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PLEASE CHECK FOR CHANGE INFORMATION AT THE REAR OF THIS MANUAL.

5111A/R5111A STORAGE OSCILLOSCOPE
WITH OPTIONS

INSTRUCTION MANUAL

Tektronix, Inc.
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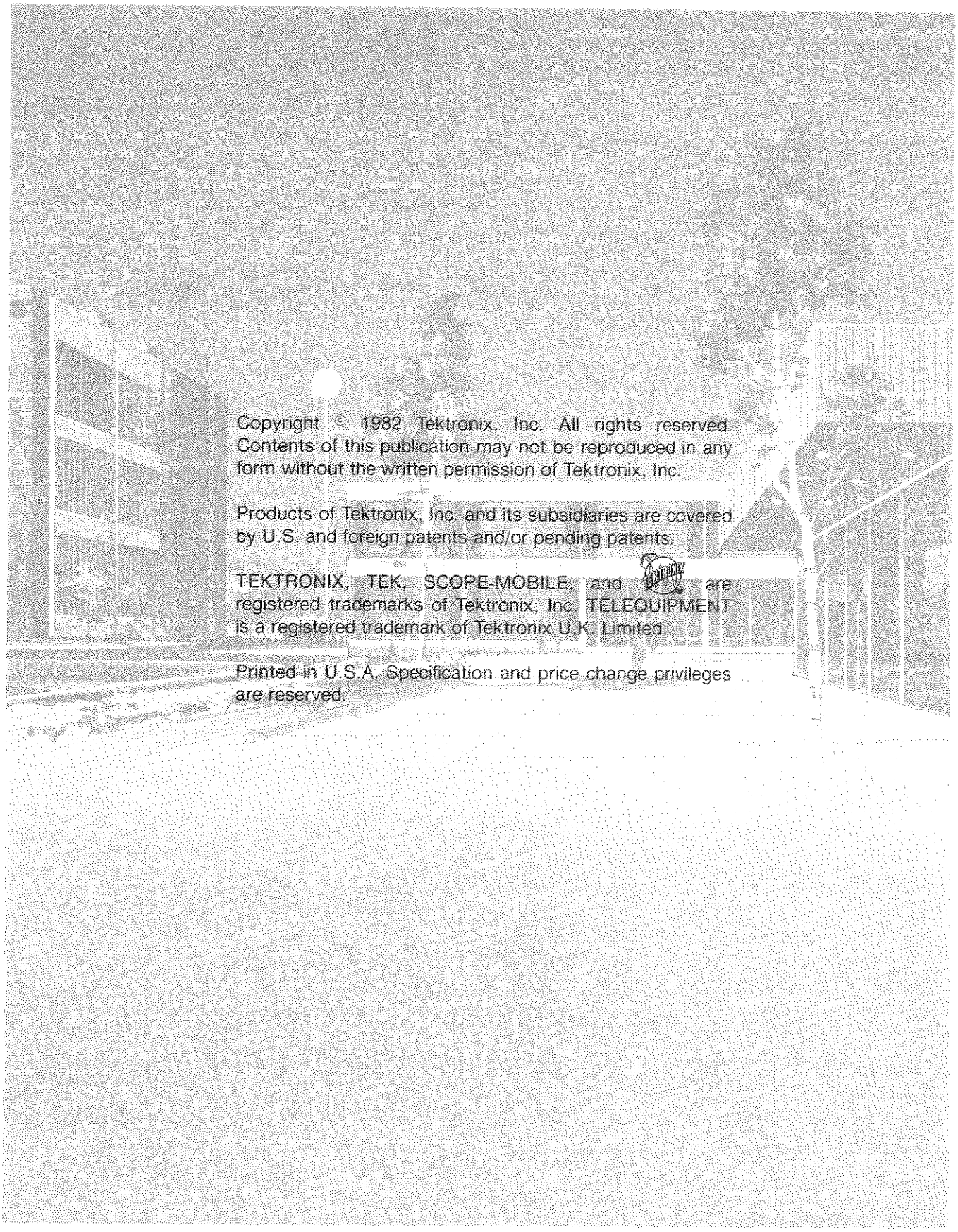

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WARNING

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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OPERATORS SAFETY SUMMARY

The general safety information in this part of the summary is for 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


Static-Sensitive Devices


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.

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 cord, see page 1-1 and figure 1-1.

Refer cord and connector changes to qualified personnel.

GROUNDING THE PRODUCT

This product is grounded through the grounding conductor of the power cord. To avoid electric 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.

DANGER ARISING FROM LOSS OF GROUND

Upon loss of the protective-ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulating), can render an electric shock.

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 gasses 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.

SERVICING SAFETY SUMMARY

FOR QUALFIFIED 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.

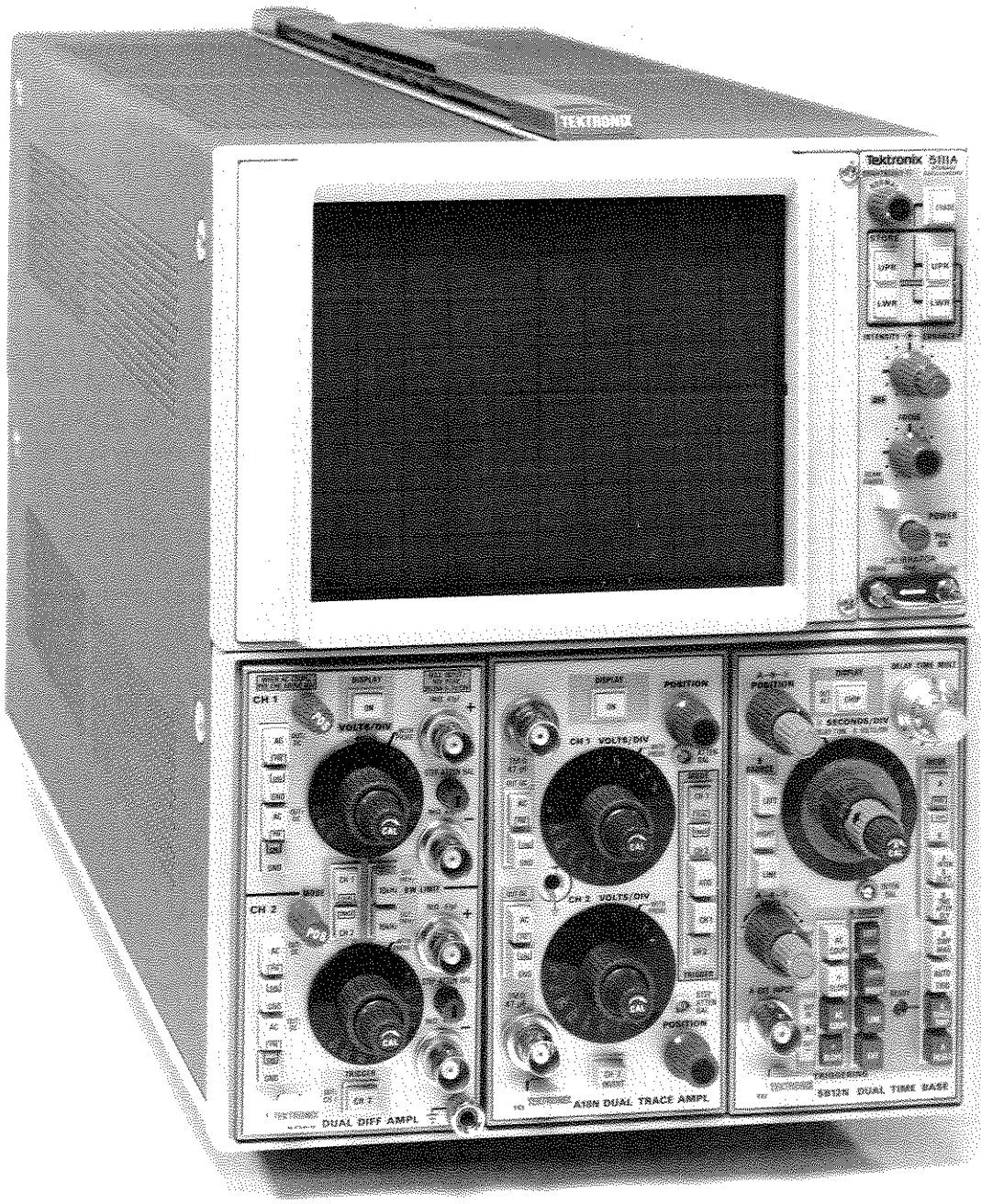
USE CARE WHEN SERVICING WITH POWER ON

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 grounding conductor in the power cord is essential for safe operation.



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5111A Features

OPERATING INSTRUCTIONS

This instruction manual provides both operating and servicing information for the oscilloscope. The manual is divided into nine sections. Operating, specification, and performance check information is covered in the first two sections, and is intended for operating and service personnel. Servicing information is covered in the remaining section of the manual, and is intended for qualified service personnel only.

PRELIMINARY INFORMATION

Oscilloscope Features

This oscilloscope is a solid state, light weight instrument designed for general-purpose measuring applications with the capability for extending measurements into areas requiring storage of displays for long-term examination and photography. This instrument has three plug-in compartments that accept plug-in units to form a complete measurement system. The two plug-in compartments on the left are connected to the vertical deflection system.

The right plug-in compartment is connected to the horizontal deflection system. Electronic switching between the vertical plug-in compartments allows a multitrace vertical display. The flexibility of this plug-in feature and the variety of plug-in units available allow this system to be used for many measurement applications.

This instrument features a large-screen, 8 X 10 division display; each division equals 0.5 inch (1.27 centimeter). Regulated dc power supplies ensure that performance is not affected by variations in line voltage and frequency, or by changes in the load due to the varying power requirements of the plug-in units.

Safety Information

This instruction manual contains warning information which the user must follow to ensure safe operation of the instrument. Warning information is intended to protect the operator and Caution information is intended to protect the instrument.

WARNING

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

OPERATING POWER

This instrument can be operated from either a 120-volt or 240-volt nominal line-voltage source, 48 to 440 hertz. In addition, three regulating ranges are provided for each nominal line-voltage source. (Refer qualified service personnel to the service portion of this manual for further information).

CAUTION

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

WARNING

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

Before making connection to the power source, determine that the instrument is adjusted to match the voltage of the power source, and has a suitable plug (two-pole, three-terminal, grounding type).

This instrument is safety class 1 equipment (IEC designation). All accessible conductive parts are directly connected through the grounding conductor of the power cord to the grounding contact of the power cord. Therefore, the power plug must only be inserted in a mating receptacle with a grounding contact. Do not defeat the grounding connection. Any interruption of the grounding connection can create an electric shock hazard.*

For electric shock protection, the grounding connection must be made before making connection to the instrument's input or output terminals.

*International Electrotechnical Commission

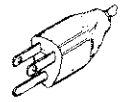
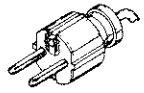
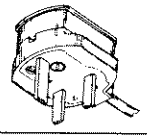
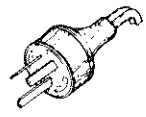
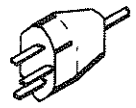
Power Cord Information

A power cord with the appropriate plug configuration is supplied with each instrument. Should you require a power-cord plug other than that supplied, refer to the Power-Cord and Plug Identification Information Table 1-1.

OPERATING TEMPERATURE

The instrument can be operated where the ambient air temperature is between 0° C and +50° C. The instrument can be stored in ambient temperature between −40° C and

TABLE 1-1
Power-Cord and Plug Identification Information

Plug Configuration	Usage	Nominal Line-Voltage (AC)	Reference Standards	Option #
	North American 120V/15A	120 V	[1]ANSI C73.11 [2]NEMA 5-15-P [3]IEC 83	STANDARD
	Universal Euro 240V/10-16A	240 V	[4]CEE (7), II, IV, VII [3]IEC 83	A1
	UK 240V/13A	240 V	[5]BS 1363 [3]IEC 83	A2
	Australian 240V/10A	240 V	[6]AS C112	A3
	North American 240V/15A	240 V	[1]ANSI C73.20 [2]NEMA 6-15-P [3]IEC 83	A4
	Switzerland 220V/10A	220 V	[7]SEV	A5

[1]ANSI—American National Standards Institute
[2]NEMA—National Electrical Manufacturer's Association
[3]IEC—International Electrotechnical Commission
[4]CEE—International Commission on Rules for the Approval of Electrical Equipment
[5]BS—British Standards Institution
[6]AS—Standards Association of Australia

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+70° C. After storage at a temperature beyond the operating limits, allow the chassis temperature to come within the operating limit before power is applied.

A thermal cutout in the display module provides thermal protection and disconnects the power to the instrument if the internal temperature exceeds a safe operating level. This device will automatically re-apply power when the temperature returns to a safe level.

PLUG-IN UNITS

The oscilloscope is designed to accept up to three Tektronix 5000-series plug-in units (use only "N" suffix plug-in units unless otherwise specified). This plug-in feature allows a variety of display combinations and also allows selection of bandwidth, sensitivity, display mode, etc., to meet the measurement requirements. In addition, it allows the oscilloscope system to be expanded to meet future measurement requirements. The overall capabilities of the resultant system are largely determined by the characteristics of the plug-in selected.

Installation

CAUTION

Plug-in units should not be removed or installed without turning off the instrument power.

To install a plug-in unit into one of the plug-in compartments, align the slots in the top and bottom of the plug-in with the associated guides in the plug-in compartment. Push the plug-in unit firmly into the plug-in compartment until it locks into place. To remove a plug-in, pull the release latch on the plug-in unit to disengage it and pull the unit out of the plug-in compartment. It is not necessary that all of the plug-in compartments be filled to operate the instrument, the only plug-ins needed are those required for the measurement to be made.

When the oscilloscope is adjusted in accordance with the adjustment procedure given in this manual, the vertical and horizontal gain are standardized. This allows adjusted plug-in units to be changed from one plug-in compart-

ment to another without readjustment. However, the basic adjustment of the individual plug-in units should be checked when they are installed in this system to verify their measurement accuracy. See the plug-in unit manual for verification procedure.

Selection

The plug-in versatility of the oscilloscope allows a variety of display modes with many different plug-ins. The following information is provided to aid in plug-in selection.

NOTE

Use only "N" suffix plug-in units with the oscilloscope unless otherwise specified.

To produce a single-trace display, install a single-channel vertical unit (or multi-channel unit set for single-channel operation) in either of the vertical (left or center) compartments and a time-base unit in the horizontal (right) compartment. For dual-trace displays, either install a dual-channel vertical unit in one of the vertical compartments or install a single-channel vertical unit in each vertical compartment. A combination of a single-channel and a dual-channel vertical unit allows a three-trace display; likewise, a combination of two dual-channel vertical units allows a four-trace display.

To obtain a vertical sweep with the input signal displayed horizontally, insert the time-base unit into one of the vertical compartments and the amplifier unit in the horizontal compartment. If a vertical sweep is used, there is no retrace blanking; however, if used in the right vertical (center) compartment, internal triggering is provided.

For X-Y displays, either a 5A-series amplifier unit or a 5B-series time-base unit having an amplifier channel can be installed in the horizontal compartment to accept the X signal. The Y signal is connected to a 5A-series amplifier unit installed in a vertical compartment.

Special purpose plug-in units may have specific restrictions regarding the compartments in which they can be installed. This information will be given in the instruction manuals for these plug-ins.

CONTROLS AND CONNECTORS

Controls and connectors necessary for operation of the oscilloscope are located on the front and rear panels of the instrument. To make full use of the capabilities of this instrument, the operator should be familiar with the function and use of each external control and connector. A brief description of the controls and connectors is given here. More detailed information is given under General Operating Information (later in this section). See Fig. 1-1 for the location and description of the controls and connectors.

FIRST TIME OPERATION

The following procedure provides an operational checkout as a means of verifying instrument operation and basic calibration without removing the cabinet or making internal adjustments. Since it demonstrates the use of front-panel controls and connectors, it can also be used to provide basic training on the operation of this instrument. If recalibration of the oscilloscope or plug-ins appears to be necessary, refer the instrument system to qualified service personnel. If more familiarization with a plug-in unit is needed, see the instruction manual for the appropriate plug-in unit. Refer to Fig. 1-1 for the oscilloscope control and connector locations.

Checkout Procedure

1. For the following procedure, an amplifier plug-in should be in one of the vertical (left or center) plug-in compartments and a time-base plug-in should be in the horizontal (right) compartment.

2. Set the POWER switch to off (pushed in) and connect the oscilloscope to a power source that meets the voltage and frequency requirements of this instrument.

Initial Control Settings

Set the front-panel controls as follows:

NOTE

Titles for external controls of the oscilloscope are capitalized in this procedure (e.g. INTENSITY, POWER).

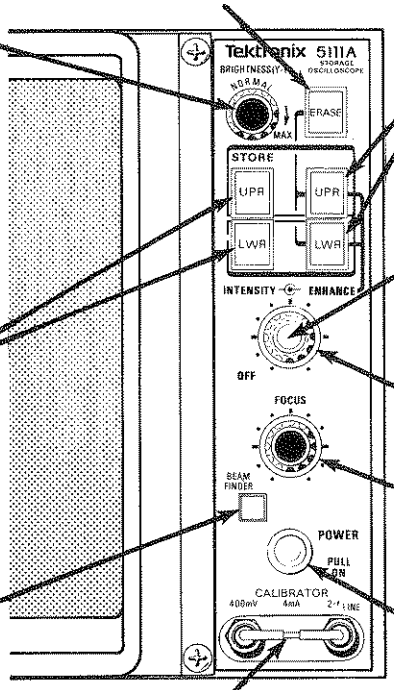
OSCILLOSCOPE

INTENSITY	Fully counter-clockwise
FOCUS	Centered
STORE (UPR and LWR)	Off
ERASE/ENHANCE Select (UPR and LWR)	Off
BRIGHTNESS (Y-T)	MAX
ENHANCE	OFF

BRIGHTNESS (Y-T) Control
Provides continuously variable flood-gun current duty cycle from about 10% to 100%, permitting the intensity of a stored display to be varied. Permits extended retention of displayed information; also serves as an integrator for storing fast, repetitive signals.

ERASE Pushbutton
Momentary contact pushbutton initiates erasure of the storage display selected to be erased.

UPR and LWR ERASE/ENHANCE Select Pushbuttons
Self-cancelling switches select screen to be erased. Both buttons pushed in selects both screens.



ENHANCE Control
Provides additional writing speed capability for single-sweep storage. Enhance level may be adjusted to increase the writing speed capability as desired.

UPR and LWR STORE Pushbuttons
Button pushed in selects storage operation. Button out selects normal operation without storage. Each button has push-push action and each operates independently of the other.

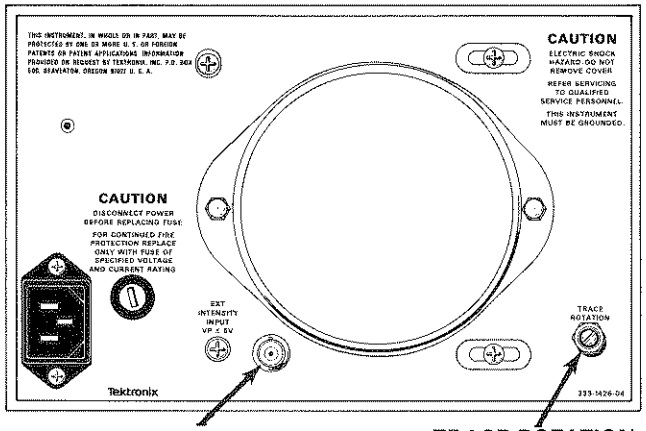
INTENSITY Control
Controls display brightness.

FOCUS Control
Provides adjustment to obtain a well-defined display.

BEAM FINDER Pushbutton
Brings beam on-screen; limits intensified display to area inside graticule.

POWER Switch
Turns instrument power on or off.

CALIBRATOR Loop
Provides positive-going accurate 400-millivolt and 4-milliampere squarewave at a frequency of twice the line frequency for calibration and probe compensation.



EXT INTENSITY INPUT Connector
Permits application of Z-axis signals to the crt(dc coupled). Positive-going signal increases intensity.

TRACE ROTATION Control
Controls alignment of trace with horizontal graticule lines.

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Fig. 1-1. Front- and rear-panel controls and connectors.

AMPLIFIER PLUG-IN

Display	On
Position	Centered
Volts/Div	.1
Volts/Div Cal	Fully clockwise
Input coupling	DC

TIME-BASE PLUG-IN

Display	Chop
Position	Centered
Seconds/Div	2 ms
Seconds/Div Cal	Fully clockwise
Swp Mag	Off
Triggering	+ Slope, Auto Trig, AC Coupl
Triggering Source	Composite

NOTE

This turn-on procedure should be followed when first receiving the instrument or when the instrument has been turned off for two weeks or more. This turn-on procedure reduces the ion content in the crt and extends crt life. (If this turn-on procedure is not needed, proceed to step 3.)

Be sure the initial control settings of this procedure are strictly adhered to. Press the STORE buttons (both UPR and LWR) to their on position. Pull the power switch to turn on the oscilloscope, then do not alter any control setting. After a short delay the screen will become fully illuminated. Leave the instrument in this mode for 5 minutes before erasing or going to non-store mode. To continue with the Checkout Procedure, press and release the STORE buttons (both UPR and LWR) to their off position. Proceed to step 4.

3. Pull the POWER switch out to turn the instrument on. Allow a short warm-up time if the instrument has been off.

Intensity Adjustment

4. Advance the INTENSITY control until the trace is at the desired viewing level. Set the trace near the graticule center line.

Focus Adjustment

5. Adjust the FOCUS control for a sharp, well-defined trace over the entire trace length.

Trace Alignment Adjustment

6. If a free-running trace is not parallel with the horizontal graticule lines, set the TRACE ROTATION control (rear panel adjustment) as follows: Position the trace to the center horizontal line and adjust the TRACE ROTATION control so that the trace is parallel with the horizontal graticule lines.

Calibration Check

7. Connect a 1X probe, or a test lead from the amplifier plug-in connector to the CALIBRATOR loop.

8. Set the time-base unit triggering level for a stable triggered display. Adjust the vertical and horizontal position controls so that the display is centered vertically and starts at the left edge of the graticule.

9. The display should be four divisions in amplitude with approximately 2.5 complete cycles over 10 divisions (for 60-hertz line frequency) shown horizontally. An incorrect display indicates that the oscilloscope or plug-ins needs to be recalibrated.

Beam Finder Check

10. Move the display off-screen with the vertical position control.

11. Push the BEAM FINDER button and observe that the display compresses into the screen area. Reposition the display to screen center and release the BEAM FINDER button. Disconnect the 1X probe or test lead.

External Intensity Input

12. Connect a 5-volt, 1-kHz sine-wave or square-wave signal to the EXT INTENSITY INPUT connector (on rear panel). Also, use the signal to externally trigger the time-base plug-in.

13. Slowly rotate the INTENSITY control counterclockwise until the trace appears to be a series of dimmed and brightened segments. The brightened segments correspond with the tops of the signal input waveform.

14. Disconnect the signal setup.

Storage Check

15. Press the STORE buttons (both UPR and LWR) to their on position. Press the ERASE/ENHANCE select buttons (both UPR and LWR) to their on position. Adjust the BRIGHTNESS (Y-T) control fully clockwise to MAX position. Press the ERASE button to erase both screens and prepare the targets for storage.

16. Write a few traces across both targets by slewing the free-running trace vertically with the vertical position control. Observe that stored images of the sweep remain on the screen. If the trace does not store, adjust the INTENSITY control for a slightly higher brightness level, then write a few traces across both targets.

17. Press and release the STORE buttons (both UPR and LWR) to their off position.

This completes the checkout procedure for the oscilloscope. Instrument operations not explained here, or operations that need further explanation, are discussed under General Operating Information.

GENERAL OPERATING INFORMATION

Intensity Control

The setting of the INTENSITY control may affect the correct focus of the display. Slight adjustment of the FOCUS control may be necessary when the intensity level is changed. To protect the crt phosphor, do not turn the INTENSITY control higher than necessary to provide a satisfactory display.

CAUTION

Damage to the crt phosphor can occur under adverse conditions. Avoid any condition where an extremely bright, sharply focused spot exists on the crt.

Apparent trace intensity can be improved by reducing the ambient light level or using a viewing hood. Also, be careful that the INTENSITY control is not set too high when changing the time-base unit sweep rate from a fast to a slow sweep rate, or when changing to the X-Y mode of operation.

Display Focus

If a well-defined display cannot be obtained with the FOCUS control, even at low INTENSITY control settings, re-setting of the internal astigmatism adjustment may be required (adjustment must only be made by qualified service personnel).

To check for proper setting of the astigmatism adjustment, slowly turn the FOCUS control through the optimum setting with a signal displayed on the crt screen. If the astigmatism adjustment is correctly set, the vertical and horizontal portions of the trace will come into sharpest focus at the same position of the FOCUS control.

Trace Alignment

If a free-running trace is not parallel with the horizontal graticule lines, set the TRACE ROTATION adjustment (rear-panel adjustment) as follows: Position the trace to the center horizontal line and adjust the TRACE ROTATION adjustment so that the trace is parallel with the horizontal graticule lines.

Beam Finder

The BEAM FINDER switch provides a means of locating a display that overscans the viewing area either vertically or horizontally. When the BEAM FINDER switch is pressed, the display is compressed within the graticule area and the display intensity is increased. To locate and reposition an overscanned display, use the following procedure:

1. Press the BEAM FINDER switch, hold it in, then increase the vertical and horizontal deflection factors until the display is within the graticule area.

2. Adjust the vertical and horizontal position controls to center the display about the vertical and horizontal centerlines.

3. Release the BEAM FINDER switch; the display should remain within the viewing area.

Graticule

The graticule of the oscilloscope is marked on the inside of the faceplate of the crt providing accurate, no-parallax measurements. The graticule is divided into eight vertical and ten horizontal divisions; each division is 0.5-inch (1.27 centimeters) square. In addition, each major division is divided into five minor divisions. The vertical gain and horizontal timing of the plug-in units are calibrated to the graticule so accurate measurements can be made from the crt.

When making time measurements from the graticule, the center eight divisions provide the most accurate time measurements. Position the start of the timing area to the second vertical graticule line and set the time-base unit so the end of the timing area falls between the second and tenth vertical graticule lines.

Calibrator Signal

The internal calibrator of the oscilloscope provides a convenient signal source for checking basic vertical gain and sweep timing. The calibrator signal is also very useful for adjusting probe compensation, as described in the probe instruction manual. The output square-wave voltage is 400 millivolts, within 1%, and the square-wave current is 4 milliamperes, within 1%. The frequency of the square-wave signal is twice the power-line frequency. The signal is obtained by clipping the probe to the calibration loop.

Intensity Modulation

Intensity (Z-Axis) modulation can be used to relate a third item of electrical phenomena to the vertical (Y-Axis) and the horizontal (X-Axis) coordinates without affecting the waveshape of the displayed signal. The Z-Axis modulating signal, applied to the EXT INTENSITY INPUT, changes the intensity of the displayed waveform to provide this type of display. The voltage amplitude required for visible trace modulation depends on the setting of the INTENSITY control. About +5 volts will turn on the display to a normal brightness level from an off level, and about −5 volts will turn the display off from a normal brightness level. "Gray scale" intensity modulation can be obtained by applying signals between these levels. Maximum safe input voltage is ±5 volts. Usable frequency range of the Z-Axis circuit is dc to one megahertz.

Time markers applied to the EXT INTENSITY INPUT provide a direct time reference on the display. With uncalibrated horizontal sweep or X-Y operation, the time markers provide a means of reading time directly from the display. However, if the markers are not time-related to the displayed waveform, a single-sweep display should be used (for internal sweep only) to provide a stable display.

Intensity modulation can be used in the store mode as well as in the non-store mode; however, there is only one intensity level in a stored display. The stored waveform may be modified by either dimming portions of the waveform so they do not store, or brightening portions from a dim background so only the brightened portions store.

X-Y Operation

In some applications, it is desirable to display one signal versus another (X-Y) rather than against an internal sweep. The flexibility of the plug-in units available for use with the oscilloscope provides a means for applying a signal to the horizontal deflection system for this type of display. Some of the 5B-series time-base units can be operated as amplifiers, in addition to their normal use as time-base generators.

Another method of obtaining an X-Y display is to install amplifier units in vertical and horizontal compartments (check amplifier unit gain as given in the amplifier unit instruction manual to obtain calibrated horizontal deflection factors). This method provides the best X-Y display, particularly if two identical amplifier units are used, since both the X and Y input systems will have the same delay time, gain characteristics, input coupling, etc.

Raster Display

A raster-type display can be used to effectively increase the apparent sweep length. For this type of display, the trace is deflected both vertically and horizontally by sawtooth signals, and is accomplished by installing a 5B-series time-base unit in the left vertical compartment, as well as one in the horizontal compartment (do not install any plug-in unit in the center vertical compartment). Normally, the unit in the vertical compartment should be set to a slower sweep rate than the one in the horizontal compartment; the number of horizontal traces in the raster depends upon the ratio between the two sweep rates. Information can be displayed on the raster using the EXT INTENSITY INPUT to provide intensity modulation of the display. This type of raster display can be used to provide a television-type display.

Option 7 Rear-Panel Signal Outputs

The purpose of OPTION 7 is to provide cathode-ray tube-related signals to standard connectors at the rear of the instrument. This option is particularly well suited for use in the physical life sciences. By using differential amplifiers, the oscilloscope can become a signal conditioner for other devices. Outputs may be used for driving counters or X-Y plotters in conjunction with the oscilloscope.

Display Photography

A permanent record of the crt display can be obtained with an oscilloscope camera system (see the current Tektronix catalog for a complete listing of oscilloscope cameras and mounting adapters). The instruction manuals for the Tektronix oscilloscope cameras include complete instructions for obtaining waveform photographs.

The crt bezel of the oscilloscope provides integral mounting for a Tektronix oscilloscope camera. However, no voltage is provided at the bezel for camera power. The camera selected for use with the oscilloscope may require battery operation.

When this instrument is operated in the storage mode, a photograph may easily be composed by erasing unwanted displays as many times as necessary before the desired display is obtained. This ability to compose a photograph in advance prevents wasted film due to incorrect displays.

Due to the background glow of the stored display produced by the flood guns, special care must be taken in determining the exposure time and f-stop settings. Of course, exact settings will depend upon the specific type of film. After the correct settings are obtained for a specific oscilloscope-camera-film combination, record these figures for future reference. Since the background glow does not change substantially between displays, these settings should produce satisfactory results for most displays. Background glow may be altered by adjustment of the BRIGHTNESS (Y-T) control.

WARNING

Refer replacement of green crt filter to qualified service personnel.

NOTE

The oscilloscope is provided with a green filter installed to improve contrast for general purpose viewing. When using Tektronix C5-series cameras with built-in flash, the green filter should be removed and replaced by a clear filter in order to photograph the graticule. Contact your local Tektronix Field Office or representative to order the clear filter.

Display Switching Logic

The electronic switching for time-shared displays is produced at the plug-in interface within the mainframe; however, the switching logic is selected in the plug-in units. The system allows any combination of plug-ins and Display switch settings. Refer to the individual plug-in manuals for specific capabilities and operating procedures.

Vertical Plug-In Compartments. When the vertical plug-in is in the active mode (Display button pushed in), a logic level is applied to the switching circuit in the mainframe and a display from this plug-in will occur. When two plug-ins are both active in the vertical compartments, a multitrace display will occur (Alternate or Chopped). When no plug-in is in the active mode, the signal from the left compartment will be displayed. A time-base unit operated in one of the vertical compartments has a permanent internal connection to apply a logic level to the switching circuit; thus, a vertical trace produced by this unit will always be displayed.

Horizontal Plug-In Compartment. Alternate or Chopped display switching is selected on a time-base unit operated in the horizontal compartment. When the Display switch is out (Alt), a negative impulse is supplied at the end of the sweep to allow alternate switching between plug-ins and plug-in channels. When the Display switch is pushed in (Chop), a chopped display will appear if a multi-trace display is required by the plug-ins in the vertical compartments. A vertical plug-in unit operated in the horizontal compartment has a permanent internal connection to provide a chopped display if it is required.

Switching Sequence. Four display time slots are provided on a time-sharing basis. When two vertical plug-ins are active, each receives two time slots, so the switching sequence is: left, left, center, center, etc. The two time slots allotted to each plug-in are divided between amplifier channels in a dual-trace unit; if two dual-trace plug-ins are active, then the switching sequence is: left Channel 1, left Channel 2, center Channel 1, center Channel 2, etc. If only one vertical plug-in is active, it receives all four time slots. The switching sequence is the same for both the Alternate and Chopped display modes.

Vertical Display Mode

Display on. To display a signal, the Display button of the applicable vertical plug-in unit must be pushed in to activate the unit. If two plug-ins are installed in the vertical compartments and only the signal from one of the units is wanted, set the Display switch of the unwanted unit to Off (button out). If neither plug-in is activated, the signal from the left unit is displayed. Both plug-ins can be activated for multi-trace displays.

Alternate Mode. The alternate position of the time-base unit Display switch produces a display that alternates between activated plug-ins and amplifier channels with each sweep of the crt. The switching sequence is described under Display Switching Logic in this section. Although the Alternate mode can be used at all sweep rates, the Chop mode provides a more satisfactory display at sweep rates from about one millisecond/division to five seconds/division. At these slower sweep rates, alternate-mode switching becomes difficult to view.

Chopped Mode. The Chop position of the time-base unit Display switch produces a display that is electronically switched between channels at a 200-kilohertz rate. The switching sequence is discussed earlier. In general, the Chop mode provides the best display at sweep rates slower than about one millisecond/division or whenever dual-trace, single-shot phenomena are to be displayed. At faster sweep rates, the chopped switching becomes apparent and may interfere with the display.

Dual-Sweep Displays. When a dual-sweep time-base unit is operated in the horizontal compartment, the alternate and chopped time-shared switching for either the A or B sweep is identical to that for a single time-base unit. However, if both the A and B sweeps are operating, the oscilloscope operates in the independent pairs mode. Under this condition, the left vertical unit is always displayed at the sweep rate of the A time base and the right vertical unit is displayed at the sweep rate of the B time-base. This results in two displays that have completely independent vertical deflection and chopped or alternate sweep switching.

Care of Storage Screens

To prolong the useful life of the storage screens, the following precautions should be observed when operating this instrument:

1. Use minimum beam intensity required to produce a clear, well-defined display. Care must be taken in the degree of writing-beam intensity that is used, particularly when using slow sweep rates and X-Y displays. A beam intensity that is too high may permanently damage the crt screen.

2. Avoid repeated use of the same area of the screen. If a particular display is being stored repeatedly, change the vertical position occasionally to use other portions of the display area.

3. Do not leave a stored display on the screen when it is no longer needed.

4. Turn the BRIGHTNESS (Y-T) control fully counterclockwise (with sweep held off) when storing a display for an extended period of time.

5. Operate in the non-store mode unless storage is required.

Storage Operation

General. Separate STORE switches are provided for both the upper and lower crt storage screens, permitting independent screen operation. When both screens are operated in the non-store mode (both the UPR and LWR STORE switches out), the instrument operates as a conventional oscilloscope. When either or both screens are operated in the storage mode (applicable STORE switch in), a display can be retained for further analysis.

A stored display is erased by first selecting the applicable screen for erasure and then pushing the ERASE button. The erasure of one screen has no effect on the other. The UPR and LWR ERASE/ENHANCE select switches are self-cancelling; when either button is pressed, the other button is released. Also, both switches can be pressed in or released at the same time. Thus either screen or both can be selected for erasure, or erasure of both screens can be prevented. The ERASURE momentary-contact switch initiates the voltage waveform required for erasure.

Holding and Viewing Modes. The BRIGHTNESS (Y-T) control permits extended retention of displayed information with negligible reduction in crt life. The control provides continuously variable flood-gun current duty cycle from about 10% to 100%. To hold a stored display, set the time-base plug-in unit for single-sweep operation and turn the BRIGHTNESS (Y-T) control fully counterclockwise. In this position, the storage-target flood guns are on only 10% of the time, producing the effect of decreased intensity. A stored display will be very faint and may not be discernible from the background areas. Both screens are affected. To return the instrument to a viewing mode, turn the BRIGHTNESS (Y-T) control clockwise until the desired viewing level is achieved. In the full clockwise position, the flood guns are on 100% of the time and the stored display will be its brightest. The BRIGHTNESS (Y-T) control is inoperable for X-Y displays and when the sweep is running. If the control is counterclockwise and the sweep is running, a blinking effect will be noticeable at the slower sweep rates because the crt will revert to the hold mode between sweeps. To eliminate this effect, turn the control clockwise.

Integrating Fast Displays. If fast, repetitive displays cannot be stored even at maximum intensity settings, the BRIGHTNESS (Y-T) control can be used to increase the apparent writing speed of the crt. To use this function, first obtain a triggered, well-focused display of the signal in the non-store mode. Adjust the writing-beam INTENSITY control so the trace is just starting to defocus. Then press in the STORE buttons (both UPR and LWR) and erase the screen. Turn the BRIGHTNESS (Y-T) control counterclockwise and press and release the STORE buttons to obtain the non-store mode. Wait about two seconds, press in both STORE buttons and rotate the BRIGHTNESS (Y-T) control clockwise to view the integrated display. If all portions of the display are not properly stored, rotate the BRIGHTNESS (Y-T) control counterclockwise and return to the non-store mode to integrate the display for a few more seconds. If too much integration time is used, the stored image begins to broaden, or background fade-up may occur, obscuring the desired display. Some practice may be necessary to determine the proper intensity level and integration time required for obtaining best results.

Improving Writing Speed. After continued use (two hours or more) in the non-store mode, or store mode with no display, fade the screen positive by obtaining a repetitive sweep in the store mode. Slowly position the trace from crt top to bottom. Leave the crt target fully stored for 5 minutes. After this time, erase the screen and resume storage operation if desired.

Single-Sweep Enhancement. The Enhance feature provides a method of storing single-sweep displays that exceed the normal writing speed of the crt. The ENHANCE control is concentric with the INTENSITY control, and the screen to be enhanced must be pushbutton selected by the ERASE/ENHANCE select pushbutton (UPR or LWR). Upon termination of the single sweep, a short-duration pulse is applied to the storage screen to briefly increase the storage level of the crt. The ENHANCE control may be adjusted to increase the writing speed capability as desired.

BASIC OSCILLOSCOPE APPLICATIONS

The oscilloscope and its associated plug-in units provide a very flexible measurement system. The capabilities of the overall system depend mainly upon the plug-ins that are chosen. The following information describes the techniques for making basic measurements. These applications are not described in detail, since each application must be adapted to the requirements of the individual measurement. Specific applications for the individual plug-in units are described in the manuals for these units. Contact your local Tektronix Field Office or representative for additional assistance.

The following books describe oscilloscope measurement techniques which can be adapted for use with this instrument.

John D. Lenk, *"Handbook of Oscilloscopes, Theory, and Application"*, Prentice-Hall Inc., Englewood Cliffs, New Jersey, 1968.

J. Czeck, *"Oscilloscope Measuring Techniques"*, Springer-Verlag, New York, 1965.

J.F. Golding. *"Measuring Oscilloscopes"*, Transatlantic Arts, Inc., 1971.

Charles H. Roth Jr., *"Use of the Oscilloscope"*, A programmed Text, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1970.

Peak-to-Peak Voltage Measurements—AC

To make peak-to-peak voltage measurements, use the following procedure:

1. Set the input coupling on the vertical plug-in unit to Gnd and connect the signal to the input connector.

2. Set the input coupling to ac and set the Volts/Div switch to display about 5 or 6 vertical divisions of the waveform. Check that the variable Volts/Div control (red knob) is in the Cal position.

3. Adjust the time-base triggering controls for a stable display and set the Seconds/Div switch to display several cycles of the waveform.

4. Turn the vertical Position control so that the lower portion of the waveform coincides with one of the graticule lines below the center horizontal line and the top of the waveform is in the viewing area. Move the display with the horizontal Position control so that one of the upper peaks is aligned with the center vertical reference line (see Fig. 1-2).

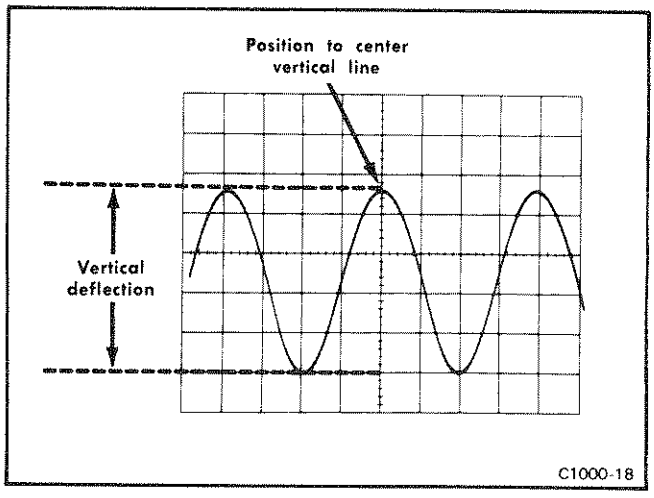


Fig. 1-2. Measuring peak-to-peak voltage of a waveform.

5. Measure the vertical deflection from peak to peak (divisions).

NOTE

This technique may also be used to make measurements between two points on the waveform, rather than peak-to-peak.

6. Multiply the distance (in divisions) measured in step 5 by the Volts/Div switch setting. Also include the attenuation factor of the probe, if applicable.

EXAMPLE: Assume a peak-to-peak vertical deflection of 4.6 divisions and a Volts/Div switch setting of 5 V.

$$\text{Peak-to-peak volts} = \text{4.6 (divisions)} \times \text{5 (Volts/Div setting)} = \text{23 volts}$$

NOTE

If an attenuator probe is used that cannot change the scale factor readout (Volts/Div), multiply the right side of the above equation by the attenuation factor.

Instantaneous Voltage Measurement—DC

To measure the dc level at a given point on a waveform, use the following procedure:

1. Set the input coupling of the vertical plug-in unit to Gnd and position the trace to the bottom line of the graticule (or other selected reference line). If the voltage to be measured is negative with respect to ground, position the trace to the top line of the graticule. Do not move the vertical Position control after this reference has been established.

NOTE

To measure a voltage level with respect to a voltage other than ground, make the following changes to step 1: Set the input coupling switch to dc and apply the reference voltage to the input connector, then position the trace to the reference line.

2. Connect the signal to the input connector. Set the input coupling to dc (the ground reference can be checked at any time by setting the input coupling to Gnd).

3. Set the Volts/Div switch to display about 5 or 6 vertical divisions of the waveform. Check that the variable Volts/Div control (red knob) is in the Cal position. Adjust the time-base triggering controls for a stable display.

4. Measure the distance in divisions between the reference line and the point on the waveform at which the dc level is to be measured. For example, in Fig. 1-3 the measurement is made between the reference line and point A.

5. Establish the polarity. The voltage is positive if the signal is applied to the + input connector and the waveform is above the reference line.

6. Multiply the distance measured in step 4 by the Volts/Div switch setting. Include the attenuation factor of the probe, if applicable (see the note following the Peak-to-Peak Voltage Measurement example).

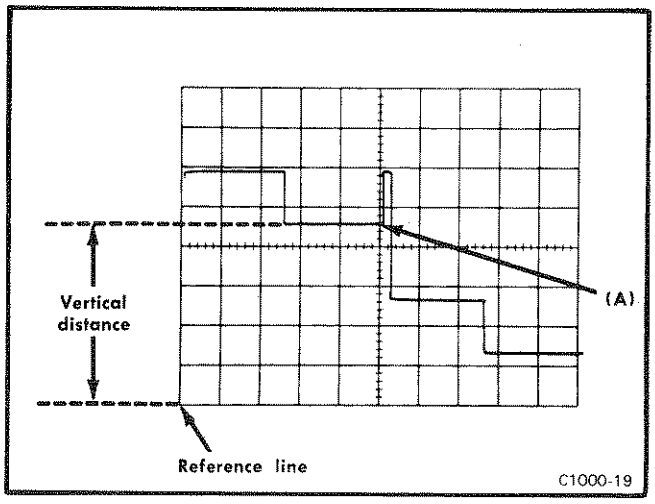


Fig. 1-3. Measuring instantaneous dc voltage with respect to a reference voltage.

EXAMPLE: Assume that the vertical distance measured is 4.6 divisions, the polarity is positive, and the Volts/Div switch setting is 2 V.

$$\text{Instantaneous Voltage} = \text{4.6 (divisions)} \times \text{2 (Volts/Div)} = \text{+9.2 volts}$$

Comparision Measurements

In some applications, it may be necessary to establish a set of deflection factors other than those indicated by the Volts/Div or Seconds/Div switches. This is useful for comparing signals to a reference voltage amplitude or period. To establish a new set of deflection factors based on a specific reference amplitude or period, proceed as follows:

Vertical Deflection Factor

1. Apply a reference signal of known amplitude to the vertical input connector. Using the Volts/Div switch and variable Volts/Div control, adjust the display for an exact number of divisions. Do not move the variable Volts/Div control after obtaining the desired deflection.

2. Divide the amplitude of the reference signal (volts) by the product of the deflection in divisions (established in step 1) and the Volts/Div switch setting. This is the Deflection Conversion Factor.

$$\text{Deflection Conversion Factor} = \frac{\text{reference signal amplitude (volts)}}{\text{deflection (divisions)} \times \text{Volts/Div setting}}$$

3. To determine the peak-to-peak amplitude of a signal compared to a reference, disconnect the reference and apply the signal to the input connector.

4. Set the Volts/Div switch to a setting that provides sufficient deflection to make the measurement. Do not readjust the variable Volts/Div control.

5. To establish a Modified Deflection Factor at any setting of the Volts/Div switch, multiply the Volts/Div switch setting by the Deflection Conversion Factor established in step 2.

$$\text{Modified Deflection Factor} = \text{Volts/Div setting} \times \text{Deflection Conversion Factor}$$

6. Measure the vertical deflection in divisions and determine the amplitude by the following formula:

$$\text{Signal Amplitude} = \text{Modified Deflection Factor} \times \text{Deflection (divisions)}$$

EXAMPLE: Assume a reference signal amplitude of 30 volts, a Volts/Div switch setting of 5 V and a deflection of four divisions. Substituting these values in the Deflection Conversion Factor formula (step 2):

$$\frac{30\ \text{V}}{(4)\ (5\ \text{V})} = 1.5$$

Then, with a Volts/Div switch setting of 2 V, the Modified Deflection Factor (step 5) is:

$$(2\ \text{V})\ (1.5) = 3\ \text{volts/division}$$

To determine the peak-to-peak amplitude of an amplitude signal that produces a vertical deflection of five divisions with the above conditions, use the Signal Amplitude formula (step 6):

$$(3\ \text{V})\ (5) = 15\ \text{volts}$$

Sweep Rate

1. Apply a reference signal of known frequency to the vertical input connector. Using the Seconds/Div switch and variable Seconds/Div control, adjust the display so that one cycle of the signal covers an exact number of horizontal divisions. Do not change the variable Seconds/Div control after obtaining the desired deflection.

2. Divide the period of the reference signal (seconds) by the product of the horizontal deflection in divisions (established in step 1) and the setting of the Seconds/Div switch. This is the Deflection Conversion Factor.

$$\text{Deflection Conversion Factor} = \frac{\text{reference signal period (seconds)}}{\text{horizontal deflection (divisions)} \times \text{Sec/Div switch setting}}$$

3. To determine the period of an unknown signal, disconnect the reference and apply the unknown signal.

4. Set the Seconds/Div switch to a setting that provides sufficient horizontal deflection to make an accurate measurement. Do not readjust the variable Seconds/Div control.

5. To establish a Modified Deflection Factor at any setting of the Seconds/Div switch, multiply the Seconds/Div switch setting by the Deflection Conversion Factor established in step 2.

$$\text{Modified Deflection Factor} = \text{Seconds/Div switch setting} \times \text{Deflection Conversion Factor}$$

6. Measure the horizontal deflection in divisions and determine the period by the following formula:

$$\text{Period} = \text{Modified Deflection Factor} \times \text{horizontal deflection (divisions)}$$

EXAMPLE: Assume a reference signal frequency of 455 hertz (period 2.2 milliseconds), a Seconds/Div switch setting of .2 ms, and a horizontal deflection of eight divisions. Substituting these values in the Deflection Conversions Factor formula (step 2):

$$\frac{2.2\ \text{ms}}{(8)\ (0.2\ \text{ms})} = 1.375$$

Then, with a Seconds/Div switch setting of 50 μs, the Modified Deflection Factor (step 5) is:

(50 μs) (1.375) = 68.75 microseconds/division

To determine the time period of an applied signal which completes one cycle in seven horizontal divisions, use the Period formula (step 6):

(68.75 μs) (7) = 481 microseconds

This product can be converted to frequency by taking the reciprocal of the period (see application of Determining Frequency).

Time Period Measurement

To measure the time (period) between two points on a waveform, use the following procedure:

1. Connect the signal to the vertical input connector, select either ac or dc input coupling, and set the Volts/Div switch to display about four divisions of the waveform.

2. Set the time-base triggering controls to obtain a stable display. Set the Seconds/Div switch to the fastest sweep rate that will permit displaying one cycle of the waveform in less than eight divisions (some non-linearity may occur in the first and last graticule divisions of display). Refer to Fig. 1-4.

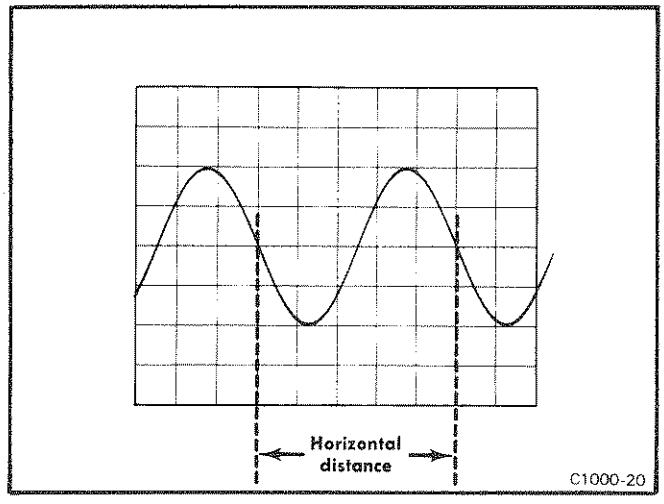


Fig. 1-4. Measuring time duration (period) between points on a waveform.

