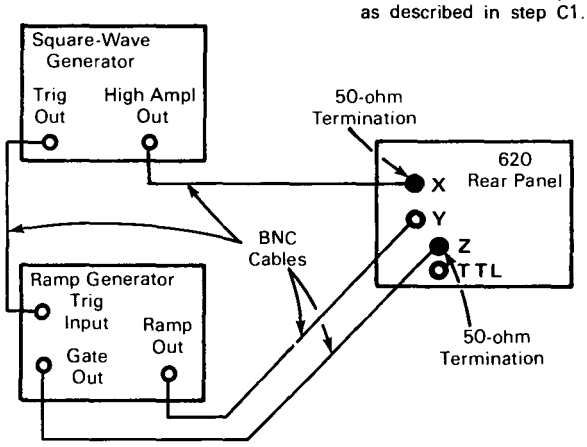
C3. CHECK HORIZONTAL SETTLING TIME

NOTE

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

C3. SETUP CONDITIONS

620 Controls
X Gain ..... Set to provide 8 divisions deflection with 1-volt input as described in step C1.



Square-Wave Generator Controls
Pulse Duration ..... 10 μs (100 kHz)
Ramp-Generator Controls
Ramp Signal ..... +20 μs Ramp
Triggering ..... +Auto, External

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

b. Set the square-wave generator amplitude for 10 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. 6-8) to within 0.50 millimeters (about one trace width) of the 100 percent level is 1 μsec (0.8 division) or less.

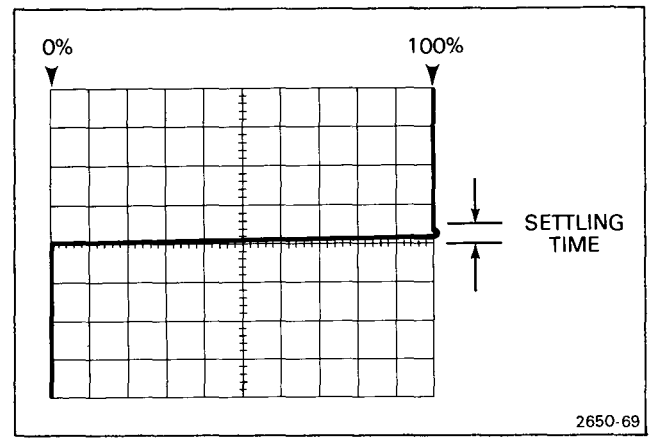


Fig. 6-7. Typical horizontal and vertical phase difference display.

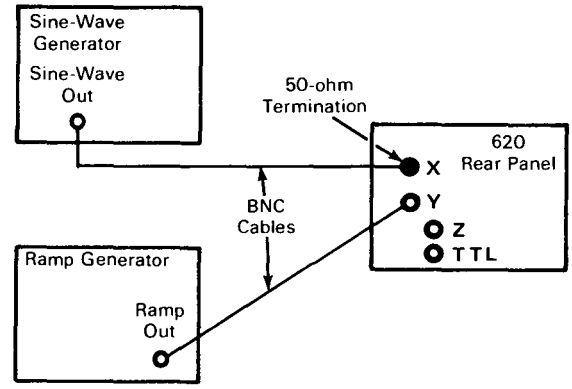
C4. CHECK HORIZONTAL BANDWIDTH

NOTE

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

C4. SETUP CONDITIONS

620 Controls
X Gain ..... Set to provide 8 divisions deflection with 1-volt input as described in step C1.



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.

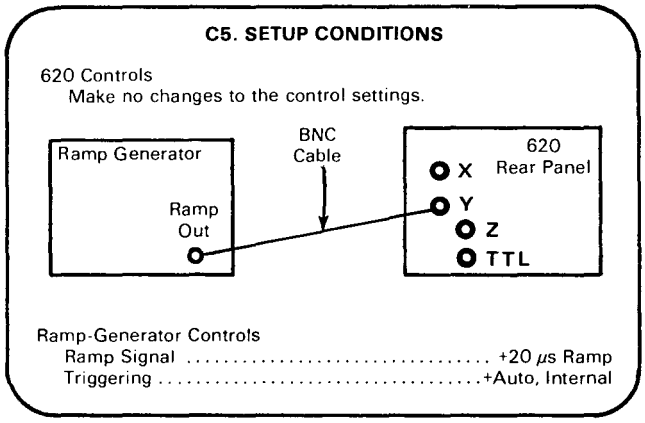
c. Slowly increase the sine-wave generator output frequency until the display's horizontal amplitude is 5.7 divisions.

d. **CHECK**—That the sine-wave generator output frequency is at least 2 megahertz.

C5. CHECK HORIZONTAL POSITIONING

NOTE

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

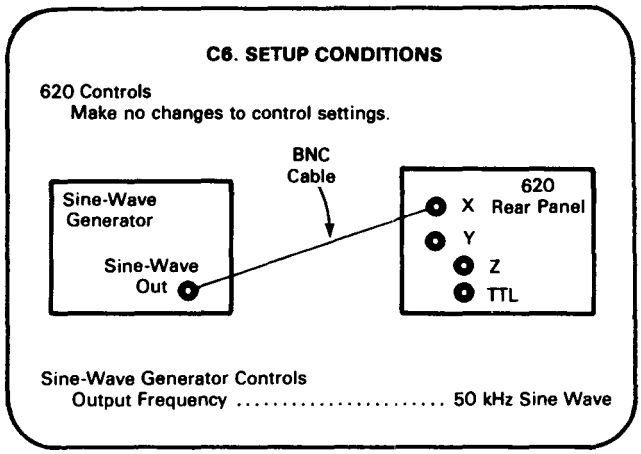


a. **CHECK**—Rotate the Horizontal Position control and check that the vertical trace can be positioned horizontally anywhere in the graticule area.

C6. CHECK HORIZONTAL DEFLECTION LINEARITY

NOTE

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



a. Set the sine-wave generator amplitude for a 2 division display centered horizontally on the graticule.

b. Horizontally position the trace to the left and then to the right of the graticule and check for 2 divisions within 5 percent (1.9 to 2.1 divisions) over the display area.

D. VERTICAL (Y) AMPLIFIER

Equipment Required: (Numbers correspond to those listed in Table 6-3, Test Equipment.)

4. Ramp generator
5. Square-wave generator
6. Sine-wave generator
8. Dual-input coupler
9. 50-ohm termination (2 required)
10. 50-ohm bnc cable (4 required)

BEFORE YOU BEGIN:

(1) Perform the Adjustment and 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 (Y) AMPLIFIER PRELIMINARY CONTROL SETTINGS:

620 Monitor
Vertical and Horizontal
Position ..... Midrange
INTENSTIY ..... Visible display
FOCUS ..... Well-defined display

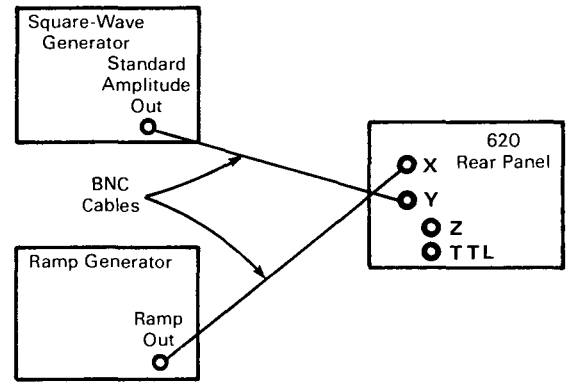
D1. CHECK/ADJUST Y GAIN (A1R125)

NOTE

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

D1. SETUP CONDITIONS

620 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 ..... Approx. +20 μs Ramp
Triggering ..... +Auto, Internal

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

b. **ADJUST**—A1R125 (Y Gain) for an 8-division vertical display.

NOTE

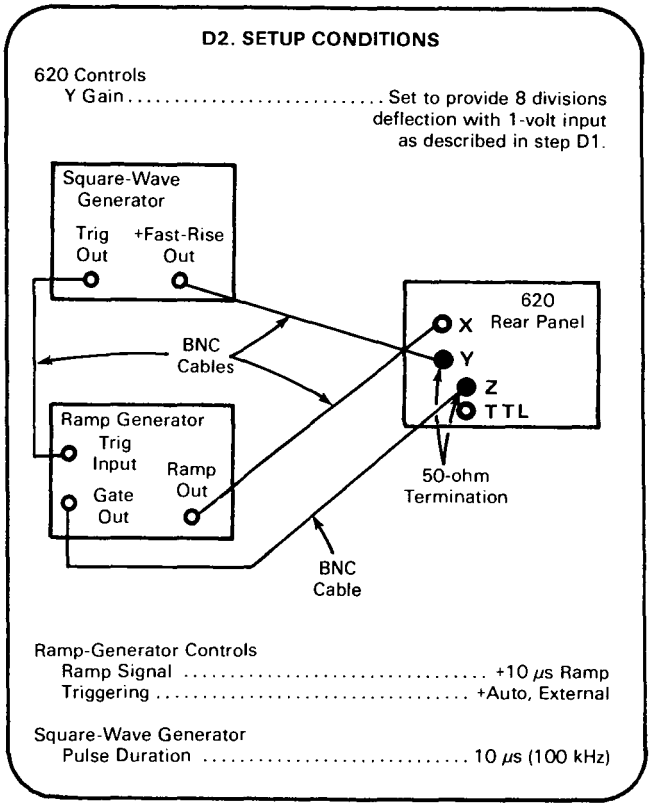
The Y Gain (A1R125) in this procedure is set to provide 8 divisions of deflection from a 1 volt input signal. This procedure can be altered for any voltage, from approximately +0. to +1.2 volts, for the desired sensitivity. However, when performing a complete Adjustment and Performance Check procedure the Y Gain must be set as specified in the preceding procedure.

@

D2. CHECK VERTICAL SETTLING TIME

NOTE

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



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

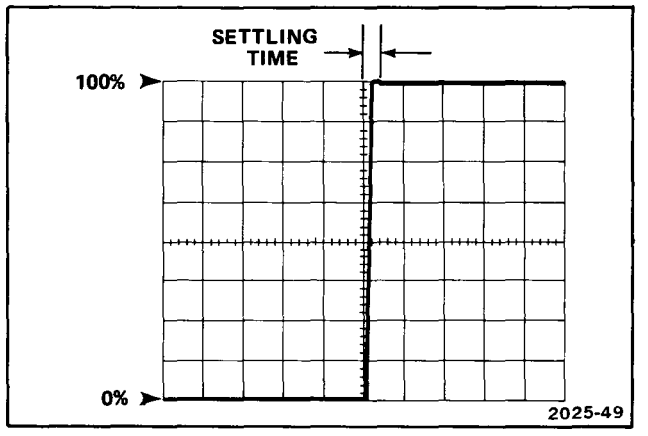


Figure 6-9. Typical crt display for vertical settling time measurement (settling time includes corner distortion).

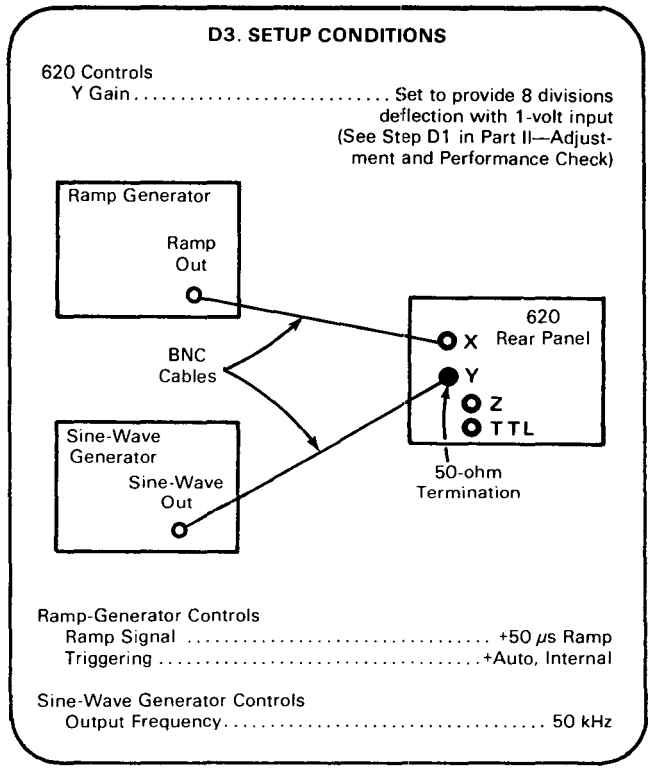
b. Set the square-wave generator amplitude for 8 divisions of vertical display and set the repetition rate to display approximately 1 cycle.

c. **CHECK**—That the time required for the leading edge of the square wave to travel from the zero percent level (see Fig. 6-9) to within 0.50 millimeters (about one trace width) of the 100 percent level is 1 μsec (1.0 division) or less.

D3. CHECK VERTICAL BANDWIDTH

NOTE

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



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.

d. **CHECK**—That the sine-wave generator output frequency is at least 2 megahertz.

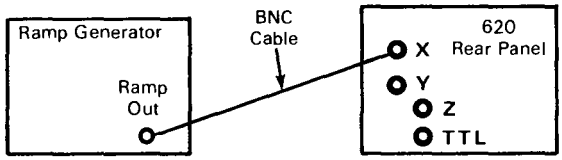
D4. CHECK VERTICAL POSITIONING

NOTE

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

D4. SETUP CONDITIONS

620 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.

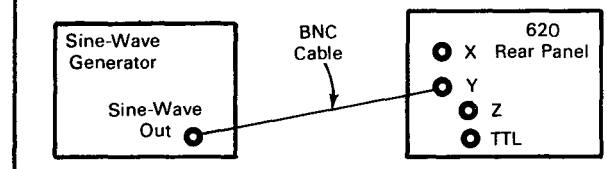
D5. CHECK VERTICAL DEFLECTION LINEARITY

NOTE

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

D5. SETUP CONDITIONS

620 Controls
Make no changes to the control settings.



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

a. Set the sine-wave generator amplitude for a 2 division vertical display centered vertically on the graticule.

b. **CHECK**—Vertically position the trace to the top and then to the bottom edge of the graticule and check for 2 divisions within 5 percent (1.9 to 2.1 divisions) over the display area.

E. Z-AXIS AMPLIFIER

Equipment Required: (Numbers correspond to those listed in Table 6-3, Test Equipment.)

3. Function generator
4. Ramp generator
6. Sine-wave generator
7. Test oscilloscope
8. Dual-input coupler
9. 50-ohm termination
10. 50-ohm bnc cable (3 required)
13. 50-ohm 10X attenuator

BEFORE YOU BEGIN:

(1) Perform the Adjustment and 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:

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

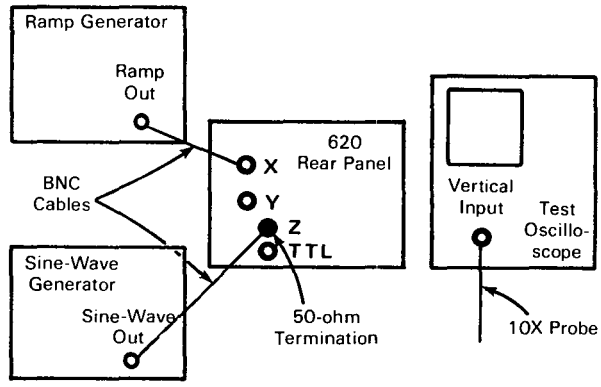
E1. CHECK Z-AXIS AMPLIFIER BANDWIDTH

NOTE

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

E1. SETUP CONDITIONS

620 Controls
Make no changes to the control settings.



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

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

Test Oscilloscope Controls
Deflection Factor ..... 10 V/div with 10X Probe
Input Coupling ..... DC
Triggering ..... Auto, Internal
Sweep Rate ..... 10 μs/div
Display ..... Well-defined, visible display

a. Connect a 10X probe from the test oscilloscope vertical input to A1TP382.

b. Set the 620 INTENSITY control and the sine-wave generator amplitude for a 5-division (-60 volts to -10 volts dc) display on the test oscilloscope. (Make sure that no clipping occurs on the test oscilloscope display.)

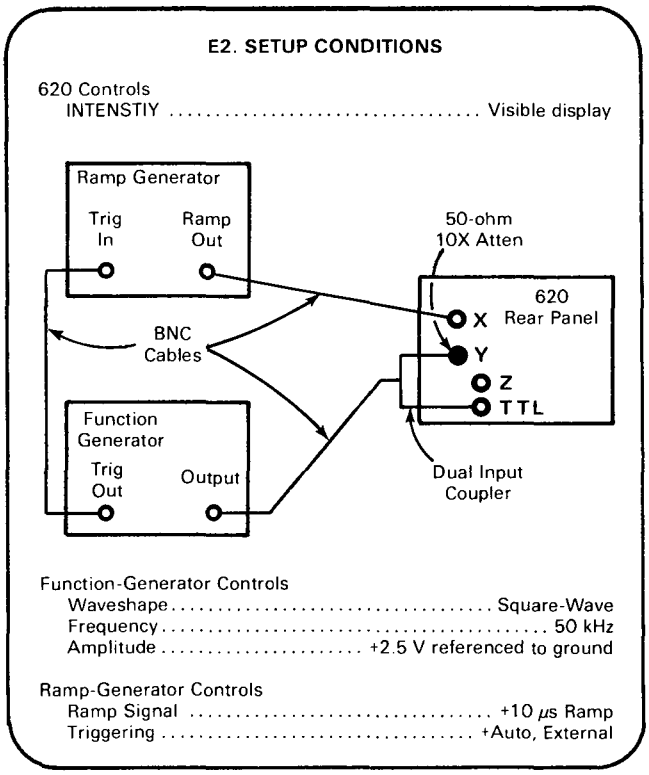
c. Slowly increase the sine-wave generator output frequency until the display amplitude is 3.5 divisions on the test oscilloscope.

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

E2. CHECK OPTION 25 Z-AXIS UNBLANKING

NOTE

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



a. **CHECK**—That only the positive portion of the square wave is displayed on the screen.

NOTE

Remove the calibration graticule as follows (refer to Fig. 6-1):

1. Remove the flexible frame mask.

2. Locate a slot at the midpoint of the left edge of the crt bezel.

3. Using the bezel as a fulcrum and a small flat blade screwdriver as a pry, carefully exert pressure against the graticule edge allowing it to bow sufficienty to clear the ridges in the bezel.

4. Snap in the flexible frame mask.

This completes the Adjustment and Performance Check procedure.

@

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. Detailed information unique to each option is provided in appropriate locations within this manual. For further information on options, see your Tektronix Catalog or contact your Tektronix Field Office.

OPTION 1

An internal, unlighted graticule of 8 x 10 divisions is included on the crt faceplate.

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

Alternate input connector (25-pin) added to the rear panel for X, Y, and Z-Axis inputs (cannot be ordered with Option 31).

OPTION 20

The ac power supply, line fuse, and power cord are removed from the rear panel of the instrument. The monitor requires nominal +20 V dc (+17 V to +25 V dc unregulated) to operate. (Cannot be ordered with Option 31.)

OPTION 23

Includes a carrying handle, protective cabinet panels, and feet. (Cannot be ordered with Option 28 or rackmount and special cabinet kits.)

OPTION 25

Modifies the Z-Axis Amplifier and rear panel to include an external TTL blanking input. (When Option 25 is ordered with Option 31 there will be no rear-panel connector; however, the Z-Axis Amplifier will be modified.)

OPTION 28

Includes protective cabinet panels and rear feet. (Cannot be ordered with Option 23 or rackmount and special cabinet kits.)

OPTION 31

The ac power supply, line fuse, power cord, and the X, Y and Z-Axis input connectors are removed from the instrument. The monitor requires nominal 20 V dc (+17 V to +25 V dc unregulated) connected to interconnect pins inside the instrument for proper operation.

OPTION 76

Provides a crt with P7 phosphor (external graticule or Option 1 available).

TABLE 7-1
Option Information Locator

Instrument Option	Location		Information
	Manual Section	Heading	
Option 1 (Internal CRT Graticule)	1 General Information	Specification	Table 1-1 contains a partial description.
Option 6 (Meets UL 544 requirements)	7 Instrument Options	Option 6	A description of the Option 6 instrument is given.
Option 9 (UL recognized component)	7 Instrument Options	Option 9	A description of the Option 9 instrument is given.
Option 10 (Alternate Input Connector, 25 pin)	2 Operating Instructions	Controls and Connectors	Figure 2-2 depicts and describes the connector.
		Signal Connectors	Purpose of the connector.
		Alternate Input Connector (Option 10)	Location and function of the connector (reference to Figure 2-4).
	3 Installation	Deflection Functions	Deflection functions check procedure.
	9 Diagrams and Circuit Board Illustrations	◇1 Deflection Amplifiers	Schematic diagrams.
		◇2 Z-Axis Amplifier	Schematic diagrams.
Option 20 (Requires 20 V DC supply to operate)	1 General Information	Specification	Weight of the Option 20 instrument.
	2 Operating Instructions	Controls and Connectors	Figure 2-3 depicts and describes the connector.
		Detailed Operating Information	Description and function information.
	3 Installation	Option 20 & Option 31 Power Requirements	Connector location and pin assignment.
	6 Calibration	Part I Performance Check	A1. procedure for checking power supply regulation.
		Part II Adjustment and Performance Check	A3. Procedure for checking power supply regulation.
		Performance Check Summary	Table 6-2 gives performance requirement.

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TABLE 7-1 (CONT.)
Option Information Locator

Instrument Option	Location		Information
	Manual Section	Heading	
Option 20 (cont.)	6 Calibration	Performance Check Power-Up Sequence	Figure 6-2 shows supply connections.
	9 Diagrams and Circuit Board Illustrations	◈4 Low-Voltage Power Supply	Schematic diagrams.
Option 23 (Handle, panels and feet)	10 Replaceable Mechanical Parts	Option 23	Provides an exploded view and mechanical parts list.
Option 25 (TTL blanking)	2 Operating Instructions	Controls and Connectors	Figure 2-2 depicts and describes the connector.
		Signal Connectors	Signal requirement and purpose.
		Input Signal Requirements	Input versatility.
	3 Installation	Figure 3-3	Input signal connector location.
		Option 25 TTL Z-Axis Functions	Functional check procedure.
	4 Theory of Operation	TTL Input Comparator (Option 25)	Circuit description of associated circuitry.
	6 Calibration	Table 6-2 Performance Check Summary	Performance requirements.
		Check Option 25 Z-Axis Unblanking	E2. Setup conditions and check procedure.
	8 Replaceable Electrical Parts	Deflection/ Z-Axis	Provides data for parts replacement.
	9 Diagrams and Circuit Board Illustrations	Z-Axis Amplifier	Schematic on diagram 2.
Option 28 (Panels and feet)	7 Instrument Options	Option 28	Provides a description.

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TABLE 7-1 (CONT)
Option Information Locator

Instrument Option	Location		Information
	Manual Section	Heading	
Option 31 (All rear panel connectors removed)	3 Installation	Option 20 & Option 31 Power Requirements	Power requirements.
		Option 31 Inputs Figure 3-3	Depicts and describes pin location.
	9 Diagrams and Circuit Board Illustrations	◇1 Deflection Amplifiers	Schematic diagrams.
		◇2 Z-Axis Amplifier	Schematic diagrams.
		◇4 Low-Voltage Power Supply	Schematic diagrams.

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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.

LIST OF ASSEMBLIES

A list of assemblies can be found at the beginning of the Electrical Parts List. The assemblies are listed in numerical order. When the complete component number of a part is known, this list will identify the assembly in which the part is located.

CROSS INDEX-MFR. CODE NUMBER TO MANUFACTURER

The Mfr. Code Number to Manufacturer index for the Electrical Parts List is located immediately after this page. The Cross Index provides codes, names and addresses of manufacturers of components listed in the Electrical Parts List.

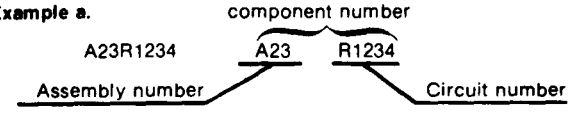
ABBREVIATIONS

Abbreviations conform to American National Standard Y1.1.

COMPONENT NUMBER (column one of the Electrical Parts List)

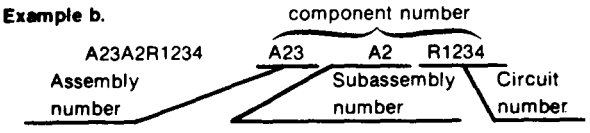
A numbering method has been used to identify assemblies, subassemblies and parts. Examples of this numbering method and typical expansions are illustrated by the following:

Example a.



Read: Resistor 1234 of Assembly 23

Example b.



Read: Resistor 1234 of Subassembly 2 of Assembly 23

Only the circuit number will appear on the diagrams and circuit board illustrations. Each diagram and circuit board illustration is clearly marked with the assembly number. Assembly numbers are also marked on the mechanical exploded views located in the Mechanical Parts List. The component number is obtained by adding the assembly number prefix to the circuit number.

The Electrical Parts List is divided and arranged by assemblies in numerical sequence (e.g., assembly A1 with its subassemblies and parts, precedes assembly A2 with its subassemblies and parts).

Chassis-mounted parts have no assembly number prefix and are located at the end of the Electrical Parts List.

TEKTRONIX PART NO. (column two of the Electrical Parts List)

Indicates part number to be used when ordering replacement part from Tektronix.

SERIAL/MODEL NO. (columns three and four of the Electrical Parts List)

Column three (3) indicates the serial number at which the part was first used. Column four (4) indicates the serial number at which the part was removed. No serial number entered indicates part is good for all serial numbers.

NAME & DESCRIPTION (column five of the Electrical Parts List)

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.

MFR. CODE (column six of the Electrical Parts List)

Indicates the code number of the actual manufacturer of the part. (Code to name and address cross reference can be found immediately after this page.)

MFR. PART NUMBER (column seven of the Electrical Parts List)

Indicates actual manufacturers part number.

