

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 μ s (\approx 3 μ s displayed, \approx 2 μ s 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, \pm 3% into \geq 100 k Ω	
DC Offset		\pm 500 mV max
Output Impedance	Approximately 1 k Ω	
Dynamic Range		\pm 4 V max
Amplifier Bandwidth	\geq 500 kHz up to +2 V output into \leq 50 pF	
Common Mode Rejection Ratio		\geq 28 dB at 1 kHz
Noise and Chop Breakthrough ^f	\leq 100 mV at each output connector	

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

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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.

CAUTION

For SN B126109 & up, a 5B10N or 5B12N time-base must not be used in the right vertical compartment if the left vertical compartment is also being used. Otherwise, the display signal of the left plug-in will be loaded (non-destructively).

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.

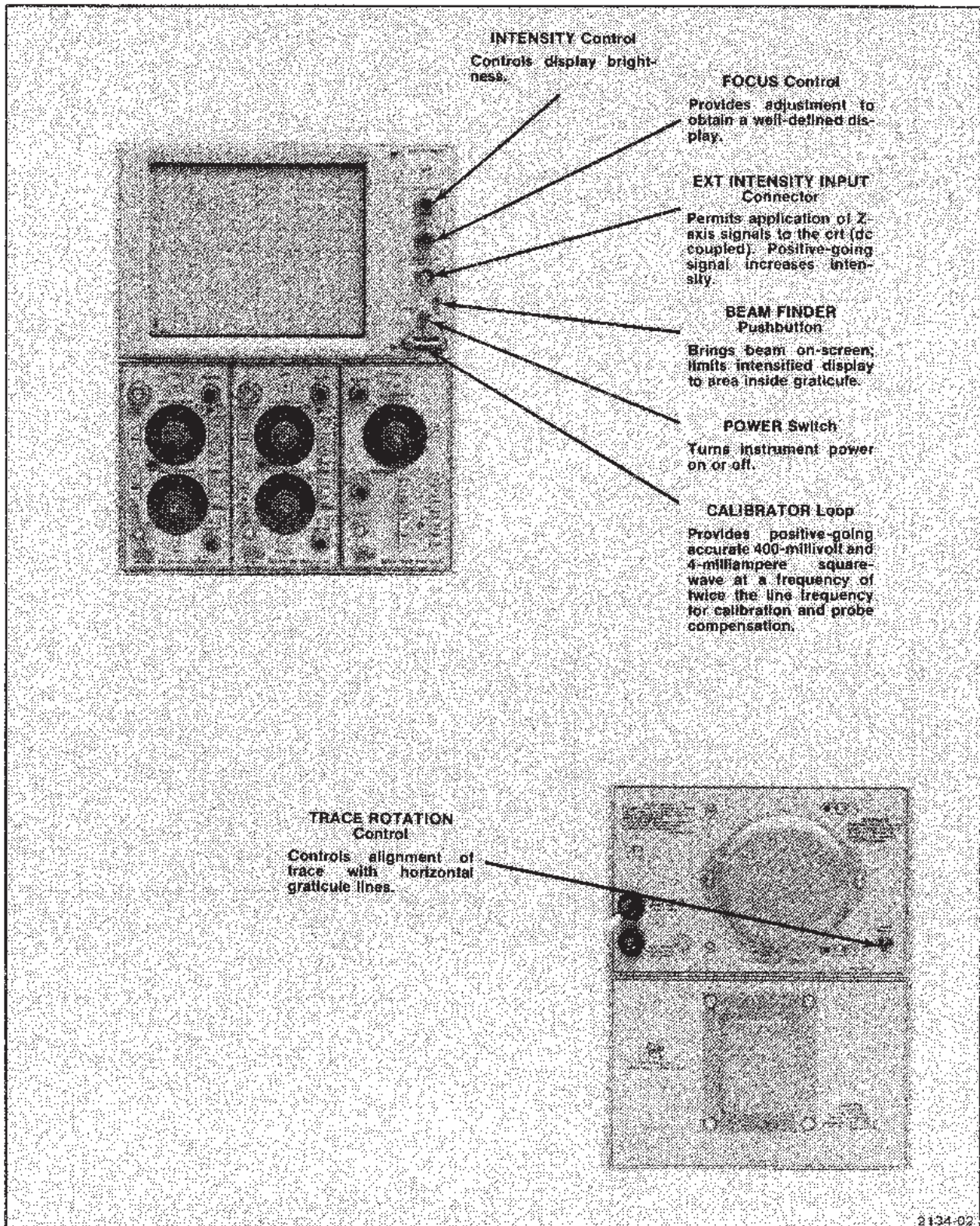


Fig. 1-2. Front and rear-panel controls and connectors.

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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, non-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.

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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 ± 150 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.

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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.

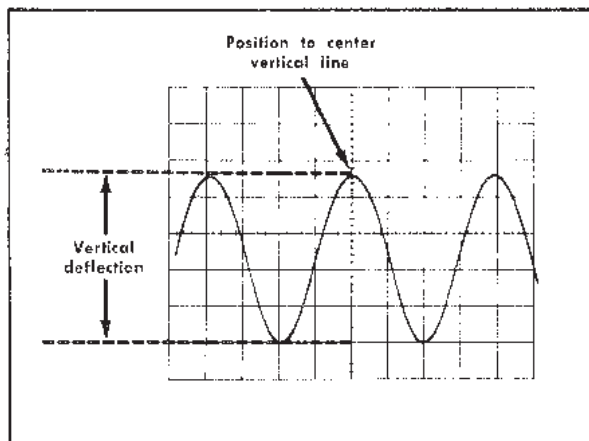


Fig. 1-3. Measuring peak-to-peak voltage of a waveform.

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

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

NOTE

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

Instantaneous Voltage Measurement—DC

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

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

NOTE

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

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

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

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

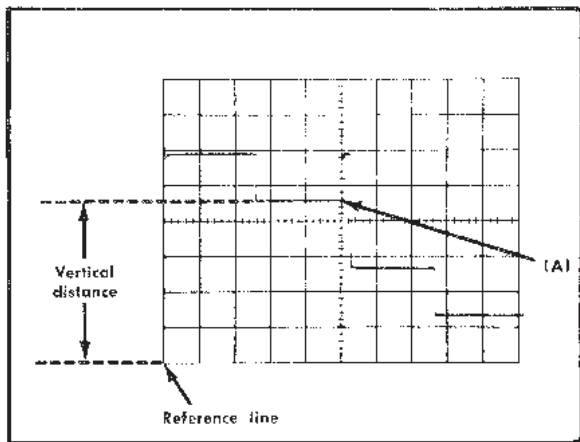


Fig. 1-4. Measuring instantaneous dc voltage with respect to a reference voltage.

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.

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

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:

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

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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):

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

Sweep Rate

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

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

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

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

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

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

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

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

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

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):

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

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

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

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

$$(68.75 \mu\text{s}) (7) = 481 \text{ microseconds}$$

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.

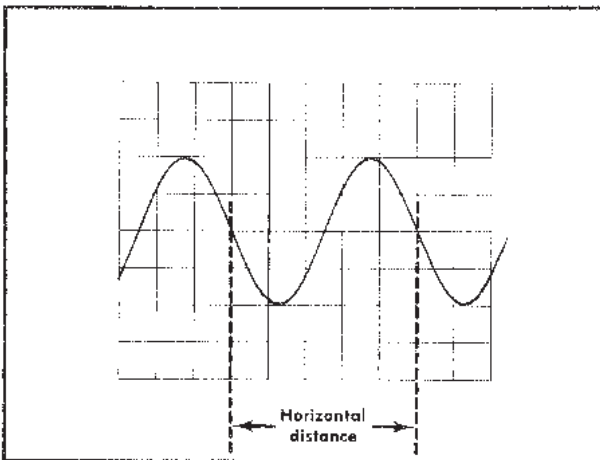


Fig. 1-5. Measuring time duration (period) between points on a waveform.

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:

$$\text{Period} = \frac{\text{horizontal distance}}{\text{Sec/Div setting}} = \frac{5}{0.1 \text{ ms}} = 0.5 \text{ ms}$$

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).

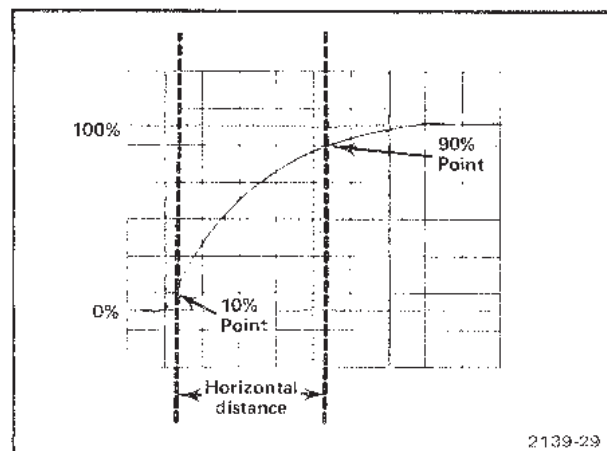


Fig. 1-6. Measuring risetime.

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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 μ s.

Using the period formula to find risetime:

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

The risetime is 4 microseconds.

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).

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).

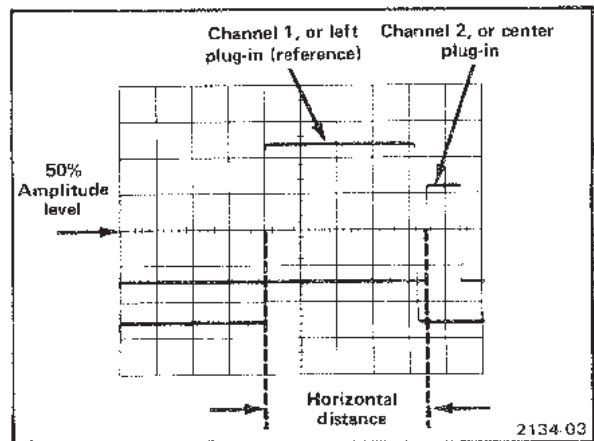


Fig. 1-7. Measuring time difference between two pulses.

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

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

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

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:

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

The phase difference is 27°.

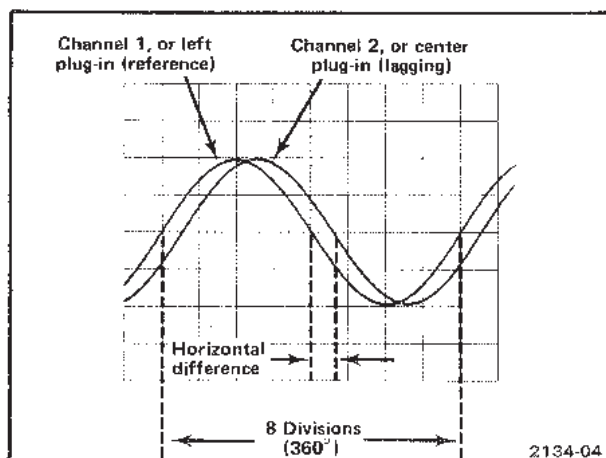


Fig. 1-8. Measuring phase difference.

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 $45^\circ/\text{division} \div 10 = 4.5^\circ/\text{division}$. 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:

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

The phase difference is 27° .

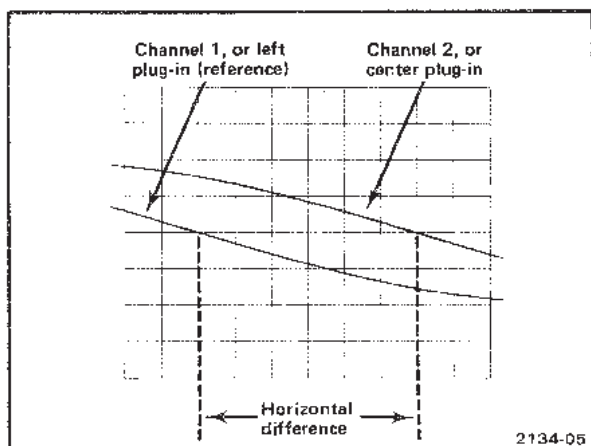


Fig. 1-9. High-resolution phase difference measurement with increased sweep rate.

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.

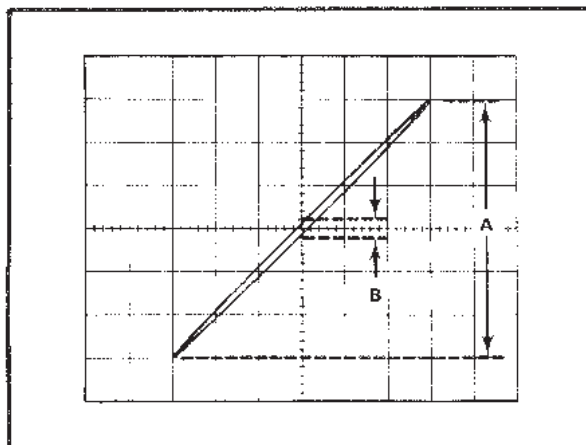


Fig. 1-10. Phase difference measurement from an X-Y display.

Using the formula:

$$\sin \phi = \frac{B}{A} = \frac{0.4}{6} = 0.0667$$

From the trigonometric tables:

$$\phi = \arcsin 0.0667 = 3.82^\circ$$

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

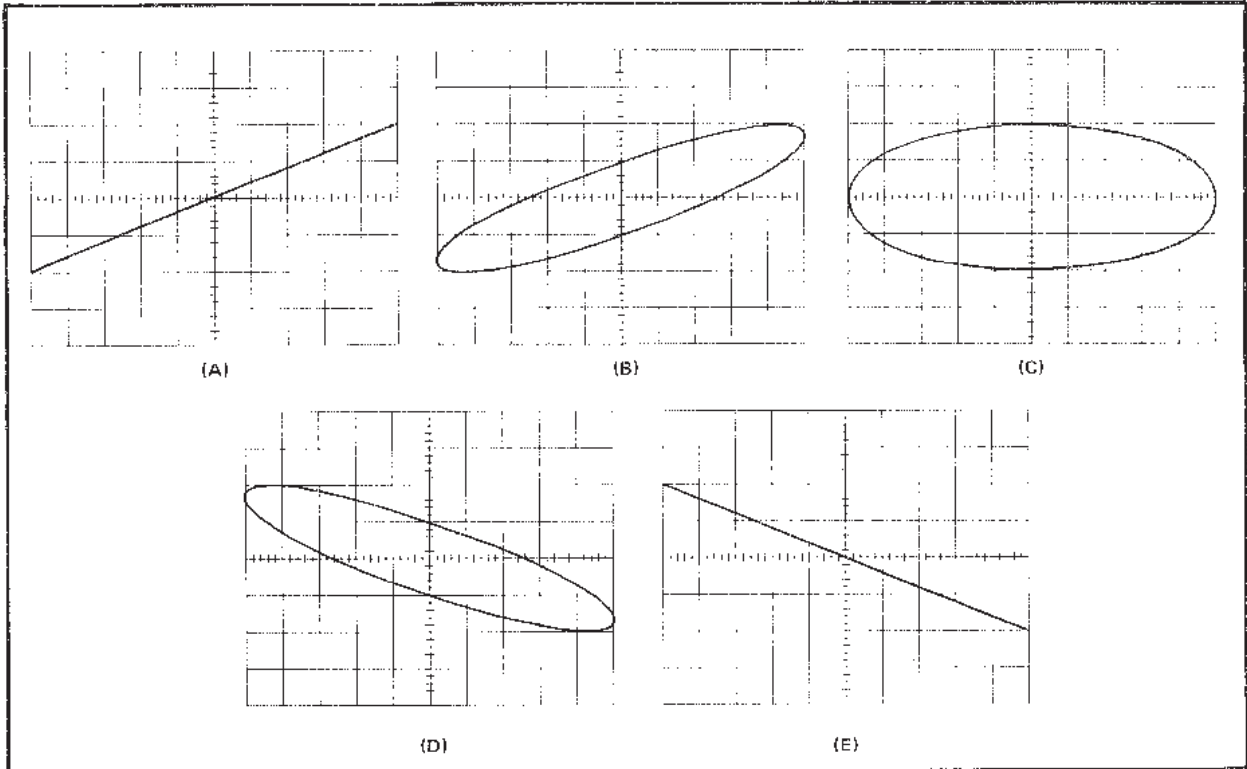


Fig. 1-11. Phase of a Lissajous display. (A) 0° or 360°, (B) 30° or 330°, (C) 90° or 270°, (D) 150° or 210°, and (E) 180°.

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 μ s (\approx 3 μ s displayed, \approx 2 μ s 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, \pm 3% into \geq 100 k Ω	
DC Offset		\pm 500 mV max
Output Impedance	Approximately 1 k Ω	
Dynamic Range		\pm 4 V max
Amplifier Bandwidth	\geq 500 kHz up to +2 V output into \leq 50 pF	
Common Mode Rejection Ratio		\geq 28 dB at 1 kHz
Noise and Chop Breakthrough ^f	\leq 100 mV at each output connector	

^f 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)		60 mV / displayed division.
Horizontal Centering		0.5 division or less.
Bandwidth	Dc to at least 2 MHz with a calibrated 5A18N having a serial number above B128130.	
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 k Ω .	
Polarity and Output Voltage	Positive-going ramp, ≥ 5 V.	DC offset provided by timebase position control.
Output Impedance	Approximately 1 k Ω .	
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 μ A, ≥ 2.4 V.
Risetime		≤ 1 μ s 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 k Ω , 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 $+50^{\circ}\text{C}$.

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 $\mu\text{s}/\text{div}$.	Steps 1 through 11, 13, 14.	a. TEKTRONIX 5B10N Time-Base.
Calibration generator	Amplitude calibration, 5 mV to 5V; accuracy, $\pm 0.25\%$ into 1 $\text{m}\Omega$; 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 .

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

²Requires a TM 500-series power module.

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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	1 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 TRACEROTATION 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.

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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 ($\pm 3\%$).

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 ($\pm 3\%$).

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 ($\pm 3\%$).

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 amplifiers and sine-wave generator.
- c. Remove the vertical amplifier from the horizontal compartment and install the time-base unit in that compartment. Pull the oscilloscope POWER switch to on.
- d. Set the time-base unit for auto, internal triggering at a sweep rate of 20 μ s/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 μ s/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.

Specification and Performance Check-5110

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.

ADJUSTMENT

Introduction

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

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

Tektronix Field Service

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

Test Equipment Required

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

Table 3-1

LIST OF TEST EQUIPMENT REQUIREMENTS FOR ADJUSTMENT

Description	Performance Requirements	Application	Example
Amplifier plug-in unit 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 μ s/div.	Steps 1 through 12.	a. TEKTRONIX 5B10N Time-Base.
Calibration generator	Amplitude calibration, 5 mV to 5 V; accuracy, $\pm 0.25\%$ into 1 M Ω ; 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 501A Option 02 Digital Multimeter. ²
DC voltmeter (vom) ³ With test leads	Range, zero to 4000 volts; accuracy, checked to within 1% at 3400 volts.	Step 5.	Valhalla Model 4500 HV Multimeter TEKTRONIX Part No. 003-0120-00 test leads
Coaxial cable	Impedance, 50 Ω ; length, 42 inch; connectors, bnc.	Steps 10, 12, and 13.	a. TEKTRONIX Part No. 012-0057-01.

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

²Requires a TM 500-series power module.

³A high-voltage probe can be used with the DM 501A Option 02 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 1-30° 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**

- Turn over the oscilloscope to lay on its left side to gain access to the LV Power Supply circuit board.
- Connect the digital voltmeter between the -30 V test point and ground. See Fig. 3-1 for voltage test point location.
- 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.

- 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

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

- 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

- Connect the digital voltmeter between the +5 V test point and ground. See Fig. 3-1 for voltage test point location.
- Check—for a meter reading of +4.89 to +5.11 volts.
- Connect the digital voltmeter between the +200 V test point and ground. See Fig. 3-1 for voltage test point location.
- 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

- 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.

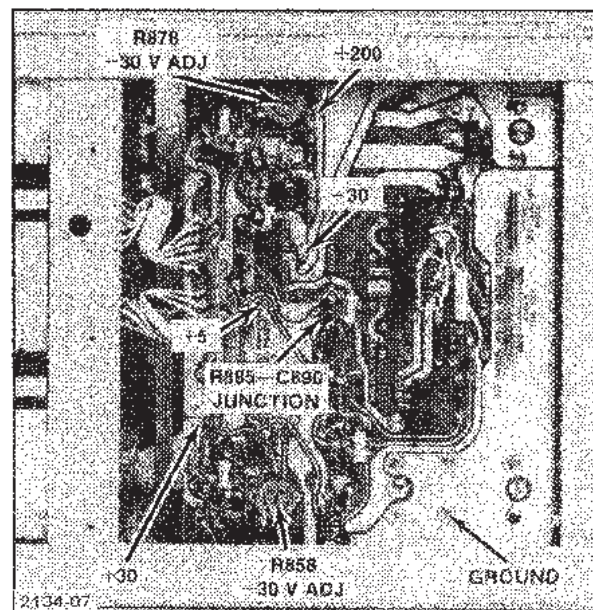


Fig. 3-1. Locations of power-supply test points and adjustments.

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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.

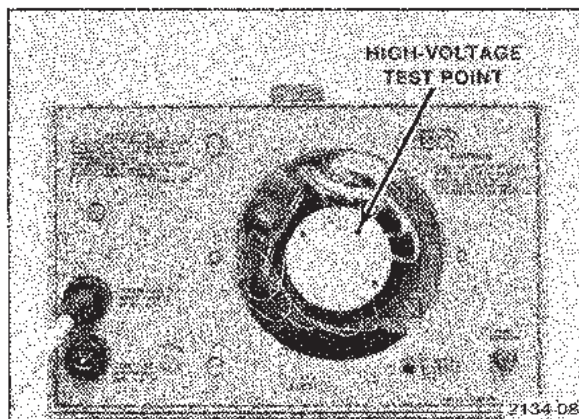


Fig. 3-2. Location of high-voltage test point.

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.

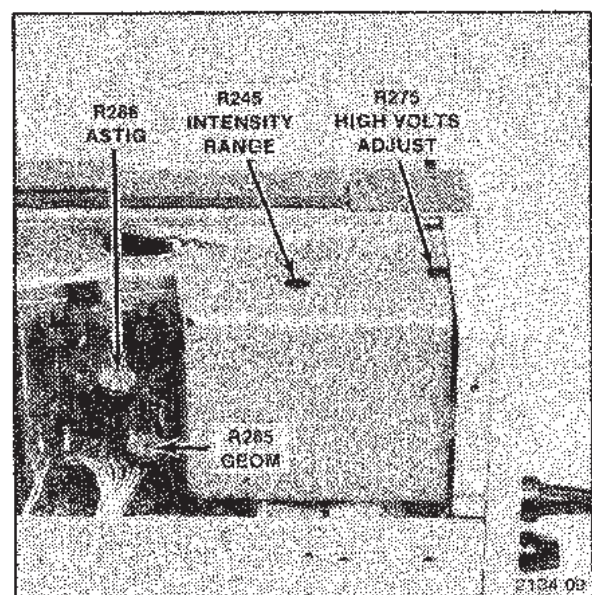


Fig. 3-3. Locations of high-voltage, intensity, and display adjustments.

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.

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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 ($\pm 3\%$).

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 ($\pm 3\%$). 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.

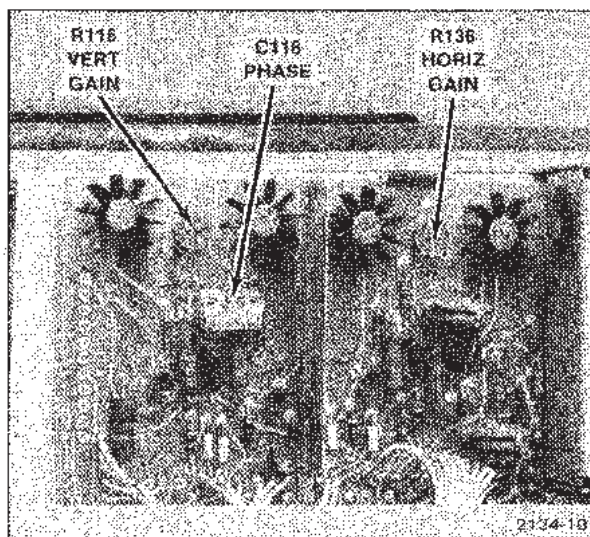


Fig. 3-4. Locations of vertical and horizontal adjustments.

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.

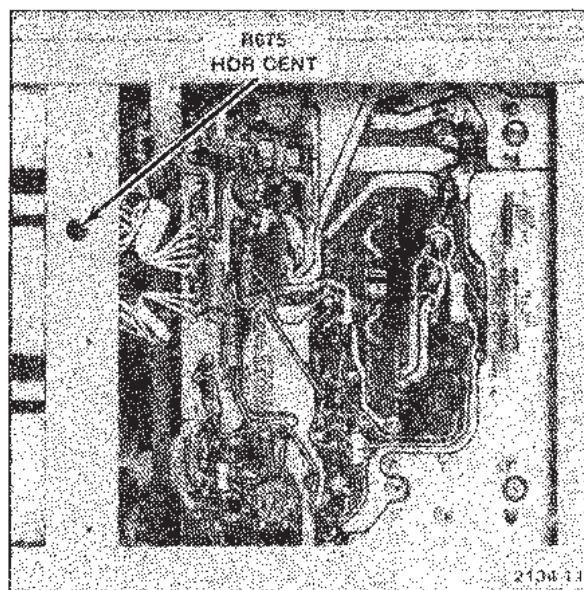


Fig. 3-5. Location of horizontal centering adjustment.

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 measuring the differential output at pins A7 and B7 of the plug-in connector. The deflection factor at the output is 50 millivolts/division.

c. Position the 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 ($\pm 3\%$).

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.

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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 \pm 10%	200 V \pm 10%
M (medium)	110 V \pm 10%	220 V \pm 10%
H (high, typical setting)	120 V \pm 10%	240 V \pm 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

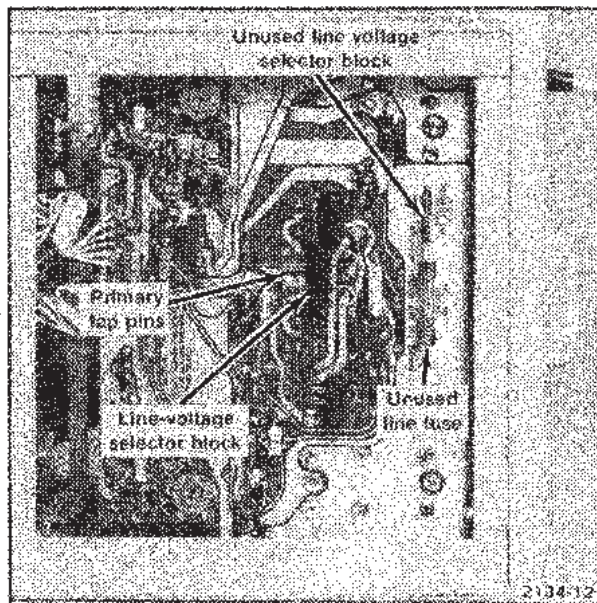


Fig. 4-1. Locations of the line-selector blocks on the LV Power Supply circuit board.

block is used and the instrument is then connected to 240-volt power).

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

6. Remove the line fuse from the fuse holder and check for the correct rating. Replace it with one having the correct rating, if necessary. Refer to Table 4-2 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.

WARNING

During rackmount installation, interchanging the left and right slide-out track assemblies defeats the extension stop (safety latch) feature of the tracks. Equipment could, when extended, come out of the slides and fall from the rack, possibly causing personal injury and equipment damage.

When mounting the supplied slide-out tracks, inspect both assemblies to find the LH (left hand) and RH (right hand) designations to determine correct placement. Install the LH assembly to your left side as you face the front of the rack and install the RH assembly to your right side. Refer to the rackmounting instructions in this manual for complete information.

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

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

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

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

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

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

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

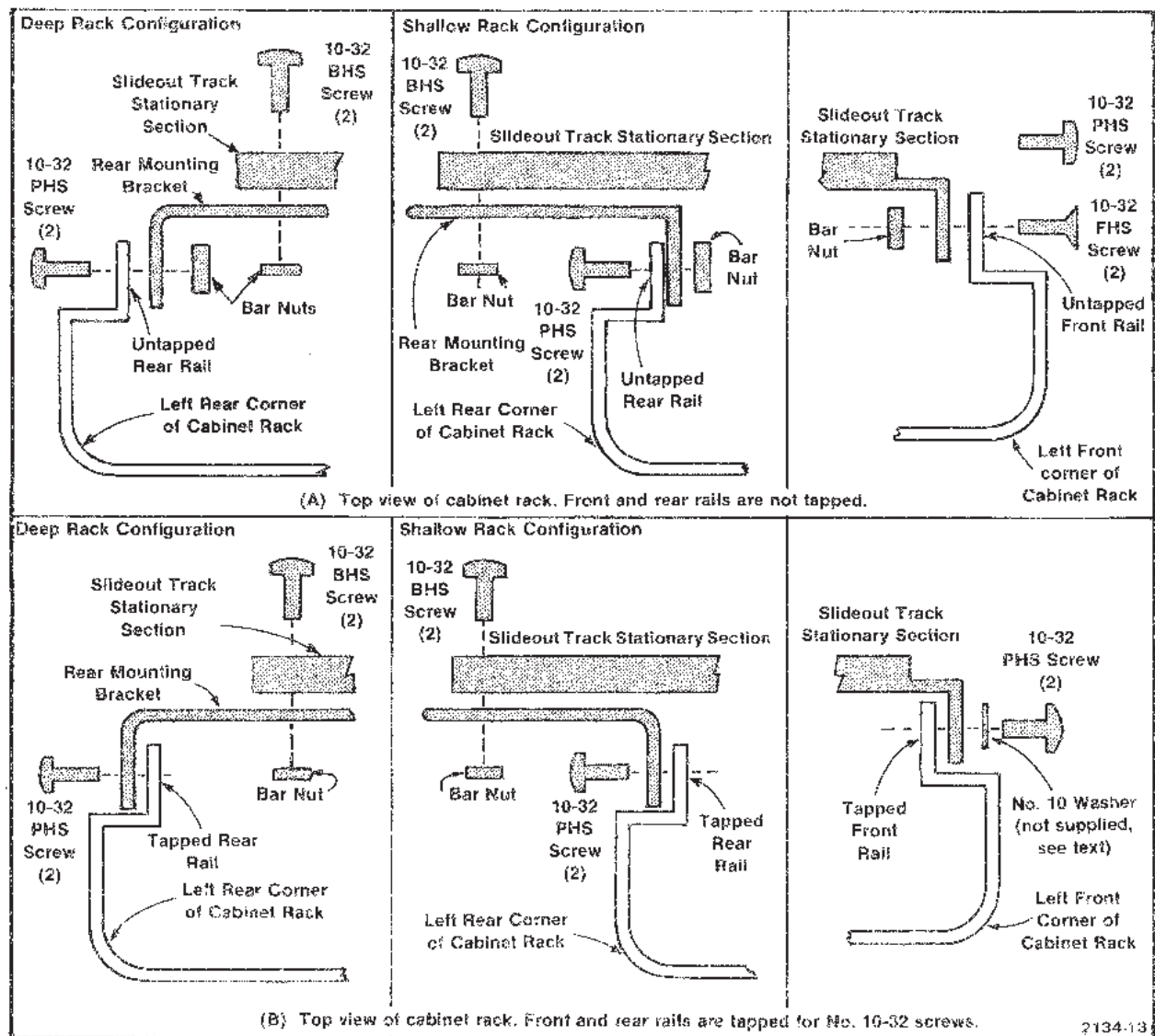


Fig. 4-2. Mounting the left stationary section (with its matched intermediate section, not shown in illustrations A and B) to the rack rails.

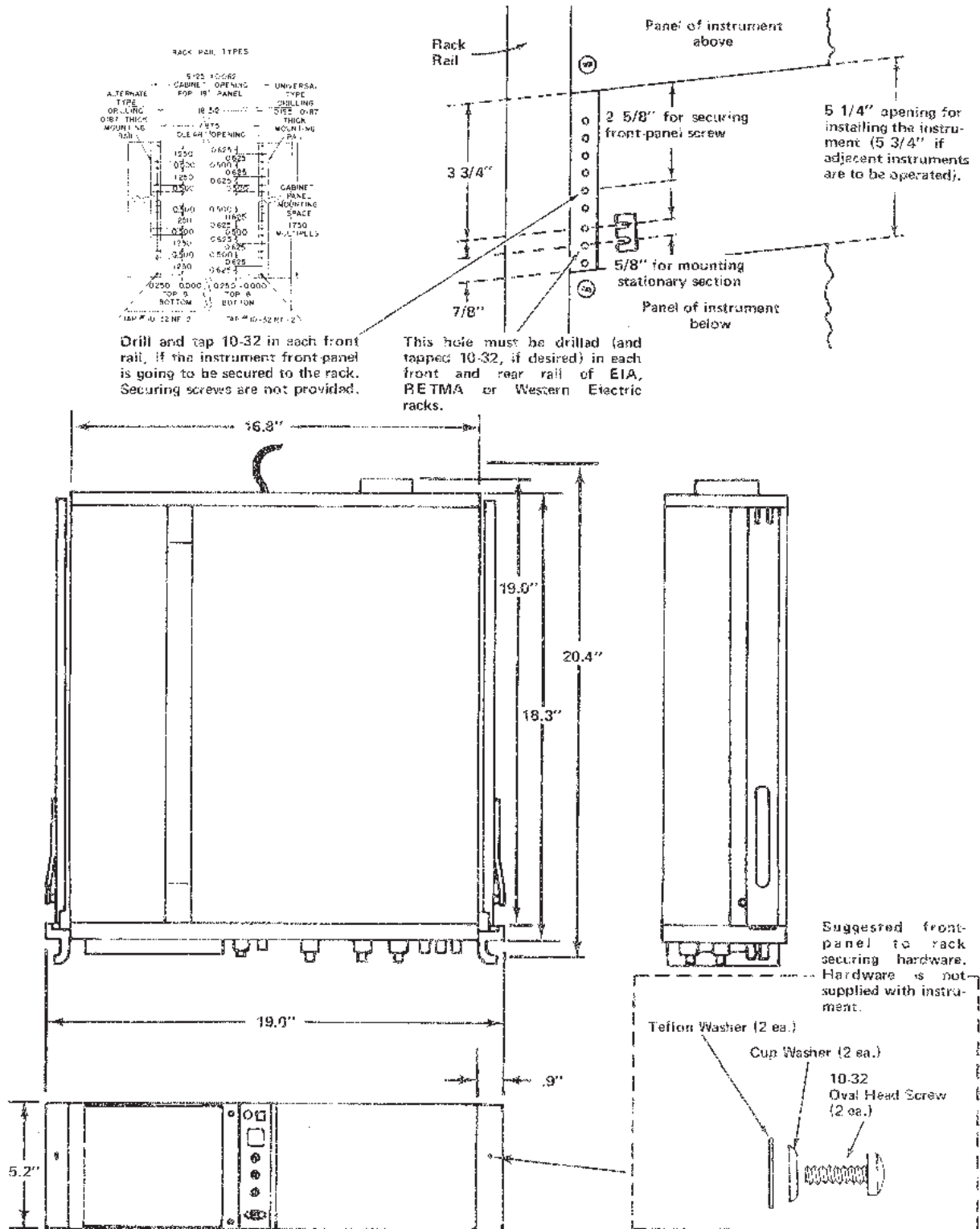


Fig. 4-3. Dimensional diagram.

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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 $+50^{\circ}\text{C}$. Additional clearance or forced ventilation methods (fan) may need to be employed to maintain ambient temperatures below $+50^{\circ}\text{C}$. 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.

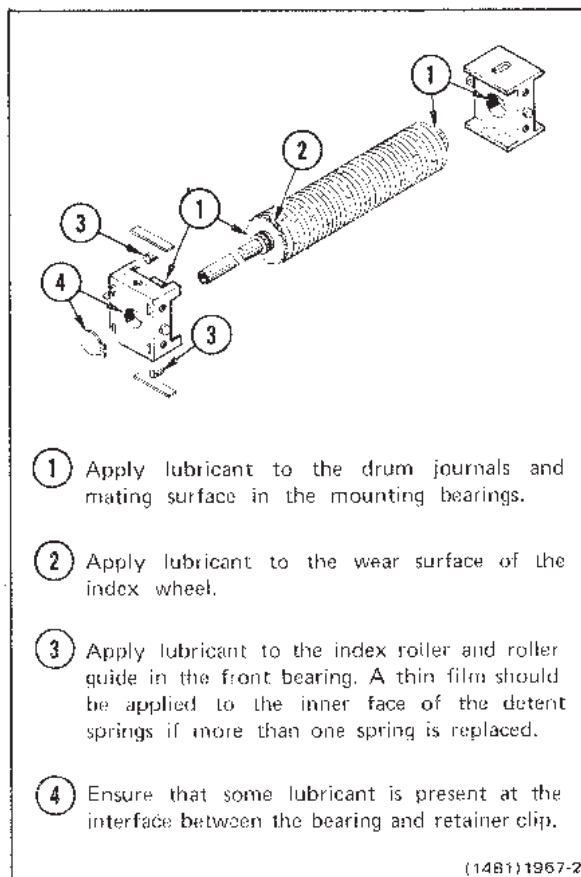


Fig. 4-4. Lubrication procedure for a typical cam switch.

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.

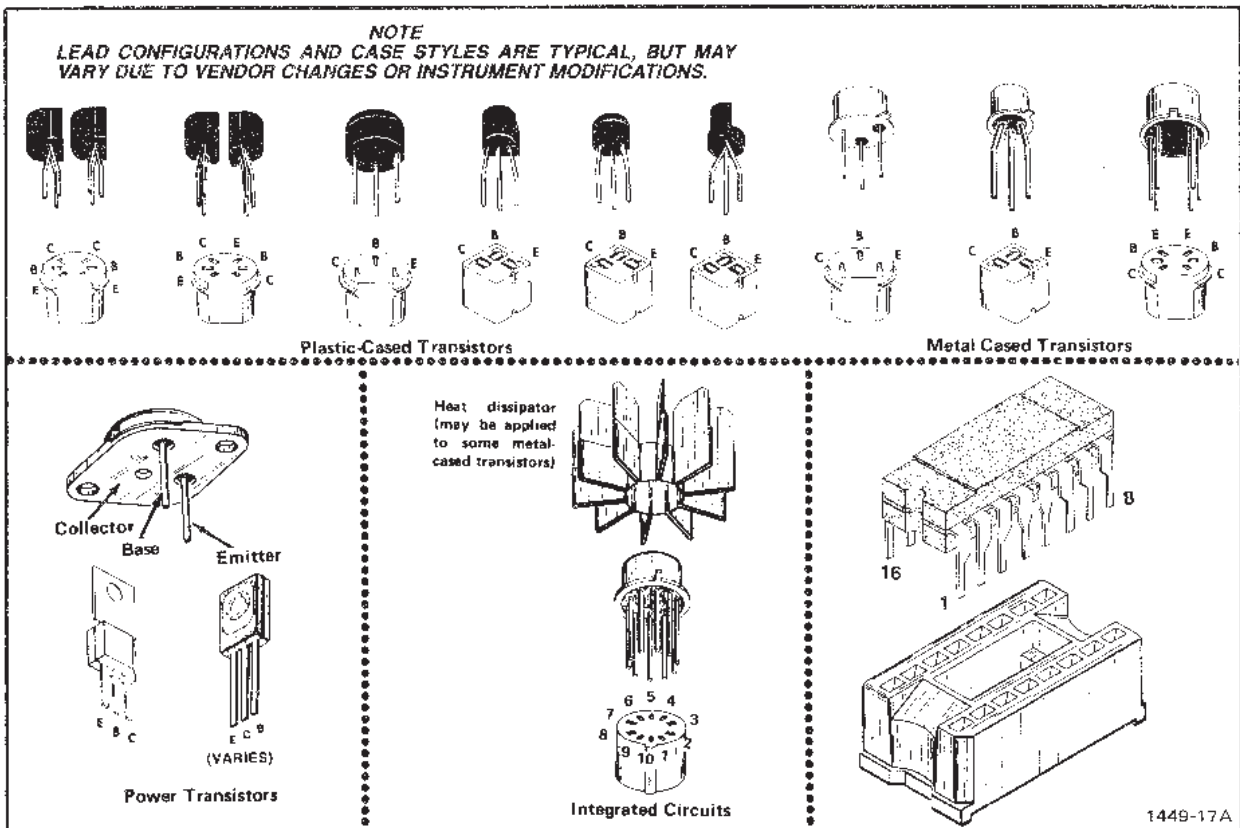


Fig. 4-5. Lead configuration data for semiconductor devices.

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.

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.

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.

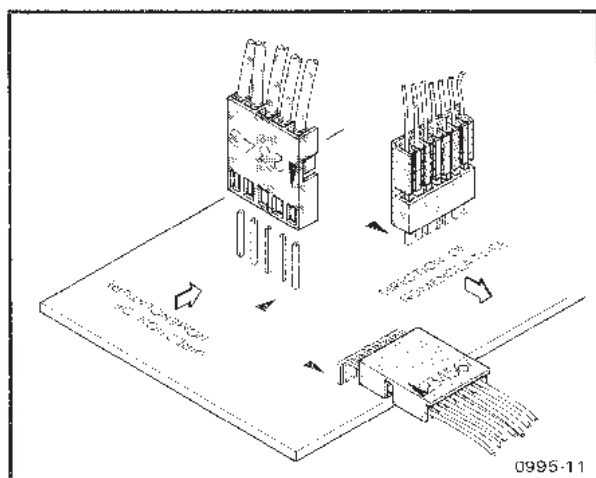


Fig. 4-6. Multi-pin connector holder orientation.

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Multimeter

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

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

Recommended Type: TEKTRONIX DM 501A Option 02 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
1200 V	1175 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.



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.

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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

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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



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.)

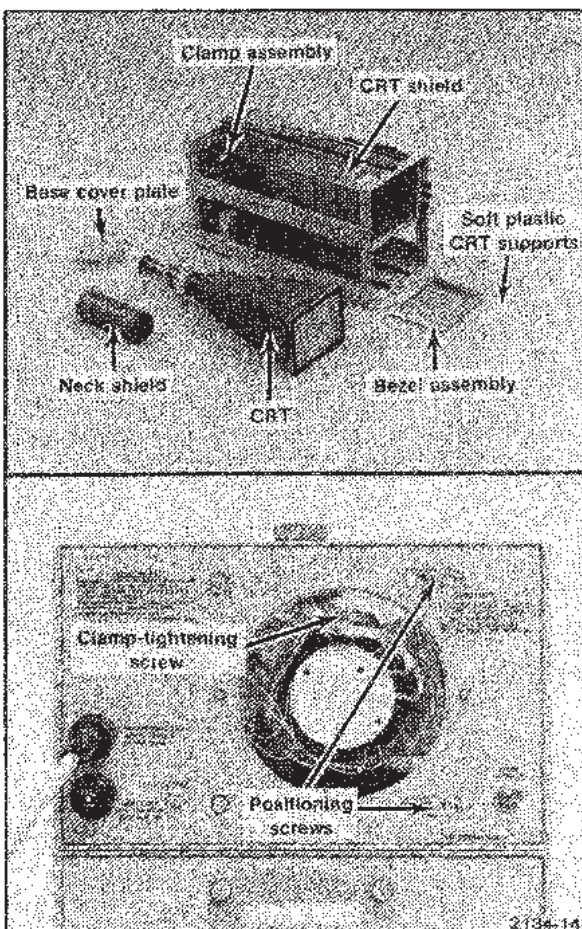


Fig. 4-7. Replacing the cathode-ray tube.

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.

Circuit Description-5110

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 P6H. 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 initially, 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.

Circuit Description-5110

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.

When ordering parts, include the following information in your order: part number, instrument type or number, serial number, and modification number if applicable.

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

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

LIST OF ASSEMBLIES

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

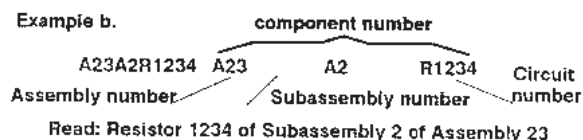
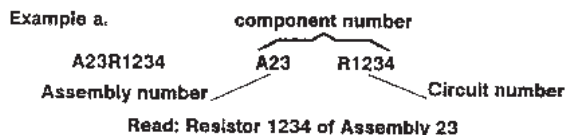
CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

The Mfg. Code Number to Manufacturer Cross Index for the electrical parts list is located immediately after this page. The cross index provides codes, names, and addresses of manufacturers of components listed in the electrical parts list.

ABBREVIATIONS

Abbreviations conform to American National Standard Y1.1.

COMPONENT NUMBER (column one of the parts list)



The circuit component's number appears on the diagrams and circuit board illustrations. Each diagram and circuit board illustration is clearly marked with the assembly number. Assembly numbers are also marked on the mechanical exploded views located in the mechanical parts list. The component number is obtained by adding the assembly number prefix to the circuit number.