3. Adjust the vertical Position control to move the points between which the time measurement is made to the center horizontal line. Adjust the horizontal Position control to center the time-measurement points within the center eight divisions of the graticule.

4. Measure the horizontal distance between the time measurement points. Be sure the variable Seconds/Div control is in the Cal position.

5. Multiply the distance measured in step 4 by the setting of the Seconds/Div switch.

EXAMPLE: Assume that the horizontal distance between the time-measurement points is five divisions and the Seconds/Div switch is set to .1 ms. Using the formula:

$$\text{Period} = \begin{matrix}\text{horizontal}\\ \text{distance}\\ \text{(divisions)}\end{matrix} \times \begin{matrix}\text{Sec/Div}\\ \text{switch}\\ \text{setting}\end{matrix} = (5)\,(0.1\text{ ms}) = 0.5\text{ ms}$$

The period is 0.5 millisecond.

Determining Frequency

The time measurement technique can also be used to determine the frequency of a signal. The frequency of a periodically recurrent signal is the reciprocal of the time duration (period) of one cycle. Use the following procedure:

1. Measure the period of one cycle of the waveform as described in the previous application.

2. Take the reciprocal of the period to determine the frequency.

EXAMPLE: The frequency of the signal shown in Fig. 1-5, which has a period of 0.5 millisecond is:

$$\text{Frequency} = \frac{1}{\text{period}} = \frac{1}{0.5\text{ ms}} = 2\text{ kilohertz}$$

Risetime Measurement

Risetime measurements employ basically the same techniques as the time-period measurements. The main difference is the points between which the measurement is made. The following procedure gives the basic method of measuring risetime between the 10% and 90% points of the waveform.

1. Connect the signal to the input connector.

2. Set the Volts/Div switch and variable Volts/Div control to produce a display exactly five divisions in amplitude.

3. Center the display about the center horizontal line with the vertical Position control.

4. Set the time-base triggering controls to obtain a stable display. Set the Seconds/Div switch to the fastest sweep rate that will display less than eight divisions between the 10% and 90% points on the waveform (see Fig. 1-5).

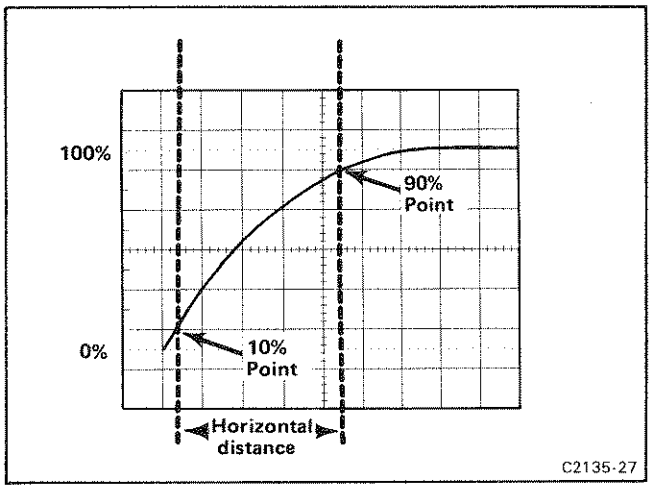


Fig. 1-5. Measuring risetime.

5. Adjust the horizontal Position control to move the 10% point of the waveform to the second vertical line of the graticule.

6. Measure the horizontal distance between the 10% and 90% points. Be sure the variable Seconds/Div control is in the Cal position.

7. Multiply the distance measured in step 6 by the setting of the Seconds/Div switch.

EXAMPLE: Assume that the horizontal distance between the 10% and 90% points is four divisions and the Seconds/Div switch is set to 1 μs.

Using the period formula to find risetime:

$$\text{Risetime period} = \text{horizontal distance (divisions)} \times \text{Sec/Div switch setting} = (4)\ (1\ \mu s) = 4\ \mu s$$

The risetime is 4 microseconds.

Time Difference Measurements

When used in conjunction with a calibrated time-base plug-in unit, the multi-trace feature of the oscilloscope permits measurement of time difference between two or more separate events. To measure time difference, use the following procedure:

1. Set the input coupling switches of the amplifier channels to either ac or dc.

2. Set the Display switch on the time-base unit to either Chop or Alt. In general, Chop is more suitable for low-frequency signals. More information on determining the mode is given under Vertical Display Mode in this section.

3. Set the vertical plug-in triggering switches to trigger the display on Channel 1 (or left plug-in) and Channel 2 (or center plug-in).

4. Connect the reference signal to the Channel 1 input connector and the comparison signal to the Channel 2 (or center plug-in) input connector. The reference signal should precede the comparison signal in time. Use coaxial cables or probes which have similar time-delay characteristics to connect the signal to the input connectors.

5. If the signals are of opposite polarity, invert the Channel 2 (or center plug-in) display. (Signals may be of opposite polarity due to 180° phase difference; if so, take this into account in the final calculation.)

6. Set the Volts/Div switches to produce about four divisions of display waveform.

7. Set the time-base triggering controls for a stable display. Set the Seconds/Div switch for a sweep rate which shows three or more divisions between the measurement points, if possible.

8. Adjust the vertical Position controls to bring the measurement points to the center horizontal reference line.

9. Adjust the horizontal Position control so the Channel 1 (or left plug-in) waveform (reference) crosses the center horizontal line at a vertical graticule line.

10. Measure the horizontal distance between the two measurement points (see Fig. 1-6).

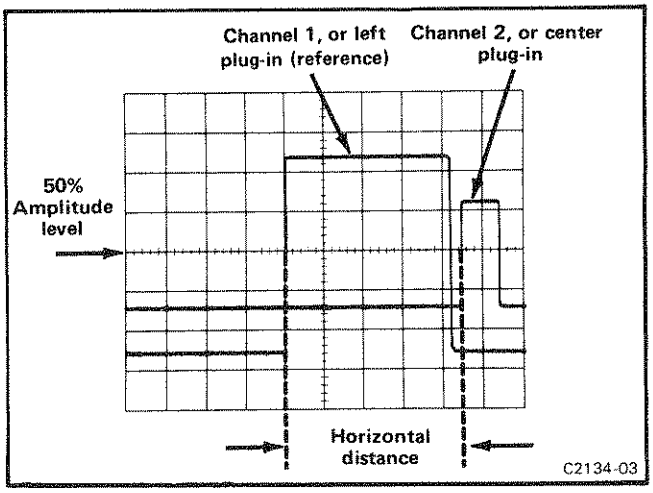


Fig. 1-6. Measuring time difference between two pulses.

11. Multiply the measured distance by the setting of the Seconds/Div switch.

EXAMPLE: Assume that the Seconds/Div switch is set to 50 μs and the horizontal distance between measurement points is four divisions. Using the formula:

$$\text{Time Delay} = \text{Sec/Div switch setting} \times \text{horizontal distance (divisions)} = (50\ \mu s)\ (4) = 200\ \mu s$$

The time delay is 200 microseconds.

Multi-Trace Phase Difference Measurement

Phase comparison between two or more signals of the same frequency can be made using a dual-trace plug-in or two single-trace plug-ins. This method of phase difference measurement can be used up to the frequency limit of the vertical system. To make the comparison, use the following procedure:

1. Set the input coupling switches of the amplifier channels to either ac or dc.

2. Set the Display switch on the time-base unit to either Chop or Alt. In general, Chop is more suitable for low-frequency signals and the Alt position is more suitable for high-frequency signals. More information on determining the mode is given under Vertical Display Mode in this section.

3. Set the vertical plug-in triggering switches to trigger the display on Channel 1 (or left plug-in) and Channel 2 (or center plug-in).

4. Connect the reference signal to the Channel 1 input connector and comparison signal to the Channel 2 (or center plug-in) input connector. The reference signal should precede the comparison signal in time. Use coaxial cables or probes which have similar time-delay characteristics to connect the signals to the input connectors.

5. If the signals are of opposite polarity, invert the Channel 2 (or center plug-in) display. (Signals may be of opposite polarity due to 180° phase difference; if so, take this into account in the final calculation.)

6. Set the Volts/Div switches and the variable Volts/Div controls so the displays are equal and about five divisions in amplitude.

7. Set the time-base triggering controls to obtain a stable display. Set the Seconds/Div switch to a sweep rate which displays about one cycle of the waveform.

8. Move the waveforms to the center of the graticule with the vertical Position controls.

9. Turn the variable Seconds/Div control until one cycle of the reference signal (Channel 1, or left plug-in) occupies exactly eight divisions between the second and tenth vertical lines of the graticule (see Fig. 1-7). Each division of the graticule represents 45° of the cycle (360° ÷ 8 divisions = 45°/division). The sweep rate can be stated in terms of degrees as 45°/division.

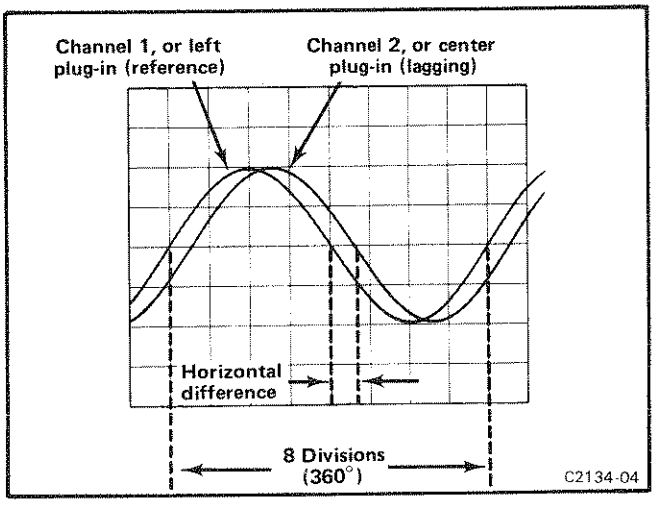


Fig. 1-7. Measuring phase difference.

10. Measure the horizontal difference between corresponding points on the waveforms.

11. Multiply the measured distance (in divisions) by 45°/division (sweep rate) to obtain the exact amount of phase difference.

EXAMPLE: Assume a horizontal difference of 0.6 division with a sweep rate of 45°/division as shown in Fig. 1-7. Use the formula:

$$\text{Phase Difference} = \text{horizontal difference (divisions)} \times \text{sweep rate (degrees/division)} = (0.6)\ (45°) = 27°$$

The phase difference is 27°.

High Resolution Phase Measurement

More accurate dual-trace phase measurements can be made by increasing the sweep rate (without changing the variable Seconds/Div control setting). One of the easiest ways to increase the sweep rate is with the Swp Mag (10X) button on the time-base unit.

EXAMPLE: If the sweep rate were increased 10 times with the magnifier, the magnifier sweep rate should be 45°/division ÷ 10 = 4.5°/division. Figure 1-8 shows the same signals as used in Fig. 1-7, but with the Swp Mag button pushed in. With a horizontal difference of six divisions the phase difference is:

$$\text{Phase Difference} = \text{horizontal difference (divisions)} \times \text{magnified sweep rate (degrees/division)} = (6)\ (4.5°) = 27°$$

The phase difference is 27°.

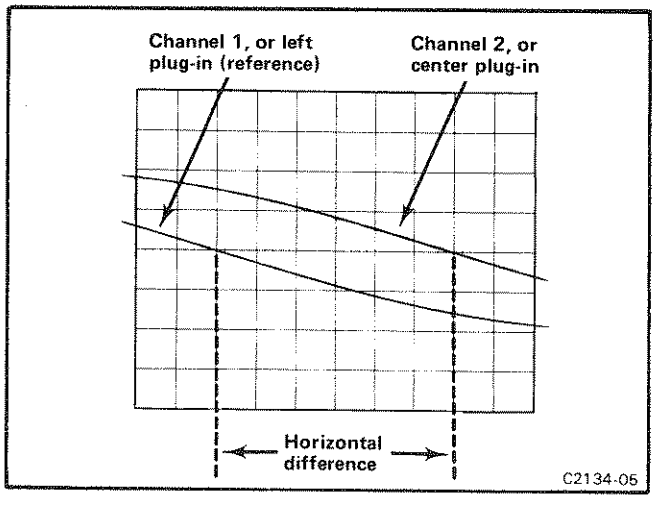


Fig. 1-8. High-resolution phase difference measurement with increased sweep rate.

X-Y Phase Measurements

The X-Y phase measurement method can also be used to measure the phase difference between two signals of the same frequency. The phase angle is determined from the Lissajous pattern as outlined in the following steps:

1. Insert an amplifier plug-in unit into one of the vertical plug-in compartments and an amplifier of the same type into the horizontal plug-in compartment.

2. Set each amplifier unit input coupling switch to dc, and set the position controls of the selected X and Y channels for a spot display at graticule center.

3. Connect low-frequency sine-wave signals of the same frequency to the selected X and Y inputs.

4. Advance the INTENSITY control until the display is at the desired viewing level. Set the amplifier deflection factors and variable Volts/Div controls for six divisions of vertical and horizontal deflection, and set the position controls to center the display on the graticule as shown in Fig. 1-9.

5. Measure and record the overall vertical deflection (A) and the opening of the Lissajous display (B), measuring vertically at the graticule horizontal center line (see Fig. 1-9).

6. Divide B by A to obtain the trigonometric sine of the phase angle difference between the two signals. Obtain the phase angle from a trigonometric table to determine the phase angle between the X and Y signals. If the display appears as a diagonal straight line, the two signals are either in phase (tilted upper right to lower left), or 180° out

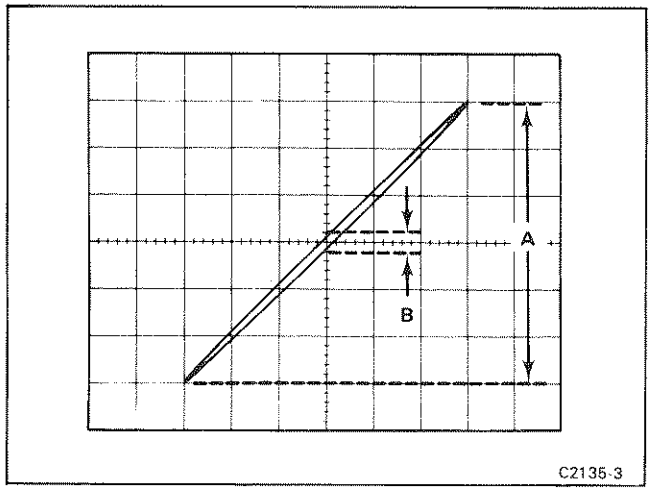


Fig. 1-9. Phase difference measurement from an X-Y display.

of phase (tilted upper left to lower right). If the display is a circle, the signals are 90° out of phase (Fig. 1-10 shows the Lissajous displays produced between 0° and 360°).

Notice that above 180° phase shift, the resultant display is the same as at some lower angle.

EXAMPLE: Assume a display as shown in Fig. 1-9, where A is 6 divisions and B is 0.4 division.

Using the formula:

$$\text{Sin } \Phi = \frac{B}{A} = \frac{0.4}{6} = 0.0667$$

From the trigonometric tables:

$$\Phi = \text{arcsin } 0.0667 = 3.82°$$

The phase angle difference between the X and Y signals is 3.82°.

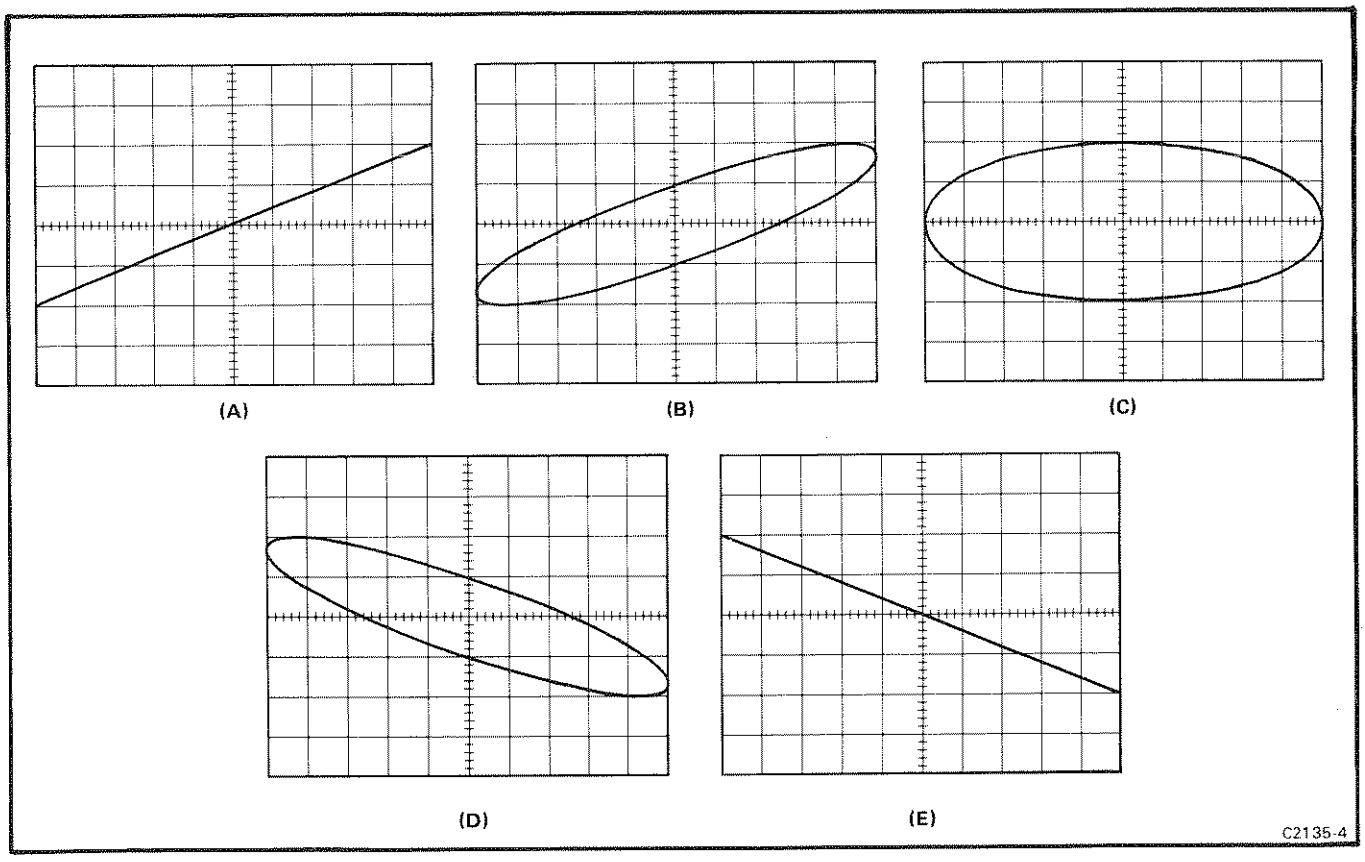


Fig. 1-10. Phase of a Lissajous display. (A) o° or 360°, (B) 30° or 330°, (C) 90° or 270°, (D) 150° or 210°, (E) 180°.

SPECIFICATION AND PERFORMANCE CHECK

SPECIFICATION

The following electrical characteristics are valid only if the instrument has been calibrated at an ambient temperature between +20° C and +30° C, the instrument is operating at an ambient temperature between 0° C and +50° C (unless otherwise noted), and each plug-in must be operating (fully installed) in a calibrated system.

Items listed in the Performance Requirements column of the Electrical Characteristics are verified by completing the Performance Check in this manual. Items listed in the Supplemental Information column may not be verified in this manual; they are either explanatory notes or performance characteristics for which no limits are specified.

ELECTRICAL CHARACTERISTICS

Table 2-1
VERTICAL AMPLIFIER

Characteristics	Performance Requirements	Supplemental Information
Input Signal Amplitude (Differential Input)		50 mV/displayed div.
Bandwidth	Dc to at least 2 MHz with a calibrated 5A18N.	
Channel Switching		
Chop Time Segment/Channel		Approximately 5 μs (≈4 μs displayed, ≈1 μs blanked).
Mainframe Compartment Chop Switching Sequence		Left, left, center, center...
Amplifier Channel Chop Switching Sequence		2 channel amplifier: Ch 1, Ch 2... 4 channel amplifier: Ch 1, Ch 2, off, off, Ch 3, Ch 4, off, off...
Alternate Frequency	Sweep rate (once each sweep).	
Mainframe Compartment Alternate Rate	One-half sweep rate (once every two sweeps).	
Amplifier Channel Alternate Rate	One-fourth sweep rate (once every four sweeps).	
Sensitivity Change		Accuracy degrades by up to 1% when operated in split-screen storage.
Signal Outputs (Option 7)		
Left Out, Center Out Signals	Crt-related vertical signals.	Derived from interface signal output pins.
Sensitivity	0.5 V/crt div, ±3% into ≥100 kΩ.	
DC Offset		±500 mV max.
Output Impedance	Approximately 1 kΩ.	
Dynamic Range		±4 V min.
Amplifier Bandwidth	≥500 kHz up to ±2 V output into ≤50 pF.	
Common Mode Rejection Ratio		≥28 dB at 1 kHz.
Noise and Chop Breakthrough[1]	≤100 mV at each output connector.	

[1] **If excessive noise and chop breakthrough occur, refer to the following discussion, Modifications to Pre-Option 7 Amplifier Plug-Ins in Section 4 Maintenance.**

Table 2-2
HORIZONTAL AMPLIFIER

Characteristics	Performance Requirements	Supplemental Information
Input Signal Amplitude (Differential Input)		50 mV/displayed div.
Horizontal Centering		0.5 division or less.
Bandwidth	Dc to at least 2 MHz with a calibrated 5A18N.	
X-Y Phase Difference Between Vertical and Horizontal Compartments	1° or less to 100 kHz.	Checked with two plug-ins of the same type.
Sensitivity Change		Accuracy degrades by up to 1% when operated in split-screen storage.
Signal Outputs (Option 7)		Crt-related sweep signal.
Right Out Signal		Derived from interface signal output pins.
Sensitivity	0.5 V/crt div, ±3% into ≥100 kΩ.	
Polarity and Output Voltage		Positive-going ramp, ≥5 V. DC offset provided by timebase position control.
Output Impedance	Approximately 1 kΩ.	
Gate Out Signal		Crt-related Z-axis signal. Selected by time-base unit.
Output Levels		TTL compatible. Low: Sinking 1.6 mA, ≤0.4 V. High: Supplying 40 μA, ≥2.4 V.
Risetime		≤1.5 μs into ≤50 pF.
Falltime		≤300 ns into ≤50 pF.

Table 2-3
Z-AXIS AMPLIFIER

Characteristics	Performance Requirements	Supplemental Information
External Intensity Input		
Useful Input Voltage	+5 V will turn on display to a normal brightness level from an off level; −5 V will turn off display from a normal brightness level.	
Usable Frequency Range	Dc to 1 MHz.	
Input R and C		Approximately 10 kΩ, paralleled by approximately 40 pF.
Maximum Safe Input		±5 V (dc + peak ac).

Table 2-4
DISPLAY

Characteristics	Performance Requirements	Supplemental Information
Cathode-Ray Tube		
Deflection		Electrostatic.
Phosphor		Equivalent to P1.
Accelerating Voltage		3.5 kV.
Orthogonality		90°, within 1°.
Geometry		0.1 division or less.
Storage		
Writing Speed	At least 20 div/ms (center 6 x 8 div).	At least 50 div/ms enhanced (center 6 x 8 div).
Option 3	At least 200 div/ms (center 6 x 8 div).	At least 800 div/ms enhanced (center 6 x 8 div).
Storage Time		1 hour.
Erase Time		Approximately 250 ms.
Beam Finder		Limits display to within graticule area and intensifies display if brightness level is low.

Table 2-5
CALIBRATOR AND POWER INPUT

Characteristics	Performance Requirements	Supplemental Information
Calibrator		
Voltage		400 mV, within 1%.
Current		4 mA, within 1%.
Frequency		Twice the line frequency.
Power Input		
Line Voltage (RMS)		Nominal 100 V, 110 V, 120 V, 200 V, 220 V, 240 V ±10% (250 V max.).
Fuse Data		1.6 A slow blow (120 V ac). 1 A slow blow (240 V ac).
Line Frequency		48 to 440 Hz.
Power Consumption		Typical mainframe only: 63 W. With 3 typical plug-ins: 74 W. Maximum: 110 W.
Insulation Voltage		1500 V rms minimum at 50 to 60 Hz for 10 seconds duration minimum.
Ground Continuity		Less than 0.1 Ω between safety ground and instrument.

ENVIRONMENTAL CHARACTERISTICS

Table 2-6

ENVIRONMENTAL

Characteristics	Information
Temperature	
Operating	0° C to +50° C.
Storage	−40° C to +70° C.
Altitude	
Operating	To 15,000 feet (4.57 km).
Storage	To 50,000 feet (15.23 km).
Vibration Operating and Non-operating	With the instrument complete and operating, vibration frequency swept from 10 to 50 to 10 Hz at 1 minute per sweep. Vibrate 15 minutes in each of the three axes at 0.015" (0.038 cm) total displacement. Hold 3 minutes at any resonance, or if none, at 50 Hz. Total time, 54 minutes.
Shock Operating and Non-Operating	30 g's, 1/2 sine, 11 ms duration, 2 shocks in each direction, along 3 major axes for a total of 12 shocks.
Transportation	Qualified under National Safe Transit Committee Test Procedure 1A, Category II.

PHYSICAL CHARACTERISTICS

Table 2-7

PHYSICAL

Characteristics	Information	
	Bench Oscilloscope	Rack Oscilloscope
Overall Dimensions		
Height	12.0 in. (305 mm).	5.2 in. (132 mm).
Length	20.4 in. (518 mm).	20.4 in. (518 mm). Rack depth required: 19.9 in. (483 mm)
Width	8.4 in. (214 mm).	19.9 in. (483 mm).
Net Weight	Approximately 22.5 lbs. (10.2 kg).	Approximately 23.6 lbs. (10.7 kg).
Shipping Weight	Approximately 30.0 lbs. (13.6 kg).	Approximately 39.0 lbs. (17.7 kg).
Export Weight	Approximately 45.0 lbs. (20.4 kg).	Approximately 59.0 lbs. (26.8 kg).
Finish	Anodized aluminum front panel. Blue-vinyl coated cabinet.	

POWER TO CUSTOM PLUG-INS

A blank plug-in kit is available from Tektronix, Inc. to enable the qualified service personnel to construct a wide variety of plug-in devices, such as strain gage power supplies and balance units, notch filters and special amplifiers. The modification kit provides a single-width plug-in housing and instructions for using the available mainframe power supplies. Order the kit through your local Tektronix Field Office or representative.

Table 2-8 lists the maximum current draw and Interface pin assignment for those power supply voltages recommended for operating custom plug-ins.

Table 2-8
POWER AVAILABLE TO CUSTOM PLUG-INS

Power Supply Voltage	Maximum Current/ Compartment	Maximum Total Current
200 V	10 mA	30 mA
+30 V	80 mA	240 mA
+5 V	133 mA	400 mA
-30 V	80 mA	240 mA

PERFORMANCE CHECK

Introduction

This procedure checks the oscilloscope for measurement accuracy against the tolerances listed as Performance Requirements that appear under Electrical Characteristics at the beginning of this section. If the instrument fails to meet the requirements given in this Performance Check, refer qualified service personnel to the service sections in this manual. The Performance Check can be used by an incoming inspection facility to determine acceptability of performance. It is not necessary to remove the instrument cabinet to perform this procedure, since all checks are made from the front panel.

The Electrical Characteristics in this section are valid only if the oscilloscope has been calibrated at an ambient temperature between +20° C to +30° C and is operating at an ambient temperature between 0° C to +50° C.

Tolerances that are specified in this Performance Check procedure apply to the instrument under test and do not include test equipment error. Limits and tolerances in this procedure are instrument performance requirements only if listed in the Performance Requirements column that appears under Electrical Characteristics in this section; information given in the Supplemental Information column is provided for user information only, and should not be interpreted as performance requirements.

PERFORMANCE CHECK INTERVAL

To ensure instrument accuracy, check the performance of the oscilloscope every 2000 hours of operation, or every 12 months if used infrequently.

TEST EQUIPMENT REQUIRED

The following test equipment, or equivalent, is required to perform a performance check of the oscilloscope. The test equipment performance requirements listed are the minimum required to verify the performance of the equipment under test. Substitute equipment must meet or exceed the stated requirements. All test equipment is assumed to be operating within tolerance.

SPECIAL TEST EQUIPMENT

Special test equipment is used where necessary to facilitate the procedure. Most of this equipment is available from Tektronix, Inc. and can be ordered through your local Tektronix Field Office or representative.

Table 2-9

LIST OF TEST EQUIPMENT REQUIREMENTS FOR PERFORMANCE CHECK

Description	Performance Requirements	Application	Example
Amplifier Plug-in unit[a]	Bandwidth, dc to 2 MHz; display modes, channel 1 and dual-trace; deflection factor, 5 mV to 5 V/div.	One required for all tests. Two required for Chop, Alt, and Phase Shift checks.	a. TEKTRONIX 5A18N Dual-Trace Amplifier.
Time-base Plug-in unit	Sweep rate, at least 2 μs/div.	All tests except Phase Shift check.	a. TEKTRONIX 5B10N Time-Base Unit.
Sine-wave generator	Frequency, 1 kHz to 2 MHz within 5%; output amplitude, variable from 250 mV to 5 V into 50 Ω; flatness, ±3% (2 MHz bandwidth only).	Vert and Horiz Bandwidth, Phase, Z-Axis, and Storage checks.	a. TEKTRONIX FG 503 Function Generator[b] for frequencies of 1 MHz and below; TEKTRONIX SG 503 Leveled Sine Wave Generator (for 2 MHz bandwidth only).[b]
Coaxial cable (2 required)	Impedance, 50 Ω; length, 42 inch; connectors, bnc.	Provides signal interconnection.	a. TEKTRONIX part 012-0057-01.
Coaxial cable	Impedance, 50 Ω; length, 18 inch; connectors, bnc.	Provides signal interconnection.	a. TEKTRONIX part 012-0076-00.
1X passive probe	Compatible with 5A-series amplifiers used in the oscilloscope.	Calibrator Signal checks.	a. TEKTRONIX P6101 Probe. b. TEKTRONIX P6062B Probe.
Termination	Impedance, 50 Ω; accuracy within 2%; connectors, bnc.	Vert and Horiz Bandwidth, Phase Shift check.	a. TEKTRONIX part 011-0049-01.
Tee connector	Connectors, bnc.	Phase and Z-Axis checks.	a. TEKTRONIX part 103-0030-00.
Screwdriver	Length, 3-inch shaft; bit size, 3/32 inch.	Trace Alignment.	a. Xcelite R3323.

[a]**Two dual-trace amplifiers are required to check vertical alternate and chop operation. Two identical amplifiers are required to check x-y phase difference.**

[b]**Requires a TM 500-series power module.**

PRELIMINARY PROCEDURE FOR PERFORMANCE CHECK

1. Ensure that all power switches are off.

2. Check the rear panel of the oscilloscope to ensure the indicated line voltage and the line voltage source are the same.

3. Ensure that all test equipment is suitably adapted to the line voltage to be applied.

4. If applicable, install the TM 500-series test equipment into the test equipment power module.

5. Install a dual-trace vertical amplifier unit into the left vertical compartment of the oscilloscope.

6. Install a time-base unit into the horizontal compartment of the oscilloscope.

7. Connect the equipment under test and the test equipment to a suitable line voltage source. Turn all equipment on and allow at least 20 minutes for the equipment to stabilize.

NOTE

Titles for external controls of the oscilloscope are capitalized in this procedure (e.g., INTENSITY, POWER).

INITIAL CONTROL SETTINGS

Set the following controls during warm-up time:

OSCILLOSCOPE

INTENSITY, FOCUS	Set for well-defined trace and normal brightness.
STORE (UPR and LWR)	Off
ERASE Select (UPR and LWR)	Off
BRIGHTNESS (Y-T)	MAX
ENHANCE	OFF

AMPLIFIER PLUG-IN

Display	On
Position	Centered
CH 1 Volts/Div	1
CH 1 Cal	Fully clockwise
CH 1 Input coupling	DC
Trigger	CH 1
Mode	CH 1

TIME BASE PLUG-IN

Display	Chop
Position	Centered
Seconds/Div	1 ms
Seconds/Div Cal	Fully clockwise
Swp Mag	Off
Triggering	+Slope, Auto Trig, AC Coupl
Triggering Source	Composite

PERFORMANCE CHECK PROCEDURE

1. Check Trace Alignment

a. Position the horizontal trace over the center horizontal graticule line.

b. Check—that the trace is parallel to the graticule line.

c. Adjust—the TRACE ROTATION control (rear-panel screwdriver adjustment) to align the trace horizontally.

2. Check Geometry

a. Press the Power switch to turn off the oscilloscope.

b. Interchange the amplifier and time-base units in their respective compartments. Pull the POWER switch to on.

c. Position the vertical trace over the center vertical graticule line, extending vertically above and below the graticule area, and set the FOCUS and INTENSITY controls for a well-defined trace.

d. Check—that vertical bowing and tilt of the trace display is less than 0.1 division at the center line and when positioned horizontally across the entire graticule area.

e. Press the POWER switch to turn off the oscilloscope and interchange the amplifier and time-base units back to their usual compartments.

f. Pull the POWER switch to on.

3. Check Beam Finder

a. Set the INTENSITY control for a dim trace.

b. Press and hold the BEAM FINDER pushbutton in, then rotate the position control of the vertical amplifier and time-base units fully clockwise and counterclockwise.

c. Check—that the display is intensified, compressed, and remains within the graticule area.

d. Release the BEAM FINDER pushbutton and return the INTENSITY control to a normal setting.

4. Check Amplifier Alternate Operation

a. Push both CH 1 and CH 2 pushbuttons in and position the traces about two divisions apart.

b. Set the time-base unit Display pushbutton to Alternate.

c. Turn the time-base Seconds/Div switch throughout its range.

d. Check—for trace alternation at all sweep rates (except in amplifier positions). At faster sweep rates, alternation is not apparent; instead, the display appears as two traces on the screen.

e. Press the POWER switch to turn off the oscilloscope and change the amplifier from the vertical compartment to the center compartment.

f. Pull the POWER switch on and repeat parts c and d of this step.

5. Check Amplifier Chop Operation

a. Set the time-base unit Display pushbutton to Chop.

b. Turn the time-base Seconds/Div switch throughout its range.

c. Check—for a dual-trace display at all sweep rates (except in amplifier positions) without alternation.

d. Press the POWER switch to turn off the oscilloscope and change the amplifier from the center compartment to the left vertical compartment.

e. Pull the POWER switch to on and repeat parts b and c of this step.

6. Check Chop Operation Between Amplifiers

a. Press the POWER switch to turn off the oscilloscope. Install a second vertical dual-trace plug-in unit in the center plug-in compartment and set its controls for dual-trace operation. Pull the POWER switch to on.

b. Turn the time-base Seconds/Div switch throughout its range.

c. Check—for two traces for each amplifier (one for each channel) at all sweep rates.

NOTE

If a single-channel amplifier is used instead of the second dual-trace amplifier, the single-channel trace will appear once per sweep.

7. Check Alternate Operation Between Amplifiers

a. Set the time-base Display pushbutton to Alternate and the Seconds/Div switch to 50 ms.

b. Check—for two traces for the left amplifier (one for each channel), then two traces for the right amplifier, alternately between amplifier units.

NOTE

If a single-channel amplifier is used instead of a second dual-trace amplifier in the right vertical compartment, the single channel trace will appear twice for each alternation between amplifier units. To check alternate operation for the right vertical compartment, press the POWER switch to turn off the oscilloscope and interchange the two vertical amplifiers in their respective compartments. Pull the POWER switch to on and check for two traces from the dual-trace amplifier in the right vertical compartment.

c. Press the POWER switch to turn off the oscilloscope.

d. Remove the vertical amplifier from the center compartment. A dual-trace amplifier should remain installed in the left vertical compartment (install if necessary).

e. Pull the POWER switch to turn on the oscilloscope.

Set the equipment controls as follows:

AMPLIFIER PLUG-IN

Display	On
CH 1 Volts/Div	.5
CH 1 Cal	Fully clockwise
CH 1 Input Coupling	DC
Trigger	CH 1
Mode	CH 1

TIME BASE PLUG-IN

Seconds/Div	1 ms
Seconds/Div Cal	Fully clockwise
Swp Mag	Off
Triggering	+Slope, Auto Trig, AC Coupl
Triggering Source	Composite

8. Check Vertical Bandwidth

a. Connect the sine-wave generator to the amplifier input with a 42-inch coaxial cable and 50 ohm termination.

b. Adjust the sine-wave generator controls for a six-division display at a frequency of 50 kHz. Center the display on the graticule.

c. Without changing the output amplitude, increase the sine-wave generator frequency until the displayed amplitude is reduced to 4.2 divisions.

d. Check—the generator for a reading of at least 2 MHz.

e. Press the POWER switch to turn off the oscilloscope and install the amplifier in the right vertical compartment. Pull the POWER switch to on.

f. Repeat parts b through d for the right vertical compartment.

g. Leave the coaxial cable and termination connected to the amplifier input connector.

9. Check Horizontal Bandwidth

a. Press the POWER switch to turn off the oscilloscope and interchange the amplifier and the time base units in their respective compartments. Pull the POWER switch to on.

b. Adjust the sine-wave generator controls for a six-division display at a frequency of 50 kHz. Position the display between the third and ninth vertical graticule lines.

c. Without changing the output amplitude, increase the sine-wave generator frequency until the displayed amplitude is reduced to 4.2 divisions.

d. Check—the generator for a reading of at least 2 MHz.

e. Disconnect the coaxial cable and termination from the amplifier input connector.

10. Check X-Y Phase Difference

a. Press the POWER switch to turn off the oscilloscope.

b. Remove the time-base unit from the vertical compartment and install the second amplifier unit in the left vertical compartment.

NOTE

Identical amplifier units should be installed in the oscilloscope.

c. Connect the sine-wave generator through a 42-inch coaxial cable, 50 ohm termination, and a tee connector, to an amplifier input. Connect an 18-inch coaxial cable from the tee connector to the other amplifier input.

d. Pull the oscilloscope POWER switch to on.

e. Set both amplifier units for a deflection factor of .5 volt/division and dc input coupling.

f. Set the sine-wave generator for a 100-kilohertz output.

g. Adjust the vertical and horizontal position controls to center the diagonal display, then adjust the sine-wave generator for a display amplitude of six divisions vertically and horizontally.

h. Check—the opening of the diagonal-loop display at the graticule center line is 0.07 division or less (measure horizontally). This indicates a phase difference of 1° or less between the vertical and horizontal systems.

11. Check Z Axis Amplifier

a. Press the POWER switch to turn off the oscilloscope.

b. Disconnect the coaxial cables, termination and tee connector between the amplifiers and sine-wave generator.

c. Remove the vertical amplifier from the horizontal compartment and install the time-base unit in that compartment. Pull the oscilloscope POWER switch to on.

d. Set the time-base unit for auto, internal triggering at a sweep rate of 20 μs/division and set the amplifier for a deflection factor of 1 V/division.

e. Connect a 50 kHz sine-wave signal from the sine-wave generator through a 42-inch coaxial cable and a tee connector to the amplifier input.

f. Set the amplifier and sine-wave generator controls to obtain five divisions of display.

g. Set the oscilloscope INTENSITY control for a dim display.

h. Connect the signal from the output of the tee connector at the amplifier input, to the EXT INTENSITY INPUT connector on the rear panel.

i. Check—the top of the waveform is intensified and the bottom portion is blanked out.

j. Temporarily disconnect the coaxial cable at only the EXT INTENSITY INPUT connector.

k. Set the time-base unit for a sweep rate of 2 μs/division, and increase the output frequency of the sine-wave generator to 1 MHz.

l. Reconnect the coaxial cable to the EXT INTENSITY INPUT connector.

m. Check—for a noticeable effect of intensification in the top portion of the displayed waveform and blanking in the bottom portion of the waveform.

n. Disconnect the signal between the tee connector and the EXT INTENSITY INPUT connector.

12. Check Storage Operation (Option 3 only)

NOTE

If the instrument under test is not an Option 3 instrument skip this step and proceed to step 13.

a. Set the time-base unit for a sweep rate of 50 μs/division.

b. Adjust the sine-wave generator controls for a 3.2 division display at a frequency of 20 kHz. Center the display on the graticule.

c. Adjust the time-base unit for a stable-triggered display, then set the oscilloscope INTENSITY control fully counterclockwise.

d. Press the STORE buttons (both UPR and LWR) to their on position. Press the ERASE/ENHANCE select buttons (both UPR and LWR) to their on position. Adjust the ENHANCE control fully counterclockwise to OFF detent position. Adjust the BRIGHTNESS (Y-T) control fully clockwise to MAX position. Press the ERASE button to remove extraneous display.

e. Adjust the INTENSITY for a normal brightness level, then return the control to its fully counterclockwise position.

f. Check—that a sharp, uniform, and continuous image remains on the screen. If it does not, momentarily adjust the INTENSITY control to a slightly higher brightness level, then return to fully counterclockwise position.

g. Press the ERASE button.

h. Check—that the stored image erases promptly and cleanly.

i. To verify writing speed, proceed as follows:

(1) Slowly advance the INTENSITY control to the point where the display begins to defocus, then set the time-base unit for single-sweep operation.

(2) Press the ERASE button to remove the stored display, then press the reset button on the time-base unit to store a single-sweep display.

(3) Check—for a stored display over the center 6 x 8 divisions of the graticule with breaks in the trace not exceeding 0.025 inch. This indicates a writing speed of at least 200 div/ms.

NOTE

If breaks in the trace exceed 0.025 inch, adjust the INTENSITY control for a slightly higher brightness level or examine the trace breaks more closely for lower luminance (acceptable). Repeat parts (2) and (3) if necessary.

j. To check ENHANCE operation, proceed as follows:

(1) Increase the frequency of the sine-wave generator to 40 kHz. Adjust the ENHANCE control to a point between its 9 and 10 o'clock position.

(2) Press the ERASE button to remove the stored display, then press the reset button on the time-base unit to store a single-sweep display.

(3) Check—for a stored display over the center 6 x 8 divisions of the graticule. The display may be improved by setting the ENHANCE control slightly clockwise, erasing, and resetting a sweep. Repeat this cycle as necessary until background fade-up is evident on the screen.

k. Disconnect the coaxial cable setup between the amplifier and the sine-wave generator.

l. Press and release the STORE buttons (both UPR and LWR) to their off position. Adjust the ENHANCE control fully counterclockwise to OFF position.

m. Return the time-base unit to repetitive-sweep operation (+Slope, Auto Trig, AC Coupl) and adjust the INTENSITY control for normal brightness.

13. Check Storage Operation

NOTE

If the instrument under test is an option 3 instrument skip this step and proceed to step 14.

a. Set the time-base unit for a sweep rate of 0.5 ms/division.

b. Adjust the sine-wave generator controls for a 3.2 division display at a frequency of 2 kHz. Center the display on the graticule.

c. Adjust the time-base unit for a stable-triggered display, then set the oscilloscope INTENSITY control fully counterclockwise.

d. Press the STORE buttons (both UPR and LWR) to their on position. Press the ERASE/ENHANCE select buttons (both UPR and LWR) to their on position. Adjust the ENHANCE control fully counterclockwise to OFF detent position. Adjust the BRIGHTNESS (Y-T) control fully clockwise to MAX position. Press the ERASE button to remove extraneous display.

e. Adjust the INTENSITY for a normal brightness level, then return the control to its fully counterclockwise position.

f. Check—that a sharp, uniform, and continuous image remains on the screen. If it does not, momentarily adjust the INTENSITY control to a slightly higher brightness level, then return to fully counterclockwise position.

g. Press the ERASE button.

h. Check—that the stored image erases promptly and cleanly.

i. To verify writing speed, proceed as follows:

(1) Slowly advance the INTENSITY control to the point where the display begins to defocus, then set the time-base unit for single-sweep operation.

(2) Press the ERASE button to remove the stored display, then press the reset button on the time-base unit to store a single-sweep display.

(3) Check—for a stored display over the center 6 x 8 divisions of the graticule with breaks in the trace not exceeding 0.025 inch. This indicates a writing speed of at least 20 div/ms.

NOTE

If breaks in the trace exceed 0.025 inch, adjust the INTENSITY control for a slightly higher brightness level or examine the trace breaks more closely for lower luminance (acceptable). Repeat parts (2) and (3) if necessary.

j. To check ENHANCE operation, proceed as follows:

(1) Increase the frequency of the sine-wave generator to 4 kHz. Adjust the ENHANCE control to a point between its 9 and 10 o'clock position.

(2) Press the ERASE button to remove the stored display, then press the reset button on the time-base unit to store a single-sweep display.

(3) Check—for a stored display over the center 6 x 8 divisions of the graticule. The display may be improved by setting the ENHANCE control slightly clockwise, erasing, and resetting a sweep. Repeat this cycle as necessary until background fade-up is evident on the screen.

k. Disconnect the coaxial cable setup between the amplifier and the sine-wave generator.

l. Press and release the STORE buttons (both UPR and LWR) to their off position. Adjust the ENHANCE control fully counterclockwise to OFF position.

m. Return the time-base unit to repetitive-sweep operation (+Slope, Auto Trig, AC Coupl) and adjust the INTENSITY control for normal brightness.

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.

ADJUSTMENT

Introduction

This adjustment procedure is to be used to restore the oscilloscope to original performance specifications. Adjustment need not be performed unless the instrument fails to meet the requirements listed in the Specification section of this manual, or the Performance Check cannot be completed satisfactorily.

Completion of all adjustment steps in this procedure ensures that the instrument will meet the performance requirements listed in the Specification section. However, to fully ensure satisfactory performance, it is recommended that the Performance Check be performed after any adjustment is made.

Tektronix Field Service

Tektronix, Inc. provides complete instrument repair and recalibration at local Field Service Centers and the Factory Service Center. Contact your local Tektronix Field Office or representative for further information.

Test Equipment Required

The following test equipment, or equivalent, is required for complete adjustment of the oscilloscope. The test equipment performance requirements listed are the minimum necessary for accurate adjustment. Substitute equipment must meet or exceed the stated requirements. All test equipment is assumed to be operating within tolerance.

Table 3-1

LIST OF TEST EQUIPMENT REQUIREMENTS FOR ADJUSTMENT

Description	Performance Requirements	Application	Example
Amplifier plug-in unit[a]	Bandwidth, dc to 2 MHz; deflection factor, 5 mV to 5 V/div.	One required for all tests. Two required for Phase Shift adjustment.	a. TEKTRONIX 5A15N Amplifier. b. TEKTRONIX 5A18N Dual-Trace Amplifier.
Time-base plug-in unit	Sweep rate, at least 2 μs/div.	All tests except Phase Shift adjustment.	a. TEKTRONIX 5B10N Time-Base.
Calibration generator	Amplitude calibration, 5 mV to 5 V; accuracy, $\pm$0.25% into 1 MΩ; output, square wave at approximately 1 kHz.	Vert and Horiz Gain Adjustments.	a. TEKTRONIX PG 506 Calibration Generator.[b]
Sine-wave generator	Frequency, 100 kHz; output amplitude, variable from 250 mV to 5 V into 50 Ω.	Phase Shift adjustment	a. TEKTRONIX FG 503 Function Generator.[b]
Digital voltmeter	Range, zero to 400 volts; accuracy, within 0.1%.	Power Supply and Storage adjustments. Calibrator check.	a. TEKTRONIX DM 501A Digital Multimeter.[b]
DC voltmeter (vom)[c]	Range, zero to 4000 volts; accuracy, checked to within 1% at 3400 volts.	High Voltage Power Supply adjustment.	a. Valhalla 4500 High Voltage Digital Multimeter with Tektronix 003-0120-00 Test leads. b. Simpson Model 262.
Coaxial cable	Impedance, 50 Ω; length, 42 inch; connectors, bnc.	Vert and Horiz Gain, Phase Shift adjustments.	a. Tektronix Part 012-0057-01.

[a] Two identical amplifiers are required to adjust x-y phase difference.

[b] Requires a TM 500-series power module.

[c] A high voltage probe can be used with the DM 501A Digital Multimeter in lieu of the DC voltmeter. See the Tektronix Catalog for a list of DM 501A option accessories.

Table 3-1 (cont)

Description	Performance Requirements	Application	Example
Coaxial cable	Impedance, 50 Ω; length 18 inch; connectors, bnc.	Phase Shift adjustment.	a. Tektronix Part 012-0076-00.
Termination	Impedance, 50 Ω; accuracy, within 2%; connectors, bnc.	Phase Shift adjustment.	a. Tektronix Part 011-0049-01.
Tee Connector	Connectors, bnc.	Phase Shift adjustment.	a. Tektronix Part 103-0030-00.
Insulated Screwdriver	Length, 1 1/2-inch shaft or longer; plastic shaft and handle with metal screwdriver tip.	Recommended for all adjustments.	a. Tektronix Part 003-0000-00.

PRELIMINARY PROCEDURE FOR ADJUSTMENT

NOTE

The oscilloscope must be adjusted within an ambient temperature range of +20° C to +30° C for best overall accuracy and to meet the electrical characteristic tolerances given as Performance Requirements in the Specification section of this manual. Information given as Supplemental Information in the Specification section is provided for user information only, and should not be interpreted as Performance Requirements.

1. Remove the cabinet sides and bottom from the oscilloscope (refer to Cabinet Removal in the Maintenance section of this manual).

2. Check the rear panel of the oscilloscope to ensure that the indicated line voltage and the line voltage source are the same (refer to Operating Voltage in the Maintenance section of this manual).