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
01121	ALLEN-BRADLEY CO	1201 SOUTH 2ND ST	MILWAUKEE WI 53204-2410
03508	GENERAL ELECTRIC CO SEMI-CONDUCTOR PRODUCTS DEPT	W GENESEE ST	AUBURN NY 13021
04009	COOPER INDUSTRIES INC ARROW HART DIV	103 HAWTHORN ST	HARTFORD CT 06101
04222	AVX CERAMICS DIV OF AVX CORP	19TH AVE SOUTH P O BOX 867	MYRTLE BEACH SC 29577
04713	MOTOROLA INC SEMICONDUCTOR PRODUCTS SECTOR	5005 E MCDOWELL RD	PHOENIX AZ 85008-4229
05397	UNION CARBIDE CORP MATERIALS SYSTEMS DIV	11901 MADISON AVE	CLEVELAND OH 44101
07263	FAIRCHILD SEMICONDUCTOR CORP NORTH AMERICAN SALES SUB OF SCHLUMBERGER LTD MS 118	10400 RIDGEVIEW CT	CUPERTINO CAW CA 95014
07716	TRW INC TRW IRC FIXED RESISTORS/BURLINGTON	2850 MT PLEASANT AVE	BURLINGTON IA 52601
11502	INTERNATIONAL RESISTIVE COMPANY INC	GREENWAY RD P O BOX 1860	BOONE NC 28607-1860
13511	AMPHENOL CADRE DIV BUNKER RAMO CORP		LOS GATOS CA
14433	ITT SEMICONDUCTORS DIV		WEST PALM BEACH FL
14552	MICROSEMI CROP	2830 S FAIRVIEW ST	SANTA ANA CA 92704-5948
14936	GENERAL INSTRUMENT CORP DISCRETE SEMI CONDUCTOR DIV	600 W JOHN ST	HICKSVILLE NY 11802
15238	ITT SEMICONDUCTORS A DIVISION OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORP	500 BROADWAY P O BOX 168	LAWRENCE MA 01841-3002
19701	MEPCO/CENTRALAB A NORTH AMERICAN PHILIPS CO	P O BOX 760	MINERAL WELLS TX 76067-0760
24546	CORNING GLASS WORKS	550 HIGH ST	BRADFORD PA 16701-3737
25088	SIEMENS CORP	186 WOOD AVE S	ISELIN NJ 08830-2704
27014	NATIONAL SEMICONDUCTOR CORP	2900 SEMICONDUCTOR DR	SANTA CLARA CA 95051-0606
31918	ITT SCHADOW INC	8081 WALLACE RD	EDEN PRAIRIE MN 55344-2224
32997	BOURNS INC TRIMPOT DIV	1200 COLUMBIA AVE	RIVERSIDE CA 92507-2114
51406	MURATA ERIE NORTH AMERICA INC GEORGIA OPERATIONS	2200 LAKE PARK DR	SMYRNA GA 30080
52306	UNITRODE CORP HIGH VOLTAGE DEVICES INC		VISALIA CA
52763	STETTNER ELECTRONICS INC	6135 AIRWAYS BLVD PO BOX 21947	CHATTANOOGA TN 37421-2970
54473	MATSUSHITA ELECTRIC CORP OF AMERICA	ONE PANASONIC WAY PO BOX 1501	SECAUCUS NJ 07094-2917
56289	SPRAGUE ELECTRIC CO WORLD HEADQUARTERS	92 HAYDEN AVE	LEXINGTON MA 02173-7929
57668	R-OHM CORP	16931 MILLIKEN AVE	IRVINE CA 92713
59660	TUSONIX INC	7741 N BUSINESS PARK DR PO BOX 37144	TUCSON AZ 85740-7144
71400	BUSSMANN DIV OF COOPER INDUSTRIES INC	114 OLD STATE RD PO BOX 14460	ST LOUIS MO 63178
74276	GENERAL INSTRUMENT CORP SIGNALITE DIV	1933 HECK AVE	NEPTUNE NJ 07753
74970	JOHNSON E F CO	299 10TH AVE S W	WASECA MN 56093-2539
75042	TRW INC TRW ELECTRONIC COMPONENTS IRC FIXED RESISTORS PHILADELPHIA DIV	401 N BROAD ST	PHILADELPHIA PA 19108-1001
75915	LITTELFUSE TRACTOR INC SUB TRACTOR INC	800 E NORTHWEST HWY	DES PLAINES IL 60016-3049
80009	TEKTRONIX INC	14150 SW KARL BRAUM DR PO BOX 500 MS 53-111	BEAVERTON OR 97077
83003	VARO INC	2203 WALNUT ST PO BOX 401426	GARLAND TX 75042
83777	E-SYSTEMS INC MEMCOR DIV FLORIDA OPERATIONS	5426 W CRENSHAW RD PO BOX 23500	TAMPA FL 33614-3009
93410	ESSIX GROUP ING CONTROLS DIV LEXINGTON PLANT	45-55 PLYMOUTH ST P O BOX 1007	LEXINGTON OH 44904

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1	670-5732-00	B010100	B024009	CIRCUIT BD ASSY:DEFLECTION & Z AXIS	80009	670-5732-00
A1	670-5732-01	B024001	B024133	CIRCUIT BD ASSY:DEFLECTION & Z AXIS	80009	670-5732-01
A1	670-5732-02	B024134		CIRCUIT BD ASSY:DEFLECTION & Z-AXIS CONTROL	80009	670-5732-02
A1	670-6388-00			CIRCUIT BD ASSY:DEFL & Z AXIS (OPTION 25 ONLY)	80009	670-6388-00
A2	670-5731-00	B010100	B022599	CIRCUIT BD ASSY:POWER SUPPLY	80009	670-5731-00
A2	670-5731-01	B022600	B023785	CIRCUIT BD ASSY:POWER SUPPLY	80009	670-5731-01
A2	670-5731-02	B023786	B030383	CIRCUIT BD ASSY:POWER SUPPLY	80009	670-5731-02
A2	670-5731-03	B030384		CIRCUIT BD ASSY:POWER SUPPLY	80009	670-5731-03

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1	670-5732-00	B010100	B024009	CIRCUIT BD ASSY:DEFLECTION & Z AXIS	80009	670-5732-00
A1	670-5732-01	B024001	B024133	CIRCUIT BD ASSY:DEFLECTION & Z AXIS	80009	670-5732-01
A1	670-5732-02	B024134		CIRCUIT BD ASSY:DEFLECTION & Z-AXIS CONTROL	80009	670-5732-02
A1	670-6388-00			CIRCUIT BD ASSY:DEFL & Z AXIS (OPTION 25 ONLY)	80009	670-6388-00
A1C121	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A1C128	281-0508-00			CAP,FXD,CER DI:12PF,+/-0.6PF,500V	52763	2RDPLZ007 12P0JC
A1C133	281-0526-00			CAP,FXD,CER DI:1.5PF,+/-0.5PF,500V	52763	2RDPLZ007 1P50DS
A1C171	281-0775-00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C183	281-0526-00			CAP,FXD,CER DI:1.5PF,+/-0.5PF,500V	52763	2RDPLZ007 1P50DS
A1C221	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A1C228	281-0508-00			CAP,FXD,CER DI:12PF,+/-0.6PF,500V	52763	2RDPLZ007 12P0JC
A1C233	281-0526-00			CAP,FXD,CER DI:1.5PF,+/-0.5PF,500V	52763	2RDPLZ007 1P50DS
A1C271	281-0775-00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C283	281-0526-00			CAP,FXD,CER DI:1.5PF,+/-0.5PF,500V	52763	2RDPLZ007 1P50DS
A1C293	281-0153-00			CAP,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-055
A1C349	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A1C369	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A1C371	281-0661-00			CAP,FXD,CER DI:0.8PF,+/-0.1PF,500V	52763	2RDPLZ007 0P80BC
A1C379	283-0341-00			CAP,FXD,CER DI:0.047UF,10%,100V	04222	SR301C473KAA
A1C396	290-0536-00			CAP,FXD,ELCTLT:10UF,20%,25V TANTALUM	05397	T368B106M025AS
A1C397	290-0536-00			CAP,FXD,ELCTLT:10UF,20%,25V TANTALUM	05397	T368B106M025AS
A1C398	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A1C402	290-0536-00			CAP,FXD,ELCTLT:10UF,20%,25V TANTALUM	05397	T368B106M025AS
A1C403	290-0534-00			CAP,FXD,ELCTLT:1UF,20%,35V	05397	T368A105M035AZ
A1C404	283-0178-00			CAP,FXD,CER DI:0.1UF,20%,100V	05397	C330C104Z1U1CA
A1CR122	152-0246-00			SEMICOND DVC,DI:SW,SI,40V,200MA,DO-7	14433	WG1537TK
A1CR142	152-0242-00			SEMICOND DVC,DI:SIG,SI,225V,0.2A,DO-7	07263	FDH5004
A1CR175	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR176	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR177	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR178	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR192	152-0242-00			SEMICOND DVC,DI:SIG,SI,225V,0.2A,DO-7	07263	FDH5004
A1CR222	152-0246-00			SEMICOND DVC,DI:SW,SI,40V,200MA,DO-7	14433	WG1537TK
A1CR242	152-0242-00			SEMICOND DVC,DI:SIG,SI,225V,0.2A,DO-7	07263	FDH5004
A1CR275	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR276	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR277	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR278	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR292	152-0242-00			SEMICOND DVC,DI:SIG,SI,225V,0.2A,DO-7	07263	FDH5004
A1CR304	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35 (A1CR304, OPTION 25 ONLY)	03508	DA2527 (1N4152)
A1CR327	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR334	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR351	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR354	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR361	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR362	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR363	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR364	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR381	152-0242-00			SEMICOND DVC,DI:SIG,SI,225V,0.2A,DO-7	07263	FDH5004
A1CR382	152-0242-00			SEMICOND DVC,DI:SIG,SI,225V,0.2A,DO-7	07263	FDH5004
A1Q123	151-1054-00			TRANSISTOR:FET,N-CHAN,SI,TO-71	80009	151-1054-00
A1Q136	151-0192-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS8801
A1Q141	151-0453-00			TRANSISTOR:PNP,SI,TO-92	27014	ORDER BY DESCR
A1Q186	151-0192-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS8801
A1Q191	151-0453-00			TRANSISTOR:PNP,SI,TO-92	27014	ORDER BY DESCR
A1Q223	151-1054-00			TRANSISTOR:FET,N-CHAN,SI,TO-71	80009	151-1054-00

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1Q236	151-0192-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS8801
A1Q241	151-0453-00			TRANSISTOR:PNP,SI,TO-92	27014	ORDER BY DESCR
A1Q286	151-0192-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS8801
A1Q291	151-0453-00			TRANSISTOR:PNP,SI,TO-92	27014	ORDER BY DESCR
A1Q310	151-0342-00			TRANSISTOR:PNP,SI,TO-92 (A1Q310, OPTION 25 ONLY)	07263	S035928
A1Q311	151-0342-00			TRANSISTOR:PNP,SI,TO-92 (A1Q311, OPTION 25 ONLY)	07263	S035928
A1Q327	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
A1Q334	151-0342-00			TRANSISTOR:PNP,SI,TO-92	07263	S035928
A1Q353	151-1054-00			TRANSISTOR:FET,N-CHAN,SI,TO-71	80009	151-1054-00
A1Q354	151-0342-00			TRANSISTOR:PNP,SI,TO-92	07263	S035928
A1Q367	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
A1Q369	151-0406-00	B010100	B022669	TRANSISTOR:PNP,SI,TO-39	04713	ST1264
A1Q369	151-0406-02	B022670		TRANSISTOR:SCREENED	04713	ST1731H
A1Q379	151-0407-00	B010100	B022669	TRANSISTOR:NPN,SI,TO-39	80009	151-0407-00
A1Q379	151-0407-01	B022670		TRANSISTOR:NPN,SI,SEL	80009	151-0407-01
A1R113	322-0481-00			RES,FXD,FILM:1M OHM,1%,0.25W,TC=T0	75042	CEBT0-1004F
A1R121	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R122	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R123	321-0286-00			RES,FXD,FILM:9.31K OHM,1%,0.125W,TC=T0	19701	5043ED9K310F
A1R125	311-1563-00			RES,VAR,NONWW:TRMR,1K OHM,0.5W	32997	3352T-DY7-102
A1R126	321-0197-00			RES,FXD,FILM:1.10K OHM,1%,0.125W,TC=T0	07716	CEAD11000F
A1R129	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
A1R133	321-0344-00			RES,FXD,FILM:37.4K OHM,1%,0.125W,TC=T0	19701	5033ED 37K40F
A1R136	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R137	315-0272-00			RES,FXD,FILM:2.7K OHM,5%,0.25W	57668	NTR25J-E02K7
A1R139	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R141	323-0608-00	B010100	B024133	RES,FXD,FILM:6K OHM,1%,0.5W,TC=T0	19701	5035RD6K000F
A1R141	307-0845-00	B024134		RES,FXD,FILM:6K OHM,1%,1W,TC=350PPM/DEG C	11502	GS36K1PERCENT
A1R142	315-0221-00			RES,FXD,FILM:220 OHM,5%,0.25W	57668	NTR25J-E220E
A1R147	315-0220-00			RES,FXD,FILM:22 OHM,5%,0.25W	19701	5043CX22R00J
A1R148	321-0174-00			RES,FXD,FILM:634 OHM,1%,0.125W,TC=T0	07716	CEAD634R0F
A1R149	315-0220-00			RES,FXD,FILM:22 OHM,5%,0.25W	19701	5043CX22R00J
A1R164	321-0225-00			RES,FXD,FILM:2.15K OHM,1%,0.125W,TC=T0	19701	5033ED2K15F
A1R165	321-0256-00			RES,FXD,FILM:4.53K OHM,1%,0.125W,TC=T9	19701	5033ED4K530F
A1R166	321-0225-00			RES,FXD,FILM:2.15K OHM,1%,0.125W,TC=T0	19701	5033ED2K15F
A1R171	321-0204-00			RES,FXD,FILM:1.30K OHM,1%,0.125W,TC=T0	19701	5033ED1K300F
A1R173	321-0286-00			RES,FXD,FILM:9.31K OHM,1%,0.125W,TC=T0	19701	5043ED9K310F
A1R178	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R183	321-0344-00			RES,FXD,FILM:37.4K OHM,1%,0.125W,TC=T0	19701	5033ED 37K40F
A1R186	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R187	315-0272-00			RES,FXD,FILM:2.7K OHM,5%,0.25W	57668	NTR25J-E02K7
A1R189	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R191	323-0608-00	B010100	B024133	RES,FXD,FILM:6K OHM,1%,0.5W,TC=T0	19701	5035RD6K000F
A1R191	307-0845-00	B024134		RES,FXD,FILM:6K OHM,1%,1W,TC=350PPM/DEG C	11502	GS36K1PERCENT
A1R192	315-0221-00			RES,FXD,FILM:220 OHM,5%,0.25W	57668	NTR25J-E220E
A1R213	322-0481-00			RES,FXD,FILM:1M OHM,1%,0.25W,TC=T0	75042	CEBT0-1004F
A1R221	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R222	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R223	321-0286-00			RES,FXD,FILM:9.31K OHM,1%,0.125W,TC=T0	19701	5043ED9K310F
A1R225	311-1563-00			RES,VAR,NONWW:TRMR,1K OHM,0.5W	32997	3352T-DY7-102
A1R226	321-0206-00			RES,FXD,FILM:1.37K OHM,1%,0.125W,TC=T0	07716	CEAD13700F
A1R229	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
A1R233	321-0344-00			RES,FXD,FILM:37.4K OHM,1%,0.125W,TC=T0	19701	5033ED 37K40F
A1R236	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R237	315-0272-00			RES,FXD,FILM:2.7K OHM,5%,0.25W	57668	NTR25J-E02K7
A1R239	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1R241	323-0608-00	B010100	B024133	RES,FXD,FILM:6K OHM,1%,0.5W,TC=T0	19701	5035RD6K000F
A1R241	307-0845-00	B024134		RES,FXD,FILM:6K OHM,1%,1W,TC=350PPM/DEG C	11502	GS36K1PERCENT
A1R242	315-0221-00			RES,FXD,FILM:220 OHM,5%,0.25W	57668	NTR25J-E220E
A1R247	315-0220-00			RES,FXD,FILM:22 OHM,5%,0.25W	19701	5043CX22R00J
A1R248	321-0174-00			RES,FXD,FILM:634 OHM,1%,0.125W,TC=T0	07716	CEAD634R0F
A1R249	315-0220-00			RES,FXD,FILM:22 OHM,5%,0.25W	19701	5043CX22R00J
A1R264	321-0225-00			RES,FXD,FILM:2.15K OHM,1%,0.125W,TC=T0	19701	5033ED2K15F
A1R265	321-0256-00			RES,FXD,FILM:4.53K OHM,1%,0.125W,TC=T9	19701	5033ED4K530F
A1R266	321-0225-00			RES,FXD,FILM:2.15K OHM,1%,0.125W,TC=T0	19701	5033ED2K15F
A1R271	321-0204-00			RES,FXD,FILM:1.30K OHM,1%,0.125W,TC=T0	19701	5033ED1K300F
A1R273	321-0286-00			RES,FXD,FILM:9.31K OHM,1%,0.125W,TC=T0	19701	5043ED9K310F
A1R278	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R283	321-0344-00			RES,FXD,FILM:37.4K OHM,1%,0.125W,TC=T0	19701	5033ED 37K40F
A1R286	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R287	315-0272-00			RES,FXD,FILM:2.7K OHM,5%,0.25W	57668	NTR25J-E02K7
A1R289	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R291	323-0608-00	B010100	B024133	RES,FXD,FILM:6K OHM,1%,0.5W,TC=T0	19701	5035RD6K000F
A1R291	307-0845-00	B024134		RES,FXD,FILM:6K OHM,1%,1W,TC=350PPM/DEG C	11502	GS36K1PERCENT
A1R292	315-0221-00			RES,FXD,FILM:220 OHM,5%,0.25W	57668	NTR25J-E220E
A1R304	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25W (A1R304, OPTION 25 ONLY)	57668	NTR25J-E05K1
A1R306	315-0752-00			RES,FXD,FILM:7.5K OHM,5%,0.25W (A1R306, OPTION 25 ONLY)	57668	NTR25J-E07K5
A1R307	315-0122-00			RES,FXD,FILM:1.2K OHM,5%,0.25W (A1R307, OPTION 25 ONLY)	57668	NTR25J-E01K2
A1R308	315-0122-00			RES,FXD,FILM:1.2K OHM,5%,0.25W (A1R308, OPTION 25 ONLY)	57668	NTR25J-E01K2
A1R309	315-0752-00			RES,FXD,FILM:7.5K OHM,5%,0.25W (A1R309, OPTION 25 ONLY)	57668	NTR25J-E07K5
A1R310	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25W (A1R310, OPTION 25 ONLY)	57668	NTR25J-E05K1
A1R317	315-0102-00	B024010		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R326	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
A1R329	321-0323-00			RES,FXD,FILM:22.6K OHM,1%,0.125W,TC=T0	07716	CEAD22601F
A1R331	315-0302-00	B010100	B024009	RES,FXD,FILM:3K OHM,5%,0.25W	57668	NTR25J-E03K0
A1R331	321-0237-00	B024010		RES,FXD,FILM:2.87K OHM,1%,0.125W,TC=T0	07716	CEAD 28700F
A1R334	321-0264-00			RES,FXD,FILM:5.49K OHM,1%,0.125W,TC=T0	07716	CEAD54900C
A1R336	321-0183-00			RES,FXD,FILM:787 OHM,1%,0.125W,TC=T0	07716	CEAD787R0F
A1R343	322-0481-00			RES,FXD,FILM:1M OHM,1%,0.25W,TC=T0	75042	CEBT0-1004F
A1R349	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R351	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R353	315-0240-00			RES,FXD,FILM:24 OHM,5%,0.25W	57668	NTR25J-E24E0
A1R354	321-0264-00			RES,FXD,FILM:5.49K OHM,1%,0.125W,TC=T0	07716	CEAD54900C
A1R355	315-0240-00			RES,FXD,FILM:24 OHM,5%,0.25W	57668	NTR25J-E24E0
A1R357	321-0249-00			RES,FXD,FILM:3.83K OHM,1%,0.125W,TC=T0	19701	5033ED3K83F
A1R363	321-0289-00			RES,FXD,FILM:10.0K OHM,1%,0.125W,TC=T0	19701	5033ED10K0F
A1R364	321-0396-00			RES,FXD,FILM:130K OHM,1%,0.125W,TC=T0	07716	CEAD13002F
A1R366	315-0201-00			RES,FXD,FILM:200 OHM,5%,0.25W	57668	NTR25J-E200E
A1R367	315-0152-00			RES,FXD,FILM:1.5K OHM,5%,0.25W	57668	NTR25J-E01K5
A1R371	321-0320-00			RES,FXD,FILM:21.0K OHM,1%,0.125W,TC=T0	19701	5033ED21K00F
A1R372	321-0320-00			RES,FXD,FILM:21.0K OHM,1%,0.125W,TC=T0	19701	5033ED21K00F
A1R376	315-0203-00			RES,FXD,FILM:20K OHM,5%,0.25W	57668	NTR25J-E 20K
A1R377	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
A1R379	315-0301-00			RES,FXD,FILM:300 OHM,5%,0.25W	57668	NTR25J-E300E
A1R382	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R396	315-0100-00			RES,FXD,FILM:10 OHM,5%,0.25W	19701	5043CX10RR00J
A1R397	315-0100-00			RES,FXD,FILM:10 OHM,5%,0.25W	19701	5043CX10RR00J
A1R398	315-0100-00			RES,FXD,FILM:10 OHM,5%,0.25W	19701	5043CX10RR00J
A1R402	315-0100-00			RES,FXD,FILM:10 OHM,5%,0.25W	19701	5043CX10RR00J

