TEKTRONIX®

5444
DUAL BEAM OSCILLOSCOPE

INSTRUCTION MANUAL

NOTE

A nomenclature change has been introduced for the 5000 Series products. The 5443/D44 is now called the 5444 Dual Beam Oscilloscope.

This composite manual incorporates the 5443 and D44 manuals, formerly bound under separate cover.

TEKTRONIX®

5444 DUAL BEAM OSCILLOSCOPE

INSTRUCTION MANUAL

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

Serial Number ____________________

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WARRANTY

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

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

Specifications and price change privileges reserved.

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INSTALLATION PROCEDURE

Before you start

1. Check the line voltage indicator. If the factory settings are compatible with the available line voltage and frequency, insert the desired plug-ins. Use the bail to raise the front of the instrument.

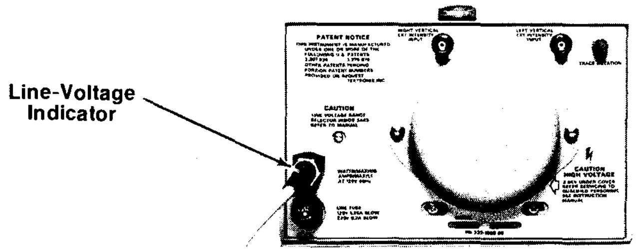


Fig. 0-1. Location of Line Voltage Indicator showing line voltage that instrument has been set to operate on.

. . . go to Operating Instructions . . .

2. If a change is needed, follow these steps:

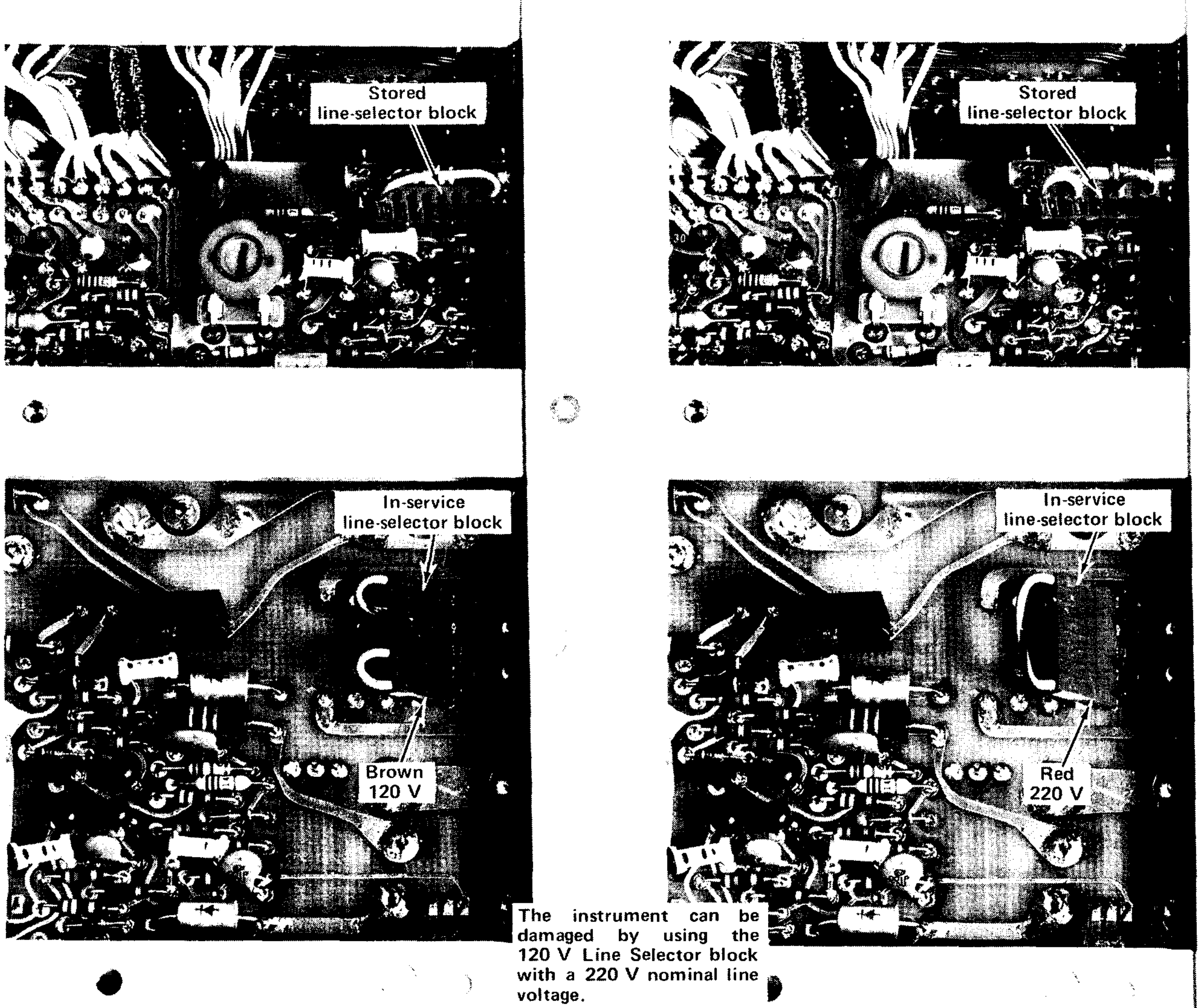


Fig. 0-2. Illustration showing a portion of power supply/amplifier module's L.V. power supply circuit board.

a. Line Selector Block(s)

a. Remove the Scope-Mobile retainer blocks and their screws, then remove the bottom dust cover from the power supply/amplifier module by turning the four slotted fasteners a 1/4 turn counterclockwise. This gives easy access to the Line Selector blocks located on the LV power supply circuit board.

Regulating Ranges for Power Transformer

Line Selector Block Position	Regulating Ranges	
	120 Volts Nominal	220 Volts Nominal
L	90 Vac to 110 Vac	180 Vac to 220 Vac
M	99 Vac to 121 Vac	198 Vac to 242 Vac
H	108 Vac to 132 Vac	216 Vac to 264 Vac
Line Fuse Data	1.6 A slow-blow	1.0 A slow-blow

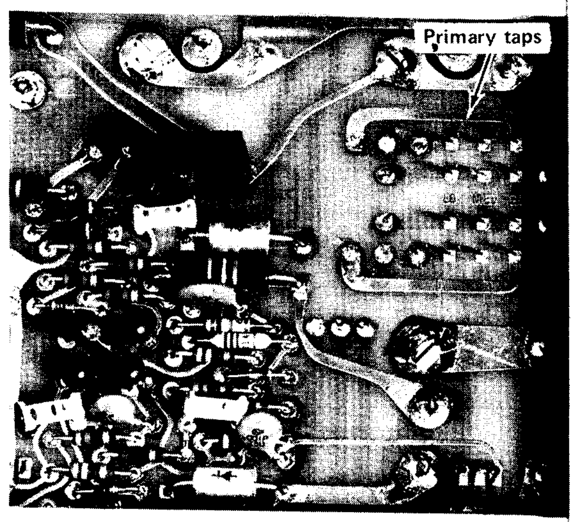


Fig. 0-3. Primary taps area of power supply/amplifier module's L.V. power supply circuit board.

b. Line Range Taps

c. Rear Panel

3. Replace the bottom dust cover and the two Scope-Mobile retainer blocks on the power supply/amplifier module.

4. If necessary, change the line cord power plug to match the power source receptacle or use an adapter.

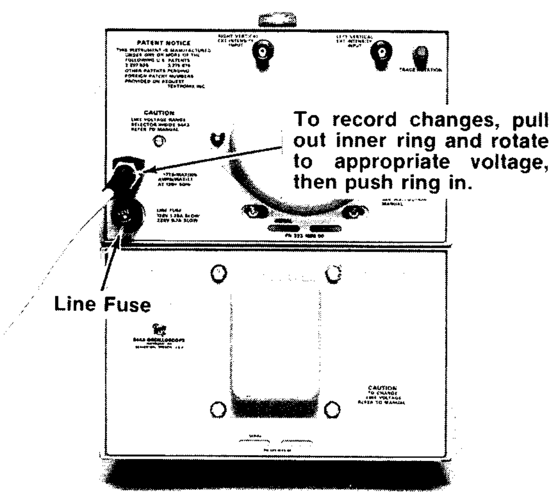


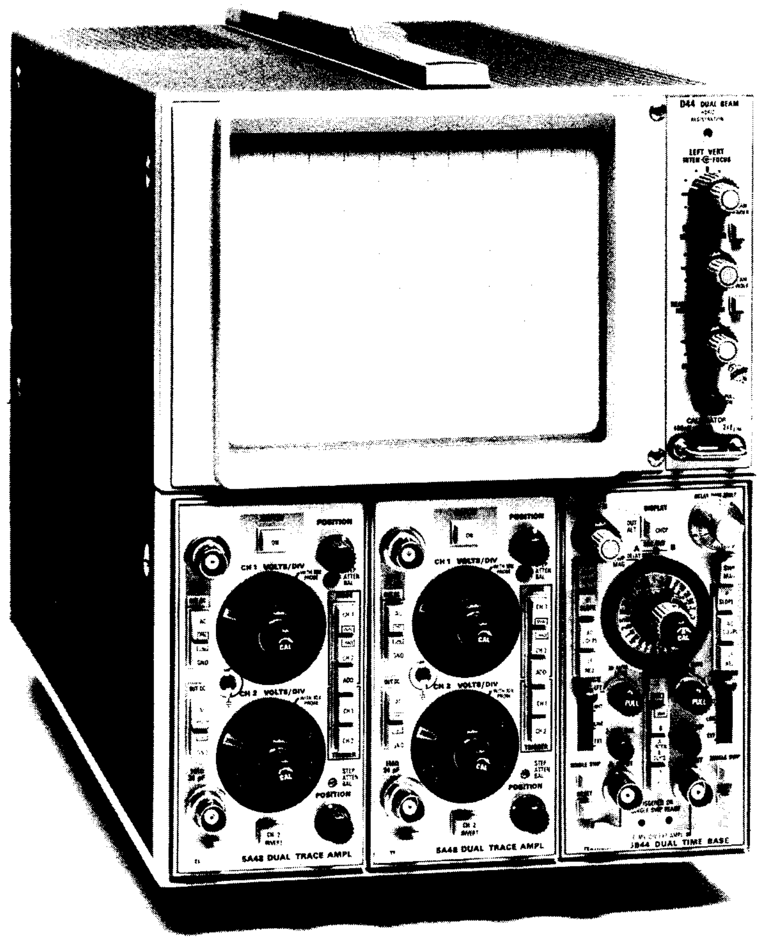
Fig. 0-4. View showing rear-panel of power supply/amplifier module.

5. Plug the cord into the power source.

6. Insert the desired plug-ins.

7. Use the bail to raise the front of the instrument.

. . . go to Operating Instructions. . .


D44 DUAL BEAM
POSITION
CH 1 VOLTS/DIV
CH 2 VOLTS/DIV
5A48 DUAL TRACE AMPL
5A48 DUAL TRACE AMPL
DUAL TIME BASE

OPERATING INSTRUCTIONS

The D44 Dual Beam display module operates with a Tektronix 5443 power supply/amplifier module to form an oscilloscope mainframe. This section gives a familiarization procedure and general operating information.

The Installation section of the 5443 instruction manual should be refered to for initial preparation. It contains information for installation of plug-ins, correct operating voltage and temperature, and general oscilloscope usage.

A brief description of the function of the front and rear panel controls and connectors is given on the controls and connectors foldout page. More detailed information is given under General Operating Information.

BASIC OPERATION

Setup Information

The following steps demonstrate the use of the controls and connectors of the D44.

1. Make sure the oscilloscope system is complete. The D44 must be properly connected to the power supply/amplifier module. A 5A-series amplifier plug-in should be in each of the vertical (left and center) plug-in compartments and a 5B-series time-base plug-in should be in the horizontal (right) compartment.

2. Set the POWER switch to off (pushed in) and connect the D44 to a power source that meets the voltage and frequency requirements of this instrument (see Installation section either in this manual or in the 5443 manual).

3. Turn the LEFT VERT and RIGHT VERT INTENSITY controls and the READOUT INTENS control counterclockwise and pull the POWER switch out to turn the instrument on. Set the plug-in front-panel control as follows:

Amplifier Plug-Ins
(5A48 plug-ins were used for this example)

Display	On
Position	Centered
CH 1 Volts/Div	.1
CH 1 Variable Volts/Div	Cal (fully clockwise)
CH 2 Input Coupling	DC
Trigger	CH 1
Mode	CH 1

Time-Base Plug-In
(5B44 plug-in was used for the example)

Display	Alternate (Button out)
A Position	Centered
B Position	Centered
A Sec/Div	5 ms
B Sec/Div	5 ms
A Variable Seconds/Div	Cal (fully clockwise)
A Mag	Off (Button out)
B Mag	Off (Button out)
A Level	Counterclockwise
B Level	Counterclockwise
Source	Left
Coupling	AC Coupl, + SLOPE
Mode	A and B buttons pushed in to obtain Dual Sweep operation

4. Advance the LEFT VERT and RIGHT VERT INTENSITY controls until the traces are at the desired viewing level. The traces should appear near the graticule center.

5. Connect a 1X probe or test lead from the CH 1 input connector on each of the amplifiers to the CALIBRATOR loop.

6. Turn the A and B Trigger Level controls clockwise until a stable display is obtained. Adjust the vertical and horizontal Position controls so that the displays are centered vertically and start at the left edge of the graticule.

7. Adjust the LEFT VERT FOCUS and RIGHT VERT FOCUS controls for a sharp, well-defined display over the entire trace length of each display.

8. Disconnect the input signals and position the traces vertically so that they coincide with the center horizontal line of the graticule.

9. If the traces are not parallel with the center horizontal line, see the Trace Alignment Adjustment procedure in this section.

10. Rotate the GRAT ILLUM control throughout its range and notice that the graticule lines are illuminated as the control is turned clockwise. Set the control so graticule lines are illuminated as desired.

Calibration Check

11. Move the traces two divisions below graticule center and reconnect the calibrator signal to CH 1 input connectors on both the amplifier plug-ins.

12. The superimposed displays should be four divisions in amplitude with six complete cycles (five complete cycles for 50-hertz line frequency) shown horizontally. An incorrect display indicates that the oscilloscope mainframe or plug-ins need to be recalibrated, unless the displays are not superimposed because of a horizontal shift. Adjustment of the front-panel HORIZ REGISTRATION control will superimpose the displays again.

Readout

13. Turn the READOUT INTENSITY control clockwise until an alpha-numeric display is visible within the top and bottom divisions of the crt (reset the FOCUS adjustments if necessary for best definition of the readout). Change the Volts/Div switches of the amplifier plug-ins that are selected for display. Note that the readout portion of the display changes as the deflection factor is changed. Likewise, change the Sec/Div switches of the time-base unit. Notice that the readout display for the time-base unit changes also as the sweep rates are changed.

14. Set both sweeps of the time-base unit for magnified operation. Notice that the readout display changes to indicate the correct magnified sweep rate. If readout-coded 10X probes are available for use with vertical units, install them on the CH 1 input connector of the vertical plug-ins. Notice that the deflection factor indicated by the readout is increased by 10 times when the probes are added. Return both sweeps of the time-base unit to normal sweep operation and disconnect the probes.

15. Notice that the readout from a particular plug-in occupies a specific location on the display area. If either of the vertical plug-in units is a dual-trace unit, notice that the readout for channel 2 appera within the lower division of the crt below the readout for channel 1.

Beam Finder

16. Move the left vertical display off-screen with the left vertical position control.

17. Push the left vertical BEAM FINDER button and observe that the display compresses into the screen area. Reposition the display to screen center using the left vertical position control and release the BEAM FINDER button.

External Intensity Input

18. Connect a 5-volt, 1 kHz sinewave or square-wave signal to both the LEFT VERT and RIGHT VERT EXT INTENSITY INPUT connectors on the rear panel of the D44. Also, use the signal to externally trigger both the time-base plug-in sweeps.

19. Slowly rotate the LEFT VERT and RIGHT VERT INTENSITY controls counterclockwise until the traces appear to be a series of dimmed and brightened segments. The brightened segments correspond with the tops of the square-waves.

This completes the description of the basic operating procedure for the D44. Instrument operations not explained here, or operations which need further explanation are discussed under General Operating Information.

GENERAL OPERATING INFORMATION

Graticule

The graticule of the D44 is internally marked on the faceplate of the crt to provide accurate, parallax-free measurements. The graticule is marked with 8 vertical and 10 horizontal divisions. Each division is 1.22 cm by 1.22 cm. In addition, each major division is divided into 5 minor divisions. The vertical gain and horizontal timing are calibrated to the graticule so that accurate measurements can be made from the graticule. The illumination of the graticule lines can be varied with the GRAT ILLUM control.

Intensity Control

The intensity of the displays on the crt is controlled by the LEFT VERT and RIGHT VERT INTENSITY controls. These controls are adjusted so the displays are easily viewed but not overly bright. It will probably require readjustment for different types of displays or sweep rates. Particular care should be exercised when only a spot is displayed. A high-intensity spot may burn the crt phosphor and cause permanent damage to the crt if allowed to remain too long.

Display Focus

If well-defined displays cannot be obtained with the LEFT VERT and RIGHT VERT FOCUS controls, even at low intensity settings, adjustment of the internal astigmatism control may be required.

To check for proper setting of the Left and Right Astig controls, slowly turn the appropriate FOCUS control through the optimum setting with a signal displayed on the crt screen. If the associated Astig control 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 Adjustment

If the free-running traces are not parallel with the horizontal graticule lines, set the Trace Rotation adjustment (rear-panel knob) as follows: Position the traces to the center horizontal line and adjust the Trace Rotation adjustment so that the traces are both parallel with the horizontal graticule lines. If necessary, compromise the adjustment so both traces are as parallel as possible to the graticule lines.

Horizontal Beam Registration

If the left and right beams do not start from the same horizontal position, the front-panel HORIZ REGISTRATION positions the left beam to the same starting position as the right beam. Always check and readjust the HORIZ REGISTRATION at the sweep rate to be used.

Beam Finder

The LEFT VERT and RIGHT VERT BEAM FINDER switches provide a means of locating a display that overscans the viewing area either vertically or horizontally. When the appropriate BEAM FINDER switch is pressed, the associated 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 appropriate BEAM FINDER switch, hold it in, then increase the vertical and horizontal deflection factors for that beam until the display is within the graticule area.

2. Adjust the vertical and horizontal position controls for the appropriate beam to center the display about the vertical and horizontal center lines.

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

Readout (Works Only With the 5400-Series Plug-In Units—Identified By A Single Slot At The Rear Interface Connector)

The readout system of the power supply/amplifier and display modules allow an alpha-numeric display of information on the crt, along with the analog waveform displays. The information displayed by the readout system is obtained from the plug-in units that are installed in the plug-in compartments. The characters of the readout display are written by the crt right beam on a time-shared basis with the signal waveforms.

The readout system operates a free-running mode to interrupt only right vertical waveform display (from the vertical plug-in in the center compartment) to present characters. The right vertical waveform display is interrupted for only about 20 microseconds for each character that is displayed. The left vertical waveform is not interrupted at all by the readout information.

The readout information from each plug-in is called a word. Up to six (eight with option 3) words of readout information can be displayed on the display module (a seventh and eighth word is available when option 3 is installed). The location at which each readout word is presented is fixed and is directly related to the plug-in unit and channel from which it originated. Fig. 1-1 shows the area of the graticule where the readout from each plug-in unit channel is displayed (external read-out programming is available only with option 3). Notice that the readout from channel 1 of each plug-in unit is displayed within the top division of the graticule and the readout from channel 2 is displayed directly below in the bottom division of the graticule. Only the readout from plug-in channels that are selected by display switches or by the mode switches of dual channel plug-ins appear in the readout display.

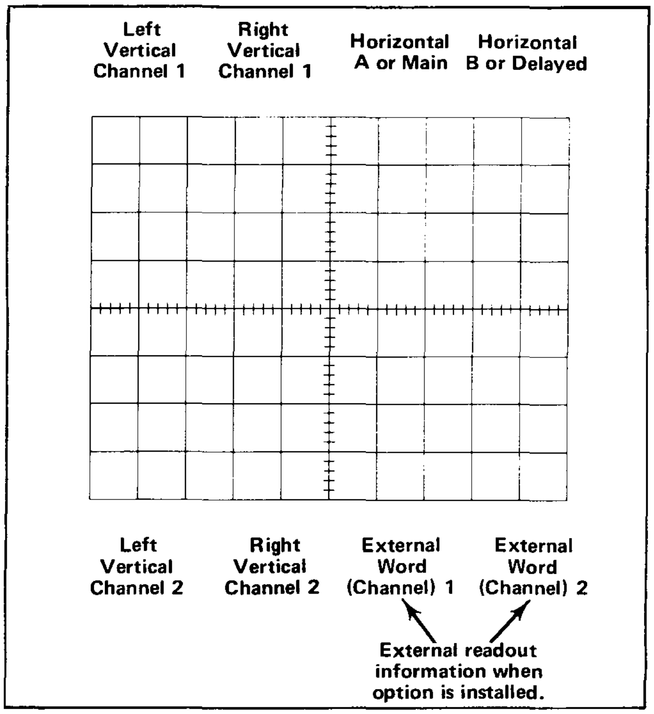


Fig. 1-1. Location of readout on the crt identifying the originating plug-in unit and channel (and external, if Option 3 is installed).

The READOUT INTENSITY control determines the intensity of only the readout portion of the display independent of the other traces. The readout system is inoperative in the fully counterclockwise OFF postion. This may be desirable when the top and bottom divisions of the graticule are to be used for waveform display or when the right vertical trace interruptions necessary to display characters, do not allow a satisfactory right vertical waveform display to be obtained.

Option 3, Externally Programmed Seventh and Eighth Readout Words

This option adds a 25-pin connector to the rear-panel of the display module, through which two 10-character readout words can be displayed on the crt (see Fig. 1-1).

Intensity Modulation

Intensity (Z-Axis) modulation can be used to relate a third item of electric phenomena to the vertical (Y-Axis) and horizontal (X-Axis) coordinates without affecting the waveshape of the displayed signal. The Z-Axis modulating signal, applied to the appropriate (LEFT or RIGHT) EXT INTENSITY INPUT, changes the intensity of the associated waveform to provide this type of display. The voltage amplitude required for visible trace modulation depends on the setting of the associated INTENSITY control. About +5 volts will turn on the display to a normal brightness level from an off level, and about −5 volts will turn the display off from a normal brightness level. "Gray scale" intensity modulation can be obtained by applying signals between these levels. Maximum safe input voltage is ±50 volts. Usable frequency range of either Z-Axis circuit is dc to 2 megahertz.

Time markers applied to the appropriate (LEFT or RIGHT) 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 display waveform, a single-sweep display should be used (for internal sweep only) to provide a stable display.

Calibrator

The internal calibrator of the D44 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.

Display Photography

A permanent record of the crt display can be obtained with an oscilloscope camera system. The crt bezel of the D44 provides integral mounting for a Tektronix oscilloscope camera. The instruction manuals for the Tektronix oscilloscope cameras include complete instructions for obtaining waveform photographs.

Oscilloscope Applications

The 5443 oscilloscope, including its associated display module and plug-in units, provides a very flexible measurement system. Specific applications for the individual plug-ins are described in the manuals for those units. Refer to the Operating Instructions section of the 5443 instruction manual for basic oscilloscope applications, including peak-to-peak ac voltage measurements, instantaneous dc voltage measurements, comparison measurements, time duration measurements, determining frequency, risetime measurements and phase difference measurements.

SPECIFICATIONS

The electrical specifications are valid only if (1) the instrument has been calibrated at an ambient temperature between +20°C and +30°C; (2) the instrument is operating at an ambient temperature between 0°C and +50°C, unless otherwise noted; (3) each plug-in must be operating (fully installed) in a calibrated system.

Unless otherwise stated, specifications are refered to the plug-in connectors of the 5443. Any conditions that are unique to a particular specification are stated as part of that specification.

TABLE 1-1
5443-D44 Vertical Amplifier

Characteristics	Performance Requirements	Supplemental Information
Input Signal Amplitude (Differential) Bandwidth	DC to at least 60 MHz with 5A48	
Risetime	5.8 ns with 5A48	3.9 ns
Aberrations	3% when measured with a 5A48	
Vertical Centering		Within ±0.5 division of graticule center
Delay Line Length		140 ns
Modes	Chopped and alternate	
Rate Chopped	200 kHz ±50%, 3 μs on, 2 μs off.	
Alternate	Once every two sweeps	

TABLE 1-2
5443-D44 Horizontal Amplifier

Characteristics	Performance Requirements	Supplemental Information
Bandwidth	DC to at least 2 MHz	Eight division signal used as a reference.
Horizontal Centering		Within 0.5 division of graticule center.
X-Y Operation	Less than 1° phase shift from dc to at least 20 kHz.	

TABLE 1-3
D44 Z-Axis Amplifier

Characteristics	Performance Requirements	Supplemental Information
External Input Input Voltage	+5 V turns crt beam on from off condition −5 V turns crt beam off from on condition	
Usable Frequency Range	DC to 2 MHz	
Input Impedance	Resistance: 10 kΩ Capacitance: 40 pF	
Maximum Safe Input	50 V (DC + Peak AC)	

TABLE 1-4
D44 Cathode Ray Tube

Characteristics	Performance Requirements	Supplemental Information
Geometry	Bowing or tilt ≤0.1 division	
Orthogonality	±1.4° before any adjustment	
Photographic Writing Speed		
Phosphor	P31	
Deflection	Electrostatic with mesh magnification	
Acceleration Potential	18 kV	

TABLE 1-5
5443-D44 Power Supply and Calibrator

Characteristics	Performance Requirements	Supplemental Information
Power Line Input		
Line Voltage (rms)	Nominal 100 V, 110 V, 120 V, 200 V, 220 V, 240 V ±10%	
Line Frequency	50 to 400 Hz	
Input Power	105 W maximum at 120 Vac, 60 Hz	
Fuse Data	1.6 A slow-blow (120 Vac)	
	1.0 A slow-blow (220 Vac)	
Calibrator		
Voltage	400 mV, ±1%	
Current	4 mA, ±1%	
Frequency	Twice the power line frequency	

TABLE 1-6
5443-D44 Readout

Characteristics	Performance Requirements	Supplemental Information
Intensity Range		Off to full brightness. Readout inoperative when READOUT INTENS fully counterclockwise in detent position.
Location		Top words are displayed in top major graticule division between left and right extreme graticule lines. Bottom words are displayed in bottom major graticule division between left and right extreme graticule lines.

TABLE 1-7
D44 Miscellaneous

Characteristics	Performance Requirements	Supplemental Information
Graticule Scale	8 x 10 divisions with 1.22 cm/Div	
Scale Color and Type Normal	White internal graticule lines	
Beam Finder	Brings trace within viewing area and increases trace intensity to a visible level	

TABLE 1-8
5443-D44 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	With the instrument complete and operating, the vibration frequency is to be swept from 10 to 50 to 10 Hz at 1 minute per sweep. Vibrate 15 minutes in each of the three major axes at 0.015" total displacement. Hold 3 minutes at any major resonance or if none, at 50 Hz. Total time, 54 minutes.	The equipment should operate normally at the end of the test.
Shock Operating and Nonoperating	30 g's, 1/2 sine, 11 ms duration, 2 shocks in each direction along 3 major axes for a total of 12 shocks.	The equipment should operate normally after this test.

TABLE 1-9
5443-D44 Physical

Parameter	Information
Finish	Anodized aluminum panel with gray vinyl coated frame. Blue-vinyl cabinet
Overall Dimensions	See Fig. 1-2.

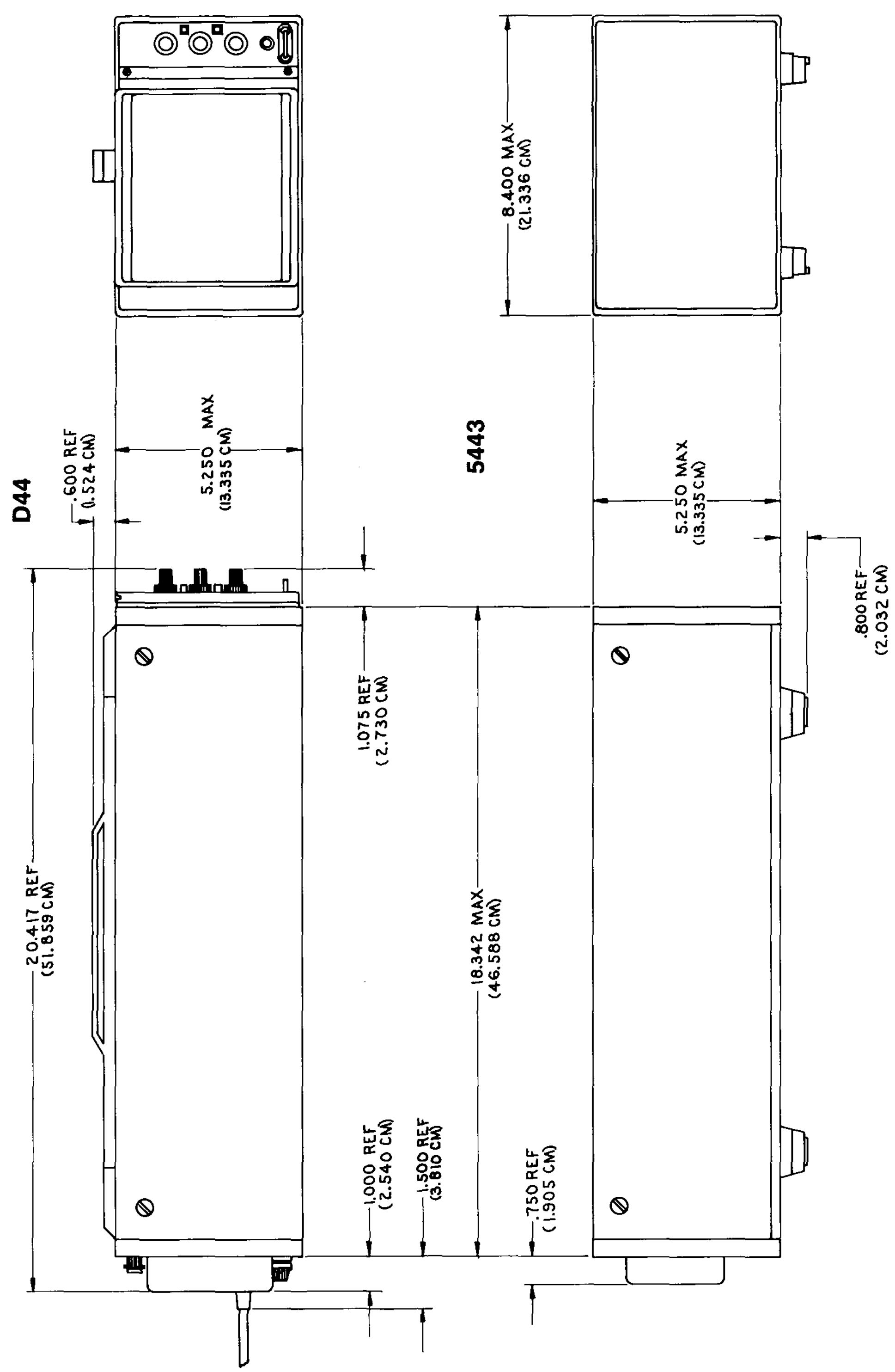


Fig. 1-2. Illustration showing dimensions of the cabinet version of the 5443 and D44.

THEORY OF OPERATION

Z-AXIS AMPLIFIER AND CRT CIRCUIT

The crt circuit produces the high voltage potentials and provides the control circuits necessary for operation of the cathode ray tube (crt). The Z-Axis amplifier circuit is included with the crt circuit discussion, since it sets the intensity of the crt display.

NOTE

Where the following description applies to the right and left beams, the circuit numbers used will be those of the right beam circuitry.

Z-Axis Amplifier

The Z-Axis amplifier is a current-driven, shunt-feedback operational amplifier with a voltage output. The amplifier consists of Q345, Q352, and Q356. The feedback path is from the Q352-Q356 collectors through C350-R349-R350 to the summing point at the base of Q345. Q352 and Q356 are connected as a collector-coupled complementary amplifier that provides a fast linear output signal while consuming minimum quiescent power. Q356 acts as the pull-up transistor and Q352 acts as the pull-down transistor for the amplifier. The output voltage from the amplifier provides the drive signal to control the crt intensity level through the control-grid supply.

The output voltage level of the Z-Axis amplifier is determined by the voltage drop across R349 and R350 in reference to the voltage level at the summing point for the amplifier (base of Q345).

The current through R349-R350 is determined by the input current from any combination of several sources, such as INTENSITY control, plug-in interface (trace and readout unblanking), and from Q320 and Q335. Q320 is an operational amplifier that sets the EXT INTENSITY INPUT connector signal to a level suitable for proper Z-Axis amplifier response. Q335 acts as an electronic switch to cause the crt display intensity to increase when the BEAM FINDER switch is pushed. Q340 acts as an impedance-matching and bias-setting transistor for the Z-Axis amplifier. CR352 and current limiting resistor R352 acts as a protection circuit for the Z-Axis amplifier in case of a high-voltage short.

High-Voltage Regulator

High-Voltage Primary. A repetitive, sinusoidal signal is produced by a regenerative feedback oscillator in the primary of T1040 and induced into the secondary. Current drive for the primary winding is furnished by Q1045.

The conduction of Q1045 is controlled by the collector voltage of Q1040.

High-Voltage Regulation. Regulation is accomplished by sampling the 3.6 kV across voltage divider R1051A. If the output level of the cathode supply goes above the nominal −3.6 kV (goes more negative), the input base of darlington transistor Q1035 goes negative from its quiescent 0 V. The output of Q1035 goes more positive, reducing the conduction of Q1040 and Q1045. This reduces the peak-to-peak sinusoidal signal amplitude, resulting in a reduced voltage in the secondary of T1040. Conversely, if the output drops below −3.6 kV (goes more positive), Q1045 will conduct harder, i.e., have a larger sinusoidal signal ammplitude. R1037 and C1037 limit the bandwidth of the regulator to prevent oscillations.

High-Voltage Outputs

The secondary winding of T1040 provides the negative and positive accelerating potentials for the crt and bias voltage for the control grids.

Positive accelerating voltage for the crt anode is supplied by voltage quadruple U1050. The applied voltage to the input of U1050 from the T1040 secondary winding is about +7.2 kV peak-to-peak. The output voltage of U1050 is about +14.4 kV at the crt anode. The negative accelerating voltage for the crt cathode is also obtained from the T1040 secondary winding. CR1050 half-wave rectifies the transformer output and supplies the −3.6 kV to the crt cathode.

Diodes CR1087 and CR1085 provide the rectified negative voltage for the crt control grid. The output level of this supply is set by Intensity Range adjustment R1080. Diodes CR1084 and CR1081 clip the crt grid bias voltage from the T1040 secondary, to determine the operating level at the control grid. CR1084 limits the negative excursions of the bias voltage, depending upon the output voltage of the Z-Axis amplifier. The positive clipping level at the cathode of CR1081 is set by the Intensity Range adjustment. CR1087 acts as a dc restorer and CR1085 as a rectifier. This results in a dc level across R1087 equal to the peak-to-peak excursion at the anode of CR1081.

CRT Control Circuits

In addition to the INTENSITY control discussed previously, front-panel FOCUS and internal astigmatism controls permit an optimum crt display to be obtained. FOCUS control R1052 provides the correct voltage for the second anode in the crt. Proper voltage for the third anode is obtained by adjusting Astig control R1020. 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.

Geometry adjustment R1000 varies the positive level on the horizontal deflection plate shields to control the overall geometry of the display. Trace Rotation control R375 permits adjustment of the dc current through beam-rotation coil L375 to align the display with the horizontal graticule lines. Orthogonality control R1016 permits adjustment of the dc current through the orthogonlaity coil L1016 to align a vertical trace at a right angle (90°) to a horizontal trace at the center of the crt screen.

Bowing adjustments of Trace (R1009), Start (R1010), and End (R1012) varies the positive level on the horizontal deflection plate bowing shield and the inner and outer horizontal deflection plate shields respectively.

CRT Heater Winding

A separate T1040 secondary winding is provided for the crt writing-gun heaters. The writing-gun heaters are elevated to −3600 volts in the crt circuit to maintain a potential near that of the crt cathode.

HORIZONTAL AMPLIFIER

The horizontal amplifier amplifies the push-pull horizontal deflection signal from the interface circuit board and applies it to the horizontal deflection plates of the crt.

NOTE

Where the following description applies to the right and left beams, the circuit numbers used will be those of the right beam circuitry only.

Input Amplifier

The horizontal signal from the interface circuit board is connected to the bases of Q200 and Q215. Under no-signal conditions, the bases of Q200 and Q215 are within 150 mV of ground. Resistive network R205-R207-R210-R212-R213, between the emitters of Q200 and Q215, controls the emitter degeneration of this stage. R212 provides a means of adjusting the emitter degeneration of the input amplifier and thereby controls the gain of the horizontal amplifier to within ±10%.

To compress an over-scanned display so that it may be viewed on the crt, the BEAM FINDER reduces the gain of the input amplifier. This is done by disconnecting CR208 in the emitter circuitry of Q200-Q215 and supplying a reduced current through current limiting resistors R205, R208, and R213.

Resistors R202 and R217 provide thermal compensation for the input amplifier, while R222 provides a means of correcting for differential unbalance in the amplifier or crt.

Output Amplifier

Transistors Q240, Q244 and Q280 are connected as two separate current-driven feedback amplifiers. Input transistor Q240 (in the left output amplifier) is a NPN transistor, providing good response to positive-going signals, while input transistor Q270 (in the right output amplifier) is a PNP transistor that provides good negative-going signal response.

The HORIZ REGISTRATION control, which is part of the left horizontal amplifier, adds a small amount of current to the base of Q1270 which results in a small horizontal movement of the horizontal display. This allows alignment of the left and right beam displays.

Negative feedback is provided from the collectors of output transistors Q244, Q250 and Q280 to the base of input transistors Q240 and Q270 through feedback networks C242-R242-R238 and C272-R272-R268. Capacitors C242 and C272 adjust the transient response of the feedback networks to provide good linearity at fast sweep rates. The Zener diode and fast switching diode combinations (CR242-VR240 and CR272-VR270) turn on when the sweep passes the right edge of the crt. This action stops the collectors of the output transistors and shunts out the feedback networks, thus current limiting the output amplifer. Capacitors C240, C250 and C280 are speed-up capacitors to improve the amplifier response to fast changes. Diodes CR246 and CR274 prevent Q244 and Q274 from going into saturation.

VERTICAL AMPLIFIER

The vertical amplifier provides the final amplification for the vertical signal before it is applied to the vertical deflection plates of the crt. The vertical amplifier circuitry includes the delay line and part of the beam finder circuit that reduces the final drive to compress an over-scanned display to within the viewing area of the crt.

NOTE

Where the following description applies to the right and left beams, the circuit numbers used will be those of the right beam circuitry.

Delay Line

Delay line DL100 provides approximately 140 ns of delay for the vertical signal. This allows the time-base circuits time to initiate a sweep before the vertical signal reaches the crt deflection plates. This delay of the vertical signal allows the leading edge of the signal originating the trigger pulse to be displayed when using internal triggering.

The delay line has a characteristic input impedance of about 75 ohms or about 150 ohms from side-to-side.

Amplifier

The vertical amplifier consists of a wide bandpass, three-stage paraphase amplifier having an input sensitivity of approximately 35 mV/division and a voltage gain of about 115. The amplifier is differentially driven at the bases of Q100 and Q125 by the input signal from the delay line. R100 and R125 terminate the delay line.

The first amplifier stage consists of Q100, Q106, Q125, and Q130. The gain of this stage is determined by the ratio of the feedback resistors R104-R103 or R128-R129 and emitter resistor R111. The networks parallel to the emitter resistor compensates for the signal losses in the delay line. R135 acts as a dc centering control that compensates for resistive tolerance errors and crt electrical center error in the vertical amplifier and allows the mainframe input to be standardized.

The next stage of amplification consists of Q148, Q170, Q168, and Q172. Thermistor RT157, resistor R157, varicap CR146, and capacitor C160 between the emitters of Q148 and Q165 comprise a thermal compensation network to correct for frequency loss with temperature changes. The two RC networks (R151-C156 and R155-C153-C155) in the emitters of Q148 and Q165 and the RCL network in the collectors of Q148 and Q165 provide high frequency compensation.

The final amplifier stage consists of Q180, Q188, Q182, and Q190. R175 provides a means of adjusting the vertical amplifier gain within a ±20% range.

Pushing the BEAM FINDER compresses an off-screen display to determine its location. When the BEAM FINDER is pushed, Q140 is turned off, which reduces the standing current in the second amplifier stage. This lowers the voltage drop across R173 and R176, which lowers the standing current in the final amplifier stage. The lower final amplifier stage standing current reduces the possible scan on the crt.

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

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

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

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

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

SPECIAL NOTES AND SYMBOLS

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

ITEM NAME

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

ABBREVIATIONS

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

CROSS INDEX MFR. CODE NUMBER TO MANUFACTURER

MFR.CODE	MANUFACTURER	ADDRESS	CITY,STATE,ZIP
01121	ALLEN-BRADLEY CO.	1201 2ND ST. SOUTH	MILWAUKEE, WI 53204
01281	TRW ELECTRONIC COMPONENTS, SEMICONDUCTOR OPERATIONS	14520 AVIATION BLVD.	LAWNDALE, CA 90260
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P. O. BOX 5012	DALLAS, TX 75222
02735	RCA CORP., SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
03508	GENERAL ELECTRIC CO., SEMI-CONDUCTOR PRODUCTS DEPT.	ELECTRONICS PARK	SYRACUSE, NY 13201
04713	MOTOROLA, INC., SEMICONDUCTOR PRODUCTS DIV.	5005 E. MCDOWELL RD.	PHOENIX, AZ 85036
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS ST.	MOUNTAIN VIEW, CA 94042
07910	TELEDYNE SEMICONDUCTOR	12515 CHADRON AVE.	HAWTHORNE, CA 90250
14936	GENERAL INSTRUMENT CORP., SEMICONDUCTOR PRODUCTS GROUP	600 W. JOHN ST.	HICKSVILLE, NY 11802
24931	SPECIALTY CONNECTOR CO., INC.	3560 MADISON AVE.	INDIANAPOLIS, IN 46227
50157	N. L. INDUSTRIES, INC., ELECTRONICS DEPT.	P. O. BOX 787	MUSKEGON, MI 49443
56289	SPRAGUE ELECTRIC CO.		NORTH ADAMS, MA 01247
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71744	CHICAGO MINIATURE LAMP WORKS	4433 RAVENSWOOD AVE.	CHICAGO, IL 60640
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BlVD.	FULLERTON, CA 92634
73445	AMPEREX ELECTRONIC CORP.	230 DUFFY AVE.	HICKSVILLE, L. I., NY 11802
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
80009	TEKTRONIX, INC.	P. O. BOX 500	BEAVERTON, OR 97077
80031	ELECTRA-MIDLAND CORP., MEPCO DIV., A NORTH AMERICAN PHILLIPS CO.	22 COLUMBIA RD.	MORRISTOWN, NJ 07960
81483	INTERNATIONAL RECTIFIER CORP.	9220 SUNSET BlVD.	LOS ANGELES, CA 90069
83003	VARO, INC.	800 W. GARLAND AVE.	GARLAND, TX 75040
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NB 68601
91929	HONEYWELL, INC., MICRO SWITCH DIV.	CHICAGO & SPRING STS.	FREEPORT, IL 61032
93410	ESSEX INTERNATIONAL, INC., CONTROLS DIV. MANSFIELD PLANT	P. O. BOX 1007	MANSFIELD, OH 44903

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-3881-00			CKT BOARD ASSY:VERTICAL AMPL,RIGHT	80009	670-3881-00
A2	670-4045-00			CKT BOARD ASSY:VERTICAL AMPL,LEFT	80009	670-4045-00
A3	670-3160-00			CKT BOARD ASSY:HORIZONTAL AMPL	80009	670-3160-00
A4	670-3141-00			CKT BOARD ASSY:HIGH VOLTAGE	80009	670-3141-00
A5	670-3211-00			CKT BOARD ASSY:FRONT PANEL CONTROL	80009	670-3211-00
A6	670-0702-04			CKT BOARD ASSY:GRATICULE LAMP	80009	670-0702-04
C100	281-0604-00			CAP.,FXD,CER DI:2.2PF,+/-0.25PF,500V	72982	301-000C0J0229C
C101	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C102	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C115	281-0204-00			CAP.,VAR,PLSTC:2-22PF,100V	80031	C010EA-20E
C120	281-0638-00			CAP.,FXD,CER DI:240PF,5%,500V	72982	301-000Z5D0241J
C121	283-0032-00			CAP.,FXD,CER DI:470PF,5%,500V	72982	831-500Z5D471J
C123	281-0524-00			CAP.,FXD,CER DI:150PF,+/-30PF,500V	72982	301-000X5U0151M
C127	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C148	281-0623-00			CAP.,FXD,CER DI:650PF,5%,500V	72982	301-000Y5D0651J
C153	281-0651-00			CAP.,FXD,CER DI:47PF,5%,200V	72982	374-001T2H0470J
C155	281-0204-00			CAP.,VAR,PLSTC:2-22PF,100V	80031	C010EA-20E
C156	281-0651-00			CAP.,FXD,CER DI:47PF,5%,200V	72982	374-001T2H0470J
C160	281-0651-00			CAP.,FXD,CER DI:47PF,5%,200V	72982	374-001T2H0470J
C165	281-0623-00			CAP.,FXD,CER DI:650PF,5%,500V	72982	301-000Y5D0651J
C167	281-0634-00			CAP.,FXD,CER DI:10PF,+/-0.25PF,500V	72982	374-011C0G0100C
C170	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C180	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C181	281-0203-00			CAP.,VAR,PLSTC:2-10PF,100V	80031	C010EA/10E
C184	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	72982	301-000X5P0331K
C185	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	72982	301-000X5P0331K
C188	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C192	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C197	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C198	290-0523-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	196D225X0025HA1
C210	281-0205-00			CAP.,VAR,PLSTC:5.5-65PF,100V	80031	C010GA/60E
C211	281-0519-00			CAP.,FXD,CER DI:47PF,+/-4.7PF,500V	72982	308-000C0G0470K
C235	281-0202-00			CAP.,VAR,PLSTC:1.5-5.5PF,100V	80031	C010EA-5E
C240	283-0057-00			CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	274C10
C242	281-0557-00			CAP.,FXD,CER DI:1.8PF,10%,500V	72982	301-000C0K0189B
C244	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C250	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C252	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C266	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C272	281-0557-00			CAP.,FXD,CER DI:1.8PF,10%,500V	72982	301-000C0K0189B
C280	283-0110-00			CAP.,FXD,CER DI:0.005UF,+80-20%,150V	56289	19C242B
C330	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C335	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C342	281-0609-00			CAP.,FXD,CER DI:1PF,+/-0.1PF,500V	72982	374-005C0K01098
C345	281-0584-00			CAP.,FXD,CER DI:100PF,5%,500V	72982	301-000Y5D0101J
C350	281-0064-00			CAP.,VAR,PLSTC:0.25-1.5PF,600V	72982	530-002
C352	283-0057-00			CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	274C10
C353	283-0057-00			CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	274C10
C354	283-0110-00			CAP.,FXD,CER DI:0.005UF,+80-20%,150V	56289	19C242B
C360	283-0057-00			CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	274C10
C1000	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C1002	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C1008	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C1010	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C1037	283-0010-00			CAP.,FXD,CER DI:0.05UF,+100-20%,50V	56289	273C20
C1043	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8141N038651105Z

