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

5116 OSCILLOSCOPE

INSTRUCTION MANUAL

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

070-4544-00
Product Group 52

Serial Number _____

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INSTRUMENT SERIAL NUMBERS

Each instrument has a serial number on a panel insert, tag, or stamped on the chassis. The first number or letter designates the country of manufacture. The last five digits of the serial number are assigned sequentially and are unique to each instrument. Those manufactured in the United States have six unique digits. The country of manufacture is identified as follows:

B000000	Tektronix, Inc., Beaverton, Oregon, USA
100000	Tektronix Guernsey, Ltd., Channel Islands
200000	Tektronix United Kingdom, Ltd., London
300000	Sony/Tektronix, Japan
700000	Tektronix Holland, NV, Heerenveen, The Netherlands

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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.

GROUNDING THE PRODUCT

This product is grounded through the grounding conductor of the mainframe power cord. To avoid electrical shock, plug the mainframe 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 mainframe 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.

DO NOT OPERATE IN EXPLOSIVE ATMOSPHERES

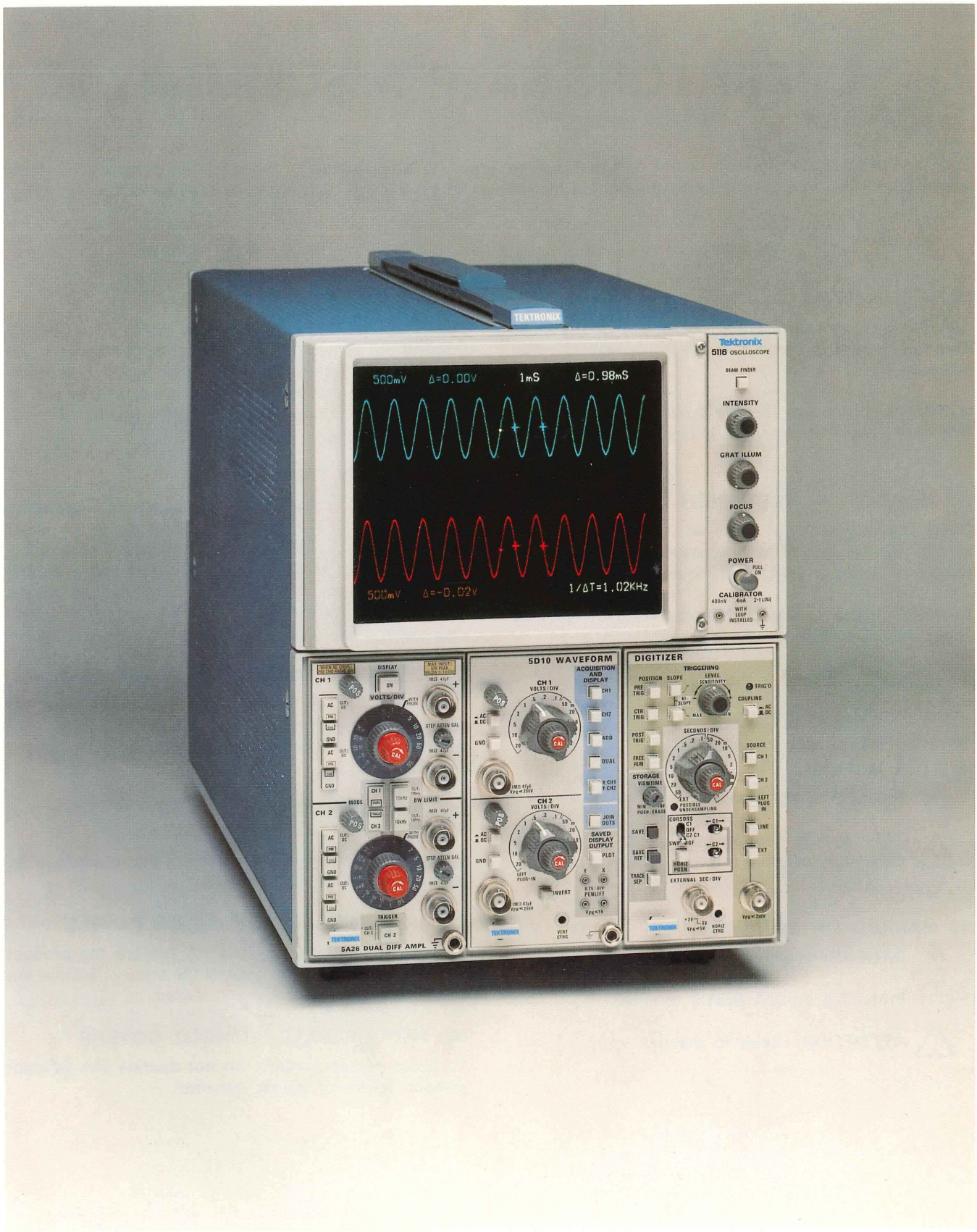
To avoid explosion, do not operate this product in an atmosphere of explosive gasses.

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.

DO NOT OPERATE WITHOUT COVERS

To avoid personal injury, do not operate this product without covers or panels installed.



5116 OSCILLOSCOPE WITH TEKTRONIX 5D10 WAVEFORM DIGITIZER PLUG-IN

OPERATING INSTRUCTIONS

This instruction manual provides both operating and servicing information for the oscilloscope. The manual is divided into nine sections. Operating and specification 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

The 5116 Oscilloscope and the 5D10 Waveform Digitizer unite to create a color system. Color enhances individual trace and readout identification, thereby, providing an improved user interface. The coding capabilities afforded by color allow interpretation and differentiation of data quickly, reduces measurement errors, and improves resolution by using the full screen for overlapping signals. The 5116 Oscilloscope, when used with the 5D10 Waveform Digitizer, displays the waveforms and readouts in blue green (cyan), orange, and neutral (off-white). (For details see "Color Operation" in this section.)

The 5116 Oscilloscope, used in noncolor applications, is compatible with the large selection of 5000-series plug-ins. When used with conventional real-time plug-ins, the display will be in one color, blue green.

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 × 10 division display; each division equals 1.27 centimeter (0.5 inch). 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.

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 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 +45°C. The instrument can be stored in ambient temperature between -55°C and +75°C. After storage at a temperature beyond the operating limits, allow the chassis temperature to come within the operating limit before power is applied.

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, color, 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.

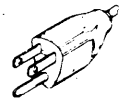
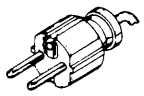
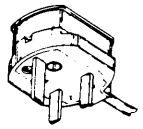
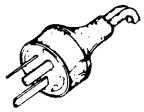
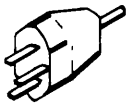
INSTALLATION

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

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 220V/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
[7]SEV—Schweizevischer Elektrotechischer Verein

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 to disengage it and pull the unit out of the plug-in compartment. (Refer to the 5D10 Waveform Digitizer Operators manual for removal of this particular plug-in.) 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 compartment 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 multichannel 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 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 XY 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.

Color is produced with the 5D10 Waveform Digitizer installed in the center and right compartments. The 5D10 Operators manual gives details of color operation, two-trace and three-trace displays, XY mode, and permanent waveform recording.

All 5D10 Waveform Digitizers with serial numbers of B020100 or greater have been modified to produce color signals for the 5116 Oscilloscope. If you need information to update a 5D10 Waveform Digitizer that has a serial number less than B020100, see your local Tektronix Field Office, or representative.

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 Figure 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 adjustment 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 particular plug-in unit. Refer to Figure 1-1 to locate the oscilloscope controls.

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. A 5D10 may be used instead of a time-base and should be installed in the center and right compartments. (See alternate settings for 5D10.)

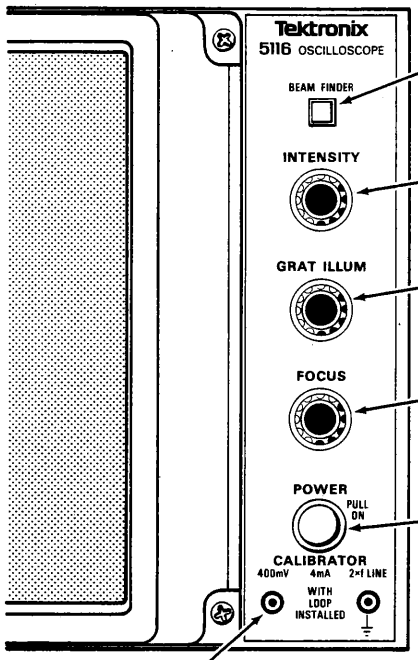
2. Set the POWER switch to off (pushed in) and connect the oscilloscope to a power source that meets the voltage and frequency requirements of this instrument.

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).



BEAMFINDER
Pushbutton

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

INTENSITY Control

Controls display brightness.

GRAT ILLUM Control

Adjusts the visibility of the graticule markings.

FOCUS Control

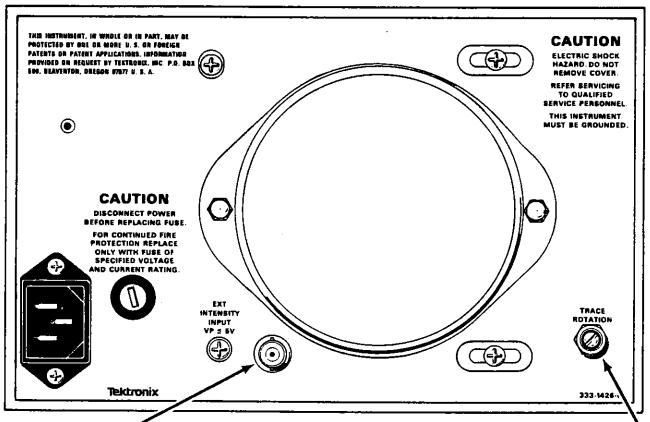
Provides adjustment to obtain a well-defined display.

POWER Switch

Turns instrument power on or off.

CALIBRATOR

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.

4544-101

Figure 1-1. Front- and rear-panel controls and connector.

5116 OSCILLOSCOPE

INTENSITY .....Fully counterclockwise
FOCUS .....Centered
GRAT ILLUM .....Fully counterclockwise

AMPLIFIER PLUG-IN

Display .....On
Position.....Centered
Volts/Div.....0.1
Volts/Div Cal .....Fully clockwise
Input coupling .....DC

TIME-BASE PLUG-IN

Display .....Chop
Position.....Centered
Swp Mag .....Off (out)
Sec/Div .....2 m
Sec/Div Cal.....Fully clockwise
Triggering .....Auto Trig (in), AC Coupl, +Slope
Triggering Source .....Composite (in)
Triggering Level .....Midrange

5D10 WAVEFORM DIGITIZER

NOTE

Use this setup when the 5D10 replaces the time-base unit.

Volts/Div (CH 1).....0.1
Cal .....Fully clockwise (in indent)
Position.....midrange
Input Coupling (CH 1) ...Dc (button out)
Gnd .....button out
Acquisition And Display
  CH 1 .....On (button in)
  Join Dots.....On (button in)
Saved Display Output
  Plot.....Off (button out)
Triggering
  Position.....Ctr Trig
  Slope .....(+ slope)
  Level .....Midrange
  Coupling.....Dc (button out)
  Source.....Ch 1
Seconds/Div .....2 m
  Cal .....Fully clockwise (in indent)
Cursors .....Off
  Swp Mgf .....Off (button out)
Storage
  Viewtime.....Min (fully counterclockwise)
  Save .....Off (button out)
  Save Ref.....Off (button out)
  Trace Sep .....Off (button out)

POWER CONTROL

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.

FOCUS ADJUSTMENT

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

GRATICULE ILLUMINATION ADJUSTMENT

6. Adjust the GRAT ILLUM control until the graticule markings can be read comfortably. Position the trace near the graticule center line using the plug-in position controls.

TRACE ALIGNMENT ADJUSTMENT

7. 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 graticule line and adjust the TRACE ROTATION control so that the trace is parallel with the graticule line.

CALIBRATION CHECK

8. Remove the CALIBRATOR patch cord and connect a 1X probe from the Ch 1 amplifier plug-in connector to the left (ungrounded) CALIBRATOR probe test jack.

9. 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. (The 5D10 does not have a horizontal position control.)

10. The display should be four divisions in amplitude with approximately 1.5 complete cycles over 10 divisions (for 60-hertz line frequency) shown horizontally. An incorrect display indicates that the oscilloscope or plug-ins should be recalibrated. Disconnect the 1X probe. Replace the CALIBRATOR patch cord.

BEAM FINDER CHECK

11. Move the display off screen with the vertical position control.

12. 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.

EXTERNAL INTENSITY INPUT

13. Connect a 5-volt peak-to-peak, 1 kHz sine-wave or square-wave signal to the EXT INTENSITY INPUT connector (on rear panel) and to the external trigger on the time-base plug-in. Adjust Volts/Div and Seconds/Div controls as needed to adequately view the signal.

14. 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.

15. Disconnect the signal setup and return INTENSITY to a normal viewing level.

COLOR TRACE CHECK

16. If the 5D10 is not installed, press the POWER button to turn off the oscilloscope and install the 5D10. Pull the POWER button to turn on the oscilloscope.

NOTE

When the oscilloscope is turned off the display will not darken uniformly. Small dark dots will grow over a period of several minutes, joining to completely darken the viewing area. This is a characteristic of the color shutter and in no way affects the crt.

17. Set 5D10 controls according to the Initial Control Settings in the front of this section. Center trace with the Ch 1 position control.

18. Press the Dual button in the Acquisition and Display section on the 5D10. A blue-green trace (Ch 1) and an orange trace (Ch 2) should be visible. The time measurement (2 ms), in the upper right corner, should be a neutral (off white) color.

NOTE

Off-axis viewing of the color display will change the quality of the color as the viewing angle increases.

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." Color operation and application is discussed in the 5D10 Waveform Digitizer Operators manual.

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. Be careful that the INTENSITY control is not set too high when changing the time-base unit sweep rate from a fast to slow sweep rate, or when changing to the XY mode of operation.

DISPLAY FOCUS

If a well-defined display cannot be obtained with the FOCUS control, even at low INTENSITY control settings, resetting 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 settings of the trace will come into sharpest focus at the same position of the FOCUS control.

GRATICULE ILLUMINATION

The graticule illumination control adjusts the visibility of the graticule markings.

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 1.27 centimeters (0.5 inch) 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. When using real-time plug-ins, position the start of the timing area to the second vertical graticule line and adjust the time-base unit so the end of the timing area does not extend beyond the tenth vertical graticule line.

BEAM FINDER

The BEAM FINDER button provides a means of locating a display that overscans the viewing area either vertically or horizontally. When the BEAM FINDER button 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 button, 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 button; the display should remain within the viewing area.

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.

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 removing the CALIBRATOR patch cord and inserting the probe tip into the left (nongrounded side) probe test jack.

COLOR SHUTTER

The color shutter combines polarizers and a type of liquid crystal which will transmit a selected color emitted from the crt. The polarizers contained in the color shutter will transmit a certain color along one axis and all other colors, including the desired color, along the other axis. The liquid crystal cell in the off state will rotate visible light by 90°. When a voltage is applied to the cell, visible light will pass through without being rotated. Alignment of the polarized light exciting the liquid crystal with the output polarizer will give an orange or blue-green color if the cell is off or on respectively. Information written in the neutral (off white) color is a combination of the orange and blue-green color. (See "Color Operation" later in this section.)

INTENSITY MODULATION

When using real-time plug-ins, 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. 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, when used with real-time plug-ins. With uncalibrated horizontal sweep or XY 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.

XY OPERATION

In some applications, it is desirable to display one signal versus another (XY) 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. When using the 5D10 Waveform Digitizer, a color XY display may be obtained (see "XY Mode" in the Color (Part II) section of the 5D10 Waveform Digitizer Operators Instruction Manual). 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 XY display is to install an amplifier unit in one of the vertical compartments and an amplifier unit in the horizontal compartment. (Check amplifier unit gain as given in the amplifier unit instruction manual to obtain calibrated horizontal deflection factors.) This method provides the best XY 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 with real-time plug-ins. Install a 5B1-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

OPTION 7 provides crt related signals to standard bnc 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 XY plotters in conjunction with the oscilloscope.

DISPLAY PHOTOGRAPHY

A permanent record of the crt display is obtained with an oscilloscope camera system. For recording color events, color film is available. The instruction manuals for the Tektronix oscilloscope cameras include complete instructions for obtaining waveform photographs. (See the current Tektronix catalog for a complete listing of oscilloscope cameras and mounting adapters.)

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.

See "Color Operation" in this section for additional means of permanently recording waveform information.

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.

Color with the TEKTRONIX 5D10 Waveform Digitizer

The 5D10 Waveform Digitizer produces color signals for the 5116 Oscilloscope. This plug-in is used in the right vertical and horizontal compartments. A waveform from each of the two channels plus a reference waveform is allowed in this configuration. The addition of a dual-trace amplifier installed in the left vertical compartment permits a waveform from each channel in this compartment and a waveform from Ch 1 of the 5D10, when the 5D10 is in Left Plug-In mode. A reference for these waveforms may be displayed, however, the number of data points per waveform is diminished for each additional waveform displayed.

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 (Alternate or Chopped) will occur. When neither 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 multitrace 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 the 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 multitrace 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.

COLOR OPERATION

Use of the 5D10 Waveform Digitizer allows signals to be displayed in color. All single-trace waveforms are blue green. Color is used to distinguish two channels of information when displayed at the same time; channel 1 is displayed in blue green and channel two is displayed in orange.

When the 5D10 Acquisition and Display is set for Ch 2 and operated in Left Plug-in mode, channel one of the left vertical amplifier is displayed in blue green and channel 2 of the left vertical amplifier is displayed in orange. When the 5D10 Acquisition and Display is set for Dual trace and Left Plug-In mode, blue green represents the signal from channel 1 of the 5D10 and orange represents the signals from the left vertical amplifier. See Tables 1-2 and 1-3 for further explanation of waveform colors.

The reference waveform is orange when used with a single trace waveform. In all other cases, the reference matches the color of the corresponding waveform.

The voltage and Δ voltage readout fields are in the color of the respective channels represented. A neutral (off-white) color is used for time, Δ time, and 1/ΔT readout fields.

Cursors are the same color as the waveform on which they are located. The trigger-point markers are intensified neutral colored dots.

Permanent waveform records, in more than one color, can be made with an XY recorder properly connected to

TABLE 1-2
Waveform Colors

5D10 ACQUISITION AND DISPLAY and Amplifier setup*	5D10: CH1	5D10: CH2	5D10: DUAL		5D10: DUAL, Left Plug-In Left Amp.: Ch1		5D10: DUAL Left Plug-In Left Amp.: Ch2		5D10: DUAL, Left Plug-In Left Amp.: Dual		5D10: CH2, Left Plug-In Left Amp.: Dual
5D10 Channel Displayed	CH1	CH2	CH1	CH2	CH1	CH2	CH1	CH2	CH1	CH2	CH2
Blue-Green Trace	CH1	CH2	CH1		CH1		CH1		CH1		Ch1
Orange Trace				CH2		Ch1		Ch2		Ch1 & Ch2	Ch2
Blue-Green Ref.			CH1		CH1		CH1		CH1		Ch1
Orange Reference	CH1	CH2		CH2		Ch1		Ch2		Ch1 & Ch2	Ch2

*The waveform is acquired and SAVE REF and TRACE SEP is reset for each setup.

TABLE 1-3
Interaction of SAVE and SAVE REF on ACQUISITION AND DISPLAY

The ACQUISITION and DISPLAY mode switch setting selected after SAVE or SAVE REF is pressed (button in).		CH1	CH2	ADD	DUAL	XY
		Resultant display format				
The ACQUISITION and DISPLAY mode switch setting when the signal was acquired and SAVEd	CH1	CH1	CH1	CH1	CH1	CH1
	CH2	CH2	CH2	CH2	CH2	CH2
	ADD	ADD	ADD	ADD	ADD	ADD
	DUAL	CH1*	CH2*	DUAL	DUAL	XY
	XY	CH1*	CH2*	DUAL	DUAL	XY

*The display in these modes is either the CH 1 or the CH 2 portion of the data in memory which is stored in dual-channel format.

the 5D10 Waveform Digitizer front-panel Saved Display Output connectors. (See the 5D10 Waveform Digitizers Operators manual.)

Apply ADD and XY color waveforms according to Table 1-2 as they interact according to Table 1-3.

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.

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).

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.

Peak-to-peak volts	=	4.6 (divisions)	×	5 (Volts/Div setting)	=	23 volts

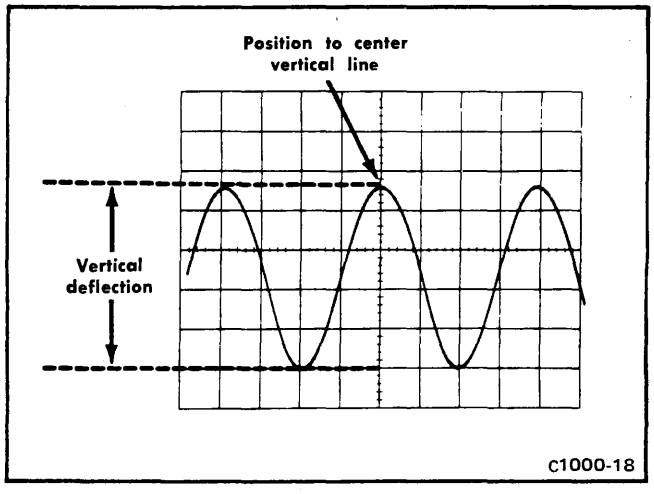


Figure 1-2. Measuring peak-to-peak voltage of a waveform.

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 Figure 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).

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

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

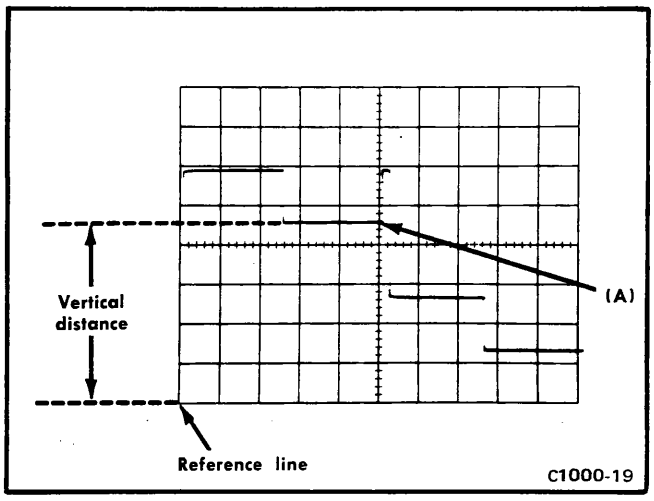


Figure 1-3. Measuring instantaneous dc voltage with respect to a reference voltage.

COMPARISON 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 switch 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.

Modified Deflection Factor	=	Volts/Div setting	×	Deflection Conversion Factor

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

Signal Amplitude	=	Modified Deflection Factor	×	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):

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

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

(2 V) (1.5) = 3 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 V) (5) = 15 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 period of the horizontal deflection in divisions (established in step 1) and the setting of the Seconds/Div switch. This is the Deflection Conversion Factor.

Deflection Conversion Factor	=	Reference: Horizontal deflection (divisions)	×	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.

Modified Deflection Factor	=	Seconds/Div switch setting	×	Deflection Conversion Factor

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

Period	=	Modified Deflection Factor	×	Horizontal deflection (divisions)

EXAMPLE: Assume a reference signal frequency of 455 hertz (period 2.2 milliseconds), a Seconds/Div switch setting of 0.2 ms, and a horizontal deflection of eight divisions. Substituting these values in the Deflection Conversions Factor formula (step 2):

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

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 a signal amplitude of about four divisions.

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 nonlinearity may occur in the first and last graticule divisions of the display). Refer to Figure 1-4.

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-

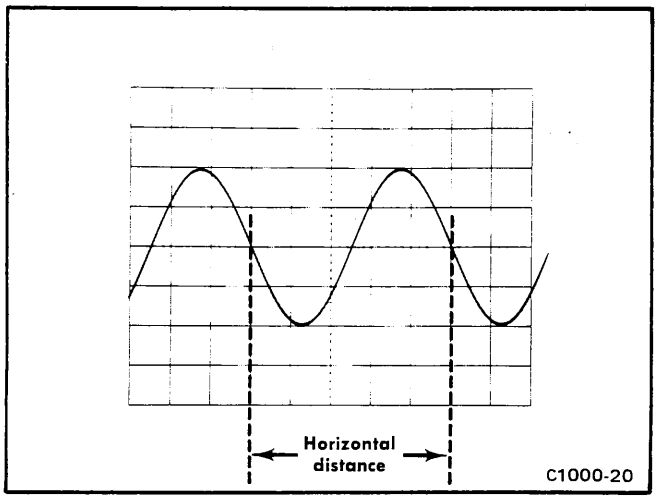


Figure 1-4. Measuring time duration (period) between points on a waveform.

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 0.1 ms. Using the formula:

$$\text{Period} = \text{Horizontal distance (divisions)} \times \text{Sec/Div switch setting} = (5)\ (0.1\ \text{ms}) = 0.5\ \text{ms}$$

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 Figure 1-5, which has a period of 0.5 millisecond is

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

RISE-TIME MEASUREMENT

Rise-time 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 rise time 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).

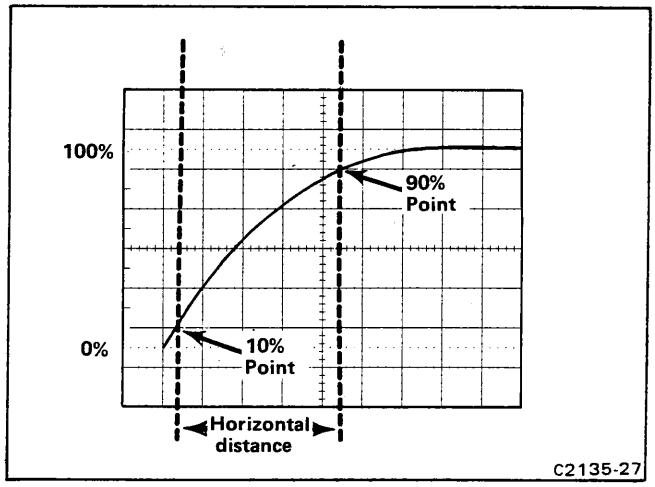


Figure 1-5. Measuring Rise Time.

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 rise time:

$$\text{Rise Time Period} = \text{Horizontal distance (divisions)} \times \text{Sec/Div switch setting} = (4)\ (1\ \mu s) = 4\ \mu s$$

The rise time is 4 microseconds.

TIME DIFFERENCE MEASUREMENTS

When used in conjunction with a calibrated time-base plug-in unit, the multitrace 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 for 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 (left plug-in) and Channel 2 (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).

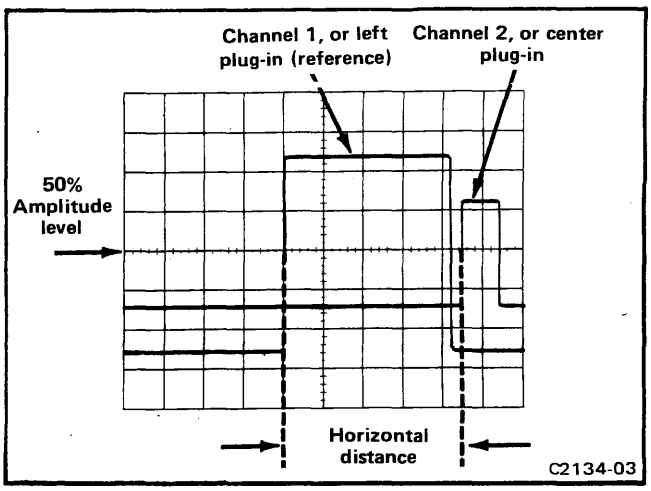


Figure 1-6. Measuring time difference between two pulses.

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.

MULTITRACE 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 for 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 (left plug-in) and Channel 2 (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 that 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 (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.

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 Figure 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 switch setting). One of the easiest ways to increase the sweep rate is with the Swp Mag (X10) 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 Figure 1-7, but with the Swp Mag button pushed in. With a horizontal difference of six divisions the phase difference is

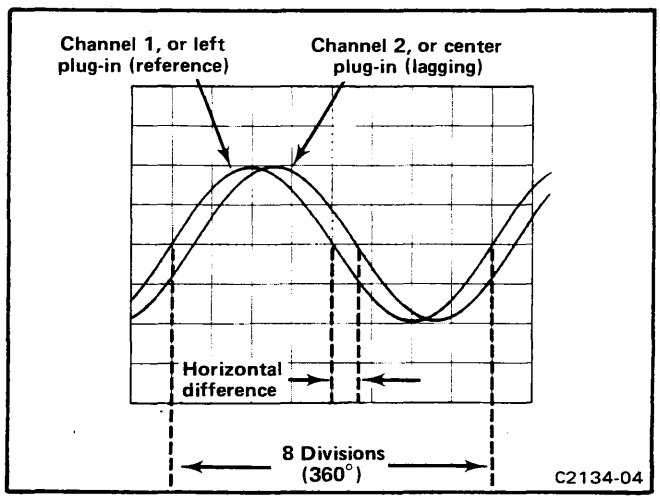


Figure 1-7. Measuring phase difference.

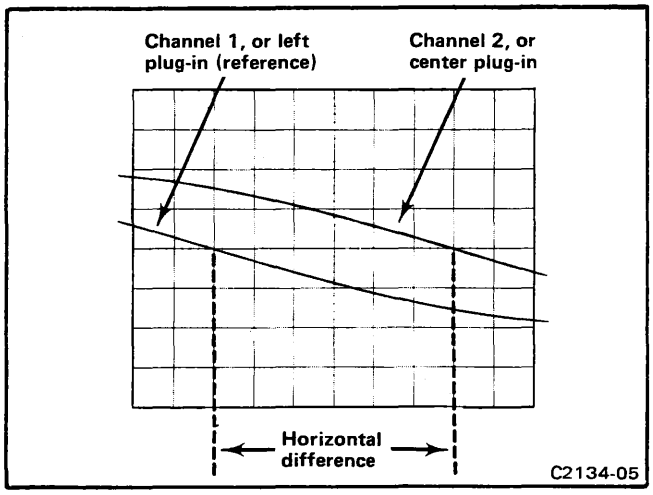


Figure 1-8. High-resolution phase difference measurement with increased sweep rate.

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

The phase difference is 27°.

XY PHASE MEASUREMENTS

The XY 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 Figure 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 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 Figure 1-9, where A is 6 divisions and B is 0.4 division.

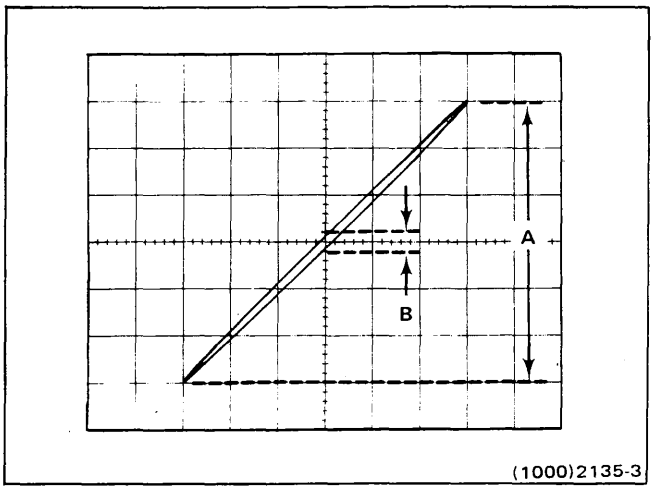


Figure 1-9. Phase difference measurement from an XY display.

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°.

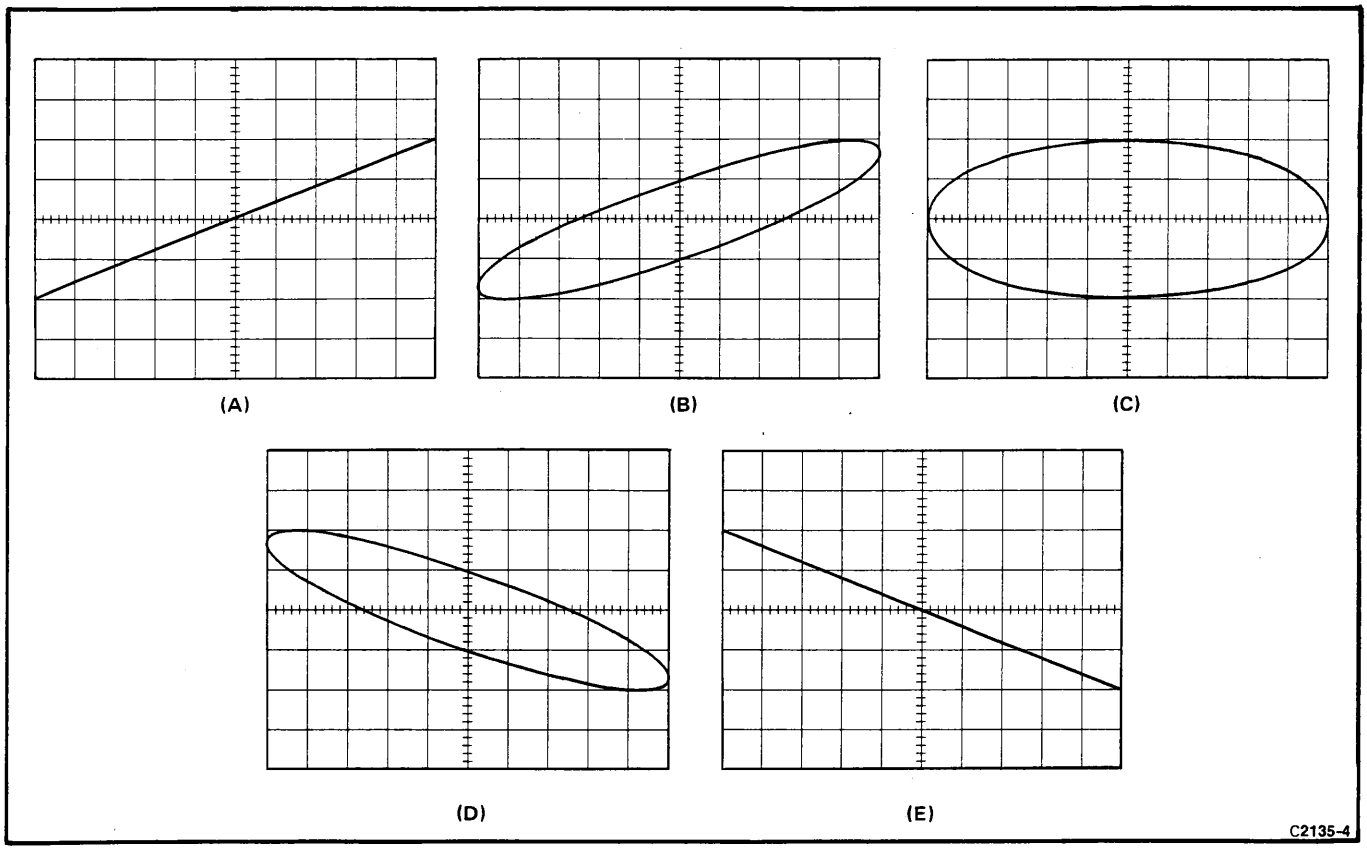


Figure 1-10. Phase of a Lissajous display. (A) 0° or 360°, (B) 30° or 330°, (C) 90° or 270°, (D) 150° or 210°, (E) 180°.

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 +45°C (unless otherwise noted), and each plug-in must be operating (fully installed) in a calibrated system.

Color capability is present when used with a TEKTRONIX 5D10 Waveform Digitizer serial number B020100 and above.

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/div.
Bandwidth	Dc to at least 2 MHz with a calibrated 5A18N.	
Channel Switching		
Chop Time Segment/Channel		Approximately 5 μs per channel. (Approx 4 μs displayed, approx 1 μs blanked.)
Vertical Compartment Chop Switching Sequence		Left, left, center, center...
Vertical Plug-In 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).	
Vertical Compartment Alternate Rate	One-half sweep rate (once every two sweeps).	
Amplifier Channel Alternate Rate	One-fourth sweep rate (once every four sweeps).	
Signal Outputs (Option 7)		
Left Out, Center Out Signals		Crt-related plug-in display signals (vertical and horizontal). Derived from interface signal output pins.
Amplitude	0.5 V/crt div, ±3% into ≥100 kΩ.	Time base provides positive-going sawtooth ≥5 V.
DC Offset		±500 mV max.

TABLE 2-1 (CONT)
Vertical Amplifier

Characteristics	Performance Requirements	Supplemental Information
Signal Outputs (Option 7) (cont)		
Left Out, Center Output Signals (cont)		
Output Impedance	Approximately 1 kΩ.	
Dynamic Range		±4 V min.
Amplifier Bandwidth	At least 500 kHz; with load ≤50 pF, and amplitude up to ±2 V.	
Common Mode Rejection Ratio		At least 28 dB at 1 kHz.
Noise and Chop Breakthrough[1]		Less than 100 mV peak at each output connector (chopped between plug-ins, with single channel in each plug-in). Measured over dc to 1 MHz bandwidth.

[1]**If excessive noise and chop breakthrough occur, refer to the 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 Sensitivity (Differential Input)		50 mV/div.
Horizontal Centering	0.5 divisions 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, dc to 100 kHz.	Checked with two plug-ins of the same type.
Signal Outputs (Option 7)		
Right Out Signal		Crt-related sweep signal. Derived from interface signal output pins.
Amplitude	0.5 V/crt div, ±3% into ≥100 kΩ.	Time base provides positive-going sawtooth ≥5 V.
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: Sourcing 40 μA, ≥2.4 V.
Rise time		≤1.5 μs into ≤50 pF.
Fall time		≤0.3 μs into ≤50 pF.

TABLE 2-3
Z-Axis Amplifier

Characteristics	Performance Requirements	Supplemental Information
External Intensity Input		
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		
Accelerating Voltage		4.5 kV.
Deflection		Electrostatic.
Geometry	0.1 division or less.	
Orthogonality		90°, within ±1°.
Beam Finder	Limits display to graticule area and intensifies display if brightness level is low.	

TABLE 2-5
Color

Characteristics	Performance Requirements	Supplemental Information
Color		
With 5D10	Orange, blue green, and neutral.	
With other plug-ins	Blue green.	

TABLE 2-6
Calibrator and Power Supply

Characteristics	Performance Requirements	Supplemental Information
Calibrator		
Voltage	400 mV, within ±1%.	
Current	4 mA, within ±1%.	
Frequency	Twice the power line frequency.	

TABLE 2-6 (CONT)
Calibrator and Power Supply

Characteristics	Performance Requirements	Supplemental Information
Power Input		
Line Voltage (RMS)		6 selectable ranges: 90-110 V 99-121 V 108-132 V 180-220 V 198-242 V 216-250 V 250 V maximum.
Line Frequency		48 to 440 Hz.
Line Fuse		1.6 A slow blow (90-132 V ranges). 1 A slow blow (180-250 V ranges).
Power Consumption		110 watts maximum.
Insulation Voltage		Withstands at least 1500 V rms at 50 to 60 Hz for minimum of 10 seconds.
Ground Continuity		Less than 0.1 Ω between safety ground connection and instrument.

ENVIRONMENTAL CHARACTERISTICS

TABLE 2-7
Environmental

Characteristics	Information
Temperature	
Operating	0°C to +45°C.
Storage	-55°C to +75°C.
Altitude	
Operating	To 15,000 feet (4.57 km).
Storage	To 50,000 feet (15.24 km).
Vibration	
Operating and Nonoperating	Tested to MIL-T-28800C, SECT. 4.5.5.3.1, Type III, Class 5, Style E&F.
Shock	
Operating and Nonoperating	Tested to MIL-T-28800C, SECT. 4.5.5.4.1, Type III, Class 5, Style E&F.
Bench Handling	Tested to MIL-T-28800C, SECT. 4.5.5.4.3, Type III, Class 5, Style E&F.

TABLE 2-7 (CONT)
Environmental

Characteristics	Information
Humidity	
Operating and Storage	5 days, per MIL-T-28800C, Type III, Class 5.
Transportation	Qualified under National Safe Transit Committee Test Procedure 1A, Category II.
Vibration and Bounce (packaged product)	NSTA 1A-B-1.
Drop (packaged product)	NSTA 1A-B-2.
Electromagnetic Compatibility	Tested to MIL-T-28800C and MIL-STD-461A.

PHYSICAL CHARACTERISTICS

TABLE 2-8
Physical

Characteristics	Information
Overall Dimensions	
Height	11.90 in. (302.3 mm)
Length	20.0 in. (508.0 mm)
Width	8.4 in. (213.4 mm)
Finish	Blue-vinyl coated aluminum cabinet.
Net Weight	Approximately 23.6 lbs. (10.7kg)

POWER TO CUSTOM PLUG-INS

A blank plug-in 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 2-9 lists the maximum current draw and Interface pin assignment for the power supply voltages recommended for operating custom plug-ins.

TABLE 2-9
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

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.

SERVICING SAFETY SUMMARY

FOR QUALIFIED SERVICE PERSONNEL ONLY

Refer to the 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.

CRT HANDLING

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

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.

PERFORMANCE CHECK AND ADJUSTMENT

PART I—PERFORMANCE CHECK

This procedure checks the oscilloscope for measurement accuracy against the tolerances listed as Performance Requirements in the Electrical Characteristics in section 2. 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, because all checks are made from the front panel or, in the case of Option 7, from connectors located at the rear of the instrument.

The electrical Characteristics in this section are valid only if the oscilloscope has been calibrated at an ambient temperature between +20° to +30°C and is operating at an ambient temperature between 0° to +45°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 under Electrical Characteristics in section 2; 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 check the performance 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.

INDEX TO PART I— PERFORMANCE CHECK

TABLE 3-1
Test Equipment

Description	Minimum Specification	Purpose	Examples of Applicable Test Equipment
1. Amplifier	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.
2. Time Base	Sweep rate, at least 2μs/div.	All tests except Phase Shift check. Two required for Option 7 Gate Out and Impedance checks.	a. TEKTRONIX 5B10N Time Base/Ampl.
3. Color Plug-In		Provides color signals.	a. TEKTRONIX 5D10 Waveform Digitizer (B020100 and above).
4. Sine-Wave Generator, High Frequency	Frequency, 50 kHz within 5%: output amplitude, variable from 250 mV to 5 V into 50 Ω; flatness ±3% (2 MHz bandwidth only).	Vertical Bandwidth, Horizontal Bandwidth, and Z-Axis checks.	a. TEKTRONIX SG 503 Leveled Sine Wave Generator with power module.
5. Sine-Wave Generator, Low frequency	Frequency, 100 kHz and below within 5%; output amplitude, variable from 250 mV to 5 V into 50 Ω.	Phase check.	a. TEKTRONIX FG 503 Function Generator with power module.
6. Calibration Generator	Amplitude calibration, 5 mV to 5 V; accuracy, ±0.25% into 1 MΩ; output, 1 kHz square wave.	Vertical and Horizontal Gain adjustments.	a. TEKTRONIX PG 506 Calibration Generator with power module.
7. Digital Multimeter[1]	Range, zero to 400 volts; accuracy, within 0.1%.	Power Supply check.	a. TEKTRONIX DM 501A Digital Multimeter with power module and test leads.
8. Power Module Mainframe (TM 500 series)	Capable of housing and powering one of the 500-series test instruments.	Provides housing and power for sine-wave generator.	a. TEKTRONIX TM 501 Power Module Mainframe. b. TEKTRONIX TM 503 Power Module Mainframe.
9. Test Oscilloscope	Deflection factor, 1 mV to 50 V/div; input impedance, 1 megohm; frequency response, dc to 2 MHz.	Check Option 7; Gate Out.	a. TEKTRONIX 5110 Oscilloscope.
10. Coaxial Cable (2 required)	Impedance, 50Ω; length, 42 inch; connectors, bnc.	Provides signal interconnection.	a. Tektronix part 012-0057-01.
11. 1X Passive Probe	Compatible with 5A-series amplifiers used in the oscilloscope.	Calibrator Signal checks.	a. TEKTRONIX P6101 Probe. a. TEKTRONIX P6062B Probe.