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1R403	315-0100-00			RES,FXD,FILM:10 OHM,5%,0.25W	19701	5043CX10RR00J
A1R404	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1VR326	152-0227-00			SEMICOND DVC,DI:ZEN,SI,6.2V,5%,0.4W,DO-7	04713	SZ13903
A1W113	131-0566-00			BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
A1W213	131-0566-00			BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
A1W304	131-0566-00			BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L (OPTION 25 ONLY)	24546	OMA 07
A1W305	131-0566-00			BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L (OPTION 25 ONLY)	24546	OMA 07
A1W317	131-0566-00	B010100	B024009	BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
A1W322	131-0566-00			BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
A1W334	131-0566-00			BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
A1W343	131-0566-00			BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
A1W354	131-0566-00			BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A2	670-5731-00	B010100	B022599	CIRCUIT BD ASSY:POWER SUPPLY	80009	670-5731-00
A2	670-5731-01	B022600	B023785	CIRCUIT BD ASSY:POWER SUPPLY	80009	670-5731-01
A2	670-5731-02	B023786	B030383	CIRCUIT BD ASSY:POWER SUPPLY	80009	670-5731-02
A2	670-5731-03	B030384		CIRCUIT BD ASSY:POWER SUPPLY	80009	670-5731-03
A2C107	290-0719-00			CAP,FXD,ELCTLT:47UF,20%,25V	56289	196D476X0025TE3
A2C108	290-0719-00			CAP,FXD,ELCTLT:47UF,20%,25V	56289	196D476X0025TE3
A2C116	283-0351-00			CAP,FXD,CER DI:5000PF,20%,3000V	51406	DHR17Z5U502M3KV
A2C121	285-1184-00			CAP,FXD,MTLZD:0.01 UF,20%,4000V	56289	430P591
A2C123	285-1184-00			CAP,FXD,MTLZD:0.01 UF,20%,4000V	56289	430P591
A2C127	281-0513-00			CAP,FXD,CER DI:27PF,+/-5.4PF,500V	52763	2RDPLZ007 27POMP
A2C131	290-0758-00	B010100	B030383	CAP,FXD,ELCTLT:2.2UF,+50-10%,200V	56289	502D227
A2C131	290-0766-00	B030384		CAP,FXD,ELCTLT:2.2UF,+50-10%,160VDC	54473	ECEA2CS2R2
A2C133	283-0279-00			CAP,FXD,CER DI:0.001UF,20%,3000V	51406	DHR12Y5S102M3KV
A2C139	285-1082-00			CAP,FXD,PLASTIC:0.47UF,20%,200V	04009	TEK33MMR.47
A2C140	290-0758-00	B010100	B030383	CAP,FXD,ELCTLT:2.2UF,+50-10%,200V	56289	502D227
A2C140	290-0766-00	B030384		CAP,FXD,ELCTLT:2.2UF,+50-10%,160VDC	54473	ECEA2CS2R2
A2C142	283-0177-00			CAP,FXD,CER DI:1UF,+80-20%,25V	04222	SR302E105ZAATR
A2C143	290-0536-00			CAP,FXD,ELCTLT:10UF,20%,25V TANTALUM	05397	T368B106M025AS
A2C151	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A2C156	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A2C161	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A2C167	285-1184-00			CAP,FXD,MTLZD:0.01 UF,20%,4000V	56289	430P591
A2C171	283-0198-00			CAP,FXD,CER DI:0.22UF,20%,50V	05397	C330C224M5U1CA
A2C173	290-0534-00			CAP,FXD,ELCTLT:1UF,20%,35V	05397	T368A105M035AZ
A2C177	283-0067-00			CAP,FXD,CER DI:0.001UF,10%,200V	59660	835-515-YSE0102K
A2C183	283-0198-00			CAP,FXD,CER DI:0.22UF,20%,50V	05397	C330C224M5U1CA
A2C186	283-0279-00			CAP,FXD,CER DI:0.001UF,20%,3000V	51406	DHR12Y5S102M3KV
A2C221	290-0571-00			CAP,FXD,ELCTLT:5000UF,+100-10%,25V	56289	68D10478
A2C243	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A2C247	290-0527-00			CAP,FXD,ELCTLT:15UF,20%,20V	05397	T368B156M020AS
A2C256	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A2C257	290-0527-00			CAP,FXD,ELCTLT:15UF,20%,20V	05397	T368B156M020AS
A2C276	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A2C277	290-0758-00	B010100	B030383	CAP,FXD,ELCTLT:2.2UF,+50-10%,200V	56289	502D227
A2C277	290-0766-00	B030384		CAP,FXD,ELCTLT:2.2UF,+50-10%,160VDC	54473	ECEA2CS2R2
A2CR116	152-0429-00			SEMICOND DVC,DI:RECT,SI,5000V,10MA,A298J	83003	VG5X-1
A2CR117	152-0429-00			SEMICOND DVC,DI:RECT,SI,5000V,10MA,A298J	83003	VG5X-1
A2CR131	152-0242-00			SEMICOND DVC,DI:SIG,SI,225V,0.2A,DO-7	07263	FDH5004
A2CR133	152-0242-00			SEMICOND DVC,DI:SIG,SI,225V,0.2A,DO-7	07263	FDH5004
A2CR134	152-0242-00			SEMICOND DVC,DI:SIG,SI,225V,0.2A,DO-7	07263	FDH5004
A2CR136	152-0242-00			SEMICOND DVC,DI:SIG,SI,225V,0.2A,DO-7	07263	FDH5004
A2CR139	152-0242-00			SEMICOND DVC,DI:SIG,SI,225V,0.2A,DO-7	07263	FDH5004
A2CR140	152-0242-00			SEMICOND DVC,DI:SIG,SI,225V,0.2A,DO-7	07263	FDH5004
A2CR142	152-0333-00			SEMICOND DVC,DI:SW,SI,55V,200MA,DO-35	07263	FDH-6012
A2CR143	152-0333-00			SEMICOND DVC,DI:SW,SI,55V,200MA,DO-35	07263	FDH-6012
A2CR171	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A2CR172	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A2CR173	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A2CR174	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A2CR181	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A2CR182	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A2CR220	152-0556-00			SEMICOND DVC,DI:RECT,SI,50,2.5A	14936	KBU4A
A2CR236	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A2CR237	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A2CR238	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A2CR262	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A2CR263	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A2CR282	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A2CR283	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A2DS122	150-0050-00			LAMP,GLOW:135V MAX,1.9MA,C2A-T,WIRE LEAD	74276	LT2-24-2 (NE2H)
A2DS191	150-0050-00			LAMP,GLOW:135V MAX,1.9MA,C2A-T,WIRE LEAD	74276	LT2-24-2 (NE2H)
A2DS192	150-0050-00			LAMP,GLOW:135V MAX,1.9MA,C2A-T,WIRE LEAD	74276	LT2-24-2 (NE2H)
A2E136	119-0181-00			ARSR,ELEC SURGE:230,GAS FILLED	25088	B1-A230
A2F225	159-0041-00	B010100	B011349	FUSE,CARTRIDGE:3AG,1.25A,250V,20SEC (OPTION 20 AND 31 ONLY)	71400	MSL 1 1/4
A2F225	159-0160-00	B011350		FUSE,CARTRIDGE:3AG,1.5 A,250 V,18 SEC,UL (OPTION 20 AND 31 ONLY)	75915	31301.5
A2F226	159-0016-00			FUSE,CARTRIDGE:3AG,1.5,250V,FAST BLOW	71400	AGC-CW-1 1/2
A2F227	159-0028-00	B010100	B010134	FUSE,CARTRIDGE:0.25A,250V,FAST BLOW	71400	AGC-1/4
A2F227	159-0029-00	B010135		FUSE,CARTRIDGE:3AG,0.3A,250V,20SEC	71400	MDL 3/10
A2Q173	151-0192-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS8801
A2Q241	151-0462-00			TRANSISTOR:PNP,SI,TO-220	04713	SJE491
A2Q265	151-0464-00			TRANSISTOR:NPN,SI,TO-220	04713	SJE412
A2Q280	151-0453-00			TRANSISTOR:PNP,SI,TO-92	27014	ORDER BY DESCR
A2Q285	151-0464-00			TRANSISTOR:NPN,SI,TO-220	04713	SJE412
A2R107	308-0685-00			RES,FXD,WW:1.5 OHM,5%,1W	75042	BW-20-1R500J
A2R121	315-0221-00			RES,FXD,FILM:220 OHM,5%,0.25W	57668	NTR25J-E220E
A2R122	315-0153-00			RES,FXD,FILM:15K OHM,5%,0.25W	19701	5043CX15K00J
A2R123	315-0391-00			RES,FXD,FILM:390 OHM,5%,0.25W	57668	NTR25J-E390E
A2R127	315-0474-00			RES,FXD,FILM:470K OHM,5%,0.25W	19701	5043CX470K0J92U
A2R130	311-1915-00			RES,VAR,NONWW:TRMR,20K OHM,10%,0.5 W	32997	3386C-T07-203
A2R131	316-0471-00			RES,FXD,CMPSN:470 OHM,10%,0.25W	01121	CB4711
A2R133	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
A2R134	316-0471-00			RES,FXD,CMPSN:470 OHM,10%,0.25W	01121	CB4711
A2R136	315-0226-00			RES,FXD,FILM:22M OHM,5%,0.25W	80009	315-0226-00
A2R145	311-1917-00			RES,VAR,NONWW:TRMR,5K OHM,10%,0.5 W	32997	3386C-T07-502
A2R150	315-0333-00			RES,FXD,FILM:33K OHM,5%,0.25W	57668	NTR25J-E33K0
A2R151	316-0471-00			RES,FXD,CMPSN:470 OHM,10%,0.25W	01121	CB4711
A2R155	311-1914-00			RES,VAR,NONWW:TRMR,50K OHM,10%,0.5 W	32997	3386C-T07-503
A2R156	317-0471-00			RES,FXD,CMPSN:470 OHM,5%,0.125W	01121	BB4715
A2R160	311-1914-00			RES,VAR,NONWW:TRMR,50K OHM,10%,0.5 W	32997	3386C-T07-503
A2R161	316-0471-00			RES,FXD,CMPSN:470 OHM,10%,0.25W	01121	CB4711
A2R163	307-0572-00			RES NTWK,FXD,FI:HIGH VOLTAGE DIVIDER	80009	307-0572-00
A2R165	311-1312-00			RES,VAR,NONWW:PNL,5M OHM,1W	32997	81C1D-E24-BA0328
A2R167	315-0221-00			RES,FXD,FILM:220 OHM,5%,0.25W	57668	NTR25J-E220E
A2R169	307-0103-00			RES,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
A2R171	315-0100-00			RES,FXD,FILM:10 OHM,5%,0.25W	19701	5043CX10RR00J
A2R174	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
A2R176	315-0155-00			RES,FXD,FILM:1.5M OHM,5%,0.25W	19701	5043CX1M500J
A2R177	315-0562-00			RES,FXD,FILM:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
A2R178	315-0473-00			RES,FXD,FILM:47K OHM,5%,0.25W	57668	NTR25J-E47K0
A2R182	315-0473-00			RES,FXD,FILM:47K OHM,5%,0.25W	57668	NTR25J-E47K0
A2R183	321-0366-00			RES,FXD,FILM:63.4K OHM,1%,0.125W,TC=T0	19701	5043ED63K40F
A2R191	316-0270-00			RES,FXD,CMPSN:27 OHM,10%,0.25W	01121	CB2701
A2R231	321-0200-00			RES,FXD,FILM:1.18K OHM,1%,0.125W,TC=T0	19701	5033ED11K80F
A2R232	315-0221-00			RES,FXD,FILM:220 OHM,5%,0.25W	57668	NTR25J-E220E
A2R233	315-0391-00			RES,FXD,FILM:390 OHM,5%,0.25W	57668	NTR25J-E390E
A2R241	307-0057-00			RES,FXD,CMPSN:5.1 OHM,5%,0.5W	01121	EB51G5
A2R242	308-0248-00	B023786		RES,FXD,WW:150 OHM,1%,5W	83777	BL5A-150PD
A2R244	321-0265-00			RES,FXD,FILM:5.62K OHM,1%,0.125W,TC=T0	19701	5043ED5K620F
A2R245	311-1564-00	B010100	B022599	RES,VAR,NONWW:TRMR,500 OHM,0.5W	32997	3352T-CK5501
A2R245	311-1563-00	B022600		RES,VAR,NONWW:TRMR,1K OHM,0.5W	32997	3352T-DY7-102
A2R246	321-0249-00			RES,FXD,FILM:3.83K OHM,1%,0.125W,TC=T0	19701	5033ED3K83F
A2R254	321-0335-00			RES,FXD,FILM:30.1K OHM,1%,0.125W,TC=T0	57668	RB14FXE30K1
A2R256	321-0335-00			RES,FXD,FILM:30.1K OHM,1%,0.125W,TC=T0	57668	RB14FXE30K1
A2R260	315-0221-00			RES,FXD,FILM:220 OHM,5%,0.25W	57668	NTR25J-E220E

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A2R261	315-0391-00			RES,FXD,FILM:390 OHM,5%,0.25W	57668	NTR25J-E390E
A2R266	307-0107-00			RES,FXD,CMPSN:5.6 OHM,5%,0.25W	01121	CB56G5
A2R274	321-0335-00			RES,FXD,FILM:30.1K OHM,1%,0.125W,TC=T0	57668	RB14FXE30K1
A2R276	321-0399-00			RES,FXD,FILM:140K OHM,1%,0.125W,TC=T0	07716	CEAD14002F
A2R279	315-0471-00			RES,FXD,FILM:470 OHM,5%,0.25W	57668	NTR25J-E470E
A2R280	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
A2R281	315-0271-00			RES,FXD,FILM:270 OHM,5%,0.25W	57668	NTR25J-E270E
A2R286	307-0057-00			RES,FXD,CMPSN:5.1 OHM,5%,0.5W	01121	EB51G5
A2R287	315-0100-00			RES,FXD,FILM:10 OHM,5%,0.25W	19701	5043CX10RR00J
A2R291	315-0221-00			RES,FXD,FILM:220 OHM,5%,0.25W	57668	NTR25J-E220E
A2R292	315-0221-00			RES,FXD,FILM:220 OHM,5%,0.25W	57668	NTR25J-E220E
A2R293	315-0221-00			RES,FXD,FILM:220 OHM,5%,0.25W	57668	NTR25J-E220E
A2R294	315-0221-00			RES,FXD,FILM:220 OHM,5%,0.25W	57668	NTR25J-E220E
A2R305	311-1313-00			RES,VAR,NONWW:PNL,2K OHM,0.5W	01121	73M4G0481202M
A2R315	311-1313-00			RES,VAR,NONWW:PNL,2K OHM,0.5W	01121	73M4G0481202M
A2R325	311-1710-00			RES,VAR,NONWW:PNL,20K OHM,1W	01121	16M148
A2T110	120-1202-00			XFMR,PWR,SDN&SU:HIGH VOLTAGE	80009	120-1202-00
A2U110	152-0637-02			SEMICOND DVC,DI:CHECKED	52306	CMX522
A2U175	156-0158-00			MICROCKT,LINEAR:DUAL OPNL AMPL	04713	MC1458P1/MC1458U
A2U232	156-0158-00			MICROCKT,LINEAR:DUAL OPNL AMPL	04713	MC1458P1/MC1458U
A2VR130	152-0268-00			SEMICOND DVC,DI:ZEN,SI,56V,5%,0.4W,DO-7	04713	SZG35009K91N979B
A2VR150	152-0241-00			SEMICOND DVC,DI:ZEN,SI,33V,5%,0.4W,DO-7	14552	1N973B
A2VR231	152-0461-00			SEMICOND DVC,DI:ZEN,SI,6.2V,5%,0.4W,DO-7	04713	SZG25002K2
A2VR232	152-0149-00			SEMICOND DVC,DI:ZEN,SI,10V,5%,0.4W,DO-7	15238	Z5406
A2VR260	152-0149-00			SEMICOND DVC,DI:ZEN,SI,10V,5%,0.4W,DO-7	15238	Z5406

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
F42	159-0029-00			FUSE,CARTRIDGE:3AG,0.3A,250V,20SEC	71400	MDL 3/10
F42	159-0054-00			FUSE,CARTRIDGE:3AG,0.15A,250V,25SEC (ALTERNATE - 220V OPERATION)	71400	MDL 15/100
J12	131-0955-00			CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
J17	131-0955-00			CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
J21	131-0955-00			CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
J25	131-0955-00			CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
Q35	151-0349-00	B010100	B022669	TRANSISTOR:NPN,SI,SELECTED,TO-127	04713	SJE924
Q35	151-0349-05	B022670		TRANSISTOR:SCREENED	80009	151-0349-05
S43	260-0724-00			SWITCH,THRMSTC:NC,OPEN 83.3,CL 66.7,10A	93410	430-367
S205	260-1849-00			SWITCH,PUSH:DPDT,4A,250VAC	31918	NE15/F2U103EE
T210	120-1201-00	B010100	B027799	XFMR,PWR,STPDN:	80009	120-1201-00
T210	120-1201-01	B027800		XFMR,PWR,STPDN:	80009	120-1201-01
V39	154-0798-00			ELECTRON TUBE:CRT,P31,T6200	80009	154-0798-00
V39	154-0797-00			ELECTRON TUBE:CRT,P31,INTERNAL SCALE (OPTION 01 ONLY)	80009	154-0797-00
V39	154-0798-03	B012157		ELECTRON TUBE:CRT,P7,T6200-7 (OPTION 76 ONLY)	80009	154-0798-03
V39	154-0797-03	B012157		ELECTRON TUBE:CRT,P7,INTERNAL SCALE (OPTIONS 01 AND 76 ONLY)	80009	154-0797-03

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols

Graphic symbols and class designation letters 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 overline on a signal name indicates that the signal performs its intended function when it is in the low state.

Abbreviations are based on ANSI Y1.1-1972.

Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

Y14.15, 1966	Drafting Practices.
Y14.2, 1973	Line Conventions and Lettering.
Y10.5, 1968	Letter Symbols for Quantities Used in Electrical Science and Electrical Engineering.

American National Standard Institute
1430 Broadway
New York, New York 10018

Component Values

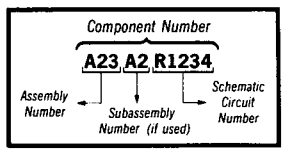
Electrical components shown on the diagrams are in the following units unless noted otherwise:

Capacitors = Values one or greater are in picofarads (pF). Values less than one are in microfarads (μF).
Resistors = Ohms (Ω).

Assembly Numbers and Grid Coordinates

Each assembly in the instrument is assigned an assembly number (e.g., A20). The assembly number appears on the circuit board outline on the diagram, in the title for the circuit board component location illustration, and in the lookup table for the schematic diagram and corresponding component locator illustration. The Replaceable Electrical Parts list is arranged by assemblies in numerical sequence; the components are listed by component number (see following illustration for constructing a component number).

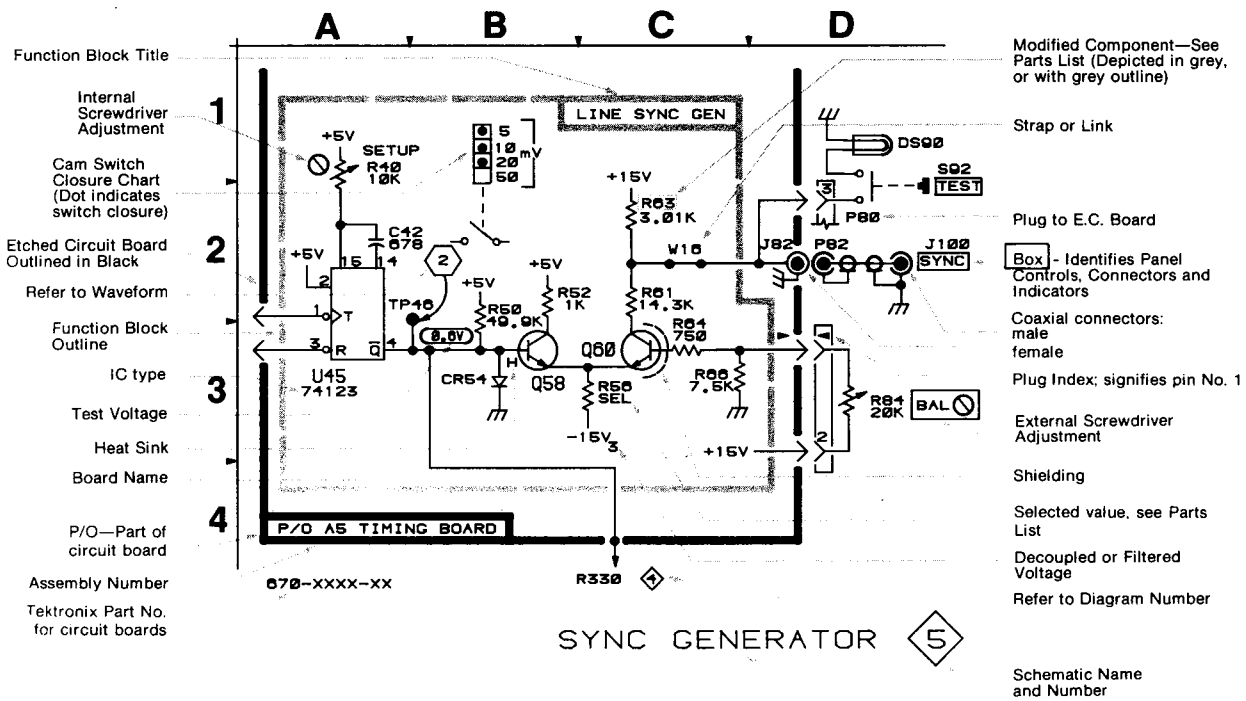
COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

The schematic diagram and circuit board component location illustration have grids. A lookup table with the grid coordinates is provided for ease of locating the component. Only the components illustrated on the facing diagram are listed in the lookup table. When more than one schematic diagram is used to illustrate the circuitry on a circuit board, the circuit board illustration may only appear opposite the first diagram on which it was illustrated; the lookup table will list the diagram number of other diagrams that the circuitry of the circuit board appears on.

The following special symbols may appear on the diagrams:



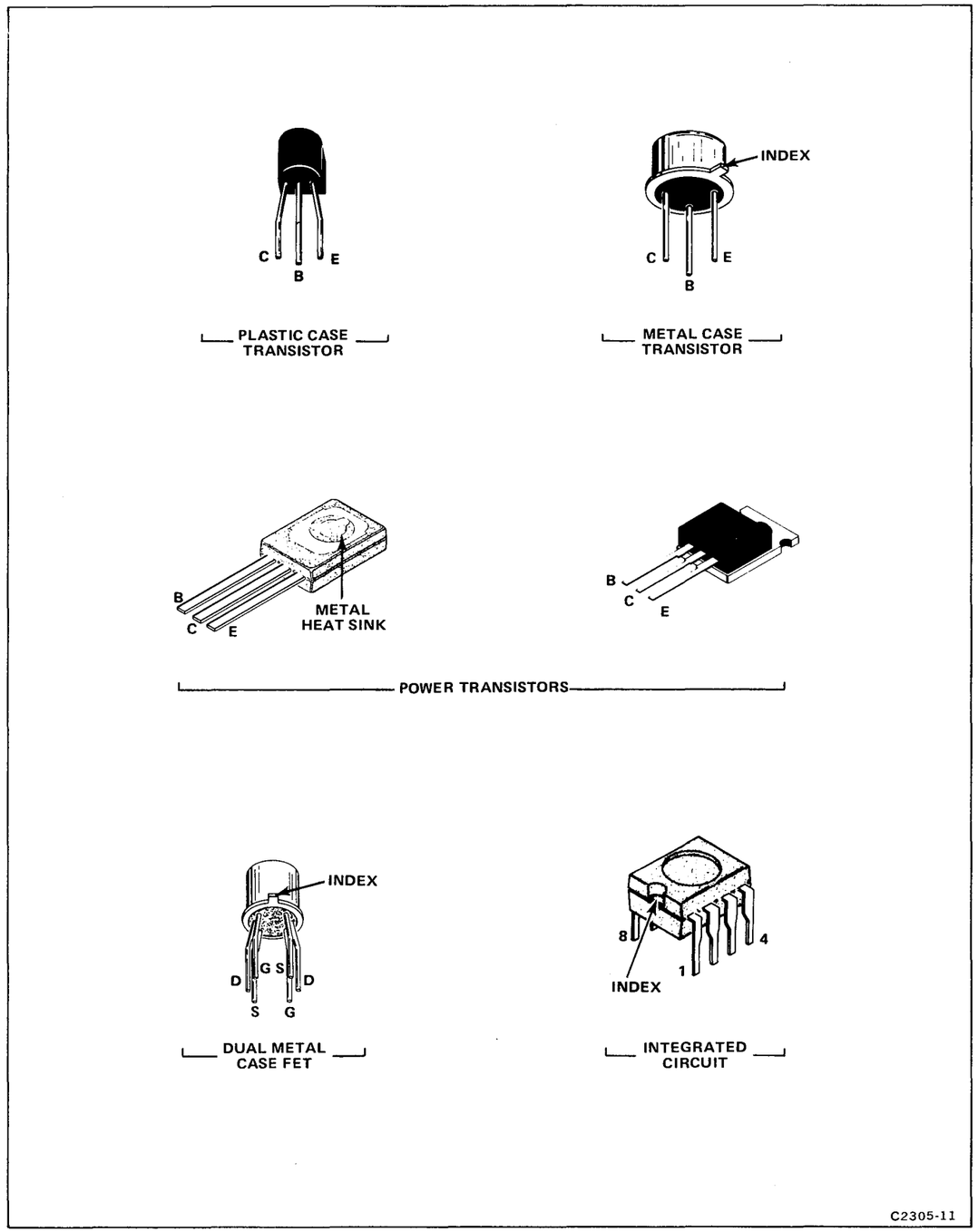


Figure 9-1. Semiconductor Lead Configurations.

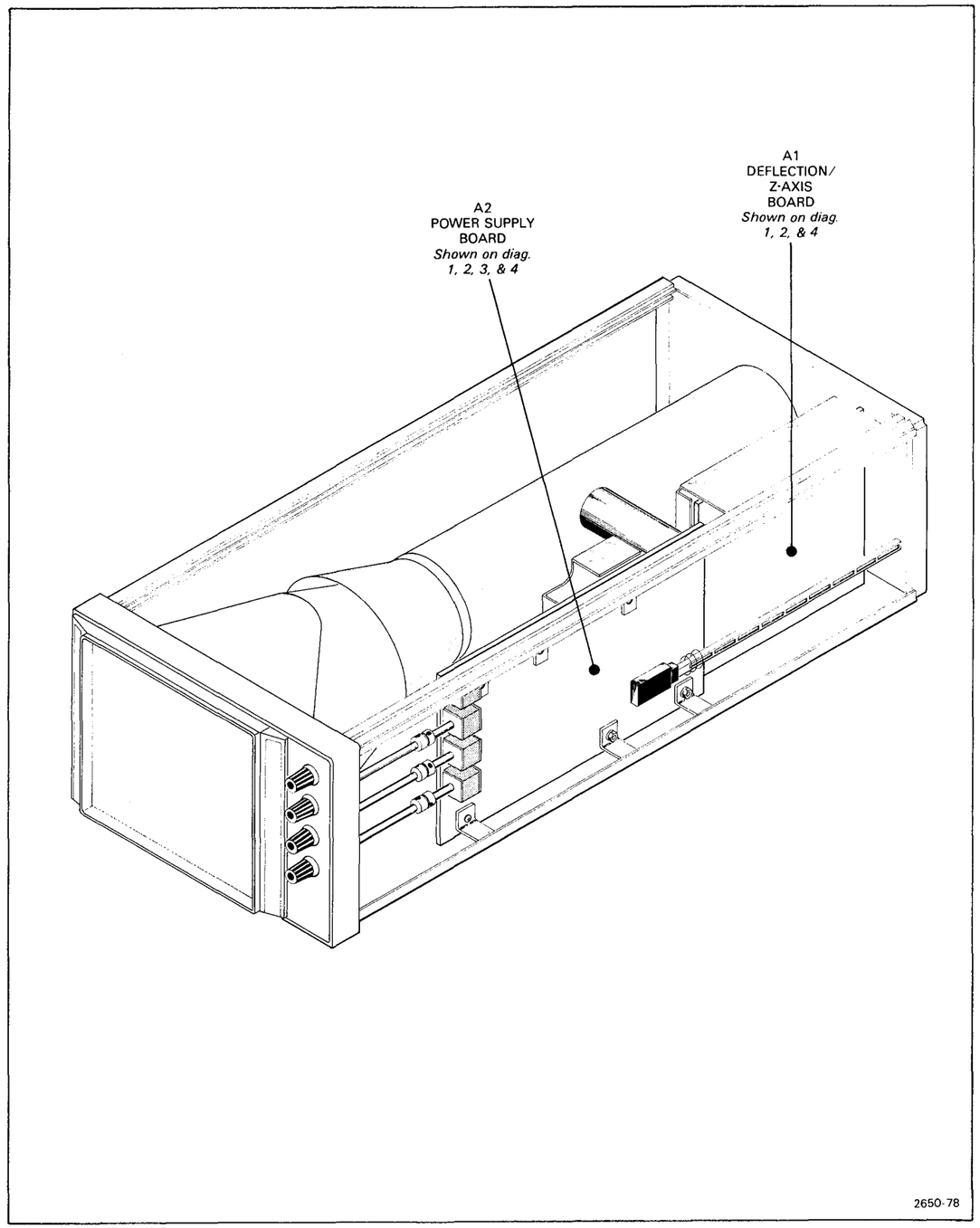


Figure 9-2. 620 Board Locator.