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C1046	283-0110-00			CAP.,FXD,CER DI:0.005UF,+80-20%,150V	56289	19C242B
C1048	290-0149-00			CAP.,FXD,ELCTLT:5UF,+75-10%,150V	56289	30D505G150DD4
C1050	283-0261-00			CAP.,FXD,CER DI:0.01UF,20%,4000V	72982	3888-510E103M
C1051	283-0021-00			CAP.,FXD,CER DI:0.001UF,20%,5000V	72982	828-005Y5S0102M
C1052	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C1053	283-0261-00			CAP.,FXD,CER DI:0.01UF,20%,4000V	72982	3888-510E103M
C1054	283-0261-00			CAP.,FXD,CER DI:0.01UF,20%,4000V	72982	3888-510E103M
C1055	283-0021-00			CAP.,FXD,CER DI:0.001UF,20%,5000V	72982	828-005Y5S0102M
C1058	281-0512-00			CAP.,FXD,CER DI:27PF,+/-2.7PF,500V	72982	308-000C0G0270K
C1059	290-0159-00			CAP.,FXD,ELCTLT:2UF,+50-10%,150V	56289	30D205F150BB4
C1071	283-0261-00			CAP.,FXD,CER DI:0.01UF,20%,4000V	72982	3888-510E103M
C1081	290-0159-00			CAP.,FXD,ELCTLT:2UF,+50-10%,150V	56289	30D205F150BB4
C1082	281-0512-00			CAP.,FXD,CER DI:27PF,+/-2.7PF,500V	72982	308-000C0G0270K
C1084	283-0261-00			CAP.,FXD,CER DI:0.01UF,20%,4000V	72982	3888-510E103M
C1085	283-0021-00			CAP.,FXD,CER DI:0.001UF,20%,5000V	72982	828-005Y5S0102M
C1100	281-0604-00			CAP.,FXD,CER DI:2.2PF,+/-0.25PF,500V	72982	301-000C0J0229C
C1101	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C1102	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C1115	281-0204-00			CAP.,VAR,PLSTC:2-22PF,100V	80031	C010EA-20E
C1120	281-0528-00			CAP.,FXD,CER DI:82PF,+/-8.2PF,500V	72982	301-000U2M0820K
C1123	281-0512-00			CAP.,FXD,CER DI:27PF,+/-2.7PF,500V	72982	308-000C0G0270K
C1127	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C1148	281-0623-00			CAP.,FXD,CER DI:650PF,5%,500V	72982	301-000Y5D0651J
C1153	281-0549-00			CAP.,FXD,CER DI:68PF,10%,500V	72982	301-000U2J0680K
C1155	281-0204-00			CAP.,VAR,PLSTC:2-22PF,100V	80031	C010EA-20E
C1156	281-0651-00			CAP.,FXD,CER DI:47PF,5%,200V	72982	374-001T2H0470J
C1160	281-0651-00			CAP.,FXD,CER DI:47PF,5%,200V	72982	374-001T2H0470J
C1165	281-0623-00			CAP.,FXD,CER DI:650PF,5%,500V	72982	301-000Y5D0651J
C1167	281-0634-00			CAP.,FXD,CER DI:10PF,+/-0.25PF,500V	72982	374-011C0G0100C
C1170	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C1180	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C1181	281-0203-00			CAP.,VAR,PLSTC:2-10PF,100V	80031	C010EA/10E
C1184	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	72982	301-000X5P0331K
C1185	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	72982	301-000X5P0331K
C1188	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C1192	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C1197	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C1198	290-0523-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	196D225X0025HA1
C1210	281-0205-00			CAP.,VAR,PLSTC:5.5-65PF,100V	80031	C010GA/60E
C1211	281-0519-00			CAP.,FXD,CER DI:47PF,+/-4.7PF,500V	72982	308-000C0G0470K
C1219	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C1235	281-0202-00			CAP.,VAR,PLSTC:1.5-5.5PF,100V	80031	C010EA-5E
C1240	283-0057-00			CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	274C10
C1241	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C1242	281-0557-00			CAP.,FXD,CER DI:1.8PF,10%,500V	72982	301-000C0K0189B
C1244	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C1248	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C1249	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8141N038651105Z
C1250	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C1266	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C1272	281-0557-00			CAP.,FXD,CER DI:1.8PF,10%,500V	72982	301-000C0K0189B
C1274	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8141N038651105Z
C1280	283-0110-00			CAP.,FXD,CER DI:0.005UF,+80-20%,150V	56289	19C242B
C1300	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C1330	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C1335	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C1342	281-0609-00			CAP.,FXD,CER DI:1PF,+/-0.1PF,500V	72982	374-005C0K01098
C1345	281-0584-00			CAP.,FXD,CER DI:100PF,5%,500V	72982	301-000Y50101J
C1350	281-0064-00			CAP.,VAR,PLSTC:0.25-1.5PF,600V	72982	530-002
C1351	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8141N038651105Z
C1352	283-0057-00			CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	274C10
C1354	283-0110-00			CAP.,FXD,CER DI:0.005UF,+80-20%,150V	56289	19C242B
C1360	283-0057-00			CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	274C10
CR146	152-0422-00			SEMICOND DEVICE:SILICON,4V,7PF	01281	PG1084
CR204	152-0574-00			SEMICOND DEVICE:SILICON,120V	80009	152-0574-00
CR206	152-0574-00			SEMICOND DEVICE:SILICON,120V	80009	152-0574-00
CR208	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR240	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR242	152-0574-00			SEMICOND DEVICE:SILICON,120V	80009	152-0574-00
CR246	152-0574-00			SEMICOND DEVICE:SILICON,120V	80009	152-0574-00
CR270	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR272	152-0574-00			SEMICOND DEVICE:SILICON,120V	80009	152-0574-00
CR274	152-0574-00			SEMICOND DEVICE:SILICON,120V	80009	152-0574-00
CR324	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR342	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR352	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR1035	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1036	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1045	152-0586-00			SEMICOND DEVICE:SILICON,600V,500MA	14936	RMP5060
CR1046	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1050	152-0409-00			SEMICOND DEVICE:SILICON,12,000V,5MA	83003	VG-12X
CR1054	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR1055	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR1057	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR1058	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR1063	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1070	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1081	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR1084	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR1085	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR1087	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR1146	152-0422-00			SEMICOND DEVICE:SILICON,4V,7PF	01281	PG1084
CR1204	152-0574-00			SEMICOND DEVICE:SILICON,120V	80009	152-0574-00
CR1206	152-0574-00			SEMICOND DEVICE:SILICON,120V	80009	152-0574-00
CR1208	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1240	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1242	152-0574-00			SEMICOND DEVICE:SILICON,120V	80009	152-0574-00
CR1246	152-0574-00			SEMICOND DEVICE:SILICON,120V	80009	152-0574-00
CR1270	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR1272	152-0574-00			SEMICOND DEVICE:SILICON,120V	80009	152-0574-00
CR1274	152-0574-00			SEMICOND DEVICE:SILICON,120V	80009	152-0574-00
CR1324	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1342	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1352	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
DL100	119-0693-00			DELAY LINE,ELEC:	80009	119-0693-00
DL1100	119-0693-00			DELAY LINE,ELEC:	80009	119-0693-00
DS310	150-0137-00			LAMP,CARTRIDGE:14V,100MA	71744	CM9818
DS312	150-0137-00			LAMP,CARTRIDGE:14V,100MA	71744	CM9818
DS314	150-0137-00			LAMP,CARTRIDGE:14V,100MA	71744	CM9818
F1048	159-0043-00			FUSE,CARTRIDGE:3AG,0.6A,250V,SLOW-BLOW	71400	MDL6-10
F1000	159-0003-00			FUSE,CARTRIDGE:3AG,1.6A,250V,SLOW-BLOW	71400	MDX16-10

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J300	131-0955-00			CONNECTOR,RCPT,:BNC,FEMALE	24931	28JR200-1
J1300	131-0955-00			CONNECTOR,RCPT,:BNC,FEMALE	24931	28JR200-1
L167	108-0733-00			COIL,RF:130NH	80009	108-0733-00
L197	108-0440-00			COIL,RF:8UH,TOROIDAL INDUCTOR	80009	108-0440-00
L198	108-0440-00			COIL,RF:8UH,TOROIDAL INDUCTOR	80009	108-0440-00
L375	108-0644-00			COIL,TUBE DEFL:TRACE ROTATOR	80009	108-0644-00
L1016	108-0811-00			COIL,TUBE DEFL:FIXED,X-Y ALIGNMENT	80009	108-0811-00
L1167	108-0733-00			COIL,RF:130NH	80009	108-0733-00
L1197	108-0440-00			COIL,RF:8UH,TOROIDAL INDUCTOR	80009	108-0440-00
L1198	108-0440-00			COIL,RF:8UH,TOROIDAL INDUCTOR	80009	108-0440-00
LR193	108-0328-00			COIL,RF:0.3UH	80009	108-0328-00
LR195	108-0328-00			COIL,RF:0.3UH	80009	108-0328-00
LR1193	108-0328-00			COIL,RF:0.3UH	80009	108-0328-00
LR1195	108-0328-00			COIL,RF:0.3UH	80009	108-0328-00
Q100	151-0441-00			TRANSISTOR:SILICON,NPN	80009	151-0441-00
Q106	151-0212-00			TRANSISTOR:SILICON,NPN	73445	A485
Q125	151-0441-00			TRANSISTOR:SILICON,NPN	80009	151-0441-00
Q130	151-0212-00			TRANSISTOR:SILICON,NPN	73445	A485
Q140	151-0342-00			TRANSISTOR:SILICON,PNP	07263	2N4249
Q148	151-0271-00			TRANSISTOR:SILICON,PNP	01295	SKA4504
Q165	151-0271-00			TRANSISTOR:SILICON,PNP	01295	SKA4504
Q170	151-0434-00			TRANSISTOR:SILICON,PNP	80009	151-0434-00
Q172	151-0434-00			TRANSISTOR:SILICON,PNP	80009	151-0434-00
Q180	151-0451-00			TRANSISTOR:SILICON,NPN	80009	151-0451-00
Q182	151-0451-00			TRANSISTOR:SILICON,NPN	80009	151-0451-00
Q188	151-0446-00			TRANSISTOR:SILICON,NPN,SE	80009	151-0446-00
Q190	151-0446-00			TRANSISTOR:SILICON,NPN,SE	80009	151-0446-00
Q200	151-0190-00			TRANSISTOR:SILICON,NPN	04713	2N3904
Q215	151-0190-00			TRANSISTOR:SILICON,NPN	04713	2N3904
Q240	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	80009	151-0333-00
Q244	151-0407-00			TRANSISTOR:SILICON,NPN	07263	S37881
Q250	151-0406-00			TRANSISTOR:SILICON,PNP	07263	S37880
Q255	151-0262-00			TRANSISTOR:SILICON,NPN	02735	62396
Q270	151-0188-00			TRANSISTOR:SILICON,PNP	04713	2N3906
Q274	151-0407-00			TRANSISTOR:SILICON,NPN	07263	S37881
Q280	151-0406-00			TRANSISTOR:SILICON,PNP	07263	S37880
Q320	151-0190-00			TRANSISTOR:SILICON,NPN	04713	2N3904
Q335	151-0190-00			TRANSISTOR:SILICON,NPN	04713	2N3904
Q340	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	80009	151-0333-00
Q345	151-0188-00			TRANSISTOR:SILICON,PNP	04713	2N3906
Q352	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q356	151-0350-00			TRANSISTOR:SILICON,PNP	07263	2N5401
Q1035	151-0254-00			TRANSISTOR:SILICON,NPN	03508	2N5308
Q1040	151-0342-00			TRANSISTOR:SILICON,PNP	07263	2N4249
Q1045	151-0262-00			TRANSISTOR:SILICON,NPN	02735	62396
Q1046	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q1065	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q1070	151-0281-00			TRANSISTOR:SILICON,NPN	03508	X16P4039
Q1100	151-0441-00			TRANSISTOR:SILICON,NPN	80009	151-0441-00
Q1106	151-0212-00			TRANSISTOR:SILICON,NPN	73445	A485
Q1125	151-0441-00			TRANSISTOR:SILICON,NPN	80009	151-0441-00
Q1130	151-0212-00			TRANSISTOR:SILICON,NPN	73445	A485
Q1140	151-0342-00			TRANSISTOR:SILICON,PNP	07263	2N4249
Q1148	151-0271-00			TRANSISTOR:SILICON,PNP	01295	SKA4504

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Q1165	151-0271-00			TRANSISTOR:SILICON,PNP	01295	SKA4504
Q1170	151-0434-00			TRANSISTOR:SILICON,PNP	80009	151-0434-00
Q1172	151-0434-00			TRANSISTOR:SILICON,PNP	80009	151-0434-00
Q1180	151-0451-00			TRANSISTOR:SILICON,NPN	80009	151-0451-00
Q1182	151-0451-00			TRANSISTOR:SILICON,NPN	80009	151-0451-00
Q1188	151-0446-00			TRANSISTOR:SILICON,NPN,SE	80009	151-0446-00
Q1190	151-0446-00			TRANSISTOR:SILICON,NPN,SE	80009	151-0446-00
Q1200	151-0190-00			TRANSISTOR:SILICON,NPN	04713	2N3904
Q1215	151-0190-00			TRANSISTOR:SILICON,NPN	04713	2N3904
Q1240	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	80009	151-0333-00
Q1244	151-0407-00			TRANSISTOR:SILICON,NPN	07263	S37881
Q1250	151-0406-00			TRANSISTOR:SILICON,PNP	07263	S37880
Q1265	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q1270	151-0188-00			TRANSISTOR:SILICON,PNP	04713	2N3906
Q1274	151-0407-00			TRANSISTOR:SILICON,NPN	07263	S37881
Q1280	151-0406-00			TRANSISTOR:SILICON,PNP	07263	S37880
Q1300	151-0352-00			TRANSISTOR:SILICON,NPN	03508	X44C282
Q1320	151-0190-00			TRANSISTOR:SILICON,NPN	04713	2N3904
Q1335	151-0190-00			TRANSISTOR:SILICON,NPN	04713	2N3904
Q1340	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	80009	151-0333-00
Q1345	151-0188-00			TRANSISTOR:SILICON,PNP	04713	2N3906
Q1352	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q1356	151-0350-00			TRANSISTOR:SILICON,PNP	07263	2N5401
R100	321-0085-00			RES.,FXD,FILM:75 OHM,1%,0.125W	75042	CEATO-75R00F
R102	315-0221-00			RES.,FXD,COMP:220 OHM,5%,0.25W	01121	CB2215
R103	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	75042	CEATO-1000F
R104	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	75042	CEATO-1000F
R108	315-0302-00			RES.,FXD,COMP:3K OHM,5%,0.25W	01121	CB3025
R110	321-0217-00			RES.,FXD,FILM:1.78K OHM,1%,0.125W	75042	CEATO-1781F
R111	321-0089-00			RES.,FXD,FILM:82.5 OHM,1%,0.125W	75042	CEATO-82R50F
R112	321-0217-00			RES.,FXD,FILM:1.78K OHM,1%,0.125W	75042	CEATO-1781F
R115	311-1566-00			RES.,VAR,NONWIR:200 OHM,20%,0.50W	73138	91A-200R0M
R117	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R118	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R120	311-1560-00			RES.,VAR,NONWIR:5K OHM,5%,0.50W	73138	91A-5000M
R121	311-1559-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	73138	91A-10001M
R123	311-1563-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	73138	91A-10000M
R125	321-0085-00			RES.,FXD,FILM:75 OHM,1%,0.125W	75042	CEATO-75R00F
R127	315-0221-00			RES.,FXD,COMP:220 OHM,5%,0.25W	01121	CB2215
R128	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	75042	CEATO-1000F
R129	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	75042	CEATO-1000F
R132	315-0302-00			RES.,FXD,COMP:3K OHM,5%,0.25W	01121	CB3025
R135	311-1563-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	73138	91A-10000M
R136	321-0121-00			RES.,FXD,FILM:178 OHM,1%,0.125W	75042	CEATO-1780F
R138	315-0472-00			RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R139	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R141	315-0152-00			RES.,FXD,COMP:1.5K OHM,5%,0.25W	01121	CB1525
R142	315-0270-00			RES.,FXD,COMP:27 OHM,5%,0.25W	01121	CB2705
R143	315-0510-00			RES.,FXD,COMP:51 OHM,5%,0.25W	01121	CB5105
R144	315-0431-00			RES.,FXD,COMP:430 OHM,5%,0.25W	01121	CB4315
R145	321-0148-00			RES.,FXD,FILM:340 OHM,1%,0.125W	75042	CEATO-3400F
R146	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R148	315-0151-00			RES.,FXD,COMP:150 OHM,5%,0.25W	01121	CB1515
R149	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R151	315-0471-00			RES.,FXD,COMP:470 OHM,5%,0.25W	01121	CB4715
R153	321-0093-00			RES.,FXD,FILM:90.9 OHM,1%,0.125W	75042	CEATO-90R90F
R155	311-1567-00			RES.,VAR,NONWIR:100 OHM,20%,0.50W	73138	91A-100R0M
R157	315-0622-00			RES.,FXD,COMP:6.2K OHM,5%,0.25W	01121	CB6225
R158	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R160	321-0148-00			RES.,FXD,FILM:340 OHM,1%,0.125W	75042	CEATO-3400F
R163	315-0431-00			RES.,FXD,COMP:430 OHM,5%,0.25W	01121	CB4315
R164	315-0510-00			RES.,FXD,COMP:51 OHM,5%,0.25W	01121	CB5105
R165	315-0151-00			RES.,FXD,COMP:150 OHM,5%,0.25W	01121	CB1515
R167	311-1564-00			RES.,VAR,NONWIR:500 OHM,20%,0.50W	73138	91A-500R0M
R172	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	75042	CEATO-2000F
R173	321-0093-00			RES.,FXD,FILM:90.9 OHM,1%,0.125W	75042	CEATO-90R90F
R175	311-1561-00			RES.,VAR,NONWIR:2.5K OHM,20%,0.50W	73138	91A-25000M
R176	321-0093-00			RES.,FXD,FILM:90.9 OHM,1%,0.125W	75042	CEATO-90R90F
R178	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	75042	CEATO-2000F
R180	315-0910-00			RES.,FXD,COMP:91 OHM,5%,0.25W	01121	CB9105
R181	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	75042	CEATO-1000F
R182	315-0910-00			RES.,FXD,COMP:91 OHM,5%,0.25W	01121	CB9105
R183	301-0300-00			RES.,FXD,COMP:30 OHM,5%,0.50W	01121	EB3005
R184	315-0680-00			RES.,FXD,COMP:68 OHM,5%,0.25W	01121	CB6805
R185	315-0680-00			RES.,FXD,COMP:68 OHM,5%,0.25W	01121	CB6805
R187	315-0820-00			RES.,FXD,COMP:82 OHM,5%,0.25W	01121	CB8205
R188	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R190	315-0820-00			RES.,FXD,COMP:82 OHM,5%,0.25W	01121	CB8205
R191	307-0435-00			RES.,FXD,FILM:510 OHM,5%,4W	91637	FP-4G510R0J
R192	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R193	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R194	307-0435-00			RES.,FXD,FILM:510 OHM,5%,4W	91637	FP-4G510R0J
R195	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R197	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R198	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R200	321-0058-00			RES.,FXD,FILM:39.2 OHM,1%,0.125W	75042	CEATO-39R20F
R201	321-0005-00			RES.,FXD,FILM:11 OHM,1%,0.125W	75042	CEATO-11R0F
R202	315-0151-00			RES.,FXD,COMP:150 OHM,5%,0.25W	01121	CB1515
R203	321-0200-00			RES.,FXD,FILM:1.18K OHM,1%,0.125W	75042	CEATO-1181F
R205	321-0205-00			RES.,FXD,FILM:1.33K OHM,1%,0.125W	75042	CEATO-1331F
R207	321-0210-00			RES.,FXD,FILM:1.5K OHM,1%,0.125W	75042	CEATO-1501F
R208	321-0142-00			RES.,FXD,FILM:294 OHM,1%,0.125W	75042	CEATO-2940F
R210	321-0158-00			RES.,FXD,FILM:432 OHM,1%,0.125W	75042	CEATO-4320F
R211	321-0093-00			RES.,FXD,FILM:90.9 OHM,1%,0.125W	75042	CEATO-90R90F
R212	311-1564-00			RES.,VAR,NONWIR:500 OHM,20%,0.50W	73138	91A-500R0M
R213	321-0205-00			RES.,FXD,FILM:1.33K OHM,1%,0.125W	75042	CEATO-1331F
R215	321-0058-00			RES.,FXD,FILM:39.2 OHM,1%,0.125W	75042	CEATO-39R20F
R216	321-0005-00			RES.,FXD,FILM:11 OHM,1%,0.125W	75042	CEATO-11R0F
R217	315-0151-00			RES.,FXD,COMP:150 OHM,5%,0.25W	01121	CB1515
R218	321-0200-00			RES.,FXD,FILM:1.18K OHM,1%,0.125W	75042	CEATO-1181F
R220	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R222	311-1558-00			RES.,VAR,NONWIR:20K OHM,20%,0.50W	73138	91A-20001M
R224	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R238	321-0193-08			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816D10000F
R240	315-0241-00			RES.,FXD,COMP:240 OHM,5%,0.25W	01121	CB2415
R242	323-0318-08			RES.,FXD,FILM:20K,1%,0.50W	91637	MFF1226D2001F
R244	315-0621-00			RES.,FXD,COMP:620 OHM,5%,0.25W	01121	CB6215
R245	315-0221-00			RES.,FXD,COMP:220 OHM,5%,0.25W	01121	CB2215
R246	315-0121-00			RES.,FXD,COMP:120 OHM,5%,0.25W	01121	CB1215

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R247	315-0471-00			RES.,FXD,COMP:470 OHM,5%,0.25W	01121	CB4715
R250	301-0393-00			RES.,FXD,COMP:39K OHM,5%,0.50W	01121	EB3935
R252	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R256	315-0821-00			RES.,FXD,COMP:820 OHM,5%,0.25W	01121	CB8215
R257	305-0102-00			RES.,FXD,COMP:1K OHM,5%,2W	01121	HB1025
R258	301-0333-00			RES.,FXD,COMP:33K OHM,5%,0.50W	01121	EB3335
R259	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R265	321-0268-00			RES.,FXD,FILM:6.04K OHM,1%,0.125W	75042	CEATO-6041F
R266	315-0114-00			RES.,FXD,COMP:110K OHM,5%,0.25W	01121	CB1145
R268	321-0193-08			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816D10000F
R270	315-0471-00			RES.,FXD,COMP:470 OHM,5%,0.25W	01121	CB4715
R272	323-0318-08			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1226D20001F
R274	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R276	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R280	315-0152-00			RES.,FXD,COMP:1.5K OHM,5%,0.25W	01121	CB1525
R282	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R284	301-0393-00			RES.,FXD,COMP:39K OHM,5%,0.50W	01121	EB3935
R286	315-0821-00			RES.,FXD,COMP:820 OHM,5%,0.25W	01121	CB8215
R289	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R320	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R321	311-1598-00			RES.,VAR,NONWW:20K OHM,1W	01121	12M260
R322	315-0203-00			RES.,FXD,COMP:20K OHM,5%,0.25W	01121	CB2035
R324	315-0332-00			RES.,FXD,COMP:3.3K OHM,5%,0.25W	01121	CB3325
R326	315-0332-00			RES.,FXD,COMP:3.3K OHM,5%,0.25W	01121	CB3325
R327	315-0822-00			RES.,FXD,COMP:8.2K OHM,5%,0.25W	01121	CB8225
R328	315-0392-00			RES.,FXD,COMP:3.9K OHM,5%,0.25W	01121	CB3925
R330	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R334	315-0224-00			RES.,FXD,COMP:220K OHM,5%,0.25W	01121	CB2245
R335	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R336	315-0224-00			RES.,FXD,COMP:220K OHM,5%,0.25W	01121	CB2245
R338	315-0474-00			RES.,FXD,COMP:470K OHM,5%,0.25W	01121	CB4745
R341	315-0123-00			RES.,FXD,COMP:12K OHM,5%,0.25W	01121	CB1235
R342	311-1565-00			RES.,VAR,NONWIR:250 OHM,20%,0.50W	73138	91A-200R0M
R343	315-0392-00			RES.,FXD,COMP:3.9K OHM,5%,0.25W	01121	CB3925
R345	315-0470-00			RES.,FXD,COMP:47 OHM,5%,0.25W	01121	CB4705
R347	315-0222-00			RES.,FXD,COMP:2.2K OHM,5%,0.25W	01121	CB2225
R349	321-0314-00			RES.,FXD,FILM:18.2K OHM,1%,0.125W	75042	CEATO-1822F
R350	321-0314-00			RES.,FXD,FILM:18.2K OHM,1%,0.125W	75042	CEATO-1822F
R351	315-0180-00			RES.,FXD,COMP:18 OHM,5%,0.25W	01121	CB1805
R352	315-0220-00			RES.,FXD,COMP:22 OHM,5%,0.25W	01121	CB2205
R356	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R358	315-0683-00			RES.,FXD,COMP:68K OHM,5%,0.25W	01121	CB6835
R359	315-0392-00			RES.,FXD,COMP:3.9K OHM,5%,0.25W	01121	CB3925
R360	315-0471-00			RES.,FXD,COMP:470 OHM,5%,0.25W	01121	CB4715
R362	305-0133-00			RES.,FXD,COMP:13K OHM,5%,2W	01121	HB1335
R365	315-0332-00			RES.,FXD,COMP:3.3K OHM,5%,0.25W	01121	CB3325
R375	311-1428-00			RES.,VAR,NONWIR:20K OHM,1W	01121	10M459
R1000	311-1552-00			RES.,VAR,NONWIR:500K OHM,20%,0.50W	73138	91A-50002M
R1002	311-1552-00			RES.,VAR,NONWIR:500K OHM,20%,0.50W	73138	91A-50002M
R1003	315-0151-00			RES.,FXD,COMP:150 OHM,5%,0.25W	01121	CB1515
R1004	311-1552-00			RES.,VAR,NONWIR:500K OHM,20%,0.50W	73138	91A-50002M
R1005	315-0151-00			RES.,FXD,COMP:150 OHM,5%,0.25W	01121	CB1515
R1006	311-1552-00			RES.,VAR,NONWIR:500K OHM,20%,0.50W	73138	91A-50002M
R1008	311-1552-00			RES.,VAR,NONWIR:500K OHM,20%,0.50W	73138	91A-50002M
R1009	311-1552-00			RES.,VAR,NONWIR:500K OHM,20%,0.50W	73138	91A-50002M
R1010	311-1552-00			RES.,VAR,NONWIR:500K OHM,20%,0.50W	73138	91A-50002M

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R1011	315-0151-00			RES.,FXD,COMP:150 OHM,5%,0.25W	01121	CB1515
R1012	311-1552-00			RES.,VAR,NONWIR:500K OHM,20%,0.50W	73138	91A-50002M
R1016	311-1558-00			RES.,VAR,NONWIR:20K OHM,20%,0.50W	73138	91A-20001M
R1018	311-1556-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	73138	91A-50001M
R1020	311-1556-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	73138	91A-50001M
R1035	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R1036	315-0472-00			RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R1037	315-0182-00			RES.,FXD,COMP:1.8K OHM,5%,0.25W	01121	CB1825
R1038	315-0154-00			RES.,FXD,COMP:150K OHM,5%,0.25W	01121	CB1545
R1039	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R1040	315-0270-00			RES.,FXD,COMP:27 OHM,5%,0.25W	01121	CB2705
R1042	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R1043	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R1045	323-0433-00			RES.,FXD,FILM:316K OHM,1%,0.50W	75042	CECT0-3163F
R1046	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	75042	CEAT0-1502F
R1048	308-0686-00			RES.,FXD,WW:2.2 OHM,5%,2W	75042	BWH-2R200J
R1050	315-0223-00			RES.,FXD,COMP:22K OHM,5%,0.25W	01121	CB2235
R1051A,B R1051C,D	307-0440-00			RES.,FXD,FILM:	80009	307-0440-00
R1052	311-1312-00			RES.,VAR,NONWIR:5M OHM,20%,1W	01121	10M156A
R1053	315-0470-00			RES.,FXD,COMP:47 OHM,5%,0.25W	01121	CB4705
R1054	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R1055	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R1056	311-1312-00			RES.,VAR,NONWIR:5M OHM,20%,1W	01121	10M156A
R1057	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R1058	315-0105-00			RES.,FXD,COMP:1M OHM,5%,0.25W	01121	CB1055
R1059	315-0473-00			RES.,FXD,COMP:47K OHM,5%,0.25W	01121	CB4735
R1060	311-1733-00			RES.,VAR,NONWIR:250K OHM,0.5W	73138	91XR250K
R1062	301-0163-00			RES.,FXD,COMP:16K OHM,5%,0.50W	01121	EB1635
R1063	301-0203-00			RES.,FXD,COMP:20K OHM,5%,0.50W	01121	EB2035
R1065	323-0431-00			RES.,FXD,FILM:301K OHM,1%,0.50W	75042	CECT0-3013F
R1070	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	75042	CEAT0-1003F
R1071	315-0106-00			RES.,FXD,COMP:10M OHM,5%,0.25W	01121	CB1065
R1080	311-1733-00			RES.,VAR,NONWIR:250K OHM,0.5W	73138	91XR250K
R1081	315-0473-00			RES.,FXD,COMP:47K OHM,5%,0.25W	01121	CB4735
R1082	315-0105-00			RES.,FXD,COMP:1M OHM,5%,0.25W	01121	CB1055
R1084	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R1085	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R1087	315-0106-00			RES.,FXD,COMP:10M OHM,5%,0.25W	01121	CB1065
R1088	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R1100	321-0085-00			RES.,FXD,FILM:75 OHM,1%,0.125W	91637	MFF186075R00C
R1101	311-1428-00			RES.,VAR,NONWIR:20K OHM,1W	01121	10M459
R1102	315-0221-00			RES.,FXD,COMP:220 OHM,5%,0.25W	01121	CB2215
R1103	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	75042	CEAT0-1000F
R1104	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	75042	CEAT0-1000F
R1108	315-0302-00			RES.,FXD,COMP:3K OHM,5%,0.25W	01121	CB3025
R1110	321-0217-00			RES.,FXD,FILM:1.78K OHM,1%,0.125W	75042	CEAT0-1781F
R1111	321-0089-00			RES.,FXD,FILM:82.5 OHM,1%,0.125W	75042	CEAT0-82R50F
R1112	321-0217-00			RES.,FXD,FILM:1.78K OHM,1%,0.125W	75042	CEAT0-1781F
R1115	311-1566-00			RES.,VAR,NONWIR:200 OHM,20%,0.50W	73138	91A-200R0M
R1117	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R1118	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R1120	311-1560-00			RES.,VAR,NONWIR:5K OHM,5%,0.50W	73138	91A-5000M
R1123	311-1560-00			RES.,VAR,NONWIR:5K OHM,5%,0.50W	73138	91A-5000M
R1125	321-0085-00			RES.,FXD,FILM:75 OHM,1%,0.125W	91637	MFF186075R00C

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R1127	315-0221-00			RES.,FXD,COMP:220 OHM,5%,0.25W	01121	CB2215
R1128	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	75042	CEATO-1000F
R1129	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	75042	CEATO-1000F
R1132	315-0302-00			RES.,FXD,COMP:3K OHM,5%,0.25W	01121	CB3025
R1135	311-1563-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	73138	91A-10000M
R1136	321-0121-00			RES.,FXD,FILM:178 OHM,1%,0.125W	75042	CEATO-1780F
R1138	315-0472-00			RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R1139	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R1141	315-0152-00			RES.,FXD,COMP:1.5K OHM,5%,0.25W	01121	CB1525
R1142	315-0270-00			RES.,FXD,COMP:27 OHM,5%,0.25W	01121	CB2705
R1143	315-0510-00			RES.,FXD,COMP:51 OHM,5%,0.25W	01121	CB5105
R1144	315-0431-00			RES.,FXD,COMP:430 OHM,5%,0.25W	01121	CB4315
R1145	321-0148-00			RES.,FXD,FILM:340 OHM,1%,0.125W	75042	CEATO-3400F
R1146	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R1148	315-0151-00			RES.,FXD,COMP:150 OHM,5%,0.25W	01121	CB1515
R1149	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R1151	315-0471-00			RES.,FXD,COMP:470 OHM,5%,0.25W	01121	CB4715
R1153	321-0093-00			RES.,FXD,FILM:90.9 OHM,1%,0.125W	75042	CEATO-90R90F
R1155	311-1567-00			RES.,VAR,NONWIR:100 OHM,20%,0.50W	73138	91A-100R0M
R1157	315-0622-00			RES.,FXD,COMP:6.2K OHM,5%,0.25W	01121	CB6225
R1158	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R1160	321-0148-00			RES.,FXD,FILM:340 OHM,1%,0.125W	75042	CEATO-3400F
R1163	315-0431-00			RES.,FXD,COMP:430 OHM,5%,0.25W	01121	CB4315
R1164	315-0510-00			RES.,FXD,COMP:51 OHM,5%,0.25W	01121	CB5105
R1165	315-0151-00			RES.,FXD,COMP:150 OHM,5%,0.25W	01121	CB1515
R1167	311-1564-00			RES.,VAR,NONWIR:500 OHM,20%,0.50W	73138	91A-500R0M
R1172	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	75042	CEATO-2000F
R1173	321-0093-00			RES.,FXD,FILM:90.9 OHM,1%,0.125W	75042	CEATO-90R90F
R1175	311-1561-00			RES.,VAR,NONWIR:2.5K OHM,20%,0.50W	73138	91A-25000M
R1176	321-0093-00			RES.,FXD,FILM:90.9 OHM,1%,0.125W	75042	CEATO-90R90F
R1178	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	75042	CEATO-2000F
R1180	315-0910-00			RES.,FXD,COMP:91 OHM,5%,0.25W	01121	CB9105
R1181	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	75042	CEATO-1000F
R1182	315-0910-00			RES.,FXD,COMP:91 OHM,5%,0.25W	01121	CB9105
R1183	301-0300-00			RES.,FXD,COMP:30 OHM,5%,0.50W	01121	EB3005
R1184	315-0680-00			RES.,FXD,COMP:68 OHM,5%,0.25W	01121	CB6805
R1185	315-0680-00			RES.,FXD,COMP:68 OHM,5%,0.25W	01121	CB6805
R1187	315-0820-00			RES.,FXD,COMP:82 OHM,5%,0.25W	01121	CB8205
R1188	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R1190	315-0820-00			RES.,FXD,COMP:82 OHM,5%,0.25W	01121	CB8205
R1191	307-0435-00			RES.,FXD,FILM:510 OHM,5%,4W	91637	FP-4G510R0J
R1192	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R1193	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R1194	307-0435-00			RES.,FXD,FILM:510 OHM,5%,4W	91637	FP-4G510R0J
R1195	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R1197	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R1198	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R1200	321-0058-00			RES.,FXD,FILM:39.2 OHM,1%,0.125W	75042	CEATO-39R20F
R1201	321-0005-00			RES.,FXD,FILM:11 OHM,1%,0.125W	75042	CEATO-11R0F
R1202	315-0151-00			RES.,FXD,COMP:150 OHM,5%,0.25W	01121	CB1515
R1203	321-0200-00			RES.,FXD,FILM:1.18K OHM,1%,0.125W	75042	CEATO-1181F
R1205	321-0205-00			RES.,FXD,FILM:1.33K OHM,1%,0.125W	75042	CEATO-1331F
R1207	321-0210-00			RES.,FXD,FILM:1.5K OHM,1%,0.125W	75042	CEATO-1501F
R1208	321-0142-00			RES.,FXD,FILM:294 OHM,1%,0.125W	75042	CEATO-2940F
R1210	321-0158-00			RES.,FXD,FILM:432 OHM,1%,0.125W	75042	CEATO-4320F

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R1211	321-0093-00			RES.,FXD,FILM:90.9 OHM,1%,0.125W	75042	CEATO-90R90F
R1212	311-1564-00			RES.,VAR,NONWIR:500 OHM,20%,0.50W	73138	91A-500ROM
R1213	321-0205-00			RES.,FXD,FILM:1.33K OHM,1%,0.125W	75042	CEATO-1331F
R1215	321-0058-00			RES.,FXD,FILM:39.2 OHM,1%,0.125W	75042	CEATO-39R20F
R1216	321-0005-00			RES.,FXD,FILM:11 OHM,1%,0.125W	75042	CEATO-11ROF
R1217	315-0151-00			RES.,FXD,COMP:150 OHM,5%,0.25W	01121	CB1515
R1218	321-0200-00			RES.,FXD,FILM:1.18K OHM,1%,0.125W	75042	CEATO-1181F
R1219	315-0683-00			RES.,FXD,COMP:68K OHM,5%,0.25W	01121	CB6835
R1220	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R1222	311-1558-00			RES.,VAR,NONWIR:20K OHM,20%,0.50W	73138	91A-20001M
R1224	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R1238	321-0193-08			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816D10000F
R1240	315-0241-00			RES.,FXD,COMP:240 OHM,5%,0.25W	01121	CB2415
R1241	315-0513-00			RES.,FXD,COMP:51K OHM,5%,0.25W	01121	CB5135
R1242	323-0318-08			RES.,FXD,FILM:20K,1%,0.50W	91637	MFF1226D20001F
R1244	315-0621-00			RES.,FXD,COMP:620 OHM,5%,0.25W	01121	CB6215
R1245	315-0221-00			RES.,FXD,COMP:220 OHM,5%,0.25W	01121	CB2215
R1246	315-0121-00			RES.,FXD,COMP:120 OHM,5%,0.25W	01121	CB1215
R1247	315-0471-00			RES.,FXD,COMP:470 OHM,5%,0.25W	01121	CB4715
R1250	301-0393-00			RES.,FXD,COMP:39K OHM,5%,0.50W	01121	EB3935
R1252	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R1256	315-0821-00			RES.,FXD,COMP:820 OHM,5%,0.25W	01121	CB8215
R1259	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R1264	321-0364-00			RES.,FXD,FILM:60.4K OHM,1%,0.125W	75042	CEATO-6042F
R1265	321-0268-00			RES.,FXD,FILM:6.04K OHM,1%,0.125W	75042	CEATO-6041F
R1266	315-0114-00			RES.,FXD,COMP:110K OHM,5%,0.25W	01121	CB1145
R1267	321-0400-00			RES.,FXD,FILM:143K OHM,1%,0.125W	75042	CEATO-1433F
R1268	321-0193-08			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816D10000F
R1269	315-0113-00			RES.,FXD,COMP:11K OHM,5%,0.25W	01121	CB1135
R1270	315-0471-00			RES.,FXD,COMP:470 OHM,5%,0.25W	01121	CB4715
R1272	323-0318-08			RES.,FXD,FILM:20K 1%,0.50W	91637	MFF1226D20001F
R1274	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R1276	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R1280	315-0152-00			RES.,FXD,COMP:1.5K OHM,5%,0.25W	01121	CB1525
R1282	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R1284	301-0393-00			RES.,FXD,COMP:39K OHM,5%,0.50W	01121	EB3935
R1286	315-0821-00			RES.,FXD,COMP:820 OHM,5%,0.25W	01121	CB8215
R1289	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R1300A,B	311-1492-00			RES.,VAR,NONWIR:2 X 5K OHM,20%,0.50W	01121	11M136
R1320	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R1321	311-1598-00			RES.,VAR,NONWIR:20K OHM,1W	01121	12M260
R1322	315-0203-00			RES.,FXD,COMP:20K OHM,5%,0.25W	01121	CB2035
R1324	315-0332-00			RES.,FXD,COMP:3.3K OHM,5%,0.25W	01121	CB3325
R1326	315-0332-00			RES.,FXD,COMP:3.3K OHM,5%,0.25W	01121	CB3325
R1327	315-0822-00			RES.,FXD,COMP:8.2K OHM,5%,0.25W	01121	CB8225
R1328	315-0392-00			RES.,FXD,COMP:3.9K OHM,5%,0.25W	01121	CB3925
R1330	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R1334	315-0224-00			RES.,FXD,COMP:220K OHM,5%,0.25W	01121	CB2245
R1335	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R1336	315-0224-00			RES.,FXD,COMP:220K OHM,5%,0.25W	01121	CB2245
R1338	315-0474-00			RES.,FXD,COMP:470K OHM,5%,0.25W	01121	CB4745
R1341	315-0123-00			RES.,FXD,COMP:12K OHM,5%,0.25W	01121	CB1235
R1342	311-1565-00			RES.,VAR,NONWIR:250 OHM,20%,0.50W	73138	91A-200ROM
R1343	315-0392-00			RES.,FXD,COMP:3.9K OHM,5%,0.25W	01121	CB3925
R1345	315-0470-00			RES.,FXD,COMP:47 OHM,5%,0.25W	01121	CB4705
R1347	315-0222-00			RES.,FXD,COMP:2.2K OHM,5%,0.25W	01121	CB2225

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R1349	321-0314-00			RES.,FXD,FILM:18.2K OHM,1%,0.125W	75042	CEATO-1822F
R1350	321-0314-00			RES.,FXD,FILM:18.2K OHM,1%,0.125W	75042	CEATO-1822F
R1351	315-0180-00			RES.,FXD,COMP:18 OHM,5%,0.25W	01121	CB1805
R1352	315-0220-00			RES.,FXD,COMP:22 OHM,5%,0.25W	01121	CB2205
R1356	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R1360	315-0471-00			RES.,FXD,COMP:470 OHM,5%,0.25W	01121	CB4715
RT157	307-0181-00			RES.,THERMAL:100K OHM,10%,4 MW/DEG C	50157	JP-51J2
RT1157	307-0181-00			RES.,THERMAL:100K OHM,10%,4 MW/DEG C	50157	JP-51J2
S300	260-1742-00			SWITCH,PUSH:ERASE,2 POLE,MOMENTARY	80009	260-1742-00
S1000	260-0227-00			SWITCH,THRMSTC:SPST,8.3A,120V	93410	110087
S1005	260-1222-00			SWITCH,PUSH-PUL:10A,250VAC	91929	2DM301
S1300	260-1742-00			SWITCH,PUSH:ERASE,2 POLE,MOMENTARY	80009	260-1742-00
T1040	120-0963-00			XFMR,PWR,SDN AND SU:HIGH VOLTAGE	80009	120-0963-00
U1050	152-0495-01			SEMIDONDUC,DI:	80009	152-0495-01
V1000	154-0728-00			ELECTRON TUBES:CRT T5440-31	80009	154-0728-00
VR175	152-0195-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	81483	69-6512
VR252	152-0087-00			SEMICOND DEVICE:ZENER,1W,100V,5%	04713	1N3044B
VR353	152-0284-00			SEMICOND DEVICE:ZENER,0.4W,47V,5%	04713	1N977B
VR1175	152-0195-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	81483	69-6512
VR1241	152-0087-00			SEMICOND DEVICE:ZENER,1W,100V,5%	04713	1N3044B

SYMBOLS AND REFERENCE DESIGNATORS

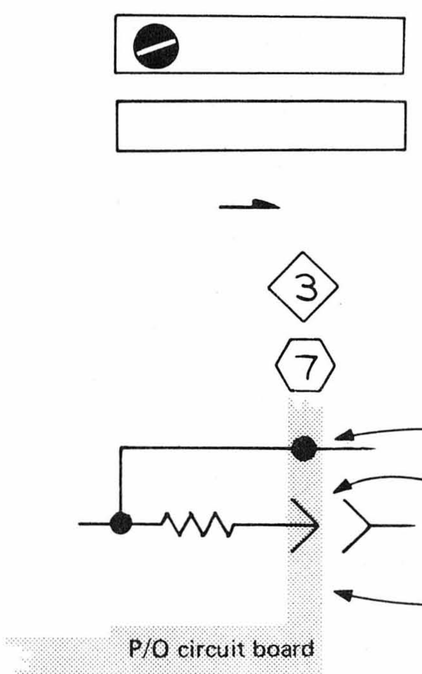
Electrical components shown on the diagrams are in the following units unless noted otherwise:

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

Symbols used on the diagrams are based on ANSI Y32.2 — 1970.

Logic symbology is based on MIL-STD-806B in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The following special symbols are used on the diagrams:



External Screwdriver adjustment.

External control or connector.

Clockwise control rotation in direction of arrow.

Refer to diagram number indicated in diamond.

Refer to waveform number indicated in hexagon.

Connection soldered to circuit board.

Connection made to circuit board with interconnecting pin.

Blue tint encloses components located on circuit board.

SERVICE INFORMATION

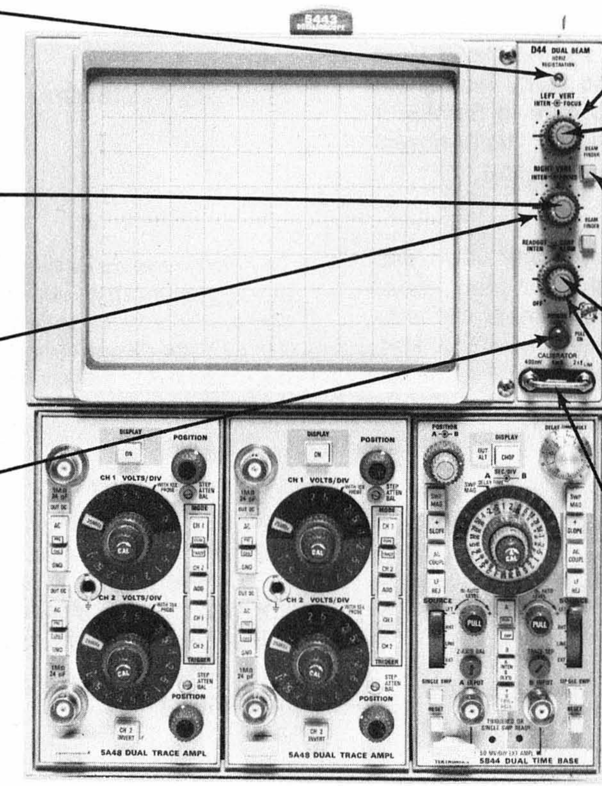
CONTROLS & CONNECTORS

HORIZ REGISTRATION Screwdriver Adjustment
Positions the left beam horizontally to allow it to be superimposed upon the right beam, i.e., both beams start from the same horizontal position.

RIGHT VERT FOCUS Control
Provides adjustment to obtain a well-defined display for the trace associated with the right vertical plug-in.

RIGHT VERT INTENSITY Control
Controls display brightness of the trace associated with the right vertical plug-in.

POWER Switch
Turns instrument power on or off.



LEFT VERT INTENSITY Control
Controls display brightness of the trace associated with the left vertical plug-in.

LEFT VERT FOCUS Control
Provides adjustment to obtain a well-defined display for the trace associated with the left vertical plug-in.

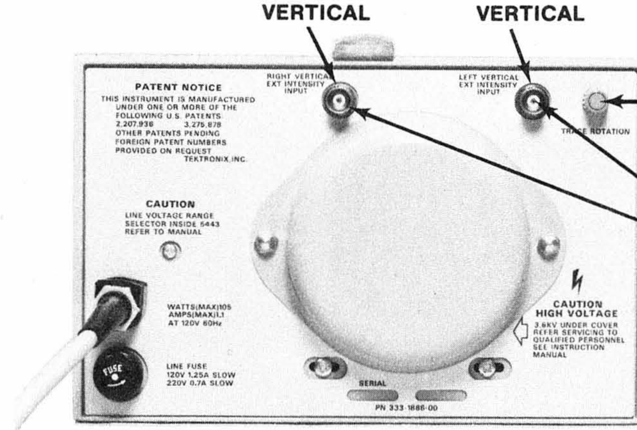
BEAM FINDER Pushbutton
Brings beam on-screen; limits display to area inside graticule and intensifies beam.

GRAT ILLUM Control
Controls Graticule illumination

READOUT INTENS Control
Controls brightness of the readout portion of the crt display. In the fully counterclockwise position, the readout system is inoperative.

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

RIGHT VERTICAL **LEFT VERTICAL**



TRACE ROTATION Control
Provides adjustment for making the trace parallel to the horizontal graticule line.

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

ADJUSTMENTS
OPERATIONAL CHECKS

Adjustment is generally required after a repair has been made, or after long time intervals in which normal aging of components may affect instrument accuracy. To ensure instrument accuracy, check the calibration after every 2,000 hours of operation, or every six months if used infrequently. For initial inspection to verify instrument operation, the basic operation procedure in Section 1 should be used (the instrument is checked with its covers on, using a minimum of peripheral equipment).

Before complete adjustment, thoroughly clean and inspect this instrument as outlined in the service section of the 5443 manual. Also, the system manual contains information for general maintenance of this instrument, including preventive maintenance, component identification and replacement, etc.

Services Available

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

Equipment Required

1. Time-base plug-in unit.

2. Two vertical plug-in units, both of which must be dual-trace units.

3. Sinewave generator with a variable 0 to 6 volt signal amplitude at 1 kHz and 60 MHz[1].

Preliminary Procedure

NOTE

The performance of this instrument can be checked at any temperature within the 0° C to +50° C range. Make any adjustments at a temperature of +25° C, +5° C. Turn all equipment on and allow a 15 minute warmup period before making adjustments.

a. Install a vertical dual-trace plug-in in the left and center plug-in compartments.

b. Check that the correct nominal line-selector block has been installed on the line-selector pins and that the regulating range selected includes the input line voltage. See Installation section for complete instructions.

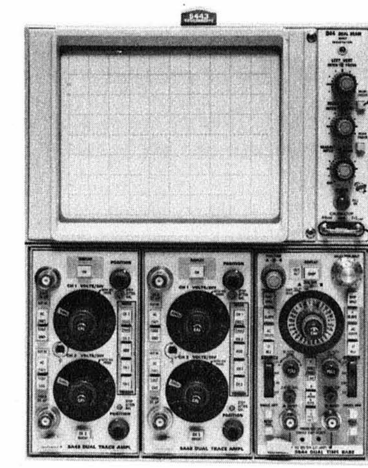
c. Connect a 5443-D44 to the line voltage source and pull the POWER switch out to turn the instrument on.

1. Check Trigger Amplifier

Connect a properly terminated 60 MHz[1] signal to channel 1 on each of the vertical plug-ins. Set the time-base Sec/Div switch to .1 μs. Set the vertical and time-base plug-in triggering controls to trigger on + slope, and channel 1 and left plug-in compartment signal.

Adjust the output amplitude of the sinewave generator for exactly 1 major graticule division of signal. Check that a stable display can be obtained.

Disconnect the signal.