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

Chassis-mounted parts have no assembly number prefix and are located at the end of the electrical parts list.

TEKTRONIX PART NO. (column two of the parts list)

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

SERIAL NO. (columns three and four of the parts list)

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

NAME & DESCRIPTION (column five of the parts list)

In the parts list, an item name is separated from the description by a colon (:). Because of space limitations, an item name may sometimes appear as incomplete. For further item name identification, the U.S. Federal Catalog handbook H6-1 can be utilized where possible.

MFR. CODE (column six of the parts list)

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

MFR. PART NO. (column seven of the parts list)

Indicates actual manufacturer's part number.

Replaceable Electrical Parts-5110

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
K8996	MULLARD LIMITED	MULLARD HOUSE TORRINGTON PLACE	LONDON WC1E 7HD ENGLAND
S0167	FUJITSU LTD	2-3-13 TORANOMON MINATO-KU	TOKYO JAPAN
TK0509	H V C INC	600 S MILWAUKEE STREET	FREDONIA WI 53021
TK0891	MICONICS	1 FAIRCHILD AVE	PLAINVIEW NY 11803
TK1424	MARCON AMERICA CORP	3 PEARL CT	ALLEDALE NJ 07401
TK1668	HARRISON ELECTRIC CO LTD	2-1 ASAHIMACHI 5-CHOME IMABARI	EHIME JAPAN
TK1725	GREENPAR CONNECTORS LTD	PO BOX 15 HARLOW	ESSEX CM20 2ER ENGLAND
TK1727	PHILIPS NEDERLAND BV AFD ELONCO	POSTBUS 90050	5600 PB EINDHOVEN THE NETHERLANDS
TK1743	UNITRODE (UK) LTD	6 CRESSWELL PARK BLACKHEATH	LONDON SE 3 9RD ENGLAND
TK1864	INTERFET CORP	322 GOLD ST	GARLAND TX 75042
TK2096	KELVIN ASSOCIATES	14724 VENTURA BLVD SUITE 1003	SHERMAN OAKS CA 91403-3501
QJR03	ZMAN AND ASSOCIATES	7633 S 180th	KENT WA 98032
QJR04	TOSHIBA AMERICA INC ELECTRONICS COMPONENTS DIV BUSINESS SECTOR	2692 DOW AVE	TUSTIN CA 92680
00213	MYTRONICS COMPONENTS GROUP INC SUBSIDIARY OF MYTRONICS INC	ORANGE ST	DARLINGTON SC 29532
00853	SANGAMO WESTON INC COMPONENTS DIV	SANGAMO RD PO BOX 128	PICKENS SC 29671-9716
01121	ALLEN-BRADLEY CO	1201 S 2ND ST	MILWAUKEE WI 53204-2410
01295	TEXAS INSTRUMENTS INC SEMICONDUCTOR GROUP	13500 N CENTRAL EXPY PO BOX 655012	DALLAS TX 75265
01983	CHERRY ELECTRICAL PRODUCTS CORP	3600 SUNSET AVE	WAUKEGAN IL 60057-3214
02114	PHILIPS COMPONENTS DISCRETE PRODUCTS DIV FERRITE FACILITY	5083 KINGS HWY	SAUGERTIES NY 12477
03508	GENERAL ELECTRIC CO SEMI-CONDUCTOR PRODUCTS DEPT	W GENESEE ST	AUBURN NY 13021
04222	AVX CERAMICS DIV OF AVX CORP	19TH AVE SOUTH P O BOX 867	MYRTLE BEACH SC 29577
04713	MOTOROLA INC SEMICONDUCTOR PRODUCTS SECTOR	5005 E MCDOWELL RD	PHOENIX AZ 85008-4229
05574	VIKING CONNECTORS INC SUB OF CRITON CORP	21001 NORDHOFF ST	CHATSWORTH CA 91311-5911
05828	GENERAL INSTRUMENT CORP GOVERNMENT SYSTEMS DIV	600 W JOHN ST	HICKSVILLE NY 11802
07263	FAIRCHILD SEMICONDUCTOR CORP NORTH AMERICAN SALES SUB OF SCHLUMBERGER LTD MS 118	10400 RIDGEVIEW CT	CUPERTINO CA 95014
09353	C AND K COMPONENTS INC	15 RIVERDALE AVE	NEWTON MA 02158-1057
11502	INTERNATIONAL RESISTIVE CO INC	GREENWAY RD PO BOX 1860	BOONE NC 28607-1860

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
12697	CLAROSTAT MFG CO INC	LOWER WASHINGTON ST	DOVER NH 03820
12954	MICROSEMI CORP - SCOTTSDALE	8700 E THOMAS RD P O BOX 1390	SCOTTSDALE AZ 85252
12969	UNITRODE CORP	5 FORBES RD	LEXINGTON MA 02173-7305
13606	SPRAGUE ELECTRIC CO	70 PEMBROKE RD	CONCORD NH 03301-5755
14552	MICROSEMI CORP	2830 S FAIRVIEW ST	SANTA ANA CA 92704-5848
14752	ELECTRO CUBE INC	1710 S DEL MAR AVE	SAN GABRIEL CA 91776-3825
14936	GENERAL INSTRUMENT CORP DISCRETE SEMI CONDUCTOR DIV	600 W JOHN ST	HICKSVILLE NY 11802
18796	MURATA ERIE NORTH AMERICAN INC STATE COLLEGE OPERATIONS	1900 W COLLEGE AVE	STATE COLLEGE PA 16801-2723
19396	ILLINOIS TOOL WORKS INC PAKTRON DIV	1205 MCCONVILLE RD PO BOX 4539	LYNCHBURG VA 24502-4535
19701	PHILIPS COMPONENTS DISCRETE PRODUCTS DIV RESISTIVE PRODUCTS FACILITY AIRPORT ROAD	PO BOX 760	MINERAL WELLS TX 76067-0760
20532	SPRAGUE ELECTRIC CO SEMICONDUCTOR DIVISION	70 PEMBROKE ROAD	CONCORD NH 03301
23880	STANFORD APPLIED ENGINEERING INC	340 MARTIN AVE	SANTA CLARA CA 95050-3112
24546	CORNING GLASS WORKS	550 HIGH ST	BRADFORD PA 16701-3737
24931	SPECIALTY CONNECTOR CO INC	2100 EARLYWOOD DR PO BOX 547	FRANKLIN IN 46131
25403	PHILIPS COMPONENTS DISCRETE PRODUCTS DIV DISCRETE SEMICONDUCTOR GROUP	GEORGE WASHINGTON HWY	SMITHFIELD RI 02917
26769	PHILIPS COMPONENTS DISCRETE PRODUCTS DIV CHIP TANTALUM FACILITY	5900 AUSTRALIAN AVE	WEST PALM BEACH FL 33407-2330
27014	NATIONAL SEMICONDUCTOR CORP	2900 SEMICONDUCTOR DR	SANTA CLARA CA 95051-0606
31781	EDAC INC	20 RAILSIDE RD	DON MILLS ONT CAN M3A 1A4
32997	BOURNS INC TRIMPOT DIV	1200 COLUMBIA AVE	RIVERSIDE CA 92507-2114
50434	HEWLETT-PACKARD CO OPTOELECTRONICS DIV	370 W TRIMBLE RD	SAN JOSE CA 95131
52763	STETCO INC	3344 SCHIERHORN	FRANKLIN PARK IL 60131
52769	SPRAGUE-GOODMAN ELECTRONICS INC	134 FULTON AVE	GARDEN CITY PARK NY 11040-5352
54583	TDK ELECTRONICS CORP	12 HARBOR PARK DR	PORT WASHINGTON NY 11550
56289	SPRAGUE ELECTRIC CO WORLD HEADQUARTERS	92 HAYDEN AVE	LEXINGTON MA 02173-7929
57668	ROHM CORP	8 WHATNEY PO BOX 19515	IRVINE CA 92713
58368	F W CAPACITORS INC	HWY 301 S 98 TOLEDO RD PO BOX 12636	FLORENCE SC 29504
58756	CTS CORP ELKHART DIV	1142 W BEARDSLEY AVE	ELKHART IN 46514-2224
59660	TUJONIX INC	7741 N BUSINESS PARK DR PO BOX 37144	TUCSON AZ 85740-7144
60211	VOLTAGE MULTIPLIERS INC	8711 W ROOSEVELT	VISALIA CA 93291-9458

Replaceable Electrical Parts-5110

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
61857	SAN-O INDUSTRIAL CORP	85 ORVILLE DR PO BOX 511	BOHEMIA LONG ISLAND NY 11716-2501
71400	BUSSMANN DIV OF COOPER INDUSTRIES INC	114 OLD STATE RD PO BOX 14460	ST LOUIS MO 63178
71450	CTS CORP	905 N WEST BLVD	ELKHART IN 46514-1875
73138	BECKMAN INDUSTRIAL CORP BECKMAN ELECTRONIC TECHNOLOGIES SUB OF EMERSON ELECTRIC	4141 PALM ST	FULLERTON CA 92635
75042	IRC ELECTRONIC COMPONENTS PHILADELPHIA DIV TRW FIXED RESISTORS	401 N BROAD ST	PHILADELPHIA PA 19108-1001
75498	MULTICOMP INC	3005 SW 154TH TERRACE #3	BEAVERTON OR 97006
75915	LITTELFUSE INC SUB TRACOR INC	800 E NORTHWEST HWY	DES PLAINES IL 60016-3049
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077-0001
83701	ELECTRONIC DEVICES INC	21 GREY OAKS AVE	YONKERS NY 10710-3205

Replaceable Electrical Parts-5110

Component Number	Tektronix Part No.	Serial No. Effective	Discont	Name & Description	Mfr. Code	Mfr. Part No.
	--			??:	80009	
A1	670-1433-00	B010100	B029999	CIRCUIT BD ASSY:HIGH VOLTAGE-DEFLECTION	80009	670143300
A1	670-1433-01	B030000	B049999	CIRCUIT BD ASSY:HIGH VOLTAGE-DEFLECTION	80009	670143301
A1	670-1433-02	B050000	B119999	CIRCUIT BD ASSY:HIGH VOLTAGE-DEFLECTION	80009	670143302
A1	670-1433-03	B120000	B125351	CIRCUIT BD ASSY:HIGH VOLTAGE DEFLECTION	80009	670143303
A1	670-1433-04	B125352	B126331	CIRCUIT BD ASSY:HIGH VOLTAGE	80009	670143304
A1	670-1433-05	B126332	B128509	CIRCUIT BD ASSY:HIGH VOLTAGE	80009	670143305
A1	670-1433-07	B128510	B140958	CIRCUIT BD ASSY:HIGH VOLTAGE	80009	670143307
A1	670-1621-14	B140959		CIRCUIT BD ASSY:HV DEFLECTION	80009	670162114
A2	670-1454-00	B010100	B124444	CIRCUIT BD ASSY:SINGLE BEAM AUX	80009	670145400
A2	670-1454-01	B124445	B140958	CIRCUIT BD ASSY:SINGLE BEAM AUX	80009	670145401
A3	670-1340-00	B010100	B124444	CIRCUIT BD ASSY:INTERFACE	80009	670134000
A3	670-1340-01	B124445	B126108	CIRCUIT BD ASSY:INTERFACE	80009	670134001
A3	670-1340-03	B126109	B128769	CIRCUIT BD ASSY:INTERFACE	80009	670134003
A3	670-1340-04	B128770	B140958	CIRCUIT BD ASSY:INTFC	80009	670134004
A3	670-7478-01	B140959		CIRCUIT BD ASSY:INTFC	80009	670747801
A4	670-1339-00	B010100	B123849	CIRCUIT BD ASSY:LV POWER SUPPLY	80009	670133900
A4	670-1339-02	B123850	B125356	CIRCUIT BD ASSY:LV POWER SUPPLY	80009	670133902
A4	670-1339-03	B125357	B130459	CIRCUIT BD ASSY:LV POWER SUPPLY	80009	670133903
A4	670-1339-06	B130460	B141084	CIRCUIT BD ASSY:LV PWR SPLY	80009	670133906
A4	670-1339-08	B141085		CIRCUIT BD ASSY:LV PWR SPLY	80009	670133908
A5	670-5757-00	B109310		CIRCUIT BD ASSY:SIGNAL OUT (OPTION 07 ONLY)	80009	670575700
A1	670-1433-00	B010100	B029999	CIRCUIT BD ASSY:HIGH VOLTAGE-DEFLECTION	80009	670143300

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Component Number	Tektronix Part No.	Serial No.		Name & Description	Mfr. Code	Mfr. Part No.
		Effective	Dscont			
A1	670-1433-01	B030000	B049999	CIRCUIT BD ASSY:HIGH VOLTAGE-DEFLECTION	80009	670143301
A1	670-1433-02	B050000	B119999	CIRCUIT BD ASSY:HIGH VOLTAGE-DEFLECTION	80009	670143302
A1	670-1433-03	B120000	B125351	CIRCUIT BD ASSY:HIGH VOLTAGE DEFLECTION	80009	670143303
A1	670-1433-04	B125352	B126331	CIRCUIT BD ASSY:HIGH VOLTAGE	80009	670143304
A1	670-1433-05	B126332	B128509	CIRCUIT BD ASSY:HIGH VOLTAGE	80009	670143305
A1	670-1433-07	B128510	B140958	CIRCUIT BD ASSY:HIGH VOLTAGE	80009	670143307
A1	670-1621-14	B140959		CIRCUIT BD ASSY:HV DEFLECTION	80009	670162114
A2	670-1454-00	B010100	B124444	CIRCUIT BD ASSY:SINGLE BEAM AUX	80009	670145400
A2	670-1454-01	B124445	B140958	CIRCUIT BD ASSY:SINGLF BEAM AUX	80009	670145401
A3	670-1340-00	B010100	B124444	CIRCUIT BD ASSY:INTERFACE	80009	670134000
A3	670-1340-01	B124445	B126108	CIRCUIT BD ASSY:INTERFACE	80009	670134001
A3	670-1340-03	B126109	B128769	CIRCUIT BD ASSY:INTERFACE	80009	670134003
A3	670-1340-04	B128770	B140958	CIRCUIT BD ASSY:INTFC	80009	670134004
A3	670-7478-01	B140959		CIRCUIT BD ASSY:INTFC	80009	670747801
A4	670-1339-00	B010100	B123849	CIRCUIT BD ASSY:LV POWER SUPPLY	80009	670133900
A4	670-1339-02	B123850	B125356	CIRCUIT BD ASSY:LV POWER SUPPLY	80009	670133902
A4	670-1339-03	B125357	B130459	CIRCUIT BD ASSY:LV POWER SUPPLY	80009	670133903
A4	670-1339-06	B130460	B141084	CIRCUIT BD ASSY:LV PWR SPLY	80009	670133906
A4	670-1339-08	B141085		CIRCUIT BD ASSY:LV PWR SPLY	80009	670133908
A5	670-5757-00	B109310		CIRCUIT BD ASSY:SIGNAL OUT (OPTION 07 ONLY)	80009	670575700
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Component Number	Tektronix Part No.	Serial No.		Name & Description	Mfr. Code	Mfr. Part No.
		Effective	Discont			
C104	281-0811-00	B140959		CAP,FXD,CER DI:10PF,10%,100V	04222	SA101A100KAA
C106	283-0684-00	B010100	B049999	CAP,FXD,MICA DI:620PF,20%,300V	TK0891	RDM15FC621G03
C106	283-0596-00	B050000	B124589	CAP,FXD,MICA DI:528PF,1%,300V	TK0891	RDM15FC5280F03
C106	283-0692-00	B124590	B140958	CAP,FXD,MICA DI:670PF,1%,300V	TK0891	RDM15FC671F03
C106	283-0690-00	B140959		CAP,FXD,MICA DI:560PF,1%,300V	TK0891	RDM15FC561F03
C115	281-0027-00	B010100	B049999	CAP,VAR,PLASTIC:0.7-3PF,350V	52769	ER-535-017
C116	283-0598-00	B010100	B049999	CAP,FXD,MICA DI:253PF,5%,500V	TK0891	RDM15FB2530J03
C116	281-0180-00	B050000	B140958	CAP,VAR,MICA DI:18-115PF,175V	58368	T50418-5
C116	283-0672-00	B140959		CAP,VAR,PLASTIC:10-180PF,100V	52769	GZD18100
C124	281-0811-00	B140959		CAP,FXD,CER DI:10PF,10%,100V	04222	SA101A100KAA
C126	283-0596-00	B010100	B124589	CAP,FXD,MICA DI:528PF,1%,300V	TK0891	RDM15FC5280F03
C126	283-0774-00	B124590	B140958	CAP,FXD,MICA DI:639 PF,1%,300V	TK0891	RDM15FC6390F03
C126	283-0669-00	B140959		CAP,FXD,MICA DI:360PF,1%,500V	TK0891	RDM15FD361F03
C136	283-0672-00	B010100	B140958	CAP,FXD,MICA DI:200PF,1%,500V	TK0891	RDM15FD201F03
C136	283-0625-00	B140959		CAP,FXD,MICA DI:220PF,1%,500V	TK0891	RDM10FD221F03
C222	281-0775-00	B140959		CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
C223	281-0775-00	B140959		CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
C224	283-0065-00	B010100	B119999	CAP,FXD,CER DI:0.001UF,5%,500V	59660	0835-591-Y5E0-1
C224	283-0051-00	B120000		CAP,FXD,CER DI:0.0033UF,5%,100V	04222	SR301A332JAA
C227	281-0537-00	B010100	B119999	CAP,FXD,CER DI:0.68PF,20%,600V	54583	MA12COG2HR68M
C236	285-0526-00	B010100	B140958	CAP,FXD,PLASTIC:0.1UF,20%,400V	56289	430P104X04M28
C236	283-0167-00	B140959		CAP,FXD,CER DI:0.1UF,10%,100V	04222	SR211C104KAA
C240	283-0008-00	B140959		CAP,FXD,CER DI:0.1UF,20%,500V	04222	SR507C104MAA
C241	283-0270-00	B010100	B119999	CAP,FXD,CER DI:6800PF,+80-20%,4000V	18796	DHR34Y55682Z4KV
C241	283-0071-00	B120000	B140958	CAP,FXD,CER DI:0.0068UF,+80-20%,5KV	18796	DHA 34Y5S682Z5K
C241	285-1154-00	B140959		CAP,FXD,PLASTIC:0.001UFD,10%,6000V	56289	430P102960
C242	283-0261-00	B010100	B119999	CAP,FXD,CER DI:0.01UF,20%,4000V	TK0509	HV043
C242	283-0071-00	B120000	B140958	CAP,FXD,CER DI:0.0068UF,+80-20%,5KV	18796	DHA 34Y5S682Z5K
C242	285-0507-01	B140959		CAP,FXD,PPR DI:0.0047UF,20%,6000V	56289	430P571
C245	283-0189-00	B140959		CAP,FXD,CER DI:0.1UF,20%,400V	04222	SR508C104MAA
C246	283-0077-00	B140959		CAP,FXD,CER DI:330PF,5%,500V	59660	831-5008331J
C248	283-0270-00	B010100	B119999	CAP,FXD,CER DI:6800PF,+80-20%,4000V	18796	DHR34Y55682Z4KV
C248	283-0071-00	B120000	B140958	CAP,FXD,CER DI:0.0068UF,+80-20%,5KV	18796	DHA 34Y5S682Z5K
C248	285-0509-01	B140959		CAP,FXD,PPR DI:0.0068UF,20%,5000V	14752	C-2541
C249	283-0270-00	B010100	B119999	CAP,FXD,CER DI:6800PF,+80-20%,4000V	18796	DHR34Y55682Z4KV
C249	283-0071-00	B120000	B140958	CAP,FXD,CER DI:0.0068UF,+80-20%,5KV	18796	DHA 34Y5S682Z5K
C249	285-0509-01	B140959		CAP,FXD,PPR DI:0.0068UF,20%,5000V	14752	C-2541
C251	290-0194-00			CAP,FXD,ELCTLT:10UF,+50-10%,100V	00853	556DC100T100B
C252	283-0617-00	B010100	B123729	CAP,FXD,MICA DI:4700PF,10%,300V	TK0891	RDM19FD472K03
C252	283-0083-00	B123730	B140958	CAP,FXD,CER DI:0.0047UF,20%,500V	59660	811-565C471J
C252	283-0203-00	B140959		CAP,FXD,CER DI:0.47UF,20%,50V	04222	SR305SC474MAA
C253	283-0003-00	B010100	B140958	CAP,FXD,CER DI:0.01UF,+80-20%,150V	59660	805-619-Z5U0-10
C254	283-0059-00	B010100	B140958	CAP,FXD,CER DI:1UF,+80-20%,50V	04222	SR305C105MAA
C258	283-0059-00	B010100	B140958	CAP,FXD,CER DI:1UF,+80-20%,50V	04222	SR305C105MAA
C259	283-0198-00	B010100	B120979	CAP,FXD,CER DI:0.22UF,20%,50V	04222	SR305C224MAA
C259	283-0164-00	B120980	B140958	CAP,FXD,CER DI:2.2UF,20%,25V	04222	SR402E225MAA
C262	281-0815-00	B140959		CAP,FXD,CER DI:0.027UF,20%,50V	04222	SA205C273MAA
C272	283-0021-00	B010100	B140958	CAP,FXD,CER DI:0.001UF,20%,5000V	18796	DE1310Y5P102M6K
C273	283-0208-00	B010100	B140958	CAP,FXD,CER DI:0.22UF,10%,200V	04222	SR502C224KAA
C273	283-0194-00	B140959		CAP,FXD,CER DI:4.7UF,20%,50V	04222	SR505E475MAA
C274	283-0104-00	B010100	B039999	CAP,FXD,CER DI:2000PF,5%,500V	59660	811 565 Y5E0 20
C274	283-0142-00	B040000	B119999	CAP,FXD,CER DI:0.0027UF,5%,200V	54583	CK45YE2D272J-A
C276	290-0145-00	B140959		CAP,FXD,ELCTLT:10UF,+75-10%,50V	K8996	030-38109
C277	281-0775-00	B140959		CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
C279	283-0065-00	B010100	B119999	CAP,FXD,CER DI:0.001UF,5%,50V	59660	0835-591-Y5E0-1

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Component Number	Tektronix Part No.	Serial No. Effective	Discount	Name & Description	Mfr. Code	Mfr. Part No.
C281	283-0003-00	B010100	B140958	CAPFXD,CER DI:0.01UF,+80-20%,150V	59660	805-619-Z5U0-10
C281	283-0068-00	B140959		CAPFXD,CER DI:0.01UF,+100-0%,500V	59660	871-533E103P
C400	281-0812-00	B140959		CAPFXD,CER DI:1000PF,10%,100V	04222	SA101C102KAA
C411	281-0797-00	B140959		CAPFXD,CER DI:15PF,10%,100V	04222	SA106A150KAA
C503	281-0775-00	B140959		CAPFXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
C510	281-0797-00	B140959		CAPFXD,CER DI:15PF,10%,100V	04222	SA106A150KAA
C530	281-0775-00	B140959		CAPFXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
C620	281-0775-00	B140959		CAPFXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
C622	283-0032-00	B010100	B140958	CAPFXD,CER DI:470PF,5%,500V	59660	831-000-Z5E0471
C628	283-0060-00	B010100	B140958	CAPFXD,CER DI:100PF,5%,200V	59660	855-535U2J101J
C632	283-0002-00	B010100	B140958	CAPFXD,CER DI:0.01UF,+80-20%,500V	59660	811-590-Z5U0-10
C634	283-0060-00	B010100	B140958	CAPFXD,CER DI:100PF,5%,200V	59660	855-535U2J101J
C636	283-0060-00	B010100	B140958	CAPFXD,CER DI:100PF,5%,200V	59660	855-535U2J101J
C640	281-0519-00	B010100	B140958	CAPFXD,CER DI:47PF,+/-4.7PF,500V	52763	2RDPZ007 47POK
C642	281-0519-00	B010100	B140958	CAPFXD,CER DI:47PF,+/-4.7PF,500V	52763	2RDPZ007 47POK
C659	283-0000-00	B010100	B140958	CAPFXD,CER DI:0.001UF,+100-0%,500V	18798	DD07512Y5P102P5
C671	281-0593-00	B010100	B029999	CAPFXD,CER DI:3.9PF,+/-0.25PF,500V	52763	2RDPZ007 3P9OC
C671	281-0811-00	B128770	B140958	CAPFXD,CER DI:10PF,10%,100V	04222	SA101A100KAA
C679	283-0000-00	B010100	B140958	CAPFXD,CER DI:0.001UF,+100-0%,500V	18798	DD07512Y5P102P5
C712	283-0000-00	B010100	B140958	CAPFXD,CER DI:0.001UF,+100-0%,500V	18798	DD07512Y5P102P5
C714	281-0628-00	B010100	B140958	CAPFXD,CER DI:15PF,5%,500V	52763	2RDPZ007 15POJ
C716	281-0628-00	B010100	B140958	CAPFXD,CER DI:15PF,5%,500V	52763	2RDPZ007 15POJ
C721	281-0628-00	B010100	B140958	CAPFXD,CER DI:15PF,5%,500V	52763	2RDPZ007 15POJ
C721	281-0812-00	B140959		CAPFXD,CER DI:1000PF,10%,100V	04222	SA101C102KAA
C740	290-0748-00	B140959		CAPFXD,ELCTLT:10UF,+50-20%,25WVDC	TK1424	CEUST1E100
C800	281-0775-00	B140959		CAPFXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
C801	281-0814-00	B140959		CAPFXD,CER DI:100 PF,10%,100V	TK1743	CGB101KEN
C810	290-0511-00			CAPFXD,ELCTLT:250UF,+75-10%,250V	56289	68D10464
C810	281-0823-00	B140959		CAPFXD,CER DI:470PF,10%,50V	04222	SA101A471KAA
C814	281-0773-00	B140959		CAPFXD,CER DI:0.01UF,10%,100V	TK1743	CGB103KEX
C815	290-0510-00			CAPFXD,ELCTLT:6000UF,+100-10%,15V	56289	68D10473
C820	290-0134-00			CAPFXD,ELCTLT:22UF,20%,15V	26769	40SS226B015M1C
C822	281-0512-00			CAPFXD,CER DI:27PF,+/-2.7PF,500V	52763	2RDPZ007 27POK
C830	285-0629-00			CAPFXD,PLASTIC:0.047UF,20%,100V	19396	473M01PT605
C837	290-0509-00			CAPFXD,ELCTLT:3000UF,+100-10%,50V	56289	68D10454
C839	290-0509-00			CAPFXD,ELCTLT:3000UF,+100-10%,50V	56289	68D10454
C842	290-0175-00			CAPFXD,ELCTLT:10UF,20%,35V	12954	D10C35M1
C852	281-0550-00			CAPFXD,CER DI:120PF,10%,500V	52763	2RDPZ007 120PM
C857	283-0003-00			CAPFXD,CER DI:0.01UF,+80-20%,150V	59660	805-619-Z5U0-10
C860	290-0175-00			CAPFXD,ELCTLT:10UF,20%,35V	12954	D10C35M1
C865	281-0550-00	B010100	B039999	CAPFXD,CER DI:120PF,10%,500V	52763	2RDPZ007 120PM
C865	281-0543-00	B040000		CAPFXD,CER DI:270PF,10%,500V	52763	2RDPZ007 27POM
C870	290-0134-00			CAPFXD,ELCTLT:22UF,20%,15V	26769	40SS226B015M1C
C872	281-0572-00	B010100	B141084	CAPFXD,CER DI:6.8PF,0.5%,500V	52763	2RDPZ007 6P80D
C872	281-0797-00	B141085		CAPFXD,CER DI:15PF,10%,100V	04222	SA106A150KAA
C875	281-0773-00	B010100	B141084	CAPFXD,CER DI:0.01UF,10%,100V	TK1743	CGB103KEX
C875	281-0865-00	B141085		CAPFXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
C881	290-0267-00			CAPFXD,ELCTLT:1UF,20%,35V	26769	40SS105A035M1C
C883	290-0267-00			CAPFXD,ELCTLT:1UF,20%,35V	26769	40SS105A035M1C
C890	281-0549-00			CAPFXD,CER DI:68PF,10%,500V	52763	2RDPZ007 68POK

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Component Number	Tektronix Part No.	Serial No.		Name & Description	Mfr. Code	Mfr. Part No.
		Effective	Discont			
C900	290-0748-00	B140959		CAP,FXD,ELCTLT:10UF,+50-20%,25WVDC	TK1424	CEUST1E100
C902	281-0786-00	B140959		CAP,FXD,CER DI:150PF,10%,100V	04222	SA101A151KAA
C930	283-0002-00	B109310		CAP,FXD,CER DI:0.01UF,+80-20%,500V (OPTION 07 ONLY)	59660	811-590-Z5U0-10
C930	281-0775-00	B140959		CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
C931	281-0504-00	B109310		CAP,FXD,CER DI:10PF,+/-1PF,500V (OPTION 07 ONLY)	52763	2RDPZZ007 10PO
C960	283-0002-00	B109310		CAP,FXD,CER DI:0.01UF,+80-20%,500V (OPTION 07 ONLY)	59660	811-590-Z5U0-10
C961	281-0504-00	B109310		CAP,FXD,CER DI:10PF,+/-1PF,500V (OPTION 07 ONLY)	52763	2RDPZZ007 10PO
C980	283-0002-00	B109310		CAP,FXD,CER DI:0.01UF,+80-20%,500V (OPTION 07 ONLY)	59660	811-590-Z5U0-10
C981	281-0504-00	B109310		CAP,FXD,CER DI:10PF,+/-1PF,500V (OPTION 07 ONLY)	52763	2RDPZZ007 10PO
CR209	152-0061-00			SEMICON DVC,DI:SW,SI,175V,0.1A,DO-35	12969	PV122
CR211	152-0061-00			SEMICON DVC,DI:SW,SI,175V,0.1A,DO-35	12969	PV122
CR214	152-0141-02			SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR215	152-0061-00			SEMICON DVC,DI:SW,SI,175V,0.1A,DO-35	12969	PV122
CR222	152-0141-02	B120000		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR224	152-0061-00			SEMICON DVC,DI:SW,SI,175V,0.1A,DO-35	12969	PV122
CR226	152-0061-00	B120000		SEMICON DVC,DI:SW,SI,175V,0.1A,DO-35	12969	PV122
CR234	152-0061-00	B120000		SEMICON DVC,DI:SW,SI,175V,0.1A,DO-35	12969	PV122
CR238	152-0061-00	B120000	B140958	SEMICON DVC,DI:SW,SI,175V,0.1A,DO-35	12969	PV122
CR239	152-0061-00	B010100	B119999	SEMICON DVC,DI:SW,SI,175V,0.1A,DO-35	12969	PV122
CR240	152-0242-00	B120000		SEMICON DVC,DI:SIG,SI,225V,0.2A,DO-7	12969	NDP341
CR241	152-0409-00	B010100	B149058	DIODE,RECT.,FAST RCVRV;12KV,10MA,250NS	80009	152040900
CR241	152-0242-00	B140959		SEMICON DVC,DI:SIG,SI,225V,0.2A,DO-7	12969	NDP341
CR242	152-0242-00	B140959		SEMICON DVC,DI:SIG,SI,225V,0.2A,DO-7	12969	NDP341
CR243	152-0242-00	B140959		SEMICON DVC,DI:SIG,SI,225V,0.2A,DO-7	12969	NDP341
CR244	152-0242-00	B140959		SEMICON DVC,DI:SIG,SI,225V,0.2A,DO-7	12969	NDP341
CR245	152-0242-00	B140959		SEMICON DVC,DI:SIG,SI,225V,0.2A,DO-7	12969	NDP341
CR247	152-0409-00	B010100	B140958	DIODE,RECT.,FAST RCVRV;12KV,10MA,250NS	80009	152040900
CR247	152-0408-00	B140959		DIODE,RECT.,FAST RCVRV;10KV,10MA,250NS	83701	ED 2188
CR252	152-0400-00	B140959		DIODE,RECT.,FAST RCVRV;400V,1A,200NS	14552	MB2501
CR253	152-0414-00			DIODE,RECT.,;200V,1.0A,750NS	80009	152041400
CR255	152-0141-02	B010100	B140958	SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR256	152-0061-00	B010100	B140958	SEMICON DVC,DI:SW,SI,175V,0.1A,DO-35	12969	PV122
CR262	152-0141-02	B010100	B140958	SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR264	152-0141-02			SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR269	152-0061-00	B010100	B119999	SEMICON DVC,DI:SW,SI,175V,0.1A,DO-35	12969	PV122
CR269	152-0586-00	B120000	B140958	SEMICON DVC,DI:RECT,SI,600V,0.5A	25403	BYV96D OR BYV95
CR269	152-0141-02	B140959		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR270	152-0586-00	B120000	B140958	SEMICON DVC,DI:RECT,SI,600V,0.5A	25403	BYV96D OR BYV95
CR270	152-0141-02	B140959		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR272	152-0246-00	B140959		SEMICON DVC,DI:SW,SI,40V,200MA,DO-7	27014	FDH5227.03
CR273	152-0246-00	B140959		SEMICON DVC,DI:SW,SI,40V,200MA,DO-7	27014	FDH5227.03
CR276	152-0141-02	B140959		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR298	152-0331-00	B140959		DIODE,RECT.,FAST RCVRV;1,500V,30MA,300NS	60211	RM113
CR400	152-0141-02	B140959		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR420	152-0141-02	B140959		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR421	152-0141-02	B140959		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR423	152-0141-02	B140959		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR432	152-0141-02	B140959		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR433	152-0141-02	B140959		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR501	152-0141-02	B140959		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR

Replacable Electrical Parts-5110

Component Number	Tektronix Part No.	Serial No.		Name & Description	Mfr. Code	Mfr. Part No.
		Effective	Discont			
CR520	152-0141-02	B140959		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR620	152-0141-02	B010100	B140958	SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR658	152-0141-02	B010100	B140958	SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR668	152-0141-02	B010100	B140958	SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR678	152-0141-02	B010100	B140958	SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR688	152-0141-02	B010100	B140958	SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR702	152-0141-02	B010100	B140958	SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR704	152-0141-02	B010100	B140958	SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR712	152-0141-02	B010100	B140958	SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR714	152-0141-02	B010100	B140958	SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR721	152-0141-02	B010100	B140958	SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR722	152-0141-02	B010100	B140958	SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR800	152-0141-02	B140959		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR810	152-0107-00			SEMICON DVC,DI:RECT,SI,400 V,400MA,A1	12969	"G727"
CR811	152-0107-00			SEMICON DVC,DI:RECT,SI,400 V,400MA,A1	12969	"G727"
CR812	152-0107-00			SEMICON DVC,DI:RECT,SI,400 V,400MA,A1	12969	"G727"
CR813	152-0107-00			SEMICON DVC,DI:RECT,SI,400 V,400MA,A1	12969	"G727"
CR815	152-0488-00			DIODE,RECT,.;BRIDGE,200V,1.5A	14936	2KBP02M-8
CR820	152-0066-00			SEMICON DVC,DI:RECT,SI,400V,1A,DO-41 (USED ON 670-1339-05 ONLY)	05828	GP10G-020
CR820	152-0141-02	B140959		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35 (USED ON 670-7478-01 ONLY)	12969	NDP/263/TR
CR824	152-0141-02			SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR830	152-0141-02	B140959		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR835	152-0107-00			SEMICON DVC,DI:RECT,SI,400 V,400MA,A1	12969	"G727"
CR836	152-0107-00			SEMICON DVC,DI:RECT,SI,400 V,400MA,A1	12969	"G727"
CR837	152-0488-00			DIODE,RECT,.;BRIDGE,200V,1.5A	14936	2KBP02M-8
CR841	152-0066-00			SEMICON DVC,DI:RECT,SI,400V,1A,DO-41	05828	GP10G-020
CR842	152-0066-00			SEMICON DVC,DI:RECT,SI,400V,1A,DO-41	05828	GP10G-020
CR850	152-0141-02			SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR851	152-0141-02			SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR860	152-0066-00	B010100	B125356	SEMICON DVC,DI:RECT,SI,400V,1A,DO-41	05828	GP10G-020
CR865	152-0141-02			SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR870	152-0141-02			SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR875	152-0141-02			SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR885	152-0141-02			SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR890	152-0141-02			SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP/263/TR
CR930	152-0141-02	B109310		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35 (OPTION 07 ONLY)	LEADSTK1 668	NDP/263/TR
CR960	152-0141-02	B109310		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35 (OPTION 07 ONLY)		NDP/263/TR
CR980	152-0141-02	B109310		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35 (OPTION 07 ONLY)		NDP/263/TR
CR990	152-0322-00	B109310		SEMICON DVC,DI:SCHOTTKY,SI,15V,1.2PF,DO-35 (OPTION 07 ONLY)		5082-2672
DS271	150-0030-00			LAMP,GLOW:60-90V MAX,0.6MA,A28-T,WIRE LEADSTK1668		NE-2B(AC/DC)R-T
DS272	150-0030-00			LAMP,GLOW:60-90V MAX,0.6MA,A28-T,WIRE LEADS	TK1668	NE-2B(AC/DC)R-T
DS273	150-0030-00			LAMP,GLOW:60-90V MAX,0.6MA,A28-T,WIRE LEADS	TK1668	NE-2B(AC/DC)R-T
DS274	150-0030-00	B120000		LAMP,GLOW:60-90V MAX,0.6MA,A28-T,WIRE LEADS	TK1668	NE-2B(AC/DC)R-T
E513	276-0532-00	B140959		SHLD BEAD,ELEK:FERRITE	02114	56-590-65/4A6
E514	276-0532-00	B140959		SHLD BEAD,ELEK:FERRITE	02114	56-590-65/4A6

Replaceable Electrical Parts-5110

Component Number	Tektronix Part No.	Serial No.		Name & Description	Mfr. Code	Mfr. Part No.
		Effective	Dscont			
F201	159-0003-00			FUSE,CARTRIDGE:3AG,1.6A,250V,25SEC (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	MDL 1
F274	159-0124-00	B125352	B140958	FUSE,WIRE LEAD:3A,125V,0.05SEC	75915	272003
F809	159-0029-00	B125357		FUSE,CARTRIDGE:3AG,0.3A,250V,20SEC	71400	MDL 3/10
F810	159-0028-00			FUSE,CARTRIDGE:0.25A,250V,FAST BLOW	61857	SS2-0.25
F815	159-0015-00	B125357		FUSE,CARTRIDGE:3AG,3A,250V,0.65SEC	75915	312 003
F834	159-0015-00	B125357		FUSE,CARTRIDGE:3AG,3A,250V,0.65SEC	75915	312 003
F835	159-0025-00			FUSE,CARTRIDGE:3AG,0.5A,250V,0.25SEC	75915	312.500
F836	159-0015-00	B125357		FUSE,CARTRIDGE:3AG,3A,250V,0.65SEC	75915	312 003
F850	159-0015-00	B125357		FUSE,CARTRIDGE:3AG,3A,250V,0.65SEC	75915	312 003
FL201	119-1313-00	B010100	B140958	FILTER,RFI:10A,115-250V,50-400HZ	56289	10JX5441A
FL201	119-1538-00	B140959		FILTER,RFI:3A,250VAC,50/60HZ	54583	ZUB2203-00
J210	131-0855-00			CONN,RCPT,ELEC:BNC,FEMALE	TK1725	G35152BN
J601	131-1078-00	B010100	B099999	CONN,RCPT,ELEC:CKT BD,28/56 CONTACT	31781	303-056-520-301
J601	131-1078-01	B100000	B106746	CONN,RCPT,ELEC:CKT BD,28/56 CONTACT	23880	SAM 28D/2-TX
J601	131-1078-00	B106747		CONN,RCPT,ELEC:CKT BD,28/56 CONTACT	31781	303-056-520-301
J602	131-1078-00	B010100	B099999	CONN,RCPT,ELEC:CKT BD,28/56 CONTACT	31781	303-056-520-301
J602	131-1078-01	B100000	B106746	CONN,RCPT,ELEC:CKT BD,28/56 CONTACT	23880	SAM 28D/2-TX
J602	131-1078-00	B106747		CONN,RCPT,ELEC:CKT BD,28/56 CONTACT	31781	303-056-520-301
J603	131-1078-00	B010100	B105856	CONN,RCPT,ELEC:CKT BD,28/56 CONTACT	31781	303-056-520-301
J603	131-1078-01	B105857	B099999	CONN,RCPT,ELEC:CKT BD,28/56 CONTACT	23880	SAM 28D/2-TX
J603	131-1078-00	B100000		CONN,RCPT,ELEC:CKT BD,28/56 CONTACT	31781	303-056-520-301
J604	131-1043-00	B010100	B140958	CONN,RCPT,ELEC:EDGE CARD,18/36 CONT,0.156 SP	05574	00Q201-5437
J916	131-0126-00	B109310		CONN,RCPT,ELEC:BNC,FEMALE	24931	28JR205-2
L259	108-0564-00	B010100	B140958	COIL,RF:FIXED,74UH	0JRC3	108-0564-00
L291	108-0644-00			COIL,TUBE DEFL:TRACE ROTATION	75498	108-0644-00
Q104	151-0279-00	B010100	B079999	TRANSISTOR:NPN,SI,TO-39	04713	2N5058
Q104	151-0150-00	B080000	B119999	TRANSISTOR:NPN,SI,TO-39	04713	2N3440
Q104	151-0615-00	B120000		TRANSISTOR:NPN,SI,TO-202	25403	BF859A
Q106	151-0190-02	B010100	B069999	TRANSISTOR:NPN,SI,TO-92	04713	2N3904
Q106	151-0190-00	B070000		TRANSISTOR:NPN,SI,TO-92	07263	2N3904
Q114	151-0279-00	B010100	B079999	TRANSISTOR:NPN,SI,TO-39	04713	2N5058
Q114	151-0150-00	B080000	B119999	TRANSISTOR:NPN,SI,TO-39	04713	2N3440
Q114	151-0615-00	B120000		TRANSISTOR:NPN,SI,TO-202	25403	BF859A
Q116	151-0190-02	B010100	B069999	TRANSISTOR:NPN,SI,TO-92	04713	2N3904
Q116	151-0190-00	B070000		TRANSISTOR:NPN,SI,TO-92	07263	2N3904
Q124	151-0279-00	B010100	B079999	TRANSISTOR:NPN,SI,TO-39	04713	2N5058
Q124	151-0150-00	B080000	B119999	TRANSISTOR:NPN,SI,TO-39	04713	2N3440
Q124	151-0615-00	B120000		TRANSISTOR:NPN,SI,TO-202	25403	BF859A
Q126	151-0190-02	B010100	B069999	TRANSISTOR:NPN,SI,TO-92	04713	2N3904
Q126	151-0190-00	B070000		TRANSISTOR:NPN,SI,TO-92	07263	2N3904
Q134	151-0279-00	B010100	B079999	TRANSISTOR:NPN,SI,TO-39	04713	2N5058
Q134	151-0150-00	B080000	B119999	TRANSISTOR:NPN,SI,TO-39	04713	2N3440
Q134	151-0615-00	B120000		TRANSISTOR:NPN,SI,TO-202	25403	BF859A
Q138	151-0190-02	B010100	B069999	TRANSISTOR:NPN,SI,TO-92	04713	2N3904
Q136	151-0190-00	B070000		TRANSISTOR:NPN,SI,TO-92	07263	2N3904
Q138	151-0341-00	B050000	B119999	TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
Q214	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
Q222	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
Q226	151-0179-00	B010100	B069999	TRANSISTOR:NPN,SI,TO-98	03508	X16X2069