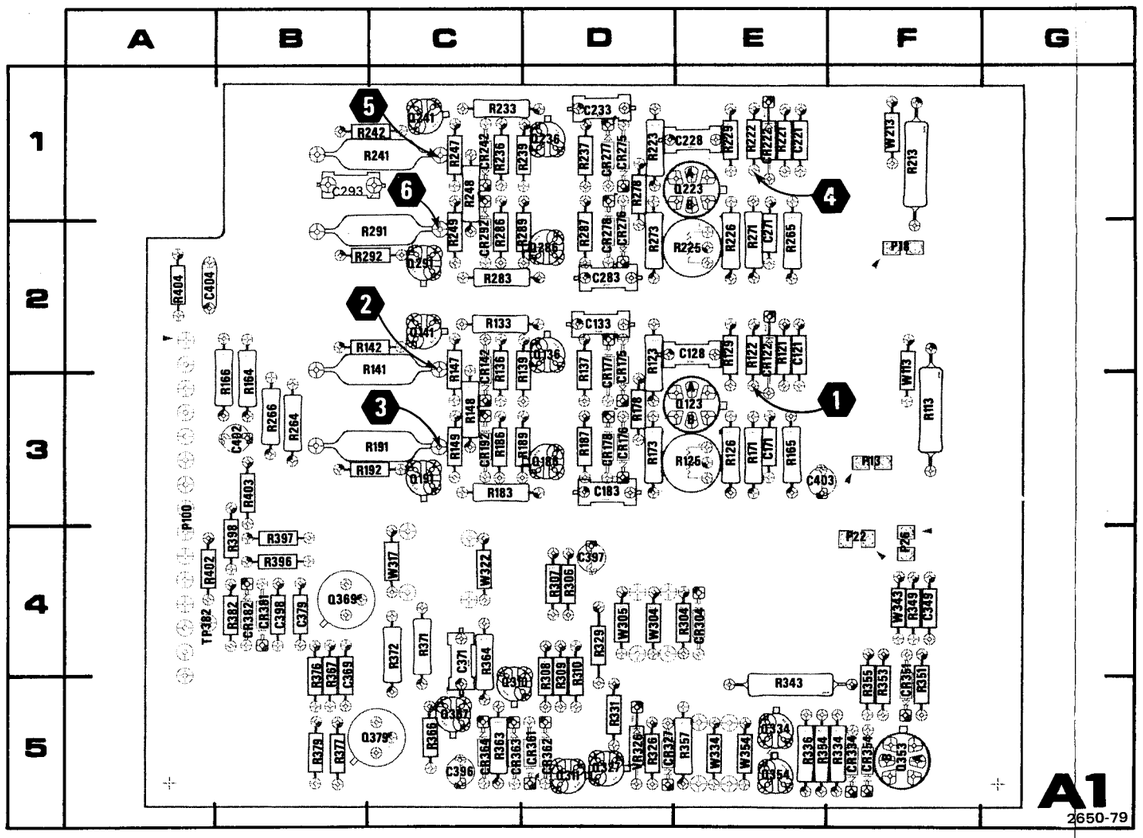
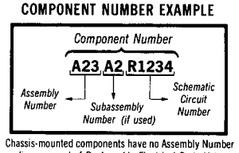
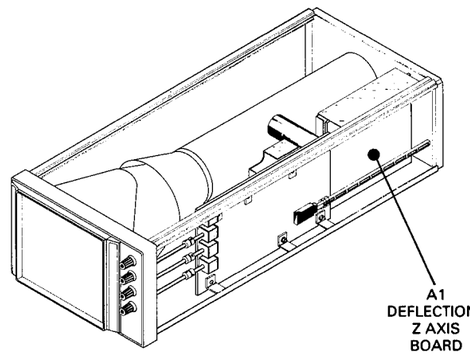


Figure 9-3. A1-Deflection/Z-Axis circuit board assembly.

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.



A1
DEFLECTION/
Z AXIS
BOARD
Shown on diags.
1, 2, & 4

P/O A1 ASSY			Deflection Amplifiers ①		
CIRCUIT NUMBER	SCHEM. LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM. LOCATION	BOARD LOCATION
C121	B1	E2	R133	C1	C2
C128	C2	E2	R136	D1	C2
C133	C1	D2	R137	D1	D2
C171	B2	E3	R139	D1	D2
C183	C3	D3	R141	D1	C2
C221	B4	E1	R142	D1	B2
C228	C4	E1	R147	D2	C2
C233	C3	D1	R148	D2	C3
C271	B5	E2	R149	D2	C3
C283	C5	D2	R164	B2	B3
C293	E4	B1	R165	B2	E3
			R166	B3	B3
CR122	B1	E2	R171	B2	E3
CR142	D1	C2	R173	B2	D3
CR175	C2	D2	R178	C2	D3
CR176	C2	D3	R183	C3	C3
CR177	C2	D2	R186	D3	C3
CR178	C2	D3	R187	D2	D3
CR192	D3	C3	R189	D2	D3
CR222	B4	E1	R191	D3	C3
CR242	D3	C1	R192	D3	C3
CR275	C4	D1	R213	B4	F1
CR276	C4	D2	R221	B4	E1
CR277	C4	D1	R222	B4	E1
CR278	C4	D2	R223	B3	D1
CR292	D5	C2	R225	C4	E2
			R226	C4	E2
P13	A1	F3	R229	C4	E1
P18	A3	F2	R233	C3	C1
P100	B2	A3	R236	D3	C1
P100	B4	A3	R237	D4	D1
			R239	D4	D1
Q123A	B1	E3	R241	D3	C1
Q123B	B2	E3	R242	D3	B1
Q136	D1	D2	R247	D4	C1
Q141	D1	C2	R248	D4	C1
Q186	D2	D3	R249	D4	C2
Q191	D2	C3	R264	B5	B3
Q223A	B4	E1	R265	B5	E2
Q223B	B5	E1	R266	B5	B3
Q236	D4	D1	R271	B5	E2
Q241	D4	C1	R273	B5	D2
Q286	D5	D2	R278	C5	D1
Q291	D5	C2	R283	C5	C2
			R286	D5	C2
R113	B1	F3	R287	D5	D2
R121	B1	E2	R289	D5	C2
R122	B1	E2	R291	D5	C2
R123	B1	D2	R292	D5	B2
R125	C2	E3			
R126	C2	E3	W113	B1	F2
R129	C2	E2	W213	B4	F1

P/O A1 ASSY also shown on diagrams 2 & 4.

P/O A2 ASSY			Deflection Amplifiers ①
CIRCUIT NUMBER	SCHEM. LOCATION	BOARD LOCATION	
R305	A2	B1*	
R315	A5	B2*	
*See Figure 9-6 to locate these parts.			

P/O A2 ASSY also shown on diagrams 2, 3, & 4.

CHASSIS MOUNTED PARTS			Deflection Amplifiers ①		
CIRCUIT NUMBER	SCHEM. LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM. LOCATION	BOARD LOCATION
J12	A1	CHASSIS	P10	A1	CHASSIS
J17	A4	CHASSIS	P10	A3	CHASSIS

VOLTAGE AND WAVEFORM CONDITIONS

NOTE

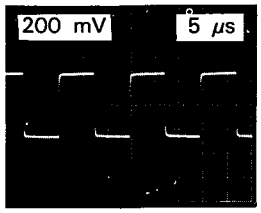
The test equipment used to obtain the voltages and waveforms is listed in Table 6-3, Test Equipment.

Voltage Conditions. The dc voltages indicated on the schematic diagrams were obtained with a digital multimeter and with no test signal input. The 620 INTENSITY and position controls were set for a barely visible spot positioned at near center screen.

Waveform Conditions (Vertical Deflection Amplifier). The following waveforms were monitored with a test oscilloscope equipped with a X10 probe. A 0.5 peak-to-peak square wave was applied to the Y INPUT (J12) with the vertical position control (↕) centered. Test oscilloscope deflection factor and sweep rate settings appear on the waveform illustrations.

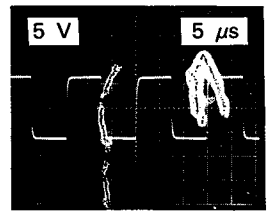
Waveform Conditions (Horizontal Deflection Amplifier). The following waveforms were monitored with a test oscilloscope equipped with a X10 probe. A 0.5 peak-to-peak square wave was applied to the X INPUT (J17) with the horizontal position control (↔)centered. Test oscilloscope deflection factor and sweep rate settings appear on the waveform illustrations.

1



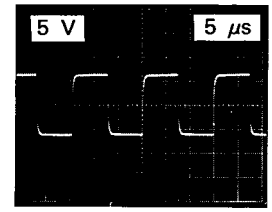
+250 mV

2



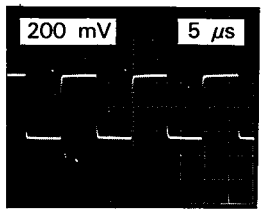
-25 V

3



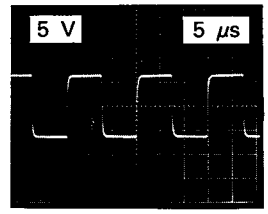
-34 V

4



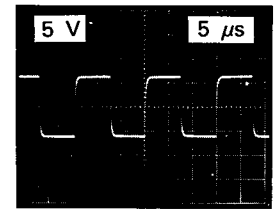
+250 mV

5

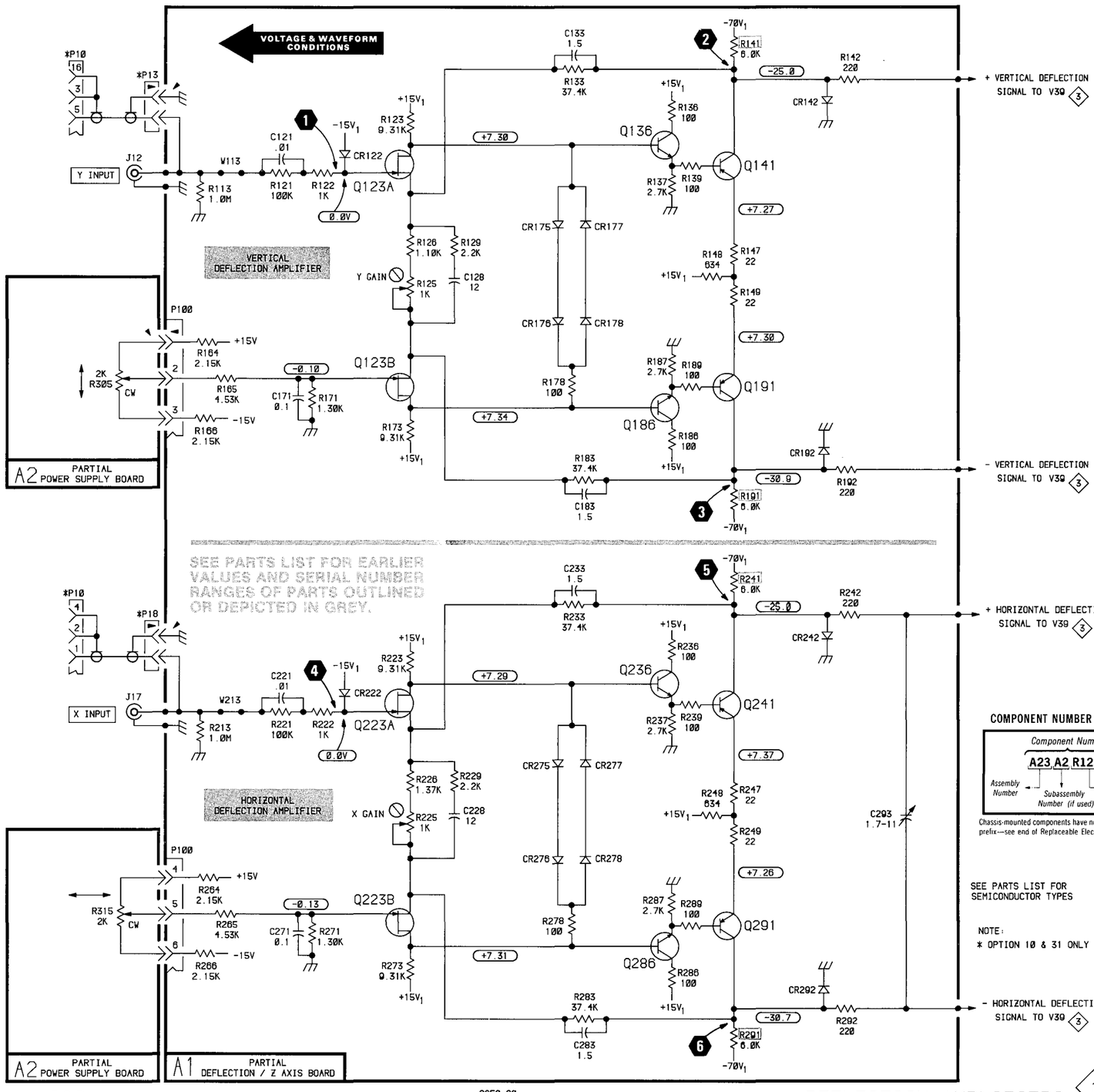


-25 V

6



-34 V



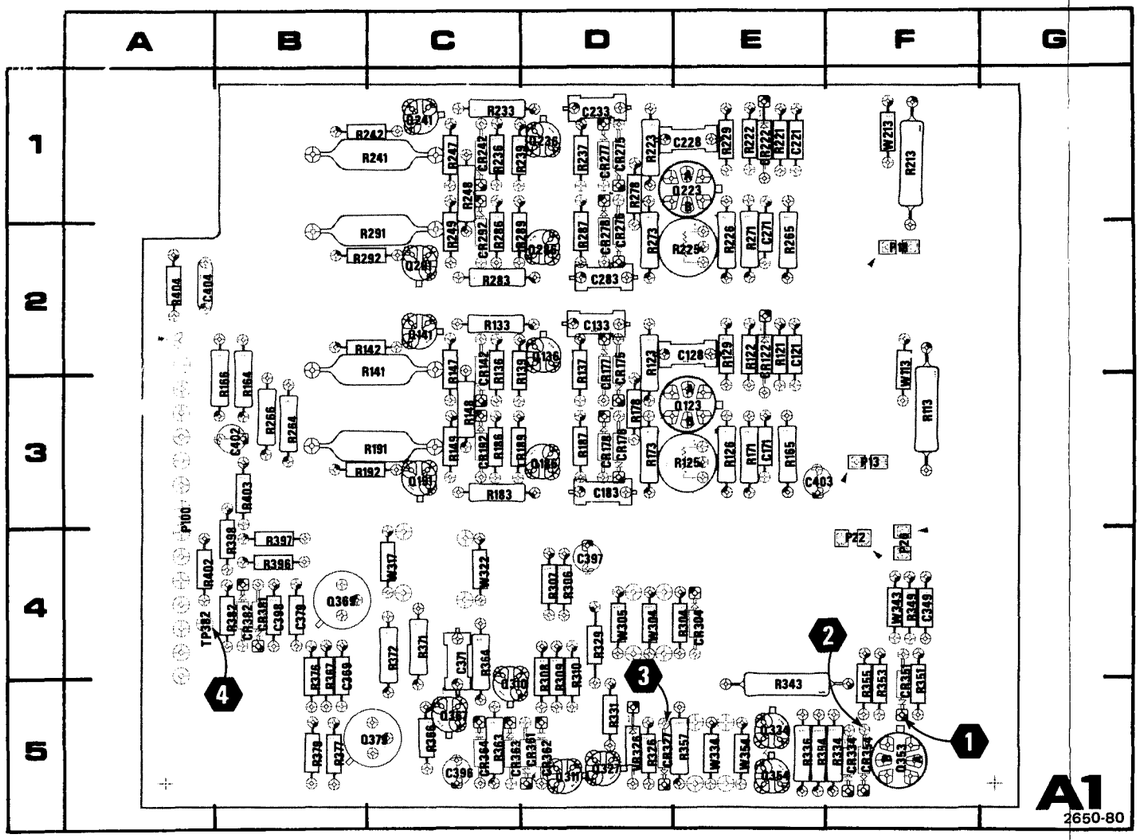


Figure 9-4. A1-Deflection/Z-Axis circuit board assembly.

P/O A1 ASSY			Z AXIS AMPLIFIER ②		
CIRCUIT NUMBER	SCHEM. LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM. LOCATION	BOARD LOCATION
C349	B3	F4	R307	C1	D4
C369	E2	B5	R308	C1	D4
C371	E1	C4	R309	C2	D4
C379	E2	B4	R310	C1	D4
C396	E3	C5	R326	C2	D5
C397	E4	D4	R329	B3	D4
C398	E4	B4	R331	C3	D5
			R334	C3	F5
CR304	B1	E4	R336	C3	E5
CR327	D2	D5	R343	B4	E5
CR334	C3	F5	R349	B4	F4
CR351	B4	F5	R351	B4	F5
CR354	C4	F5	R353	C4	F5
CR361	D1	D5	R354	C4	E5
CR362	D2	D5	R355	C4	F5
CR363	D2	C5	R357	D4	E5
CR364	D2	C5	R363	D1	C5
CR381	F2	B4	R364	E1	B3
CR382	F2	B4	R366	E1	C5
			R367	E2	B5
P22	A1	F4	R371	E1	C4
P26	A4	F4	R372	E1	C4
P100	A2	A3	R376	E2	B5
P100	F2	A3	R377	E2	B5
			R379	E3	B5
Q310	C1	C5	R382	F2	B4
Q311	C1	D5	R396	E3	B4
Q327	D2	D5	R397	E4	B4
Q334	C3	E5	R398	E4	B4
Q353A	C4	F5			
Q353B	C4	F5	TP382	F2	A4
Q354	C4	E5			
Q367	E2	C5	VR326	C2	D5
Q369	E2	B4			
Q379	E2	C5	W304	B1	D4
			W305	B1	D4
R304	B2	E4	W343	B4	F4
R306	C1	D4			

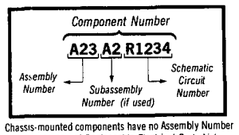
P/O A1 ASSY also shown on diagrams 1 & 4.

P/O A2 ASSY			Z AXIS AMPLIFIER ②
CIRCUIT NUMBER	SCHEM. LOCATION	BOARD LOCATION	
R325	A3	B3*	
*See Figure 9-6 to locate part.			

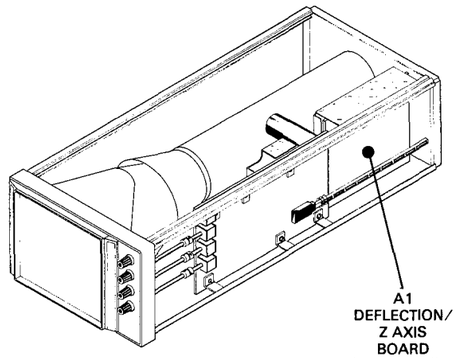
P/O A2 ASSY also shown on diagrams 1, 3, & 4.

CHASSIS MOUNTED PARTS			Z AXIS AMPLIFIER ②		
CIRCUIT NUMBER	SCHEM. LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM. LOCATION	BOARD LOCATION
J21	A1	CHASSIS	P10	A1	CHASSIS
J25	A4	CHASSIS	P10	A4	CHASSIS

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix – see end of Replaceable Electrical Parts List.



A1 DEFLECTION/ Z AXIS BOARD *Shown on diag. 1, 2, & 4*

VOLTAGE AND WAVEFORM CONDITIONS

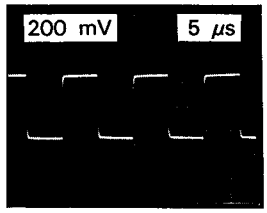
NOTE

The test equipment used to obtain voltages and waveforms is listed in Table 6-3, 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 620 INTENSITY and position controls were set for a barely visible spot positioned at near center screen.

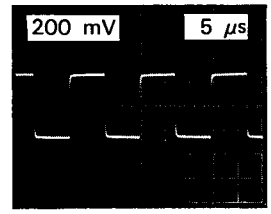
Waveform Conditions. The following waveforms were monitored with a test oscilloscope equipped with a X10 probe. A 0.5 volt peak-to-peak square wave was applied to the Z INPUT (J25) with the displayed spot positioned off screen to prevent burning the crt phosphor. The INTENSITY control was set to -35 V as measured at A1TP382 (Z-Axis amplifier output). Test oscilloscope deflection factor and sweep rate settings appear on the waveform illustrations.

1



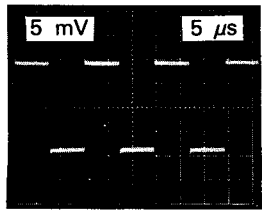
+250 mV

2



+250 mV

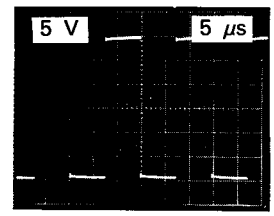
3



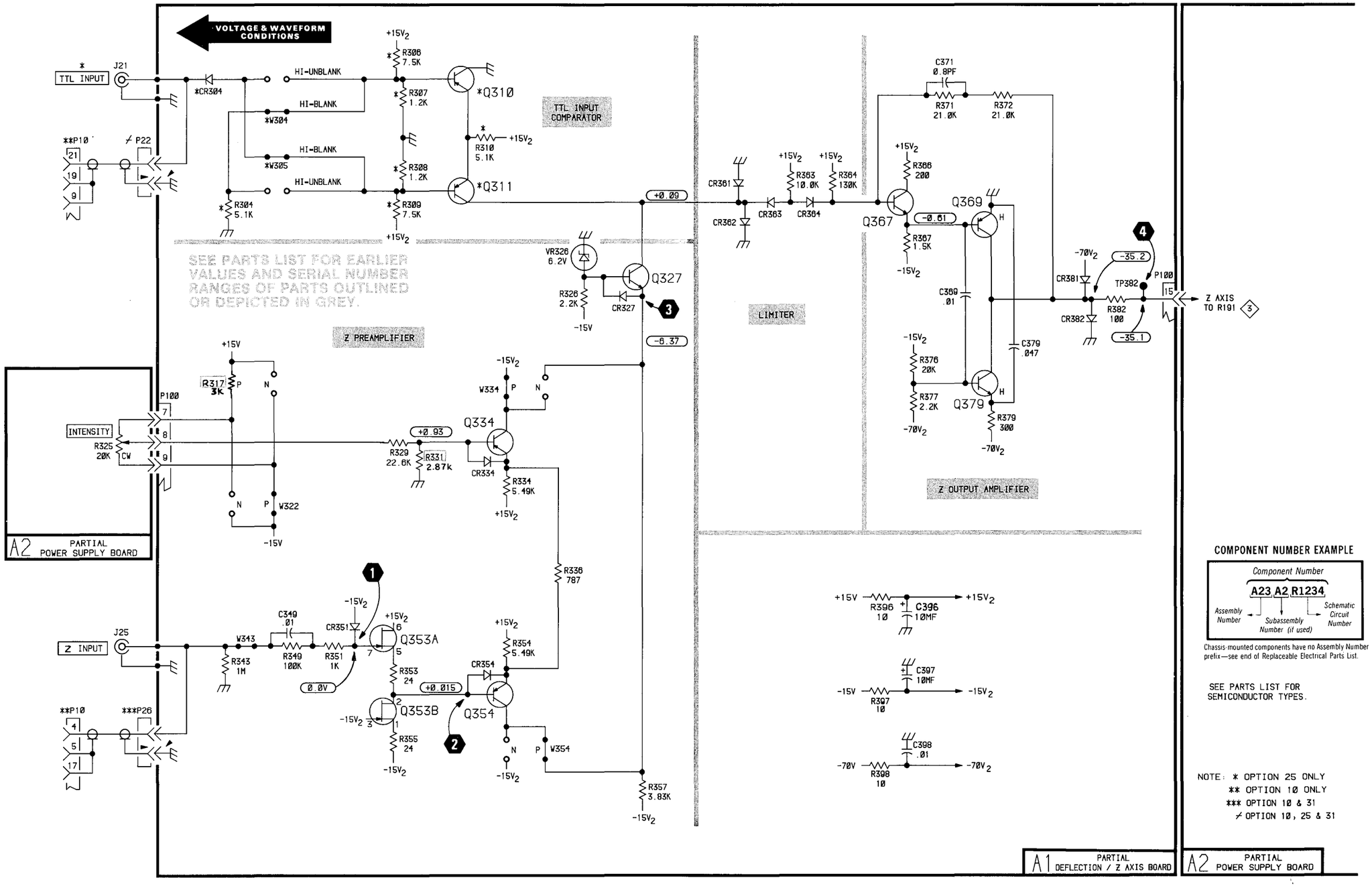
-6 V

AC COUPLED

4



-38 V



COMPONENT NUMBER EXAMPLE

Component Number: A23 A2 R1234
- A23 — Assembly Number
- A2 — Subassembly Number (if used)
- R1234 — Schematic Circuit Number

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

NOTE: * OPTION 25 ONLY
** OPTION 10 ONLY
*** OPTION 10 & 31
≠ OPTION 10, 25 & 31

Z-AXIS AMPLIFIER 2

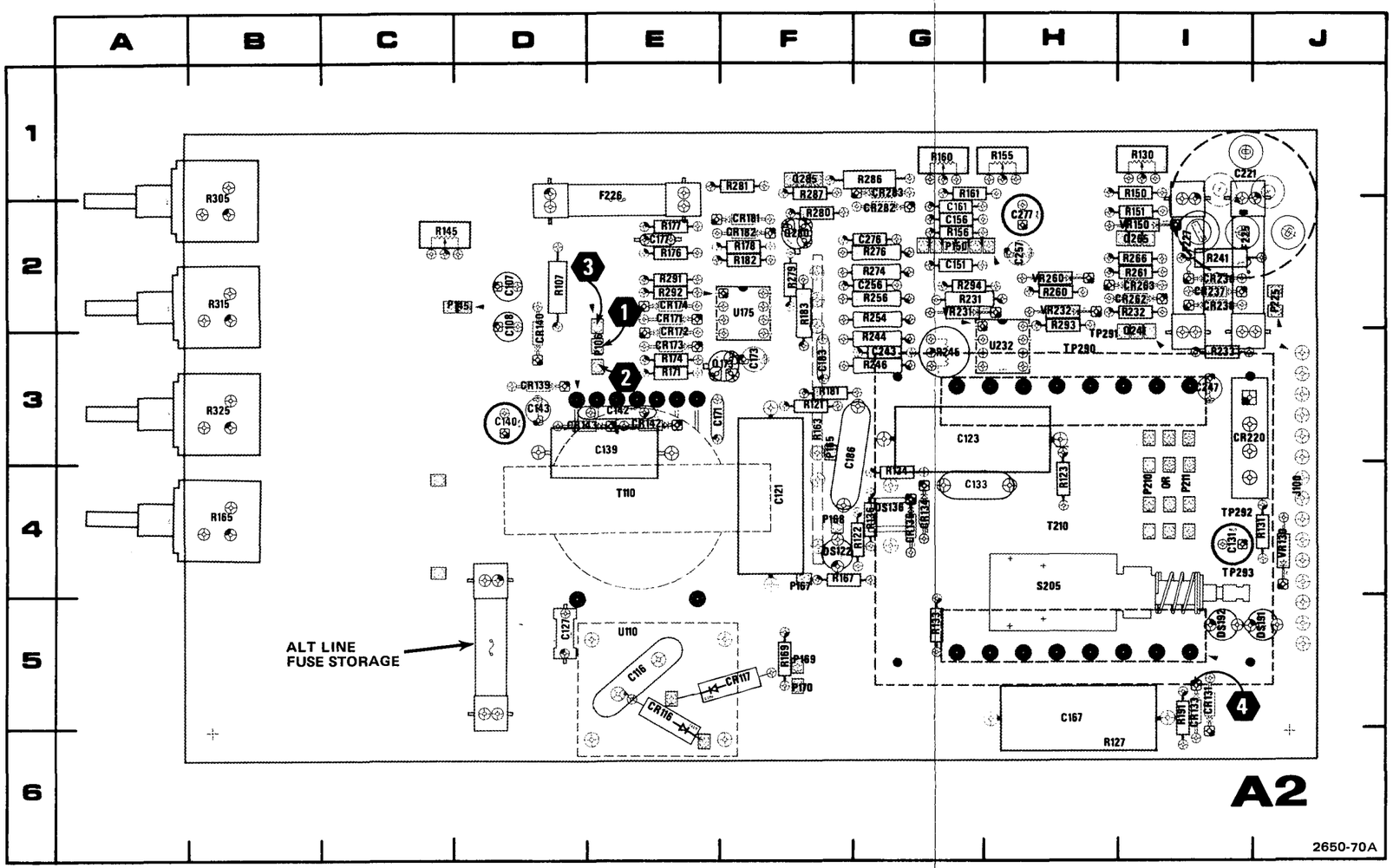


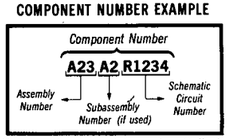
Figure 9-5. A2-Power Supply circuit board assembly.