[1]**Used in Adjustment procedure ONLY; not used for Performance Check.**

TABLE 3-1 (CONT)
Test Equipment

Description	Minimum Specification	Purpose	Example of Applicable Test Equipment
12. Termination (2 required)	Impedance, 50Ω; accuracy within 2%; connectors, bnc.	Vert and Horiz Bandwidth, Phase Shift check.	a. Tektronix part 011-0049-01.
13. Tee Connector	Connectors, bnc.	Phase and Z-Axis checks.	a. Tektronix part 103-0030-00.
14. Screwdriver	Length, 3-inch shaft; bit size, 3/32 inch; insulated.	Trace Alignment.	a. Xcelite R3323.
15. Slotted Screwdriver[1]	Overall length 7 7/8".	Cabinet removal.	a. Xcelite R144.
16. Pozidriv Screwdriver[1]	Overall length 6 3/4".	Cabinet removal.	a. Pozidriv 64-131
17. Resistor[1]	20 Ω, 125 mW, .1%.	Calibrator output voltage check.	a. Tektronix part 321-0030-04.
18. Interconnection Aid[1]	Two pin harmonica type on 0.100 inch centers.	Check Calibrator voltage and current.	a. Tektronix part 131-0993-00.

[1]**Used in Adjustment procedure ONLY; not used for Performance Check.**

PERFORMANCE CHECK INITIAL SETUP AND POWER-UP SEQUENCE

1. Ensure that all power switches are off.
2. Check the rear panel of the oscilloscope to ensure that the indicated line voltage and the line voltage source are the same. Connect a power cord to the oscilloscope.
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 in the power module.
5. Install a dual-trace vertical amplifier into the left vertical compartment of the oscilloscope.
6. Install a time base into the horizontal compartment of the oscilloscope.
7. Set 5116 Oscilloscope controls:

   INTENSITY ..... Centered
   GRAT ILLUM ..... Fully clockwise
   FOCUS ..... Centered

8. 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.
9. Set controls according to setup conditions in applicable section during warm-up.

NOTE

Titles for external controls, connectors, and indicators of the oscilloscope front- and rear-panel are capitalized in this procedure (e.g., INTENSITY, POWER).

A. DISPLAY

Equipment Required: (Numbers correspond to those listed in Table 3-1, Test Equipment.)

1. Amplifier
2. Time Base

Shaded lines identify Performance Requirement CHECK.

A1. DISPLAY PRELIMINARY SETUP

a. Perform the Performance Check Initial Setup and Power-Up Sequence procedure at the beginning of the Part I—Performance Check procedure.

b. Refer to Section 6, Instrument Options, and to the Change Information section at the back of this manual for any changes which may affect this procedure.

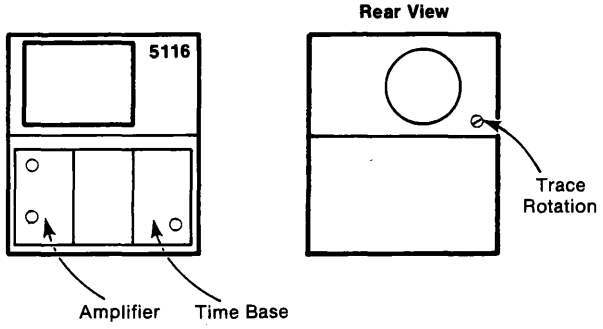
A2. CHECK TRACE ALIGNMENT

NOTE

First perform step A1, then proceed.

A2. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:

Amplifier

Display	On (In)
CH 1 Position	Centered
Mode	CH 1 (In)
CH 1 Volts/Div	1
CH 1 Volts/Div Cal	Fully clockwise
CH 1 Input Coupling	DC
Trigger	CH 1 (In)

Time Base

Display	Chop
Position	Centered
Swp Mag	Off (Out)
Seconds/Div	1 m
Seconds/Div Cal	Fully clockwise
Triggering	Auto Trig. (In), AC Coupl, +Slope
Triggering Source	Composite (In)

4544-300

a. Adjust INTENSITY, FOCUS, and GRAT ILLUM for a well-defined trace and comfortable viewing level.

b. Position the horizontal trace over the center horizontal graticule line. The trace should extend horizontally past the edges of the graticule area.

c. **CHECK**—that the trace is parallel to the graticule line.

d. Adjust the TRACE ROTATION control (rear-panel adjustment) to align the trace horizontally. This may be adjusted by hand or with a screwdriver.

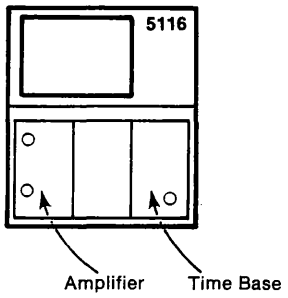
A3. CHECK GEOMETRY

NOTE

If the preceding step was not performed, first perform step A1, then proceed.

A3. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:

Amplifier

Display	On (In)
CH 1 Position	Centered
Mode	CH 1 (In)
CH 1 Volts/Div	1
CH 1 Volts/Div Cal	Fully clockwise
CH 1 Input Coupling	DC
Trigger	CH 1 (In)

Time Base

Display	Chop
Position	Centered
Swp Mag	Off (Out)
Seconds/Div	1 m
Seconds/Div Cal	Fully clockwise
Triggering	Auto Trig. (In), AC Coupl, +Slope
Triggering Source	Composite (In)

4544-301

a. Adjust INTENSITY, FOCUS, and GRAT ILLUM for a well-defined trace and comfortable viewing level.

b. Position the horizontal trace over the center graticule line. The trace should extend horizontally past the edges of the graticule area.

c. **CHECK**—that horizontal bowing and tilt of the trace display is less than 0.1 division when the trace is set at the top, then the bottom horizontal graticule lines, respectively.

d. Center trace.

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

f. Position the vertical trace to the center graticule line. The trace should extend vertically past the edges of the graticule area.

g. **CHECK**—that vertical bowing and tilt of the trace display is less than 0.1 division when the trace is positioned at the first and eleventh vertical graticule lines.

h. Center trace.

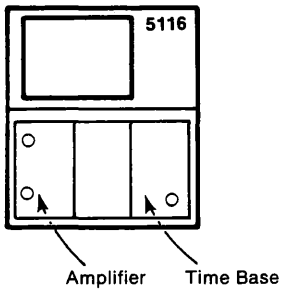
A4. CHECK BEAM FINDER

NOTE

If the preceding step was not performed, first perform step A1, then proceed.

A4. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:

Amplifier

Display	On (In)
CH 1 Position	Centered
Mode	CH 1 (In)
CH 1 Volts/Div	1
CH 1 Volts/Div Cal	Fully clockwise
CH 1 Input Coupling	DC
Trigger	CH 1 (In)

Time Base

Display	Chop
Position	Centered
Swp Mag	Off (Out)
Seconds/Div	1 m
Seconds/Div Cal	Fully clockwise
Triggering	Auto Trig. (In), AC Coupl, +Slope
Triggering Source	Composite (In)

4544-302

a. Adjust FOCUS and GRAT ILLUM for a well-defined trace and comfortable viewing level.

b. Set the INTENSITY control for a dim trace.

c. Press and hold the BEAM FINDER pushbutton in, then rotate the Position control of the vertical amplifier and the time base fully clockwise and counterclockwise.

d. **CHECK**—that the display is intensified, compressed, and remains within the graticule area.

e. Center the trace and release the BEAM FINDER pushbutton. Return the INTENSITY control to a normal setting.

B. AMPLIFIER OPERATION

Equipment Required: (Numbers correspond to those listed in Table 3-1, Test Equipment.)

1. Amplifier (2 required)
2. Time Base (2 required)
5. Sine-Wave Generator, Low Frequency
8. Power Module Mainframe
9. Test Oscilloscope
10. Coaxial Cable (42-inch)
11. 1X Passive Probe

Shaded lines identify Performance Requirement CHECK.

B1. AMPLIFIER PRELIMINARY SETUP

a. Perform the Performance Check Initial Setup and Power-Up Sequence procedure at the beginning of the Part I—Performance Check procedure.

b. Refer to Section 6, Instrument Options, and to the Change Information section at the back of this manual for any changes which may affect this procedure.

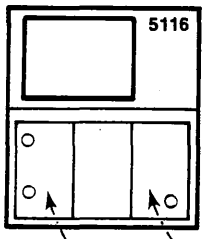
B2. CHECK AMPLIFIER ALTERNATE OPERATION

NOTE

First perform step B1, then proceed.

B2. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:

Amplifier

Display	On (In)
CH 1 & CH 2 Position	Centered
Mode	Dual Trace (In)
CH 1 & CH 2 Volts/Div	1
CH 1 & CH 2 Volts/Div Cal	Fully clockwise
CH 1 & CH 2 Input Coupling	DC
Trigger	CH 1 & CH 2 (In)

Time Base

Display	Alt
Position	Centered
Swp Mag	Off (Out)
Seconds/Div	1 m
Seconds/Div Cal	Fully clockwise
Triggering	Auto Trig. (In), AC Coupl, +Slope
Triggering Source	Composite (In)

4544-303

a. Adjust INTENSITY, FOCUS, and GRAT ILLUM for a well-defined trace and comfortable viewing level.

b. Position the traces about two divisions apart.

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 left vertical compartment to the right vertical (center) compartment. Pull the POWER switch on.

f. Repeat parts b, c, and d of this step.

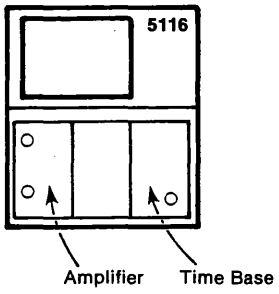
B3. CHECK AMPLIFIER CHOP OPERATION

NOTE

If the preceding step was not performed, first perform step B1, then proceed.

B3. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:

Amplifier

Display	On (In)
CH 1 & CH 2 Position	Centered
Mode	Dual Trace (In)
CH 1 & CH 2 Volts/Div	1
CH 1 & CH 2 Volts/Div Cal	Fully clockwise
CH 1 & CH 2 Input Coupling	DC
Trigger	CH 1 & CH 2 (In)

Time Base

Display	Chop
Position	Centered
Swp Mag	Off (Out)
Seconds/Div	1 m
Seconds/Div Cal	Fully clockwise
Triggering	Auto Trig. (In), AC Coupl, +Slope
Triggering Source	Composite (In)

4544-304

a. Adjust INTENSITY, FOCUS, and GRAT ILLUM for a well-defined trace and comfortable viewing level.

b. Position traces about two divisions apart.

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

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

e. Press the POWER switch to turn off the oscilloscope and change the amplifier from the left vertical compartment to the right vertical (center) compartment. Pull the POWER switch on.

f. Repeat parts b, c, and d of this step.

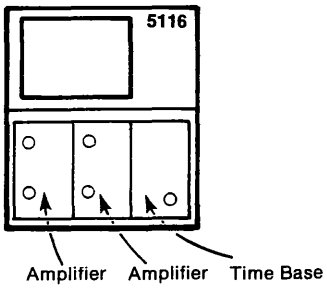
B4. CHECK CHOP OPERATION BETWEEN AMPLIFIERS

NOTE

If the preceding step was not performed, first perform step B1, then proceed.

B4. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:

Left Amplifier
- Display ..... On (In)
- CH 1 & CH 2 Position ..... Centered
- Mode ..... Dual Trace (In)
- CH 1 & CH 2 Volts/Div 1
- CH 1 & CH 2 Volts/Div Cal ..... Fully clockwise
- CH 1 & CH 2 Input Coupling ..... DC
- Trigger ..... CH 1 & CH 2 (In)

Right Amplifier
- Display ..... On (In)
- CH 1 & CH 2 Position ..... Centered
- Mode ..... Dual Trace (In)
- CH 1 & CH 2 Volts/Div 1
- CH 1 & CH 2 Volts/Div Cal ..... Fully clockwise
- CH 1 & CH 2 Input Coupling ..... DC
- Trigger ..... CH 1 & CH 2 (In)

Time Base
- Display ..... Chop
- Position ..... Centered
- Swp Mag ..... Off (Out)
- Seconds/Div ..... 1 m
- Seconds/Div Cal ..... Fully clockwise
- Triggering ..... Auto Trig. (In), AC Coupl, +Slope
- Triggering Source ..... Composite (In)

4544-305

a. Adjust INTENSITY, FOCUS, and GRAT ILLUM for a well-defined trace and comfortable viewing level.

b. Position left vertical amplifier traces two divisions apart from right vertical amplifier traces.

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

d. **CHECK**—for two traces for each amplifier, (one for each channel) at all sweep rates, without alternation.

NOTE

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

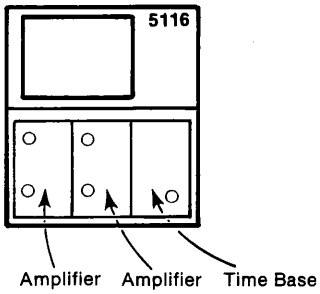
B5. CHECK ALTERNATE OPERATION BETWEEN AMPLIFIERS

NOTE

If the preceding step was not performed, first perform step B1, then proceed.

B5. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:

Left Amplifier
- Display ..... On (In)
- CH 1 & CH 2 Position ..... Centered
- Mode ..... Dual Trace (In)
- CH 1 & CH 2 Volts/Div 1
- CH 1 & CH 2 Volts/Div Cal ..... Fully clockwise
- CH 1 & CH 2 Input Coupling ..... DC
- Trigger ..... CH 1 & CH 2 (In)

Right Amplifier
- Display ..... On (In)
- CH 1 & CH 2 Position ..... Centered
- Mode ..... Dual Trace (In)
- CH 1 & CH 2 Volts/Div 1
- CH 1 & CH 2 Volts/Div Cal ..... Fully clockwise
- CH 1 & CH 2 Input Coupling ..... DC
- Trigger ..... CH 1 & CH 2 (In)

Time Base
- Display ..... Alt
- Position ..... Centered
- Swp Mag ..... Off (Out)
- Seconds/Div ..... 1 m
- Seconds/Div Cal ..... Fully clockwise
- Triggering ..... Auto Trig. (In), AC Coupl, +Slope
- Triggering Source ..... Composite (In)

4544-306

a. Adjust INTENSITY, FOCUS, and GRAT ILLUM for a well-defined trace and comfortable viewing level.

b. Position left vertical amplifier traces about two divisions apart from right vertical amplifier traces.

c. **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.

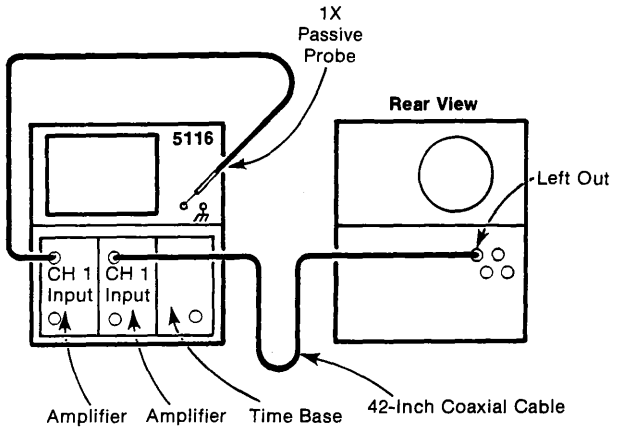
B6. CHECK OPTION 7; LEFT OUT

NOTE

If the preceding step was not performed, first perform step B1, then proceed.

B6. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:

Left Amplifier
- Display ..... On (In)
- CH 1 Position ..... Centered
- Mode ..... CH 1 (In)
- CH 1 Volts/Div 0.1
- CH 1 Volts/Div Cal ..... Fully clockwise
- CH 1 Input Coupling ..... DC
- Trigger ..... CH 1 (In)

Right Amplifier
- Display ..... Off (Out)
- CH 1 Position ..... Centered
- Mode ..... CH 1 (In)
- CH 1 Volts/Div 0.5
- CH 1 Volts/Div Cal ..... Fully clockwise
- CH 1 Input Coupling ..... DC
- Trigger ..... CH 1 (In)

Time Base
- Display ..... Chop
- Position ..... Centered
- Swp Mag ..... Off (Out)
- Seconds/Div ..... 1 m
- Seconds/Div Cal ..... Fully clockwise
- Triggering ..... Auto Trig. (In), AC Coupl, +Slope
- Triggering Source ..... Line (In)
- Triggering Level ..... Centered

4544-308

a. Adjust INTENSITY, FOCUS, and GRAT ILLUM for a well-defined trace and comfortable viewing level.

b. Adjust the Position control on the left vertical amplifier to set the bottom of the square-wave signal 2 divisions below the center graticule line and observe a signal amplitude of 4 divisions.

c. Push the Display button on the right vertical amplifier to turn on the display.

d. Position the right vertical amplifier trace 2 divisions below the center graticule line.

e. **CHECK**—for identical positive-going waveforms, ±0.15 div.

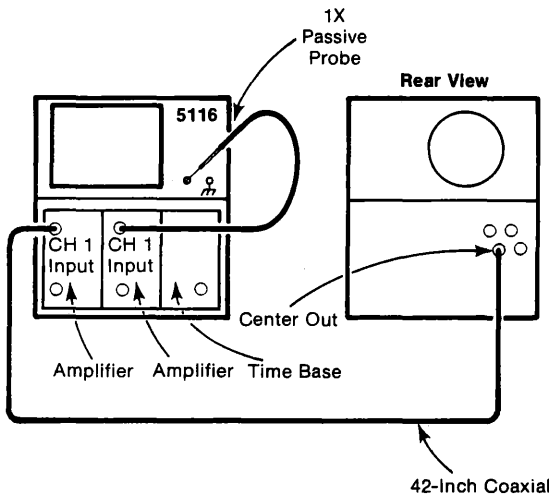
B7. CHECK OPTION 7; CENTER OUT

NOTE

If the preceding step was not performed, first perform step B1, then proceed.

B7. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:

Left Amplifier
- Display ..... Off (Out)
- CH 1 Position ..... Centered
- Mode ..... CH 1 (In)
- CH 1 Volts/Div 0.5
- CH 1 Volts/Div Cal ..... Fully clockwise
- CH 1 Input Coupling ..... DC
- Trigger ..... CH 1 (In)

Right Amplifier
- Display ..... On (In)
- CH 1 Position ..... Centered
- Mode ..... CH 1 (In)
- CH 1 Volts/Div 0.1
- CH 1 Volts/Div Cal ..... Fully clockwise
- CH 1 Input Coupling ..... DC
- Trigger ..... CH 1 (In)

Time Base
- Display ..... Chop
- Position ..... Centered
- Swp Mag ..... Off (Out)
- Seconds/Div ..... 1 m
- Seconds/Div Cal ..... Fully clockwise
- Triggering ..... Auto Trig. (In), AC Coupl, +Slope
- Triggering Source ..... Line (In)
- Triggering Level ..... Centered

4544-309

a. Adjust INTENSITY, FOCUS, and GRAT ILLUM for a well-defined trace and comfortable viewing level.

b. Adjust the Position control on the right vertical amplifier to set the bottom of the square-wave signal 2 divisions below the center graticule line and observe a signal amplitude of 4 divisions.

c. Push the Display button on the left vertical amplifier to turn on the display.

d. Position the right vertical amplifier trace 2 divisions below the center graticule line. (The right amplifier Position control will move both left and right traces.)

e. **CHECK**—for identical positive-going waveforms, ±0.15 div.

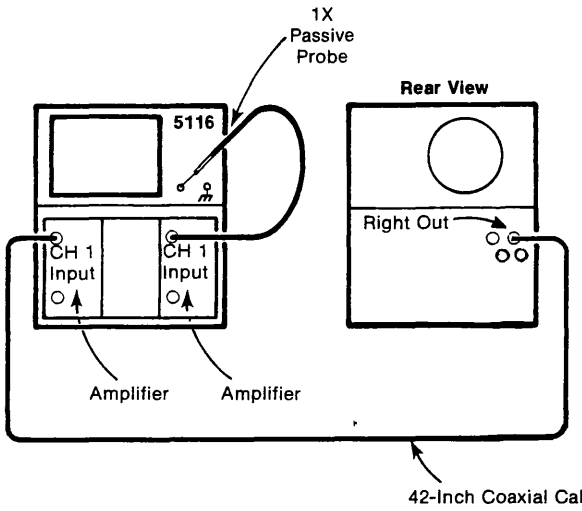
B8. CHECK OPTION 7; RIGHT OUT

NOTE

If the preceding step was not performed, first perform step B1, then proceed.

B8. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:

Left Amplifier

Display	On (In)
CH 1 Position	Centered
Mode	CH 1 (In)
CH 1 Volts/Div	0.5
CH 1 Volts/Div Cal	Fully clockwise
CH 1 Input Coupling	DC
Trigger	CH 1 (In)

Right Amplifier

Display	On (In)
CH 1 Position	Centered
Mode	CH 1 (In)
CH 1 Volts/Div	0.1
CH 1 Volts/Div Cal	Fully clockwise
CH 1 Input Coupling	DC
Trigger	CH 1 (In)

4544-310A

a. Adjust INTENSITY, FOCUS, and GRAT ILLUM for a well-defined trace and comfortable viewing level.

b. **CHECK**—for two dots 4 horizontal divisions and 4 vertical divisions apart.

c. Disconnect the coaxial cable and probe.

B9. CHECK OPTION 7; GATE OUT

NOTE

If the preceding step was not performed, first perform step B1, then proceed.

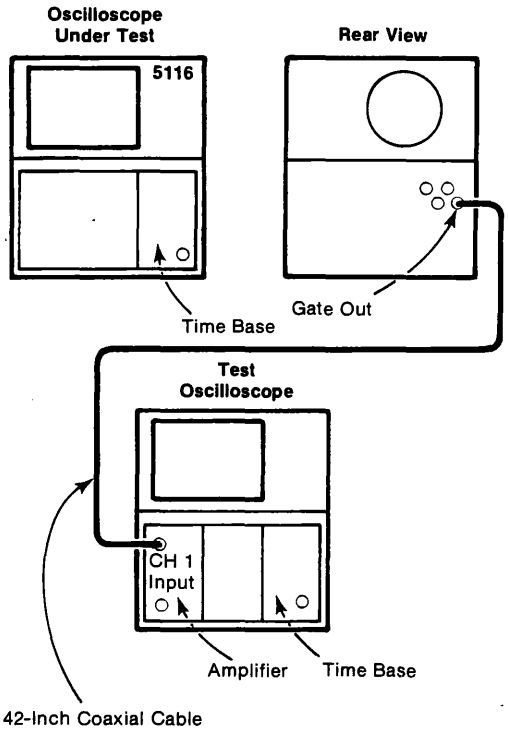
a. Adjust INTENSITY, FOCUS, and GRAT ILLUM for a well-defined trace and comfortable viewing level.

b. **CHECK**—that the GATE OUT signal is > 2.4 V and < 5 V. The period is set by the Seconds/Div setting of the time base in the 5116.

c. Disconnect the coaxial cable.

B9. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:

Amplifier

Display	On (In)
CH 1 Position	Centered
Mode	CH 1 (In)
CH 1 Volts/Div	2
CH 1 Volts/Div Cal	Fully clockwise
CH 1 Input Coupling	DC
Trigger	CH 1 (In)

Time Base

Display	Chop
Position	Centered
Swp Mag	Off (Out)
Seconds/Div	0.5 m
Seconds/Div Cal	Fully clockwise
Triggering	Auto Trig. (In), AC Coupl, +Slope
Triggering Source	Composite (In)
Triggering Level	Centered

Oscilloscope Under Test:

Time Base

Display	Chop
Position	Centered
Swp Mag	Off (Out)
Seconds/Div	0.1 m
Seconds/Div Cal	Fully clockwise
Triggering	Auto Trig. (In), AC Coupl, +Slope
Triggering Source	Left (In)
Triggering Level	Centered

4544-311

B10. CHECK OPTION 7; OUTPUT IMPEDANCE

NOTE

If the preceding step was not performed, first perform step B1, then proceed.

a. Adjust INTENSITY, FOCUS, and GRAT ILLUM for a well-defined trace and comfortable viewing level.

b. Remove cable from the test oscilloscope input and connect a 50 Ω termination to the cable. Reconnect the cable and termination to the test oscilloscope input. Set the test oscilloscope for 0.1V/Div.

c. **CHECK**—for a display amplitude of 2.9 div ±0.3 divisions.

d. Press the POWER switch to turn off the 5116 Oscilloscope, then move the amplifier to the center compartment. Move the coaxial cable at the rear of the oscilloscope to the CENTER OUT connector. Pull the POWER switch to turn on the oscilloscope.

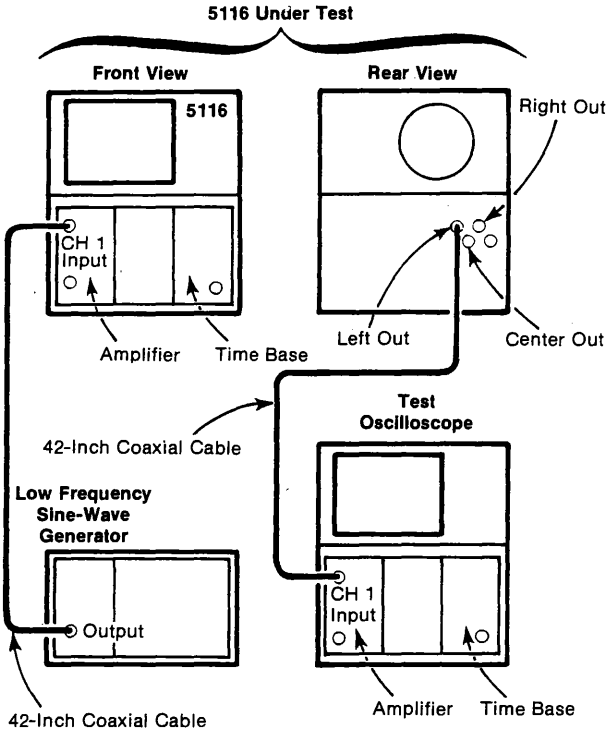
e. **CHECK**—for a display amplitude of 2.9 div ±0.3 divisions.

f. Press the POWER switch to turn off the 5116 Oscilloscope. Remove the time base, then move the amplifier to the right compartment. Move the coaxial cable at the rear of the oscilloscope to the RIGHT OUT connector. Pull the POWER switch to turn on the oscilloscope.

g. **CHECK**—for a display amplitude of 2.9 div ±0.3 divisions.

B10. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:

Amplifier
- Display ..... On (In)
- CH 1 Position ..... Centered
- Mode ..... CH 1 (In)
- CH 1 Volts/Div 1
- CH 1 Volts/Div Cal ..... Fully clockwise
- CH 1 Input Coupling ..... DC
- Trigger ..... CH 1 (In)

Time Base
- Display ..... Chop
- Position ..... Centered
- Swp Mag ..... Off (Out)
- Seconds/Div ..... 20 μ
- Seconds/Div Cal ..... Fully clockwise
- Triggering ..... Auto Trig. (In), AC Coupl, +Slope
- Triggering Source ..... Composite (In)
- Triggering Level ..... Fully clockwise

Sine-Wave Generator
- Function ..... ~
- Frequency 5
- Multiplier ..... 10^2
- Amplitude ..... 6 division display on test oscilloscope

Oscilloscope Under Test:

Amplifier
- Display ..... On (In)
- CH 1 Position ..... Centered
- Mode ..... CH 1 (In)
- CH 1 Volts/Div 0.1
- CH 1 Volts/Div Cal ..... Fully clockwise
- CH 1 Input Coupling ..... DC
- Trigger ..... CH 1 (In)

4544-312

C. GAIN, BANDWIDTH, XY PHASE DIFFERENCE, AND Z-AXIS AMPLIFIER

Equipment Required: (Numbers correspond to those listed in Table 3-1, Test Equipment.)

1. Amplifier
2. Time Base
4. Sine-Wave Generator, High Frequency
5. Sine-Wave Generator, Low Frequency
6. Calibration Generator
8. Power Module Mainframe
10. Coaxial Cable (42-inch)
11. 1X Passive Probe
12. Termination (2 required)
13. Tee Connector

Shaded lines identify Performance Requirement CHECK.

C1. GAIN, BANDWIDTH, XY PHASE DIFFERENCE, AND Z-AXIS AMPLIFIER PRELIMINARY SETUP

a. Perform the Performance Check Initial Setup and Power-Up Sequence procedure at the beginning of the Part I—Performance Check procedure

b. Refer to Section 6, Instrument Options, and to the Change Information section at the back of this manual for any changes which may affect this procedure.

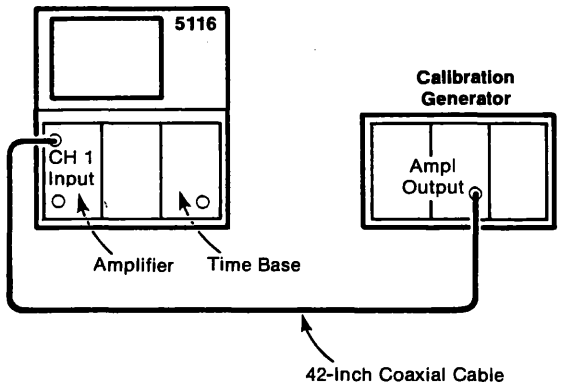
C2. CHECK VERTICAL GAIN

NOTE

First perform step C1, then proceed.

C2. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:

Calibration Generator
- Output ..... Std Ampl
- Amplitude Variable ..... In
- Amplitude ..... 5 V
- Period ..... 1 ms
- Internal Switch ..... ⅃ (down)

Amplifier
- Display ..... On (In)
- CH 1 Position ..... Centered
- Mode ..... CH 1 (In)
- CH 1 Volts/Div 1
- CH 1 Volts/Div Cal ..... Fully clockwise
- CH 1 Input Coupling ..... DC
- Trigger ..... CH 1 (In)

Time Base
- Display ..... Chop
- Position ..... Centered
- Swp Mag ..... Off (Out)
- Seconds/Div ..... 1 m
- Seconds/Div Cal ..... Fully clockwise
- Triggering ..... Auto Trig. (In), AC Coupl, +Slope
- Triggering Source ..... Composite (In)
- Triggering Level ..... Centered

4544-313

a. Set INTENSITY, FOCUS, and GRAT ILLUM for a well-defined trace and comfortable viewing level.

b. Center the display on the graticule.

c. **CHECK**—the display for a vertical deflection of five divisions ±0.15 div (±3%).

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

e. **CHECK**—the display for a vertical deflection of five divisions, ±0.15 division (±3%).

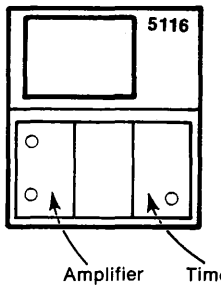
C3. CHECK HORIZONTAL CENTERING

NOTE

If the preceding step was not performed, first perform step C1, then proceed.

C3. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:

Amplifier

Display	On (In)
CH 1 Position	Centered
Mode	CH 1 (In)
CH 1 Volts/Div	1
CH 1 Volts/Div Cal	Fully clockwise
CH 1 Input Coupling	DC
Trigger	CH 1 (In)

Time Base

Display	Chop
Position	Centered
Swp Mag	Off (Out)
Seconds/Div	1 m
Seconds/Div Cal	Fully clockwise
Triggering	Auto Trig. (In), AC Coupl, +Slope
Triggering Source	Composite (In)

4544-314

a. Set INTENSITY, FOCUS, and GRAT ILLUM for a well-defined trace and comfortable viewing level.

b. Set the time base Swp Mag control for a magnified sweep.

c. Position the sweep start to the center vertical graticule line.

d. Set the time base Swp Mag control for an unmagnified sweep.

e. **CHECK**—that the start of the unmagnified sweep is within 0.2 division of the center vertical graticule line.

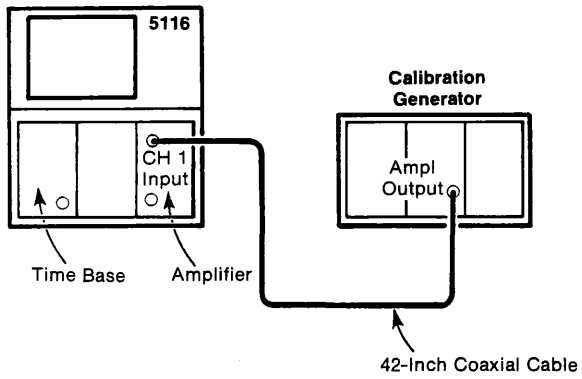
C4. CHECK HORIZONTAL GAIN

NOTE

If the preceding step was not performed, first perform step C1, then proceed.

C4. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



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.

Test Equipment Controls:

Calibration Generator
- Output ..... Std Ampl
- Amplitude Variable ..... In
- Amplitude ..... 5 V
- Period ..... 1 ms
- Internal Switch ..... ⌐L(down)

Time Base
- Display ..... Chop
- Position ..... Centered
- Swp Mag ..... Off (Out)
- Seconds/Div ..... 1 m
- Seconds/Div Cal ..... Fully clockwise
- Triggering ..... Auto Trig. (In), AC Coupl, +Slope
- Triggering Source ..... Composite (In)

Amplifier
- Display ..... On (In)
- CH 1 Position ..... Centered
- Mode ..... CH 1 (In)
- CH 1 Volts/Div 1
- CH 1 Volts/Div Cal ..... Fully clockwise
- CH 1 Input Coupling ..... DC
- Trigger ..... CH 1 (In)

4544-315

a. Set INTENSITY, FOCUS, and GRAT ILLUM for a well-defined trace and comfortable viewing level.

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

c. **CHECK**—the display for a horizontal deflection of five divisions, ±0.15 division (±3%).

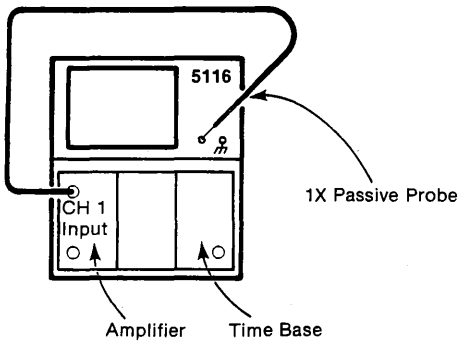
C5. CHECK CALIBRATOR

NOTE

If the preceding step was not performed, first perform step B1, then proceed.

C5. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.
Remove Calibrator patch cord.



Test Equipment Controls:

Amplifier
- Display ..... On (In)
- CH 1 Position ..... Centered
- Mode ..... CH 1 (In)
- CH 1 Volts/Div 0.1
- CH 1 Volts/Div Cal ..... Fully clockwise
- CH 1 Input Coupling ..... DC
- Trigger ..... CH 1 (In)

Time Base
- Display ..... Chop
- Position ..... Centered
- Swp Mag ..... Off (Out)
- Seconds/Div ..... 2 m
- Seconds/Div Cal ..... Fully clockwise
- Triggering ..... Auto Trig. (In), AC Coupl, +Slope
- Triggering Source ..... Composite (In)
- Triggering Level ..... Centered

4544-307

a. Adjust INTENSITY, FOCUS, and GRAT ILLUM for a well-defined trace and comfortable viewing level.

b. **CHECK**—for a signal amplitude of 4 divisions (400 mV).

c. Remove probe.

d. Replace Calibrator patch cord.

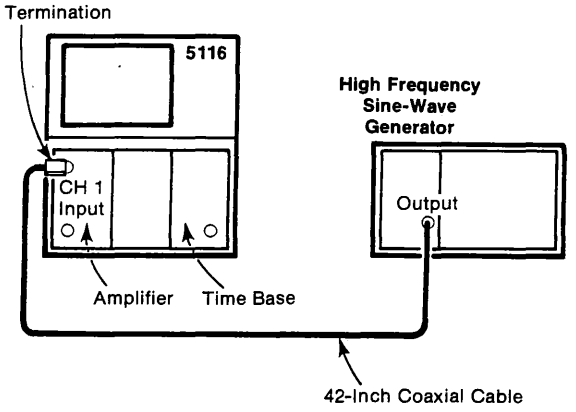
C6. CHECK VERTICAL BANDWIDTH

NOTE

First perform step C1, then proceed.

C6. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:

Sine-Wave Generator
- Frequency Range ..... Ref (.05 MHz)
- Frequency Variable 0.050
- Amplitude Multiplier X1

Amplifier
- Display ..... On (In)
- CH 1 Position ..... Centered
- Mode ..... CH 1 (In)
- CH 1 Volts/Div 0.5
- CH 1 Volts/Div Cal ..... Fully clockwise
- CH 1 Input Coupling ..... DC
- Trigger ..... CH 1 (In)

Time Base
- Display ..... Chop
- Position ..... Centered
- Swp Mag ..... Off (Out)
- Seconds/Div ..... 1 m
- Seconds/Div Cal ..... Fully clockwise
- Triggering ..... Auto Trig. (In), AC Coupl, +Slope
- Triggering Source ..... Composite (In)
- Triggering Level ..... Centered

4544-316

a. Adjust INTENSITY, FOCUS, and GRAT ILLUM for a well-defined trace and comfortable viewing level.

b. Set the sine-wave generator Output Amplitude to display an amplitude of 6 divisions on the crt.

c. Center the display on the graticule.

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

e. **CHECK**—the generator for a reading of at least 2 MHz.

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

g. Set the sine-wave generator controls for a frequency of 50 kHz and set the output amplitude to display 6 divisions of signal on the crt.

h. Repeat parts c through e for the right vertical compartment.

i. If the next step is to be performed, leave the coaxial cable and termination connected to the amplifier input connector.

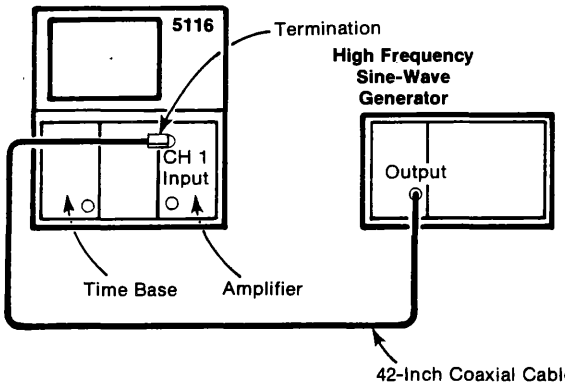
C7. CHECK HORIZONTAL BANDWIDTH

NOTE

If the preceding step was not performed, first perform step C1, then proceed.

C7. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:

Sine-Wave Generator
- Frequency Range ..... Ref (.05 MHz)
- Frequency Variable 0.050
- Amplitude Multiplier X1

Time Base
- Display ..... Chop
- Position .....Centered
- Swp Mag .....Off (Out)
- Seconds/Div ..... 1 m
- Seconds/Div Cal ..... Fully clockwise
- Triggering ..... Auto Trig. (In), AC Coupl, +Slope
- Triggering Source ..... Composite (In)

Amplifier
- Display .....On (In)
- CH 1 Position.....Centered
- Mode.....CH 1 (In)
- CH 1 Volts/Div..... 0.5
- CH 1 Volts/Div Cal ..... Fully clockwise
- CH 1 Input Coupling ..... DC
- Trigger .....CH 1 (In)

4544-317

a. Adjust INTENSITY, FOCUS, and GRAT ILLUM for a well-defined trace and comfortable viewing level.

b. Adjust the sine-wave generator controls for an amplitude display of six-divisions vertically.

c. Vertically position the display between the third and ninth graticule lines.

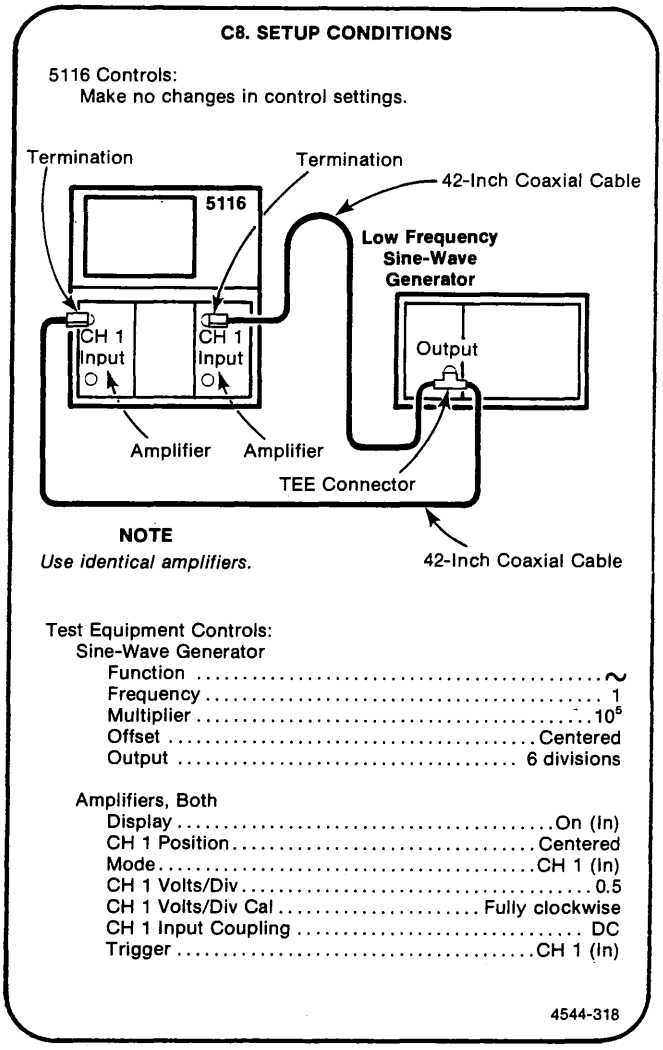
d. Without changing the output amplitude, increase the sine-wave generator frequency until the displayed amplitude is reduced to 4.2 divisions.

e. **CHECK**—the generator for a reading of at least 2 MHz.

C8. CHECK XY PHASE DIFFERENCE

NOTE

If the preceding step was not performed, first perform step C1, then proceed.



a. Adjust INTENSITY, FOCUS, and GRAT ILLUM for a well-defined trace and comfortable viewing level.

b. 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.

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

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

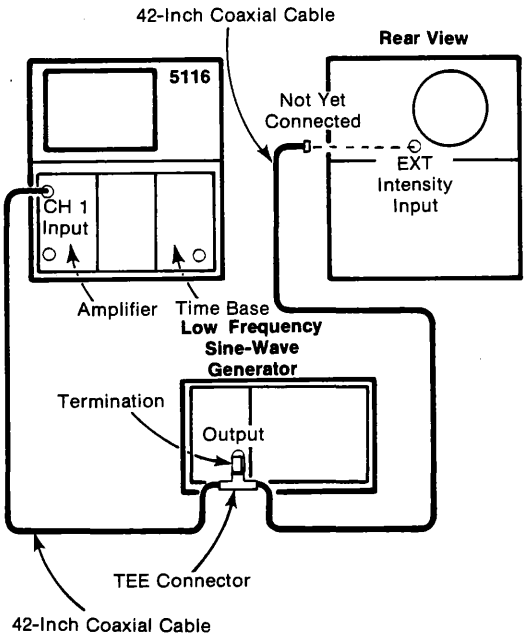
C9. CHECK Z-AXIS AMPLIFIER

NOTE

If the preceding step was not performed, first perform step C1, then proceed.