Replaceable Electrical Parts-5110

Component Number	Tektronix Part No.	Serial No.		Name & Description	Mfr. Code	Mfr. Part No.
		Effective	Discont			
Q226	151-0347-00	B070000	B119999	TRANSISTOR:NPN,SI,TO-92	0JR04	2N5551
Q226	151-0407-00	B120000		TRANSISTOR:NPN,SI,TO-39	04713	SS2456
Q234	151-0228-00	B010100	B069999	TRANSISTOR:PNP,SI,TO-105	27014	S21862
Q234	151-0350-00	B070000	B072987	TRANSISTOR:PNP,SI,TO-92	0JR04	TO BE ASSIGNED
Q234	151-0406-00	B072988		TRANSISTOR:PNP,SI,TO-39	04713	2N3637
Q252	151-0256-00	B010100	B140958	TRANSISTOR,SIG:NPN,SI,TO-3	04713	MJ411
Q252	151-0701-00	B140959		TRANSISTOR:NPN,SI,TO-220	S0167	2SC2527G
Q262	151-0207-00	B010100	B140958	TRANSISTOR:NPN,SI,TO-92	13606	PT1N8171TP
Q264	151-0342-00	B010100	B140958	TRANSISTOR:PNP,SI,TO-92	04713	MPS4249
Q264	151-0435-00	B140959		TRANSISTOR:DARLINGTON,PNP,SI,TO-92	04713	SPS8335
Q278	151-1005-00	B010100	B119999	TRANSISTOR,SIG:JFET,N-CHANNEL;	TK1864	SNJ1640
Q278	151-0341-00	B140959		TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
Q400	151-0188-00	B140959		TRANSISTOR:PNP,SI,TO-92	04713	2N3906
Q401	151-0192-00	B140959		TRANSISTOR:NPN,SI,TO-92	04713	SPS8801
Q413	151-0341-00	B140959		TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
Q420	151-1005-00	B140959		TRANSISTOR,SIG:JFET,N-CHANNEL;	TK1864	SNJ1640
Q421	151-0341-00	B140959		TRANSISTOR,SIG:JFET,N-CHANNEL;	TK1864	SNJ1640
Q430	151-0341-00	B140959		TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
Q431	151-0341-00	B140959		TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
Q510	151-0341-00	B140959		TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
Q520	151-1005-00	B140959		TRANSISTOR,SIG:JFET,N-CHANNEL;	TK1864	SNJ1640
Q521	151-1005-00	B140959		TRANSISTOR,SIG:JFET,N-CHANNEL;	TK1864	SNJ1640
Q600	151-0188-00	B140959		TRANSISTOR:PNP,SI,TO-92	04713	2N3906
Q601	151-0192-00	B140959		TRANSISTOR:NPN,SI,TO-92	04713	SPS8801
Q620	151-0190-00	B010100	B140958	TRANSISTOR:NPN,SI,TO-92	07263	2N3904
Q626	151-0190-00	B010100	B140958	TRANSISTOR:NPN,SI,TO-92	07263	2N3904
Q630	151-0341-00	B010100	B140958	TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
Q630	151-0341-00	B140959		TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
Q631	151-0341-00	B140959		TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
Q650	151-0192-00	B010100	B140958	TRANSISTOR:NPN,SI,TO-92	04713	SPS8801
Q658	151-0220-00	B010100	B140958	TRANSISTOR:PNP,SI,TO-92	2D532	PTBTC105BK
Q660	151-0192-00	B010100	B140958	TRANSISTOR:NPN,SI,TO-92	04713	SPS8801
Q668	151-0220-00	B010100	B140958	TRANSISTOR:PNP,SI,TO-92	2D532	PTBTC105BK
Q670	151-0192-00	B010100	B140958	TRANSISTOR:NPN,SI,TO-92	04713	SPS8801
Q678	151-0220-00	B010100	B140958	TRANSISTOR:PNP,SI,TO-92	2D532	PTBTC105BK
Q680	151-0192-00	B010100	B140958	TRANSISTOR:NPN,SI,TO-92	04713	SPS8801
Q688	151-0220-00	B010100	B140958	TRANSISTOR:PNP,SI,TO-92	2D532	PTBTC105BK
Q700	151-0190-00	B140959		TRANSISTOR:NPN,SI,TO-92	07263	2N3904
Q701	151-0341-00	B010100	B140958	TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
Q701	151-0190-00	B140959		TRANSISTOR:NPN,SI,TO-92	07263	2N3904
Q702	151-1005-00	B010100	B140958	TRANSISTOR,SIG:JFET,N-CHANNEL;	TK1864	SNJ1640
Q703	151-0341-00	B010100	B140958	TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
Q704	151-1005-00	B010100	B140958	TRANSISTOR,SIG:JFET,N-CHANNEL;	TK1864	SNJ1640
Q710	151-0190-00	B140959		TRANSISTOR:NPN,SI,TO-92	07263	2N3904
Q711	151-0341-00	B010100	B140958	TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
Q712	151-1005-00	B010100	B140958	TRANSISTOR,SIG:JFET,N-CHANNEL;	TK1864	SNJ1640
Q713	151-0341-00	B010100	B140958	TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
Q714	151-1005-00	B010100	B140958	TRANSISTOR,SIG:JFET,N-CHANNEL;	TK1864	SNJ1640
Q721	151-0192-00	B010100	B140958	TRANSISTOR:NPN,SI,TO-92	04713	SPS8801
Q722	151-0192-00	B010100	B140958	TRANSISTOR:NPN,SI,TO-92	04713	SPS8801
Q815	151-0331-00	B010100	B070028	TRANSISTOR:NPN,SI	03508	X40CR115
Q815	151-0496-00	B070029		TRANSISTOR:NPN,SI	03508	X40KR374
Q820	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
Q820	151-0188-00	B140959		TRANSISTOR:PNP,SI,TO-92	04713	2N3906
Q821	151-0192-00	B140959		TRANSISTOR:NPN,SI,TO-92	04713	SPS8801

Replaceable Electrical Parts-5110

Component Number	Tektronix Part No.	Serial No.		Name & Description	Mfr. Code	Mfr. Part No.
		Effective	Discont			
Q825	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
Q840	151-0331-00	B010100	B070028	TRANSISTOR:NPN,SI	03508	X40CR115
Q840	151-0496-00	B070029		TRANSISTOR:NPN,SI	03508	X40KR374
Q845	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
Q850	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
Q860	151-0331-00	B010100	B070028	TRANSISTOR:NPN,SI	03508	X40CR115
Q860	151-0496-00	B070029		TRANSISTOR:NPN,SI	03508	X40KR374
Q865	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
Q870	151-0220-00			TRANSISTOR:PNP,SI,TO-92	2D532	PTBTC105BK
Q875	151-0301-00			TRANSISTOR:PNP,SI,TO-18	27014	S043948
Q885	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
Q890	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
Q910	151-0190-00	B109310		TRANSISTOR:NPN,SI,TO-92 (OPTION 07 ONLY)	07263	2N3904
Q910	151-0341-00	B140959		TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
Q915	151-0190-00	B109310		TRANSISTOR:NPN,SI,TO-92 (OPTION 07 ONLY)	07263	2N3904
Q920	151-0190-00	B109310		TRANSISTOR:NPN,SI,TO-92 (OPTION 07 ONLY)	07263	2N3904
Q925	151-0190-00	B109310		TRANSISTOR:NPN,SI,TO-92 (OPTION 07 ONLY)	07263	2N3904
Q930	151-0188-00	B109310		TRANSISTOR:PNP,SI,TO-92 (OPTION 07 ONLY)	04713	2N3906
Q930	151-0188-00	B140959		TRANSISTOR:PNP,SI,TO-92	04713	2N3906
Q931	151-0192-00	B140959		TRANSISTOR:NPN,SI,TO-92	04713	SPS6901
Q940	151-0190-00	B109310		TRANSISTOR:NPN,SI,TO-92 (OPTION 07 ONLY)	07263	2N3904
Q945	151-0190-00	B109310		TRANSISTOR:NPN,SI,TO-92 (OPTION 07 ONLY)	07263	2N3904
Q950	151-0190-00	B109310		TRANSISTOR:NPN,SI,TO-92 (OPTION 07 ONLY)	07263	2N3904
Q955	151-0190-00	B109310		TRANSISTOR:NPN,SI,TO-92 (OPTION 07 ONLY)	07263	2N3904
Q960	151-0188-00	B109310		TRANSISTOR:PNP,SI,TO-92 (OPTION 07 ONLY)	04713	2N3906
Q967	151-0190-00	B109310		TRANSISTOR:NPN,SI,TO-92 (OPTION 07 ONLY)	07263	2N3904
Q970	151-0190-00	B109310		TRANSISTOR:NPN,SI,TO-92 (OPTION 07 ONLY)	07263	2N3904
Q972	151-0190-00	B109310		TRANSISTOR:NPN,SI,TO-92 (OPTION 07 ONLY)	07263	2N3904
Q975	151-0190-00	B109310		TRANSISTOR:NPN,SI,TO-92 (OPTION 07 ONLY)	07263	2N3904
Q980	151-0188-00	B109310		TRANSISTOR:PNP,SI,TO-92 (OPTION 07 ONLY)	04713	2N3906
Q990	151-0190-00	B109310		TRANSISTOR:NPN,SI,TO-92 (OPTION 07 ONLY)	07263	2N3904
R101	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	TK1727	SFR25 2322-181-
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,FILM:220 OHM,5%,0.25W	TK1727	SFR25 2322-181-
R103	316-0390-00	B030000	B119999	RES,FXD,CMPSN:39 OHM,10%,0.25W	80008	316039000
R103	315-0390-00	B120000		RES,FXD,FILM:39 OHM,5%,0.25W	TK1727	SFR25 2322-181-
R104	308-0688-00			RES,FXD,WW:6.2K OHM,3%,7W	00213	1800S-6200-3
R106	321-0128-00			RES,FXD,FILM:210 OHM,1%,0.125W,TC=TO	TK1727	MR25 2322-151-2
R107	315-0101-00	B140959		RES,FXD,FILM:100 OHM,5%,0.25W	TK1727	SFR25 2322-181-

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 (μ F).
- 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.

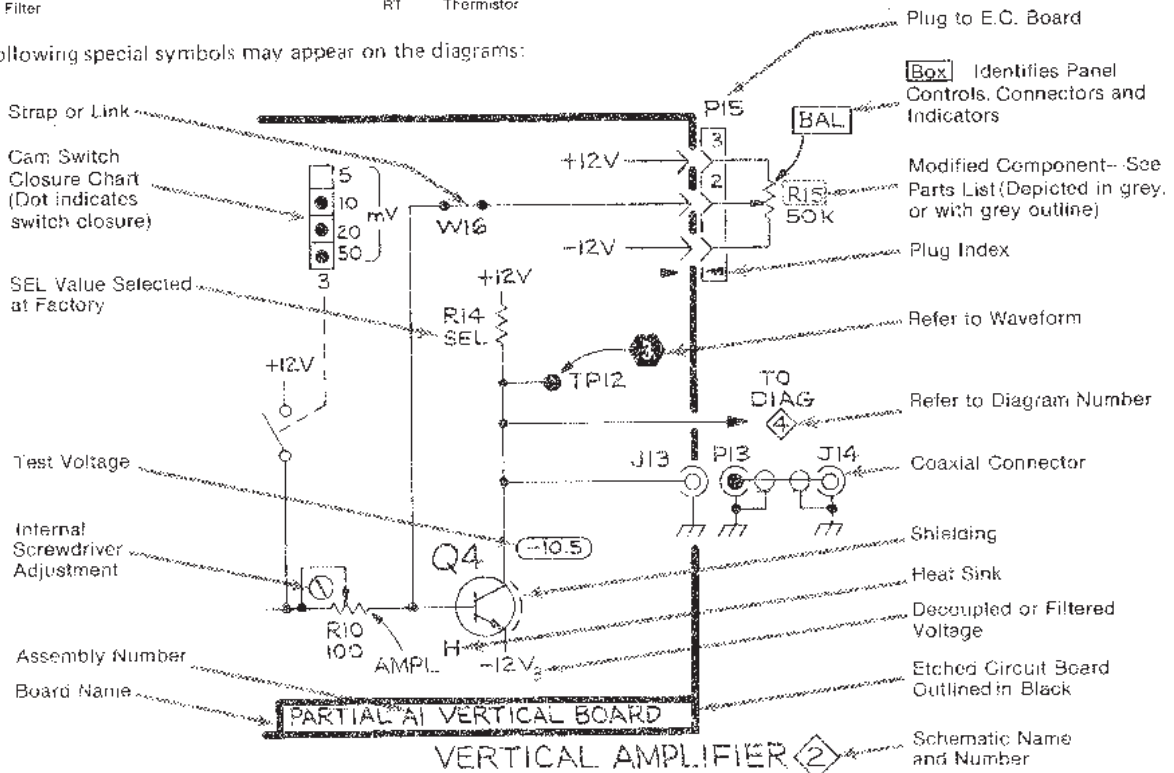
Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

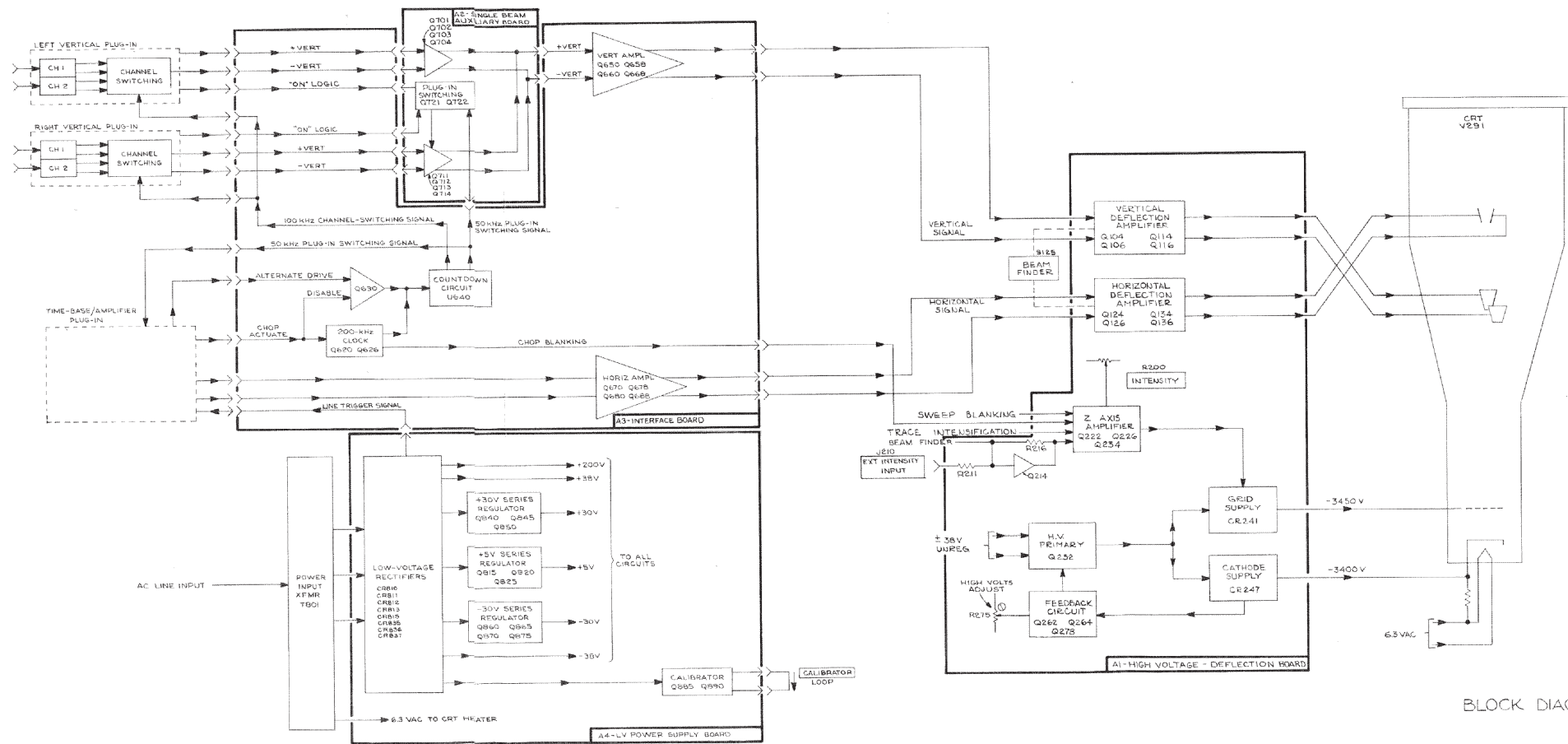
- Y14.15, 1966 Drafting Practices.
- Y14.2, 1973 Line Conventions and Lettering.
- Y10.5, 1968 Letter Symbols for Quantities Used in Electrical Science and Electrical Engineering.

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
A.	Attenuator, fixed or variable	HR	Heater	T	Transformer
B	Motor	HY	Hybrid circuit	TC	Thermocouple
BI	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	VH	Voltage regulator (zener diode, etc.)
DL	Doty line	P	Connector, movable portion	W	Wirestrap or cable
DS	Indicating device (lamp)	O	Transistor or silicon-controlled rectifier	Y	Crystal
E	Spark Gap, Ferrite bead	R	Resistor, fixed or variable	Z	Phase shifter
F	Fuse	RT	Thermistor		
FI	Filter				

The following special symbols may appear on the diagrams:





(143) (132) 2134-15
REV FEB 1982

571
R_{HL}
BLOCK DIAGRAM

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.

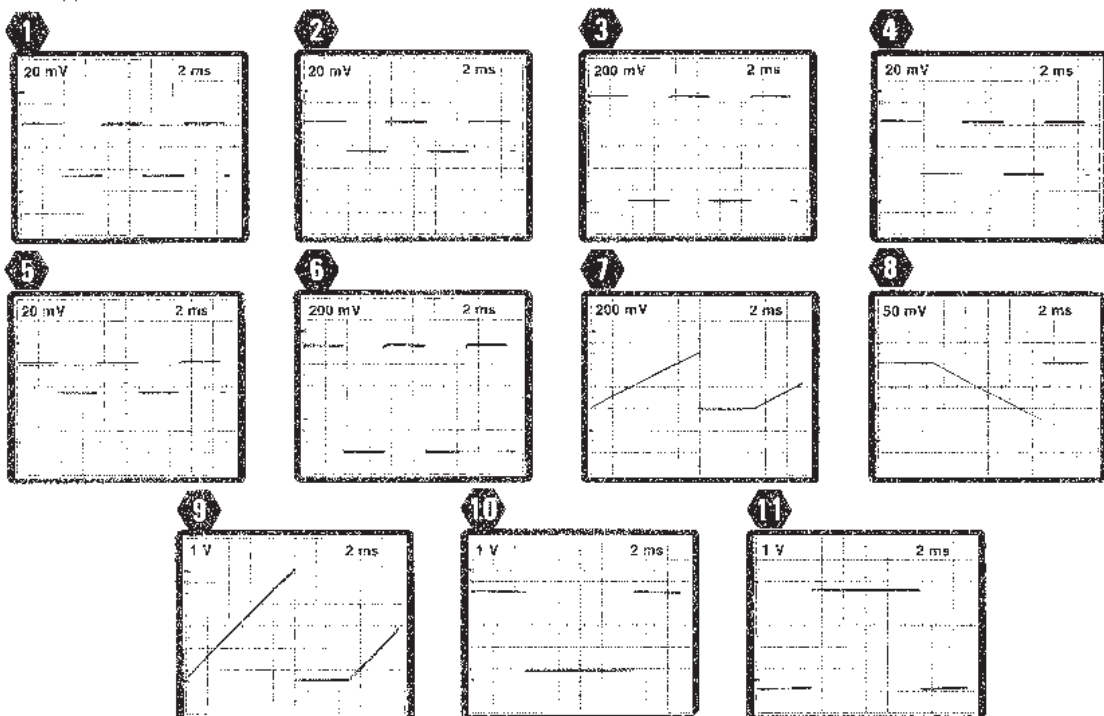
WAVEFORM CONDITIONS

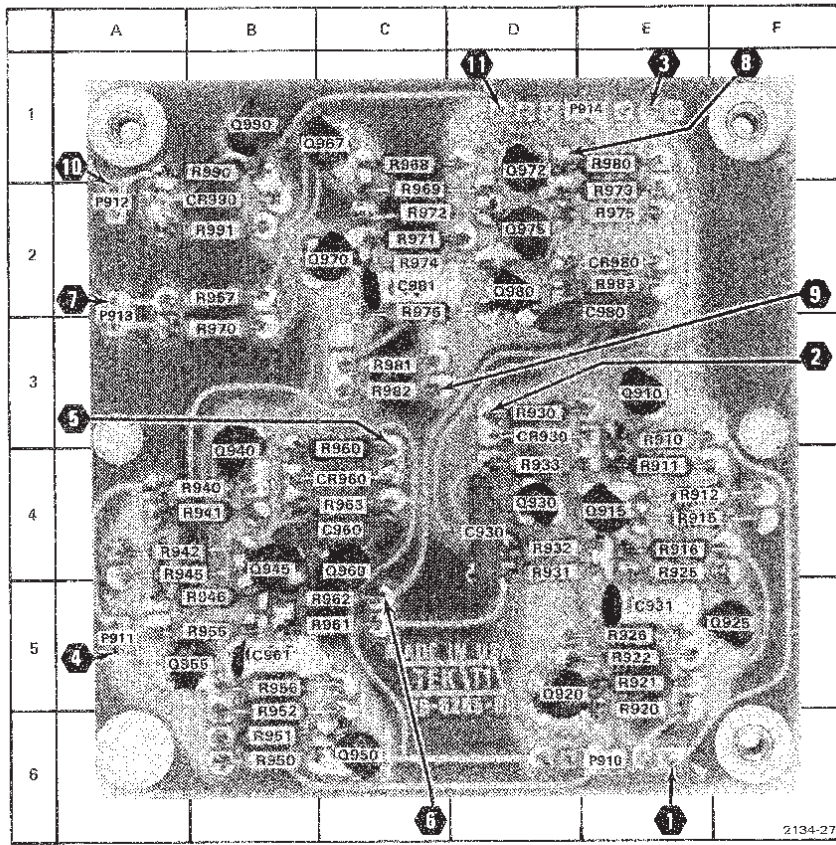
OSCILLOSCOPE UNDER TEST. Install an amplifier unit in both vertical compartments and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier units (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal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

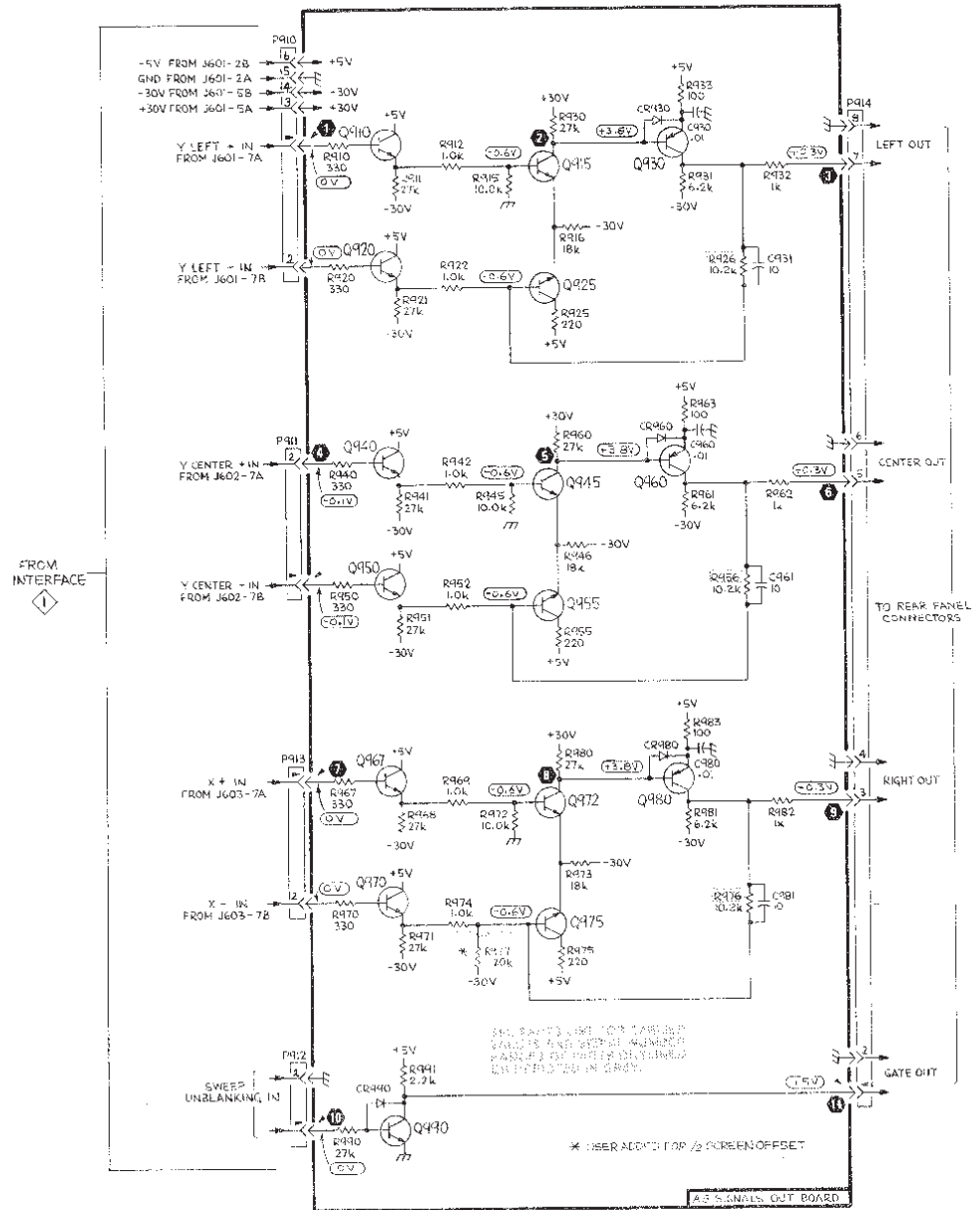




A5-Signals Out circuit board

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	5E	R930	3D	R973	2E		
Q930	4D	R931	4D	R974	2C		
Q940	3B	R932	4D	R975	2E		
Q945	4R	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		

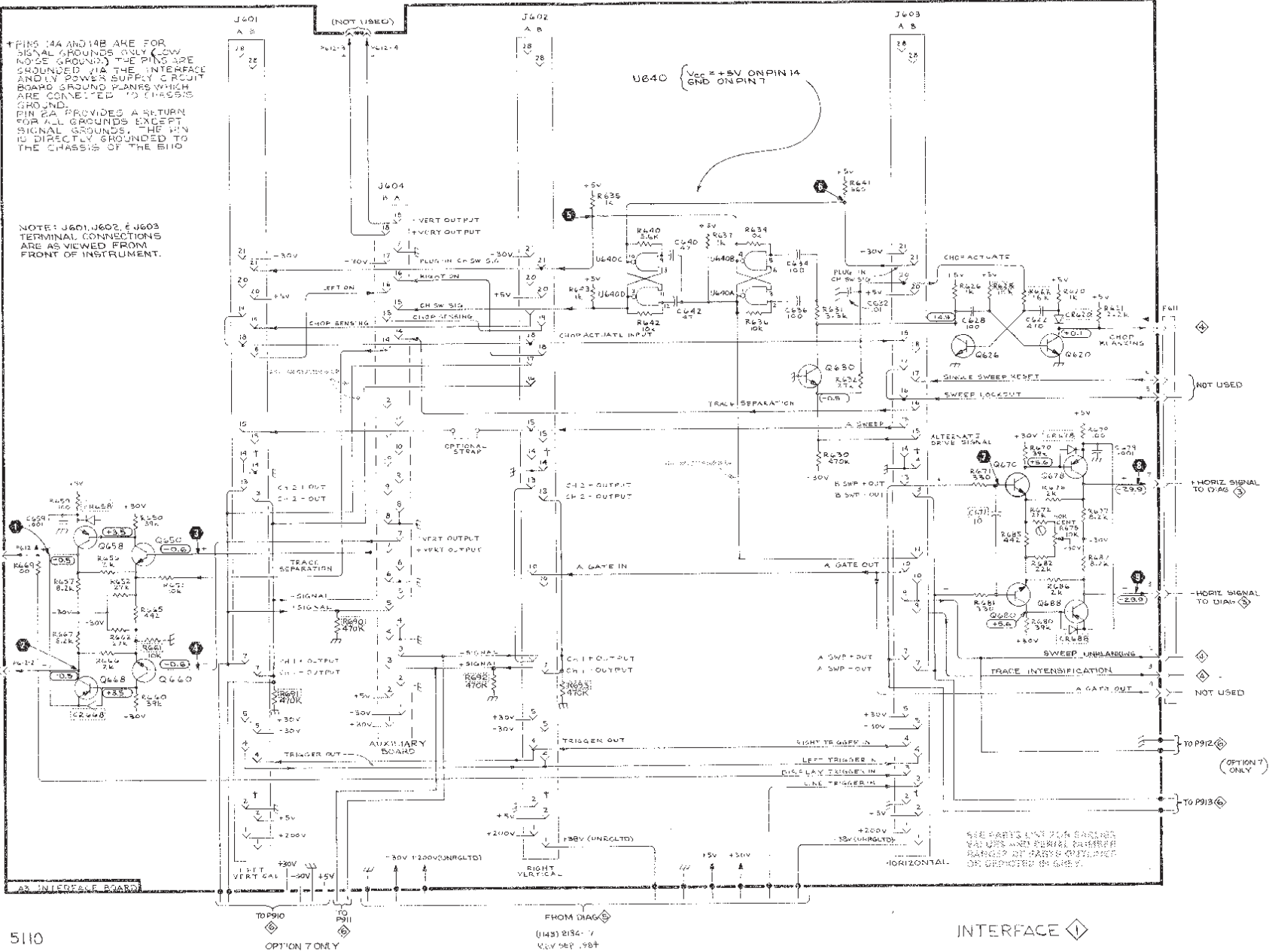
VOLTAGE & WAVEFORM CONDITIONS

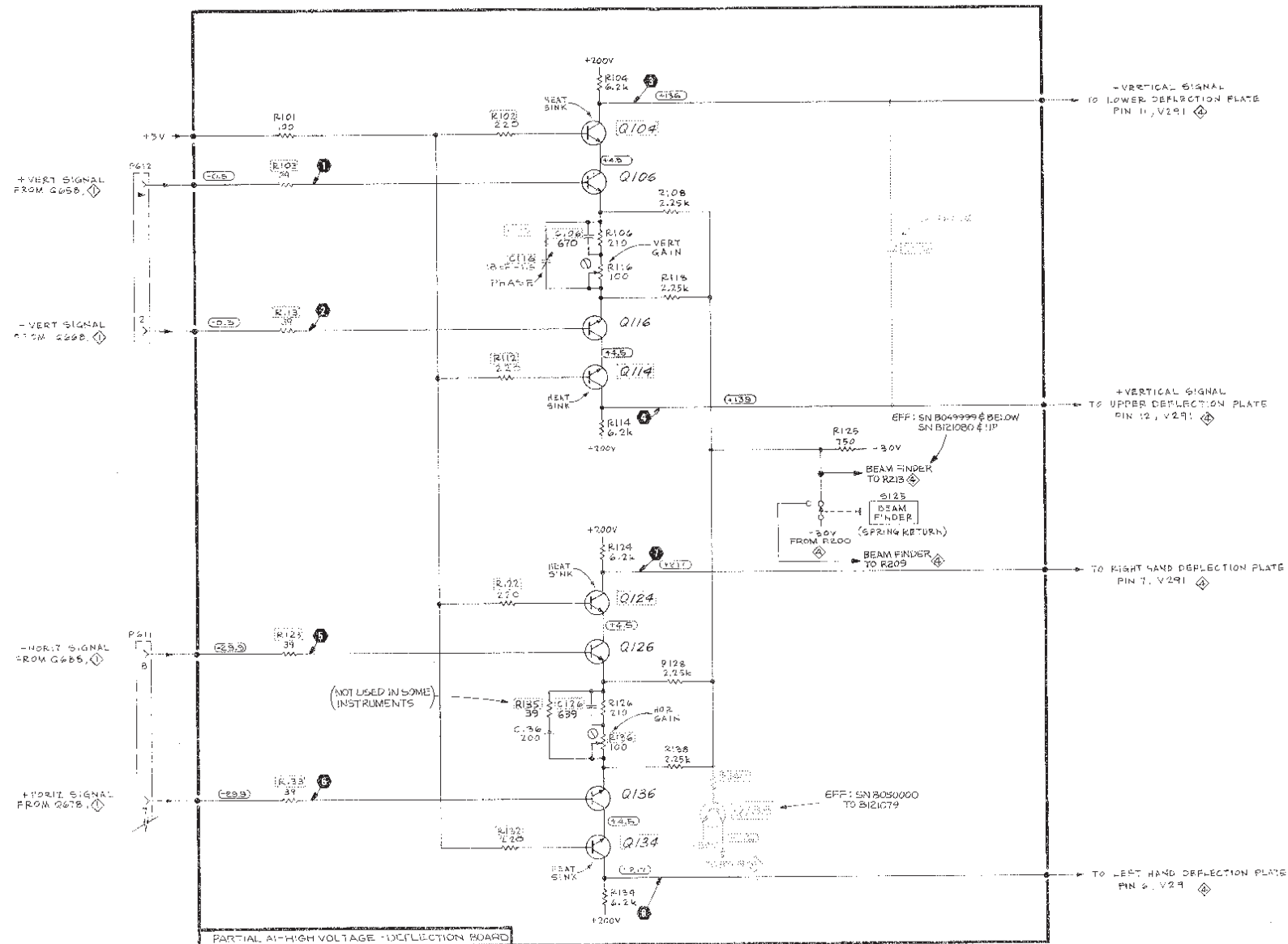


5110 OPT 7

2134-24
REV A, FEB 1979

SIGNALS OUT
(OPTION 7 ONLY)





SEE PARTS LIST FOR EARLIER VALUES AND DESIRED RANGES OF VALUES OBTAINED OR SPECIFIED IN CREF.

(113)P134-17
REV SEP 1981

VERTICAL & HORIZONTAL DEFLECTION AMPLIFIERS 3

G-12
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 Probs.
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.

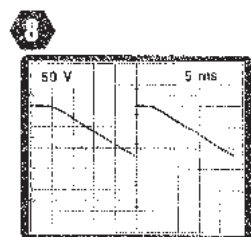
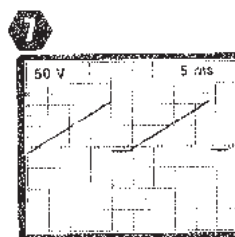
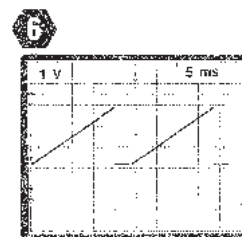
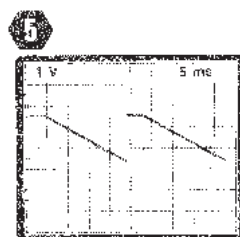
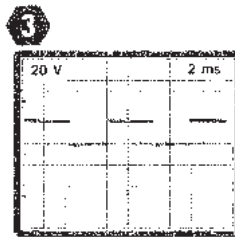
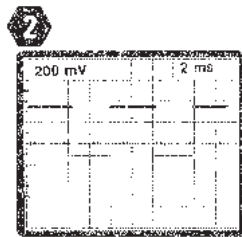
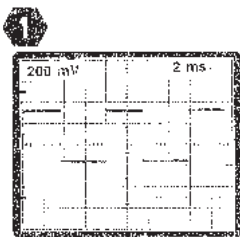
WAVEFORM CONDITIONS

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.



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.

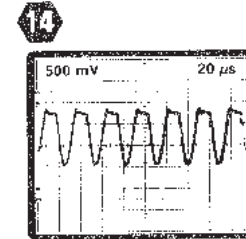
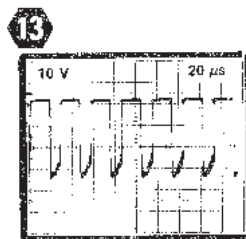
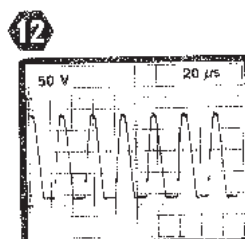
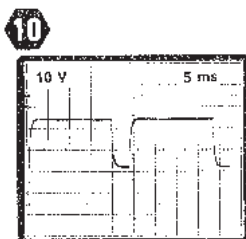
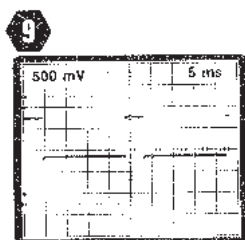
WAVEFORM CONDITIONS

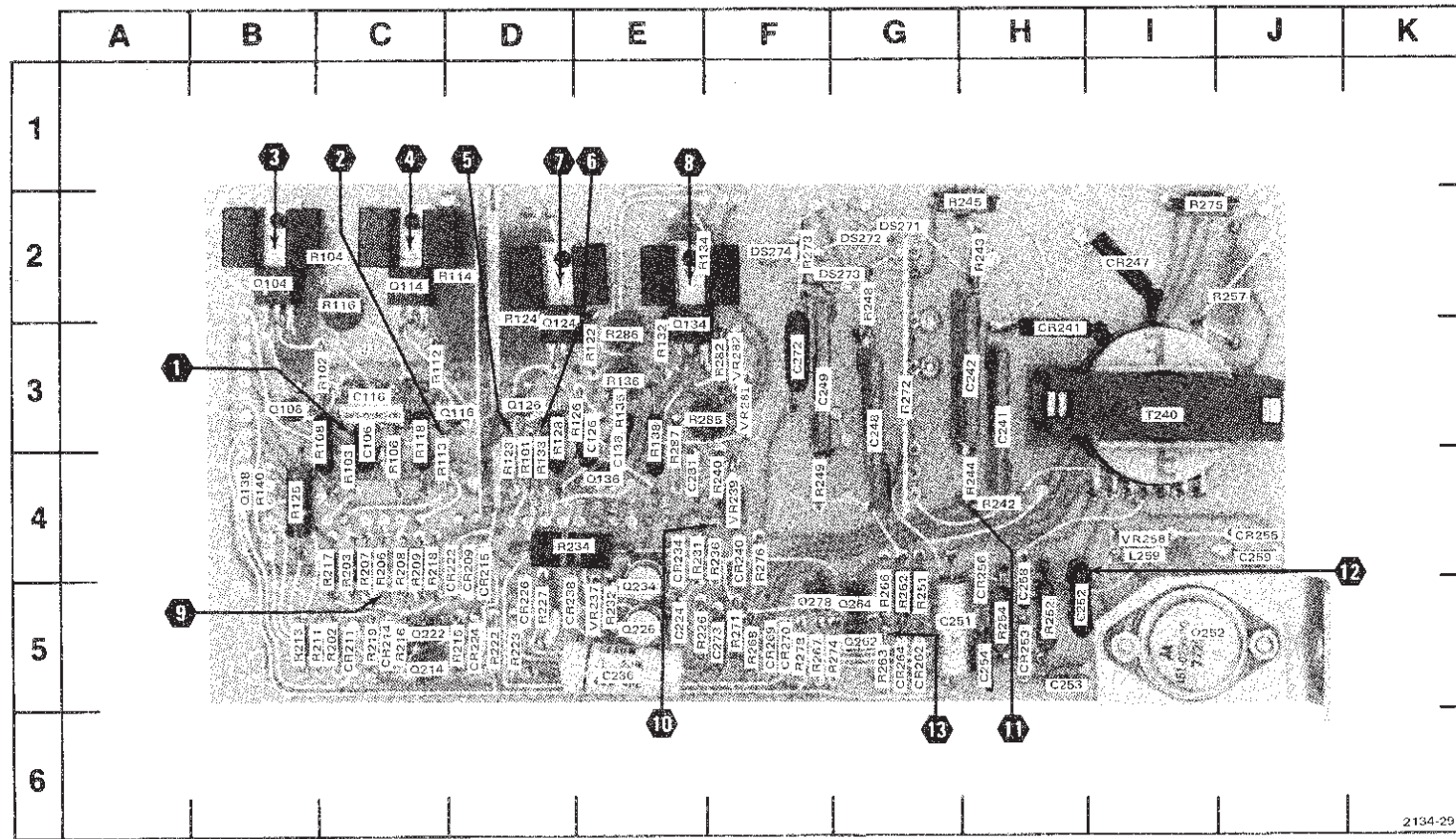
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The waveforms shown are actual waveform photographs taken with a Tektronix Oscilloscope Camera System and Projected Graticule. Vertical deflection factor shown on the waveform is the actual deflection factor from the probe tip. Voltages and waveforms 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.



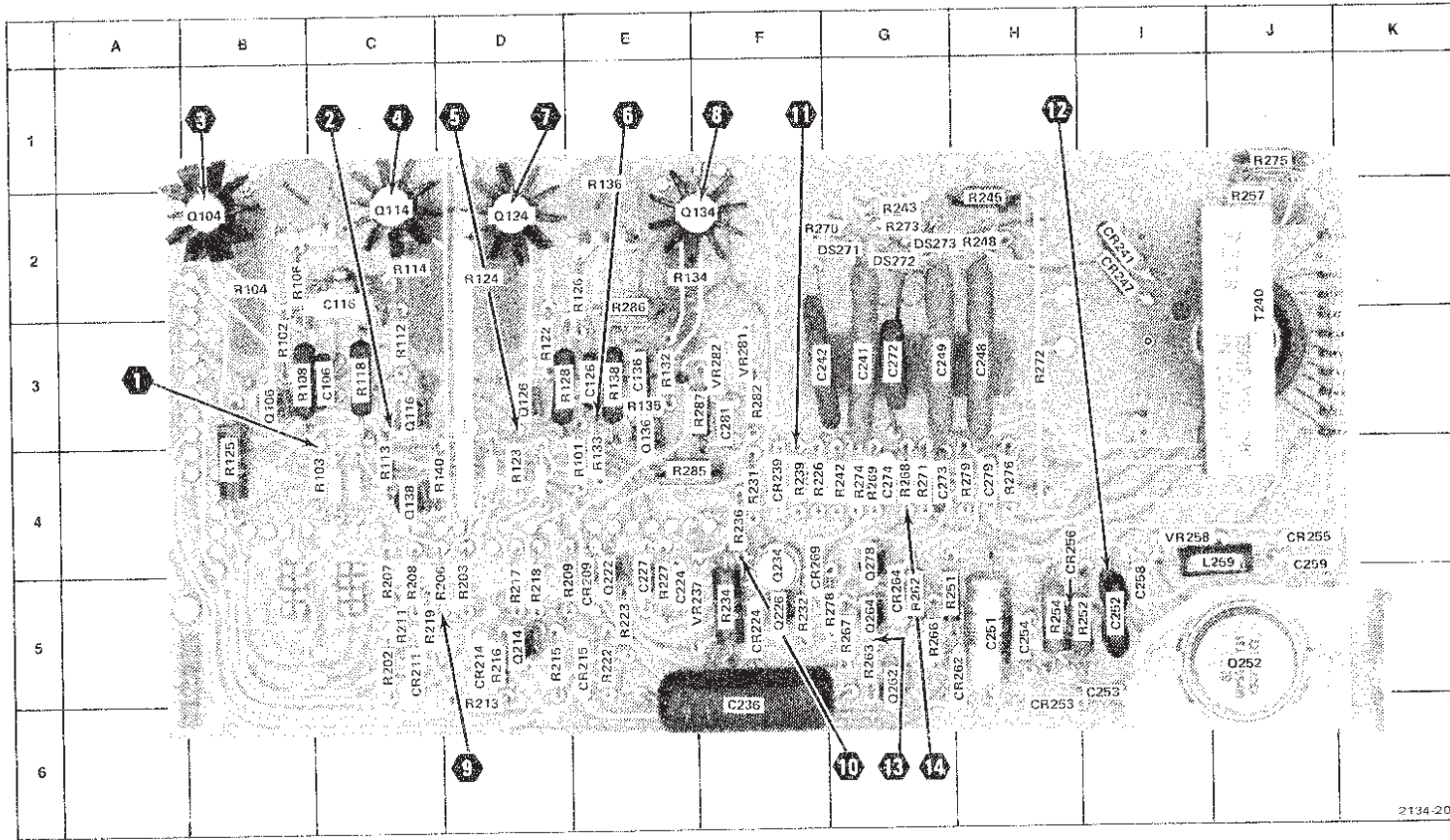


A1—High Voltage—Deflection circuit board (SN B120000 & above).

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	C234	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	E3	R125	E3	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	F4	CR247	I2	L259†	I4	Q226	E5	R108	C3	R133	D4	R211	B5	R232	E5	R2571*	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	R2	Q252	I5	R113	D4	R135	E3	R215	D5	R236	F4	R263	G5	R285	E3		
C248	G3	CR211	C5	CR256	H5	Q106	R3	Q262	G5	R114	C2	R136	E3	R216	C5	R240	F4	R266	G5	R286	E2		
C249	F3	CR214	C5	CR262	G5	Q114	C3	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.