P/O A2 ASSY			HIGH-VOLTAGE POWER SUPPLY ◈3		
CIRCUIT NUMBER	SCHEM. LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM. LOCATION	BOARD LOCATION
C107	B3	D2	P167	E4	F4
C108	B3	D2	P168	E4	F4
C116	C2	E5	P169	E4	F5
C121	D1	F4	P170	E4	F5
C123	D1	G3			
C127	C2	D5	Q173	B4	F3
C131	D3	I4			
C133	D2	G4	R107	B3	D2
C139	C3	E3	R121	D1	F3
C140	C3	D3	R122	D1	G4
C142	C3	E3	R123	D1	H4
C143	C3	D3	R127	C2	H5
C151	E2	G2	R130	C3	I1
C156	E3	G2	R131	C3	J4
C161	E3	G2	R133	D2	G5
C167	D2	H5	R134	D3	G4
C171	B4	E3	R136	D3	G4
C173	B4	F3	R145	E1	C2
C177	A5	E2	R150	E2	I1
C183	D5	F3	R151	E2	I2
C186	E5	F3	R155	E3	H1
			R156	E3	G2
CR116	C2	E5	R160	E3	G1
CR117	C2	F5	R161	E3	G1
CR131	C2	I5	R163A	D4	F3
CR133	C2	I5	R163B	E4	F3
CR134	D3	G4	R163C	D5	F3
CR136	D2	G4	R163D	D5	F3
CR139	C3	D3	R165	E4	B4
CR140	C3	D2	R167	E4	F4
CR142	C4	E3	R169	E5	F5
CR143	C4	D3	R171	B4	E3
CR171	B4	E2	R174	B4	E3
CR172	B5	E2	R176	A4	E2
CR173	B4	E3	R177	A5	E2
CR174	B4	E2	R178	A4	F2
CR181	D5	F2	R181	D5	F3
CR182	D5	F2	R182	D5	F2
			R183	D5	F2
DS122	D2	F4	R191	D2	I5
DS136	D2	G4			
DS191	D2	J5	T110	B1	E4
DS192	D2	I5			
			U110	D1	E5
P106	A2	E3	U175A	A4	F2
P145	E1	D2			
P150	E2	G2	VR130	C3	J4
P150	E4	G2	VR150	E2	I2
P165	E3	F3			

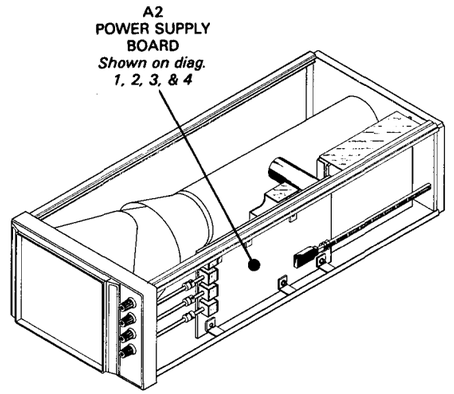
P/O A2 ASSY also shown on diagrams 1, 2, & 4.

CHASSIS MOUNTED PARTS			HIGH-VOLTAGE POWER SUPPLY ◈3
CIRCUIT NUMBER	SCHEM. LOCATION	BOARD LOCATION	
L39	F2	CHASSIS	
Q35	A3	CHASSIS	
V39	F1	CHASSIS	

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.



VOLTAGE AND WAVEFORM CONDITIONS

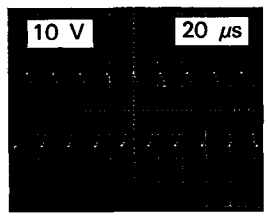
NOTE

The test equipment used to obtain the voltages and waveforms is listed in Table 6-3, 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 620 INTENSITY and position controls were set for a barely visible spot positioned at near center screen.

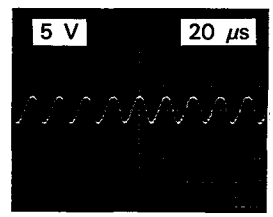
Waveform Conditions. The following waveforms were monitored with a test oscilloscope equipped with a X10 probe. The 620 INTENSITY and position controls were set for a barely visible spot positioned at near center screen. No input signals were applied to the monitor.

1



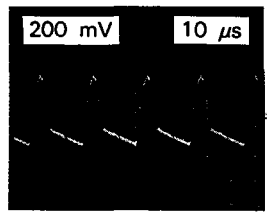
+24 V

2



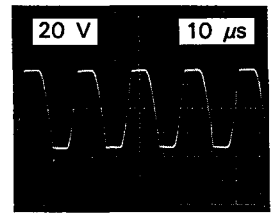
0 V

3

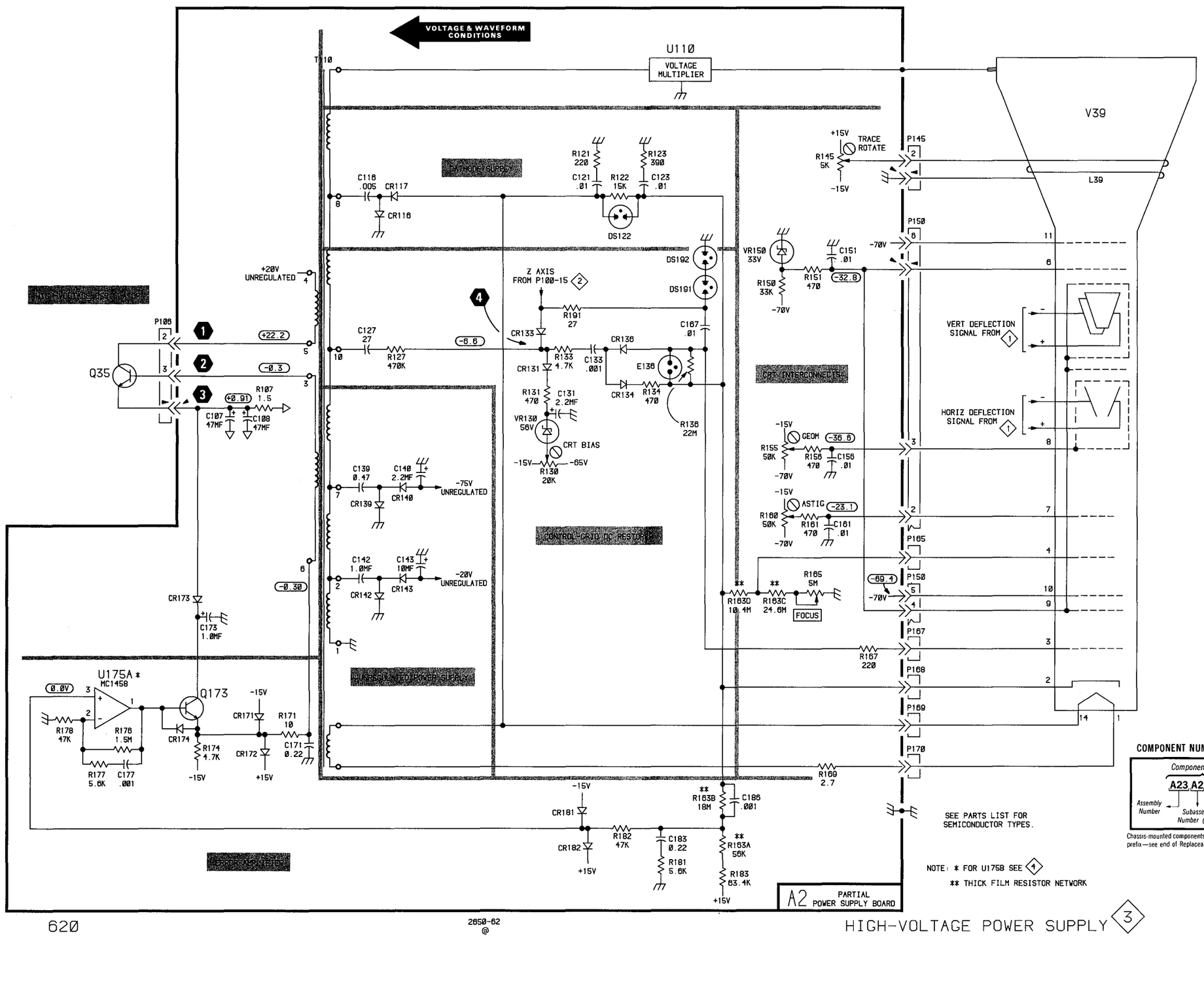


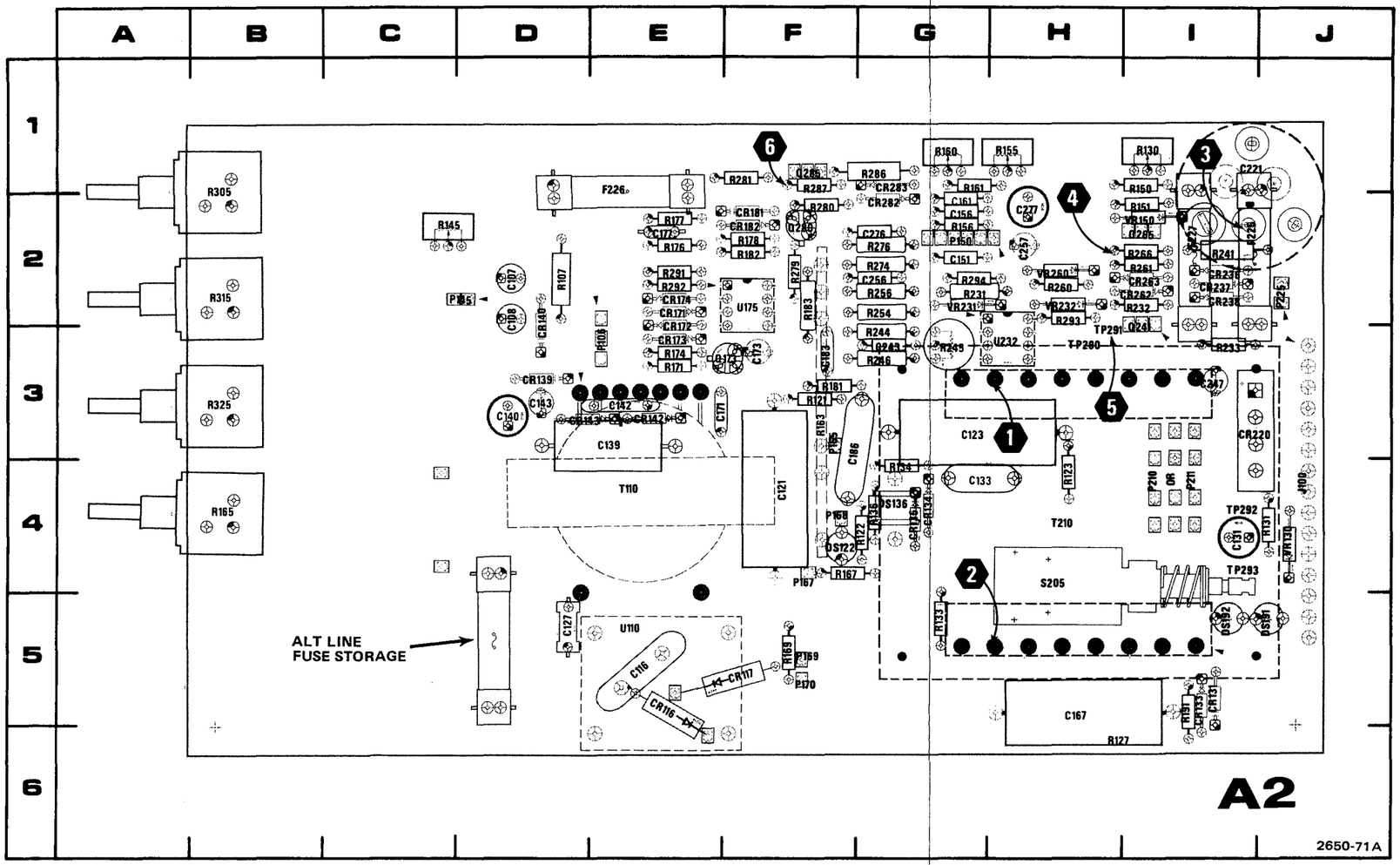
+1 V

4



-34 V

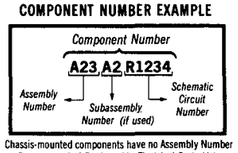




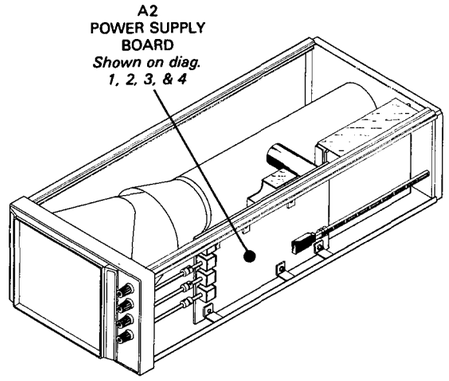
2650-71A

Figure 9-6. A2-Power Supply circuit board assembly.

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.



P/O A1 ASSY			LOW-VOLTAGE POWER SUPPLY ◈4		
CIRCUIT NUMBER	SCHEM. LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM. LOCATION	BOARD LOCATION
C402	F2	B3*	R402	F2	A4*
C403	F3	E3*	R403	F3	B3*
C404	F4	A2*	R404	F4	A2*
P100	F1	A3*			
			*See Figure 9-3 to locate these parts.		

P/O A1 ASSY also shown on diagrams 1 & 2.

P/O A2 ASSY			LOW-VOLTAGE POWER SUPPLY ◈4		
CIRCUIT NUMBER	SCHEM. LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM. LOCATION	BOARD LOCATION
C221	D2	I1	R246	E3	G3
C243	E3	G3	R254	D3	G2
C247	E2	I3	R256	E3	G2
C256	E3	G2	R260	E3	H2
C257	E3	H2	R261	E4	I2
C276	E4	G2	R266	E4	I2
C277	E4	H2	R274	D4	G2
			R276	E4	G2
CR220	C2	I3	R279	D4	F2
CR236	E2	I2	R280	E4	F2
CR237	E2	I2	R281	E4	F1
CR238	E2	I2	R286	E4	G1
CR262	E3	I2	R287	E5	F1
CR263	E4	I2	R291	B4	E2
CR282	E4	G2	R292	B4	E2
CR283	E4	G1	R293	C4	H2
			R294	C4	G2
F225	C1	I2			
F226	D2	E1	S205	B1	H4
F227	D2	I2			
			T210	C1	H4
P210	B2	I4			
P211	B2	I4	TP290	F1	H3
P225	A1	J2	TP291	F2	H3
			TP292	F3	I4
Q241	E2	I3	TP293	F4	I4
Q265	E3	I2			
Q280	D4	F2	U175	B4	F2
Q285	E4	F1	U175B	D4	F2
			U232	C4	H3
R231	D2	G2	U232A	D2	H3
R232	E2	I2	U232B	D3	H3
R232	E2	I2			
R241	E2	I2	VR231	D2	G2
R244	E2	G3	VR232	D2	H2
R245	E3	G3	VR260	D3	H2

P/O A2 ASSY also shown on diagrams 1, 2, & 3.

CHASSIS MOUNTED PARTS			LOW-VOLTAGE POWER SUPPLY ◈4		
CIRCUIT NUMBER	SCHEM. LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM. LOCATION	BOARD LOCATION
F42	A1	CHASSIS	P42	A1	CHASSIS
P20	A1	CHASSIS	S43	A1	CHASSIS
P41	A2	CHASSIS			

VOLTAGE AND WAVEFORM CONDITIONS

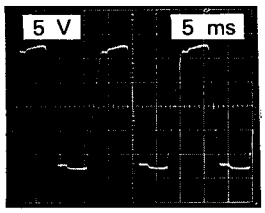
NOTE

The test equipment used to obtain the voltages and waveforms is listed in Table 6-3, 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 620 INTENSITY and position controls were set for a barely visible spot positioned at near center screen.

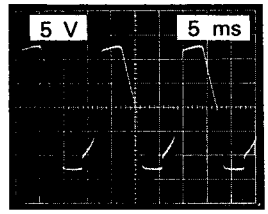
Waveform Conditions. The following waveforms were monitored with a test oscilloscope equipped with a X10 probe. The 620 INTENSITY and position controls were set for a barely visible spot positioned at near center screen. No input signals were applied to the monitor.

1



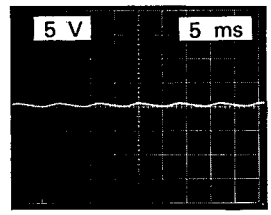
+12 V

2



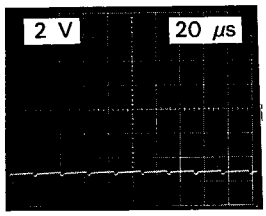
+12 V

3



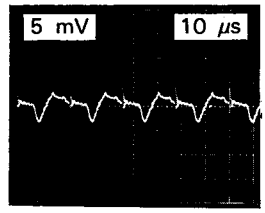
+22 V

4



-17 V

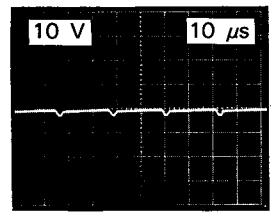
5



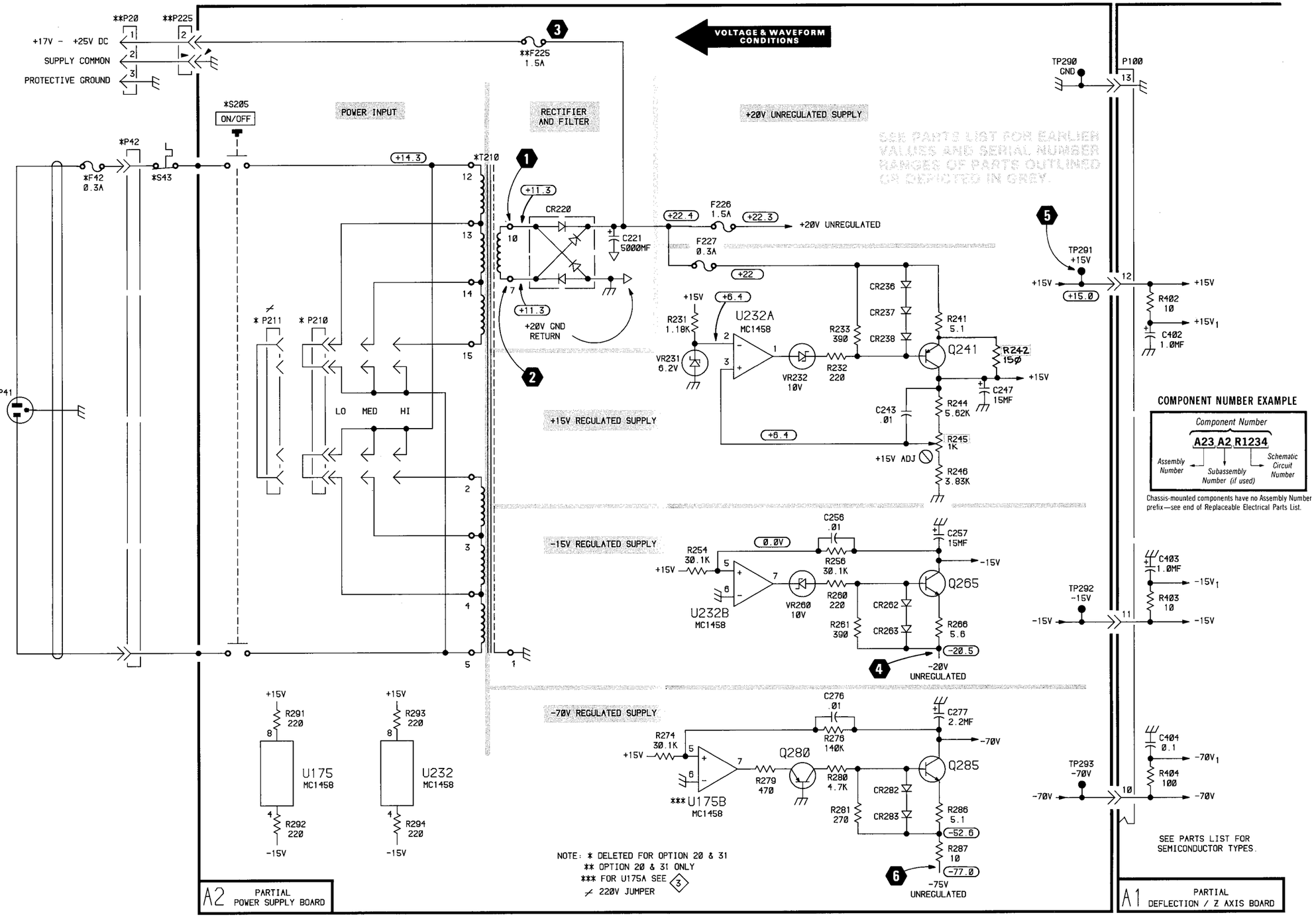
+15 V

AC COUPLED

6



-77 V



COMPONENT NUMBER EXAMPLE

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

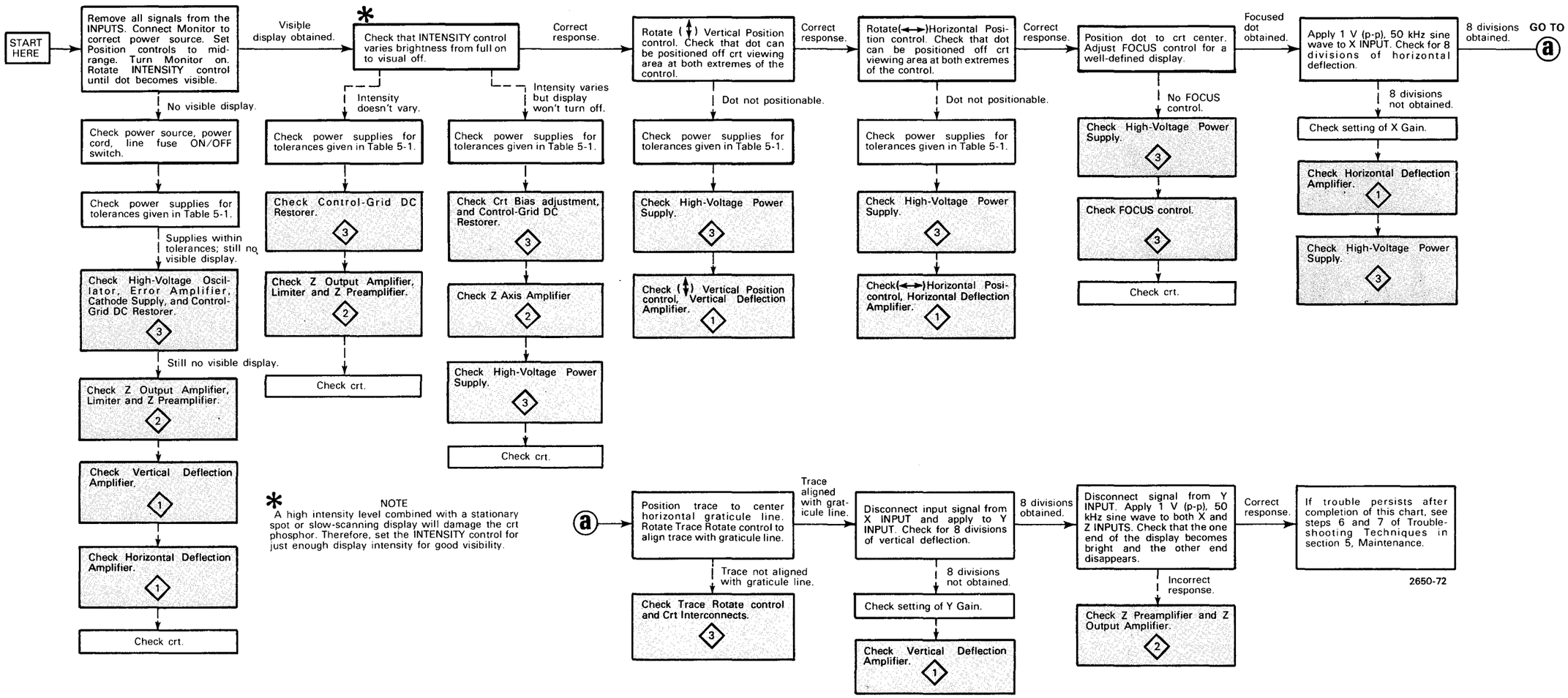
TROUBLESHOOTING CHART INSTRUCTIONS

1. Beginning at the top left block of the chart proceed to the right until the 620 does not perform as indicated.

2. Then follow the dashed line as the symptom indicates until a malfunction is located. Each shaded block in this chart indicates a circuit or stage which may be the cause of the malfunction, and corresponds directly to the circuit or stage names given on the schematic diagrams.