3. Ensure that all test equipment is suitably adapted to the line voltage to be applied.

4. If applicable, install the TM 500-series test equipment into the test equipment power module.

5. Install a vertical amplifier unit into the left vertical compartment of the oscilloscope.

6. Install a time-base unit into the horizontal compartment of the oscilloscope.

7. Connect the equipment under test and the test equipment to a suitable line voltage source. Turn all equipment on and allow at least 20 minutes for the equipment to stabilize.

NOTE

Titles for external controls of the oscilloscope are capitalized in this procedure (e.g. INTENSITY, POWER). Internal adjustments are initial capitalized only (e.g. Intensity Range, Vertical Gain).

Initial Control Settings

Set the following controls during warm-up time:

OSCILLOSCOPE

INTENSITY, FOCUS	Set for well-defined trace and normal brightness.
STORE (UPR and LWR)	Off
ERASE/ENHANCE Select (UPR and LWR)	Off
BRIGHTNESS (Y-T)	MAX
ENHANCE	OFF

AMPLIFIER PLUG-IN

Display	On
Position	Centered
Volts/Div	1
Volts/Div Cal	Fully clockwise
Input coupling	DC

TIME-BASE PLUG-IN

Display	Chop
Position	Centered
Seconds/Div	1 ms
Seconds/Div Cal	Fully clockwise
Swp Mag	Off
Triggering	+Slope, Auto Trig, AC Coupl
Triggering Source	Composite

ADJUSTMENT PROCEDURE

1. Adjust −30 Volt Power Supply

a. Turn over the oscilloscope to lay on its left side to gain access to the LV Power Supply circuit board.

b. Connect the digital voltmeter between the −30 V test point and ground. See 5111A Test Point and Adjustment Locator in Section 8 of this manual.

c. Check—for a meter reading of -29.95 to -30.05 volts.

NOTE

If the -30 volt supply is within the specified tolerance, proceed with step 2. If the -30 volt adjustment is to be made, all circuits will be affected and the entire power supply adjustment procedure should be performed to verify the accuracy of the supplies.

d. Adjust—−30 V Adj, R878, for a meter reading of exactly −30 volts. See 5111A Test Point and Adjustment Locator in Section 8, of this manual, for adjustment location.

2. Adjust +30 Volt Power Supply

a. Connect the digital voltmeter between the +30 V test point and ground. See 5111A Test Point and Adjustment Locator in Section 8, of this manual, for voltage test point location.

b. Check—for a meter reading of +29.95 to +30.05 volts.

NOTE

If the +30 volt supply is within the specified tolerance, proceed with step 3. If the +30 volts adjustment is to be made, all circuits will be affected and the entire power supply adjustment procedure should be performed to verify the accuracy of the supplies.

c. Adjust—+30 V Adj, R858, for a meter reading of exactly +30 volts. See 5111A Test Point and Adjustment Locator in Section 8, of this manual, for adjustment location.

3. Check Remaining Power Supply Voltages

a. Connect the digital voltmeter between the +5 V test point and ground. See 5111A Test Point and Adjustment Locator in Section 8, of this manual, for voltage test point location.

b. Check—for a meter reading of +4.90 to +5.10 volts.

c. Connect the digital voltmeter between the +200 V test point and ground. See 5111A Test Point and Adjustment Locator in Section 8, of this manual, for voltage test point location.

d. Check—for a meter reading of +175 to +247.5 volts.

NOTE

Ripple and regulation of the individual supplies can be checked using the procedure given under Troubleshooting Techniques in the Maintenance section of this manual.

4. Check Calibrator Output Voltage

a. Connect the digital voltmeter between the CALIBRATOR current loop on the front panel, and a ground test point. See 5111A Test Point and Adjustment Locator in Section 8, of this manual, for ground test point location.

b. Apply a ground connection (short circuit) between the junction of R885 and C890, and a ground test point. See 5111A Test Point and Adjustment Locator in Section 8, of this manual, for the junction and ground test point locations.

c. Check—for a meter reading of +396 to +404 millivolts.

d. Disconnect the ground connection (short circuit) from the junction and ground test point.

e. Disconnect the digital voltmeter.

5. Adjust High-Voltage Power Supply

a. Press the POWER switch to turn off the oscilloscope and return the oscilloscope to its normal upright position.

b. On the rear panel of the instrument, remove the two cap nuts securing the cover over the crt socket, then remove the cover (a 5/16-inch nutdriver may be needed to remove the cap nuts).

c. Set the dc voltmeter (vom) to measure at least −4500 volts dc. Remove the insulating sleeve from the probe tip of the test lead to be used for measuring the negative voltage. Connect the voltmeter leads between a convenient chassis ground and the High-Voltage Test Point. See 5111A Test Point and Adjustment Locator in Section 8, of this manual, for test point location. (The high-voltage lead should be fully inserted through the crt socket cover so that the lead connects to the test points without having to hold it by hand).

d. Pull the POWER switch to turn on the oscilloscope.

e. Check—for a meter reading of -3400 volts, ±170 volts.

NOTE

If the high-voltage power supply is within the specified tolerance, proceed with part g. If the adjustment is to be made, all remaining adjustments in this procedure could be affected and should be performed to verify the accuracy of all adjustments.

CAUTION

An insulated screwdriver must be used to adjust variable components in this instrument, especially in the high-voltage area, to prevent shorting voltages to ground and damaging the instrument.

f. Adjust—High Volts, R275, using an insulated screwdriver, for a meter reading of exactly −3400 volts. See 5111A Test Point and Adjustment Locator in Section 8, of this manual, for adjustment location.

g. Press the POWER switch to turn off the oscilloscope before disconnecting the voltmeter.

h. Disconnect the dc voltmeter and replace the cover over the crt socket, reversing the procedure given in part b of this step.

6. Adjust Intensity Range

a. Pull the POWER switch to turn on the oscilloscope.

b. Set the INTENSITY control fully counterclockwise.

c. Set the time-base unit Seconds/Div switch to an amplifier position or for the slowest sweep rate.

d. Turn the INTENSITY control slowly clockwise and check for a visible spot display. Note that the spot appears when the control is between its 10 and 11 o'clock position. If the spot appears when the control is within the given position, proceed with step 7a.

e. Set the INTENSITY control to its 10 o'clock position.

f. Adjust—Intensity Range, R245, using an insulated screwdriver, for a very dim spot display. See 5111A Test Point and Adjustment Locator in Section 8, of this manual, for adjustment location.

7. Adjust Astigmatism

a. Set the INTENSITY control for a spot display at normal viewing level.

b. Turn the FOCUS control through its range.

c. Check—for a spot display that is nearly round in shape when defocused, and well defined when focused.

d. Adjust—Astig, R286, and FOCUS control together, using an insulated screwdriver, to obtain the best defined round-spot display. See 5111A Test Point and Adjustment Locator in Section 8, of this manual, for adjustment location.

8. Adjust Trace Alignment

a. Set the time-base unit for a sweep rate of 1 ms/divsion.

b. Set the INTENSITY control for a trace of normal brightness.

c. Position the horizontal trace over the center horizontal graticule line.

d. Check—that the trace is parallel to the graticule line.

e. Adjust—the TRACE ROTATION control (rear-panel screwdriver adjustment) to align the trace horizontally.

9. Adjust Geometry

a. Press the POWER switch to turn off the oscilloscope.

b. Interchange the amplifier and time-base units in their respective compartments. Pull the POWER switch to on.

c. Position the vertical trace over the center vertical graticule line, extending vertically above and below the graticule area, and set the FOCUS and INTENSITY controls for a well-defined trace, if necessary.

d. Check—that vertical bowing and tilt of the trace display is less than 0.1 division at the center line and when positioned horizontally across the entire graticule area.

e. Adjust—Geom, R285, for minimum bowing and tilt of the trace display at the left and right edges of the graticule. Adjustment may have to be compromised to obtain less than 0.1 division bowing and tilt everywhere within the graticule area. See 5111A Test Point and Adjustment Locator in Section 8, of this manual, for adjustment location.

f. Press the POWER switch to turn off the oscilloscope and interchange the amplifier and time-base units back to their usual compartments.

g. Pull the POWER switch to on and check that horizontal bowing and tilt of the trace display is less than 0.1 division at the center line and when positioned vertically across the entire graticule area.

Set the equipment controls as follows:

AMPLIFIER PLUG-IN

Display	On
Position	Centered
Volts/Div	1
Volts/Div Cal	Fully clockwise
Input Coupling	DC

TIME-BASE PLUG-IN

Position	Centered
Seconds/Div	1 ms
Seconds/Div Cal	Fully clockwise
Swp Mag	Off
Triggering	+Slope, Auto Trig, AC Coupl
Triggering Source	Composite

10. Adjust Vertical Gain

a. Connect a 5-volt, 1-kilohertz square-wave signal of standardized amplitude from the calibration generator to the amplifier input, using a 42-inch coaxial cable.

NOTE

Use an amplifier plug-in known to be accurately calibrated, or verify correct calibration by applying a known signal and measuring the differential output at pins A7 and B7 of the plug-in connector. The deflection factor at the output is 50 millivolts/division.

b. Position the resultant five-division display to a convenient, centered location on the graticule. Set the INTENSITY and FOCUS controls for a well-defined display of normal brightness.

c. Check—the display for a vertical deflection of five divisions, ±0.15 division (±3%).

d. Adjust—Vert Gain, R116, for exactly five divisions of deflection. See 5111A Test Point and Adjustment Locator in Section 8, of this manual, for adjustment location.

e. Press the POWER switch to turn off the oscilloscope and remove the amplifier from the left vertical compartment and install it in the center compartment. Do not disconnect the signal from the amplifier input. Pull the POWER switch to on.

f. Check—the display for a vertical deflection of five divisions, ±0.15 division (±3%). If necessary, readjust Vertical Gain R116 for the optimum gain setting. Compromise for both vertical compartments.

g. Adjust the INTENSITY control for low brightness and note the exact vertical deflection.

h. Press the STORE buttons (both UPR and LWR) to their on position. Press the ERASE/ENHANCE select buttons (both UPR and LWR) to their on position. Press the ERASE button to remove extraneous display.

i. Check—that the vertical deflection in store mode has not changed more than ±0.05 division (±1%) from the exact deflection noted in part g (switch between the two modes as necessary and compare deflection amplitudes).

NOTE

If the deflection change is within the specified tolerance, proceed with part j. Any vertical deflection change may be a compromised adjustment against the horizontal deflection change (horizontal checked later in this procedure).

j. Adjust—Sens Corr, R385, while in the store mode, only enough to bring the store-mode deflection within 0.05 division of the deflection noted in the non-store mode. See 5111A Test Point and Adjustment Locator in Section 8, of this manual, for adjustment location.

k. Press and release the STORE buttons to their off position and adjust the INTENSITY control for normal brightness.

l. Disconnect the coaxial cable between the amplifier and calibration generator.

m. Press the POWER switch to turn off the oscilloscope and remove the amplifier from the center compartment and return it to the left vertical compartment. Pull the POWER switch to on.

11. Adjust Horizontal Centering

a. Set the time-base unit Swp Mag control for a magnified sweep and position the sweep start to the center vertical graticule line.

b. Return the time-base unit Swp Mag control to unmagnified sweep position.

c. Check—that the start of the unmagnified sweep is within 0.2 division of the center vertical graticule line. If the sweep start is within the given tolerance and no adjustment is to be made, proceed with step 12a.

d. Turn over the oscilloscope to lay on its left side to gain access to the bottom of the interface board.

e. Adjust—Horiz Cent, R730, to set the start of the unmagnified sweep at the center vertical graticule line. See 5111A Test Point and Adjustment Locator in Section 8, of this manual, for adjustment location.

f. Return the oscilloscope to its normal upright position.

12. Adjust Horizontal Gain

a. Press the POWER switch to turn off the oscilloscope and interchange the amplifier and the time-base units in their respective compartments. Pull the POWER switch to on.

b. Connect a 5-volt, 1-kilohertz square-wave signal of standardized amplitude from the calibration generator to the amplifier input connector, using a 42-inch coaxial cable.

NOTE

Use an amplifier plug-in known to be accurately calibrated, or verify correct calibration by applying a known signal and measuring the differential output at pins A7 and B7 of the plug-in connector. The deflection factor at the output is 50 millivolts/division.

c. Position the five-division display between the third and eighth vertical graticule lines.

d. Check—the display for a horizontal deflection of five divisions, ±0.15 division (±3%).

e. Adjust—Horiz Gain, R136, for exactly five divisions of deflection. See 5111A Test Point and Adjustment Locator in Section 8, of this manual, for adjustment location.

f. Adjust the INTENSITY control for low brightness and note the exact horizontal deflection.

g. Press the STORE buttons (both UPR and LWR) to their on position, press the ERASE/ENHANCE select buttons (both UPR and LWR) to their on position. Press the ERASE button to remove extraneous display.

h. Check—that the horizontal deflection in store mode has not changed more than ±0.05 division (±1%) from the exact deflection noted in part f (switch between the two modes as necessary and compare deflection amplitudes).

NOTE

If the deflection change is within the specified tolerance, proceed with part j. Any horizontal deflection change may be a compromised adjustment against the vertical deflection change (checked earlier in this procedure).

i. Adjust—Sens Corr, R385, while in the store mode, only enough to bring the store mode deflection within 0.05 division of the deflection noted in the non-store mode. See 5111A Test Point and Adjustment Locator in Section 8, of this manual, for adjustment location. Recheck the vertical deflection change (see Step 10).

j. Press and release the STORE buttons to their off position and adjust the INTENSITY control for normal brightness.

k. Disconnect the coaxial cable between the amplifier and the calibration generator.

13. Adjust X-Y Phase Difference

a. Press the POWER switch to turn off the oscilloscope.

b. Remove the time-base unit from the vertical compartment and install a second amplifier in the left vertical compartment.

NOTE

Identical amplifier units should be installed in the oscilloscope.

c. Connect the sine-wave generator through a 42-inch coaxial cable, 50 ohm termination, and a tee connector, to an amplifier input. Connect an 18-inch coaxial cable from the tee connector to the other amplifier input.

d. Pull the oscilloscope POWER switch to on.

e. Set both amplifier units for a deflection factor of 0.1 V/div.

f. Set the sine-wave generator for a 100-kilohertz output.

g. Adjust the vertical and horizontal position controls to center the diagonal display, then adjust the sine-wave generator for a display amplitude of six divisions vertically and horizontally.

h. Check—that any opening of the diagonal-loop display at the graticule center line is 0.07 division or less (measured horizontally). This indicates a phase difference of 1° or less between the vertical and horizontal systems.

i. Adjust—Phase, C116, for minimum loop opening (a straight line) in the diagonal-loop display. See 5111A Test Point and Adjustment Locator in Section 8, of this manual, for adjustment location.

j. Press the POWER switch to turn off the oscilloscope.

k. Disconnect the coaxial cables, termination and tee connector between the amplifier and sine-wave generator.

l. Remove the vertical amplifier from the horizontal compartment and install the time-base unit in that compartment. Pull the oscilloscope POWER switch to on.

Set the equipment controls as follows:

OSCILLOSCOPE

INTENSITY	Fully counterclockwise
STORE (UPR and LWR)	On
ERASE/ENHANCE Select (UPR AND LWR)	On
BRIGHTNESS (Y-T)	MAX
ENHANCE	OFF

AMPLIFIER PLUG-IN

Display	On
Position	Centered
Volts/Div	1
Volts/Div Cal	Fully clockwise
Input Coupling	DC

TIME-BASE PLUG-IN

Position	Centered
Seconds/Div	.5 ms
Seconds/Div Cal	Fully clockwise
Swp Mag	Off
Triggering	+Slope, Auto Trig, AC Coupl
Triggering Source	Composite

14. Adjust Storage Operation

a. Connect the digital voltmeter, set to measure 400 volts, between TP2 (the +230-volt test point) and ground. See 5111A Test Point and Adjustment Locator in Section 8, of this manual, for test point location.

b. Check—for a meter reading of +225 to +235 volts.

c. Adjust—R387, 230 V Adj, for a meter reading of exactly +230 volts. See 5111A Test Point and Adjustment Locator in Section 8, of this manual, for adjustment location.

d. Disconnect the digital voltmeter leads.

NOTE

If storage performance has been satisfactory, the following procedure to adjust the storage level is not necessary. If you decide to bypass the storage level adjustment, perform the instructions in the following parts e and f. Then proceed to the storage balance adjustment procedure beginning with part k of this step.

For replacement crt, an information card is provided to show the optimum levels established by the factory for the individual crt. All voltage levels associated with storage operation are made with respect to the flood-gun cathodes.

e. Connect the digital voltmeter negative lead to pin 3 of P389 (flood-gun cathodes) and connect the positive lead to TP1 (the store level test point). See 5111A Test Point and Adjustment Locator in Section 8, of this manual, for test point locations.

f. Record the voltmeter reading so that if necessary you can return the operating level to the original setting or obtain a balance between the storage levels.

g. Locate the writing threshold (minimum store level) as follows:

(1) Turn the INTENSITY control clockwise until the trace starts to defocus rapidly. Press the ERASE button to prepare the target area for storage.

(2) Write about three lines per division across both targets by slewing the free-running trace vertically with the vertical position control.

(3) Carefully check the written lines for breaks or gaps of 0.025 inch or more. If no breaks or gaps are evident after 10 seconds, adjust Store Level R350 to reduce the operating level by 5 volts. See 5111A Test Point and Adjustment Locator in Section 8, of this manual, for adjustment location.

(4) Erase twice, wait 10 seconds, then write again and check for breaks or gaps.

(5) Repeat this procedure of decreasing the operating voltage level in 5-volt steps until breaks of about 0.025 inch occur. This is the writing threshold.

(6) Record the voltmeter reading, then turn Store Level R350 clockwise until the original operating level recorded in part f is indicated on the voltmeter.

NOTE

Do not change the INTENSITY or FOCUS control settings.

h. Locate the upper writing limit (maximum store level) as follows:

(1) Again write about three lines per division. Carefully check the stored lines and background for trace spreading or background fade-up. If no trace spreading or background fade-up is evident after 10 seconds, adjust Store Level R350 to increase the operating level by 5 volts.

(2) Erase twice, wait 10 seconds, then write again and check for spreading of fade-up.

(3) Repeat this procedure until trace spreading of about 0.025 inch, or background fade-up occurs. This is the upper writing limit. Record this voltage.

i. Adjust—Store Level, R350, for an operating point midway between the recorded voltmeter readings for the upper writing limit and the writing threshold. Record the final voltmeter reading.

j. Interaction—between operating level and collimation, gain adjustment. If any change in operating level is significant, check vertical gain (Step 10 of this procedure) and check horizontal gain (Step 12). The collimation adjustment follows later in this step.

k. Move the positive lead of the voltmeter from TP1 to TP4, the store balance test point (negative lead remains at p in 3 of P389). See 5111A Test Point and Adjustment Locator in Section 8, of this manual, for test point location.

l. Adjust—Store Bal, R370, to set the store level to the same voltage as that recorded at TP1. See 5111A Test Point and Adjustment Locator in Section 8, of this manual, for adjustment location.

m. Move the positive lead of the voltmeter from TP4 to TP3 (the CE1 test point). See 5111A Test Point and Adjustment Locator in Section 8, of this manual, for test point location.

n. Write the entire screen by slowly positioning the trace vertically. If the screen fails to write, adjust the INTENSITY control slightly clockwise and repeat the process until the screen is fully written; then turn the INTENSITY control fully counterclockwise.

o. Record the voltmeter reading before an adjustment is made so that if necessary you can return the collimation voltage to its original setting.

p. Adjust—CE1, R390, fully counterclockwise noting that the screen edges are brightened and pulled. Slowly turn CE1 clockwise to the point where the bright area just covers the graticule area. See 5111A Test Point and Adjustment Locator in Section 8, of this manual, for adjustment location.

q. Erase the screen and disconnect the voltmeter.

r. Interaction—between collimation voltage, storage performance, and display geometry. If a significant change was made in the collimation voltage, check storage operation (Step 12 of Performance Check procedure) and check geometry (Step 9 of this procedure).

s. Turn the INTENSITY control to midrange, then fully write the entire screen by slowly positioning the trace vertically.

t. Adjust—Non Store, R395, counterclockwise just enough so background glow quickly (less than 1 second) disappears when the screen is placed in the non-store mode (STORE buttons out). Repeat this part as necessary to achieve the most desirable adjustment of the non-store voltage level. See 5111A Test Point and Adjustment Locator in Section 8, of this manual, for adjustment location.

u. Press and release the STORE buttons to their off position and adjust the INTENSITY control for nominal brightness. This completes the Adjustment procedure for the oscilloscope.

MAINTENANCE

This section of the manual contains information on preparation for use and reshipment, information for performing preventive maintenance, troubleshooting, and corrective maintenance for this instrument.

PREPARATION FOR USE AND RESHIPMENT

The following information provides detailed installation and operating voltage instructions for the oscilloscope.

LINE-VOLTAGE AND REGULATING-RANGE SELECTION

This instrument can be operated from either a 120-volt or a 240-volt nominal line-voltage source with power-line frequencies of 48 to 440 hertz. In addition, three operating ranges can be selected within each nominal line-voltage source. This permits the oscilloscope transformer to operate from 100-volt, 110-volt, 120-volt, 200-volt, 220-volt, and 240-volt sources. The nominal voltage and regulating range for which the instrument is currently set, is marked on the rear panel of the instrument. Before connecting the oscilloscope to line-voltage power, always check the rear panel to see if the voltage marked there complies with the expected line-voltage usage. If the voltage marked is proper, change of line voltage or regulating range will not be necessary.

To select a different operating range, use the following procedure to obtain correct instrument operation from the line voltage available:

1. Disconnect the instrument from the power source.

2. Remove the bottom cabinet panel of the instrument (see Cabinet Removal in this section) to gain access to the LV Power Supply circuit board.

3. In Table 4-1, select the desired regulating range for the nominal line voltage that will operate the oscilloscope. For that voltage, note the recommended primary-tap pins from Table 4-1 (note L, M, or H).

Table 4-1

REGULATING RANGE AND FUSE DATA

Primary Tap Pins Selected	Regulating Range	
	120-V Nominal (Brown Plug)	240-V Nominal (Red Plug)
L (low)	100 V ±10%	200 V ±10%
M (medium)	110 V ±10%	220 V ±10%
H (high, typical setting)	120 V ±10%	240 V ±10%[a]
Line Fuse	1.6 A slow-blow	1 A slow-blow

[a] **250 V maximum.**

4. In the instrument, select the proper line-voltage selector block (see Fig. 4-1 for line-selector block locations). Select the brown block for 120-volt operation or select the red block for 240-volt operation. Install the block on the row of primary-tap pins noted from Table 4-1 in the previous step (either L, M, or H).

CAUTION

Damage to the instrument may result if the line-selector block is used incorrectly (e.g., if the 120-volt block is used and the instrument is then connected to 240-volt power).

5. Install the unused block on the unused line-selector block pins (see Fig. 4-1 for pin location).

6. 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 Table 4-1 for line fuse information.

NOTE

An unused line fuse, intended for the line-voltage source for which the oscilloscope was not set when shipped from the factory, is clipped to the LV Power Supply circuit board (see Fig. 4-1). Return the resultant unused fuse to the unused fuse clips.

7. If appropriate, change the line-cord plug to match the power source receptacle or use a suitable adapter.

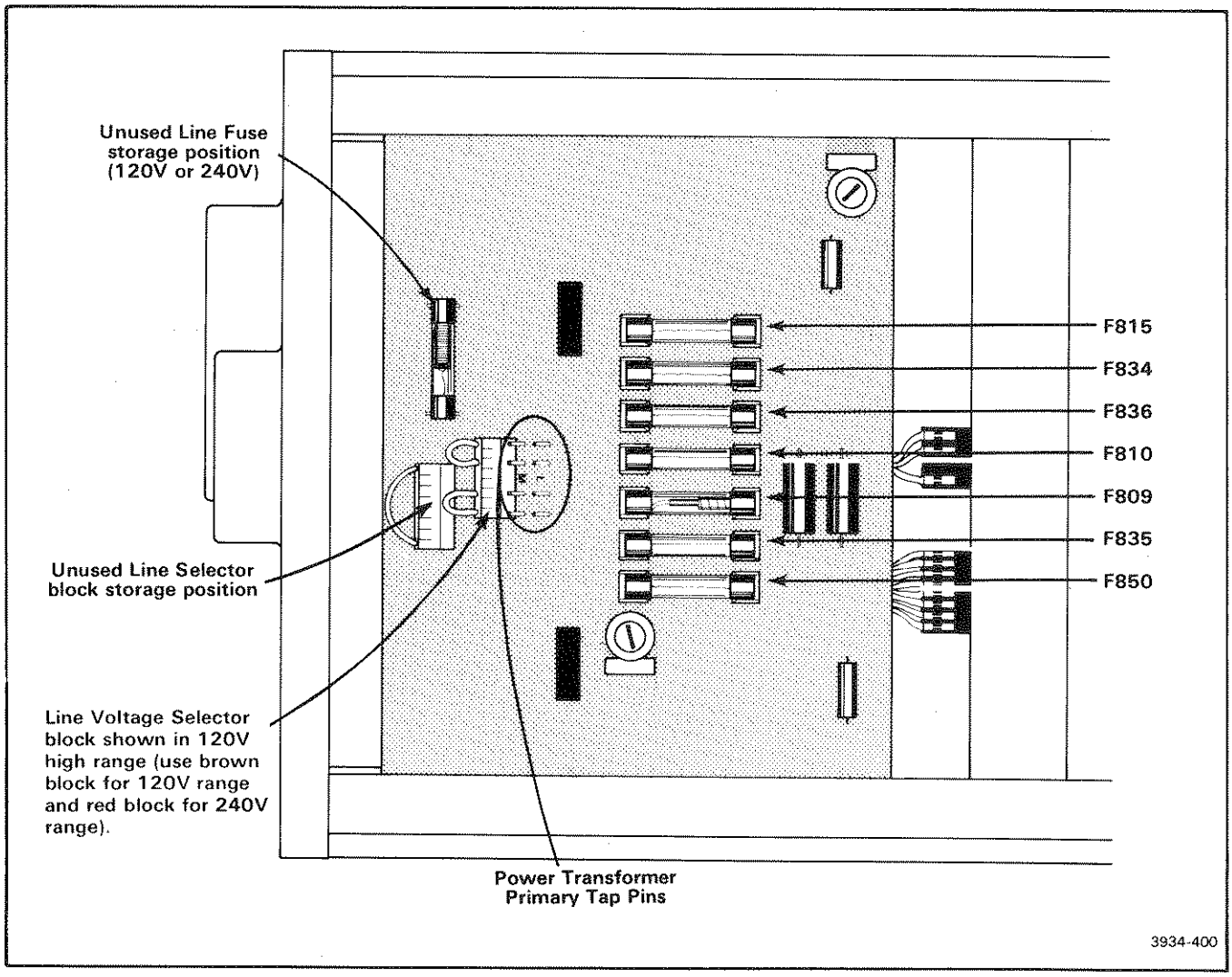


Fig. 4-1. Locations of the line-selector blocks on the LV Power Supply circuit board.

8. Change the nominal line-voltage information recorded on the rear panel. Use a non-abrasive eraser to remove previous data, and mark on the new data with a pencil.

9. Replace the bottom cabinet panel and apply power to the oscilloscope.

INSTRUMENT CONVERSION

The oscilloscope can be separated into two parts; a power supply/amplifier module, and a display module. These can be fastened together stacked or side by side; this permits operation as a bench oscilloscope, or in a standard 19-inch rack. The two modules can quickly be converted from a bench model to a rackmount model, or vice versa. Field conversion kits, including the necessary parts, and instructions are available from Tektronix, Inc.

NOTE

Before attempting to operate the oscilloscope after an instrument conversion, be sure the module wiring interconnections are correct. If display modules have been changed, check that the correct auxiliary board is installed in the socket on the plug-in interface board.

RACKMOUNTING

The rackmount version of the oscilloscope is designed for operation in a standard 19-inch wide rack that has Universal, EIA, RETMA, or Western Electric hole spacing. When properly mounted, this instrument will meet all electrical and environmental specifications given in Section 2 of this manual.

Mounting Method

This instrument will fit most 19-inch wide racks whose front and rear holes conform to Universal hole spacing, some drilling may be required on racks having EIA, RETMA, or Western Electric hole spacing. The slide-out tracks easily mount to the cabinet rack front and rear vertical mounting rails if the inside distance between the front and rear rails is within 10-9/16 inches to 24-3/8 inches. If the inside distance exceeds 24-3/8 inches, some means of support is required for the rear ends of the slide-out tracks. (For example make extensions for the rear mounting brackets.)

Rack Dimensions

Height. At least 5-1/4 inches of vertical space is required to mount this instrument in a rack. If other instruments are operated in the rack, an additional 1/4 inch is required, both above and below the oscilloscope, to allow space for proper circulation of cooling air.

Width. A standard 19-inch wide rack may be used. The dimension of opening between the front rails must be at least 17-5/8 inches for a cabinet in which the front lip of the stationary section is mounted behind the untapped front rail as shown in Fig. 4-2A. If the front rails are tapped, and the stationary section is mounted in front of the front rail as shown in Fig. 4-2B, the dimension between the front rails should be at least 17-3/4 inches. These dimensions allow room on each side of the instrument for the slide-out tracks to operate so the instrument can move freely in and out of the rack.

Depth. For proper circulation of cooling air, allow at least two inches clearance behind the rear of the instrument and any enclosure on the rack. If it is sometimes necessary or desirable to operate the oscilloscope in the fully extended position, use cables that are long enough to reach from the signal source to the instrument.

Installing The Slide-Out Tracks

The slide-out tracks for the instrument consist of two assemblies, one for the left side of the instrument and one for the right side. Each assembly consists of three sections. A stationary section attaches to the front and rear rails of the rack, the chassis section attaches to the instrument (and is installed at the factory), and the intermediate section fits between the other two sections to allow the instrument to fully extend out of the rack.

The small hardware components included with the slide-out track assemblies are used to mount the tracks to most standard 19-inch rack rails having this compatibility.

NOTE

1. Front and rear rail holes must be large enough to allow inserting a 10-32 screw through the rail mounting hole if the rails are untapped (see Fig. 4-2A).

2. Or, front and rear rail holes must be tapped to accept a 10-32 screw if Fig. 4-2B mounting method is used. Note in Fig. 4-2B right illustration that a No. 10 washer (not supplied) may be added to provide increased bearing surface for the slide-out track stationary section front flange.

Because of the above compatibility, there will be some small parts left over. The stationary and intermediate sections for both sides of the rack are shipped as a matched set and should not be separated. The matched sets of both sides including hardware are marked 351-0195-00 on the package. To identify the assemblies, note that the automatic latch and intermediate section stop is located near the top of the matched set.

Mounting Procedure. Use the following procedure to mount both sides. See Fig. 4-2 for installation details.

1. To mount the instrument directly above or below another instrument in a cabinet rack, select the appropriate holes in the front rack rails for the stationary sections, using Fig. 4-3 as a guide.

2. Mount the stationary slide-out track sections to the front rack rails using either of these methods:

(a) If the front flanges of the stationary sections are to be mounted behind the front rails (rails are countersunk or not tapped), mount the stationary sections as shown in Fig. 4-2A right illustration.

(b) If the front flanges of the stationary sections are to be mounted in front of the front rails (rails are tapped for 10-32 screws), mount the stationary sections as shown in Fig. 4-2B right illustration. To provide increased bearing surface for the screw head to securely fasten the front flange to the rail, a flat washer (not supplied) may be added under the screw head. However, if this mounting method is used, the front panel will not fit flush against the front rail because of the stationary section and washer thickness. If a flush fit is preferred, method 2 (a) should be used.

3. Mount the stationary slide-out sections to the rear rack rails using either of these methods.

(a) If the rear rail holes are not tapped to accept 10-32 machine screws, mount the left stationary section with hardware provided as shown in the left or center

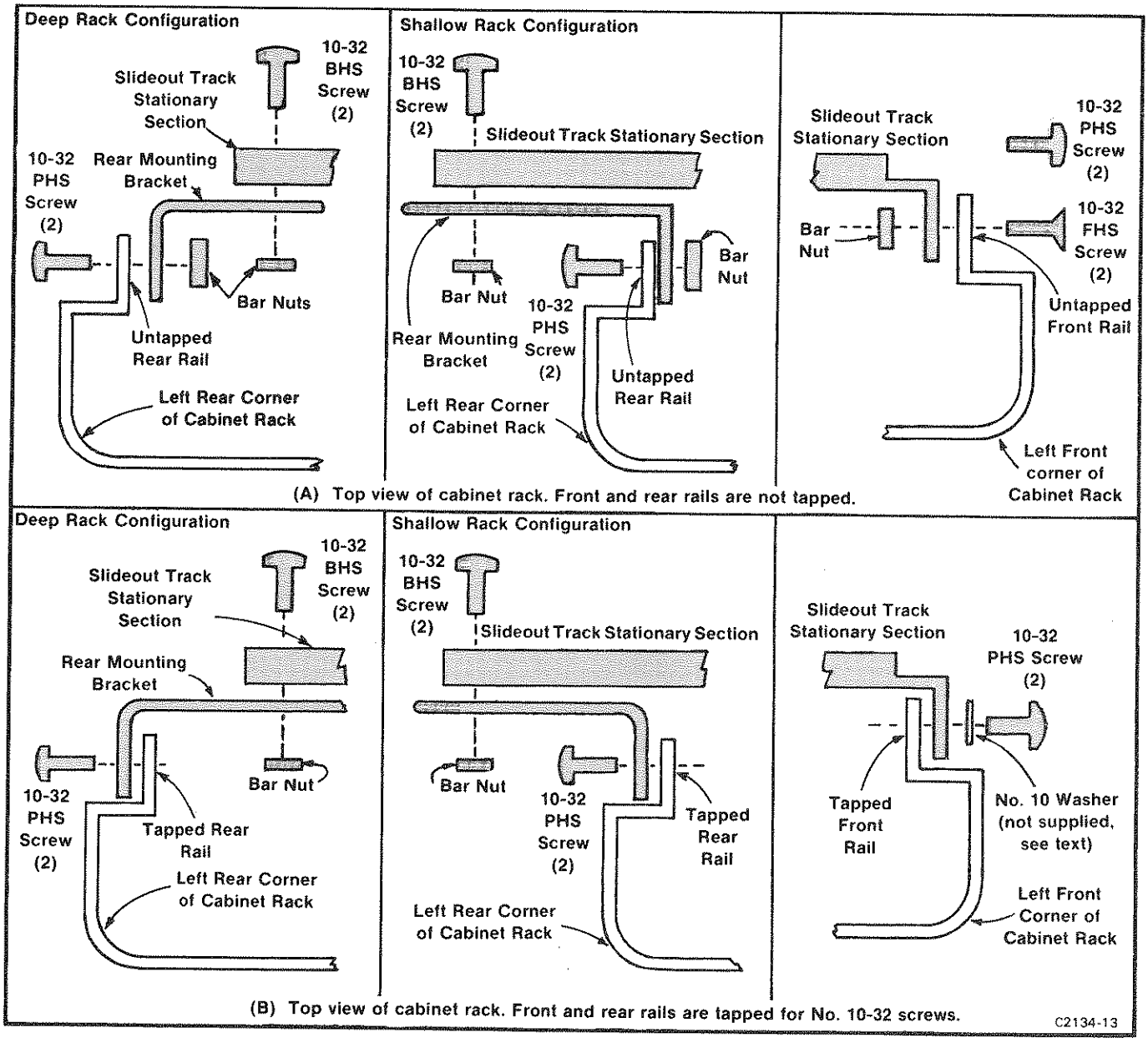


Fig. 4-2. Mounting the left stationary section (with its matched intermediate section, but not shown in illustrations A and B) to the rack rails.

illustration of Fig. 4-2A. Note that the rear mounting bracket can be installed either way so the slide-out tracks will fit a deep or shallow cabinet rack. Use Fig. 4-2A as a guide for mounting the right stationary section. Make sure that the stationary sections are horizontally aligned so they are level and parallel with each other.

(b) If the rear rack rail holes are tapped to accept 10-32 machine screws, mount the left stationary section with hardware provided as shown in the left or center illustration of Fig. 4-2B. Note that the rear mounting bracket can be installed either way so the slide-out track will fit a deep or shallow cabinet rack stationary section. Make sure the stationary sections are horizontally aligned so they are level and parallel with each other.

Installation And Adjustment

To insert the instrument into the rack, proceed as follows:

1. Pull the slide-out track intermediate sections out to the fully extended position.

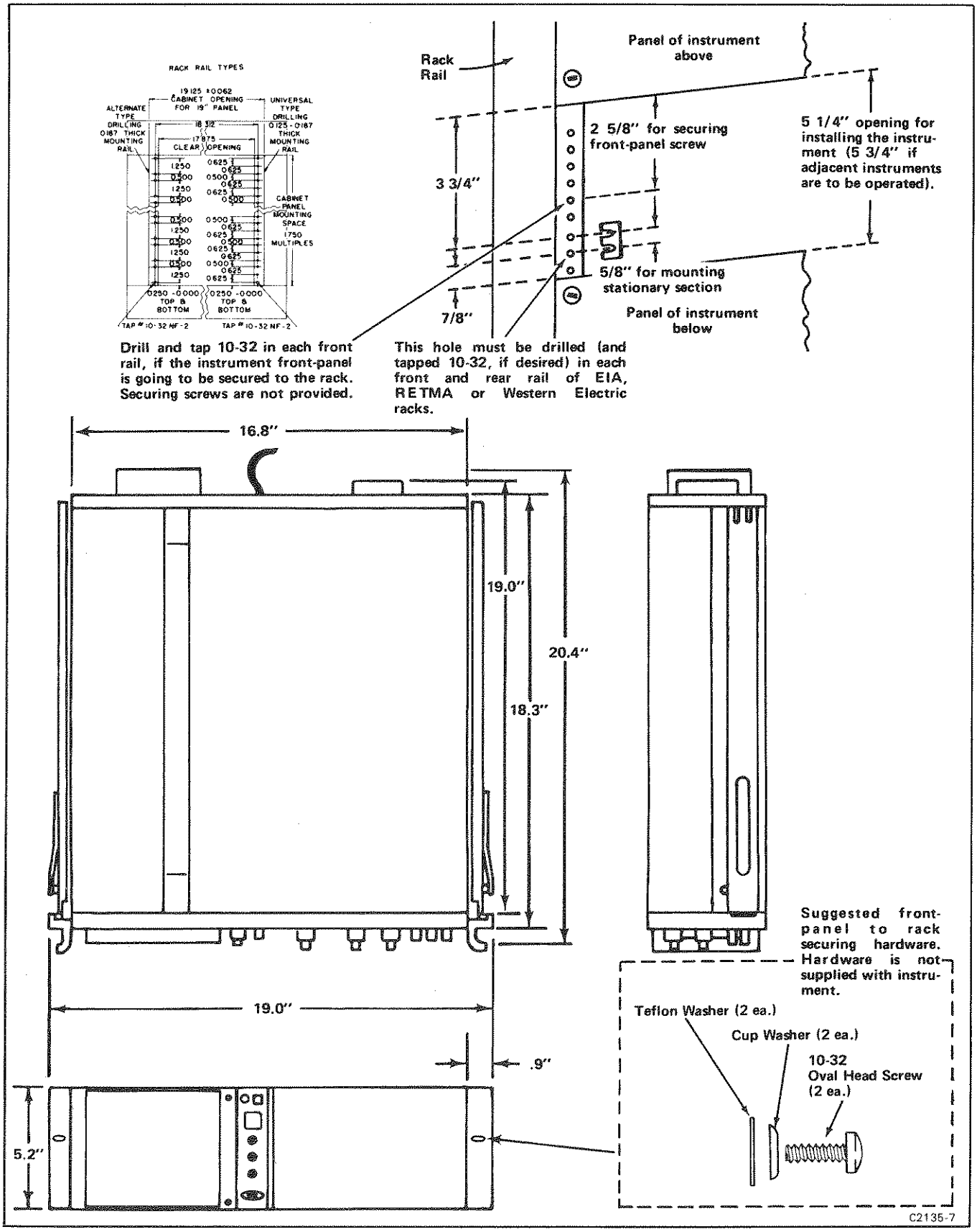


Fig. 4-3. Dimensional diagram.

2. Insert the instrument chassis sections into the intermediate sections.

3. Press the stop latches on the chassis sections and push the instrument toward the rack until the latches snap into their holes.

4. Again press the stop latches and push the instrument into the rack.

To adjust the slide-out tracks for smooth sliding action, loosen the screws used to join the stationary sections to the rails of the rack. Center the instrument, allowing the slide-out tracks to seek the proper width, then tighten the screws.

To secure the instrument front-panel to the rack, the rack must either have universal hole spacing, or a hole must be drilled and tapped for a 10-32 screw, see Fig. 4-3. Using the hardware (not furnished) indicated in Fig. 4-3, secure the instrument to the front rails of the rack.

Slide-out Track Maintenance

The slide-out tracks require no lubrication. The special dark gray finish on the sliding parts is a permanent lubrication.

Ventilation Requirements

When the oscilloscope is mounted in a rack with other equipment, it is important that the ambient temperature surrounding it does not exceed +50° C. Additional clearance or forced ventilation methods (fan) may need to be employed to maintain ambient temperatures below +50° C. Reliability and performance of the oscilloscope will be affected if the ventilation holes in the protective panels are obstructed, or if it is operated at an ambient temperature higher than +50° C.

REPACKAGING FOR SHIPMENT

If the Tektronix instrument is to be shipped to a Tektronix Service Center for service or repair, attach a tag showing: owner (with address) and the name of an individual at your firm that can be contacted. Include complete instrument serial number and a description of the service required.

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

Surround the instrument with polyethylene sheeting to protect the finish of the instrument. Obtain a carton of corrugated cardboard of the correct carton strength and having inside dimensions of no less than six inches more than the instrument dimensions. Cushion the instrument by tightly packing three inches of dunnage or urethane foam between carton and instrument, on all sides. Seal carton with shipping tape or industrial stapler.

The carton test strength for your instrument is 275 pounds.

PREVENTIVE MAINTENANCE

Preventive maintenance consists of cleaning, visual inspection, lubrication, etc. Preventive maintenance performed on a regular basis may prevent instrument breakdown and will improve the reliability of the instrument. The severity of the environment to which this instrument is subjected determines the frequency of maintenance. A convenient time to perform preventive maintenance is preceding adjustment of the instrument.

CABINET REMOVAL

WARNING

Dangerous voltages exist at several points throughout this instrument. When the instrument is operated with the covers removed, do not touch exposed connections or components. Some transistors have voltages present on their cases. Disconnect power before cleaning the instrument or replacing parts.

The cabinet sides are held in place by four latches. To remove the cabinet sides, turn the latches 90 degrees and pull the sides away from the carrying handle; then, lift the cabinet sides away from the instrument. The cabinet bottom is held in place with four latches and four screws.

The cabinet sides protect this instrument from dust in the interior, and also provide protection to personnel from the operating voltages present. They also reduce the electromagnetic radiation from this instrument or interference to the display due to other equipment.

CLEANING

This instrument should be cleaned as often as operating conditions require. Accumulation of dirt on components acts as an insulating blanket and prevents efficient heat dissipation which can cause overheating and component breakdown.

CAUTION

Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Use a non-residue type of cleaner, preferably isopropyl alcohol, total denatured ethyl alcohol, or kelite.

Exterior

Loose dust accumulated on the front panel can be removed with a soft cloth or small brush. Dirt that remains can be removed with a soft cloth dampened with a mild detergent and water solution. Abrasive cleaners should not be used.

Interior

Dust in the interior of the instrument should be removed occasionally due to its electrical conductivity under high-humidity conditions. The best way to clean the interior is to blow off the accumulated dust with dry, low-pressure air. 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.

VISUAL INSPECTION

This instrument 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 components are found. Overheating usually indicates other trouble in the instrument; therefore, it is important that the cause of overheating be corrected to prevent recurrence of the damage.

LUBRICATION

Generally, there are no components in this instrument that require a regular lubrication program during the life of the instrument.

SEMICONDUCTOR CHECKS

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

PERFORMANCE CHECK AND ADJUSTMENT INTERVAL

To ensure accurate measurements, perform the Performance Check procedure on this isntrument after each 2000 hours of operation or every 12 months if used infrequently. In addition, replacement of components may necessitate performing the Adjustment procedure to calibrate the affected circuits. The Adjustment procedure can also be helpful in localizing certain troubles in the instrument. In some cases, minor troubles may be revealed or corrected by performing the Adjustment procedure.

TROUBLESHOOTING

The following information is provided to help troubleshoot this instrument. Information contained in other sections of this manual should be used along with the following information to aid in locating a defective component. An understanding of the circuit operation is very helpful in locating troubles.

TROUBLESHOOTING AIDS

Diagrams

Circuit diagrams are given on foldout pages in Section 8. The component number and electrical value of each component in this instrument is shown on the diagrams.

Circuit-Board Illustrations

Circuit-board illustrations are shown on a foldout page preceding the associated diagram. Each board-mounted electrical component is identified by its circuit number, as are interconnecting wires and connectors.

Wiring Color Code

Insulated wire and cable used in this instrument is color-coded to facilitate circuit tracing.

Semiconductor Basing

Figure 4-5 illustrates the basing configurations for semiconductors that may appear in this instrument. Some plastic-case transistors have lead configurations that do not agree with those shown here. If a replacement transistor is made by a different manufacturer than the original, check the manufacturer's basing diagram. All transistor sockets in this instrument are wired for the standard basing used for metal-case transistors.

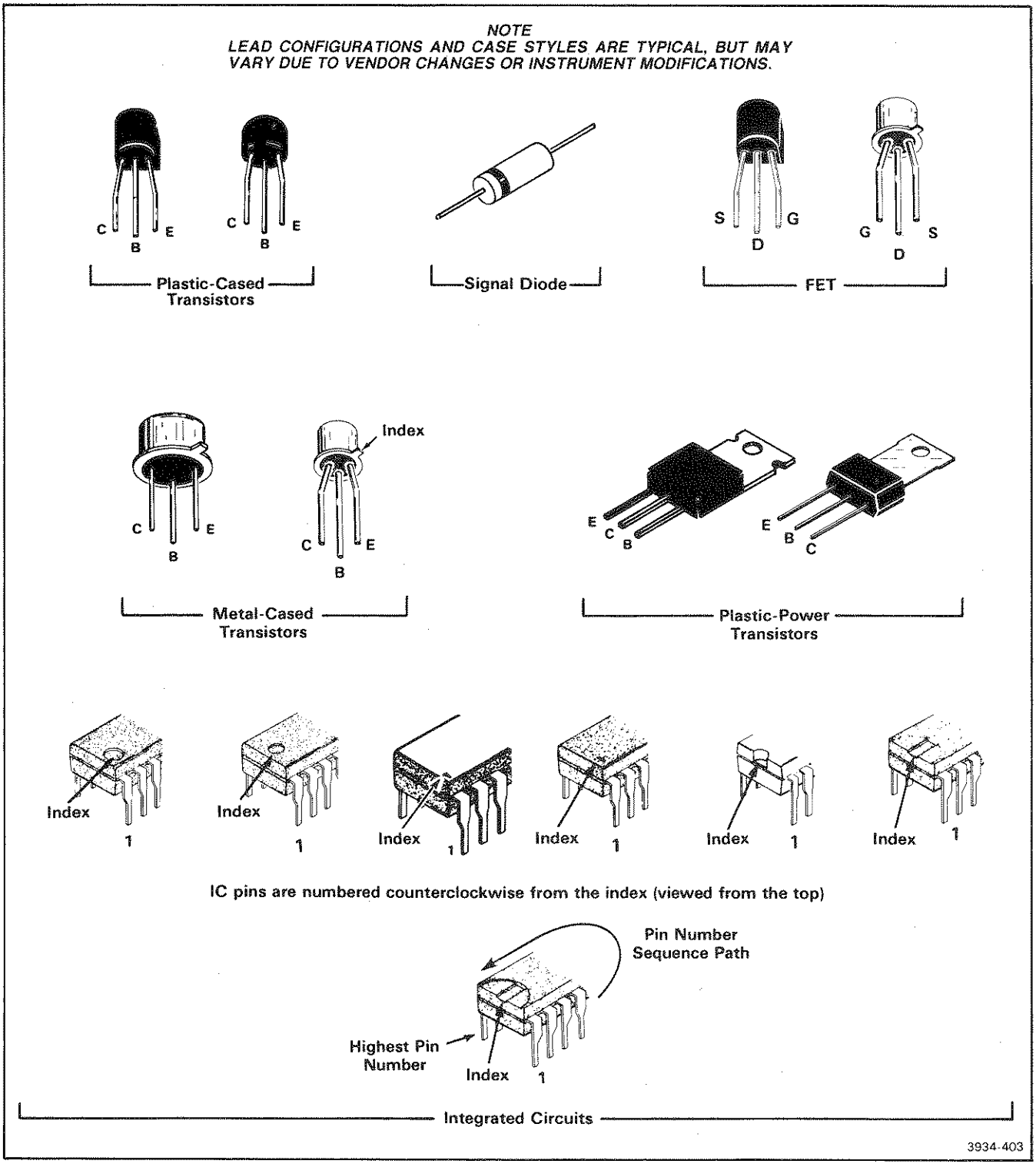


Fig. 4-4. Lead configuration data for semiconductor devices.

Multi-Pin Connector Holders

Multi-pin connectors mate with groups of pins soldered to circuit boards. Pin number 1 is indicated with a triangular mark on the holder and is indexed with a triangular mark on the circuit board, as shown in Fig. 4-6.

TROUBLESHOOTING EQUIPMENT

The following equipment in addition to that listed in Table 2-9 (list of test equipment required for performance check in Section 2 of this manual) is useful for troubleshooting.

Semiconductor Tester

Description: Dynamic-type tester.

Purpose: To test the semiconductors used in this instrument.

Recommended Type: TEKTRONIX 576 Curve Tracer or TEKTRONIX 577/177 Curve Tracer system, 7CT1N Curve Tracer unit and a 7000-series oscilloscope system, or a 5CT1N Curve Tracer unit and a 5000-series oscilloscope.

