NOTE

The 5110 Oscilloscope formerly was known under another nomenclature, the 5103N/D10. This manual contains information that applies to all of these instruments.

TEKTRONIX®

5110 OSCILLOSCOPE

81 -01- 29

INSTRUCTION MANUAL

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

Serial Number _____

070-2134-01

First Printing APR 1976

WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year. Any questions with respect to the warranty should be taken up with your Tektronix Field Engineer or representative.

All requests for repairs and replacement parts should be directed to the Tektronix Field Office or representative in your area. This will assure you the fastest possible service. Please include the instrument Type Number or Part Number and Serial Number with all requests for parts or service.

Specifications and price change privileges reserved.

U.S.A. and foreign Tektronix products covered by U.S. and foreign patents and/or patents pending.

TABLE OF CONTENTS

OPERATING INSTRUCTIONS TABLE OF CONTENTS

TABLE OF CONTENTS (cont)

SERVICING INSTRUCTIONS TABLE OF CONTENTS

WARNING

The remaining portion of this Table of Contents lists servicing instructions that expose personnel to hazardous voltages. These instructions are for qualified service 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.

@

TABLE OF CONTENTS (cont)

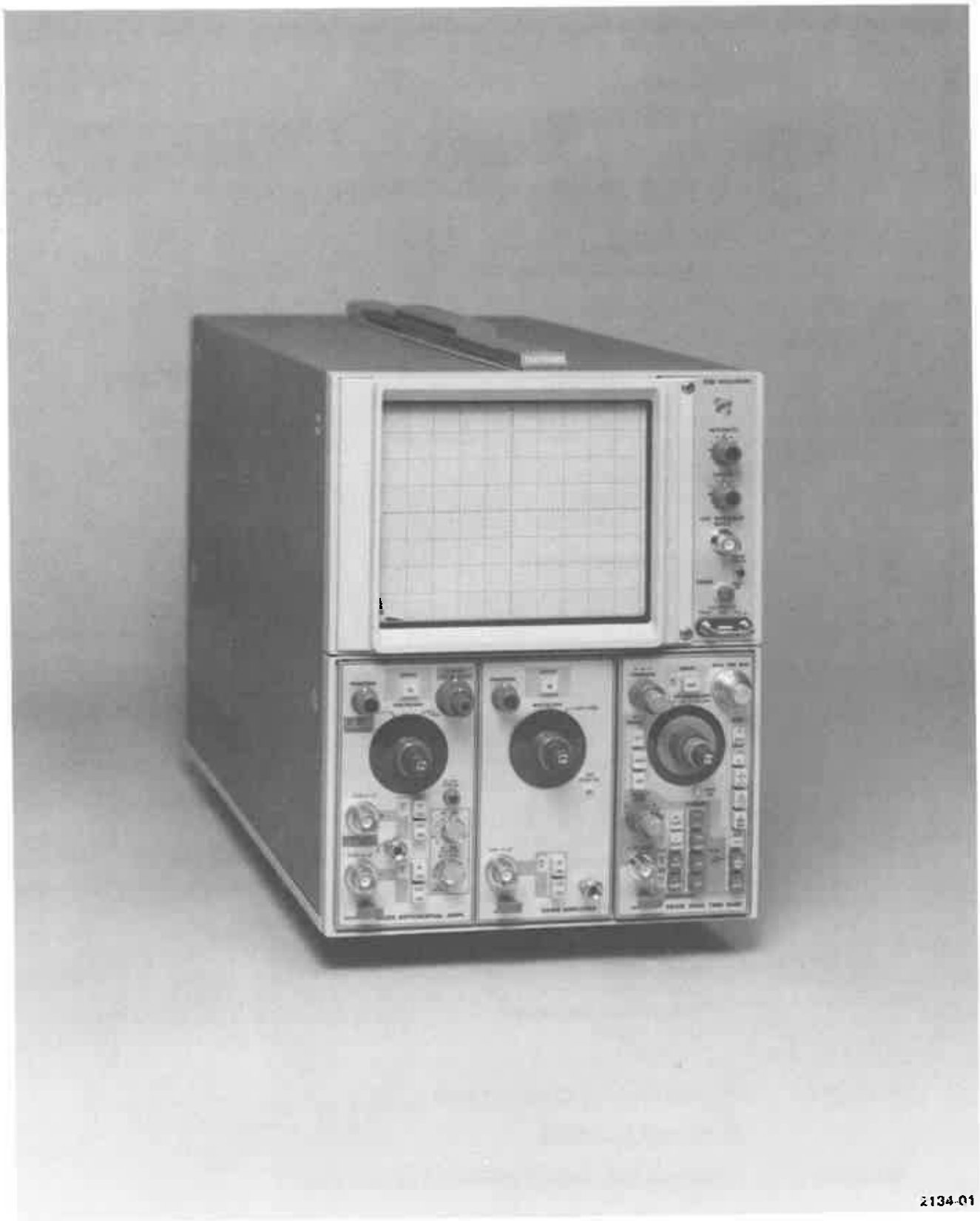


Fig. 1-1. 5110 Oscilloscope.

OPERATING INSTRUCTIONS

This instruction manual provides both operating and servicing information for the 5110 Oscilloscope. The manual is divided into nine sections. Operating, specification, and performance check information is covered in the first two sections, and is intended for operating and service personnel. Servicing information is covered in the remaining sections of the manual, and is intended for qualified service personnel only.

PRELIMINARY INFORMATION

Oscilloscope Features

The oscilloscope is a solid state, light weight instrument designed for general-purpose measuring applications. This instrument has three plug-in compartments that accept plug-in units to form a complete measurement system. The two-plug-in compartments on the left are connected to the vertical deflection system. The right plug-in compartment is connected to the horizontal deflection system. Electronic switching between the vertical plug-in compartments allows a multitrace vertical display. The flexibility of this plug-in feature and the variety of plug-in units available allow this system to be used for many measurement applications.

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

Safety Information

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

WARNING

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

OPERATING POWER

This instrument can be operated from either a 120-volt or 240-volt nominal line-voltage source, 48 to 440 hertz. In addition, three regulating ranges are provided for each nominal line-voltage source.

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

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

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

OPERATING TEMPERATURE

The instrument can be operated where the ambient air temperature is between 0° C and +50° C. The instrument can be stored in ambient temperature between −40° C and +70° C. After storage at a temperature beyond the operating limits, allow the chassis temperature to come within the operating limits before power is applied.

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

PLUG-IN UNITS

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

Installation

To install a plug-in unit into one of the plug-in compartments, align the slots in the top and bottom of the plug-in with the associated guides in the plug-in compartment. Push the plug-in unit firmly into the plug-in compartment until it locks into place. To remove a plug-in, pull the release latch on the plug-in unit to disengage it and pull the unit out of the plug-in compartment. Plug-in units should not be removed or installed without turning off the instrument power. 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 here 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 dual-channel unit set for single-channel operation) in either of the vertical (left or center) compartments and a time-base unit in the horizontal (right) compartment. For dual-trace displays, either install a dual-channel vertical unit in one of the vertical compartments or install a single-channel vertical unit in each vertical compartment. A combination of a single-channel and a dual-channel vertical unit allows a three-trace display; likewise, a combination of two dual-channel vertical units allows a four-trace display.

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

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

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

CONTROLS AND CONNECTORS

Controls and connectors necessary for operation of the oscilloscope are located on the front and rear panels of the instrument. To make full use of the capabilities of this instrument, the operator should be familiar with the function and use of each external control and connector. A brief description of the controls and connectors is given here. More detailed information is given under General Operating Information (later in this section). See Fig. 1-2 for the location and description of the controls and connectors.

FIRST TIME OPERATION

The following procedure provides an operational checkout as a means of verifying instrument operation and basic calibration without removing the cabinet or making internal adjustments. Since it demonstrates the use of front-panel controls and connectors, it can also be used to provide basic training on the operation of this instrument. If recalibration of the oscilloscope or plug-ins appears to be necessary, refer the instrument system to qualified service personnel. If more familiarization with a plug-in unit is needed, see the instruction manual for the appropriate plug-in unit. Refer to Fig. 1-2 for the oscilloscope control and connector locations.

@

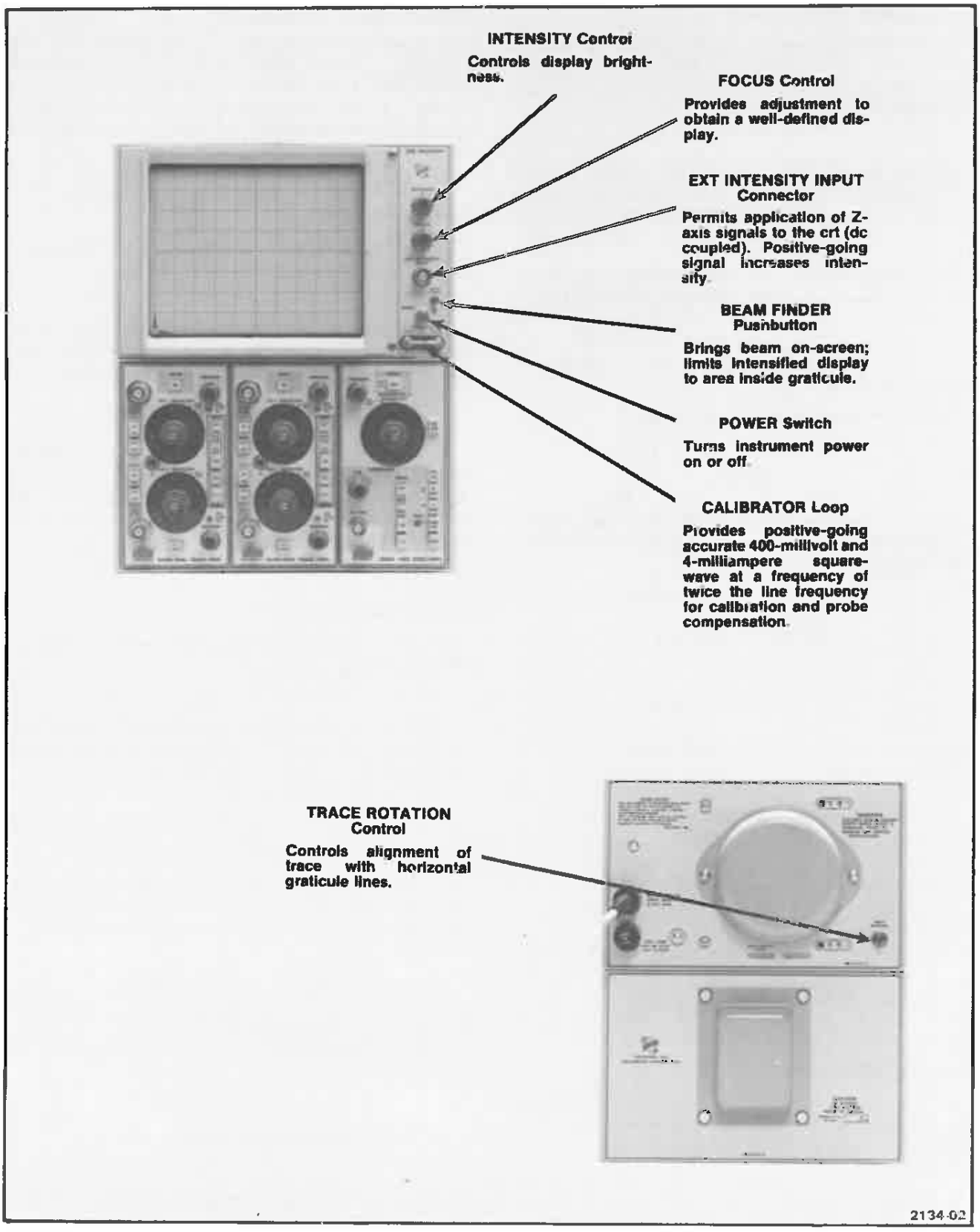


Fig. 1-2. Front-and rear-panel controls and connectors.

CHECKOUT PROCEDURE

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

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

3. Turn the INTENSITY control counterclockwise and pull the POWER switch out to turn the instrument on.

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).

AMPLIFIER PLUG-IN

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

TIME-BASE PLUG-IN

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

Intensity Adjustment

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

Focus Adjustment

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

Trace Alignment Adjustment

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

Calibration Check

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

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

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

Beam Finder Check

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

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

External Intensity Input

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

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

14. Disconnect the signal setup.

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

GENERAL OPERATING INFORMATION

Intensity Control

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

WARNING

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

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

Display Focus

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

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

Trace Alignment

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

Beam Finder

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

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

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

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

Graticule

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

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

Calibrator Signal

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

Intensity Modulation

Intensity (Z-Axis) modulation can be used to relate a third item of electrical phenomena to the vertical (Y-Axis) and the horizontal (X-Axis) coordinates without affecting the waveshape of the displayed signal. The Z-Axis modulating signal, applied to the EXT INTENSITY INPUT, changes the intensity of the displayed waveform to provide this type of display. The voltage amplitude required for visible trace modulation depends on the setting of the INTENSITY control. About +5 volts will turn on the display to a normal brightness level from an off level, and about −5 volts will turn the display off from a normal brightness level. "Gray scale" intensity modulation can be obtained by applying signals between these levels. Maximum safe input voltage is ±50 volts. Usable frequency range of the Z-Axis circuit is dc to one megahertz.

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

X-Y Operation

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

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

Raster Display

A raster-type display can be used to effectively increase the apparent sweep length. For this type of display, the trace is deflected both vertically and horizontally by sawtooth signals, and is accomplished by installing a 5B-series time-base unit in the left vertical compartment, as well as one in the horizontal compartment. 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 cathode-ray tube-related signals to standard connectors at the rear of the instrument. This option is particularly well suited for use in the physical life sciences. By using differential amplifiers, the oscilloscope can become a signal conditioner for other devices. Outputs may be used for driving counters or X-Y plotters in conjunction with the oscilloscope.

Display Photography

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

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

Display Switching Logic

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

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

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

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

Vertical Display Mode

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

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

Chopped Mode. The Chop position of the time-base unit Display switch produces a display that is electronically switched between channels at a 100-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.

BASIC OSCILLOSCOPE APPLICATIONS

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

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

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

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

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

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

Peak-to-Peak Voltage Measurements—AC

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

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

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

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

4. Turn the vertical Position control so that the lower portion of the waveform coincides with one of the graticule lines below the center horizontal line, and the top of the waveform is in the viewing area. Move the display with the horizontal Position control so that one of the upper peaks is aligned with the center vertical reference line (see Fig. 1-3).

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.

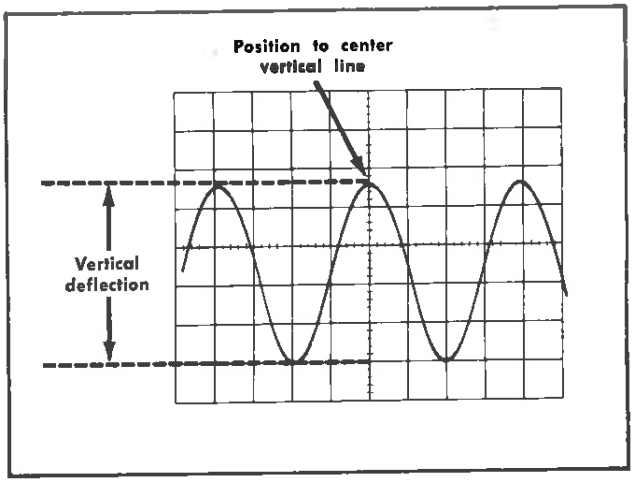


Fig. 1-3. Measuring peak-to-peak voltage of a waveform.

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

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

NOTE

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

Instantaneous Voltage Measurement—DC

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

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

NOTE

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

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

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

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

@

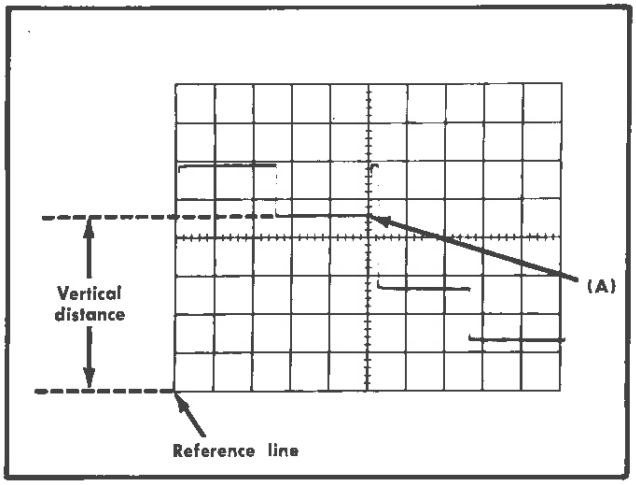


Fig. 1-4. Measuring instantaneous dc voltage with respect to a reference voltage.

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.

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

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 control after obtaining the desired deflection.

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

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

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

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

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

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

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

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

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

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

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

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

To determine the peak-to-peak amplitude of an applied 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 product of the horizontal deflection in divisions (established in step 1) and the setting of the Seconds/Div switch. This is the Deflection Conversion Factor.

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

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

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

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

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

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

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

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

$$(50\ \mu s)\ (1.375) = 68.75\ microseconds/division$$

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

$$(68.75\ \mu s)\ (7) = 481\ microseconds$$

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

Time Period Measurement

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

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

2. Set the time-base triggering controls to obtain a stable display. Set the Seconds/Div switch to the fastest sweep rate that will permit displaying one cycle of the waveform in less than eight divisions (some non-linearity may occur in the first and last graticule divisions of display). Refer to Fig. 1-5.

@

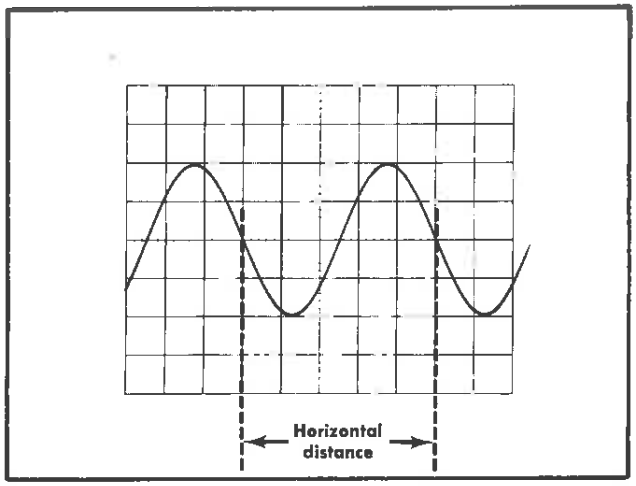


Fig. 1-5. Measuring time duration (period) between points on a waveform.

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

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

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

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

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

The period is 0.5 millisecond.

Determining Frequency

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

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

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

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

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

Risetime Measurement

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

1. Connect the signal to the input connector.

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

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

4. Set the time-base triggering controls to obtain a stable display. Set the Seconds/Div switch to the fastest sweep rate that will display less than eight divisions between the 10% and 90% points on the waveform (see Fig. 1-6).

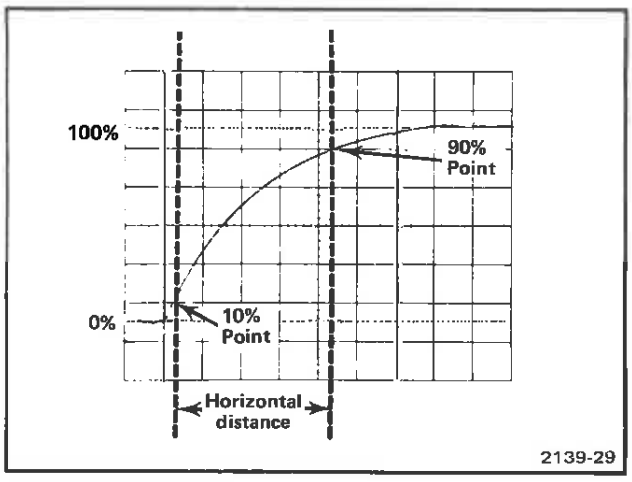


Fig. 1-6. Measuring risetime.

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

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

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

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

Using the period formula to find risetime:

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

The risetime is 4 microseconds.

Time Difference Measurements

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

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

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

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

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

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

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

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

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

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

10. Measure the horizontal distance between the two measurement points (see Fig. 1-7).

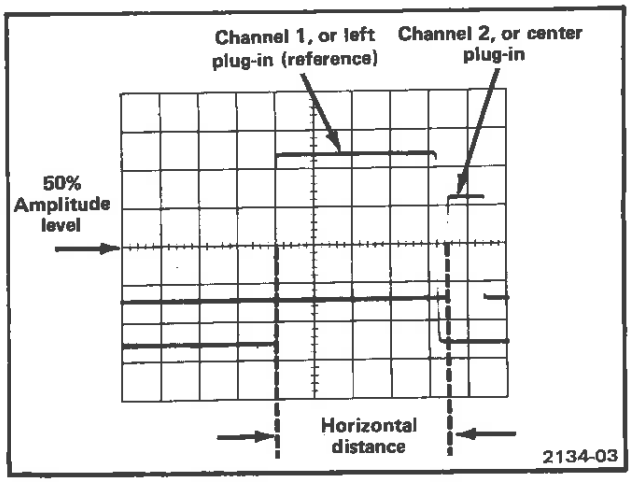


Fig. 1-7. Measuring time difference between two pulses.

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

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

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

The time delay is 200 microseconds.

Multi-trace Phase Difference Measurement

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

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

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

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

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

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

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

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

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

9. Turn the variable Seconds/Div control until one cycle of the reference signal (Channel 1, or left plug-in) occupies exactly eight divisions between the second and tenth vertical lines of the graticule (see Fig. 1-8). 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 Fig. 1-8. 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°.

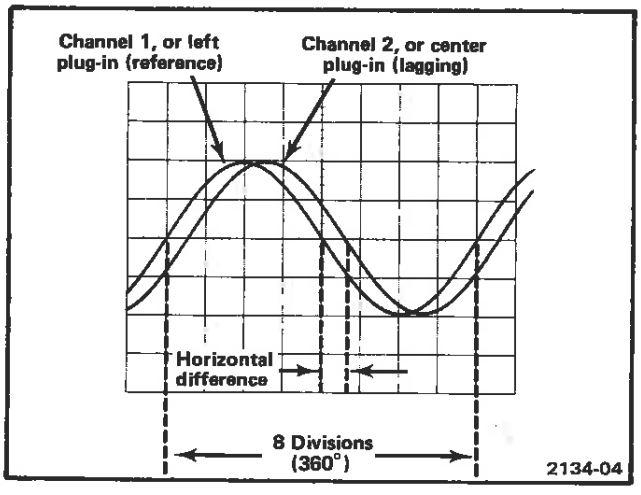


Fig. 1-8. Measuring phase difference.

High Resolution Phase Measurement

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

EXAMPLE: If the sweep rate were increased 10 times with the magnifier, the magnifier sweep rate should be 45°/division ÷ 10 = 4.5°/division. Figure 1-9 shows the same signals as used in Figure 1-8, but with the Swp Mag button pushed in. With a horizontal difference of six divisions the phase difference is:

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

The phase difference is 27°.

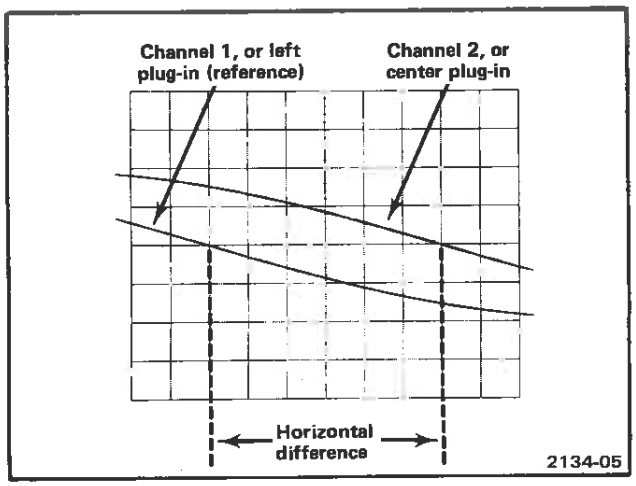


Fig. 1-9. High-resolution phase difference measurement with increased sweep rate.

X-Y Phase Measurements

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

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

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

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

4. Advance the INTENSITY control until the display is at the desired viewing level. Set the amplifier deflection factors and variable Volts/Div controls for six divisions of vertical and horizontal deflection, and set the position controls to center the display on the graticule as shown in Fig. 1-10.

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. 1-10).

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. 1-11 shows the Lissajous displays produced between 0° and 360°. Notice that above 180° phase shift, the resultant display is the same as at some lower angle.

EXAMPLE: Assume a display as shown in Fig. 1-10 where A is 6 divisions and B is 0.4 division.

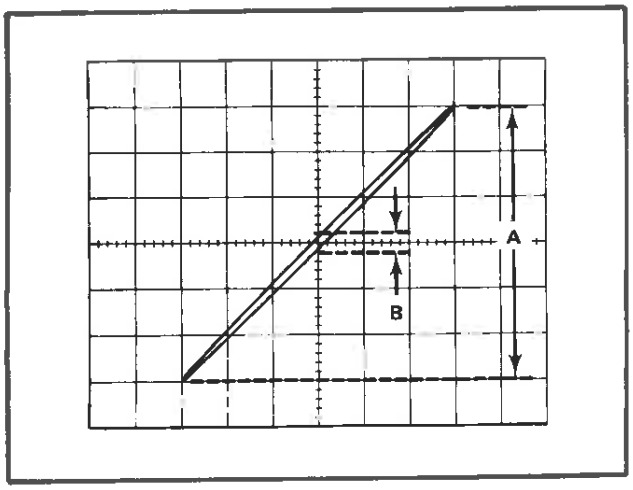


Fig. 1-10. Phase difference measurement from an X-Y display.

Using the formula:

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

From the trigonometric tables:

$$\Phi = \arcsin 0.0667 = 3.82°$$

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

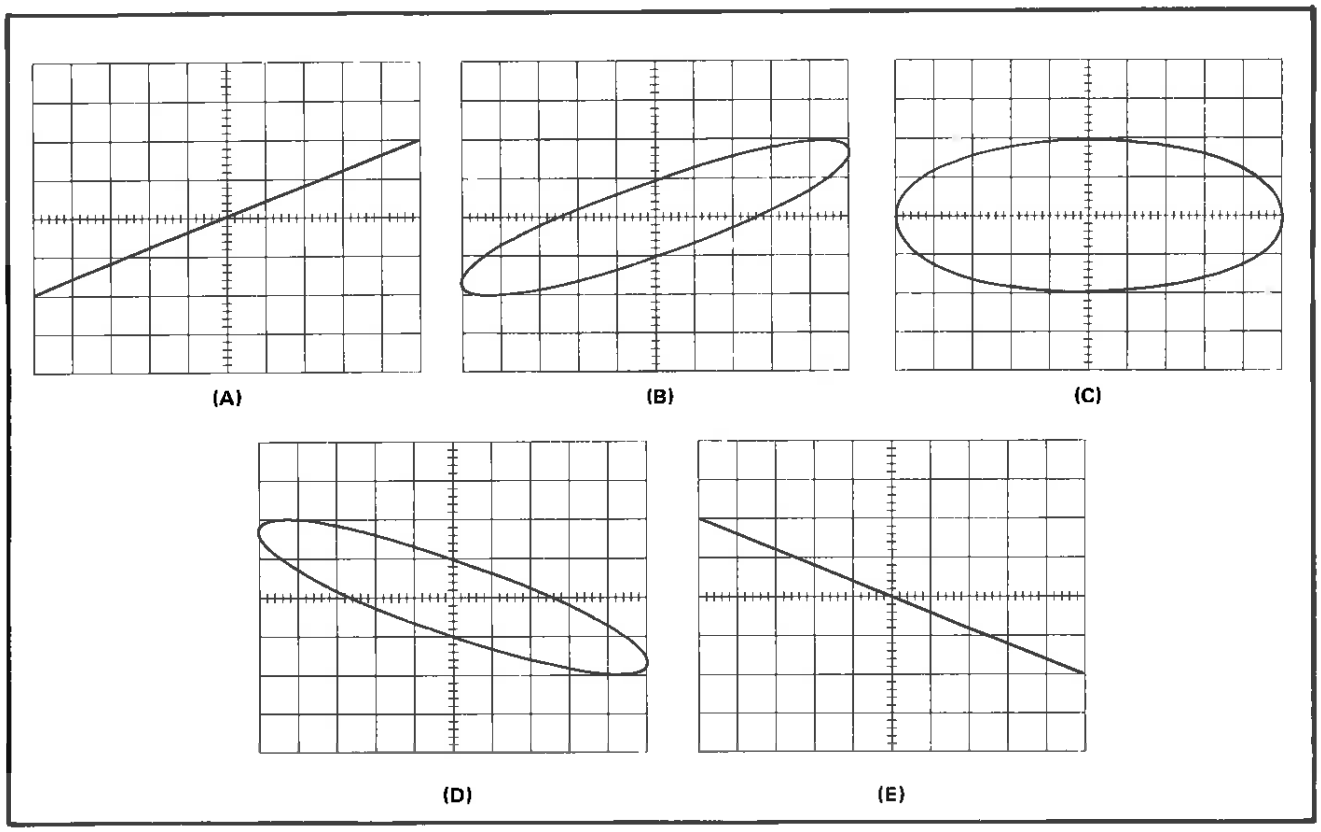


Fig. 1-11. Phase of a Lissajous display. (A) 0° or 360°, (B) 30° or 330°, (C) 90° or 270°, (D) 150° or 210°, and (E) 180°.

SPECIFICATION AND PERFORMANCE CHECK

SPECIFICATION

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

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

ELECTRICAL CHARACTERISTICS

Table 2-1

VERTICAL AMPLIFIER

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

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

Table 2-2
HORIZONTAL AMPLIFIER

Characteristics	Performance Requirements	Supplemental Information
Input Signal Amplitude (Differential Input)		50 mV/displayed division.
Horizontal Centering		0.5 division or less.
Bandwidth	Dc to at least 2 MHz with a calibrated 5A18N.	
X-Y Phase Difference Between Vertical and Horizontal Compartments	1° or less to 100 kHz.	Checked with two plug-ins of the same type.
Signal Outputs (Option 7)		
Right Out Signal	Crt-related sweep signal	Derived from interface signal output pins
Sensitivity	0.5 V/crt div, ±3% into ≥100 kΩ	
Polarity and Output Voltage	Positive-going ramp, ≥5 V	DC offset provided by timebase position control
Output Impedance	Approximately 1 kΩ	
Gate Out Signal	Crt-related Z-axis signal	Selected by timebase
Output Levels	TTL compatible	Low: Sinking 1.6 mA, ≤0.4 V High: Supplying 40 μA, ≥2.4 V
Risetime		≤1 μs into ≤50 pF
Falltime		≤200 ns into ≤50 pF

Table 2-3
Z-AXIS AMPLIFIER

Characteristics	Performance Requirements	Supplemental Information
External Intensity Input		
Useful Input Voltage	+5 V will turn on display to a normal brightness level from an off level; −5 V will turn off display from a normal brightness level.	
Useable Frequency Range	Dc to 1 MHz.	
Input R and C		Approximately 10 kΩ, paralleled by approximately 40 pF.
Maximum Safe Input		±50 V (dc + peak ac).

Table 2-4
DISPLAY

Characteristics	Performance Requirements	Supplemental Information
Cathode-Ray Tube		
Deflection		Electrostatic.
Phosphor		P31 standard; P7 or P11 optional.

Table 2-4 (cont)
DISPLAY

Characteristics	Performance Requirements	Supplemental Information
Accelerating Voltage		3.5 kV.
Orthogonality		90°, within 1°.
Geometry		0.1 division or less.
Beam Finder		Limits display to within graticule area and intensifies display if brightness level is low.

Table 2-5
CALIBRATOR AND POWER INPUT

Characteristics	Performance Requirements	Supplemental Information
Calibrator Voltage		400 mV, within 1%.
Current		4 mA, within 1%.
Frequency		Twice the line frequency.
Power Input Line Voltage (RMS)		Nominal 100 V, 110 V, 120 V, 200 V, 220 V, 240 V ±10% (250 V maximum).
Fuse Data		1.6 A slow blow (120 V ac). 1 A slow blow (240 V ac).
Line Frequency		48 to 440 Hz.
Power Consumption		Typical: 53 W. Maximum: 75 W.
Insulation Voltage		1500 V (RMS) minimum at 50 to 60 Hz for 10 seconds duration minimum.
Ground Continuity (Between Safety Ground and Instrument)		Less than 0.1 Ω.

ENVIRONMENTAL CHARACTERISTICS

Table 2-6
ENVIRONMENTAL

Characteristics	Performance Requirements	Supplemental Information
Temperature Operating	0°C to +50°C.	
Storage	−40°C to +70°C.	
Altitude Operating	To 15,000 feet.	
Storage	To 50,000 feet.	
Vibration Operating and Non-Operating	With the instrument complete and operating, vibration frequency swept from 10 to 50 to 10 Hz at 1 minute per sweep. Vibrate 15 minutes in each of the three axes at 0.015" total displacement. Hold 3 minutes at any resonance, or if none, at 50 Hz. Total time, 54 minutes.	

Table 2-6 (cont)
ENVIRONMENTAL

Characteristics	Performance Requirements	Supplemental Information
Shock Operating and Non-Operating	30 g's, 1/2 sine, 11 ms duration, 2 shocks in each direction along 3 major axes for a total of 12 shocks.	
Transportation	Qualified under National Safe Transit Committee Test Procedure 1A, Category II.	

PHYSICAL CHARACTERISTICS

Table 2-7

PHYSICAL

Parameter	Bench Oscilloscope	Rack Oscilloscope
Overall Dimensions Height	12.0 in. (30.5 cm).	5.2 in. (13.2 cm).
Length	20.4 in. (51.8 cm).	20.4 in. (51.8 cm). Rack depth required: 19.0 in. (48.3 cm).
Width	8.4 in (21.4 cm).	19.0 in (48.3 cm).
Net Weight	Approximately 19.1 lbs. (8.7 kg).	Approximately 23.1 lbs. (10.5 kg).
Shipping Weight	Approximately 30.0 lbs. (13.6 kg).	Approximately 39.0 lbs. (17.7 kg).
Export Weight	Approximately 45.0 lbs. (20.4 kg).	Approximately 59.0 lbs. (26.8 kg).
Finish	Anodized aluminum panel and chassis. Blue-vinyl coated cabinet.	

POWER TO EXTERNAL EQUIPMENT

With the plug-in units removed from the oscilloscope, the unused power capability of the oscilloscope power supplies may be used to operate external electronic equipment. The recommended access to the power supplies is through the Interface circuit board. Special equipment is available from Tektronix, Inc. to facilitate connection to the individual power supply voltages. Order the equipment through your local Tektronix Field Office or representative.

Table 2-8 lists the maximum current draw and Interface pin assignment for only those power supply voltages recommended for operating external electronic equipment.

Table 2-8

POWER AVAILABLE TO EXTERNAL EQUIPMENT

Power Supply Voltage	Maximum Current/ Compartment	Maximum Total Current	Interface Pin No.
+200 V	10 mA	30 mA	A1
+30 V	80 mA	240 mA	A5
+5 V	130 mA	390 mA	B2
−30 V	80 mA	240 mA	B5

PERFORMANCE CHECK

Introduction

This procedure checks the oscilloscope for measurement accuracy against the tolerances listed as Performance Requirements that appear under Electrical Characteristics at the beginning of this section. If the instrument fails to meet the requirements given in this Performance Check, the Adjustment procedure (Section 3 in this manual) should be performed. The Performance Check can be used by an incoming inspection facility to determine acceptability of performance. It is not necessary to remove the instrument cabinet to perform this procedure, since all checks are made from the front panel.

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

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

PERFORMANCE CHECK INTERVAL

To ensure instrument accuracy, check the performance of the oscilloscope every 1000 hours of operation, or every 6 months if used infrequently.

TEST EQUIPMENT REQUIRED

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

SPECIAL TEST EQUIPMENT

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

Table 2-9

LIST OF TEST EQUIPMENT REQUIREMENTS FOR PERFORMANCE CHECK

Description	Performance Requirements	Application	Example
Amplifier Plug-in unit[1]	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 steps 6, 7, 12.	a. TEKTRONIX 5A18N Dual-Trace Amplifier.
Time-base Plug-in unit	Sweep rate, at least 2 μs/div.	Steps 1 through 11, 13, 14.	a. TEKTRONIX 5B10N Time-Base.
Calibration generator	Amplitude calibration, 5 mV to 5V; accuracy, ±0.25% into 1 mΩ; output, square wave at approximately 1 kHz.	Steps 8, 10.	a. TEKTRONIX PG 506 Calibration Generator [2].
Sine-wave generator	Frequency, 50 kHz to 2 MHz; output amplitude, variable from 250 mV to 6 V into 50 Ω.	Steps 9, 11, 12, 13.	a. TEKTRONIX FG 503 Function Generator[2].

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

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

Table 2-9 (cont)

LIST OF TEST EQUIPMENT REQUIREMENTS FOR PERFORMANCE CHECK

Description	Performance Requirements	Application	Example
Coaxial cable	Impedance, 50 Ω; length, 42 inch; connectors, bnc.	Steps 8 through 13.	a. TEKTRONIX part 012-0057-01.
Coaxial cable	Impedance, 50 Ω, length, 18 inch; connectors, bnc.	Steps 12, 13.	a. TEKTRONIX part 012-0076-00.
1X passive probe	Compatible with 5A-series amplifiers used in the Oscilloscope.	Step 14.	a. TEKTRONIX P6101 Probe. b. TEKTRONIX P6062B Probe.
Termination	Impedance, 50 Ω; accuracy within 2%; connectors, bnc.	Steps 9, 11, 12.	a. TEKTRONIX part 011-0049-01.
Tee connector	Connectors, bnc.	Steps 12, 13.	a. TEKTRONIX part 103-0030-00.
Screwdriver	Length, 3-inch shaft; bit size, 3/32 inch.	Step 1.	a. Xcelite R3323.

PRELIMINARY PROCEDURE FOR PERFORMANCE CHECK

1. Ensure that all power switches are off.

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

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

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

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

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

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

NOTE

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

INITIAL CONTROL SETTINGS

Set the following controls during warm-up time:

OSCILLOSCOPE

INTENSITY, FOCUS	Set for well-defined trace and normal brightness.

AMPLIFIER PLUG-IN

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

TIME BASE PLUG-IN

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

PERFORMANCE CHECK PROCEDURE

1. Check Trace Alignment

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

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

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

2. Check Geometry

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

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

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

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

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

f. Pull the POWER switch to on.

3. Check Beam Finder

a. Set the INTENSITY control for a dim trace.