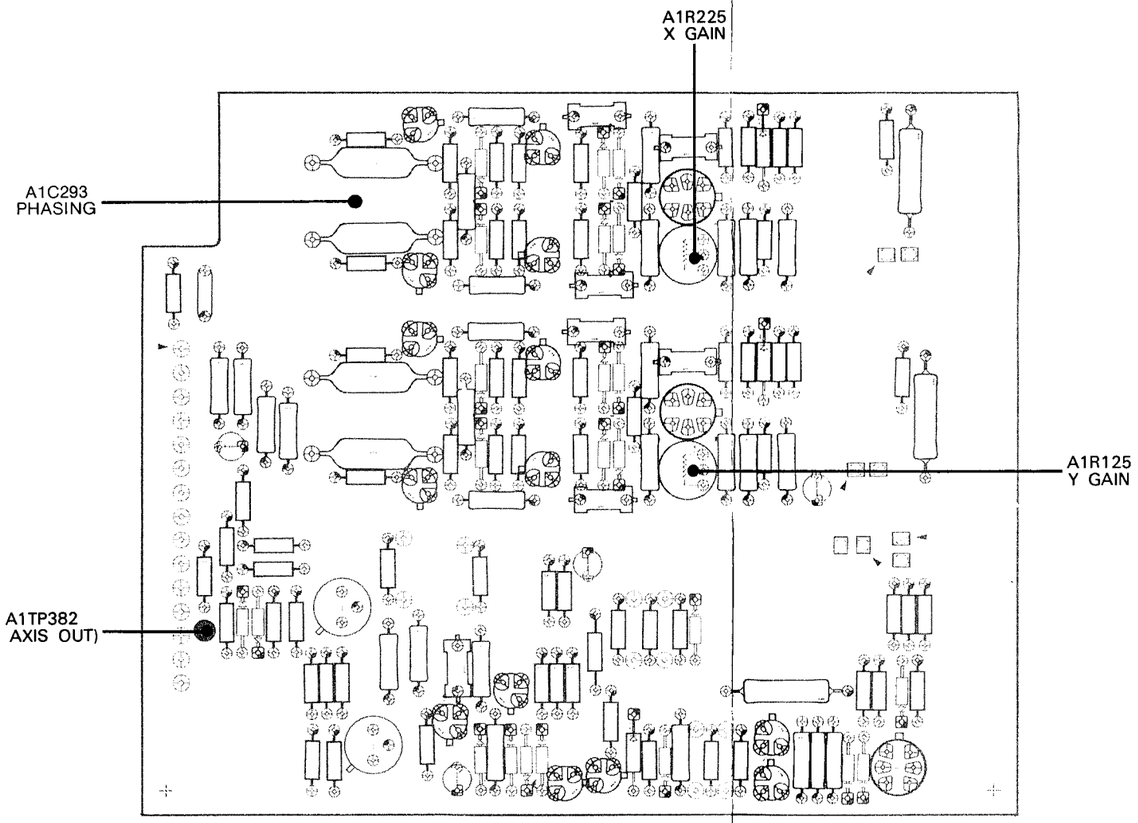
3. Refer to the numbered schematic diagram indicated in the shaded box. Important voltages and numbered waveform test points are given on the schematics to aid in troubleshooting. Typical waveforms, and the conditions under which the voltages and waveforms were taken, are located adjacent to the schematic. Located on the back of the foldout page facing the schematic is an illustration of the 620 showing the location of the board which the circuit is on. In addition, an illustration of that circuit board is included here, identifying the physical location of the circuit components and waveform test points.

4. If additional understanding of the circuit or stage is required, refer to the Theory of Operation, section 4. The circuit or stage names given in this chart and on the schematic diagrams are repeated as sub-headings in section 4, where they are discussed in detail.



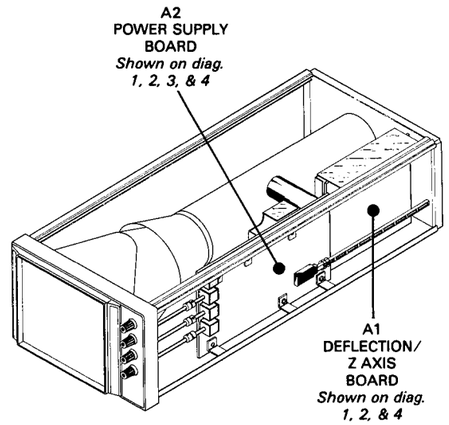
* NOTE
A high intensity level combined with a stationary spot or slow-scanning display will damage the crt phosphor. Therefore, set the INTENSITY control for just enough display intensity for good visibility.

Figure 9-7. 620 Troubleshooting Chart.



DEFLECTION Z AXIS BOARD

A1



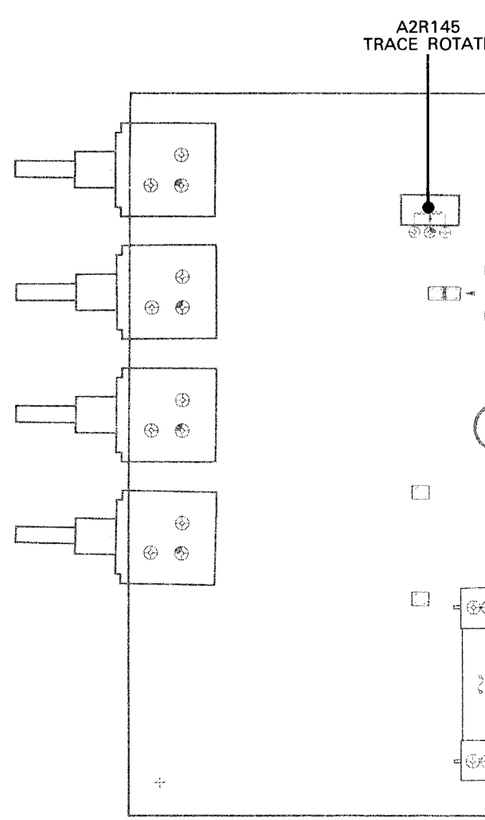
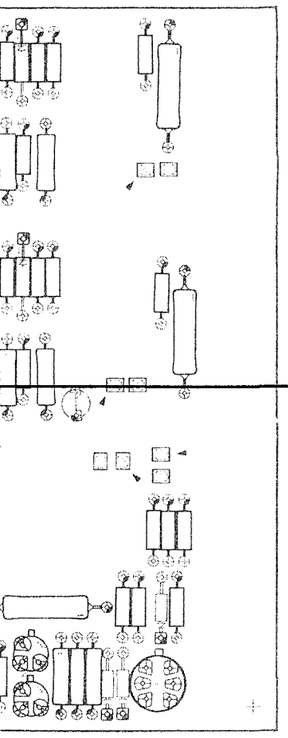
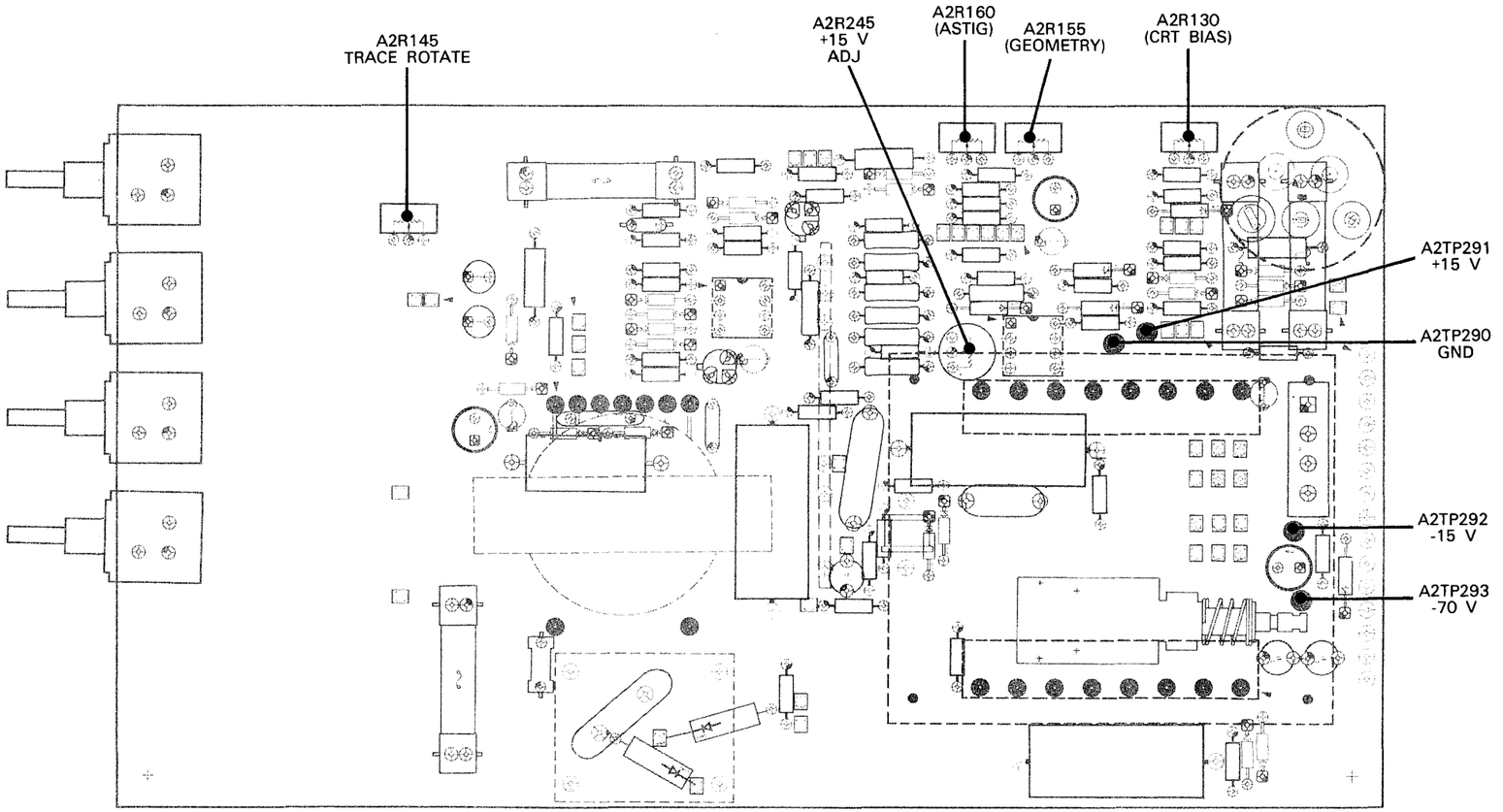


Figure 9-8. Test Point and Adjustment Locations.



A1



POWER SUPPLY BOARD

A2

Figure 9-8. Test Point and Adjustment Locations.

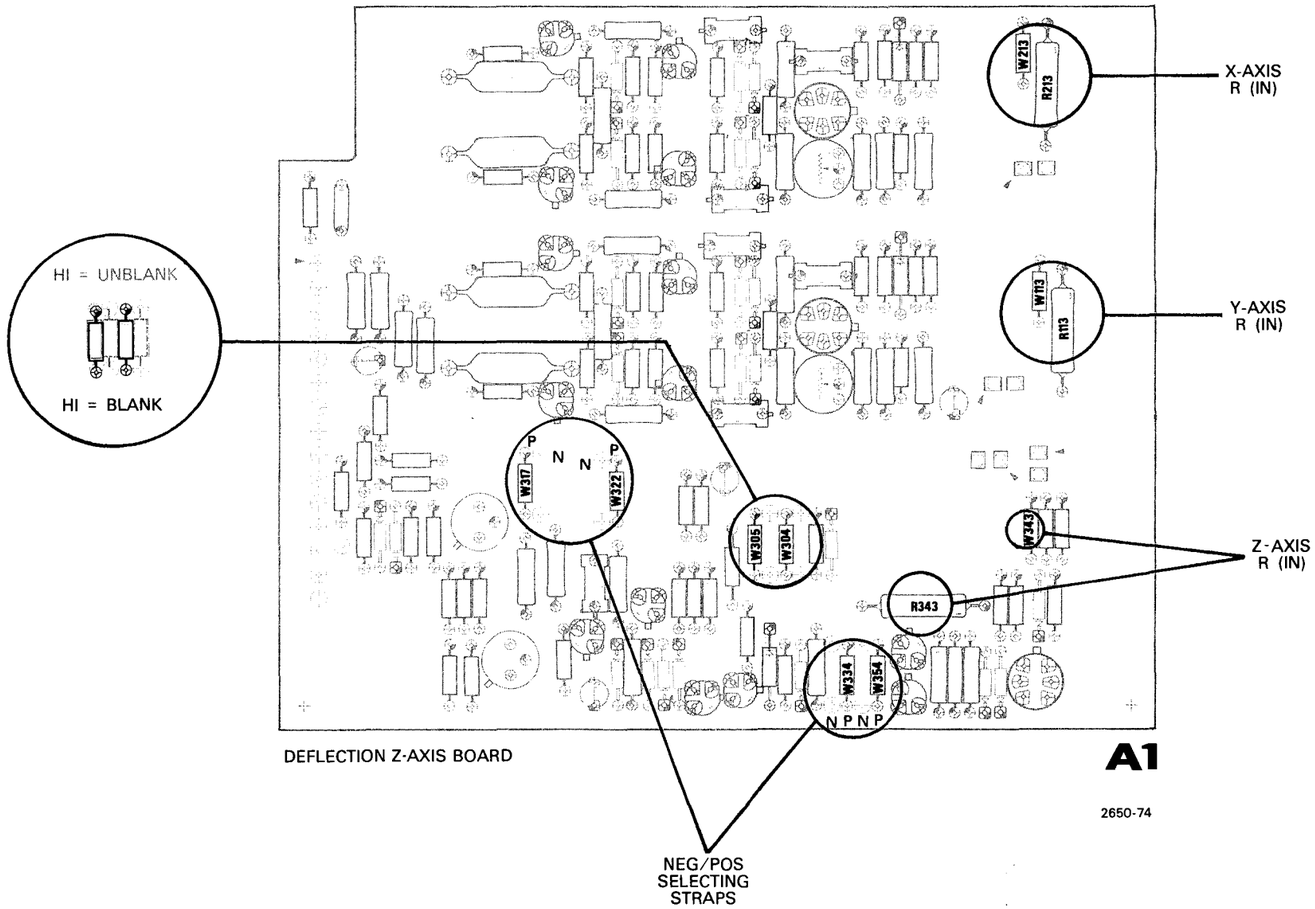
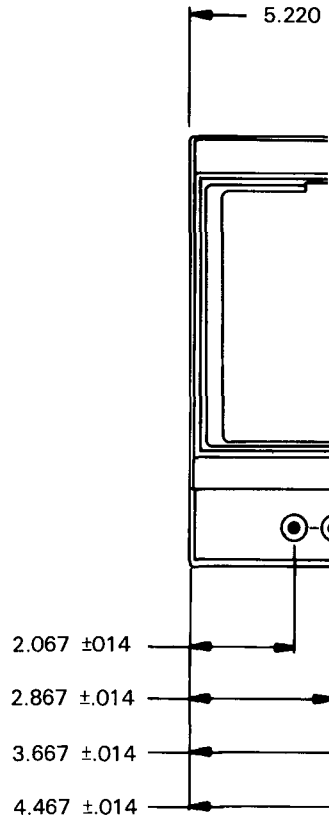


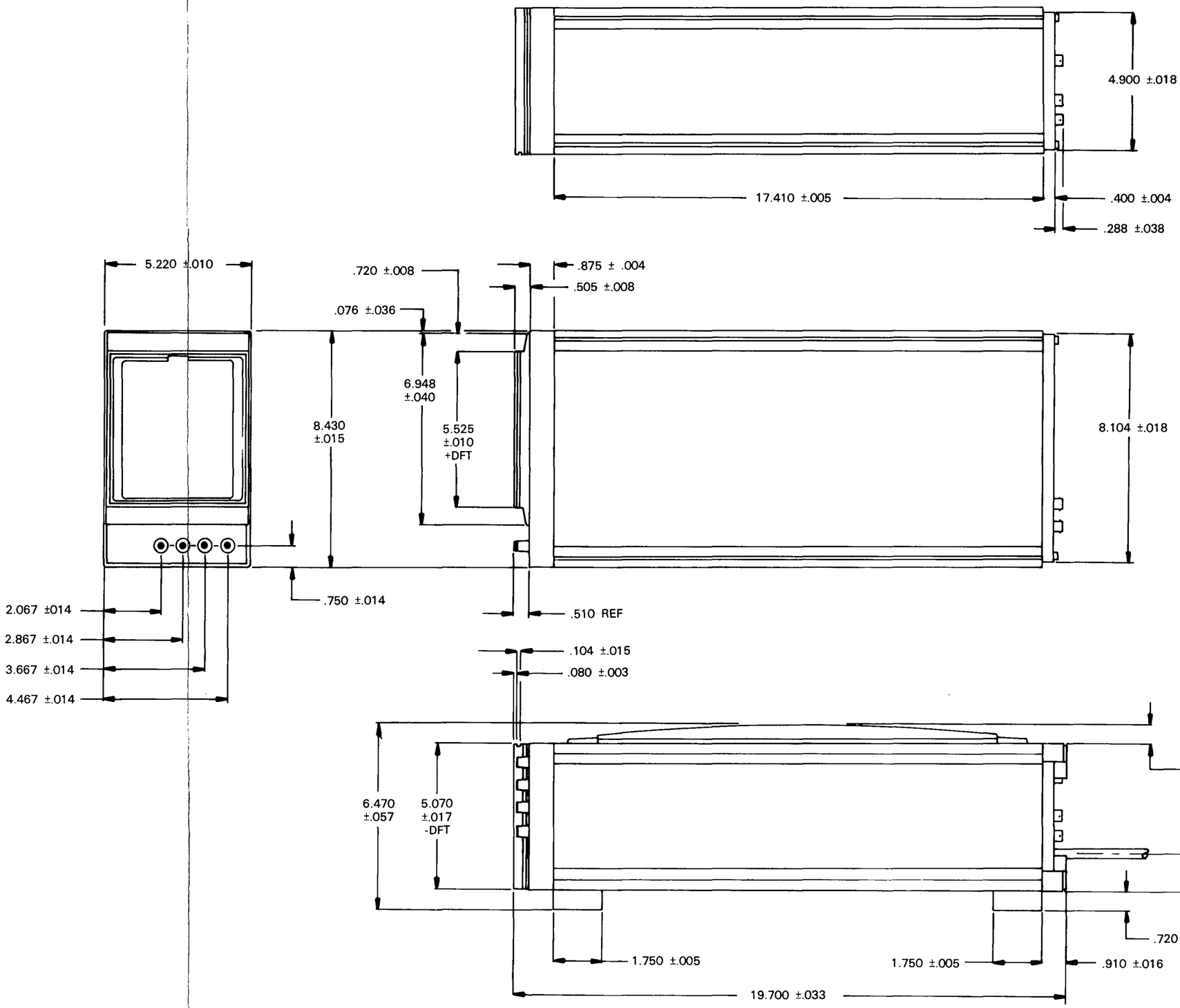
Figure 9-9. Internal Control and Selector Locations.

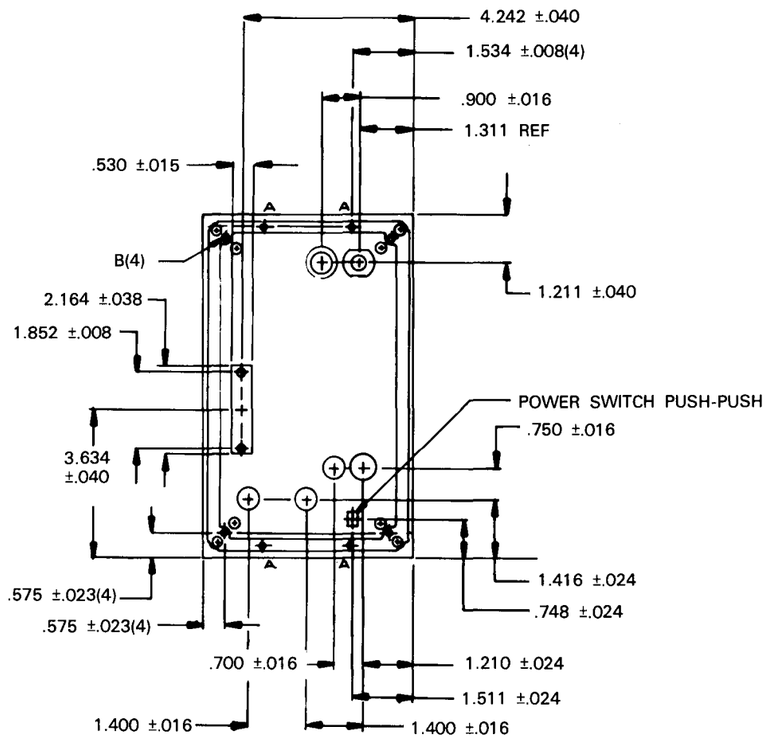
620 MONITOR

Inch to Metric Conversion

INCHES	CENTIMETERS	INCHES	CENTIMETERS
0.002	0.0051	0.720	1.829
0.003	0.0076	0.748	1.9
0.004	0.0102	0.750	1.905
0.005	0.0127	0.875	2.223
0.008	0.0232	0.900	2.286
0.010	0.0254	0.910	2.311
0.014	0.0356	1.210	3.073
0.015	0.0381	1.211	3.076
0.016	0.0406	1.311	3.33
0.017	0.0432	1.400	3.556
0.018	0.0457	1.416	3.597
0.023	0.0584	1.511	3.838
0.024	0.0610	1.534	3.896
0.027	0.0686	1.750	4.445
0.033	0.0838	1.852	4.704
0.036	0.0914	2.067	5.250
0.038	0.0965	2.164	5.497
0.040	0.1016	2.867	7.282
0.051	0.1295	3.634	9.230
0.057	0.1448	3.667	9.314
0.076	0.1930	4.242	10.775
0.080	0.2032	4.467	11.346
0.104	0.2642	4.900	12.446
0.118	0.2997	5.070	12.878
0.148	0.3759	5.220	13.259
0.288	0.7315	5.525	14.034
0.400	1.016	6.470	16.434
0.505	1.283	6.948	17.648
0.510	1.295	8.104	20.584
0.530	1.346	8.430	21.412
0.546	1.387	17.410	44.221
0.575	1.461	19.700	50.038
0.700	1.778		







1. HOLES A. .118 ±.002 DIA + DFT
   B. .148 ±.002 DIA + DFT

2650-75

Figure 9-10. 620 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.

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.

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.