2. Check Beam Finder

Connect a 1 kHz sinewave signal to channel 1 on each of the vertical plug-ins. Set the time-base Sec/Div switch to 1 ms. Press the BEAM FINDER pushbutton. Check that the display intensity increases and that the signal cannot be positioned out of the viewing area as long as the BEAM FINDER pushbutton is depressed.

Disconnect the signal.

3. Check Calibrator

Connect the signal from the front-panel CALIBRATOR loop to channel 1 on each of the vertical plug-ins. Set the time-base Sec/Div switch to 5 ms and the vertical channel 1 Volts/Div to .1. Adjust the time-base triggering controls for a stable display. Check for a display four major graticule divisions in height.

Disconnect the signal.

4. Check Z Axis Amplifier

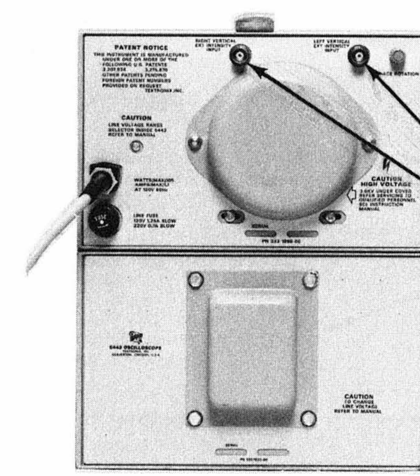
Connect a 5-volt, 1 kHz sinewave signal to the RIGHT VERTICAL and LEFT VERTICAL EXT INTENSITY INPUT connectors. Also, use the sinewave signal to externally trigger the time-base plug-in. Set the time-base plug-in controls for an automatic externally triggered 1 ms sweep. Press the Display On pushbutton on each vertical plug-in. Check that bright spots occur at regular intervals along the trace. It may be necessary to reduce the trace brightness to observe Z-axis modulation.

Disconnect the signal.

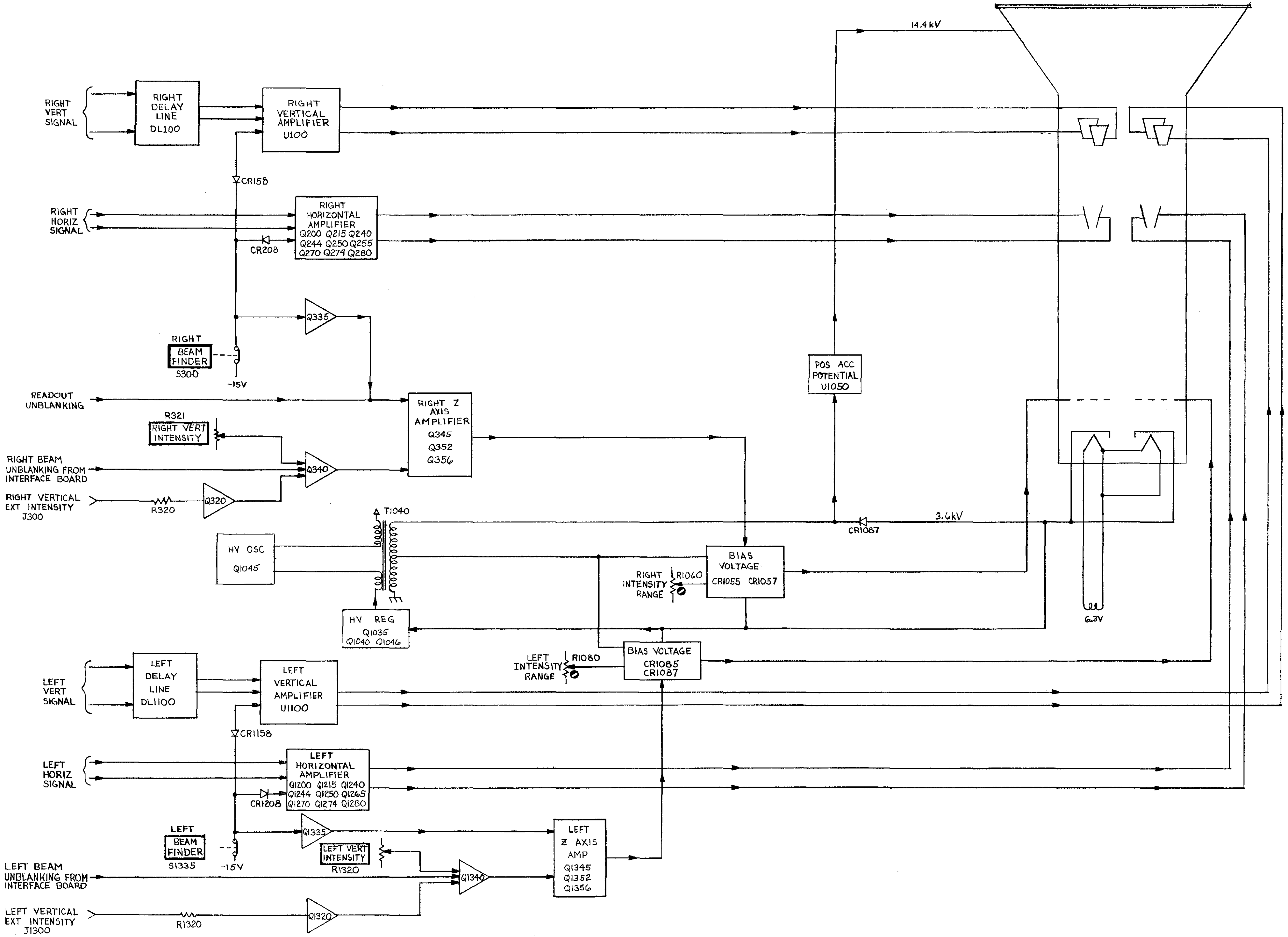
5. Check Chop and Alternate

Set the time-base Sec/Div switch to 50 ms and push the Chop pushbutton in. Set both vertical plug-ins for dual-trace operation. Check for four spots, vertically aligned, going across the crt.

Set the time-base Chop pushbutton to its out position. Check for two alternating sweeps (one for each channel) for each plug-in.



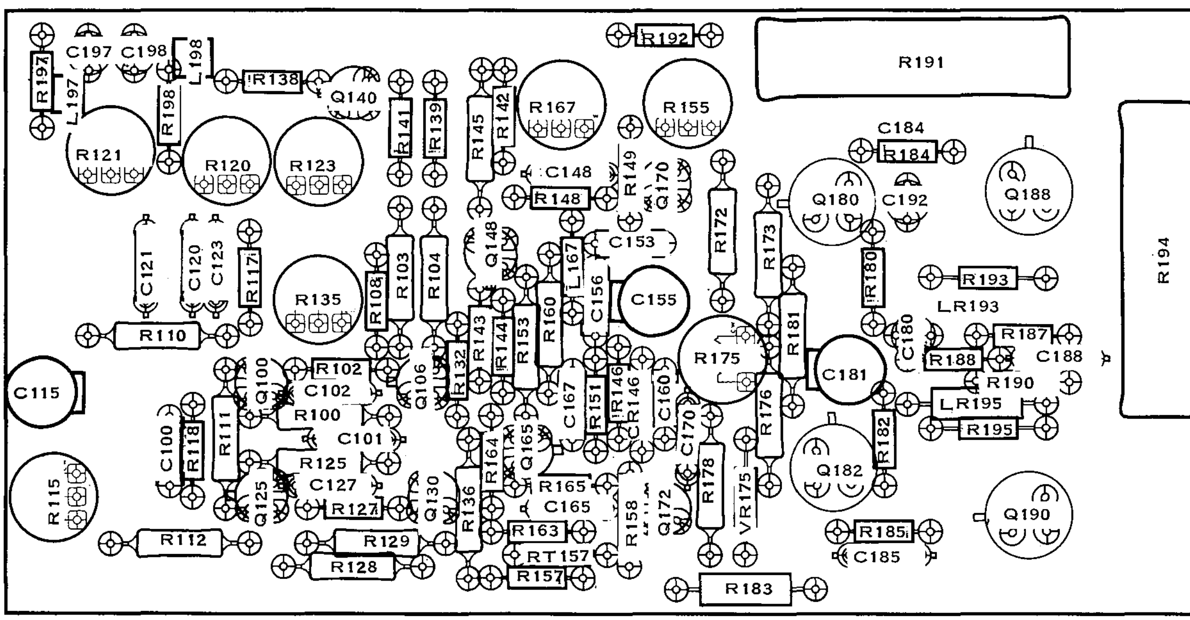
[1]Two 5A48 Dual Trace Amplifiers and a 5B44 Dual Time Base plug-in unit were used for this check. If other plug-in units are used, the trigger amplifier bandpass will depend on the vertical plug-in unit bandpass and the triggering capabilities of the time-base plug-in unit.



BLOCK DIAGRAM

PARTS LOCATION GRID

RIGHT VERTICAL BOARD



CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C100	B3	CR146	D3	R100	B3	R143	C3	R183	E4
C101	C3			R102	C3	R144	C3	R184	F2
C102	C3	L167	D2	R103	C2	R145	C2	R185	E4
C115	A3	L197	A1	R104	C2	R146	D3	R187	F3
C120	B2	L198	B1	R108	C2	R148	D2	R188	F3
C121	B2			R110	B3	R149	D2	R190	F3
C123	B2	LR193	F2	R111	B3	R151	D3	R191	F1
C127	C3	LR195	F3	R112	B4	R153	D3	R192	D1
C148	D2			R115	A3	R155	D1	R193	F2
C153	D2	Q100	B3	R117	B2	R157	D4	R194	G2
C155	D2	Q106	C3	R118	B3	R158	D4	R195	F3
C156	D2	Q125	B3	R120	B2	R160	D3	R197	A1
C160	D3	Q130	C3	R121	A2	R163	D4	R198	B1
C165	D3	Q140	C1	R123	B2	R164	C3		
C167	D3	Q148	C2	R125	B3	R165	D3	RT157	D4
C170	D3	Q165	D3	R128	C4	R167	D1		
C180	F3	Q170	D2	R129	C4	R172	E2	VR175	E3
C181	E3	Q172	D4	R132	C3	R173	E2		
C184	F1	Q180	E2	R135	B2	R175	E3		
C185	E4	Q182	E3	R136	C4	R176	E3		
C188	F3	Q188	F2	R138	B1	R178	D3		
C192	F2	Q190	F4	R139	C2	R180	E2		
C197	A1			R141	C2	R181	E3		
C198	B1			R142	C1	R182	E3		

@

ADJUSTMENTS VERTICAL CIRCUIT BOARD

Equipment Required

1. Time-base plug-in unit with a triggered sweep rate of at least 0.1 μs. For example, a Tektronix 5B44 Delaying Time Base or any time base that is compatible with the Tektronix 5443-D44 Oscilloscope.

2. Special Tektronix Calibration Fixture 067-0680-00.

3. Sinewave generator with output frequencies of 3 MHz and 100 MHz.

Preliminary Procedure

NOTE

The performance of this instrument can be checked at any temperature within the 0° C to +50° C range. Make any adjustments at a temperature of +25° C, ±5° C.

1. Remove the cabinet panels covering the D44.

2. Install the 067-0680-00 Calibration Fixture in the vertical plug-in compartment to be adjusted and a time-base plug-in in the right plug-in compartment.

3. Check that the correct nominal line-selector block has been installed on the line-selector pins and that the regulating range selected includes the input line voltage. See Installation section for complete instructions.

4. Connect the 5443-D44 to the line voltage source and pull the POWER switch out to turn the instrument on.

FOLLOW STEP SEQUENCE

3. Vertical Compensation Flat Top—Right, R121, R120, R123; Left, R1121, R1120, R1123

Install the 067-0680-00 Calibration Fixture in appropriate vertical plug-in compartment.

Set the test switch ot the 067-0680-00 Calibration Fixture to Vert or Horiz + Step Resp and depress the 100 kHz Rep Rate switch. Center the square-wave signal, then increase its amplitude to six major divisions with the amplitude control of the 067-0680-00.

Set the time-base plug-in main Sec/Div switch to 2 μs sweep rate. Adjust R121 (right beam) or R1121 (left beam) for optimum level top of square-wave. Change the sweep rate of the time-base plug-in to 1 μs and adjust the R120 (right beam) or R1120 (left beam) for a flat waveform top. Change the Sec/Div switch of the time-base plug-in to 0.5 μs sweep rate and adjust R123 (right beam) or R1123 (left beam) for optimum level top of the signal. Repeat as necessary to obtain optimum flat top on the waveform.

. Square Front Corner—Right, C115, R115, C155, R155, R167, and C181; Left, C1115, R1115, C1155, R1155, R1167, and C1181

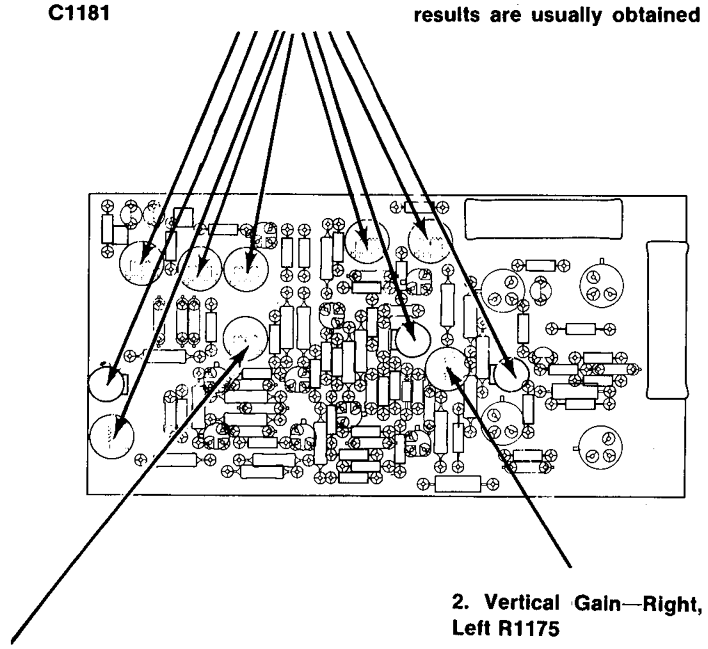
With the 067-0680-00 Calibration Fixture in the appropriate vertical plug-in compartment, depress the 1 MHz Rep Rate switch on the 067-0680-00 Calibration Fixture. Set the Sec/Div switch of the time-base plug-in to 0.1 μs, and adjust the main Trigger Level for a stable step function display.

Adjust C115, R115, C155, R155, R167, and C181 (right beam) or C1115, R1115, C1155, R1155, R1167, and C1181 (left beam) for a square front corner. There is direct interaction between C115 (C115) and R115 (R1115) and between C155 (C1155) and R155 (R1155). Best results are usually obtained by setting R115 (R1115) fully cw, then adjusting C115 (C1115).

Adjust R155 (R1155) and R167 (R1167) for a minimum ringing of the front corner. Adjust C155 (C1155) and C115 (C1115) for a level front corner. After other front corner adjustments have been made, adjust C181 (C1181) for optimum risetime and minimum front corner spike.

The waveform should have a square leading corner and the top should be within 3% of being flat. Position the waveform with 4 major divisions of the waveform off the graticule area, to the top and bottom extremes of the graticule and check for no more than ±3% of waveform aberrations.

Change the Calibration fixture Test switch to Vert or Horiz — Step Resp. Check negative waveform for no more than ±3% of waveform aberrations anywhere within the extremes of the graticule.



1. Vertical Centering—Right, R135; Left, R1135

Install the 067-0680-00 Calibration Fixture in appropriate (center or left) vertical plug-in compartment. Set the 067-0680-00 Test switch to Com Mode. Adjust R135 (right beam) or R1135 (left beam) to center the trace vertically on the graticule.

2. Vertical Gain—Right, R175; Left R1175

Move the 067-0680-00 to the appropriate vertical plug-in compartment. Set the test switch of the Calibration Fixture to Vert or Horiz gain and depress the 1 kHz Rep Rate switch. Position the bright trace to the center graticule line with the Position control of the 067-0680-00.

Adjust R175 (right beam) or R1175 (left beam) so that the horizontal traces coincide with the horizontal graticule lines (one trace per division). Place the first and last trace of the center seven traces exactly on their respective graticule lines.

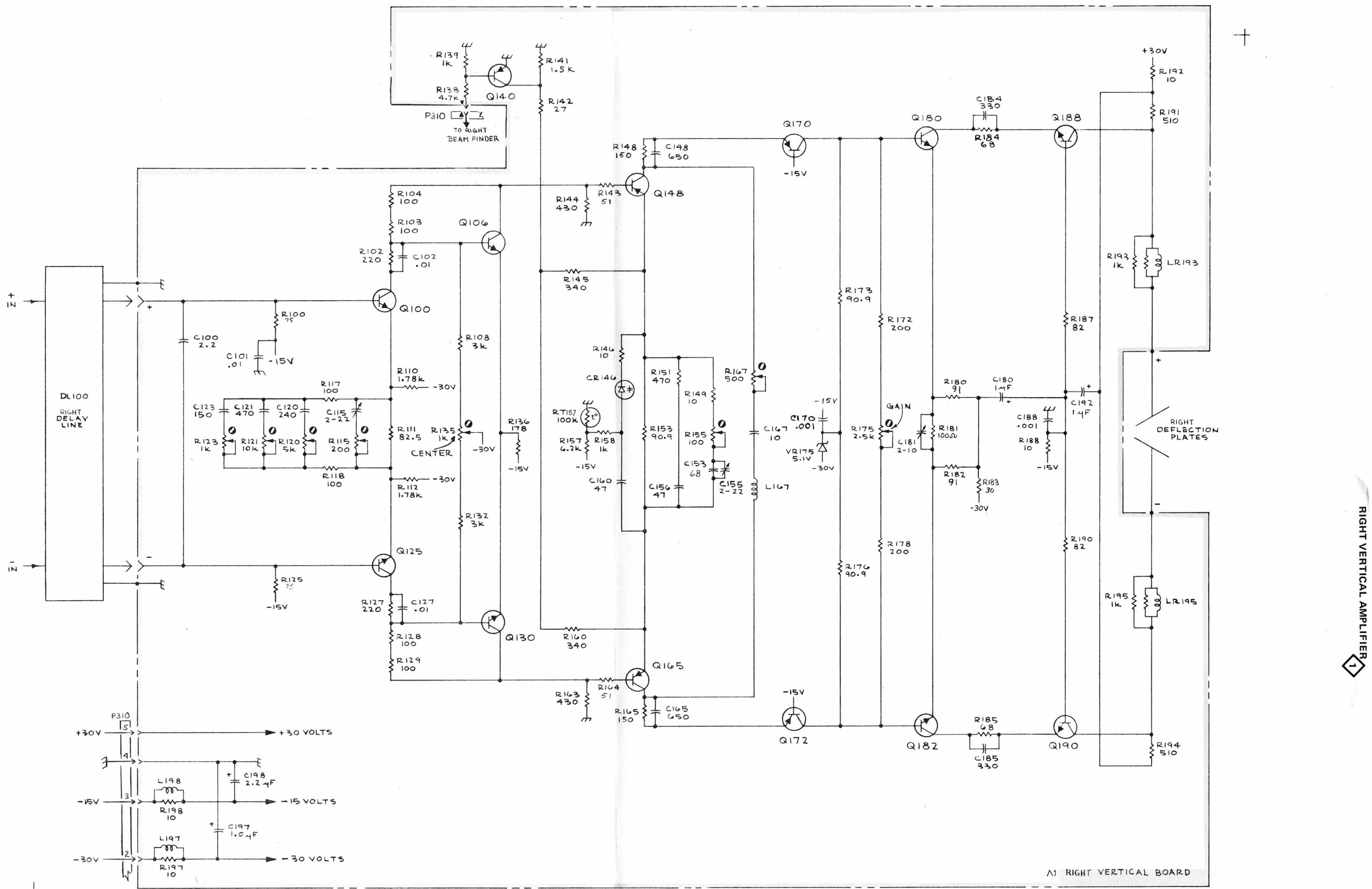
4. Check Vertical Bandwidth

With the 067-0680-00 Calibration Fixture in the appropriate vertical plug-in compartment, set the 067-0680-00 Test switch to Vert or Horiz Freq Resp. Connect a 3 MHz sinewave from a 50 Ω source to the 067-0680-00 Aux In CW In (Freq Resp) connector. Adjust the output amplitude of the sinewave generator to obtain a vertical crt display of six major graticule divisions.[1] (Green light must go on.)

Change the sinewave frequency to 90 MHz. Check that the vertical crt display is still at least 4.2 major graticule divisions.

[1]Refer to the 067-0680-00 Calibration Fixture manual for how to get a leveled sinewave output.

Scan by Zenith



D44

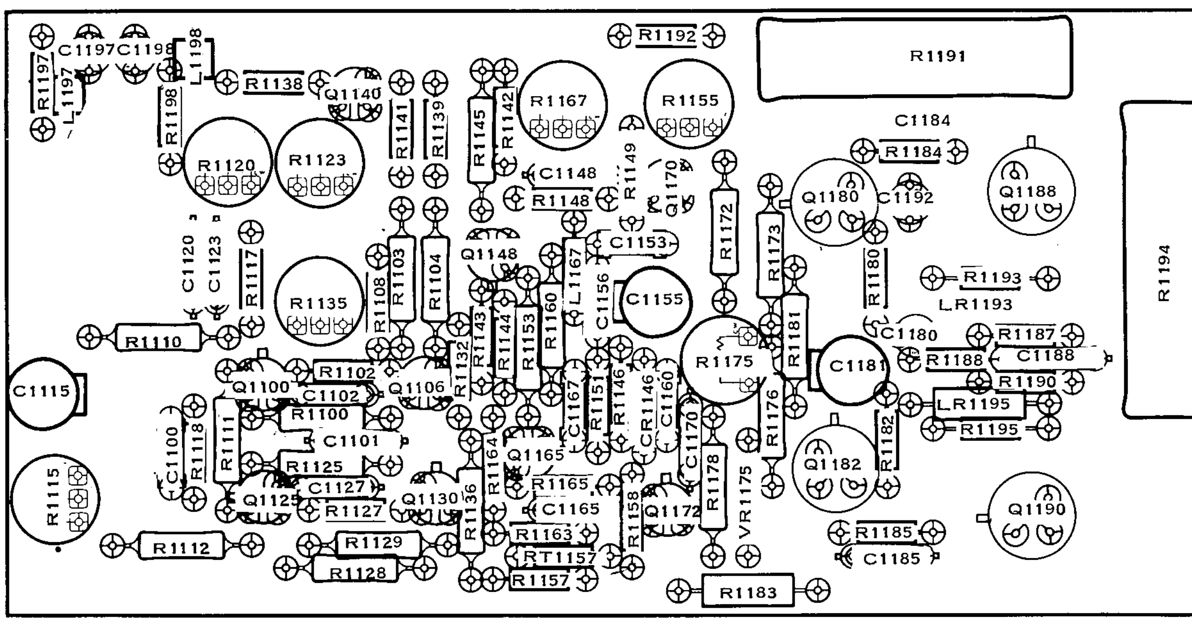
RIGHT VERTICAL AMPLIFIER 1 1-75

Scan by Zenith

D44

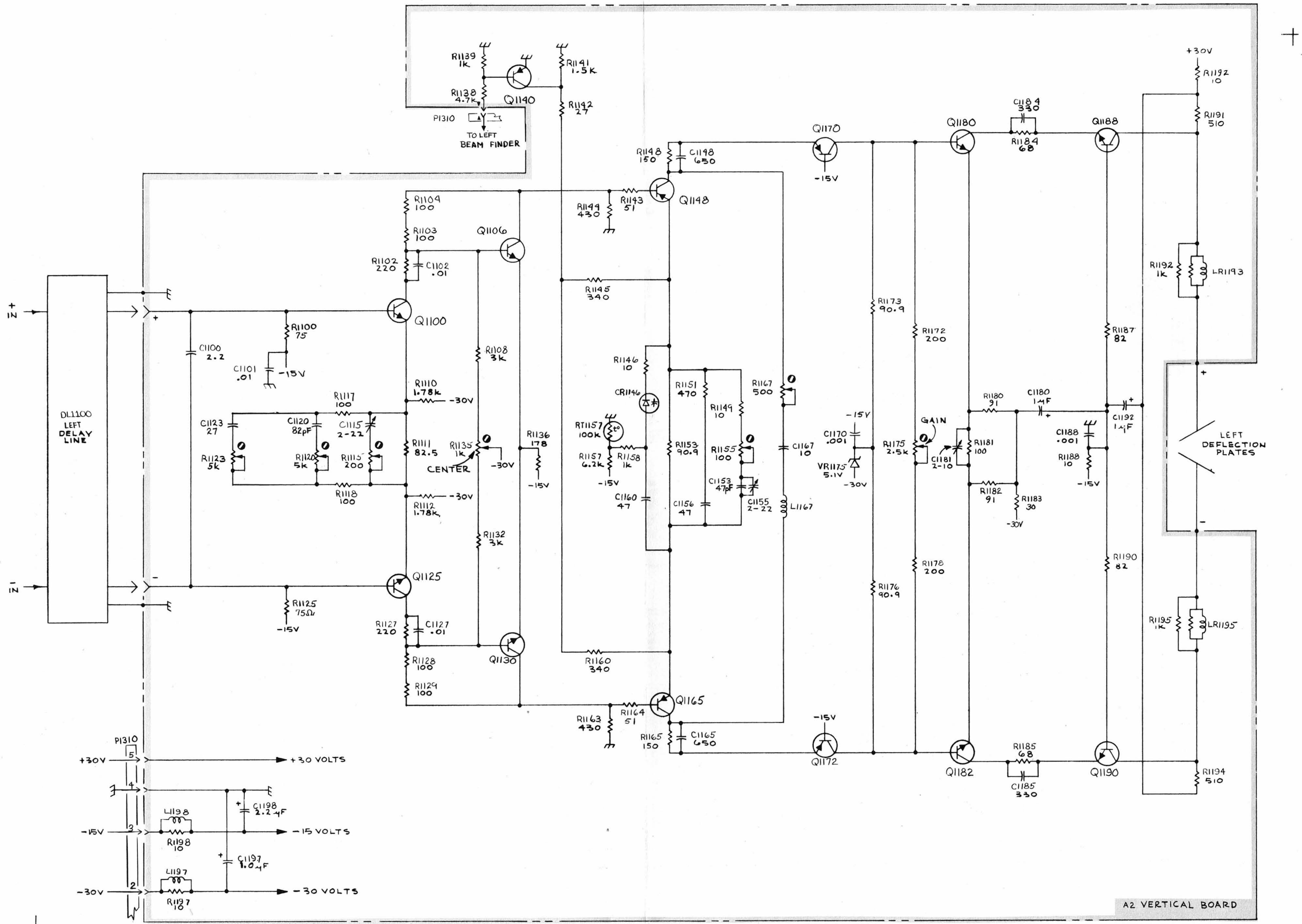
PARTS LOCATION GRID

LEFT VERTICAL



LEFT VERTICAL
PARTS LOCATION GRID

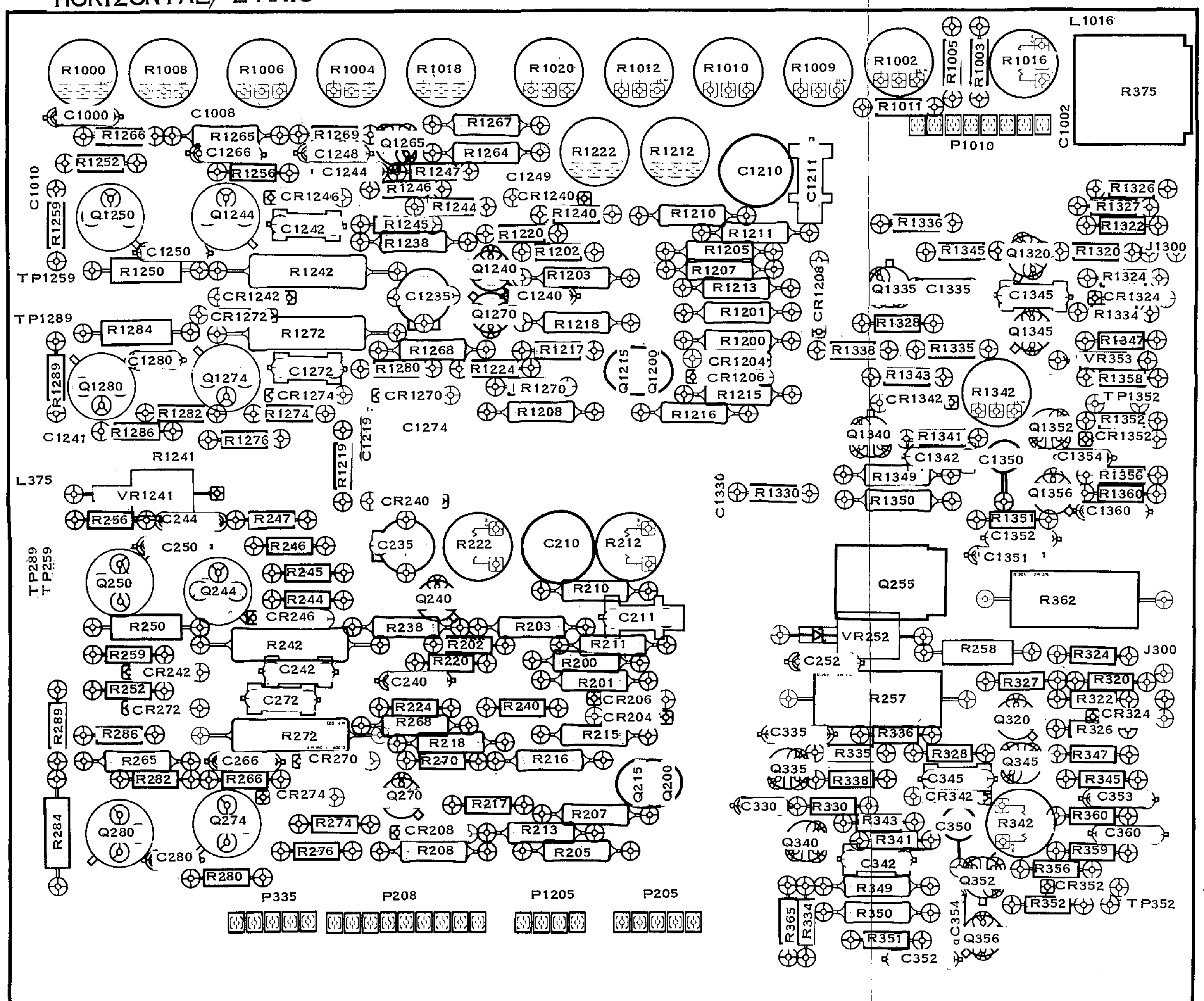
CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C1100	B3	CR1146	D3	R1100	B3	R1143	C3	R1182	E3
C1101	C3			R1102	C3	R1144	C3	R1183	E4
C1102	C3	L1167	D2	R1103	C2	R1145	C2	R1184	F2
C1115	A3	L1197	A1	R1104	C2	R1146	D3	R1185	E4
C1120	B2	L1198	B1	R1108	C2	R1148	D2	R1187	F3
C1123	B2			R1110	B3	R1149	D2	R1188	F3
C1127	C3	LR1193	F2	R1111	B3	R1151	D3	R1190	F3
C1148	D2	LR1195	F3	R1112	B4	R1153	D3	R1191	F1
C1153	D2			R1115	A3	R1155	D1	R1192	D1
C1155	D2	Q1100	B3	R1117	B2	R1157	D4	R1193	F2
C1156	D2	Q1106	C3	R1118	B3	R1158	D4	R1194	G2
C1160	D3	Q1125	B3	R1120	B2	R1160	D3	R1195	F3
C1165	D3	Q1130	C3	R1123	B2	R1163	D4	R1197	A1
C1167	D3	Q1140	C1	R1125	B3	R1164	C3	R1198	B1
C1170	D3	Q1148	C2	R1128	C4	R1165	D3		
C1180	F3	Q1165	D3	R1129	C4	R1167	D1	RT1157	D4
C1181	E3	Q1170	D2	R1132	C3	R1172	E2		
C1184	F1	Q1172	D4	R1135	B2	R1173	E2	VR1175	E3
C1185	E4	Q1180	E2	R1136	C4	R1175	E3		
C1188	F3	Q1182	E3	R1138	B1	R1176	E3		
C1192	F2	Q1188	F2	R1139	C2	R1178	D3		
C1197	A1	Q1190	F4	R1141	C2	R1180	E2		
C1198	B1			R1142	C1	R1181	E3		



+IN
-IN
DL1100 LEFT DELAY LINE
Q1100
Q1125
Q1106
Q1130
Q1140
Q1148
Q1165
Q1170
Q1172
Q1180
Q1182
Q1188
Q1190
R1100 75
C1100 2.2
C1101 .01
-15V
R1102 220
C1102 .01
R1103 100
R1104 100
R1108 3k
R1110 1.78k
-30V
R1111 82.5
R1112 1.78k
R1117 100
R1118 100
C1115 2-22
C1120 82pF
R1120 5k
R1115 200
C1123 27
R1123 5k
R1125 75Ω
R1127 220
C1127 .01
R1128 100
R1129 100
R1132 3k
R1135 1k
CENTER
R1136 178
R1138 4.7k
R1139 1k
P1310
TO LEFT BEAM FINDER
R1141 1.5k
R1142 27
R1143 51
R1144 430
R1145 340
R1146 10
CR1146
RT1157 100k
R1157 6.2k
R1158 1k
C1160 47
R1148 150
C1148 650
R1151 470
R1149 10
R1153 90.9
R1155 100
C1153 47pF
C1155 2-22
C1156 47
R1167 500
C1167 10
L1167
R1160 340
R1163 430
R1164 51
R1165 150
C1165 650
C1170 .001
VR1175 5.1V
R1173 90.9
R1176 90.9
R1172 200
R1178 200
R1175 2.5k
GAIN
C1181 2-10
R1180 91
R1181 100
R1182 91
R1183 30
C1180 1μF
C1188 .001
R1188 10
C1192 1μF
C1184 330
R1184 68
R1185 68
C1185 330
R1187 82
R1190 82
+30V
R1192 10
R1191 510
R1192 1k
LR1193
R1195 1k
LR1195
R1194 510
LEFT DEFLECTION PLATES
+30V
+30 VOLTS
-15V
L1198
R1198 10
C1198 2.2μF
-15 VOLTS
-30V
L1197
R1197 10
C1197 1.0μF
-30 VOLTS
A2 VERTICAL BOARD

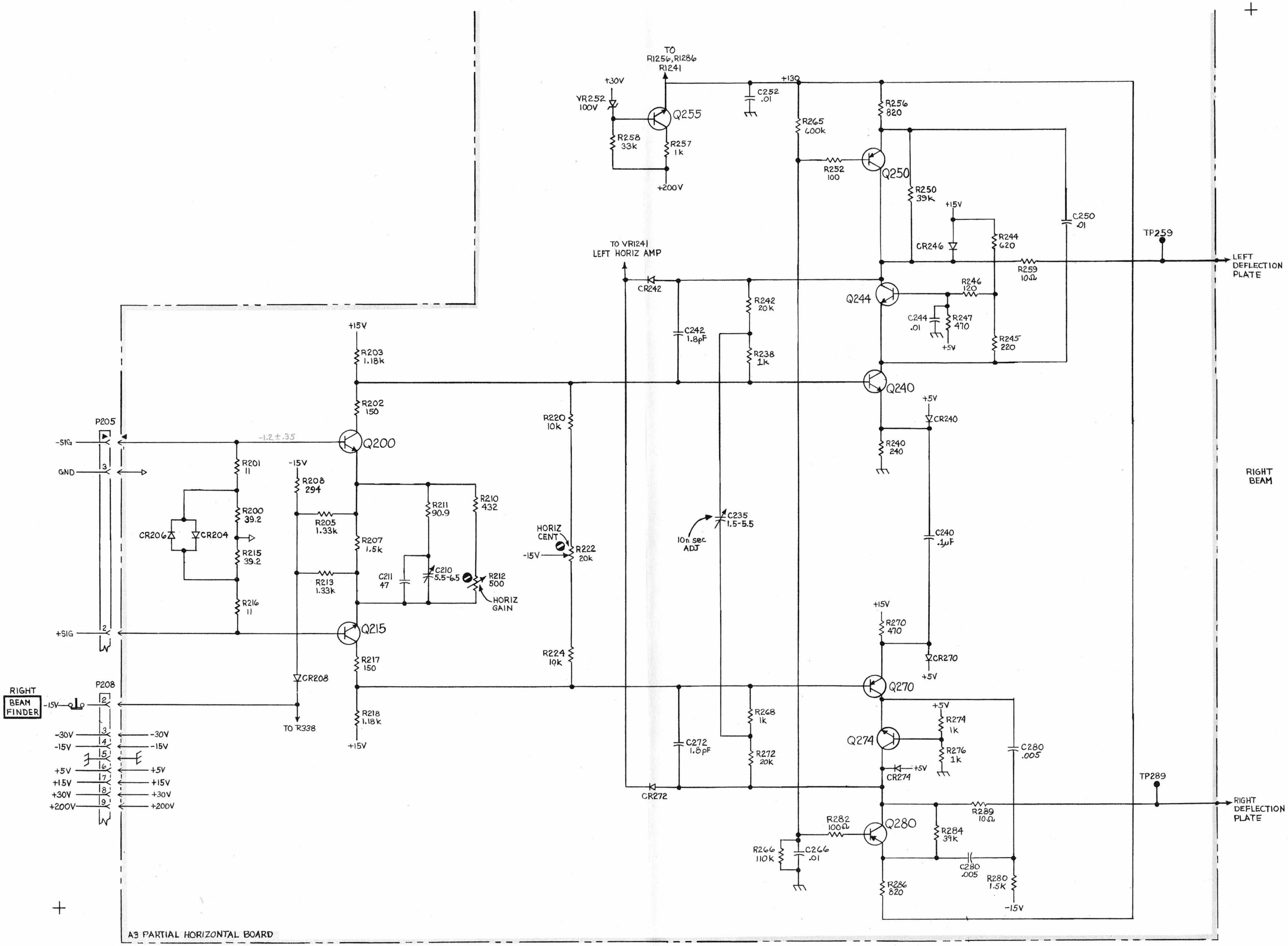
PARTS LOCATION GRIDS

HORIZONTAL/ Z AXIS



CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C210	E4	CR1246	C2	R220	D5	R1016	H1	R1350	G4
C211	E5	CR1270	D3	R222	D4	R1018	D1	R1351	H4
C235	D4	CR1272	B3	R224	D5	R1020	E1	R1352	H3
C240	D5	CR1274	C3	R238	D5	R1200	F3	R1356	H4
C242	C5	CR1324	H3	R240	D5	R1201	F3	R1360	H4
C244	B4	CR1342	G3	R242	C5	R1202	E2		
C250	B4	CR1352	H4	R244	C5	R1203	E2	TP259	A4
C252	F5			R245	C4	R1205	F2	TP289	A4
C266	B6	J300	I5	R246	C4	R1207	F2	TP352	I7
C272	C5	J1300	I2	R247	C4	R1208	E3	TP1259	A2
C280	B6			R250	B5	R1210	F2	TP1289	A3
C330	F6	L375	A4	R252	B5	R1211	F2	TP1352	H3
C335	F5	L1016	H1	R256	B4	R1212	E2		
C342	G6			R257	G5	R1213	F3	VR252	G5
C345	G6	P205	E7	R258	G5	R1215	F3	VR353	H3
C350	G6	P208	D7	R259	B5	R1216	F3	VR1241	B4
C352	G7	P335	C7	R265	B6	R1217	E3		
C353	H6	P1010	G1	R266	B6	R1218	E3		
C354	G7	P1205	E7	R268	D5	R1219	C4		
C360	H6			R270	D6	R1220	D2		
C1000	A1	Q200	E6	R272	C5	R1222	E2		
C1002	H1	Q215	E6	R274	C6	R1224	D3		
C1008	B1	Q240	D5	R276	C6	R1238	D2		
C1010	A2	Q244	B5	R280	B6	R1240	E2		
C1210	F2	Q250	B5	R282	B6	R1241	B4		
C1211	F2	Q255	G5	R284	A6	R1242	C2		
C1219	C4	Q270	D6	R286	B5	R1244	D2		
C1235	D3	Q274	B6	R289	A5	R1245	D2		
C1240	D3	Q280	B6	R320	H5	R1246	D2		
C1241	A4	Q320	H5	R322	H5	R1247	D2		
C1242	C2	Q335	F6	R324	H5	R1250	B2		
C1244	C2	Q340	F6	R326	H5	R1252	B2		
C1248	C2	Q345	H6	R327	H5	R1256	C2		
C1249	D2	Q352	G6	R328	G6	R1259	A2		
C1250	B2	Q356	G7	R330	F6	R1264	D2		
C1266	B2	Q1200	E3	R334	F7	R1265	B1		
C1272	C3	Q1215	E3	R335	G6	R1266	B1		
C1274	D3	Q1240	D2	R336	G5	R1267	D1		
C1280	B3	Q1244	B2	R338	G6	R1268	D3		
C1330	F4	Q1250	B2	R341	G6	R1269	C1		
C1335	G3	Q1265	D2	R342	H6	R1270	E3		
C1342	G4	Q1270	D3	R343	G6	R1272	C3		
C1345	H3	Q1274	B3	R345	H6	R1274	C3		
C1350	H4	Q1280	B3	R347	H6	R1276	C4		
C1351	H4	Q1320	H2	R349	G7	R1280	D3		
C1352	H4	Q1335	G3	R350	G7	R1282	B3		
C1354	H4	Q1340	G3	R351	G7	R1284	B3		
C1360	H4	Q1345	H3	R352	H7	R1286	B3		
		Q1352	H3	R356	H6	R1289	A3		
CR204	E5	Q1356	H4	R358	H3	R1320	H2		
CR206	E5			R359	H6	R1322	H2		
CR208	D6	R200	E5	R360	H6	R1324	H2		
CR240	D4	R201	E5	R362	H5	R1326	H2		
CR242	B5	R202	D5	R375	H1	R1327	H2		
CR246	C5	R203	D5	R365	F7	R1328	G3		
CR270	C6	R205	E6	R1000	A1	R1330	F4		
CR272	B5	R207	E6	R1002	G1	R1334	H3		
CR274	C6	R208	D6	R1003	G1	R1335	G3		
CR324	H5	R210	E5	R1004	C1	R1336	G2		
CR342	G6	R211	E5	R1005	G1	R1338	G3		
CR352	H7	R212	E4	R1006	C1	R1341	G4		
CR1204	F3	R213	D6	R1008	B1	R1342	H3		
CR1206	F3	R215	E6	R1009	F1	R1343	G3		
CR1208	F3	R216	E6	R1010	F1	R1345	G2		
CR1240	E2	R217	D6	R1011	G1	R1347	H3		
CR1242	B3	R218	D6	R1012	E1	R1349	G4		

RIGHT & LEFT HORIZ & Z AXIS PARTS LOCATION GIRD



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RIGHT HORIZONTAL AMPLIFIER ③ 175 JEB

Equipment Required

1. Two vertical plug-in units having dual-trace operation capability.

2. Dual time-base plug-in unit is preferred, however, any 5000-series time base plug-in having a 10 ns sweep rate can be used.

3. Special Tektronix Calibration Fixture 067-0680-00.

4. Time-marker generator having 5 ns and 1 ms markers.

5. Sinewave generator with output frequencies of 50 kHz and 2 MHz.

6. Test oscilloscope with compatible 10X probe. Bandwidth, dc to 60 MHz; deflection factor, 2 Volts/Div; sweep rate, 50 ns/Div. For example, a 5403/D40 Oscilloscope with a P6065 Probe, 5A48 Dual Trace Amplifier and either a 5B40, 5B42 or 5B44 Time Base plug-in.

Preliminary Procedure

NOTE

The performance of this instrument can be checked at any temperature within the 0° C to +50° C range. Make any adjustments at a temperature of +25° C, ±5° C.

1. Remove the cabinet panels covering the D44.

2. Install vertical plug-ins in the left and center plug-in compartments and a time-base plug-in in the right plug-in compartment.

3. Check that the correct nominal line-selector block has been installed on the line-selector pins and that the regulating range selected includes the input line voltage. See Installation section for complete instructions.

4. Connect the 5443-D44 to the line voltage source and pull the POWER switch out to turn the instrument on.

1. Astig—Right, R1018 Left, R1020

Set the time-base Sec/Div switch to Amp . Turn both beam FOCUS controls fully clockwise, then adjust R370 and R1370 for a nearly round spot on the crt. Adjust the FOCUS controls for smallest spot.

2. Horizontal Centering —R1002

Remove the time-base plug-in from the right plug-in compartment and install the 067-0680-00 Calibration Fixture in its place.

Set the 067-0680-00 test switch to the com mode and the front-panel HORIZ REGISTRATION control to midrange. Adjust R1100 to vertically align the spots of the two beams.

3. Amplifier Horizontal Centering — Right, R222; Left, R1222

With the test equipment set as in step 2 and the HORIZ REGISTRATION control set to midrange, adjust R222, right beam, and R1222, left beam, to horizontally position the spot for each beam to the vertical center line of the graticule.

4. Trace Rotation—R375

Remove the 067-0680-00 from the right plug-in compartment and install the time-base plug-in in its place. Set the time-base controls for a 1 ms/Div sweep with auto triggering for both beams. Adjust R375 to make the traces parallel to the horizontal graticule lines. The adjustment of R375 may have to be compromised to make the traces of each beam as parallel to the graticule lines as possible.

5. Orthogonality—R1016

Connect 1 ms markers from the time marker generator to each of the vertical plug-in input connectors using coaxial cables and a BNC T connector.

Set the time base controls for a 1 ms/Div sweep with auto triggering for both beams. Position the trace of each beam to the horizontal center line of the graticule.

ADJUSTMENTS HORIZONTAL CIRCUIT BOARD

Adjust R1016 so that the vertical time markers make a 90° angle with the trace for each beam as observed at the graticule center. The adjustment of R1016 may have to be compromised to make the angle of each beam as closely as possible to the desired 90°.

6. Geometry Control—R1000

With the test equipment set as in step 5, adjust R1000 by observing the vertical time markers at each side of the graticule for minimum bow or tilt of vertical trace, using the graticule as a reference. Check that the bowing or tilting does not exceed 1/2 minor graticule division. The adjustment of R1000 may have to be a compromise to bring all points for both beams within the tolerance.

Disconnect the time-marker generator.

7. Horizontal Bowing—Start - Right, R1010; Left, R1006
End - Right, R1012, Left, R1008

Set the time base controls for a 1 ms/Div free-running sweep for both beams. Set the controls of each vertical plug-in for dual-trace operation. Using the positioning controls for each vertical plug-in channel, position the channel 1 trace for each beam to the top graticule line and the channel 2 trace for each beam to the bottom graticule line.

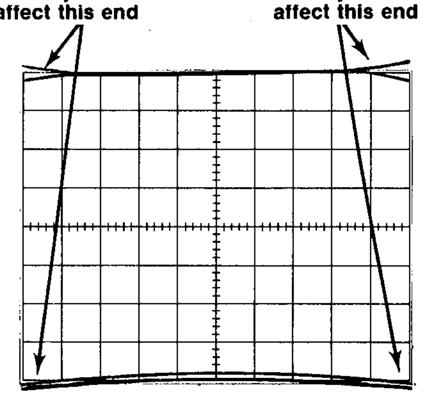
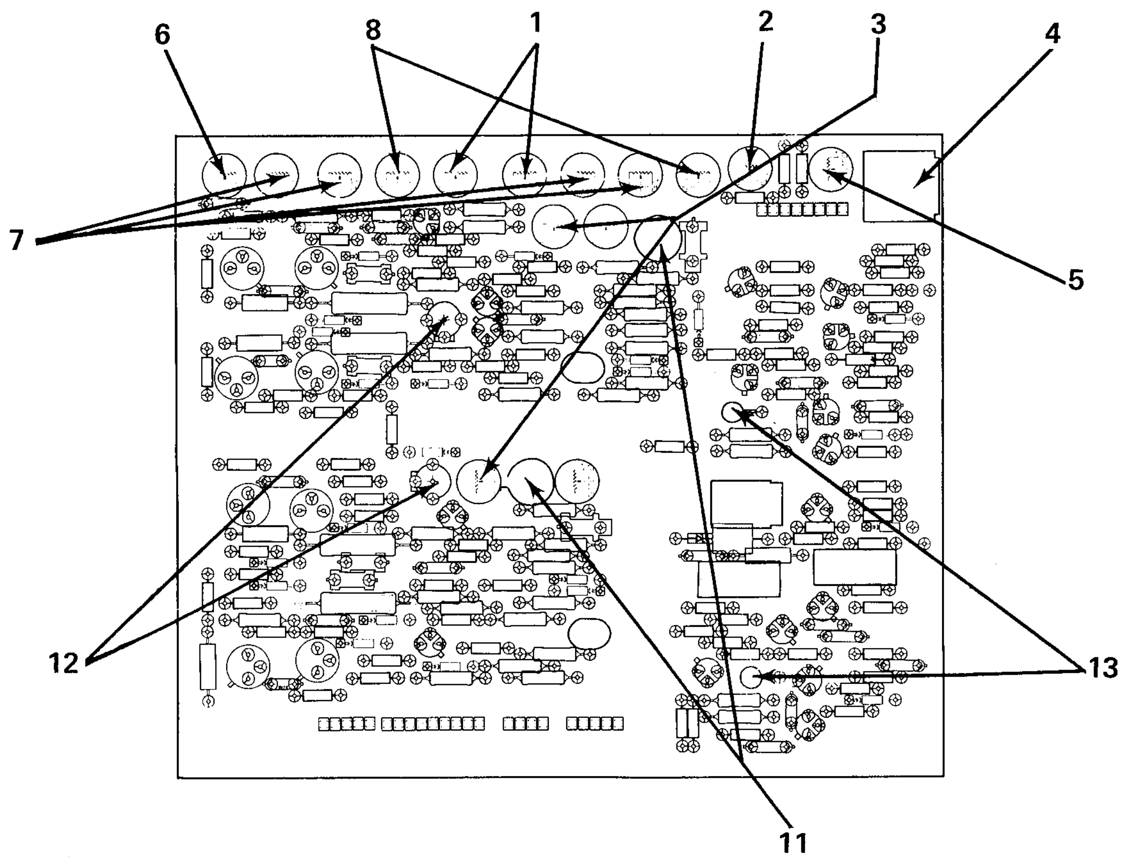


Fig. A



Adjust Start R1010 (right beam) and R1006 (left beam), until the left end of both beam traces are superimposed on the top and bottom graticule lines. See Fig. A.