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

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

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

4. Check Amplifier Alternate Operation

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

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

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

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

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

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

5. Check Amplifier Chop Operation

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

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

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

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

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

6. Check Chop Operation Between Amplifiers

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

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

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

NOTE

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

7. Check Alternate Operation Between Amplifiers

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

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

NOTE

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

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

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

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

Set the equipment controls as follows:

AMPLIFIER PLUG-IN

Display	On
CH 1 Volts/Div	1
CH 1 Cal	Fully Clockwise
CH 1 Input Coupling	dc
Trigger	CH 1
Mode	CH 1

TIME BASE PLUG-IN

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

8. Check Vertical Gain

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

b. Position the resultant 5-division display to a convenient, centered location on the graticule. Set the INTENSITY and FOCUS controls for a well-defined display of normal brightness.

c. Check—the display for a vertical deflection of 5 divisions ±0.15 division (±3%).

d. 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. Pull the POWER switch to on.

e. Check—the display for a vertical deflection of 5 divisions ±0.15 division (±3%).

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

9. Check Vertical Bandwidth

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

b. Adjust the sine-wave generator controls for a 6-division display at a frequency of 50 kHz. Center the display on the graticule.

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

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

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

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

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

10. Check Horizontal Gain

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

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

c. Position the 5-division display between the second and seventh vertical graticule lines.

d. Check—the display for a horizontal deflection of 5 divisions ±0.15 division (±3%).

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

@

11. Check Horizontal Bandwidth

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

b. Adjust the sine-wave generator controls for a 6-division display at a frequency of 50 kHz. Position the display between the second and eighth vertical graticule lines.

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

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

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

12. Check X-Y Phase Difference

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

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

NOTE

Identical amplifier units should be installed in the oscilloscope.

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

d. Pull the oscilloscope POWER switch to on.

e. Set both amplifier units for a deflection factor of 1 volt/division and dc input coupling.

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

g. Adjust the vertical and horizontal position controls to center the diagonal display, then adjust the sine-wave generator for a display amplitude of 6 divisions vertically and horizontally.

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

13. Check Z Axis Amplifier

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

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

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

d. Set the time-base unit for auto, internal triggering at a sweep rate of 20 μs/division and set the amplifier for a deflection factor of 2 V/division.

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

f. Set the amplifier and sine-wave generator controls to obtain a calibrated 10 volt reference display (5 divisions of display).

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

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

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

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

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

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

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

n. Disconnect the coaxial cables and tee connector from the amplifier and oscilloscope.

14. Check Calibrator Signal

a. Connect the 1X probe to the CH 1 input of the amplifier. Connect the probe tip to the CALIBRATOR loop.

b. Set the amplifier CH 1 Volts/Div switch to .1, and set the time-base sweep rate to 2 ms/division.

c. Check—the display for a vertical deflection of approximately 4 divisions.

d. Check—the display for approximately 2.5 cycles in 10 divisions (based on a line frequency of 60 Hz).

e. Disconnect the 1X probe.

This completes the Performance Check of the oscilloscope. If the instrument has performed as given in this procedure, it is correctly calibrated and within specifications.

@

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.

ADJUSTMENT

Introduction

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

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

Tektronix Field Service

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

Test Equipment Required

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

Table 3-1

LIST OF TEST EQUIPMENT REQUIREMENTS FOR ADJUSTMENT

Description	Performance Requirements	Application	Example
Amplifier plug-in unit[1]	Bandwidth, dc to 2 MHz; deflection factor, 5 mV to 5 V/div.	One required for all tests. Two required for step 13.	a. TEKTRONIX 5A15N Amplifier. b. TEKTRONIX 5A18N Dual-Trace Amplifier.
Time-base plug-in unit	Sweep rate, at least 2 μs/div.	Steps 1 through 12.	a. TEKTRONIX 5B10N Time-Base.
Calibration generator	Amplitude calibration, 5 mv to 5 V; accuracy, ±0.25% into 1 MΩ; output, square wave at approximately 1 kHz.	Steps 10 and 12.	a. TEKTRONIX PG 506 Calibration Generator.[2]
Sine-wave generator	Frequency, 100 kHz; output amplitude, variable from 250 mV to 6 V into 50 Ω.	Step 13.	a. TEKTRONIX FG 503 Function Generator.[2]
Digital voltmeter	Range, zero to 250 volts; accuracy, within 0.1%.	Steps 1 through 4.	a. TEKTRONIX DM 501 Digital Multimeter.[2]
DC voltmeter (vom)[3]	Range, zero to 4000 volts; accuracy, checked to within 1% at 3400 volts.	Step 5.	a. Triplett Model 630-NA. b. Simpson Model 262.
Coaxial cable	Impedance, 50 Ω; length, 42 inch; connectors, bnc.	Steps 10, 12, and 13.	a. TEKTRONIX part 012-0057-01.

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

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

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

Table 3-1 (cont)

LIST OF TEST EQUIPMENT REQUIREMENTS FOR ADJUSTMENT

Description	Performance Requirements	Application	Example
Coaxial cable	Impedance, 50 Ω, length, 18 inch; connectors, bnc.	Step 13.	a. TEKTRONIX part 012-0076-00.
Termination	Impedance, 50 Ω; accuracy, within 2%, connectors, bnc.	Step 13.	a. TEKTRONIX part 011-0049-01.
Tee connector	Connectors, bnc.	Step 13.	a. TEKTRONIX part 103-0030-00.
Insulated Screwdriver	Length, 1 1/2-inch shaft or longer; plastic shaft and handle with metal screwdriver tip.	Recommended for all adjustments.	a. TEKTRONIX part 003-0000-00.

PRELIMINARY PROCEDURE FOR ADJUSTMENT

NOTE

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

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

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

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

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

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

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

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

NOTE

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

Initial Control Settings

Set the following controls during warm-up time:

OSCILLOSCOPE

INTENSITY, FOCUS	Set for well defined trace and normal brightness.

AMPLIFIER PLUG-IN

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

@

TIME-BASE PLUG-IN

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

ADJUSTMENT PROCEDURE

1. Adjust −30 Volt Power Supply

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

b. Connect the digital voltmeter between the −30 V test point and ground. See Fig. 3-1 for voltage test point location.

c. Check—for a meter reading of −29.89 to −30.11 volts.

NOTE

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

d. Adjust—−30 V Adj R878 for a meter reading of exactly −30 volts. See Fig. 3-1 for adjustment location.

2. Adjust +30 Volt Power Supply

a. Connect the digital voltmeter between the +30 V test point and ground. See Fig. 3-1 for voltage test point location.

b. Check—for a meter reading of +29.82 to +30.18 volts.

NOTE

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

c. Adjust—+30 V Adj R858 for a meter reading of exactly +30 volts. See Fig. 3-1 for adjustment location.

3. Check Remaining Power Supply Voltages

a. Connect the digital voltmeter between the +5 V test point and ground. See Fig. 3-1 for voltage test point location.

b. Check—for a meter reading of +4.89 to +5.11 volts.

c. Connect the digital voltmeter between the +200 V test point and ground. See Fig. 3-1 for voltage test point location.

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

NOTE

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

4. Check Calibrator Output Voltage

a. Connect the digital voltmeter between the CALIBRATOR current loop on the front panel, and a ground test point. See Fig. 3-1 for ground test point location.

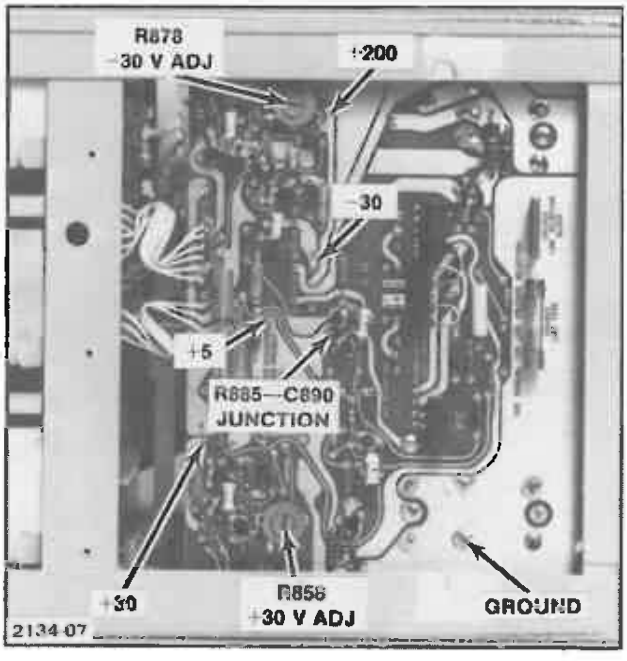


Fig. 3-1. Locations of power-supply test points and adjustments.

b. Apply a ground connection (short circuit) between the junction of R885 and C890, and a ground test point. See Fig. 3-1 for the junction and ground test point locations.

c. Check—for a meter reading of +395 to +405 millivolts.

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

e. Disconnect the digital voltmeter.

5. Adjust High-Voltage Power Supply

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

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

c. Set the dc voltmeter (vom) to measure at least −4000 volts dc. Remove the insulating sleeve from the probe tip of the test lead to be used for measuring the negative voltage. Connect the voltmeter leads between a convenient chassis ground and the high-voltage test point. See Fig. 3-2 for test point location. (The high-voltage lead should be fully inserted through the crt socket cover so that the lead connects to the test point without having to hold it by hand).

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

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

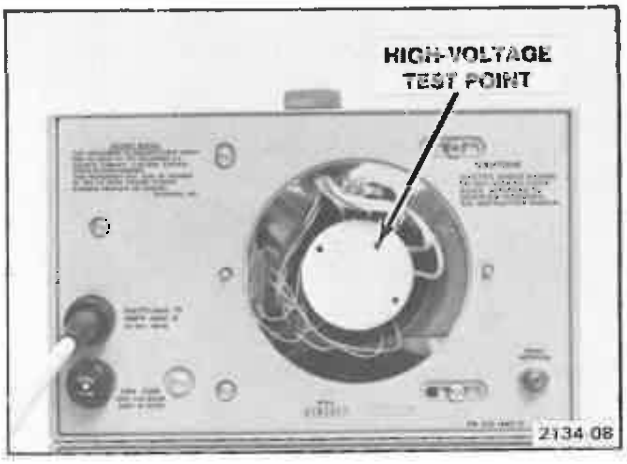


Fig. 3-2. Location of high-voltage test point.

NOTE

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

CAUTION

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

f. Adjust—High Volts Adjust R275, using an insulated screwdriver, for a meter reading of exactly −3400 volts. See Fig. 3-3 for adjustment location.

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

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

6. Adjust Intensity Range

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

b. Set the INTENSITY control fully counterclockwise.

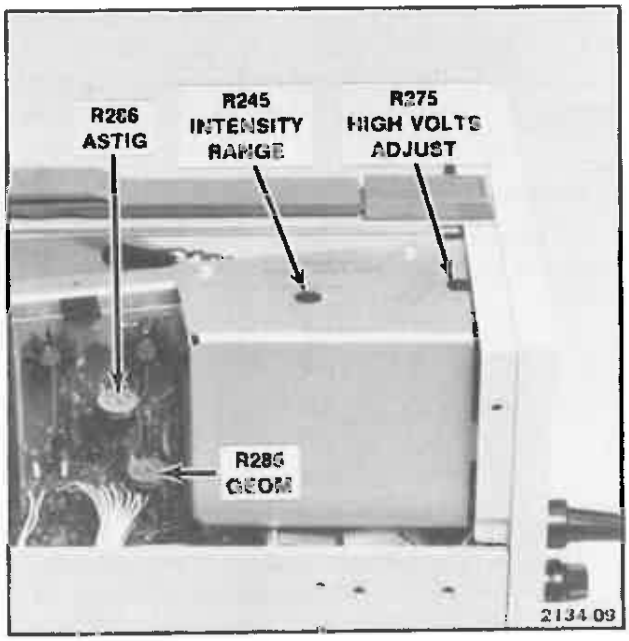


Fig. 3-3. Locations of high-voltage, intensity, and display adjustments.

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

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

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

f. Adjust—Intensity Range R245, using an insulated screwdriver, for a very dim spot display. See Fig. 3-3 for adjustment location.

7. Adjust Astigmatism

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

b. Turn the FOCUS control through its range.

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

d. Adjust—Astig R286 and FOCUS control together, using an insulated screwdriver, to obtain the best definition round-spot display. See Fig. 3-3 for adjustment location.

8. Adjust Trace Alignment

a. Set the time-base unit for a sweep rate of 1 millisecond/division.

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

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

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

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

9. Adjust Geometry

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

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

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

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

e. Adjust—Geom R285 for minimum bowing and tilt of the trace display at the left and right edges of the graticule. Adjustment may have to be compromised to obtain less than 0.1 division bowing and tilt everywhere within the graticule area. See Fig. 3-3 for adjustment location.

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

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

Set the equipment controls as follows:

AMPLIFIER PLUG-IN

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

TIME-BASE PLUG-IN

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

10. Adjust Vertical Gain

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

NOTE

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

b. Position the resultant 5-division display to a convenient, centered location on the graticule. Set the INTENSITY and FOCUS controls for a well-defined display of normal brightness.

c. Check—the display for a vertical deflection of 5 divisions, ±0.15 division (±3%).

d. Adjust—Vert Gain R116 for exactly 5 divisions of deflection. See Fig. 3-4 for adjustment location.

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

f. Check—the display for a vertical deflection of 5 divisions, ±0.15 division (±3%). If necessary, readjust Vertical Gain R116 for the optimum gain setting. Compromise for both vertical compartments.

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

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

11. Adjust Horizontal Centering

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

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

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

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

e. Adjust—Hor Cent R675 to set the start of the unmagnified sweep at the center vertical graticule line. See Fig. 3-5 for adjustment location.

f. Return the oscilloscope to its normal upright position.

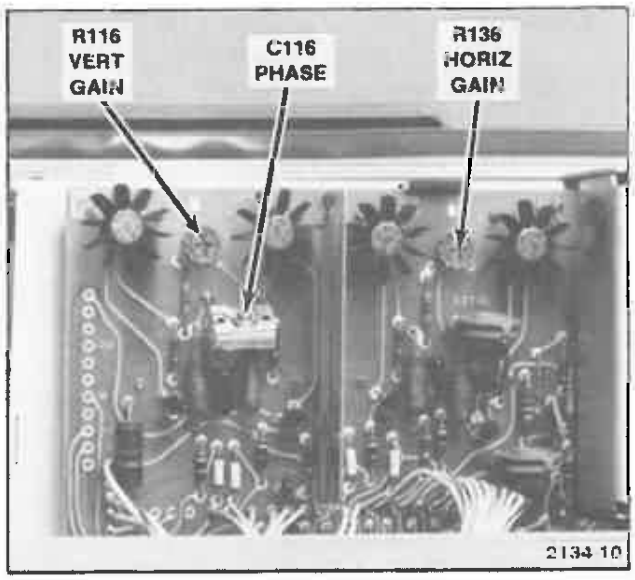


Fig. 3-4. Locations of vertical and horizontal adjustments.

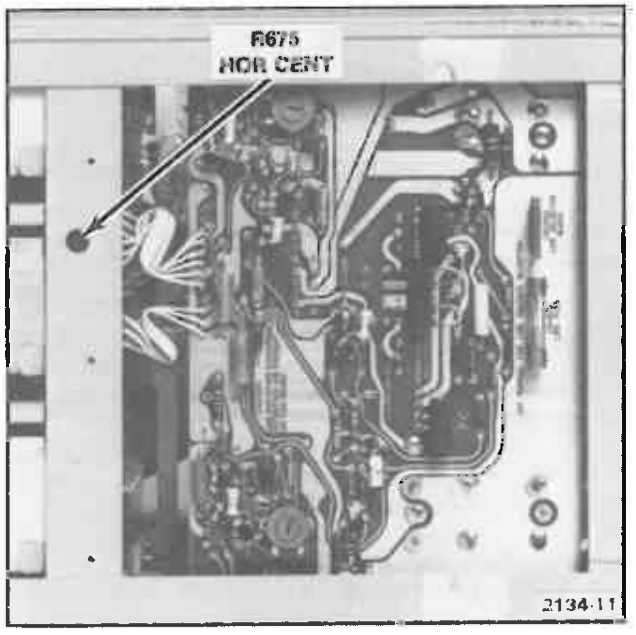


Fig. 3-5. Location of horizontal centering adjustment.

12. Adjust Horizontal Gain

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

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

NOTE

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

c. Position the 5-division display between the second and seventh vertical graticule lines.

d. Check—the display for a horizontal deflection of 5 divisions, ±0.15 division (±3%).

e. Adjust—Hor Gain R136 for exactly 5 divisions of deflection. See Fig. 3-4 for adjustment location.

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

13. Adjust X-Y Phase Difference

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

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

NOTE

Identical amplifier units should be installed in the oscilloscope.

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

d. Pull the oscilloscope POWER switch to on.

e. Set both amplifier units for a deflection factor of 1 volt/division and dc input coupling.

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

g. Adjust the vertical and horizontal position controls to center the diagonal display, then adjust the sine-wave generator for a display amplitude of 6 divisions vertically and horizontally.

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

i. Adjust—Phase C116 for minimum loop opening (a straight line) in the diagonal-loop display. See Fig. 3-4 for adjustment location.

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

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

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

MAINTENANCE

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

PREPARATION FOR USE AND RESHIPMENT

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

DETAILED OPERATING POWER INFORMATION

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.

CAUTION

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

Power Cord Information

WARNING

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

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

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

The color coding of the cord conductors may be in accordance with the following table.

Table 4-1

POWER CORD CONDUCTOR IDENTIFICATION

Conductor	Color	Alternate Color
Ungrounded (Line)	Brown	Black
Grounded (Neutral)	Blue	White
Grounding (Earthing)	Green-Yellow	Green-Yellow

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, a 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 4-2, 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 4-2 (note L, M, or H).

Table 4-2

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%
Line Fuse	1.6 A slow-blow	1 A slow-blow

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 4-2 in the previous step (either L, M, or H).

CAUTION

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

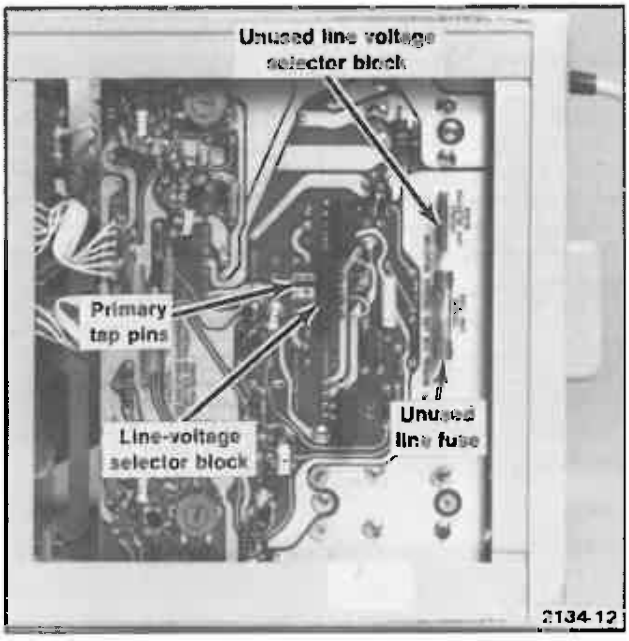


Fig. 4-1. Locations of the line-selector blocks on the LV Power Supply circuit board.

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 4-2 for line fuse information.

NOTE

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

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

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

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

INSTRUMENT CONVERSION

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

NOTE

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

RACKMOUNTING

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

Mounting Method

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

Rack Dimensions

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

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

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

Installing The Slide-Out Tracks

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

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

NOTE

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

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

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

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

1. To mount the instrument directly above or below another instrument in a cabinet rack, select the ap-

propriate holes in the front rack rails for the stationary sections, using Fig. 4-3 as a guide.

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

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

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

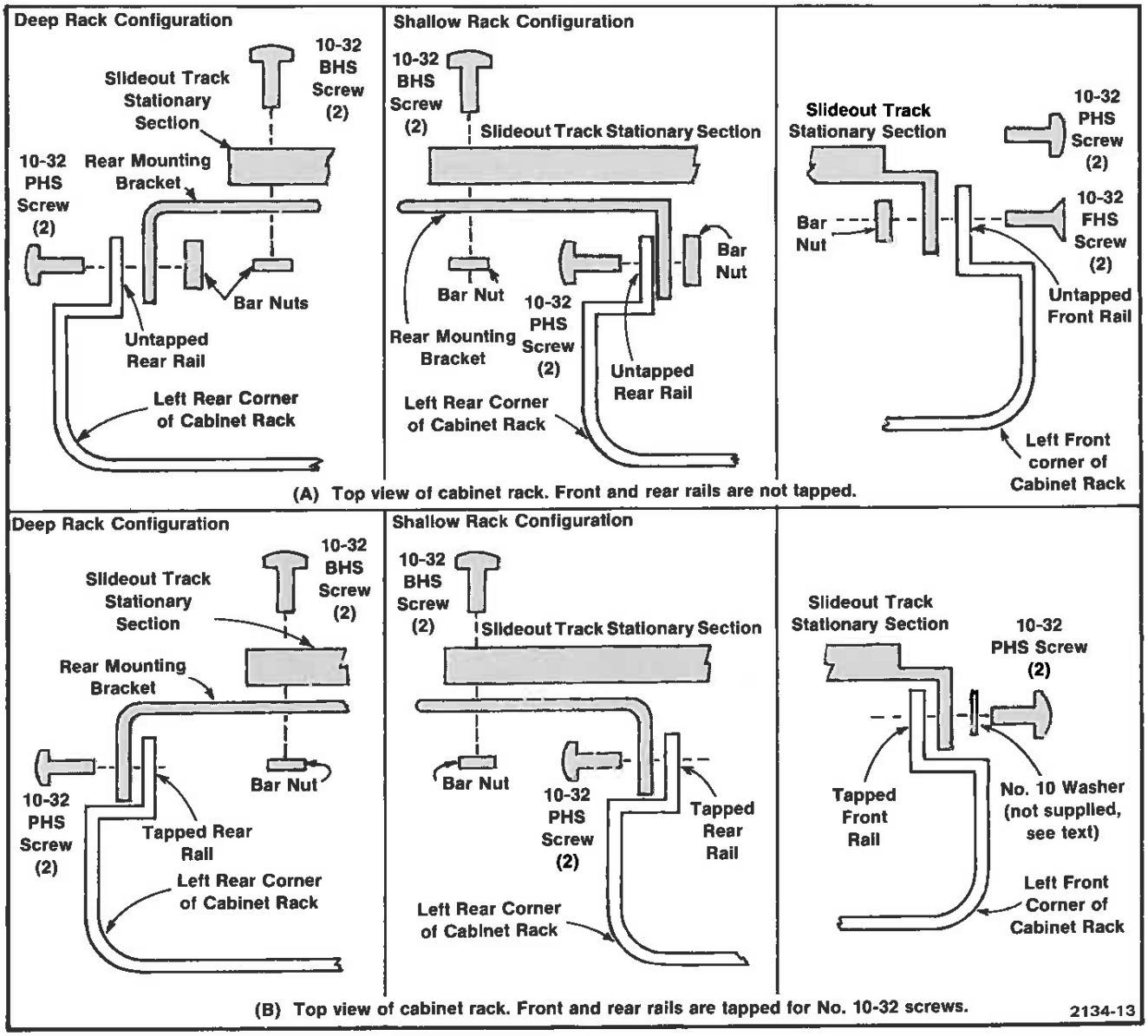


Fig. 4-2. Mounting the left stationary section (with its matched intermediate section, not shown in illustrations A and B) to the rack rails.

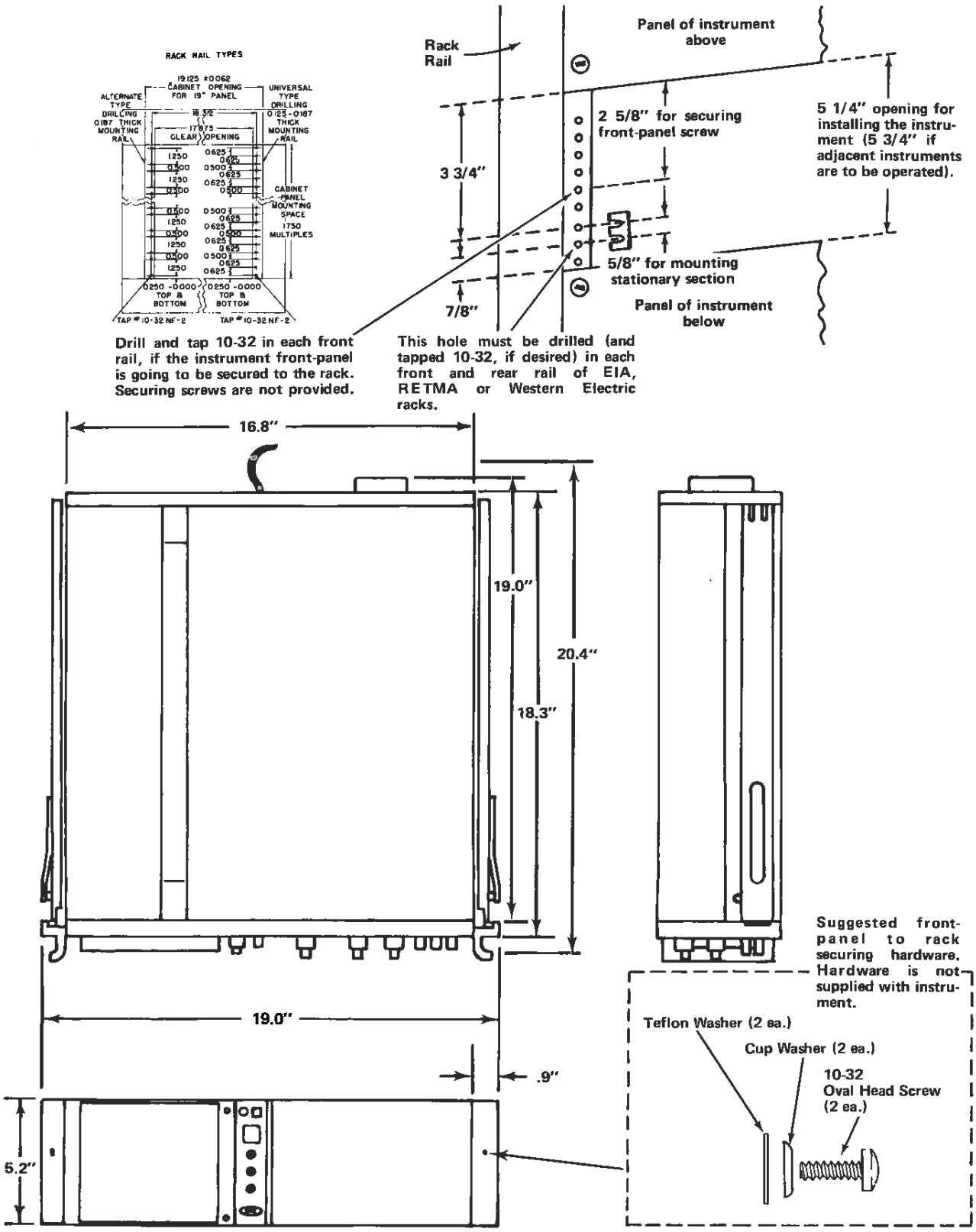


Fig. 4-3. Dimensional diagram.

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

(a) If the rear rail holes are not tapped to accept 10-32 machine screws, mount the left stationary section with hardware provided as shown in the left or center illustration of Fig. 4-2A. Note that the rear mounting bracket can be installed either way so the slide-out tracks will fit a deep or shallow cabinet rack. Use Fig. 4-2A as a guide for mounting the right stationary section. Make sure that the stationary sections are horizontally aligned so they are level and parallel with each other.

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

Installation And Adjustment

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

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

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

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

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

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

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

Slide-Out Track Maintenance

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

Ventilation Requirements

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

REPACKAGING FOR RESHIPMENT

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

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

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

The carton test strength for your instrument is 275 pounds.

PREVENTIVE MAINTENANCE

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

CABINET REMOVAL

WARNING

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

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

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

CLEANING

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

CAUTION

Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Use a non-residue type of cleaner, preferably isopropyl alcohol, total denatured ethyl alcohol, or TP35.

Exterior

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

Interior

Dust in the interior of the instrument should be removed occasionally due to its electrical conductivity under high-humidity conditions. The best way to clean the interior is to blow off the accumulated dust with dry, low-pressure air. Remove any dirt which remains with a soft brush or a cloth dampened with a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces.

Switch Contacts

Switch contacts and pads are designed to operate dry for the life of the switch. However, as the switches are not sealed, dust attracted to the contact area may cause switch contacts to become electrically noisy. Cleaning may be accomplished by flushing the contact area with isopropyl alcohol or kelite (1 part kelite to 20 parts water). Do not use chemical cleaning agents that leave a film or that might damage plastic parts. Do not use cotton swabs or similar applicators to apply cleaning agents, as they tend to snag and leave strands of cotton on switch contacts. Should it become necessary to remove a switch for replacement or cleaning, refer to Component Removal and Replacement in this section.

VISUAL INSPECTION

This instrument should be inspected occasionally for such defects as broken connections, improperly seated semiconductors, damaged circuit boards, and heat-damaged parts.

The corrective procedure for most visible defects is obvious; however, particular care must be taken if heat-damaged components are found. Overheating usually indicates other trouble in the instrument; therefore, it is important that the cause of overheating be corrected to prevent recurrence of the damage.

LUBRICATION

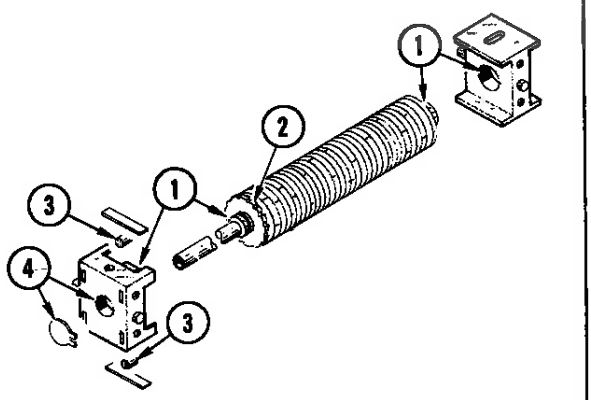
Generally, there are no components in this instrument that require a regular lubrication program during the life of the instrument.

Cam Switch Lubrication

In most cases, factory lubrication should be adequate for the life of the instrument. However, if the switch has been disassembled for replacement of switch sub-parts, a lubrication kit containing the necessary lubricating materials and instructions is available through any Tektronix Field Office. General Electric Versilube® is a recommended silicone grease and should be applied sparingly so that the lubricant does not get on the contacts. Refer to Fig. 4-4 for lubrication instructions.

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.



(1) Apply lubricant to the drum journals and mating surface in the mounting bearings.

(2) Apply lubricant to the wear surface of the index wheel.

(3) Apply lubricant to the index roller and roller guide in the front bearing. A thin film should be applied to the inner face of the detent springs if more than one spring is replaced.

(4) Ensure that some lubricant is present at the interface between the bearing and retainer clip.

(1481)1967-2

Fig. 4-4. Lubrication procedure for a typical cam switch.

PERFORMANCE CHECK AND ADJUSTMENT INTERVAL

To ensure accurate measurements, perform the Performance Check procedure on this instrument after each 1000 hours of operation or every 6 months if used infrequently. In addition, replacement of components may necessitate performing the Adjustment procedure to calibrate the affected circuits. The Adjustment procedure can also be helpful in localizing certain troubles in the instrument. In some cases, minor troubles may be revealed or corrected by performing the Adjustment procedure.

TROUBLESHOOTING

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

TROUBLESHOOTING AIDS

Diagrams

Circuit diagrams are given on foldout pages in Section 7. The component number and electrical value of each component in this instrument is shown on the diagrams.

Circuit-Board Illustrations

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

Wiring Color Code

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

Semiconductor Basing

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

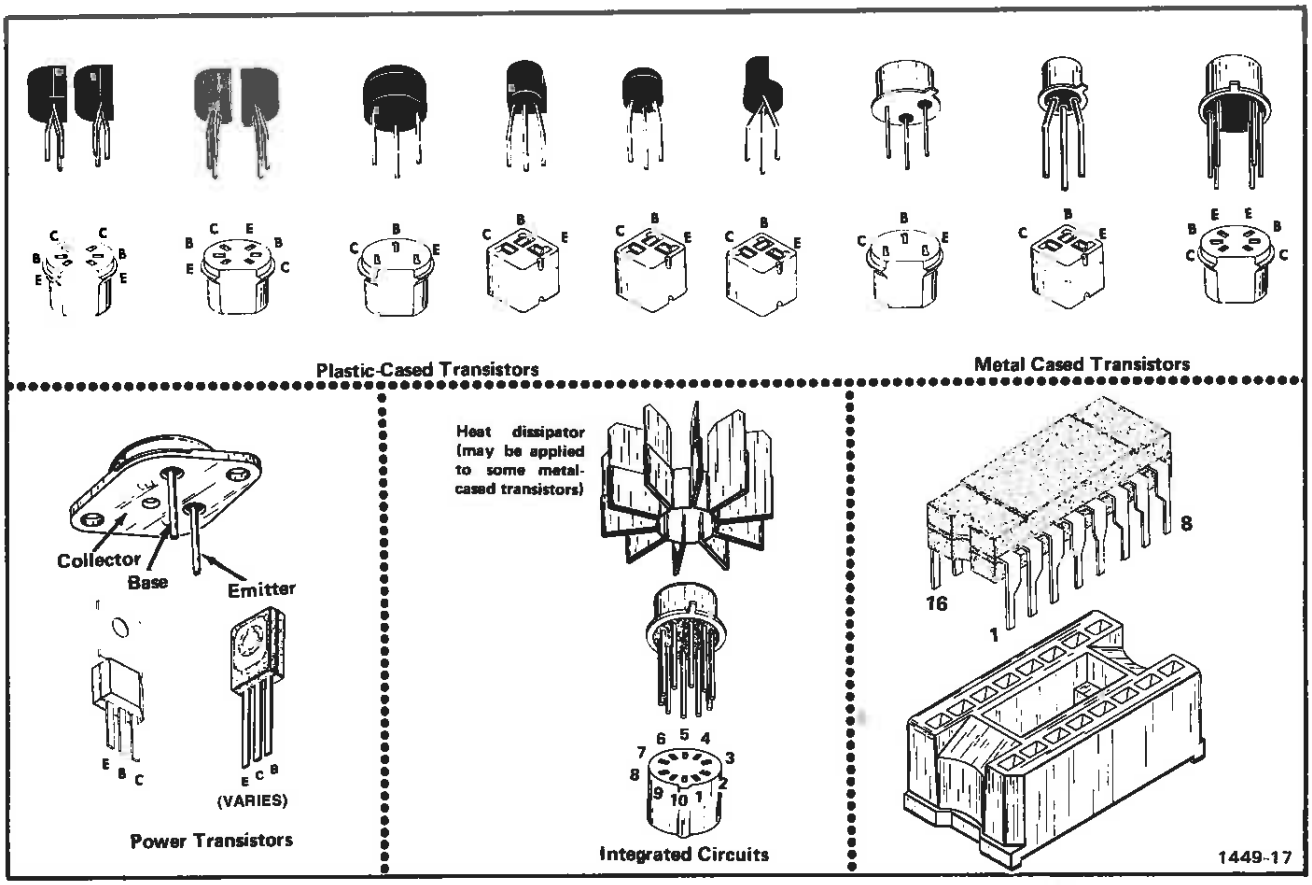


Fig. 4-5. Lead configuration data for semiconductor devices.

Multi-Pin Connector Holders

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

TROUBLESHOOTING EQUIPMENT

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

Semiconductor Tester

Description: Dynamic-type tester.

Purpose: To test the semiconductors used in this instrument.

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

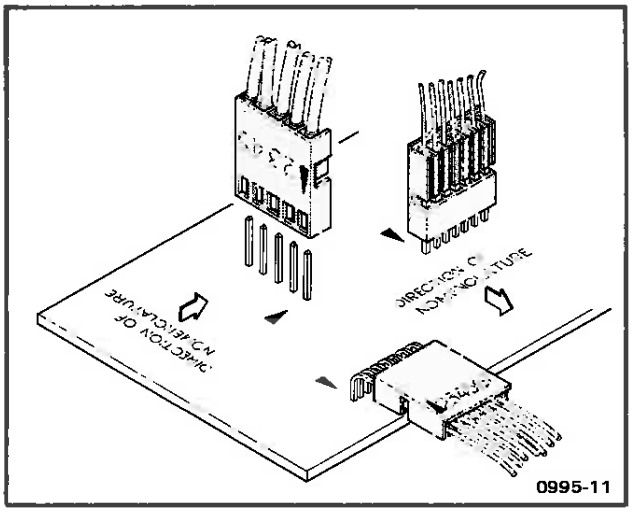


Fig. 4-6. Multi-pin connector holder orientation.

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 501 Digital Multimeter (requires a TM 500-series power module).

Test Oscilloscope

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

Purpose: To check operating waveforms and for general troubleshooting.

Recommended Type: TEKTRONIX 5110, 5A13N, 5B10N oscilloscope system or equivalent. Use a TEKTRONIX P6108 or P6062A Probe.

TROUBLESHOOTING TECHNIQUES

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

Troubleshooting Procedure

1. Check Control Settings: Incorrect control settings can indicate a trouble that does not exist. If there is any question about the correct function or operation of any control, see Fig. 1-2 in the Operating Instructions section.

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

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

4. Isolate Trouble to a Circuit. To isolate trouble to a circuit, note the trouble symptom. The symptom often identifies the circuit in which the trouble is located. When trouble symptoms appear in more than one circuit, check the affected circuits by taking voltage and waveform readings. Incorrect operation of all circuits often indicates trouble in the power supply. Check first for correct voltages of the individual supplies. See Table 4-3. 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 4-3

POWER SUPPLY OUTPUT VOLTAGES

Power Supply	Output Voltage Range	Typical 120 Hz Ripple
+200 V	+175 V to +247.5 V	3 V or less
+30 V	+29.82 V to +30.18 V	3 mV or less
+5 V	+4.89 V to +5.11 V	2 mV or less
−30 V	−29.89 V to −30.11 V	2 mV or less

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

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

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

CAUTION

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

TRANSISTORS. The best check of transistor operation is actual performance under operating conditions. A transistor can be most 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. IC's can be checked with a voltmeter, test oscilloscope, or by direct substitution. A good understanding of circuit operation is desirable when troubleshooting circuits using IC's. Use care when checking voltages and waveforms around the IC's so that adjacent leads are not shorted together. A convenient means of clipping a test probe to the 14- and 16-pin IC's is with an IC test clip. This device also serves as an extraction tool.

CAUTION

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

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

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

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

CAPACITORS. A leaky or shorted capacitor can 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 Corrective Maintenance. Be sure to check the performance of any circuit that has been repaired or had any electrical components replaced.