Multimeter

Description: Voltmeter, 10 megohm input impedance and 0 to 250 volts range; accuracy, within 0.1%. Ohmmeter, 0 to 20 megohms; accuracy, within 3%. Test probes must be insulated to prevent accidental shorting.

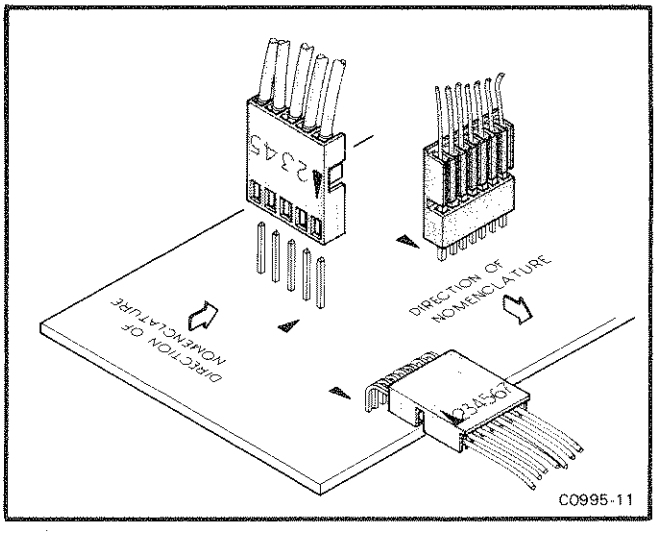


Fig. 4-5. Multi-pin connector holder orientation.

Purpose: To check voltages and for general troubleshooting in this instrument.

Recommended Type: TEKTRONIX DM 501A Digital Multimeter (requires a TM 500-series power module).

Test Oscilloscope

Description: Frequency response, dc to 2 megahertz minimum; deflection factor, 1 millivolt to 5 volts/division. A 10X, 10 megohm voltage probe should be used to reduce circuit loading.

Purpose: To check operating waveforms and for general troubleshooting.

Recommended Type: TEKTRONIX 5110, 5A13N, 5B10N oscilloscope system or equivalent. Use an appropriate Tektronix 10X probe.

TROUBLESHOOTING TECHNIQUES

The following troubleshooting procedure is arranged to check the simple trouble possiblities before proceeding with extensive troubleshooting. The first few checks insure proper connection, operation, and adjustment. If the trouble is not located by these checks, the remaining steps aid in locating the defective component. When the defective component is located, it should be replaced using the replacement procedure given under Corrective Maintenance.

Troubleshooting Procedure

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, see Fig. 1-1 in the Operating Instructions section.

2. Check Associated Equipment. Before troubleshooting, check that the equipment used with this instrument is properly connected and that the interconnecting cables are not defective. Also, check the power source.

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

4. Isolate Trouble to a Circuit. To isolate trouble to a 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 supply. Check first for correct voltages of the individual supplies. See Table 4-2. However, a defective component elsewhere in the instrument can appear as a power-supply trouble and may also affect the operation of other circuits.

Table 4-2

POWER SUPPLY OUTPUT VOLTAGES

Power Supply	Output Voltage Range	Typical 120 Hz P-P Ripple
+200 V	+175 V to +247.5 V	3 V or less
+30 V	29.95 V to +30.05 V	3 mV or less
+5 V	+4.90 V to +5.10 V	2 mV or less
−30 V	−29.95 V to −30.05 V	2 mV or less

5. Check Voltages and Waveforms. Often the defective component can be located by checking for the correct voltages and waveforms in the circuit.

6. Check Instrument Adjustment. Check the adjustment of this instrument, or the affected circuit if the trouble appears in one circuit. The apparent trouble may be the result of misadjustment. Complete adjustment instructions are given in Section 3.

7. Check Individual Components. The following procedures describe methods for checking individual components. Two-lead components that are soldered in place are best checked by first disconnecting one end. This isolates the measurement from the effects of surrounding circuitry.

CAUTION

To avoid component damage, disconnect the power source before removing or replacing semiconductors.

TRANSISTORS. The best check of transistor operation is actual performance under operating conditions. A transistor can be more effectively checked by substituting a new component or one that 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. An integrated circuit can be checked with a voltmeter, test oscilloscope, or by direct substitution. A good understanding of circuit operation is desireable when troubleshooting circuits using an IC. Use care when checking voltages and waveforms around the IC so that adjacent leads are not shorted together. A convenient means of clipping a test probe to the 14 pin IC is with an IC test clip. This device also serves as an extraction tool.

CAUTION

Do not use an ohmmeter scale that has a high internal current. High currents may damage the diode.

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

RESISTORS. Check resistors with an ohmmeter. See the Replaceable Electrical Parts list for the tolerance of the resistors used in this instrument. Resistors normally do not need to be replaced unless the measured value varies widely from that specified.

INDUCTORS. Check for open inductors by checking continuity with an ohmmeter. Shorted or partially shorted inductors can usually be found by checking the waveform response when high-frequency signals are passed through the circuit. Partial shorting often reduces high-frequency response.

CAPACITORS. A leaky or shorted capacitor can ususally 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 that the capacitor passes ac signals.

8. Repair and Adjustment. If any defective parts are located, follow the replacement procedures given in Corrective Maintenance. Be sure to check the performance of any circuit that has been repaired or had any electrical components replaced.

CORRECTIVE MAINTENANCE

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

OBTAINING REPLACEMENT PARTS

Standard Parts

All electrical and mechanical part replacements can be obtained through your local Tektronix Field Office or representative. However, many of the electronic components can be obtained locally in less time than is required to order them from Tektronix, Inc. Before purchasing or ordering replacement parts, check the Replaceable Electrical Parts list in Section 7 for value, tolerance, rating and description. To determine the manufacturer of a part, note the number listed under Mfg. Code in the Parts List and refer to a Cross Index Mfr. Code Number to Manufacturer listing at the beginning of the Parts List.

NOTE

When selecting replacement parts, it is important to remember that the physical size and shape of a component may affect the performance of the instrument, particularly at high frequencies. All replacement parts should be direct replacements unless it is known that a different component will not adversely affect instrument performance.

Special Parts

In addition to the standard electronic components, some special parts are used in this instrument. These parts are manufactured or selected by Tektronix, Inc, in accordance with our specifications. Most of the mechanical parts used in this instrument have been manufactured by Tektronix, Inc. Order all special parts directly from your local Tektronix Field Office or representative.

Ordering Parts

When ordering replacement parts from Tektronix, Inc., it is imperative that all of the following information be included in the order to ensure receiving the proper parts.

1. Instrument type (5111A, 5A18N, 5B10N, etc.)

2. Instrument serial number.

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

4. Tektronix part number.

SOLDERING TECHNIQUES

WARNING

High voltage and current levels are present in this instrument. To avoid electrical shock, disconnect the instrument from the power before soldering.

The reliability and accuracy of this instrument can be maintained only if proper soldering techniques, which apply to maintenance of any precision electronic equipment, are used when working on this instrument. Use only 60/40 rosin-core, electronic-grade solder. The choice of soldering iron is determined by the repair to be made. When soldering on circuit boards, use a 15- to 40-watt pencil-type soldering iron with a 1/8-inch wide, wedge-shaped tip. Keep the tip properly tinned for best heat transfer to the solder joint. A high wattage soldering iron may separate the wiring from the base material. Avoid excessive heat; apply only enough heat to remove the component or to make a good solder joint. Also, apply only enough solder to make a firm solder joint; do not apply too much solder.

For metal terminals (e.g., switch terminals, potentiometers, etc.) a higher wattage-rating soldering iron may be required. Match the soldering iron to the work being done. For example, if the component is connected to the chassis or other large heat-radiating surface, it will require a 75-watt or larger soldering iron.

The following technique should be used to replace a component on a circuit board. Most components can be replaced without removing the boards from the instrument.

1. Grip the component lead with long-nose pliers. Touch the soldering iron to the lead at the solder connection. Do not lay the iron directly on the board, as it may damage the board.

2. When the solder begins to melt, pull the lead out gently. If unable to pull the lead without using force, try removing the other end of the component as it may be more easily removed.

NOTE

The reason some component leads are troublesome to remove is due to a bend placed on each lead during the manufacturing process. The bent leads hold components in place during a process that solders many components at one time.

If a component lead is extremely difficult to remove, it may be helpful to straighten the leads on the back side of the board with a small screwdriver or pliers while heating the solder connection.

Unsolder the component from the circuit board, using heat on the component lead so that the solder will stay behind on the board. If it is desired to remove solder from a circuit-board hole for easier installation of a new component, use a vacuum-type desoldering tool or a solder-removing wick.

3. Bend the leads of the new component to fit the holes in the 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 the component is firmly seated against the board (or as positioned originally). If it does not seat properly, heat the solder and gently press the component into place.

4. Touch the iron to the connection and apply a small amount of solder to make a firm solder joint. To protect heat-sensitive components, hold the lead between the component body and the solder joint with a pair of long-nose pliers or other heat sink.

5. Clip the excess lead that protrudes through the board (if not clipped in step 3).

6. Clean the area around the solder connection with flux remover solvent. Be careful not to remove information printed on the board.

COMPONENT REMOVAL AND REPLACEMENT

WARNING

To avoid electrical shock, disconnect the instrument from the power source before replacing components.

Semiconductor Replacement

Transistors should not be replaced unless actually defective. If removed from their sockets during routine maintenance, return them to their original sockets. Unnecessary replacement of transistors may affect the calibration of this instrument. When transistors are replaced, check the performance of the part of the instrument which may be affected.

CAUTION

Power must be disconnected before removing or replacing semiconductors to avoid component damage.

Replacement semiconductors should be of the original type or a direct replacement. The lead configuration of most semiconductors used in this instrument are shown in Fig. 4-4. Some plastic case transistors have lead configurations which do not agree with those shown here. If a replacement transistor is made by a different manuacturer than the original, check the manufacturer's basing diagram for correct basing. All transistor sockets in this instrument are wired for the standard basing used for metal-case transistors.

An extraction tool should be used to remove the 14- and 16-pin integrated circuits to prevent damage to the pins. This tool is available from Tektronix, Inc. Order through your local field office or representative. If an extraction tool is not available when removing one of these integrated circuits, pull slowly and evenly on both ends of the device. Try to avoid having one end of the integrated circuit disengage from the socket before the other, as the pins may be damaged.

To replace one of the power transistors mounted on the chassis; first unsolder the leads. Remove the screw that clamps the transistor to the chassis, then remove the defective transistor.

Switch Replacement

The pushbutton switches are not repairable and should be replaced as a unit if defective. Use a suction-type desoldering tool to remove solder from the holes in the circuit board when unsoldering the switches.

Circuit Board Replacement

If a circuit board is damaged beyond repair, replace the entire board assembly. Part numbers for completely wired boards are given in the Replaceable Electrical Parts list.

To remove or replace a board, proceed as follows:

1. Disconnect all leads connected to the board (both soldered lead connections and solderless pin connections).

2. Remove all screws holding the board to the chassis or other mounting surface. Some boards may be held fast on one side by a slotted plastic bar in addition to the screws; for these, remove the screws, then pull the circuit board from its slot to free the board. Also, remove any obstructions that would prevent the board from being lifted out of the instrument.

3. Lift the circuit board out of the unit. Do not force or bend the board.

4. To replace the board, reverse the order of removal. Use care when replacing pin connectors; if forced into place incorrectly, the pin connectors may be damaged.

Circuit-Board Pin Replacement

A circuit-board replacement kit including the necessary tools, instructions, and replacement pins is available from Tektronix, Inc. Order through your local Tektronix Field Office or representative.

To replace a pin which is mounted on a circuit board, first disconnect any pin connectors. Unsolder the damaged pin and pull it out of the circuit board with a pair of pliers (see Soldering Techniques, in this section, for recommended soldering and unsoldering procedures). Be careful not to damage the wiring on the board with too much heat. The ferrule on the pin may or may not disconnect from the hole with the damaged pin. If the ferrule remains in the circuit board, remove the ferrule from the replacement pin and press the new pin into the hole in the circuit board. If the original ferrule is removed with the damaged pin, clean out the hole using soldering-iron heat, a solder-removing wick, and a scribe. Press the replacement pin with attached ferrule into the circuit-board hole. Position the replacement pin in the same manner as the removed pin. Solder the pin to the circuit board on each side of the board. If the removed pin was bent at an angle to mate with a connector, carefully bend the new pin to the same angle. Replace the pin connector.

Cathode-Ray Tube Replacement

The following procedure outlines the removal and replacement of the cathode-ray tube. Refer to Fig. 4-6.

WARNING

Use care when handling a crt. Protective clothing and safety glasses should be worn. Avoid striking it 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 to protect it from scratches.

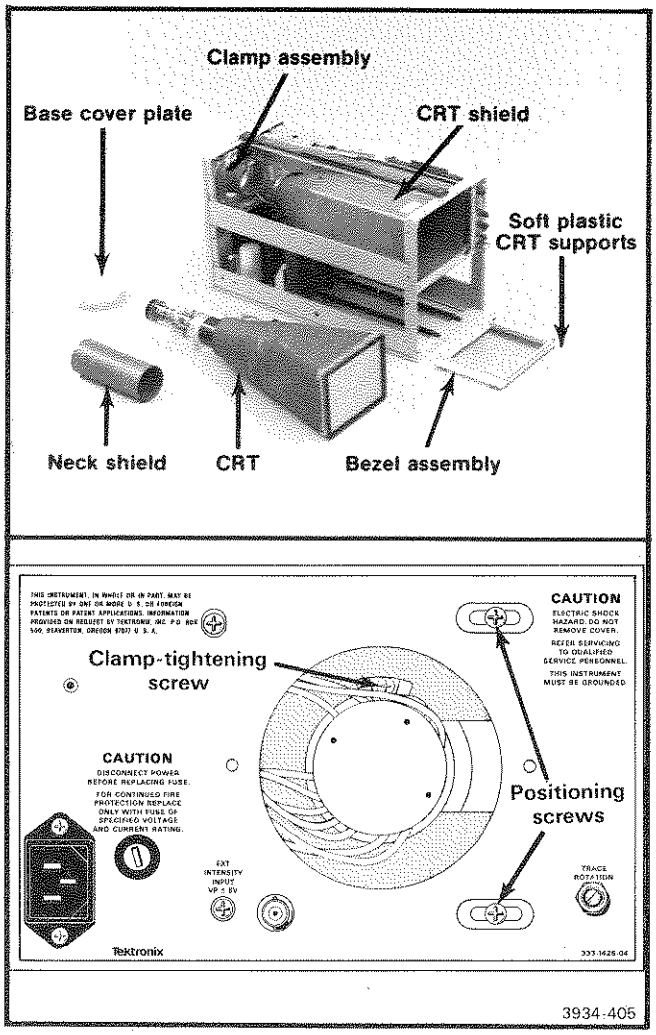


Fig. 4-6. Replacing the cathode-ray tube.

A. REMOVAL

1. Remove the bezel assembly, which is held in place with two screws. (The bezel assembly includes a snap-in implosion shield.)

2. Disconnect the storage-element cable connector from the Storage circuit board.

3. Remove the crt base cover on the rear panel of the instrument.

4. Remove the crt base socket.

5. Loosen the crt clamp. The crt and neck portion of the shield will be removed as a unit; to facilitate removal, it may be best to remove all hardware from the crt clamp (bracket and positioning screws, and clamp-tightening hardware).

NOTE

The red and black wires entering the crt shield are connected to the trace-rotation coil inside the shield. They will not hamper crt removal and need not be unsoldered.

6. With one hand on the crt faceplate, push on the crt base and neck shield. Slide the crt and neck shield forward, and at the same time feed the storage-element cable through the slot in the main portion of the crt shield. Pull the crt out of the instrument from the front, then remove the neck shield.

B. REPLACEMENT

1. Slide the neck shield onto the crt neck.

2. Make sure the soft plastic crt faceplate support are in place, then insert the crt into the main shield while feeding the storage-element cable through the slot in the shield.

3. With the crt fully inserted, mount the bezel assembly into place and tighten the bezel screws.

4. Mount the crt clamp and positioning hardware, temporarily leaving it loose.

5. Position the rear of the crt (socket end) so there is no tilt of the faceplate in relation to the bezel assembly. Tighten the positioning screws.

6. Place the crt base socket onto the crt base pins. Replace the cover. Connect the storage-element cable to the pin connectors on the Storage circuit board.

7. Replacing the crt will require partial instrument adjustment. Refer to the Adjustment section of this manual.

Power Transformer Replacement

Replace the power transformer only with a direct replacement transformer. When removing the transformer, be sure to mark the leads to aid in connecting the new transformer. After the transformer has been replaced, check the performance of the complete instrument using the procedure given in the Adjustment section.

Fuse Replacement

Table 4-3 gives the rating, location, and function of the fuses used in this instrument.

Table 4-3
FUSE RATING, FUNCTION, AND LOCATION

Circuit No.	Rating	Function	Location
F201	1.6 A Slow-blow	110 V Line-voltage input	Rear Panel (stored on LV Power Supply board when not in use.)
F201	1 A Slow-blow	220 V Line-voltage input	Rear panel (stored on LV Power Supply board when not in use.)
F810	0.25 A Fast-blow	+200 V Unrgltd supply	Rear, LV Power Supply board
F835	0.5 A Fast-blow	+38 V Unrgltd supply	Rear, LV Power Supply board
F850	3A Fast blow	Protection for secondaries of Power Supply transformer, T801.	LV Power Supply board
F809	0.3 A Slow-blow A		
F815	3A Fast-blow		
F834	3A Fast-blow		
F836	3A Fast-blow		
F273	3A Fast-low		HV-Deflection board

ADJUSTMENT AFTER REPAIR

After any electrical component has been replaced, the adjustment of that particular circuit should be checked, as well as other closely related circuits. See Section 3 for a complete adjustment procedure.

MODIFICATIONS TO PRE-OPTION 7 AMPLIFIER PLUG-INS (OPTION 7 ONLY)

The channel switching amplifier plug-ins that are recommended for use with 5100-series mainframes (5A14N, 5A18N, 5A26) have been modified to reduce display noise and chop breakthrough when used in an option 7 mainframe. If any of the mentioned amplifier plug-ins cause the noise and chop breakthrough specification to be exceeded, an earlier version (before option 7) of the plug-in is probably being used. The following information is provided to explain how to modify earlier version plug-ins for reduced display noise and chop breakthrough.

To modify a 5A14N (SN B063288 and below only) change R513, R523, and R533 on the Main circuit board to a 100 kΩ, 5%, 0.25 W composition resistor, Tektronix part no. 315-0104-00. Cut the board run (at both components) that connects Q540 and R542, so as to remove electrically, the run from the front side of the board. Connect an insulated wire strap between Q540 and R542, on the back side of the board so as to replace the board run removed from the front.

To modify a 5A18N (SN B050000 to SN B099999 only) change R301 on the Main Amplifier circuit board to a 20 kΩ, 5%, 0.25 W composition resistor, Tektronix part no. 315-0203-00.

To modify a 5A18N (SN B049999 and below only) change R301 on the Main Amplifier circuit board to a 20 kΩ, 5%, 0.25 W composition resistor, Tektronix part no. 315-0203-00. Also, change R302 and R303 to a 10 kΩ, 1%, 0.125 W film resistor, Tektronix part no. 321-0289-00.

To modify a 5A26 (SN B029000 and below only) change R289 on the Main circuit board to a 20 kΩ, 5%, 0.25 W composition resistor, Tektronix part no. 315-0203-00. Also, change Q386 to a NPN silicon transistor, 2N3565, TO—106 case, Tektronix part no. 151-0341-00.

CIRCUIT DESCRIPTION

This section of the manual contains a description of the circuitry used in the oscilloscope. Individual descriptions are separated into the following parts: Block Description, Interface, Vertical and Horizontal Deflection Amplifiers, CRT Circuit, Storage Circuit, and Low-Voltage Power Supply and Calibrator. Refer to the appropriate diagrams in the Diagrams section of this manual while reading the circuit descriptions.

BLOCK DESCRIPTION

Vertical signals to be displayed on the cathode-ray tube are applied through the A1 Interface board, (diagram 1) to A3 High Voltage-Deflection board, (diagram 2) from both vertical plug-in compartments. The Interface circuit on diagram 1 determines whether the signal from the left or right vertical unit is displayed, and provides intermediate amplification between the vertical plug-in units and the vertical deflection amplifier (diagram 2).

Time-base and external signals for horizontal display on the crt are connected to the Interface circuit from the horizontal plug-in compartment. The horizontal amplifier circuit (diagram 1) provides intermediate amplification between the horizontal plug-in unit and the horizontal deflection amplifier (diagram 2).

Additionally, the interface circuit provides an interconnection of logic levels, time-base triggering signals, display-related signals, and the power-supply voltages between the plug-in units and the oscilloscope.

The vertical and horizontal deflection amplifiers (diagram 1), provide final amplification for the signals from the plug-in units. They produce push-pull outputs suitable to drive the crt vertical and horizontal deflection plates. Beam-finding circuitry is incorporated to limit the display within the screen area when the front-panel BEAM FINDER button is pressed.

The crt circuit (diagram 3), produces the high voltage (about -3.4 kilovolts) and contains the controls necessary for proper operation of the cathode-ray tube. The crt circuit also contains the z-axis amplifier. It provides the drive signal to control the intensity level of the display, and can be used to intensity modulate the display.

The Storage Circuit (diagram 5), provides the voltage levels necessary to operate the storage elements associated with the crt. The circuit includes the erase-pulse generator for erasing stored information and a multivibrator which permits the flood-gun duty cycle to be varied.

The low-voltage power supply regulator (diagram 4), provides the voltages necessary for operating the oscilloscope system. These voltages are connected to all circuits within the instrument. Also included in this circuit is the calibrator which produces a square-wave output signal at the front-panel. The output is an accurate amplitude which is used to check the vertical-deflection factor accuracy and probe high-frequency compensation.

INTERFACE ①

The interface circuit provides an interconnection of signals, logic levels, and power-supply voltages between plug-in units and the oscilloscope mainframe. It incorporates circuits that determine the vertical display mode and amplify the vertical and horizontal display signals. Functions of interconnections not discussed are labelled on the Interface diagram.

Clock Generator

The Clock Generator stage produces a 200-kilohertz timing signal (clock) for chopping between vertical plug-ins and amplifier channels within the plug-ins. This circuit consists of Q710, Q700, and their associated passive components, which are connected as a multivibrator. When the multivibrator receives a chop actuate level (+5 volts), it free runs at a 200-kilohertz rate. (The chop actuate level is routed through the vertical plug-ins to the time-base unit, and is present at contact A20 of J1000 when a multi-trace display is required and the time-base Display switch is set to Chop.) The chop actuate level also disables Q910, locking out alternate-drive pulses. The Clock Generator has two outputs; one is sent to the Countdown circuit, U800, as a timing signal, and the other is sent to the crt circuit to blank the chop-switching transients.

Countdown Circuit

The Countdown Circuit produces the display switching signal for both the Alternate and Chopped switching modes. This circuit is composed of U800 and its discrete passive components. Each J-K flip-flop is a divide-by-two counter, and the first one drives the second. The Countdown circuit is activated by a negative-going transition which can come from either the Clock Generator, Q710, or from the time-base plug-in unit via grounded-base amplifier Q910. The Clock Generator input results in chopped-mode vertical switching. The input from the time-base unit coincides with the end of each sweep, and results in alternate-mode vertical switching. The output from the divide-by-two portion of the Countdown circuit (U800A-U800B) is sent via contacts B21 of J300 and J600 to the channel-switching circuits incorporated within dual-trace vertical plug-in units. The outputs from the divide-by-four portion of the

Countdown circuit, U800B, are used for plug-in switching; one output is sent to the base of Q413 to produce plug-in switching of the single-beam-display, and the other output is sent via contact B21 of J1000 to produce dual-sweep switching in dual time-base units. The Vertical mode switching sequence and some of the display combination possibilities are fully discussed under General Operating Information in the Operating Instructions section of this manual.

Vertical Amplifier

The Vertical Amplifier circuit provides approximately 10X amplification of the vertical signal before passing it to the vertical deflection amplifier in the display unit. The Vertical Amplifier consists of Q400, Q401, Q600, Q601, (diagram 1), and their associated passive components, connected in a differential configuration. The output signal is in phase with the output of the vertical plug-in.

Horizontal Amplifier

The Horizontal Amplifier consists of Q821, Q820, Q931, Q930 and their associated passive components. The circuit is nearly identical to the Vertical Amplifier just described. It receives a push-pull input directly from the horizontal plug-in compartment via contact A7, A13, B7, and B13 of J1000. The two halves of this amplifier are balanced in the quiescent condition by adjustment of R730, Horiz Ctrg. The output of the Horizontal Amplifier is sent to the horizontal deflection amplifier.

VERTICAL PLUG-IN SWITCHING

The vertical plug-in switching circuit accepts the push-pull signal outputs from both vertical plug-ins. Emitter followers Q630, Q631, Q430, and Q431 provide a high-impedance input to two pairs of grounded-gate FET amplifiers, Q520, Q521, and Q420-Q421. The switching circuit consists of Q413 and Q510, connected as a comparator. Plug-in "on" logic levels are applied to the switching circuit in addition to the switching signal from the Countdown circuit. The switching circuit permits only one pair of amplifiers to be on a time, thus permitting only one of the two vertical plug-in signals to pass to the Vertical Amplifier. In the chopped switching mode, the switching between pairs of amplifiers occurs at a 100-kilohertz rate (switching occurs on both the negative- and positive-going transition), and in the alternate mode, switching occurs at the end of every second sweep. If no "on" logic level is applied to the switching circuit from either vertical plug-in, Q420 and Q421 will remain on, passing any signal from the left vertical plug-in.

VERTICAL AND HORIZONTAL DEFLECTION AMPLIFIERS ②

Vertical Deflection Amplifier

The Vertical Deflection Amplifier provides the final amplification of signals applied from the vertical plug-in units. It produces a push-pull output sufficient to drive the crt vertical deflection plates. The amplifier consists of Q104, Q106, Q114, and Q116, connected in a differential configuration.

The input signal arrives via P500 from the Interface circuit. The output signal is developed across the collector-load resistors, R104 and R114, and is about 50 times the magnitude of the input signal. Resistor R116 Vert Gain, provides Q106-Q116 emitter degeneration to set the gain of the stage to provide a calibrated vertical display.

Horizontal Deflection Amplifier

The Horizontal Deflection Amplifier consists of Q124, Q126, Q134, and Q136, and is basically the same as the Vertical Deflection Amplifier just described. It provides final amplification of signals from the horizontal plug-in unit, which arrive via P800. The gain of the stages is set by Hor. Gain R136 to provide a calibrated horizontal display.

Beam Finder

If a high-amplitude signal or a misadjusted control has deflected the trace or display off screen, it can be located by pressing the front-panel BEAM FINDER pushbutton. This opens S125, allowing current through R125 into the emitter circuits of both deflection amplifiers, R125 limits the current available to the transistors, and hence, to the collector-load resistors. Thus, the dynamic range of the deflection plates is limited to an on-screen level, and the display is compressed within the viewing area.

Also when the BEAM FINDER switch is pressed, extra current is fed into the Z axis amplifier via R209 (diagram 3) to the base of Q222 which produces a slight increase in crt beam intensity, allowing the trace to be displayed even though the INTENSITY control may be fully counterclockwise.

X-Y Phasing

Variable capacitor C116, is connected across the input emitters of the Vertical Deflection Amplfiiers. This capacitor is adjusted to eliminate the inherent phase difference between the vertical and horizontal deflection systems when operating in the X-Y mode.

CRT CIRCUIT ③

The crt circuit produces the high-voltage potential and provides the control circuits necessary for operation of the cathode-ray tube (crt). This circuit also includes the Z-Axis Amplifier stage to set the intensity of the crt display.

Z-Axis Amplifier

The Z-Axis Amplfiier is a current driven shunt-feedback operational amplifier with a voltage output, and consists of Q222, Q226, and Q234. The feedback path is from the collectors of Q226 and Q234 through R227 to the base of Q222. Transistors Q226 and Q234 are connected as a collector-coupled complimentary amplifier to provide a fast linear output signal while consuming minimum quiescent power. The output voltage provides the drive signal to control the crt intensity level through the Control-Grid supply.

The output level of the Z-Axis Amplifier is established by the voltage drop across R227 in reference to virtual ground at the base of Q222 (the operational amplifier summing point). The current through R227 is determined by the input current from any combination of several sources, such as from the front-panel INTENSITY control, plug-in interface (blanking intensification, etc.), and from Q214. Transistor Q214 is an amplifier with two inputs; one from the rear-panel EXT INTENSITY INPUT connector and the other from the front-panel BEAM FINDER switch. It sets those input signals to a level suitable for proper response by the Z-Axis Amplifier.

High-Voltage Regulator

High-Voltage Primary. A repetitive non-sinusoidal signal is produced by a phase-modulated switching circuit in the primary of T240 and induced into the secondaries. Current drive for the primary winding is furnished by Q252 in its conduction state. Q252 is turned on by positive feedback applied through C259 and L259 from the feedback winding. The feedback is limited by VR258. The conduction time of Q252 is established by the mean current supplied from R262. The excess current through R262 is bypassed by Q262 depending on the regulation requirements.

High-Voltage Regulation. Regulation is accomplished as follows: Feedback from the -3400 volt cathode supply is summed with low-voltage levels through the voltage divider consisting of resistors R272B-E, R275, and R276 to establish the dc level at the base of Q278. If the output level of the cathode supply drops below the nominal -3400 volts (becomes more positive), the level at the base of Q278 rises. Hence the conduction time of Q252 increases. This allows more energy to be delivered to the primary winding of T240, resulting in an increase of voltage in the secondaries. Conversely, if the output level increases, Q252 is allowed to conduct for a shorter length of time. The dc level at the base of Q278 is adjusted by High Volts adjustment R275, to set the output at exactly -3400 volts.

High Voltage Outputs

Transformer T240 has two high-voltage output windings which provide the potentials required for the crt cathode and control grid supplies. The -3400 volt accelerating potential for the cathode is supplied by half-wave rectifier CR247. The cathode heater is elevated to the cathode potential through R273.

Half-wave rectifier CR241 provides about -3450 volts to establish bias voltage on the crt control grid. This voltage (and hence the crt beam current) is dynamically controlled by the Z-Axis Amplifier, which contains the INTENSITY control, blanking inputs, and intensification inputs. Intensity Range R245 provides a fine adjustment of the quiescent grid voltage to bias the crt just below cutoff when the Z-Axis Amplifier output is at its minimum quiescent level (INTENSITY control counterclockwise and no intensifying or blanking inputs).

Neon bulbs DS271, DS272, and DS273 provide protection to the crt if the voltage difference between the control grid and the cathode exceeds about 180 volts.

Crt Control Circuits

In addition to the INTENSITY control discussed previously, front-panel FOCUS and internal Astigmatism controls have been incorporated for arriving at an optimum crt display. FOCUS control R295 provides the correct voltage for the second anode in the crt. Proper voltage for the third anode is obtained by adjusting Astig control R286. In order to obtain optimum spot size and shape, both the FOCUS and Astig controls are adjusted to provide the proper electrostatic lens configuration in the crt.

The Geometry adjustment R285 varies the positive level on the horizontal deflection plate shields to control the overall geometry of the display. The TRACE ROTATION control R291, permits adjustment of the dc current through beam-rotation coil L291 to align the display with the horizontal graticule lines.

LOW-VOLTAGE POWER SUPPLY AND CALIBRATOR ④

The Low-Voltage Power Supply circuit provides the low-voltage operating power for the oscilloscope system from three regulated supplies and three unregulated supplies. Electronic regulation is used to provide stable, low-ripple output voltages. The circuit also includes the Calibrator circuit to produce an accurate-amplitude square-wave output.

Power Input

Power is applied to the primary of transformer T801 through fuse F201, thermal cutout S200, and Power switch S201, and the line-selector block, P801. The line-selector block allows changing the primary-winding taps of T801 to fit different line requirements.

Low-Voltage Rectifiers and Unregulated Outputs

The full-wave bridge rectifiers and associated filter components in the secondaries of T801 provide filtered dc voltages for operation of the oscilloscope system or for regulation by the Low-Voltage Regulators. The unregulated outputs are +200 volts, +38 volts, and -38 volts. The +200 volt and +38 volt outputs to the instrument are fuse-protected by F810 and F835 respectively.

Low-Voltage Regulators

-30 Volts Supply. The -30 Volt Supply, besides providing power to circuitry throughout the instrument, provides a reference-voltage source to establish operating levels for the feedback regulators in the +30 Volt and +5 Volt supplies. The regulator for the -30 Volt Supply is a feedback amplifier system which operates between ground and the unregulated -38 volts. Current to the load is delivered by the series-pass transistor,

Q860, and the supply voltage is established by the drop across R877, R878, and R879. The feedback path is through R875, Q875, and Q865 to the base of Q860. Any variation in output voltage due to ripple, change of current through the load, etc., is immediately transmitted to the base of Q860 and nullified by a change in the conduction of Q860, thus maintaining a steady output. The output of the supply is set to exactly −30 volts by adjustment of R878, −30 V Adj. This control sets the conduction of Q870, which controls the bias levels of Q865 and Q860. CR865 and Q865 provide short-circuit protection by limiting the current through Q860.

+30 Volt Supply. The regulator for the +30 Volt Supply consists of series-pass transistor Q840 and error amplifier Q850. This is a feedback amplifier system similar to that described for the −30 Volt Supply. R858, +30 Volt Adj. provides an adjustment to set the output of the supply at exactly +30 volts. Q845 protects the supply in the event the output is shorted by limiting the current demanded fromthe series-pass transistor under excessive load. During normal operation, Q845 is biased off.

+5 Volt Supply. The regulator for the +5 Volt Supply consists of a series-pass transistor Q815 and error amplifier Q820. Operation of this feedback amplifier system is similar to that described for the −30 Volt Supply. The short-protection transistor, Q825, functions as described for Q845 in the +30 Volt Supply.

Line Trigger

A line-frequency signal is obtained from the secondary of T801 and attenuated by R830, R832, and R834 to provide a line-trigger source for the time-base plug-in unit.

Crt Heater Windings

Two separate secondary windings are provided for crt operation, one for writing-gun heaters and the other for flood-gun heaters. The writing-gun heaters are elevated to −3400 volts in the crt circuit to maintain a potential near that of the crt cathode.

Calibrator

The Calibrator circuit composed of Q885, Q890, and their associated passive components produces a square-wave output with accurate amplitude and a rate of twice that power-line frequency. This output is available at the probe test loop on the display unit front panel as a 4-milliampere (peak-to-peak) square-wave current, or as a 400-millivolt (ground–to–peak) square-wave voltage.

The resistive-capacitive network at the base of Q885 receives a pulsating dc voltage from full-wave rectifier CR835-CR836 and produces a nearly symmetrical switching signal for Q885 and Q890. As Q890 is alternately switched on and off at twice the line frequency, current through R890 is alternately switched through the transistor or through CR890, the probe test loop, and R891, producing the required test signal.

STORAGE CIRCUIT ⑤

The crt is a direct-view bistable storage cathode-ray tube with a split-screen viewing area that permits each half to be operated individually for stored displays. Only those elements associated with the storage capability of the crt are shown in the crt enclosure on the right side of the Storage Circuit schematic diagram. The writing gun, its deflection systems and associated elements have been discussed previously under Crt Circuit.

Crt Internal Storage Operation

Four low-energy electron guns (flood guns) provide full coverage of the large screen area. Each consists of a heated cathode and an anode. The cathode heaters, which receive an unfiltered pulsating dc from full-wave rectifier CR329, are elevated to the cathode potential through R329. Quiescently Q308 is saturated, providing current to the flood-gun cathodes. The anode potential is established by VR396 and supplied through emitter follower Q396.

The collimation electrode is a metallic band around the inner wall of the crt envelope. It produces an electrostatic field to distribute the flood-gun electrons uniformly over the storage target. Resistor R390, CE1, provides adjustment of the flood electron trajectories to cover the extreme rim of the targets and optimize uniformity of the target coverage. Emitter follower Q392 maintains a stable voltage on the collimation electrode, providing a low-impedance current path to absorb current variations.

The storage screen consists of a thin tin-oxide layer called the target backplate, which is coated with an insulator material containing finely-ground phosphor particles called the target. A positive voltage potential is applied through Q372 and S375-S372 to the backplate to establish the operating level of the tube, which is the difference in potential between the backplate and the flood-gun cathodes. The crt screen area is divided into two halves, which are electrically insulated from each other to permit independent operation.

The target operates in a bistable mode because of the secondary-emission properties of the insulator material The first stable state is the rest potential, at which the target has gathered low-energy flood-gun electrons, causing it to charge down to the flood-gun cathode potential. The second stable state is the stored state, at which the target (or portions of it) is shifted to the backplate potential by increasing the secondary emission. While the flood guns do not have sufficient energy to shift the target to the stored state, they do supply sufficient energy to hold the target in the stored state after it has been shifted by the high-energy writing-gun beam (crt beam). This is because the landing energy of the flood electrons has increased with the increased potential difference between the flood gun cathode and the target. These higher energy electrons produce a visual display as long as the flood gun beam covers the target.

When the stored display is no longer needed, the information is erased by first shifting the entire target to the stored state, and then removing the charge. A positive going short-duration pulse is first applied to the backplate increasing the flood-gun electron landing energy and writing the entire target area. Next, the backplate voltage is pulled well below the rest potential of the target, which follows due to its inherent capacitive coupling. Then, as the backplate is gradually returned to its quiescent potential, the target charges to the rest potential and is ready to write again.

Backplate Supply

A regulated +230 volt dc power supply is incorporated in the Storage Circuit to provide the storage level for the crt and to ensure a potential sufficient for the erasure process. A winding of high-voltage transformer T240 supplies 270 volts peak, which is rectified by CR386. Transistors Q386 and Q388 are connected as a feedback pair to provide the regulated +230 volt dc output. Zener diode VR388 establishes the reference voltage, and R387 (+230 V Adj), sets the current through Q386 to set the output level. Zener diode VR387 is a protection device for the transistors, and is normally operated in a region of its characteristic curve below its zener knee.

Backplate Control

Separate STORE switches, S375A and S375B, are provided for the target backplates to permit each storage screen to be operated individually. In the store mode, the store-level potential for the backplate is supplied by either Q372 or by the erase-generator output operational amplifier, depending upon the setting of the ERASE Select switches, S372A and S372B.

A high degree of control of target backplates is maintained by a feedback amplifier system consisting of Q356, Q358, and Q362. The operational amplifier summing point is at the base of Q356, and the feedback resistor is R355. Variable resistor R350, Store Level, provides an adjustment of the current to the null point and hence, sets the backplate voltage through R355 to an optimum storage level. Variable resistor R370, Store Bal, permits matching the backplate voltages for uniform screen luminance, whether they are selected for erasure or not. When either or both screens are operated in the store mode, the divider network in the high-voltage regulator circuit is modified to shift the high voltage slightly, correcting for the deflection sensitivity changes that occur. The backplate voltage is applied through either R381 or R382 to the base of Q384, removing the ground potential from the Q384 collector. Variable resistor R385, Sens Correct, permits an adjustable sensitivity correction voltage to be applied to the high-voltage regulator.

Erase Generator

The previously discussed operational amplifier is driven by a monostable multivibrator when it is desired to erase a stored display. The multivibrator consists of Q334, which is normally on, and Q336, which is normally off. When ERASE button S330 is pressed, R330 is grounded, producing a negative-going step through C331 to cut Q334 off. Transistor Q336 turns on, and the negative-going step produced at its collector causes a corresponding positive-going step at the output of the operational amplifier. This positive-going step is applied to the target backplate, increasing the storage level and writing the entire target.

After an RC-controlled time of 10 milliseconds, the multivibrator reverts to its quiescent state, producing a positive-going step at the collector of Q336 as the transistor turns off. This positive-going step is coupled through C342, and the backplate is pulled negative through the action of the operational amplifier. The target is pulled well below its reset potential. As C342 charges, the voltage at the cathode of CR343 decays from about +20 volts toward the −30 volt supply at an RC-controlled rate until it is clamped at ground by conduction of CR343. This action allows the target backplate to be raised slowly to its operating level, while the target remains at the flood-gun cathode potential. The total time from initiation of erasure to the ready-to-write condition is about 250 milliseconds.

Flood-Gun Cathode Control

As previously mentioned, Q308 provides the current for the flood-gun cathodes. It operates at saturation, establishing a cathode potential of nearly −30 volts. Transistor Q308 is controlled by two circuits: a transistor switch activated by the sweep gate and a multivibrator. While the sweep is running, Q304 overrides the multivibrator output and holds Q308 in its conduction state. Emitter follower Q302 receives the sweep blanking input from R203 in the Z-Axis Amplifier circuit; however, the level of interest is the zero volts applied to the base of Q302 while the sweep is running. This level permits the base of Q304 to move slightly negative, biasing the transistor into saturation and grounding the collector of Q320; through R307-R308 divider action, Q308 is held on.

Between sweeps or when the sweep is held off, the +5 volt sweep-blanking level is applied to Q302, raising its emitter positive. This level switches Q304 off, releasing its hold on Q308. In this condition, Q308 is controlled by collector-coupled multivibrator Q310-Q320. When Q320 conducts, Q308 conducts. Symmetry of the multivibrator is controlled by R313 and R325. The BRIGHTNESS control, R325, is adjustable to allow Q320 to conduct anywhere from 10% to 100% of the time. Thus the duty cycle of the flood gun cathode can be varied from 10% to 100%, which has the effect of varying the stored brightness.

Enhance Operation

Writing speed is primarily a function of the writing gun beam current density and physical properties of the storage tube. At very fast sweep speeds, the writing beam of a single sweep does not change the scanned portions of the target enough to shift them to the stored state. Writing beyond the normal writing speed of the crt is attained through the process of enhancement. Upon termination of the single sweep, a short-duration pulse is applied to the target backplate, which increases the operating level slightly so that less writing current is required to shift the scanned section to the stored state.

When the sweep terminates, the sweep blanking pulse causes the emitter of Q302 to quickly go positive. This positive-going transition is applied through C326 to the base of Q322. Monostable multivibrator Q322-Q328 changes states, producing a negative-going pulse at the collector of Q322. The current level applied to the backplate operational amplifier null point (Q356 base) is adjustable by R200B, ENHANCE, to control the amplitude of the positive enhance pulse applied to the target backplate.

SIGNALS OUT ◇7

The Signals Out circuit, provides the Left Out, Center Out, Right Out, and Gate Out signals to the rear-panel bnc connectors. These signals are derived from the plug-in units installed in the plug-in compartments.

Gate Out Amplifier

The Gate Out amplifier is a high-gain, common-emitter amplifier consisting of Q990. The sweep unblanking signal, applied to the base of Q990 is inverted at the collector. Transistor Q990 is effectively switched on and off by the unblanking signal which produces a 5 volt to approximately 0 volt signal.

Left Out, Center Out and Right Out Amplifiers

The push-pull amplifier which consists of Q967, Q972, Q980, Q970 and Q975 provides a replica of the plug-in unit signal installed in the right plug-in compartment, to the rear-panel bnc RIGHT OUT connector. The differential signal applied to the emitter followers Q967 and Q970 is 50 millivolts per crt division signal and is amplified by Q972, Q975 and Q980 used as an operational amplifier in a shunt feedback configuration. The stage has a gain of ten. The signal at the collector of Q980 is centered at ground; the addition of R977 shifts the negative level to near ground so the signal starts at ground and goes positive.

The remaining amplifiers associated with the Left Out and Center Out signals are identical to the Right Out amplifier just described except, the source of the applied signals is from the plug-in units installed in the left and center plug-in compartments respectively.

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. Option information is incorporated into the appropriate sections of the manual. Refer to Table 6-1 and the Table of Contents for location of option information. For further information on instrument options, see your Tektronix Products catalog or contact your Tektronix Field Office.

NOTE

Conversion kits (cabinet-to-rackmount, rackmount-to-cabinet), for most options, are available and can be installed at a later time. For further information on instrument options, see your Tektronix Catalog or contact your Tektronix Field Office.

LIST OF OPTIONS

OPTION 2

Provides a protective front-panel cover for bench cabinet models only. The cover protects the front panel and knobs during transportation and storage. The Tektronix part numbers are listed in Section 9, Replaceable Mechanical Parts (see the listing for bench cabinet).

The protective front-panel cover can be added to existing 5000-series bench oscilloscope. Order the modification kit through your local Tektronix Field Office or representative.

OPTION 3

Provides a faster stored writing speed crt. Writing speed is increased to at least 200 divisions per millisecond (center 6 x 8 divisions) and at least 800 divisons per millisecond in the enhanced mode (center 6 x 8 divisions).

OPTION 7

Provides cathode-ray tube-related signals to standard connectors at the rear of the instrument. This option is particularly well suited for use in the physical life sciences. By using differential amplifiers, the oscilloscope can become a signal conditioner for other devices. Outputs may be used for driving counters or X-Y plotters in conjunction with the oscilloscope. The Tektronix Part numbers for the electrical parts are listed in Section 7, Replaceable Electrical Parts.

OPTION A1

The standard power cord is replaced with Universal European 240-volt type power cord.

OPTION A2

The standard power cord is replaced with the United Kingdown 240-volt type power cord.

OPTION A3

The standard power cord is replaced with the Australian 240-volt type power cord.

OPTION A4

The standard power cord is replaced with the North American 240-volt type power cord.

OPTION A5

The standard power cord is replaced with the Switzerland 220V/10A type power cord.

INSTRUMENT OPTION IDENTIFICATION

OPTION 2

Front-panel protective cover accompanies bench cabinet model.

OPTION 3

Label on the rear panel identifies this option.

OPTION 7

Rear-panel bnc connectors labeled LEFT OUT, CENTER OUT, RIGHT OUT and GATE OUT identify this option.

OPTION A1, A2, A3, A4, AND A5

Refer to Figure 1-1 in this manual to determine type of cord used with your instrument.

TABLE 6-1
Option Information Locator

Option	Location in Manual		Information
	Section	Heading	
2	6 Instrument Options	Option 2	Gives a brief description of Option 2.
3	2 Specification and Performance Check	Electrical Characteristic Table 2-1	Gives specifications for Option 3.
		Performance Check	Step 12. Check Storage Operations (Option 3 only) provides procedure for checking stored writing speed.
	6 Instrument Options	Option 3	Gives a brief description of Option 3.
7	6 Instrument Options	Option 7	Gives a brief description of Option 7.
A1	1 Operating Instructions	Power Cord Information Figure 1-1.	Lists details of Option A1
	6 Instrument Options	Option A1	Gives a brief description of Option A1.
A2	1 Operating Instructions	Power Cord Information Figure 1-1	Lists details of Option A2.
	6 Instrument Options	Option A2	Gives a brief description of Option A2.
A3	1 Operating Instructions	Power Cord Information Figure 1-1.	Lists details of Option A3.
	6 Instrument Options	Option A3	Gives a brief description of Option A3.
A4	1 Operating Instructions	Power Cord Information Figure 1-1.	Lists details of Option A4.
	6 Instrument Options	Option A4	Gives a brief description of Option A4.
A5	1 Operating Instructions	Power Cord Information Figure 1-1.	Lists details of Option A5.
	6 Instrument Options	Option A5	Gives a brief description of Option A5.

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.

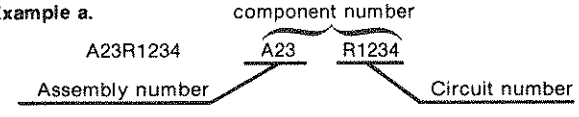
ABBREVIATIONS

Abbreviations conform to American National Standard Y1.1.