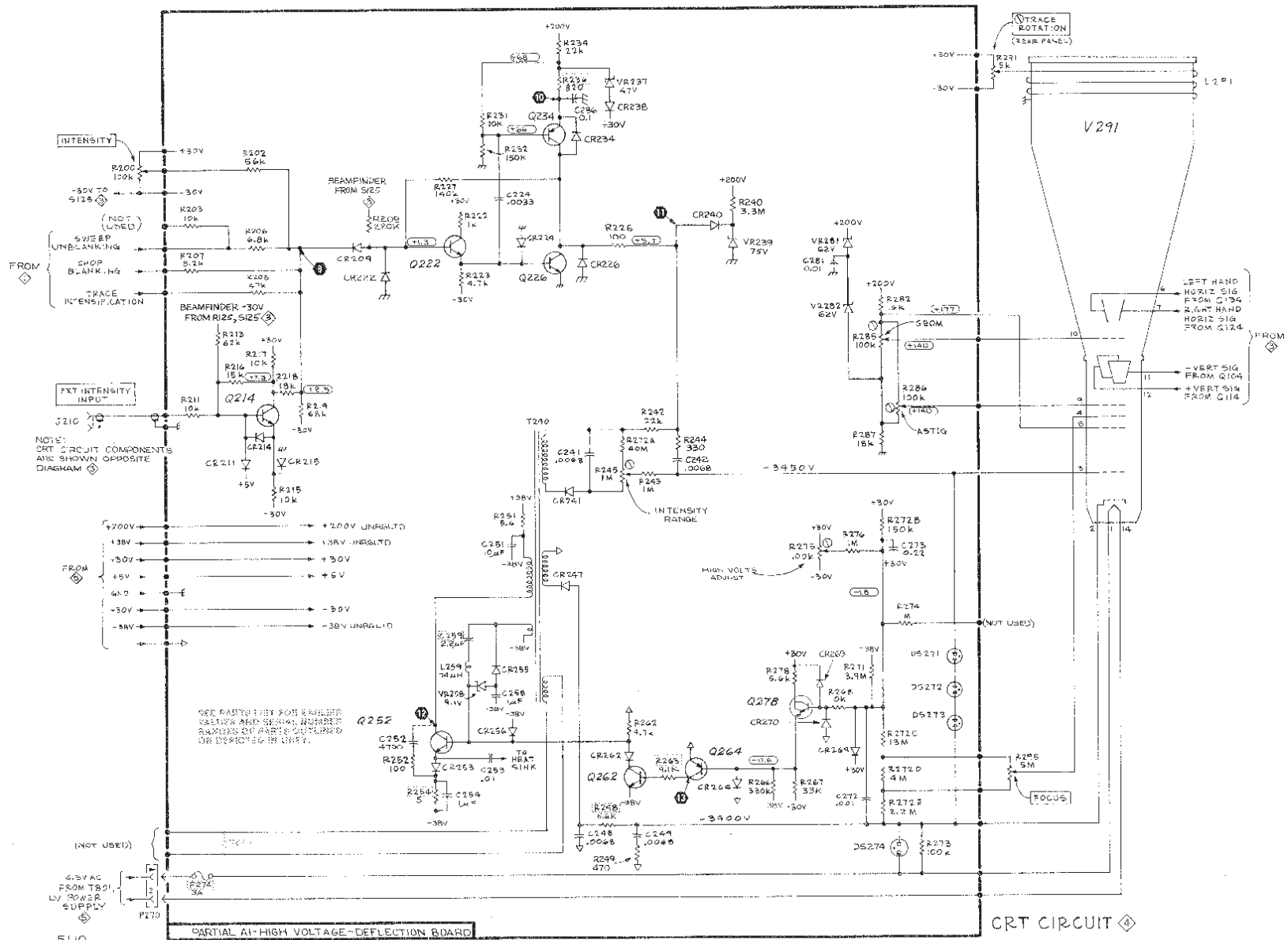


2134-20A

A1—High Voltage—Deflection circuit board (SN E050000 to R119999).

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	C-3	C259	J-4	CR262	G-5	Q134	F-2	R106	B-2	R135	E-3	R219	C-5	R254	H-5
C116	C-2	C272	G-3	CR264	G-5	Q136	E-3	R108	B-3	R136	F-2	R222	E-5	R257	J-2
C126	E-3	C273	G-3	CR269	F-4	Q138	C-4	R112	C-3	R138	E-3	R223	F-5	R262	G-5
C136	E-3	C274	G-4			Q214	D-5	R113	C-4	R140	C-4	R226	F-4	R263	G-5
C224	E-5	C279	H-4	DS271	G-2	Q222	E-5	R114	A-1	R202	C-5	R227	E-5	R266	G-5
C227	E-5	C281	F-3	DS272	G-2	Q226	F-5	R116	B-2	R203	D-5	R227	G-5	R267	G-5
C236	F-5			DS273	G-2	Q234	F-5	R118	C-3	R206	C-5	R232	F-5	R268	G-4
C241	G-3	CR209	E-5			Q252	J-5	R122	D-3	R207	C-5	R234	F-5	R269	G-4
C242	F-3	CR211	C-5	L259	J-4	Q262	G-5	R123	D-4	R208	C-5	R236	F-4	R270	G-2
C248	H-3	CR214	D-5			Q264	G-5	R124	D-2	R209	D-5	R239	F-4	R271	G-4
C249	G-3	CR224	F-5	Q164	B-2	Q278	G-4	R125	B-4	R211	C-5	R242	G-4	R272	H-3
C251	H-5	CR239	F-4	Q106	B-3			R126	E-2	R213	D-6	R243	G-2	R273	G-2
C252	I-5	CR241	I-2	Q114	C-2	R101	E-4	R128	D-3	R215	D-5	R245	H-2	R274	G-4
C253	I-5	CR247	I-2	Q116	C-3	R102	B-3	R132	E-3	R216	D-5	R248	H-2	R275	J-1
C254	H-5	CR253	H-6	Q124	D-2	R103	C-4	R133	E-4	R217	D-5	R251	G-5	R276	H-4
C258	I-5	CR256	H-5	Q126	D-3	R104	B-2	R134	E-2	R218	D-5	R252	H-5	R278	G-5

T1 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 P6062B Probe.
Voltmeter (Non-loading digital multimeter)	Range, 0 to 250 V; input impedance, 10 megohms.	Tektronix DM 501A Digital Multimeter with power module.

VOLTAGE CONDITIONS

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

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.

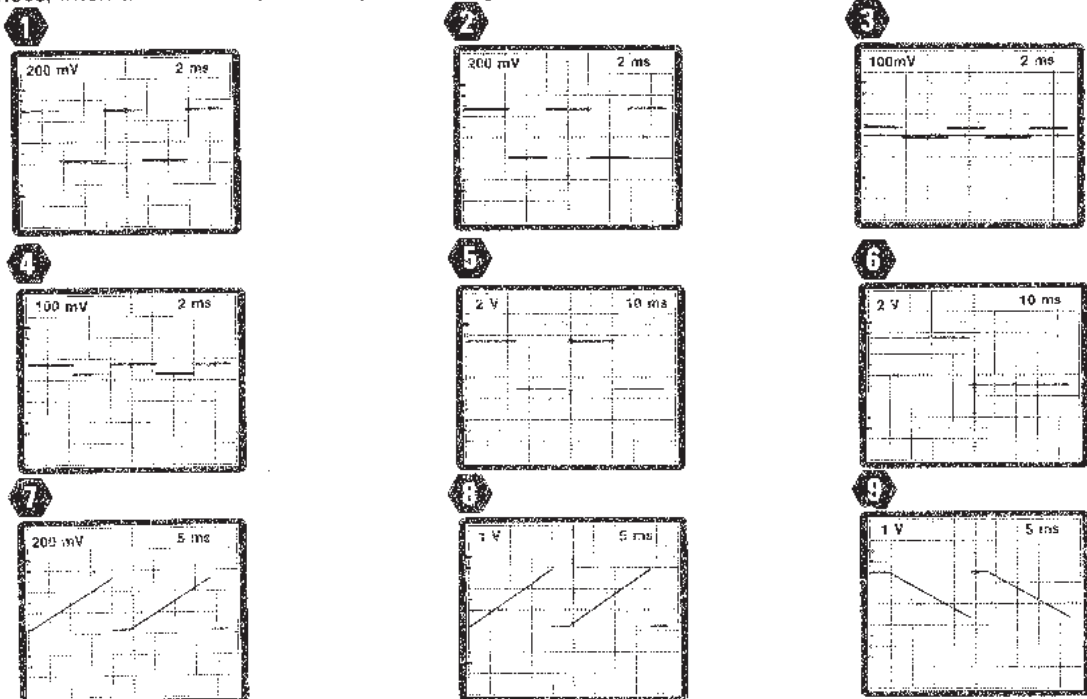
WAVEFORM CONDITIONS

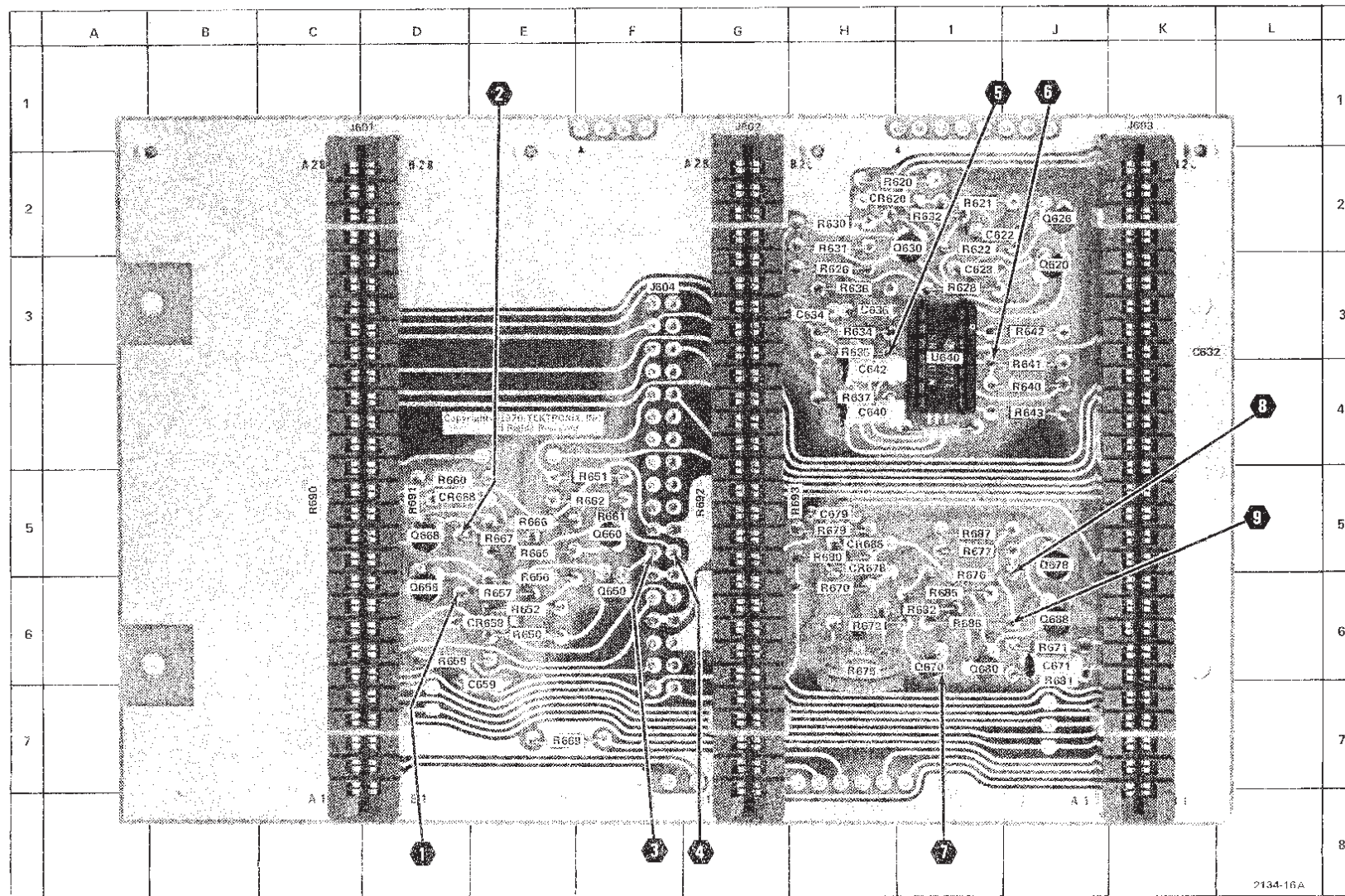
OSCILLOSCOPE UNDER TEST. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal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





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	R690*†	C-5
CR668	D-5	R691*†	D-5
CR678	H-5	R692*†	G-5
CR688	H-5	R693*†	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		
R661*	F-5		
R662	F-5		
R665	E-5		
R666	E-5		
R667	E-5		
R669	E-7		

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 cw. Voltmeter common is connected to chassis ground.

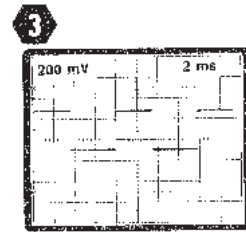
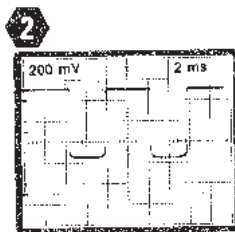
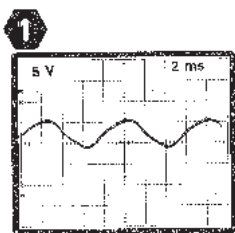
WAVEFORM CONDITIONS

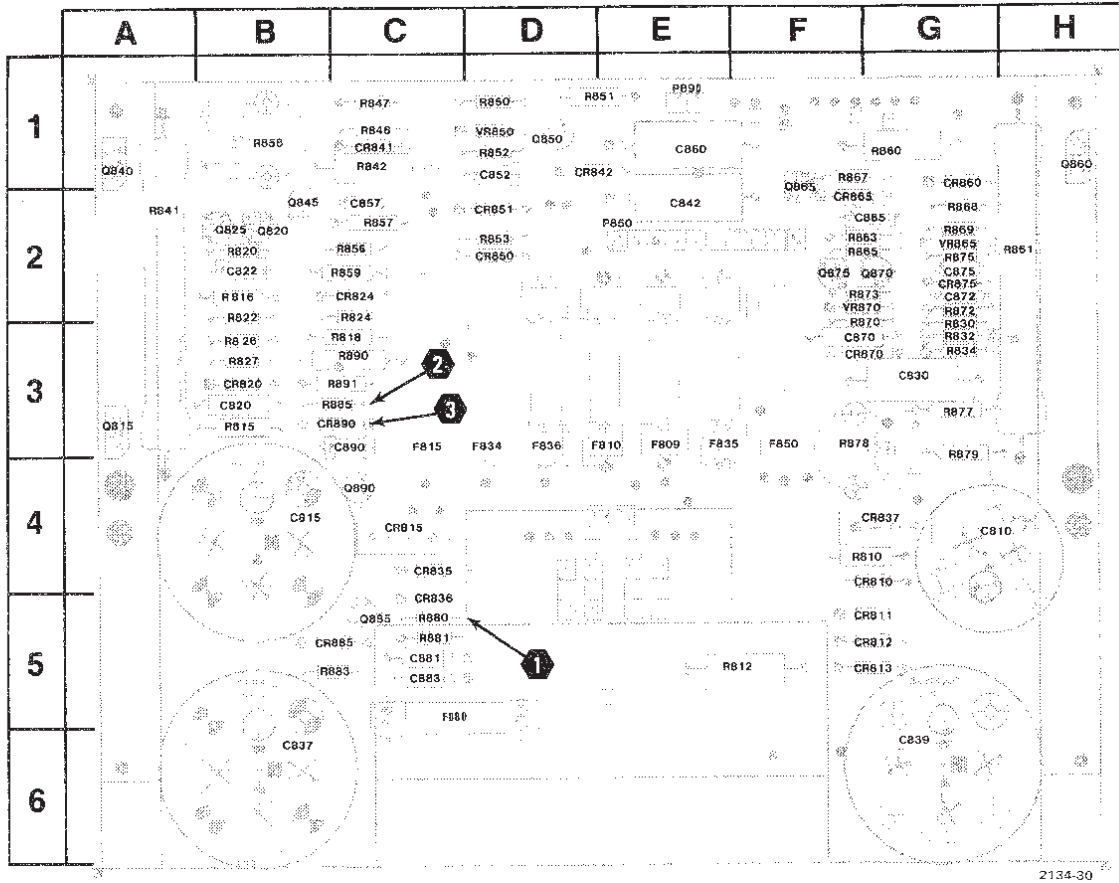
OSCILLOSCOPE UNDER TEST. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal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

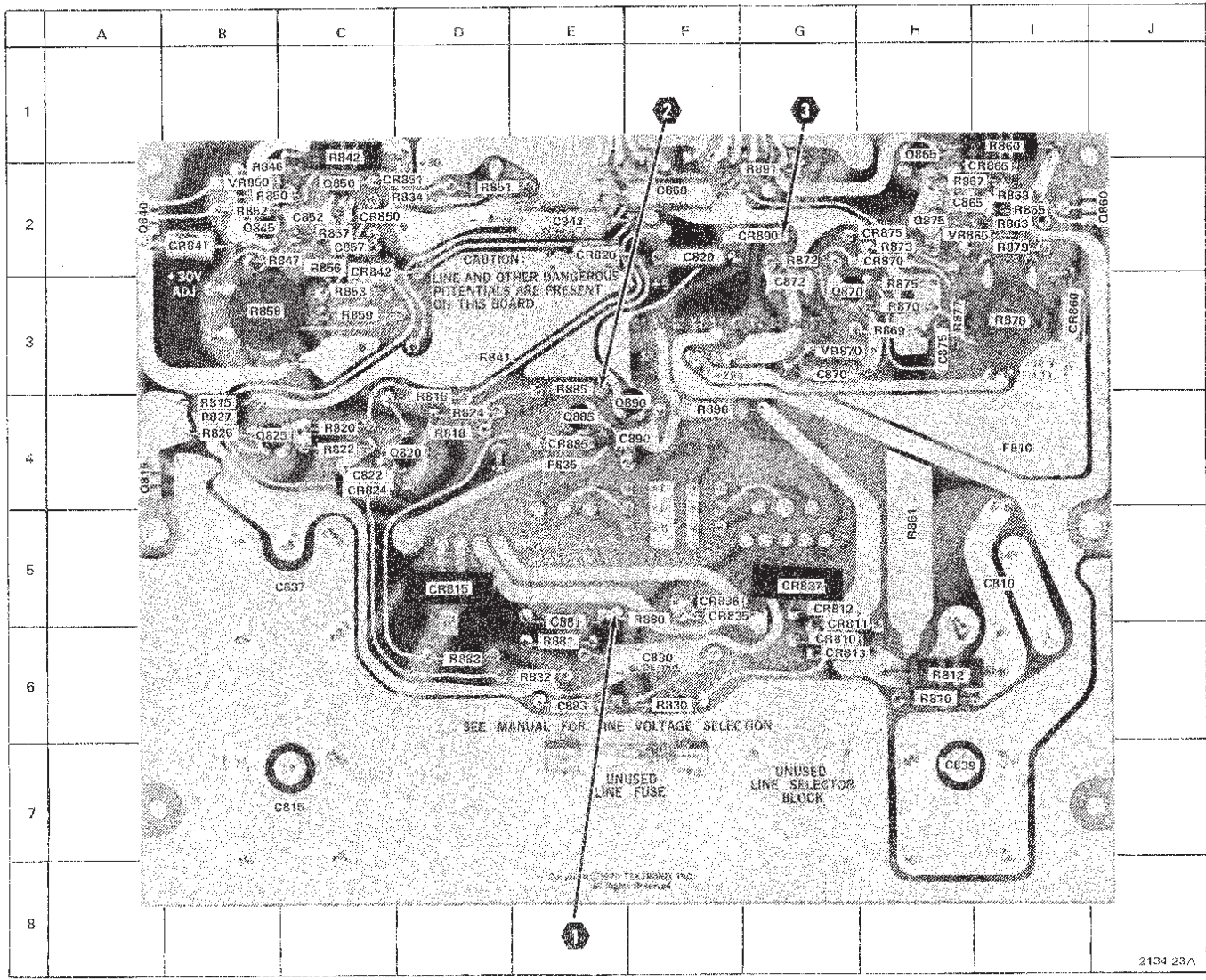
The waveforms shown are actual waveform photographs taken with a Tektronix Oscilloscope Camera System and Projected Graticule. Vertical deflection factor shown on the waveform is the actual deflection factor from the probe tip. Voltages and waveforms on the diagrams are not absolute and may vary between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





A4-LV Power Supply circuit board (SN B125357 & above).

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C810	G4	F809	E3	R847	C1
C815	B4	F810	E3	R850	D1
C820	B3	F815	C3	R851	D1
C822	B2	F834	D3	R852	D1
C830	G3	F835	E3	R853	D2
C837	B6	F836	D3	R856	C2
C839	G6	F850	F3	R857	C2
C842	E2	F880	C5	R858	B1
C852	D1			R859	C2
C857	C2	P850	E2	R860	G1
C860	E1	P890	E1	R861	H2
C865	F2			R863	F2
C870	F3	Q815	A3	R865	F2
C872	G2	Q820	B2	R867	F1
C875	G2	Q825	B2	R868	G2
C881	C5	Q840	A1	R869	G2
C883	C5	Q845	B2	R870	F3
C890	C3	Q850	D1	R872	G2
		Q860	H1	R873	F2
CR810	G4	Q870	G2	R875	G2
CR811	F5	Q875	F2	R877	G3
CR812	F5	Q885	C5	R878	F3
CR813	F5	Q890	C4	R879	G4
CR815	C4			R880	C5
CR820	B3	R810	G4	R881	C5
CR824	C2	R812	E5	R883	B5
CR835	C4	R815	B3	R885	C3
CR836	C5	R816	B2	R890	C3
CR837	G4	R818	C3	R891	C3
CR841	C1	R820	B2		
		R822	B2	VR850	D1
CR842	D1	R824	C2	VR865	G2
CR850	D2	R826	B3	VR870	F2
CR851	D2	R827	B3		
CR860	G2	R830	G3		
CR865	F2	R832	G3		
CR870	F3	R834	G3		
CR875	G2	R841	A2		
CR885	B5	R842	C1		
CR890	C3	R846	C1		

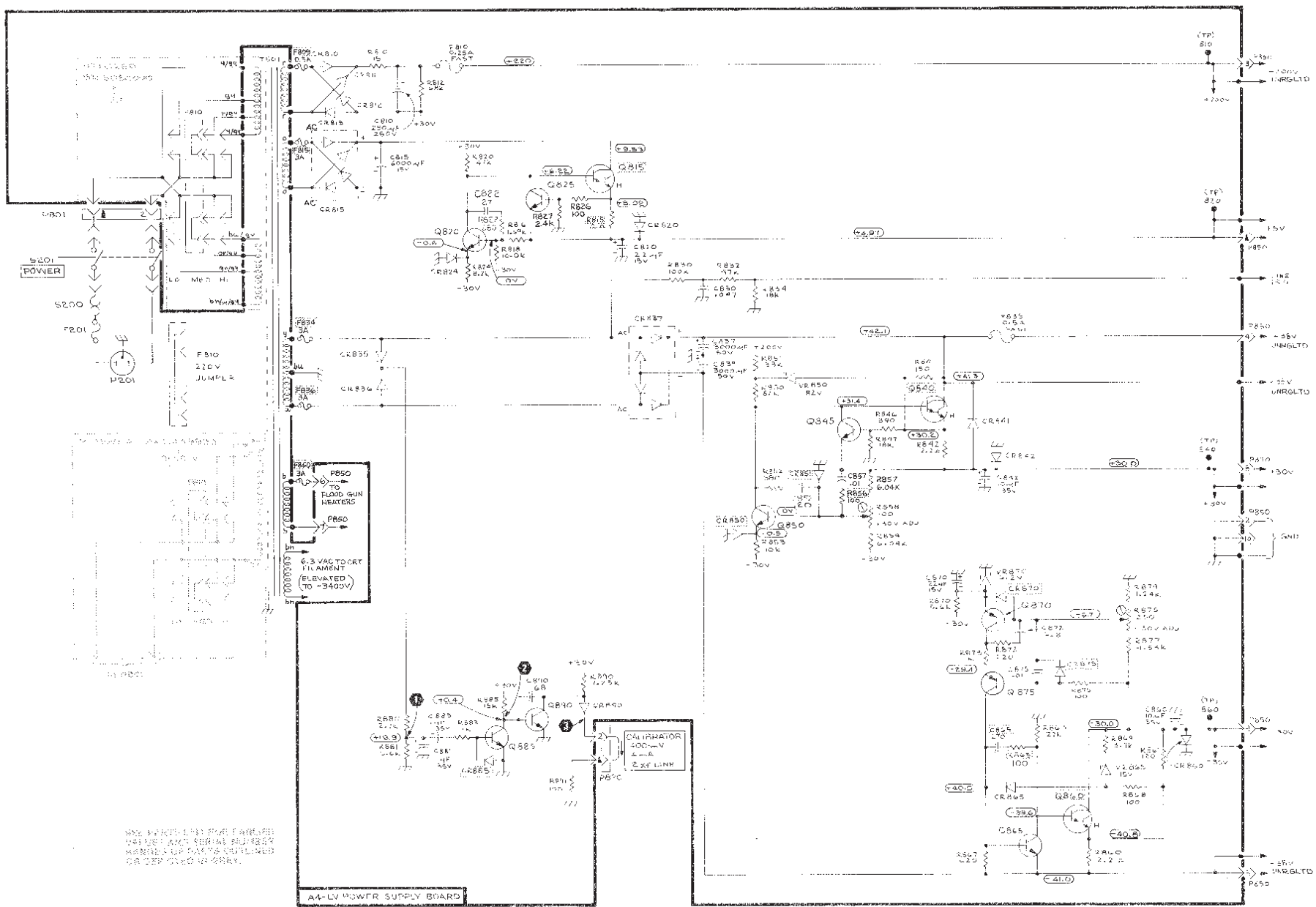


A4-LV Power Supply circuit board (SN P125356 & below).

CKT NO	GRID LOC	CKT NO	GRID LOC
C810†	I-5	Q875	H-2
C815†	C-7	Q885	E-4
C820	F-2	Q890	F-4
C822	C-4		
C830	F-6		
C837†	C-5		
C839†	H-7	R810	H-6
C842	E-2	R812	H-6
C852	C-2	R815	B-4
C857	C-2	R816	D-4
C860	F-2	R818	D-4
C865*	H-2	R820	C-4
C870	G-3	R822*	C-4
C872	G-3	R824*	D-4
C875	H-3	R826	B-4
C881	E-5	R827	B-4
C883	E-6	R830	F-6
C890	F-4	R832	E-6
		R834	D-2
		R841†	D-3
		R842	C-1
CR810	G-6	R846*	B-2
CR811	G-6	R847	C-2
CR812	G-5	R850*	B-2
CR813	G-6	R851	D-2
CR815	D-5	R852	B-2
CR820	E-2	R853	C-3
CR824	C-4	R856*	C-2
CR835	F-5	R857	C-2
CR836	F-5	R858	B-3
CR837	G-5	R859	C-3
CR841	B-2	R860	I-1
CR842	C-2	R861†	H-5
CR850	C-2	R863*	I-2
CR851	D-2	R865*	I-2
CR860	I-3	R867	H-2
CR865	I-2	R868	I-2
CR870	H-2	R869	H-3
CR875	H-2	R870	H-3
CR885	E-4	R872*	G-2
CR890	G-2	R873*	H-2
		R875	H-3
		R877	H-3
		R878	I-3
VR850	B-2	R879	I-2
VR865	I-2	R880*	F-5
VR870	G-3	R881	E-6
		R883*	D-6
		R885*	E-3
		R890	F-4
F810†	I-4	R891	G-2
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		

† Located on back of board.

* See Parts List for serial number ranges.



SEE PARTS LIST FOR PARTS NOT SHOWN AND SERIAL NUMBER RANGE FOR PARTS CONTAINED OR DERIVED THEREFROM.

A4-LV POWER SUPPLY 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 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 the left vertical compartment (for power supply loading). INTENSITY control is set fully ccw. Voltmeter common is connected to chassis ground.

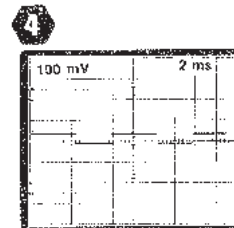
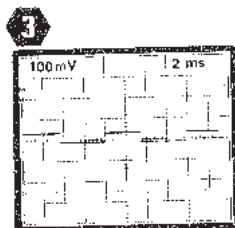
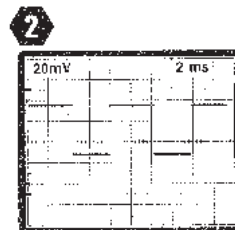
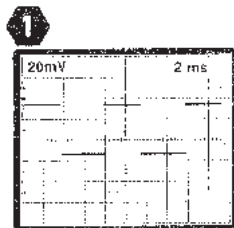
WAVEFORM CONDITIONS

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.

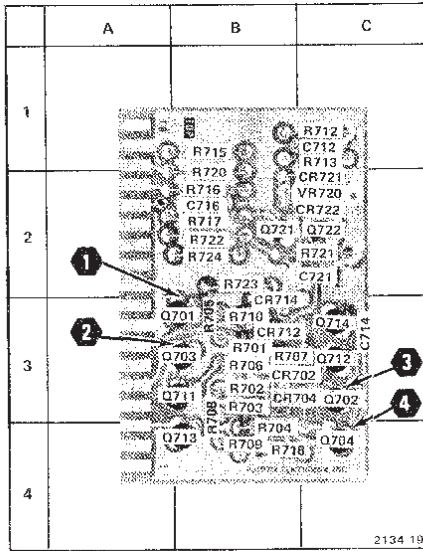
TEST OSCILLOSCOPE. Set the test oscilloscope triggering for auto mode with ac coupling from the internal source and set vertical input coupling to ac. Connect a 10X Probe to the vertical input. Position the display as necessary.

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.



VOLTAGE & WAVEFORM CONDITIONS

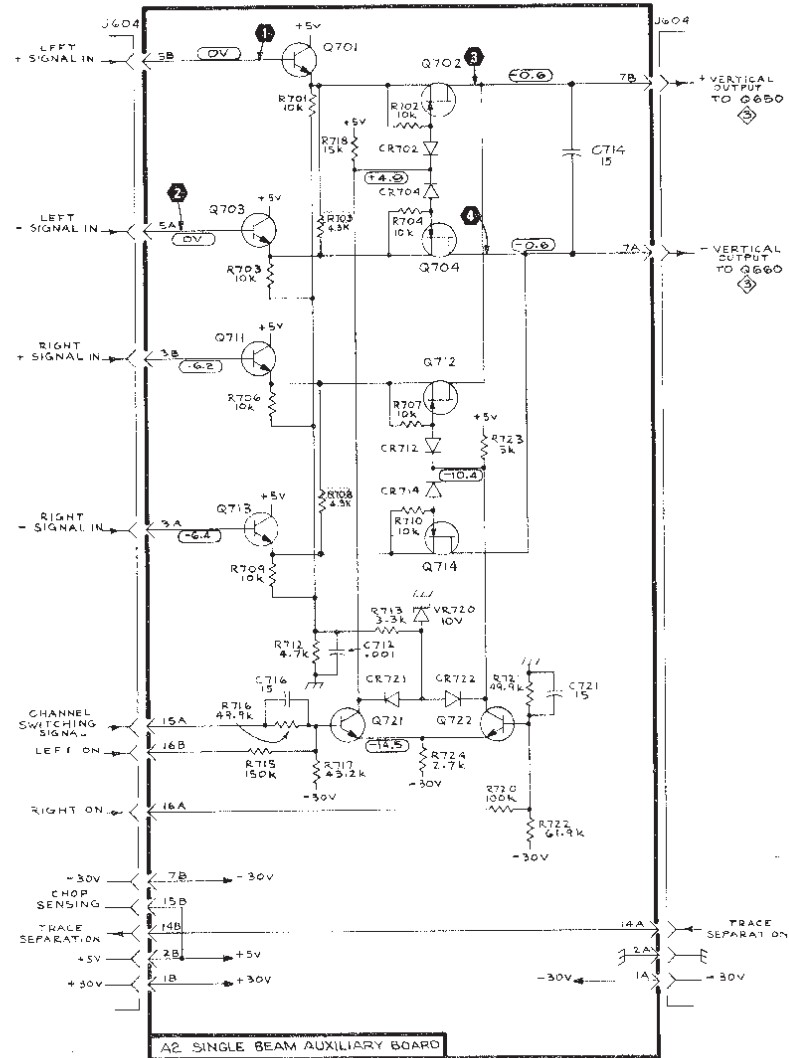


A2—Single Beam Auxiliary circuit board.

CKT NO	GRID LOC	CKT NO	GRID LOC
C712	C-1	Q721	B-2
C7141	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	R705*	B-3
CR714	B-3	R706	B-3
CR721	C-2	R707	B-3
CR722	C-2	R708*	B-3
		R709	B-4
VR720	C-2	R710	B-3
		R712	C-1
Q701	B-3	R713	C-1
Q702	C-3	R715	B-1
Q703	B-3	R716	B-2
Q704	C-4	R717	B-2
Q711	B-3	R718	B-4
Q712	C-3	R720	B-2
Q713	B-4	R721	C-2
Q714	C-3	R722	B-2
		R723	B-2
		R724	B-2

*See Parts List for serial number ranges.

†Located on back of board.



SEE PARTS LIST FOR CARRIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR OMITTED IN BODY

(149)2134-18
REV MAY 1981

AUXILIARY BOARD ②

AUXILIARY BOARD

②

REPLACEABLE MECHANICAL PARTS

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

When ordering parts, include the following information in your order: part number, instrument type or number, serial number, and modification number if applicable.

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

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

ITEM NAME

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

FIGURE AND INDEX NUMBERS

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

INDENTATION SYSTEM

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

1 2 3 4 5 *Name & Description*

Assembly and/or component

Attaching parts for assembly and/or component

END ATTACHING PARTS

Detail part of assembly and/or component

Attaching parts for detail part

END ATTACHING PARTS

Parts of detail part

Attaching parts for parts or detail part

END ATTACHING PARTS

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.

Attaching parts must be purchased separately, unless otherwise specified.

ABBREVIATIONS

Abbreviations conform to American National Standard Y1.1.

Replaceable Mechanical Parts-5110

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
S3629	SCHURTER AG H C/O PANEL COMPONENTS CORP	2015 SECOND STREET	BERKELEY CA 94170
TK0303	FAB TEK INC	17 SUGAR HOLLOW RD	DANBURY CT 06810
TK0392	NORTHWEST FASTENER SALES INC	7923 SW CIRRIUS DRIVE	BEAVERTON OR 97005-6448
TK0435	LEWIS SCREW CO	4300 S RACINE AVE	CHICAGO IL 60609-3320
TK0503	AIMSCO INC	600 SW 10TH	BEAVERTON OR 97005
TK0508	NORTHWEST SPRING AND MFG CO	5858 WILLOW LANE	LAKE OSWEGO OR 97034-5343
TK0588	UNIVERSAL PRECISION PRODUCTS	1775 NW 216TH	HILLSBORO OR 97123
TK0858	STAUFFER SUPPLY CO (DIST)	810 SE SHERMAN	PORTLAND OR 97214
TK0860	LABEL GRAPHICS	6700 SW BRADBURY CT	PORTLAND OR 97224
TK0892	GEROME CORP	OLIVER RD PO BOX 1089	UNIONTOWN PA 15041
TK0938	P-R FASTENERS	3351 59TH ST	LONG BEACH CA 90805
TK0977	ELECTRICAL INSULATION SUPPLIERS, INC -(DIST)	3549 N W YEON	PORTLAND OR 97210
TK1158	POWEL AND ASSOCIATES	111 S FINDLAY ST	SEATTLE WA 98108-2427
TK1181	SEA-TAC INDUSTRIES INC	1217 FOURTH AVE N	KENT WA 98031
TK1319	MORELLIS Q & D PLASTICS	1812 16-TH AVE	FOREST GROVE OR 97116
TK1375	ESAM	PO BOX 376	GRANTS PASS OR 97526
TK1562	WESTERN PAPER CO	6000 NORTH CUTTER CIRCLE	PORTLAND OR 97217
TK1572	RAN-ROB INC	631 85TH AVE	OAKLAND CA 94621-1254
TK1591	EASTMAN PLASTICS INC	4605 SW 180TH	ALOHA OR 97007
TK1641	GAGE INDUSTRIES INC	P O BOX 1318	LAKE OSWEGO OR 97034
TK1684	TECHNICAL IMAGES INC	2206 MOUNTAIN VIEW DR	NEWBURG OR 97132-9265
TK1725	GREENPAR CONNECTORS LTD	PO BOX 15 HARLOW	ESSEX CM20 2ER ENGLAND
TK1741	COLMAN FASTENERS CO LTD	HATTONS ROAD OFF WESTINGHOUSE RD TRAFFORD PARK	MANCHESTER M17 1DF ENGLAND
TK1853	GRIES DYNACAST CORP	1035 S LINWOOD AVE	SANTA ANA CA 92705
TK1967	SYNDETEK	3915 E MAIN	SPOKANE WA 99202
TK2000	A E PETSCHER CO INC	17527 NE 67TH CT	REDMOND WA 98052
0JR05	TRIQUEST CORP	3000 LEWIS AND CLARK HWY	VANCOUVER WA 98661-2999
0J260	COMTEK MANUFACTURING OF OREGON (METALS)	PO BOX 4200	BEAVERTON OR 97076-4200
00779	AMP INC	2800 FULLING MILL PO BOX 3608	HARRISBURG PA 17105
05469	BEARINGS INC	3634 EUCLID P O BOX 6925	CLEVELAND OH 44101
05820	EG AND G WAKEFIELD ENGINEERING	60 AUDUBON RD	WAKEFIELD MA 01880-1203
06666	GENERAL DEVICES CO INC	1410 S POST RD PO BOX 39100	INDIANAPOLIS IN 46239-9632
07416	NELSON NAME PLATE CO	3191 CASITAS	LOS ANGELES CA 90039-2410
08261	SPECTRA-STRIP AN ELTRA CO	7100 LAMPSON AVE	GARDEN GROVE CA 92642
09922	BURWDY CORP	RICHARDS AVE	NORWALK CT 06852

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
12136	P H C INDUSTRIES INC	1643 HADDON AVE PO BOX 1448	CAMDEN NJ 08103-3109
12327	FREEWAY CORP	9301 ALLEN DR	CLEVELAND OH 44125-4632
12697	CLAROSTAT MFG CO INC	LOWER WASHINGTON ST	DOVER NH 03820
16428	COOPER BELDEN ELECTRONIC WIRE AND CABLE SUB OF COOPER INDUSTRIES INC	NW N ST	RICHMOND IN 47374
22526	DU PONT E I DE NEMOURS AND CO INC DU PONT CONNECTOR SYSTEMS DIV MILITARY PRODUCTS GROUP	515 FISHING CREEK RD	NEW CUMBERLAND PA 17070-3007
23880	STANFORD APPLIED ENGINEERING INC	340 MARTIN AVE	SANTA CLARA CA 95050-3112
24546	CORNING GLASS WORKS	550 HIGH ST	BRADFORD PA 16701-3737
24931	SPECIALTY CONNECTOR CO INC	2100 EARLYWOOD DR PO BOX 547	FRANKLIN IN 46131
28520	HEYCO MOLDED PRODUCTS	750 BOULEVARD P O BOX 160	KENILWORTH NJ 07033-1721
45391	PACIFIC METAL CO	3400 SW BOND	PORTLAND OR 97201
70318	ALLMETAL SCREW PRODUCTS CO INC	821 STEWART AVE	GARDEN CITY NY 11530-4810
71785	CINCH CONNECTORS	1501 MORSE AVE	ELK GROVE VILLAGE IL 60007-5723
72228	AMCA INTERNATIONAL CORP CONTINENTAL SCREW CO DIV	459 MT PLEASANT	NEW BEDFORD MA 02742
73743	FISCHER SPECIAL MFG CO	111 INDUSTRIAL RD	COLD SPRING KY 41076-9749
75915	LITTELFUSE INC SUB TRACOR INC	800 E NORTHWEST HWY	DES PLAINES IL 60016-3049
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF DIV	ST CHARLES ROAD	ELGIN IL 60120
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077-0001
83486	ELCO INDUSTRIES INC	1101 SAMUELSON RD	ROCKFORD IL 61101
83553	ASSOCIATED SPRING BARNES GROUP INC	15001 S BROADWAY P O BOX 231	GARDENA CA 90248-1819
85471	BOYD CORP	13885 RAMOMA AVE	CHINO CA 91710
86928	SEASTROM MFG CO INC	701 SONORA AVE	GLENDALE CA 91201-2431
92830	ASSOCIATED SPRING BARNES GROUP INC	18 MAIN ST	BRISTOL CT 06010-8527
98278	MALCO A MICRODOT CO	306 PASADENA AVE	SOUTH PASADENA CA 91030-2905

Replaceable Mechanical Parts-5110

Fig. & Index No.	Tektronix Part No.	Serial No.		Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
		Effective	Dscont				
1 -1	-----			1	CKT BOARD ASSY:SINGLE BEAM AUX(SEE A2 REPL)		
-2	200-1218-00			1	RTNR,CRT SCALE:6.814 X 5.125,NYLON (ATTACHING PARTS)	DJR05	ORDER BY DESCRI
-3	211-0188-00			2	SCREW,MACHINE:4-40 X 0.6,PNH,SST	TK0435	ORDER BY DESCRI
-4	354-0233-00	B010100	B072526	2	RING,RETAINING:TYPE E,EXT,U/O 0.14 DIA SFT (END ATTACHING PARTS)	05469	X-5133-14
-5	337-1440-00	B010100	B104588	1	SHLD,IMPLOSION: (OPTION 76 ONLY)	QJR05	ORDER BY DESCRI
	337-1440-01	B104589		1	SHLD,IMPLOSION:GREEN (OPTION 76 ONLY)	QJR05	337144001
-6	386-1946-00			1	SUPPORT,CRT:FRONT	QJR05	ORDER BY DESCRI
-7	348-0279-00			2	PAD,CUSHIONING:3.5 X 0.67 X 0.188,RUBBER	80009	348027900
-8	348-0070-01			3	PAD,CUSHIONING:2.03 X 0.69 X 0.18 SI RBR	85471	ORDER BY DESCRI
-9	348-0145-00			2	GROMMET,PLASTIC:GRAY,U SHAPE,0.48 ID	QJR05	ORDER BY DESCRI
-10	334-1379-00			1	MARKER,IDENT:MKD HI VACUUM	07416	ORDER BY DESCRI
-11	337-1419-00	B010100	B069999	1	SHIELD,CRT:	80009	337141900
	337-1419-05	B070000		1	SHIELD SECT,CRT:	80009	337141905
-12	337-1420-00			1	SHIELD SECT,CRT:	80009	337142000
-13	354-0409-00			1	R,CLP,CRT SHLD:U/O 2.375 OD SHIELD (ATTACHING PARTS)	QJR05	ORDER BY DESCRI
-14	211-0632-00			1	SCREW,MACHINE:6-32 X 2.25,FILH,STL	TK0392	ORDER BY DESCRI
-15	343-0123-01			2	CLP,ELECTRN TUBE:AL,CD PL	TK1863	ORDER BY DESCRI
-16	220-0444-00			1	NUT,PLAIN,SQ:6-32 X 0.25 SQ,SST	70318	ORDER BY DESCRI
-17	211-0507-00			2	SCREW,MACHINE:6-32 X 0.312,PNH,STL	TK0435	ORDER BY DESCRI
-18	407-0922-00			1	BRACKET,CRT CLP:ALUMINUM (END ATTACHING PARTS)	0J260	ORDER BY DESCRI
-19	384-1064-00			1	KNOB:14.42 L X 0.125 OD,5-40 ONE END	TK1591	ORDER BY DESCRI
-20	119-0238-00	B010100	B090724	1	COIL,CAL:	0J260	ORDER BY DESCRI
	119-0373-00	B090725		1	COIL,CAL: (ATTACHING PARTS)	0J260	ORDER BY DESCRI
	210-0442-00			2	NUT,PLAIN,HEX:3-48 X 0.188,BRS CD PL	73743	3014-402
	210-0004-00			2	WASHER,LOCK:#4 INTL,0.015 THK,STL	78189	1204-00-00-0541
	210-0994-00			2	WASHER,FLAT:0.125 ID X 0.25 OD X 0.022,STL	12327	ORDER BY DESCRI
	210-0935-00			2	WASHER,SHLDR:0.141 ID X 0.375 OD X 0.078 THK, FBR	TK0858	ORDER BY DESCRI
-21	361-0059-01			1	INSULATOR,PLATE:1.093 X 0.343 X 0.125,DEL RIN	QJR05	ORDER BY DESCRI
-22	210-0593-00			2	NUT,FINISHING:3-48 X 0.25 HEX,BRS NP (END ATTACHING PARTS)	80009	210059300
-23	358-0216-00			1	GROMMET,PLASTIC:GRAY,ROUND,0.257 ID	80009	358021600
-24	366-0494-00	B010100	B108289	1	KNOB:GRAY WITH SETSCREW	QJR05	366-0494-00
	366-1059-00	B108290		1	PUSH BUTTON:GRAY,0.227 OD X 0.3	QJR05	ORDER BY DESCRI
	366-1077-00	B108290		1	KNOB:GRAY W/SETSCREW	QJR05	ORDER BY DESCRI
	213-0153-00			1	.SETSCREW:5-40 X 0.125,STL	TK0392	ORDER BY DESCRI
-25	366-0494-00			1	KNOB:GRAY WITH SETSCREW	QJR05	366-0494-00
	213-0153-00			1	.SETSCREW:5-40 X 0.125,STL	TK0392	ORDER BY DESCRI
-26	131-0955-00			1	CONN,RCPT,ELEC:BNC,FEMALE (ATTACHING PARTS)	TK1725	G351526N
-27	210-0255-00			1	TERMINAL,LUG:0.391 ID,LOCKING,BRS CD PL (END ATTACHING PARTS)	TK1572	ORDER BY DESCRI
-28	-----				SWITCH,PUSH:(SEE S125 REPL)		
-29	-----				RESISTOR,VAR:(SEE R200 AND R295 REPL) (ATTACHING PARTS)		2X-20319-402
-30	210-0583-00			2	NUT,PLAIN,HEX:0.25-32 X 0.312,BRS CD PL		ORDER BY DESCRI
-31	210-0940-00			2	WASHER,FLAT:0.25 ID X 0.375 OD X 0.02,STL	73743	1214-05-00-0541
-32	210-0046-00			2	WASHER,LOCK:0.261 ID,INTL,0.018 THK,STL (END ATTACHING PARTS)	12327	
-33	200-0608-00			1	SHIELD,RESISTOR:0.7 X 1.0 X 0.75,POLYPROPYLENE, VAR	78189	ORDER BY DESCRI
						QJR05	ORDER BY DESCRI