CORRECTIVE MAINTENANCE

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

OBTAINING REPLACEMENT PARTS

Standard Parts

All electrical and mechanical part replacements can be obtained through your local Tektronix Field Office or representative. However, many of the electronic components can be obtained locally in less time than is required to order them from Tektronix, Inc. Before purchasing or ordering replacement parts, check the Replaceable Electrical Parts list in Section 6 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 (5110, 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. General soldering techniques, which apply to maintenance of any precision electronic equipment, should be used when working on this instrument. Use only 60/40 rosin-core, electronic-grade solder. The choice of soldering iron is determined by the repair to be made. When soldering on circuit boards, use a 15- to 40-watt pencil-type soldering iron with a 1/8-inch wide, wedge-shaped tip. Keep the tip properly tinned for best heat transfer to the solder joint. A higher wattage soldering iron may separate the wiring from the base material. Avoid excessive heat; apply only enough heat to remove the component or to make a good solder joint. Also, apply only enough solder to make a firm solder joint; do not apply too much solder.

CAUTION

Some circuit boards in this instrument are multi-layer boards with a conductive path(s) laminated between the top and bottom board layers. All soldering on these boards should be done with extreme care to prevent breaking the connections to the center conductor(s); only experienced maintenance personnel should attempt repair on these boards.

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

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

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

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

NOTE

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

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

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

3. Bend the leads of the new component to fit the holes in the board. If the component is replaced while the board is mounted in the instrument, cut the leads so they will just protrude through the board. Insert the leads into the holes in the board so the component is firmly seated against the board (or as positioned originally). If it does not seat properly, heat the solder and gently press the component into place.

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

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

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

COMPONENT REMOVAL AND REPLACEMENT

WARNING

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

Semiconductor Replacement

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

CAUTION

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

Replacement semiconductors should be of the original type or a direct replacement. The lead configuration of most semiconductors used in this instrument are shown in Fig. 4-5. 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. Transistors which have heat radiators, or are mounted on the chassis, use silicone grease to increase heat transfer. Replace the silicone grease when replacing these transistors.

WARNING

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

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 adjacent to the Power Supply circuit board, first unsolder the leads. Then, loosen the nuts on the plastic bar that clamps the transistor to the chassis. Remove the defective transistor. When replacing the transistor, use silicone grease on the metal tab to increase heat transfer from the transistor to the chassis.

Switch Replacement

Two types of switches are used in this instrument. Contact alignment and spacing are critical to the operation of the pushbutton and cam switches. Therefore, defective switches should either be replaced as a unit or repaired only by personnel experienced with these types of switches. Your local Tektronix Field Office or representative can provide additional information. The following special maintenance information is provided for switch replacement.

CAUTION

Repair of cam switches should be undertaken only by experienced repair personnel. Switch alignment and spring tension of the contacts must be carefully maintained for proper operation of the switch. For assistance in repair of the cam switches, contact your local Tektronix Field Office or representative.

A. CAM SWITCHES

Cam switch repair kits are available from Tektronix, Inc. Order through your local field office or representative.

One switch kit is used to repair the cam switches in most time-base plug-in units and some vertical plug-in units. Another kit is used to repair the cam switches using the high-frequency contact, which is used in several vertical plug-in units.

The cam-type switches consist of rotating cam drums which are turned by front-panel knobs, and sets of spring-leaf contacts mounted on adjacent circuit boards. The contacts are actuated by lobes on the cams. In the

oscilloscope system, the Volts/Div and Seconds/Div switches are of the cam type. These switches can be disassembled for inspection, cleaning, repair, or replacement as follows:

1. Remove the screws which hold the metal cover on the switch, and lift the cover off the switch. The switch is now open for inspection or cleaning.

2. To completely remove a switch from the circuit board, first remove any knobs or shaft extensions. Loosen the coupling at the potentiometer at the rear of the switch, and pull the long shaft (with red knob attached) out of the switch assembly.

3. Remove the screws (from the opposite side of the circuit board) which hold the cam drum to the board.

4. To remove the cam drum from the front support block, remove the retaining ring from the shaft on the front of the switch and slide the cam drum out of the support block. Be careful not to lose the small detent roller.

5. To replace defective switch contacts, follow the instructions given in the switch repair kit.

6. To re-install the switch assembly, reverse the above procedure.

B. PUSHBUTTON SWITCHES

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

Circuit Board Replacement

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

To remove or replace a board, proceed as follows:

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

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

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

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

Circuit-Board Pin Replacement

CAUTION

Some circuit boards in this instrument are multi-layer type boards with a conductive path(s) laminated between the top and bottom board layers. All soldering on these boards should be done with extreme care to prevent breaking the connection to the center conductor(s); only experienced maintenance personnel should attempt repair of these board.

A circuit-board pin replacement kit including the necessary tools, instructions, and replacement pins is available from Tektronix, Inc. Order through your local Tektronix Field Office or representative. Replacement of circuit-board pins on multi-layer boards is not recommended; refer such repairs to your local Tektronix Field Office or representative.

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

@

Cathode-Ray Tube Replacement

The following procedure outlines the removal and replacement of the cathode-ray tube. Refer to Fig. 4-7.

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

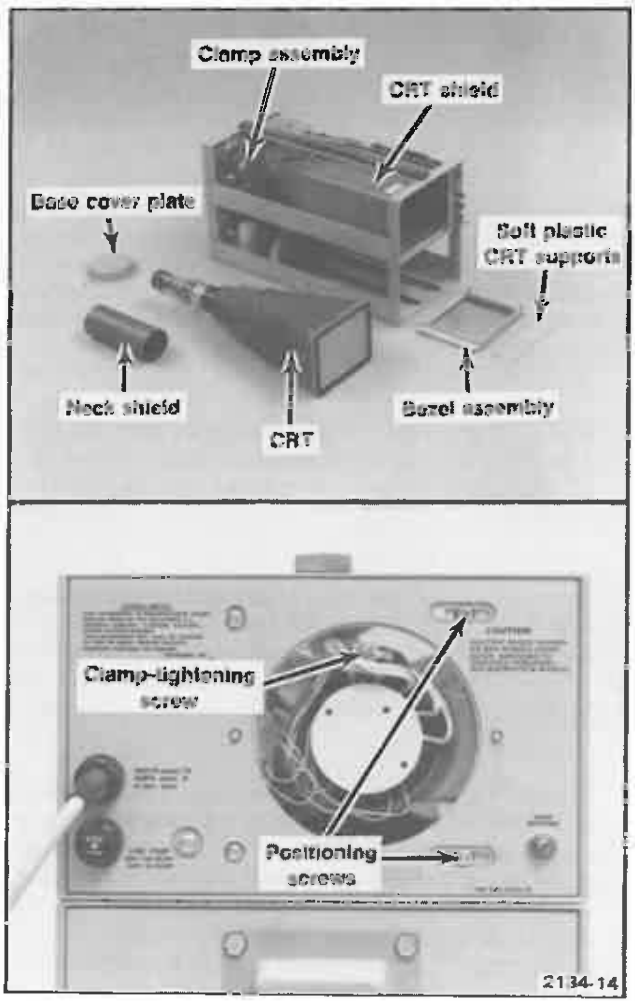


Fig. 4-7. Replacing the cathode-ray tube.

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

3. Remove the crt base socket.

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

NOTE

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

5. With one hand on the crt faceplate, push on the crt base (and neck shield). Slide the crt and neck shield forward, and pull the crt out of the instrument from the front, then remove the neck shield.

B. REPLACEMENT

1. Slide the neck shield onto the crt neck.

2. Make sure the soft plastic crt faceplate supports are in place, then insert the crt into the main shield. Before the crt is completely inserted, slide the crt clamp over the neck shield.

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

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

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

6. Place the crt base socket onto the crt base pins. Replace the cover.

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

Bulb Replacement

To replace the knob-skirt deflection-factor readout bulbs, proceed as follows:

NOTE

To gain access to bulbs on some instruments, it may be necessary to remove circuit boards and pushbutton switch extension shafts. Extension shafts are removed and installed by pulling straight off and pushing straight on.

1. Remove the light shield.

2. Unsolder the defective bulb, and install its replacement.

3. Replace the light shield.

Power Transformer Replacement

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

Fuse Replacement

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

Table 4-4

FUSE RATING, LOCATION AND FUNCTION

Circuit Number	Rating	Function	Location
F201	1.6 A Slow-blow	110 V Line-voltage input	Rear panel
F201	1 A Slow-blow	220 V Line-voltage input	Rear panel
F810	0.25 A Fast-blow	+200 V Unrgltd supply	Rear, LV Power Supply board
F835	0.5 A Fast-blow	+38 V Unrgltd supply	Rear, LV Power Supply board

ADJUSTMENT AFTER REPAIR

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

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

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

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

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

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

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

CIRCUIT DESCRIPTION

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

BLOCK DIAGRAM DESCRIPTION

Vertical signals to be displayed on the cathode-ray tube are applied through the Interface circuit to the Auxiliary board from both vertical plug-in compartments. The Interface circuit determines whether the signal from the left or right vertical unit is displayed. The Vertical Amplifier circuit provides intermediate amplification between the vertical plug-in units and the Vertical Deflection Amplifier.

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 provides intermediate amplification between the horizontal plug-in unit and the Horizontal Deflection Amplifier.

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

The Vertical and Horizontal Deflection Amplifiers 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 produces the high voltage (about −3.4 kilovolts) and contains the controls necessary for operation of the cathode-ray tube. The CRT circuit also contains the Z-Axis Amplifier, which provides the drive signal to control the intensity level of the display.

The Low-Voltage Power Supply Regulator circuits provide the voltage necessary for operation of 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 has an accurate amplitude which can be used to check vertical deflection factor accuracy and probe compensation.

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 labelled on the Interface diagram.

Clock Generator

The Clock Generator stage produces a 200-kilohertz timing signal (clock) for chopping between vertical plug-ins and amplifier channels within the plug-ins. This circuit consists of Q620, Q626, and their associated passive components, which are connected as a multivibrator. When the multivibrator receives a chop actuate level (+5 volts), it free runs at a 200-kilohertz rate. (The chop actuate level is routed through the vertical plug-ins to the time-base unit, and is present at contact A20 of J603 when a multi-trace display is required and the time-base Display switch is set to Chop.) The chop actuate level also disables Q630, locking out alternate-drive pulses. The Clock Generator has two outputs; one is sent to the Countdown circuit as a timing signal, and the other is sent to the crt circuit to blank the chop-switching transients.

Countdown Circuit

The Countdown circuit produces the display switching signal for both the Alternate and Chopped switching modes. This circuit is composed of U640 and its discrete passive components, which are connected as a pair of RS flip-flops. Each 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 or from the time-base plug-in unit via grounded-base amplifier Q630. 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 (U640A-U640B) is sent via contacts B21 of J601 and J602 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 (U640C-U640D) are used for plug-in switching; one output is sent to contact A15 of J604 to produce plug-in switching on the single-beam-display auxiliary board, and the other output is sent via contact B21 of J603 to produce dual-sweep switching in dual time-base units. The vertical mode switching sequence and some of the display combination possibilities are fully discussed under General Operating Information in the Operating Instructions section of this manual.

Vertical Amplifier

The Vertical Amplifier circuit provides approximately 10X amplification of the vertical signal before passing it to the vertical deflection amplifier in the display unit. The Vertical Amplifier consists of Q650, Q658, Q660, Q668, and their associated passive components, connected in a differential configuration. The output signal is in phase with the output of the vertical plug-in.

Horizontal Amplifier

The Horizontal Amplifier consists of Q670, Q678, Q680, Q688, and their associated passive components. The circuit is nearly identical to the Vertical Amplifier just described. It receives a push-pull input directly from the horizontal plug-in compartment via contacts A7, A13, B7, and B13 of J603. The two halves of this amplifier are balanced in the quiescent condition by adjustment of R675, Hor. Cent. The output of the Horizontal Amplifier is sent to the horizontal deflection amplifier.

AUXILIARY BOARD

An auxiliary board plugs into J604 on the Interface circuit board, and becomes part of the Interface circuit, The single-beam auxiliary board accepts the push-pull signal outputs from both vertical plug-ins. Emitter followers Q701, Q703, Q711, and Q713 provide a high-impedance input to two pairs of grounded-gate FET amplifiers, Q702-Q704 and Q712-Q714. The switching circuit consists of Q721 and Q722, connected as a comparator. Plug-in "on" logic levels are applied to the switching circuit in addition to the switching signal from the Countdown circuit. The switching circuit permits only one pair of amplifiers to be on at a time, thus permitting only one of the two vertical plug-in signals to pass to the Vertical Amplifier. In the chopped switching mode, the switching between pairs of amplifiers occurs at a 50-kilohertz rate (switching occurs on both the negative- and positive-going transition), and in the alternate mode, switching occurs at the end of every second sweep. If no "on" logic level is applied to the switching circuit from either vertical plug-in, Q702 and Q704 will remain on, passing any signal from the left vertical plug-in.

VERTICAL AND HORIZONTAL DEFLECTION AMPLIFIERS

Vertical Deflection Amplifier

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

The input signal arrives via P612 from the Interface circuit. The output signal is developed across the collector-load resistors, R104 and R114, and is about 50 times the magnitude of the input signal. Resistor R116 Vert Gain, provides Q106-Q116 emitter degeneration to set the gain of the stage to provide a calibrated vertical display.

Horizontal Deflection Amplifier

The Horizontal Deflection Amplifier consists of Q124, Q126, Q134, and Q136, and is basically the same as the Vertical Deflection Amplifier just described. It provides final amplification of signals from the horizontal plug-in unit, which arrive via P6II. The gain of the stage is set by Hor. Gain R136 to provide a calibrated horizontal display.

Beam Finder

If a high-amplitude signal or a misadjusted control has deflected the trace or display off screen, it can be located by pressing the front-panel BEAM FINDER pushbutton. This opens S125, allowing current through R125 into the emitter circuits of both deflection amplifiers. R125 limits the current available to the transistor, 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, the Z Axis Amplifier in the crt circuit senses the slight increase in voltage level at the R108-R118-R128-R138 junction. The Z Axis Amplifier produces a slight increase in crt beam intensity, allowing the trace to be displayed even though the INTENSITY control may be fully counterclockwise.

X-Y Phasing

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

CRT CIRCUIT

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

Z-Axis Amplifier

The Z-Axis Amplifier is a current driven shunt-feedback operational amplifier with a voltage output, and consists of Q222, Q226, and Q234. The feedback path is from the collectors of Q226 and Q234 through R227-C227 to the base of Q222. Q226 and Q234 are connected as a collector-coupled complementary amplifier to provide a fast, linear output signal while consuming minimum quiescent power. The output voltage provides the drive signal to control the crt intensity level through the Control-Grid Supply.

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

High-Voltage Regulator

High-Voltage Primary. A repetitive, non-sinusoidal signal is produced by a phase-modulated switching circuit in the primary of T240 and induced into the secondaries. Current drive for the primary winding is furnished by Q252 in its conduction state. Q252 is turned on by positive-going feedback applied through C259 and L259 from the feedback winding, and then turned off by switching action from Q262. A sample of the output dc voltage is modulated by the ac voltage from another feedback winding at the gate of Q278 to establish the conduction time of Q252 and thus maintain the proper output level. Q252 delivers energy to T240 only once each cycle.

Assuming Q262 and Q264 are off initally, R262 provides base drive for Q252, causing it to deliver current to T240 primary. As Q252 conducts, the increasing current through the primary winding induces a voltage into the secondaries. The gate of Q278 is driven negative by the voltage from the feedback winding, switching Q264 and Q262 on. With conduction of Q262, base drive for Q252 is removed.

With Q252 off, the transformer field collapses, reversing the polarity of the voltage induced into the secondaries. When the gate of Q278 is driven sufficiently positive to switch Q264 and Q262 off, Q252 is switched on again. Q252 again delivers energy to the primary winding and the action is repeated.

High-Voltage Regulation. Regulation is accomplished as follows: Feedback from the −3400-volt cathode supply is summed with low-voltage levels through the voltage divider consisting of resistors R272B-E, R275, and R276 to establish the dc level at the gate of Q278. The ac component, which is the switching signal, is derived from the transformer as described previously. If the output level of the cathode supply drops below the nominal −3400 volts (becomes more positive), the level at the gate of Q278 rises.

A new point is selected on the varying ac component to cause switching of Q262-Q264 later and hence increase conduction time of Q252. This allows more energy to be delivered to the primary winding of T240, resulting in an increase of voltage in the secondaries. Conversely, if the output level increases, Q252 is allowed to conduct for a shorter length of time. The dc level at the gate of Q278 is adjusted by High Volts Adjust R275 to set the output at exactly −3400 volts.

High Voltage Outputs

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

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

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

Crt Control Circuits

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

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

LOW-VOLTAGE POWER SUPPLY AND CALIBRATOR

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

Power Input

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

Low-Voltage Rectifiers and Unregulated Outputs

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

Low-Voltage Regulators

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

+30-Volt Supply. The regulator for the +30-Volt Supply consists of series-pass transistor Q840 and error amplifier Q850. This is a feedback amplifier system similar to that just described for the −30-Volt Supply. R858, +30 V 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 composed of Q885, Q890, and their associated passive components produces a square-wave output with accurate amplitude and at a rate of twice the power-line frequency. This output is available at the probe test loop on the display unit front panel as a 4-milliampere (peak to peak) square-wave current, or as a 400-millivolt (ground to peak) square-wave voltage.

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

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

ITEM NAME

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

ABBREVIATIONS

ACTR	ACTUATOR	PLSTC	PLASTIC
ASSY	ASSEMBLY	QTZ	QUARTZ
CAP	CAPACITOR	RECP	RECEPTACLE
CER	CERAMIC	RES	RESISTOR
CKT	CIRCUIT	RF	RADIO FREQUENCY
COMP	COMPOSITION	SEL	SELECTED
CONN	CONNECTOR	SEMICOND	SEMICONDUCTOR
ELCTLT	ELECTROLYTIC	SENS	SENSITIVE
ELEC	ELECTRICAL	VAR	VARIABLE
INCAND	INCANDESCENT	WW	WIREWOUND
LED	LIGHT EMITTING DIODE	XFMR	TRANSFORMER
NONWIR	NON WIREWOUND	XTAL	CRYSTAL

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
00213	NYTRONICS, COMPONENTS GROUP, INC., SUBSIDIARY OF NYTRONICS, INC.	ORANGE STREET	DARLINGTON, SC 29532
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P O BOX 128	PICKENS, SC 29671
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
03508	GENERAL ELECTRIC COMPANY, SEMI-CONDUCTOR PRODUCTS DEPARTMENT	ELECTRONICS PARK	SYRACUSE, NY 13201
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867, 19TH AVE. SOUTH	MYRTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
08806	GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPARTMENT	NELA PARK	CLEVELAND, OH 44112
09023	CORNELL-DUBILIER ELECTRONIC DIVISION FEDERAL PACIFIC ELECTRIC CO.	2652 DALRYMPLE ST.	SANFORD, NC 27330
10582	CTS OF ASHEVILLE, INC.	MILLS GAP ROAD	SKYLAND, NC 28776
12697	CLAROSTAT MFG. CO., INC.	LOWER WASHINGTON STREET	DOVER, NH 03820
12954	SIEMENS CORPORATION, COMPONENTS GROUP	8700 E THOMAS RD, P O BOX 1390	SCOTTSDALE, AZ 85252
12969	UNITRODE CORPORATION	580 PLEASANT STREET	WATERTOWN, MA 02172
13511	AMPHENOL CARDRE DIV., BUNKER RAMO CORP.		LOS GATOS, CA 95030
14433	ITT SEMICONDUCTORS	3301 ELECTRONICS WAY P O BOX 3049	WEST PALM BEACH, FL 33402
14552	MICRO SEMICONDUCTOR CORP.	2830 F FAIRVIEW ST.	SANTA ANA, CA 92704
14936	GENERAL INSTRUMENT CORP., SEMICONDUCTOR PRODUCTS GROUP	P.O. BOX 600,600 W. JOHN ST.	HICKSVILLE, NY 11802
23880	STANFORD APPLIED ENGINEERING, INC.	340 MARTIN AVE.	SANTA CLARA, CA 95050
24546	CORNING GLASS WORKS, ELECTRONIC COMPONENTS DIVISION	550 HIGH STREET	BRADFORD, PA 16701
31514	STANFORD APPLIED ENGINEERING, INC. ADVANCED PACKAGING DIV.	3080 AIRWAY DRIVE	COSTA MESA, CA 92626
50434	HEWLETT-PACKARD COMPANY	640 PAGE MILL ROAD	PALO ALTO, CA 94304
52769	SPRAGUE GOODMAN ELEC., INC.	134 FULTON AVENUE	GARDEN CITY PARK, NY 11040
56289	SPRAGUE ELECTRIC CO.		NORTH ADAMS, MA 01247
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71450	CTS CORP.	905 N. WEST BLVD	ELKHART, IN 46514
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
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
81073	GRAYHILL, INC.	561 HILLGROVE AVE., PO BOX 373	LA GRANGE, IL 60525
81439	THERM-O-DISC, INC.	1320 S MAIN, P O BOX 1538	MANSFIELD, OH 44907
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	3029 E. WASHINGTON STREET P. O. BOX 372	INDIANAPOLIS, IN 46206
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601
91929	HONEYWELL, INC., MICRO SWITCH DIV.	CHICAGO & SPRING STS.	FREEPORT, IL 61032
95238	CONTINENTAL CONNECTOR CORP.	34-63 56TH ST.	WOODSIDE, NY 11377

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-1433-00	B010100	B029999	CKT BOARD ASSY:HIGH VOLTAGE DEFLECTION	80009	670-1433-00
A1	670-1433-01	B030000	B049999	CKT BOARD ASSY:HIGH VOLTAGE DEFLECTION	80009	670-1433-01
A1	670-1433-02	B050000	B119999	CKT BOARD ASSY:HIGH VOLTAGE DEFLECTION	80009	670-1433-02
A1	670-1433-03	B120000		CKT BOARD ASSY:HIGH VOLTAGE DEFLECTION	80009	670-1433-03
A2	670-1454-00			CKT BOARD ASSY:SINGLE BEAM AUX	80009	670-1454-00
A3	670-1340-00			CKT BOARD ASSY:INTERFACE	80009	670-1340-00
A4	670-1339-00			CKT BOARD ASSY:LV POWER SUPPLY	80009	670-1339-00
A5	670-5757-00	XB109310		CKT BOARD ASSY:SIGNAL OUT	80009	670-5757-00
	----- -----			(OPTION 7 ONLY)		
C106	283-0684-00	B010100	B049999	CAP.,FXD,MICA D:620PF,20%,300V	00853	D153E621G0
C106	283-0596-00	B050000		CAP.,FXD,MICA D:528PF,1%,300V	00853	D153F5280F0
C115	281-0027-00	B010100	B049999X	CAP.,VAR,PLSTC:0.7-3PF,350V	72982	535-017
C116	283-0598-00	B010100	B049999	CAP.,FXD,MICA D:253PF,5%,300V	09023	CD15EC(253)J03
C116	281-0180-00	B050000		CAP.,VAR,MICA D:18-115PF,175V	52769	CMD20600
C126	283-0596-00			CAP.,FXD,MICA D:528PF,1%,300V	00853	D153F5280F0
C136	283-0672-00			CAP.,FXD,MICA D:200PF,1%,500V	00853	D155F2010F0
C224	283-0065-00	B010100	B119999	CAP.,FXD,CER DI:0.001UF,5%,100V	72982	805-518-Z5D0102J
C224	283-0051-00	B120000		CAP.,FXD,CER DI:0.0033UF,5%,100V	72982	8131N145C0G033AJ
C227	281-0537-00	B010100	B119999X	CAP.,FXD,CER DI:0.68PF,20%,600V	80009	281-0537-00
C236	285-0526-00			CAP.,FXD,PLSTC:0.1UF,20%,400V	56289	410P10404
C241	283-0270-00	B010100	B119999	CAP.,FXD,CER DI:0.0068UF,+80/-20%,4000V	56289	45C17
C241	283-0071-00	B120000		CAP.,FXD,CER DI:0.0068UF,+80-30%,5000V	56289	45C10A1
C242	283-0261-00	B010100	B119999	CAP.,FXD,CER DI:0.01UF,20%,4000V	56289	575C1A1
C242	283-0071-00	B120000		CAP.,FXD,CER DI:0.0068UF,+80-30%,5000V	56289	45C10A1
C248	283-0270-00	B010100	B119999	CAP.,FXD,CER DI:0.0068UF,+80/-20%,4000V	56289	45C17
C248	283-0071-00	B120000		CAP.,FXD,CER DI:0.0068UF,+80-30%,5000V	56289	45C10A1
C249	283-0270-00	B010100	B119999	CAP.,FXD,CER DI:0.0068UF,+80/-20%,4000V	56289	45C17
C249	283-0071-00	B120000		CAP.,FXD,CER DI:0.0068UF,+80-30%,5000V	56289	45C10A1
C251	290-0194-00			CAP.,FXD,ELCTLT:10UF,+50-10%,100V	56289	30D106F100DC4
C252	283-0617-00			CAP.,FXD,MICA D:4700PF,10%,300V	00853	D193F472K0
C253	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C254	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N031Z5U0105Z
C258	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N031Z5U0105Z
C259	283-0198-00	B010100	B120979	CAP.,FXD,CER DI:0.22UF,20%,50V	72982	8121N083Z5U0224M
C259	283-0164-00	B120979		CAP.,FXD,CER DI:2.2UF,20%,25V	72982	8141N037Z5U0225M
C272	283-0021-00			CAP.,FXD,CER DI:0.001UF,20%,5000V	72982	848-556-Y5S-102M
C273	283-0208-00			CAP.,FXD,CER DI:0.22UF,10%,200V	72982	8151N230 C 224K
C274	283-0104-00	B010100	B039999	CAP.,FXD,CER DI:2000PF,5%,500V	72982	811-565B202J
C274	283-0142-00	B040000	B119999X	CAP.,FXD,CER DI:0.0027UF,5%,200V	72982	875-571-Y5E0272J
C279	283-0065-00	B010100	B119999X	CAP.,FXD,CER DI:0.001UF,5%,100V	72982	805-518-Z5D0102J
C281	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C622	283-0032-00			CAP.,FXD,CER DI:470PF,5%,500V	72982	0831085Z5E00471J
C628	283-0060-00			CAP.,FXD,CER DI:100PF,5%,200V	72982	855-535U2J101J
C632	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C634	283-0060-00			CAP.,FXD,CER DI:100PF,5%,200V	72982	855-535U2J101J
C636	283-0060-00			CAP.,FXD,CER DI:100PF,5%,200V	72982	855-535U2J101J
C640	281-0519-00			CAP.,FXD,CER DI:47PF,+/-4.7PF,500V	72982	308-000C0G0470K
C642	281-0519-00			CAP.,FXD,CER DI:47PF,+/-4.7PF,500V	72982	308-000C0G0470K
C659	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C671	281-0593-00	B010100	B029999X	CAP.,FXD,CER DI:3.9PF,10%,500V	72982	301-000C0J0399C
C679	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C712	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C714	281-0628-00			CAP.,FXD,CER DI:15PF,5%,500V	72982	301-000C0G0150J
C716	281-0628-00			CAP.,FXD,CER DI:15PF,5%,500V	72982	301-000C0G0150J
C721	281-0628-00			CAP.,FXD,CER DI:15PF,5%,500V	72982	301-000C0G0150J
C810	290-0511-00			CAP.,FXD,ELCTLT:250UF,+75-10%,250V	90201	20-35958
C815	290-0510-00			CAP.,FXD,ELCTLT:6000UF,+100-10%,15V	56289	68D10473

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C820	290-0134-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	150D226X0015B2
C822	281-0512-00			CAP.,FXD,CER DI:27PF,+/-2.7PF,500V	72982	308-000C0G0270K
C830	285-0629-00			CAP.,FXD,PLSTC:0.047UF,20%,100V	56289	410P47301
C837	290-0509-00			CAP.,FXD,ELCTLT:3000UF,+100-10%,50V	56289	68D10454
C839	290-0509-00			CAP.,FXD,ELCTLT:3000UF,+100-10%,50V	56289	68D10454
C842	290-0175-00			CAP.,FXD,ELCTLT:10UF,20%,35V	56289	150D106X0035R2
C852	281-0550-00			CAP.,FXD,CER DI:120PF,10%,500V	04222	7001-1373
C857	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C860	290-0175-00			CAP.,FXD,ELCTLT:10UF,20%,35V	56289	150D106X0035R2
C865	281-0550-00	B010100	B039999	CAP.,FXD,CER DI:120PF,10%,500V	04222	7001-1373
C865	281-0543-00	B040000		CAP.,FXD,CER DI:270PF,10%,500V	72982	301055X5P271K
C870	290-0134-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	150D226X0015B2
C872	281-0572-00			CAP.,FXD,CER DI:6.8PF,+/-0.5PF,500V	72982	301-000C0H0689D
C875	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C881	290-0267-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	162D105X0035CD2
C883	290-0267-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	162D105X0035CD2
C890	281-0549-00			CAP.,FXD,CER DI:68PF,10%,500V	72982	301-000U2J0680K
C930	283-0002-00	XB109310		CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
	----- -----			(OPTION 7 ONLY)		
C931	281-0504-00	XB109310		CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-055C0G0100F
	----- -----			(OPTION 7 ONLY)		
C960	283-0002-00	XB109310		CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
	----- -----			(OPTION 7 ONLY)		
C961	281-0504-00	XB109310		CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-055C0G0100F
	----- -----			(OPTION 7 ONLY)		
C980	283-0002-00	XB109310		CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
	----- -----			(OPTION 7 ONLY)		
C981	281-0504-00	XB109310		CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-055C0G0100F
	----- -----			(OPTION 7 ONLY)		
CR209	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR211	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR214	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR215	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR222	152-0141-02	XB120000		SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR224	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR226	152-0061-00	XB120000		SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR234	152-0061-00	XB120000		SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR238	152-0061-00	XB120000		SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR239	152-0061-00	B010100	B119999X	SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR240	152-0242-00	XB120000		SEMICOND DEVICE:SILICON,225V,200MA	07263	FDH5004
CR241	152-0409-00			SEMICOND DEVICE:SILICON,12,000V,5MA	80009	152-0409-00
CR247	152-0409-00			SEMICOND DEVICE:SILICON,12,000V,5MA	80009	152-0409-00
CR253	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
CR255	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR256	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR262	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR264	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR269	152-0061-00	B010100	B119999	SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR269	152-0586-00	B120000		SEMICOND DEVICE:SILICON,600V,500MA	14936	RGP10J
CR270	152-0586-00	XB120000		SEMICOND DEVICE:SILICON,600V,500MA	14936	RGP10J
CR620	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR658	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR668	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR678	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR688	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR702	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR704	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR712	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR714	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR721	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR722	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR810	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
CR811	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
CR812	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
CR813	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
CR815	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	04713	3N55 FAMILY
CR820	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	14433	LG4016
CR824	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR835	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
CR836	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
CR837	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	04713	3N55 FAMILY
CR841	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	14433	LG4016
CR842	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	14433	LG4016
CR850	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR851	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR860	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	14433	LG4016
CR865	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR870	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR875	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR885	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR890	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	01295	1N4152R
CR930	152-0141-02 ----- -----	XB109310		SEMICOND DEVICE:SILICON,30V,50NA (OPTION 7 ONLY)	01295	1N4152R
CR960	152-0141-02 ----- -----	XB109310		SEMICOND DEVICE:SILICON,30V,50NA (OPTION 7 ONLY)	01295	1N4152R
CR980	152-0141-02 ----- -----	XB109310		SEMICOND DEVICE:SILICON,30V,50NA (OPTION 7 ONLY)	01295	1N4152R
CR990	152-0322-00 ----- -----	XB109310		SEMICOND DEVICE:SILICON,15V,HOT CARRIER (OPTION 7 ONLY)	50434	5082-2672
DS271	150-0030-00			LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS	08806	A2B-T
DS272	150-0030-00			LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS	08806	A2B-T
DS273	150-0030-00			LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS	08806	A2B-T
DS274	150-0030-00	XB120000		LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS	08806	A2B-T
F201	159-0003-00 ----- -----			FUSE,CARTRIDGE:3AG,1.6A,250V,SLOW-BLOW (DOMESTIC (120V NOMINAL LINE)	71400	MDX 1 6/10
F201	159-0019-00 ----- -----			FUSE,CARTRIDGE:3AG,1A,250V,SLOW BLOW (EXPORT (240V NOMINAL LINE)	71400	MDL1
F810	159-0028-00			FUSE,CARTRIDGE:3AG,0.25A,250V,FAST-BLOW	71400	AGC 1/4
F835	159-0025-00			FUSE,CARTRIDGE:3AG,0.5A,250V,FAST-BLOW	71400	AGC 1/2
J210	131-0955-00			CONNECTOR,RCPT,:CKT BD,28/56 CONTACT	13511	31-279
J601	131-1078-00	B010100	B099999	CONNECTOR,RCPT,:28/56 CONTACT	95238	600-1156Y256DF30
J601	131-1078-01	B100000	B106746	CONN,RCPT,ELEC:CKT CARD,28/56 CONTACT	31514	SAM28D/2-TX
J601	131-1078-00	B106747		CONNECTOR,RCPT,:28/56 CONTACT	95238	600-1156Y256DF30
J602	131-1078-00	B010100	B099999	CONNECTOR,RCPT,:28/56 CONTACT	95238	600-1156Y256DF30
J602	131-1078-01	B100000	B106746	CONN,RCPT,ELEC:CKT CARD,28/56 CONTACT	31514	SAM28D/2-TX
J602	131-1078-00	B106747		CONNECTOR,RCPT,:28/56 CONTACT	95238	600-1156Y256DF30
J603	131-1078-00	B010100	B105856	CONNECTOR,RCPT,:28/56 CONTACT	95238	600-1156Y256DF30
J603	131-1078-01	B105857	B099999	CONN,RCPT,ELEC:CKT CARD,28/56 CONTACT	31514	SAM28D/2-TX
J603	131-1078-00	B100000		CONNECTOR,RCPT,:28/56 CONTACT	95238	600-1156Y256DF30
J604	131-1043-00			CONNECTOR,RCPT,:18/36 CONTACT	23880	SAC18D/4-2
L259	108-0564-00			COIL,RF:FIXED,74UH	80009	108-0564-00
L291	108-0644-00			COIL,TUBE DEFLE:TRACE ROTATOR	80009	108-0644-00

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q104	151-0279-00	B010100	B079999	TRANSISTOR:SILICON,NPN	80009	151-0279-00
Q104	151-0150-00	B080000	B119999	TRANSISTOR:SILICON,NPN	80009	151-0150-00
Q104	151-0615-00	B120000		TRANSISTOR:SILICON,NPN	80009	151-0615-00
Q106	151-0190-02	B010100	B069999	TRANSISTOR:SILICON,NPN	80009	151-0190-02
Q106	151-0190-00	B070000		TRANSISTOR:SILICON,NPN	07263	S032677
Q114	151-0279-00	B010100	B079999	TRANSISTOR:SILICON,NPN	80009	151-0279-00
Q114	151-0150-00	B080000	B119999	TRANSISTOR:SILICON,NPN	80009	151-0150-00
Q114	151-0615-00	B120000		TRANSISTOR:SILICON,NPN	80009	151-0615-00
Q116	151-0190-02	B010100	B069999	TRANSISTOR:SILICON,NPN	80009	151-0190-02
Q116	151-0190-00	B070000		TRANSISTOR:SILICON,NPN	07263	S032677
Q124	151-0279-00	B010100	B079999	TRANSISTOR:SILICON,NPN	80009	151-0279-00
Q124	151-0150-00	B080000	B119999	TRANSISTOR:SILICON,NPN	80009	151-0150-00
Q124	151-0615-00	B120000		TRANSISTOR:SILICON,NPN	80009	151-0615-00
Q126	151-0190-02	B010100	B069999	TRANSISTOR:SILICON,NPN	80009	151-0190-02
Q126	151-0190-00	B070000		TRANSISTOR:SILICON,NPN	07263	S032677
Q134	151-0279-00	B010100	B079999	TRANSISTOR:SILICON,NPN	80009	151-0279-00
Q134	151-0150-00	B080000	B119999	TRANSISTOR:SILICON,NPN	80009	151-0150-00
Q134	151-0615-00	B120000		TRANSISTOR:SILICON,NPN	80009	151-0615-00
Q136	151-0190-02	B010100	B069999	TRANSISTOR:SILICON,NPN	80009	151-0190-02
Q136	151-0190-00	B070000		TRANSISTOR:SILICON,NPN	07263	S032677
0138	151-0341-00	XB050000	B119999X	TRANSISTOR:SILICON,NPN	07263	S040065
Q214	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q222	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q226	151-0179-00	B010100	B069999	TRANSISTOR:SILICON,NPN	80009	151-0179-00
Q226	151-0347-00	B070000	B119999	TRANSISTOR:SILICON,NPN	04713	SPS7951
Q226	151-0407-00	B120000		TRANSISTOR:SILICON,NPN	04713	SS2456
Q234	151-0228-00	B010100	B069999	TRANSISTOR:SILICON,PNP,SEL FROM 2N4888	80009	151-0228-00
Q234	151-0350-00	B070000	B072987	TRANSISTOR:SILICON,PNP	04713	SPS6700
Q234	151-0406-00	B072988		TRANSISTOR:SILICON,PNP	01295	SGC7282
Q252	151-0256-00			TRANSISTOR:SILICON,NPN	80009	151-0256-00
Q262	151-0207-00			TRANSISTOR:SILICON,NPN	80009	151-0207-00
Q264	151-0342-00			TRANSISTOR:SILICON,PNP	07263	S035928
Q278	151-1005-00	B010100	B119999	TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
Q278	151-0254-00	B120000		TRANSISTOR:SILICON,NPN	80009	151-0254-00
Q620	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q626	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q630	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q650	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q658	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q660	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q668	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q670	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q678	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q680	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q688	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q701	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q702	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
Q703	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q704	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
Q711	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q712	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
Q713	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q714	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
Q721	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q722	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q815	151-0331-00	B010100	B070028	TRANSISTOR:SILICON,NPN	03508	X40C115
Q815	151-0496-00	B070029		TRANSISTOR:SILICON,NPN	80009	151-0496-00