Adjust End R1012 (right beam) and R1008 (left beam), until the right end of both beam traces are superimposed on the top and bottom graticule lines. See Fig. A.

8. Vertical Trace Bowling—Right, R1009; Left, R1004

Set the controls of the vertical plug-ins for single trace operation.

Connect 1 ms markers from the time-marker generator to each of the vertical plug-in input connectors using coaxial cables and a BNC T connector.

Set the time base controls for a 1 ms/Div sweep with auto triggering for both beams. Position the horizontal traces for the beams off (below) the bottom of the graticule and set the vertical plug-in sensitivity such that the time-markers will vertically overscan the graticule. Horizontally position a time-marker for each beam to the vertical graticule center-line.

Adjust Vert, R1009 (right beam), and R1004 (left beam), for a vertical straight line without bowing. Recheck step 5 if vertical line is not at 90° angle to horizontal graticule center line.

9. Horiz Gain—Right, R212; Left, R1212

With the test equipment set as in step 8, adjust R212 (right beam) and R1212 (left beam) for exactly eight major graticule divisions between the second and eighth vertical traces. Check for a display of one vertical line per major graticule division within 1/4 minor division.

10. Check Horizontal Bandwidth

Remove the time-base plug-in from the right plug-in compartment and install the 067-0680-00 Calibration Fixture in its place. Set the 067-0680-00 test switch to aux in. Connect a correctly terminated 50 kHz sinewave to the 067-0680-00 Aux In CW In (Freq Resp) connector. Adjust the output amplitude of the sinewave generator to obtain a horizontal crt display of six major graticule divisions.[1]

Change the input sinewave frequency to the 067-0680-00 to 2 MHz. Check that the horizontal crt display is at least 4.2 major graticule divisions.

[1]Refer to the 067-0680-00 Calibration Fixture manual for how to get a leveled sinewave output.

11. 10 ns Timing—Right, C210; Left, C1210

Remove the 067-0680-00 from the right plug-in compartment and install the time-base plug-in its place.

Connect 10 ns markers from the time-marker generator to each of the vertical plug-in input connectors using coaxial cables and a BNC T connector. Set the amplitude controls of the vertical plug-ins for a marker height of about five major divisions.

Set the time-base Sec/Div switch to .1 μs and push the Mag pushbutton in. Adjust the time-base Triggering controls for a stable display.

Adjust C210 (right beam) and C1210 (left beam) for one 10 ns marker per division over the center eight major graticule divisions. Check linearity ($\pm$6 1/2%) of entire sweep, excluding the first three and the last ten major divisions.

12. 5 ns Timing—Right, C235, Left, C1235

Do not make this adjustment unless a time-base plug-in having a 5 ns sweep is available.

Connect 5 ns markers from the time-marker generator to each of the vertical plug-in input connectors using coaxial cables and a BNC T connector. Set the amplitude controls of the vertical plug-ins for a marker height of about 5 major divisions.

Set the time-base Sec/Div switch to .05 μs and push the Mag pushbutton in. Adjust the time-base triggering controls for a stable display.

Adjust C235 (right beam) and C1235 (left beam) for one 5 ns marker per division over the center eight major graticule divisions. Check linearity ($\pm$6 1/2%) of entire sweep, excluding the first three and the last ten major divisions.

The 5 ns and 10 ns adjustments interact with each other. It therefore may be necessary to recheck step 11 and this step.

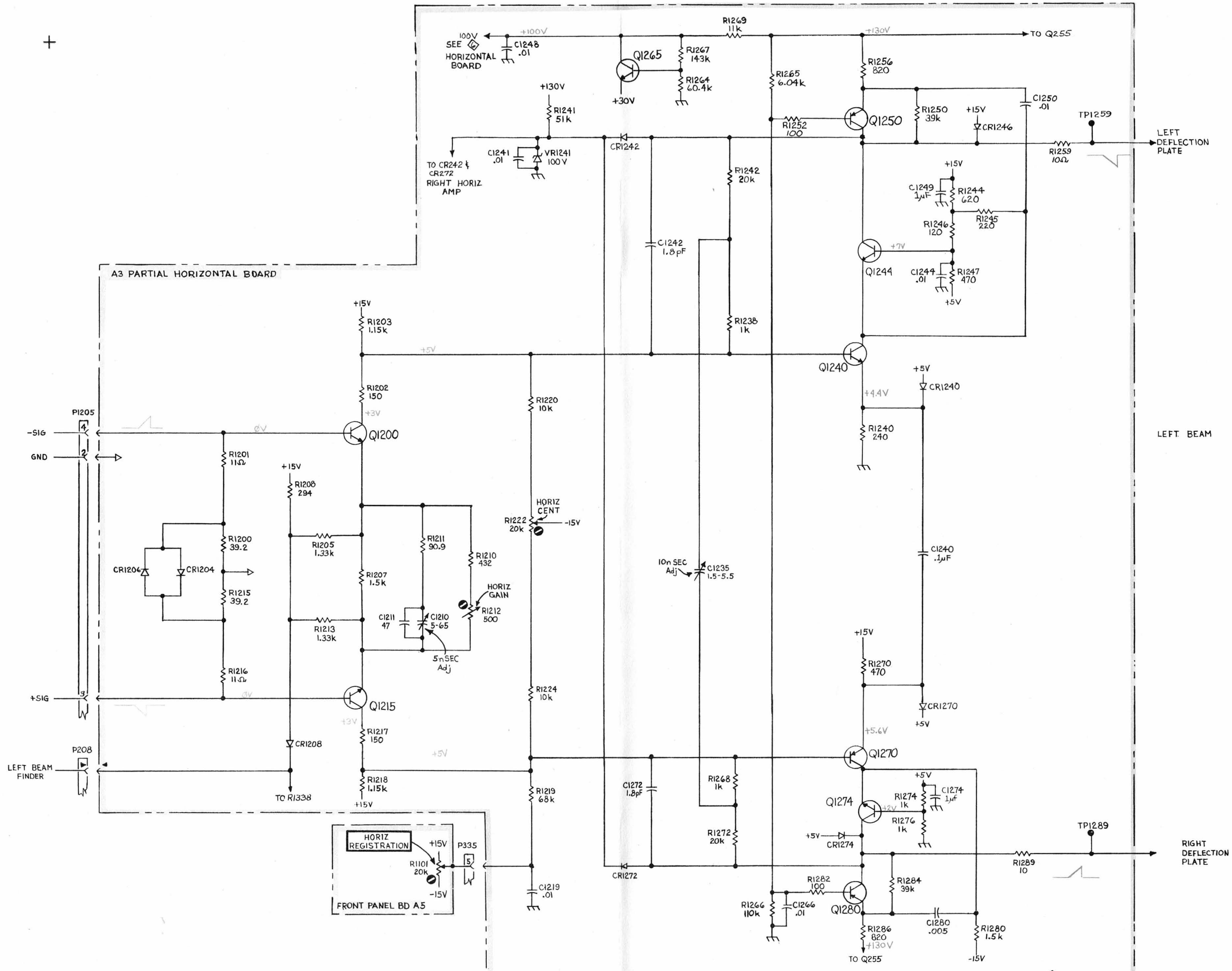
Disconnect the time-marker generator.

13. Z Axis—Right, C350, Left, C1350

Set the time base controls for a 1 μs/Div free-running sweep for both beams. Connect the test oscilloscope to TP352 (right beam) or TP1352 (left beam) using a 10X probe. Set the test oscilloscope vertical deflection factor to display about three divisions of signal and the sweep rate to 50 ns.

Adjust C350 (right beam) or C1350 (left beam) to obtain the best square leading corner on the test oscilloscope displayed waveform.

Disconnect the test oscilloscope.



LEFT HORIZONTAL AMPLIFIER 4

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LEFT HORIZONTAL AMPLIFIER 4 12-74 JEB

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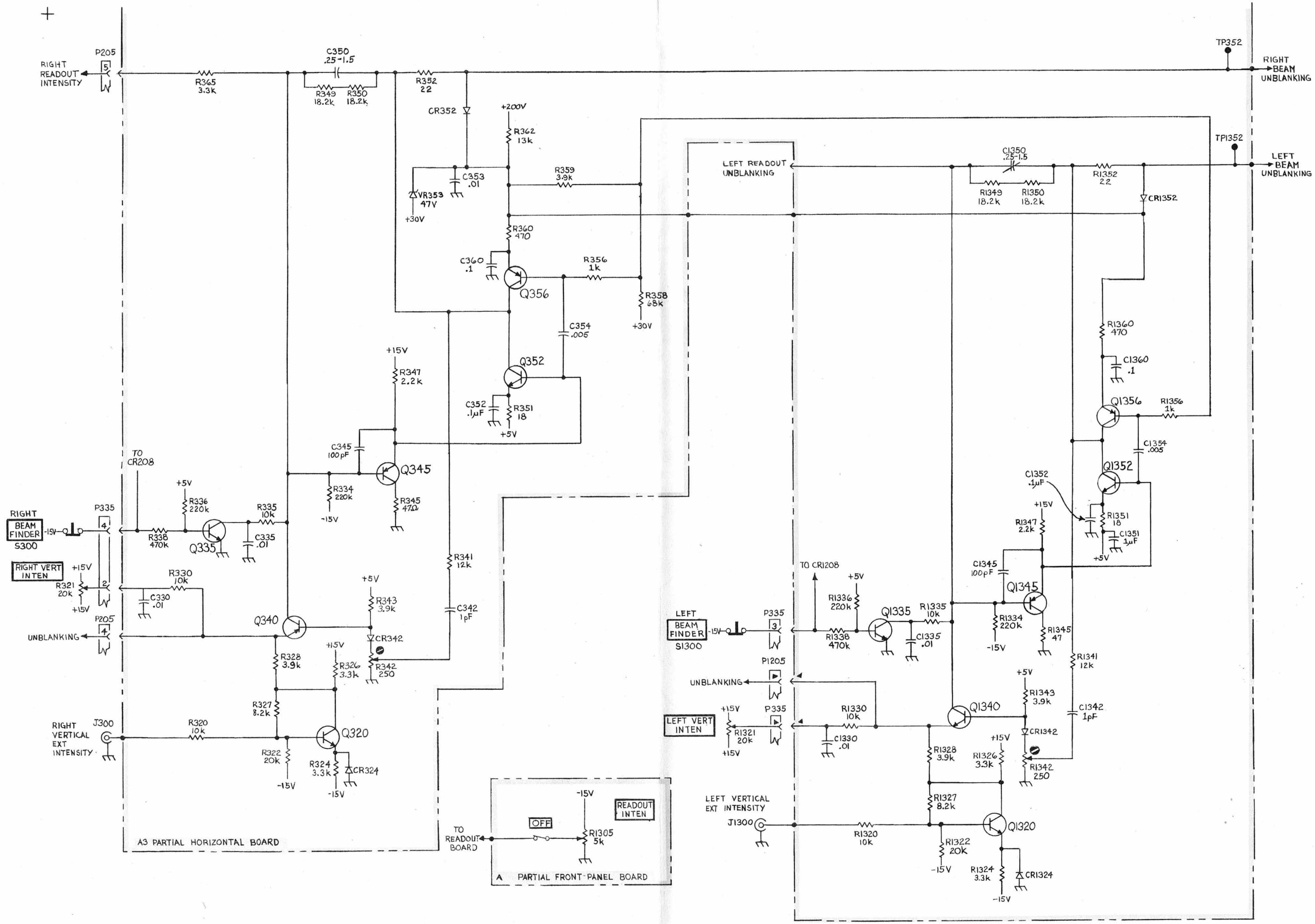
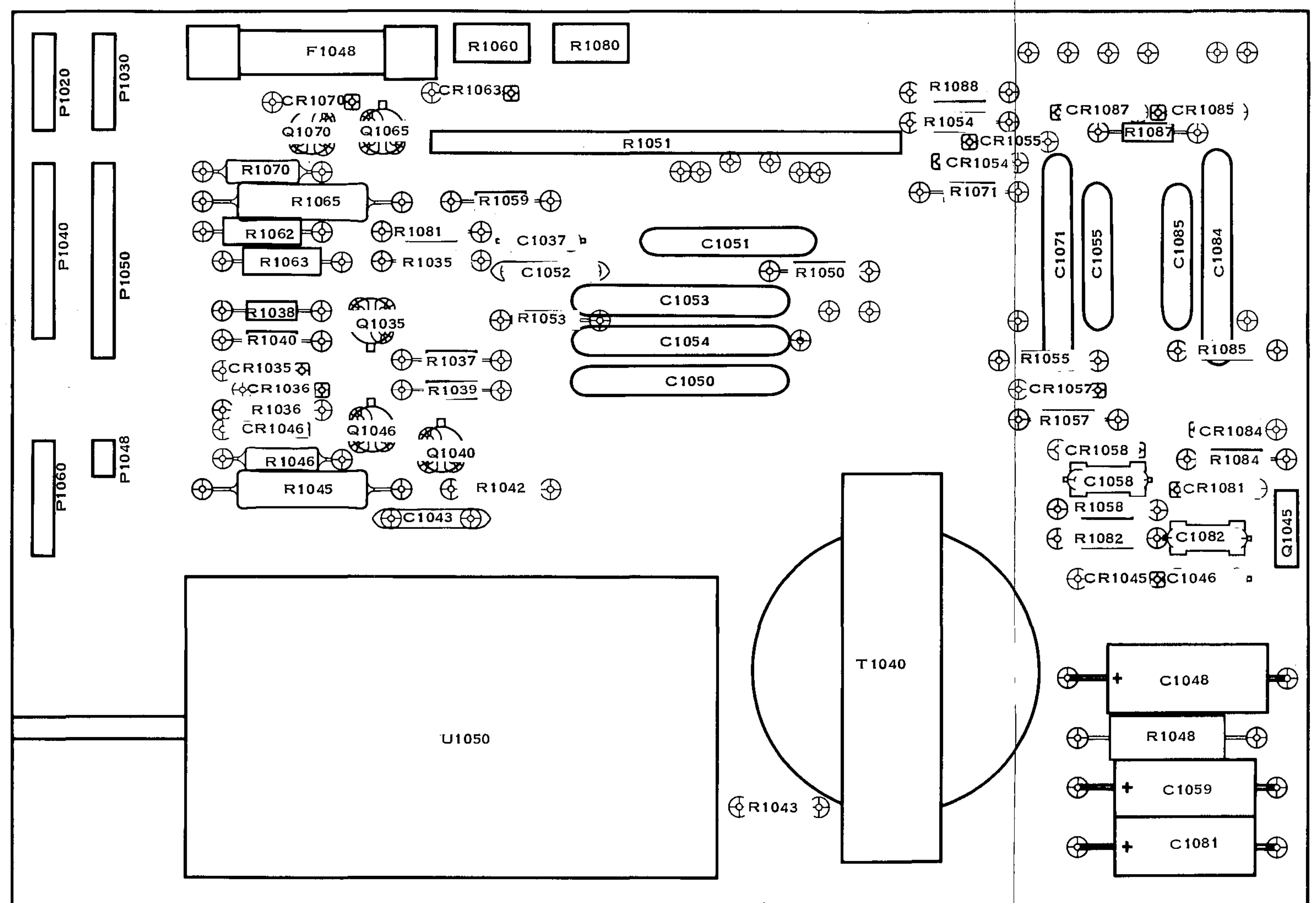


RIGHT AND LEFT Z AXIS AMPLIFIERS ⑤

Right & Left Z Axis Amplifier ⑤ 1274 JEB

PARTS LOCATION GRID

HIGH VOLTAGE BOARD



CKT NO	GRID LOC	CKT NO	GRID LOC
C1037	D2	Q1035	C3
C1043	D4	Q1040	D4
C1046	H4	Q1045	I4
C1048	H5	Q1046	C3
C1050	E3	Q1065	C2
C1051	E2	Q1070	C2
C1052	D2		
C1053	E3	R1035	D2
C1054	E3	R1036	C3
C1055	H2	R1037	D3
C1058	H4	R1038	C3
C1059	H6	R1039	D3
C1071	G2	R1040	C3
C1081	H6	R1042	D4
C1082	H4	R1043	F6
C1084	H2	R1045	C4
C1085	H2	R1046	C4
		R1048	H5
		R1050	F2
		R1051	E2
CR1035	C3	R1053	D3
CR1036	C3	R1054	G2
CR1045	H4	R1055	G3
CR1046	C3	R1057	G3
CR1054	G2	R1058	H4
CR1055	G2	R1059	D2
CR1057	G3	R1060	D1
CR1058	H3	R1062	C2
CR1063	D1	R1063	C2
CR1070	C1	R1065	C2
CR1081	H4	R1070	C2
CR1084	H3	R1071	G2
CR1085	H1	R1080	E1
CR1087	H1	R1081	D2
		R1082	H4
F1048	C1	R1084	H4
		R1085	H3
P1020	A1	R1087	H2
P1030	B1	R1088	G1
P1040	A2		
P1048	B4	T1040	F5
P1050	B2		
P1060	A4	U1050	D5

INTERNAL ADJUSTMENTS

NOTE

This adjustment need only be made if the crt was changed.

Equipment Required

For intensity range adjustment, two vertical plug-ins are required.

Preliminary Procedure

NOTE

The performance of this instrument can be checked at any temperature within the 0° C to +50° C range. Make any adjustments at a temperature of +25° C, ±5° C.

1. Remove the cabinet panels covering the D44.

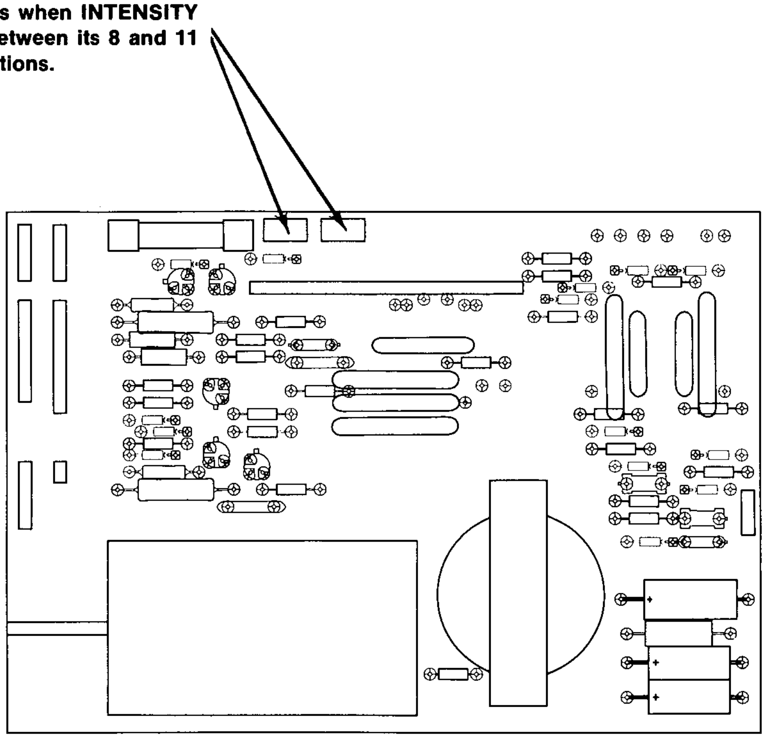
2. Install a vertical plug-in in the right and in the left plug-in compartments.

3. Check that the correct nominal line-selector block has been installed on the line-selector pins and that the regulating range selected includes the input line voltage. See Installation section for complete instructions.

4. Connect the 5443-D44 to the line voltage source and pull the POWER switch out to turn the instrument on.

1. Intensity Range—Right, R435; Left, R1435

Turn INTENSITY control fully counterclockwise. Adjust R435 (right), R1435 (left), through the hole in the high-voltage shield, so the spot is just extinguished. Turn INTENSITY control clockwise and note that visible spot appears when INTENSITY control is between its 8 and 11 o'clock positions.



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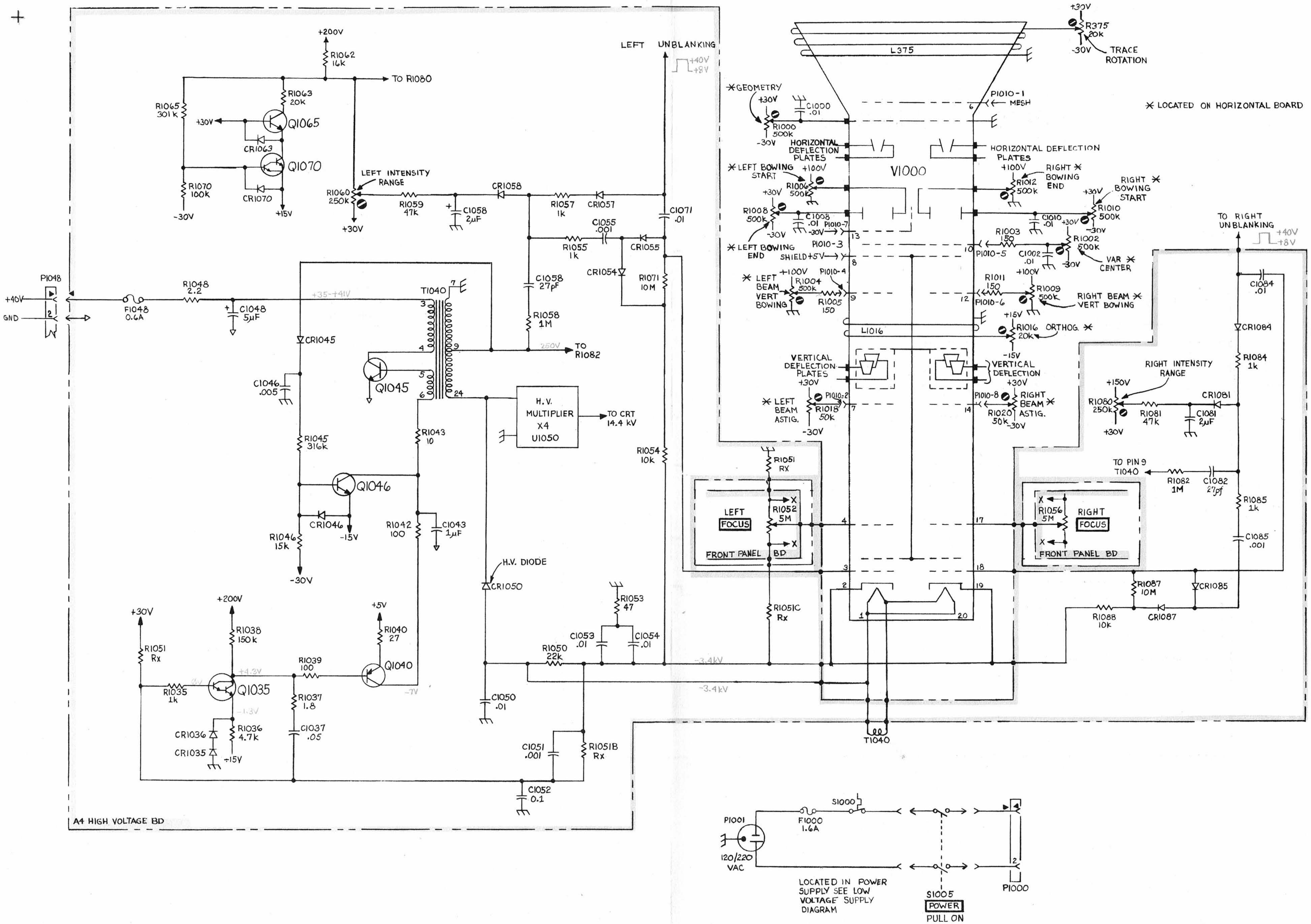
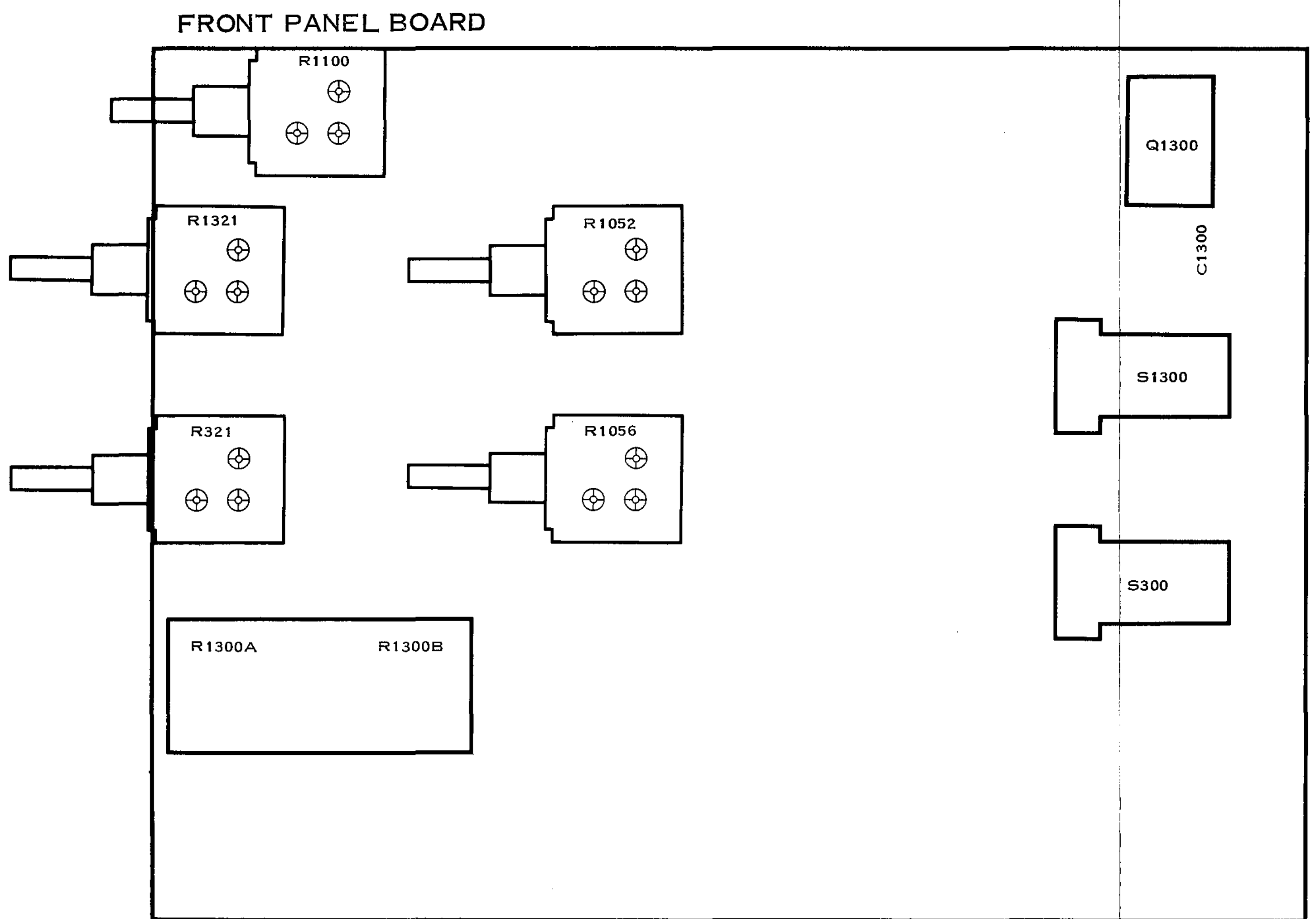
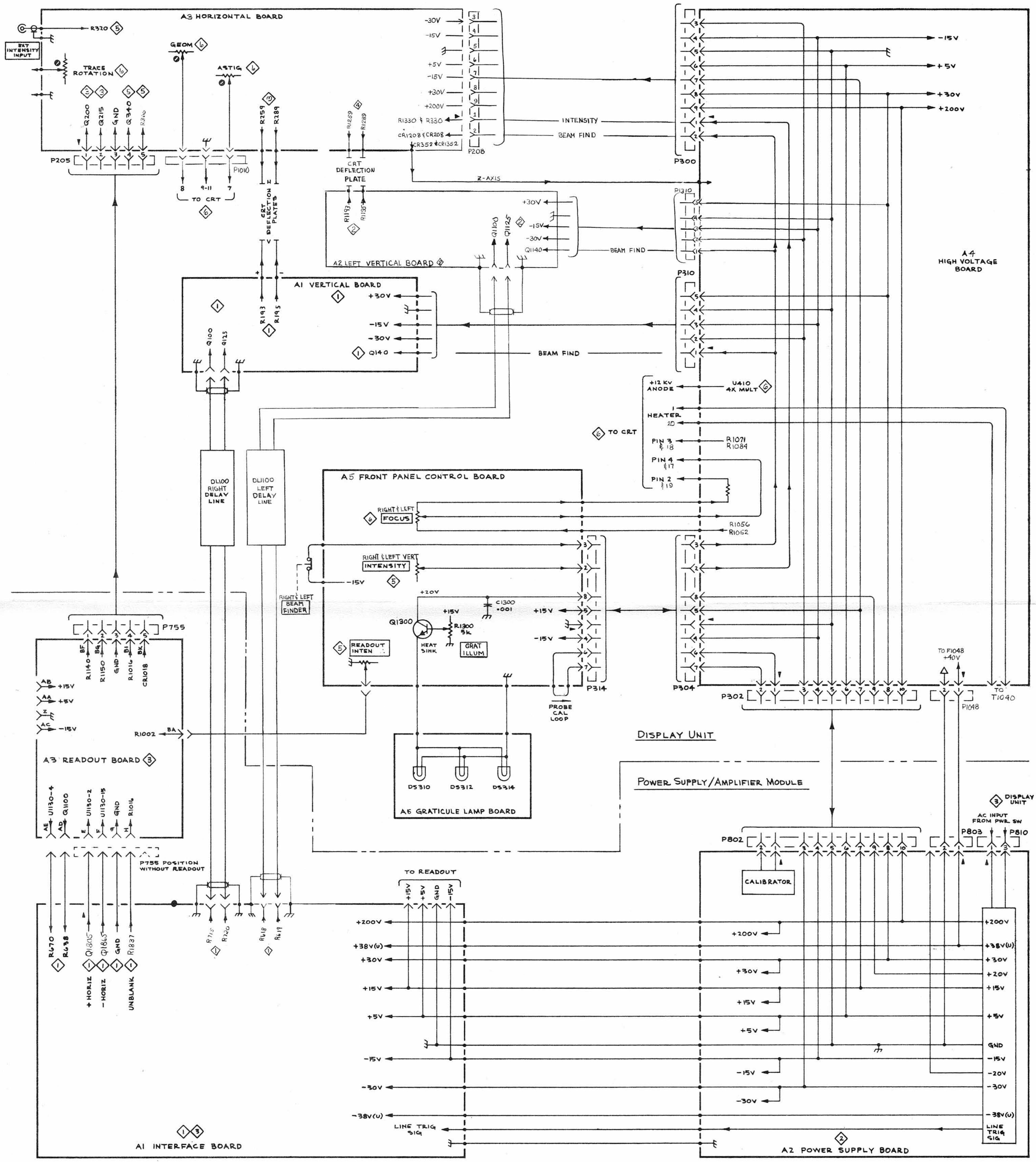


PARTS LOCATION GRID



CKT NO	GRID LOC
C1300	H2
Q1300	G2
R321	B3
R1052	D2
R1056	D3
R1100	C1
R1300A	B4
R1300B	C4
R1305	B5
R1321	B2
S300	G4
S1300	G3

FRONT-PANEL
CIRCUIT BOARD
PARTS LOCATION GRID



INTERCONNECT AND VOLTAGE DISTRIBUTION 7

INTERCONNECT AND VOLTAGE DISTRIBUTION 7

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

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

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

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

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

SPECIAL NOTES AND SYMBOLS

X000 Part first added at this serial number

00X Part removed after this serial number

FIGURE AND INDEX NUMBERS

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

INDENTATION SYSTEM

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

1 2 3 4 5 Name & Description

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

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

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

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

ABBREVIATIONS

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

CROSS INDEX MFR. CODE NUMBER TO MANUFACTURER

MFR.CODE	MANUFACTURER	ADDRESS	CITY,STATE,ZIP
00779	AMP, INC.	P. O. BOX 3608	HARRISBURG, PA 17105
05820	WAKEFIELD ENGINEERING, INC.	AUDUBON ROAD	WAKEFIELD, MA 01880
12327	FREEWAY CORP.	9301 ALLEN DR.	CLEVELAND, OH 44125
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
23499	GAVITT WIRE AND CABLE, DIVISION OF RSC INDUSTRIES, INC.	455 N. QUINCE ST.	ESCONDIDO, CA 92025
24931	SPECIALTY CONNECTOR CO., INC.	3560 MADISON AVE.	INDIANAPOLIS, IN 46227
59730	THOMAS AND BETTS CO., THE	36 BUTLER ST.	ELIZABETH, NJ 07207
70276	ALLEN MFG. CO.	P. O. DRAWER 570	HARTFORD, CT 06101
70485	ATLANTIC INDIA RUBBER WORKS, INC.	571 W. POLK ST.	CHICAGO, IL 60607
71159	BRISTOL SOCKET SCREW, DIV. OF AMERICAN CHAIN AND CABLE CO., INC.	40 BRISTOL ST.	WATERBURY, CT 06720
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	5757 N. GREEN BAY AVE.	MILWAUKEE, WI 53201
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
74445	HOLO-KROME CO.	31 BROOK ST. WEST	HARTFORD, CT 06110
74921	ITEN FIBRE CO., THE	4001 BENEFIT AVE.	ASHTABULA, OH 44004
75915	LITTELFUSE, INC.	800 E. NORTHWEST HWY	DES PLAINES, IL 60016
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
79807	WROUGHT WASHER MFG. CO.	2100 S. O BAY ST.	MILWAUKEE, WI 53207
80009	TEKTRONIX, INC.	P. O. BOX 500	BEAVERTON, OR 97077
83058	CARR CO., THE, UNITED-CARR DIV. OF TRW, INC.	31 AMES ST.	CAMBRIDGE, MA 02142
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
83501	GAVITT WIRE AND CABLE, DIVISION OF RSC INDUSTRIES, INC.	CENTRAL ST.	BROOKFIELD, MA 01506
83903	ACCURATE DIE AND STAMPING DIV., ALLIED PRODUCTS CORP.	1941 N. MAUD AVE.	CHICAGO, IL 60614
83907	ACCURATE RUBBER PRODUCTS CO.	123 N. RACINE	CHICAGO, IL 60607
91929	HONEYWELL, INC., MICRO SWITCH DIV.	CHICAGO & SPRING STS.	FREEPORT, IL 61032
93410	ESSEX INTERNATIONAL, INC., CONTROLS DIV. MANSFIELD PLANT	P. O. BOX 1007	MANSFIELD, OH 44903
95987	WECKESSER CO., INC.	4444 WEST IRVING PARK RD.	CHICAGO, IL 60641
98278	MALCO A MICRODOT CO., INC., CONNECTOR AND CABLE DIVISION	220 PASADENA AVE.	SOUTH PASADENA, CA 91030

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-1	200-1218-00			1	RTNR,CRT SCALE:	80009	200-1218-00
					(ATTACHING PARTS)		
-2	211-0188-00			2	SCREW,MACHINE:4-40 X 0.30 INCH,SST	80009	211-0188-00
					- - - * - - -		
-3	337-1440-00			1	SHLD,IMPLOSION:	80009	337-1440-00
-4	386-2544-00			4	SUPPORT,CRT:	80009	386-2544-00
-5	366-1327-00			3	KNOB:GRAY	80009	366-1327-00
					. EACH KNOB INCLUDES		
	213-0048-00			1	. SETSCREW:4-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-6	366-1280-00			3	KNOB:GRAY	80009	366-1280-00
					. EACH KNOB INCLUDES:		
	213-0153-00			1	. SETSCREW:5-40 X 0.125", HEX SOC S	74445	OBD
-7	366-1559-00			2	PUSHBUTTON:GRAY	80009	366-1559-00
-8	384-1161-00			1	EXTENSION SHAFT:PWR SW.	80009	384-1161-00
-9	358-0216-00			1	BUSHING,PLASTIC:0.257 ID X 0.412 INCH OD	80009	358-0216-00
-10	426-1072-00			2	FRAME,PUSH BTN:	80009	426-1072-00
-11	358-0378-00			1	BUSHING,SLEEVE:PRESS MOUNT	80009	358-0378-00
-12	119-0373-00			1	COIL,CABIBRATIO:	80009	119-0373-00
					(ATTACHING PARTS)		
	210-0442-00			2	NUT,PLAIN,HEX.:3-48 X 0.187 INCH,CD PL BRS	73743	3014-402
	210-0004-00			2	WASHER,LOCK:INTL,0.12 ID X 0.26"OD,STL	78189	1204-00-00-0541C
	210-0994-00			2	WASHER,FLAT:0.125 ID X 0.25" OD,STL	83385	OBD
	210-0935-00			2	WASHER,NONMETAL:FIBER,0.14 IDX 0.375"OD	74921	OBD
					- - - * - - -		
-13	361-0059-01			1	SPACER,CUR LOOP:1.094 X 0.344 X 0.125 INCH	80009	361-0059-01
-14	210-0593-00			2	NUT,FINISHING:0.25 HEX X 0.312" LONG,BRS	80009	210-0593-00
-15	384-1101-00			2	EXTENSION SHAFT:4.14 INCH LONG	80009	384-1101-00
-16	343-0081-00			1	STRAP,RETAINING:	95987	3-16H
					(ATTACHING PARTS)		
-17	211-0504-00			1	SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
-18	210-0457-00			1	NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
					- - - * - - -		
-19	200-1327-00			2	COVER,VAR RES.:	80009	200-1327-00
-20	334-2363-00			1	MARKER IDENT:WARNING, DANGER,HV	80009	334-2363-00
-21	----- -----			1	CKT BOARD ASSY:FRONT PANEL(SEE A5 EPL)		
					(ATTACHING PARTS)		
-22	210-0583-00			3	NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20319-402
-23	210-0940-00			3	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
					- - - * - - -		
-24	----- -----			1	. RESISTOR, VARIABLE:(SEE R1100 EPL)		
-25	----- -----			2	. RESISTOR VARIABLE:(SEE R1052, R1056 EPL)		
-26	----- -----			2	. RESISTOR VARIABLE: (SEE R321, R1321 EPL)		
-27	----- -----			1	. RESISTOR,VARIABLE:(SEE R1300,A,B EPL)		
-28	376-0165-00			2	. CPLG,SHAFT,RGD:HIGH VOLTAGE	80009	376-0165-00
					. . SHAFT ASSY INCLUDES:		
	213-0075-00			2	. . SETSCREW:4-40 X 0.094 INCH,HEX SOC STL	70276	OBD
-29	----- -----			1	. TRANSISTOR:(SEE Q1300 EPL)		
					(ATTACHING PARTS)		
-30	211-0008-00			1	. SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-31	210-0586-00			1	. NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
					- - - * - - -		
-32	260-1742-00			2	. SWITCH,PUSH:ERASE,2 POLE,MOMENTARY	80009	260-1742-00
-33	361-0382-00			8	. SPACER,PB SW:BROWN,0.275 INCH LONG	80009	361-0382-00
-34	----- -----			1	CKT BOARD ASSY:GRAD LAMPS(SEE A6 EPL)		
					(ATTACHING PARTS)		
-35	213-0088-00			2	SCR,TPG,THD CTG:4-24 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-36	378-0732-00			1	. DIFFUSER,LIGHT:	80009	378-0732-00
					(ATTACHING PARTS)		
-37	211-0062-00			2	. SCREW,MACHINE:2-56 X 0.312 INCH,RDH STL	83385	OBD
					- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-38	426-1017-00			2	. MOUNT REFLECTOR:	80009	426-1017-00
-39	131-0704-00			3	. CONTACT,ELEC:GRATICULE LAMP	80009	131-0704-00
					(ATTACHING PARTS FOR EACH)		
-40	210-0759-00			1	. EYELET,METALLIC:0.61 OD X 0.192 INCH L,BRS	71590	16076-11
-41	210-0957-00			1	. WASHER,FLAT:0.0625 ID X 0.125" OD,STL	83903	OBD
					- - - * - - -		
-42	175-0825-00			FT	. WIRE,ELECTRICAL:2 WIRE RIBBON,0.250 FT	23499	TEK-175-0825-00
-43	333-1887-00			1	PANEL,FRONT:	80009	333-1887-00
-44	376-0127-00			1	COUPLER,SHAFT:PLASTIC	80009	376-0127-00
-45	200-1075-00			1	COVER,ELEC CONN:PLASTIC	00779	1-480435-0
-46	260-1222-00			1	SWITCH,PUSH-PUL:10A,250VAC	91929	2DM301
-47	----- -----			1	CKT BOARD ASSY:VERTICAL RIGHT(SEE A1 EPL)		
					(ATTACHING PARTS)		
-48	211-0007-00			2	SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
					- - - * - - -		
-49	214-1291-00			2	. HEAT SINK,ELEC:XSTR,0.72 OD X 0.375"H	05820	207-AB
-50	441-1250-00			1	CHASSIS,SCOPE:	80009	441-1250-00
					(ATTACHING PARTS)		
-51	211-0114-00			2	SCREW,MACHINE:4-40 X 0.438 INCH,FLH STL	83385	OBD
-52	210-0586-00			2	NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
					- - - * - - -		
-53	200-1686-00			1	COVER,PWR SPLY:	80009	200-1686-00
					(ATTACHING PARTS)		
-54	211-0008-00			2	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-55	----- -----			1	CKT BOARD ASSY:HIGH VOLTAGE (SEE A4 EPL)		
					(ATTACHING PARTS)		
-56	211-0007-00			2	SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
					- - - * - - -		
-57	131-0608-00			37	. CONTACT,ELEC:0.365 INCH LONG	22526	47357
-58	----- -----			1	. DIODE:(SEE U1050 EPL)		
					(ATTACHING PARTS)		
-59	211-0008-00			3	. SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-60	344-0154-00			2	. CLIP,ELECTRICAL:FOR 0.25 INCH DIA FUSE	80009	344-0154-00
-61	200-1753-01			1	COVER,CRT:REAR PAINTED	80009	200-1753-01
					(ATTACHING PARTS)		
-62	210-0401-00			2	NUT,PLAIN,HEX.:6-32 X 0.312 INCH,CD PLATED	73743	3262-402
					- - - * - - -		
-63	366-1146-00			1	KNOB:GRAY	80009	366-1146-00
	213-0246-00			1	. SETSCREW:5-40 X 0.93 INCH L,HEX SOC	71159	OBD
-64	333-1888-00			1	PANEL REAR:	80009	333-1888-00
-65	352-0076-00			1	FUSEHOLDER:W/HARDWARE	75915	342012
-66	210-0873-00			1	WASHER,NONMET:0.5 ID X 0.688" OD,N PRN	74085	OBD
-67	161-0033-12			1	CABLE ASSY,PWR,:	80009	161-0033-12
-68	358-0515-00			1	BSHG,STRAIN RLF:TOP	80009	358-0515-00
-69	358-0516-00			1	BSHG,STRAIN RLF:BOTTOM	80009	358-0516-00
-70	200-1646-00			1	CABLE ASSY,PWR:	80009	200-1646-00
-71	214-2038-00			1	IND,LINE V:	80009	214-2038-00
-72	343-0521-00			1	CLAMP,XSTR:0.750" WIDE W(2) 4-40 THD HOLE	80009	343-0521-00
					(ATTACHING PARTS)		
-73	211-0014-00			1	SCREW,MACHINE:4-40 X 0.50 INCH,PNH STL	83385	OBD
					- - - * - - -		
-74	342-0082-00			1	INSULATOR,PLATE:0.52 SQ X 0.015 INCH THK,AL	80009	342-0082-00
-75	----- -----			1	TRANSISTOR:(SEE Q1045 EPL)		
-76	210-0201-00			1	TERMINAL,LUG:SE #4	78189	2104-04-00-2520N
					(ATTACHING PARTS)		
-77	210-0586-00			1	NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
					- - - * - - -		
-78	131-0955-00			2	CONNECTOR,RCPT,:BNC,FEMALE	24931	28JR200-1
-79	210-0255-00			2	TERMINAL,LUG:0.391" ID INT TOOTH	80009	210-0255-00
-80	----- -----			1	CKT BOARD ASSY:HORIZ(SEE A3 EPL)		
					(ATTACHING PARTS)		
-81	211-0007-00			4	SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
					- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-82	131-0608-00			31	. CONTACT,ELEC:0.365 INCH LONG	22526	47357
-83	----- -----			1	. TRANSISTOR:(SEE Q255 EPL)		
					(ATTACHING PARTS)		
-84	211-0008-00			1	. SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-85	210-0586-00			1	. NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	83385	OBD
					- - - * - - -		
-86	214-0579-00			6	. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-87	214-1916-00			2	. HEAT SINK,ELEC:TEMPERATURE STABILIZING	05820	256-D
-88	----- -----			1	. RESISTOR, VARIABLE: (SEE R375 EPL)		
-89	----- -----			1	CKT BOARD ASSY:VERTICAL LEFT(SEE A2 EPL)		
					(ATTACHING PARTS)		
-90	211-0007-00			2	SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
					- - - * - - -		
-91	214-1291-00			1	. HEAT SINK,ELEC:XSTR,0.72 OD X 0.375"H	05820	207-AB
-92	260-0227-00			1	SWITCH,THRMSTIC:	93410	110087
					(ATTACHING PARTS)		
-93	210-0586-00			2	NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
					- - - * - - -		
-94	348-0051-00			1	GROMMET,RUBBER:0.938 INCH DIA	83907	1107
-95	441-1248-00			1	CHASSIS SCOPE:	80009	441-1248-00
-96	344-0131-00			3	. CLIP,SPG TENS:CIRCUIT BOARDMOUNTING	80009	344-0131-00
					(ATTACHING PARTS FOR EACH)		
	210-0659-01			1	. EYELET,METALLIC:0.121 OD X 0.156 INCH LONG	80009	210-0659-01
					- - - * - - -		
-97	129-0112-00			2	. SPACER,POST:	80009	129-0112-00
					(ATTACHING PARTS)		
-98	211-0101-00			2	SCREW,MACHINE:4-40 X 0.25" 100 DEG,FLH STL	83385	OBD
-99	211-0559-00			3	SCREW,MACHINE:6-32 X 0.375"100 DEG,FLH STL	83385	OBD
-100	210-0457-00			3	NUT,PL,ASSEM WA:6-32 X 0.312 INCH,STL	83385	OBD
					- - - * - - -		
-101	119-0693-00			2	DELAY LINE,ELEC:	80009	119-0693-00
					(ATTACHING PARTS FOR EACH)		
-102	211-0507-00			3	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
-103	210-1092-00			3	WASHER,FLAT:0.147 ID X 0.312" OD,BRS	12327	OBD
					- - - * - - -		
-104	346-0121-00			3	. STRAP,ELEC COMP:TIEDOWN,5.0 L,W.125 D HOLE	59730	T4-34M
-105	131-1576-00			1	. CONTACT,ELEC:DELAY LINE TERMINAL	80009	131-1576-00
-106	131-1725-00			1	. CONTACT,ELEC:DELAY LINE TERMINAL	80009	131-1725-00
-107	441-1249-00			1	CHASSIS SCOPE:	80009	441-1249-00
					(ATTACHING PARTS)		
-108	211-0101-00			2	SCREW,MACHINE:4-40 X 0.25" 100 DEG,FLH STL	83385	OBD
					- - - * - - -		
-109	200-0869-00			1	COVER,CRT SKT:	80009	200-0869-00
-110	136-0606-00			1	SOCKET ASSY,CRT:	80009	136-0606-00
-111	255-0334-00			FT	PLASTIC CHANNEL:0.271 INCHES LONG	80009	255-0334-00
-112	407-0931-00			1	BRKT,CRT SHIELD:	80009	407-0931-00
					(ATTACHING PARTS)		
-113	211-0507-00			2	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
	211-0589-00			3	SCREW,MACHINE:6-32 X 0.312 INCH,PNH BRS	83385	OBD
-114	220-0419-00			5	NUT,PLAIN,SQ:6-32 X 0.312 INCH,STL	83385	OBD
					- - - * - - -		
-115	348-0070-01			3	PAD,CUSHIONING:	80009	348-0070-01
-116	----- -----			1	COIL:(SEE L1016 EPL)		
-117	334-2360-00			1	MARKER,IDENT:WARNING	80009	334-2360-00
-118	337-2044-00			1	SHIELD,CRT:	80009	337-2044-00
-119	131-0026-00			1	ADPTR,CATO CON:	83058	118738
-120	200-0544-00			1	COVER,ELEC CONN:	80009	200-0544-00
-121	348-0006-00			1	GROMMET,RUBBER:0.562 ID X 0.875 INCH OD	70485	1720
-122	348-0056-00			1	GROMMET,PLASTIC:0.375 INCH DIA	80009	348-0056-00
-123	334-1379-00			1	LABEL:CRT,ADHESIVE BACK	80009	334-1379-00
-124	348-0279-00			2	PAD,CUSHIONING:3.50 INCH LONG	80009	348-0279-00
-125	----- -----			1	COIL:(SEE L375 EPL)		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-126	337-2043-00			1	SHIELD,CRT:	80009	337-2043-00
					(ATTACHING PARTS)		
-127	211-0587-00			1	SCREW,MACHINE:6-32 X 0.188 INCH,HSB	80009	211-0587-00
					- - - * - - -		
-128	426-1147-00			1	FR ASSY,DSPL UN:	80009	426-1147-00
-129	179-2164-00			1	WIRING HARNESS:	80009	179-2164-00
-130	131-0861-00			3	. CONTACT,ELEC:QUICK DISCONNECT	00779	42617-2
-131	200-1075-00			3	. COVER,ELEC CONN:PLASTIC	00779	1-480435-0
-132	175-0825-00			FT	WIRE,ELECTRICAL:2 WIRE RIBBON,0.833 FT	23499	TEK-175-0825-00
	175-0863-00			FT	WIRE,ELECTRICAL:2 WIRE RIBBON,1.104 FT	23499	TEK-175-0863-00
-133	175-0861-00			FT	WIRE,ELECTRICAL:4 WIRE RIBBON,1.000 FT	23499	TEK-175-0861-00
-134	175-0828-00			FT	WIRE,ELECTRICAL:5 WIRE RIBBON,2.833 FT	23499	TEK-175-0828-00
	175-0860-00			FT	WIRE,ELECTRICAL:5 WIRE RIBBON,1.083 FT	23499	TEK-175-0860-00
-135	175-0829-00			FT	WIRE,ELECTRICAL:6 WIRE RIBBON,0.585 FT	83501	TEK-175-0829-00
-136	175-0832-00			FT	WIRE,ELECTRICAL:9 WIRE RIBBON,0.542 FT	23499	TEK-175-0832-00
-137	175-0855-00			FT	WIRE,ELECTRICAL:10 WIRE RIBBON,0.875 FT	23499	TEK-175-0855-00
-138	352-0171-00			1	HOLDER,TERM.CON:1 WIRE BLACK	80009	352-0171-00
-139	352-0169-03			1	HOLDER,TERM.CON:2 WIRE ORANGE	80009	352-0169-03
-140	352-0199-03			1	HOLDER,TERM.CON:3 WIRE ORANGE	80009	352-0199-03
-141	352-0162-00			1	HOLDER,TERM.CON:4 WIRE BLACK	80009	352-0162-00
	352-0200-00			1	HOLDER,TERM.CON:4 WIRE BLACK	80009	352-0200-00
-142	352-0163-02			1	HOLDER,TERM.CON:5 WIRE RED	80009	352-0163-02
	352-0163-04			1	HOLDER,TERM.CON:5 WIRE YELLOW	80009	352-0163-04
	352-0163-05			2	HOLDER,TERM.CON:5 WIRE GREEN	80009	352-0163-05
	352-0201-05			1	HOLDER,TERM.CON:5 WIRE GREEN	80009	352-0201-05
-143	352-0164-01			1	HOLDER,TERM.CON:6 WIRE BROWN	80009	352-0164-01
-144	352-0167-00			1	HOLDER,TERM.CON:9 WIRE BLACK	80009	352-0167-00
-145	352-0168-02			1	HOLDER,TERM.CON:10 WIRE RED	80009	352-0168-02
	352-0206-02			1	HOLDER,TERM.CON:10 WIRE RED	80009	352-0206-02
-146	131-0707-00			52	CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	47439
	131-0621-00			21	CONNECTOR,TERM:0.577" L,22-26 AWG WIRE	22526	56231
	131-0371-00			2	CONTACT,ELEC:FOR NO.26 AWG WIRE	98278	12093-8
	195-0136-00			1	LEAD SET, ELEC:CRT DEFLECTION	80009	195-0136-00
			ACCESSORIES				
	070-1771-00			1	MANUAL,TECH:INSTRUCTION(NOT SHOWN)	80009	070-1771-00
			REPACKAGING				
	065-0150-00			1	SHPNG CTN KIT:FOR DISC & PWR MOL(NOT SHOWN)	80009	065-0150-00