C9. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:

Sine-Wave Generator
- Function ..... ~ Dc Offset
- Frequency 5
- Multiplier ..... 10^3
- Offset ..... Centered
- Output ..... 2.5 divisions

Amplifier
- Display ..... On (In)
- CH 1 Position ..... Centered
- Mode ..... CH 1 (In)
- CH 1 Volts/Div 2
- CH 1 Volts/Div Cal ..... Fully clockwise
- CH 1 Input Coupling ..... DC
- Trigger ..... CH 1 (In)

Time Base
- Display ..... Chop
- Position ..... Centered
- Swp Mag ..... Off (Out)
- Seconds/Div ..... 20 μ
- Seconds/Div Cal ..... Fully clockwise
- Triggering ..... Auto Trig. (In), AC Coupl, +Slope
- Triggering Source ..... Composite (In)

4544-319

a. Adjust FOCUS and GRAT ILLUM for a well-defined trace and comfortable viewing level.

b. Press Gnd on Ch 1 of the vertical amplifier and set the trace to the center horizontal graticule line.

c. Press Gnd on Ch 1 of the vertical amplifier to release button.

d. Use the Offset control on the sine-wave generator to set the bottom of the waveform on the center horizontal graticule line (ground).

e. Turn the oscilloscope INTENSITY control counterclockwise until the trace is no longer visible.

f. Connect the signal output from the sine-wave generator to the EXT INTENSITY INPUT connector on the rear panel.

g. **CHECK**—that the top of the waveform is intensified and the bottom portion is blanked.

h. Temporarily disconnect the coaxial cable to the EXT INTENSITY INPUT connector.

i. Return the INTENSITY control to normal viewing level.

j. Use the Offset control on the sine-wave generator to set the top of the waveform to the center horizontal graticule line (ground).

k. Connect the signal output from the sine-wave generator to the EXT INTENSITY INPUT connector on the rear panel.

l. **CHECK**—that the top of the waveform is intensified and the bottom portion is blanked.

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

n. **CHECK**—for a noticeable effect of intensification in the top portion of the displayed waveform and blanking in the bottom portion of the waveform.

D. COLOR

Equipment Required: (Numbers correspond to those listed in Table 3-1, Test Equipment.)

3. Color Plug-In (5D10)
14. Screwdriver

Shaded lines identify Performance Requirement CHECK.

D1. COLOR PRELIMINARY SETUP

a. Perform the following steps.

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 suitable for the line voltage to be applied.
4. Install the Color Plug-In (5D10) in the right vertical and horizontal compartments of the oscilloscope mainframe.
5. See the Power-Up Self Test and the Vertical and Horizontal Centering instructions in Section 2 of 5D10 Operators manual.
6. Connect the equipment under test and the test equipment to a suitable line voltage source. Turn all equipment on.
7. Set 5116 controls:

   INTENSITY ..... Centered
   GRAT ILLUM .....Fully clockwise
   FOCUS ..... Centered

8. Set controls according to setup conditions in applicable section during warm-up.

b. Refer to Section 6, Instrument Options, and to the Change Information section at the back of this manual for any changes which may affect this procedure.

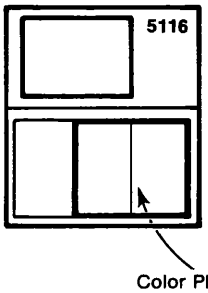
D2. CHECK COLOR

NOTE

First perform step D1, then proceed.

D2. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:
Color Plug-In (5D10)
Volts/Div (Ch 1) 0.5
Cal ..... Fully clockwise (in detent)
Input Coupling (Ch 1) .....Dc (button out)
Gnd .....button out
Acquisition and Display
Ch 1 .....On (button in)
Join Dots .....On (button in)
Saved Display Out
Plot..... Off (button out)

Triggering
Position..... Ctr Trig
Slope ..... (+ slope)
Level .....Midrange
Coupling..... Dc
Source..... Ch 1
Seconds/Div 0.1
Cal ..... Fully clockwise (in detent)
Cursors .....Off
Swp Mgf ..... Off (button out)
Storage
Viewtime ..... Min (fully counterclockwise)
Save ..... Off (button out)
Save Ref ..... Off (button out)
Trace Sep..... Off (button out)

4544-320

a. Adjust INTENSITY, FOCUS, and GRAT ILLUM for a well-defined trace and comfortable viewing level.

b. **CHECK**—that the trace is blue green.

c. In the Acquisition and Display section of the 5D10, push the Dual button in.

d. **CHECK**—one orange trace, one blue-green trace, and time measurement (100 ms) in top center displayed in neutral (off-white).

This completes the Performance Check procedure for the 5116 Oscilloscope.

PART II—ADJUSTMENT

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 test equipment, or equivalent, required for complete adjustment of the oscilloscope is listed in table 3-1 of the Performance Check section. 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.

INDEX TO PART II—ADJUSTMENT

ADJUSTMENT INITIAL SETUP AND POWER-UP SEQUENCE

NOTE

The oscilloscope must be adjusted within an ambient temperature range of +20° 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. Ensure that all power switches are off.

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

3. Check the rear panel of the oscilloscope to ensure the indicated line voltage and the line voltage source are the same (refer to "Line-Voltage and Regulating-Range Selection" in the Maintenance section of this manual). Connect a power cord to the oscilloscope.

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

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

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

7. Install a time base into the horizontal compartment of the oscilloscope.

8. Set oscilloscope controls:

   INTENSITY ..... Centered
   GRAT ILLUM ..... Fully clockwise
   FOCUS ..... Centered

9. 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.

10. Set controls according to setup conditions in applicable section during warm-up.

NOTE

Titles for external controls, connectors, and indicators on the oscilloscope front- and rear-panel are capitalized in this procedure (e.g., INTENSITY, POWER).

A. POWER SUPPLIES AND CALIBRATOR

Equipment Required: (Numbers correspond to those listed in Table 3-1, Test Equipment.)

1. Amplifier
2. Time Base
7. Digital Multimeter (DMM)
8. Power Module Mainframe
15. Slotted Screwdriver
16. Pozidriv Screwdriver
17. Resistor
18. Interconnection Aid

Shaded lines identify Performance Requirement CHECK.

A1. POWER SUPPLY AND CALIBRATOR PRELIMINARY SETUP

a. Perform the Adjustment Initial Setup and Power-Up Sequence procedure at the beginning of the Part II—Adjustment procedure.

b. Refer to Section 6, Instrument Options, and to the Change Information section at the back of this manual for any changes which may affect this procedure.

c. See the CIRCUIT BOARD, TEST POINT, AND ADJUSTMENT LOCATIONS page in Section 8, Diagrams and Circuit Board Illustrations.

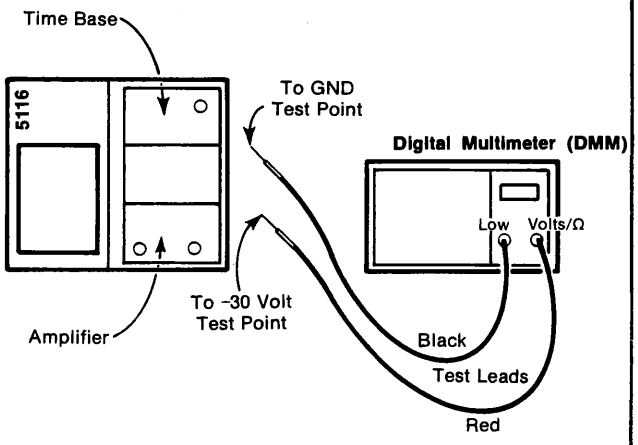
A2. -30 VOLT POWER SUPPLY ADJUSTMENT

NOTE

First perform step A1, then proceed.

A2. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:

Digital Multimeter
- Power ..... On
- Volts ..... DC
- Range ..... 200 V
- Input ..... Ext

Amplifier
- Display ..... On (In)
- CH 1 Position ..... Centered
- Mode ..... CH 1 (In)
- CH 1 Volts/Div 1
- CH 1 Volts/Div Cal ..... Fully clockwise
- CH 1 Input Coupling ..... DC
- Trigger ..... CH 1 (In)

Time Base
- Display ..... Chop
- Position ..... Centered
- Swp Mag ..... Off (Out)
- Seconds/Div ..... 1 m
- Seconds/Div Cal ..... Fully clockwise
- Triggering ..... Auto Trig. (In), AC Coupl, +Slope
- Triggering Source ..... Composite (In)

4544-321

a. **EXAMINE**—the DMM for a reading of -29.925 to -30.075 volts.

NOTE

If the -30 volt supply is within the specified tolerance, proceed to step A3.

b. **ADJUST**—the -30 V Adj, R878 (A2 on the 5116 Board, Test Point, and Adjustment Locator page), for a DMM reading of exactly -30 volts.

c. **INTERACTION**—If the -30 volt adjustment is made, all circuits will be affected and the entire power supply adjustment procedure should be performed to verify the accuracy of the supplies.

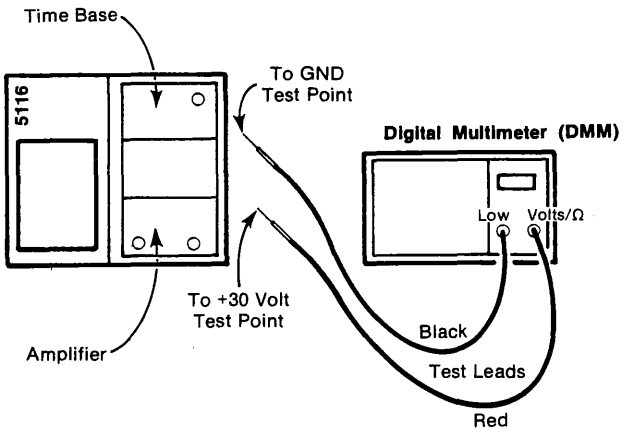
A3. +30 VOLT POWER SUPPLY ADJUSTMENT

NOTE

If the preceding step was not performed, first perform step A1, then proceed.

A3. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:

Digital Multimeter

Power	On
Volts	DC
Range	200 V
Input	Ext

Amplifier

Display	On (In)
CH 1 Position	Centered
Mode	CH 1 (In)
CH 1 Volts/Div	1
CH 1 Volts/Div Cal	Fully clockwise
CH 1 Input Coupling	DC
Trigger	CH 1 (In)

Time Base

Display	Chop
Position	Centered
Swp Mag	Off (Out)
Seconds/Div	1 m
Seconds/Div Cal	Fully clockwise
Triggering	Auto Trig. (In), AC Coupl, +Slope
Triggering Source	Composite (In)

4544-322

a. **EXAMINE**—the DMM for a reading of +29.925 to +30.075 volts.

NOTE

If the +30 volt supply is within the specified tolerance, proceed with step A4.

b. **ADJUST**—the +30 V Adj, R858 (A2 on the 5116 Board, Test Point, and Adjustment Locator page), for a DMM reading of exactly 30 volts.

c. **INTERACTION**—If the +30 volt adjustment is made, all circuits will be affected and the entire power supply adjustment procedure should be performed to verify the accuracy of the supplies.

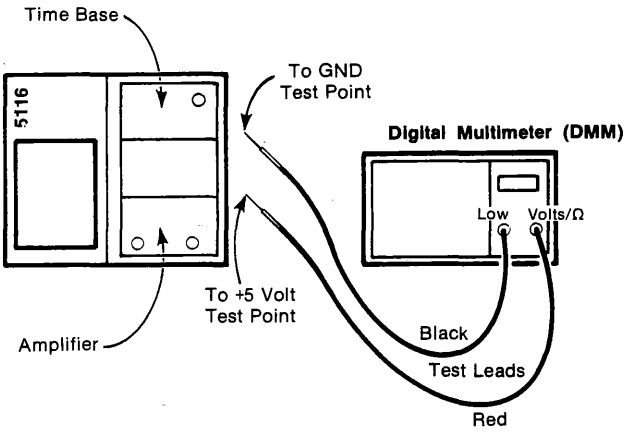
A4. CHECK REMAINING POWER SUPPLY VOLTAGES

NOTE

If the preceding step was not performed, first perform step A1, then proceed.

A4. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:

Digital Multimeter

Power	On
Volts	DC
Range	20 V
Input	Ext

Amplifier

Display	On (In)
CH 1 Position	Centered
Mode	CH 1 (In)
CH 1 Volts/Div	1
CH 1 Volts/Div Cal	Fully clockwise
CH 1 Input Coupling	DC
Trigger	CH 1 (In)

Time Base

Display	Chop
Position	Centered
Swp Mag	Off (Out)
Seconds/Div	1 m
Seconds/Div Cal	Fully clockwise
Triggering	Auto Trig. (In), AC Coupl, +Slope
Triggering Source	Composite (In)

4544-323

a. **EXAMINE**—the DMM for a reading of +4.90 to +5.10 volts.

b. Set the DMM range to 1000 V dc.

c. Connect the DMM between the +200 V test point and ground. See A2 on the 5116 Board, Test Point, and Adjustment Locator page.

d. **EXAMINE**—the DMM for a 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.

A5. CHECK CALIBRATOR OUTPUT VOLTAGE

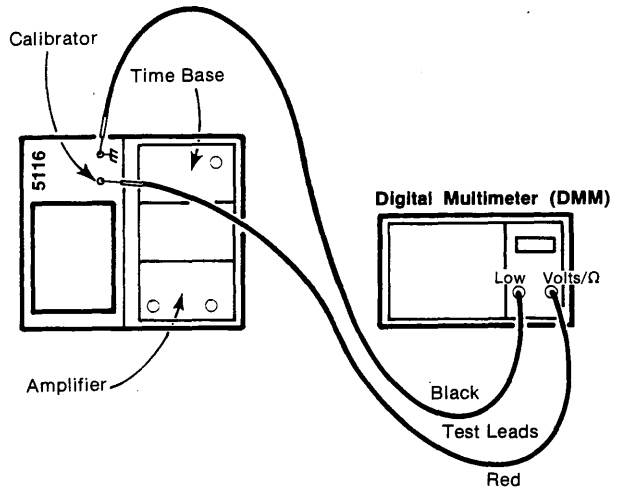
NOTE

If the preceding step was not performed, first perform step A1, then perform step A3 before proceeding.

A5. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.
Remove the CALIBRATOR patch cord.

Use a two pin interconnection aid to connect R885 and C890. Two pins (J820) are provided on the circuit board for this application. See Figure 8-2. Board, Test Point, and Adjustment Locations.



Test Equipment Controls:

Digital Multimeter
- Power ..... On
- Volts ..... DC
- Range ..... 2 V
- Input ..... Ext

Amplifier
- Display ..... On (In)
- CH 1 Position ..... Centered
- Mode ..... CH 1 (In)
- CH 1 Volts/Div 0.2
- CH 1 Volts/Div Cal ..... Fully clockwise
- CH 1 Input Coupling ..... DC
- Trigger ..... CH 1 (In)

Time Base
- Display ..... Chop
- Position ..... Centered
- Swp Mag ..... Off (Out)
- Seconds/Div ..... 1 m
- Seconds/Div Cal ..... Fully clockwise
- Triggering ..... Auto Trig. (In), AC Coupl, +Slope
- Triggering Source ..... Composite (In)
- Triggering Level ..... Centered

4544-324

a. **CHECK**—for a meter reading of +396 to +404 mV.

b. If not continuing to the next step, press the POWER switch to turn off oscilloscope. Remove the test leads and the short circuit. Replace the Calibrator patch cord.

A6. CHECK CALIBRATOR OUTPUT CURRENT

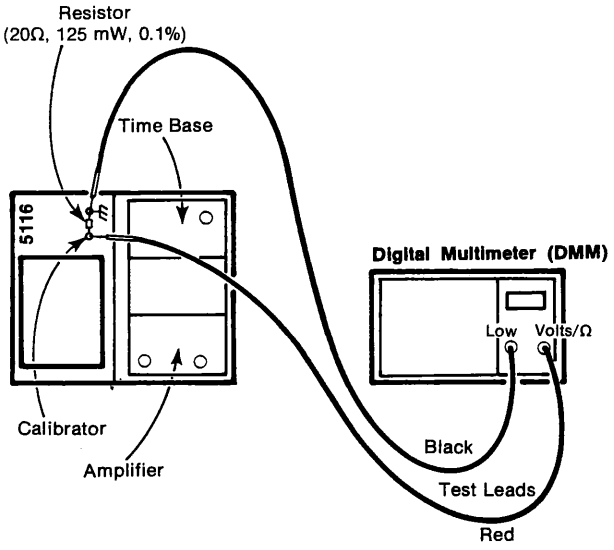
NOTE

If the preceding step was not performed, first perform step A1, then perform step A3 before proceeding.

A6. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.

Use a two pin interconnection aid to connect R885 and C890. Two pins (J820) are provided on the circuit board for this application. See Figure 8-2. Board, Test Point, and Adjustment Locations.



Test Equipment Controls:

Digital Multimeter
- Power ..... On
- Volts ..... DC
- Range ..... 200 mV
- Input ..... Ext

Amplifier
- Display ..... On (In)
- CH 1 Position ..... Centered
- Mode ..... CH 1 (In)
- CH 1 Volts/Div 1
- CH 1 Volts/Div Cal ..... Fully clockwise
- CH 1 Input Coupling ..... DC
- Trigger ..... CH 1 (In)

Time Base
- Display ..... Chop
- Position ..... Centered
- Swp Mag ..... Off (Out)
- Seconds/Div ..... 1 m
- Seconds/Div Cal ..... Fully clockwise
- Triggering ..... Auto Trig. (In), AC Coupl, +Slope
- Triggering Source ..... Composite (In)

4544-325

a. **CHECK**—for a DMM reading of +66.1 to +67.1 millivolts.

b. Press the POWER switch to turn off oscilloscope. Remove the test leads and the short circuit. Replace the Calibrator patch cord.

B. DISPLAY

Equipment Required: (Numbers correspond to those listed in Table 3-1, Test Equipment.)

1. Amplifier
2. Time Base
3. Color Plug-In (5D10)
14. Screwdriver

Shaded lines identify Performance Requirement CHECK.

B1. DISPLAY PRELIMINARY SETUP

a. Perform the Adjustment Initial Setup and Power-Up Sequence procedure at the beginning of the Part II—Adjustment procedure.

b. Refer to Section 6, Instrument Options, and to the Change Information section at the back of this manual for any changes which may affect this procedure.

c. See the CIRCUIT BOARD, TEST POINT, AND ADJUSTMENT LOCATIONS page in Section 8, Diagrams and Circuit Board Illustrations.

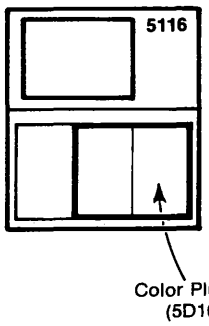
B2. ADJUST INTENSITY RANGE (5D10)

NOTE

First perform step B1, then proceed.

B2. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:

Color Plug-In (5D10)
- Volts/Div (Ch 1) 0.5
  - Cal ..... Fully clockwise (in detent)
- Input Coupling (Ch 1) ..... Dc (button out)
  - Gnd ..... button out
- Acquisition and Display
  - Ch 1 ..... On (button in)
  - Join Dots ..... On (button in)
- Saved Display Out
  - Plot ..... Off (button out)

Triggering
- Position ..... Ctr Trig
- Slope ..... (+ slope)
- Level ..... Midrange
- Coupling ..... Dc
- Source ..... Ch 1

Seconds/Div 0.1
- Cal ..... Fully clockwise (in detent)

Cursors ..... Off
- Swp Mgf ..... Off (button out)

Storage
- Viewtime ..... Min (fully counterclockwise)
- Save ..... Off (button out)
- Save Ref ..... Off (button out)
- Trace Sep ..... Off (button out)

4544-326

a. Set the INTENSITY control fully clockwise.

b. **ADJUST**—Intensity Range, R245 (A3 on the 5116 Board, Test Point, and Adjustment Locator page), using an insulated screwdriver, until the blank-character vectors disappear.

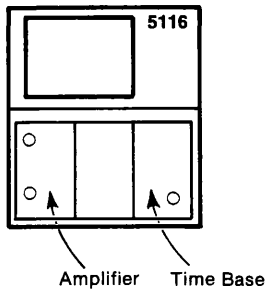
B3. ADJUST INTENSITY RANGE (ALTERNATE)

NOTE

First perform step B1, then proceed.

B3. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:

Amplifier

Display	On (In)
CH 1 Position	Centered
Mode	CH 1 (In)
CH 1 Volts/Div	1
CH 1 Volts/Div Cal	Fully clockwise
CH 1 Input Coupling	DC
Trigger	CH 1 (In)

Time Base

Display	Chop
Position	Centered
Swp Mag	Off (Out)
Seconds/Div	50 mV
Seconds/Div Cal	Fully clockwise
Triggering	Auto Trig. (In), AC Coupl, +Slope
Triggering Source	Composite (In)
Triggering Level	Centered

4544-327

a. Set the INTENSITY control fully counterclockwise.

b. 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 to step B4.

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

d. **ADJUST**—Intensity Range, R245 (A3 on the 5116 Board, Test Point, and Adjustment Locator page), using an insulated screwdriver, for a very dim spot display.

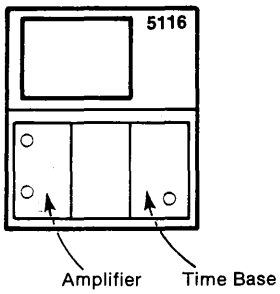
B4. ADJUST ASTIGMATISM

NOTE

If the preceding step was not performed, first perform step B1, then proceed.

B4. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:

Amplifier

Display	On (In)
CH 1 Position	Centered
Mode	CH 1 (In)
CH 1 Volts/Div	1
CH 1 Volts/Div Cal	Fully clockwise
CH 1 Input Coupling	DC
Trigger	CH 1 (In)

Time Base

Display	Chop
Position	Centered
Swp Mag	Off (Out)
Seconds/Div	50 mV
Seconds/Div Cal	Fully clockwise
Triggering	Auto Trig. (In), AC Coupl, +Slope
Triggering Source	Composite (In)
Triggering Level	Centered

4544-328

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 (A3 on the 5116 Board, Test Point, and Adjustment Locator page), and FOCUS control together, using an insulated screwdriver, to obtain the best defined round-spot display.

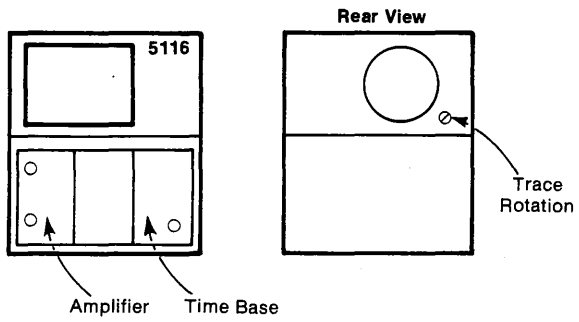
B5. ADJUST TRACE ALIGNMENT

NOTE

If the preceding step was not performed, first perform step B1, then proceed.

B5. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:

Amplifier

Display	On (In)
CH 1 Position	Centered
Mode	CH 1 (In)
CH 1 Volts/Div	1
CH 1 Volts/Div Cal	Fully clockwise
CH 1 Input Coupling	DC
Trigger	CH 1 (In)

Time Base

Display	Chop
Position	Centered
Swp Mag	Off (Out)
Seconds/Div	1 mV
Seconds/Div Cal	Fully clockwise
Triggering	Auto Trig. (In), AC Coupl, +Slope
Triggering Source	Composite (In)

4544-329

a. Set INTENSITY, FOCUS, and GRAT ILLUM for a well-defined trace and comfortable viewing level.

b. Position the trace over the center horizontal graticule line. The trace should extend horizontally past the edges of the graticule area.

c. **CHECK**—that the trace is parallel to the center graticule line.

d. **ADJUST**—the TRACE ROTATION control (rear-panel adjustment) to align the trace horizontally. This may be adjusted either by hand or with a screwdriver.

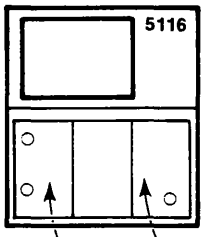
B6. ADJUST GEOMETRY

NOTE

If the preceding step was not performed, first perform step B1, then proceed.

B6. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:

Amplifier

Display	On (In)
CH 1 Position	Centered
Mode	CH 1 (In)
CH 1 Volts/Div	1
CH 1 Volts/Div Cal	Fully clockwise
CH 1 Input Coupling	DC
Trigger	CH 1 (In)

Time Base

Display	Chop
Position	Centered
Swp Mag	Off (Out)
Seconds/Div	1 m
Seconds/Div Cal	Fully clockwise
Triggering	Auto Trig. (In), AC Coupl, +Slope
Triggering Source	Composite (In)

4544-330

a. Set INTENSITY, FOCUS, and GRAT ILLUM for a well-defined trace and comfortable viewing level.

b. Position the trace over the center horizontal graticule line. The trace should extend horizontally past the edges of the graticule area.

c. **CHECK**—that horizontal bowing and tilt of the trace display is less than 0.1 division when trace is positioned to the top and bottom graticule lines.

d. **ADJUST**—Geom, R285 (A3 on the 5116 Board, Test Point, and Adjustment Locator page), for minimum bowing and tilt of the trace display at the top and bottom 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.

e. Position the trace to the center horizontal graticule line.

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

g. Position the trace over the center vertical graticule line. The trace should extend vertically past the edges of the graticule area. Set the FOCUS and INTENSITY controls for a well-defined trace, if necessary.

h. **CHECK**—that vertical bowing and tilt of the trace display is less than 0.1 division when the trace is positioned at the left-most and right-most graticule lines.

C. AMPLIFIER OPERATION

Equipment Required: (Numbers correspond to those listed in Table 3-1, Test Equipment.)

1. Amplifier
2. Time Base
5. Sine-Wave Generator, Low Frequency
6. Calibration Generator
8. Power Module Mainframe
10. Coaxial Cable (42-inch)
12. Termination (2 required)
13. Tee Connector

Shaded lines identify Performance Requirement CHECK.

C1. AMPLIFIER OPERATION PRELIMINARY SETUP

a. Perform the Adjustment Initial Setup and Power-Up Sequence procedure at the beginning of the Part II—Adjustment procedure.

b. Refer to Section 6, Instrument Options, and to the Change Information section at the back of this manual for any changes which may affect this procedure.

c. See the CIRCUIT BOARD, TEST POINT, AND ADJUSTMENT LOCATIONS page in Section 8, Diagrams and Circuit Board Illustrations.

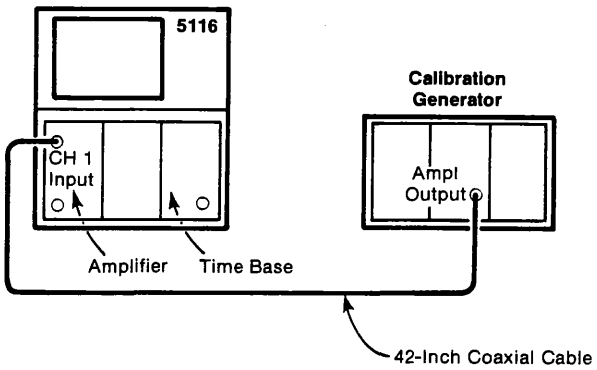
C2. ADJUST VERTICAL GAIN

NOTE

First perform step C1, then proceed.

C2. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:

Calibration Generator
- Output ..... Std Ampl
- Amplitude Variable ..... In
- Amplitude ..... 5 V
- Period ..... 1 ms
- Internal switch ..... ⌐ (down)

Amplifier
- Display ..... On (In)
- CH 1 Position ..... Centered
- Mode ..... CH 1 (In)
- CH 1 Volts/Div 1
- CH 1 Volts/Div Cal ..... Fully clockwise
- CH 1 Input Coupling ..... DC
- Trigger ..... CH 1 (In)

Time Base
- Display ..... Chop
- Position ..... Centered
- Swp Mag ..... Off (Out)
- Seconds/Div ..... 1 m
- Seconds/Div Cal ..... Fully clockwise
- Triggering ..... Auto Trig. (In), AC Coupl, +Slope
- Triggering Source ..... Composite (In)
- Triggering Level ..... Centered

4544-313

a. Set FOCUS and GRAT ILLUM for a well-defined trace and comfortable viewing level.

b. Set the INTENSITY control for low brightness.

c. Center the display on the graticule.

d. **CHECK**—the display for a vertical deflection of five divisions ±0.15 div.

e. **ADJUST**—Vert Gain, R136 (A3 on the 5116 Board, Test Point, and Adjustment Locator page), for exactly five divisions of deflection.

f. 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.

g. **CHECK**—the display for a vertical deflection of five divisions, ±0.15 division (±3%). If necessary, readjust Vert Gain, R136, for the optimum gain setting. Compromise the adjustment to distribute any error between compartments.

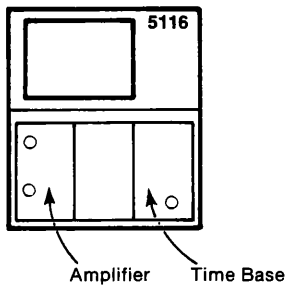
C3. ADJUST HORIZONTAL CENTERING

NOTE

If the preceding step was not performed, first perform step C1, then proceed.

C3. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



Test Equipment Controls:

Amplifier

Display	On (In)
CH 1 Position	Centered
Mode	CH 1 (In)
CH 1 Volts/Div	1
CH 1 Volts/Div Cal	Fully clockwise
CH 1 Input Coupling	DC
Trigger	CH 1 (In)

Time Base

Display	Chop
Position	Centered
Swp Mag	Off (Out)
Seconds/Div	1 m
Seconds/Div Cal	Fully clockwise
Triggering	Auto Trig. (In), AC Coupl, +Slope
Triggering Source	Composite (In)

4544-314

a. Set INTENSITY, FOCUS, and GRAT ILLUM for a well-defined trace and comfortable viewing level.

b. Set the time-base unit Swp Mag control for a magnified sweep.

c. Position the sweep start to the center vertical graticule line.

d. Set the time-base unit Swp Mag control for an unmagnified sweep.

e. **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, center trace and proceed to step C4.

f. Press POWER switch to turn off oscilloscope. Lay the oscilloscope on its left side to gain access to the bottom of the interface board. Pull POWER switch to turn on oscilloscope.

g. **ADJUST**—Horiz Ctrg, R730 (A1 on the 5116 Board, Test Point, and Adjustment Locator page), to set the start of the unmagnified sweep at the center vertical graticule line.

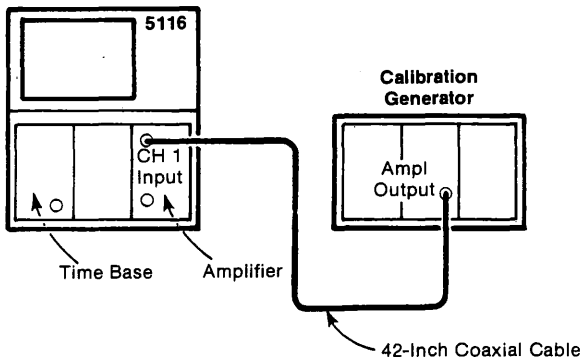
C4. ADJUST HORIZONTAL GAIN

NOTE

If the preceding step was not performed, first perform step C1, then proceed.

C4. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



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.

Test Equipment Controls:

Calibration Generator
- Output ..... Std Ampl
- Amplitude Variable ..... In
- Amplitude ..... 5 V
- Period ..... 1 ms
- Internal Switch ..... ⌐└ (down)

Time Base
- Display ..... Chop
- Position ..... Centered
- Swp Mag ..... Off (Out)
- Seconds/Div ..... 1 m
- Seconds/Div Cal ..... Fully clockwise
- Triggering ..... Auto Trig. (In), AC Coupl, +Slope
- Triggering Source ..... Composite (In)

Amplifier
- Display ..... On (In)
- CH 1 Position ..... Centered
- Mode ..... CH 1 (In)
- CH 1 Volts/Div 1
- CH 1 Volts/Div Cal ..... Fully clockwise
- CH 1 Input Coupling ..... DC
- Trigger ..... CH 1 (In)

4544-315

a. Set INTENSITY, FOCUS, and GRAT ILLUM for a well-defined trace and comfortable viewing level.

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

c. **CHECK**—the display for a horizontal deflection of five divisions, ±0.15 division (±3%).

d. **ADJUST**—Horiz Gain, R116 (A3 on the 5116 Board, Test Point, and Adjustment Locator page), for exactly five divisions of deflection.

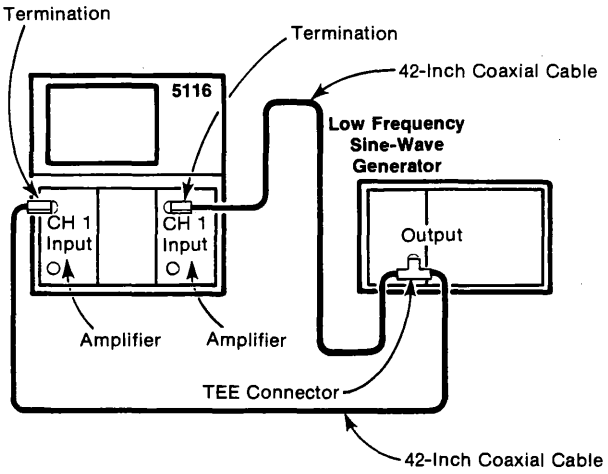
C5. ADJUST XY PHASE DIFFERENCE

NOTE

If the preceding step was not performed, first perform step C1, then proceed.

C5. SETUP CONDITIONS

5116 Controls:
Make no changes in control settings.



NOTE
Use identical amplifiers.

Test Equipment Controls:
Sine-Wave Generator
Function ..... ~
Frequency 1
Multiplier ..... 10^5
Offset ..... Centered
Output ..... 6 divisions

Amplifiers, Both
Display ..... On (In)
CH 1 Position ..... Centered
Mode ..... CH 1 (In)
CH 1 Volts/Div 0.5
CH 1 Volts/Div Cal ..... Fully clockwise
CH 1 Input Coupling ..... DC
Trigger ..... CH 1 (In)

4544-331

a. Center the display on the crt.

b. Set INTENSITY, FOCUS, and GRAT ILLUM for a well-defined diagonal trace and comfortable viewing level.

c. Set the sine-wave generator for a display amplitude of six divisions vertically and horizontally.

d. **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.

e. **ADJUST**—Phase, C116 (A3 on the 5116 Board, Test Point, and Adjustment Locator page), for minimum loop opening (a straight line) in the diagonal-loop display.

f. Press the POWER switch to turn off the oscilloscope. Disconnect the coaxial cables, termination and tee connector between the amplifier and sine-wave generator. Replace the side and bottom covers.

This completes the Adjustment procedure for the 5116 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).

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).

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.

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 is clipped to the LV Power Supply circuit board. This is for the line-voltage source that has not been set at the factory (see Fig. 4-1). If the line-voltage source is changed, store the unused fuse in these clips.

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

8. Change the nominal line-voltage information recorded on the rear panel. Use with a pencil, a nonabrasive eraser to remove previous data, then relabel with the new data.

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

REPACKAGING FOR SHIPMENT

If the oscilloscope 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.

NOTE

If the TEKTRONIX 5D10 Waveform Digitizer was purchased to produce color signals for the 5116 Oscilloscope, it must accompany the oscilloscope when returned for service or repair.

The color shutter needs no special packaging other than the original packaging material.

Save and reuse the package in which your instrument was shipped. If the original packaging is not reusable or not available, repackage the instrument as follows:

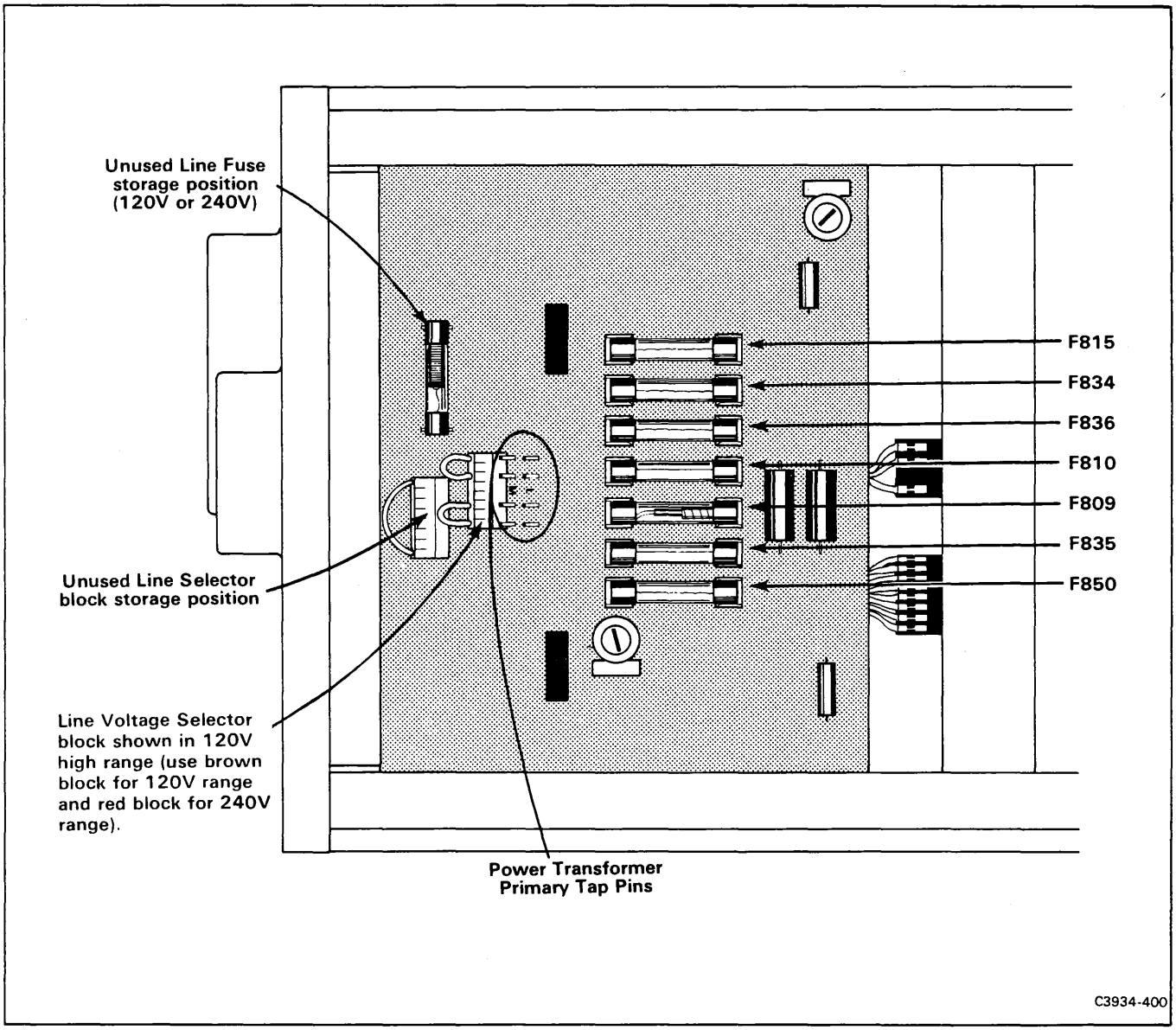


Figure 4-1. Locations of the line-selector blocks on the LV Power Supply circuit board.

1. Obtain a corrugated cardboard shipping carton with a 275-pound test strength and inside dimensions at least six inches greater than the instrument dimensions (this allows for cushioning material).

2. Enclose the instrument with polyethylene sheeting or equivalent to protect the finish of the instrument.

3. Allowing three inches on each side, cushion the instrument on all sides by tightly packing dunnage or urethane foam between the carton and the instrument.

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

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

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 provides 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 nonresidue type of cleaner, preferably isopropyl alcohol or totally denatured ethyl alcohol. Before using any other type of cleaner, consult your Tektronix Service Center or representative.

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.

COLOR SHUTTER

Spray glass cleaner on a soft clean cloth and wipe color shutter. Spraying the cloth rather than the color shutter prevents excess spray that may drip into the oscilloscope chassis. Any cleaner manufactured purposely for use on glass can be used.

INTERIOR

Dust inside 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 remaining dirt 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. Over heating 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 instrument after each 2000 hours of operation or every 12 months if used infrequently. In addition, replacement of components may necessitate adjustment of the affected circuits. Complete adjustment instructions are given in Section 3, Performance Check and Adjustment. This procedure can be helpful in localizing certain troubles in the instrument, and in some cases, may correct them.

TROUBLESHOOTING

The following information is provided to 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, Diagrams and Circuit Board Illustrations. 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.

MULTIPIN CONNECTOR HOLDERS

Multipin 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 Figure 4-2.

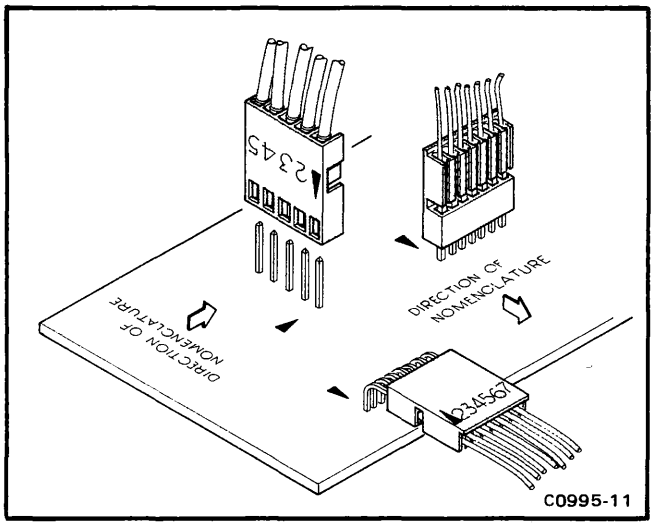


Figure 4-2. Multipin connector holder orientation.

SEMICONDUCTOR BASING

Figure 4-3 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.