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q820	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q825	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q840	151-0331-00	B010100	B070028	TRANSISTOR:SILICON,NPN	03508	X40C115
Q840	151-0496-00	B070029		TRANSISTOR:SILICON,NPN	80009	151-0496-00
Q845	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q850	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q860	151-0331-00	B010100	B070028	TRANSISTOR:SILICON,NPN	03508	X40C115
Q860	151-0496-00	B070029		TRANSISTOR:SILICON,NPN	80009	151-0496-00
Q865	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q870	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q875	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q885	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q890	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q910	151-0190-00	XB109310		TRANSISTOR:SILICON,NPN	07263	S032677
	----- -----			(OPTION 7 ONLY)		
Q915	151-0190-00	XB109310		TRANSISTOR:SILICON,NPN	07263	S032677
	----- -----			(OPTION 7 ONLY)		
Q920	151-0190-00	XB109310		TRANSISTOR:SILICON,NPN	07263	S032677
	----- -----			(OPTION 7 ONLY)		
Q925	151-0190-00	XB109310		TRANSISTOR:SILICON,NPN	07263	S032677
	----- -----			(OPTION 7 ONLY)		
Q930	151-0188-00	XB109310		TRANSISTOR:SILICON,PNP	04713	SPS6868K
	----- -----			(OPTION 7 ONLY)		
Q940	151-0190-00	XB109310		TRANSISTOR:SILICON,NPN	07263	S032677
	----- -----			(OPTION 7 ONLY)		
Q945	151-0190-00	XB109310		TRANSISTOR:SILICON,NPN	07263	S032677
	----- -----			(OPTION 7 ONLY)		
Q950	151-0190-00	XB109310		TRANSISTOR:SILICON,NPN	07263	S032677
	----- -----			(OPTION 7 ONLY)		
Q955	151-0190-00	XB109310		TRANSISTOR:SILICON,NPN	07263	S032677
	----- -----			(OPTION 7 ONLY)		
Q960	151-0188-00	XB109310		TRANSISTOR:SILICON,PNP	04713	SPS6868K
	----- -----			(OPTION 7 ONLY)		
Q967	151-0190-00	XB109310		TRANSISTOR:SILICON,NPN	07263	S032677
	----- -----			(OPTION 7 ONLY)		
Q970	151-0190-00	XB109310		TRANSISTOR:SILICON,NPN	07263	S032677
	----- -----			(OPTION 7 ONLY)		
Q972	151-0190-00	XB109310		TRANSISTOR:SILICON,NPN	07263	S032677
	----- -----			(OPTION 7 ONLY)		
Q975	151-0190-00	XB109310		TRANSISTOR:SILICON,NPN	07263	S032677
	----- -----			(OPTION 7 ONLY)		
Q980	151-0188-00	XB109310		TRANSISTOR:SILICON,PNP	04713	SPS6868K
	----- -----			(OPTION 7 ONLY)		
Q990	151-0190-00	XB109310		TRANSISTOR:SILICON,NPN	07263	S032677
	----- -----			(OPTION 7 ONLY)		
R101	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R102	316-0470-00	B010100	B029999	RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701
R102	316-0221-00	B030000	B119999	RES.,FXD,CMPSN:220 OHM,10%,0.25W	01121	CB2211
R102	315-0221-00	B120000		RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R103	316-0390-00	XB030000	B119999	RES.,FXD,CMPSN:39 OHM,10%,0.25W	01121	CB3901
R103	315-0390-00	B120000		RES.,FXD,CMPSN:39 OHM,5%,0.25W	01121	CB3905
R104	308-0668-00			RES.,FXD,WW:6.2K OHM,3%,7W	00213	1600S62000H
R106	321-0128-00			RES.,FXD,FILM:210 OHM,1%,0.125W	91637	MFF1816G210R0F
R108	308-0539-00			RES.,FXD,WW:2.25K OHM,0.5%,3W	91637	RS2BK22500D
R112	316-0470-00	B010100	B029999	RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701
R112	316-0221-00	B030000	B119999	RES.,FXD,CMPSN:220 OHM,10%,0.25W	01121	CB2211
R112	315-0221-00	B120000		RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R113	316-0390-00	XB030000	B119999	RES.,FXD,CMPSN:39 OHM,10%,0.25W	01121	CB3901
R113	315-0390-00	B120000		RES.,FXD,CMPSN:39 OHM,5%,0.25W	01121	CB3905
R114	308-0668-00			RES.,FXD,WW:6.2K OHM,3%,7W	00213	1600S62000H
R115	316-0470-00	XB030000	B049999X	RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701
R116	311-1132-00	B010100	B119999	RES.,VAR,NONWIR:TRMR,100 OHM,0.50W	73138	91-66-0
R116	311-1567-00	B120000		RES.,VAR,NONWIR:TRMR,100 OHM,0.50W	73138	91-89-0
R118	308-0539-00			RES.,FXD,WW:2.25K OHM,0.5%,3W	91637	RS2BK22500D
R122	316-0470-00	B010100	B029999	RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701
R122	316-0221-00	B030000	B119999	RES.,FXD,CMPSN:220 OHM,10%,0.25W	01121	CB2211
R122	315-0221-00	B120000		RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R123	316-0390-00	XB030000	B119999	RES.,FXD,CMPSN:39 OHM,10%,0.25W	01121	CB3901
R123	315-0390-00	B120000		RES.,FXD,CMPSN:39 OHM,5%,0.25W	01121	CB3905
R124	308-0668-00			RES.,FXD,WW:6.2K OHM,3%,7W	00213	1600S62000H
R125	303-0751-00			RES.,FXD,CMPSN:750 OHM,5%,1W	01121	GB7515
R126	321-0128-00			RES.,FXD,FILM:210 OHM,1%,0.125W	91637	MFF1816G210ROF
R128	308-0539-00			RES.,FXD,WW:2.25K OHM,0.5%,3W	91637	RS2BK22500D
R132	316-0470-00	B010100	B029999	RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701
R132	316-0221-00	B030000	B119999	RES.,FXD,CMPSN:220 OHM,10%,0.25W	01121	CB2211
R132	315-0221-00	B120000		RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R133	316-0390-00	XB030000	B119999	RES.,FXD,CMPSN:39 OHM,10%,0.25W	01121	CB3901
R133	315-0390-00	B120000		RES.,FXD,CMPSN:39 OHM,5%,0.25W	01121	CB3905
R134	308-0668-00			RES.,FXD,WW:6.2K OHM,3%,7W	00213	1600S62000H
R135	316-0470-00	XB030000	B049999X	RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701
R135	316-0390-00	XB080000	B119999	RES.,FXD,CMPSN:39 OHM,10%,0.25W	01121	CB3901
R135	315-0390-00	B120000		RES.,FXD,CMPSN:39 OHM,5%,0.25W	01121	CB3905
R136	311-1132-00	B010100	B119999	RES.,VAR,NONWIR:TRMR,100 OHM,0.50W	73138	91-66-0
R136	311-1567-00	B120000		RES.,VAR,NONWIR:TRMR,100 OHM,0.50W	73138	91-89-0
R138	308-0539-00			RES.,FXD,WW:2.25K OHM,0.5%,3W	91637	RS2BK22500D
R140	316-0225-00	XB050000	B119999X	RES.,FXD,CMPSN:2.2M OHM,10%,0.25W	01121	CB2251
R200	311-1160-00	B010100	B108289	RES.,VAR,NONWIR:100K OHM,20%,1W	80009	311-1160-00
R200	311-1961-00	B108290		RES.,VAR,NONWIR:PANEL,100K OHM,20%,0.75W (FURNISHED AS A UNIT WITH S125)	01121	17M025
R202	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
R203	316-0103-00	B010100	B119999	RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R203	315-0103-00	B120000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R206	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R207	316-0822-00	B010100	B119999	RES.,FXD,CMPSN:8.2K OHM,10%,0.25W	01121	CB8221
R207	315-0822-00	B120000		RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R208	316-0473-00	B010100	B119999	RES.,FXD,CMPSN:47K OHM,10%,0.25W	01121	CB4731
R208	315-0473-00	B120000		RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R209	316-0224-00	XB050000	B119999	RES.,FXD,CMPSN:220K OHM,10%,0.25W	01121	CB2241
R209	315-0224-00	B120000		RES.,FXD,CMPSN:220K OHM,5%,0.25W	01121	CB2245
R211	316-0103-00	B010100	B119999	RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R211	315-0103-00	B120000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R213	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
R215	316-0103-00	B010100	B119999	RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R215	315-0103-00	B120000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R216	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R217	316-0103-00	B010100	B119999	RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R217	315-0103-00	B120000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R218	316-0183-00	B010100	B119999	RES.,FXD,CMPSN:18K OHM,10%,0.25W	01121	CB1831
R218	315-0183-00	B120000		RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R219	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
R222	316-0102-00	B010100	B119999	RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R222	315-0102-00	B120000		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R223	316-0472-00	B010100	B119999	RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R223	315-0472-00	B120000		RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R226	316-0101-00	XB050000	B119999	RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R226	315-0101-03	B120000		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R227	321-0399-00			RES.,FXD,FILM:140K OHM,1%,0.125W	91637	MFF1816G14002F
R231	316-0472-00	B010100	B119999	RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R231	315-0103-00	B120000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R232	316-0274-00	B010100	B119999	RES.,FXD,CMPSN:270K OHM,10%,0.25W	01121	CB2741
R232	315-0154-00	B120000		RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R234	304-0223-00	B010100	B119999	RES.,FXD,CMPSN:22K OHM,10%,1W	01121	GB2231
R234	305-0223-00	B120000		RES.,FXD,CMPSN:22K OHM,5%,2W	01121	HB2235
R236	315-0101-00	B010100	B119999	RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R236	315-0152-00	B120000	B121979	RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R236	315-0821-00	B121980		RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R239	315-0101-00	B010100	B119999X	RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R240	315-0335-03	XB120000		RES.,FXD,CMPSN:3.3M OHM,5%,0.25W	01121	CB3355
R242	316-0223-00	B010100	B119999	RES.,FXD,CMPSN:22K OHM,10%,0.25W	01121	CB2231
R242	315-0223-03	B120000		RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R243	316-0105-00	B010100	B119999	RES.,FXD,CMPSN:1M OHM,10%,0.25W	01121	CB1051
R243	315-0105-03	B120000		RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R244	315-0331-03	XB120000		RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R245	311-1135-00	B010100	B029999	RES.,VAR,NONWIR:TRMR,1M OHM,0.25W	71450	YA5535
R245	311-1205-00	B030000	B119999	RES.,VAR,NONWIR:TRMR,2M OHM,0.25W	71450	YA5545
R245	311-1135-00	B120000		RES.,VAR,NONWIR:TRMR,1M OHM,0.25W	71450	YA5535
R248	316-0223-00	B010100	B119999	RES.,FXD,CMPSN:22K OHM,10%,0.25W	01121	CB2231
R248	315-0103-03	B120000	B120979	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R248	315-0562-03	B120980		RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R249	315-0471-03	XB120000		RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R251	307-0058-00			RES.,FXD,CMPSN:5.6 OHM,5%,0.5W	01121	EB56G5
R252	308-0075-00			RES.,FXD,WW:100 OHM,5%,3W	91637	CW2B-100R0J
R254	308-0690-00	B010100	B120979	RES.,FXD,WW:3 OHM,10%,3W	91637	CW2B-3R000K
R254	308-0365-00	B120980		RES.,FXD,WW:1.5 OHM,5%,3W	91637	CW2B-1R500J
R257	306-0104-00	B010100	B119999	RES.,FXD,CMPSN:100K OHM,10%,2W	01121	HB1041
R257	305-0104-00	B120000	B120979X	RES.,FXD,CMPSN:100K OHM,5%,2W	01121	HB1045
R262	302-0472-00	B010100	B119999	RES.,FXD,CMPSN:4.7K OHM,10%,050W	01121	EB4721
R262	301-0472-00	B120000		RES.,FXD,CMPSN:4.7K OHM,5%,0.50W	01121	EB4725
R263	316-0183-00	B010100	B119999	RES.,FXD,CMPSN:18K OHM,10%,0.25W	01121	CB1831
R263	315-0183-00	B120000	B121803	RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R263	315-0912-00	B121804		RES.,FXD,CMPSN:9.1K OHM,5%,0.25W	01121	CB9125
R266	316-0334-00	B010100	B119999	RES.,FXD,CMPSN:330K OHM,10%,0.25W	01121	CB3341
R266	315-0334-00	B120000		RES.,FXD,CMPSN:330K OHM,5%,0.25W	01121	CB3345
R267	316-0333-00	B010100	B119999	RES.,FXD,CMPSN:33K OHM,10%,0.25W	01121	CB3331
R267	315-0333-00	B120000		RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R268	316-0103-00	B010100	B119999	RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R268	315-0103-03	B120000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R269	315-0101-00	B010100	B119999X	RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R270	316-0223-00	XB060000	B119999X	RES.,FXD,CMPSN:22K OHM,10%,0.25W	01121	CB2231
R271	316-0395-00	B010100	B119999	RES.,FXD,CMPSN:3.9M OHM,10%,0.25W	01121	CB3951
R271	315-0395-00	B120000		RES.,FXD,CMPSN:3.9M OHM,5%,0.25W	01121	CB3955
R272A R272B R272C R272D R272E	307-0296-00			RES.,FXD,FILM:FOR D10 & D11	80009	307-0296-00
R273	315-0104-00	B010100	B119999	RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R273	315-0104-03	B120000		RES.,FXD CMPSN:100K OHM,5%,0.25W	01121	CB1045
R274	316-0105-00	B010100	B119999	RES.,FXD,CMPSN:1M OHM,10%,0.25W	01121	CB1051
R274	315-0105-03	B120000		RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R275	311-1136-00			RES.,VAR,NONWIR:100K OHM,30%,0.25W	71450	201-YA5536

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R276	316-0105-00	B010100	B119999	RES.,FXD,CMPSN:1M OHM,10%,0.25W	01121	CB1051
R276	315-0105-03	B120000		RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R278	316-0562-00	B010100	B119999	RES.,FXD,CMPSN:5.6K OHM,10%,0.25W	01121	CB5621
R278	315-0562-00	B120000		RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R279	315-0104-00	B010100	B119999X	RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R282	315-0163-00	B010100	B119999	RES.,FXD,CMPSN:16K OHM,5%,0.25W	01121	CB1635
R282	315-0163-01	B120000		RES.,FXD,CMPSN:16K OHM,5%,0.25W	01121	CB1635
R285	311-1136-00	B010100	B119999	RES.,VAR,NONWIR:100K OHM,30%,0.25W	71450	201-YA5536
R285	311-1555-00	B120000		RES.,VAR,NONWIR:100K OHM,20%,0.5W	73138	91-77-0
R286	311-1136-00	B010100	B119999	RES.,VAR,NONWIR:100K OHM,30%,0.25W	71450	201-YA5536
R286	311-1555-00	B120000		RES.,VAR,NONWIR:100K OHM,20%,0.5W	73138	91-77-0
R287	301-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.50W	01121	EB1835
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
R620	316-0102-00	B010100	B121189	RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R620	315-0102-00	B121190		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R621	316-0222-00	B010100	B121189	RES.,FXD,CMPSN:2.2K OHM,10%,0.25W	01121	CB2221
R621	315-0222-00	B121190		RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R622	315-0223-00	B010100	B029999	RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R622	315-0163-00	B030000		RES.,FXD,CMPSN:16K OHM,5%,0.25W	01121	CB1635
R626	316-0102-00	B010100	B121189	RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R626	315-0102-00	B121190		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R628	315-0223-00	B010100	B029999	RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R628	315-0183-00	B030000		RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R630	316-0474-00	B010100	B121189	RES.,FXD,CMPSN:470K OHM,10%,0.25W	01121	CB4741
R630	315-0474-00	B12490		RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R631	316-0332-00	B010100	B121189	RES.,FXD,CMPSN:3.3K OHM,10%,0.25W	01121	CB3321
R631	315-0332-00	B121190		RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R632	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R634	316-0103-00	B010100	B121189	RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R634	315-0103-00	B121190		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R635	316-0102-00	B010100	B121189	RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R635	315-0102-00	B121190		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R636	316-0103-00	B010100	B121189	RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R636	315-0103-00	B121190		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R637	316-0102-00	B010100	B121189	RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R637	315-0102-00	B121190		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R640	316-0562-00	B010100	B121189	RES.,FXD,CMPSN:5.6K OHM,10%,0.25W	01121	CB5621
R640	315-0562-00	B121190		RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R641	316-0561-00	B010100	B121189	RES.,FXD,CMPSN:560 OHM,10%,0.25W	01121	CB5611
R641	315-0561-00	B121190		RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R642	316-0103-00	B010100	B121189	RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R642	315-0103-00	B121190		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R643	316-0102-00	B010100	B121189	RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R643	315-0102-00	B121190		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R650	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R651	316-0103-00	B010100	B121189	RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R651	315-0103-00	B121190		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R652	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R656	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R657	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R659	316-0101-00	B010100	B121189	RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R659	315-0101-00	B121190		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R660	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R662	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R665	321-0159-00			RES.,FXD,FILM:442 OHM,1%,0.125W	91637	MFF1816G442R0F
R666	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R667	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R669	316-0101-00	B010100	B121189	RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R669	315-0101-00	B121190		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R670	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R671	316-0331-00	B010100	B121190	RES.,FXD,CMPSN:330 OHM,10%,0.25W	01121	CB3311
R671	315-0331-00	B121190		RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R672	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R675	311-1133-00			RES.,VAR,NONWIR:10K OHM,30%,0.25W	71450	201-YA5534
R676	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R677	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R679	316-0101-00	B010100	B121189	RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R679	315-0101-00	B121190		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R680	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R681	316-0331-00	B010100	B121189	RES.,FXD,CMPSN:330 OHM,10%,0.25W	01121	CB3311
R681	315-0331-00	B121190		RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R682	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R685	321-0159-00			RES.,FXD,FILM:442 OHM,1%,0.125W	91637	MFF1816G442R0F
R686	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R687	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R701	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R702	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R703	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R704	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R706	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R707	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R709	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R710	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R712	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R713	316-0332-00			RES.,FXD,CMPSN:3.3K OHM,10%,0.25W	01121	CB3321
R715	321-0402-00			RES.,FXD,FILM:150K OHM,1%,0.125W	24546	NA55D1503F
R716	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W	91637	MFF1816G49901F
R717	321-0350-00			RES.,FXD,FILM:43.2K OHM,1%,0.125W	91637	MFF1816G43201F
R718	316-0153-00			RES.,FXD,CMPSN:15K OHM,10%,0.25W	01121	CB1531
R720	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
R721	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W	91637	MFF1816G49901F
R722	321-0365-00			RES.,FXD,FILM:61.9K OHM,1%,0.125W	91637	MFF1816G61901F
R723	316-0153-00			RES.,FXD,CMPSN:15K OHM,10%,0.25W	01121	CB1531
R724	316-0272-00			RES.,FXD,CMPSN:2.7K OHM,10%,0.25W	01121	CB2721
R810	302-0150-00			RES.,FXD,CMPSN:15 OHM,10%,0.50W	01121	EB1501
R812	304-0683-00			RES.,FXD,CMPSN:68K OHM,10%,1W	01121	GB6831
R815	308-0685-00			RES.,FXD,WW:1.5 OHM,5%,1W	75042	BW20-1R500J
R818	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R820	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R822	316-0681-00	B010100	B121189	RES.,FXD,CMPSN:680 OHM,10%,0.25W	01121	CB6811
R822	315-0681-00	B121190		RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R824	316-0822-00	B010100	B121189	RES.,FXD,CMPSN:8.2K OHM,10%,0.25W	01121	CB8221
R824	315-0822-00	B121190		RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R826	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R827	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R830	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R832	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R834	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R841	307-0300-00			RES.,FXD,FILM:150 OHM,5%,10W	24546	FP10 150 OHM 5%
R842	308-0686-00			RES.,FXD,WW:2.2 OHM,5%,2W	75042	BWH-2R200J
R846	316-0391-00	B010100	B121189	RES.,FXD,CMPSN:390 OHM,10%,0.25W	01121	CB3911
R846	315-0391-00	B121190		RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R847	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R850	316-0823-00	B010100	B121189	RES.,FXD,CMPSN:82K OHM,10%,0.25W	01121	CB8231
R850	315-0823-00	B121190		RES.,FXD,CMPSN:82K OHM,5%,0.25W	01121	CB8235
R851	302-0333-00			RES.,FXD,CMPSN:33K OHM,10%,0.50W	01121	EB3331
R852	316-0681-00	B010100	B121189	RES.,FXD,CMPSN:680 OHM,10%,0.25W	01121	CB6811
R852	315-0681-00	B121190		RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R853	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R857	321-0268-00			RES.,FXD,FILM:6.04K OHM,1%,0.125W	91637	MFF1816G60400F
R858	311-1120-00			RES.,VAR,NONWIR:100 OHM,30%,0.25W	71450	201-YA5531
R859	321-0268-00			RES.,FXD,FILM:6.04K OHM,1%,0.125W	91637	MFF1816G60400F
R860	308-0686-00			RES.,FXD,WW:2.2 OHM,5%,2W	75042	BWH-2R200J
R861	307-0301-00			RES.,FXD,FILM:120 OHM,5%,10W	24546	FP10 120 OHM 5%
R863	316-0273-00	B010100	B121189	RES.,FXD,CMPSN:27K OHM,10%,0.25W	01121	CB2731
R863	315-0273-00	B121190		RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R865	315-0131-00	B010100	B039999	RES.,FXD,CMPSN:130 OHM,5%,0.25W	01121	CB1315
R865	315-0301-00	B040000		RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R867	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R868	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R869	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R870	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R872	316-0221-00	B010100	B121189	RES.,FXD,CMPSN:220 OHM,10%,0.25W	01121	CB2211
R872	315-0221-00	B121190		RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R873	316-0102-00	B010100	B121189	RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R873	315-0102-00	B121190		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R875	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R877	321-0256-00			RES.,FXD,FILM:4.53K OHM,1%,0.125W	91637	MFF1816G45300F
R878	311-1124-00			RES.,VAR,NONWIR:250 OHM,30%,0.25W	71450	201-YA5533
R879	321-0202-00			RES.,FXD,FILM:1.24K OHM,1%,0.125W	91637	MFF1816G12400F
R880	316-0272-00	B010100	B121189	RES.,FXD,CMPSN:2.7K OHM,10%,0.25W	01121	CB2721
R880	315-0272-00	B121190		RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R881	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R883	316-0102-00	B010100	B121189	RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R883	315-0102-00	B121190		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R885	316-0153-00	B010100	B121189	RES.,FXD,CMPSN:15K OHM,10%,0.25W	01121	CB1531
R885	315-0153-00	B121190		RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R890	322-0686-03			RES.,FXD,FILM:7.23K OHM,0.25%,0.25W	91637	MFF1421D72300C
R891	321-0097-03			RES.,FXD,FILM:100 OHM,0.25%,0.125W	91637	MFF1816D100R0C
R910	315-0331-00	XB109310		RES.,FXD,CMPSN:330 OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB3315
R911	315-0273-00	XB109310		RES.,FXD,CMPSN:27K OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB2735
R912	321-0193-00	XB109310		RES.,FXD,FILM:1K OHM,1%,0.125W (OPTION 7 ONLY)	91637	MFF1816G10000F
R915	321-0289-00	XB109310		RES.,FXD,FILM:10K OHM,1%,0.125W (OPTION 7 ONLY)	91637	MFF1816G10001F
R916	315-0183-00	XB109310		RES.,FXD,CMPSN:18K OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB1835
R920	315-0331-00	XB109310		RES.,FXD,CMPSN:330 OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB3315
R921	315-0273-00	XB109310		RES.,FXD,CMPSN:27K OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB2735
R922	321-0193-00	XB109310		RES.,FXD,FILM:1K OHM,1%,0.125W (OPTION 7 ONLY)	91637	MFF1816G10000F
R925	315-0221-00	XB109310		RES.,FXD,CMPSN:220 OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB2215
R926	321-0290-00	XB109310		RES.,FXD,FILM:10.2K OHM,1%,0.125W (OPTION 7 ONLY)	91637	MFF1816G10201F
R930	315-0273-00	XB109310		RES.,FXD,CMPSN:27K OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB2735

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R931	315-0622-00	XB109310		RES.,FXD,CMPSN:6.2K OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB6225
R932	315-0102-00	XB109310		RES.,FXD,CMPSN:1K OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB1025
R933	315-0101-00	XB109310		RES.,FXD,CMPSN:100 OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB1015
R940	315-0331-00	XB109310		RES.,FXD,CMPSN:330 OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB3315
R941	315-0273-00	XB109310		RES.,FXD,CMPSN:27K OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB2735
R942	321-0193-00	XB109310		RES.,FXD,FILM:1K OHM,1%,0.125W (OPTION 7 ONLY)	91637	MFF1816G10000F
R945	321-0289-00	XB109310		RES.,FXD,FILM:10K OHM,1%,0.125W (OPTION 7 ONLY)	91637	MFF1816G10001F
R946	315-0183-00	XB109310		RES.,FXD,CMPSN:18K OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB1835
R950	315-0331-00	XB109310		RES.,FXD,CMPSN:330 OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB3315
R951	315-0273-00	XB109310		RES.,FXD,CMPSN:27K OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB2735
R952	321-0193-00	XB109310		RES.,FXD,FILM:1K OHM,1%,0.125W (OPTION 7 ONLY)	91637	MFF1816G10000F
R955	315-0221-00	XB109310		RES.,FXD,CMPSN:220 OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB2215
R956	321-0290-00	XB109310		RES.,FXD,FILM:10.2K OHM,1%,0.125W (OPTION 7 ONLY)	91637	MFF1816G10201F
R960	315-0273-00	XB109310		RES.,FXD,CMPSN:27K OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB2735
R961	315-0622-00	XB109310		RES.,FXD,CMPSN:6.2K OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB6225
R962	315-0102-00	XB109310		RES.,FXD,CMPSN:1K OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB1025
R963	315-0101-00	XB109310		RES.,FXD,CMPSN:100 OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB1015
R967	315-0331-00	XB109310		RES.,FXD,CMPSN:330 OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB3315
R968	315-0273-00	XB109310		RES.,FXD,CMPSN:27K OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB2735
R969	321-0193-00	XB109310		RES.,FXD,FILM:1K OHM,1%,0.125W (OPTION 7 ONLY)	91637	MFF1816G10000F
R970	315-0331-00	XB109310		RES.,FXD,CMPSN:330 OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB3315
R971	315-0273-00	XB109310		RES.,FXD,CMPSN:27K OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB2735
R972	321-0289-00	XB109310		RES.,FXD,FILM:10K OHM,1%,0.125W (OPTION 7 ONLY)	91637	MFF1816G10001F
R973	315-0183-00	XB109310		RES.,FXD,CMPSN:18K OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB1835
R974	321-0193-00	XB109310		RES.,FXD,FILM:1K OHM,1%,0.125W (OPTION 7 ONLY)	91637	MFF1816G10000F
R975	315-0221-00	XB109310		RES.,FXD,CMPSN:220 OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB2215
R976	321-0290-00	XB109310		RES.,FXD,FILM:10.2K OHM,1%,0.125W (OPTION 7 ONLY)	91637	MFF1816G10201F
R980	315-0273-00	XB109310		RES.,FXD,CMPSN:27K OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB2735

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R981	315-0622-00	XB109310		RES.,FXD,CMPSN:6.2K OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB6225
R982	315-0102-00	XB109310		RES.,FXD,CMPSN:1K OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB1025
R983	315-0101-00	XB109310		RES.,FXD,CMPSN:100 OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB1015
R990	315-0273-00	XB109310		RES.,FXD,CMPSN:27K OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB2735
R991	315-0222-00	XB109310		RES.,FXD,CMPSN:2.2K OHM,5%,0.25W (OPTION 7 ONLY)	01121	CB2225
S125	260-1238-00	B010100	B108289	SWITCH,PUSH:0.5A AT 115VAC	81073	39YY2084
S125	311-1961-00	B108290		RES.,VAR,NONWIR:PANEL,100K OHM,20%,0.75W (FURNISHED AS A UNIT WITH R200)	01121	17M025
S200	260-0227-00			SWITCH,THRMSTC:NC,OPEN 73.9,CL 51.7,10 A	81439	36T21 S#3776
S201	260-1222-00			SWITCH,PUSH-PUL:10A,250VAC	91929	2DM301
T240	120-0705-01	B010100	B049999	XFMR,PWR,STU:	80009	120-0705-01
T240	120-0761-00	B050000	B119999	XFMR,PWR,STU:HV	80009	120-0761-00
T240	120-1230-00	B120000		XFMR,PWR,STU:HIGH VOLTAGE	80009	120-1230-00
T801	120-0692-00	B010100	B049999	XFMR,PWR,STPDN:	80009	120-0692-00
T801	120-0704-00	B050000		XFMR,PWR,SDN&SU:	80009	120-0704-00
U640	156-0057-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	01295	SN7401N OR J
V291	154-0633-00	B010100	B069999	ELECTRON TUBE:CRT,P31,INT SCALE	80009	154-0633-00
V291	154-0633-05	B070000	B103610	ELECTRON TUBE:CRT,P31,INT SCALE	80009	154-0633-05
V291	154-0633-10	B103611		ELECTRON TUBE:CRT,P31,INT SCALE	80009	154-0633-10
V291	154-0633-08	B010100	B103610	ELECTRON TUBE:CRT,P7,INT SCALE (OPTION 76 ONLY)	80009	154-0633-08
V291	154-0633-13	B103611		ELECTRON TUBE:CRT,P7 (OPTION 76 ONLY)	80009	154-0633-13
V291	154-0633-09	B010100	B103610	ELECTRON TUBE:CRT,P11,INT SCALE (OPTION 78 ONLY)	80009	154-0633-09
V291	154-0633-14	B103611		ELECTRON TUBE:CRT,P11 (OPTION 78 ONLY)	80009	154-0633-14
VR237	152-0283-00	B010100	B119999	SEMICOND DEVICE:ZENER,0.4W,43V,5%	12954	DZ750903B1N976B
VR237	152-0284-00	B120000		SEMICOND DEVICE:ZENER,0.4W,47V,5%	80009	152-0284-00
VR239	152-0101-00	XB120000		SEMICOND DEVICE:ZENER,1W,75V,5%	04713	1N3041B
VR258	152-0438-00			SEMICOND DEVICE:ZENER,3W,9.1V,5%	12969	UZ1364
VR281	152-0357-00	B010100	B119999	SEMICOND DEVICE:ZENER,0.4W,82V,5%	04713	SZ12461KRL
VR281	152-0285-00	B120000		SEMICOND DEVICE:ZENER,0.4W,62V,5%	80009	152-0285-00
VR282	152-0255-00	B010100	B119999	SEMICOND DEVICE:ZENER,0.4W,51V,5%	80009	152-0255-00
VR282	152-0285-00	B120000		SEMICOND DEVICE:ZENER,0.4W,62V,5%	80009	152-0285-00
VR720	152-0149-00			SEMICOND DEVICE:ZENER,0.4W,10V,5%	80009	152-0149-00
VR850	152-0357-00			SEMICOND DEVICE:ZENER,0.4W,82V,5%	04713	SZ12461KRL
VR865	152-0243-00			SEMICOND DEVICE:ZENER,0.4W,15V,5%	14552	1N965B
VR870	152-0227-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	04713	SZ13903

INSTRUMENT OPTIONS

Your instrument may be equipped with one or more options. A brief description of each available option is given in this section.

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

OPTION 2

PROTECTIVE PANEL COVER

The purpose of OPTION 2 is to provide a protective front-panel cover for bench cabinet models only. The cover protects the front panel and knobs during transportation and storage. The cabinet sides have been modified by the addition of a retaining hook for the protective cover. The Tektronix part number for the cabinet sides are listed in Section 8, Replaceable Mechanical Parts (see the listing for bench cabinet).

OPTION 7
REAR PANEL SIGNAL OUTPUTS

The purpose of OPTION 7 is to provide cathode-ray tube-related signals to standard connectors at the rear of the instrument. This option is particularly well suited for use in the physical life sciences. By using differential amplifiers, the oscilloscope can become a signal conditioner for other devices. Outputs may be used for driving counters or X-Y plotters in conjunction with the oscilloscope. The Tektronix part numbers for the electrical parts are listed in Section 6, Replaceable Electrical Parts.

OPTION 76

P7 PHOSPHOR

The purpose of OPTION 76 is to provide a cathode-ray tube with P7 phosphor, which is excellent for long-persistence display requirements. The Tektronix part number for the tube is listed in Section 6, Replaceable Electrical Parts (see V291).

OPTION 78

P11 PHOSPHOR

The purpose of OPTION 78 is to provide a cathode-ray tube with P11 phosphor, which is best suited for waveform photography. The Tektronix part number for the tube is listed in Section 6, Replaceable Electrical Parts (see V291).

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

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

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

Resistors = Ohms (Ω).

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.

Abbreviations are based on ANSI Y1.1-1972.

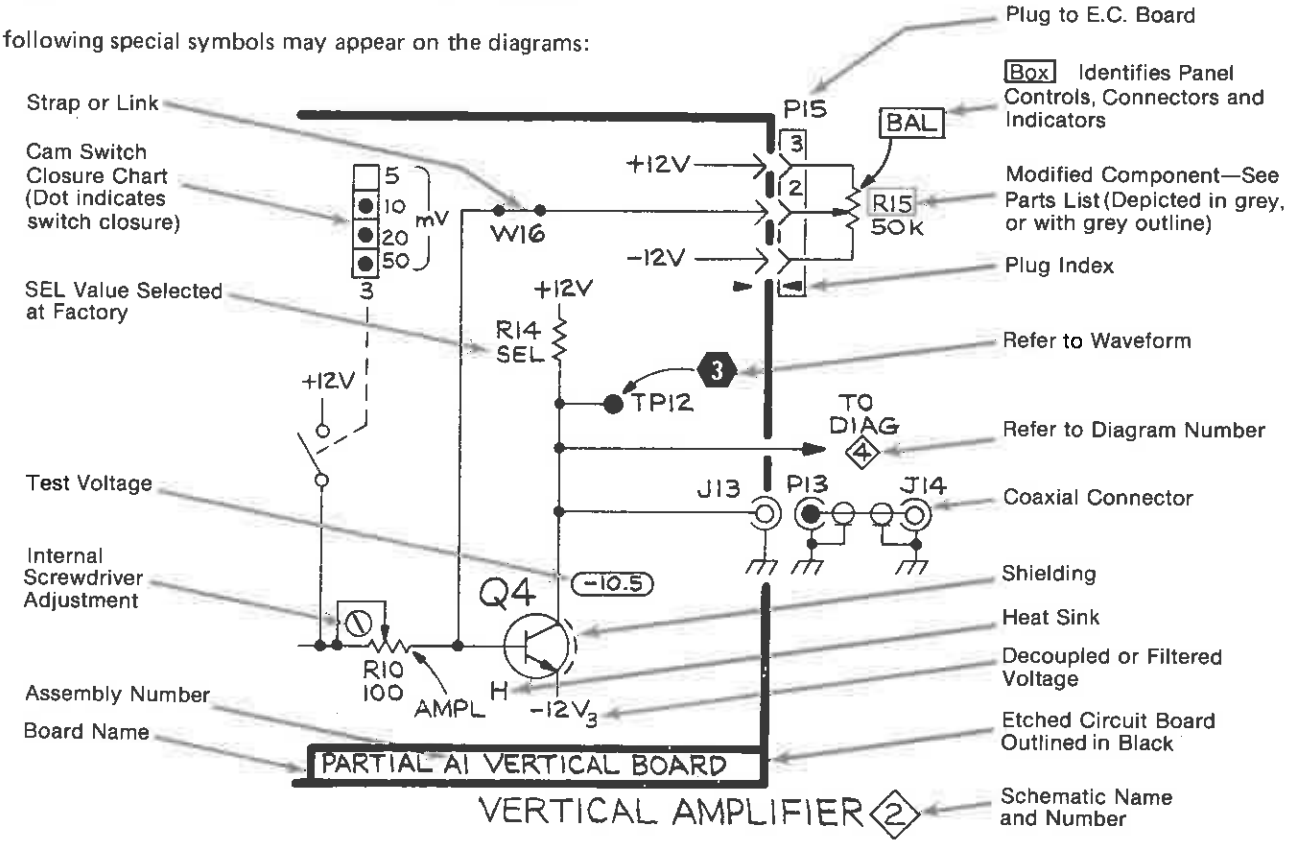
Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

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.