COMPONENT NUMBER (column one of the Electrical Parts List)

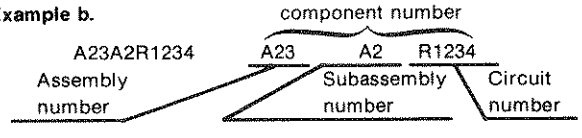
A numbering method has been used to identify assemblies, subassemblies and parts. Examples of this numbering method and typical expansions are illustrated by the following:

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
0000M	SONY/TEKTRONIX CORPORATION	P O BOX 14, HANEDA AIRPORT	TOKYO 149, JAPAN
00213	NYTRONICS, COMPONENTS GROUP, INC., SUBSIDIARY OF NYTRONICS, INC.	ORANGE STREET	DARLINGTON, SC 29532
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P O BOX 128	PICKENS, SC 29671
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
02111	SPECTROL ELECTRONICS CORPORATION	17070 EAST GALE AVENUE	CITY OF INDUSTRY, CA 91745
03508	GENERAL ELECTRIC COMPANY, SEMI-CONDUCTOR PRODUCTS DEPARTMENT	ELECTRONICS PARK	SYRACUSE, NY 13201
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867, 19TH AVE. SOUTH	MYRTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
10582	CTS OF ASHEVILLE, INC.	MILLS GAP ROAD	SKYLAND, NC 28776
12697	CLAROSTAT MFG. CO., INC.	LOWER WASHINGTON STREET	DOVER, NH 03820
12954	SIEMENS CORPORATION, COMPONENTS GROUP	8700 E THOMAS RD, P O BOX 1390	SCOTTSDALE, AZ 85252
12969	UNITRODE CORPORATION	580 PLEASANT STREET	WATERTOWN, MA 02172
14433	ITT SEMICONDUCTORS	3301 ELECTRONICS WAY P O BOX 3049	WEST PALM BEACH, FL 33402
14552	MICRO SEMICONDUCTOR CORP.	2830 E FAIRVIEW ST.	SANTA ANA, CA 92704
14936	GENERAL INSTRUMENT CORP., SEMICONDUCTOR PRODUCTS GROUP	P.O. BOX 600,600 W. JOHN ST.	HICKSVILLE, NY 11802
24546	CORNING GLASS WORKS, ELECTRONIC COMPONENTS DIVISION	550 HIGH STREET	BRADFORD, PA 16701
27014	NATIONAL SEMICONDUCTOR CORP.	2900 SEMICONDUCTOR DR.	SANTA CLARA, CA 95051
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
50434	HEWLETT-PACKARD COMPANY	640 PAGE MILL ROAD	PALO ALTO, CA 94304
51984	NEC AMERICA INC. RADIO AND TRANSMISSION DIV.	2990 TELESTAR CT. SUITE 212	FALLS CHURCH, VA 22042
52769	SPRAGUE GOODMAN ELEC., INC.	134 FULTON AVENUE	GARDEN CITY PARK, NY 11040
55210	GETTIG ENG. AND MFG. COMPANY	PO BOX 85, OFF ROUTE 45	SPRING MILLS, PA 16875
55578	CTS OF WEST LIBERTY INC.	6800 COUNTY RD. 189 WEST	LIBERTY, OH 43357
56289	SPRAGUE ELECTRIC CO.	87 MARSHALL ST.	NORTH ADAMS, MA 01247
59660	TUSONIX INC.	2155 N FORBES BLVD	TUCSON, AZ 85705
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71450	CTS CORP.	905 N. WEST BLVD	ELKHART, IN 46514
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
74276	SIGNALITE DIV., GENERAL INSTRUMENT CORP.	1933 HECK AVE.	NEPTUNE, NJ 07753
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
75915	LITTELFUSE, INC.	800 E. NORTHWEST HWY	DES PLAINES, IL 60016
77820	BENDIX CORP., THE, ELECTRICAL COMPONENTS DIVISION	SHERMAN AVE.	SIDNEY, NY 13838
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	3029 E. WASHINGTON STREET P. O. BOX 372	INDIANAPOLIS, IN 46206
91418	RADIO MATERIALS COMPANY, DIV. OF P.R. MALLORY AND COMPANY, INC.	4242 W BRYN MAWR	CHICAGO, IL 60646
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601
91929	HONEYWELL, INC., MICRO SWITCH DIV.	CHICAGO & SPRING STS.	FREEPORT, IL 61032
93410	ESSEX INTERNATIONAL, INC., CONTROLS DIV. LEXINGTON PLANT	P. O. BOX 1007	MANSFIELD, OH 44903
95238	CONTINENTAL CONNECTOR CORP.	34-63 56TH ST.	WOODSIDE, NY 11377

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-7478-00			CKT BOARD ASSY:INTERFACE	80009	670-7478-00
A2	670-1339-03			CKT BOARD ASSY:LV POWER SUPPLY	80009	670-1339-03
A3	670-1621-06			CKT BOARD ASSY:HIGH VOLTAGE	80009	670-1621-06
A4	670-1434-04			CKT BOARD ASSY:STORAGE	80009	670-1434-04
A7	670-5757-00			CKT BOARD ASSY:SIGNAL OUT	80009	670-5757-00
	----- -----			(OPTION 07 ONLY)		
A1	----- -----			CKT BOARD ASSY:INTERFACE		
A1C400	281-0812-00			CAP.,FXD,CER DI:1000PF,10%,100V	72982	8035D9AADX7R102K
A1C402	281-0797-00			CAP.,FXD,CER DI:15PF,10%,100V	72982	8035D9AADC0G150K
A1C411	281-0797-00			CAP.,FXD,CER DI:15PF,10%,100V	72982	8035D9AADC0G150K
A1C510	281-0797-00			CAP.,FXD,CER DI:15PF,10%,100V	72982	8035D9AADC0G150K
A1C520	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A1C620	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A1C721	281-0812-00			CAP.,FXD,CER DI:1000PF,10%,100V	72982	8035D9AADX7R102K
A1C740	290-0748-00			CAP.,FXD,ELCTLT:10UF,+50-10%,20V	56289	500D149
A1C801	281-0814-00			CAP.,FXD,CER DI:100PF,10%,100V	04222	GC70-1-A101K
A1C810	281-0823-00			CAP.,FXD,CER DI:470PF,10%,50V	12969	CGB471KDN
A1C814	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	GC70-1C103K
A1C900	290-0748-00			CAP.,FXD,ELCTLT:10UF,+50-10%,20V	56289	500D149
A1C902	281-0786-00			CAP.,FXD,CER DI:150PF,10%,100V	72982	8035D2AADX5P151K
A1C921	281-0811-00			CAP.,FXD,CER DI:10PF,10%,100V	72982	8035D2AADC1G100K
A1CR400	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR420	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR421	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR423	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR432	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR433	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR501	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR520	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR800	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR820	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR830	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1J300	131-1078-00			CONNECTOR,RCPT,:28/56 CONTACT	95238	600-1156Y25GDF30
A1J600	131-1078-00			CONNECTOR,RCPT,:28/56 CONTACT	95238	600-1156Y25GDF30
A1J1000	131-1078-00			CONNECTOR,RCPT,:28/56 CONTACT	95238	600-1156Y25GDF30
A1P500	352-0198-00			HLDR,TERM CONN:2 WIRE BLACK	80009	352-0198-00
A1P640	352-0200-00			HLDR,TERM CONN:4 WIRE BLACK	80009	352-0200-00
A1P740	352-0202-00			HLDR,TERM CONN:6 WIRE BLACK	80009	352-0202-00
A1P800	352-0204-00			CONN BODY,PL,EL:8 WIRE BLACK	80009	352-0204-00
A1Q400	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
A1Q401	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
A1Q413	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
A1Q420	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
A1Q421	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
A1Q430	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
A1Q431	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
A1Q510	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
A1Q520	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
A1Q521	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
A1Q600	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
A1Q601	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
A1Q630	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
A1Q631	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
A1Q700	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1Q701	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A1Q710	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A1Q820	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
A1Q821	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
A1Q910	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
A1Q930	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
A1Q931	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
A1R200	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A1R220	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
A1R221	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
A1R400	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
A1R401	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
A1R402	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
A1R403	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
A1R404	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
A1R405	321-0159-00			RES.,FXD,FILM:442 OHM,1%,0.125W	91637	MFF1816G442R0F
A1R406	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A1R410	321-0402-00			RES.,FXD,FILM:150K OHM,1%,0.125W	24546	NA55D1503F
A1R411	321-0350-00			RES.,FXD,FILM:43.2K OHM,1%,0.125W	91637	MFF1816G43201F
A1R412	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W	91637	MFF1816G49901F
A1R413	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
A1R414	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
A1R420	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
A1R421	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A1R422	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
A1R430	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
A1R431	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A1R432	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
A1R433	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
A1R500	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
A1R501	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A1R502	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
A1R503	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A1R504	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
A1R510	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W	91637	MFF1816G49901F
A1R511	321-0365-00			RES.,FXD,FILM:61.9K OHM,1%,0.125W	91637	MFF1816G61901F
A1R512	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
A1R514	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
A1R521	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
A1R522	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A1R530	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A1R531	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A1R532	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A1R533	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
A1R534	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
A1R629	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
A1R639	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
A1R700	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A1R701	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
A1R710	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A1R711	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
A1R720	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
A1R721	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
A1R722	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
A1R730	311-1133-00			RES.,VAR,NONWIR:10K OHM,30%,0.25W	71450	201-YA5534
A1R800	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A1R801	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1R810	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A1R812	315-0163-00			RES.,FXD,CMPSN:16K OHM,5%,0.25W	01121	CB1635
A1R813	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
A1R820	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
A1R821	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
A1R830	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
A1R831	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
A1R832	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
A1R900	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
A1R902	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A1R903	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
A1R904	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A1R910	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
A1R911	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
A1R920	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
A1R921	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A1R922	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
A1R930	321-0159-00			RES.,FXD,FILM:442 OHM,1%,0.125W	91637	MFF1816G442R0F
A1R931	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
A1R932	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
A1U800	156-0567-02			MICROCIRCUIT,DI:DUAL J-K NEG-EDGE-TRIG	01295	SN74LS113NP3
A1VR530	152-0149-00			SEMICOND DEVICE:ZENER,0.4W,10V,5%	04713	SZG35009K3
A1W513	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
A1W514	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A2	----- -----			CKT BOARD ASSY:LV POWER SUPPLY		
A2C810	290-0511-00			CAP.,FXD,ELCTLT:250UF,+75-10%,250V	90201	20-35958
A2C815	290-0510-00			CAP.,FXD,ELCTLT:6000UF,+100-10%,15V	56289	68D10473
A2C820	290-0134-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	150D226X0015B2
A2C822	281-0512-00			CAP.,FXD,CER DI:27PF,+/-2.7PF,500V	59660	308-000C0G0270K
A2C830	285-0629-00			CAP.,FXD,PLSTC:0.047UF,20%,100V	56289	410P47301
A2C837	290-0509-00			CAP.,FXD,ELCTLT:3000UF,+100-10%,50V	56289	68D10454
A2C839	290-0509-00			CAP.,FXD,ELCTLT:3000UF,+100-10%,50V	56289	68D10454
A2C842	290-0175-00			CAP.,FXD,ELCTLT:10UF,20%,35V	56289	150D106X0035R2
A2C852	281-0550-00			CAP.,FXD,CER DI:120PF,10%,500V	04222	7001-1373
A2C857	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	91418	SP103Z151-4R9
A2C860	290-0175-00			CAP.,FXD,ELCTLT:10UF,20%,35V	56289	150D106X0035R2
A2C865	281-0543-00			CAP.,FXD,CER DI:270PF,10%,500V	72982	301055X5P271K
A2C870	290-0134-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	150D226X0015B2
A2C872	281-0572-00			CAP.,FXD,CER DI:6.8PF,+/-0.5PF,500V	59660	301-000C0H0689D
A2C875	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	91418	SP103Z151-4R9
A2C881	290-0267-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	162D105X0035CD2
A2C883	290-0267-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	162D105X0035CD2
A2C890	281-0549-00			CAP.,FXD,CER DI:68PF,10%,500V	59660	301-000U2J0680K
A2CR810	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
A2CR811	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
A2CR812	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
A2CR813	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
A2CR815	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	04713	3N55 FAMILY
A2CR820	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	14433	LG4016
A2CR824	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A2CR835	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
A2CR836	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
A2CR837	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	04713	3N55 FAMILY
A2CR841	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	14433	LG4016
A2CR842	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	14433	LG4016
A2CR850	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A2CR851	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A2CR860	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	14433	LG4016
A2CR865	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A2CR870	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A2CR875	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A2CR885	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A2CR890	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A2F809	159-0029-00			FUSE,CARTRIDGE:3AG,0.3A,250V,SLOW-BLOW	71400	MDL3/10
A2F810	159-0028-00			FUSE,CARTRIDGE:3AG,0.25A,250V,FAST-BLOW	71400	AGC 1/4
A2F815	159-0015-00			FUSE,CARTRIDGE:3AG,3A,250V,FAST-BLOW	71400	AGC 3
A2F834	159-0015-00			FUSE,CARTRIDGE:3AG,3A,250V,FAST-BLOW	71400	AGC 3
A2F835	159-0025-00			FUSE,CARTRIDGE:3AG,0.5A,250V,FAST-BLOW	71400	AGC 1/2
A2F836	159-0015-00			FUSE,CARTRIDGE:3AG,3A,250V,FAST-BLOW	71400	AGC 3
A2F850	159-0015-00			FUSE,CARTRIDGE:3AG,3A,250V,FAST-BLOW	71400	AGC 3
A2P850	352-0206-00			HLDR,TERM CONN:10 WIRE BLACK	80009	352-0206-00
A2P890	352-0198-00			HLDR,TERM CONN:2 WIRE BLACK	80009	352-0198-00
A2Q820	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
A2Q825	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
A2Q845	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
A2Q850	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A2Q865	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
A2Q870	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
A2Q875	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
A2Q885	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
A2Q890	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A2R810	302-0150-00			RES.,FXD,CMPSN:15 OHM,10%,0.50W	01121	EB1501
A2R812	304-0683-00			RES.,FXD,CMPSN:68K OHM,10%,1W	01121	GB6831
A2R815	308-0685-00			RES.,FXD,WW:1.5 OHM,5%,1W	75042	BW20-1R500J
A2R816	321-0215-00			RES.,FXD,FILM:1.69K OHM,1%,0.125W	91637	MFF1816G16900F
A2R818	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
A2R820	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
A2R822	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
A2R824	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
A2R826	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
A2R827	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A2R830	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A2R832	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
A2R834	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
A2R841	307-0300-00			RES.,FXD,FILM:150 OHM,5%,10W	24546	FP10 150 OHM 5%
A2R842	308-0686-00			RES.,FXD,WW:2.2 OHM,5%,2W	75042	BWH-2R200J
A2R846	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
A2R847	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
A2R850	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	01121	CB8235
A2R851	302-0333-00			RES.,FXD,CMPSN:33K OHM,10%,0.50W	01121	EB3331
A2R852	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
A2R853	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A2R856	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A2R857	321-0268-00			RES.,FXD,FILM:6.04K OHM,1%,0.125W	91637	MFF1816G60400F
A2R858	311-1120-00			RES.,VAR,NONWIR:100 OHM,30%,0.25W	71450	201-YA5531
A2R859	321-0268-00			RES.,FXD,FILM:6.04K OHM,1%,0.125W	91637	MFF1816G60400F
A2R860	308-0686-00			RES.,FXD,WW:2.2 OHM,5%,2W	75042	BWH-2R200J
A2R861	307-0301-00			RES.,FXD,FILM:120 OHM,5%,10W	24546	FP10 120 OHM 5%
A2R863	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
A2R865	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A2R867	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
A2R868	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A2R869	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
A2R870	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
A2R872	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
A2R873	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A2R875	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A2R877	321-0256-00			RES.,FXD,FILM:4.53K OHM,1%,0.125W	91637	MFF1816G45300F
A2R878	311-1124-00			RES.,VAR,NONWIR:TRMR,250 OHM,0.25W	71450	201-YA5533
A2R879	321-0202-00			RES.,FXD,FILM:1.24K OHM,1%,0.125W	91637	MFF1816G12400F
A2R880	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
A2R881	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
A2R883	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A2R885	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
A2R890	322-0686-03			RES.,FXD,FILM:7.23K OHM,0.25%,0.25W	91637	MFF1421D72300C
A2R891	321-0097-03			RES.,FXD,FILM:100 OHM,0.25%,0.125W	91637	MFF1816D100R0C
A2TP810	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A2TP820	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A2TP840	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A2TP860	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A2VR850	152-0357-00			SEMICOND DEVICE:ZENER,0.4W,82V,5%	04713	SZ12461KRL
A2VR865	152-0243-00			SEMICOND DEVICE:ZENER,0.4W,15V,5%	14552	TD3810983
A2VR870	152-0227-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	04713	SZ13903

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A3	----- -----			CKT BOARD ASSY:HIGH VOLTAGE		
A3C106	283-0596-00			CAP.,FXD,MICA D:528PF,1%,300V	00853	D153F5280F0
A3C116	281-0180-00			CAP.,VAR,MICA D:18-115PF,175V	52769	GSM241
A3C126	283-0596-00			CAP.,FXD,MICA D:528PF,1%,300V	00853	D153F5280F0
A3C136	283-0672-00			CAP.,FXD,MICA D:200PF,1%,500V	00853	D155F2010F0
A3C224	283-0051-00			CAP.,FXD,CER DI:0.0033UF,5%,100V	72982	8131N145C0G0332J
A3C236	285-0526-00			CAP.,FXD,PLSTC:0.1UF,20%,400V	56289	410P10404
A3C241	283-0272-00			CAP.,FXD,CER DI:0.0068UF,30%,4000V	72982	3888-510C 682M
A3C242	283-0272-00			CAP.,FXD,CER DI:0.0068UF,30%,4000V	72982	3888-510C 682M
A3C248	283-0272-00			CAP.,FXD,CER DI:0.0068UF,30%,4000V	72982	3888-510C 682M
A3C249	283-0272-00			CAP.,FXD,CER DI:0.0068UF,30%,4000V	72982	3888-510C 682M
A3C251	290-0194-00			CAP.,FXD,ELCTLT:10UF,+50-10%,100V	56289	30D106F100DC2
A3C252	283-0083-00			CAP.,FXD,CER DI:0.0047UF,20%,500V	72982	811-565C471J
A3C253	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	91418	SP103Z151-4R9
A3C254	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N031Z5U0105Z
A3C258	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N031Z5U0105Z
A3C259	283-0164-00			CAP.,FXD,CER DI:2.2UF,20%,25V	72982	8141N037Z5U0225M
A3C272	283-0021-00			CAP.,FXD,CER DI:0.001UF,20%,5000V	72982	848-556-Y5S-102M
A3C273	283-0208-00			CAP.,FXD,CER DI:0.22UF,10%,200V	72982	8151N230 C 224K
A3C281	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	91418	SP103Z151-4R9
A3CR209	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
A3CR211	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
A3CR214	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A3CR215	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
A3CR222	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A3CR224	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
A3CR226	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
A3CR234	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
A3CR238	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
A3CR240	152-0242-00			SEMICOND DEVICE:SILICON,225V,200MA	07263	FDH5004
A3CR241	152-0409-00			SEMICOND DEVICE:SILICON,12,000V,5MA	80009	152-0409-00
A3CR247	152-0409-00			SEMICOND DEVICE:SILICON,12,000V,5MA	80009	152-0409-00
A3CR253	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A3CR255	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A3CR256	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
A3CR262	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A3CR264	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A3CR269	152-0586-00			SEMICOND DEVICE:SILICON,600V,500MA	14936	RGP10J
A3CR270	152-0586-00			SEMICOND DEVICE:SILICON,600V,500MA	14936	RGP10J
A3DS271	150-0030-00			LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS	74276	NE2V-T
A3DS272	150-0030-00			LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS	74276	NE2V-T
A3DS273	150-0030-00			LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS	74276	NE2V-T
A3DS274	150-0030-00			LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS	74276	NE2V-T
A3F273	159-0124-00			FUSE,WIRE LEAD:3A,125V	75915	272003
A3L259	108-0564-00			COIL,RF:FIXED,74UH	80009	108-0564-00
A3P205	352-0201-00			CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0201-00
A3P260	352-0205-00			CONN BODY,PL,EL:9 WIRE BLACK	80009	352-0205-00
A3Q104	151-0615-00			TRANSISTOR:SILICON,NPN	04713	SDS358K
A3Q106	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A3Q114	151-0615-00			TRANSISTOR:SILICON,NPN	04713	SDS358K
A3Q116	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A3Q124	151-0615-00			TRANSISTOR:SILICON,NPN	04713	SDS358K
A3Q126	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A3Q134	151-0615-00			TRANSISTOR:SILICON,NPN	04713	SDS358K
A3Q136	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A3Q214	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
A3Q222	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A3Q226	151-0407-00			TRANSISTOR:SILICON,NPN	04713	SS2456
A3Q234	151-0406-00			TRANSISTOR:SILICON,PNP	04713	OBD
A3Q252	151-0256-00			TRANSISTOR:SILICON,NPN	04713	SJ2304
A3Q262	151-0207-00			TRANSISTOR:SILICON,NPN	03508	X32D6191
A3Q264	151-0342-00			TRANSISTOR:SILICON,PNP	07263	S035928
A3Q278	151-0254-00			TRANSISTOR:SILICON,NPN	03508	X38L3118
A3R101	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A3R102	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
A3R103	315-0390-00			RES.,FXD,CMPSN:39 OHM,5%,0.25W	01121	CB3905
A3R104	308-0668-00			RES.,FXD,WW:6.2K OHM,3%,7W	00213	1600S62000H
A3R106	321-0128-00			RES.,FXD,FILM:210 OHM,1%,0.125W	91637	MFF1816G210R0F
A3R108	308-0539-00			RES.,FXD,WW:2.25K OHM,0.5%,3W	91637	RS2BK22500D
A3R112	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
A3R113	315-0390-00			RES.,FXD,CMPSN:39 OHM,5%,0.25W	01121	CB3905
A3R114	308-0668-00			RES.,FXD,WW:6.2K OHM,3%,7W	00213	1600S62000H
A3R116	311-1567-00			RES.,VAR,NONWIR:TRMR,100 OHM,0.50W	73138	91-89-0
A3R118	308-0539-00			RES.,FXD,WW:2.25K OHM,0.5%,3W	91637	RS2BK22500D
A3R122	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
A3R123	315-0390-00			RES.,FXD,CMPSN:39 OHM,5%,0.25W	01121	CB3905
A3R124	308-0668-00			RES.,FXD,WW:6.2K OHM,3%,7W	00213	1600S62000H
A3R125	303-0751-00			RES.,FXD,CMPSN:750 OHM,5%,1W	01121	GB7515
A3R126	321-0128-00			RES.,FXD,FILM:210 OHM,1%,0.125W	91637	MFF1816G210R0F
A3R128	308-0539-00			RES.,FXD,WW:2.25K OHM,0.5%,3W	91637	RS2BK22500D
A3R132	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
A3R133	315-0390-00			RES.,FXD,CMPSN:39 OHM,5%,0.25W	01121	CB3905
A3R134	308-0668-00			RES.,FXD,WW:6.2K OHM,3%,7W	00213	1600S62000H
A3R135	315-0390-00			RES.,FXD,CMPSN:39 OHM,5%,0.25W	01121	CB3905
A3R136	311-1567-00			RES.,VAR,NONWIR:TRMR,100 OHM,0.50W	73138	91-89-0
A3R138	308-0539-00			RES.,FXD,WW:2.25K OHM,0.5%,3W	91637	RS2BK22500D
A3R202	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
A3R203	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A3R206	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
A3R207	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
A3R208	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
A3R209	315-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.25W	01121	CB2245
A3R211	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A3R213	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
A3R215	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A3R216	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
A3R217	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A3R218	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
A3R219	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
A3R222	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A3R223	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
A3R226	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A3R227	321-0399-00			RES.,FXD,FILM:140K OHM,1%,0.125W	91637	MFF1816G14002F
A3R231	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A3R232	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
A3R234	305-0223-00			RES.,FXD,CMPSN:22K OHM,5%,2W	01121	HB2235
A3R236	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
A3R240	315-0335-03			RES.,FXD,CMPSN:3.3M OHM,5%,0.25W	01121	CB3355
A3R242	315-0223-03			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
A3R243	315-0105-03			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A3R244	315-0331-03			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
A3R245	311-1135-00			RES.,VAR,NONWIR:TRMR,1M OHM,0.25W	71450	YA5535
A3R248	315-0103-03			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A3R249	315-0471-03			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A3R251	307-0058-00			RES.,FXD,CMPSN:5.6 OHM,5%,0.5W	01121	EB56G5
A3R252	308-0075-00			RES.,FXD,WW:100 OHM,5%,3W	91637	CW2B-100R0J
A3R254	308-0365-00			RES.,FXD,WW:1.5 OHM,5%,3W	91637	CW2B-1R500J
A3R262	301-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.50W	01121	EB4725
A3R263	315-0912-00			RES.,FXD,CMPSN:9.1K OHM,5%,0.25W	01121	CB9125
A3R266	315-0334-00			RES.,FXD,CMPSN:330K OHM,5%,0.25W	01121	CB3345
A3R267	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
A3R268	315-0103-03			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A3R271	315-0395-00			RES.,FXD,CMPSN:3.9M OHM,5%,0.25W	01121	CB3955
A3R272A-E	307-0296-00			RES.,FXD,FILM:	80009	307-0296-00
A3R273	315-0104-03			RES.,FXD CMPSN:100K OHM,5%,0.25W	01121	CB1045
A3R274	315-0105-03			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A3R275	311-1136-00			RES.,VAR,NONWIR:100K OHM,30%,0.25W	71450	201-YA5536
A3R276	315-0105-03			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A3R278	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
A3R282	315-0163-01			RES.,FXD,CMPSN:16K OHM,5%,0.25W	01121	CB1635
A3R285	311-1555-00			RES.,VAR,NONWIR:100K OHM,20%,0.5W	73138	91-77-0
A3R286	311-1555-00			RES.,VAR,NONWIR:100K OHM,20%,0.5W	73138	91-77-0
A3R287	301-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.50W	01121	EB1835
A3T240	120-1230-02			XFMR,PWR,STU:HIGH VOLTAGE	80009	120-1230-02
A3VR237	152-0284-00			SEMICOND DEVICE:ZENER,0.4W,47V,5%	80009	152-0284-00
A3VR239	152-0101-00			SEMICOND DEVICE:ZENER,1W,75V,5%	04713	1N3041B
A3VR258	152-0438-00			SEMICOND DEVICE:ZENER,3W,9.1V,5%	12969	UZ1364
A3VR281	152-0285-00			SEMICOND DEVICE:ZENER,0.4W,62V,5%	80009	152-0285-00
A3VR282	152-0285-00			SEMICOND DEVICE:ZENER,0.4W,62V,5%	80009	152-0285-00

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A4	----- -----			CKT BOARD ASSY:STORAGE		
A4C303	283-0067-00			CAP.,FXD,CER DI:0.001UF,10%,200V	56289	19C607
A4C307	283-0067-00			CAP.,FXD,CER DI:0.001UF,10%,200V	56289	19C607
A4C311	281-0500-00			CAP.,FXD,CER DI:2.2PF,+/-0.5PF,500V	04222	7001-1092
A4C321	281-0500-00			CAP.,FXD,CER DI:2.2PF,+/-0.5PF,500V	04222	7001-1092
A4C325	283-0026-00			CAP.,FXD,CER DI:0.2UF,+80-20%,25V	56289	274C3
A4C326	283-0067-00			CAP.,FXD,CER DI:0.001UF,10%,200V	56289	19C607
A4C327	290-0264-00			CAP.,FXD,ELCTLT:0.22UF,10%,35V	56289	162D224X9035BC2
A4C330	290-0267-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	162D105X0035CD2
A4C331	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	91418	SP103Z151-4R9
A4C337	290-0188-00			CAP.,FXD,ELCTLT:0.1UF,10%,35V	56289	162D104X9035BC2
A4C342	290-0135-00			CAP.,FXD,ELCTLT:15UF,20%,20V	56289	150D156X0020B2
A4C385	290-0134-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	150D226X0015B2
A4C386	285-0562-00			CAP.,FXD,PLSTC:0.47UF,20%,400V	56289	430P474X04
A4C387	283-0067-00			CAP.,FXD,CER DI:0.001UF,10%,200V	56289	19C607
A4C389	283-0013-00			CAP.,FXD,CER DI:0.01UF,+100-0%,1000V	56289	33C29A7
A4C391	283-0008-00			CAP.,FXD,CER DI:0.1UF,20%,500V	56289	275C8
A4C394	283-0057-00			CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	2C20Z5U104Z200B
A4C397	290-0414-00			CAP.,FXD,ELCTLT:8UF,+50-10%,200V	90201	TT8R0T200C1C3P
A4C398	290-0177-00			CAP.,FXD,ELCTLT:1UF,20%,50V	56289	162D105X0050CD2
A4C399	290-0247-00			CAP.,FXD,ELCTLT:5.6UF,10%,6V	56289	162D565X9006CD2
A4CR320	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR322	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR329	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	04713	3N55 FAMILY
A4CR332	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR348	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR351	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR358	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR386	152-0331-00			SEMICOND DEVICE:SILICON,800V,25MA	0000M	152-0331-00
A4CR387	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
A4CR388	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR389	152-0242-00			SEMICOND DEVICE:SILICON,225V,200MA	07263	FDH5004
A4CR390	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR392	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
A4P200	352-0161-00			HLDR,TERM CONN:3 WIRE,BLACK	80009	352-0161-00
A4Q302	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
A4Q304	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A4Q308	151-0279-00			TRANSISTOR:SILICON,NPN	80009	151-0279-00
A4Q310	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A4Q320	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A4Q322	151-0342-00			TRANSISTOR:SILICON,PNP	07263	S035928
A4Q328	151-0342-00			TRANSISTOR:SILICON,PNP	07263	S035928
A4Q334	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
A4Q336	151-0207-00			TRANSISTOR:SILICON,NPN	03508	X32D6191
A4Q356	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
A4Q358	151-0169-00			TRANSISTOR:SILICON,NPN	04713	ST830
A4Q384	151-0216-00			TRANSISTOR:SILICON,PNP	04713	SPS8803
A4Q386	151-0342-00			TRANSISTOR:SILICON,PNP	07263	S035928
A4Q388	151-0331-00			TRANSISTOR:SILICON,NPN	03508	X40C115
A4Q397	151-0169-00			TRANSISTOR:SILICON,NPN	04713	ST830
A4Q398	151-0169-00			TRANSISTOR:SILICON,NPN	04713	ST830
A4Q399	151-0169-00			TRANSISTOR:SILICON,NPN	04713	ST830
A4R301	315-0472-03			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
A4R302	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A4R303	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
A4R304	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
A4R305	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A4R307	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
A4R308	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A4R310	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
A4R311	315-0125-00			RES.,FXD,CMPSN:1.2M OHM,5%,0.25W	01121	CB1255
A4R312	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A4R313	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
A4R314	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
A4R316	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
A4R317	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
A4R318	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A4R321	315-0125-00			RES.,FXD,CMPSN:1.2M OHM,5%,0.25W	01121	CB1255
A4R322	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A4R324	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
A4R325	311-1155-00			RES.,VAR,NONWIR:20K OHM,0.5W	01121	W-7796
A4R326	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
A4R327	315-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	01121	CB1325
A4R328	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
A4R329	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A4R330	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A4R331	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
A4R332	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
A4R334	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
A4R336	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
A4R337	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A4R339	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
A4R341	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
A4R342	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A4R343	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
A4R346	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
A4R347	321-0359-00			RES.,FXD,FILM:53.6K OHM,1%,0.125W	91637	MFF1816G53601F
A4R350	311-1238-00			RES.,VAR,NONWIR:5K OHM,10%,0.50W	73138	72-27-0
A4R351	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
A4R352	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A4R354	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
A4R355	323-0452-00			RES.,FXD,FILM:499K OHM,1%,0.50W	75042	CECT0-4993F
A4R365	303-0433-00			RES.,FXD,CMPSN:43K OHM,5%,1W	01121	GB4335
A4R370	311-1242-00			RES.,VAR,NONWIR:200K OHM,10%,0.50W	02111	63X-204-T602
A4R371	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
A4R381	315-0334-00			RES.,FXD,CMPSN:330K OHM,5%,0.25W	01121	CB3345
A4R382	315-0334-00			RES.,FXD,CMPSN:330K OHM,5%,0.25W	01121	CB3345
A4R383	315-0244-00			RES.,FXD,CMPSN:240K OHM,5%,0.25W	01121	CB2445
A4R384	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
A4R385	311-1238-00			RES.,VAR,NONWIR:5K OHM,10%,0.50W	73138	72-27-0
A4R386	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
A4R387	311-1237-00			RES.,VAR,NONWIR:1K OHM,10%,0.50W	32997	3386X-T07-102
A4R388	321-0261-00			RES.,FXD,FILM:5.11K OHM,1%,0.125W	91637	MFF1816G51100F
A4R389	323-0414-00			RES.,FXD,FILM:200K OHM,1%,0.50W	75042	CECT0-2003F
A4R390	311-1242-00			RES.,VAR,NONWIR:200K OHM,10%,0.50W	02111	63X-204-T602
A4R392	301-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.50W	01121	EB7535
A4R393	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
A4R394	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
A4R395	311-1241-00			RES.,VAR,NONWIR:100K OHM,10%,0.5W	32997	3386X-T07-104
A4R396	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
A4R397	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A4R398	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
A4S125	260-1503-01			SWITCH,PUSH:1 BTN,2 POLE,START	80009	260-1503-01
A4S330AB	260-1503-01			SWITCH,PUSH:1 BTN,2 POLE,START	80009	260-1503-01

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A4S372AB	260-1570-01			SWITCH,PUSH:2 BTN,2 POLE,PULSE	80009	260-1570-01
A4S375A,B,C,D	260-1207-00			SWITCH,PUSH:DPDT,28VDC,PUSH-PUSH	80009	260-1207-00
A4TP1	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A4TP2	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A4TP3	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A4TP4	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A4VR387	152-0283-00			SEMICOND DEVICE:ZENER,0.4W,43V,5%	12954	DZ750903B1N976B
A4VR388	152-0166-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	04713	SZ11738
A4VR396	152-0288-00			SEMICOND DEVICE:ZENER,0.4W,140V,5%	12954	DZ720717C
A4VR397	152-0101-00			SEMICOND DEVICE:ZENER,1W,75V,5%	04713	1N3041B
A4W329	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
A4W330	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
A4W372	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A7	----- -----			CKT BOARD ASSY:SIGNAL OUT		
	----- -----			(OPTION 07 ONLY)		
A7C930	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	91418	SM103Z5014R9
A7C931	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	59660	301-055C0G0100F
A7C960	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	91418	SM103Z5014R9
A7C961	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	59660	301-055C0G0100F
A7C980	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	91418	SM103Z5014R9
A7C981	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	59660	301-055C0G0100F
A7CR930	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A7CR960	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A7CR980	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A7CR990	152-0322-00			SEMICOND DEVICE:SILICON,15V,HOT CARRIER	50434	5082-2672
A7P910	352-0164-00			CONN BODY,PL,EL:6 WIRE BLACK	80009	352-0164-00
A7P911	352-0169-02			CONN BODY,PL,EL:2 WIRE RED	80009	352-0169-00
A7P912	352-0169-03			CONN BODY,PL,EL:2 WIRE ORANGE	80009	352-0169-03
A7P913	352-0169-09			CONN BODY,PL,EL:2 WIRE WHITE	80009	352-0169-09
A7Q910	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A7Q915	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A7Q920	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A7Q925	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A7Q930	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A7Q940	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A7Q945	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A7Q950	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A7Q955	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A7Q960	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A7Q967	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A7Q970	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A7Q972	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A7Q975	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A7Q980	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A7Q990	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
A7R910	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
A7R911	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
A7R912	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
A7R915	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
A7R916	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
A7R920	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
A7R921	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
A7R922	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
A7R925	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
A7R926	321-0290-00			RES.,FXD,FILM:10.2K OHM,1%,0.125W	91637	MFF1816G10201F
A7R930	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
A7R931	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
A7R932	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A7R933	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A7R940	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
A7R941	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
A7R942	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
A7R945	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
A7R946	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
A7R950	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
A7R951	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
A7R952	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
A7R955	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
A7R956	321-0290-00			RES.,FXD,FILM:10.2K OHM,1%,0.125W	91637	MFF1816G10201F
A7R960	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A7R961	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
A7R962	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A7R963	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A7R967	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
A7R968	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
A7R969	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
A7R970	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
A7R971	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
A7R972	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
A7R973	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
A7R974	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
A7R975	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
A7R976	321-0290-00			RES.,FXD,FILM:10.2K OHM,1%,0.125W	91637	MFF1816G10201F
A7R977	315-0124-00			RES.,FXD,CMPSN:120K OHM,5%,0.25W	01121	CB1245
A7R980	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
A7R981	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
A7R982	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A7R983	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A7R990	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
A7R991	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				CHASSIS PARTS		
C891	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	56289	20C114A8
F201	159-0003-00			FUSE,CARTRIDGE:3AG,1.6A,250V,SLOW-BLOW	71400	MDX 1 6/10
FL201	119-1313-00			FILTER,RFI:10A,115-230V,50-400HZ	56289	10JX5441A
J916	131-0126-00			CONNECTOR,RCPT,:BNC,FEMALE	77820	9663-1 NT-34
	----- -----			(OPTION 07 ONLY)		
J917	131-0126-00			CONNECTOR,RCPT,:BNC,FEMALE	77820	9663-1 NT-34
	----- -----			(OPTION 07 ONLY)		
J918	131-0126-00			CONNECTOR,RCPT,:BNC,FEMALE	77820	9663-1 NT-34
	----- -----			(OPTION 07 ONLY)		
J919	131-0126-00			CONNECTOR,RCPT,:BNC,FEMALE	77820	9663-1 NT-34
	----- -----			(OPTION 07 ONLY)		
L291	108-0644-00			COIL,TUBE DEFLE:TRACE ROTATOR	80009	108-0644-00
Q362	151-0279-00			TRANSISTOR:SILICON,NPN	80009	151-0279-00
Q372	151-0279-00			TRANSISTOR:SILICON,NPN	80009	151-0279-00
Q392	151-0423-00			TRANSISTOR:SILICON,NPN	51984	NTC2333L
Q396	151-0423-00			TRANSISTOR:SILICON,NPN	51984	NTC2333L
Q815	151-0496-00			TRANSISTOR:SILICON,NPN	80009	151-0496-00
Q840	151-0496-00			TRANSISTOR:SILICON,NPN	80009	151-0496-00
Q860	151-0496-00			TRANSISTOR:SILICON,NPN	80009	151-0496-00
R200A-B	311-1331-00			RES.,VAR,NONWIR:PNL,100K X 20K OHM,1.3W	55578	WG04583
R291	311-1189-00			RES.,VAR,WW:PNL,5K OHM,2W	10582	AW3349
R295	311-0254-00			RES.,VAR,NONWIR:5M OHM,10%,1W	12697	CM29709
S200	260-0638-00			SW,THERMOSTATIC:10A,240V,OPEN 75 DEG C	93410	430-364
S201	260-1222-00			SWITCH,PUSH-PUL:10A,250VAC	91929	2DM301
T801	120-1327-00			XFMR,PWR,SDN & SU:LOW FREQUENCY	80009	120-1327-00
V291	154-0634-11			ELECTRON TUBE:CRT FINISHED	80009	154-0634-11
V291	154-0634-12			ELECTRON TUBE:CRT,P402,INT SCALE	80009	154-0634-12
	----- -----			(OPTION 03 ONLY)		

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:

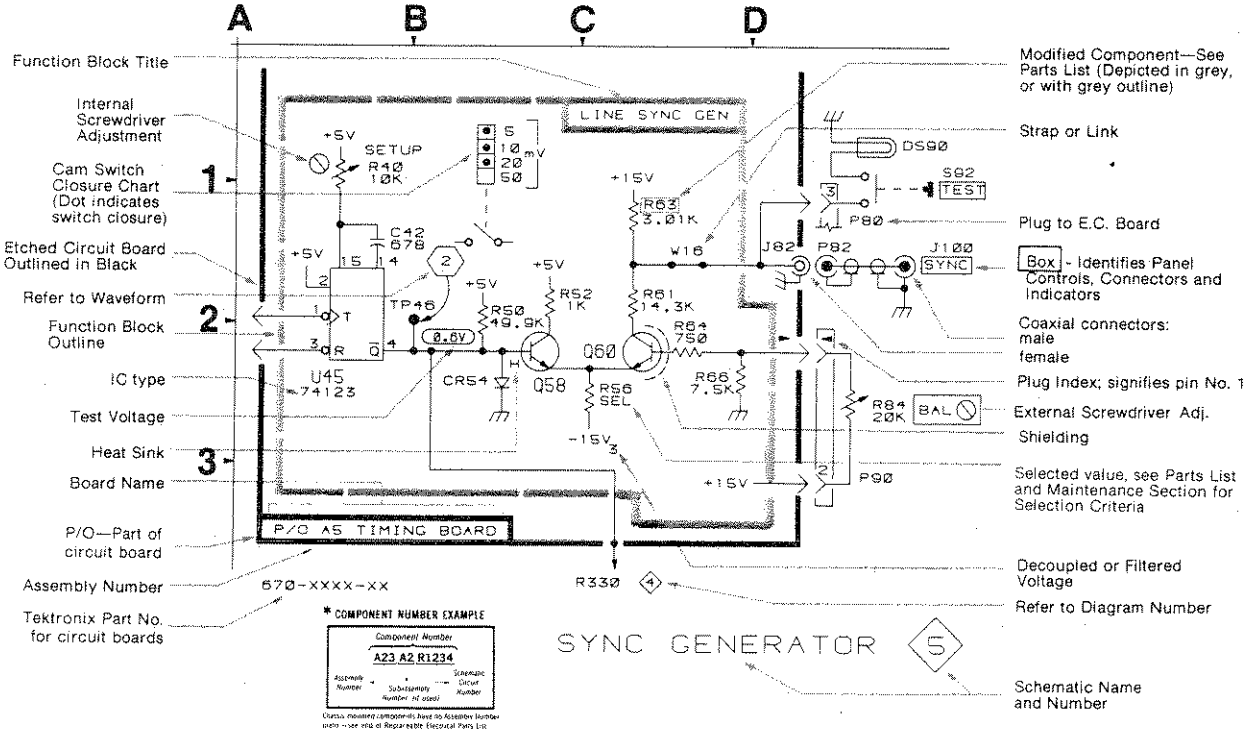
Capacitors = Values one or greater are in picofarads (pF). Values less than one are in microfarads (μF).
Resistors = Ohms (Ω).

The information and special symbols below may appear in this manual.

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).

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.



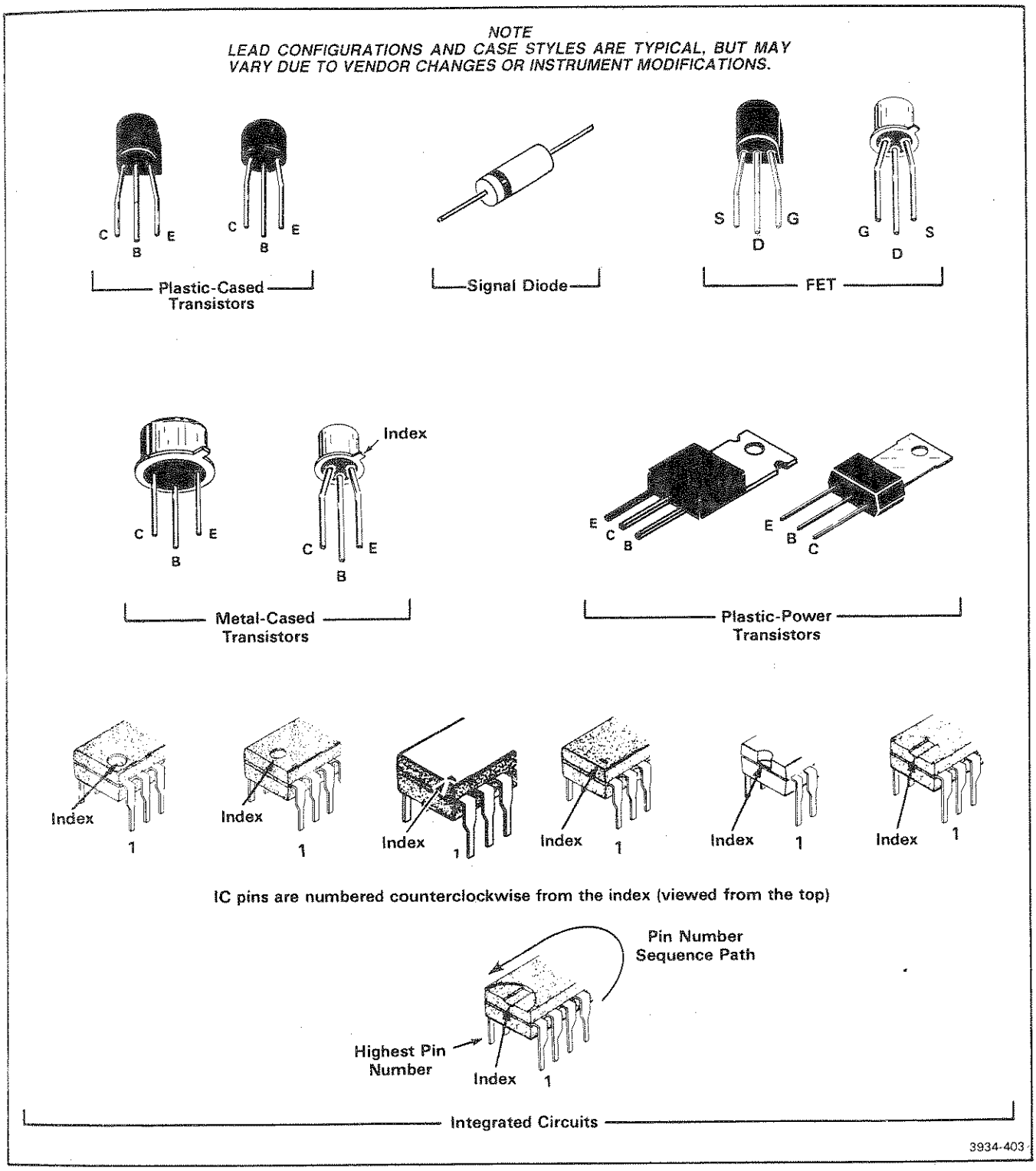
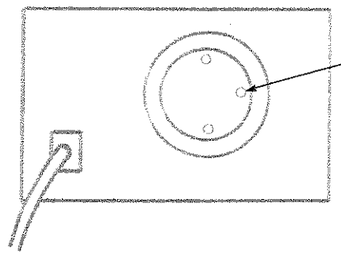
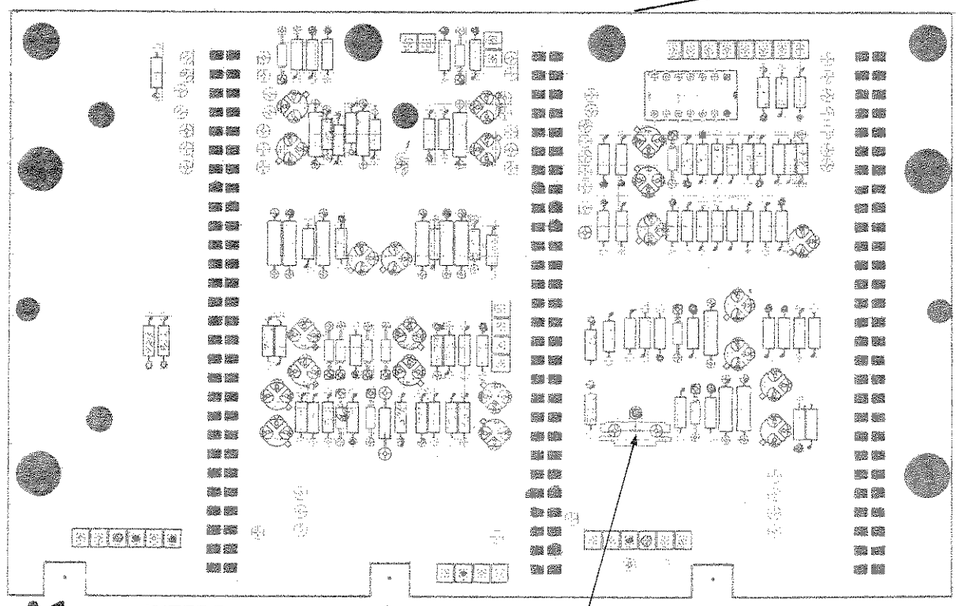


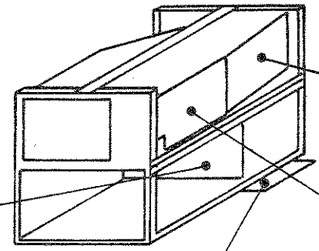
Figure 8-1. Semiconductor Lead Configurations.

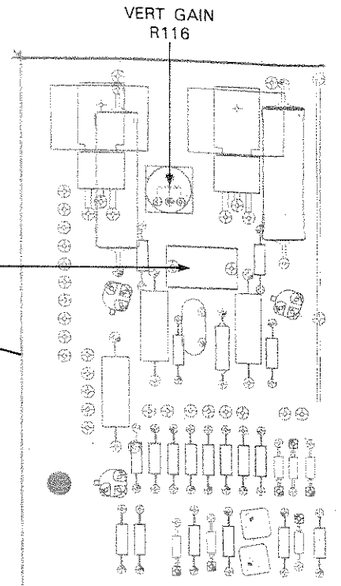
CHASSIS MOUNTED PARTS

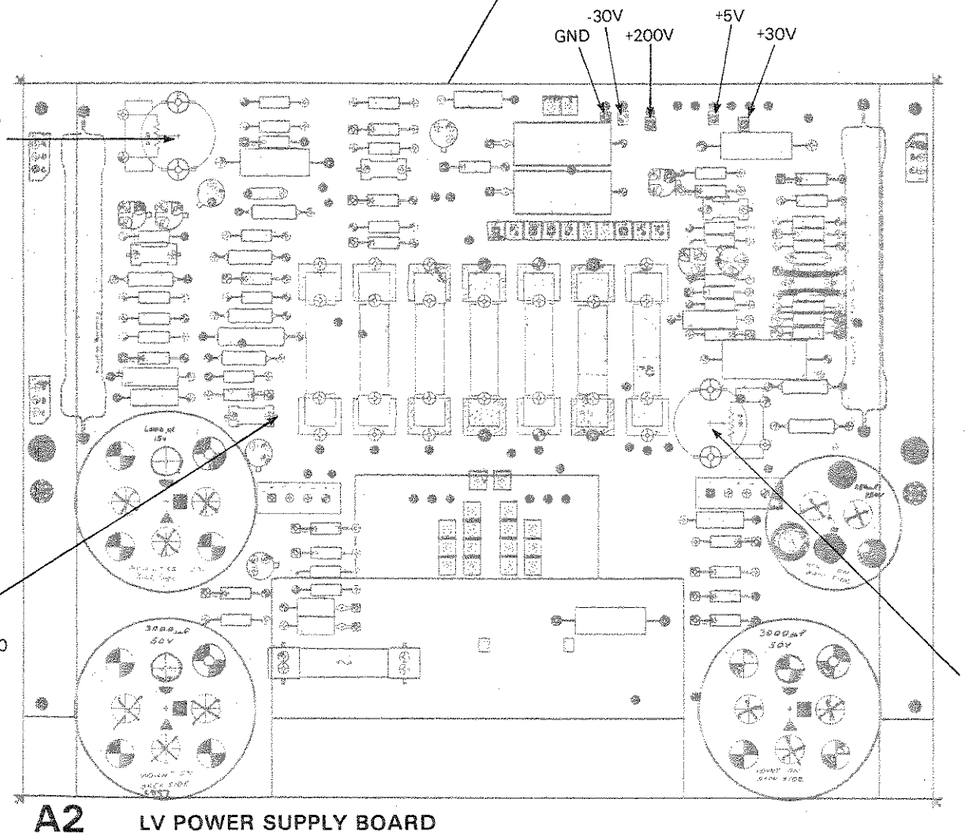
CIRCUIT NUMBER	SCHEM NUMBER	SCHEM LOCATION	CIRCUIT NUMBER	SCHEM NUMBER	SCHEM LOCATION	CIRCUIT NUMBER	SCHEM NUMBER	SCHEM LOCATION
C891	4	D4	J918	7	D3	R291	3	F1
			J919	7	D1	R295	3	F5
F201	4	A4						
			L291	3	G1	S200	4	A4
FL201	4	A5				S201	4	A4
			P205	3	A2			
J201	4	A5	P260	3	A1	T801	4	B1
J210	3	A2						
J916	7	D5	R200A	3	A2	V291	3	G1
J917	7	D4	R200B	5	C5			











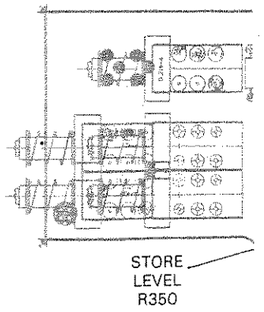


Figure 8-2. Test Point and Adjustment Locations.