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Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1 -34	333-1409-00	B010100	B099999	1	PANEL,FRONT:	80009	333140900
	333-1409-01	B100000	B108289	1	PANEL,FRONT:	80009	333140901
	333-1409-03	B108290	B140958	1	PANEL,FRONT:	80009	333140903
	333-1409-04	B140959		1	PANEL,FRONT:	TK1684	ORDER BY DESCRI
-35	337-1421-00			1	SHIELD,ELEC:HIGH VOLTAGE (ATTACHING PARTS)	80009	337142100
-36	211-0504-00			3	SCREW,MACHINE:6-32 X 0.250,PNH,STL (END ATTACHING PARTS)	TK0435	ORDER BY DESCRI
-37	348-0115-00			3	GROMMET,PLASTIC:BLACK,U-SHAPE,0.368 ID	QJR05	ORDER BY DESCRI
-38	407-0896-00			1	BRACKET,CHASSIS:ALUMINUM (ATTACHING PARTS)	QJ260	ORDER BY DESCRI
-39	211-0541-00			1	SCREW,MACHINE:6-32 X 0.25,FLH,100 DEG,STL (END ATTACHING PARTS)	TK0435	ORDER BY DESCRI
-40	407-0895-00	B010100	B091615	1	SWITCH,PUSH-PUL:(SEE S201 REPL)		
	407-0895-01	B091616		1	BRACKET,ELEC SW:ALUMINUM	80009	407089500
-41	376-0127-00			1	BRACKET,ELEC SW:ALUMINUM	QJ260	ORDER BY DESCRI
-42	-----			1	CPLG,SHAFT,FLEX:0.055 & 0.326 ID,DELRLN	QJR05	ORDER BY DESCRI
-43	358-0029-00			1	RESISTOR,VAR:(SEE R291 REPL)		
-44	210-0978-00			1	(ATTACHING PARTS)		
-45	210-0421-00			1	BSHG,MACH THD:0.375-32 X 0.5 HEX,BRS NP	QJ260	ORDER BY DESCRI
-46	210-0012-00			1	WASHER,FLAT:0.375 ID X 0.5 OD X 0.024,STL	12327	ORDER BY DESCRI
-47	210-0207-00			1	NUT,PLAIN,HEX:0.375-32 X 0.5,AL	80009	210042100
-48	200-1204-01			2	WASHER,LOCK:0.384 ID,INTL,0.022 THK,STL	78189	ORDER BY DESCRI
-49	210-0401-00			1	TERMINAL,LUG:0.385 OD,PLAIN,BRS CD PL (END ATTACHING PARTS)	12697	01136902
-50	006-0531-00	B108068		1	COVER,CRT:REAR ALUMINUM,PTD BLUE (ATTACHING PARTS)	80009	200120401
-51	161-0033-12			2	NUT,PLAIN,CAP:6-32 X 0.312 HEX,BRS CD PL (END ATTACHING PARTS)	80009	210040100
-52	358-0366-00			1	STRAP,TIEDOWN,E:BLUE PLASTIC BEADED	TK1562	ORDER BY DESCRI
-53	200-1004-00			1	CABLE ASSY,PWR:3,18 AWG,125V,96.0 L (SEE BACK OF ACCESSORY PAGE FOR POWER CORD OPTIONS)	16428	ORDER BY DESCRI
-54	352-0076-00	B010100	B105881	1	BSHG,STRAIN RLF:U/W 0.29 DIA CABLE,STRAIGHT	QJR05	ORDER BY DESCRI
-55	352-0362-00	B105882	B126307	1	BSHG,STRAIN RLF:U/W 0.29 DIA CABLE,STRAIGHT	QJR05	ORDER BY DESCRI
-56	204-0832-00	B126308		1	CABLE NIPELEC:0.253 ID X 1.5 L,BLACK	80009	200100400
-57	200-2264-00	B126308		1	FUHLR,EXTR POST:3AG,20A,250V,PNL MT	75915	3420212-L
-58	210-0873-00			1	BODY,FUSEHOLDER:3AG & 5 X 20MM FUSES	S3629	345603 WITH 901
-59	210-0201-00	B010100	B106650	1	CAR,FUSEHOLDER:3AG FUSES (ATTACHING PARTS)	S3629	031 1673 (FEU M
-60	210-0202-00	B106651		1	WASHER,FLAT:0.5 ID X 0.688 OD X 0.047,RBR (END ATTACHING PARTS)	TK0503	FEK 031 1666
-61	210-0586-00	B010100	B106650	1	TERMINAL,LUG:0.12 ID,LOCKING,BRZ TIN PL	TK1741	2004-4 PHOSPHOR
-62	210-0457-00	B106651		1	TERMINAL,LUG:0.146 ID,LOCKING,BRZ TIN PL (ATTACHING PARTS)	TK1181	ORDER BY DESCRI
-63	333-1429-00	B010100	B099999	1	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	TK0435	ORDER BY DESCRI
-64	333-1429-01	B100000	B109889	1	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL (END ATTACHING PARTS)	TK0435	ORDER BY DESCRI
-65	333-1429-02	B109890		1	PANEL,REAR:	80009	333142900
-66	334-2154-01	B122930		1	PANEL,REAR:	80009	333142901
-67	441-0991-00	B010100	B107632	1	PANEL,REAR:	TK1684	ORDER BY DESCRI
-68	441-0991-02	B107633	B119999	1	MARKER,IDENT:MKD CAUTION	TK0860	ORDER BY DESCRI
-69	441-0991-03	B120000	B128481	1	CHAS,DSPL UNIT:MAIN	80009	441099100
-70	441-0991-06	B128482		1	CHAS,DSPL UNIT:MAIN	80009	441099102
-71	407-2270-00	B120000	B140958	1	CHAS,DSPL UNIT:MAIN	80009	441099103
-72	407-2270-02	B140959		1	BRACKET,CHASSIS:ALUMINUM	QJ260	ORDER BY DESCRI
-73				1	BRACKET,CHASSIS:ALUMINUM (ATTACHING PARTS)	QJ260	ORDER BY DESCRI

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Fig. & Index No.	Tektronix Part No.	Serial No.		Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
		Effective	Dscont				
1-	211-0504-00	B120000		3	SCREW,MACHINE:6-32 X 0.250,PNH,STL	TK0435	ORDER BY DESCRI
	210-0005-00	B120000		1	WASHER,LOCK:#6 EXT,0.02 THK,STL	78189	1106-00
	210-0457-00	B120000		2	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL (END ATTACHING PARTS)	TK0435	ORDER BY DESCRI
-59	210-0659-01			4	.EYELET,METALLIC:0.121 OD X 0.156 L,BRS CD PL	80009	210065901
-60	344-0131-00			4	.CLIP,SPR TNSN:CKT BOARD MT,ACETAL BLACK (ATTACHING PARTS FOR CHASSIS)	80009	344013100
-61	211-0504-00			2	SCREW,MACHINE:6-32 X 0.250,PNH,STL	TK0435	ORDER BY DESCRI
-62	211-0538-00			2	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL	TK0435	ORDER BY DESCRI
-63	210-0457-00			2	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL (END ATTACHING PARTS)	TK0435	ORDER BY DESCRI
-64	-----			1	SWITCH,THERMOSTATIC:(SEE S200 REPL) (ATTACHING PARTS)		
-65	210-0586-00			2	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL (END ATTACHING PARTS)	TK0435	ORDER BY DESCRI
-66	344-0225-00			2	CLIP,CABLE:4 CONDUCTOR RIBBON,DEL RIN	OJR05	ORDER BY DESCRI
-67	348-0067-00	B010100	B104185	1	GROMMET,PLASTIC:GRAY,ROUND,0.252 ID	OJR05	ORDER BY DESCRI
	348-0516-00	B104186		1	GROMMET,PLASTIC:BLACK,ROUND,0.188 ID	28520	SB312-3
-68	343-0088-00			3	CLAMP,CABLE:0.062 DIA,PLASTIC	80009	343008800
-69	-----				CKT BOARD ASSY:HV DEFL(SEE A1 REPL)		
-70	131-0566-00	B010100	B030000	4	.BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
	131-0566-00	B050000	B119999	4	.BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
-71	131-0589-00	B010100	B140958	2	.TERMINAL,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL	22526	48283-029
	131-0589-00	B140959		41	.TERMINAL,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL	22526	48283-029
-72	136-0183-00	B010100	B049999	5	.SKT,PL-IN ELEK:TRANSISTOR,3 CONTACT,PCB MT	71785	133-23-11-024
	136-0183-00	B050000	B119999	1	.SKT,PL-IN ELEK:TRANSISTOR,3 CONTACT,PCB MT	71785	133-23-11-024
	136-0183-00	B120000	B140958	2	.SKT,PL-IN ELEK:TRANSISTOR,3 CONTACT,PCB MT	71785	133-23-11-024
-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	B140958	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:U/W 0.031 TO 0.04 DIA PINS	00779	50865-8
	136-0254-01	B120980	B140958	2	.SOCKET,PIN TERM:U/W 0.031 TO 0.04 DIA PINS	00779	1-331892-8
	136-0252-04	B050000	B070000	12	.SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
-75	-----			1	TRANSISTOR:(SEE Q252 REPL) (ATTACHING PARTS)		
-76	210-0407-00	B010100	B140958	2	.NUT,PLAIN,HEX:6-32 X 0.25,BRS CD PL	73743	3038-402
-77	210-0055-00	B010100	B140958	2	.WASHER,LOCK:#6 SPLIT,0.031 THK,STL	86928	ORDER BY DESCRI
-78	210-0801-00	B010100	B140958	2	.WASHER,FLAT:0.14 ID X 0.281 OD X 0.25,BRS	80009	210080100
-79	214-1610-00	B010100	B140958	1	.HEAT SINK,XSTR:TO-3,ALUMINA	80009	214161000
-80	210-1133-00	B010100	B140958	4	.WASHER,FLAT:0.142 ID X 0.25 OD X 0.058,FBR	86928	ORDER BY DESCRI
-81	214-1536-00	B010100	B140958	1	.HEAT SINK,DIODE:TO-3,AL	80009	214153600
	210-1017-00	B123440	B140958	1	.WASHER,FLAT:0.281 ID X 0.875 OD X 0.032,NYL	TK1319	ORDER BY DESCRI
-82	214-1610-00	B010100	B140958	1	.HEAT SINK,XSTR:TO-3,ALUMINA (END ATTACHING PARTS)	80009	214161000
-83	211-0511-00	B010100	B140958	2	.SCREW,MACHINE:6-32 X 0.5,PNH,STL	TK0435	ORDER BY DESCRI
-84	214-1291-00	B010100	B119999	4	.HEAT SINK,XSTR:TO-5,SIL BRZ PTD BLACK	05820	20758
	214-2811-00	B120000		4	.HEAT SINK,XSTR:TO-202,ALUMINUM	TK0303	311-012
-85	337-1179-00			1	.SHIELD,ELEC:DEFLECTION AMP	0J260	ORDER BY DESCRI
	214-0579-00	B140959		3	.TERM,TEST POINT:BRS CD PL	TK0858	ORDER BY DESCRI
	344-0286-00	B125352	B140958	1	.CLIP,ELECTRICAL:FUSE,SPR BRS (ATTACHING PARTS FOR CKT BOARD)	75915	102074
-86	211-0510-00			1	SCREW,MACHINE:6-32 X 0.375,PNH,STL	TK0435	ORDER BY DESCRI

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Fig. & Index No.	Tektronix Part No.	Serial No.		Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
		Effective	Discont				
1 -87	210-0975-00			1	WASHER,SHLDR:0.14 ID X 0.375 OD X 0.1 THK,DEL RIN (END ATTACHING PARTS)	80009	210097500
	198-2752-00	B010100	B104832	1	WIRE SET,ELEC:670-1433-02	80009	198275200
	198-2752-01	B104833	B128509	1	WIRE SET,ELEC:670-1433-03	80009	198275201
	175-5463-00	B128510		1	CA ASSY,SP,ELEC:6,22 AWG,12.5 L,RIBBON	TK1967	ORDER BY DESCRI
	175-5464-00	B128510		1	CA ASSY,SP,ELEC:10,22 AWG,10.5 L,RIBBON	TK1967	ORDER BY DESCRI
	198-4820-00	B128510		1	WIRE SET,ELEC:602-1699-00	80009	ORDER BY DESCRI
	195-5008-00	B128510	B140958	1	LEAD,ELECTRICAL:24 AWG,2.625 L,9-1	80009	ORDER BY DESCRI
-88	343-0254-00	B010100	B069999	1	CLP,ELCTR N TUBE:DEL RIN	QJR05	343-0254-00
-89	367-0117-00	B010100	B069999	1	PULL, SOCKET: CRT, PLASTIC	QJR05	ORDER BY DESCRI
-90	200-0917-02	B010100	B069999	1	COVER, CRT SKT: 2.052 OD X 0.291 H, PLASTIC	80009	200091702
-91	136-0450-00	B010100	B069999	1	SKT, PL-IN ELEK: ELCTR N TUBE, 14 CONT W/LEADS	80009	136045000
	136-0492-01	B070000	B119999	1	SKT, PL-IN ELEK: ELCTR N TUBE, 14 CONT W/LEADS	TK1967	ORDER BY DESCRI
	136-0723-00	B120000	B140958	1	SKT, PL-IN ELEK: ELCTR N TUBE, 14 CONT W/LEADS	80009	ORDER BY DESCRI
	136-0865-00	B140959		1	SKT, PL-IN ELEK: CRT CABLE	TK1967	ORDER BY DESCRI
	198-4223-00	B120000		1	WIRE SET, ELEC:	80009	198422300
-92	136-0304-02	B010100	B069999	1	SKT, PL-IN ELEK: ELECTRON TUBE, 14 CONTACT (5110 ONLY)	80009	136030402
	136-0301-01	B070000	B122289	1	SKT, PL-IN ELEK: ELECTRON TUBE, 14 CONTACT (5110 ONLY)	80009	136030101
	136-0202-04	B122290		1	SKT, PL-IN ELEK: ELECTRON TUBE, 14 CONTACT (5110 ONLY)	QJR05	136-0202-04
	136-0304-02	B010100	B069999	1	SKT, PL-IN ELEK: ELECTRON TUBE, 14 CONTACT (R5110 ONLY)	80009	136030402
	136-0301-01	B070000	B122304	1	SKT, PL-IN ELEK: ELECTRON TUBE, 14 CONTACT (R5110 ONLY)	80009	136030101
	136-0202-04	B122305		1	SKT, PL-IN ELEK: ELECTRON TUBE, 14 CONTACT (R5110 ONLY)	QJR05	136-0202-04
	195-0086-00	B070000		1	LEAD SET, ELEC: CRT DEFLECTION	80009	195008600
	200-0616-01	B070000		1	COVER, CRT SKT: 1.78 DIA X 0.2 D, WHITE	QJR05	ORDER BY DESCRI
-93	200-1075-00			4	COVER, TERMINAL: 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	61387-1 (SINGLE
-95	195-0088-00	B010100	B069999	1	LEAD SET, ELEC: CRT DEFLECTION	80009	195008600
-96	426-0740-00	B010100	B140958	1	FR ASSY, DSPL UN:	80009	426074000
	426-0739-02	B140959		1	FR ASSY, DSPL UN:	QJ260	ORDER BY DESCRI
-97	175-0863-00			AR	CABLE, SP, ELEC: 2.22 AWG, STRD, PVC JKT, RBN	08261	SS-0222-7 (1061
-98	175-0862-00			AR	CABLE, SP, ELEC: 3.22 AWG, STRD, PVC JKT, RBN	08261	SS-0322-19(1061
-99	175-0859-00			AR	CABLE, SP, ELEC: 6.22 AWG, STRD, PVC JKT, RBN	TK1375	175-0859-00
-100	175-0855-00			AR	CABLE, SP, ELEC: 10, 22 AWG, STRD, PVC, RBN	08261	SS-1022(1061)OC
-101	131-0621-00			22	CONNECTOR, TERM: 22-26 AWG, BRS & CU BE GOLD PL	22526	46231-000
-102	352-0198-00			3	HLD, TERM CONN: 2 WIRE, BLACK	QJR05	352-0198-00
-103	352-0204-00			1	HLD, TERM CONN: 3 WIRE, BLACK	QJR05	352-0204-00
-104	352-0206-00			1	HLD, TERM CONN: 10 WIRE, BLACK	80009	352020600
	175-1453-00			1	LEAD ASSY, ELEC: 2.22 AWG, 9.0 L	80009	175145300
	131-0861-00			2	TERM, QIK DISC.: 16-20 AWG, 0.22 W X 0.02 THK	00779	61387-1 (SINGLE
	200-1075-00			2	COVER, TERMINAL: QUICK DISCONNECT	00779	1-480435-0
	131-0707-00			2	CONTACT, ELEC: 22-26 AWG, BRS & CU BE GOLD PL	22526	47439-000
	352-0161-00			1	HLD, TERM CONN: 3 WIRE, BLACK	QJR05	ORDER BY DESCRI
	198-2029-00	B010100	B108289	1	WIRE SET, ELEC:	80009	198202800
	198-3879-00	B108290	B119999	1	WIRE SET, ELEC:	80009	198387900
	198-3879-01	B120000	B140958	1	WIRE SET, ELEC:	TK1967	ORDER BY DESCRI
	131-0677-00			2	CONNECTOR, TERM: 20-24 AWG	98278	122-0192-019
	131-0621-00			2	CONNECTOR, TERM: 22-26 AWG, BRS & CU BE GOLD PL	22526	46231-000
	131-0707-00	B010100	B125351	2	CONTACT, ELEC: 22-26 AWG, BRS & CU BE GOLD PL	22526	47439-000
	131-1810-00	B125352		2	CONTACT, ELEC: WIRE TO PIN, PH BRZ GOLD PL	00779	87124-1

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Fig. & Index No.	Tektronix Part No.	Serial No.		Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
		Effective	Dscont				
1-	131-2065-00			3	.TERM,QIK DISC.:18-22 AWG,BRASS TIN PLATED	00779	2-520181-2
	175-0828-00			AR	CABLE,SPELEC:5,26 AWG,STRD,PVC JKT,RBN	08261	111-2899-955
	175-0863-00			AR	CABLE,SPELEC:2,22 AWG,STRD,PVC JKT,RBN	08261	SS-0222-7 (1061
	175-1020-00			AR	CABLE,RF:50 OHM COAX,WHT POLYTHN JKT	TK2000	ORDER BY DESCRI
	352-0161-00	B010100	B125351	1	.HLDR,TERM CONN:3 WIRE,BLACK	OJR05	ORDER BY DESCRI
	204-0736-00	B125352		1	.CONN BODY,PLUG:4 CONTACTS,SGI. ROW,LKG CLIP	00779	1-87175-0
	352-0198-00			1	.HLDR,TERM CONN:2 WIRE,BLACK	OJR05	352-0198-00
	131-0621-00			18	CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD PL	22526	46231-000
	175-0855-00			AR	CABLE,SPELEC:10,22 AWG,STRD,PVC,RBN	08261	SS-1022(1061)OC
	175-0859-00			AR	CABLE,SPELEC:6,22 AWG,STRD,PVC JKT,RBN	TK1375	175-0859-00
	175-0863-00			AR	CABLE,SPELEC:2,22 AWG,STRD,PVC JKT,RBN	08261	SS-0222-7 (1061
	352-0198-00			1	.HLDR,TERM CONN:2 WIRE,BLACK	OJR05	352-0198-00
	352-0204-00			1	.HLDR,TERM CONN:8 WIRE,BLACK	OJR05	352-0204-00
	352-0206-00			1	.HLDR,TERM CONN:10 WIRE,BLACK	80009	352020600
	175-9841-00	B140959		1	CA ASSY,SPELEC:5,22 AWG,14.0 L,RIBBON	TK1967	ORDER BY DESCRI

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Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Discont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
2 -1	-----			1	CKT BOARD ASSY:INTERFACE(SEE A3 REPL)		
-2	131-0608-00	B010100	B140958	12	.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD PL	22526	48283-036
	131-0589-00	B140959		20	.TERMINAL,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL	22526	48283-029
-3	-----			1	CONN,RCPT,ELEC:(SEE J604 REPL)		
-4	-----			3	CONN,RCPT:(SEE J601,J602 AND J603 REPL)		
-5	136-0269-00	B010100	B126779	1	.SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,PCB MT	71785	133-51-02-073
	136-0726-00	B126780	B140958	1	.SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
-6	214-1593-02	B010100	B105856	6	.KEY,CONN PLZN:CKT BOARD CONN	0JR05	ORDER BY DESCRI
	214-2627-00	B105857	B106746	6	.KEY,CONN PLZN:CIRCUIT BOARD CONNECTOR	23880	007900
	214-1593-02	B106747	B140958	6	.KEY,CONN PLZN:CKT BOARD CONN	0JR05	ORDER BY DESCRI
	214-1593-02	B140959		3	.KEY,CONN PLZN:CKT BOARD CONN	0JR05	ORDER BY DESCRI
	200-2601-00	B140959		3	.COVER,ELEC CONN:W/POLARIZING KEY	0JR05	ORDER BY DESCRI
	175-2829-00	B126109		1	.CA ASSY,SPELEC:2,26 AWG,5.5 L,RIBBON	80009	175282900
-7	386-1938-00			1	.REINF,CKT BD:INTERFACE (ATTACHING PARTS)	0J260	ORDER BY DESCRI
-8	210-0777-00			4	.RIVET,BLIND:0.232 L X 0.125 OD,AL (END ATTACHING PARTS)	45391	AD-42-ABS
-9	213-0146-00			4	.SCREW,TPG,TF:6-20 X 0.312,TYPE B,PNH,STL (END ATTACHING PARTS) CKT BOARD ASSY:SIGNAL OUT(SEE A5 REPL) (OPTION 07 ONLY)	TK0435	ORDER BY DESCRI
	129-0259-00	B109310		3	.SPACER,POST:0.39 L,4-40 THRU,BRS,ALBALOY PL ,0.219 OD (OPTION 07 ONLY)	TK0858	ORDER BY DESCRI
	131-0608-00	B109310		20	.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD PL (OPTION 07 ONLY)	22526	48283-036
	198-4025-00	B109310		1	.WIRE SET,ELEC:670-5757-00 (OPTION 07 ONLY)	TK1967	ORDER BY DESCRI
	131-0707-00	B109310		12	.CONTACT,ELEC:22-26 AWG,BRS & CU BE GOLD PL (OPTION 07 ONLY)	22526	47439-000
	175-0825-00	B109310		AR	.CABLE,SPELEC:2,26 AWG,STRD,PVC JKT,RBN (OPTION 07 ONLY)	80009	175-0825-00
	175-0829-00	B109310		AR	.CABLE,SPELEC:6,26 AWG,STRD,PVC JKT,RBN (OPTION 07 ONLY)	08261	111-2699-973
	352-0164-00	B109310		1	.HLDR,TERM CONN:6 WIRE,BLACK (OPTION 07 ONLY)	0JR05	ORDER BY DESCRI
	352-0169-02	B109310		1	.HLDR,TERM CONN:2 WIRE,RED (OPTION 07 ONLY)	0JR05	352-0169-02
	352-0169-03	B109310		1	.HLDR,TERM CONN:2 WIRE,ORANGE (OPTION 07 ONLY)	80009	352016903
	352-0169-09	B109310		1	.HLDR,TERM CONN:2 WIRE,WHITE (OPTION 07 ONLY) (ATTACHING PARTS FOR CKT BD ASSY)	80009	352016909
	211-0116-00	B109310	B122939	3	.SCR,ASSEM WSHR:4-40 X 0.312,PNH,BRS,NR,POZ	TK0435	ORDER BY DESCRI
	211-0292-00	B122940		3	.SCR,ASSEM WSHR:4-40 X 0.29,PNH,BRS NI PL	TK0435	ORDER BY DESCRI
	211-0116-00	B109310	B123040	3	.SCR,ASSEM WSHR:4-40 X 0.312,PNH,BRS,NR,POZ (OPTION 07 ONLY)	TK0435	ORDER BY DESCRI
	211-0292-00	B123041		3	.SCR,ASSEM WSHR:4-40 X 0.29,PNH,BRS NI PL,POZ (OPTION 07 ONLY) (END ATTACHING PARTS)	TK0435	ORDER BY DESCRI
-10	-----			1	CKT BOARD ASSY:LV POWER SUPPLY(SEE A4 REPL)		
-11	131-0608-00			14	.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD PL	22526	48283-036
	131-0589-00			14	.TERMINAL,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL	22526	48283-029
-12	200-0293-00			1	.SHIELD,CAP:1.365 DIA X 2.562 L,POLYHN	80009	200029300
-13	200-0294-00	B010100	B043669	2	.SHIELD,CAP:1.0 DIA X 3.562 L,POLYHN	80009	200029400
	200-0294-00	B043670		1	.SHIELD,CAP:1.0 DIA X 3.562 L,POLYHN	80009	200029400

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Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.	
2	-14	214-0579-00	B010100	B125356	4	.TERM,TEST POINT:BRS CD PL	TK0858	ORDER BY DESCRI
		214-0579-00	B125357		5	.TERM,TEST POINT:BRS CD PL	TK0858	ORDER BY DESCRI
	-15	344-0154-00			6	.CLIP,ELECTRICAL:FUSE,CKT 80 MT,CU BE CU-SN-ZN PL	80009	344015400
		344-0326-00	B125357		14	.CLIP,ELECTRICAL:FUSE,BRASS	75915	102071
		385-0149-00	B125357		2	.SPACER,POST:0.625 L W/4-40 THD EA END,NYL (ATTACHING PARTS)	TK0588	ORDER BY DESCRI
		211-0040-00	B125357		2	.SCREW,MACHINE:4-40 X 0.25,BDGH,NYL (END ATTACHING PARTS) (ATTACHING PARTS FOR CKT BD ASSY)	TK1158	0104408025
	-16	211-0504-00			6	SCREW,MACHINE:6-32 X 0.250,PNH,STL (END ATTACHING PARTS)	TK0435	ORDER BY DESCRI
	-17	-----			1	TRANSFORMER:(SEE T801 REPL)		
	-18	352-0198-00			1	.HLDR,TERM CONN:2 WIRE,BLACK	0JR05	352-0198-00
	-19	131-0622-00			2	.CONTACT,ELEC:28-32 AWG,BRS & CU BE GOLD PL (ATTACHING PARTS FOR XFMR)	22526	46241-000
-20	212-0516-00	B010100	B049999	4	SCREW,MACHINE:10-32 X 2.0,HEX HD,STL	TK0435	ORDER BY DESCRI	
	212-0522-00	B050000		4	SCREW,MACHINE:10-32 X 2.5,HEX HD,STL	TK0435	ORDER BY DESCRI	
	210-0812-00	B062200		4	WASHER,FLAT:0.188 ID X 0.375 OD X 0.31	TK1181	ORDER BY DESCRI	
-21	166-0226-00	B010100	B049999	4	INSUL SLVG,ELEC:0.187 ID X 1.125 L,MYLAR	TK0977	ORDER BY DESCRI	
	166-0457-00	B050000		4	INSUL SLVG,ELEC:0.19 ID X 1.875 L,MYLAR	80009	166045700	
-22	220-0410-00			4	NUT,PL,ASSEM WA:10-32 X 0.375 HEX,STL CD PL (END ATTACHING PARTS)	TK0858	511-101200-50-0	
-23	200-0772-02			1	COVER,ELEC XFMR:3.125 X 3.75 X 0.875,STEEL GRAY	0J260	ORDER BY DESCRI	
	131-0126-00	B109310		4	CONN,RCPT,ELEC:BNC,FEMALE (OPTION 07 ONLY)	24931	28JR205-2	
-24	333-1425-00	B010100	B099999	1	PANEL,REAR:	80009	333142500	
	333-1425-06	B100000	B121189	1	PANEL,REAR:	80009	333142506	
	333-1425-08	B121190		1	PANEL,REAR:	80009	333142508	
	333-1425-07	B109310	B121189	1	PANEL,REAR: (OPTION 07 ONLY)	80009	333142507	
	333-1425-09	B121190		1	PANEL,REAR: (OPTION 07 ONLY)	80009	333142509	
-25	343-0315-00			2	CLAMPXSTR:PHENOLIC (ATTACHING PARTS)	0JR05	ORDER BY DESCRI	
-26	210-0407-00			6	NUT,PLAIN,HEX:6-32 X 0.25,BRS CD PL (END ATTACHING PARTS)	73743	3038-402	
-27	342-0082-00			3	INSULATOR,PLATE:TRANSISTOR,ALUMINA	80009	342008200	
-28	351-0293-00			3	GUIDE,PL-IN UNI:UPPER,BLUE ACETAL	0JR05	ORDER BY DESCRI	
-29	351-0286-00	B010100	B039999	3	GUIDE,PL-IN UNI:BOTTOM,BLK DELRIN	80009	351028600	
	351-0286-01	B040000	B062225	3	GUIDE,PL-IN UNI:BOTTOM,BLK DELRIN	80009	351028601	
	351-0286-02	B062226	B065347	3	GUIDE,PL-IN UNI:BOTTOM,BLK DELRIN	80009	351028602	
	351-0286-04	B065348	B111019	3	GUIDE,PL-IN UNI:LOWER,BLACK NYLON	80009	351028604	
	351-0286-07	B111020		3	GUIDE,PL-IN UNI:LOWER,NYLON (ATTACHING PARTS)	0JR05	ORDER BY DESCRI	
-30	211-0105-00	B010100	B111019	3	SCREW,MACHINE:4-40 X 0.188,FLH,100 DEG,STL	TK0435	ORDER BY DESCRI	
	213-0813-00	B111020		6	SCREW,TPG,TF:4-20,0.312L,PLASTITE,FLH,STL	72228	ORDER BY DESCRI	
	213-0814-00	B111020		3	SCREW,TPG,TR:4-20,0.25L,PLASTITE,FLH,STL (END ATTACHING PARTS)	TK0858	ORDER BY DESCRI	
-31	426-0738-00			1	FR ASSY,PWR-AMP:	0J260	ORDER BY DESCRI	
	210-0617-00	B030000		3	.EYELET,METALLIC:0.089 OD X 0.125 L,BRASS	TK0938	SE-34	
	131-1254-01	B030000		3	.CONTACT,ELEC:GROUNDING,BE AL,HT TR	80009	131125401	
-32	175-0826-00			AR	CABLE,S/ELEC:3.26 AWG,STRD,PVC JKT,RBN	80009	175-0826-00	
-33	175-0829-00			AR	CABLE,S/ELEC:6.26 AWG,STRD,PVC JKT,RBN	08261	111-2699-973	
	131-1896-00			1	BUS,CONDUCTOR:8.22 AWG,1.5 L	80009	131189600	
-34	131-0707-00			2	.CONTACT,ELEC:22-26 AWG,BRS & CU BE GOLD PL	22526	47439-000	

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Fig. & Index No.	Tektronix Part No.	Serial No.		Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
		Effective	Dscont				
2 -35	352-0166-02			1	.HLDR, TERM CONN:8 WIRE, RED	80009	352016602
	131-1895-00			1	BUS, CONDUCTOR: 8, 22 AWG, 1.5L	TK1967	ORDER BY DESCRI
	131-0707-00			2	.CONTACT, ELEC: 22-26 AWG, BRS & CU BE GOLD PL	22526	47439-000
	352-0166-01			1	.HLDR, TERM CONN: 8 WIRE, BROWN	80009	352016601
	198-4024-00	B109310		1	WIRE SET, ELEC: (OPTION 07 ONLY)	TK1967	ORDER BY DESCRI
	131-0707-00			8	.CONTACT, ELEC: 22-26 AWG, BRS & CU BE GOLD PL	22526	47439-000
	175-0857-00			AR	.CABLE, SPELEC: 8, 22 AWG, STRD, PVC JKT, RBN	TK1375	175-0857-00
	352-0166-04			1	.HLDR, TERM CONN: 8 WIRE, YELLOW	80009	352016604

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Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
3 -	200-1375-00			1	COVER,SCOPE:FRONT (OPTION 02 ONLY)	TK1641	ORDER BY DESCRI
-1	200-0728-01	B010100	B099999	1	COVER,HDL END:	80009	200072801
	200-0728-06	B100000		1	COVER,HDL END:	0JR05	ORDER BY DESCRI
-2	200-0728-00			1	COVER,HDL END:1.91 X 0.91 X 0.36 BLUE	0JR05	200-0728-00
-3	367-0116-00			1	HANDLE,CARRYING:16.54 L,BLUE VINYL (ATTACHING PARTS)	12136	ORDER BY DESCRI
-4	212-0597-00			4	SCREW,SHOULDER:10-32 X 0.55,0.5 RDH,STL	83486	ORDER BY DESCRI
-5	386-1624-00			2	PLATE,HDL RTNG:STAINLESS STEEL	0J260	ORDER BY DESCRI
-6	386-1283-00			2	PLATE,HDL MTG:FRONT (END ATTACHING PARTS)	0JR05	ORDER BY DISCRI
-7	390-0193-00	B010100	B105297	1	COVER,SCOPE:LEFT SIDE	80009	390019300
	390-0469-00	B105298		1	CAB.SIDE,DSPL:SIDE	0J260	ORDER BY DESCRI
	390-0193-01	B010100	B104843	1	COVER,SCOPE:LEFT SIDE (OPTION 02 ONLY)	80009	390019301
	390-0471-00	B104844		1	COVER,DISPLAY:LEFT SIDE (OPTION 02 ONLY)	0JR05	ORDER BY DESCRI
	214-0812-00			4	.FASTENER,PAWL:U/W 0.08 THK PANEL	80009	214081200
-8	386-1151-00			4	.CLAMP,PRIM CL:ENG:SPG STL CD PL	83553	ORDER BY DESCRI
-9	386-0227-00			4	.STOP,CL,PRIM CL:ACETAL	0JR05	386-0227-00
-10	214-0604-00			4	.WASHER,SPR TNSN:0.26 ID X 0.47 OD X 0.01 .THK,SST	92830	ORDER BY DESCRI
-11	214-0603-01			4	.PIN,SECURING:0.45 DIA X 0.27,ZAMAK CD PL	80009	214060301
-12	390-0192-00	B010100	B105297	1	COVER,SCOPE:RIGHT SIDE	80009	390019200
	390-0469-00	B105298		1	CAB.SIDE,DSPL:SIDE	0J260	ORDER BY DESCRI
	390-0192-01	B010100	B104843	1	COVER,SCOPE:RIGHT SIDE (OPTION 02 ONLY)	80009	390019201
	390-0471-01	B104844		1	COVER,DISPLAY:RIGHT SIDE BENCH W/LATCH (OPTION 02 ONLY)	0JR05	ORDER BY DESCRI
	214-0812-00			4	.FASTENER,PAWL:U/W 0.08 THK PANEL	80009	214081200
-13	386-1151-00			4	.CLAMP,PRIM CL:ENG:SPG STL CD PL	83553	ORDER BY DESCRI
-14	386-0227-00			4	.STOP,CL,PRIM CL:ACETAL	0JR05	386-0227-00
-15	214-0604-00			4	.WASHER,SPR TNSN:0.26 ID X 0.47 OD X 0.01 .THK,SST	92830	ORDER BY DESCRI
-16	214-0603-01			4	.PIN,SECURING:0.45 DIA X 0.27,ZAMAK CD PL	80009	214060301
-17	390-0190-00	B010100	B105297	1	COVER,SCOPE:BOTTOM	80009	390019000
	390-0470-00	B105298		1	CAB BOT,DISPLAY:BOTTOM	0J260	ORDER BY DESCRI
	214-0812-00			4	.FASTENER,PAWL:U/W 0.08 THK PANEL	80009	214081200
-18	386-1151-00			4	.CLAMP,PRIM CL:ENG:SPG STL CD PL	83553	ORDER BY DESCRI
-19	386-0227-00			4	.STOP,CL,PRIM CL:ACETAL	0JR05	386-0227-00
-20	214-0604-00			4	.WASHER,SPR TNSN:0.26 ID X 0.47 OD X 0.01 .THK,SST	92830	ORDER BY DESCRI
-21	214-0603-01			4	.PIN,SECURING:0.45 DIA X 0.27,ZAMAK CD PL	80009	214060301
-22	348-0073-00			2	.HINGE BLOCK,STA:L FR,R REAR,BLACK ACETAL (ATTACHING PARTS)	80009	348007300
-23	211-0532-00			4	.SCREW,MACHINE:6-32 X .750,FILH,STL	TK0435	ORDER BY DESCRI
-24	210-0457-00			4	.NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL (END ATTACHING PARTS)	TK0435	ORDER BY DESCRI
-25	348-0208-00			2	.FOOT,CABINET:L FRONT,BLACK PU	80009	348020800
-26	348-0074-00			2	HINGE BLOCK,STA:R FR,L REAR,BLACK ACETAL (ATTACHING PARTS)	80009	348007400
-27	211-0532-00			4	SCREW,MACHINE:6-32 X .750,FILH,STL	TK0435	ORDER BY DESCRI
-28	210-0457-00			4	.NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL (END ATTACHING PARTS)	TK0435	ORDER BY DESCRI

Replaceable Mechanical Parts-5110

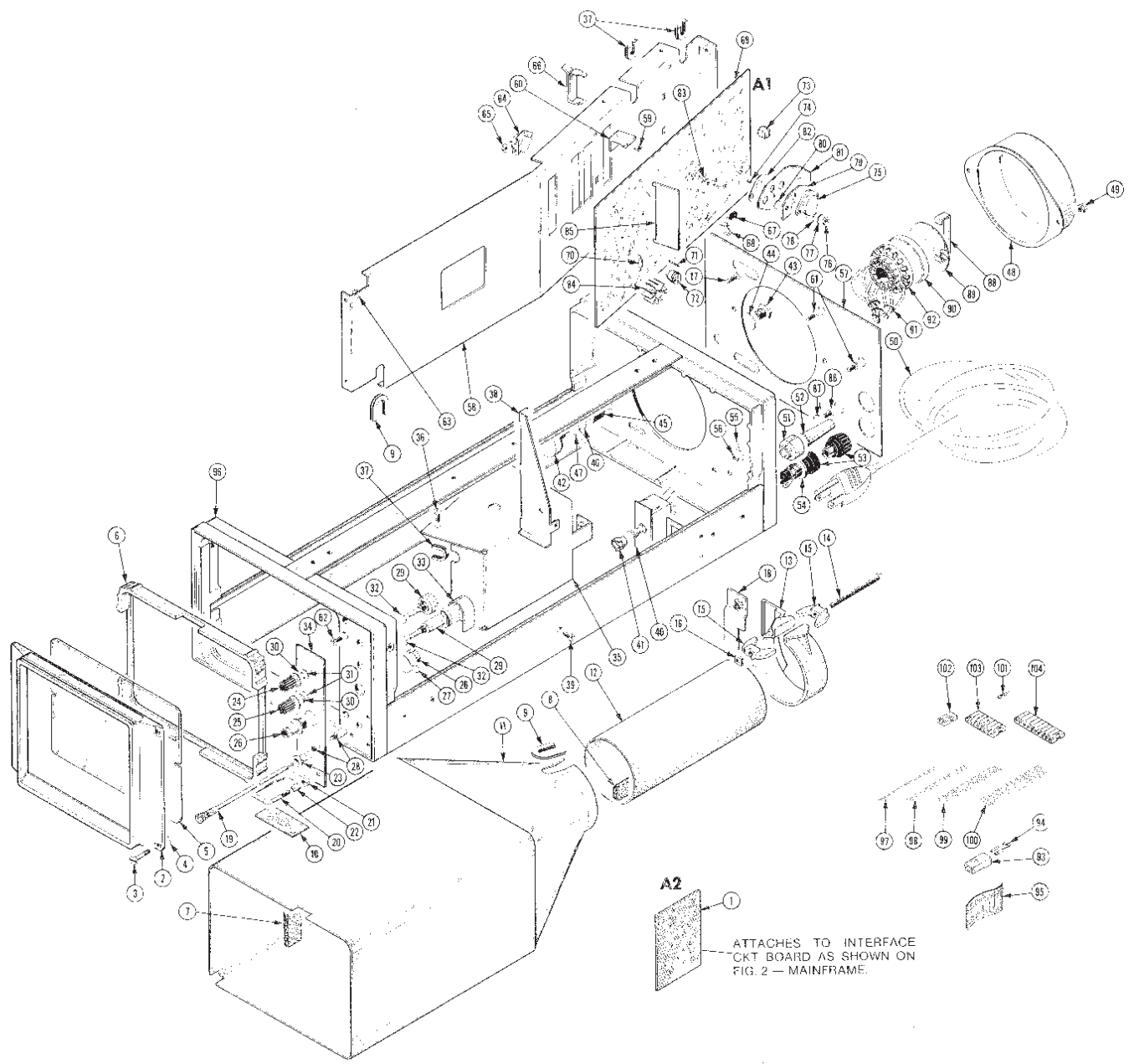
Fig. & Index No.	Tektronix Part No.	Serial No.		Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
		Effective	Dscont				
3 -29	348-0207-00			2	FOOT,CABINET:R FRONT,BLACK,PU	80009	348020700
-30	348-0275-00			1	FLIP-STAND,CAB.:3.75 H,SST	TK0508	ORDER BY DESCRI
-31	212-0105-00			2	SCREW,EXT RLV:8-32 X 0.312,HEX HD,STL	0J260	ORDER BY DESCRI
-32	212-0008-00			2	SCREW,MACHINE:8-32 X 0.5,PNH,STL	TK0435	MACHINE SCREW:
-33	210-0008-00			2	WASHER,LOCK:#8 INTL,0.02 THK,STL	TK0858	ORDER BY DESCRI
-34	361-0388-00			2	SPACER,PLATE:0.125 X 6.57 X 0.8,AL	0J260	ORDER BY DESCRI
-35	343-0256-00			2	RTNR BLK,SCOPE:PLASTIC (ATTACHING PARTS)	0JR05	ORDER BY DESCRI
-36	211-0531-00			4	SCREW,MACHINE:8-32 X .375,FILH,STL (END ATTACHING PARTS)	TK0435	ORDER BY DESCRI