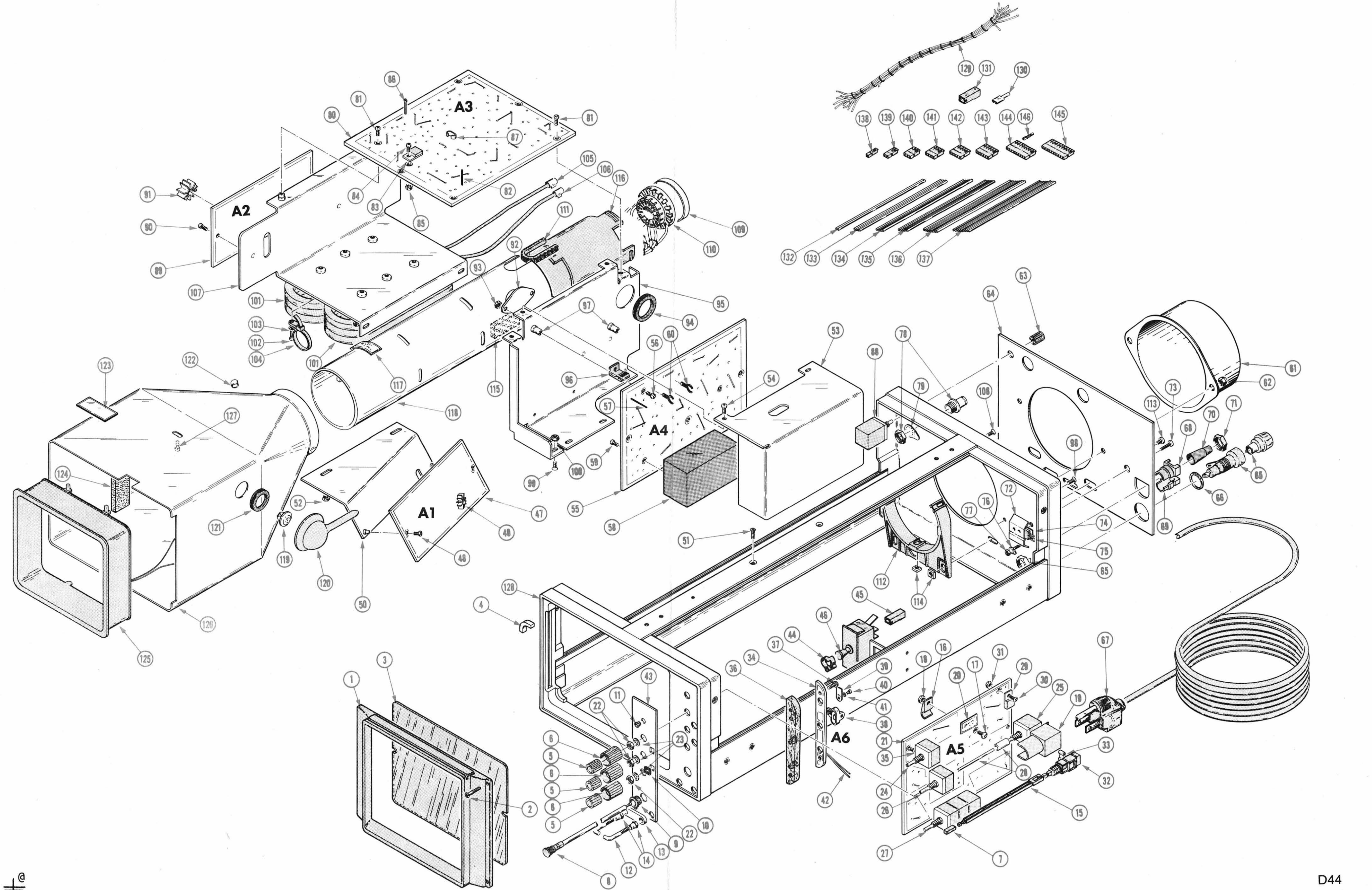


FIG. 1 EXPLODED

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. Sections of the manual are often printed at different times, so some of the information on the change pages may already be in your manual. 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 in this section, your manual is correct as printed.

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MANUAL CHANGE INFORMATION

PRODUCT D44
070-1771-00

CHANGE REFERENCE C1/375
DATE 3-13-75

CHANGE:	DESCRIPTION

ADJUSTMENTS VERTICAL CIRCUIT BOARD

REPLACE: The last two paragraphs of Step 3. with the following:

Position effect: Using a 6 division square-wave, position it down so 4 divisions remain on screen. Check for a front corner change of no greater than 0.2 division (3.3%) from the main level. Change the STEP RESP. to (-) and position the 6 division square-wave up so 4 divisions remain on screen. Check the front corner again for no greater than 0.2 division change from the main level.

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MANUAL CHANGE INFORMATION

PRODUCT D44	CHANGE REFERENCE C2/375
EFF SN B010100-up	DATE 3-25-75

CHANGE:	DESCRIPTION

070-1771-00 Pilot Changes #1, #2, #3, & #4

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

CHANGE TO:

C153	281-0549-00	CAP.,FXD,CER DI:68 PF, 10%, 500V
C1153	281-0651-00	CAP.,FXD,CER DI:47 PF, 5%, 200V
R326	315-0202-00	RES.,FXD,COMP:2K OHM, 5%, 0.25W
R1326	315-0202-00	RES.,FXD,COMP:2K OHM, 5%, 0.25W

MECHANICAL PARTS LIST CHANGES

Pages 5-4 and 5-5

CHANGE TO:

Fig. 1-81	211-0012-00	4	SCREW,MACHINE:4-40 X 3/8 INCH PHS
1-99	211-0538-00	3	SCREW,MACHINE:6-32 X 0.312 PHS
1-115	348-0090-00	3	PAD,CUSHIONING:

ADD:

	255-0319-00	1	SHEET, POLYESTER
	166-0024-00	1	SPACER

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MANUAL CHANGE INFORMATION

PRODUCT D44
EFF ALL SN

CHANGE REFERENCE C3/675
DATE 6-5-75

CHANGE:	DESCRIPTION

Pilot Change #6

070-1771-00

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

CHANGE TO:

C192	290-0522-00	CAP.,FXD,ELCTLT:1UF,20%,50V
C1192	290-0522-00	CAP.,FXD,ELCTLT:1UF,20%,50V

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MANUAL CHANGE INFORMATION

PRODUCT D44
EFF SN B020267-up

CHANGE REFERENCE M24,188
DATE 11-12-75 REV. 11-3-75

CHANGE:	DESCRIPTION

070-1771-00

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGE

CHANGE TO:

A3	670-3160-01	CKT BOARD ASSY:HORIZONTAL AMPL

REMOVE:

L1016	108-0811-00	COIL,TUBE DEFL:FIXED,X-Y ALIGNMENT
R1016	311-1558-00	RES.,VAR,NONWIR:20K OHM,20%,0.50W

L1016 and R1016 are located on diagram 6 HIGH VOLTAGE AND CRT CIRCUIT.

TEXT CORRECTION

Page 2-2 Right column, paragraph 1, last sentence.

DELETE: Last sentence. (Orthogonality control is removed)

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MANUAL CHANGE INFORMATION

PRODUCT D44 | CHANGE REFERENCE M24,585
EFF SN B020321-up | DATE 3-31-76

CHANGE:	DESCRIPTION

070-1771-00

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGE

ADD:

C173	283-0000-00	CAP.,FXD,CER DI:0.001UF,+100-0%,500V
C1173	283-0000-00	CAP.,FXD,CER DI:0.001UF,+100-0%,500V

C173 is added from the base of Q172 to ground located on the RIGHT VERTICAL AMPLIFIER circuit board and shown on diagram 1.

C1173 is added from the base of Q1172 to ground and is located on the LEFT VERTICAL AMPLIFIER circuit board and is shown on diagram 2.

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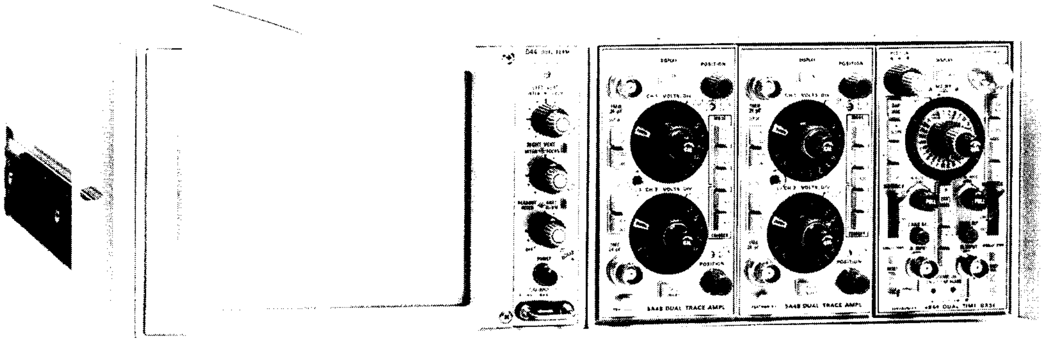
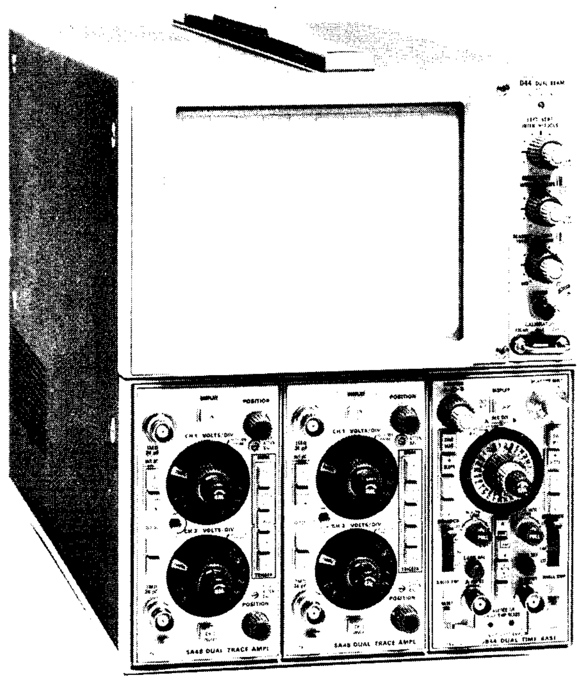

5A48 DUAL TRACE AMPL
5A48 DUAL TRACE AMPL


5A48 DUAL TRACE AMPL
5A48 DUAL TRACE AMPL

INSTALLATION

OPERATING VOLTAGE

CAUTION

This instrument is designed for operation from a power source with its neutral at or near earth (ground) potential, and with a separate safety-earth conductor. It is not intended for operation from two phases of a multi-phase system or across the legs of a single-phase, three-wire system.

5400 Panel (Dust Cover) Removal

WARNING

Dangerous potentials exist at several points throughout the oscilloscope. When the instrument must be operated with the cabinet panels removed, do not touch exposed connections or components. Some transistors have voltage present on their cases. Disconnect the power before cleaning the instrument or replacing parts.

The cabinet panels (dust covers) of the 5400-series oscilloscope are held in place by slotted fasteners. To remove the panels, turn each fastener counterclockwise a quarter turn with a large screwdriver, coin or similar device; then the panels can be lifted away. This instrument should be operated with the panels in place to protect the interior from dust and to eliminate shock hazard.

Power Transformer

The 5400-series oscilloscope transformer permits operation from 100-volt, 110-volt, 120-volt, 200-volt, 220-volt, and 240-volt sources with power-line frequencies of 50 to 400 hertz. The range for which the primary taps are set is marked on the rear panel of the instrument. 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 dust cover of the instrument to gain access to the Power Supply circuit board.

3. To convert from 120 volts to 220 volts nominal line voltage, or vice versa, remove the line-selector block from the square-pin connectors (see Fig. 0-1) and replace it with the other block. Remove the line fuse from the fuse holder located on the rear panel of the display module and replace it with one having the correct rating. The unused line-selector block and line fuse can be stored on the Power Supply circuit board. Change the line-cord power plug to match the power-source receptable or use an adapter.

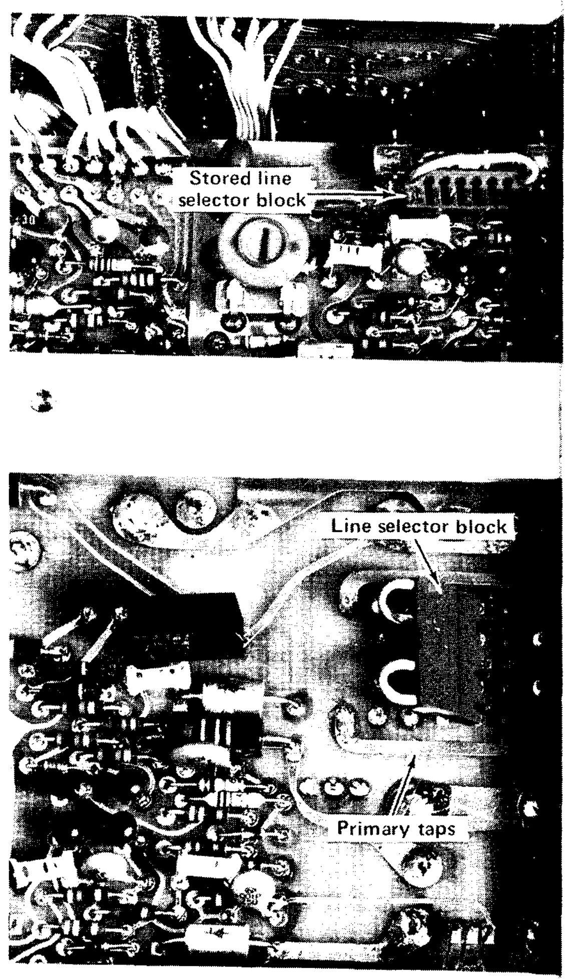


Fig. 0-1. Location of the line-selector block on the Power Supply circuit board.

NOTE

The 120-volt block is color-coded brown, and connects the transformer primary windings in parallel. The 220-volt block is color-coded red and connects the primary windings in series.

4. To change the regulating ranges, place the line-selector block on the desired set of square pins. Select a range that is centered about the average line voltage to which the instrument is to be connected (see Table 0-1).

5. Change the nominal line voltage information on the cable nipple at the rear panel of the instrument. Pull out the inner ring (line voltage indicator) and rotate it to the appropriate voltage, then push the ring in.

6. Replace the bottom dust cover and apply power to the instrument.

CAUTION

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

TABLE 0-1
Regulating Ranges for Power Transformer

Line Selector Block Position	Regulating Range	
	120-Volts Nominal	220-Volts Nominal
L	90 V ac to 110 V ac	180 V ac to 220 V ac
M	99 V ac to 121 V ac	198 V ac to 242 V ac
H	108 V ac to 132 V ac	216 V ac to 264 V ac
Line Fuse	1.6 A slow-blow	1.0 A slow-blow

INSTRUMENT CONVERSION

The 5443 Power Supply/Amplifier module and the display module 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 tools, parts and instructions are available from Tektronix, Inc. Order Tektronix Part No. 040-0583-01 (bench-to-rack conversion) or Tektronix Part No. 040-0584-02 (rack-to-bench conversion).

NOTE

Before attemping to operate the instrument, make sure the module wiring interconnections are correct.

RACKMOUNTING

The rackmount version of the 5400-series 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 1 of the Display Unit manual.

Mounting Method

This instrument will fit most 19-inch width 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 addition 1/4 inch is required (both above and below the R5400) to allow space for proper circulation of cooling air.

Width. A standard 19-inch width rack may be used. The width of the 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 of the slide-out tracks is mounted behind an untapped front rail as shown in Fig. 0-2A. If the front rails are tapped, and the stationary section is mounted in front of the front rail as shown in Fig. 0-2B, the width 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 R5400 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

Preliminary Information. 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 on those instruments ordered as rack mounts), and the intermediate section fits between the other two sections to allow the instrument to fully extend out of the rack.

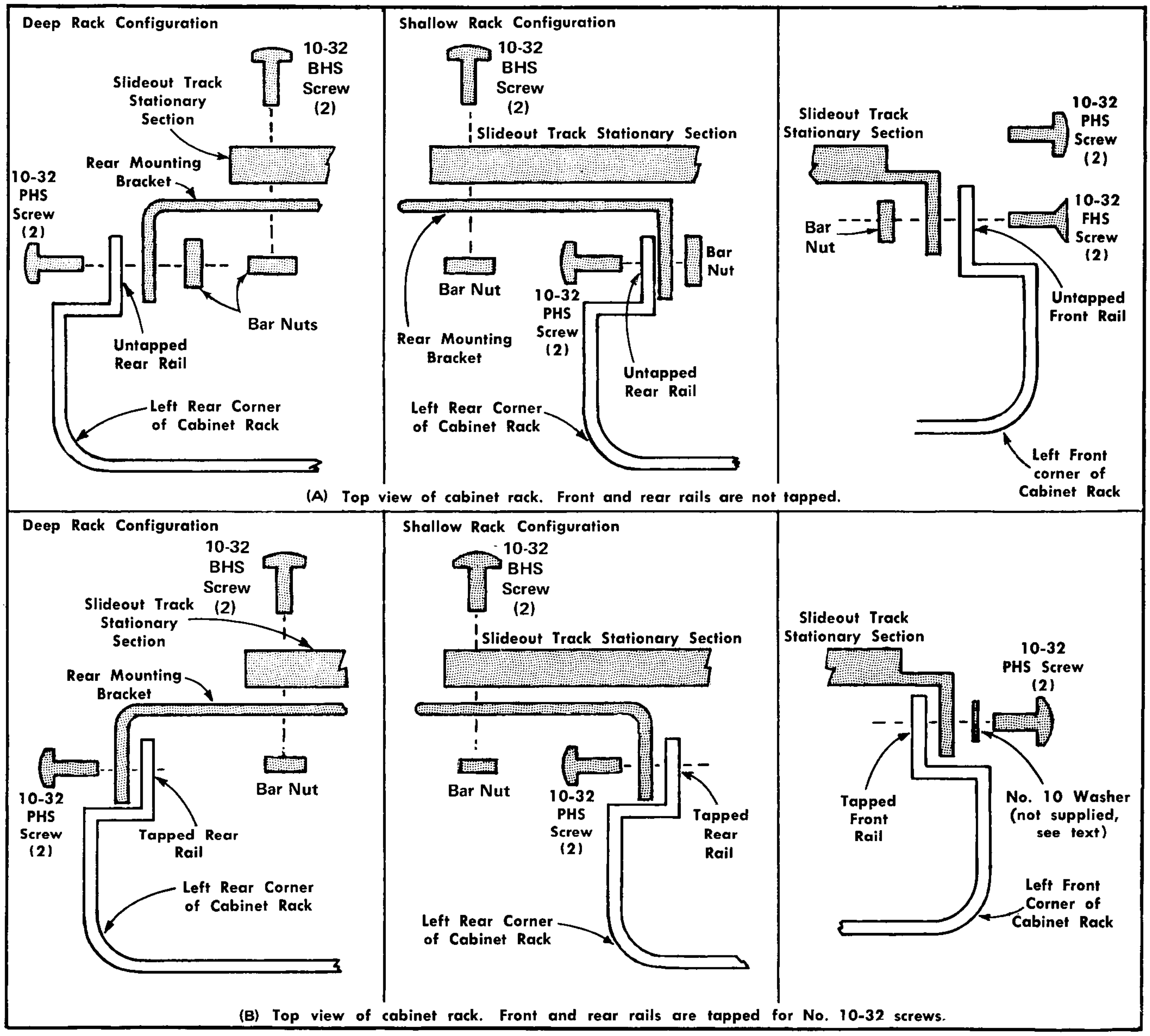


Fig. 0-2. Mounting the left stationary section (with its matched intermediate section, not shown in illustrations A and B) to the rack rails.

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

NOTE

1. Front and rear rail holes must be large enough to allow inserting a 10-32 screw through the rail mounting hole if the rails are untapped (see Fig. 0-2A).

2. Or, front and rear rail holes must be tapped to accept a 10-32 screw if Fig. 0-2B mounting method is used. Note in Fig. 0-2B 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 including both sides and hardware, are marked 351-0195-00 on the package. To identify the assemblies, note that the automatic latch and intermediate section stop are located near the top of the matched set.

Mounting Procedure. Use the following procedure to mount both sides. See Fig. 0-2 for installation details.

1. To mount the instrument directly above or below another instrument in a cabinet rack, select the appropriate holes in the front rack rails for the stationary sections, using Fig. 0-3 as a guide.

2. Mount the stationary slide-out track sections to the front rack rails using either one 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. 0-2A 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. 0-2B right illustration. To provide increased bearing surface for the screw head to securely fasten the front flange to the rail, a flat washer (not supplied) may be added under the screw head. However, if this mounting method is used, the front panel will not fit flush against the front rail because of the stationary section and washer thickness. If a flush fit is preferred method 2 (a) should be used.

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

(a). If the rear rack 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. 0-2A. 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. 0-2A 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. 0-2B. Note that the rear mounting bracket can be installed either way so the slide-out tracks will fit a deep or shallow cabinet rack. Use Fig. 0-2B as a guide for mounting the right stationary section. Make sure the stationary sections are horizontally aligned so they are level and parallel with each other.

R5400 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 latches on the chassis sections and push the instrument toward the rack until the latches snap into their holes.

4. Again press the 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. 0-3. Using the hardware (not furnished) indicated in Fig. 0-3, secure the R5443 to the front rails of the track.

Slide-Out Track Maintenance

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

Scan by Zenith

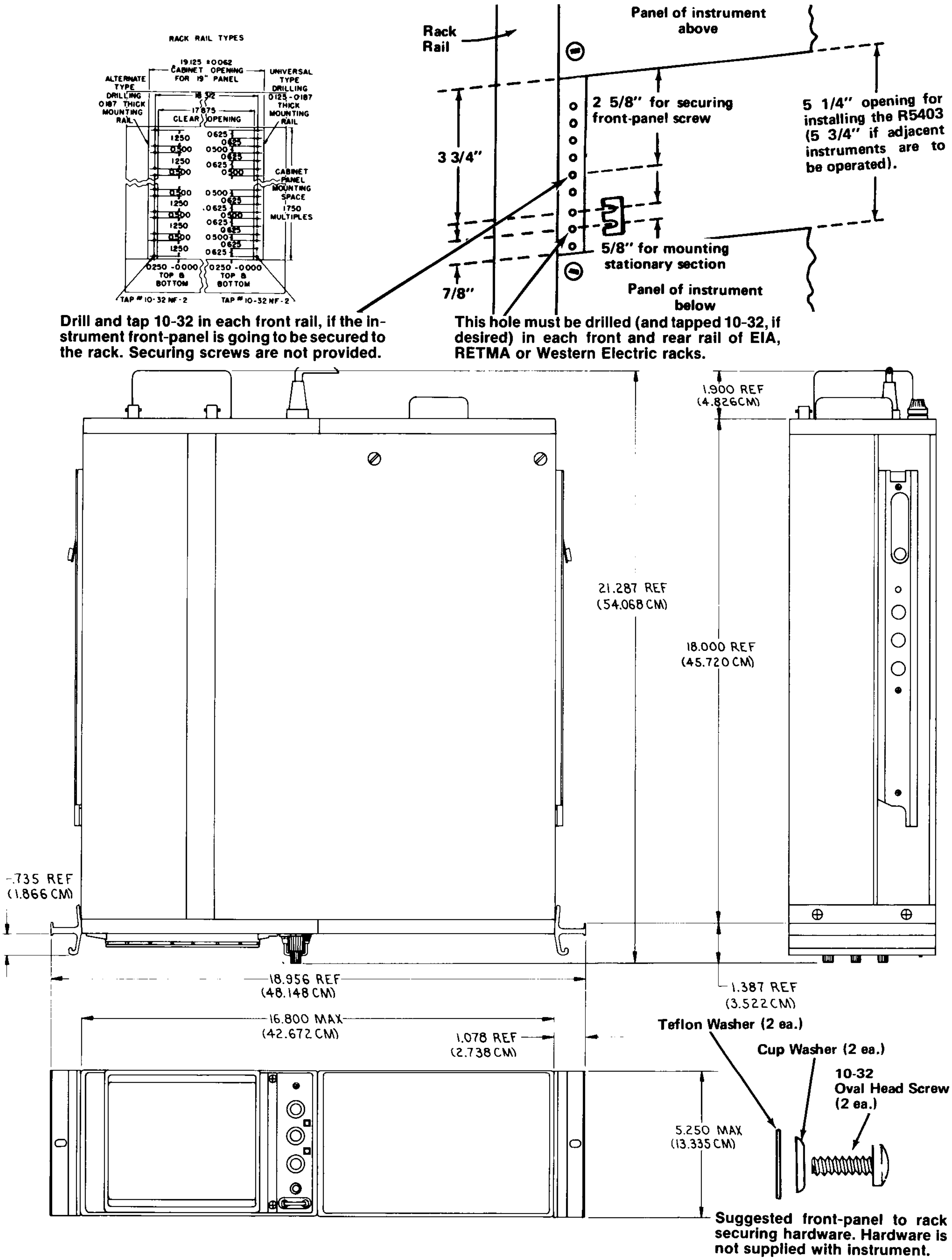


Fig. 0-3. Dimensional diagram.

OPERATING TEMPERATURE

The 5443 can be operated where the ambient air temperature is between 0°C and +50°C. The instrument can be stored in ambient temperature between −40°C and +70°C. After storage at a temperature beyond the operating limits, allow the chassis temperature to come within the operating limits before power is applied.

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

PLUG-IN UNITS

The 5443 is designed to accept up to three Tektronix 5-series plug-in units. (Only the plug-in units without an N suffix will provide display readout.) 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 disengate it and pull the unit out. Plug-in units can be removed or installed without turning off the instrument power. It is not necessary that all of the plug-in compartments be filled to operate the instrument, the only plug-ins needed are those required for the measurement to be made.

When the display unit is adjusted in accordance with the adjustment procedure given in the display unit instruction manual, the vertical and horizontal gains 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 service information section of the plug-in unit manual for verification procedure.

Selection

The plug-in versatility of the 5400-series oscilloscope allows a variety of display modes with many different plug-ins. The following information is provided here to aid in plug-in selection.

To produce a single-trace display, install a single-channel vertical unit (or dual-channel unit set for a 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, install a dual-channel vertical unit in one of the vertical compartments). 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 and the time-base unit must be externally triggered.

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. The dual-trace capability of dual-trace amplifier plug-ins cannot be used for X-Y displays.

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.

OPERATING INSTRUCTIONS

The 5443 Power Supply/Amplifier module forms the basis of an oscilloscope system that requires a display module and plug-ins to complete the system. This section describes general operating information and some basic oscilloscope applications.

Detailed operating information for a specific display module or plug-in is given in the instruction manual for that unit.

GENERAL OPERATING INFORMATION

Display Switching Logic

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

NOTE

At sweep rates faster than approximately 1 μs, the 5B10, 5B12, and 5B13 Time Base plug-in trigger circuits will not respond fast enough (when used in a 5443) to allow the leading edge of the display to be observed.

Differences in wiring between the 5100-series and 5400-series oscilloscope plug-in interfaces do not allow the use of the composite trigger mode of the 5B10, 5B12, and 5B13 Time Base plug-ins when these are used in the 5443. If the time base units are put in composite mode, they will trigger off the left vertical plug-in only.

Vertical Plug-In Compartments. When the left or right vertical plug-in is in the active mode (Display button pushed in), the left beam or the right beam is turned on, a logic level is applied to the switching circuit in the mainframe, and a display of the beam affected by this plug-in occurs. When no plug-in is in the left or right compartment, no trace from that 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 on that beam associated with the plug-in compartment.

Horizontal Plug-In Compartment. Alternate or Chopped display switching is selected on a time-base unit operated in the horizontal compartment. When both vertical plug-ins are slaved to the same time-base sweep and 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 both vertical plug-ins are slaved to the same time-base sweep and 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. When both vertical plug-ins are slaved to the same time-base sweep, each plug-in is driven by an alternate multivibrator when it is in the active mode (Display button set for ALT operation). When each vertical plug-in is slaved to a different time-base sweep, each vertical plug-in receives two time slots. The two time slots allocated to each plug-in are divided between amplifier channels in a dual trace unit.

Vertical Display Mode

Alternate Mode. The alternate position of the time-base unit Display switch allows alternate mode operation in the vertical plug-in compartment when a multiple trace plug-in is used in either of the compartments. 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 of the vertical plug-in at a 200-kilohertz rate. In general, the Chop mode provides the best display at sweep rates slower than about one millisecond/division or whenever dual-trace, single-plot phenomena are to be displayed. At faster sweep rates, the chopped switching becomes apparent and may interfere with the display.

Dual Beam Displays. If both the A and B sweeps are operating in a dual time-base plug-in, 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 (nondelayed sweep mode only). This results in two displays that have completely independent vertical deflection. 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.

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 5443 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. For X-Y application using multiple trace plug-ins, see the information on Display Capability at the back of this section.

Raster Display

A raster-type display can be used to effectively increase the apparent sweep lengths. 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 either of the vertical compartments 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 appropriate Ext Intensity Input to provide intensity modulation of the display. This type of raster display can be used to provide a television-type display. Complete information on operation using the Z-axis feature is given in the operating instructions section of the display module manuals.

BASIC OSCILLOSCOPE APPLICATIONS

The 5400-series oscilloscopes 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.

Harley Carter, "An Introduction to the Cathode Ray Oscilloscope", Phillips Technical Library, Cleaver-Hume Press Ltd., London, 1960.

J. Czeck, "Oscilloscope Measuring Techniques", Phillips Technical Library, Springer-Verlag, New York, 1965.

Robert G. Middleton, "Scope Waveform Analysis", Howard W. Sams & Co., Inc., The Bobbs-Merrill Company Inc., Indianapolis, 1963.

Robert G. Middleton and L. Donald Payne, "Using the Oscilloscope in Industrial Electronics", Howard W. Sams & Co., Inc., The Bobbs-Merrill Company, Inc., Indianapolis, 1961.

John F. Rider and Seymour D. Uslan, "Encyclopedia of Cathode-Ray Oscilloscopes and Their Uses", John F. Rider Publisher Inc., New York, 1959.

John F. Rider, "Obtaining and Interpreting Test Scope Traces", John F. Rider Publisher Inc., New York, 1959.

Rufus P. Turner, "Practical Oscilloscope Handbook", Volumes 1 and 2, John F. Rider Publisher Inc., New York, 1964.

Peak-to-Peak Voltage Measurements—AC

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

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

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

3. Adjust the time-base triggering controls for a stable display and set the Sec/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. 1-1).

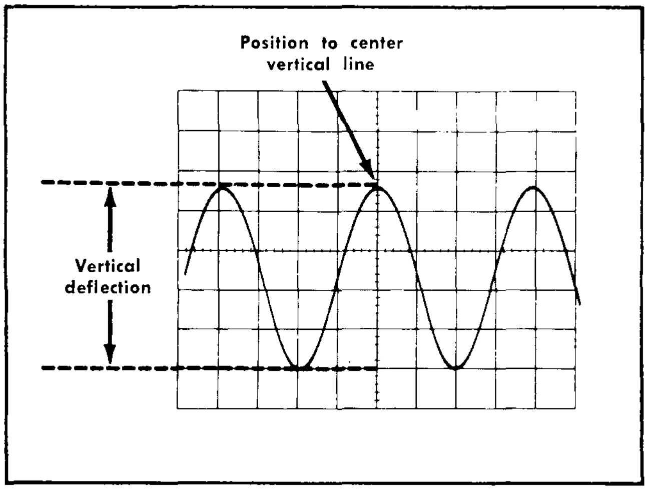


Fig. 1-1. Measuring peak-to-peak voltage of a waveform.

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

NOTE

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

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

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

Peak-to-peak volts =

$$\underset{\text{(divisions)}}{4.6} \times \underset{\text{setting)}}{5 \text{ (Volts/Div}} = \underset{\text{volts}}{23}$$

NOTE

If an attenuator probe is used that does not have readout scaling capabilities, multiply the right side of the above equation by the attenuation factor.

Instantaneous Voltage Measurements—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 and then position the trace to the reference line.

2. Connect the signal to the input connector. Set the input coupling switch to dc (the ground reference can be checked at any time by setting the input coupling switch 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. 1-2, the measurement is made between the reference line and point A.

5. Establish the polarity. The voltage is positive if the signal is applied to the input connector and the waveform is above the reference line (some plug-ins have both + and − connectors).

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

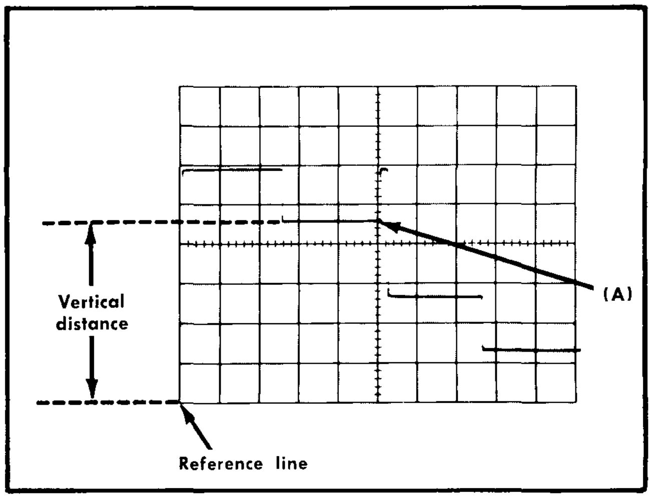


Fig. 1-2. Measuring instantaneous dc voltage with respect to a reference voltage.

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

Instaneous Voltage =

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

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 Sec/Div switches. This is useful for comparing signals to a reference voltage amplitude or period. To establish a new set of deflection factors based upon 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.

Deflection Conversion Factor =

$$\frac{\text{reference signal amplitude (volts)}}{\text{deflection (divisions) X Volts/Div setting}}$$

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:

(2V) (1.5) = 3 volts/division

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

(3V) (5) = 15 volts

Sweep Rate

1. Apply a reference signal of unknown frequency to the vertical input connector. Using the Sec/Div switch and variable Sec/Div control, adjust the display so that one cycle of the signal covers an exact number of horizontal divisions. Do not change the variable Sec/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 Sec/Div switch. This is the Deflection Conversion Factor.

Deflection Conversion Factor =

$$\frac{\text{reference signal period (seconds)}}{\begin{matrix}\text{horizontal} \\ \text{deflection} \\ \text{(divisions)}\end{matrix} \times \begin{matrix}\text{Sec/Div} \\ \text{switch} \\ \text{setting}\end{matrix}}$$

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

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

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

$$\begin{matrix}\text{Modified} \\ \text{Deflection} \\ \text{Factor}\end{matrix} = \begin{matrix}\text{Sec/Div} \\ \text{switch setting}\end{matrix} \times \begin{matrix}\text{Deflection} \\ \text{Conversion} \\ \text{Factor}\end{matrix}$$

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

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

EXAMPLE: Assume a reference signal frequency of 455 hertz (period 2.2 milliseconds), a Sec/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 Sec/Div switch setting of 50 μs, the Modified Deflection Factor (step 5) is:

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

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

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

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 Sec/Div switch to the fastest sweep rate that will permit displaying one cycle of the waveform in less than eight divisions (some nonlinearity may occur in the first and last graticule divisions of display). Refer to Fig. 1-3.

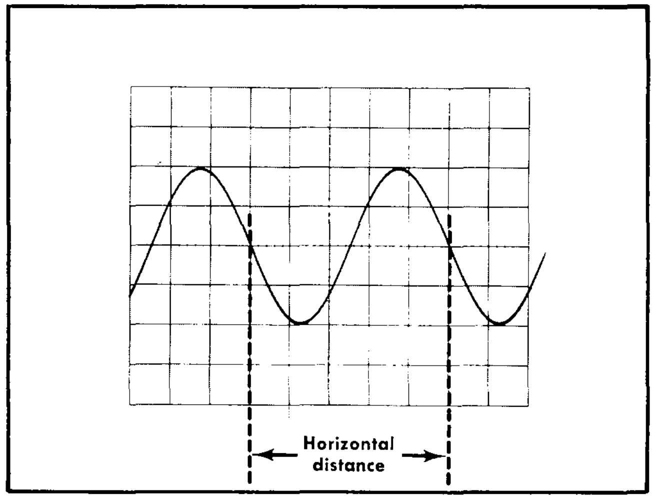


Fig. 1-3. Measuring time duration (period) between points on a waveform.

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 Sec/Div control is in the Cal position.

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

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

Period =

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

The period is 0.5 millisecond

Determining Frequency

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

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

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

EXAMPLE: The frequency of the signal shown in Fig. 1-3, 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 Sec/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. 1-4).

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 Sec/Div control is in the Cal position.

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

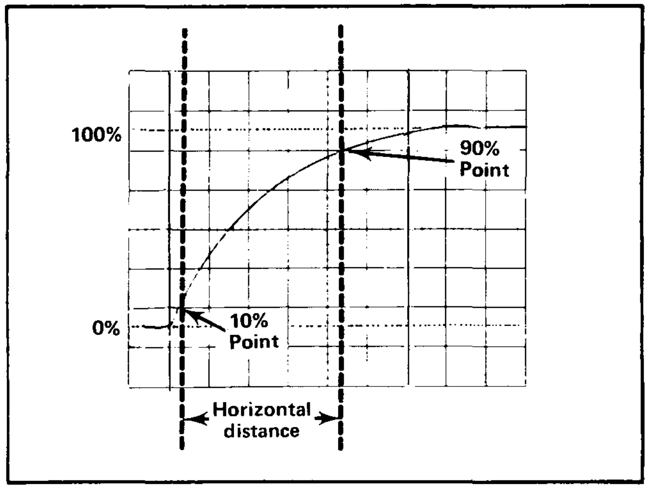


Fig. 1-4. Measuring risetime.

EXAMPLE: Assume that the horizontal distance betwen the 10% and 90% points is six divisions and the Sec/Div switch is set to 1 μs.

Using the period formula to find risetime:

Risetime period =

$$\begin{array}{l} \text{horiozntal} \\ \text{distance} \\ \text{(divisions)} \end{array} \times \begin{array}{l} \text{Sec/Div} \\ \text{switch} \\ \text{setting} \end{array} = (6)\ (1\ \mu\text{s}) = 6\ \mu\text{s}$$

The risetime is 6 microseconds.

Time Difference Measurements

There are numerous methods of performing time difference measurements using a dual beam oscilloscope. The method described below uses a single sweep time-base and single trace vertical plug-ins. Other methods of measuring time difference are described in the time-base plug-in manuals.

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 at sweep rates of 1 ms and slower.

3. Set the vertical plug-in triggering switches to trigger the display on channel 1 of the left beam and channel 1 of the right beam.

4. Connect the reference signal to the left vertical channel 1 input connector and the comparison signal to

@

the right vertical channel 1 input connector. The reference signal should precede the comparison signal in time. Use coaxial cables or probes that have similar time-delay characteristics to connect the signal to the input connectors.

5. If the signals are of opposite polarity, use channel 2 and invert the channel 2 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 Sec/Div switch for a sweep rate that shows three or more divisions between the measurement points, if possible. Use either A or B sweep on dual time-base plug-ins, but not both sweeps.

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. 1-5).

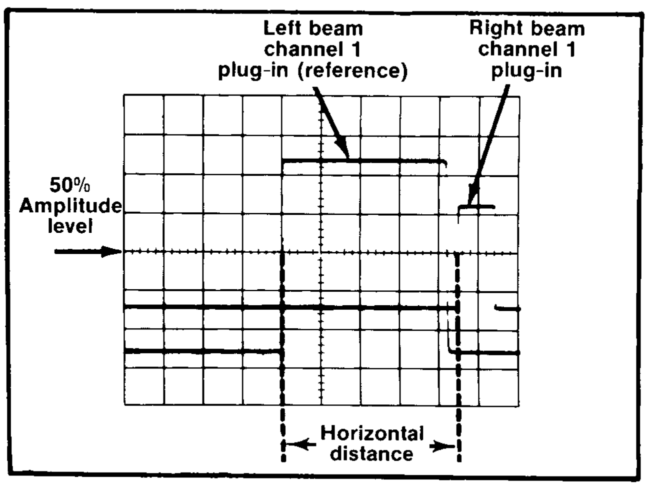


Fig. 1-5. Measuring time difference between two pulses.

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

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

Time Delay =

$$\begin{matrix}\text{Sec/Div} & & \text{horizontal} \\ \text{switch} & \times & \text{distance} \\ \text{setting} & & \text{(divisions)}\end{matrix} = (50\ \mu s)\ (4) = 200\ \mu s$$

The time delay is 200 microseconds.

Multi-trace Phase Difference Measurement

Phase comparison between two or more signals of the same frequency can be made using a multiple-trace plug-in or two single-trace plug-ins if both vertical plug-ins are slaved to the same time-base sweep. 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 of the left beam and channel 1 of the right beam.

4. Connect the reference signal to the left vertical channel 1 input connector and the comparison signal to the right vertical channel 1 input connector. The reference signal should precede the comparison signal in time. Use coaxial cables or probes that have similar time-delay characteristics to connect the signals to the input connectors.

5. If the signals are of opposite polarity, use channel 2 and invert the beam having the channel 2 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 Sec/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 Sec/Div control until one cycle of the reference signal (channel 1 of left beam) occupies exactly eight divisions between the second and tenth vertical lines of the graticule (see Fig. 1-6). 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. 1-6. Use the formula:

Phase Difference =

$$\begin{array}{c}\text{horizonal}\\ \text{difference}\\ \text{(divisions)}\end{array} \times \begin{array}{c}\text{sweep rate}\\ \text{(degrees/}\\ \text{divisions)}\end{array} = (0.6)\,(45^\circ) = 27^\circ$$

The phase difference is 27°.

High Resolution Phase Measurement

More accurate dual-trace phase measurements can be made by increasing the sweep rate (without changing the variable Sec/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. The magnified sweep rate is automatically indicated by the crt readout and knob-skirt scale-factor readout.

EXAMPLE: If the sweep rate were increased 10 times with the magnifier, the magnifier sweep rate should be 45°/division ÷ 10 = 4.5°/division. Fig. 1-7 shows the same signals as used in Fig. 1-6, but with the Swp Mag button pushed in. With a horizontal difference of six divisions the phase difference is:

Phase Difference =

$$\begin{array}{c}\text{horizontal}\\ \text{difference}\\ \text{(divisions)}\end{array} \times \begin{array}{c}\text{magnified}\\ \text{sweep rate}\\ \text{(degrees/}\\ \text{division)}\end{array} = (6)\,(4.5^\circ) = 27^\circ$$

The phase difference is 27°.

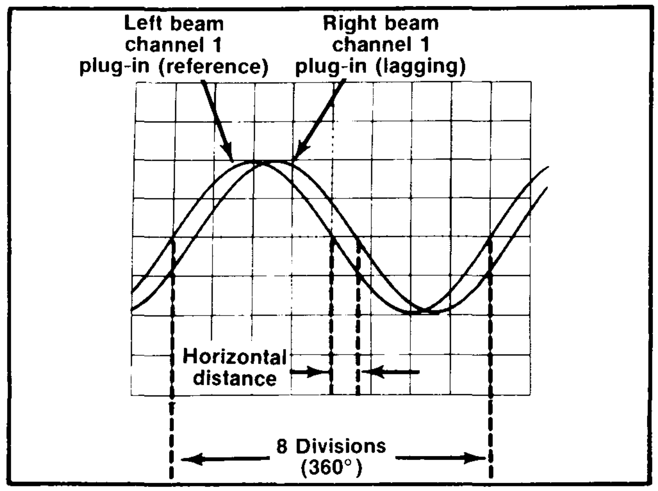


Fig. 1-6. Measuring phase difference.