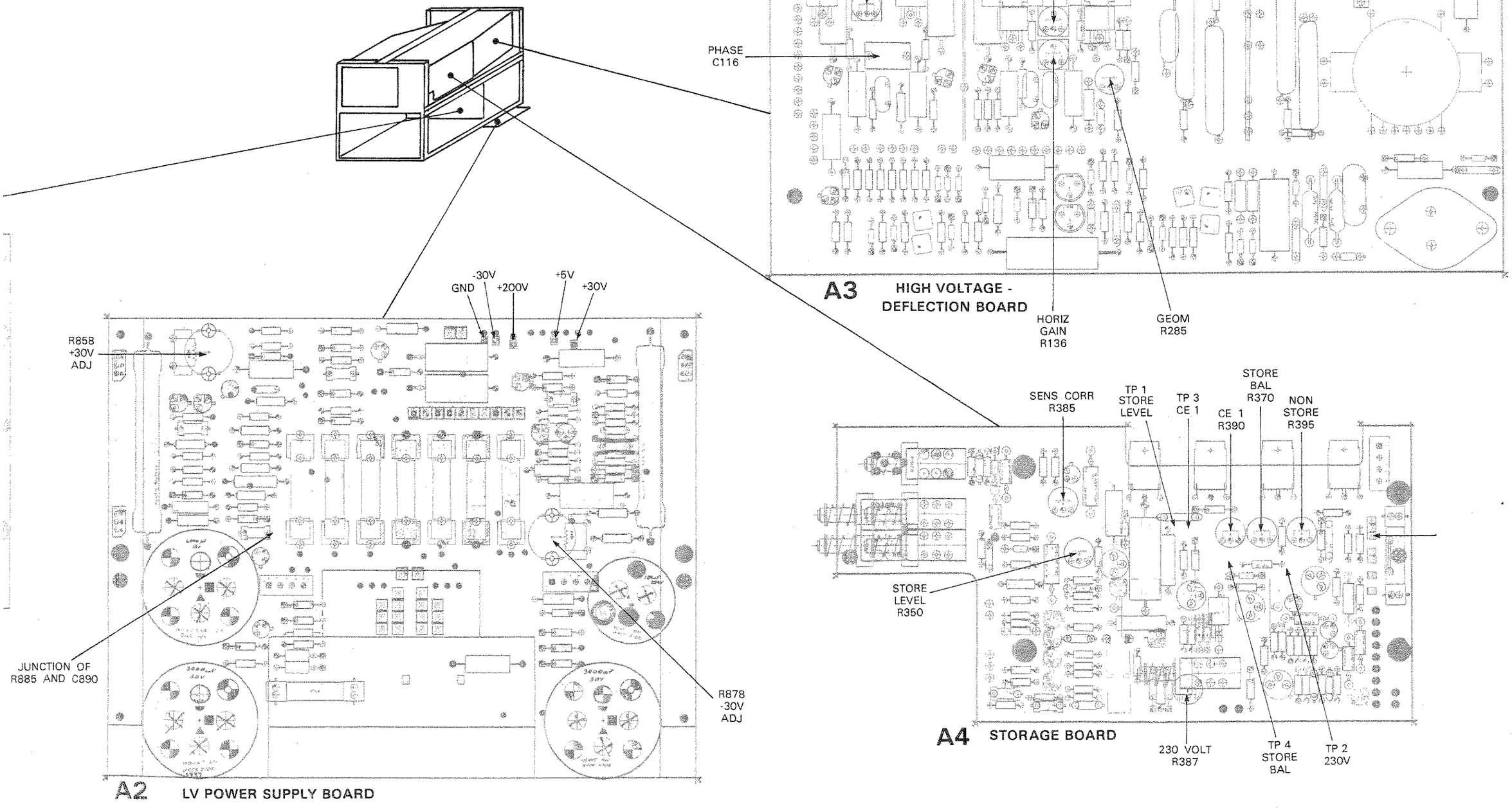


Figure 8-2. Test Point and Adjustment Locations.

3934-800

INTERFACE DIAGRAM ⟨1⟩

ASSEMBLY A1

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C400	B4	C1
C402	B4	C2
C411	B2	C3
C510	C2	D3
C520	B3	D4
C620	C3	D4
C721	G3	F3
C740	F4	F5
C801	E1	F2
C810	E1	F2
C814	E1	G2
C900	C1	G1
C902	D2	G2
C921	F3	G3
CR400	B4	C1
CR420	B3	C3
CR421	B3	C3
CR423	C3	D3
CR432	B2	C4
CR433	B2	D4
CR501	C4	D1
CR520	C3	D3
CR800	E1	F2
CR820	G2	F3
CR830	G3	F4
J300	A1	B5
J600	C1	E5
J1000	F1	H5
P500	C4	D1
P740	F4	F5
P800	G1	F1
Q400	B4	C1
Q401	B4	C2
Q413	B2	D3
Q420	B3	C3
Q421	B3	C4
Q430	B3	C4
Q431	B3	C4
Q510	B2	D3
Q520	C3	D3
Q521	C3	D4
Q600	C4	E1
Q601	C4	D2
Q630	C3	E4
Q631	C3	E4
Q700	E1	F2
Q701	F1	F2
Q710	E1	F2
Q820	G3	G3
Q821	G3	G3
Q910	E2	G2
Q930	G3	G4
Q931	G3	G4
R200	B4	B1
R220	A3	B3
R221	A3	B3
R400	B4	C1
R401	B4	C1
R402	B4	C2
R403	B4	C2
R404	B4	C2
R405	B4	D2
R406	B4	D2
R410	B2	C3
R411	B2	C3
R412	B2	C3
R413	B2	C3
R414	B2	C3
R420	B3	C3
R421	B3	C3
R422	B1	C3
R430	B3	C4
R431	B3	C4
R432	B3	C4
R433	B1	C4
R500	C4	D1
R501	A4	D1
R502	B4	D2
R503	B4	D2
R504	C4	D2
R510	C2	D3
R511	C2	D3
R512	C2	D3
R514	B2	E3
R521	C3	D3
R522	C3	D3
R530	A3	D3
R531	C3	E3
R532	C3	D4
R533	C3	D4
R534	C3	D4
R629	C3	E3
R639	C3	E4
R700	D1	E2
R701	E1	F2
R701	F1	F2
R710	B1	E2
R711	F1	F2
R720	F1	F3
R721	G3	F3
R722	G3	F3
R730	G3	F4
R800	D1	F2
R801	E1	F2
R810	E1	F2
R812	E1	F2
R813	E2	G2
R820	G2	F3
R821	G3	F3
R830	G3	F4
R831	G3	F4
R832	G3	G4
R900	E1	G2
R902	D1	G1
R903	D1	G2
R904	D1	G2
R910	E2	G2
R911	E3	G2
R920	G3	G3
R921	G3	G3
R922	F3	G3
R930	G3	G4
R931	E3	G4
R932	F3	G4
U800	D1	F1
VR530	B1	D4
W513	A2	D3
W514	A3	D3

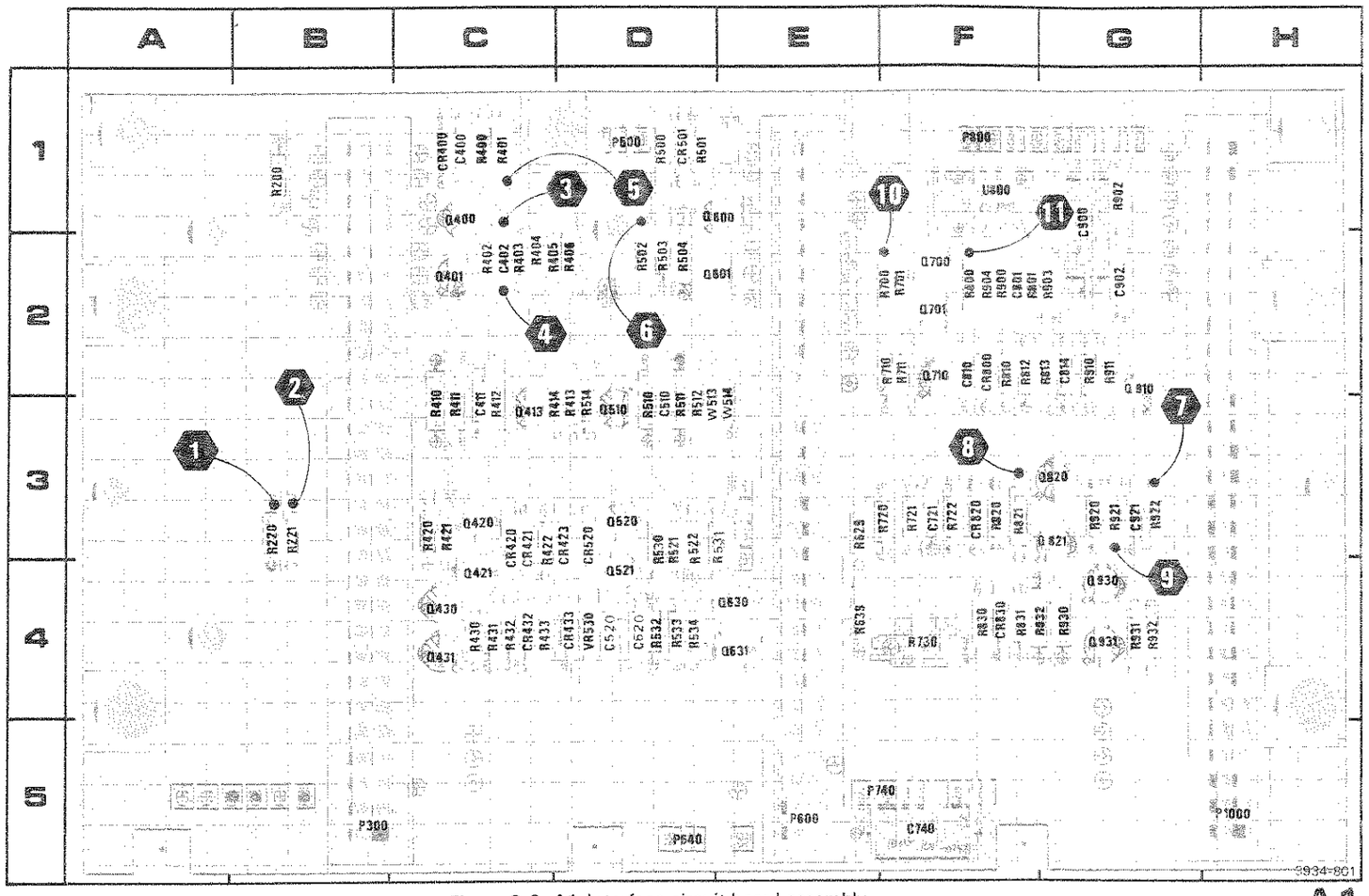
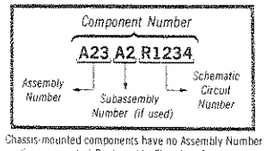


Figure 8-3. A1-Interface circuit board assembly.

A1

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



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

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

Dangerous potentials exist at several points throughout this instrument. When the instrument is operated with the covers removed, do not touch exposed connections or components. Some transistors have voltages present on their cases. Disconnect the power source before replacing parts.

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Test oscilloscope system	Deflection factor, 1 mV to 50 V/div; input impedance, 1 megohm; frequency response, dc to 2 MHz. Probe: 10X attenuation probe compatible with vertical input. Rigid Plug-in extender.	Tektronix 5110, 5A13N, 5B10N Oscilloscope system or equiv. Use a Tektronix P6060 or P6062B Probe.
Voltmeter (non-loading digital multimeter)	Range, 0 to 250 V input, input impedance, 10 megohms.	Tektronix DM 501 Digital Multimeter with power module.

VOLTAGE CONDITIONS

Voltage measurements on this diagram were made under the following conditions:

Amplifier units are installed in both vertical compartments, left vertical plug-in is switched on, right vertical plug-in is switched off and a time-base unit is installed in the horizontal compartment. INTENSITY control is set to fully ccw. Voltmeter common is connected to chassis ground.

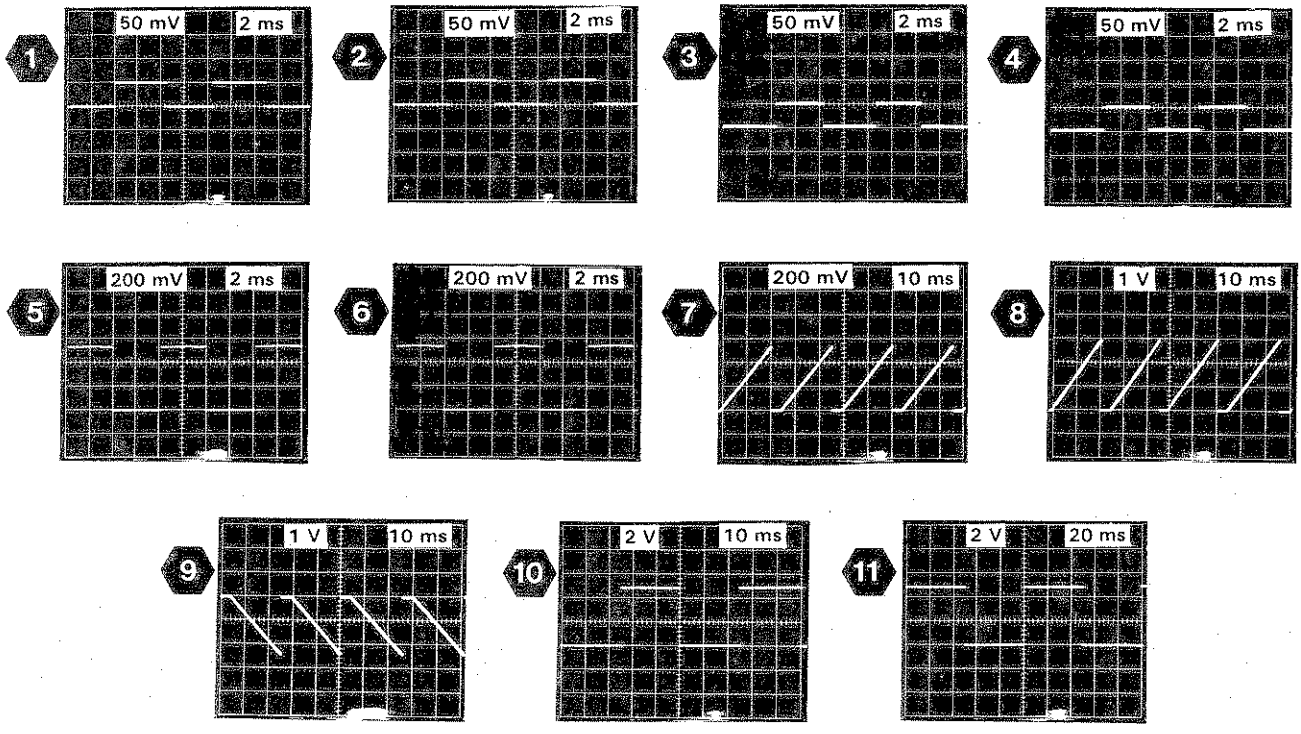
WAVEFORM CONDITIONS

OSCILLOSCOPE UNDER TEST. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal auto-trigger, 2 ms/division sweep rate.

TEST OSCILLOSCOPE. Set the test oscilloscope triggering for auto mode with ac coupling from the internal source and set vertical input coupling to ac. Connect a 10X Probe to the vertical input. Position the display as necessary.

NOTE

The waveforms shown are actual waveform photographs taken with a Tektronix Oscilloscope Camera System and Projected Graticule. Vertical deflection factor shown on the waveform is the actual deflection factor from the probe tip. Voltages and waveforms on the diagrams are not absolute and may vary between instruments because of component tolerances, internal calibration, or front-panel settings. Readouts are simulated in larger-than-normal type.



A B C D E F G

1 2 3 4

VOLTAGE & WAVEFORM CONDITIONS

(LEFT VERT) J300 A B

(RIGHT VERT) J600 A B

(HORIZ) J1000 A B

U800 74LS113

U800B 74LS113

U800A 74LS113

Q710 Q700 Q701

Q910

Q413 Q510

Q430 Q431 Q420 Q421

Q520 Q521 Q630 Q631

Q401 Q400 Q601 Q600

Q821 Q820 Q931 Q930

VR530 10V

CR432 CR433 CR420 CR421 CR423 CR520 CR800 CR820 CR830 CR400 CR501

P800 TO CRT CKT 3

CHOP BLANKING

SWP UNBLANKING

TRACE INTENSIFY

A GATE

SWP LOCKOUT

S.S. RESET

+ HORIZ SIG

- HORIZ SIG

BLANKING DISABLE

CH SW SIG

CHOP ACTIVATE

LEFT DISPLAY DISABLE

CHOP SENSE

RIGHT PLUG-IN ON

MULTI TRACE

DISPLAY ON

LEFT + SIGNAL

LEFT - SIGNAL

TRACE SEP

A SWP

ALT DRIVE

A GATE

RIGHT TRIG

LEFT TRIG

COMP TRIG

LINE TRIG

HORIZ CTRG

+ SIG

- SIG

+5V

-30V

+200V UNREG

+38V UNREG

+30V

-38V UNREG

+4.9

-10.4

+0.1

+0.5

+0.6

OPTION 7

OPT 7

VERT SIG TO 2

FROM LV PWR SPLY 4

P740 P640

A1 INTERFACE BOARD

COMPONENT NUMBER EXAMPLE

Component Number A23 A2 R1234

Assembly Number — Subassembly Number (if used) — Schematic Circuit Number

Static Sensitive Devices See Maintenance Section

SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

5111A

3934-850

INTERFACE 1

VERTICAL & HORIZONTAL DEFLECTION AMPLIFIERS DIAGRAM 2

ASSEMBLY A3

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C106	D2	B3	Q136	D5	D3	R118	E2	C3
C116	D2	B2				R122	C4	D2
C126	D4	D3	R101	C3	D3	R123	B4	C3
C136	D5	D3	R102	C1	B2	R124	D4	D2
			R103	B2	B3	R125	E3	B4
Q104	D1	A2	R104	D1	B2	R126	D4	D3
Q106	D1	B3	R106	D2	B3	R128	E4	D3
Q114	D3	C2	R108	E2	B3	R132	C5	E2
Q116	D2	C3	R112	C3	C2	R133	B5	D3
Q124	D4	D2	R113	B2	C3	R134	D5	E2
Q126	D4	D3	R114	D3	C2	R136	D5	D2
Q134	D5	E2	R116	D2	B2	R138	E5	E3

Partial A3 also shown on diagram 3.

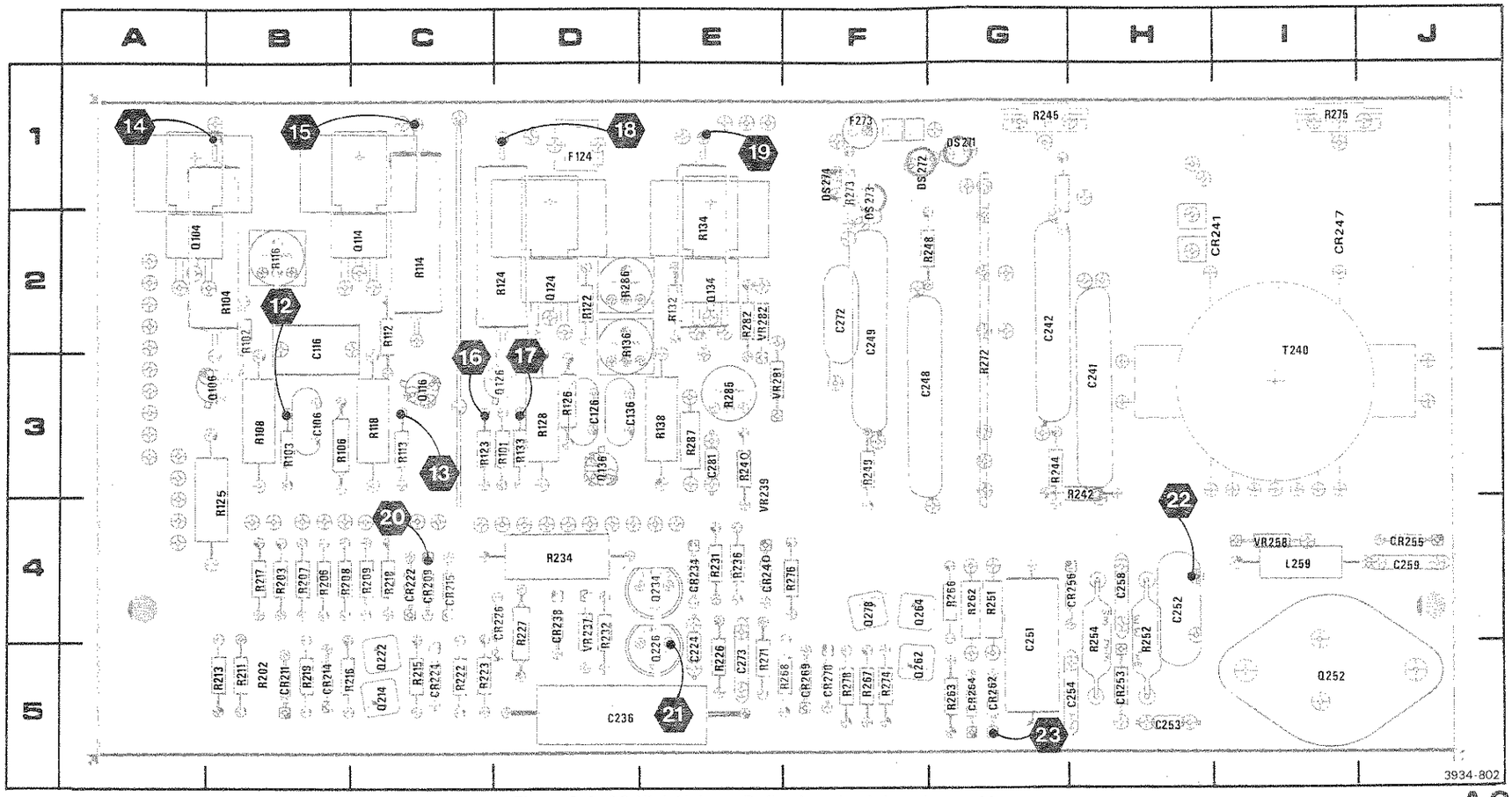


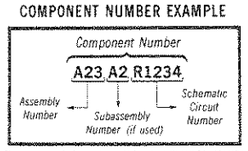
Figure 8-4. A3-High Voltage-Deflection circuit board assembly.

A3

A3—High Voltage Deflection Circuit Board Illustration and Locator

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



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

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

Dangerous potentials exist at several points throughout this instrument. When the instrument is operated with the covers removed, do not touch exposed connections or components. Some transistors have voltages present on their cases. Disconnect the power source before replacing parts.

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Test oscilloscope system	Deflection factor, 1 mV to 50 V/div; input impedance, 1 megohm; frequency response, dc to 2 MHz. Probe: 10X attenuation probe compatible with vertical input.	Tektronix 5110, 5A13N, 5B10N Oscilloscope system or equiv. Use a Tektronix P6060 or P6062B Probe.
Voltmeter (non-loading digital multimeter)	Range, 0 to 250 V input, input impedance, 10 megohms.	Tektronix DM 501 Digital Multimeter with power module.

VOLTAGE CONDITIONS

Voltage measurements on this diagram were made under the following conditions:

Amplifier units are installed in both vertical compartments, left vertical plug-in is switched on, right vertical plug-in is switched off and a time-base unit is installed in the horizontal compartment. INTENSITY control is set to fully ccw. Voltmeter common is connected to chassis ground.

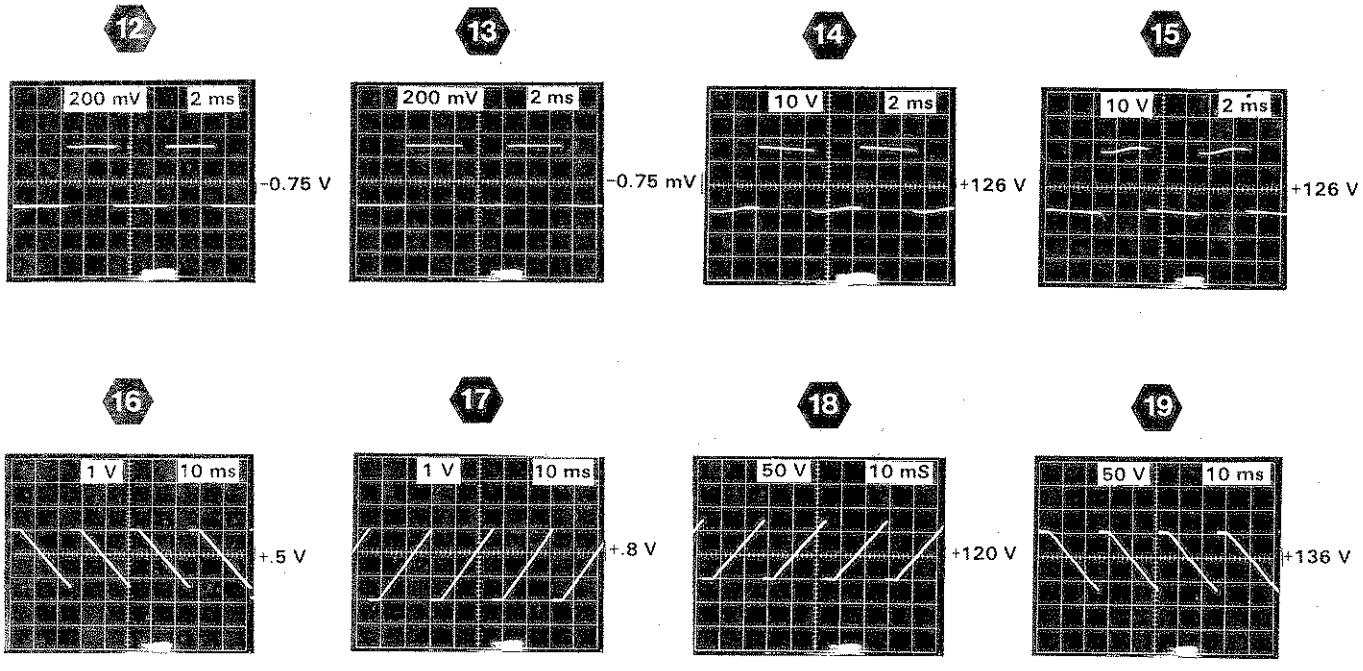
WAVEFORM CONDITIONS

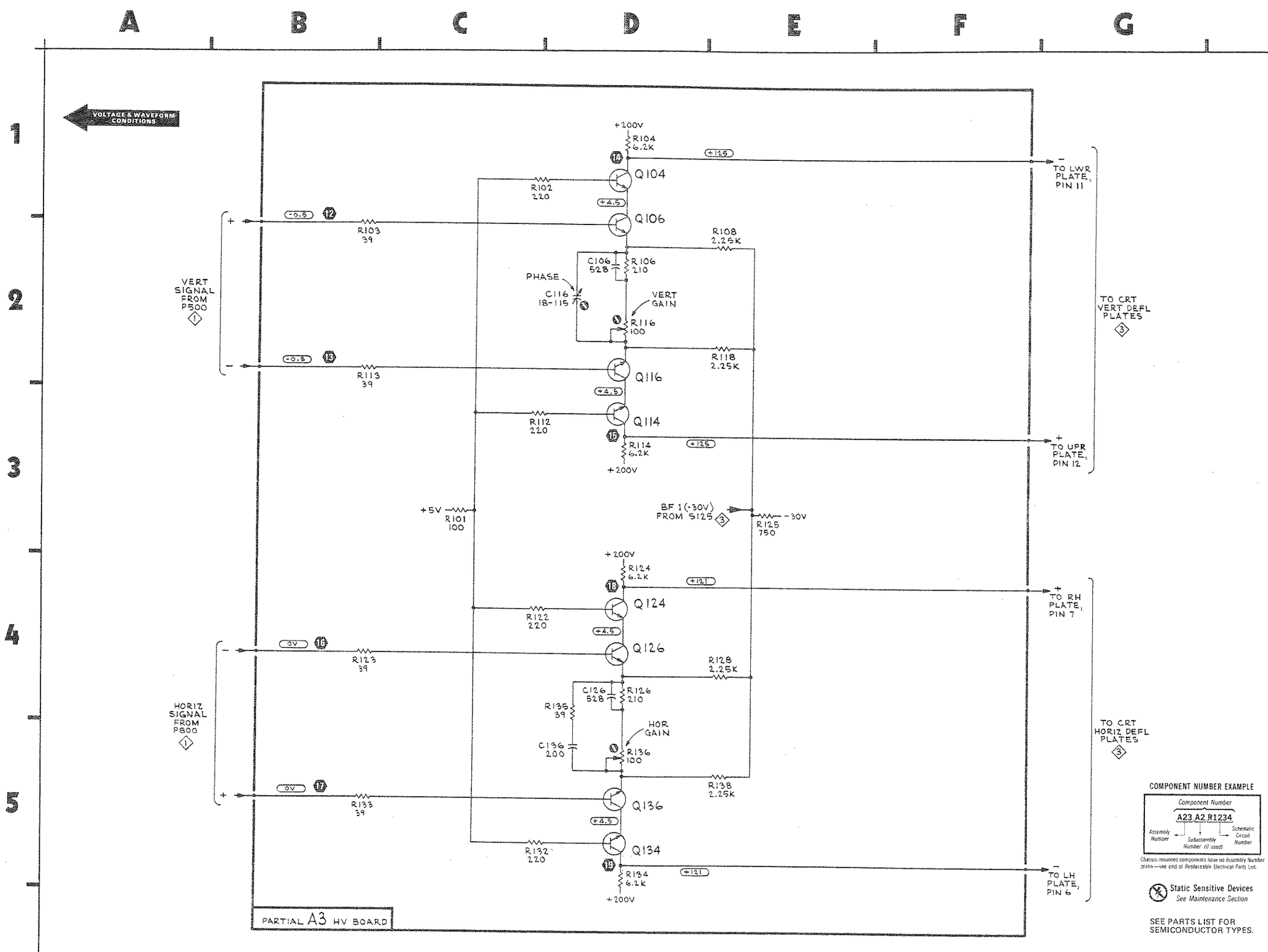
OSCILLOSCOPE UNDER TEST. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal auto-trigger, 2 ms/division sweep rate.

TEST OSCILLOSCOPE. Set the test oscilloscope triggering for auto mode with ac coupling from the internal source and set vertical input coupling to ac. Connect a 10X Probe to the vertical input. Position the display as necessary.

NOTE

The waveforms shown are actual waveform photographs taken with a Tektronix Oscilloscope Camera System and Projected Graticule. Vertical deflection factor shown on the waveform is the actual deflection factor from the probe tip. Voltages and waveforms on the diagrams are not absolute and may vary between instruments because of component tolerances, internal calibration, or front-panel settings. Readouts are simulated in larger-than-normal type.





5111A

VERTICAL & HORIZONTAL DEFLECTION AMPLIFIERS ②

3934-851

CRT CIRCUIT DIAGRAM ③

ASSEMBLY A3

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C224	D2	E5	F273	B5	F1	R245	D3	G1
C236	D1	D5	F273	B6	F1	R248	E4	F2
C241	D3	H3				R249	E4	F3
C242	E3	G2	L259	C4	I4	R251	D3	G4
C248	D4	F3				R252	C4	H5
C249	E4	F2	Q214	C2	C5	R254	C4	H5
C251	D4	G4	Q222	D2	C5	R262	D4	G4
C252	C4	H4	Q226	D2	E5	R263	D5	G5
C253	C4	H5	Q234	D1	E4	R266	D5	G4
C254	C4	H5	Q252	C4	I5	R267	D5	F5
C258	C4	H4	Q262	C5	F5	R268	E5	F5
C259	D4	J4	Q264	D5	F4	R271	E5	E5
C272	E4	F2	Q278	D5	F4	R272A	E3	G3
C273	E5	E5				R272B	E5	G3
C281	E3	E3	R202	B2	B5	R272C	E5	G3
			R203	B1	B4	R272D	E5	G3
CR209	C2	C4	R206	B1	B4	R272E	E5	G3
CR211	C2	B5	R207	B1	B4	R273	E3	F1
CR214	C2	B5	R208	B2	B4	R273	E5	F1
CR215	C2	C4	R209	D3	C4	R274	E5	F5
CR222	C2	C4	R211	B2	B5	R275	F5	I1
CR224	D2	C5	R213	B2	B5	R276	F5	F4
CR226	E2	D4	R215	C3	C5	R278	D4	F5
CR234	E1	E4	R216	C2	B5	R282	F2	E2
CR238	E1	D4	R217	C2	B4	R285	E2	E3
CR240	E2	E4	R218	C2	C4	R286	F3	D2
CR253	C4	H5	R219	C2	B5	R287	E3	E3
CR255	D4	J4	R222	D2	C5			
CR256	C4	H4	R223	D2	C5	T240	D3	I2
CR262	C5	G5	R226	E2	E5			
CR264	D5	G5	R227	D2	D4	VR237	E1	D4
CR269	E5	F5	R231	D1	E4	VR239	E2	E3
CR270	E5	F5	R232	D1	D4	VR258	C4	I4
			R234	D1	D4	VR281	E2	E3
DS271	F4	G1	R236	D1	E4	VR282	E3	E2
DS272	F4	F1	R240	E1	E3			
DS273	F4	F1	R242	E3	H3			
DS274	F5	F1	R244	E3	G3			

Partial A3 also shown on diagram 2.

ASSEMBLY A4

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	
R301	A3	F4	SW372	E1	B2	

Partial A4 also shown on diagram 5.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
J210	A2	CHASSIS	P205	A2	CHASSIS	R291	F1	CHASSIS
			P260	A1	CHASSIS	R295	F5	CHASSIS
L291	G1	CHASSIS						
			R200A	A2	CHASSIS	V291	G1	CHASSIS

For circuit board illustrations see Figure 8-4 on reverse side of Diagram ① Interface and Figure 8-6 on reverse side of Diagram ④ LV Power Supply & Calibration.

A3 — High Voltage Deflection Circuit Board Locator

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

Dangerous potentials exist at several points throughout this instrument. When the instrument is operated with the covers removed, do not touch exposed connections or components. Some transistors have voltages present on their cases. Disconnect the power source before replacing parts.

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Test oscilloscope system	Deflection factor, 1 mV to 50 V/div; input impedance, 1 megohm; frequency response, dc to 2 MHz. Probe: 10X attenuation probe compatible with vertical input.	Tektronix 5110, 5A13N, 5B10N Oscilloscope system or equiv. Use a Tektronix P6060 or P6062B Probe.
Voltmeter (non-loading digital multimeter)	Range, 0 to 250 V input, input impedance, 10 megohms.	Tektronix DM 501 Digital Multimeter with power module.

VOLTAGE CONDITIONS

Voltage measurements on this diagram were made under the following conditions:

Amplifier units are installed in both vertical compartments, left vertical plug-in is switched on, right vertical plug-in is switched off and a time-base unit is installed in the horizontal compartment. INTENSITY control is set to fully ccw. Voltmeter common is connected to chassis ground.

WAVEFORM CONDITIONS

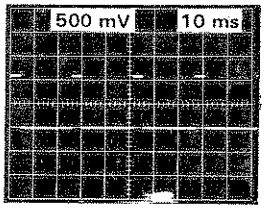
OSCILLOSCOPE UNDER TEST. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal auto-trigger, 2 ms/division sweep rate.

TEST OSCILLOSCOPE. Set the test oscilloscope triggering for auto mode with ac coupling from the internal source and set vertical input coupling to ac. Connect a 10X Probe to the vertical input. Position the display as necessary.

NOTE

The waveforms shown are actual waveform photographs taken with a Tektronix Oscilloscope Camera System and Projected Graticule. Vertical deflection factor shown on the waveform is the actual deflection factor from the probe tip. Voltages and waveforms on the diagrams are not absolute and may vary between instruments because of component tolerances, internal calibration, or front-panel settings. Readouts are simulated in larger-than-normal type.

20



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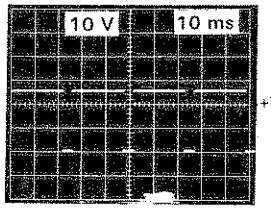

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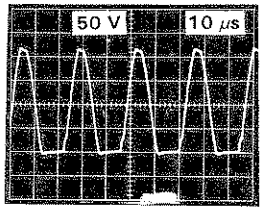

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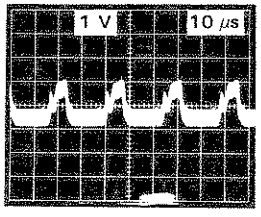
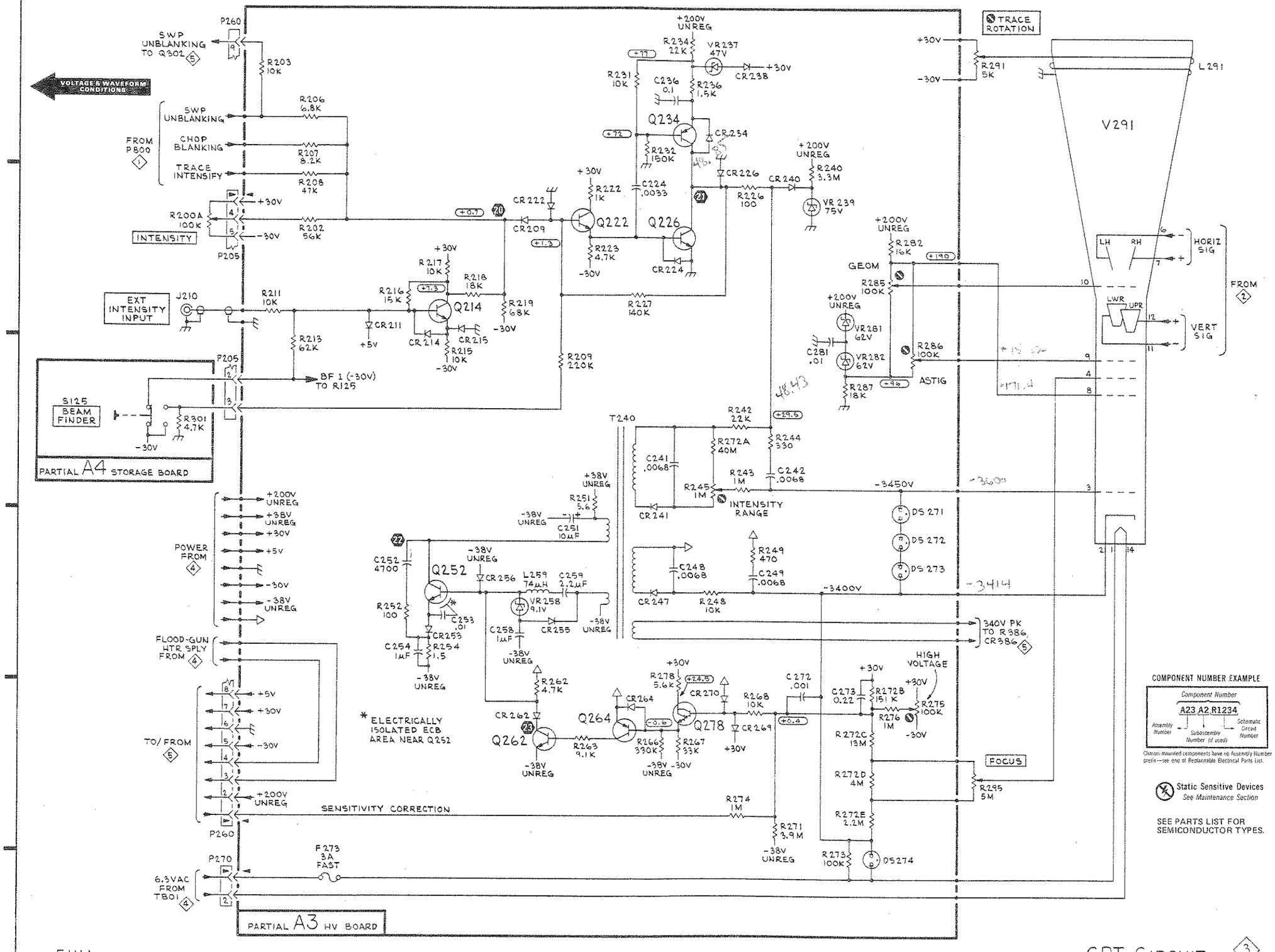




5111A

3934-852

CRT CIRCUIT ③

LV POWER SUPPLY & CALIBRATOR DIAGRAM 4

ASSEMBLY A2

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C810	D2	H4
C815	C2	B4
C820	G3	B4
C822	E2	B3
C830	E1	G3
C837	E3	B6
C839	E3	G6
C842	G4	E2
C852	F4	D2
C857	F4	C2
C860	G5	E2
C865	E5	G2
C870	E4	G3
C872	E5	G3
C875	F5	G3
C881	C4	C5
C883	C4	C6
C890	C4	C4
CR810	C2	G5
CR811	C2	G5
CR812	C2	G5
CR813	C2	G5
CR815	C2	C4
CR820	G3	B3
CR824	E3	C3
CR835	C3	C5
CR836	C3	C5
CR837	D3	G4
CR841	G3	C2
CR842	G4	E2
CR850	E4	D2
CR851	F4	D2
CR860	G5	G2
CR865	E5	G2
CR870	E4	G3
CR875	E5	G3
CR885	C4	C5
CR890	D4	C4
F809	B2	E4
F810	G2	E4
F815	B2	C4
F834	B3	D4
F835	G3	E4
F836	B3	D4
F850	C2	F4
P850	G1	E2
P890	D4	E1
Q815	F2	A4
Q820	E3	B2
Q825	F2	B2
Q840	F3	A2
Q845	F4	B2
Q850	E4	D2
Q860	F6	H2
Q865	F6	F2
Q870	E5	G3
Q875	E5	F3
Q885	C4	C5
Q890	C4	C4
R810	D2	G5
R812	D2	F5
R815	F2	C3
R816	F3	B3
R818	F3	C3
R820	E2	B2
R822	E2	B3
R824	E3	C3
R826	F2	B3
R827	F2	B3
R830	D1	G3
R832	E1	G3
R834	E1	G3
R841	F3	A2
R842	G4	C2
R846	F4	C1
R847	F4	C1
R850	E3	D1
R851	E3	E1
R852	F4	D2
R853	F4	D2
R856	F4	C2
R857	G4	C2
R858	G4	B2
R859	G4	C3
R860	F6	G2
R861	F5	H2
R863	F5	G2
R865	E5	G2
R867	E6	G2
R868	F5	G2
R869	F5	G2
R870	E4	G3
R872	E5	G3
R873	E5	G3
R875	F5	G2
R877	F5	G4
R878	F5	F4
R879	F4	G4
R880	B4	C5
R881	B4	C5
R883	C4	C5
R885	C4	C4
R890	C4	C3
R891	D4	C3
VR850	F3	D1
VR865	F5	G2
VR870	E4	G3

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C891	D4	CHASSIS
F201	A4	CHASSIS
FL201	A5	CHASSIS
J201	A5	CHASSIS
S200	A4	CHASSIS
S201	A4	CHASSIS
T801	B1	CHASSIS

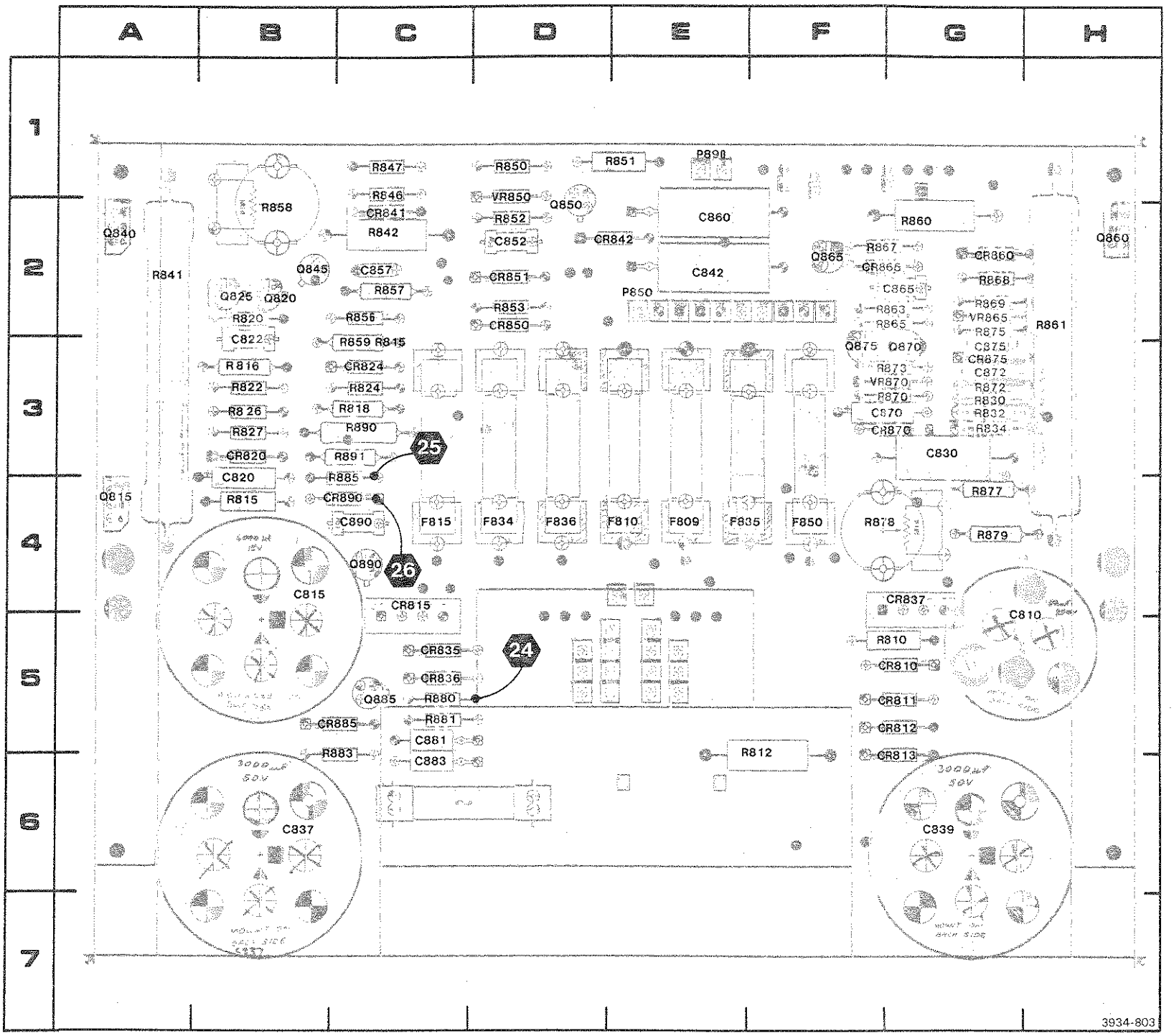
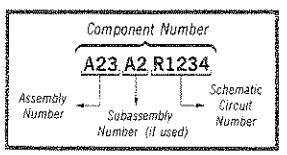


Figure 8-5. A2-LV Power Supply circuit board assembly.

A2

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



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

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

Dangerous potentials exist at several points throughout this instrument. When the instrument is operated with the covers removed, do not touch exposed connections or components. Some transistors have voltages present on their cases. Disconnect the power source before replacing parts.

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Test oscilloscope system	Deflection factor, 1 mV to 50 V/div; input impedance, 1 megohm; frequency response, dc to 2 MHz. Probe: 10X attenuation probe compatible with vertical input.	Tektronix 5110, 5A13N, 5B10N Oscilloscope system or equiv. Use a Tektronix P6060 or P6062B Probe.
Voltmeter (non-loading digital multimeter)	Range, 0 to 250 V input, input impedance, 10 megohms.	Tektronix DM 501 Digital Multimeter with power module.

VOLTAGE CONDITIONS

Voltage measurements on this diagram were made under the following conditions:

Amplifier units are installed in both vertical compartments, left vertical plug-in is switched on, right vertical plug-in is switched off and a time-base unit is installed in the horizontal compartment. INTENSITY control is set to fully ccw. Voltmeter common is connected to chassis ground.

WAVEFORM CONDITIONS

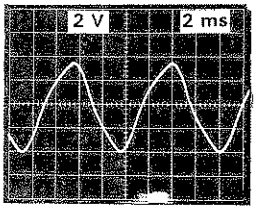
OSCILLOSCOPE UNDER TEST. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal auto-trigger, 2 ms/division sweep rate.

TEST OSCILLOSCOPE. Set the test oscilloscope triggering for auto mode with ac coupling from the internal source and set vertical input coupling to ac. Connect a 10X Probe to the vertical input. Position the display as necessary.

NOTE

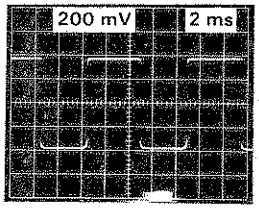
The waveforms shown are actual waveform photographs taken with a Tektronix Oscilloscope Camera System and Projected Graticule. Vertical deflection factor shown on the waveform is the actual deflection factor from the probe tip. Voltages and waveforms on the diagrams are not absolute and may vary between instruments because of component tolerances, internal calibration, or front-panel settings. Readouts are simulated in larger-than-normal type.