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 Code
00779	AMP INC	2800 FULLING MILL PO BOX 3608	HARRISBURG PA 17105
03984	GENERAL ELECTRIC CO SEMI-CONDUCTOR PRODUCTS DEPT		CLYDE NY
05820	EG AND G WAKEFIELD ENGINEERING	60 AUDUBON RD	WAKEFIELD MA 01880-1203
06776	ROBINSON NUGENT INC	800 E 8TH ST PO BOX 1208	NEW ALBANY IN 47150-3264
07416	NELSON NAME PLATE CO	3191 CASITAS	LOS ANGELES CA 90039-2410
09922	BURNDY CORP	RICHARDS AVE	NORWALK CT 06852
11897	PLASTIGLIDE MFG CORP	2701 W EL SEGUNDO BLVD	HAWTHORNE CA 90250-3318
13103	THERMALLOY CO INC	2021 W VALLEY VIEW LN PO BOX 810839	DALLAS TX 75381
13511	AMPHENOL CADRE DIV BUNKER RAMO CORP		LOS GATOS CA
22526	DU PONT E I DE NEMOURS AND CO INC DU PONT CONNECTOR SYSTEMS DIV MILITARY PRODUCTS GROUP	515 FISHING CREEK RD	NEW CUMBERLAND PA 17070-3007
22670	G M NAMEPLATE INC	2040 15TH AVE WEST	SEATTLE WA 98119-2728
24546	CORNING GLASS WORKS	550 HIGH ST	BRADFORD PA 16701-3737
27264	MOLEX INC	2222 WELLINGTON COURT	LISLE IL 60532-1613
28520	HEYCO MOLDED PRODUCTS	750 BOULEVARD P O BOX 160	KENILWORTH NJ 07033-1721
59730	THOMAS AND BETTS CORP	HWY 218 S	IOWA CITY IA 52240
70485	ATLANTIC INDIA RUBBER WORKS INC	571 W POLK ST	CHICAGO IL 60607
71159	BRISTOL SOCKET SCREW CO		WATERBURY CT
71468	ITT CANNON DIV OF ITT CORP	10550 TALBERT AVE PO BOX 8040	FOUNTAIN VALLEY CA 92728-8040
72228	AMCA INTERNATIONAL CORP CONTINENTAL SCREW CO DIV	459 MT PLEASANT	NEW BEDFORD MA 02742
73743	FISCHER SPECIAL MFG CO	111 INDUSTRIAL RD	COLD SPRING KY 41076-9749
75915	LITTELFUSE TRACTOR INC SUB TRACTOR INC	800 E NORTHWEST HWY	DES PLAINES IL 60016-3049
77900	SHAKEPROOF DIV OF ILLINOIS TOOL WORKS	SAINT CHARLES RD	ELGIN IL 60120
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF DIV	ST CHARLES ROAD	ELGIN IL 60120
80009	TEKTRONIX INC	14150 SW KARL BRAUM DR PO BOX 500 MS 53-111	BEAVERTON OR 97077
83309	ELECTRICAL SPECIALITY CO SUBSIDIARY OF BELDEN CORP	345 SWIFT AVE	SOUTH SAN FRANCISCO CA 94080-6206
83385	MICRODOT MFG INC GREER-CENTRAL DIV	3221 W BIG BEAVER RD	TROY MI 48098
83486	ELCO INDUSTRIES INC	1101 SAMUELSON RD	ROCKFORD IL 61101
85471	BOYD CORP	13885 RAMONA AVE	CHINO CA 91710
86928	SEASTROM MFG CO INC	701 SONORA AVE	GLENDALE CA 91201-2431
93907	TEXTRON INC CAMCAR DIV	600 18TH AVE	ROCKFORD IL 61101
96904	HIGH VOLTAGE ENGINEERING CORP NARVAR CO DIV	ROUTE 70 EAST PO BOX 658	CLAYTON NC 27520
S3629	SCHURTER AG H C/O PANEL COMPONENTS CORP	2015 SECOND STREET	BERKELEY CA 94170
TK0392	NORTHWEST FASTENER SALES INC	7923 SW CIRRUS DRIVE	BEAVERTON OR 97005-6448
TK0435	LEWIS SCREW CO	4300 S RACINE AVE	CHICAGO IL 60609-3320
TK0588	UNIVERSAL PRECISION PRODUCTS	1775 NW 216TH	HILLSBORO OR 97123

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1-1	426-1468-00			1	FRAME,MASK:PLASTIC	80009	426-1468-00
-2	200-2193-00			1	COVER,OPENING:LEFT,CRT RETAINER	80009	200-2193-00
	200-2192-00			1	COVER,OPENING:RIGHT,CRT RETAINER	80009	200-2192-00
-3	200-2143-01			1	RTNR,CRT SCALE:6.0 CRT,ALUMINUM	80009	200-2143-01
					(ATTACHING PARTS)		
-4	213-0808-00			4	SCREW,TPG,TR:8-32 X 0.625 L,TAPTITE,FILH	83486	239-006-408062
					(END ATTACHING PARTS)		
-5	337-2537-02	B010100	B010538	1	SHLD,IMPLOSION:5.854 X 4.714 X 0.09,CLEAR	80009	337-2537-02
	331-0455-00	B010539		1	SCALE,CRT:GRID,CLEAR,W/GRATICULE	80009	331-0455-00
	378-0178-00	B021800		1	FILTER,LT,CRT:AMBER,ACRYLIC	80009	378-0178-00
					(OPTION 76 ONLY)		
-6	343-0751-00	B010100	B029882	4	CLP,ELCTRN TUBE:CRT,6 INCH,NYLON,GRAY	80009	343-0751-00
	343-0751-01	B029883		4	CLP,ELCTRN TUBE:CRT,6 INCH,NYLON,GRAY	80009	343-0751-01
					(ATTACHING PARTS)		
-7	211-0669-00	B010100	B029882	4	SCREW,MACHINE:6-32 X 0.75,PNH,SST	83486	ORDER BY DESCR
	211-0694-00	B029883		4	SCREW,MACHINE:6-32 X 1.125,PNH SST	83385	ORDER BY DESCR
					(END ATTACHING PARTS)		
-8	366-1189-00			4	KNOB:GY,0.127 ID X 0.5 OD X 0.531	80009	366-1189-00
	213-0246-00			4	.SETSCREW:5-40 X 0.094,STL	71159	ORDER BY DESCR
-9	333-2490-00			1	PANEL,FRONT:	80009	333-2490-00
					(ATTACHING PARTS)		
-10	210-0586-00			2	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	78189	211-041800-00
					(END ATTACHING PARTS)		
-11	384-0341-00			4	EXTENSION SHAFT:3.6 L X 0.125 OD,AL	80009	384-0341-00
-12	376-0051-01			4	CPLG,SHAFT,FLEX:0.127 ID X 0.375 OD,DELRIN	80009	376-0051-01
					EACH COUPLER INCLUDES:		
	213-0048-00			4	.SETSCREW:4-40 X 0.125,STL	TK0392	ORDER BY DESCR
-13	426-1517-01	B010100	B021599	1	FRAME,CABINET:FRONT	80009	426-1517-01
	426-1517-06	B021600		1	FRAME,CABINET:FRONT	80009	426-1517-06
					(ATTACHING PARTS)		
-14	213-0760-00			4	SCREW,TPG,TF:8-32 X 0.875,SPCL TAPTITE,FILH	72228	ORDER BY DESCR
					(END ATTACHING PARTS)		
-15	----- -----			1	TRANSISTOR:(SEE Q35 REPL)		
					(ATTACHING PARTS)		
-16	211-0198-00			1	SCREW,MACHINE:4-40 X 0.438,PNH,STL	TK0435	ORDER BY DESCR
-17	210-0586-00			1	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	78189	211-041800-00
-18	210-1122-00			1	WASHER,LOCK:0.12 ID,DISHED,0.025 THK,STL	86928	ORDER BY DESCR
					(END ATTACHING PARTS)		
-19	342-0163-00			1	INSULATOR,PLATE:TRANSISTOR,MICA	80009	342-0163-00
-20	108-0918-00			1	COIL,TUBE DEFL:TRACE ROTATOR	80009	108-0918-00
-21	348-0233-00			1	GROMMET,PLASTIC:GRAY,OBLONG 0.847 X 0.347	80009	348-0233-00
-22	348-0145-00			1	GROMMET,PLASTIC:GRAY,U SHAPE,0.48 ID	80009	348-0145-00
-23	348-0090-00			3	PAD,CUSHIONING:2.03 X 0.69 X 0.312 SI RBR	85471	R-1047OMED/PSA
-23.1	334-1379-00			1	MARKER,IDENT:MKD HI VACUUM	07416	ORDER BY DESCR
-24	337-2521-00			1	SHIELD,CRT:	80009	337-2521-00
					(ATTACHING PARTS)		
-25	210-0586-00			3	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	78189	211-041800-00
-26	211-0008-00	B010100	B021799	3	SCREW,MACHINE:4-40 X 0.25,PNH,STL	93907	ORDER BY DESCR
	211-0012-00	B021800		3	SCREW,MACHINE:4-40 X 0.375,PNH,STL	TK0435	ORDER BY DESCR
	210-0004-00	B021800		3	WASHER,LOCK:#4 INTL,0.015 THK,STL	77900	1204-00-00-0541C
					(END ATTACHING PARTS)		
-27	136-0706-00			1	SKT,PL-IN ELEK:ELCTRN TUBE,11 CONT,W/LEADSS	80009	136-0706-00
					AFETY CONTROLLED		
-28	136-0202-04			1	.SKT,PL-IN ELEK:ELECTRON TUBE,14 CONTACT	80009	136-0202-04
-29	131-0707-00			6	.CONTACT,ELEC:22-26 AWG,BRS,CU BE GLD PL	22526	47439-000
	131-0621-00			5	.CONN,TERM:22-26 AWG,BRS,CU BE GLD PL	22526	46231-000
-30	352-0164-00			1	.HLDR,TERM CONN:6 WIRE,BLACK	80009	352-0164-00
-31	162-0009-00			1	.INSUL SLVG,ELEC:0.234 ID,PVC,BLK,105 DEG C,	96904	TYPE400SIZE3BLK
					.0.025 THK W,UL		
-32	204-0640-00			1	CONN BODY,RCPT:3 FEMALE CONTACTS	00779	1-480304-0
-33	343-0786-01			1	CLAMP,CRT SHLD:	80009	343-0786-01
					(ATTACHING PARTS)		
-34	211-0542-00			2	SCREW,MACHINE:6-32 X 0.312,TRH,STL	TK0435	ORDER BY DESCR
-35	210-1124-00			2	WASHER,SPR TNSN:0.171 ID X 0.562 OD X 0.015	78189	3502-08-15
					THK,STL		
	220-0419-00			2	NUT,PLAIN,SQ:6-32 X 0.312 SQ,STL CD PL	83385	ORDER BY DESCR
					(END ATTACHING PARTS)		
-36	346-0133-00			3	STRAP,TIEDOWN,E:14.0 X 0.091,NYLON	59730	TY234M

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1-36.1	334-3457-00			1	MARKER,IDENT:MARKED DANGER	80009	334-3457-00
-37	348-0005-00			2	GROMMET,RUBBER:BLACK,ROUND,0.375 ID	70485	230X-36017
-37.1	334-3710-00	B011100	B011349	1	MARKER,IDENT:MARKED CAUTION	80009	334-3710-00
	334-3710-01	B011350		1	MARKER,IDENT:MKD CAUTION	80009	334-3710-01
-38	337-2582-00			1	SHIELD,ELEC:CIRCUIT BOARD (ATTACHING PARTS)	80009	337-2582-00
-39	211-0019-00			4	SCREW,MACHINE:4-40 X 1.0,PNH,STL	TK0435	ORDER BY DESCR
-40	361-0396-00			4	SPACER,SLEEVE:0.56 L X 0.125 ID,DELRIN (END ATTACHING PARTS)	TK0588	ORDER BY DESCR
-41	----- -----			1	CKT BOARD ASSY:DEFL & Z AXIS(SEE A1 REPL)		
-42	131-2225-00			1	.CONN,RCPT,ELEC:CKT BD,15 CONT,FEMALE	27264	09-52-3153
-43	131-0608-00			8	.TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
-44	214-1291-00			2	.HEAT SINK,XSTR:TO-5,SIL BRZ PTD BLACK	05820	207SB
-45	348-0566-00			2	.PAD,MOUNTING:TO-5 TRANSISTOR	13103	7717-159N WHITE
-46	131-0566-00			7	.BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
-47	214-0579-00			1	.TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-48	337-1995-00			2	.SHIELD,ELEC:DEFLECTION CKT BD	80009	337-1995-00
-48.1	198-4091-00	B010100	B022689	1	.WIRE SET,ELEC:	80009	198-4091-00
	198-4091-01	B022690		1	.WIRE SET,ELEC:	80009	198-4091-01
-49	131-1109-01	B010100	B022689	4	..CONNECTOR,TERM:20-26 AWG,U/O 0.04 OD PIN	80009	131-1109-01
	131-2525-00	B022690		4	..CONN,PLUG,ELEC:CRT,22-26 AWG	06776	PS40-101
-49.1	343-0854-00	B022690		4	..STRAIN RLF,TERM:CIRCUIT BOARD,22-26 AWG	27264	16-02-0034
-50	337-2596-00			1	SHIELD,ELEC:HIGH VOLTAGE (ATTACHING PARTS)	80009	337-2596-00
-51	211-0020-00			2	SCREW,MACHINE:4-40 X 1.125,PNH,STL	TK0435	ORDER BY DESCR
	212-0507-00			2	SCREW,MACHINE:10-32 X 0.375,PNH,STL (OPTION 20 AND 31 ONLY)	TK0435	ORDER BY DESCR
	210-0586-00			1	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL (OPTIONS 20 AND 31 ONLY) (END ATTACHING PARTS)	78189	211-041800-00
-52	----- -----			1	SWITCH,THRMSTC:(SEE S43 REPL) (ATTACHING PARTS)		
-53	211-0008-00	B010100	B021799	2	SCREW,MACHINE:4-40 X 0.25,PNH,STL	93907	ORDER BY DESCR
	211-0012-00	B021800		3	SCREW,MACHINE:4-40 X 0.375,PNH,STL	TK0435	ORDER BY DESCR
	210-0004-00	B021800		3	WASHER,LOCK:#4 INTL,0.015 THK,STL	77900	1204-00-00-0541C
	210-0994-00	B021800		3	WASHER,FLAT:0.125 ID X 0.25 OD X 0.022,STL (END ATTACHING PARTS)	86928	A371-283-20
-54	255-0334-00			AR	PLASTIC CHANNEL:12.75 X 0.175 X 0.155,NYLON	11897	122-37-2500
-55	407-2235-00			1	BRACKET,SUPPORT:TRANSFORMER,AL (ATTACHING PARTS)	80009	407-2235-00
-56	212-0515-00			2	SCREW,MACHINE:10-32 X 2.25,HEX HD,STL	TK0435	ORDER BY DESCR
-57	212-0520-00			2	SCREW,MACHINE:10-32 X 1.25,HEX HD,STL	83385	ORDER BY DESCR
-58	220-0410-00			4	NUT,PL,ASSEM WA:10-32 X 0.375 HEX,STL CD PL	78189	511-101800-50
-59	210-0812-00			4	WASHER,FLAT:0.188 ID X 0.375 OD X 0.31	83309	ORDER BY DESCR
-60	361-0943-00			2	SPACER,SLEEVE:0.75 L X 0.196 ID,AL (END ATTACHING PARTS)	80009	361-0943-00
-61	166-0226-00			4	INSUL SLVG,ELEC:0.187 ID X 1.125 L,MYLAR	80009	166-0226-00
-62	----- -----			1	TRANSFORMER:(SEE T210 REPL) (ATTACHING PARTS)		
-63	129-0388-00			1	SPACER,POST:1.673 L,6-32 & 4-40 ENDS,AL,0.2 5 HEX	80009	129-0388-00
-64	211-0507-00			1	SCREW,MACHINE:6-32 X 0.312,PNH,STL (END ATTACHING PARTS)	83385	ORDER BY DESCR
-64.1	334-3457-00			1	MARKER,IDENT:MARKED DANGER	80009	334-3457-00
-65	----- -----			1	CKT BOARD ASSY:POWER SUPPLY(SEE A2 REPL) (ATTACHING PARTS)		
-66	213-0789-00			4	SCREW,TPG,TF:6-32 X 0.375,TAPTITE,PNH,STL (END ATTACHING PARTS)	93907	234-21860-024
-67	131-0608-00			24	.TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
-68	131-0589-00			8	.TERMINAL,PIN:0.46 L X 0.025 SQ PH BRZ	22526	48283-029
-69	131-1895-00			1	.BUS,CONDUCTOR:8,22 AWG,1.5L	80009	131-1895-00
	131-1896-00			1	.BUS,CONDUCTOR:8.22 AWG,1.5 L	80009	131-1896-00
-70	131-2233-00			1	.CONN,RCPT,ELEC:HEADER 1X15,0.045 SQ PIN,0.1 .56 CTR	27264	09-67-1153
-71	136-0514-00			2	.SKT,PL-IN ELEK:MICROCIRCUIT,8 DIP	09922	DILB8P-108
-72	214-0579-00			4	.TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-73	131-0566-00			8	.BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
-74	----- -----			2	.RES.,VAR NONWIR:(SEE R305 AND R315 REPL)		

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1-					.RES.,VAR NONWIR:(SEE R245 REPL)		
					.RES.,VAR NONWIR:(SEE R165 REPL)		
-75	344-0154-00			8	.CLIP,ELECTRICAL:FUSE,CKT BD MT	80009	344-0154-00
	129-0368-00			3	.SPACER,POST:0.250	80009	129-0368-00
-76	407-2157-00			4	.BRACKET,CMPNT:UPPER EXTENSION,ALUMINUM	80009	407-2157-00
					(ATTACHING PARTS)		
-77	213-0868-00			4	SCREW,TPG,TF:6-32 X 0.375 L,FILH,STL	93907	ORDER BY DESCR
					(END ATTACHING PARTS)		
-78	407-2158-00			1	BRACKET,CMPNT:UPPER EXTENSION,ALUMINUM	80009	407-2158-00
					(ATTACHING PARTS)		
-79	213-0868-00			1	SCREW,TPG,TF:6-32 X 0.375 L,FILH,STL	93907	ORDER BY DESCR
					(END ATTACHING PARTS)		
-80	407-2204-00			2	BRACKET,CMPNT:ALUMINUM	80009	407-2204-00
					(ATTACHING PARTS)		
-81	213-0868-00			2	SCREW,TPG,TF:6-32 X 0.375 L,FILH,STL	93907	ORDER BY DESCR
					(END ATTACHING PARTS)		
-82	407-2250-00			4	BRACKET,CMPNT:ALUMINUM	80009	407-2250-00
					(ATTACHING PARTS)		
-83	213-0868-00			4	SCREW,TPG,TF:6-32 X 0.375 L,FILH,STL	93907	ORDER BY DESCR
					(END ATTACHING PARTS)		
-84	200-0865-00			1	COVER,MTG HOLE:2.164 X 0.53,AL	80009	200-0865-00
					(ATTACHING PARTS)		
-85	211-0008-00	B010100	B021799	2	SCREW,MACHINE:4-40 X 0.25,PNH,STL	93907	ORDER BY DESCR
	211-0012-00	B021800		3	SCREW,MACHINE:4-40 X 0.375,PNH,STL	TK0435	ORDER BY DESCR
	210-0004-00	B021800		3	WASHER,LOCK:#4 INTL,0.015 THK,STL	77900	1204-00-00-0541C
	210-0994-00	B021800		3	WASHER,FLAT:0.125 ID X 0.25 OD X 0.022,STL	86928	A371-283-20
-86	210-0586-00			2	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	78189	211-041800-00
					(END ATTACHING PARTS)		
-87	200-0237-03	B010100	B011110	1	COVER,FUHLR:	80009	200-0237-03
	200-0237-04	B011111		1	COVER,FUHLR:PLASTIC	80009	200-0237-04
-88	352-0362-01	B010100	B011099	1	FUHLR,EXTR POST:3AG,20A,300V	75915	345613 W/901002
	200-2264-00	B011100		1	CAP,FUSEHOLDER:3AG FUSES	S3629	FEK 031 1666
	204-0837-00	B011100		1	BODY,FUSEHOLDER:3AG,6.3A,250V,PNL MT,UL	S3629	031.1681
-89	161-0017-12			1	CABLE ASSY,PWR,:3,18 AWG,125V,96.0 L	80009	161-0017-12
-90	358-0529-00			1	BSHG,STRAIN RLF:U/W 0.36 DIA CABLE,STRAIGHT	28520	207 (UL 6P3-4)
					SAFETY CONTROLLED		
-91	134-0159-00			1	BUTTON,PLUG:0.38 DIA,PLASTIC	80009	134-0159-00
-92	----- -----			3	CONNECTOR,RCPT:(SEE J12,J17,J25 REPL)		
-93	407-2203-00	B010100	B010134	1	BRACKET,CMPNT:BRASS	80009	407-2203-00
	407-2203-01	B010135		1	BRACKET,CMPNT:ALUMINUM	80009	407-2203-01
					(ATTACHING PARTS)		
-94	211-0008-00	B010100	B021799	2	SCREW,MACHINE:4-40 X 0.25,PNH,STL	93907	ORDER BY DESCR
	211-0012-00	B021800		3	SCREW,MACHINE:4-40 X 0.375,PNH,STL	TK0435	ORDER BY DESCR
	210-0004-00	B021800		3	WASHER,LOCK:#4 INTL,0.015 THK,STL	77900	1204-00-00-0541C
	210-0994-00	B021800		3	WASHER,FLAT:0.125 ID X 0.25 OD X 0.022,STL	86928	A371-283-20
					(END ATTACHING PARTS)		
-95	407-2201-00	B010100	B010134	1	BRACKET,CMPNT:BRASS	80009	407-2201-00
	407-2201-01	B010135		1	BRACKET,CMPNT:ALUMINUM	80009	407-2201-01
					(ATTACHING PARTS)		
-96	211-0008-00	B010100	B021799	1	SCREW,MACHINE:4-40 X 0.25,PNH,STL	93907	ORDER BY DESCR
	211-0012-00	B021800		3	SCREW,MACHINE:4-40 X 0.375,PNH,STL	TK0435	ORDER BY DESCR
	210-0004-00	B021800		3	WASHER,LOCK:#4 INTL,0.015 THK,STL	77900	1204-00-00-0541C
	210-0994-00	B021800		3	WASHER,FLAT:0.125 ID X 0.25 OD X 0.022,STL	86928	A371-283-20
					(END ATTACHING PARTS)		
-97	366-1402-93			1	PUSH BUTTON:SIL GY,POWER	80009	366-1402-93
-98	384-1059-00			1	EXTENSION SHAFT:6.58 L	80009	384-1059-00
-99	----- -----			1	SWITCH,PUSH(SEE S205 REPL)		
	334-3379-00	B010100	B031074	1	MARKER,IDENT:MARKED GROUND SYMBOL	07416	ORDER BY DESCR
	334-3379-02	B031075		1	MARKER,IDENT:MARKED GROUND SYMBOL	22670	ORDER BY DESCR
-100	386-4004-00	B010100	B010694	1	PLATE,CAB.FRAME:REAR,ALUMINUM	80009	386-4004-00
	386-4004-01	B010695		1	PLATE,CAB.FRAME:REAR,ALUMINUM	80009	386-4004-01
					(ATTACHING PARTS)		
-101	213-0801-00	B010100	B023299	4	SCREW,TPG,TF:8-32 X 0.312,TAPTITE,PNH,STL	83486	ORDER BY DESCR
	213-0258-00	B023300	B032766	4	SCREW,TPG,TF:8-32 X 0.5,SPCL TYPE,FILH,STL	83385	ORDER BY DESCR
	213-0808-00	B032767		4	SCREW,TPG,TR:8-32 X 0.625 L,TAPTITE,FILH	83486	239-006-408062
					(END ATTACHING PARTS)		
-102	210-0202-00			1	TERMINAL,LUG:0.146 ID,LOCKING,BRZ TIN PL	86928	A-373-158-2
					(ATTACHING PARTS)		

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1-103	210-0457-00			1	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	78189	511-061800-00
					(END ATTACHING PARTS)		
-104	426-1449-03	B010100	B021599	1	FRAME,CABINET:REAR,AL	80009	426-1449-03
	426-1449-06	B021600		1	FRAME,CABINET:REAR	80009	426-1449-06
-105	426-1541-00			4	FRAME SECT,CAB.:17.41 L,AL	80009	426-1541-00
					(ATTACHING PARTS)		
-106	213-0760-00			4	SCREW,TPG,TF:8-32 X 0.875,SPCL TAPTITE,FILH	72228	ORDER BY DESCR
					(END ATTACHING PARTS)		
	198-4088-00			1	WIRE SET,ELEC:	80009	198-4088-00
-107	131-0621-00			1	.CONN,TERM:22-26 AWG,BRS,CU BE GLD PL	22526	46231-000
-108	352-0199-00			1	.HLDR,TERM CONN:3 WIRE,BLACK	80009	352-0199-00
-109	175-0862-00			AR	.CABLE,SP,ELEC:3,22 AWG,STRD,PVC JKT,RBN	TK0846	03CF22M19-BBT
	198-4089-00	B010100	B021730	1	WIRE SET,ELEC:	80009	198-4089-00
	198-4089-01	B021731		1	WIRE SET,ELEC:	80009	198-4089-01
-110	131-1055-00			2	.CONTACT,ELEC:CONN PIN,BRASS TIN PL	00779	61118-1
	204-0639-00			1	.CONN BODY,PLUG:3 MALE CONTACTS	80009	204-0639-00