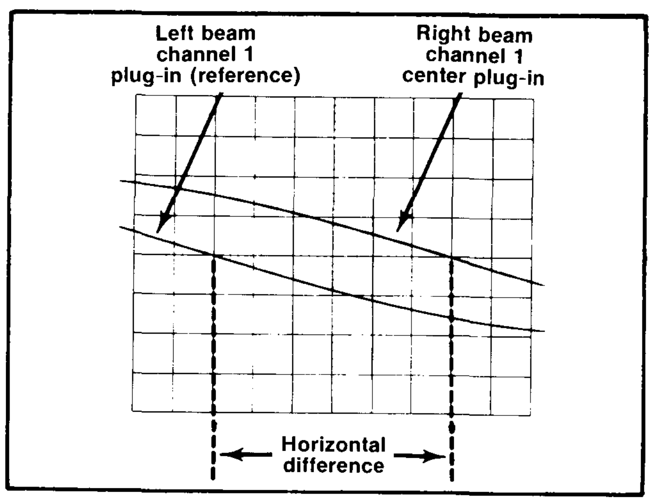


Fig. 1-7. High-resolution phase difference measurement with increased sweep rate.

DISPLAY CAPABILITY

The 5-series amplifier and time-base plug-ins are designed to operate in both single and dual-beam oscilloscopes. Since the 5443/D44 Dual Beam Oscilloscope has two horizontal deflection amplifiers (inputs are pins 7A and 7B, and 13A and 13B respectively) that are separated for dual-beam and paralleled for single-beam operation), some operational differences which are described below, can be expected in the dual-beam oscillscope.

Amplifier or Single Time-Base Plug-Ins in the Horizontal Deflection Compartment

In all single-trace amplifier plug-ins, except the 5A45 and single time-base plug-ins, the inputs to the horizontal amplifiers for the two beams are connected in parallel.

The outputs of the 5A45 single-trace plug-in and the 5A38 and 5A48 multi-trace plug-ins are connected only to the inputs of the left beam horizontal amplifier. Therefore, only signals from the left vertical plug-in will be deflected horizontally.

In the 5A18N and 5A14N, multi-trace plug-ins, the plug-in outputs are separated. Channel 1 of the 5A18N is connected to the left horizontal amplifier input while channel 2 is connected to the right horizontal amplifier input. In the 5A14N channels 1 and 2 are connected to the left horizontal amplifier input while channels 3 and 4 are connected to the right horizontal amplifier input.

Dual Time-Base Plug-Ins in the Horizontal Deflection Compartment

The 5B12N time-base A sweep is permanently connected to the left beam horizontal amplifier input while B sweep is connected to the right beam horizontal amplifier input. This results in the A sweep driving only the left and the sweep driving only the right vertical plug-ins.

In the 5B42 time base either the main or the delayed sweep is connected to the paralleled inputs of both horizontal amplifiers, i.e., either time base will sweep both left and right vertical plug-ins.

In the dual beam mainframe, the 5B44 time base can be used in several display modes. Either the A or B sweep can drive both horizontal deflection amplifiers, or if both A and B sweeps are selected then A sweep will deflect the left beam and B sweep will deflect the right beam allowing fully independent operation of each beam.

THEORY OF OPERATION

LOW-VOLTAGE POWER SUPPLY AND CALIBRATOR

The low-voltage power supply circuit (see Diagram 2) provides the operating power for the oscilloscope system. Electronic regulation is used (where necessary) to provide stable, low-ripple output voltages. The circuit also includes the calibrator circuit to produce an accurate square-wave output.

Power Input

Power is applied to the primary of transformer T800 through the line-selector block, P800 or P801 via the display unit fuse F300, thermal cutout S300, and Power switch S302. The line-selector blocks allow changing the primary-winding taps of T800 to fit different line requirements.

Low-Voltage Rectifiers and Unregulated Outputs

The full-wave bridge rectifiers and associated filter components in the secondaries of T800 provide filtered dc voltages. The unregulated outputs are +200 volts, +18 volts, +38 volts, −18 volts and −38 volts. The +200-volt output to the display unit is protected by F800.

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 −15-volt, +15-volt, +30-volt and +5-volt supplies. The regulator for the −30-volt supply is a feedback amplifier system that operates between ground and the unregulated −38 volts. Current to the load is delivered by series-pass transistor Q940. The supply voltage is established by the voltage drop across R948, R950, and R952, which is compared to the voltage drop across VR950 and the emitter-base junction of Q950. The feedback path is through R949, Q955, and Q958 to the base of Q940. Any variation in output voltage due to ripple, change of current through the load, etc., is immediately transmitted to the base of Q940 and nullified by a change in Q940 conduction, thus maintaining a steady output. The output of the supply is set to exactly −30 volts by adjustment of R950 (−30 V Adj). This control sets the conduction of Q950, which controls the bias levels of Q958 and Q940. CR955 and Q958 provide short-circuit protection by limiting the current through Q940 when the voltage drop across R940 exceeds 1.1 V.

−15-Volt Supply. The regulator for the −15-volt supply consists of series-pass transistor Q880, error amplifier Q900 and error-sensing transistors Q894 and Q896. This is a feedback amplifier system that operates between +30 volts and −20 volts. Current to the load is delivered by series-pass transistor Q880. The supply voltage is established by comparing the supply voltage sample at the base of error-sensing transistor Q894 with the reference at the base of error-sensing transistor Q896. Any differences between the bases of the error-sensing transistors causes a change in the Q894 collector. The error-sensing circuit change is applied to the base of the error amplifier, Q900. The output of the error amplifier changes the conduction of the series-pass transistor Q880 to correct for any output error. Q885 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, Q885 is biased off.

+15-Volt Supply. The regulator for the +15-volt supply consists of series-pass transistor Q850, error amplifier Q870 and error-sensing transistors Q864 and Q866. Operation of this feed-back amplifier system is similar to that described for the −15-volt supply.

+30-Volt Supply. The regulator for the +30-volt supply consists of series-pass transistor Q910 and error amplifier Q925. This is a feed-back amplifier system similar to that just described for the −30-volt supply. R920, +30 V Adj, provides an adjustment to set the output of the supply at exactly +30 volts. Q915 protects the supply, if the output is shorted, by limiting the current demanded from the series-pass transistor under excessive load. During normal operation, Q915 is biased off.

+5-Volt Supply. The regulator for the +5-volt supply consists of series-pass transistor Q820, error amplifier Q824 and Q832, and error-sensing transistor Q838. This is a feed-back amplifier system which operates between +5 volts and −30 volts. Current to the load is delivered by the series-pass transistor Q820. The supply voltage is established by the drop across R845 and R846. The feedback path is through error signal R845 to the base of Q838. Any variation in output voltage is immediately transmitted to the base of Q820 and nullified by a change in the conduction of Q820, which shifts the whole supply. Q830 protects the supply (if the output is shorted) by limiting the current demanded by the error-amplifier transistor Q824. During normal operation, Q830 is biased off.

Line Trigger

A line-frequency signal is obtained from the secondary of T800 and attenuated by R935, R936, and R937 to provide a line-trigger source for the time-base plug-in unit.

Calibrator

The calibrator circuit (composed of Q982, Q984, and their associated passive components) produces a square-wave output with accurate amplitude and at a rate that is 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 Q982 receives a pulsating dc voltage from full-wave rectifier CR980 and CR981 and produces a nearly symmetrical switching signal for Q982 and Q984. As Q984 is alternately switched on and off at twice the line frequency, current through R986 is alternately switched, first through the transistor; then through CR986, the probe test loop, and R987 to produce the required test signal.

INTERFACE

The interface circuit (see Diagram 1) provides the 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.

NOTE

Where the following description applies to the right and left beams, the circuit numbers used will be those of the right-beam circuitry.

Chop Oscillator

The chop oscillator produces a 200-kilohertz square-wave signal for chopping between amplifier channels within the plug-ins. This astable oscillator circuit consists of U675B, U675C, and their associated passive components. When the oscillator receives a chop actuate level (+5 volts), it free runs at a 200 kHz rate. The chop actuate level is routed through the vertical plug-ins to the time-base unit, and is present at contact A20 of J630 when a multi-trace display is required and the time-base Display switch is set to Chop. The oscillator has two outputs; one is sent through inverters to the left and right channel switching D-type flip flops and the other is sent to CR784, CR781 and CR787 to blank the chop-switching transients.

Channel Switch Multivibrator Circuits

The right beam channel-switching multivibrator produces the right beam display switching signal for both the Alternate and Chopped switching modes. This circuit is composed of U760, U675F and its discrete passive components, which is connected as a D-type flip-flop. The flip-flop is a divide-by-two counter. The channel-switching multivibrators are activated by a positive-going transition, which can come from either the chop oscillator or from the time-base plug-in unit via emitter follower transistor Q1850 and the inverter transistor Q760. The chop oscillator input results in chopped-mode vertical switching. The input from the time-base unit via Q1850 coincides with the end of each sweep for the right beam, and results in alternate-mode vertical switching. The output from the divide-by-two circuit, U760A via U675F, is sent via contact B21 of J620 to the channel-switching circuits incorporated within a multi-trace vertical plug-in unit. Some of the display combination possibilities are fully discussed in the General Operating Instructions section of this manual.

Right Vertical Amplifier and Vertical Switching Integrated Circuit

Emitter followers Q665 and Q670 provides a high impedance input to the vertical amplifier and vertical switching integrated circuit U630. The vertical amplifier input resistance for the oscilloscope mainframe is determined by R666 and R665.

The gain of the vertical amplifier portion of U630 is set by resistor R680. The vertical output signal at pins 12 and 13 of U630 goes to a grounded-base stage consisting of Q715 and Q720. Q715 and Q720 change the dc level of the vertical signal so that it is compatible with the vertical amplifier in the display module. Q710 and Q700 act as both a current source for the grounded base stage and an insertion point for the vertical readout information.

The vertical CH switch OFF signal goes to pin 6 of U630 where it is used to prevent any vertical signal output from U630 during readout time. During the time of the vertical CH switch OFF signal, vertical readout signal information is supplied to the emitter of Q710.

Left Vertical Amplifier

The left vertical amplifier consists of an emitter-follower stage (Q605 and Q600) and a gain stage (Q615 and Q610). The gain-setting resistor is R613.

Horizontal Amplifier

The horizontal amplifier consists of an emitter follower stage (Q1880 and Q1860) and a gain stage (Q1875 and Q1865). The gain setting resistor is R1869. Thermistor RT1867 and resistor R1867 provide a temperature compensation network for the amplifier.

Trigger Amplifiers

Left Vertical Plug-In. A nominal 250 mV/division, single-ended, signal is applied to the input stage of a two stage amplifier from contact A4 of J610. The first stage, a paraphase amplifier, consisting of Q645 and Q650 amplifies the signal by 1/4. The second gain stage consists of Q660 and Q655; R658 sets the stage gain. The output signal amplitude depends upon the input impedance of the time-base trigger circuit at contacts A3 and B4 of J630. Time-base plug-ins designed for the 5400-series oscilloscope have a 50 Ω input impedance, which results in a signal amplitude of 50 mV/division.

Right Vertical Plug-In. The right vertical plug-in trigger amplifier (Q745, Q730, Q740 and Q735) operates the same as described above.

Z-Axis Signal

The gate signal from the B sweep is summed on the interface circuit board with the chopped-blanking signal before being supplied via contact 4 of P755, to the display module as the Z-Axis signal. The right beam Z-Axis circuit is the only beam that is affected by the readout system.

READOUT SYSTEM

The readout system provides an alpha-numeric display of information encoded by the plug-in units. This information is presented on the crt on a time-shared basis with the analog waveform for the right beam display only.

Up to eight groups of characters can be displayed on the display unit crt. The position of each group (word) is fixed and directly related to the originating plug-in. Fig. 2-1 shows the word positions on the display unit crt.

DEVELOPING THE DISPLAY

Refer to the readout portion of the block diagram during the following discussion.

The key block in the read-out system is the timer stage. This stage produces the basic signals that establish the timing sequences within the read-out system. The timer stage also produces control signals for other stages within the read-out system, and interrupt signals to the right beam vertical and Z-Axis amplifiers to allow a read-out display to be presented.

Included in the timer block is the time-slot generator. The time-slot generator has ten outputs, each of which is energized sequentially. After the tenth output is energized, the first is again energized to repeat the cycle. The ten outputs are connected to the vertical and horizontal plug-in compartments as well as to other stages within the read-out system. Each time the first time-slot output line is energized, an address counter is incremented by one. The address counter counts to seven, then returns to zero. The address counter's three outputs are connected to various read-out system stages.

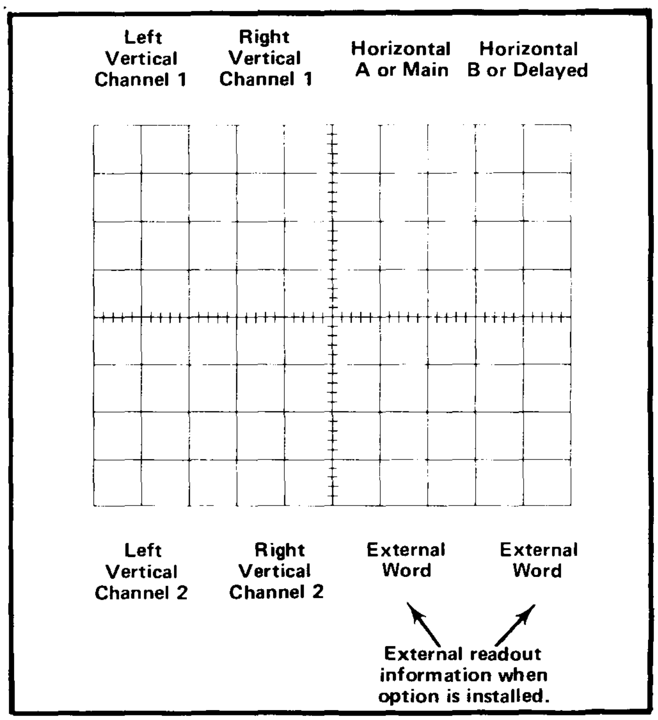


Fig. 2-1. Location of readout words on the crt, identifying the originating plug-in and channel.

Within each plug-in are read-out coding resistors. The coding resistors are selected by the plug-in control settings, which connect the resistors between the various time-slot lines and one of four plug-in output lines. Two of the plug-in output lines are associated with channel 1 of amplifier plug-ins or the main sweep of sweep plug-ins. The other two output lines are associated with channel 2 of the amplifier plug-ins, or with delayed (or B) sweep of time-base plug-ins.

Each pair of output lines from the plug-ins or external readout (option 3) is connected to the data switches. Currents in these eight pairs (two pairs added with option 3) of lines are transferred to the outputs of the data switches, as selected by the address counter.

The data decoders convert each of the current signals from the data switches to make one of the ten logic lines (together with signals from the timer) select the character generated by the character generators.

The output amplifier combines signals from the character generator with positioning signals from the address counter position generator. The combined signals then form the vertical and horizontal components of the read-out display.

The vertical component of the read-out display is injected directly into the output of the vertical channel switch on the interface board. During the interval when the read-out is generated, the vertical channel switch is turned off, so only the read-out signal is displayed.

The horizontal component of the read-out display is connected to the horizontal channel switch. When the read-out is not displayed, signals from the horizontal plug-in pass through the channel switch without change. During the interval when read-out is displayed, the horizontal read-out signal appears at the output of the horizontal channel switch instead of the horizontal plug-in signal.

CIRCUIT ANALYSIS OF READOUT SYSTEM

The following analysis of the Readout System discusses the operation of each stage in detail. A complete schematic of the readout system is shown on the diagram at the rear of this manual.

The definitions of several terms used in this description of the Readout System follow:

Character—A character is a single number, letter, or symbol that is displayed on the crt, either alone or in combination with other characters.

Word—A word is made up of a related group of characters. In the readout system, a word can consist of up to ten characters.

Frame—A frame is a display of all words for a given operating mode and plug-in combination. Up to eight words can be displayed in one frame.

Column—One of the vertical groups in the charcter selection matrix (see Fig. 2-6). Columns C-0 (column zero) to C-10 (column 10) can be addressed in the system.

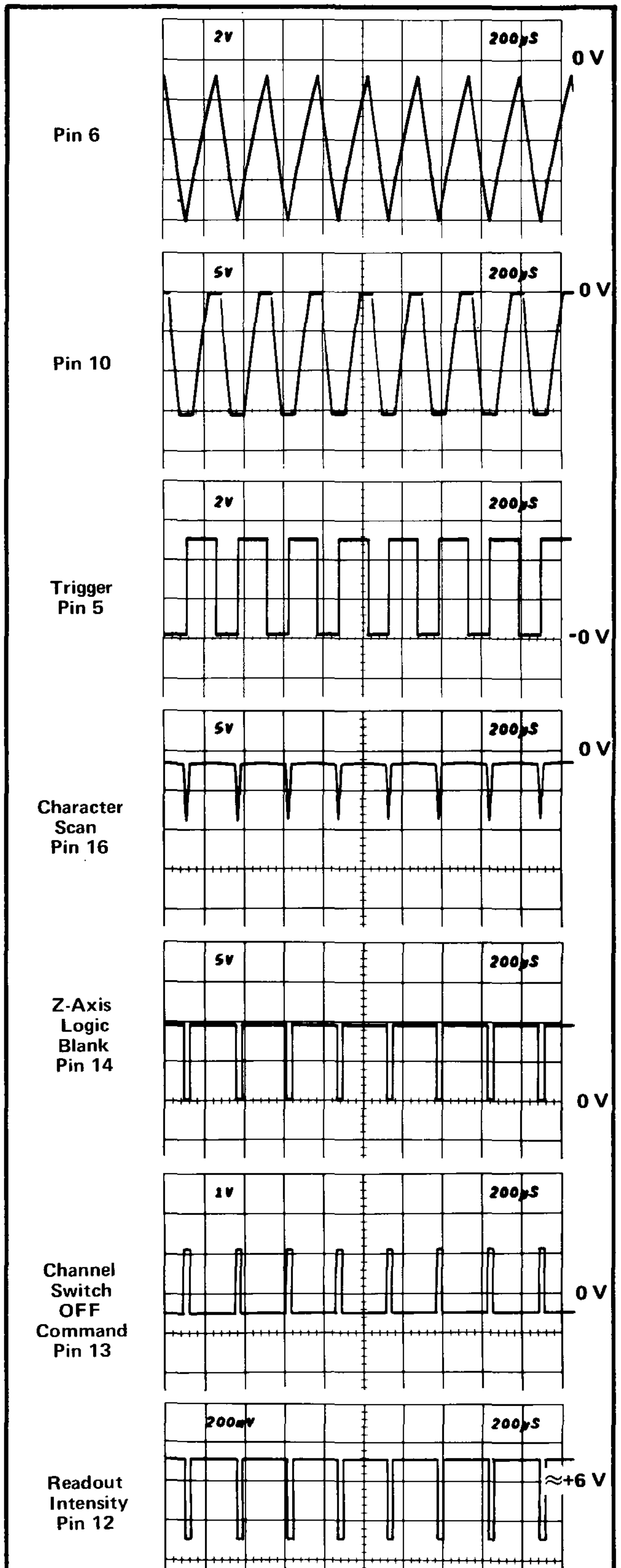
Row—One of the horizontal groups in the character selection matrix (Fig. 2-6). Row R-1 (row 1) to R-10 (row 10) can be addressed in the system.

Time Slot—A location in a pulse train. In the readout system, the pulse train consists of 10 negative-going pulses. Each of these time-slots is assigned a number between one and ten. For example, the first time-slot is TS-1.

Timer

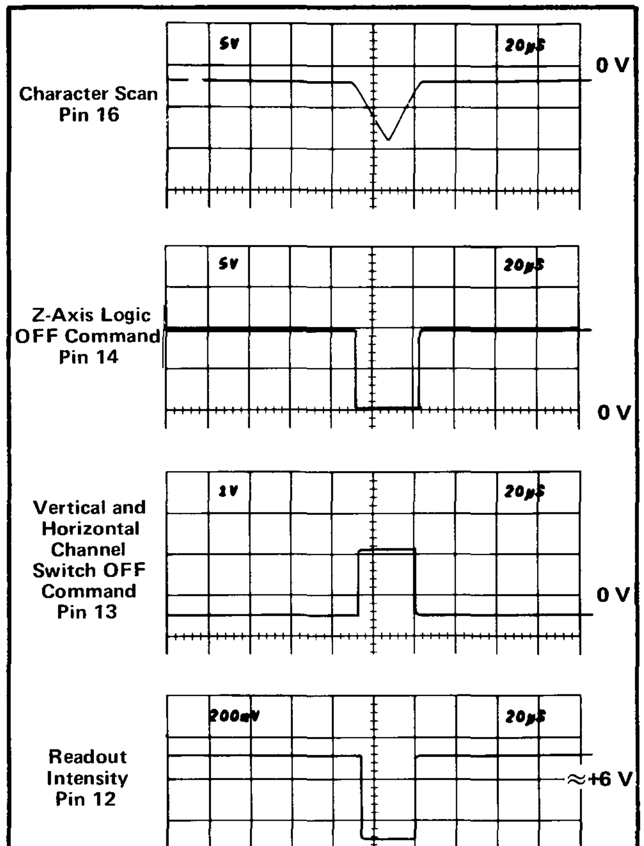
Timer U1000 establishes the timing sequence for all circuits within the readout system. This stage produces seven time-related output waveforms (see Fig. 2-2). The triangle waveform produced at pin 6 forms the basis for the remaining signals. The basic period of this triangle waveform is about 250 microseconds, as controlled by RC network C1021-R1021. The triangle waveform is clipped and amplified by U1000 to form the trapezoidal output signal at pin 10. The amplitude of this output signal is exactly 15 volts as determined by U1000 (exact amplitude necessary to accurately encode data in plug-in units; see Encoding the Data). The trigger output at pin 5 provides the switching signal for the time-slot counter and readout intensity control Q1018.

The signals at pin 12, 13, 14, and 16 are produced only when the triangle waveform is on its negative slope and the trapezoidal waveform has reached the lower level. The timing sequence of these waveforms is very important to the correct operation of the readout system (see expanded waveforms in Fig. 2-3). The Z-Axis blanking at pin 14 is produced first. This negative going signal drives Q1015, which removes the current input to the interface for the Z-Axis amplifier to blank the crt before the display is switched to the readout system. It also produces the strobe pulse through R1010, Q1010 and CR1013 to signal other stages within the readout system to begin the sequence necessary to produce a character. The collector level of Q1010 is also connected to character generator No. 2 (U1092) through Q1010 and CR1010. This activates



NOTE: Test oscilloscope externally triggered from channel address 4.

Fig. 2-2. Output waveforms of timer stage.



NOTE: Test oscilloscope externally triggered from channel address 4.

Fig. 2-3. Detail of output at pins 12, 13, 14 and 16 of U1000.

U1092 during the quiescent period of the strobe pulse (collector of Q1010 negative) and diverts the output current of row decoder U1035 to row 2. The purpose of this configuration is to prevent the zeros logic and memory stage U1060 from storing incorrect data during the quiescent period of the strobe pulse. When the strobe pulse goes positive, CR1010 is reverse biased to disconnect Q1010 from U1092, and to allow the row decoder to operate in the normal manner.

The next signal to be produced is the channel switch OFF command at pin 13. This positive-going signal disconnects the plug-in signals in the vertical and horizontal deflection system so that the plug-in units do not control the position of the crt beam during the readout display. This signal is also connected to the decimal point logic, the character position counter stage, and the format generator stage. The readout unblanking output at pin 12 is produced next. This current is connected to the Z-Axis amplifier to unblank the crt to the intensity level determined by READOUT INTENSITY control R1000. However, Q1018 prevents the intensity current from reaching the Z-Axis amplifier until the character scan ramp at pin 16 begins its positive slope. The character scan ramp at pin

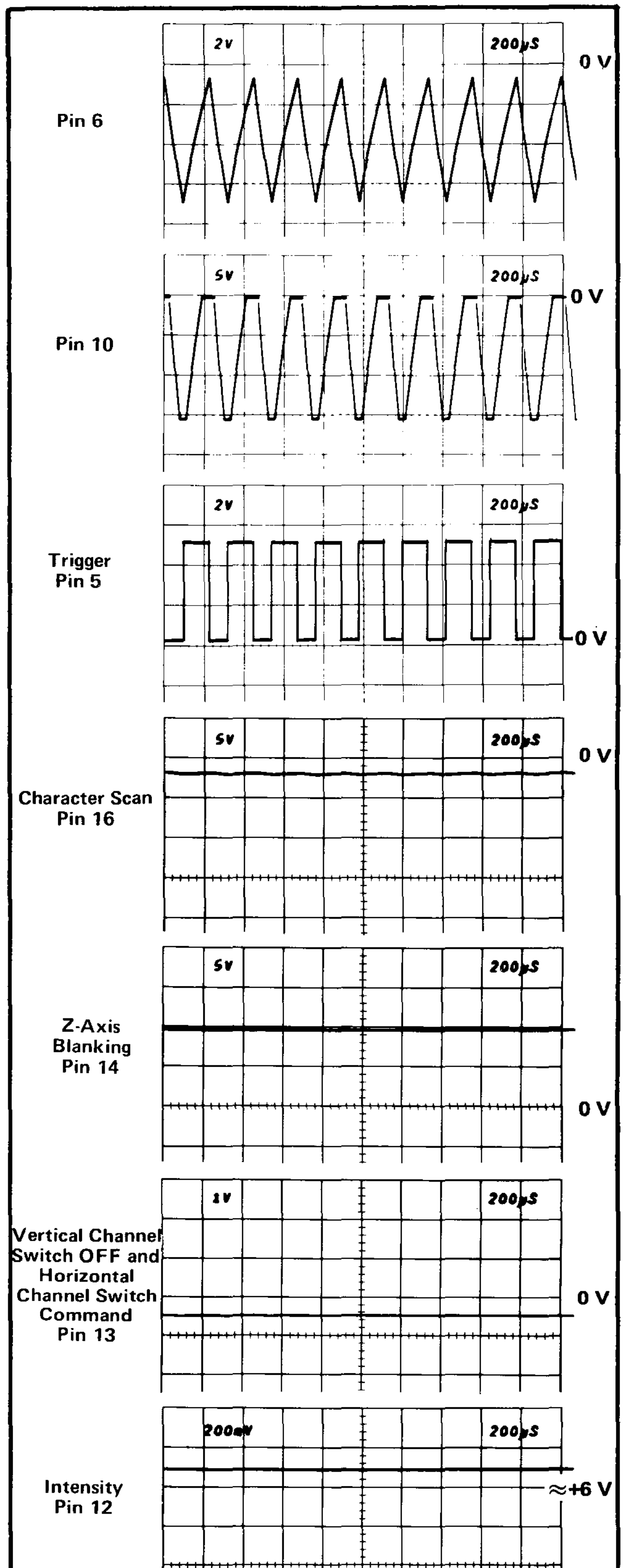
16 started to go negative as this timing sequence began. The triangular character scan ramp runs negatively from about −2 volts to about −8.5 volts, then returns back to the original level. This waveform provides the scanning signal for the character generator stages. Full character scan adjustment R1006 sets the dc level of the character scan ramp to provide complete characters on the display.

The timer stage operates in one of two modes, as controlled by the display skip level at pin 4. The basic mode just described is a condition that does not occur unless all ten characters of each word (80 characters total) are displayed on the crt. Under typical conditions only a few characters are displayed in each word. The display skip level at pin 4 determines the period of the timer output signal. When a character is to be generated, pin 4 is LO and the circuit operates as just described. However, when a character is not be displayed, a HI level is applied to pin 4 of U1000 through CR1003 from the display skip generator stage. This signal causes the timer to shorten its period of operation to about 210 microseconds. The waveforms in Fig. 2-4 show the operation of the timer stage when the display skip conditiion occurs for all positions in a word. Notice that there is no output at pins 12, 13, 14, and 16 under this condition. This means that the crt display is not interrupted to display characters. Also notice that the triangle waveform at pin 6 does not go as far negative and that the negative portion of the trapezoidal waveform at pin 10 is shorter. Complete details on operation of the display-skip generator are given later.

READOUT INTENSITY control R1000 sets the intensity of the readout display independently of the INTENSITY control. The READOUT INTENSITY control also provides a means of turning the readout system off when a readout display is not desired. When R1000 is turned fully counterclockwise, switch S1000 opens. The current to pin 11 of U1000 is interrupted and, at the same time, a positive voltage is applied to pin 4 through R1003 and CR1002. This positive voltage switches the stage to the same conditions that were present under the display-skip conditions. Therefore, the crt display is not interrupted to present characters. However, time-slot pulses continue to be generated.

Time-Slot Counter

Time-Slot counter U1025 is a sequential switch that directs the trapezoidal waveform input at pin 8 to one of its 10 output lines. These time-slot pulses are used to interrogate the plug-in units to obtain data for the readout system. The trigger pulse at pin 15 switches the time-slot counter to the next output line; the output signal is sequenced consecutively from time-slot 1 through time-slot 10. Fig. 2-5 shows the time-relationship of the time-slot pulses. Notice that only one of the lines carries a time-slot pulse at any given time. When time-slot 10 is completed, a negative-going end-of-word pulse is



NOTE: Test oscilloscope externally triggered from word address 4.

Fig. 2-4. Timer stage operation when display-skip condition occurs.

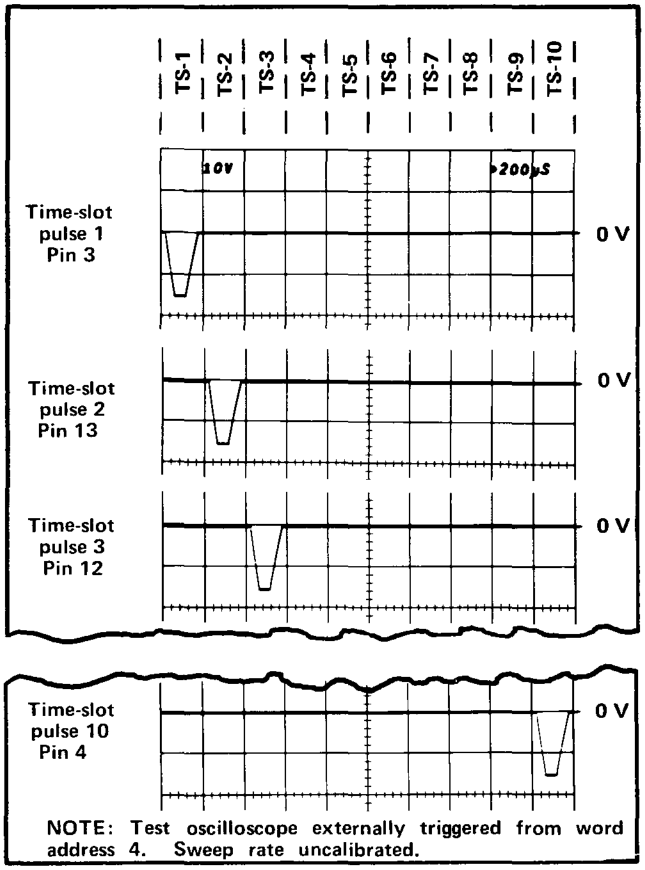


Fig. 2-5. Time relationship of the time-slot (TS) pulses produced by U1025.

produced at pin 2. The end-of-word pulse provides a drive pulse for the channel counter and also provides an enabling level to the display-skip generator during time-slot 1 only. The end-of-word pulse also resets the decimal point logic and zeros logic.

Word Counter

The word counter (made up of three flip flops in integrated circuit U1075) is a binary counter that produces the word address code for the column and row decoder stages.

This code instructs these stages to sequentially select and display the data from the plug-ins. The input channel that is displayed with each combination of the word address code is given in the discussion for the applicable stages.

Encoding the Data

Data is conveyed from the plug-in units to the readout system in the form of an analog code having up to 11 current levels (from zero to one milliampere in 100 microampere steps). The characters that can be selected by the encoded data are shown on the character selection matrix (see Fig. 2-6). Each character requires two currents to define it; these currents are identified as the column current and the row current which correspond to the column and row of the matrix. The column and row data is encoded by resistive programming in the plug-in units. The resistors are connected between the time-slot lines and the row or column lines.

The amplitude of the time-slot pulses is exactly −15 volts as determined by the timer stage. Therefore, the resultant output from the plug-in units can be accurately controlled by the programming resistors in the plug-in units.

Fig. 2-7A shows an idealized current waveform of row analog data, which results from the 10 time-slot pulses. Each of the steps shown in these waveforms corresponds to 100 microamperes. The row numbers on the left-hand side of the waveform correspond to the rows in the character selection matrix shown in Fig. 2-6. The row analog data is connected back to the readout system via contact B28 of the plug-in interface. Idealized column current waveforms at contact A28 of the plug-in interface are shown in Fig. 2-7B.

Referring to the character selection matrix, two units of column current, along with the two units of row current encoding during TS-1, indicate that two zeros should be added to the display. One unit of column current during time-slot 2, along with the one unit of current from the row output, instructs the readout system to add an invert arrow to the display.

Without column current output during TS-3 there can be no display on the crt (see Display-Skip Generator for further information). Two units of column current are encoded during TS-4. There is no row current encoded during this time-slot; this results in the numeral 1 being displayed on the crt. Neither row nor column analog data is encoded during time-slots 5, 6, and 7. During TS-8 two units of column current and three units of row current are encoded. This addresses the μ prefix in the character selection matrix. The final data output is provided during time slot 9: three units of column current and four units of row current cause a V (volts) to be displayed. The resultant crt readout is 100 μV.

The column analog data encoded by the plug-in unit can be modified by attenuator probes connected to the input connectors of vertical plug-in units. A special coding ring around the input connector of the plug-in unit senses the attenuation ratio of the probe (with readout-coded probes only). The probe contains a resistor that causes additional column current. For example, if a 10X attenuator probe is connected to a plug-in with the coding for 100 microvolts, an additional unit of current is added to

Row Number ↓ \ Column Number →	Current (Milli-amperes) (Resistance)	C-0	C-1	C-2	C-3	C-4	C-5	C-6	C-7	C-8	C-9	C-10
		0 ∞	0.1 150k	0.2 75k	0.3 51k	0.4 37.4k	0.5 30.1k	0.6 24.9k	0.7 21.5k	0.8 18.7k	0.9 16.5k	⩾1.0 13k
R-1	0 ∞	SKIP*	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
R-2	0.1 150k		↙	<	*I*	/	+	–	+	*C*	Δ	>
R-3	0.2 75k		Add* one zero	Add* two zeros	Reduce* prefix	Reduce* prefix and add one zero						Blank word
R-4	0.3 51k		*m*	*µ*	*n*	*p*	*X*	*K*	*M*	*G*	*T*	*R*
R-5	0.4 37.4k		*S*	*V*	*A*	*W*	*H*	*d*	*B*	*c*	Ω	*E*
R-6	0.5 30.1k		*U*	*N*	*L*	*Z*	*Y*	*P*	*F*	*J*	*Q*	*D*
R-7	0.6 24.9k				Decimal* point location No. 3	Decimal* point location No. 4	Decimal* point location No. 5	Decimal* point location No. 6	Decimal* point location No. 7			
R-8	0.7 21.5k											
R-9	0.8 18.7k											
R-10	0.9 16.5k	Add Space In Display*										

(Shaded) Unused locations. Available for future expansion of Readout System

* Operational address.

Fig. 2-6. Character selection matrix for readout system.

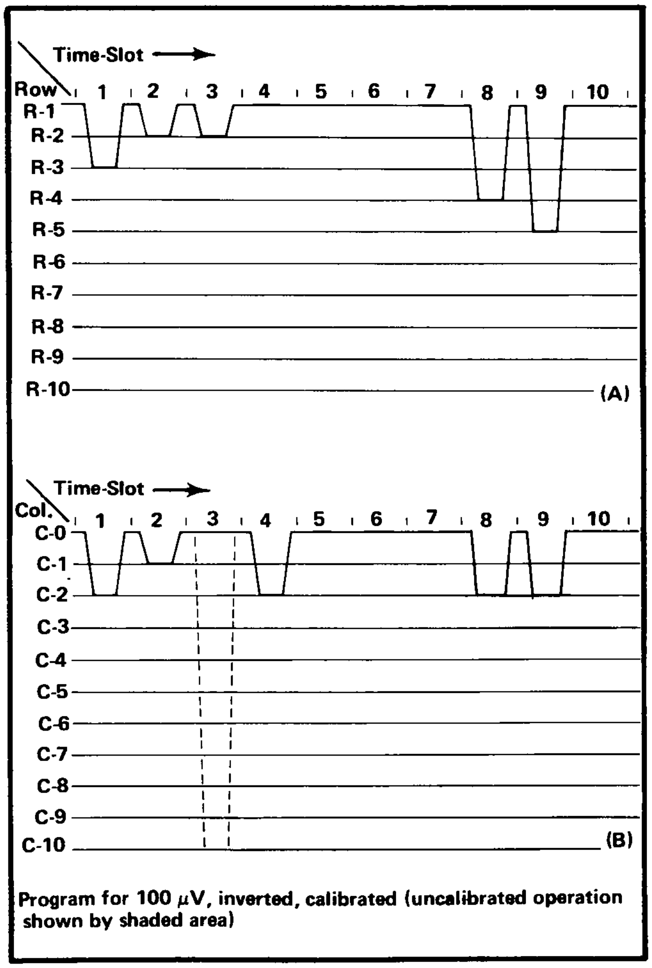


Fig. 2-7. Idealized current waveforms of: (A) Row analog data, (B) Column analog data.

the column analog data during time-slot 1. Since two units of current were encoded in Fig. 2-7, this additional current results in a total of three units of column analog current during this time-slot.

Referring to the character selection matrix, three units of column current, along with the two units of row current, indicates that the prefix should be reduced. Since this instruction occurs in the same time-slot that previously indicated that two zeros should be added to the display, and only one instruction can be encoded during a time-slot, the zeros do not appear in the display. The crt readout now changes to 1 mV.

Likewise, if a 100X readout-coded probe is connected to the input of the plug-in unit, the column current during time-slot 1 is increased two units for a total of four units of column current. This addresses an instruction in the character selection matrix, which reduces the prefix and adds one zero to the display. The resultant crt readout with the previous program is 10 mV.

Two other lines of information are connected from each plug-in compartment to the readout system. The column and row analog data from channel 2 of a dual-channel plug-in are connected to the readout system through contacts A24 and B24 of the plug-in interface, respectively.

Column and Row Data Switches

The readout data from the plug-in units is connected to the column and row data switch stages. A column-data line and a row-data line convey analog data from each of the eight data sources (two channels from each of the three plug-in compartments and two external channels, option 3).

The column data switch U1040 and the row data switch U1030 receive the word address code from the word counter. This binary code directs the column data switch and the row data switch as to which channel should be the source of the readout data. Table 2-1 gives the eight combinations of the word address code and the resultant channel is selected with each combination. These stages have eight inputs and provide a single time-multiplexed output at pin 7, which includes the information from all of the input channels. Six of the eight inputs to each stage originate in the plug-in units; the seventh and eighth inputs come from an optional external access jack.

TABLE 2-1

Word Address Code

Pin 8 U1075	Pin 9 U1075	Pin 12 U1075	Channel Selected
LO	LO	LO	Channel 2 Left Vertical
LO	LO	HI	Channel 1 Left Vertical
LO	HI	LO	Channel 2 Right Vertical
LO	HI	HI	Channel 1 Right Vertical
HI	LO	LO	Channel 2 Horizontal
HI	LO	HI	Channel 1 Horizontal
HI	HI	LO	Channel 2 External Access
HI	HI	HI	Channel 1 External Access

Display-Skip Generator

The display-skip generator, Q1040-Q1048-Q1050-Q1052 monitors the time-multiplexed column data at the output of the column data switch during each time-slot, to determine if the information at this point is valid data that should result in a crt display. The voltage at the base of Q1040B is set by divider CR1040-CR1041-R1046-R1047-R1048. Quiescently, there is about 100 microamperes of current flowing through R1040 from Q1056 and the zeros logic and memory stage (the purpose of this quiescent current will be discussed in connection with the zeros logic and memory stage). This current biases Q1040A so that its base is about 0.2 volt more positive than the base of Q1040B in the absence of column data. Therefore, since Q1040A and Q1040B are connected as a comparator, Q1040A will remain on unless its base is pulled more negative than the base of Q1040B. The analog data output from the column data switch produces a 0.5-volt change at the base of Q1040A for each unit of column current that has been encoded by the plug-in unit. Therefore, whenever any information appears at the output of the column data switch, the base of Q1040A is pulled more negative than the base of Q1040B, resulting in a negative (LO) display-skip output to the timer stage through Q1052. Recall that a LO was necessary at the skip input of the timer so it could perform the complete sequence necessary to display a character.

Q1048-Q1050 also provide display-skip action. The end-of-word level connected to their emitters through R1050 is LO only during time-slot 1. This means that Q1048-Q1050 are enabled only during time-slot 1. These transistors allow the zero logic and memory stage to generate a display-skip signal during time-slot 1 when information that is not to be displayed on the crt has been stored in memory (further information given under Zeros Logic and Memory discussion).

Column and Row Decoder

The column decoder U1070 and row decoder U1035 sense the magnitude of the analog voltages at their inputs and produce a binary output on one of ten lines corresponding to the column or row data which was encoded by the plug-in unit. These outputs provide the column digital data and row digital data, which is used by the character generator stages to select the desired character for display on the crt. The column and row data is also used throughout the readout system to perform other functions. The input current at pin 9 of the column decoder stage is steered to only one of the ten column digital data outputs. When a display-skip signal is present (collector of Q1052 HI), pin 9 is pulled HI through CR1052. This ensures that no current is connected to the character generator stage under this condition. Notice the corresponding input on the row decoder. This input is connected to ground and causes one of the ten row outputs to saturate to ground.

Zeros Logic and Memory

The zeros logic and memory stage U1060 stores data encoded by the plug-in units to provide zeros-adding and prefix-shifting logic for the readout system. The strobe pulse at pin 15 goes positive when the data has stabilized and can be inspected. This activates the zeros logic and memory stage so it can store the encoded data. A block representation of the memory sequence is shown in Fig. 2-8. If the plug-in unit encoded data for column 1, 2, 3, 4, or 10 agrees with row 3, the appropriate memory (or memories) is set.

If data is encoded, a negative-going output is produced at pin 7 as the memories are being set. This negative-going pulse is connected to the base of Q1050 in the display-skip generator to produce a display-skip output. Since the information that is encoded is only provided to set the memories and not intended to be displayed on the crt at this time, the display-skip output prevents a readout display if this encoding occurs during time-slot 1.

During time-slot 5, memory A is interrogated. If information is stored in this memory, positive-going output is produced at pin 7. This pulse is connected to pin 10 of the column decoder through Q1056 to add one unit of current at the input of the column decoder. This produces a zero after the character displayed on the crt during time-slot 4. During time-slot 6, memory B is interrogated to see if another zero should be added. If another zero is necessary, a second positive output is produced at pin 7, which again results in a column 1 output from the column decoder and a second zero in the crt display.

Finally, memory C is interrogated during time-slot 8 to obtain information on whether the prefix should be reduced, or left at the value that was encoded. If data has been encoded that calls for a reduction in prefix, a negative-going output level is produced at pin 7. This negative level subtracts one unit of column current from the data at the input to the column decoder. Notice on the character selection matrix of Fig. 2-6 that a reduction of one column when row 4 is programmed results in a one unit reduction of the prefix. For example, with the 100 μV program, if data was received from the plug-in calling for a reduction in prefix, the crt readout would be changed to 1 mV (zeros deleted by program; see Encoding the Data).

The 100 microamperes of quiescent current through R1041, provided by Q1056 (see Display-Skip Generator), allows the prefix to be reduced from μ (200 microamperes column current; column 2) to m (100 microamperes column current; column 1). Notice that if the prefix program is reduced from column 1 to column zero, the readout system does not display a character at this readout location.

A further function of the zeros logic is the blank word function. If ten units of column current are encoded along with two units of row current (row 3, column 10), the zero logic produces a negative-going output pulse at pin 1 of U1060. This pulse lasts until the end of time-slot 10. Pin 1 of U1060 is connected to the base of Q1018 through

Scan by Zenith

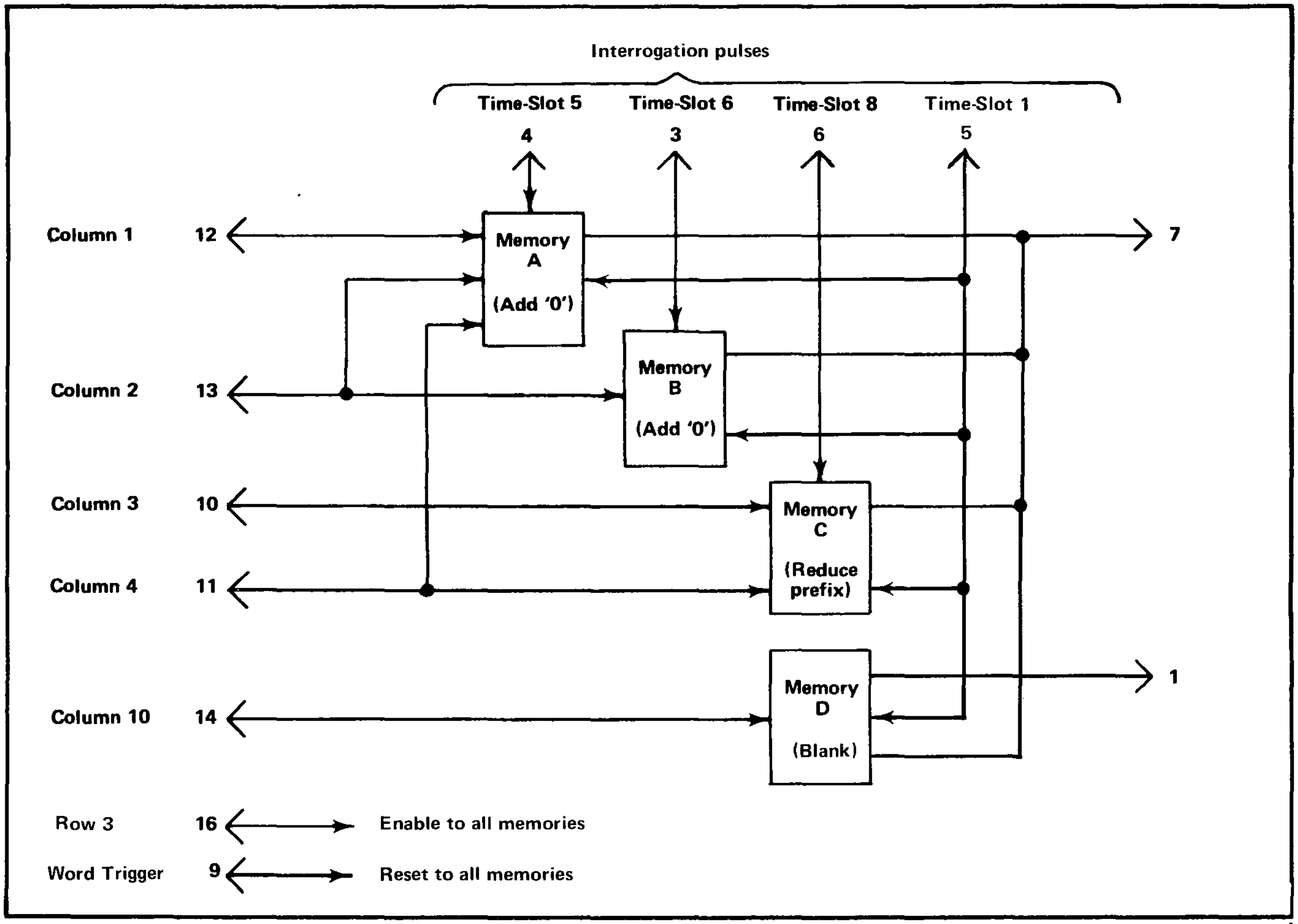


Fig. 2-8. Block representation of memory sequence in U1060.

R1020. When turned on, Q1018 prevents the readout intensity current from reaching the Z-Axis amplifier.

The end-of-word signal from the time-slot counter is connected to pin 9 of U1060 through C1065. At the end of each word of readout information, this pulse goes LO. This erases the four memories in the zeros logic and memory in preparation for the data to be received from the next channel.

Character Generators

The Character Generator stage consists of five similar integrated circuits U1090 through U1098, which generate the X (horizontal) and Y (vertical) outputs (at pins 16 and 1 respectively) to produce the character displayed on the crt. Each integrated circuit can produce 10 individual characters. U1090, which is designated as the "numerals" character generator, can produce the numerals 0 through 9 shown in row 1 of the character selection matrix (Fig. 2-6). U1092 can produce the symbols shown in row 2 of the character selection matrix and U1094 produces the prefixes and some letters of the alphabet that are used as prefixes in row 4. U1096 and U1098 produce the remaining letters of the alphabet shown in rows 5 and 6 of the character selection matrix. All of the character-generator stages receive the column digital data from column decoder U1070 in parallel. However, only one of the character generators receives row data at a particular time and only the stage that receives both row and column data is activated. For example, if column 2 is encoded by a plug-in unit, the five character generators are enabled so that either a 1, <, μ, V, or an N can be produced. However, if at the same time row 4 has also been encoded by the plug-in unit, only the prefix character generator U1094 will produce an output to result in a μ displayed on the screen. This integrated circuit provides current outputs to the format generator, which produces the selected character on the crt. In a similar manner, any of the 50 characters shown in the character selection matrix can be displayed by correct addressing of the row and column.