Replaceable Mechanical Parts-5110

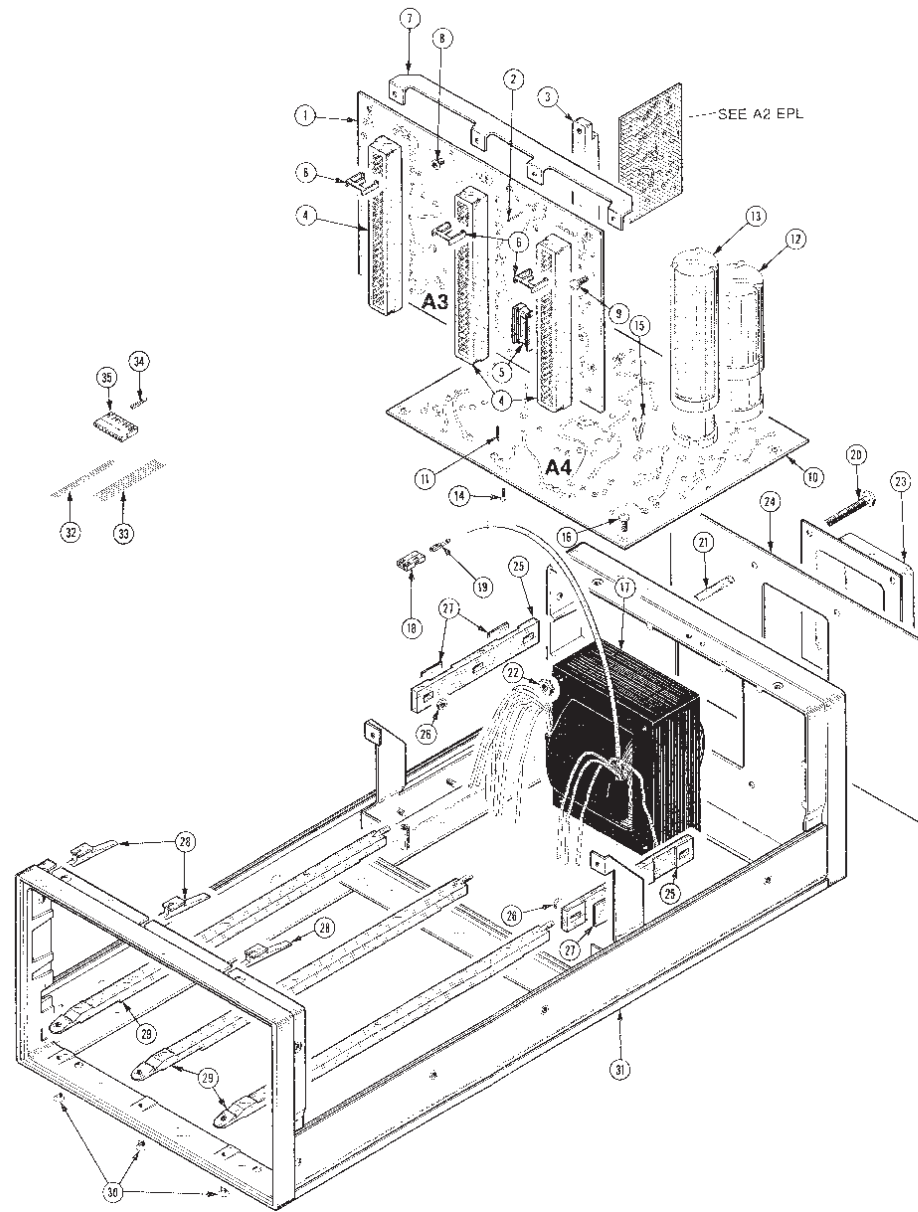
Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
4 -1	351-0195-00	B010100	B123319	1	SLIDE,DWR,EXT:23.0 L X 1.69 (RACKMOUNT ONLY)	80009	351019500
	351-0195-01	B123320		1	SLIDE,DWR,EXT:W/CLOSED MOUNTING SLOTS (RACKMOUNT ONLY)	06666	C-719-01
-2	351-0104-00			1	SL SECT,DWR EXT:12.625 X 2.25 (ATTACHING PARTS)	06666	C-720-2
-3	212-0004-00			6	SCREW,MACHINE:8-32 X 0.312,PNH,STL	TK0435	ORDER BY DESCRI
	210-0858-00			6	WASHER,FLAT:0.172 ID X 0.5 OD X 0.062,BRG (END ATTACHING PARTS)	12327	ORDER BY DESCRI
-4	407-0899-02	B010100	B099999	1	BRACKET,RACK MT:RIGHT,ALUMINUM	80009	407089902
	407-0899-00	B100000		1	BRACKET,RACK MT:ALUMINUM (ATTACHING PARTS)	0J260	ORDER BY DESCRI
-5	212-0040-00			2	SCREW,MACHINE:8-32 X 0.375,FLH,100 DEG,STL (END ATTACHING PARTS)	TK0435	ORDER BY DESCRI
-6	407-0899-00			1	BRACKET,RACK MT:ALUMINUM (ATTACHING PARTS)	0J260	ORDER BY DESCRI
-7	212-0040-00			2	SCREW,MACHINE:8-32 X 0.375,FLH,100 DEG,STL (END ATTACHING PARTS)	TK0435	ORDER BY DESCRI
-8	390-0191-00	B010100	B105297	1	COVER,SCOPE:RIGHT SIDE	80009	390019100
	390-0502-00	B105298		1	CAB SIDE,DSPL:RIGHT,RACK	0J260	ORDER BY DESCRI
	390-0192-01	B010100	B104843	1	COVER,SCOPE:RIGHT SIDE (OPTION 02 ONLY)	80009	390019201
	390-0471-01	B104844		1	COVER,DISPLAY:RIGHT SIDE BENCH W/LATCH (OPTION 02 ONLY)	0JR05	ORDER BY DESCRI
	214-0812-00			4	.FASTENER,PAWL:U/W 0.08 THK PANEL	80009	214081200
-9	386-1151-00			4	.CLAMP,PRIM CLENC:SPG STL CD PL	83553	ORDER BY DESCRI
-10	386-0227-00			4	.STOP,CL,PRIM CL:ACETAL	0JR05	386-0227-00
-11	214-0604-00			4	.WASHER,SPR TNSN:0.26 ID X 0.47 OD X 0.01 THK,SST	92830	ORDER BY DESCRI
-12	214-0603-01			4	.PIN,SECURING:0.45 DIA X 0.27,ZAMAK CD PL	80009	214060301
-13	390-0194-00	B010100	B105297	1	COVER,SCOPE:LEFT SIDE	80009	390019400
	390-0503-00	B105298		1	CAB SIDE,DSPL:LEFT,RACK	0J260	ORDER BY DESCRI
	390-0193-01	B010100	B104843	1	COVER,SCOPE:LEFT SIDE (OPTION 02 ONLY)	80009	390019301
	390-0471-00	B104844		1	COVER,DISPLAY:LEFT SIDE (OPTION 02 ONLY)	0JR05	ORDER BY DESCRI
	214-0812-00			2	.FASTENER,PAWL:U/W 0.08 THK PANEL	80009	214081200
-14	386-1151-00			2	.CLAMP,PRIM CLENC:SPG STL CD PL	83553	ORDER BY DESCRI
-15	386-0227-00			2	.STOP,CL,PRIM CL:ACETAL	0JR05	386-0227-00
-16	214-0604-00			2	.WASHER,SPR TNSN:0.26 ID X 0.47 OD X 0.01 THK,SST	92830	ORDER BY DESCRI
-17	214-0603-01			2	.PIN,SECURING:0.45 DIA X 0.27,ZAMAK CD PL	80009	214060301
-18	390-0222-00	B010100	B105297	2	COVER,SCOPE:BOTTOM	80009	390022200
	390-0505-00	B105298		1	CAB BOT,SCOPE	0J260	ORDER BY DESCRI
	214-0812-00			4	.FASTENER,PAWL:U/W 0.08 THK PANEL	80009	214081200
-19	386-1151-00			4	.CLAMP,PRIM CLENC:SPG STL CD PL	83553	ORDER BY DESCRI
-20	386-0227-00			4	.STOP,CL,PRIM CL:ACETAL	0JR05	386-0227-00
-21	214-0604-00			4	.WASHER,SPR TNSN:0.26 ID X 0.47 OD X 0.01 THK,SST	92830	ORDER BY DESCRI
-22	214-0603-01			4	.PIN,SECURING:0.45 DIA X 0.27,ZAMAK CD PL	80009	214060301
-23	212-0103-00			3	SCREW,MACHINE:8-32 X 0.375,HCX HD,STL	TK0858	ORDER BY DESCRI
	212-0104-00			3	SCREW,MACHINE:8-32 X 0.375,HEX HD,STL	0J260	ORDER BY DESCRI
-24	210-0008-00			10	WASHER,LOCK:#8 INTL,0.02 THK,STL	TK0858	ORDER BY DESCRI
-25	361-0389-00			1	SPACER,PLATE:0.125 AL,L-SHAPE	0J260	ORDER BY DESCRI

Replaceable Mechanical Parts-5110

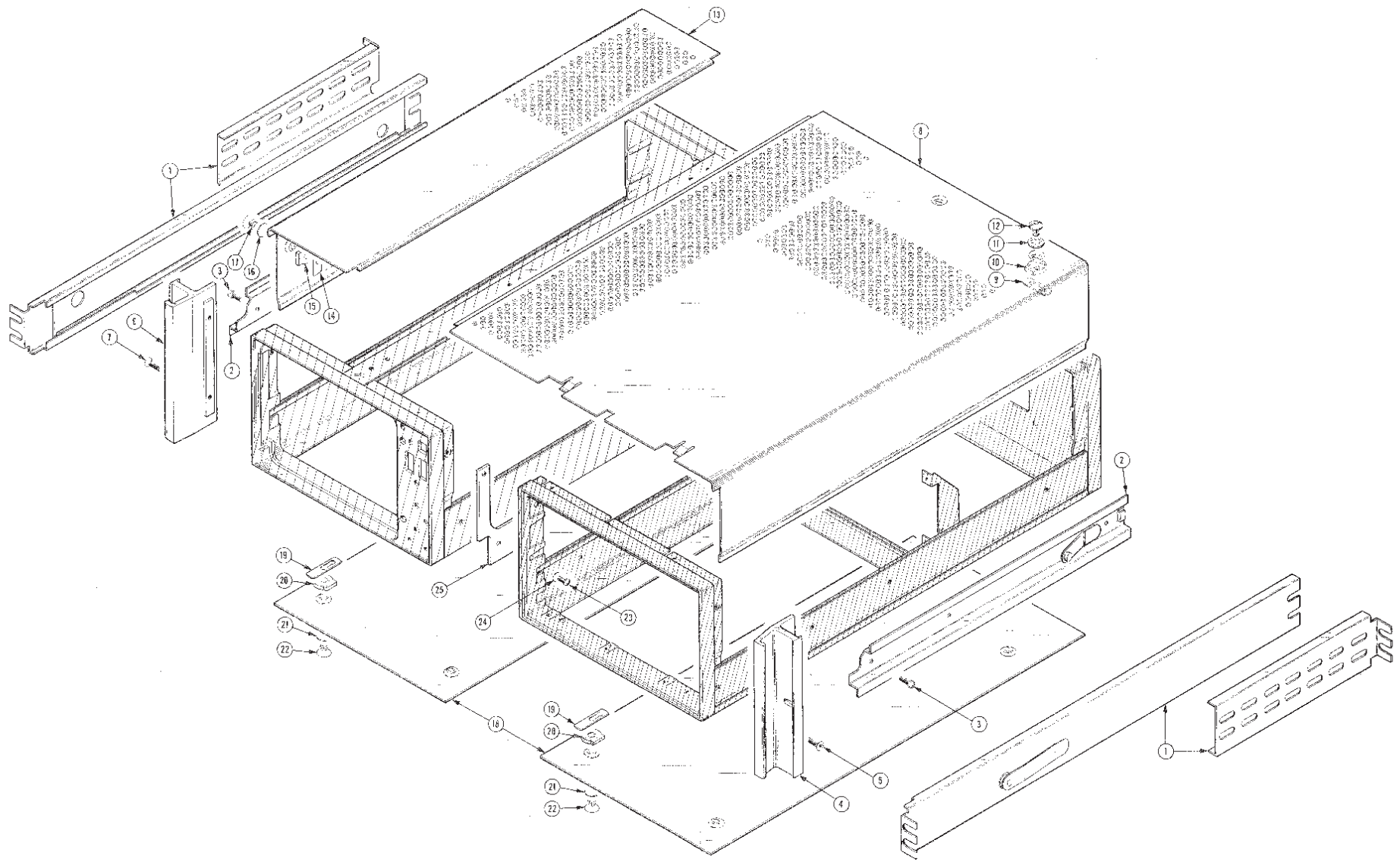
Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
5					STANDARD ACCESSORIES		
	070-2134-01			1	MANUAL, TECH INSTRUCTION	80009	070213401
-1	161-0033-46			1	CABLE ASSY,PWR.;3,0.75MM SQ,220V,98.0 L	80009	ORDER BY DESCRI
-2	161-0033-49			1	CABLE ASSY,PWR.;3,0.75MM SQ,240V,98.0 L	80009	ORDER BY DESCRI
-3	161-0033-44			1	CABLE ASSY,PWR.;3,0.75MM SQ,240V,98.0 L	80009	ORDER BY DESCRI

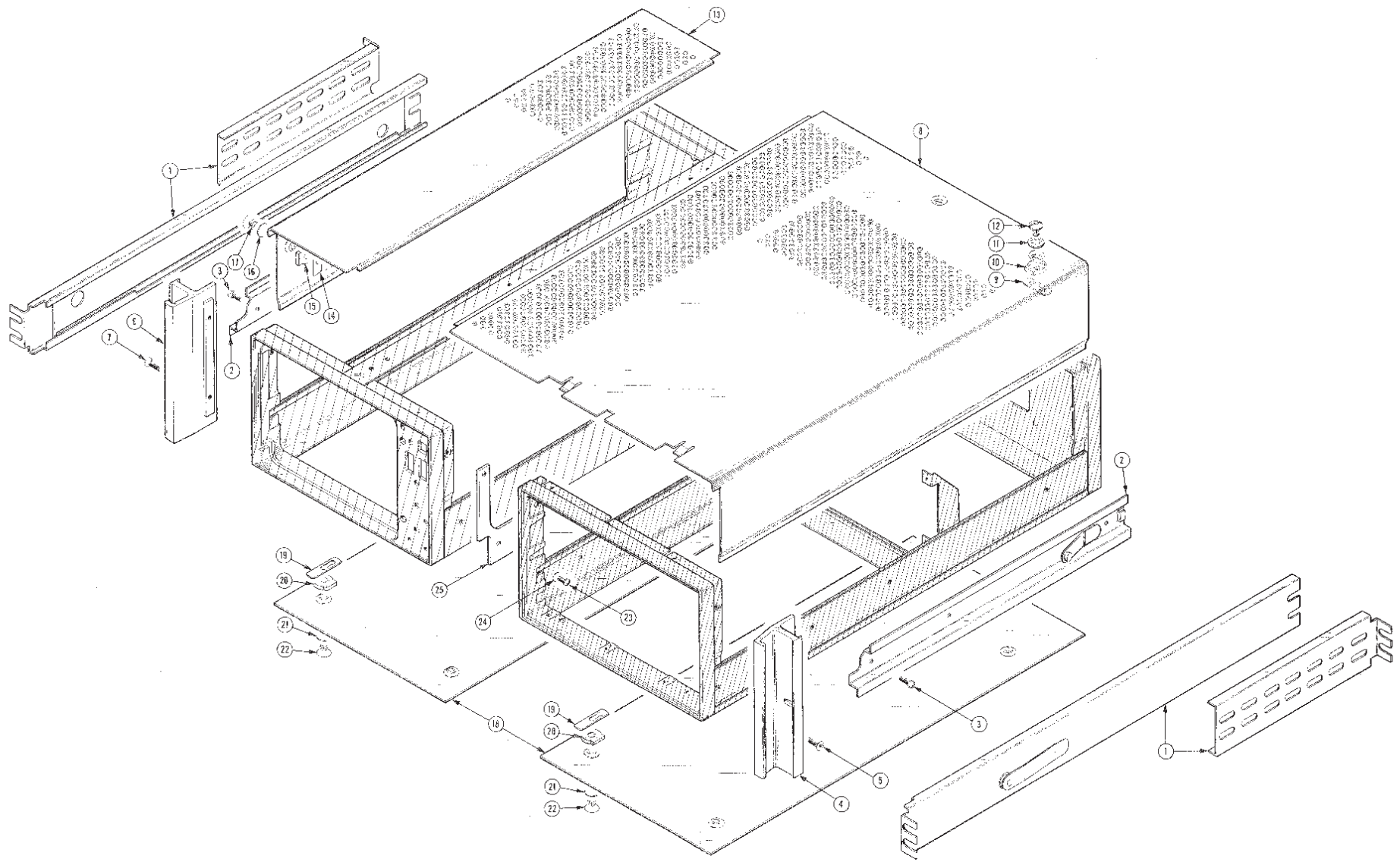


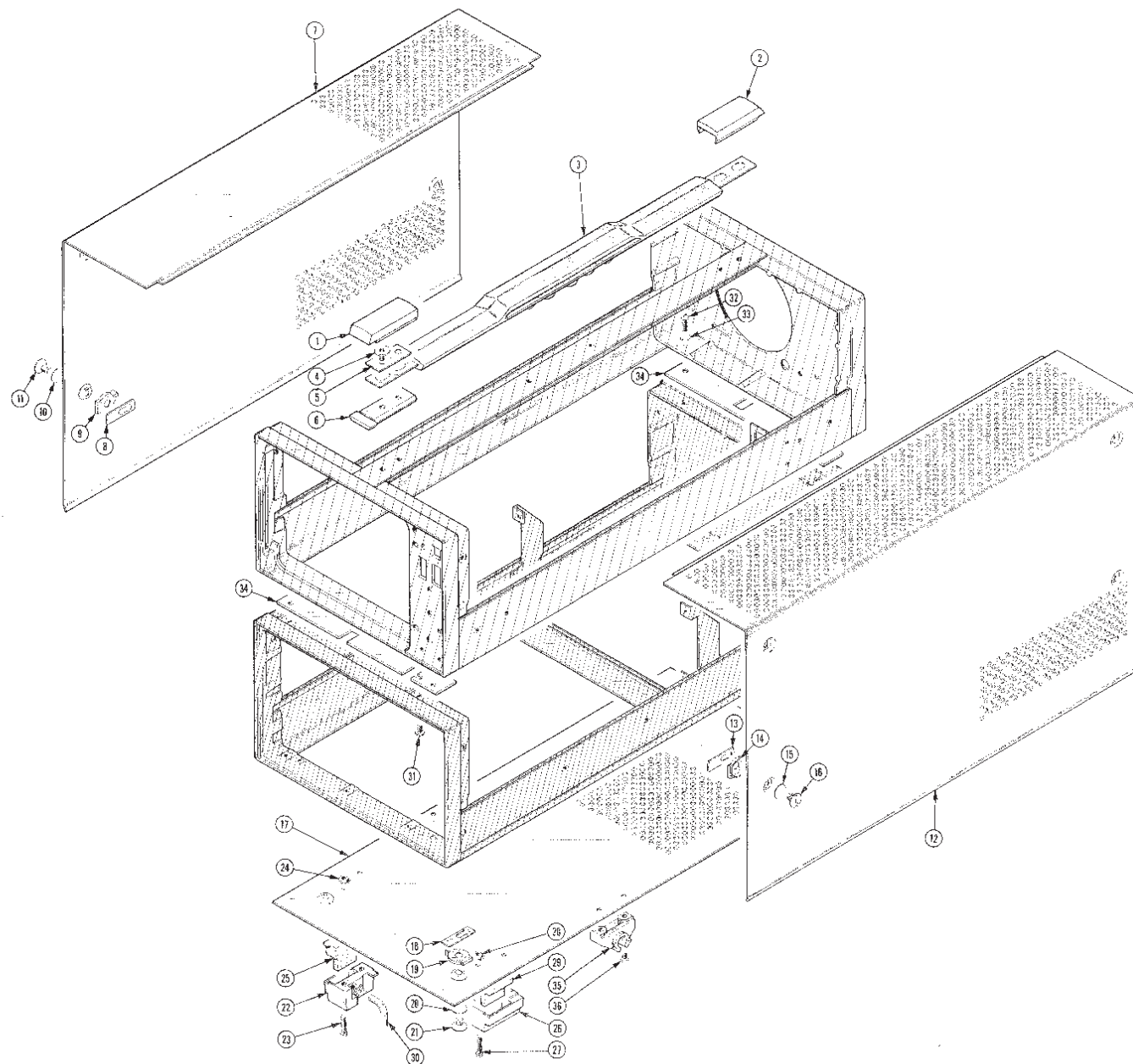
A2
 1
 ATTACHES TO INTERFACE
 CKT BOARD AS SHOWN ON
 FIG. 2 — MAINFRAME.



5110 OSCILLOSCOPE

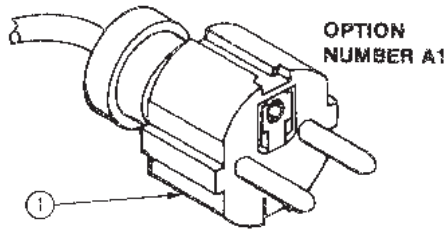




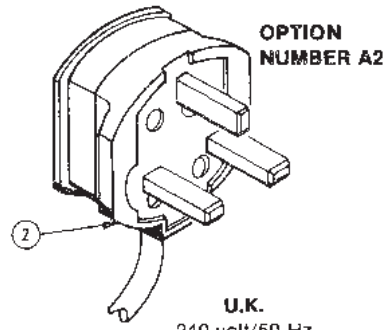


ACCESSORIES

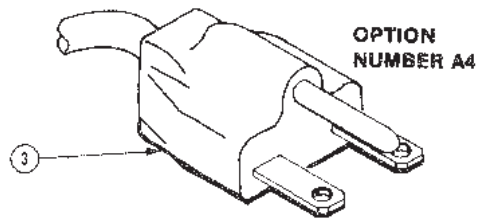
Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty						Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont		1	2	3	4	5			
	070-2134-01			1						MANUAL, TECH: INSTRUCTION	80009	070-2134-01



Universal Euro
220 volt/50 Hz
Rated 16 ampere



U.K.
240 volt/50 Hz
Rated 13 ampere



North American
240 volt/60 Hz
Rated 15 ampere
(12 amp max; NEC)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscnt	Qty						Name & Description	Mfr Code	Mfr Part Number
					1	2	3	4	5			
-1	161-0033-46			1						CABLE ASSY, PWR: 3, 0.75MM SQ, 220V, 98.0 L	80009	161-0033-46
-2	161-0033-49			1						CABLE ASSY, PWR: 3, 0.75MM SQ, 240V, 98.0 L	80009	161-0033-49
-3	161-0033-44			1						CABLE ASSY, PWR: 3, 0.75MM SQ, 240V, 98.0 L	80009	161-0033-44

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.

THESE CHANGES ARE EFFECTIVE AT SN B141085

REPLACEABLE ELECTRICAL PARTS LIST CHANGES

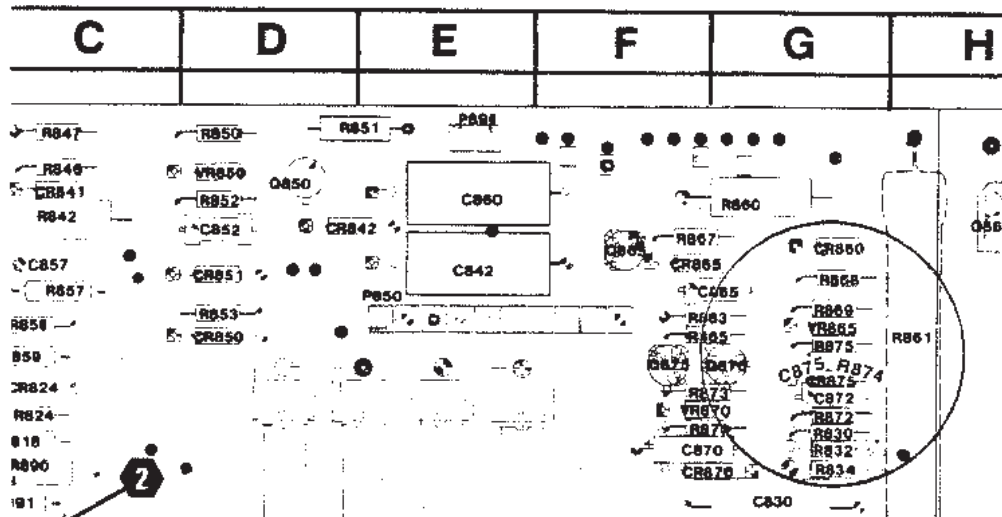
CHANGE TO:

A4	670-1339-08	CIRCUIT BD ASSY:LV POWER SUPPLY
A4C872	281-0797-00	CAP,FXD,CER DI:15PF,10%,100V
A4C875	281-0866-00	CAP,FXD,CER DI:1000PF,5%,100V
A4R872	315-0911-00	RES,FXD,FILM:910 OHM,5%,0.25W

ADD:

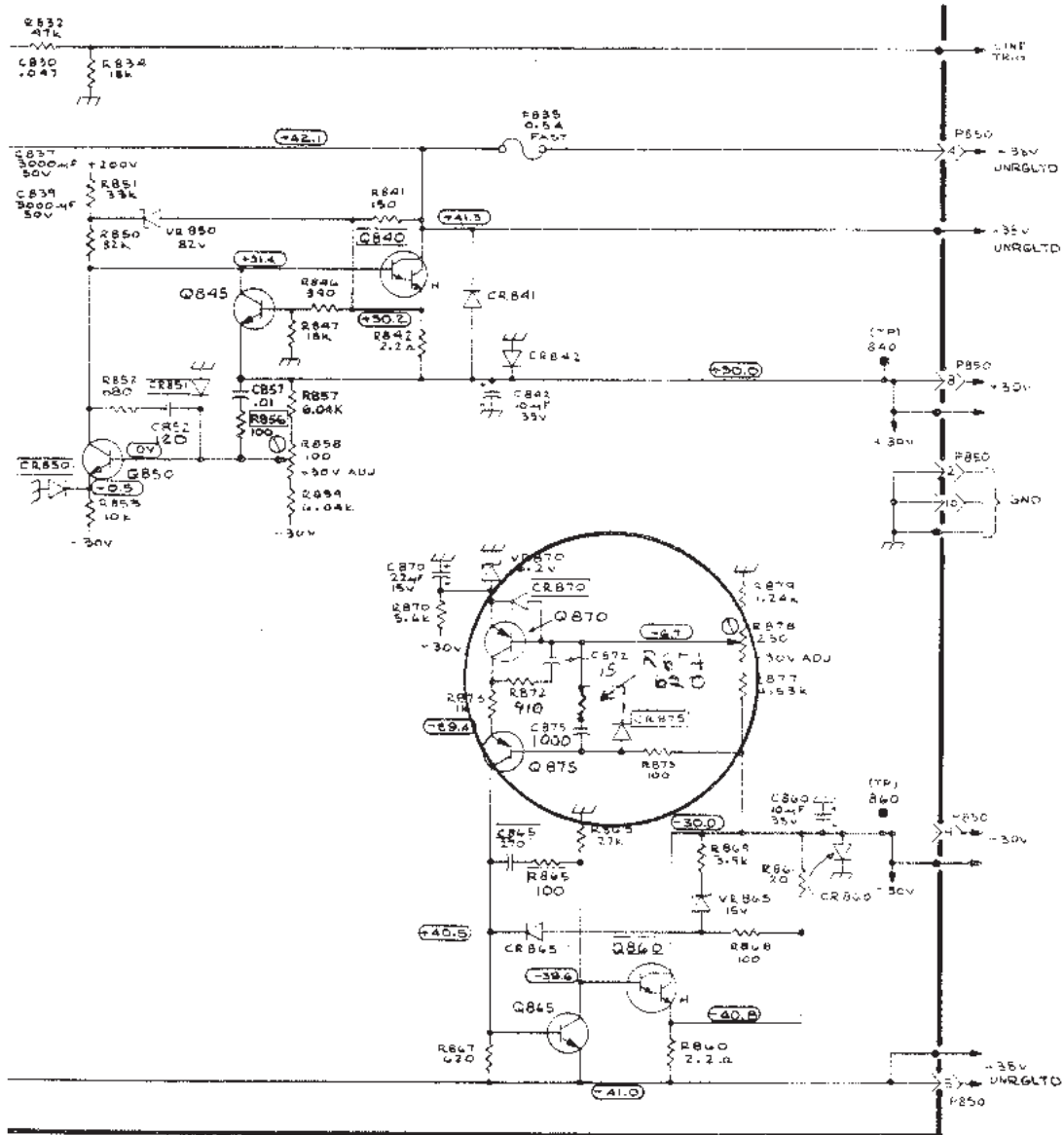
A4R874	315-0621-00	RES,FXD,FILM:620 OHM,5%,0.25W
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DIAGRAM CHANGES



A4-LV POWER SUPPLY CIRCUIT BOARD (SN B125357 & ABOVE).

DESCRIPTION



LV POWER SUPPLY & CALIBRATOR



EFFECTIVE SERIAL NUMBER B140959

Revised 8/10/87
Revised 11/24/87

TEXT, REPLACEABLE PARTS LIST & DIAGRAM CHANGES

TEXT CHANGES

ADJUSTMENT, page 3-1

Change Table 3-1 to read:

TABLE 3-1

LIST OF TEST EQUIPMENT REQUIREMENTS FOR ADJUSTMENTS

Description	Performance Requirements	Application	Example
Amplifier plug-in unit ¹	Bandwidth, dc to 2 MHz; deflection factor, 5 mV to 5V/div.	One required for a! tests. Two required for X-Y Phase Shift adjustment.	a. TEKTRONIX 5A15N Amplifier. b. TEKTRONIX 5A18N Dual-Trace Amplifier.
Time-base plug-in unit	Sweep rate, at least 2 μ s/div.	All tests except X-Y Phase Shift adjustment.	a. TEKTRONIX 5B10N Time-Base.
Calibration generator	Amplitude calibration, 5 mV to 5 V; accuracy, $\pm 0.25\%$ into 1M Ω ; output, square wave at approximately 1 kHz.	Vertical and Horizontal Gain adjustment.	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 .	X-Y Phase Shift adjustment.	a. TEKTRONIX FG 503 Function Generator. ²
Digital voltmeter	Range, zero to 250 volts; accuracy, within 0.1%.	Power Supply Calibrator Storage adjustment.	a. TEKTRONIX DM501A Option 02 Digital Multimeter. ²
Coaxial cable	Impedance, 50 Ω ; length, 42 inch; connectors, bnc.	Vert and Horiz Gain adjustments.	a. TEKTRONIX Part No. 012-0057-01.

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

² Requires a TM 500-series power module.

DESCRIPTION

5. Adjust High-Voltage Power Supply

Delete this portion of the manual Adjustment procedure as it does not apply to the new configuration.

10. Adjust Vertical Gain

For steps d, e and g substitute the following:

d. Check—the display for a vertical deflection for five divisions ± 0.15 div.

e. Adjust—Vert Gain, R136 for exactly five divisions of deflections. See high voltage locator page for location of R136.

g. Check—the display for vertical deflection of five divisions, ± 0.15 division ($\pm 3\%$). If necessary, re-adjust Vert Gain, R136 for the optimum gain setting. compromise the adjustment to distribute any error between compartments.

11. Adjust Horizontal Centering

This portion of the procedure may be used as given in the manual except for step e, which should now read:

e. Adjust—Hor Cent R730 to set the start of the unmagnified sweep at the center vertical graticule line. See Figure 3-5 for adjustment location.

12. Adjust Horizontal Gain

For steps d and e substitute the following:

d. Check—the display for a horizontal deflection of five divisions, ± 0.15 division $\pm 3\%$.

e. Adjust—Horiz Gain, R116 for exactly five divisions of deflection. See high voltage locator page for location of R116.

DESCRIPTION

Page 5-2, ADD:

INTERFACE (SN B0140959 & above)

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

Clock Generator

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

Countdown Circuit

The Countdown Circuit produces the display switching signal for both the Alternate and Chopped switching modes. This circuit is composed of U800 and its discrete passive components. Each J-K flip-flop is a divide-by-two counter, and the first one drives the second. The Countdown circuit is activated by a negative-going transition which can come from either the Clock Generator Q710 or from the timebase plug-in unit via grounded-base amplifier Q910.

The Clock Generator input results in chopped-mode vertical switching. The input from the timebase unit coincides with the end of each sweep, and results in alternate-mode vertical switching. The output from the divide-by-two portion of the Countdown circuit (U800A-U800B) is sent via contacts B21 of J300 and J600 to the channel-switching circuits incorporated within dual-trace vertical plug-in units.

DESCRIPTION

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

Vertical Amplifier

The Vertical Amplifier circuit provides approximately X10 amplification of the vertical signal before passing it to the vertical deflection amplifier in the display unit. The Vertical Amplifier consists of Q400, Q401, Q600, Q601, and respective passive components connected in a differential configuration. The output signal is in phase with the output of the vertical plug-in.

Horizontal Amplifier

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

Vertical Plug-in Switching

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

DESCRIPTION

Page 5-2, CIRCUIT DESCRIPTION.

ADD:

VERTICAL & HORIZONTAL DEFLECTION AMPLIFIERS (SN B140959 & above)

Vertical Deflection Amplifier

The Vertical Deflection Amplifier provides the final amplification of signals applied from the vertical plug-in units. It produces a push-pull output sufficient to drive the crt vertical deflection plates. The amplifier consists of Q124, Q126, Q134 and Q136 connected in a differential configuration.

The input signal arrives via P500 from the Interface circuit. The output signal is developed across the collector-load resistors, R124 and R134, and is about 50 times the magnitude of the input signal. The gain of this stage is set by the Vertical Gain adjustment, R136, to provide a calibrated vertical display.

Horizontal Deflection Amplifier

The Horizontal Deflection Amplifier consists of Q104, Q106, Q114, and Q116. This circuit is basically the same as the Vertical Deflection Amplifier just described. It provides final amplification of signals from the horizontal plug-in unit, which arrive via P900. Resistor R116, Horiz Gain, provides Q106-Q116 emitter degeneration to set the gain of the stage to provide a calibrated horizontal display.

Beam Finder

If a high-amplitude signal or a misadjusted control has deflected the trace or display off screen, it can be located by pressing the front-panel BEAM FINDER pushbutton. This opens S200 allowing current through R125 into the emitter circuits of both deflection amplifiers. R125 limits the current available to the transistors and, hence, to the collector-load resistors. Thus, the dynamic range of the deflection plates is limited to an on-screen level, and the display is compressed within the viewing area.

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

XY Phasing

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

DESCRIPTION

Page 5-2, CIRCUIT DESCRIPTION

ADD:

CRT CIRCUIT (SN B0140959 & above)

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

Z-Axis Amplifier

The Z-Axis Amplifier (consisting of Q222, Q226, and Q234) is a current driven shunt-feedback operational amplifier with a voltage output. The feedback path is from the collectors of Q226 and Q234 through R227 to the base of Q222. Transistors Q226 and Q234 are connected as a collector-coupled complimentary amplifier to provide a fast linear output signal while consuming minimum quiescent power. The output voltage provides the drive signal to control the CRT intensity level through the control-grid drive circuit.

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

High-Voltage Oscillator

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

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

DESCRIPTION

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

High-Voltage Regulator

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

Regulation is provided by feedback to the cathode supply through divider network R272A, R272B, C249, and C273. If the cathode supply voltage drops below its nominal -3330 volts (more positive), the base of Q278 is pulled up and more current is delivered to Q252 by Q264, hence, increasing the oscillation amplitude. Conversely, if the output level increases, Q264 supplies less current to Q252 and the oscillation amplitude decreases.

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

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

NOTE

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

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

High-Voltage Rectifiers and Output

The high-voltage transformer, T240, has three output windings. The first winding is 6.3 volts for the crt filament. This winding (no terminal numbers) at the top of the transformer is referenced to the cathode voltage to prevent cathode-to-filament breakdown. The second transformer winding, terminals 7, 8, and 10, supplies the high-voltage AC which is rectified and filtered to produce the negative voltage at the cathode. The third winding, terminals 1 and 2 of transformer, is not used in this oscilloscope.

With diode CR247 attached to terminal 13 on transformer T240, -3330 volts is supplied to the cathode of the CRT. When jumper W298 is installed (parallel to R272C) and diode CR247 is attached to terminal 10 on transformer T240, the cathode supply output is -4330 volts; but it is not used on this oscilloscope.

DESCRIPTION

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

CRT Control Circuits

The INTENSITY control, when used in conjunction with the FOCUS control, provides a well-defined display. The Intensity range control, R245, is a fine adjustment of the quiescent grid voltage to bias the CRT just below cutoff when the Z-Axis Amplifier output is at its minimum quiescent level (INTENSITY control counter-clockwise and no intensifying or blanking inputs).

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

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

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

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

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

DESCRIPTION

Page 5-4

ADD:

LOW-VOLTAGE POWER SUPPLY AND CALIBRATOR (SN B0140959 & above)

Calibrator

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

The resistive-capacitive network at the base of Q885 receives a pulsating DC voltage from full-wave rectifier CR835 and CR836, producing a nearly symmetrical switching signal for Q885 and Q890. As Q890 is alternately switched on and off at twice the line frequency, current through R890 is alternately switched through the transistor and CR890. With the calibrator patch cord installed, 4 milliamperes of current flows through R893 with zero volts out. When the calibrator patch cord is removed, current flows through R892, and 400 millivolts is measured across R892.

CIRCUIT DESCRIPTION, SIGNALS OUT (OPTION 7 ONLY)

Add the following SIGNALS OUT circuit description, which applies only to instruments with Option 7 installed.

SIGNALS OUT (OPTION 7 ONLY)

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

Gate Out Amplifier

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

DESCRIPTION

Left Out, Center Out, and Right Out Amplifiers

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

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

DESCRIPTION

The following changes are effective at serial number B140959

This information details changes to the manual made necessary by modifications to the 5110. The modifications resulted in the removal of one circuit board, the changing of three others, as well as changes to many of the mechanical parts.

REPLACEABLE ELECTRICAL PARTS LIST CHANGES

REMOVE:

A2	670-1454-01	B124445	CKT BOARD ASSY:SINGLE BEAM AUX
C712	283-0000-00		CAP.,FXD,CER DI:0.001UF,+100-0%,500V
C714	281-0628-00		CAP.,FXD,CER DI:15PF,5%,500V
C716	281-0628-00		CAP.,FXD,CER DI:15PF,5%,500V
C721	281-0628-00		CAP.,FXD,CER DI:15PF,5%,500V
CR702	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35
CR704	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35
CR712	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35
CR714	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35
CR721	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35
CR722	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35
Q701	151-0341-00		TRANSISTOR:NPN,SI,TO-106
Q702	151-1005-00		TRANSISTOR:SILICON,JFE,N-CHANNEL
Q703	151-0341-00		TRANSISTOR:NPN,SI,TO-106
Q704	151-1005-00		TRANSISTOR:SILICON,JFE,N-CHANNEL
Q711	151-0341-00		TRANSISTOR:NPN,SI,TO-106
Q712	151-1005-00		TRANSISTOR:SILICON,JFE,N-CHANNEL
Q713	151-0341-00		TRANSISTOR:NPN,SI,TO-106
Q714	151-1005-00		TRANSISTOR:SILICON,JFE,N-CHANNEL
Q721	151-0192-00		TRANSISTOR:SELECTED
Q722	151-0192-00		TRANSISTOR:SELECTED

DESCRIPTION

R701	316-0103-00	B010100	B126262	RES.,FXD,CMPSN:10K OHM,10%,0.25W
R701	315-0103-00	B126263		RES.,FXD,CMPSN:10K OHM,5%,0.25W
R702	316-0103-00	B010100	B126262	RES.,FXD,CMPSN:10K OHM,10%,0.25W
R702	315-0103-00	B126263		RES.,FXD,CMPSN:10K OHM,5%,0.25W
R703	316-0103-00	B010100	B126262	RES.,FXD,CMPSN:10K OHM,10%,0.25W
R703	315-0103-00	B126263		RES.,FXD,CMPSN:10K OHM,5%,0.25W
R704	316-0103-00	B010100	B126262	RES.,FXD,CMPSN:10K OHM,10%,0.25W
R704	315-0103-00	B126263		RES.,FXD,CMPSN:10K OHM,5%,0.25W
R705	315-0432-00	B124445		RES.,FXD,CMPSN:4.3K OHM,5%,0.25W
R706	316-0103-00	B010100	B126262	RES.,FXD,CMPSN:10K OHM,10%,0.25W
R706	315-0103-00	B12445		RES.,FXD,CMPSN:10K OHM,5%,0.25W
R707	316-0103-00	B010100	B126262	RES.,FXD,CMPSN:10K OHM,10%,0.25W
R707	315-0103-00	B126263		RES.,FXD,CMPSN:10K OHM,5%,0.25W
R708	315-0432-00	B124445		RES.,FXD,CMPSN:4.3K OHM,5%,0.25W
R709	316-0103-00	B010100	B126262	RES.,FXD,CMPSN:10K OHM,10%,0.25W
R709	315-0103-00	B126263		RES.,FXD,CMPSN:10K OHM,5%,0.25W
R710	316-0103-00	B010100	B126262	RES.,FXD,CMPSN:10K OHM,10%,0.25W
R710	315-0103-00	B126263		RES.,FXD,CMPSN:10K OHM,5%,0.25W
R712	316-0472-00	B010100	B126262	RES.,FXD,CMPSN:4.7K OHM,10%,0.25W
R712	315-0472-00	B126263		RES.,FXD,CMPSN:4.7K OHM,5%,0.25W
R713	316-0332-00	B010100	B126262	RES.,FXD,CMPSN:3.3K OHM,10%,0.25W
R713	315-0332-00	B126263		RES.,FXD,CMPSN:3.3K OHM,5%,0.25W
R715	321-0402-00			RES.,FXD,FILM:150K OHM,1%,0.125W
R716	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W
R717	321-0350-00			RES.,FXD,FILM:43.2K OHM,1%,0.125W
R718	316-0153-00	B010100	B126262	RES.,FXD,CMPSN:15K OHM,10%,0.25W
R718	315-0153-00	B126263		RES.,FXD,CMPSN:15 K OHM,5%,0.25W
R720	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W
R721	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W
R722	321-0365-00			RES.,FXD,FILM:61.9K OHM,1%,0.125W
R723	316-0153-00	B010100	B126262	RES.,FXD,CMPSN:15K OHM,10%,0.25W
R723	315-0153-00	B126263		RES.,FXD,CMPSN:15K OHM,5%,0.25W
R724	316-0272-00	B010100	B126262	RES.,FXD,CMPSN:2.7K OHM,10%,0.25W
R724	315-0272-00	B126263		RES.,FXD,CMPSN:2.7K OHM,5%,0.25W
VR270	152-0149-00			SEMICOND DEVICE:ZENER,0.4W,10V,5%

CHANGE TO:

A1	670-1621-14	CKT BOARD ASSY:HIGH VOLTAGE DEFLECTION
A3	670-7478-01	CKT BOARD ASSY:INTERFACE
A4	670-1339-04	CKT BOARD ASSY:LV POWER SUPPLY

The following part numbers are for the new A1 High Voltage Deflection circuit board and supersede the part numbers currently shown in the Replaceable Electrical Parts list for the old A1 High Voltage Deflection circuit board.