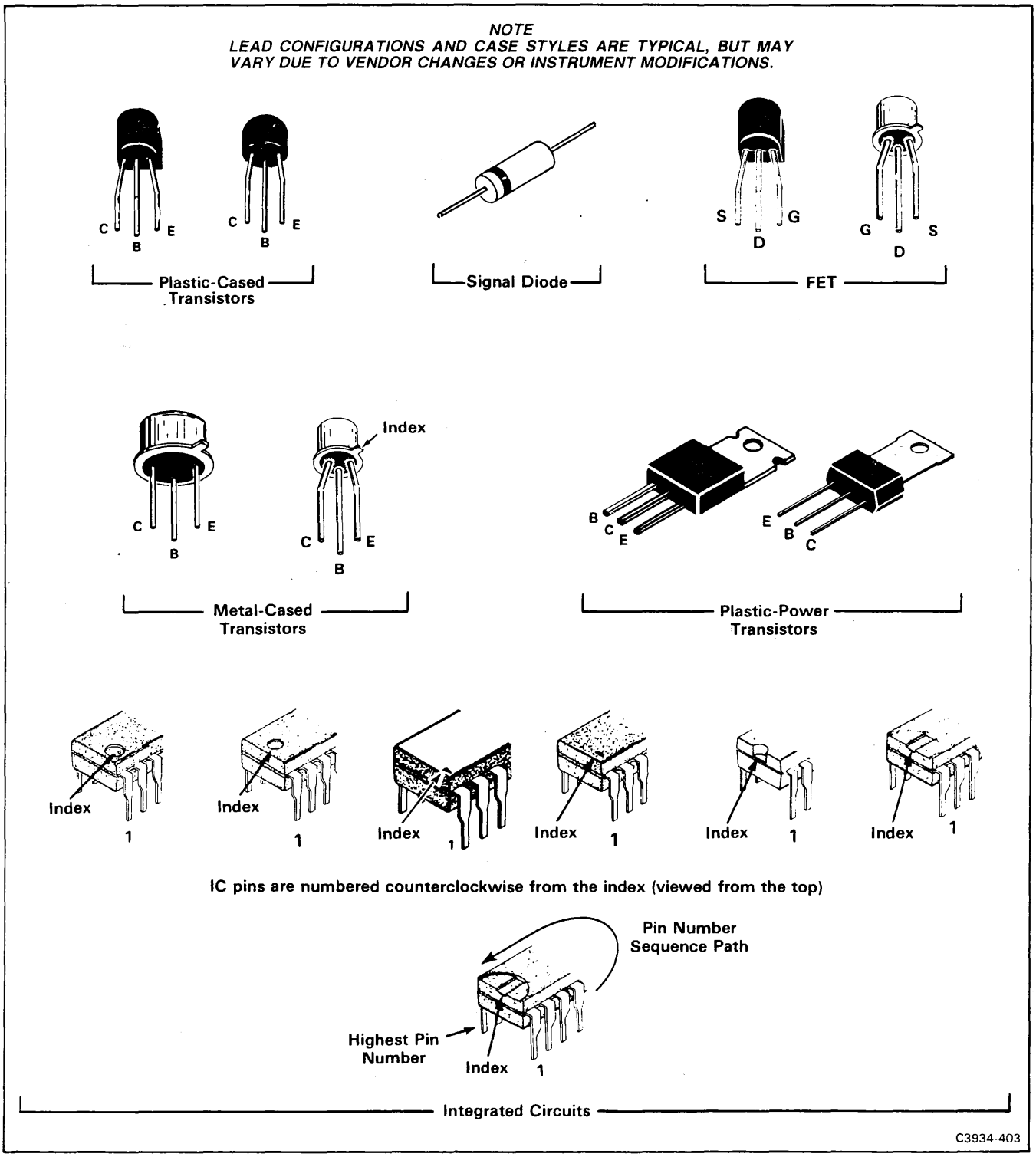


Figure 4-3. Lead Configuration data for semiconductor devices.

TROUBLESHOOTING EQUIPMENT

The following equipment, in addition to that listed in Table 3-1 (list of test equipment required for performance check in section 3 of this manual), is useful for troubleshooting.

1. 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.

2. 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.

   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).

3. 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 possibilities 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.

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 Figure 1-1 in the Operating Instructions section.

2. CHECK ASSOCIATED EQUIPMENT

Before troubleshooting, check that 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 maladjustment. 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 desirable 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.

Diodes

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

CAUTION

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

Resistors

Check resistors with an ohmmeter. See the Replacement 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 usually 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 the Corrective Maintenance. Be sure to check the performance of any circuit that has been repaired or had any electrical components replaced.

9. COLOR CHECK

If the 5116 is not producing color, first check to see if your 5D10 Waveform Digitizer has a serial number of B020100 or greater. If not, see your local Tektronix Field Office or representative to update your 5D10 to produce color signals.

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 (5116, 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 source before soldering.

The reliability and accuracy of this instrument can be maintained only if proper soldering techniques are used when repairing or replacing parts.

The desoldering and removal of parts is especially critical and should be done only with a vacuum solder extractor; preferably, one approved by a Tektronix, Inc., Service Center.

Use wire solder with rosin core, 63% tin, 37% lead. contact your local Tektronix Inc. representative or field office for approved solders.

All circuit boards used in this instrument are double sided. Once the conductive path is broken (due mainly to poor soldering practices) between the top layer and the bottom layer, the board is unusable and must be replaced. Damage can void warranty.

CAUTION

Only an experienced maintenance person, proficient in the use of vacuum type desoldering equipment, should attempt repair on any board in this instrument.

When soldering on circuit boards or small wiring, use only a 15-watt, pencil-type soldering iron. A higher wattage soldering iron can cause the etched circuit wiring to separate from the board base material, and melt the insulation from small wiring. Always keep the soldering-iron tip properly tinned to ensure the best heat transfer to the solder joint. Apply only enough heat to make a good solder joint. To protect heat-sensitive components, hold the component lead with a pair of long-nose pliers between the component body and the solder joint.

The following technique should be used to replace a component on any of the circuit boards.

Touch the tip of the vacuum desoldering tool directly to the solder to be removed.

CAUTION

Excessive heat can cause the etched circuit wiring to separate from the board base material.

Never allow the solder extractor to remain on the board for more than three (3) seconds. Solder wick, spring-actuated or squeeze-bulb desoldering tools, and heat blocks (for multipin components) must not be used. Damage can void warranty.

NOTE

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

When removing multipin components (e.g., IC's) do not heat adjacent conductors consecutively (see Fig. 4-4). Allow a moment for the circuit board to cool before proceeding to the next pin.

Bend the leads of the replacement components to fit the holes in the circuit board. Insert the leads into the holes in the board, or as originally positioned.

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

Cut off any excess lead protruding through the board.

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

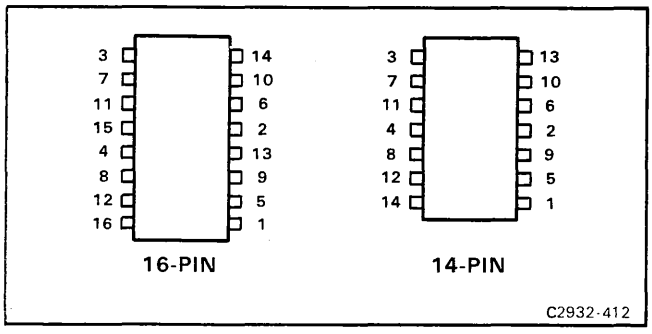


Figure 4-4. Recommended IC desoldering sequence.

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 Figure 4-3. Some plastic case transistors have lead configurations which 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 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 vacuum-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 pin replacement kit (including necessary tools, instructions, and replacement pins with attached ferrules) is available from Tektronix, Inc. Order Tektronix part, 040-0542-01.

To replace a damaged pin, first disconnect any pin connectors. Then remove the solder from the connection using a vacuum desoldering tool. (See "Soldering Techniques.") Remove the damaged pin from the board with a pair of pliers, leaving the ferrule (see Fig. 4-5) in the circuit board, if possible. If the ferrule remains in the circuit board, remove the spare ferrule from the replacement pin and press the new pin into the hole in the circuit board. If the ferrule is removed with the damaged pin, then press the replacement pin, with attached spare ferrule, into the circuit board. Position the replacement pin in the same manner as the original. Solder the pin to the circuit board on each side of the board. If the original pin was bent at an angle to mate with a connector, carefully bend the new pin to the same angle. Replace the pin connector.

CATHODE-RAY TUBE REPLACEMENT

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

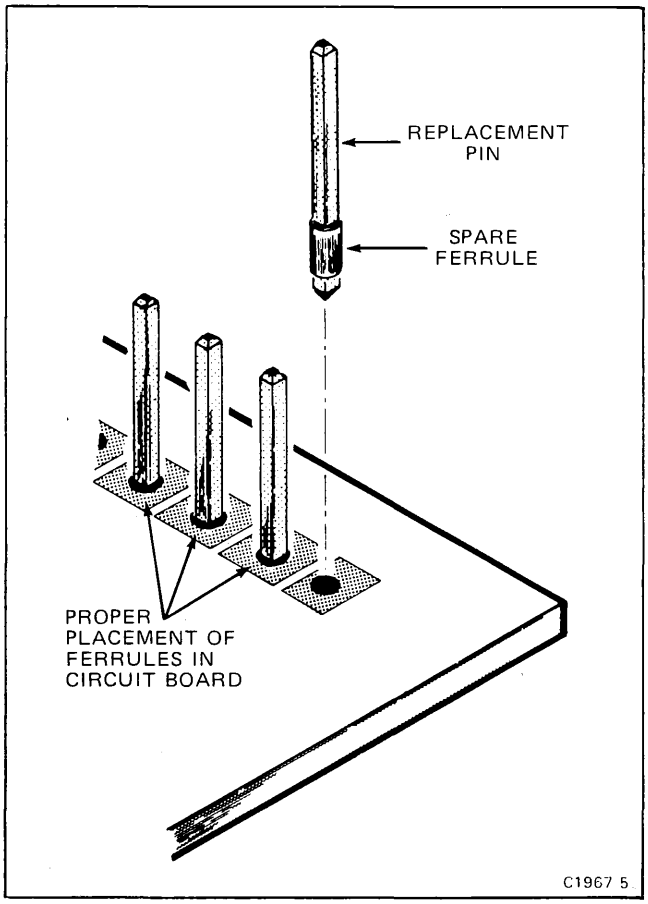


Figure 4-5. Enlarged view of circuit-board pin and ferrule.

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.

A. Removal

1. Remove the Color Shutter Assembly. (The Color Shutter Assembly includes the Color Shutter, Strain Relief Plate, Crt Retainer, Color Shutter Bezel, and Cable Assembly.) The Color Shutter Assembly is held in place with two screws. (In this oscilloscope, the color shutter is also the implosion shield.)

2. Disconnect the color-shutter cable from the Front Panel circuit board.

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

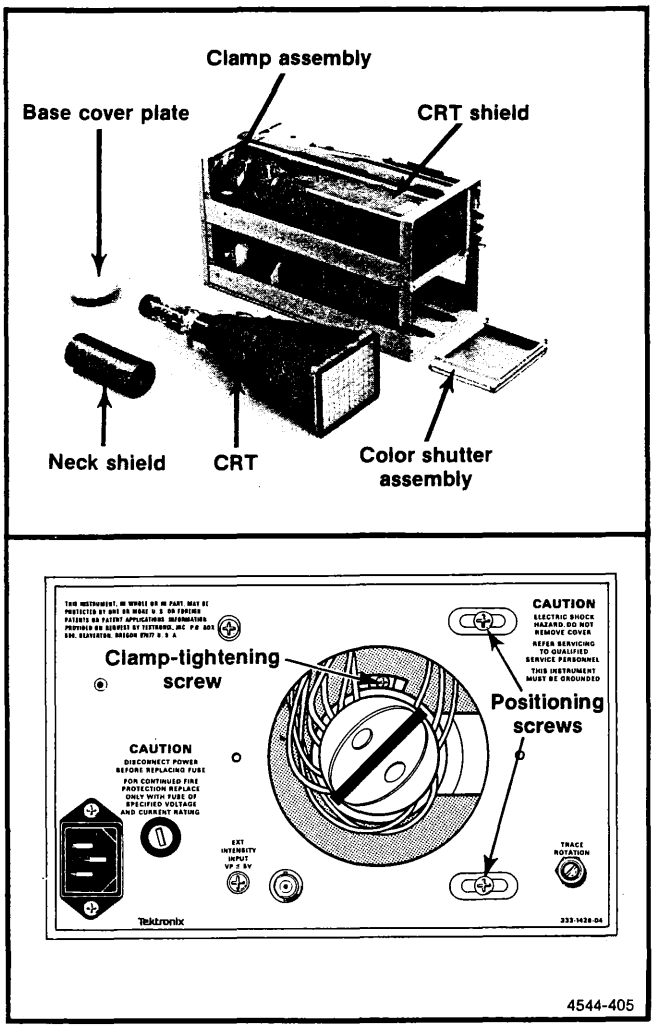


Figure 4-6. Replacing the cathode-ray tube.

4. Remove the crt base socket by pulling on the Socket Pull attached to the base socket.

5. Loosen the crt clamp. The crt and neck portion of the shield will be removed as a unit.

6. With one hand on the crt faceplate, push on the base of the crt. Slide the crt and neck shield forward. 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. The rubber cushions inside the neck shield should be towards the crt base. Push the neck shield on until it is even with the crt pins.

2. Make sure the soft plastic crt support is in place around the crt faceplate, then insert the crt into the main shield with the key on the base of the crt pointing to the left when facing the rear of the oscilloscope. While inserting the crt, favor the left side to avoid hitting the light pipe graticule illuminating assembly. Check that the crt support stays in place as the crt is inserted. (If the crt is difficult to slide through the chassis opening, apply a small amount of silicone grease to the crt support.)

3. Position the rear of the crt (socket end) so there is no tilt of the faceplate in relation to the front of the oscilloscope. Push the crt neck shield until the end is in line with the base socket. Tighten the crt clamp. If the crt does not seem to position correctly, loosen the positioning screws on the rear of the oscilloscope, readjust bracket, and tighten the screws.

CAUTION

The crt must be fully inserted or the Color Shutter may be damaged.

4. With the crt fully inserted, mount the Color Shutter Assembly. Check that the Color Shutter Assembly is hinged properly on the left side before tightening the screws.

5. Place the crt base socket onto the crt base pins. The "key" on the socket should be pointing to the left when viewed from the rear of the oscilloscope. Replace the cover. Connect the color-shutter cable to the pin connectors on the Front Panel circuit board.

6. Replacing the crt will require partial instrument adjustment. Refer to Section 3, Performance Check and Adjustment.

COLOR SHUTTER REPLACEMENT

NOTE

The 5116 will not produce color signals if the 5D10 Waveform Digitizer does not have a serial number of B020100 or greater.

1. Remove the Color Shutter Assembly from the oscilloscope. (The Color Shutter Assembly includes the Color Shutter, Crt Retainer, Strain Relief Plate, Color Shutter Bezel, and Cable Assembly.) The Color Shutter Assembly is held in place with two screws. (In this oscilloscope, the Color Shutter is also the implosion shield.)

2. Disconnect the color-shutter cable connector from the Front Panel circuit board.

3. Place the Color Shutter Assembly face down on a padded surface.

4. Remove the 3 Pozidriv screws securing the Crt Retainer and Strain Relief Plate. Remove the Crt Retainer and Strain Relief Plate from the Color Shutter.

5. Invert the Color Shutter Assembly. Begin removing the Color Shutter by gently pushing the end of the Color Shutter Assembly that contains the mounting holes for the Crt Retainer.

6. Place the Color Shutter into the new Color Shutter Bezel. Position the cell so that the wire passes through the Strain Relief Plate as it was originally.

7. Reinstall the Strain Relief Plate using the Pozidriv pan-head machine screw.

8. Reinstall the Crt Retainer with the remaining two Pozidriv flat-head screws.

9. Mount the Color Shutter Assembly. Check that the Color Shutter Assembly is hinged properly on the left side before tightening the screws.

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 Performance Check and 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 unregulated supply	Rear, LV Power Supply board.
F835	0.75 A Fast-Blow	+38 V unregulated supply	Rear, LV Power Supply board.
F850	3A Fast-Blow	Protection for secondaries	LV Power Supply board.
F809	0.3 A Slow-Blow A		of power supply transformer, T801.
F815	3A Fast-Blow		
F834	3A Fast-Blow		
F836	3A Fast-Blow		

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, Performance Check and Adjustment, for a complete adjustment procedure.

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

The channel switching amplifier plug-ins (5A14N, 5A18N, 5A26) that are recommended for use with 5100-series mainframes 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, to electrically remove the run from the front side of the board. On the back side of the board connect an insulated wire strap between Q540 and R542, 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.

THEORY OF OPERATION

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, Low-Voltage Power Supply and Calibrator, Front Panel Board, and Signals Out.

Complete schematic diagrams are provided in Section 8, Diagrams and Circuit Board Illustrations. In the following discussions, the schematic diagrams are referenced by a number inside a diamond preceding the heading. The schematic diagrams contain wide shaded borders around the major stages of the circuits to conveniently locate the components mentioned in the following discussions. The name of each stage is shown in a shaded box on the diagram and appears as a sub-heading in the discussion of that schematic diagram.

BLOCK DESCRIPTION

Vertical signals to be displayed on the cathode-ray tube (crt) 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

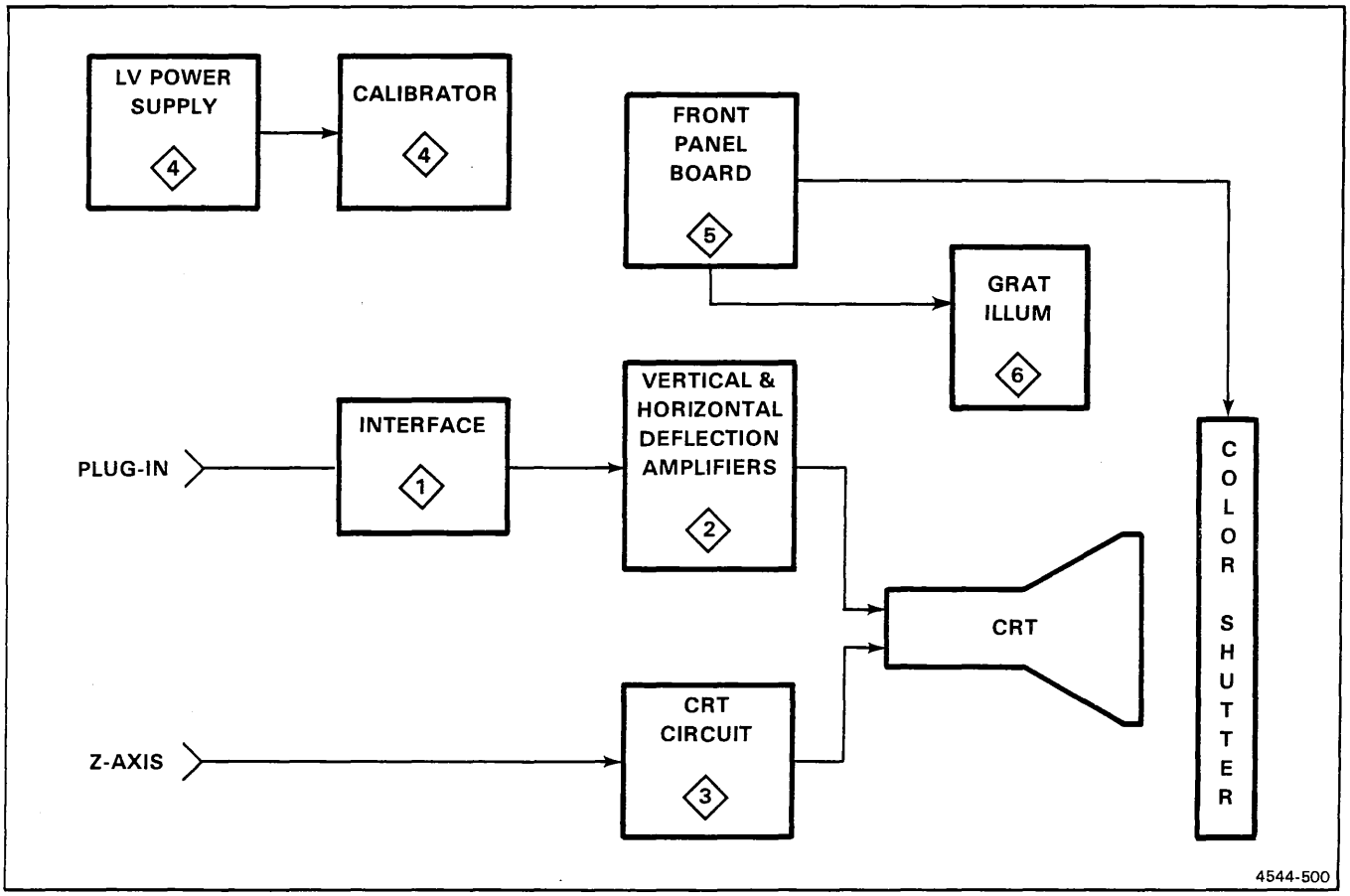


Figure 5-1. 5116 Block Diagram.

amplification between the horizontal plug-in unit and the horizontal deflection amplifier (diagram 2).

Additionally, the interface circuit supplies 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 2) 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 -4.3 kilovolts) and contains the controls necessary for proper operation of the crt. The crt circuit also contains the Z-axis amplifier. The Z-axis amplifier provides the drive signal to control the intensity level of the display, and it can be used to intensity modulate the display.

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.

The Front Panel Board (diagram 5) contains the Graticule Illumination control and color shutter driver circuits.

INTERFACE

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 labeled 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 associated passive components, which are connected as a multivibrator. When the multivibrator receives a chop actuate level (+5 volts), it free runs at 200 kilohertz. (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 multitrace display is required and the time-base Display switch is set to Chop.) The chop actuate level also disables Q910 which locks out the alternate-drive pulses. The Clock Generator has two outputs. One output is sent to the Countdown circuit (U800) as a timing signal, and the other output 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 X10 amplification of the vertical signal before passing it to the vertical deflection amplifier in the display unit. The Vertical Amplifier (diagram 1) consists of Q400, Q401, Q600, Q601, and respective 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 Q820, Q821, Q930, Q931, and respective passive components. This 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 the 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 and Q430-Q431 switch a high-impedance input to two pairs of FETS, 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 of the two vertical plug-in signals to pass to the Vertical Amplifier. In the chopped switching mode, the switching between input signals occurs at 100-kilohertz (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.

2 VERTICAL AND HORIZONTAL DEFLECTION AMPLIFIERS

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 Q124, Q126, Q134, and Q136 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, R124 and R134, and is about 50 times the magnitude of the input signal. The gain of this stage is set by the Vertical Gain adjustment, R136, to provide a calibrated vertical display.

HORIZONTAL DEFLECTION AMPLIFIER

The Horizontal Deflection Amplifier consists of Q104, Q106, Q114, and Q116. This circuit 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 P900. Resistor R116, Horiz Gain, provides Q106-Q116 emitter degeneration to set the gain of the stage 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 S200 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. This allows the trace to be displayed even though the INTENSITY control may be positioned fully counterclockwise.

XY PHASING

Variable capacitor C116 is connected across the input emitters of the Horizontal Deflection Amplifiers. This capacitor is adjusted to eliminate any phase difference between the vertical and horizontal deflection systems when operating in the XY mode.

3 CRT CIRCUIT

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

Z-AXIS AMPLIFIER

The Z-Axis Amplifier (consisting of Q222, Q226, and Q234) is a current driven shunt-feedback operational amplifier with a voltage output. 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 drive circuit.

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. Q214 sets these input signals to a level suitable for proper response by the Z-Axis Amplifier.

HIGH-VOLTAGE OSCILLATOR

Transistor Q252, transformer T240, and associated circuitry make up the oscillator that produces the high-voltage ac waveform. The voltage waveform at the collector of Q252 is a sine wave at the resonant frequency of T240 and RC network R254-C252.

When the instrument is turned on, current through Q264 provides forward bias for Q252. Transistor Q252 conducts and the collector current increases. This develops a voltage across the primary winding (Q252 collector) of T240. A corresponding voltage increase is produced in the feedback winding of T240 (terminals 3 and 6), which is connected via R254 to the base of Q252, and Q252 conducts even harder. When base current flows, C262 charges negatively, eventually, turning off Q252. With Q252 off, the transformer is free to oscillate through one cycle. During this time, the regulator circuit supplies current to charge C262 to its starting value. Then as the primary voltage nears its negative peak, Q252 is turned on again and the cycle repeats.

The amplitude of sustained oscillation depends upon the average current delivered to the base of Q252 by the regulator circuitry. The frequency of oscillation is approximately 35 kHz. Components C251 and R251 decouple the unregulated +38 V supply line.

HIGH-VOLTAGE REGULATOR

Transistors Q278, Q264, and associated circuitry form an amplifier that regulates the output voltage of the high-voltage supply by controlling the current delivered to the high-voltage oscillator.

Regulation is provided by feedback to the cathode supply through divider network R272A, R272B, C249, and C273. If the cathode supply voltage drops below its nominal -4330 volts (more positive) the base of Q278 is pulled up and more current is delivered to Q252 by Q264, hence, increasing the oscillation amplitude. Conversely, if the output level increases Q264 supplies less current to Q252 and the oscillation amplitude decreases.

R277 and C277 reduce the amplifier gain at higher frequencies to dampen the regulator response to large load changes caused by the Z-axis blanking pulses.

R272D compensates for anode (crt pin 2) variations with line voltage. As the line voltage increases the anode voltage increases. R272D forces the cathode voltage to decrease (more positive) keeping the crt accelerating-voltage constant.

NOTE

The +30 volt supply is used as the positive reference for the divider network. The voltage has to be set accurately to get the correct high voltage out.

R276 and C276 form a startup circuit which allows the high-voltage oscillator to startup slowly. Voltage rises with the RC time constant of R276 and C276 until the diode (CR276) clamps it at approximately 30.5 volts.

HIGH-VOLTAGE RECTIFIERS AND OUTPUT

The high-voltage transformer, T240, has 3 output windings. (See A3 circuit board illustration and locator in section 8 for terminal configuration.) The first winding is 6.3 V for the crt filament. This winding (no terminal numbers) at the top of the transformer is referenced to the cathode voltage to prevent cathode-to-filament breakdown. The second transformer winding, terminals 7, 8, and 10, supplies the high-voltage ac which is rectified and filtered producing the negative voltage at the cathode. The third winding, terminals 1 and 2 of the transformer, is not used in this oscilloscope.

When jumper W298 is installed and diode CR247 attached to terminal 10 on transformer T240, -4330 volts is supplied to the cathode of the 5116 Oscilloscope. With jumper W298 removed and diode CR247 attached to terminal 13 on transformer T240, the cathode supply output is -3330 volts; but it is unused on this oscilloscope.

The rectifier and filter circuit consists of CR247, C248, and C249. Note that capacitor C249 serves a dual purpose. First it provides filtering for the crt cathode, and second it provides an ac feedback path to the supply regulator.

CRT CONTROL CIRCUITS

The INTENSITY control, when used in conjunction with the FOCUS control, provides a well-defined display. The Intensity range control, R245, is 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).

Transformer T240 provides the signal used to generate the crt control grid voltage. Components R299, C246, and CR245 half-wave rectify the waveform to reduce the load on the Z-axis amplifier. After resistor R246, the signal is an ac square wave with diode CR244 setting the upper level and diode CR243 setting the lower level. The upper level is controlled by the Intensity range adjustment, R245, and the lower level is controlled by the Z-axis amplifier output level.

The negative control ground voltage for the crt is provided by diodes CR241 and CR242, rectifying the square wave and using the cathode supply as a reference. C242 acts as a filter for the rectifier and provides a high-frequency path for Z-axis control signals.

Protection to the crt is provided by neon bulbs DS271, DS272, and DS273 when the voltage difference between the control grid and the cathode exceeds about 180 volts.

Front-panel FOCUS and internal Astigmatism controls have been incorporated for arriving at an optimum crt display. The 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 vertical 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.

4 LV POWER SUPPLY AND CALIBRATOR

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

POWER INPUT

Power is applied to the primary of transformer T801 through fuse F201, line filter FL201, 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 voltage 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 and 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.

-30 VOLT 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, such as ripple or change of current through the load, 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 the adjustment of R878, -30 V Adj. This control sets the conduction to Q870, which controls the bias levels of Q860 and Q865. 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 from the 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 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.

CALIBRATOR

The Calibrator circuit comprised of Q885, Q890, and associated passive components produces a square-wave output with accurate amplitude at a rate of twice that of the power-line frequency. This output is available at the probe test jack on the display unit front panel. With the calibrator patch cord installed, a 4 milliampere (peak-to-peak) square-wave current is available. When the calibrator jumper is removed, a 400 millivolt (ground-to-peak) square-wave voltage can be measured at the left (nongrounded side) front-panel calibrator jack.

The resistive-capacitive network at the base of Q885 receives a pulsating dc voltage from full-wave rectifier CR835 and CR836 producing 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 and CR890. With the calibrator patch cord installed, 4 milliamperes of current flow through R893 with zero volts out. When the calibrator patch cord is removed, current flows through R892, and 400 millivolts is measured across R892.

5 FRONT PANEL BOARD

The Front Panel Board contains the GRAT ILLUM circuitry and the driver circuits for the color shutter.

GRATICULE ILLUMINATION

Graticule illumination is supplied by seven lamps mounted in a light pipe which is positioned next to the crt faceplate. Power for the lamps is obtained by rectifying the flood-gun heater supply. The lamp voltage (intensity) is set with the GRAT ILLUM front-panel control and Q400.

COLOR SHUTTER DRIVER

The color shutter is driven with a plus and minus 20 volt, 1 KHz square wave (plus and minus 15 volt, 700 Hz for serial numbers below B020317) to produce a blue green display. The color shutter is driven with 0 volt DC to produce an orange display. Peak currents up to 100 mA are required to drive the cell's capacitance. The average (DC) voltage across the cell must be within 25 mV of 0 volt. This requirement is met by measuring the average voltage and varying the duty factor of the square wave to force the average to zero.

The shutter is driven by a feedback amplifier consisting of U334, Q210, Q211, Q238 and Q239. Resistor R326 and capacitor C334 provide the feedback impedance. The input is driven with ± 0.6 mA at ground or disconnected (0 mA) to force the output to plus and minus 20 volts (plus and minus 15 volts for serial numbers below B020317) or to ground (0 V). Operational amplifier U334 provides high input impedance, low offset voltage, and gain. Transistors Q238 and Q239 generate the output voltage swing and transistors Q210 and Q211 provide the output current.

Oscillator Q314, Q316 and associated components generate a square wave at approximately 1 KHz (700 Hz for serial numbers below B020317). When color is low ("blue-green") Q428 is off. Therefore, the gate of Q430 is at a zero level and causes Q430 to turn on. Q426, driven by the oscillator square wave, causes the drain current of Q430 to switch between plus and minus 0.6 mA. This current drives the feedback amplifier's output between plus and minus 20 volts (plus and minus 15 volts for serial numbers below B020317).

When color is high ("orange") Q428 is on, therefore, the gate of Q430 is at -7 volts causing Q430 to turn off. Input current to the feedback amplifier is zero, and its output is driven to a zero volt level.

Components U410, R412, and C318 observe the color shutter drive voltage and generate a voltage which is applied to the square-wave oscillator. The duty factor (and frequency) of the oscillator is varied to force the average color shutter drive voltage to zero.

Resistor R514 at the base of Q428 is returned to ground to provide the necessary low-logic level when a noncolor plug-in is installed.

7 SIGNALS OUT (OPTION 7 ONLY)

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 5 volts to approximately a zero 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 of signal. This 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 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 cover that 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).

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 XY 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 the Universal European 240-volt type power cord.

OPTION A2

The standard power cord is replaced with the United Kingdom 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 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 Table 1-1 in this manual to determine type of cord used with your instrument.

TABLE 6-1
Option Information Locator

Option	Location		Information
	Manual Section	Heading	
2	6 Instrument Options	Option 2	Gives a brief description of Option 2.
7	6 Instrument Options	Option 7	Gives a brief description of Option 7.
A1	1 Operating Instructions	Power Cord Information Table 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 Table 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 Table 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 Table 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 Table 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.

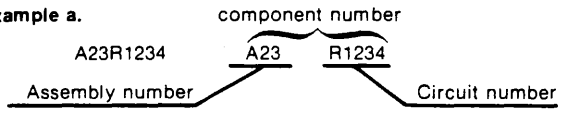
ABBREVIATIONS

Abbreviations conform to American National Standard Y1.1.

COMPONENT NUMBER (column one of the Electrical Parts List)

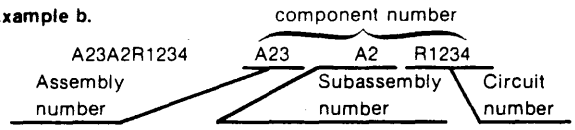
A numbering method has been used to identify assemblies, subassemblies and parts. Examples of this numbering method and typical expansions are illustrated by the following:

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	DALLAS, TX 75222
02114	FERROXCUBE CORPORATION	PO BOX 359, MARION ROAD	SAUGERTIES, NY 12477
02660	BUNKER RAMO CORP., CONNECTOR DIVISION	2801 S 25TH AVENUE	BROADVIEW, IL 60153
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867	MYRTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
05828	GENERAL INSTRUMENT CORP ELECTRONIC SYSTEMS DIV.	600 W JOHN ST.	HICKSVILLE LI, NY 11802
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
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
15238	ITT SEMICONDUCTORS, A DIVISION OF INTER NATIONAL TELEPHONE AND TELEGRAPH CORP.	P.O. BOX 168, 500 BROADWAY	LAWRENCE, MA 01841
19701	ELECTRA-MIDLAND CORP., MEPCO ELECTRA INC.	P O BOX 760	MINERAL WELLS, TX 76067
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
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
51642	CENTRE ENGINEERING INC.	2820 E COLLEGE AVENUE	STATE COLLEGE, PA 16801
52769	SPRAGUE GOODMAN ELEC., INC.	134 FULTON AVENUE	GARDEN CITY PARK, NY 11040
54473	MATSUSHITA ELECTRIC, CORP. OF AMERICA	1 PANASONIC WAY	SECAUCUS, NJ 07094
54583	TDK ELECTRONICS CORP.	755 EASTGATE BLVD.	GARDEN CITY, NY 11530
55680	NICHICON/AMERICA/CORP.	6435 N PROESEL AVENUE	CHICAGO, IL 60645
56289	SPRAGUE ELECTRIC CO.	87 MARSHALL ST.	NORTH ADAMS, MA 01247
57668	R-OHM CORP.	16931 MILLIKEN AVE.	IRVINE, CA 92713
59660	TUSONIX INC.	2155 N FORBES BLVD	TUCSON, AZ 85705
59821	CENTRALAB INC SUB NORTH AMERICAN PHILIPS CORP	7158 MERCHANT AVE	EL PASO, TX 79915
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
71744	CHICAGO MINIATURE LAMP WORKS	4433 RAVENSWOOD AVE.	CHICAGO, IL 60640
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
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
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
83003	VARO, INC.	P O BOX 411, 2203 WALNUT STREET	GARLAND, TX 75040
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601
91929	HONEYWELL, INC., MICRO SWITCH DIV.	CHICAGO & SPRING STS.	FREEPORT, IL 61032
95238	CONTINENTAL CONNECTOR CORP.	34-63 56TH ST.	WOODSIDE, NY 11377
96733	SAN FERNANDO ELECTRIC MFG CO	1501 FIRST ST	SAN FERNANDO, CA 91341

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-7478-01			CKT BOARD ASSY:INTERFACE	80009	670-7478-01
A2	670-1339-04			CKT BOARD ASSY:L.V. POWER SUPPLY	80009	670-1339-04
A3	670-1621-11			CKT BOARD ASSY:HIGH VOLTAGE	80009	670-1621-11
A5	670-7798-00			CKT BOARD ASSY:FRONT PANEL	80009	670-7798-00
A6	670-7799-00			CKT BOARD ASSY:GRATICULE ILLUM	80009	670-7799-00
A7	670-5757-00			CKT BOARD ASSY:SIGNAL OUT	80009	670-5757-00
A7	---- ----			(OPTION 07 ONLY)		
A1	670-7478-01			CKT BOARD ASSY:INTERFACE	80009	670-7478-01
A1C400	281-0812-00			CAP.,FXD,CER DI:1000PF,10%,100V	04222	MA101C102KAA
A1C411	281-0797-00			CAP.,FXD,CER DI:15PF,10%,100V	04222	MA106A150KAA
A1C503	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C510	281-0797-00			CAP.,FXD,CER DI:15PF,10%,100V	04222	MA106A150KAA
A1C520	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C620	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C721	281-0812-00			CAP.,FXD,CER DI:1000PF,10%,100V	04222	MA101C102KAA
A1C740	290-0748-00			CAP.,FXD,ELCTLT:10UF,+50-10%,25V	54473	ECE-BIEV100S
A1C800	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C801	281-0814-00			CAP.,FXD,CER DI:100PF,10%,100V	04222	GC101A101K
A1C810	281-0823-00			CAP.,FXD,CER DI:470PF,10%,50V	04222	MA105A471KAA
A1C814	281-0773-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA201C103KAA
A1C900	290-0748-00			CAP.,FXD,ELCTLT:10UF,+50-10%,25V	54473	ECE-BIEV100S
A1C902	281-0786-00			CAP.,FXD,CER DI:150PF,10%,100V	04222	MA101A151KAA
A1C930	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1CR400	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR420	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR421	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR423	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR432	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR433	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR501	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR520	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR800	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR820	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1CR830	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A1E513	276-0532-00			SHIELDING BEAD,:	02114	56-590-65/4A6
A1E514	276-0532-00			SHIELDING BEAD,:	02114	56-590-65/4A6
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	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A1P640	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A1P710	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A1P740	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A1P800	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A1P900	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A1Q400	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
A1Q401	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
A1Q413	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
A1Q420	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	27014	F55037
A1Q421	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	27014	F55037
A1Q430	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1Q431	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
A1Q510	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
A1Q520	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	27014	F55037
A1Q521	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	27014	F55037
A1Q600	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
A1Q601	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
A1Q630	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
A1Q631	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
A1Q700	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A1Q701	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A1Q710	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A1Q820	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
A1Q821	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
A1Q910	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
A1Q930	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
A1Q931	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
A1R200	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R220	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	57668	NTR25J-E470K
A1R221	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	57668	NTR25J-E470K
A1R400	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	57668	NTR25J-E39K0
A1R401	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	57668	NTR25J-E 8K2
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	57668	NTR25J-E27K0
A1R404	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	57668	NTR25J-E27K0
A1R405	321-0159-00			RES.,FXD,FILM:442 OHM,1%,0.125W	91637	CMF55116G442R0F
A1R406	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
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	CMF55116G43201F
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	57668	NTR25J-E02K7
A1R414	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	57668	NTR25J-E 22E
A1R420	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	57668	NTR25J-E75K0
A1R421	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A1R422	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
A1R430	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	57668	NTR25J-E 3K6
A1R431	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A1R432	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	57668	NTR25J-E75K0
A1R433	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
A1R500	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	57668	NTR25J-E39K0
A1R501	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R502	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	57668	NTR25J-E 8K2
A1R503	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
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	57668	NTR25J-E 22E
A1R521	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	57668	NTR25J-E75K0
A1R522	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A1R530	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R531	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R532	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A1R533	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	57668	NTR25J-E75K0
A1R534	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	57668	NTR25J-E 3K6

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A1R629	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	57668	NTR25J-E470K
A1R639	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	57668	NTR25J-E470K
A1R700	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R701	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
A1R710	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R711	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
A1R720	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
A1R721	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
A1R722	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	57668	NTR25J-E 8K2
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	57668	NTR25JE01K0
A1R801	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R810	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R812	315-0163-00			RES.,FXD,CMPSN:16K OHM,5%,0.25W	57668	NTR25J-E16K0
A1R813	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	57668	NTR25J-E75E0
A1R820	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	57668	NTR25J-E39K0
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	57668	NTR25J-E 22K
A1R831	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	57668	NTR25J-E39K0
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	57668	NTR25J-E 18K
A1R902	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R903	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	57668	NTR25J-E200E
A1R904	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A1R910	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	57668	NTR25J-E27K0
A1R911	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	57668	NTR25J-E470K
A1R920	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R921	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	57668	NTR25J-E 8K2
A1R922	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	57668	NTR25J-E330E
A1R930	321-0159-00			RES.,FXD,FILM:442 OHM,1%,0.125W	91637	CMF55116G442R0F
A1R931	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	57668	NTR25J-E150K
A1R932	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	57668	NTR25J-E330E
A1U800	156-0567-02			MICROCIRCUIT,DI:DUAL J-K NEG-EDGE-TRIG FF	01295	SN74LS113NP3
A1VR530	152-0149-00			SEMICOND DEVICE:ZENER,0.4W,10V,5%	04713	SZG35009K3

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A2	670-1339-04			CKT BOARD ASSY:L.V. POWER SUPPLY	80009	670-1339-04
A2C810	290-0511-00			CAP.,FXD,ELCTLT:250UF,+75-10%,250V	56289	68D10464
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	281-0762-00			CAP.,FXD,CER DI:27PF,20%,100V	96733	R2737
A2C830	285-0629-00			CAP.,FXD,PLSTC:0.047UF,20%,100V	56289	192P47302R467
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	290-0969-00			CAP.,FXD,ELCTLT:22UF,+50-10%,100V	55680	TLB2A220TCAANA
A2C852	281-0550-00			CAP.,FXD,CER DI:120PF,10%,500V	59660	301000X5P121K
A2C857	281-0773-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA201C103KAA
A2C860	290-0969-00			CAP.,FXD,ELCTLT:22UF,+50-10%,100V	55680	TLB2A220TCAANA
A2C865	281-0861-00			CAP.,FXD,CER DI:270 PF,5%,50V	51642	G1710-050-NP0-27
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	281-0773-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA201C103KAA
A2C881	290-0267-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	173D105X0035V
A2C883	290-0267-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	173D105X0035V
A2C890	281-0785-00			CAP.,FXD,CER DI:68PF,10%,100V	04222	MA101A680KAA
A2CR810	152-0066-00			SEMICOND DVC DI:RECT,SI,400V,1A,D0-41	05828	GP10G-020
A2CR811	152-0066-00			SEMICOND DVC DI:RECT,SI,400V,1A,D0-41	05828	GP10G-020
A2CR812	152-0066-00			SEMICOND DVC DI:RECT,SI,400V,1A,D0-41	05828	GP10G-020
A2CR813	152-0066-00			SEMICOND DVC DI:RECT,SI,400V,1A,D0-41	05828	GP10G-020
A2CR815	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	04713	SDA317
A2CR820	152-0066-00			SEMICOND DVC DI:RECT,SI,400V,1A,D0-41	05828	GP10G-020
A2CR824	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A2CR835	152-0066-00			SEMICOND DVC DI:RECT,SI,400V,1A,D0-41	05828	GP10G-020
A2CR836	152-0066-00			SEMICOND DVC DI:RECT,SI,400V,1A,D0-41	05828	GP10G-020
A2CR837	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	04713	SDA317
A2CR841	152-0066-00			SEMICOND DVC DI:RECT,SI,400V,1A,D0-41	05828	GP10G-020
A2CR842	152-0066-00			SEMICOND DVC DI:RECT,SI,400V,1A,D0-41	05828	GP10G-020
A2CR850	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A2CR851	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A2CR860	152-0066-00			SEMICOND DVC DI:RECT,SI,400V,1A,D0-41	05828	GP10G-020
A2CR865	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A2CR870	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A2CR875	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A2CR885	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A2CR890	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
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	ABC-1/4
A2F815	159-0015-00			FUSE,CARTRIDGE:3AG,3A,250V,0.65 SEC	71400	AGC-CW-3
A2F834	159-0015-00			FUSE,CARTRIDGE:3AG,3A,250V,0.65 SEC	71400	AGC-CW-3
A2F835	159-0042-00			FUSE,CARTRIDGE:3AG,0.75A,250V,FAST-BLOW	71400	AGC-CW-3/4
A2F836	159-0015-00			FUSE,CARTRIDGE:3AG,3A,250V,0.65 SEC	71400	AGC-CW-3
A2F850	159-0015-00			FUSE,CARTRIDGE:3AG,3A,250V,0.65 SEC	71400	AGC-CW-3
A2P370	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A2P830	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A2P840	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A2P850	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A2P890	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A2Q820	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
A2Q825	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919