Decimal Point Logic and Character Position Counter

Decimal point logic and character position counter U1080 performs two functions. The first function is to produce a staircase current, which is added to the X (horizontal) signal to space the characters horizontally on the crt. After each character is generated, the negative-going edge of the CH switch OFF signal at pin 5 advances the character position counter. This produces a current step output at pin 3, which (when added to the X signal) causes the next character to be displayed one character space to the right. This stage can also be advanced when a space instruction is encoded by the plug-in unit so that a space is left between the displayed characters on the crt. Row 10 information from the row decoder is connected to pin 4 of U1080 through R1083. When row 10 and column 0 is encoded, the output of this stage advances one step to move the next character another space to the right. However, under this condition, no display is produced on the crt during this time-slot, since the character generators are not activated.

Time-slot pulses 1, 2, and 3 are also connected to pin 4 of U1080 through VR1080, VR1081, and VR1082 respectively (and through R1088 and R1083). This configuration adds a space to the displayed word during time-slots 1, 2, and 3 even if information is not encoded for display during these time-slots. With this feature, the information that is displayed during time-slot 4 (1-2-5 data) always starts in the fourth character position whether or not data has been displayed in the previous time-slots. Therefore, the resultant crt display does not shift position as normal/invert or cal/uncal information is encoded by the plug-in. The end-of-word pulse connected to pin 8 of U1080 through C1080 resets the character position counter to the first character position at the end of each word.

The decimal point logic portion of this stage allows decimal points to be added to the crt display as encoded by the plug-in units. When row 7 is encoded in coincidence with columns 3 through 7 (usually encoded during time-slot 1), a decimal point is placed at one of the five locations on the crt identified in row 7 of the character selection matrix (Fig. 2-6). This instruction refers to the decimal point location in relation to the total number of characters that can be displayed on the crt (see Fig. 2-9). For example, if column 3 and row 7 are encoded during time-slot 1, the system is instructed to place a decimal point in location No. 3. As shown in Fig. 2-9, this displays a decimal point before the third character that can be displayed on the crt (first three time-slots produce a space whether data is encoded or not; see previous paragraph). The simultaneous application of row 7 data to the Y-input of the format generator through R1080 raises the decimal point so it appears between the displayed characters.

When decimal-point data is encoded, the crt is unblanked so a readout display is presented. However, since row 7 does not activate any of the five character generators, the crt beam is not deflected but instead remains in a fixed position to display a decimal point between the character along the bottom line of the readout word. After the decimal point is produced in the addressed location, the crt beam returns to the location indicated by the character position counter to produce the remainder of the display.

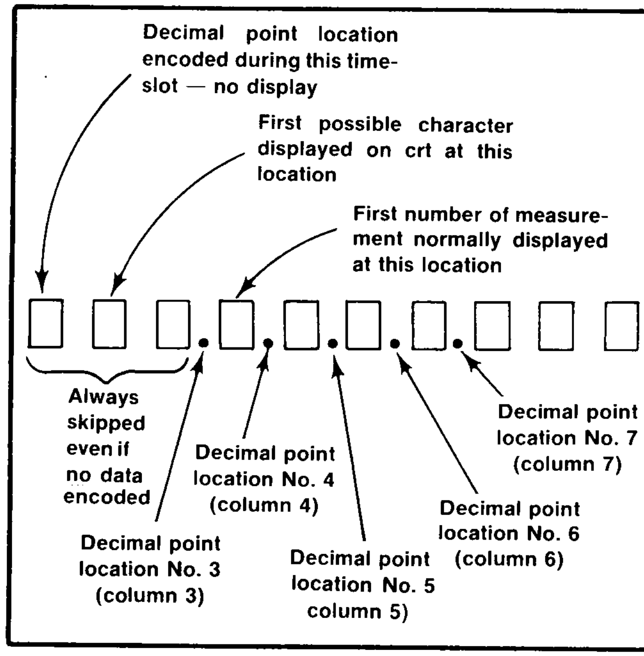


Fig. 2-9. Readout word relating 10 possible character locations to the decimal point instructions that can be encoded, and the resultant crt display.

In addition, the character position current from the decimal point logic and character position stage is added to the X (horizontal) input signal to space the characters horizontally on the crt (see previous discussion). The CH switch OFF signal at pin 13 activates this stage when a character is to be displayed on the crt. Vertical spacing adjustment, R1118, sets the separation between the upper and lower readout displays.

Format Generator

The X and Y deflection signals (produced by the character generator stage) are connected to pins 2 and 7 respectively of format generator U1100. The word address code from the word counter is also connected to pins 1, 8, and 15 of this stage. The word address code directs the format generator to add current to the X and Y signals to deflect the crt beam to the area of the crt that is associated with the plug-in channel that originated the information (see Fig. 2-1).

Y-Output Amplifier

The Y-output signal at pin 6 of U1100 is connected to the Y-output amplifier Q1100. This stage provides a low impedance load for the format generator while providing isolation between the readout system and the vertical amplifier.

X-Output Amplifier

The X-output amplifier Q1110 operates similarly to the Y-output amplifier. It provides the horizontal deflection from the readout signal available at pin 4 of U1100. Horizontal position is controlled by R1110, which changes the emitter current of Q1110.

Horizontal channel switch U1130 normally passes signals from the horizontal plug-in connector to the horizontal amplifier with unity gain. When the CH switch OFF signal is generated by timer U1000, U1130 provides the horizontal readout signal for the horizontal plug-in connector signal.

MAINTENANCE INFORMATION

Maintenance and Repair information in this section applies to all instruments in the 5400-series oscilloscope system, including display units and plug-ins.

Preventive maintenance (consisting of cleaning, visual inspection, and correction of obvious abnormalities), performed on a regular basis, will maintain the reliability of the oscilloscope. Periodic checks of the semiconductor devices used in the system are not recommended as a preventive maintenance measure. See semiconductor-checking information given under troubleshooting. A convenient time to perform preventive maintenance is preceding instrument adjustments.

Cleaning

CAUTION

Avoid the use of chemical cleaning agents which might damage plastic parts. Avoid chemicals containing benzene, toluene, xylene, acetone, or similar solvents.

Exterior. Loose dust may be removed with a soft cloth or a dry brush. Water and mild detergent may be used; however, abrasive cleaners should not be used.

Interior. Cleaning the interior of the unit should precede adjustment, since the cleaning process can alter the settings of the adjustments. Use low-velocity compressed air to blow off the accumulated dust. Hardened dirt can be removed with a soft, dry brush, a cotton-tipped swab, or a cloth dampened with a water and mild detergent solution.

Adjustment

To ensure accurate measurements, the performance of individual units composing the 5400-series oscilloscope should be checked every 2000 hours of operation, or every six months if used infrequently. Complete adjustment instructions are given in the manual for each unit.

The adjustment procedure can be helpful in isolating major troubles in a unit. Moreover, minor troubles not apparent during regular operation may be revealed and corrected during adjustment.

REPAIR

Troubleshooting Aids

Diagrams. Circuit diagrams are given on foldout pages in each individual manual. The circuit number and electrical value of each component in this instrument system is shown on the diagrams (see first page with a tab for definition of the reference designators used to identify components in each unit). Each main circuit is assigned a series of component numbers. The portions of the circuits mounted on circuit boards are enclosed with blue lines.

Cam Switch Contact Identification. Cam switches shown on the diagrams are coded to indicate the position of the contact in the complete switch assembly, counting from the front (or knob end of the switch) toward the rear. The contact closure chart given on the diagrams indicates when each contact is closed.

Circuit Boards. Illustrations of the circuit boards are shown on the foldouts. These pictures are located near their respective associated schematic diagrams to aid in cross-reference between the diagrams and the circuit board illustrations. Each electrical component on the boards is identified by its circuit number. The circuit boards are also outlined on the diagrams with a blue line that shows which portions of the circuit are located on a circuit board.

Component and Wiring Color Code. Colored stripes or dots on resistors and capacitors signify electrical values, tolerances, etc., according to the EIA standard color code. Components not color-coded usually have the value printed on the body.

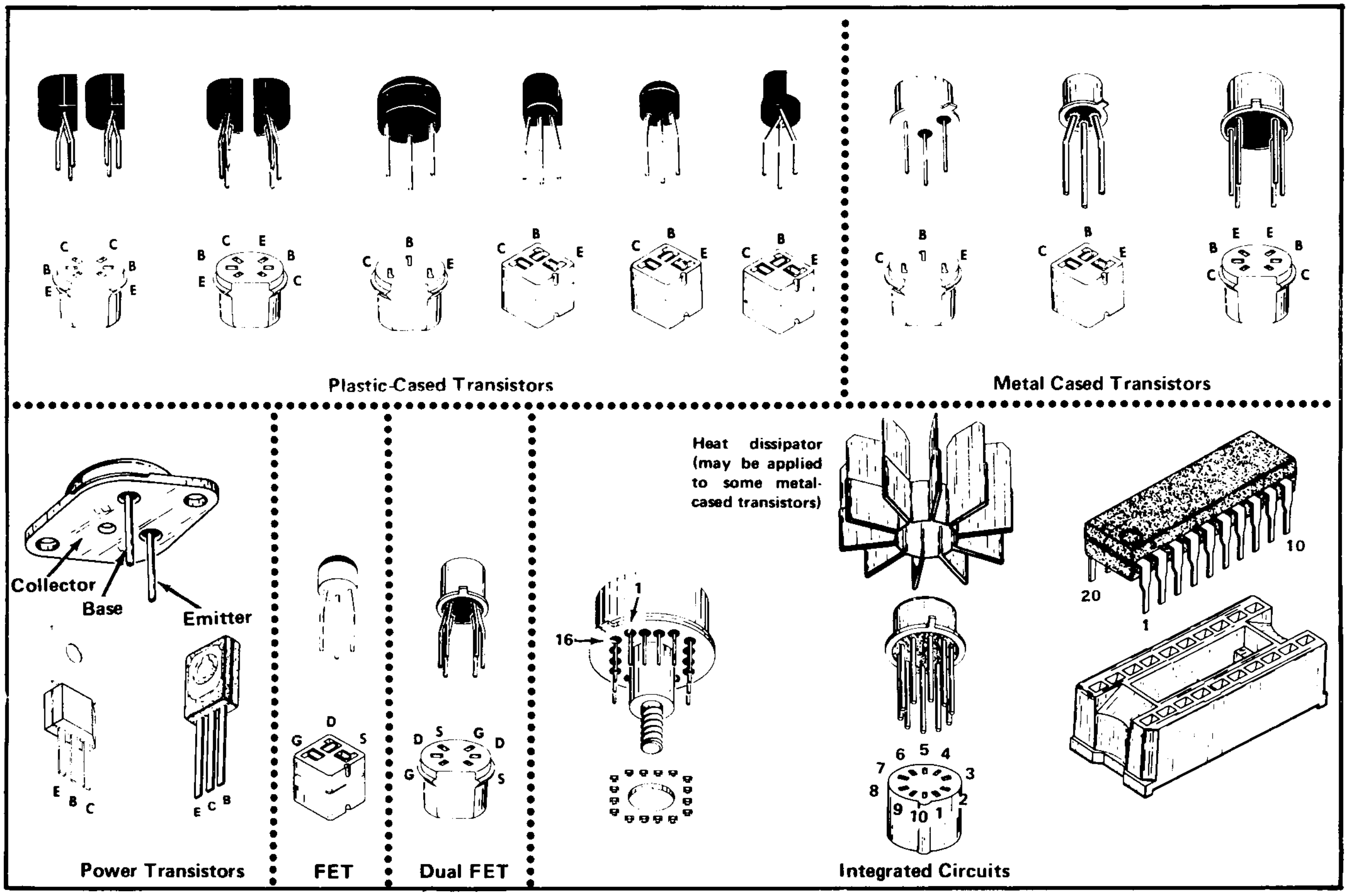


Fig. 3-1. Electrode configuration data for semiconductor devices.

WARNING

This color code applies to leads within the 5400-series oscilloscope system only. Color code of the ac power cord is:

Black	*Line*
White	*Neutral*
Green with a yellow stripe	*Safety Earth (ground)*

Semiconductor Lead Configuration. Fig. 3-1 shows the lead configuration for most of the semiconductor devices used in this system.

Multi-Connector Holders. The multi-connector holder is keyed with two triangles, one on the holder and one on the circuit board. When a connection is made perpendicular to a circuit board surface, the orientation of the triangle and the slot numbers on the connector holder is determined by the direction of the nomenclature marking (see Fig. 3-2).

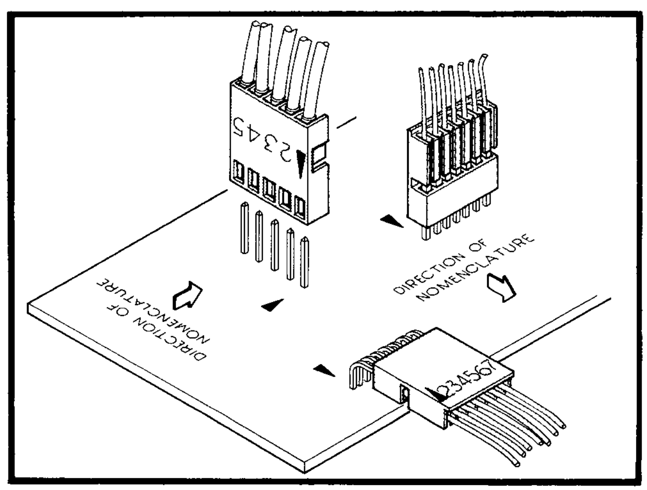


Fig. 3-2. Multi-connector holder orientation.

Troubleshooting Equipment

The following equipment is useful for troubleshooting the 5400-series oscilloscope and its plug-in units:

Semiconductor Tester

Description: Dynamic-type tester.

Purpose: To test the semiconductors used in this instrument system.

Recommended type: Tektronix 576 Transistor Curve Tracer, or equivalent.

Multimeter

Description: Digital Multimeter or 10-megohm input impedance and at least 0 to ±300 volts range (ac and dc); 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 system.

Recommended type: Tektronix DM501 Digital Multimeter and TM501 Power Module, or equivalent.

NOTE

A 20,000 ohms/volt VOM can be used to check the voltages in this instrument if allowances are made for the circuit loading of the VOM at high-impedance points.

Test Oscilloscope

Description: Frequency response, dc to 50 megahertz minimum; deflection factor, 1 millivolt/division to 5 volts/division. A 10X, 10-megohm voltage probe should be used to reduce circuit loading for voltage measurements.

Purpose: To check operating waveforms in this instrument system.

Recommended type: Tektronix 5403, D40, 5A48, and 5B42 Oscilloscope System, or equivalent.

Troubleshooting Techniques

This troubleshooting procedure is arranged in an order that checks the simple trouble possibilities before proceeding with extensive troubleshooting. When a defective component is located, it should be replaced, following the replacement procedure given under Component Replacement.

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 the operating instructions for the instrument involved.

2. Check System and Associated Equipment. Before proceeding with troubleshooting of the 5400 system, check that the instruments in the system are operating correctly. Check for proper interconnection between the display unit and power supply/amplifier unit. Check that the signal is properly connected and that the interconnecting cables or signal source are not defective. Also, check the power source. The associated plug-in units can be checked for proper operation by substituting other units that are known to be operating properly, (preferably of the same types), or by interchanging plug-in units within the 5443. If the trouble persists after substitution, the oscilloscope mainframe is probably at fault.

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

4. Check Instrument Adjustment. Check the adjustment of the 5400-series oscilloscope and its associated plug-ins, or check the affected circuit if the trouble appears in one circuit. The apparent trouble may only be a result of misadjustment. Complete adjustment instructions are given in the Service Information section for each instrument in the system.

5. Isolate the Trouble to a Circuit. To isolate trouble to a particular circuit, note the trouble symptom. The symptom often identifies the circuit in which the trouble is located. For example, poor focus indicates that the crt circuit (includes high-voltage supplies) is probably at fault. When trouble symptoms appear in more than one circuit, check affected circuits by taking voltage and waveform readings.

In some cases where the left and right beam circuitry is identical, it is possible to apply the same signal to each beam and check the working beam against the defective beam.

Incorrect operation of all circuits often indicates trouble in the power supply. Check first for correct voltages of the individual supplies. 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 3-1 lists the tolerances of the power supplies in this instrument. These voltages are measured between the power-supply test points and ground on the Power Supply circuit board (see the adjustments LV Power Supply Circuit Board foldout page in this manual for test point locations). If a power-supply voltage is within the listed tolerance, the supply can be assumed to be working correctly. If outside the tolerance, the supply may be misadjusted or operating incorrectly. Use the procedure given in the adjustment procedure to adjust the power supplies.

TABLE 3-1

Power Supply Tolerances

Power Supply	Tolerance	Typical Ripple
200 V	+180 V to +240 V	2 V or less
+30 V	+29.925 V to +30.075 V	2 mV or less
+15 V	+14.85 V to +15.15 V	2 mV or less
+5 V	+4.9 V to +5.1 V	2 mV or less
−15 V	−14.85 V to −15.15 V	2 mV or less
−30 V	−29.925 V to −30.075 V	2 mV or less

6. Check Voltages and Waveforms. Often the defective component can be located by checking for the correct voltage or waveform in the circuit.

7. Check Individual Components. The following methods are provided for checking the individual components in the 5400-series instrument system. Passive components that are soldered in place are best checked by disconnecting one end, isolating the measurement from the effects of surrounding circuitry.

CAUTION

The POWER switch must be turned off before removing or replacing components, including semiconductors.

a. Transistors and Integrated Circuits. A good check of transistor operation is actual performance under operating conditions. A transistor can most effectively be checked by substituting a new component for it (or one which has been checked previously). However, be sure that circuit conditions are not such that a replacement transistor might also be damaged. If substitute transistors are not available, use a dynamic tester. Static-type testers are not recommended, since they do not check operation under simulated operating conditions. A desoldering tool must be used to remove soldered-in transistors; see component replacement procedure for details.

Integrated circuits can be checked with a voltmeter, test oscilloscope, or by direct substitution. A good understanding of the circuit description is essential to troubleshooting circuits using IC:s. Operating waveforms, logic levels, and other operating information for the IC:s are given in the Theory Of Operation section of the appropriate manual. 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 in-line IC:s is with an integrated-circuit test clip. This device also doubles as an extraction tool.

b. Diodes. A diode can be checked for an open or shorted condition by measuring the resistance between terminals. With the ohmmeter set to the R X 1 k scale to limit the current, the resistance should be very high in one direction and very low when the leads are reversed.

CAUTION

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

c. Resistors. Check the resistors with an ohmmeter. Resistor tolerance is given in the Electrical Parts List. Resistors normally do not need to be replaced unless the measured value varies widely from the specified value.

d. Capacitors. A leaky or shorted capacitor can be detected by checking its resistance with an ohmmeter on the highest scale. Use an ohmmeter that does not exceed the voltage rating of the capacitor. The resistance reading should be high after initital charge of the capacitor. An open capacitor can best be detected with a capacitance meter, or by checking whether the capacitor passes ac signals.

8. Repair and Readjust the Circuit. Special techniques required to replace the components in this unit are given under Component Replacement. Be sure to check the performance of any circuit that has been repaired or that has had any electrical components replaced. Adjustment of the affected circuit may be necessary.

Component Replacement

The exploded-view drawings associated with the mechanical parts list (foldout pages) may be helpful when disassembling or re-assembling individual components or sub-assemblies.

Circuit Board Replacement. If a circuit board is damaged beyond repair, the entire assembly (including all soldered-on components) can be replaced. Part numbers are given in the mechanical parts lists for the completely wired board.

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 example, the H.V. in the display module). 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 positioned, the pin connectors may be damaged.

Transistor and Integrated Circuit Replacement. Transistors and IC's should not be replaced unless they are actually defective. If removed from their sockets during routine maintenance, return them to their original sockets. Unnecessary replacement or switching of semiconductor devices may affect the instrument adjustment. When a transistor is replaced, check the operation of the part of the instrument that may be affected.

CAUTION

The POWER switch must be turned off before removing or replacing semiconductors.

Replacement semiconductors should be of the original type or a direct replacement. Fig. 3-1 shows the lead configuration of the semiconductors used in this instrument system. When removing soldered-in transistors, use a de-soldering tool to remove the solder from the holes in the circuit board.

To prevent damage to the pins, an extracting tool should be used to remove the 14- and 16-pin integrated circuits from their sockets. This tool is available from Tektronix, Inc. Order Tektronix Part No. 003-0619-00. If an extracting tool is not available, use care to avoid damaging the pins. Pull slowly and evenly on both ends of the IC. Try to avoid having one end of the IC disengage from the socket before the other end.

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 or the screw in the metal clamp that clamps the transistor to the chassis. Remove the defective transistor. When replacing the transistor, use silicone grease on both sides of the insulator plate and on the metal tab (if the transistor has one) to increase heat transfer from the transistor the chassis.

Interconnecting Pin Replacement. To replace a pin that is mounted on a circuit board, first disconnect any pin connectors. Then, unsolder the damaged pin and pull it out of the board with a pair of pliers. Be careful not to damage the wiring on the board with too much heat. Ream out the hole in the circuit board with a 0.031-inch drill. Remove the ferrule from the new interconnecting pin and press the new pin into the hole in the circuit board. Position the pin in the same manner as the old pin. If the old pin was bent at an angle to mate with a connector, bend the new pin to match the associated pins.

NOTE

A pin replacement kit including necessary tools, instructions, and replacement pins is available from Tektronix, Inc. Order Tektronix Part No. 040-0542-00.

Switch Replacement. The following special maintenance information is provided for the cam switches and pushbutton switches used in this instrument system.

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.

1. CAM SWITCHES

Two cam switch repair kits are available, they are: Cam Switch Repair Kit, Tektronix Part No. 040-0541-00; High Frequency Cam Switch Repair Kit, Tektronix Part No. 003-0708-00.

The first kit (Part No. 040-0541-00) is used to repair the cam switches in most time-base plug-in units and some vertical plug-in units. The second kit (Part No. 003-0708-00) is used to repair the cam switches using the high-frequency contact, which is used in several vertical plug-in units.

The cam switches consist of a rotating drum with lobes that actuate spring-leaf contacts. The drum position is controlled through front-panel knobs.

The following instructions have been generalized to fit all instruments. Detailed instructions for cam switch repair (where required) will be found in the appropriate manual.

a. Remove any shields, switch shafts, interfering wires, components, or circuit boards that prevent access to the circuit board with the bad cam switch contact.

NOTE

Cam switch bearing blocks that attach to more than one circuit board should not be separated from both boards during disassembly, unless absolutely necessary, as proper bearing alignment will be difficult.

b. Completely remove from the instrument the circuit board having the defective cam switch contact.

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

d. To reassemble the instrument, reverse the disassembly procedure.

2. PUSHBUTTON SWITCHES

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

Cathode-Ray Tube Replacement. The following procedure outlines the removal and replacement of the cathode-ray tube. Refer to Figs. 3-3 and 3-4.

WARNING

Use care when handling a crt. Protective clothing and safety glasses should be worn. Avoid striking it on any object that might cause it to crack or implode. When storing a crt, place it in a protective carton or set it face down on a smooth surface in a protected location with a soft mat under the faceplate to protect it from scratches.

1. REMOVAL

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

b. Disconnect deflection leads from the crt neck pin receptacles.

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.

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

d. Remove the crt base socket.

e. With one hand on the crt faceplate, push on the crt base. Slide the crt forward until the crt anode plug is disconnected. Pull the crt out of the instrument from the front.

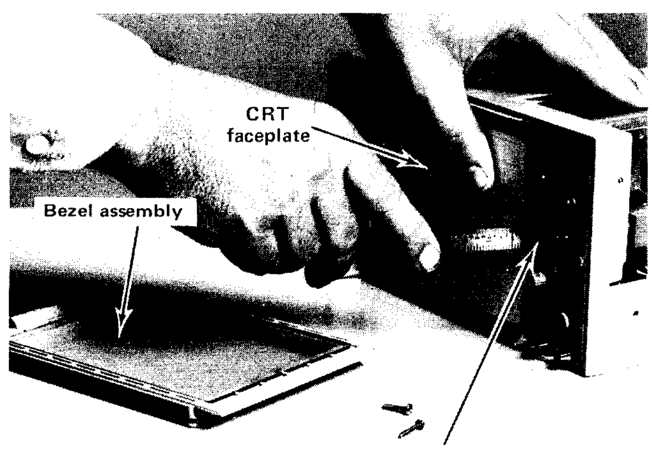


Fig. 3-3. Illustration showing equipment and method used to correctly align light reflector with crt faceplate.

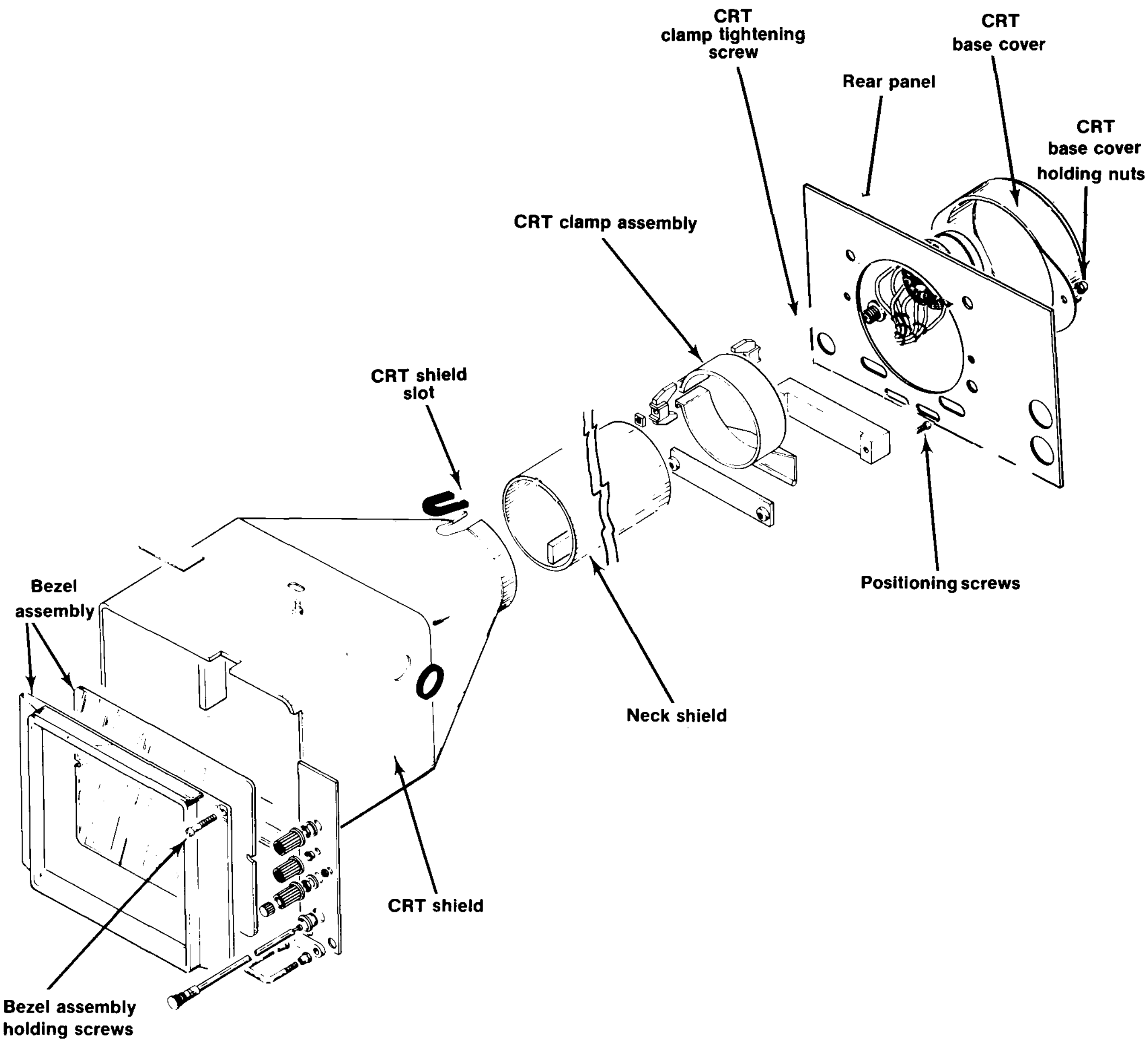


Fig. 3-4. Illustration showing location of crt mounting hardware described in crt replacement instructions.

2. REPLACEMENT

a. Make sure the soft plastic crt faceplate supports are in place, then insert the crt into the shield. Before the crt is completely inserted, reconnect the anode plug and place the steel rulers for the light reflector alignment, see Fig. 3-3.

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

c. Position the rear of the crt (socket end) so that there is no tilt of the faceplate in relation to the bezel assembly, then tighten the positioning screws. Check that the crt neck deflection pin receptacles are centered in the neck shield cutout.

d. Place the crt base socket onto the crt base pins. Replace the crt base cover on the rear panel. Connect the deflection leads to the crt neck pins.

e. Replacing the crt will require partial instrument adjustment. Refer to the Service Information section of the display unit manual.

Bulb Replacement.

1. 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.

a. Remove the light shield.

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

c. Replace the light shield.

2. To replace the graticule lights, proceed as follows:

a. Remove the control knobs and nuts that hold the front-panel circuit board to the display unit front-panel.

b. Unplug the wires going to the board and remove the board from the display unit.

c. Replace the burned out light(s).

d. Remove the crt bezel assembly and disconnect the crt neck pins. Remove the crt base cover on the display unit rear-panel, then push the crt forward until its faceplate is about one-half inch out of the instrument.

e. Install the front-panel circuit board, replacing all nuts and knobs.

f. Install the crt into display unit using CRT Replacement instructions.

Power Transformer Replacement. Replace the power transformer only with a direct replacement Tektronix transformer. After the transformer has been replaced, check the power supply output voltages as outlined in the Service Information section of this manual. Also, check the crt operation as outlined in the Service Information section of the display unit manual.

Fuse Replacement. Table 3-2 gives the rating, location, and function of the fuses used in this instrument system.

TABLE 3-2

Circuit Number	Rating	Function	Location
F300	120 VAC, 1.6 A Slow 220 VAC, 1.0 A Slow	Line-Voltage Input	Display unit rear panel
F800	0.25 A Fast	+200 V Unreg supply	5443 L.V. Power Supply board
F410	0.5 A Slow	+38 V Unreg supply	Display Unit H.V. Power Supply board

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

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

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

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

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

SPECIAL NOTES AND SYMBOLS

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

ITEM NAME

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

ABBREVIATIONS

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

CROSS INDEX MFR. CODE NUMBER TO MANUFACTURER

MFR.CODE	MANUFACTURER	ADDRESS	CITY,STATE,ZIP
01121	ALLEN-BRADLEY CO.	1201 2ND ST. SOUTH	MILWAUKEE, WI 53204
02735	RCA CORP., SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
03508	GENERAL ELECTRIC CO., SEMI-CONDUCTOR PRODUCTS DEPT.	ELECTRONICS PARK	SYRACUSE, NY 13201
04713	MOTOROLA, INC., SEMICONDUCTOR PRODUCTS DIV.	5005 E. MCDOWELL RD.	PHOENIX, AZ 85036
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS ST.	MOUNTAIN VIEW, CA 94042
07910	TELEDYNE SEMICONDUCTOR	12515 CHADRON AVE.	HAWTHORNE, CA 90250
12040	NATIONAL SEMICONDUCTOR CORP.	COMMERCE DRIVE	DANBURY, CT 06810
50157	N. L. INDUSTRIES, INC., ELECTRONICS DEPT.	P. O. BOX 787	MUSKEGON, MI 49443
56289	SPRAGUE ELECTRIC CO.		NORTH ADAMS, MA 01247
63743	WARD LEONARD ELECTRIC CO., INC.	31 SOUTH ST.	MOUNT VERNON, NY 10550
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71450	CTS CORP.	1142 W. BEARDSLEY AVE.	ELKHART, IN 46514
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BlVD.	FULLERTON, CA 92634
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
80009	TEKTRONIX, INC.	P. O. BOX 500	BEAVERTON, OR 97077
81483	INTERNATIONAL RECTIFIER CORP.	9220 SUNSET BlVD.	LOS ANGELES, CA 90069
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY CO., INC.	3029 E. WASHINGTON ST.	INDIANAPOLIS, IN 46206
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NB 68601
95238	CONTINENTAL CONNECTOR CORP.	34-63 56TH ST.	WOODSIDE, NY 11377

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-3165-00			CKT BOARD ASSY:INTERFACE	80009	670-3165-00
A2	670-3713-00			CKT BOARD ASSY:POWER SUPPLY	80009	670-3713-00
A3	670-2413-00			CKT BOARD ASSY:READOUT	80009	670-2413-00
C618	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	72982	301-000X5P0331K
C619	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	72982	301-000X5P0331K
C621	283-0023-00			CAP.,FXD,CER DI:0.1UF,+80-20%,10V	56289	20C374
C630	283-0023-00			CAP.,FXD,CER DI:0.1UF,+80-20%,10V	56289	20C374
C635	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C640	283-0023-00			CAP.,FXD,CER DI:0.1UF,+80-20%,10V	56289	20C374
C646	281-0604-00			CAP.,FXD,CER DI:2.2PF,+/-0.25PF,500V	72982	301-000C0J0229C
C656	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C658	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020NLF
C675	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020NLF
C681	283-0023-00			CAP.,FXD,CER DI:0.1UF,+80-20%,10V	56289	20C374
C690	281-0503-00			CAP.,FXD,CER DI:8PF,+/-0.5PF,500V	72982	301-000C0H0809D
C711	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C712	283-0023-00			CAP.,FXD,CER DI:0.1UF,+80-20%,10V	56289	20C374
C715	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	72982	301-000X5P0331K
C720	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	72982	301-000X5P0331K
C730	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020NLF
C731	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C733	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020NLF
C735	281-0604-00			CAP.,FXD,CER DI:2.2PF,+/-0.25PF,500V	72982	301-000C0J0229C
C750	281-0605-00			CAP.,FXD,CER DI:200PF,10%,500V	72982	301-000Y5D0201K
C760	281-0605-00			CAP.,FXD,CER DI:200PF,10%,500V	72982	301-000Y5D0201K
C761	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C775	281-0662-00			CAP.,FXD,CER DI:10PF,+/-0.5PF,500V	72982	301-000H3M0100D
C776	281-0629-00			CAP.,FXD,CER DI:33PF,5%,600V	72982	308-000COG0330G
C800	290-0587-00			CAP.,FXD,ELCTLT:165UF,-10%+5%,275V	56289	68D10496
C820	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C821	283-0167-00			CAP.,FXD,CER DI:0.1UF,10%,100V	72982	8131N147W5R104K
C825	290-0535-00			CAP.,FXD,ELCTLT:33UF,20%,10V	56289	196D336X0010KA1
C834	281-0501-00			CAP.,FXD,CER DI:4.7PF,+/-1PF,500V	72982	301-000S2H0479F
C836	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C845	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C848	290-0645-00			CAP.,FXD,ELCTLT:10,000UF,+100-10%	56289	68D10548
C850	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020NLF
C860	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C867	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C871	281-0580-00			CAP.,FXD,CER DI:470PF,10%,500V	72982	301-000Z5D0471K
C875	290-0636-00			CAP.,FXD,ELCTLT:7,500UF,+100-10%,25V	56289	68D10501
C876	290-0636-00			CAP.,FXD,ELCTLT:7,500UF,+100-10%,25V	56289	68D10501
C880	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020NLF
C890	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C897	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C901	281-0623-00			CAP.,FXD,CER DI:650PF,5%,500V	72982	301-000Y5D0651J
C910	290-0528-00			CAP.,FXD,ELCTLT:15UF,20%,50V	90201	TDC156M050WLC
C920	283-0010-00			CAP.,FXD,CER DI:0.05UF,+100-20%,50V	56289	273C20
C925	281-0589-00			CAP.,FXD,CER DI:170PF,5%,500V	72982	301-057Z5D0171J
C930	290-0637-00			CAP.,FXD,ELCTLT:500UF,+75-10%,50V	56289	68D10527
C932	290-0637-00			CAP.,FXD,ELCTLT:500UF,+75-10%,50V	56289	68D10527
C935	285-0629-00			CAP.,FXD,PLSTC:0.047UF,20%,100V	56289	410P47301
C944	290-0528-00			CAP.,FXD,ELCTLT:15UF,20%,50V	90201	TDC156M050WLC

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C948	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-547E103Z
C950	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C953	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-000C0G0100F
C955	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	72982	301-000X5P0331K
C981	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C982	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C984	281-0549-00			CAP.,FXD,CER DI:68PF,10%,500V	72982	301-000U2J0680K
C1010	283-0103-00			CAP.,FXD,CER DI:180PF,5%,500V	56289	40C638
C1021	285-0698-00			CAP.,FXD,PLSTC:0.0082UF,5%,100V	56289	410P82251
C1024	281-0511-00			CAP.,FXD,CER DI:22PF,+/-2.2PF,500V	72982	301-000C0G0220K
C1027	281-0501-00			CAP.,FXD,CER DI:4.7PF,+/-1PF,500V	72982	301-000S2H0479F
C1032	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	72982	301-000X5U0471M
C1041	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	72982	301-000X5U0471M
C1065	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C1073	283-0095-00			CAP.,FXD,CER DI:56PF,10%,200V	72982	855-535A560K
C1080	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C1083	283-0110-00			CAP.,FXD,CER DI:0.005UF,+80-20%,150V	56289	19C242B
C1100	283-0110-00			CAP.,FXD,CER DI:0.005UF,+80-20%,150V	56289	19C242B
C1120	283-0116-00			CAP.,FXD,CER DI:820PF,5%,500V	72982	801-547B821J
C1134	281-0541-00			CAP.,FXD,CER DI:6.8PF,10%,500V	72982	301-000C0H0689D
C1140	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C1150	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C1180	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C1181	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C1182	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C1800	283-0023-00			CAP.,FXD,CER DI:0.1UF,+80-20%,10V	56289	20C374
CR670	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR754	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR761	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR765	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR766	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR770	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR771	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR775	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR776	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR780	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR781	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR783	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR784	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR786	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR787	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR800	152-0107-00			SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00
CR801	152-0107-00			SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00
CR802	152-0107-00			SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00
CR803	152-0107-00			SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00
CR820	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	02735	37304
CR821	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR825	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	02735	37304
CR832	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR838	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR839	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR848	152-0556-00			SEMICOND DEVICE:BRIDGE,50V,2.5A	04713	MDA960-1

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CR850	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	02735	37304
CR851	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	02735	37304
CR863	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR864	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR875	152-0556-00			SEMICOND DEVICE:BRIDGE,50V,2.5A	04713	MDA960-1
CR880	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	02735	37304
CR881	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	02735	37304
CR893	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR894	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR903	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR910	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	02735	37304
CR911	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	02735	37304
CR925	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR927	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR930	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	80009	152-0488-00
CR944	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	02735	37304
CR950	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR955	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR980	152-0107-00			SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00
CR981	152-0107-00			SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00
CR982	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR986	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1002	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1003	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1005	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1010	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1012	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1013	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1018	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1024	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1025	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1040	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1041	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1052	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1825	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1834	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1835	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1845	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
F800[1]	159-0019-00			FUSE,CARTRIDGE:3AG,1A,250V,20SEC	71400	MDL1
F800	159-0028-00			FUSE,CARTRIDGE:3AG,0.25A,250V,FAST-BLOW	71400	AGC1-4
J610	131-1078-00			CONNECTOR,RCPT,:28/56 CONTACT	95238	K600-11-56Y25
J620	131-1078-00			CONNECTOR,RCPT,:28/56 CONTACT	95238	K600-11-56Y25
J630	131-1078-00			CONNECTOR,RCPT,:28/56 CONTACT	95238	K600-11-56Y25
LR1100	108-0212-00			COIL,RF:0.5UH	80009	108-0212-00
Q600	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q605	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q610	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q615	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q645	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q650	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q655	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00

[1]For export use only.

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Q660	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q665	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q670	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q700	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q710	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q715	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q720	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q730	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q735	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q740	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q745	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q750	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q760	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q820	151-0405-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE800	04713	SJE943
Q824	151-0342-00			TRANSISTOR:SILICON,PNP	07263	2N4249
Q830	151-0188-00			TRANSISTOR:SILICON,PNP	04713	2N3906
Q832	151-0341-00			TRANSISTOR:SILICON,NPN	07263	2N3565
Q838	151-0342-00			TRANSISTOR:SILICON,PNP	07263	2N4249
Q850	151-0405-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE800	04713	SJE943
Q855	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q864	151-0341-00			TRANSISTOR:SILICON,NPN	07263	2N3565
Q866	151-0341-00			TRANSISTOR:SILICON,NPN	07263	2N3565
Q870	151-0341-00			TRANSISTOR:SILICON,NPN	07263	2N3565
Q880	151-0405-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE800	04713	SJE943
Q885	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q894	151-0342-00			TRANSISTOR:SILICON,PNP	07263	2N4249
Q896	151-0342-00			TRANSISTOR:SILICON,PNP	07263	2N4249
Q900	151-0341-00			TRANSISTOR:SILICON,NPN	07263	2N3565
Q910	151-0496-00			TRANSISTOR:SILICON,NPN	03508	D40K2
Q915	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q925	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q940	151-0496-00			TRANSISTOR:SILICON,NPN	03508	D40K2
Q950	151-0342-00			TRANSISTOR:SILICON,PNP	07263	2N4249
Q955	151-0342-00			TRANSISTOR:SILICON,PNP	07263	2N4249
Q958	151-0341-00			TRANSISTOR:SILICON,NPN	07263	2N3565
Q982	151-0341-00			TRANSISTOR:SILICON,NPN	07263	2N3565
Q984	151-0341-00			TRANSISTOR:SILICON,NPN	07263	2N3565
Q1010	151-0410-00			TRANSISTOR:SILICON,PNP	04713	SPS6765
Q1015	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q1018	151-0221-00			TRANSISTOR:SILICON,PNP	80009	151-0221-00
Q1040A,B	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	12040	NS7348
Q1048	151-0341-00			TRANSISTOR:SILICON,NPN	07263	2N3565
Q1050	151-0341-00			TRANSISTOR:SILICON,NPN	07263	2N3565
Q1052	151-0410-00			TRANSISTOR:SILICON,PNP	04713	SPS6765
Q1056	151-0341-00			TRANSISTOR:SILICON,NPN	07263	2N3565
Q1100	151-0410-00			TRANSISTOR:SILICON,PNP	04713	SPS6765
Q1110	151-0410-00			TRANSISTOR:SILICON,PNP	04713	SPS6765
Q1140, Q1150	153-0597-00			SEMICOND DVC SE:SILICON,PNP	80009	153-0597-00
Q1800	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q1805	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	80009	151-0333-00
Q1810	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	80009	151-0333-00
Q1815	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00

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Q1820	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q1825	151-0188-00			TRANSISTOR:SILICON,PNP	04713	2N3906
Q1850	151-0188-00			TRANSISTOR:SILICON,PNP	04713	2N3906
Q1860	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q1865	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	80009	151-0333-00
Q1875	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	80009	151-0333-00
Q1880	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
R600	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R602	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R603	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R605	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R607	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R609	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R610	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R612	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R613	321-0095-00			RES.,FXD,FILM:95.3 OHM,1%,0.125W	75042	CEATO-95R30F
R614	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R618	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R619	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R620	321-0114-00			RES.,FXD,FILM:150 OHM,1%,0.125W	75042	CEATO-1500F
R641	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R643	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R645	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R646	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R647	321-0177-00			RES.,FXD,FILM:681 OHM,1%,0.125W	75042	CEATO-6810F
R649	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R650	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R652	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R653	321-0146-00			RES.,FXD,FILM:324 OHM,1%,0.125W	75042	CEATO-3240F
R655	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R656	315-0112-00			RES.,FXD,CMPSN:1.1K OHM,5%,0.25W	01121	CB1125
R658	321-0095-00			RES.,FXD,FILM:95.3 OHM,1%,0.125W	75042	CEATO-95R30F
R659	315-0112-00			RES.,FXD,CMPSN:1.1K OHM,5%,0.25W	01121	CB1125
R665	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R666	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R667	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R669	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R670	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R671	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R672	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R675	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R677	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R679	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R680	321-0095-00			RES.,FXD,FILM:95.3 OHM,1%,0.125W	75042	CEATO-95R30F
R681	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R682	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R684	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R686	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R687	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R688	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R690	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R693	315-0390-00			RES.,FXD,CMPSN:39 OHM,5%,0.25W	01121	CB3905

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R695	315-0390-00			RES.,FXD,CMPSN:39 OHM,5%,0.25W	01121	CB3905
R700	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R702	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R705	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R706	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R708	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R710	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R712	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R714	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R715	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R718	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R720	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R722	321-0114-00			RES.,FXD,FILM:150 OHM,1%,0.125W	75042	CEATO-1500F
R730	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R731	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R732	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R734	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R735	321-0177-00			RES.,FXD,FILM:681 OHM,1%,0.125W	75042	CEATO-6810F
R736	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R738	321-0146-00			RES.,FXD,FILM:324 OHM,1%,0.125W	75042	CEATO-3240F
R739	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R740	315-0112-00			RES.,FXD,CMPSN:1.1K OHM,5%,0.25W	01121	CB1125
R741	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R742	321-0095-00			RES.,FXD,FILM:95.3 OHM,1%,0.125W	75042	CEATO-95R30F
R744	315-0112-00			RES.,FXD,CMPSN:1.1K OHM,5%,0.25W	01121	CB1125
R745	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R746	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R748	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R750	321-0357-00			RES.,FXD,FILM:51.1K OHM,1%,0.125W	75042	CEATO-5112F
R752	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R753	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R754	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R756	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W	75042	CEATO-4992F
R760	321-0357-00			RES.,FXD,FILM:51.1K OHM,1%,0.125W	75042	CEATO-5112F
R761	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R763	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R765	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W	75042	CEATO-4992F
R768	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R770	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R775	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R776	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R777	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R780	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R781	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R800	302-0150-00			RES.,FXD,CMPSN:15 OHM,10%,0.50W	01121	EB1501
R802	304-0683-00			RES.,FXD,CMPSN:68K OHM,10%,1W	01121	GB6831
R820	316-0471-00			RES.,FXD,CMPSN:470 OHM,10%,0.25W	01121	CB4711
R822	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R823	315-0150-00			RES.,FXD,CMPSN:15 OHM,5%,0.25W	01121	CB1505
R824	316-0271-00			RES.,FXD,CMPSN:270 OHM,10%,0.25W	01121	CB2711
R827	308-0742-00			RES.,FXD,WW:0.24 OHM,5%,2W	75042	BWH-R2400J
R829	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R832	316-0271-00			RES.,FXD,CMPSN:270 OHM,10%,0.25W	01121	CB2711

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R833	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R834	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R836	316-0682-00			RES.,FXD,CMPSN:6.8K OHM,10%,0.25W	01121	CB6821
R838	316-0682-00			RES.,FXD,CMPSN:6.8K OHM,10%,0.25W	01121	CB6821
R839	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R840	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R842	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R845	321-0764-01			RES.,FXD,FILM:5.09K OHM,0.5%,0.125W	75042	CEAT0-5091D
R846	321-0685-00			RES.,FXD,FILM:30K OHM,0.5%,0.125W	75042	CEAT2-3002D
R850	307-0405-00			RES.,FXD,FILM:82 OHM,5%,7W	91637	FP34G82R00J
R851	308-0679-00			RES.,FXD,WW:0.51 OHM,5%,2W	75042	BWH-R5100J
R853	316-0470-00			RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701
R855	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R856	316-0153-00			RES.,FXD,CMPSN:15K OHM,10%,0.25W	01121	CB1531
R860	321-0816-03			RES.,FXD,FILM:5K OHM,0.25%,0.125W	75042	CEAT2-5KC
R861	321-0289-03			RES.,FXD,FILM:10K OHM,0.25%,0.125W	75042	CEAT2-1002C
R863	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R866	315-0113-00			RES.,FXD,CMPSN:11K OHM,5%,0.25W	01121	CB1135
R867	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R870	316-0392-00			RES.,FXD,CMPSN:3.9K OHM,10%,025W	01121	CB3921
R871	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R873	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R880	307-0404-00			RES.,FXD,FILM:51 OHM,5%,10W	91637	FP35G51R00J
R881	308-0679-00			RES.,FXD,WW:0.51 OHM,5%,2W	75042	BWH-R5100J
R883	316-0470-00			RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701
R885	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R886	316-0153-00			RES.,FXD,CMPSN:15K OHM,10%,0.25W	01121	CB1531
R890	321-0816-03			RES.,FXD,FILM:5K OHM,0.25%,0.125W	75042	CEAT2-5KC
R891	321-0289-03			RES.,FXD,FILM:10K OHM,0.25%,0.125W	75042	CEAT2-1002C
R893	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R896	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R897	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R900	316-0392-00			RES.,FXD,CMPSN:3.9K OHM,10%,025W	01121	CB3921
R901	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R903	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R910	308-0365-00			RES.,FXD,WW:1.5 OHM,5%,3W	56289	RS28-D1R5D0J
R911	308-0078-00			RES.,FXD,WW:70 OHM,5%,5W	63743	7686
R913	316-0391-00			RES.,FXD,CMPSN:390 OHM,10%,0.25W	01121	CB3911
R915	316-0153-00			RES.,FXD,CMPSN:15K OHM,10%,0.25W	01121	CB1531
R917	321-0268-00			RES.,FXD,FILM:6.04K OHM,1%,0.125W	75042	CEAT0-6041F
R920	311-1120-00			RES.,VAR,NONWIR:100 OHM,30%,0.25W	71450	U201R101B
R922	321-0268-00			RES.,FXD,FILM:6.04K OHM,1%,0.125W	75042	CEAT0-6041F
R924	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R925	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R927	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R929	316-0823-00			RES.,FXD,CMPSN:82K OHM,10%,0.25W	01121	CB8231
R930	302-0333-00			RES.,FXD,CMPSN:33K OHM,10%,0.50W	01121	EB3331
R935	316-0104-00			RES.,FXD,CMPSN:100K OHM,10%,0.25W	01121	CB1041
R936	316-0473-00			RES.,FXD,CMPSN:47K OHM,10%,0.25W	01121	CB4731
R937	316-0183-00			RES.,FXD,CMPSN:18K OHM,10%,0.25W	01121	CB1831
R940	308-0365-00			RES.,FXD,WW:1.5 OHM,5%,3W	56289	RS28-D1R5D0J
R942	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011