C104	281-0811-00	CAP.,FXD,CER DI:10PF,10%,100V
C106	283-0690-00	CAP.,FXD,MICA:560PF,1%,300V
C116	281-0256-00	CAP.,VAR,PLASTIC:10-180PF,100V
C124	281-0811-00	CAP.,FXD,CER DI:10PF,10%,100V
C126	283-0699-00	CAP.,FXD,MICA D:360PF,1%,500V
C136	283-0625-00	CAP.,FXD,MICA D:220PF,1%,500V
C222	281-0775-00	CAP.,FXD,CER DI:0.1UF,20%,50V
C223	281-0775-00	CAP.,FXD,CER DI:0.1UF,20%,50V
C224	283-0051-00	CAP.,FXD,CER DI:0.0033UF,5%,100V
C236	283-0167-00	CAP.,FXD,CER DI:0.1UF,10%,100V
C240	283-0008-00	CAP.,FXD,CER,DI:0.1UF,20%,500V
C241	285-1154-00	CAP.,FXD,PLSTC:0.001UF,10%,6000V
C242	285-0507-01	CAP.,FXD,PPR DI:0.0047UF,20%,6000V
C245	283-0189-00	CAP.,FXD,CER DI:0.1UF,20%,400V
C246	283-0077-00	CAP.,FXD,CER DI:330PF,5%,500V
C248	285-0509-01	CAP.,FXD,PPR,DI:0.0068UF,20%,5000V
C249	285-0509-01	CAP.,FXD,PPR DI:0.0068UF,20%,5000V
C251	290-0194-00	CAP.,FXD,ELECTLT:10UF,+50-10%,100V
C252	283-0203-00	CAP.,FXD,CER DI:0.47UF,20%,50V
C262	281-0815-00	CAP.,FXD,CER DI:0.027UF,20%,50V
C273	283-0194-00	CAP.,FXD,CER DI:4.7UF,20%,50V
C276	290-0145-00	CAP.,FXD,ELECTLT:10UF,+75-10%,50V
C277	281-0775-00	CAP.,FXD,CER DI:0.1UF,20%,50V
C281	283-0068-00	CAP.,FXD,CER DI:0.01UF,+100-0%,500V
CR209	152-0061-00	SEMICOND DEVICE:SILICON,175V,100MA
CR211	152-0061-00	SEMICOND DEVICE:SILICON,175V,100MA
CR214	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA
CR215	152-0061-00	SEMICOND DEVICE:SILICON,175V,100MA
CR222	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA
CR224	152-0061-00	SEMICOND DEVICE:SILICON,175V,100MA
CR226	152-0061-00	SEMICOND DEVICE:SILICON,175V,100MA
CR234	152-0061-00	SEMICOND DEVICE:SILICON,175V,100MA
CR240	152-0242-00	SEMICOND DEVICE:SILICON,225V,200MA
CR241	152-0242-00	SEMICOND DEVICE:SILICON,225V,200MA
CR242	152-0242-00	SEMICOND DEVICE:SILICON,225V,200MA
CR243	152-0242-00	SEMICOND DEVICE:SILICON,225V,200MA
CR244	152-0242-00	SEMICOND DEVICE:SILICON,225V,200MA
CR245	152-0242-00	SEMICOND DEVICE:SILICON,225V,200MA
CR247	152-0408-00	SEMICOND DEVICE:SILICON,10KV,5MA
CR252	152-0400-00	SEMICOND DEVICE:SILICON,400V,1A

CR264	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA
CR265	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA
CR269	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA
CR270	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA
CR272	152-0246-00	SEMICOND DEVICE:SW,SI,40V,200MA
CR273	152-0246-00	SEMICOND DEVICE:SW,SI,40V,200MA
CR276	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA
CR298	152-0331-00	SEMICOND DEVICE:SILICON,800V,25MA
DS271	150-0030-00	LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS
DS272	150-0030-00	LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS
DS273	150-0030-00	LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS
DS274	150-0030-00	LAMP,GLOW:NEON,T-2,60 TO 90 VOLTS
P102	131-0589-00	TERMINAL,PIN:0.46 L X 0.025 SQ
P111	131-0589-00	TERMINAL,PIN:0.46 L X 0.025 SQ
P116	131-0589-00	TERMINAL,PIN:0.46 L X 0.025 SQ
P121	131-0589-00	TERMINAL,PIN:0.46 L X 0.025 SQ
P130	131-0589-00	TERMINAL,PIN:0.46 L X 0.025 SQ
P205	131-0589-00	TERMINAL,PIN:0.46 L X 0.025 SQ
P252	131-0589-00	TERMINAL,PIN:0.46 L X 0.025 SQ
P260	131-0589-00	TERMINAL,PIN:0.46 L X 0.025 SQ
P290	131-0589-00	TERMINAL,PIN:0.46 L X 0.025 SQ
P298	131-0589-00	TERMINAL,PIN:0.46 L X 0.025 SQ
Q104	151-0615-00	TRANSISTOR:SILICON,NPN
Q106	151-0190-00	TRANSISTOR:SILICON,NPN
Q114	151-0615-00	TRANSISTOR:SILICON,NPN
Q116	151-0190-00	TRANSISTOR:SILICON,NPN
Q124	151-0615-00	TRANSISTOR:SILICON,NPN
Q126	151-0190-00	TRANSISTOR:SILICON,NPN
Q134	151-0615-00	TRANSISTOR:SILICON,NPN
Q136	151-0190-00	TRANSISTOR:SILICON,NPN
Q214	151-0341-00	TRANSISTOR:SILICON,NPN
Q222	151-0190-00	TRANSISTOR:SILICON,NPN
Q226	151-0407-00	TRANSISTOR:SILICON,NPN
Q234	151-0406-00	TRANSISTOR:SILICON,PNP
Q264	151-0435-00	TRANSISTOR:SILICON,PNP
Q278	151-0341-00	TRANSISTOR:SILICON,NPN
R101	315-0101-00	RES.,FXD,CMPSN:100 OHM,5%,0.25W
R102	315-0221-00	RES.,FXD,CMPSN:220 OHM,5%,0.25W
R103	315-0390-00	RES.,FXD,CMPSN:39 OHM,5%,0.25W
R104	308-0668-00	RES.,FXD,WW:6.2K OHM,3%,7W
R106	321-0128-00	RES.,FXD,FILM:210 OHM,1%,0.125W
R107	315-0470-00	RES.,FXD,CMPSN:47 OHM,5%,0.25W
R108	308-0539-00	RES.,FXD,WW:2.25K OHM,0.5%,3W
R112	315-0221-00	RES.,FXD,CMPSN:220 OHM,5%,0.25W
R113	315-0390-00	RES.,FXD,CMPSN:39 OHM,5%,0.25W

R114	308-0668-00	RES.,FXD,WW:6.2K OHM,3%,7W
R116	311-1244-00	RES.,VAR,NONWIR:100 OHM,10%,0.50W
R118	308-0539-00	RES.,FXD,WW:2.25K OHM,0.5%,3W
R112	315-0221-00	RES.,FXD,CMPSN:220 OHM,5%,0.25W
R123	315-0390-00	RES.,FXD,CMPSN:39 OHM,5%,0.25W
R124	308-0668-00	RES.,FXD,WW:6.2 K OHM,3%,7W
R125	303-0751-00	RES.,FXD,CMPSN:750 OHM,5%,1W
R126	321-0128-00	RES.,FXD,FILM:210 OHM,1%,0.125W
R128	308-0539-00	RES.,FXD,WW:2.25K OHM,0.5%,3W
R132	315-0221-00	RES.,FXD,CMPSN:220 OHM,5%,0.25W
R133	315-0390-00	RES.,FXD,CMPSN:39 OHM,5%,0.25W
R134	308-0668-00	RES.,FXD,WW:6.2K OHM,3%,7W
R135	315-0390-00	RES.,FXD,CMPSN:39 OHM,5%,0.25W
R136	311-1244-00	RES.,VAR,NONWIR:100 OHM,10%,0.50W
R138	308-0539-00	RES.,FXD,WW:2.25K OHM,0.5%,3W
R202	315-0563-00	RES.,FXD,CMPSN:56K OHM,5%,0.25W
R203	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R206	315-0682-00	RES.,FXD,CMPSN:6.8K OHM,5%,0.25W
R207	315-0822-00	RES.,FXD,CMPSN:8.2K OHM,5%,0.25W
R208	315-0473-00	RES.,FXD,CMPSN:47K OHM,5%,0.25W
R209	315-0164-00	RES.,FXD,CMPSN:160K OHM,5%,0.25W
R211	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R213	315-0623-00	RES.,FXD,CMPSN:62K OHM,5%,0.25W
R215	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R216	315-0153-00	RES.,FXD,CMPSN:15K OHM,5%,0.25W
R217	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R218	315-0183-00	RES.,FXD,CMPSN:18K OHM,5%,0.25W
R219	315-0683-00	RES.,FXD,CMPSN:68K OHM,5%,0.25W
R222	315-0102-00	RES.,FXD,CMPSN:1K OHM,5%,0.25W
R223	315-0472-00	RES.,FXD,CMPSN:4.7K OHM,5%,0.25W
R226	315-0101-00	RES.,FXD,CMPSN:100 OHM,5%,0.25W
R227	321-0399-00	RES.,FXD,FILM:140K OHM,1%,0.125W
R231	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R232	315-0154-00	RES.,FXD,CMPSN:150K OHM,5%,0.25W
R234	305-0183-00	RES.,FXD,CMPSN:18K OHM,5%,2W
R236	315-0821-00	RES.,FXD,CMPSN:820 OHM,5%,0.25W
R240	315-0102-03	RES.,FXD,CMPSN:1K OHM,5%,0.25W
R241	315-0102-03	RES.,FXD,CMPSN:1K OHM,5%,0.25W
R242	315-0331-03	RES.,FXD,CMPSN:330 OHM,5%,0.25W
R243	315-0106-00	RES.,FXD,CMPSN:10M OHM,5%,0.25W
R244	315-0101-03	RES.,FXD,CMPSN:100 OHM,5%,0.25W
R245	311-1136-00	RES.,VAR,NONWIR:100K OHM,30%,0.25W
R246	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
R247	315-0103-03	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R248	315-0103-03	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R249	315-0100-02	RES.,FXD,CMPSN:10 OHM,5%,0.25W

R250	315-0430-02	RES.,FXD,CMPSN:43 OHM,5%,0.25W
R251	308-0801-00	RES.,FXD,WW:5.1 OHM,5%,2W
R254	307-0105-00	RES.,FXD,CMPSN:3.9 OHM,5%,0.25W
R263	315-0122-00	RES.,FXD,CMPSN:1.2K OHM,5%,0.25W
R264	315-0561-00	RES.,FXD,CMPSN:560 OHM,5%,0.25W
R265	315-0105-00	RES.,FXD,CMPSN:1M OHM,5%,0.25W
R267	315-0101-03	RES.,FXD,CMPSN:100 OHM,5%,0.25W
R268	315-0103-03	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R272	307-1224-00	PASSIVE NETWORK:HV DIVIDED NETWORK
R273	315-0103-03	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R274	315-0205-00	RES.,FXD,CMPSN:2M OHM,5%,0.25W
R276	315-0684-00	RES.,FXD,CMPSN:680K OHM,5%,0.25W
R277	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
R278	315-0102-03	RES.,FXD,CMPSN:1K OHM,5%,0.25W
R279	315-0103-03	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R282	315-0163-01	RES.,FXD,CMPSN:16K OHM,5%,0.25W
R285	311-1235-00	RES.,VAR,NONWIR:100K OHM,20%,0.50W
R286	311-1241-00	RES.,VAR,NONWIR:100K OHM,10%,0.5W
R287	301-0183-00	RES.,FXD,CMPSN:18K OHM,5%,0.50W
R297	315-0470-00	RES.,FXD,CMPSN:47 OHM,5%,0.25W
R298	301-0563-00	RES.,FXD,CMPSN:56K OHM,5%,0.50W
R299	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
T240	120-1466-00	XFMR,PWR,SDN&SU:HIGH VOLTAGE
TP226	214-0579-00	TERM,TEST POINT:BRS CD PL
TP267	214-0579-00	TERM,TEST POINT:BRS CD PL
VR239	152-0295-00	SEMICONV DEVICE:ZENER,1W,82V,5%
VR245	152-0427-00	SEMICONV DEVICE:ZENER,0.4W,100V,5%
VR263	152-0304-00	SEMICONV DEVICE:ZENER,0.4W,20V,5%
VR281	152-0285-00	SEMICONV DEVICE:ZENER,0.4W,62V,5%
VR282	152-0285-00	SEMICONV DEVICE:ZENER,0.4W,62V,5%

The following part numbers are for the new A3 Interface circuit board and supersede the part numbers currently shown in the Replaceable Electrical Parts list for the old A3 Interface circuit board.

C400	281-0812-00	CAP.,FXD,CER DI:1000PF,10%,100V
C411	281-0797-00	CAP.,FXD,CER DI:15PF,10%,100V
C503	281-0775-00	CAP.,FXD,CER DI:0.1UF,20%,50V
C510	281-0797-00	CAP.,FXD,CER DI:15PF,10%,100V
C520	281-0775-00	CAP.,FXD,CER DI:0.1UF,20%,50V
C620	281-0775-00	CAP.,FXD,CER DI:0.1UF,20%,50V
C721	281-0812-00	CAP.,FXD,CER DI:1000PF,10%,100V
C740	290-0748-00	CAP.,FXD,ELCTLT:10UF,+50-10%,25V
C800	281-0775-00	CAP.,FXD,CER DI:0.1UF,20%,50V

C801	281-0814-00	CAP.,FXD,CER DI:100PF,10%,100V
C810	281-0823-00	CAP.,FXD,CER DI:470PF,10%,50V
C814	281-0773-00	CAP.,FXD,CER DI:0.01UF,10%,100V
C900	290-0748-00	CAP.,FXD,ELCTLT:10UF,+50-10%,25V
C902	281-0786-00	CAP.,FXD,CER DI:150PF,10%,100V
C930	281-0775-00	CAP.,FXD,CER DI:0.1UF,20%,50V
CR400	152-0141-02	SEMICONV DEVICE:SILICON,30V,150MA
CR420	152-0141-02	SEMICONV DEVICE:SILICON,30V,150MA
CR421	152-0141-02	SEMICONV DEVICE:SILICON,30V,150MA
CR423	152-0141-02	SEMICONV DEVICE:SILICON,30V,150MA
CR432	152-0141-02	SEMICONV DEVICE:SILICON,30V,150MA
CR433	152-0141-02	SEMICONV DEVICE:SILICON,30V,150MA
CR501	152-0141-02	SEMICONV DEVICE:SILICON,30V,150MA
CR520	152-0141-02	SEMICONV DEVICE:SILICON,30V,150MA
CR800	152-0141-02	SEMICONV DEVICE:SILICON,30V,150MA
CR820	152-0141-02	SEMICONV DEVICE:SILICON,30V,150MA
CR830	152-0141-02	SEMICONV DEVICE:SILICON,30V,150MA
E513	276-0532-00	SHIELDING BEAD:
E514	276-0532-00	SHIELDING BEAD:
J300	131-1078-00	CONNECTOR,RCPT:28/56 CONTACT
J600	131-1078-00	CONNECTOR,RCPT:28/56 CONTACT
J1000	131-1078-00	CONNECTOR,RCPT:28/56 CONTACT
P500	131-0589-00	TERMINAL,PIN:0.46 L X 0.025 SQ
P640	131-0589-00	TERMINAL,PIN:0.46 L X 0.025 SQ
P710	131-0589-00	TERMINAL,PIN:0.46 L X 0.025 SQ
P740	131-0589-00	TERMINAL,PIN:0.46 L X 0.025 SQ
P800	131-0589-00	TERMINAL,PIN:0.46 L X 0.025 SQ
P900	131-0589-00	TERMINAL,PIN:0.46 L X 0.025 SQ
Q400	151-0188-00	TRANSISTOR,SILICON,PNP
Q401	151-0192-00	TRANSISTOR,SILICON,NPN,SEL FROM MPS652
Q413	151-0341-00	TRANSISTOR,SILICON,NPN
Q420	151-1005-00	TRANSISTOR,SILICON,JFE,N-CHANNEL
Q421	151-1005-00	TRANSISTOR,SILICON,JFE,N-CHANNEL
Q430	151-0341-00	TRANSISTOR,SILICON,NPN
Q431	151-0341-00	TRANSISTOR,SILICON,NPN
Q510	151-0341-00	TRANSISTOR,SILICON,NPN
Q520	151-1005-00	TRANSISTOR,SILICON,JFE,N-CHANNEL
Q521	151-1005-00	TRANSISTOR,SILICON,JFE,N-CHANNEL
Q600	151-0188-00	TRANSISTOR,SILICON,PNP
Q601	151-0192-00	TRANSISTOR,SILICON,NPN,SEL FROM MPS652
Q630	151-0341-00	TRANSISTOR,SILICON,NPN
Q631	151-0341-00	TRANSISTOR,SILICON,NPN
Q700	151-0190-00	TRANSISTOR,SILICON,NPN
Q701	151-0190-00	TRANSISTOR,SILICON,NPN
Q710	151-0190-00	TRANSISTOR,SILICON,NPN
Q820	151-0188-00	TRANSISTOR,SILICON,PNP

Q821	151-0192-00	TRANSISTOR:SILICON,NPN,SEL FROM MPS652
Q910	151-0341-00	TRANSISTOR:SILICON,NPN
Q930	151-0188-00	TRANSISTOR:SILICON,PNP
Q931	151-0192-00	TRANSISTOR:SILICON,NPN,SEL FROM MPS652
R200	315-0101-00	RES.,FXD,CMPSN:100 OHM,5%,0.25W
R220	315-0474-00	RES.,FXD,CMPSN:470K OHM,5%,0.25W
R221	315-0474-00	RES.,FXD,CMPSN:470K OHM,5%,0.25W
R400	315-0393-00	RES.,FXD,CMPSN:39K OHM,5%,0.25W
R401	315-0822-00	RES.,FXD,CMPSN:8.2K OHM,5%,0.25W
R402	321-0222-00	RES.,FXD,FILM:2K OHM,1%,0.125W
R403	315-0273-00	RES.,FXD,CMPSN:27K OHM,5%,0.25W
R404	315-0273-00	RES.,FXD,CMPSN:27K OHM,5%,0.25W
R405	321-0159-00	RES.,FXD,FILM:442 OHM,1%,0.125W
R406	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R410	321-0402-00	RES.,FXD,FILM:150K OHM,1%,0.125W
R411	321-0350-00	RES.,FXD,FILM:43.2K OHM,1%,0.125W
R412	321-0356-00	RES.,FXD,FILM:49.9K OHM,1%,0.125W
R413	315-0272-00	RES.,FXD,CMPSN:2.7K OHM,5%,0.25W
R414	315-0220-00	RES.,FXD,CMPSN:22 OHM,5%,0.25W
R420	315-0753-00	RES.,FXD,CMPSN:75K OHM,5%,0.25W
R421	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R422	315-0153-00	RES.,FXD,CMPSN:15K OHM,5%,0.25W
R430	315-0362-00	RES.,FXD,CMPSN:3.6K OHM,5%,0.25W
R431	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R432	315-0753-00	RES.,FXD,CMPSN:75K OHM,5%,0.25W
R433	315-0153-00	RES.,FXD,CMPSN:15K OHM,5%,0.25W
R500	315-0393-00	RES.,FXD,CMPSN:39K OHM,5%,0.25W
R501	315-0101-00	RES.,FXD,CMPSN:100 OHM,5%,0.25W
R502	315-0822-00	RES.,FXD,CMPSN:8.2K OHM,5%,0.25W
R503	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R504	321-0222-00	RES.,FXD,FILM:2K OHM,1%,0.125W
R510	321-0356-00	RES.,FXD,FILM:49.9K OHM,1%,0.125W
R511	321-0365-00	RES.,FXD,FILM:61.9K OHM,1%,0.125W
R512	321-0385-00	RES.,FXD,FILM:100K OHM,1%,0.125W
R514	315-0220-00	RES.,FXD,CMPSN:22 OHM,5%,0.25W
R521	315-0753-00	RES.,FXD,CMPSN:75K OHM,5%,0.25W
R522	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R530	315-0101-00	RES.,FXD,CMPSN:100 OHM,5%,0.25W
R531	315-0101-00	RES.,FXD,CMPSN:100 OHM,5%,0.25W
R532	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R533	315-0753-00	RES.,FXD,CMPSN:75K OHM,5%,0.25W
R534	315-0362-00	RES.,FXD,CMPSN:3.6K OHM,5%,0.25W
R629	315-0474-00	RES.,FXD,CMPSN:470K OHM,5%,0.25W
R639	315-0474-00	RES.,FXD,CMPSN:470K OHM,5%,0.25W
R700	315-0102-00	RES.,FXD,CMPSN:1K OHM,5%,0.25W
R701	315-0222-00	RES.,FXD,CMPSN:2.2K OHM,5%,0.25W

R710	315-0102-00	RES.,FXD,CMPSN:1K OHM,5%,0.25W
R711	315-0223-00	RES.,FXD,CMPSN:22K OHM,5%,0.25W
R720	315-0223-00	RES.,FXD,CMPSN:22K OHM,5%,0.25W
R721	315-0223-00	RES.,FXD,CMPSN:22K OHM,5%,0.25W
R722	315-0822-00	RES.,FXD,CMPSN:8.2K OHM,5%,0.25W
R730	311-1133-00	RES.,VAR,NONWIR:10K OHM,30%,0.25W
R800	315-0102-00	RES.,FXD,CMPSN:1K OHM,5%,0.25W
R801	315-0102-00	RES.,FXD,CMPSN:1K OHM,5%,0.25W
R810	315-0102-00	RES.,FXD,CMPSN:1K OHM,5%,0.25W
R812	315-0163-00	RES.,FXD,CMPSN:16K OHM,5%,0.25W
R813	315-0750-00	RES.,FXD,CMPSN:75 OHM,5%,0.25W
R820	315-0393-00	RES.,FXD,CMPSN:39K OHM,5%,0.25W
R821	321-0222-00	RES.,FXD,FILM:2K OHM,1%,0.125W
R830	315-0223-00	RES.,FXD,CMPSN:22K OHM,5%,0.25W
R831	315-0393-00	RES.,FXD,CMPSN:39K OHM,5%,0.25W
R832	321-0222-00	RES.,FXD,FILM:2K OHM,1%,0.125W
R900	315-0183-00	RES.,FXD,CMPSN:18K OHM,5%,0.25W
R902	315-0102-00	RES.,FXD,CMPSN:1K OHM,5%,0.25W
R903	315-0201-00	RES.,FXD,CMPSN:200 OHM,5%,0.25W
R904	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R910	315-0273-00	RES.,FXD,CMPSN:27K OHM,5%,0.25W
R911	315-0474-00	RES.,FXD,CMPSN:470K OHM,5%,0.25W
R920	315-0101-00	RES.,FXD,CMPSN:100 OHM,5%,0.25W
R921	315-0822-00	RES.,FXD,CMPSN:8.2K OHM,5%,0.25W
R922	315-0331-00	RES.,FXD,CMPSN:330 OHM,5%,0.25W
R930	321-0159-00	RES.,FXD,FILM:442 OHM,1%,0.125W
R931	315-0154-00	RES.,FXD,CMPSN:150K OHM,5%,0.25W
R932	315-0331-00	RES.,FXD,CMPSN:330 OHM,5%,0.25W
U800	156-0567-02	MICROCIRCUIT,DI:DUAL J-K NEG-EDGE-TRIG FF
VR530	152-0149-00	SEMICONV DEVICE:ZENER,0.4W,10V,5%

The following part numbers are for the A4 LV Power Supply circuit board at serial number B140959 & up and supersede the part numbers currently shown in the Replaceable Electrical Parts list for the A4 High Voltage Deflection circuit board, serial number B140958 & below.

C810	290-0511-00	CAP.,FXD,ELCTLT:250UF,+75-10%,250V
C815	290-0510-00	CAP.,FXD,ELCTLT:6000UF,+100-10%,15V
C820	290-0134-00	CAP.,FXD,ELCTLT:22UF,20%,15V
C822	281-0762-00	CAP.,FXD,CER DI:27PF,20%,100V
C830	285-0629-00	CAP.,FXD,PLSTC:0.047UF,20%,100V
C837	290-0509-00	CAP.,FXD,ELCTLT:3000UF,+100-10%,50V
C839	290-0509-00	CAP.,FXD,ELCTLT:3000UF,+100-10%,50V
C842	290-0969-00	CAP.,FXD,ELCTLT:22UF,+50-10%,100V
C852	281-0550-00	CAP.,FXD,CER DI:120PF,10%,500V
C857	281-0773-00	CAP.,FXD,CER DI:0.01UF,10%,100V

C860	290-0969-00	CAP.,FXD,ELCTLT:22UF,+50-10%,100V
C865	281-0861-00	CAP.,FXD,CER DI:270PF,5%,50V
C870	290-0134-00	CAP.,FXD,ELCTLT:22UF,20%,15V
C872	281-0572-00	CAP.,FXD,CER DI:6.8PF,+/- 0.5PF,500V
C875	281-0773-00	CAP.,FXD,CER DI:0.01UF,10%,100V
C881	290-0267-00	CAP.,FXD,ELCTLT:1UF,20%,35V
C883	290-0267-00	CAP.,FXD,ELCTLT:1UF,20%,35V
C890	281-0785-00	CAP.,FXD,CER DI:68PF,10%,100V
CR810	152-0066-00	SEMICOND DEVICE:SILICON,400V,750MA
CR811	152-0066-00	SEMICOND DEVICE:SILICON,400V,750MA
CR812	152-0066-00	SEMICOND DEVICE:SILICON,400V,750MA
CR813	152-0066-00	SEMICOND DEVICE:SILICON,400V,750MA
CR815	152-0488-00	SEMICOND DEVICE:SILICON,200V,1500MA
CR820	152-0066-00	SEMICOND DEVICE:SILICON,400V,750MA
CR824	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA
CR835	152-0066-00	SEMICOND DEVICE:SILICON,400V,750MA
CR836	152-0066-00	SEMICOND DEVICE:SILICON,400V,750MA
CR837	152-0488-00	SEMICOND DEVICE:SILICON,200V,1500MA
CR841	152-0066-00	SEMICOND DEVICE:SILICON,400V,750MA
CR842	152-0066-00	SEMICOND DEVICE:SILICON,400V,750MA
CR850	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA
CR851	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA
CR860	152-0066-00	SEMICOND DEVICE:SILICON,400V,750MA
CR856	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA
CR870	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA
CR875	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA
CR885	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA
CR890	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA
F809	159-0029-00	FUSE,CARTRIDGE:3AG,0.3A,250V,SLOW-BLOW
F810	159-0028-00	FUSE,CARTRIDGE:3AG,0.25A,250V,FAST-BLOW
F815	159-0015-00	FUSE,CARTRIDGE:3AG,3A,250V,0.65 SEC
F834	159-0015-00	FUSE,CARTRIDGE:3AG,3A,250V,0.65 SEC
F835	159-0042-00	FUSE,CARTRIDGE:3AG,0.75A,250V,FAST-BLOW
F836	159-0015-00	FUSE,CARTRIDGE:3AG,3A,250V,0.65 SEC
F850	159-0015-00	FUSE,CARTRIDGE:3AG,3A,250V,0.65 SEC
P370	131-0589-00	TERMINAL,PIN:0.46 L X 0.025 SQ
P830	131-0589-00	TERMINAL,PIN:0.46 L X 0.025 SQ
P840	131-0589-00	TERMINAL,PIN:0.46 L X 0.025 SQ
P850	131-0589-00	TERMINAL,PIN:0.46 L X 0.025 SQ
P890	131-0589-00	TERMINAL,PIN:0.46 L X 0.025 SQ
Q820	151-0341-00	TRANSISTOR:SILICON,NPN
Q825	151-0341-00	TRANSISTOR:SILICON,NPN
Q845	151-0341-00	TRANSISTOR:SILICON,NPN
Q850	151-0190-00	TRANSISTOR:SILICON,NPN
Q865	151-0341-00	TRANSISTOR:SILICON,NPN
Q870	151-0188-00	TRANSISTOR:SILICON,PNP

Q875	151-0301-00	TRANSISTOR:SILICON,PNP
Q885	151-0341-00	TRANSISTOR:SILICON,NPN
Q890	151-0341-00	TRANSISTOR:SILICON,NPN
R810	301-0150-00	RES.,FXD,CMPSN:15 OHM,5%,0.50W
R812	303-0683-00	RES.,FXD,CMPSN:68K OHM,5%,1W
R815	308-0685-00	RES.,FXD,WW:1.5 OHM,5%,1W
R816	321-0215-00	RES.,FXD,FILM:1.69K OHM,1%,0.125W
R818	321-0289-00	RES.,FXD,FILM:10K OHM,1%,0.125W
R820	315-0473-00	RES.,FXD,CMPSN:47K OHM,5%,0.25W
R822	315-0681-00	RES.,FXD,CMPSN:680 OHM,5%,0.25W
R824	315-0822-00	RES.,FXD,CMPSN:8.2K OHM,5%,0.25W
R826	315-0242-00	RES.,FXD,CMPSN:2.4K OHM,5%,0.25W
R827	315-0101-00	RES.,FXD,CMPSN:100 OHM,5%,0.25W
R830	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
R832	315-0473-00	RES.,FXD,CMPSN:47K OHM,5%,0.25W
R834	315-0183-00	RES.,FXD,CMPSN:18K OHM,5%,0.25W
R841	307-0300-00	RES.,FXD,FILM:150 OHM,5%,10W
R842	308-0686-00	RES.,FXD,WW:2.2 OHM,5%,2W
R846	315-0391-00	RES.,FXD,CMPSN:390 OHM,5%,0.25W
R847	315-0183-00	RES.,FXD,CMPSN:18K OHM,5%,0.25W
R850	315-0823-00	RES.,FXD,CMPSN:82K OHM,5%,0.25W
R851	301-0333-00	RES.,FXD,CMPSN:33K OHM,5%,0.50W
R852	315-0681-00	RES.,FXD,CMPSN:680 OHM,5%,0.25W
R853	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R856	315-0101-00	RES.,FXD,CMPSN:100 OHM,5%,0.25W
R857	322-0268-00	RES.,FXD,FILM:6.04K OHM,1%,0.25W
R858	311-1120-00	RES.,VAR,NONWIR:100 OHM,30%,0.25W
R859	322-0268-00	RES.,FXD,FILM:6.04K OHM,1%,0.25W
R860	308-0686-00	RES.,FXD,WW:2.2 OHM,5%,2W
R861	307-0301-00	RES.,FXD,FILM:120 OHM,5%,10W
R863	315-0273-00	RES.,FXD,CMPSN:27K OHM,5%,0.25W
R865	315-0101-00	RES.,FXD,CMPSN:100 OHM,5%,0.25W
R867	315-0621-00	RES.,FXD,CMPSN:620 OHM,5%,0.25W
R868	315-0101-00	RES.,FXD,CMPSN:100 OHM,5%,0.25W
R869	315-0392-00	RES.,FXD,CMPSN:3.9K OHM,5%,0.25W
R870	315-0562-00	RES.,FXD,CMPSN:5.6K OHM,5%,0.25W
R872	315-0221-00	RES.,FXD,CMPSN:220 OHM,5%,0.25W
R873	315-0102-00	RES.,FXD,CMPSN:1K OHM,5%,0.25W
R875	315-0101-00	RES.,FXD,CMPSN:100 OHM,5%,0.25W
R877	321-0256-00	RES.,FXD,FILM:4.53K OHM,1%,0.125W
R878	311-1124-00	RES.,VAR,NONWIR:TRMR,250 OHM,0.25W
R879	321-0202-00	RES.,FXD,FILM:1.24K OHM,1%,0.125W
R880	315-0272-00	RES.,FXD,CMPSN:2.7K OHM,5%,0.25W
R881	315-0562-00	RES.,FXD,CMPSN:5.6K OHM,5%,0.25W
R883	315-0102-00	RES.,FXD,CMPSN:1K OHM,5%,0.25W
R885	315-0153-00	RES.,FXD,CMPSN:15K OHM,5%,0.25W

R890	322-0686-03	RES.,FXD,FILM:7.23K OHM,0.25%,0.25W
R892	321-0097-03	RES.,FXD,FILM:100 OHM,0.25%,0.125W
R893	308-0685-00	RES.,FXD,WW:1.5 OHM,5%,1W
TP810	214-0579-00	TERM,TEST POINT:BRS CD PL
TP820	214-0579-00	TERM,TEST POINT:BRS CD PL
TP830	214-0579-00	TERM,TEST POINT:BRS CD PL
TP840	214-0579-00	TERM,TEST POINT:BRS CD PL
TP860	214-0579-00	TERM,TEST POINT:BRS CD PL
VR850	152-0357-00	SEMICONV DEVICE:ZENER,0.4W,82V,5%
VR865	152-0243-00	SEMICONV DEVICE:ZENER,0.4W,15V,5%
VR870	152-0227-00	SEMICONV DEVICE:ZENER,0.4W,6.2V,5%
W891	131-0566-00	BUS CONDUCTOR:DUMMY RES,2.375,22 AWG

The following **CHASSIS PARTS** list is new and is to be used in conjunction with the new schematic and exploded view diagrams located in the **DIAGRAM CHANGES** portion of this insert.

F201	159-0003-00	FUSE,CARTRIDGE:3AG,1.6A,250V,SLOW-BLOW
FL201	119-1536-00	FILTER,RFI:3A,250VAC,50/60HZ
J210	131-0955-00	CONN,RCPT,ELEC:BNC,FEMALE
J916	131-0126-00	CONNECTOR,RCPT,BNC,FEMALE
J916	-----	(OPTION 07 ONLY)
J917	131-0126-00	CONNECTOR,RCPT,BNC,FEMALE
J917	-----	(OPTION 07 ONLY)
J918	131-0126-00	CONNECTOR,RCPT,BNC,FEMALE
J918	-----	(OPTION 07 ONLY)
J919	131-0126-00	CONNECTOR,RCPT,BNC,FEMALE
J919	-----	(OPTION 07 ONLY)
L291	108-0644-00	COIL,TUBE DEFLE:TRACE ROTATOR
Q252	151-0701-00	TRANSISTOR:SILICON,NPN
Q400	151-0656-00	TRANSISTOR:SILICON,NPN
Q815	151-0496-00	TRANSISTOR:SILICON,NPN
Q840	151-0496-00	TRANSISTOR:SILICON,NPN
Q860	151-0496-00	TRANSISTOR:SILICON,NPN
R291	311-1189-00	RES.,VAR,WW:PNL,5K OHM,2W
R295	311-0254-00	RES.,VAR,NONWIR:5M OHM,10%,1W
R610	311-1961-00	RES.,VAR,NONWIR:PANEL,100K OHM,20%,0.75W
S200		(FURNISHED AS UNIT WITH R610)
S201	260-1222-00	SWITCH,PUSH-PUL:10A,250VAC
T801	120-1327-00	XFMR,PWR,SDN & SU:LOW FREQUENCY
V291	154-0633-00	ELECTRON TUBE:CRT,P31,INT SCALE
V291	154-0663-13	ELECTRON TUBE:CRT,P7
V291	-----	(OPTION 76 ONLY)

V291 154-0633-14
V291

ELECTRON TUBE:CRT,P11
(OPTION 78 ONLY)

REPLACEABLE MECHANICAL PARTS LIST CHANGES

This new parts list replaces the one currently given for the FIG. 1 DISPLAY diagram in the manual and is to be used in conjunction with the new FIG. 1 DISPLAY diagram found in the DIAGRAM CHANGES portion of this insert.

1-	-----		
-1	200-1218-00	1	.RTNR,CRT SCALE:6.814 X 5.125,NYLON ***** (ATTACHING PARTS) *****
-2	211-0188-00	2	.SCREW,MACHINE:4-40 X 0.6,PNH,SST ***** (END ATTACHING PARTS) *****
-3	337-1440-00	1	.SHLD,IMPLOSION:SM10
-8	386-1946-00	1	SUPPORT,CRT:FRONT
-9	348-0279-00	2	PAD,CUSHIONING:G(CUT TO FIT)
-10	348-0070-01	3	PAD,CUSHIONING:0.69 INCH,RUBBER
-11	348-0145-00	1	GROMMET,PLASTIC:U-SHP,1.0 X 0.42 INCH
-12	344-0226-00	1	CLIP,CABLE: ***** (ATTACHING PARTS) *****
-13	210-0401-00	1	NUT,PLAIN,HEX:6-32 X 0.312 HEX,BRS CD PL ***** (END ATTACHING PARTS) *****
-14	334-1379-00	1	LABEL,CRT,ADHESIVE BACK
-15	337-1419-05	1	SHIELD SECT,CRT:
-16	337-1420-00	1	SHIELD SECT,CRT:
-17	354-0409-00	1	R,CLP,CRT SHLD:U/O 2.375 OD SHIELD
-18	343-0123-01	2	CLAMP,RET.,ELEC:CRT,REAR ***** (ATTACHING PARTS) *****
-19	211-0632-00	1	SCREW,MACHINE:6-32 X 2.250 INCH,FILH,STL
-20	220-0444-00	1	NUT,PLAIN,SQ:6-32 X 0.250 INCH,STL ***** (END ATTACHING PARTS) *****
-21	407-0922-00	1	BRACKET,CRT CLP:ALUMINUM ***** (ATTACHING PARTS) *****
-22	211-0507-00	2	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL ***** (END ATTACHING PARTS) *****
-23	384-1064-03	1	KNOB:14.061 X 0.125 OD,W/SHAFT
-24	358-0216-00	1	BUSHING,PLASTIC:0.257 ID X 0.412 INCH OD
-25	366-0494-00	3	KNOB:GRAY WITH SETSCREW
	213-0153-00	3	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX
-26	366-1059-00	1	PUSHBUTTON:GRAY,0.227 OD X 0.3
-27	366-1077-00	1	KNOB:GRAY W/SETSCREW
-28	-----	1	RESISTOR,VAR:(SEE R610 REPL) ***** (END ATTACHING PARTS) *****
-29	210-0583-00	1	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS
-30	210-0940-00	1	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL ***** (END ATTACHING PARTS) *****

-31	-----	1	RESISTOR,VAR:(SEE R295 REPL) ***** (ATTACHING PARTS)*****
-32	210-0583-00	2	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS
-33	210-0046-00	1	WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS
-34	210-0940-00	1	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL ***** (END ATTACHING PARTS)*****
-35	200-0608-00	1	COVER,VAR RES.,:PLASTIC
-36	136-0387-00	2	JACK,TIP:GRAY
-37	333-2898-02	1	PANEL,FRONT:
-38	-----	1	RESISTOR,VAR:(SEE R291 REPL) ***** (ATTACHING PARTS)*****
-39	210-0590-00	1	NUT,PLAIN,HEX.:0.375-32 X 0.438" BRS
-40	210-0978-00	1	WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL
-41	210-0012-00	2	WASHER,LOCK:INTL,0.384 ID,INTL,0.022 TH
-42	210-0207-00	1	TERMINAL,LUG:0.375 INCH DIAMETER ***** (END ATTACHING PARTS)*****
-43	-----	1	SWITCH,PUSH:(SEE S201 REPL)
-44	376-0127-00	1	COUPLER,SHAFT:PLASTIC
-45	-----	1	TRANSISTOR:(SEE Q252 REPL) ***** (ATTACHING PARTS)*****
-46	211-0097-00	1	SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL
-47	210-1178-00	1	WASHER,SHLDR:U/W TO-220 TRANSISTOR
-48	210-0586-00	1	NUT,PL,ASSEM WA:4-40 X 0.25,STL ***** (END ATTACHING PARTS)*****
-49	342-0354-00	1	INSULATOR,PLATE:TRANSISTOR,SILICON RUBBER
-50	348-0115-00	1	GROMMET,PLASTIC:U-SHP,0.548 X 0.462 INCH
-51	337-1421-02	1	SHIELD,ELEC:HIGH VOLTAGE ***** (ATTACHING PARTS)*****
-52	211-0504-00	3	SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL ***** (END ATTACHING PARTS)*****
-53	407-0896-00	1	BRACKET,CHASSIS:ALUMINUM ***** (ATTACHING PARTS)*****
-54	211-0541-00	1	SCREW,MACHINE:6-32 X 0.25" 100 DEG,FLH STL ***** (END ATTACHING PARTS)*****
-55	214-0982-04	1	SPRING,GROUND:GROUNDING ***** (ATTACHING PARTS)*****
-56	211-0538-00	3	SCREW,MACHINE:6-32 X 0.312" 100 DEG,FLH ST ***** (END ATTACHING PARTS)*****
-57	200-1204-01	1	COVER,ORT:REAR ALUMINUM,PTD BLUE ***** (ATTACHING PARTS)*****
-58	210-0401-00	2	NUT,PLAIN,HEX.:6-32 X 0.312 HEX,BRS CD PL
-59	210-0005-00	2	WASHER,LOCK:#6 EXT,0.02 THK,STL ***** (END ATTACHING PARTS)*****
-60	161-0066-00	1	CABLE ASSY,PWR,;3,18 AWG,240V,96.0 L
-61	161-0066-09	1	CABLE ASSY,PWR,;3,0.75MM SQ,240V,96.0 L (OPTION A1 EUROPEAN)
-62	161-0066-10	1	CABLE ASSY,PWR:3,0.75MM SQ,240V,96.0 L (OPTION A2 UNITED KINGDOM)
-63	161-0066-11	1	CABLE ASSY,PWR:3,0.75MM,240V,96.0 L (OPTION A3 AUSTRALIAN)
-64	161-0066-12	1	CABLE ASSY,PWR:3,18AWG,240V,96.0 L (OPTION A4 NORTH AMERICAN)
-65	161-0154-00	1	CABLE ASSY,PWR:3,0.75MM SQ,240V,6A,2.5M L (OPTION A5 SWISS)

-66	204-0832-00	1	BODY,FUSEHOLDER:3AG,5 X 20MM FUSES ***** (ATTACHING PARTS) *****
-67	210-1039-00	1	WASHER,LOCK:INT,0.521 ID X 0.625 INCH 0 ***** (END ATTACHING PARTS) *****
-68	200-2264-00	1	CAP.,FUSEHOLDER:3AG FUSES
-69	200-0237-04	1	COVER,FUSE HLDR:PLASTIC,SAFETY CONTROLLED
-70	131-0955-00	1	CONN,ROPT,ELEC:BNC,FEMALE
-71	210-0255-00	1	TERMINAL,LUG:0.391 ID,LOCKING,BRS CD PL
-72	210-0202-00	2	TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED ***** (ATTACHING PARTS) *****
-73	210-0407-00	2	NUT,PLAIN,HEX,6-32 X 0.25 INCH,BRS ***** (END ATTACHING PARTS) *****
-74	334-3379-01	1	MARKER.IDENT:MARKED GROUND SYMBOL
-75	136-0796-01	1	SKT,PL-IN ELEK:CRT CABLE
-76	-----	1	FILTER,RFI:(SEE FL201 REPL) ***** (ATTACHING PARTS) *****
-77	211-0510-00	2	SCREW,MACHINE:6-32 X 0.375,PNH,STL,CD PL ***** (END ATTACHING PARTS) *****
-78	333-1426-04	1	PANEL,REAR:
-90	-----	1	CKT BOARD ASSY:HIGH VOLTAGE (SEE A3 REPL)
-91	-----	41	.TERM,PIN:(SEE A3P102,P111,P116,P121,P130, P205,P252,P260,P290,P298 REPL)
-92	-----	2	.TEST POINT:(SEE TP226,TP267 REPL)
-93	214-2811-00	4	.HEAT,SINK,XSTR:TO-202 ALUMINUM
-94	337-1179-00	1	.SHIELD,ELEC:DEFLECTION AMP
-105	343-0088-00	3	CLAMP,LOOP:0.062 INCH DIA
-106	407-2270-02	1	BRACKET,CHASSIS: ***** (ATTACHING PARTS) *****
-107	211-0504-00	2	SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL
-108	211-0559-00	1	SCREW,MACHINE:6-32 X 0.375" 100 DEG,FLH ST ***** (END ATTACHING PARTS) *****
-109	348-0516-00	1	GROMMET,PLASTIC:BLACK,ROUND,0.188 ID
-110	386-5073-00	1	SUPPORT,CKT BD:
-111	344-0225-00	2	CLIP,CABLE:
-112	348-0115-00	1	GROMMET,PLASTIC:U-SHP,0.548 X 0.462 INCH
-113	441-0991-06	1	CHAS,DSPL UNIT:MAIN ***** (ATTACHING PARTS) *****
-114	211-0504-00	2	SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL
-115	211-0538-00	2	SCREW,MACHINE:6-32 X 0.312" 100 DEG,FLH ST ***** (END ATTACHING PARTS) *****
-116	426-0739-02	1	FR ASSY,DSPL UN:

This new parts list replaces the one currently given for the FIG. 2 MAINFRAME diagram in the manual and is to be used in conjunction with the new FIG. 2 MAINFRAME diagram found in the DIAGRAM CHANGES portion of this insert.