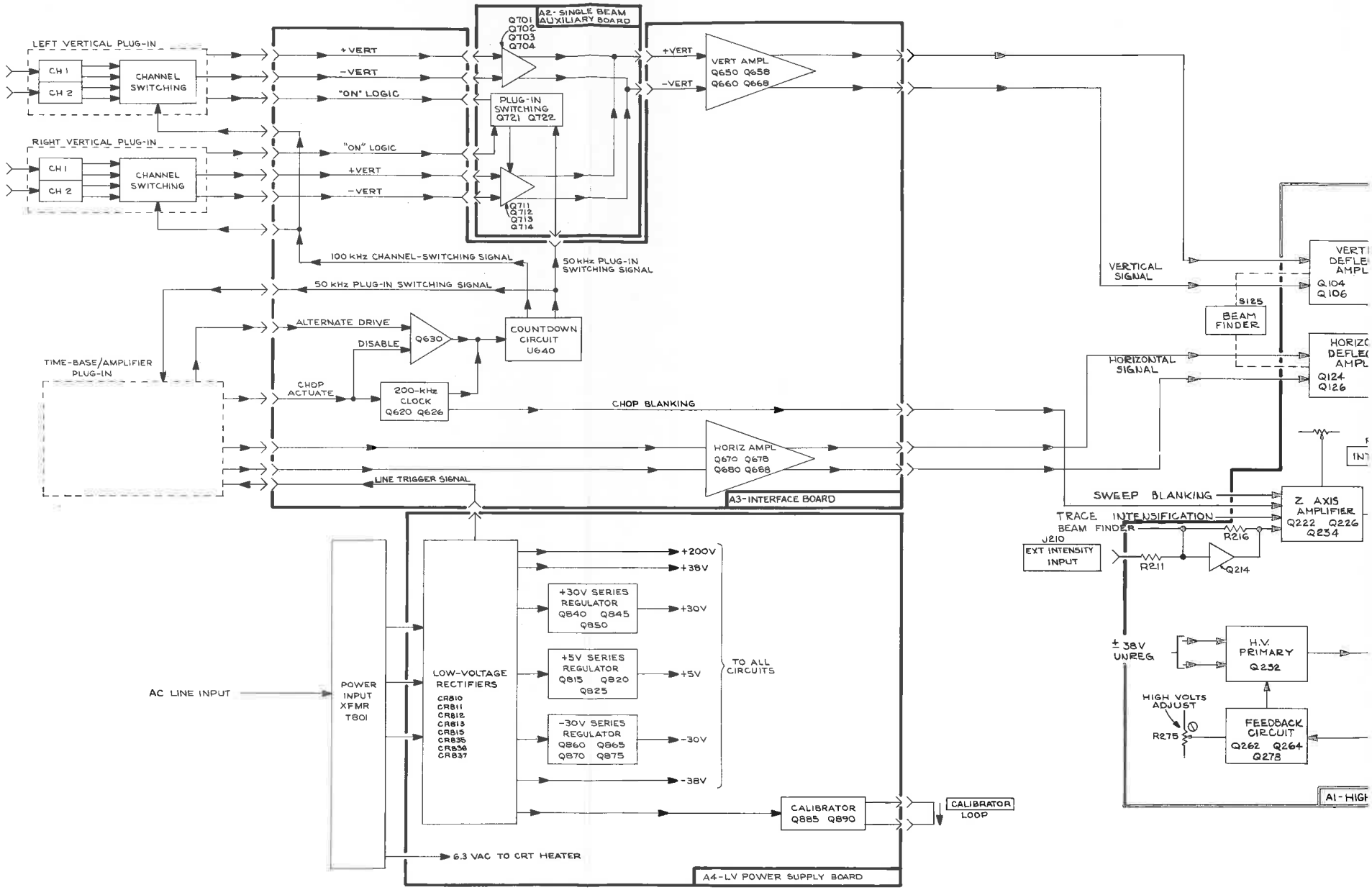
The following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

A	Assembly, separable or repairable (circuit board, etc)	H	Heat dissipating device (heat sink, heat radiator, etc)	S	Switch or contactor
AT	Attenuator, fixed or variable	HR	Heater	T	Transformer
B	Motor	HY	Hybrid circuit	TC	Thermocouple
BT	Battery	J	Connector, stationary portion	TP	Test point
C	Capacitor, fixed or variable	K	Relay	U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
CB	Circuit breaker	L	Inductor, fixed or variable	V	Electron tube
CR	Diode, signal or rectifier	M	Meter	VR	Voltage regulator (zener diode, etc.)
DL	Delay line	P	Connector, movable portion	W	Wirestrap or cable
DS	Indicating device (lamp)	Q	Transistor or silicon-controlled rectifier	Y	Crystal
E	Spark Gap, Ferrite bead	R	Resistor, fixed or variable	Z	Phase shifter
F	Fuse	RT	Thermistor		
FL	Filter				

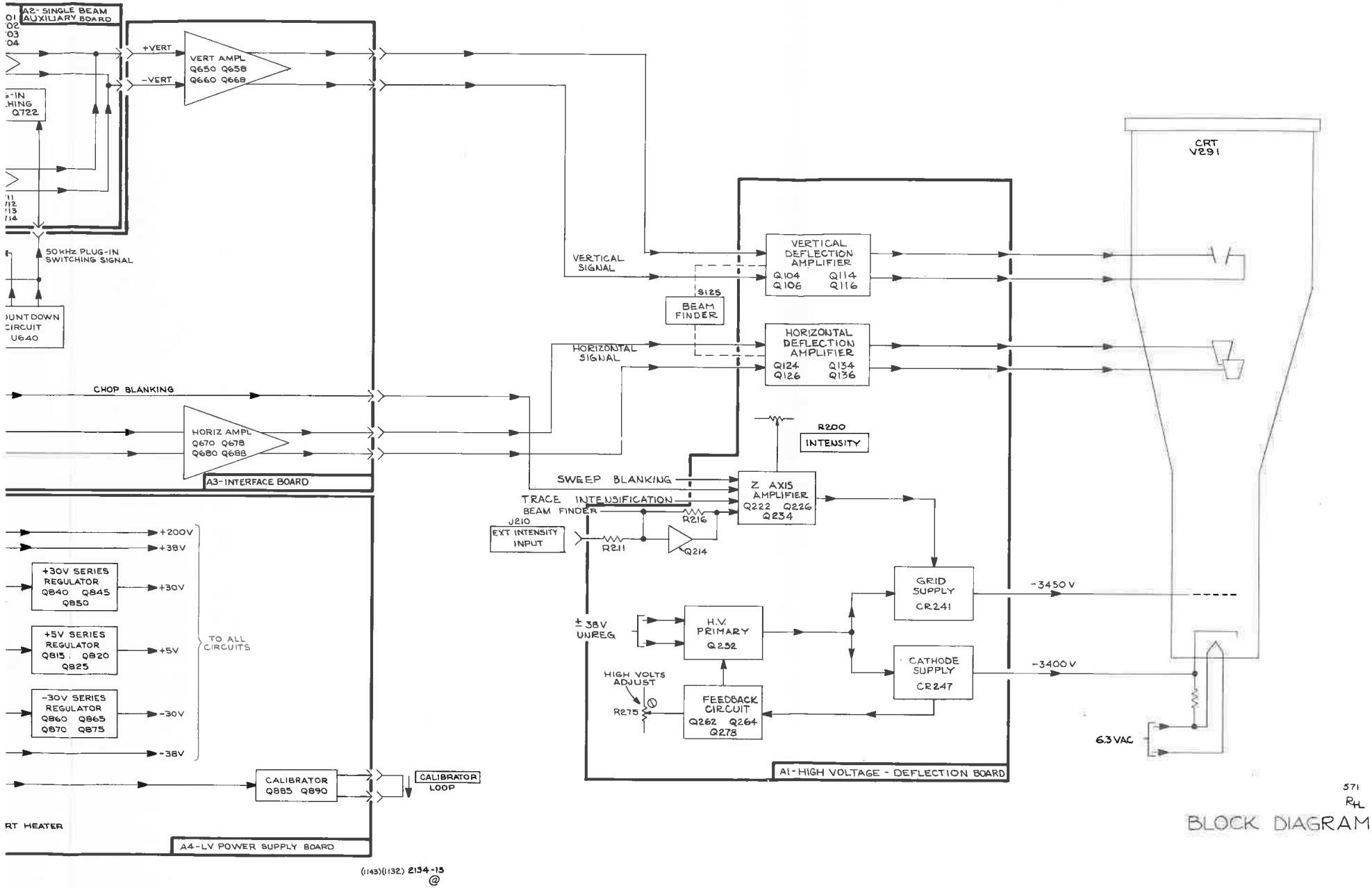
The following special symbols may appear on the diagrams:



@



(1143)(1132) 2134-15
@

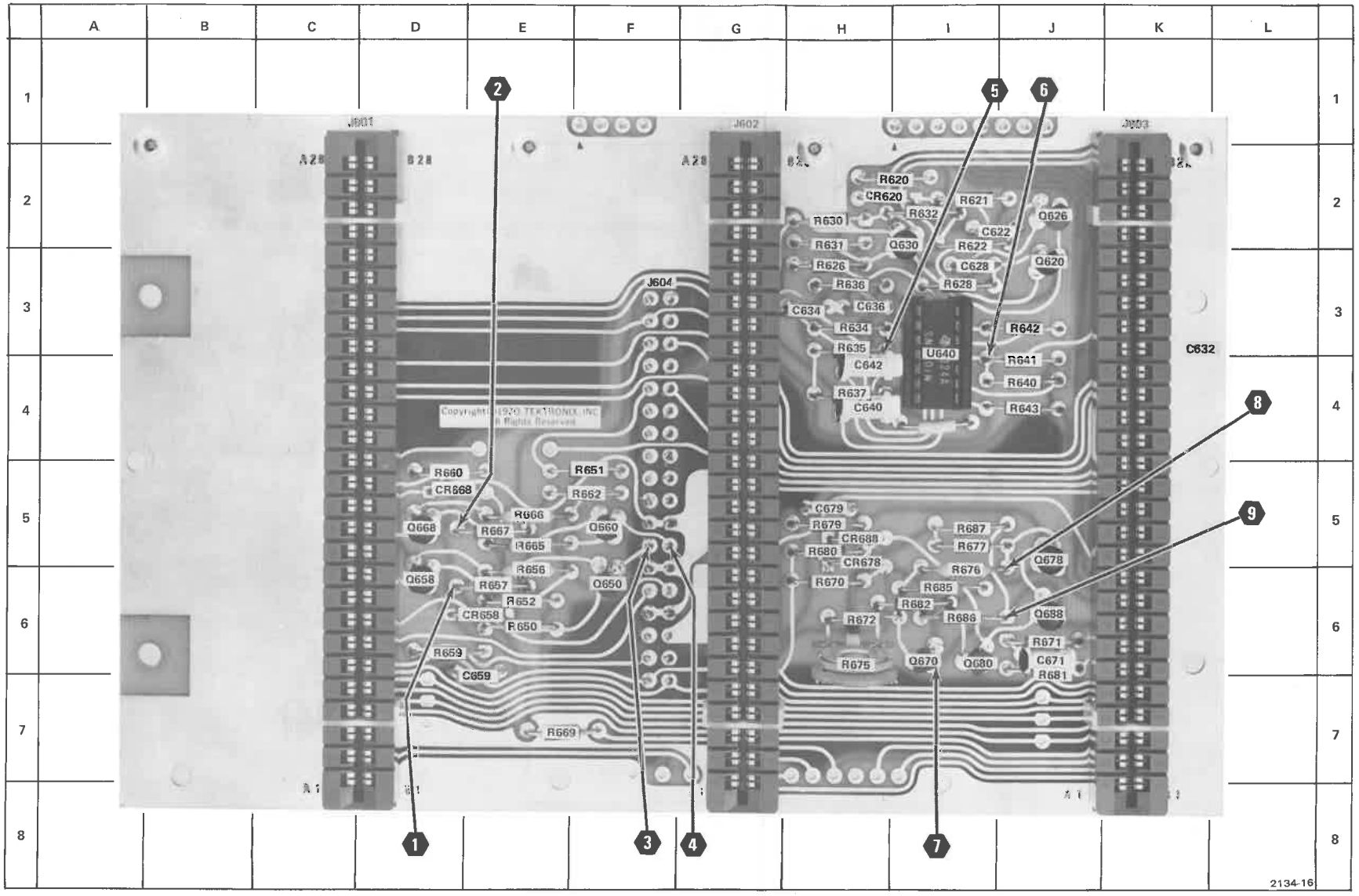


(1143)(1132) 2134-15

571

RHL

BLOCK DIAGRAM



A3—Interface circuit board.

CKT NO	GRID LOC	CKT NO	GRID LOC
C622	J-2	R670	H-6
C628	I-3	R671	J-6
C632†	K-3	R672	H-6
C634	H-3	R675	H-6
C636	H-3	R676	I-6
C640	H-4	R677	I-5
C642	H-4	R679	H-5
C659	E-7	R680	H-5
C671 *	J-6	R681	J-7
C679	H-5	R682	I-6
		R685	I-6
		R686	I-6
CR620	H-2	R687	I-5
CR658	E-6		
CR668	D-5		
CR678	H-5		
CR688	H-5	U640	I-3
J601	C-1		
J602	G-1		
J603	K-1		
J604†	F-3		
Q620	J-3		
Q626	J-2		
Q630	I-2		
Q650	F-6		
Q658	D-6		
Q660	F-5		
Q668	D-5		
Q670	I-6		
Q678	J-5		
Q680	I-6		
Q688	J-6		
R620	I-2		
R621	I-2		
R622	I-2		
R626	H-3		
R628	I-3		
R630	H-2		
R631	H-2		
R632	I-2		
R634	H-3		
R635	H-3		
R636	H-3		
R637	H-4		
R640	J-4		
R641	J-4		
R642	J-3		
R643	J-4		
R650	E-6		
R651	F-5		
R652	E-6		
R656	E-6		
R657	E-6		
R659	D-6		
R660	D-5		
R662	F-5		
R665	E-5		
R666	E-5		
R667	E-5		
R669	E-7		

*See Parts List for serial number ranges.

†Located on back of board.

@

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

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

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Test oscilloscope system	Deflection factor, 1 mV to 50 V/div; input impedance, 1 megohm; frequency response, dc to 2 MHz. Probe: 10X attenuation probe compatible with vertical input.	Tektronix 5110, 5A13N, 5B10N oscilloscope system or equiv. Use a Tektronix P6108 or P6062A Probe.
Voltmeter (Non-loading digital multimeter)	Range, 0 to 250 V; input impedance, 10 megohms.	Tektronix DM 501 Digital Multimeter with power module.

VOLTAGE CONDITIONS

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

An amplifier unit is installed in the left vertical compartment (for power supply loading). INTENSITY control is set fully ccw. Voltmeter common is connected to chassis ground.

WAVEFORM CONDITIONS

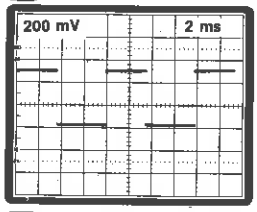
OSCILLOSCOPE UNDER TEST. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal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

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

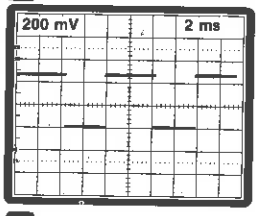
NOTE

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

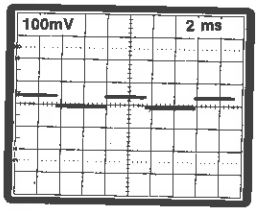
1



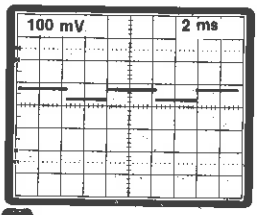
2



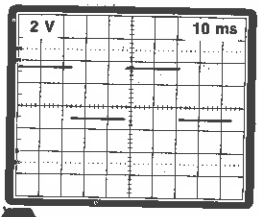
3



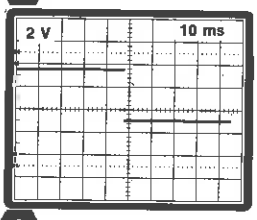
4



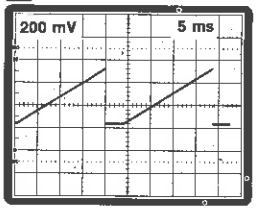
5



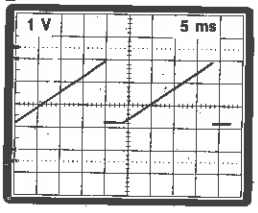
6



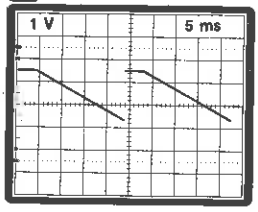
7

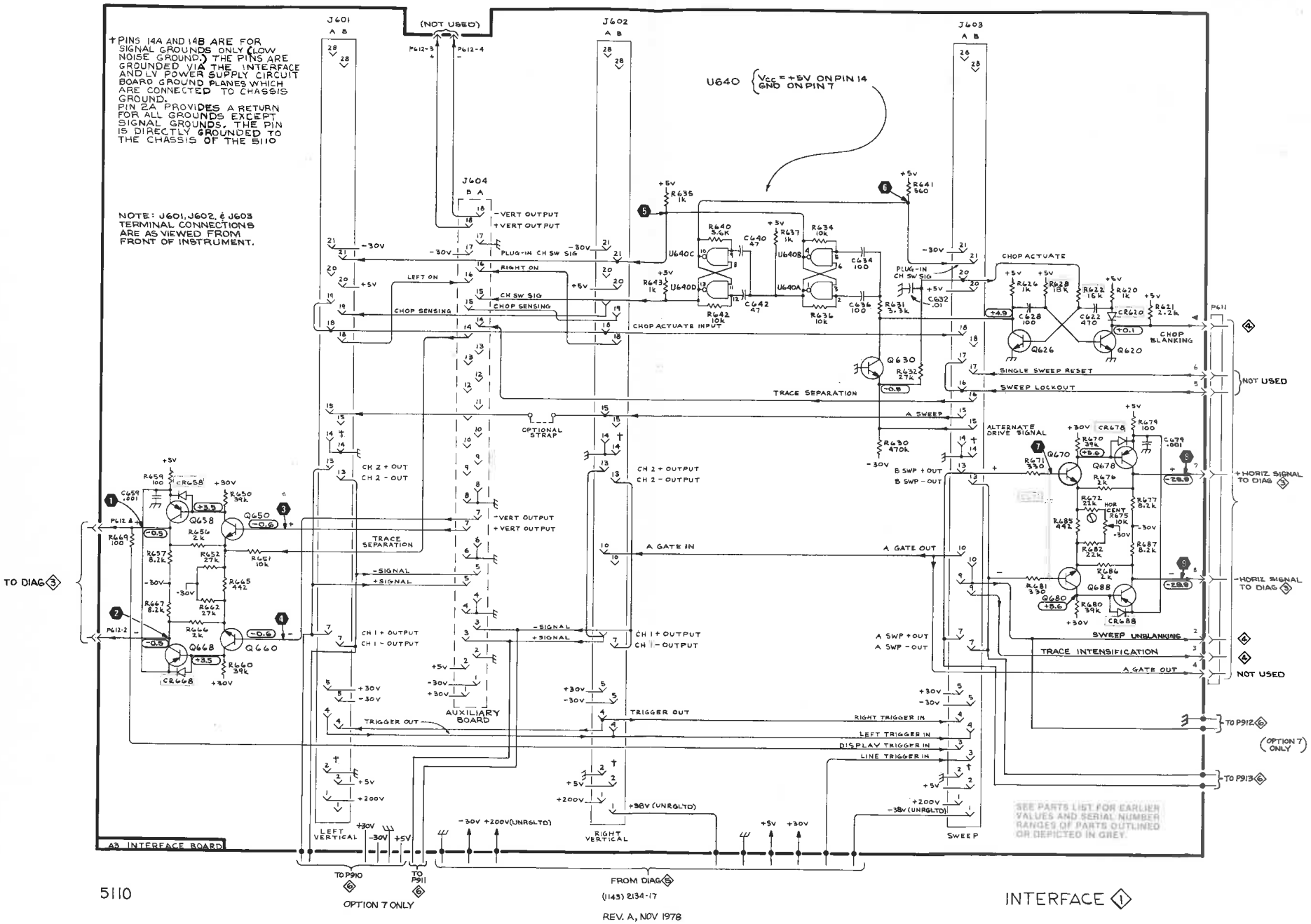


8



9




†PINS 14A AND 14B ARE FOR SIGNAL GROUNDS ONLY (LOW NOISE GROUND.) THE PINS ARE GROUNDED VIA THE INTERFACE AND LV POWER SUPPLY CIRCUIT BOARD GROUND PLANES WHICH ARE CONNECTED TO CHASSIS GROUND.
PIN 2A PROVIDES A RETURN FOR ALL GROUNDS EXCEPT SIGNAL GROUNDS. THE PIN IS DIRECTLY GROUNDED TO THE CHASSIS OF THE 5110
NOTE: J601, J602, & J603 TERMINAL CONNECTIONS ARE AS VIEWED FROM FRONT OF INSTRUMENT.
J601
J602
J603
J604
(NOT USED)
U640 {Vcc = +5V ON PIN 14 GND ON PIN 7
-VERT OUTPUT
+VERT OUTPUT
PLUG-IN CH SW SIG
RIGHT ON
LEFT ON
CH SW SIG
CHOP SENSING
CHOP ACTUATE INPUT
CHOP ACTUATE
CHOP BLANKING
SINGLE SWEEP RESET
SWEEP LOCKOUT
NOT USED
TRACE SEPARATION
A SWEEP
OPTIONAL STRAP
ALTERNATE DRIVE SIGNAL
B SWP + OUT
B SWP - OUT
+HORIZ SIGNAL TO DIAG 3
CH 2 + OUT
CH 2 - OUT
CH 2 + OUTPUT
CH 2 - OUTPUT
A GATE IN
A GATE OUT
-SIGNAL
+SIGNAL
CH 1 + OUTPUT
CH 1 - OUTPUT
A SWP + OUT
A SWP - OUT
-HORIZ SIGNAL TO DIAG 3
SWEEP UNBLANKING
TRACE INTENSIFICATION
A GATE OUT
NOT USED
TRIGGER OUT
RIGHT TRIGGER IN
LEFT TRIGGER IN
DISPLAY TRIGGER IN
LINE TRIGGER IN
TO P912 6
(OPTION 7 ONLY)
TO P913 6
TO DIAG 3
AUXILIARY BOARD
LEFT VERTICAL
RIGHT VERTICAL
SWEEP
A3 INTERFACE BOARD
TO P910 6
TO P911 6
OPTION 7 ONLY
FROM DIAG 5
(1143) 2134-17
REV. A, NOV 1978
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.
INTERFACE 1

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

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

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Test oscilloscope system	Deflection factor, 1 mV to 50 V/div; input impedance, 1 megohm; frequency response, dc to 2 MHz. Probe: 10X attenuation probe compatible with vertical input.	Tektronix 5110, 5A13N, 5B10N oscilloscope system or equiv. Use a Tektronix P6108 or P6062A Probe.
Voltmeter (Non-loading digital multimeter)	Range, 0 to 250 V; input impedance, 10 megohms.	Tektronix DM 501 Digital Multimeter with power module.

VOLTAGE CONDITIONS

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

An amplifier unit is installed in the left vertical compartment (for power supply loading). INTENSITY control is set fully ccw. Voltmeter common is connected to chassis ground.

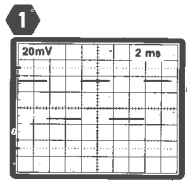
WAVEFORM CONDITIONS

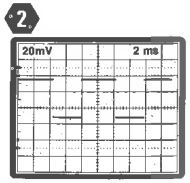
OSCILLOSCOPE UNDER TEST. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal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

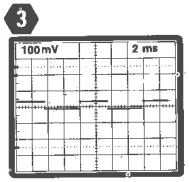
TEST OSCILLOSCOPE. Set the test oscilloscope triggering for auto mode with ac coupling from the internal source and set vertical input coupling to ac. Connect a 10X Probe to the vertical input. Position the display as necessary.

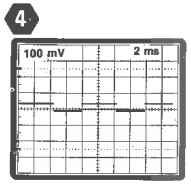
NOTE

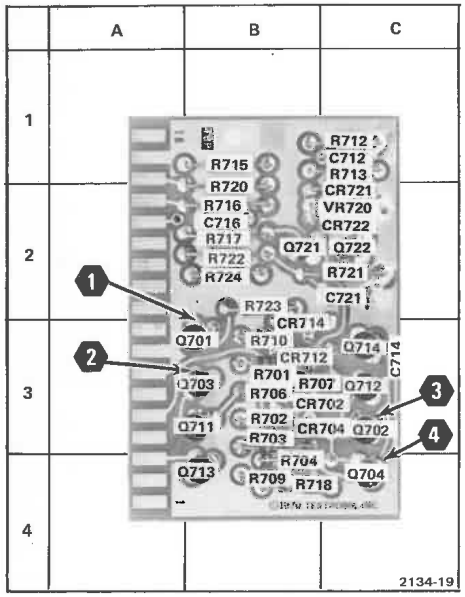
The waveforms shown are actual waveform photographs taken with a Tektronix Oscilloscope Camera System and Projected Graticule. Vertical deflection factor shown on the waveform is the actual deflection factor from the probe tip. Voltages and waveforms on the diagrams are not absolute and may vary between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









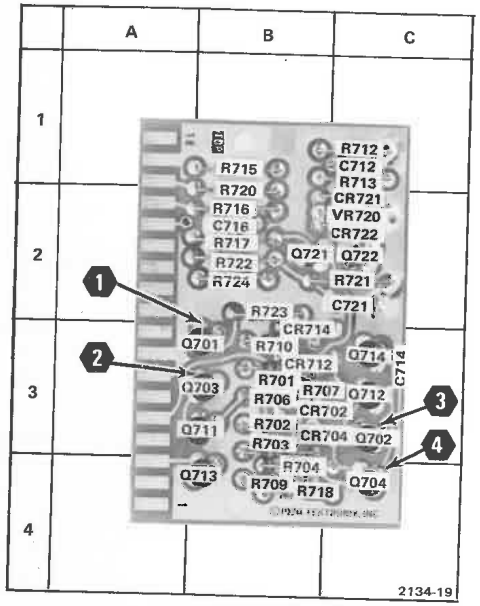


A2—Single Beam Auxiliary circuit board.

CKT NO	GRID LOC	CKT NO	GRID LOC
C712	C-1	Q721	B-2
C714†	C-3	Q722	C-2
C716	B-2		
C721	C-2	R701	B-3
		R702	B-3
CR702	C-3	R703	B-3
CR704	C-3	R704	B-4
CR712	B-3	R706	B-3
CR714	B-3	R707	B-3
CR721	C-2	R709	B-4
CR722	C-2	R710	B-3
		R712	C-1
VR720	C-2	R713	C-1
		R715	B-1
Q701	B-3	R716	B-2
Q702	C-3	R717	B-2
Q703	B-3	R718	B-4
Q704	C-4	R720	B-2
Q711	B-3	R721	C-2
Q712	C-3	R722	B-2
Q713	B-4	R723	B-2
Q714	C-3	R724	B-2

†Located on back of board.

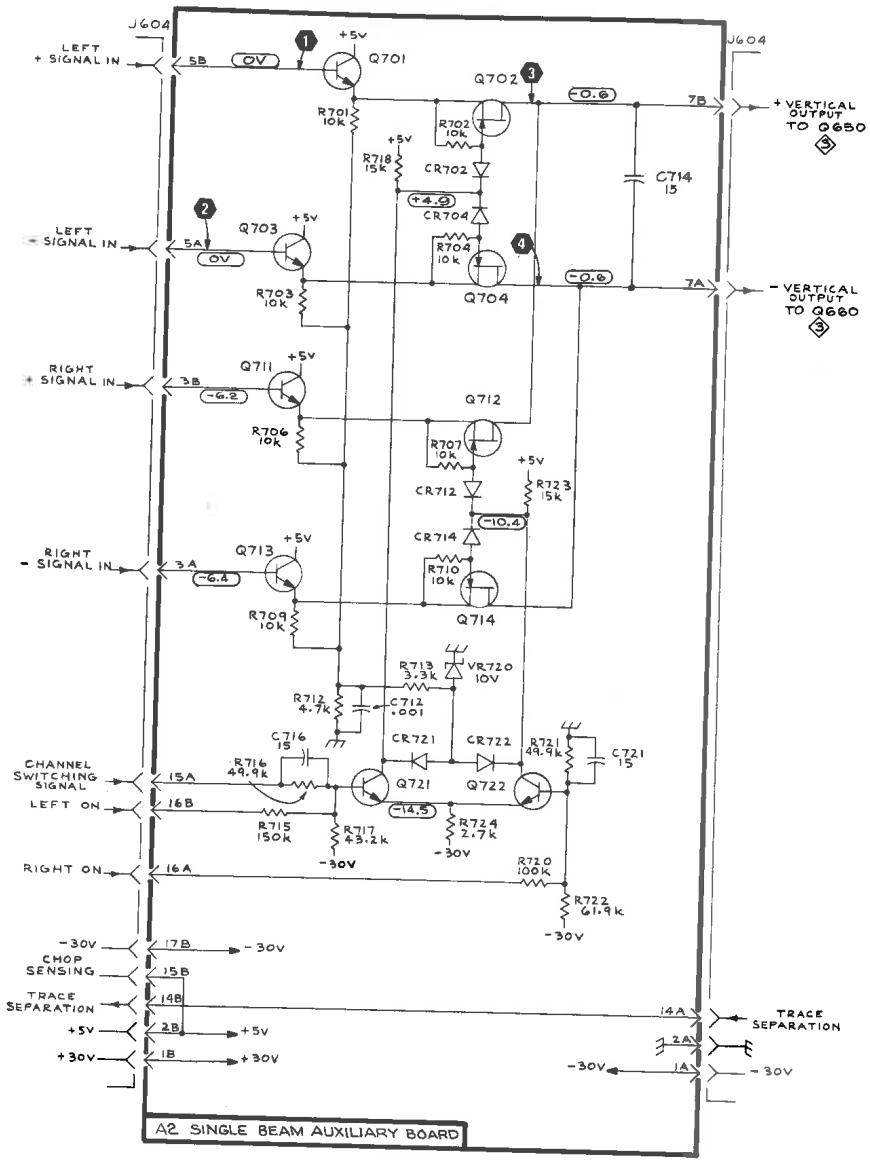
VOLTAGE & WAVEFORM CONDITIONS



A2—Single Beam Auxiliary circuit board.

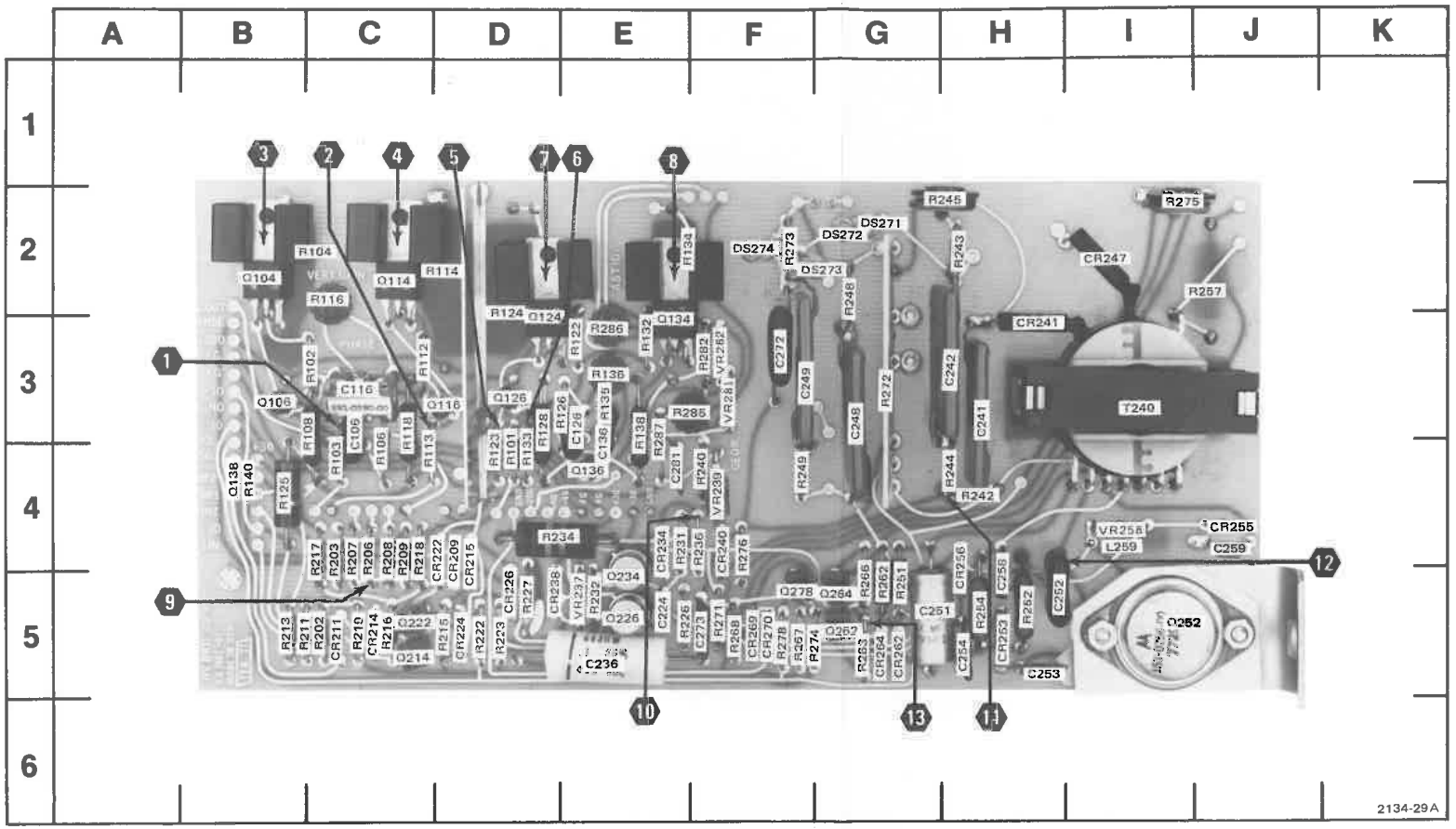
CKT NO	GRID LOC	CKT NO	GRID LOC
C712	C-1	Q721	B-2
C714†	C-3	Q722	C-2
C716	B-2		
C721	C-2	R701	B-3
		R702	B-3
CR702	C-3	R703	B-3
CR704	C-3	R704	B-4
CR712	B-3	R706	B-3
CR714	B-3	R707	B-3
CR721	C-2	R709	B-4
CR722	C-2	R710	B-3
		R712	C-1
VR720	C-2	R713	C-1
		R715	B-1
Q701	B-3	R716	B-2
Q702	C-3	R717	B-2
Q703	B-3	R718	B-4
Q704	C-4	R720	B-2
Q711	B-3	R721	C-2
Q712	C-3	R722	B-2
Q713	B-4	R723	B-2
Q714	C-3	R724	B-2

†Located on back of board.



(143)2134-18

AUXILIARY BOARD ②



A1—High Voltage—Deflection circuit board (SN B120000 & above).

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C106	C3	C254	H5	CR226	D5	DS271	G2	Q134	E3	R101	D4	R124†	D2	R203	C4	R222	D5	R248	G2	R272	G3	T240	I3
C116	C3	C258	H5	CR234	E4	DS272	G2	Q136	E4	R102	B3	R125	B4	R206	C4	R223	D5	R249	F4	R273	F2		
C126	E3	C259	J4	CR238	D5	DS273	G2	Q138*	B4	R103	C4	R126	E3	R207	C4	R226	E5	R251	G5	R274	F5	VR237	E5
C136	E3	C272	F3	CR240	F4	DS274	F2	Q214	C5	R104†	B2	R128	D3	R208	C4	R227	D5	R252	H5	R275	I1	VR239	F4
C224	E5	C273	F5	CR241	I2			Q222	C5	R106	C3	R132	E3	R209	C4	R231	E4	R254	H5	R276	F4	VR258	I4
C236	E5	C281	E4	CR247	I2	L259†	I4	Q226	E5	R108	C3	R133	D4	R211	B5	R232	E5	R257†*	J2	R278	F5	VR281	F3
C241	H3			CR253	H5			Q234	E5	R112	C3	R134†	E2	R213	B5	R234	D4	R262	G5	R282	F3	VR282	F3
C242	H3	CR209	D4	CR255	J4	Q104	B2	Q252	I5	R113	D4	R135	E3	R215	D5	R236	F4	R263	G5	R285	E3		
C248	G3	CR211	C5	CR256	H5	Q106	B3	Q262	G5	R114†	C2	R136	E3	R216	C5	R240	F4	R266	G5	R286	E2		
C249	F3	CR214	C5	CR262	G5	Q114	C2	Q264	G5	R116	C2	R138	E3	R217	C4	R242†	H4	R267	G5	R287	E4		
C251	G5	CR215	D4	CR264	G5	Q116	C3	Q278	G5	R118	C3	R140*	B4	R218	C4	R243	H2	R267	F5				
C252	H5	CR222	D4	CR269	F5	Q124	D2			R122	E3	R202	C5	R219	C5	R244	H4	R268	F5				
C253	H5	CR224	D5	CR270	F5	Q126	D3			R123	D4					R245	H2	R271	F5				

*See Parts List for serial number ranges.

† Located on back of board.

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

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

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Test oscilloscope system	Deflection factor, 1 mV to 50 V/div; input impedance, 1 megohm; frequency response, dc to 2 MHz. Probe: 10X attenuation probe compatible with vertical input.	Tektronix 5110, 5A13N, 5B10N oscilloscope system or equiv. Use a Tektronix P6108 or P6062A Probe.
Voltmeter (Non-loading digital multimeter)	Range, 0 to 250 V; input impedance, 10 megohms.	Tektronix DM 501 Digital Multimeter with power module.

VOLTAGE CONDITIONS

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

An amplifier unit is installed in the left vertical compartment (for power supply loading). INTENSITY control is set fully ccw. Voltmeter common is connected to chassis ground.

WAVEFORM CONDITIONS

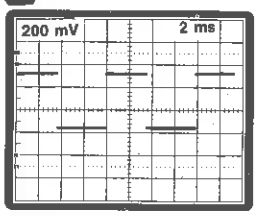
OSCILLOSCOPE UNDER TEST. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal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

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

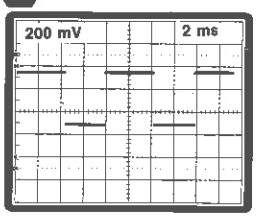
NOTE

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

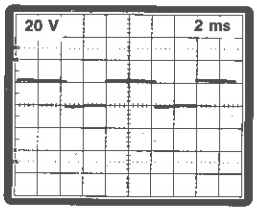
1



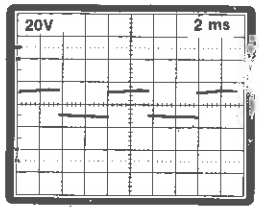
2



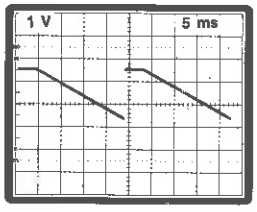
3



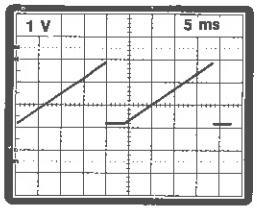
4



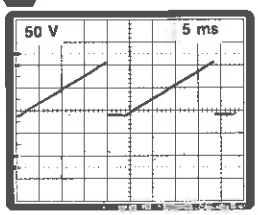
5



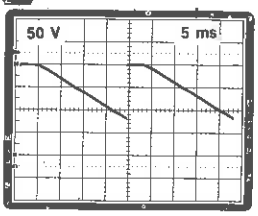
6

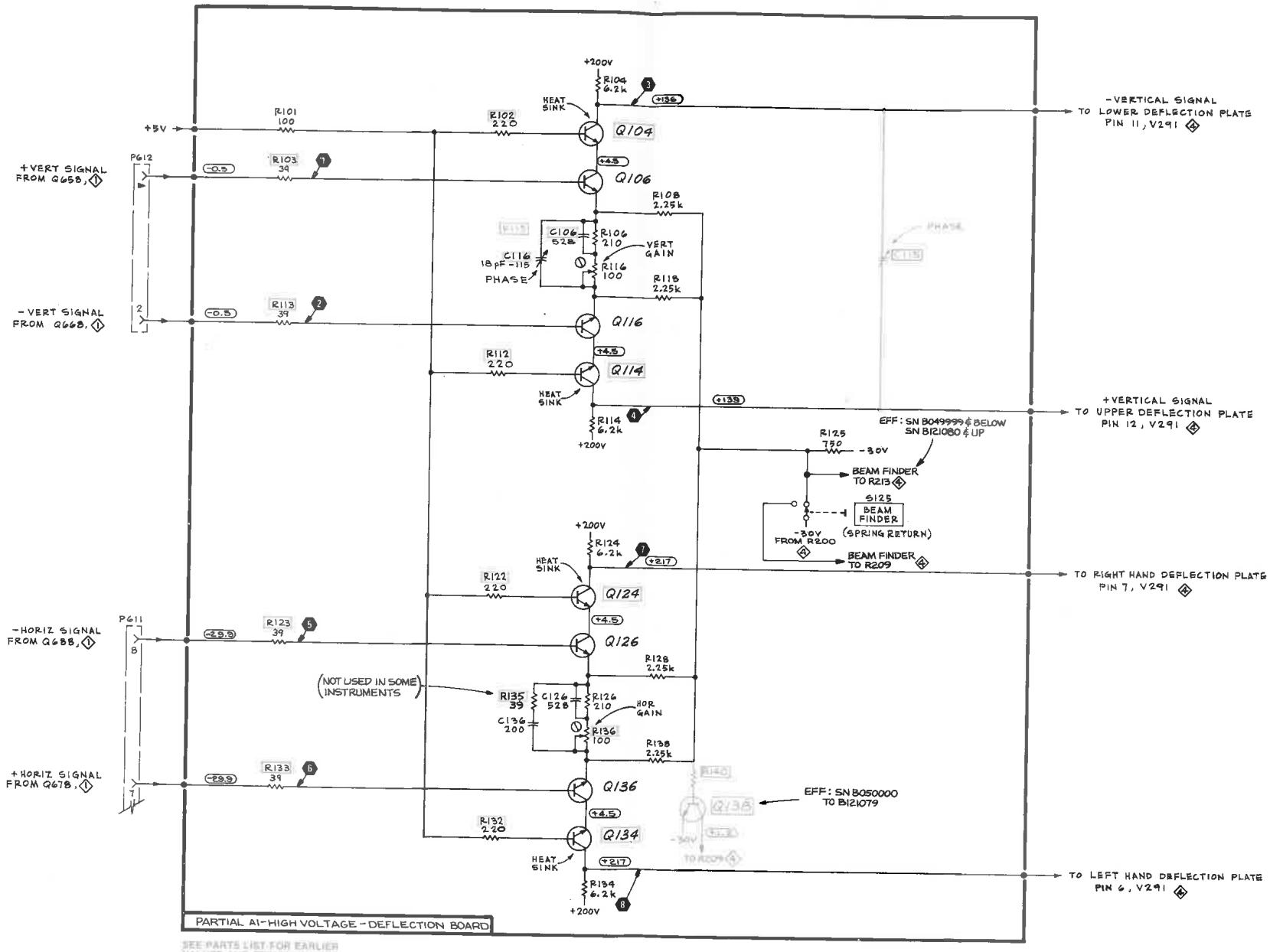


7



8





SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.