24



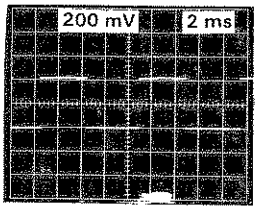
+20.5 V

25

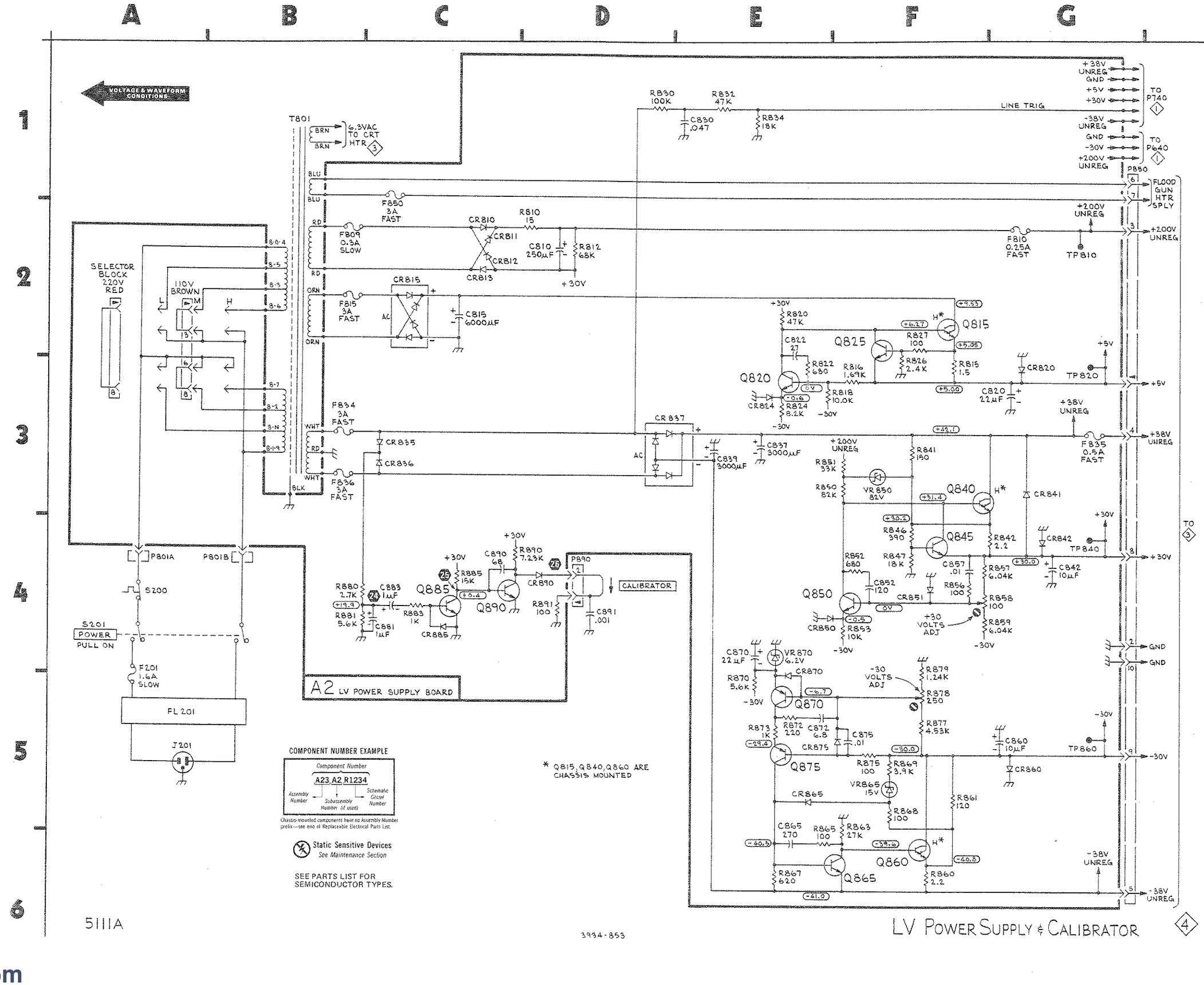


+0.43 V

26



+0.20 V


VOLTAGE & WAVEFORM CONDITIONS
T801
6.3VAC TO CRT HTR
SELECTOR BLOCK 220V RED
110V BROWN
P801A
P801B
S200
S201 POWER PULL ON
F201 1.6A SLOW
FL 201
J201
F850 3A FAST
F809 0.3A SLOW
F815 3A FAST
F834 3A FAST
F836 3A FAST
CR810
CR811
CR812
CR813
R810 15
C810 250µF
R812 68K
CR815
C815 6000µF
CR835
CR836
R830 100K
R832 47K
C830 .047
R834 18K
LINE TRIG
+38V UNREG
GND
+5V
+30V
-38V UNREG
-30V
+200V UNREG
TO P740
TO P640
P850
FLOOD GUN HTR SPLY
F810 0.25A FAST
TP810
R820 47K
Q815
Q825
C822 27
R822 680
R827 100
R826 2.4K
R816 1.69K
R815 1.5
Q820
R824 8.2K
R818 10.0K
CR824
CR820
TP820
C820 22µF
CR837
C837 3000µF
C839 3000µF
R841 150
R851 33K
R850 82K
VR850 82V
Q840
CR841
R846 390
Q845
R842 2.2
CR842
TP840
C842 10µF
R852 680
C852 120
Q850
CR850
R853 10K
CR851
C857 .01
R856 100
R857 6.04K
R858 100
R859 6.04K
+30 VOLTS ADJ
C870 22µF
VR870 6.2V
CR870
R870 5.6K
Q870
-30 VOLTS ADJ
R879 1.24K
R878 250
R873 1K
R872 220
C872 6.8
C875 .01
CR875
Q875
R875 100
R869 3.9K
C860 10µF
CR860
TP860
VR865 15V
CR865
R868 100
R861 120
C865 270
R865 100
R863 2.7K
Q865
Q860
R867 620
R860 2.2
GND
GND
-30V
-38V UNREG
TO 3
TO 4
R880 2.7K
C883 1µF
R881 5.6K
C881 1µF
R883 1K
Q885
R885 15K
C890 68
R890 7.23K
Q890
CR890
CR885
R891 100
C891 .001
P890
CALIBRATOR
A2 LV POWER SUPPLY BOARD
COMPONENT NUMBER EXAMPLE
Component Number
A23 A2 R1234
Assembly Number
Subassembly Number (if used)
Schematic Circuit Number
Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.
Static Sensitive Devices
See Maintenance Section
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
* Q815, Q840, Q860 ARE CHASSIS MOUNTED
5111A
3934-853
LV POWER SUPPLY & CALIBRATOR
4

STORAGE CIRCUIT DIAGRAM 5

ASSEMBLY A4

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C303	D5	G4
C307	E5	D5
C311	E5	C4
C321	E5	D5
C325	E4	C3
C326	D5	G4
C327	D4	G3
C330	B3	C2
C331	B3	C1
C337	B3	C1
C342	C3	D3
C385	F1	D2
C387	A1	E4
C389	B2	D4
C391	E2	E2
C394	E3	G2
C397	D1	E3
C398	A2	H4
C399	A2	G4
CR320	E5	D5
CR322	D4	G4
CR329	D5	H1
CR332	B3	C1
CR343	C3	C2
CR351	D3	D3
CR358	D2	E2
CR386	A1	F4
CR387	D2	F3
CR388	C2	F3
CR389	C2	F4
CR390	C2	F4
CR392	E2	F2
P200	C4	C4
P389	F1	H2
Q302	D5	H4
Q304	E5	G4
Q308	E5	G3
Q310	F4	D4
Q320	E4	D4
Q322	D4	G4
Q328	C4	G3
Q334	B3	D3
Q336	C3	D4
Q356	D3	E3
Q358	D3	D3
Q362	D2	E2
Q372	E1	G2
Q384	F1	D2
Q386	A1	E4
Q388	A1	E4
Q388	A2	E4
Q392	E2	F2
Q396	F3	G2
Q397	C2	F3
Q398	C2	E3
Q399	C2	G4
R302	D5	G4
R303	D5	G4
R304	D5	G4
R305	D5	G4
R307	E5	D4
R308	E5	G3
R310	F5	D4
R311	E5	C4
R312	E4	C4
R313	F4	C2
R314	D4	G4
R316	C4	G4
R317	C4	G4
R318	C3	D4
R321	E5	D4
R322	E4	C4
R324	E3	C2
R325	E4	B1
R326	D4	G4
R327	D4	G4
R328	C4	G4
R329	E6	H2
R330	B3	C1
R331	B3	C4
R332	B3	C3
R334	B3	C3
R336	C2	D3
R337	C2	D3
R339	B3	C1
R341	C3	D3
R342	C3	C3
R343	C3	C3
R346	C3	C2
R347	C3	C3
R360	D3	D3
R361	D3	D3
R362	D2	D3
R364	D3	D4
R365	D3	E3
R365	D2	D2
R370	D1	F2
R371	E1	G2
R381	F1	D1
R382	F2	D1
R383	D2	E3
R384	F1	H3
R385	F1	D2
R386	B1	D4
R387	B1	E4
R388	B1	E4
R389	B2	E3
R390	D2	F2
R392	E3	G3
R393	C2	E4
R394	C2	E4
R395	F3	G2
R396	E3	G2
R397	F3	G2
R398	C1	F3
S330	A3	B1
S372A	E1	B2
S372B	E2	B2
S375A	D3	B2
S375B	E1	B2
S375C	E2	B2
S375D	D3	B2
SW330	A3	B1
VR387	B1	E4
VR388	B1	E4
VR396	E3	G2
VR397	C2	F3
W329	C5	H3
W330	B3	C1
W372	E1	F3

Partial A4 also shown on diagram 3.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R200B	C5	CHASSIS
V291	G2	CHASSIS

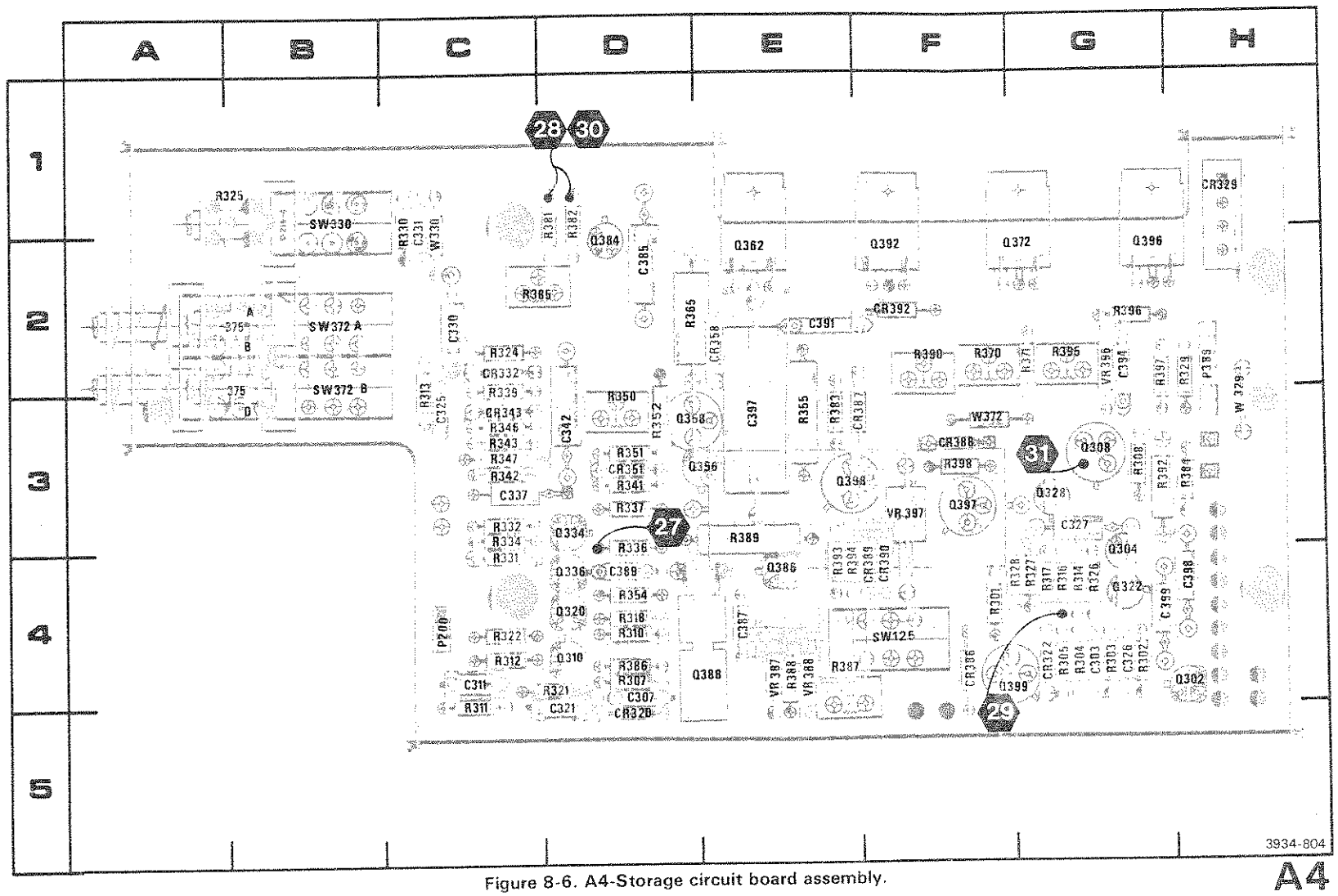
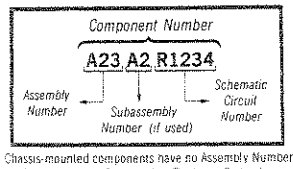


Figure 8-6. A4-Storage circuit board assembly.

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



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

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

Dangerous potentials exist at several points throughout this instrument. When the instrument is operated with the covers removed, do not touch exposed connections or components. Some transistors have voltages present on their cases. Disconnect the power source before replacing parts.

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Test oscilloscope system	Deflection factor, 1 mV to 50 mV/div; input impedance, 1 megohm; frequency response, dc to 2 MHz. Probe: 10X attenuation probe compatible with vertical input.	Tektronix 5110, 5A13N, 5B10N Oscilloscope system or equiv. Use a Tektronix P6060 or P6062B Probe.
Voltmeter (non-loading digital multimeter)	Range, 0 to 250 V input, input impedance, 10 megohms.	Tektronix DM 501 Digital Multimeter with power module.

VOLTAGE CONDITIONS

Voltage measurements on this diagram were made under the following conditions:

Amplifier units are installed in both vertical compartments, left vertical plug-in is switched on, right vertical plug-in is switched off and a time-base unit is installed in the horizontal compartment. INTENSITY control is set to fully ccw. Voltmeter common is connected to chassis ground. STORE and ERASE/ENHANCE select buttons are set to on. BRIGHTNESS (Y-T) control is set to MAX.

WAVEFORM CONDITIONS

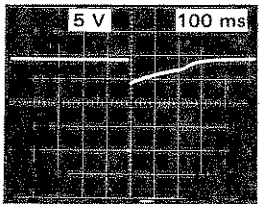
OSCILLOSCOPE UNDER TEST. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal auto-trigger, 2 ms/division sweep rate. INTENSITY control is set fully ccw. STORE and ERASE/ENHANCE select buttons are set to on. BRIGHTNESS (Y-T) control is set to MIN ENHANCE control is set fully ccw.

TEST OSCILLOSCOPE. Set the test oscilloscope triggering for auto mode with ac coupling from the internal source and set vertical input coupling to ac. Connect a 10X Probe to the vertical input. Position the display as necessary.

NOTE

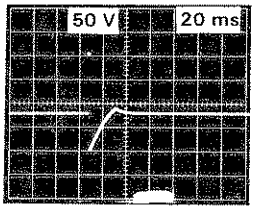
The waveforms shown are actual waveform photographs taken with a Tektronix Oscilloscope Camera System and Projected Graticule. Vertical deflection factor shown on the waveform is the actual deflection factor from the probe tip. Voltages and waveforms on the diagrams are not absolute and may vary between instruments because of component tolerances, internal calibration, or front-panel settings. Readouts are simulated in larger-than-normal type.

27



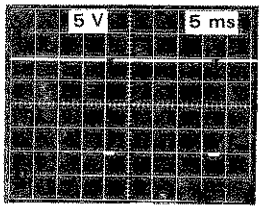
+10.3 V Press Erase Button

28



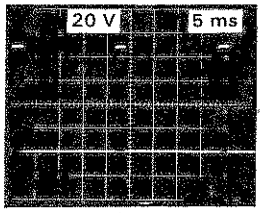
+148 V Press Erase Button

29



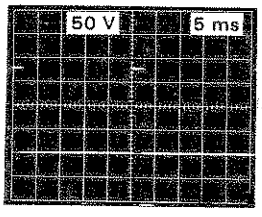
−9.3 V

30

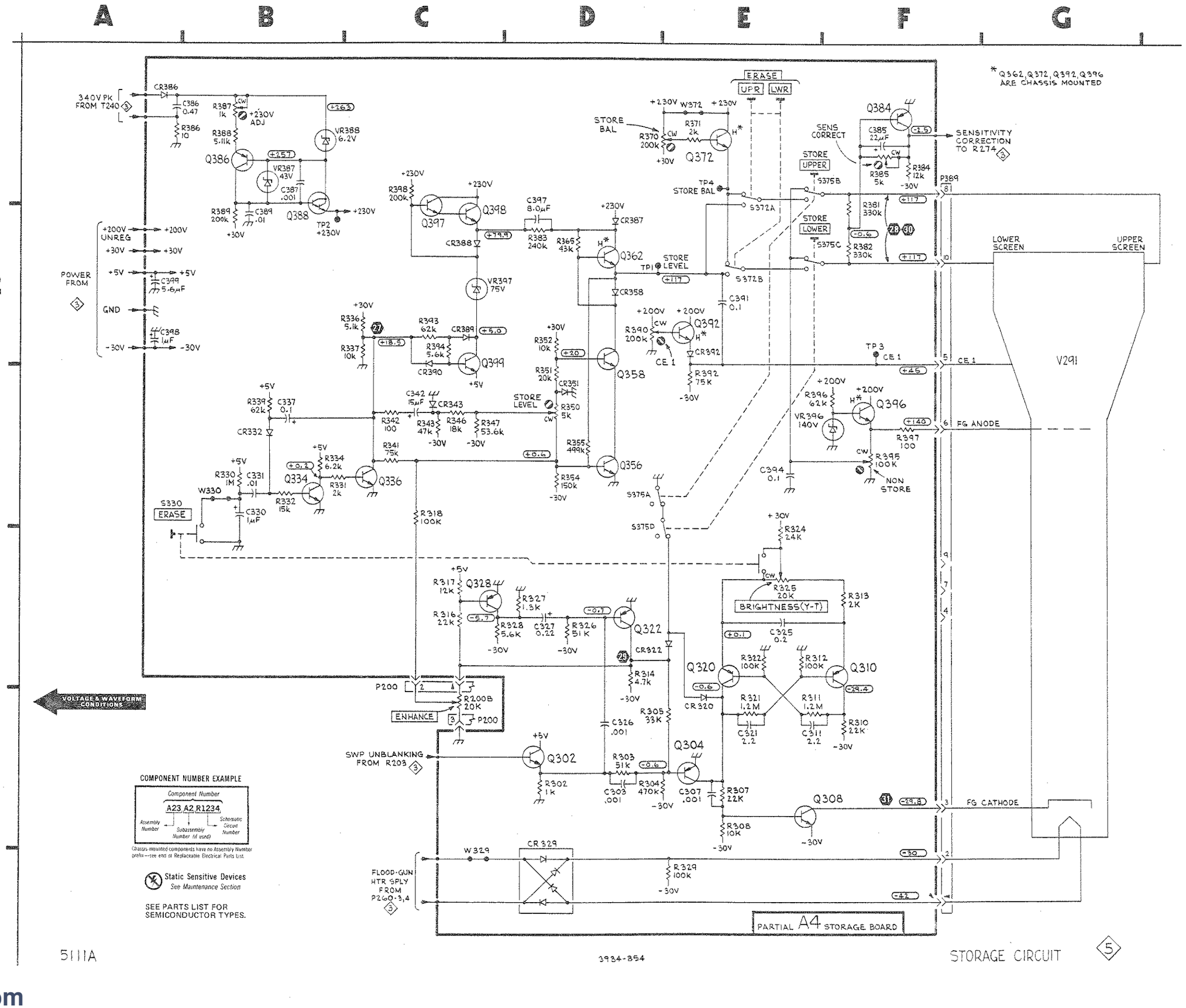


+133 V ENHANCE control fully clockwise

31



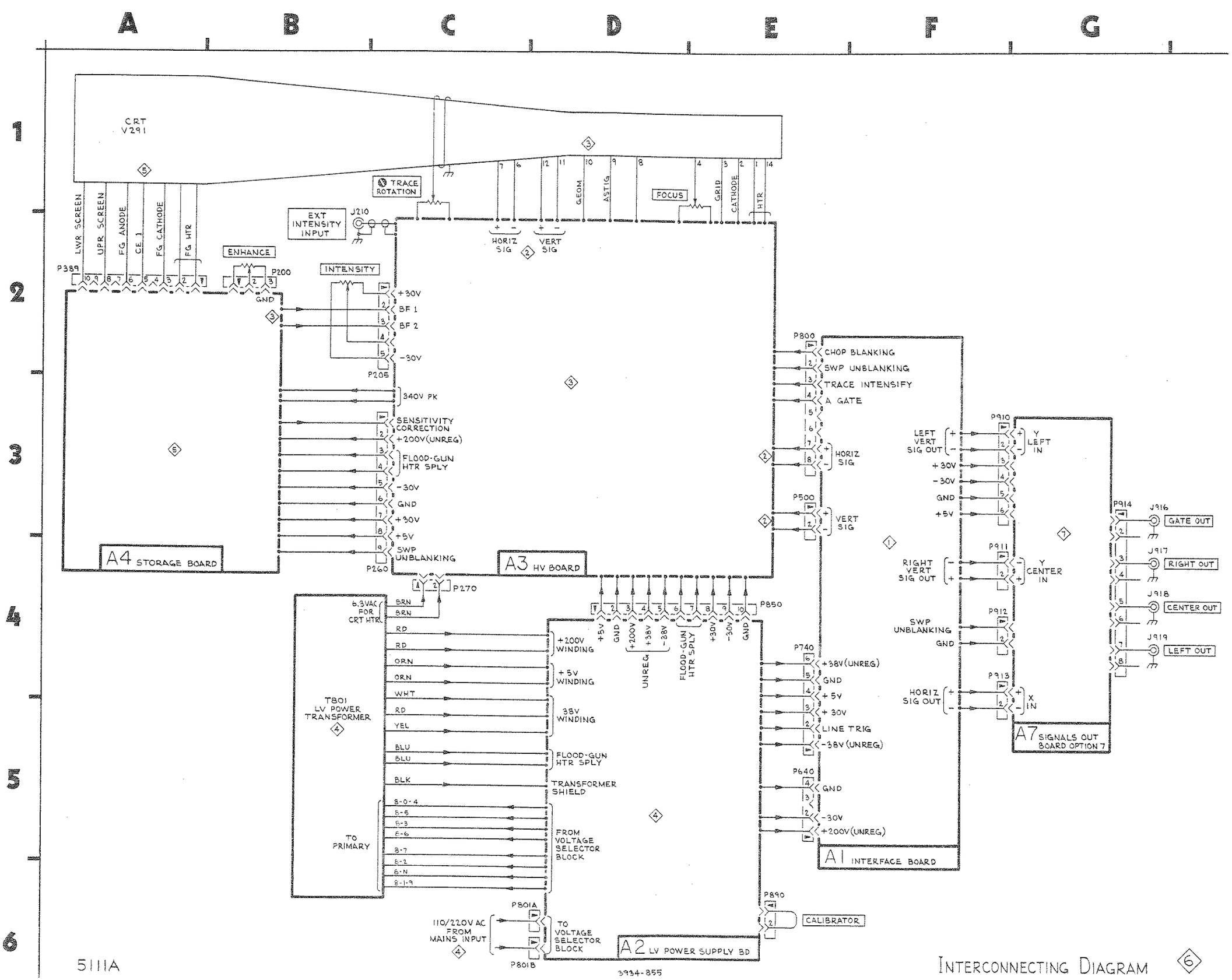
+367 V



5111A

3934-854

STORAGE CIRCUIT 5


A B C D E F G
1 2 3 4 5 6
CRT V291
LWR SCREEN
UPR SCREEN
F.G. ANODE
C.E. 1
F.G. CATHODE
F.G. HTR
TRACE ROTATION
EXT INTENSITY INPUT
J210
ENHANCE
INTENSITY
HORIZ SIG
VERT SIG
GEOM
ASTIG
FOCUS
GRID
CATHODE
HTR
P389
P200
GND
+30V
BF 1
BF 2
-30V
P205
340V PK
SENSITIVITY CORRECTION
+200V(UNREG)
FLOOD-GUN HTR SPLY
-30V
GND
+30V
+5V
SWP UNBLANKING
P260
A4 STORAGE BOARD
A3 HV BOARD
P270
P850
P800
CHOP BLANKING
SWP UNBLANKING
TRACE INTENSIFY
A GATE
HORIZ SIG
P500
VERT SIG
P910
LEFT VERT SIG OUT
Y LEFT IN
+30V
-30V
GND
+5V
P911
RIGHT VERT SIG OUT
Y CENTER IN
P912
SWP UNBLANKING
GND
P913
HORIZ SIG OUT
X IN
P914
J916
GATE OUT
J917
RIGHT OUT
J918
CENTER OUT
J919
LEFT OUT
A7 SIGNALS OUT BOARD OPTION 7
6.3VAC FOR CRT HTR
BRN
BRN
RD
RD
ORN
ORN
WHT
RD
YEL
BLU
BLU
BLK
+200V WINDING
+5V WINDING
38V WINDING
FLOOD-GUN HTR SPLY
TRANSFORMER SHIELD
T801 LV POWER TRANSFORMER
TO PRIMARY
FROM VOLTAGE SELECTOR BLOCK
+5V
GND
+200V
+38V
-38V
UNREG
FLOOD-GUN HTR SPLY
+30V
-30V
GND
P740
+38V(UNREG)
GND
+5V
+30V
LINE TRIG
-38V(UNREG)
P640
GND
-30V
+200V(UNREG)
A1 INTERFACE BOARD
P890
CALIBRATOR
P801A
P801B
110/220V AC FROM MAINS INPUT
TO VOLTAGE SELECTOR BLOCK
A2 LV POWER SUPPLY BD
3934-855
5111A
INTERCONNECTING DIAGRAM
6
Diagram
Option 7—A7

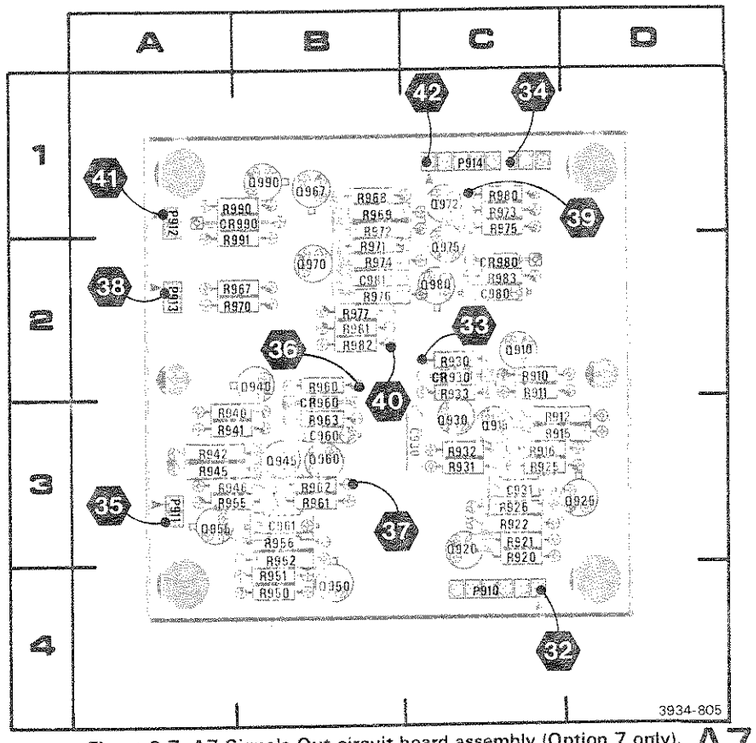


Figure 8-7. A7-Signals Out circuit board assembly (Option 7 only). A7

SIGNALS OUT DIAGRAM ⟨7⟩

ASSEMBLY A7

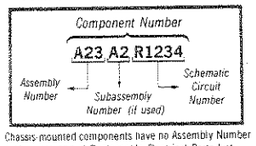
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C930	C1	C3
C931	D2	C3
C960	C3	B3
C961	D3	B3
C980	C4	C2
C981	D4	B2
CR930	C1	C2
CR960	C2	B3
CR980	C4	C2
CR990	B5	B1
P910	B1	C4
P911	B3	A3
P912	B5	A1
P913	B4	A2
P914	D1	C1
Q910	B1	C2
Q915	C1	C3
Q920	B2	C3
Q925	C2	D3
Q930	C1	C3
Q940	B3	B2
Q945	C3	B3
Q950	B3	B4
Q955	C3	A3
Q960	C3	B2
Q967	B4	B1
Q970	B4	B2
Q972	C4	C1
Q975	C5	C2
Q980	C4	C2
Q990	B6	B1
R910	B1	C2
R911	B1	C2
R912	B1	C3
R915	B1	C3
R916	C2	C3
R920	B2	C3
R921	B2	C3
R922	B2	C3
R925	C2	C3
R926	C2	C3
R930	C1	C2
R931	C1	C3
R932	D1	C3
R933	C1	C2
R940	B3	B3
R941	B3	B3
R942	B3	A3
R945	B3	A3
R946	C3	B3
R950	B3	B4
R951	B3	B4
R952	B3	B3
R955	C3	B3
R956	C3	B3
R960	C2	B2
R961	C3	B3
R962	D3	B3
R963	C2	B3
R967	B4	B2
R968	B4	B1
R969	B4	B1
R970	B5	B2
R971	B5	B2
R972	B4	B1
R973	C4	C1
R974	B5	B2
R975	C5	C1
R976	C4	B2
R977	B5	B2
R980	C4	C1
R981	C4	B2
R982	D4	B2
R983	C4	C2
R990	B6	B1
R991	B5	B2

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
J916	D5	CHASSIS
J917	D4	CHASSIS
J918	D3	CHASSIS
J919	D1	CHASSIS

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



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

A7—Signals Out Circuit Board
Illustration and Locator

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

Dangerous potentials exist at several points throughout this instrument. When the instrument is operated with the covers removed, do not touch exposed connections or components. Some transistors have voltages present on their cases. Disconnect the power source before replacing parts.

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Test oscilloscope system	Deflection factor, 1 mV to 50 V/div; input impedance, 1 megohm; frequency response, dc to 2 MHz. Probe: 10X attenuation probe compatible with vertical input.	Tektronix 5110, 5A13N, 5B10N Oscilloscope system or equiv. Use a Tektronix P6060 or P6062B Probe.
Voltmeter (non-loading digital multimeter)	Range, 0 to 250 V input, input impedance, 10 megohms.	Tektronix DM 501 Digital Multimeter with power module.

VOLTAGE CONDITIONS

Voltage measurements on this diagram were made under the following conditions:

Amplifier units are installed in both vertical compartments, left vertical plug-in is switched on, right vertical plug-in is switched off and a time-base unit is installed in the horizontal compartment. INTENSITY control is set to fully ccw. Voltmeter common is connected to chassis ground.

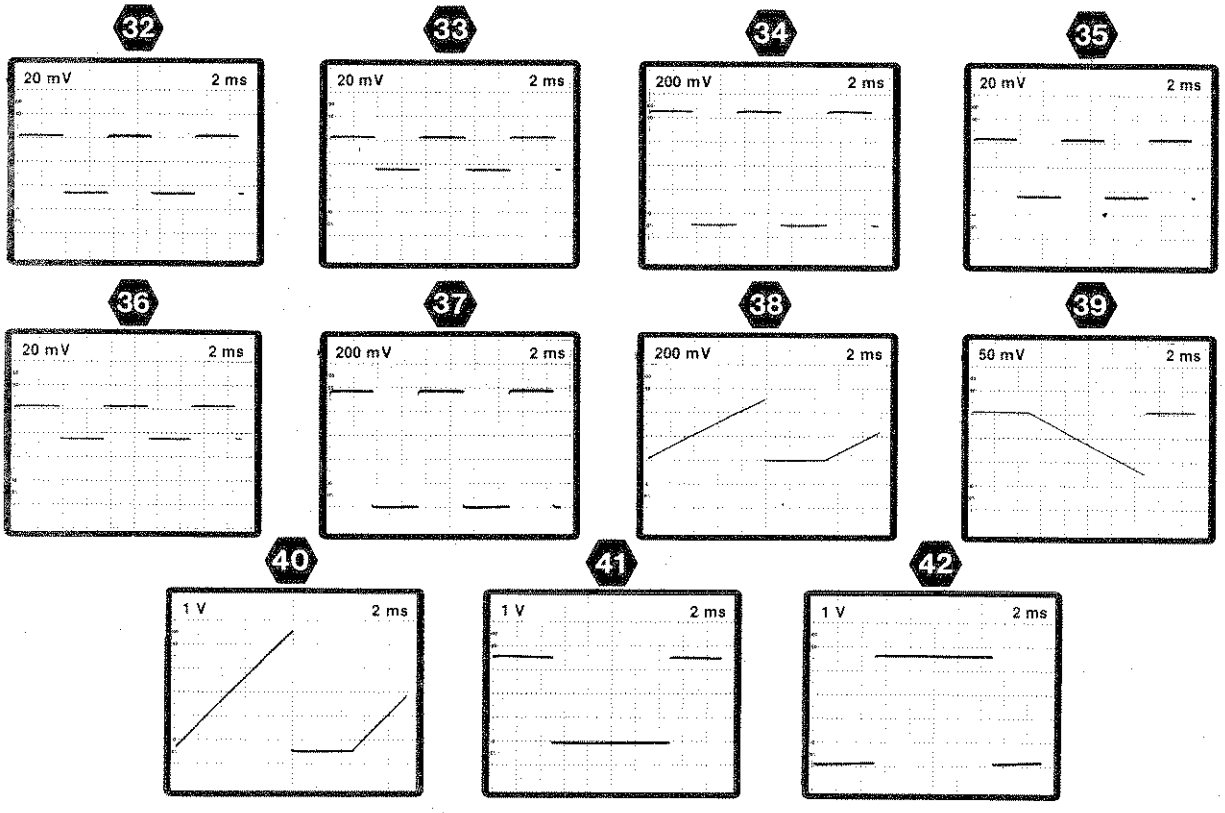
WAVEFORM CONDITIONS

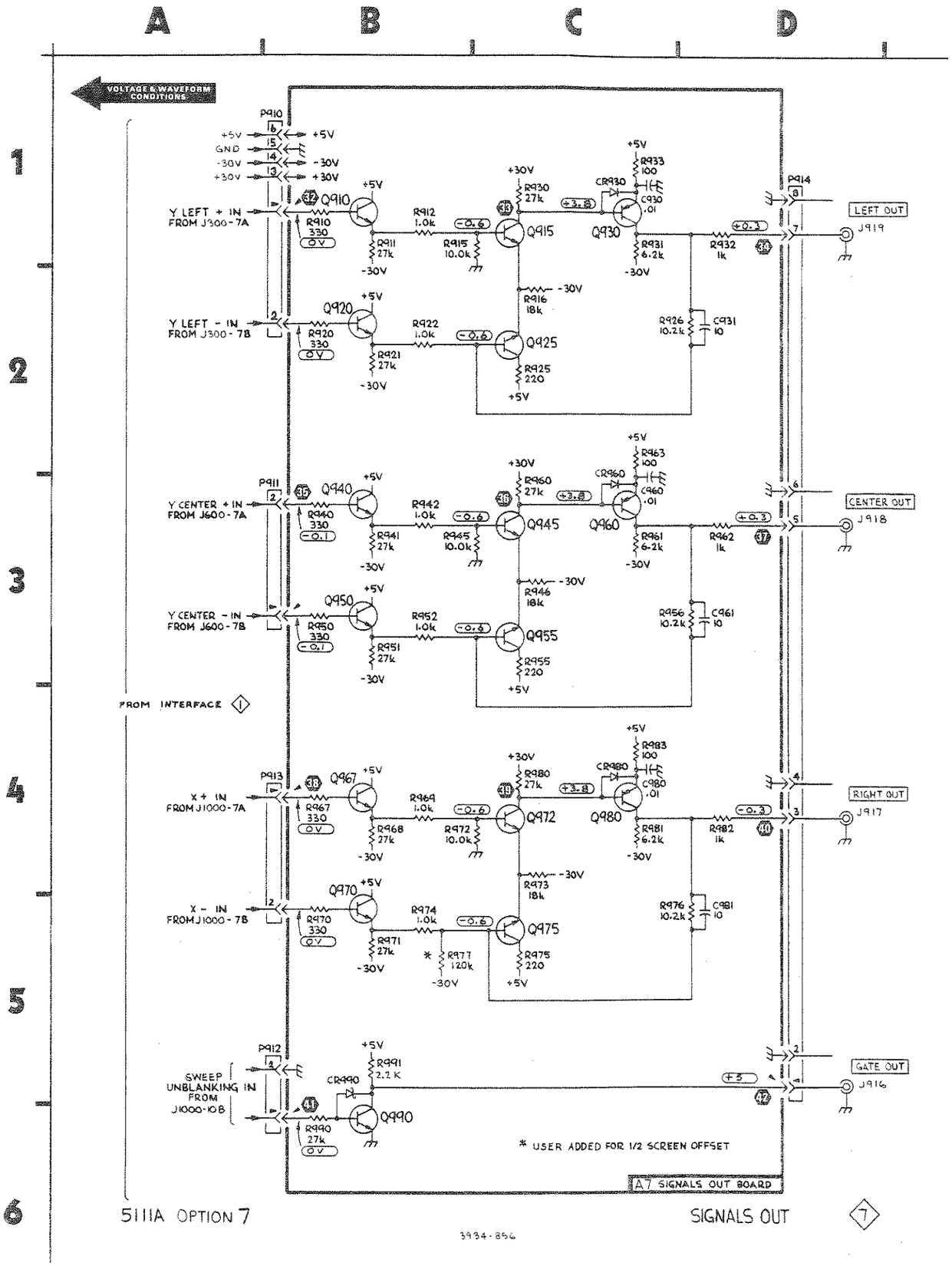
OSCILLOSCOPE UNDER TEST. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal auto-trigger, 2 ms/division sweep rate.

TEST OSCILLOSCOPE. Set the test oscilloscope triggering for auto mode with ac coupling from the internal source and set vertical input coupling to ac. Connect a 10X Probe to the vertical input. Position the display as necessary.

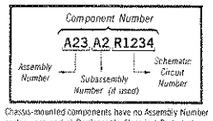
NOTE

The waveforms shown are actual waveform photographs taken with a Tektronix Oscilloscope Camera System and Projected Graticule. Vertical deflection factor shown on the waveform is the actual deflection factor from the probe tip. Voltages and waveforms on the diagrams are not absolute and may vary between instruments because of component tolerances, internal calibration, or front-panel settings. Readouts are simulated in larger-than-normal type.





COMPONENT NUMBER EXAMPLE



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

Static Sensitive Devices
See Maintenance Section

SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the description column.

1 2 3 4 5 Name & Description

Assembly and/or Component
Attaching parts for Assembly and/or Component
\- - - * - - -
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
\- - - * - - -
Parts of Detail Part
Attaching parts for Parts of Detail Part
\- - - * - - -

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. The separation symbol - - - * - - - indicates the end of attaching parts.

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

"	INCH
#	NUMBER SIZE
ACTR	ACTUATOR
ADPTR	ADAPTER
ALIGN	ALIGNMENT
AL	ALUMINUM
ASSEM	ASSEMBLED
ASSY	ASSEMBLY
ATTEN	ATTENUATOR
AWG	AMERICAN WIRE GAGE
BD	BOARD
BRKT	BRACKET
BRS	BRASS
BRZ	BRONZE
BSHG	BUSHING
CAB	CABINET
CAP	CAPACITOR
CER	CERAMIC
CHAS	CHASSIS
CKT	CIRCUIT
COMP	COMPOSITION
CONN	CONNECTOR
COV	COVER
CPLG	COUPLING
CRT	CATHODE RAY TUBE
DEG	DEGREE
DWR	DRAWER
ELCTRN	ELECTRON
ELEC	ELECTRICAL
ELCTLT	ELECTROLYTIC
ELEM	ELEMENT
EPL	ELECTRICAL PARTS LIST
EQPT	EQUIPMENT
EXT	EXTERNAL
FIL	FILLISTER HEAD
FLEX	FLEXIBLE
FLH	FLAT HEAD
FLTR	FILTER
FR	FRAME or FRONT
FSTNR	FASTENER
FT	FOOT
FXD	FIXED
GSKT	GASKET
HDL	HANDLE
HEX	HEXAGON
HEX HD	HEXAGONAL HEAD
HEX SOC	HEXAGONAL SOCKET
HLCPS	HELICAL COMPRESSION
HLEXT	HELICAL EXTENSION
HV	HIGH VOLTAGE
IC	INTEGRATED CIRCUIT
ID	INSIDE DIAMETER
IDENT	IDENTIFICATION
IMPLR	IMPELLER
IN	INCH
INCAND	INCANDESCENT
INSUL	INSULATOR
INTL	INTERNAL
LPHLDR	LAMPHOLDER
MACH	MACHINE
MECH	MECHANICAL
MTG	MOUNTING
NIP	NIPPLE
NON WIRE	NOT WIRE WOUND
OBD	ORDER BY DESCRIPTION
OD	OUTSIDE DIAMETER
OVH	OVAL HEAD
PH BRZ	PHOSPHOR BRONZE
PL	PLAIN or PLATE
PLSTC	PLASTIC
PN	PART NUMBER
PNH	PAN HEAD
PWR	POWER
RCPT	RECEPTACLE
RES	RESISTOR
RGD	RIGID
RLF	RELIEF
RTNR	RETAINER
SCH	SOCKET HEAD
SCOPE	OSCILLOSCOPE
SCR	SCREW
SE	SINGLE END
SECT	SECTION
SEMICOND	SEMICONDUCTOR
SHLD	SHIELD
SHLDR	SHOULDERED
SKT	SOCKET
SL	SLIDE
SLFLKG	SELF-LOCKING
SLVG	SLEEVING
SPR	SPRING
SQ	SQUARE
SST	STAINLESS STEEL
STL	STEEL
SW	SWITCH
T	TUBE
TERM	TERMINAL
THD	THREAD
THK	THICK
TNSN	TENSION
TPG	TAPPING
TRH	TRUSS HEAD
V	VOLTAGE
VAR	VARIABLE
W/	WITH
WSHR	WASHER
XFMR	TRANSFORMER
XSTR	TRANSISTOR

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

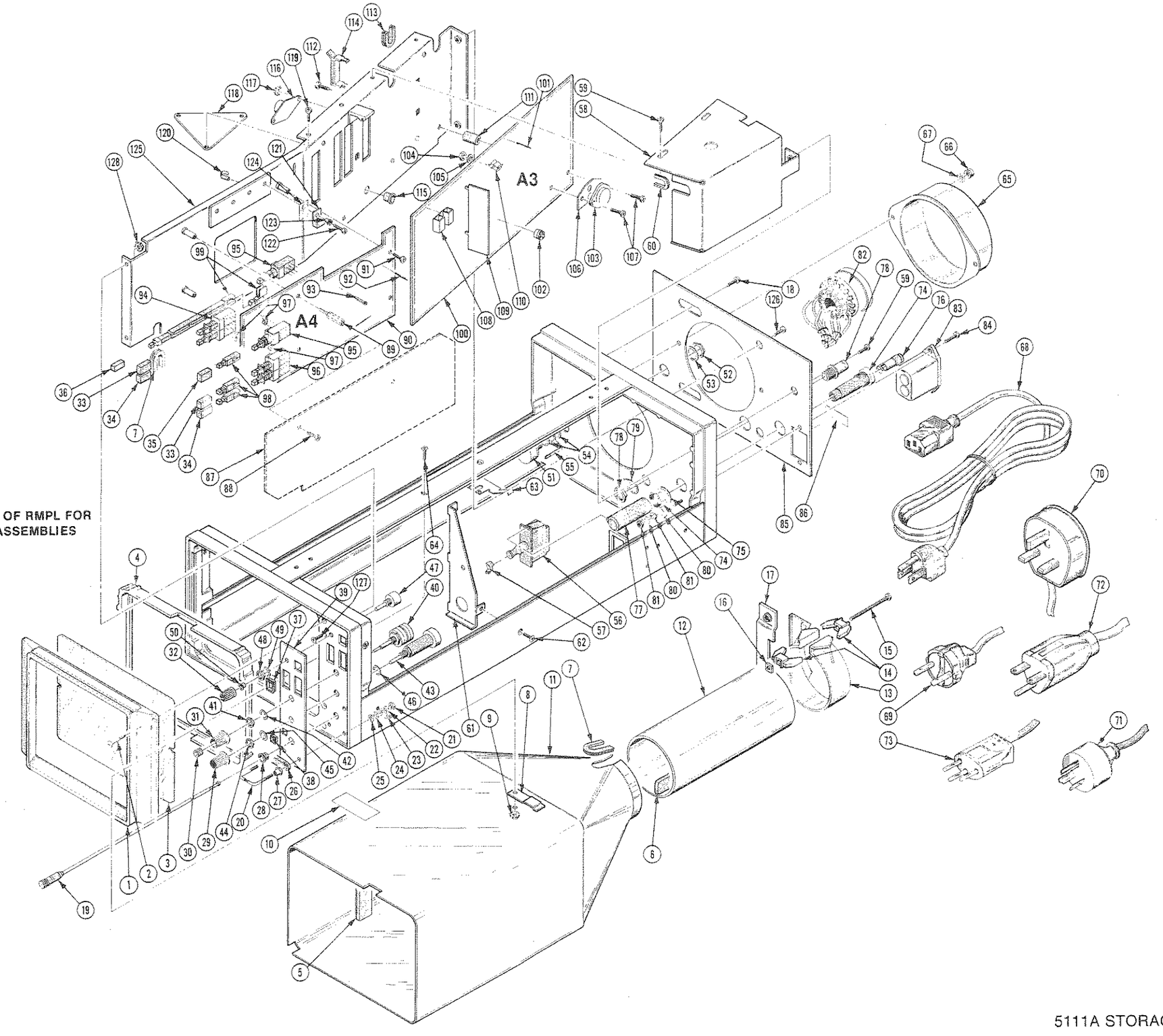
Mfr. Code	Manufacturer	Address	City, State, Zip
S3109	C/O PANEL COMPONENTS CORP.	P.O. BOX 6626	SANTA ROSA, CA 95406
S3629	PANEL COMPONENTS CORP.	2015 SECOND ST.	BERKELEY, CA 94170
000BB	BERQUIST COMPANY	4350 WEST 78TH	MINNEAPOLIS, MN 55435
000CY	NORTHWEST FASTENER SALES, INC.	7923 SW CIRRUS DRIVE	BEAVERTON, OR 97005
000JA	J. PHILLIP INDUSTRIES INC.	5713 NORTHWEST HIGHWAY	CHICAGO, ILL 60646
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
06666	GENERAL DEVICES CO., INC.	525 S. WEBSTER AVE.	INDIANAPOLIS, IN 46219
12136	PHILADELPHIA HANDLE COMPANY, INC.	1643 HADDON AVENUE	CAMDEN, NJ 08103
12327	FREEWAY CORPORATION	9301 ALLEN DRIVE	CLEVELAND, OH 44125
12697	CLAROSTAT MFG. CO., INC.	LOWER WASHINGTON STREET	DOVER, NH 03820
13511	AMPHENOL CARDRE DIV., BUNKER RAMO CORP.		LOS GATOS, CA 95030
16428	BELDEN CORP.	P. O. BOX 1331	RICHMOND, IN 47374
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
26365	GRIES REPRODUCER CO., DIV. OF COATS AND CLARK, INC.	125 BEECHWOOD AVE.	NEW ROCHELLE, NY 10802
28520	HEYMAN MFG. CO.	147 N. MICHIGAN AVE.	KENILWORTH, NJ 07033
49671	RCA CORPORATION	30 ROCKEFELLER PLAZA	NEW YORK, NY 10020
70318	ALLMETAL SCREW PRODUCTS CO., INC.	821 STEWART AVE.	GARDEN CITY, NY 11530
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
74445	HOLO-KROME CO.	31 BROOK ST. WEST	HARTFORD, CT 06110
74921	ITEN FIBRE CO.,	4001 BENEFIT AVE., P O BOX 9	ASHTABULA, OH 44004
75915	LITTELFUSE, INC.	800 E. NORTHWEST HWY	DES PLAINES, IL 60016
77250	PHEOLL MANUFACTURING CO., DIVISION OF ALLIED PRODUCTS CORP.	5700 W. ROOSEVELT RD.	CHICAGO, IL 60650
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
78471	TILLEY MFG. CO.	900 INDUSTRIAL RD.	SAN CARLOS, CA 94070
79807	WROUGHT WASHER MFG. CO.	2100 S. O BAY ST.	MILWAUKEE, WI 53207
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
80126	PACIFIC ELECTRICORD CO.	747 W. REDONDO BEACH,P O BOX 10	GARDENA, CA 90247
80710	ALLEGHENY LUDLUM STEEL CORP., A DIVISION OF ALLEGHENY LUDLUM INDUSTRIES, INC.	BRACKENRIDGE WORKS, RIVER AVE.	BRACKENRIDGE, PA 15014
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
86445	PENN FIBRE AND SPECIALTY CO., INC.	2032 E. WESTMORELAND ST.	PHILADELPHIA, PA 19134
86928	SEASTROM MFG. COMPANY, INC.	701 SONORA AVENUE	GLENDALE, CA 91201
93907	TEXTRON INC. CAMCAR DIV	600 18TH AVE	ROCKFORD, IL 61101