2-1	-----	1	CKT BOARD ASSY:INTERFACE (SEE A1 REPL) ***** (ATTACHING PARTS) *****
-2	213-0146-00	4	SCR,TPG,THD FOR:6-20 X 0.313 INCH,PNH STL ***** (END ATTACHING PARTS) *****
	-----	-	CKT BOARD ASSY INCLUDES:
-3	131-0589-00	20	.TERMINAL,PIN:0.46 L X 0.025 SQ
-4	-----	3	.CONN,RCPT:(SEE A1J300,J600,J1000 REPL)
-5	214-1593-02	3	.KEY,CONN PLZN:CKT BD CONN
-6	200-2601-00	3	.COVER,ELEC CONN:W/POLARIZING KEY
-7	131-2423-00	3	CONTRACT,ELEC:PLUG-IN GND,CU BE BRT DIP
-8	441-1641-00	1	CHASSIS,SCOPE:INTERFACE ***** (ATTACHING PARTS) *****
-9	211-0008-00	4	SCREW,MACHINE:4-40 X 0.250,PNH,STL,POZ ***** (END ATTACHING PARTS) *****
-10	-----	1	CKT BOARD ASSY:LV POWER SUPPLY (SEE A2 REPL) ***** (ATTACHING PARTS) *****
-11	211-0504-00	6	SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL ***** (END ATTACHING PARTS) *****
	-----	-	CKT BOARD ASSY INCLUDES:
-12	131-0608-00	16	.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD
-13	131-0589-00	26	.TERMINAL,PIN:0.46 L X 0.025 SQ
-14	-----	5	.TERM TEST POINT:(SEE A2TP810,TP820,TP830, TP840,TP860 REPL)
-15	344-0326-00	14	.CLIP,ELECTRICAL:FUSE,BRASS
-16	385-0149-00	2	.SPACER,POST:0.625 L W/4-40 THD EA END,N ***** (ATTACHING PARTS) *****
-17	211-0040-00	2	.SCREW,MACHINE:4-40 X 0.25",BDGH PLSTC ***** (END ATTACHING PARTS) *****
-18	-----	1	TRANSFORMER:(SEE T801 REPL) ***** (ATTACHING PARTS) *****
-19	212-0522-00	4	SCREW,MACHINE:10-32 X 2.50",HEX HD STL
-20	210-0812-00	4	WASHER,NONMETAL:#10,FIBER
-21	166-0457-00	4	INSUL SLVG,ELEC:0.19 ID X 1.875" LONG MYLAR
-22	220-0410-00	4	NUT,EXTENDED WA:10-32 X 0.375 INCH,STL
-23	210-0401-00	1	NUT,PLAIN,HEX:6-32 X 0.312 HEX,BRS CD PL
-24	210-0407-00	1	NUT,PLAIN,HEX:6-32 X 0.25 INCH,BRS ***** (END ATTACHING PARTS) *****
-25	200-0772-09	1	COVER,ELEC XFMR:3.125 X 3.75 X 0.875
-26	333-1425-11	1	PANEL,REAR:
-27	385-0012-00	1	SPACER,POST:0.312 OD,0.562 L W/8-32 THD ***** (ATTACHING PARTS) *****
-28	211-0025-00	1	SCREW,MACHINE:4-40 X 0.375 100 DEG,FLH ST ***** (END ATTACHING PARTS) *****
-29	343-0315-00	2	CLAMP,XSTR: ***** (ATTACHING PARTS) *****
-30	210-0407-00	6	NUT,PLAIN,HEX:6-32 X 0.25 INCH,BRS
-31	210-0802-00	6	WASHER,FLAT:0.15 ID X 0.312 INCH OD ***** (END ATTACHING PARTS) *****

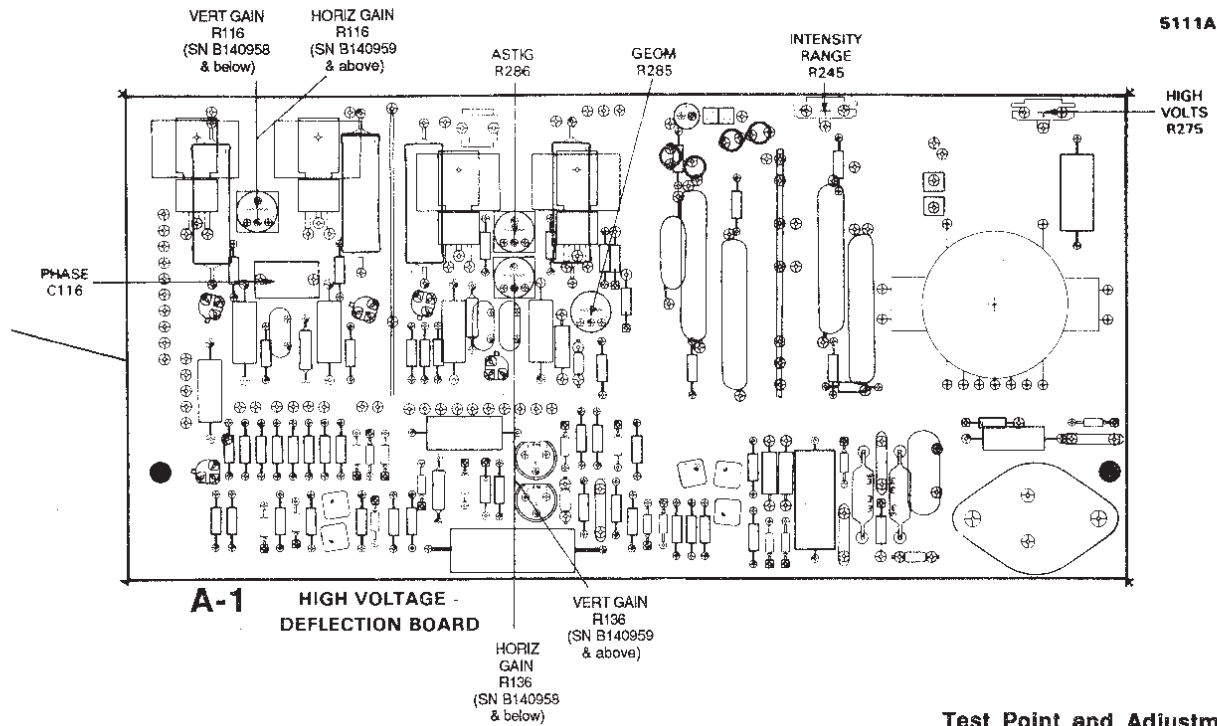
-32	342-0355-00	3	INSULATOR,PLATE:TRANSISTOR,SILICONE RUBBER
-33	351-0293-00	3	GUIDE,SLIDE:BLUE
-34	351-0286-07	3	GUIDE,PL-IN UNI:LOWER,NYLON ***** (ATTACHING PARTS) *****
-35	213-0814-00	1	SCREW,TPG,TR:4-20,0.25 L,PLASTITE
-36	213-0813-00	2	SCREW,TPG,TR:4-20,0.312 L,PLASTITE ***** (END ATTACHING PARTS) *****
-37	426-0738-02	1	FRAME ASSY MON:
-38	-----	1	CKT BOARD ASSY: SIGNAL OUT (SEE A7 REPL) ----- (OPTION 07 ONLY) ***** (ATTACHING PARTS) *****
-39	211-0292-00	3	SCR,ASSEM WSHR:4-40 X 0.29,BRS NI PL ----- (OPTION 07 ONLY) ----- CKT BOARD ASSY INCLUDES:
-40	131-0589-00	20	.TERMINAL,PIN:0.46 L X 0.025 SQ ----- (OPTION 07 ONLY)
-41	-----	4	CONN,RCPT,: (SEE J916,J917,J918,J919 REPL) ----- (OPTION 07 ONLY)
-42	333-1425-12	1	PANEL,REAR: ----- (OPTION 07 ONLY)

*This new parts list replaces the one currently given for the FIG. 3 BENCH CABINET diagram in the manual and is to be used in conjunction with the new FIG. 3 BENCH CABINET diagram found in the **DIAGRAM CHANGES** portion of this insert.*

3-1	200-0728-06	1	COVER,HDL END:
-2	200-0728-00	1	COV,HANDLE END:
-3	386-1624-00	2	PLATE,HDL RTNG:STAINLESS STEEL
-4	367-0116-00	1	HANDLE,CARRYING: ***** (ATTACHING PARTS) *****
-5	212-0597-00	4	SCREW,MACHINE:10-32 X 0.50 INCH,STL ***** (END ATTACHING PARTS) *****
-6	386-1283-00	2	PLATE,HDL MTG:FRONT
-7	390-0469-00	2	CAB,SIDE,DSPL:SIDE
-8	337-3015-01	1	SHIELD,ELEC:HIGH VOLTAGE,W/SPCR ***** (ATTACHING PARTS) *****
-9	212-0105-00	2	SCREW,EXT RLV:8-32 X 0.312 INCH,HEX HD ST
-10	212-0008-00	2	SCREW,MACHINE:8-32 X 0.500 INCH,PNH STL
-11	210-0008-00	2	WASHER,LOCK:INTL,0.172 ID X 0.331" OD,S ***** (END ATTACHING PARTS) *****
-12	390-0470-00	1	CAB,BOT,DSPL:BOTTOM
-13	348-0208-00	2	.FOOT,CABINET:LEFT FRONT AND RIGHT REAR
-14	348-0073-00	2	.HINGE BLOCK,STA:L FR,R REAR,BLACK ACETAL ***** (ATTACHING PARTS) *****
-15	211-0532-00	2	.SCREW,MACHINE:6-32 X 0.75 INCH,FILH STL
-16	210-0457-00	2	.NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL ***** (END ATTACHING PARTS) *****
-17	348-0207-00	2	.FOOT,CABINET:RIGHT FRONT AND LEFT REAR
-18	348-0074-00	2	.HINGE BLOCK,STA:R FR,L REAR,BLACK ACETAL ***** (ATTACHING PARTS) *****
-19	211-0532-00	2	.SCREW,MACHINE:6-32 X 0.75 INCH,FILH STL

DIAGRAM CHANGES

The diagrams given on the following pages are added at serial number B140959 & up.



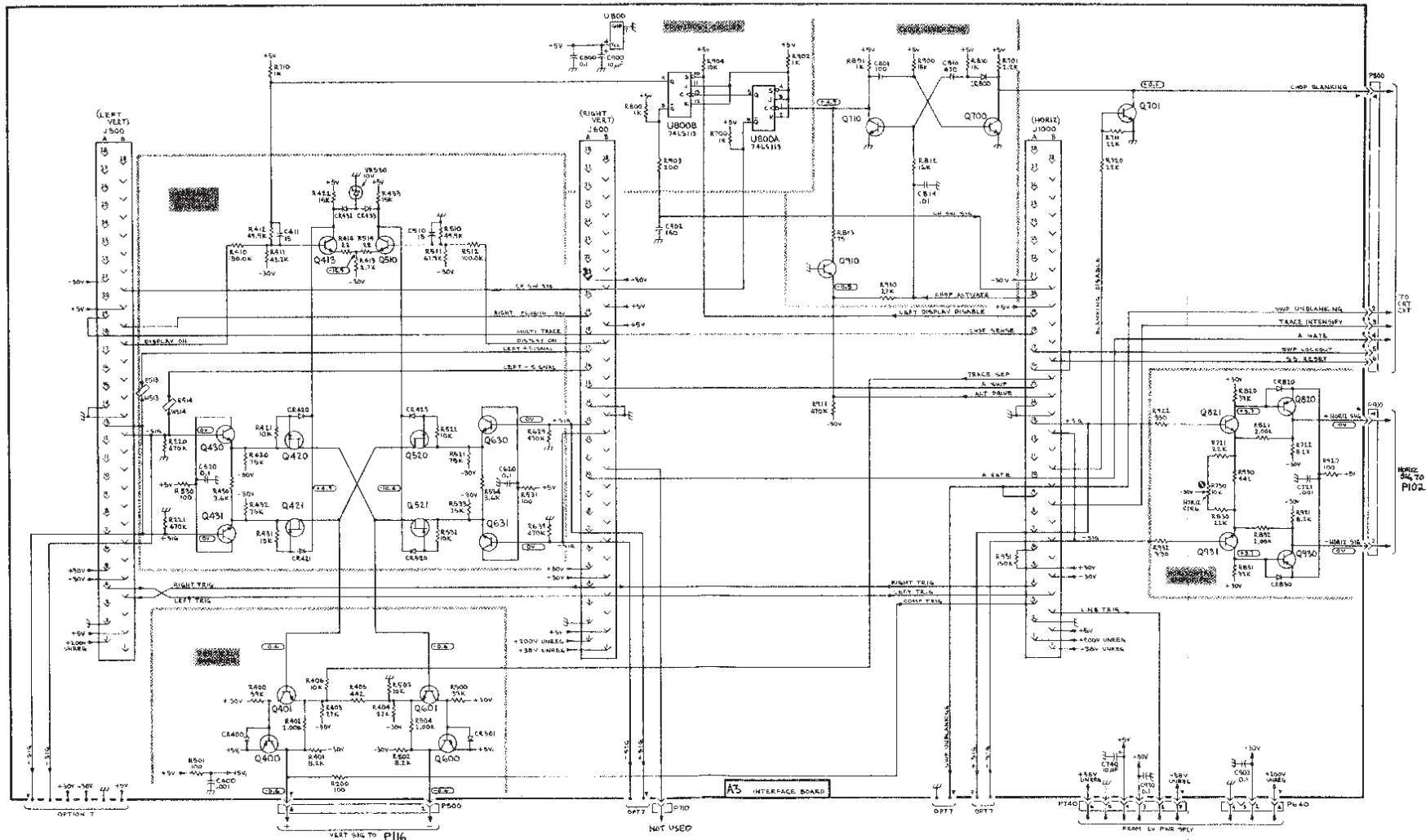
A B C D E F G

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3

4



INTERFACE 1 (SN B140959 & above)

WARNING

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

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Test oscilloscope system	Deflection factor, 1 mV to 50 V/div; input impedance, 1 megohm; frequency response, dc to 2 MHz. Probe: 10X attenuation probe compatible with vertical input. Rigid Plug-in extender.	TEKTRONIX 5110 Oscilloscope 5A13N Differential Comparator, and 5B10N Time Base/Ampl system or equiv. Use a TEKTRONIX P6062E Probe.
Voltmeter (nonloading digital multimeter)	Range, 0 to 250 V input; input impedance, 10 megohms.	TEKTRONIX DM 501A Digital Multi-meter with power module.

VOLTAGE CONDITIONS

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

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

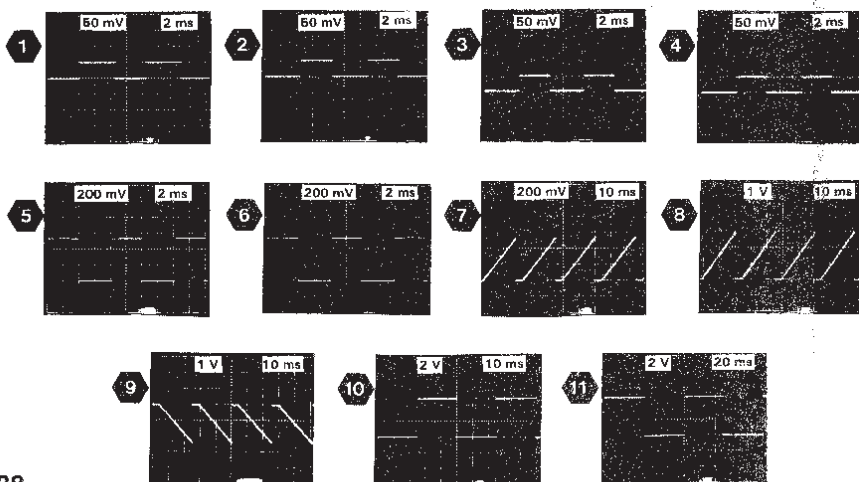
WAVEFORM CONDITIONS

Oscilloscope Under Test. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect the CALIBRATOR output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal auto-trigger, 2 ms/division sweep rate. Use plug-in extender to gain access to measurement points.

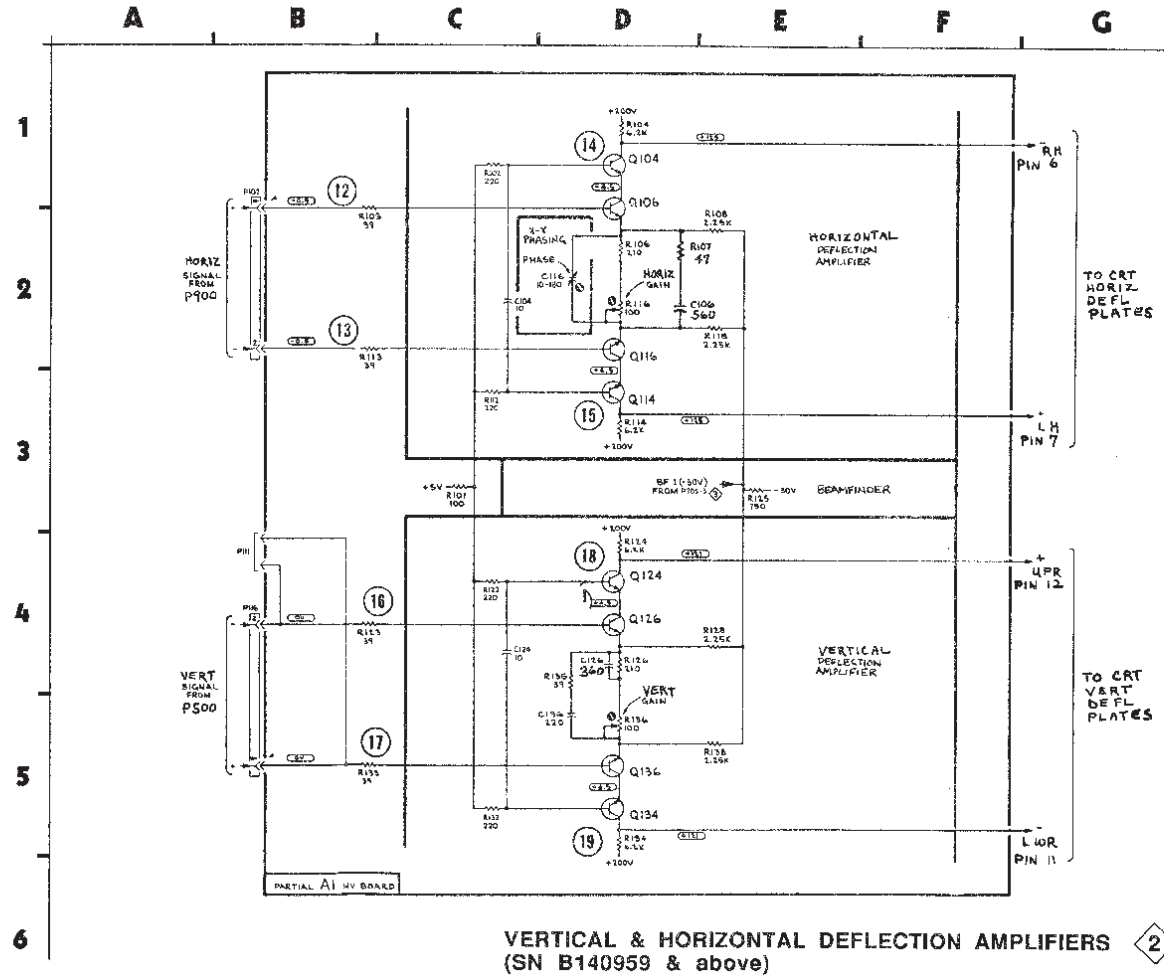
Test Oscilloscope. Set the test oscilloscope triggering for auto mode with ac coupling from the internal source and set vertical input coupling to ac. Connect a 10X Probe to the vertical input. Position the display as necessary.

NOTE

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



VERT & HORIZ DEFLECTION AMPLIFIERS (SN B140959 & above)					
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C104	C2	B2	R101	C3	D3
C106	D2	B3	R102	C1	A3
C116	D2	B3	R103	B2	B3
C124	C4	E3	R104	D1	B2
C125	D4	C3	R106	D2	B3
C135	C5	C3	R108	E2	B3
			R112	C3	C3
P102	B2	B4	R113	B2	B4
P111	B4	C4	R114	D3	C2
P116	B4	C4	R116	D2	C3
			R118	E2	C3
Q104	D1	A2	R122	C4	D3
Q106	D1	B3	R123	B4	D3
Q114	D3	B2	R124	D4	D2
Q116	D2	C4	R125	E3	B4
Q124	D4	D3	R126	D4	D3
Q126	D4	D4	R128	E4	D3
Q134	D5	E3	R132	C5	E2
Q136	D5	E4	R133	E5	D3
			R134	D5	E2
			R135	D4	E3
			R136	D5	E3
			R138	E5	E3



CRT CIRCUIT DIAGRAM (3) (SN B140959 & above)								
ASSEMBLY A3								
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C227	B4	C5	D5273	G4	K2	R245	F4	G1
C233	B4	C5	D5274	G4	K2	R246	F4	F2
C224	E2	E6				R247	G4	K2
C238	E1	E5	P121	B1	B4	R248	E4	J2
C240	F2	E5	P130	B4	D4	R249	E4	J5
C241	F3	H1	P205	B2	A3	R250	E4	J5
C242	F3	H2	P205	B3	A3	R251	D4	F4
C245	F3	H1	P252	D4	E3	R254	D6	F5
C245	F4	F2	P280	B1	A2	R263	C5	G5
C246	E4	J3	P280	B4	A2	R264	C4	G5
C249	E4	J3	P280	H1	E4	R265	C4	H5
C251	D4	F5	P298	H5	E3	R267	C5	J5
C252	D5	G4				R268	C5	H5
C252	C5	G5	Q214	C3	C5	R273A	E4	K3
C273	E3	J5	Q222	E2	C5	R272B	E3	K3
C276	E3	H4	Q228	E2	D6	R272C	E4	K3
C277	C4	J5	Q234	E1	D5	R272D	E4	K3
C291	G2	F4	Q254	C4	H5	R272E	G3	K3
			Q278	C5	H5	R272F	G3	K3
CR209	C2	C4				R273	E4	K2
CR211	D3	B5	R202	B2	B5	R274	B6	H5
CR214	C3	B6	R203	B1	B4	R275	E3	D5
CR215	D3	C4	R205	B1	B4	R277	C4	J5
CR222	D2	C4	R207	B2	B4	R278	C5	H5
CR224	E2	C5	R208	B2	C4	R279	C5	H5
CR228	F2	D4	R209	D2	C4	R282	G2	E1
CR234	F1	E4	R211	B3	B5	R285	G2	D1
CR240	F2	E4	R213	B3	B5	R286	G2	C1
CR241	F3	J2	R215	C3	C5	R287	G2	E3
CR242	F3	J1	R216	C3	C5	R287	P5	F2
CR243	F3	G1	R217	C2	B4	R288	E5	F3
CR244	F3	F1	R218	C2	C4	R290	F4	K2
CR245	F4	F2	R219	C3	B5			
CR247	E4	H3	R222	E2	C5	T240	E4	G3
CR282	D4	F4	R223	E2	D5			
CR284	C4	G5	R226	F2	E5	TP228	F2	F5
CR285	C4	G5	R227	E2	D4	TP227	C5	J5
CR289	C4	H5	R227	E2	D4			
CR270	C5	H5	R232	E2	E4	VR236	F2	E5
CR272	C5	J5	R234	F1	D5	VR245	F4	F1
CR273	C5	J5	R236	F1	E4	VR253	C5	G5
CR276	E3	G5	R240	F3	J2	VR281	G2	E2
CR298	F5	F3	R241	F3	G1	VR292	G2	E3
			R242	F3	G1			
DS271	G3	K1	R243	G3	J2			
DS272	G3	K2	R244	F3	F1			

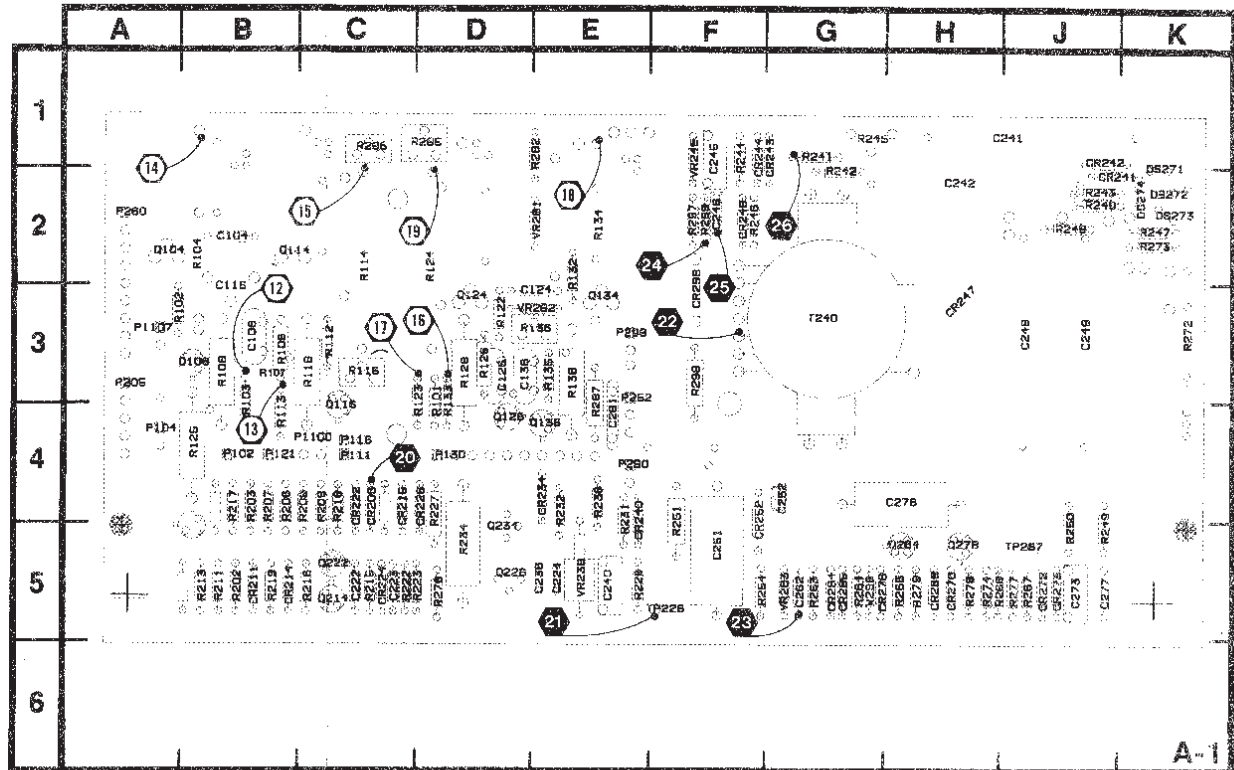
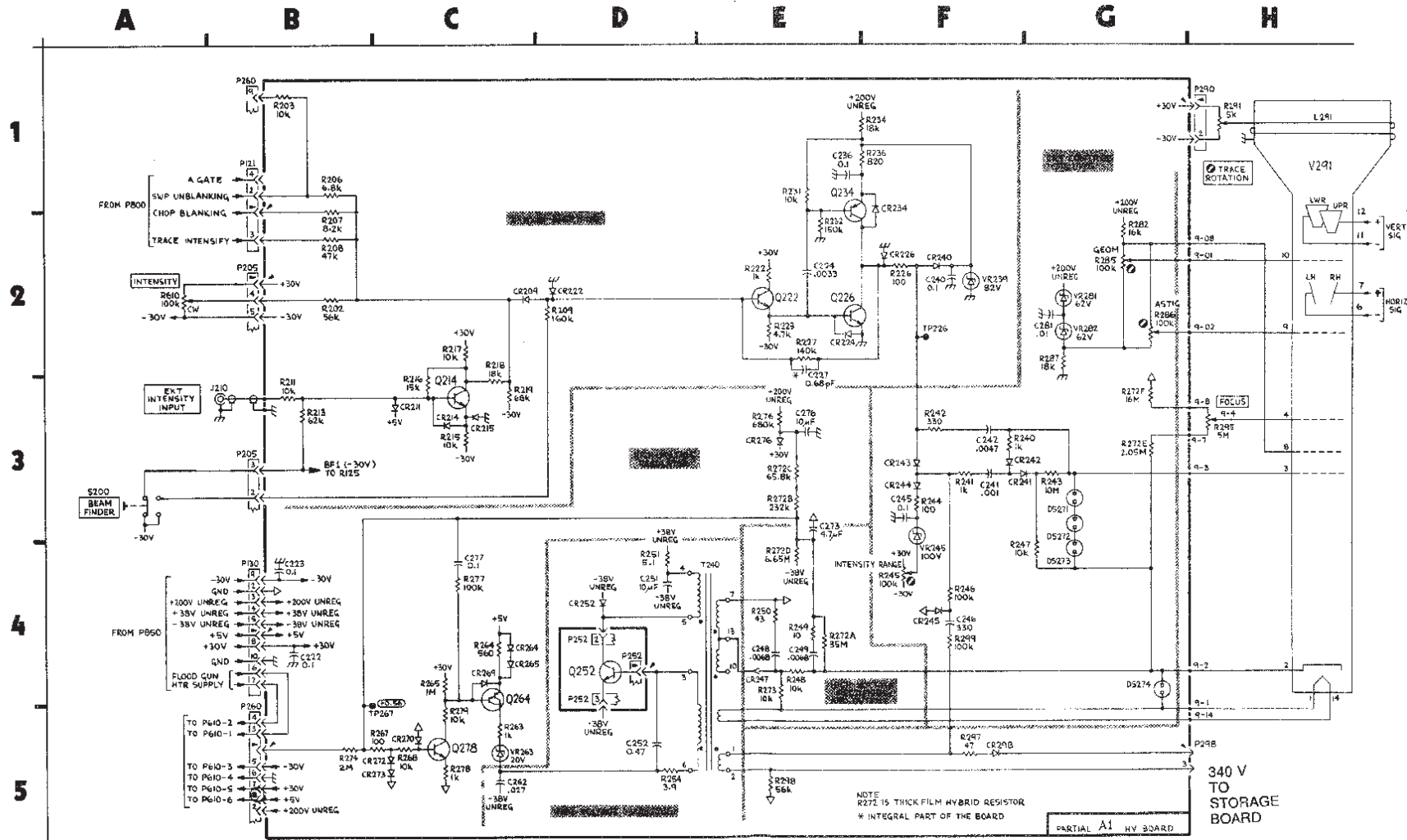
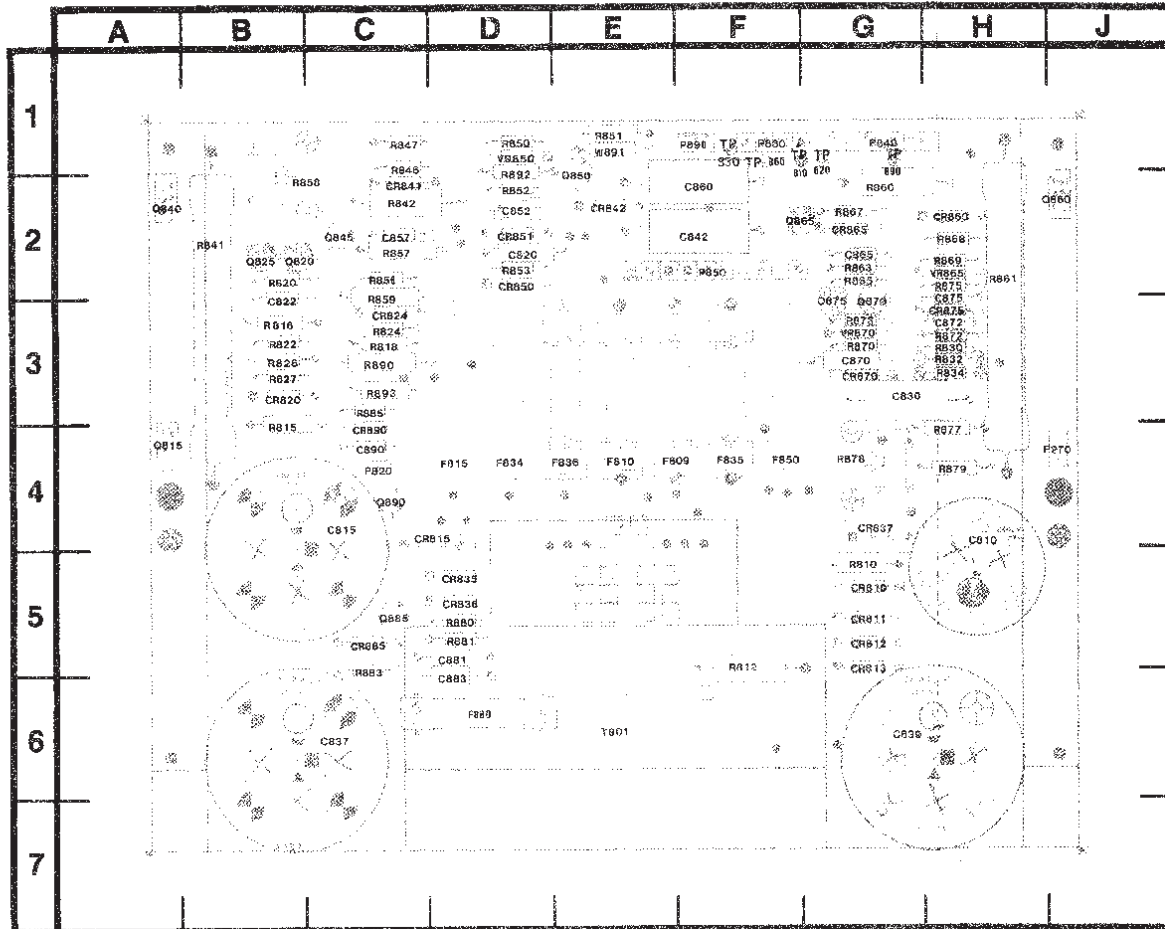


Figure 8-4. A1—High-Voltage Deflection circuit board assembly (SN B140959 & above)

4514-1075



CRT CIRCUIT DIAGRAM 3 (SN B140959 & above)



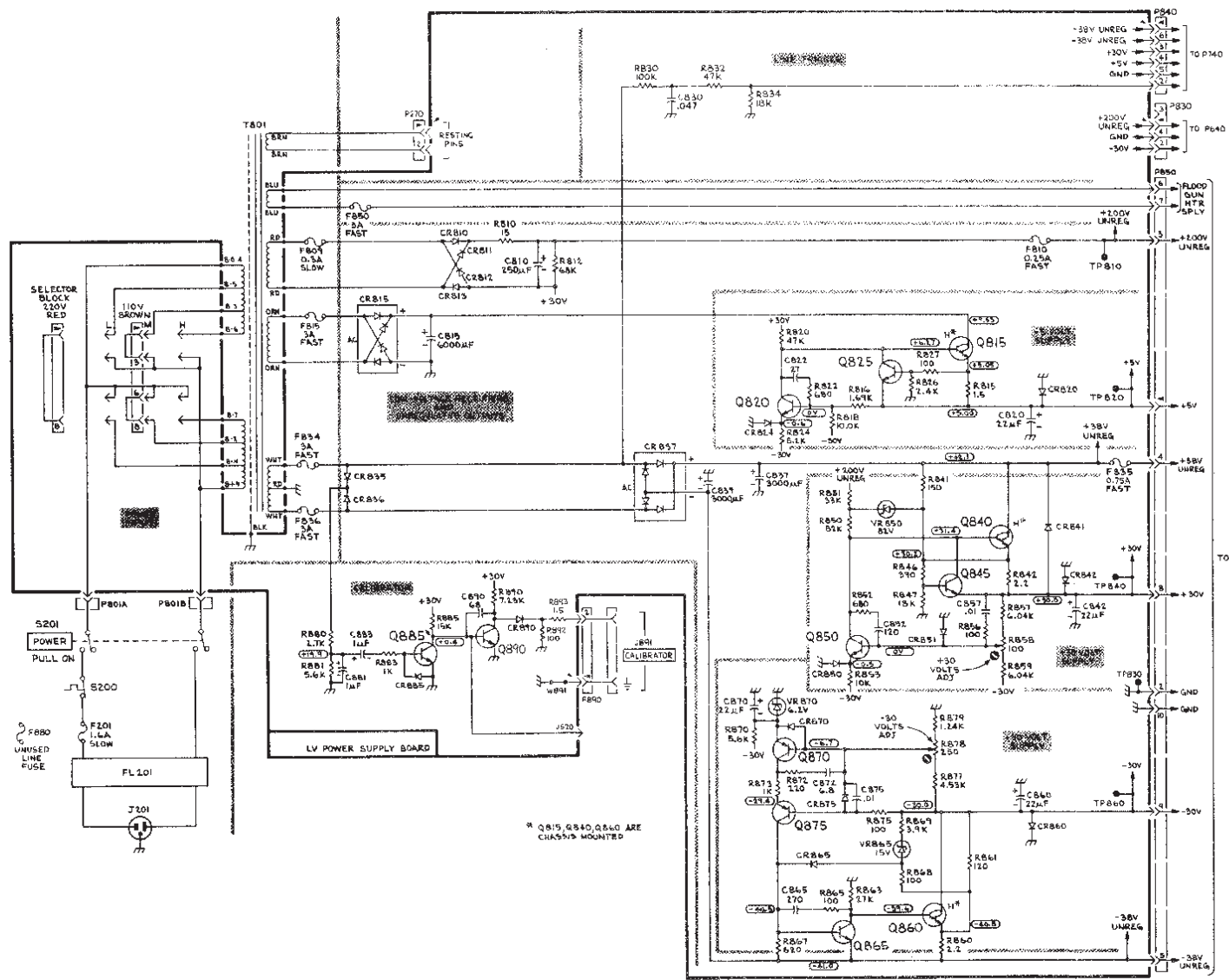
A4 Low Voltage Power Supply circuit board assembly (SN B140959 & above)

**LV POWER SUPPLY AND CALIBRATOR DIAGRAM
(SN B140959 & above)**

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
CR10	D2	H4	FB34	B3	D4	R851	F3	E1
CR15	C3	C4	FB35	G3	F3	R852	F4	D2
CR20	G3	D2	FB36	B4	E4	R853	F4	D2
CR22	E3	B3	FB50	C2	F3	R856	F4	C2
CR30	E1	G3	FB50	D6	D6	R857	G4	C2
CR37	E3	C6	F270	C1	J4	R858	G4	R2
CR39	E3	G6	FB30	H1	F1	R859	G4	C2
CR42	G4	F2	FB40	G1	G1	R860	F6	G2
CR52	F4	D2	FB50	H2	F2	R861	F6	H2
CR57	F4	C2	FB90	D6	F1	R863	F6	G2
CR60	G5	F2				R865	F6	G2
CR65	G6	G2	QB15	F3	A4	R867	E6	G2
CR70	E5	G3	QB20	E3	B2	R868	F6	H2
CR72	F5	H3	QB25	F3	B2	R869	F6	H2
CR75	F5	H3	QB40	F4	A1	R870	E5	G3
CR81	C4	D5	QB46	F4	C2	R872	E5	H3
CR83	C4	D6	QB50	F4	E2	R873	E5	G3
CR90	C4	C4	QB50	F8	J2	R875	F5	H2
			QB65	F6	F2	R877	F5	H4
CR10	C2	G6	QB70	E5	G3	R878	F5	G4
CR11	C2	G6	QB75	E5	G3	R879	F6	H4
CR12	C2	G6	QB85	C4	C6	R880	C4	D6
CR13	C2	G6	QB90	D4	C4	R881	C4	D5
CR15	C2	D4				R883	C4	C6
CR20	G3	B3	RB10	D2	G6	R885	C4	C3
CR24	E3	C3	RB12	D2	F6	R890	D4	C3
CR35	C3	D6	RB15	F3	B3	R882	D4	D2
CR36	C3	D6	RB15	F3	B3	R883	D4	C3
CR37	E3	G4	RB18	F3	B3			
CR41	G4	C2	RB18	F3	C3	T801	B1	E6
CR42	G4	E2	RB20	E3	B2			
CR850	F4	D2	RB22	E3	B3	TP810	G2	G1
CR851	F4	D2	RB24	E3	C3	TP820	G3	G1
CR860	G6	H2	RB26	F3	B3	TP830	G4	F1
CR865	E6	G2	RB27	F3	B3	TP890	G5	F1
CR870	E5	G3	RB30	D1	H3			
CR875	F6	H3	RB32	E1	H3	VR850	F4	D1
CR885	C5	C6	RB34	E1	H3	VR855	F5	H2
CR890	D4	C4	RB41	F3	B2	VR870	E6	G3
			RB42	G4	C2			
FB09	B2	E4	RB46	F4	C1	WB81	D5	E1
FB10	G2	E4	RB47	F4	C1			
FB15	B2	D4	RB60	F4	D1			

A B C D E F G H

1
2
3
4
5
6



LV POWER SUPPLY & CALIBRATOR DIAGRAM (SN B140959 & above) 4

This new exploded-view illustration replaces the one currently given in the manual for FIG. 1 DISPLAY. It is to be used in conjunction with the new Figure 1 parts list in the REPLACEABLE MECHANICAL PARTS LIST CHANGES section of this Manual Change Information insert.

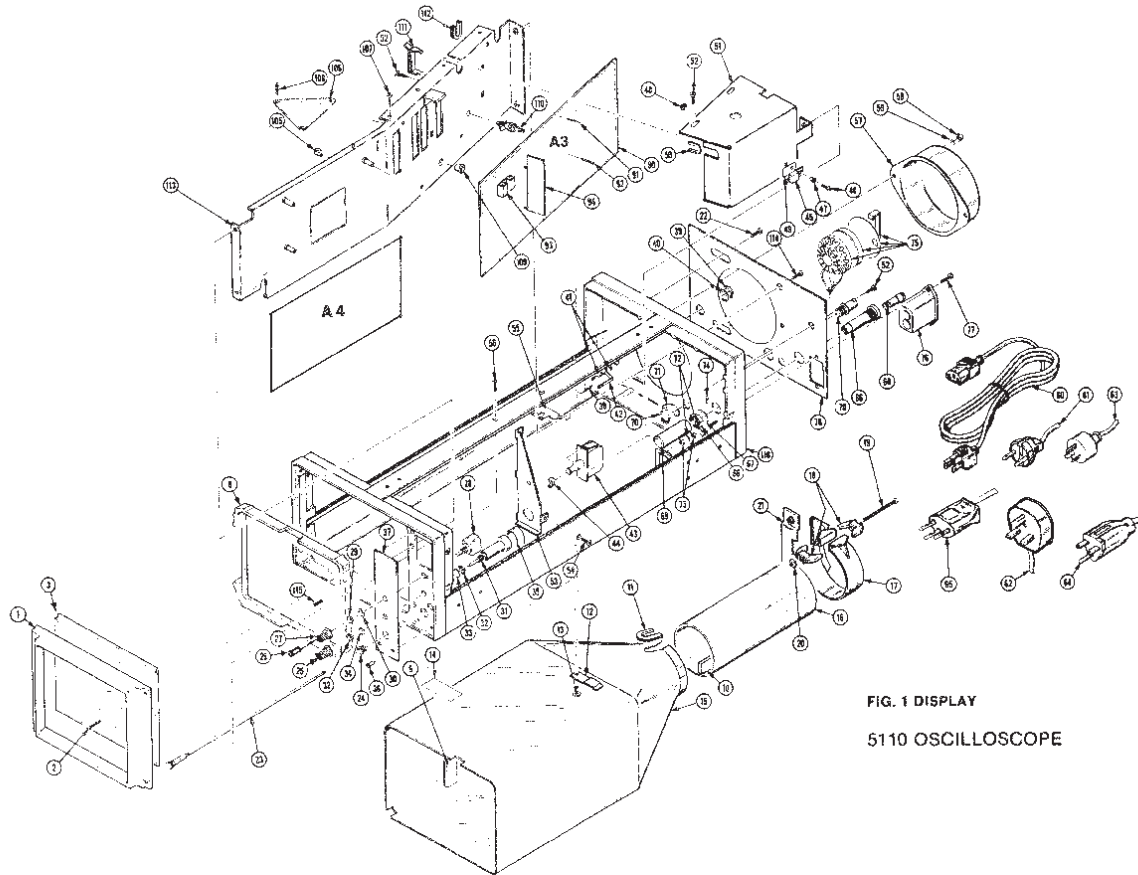


FIG. 1 DISPLAY

5110 OSCILLOSCOPE

This new exploded-view illustration replaces the one currently given in the manual for FIG. 2 MAINFRAME. It is to be used in conjunction with the new Figure 2 parts list given in the REPLACEABLE MECHANICAL PARTS LIST CHANGES section of this Manual Change Information insert.

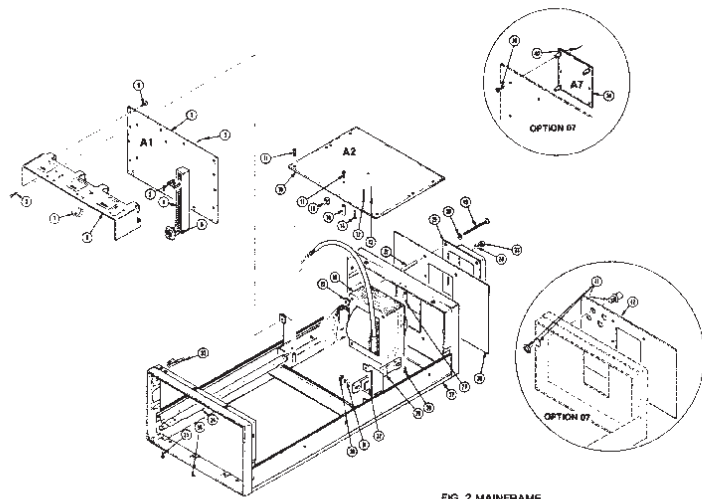
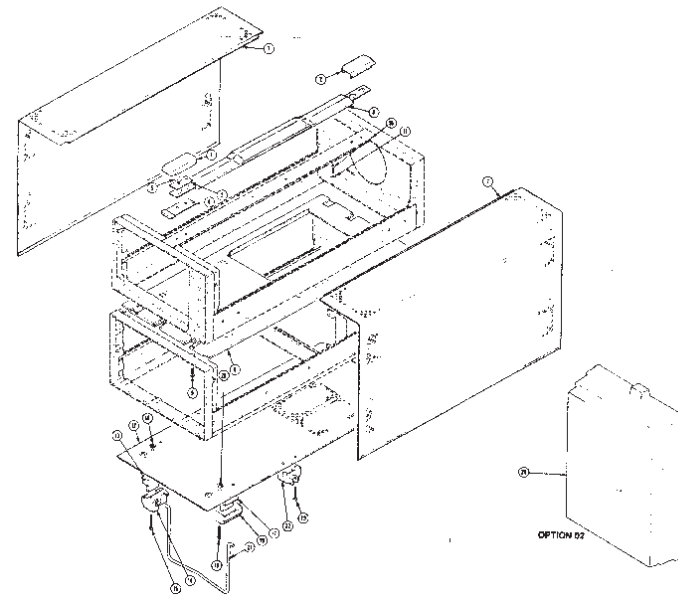


FIG. 2 MAINFRAME
5110 OSCILLOSCOPE

This new exploded-view illustration replaces the one currently given in the manual for FIG. 3 BENCH CABINET. It is to be used in conjunction with the new Figure 3 parts list given in the REPLACEABLE MECHANICAL PARTS LIST CHANGES section of this Manual Change Information insert.



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