(1132)2134-17
REV. A, JUL 1979

VERTICAL & HORIZONTAL DEFLECTION AMPLIFIERS 3

GAB 1271

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

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

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Test oscilloscope system	Deflection factor, 1 mV to 50 V/div; input impedance, 1 megohm; frequency response, dc to 2 MHz. Probe: 10X attenuation probe compatible with vertical input.	Tektronix 5110, 5A13N, 5B10N oscilloscope system or equiv. Use a Tektronix P6108 or P6062B Probe.
Voltmeter (Non-loading digital multimeter)	Range, 0 to 250 V; input impedance, 10 megohms.	Tektronix DM 501A Option 02 Digital Multimeter with power module.

VOLTAGE CONDITIONS

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

An amplifier unit is installed in the left vertical compartment (for power supply loading). INTENSITY control is set fully ccw. Voltmeter common is connected to chassis ground.

WAVEFORM CONDITIONS

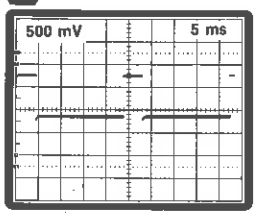
OSCILLOSCOPE UNDER TEST. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal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

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

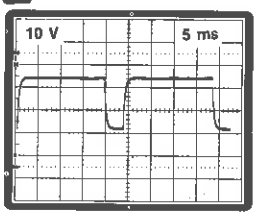
NOTE

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

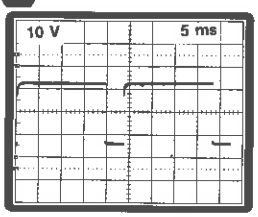
9



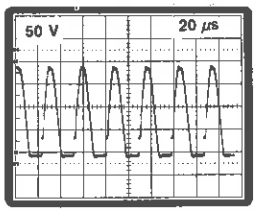
10



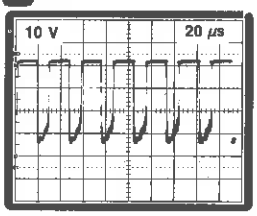
11

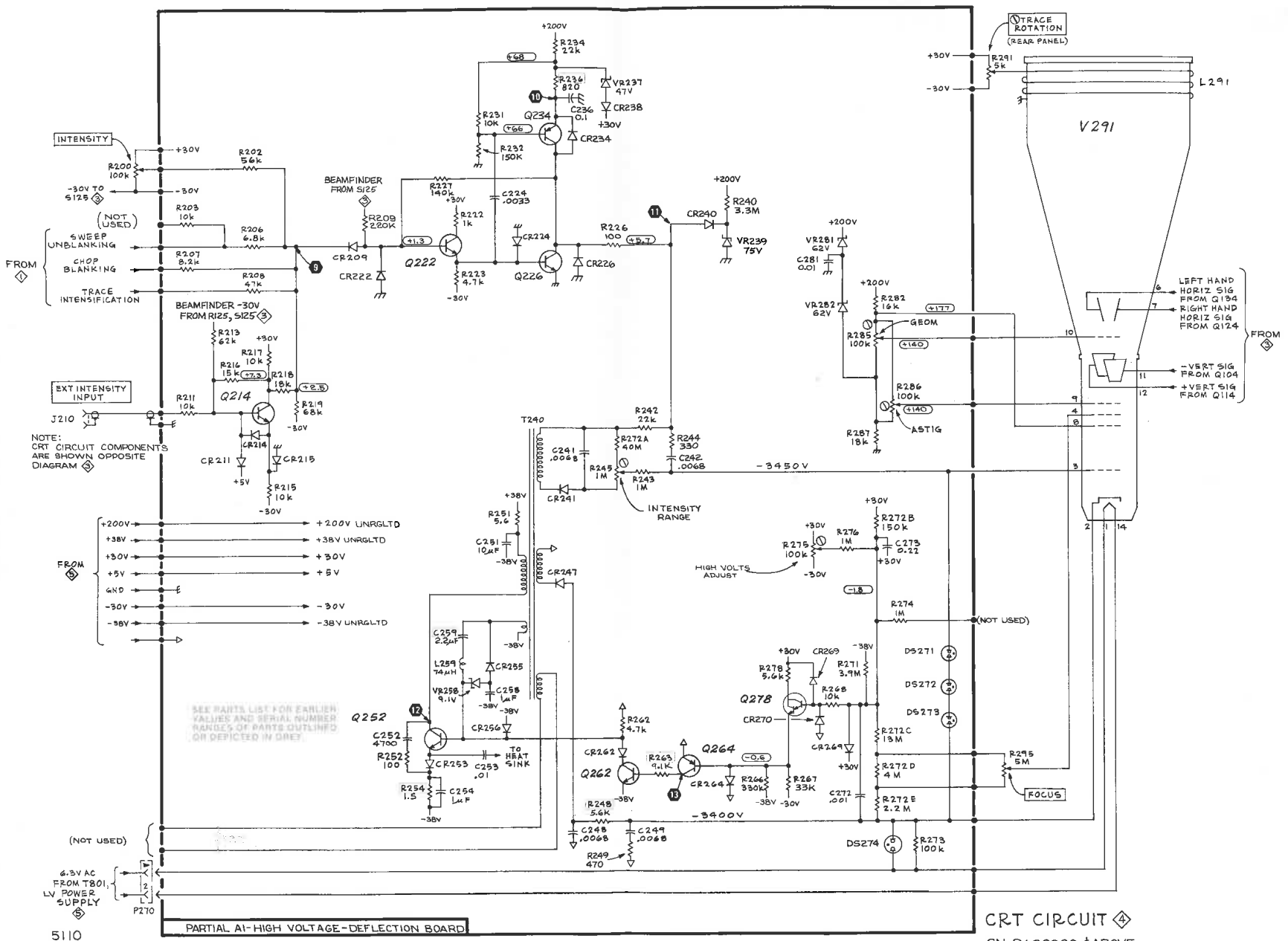


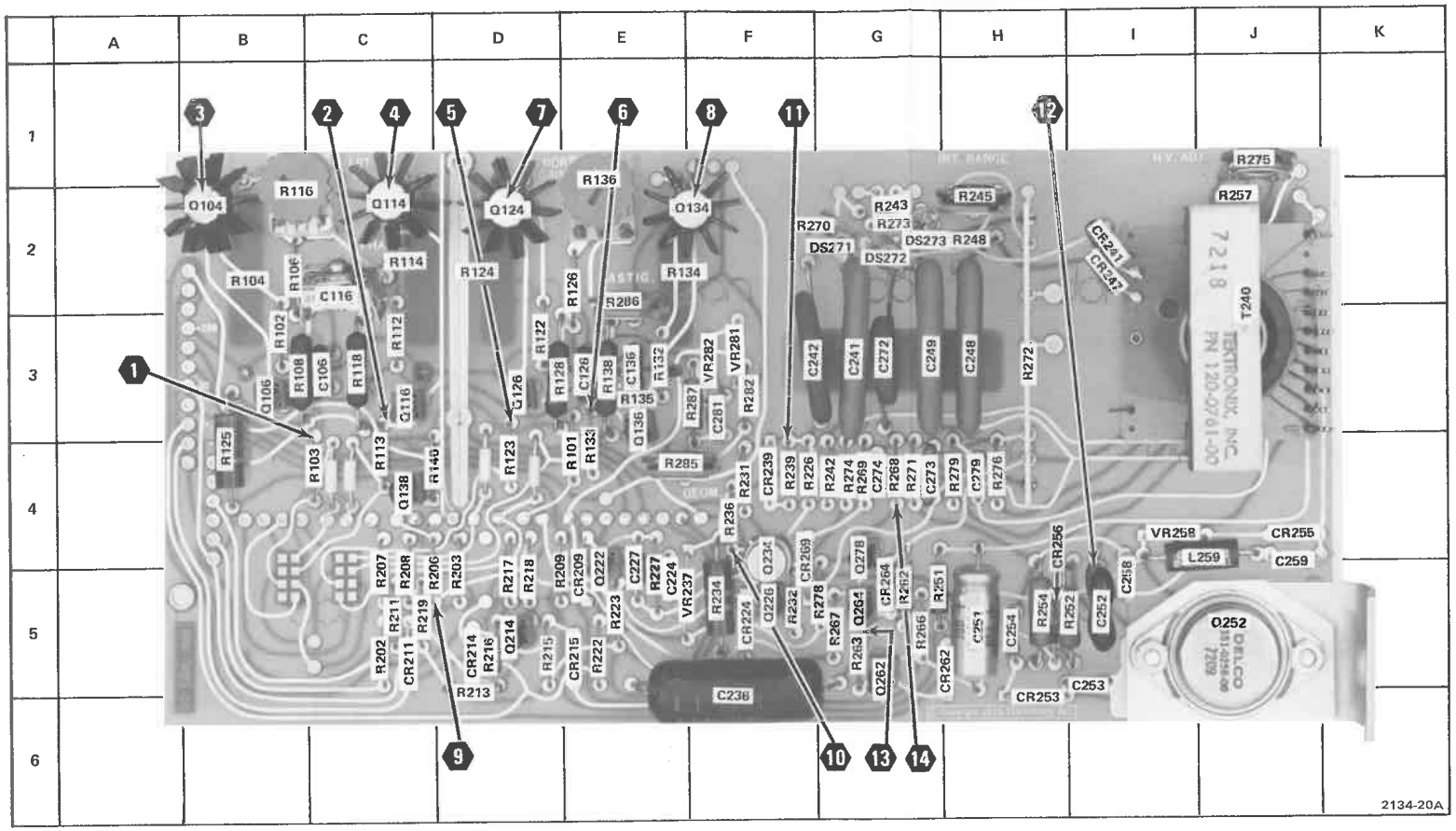
12



13



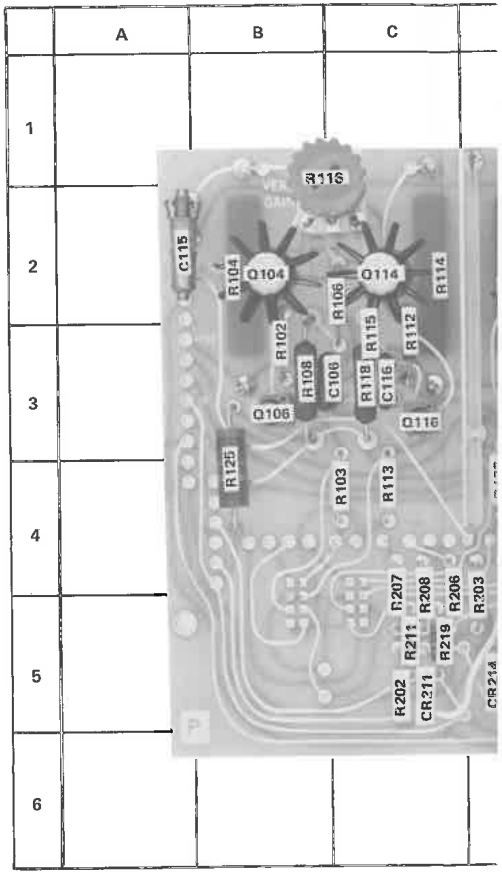

INTENSITY
R200 100k
-30V TO S125 3
(NOT USED)
SWEEP UNBLANKING
CHOP BLANKING
TRACE INTENSIFICATION
FROM 1
R202 56k
R203 10k
R206 6.8k
R207 8.2k
R208 47k
BEAMFINDER FROM S125 3
R209 220K
CR209
CR222
Q222
R227 140k
R222 1k
R223 9.7k
C224 .0033
CR224
Q226
CR226
R226 100
R234 22k
R236 820
C236 0.1
R231 10K
Q234
R232 150K
CR234
VR237 47V
CR238
+30V
+200V
CR240
R240 3.3M
VR239 75V
BEAMFINDER -30V FROM R125, S125 3
R213 62k
R217 10k
R216 15k
R218 18k
R219 68k
EXT INTENSITY INPUT
J210
R211 10k
Q214
CR214
CR211
CR215
+5V
R215 10k
NOTE: CRT CIRCUIT COMPONENTS ARE SHOWN OPPOSITE DIAGRAM 3
FROM 5
+200V UNRGLTD
+38V UNRGLTD
+30V
+5V
GND
-30V
-38V UNRGLTD
T240
R242 22k
R272A 40M
R244 330
C241 .0068
C242 .0068
R245 1M
R243 1M
CR241
INTENSITY RANGE
-3450V
R251 5.6
C251 10µF
CR247
C259 2.2µF
L259 74µH
CR255
VR258 9.1V
C258 1µF
CR256
Q252
C252 4700
R252 100
CR253
C253 .01
TO HEAT SINK
R254 1.5
C254 1µF
R262 4.7k
CR262
Q262
R263 9.1K
Q264
CR264
R266 330K
R267 33K
R248 5.6K
C248 .0068
C249 .0068
R249 470
-3400V
HIGH VOLTS ADJUST
R275 100k
R276 1M
R272B 150k
C273 0.22
R274 1M
(NOT USED)
R278 5.6k
CR269
R271 3.9M
R268 10k
Q278
CR270
CR269
R272C 13M
R272D 4M
R272E 2.2M
C272 .001
R295 5M
FOCUS
DS271
DS272
DS273
DS274
R273 100k
TRACE ROTATION
(REAR PANEL)
R291 5k
L291
V291
VR281 62V
C281 0.01
VR282 62V
R282 16k
GEOM
R285 100k
R286 100k
ASTIG
R287 18k
LEFT HAND HORIZ SIG FROM Q134
RIGHT HAND HORIZ SIG FROM Q124
-VERT SIG FROM Q104
+VERT SIG FROM Q114
FROM 3
(NOT USED)
6.3V AC FROM TB01, LV POWER SUPPLY 5
P270
PARTIAL A1-HIGH VOLTAGE-DEFLECTION BOARD
5110
(1132) 2134-28
REV A JUL 1980
CRT CIRCUIT 4
SN B120000 & ABOVE



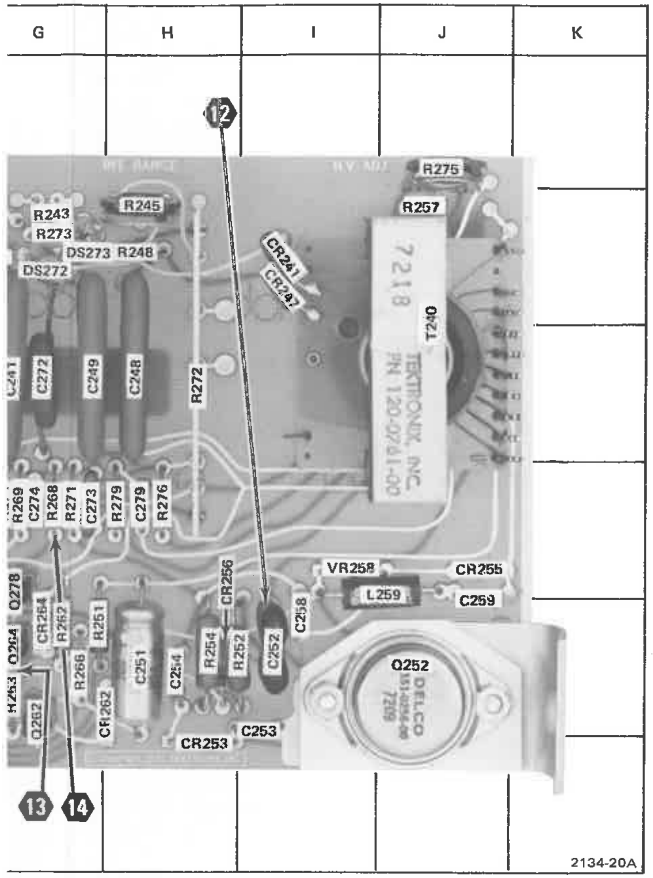
A1—High Voltage—Deflection circuit board(SN B050000 to B119999).

CKT NO	GRID LOC
C106	C-3
C116	C-2
C126	E-3
C136	E-3
C224	E-5
C227	E-5
C236	F-5
C241	G-3
C242	F-3
C248	H-3
C249	G-3
C251	H-5
C252	I-5
C253	I-5
C254	H-5
C258	I-5
C259	J-4
C272	G-3
C273	G-4
C274	G-4
C279	H-4
C281	F-4
CR209	E-5
CR211	C-5
CR214	D-5
CR215	E-5
CR224	F-5
CR239	F-4
CR241	I-2
CR247	I-2
CR253	H-6
CR255	J-4
CR256	H5
CR262	G-5
CR264	G-5
CR269	F-4
DS271	G-2
DS272	G-2
DS273	G-2
L259	J-4
Q104	B-2
Q106	B-3
Q114	C-2
Q116	C-3
Q124	D-2
Q126	D-3
Q134	F-2
Q136	E-3
Q138	C-4
Q214	D-5
Q222	E-5
Q226	F-5
Q234	F-5
Q252	J-5
Q262	G-5
Q264	G-5
Q278	G-4
R101	E-4
R102	B-3
R103	C-4
R104†	B-2
R106	B-2
R108	B-3
R112	C-3
R113	C-4
R114†	C-2
R116	B-2
R118	C-3
R122	D-3
R123	D-4
R124†	D-2
R125	B-4
R126	E-2
R128	D-3
R132	E-3
R133	E-4
R134†	E-2
R135	E-3
R136	E-2
R138	E-3
R140	C-4
R202	C-5
R203	D-5
R206	C-5
R207	C-5
R208	C-5
R209	D-5
R211	C-5
R213	D-6
R215	D-5
R216	D-5
R217	D-5
R218	D-5
R219	C-5
R222	E-5
R223	E-5
R226	F-4
R227	E-5
R231	F-4
R232	F-5
R234	F-5
R236	F-4
R239	F-4
R242	G-4
R243	G-2
R245	H-2
R248	H-2
R251	G-5
R252	H-5
R254	H-5
R257†	J-2
R262	G-5
R263	G-5
R266	G-5
R267	G-5
R268	G-4
R269	G-4
R270	G-2
R271	G-4
R272	H-3
R273	G-2
R274	G-4
R275	J-1
R276	H-4
R278	G-5
R279	H-4
R282	F-3
R285	E-4
R286	E-2
R287	E-3
T240	J-2

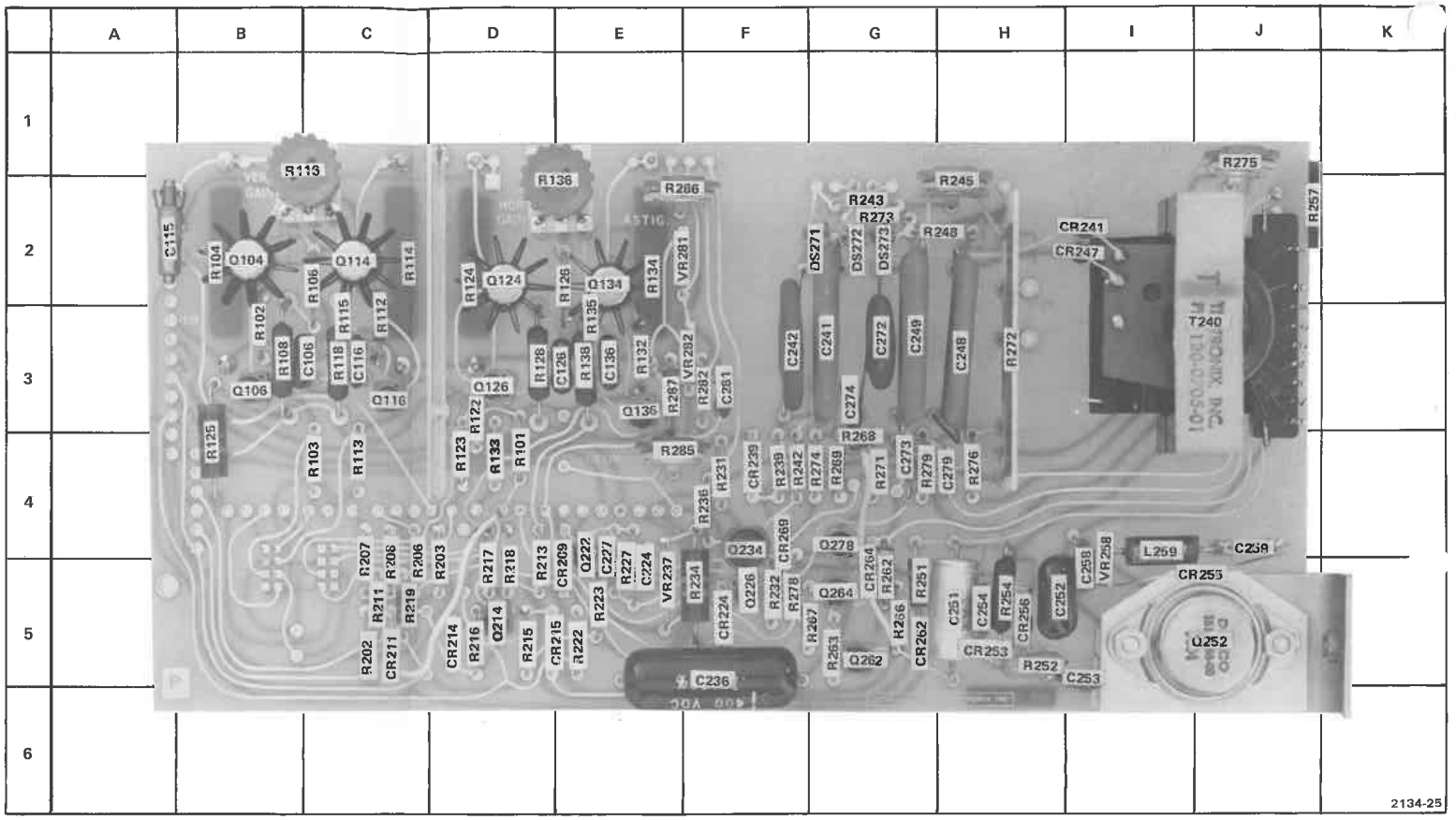
†Located on back of board.



REV A JUL 1980



to B119999).



A1—High Voltage—Deflection circuit board (SN B049999 & below).

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
-4	R124†	D-2	R206	C-5	R223	E-5	R251	G-5	R273	G-2																	
-3	R125	B-4	R207	C-5	R226	F-4	R252	H-5	R274	G-4																	
-4	R126	E-2	R208	C-5	R227	E-5	R254	H-5	R275	J-1																	
-2	R128	D-3	R209	D-5	R231	F-4	R257†	J-2	R276	H-4																	
-2	R132	E-3	R211	C-5	R232	F-5	R262	G-5	R278	G-5																	
-3	R133	E-4	R213	D-6	R234	F-5	R263	G-5	R279	H-4																	
-3	R134†	E-2	R215	D-5	R236	F-4	R266	G-5	R282	F-3																	
-4	R135	E-3	R216	D-5	R239	F-4	R267	G-5	R285	E-4																	
-2	R136	E-2	R217	D-5	R242	G-4	R268	G-4	R286	E-2																	
-2	R138	E-3	R218	D-5	R243	G-2	R269	G-4	R287	E-3																	
-3	R140	C-4	R219	C-5	R245	H-2	R270	G-2	T240	J-2																	
-3	R202	C-5	R222	E-5	R248	H-2	R271	G-4																			
-4	R203	D-5					R272	H-3																			

†Located on back of board.

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C106	B-3	C251	H-5	CR209	E-5	CR262	G-5	VR237	E-5	DS271	G-2	Q104	B-2	Q252	J-5	R101	D-4	R122	D-3	R202	C-5	R222	E-5	R251	G-5	R273	G-2
C115	A-2	C252	H-5	CR211	C-5	CR264	G-5	VR258	I-5	DS272	G-2	Q106	B-3	Q262	G-5	R102	B-3	R123	D-4	R203	D-5	R223	E-5	R252	H-5	R274	F-4
C116	C-3	C253	I-5	CR214	D-5	CR269	F-4	VR281	F-3	DS273	G-2	Q114	C-2	Q264	G-5	R103	C-4	R124	D-2	R206	C-5	R227	E-5	R254	H-5	R275	J-1
C126	E-3	C254	H-5	CR215	D-5			VR282	F-3			Q116	C-3	Q278	G-4	R104	B-2	R125	B-4	R207	C-5	R231	F-4	R257	J-2	R276	H-4
C136	E-3	C258	I-5	CR224	F-5							Q124	D-2			R106	C-2	R126	E-2	R208	C-5	R232	F-5	R262	G-5	R278	F-5
C224	E-5	C259	J-4	CR239	F-4					L259	I-4	Q126	D-3			R108	B-3	R128	D-3	R211	C-5	R234	F-5	R263	G-5	R279	G-4
C227	E-5	C272	G-3	CR241	I-2							Q134	E-2			R112	C-3	R132	E-3	R213	D-5	R236	F-4	R266	G-5	R282	F-3
C236	F-5	C273	G-4	CR247	I-2							Q136	E-3			R113	C-4	R133	D-4	R215	D-5	R239	F-4	R267	G-5	R285	E-4
C241	G-3	C274	G-3	CR252	H-5							Q214	D-5			R114	C-2	R134	E-2	R216	D-5	R242	F-4	R268	G-4	R286	E-2
C242	F-3	C279	H-4	CR253	H-5							Q222	E-5			R115	C-3	R135	E-3	R217	D-5	R243	G-2	R269	G-4	R287	
C248	H-3	C281	F-3	CR255	J-4							Q226	F-5			R116	B-1	R136	E-2	R218	D-5	R245	H-2	R271	G-4		
C249	G-3			CR256	H-5							Q234	F-4			R118	C-3	R138	E-3	R219	C-5	R248	H-2	R272	H-3	T240	J-3

REV A JUL 1980

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

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

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Test oscilloscope system	Deflection factor, 1 mV to 50 V/div; input impedance, 1 megohm; frequency response, dc to 2 MHz. Probe: 10X attenuation probe compatible with vertical input.	Tektronix 5110, 5A13N, 5B10N oscilloscope system or equiv. Use a Tektronix P6108 or P6062B Probe.
Voltmeter (Non-loading digital multimeter)	Range, 0 to 250 V; input impedance, 10 megohms.	Tektronix DM 501A Option 02 Digital Multimeter with power module.

VOLTAGE CONDITIONS

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

An amplifier unit is installed in the left vertical compartment (for power supply loading). INTENSITY control is set fully ccw. Voltmeter common is connected to chassis ground.

WAVEFORM CONDITIONS

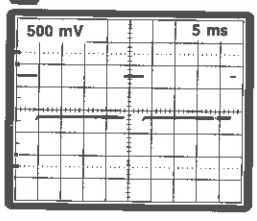
OSCILLOSCOPE UNDER TEST. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal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

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

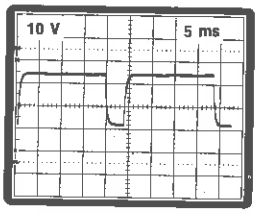
NOTE

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

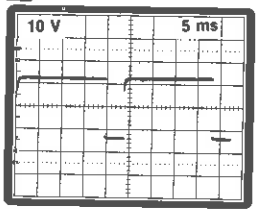
9



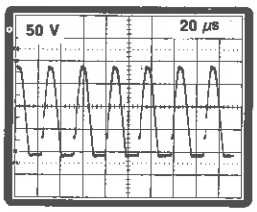
10



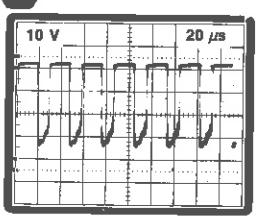
11



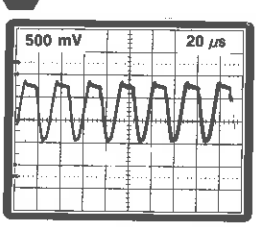
12

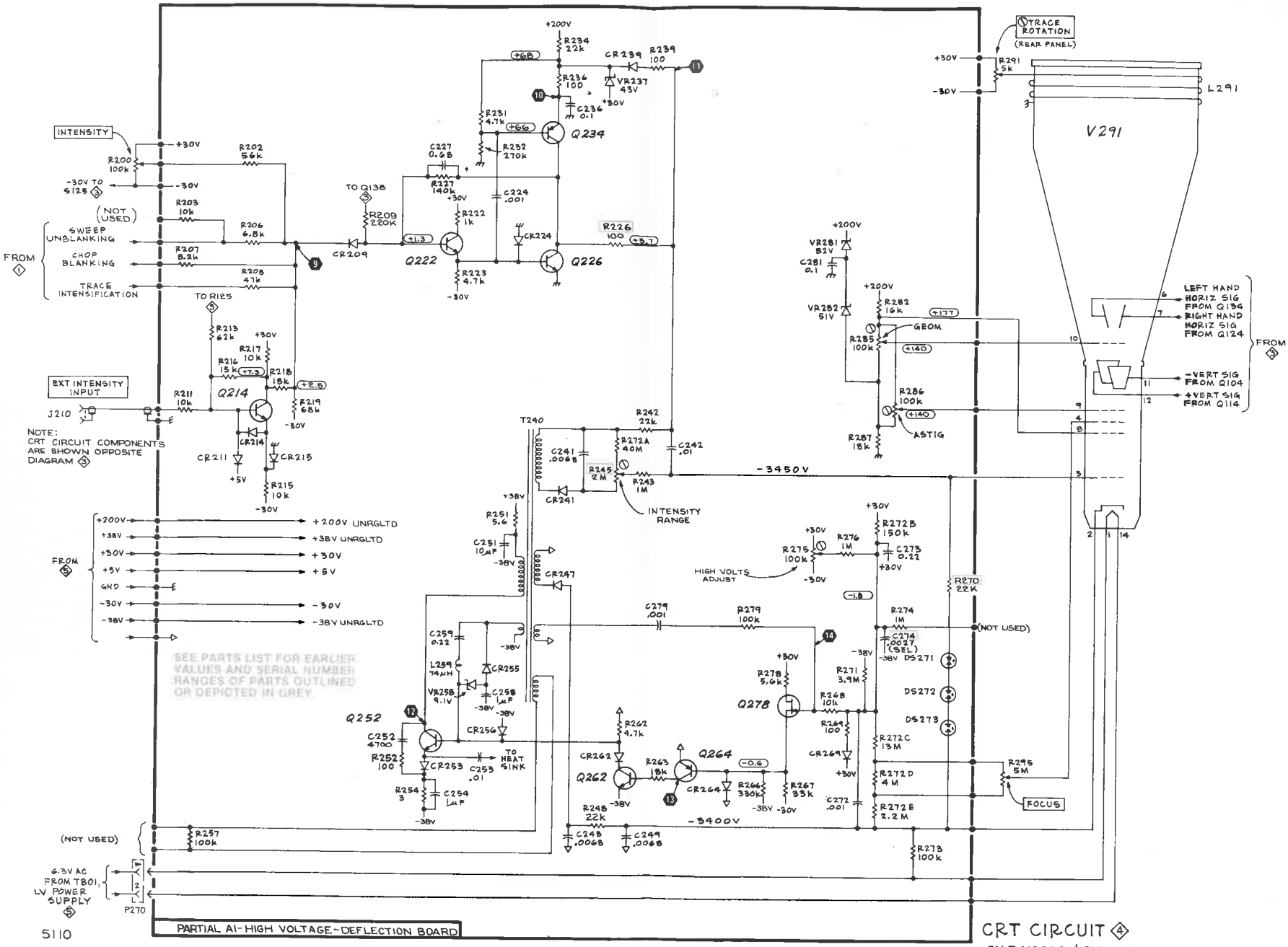


13

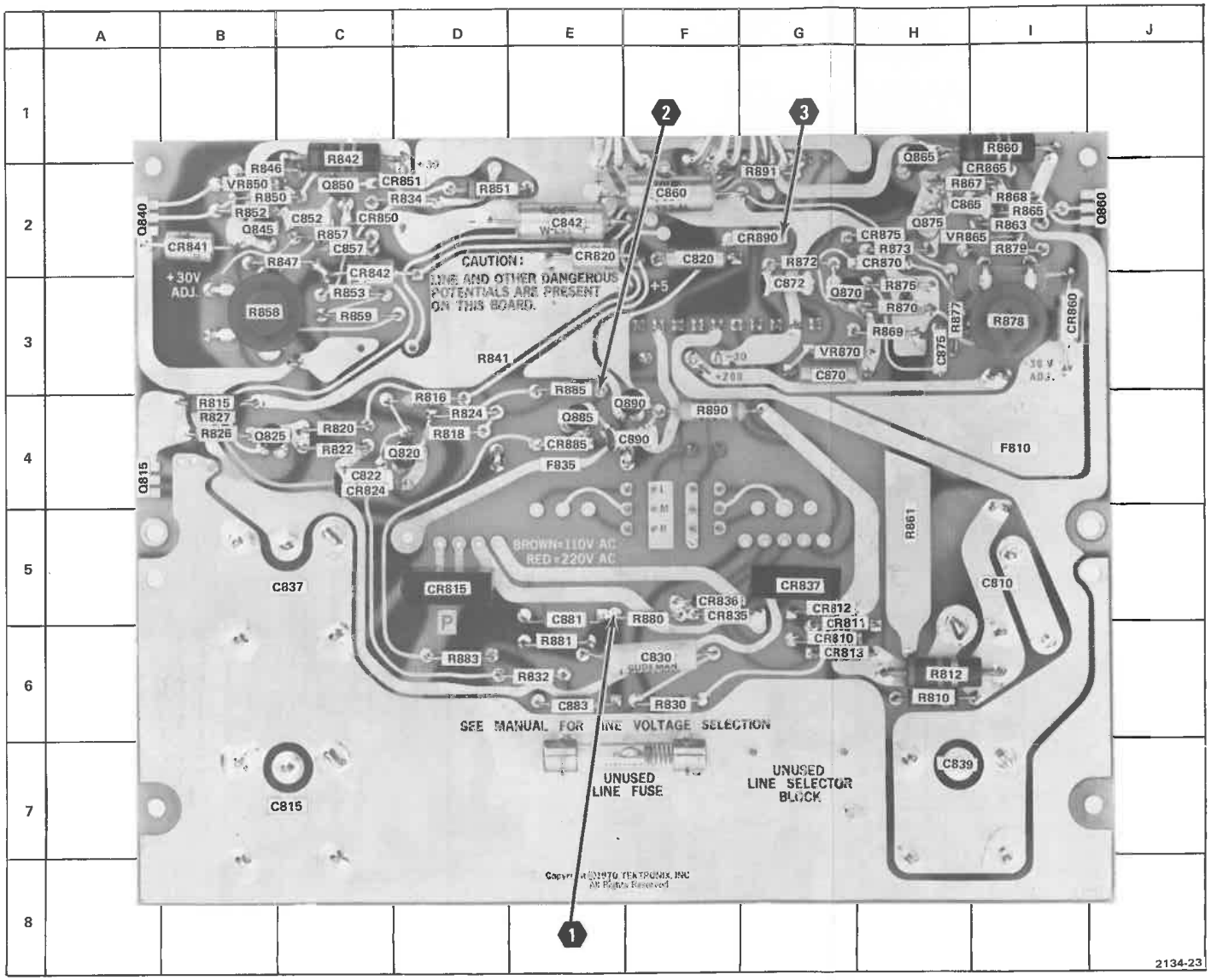


14





CRT CIRCUIT ④
SN B 119999 & BELOW



A4—LV Power Supply circuit board.

CKT NO	GRID LOC
C810†	I-5
C815†	C-7
C820	F-2
C822	C-4
C830	F-6
C837†	C-5
C839†	H-7
C842	E-2
C852	C-2
C857	C-2
C860	F-2
C865	H-2
C870	G-3
C872	G-3
C875	H-3
C881	E-5
C883	E-6
C890	F-4
CR810	G-6
CR811	G-6
CR812	G-5
CR813	G-6
CR815	D-5
CR820	E-2
CR824	C-4
CR835	F-5
CR836	F-5
CR837	G-5
CR841	B-2
CR842	C-2
CR850	C-2
CR851	D-2
CR860	I-3
CR865	I-2
CR870	H-2
CR875	H-2
CR885	E-4
CR890	G-2
VR850	B-2
VR865	I-2
VR870	G-3
F810†	I-4
F835†	E-4
Q815	A-4
Q820	D-4
Q825	B-4
Q840	A-2
Q845	B-2
Q850	C-2
Q860	J-2
Q865	H-1
Q870	G-3
Q875	H-2
Q885	E-4
Q890	F-4
R810	H-6
R812	H-6
R815	B-4
R816	D-4
R818	D-4
R820	C-4
R822	C-4
R824	D-4
R826	B-4
R827	B-4
R830	F-6
R832	E-6
R834	D-2
R841†	D-3
R842	C-1
R846	B-2
R847	C-2
R850	B-2
R851	D-2
R852	B-2
R853	C-3
R857	C-2
R858	B-3
R859	C-3
R860	I-1
R861†	H-5
R863	I-2
R865	I-2
R867	H-2
R868	I-2
R869	H-3
R870	H-3
R872	G-2
R873	H-2
R875	H-3
R877	H-3
R878	I-3
R879	I-2
R880	F-5
R881	E-6
R883	D-6
R885	E-3
R890	F-4
R891	G-2

†Located on back of board.

@

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

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

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Test oscilloscope system	Deflection factor, 1 mV to 50 V/div; input impedance, 1 megohm; frequency response, dc to 2 MHz. Probe: 10X attenuation probe compatible with vertical input.	Tektronix 5110, 5A13N, 5B10N oscilloscope system or equiv. Use a Tektronix P6108 or P6062A Probe.
Voltmeter (Non-loading digital multimeter)	Range, 0 to 250 V; input impedance, 10 megohms.	Tektronix DM 501 Digital Multimeter with power module.