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A2Q845	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
A2Q850	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A2Q865	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
A2Q870	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
A2Q875	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
A2Q885	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
A2Q890	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
A2R810	301-0150-00			RES.,FXD,CMPSN:15 OHM,5%,0.5W	01121	EB1505
A2R812	303-0683-00			RES.,FXD,CMPSN:68K OHM,5%,1W	01121	GB6835
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	57668	NTR25J-E47K0
A2R822	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	57668	NTR25J-E680E
A2R824	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	57668	NTR25J-E 8K2
A2R826	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	57668	NTR25J-E02K4
A2R827	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A2R830	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
A2R832	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	57668	NTR25J-E47K0
A2R834	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	57668	NTR25J-E 18K
A2R841	307-0300-00			RES.,FXD,FILM:150 OHM,5%,10W	24546	FP10 5% 150R
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	57668	NTR25J-E390E
A2R847	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	57668	NTR25J-E 18K
A2R850	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	57668	NTR25J-E82K
A2R851	301-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.5W	57668	TR50J-E33K
A2R852	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	57668	NTR25J-E680E
A2R853	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A2R856	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A2R857	322-0268-00			RES.,FXD,FILM:6.04K OHM,1%,0.25W	75042	CEBT0-6041F
A2R858	311-1120-00			RES.,VAR,NONWIR:100 OHM,30%,0.25W	71450	201-YA5531
A2R859	322-0268-00			RES.,FXD,FILM:6.04K OHM,1%,0.25W	75042	CEBT0-6041F
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	57668	NTR25J-E27K0
A2R865	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A2R867	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	57668	NTR25J-E620E
A2R868	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A2R869	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	57668	NTR25J-E03K9
A2R870	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
A2R872	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	57668	NTR25J-E220E
A2R873	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A2R875	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
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	CMF55116G12400F
A2R880	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	57668	NTR25J-E02K7
A2R881	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
A2R883	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A2R885	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
A2R890	322-0686-03			RES.,FXD,FILM:7.23K OHM,0.25%,0.25W	24546	NC60 7.23K 0.25%
A2R892	321-0097-03			RES.,FXD,FILM:100 OHM,0.25%,0.125W	91637	MFF1816D100R0C
A2R893	308-0685-00			RES.,FXD,WW:1.5 OHM,5%,1W	75042	BW20-1R500J
A2TP810	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00

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A2TP820	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A2TP830	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
A2W891	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A3	670-1621-11			CKT BOARD ASSY:HIGH VOLTAGE	80009	670-1621-11
A3C104	281-0811-00			CAP.,FXD,CER DI:10PF,10%,100V	96733	R2911
A3C106	283-0690-00			CAP.,FXD,MICA D:560PF,1%,300V	00853	D153F561F0
A3C116	281-0256-00			CAP.,VAR,PLASTIC:10-180PF,100V	52769	GZD18100
A3C124	281-0811-00			CAP.,FXD,CER DI:10PF,10%,100V	96733	R2911
A3C126	283-0692-00			CAP.,FXD,MICA D:670PF,1%,300V	00853	D15-3F671F0
A3C136	283-0625-00			CAP.,FXD,MICA D:220PF,1%,500V	00853	D105F221F0
A3C222	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A3C223	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A3C224	283-0051-00			CAP.,FXD,CER DI:0.0033UF,5%,100V	56289	1C20C0G332J100B
A3C236	283-0167-00			CAP.,FXD,CER DI:0.1UF,10%,100V	72982	8131N145X5R0104K
A3C240	283-0008-00			CAP.,FXD,CER DI:0.1UF,20%,500V	56289	3C37X7R104M500B
A3C241	285-1154-00			CAP.,FXD,PLSTC:0.001UF,10%,6000V	56289	430P102960
A3C242	285-0507-01			CAP.,FXD,PPR DI:0.0047UF,20%,6000V	56289	430P571
A3C245	283-0189-00			CAP.,FXD,CER DI:0.1UF,20%,400V	56289	5C40X5R104M400B
A3C246	283-0077-00			CAP.,FXD,CER DI:330PF,5%,500V	59660	831-500B331J
A3C248	285-0509-01			CAP.,FXD,PPR DI:0.0068UF,20%,5000V	56289	430P507
A3C249	285-0509-01			CAP.,FXD,PPR DI:0.0068UF,20%,5000V	56289	430P507
A3C251	290-0194-00			CAP.,FXD,ELCTLT:10UF,+50-10%,100V	56289	30D106F100C9
A3C252	283-0203-00			CAP.,FXD,CER DI:0.47UF,20%,50V	04222	SR305SC474MAA
A3C262	281-0815-00			CAP.,FXD,CER DI:0.027UF,20%,50V	72982	8005D9AABW5R273M
A3C273	283-0194-00			CAP.,FXD,CER DI:4.7UF,20%,50V	56289	5C37Z5U475M050B
A3C276	290-0145-00			CAP.,FXD,ELCTLT:10UF,+75-10%,50V	56289	30D106G050CB9
A3C277	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A3C281	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	59660	871-533E103P
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 DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A3CR215	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
A3CR222	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
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
A3CR240	152-0242-00			SEMICOND DVC:SIG,SI,225V,0.2A,D0-7	07263	FDH5004
A3CR241	152-0242-00			SEMICOND DVC:SIG,SI,225V,0.2A,D0-7	07263	FDH5004
A3CR242	152-0242-00			SEMICOND DVC:SIG,SI,225V,0.2A,D0-7	07263	FDH5004
A3CR243	152-0242-00			SEMICOND DVC:SIG,SI,225V,0.2A,D0-7	07263	FDH5004
A3CR244	152-0242-00			SEMICOND DVC:SIG,SI,225V,0.2A,D0-7	07263	FDH5004
A3CR245	152-0242-00			SEMICOND DVC:SIG,SI,225V,0.2A,D0-7	07263	FDH5004
A3CR247	152-0408-00			SEMICOND DEVICE:SILICON,10KV,5MA	83003	H345
A3CR252	152-0400-00			SEMICOND DEVICE:SILICON,400V,1A	80009	1N4936
A3CR264	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A3CR265	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A3CR269	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A3CR270	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A3CR272	152-0246-00			SEMICOND DEVICE:SW,SI,40V,200MA	14433	WG1537TK
A3CR273	152-0246-00			SEMICOND DEVICE:SW,SI,40V,200MA	14433	WG1537TK
A3CR276	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A3CR298	152-0331-00			SEMICOND DEVICE:SILICON,800V,25MA	0000M	152-0331-00
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

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A3P102	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A3P111	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A3P116	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A3P121	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A3P130	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A3P205	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A3P252	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A3P260	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A3P290	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A3P298	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A3Q104	151-0615-00			TRANSISTOR:NPN,SI,TO-202	04713	SDS358K
A3Q106	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A3Q114	151-0615-00			TRANSISTOR:NPN,SI,TO-202	04713	SDS358K
A3Q116	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A3Q124	151-0615-00			TRANSISTOR:NPN,SI,TO-202	04713	SDS358K
A3Q126	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A3Q134	151-0615-00			TRANSISTOR:NPN,SI,TO-202	04713	SDS358K
A3Q136	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A3Q214	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
A3Q222	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A3Q226	151-0407-00			TRANSISTOR:SILICON,NPN	04713	SS2456
A3Q234	151-0406-00			TRANSISTOR:SILICON,PNP	04713	ST1264
A3Q264	151-0435-00			TRANSISTOR:SILICON,PNP	04713	SPS8335
A3Q278	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
A3R101	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A3R102	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	57668	NTR25J-E220E
A3R103	315-0390-00			RES.,FXD,CMPSN:39 OHM,5%,0.25W	57668	NTR25J-E39E0
A3R104	308-0668-00			RES.,FXD,WW:6.2K OHM,3%,7W	00213	1600S62003
A3R106	321-0128-00			RES.,FXD,FILM:210 OHM,1%,0.125W	91637	CMF55116G210R0F
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	57668	NTR25J-E220E
A3R113	315-0390-00			RES.,FXD,CMPSN:39 OHM,5%,0.25W	57668	NTR25J-E39E0
A3R114	308-0668-00			RES.,FXD,WW:6.2K OHM,3%,7W	00213	1600S62003
A3R116	311-1244-00			RES.,VAR,NONWIR:100 OHM,10%,0.50W	32997	3386X-T07-101
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	57668	NTR25J-E220E
A3R123	315-0390-00			RES.,FXD,CMPSN:39 OHM,5%,0.25W	57668	NTR25J-E39E0
A3R124	308-0668-00			RES.,FXD,WW:6.2K OHM,3%,7W	00213	1600S62003
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	CMF55116G210R0F
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	57668	NTR25J-E220E
A3R133	315-0390-00			RES.,FXD,CMPSN:39 OHM,5%,0.25W	57668	NTR25J-E39E0
A3R134	308-0668-00			RES.,FXD,WW:6.2K OHM,3%,7W	00213	1600S62003
A3R135	315-0390-00			RES.,FXD,CMPSN:39 OHM,5%,0.25W	57668	NTR25J-E39E0
A3R136	311-1244-00			RES.,VAR,NONWIR:100 OHM,10%,0.50W	32997	3386X-T07-101
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	57668	NTR25J-E 56K
A3R203	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A3R206	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
A3R207	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	57668	NTR25J-E 8K2
A3R208	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	57668	NTR25J-E47K0
A3R209	315-0164-00			RES.,FXD,CMPSN:160K OHM,5%,0.25W	57668	NTR25J-E160K
A3R211	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A3R213	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	57668	NTR25J-E 62K
A3R215	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A3R216	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
A3R217	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A3R218	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	57668	NTR25J-E 18K
A3R219	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	57668	NTR25J-E68K0
A3R222	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A3R223	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
A3R226	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
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	57668	NTR25J-E10K0
A3R232	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	57668	NTR25J-E150K
A3R234	305-0183-00			RES.,FXD,CMPSN:18K OHM,5%,2W	01121	HB1835
A3R236	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	57668	NTR25J-E 820E
A3R240	315-0102-03			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A3R241	315-0102-03			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A3R242	315-0331-03			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
A3R243	315-0106-00			RES.,FXD,CMPSN:10M OHM,5%,0.25W	01121	CB1065
A3R244	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A3R245	311-1136-00			RES.,VAR,NONWIR:100K OHM,30%,0.25W	71450	201-YA5536
A3R246	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
A3R247	315-0103-03			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A3R248	315-0103-03			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A3R249	315-0100-02			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
A3R250	315-0430-02			RES.,FXD,CMPSN:43 OHM,5%,0.25W	01121	CB4305
A3R251	308-0801-00			RES.,FXD,WW:5.1 OHM,5%,2W	00213	210S 5R100J
A3R254	307-0105-00			RES.,FXD,CMPSN:3.9 OHM,5%,0.25W	01121	CB39G5
A3R263	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	57668	NTR25J-E01K2
A3R264	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	57668	NTRERJ-E 560E
A3R265	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	57668	NTR255-E 1M
A3R267	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A3R268	315-0103-03			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A3R272	307-1224-00			PASSIVE NETWORK:HV DIVIDED NETWORK	80009	307-1224-00
A3R273	315-0103-03			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A3R274	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	57668	NTR255-E 1M
A3R276	315-0684-00			RES.,FXD,CMPSN:680K OHM,5%,0.25W	01121	CB6845
A3R277	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
A3R278	315-0102-03			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A3R279	315-0103-03			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A3R282	315-0163-01			RES.,FXD,CMPSN:16K OHM,5%,0.25W	01121	CB1635
A3R285	311-1235-00			RES.,VAR,NONWIR:100K OHM,20%,0.50W	32997	3386F-T04-104
A3R286	311-1241-00			RES.,VAR,NONWIR:100K OHM,10%,0.5W	32997	3386X-T07-104
A3R287	301-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.5W	01121	EB1835
A3R297	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	57668	NTR25J-E47E0
A3R298	301-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.50W	01121	EB5635
A3R299	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
A3T240	120-1466-00			XFMR,PWR,SDN&SU:HIGH VOLTAGE	80009	120-1466-00
A3TP226	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A3TP267	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A3VR239	152-0295-00			SEMICOND DEVICE:ZENER,1W,82V,5%	04713	SZM25000K7RL
A3VR245	152-0427-00			SEMICOND DEVICE:ZENER,0.4W,100V,5%	80009	152-0427-00
A3VR263	152-0304-00			SEMICOND DEVICE:ZENER,0.4W,20V,5%	15238	Z5411
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
A3W298	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A5	670-7798-00			CKT BOARD ASSY:FRONT PANEL	80009	670-7798-00
A5C218	281-0815-00			CAP.,FXD,CER DI:0.027UF,20%,50V	72982	8005D9AABW5R273M
A5C220	290-0846-00			CAP.,FXD,ELCTLT:47UF,-10+75%,35 WVDC	54473	ECE-A35V47LU
A5C221	290-0846-00			CAP.,FXD,ELCTLT:47UF,-10+75%,35 WVDC	54473	ECE-A35V47LU
A5C302	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A5C318	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A5C334	281-0812-00			CAP.,FXD,CER DI:1000PF,10%,100V	04222	MA101C102KAA
A5C418	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A5C430	281-0809-00			CAP.,FXD,CER DI:200PF,5%,100V	04222	MA101A201JAA
A5C630	290-0838-00			CAP.,FXD,ELCTLT:2200UF,+50-10%,35V	54473	ECE-B1VV222S
A5CR234	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A5CR330	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A5CR412	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A5CR422	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A5CR424	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A5CR426	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A5CR432	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A5CR510	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A5CR612	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	04713	SDA317
A5P210	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
A5P500	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
A5P510	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
A5P520	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A5P600	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
A5P610	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
A5Q210	151-0347-00			TRANSISTOR:SILICON,NPN	56289	T7916
A5Q211	151-0350-00			TRANSISTOR:SILICON,PNP	04713	SPS6700
A5Q238	151-0347-00			TRANSISTOR:SILICON,NPN	56289	T7916
A5Q239	151-0347-00			TRANSISTOR:SILICON,NPN	56289	T7916
A5Q314	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A5Q316	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A5Q426	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
A5Q428	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A5Q430	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	27014	F55037
A5R200	301-0162-00			RES.,FXD,CMPSN:1.6K OHM,5%,0.5W	01121	EB1625
A5R202	301-0162-00			RES.,FXD,CMPSN:1.6K OHM,5%,0.5W	01121	EB1625
A5R210	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
A5R212	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	57668	NTR25J-E02K0
A5R214	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
A5R216	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	57668	NTR25J-E470E
A5R232	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A5R234	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A5R236	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
A5R238	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A5R300	303-0102-00			RES.,FXD,CMPSN:1K OHM,5%,1W	01121	GB1025
A5R304	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	57668	NTR25J-E 10E0
A5R310	315-0164-00			RES.,FXD,CMPSN:160K OHM,5%,0.25W	57668	NTR25J-E160K
A5R312	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A5R313	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	57668	NTR25J-E47K0
A5R314	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	57668	NTR25J-E 200K
A5R316	315-0164-00			RES.,FXD,CMPSN:160K OHM,5%,0.25W	57668	NTR25J-E160K
A5R326	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
A5R328	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A5R330	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A5R332	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A5R410	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	57668	NTR255-E 1M
A5R412	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	57668	NTR255-E 1M
A5R414	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	57668	NTR25J-E 30K
A5R416	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	57668	NTR25J-E02K0
A5R418	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
A5R420	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
A5R422	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	57668	NTR25J-E02K0
A5R436	321-0327-00			RES.,FXD,FILM:24.9K OHM,1%,0.125W	91637	MFF1816G24901F
A5R438	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W	91637	MFF1816G49901F
A5R510	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	57668	NTR25J-E 30K
A5R512	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	57668	NTR25J-E 30K
A5R514	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	57668	NTR25J-E 30K
A5R516	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
A5R610	311-1372-00			RES.,VAR,NONWIR:100K OHM,20%,1W	01121	73M1G040L104M
A5S200	260-1573-01			SWITCH,PUSH:1 BUTTON,2 POLE,PAPER ADV	59821	2KAA010000-1041
A5U334	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1741CP1
A5U410	156-1149-01			MICROCIRCUIT,LI:OPER AMPL,JFET,BURN-IN	27014	AL160307
A5VR216	152-0571-00			SEMICOND DEVICE:ZENER,0.4W,16V,5%	04713	SZ35014K1
A5VR217	152-0571-00			SEMICOND DEVICE:ZENER,0.4W,16V,5%	04713	SZ35014K1
A5VR324	152-0304-00			SEMICOND DEVICE:ZENER,0.4W,20V,5%	15238	Z5411

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A6	670-7799-00			CKT BOARD ASSY:GRATICULE ILLUM	80009	670-7799-00
A6DS210	150-0137-00			LAMP,CARTRIDGE:14V,100MA	71744	CM 8918
A6DS220	150-0137-00			LAMP,CARTRIDGE:14V,100MA	71744	CM 8918
A6DS230	150-0137-00			LAMP,CARTRIDGE:14V,100MA	71744	CM 8918
A6DS240	150-0137-00			LAMP,CARTRIDGE:14V,100MA	71744	CM 8918
A6DS250	150-0137-00			LAMP,CARTRIDGE:14V,100MA	71744	CM 8918
A6DS260	150-0137-00			LAMP,CARTRIDGE:14V,100MA	71744	CM 8918
A6DS270	150-0137-00			LAMP,CARTRIDGE:14V,100MA	71744	CM 8918
A7	670-5757-00			CKT BOARD ASSY:SIGNAL OUT	80009	670-5757-00
A7	---- ----			(OPTION 07 ONLY)		
A7C930	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z47Z5ULDCEX
A7C931	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	59660	301000C0G0100F
A7C960	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z47Z5ULDCEX
A7C961	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	59660	301000C0G0100F
A7C980	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z47Z5ULDCEX
A7C981	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	59660	301000C0G0100F
A7CR930	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A7CR960	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A7CR980	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
A7CR990	152-0322-00			SEMICOND DEVICE:SILICON,15V,HOT CARRIER	50434	5082-2672
A7P910	352-0164-00			HLDR,TERM CONN:6 WIRE,BLACK	80009	352-0164-00
A7P911	352-0169-02			HLDR,TERM CONN:2 WIRE,RED	80009	352-0169-00
A7P912	352-0169-03			HLDR,TERM CONN:2 WIRE,ORANGE	80009	352-0169-03
A7P913	352-0169-09			HLDR,TERM CONN:2 WIRE,WHITE	80009	352-0169-09
A7Q910	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A7Q915	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A7Q920	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A7Q925	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A7Q930	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
A7Q940	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A7Q945	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A7Q950	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A7Q955	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A7Q960	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
A7Q967	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A7Q970	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A7Q972	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A7Q975	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A7Q980	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
A7Q990	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
A7R910	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	57668	NTR25J-E330E
A7R911	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	57668	NTR25J-E27K0
A7R912	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	19701	5043ED1K00F
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	57668	NTR25J-E 18K
A7R920	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	57668	NTR25J-E330E
A7R921	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	57668	NTR25J-E27K0
A7R922	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	19701	5043ED1K00F
A7R925	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	57668	NTR25J-E220E
A7R926	321-0290-00			RES.,FXD,FILM:10.2K OHM,1%,0.125W	91637	CMF55116G10201F

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A7R930	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	57668	NTR25J-E27K0
A7R931	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	57668	NTR25J-E 6K2
A7R932	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A7R933	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A7R940	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	57668	NTR25J-E330E
A7R941	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	57668	NTR25J-E27K0
A7R942	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	19701	5043ED1K00F
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	57668	NTR25J-E 18K
A7R950	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	57668	NTR25J-E330E
A7R951	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	57668	NTR25J-E27K0
A7R952	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	19701	5043ED1K00F
A7R955	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	57668	NTR25J-E220E
A7R956	321-0290-00			RES.,FXD,FILM:10.2K OHM,1%,0.125W	91637	CMF55116G10201F
A7R960	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	57668	NTR25J-E27K0
A7R961	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	57668	NTR25J-E 6K2
A7R962	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A7R963	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A7R967	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	57668	NTR25J-E330E
A7R968	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	57668	NTR25J-E27K0
A7R969	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	19701	5043ED1K00F
A7R970	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	57668	NTR25J-E330E
A7R971	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	57668	NTR25J-E27K0
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	57668	NTR25J-E 18K
A7R974	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	19701	5043ED1K00F
A7R975	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	57668	NTR25J-E220E
A7R976	321-0290-00			RES.,FXD,FILM:10.2K OHM,1%,0.125W	91637	CMF55116G10201F
A7R977	315-0124-00			RES.,FXD,CMPSN:120K OHM,5%,0.25W	57668	NTR25J-E 120K
A7R980	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	57668	NTR25J-E27K0
A7R981	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	57668	NTR25J-E 6K2
A7R982	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
A7R983	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A7R990	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	57668	NTR25J-E27K0
A7R991	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				CHASSIS PARTS		
F201	159-0003-00			FUSE,CARTRIDGE:3AG,1.6A,250V,SLOW-BLOW	71400	MDX 1 6/10
FL201	119-1536-00			FILTER,RFI:3A,250VAC,50/60 HZ	54583	ZUB2203-000
J916	131-0126-00			CONNECTOR,RCPT,:BNC,FEMALE	02660	31-199-1001
J916	—— ——			(OPTION 07 ONLY)		
J917	131-0126-00			CONNECTOR,RCPT,:BNC,FEMALE	02660	31-199-1001
J917	—— ——			(OPTION 07 ONLY)		
J918	131-0126-00			CONNECTOR,RCPT,:BNC,FEMALE	02660	31-199-1001
J918	—— ——			(OPTION 07 ONLY)		
J919	131-0126-00			CONNECTOR,RCPT,:BNC,FEMALE	02660	31-199-1001
J919	—— ——			(OPTION 07 ONLY)		
L291	108-0644-00			COIL,TUBE DEFLE:TRACE ROTATOR	80009	108-0644-00
Q252	151-0701-00			TRANSISTOR:SILICON,NPN	80009	151-0701-00
Q400	151-0656-00			TRANSISTOR:SILICON,NPN	04713	SJE1972
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
R205	311-1368-00			RES.,VAR,NONWIR:5K OHM,20%,1W	01121	73A1G040L502M
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
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
U500	119-1683-00	B010100	B020183	SHUTTER,CRT:LIQUID CRYSTAL	80009	119-1683-00
U500	119-1683-01	B020184		SHUTTER,CRT:LIQUID CRYSTAL	80009	119-1683-01
V291	154-0871-00			ELECTRON TUBE:CRT	80009	154-0871-00

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:

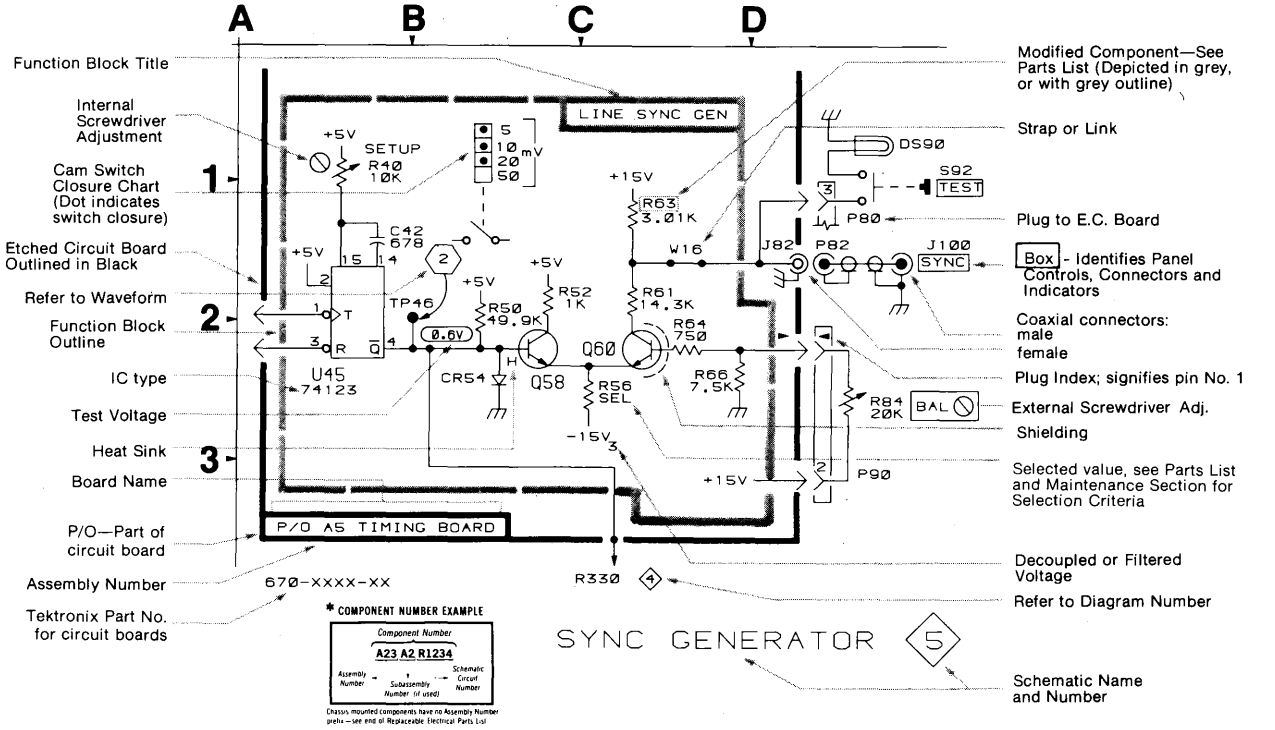
Capacitors = Values one or greater are in picofarads (pF). Values less than one are in microfarads (μF).
Resistors = Ohms (Ω).

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.



CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM NUMBER	SCHEM LOCATION	CIRCUIT NUMBER	SCHEM NUMBER	SCHEM LOCATION	CIRCUIT NUMBER	SCHEM NUMBER	SCHEM LOCATION
F201	4	A5	J918	7	D3	R295	3	H3
			J919	7	D1			
FL201	4	A5				S200	4	A5
			L291	3	H1	S201	4	A4
J201	4	A5						
J210	3	B3	Q252	3	D4	U500	5	F2
J891	4	D4						
J916	7	D5	R205	5	A1			
J917	7	D4	R291	3	H1			

NOTE
LEAD CONFIGURATIONS AND CASE STYLES ARE TYPICAL, BUT MAY VARY DUE TO VENDOR CHANGES OR INSTRUMENT MODIFICATIONS.

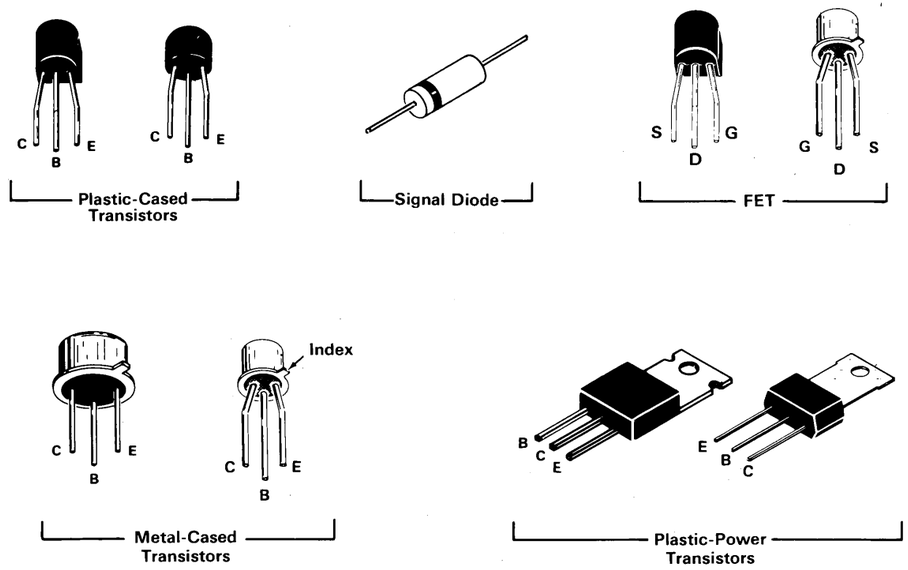


Figure 8-1. Semiconductor Lead Configurations.

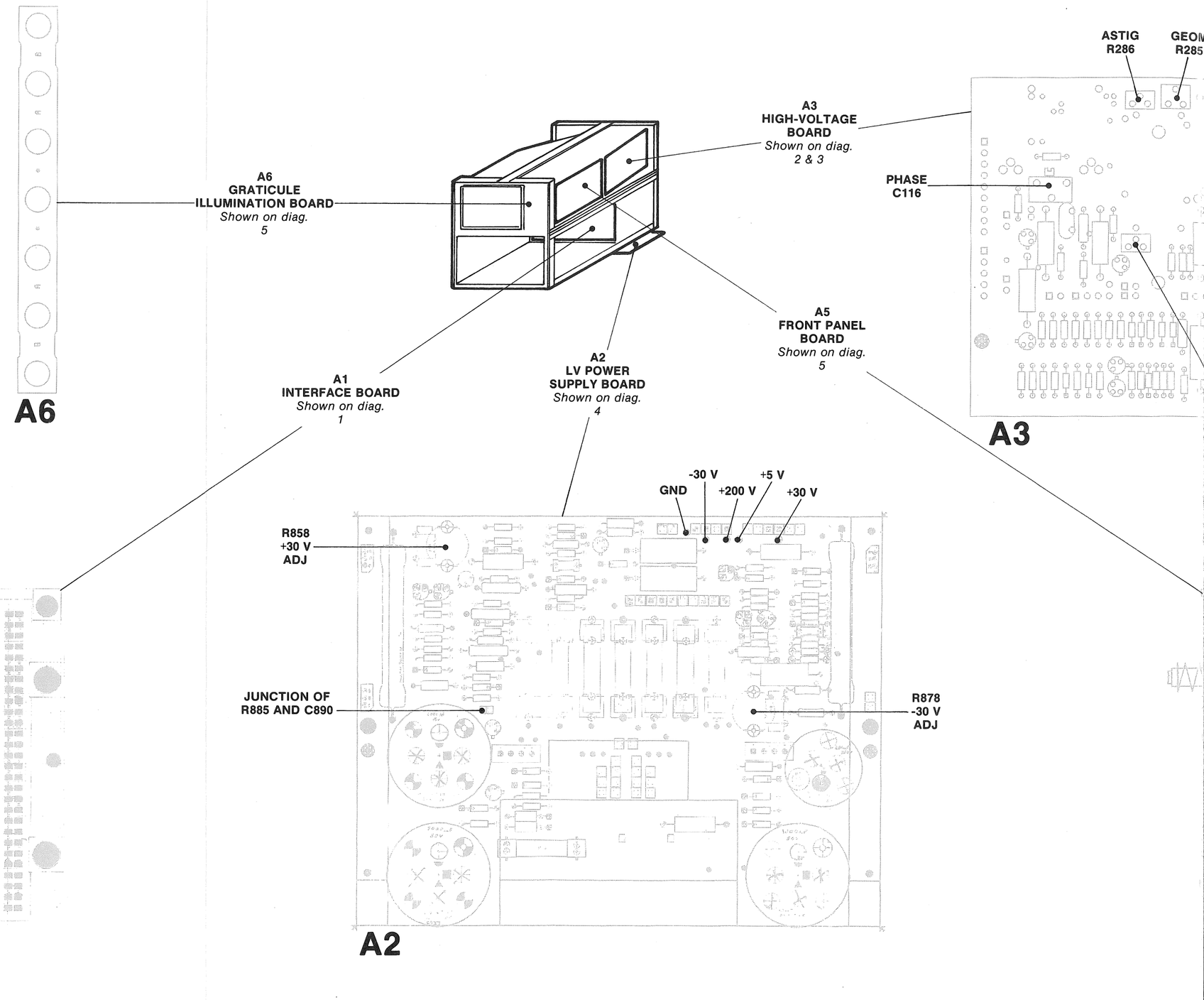


Figure 8-2. Circuit Board, Test Point, and Adjustment Locations.

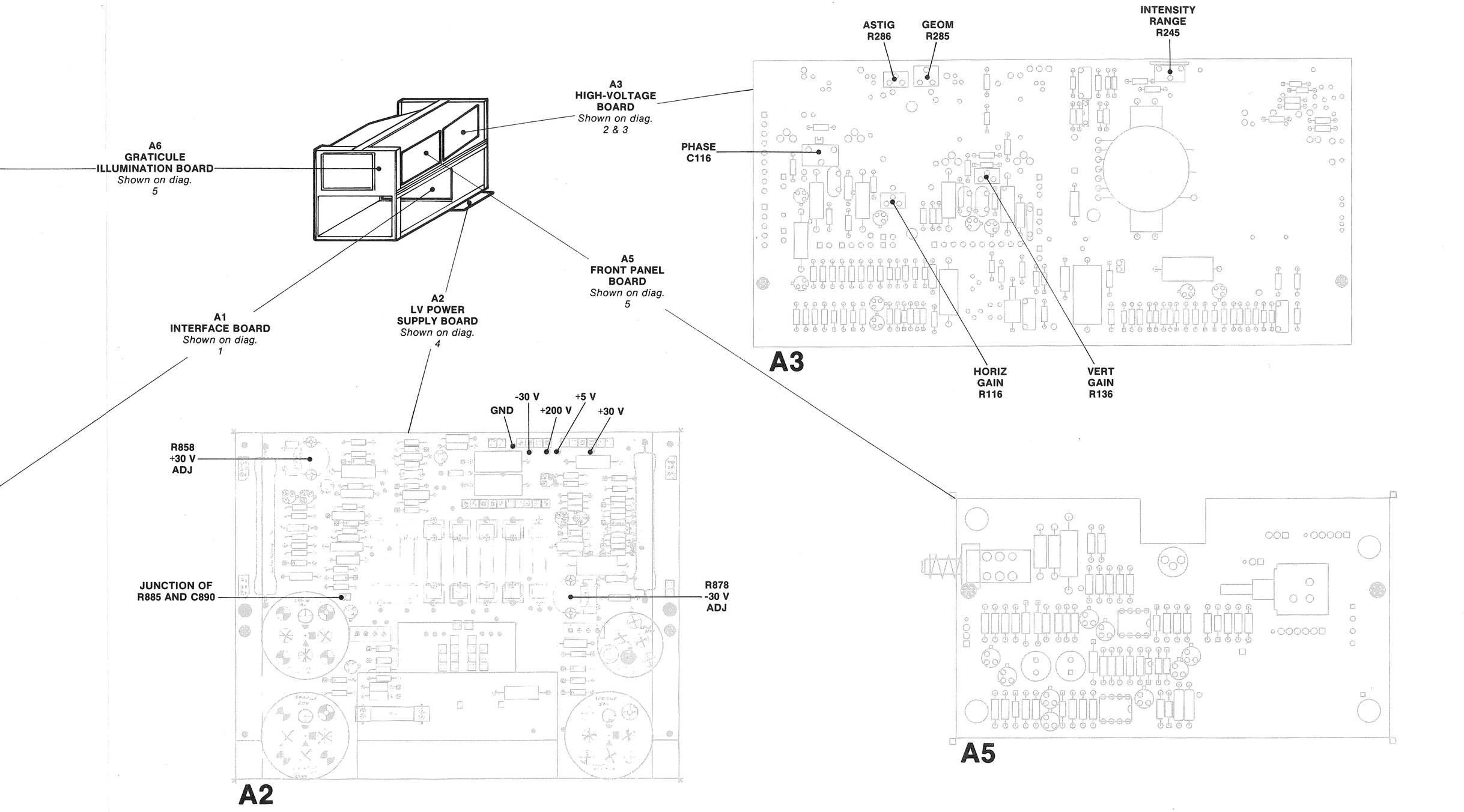


Figure 8-2. Circuit Board, Test Point, and Adjustment Locations.

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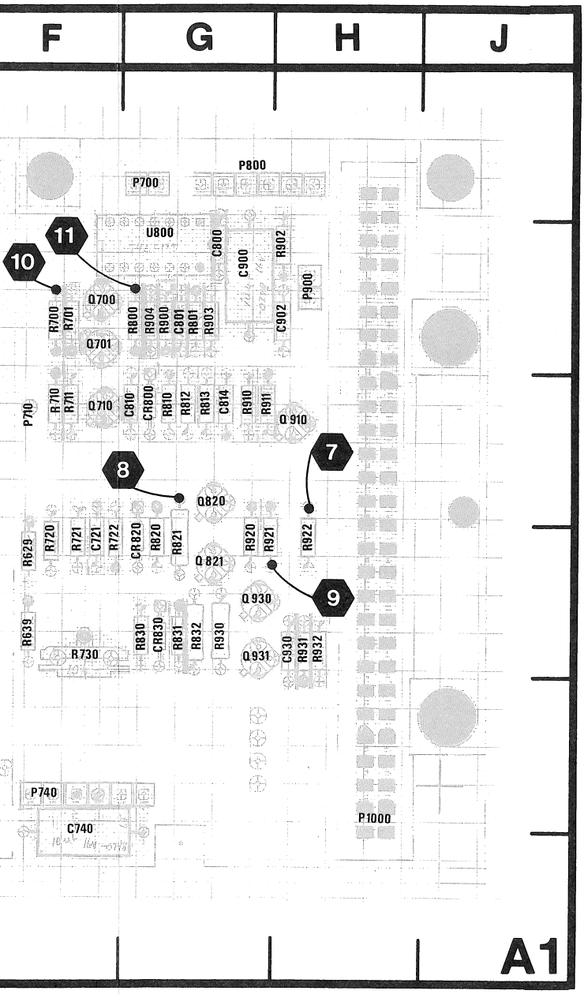

sembly.

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INTERFACE DIAGRAM 1

ASSEMBLY A1

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C400	B4	C1
C411	B2	D3
C503	G4	E2
C510	C2	E3
C520	B3	D4
C620	C3	E4
C721	G3	F4
C740	F4	F5
C800	C1	G2
C801	E1	G2
C810	E1	G3
C814	E2	G3
C900	D1	G2
C902	D2	H2
C930	F4	H4
CR400	B4	C1
CR420	B3	D4
CR421	B3	D4
CR423	C3	D4
CR432	B2	D4
CR433	B2	D4
CR501	C4	E1
CR520	C3	D4
CR800	E1	G3
CR820	G2	G4
CR830	G3	G4
E513	A2	E3
E514	A3	E3
P500	C4	D1
P640	G4	E6
P710	D4	F3
P740	F4	F5
P800	G1	G1
P900	G3	H2
Q400	B4	C2
Q401	B4	C2
Q413	B2	D3
Q420	B3	D4
Q421	B3	D4
Q430	B3	C4
Q431	B3	C4
Q510	B2	D3
Q520	C3	D4
Q521	C3	D4
Q600	C4	E1
Q601	C4	E2
Q630	C3	E4
Q631	C3	E4
Q700	E1	F2
Q701	F1	F2
Q710	E1	F3
Q820	G3	G3
Q821	G3	G4
Q910	E2	H3
Q930	G3	G4
Q931	G3	G4
R200	B4	D2
R220	A3	B4
R221	A3	B4
R400	B4	D1
R401	B4	D1
R402	B4	D2
R403	B4	D2
R404	B4	D2
R405	B4	D2
R406	B4	D2
R410	B2	C3
R411	B2	C3
R412	B2	D3
R413	B2	D3
R414	B2	D3
R420	B3	C4
R421	B3	C4
R422	B2	D4
R430	B3	D4
R431	B3	D4
R432	B3	D4
R433	B2	D4
R500	C4	E1
R501	B4	E2
R502	C4	E2
R503	C4	E2
R504	C4	E2
R510	C2	E3
R511	C2	E3
R512	C2	E3
R514	B2	D3
R521	C3	E4
R522	C3	E4
R530	A3	E4
R531	C3	E4
R532	C3	E4
R533	C3	E4
R534	C3	E4
R629	C3	F4
R639	C3	F4
R700	D1	F2
R701	F1	F2
R710	B1	F3
R711	F1	F3
R720	F1	F4
R721	G3	F4
R722	G3	F4
R730	G3	F4
R800	D1	G2
R801	E1	G2
R810	E1	G3
R812	E1	G3
R813	E2	G3
R820	G2	G4
R821	G3	G4
R830	G3	G4
R831	G3	G4
R832	G3	G4
R900	E1	G2
R902	E1	H2
R903	D1	G2
R904	D1	G2
R910	E2	G3
R911	E3	G3
R920	G3	G4
R921	G3	G4
R922	F3	H4
R930	G3	G4
R931	F3	H4
R932	F3	H4
U800A	D1	G2
U800B	D1	G2
U800	D1	G2
VR530	B1	D4
W513	A3	E3
W514	A3	E3

ASSEMBLY A2

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
F880	D6	D6

Partial A2 also shown on diagram 4.

A1—Interface Circuit Board
Illustration and Locator

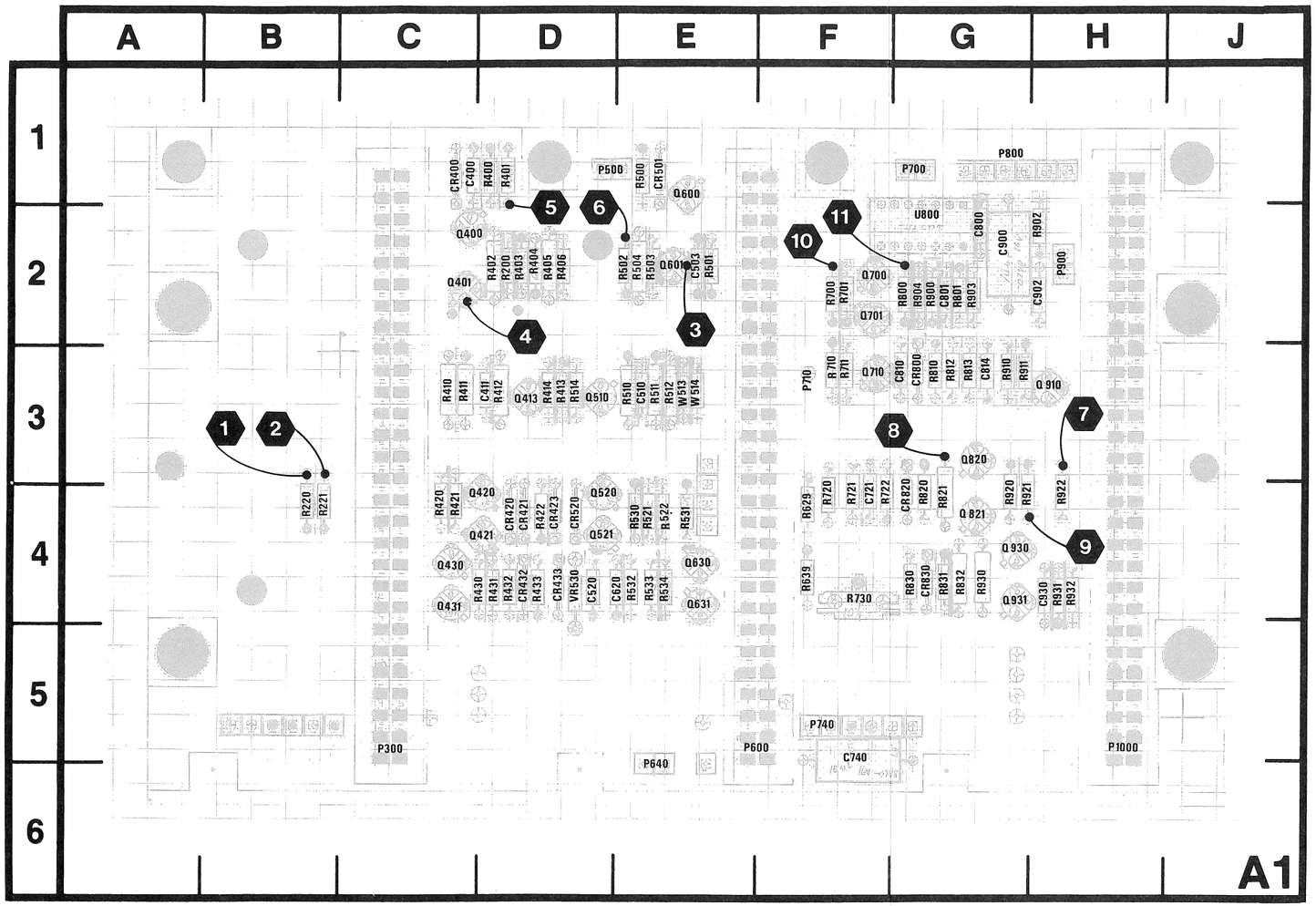
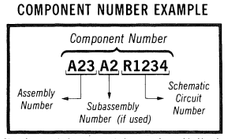


Figure 8-3. A1—Interface circuit board assembly.