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty 1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-1	200-1218-00			1	RTNR,CRT SCALE:6.814 X 5.125,NYLON	80009	200-1218-00
					(ATTACHING PARTS)		
-2	211-0188-00			2	SCREW,MACHINE:4-40 X 0.30 INCH,SST	83385	OBD
					- - - * - - -		
-3	337-1440-01			1	SHLD,IMPLOSION:GREEN	80009	337-1440-01
-4	386-1946-00			1	SUPPORT,CRT:FRONT	80009	386-1946-00
-5	348-0279-00			2	PAD,CUSHIONING:G (CUT TO FIT)	80009	348-0279-00
-6	348-0070-01			3	PAD,CUSHIONING:0.69 INCH,RUBBER	80009	348-0070-01
-7	348-0145-00			1	GROMMET,PLASTIC:U-SHP,1.0 X 0.42 INCH	80009	348-0145-00
-8	344-0226-00			1	CLIP,CABLE:	80009	344-0226-00
					(ATTACHING PARTS)		
-9	210-0401-00			1	NUT,PLAIN,HEX.:6-32 X 0.312 INCH,CD PLATED	73743	93262-02
					- - - * - - -		
-10	334-1379-00			1	LABEL:CRT,ADHESIVE BACK	80009	334-1379-00
-11	337-1419-05			1	SHIELD SECT,CRT:	80009	337-1419-05
-12	337-1420-00			1	SHIELD SECT,CRT:	80710	337-1420-00-B
-13	354-0409-00			1	R,CLP,CRT SHLD:U/O 2.375 OD SHIELD	80009	354-0409-00
-14	343-0123-01			2	CLAMP,RET.,ELEC:CRT,REAR	80009	343-0123-01
					(ATTACHING PARTS)		
-15	211-0632-00			1	SCREW,MACHINE:6-32X2.250 INCH,FILH,STL	83385	OBD
-16	220-0444-00			1	NUT,PLAIN,SQ:6-32 X 0.250 INCH,STL	70318	OBD
					- - - * - - -		
-17	407-0922-00			1	BRACKET,CRT CLP:ALUMINUM	80009	407-0922-00
					(ATTACHING PARTS)		
-18	211-0507-00			2	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
					- - - * - - -		
-19	384-1064-00			1	KNOB:10.185 L X 0.125 OD,5-40 THD	80009	384-1064-00
-20	119-0373-00			1	COIL,CAL:	80009	119-0373-00
					(ATTACHING PARTS)		
-21	210-0442-00			2	NUT,PLAIN,HEX.:3-48 X 0.187 INCH,CD PL BRS	73743	3014-402
-22	210-0004-00			2	WASHER,LOCK:#4 INTL,0.015THK,STL CD PL	78189	OBD
-23	210-0259-00			1	TERMINAL,LUG:0.099"ID INT TOOTH,SE	80009	210-0259-00
-24	210-0994-00			2	WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5702-201-20
-25	210-0935-00			2	WASHER,NONMETAL:FIBER,0.14 IDX 0.375"OD	74921	OBD
-26	361-0059-01			1	INSULATOR,PLATE:1.093 X 0.343 X 0.125 INCH	80009	361-0059-01
-27	210-0593-00			2	NUT,FINISHING:0.25 HEX X 0.312" LONG,BRS	80009	210-0593-00
					- - - * - - -		
-28	358-0216-00			1	BUSHING,PLASTIC:0.257 ID X 0.412 INCH OD	80009	358-0216-00
-29	366-0494-00			1	KNOB:GRAY WITH SETSCREW	80009	366-0494-00
	213-0153-00			1	. SETSCREW:5-40 X 0.125,STL BK OXD,HEX SKT	000CY	OBD
-30	366-1391-00			1	KNOB:GY,0.081 ID X0.28 OD	80009	366-1391-00
	213-0725-00			1	. SETSCREW:3-48 X 0.095 INCH,HEX SOC STL	74445	OBD
-31	366-1077-00			1	KNOB:GRAY	80009	366-1077-00
	213-0153-00			1	. SETSCREW:5-40 X 0.125,STL BK OXD,HEX SKT	000CY	OBD
-32	366-1023-01			1	KNOB:GY,0.127 ID X0.392 OD X 0.531 H	80009	366-1023-01
	213-0153-00			1	. SETSCREW:5-40 X 0.125,STL BK OXD,HEX SKT	000CY	OBD
-33	366-1257-44			2	PUSH BUTTON:SIL GRAY,UPPER	80009	366-1257-44
-34	366-1257-45			2	PUSH BUTTON:SIL GRAY,LOWER	80009	366-1257-45
-35	366-1257-46			1	PUSH BUTTON:SIL GRAY,ERASE	80009	366-1257-46
-36	366-1559-00			1	PUSH BUTTON:SIL GY,0.18 SQ X 0.43	80009	366-1559-00
-37	426-0681-00			5	FR,PUSH BUTTON:GRAY PLASTIC	80009	426-0681-00
-38	426-1072-00			1	FRAME,PUSH BTN:PLASTIC	80009	426-1072-00
-39	333-2898-00			1	PANEL,FRONT:	80009	333-2898-00
-40	----- -----			1	RES.,VAR,NONWIR:(SEE R200A,B REPL)		
					(ATTACHING PARTS)		
-41	210-0583-00			1	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-42	210-0940-00			1	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
					- - - * - - -		
-43	----- -----			1	RES.,VAR,NONWIR:(SEE R295 REPL)		
					(ATTACHING PARTS)		
-44	210-0583-00			1	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-45	210-0940-00			1	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
-46	210-0046-00			1	WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	78189	1214-05-00-0541C
					- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-47	----- -----			1		RES.,VAR,NONWIR:(SEE A4R325 REPL)		
						(ATTACHING PARTS)		
-48	210-0583-00			1		NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-49	210-0940-00			1		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
-50	358-0378-00			1		BUSHING,SLEEVE:0.131 ID X 0.125 L	80009	358-0378-00
						- - - * - - -		
-51	----- -----			1		RES.,VAR,NONWIR:(SEE R291 REPL)		
						(ATTACHING PARTS)		
-52	220-0495-00			1		NUT,PLAIN,HEX.:0.375-32 X 0.438 INCH BRS	73743	OBD
-53	210-0978-00			1		WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	78471	OBD
-54	210-0012-00			2		WASHER,LOCK:INTL,0.375 ID X 0.50" OD STL	78189	1220-02-00-0541C
-55	210-0207-00			1		TERMINAL,LUG:0.375 INCH DIAMETER	12697	01136902
						- - - * - - -		
-56	----- -----			1		SWITCH,PUSH:(SEE S201 REPL)		
-57	376-0127-00			1		COUPLER,SHAFT:PLASTIC	80009	376-0127-00
-58	337-1421-00			1		SHIELD,ELEC:HI-VOLTAGE	80009	337-1421-00
						(ATTACHING PARTS)		
-59	211-0504-00			3		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-60	348-0115-00			2		GROMMET,PLASTIC:U-SHP,0.548 X0.462 INCH	80009	348-0115-00
-61	407-0896-00			1		BRACKET,CHASSIS:ALUMINUM	80009	407-0896-00
						(ATTACHING PARTS)		
-62	211-0538-00			1		SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-63	214-0982-00			1		CONTACT,ELEC:GROUNDING	80009	214-0982-00
						(ATTACHING PARTS)		
-64	211-0538-00			3		SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-65	200-1204-01			1		COVER,CRT:REAR ALUMINUM,PTD BLUE	80009	200-1204-01
						(ATTACHING PARTS)		
-66	210-0401-00			2		NUT,PLAIN,HEX.:6-32 X 0.312 INCH,CD PLATED	73743	93262-02
-67	210-0005-00			2		WASHER,LOCK:#6 EXT,0.02 THK,STL	78189	1106-00
						- - - * - - -		
-68	161-0066-00			1		CABLE ASSY,PWR,:3,18 AWG,115V,98.0 L	16428	KH8481
-69	161-0066-09			1		CABLE ASSY,PWR:3,0.75MM SQ,220V,96.0 L	80126	OBD
	----- -----			-		(OPTION A1 EUROPEAN)		
70	161-0066-10			1		CABLE ASSY,PWR:3,0.75MM SQ,240V,96.0 L	S3109	OBD
	----- -----			-		(OPTION A2 UNITED KINGDOM)		
-71	161-0066-11			1		CABLE ASSY,PWR:3,0.75MM,240V,96.0L	S3109	OBD
	----- -----			-		(OPTION A3 AUSTRALIAN)		
-72	161-0066-12			1		CABLE ASSY,PWR:3,18 AWG,240V,96.0 L	80126	OBD
	----- -----			-		(OPTION A4 NORTH AMERICAN)		
-73	161-0154-00			1		CABLE ASSY,PWR:3,0.75MM SQ,240V,6A,2.5M L	000JA	OBD
	----- -----			-		(OPTION A5 SWISS)		
-74	204-0832-00			1		BODY,FUSEHOLDER:3AG,5 X 20MM FUSES	S3629	031.1673(MDLFEU)
						(ATTACHING PARTS)		
-75	210-0012-00			1		WASHER,LOCK:INTL,0.375 ID X 0.50" OD STL	78189	1220-02-00-0541C
						- - - * - - -		
-76	200-2264-00			1		CAP.,FUSEHOLDER:3AG FUSES	S3629	FEK 031 1666
-77	200-0237-04			1		COVER,FUSE HLDR:PLASTIC	80009	200-0237-04
-78	131-0955-00			1		CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
						(ATTACHING PARTS)		
-79	210-0255-00			1		TERMINAL,LUG:0.391" ID INT TOOTH	80009	210-0255-00
						- - - * - - -		
-80	210-0202-00			2		TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED	78189	2104-06-00-2520N
						(ATTACHING PARTS)		
-81	210-0401-00			2		NUT,PLAIN,HEX.:6-32 X 0.312 INCH,CD PLATED	73743	93262-02
						- - - * - - -		
-82	136-0723-00			1		SKT,PL-IN ELEK:ELCTRN TUBE,14 CONT W/LEAD	80009	136-0723-00
-83	----- -----			1		FILTER,RFI:(SEE FL201 REPL)		
						(ATTACHING PARTS)		
-84	211-0012-00			2		SCREW,MACHINE:4-40 X 0.375,PNH STL CD PL	83385	OBD
						- - - * - - -		
-85	333-1426-04			1		PANEL,REAR:	80009	333-1426-04
-86	334-2154-00			1		MARKER,IDENT:MKD CAUTION	80009	334-2154-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-87	337-2994-00			1		SHIELD,ELEC:CKT BOARD	80009	337-2994-00
	----- -----			-		(RACKMOUNT ONLY)		
						(ATTACHING PARTS)		
-88	212-0103-00			3		SCREW,MACHINE:8-32 X 0.375 HEX HD,STL	77250	OBD
	----- -----			-		(RACKMOUNT ONLY)		
-89	129-0456-00			2		SPACER,POST:0.75 L,W/4-40STUD,TAP,BRASS	80009	129-0456-00
	----- -----			-		(RACKMOUNT ONLY)		
						- - - * - - -		
-90	----- -----			1		CKT BOARD ASSY:STORAGE(SEE A4 REPL)		
						(ATTACHING PARTS)		
-91	211-0008-00			4		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
	----- -----			-		CKT BOARD ASSY INCLUDES:		
-92	131-0608-00			12		. TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-93	----- -----			4		. TERM,TEST POINT:(SEE A4TP1,2,3,4 REPL)		
-94	----- -----			1		. SWITCH,PUSH:(SEE A4S375 REPL)		
-95	----- -----			2		. SWITCH,PUSH:(SEE A4S125,S330 REPL)		
-96	----- -----			1		. SWITCH,PUSH:(SEE A4S372 REPL)		
-97	361-0411-00			12		. SPACER,PUSH SW:0.13 W X 0.375 INCH L,PLSTC	71590	J64285-00
-98	384-1136-00			3		EXTENSION SHAFT:0.95 INCH LONG	80009	384-1136-00
-99	384-1390-00			1		EXTENSION SHAFT:4.460 INCH LONG,OFFSET	80009	384-1390-00
-100	----- -----			1		CKT BOARD ASSY:HIGH VOLTAGE(SEE A3 REPL)		
-101	131-0589-00			16		. TERMINAL,PIN:0.46 L X 0.025 SQ	80009	131-0589-00
-102	136-0183-00			2		. SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00
	136-0254-01			2		. SOCKET,PIN TERM:U/W 0.031 TO 0.04 DIA PINS	00779	1-331892-8
-103	----- -----			1		. TRANSISTOR:(SEE A3Q252 REPL)		
						(ATTACHING PARTS)		
-104	210-0407-00			1		. NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
-105	210-0055-00			1		. WASHER,LOCK:SPLIT,0.145 ID X 0.253 OD,STL	83385	OBD
-106	214-1610-00			1		. HEAT SINK,ELEC:TRANSISTOR	80009	214-1610-00
-107	211-0578-00			2		. SCREW,MACHINE:6-32 X 0.438 INCH,PNH STL	83385	OBD
						- - - * - - -		
-108	214-2811-00			4		. HEAT,SINK,XSTR:TO-202 ALUMINUM	80009	214-2811-00
-109	337-1179-00			1		. SHIELD,ELEC:DEFLECTION AMP	80009	337-1179-00
-110	344-0286-00			1		. CLIP,ELECTRICAL:FOR 3AG FUSE,BRS	75915	102074
-111	129-0891-00			1		. SPACER,POST:0.406 L,W/16-32 THD THRU NYL	80009	129-0891-00
						(ATTACHING PARTS)		
-112	211-0503-00			1		. SCREW,MACHINE:6-32 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
-113	348-0115-00			2		GROMMET,PLASTIC:U-SHP,0.548 X0.462 INCH	80009	348-0115-00
-114	344-0225-00			2		CLIP,CABLE:	80009	344-0225-00
-115	348-0516-00			1		GROMMET,PLASTIC:BLACK,ROUND,0.188 ID	28520	SB312-3
-116	----- -----			1		SWITCH,THERMOSTATIC:(SEE S200 REPL)		
						(ATTACHING PARTS)		
-117	210-0586-00			2		NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	83385	OBD
						- - - * - - -		
-118	407-2270-02			1		BRACKET,CHASSIS:	80009	407-2270-02
						(ATTACHING PARTS)		
-119	211-0504-00			2		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-120	343-0088-00			3		CLAMP,LOOP:0.062 INCH DIA	80009	343-0088-00
-121	----- -----			4		TRANSISTOR:(SEE Q362,372,392,396 REPL)		
						(ATTACHING PARTS)		
-122	211-0008-00			4		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-123	210-1178-00			4		WASHER,SHLDR:U/W TO-220 TRANSISTOR	49671	DF137A
						- - - * - - -		
-124	342-0355-00			4		INSULATOR,PLATE:TRANSISTOR,SILICONE RUBBER	000BB	7403-09FR-51
-125	441-0991-05			1		CHAS,DSPL UNIT:MAIN	80009	441-0991-05
						(ATTACHING PARTS)		
-126	211-0504-00			2		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
-127	211-0538-00			2		SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH STL	83385	OBD
-128	210-0457-00			2		NUT,PL,ASSEM WA:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		

SEE END OF RMPL FOR
WIRE ASSEMBLIES



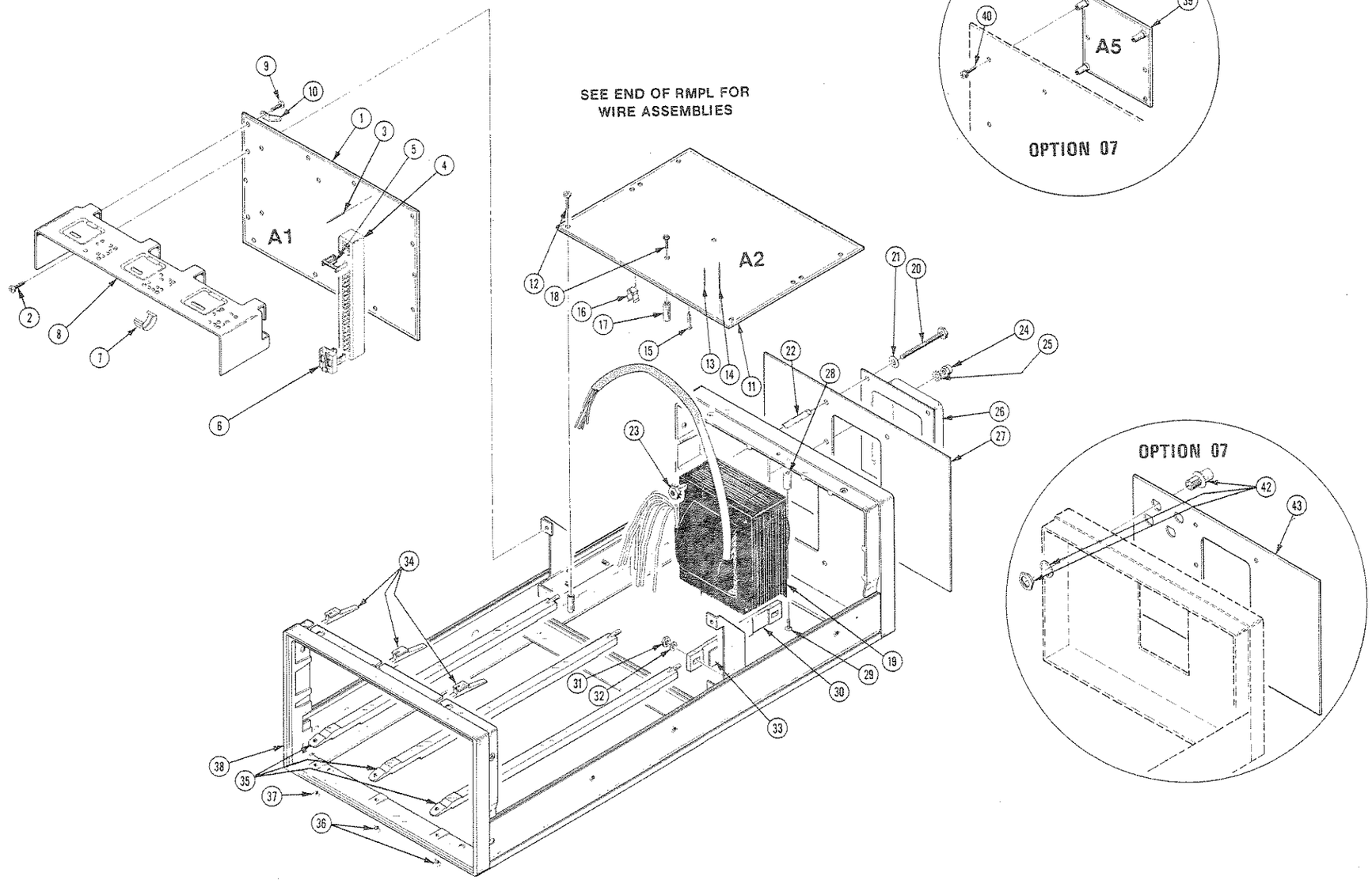
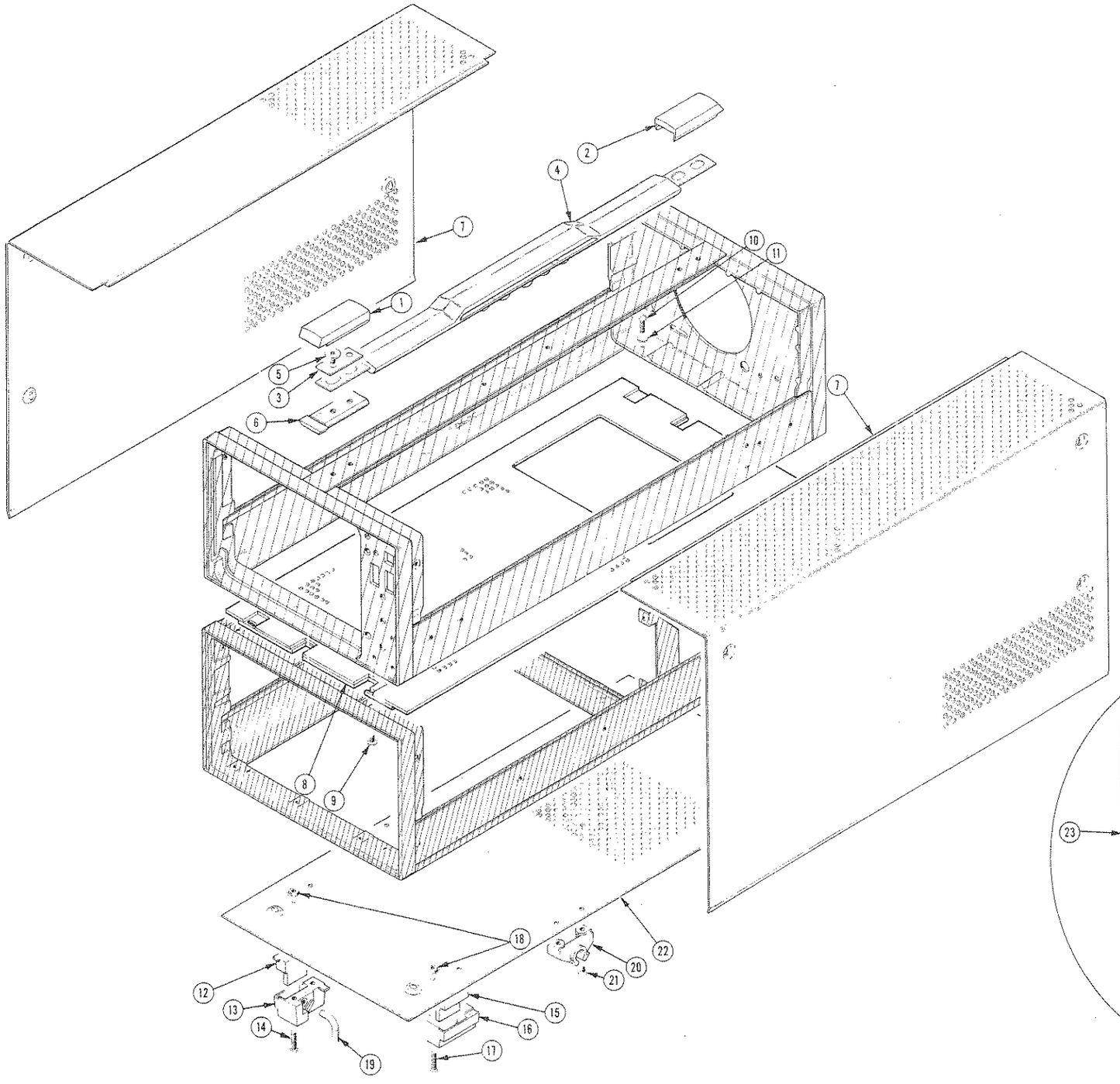
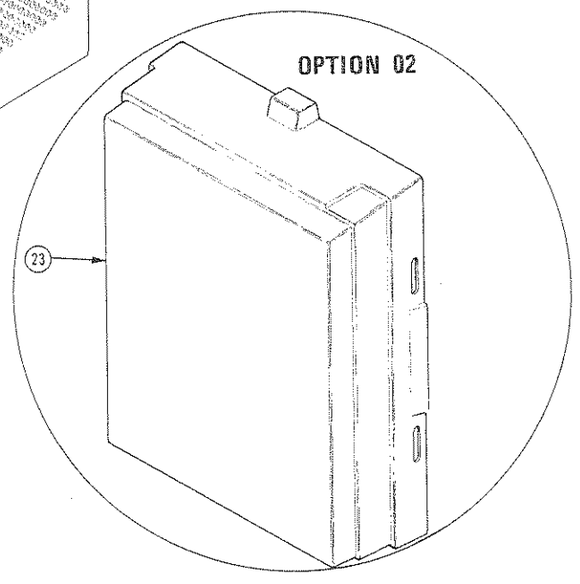


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-1	----- -----			1		CKT BOARD ASSY:INTERFACE(SEE A1 REPL)		
						(ATTACHING PARTS)		
-2	213-0146-00			4		SCR,TPG,THD FOR:6-20 X 0.313 INCH,PNH STL	83385	OBD
						- - - * - - -		
	----- -----			-		CKT BOARD ASSY INCLUDES:		
-3	131-0589-00			20		. TERMINAL PIN:0.46 L X 0.025 SQ.	80009	131-0589-00
-4	----- -----			3		. CONNECTOR,RCPT,:(SEE A1J300,J600,J1000 REPL)		
-5	214-1593-02			6		. KEY,CONN PLZN:CKT BD CONN	80009	214-1593-02
-6	200-2601-00			3		. COVER,ELEC CONN:W/POLARIZING KEY	80009	200-2601-00
-7	131-2423-00			3		CONTACT,ELEC:PLUG-IN GND,CU BE BRT DIP	80009	131-2423-00
-8	441-1641-00			1		CHASSIS,SCOPE:INTERFACE	80009	441-1641-00
						(ATTACHING PARTS)		
-9	211-0008-00			4		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-10	210-0201-00			1		TERMINAL,LUG:0.12 ID,LOCKING,BRZ TIN PL	86928	OBD
						- - - * - - -		
-11	----- -----			1		CKT BOARD ASSY:LV POWER SUPPLY(SEE A2 REPL)		
						(ATTACHIG PARTS)		
-12	211-0504-00			6		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
	----- -----			-		CKT BOARD ASSY INCLUDES:		
-13	131-0608-00			16		. TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-14	131-0589-00			12		. TERMINAL,PIN:0.46 L X 0.025 SQ	80009	131-0589-00
-15	----- -----			4		. TERM,TEST POINT:(SEE A2TP810,820,840,860 REPL)		
-16	344-0326-00			14		. CLIP,ELECTRICAL:FUSE,BRASS	75915	102071
-17	385-0149-00			2		. SPACER,POST:0.625 L W/4-40 THD EA END,NYL	80009	385-0149-00
						(ATTACHING PARTS)		
-18	211-0040-00			2		. SCREW,MACHINE:4-40 X 0.25",BDGH PLSTC	26365	OBD
						- - - * - - -		
-19	----- -----			1		TRANSFORMER:(SEE T801 REPL)		
						(ATTACHING PARTS)		
-20	212-0522-00			4		SCREW,MACHINE:10-32 X 2.50",HEX HD STL	83385	OBD
-21	210-0812-00			4		WASHER,NONMETAL:#10,FIBER	86445	OBD
-22	166-0457-00			4		INSUL SLVG,ELEC:0.19 ID X 1.875"LONG MYLAR	80009	166-0457-00
-23	220-0410-00			4		NUT,EXTENDED WA:10-32 X 0.375 INCH,STL	83385	OBD
-24	210-0401-00			1		NUT,PLAIN,HEX.:6-32 X 0.312 INCH,CD PLATED	73743	93262-02
-25	210-0005-00			1		WASHER,LOCK:#6 EXT,0.02 THK,STL	78189	1106-00
						- - - * - - -		
-26	200-0772-09			1		COVER,ELEC XFMR:3.125 X 3.75 X 0.875	80009	200-0772-09
-27	333-1425-11			1		PANEL,REAR:	80009	333-1425-11
-28	385-0012-00			1		SPACER,POST:0.312 OD,0.562 L W/8-32 THD	80009	385-0012-00
						(ATTACHING PARTS)		
-29	211-0025-00			1		SCREW,MACHINE:4-40 X 0.375 100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-30	343-0315-00			2		CLAMP,XSTR:	80009	343-0315-00
						(ATTACHING PARTS)		
-31	210-0407-00			6		NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
-32	210-0802-00			6		WASHER,FLAT:0.15 ID X 0.312 INCH OD	12327	OBD
						- - - * - - -		
-33	342-0082-00			3		INSULATOR,PLATE:0.52 SQ X 0.015 INCH THK,AL	80009	342-0082-00
-34	351-0293-00			3		GUIDE,SLIDE:BLUE	80009	351-0293-00
-35	351-0286-07			3		GUIDE,PL-IN UNI:LOWER,NYLON	80009	351-0286-07
						(ATTACHING PARTS)		
-36	213-0813-00			2		SCREW,TPG,TR:4-20,0.312 L,PLASTITE	93907	OBD
-37	213-0814-00			1		SCREW,TPG,TR:4-20,0.25 L,PLASTITE	93907	OBD
						- - - * - - -		
-38	426-0738-02			1		FRAME ASSY MON:	80009	426-0738-02
-39	----- -----			1		CKT BOARD ASSY:SIGNAL OUT(SEE A5 REPL)		
	----- -----			-		(OPTION 07 ONLY)		
						(ATTACHING PARTS)		
-40	211-0292-00			3		SCR,ASSEM WSHR:4-40 X 0.29,BRS NI PL	78189	OBD
	----- -----			-		(OPTION 07 ONLY)		
						- - - * - - -		
	----- -----			-		CKT BOARD ASSY INCLUDES:		
-41	131-0589-00			20		. TERMINAL,PIN:0.46 L X 0.025 SQ	80009	131-0589-00
	----- -----			-		. (OPTION 07 ONLY)		
-42	----- -----			4		CONN,RCPT,ELEC:(SEE J916,917,918,919 REPL)		
	----- -----			-		(OPTION 07 ONLY)		
-43	333-1425-12			1		PANEL,REAR:	80009	333-1425-12
	----- -----			-		(OPTION 07 ONLY)		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
3-1	200-0728-06			1		COVER,HDL END:	80009	200-0728-06
-2	200-0728-00			1		COV,HANDLE END:	80009	200-0728-00
-3	386-1624-00			2		PLATE,HDL RTNG:STAINLESS STEEL	80009	386-1624-00
-4	367-0116-00			1		HANDLE,CARRYING:	12136	OBD
						(ATTACHING PARTS)		
-5	212-0597-00			4		SCREW,MACHINE:10-32 X 0.50 INCH,STL	93907	OBD
						- - - * - - -		
-6	386-1283-00			2		PLATE,HDL MTG:FRONT	80009	386-1283-00
-7	390-0469-00			2		CAB.SIDE,DSPL:SIDE	80009	390-0469-00
	390-0471-00			1		COVER,DISPLAY:LEFT SIDE BENCH W/LATCH	80009	390-0471-00
	----- -----			-		(OPTION 02 ONLY)		
-8	337-3015-01			1		SHIELD,ELEC:HIGH VOLTAGE,W/SPCR	80009	337-3015-01
						(ATTACHING PARTS)		
-9	212-0105-00			2		SCREW,EXT RLV:8-32 X 0.312 INCH,HEX HD STL	80009	212-0105-00
-10	212-0008-00			2		SCREW,MACHINE:8-32 X 0.500 INCH,PNH STL	83385	OBD
-11	210-0008-00			2		WASHER,LOCK:INTL,0.172 ID X 0.331"OD,STL	78189	1208-00-00-0541C
						- - - * - - -		
-12	348-0208-00			2		FOOT,CABINET:LEFT FRONT AND RIGHT REAR	80009	348-0208-00
	----- -----			-		(SUBPART OF 390-0470-00)		
-13	348-0073-00			2		HINGE BLOCK,STA:L FR,R REAR,BLACK ACETAL	80009	348-0073-00
	----- -----			-		(SUBPART OF 390-0470-00)		
						(ATTACHING PARTS)		
-14	211-0532-00			4		SCREW,MACHINE:6-32 X 0.75 INCH,FILH STL	83385	OBD
	----- -----			-		(SUBPART OF 390-0470-00)		
						- - - * - - -		
-15	348-0207-00			2		FOOT,CABINET:RIGHT FRONT AND LEFT REAR	80009	348-0207-00
	----- -----			-		(SUBPART OF 390-0470-00)		
-16	348-0074-00			2		HINGE BLOCK,STA:R FR,L REAR,BLACK ACETAL	80009	348-0074-00
	----- -----			-		(SUBPART OF 390-0470-00)		
						(ATTACHING PARTS)		
-17	211-0532-00			4		SCREW,MACHINE:6-32 X 0.75 INCH,FILH STL	83385	OBD
-18	210-0457-00			4		NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	OBD
						- - - * - - -		
-19	348-0275-00			1		FLIPSTAND,CAB.:	80009	348-0275-00
-20	343-0256-00			2		RTNR BLK,SCOPE:	80009	343-0256-00
						(ATTACHING PARTS)		
-21	211-0531-00			4		SCREW,MACHINE:6-32 X 0.375,FIL,STL	83385	OBD
						- - - * - - -		
-22	390-0470-00			1		CAB.BOT,DSPL:BOTTOM	80009	390-0470-00
-23	200-1375-00			1		COVER,SCOPE:FRONT	80009	200-1375-00
	----- -----			-		(OPTION 02 ONLY)		





5111A STORAGE OSCILLOSCOPE

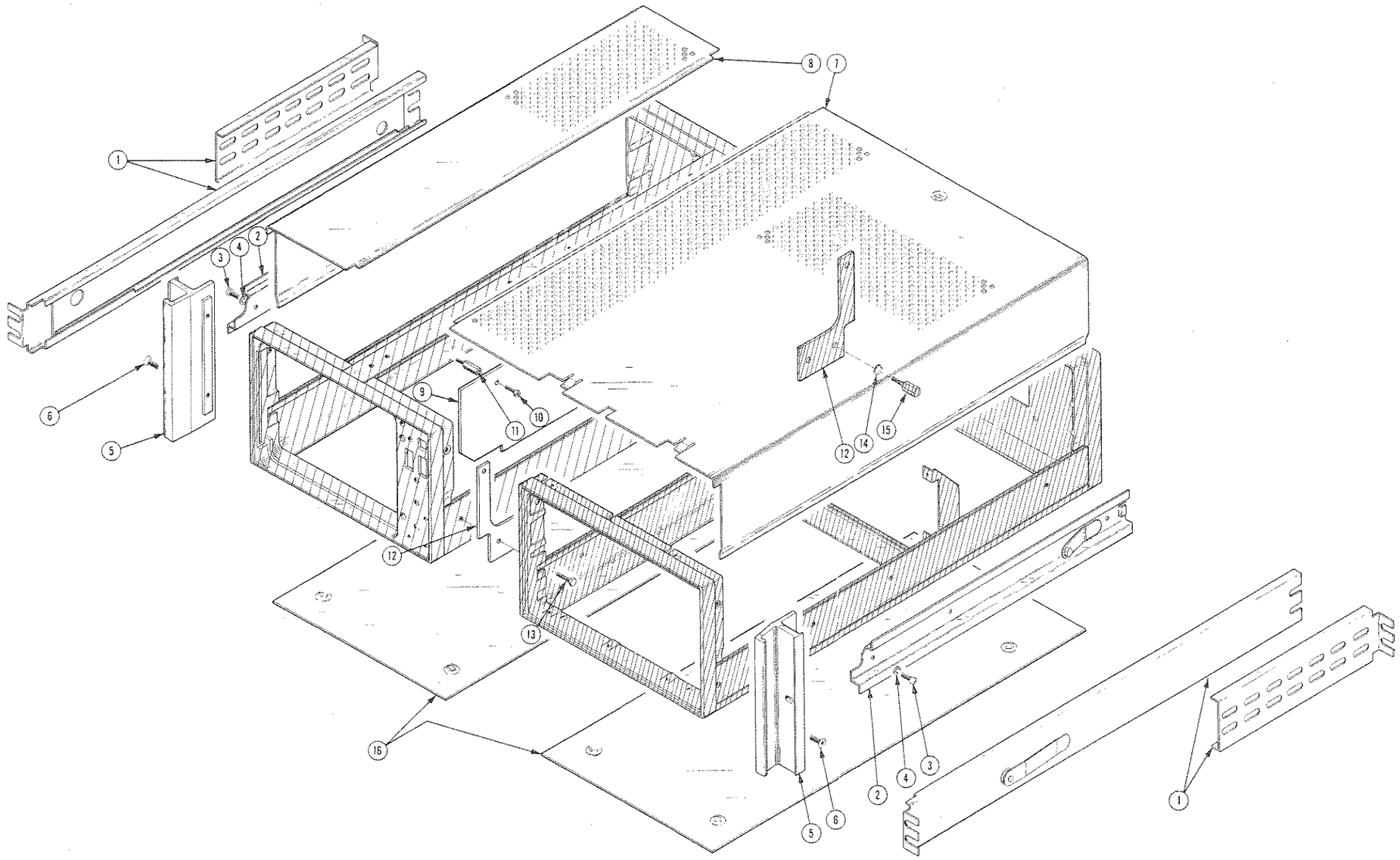


FIG. 4 RACKMOUNT CABINET

5111A STORAGE OSCILLOSCOPE

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
4-1	351-0195-01			1		SLIDE,DWR,EXT:W/CLOSED MOUNTING SLOTS	80009	351-0195-01
-2	351-0104-00			1		SLIDE SECT,DWR:12.625 X 2.25	06666	C-720-2
						(ATTACHING PARTS)		
-3	212-0004-00			6		SCREW,MACHINE:8-32 X 0.312 INCH,PNH STL	83385	OBD
-4	210-0858-00			6		WASHER,FLAT:0.500 OD X 0.171 ID X 0.063 THK	80009	210-0858-00
						- - - * - - -		
-5	407-0899-00			2		BRACKET,RACK MT:ALUMINUM	80009	407-0899-00
						(ATTACHING PARTS)		
-6	212-0040-00			2		SCREW,MACHINE:8-32 X 0.375 100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-7	390-0502-00			1		CAB.SIDE,DSPL:RIGHT,RACK	80009	390-0502-00
-8	390-0503-00			1		CAB.SIDE,DSPL:LEFT,RACK	80009	390-0503-00
-9	337-2994-00			1		SHIELD,ELEC:CIRCUIT BOARD	80009	337-2994-00
						(ATTACHING PARTS)		
-10	212-0103-00			3		SCREW,MACHINE:8-32 X 0.375 HEX HD,STL	77250	OBD
-11	129-0456-00			1		SPACER,POST:0.75 L,W/4-40STUD,TAP,BRASS	80009	129-0456-00
						- - - * - - -		
-12	361-0389-00			2		SPACER,PLATE:0.125 AL,L-SHAPE	80009	361-0389-00
						(ATTACHING PARTS)		
-13	212-0104-00			3		SCREW,MACHINE:8-32,0.75 HEXSTL	80009	212-0104-00
-14	210-0008-00			3		WASHER,LOCK:INTL,0.172 ID X 0.331"OD,STL	78189	1208-00-00-0541C
-15	129-0456-00			1		SPACER,POST:0.75 L,W/4-40STUD,TAP,BRASS	80009	129-0456-00
						- - - * - - -		
-16	390-0505-00			2		CAB.BOT,SCOPE:	80009	390-0505-00
						WIRE ASSEMBLIES		
	175-6076-00			-		CA ASSY,SP,ELEC:3,22 AWG,3.5 L RIBBON	80009	175-6076-00
	----- -----			-		(FROM A2 TO A1P640)		
	175-6077-00			-		CA ASSY,SP,ELEC:6,22 AWG,3.0 L RIBBON	80009	175-6077-00
	----- -----			-		(FROM A2 TO A1P740)		
	175-4792-00			-		CA ASSY,SP,ELEC:2,22 AWG,20.0 L RIBBON	80009	175-4792-00
	----- -----			-		(FROM A2P890 TO CAL. COIL)		
	175-4793-00			-		CA ASSY,SP,ELEC:5,22 AWG,10.0 L RIBBON	80009	175-4793-00
	----- -----			-		(FROM A3P205 TO R200A & A4)		
	175-4794-00			-		CA ASSY,SP,ELEC:3,22 AWG,3.5 L RIBBON	80009	175-4794-00
	----- -----			-		(FROM A4P200 TO R200B)		
	175-4795-00			-		CA ASSY,SP,ELEC:9,22 AWG,3.5 L RIBBON	80009	175-4795-00
	----- -----			-		(FROM A3P260 TO A4)		
	175-4796-00			-		CA ASSY,SP,ELEC:10,22 AWG,11.0 L RIBBON	80009	175-4796-00
	----- -----			-		(FROM A3 TO A2P850)		
	175-4797-00			-		CA ASSY,SP,ELEC:6,22 AWG,13.0 L RIBBON	80009	175-4797-00
	----- -----			-		(FROM A3 TO A1P800)		
	175-4798-00			-		CA ASSY,SP,ELEC:2,22 AWG,10.0 L RIBBON	80009	175-4798-00
	----- -----			-		(FROM A3 TO A1P500)		
						WIRE ASSEMBLIES (OPTION 07 ONLY)		
	198-4024-00			-		WIRE SET,ELEC:	80009	198-4024-00
	----- -----			-		(FROM A7P914 TO J916,J917,J918 & J919)		
	198-4025-00			-		WIRE SET,ELEC:	80009	198-4025-00
	----- -----			-		(FROM A7P910 TO A1)		
	----- -----			-		(FROM A7P911 TO A1)		
	----- -----			-		(FROM A7P912 TO A1)		
	----- -----			-		(FROM A7P913 TO A1)		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
	070-3934-00			1		MANUAL,TECH:INSTRUCTION	80009	070-3934-00

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages.

A single change may affect several sections. Since the change information sheets are carried in the manual until all changes are permanently entered, some duplication may occur. If no such change pages appear following this page, your manual is correct as printed.

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MANUAL CHANGE INFORMATION

Date: 2-11-81 Change Reference: C100/281

Product: GENERAL Manual Part No.: GENERAL

DESCRIPTION

WARNING

During rackmount installation, interchanging the left and right slide-out track assemblies defeats the extension stop (safety latch) feature of the tracks. Equipment could, when extended, come out of the slides and fall from the rack, possibly causing personal injury and equipment damage.

When mounting the supplied slide-out tracks, inspect both assemblies to find the LH (left hand) and RH (right hand) designations to determine correct placement. Install the LH assembly to your left side as you face the front of the rack and install the RH assembly to your right side. Refer to the rackmounting instructions in this manual for complete information.

DESCRIPTION

b. Install an amplifier plug-in in the left compartment and set it for CH 1 mode; 50 mv/div..

c. Connect the test scope to the LEFT OUT connector. Set-up the test scope for 1 volt/div, 20 µs/div, untriggered.

d. Connect the output of the sine-wave generator to the amplifier CH 1 input. Set the sine-wave generator for 500 Hz, and adjust the generator amplitude control to display a 6 div. signal on the test scope.

e. Remove the cable from the test scope input and connect a 50 Ω termination to the cable. Reconnect the cable and termination to the test scope input.

f. Set the test scope for .1 Volt/div..

g. Check-for a display of 2.9 div. ± .3 div..

h. Repeat the procedure of Step 7a. through 7g. (for the left compartment) to check the CENTER and RIGHT compartments/outputs. Note that parts b and c will refer to either the CENTER or RIGHT compartments and connectors respectively.

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MANUAL CHANGE INFORMATION

Date: Aug. 26, 1982 Change Reference: M48148

Product: 5111A /R Manual Part No.: 070-3934-00

DESCRIPTION

EFF SN B010307

REPLACEABLE ELECTRICAL PARTS CHANGES

CHANGE TO:

A1W513	276-0532-00 & 176-0005-00	SHLD BEAD,ELEK:FERRITE & WIRE,ELEC
A1W514	276-0532-00 & 176-0005-00	SHLD BEAD,ELEK:FERRITE & WIRE,ELEC

These parts (toroids) are located on the A1-INTERFACE board.

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MANUAL CHANGE INFORMATION

Date: Aug. 12, 1982 Change Reference: M47730

Product: 5111A/R5111A Manual Part No.: 070-3934-00

DESCRIPTION

EFF SN B010224

REPLACEABLE ELECTRICAL PARTS & SCHEMATIC CHANGES

CHANGE TO:

A3	670-1621-12	CKT BOARD ASSY:HIGH VOLTAGE
A3C106	283-0692-00	CAP,FXD,MICA,DI:670PF,1%,300V
A3C126	283-0774-00	CAP,FXD,MICA,DI:639PF,1%,300V

These capacitors are located on the HIGH VOLTAGE board, and are shown on Diagram 2.

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MANUAL CHANGE INFORMATION

Date: June 24, 1982 Change Reference: M47313

Product: 5111A/R5111A Manual Part No.: 070-3934-00

DESCRIPTION

EFF SN B010100 (all serial numbers)

REPLACEABLE ELECTRICAL PARTS & SCHEMATIC CHANGES

REMOVE:

A1C921	281-0811-00	CAP,FXD,CER DI:10 PF,10%,100V

A1C921 is located on the A1-INTERFACE board and is shown on Diagram 1, Interface.

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MANUAL CHANGE INFORMATION

Date: April 29, 1982 Change Reference: C1/482

Product: 5111A/R5111A Manual Part No.: 070-3934-00

DESCRIPTION

REPLACEABLE ELECTRICAL PARTS CHANGES

CHANGE TO:

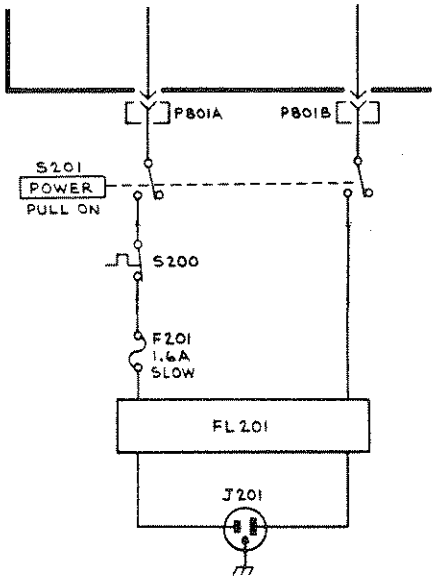
A3R236	315-0821-00	RES.,FXD,CMPSN: 820 OHM, 5%, 0.25 W
A3R254	308-0555-00	RES.,FXD, WW : 5 OHM, 5%, 3 W

A3R236 and A3R254 are located on the H.V. board, and are shown on Diagram 3, CRT Circuit.

SCHEMATIC CORRECTIONS

DIAGRAM 4, L.V. POWER SUPPLY & CALIBRATOR

S200 and S201 are reversed in the circuit.



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MANUAL CHANGE INFORMATION

Date: May 7, 1982 Change Reference: C2/582

Product: 5111A/R5111A Manual Part No.: 070-3934-00

DESCRIPTION

TEXT CHANGES

ADD AT END OF SPECIFICATION AND PERFORMANCE CHECK:

OUTPUT SIGNAL CHECK FOR OPTION 7 (ONLY)

1. SET-UP

a. Install amplifier plug-ins in both the left and center compartments, with a time-base in the right (horizontal) compartment.

b. Set the left amplifier as follows:

Display	on
Mode	CH 1
Trigger	CH 1
CH 1 Volts/Div	.1

c. Set the time-base as follows:

Display	Chop
Seconds/Div	1µs
Triggering	Auto
Source	Comp
Trig Level	Fully CW

d. Set the center amplifier Display off.

2. CHECK LEFT OUTPUT GAIN AND BANDWIDTH

a. Connect a 500 Hz sine-wave from a sine-wave generator to the left amplifier CH 1 input. Adjust the generator amplitude control to display a 6 div. signal on the 5111A Oscilloscope.

b. Connect the Opt. 7 LEFT signal output to a test scope, which is set-up to view .5 Volts/div at 20 µs/div, untriggered.

c. Check-that the test scope has a 6 div display ±.2 div..

d. Without re-adjusting the sine-wave generator amplitude, set the generator frequency for 500 kHz.

e. Check-that the test scope displays a minimum of 4.2 div.

f. Remove the signal from the left amplifier.

3. CHECK NOISE AND CHOP BREAKTHROUGH

a. Set the center amplifier plug-in as follows:

Display	on	CH 1 Volts/Div	.1
Mode	CH 1		
Trigger	CH 1		

DESCRIPTION

b. Position the left amplifier CH 1 and the center amplifier CH 1 so the displays overlap at center screen.

c. Set the test scope to 50 mv/div and adjust the trigger level for a stable display.

d. Check-for 100 mv peak of noise, displayed on the test scope.

4. CHECK CENTER OUTPUT GAIN AND BANDWIDTH

a. Set the test scope to .5 Volts/div.. Turn the left amplifier display off and connect a 500 Hz, 6 div. sine-wave from the sine-wave generator to the center amplifier CH 1 input.

b. Check-the test scope for a display of 6 div. ± .2 div..

c. Without varying the generator output amplitude, adjust the frequency for 500 kHz.

d. Check-the test scope display for a minimum of 4.2 div. of amplitude.

5. CHECK RIGHT OUTPUT GAIN AND SIGNAL POLARITY

a. Remove the cable from the center output and connect it to the right signal output.

b. Remove the signal from the center amplifier CH 1 input and connect it to the time-base input.

c. Set the time-base to 50 mv/div, external trigger, and adjust the sine-wave generator for a 500 Hz, 6 div. horizontal line.

d. Check-that the test scope displays 6 div. ± .2 div. amplitude.

e. Remove the signal from the time-base plug-in.

f. Set the time-base to 1µs/div and set the test scope to 1 Volt/div.. Adjust the test scope for a stable display.

g. Check-that the test scope displays a positive going ramp of at least 5 volts in amplitude.

6. CHECK GATE OUT

a. Remove the cable from the RIGHT output and connect it to the GATE OUT signal.

b. Ground the input to the test scope and position the trace on the test scope to the 2nd vertical graticule. Set the test scope to dc coupling.

c. Check-that the GATE OUT signal has a lower voltage of ≤ 0.4 V and a higher voltage of ≥ 2.4 V.

7. CHECK OUTPUT IMPEDANCE

a. Remove all plug-ins.

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MANUAL CHANGE INFORMATION

Date: May 18, 1982 Change Reference: 03/582

Product: 5111A/R5111A Manual Part No.: 070-3934-00

DESCRIPTION

TEXT CHANGES

ADDITIONS TO C2/582, OUTPUT SIGNAL CHECK FOR OPTION 7 (ONLY), STEP 3, AFTER PART d., Page 2 of 3.

ADD:

e. Move the test scope 50Ω bnc cable from the LEFT OUTPUT connector to the CENTER OUTPUT connector.

f. Check- for 100mv peak of noise, displayed on the test scope.