VOLTAGE CONDITIONS

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

An amplifier unit is installed in the left vertical compartment (for power supply loading). INTENSITY control is set fully ccw. Voltmeter common is connected to chassis ground.

WAVEFORM CONDITIONS

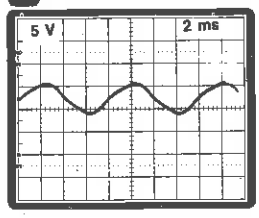
OSCILLOSCOPE UNDER TEST. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal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

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

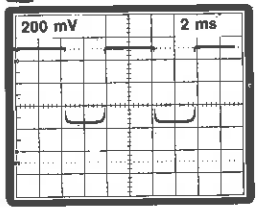
NOTE

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

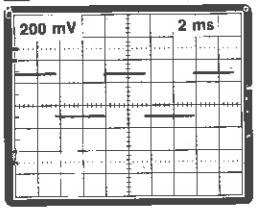
1

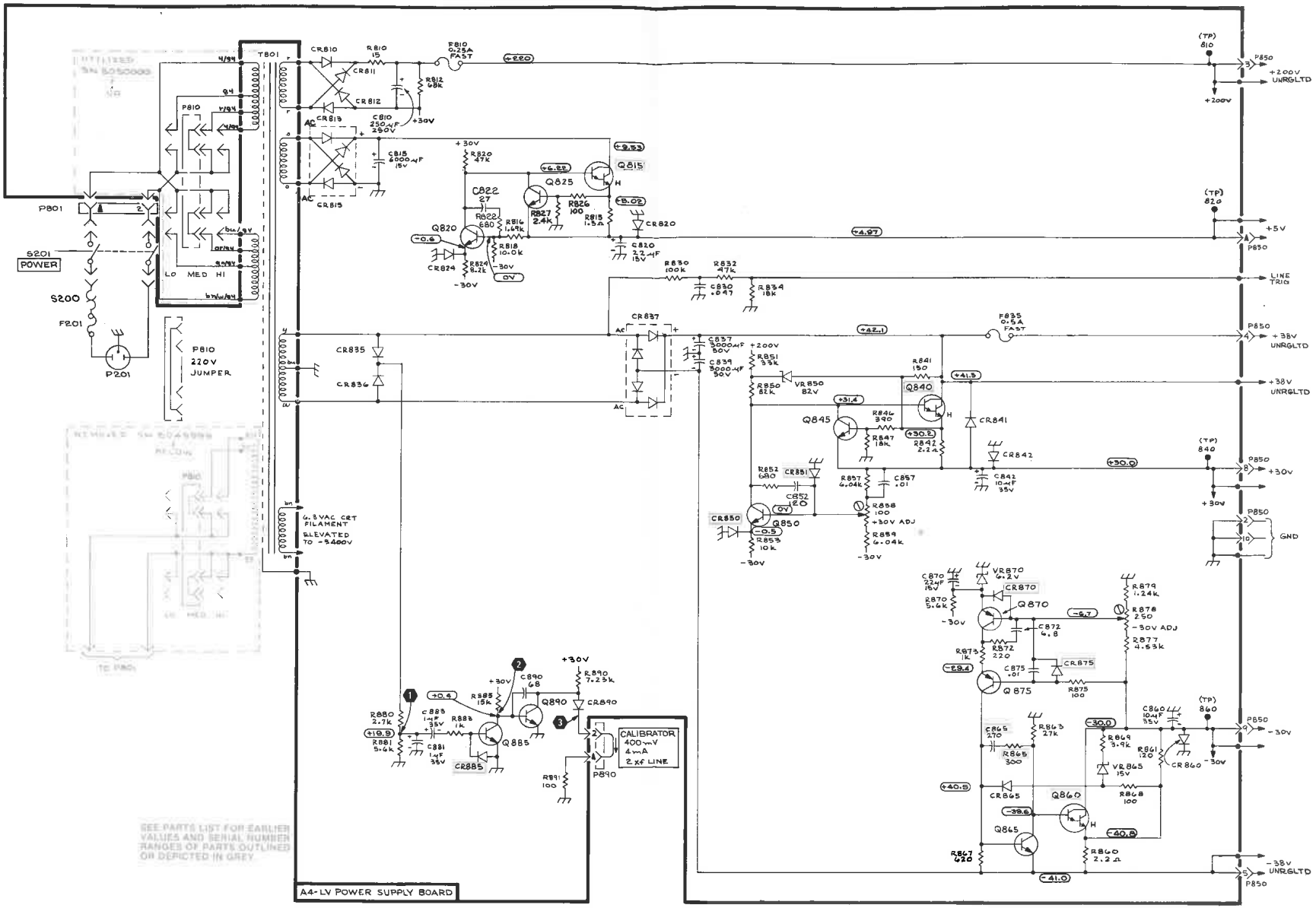


2



3




T801
CR810
CR811
CR812
CR813
CR815
R810 15
R812 68K
F810 0.25A FAST
+22.0
C810 250uF 250V
C815 4000uF 15V
+30V
P801
S201 POWER
S200
F201
P201
LO MED HI
P810 220V JUMPER
6.3 VAC CRT FILAMENT ELEVATED TO -3400V
R820 47K
Q815
Q825
Q820
C822 27
R822 680
R816 1.69K
R818 10.0K
R824 8.2K
R827 2.4K
R826 100
R815 1.5K
CR820
CR824
C820 22uF 15V
-30V
0V
+9.53
+6.22
+5.02
-0.6
+4.97
(TP) 810
P850
+200V UNRGLTD
+200V
(TP) 820
+5V
LINE TRIG
R830 100K
R832 47K
C830 .047
R834 18K
CR837
C837 3000uF 50V
C839 3000uF 50V
+42.1
F835 0.5A FAST
+38V UNRGLTD
R851 33K
R850 82K
VR850 82V
R841 150
Q840
Q845
R846 330
R847 18K
R842 2.2K
CR841
CR842
+41.5
+31.4
+30.2
+30.0
(TP) 840
+30V
R852 680
CR851
C852 .01
R857 6.04K
C857 .01
R858 100
+30V ADJ
R859 6.04K
CR850
Q850
R853 10K
-0.5
GND
C870 22uF 15V
VR870 9.2V
CR870
R870 5.6K
Q870
-5.7
R879 1.24K
R878 250
-30V ADJ
R877 4.53K
C872 4.8
R873 1K
R872 220
-29.4
C875 .01
CR875
R875 100
Q875
(TP) 860
C860 10uF 35V
-30.0
-30V
R865 270
R863 27K
R869 3.9K
R861 120
CR860
R865 300
VR865 15V
R868 100
+40.5
CR865
Q860
-38.6
-40.8
Q865
R867 420
R860 2.2Ω
-41.0
-38V UNRGLTD
R880 2.7K
R881 5.6K
+10.9
C881 1uF 35V
C885 1uF 35V
R885 15K
R888 1K
Q885
CR885
+0.4
C890 68
Q890
CR890
R890 7.25K
R891 100
P890
CALIBRATOR 400mV 4mA 2.5% LINE
A4-LV POWER SUPPLY BOARD
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

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

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Test oscilloscope system	Deflection factor, 1 mV to 50 V/div; input impedance, 1 megohm; frequency response, dc to 2 MHz. Probe: 10X attenuation probe compatible with vertical input.	Tektronix 5110, 5A13N, 5A18N, 5B10N oscilloscope system or equiv. Use a Tektronix P6108 or P6062B Probe.
Voltmeter (Non-loading digital multimeter)	Range, 0 to 250 V; input impedance, 10 megohms.	Tektronix DM 501 Digital Multimeter with power module.

VOLTAGE CONDITIONS

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

An amplifier unit is installed in both vertical compartments. A time-base unit is installed in the horizontal compartment (set for external volts/div). INTENSITY control is set fully ccw.

Voltmeter common is connected to chassis ground.

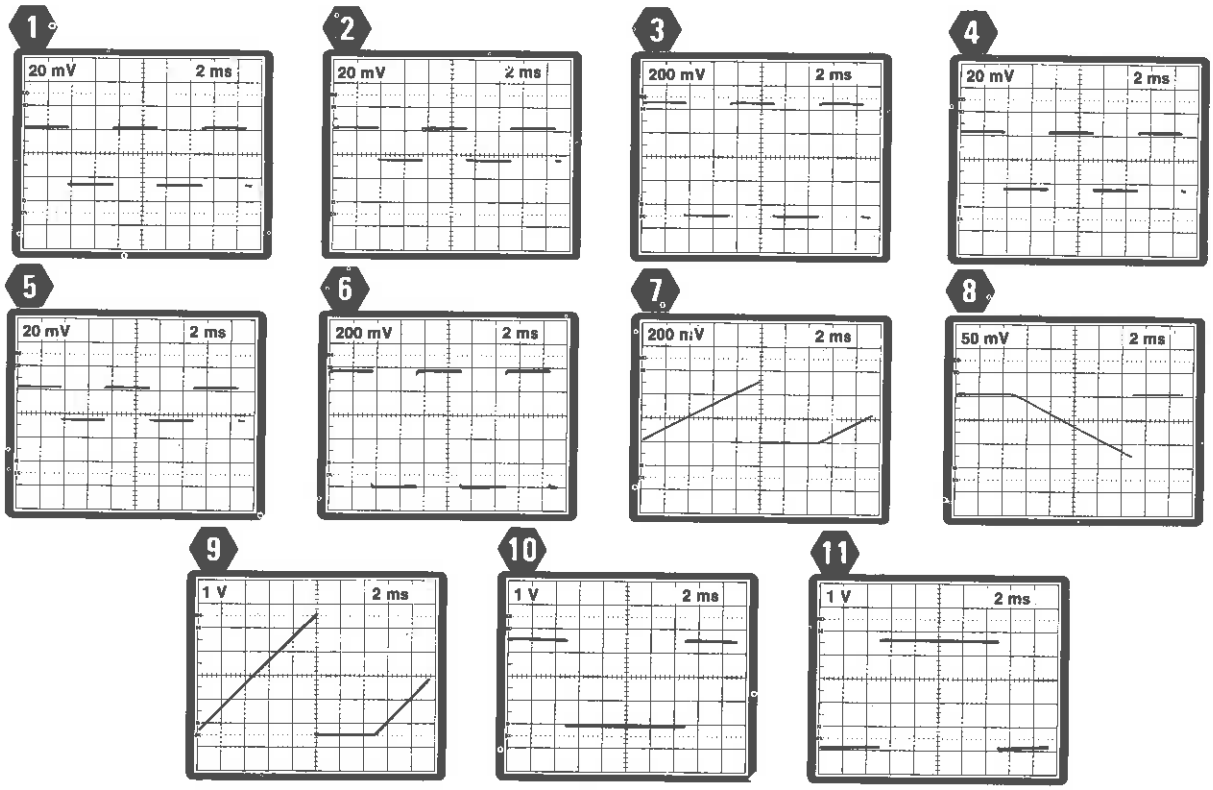
WAVEFORM CONDITIONS

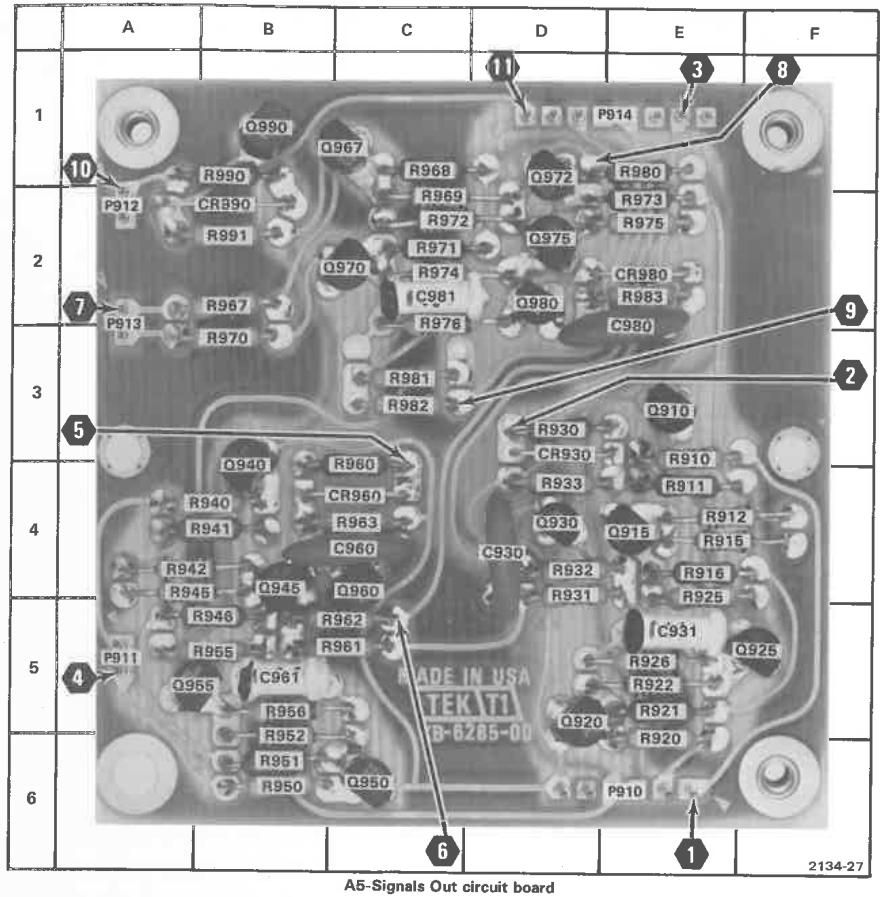
OSCILLOSCOPE UNDER TEST. Install an amplifier unit in both vertical compartments and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier units (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal 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.

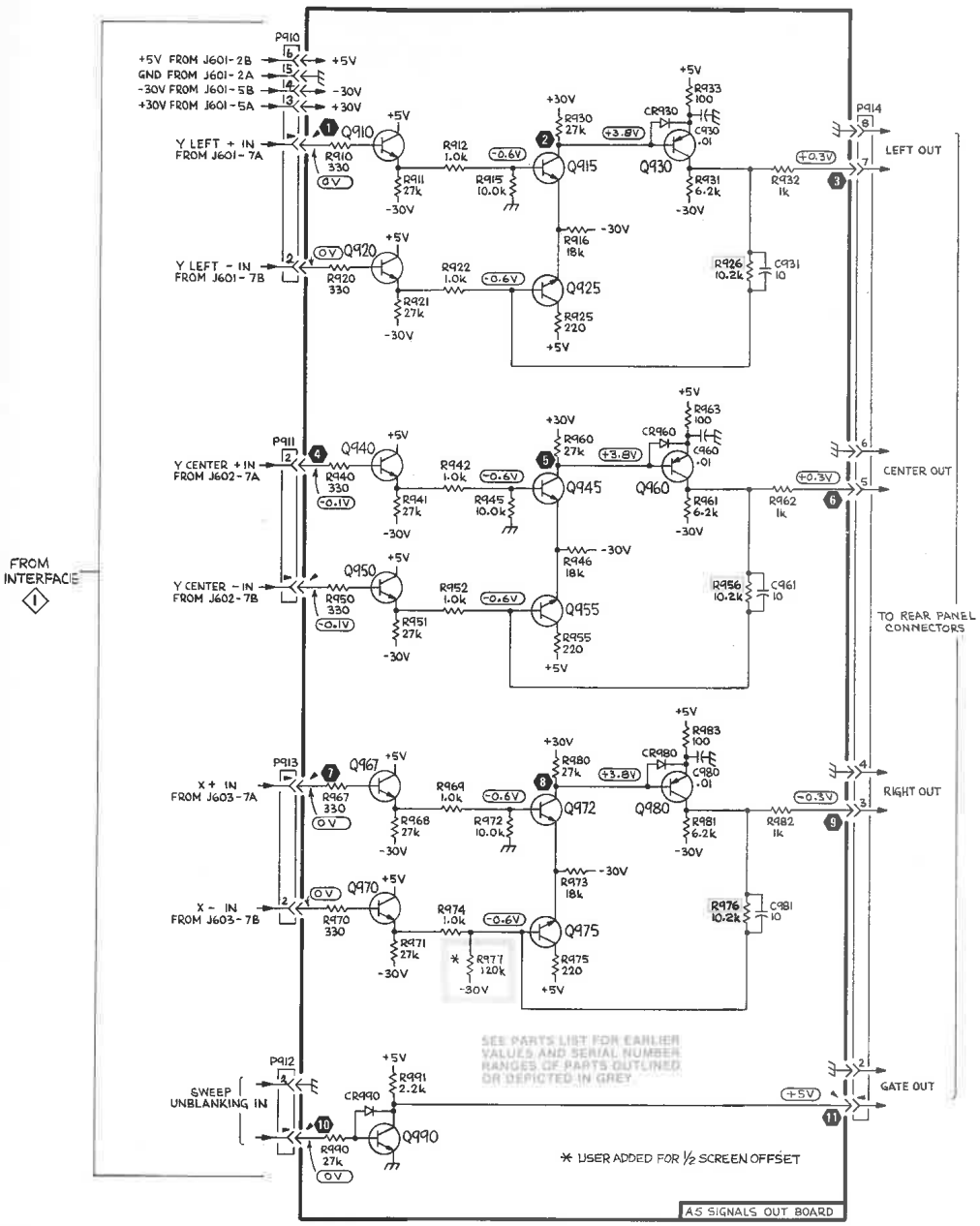




A5-Signals Out circuit board

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C930	4D	Q972	1D	R950	6B	R991	2B
C931	5E	Q975	2D	R951	6B		
C960	4C	Q980	2D	R952	5B	P914	1D
C961	5B	Q990	1B	R955	5B		
C980	3E			R956	5B		
C981	2C	R910	3E	R960	3C		
		R911	4E	R961	5B		
CR930	3D	R912	4E	R962	5B		
CR960	4C	R915	4E	R963	4C		
CR980	2E	R916	4E	R967	2B		
CR990	2B	R920	6E	R968	1C		
		R921	5E	R969	2C		
Q910	3E	R922	5E	R970	3B		
Q915	4E	R925	4E	R971	2C		
Q920	5D	R926	5E	R972	2C		
Q925	5F	R930	3D	R973	2E		
Q930	4D	R931	4D	R974	2C		
Q940	3B	R932	4D	R975	2E		
Q945	4B	R933	4D	R976	2C		
Q950	6C	R940	4A	R980	1E		
Q955	5A	R941	4A	R981	3C		
Q960	4C	R942	4A	R982	3C		
Q967	1B	R945	4A	R983	2E		
Q970	2B	R946	5A	R990	1B		

VOLTAGE & WAVEFORM CONDITIONS



5110 OPT. 7

2134-26
REV A, FEB1979

SIGNALS OUT (OPTION 7 ONLY)