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



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

INTERFAC

ASSEMBLY A1

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER
C400	B4	C1	Q521
C411	B2	D3	Q600
C503	G4	E2	Q601
C510	C2	E3	Q630
C520	B3	D4	Q631
C620	C3	E4	Q700
C721	G3	F4	Q701
C740	F4	F5	Q710
C800	C1	G2	Q820
C801	E1	G2	Q821
C810	E1	G3	Q910
C814	E2	G3	Q930
C900	D1	G2	Q931
C902	D2	H2	
C930	F4	H4	R200
			R220
CR400	B4	C1	R221
CR420	B3	D4	R400
CR421	B3	D4	R401
CR423	C3	D4	R402
CR432	B2	D4	R403
CR433	B2	D4	R404
CR501	C4	E1	R405
CR520	C3	D4	R406
CR800	E1	G3	R410
CR820	G2	G4	R411
CR830	G3	G4	R412
			R413
E513	A2	E3	R414
E514	A3	E3	R420
			R421
P500	C4	D1	R422
P640	G4	E6	R430
P710	D4	F3	R431
P740	F4	F5	R432
P800	G1	G1	R433
P900	G3	H2	R500
			R501
Q400	B4	C2	R502
Q401	B4	C2	R503
Q413	B2	D3	R504
Q420	B3	D4	R510
Q421	B3	D4	R511
Q430	B3	C4	R512
Q431	B3	C4	R514
Q510	B2	D3	R521
Q520	C3	D4	R522

ASSEMBLY A2

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	
F880	D6	D6	

Partial A2 also shown on diagram 4.

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 Oscilloscope 5A13N Differential Comparator, and 5B10N Time Base/Ampl system or equiv. Use a TEKTRONIX P6062B Probe.
Voltmeter (nonloading digital multimeter)	Range, 0 to 250 V input; input impedance, 10 megohms.	TEKTRONIX DM 501A 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 fully counterclockwise. Voltmeter common is connected to chassis ground.

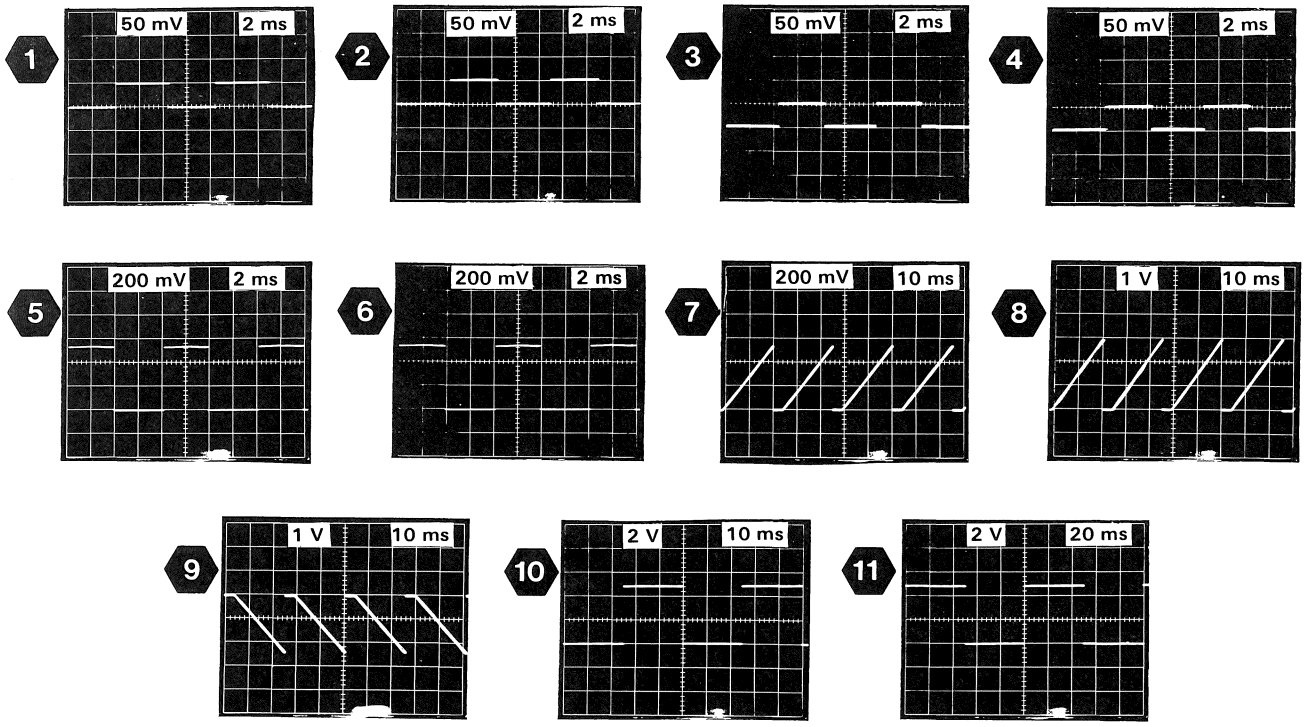
WAVEFORM CONDITIONS

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. Use plug-in extender to gain access to measurement points.

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.



VOLTAGE & WAVEFORM CONDITIONS

COUNTDOWN CIRCUIT

CLOCK GENERATOR

VERTICAL PLUG-IN SWITCHING

VERTICAL AMPLIFIER

HORIZONTAL AMPLIFIER

(LEFT VERT) J300

(RIGHT VERT) J600

(HORIZ) J1000

U800 GMD Vcc

U800B 74LS113

U800A 74LS113

Q710 Q700 Q701 Q910 Q413 Q510 Q430 Q420 Q431 Q421 Q520 Q630 Q521 Q631 Q401 Q601 Q400 Q600 Q821 Q820 Q931 Q930

CR432 CR433 CR420 CR421 CR423 CR620 CR400 CR501 CR800 CR820 CR830

VR530 10V

CH SW SIG

RIGHT PLUG-IN ON

MULTI TRACE

DISPLAY ON

LEFT + SIGNAL

LEFT - SIGNAL

RIGHT TRIG

LEFT TRIG

COMP TRIG

LINE TRIG

CHOP BLANKING

CHOP ACTIVATE

LEFT DISPLAY DISABLE

CHOP SENSE

BLANKING DISABLE

TRACE SEP

A SWP

ALT DRIVE

A GATE

SWP UNBLANKING

TRACE INTENSIFY

A GATE

SWP LOCKOUT

SS RESET

HORIZ SIG

-HORIZ SIG

HORIZ SIG TO F102

HORIZ CTRL

TO CRT CKT

OPTION 7

VERT SIG TO P110

COLOR TO P520

FROM LV PWR SPLY

A1 INTERFACE BOARD

4544-800

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.

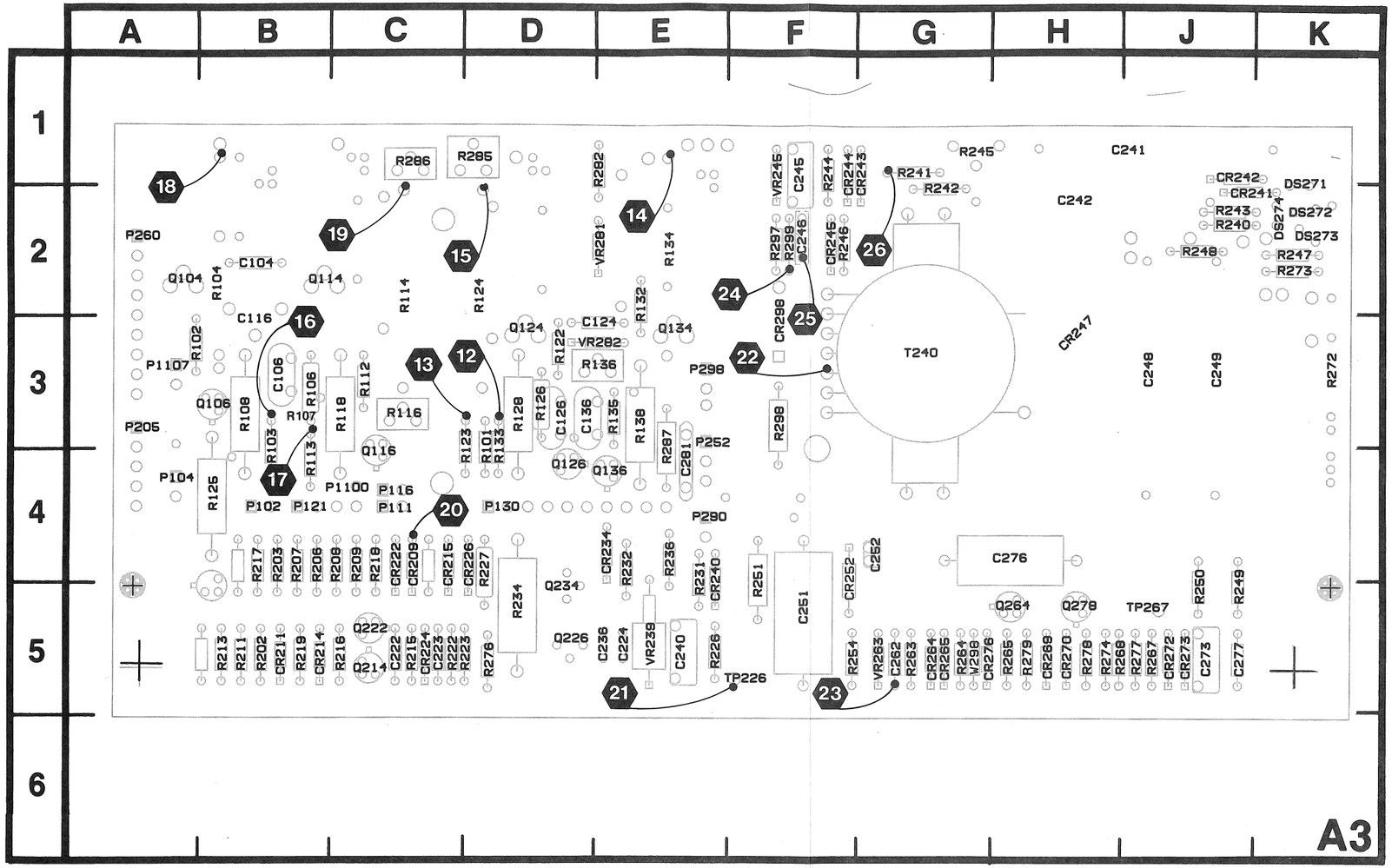


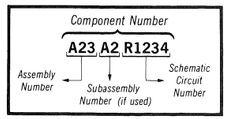
Figure 8-4. A3—High-Voltage Deflection circuit board assembly.

4544-809A

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.

VERTICAL AND 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
C104	C2	B2	Q124	D4	D3	R118	E2	C3
C106	D2	B3	Q126	D4	D4	R122	C4	D3
C116	D2	B3	Q134	D5	E3	R123	B4	D3
C124	C4	E3	Q136	D5	E4	R124	D4	D2
C126	D4	D3				R125	E3	B4
C136	D5	D3	R101	C3	D3	R126	D4	D3
			R102	C1	A3	R128	E4	D3
P102	B1	B4	R103	B2	B3	R132	C5	E2
P111	B4	C4	R104	D1	A4	R133	B5	D3
P116	B4	C4	R106	D2	B3	R134	D5	E2
			R107	D2	B3	R135	D4	E3
Q104	D1	A2	R108	E2	B3	R136	D5	E3
Q106	D1	B3	R112	C3	C3	R138	E5	E3
Q114	D3	A4	R113	B2	B4			
Q116	D2	C4	R114	D3	C2			
			R116	D2	C3			

Partial A3 also shown on diagram 3.

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 Oscilloscope, 5A13N Differential Comparator, and 5B10N Time Base/Ampl system or equiv. Use a TEKTRONIX P6062B Probe.
Voltmeter (nonloading digital multimeter)	Range, 0 to 250 V input; input impedance, 10 megohms.	TEKTRONIX DM 501A 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 fully counterclockwise. Voltmeter common is connected to chassis ground.

WAVEFORM CONDITIONS

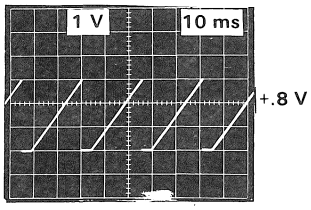
Oscilloscope Under Test. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for dc, 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

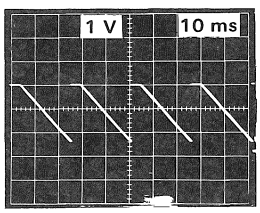
The waveforms shown are actual waveform photographs taken with a Tektronix Oscilloscope Camera System and Projected Graticule. Vertical deflection factor shown on the waveform is the actual deflection factor from the probe tip. Voltages and waveforms on the diagrams are not absolute and may vary between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

12



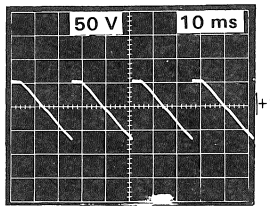
+.8 V

13



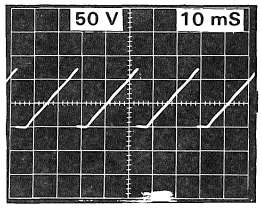
+.5 V

14



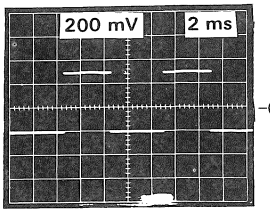
+136 V

15



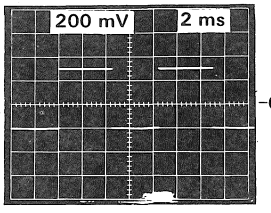
+120 V

16



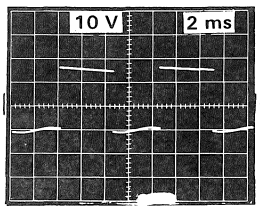
−0.75 V

17



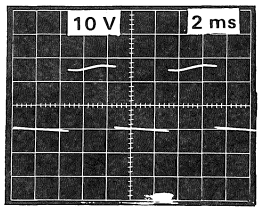
−0.75 mV

18

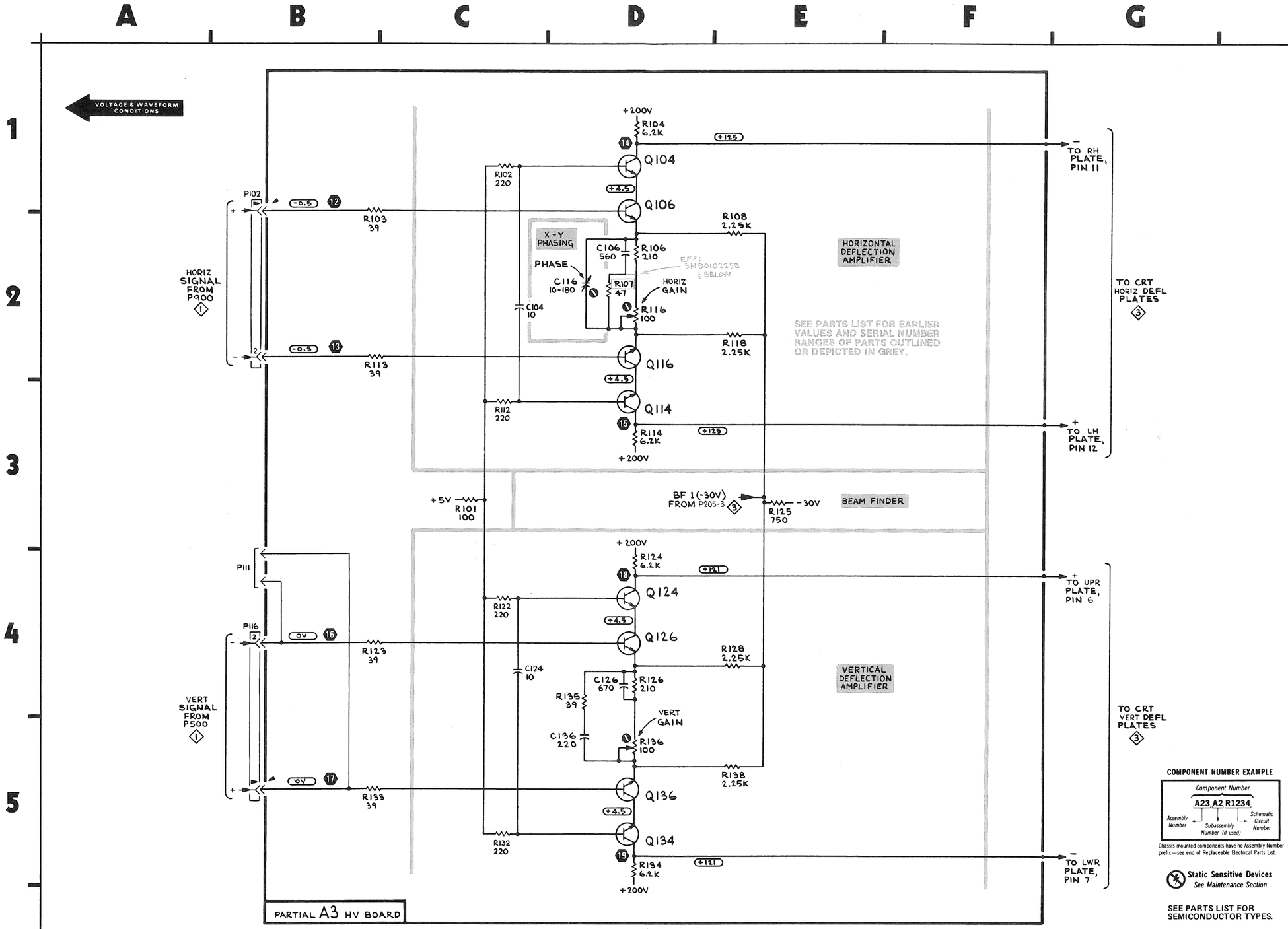


+126 V

19



+126 V



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VERTICAL & HORIZONTAL DEFLECTION AMPLIFIERS

CRT CIRCUIT DIAGRAM 3

ASSEMBLY A3

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C222	B4	C5
C223	B4	C5
C224	E2	E5
C236	E1	E5
C240	F2	E5
C241	F3	H1
C242	F3	H2
C245	F3	F1
C246	F4	F2
C248	E4	J3
C249	E4	J3
C251	D4	F5
C252	D5	G4
C262	C5	G5
C273	E3	J5
C276	E3	H4
C277	C4	J5
C281	G2	E4
CR209	C2	C4
CR211	C3	B5
CR214	C3	B5
CR215	C3	C4
CR222	D2	C4
CR224	E2	C5
CR226	F2	D4
CR234	F1	E4
CR240	F2	E4
CR241	F3	J2
CR242	F3	J1
CR243	F3	G1
CR244	F3	F1
CR245	F4	F2
CR247	E4	H3
CR252	D4	F4
CR264	C4	G5
CR265	C4	G5
CR269	C4	H5
CR270	C5	H5
CR272	C5	J5
CR273	C5	J5
CR276	E3	G5
CR298	F5	F3
DS271	G3	K1
DS272	G3	K2
DS273	G4	K2
DS274	G4	K2
P121	B1	B4
P130	B4	D4
P205	B2	A3
P205	B3	A3
P252	D4	E3
P260	B1	A2
P260	B4	A2
P290	H1	E4
P298	H5	E3
Q214	C3	C5
Q222	E2	C5
Q226	E2	D5
Q234	E1	D5
Q264	C4	H5
Q278	C5	H5
R202	B2	B5
R203	B1	B4
R206	B1	B4
R207	B2	B4
R208	B2	C4
R209	D2	C4
R211	B3	B5
R213	B3	B5
R215	C3	C5
R216	C3	C5
R217	C2	B4
R218	C2	C4
R219	C3	B5
R222	E2	C5
R223	E2	D5
R226	F2	E5
R227	E2	D4
R227	E2	D4
R232	E2	E4
R234	F1	D5
R236	F1	E4
R240	F3	J2
R241	F3	G1
R242	F3	G1
R243	G3	J2
R244	F3	F1
R245	F4	G1
R246	F4	F2
R247	G4	K2
R248	E4	J2
R249	E4	J5
R250	E4	J5
R251	D4	F4
R254	D5	F5
R263	C5	G5
R264	C4	G5
R265	C4	H5
R267	C5	J5
R268	C5	H5
R272A	E4	K3
R272B	E3	K3
R272C	E3	K3
R272D	E4	K3
R272E	G3	K3
R272F	G3	K3
R273	E4	K2
R274	B5	H5
R276	E3	D5
R277	C4	J5
R278	C5	H5
R279	C5	H5
R282	G2	E1
R285	G2	D1
R286	G2	C1
R287	G2	E3
R297	F5	F2
R298	E5	F3
R299	F4	F2
T240	E4	G3
TP226	F2	F5
TP267	C5	J5
VR239	F2	E5
VR245	F4	F1
VR263	C5	G5
VR281	G2	E2
VR282	G2	E3
W278	E3	G5

Partial A3 also shown on diagram 2.

ASSEMBLY A5

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P600	B2	F1
P600	B3	F1
R210	A3	B3
R610	A2	E2
S200	A3	B2

Partial A5 also shown on diagram 5.

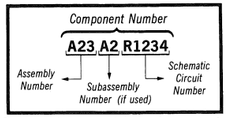
CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
J210	B3	CHASSIS
L291	H1	CHASSIS
Q252	D4	CHASSIS
R291	H1	CHASSIS
R295	H3	CHASSIS
V291	H1	CHASSIS

CRT Circuit Component 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 Oscilloscope, 5A13N Differential Comparator, and 5B10N Time Base/Ampl system or equiv. Use a TEKTRONIX P6062B Probe.
Voltmeter (nonloading digital multimeter)	Range, 0 to 250 V input; input impedance, 10 megohms.	TEKTRONIX DM 501A 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 fully counterclockwise. Voltmeter common is connected to chassis ground.

WAVEFORM CONDITIONS

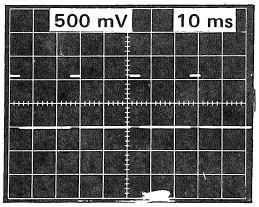
Oscilloscope Under Test. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal 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

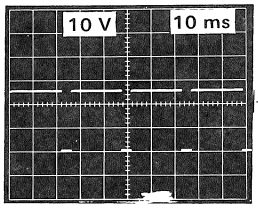
The waveforms shown are actual waveform photographs taken with a Tektronix Oscilloscope Camera System and Projected Graticule. Vertical deflection factor shown on the waveform is the actual deflection factor from the probe tip. Voltages and waveforms on the diagrams are not absolute and may vary between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

20



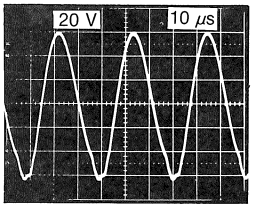
+1.32 V

21



+79 V

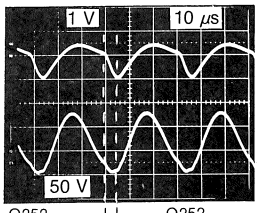
22



+40 V

(INTERMEDIATE INTENSITY)

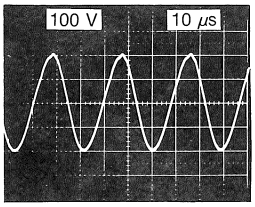
23



Q252 ON — Q252 OFF

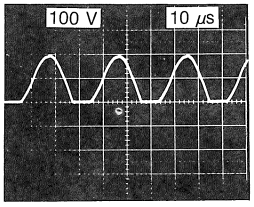
DIFFERENTIAL C262

24



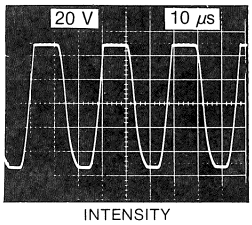
0 V

25



0 V

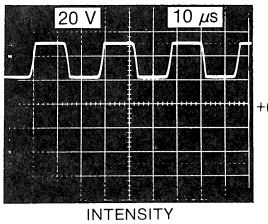
26A



+60 V

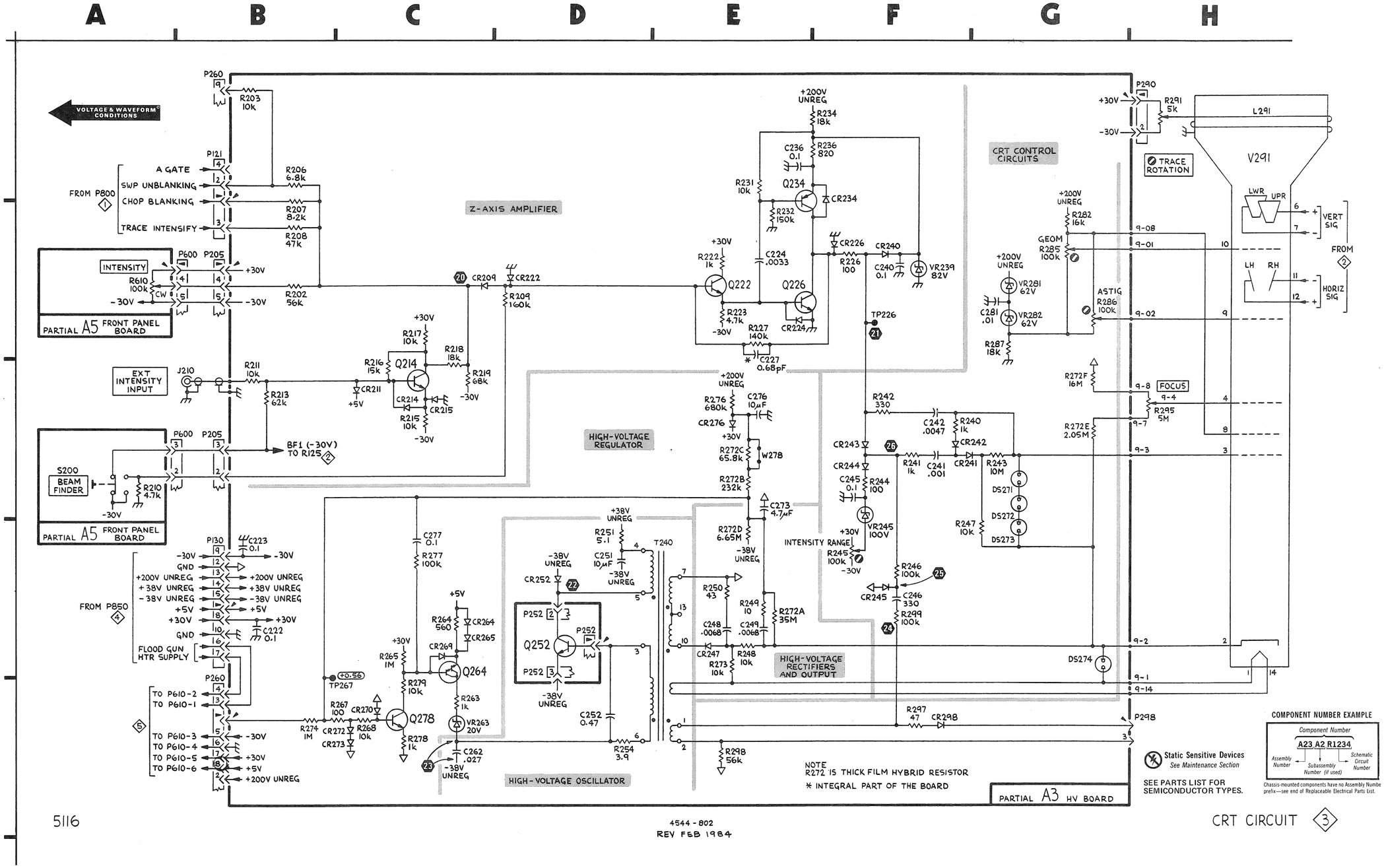
INTENSITY MINIMUM

26B



+60 V

INTENSITY MAXIMUM


A
B
C
D
E
F
G
H
1
2
3
4
5
VOLTAGE & WAVEFORM CONDITIONS
P260
R203 10k
P121
A GATE
SWP UNBLANKING
CHOP BLANKING
TRACE INTENSIFY
FROM P800
R206 6.8k
R207 8.2k
R208 47k
INTENSITY
P600
P205
R610 100k
CW
-30V
+30V
R202 56k
PARTIAL A5 FRONT PANEL BOARD
EXT INTENSITY INPUT
J210
R211 10k
R213 62k
CR211
+5V
Q214
R216 15k
R217 10k
R218 18k
R219 68k
CR214
CR215
R215 10k
BF1 (-30V) TO R125
S200 BEAM FINDER
R210 4.7k
Z-AXIS AMPLIFIER
CR209
CR222
R209 160k
+200V UNREG
R234 18k
C236 0.1
R236 820
R231 10k
Q234
CR234
R232 150k
C224 .0033
R222 1k
Q222
Q226
R223 4.7k
R227 140k
C227 0.68pF
CR226
CR240
R226 100
C240 0.1
VR239 82V
TP226
HIGH-VOLTAGE REGULATOR
R276 680k
C276 10µF
CR276
R272C 65.8k
W278
R272B 232k
C273 4.7µF
R272D 6.65M
+38V UNREG
R251 5.1
C251 10µF
T240
-38V UNREG
CR252
P252
Q252
C252 0.47
R250 43
R249 10
R272A 35M
C248 .0068
C249 .0068
CR247
R273 10k
R248 10k
HIGH-VOLTAGE RECTIFIERS AND OUTPUT
R242 330
C242 .0047
R240 1k
CR243
CR244
C245 0.1
R244 100
VR245 100V
INTENSITY RANGE
R245 100k
R241 1k
C241 .001
CR241
R243 10M
DS271
DS272
DS273
R247 10k
R246 100k
CR245
C246 330
R299 100k
DS274
CRT CONTROL CIRCUITS
P290
+30V
-30V
R291 5K
L291
V291
TRACE ROTATION
LWR
UPR
VERT SIG
FROM 2
LH
RH
HORIZ SIG
+200V UNREG
R282 16k
GEOM R285 100k
VR281 62V
VR282 62V
C281 .01
ASTIG R286 100k
R287 18K
R272F 16M
FOCUS
R295 5M
R272E 2.05M
9-08
9-01
9-02
9-8
9-4
9-7
9-3
9-2
9-1
9-14
P130
FROM P850
-30V
GND
+200V UNREG
+38V UNREG
-38V UNREG
+5V
+30V
C223 0.1
C222 0.1
FLOOD GUN HTR SUPPLY
TO P610-2
TO P610-1
TO P610-3
TO P610-4
TO P610-5
TO P610-6
C277 0.1
R277 100K
R264 560
CR264
CR265
CR269
Q264
R265 1M
R279 10k
TP267
+0.56
R267 100
CR270
CR272
CR273
R268 10k
R274 1M
Q278
R278 1k
R263 1k
VR263 20V
C262 .027
HIGH-VOLTAGE OSCILLATOR
R254 3.9
R298 56k
R297 47
CR298
P298
NOTE
R272 IS THICK FILM HYBRID RESISTOR
* INTEGRAL PART OF THE BOARD
PARTIAL A3 HV BOARD
Static Sensitive Devices
See Maintenance Section
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
COMPONENT NUMBER EXAMPLE
Component Number
A23 A2 R1234
Assembly Number
Subassembly Number (if used)
Schematic Circuit Number
Chassis-mounted components have no Assembly Numbe prefix—see end of Replaceable Electrical Parts List.

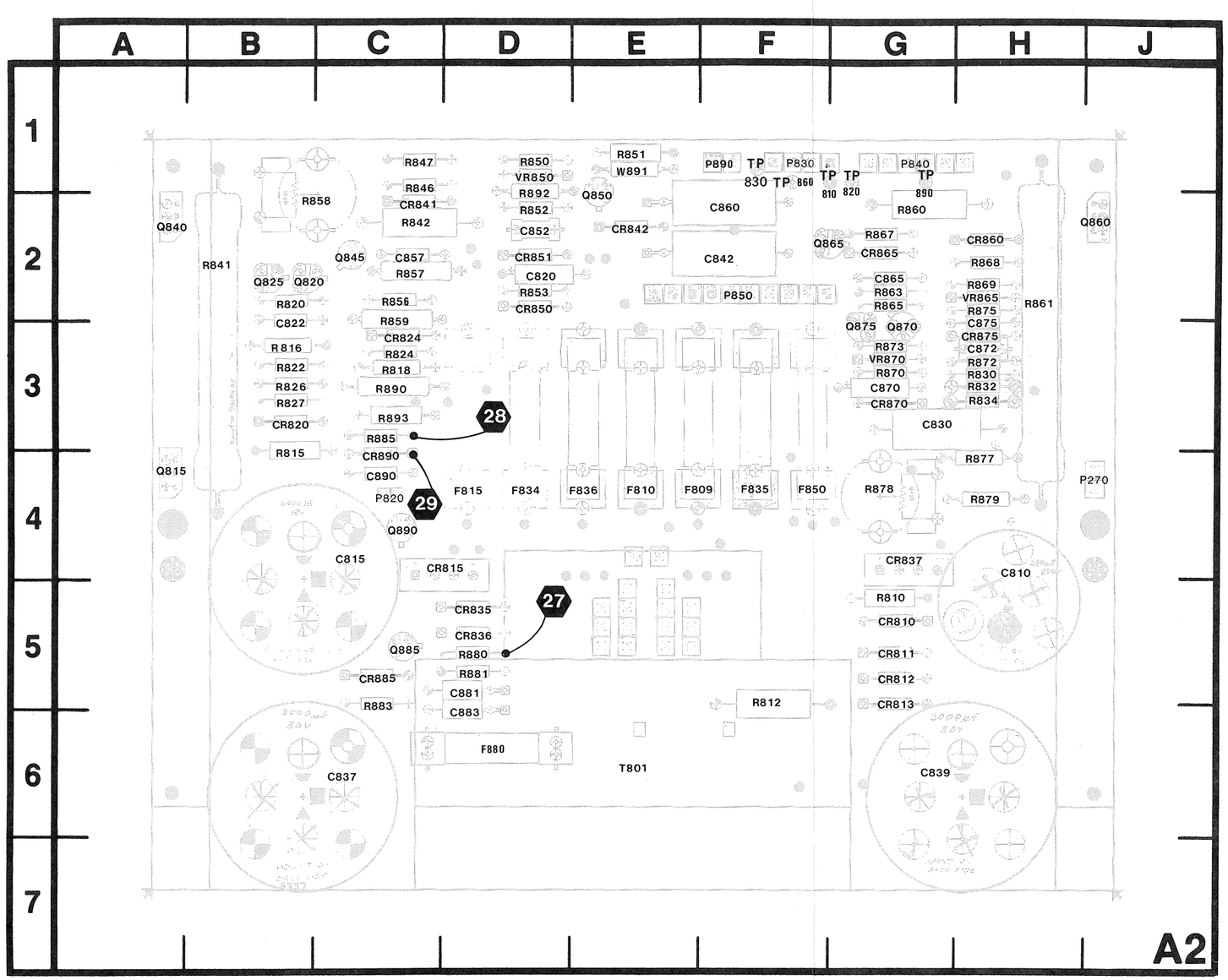
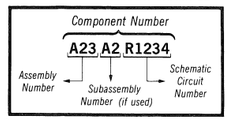


Figure 8-5. A2—Low Voltage Power Supply circuit board assembly.

4544-810

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



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

LV POWER SUPPLY

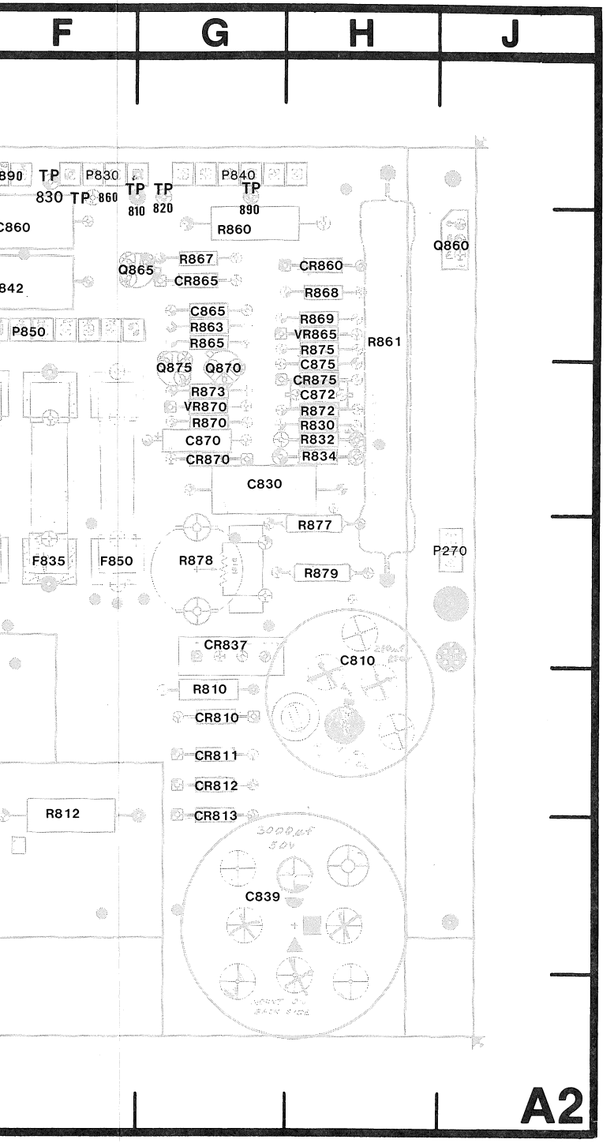
ASSEMBLY A2

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CI NU
C810	D2	H4	F8
C815	C3	C4	F8
C820	G3	D2	F8
C822	E3	B3	F8
C830	E1	G3	
C837	E3	C6	P2
C839	E3	G6	P8
C842	G4	F2	P8
C852	F4	D2	P8
C857	F4	C2	P8
C860	G5	F2	
C865	E6	G2	Q8
C870	E5	G3	Q8
C872	F5	H3	Q8
C875	F5	H3	Q8
C881	C4	D5	Q8
C883	C4	D6	Q8
C890	C4	C4	Q8
			Q8
CR810	C2	G5	Q8
CR811	C2	G5	Q8
CR812	C2	G5	Q8
CR813	C2	G5	Q8
CR815	C2	D4	
CR820	G3	B3	R8
CR824	E3	C3	R8
CR835	C3	D5	R8
CR836	C3	D5	R8
CR837	E3	G4	R8
CR841	G4	C2	R8
CR842	G4	E2	R8
CR850	F4	D2	R8
CR851	F4	D2	R8
CR860	G5	H2	R8
CR865	E6	G2	R8
CR870	E5	G3	R8
CR875	F5	H3	R8
CR885	C5	C5	R8
CR890	D4	C4	R8
			R8
F809	B2	E4	R8
F810	G2	E4	R8
F815	B2	D4	R8

Partial A2 also shown on diagram 1.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CI NU
F201	A5	CHASSIS	J2 J6
FL201	A5	CHASSIS	



4544-810

uit board assembly.

LV POWER SUPPLY AND CALIBRATOR DIAGRAM 4

ASSEMBLY A2

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C810	D2	H4
C815	C3	C4
C820	G3	D2
C822	E3	B3
C830	E1	G3
C837	E3	C6
C839	E3	G6
C842	G4	F2
C852	F4	D2
C857	F4	C2
C860	G5	F2
C865	E6	G2
C870	E5	G3
C872	F5	H3
C875	F5	H3
C881	C4	D5
C883	C4	D6
C890	C4	C4
CR810	C2	G5
CR811	C2	G5
CR812	C2	G5
CR813	C2	G5
CR815	C2	D4
CR820	G3	B3
CR824	E3	C3
CR835	C3	D5
CR836	C3	D5
CR837	E3	G4
CR841	G4	C2
CR842	G4	E2
CR850	F4	D2
CR851	F4	D2
CR860	G5	H2
CR865	E6	G2
CR870	E5	G3
CR875	F5	H3
CR885	C5	C5
CR890	D4	C4
F809	B2	E4
F810	G2	E4
F815	B2	D4
F834	B3	D4
F835	G3	F3
F836	B4	E4
F850	C2	F3
P270	C1	J4
P830	H1	F1
P840	G1	G1
P850	H2	F2
P890	D5	F1
Q815	F3	A4
Q820	E3	B2
Q825	F3	B2
Q840	F4	A1
Q845	F4	C2
Q850	F4	E2
Q860	F6	J2
Q865	F6	F2
Q870	E5	G3
Q875	E5	G3
Q885	C4	C5
Q890	D4	C4
R810	D2	G5
R812	D2	F5
R815	F3	B3
R815	F3	B3
R816	F3	B3
R818	F3	C3
R820	E3	B2
R822	E3	B3
R824	E3	C3
R826	F3	B3
R827	F3	B3
R830	D1	H3
R832	E1	H3
R834	E1	H3
R841	F3	B2
R842	G4	C2
R846	F4	C1
R847	F4	C1
R850	F4	D1
R851	F3	E1
R852	F4	D2
R853	F4	D2
R856	F4	C2
R857	G4	C2
R858	G4	B2
R859	G4	C2
R860	F6	G2
R861	F6	H2
R863	F6	G2
R865	F6	G2
R867	E6	G2
R868	F6	H2
R869	F5	H2
R870	E5	G3
R872	E5	H3
R873	E5	G3
R875	F5	H2
R877	F5	H4
R878	F5	G4
R879	F5	H4
R880	C4	D5
R881	C4	D5
R883	C4	C5
R885	C4	C3
R890	D4	C3
R892	D4	D2
R893	D4	C3
T801	B1	E6
TP810	G2	G1
TP820	G3	G1
TP830	G4	F1
TP860	G5	F1
VR850	F4	D1
VR865	F5	H2
VR870	E5	G3
W891	D5	E1

Partial A2 also shown on diagram 1.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
F201	A5	CHASSIS
FL201	A5	CHASSIS
J201	A5	CHASSIS
J891	D4	CHASSIS
S200	A5	CHASSIS
S201	A4	CHASSIS

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 Oscilloscope, 5A13N Differential Comparator, and 5B10N Time Base/Ampl system or equiv. Use a TEKTRONIX P6062B Probe.
Voltmeter (nonloading digital multimeter)	Range, 0 to 250 V input; input impedance, 10 megohms.	TEKTRONIX DM 501A 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 fully counterclockwise. Voltmeter common is connected to chassis ground.