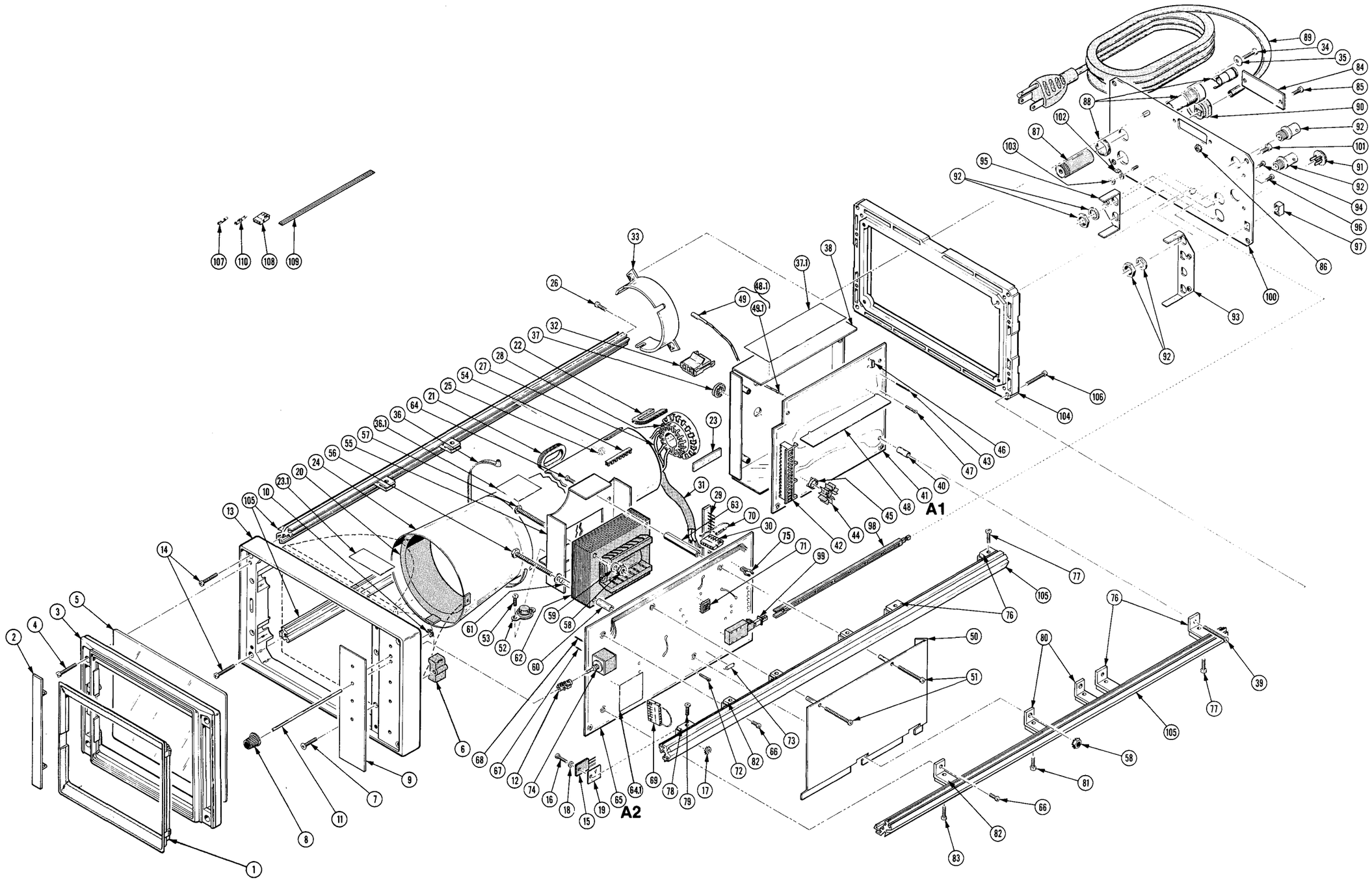


FIG. 1 EXPLODED

FIG. 2 OPTION 6

OPTION 6

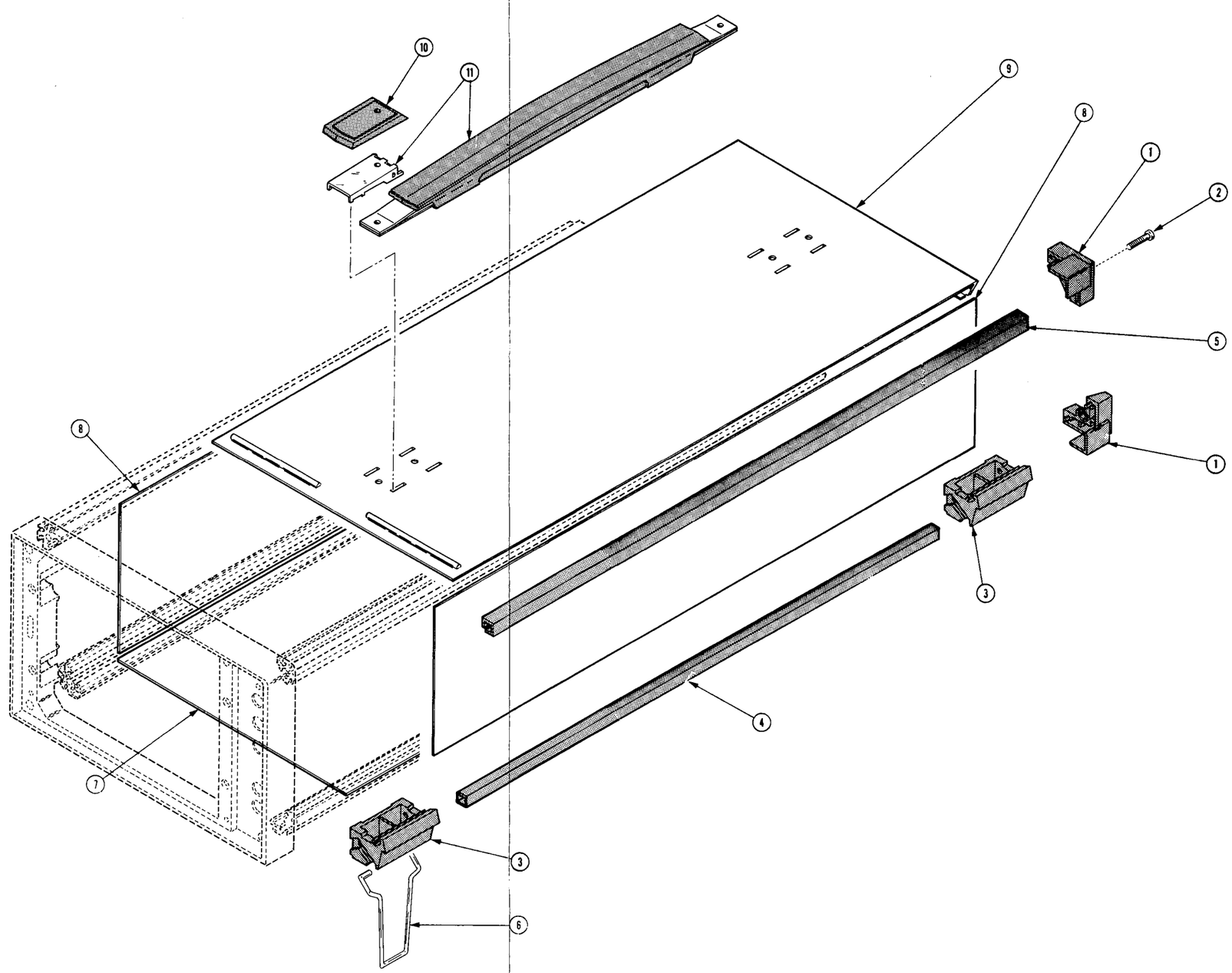
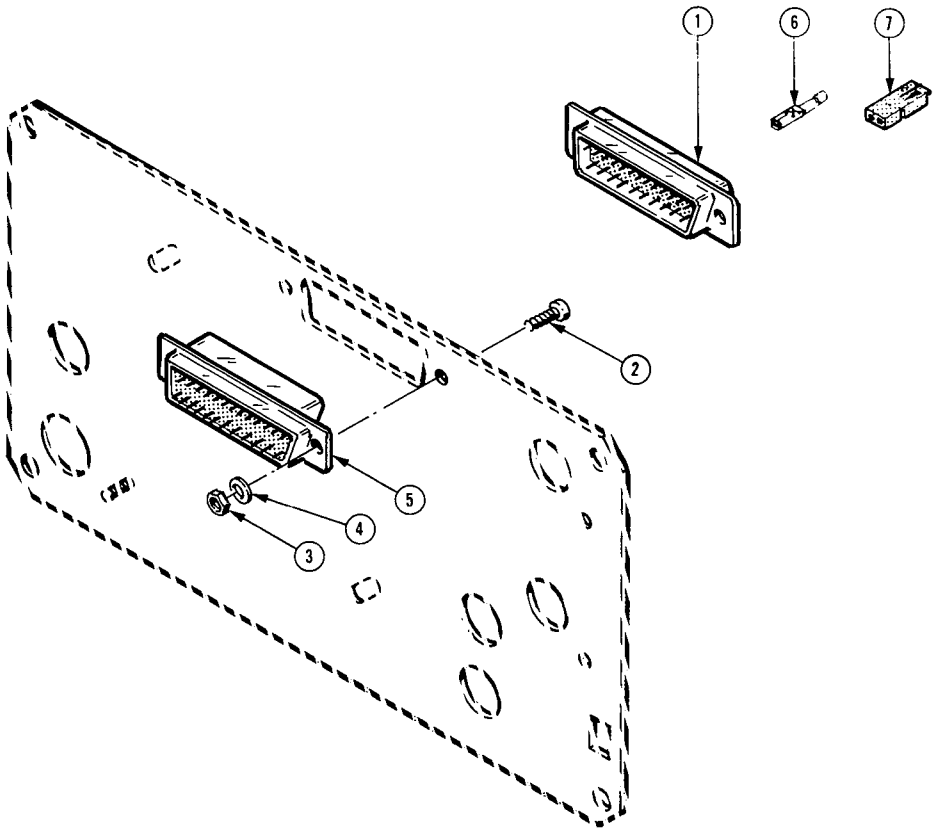


Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345	Name & Description	Mfr. Code	Mfr. Part No.
2-						OPTION 06		
-1	348-0544-00			4		RTNR,CAB.COVER:CORNER,TEK BLUE,PC	80009	348-0544-00
						(ATTACHING PARTS)		
-2	213-0782-00			4		SCREW,TPG,TF:8-32 X 0.625,FILH,STL	83486	ORDER BY DESCR
						(END ATTACHING PARTS)		
-3	348-0543-00	B010100	B010412	4		FOOT,CABINET:BOT,TEK BLUE,POLYCARBONATE	80009	348-0543-00
	348-0617-00	B010413		4		FOOT,CABINET:BOT,TEK BLUE,POLYCARBONATE	80009	348-0617-00
-4	124-0355-00			2		STRIP,TRIM:CORNER,BOT,BLUE,13.91 L	80009	124-0355-00
-5	124-0354-00			2		STRIP,TRIM:CORNER,TOP,BLUE,17.41 L	80009	124-0354-00
-6	348-0568-01	B010100	B010412	2		FLIP-STAND,CAB.:2.5 H,AL,FINISHED	80009	348-0568-01
	348-0618-01	B010413	B010814	2		FLIP-STAND,CAB.:2.5 H,AL,FINISHED	80009	348-0618-01
	348-0275-00	B010815		1		FLIP-STAND,CAB.:3.75 H,SST	80009	348-0275-00
	348-0596-00			4		PAD,CAB.FOOT:0.69 X 0.255 X 0.06,PU	80009	348-0596-00
-7	390-0647-00			1		CABINET BOTTOM:0.5 RACK X 17.960	80009	390-0647-00
-8	390-0646-00			1		CABINET SIDE:5.25 X 17.960	80009	390-0646-00
-9	390-0655-01			1		CABINET TOP:W/HANDLE RETAINER,17.960	80009	390-0655-01
-10	200-2191-00			2		CAP,RETAINER:PLASTIC	80009	200-2191-00
-11	367-0248-01			1		HANDLE,CARRYING:16.341 L,W/CLIP	80009	367-0248-01
	334-3567-00			1		MARKER,IDENT:MARKED DANGER	80009	334-3567-00
	131-1703-00			1		CONN,PLUG,ELEC:PWR,MALE,125V,15A W/HOSP GND	03984	GED 0511H

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345	Name & Description	Mfr. Code	Mfr. Part No.
3-						OPTION 10		
-1	131-0569-00			1		CONN,RCPT,ELEC:25 CONTACT,FEMALE	71468	DB-25S
						(ATTACHING PARTS)		
-2	211-0101-00			2		SCREW,MACHINE:4-40 X 0.25,FLH,100 DEG,STL	TK0435	ORDER BY DESCR
-3	210-0406-00			2		NUT,PLAIN,HEX:4-40 X 0.188,BRS CD PL	73743	12161-50
-4	210-0004-00			2		WASHER,LOCK:#4 INTL,0.015 THK,STL	77900	1204-00-00-0541C
						(END ATTACHING PARTS)		
-5	131-0570-00			1		CONN,RCPT,ELEC:25 CONTACT,MALE	71468	DB-25P
	198-4174-00			1		WIRE SET,ELEC:	80009	198-4174-00
-6	131-0792-00			1		.CONNECTOR,TERM:18-20 AWG,CU BE GOLD PL	22526	46221
	131-0622-00			1		.CONTACT,ELEC:28-32 AWG,BRS & CU BE GLD PL	22526	46241-000
-7	352-0198-00			4		.HLDR,TERM CONN:2 WIRE,BLACK	80009	352-0198-00

OPTION 10



OPTION 20

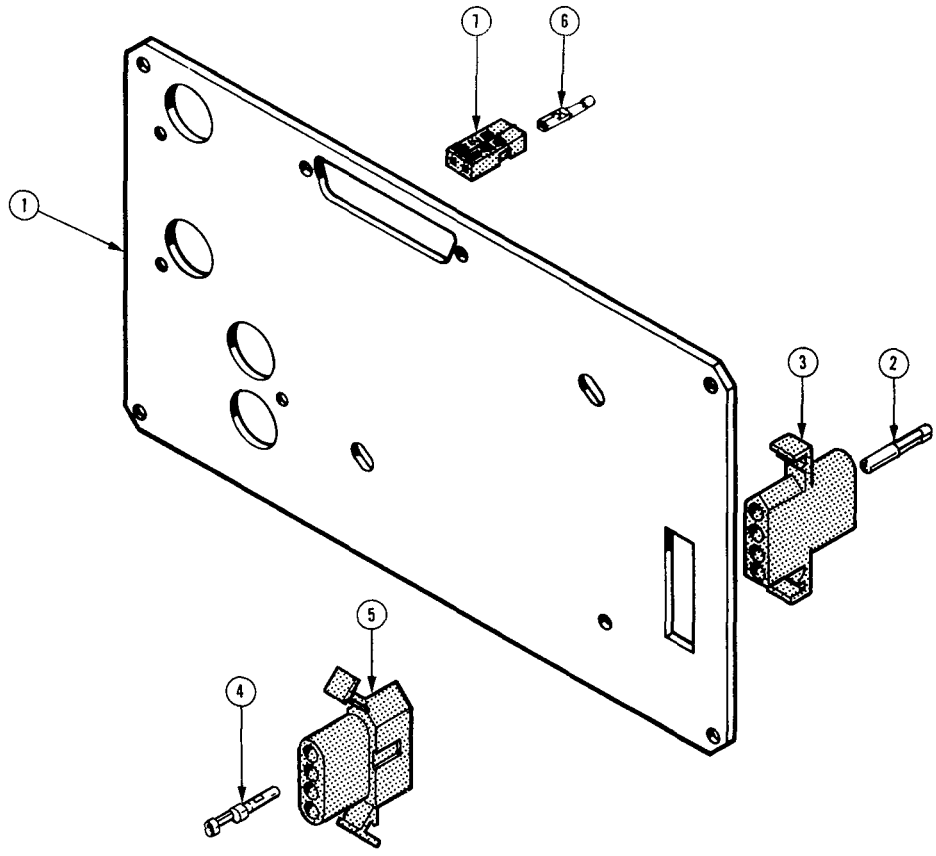


Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
4-					OPTION 20		
-1	386-4018-00	B010100	B010694	1	PLATE,CAB.FRAME:REAR,ALUMINUM	80009	386-4018-00
	386-4018-01	B010695		1	PLATE,CAB.FRAME:REAR,ALUMINUM	80009	386-4018-01
-2	131-0948-00			4	CONTACT,ELEC:CONNECTOR,BRASS TIN PL	27264	02-09-1101
-3	131-0947-00			1	CONN BODY,RCPT:MALE,SNAP-IN PNL MT,4 CONT	27264	03-09-1041
	198-4173-00			1	WIRE SET,ELEC:	80009	198-4173-00
-4	131-0945-00			3	.CONTACT,ELEC:CONNECTOR,BRASS TIN PL	27264	02092101(1190T)
-5	131-0946-00			1	.CONN BODY,RCPT:FEMALE,SNAP-IN PNL MT,4 CONT	27264	03-09-2041
-6	131-0621-00			2	.CONN,TERM:22-26 AWG,BRS,CU BE GLD PL	22526	46231-000
-7	352-0198-00			1	.HLDR,TERM CONN:2 WIRE,BLACK	80009	352-0198-00

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
5-					OPTIONS 23 & 28		
-1	348-0544-00			4	RTNR,CAB.COVER:CORNER,TEK BLUE,PC (OPTION 23 AND 28 ONLY) (ATTACHING PARTS)	80009	348-0544-00
-2	213-0782-00			4	SCREW,TPG,TF:8-32 X 0.625,FILH,STL (OPTION 23 AND 28 ONLY) (END ATTACHING PARTS)	83486	ORDER BY DESCR
-3	348-0543-00	B010100	B010412	4	FOOT,CABINET:BOT,TEK BLUE,POLYCARBONATE (OPTION 23 ONLY)	80009	348-0543-00
	348-0617-00	B010413		4	FOOT,CABINET:BOT,TEK BLUE,POLYCARBONATE (OPTION 23 ONLY)	80009	348-0617-00
-4	124-0355-00			2	STRIP,TRIM:CORNER,BOT,BLUE,13.91 L (OPTION 23 ONLY)	80009	124-0355-00
-5	124-0354-00			2	STRIP,TRIM:CORNER,TOP,BLUE,17.41 L (OPTION 23 ONLY)	80009	124-0354-00
-6	348-0568-01	B010100	B010412	2	FLIP-STAND,CAB.:2.5 H,AL,FINISHED (OPTION 23 ONLY)	80009	348-0568-01
	348-0618-01	B010413	B010814	2	FLIP-STAND,CAB.:2.5 H,AL,FINISHED (OPTION 23 ONLY)	80009	348-0618-01
	348-0275-00	B010815		1	FLIP-STAND,CAB.:3.75 H,SST (OPTION 23 ONLY)	80009	348-0275-00
	348-0596-00			2	PAD,CAB.FOOT:0.69 X 0.255 X 0.06,PU (OPTION 23 ONLY)	80009	348-0596-00
-7	390-0647-00			1	CABINET BOTTOM:0.5 RACK X 17.960 (OPTION 23 ONLY)	80009	390-0647-00
	390-0647-00			2	CABINET BOTTOM:0.5 RACK X 17.960 (OPTION 28 ONLY)	80009	390-0647-00
-8	390-0646-00			2	CABINET SIDE:5.25 X 17.960 (OPTION 23 AND 28 ONLY)	80009	390-0646-00
-9	390-0655-01			1	CABINET TOP:W/HANDLE RETAINER,17.960 (OPTION 23 AND 28 ONLY)	80009	390-0655-01
-10	200-2191-00			2	CAP,RETAINER:PLASTIC (OPTION 23 ONLY)	80009	200-2191-00
-11	367-0248-01			1	HANDLE,CARRYING:16.341 L,W/CLIP (OPTION 23 ONLY)	80009	367-0248-01

OPTION 23 & 28

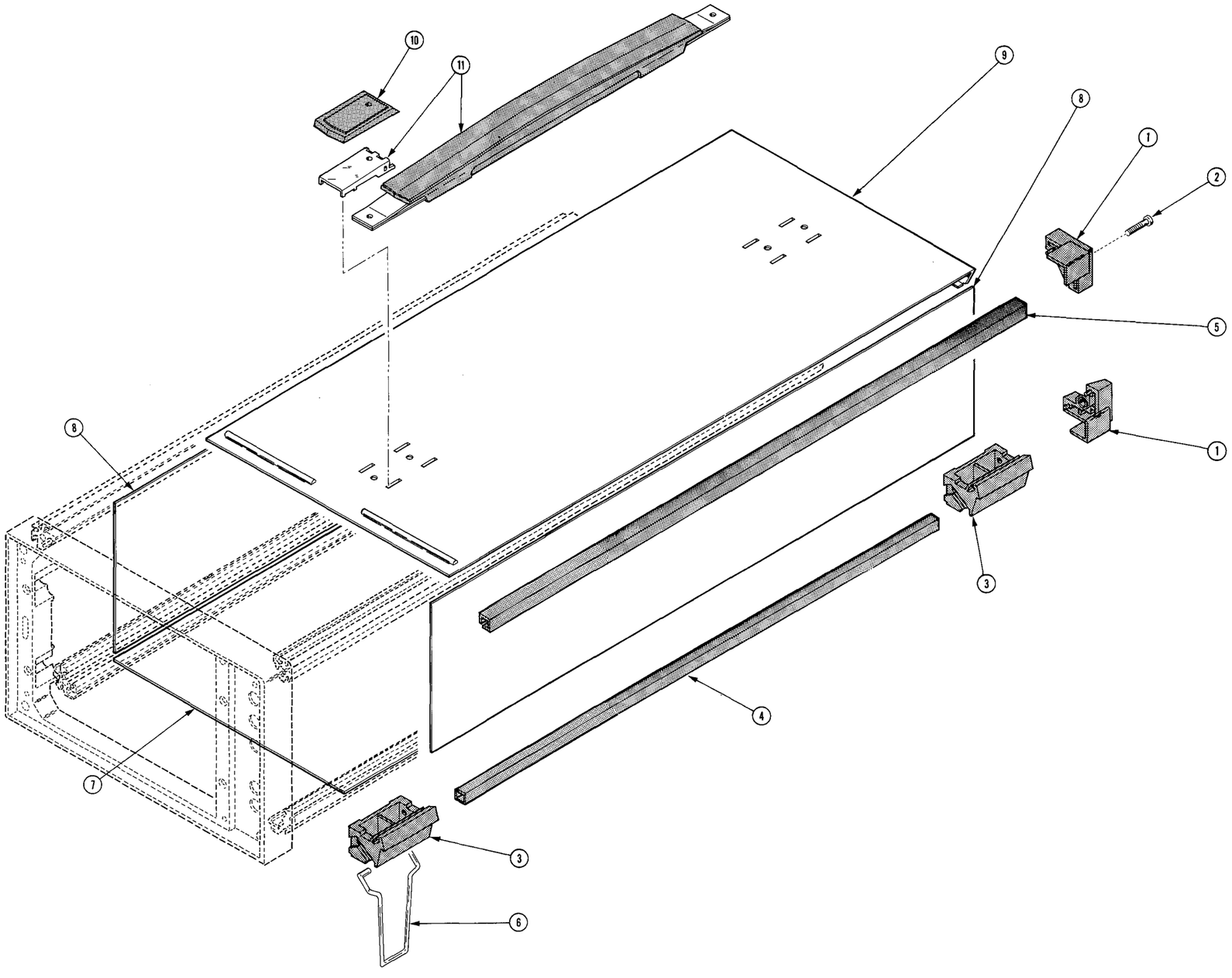


FIG. 5 OPTION 23 & 28

OPTION 25

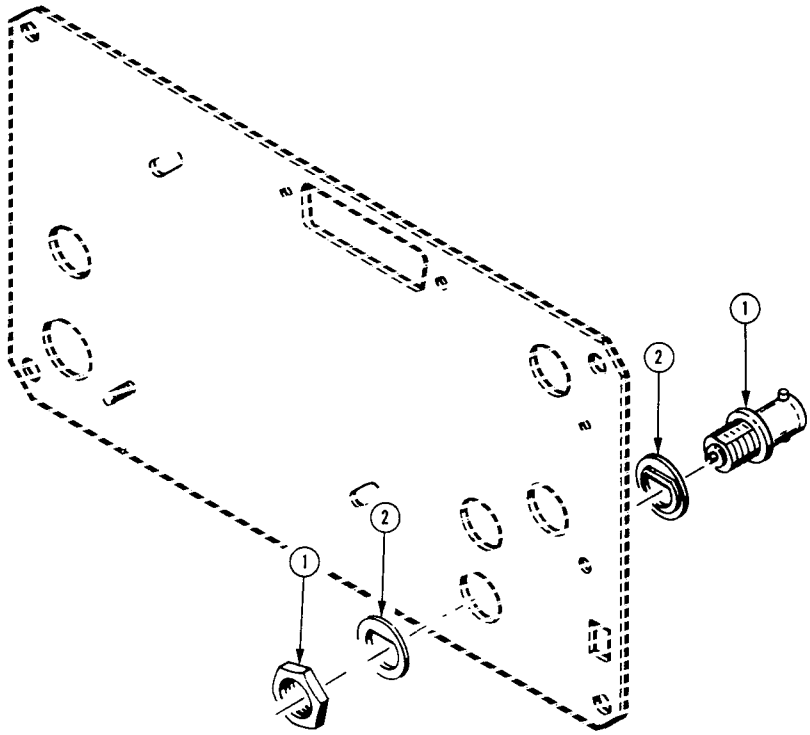
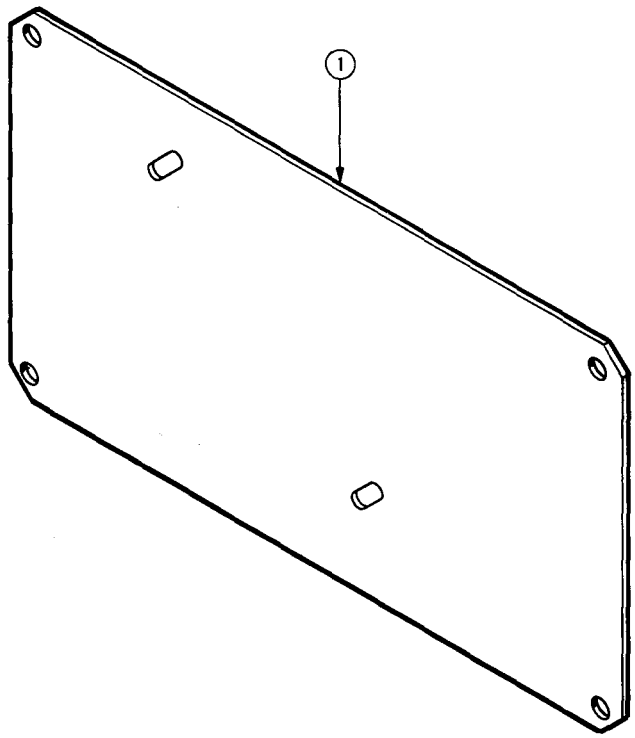


FIG. 6 OPTION 25

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345	Name & Description	Mfr. Code	Mfr. Part No.
6-						OPTION 25		
-1	131-0955-00			1		CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
	342-0117-00			2		INSULATOR,BSHG:0.375 ID X 0.625 OD	80009	342-0117-00

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345	Name & Description	Mfr. Code	Mfr. Part No.
7-						OPTION 31		
-1	386-4003-00	B010100	B010694	1		PLATE,CAB.FRAME:REAR,BLANK,ALUMINUM	80009	386-4003-00
	386-4003-01	B010695		1		PLATE,CAB.FRAME:REAR,BLANK,ALUMINUM	80009	386-4003-01

OPTION 31



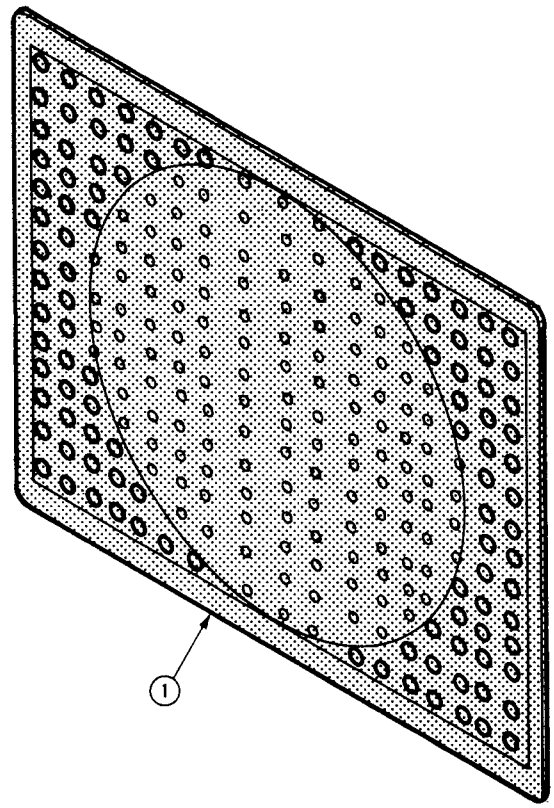


Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345	Name & Description	Mfr. Code	Mfr. Part No.
8-						STANDARD ACCESSORIES		
-1	337-2537-02			1		SHLD,IMPLOSION:5.854 X 4.714 X 0.09,CLEAR	80009	337-2537-02
	070-2650-00			1		MANUAL,TECH:INSTRUCTION	80009	070-2650-00
	070-2651-00			1		MANUAL,TECH:OPERATORS	80009	070-2651-00