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

FIGURE AND INDEX NUMBERS

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

INDENTATION SYSTEM

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

```
1 2 3 4 5                    Name & Description

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

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

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

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

ABBREVIATIONS

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

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000CY	NORTHWEST FASTENER SALES, INC.	7923 SW CIRRUS DRIVE	BEAVERTON, OREGON 97005
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
05820	WAKEFIELD ENGINEERING, INC.	AUDUBON ROAD	WAKEFIELD, MA 01880
06666	GENERAL DEVICES CO., INC.	525 S. WEBSTER AVE.	INDIANAPOLIS, IN 46219
08261	SPECTRA-STRIP CORP.	7100 LAMPSON AVE.	GARDEN GROVE, CA 92642
12136	PHILADELPHIA HANDLE COMPANY, INC.	1643 HADDON AVENUE	CAMDEN, NJ 08103
12327	FREEWAY CORPORATION	9301 ALLEN DRIVE	CLEVELAND, OH 44125
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
23880	STANFORD APPLIED ENGINEERING, INC.	340 MARTIN AVE.	SANTA CLARA, CA 95050
24618	TRANSCON MFG. CO.	2655 PERTH ST.	DALLAS, TX 75220
28520	HEYMAN MFG. CO.	147 N. MICHIGAN AVE.	KENILWORTH, NJ 07033
31514	STANFORD APPLIED ENGINEERING, INC. ADVANCED PACKAGING DIV.	3080 AIRWAY DRIVE	COSTA MESA, CA 92626
45722	USM CORP., PARKER-KALON FASTENER DIV.		CAMPBELLSVILLE, KY 42718
55210	GETTIG ENG. AND MFG. COMPANY	PO BOX 85, OFF ROUTE 45	SPRING MILLS, PA 16875
57771	STIMPSON, EDWIN B., CO., INC.	900 SYLVAN AVENUE	BAYPORT, NY 11705
70318	ALLMETAL SCREW PRODUCTS CO., INC.	821 STEWART AVE.	GARDEN CITY, NY 11530
70485	ATLANTIC INDIA RUBBER WORKS, INC.	571 W. POLK ST.	CHICAGO, IL 60607
71785	TRW, CINCH CONNECTORS	1501 MORSE AVENUE	ELK GROVE VILLAGE, IL 60007
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
73803	TEXAS INSTRUMENTS, INC., METALLURGICAL MATERIALS DIV.	34 FOREST STREET	ATTLEBORO, MA 02703
74921	ITEN FIBRE CO.,	4001 BENEFIT AVE., P O BOX 9	ASHTABULA, OH 44004
75915	LITTELFUSE, INC.	800 E. NORTHWEST HWY	DES PLAINES, IL 60016
77250	PHEOLL MANUFACTURING CO., DIVISION OF ALLIED PRODUCTS CORP.	5700 W. ROOSEVELT RD.	CHICAGO, IL 60650
77820	BENDIX CORP., THE, ELECTRICAL COMPONENTS DIVISION	SHERMAN AVE.	SIDNEY, NY 13838
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
78471	TILLEY MFG. CO.	900 INDUSTRIAL RD.	SAN CARLOS, CA 94070
79136	WALDES, KOHINOOR, INC.	47-16 AUSTEL PLACE	LONG ISLAND CITY, NY 11101
79807	WROUGHT WASHER MFG. CO.	2100 S. O BAY ST.	MILWAUKEE, WI 53207
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
80710	ALLEGHENY LUDLUM STEEL CORP., A DIVISION OF ALLEGHENY LUDLUM INDUSTRIES, INC.	BRACKENRIDGE WORKS, RIVER AVE.	BRACKENRIDGE, PA 15014
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
86445	PENN FIBRE AND SPECIALTY CO., INC.	2032 E. WESTMORELAND ST.	PHILADELPHIA, PA 19134
86928	SEASTROM MFG. COMPANY, INC.	701 SONORA AVENUE	GLENDALE, CA 91201
90484	ITT, SURPRENANT DIV.	172 STERLING STREET	CLINTON, MA 01510
91886	MALCO A MICRODOT CO.	12 PROGRESS DRIVE	MONTGOMERYVILLE, PA 18936
93907	CAMCAR SCREW AND MFG. CO.	600 18TH AVE.	ROCKFORD, IL 61101

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1 -1	----- -----			1		CKT BOARD ASSY:SINGLE BEAM AUX(SEE A2 EPL)		
-2	200-1218-00			1		RTNR,CRT SCALE:6.814 X 5.125,NYLON	80009	200-1218-00
						(ATTACHING PARTS)		
-3	211-0188-00			2		SCREW,MACHINE:4-40 X 0.30 INCH,SST	83385	OBD
-4	354-0233-00	B010100	B072526X	2		RING,RETAINING:0.100 ID X 0.203 INCH OD	79136	5133-14PP
						- - - * - - -		
-5	337-1440-00			1		SHLD,IMPLOSION:	80009	337-1440-00
	337-1440-00	B010100	B104588	1		SHLD,IMPLOSION:	80009	337-1440-00
	----- -----			-		(OPTION 76 INSTRUMENTS ONLY)		
	337-1440-01	B104589		1		SHLD,IMPLOSION:GREEN	80009	337-1440-01
	----- -----			-		(OPTION 76 INSTRUMENTS ONLY)		
-6	386-1946-00			1		SUPPORT,CRT:FRONT	80009	386-1946-00
-7	348-0279-00			2		PAD,CUSHIONING:G (CUT TO FIT)	80009	348-0279-00
-8	348-0070-01			3		PAD,CUSHIONING:0.69 INCH,RUBBER	80009	348-0070-01
-9	348-0145-00			2		GROMMET,PLASTIC:U-SHP,1.0 X 0.42 INCH	80009	348-0145-00
-10	334-1379-00			1		LABEL:CRT,ADHESIVE BACK	80009	334-1379-00
-11	337-1419-00	B010100	B069999	1		SHIELD,CRT:	80009	337-1419-00
	337-1419-05	B070000		1		SHIELD SECT,CRT:	80009	337-1419-05
-12	337-1420-00			1		SHIELD SECT,CRT:	80710	337-1420-00
-13	354-0409-00			1		R,CLP,CRT SHLD:U/O 2.375 OD SHIELD	80009	354-0409-00
						(ATTACHING PARTS)		
-14	211-0632-00			1		SCREW,MACHINE:6-32X2.250 INCH,FILH,STL	83385	OBD
-15	343-0123-01			2		CLAMP,RET.,ELEC:CRT,REAR	80009	343-0123-01
-16	220-0444-00			1		NUT,PLAIN,SQ:6-32 X 0.250 INCH,STL	70318	OBD
-17	211-0507-00			2		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
-18	407-0922-00			1		BRACKET,CRT CLP:ALUMINUM	80009	407-0922-00
						- - - * - - -		
-19	384-1064-00			1		KNOB:10.185 L X 0.125 OD,5-40 THD	80009	384-1064-00
-20	119-0238-00	B010100	B090724	1		COIL,CAL:	80009	119-0238-00
	119-0373-00	B090725		1		COIL,CAL:	80009	119-0373-00
						(ATTACHING PARTS)		
	210-0442-00			2		NUT,PLAIN,HEX.:3-48 X 0.187 INCH,CD PL BRS	73743	3014-402
	210-0004-00			2		WASHER,LOCK:#4 INTL,0.015THK,STL CD PL	78189	1204-00-00-0541C
	210-0994-00			2		WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5714-147-20N
	210-0935-00			2		WASHER,NONMETAL:FIBER,0.14 IDX 0.375"OD	74921	OBD
-21	361-0059-01			1		INSULATOR,PLATE:1.093 X 0.343 X 0.125 INCH	80009	361-0059-01
-22	210-0593-00			2		NUT,FINISHING:0.25 HEX X 0.312" LONG,BRS	80009	210-0593-00
						- - - * - - -		
-23	358-0216-00			1		BUSHING,PLASTIC:0.257 ID X 0.412 INCH OD	80009	358-0216-00
-24	366-0494-00	B010100	B108289	1		KNOB:GRAY WITH SETSCREW	80009	366-0494-00
	366-1059-00	B108290		1		PUSH BUTTON:GRAY	80009	366-1059-00
	366-1077-00	XB108290		1		KNOB:GRAY	80009	366-1077-00
	213-0153-00			1		. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-25	366-0494-00			1		KNOB:GRAY WITH SETSCREW	80009	366-0494-00
	213-0153-00			1		. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-26	131-0955-00			1		CONNECTOR,RCPT,:CKT BD,28/56 CONTACT	13511	31-279
						(ATTACHING PARTS)		
-27	210-0255-00			1		TERMINAL,LUG:0.391" ID INT TOOTH	80009	210-0255-00
						- - - * - - -		
-28	----- -----			1		SWITCH,PUSH:(SEE S125 EPL)		
-29	----- -----			2		RESISTOR,VAR:(SEE R200 AND R295 EPL)		
						(ATTACHING PARTS)		
-30	210-0583-00			2		NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-31	210-0940-00			2		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
-32	210-0046-00			2		WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	78189	1214-05-00-0541C
						- - - * - - -		
-33	200-0608-00			1		COVER,VAR RES.:PLASTIC	80009	200-0608-00
-34	333-1409-00	B010100	B099999	1		PANEL,FRONT:	80009	333-1409-00
	333-1409-01	B100000	B108289	1		PANEL,FRONT:	80009	333-1409-01
	333-1409-03	B108290		1		PANEL,FRONT:	80009	333-1409-03
-35	337-1421-00			1		SHIELD,ELEC:HI-VOLTAGE	80009	337-1421-00
						(ATTACHING PARTS)		
-36	211-0504-00			3		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-37	348-0115-00			3		GROMMET,PLASTIC:U-SHP,0.548 X0.462 INCH	80009	348-0115-00
-38	407-0896-00			1		BRACKET,CHASSIS:ALUMINUM	80009	407-0896-00
						(ATTACHING PARTS)		
-39	211-0541-00			1		SCREW,MACHINE:6-32 X 0.25"100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-40	----- -----			1		SWITCH,PUSH-PUL:(SEE S201 EPL)		
	407-0895-00	B010100	B091615	1		BRACKET,ELEC SW:ALUMINUM	80009	407-0895-00
	407-0895-01	B091616		1		BRACKET,ELEC SW:ALUMINUM	80009	407-0895-01
-41	376-0127-00			1		COUPLER,SHAFT:PLASTIC	80009	376-0127-00
-42	----- -----			1		RESISTOR,VAR:(SEE R291 EPL)		
						(ATTACHING PARTS)		
-43	358-0029-00			1		BSHG,MACH.THD:HEX,0.375-32 X 0.438"LONG	80009	358-0029-00
-44	210-0978-00			1		WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	78471	OBD
-45	210-0421-00			1		NUT,PLAIN,HEX.:0.375-32 X 0.50 INCH,AL	80009	210-0421-00
-46	210-0012-00			2		WASHER,LOCK:INTL,0.375 ID X 0.50" OD STL	78189	1220-02-00-0541C
-47	210-0207-00			1		TERMINAL,LUG:0.375 INCH DIAMETER	12697	01136902
						- - - * - - -		
-48	200-1204-01			1		COVER,CRT:REAR ALUMINUM,PTD BLUE	80009	200-1204-01
						(ATTACHING PARTS)		
-49	210-0401-00			2		NUT,PLAIN,HEX.:6-32 X 0.312 INCH,CD PLATED	73743	93262-02
						- - - * - - -		
	006-0531-00	XB108068		1		STRAP,TIEDOWN,E:BLUE PLASTIC BEADED	24618	700-3688
-50	161-0033-08			1		CABLE ASSY,PWR,:	16428	OBD
-51	358-0366-00			1		BSHG,STRAIN RLF:	80009	358-0366-00
	358-0365-00			1		BSHG,STRAIN RLF:	80009	358-0365-00
-52	200-1004-00			1		CABLE,NIP.,ELEC:0.265 ID X 0.38"OD W/FLG	80009	200-1004-00
-53	352-0076-00	B010100	B0105881	1		FUSEHOLDER:W/HARDWARE	75915	342012-L
	352-0362-00	B0105882		1		FUSEHOLDER: W/MOUNTING HARDWARE	75915	345001
						(ATTACHING PARTS)		
-54	210-0873-00			1		WASHER,NONMETAL:0.5 ID X 0.688 INCH OD,NPRN	70485	OBD
						- - - * - - -		
-55	210-0201-00	B010100	B106650	1		TERMINAL,LUG:SE #4	86928	A373-157-2
	210-0202-00	B106651		1		TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED	78189	2104-06-00-2520N
						(ATTACHING PARTS)		
-56	210-0586-00	B010100	B106650	1		NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	83385	211-041800-00
	210-0457-00	B106651		1		NUT,PL,ASSEM WA:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-57	333-1429-00	B010100	B099999	1		PANEL,REAR:	80009	333-1429-00
	333-1429-01	B100000	B109889	1		PANEL,REAR:	80009	333-1429-01
	333-1429-02	B109890		1		PANEL,REAR:	80009	333-1429-02
	334-2154-01	XB122930		1		MARKER,IDENT:MKD CAUTION	80009	334-2154-01
-58	441-0991-00	B010100	B107632	1		CHAS,DSPL UNIT:MAIN	80009	441-0991-00
	441-0991-02	B107633	B119999	1		CHAS,DSPL UNIT:MAIN	80009	441-0991-02
	441-0991-03	B120000		1		CHAS,DSPL UNIT:MAIN	80009	441-0991-03
	407-2270-00	XB120000		1		BRACKET,CHASSIS:ALUMINUM	80009	407-2270-00
						(ATTACHING PARTS)		
	211-0504-00	XB120000		3		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
	210-0005-00	XB120000		1		WASHER,LOCK:EXT #6	78189	1106-00
	210-0457-00	XB120000		2		NUT,PL,ASSEM WA:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-59	210-0659-01			4		. EYELET,METALLIC:0.121 OD X 0.156 INCH LONG	80009	210-0659-01
-60	344-0131-00			4		. CLIP,SPG TENS:CIRCUIT CARD MOUNTING	80009	344-0131-00
						(ATTACHING PARTS FOR CHASSIS)		
-61	211-0504-00			2		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
-62	211-0538-00			2		SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH STL	83385	OBD
-63	210-0457-00			2		NUT,PL,ASSEM WA:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-64	----- -----			1		SWITCH,THERMOSTATIC:(SEE S200 EPL)		
						(ATTACHING PARTS)		
-65	210-0586-00			2		NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	83385	211-041800-00
						- - - * - - -		
-66	344-0225-00			2		CLIP,CABLE:	80009	344-0225-00
-67	348-0067-00	B010100	B104185	1		GROMMET,PLASTIC:0.312 INCH DIA	80009	348-0067-00
	348-0516-00	B104186		1		GROMMET,PLASTIC:BLACK,ROUND,0.188 ID	28520	SB312-3

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-68	343-0088-00			3		CLAMP,LOOP:0.062 INCH DIA	80009	343-0088-00
-69	----- -----			1		CKT BOARD ASSY:HV DEFL(SEE A1 EPL)		
-70	131-0566-00	B010100	B030000X	4		. BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
	131-0566-00	XB050000	B119999X	4		. BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
-71	131-0589-00			2		. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
-72	136-0183-00	B010100	B049999	5		. SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00
	136-0183-00	B050000	B119999	1		. SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00
	136-0183-00	B120000		2		. SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00
-73	136-0220-00	B010100	B049999	10		. SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB MT	71785	133-23-11-034
	136-0220-00	B050000	B119999	11		. SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB MT	71785	133-23-11-034
	136-0220-00	B120000	B121392	10		. SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB MT	71785	133-23-11-034
	136-0220-00	B121393		5		. SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB MT	71785	133-23-11-034
-74	136-0254-00	B010100	B120979	2		. SOCKET,PIN TERM:0.088 OD X 0.145 INCH LONG	00779	1-331892-5
	136-0254-01	B120980		2		. SOCKET,PIN TERM:U/W 0.031 TO 0.04 DIA PINS	00779	1-331892-8
	136-0252-04	XB050000	B070000X	12		. SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
-75	----- -----			1		. TRANSISTOR:(SEE Q252 EPL)		
						(ATTACHING PARTS)		
-76	210-0407-00			2		. NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
-77	210-0055-00			2		. WASHER,LOCK:SPLIT,0.145 ID X 0.253 OD,STL	83385	OBD
-78	210-0801-00			2		. WASHER,FLAT:0.14 ID X 0.281 OD NP STL	12327	OBD
-79	214-1610-00			1		. HEAT SINK,ELEC:TRANSISTOR	80009	214-1610-00
-80	210-1133-00			4		. WASHER,NONMETAL:0.142 ID X 0.25"OD FIBER	86445	OBD
-81	214-1536-00			1		. HEAT SINK,DIODE:TO-3,AL	80009	214-1536-00
-82	214-1610-00			1		. HEAT SINK,ELEC:TRANSISTOR	80009	214-1610-00
-83	211-0511-00			2		. SCREW,MACHINE:6-32 X 0.500,PNH,STL,CD PL	83385	OBD
						- - - * - - -		
-84	214-1291-00	B010100	B119999	4		. HEAT SINK,ELEC:XSTR,0.72 OD X 0.375"H	05820	207-AB
	214-2811-00	B120000		4		. HEAT,SINK,XSTR:TO-202 ALUMINUM	80009	214-2811-00
-85	337-1179-00			1		. SHIELD,ELEC:DEFLECTION AMP	80009	337-1179-00
						(ATTACHING PARTS FOR CKT BOARD)		
-86	211-0510-00			1		SCREW,MACHINE:6-32 X 0.375 INCH,PNH STL	83385	OBD
-87	210-0975-00			1		WSHR,SHOULDERED:0.14 ID X 0.247" OD,PLSTC	80009	210-0975-00
						- - - * - - -		
-88	343-0254-00	B010100	B069999X	1		CLP,ELCTRN TUBE:	80009	343-0254-00
-89	367-0117-00	B010100	B069999X	1		PULL,SOCKET:	80009	367-0117-00
-90	200-0917-02	B010100	B069999X	1		COVER,CRT SKT:2.052 OD X 0.291 H,PLASTIC	80009	200-0917-02
-91	136-0450-00	B010100	B069999	1		SKT,PL-IN ELEK:ELCTRN TUBE,14 CONT W/LEAD	80009	136-0450-00
	136-0492-01	B070000	B119999	1		SKT,PL-IN ELEK:ELCTRN TUBE,14 CONT W/LEAD	80009	136-0492-01
	136-0723-00	B120000		1		SKT,PL-IN ELEK:ELCTRN TUBE,14 CONT W/LEAD	80009	136-0723-00
	198-4223-00	XB120000		1		. WIRE SET,ELEC:	80009	198-4223-00
-92	136-0304-02	B010100	B069999	1		. SOCKET,PLUG-IN:CRT,14 PIN SOCKET,W/PINS	80009	136-0304-02
	136-0301-01	B070000		1		. SKT,PL-IN ELEK:ELCTN TUBE,14CONTACT	80009	136-0301-01
	195-0086-00	XB070000		1		. LEAD SET,ELEC:CRT DEFLECTION	80009	195-0086-00
	200-0616-01	XB070000		1		. COV,ELECTRON TU:	80009	200-0616-01
-93	200-1075-00			4		COVER,TERM:QUICK DISCONNECT	00779	1-480435-0
-94	131-0861-00			3		TERM,QIK DISC:16-20 AWG,0.22 W X 0.02 THK	00779	42617-2
-95	195-0086-00	B010100	B069999X	1		LEAD SET,ELEC:CRT DEFLECTION	80009	195-0086-00
-96	426-0740-00			1		FR ASSY,DSPL UN:	80009	426-0740-00
-97	175-0863-00			FT		WIRE,ELECTRICAL:2 WIRE RIBBON	08261	SS-0222-1910610C
-98	175-0862-00			FT		WIRE,ELECTRICAL:3 WIRE RIBBON	08261	SS-0322-1910610C
-99	175-0859-00			FT		WIRE,ELECTRICAL:6 WIRE RIBBON	08261	SS-0622-1910610C
-100	175-0855-00			FT		WIRE,ELECTRICAL:10 WIRE RIBBON	08261	SS-1022(1061)0C
-101	131-0621-00			22		CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	46231
-102	352-0198-00			3		HLDR,TERM CONN:2 WIRE BLACK	80009	352-0198-00
-103	352-0204-00			1		CONN BODY,PL,EL:8 WIRE BLACK	80009	352-0204-00
-104	352-0206-00			1		HLDR,TERM CONN:10 WIRE BLACK	80009	352-0206-00
	175-1453-00			1		LEAD ASSY,ELEC:	80009	175-1453-00
	131-0861-00			2		. TERM,QIK DISC:16-20 AWG,0.22 W X 0.02 THK	00779	42617-2
	200-1075-00			2		. COVER,TERM:QUICK DISCONNECT	00779	1-480435-0
	131-0707-00			2		. CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
	352-0161-00			1		. HLDR,TERM CONN:3 WIRE BLACK	80009	352-0161-00

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-	198-2028-00	B010100	B108289	1		WIRE SET,ELEC:	80009	198-2028-00
	198-3879-00	B108290	B119999	1		WIRE SET,ELEC:	80009	198-3879-00
	198-3879-01	B120000		1		WIRE SET,ELEC:	80009	198-3879-01
	131-0677-00			2		. CONNECTOR,TERM:18 AWG	91886	122-0192-019
	131-0621-00			2		. CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	46231
	131-0707-00			2		. CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
	131-2065-00			3		. TERM,QIK DISC:18-22 AWG,BRASS TIN PLATED	00779	2-350799-2
	175-0828-00			FT		. WIRE,ELECTRICAL:5 WIRE RIBBON	08261	SS-0526-710610C
	175-0863-00			FT		. WIRE,ELECTRICAL:2 WIRE RIBBON	08261	SS-0222-1910610C
	175-1020-00			FT		. CABLE,RF:50 OHM COAX,WHT POLYTHN JKT	90484	DAB70JAAAWHITE
	352-0161-00			1		. HLDR,TERM CONN:3 WIRE BLACK	80009	352-0161-00
	352-0198-00			1		. HLDR,TERM CONN:2 WIRE BLACK	80009	352-0198-00
	198-2752-00	B010100	B104832	1		WIRE SET,ELEC:	80009	198-2752-00
	198-2752-01	B014833		1		WIRE SET,ELEC:	80009	198-2752-01
	131-0621-00			18		. CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	46231
	175-0855-00			FT		. WIRE,ELECTRICAL:10 WIRE RIBBON	08261	SS-1022(1061)0C
	175-0859-00			FT		. WIRE,ELECTRICAL:6 WIRE RIBBON	08261	SS-0622-1910610C
	175-0863-00			FT		. WIRE,ELECTRICAL:2 WIRE RIBBON	08261	SS-0222-1910610C
	352-0198-00			1		. HLDR,TERM CONN:2 WIRE BLACK	80009	352-0198-00
	352-0204-00			1		. CONN BODY,PL,EL:8 WIRE BLACK	80009	352-0204-00
	352-0206-00			1		. HLDR,TERM CONN:10 WIRE BLACK	80009	352-0206-00

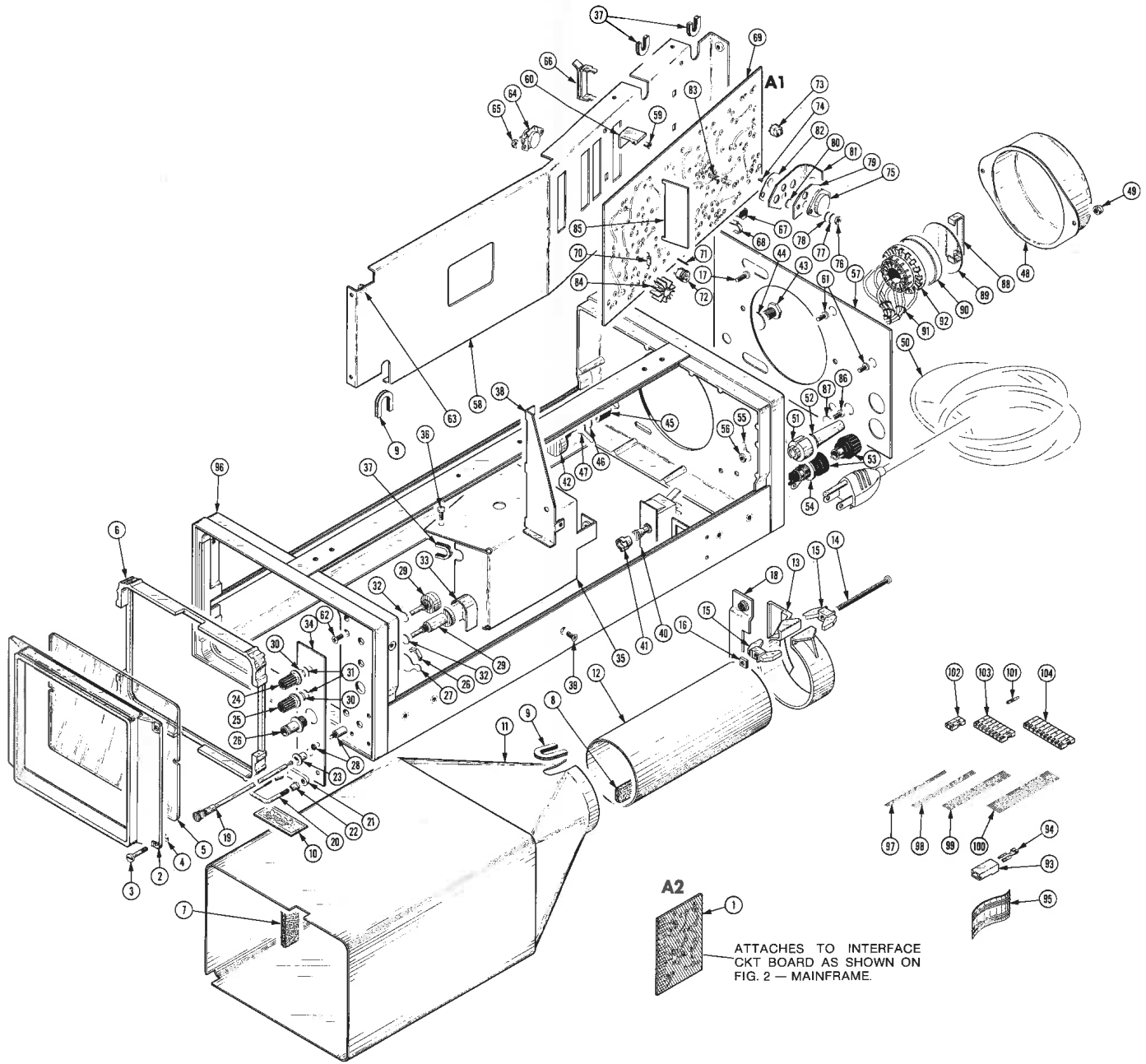

A1
A2
ATTACHES TO INTERFACE CKT BOARD AS SHOWN ON FIG. 2 — MAINFRAME.

FIG. 2 MAINFRAME

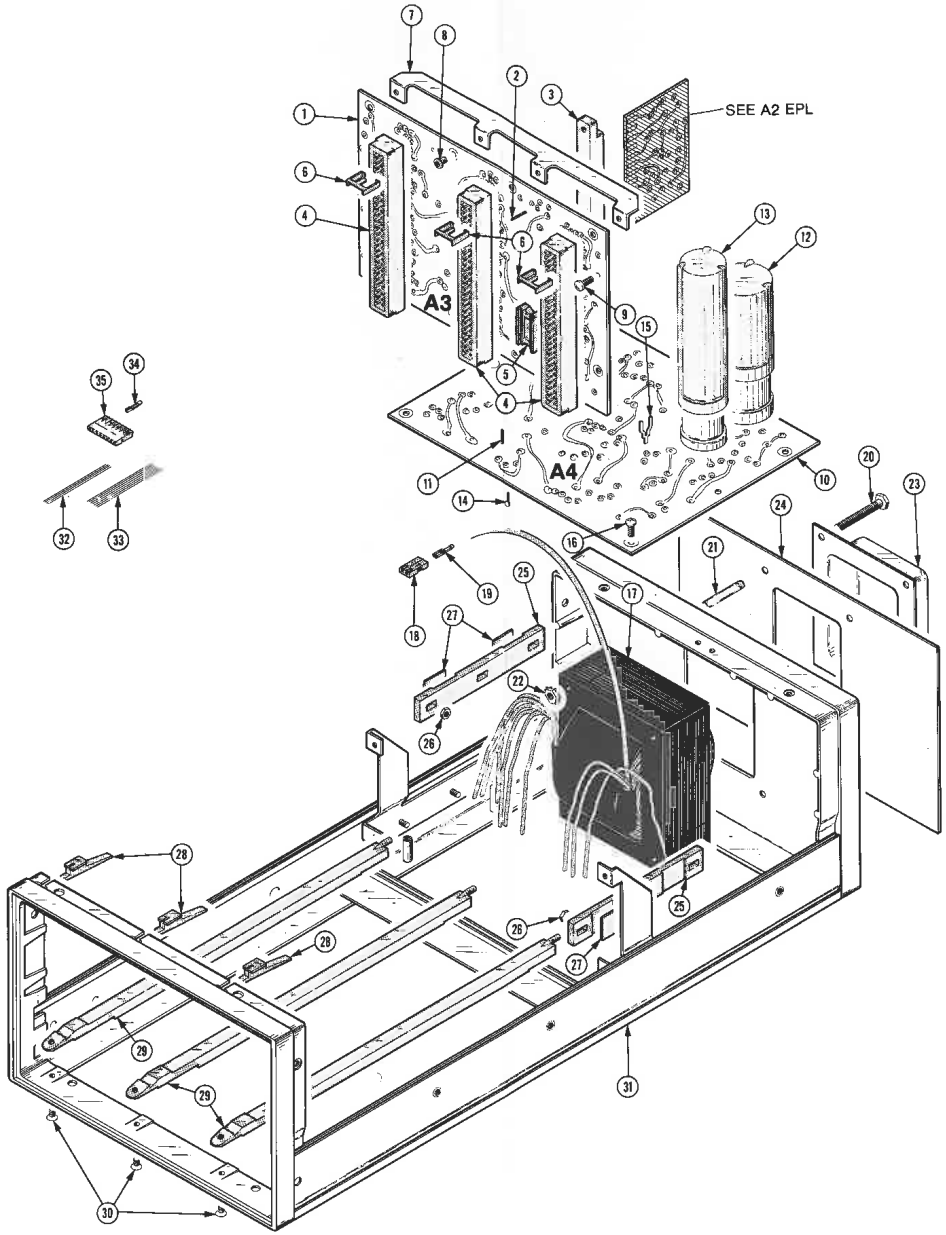
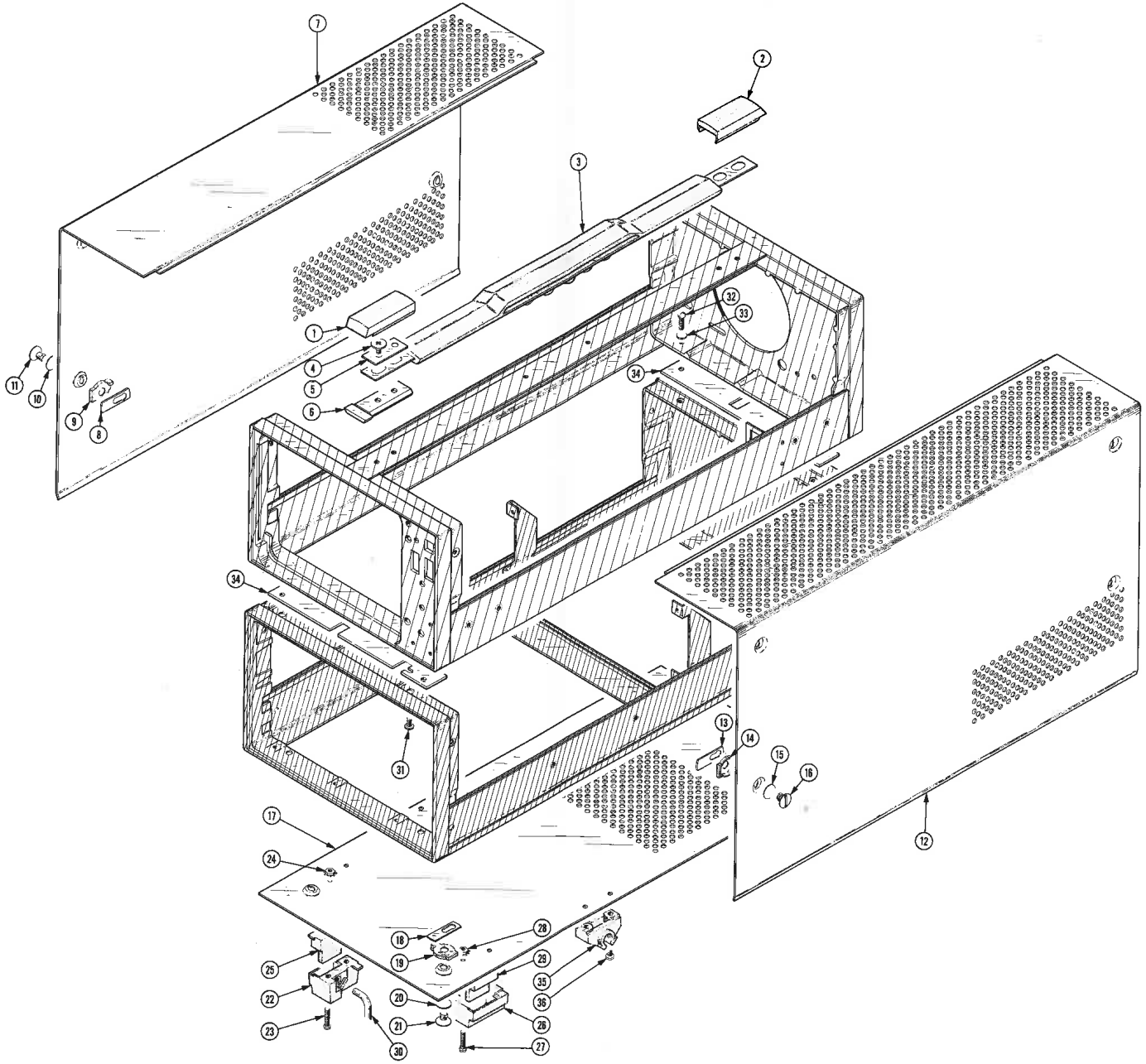


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-1	----- -----			1		CKT BOARD ASSY:INTERFACE(SEE A3 EPL)		
-2	131-0608-00			12		. TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-3	131-1043-00			1		. CONNECTOR,RCPT,:18/36 CONTACT	23880	SAC18D/4-2
-4	----- -----			3		. CONNECTOR,RCPT,:(SEE J601,J602 AND J603 EPL)		
-5	136-0269-00			1		. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	73803	CS9002-14
-6	214-1593-02	B010100	B105856	6		. KEY,CONN PLZN:CKT BD CONN	80009	214-1593-02
	214-2627-00	B105857	B106746	6		. KEY,CONN PLZN:CIRCUIT CARD CONNECTOR	31514	Q07900
	214-1593-02	B106747		6		. KEY,CONN PLZN:CKT BD CONN	80009	214-1593-02
-7	386-1938-00			1		. REINF,CKT BD:INTERFACE	80009	386-1938-00
						(ATTACHING PARTS)		
-8	210-0777-00			4		. RIVET,BLIND:0.125 DIA GRIP,AL	45722	AD42AB5
						- - - * - - -		
						(ATTACHING PARTS FOR CKT BD ASSY)		
-9	213-0146-00			4		SCR,TPG,THD FOR:6-20 X 0.313 INCH,PNH STL	83385	OBD
						- - - * - - -		
	----- -----	XB109310		1		CKT BOARD ASSY:SIGNAL OUT(SEE A5 EPL)		
	----- -----			-		(OPTION 7 ONLY)		
	129-0259-00	XB109310		3		. POST,ELEC-MECH:4-40 X 0.187 OD X 0.39" LG	80009	129-0259-00
	131-0589-00	XB109310		20		. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
	198-4025-00	XB109310		1		. WIRE SET,ELEC:	80009	198-4025-00
	131-0707-00	XB109310		12		. . CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
	175-0825-00	XB109310		FT		. . WIRE,ELECTRICAL:2 WIRE RIBBON	80009	175-0825-00
	175-0829-00	XB109310		FT		. . WIRE,ELECTRICAL:6 WIRE RIBBON	08261	SS-0626-710610C
	352-0164-00	XB109310		1		. . CONN BODY,PL,EL:6 WIRE BLACK	80009	352-0164-00
	352-0169-02	XB109310		1		. . CONN BODY,PL,EL:2 WIRE RED	80009	352-0169-00
	352-0169-03	XB109310		1		. . CONN BODY,PL,EL:2 WIRE ORANGE	80009	352-0169-03
	352-0169-09	XB109310		1		. . CONN BODY,PL,EL:2 WIRE WHITE	80009	352-0169-09
						(ATTACHING PARTS FOR CKT BD ASSY)		
	211-0116-00	XB109310		3		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
						- - - * - - -		
-10	----- -----			1		CKT BOARD ASSY:LV POWER SUPPLY(SEE A4 EPL)		
-11	131-0608-00			14		. TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
	131-0589-00			14		. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
-12	200-0293-00			1		. SHLD,CAPACITOR:2.563 INCHES LONG	80009	200-0293-00
-13	200-0294-00	B01010	B043669	2		. SHLD,CAPACITOR:	80009	200-0294-00
	200-0294-00	B043670		1		. SHLD,CAPACITOR:	80009	200-0294-00
-14	214-0579-00			4		. TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-15	344-0154-00			6		. CLIP,ELECTRICAL:FUSE,CKT BD MT	80009	344-0154-00
						(ATTACHING PARTS FOR CKT BD ASSY)		
-16	211-0504-00			6		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-17	----- -----			1		TRANSFORMER:(SEE T801 EPL)		
-18	352-0198-00			1		. HLDR,TERM CONN:2 WIRE BLACK	80009	352-0198-00
-19	131-0622-00			2		. CONTACT,ELEC:0.577"L,28-32 AWG WIRE	22526	46241
						(ATTACHING PARTS FOR XFMR)		
-20	212-0516-00	B010100	B049999	4		SCREW,MACHINE:10-32 X 2 INCH,HEX HD STL	77250	OBD
	212-0522-00	B050000		4		SCREW,MACHINE:10-32 X 2.50",HEX HD STL	83385	OBD
	210-0812-00	XB062200		4		WASHER,NONMETAL:#10,FIBER	86445	OBD
-21	166-0226-00	B010100	B049999	4		INS SLV,ELEC:1.125 INCHES LONG	80009	166-0226-00
	166-0457-00	B050000		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	OBD
						- - - * - - -		
-23	200-0772-02			1		COVER,ELEC XFMR:3.125 X 3.75 X 0.875	80009	200-0772-02
	131-0126-00	XB109310		4		CONNECTOR,RCPT,:BNC,FEMALE	77820	9663-1 NT-34
	----- -----			-		(OPTION 7 ONLY)		
-24	333-1425-00	B010100	B099999	1		PANEL,REAR:	80009	333-1425-00
	333-1425-06	B100000	B121189	1		PANEL,REAR:	80009	333-1425-06
	333-1425-08	B121190		1		PANEL,REAR:	80009	333-1425-08
	333-1425-07	XB109310	B121189	1		PANEL,REAR:	80009	333-1425-07
	----- -----			-		(OPTION 7 ONLY)		
	333-1425-09	B121190		1		PANEL,REAR:	80009	333-1425-09
	----- -----			-		(OPTION 7 ONLY)		
-25	343-0315-00			2		CLAMP,XSTR:	80009	343-0315-00
						(ATTACHING PARTS)		
-26	210-0407-00			6		NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
						- - - * - - -		

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 -27	342-0082-00			3	INSULATOR,PLATE:0.52 SQ X 0.015 INCH THK,AL	80009	342-0082-00
-28	351-0293-00			3	GUIDE,SLIDE:BLUE	80009	351-0293-00
-29	351-0286-00	B010100	B039999	3	GUIDE,PL-IN UNI:	80009	351-0286-00
	351-0286-01	B040000	B062225	3	GUIDE,PL-IN UNI:	80009	351-0286-01
	351-0286-02	B062226	B065347	3	GUIDE,PL-IN UNI:	80009	351-0286-02
	351-0286-04	B065348	B111019	3	GUIDE,PL-IN UNI:LOWER,BLACK NYLON	80009	351-0286-04
	351-0286-07	B111020		3	GUIDE,PL-IN UNI:LOWER,NYLON	80009	351-0286-07
					(ATTACHING PARTS)		
-30	211-0105-00	B010100	B111019	3	SCREW,MACHINE:4-40 X 0.188"100 DEG,FLH STL	83385	OBD
	213-0813-00	B111020		6	SCREW,TPG,TR:4-20,0.312 L,PLASTITE	93907	OBD
	213-0814-00	XB111020		3	SCREW,TPG,TR:4-20,0.25 L,PLASTITE	93907	OBD
					- - - * - - -		
-31	426-0738-00			1	FR ASSY,PWR-AMP:	80009	426-0738-00
	210-0617-00	XB030000		3	. EYELET,METALLIC:0.089 OD X 0.125" L,BRASS	57771	2245
	131-1254-01	XB030000		3	. CONTACT,ELEC:GROUNDING	80009	131-1254-01
-32	175-0826-00			FT	WIRE,ELECTRICAL:3 WIRE RIBBON	80009	175-0826-00
-33	175-0829-00			FT	WIRE,ELECTRICAL:6 WIRE RIBBON	08261	SS-0626-710610C
	131-1896-00			1	LINK,TERM. CONN:8,22 AWG,1.5 L	80009	131-1896-00
-34	131-0707-00			2	. CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-35	352-0166-02			1	. HLDR,TERM CONN:8 WIRE,RED	80009	352-0166-02
	131-1895-00			1	LINK,TERM. CONN:8,22 AWG,1.5 L	80009	131-1895-00
	131-0707-00			2	. CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
	352-0166-01			1	. CONN BODY,PL,EL:8 WIRE BROWN	80009	352-0166-01
	198-4024-00	XB109310		1	WIRE SET,ELEC:	80009	198-4024-00
	----- -----			-	(OPTION 7 ONLY)		
	131-0707-00			8	. CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
	175-0857-00			FT	. WIRE,ELECTRICAL:8 WIRE RIBBON	08261	SS-0822-1910610C
	352-0166-04			1	. CONN BODY,PL,EL:8 WIRE YELLOW	80009	352-0166-04

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-	200-1375-00			1		COVER,SCOPE:FRONT	80009	200-1375-00
	----- -----			-		(OPTION 2 ONLY)		
-1	200-0728-01	B010100	B099999	1		COV,HANDLE END:	80009	200-0728-01
	200-0728-06	B100000		1		COVER,HDL END:	80009	200-0728-06
-2	200-0728-00			1		COV,HANDLE END:	80009	200-0728-00
-3	367-0116-00			1		HANDLE,CARRYING:	12136	OBD
						(ATTACHING PARTS)		
-4	212-0597-00			4		SCREW,MACHINE:10-32 X 0.50 INCH,STL	93907	OBD
-5	386-1624-00			2		PLATE,HDL RTNG:STAINLESS STEEL	80009	386-1624-00
-6	386-1283-00			2		PLATE,HDL MTG:FRONT	80009	386-1283-00
						- - - * - - -		
-7	390-0193-00	B010100	B105297	1		COVER,SCOPE:LEFT SIDE	80009	390-0193-00
	390-0469-00	B105298		1		CAB.SIDE,DSPL:SIDE	80009	390-0469-00
	390-0193-01	B010100	B104843	1		COVER,SCOPE:LEFT SIDE	80009	390-0193-01
	----- -----			-		(OPTION 2 ONLY)		
	390-0471-00	B104844		1		COVER,DISPLAY:LEFT SIDE BENCH W/LATCH	80009	390-0471-00
	----- -----			-		(OPTION 2 ONLY)		
	214-0812-00			4		. FASTENER,PAWL:	80009	214-0812-00
	----- -----			-		. EACH ASSY INCLUDES:		
-8	386-1151-00			1		. . CLAMP,RIM CLENC:SPG STL CD PL	80009	386-1151-00
-9	386-0227-00			1		. . STOP,CLP,RIM CL:ACETAL	80009	386-0227-00
-10	214-0604-00			1		. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-11	214-0603-01			1		. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-12	390-0192-00	B010100	B105297	1		COVER,SCOPE:RIGHT SIDE	80009	390-0192-00
	390-0469-00	B105298		1		CAB.SIDE,DSPL:SIDE	80009	390-0469-00
	390-0192-01	B010100	B104843	1		COVER,SCOPE:RIGHT SIDE	80009	390-0192-01
	----- -----			-		(OPTION 2 ONLY)		
	390-0471-01	B104844		1		COVER,DISPLAY:RIGHT SIDE BENCH W/LATCH	80009	390-0471-01
	----- -----			-		(OPTION 2 ONLY)		
	214-0812-00			4		. FASTENER,PAWL:	80009	214-0812-00
-13	386-1151-00			1		. . CLAMP,RIM CLENC:SPG STL CD PL	80009	386-1151-00
-14	386-0227-00			1		. . STOP,CLP,RIM CL:ACETAL	80009	386-0227-00
-15	214-0604-00			1		. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-16	214-0603-01			1		. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-17	390-0190-00	B010100	B105297	1		COVER,SCOPE:BOTTOM	80009	390-0190-00
	390-0470-00	B105298		1		CAB.BOT,DSPL:BOTTOM	80009	390-0470-00
	214-0812-00			4		. FASTENER,PAWL:	80009	214-0812-00
-18	386-1151-00			1		. . CLAMP,RIM CLENC:SPG STL CD PL	80009	386-1151-00
-19	386-0227-00			1		. . STOP,CLP,RIM CL:ACETAL	80009	386-0227-00
-20	214-0604-00			1		. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-21	214-0603-01			1		. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-22	348-0073-00			2		. . HINGE BLOCK,STA:L FR,R REAR,BLACK ACETAL	80009	348-0073-00
						(ATTACHING PARTS)		
-23	211-0532-00			4		. . SCREW,MACHINE:6-32 X 0.75 INCH,FILH STL	83385	OBD
-24	210-0457-00			4		. . NUT,PL,ASSEM WA:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-25	348-0208-00			2		. FOOT,CABINET:LEFT FRONT AND RIGHT REAR	80009	348-0208-00
-26	348-0074-00			2		. HINGE BLOCK,STA:R FR,L REAR,BLACK ACETAL	80009	348-0074-00
						(ATTACHING PARTS)		
-27	211-0532-00			4		. SCREW,MACHINE:6-32 X 0.75 INCH,FILH STL	83385	OBD
-28	210-0457-00			4		. NUT,PL,ASSEM WA:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-29	348-0207-00			2		FOOT,CABINET:RIGHT FRONT AND LEFT REAR	80009	348-0207-00
-30	348-0275-00			1		FLIPSTAND,CAB.:	80009	348-0275-00
-31	212-0105-00			2		SCREW,EXT RLV:8-32 X 0.312 INCH,HEX HD STL	80009	212-0105-00
-32	212-0008-00			2		SCREW,MACHINE:8-32 X 0.500 INCH,PNH STL	83385	OBD
-33	210-0008-00			2		WASHER,LOCK:INTL,0.172 ID X 0.331"OD,STL	78189	1208-00-00-0541C
-34	361-0388-00			2		SPACER,PLATE:	80009	361-0388-00
-35	343-0256-00			2		RTNR BLK,SCOPE:	80009	343-0256-00
						(ATTACHING PARTS)		
-36	211-0531-00			4		SCREW,MACHINE:6-32 X 0.375,FIL,STL	83385	OBD
						- - - * - - -		



@

5110 OSCILLOSCOPE

FIG. 4 RACKMOUNT CABINET

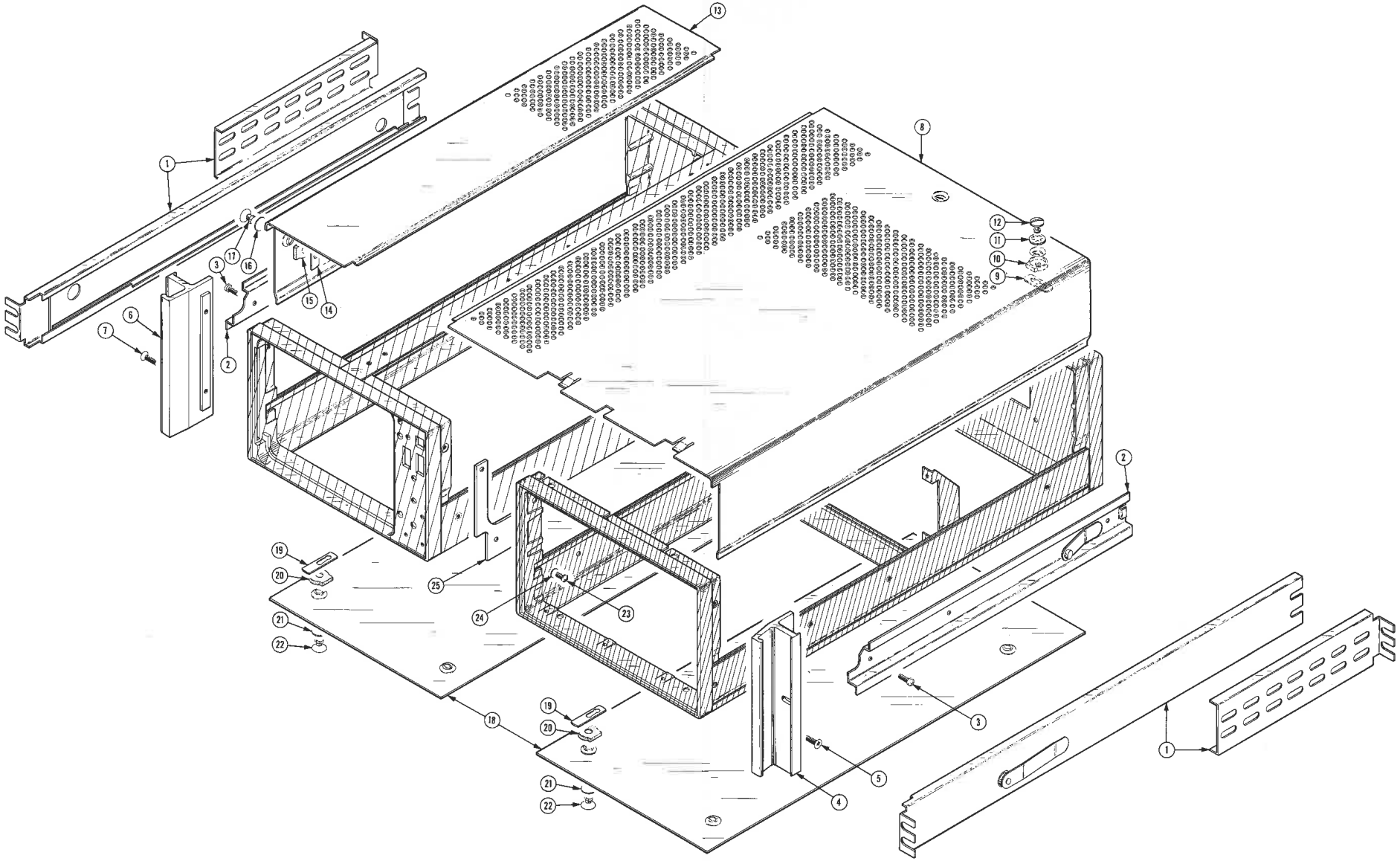


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
4 -1	351-0195-00			1	SLIDE,DWR,EXT:SLIDE,PAIR(RACKMOUNT ONLY)	06666	C719
-2	351-0104-00			1	SLIDE SECT,DWR:12.625 X 2.25	06666	C-720-2
					(ATTACHING PARTS)		
-3	212-0004-00			6	SCREW,MACHINE:8-32 X 0.312 INCH,PNH STL	83385	OBD
	210-0858-00			6	WASHER,FLAT:0.500 OD X 0.171 ID X 0.063 THK	80009	210-0858-00
					- - - * - - -		
-4	407-0899-02	B010100	B099999	1	BRACKET,RACK MT:RIGHT,ALUMINUM	80009	407-0899-02
	407-0899-00	B100000		1	BRACKET,RACK MT:ALUMINUM	80009	407-0899-00
					(ATTACHING PARTS)		
-5	212-0040-00			2	SCREW,MACHINE:8-32 X 0.375 100 DEG,FLH STL	83385	OBD
					- - - * - - -		
-6	407-0899-00			1	BRACKET,RACK MT:ALUMINUM	80009	407-0899-00
					(ATTACHING PARTS)		
-7	212-0040-00			2	SCREW,MACHINE:8-32 X 0.375 100 DEG,FLH STL	83385	OBD
					- - - * - - -		
-8	390-0191-00	B010100	B105297	1	COVER,SCOPE:RIGHT SIDE	80009	390-0191-00
	390-0502-00	B105298		1	CAB.SIDE,DSPL:RIGHT,RACK	80009	390-0502-00
	390-0192-01	B010100	B104843	1	COVER,SCOPE:RIGHT SIDE	80009	390-0192-01
	----- -----			-	(OPTION 2 ONLY)		
	390-0471-01	B104844		1	COVER,DISPLAY:RIGHT SIDE BENCH W/LATCH	80009	390-0471-01
	----- -----			-	(OPTION 2 ONLY)		
	214-0812-00			4	. FASTENER,PAWL:	80009	214-0812-00
-9	386-1151-00			1	. . CLAMP,RIM CLENC:SPG STL CD PL	80009	386-1151-00
-10	386-0227-00			1	. . STOP,CLP,RIM CL:ACETAL	80009	386-0227-00
-11	214-0604-00			1	. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-12	214-0603-01			1	. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-13	390-0194-00	B010100	B105297	1	COVER,SCOPE:LEFT SIDE	80009	390-0194-00
	390-0503-00	B105298		1	CAB.SIDE,DSPL:LEFT,RACK	80009	390-0503-00
	390-0193-01	B010100	B104843	1	COVER,SCOPE:LEFT SIDE	80009	390-0193-01
	----- -----			-	(OPTION 2 ONLY)		
	390-0471-00	B104844		1	COVER,DISPLAY:LEFT SIDE BENCH W/LATCH	80009	390-0471-00
	----- -----			-	(OPTION 2 ONLY)		
	214-0812-00			2	. FASTENER,PAWL:	80009	214-0812-00
-14	386-1151-00			1	. . CLAMP,RIM CLENC:SPG STL CD PL	80009	386-1151-00
-15	386-0227-00			1	. . STOP,CLP,RIM CL:ACETAL	80009	386-0227-00
-16	214-0604-00			1	. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-17	214-0603-01			1	. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-18	390-0222-00	B010100	B105297	2	COVER,SCOPE:BOTTOM	80009	390-0222-00
	390-0505-00	B105298		1	CAB.BOT,SCOPE:	80009	390-0505-00
	----- -----			-	. EACH ASSY INCLUDES:		
	214-0812-00			4	. FASTENER,PAWL:	80009	214-0812-00
	----- -----			-	. EACH ASSY INCLUDES:		
-19	386-1151-00			1	. . CLAMP,RIM CLENC:SPG STL CD PL	80009	386-1151-00
-20	386-0227-00			1	. . STOP,CLP,RIM CL:ACETAL	80009	386-0227-00
-21	214-0604-00			1	. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-22	214-0603-01			1	. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-23	212-0103-00			3	SCREW,MACHINE:8-32 X 0.375 HEX HD,STL	77250	OBD
	212-0104-00			3	SCREW,MACHINE:8-32,0.75 HEX STL	80009	212-0104-00
-24	210-0008-00			10	WASHER,LOCK:INTL,0.172 ID X 0.331"OD,STL	78189	1208-00-00-0541C
-25	361-0389-00			1	SPACER,PLATE:0.125 AL,L-SHAPE	80009	361-0389-00

ACCESSORIES

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
	070-2134-01			1		MANUAL,TECH:INSTRUCTION	80009	070-2134-01

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.

SERVICE NOTE

Because of the universal parts procurement problem, some electrical parts in your instrument may be different from those described in the Replaceable Electrical Parts List. The parts used will in no way alter or compromise the performance or reliability of this instrument. They are installed when necessary to ensure prompt delivery to the customer. Order replacement parts from the Replaceable Electrical Parts List.

CALIBRATION TEST EQUIPMENT REPLACEMENT

Calibration Test Equipment Chart

This chart compares TM 500 product performance to that of older Tektronix equipment. Only those characteristics where significant specification differences occur, are listed. In some cases the new instrument may not be a total functional replacement. Additional support instrumentation may be needed or a change in calibration procedure may be necessary.

Comparison of Main Characteristics

DM 501 replaces 7D13		
PG 501 replaces 107	PG 501 - Risetime less than 3.5 ns into 50 Ω.	107 - Risetime less than 3.0 ns into 50 Ω.
108	PG 501 - 5 V output pulse; 3.5 ns Risetime	108 - 10 V output pulse 1 ns Risetime
PG 502 replaces 107		
108	PG 502 - 5 V output	108 - 10 V output
111	PG 502 - Risetime less than 1 ns; 10 ns Pretrigger pulse delay	111 - Risetime 0.5 ns; 30 to 250 ns Pretrigger pulse delay
PG 508 replaces 114	Performance of replacement equipment is the same or better than equipment being replaced.	
115		
2101		
PG 506 replaces 106	PG 506 - Positive-going trigger output signal at least 1 V; High Amplitude output, 60 V.	106 - Positive and Negative-going trigger output signal, 50 ns and 1 V; High Amplitude output, 100 V.
067-0502-01	PG 506 - Does not have chopped feature.	0502-01 - Comparator output can be alternately chopped to a reference voltage.
SG 503 replaces 190, 190A, 190B	SG 503 - Amplitude range 5 mV to 5.5 V p-p.	190B - Amplitude range 40 mV to 10 V p-p.
191		
067-0532-01	SG 503 - Frequency range 250 kHz to 250 MHz.	0532-01 - Frequency range 65 MHz to 500 MHz.
SG 504 replaces 067-0532-01	SG 504 - Frequency range 245 MHz to 1050 MHz.	0532-01 - Frequency range 65 MHz to 500 MHz.
067-0650-00		
TG 501 replaces 180, 180A	TG 501 - Trigger output-slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	180A - Trigger pulses 1, 10, 100 Hz; 1, 10, and 100 kHz. Multiple time-marks can be generated simultaneously.
181		181 - Multiple time-marks
184	TG 501 - Trigger output-slaved to market output from 5 sec through 100 ns. One time-mark can be generated at a time.	184 - Separate trigger pulses of 1 and 0.1 sec; 10, 1, and 0.1 ms; 10 and 1 μs.
2901	TG 501 - Trigger output-slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	2901 - Separate trigger pulses, from 5 sec to 0.1 μs. Multiple time-marks can be generated simultaneously.

NOTE: All TM 500 generator outputs are short-proof. All TM 500 plug-in instruments require TM 500-Series Power Module.

REV B, JUN 1978