WAVEFORM CONDITIONS

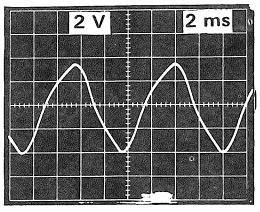
Oscilloscope Under Test. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for dc, 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

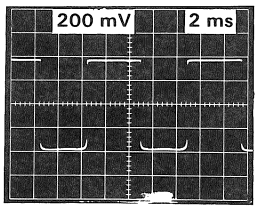
The waveforms shown are actual waveform photographs taken with a Tektronix Oscilloscope Camera System and Projected Graticule. Vertical deflection factor shown on the waveform is the actual deflection factor from the probe tip. Voltages and waveforms on the diagrams are not absolute and may vary between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

27



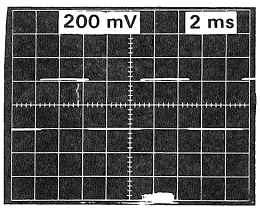
+20.5 V

28



+0.43 V

29



+0.20 V

A B C D E F G H

1 2 3 4 5 6

VOLTAGE & WAVEFORM CONDITIONS

SELECTOR BLOCK 220V RED

110V BROWN

POWER INPUT

P801A P801B

S201 POWER PULL ON

S200

F880 UNUSED LINE FUSE

F201 1.6A SLOW

FL201

J201

T801

P270 RESTING PINS

F809 0.3A SLOW

F815 3A FAST

F834 3A FAST

F836 3A FAST

F850 3A FAST

CR810 CR811 CR812 CR813

R810 15

C810 250µF

R812 68K

+30V

CR815

C815 6000µF

LOW-VOLTAGE RECTIFIERS AND UNREGULATED OUTPUTS

CR835 CR836

CR837

C837 3000µF

C839 3000µF

LINE TRIGGER

R830 100K

C830 .047

R832 47K

R834 18K

P840

-38V UNREG
+38V UNREG
+30V
+5V
GND

TO P740 (1)

P830

+200V UNREG
GND
-30V

TO P640 (1)

P850

FLOOD GUN HTR SPLY

+200V UNREG

F810 0.25A FAST

TP810

+5 VOLT SUPPLY

R820 47K

Q815

Q825

Q820

R827 100

R826 2.4K

R822 680

R816 1.69K

R818 10.0K

R824 8.2K

C822 27

R815 1.5

CR820

TP820

C820 22µF

CR824

+5V

+38V UNREG

F835 0.75A FAST

R841 150

R851 33K

R850 82K

VR850 82V

Q840

CR841

R846 390

Q845

R842 2.2

CR842

TP840

R852 680

R847 18K

C857 .01

R857 6.04K

C852 120

R856 100

R858 100

CR851

Q850

CR850

R853 10K

+30 VOLTS ADJ

R859 6.04K

+30 VOLT SUPPLY

TP830

GND

GND

-30 VOLT SUPPLY

C870 22µF

VR870 6.2V

CR870

R870 5.6K

Q870

-30 VOLTS ADJ

R879 1.24K

R878 250

R877 4.53K

R873 1K

R872 220

C872 6.8

C875 .01

CR875

Q875

R875 100

R869 3.9K

VR865 15V

CR865

R861 120

R868 100

C865 270

R865 100

R863 27K

Q860

R860 2.2

R867 620

Q865

C860 22µF

CR860

TP860

-30V

-38V UNREG

TO (3)

CALIBRATOR

R880 2.7K

C883 1µF

R881 5.6K

C881 1µF

R883 1K

Q885

R885 15K

C890 68

R890 7.23K

CR890

Q890

R893 1.5

R892 100

CR885

W891

J891 CALIBRATOR

P890

J820

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

5116

4544-803

LV POWER SUPPLY & CALIBRATOR (4)

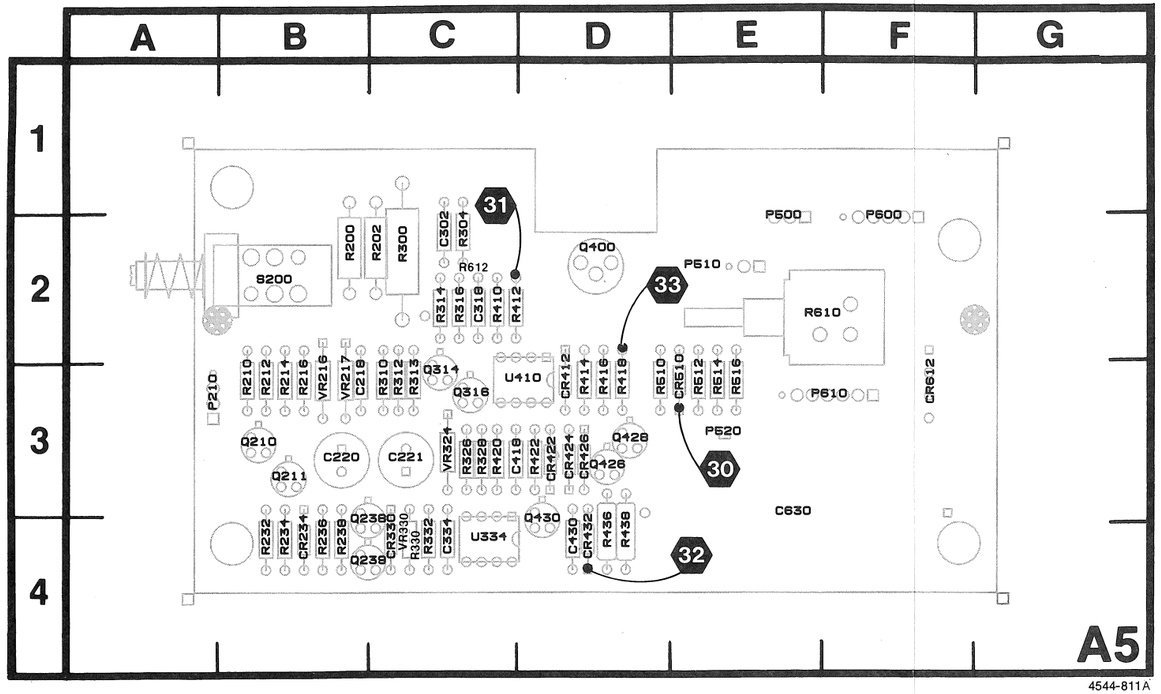
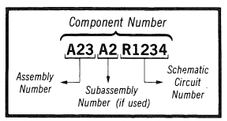


Figure 8-6. A5—Front Panel circuit board assembly.

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



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

FRONT PANE

ASSEMBLY A5

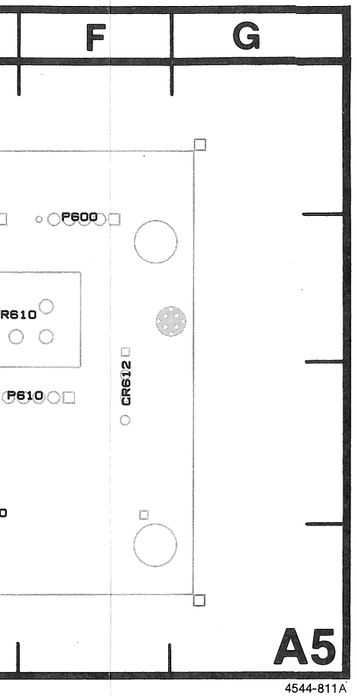
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCU NUMB
C218	D4	B3	Q211
C220	B4	B3	Q238
C221	B4	C3	Q239
C302	B4	C2	Q314
C318	D4	C2	Q316
C334	D3	C4	Q400
C418	B4	C3	Q426
C430	D2	D4	Q428
C630	B2	E3	Q430
CR234	D2	B4	R200
CR330*	C2	C4	R202
CR412	B3	D3	R212
CR422	C4	D3	R214
CR424	C3	D3	R216
CR426	C4	D3	R232
CR432	C4	D4	R234
CR510	A3	E3	R236
CR612	B1	F3	R238
			R300
P210	A1	A3	R304
P500	E2	E2	R310
P510	D1	E2	R312
P610	A1	F3	R313
			R314
Q210	E2	B3	R316

Partial A5 also shown on diagram 3.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCU NUMB
R205	A1	CHASSIS	U500

***See Parts List for serial number ranges.**



4544-811A

FRONT PANEL BOARD DIAGRAM 5

ASSEMBLY A5

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C218	D4	B3
C220	B4	B3
C221	B4	C3
C302	B4	C2
C318	D4	C2
C334	D3	C4
C418	B4	C3
C430	D2	D4
C630	B2	E3
CR234	D2	B4
CR330*	C2	C4
CR412	B3	D3
CR422	C4	D3
CR424	C3	D3
CR426	C4	D3
CR432	C4	D4
CR510	A3	E3
CR612	B1	F3
P210	A1	A3
P500	E2	E2
P510	D1	E2
P610	A1	F3
Q210	E2	B3
Q211	E3	B3
Q238	D2	C3
Q239	E2	B4
Q314	D4	C3
Q316	C4	C3
Q400	B1	D2
Q426	C4	D3
Q428	B3	D3
Q430	C3	D3
R200	A3	B2
R202	A4	C2
R212	B1	B3
R214	B1	B3
R216	A1	B3
R232	E3	B4
R234	E3	B4
R236	D2	B4
R238	D2	B4
R300	A4	C2
R304	B2	C2
R310	D4	C3
R312	D4	C3
R313	D4	C3
R314	D4	C2
R316	D4	C2
R326	D3	C3
R328	C2	C3
R330	C3	C4
R332	D3	C4
R410	E4	C2
R412	E4	C2
R414	B3	D3
R416	C3	D3
R418	D4	D3
R420	B3	C3
R422	B3	D3
R436	C4	D4
R438	C3	D4
R510	B3	D3
R512	B3	E3
R514	B3	E3
R516	B2	E3
R612*	E4	C2
U334	B4	C4
U334	C2	C4
U410	C4	D3
U410	D4	D3
VR216*	A4	B3
VR217*	A4	B3
VR324	A4	C3
VR330	C3	C2

Partial A5 also shown on diagram 3.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R205	A1	CHASSIS
U500	F2	CHASSIS

***See Parts List for serial number ranges.**

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 Oscilloscope, 5A13N Differential Comparator, and 5B10N Time Base/Ampl system or equiv. Use a TEKTRONIX P6062B Probe.
Voltmeter (nonloading digital multimeter)	Range, 0 to 250 V input; input impedance, 10 megohms.	TEKTRONIX DM 501A 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 counterclockwise. Voltmeter common is connected to chassis ground.

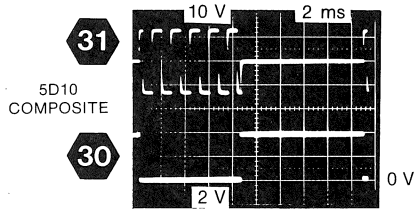
WAVEFORM CONDITIONS

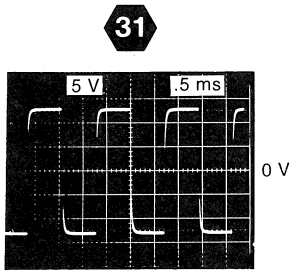
Oscilloscope Under Test. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal auto-trigger, 2 ms/division sweep rate. Set 5D10 Waveform Digitizer to SAVE, DUAL.

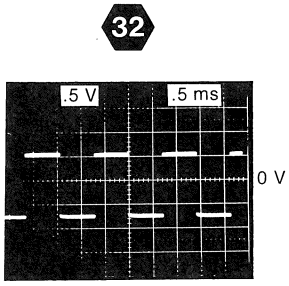
Test Oscilloscope. Set the test oscilloscope triggering for auto mode with ac coupling from the internal source and set vertical input coupling to ac. Connect a 10X Probe to the vertical input. Position the display as necessary.

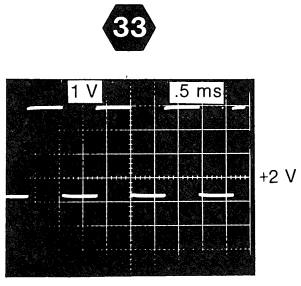
NOTE

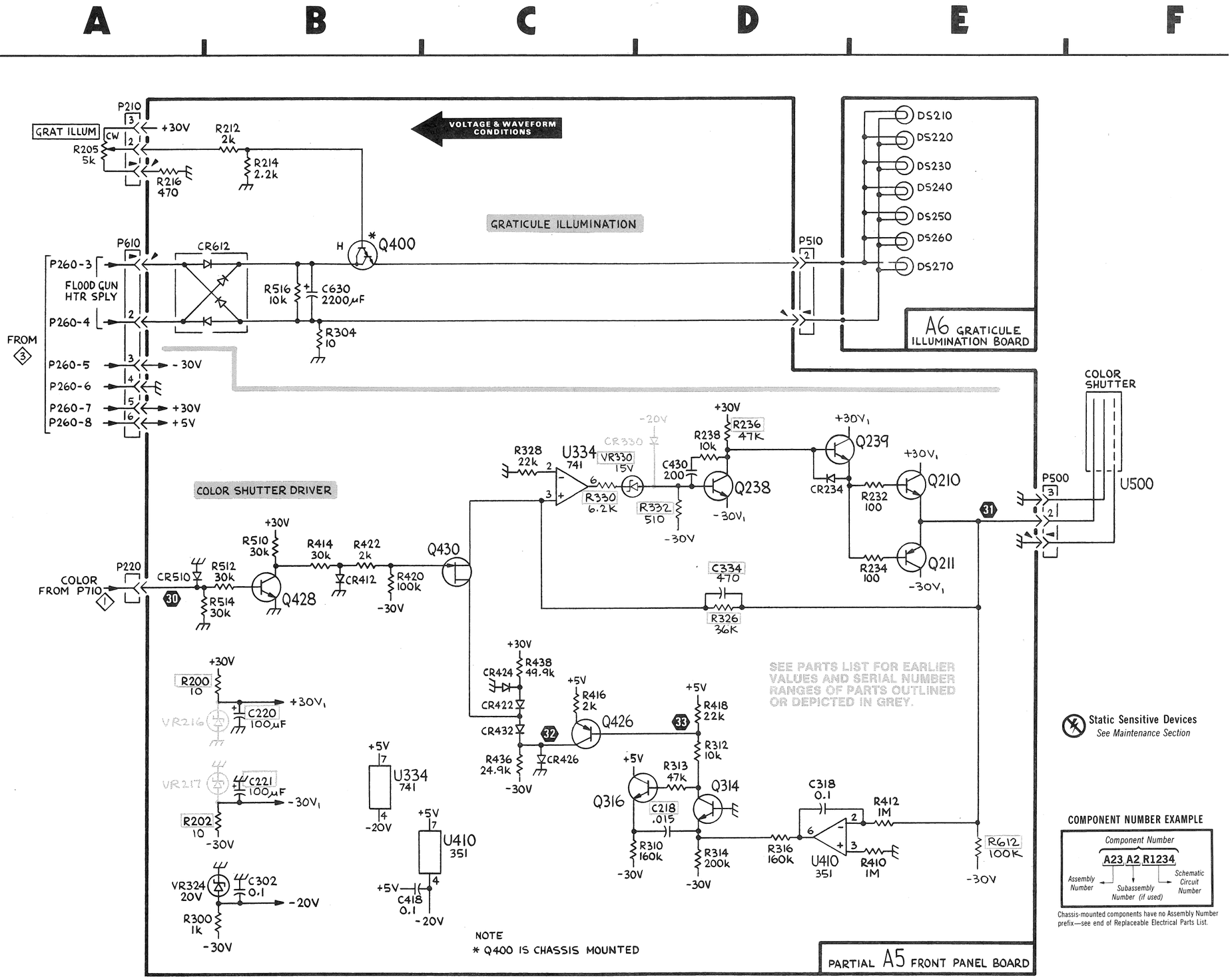
The waveforms shown are actual waveform photographs taken with a Tektronix Oscilloscope Camera System and Projected Graticule. Vertical deflection factor shown on the waveform is the actual deflection factor from the probe tip. Voltages and waveforms on the diagrams are not absolute and may vary between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

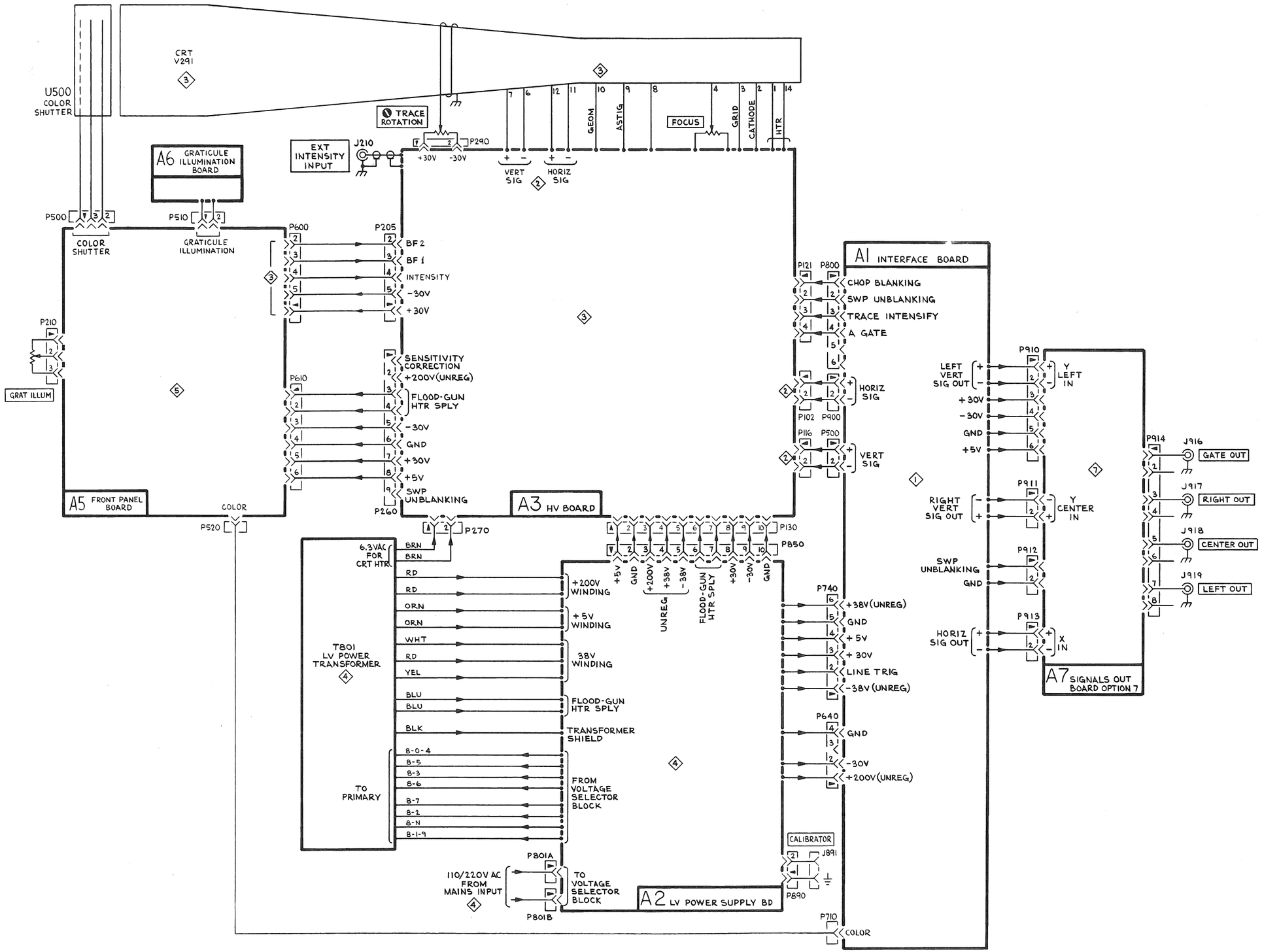






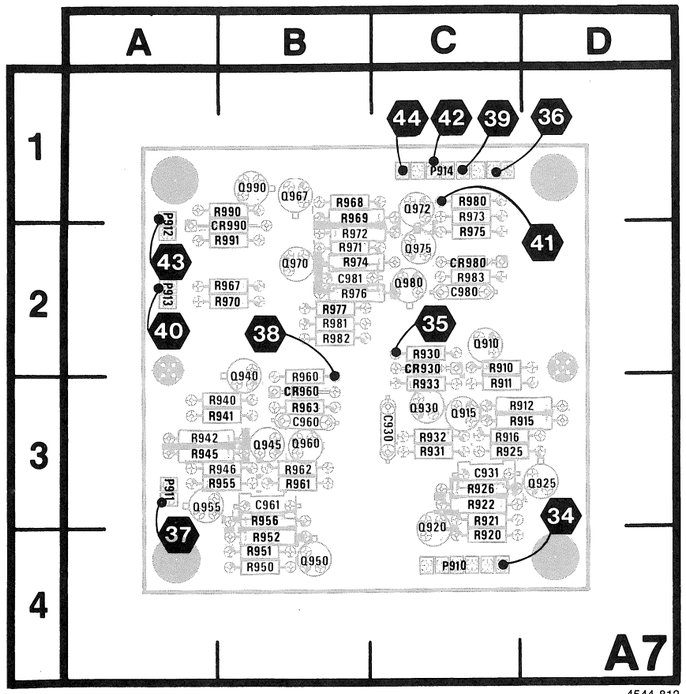



VOLTAGE & WAVEFORM CONDITIONS
GRATICULE ILLUMINATION
P210
GRAT ILLUM
CW
+30V
R205 5k
R212 2k
R214 2.2k
R216 470
P610
CR612
H
*Q400
P260-3
FLOOD GUN HTR SPLY
P260-4
R516 10k
C630 2200µF
R304 10
FROM 3
P260-5
P260-6
P260-7
P260-8
-30V
+30V
+5V
P510
DS210
DS220
DS230
DS240
DS250
DS260
DS270
A6 GRATICULE ILLUMINATION BOARD
COLOR SHUTTER DRIVER
+30V
R510 30k
R414 30k
R422 2k
Q430
P220
COLOR FROM P710
CR510
R512 30k
R514 30k
Q428
CR412
R420 100k
-30V
R328 22k
U334 741
VR330 15V
R330 6.2K
-20V
CR330
C430 200
R332 510
R238 10k
R236 47K
+30V1
Q239
Q238
-30V1
CR234
R232 100
Q210
R234 100
Q211
C334 470
R326 36K
P500
U500
COLOR SHUTTER
R200 10
+30V1
VR216
C220 100µF
VR217
C221 100µF
-30V1
R202 10
VR324 20V
C302 0.1
-20V
R300 1k
U334 741
U410 351
C418 0.1
CR424
CR422
CR432
R438 49.9k
R436 24.9k
CR426
Q426
R416 2k
R418 22k
R312 10k
Q316
R313 47k
Q314
C218 .015
R310 160k
R314 200k
C318 0.1
R412 1M
R316 160k
U410 351
R410 1M
R612 100K
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.
NOTE
* Q400 IS CHASSIS MOUNTED
PARTIAL A5 FRONT PANEL BOARD
Static Sensitive Devices
See Maintenance Section
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.



4544-805

INTERCONNECTING DIAGRAM 6



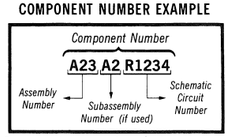
4544-812

Figure 8-7. A7—Signals Out circuit board assembly.

A7—Signals Out 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.

SIGNALS OUT (OPTION 7 ONLY) 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	D5	B2
CR930	C1	C2
CR960	C2	B3
CR980	C4	C2
CR990	B5	B2
P910	B1	C4
P911	B3	A3
P912	B5	A1
P913	B4	A2
P914	D1	C1
Q910	B1	C2
Q915	C1	C3
Q920	B2	C4
Q925	C2	D3
Q930	C1	C3
Q940	B3	B2
Q945	C3	B3
Q950	B3	B4
Q955	C3	A3
Q960	C3	B3
Q967	B4	B1
Q970	B5	B2
Q972	C4	C1
Q975	C5	C2
Q980	C4	C2
Q990	B6	B1
R910	B1	C2
R911	B1	C3
R912	B1	D3
R915	C1	D3
R916	C2	C3
R920	B2	C4
R921	B2	C3
R922	B2	C3
R925	C2	C3
R926	D2	C3
R930	C1	C2
R931	C1	C3
R932	D1	C3
R933	C1	C3
R940	B3	B3
R941	B3	B3
R942	B3	A3
R945	C3	A3
R946	C3	B3
R950	B3	B4
R951	B3	B4
R952	B3	B4
R955	C3	B3
R956	D3	B3
R960	C3	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	C4	B2
R973	C4	C1
R974	B5	B2
R975	C5	C2
R976	D5	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

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 Oscilloscope, 5A13N Differential Comparator, and 5B10N Time Base/Ampl system or equiv. Use a TEKTRONIX P6062B Probe.
Voltmeter (nonloading digital multimeter)	Range, 0 to 250 V input; input impedance, 10 megohms.	TEKTRONIX DM 501A 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 fully counterclockwise. Voltmeter common is connected to chassis ground.

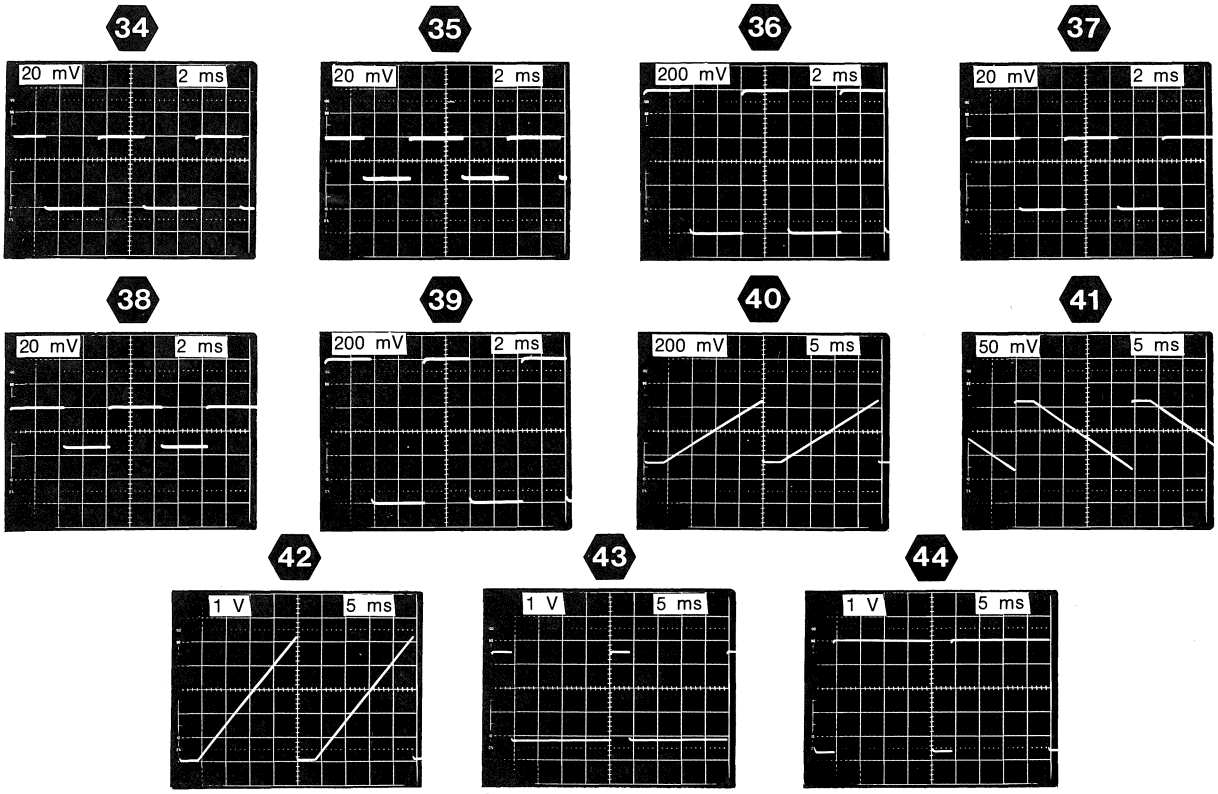
WAVEFORM CONDITIONS

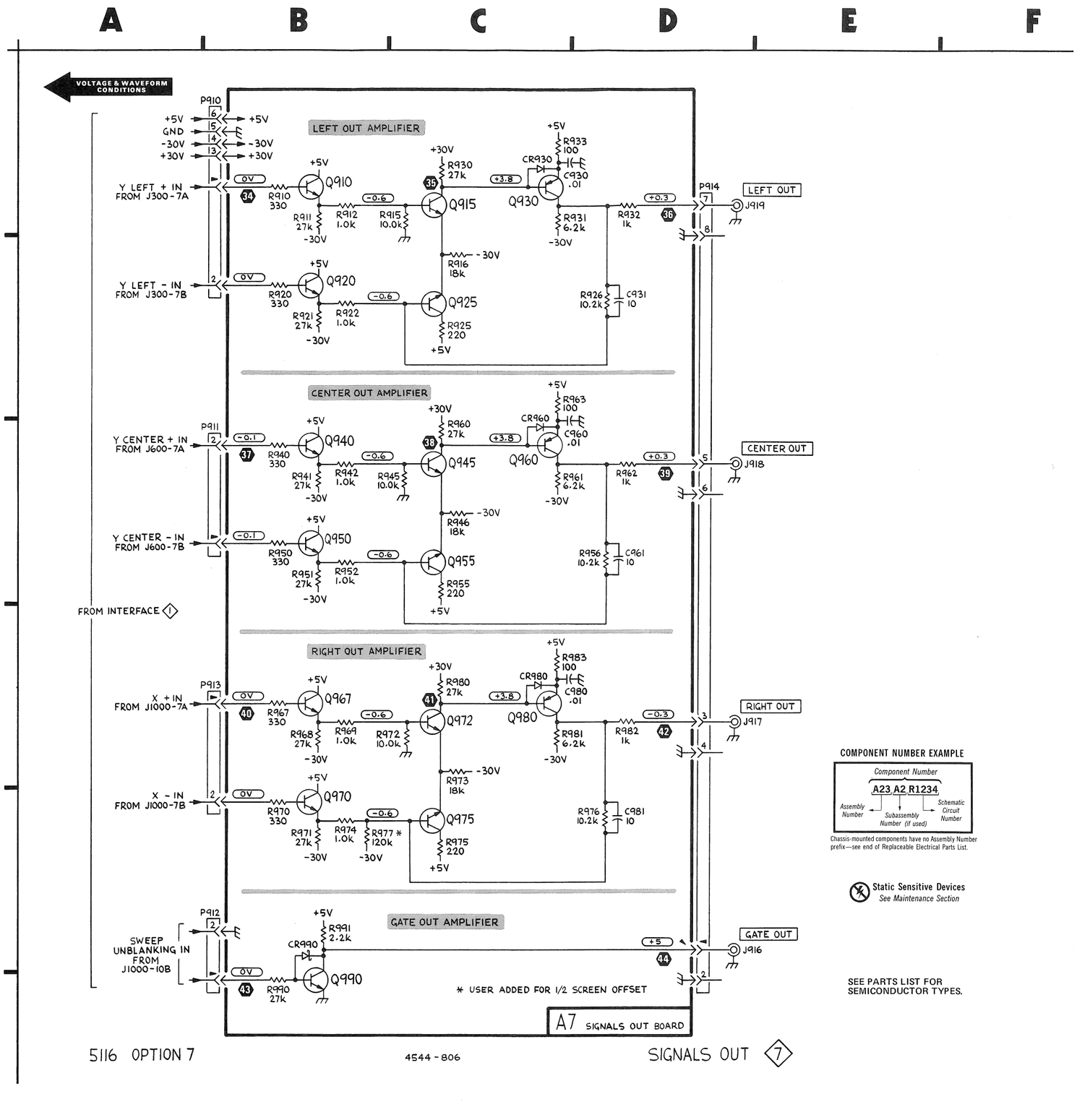
Oscilloscope Under Test. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for dc, 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.

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the description column.

1 2 3 4 5 Name & Description

Assembly and/or Component
Attaching parts for Assembly and/or Component
\- - - * - - -
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
\- - - * - - -
Parts of Detail Part
Attaching parts for Parts of Detail Part
\- - - * - - -

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. The separation symbol - - - * - - - indicates the end of attaching parts.

Attaching parts must be purchased separately, unless otherwise specified.

ABBREVIATIONS

"	INCH
#	NUMBER SIZE
ACTR	ACTUATOR
ADPTR	ADAPTER
ALIGN	ALIGNMENT
AL	ALUMINUM
ASSEM	ASSEMBLED
ASSY	ASSEMBLY
ATTEN	ATTENUATOR
AWG	AMERICAN WIRE GAGE
BD	BOARD
BRKT	BRACKET
BRS	BRASS
BRZ	BRONZE
BSHG	BUSHING
CAB	CABINET
CAP	CAPACITOR
CER	CERAMIC
CHAS	CHASSIS
CKT	CIRCUIT
COMP	COMPOSITION
CONN	CONNECTOR
COV	COVER
CPLG	COUPLING
CRT	CATHODE RAY TUBE
DEG	DEGREE
DWR	DRAWER
ELCTRN	ELECTRON
ELEC	ELECTRICAL
ELCTLT	ELECTROLYTIC
ELEM	ELEMENT
EPL	ELECTRICAL PARTS LIST
EQPT	EQUIPMENT
EXT	EXTERNAL
FIL	FILLISTER HEAD
FLEX	FLEXIBLE
FLH	FLAT HEAD
FLTR	FILTER
FR	FRAME or FRONT
FSTNR	FASTENER
FT	FOOT
FXD	FIXED
GSKT	GASKET
HDL	HANDLE
HEX	HEXAGON
HEX HD	HEXAGONAL HEAD
HEX SOC	HEXAGONAL SOCKET
HLCPS	HELICAL COMPRESSION
HLEXT	HELICAL EXTENSION
HV	HIGH VOLTAGE
IC	INTEGRATED CIRCUIT
ID	INSIDE DIAMETER
IDENT	IDENTIFICATION
IMPLR	IMPELLER
IN	INCH
INCAND	INCANDESCENT
INSUL	INSULATOR
INTL	INTERNAL
LPHLDR	LAMPHOLDER
MACH	MACHINE
MECH	MECHANICAL
MTG	MOUNTING
NIP	NIPPLE
NON WIRE	NOT WIRE WOUND
OBD	ORDER BY DESCRIPTION
OD	OUTSIDE DIAMETER
OVH	OVAL HEAD
PH BRZ	PHOSPHOR BRONZE
PL	PLAIN or PLATE
PLSTC	PLASTIC
PN	PART NUMBER
PNH	PAN HEAD
PWR	POWER
RCPT	RECEPTACLE
RES	RESISTOR
RGD	RIGID
RLF	RELIEF
RTNR	RETAINER
SCH	SOCKET HEAD
SCOPE	OSCILLOSCOPE
SCR	SCREW
SE	SINGLE END
SECT	SECTION
SEMICOND	SEMICONDUCTOR
SHLD	SHIELD
SHLDR	SHOULDERED
SKT	SOCKET
SL	SLIDE
SLFLKG	SELF-LOCKING
SLVG	SLEEVING
SPR	SPRING
SQ	SQUARE
SST	STAINLESS STEEL
STL	STEEL
SW	SWITCH
T	TUBE
TERM	TERMINAL
THD	THREAD
THK	THICK
TNSN	TENSION
TPG	TAPPING
TRH	TRUSS HEAD
V	VOLTAGE
VAR	VARIABLE
W	WITH
WSHR	WASHER
XFMR	TRANSFORMER
XSTR	TRANSISTOR

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000CY	NORTHWEST FASTENER SALES, INC.	7923 SW CIRRUS DRIVE	BEAVERTON, OR 97005
02768	ILLINOIS TOOL WORKS, INC., FASTEX DIV.	195 ALGONQUIN ROAD	DES PLAINES, IL 60016
07707	USM CORP., USM FASTENER DIV.	510 RIVER RD.	SHELTON, CT 06484
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
23740	AMUNEAL MFG., CORP.	4737 DARRAH	PHILADELPHIA, PA 19124
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
55285	BERGQUIST CO. INC.	5300 EDINA INDUSTRIAL BLVD	MINNEAPOLIS, MN 55435
70318	ALLMETAL SCREW PRODUCTS CO., INC.	821 STEWART AVE.	GARDEN CITY, NY 11530
70903	BELDEN CORP.	2000 S BATAVIA AVENUE	GENEVA, IL 60134
71279	CAMBRIDGE THERMIONIC CORP.	445 CONCORD AVE.	CAMBRIDGE, MA 02138
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
75915	LITTELFUSE, INC.	800 E. NORTHWEST HWY	DES PLAINES, IL 60016
77900	SHAKEPROOF DIV OF ILLINOIS TOOL WORKS	SAINT CHARLES RD	ELGIN, IL 60120
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
79807	WROUGHT WASHER MFG. CO.	2100 S. O BAY ST.	MILWAUKEE, WI 53207
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
86445	PENN FIBRE AND SPECIALTY CO., INC.	2032 E. WESTMORELAND ST.	PHILADELPHIA, PA 19134
93907	TEXTRON INC. CAMCAR DIV	600 18TH AVE	ROCKFORD, IL 61101
S3109	C/O PANEL COMPONENTS CORP.	P.O. BOX 6626	SANTA ROSA, CA 95406
S3629	PANEL COMPONENTS CORP.	2015 SECOND ST.	BERKELEY, CA 94170
T0435	LEWIS SCREW CO.	4114 SOUTH PERORIA AVE.	CHICAGO, IL 60609

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		SHUTTER,CRT:(SEE U500 REPL)		
-1	200-2843-00			1		.RTNR,COLOR SHTR:6.54 X 5.10		
						.**********(ATTACHING PARTS)**********		
-2	211-0017-00			2		.SCREW,MACHINE:4-40 X 0.750 PNH,STL CD PL	83385	ORD BY DESCR
						.**********(END ATTACHING PARTS)**********		
-3	175-9029-00			1		.CA ASSY,SP,ELEC:3,26 AWG,33.0 L,RIBBON	80009	175-9029-00
-4	343-0490-00			1		.STRAIN RLF,CA:		
						.**********(ATTACHING PARTS)**********		
-5	213-0717-00			1		.SCREW,TPG,TF:4-20 X 0.312 PNH,STL,CD PL	93907	ORD BY DESCR
						.**********(END ATTACHING PARTS)**********		
-6	343-1089-00			1		.RETANER,CRT:		
						.**********(ATTACHING PARTS)**********		
-7	213-0813-00			3		.SCREW,TPG,TR:4-20,0.312 L,PLASTITE	93907	ORD BY DESCR
						.**********(END ATTACHING PARTS)**********		
-8	386-1946-00			1		SUPPORT,CRT:FRONT	80009	386-1946-00
-9	348-0279-00			2		PAD,CUSHIONING:3.5 BY 0.67 BY 0.188	80009	348-0279-00
-10	348-0070-01			3		PAD,CUSHIONING:2.03 X 0.69 X 0.18 SI RBR	80009	348-0070-01
-11	348-0145-00			1		GROMMET,PLASTIC:U-SHP,1.0 X 0.42 INCH	80009	348-0145-00
-12	344-0226-00			1		CLIP,CABLE:	80009	344-0226-00
						**********(ATTACHING PARTS)**********		
-13	210-0401-00			1		NUT,PLAIN,HEX.:6-32 X 0.312 HEX,BRS CD PL	73743	93262-02
						**********(END ATTACHING PARTS)**********		
-14	334-1379-00			1		MARKER,IDENT:MARKED HI VACUUM	80009	334-1379-00
-15	337-1419-05			1		SHIELD SECT,CRT:	80009	337-1419-05
-16	337-1420-00			1		SHIELD SECT,CRT:	23740	337-1420-00-B
-17	354-0409-00			1		R,CLP,CRT SHLD:U/O 2.375 OD SHIELD	80009	354-0409-00
-18	343-0123-01			2		CLAMP,RET.,ELEC:CRT,REAR	80009	343-0123-01
						**********(ATTACHING PARTS)**********		
-19	211-0632-00			1		SCREW,MACHINE:6-32X2.250 INCH,FILH,STL	83385	ORD BY DESCR
-20	220-0444-00			1		NUT,PLAIN,SQ:6-32 X 0.250 INCH,STL	70318	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-21	407-0922-00			1		BRACKET,CRT CLP:ALUMINUM	80009	407-0922-00
						**********(ATTACHING PARTS)**********		
-22	211-0507-00			2		SCREW,MACHINE:6-32 X 0.312,PNH STL,CD PL	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-23	384-1064-03			1		KNOB:14.061 X 0.125 OD,W/SHAFT	80009	384-1064-03
-24	358-0216-00			1		BUSHING,PLASTIC:0.257 ID X 0.412 INCH OD	80009	358-0216-00
-25	366-0494-00			3		KNOB:GRAY WITH SETSCREW	80009	366-0494-00
	213-0153-00			3		.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	ORD BY DESCR
-26	366-1512-00			1		PUSH BUTTON:GRAY,0.18 SQ X 0.83 INCH LG	80009	366-1512-00
-27	426-1072-00			1		FRAME,PUSH BTN:PLASTIC	80009	426-1072-00
-28	---- ----			1		RESISTOR,VAR:(SEE R205 REPL)		
						**********(ATTACHING PARTS)**********		
-29	210-0583-00			1		NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-30	210-0940-00			1		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-31	---- ----			1		RESISTOR,VAR:(SEE R295 REPL)		
						**********(ATTACHING PARTS)**********		
-32	210-0583-00			2		NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-33	210-0046-00			1		WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	77900	1214-05-00-0541C
-34	210-0940-00			1		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-35	200-0608-00			1		COVER,VAR RES.,:PLASTIC:	80009	200-0608-00
-36	136-0387-00			2		JACK,TIP:GRAY	71279	450-4352-01-0318
-37	333-2988-00			1		PANEL,FRONT:	80009	333-2988-00
-38	---- ----			1		RESISTOR,VAR:(SEE R291 REPL)		
						**********(ATTACHING PARTS)**********		
-39	210-0590-00			1		NUT,PLAIN,HEX.:0.375-32 X 0.438" BRS	73743	2X28269-402
-40	210-0978-00			1		WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	12327	ORD BY DESCR
-41	210-0012-00			2		WASHER,LOCK:INTL,0.384 ID,INTL,0.022 TH	78189	1220-02-00-0541C
-42	210-0207-00			1		TERMINAL,LUG:0.375 INCH DIAMETER	12697	01136902
						**********(END ATTACHING PARTS)**********		
-43	---- ----			1		SWITCH,PUSH:(SEE S201 REPL)		
-44	376-0127-00			1		COUPLER,SHAFT:PLASTIC	80009	376-0127-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-45	----- -----			1		TRANSISTOR:(SEE Q252 REPL)		
						**********(ATTACHING PARTS)**********		
-46	211-0097-00			1		SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
-47	210-1178-00			1		WASHER,SHLDR:U/W T0-220 TRANSISTOR	49671	DF 137A
-48	210-0586-00			1		NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	T0435	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-49	342-0354-00			1		INSULATOR,PLATE:TRANS,SILICON RUBBER	55285	7403-09FR-52
-50	348-0115-00			1		GROMMET,PLASTIC:U-SHP,0.548 X 0.462 INCH	80009	348-0115-00
-51	337-1421-02			1		SHIELD,ELEC:HIGH VOLTAGE	80009	337-1421-02
						**********(ATTACHING PARTS)**********		
-52	211-0504-00			3		SCREW,MACHINE:6-32 X 0.250,PNH STL,CD PL	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-53	407-0896-00			1		BRACKET,CHASSIS:ALUMINUM	80009	407-0896-00
						**********(ATTACHING PARTS)**********		
-54	211-0541-00			1		SCREW,MACHINE:6-32 X 0.25"100 DEG,FLH STL	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-55	214-0982-04			1		SPRING,GROUND:GROUNDING	80009	214-0982-04
						**********(ATTACHING PARTS)**********		
-56	211-0538-00			3		SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-57	200-1204-01			1		COVER,CRT:REAR ALUMINUM,PTD BLUE	80009	200-1204-01
						**********(ATTACHING PARTS)**********		
-58	210-0401-00			2		NUT,PLAIN,HEX.:6-32 X 0.312 HEX,BRS CD PL	73743	93262-02
-59	210-0005-00			2		WASHER,LOCK:#6 EXT,0.02 THK,STL	78189	1106-00
						**********(END ATTACHING PARTS)**********		
-60	161-0066-00			1		CABLE ASSY,PWR,:3,18 AWG,115V,98.0 L	16428	CH8481,FH8481
-61	161-0066-09			1		CABLE ASSY,PWR:3,0.75MM SQ,220V,99.0 L	S3109	86511000
	----- -----			-		(OPTION A1 EUROPEAN)		
-62	161-0066-10			1		CABLE ASSY,PWR:3,0.75MM SQ,240V,96.0 L	S3109	ORD BY DESCR
	----- -----			-		(OPTION A2 UNITED KINGDOM)		
-63	161-0066-11			1		CABLE ASSY,PWR:3,0.75MM,240V,96.0L	S3109	SAA/3-003CCFC3X0
	----- -----			-		(OPTION A3 AUSTRALIAN)		
-64	161-0066-12			1		CABLE ASSY,PWR:3,18 AWG,240V,96.0 L	70903	CH-77893
	----- -----			-		(OPTION A4 NORTH AMERICAN)		
-65	161-0154-00			1		CABLE ASSY,PWR:3,0.75MM SQ,240V,6A,2.5M L	S3109	86515000
	----- -----			-		(OPTION A5 SWISS)		
-66	204-0832-00			1		BODY,FUSEHOLDER:3AG,5 X 20MM FUSES	S3629	031.1673(MDLFEU)
						**********(ATTACHING PARTS)**********		
-67	210-1039-00			1		WASHER,LOCK:INT,0.521 ID X 0.625 INCH O	77900	1224-02
						**********(END ATTACHING PARTS)**********		
-68	200-2264-00			1		CAP.,FUSEHOLDER:3AG FUSES	S3629	FEK 031 1666
-69	200-0237-04			1		COVER,FUSE HLDR:PLASTIC,SAFETY CONTROLLED	80009	200-0237-04
-70	131-0955-00			1		CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
-71	210-0255-00			1		TERMINAL,LUG:0.391 ID,LOCKING,BRS CD PL	80009	210-0255-00
-72	210-0202-00			2		TERMINAL,LUG:0.146 ID,LOCKING,BRZ,TIN PL	78189	2104-06-00-2520N
						**********(ATTACHING PARTS)**********		
-73	210-0407-00			2		NUT,PLAIN,HEX:6-32 X 0.25 INCH,BRS	73743	3038-402
						**********(END ATTACHING PARTS)**********		
-74	334-3379-01			1		MARKER,IDENT:MARKED GROUND SYMBOL	80009	334-3379-01
-75	136-0796-00			1		SKT,PL-IN ELEK:CRT CABLE	80009	136-0796-00
-76	----- -----			1		FILTER,RFI:(SEE FL201 REPL)		
						**********(ATTACHING PARTS)**********		
-77	211-0510-00			2		SCREW,MACHINE:6-32 X 0.375,PNH,STL,CD PL	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-78	333-1426-04			1		PANEL,REAR:	80009	333-1426-04
-79	----- -----			1		CKT BOARD ASSY:FRONT PANEL(SEE A5 REPL)		
						**********(ATTACHING PARTS)**********		
-80	211-0008-00			4		SCREW,MACHINE:4-40 X 0.250,PNH,STL,POZ	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
	----- -----			-		CKT BOARD ASSY INCLUDES:		
-81	----- -----			19		.TERMINAL PIN:(SEE A5P210,P500,P510,P600,		
	----- -----			-		.P610 REPL)		
-82	----- -----			1		.TERMINAL PIN:(SEE A5P520 REPL)		
-83	----- -----			1		.SWITCH,PUSH:(SEE A5S200 REPL)		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-84	361-0411-00			2		.SPACER,PUSH SW:0.13 W X 0.375 INCH L,PLST	71590	J64285-00
-85	---- ----			1		.RESISTOR,VAR:(SEE A5R610 REPL)		
-86	376-0051-01			1		.CPLG,SHAFT,FLEX:0.127 ID X 0.375 OD	80009	376-0051-01
-87	384-0700-00			1		EXTENSION SHAFT:6.3 L X 0.123 OD EPOXY-GL	80009	384-0700-00
-88	384-1099-00			1		EXTENSION SHAFT:PUSH BUTTON,1.54 INCH LONG	80009	384-1099-00
-89	103-0186-01			1		ADAPTER,EXT SFT:PUSH SW,0.45 OFFSET	80009	103-0186-01
-90	---- ----			1		CKT BOARD ASSY:HIGH VOLTAGE(SEE A3 REPL)		
-91	---- ----			41		.TERM,PIN:(SEE A3P102,P111,P116,P121,P130,		
	---- ----			-		.P205,P252,P260,P290,P298 REPL)		
-92	---- ----			2		.TEST POINT:(SEE TP226,TP267 REPL)		
-93	214-2811-00			4		.HEAT,SINK,XSTR:TO-202 ALUMINUM	80009	214-2811-00
-94	337-1179-00			1		.SHIELD,ELEC:DEFLECTION AMP	80009	337-1179-00
-95	---- ----			1		CKT BOARD ASSY:GRAT ILLUM(SEE A6 REPL)		
-96	214-3515-00			1		.CONDUCTOR,LIGHT:3.935 L X 0.257 OD		
	210-3050-00			4		.EYELET,METALLIC:0.218 L X 0.059 OD,BRS	07707	SE-27
-97	344-0266-00			2		.CLIP,RETAINING:CKT BD		
						.**********(ATTACHING PARTS)**********		
-98	211-0501-00			2		.SCREW,MACHINE:6-32 X 0.125 INCH,PNH STL	83385	ORD BY DESCR
						.**********(END ATTACHING PARTS)**********		
-99	---- ----			1		TRANSISTOR:(SEE Q400 REPL)		
						**********(ATTACHING PARTS)**********		
-100	211-0012-00			1		SCREW,MACHINE:4-40 X 0.375,PNH STL CD PL	83385	ORD BY DESCR
-101	342-0536-00			1		INSULATOR,XSTR:TO-220,POLYENELENE	80009	342-0536-00
						**********(END ATTACHING PARTS)**********		
-102	342-0354-00			1		INSULATOR,PLATE:TRANS,SILICON RUBBER	55285	7403-09FR-52
-103	214-3144-01			1		HEAT SINK,ELEC:	80009	214-3144-01
						**********(ATTACHING PARTS)**********		
-104	211-0504-00			2		SCREW,MACHINE:6-32 X 0.250,PNH STL,CD PL	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-105	343-0088-00			3		CLAMP,LOOP:0.062 INCH DIA	80009	343-0088-00
-106	407-2270-02			1		BRACKET,CHASSIS:	80009	407-2270-02
						**********(ATTACHING PARTS)**********		
-107	211-0504-00			2		SCREW,MACHINE:6-32 X 0.250,PNH STL,CD PL	83385	ORD BY DESCR
-108	211-0559-00			1		SCREW,MACHINE:6-32 X 0.375"100 DEG,FLH ST	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-109	348-0516-00			1		GROMMET,PLASTIC:BLACK,ROUND,0.188 ID	28520	SB312-3
-110	386-5073-00			1		SUPPORT,CKT BD:	02768	215-150909-04
-111	344-0225-00			2		CLIP,CABLE:	80009	344-0225-00
-112	348-0115-00			1		GROMMET,PLASTIC:U-SHP,0.548 X 0.462 INCH	80009	348-0115-00
-113	441-0991-06			1		CHAS,DSPL UNIT:MAIN	80009	441-0991-06
						**********(ATTACHING PARTS)**********		
-114	211-0504-00			2		SCREW,MACHINE:6-32 X 0.250,PNH STL,CD PL	83385	ORD BY DESCR
-115	211-0538-00			2		SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-116	426-0739-02			1		FR ASSY,DSPL UN:	80009	426-0739-02

SEE END OF RMPL FOR WIRE ASSEMBLIES

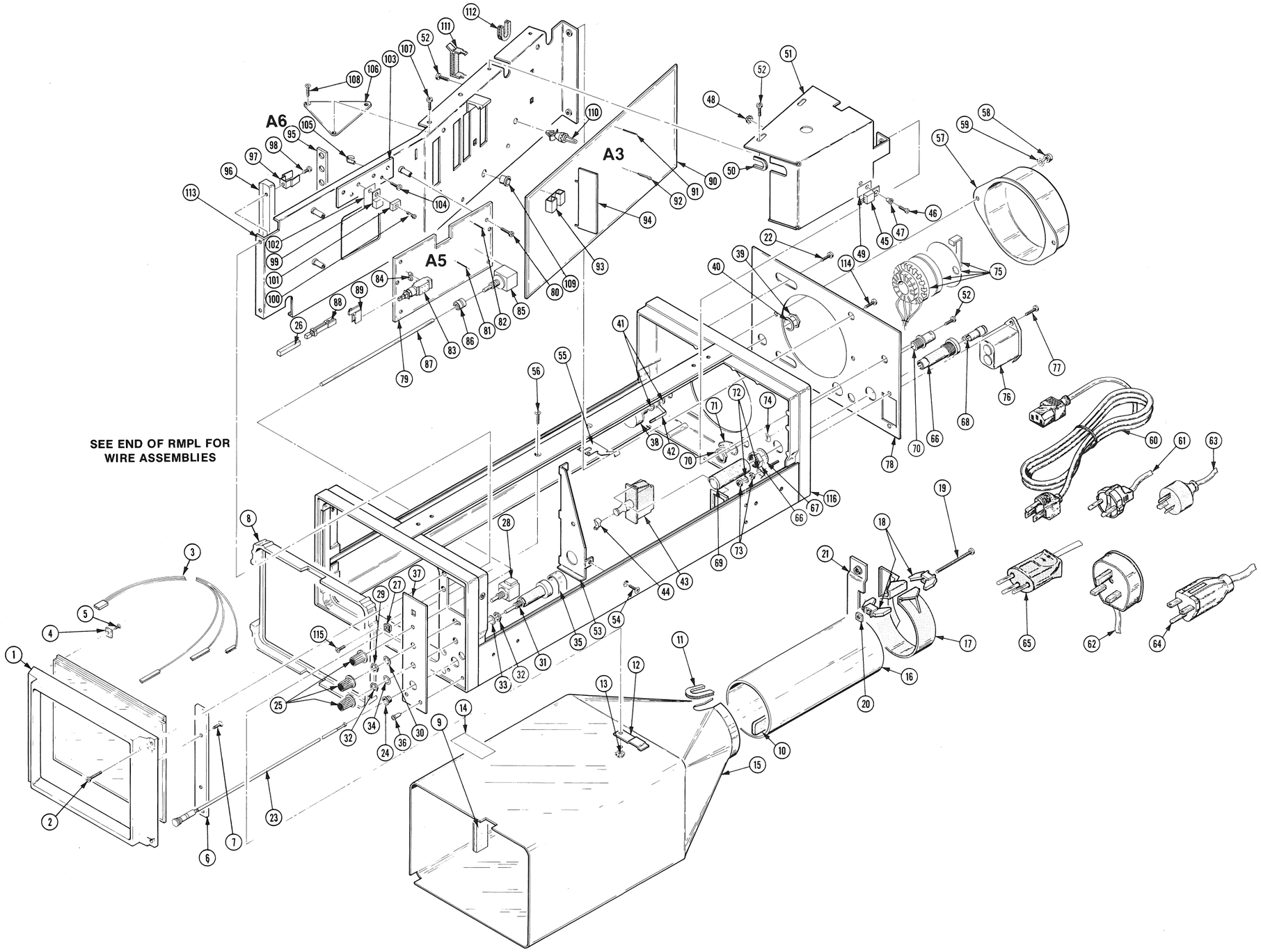
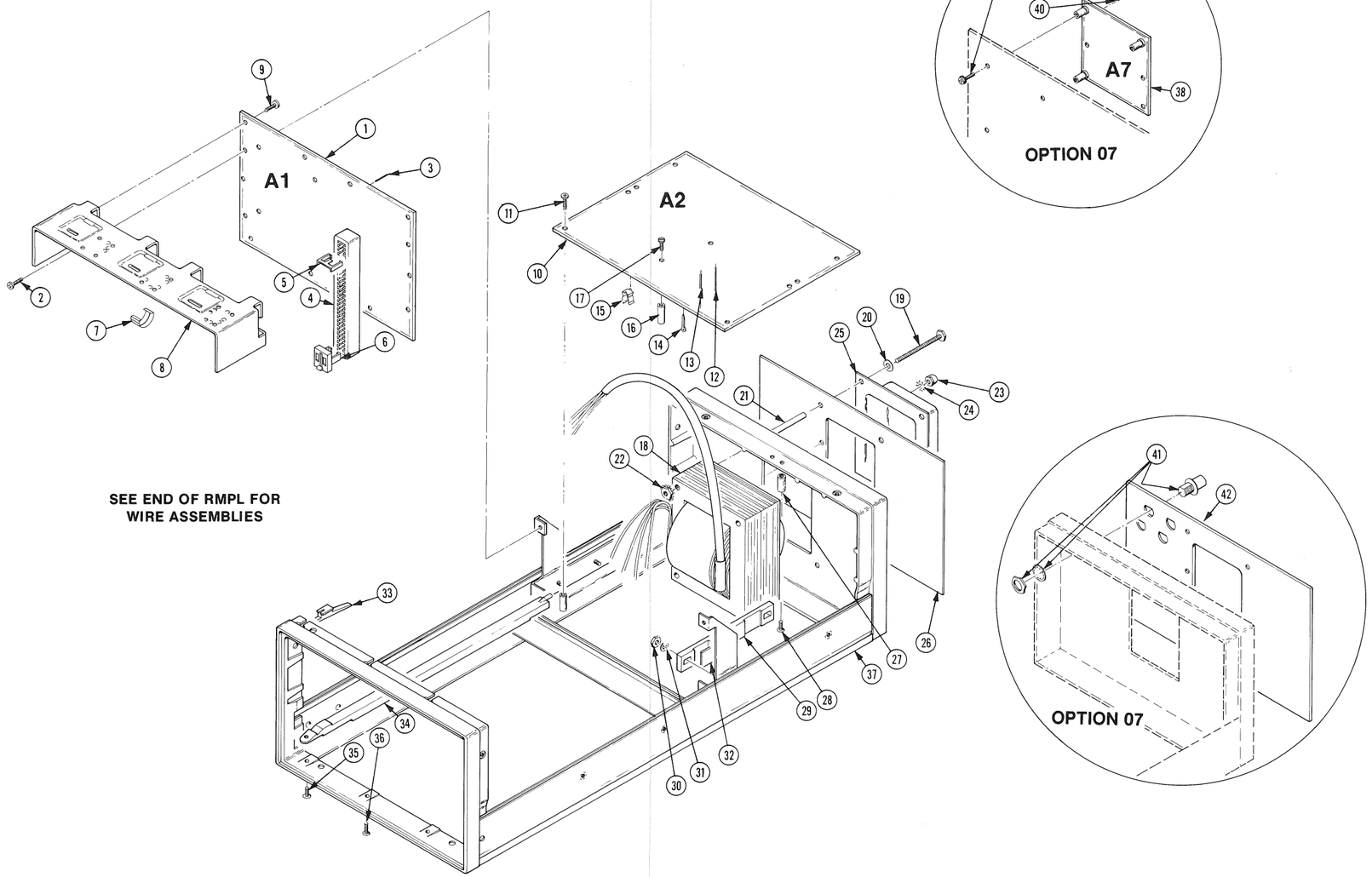


FIG. 2 MAINFRAME



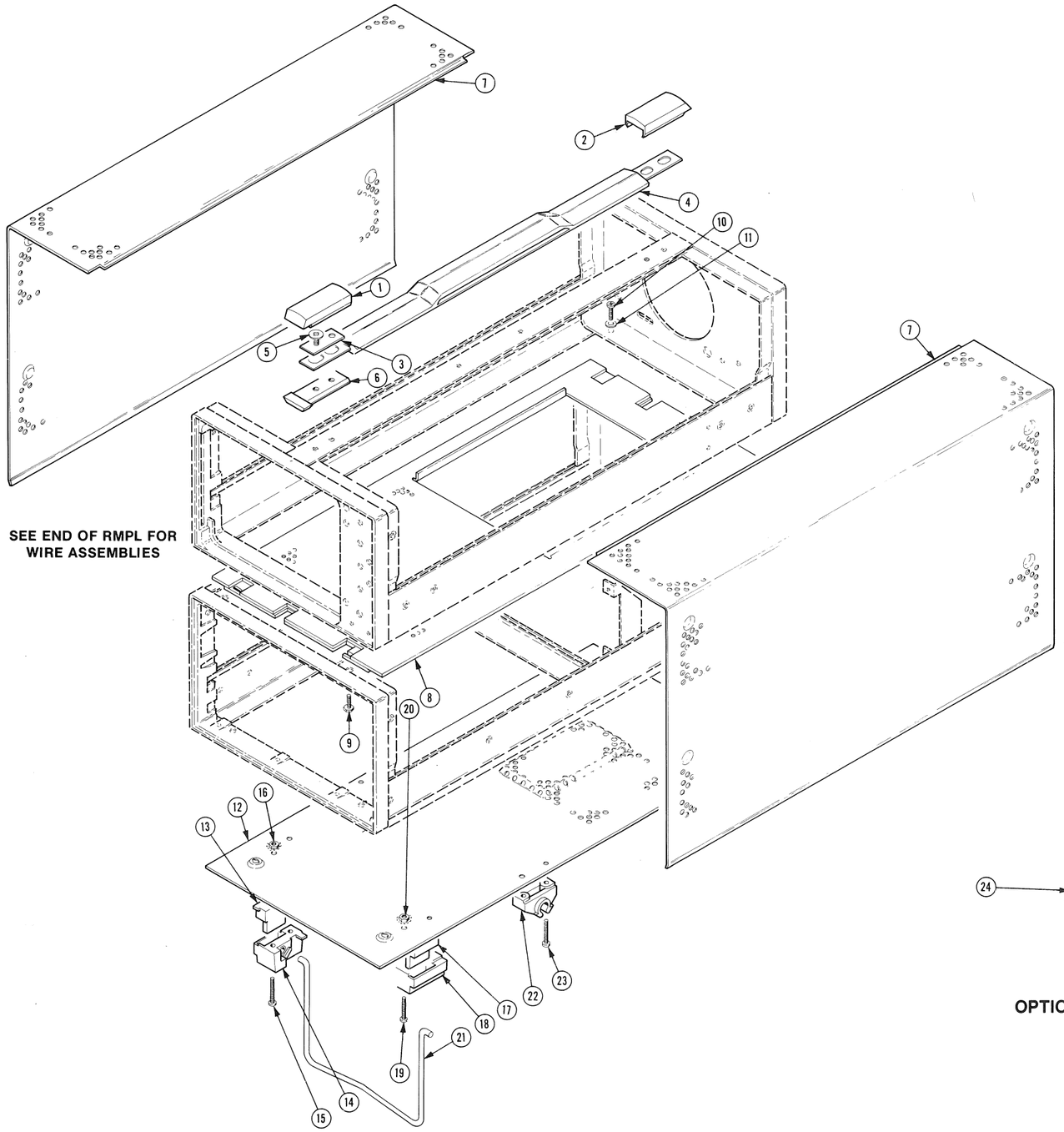
SEE END OF RMPL FOR WIRE ASSEMBLIES

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	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
	---- ----			-		CKT BOARD ASSY INCLUDES:		
-3	131-0589-00			20		.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-4	---- ----			3		.CONN,RCPT:(SEE A1J300,J600,J1000 REPL)		
-5	214-1593-02			3		.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 0.250,PNH,STL,POZ	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-10	---- ----			1		CKT BOARD ASSY:LV POWER SUPPLY(SEE A2 REPL		
						**********(ATTACHING PARTS)**********		
-11	211-0504-00			6		SCREW,MACHINE:6-32 X 0.250,PNH STL,CD PL	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
	---- ----			-		CKT BOARD ASSY INCLUDES:		
-12	131-0608-00			16		.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
-13	131-0589-00			26		.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-14	---- ----			5		.TERM TEST POINT:(SEE A2TP810,TP820,TP830,		
	---- ----			-		.TP840,TP860 REPL)		
-15	344-0326-00			14		.CLIP,ELECTRICAL:FUSE,BRASS	75915	102071
-16	385-0149-00			2		.SPACER,POST:0.625 L W/4-40 THD EA END,N	80009	385-0149-00
						.**********(ATTACHING PARTS)**********		
-17	211-0040-00			2		.SCREW,MACHINE:4-40 X 0.25",BDGH PLSTC	26365	ORD BY DESCR
						.**********(END ATTACHING PARTS)**********		
-18	---- ----			1		TRANSFORMER:(SEE T801 REPL)		
						**********(ATTACHING PARTS)**********		
-19	212-0522-00			4		SCREW,MACHINE:10-32 X 2.50",HEX HD STL	83385	ORD BY DESCR
-20	210-0812-00			4		WASHER,NONMETAL:#10,FIBER	86445	ORD BY DESCR
-21	166-0457-00			4		INSUL SLVG,ELEC:0.19 ID X 1.875"LONG MYLAR	80009	166-0457-00
-22	220-0410-00			4		NUT,EXTENDED WA:10-32 X 0.375 INCH,STL	83385	ORD BY DESCR
-23	210-0401-00			1		NUT,PLAIN,HEX::6-32 X 0.312 HEX,BRS CD PL	73743	93262-02
-24	210-0407-00			1		NUT,PLAIN,HEX:6-32 X 0.25 INCH,BRS	73743	3038-402
						**********(END ATTACHING PARTS)**********		
-25	200-0772-09			1		COVER,ELEC XFMR:3.125 X 3.75 X 0.875	80009	200-0772-09
-26	333-1425-11			1		PANEL,REAR:	80009	333-1425-11
-27	385-0012-00			1		SPACER,POST:0.312 OD,0.562 L W/8-32 THD	80009	385-0012-00
						**********(ATTACHING PARTS)**********		
-28	211-0025-00			1		SCREW,MACHINE:4-40 X 0.375 100 DEG,FLH ST	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-29	343-0315-00			2		CLAMP,XSTR:	80009	343-0315-00
						**********(ATTACHING PARTS)**********		
-30	210-0407-00			6		NUT,PLAIN,HEX:6-32 X 0.25 INCH,BRS	73743	3038-402
-31	210-0802-00			6		WASHER,FLAT:0.15 ID X 0.312 INCH OD	12327	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-32	342-0355-00			3		INSULATOR,PLATE:TRANSISTOR,SILICONE RUBBER	55285	7403-09FR-51
-33	351-0293-00			3		GUIDE,SLIDE:BLUE	80009	351-0293-00
-34	351-0286-07			3		GUIDE,PL-IN UNI:LOWER,NYLON	80009	351-0286-07
						**********(ATTACHING PARTS)**********		
-35	213-0814-00			1		SCREW,TPG,TR:4-20,0.25 L,PLASTITE	93907	224-05931-024
-36	213-0813-00			2		SCREW,TPG,TR:4-20,0.312 L,PLASTITE	93907	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-37	426-0738-02			1		FRAME ASSY MON:	80009	426-0738-02
-38	---- ----			1		CKT BOARD ASSY:SIGNAL OUT(SEE A7 REPL)		
	---- ----			-		(OPTION 07 ONLY)		
						**********(ATTACHING PARTS)**********		
-39	211-0292-00			3		SCR,ASSEM WSHR:4-40 X 0.29,BRS NI PL	78189	51-040445-01
	---- ----			-		(OPTION 07 ONLY)		
	---- ----			-		CKT BOARD ASSY INCLUDES:		
-40	131-0589-00			20		.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
	---- ----			-		(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
2-41	----- -----			4		CONN,RCPT,:(SEE J916,J917,J918,J919 REPL)		
	----- -----			-		(OPTION 07 ONLY)		
-42	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:16.54 L,BLUE VINYL	12136	ORD BY DESCR
						**********(ATTACHING PARTS)**********		
-5	212-0597-00			4		SCREW,MACHINE:10-32 X 0.50 INCH,STL	93907	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-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
-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 ST	80009	212-0105-00
-10	212-0008-00			2		SCREW,MACHINE:8-32 X 0.500 INCH,PNH STL	83385	ORD BY DESCR
-11	210-0008-00			2		WASHER,LOCK:INTL,0.02 THK	77900	1208-00-00-0541C
						**********(END ATTACHING PARTS)**********		
-12	390-0470-00			1		CAB.BOT,DSPL:BOTTOM	80009	390-0470-00
-13	348-0208-00			2		.FOOT,CABINET:LEFT FRONT AND RIGHT REAR	80009	348-0208-00
-14	348-0073-00			2		.HINGE BLOCK,STA:L FR,R REAR,BLACK ACETAL	80009	348-0073-00
						.**********(ATTACHING PARTS)**********		
-15	211-0532-00			2		.SCREW,MACHINE:6-32 X 0.75 INCH,FILH STL	83385	ORD BY DESCR
-16	210-0457-00			2		.NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
						.**********(END ATTACHING PARTS)**********		
-17	348-0207-00			2		.FOOT,CABINET:RIGHT FRONT AND LEFT REAR	80009	348-0207-00
-18	348-0074-00			2		.HINGE BLOCK,STA:R FR,L REAR,BLACK ACETAL	80009	348-0074-00
						.**********(ATTACHING PARTS)**********		
-19	211-0532-00			2		.SCREW,MACHINE:6-32 X 0.75 INCH,FILH STL	83385	ORD BY DESCR
-20	210-0457-00			2		.NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
						.**********(END ATTACHING PARTS)**********		
-21	348-0275-00			1		FLIPSTAND,CAB.:	80009	348-0275-00
-22	343-0256-00			2		RTNR BLK,SCOPE:	80009	343-0256-00
						**********(ATTACHING PARTS)**********		
-23	211-0531-00			4		SCREW,MACHINE:6-32 X 0.375,FIL,STL	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-24	200-1375-00			1		COVER,SCOPE:FRONT	80009	200-1375-00
	---- ----			-		(OPTION 02 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
						WIRE ASSEMBLIES		
	175-0210-00			1		CA ASSY,SP,ELEC:3,22 AWG,4.0 L,RIBBON	80009	175-0210-00
	---- ----			-		(FROM A1P640 TO A2P830)		
	175-0992-00			1		CA ASSY,SP,ELEC:6,22 AWG,3.0 L,RIBBON	80009	175-0992-00
	---- ----			-		(FROM A1P740 TO A2P840)		
	175-4799-00			1		CABLE ASSY,RF:50 OHM COAX,13.0 L	80009	175-4799-00
	---- ----			-		(FROM BNC TO A3)		
	175-7411-00			1		CA ASSY,SP,ELEC:3,22 AWG,5.0 L,RIBBON	80009	175-7411-00
	---- ----			-		(HIGH VOLTAGE COVER)		
	175-7842-00			1		CA ASSY,SP,ELEC:6,26 AWG,5.0 L,RIBBON	80009	175-7842-00
	---- ----			-		(FROM A3P260 TO A5P610)		
	175-7843-00			1		CA ASSY,SP,ELEC:5,26 AWG,5.0 L,RIBBON	80009	175-7843-00
	---- ----			-		(FROM A3P205 TO A5P600)		
	175-7844-00			1		CA ASSY,SP,ELEC:6,22 AWG,11.0 L,RIBBON	80009	175-7844-00
	---- ----			1		(FROM A3P121 TO A1P800)		
	175-7845-00			2		CA ASSY,SP,ELEC:2,22 AWG,10.0 L,RIBBON	80009	175-7845-00
	---- ----			-		(FROM A3P102 TO A1P900)		
	---- ----			-		(FROM A3P116 TO A1P500)		
	175-7846-00			1		CA ASSY,SP,ELEC:10,22 AWG,11.0 L,RIBBON	80009	175-7846-00
	---- ----			-		(FROM A3P130 TO A2P830)		
	175-7847-00			1		CA ASSY,SP,ELEC:2,22 AWG,13.0 L,RIBBON	80009	175-7847-00
	---- ----			-		(FROM A3P290 TO ROTATION POT)		
	175-7905-00			1		CA ASSY,SP,ELEC:3,26 AWG,3.5 L,RIBBON	80009	175-7905-00
	---- ----			-		(FROM A5P210 TO FOCUS POT)		
	175-8889-00			1		CA ASSY,SP,ELEC:2,22 AWG,20.0 L,RIBBON	80009	175-8889-00
	---- ----			-		(FROM JACKS TO A2)		
	198-4820-00			1		WIRE SET,ELEC:	80009	198-4820-00
	---- ----			-		(FROM POWER SWITCH TO A2)		
	175-8890-00			1		CA ASSY,SP,ELEC:2,26 AWG,2.0 L,RIBBON	80009	175-8890-00



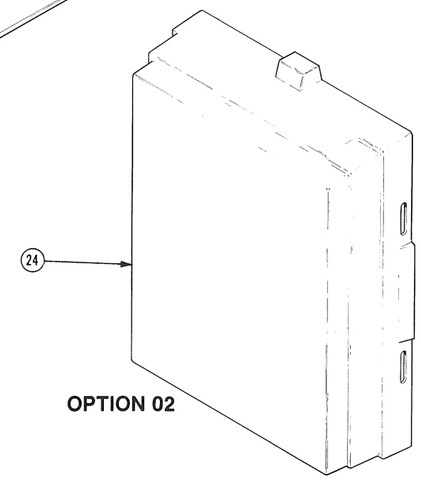


FIG. 3 BENCH CABINET

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
	070-4544-00			1		MANUAL,TECH:INSTR	80009	070-4544-00

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: 9-24-84 **Change Reference:** M55700

Product: 5116 Oscilloscope **Manual Part No.:** 070-4544-00

DESCRIPTION PG 52

Effective Serial B010226:

REPLACEABLE ELECTRICAL PARTS LIST and SCHEMATIC CHANGE

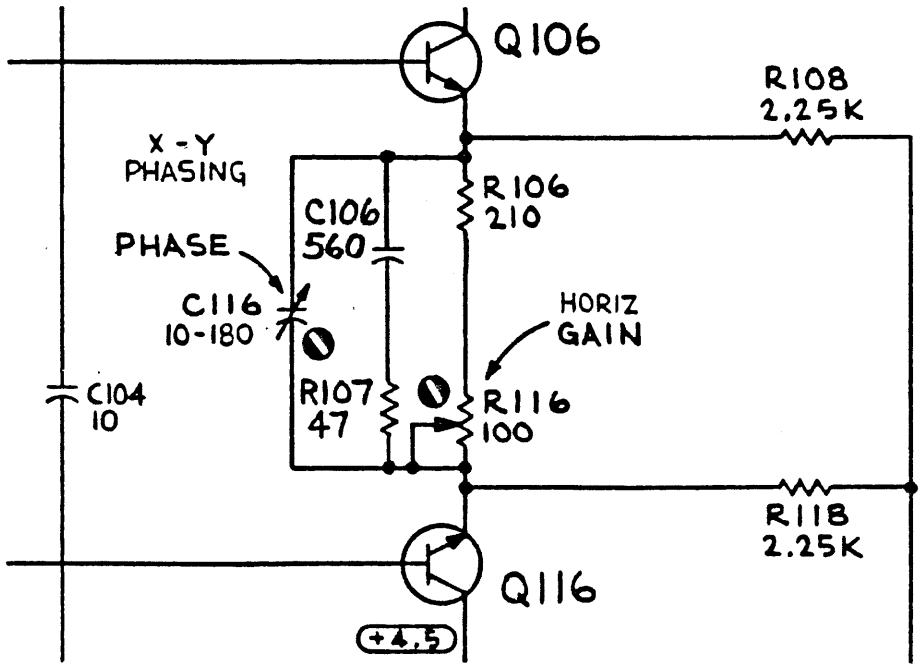
CHANGE TO:

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description
A3	670-1621-13	B010226		CKT BOARD ASSY:HIGH VOLTAGE

The 670-1621-13 is the same as the 670-1621-11 except C106 is lifted at the junction of R116 and R106, and a resistor (R107) is added in series with C106 to the junction of R116 and R118.

ADD:

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description
A3R107	315-0470-00	B010226		RES,FXD,CMPSN:47 OHM,5%,0.25W



Partial Diagram ◇2◇, VERTICAL & HORIZONTAL DEFLECTION AMPLIFIERS

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MANUAL CHANGE INFORMATION

Date: 4-17-85 **Change Reference:** M57438

Product: 5116 **Manual Part No.:** 070-4544-00

DESCRIPTION 52

Effective at SN B020317

REPLACEABLE ELECTRICAL PARTS LIST CHANGES

CHANGE TO:

A5	670-7798-01	CKT BOARD ASSY:FRONT PANEL
A5C218	281-0707-00	CAP.,FXD,CER DI:15000PF,20%,200V
A5C220	290-0950-00	CAP.,FXD,ELCTLT:100UF,+50-10%,50V
A5C221	290-0950-00	CAP.,FXD,ELCTLT:100UF,+50-10%,50V
A5C334	281-0788-00	CAP.,FXD,CER DI:470PF,10%,100V
A5Q210	151-0444-00	TRANSISTOR:NPN,SI
A5Q211	151-0443-00	TRANSISTOR:PNP,SI
A5R200	301-0100-00	RES.,FXD,CMPSN:10 OHM,5%,0.5W
A5R202	301-0100-00	RES.,FXD,CMPSN:10 OHM,5%,0.5W
A5R236	315-0473-00	RES.,FXD,CMPSN:47K OHM,5%,0.25W
A5R326	315-0363-00	RES.,FXD,CMPSN:36K OHM,5%,0.25W
A5R330	315-0682-00	RES.,FXD,CMPSN:6.8K OHM,5%,0.25W
A5R332	315-0511-00	RES.,FXD,CMPSN:510 OHM,5%,0.25W
U500	119-1683-02	SHUTTER ASSY:LIQUID CRYSTAL

REMOVE:

A5CR330	152-0142-02	SEMICOND DVC,DI:SW,SI,30V,150MA,30V
A5VR216	152-0571-00	SEMICOND DVC,DI:ZEN,SI,16V,0.4W
A5VR217	152-0571-00	SEMICOND DVC,DI:ZEN,SI,16V,0.4W

ADD:

J238	196-3057-00	LEAD,ELECTRICAL:26 AWG,2.0 L,9-N
A5R612	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
A5VR330	152-0243-00	SEMICOND DVC,DI:ZEN,SI,15V,5%,0.4W

DESCRIPTION

TEXT CHANGES

Theory of Operation, page 5-6

Replace the first three paragraphs below **COLOR SHUTTER DRIVER** with the following text.

The color shutter is driven with a plus and minus 20 volt, 1KHz square wave (plus and minus 15 volt, 700 Hz for serial numbers below B020317) to produce a blue green display. The color shutter is driven with 0 volt DC to produce an orange display. Peak currents up to 100 mA are required to drive the cell's capacitance. The average (DC) voltage across the cell must be within 25 mV of 0 volt. This requirement is met by measuring the average voltage and varying the duty factor of the square wave to force the average to zero.

The shutter is driven by a feedback amplifier consisting of U334, Q210, Q211, Q238, and Q239. Resistor R326 and capacitor C334 provide the feedback impedance. The input is driven with ±0.6 mA at ground or disconnected (0 mA) to force the output to plus and minus 20 volts (plus and minus 15 volts for serial numbers below B020317) or to ground (0 V). Operational amplifier U334 provides high input impedance, low offset voltage, and gain. Transistors Q238 and Q239 generate the output voltage swing and transistors Q210 and Q211 provide the output current.

Oscillator Q314, Q316, and associated components generate a square wave at approximately 1KHz (700 Hz for serial numbers below B020317). When color is low ("blue-green"), Q428 is off. Therfore, the gate of Q430 is at a zero level and causes Q430 to turn on. Q426, driven by the oscillator square wave, causes the drain current of Q430 to switch between plus and minus 0.6 mA. This current drives the feedback amplifier's output between plus and minus 20 volts (plus and minus 15 volts for serial numbers below B020317).

DIAGRAM CHANGES

Figure 8-6. A5 - Front Panel circuit board assembly.

Remove CR330, VR216, and VR217 from the circuit board illustration and locator table.

Add R612 between the top lead of R314 and the top lead of R412, as well as to the locator table with Schematic location E4 and Board location C2.

Add VR330 connected "tepee" fashion with R330 in the location formerly occupied by R330. The cathode of VR330 is connected to R330.

Add VR330 to the locator table with Schematic location C3 and Board location C4.

NOTE: Electrical lead J238 connects the emitter of Q238 to the −30 V_1 supply.

DESCRIPTION

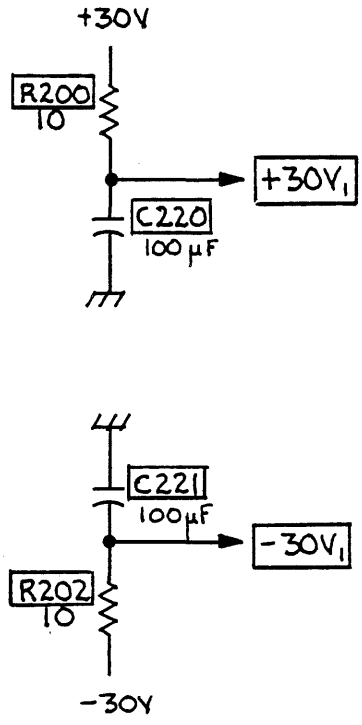
5 **Front Panel Board**

Remove VR216 and VR217.

Change C220 and C221 from 47 to 100 μF.

Change R200 and R202 from 1.6K to 10 ohms.

Change the +16 V supply to +30 V_1, and the -16 V supply to −30 V_1.



DESCRIPTION

5 **(cont.)**

Remove CR330.

Add VR330, a 15 volt zener diode, between R330 and the base of Q238.

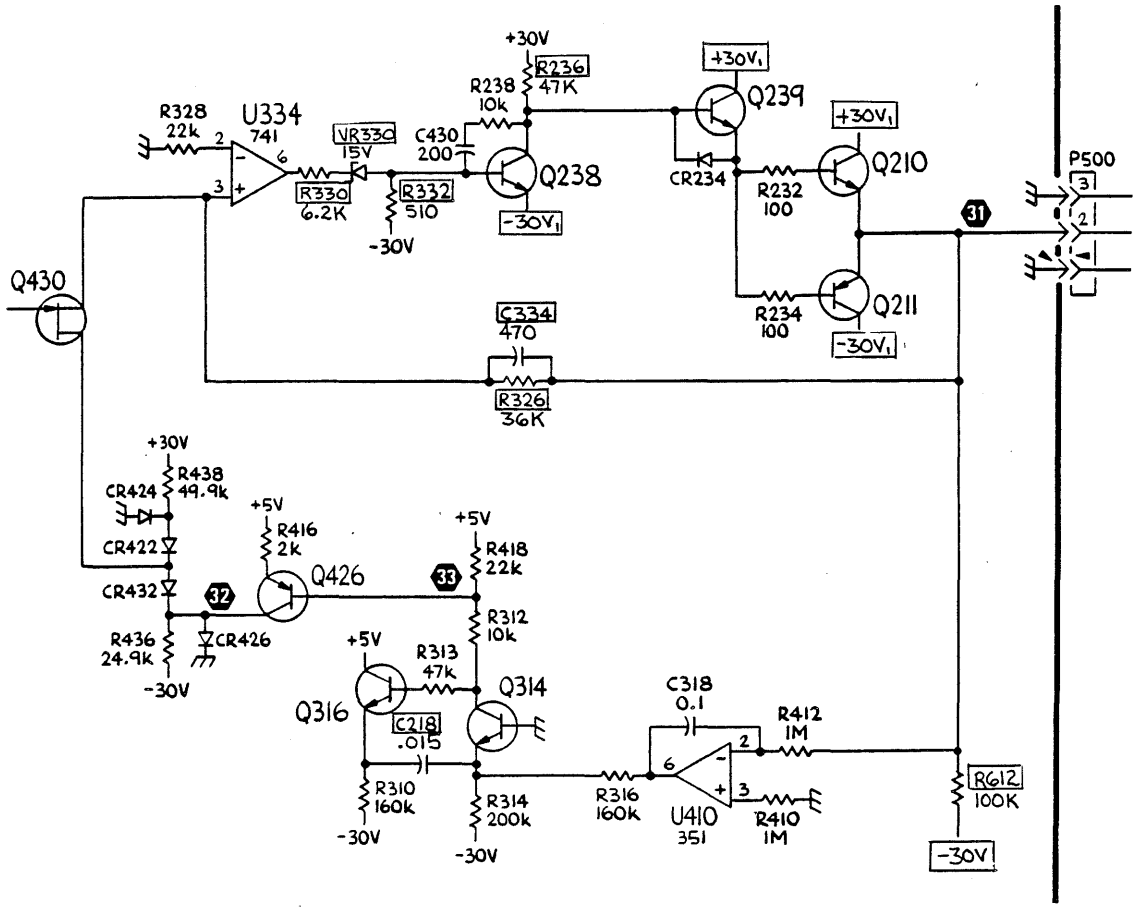
Add R612, a 100K resistor, between the $-30\ V_1$ supply and the emitters of Q210 and Q211.

Change C218 from .027 to .015 μF and C334 from 1000 to 470 pF.

Change R236 from 100K to 47K, R326 from 22K to 36K, R330 from 10K to 6.8K, and R332 from 10K to 510 ohms.

Change the $+16$ V supply to $+30\ V_1$ and the -16 V supply to $-30\ V_1$.

Change the -20 V supply at the emitter or Q238 to $-30\ V_1$.



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MANUAL CHANGE INFORMATION

Date: 11/26/85 **Change Reference:** C2/1185

Product: 5116 Oscilloscope **Manual Part No.:** 070-4544-00

DESCRIPTION Manual Insert for Product Group 52

These changes are effective for all serial numbers.

Section 2 — SPECIFICATION

In **Table 2-2 Horizontal Amplifier** on page 2-2, change the *Performance Requirements* for *Bandwidth* as follows:

DC to at least 2 MHz with a calibrated 5A18N having a serial number above B128130.

Section 3 — PERFORMANCE CHECK AND ADJUSTMENT

In TABLE 3-1 Test Equipment on page 3-2, add the following footnote to **Examples of Applicable Test Equipment** for *1. Amplifier*:

To check Horizontal Bandwidth, the 5A18N must have a serial number above B128130.