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R943	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R944	308-0078-00			RES.,FXD,WW:70 OHM,5%,5W	63743	7686
R948	321-0256-00			RES.,FXD,FILM:4.53K OHM,1%,0.125W	75042	CEATO-4531F
R949	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R950	311-1124-00			RES.,VAR,NONWIR:250 OHM,30%,0.25W	71450	U201R251B
R951	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R952	321-0202-00			RES.,FXD,FILM:1.24K OHM,1%,0.125W	75042	CEATO-1241F
R953	316-0221-00			RES.,FXD,CMPSN:220 OHM,10%,0.25W	01121	CB2211
R954	316-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R955	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R956	316-0273-00			RES.,FXD,CMPSN:27K OHM,10%,0.25W	01121	CB2731
R957	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R980	316-0272-00			RES.,FXD,CMPSN:2.7K OHM,10%,0.25W	01121	CB2721
R981	316-0562-00			RES.,FXD,CMPSN:5.6K OHM,10%,0.25W	01121	CB5621
R982	316-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R984	316-0153-00			RES.,FXD,CMPSN:15K OHM,10%,0.25W	01121	CB1531
R986	322-0686-03			RES.,FXD,FILM:7.23K,0.25%,0.125W	91637	MFF1421D72300C
R987	321-0097-03			RES.,FXD,FILM:100 OHM,0.25%,0.125%	91637	MFF1816G100R0C
R1002	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R1003	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
R1004	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1005	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R1006	311-1572-00			RES.,VAR,NONWIR:1K OHM,20%,0.5W	73138	91W-10000M
R1007	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R1010	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R1012	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R1015	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R1016	316-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R1018	316-0561-00			RES.,FXD,CMPSN:560 OHM,10%,0.25W	01121	CB5611
R1019	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R1020	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R1021	316-0393-00			RES.,FXD,CMPSN:39K OHM,10%,0.25W	01121	CB3931
R1023	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R1024	316-0391-00			RES.,FXD,CMPSN:390 OHM,10%,0.25W	01121	CB3911
R1025	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R1027	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	75042	CEATO-1003F
R1030	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R1032	321-0262-00			RES.,FXD,FILM:5.23K OHM,1%,0.125W	75042	CEATO-5231F
R1040	321-0269-00			RES.,FXD,FILM:6.19K OHM,1%,0.125W	75042	CEATO-6191F
R1041	321-0261-00			RES.,FXD,FILM:5.11K OHM,1%,0.125W	75042	CEATO-5111F
R1043	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R1044	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R1046	321-0181-00			RES.,FXD,FILM:750 OHM,1%,0.125W	75042	CEATO-7500F
R1047	321-0294-00			RES.,FXD,FILM:11.3K OHM,1%,0.125W	75042	CEATO-1132F
R1048	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	75042	CEATO-2001F
R1050	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R1052	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R1053	321-0268-00			RES.,FXD,FILM:6.04K OHM,1%,0.125W	75042	CEATO-6041F
R1056	321-0329-00			RES.,FXD,FILM:26.1K OHM,1%,0.125W	75042	CEATO-2612F
R1060	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R1062	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R1063	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R1064	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035

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R1065	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R1070	316-0561-00			RES.,FXD,CMPSN:560 OHM,10%,0.25W	01121	CB5611
R1071	316-0561-00			RES.,FXD,CMPSN:560 OHM,10%,0.25W	01121	CB5611
R1072	316-0561-00			RES.,FXD,CMPSN:560 OHM,10%,0.25W	01121	CB5611
R1073	316-0563-00			RES.,FXD,CMPSN:56K OHM,10%,0.25W	01121	CB5631
R1080	316-0823-00			RES.,FXD,CMPSN:82K OHM,10%,0.25W	01121	CB8231
R1082	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R1083	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R1084	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R1086	321-0296-00			RES.,FXD,FILM:11.8K OHM,1%,0.125W	75042	CEATO-1182F
R1088	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1092	321-0146-00			RES.,FXD,FILM:324 OHM,1%,0.125W	75042	CEATO-3240F
R1093	321-0250-00			RES.,FXD,FILM:3.92K OHM,1%,0.125W	75042	CEATO-3921F
R1095	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R1097	321-0207-00			RES.,FXD,FILM:1.4K OHM,1%,0.125W	75042	CEATO-1401F
R1098	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	75042	CEATO-2001F
R1101	321-0167-00			RES.,FXD,FILM:536 OHM,1%,0.125W	75042	CEATO-5360F
R1103	321-0255-00			RES.,FXD,FILM:4.42K OHM,1%,0.125W	75042	CEATO-4421F
R1105	321-0230-00			RES.,FXD,FILM:2.43K OHM,1%,0.125W	75042	CEATO-2431F
R1106	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R1110	311-1571-00			RES.,VAR,NONWIR:50 OHM,20%,0.5W	73138	91W-500ROM
R1111	316-0681-00			RES.,FXD,CMPSN:680 OHM,10%,0.25W	01121	CB6811
R1113	321-0125-00			RES.,FXD,FILM:196 OHM,1%,0.125W	75042	CEATO-1960F
R1115	321-0242-00			RES.,FXD,FILM:3.24K OHM,1%,0.125W	75042	CEATO-3241F
R1117	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1118	311-1571-00			RES.,VAR,NONWIR:500 OHM,20%,0.5W	73138	91W-500ROM
R1120	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R1122	321-0152-00			RES.,FXD,FILM:374 OHM,1%,0.125W	75042	CEATO-3740F
R1124	321-0228-00			RES.,FXD,FILM:2.32K OHM,1%,0.125W	75042	CEATO-2321F
R1125	321-0228-00			RES.,FXD,FILM:2.32K OHM,1%,0.125W	75042	CEATO-2321F
R1127	321-0141-00			RES.,FXD,FILM:287 OHM,1%,0.125W	75042	CEATO-2870F
R1129	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R1130	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	75042	CEATO-51R10F
R1131	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	75042	CEATO-51R10F
R1132	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R1133	321-0141-00			RES.,FXD,FILM:287 OHM,1%,0.125W	75042	CEATO-2870F
R1134	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R1136	321-0228-00			RES.,FXD,FILM:2.32K OHM,1%,0.125W	75042	CEATO-2321F
R1137	321-0228-00			RES.,FXD,FILM:2.32K OHM,1%,0.125W	75042	CEATO-2321F
R1140	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R1141	323-0178-00			RES.,FXD,FILM:698 OHM,1%,0.50W	75042	CECTO-6980F
R1142	321-0187-00			RES.,FXD,FILM:866 OHM,1%,0.125W	75042	CEATO-8660F
R1143	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	75042	CEATO-2000F
R1144	321-0187-00			RES.,FXD,FILM:866 OHM,1%,0.125W	75042	CEATO-8660F
R1146	322-0159-00			RES.,FXD,FILM:442 OHM,1%,0.25W	91637	MFF1421G442R0F
R1147	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	75042	CEATO-51R10F
R1148	322-0159-00			RES.,FXD,FILM:442 OHM,1%,0.25W	91637	MFF1421G442R0F
R1150	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R1151	323-0178-00			RES.,FXD,FILM:698 OHM,1%,0.50W	75042	CECTO-6980F
R1155	316-0681-00			RES.,FXD,CMPSN:680 OHM,10%,0.25W	01121	CB6811
R1156	316-0333-00			RES.,FXD,CMPSN:33K OHM,10%,0.25W	01121	CB3331
R1157	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R1800	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R1801	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R1803	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R1805	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R1806	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	75042	CEAT0-51R10F
R1808	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R1810	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R1812	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R1813	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R1815	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R1820	317-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0125W	01121	BB1035
R1822	317-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0125W	01121	BB1035
R1823	317-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.125W	01121	BB1015
R1825	317-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.125W	01121	BB6215
R1826	317-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.125W	01121	BB2215
R1827	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R1829	321-0145-00			RES.,FXD,FILM:316 OHM,1%,0.125W	75042	CEAT0-3160F
R1830	321-0309-00			RES.,FXD,FILM:16.2K OHM,1%,0.125W	75042	CEAT0-1622F
R1832	317-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.125W	01121	BB2235
R1834	317-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.125W	01121	BB3935
R1835	317-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.125W	01121	BB3935
R1837	317-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.125W	01121	BB2235
R1840	321-0145-00			RES.,FXD,FILM:316 OHM,1%,0.125W	75042	CEAT0-3160F
R1843	321-0309-00			RES.,FXD,FILM:16.2K OHM,1%,0.125W	75042	CEAT0-1622F
R1845	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R1846	317-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.125W	01121	BB2215
R1847	317-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0125W	01121	BB1035
R1850	317-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.125W	01121	BB1015
R1851	317-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.125W	01121	BB6215
R1860	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R1865	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R1867	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R1869	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	75042	CEAT0-51R10F
R1870	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R1871	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R1872	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R1874	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R1875	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R1880	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R1890	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R1891	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R1845	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R1895	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
RT615	307-0125-00			RES.,THERMAL:500 OHM,10%,25 DEG C	50157	2D1595
RT679	307-0125-00			RES.,THERMAL:500 OHM,10%,25 DEG C	50157	2D1595
RT1810	307-0125-00			RES.,THERMAL:500 OHM,10%,25 DEG C	50157	2D1595
RT1867	307-0125-00			RES.,THERMAL:500 OHM,10%,25 DEG C	50157	2D1595
T800	120-0962-00			XFMR,PWR:	80009	120-0962-00
U630	155-0022-00			MICROCIRCUIT,DI:ML CHANNEL SWITCH	80009	155-0022-00
U670	156-0366-00			MICROCIRCUIT,DI:DUAL FLIP-FLOP	02735	CD4013AE
U675	156-0494-00			MICROCIRCUIT,DI:HEX INVERTER/BUFFER	02735	CD4049AE
U1000	155-0021-01			MICROCIRCUIT,DI:ML,TIMING GENERATOR	80009	155-0021-01

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
U1025	155-0017-00			MICROCIRCUIT,DI:ML,ZERO LOGICOUNTER	80009	155-0017-00
U1030	155-0015-01			MICROCIRCUIT,DI:ML,ANALOG DATA SW	80009	151-0015-01
U1035	155-0014-01			MICROCIRCUIT,DI:ML,ANALOG TO DECIMAL CONV	80009	155-0014-01
U1040	155-0015-01			MICROCIRCUIT,DI:ML ANALOG DATA SW	80009	155-0015-01
U1060	155-0018-00			MICROCIRCUIT,DI:ZERO LOGIC	80009	155-0018-00
U1070	155-0014-01			MICROCIRCUIT,DI:ML,ANALOG TO DECIMAL CONV	80009	155-0014-01
U1075	156-0032-01			MICROCIRCUIT,DI:4-BIT BINARY COUNTER	80009	156-0032-01
U1080	155-0019-00			MICROCIRCUIT,DI:ML,DECIMAL POINT AND SPACE	80009	155-0019-00
U1090	155-0023-00			MICROCIRCUIT,DI:ML,CHAR GEN NUMERALS	80009	155-0023-00
U1092	155-0024-00			MICROCIRCUIT,DI:ML,CHAR GEN SPCL SYMBOLS	80009	155-0024-00
U1094	155-0025-00			MICROCIRCUIT,DI:ML,CHAR GEN PREFIXES	80009	155-0025-00
U1096	155-0026-00			MICROCIRCUIT,DI:ML,CHAR GEN LETTERS	80009	155-0026-00
U1098	155-0027-00			MICROCIRCUIT,DI:ML,CHAR GEN SPCL ALPHA	80009	155-0027-00
U1100	155-0020-00			MICROCIRCUIT,DI:ML,CHANNEL SW OUTPUT ASSY	80009	155-0020-00
U1130	155-0022-00			MICROCIRCUIT,DI:ML CHANNEL SWITCH	80009	155-0022-00
VR930	152-0357-00			SEMICOND DEVICE:ZENER,0.4W,82V,5%	04713	1N983B
VR940	152-0243-00			SEMICOND DEVICE:ZENER,0.4W,15V,5%	81483	1N965B
VR950	152-0227-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	81483	69-6585
VR1080	152-0243-00			SEMICOND DEVICE:ZENER,0.4W,15V,5%	81483	1N965B
VR1081	152-0243-00			SEMICOND DEVICE:ZENER,0.4W,15V,5%	81483	1N965B
VR1082	152-0243-00			SEMICOND DEVICE:ZENER,0.4W,15V,5%	81483	1N965B

OPTIONS

Your instrument may be equipped with one or more options. This section describes these options, or directs the reader to where the option is documented.

Option 1 —	Information on Option 1 (instrument without readout) will be found in the Electrical Parts list.
Option 2 —	Not applicable.
Option 3 —	Information relating to Option 3 (external readout input) is located immediately following this page as well as in the 5443 Theory of Operation section, Electrical Parts list, and Mechanical Parts list, and the Readout System diagram. Information will also be found in the Operating Instructions and Service Information section of the Dual Beam Display Module.
Option 4 —	Information for Option 4 (protective front panel cover) will be found in the Mechanical Parts list.

OPTION 3

EXTERNAL READOUT INPUT

The External Readout Input option provides access to the two readout display words that cannot be programmed via plug-ins in the 5443. This option does not alter the display of words that are programmed from plug-ins.

The words that are accessed by this option appear at the bottom of the screen as shown in Fig. 5-1. These words are designated EXT. 1 and EXT. 2.

CONNECTOR DESCRIPTION

The connector provided for the External Readout Input is a 25 pin female connector located on the rear panel of the 5443. The connector mates with an ITT—Cannon DB—25P or equivalent connector (Tektronix Part Number 131-0570-00). Refer to Fig. 5-2 for connector pin assignments.

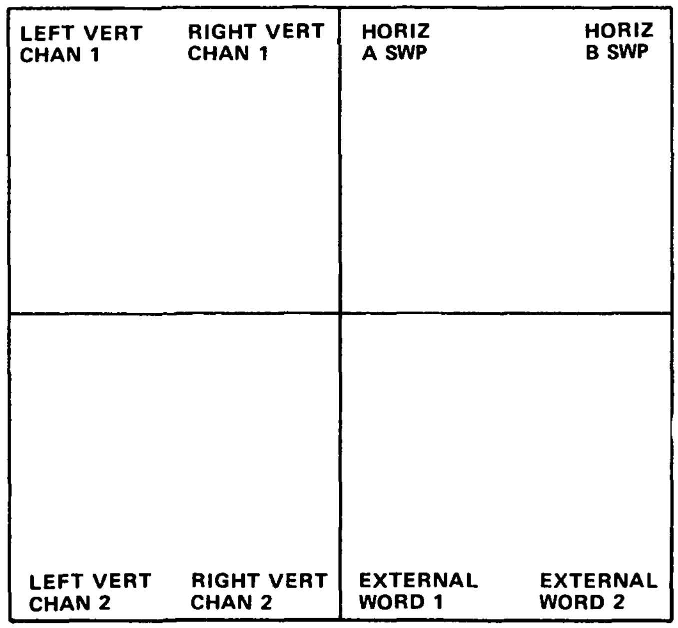

Fig. 5-1. Readout Word Location.

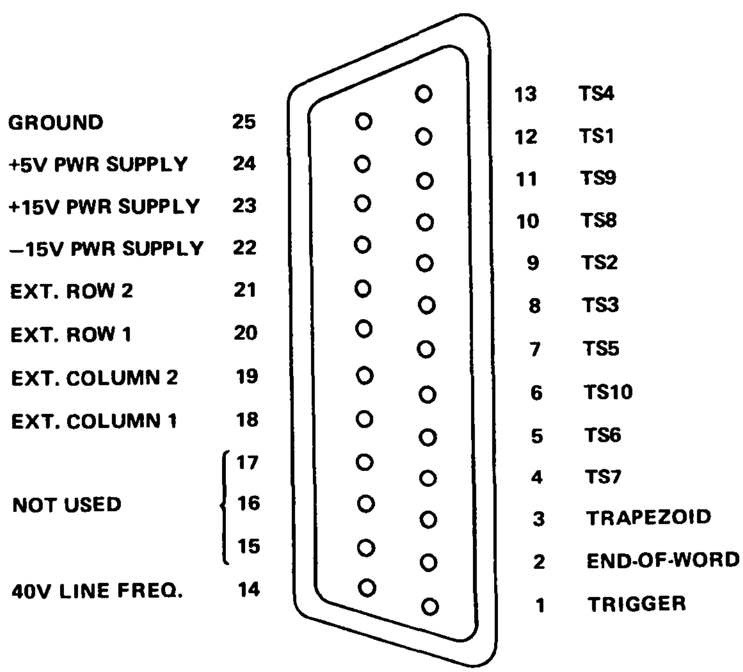

Fig. 5-2. External Readout Input Connector (View looking at rear panel of 5443).

GROUND — Readout System Ground.

+5 V, +15 V, −15 V — Power Supply connections. Maximum allowable currents: +5, 100 mA; +15, 20 mA; −15, 20 mA.

EXT. COLUMN 1 — Column data input for External Word 1.

EXT. COLUMN 2 — Column data input for External Word 2.

EXT. ROW 1 — Row data input for External Word 1.

EXT. ROW 2 — Row data input for External Word 2.

40 V Line FREQ — Line frequency signal approximately 40 V peak-to-peak. 10 mA maximum.

TS1—TS10 — Time Slot signals.

TRAPEZOID — Trapezoid signal from pin 10 of Timer U1000 on the Readout Board.

END-OF-WORD — End-of-word pulse from pin 2 of Time Slot counter U1025 on the Readout Board.

TRIGGER — Pulse from pin 5 of Timer U1000 on the Readout Board.

PROGRAMMING

The 5443 Readout system is programmed by resistors, which are connected between Time Slot lines and Row or Column lines. The resistors are chosen according to the character displayed or the operation performed. For the values of programming resistors, refer to Fig. 2-6 (the character Selection Matrix) in the 5443 Manual. All programming resistors smaller than 51 k and larger than 13 k should be 1% tolerance or better; all others can be 5%.

To illustrate resistor selection, consider the display "TEST 1" in EXT. 1. Required resistor values are shown in Table 5-1.

TABLE 5-1

Resistor Program For "TEST 1"

CHARACTER	COLUMN	COLUMN RESISTOR	ROW	ROW RESISTOR
T	9	16.5 k	4	51 k
E	10	13 k	5	37.4 k
S	1	150 k	5	37.4 k
T	9	16.5 k	4	51 k
(Space)	0	Open	10	16.5 k
1	2	75 k	1	Open

Table 5-1 shows that the character "T" is programmed by Column 9 and Row 4, as specified by the Character Selection Matrix shown in Fig. 2-6.

The Selection Matrix also indicates that a 16.5 k resistor is required for Column 9 while 51 k is required for Row 4. To obtain the space before the "1", the "ADD SPACE" operation is used.

The choice of Time Slots depends on the desired position of the character within the word. Programming the first character from TS1 displays that character in the left-most character position of the display word. Similarly, programming the first character from TS2, TS3, or TS4 displays that character in the second, third, or fourth position within the display word respectively. Programming the first character from TS5 to TS10, however, displays the character as if it is programmed from TS4. To move the character further right requires programming "ADD SPACE" (Column 0, Row 10) in Time Slots after TS3.

Once the Time Slot for the first character is chosen, succeeding characters are programmed in succeeding Time Slots. If, however, a Time Slot other than TS1, TS2, or TS3 is left unprogrammed, the next character to occur is displayed in the unprogrammed Time Slot position. For example, if TS6 and TS8 are programmed and TS7 is not, then the character displayed in TS8 is displayed in the same position as if it were programmed in TS7.

To further clarify the programming concepts outlined here, a complete circuit diagram for programming a word is given in Fig. 5-3. This circuit displays "TEST n" where

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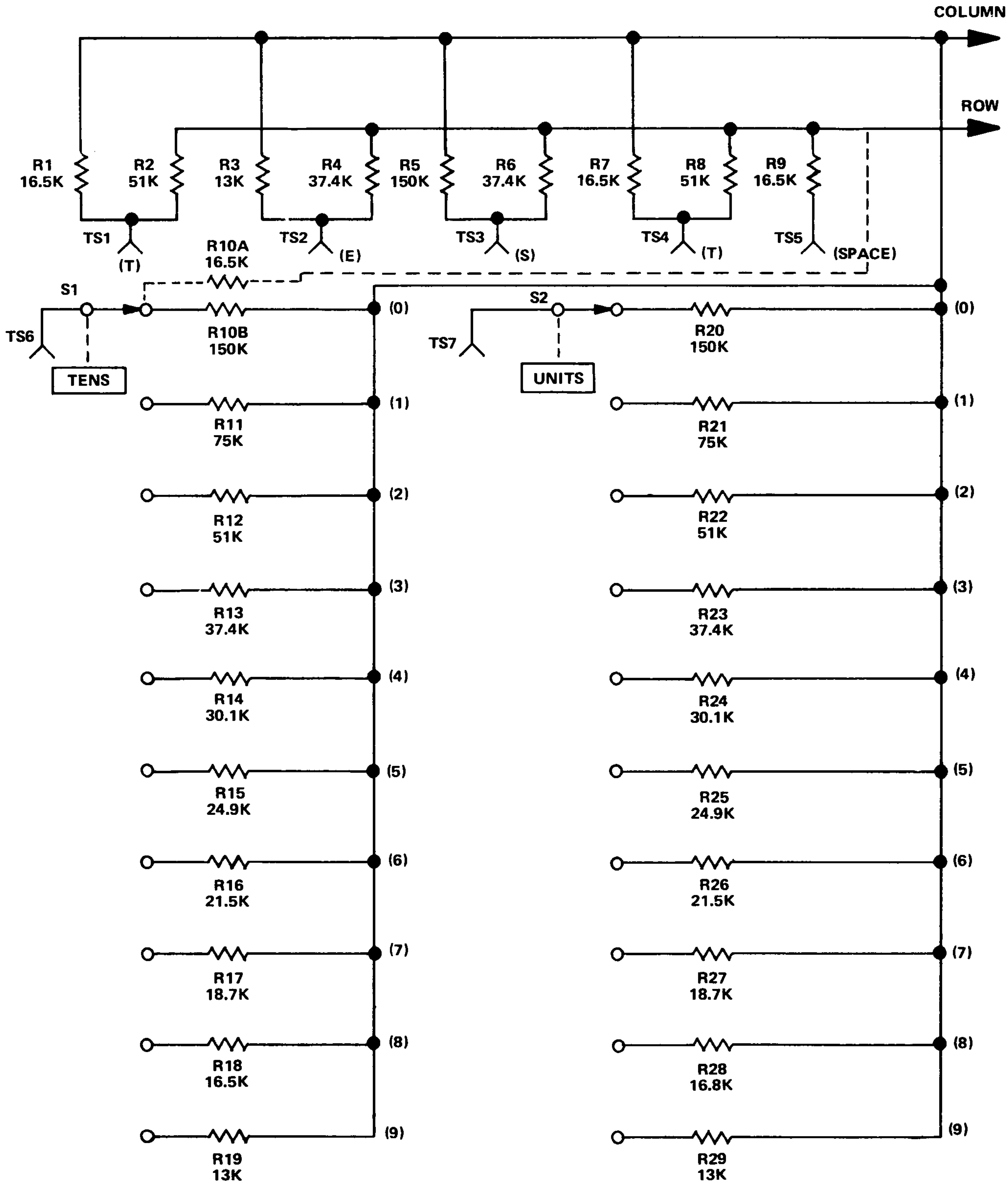


Fig. 5-3. Programming "TEST n".

"n" is a number from 0 to 99 selectable by the user. Time Slots TS1 to TS5 are used to program "TEST (space)". Time Slot 6 with Switch S1 and R10 through R19 programs the tens digit of the number. S1 selects the number displayed. Similarly, S2 selects the units digit programmed in TS7. There are several choices for the format of the number when the number is less than 10. If it is desirable to display the number "8" as "08", then R10B is used to program a "0" in the tens digit and R10A is not used. If a space is desired in the tens digit (in addition to the space in TS5) so that the location of the units digit does not shift when changing from "9" to "10", then R10A is used and R10B is not. If neither R10A nor R10B is used, the units digit in numbers less than 10 is displayed in the display location of the tens digit.

Column and Row connections are chosen according to the display location of the word on the screen. Connection of programming resistors of Row 1 and Column 1 displays in the EXT 1 location. Likewise, connection to Row 2 and Column 2 displays in the EXT 2 location.

ADDITIONAL CONSIDERATIONS

The connections to the External Readout Input connector are not short-circuit protected. Shorts may damage the Readout system.

The Trapezoid, End-of-Word, and Trigger signals are for special processing applications. They have very limited driving capability and should be emitter-follower buffered if used for any purpose.

SERVICE INFORMATION

SYMBOLS AND REFERENCE DESIGNATORS

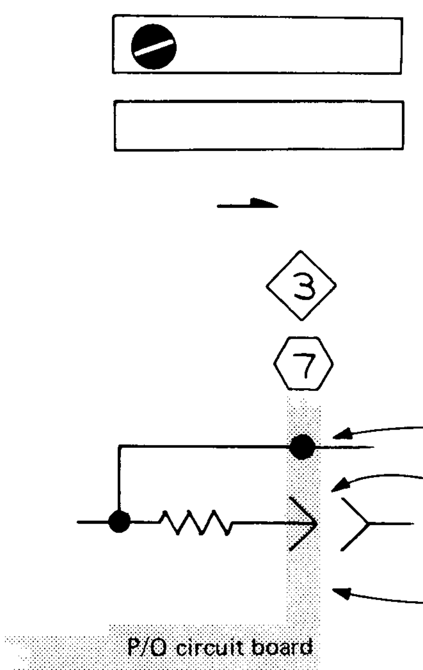
Electrical components shown on the diagrams are in the following units unless noted otherwise:

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

Symbols used on the diagrams are based on ANSI Y32.2 – 1970.

Logic symbology is based on MIL-STD-806B in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The following special symbols are used on the diagrams:



External Screwdriver adjustment.

External control or connector.

Clockwise control rotation in direction of arrow.

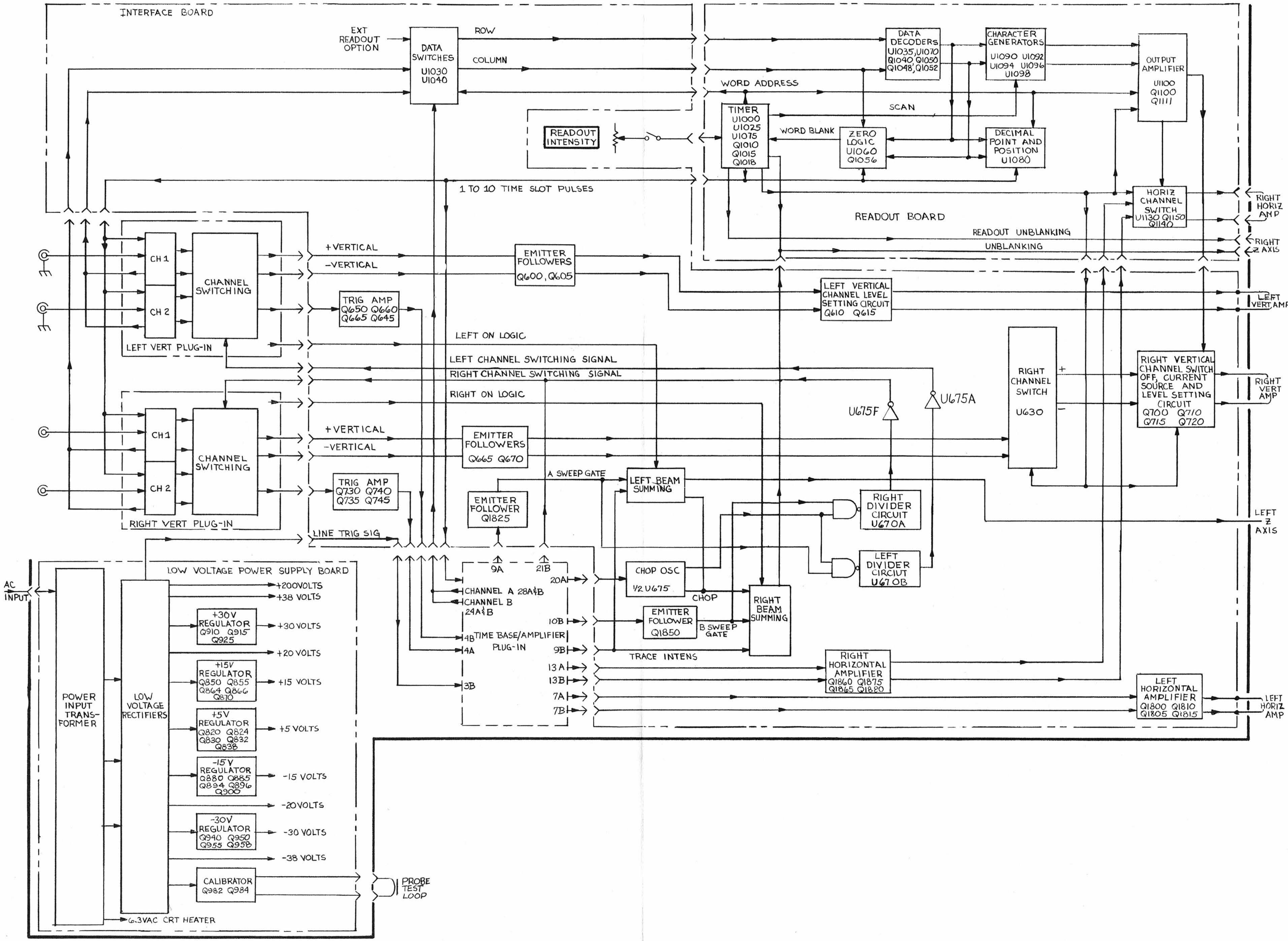
Refer to diagram number indicated in diamond.

Refer to waveform number indicated in hexagon.

Connection soldered to circuit board.

Connection made to circuit board with interconnecting pin.

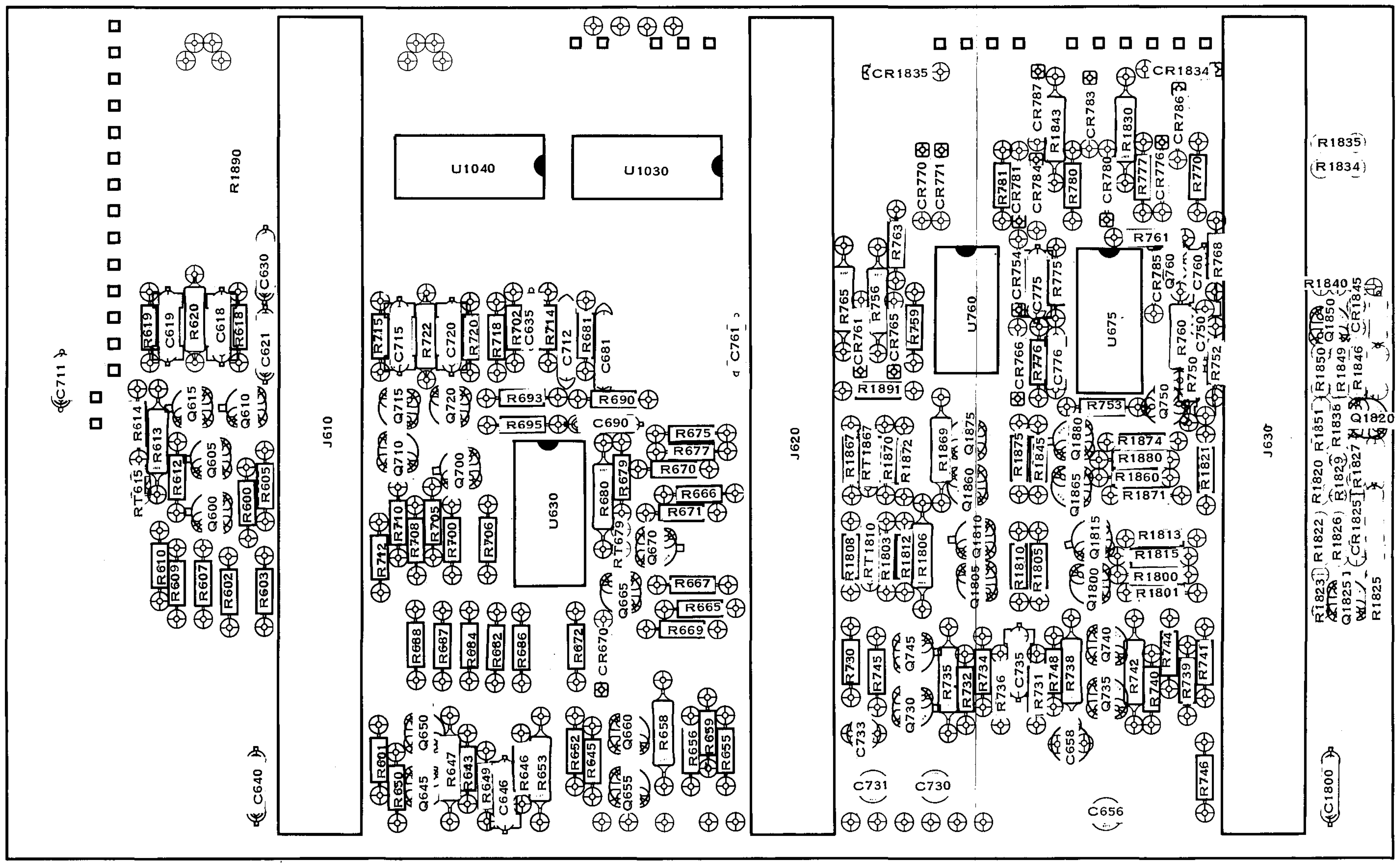
Blue tint encloses components located on circuit board.



BLOCK DIAGRAM

PARTS LOCATION GRID

INTERFACE BD



INTERFACE
PARTS LOCATION GRID

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C618	B3	Q720	D3	R691	C6	R1829	J4
C619	B3	Q730	G5	R693	D3	R1830	H1
C621	C3	Q735	H5	R695	D3	R1834	J2
C630	C3	Q740	H5	R700	D4	R1835	J2
C635	D3	Q745	G5	R705	D4	R1838	J3
C640	C6	Q750	I3	R706	D4	R1840	J2
C646	D6	Q760	I2	R708	D4	R1843	H1
C656	H6	Q1800	H4	R710	C4	R1845	H4
C658	H6	Q1805	G4	R712	C4	R1846	J3
C681	E3	Q1810	G4	R714	D3	R1849	J3
C690	E3	Q1815	H4	R715	C3	R1850	J3
C711	A3	Q1820	J3	R718	D3	R1851	J3
C712	E3	Q1825	J5	R720	D3	R1860	H4
C715	C3	Q1850	J3	R722	D3	R1867	G4
C720	D3	Q1860	H4	R730	G5	R1869	G4
C730	G6	Q1865	G4	R731	H5	R1870	G4
C731	G6	Q1875	G4	R732	G5	R1871	H4
C733	G6	Q1880	H4	R734	G5	R1872	G4
C735	H5			R735	G5	R1874	H4
C750	I3	R600	B4	R736	H5	R1875	H4
C760	I3	R602	B5	R738	H5	R1880	H4
C761	F3	R603	C5	R739	I5	R1890	B2
C775	H3	R605	C4	R740	I5	R1891	G3
C776	H3	R607	B5	R741	I5		
C1800	J6	R609	B5	R742	H5	RT615	B4
		R610	B5	R744	I5	RT679	E4
CR670	E5	R612	B4	R745	G5	RT1810	G4
CR754	H2	R613	B4	R746	I6	RT1867	G4
CR761	G3	R614	B3	R748	H5		
CR765	G3	R618	B3	R750	I3	U630	D4
CR766	H3	R619	B3	R752	I3	U675	H3
CR770	G2	R620	B3	R753	H3	U760	G3
CR771	G2	R643	D6	R756	G3	U1030	E2
CR780	H2	R645	E6	R759	G3	U1040	D2
CR781	H2	R646	D6	R760	I3		
CR783	I1	R647	D6	R761	I2		
CR784	H2	R649	D6	R763	G2		
CR785	I2	R650	C6	R765	F3		
CR786	I1	R652	E6	R768	I2		
CR787	H1	R653	D6	R770	I2		
CR1825	J4	R655	F6	R775	H2		
CR1834	I1	R656	E6	R776	H3		
CR1835	G1	R658	E6	R777	H2		
CR1845	J3	R659	F6	R780	H2		
		R665	E5	R781	H2		
J610	C3	R666	E4	R1800	I4		
J620	F3	R667	E5	R1801	I5		
J630	I3	R669	E5	R1803	G4		
		R670	E4	R1805	H4		
Q600	B4	R671	E4	R1806	G4		
Q605	B4	R672	E5	R1808	G4		
Q610	B3	R675	E3	R1810	H4		
Q615	B3	R677	E4	R1812	G4		
Q645	D6	R679	E4	R1813	I4		
Q650	D6	R680	E4	R1815	I4		
Q655	E6	R681	E3	R1820	J4		
Q660	E6	R682	D5	R1821	I4		
Q665	E5	R684	D5	R1822	J4		
Q670	E4	R686	D5	R1823	J5		
Q700	D4	R687	D5	R1825	J5		
Q710	C4	R688	D5	R1826	J4		
Q715	C3	R690	E3	R1827	J4		

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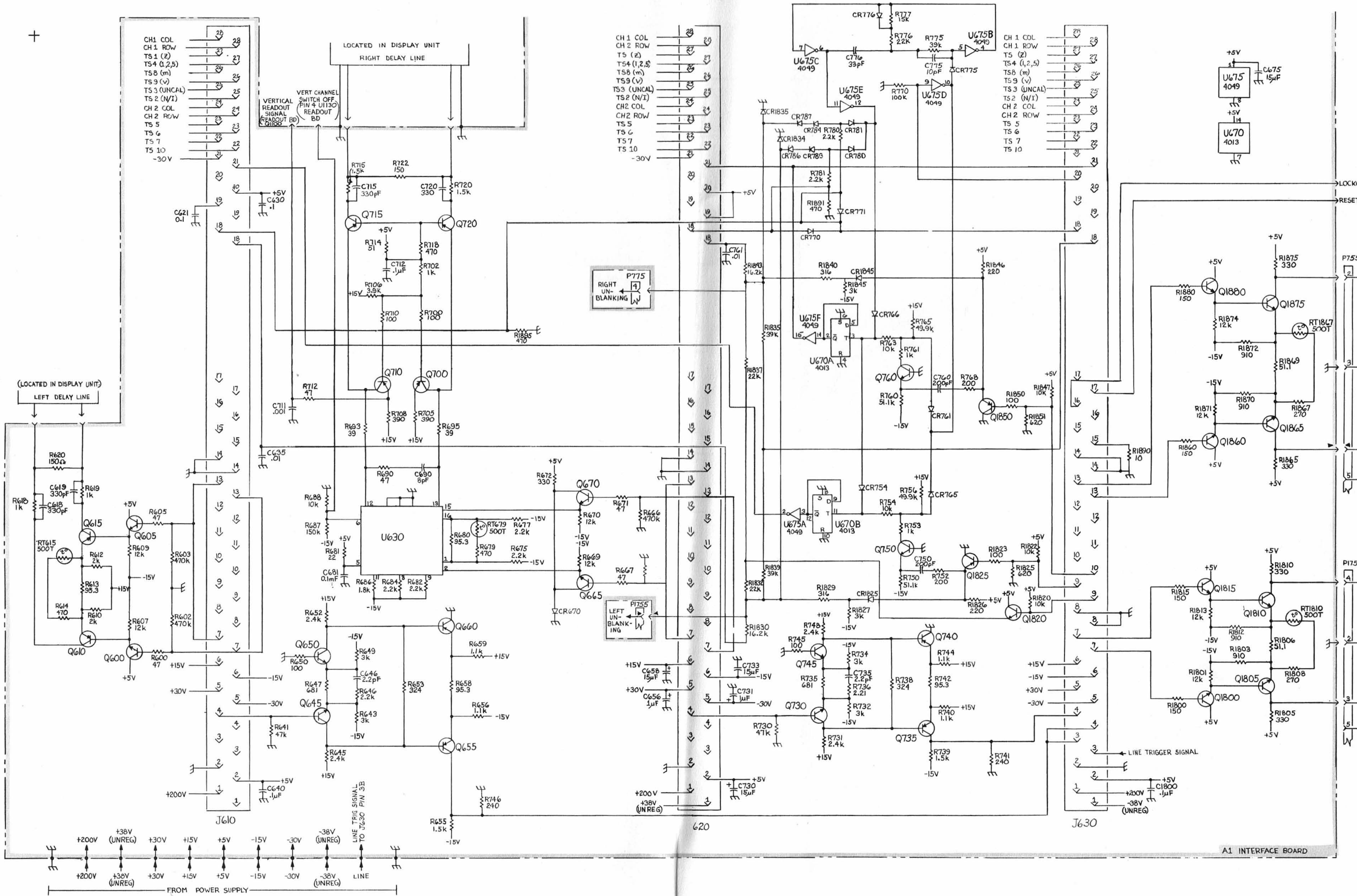
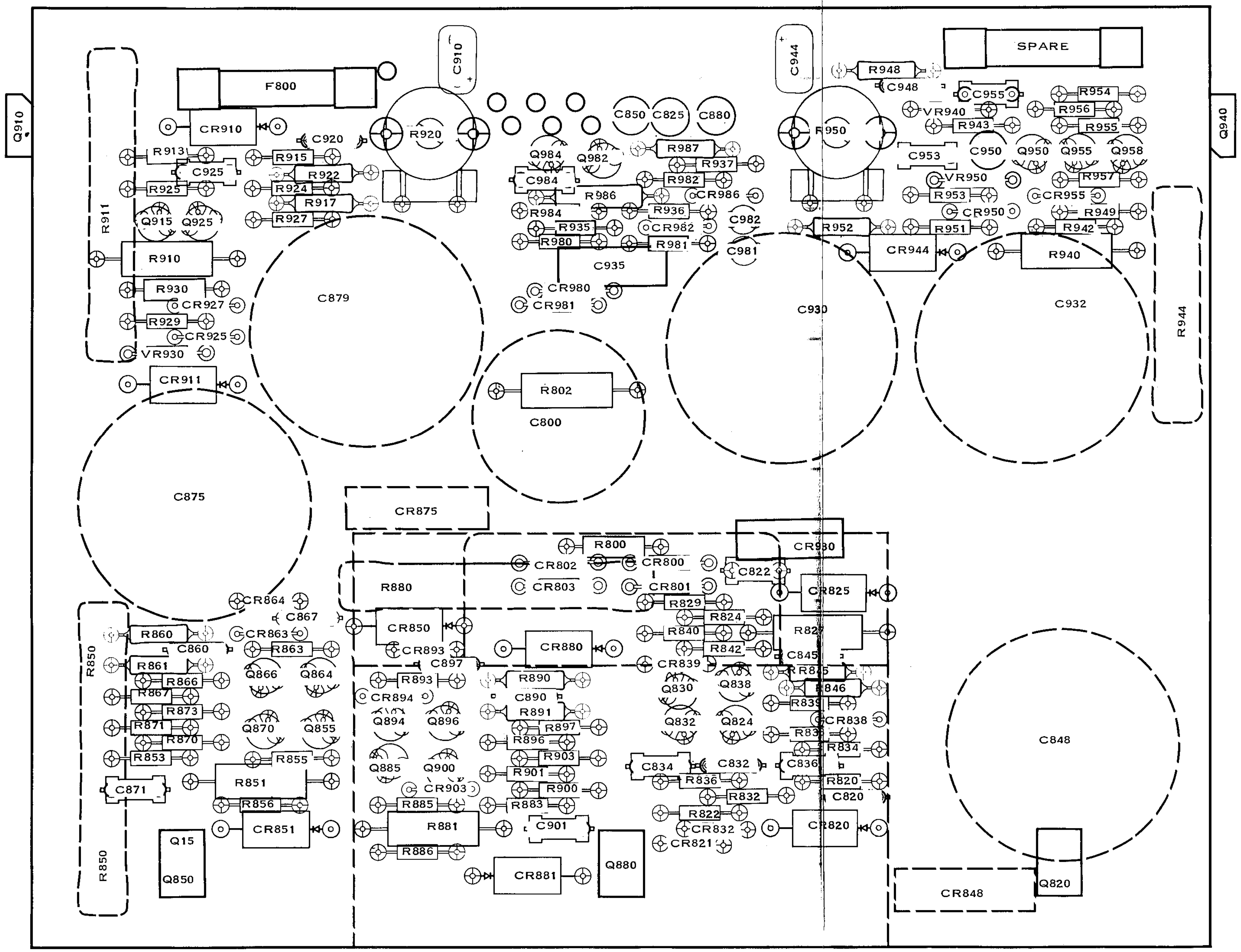

LOCATED IN DISPLAY UNIT
RIGHT DELAY LINE
(LOCATED IN DISPLAY UNIT)
LEFT DELAY LINE
VERTICAL READOUT SIGNAL (READOUT BD) Q1188
VERT CHANNEL SWITCH OFF (PIN 4 U1130) READOUT BD
RIGHT UN-BLANKING
P775
LEFT UN-BLANK-ING
P1755
LOCKOUT
RESET
RIGHT -SWEEP
RIGHT +SWEEP
LEFT -SWEEP
LEFT +SWEEP
P775 TO READOUT BD
LINE TRIGGER SIGNAL
LINE TRIG SIGNAL TO J630 PIN 3B
FROM POWER SUPPLY
J610
620
J630
U630
A1 INTERFACE BOARD

Scan by Zenith

PARTS LOCATION GRID

POWER SUPPLY BOARD



CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C800	E4	CR930	G5	R863	C6
C820	G7	CR944	H3	R866	B6
C822	F5	CR950	H3	R867	B6
C825	F2	CR955	I2	R870	B7
C832	F7	CR980	E3	R871	B6
C834	F7	CR981	E3	R873	B6
C836	F7	CR982	F3	R880	D5
C845	G6	CR986	F2	R881	D7
C848	I7			R883	E7
C850	F2	F800	C2	R885	D7
C860	B6			R886	D7
C867	C6	Q820	I8	R890	E6
C871	B7	Q824	F6	R891	E6
C875	B5	Q830	F6	R893	D6
C879	C3	Q832	F6	R896	E7
C880	F2	Q838	F6	R897	E6
C890	E6	Q850	B8	R900	E7
C897	D6	Q855	C6	R901	E7
C901	E7	Q864	C6	R903	E7
C910	D1	Q866	C6	R910	B3
C920	C2	Q870	C6	R911	B3
C925	B2	Q880	E7	R913	B2
C930	G3	Q885	D7	R915	C2
C932	I3	Q894	D6	R917	C2
C935	E3	Q896	D6	R920	D2
C944	G1	Q900	D7	R922	C2
C948	H2	Q910	A2	R924	C2
C950	H2	Q915	B3	R925	B2
C953	H2	Q925	B3	R927	C3
C955	H2	Q940	J2	R929	B3
C981	F3	Q950	I2	R930	B3
C982	F3	Q955	I2	R935	E2
C984	E2	Q958	I2	R936	F3
		Q982	E2	R937	F2
CR800	F5	Q984	E2	R940	I3
CR801	F5			R942	I3
CR802	E5	R800	E5	R943	H2
CR803	E5	R802	E4	R944	J3
CR820	G7	R820	G7	R948	G1
CR821	F7	R822	F7	R949	I3
CR825	G5	R824	F6	R950	G2
CR832	F7	R827	G6	R951	H3
CR838	G6	R829	F6	R952	G3
CR839	F6	R832	F7	R953	H2
CR848	H8	R834	G7	R954	I2
CR850	D6	R836	F7	R955	I2
CR851	C7	R838	G7	R956	I2
CR863	C6	R839	G6	R957	I2
CR864	C5	R840	F6	R980	E3
CR875	D5	R842	F6	R981	F3
CR880	E6	R845	G6	R982	F2
CR881	E8	R846	G6	R984	E3
CR893	D6	R850	A6	R986	E2
CR894	D6	R851	C7	R987	F2
CR903	D7	R853	B7		
CR910	B2	R855	C7		
CR911	B4	R856	C7	VR930	B4
CR925	B3	R860	B6	VR940	H2
CR927	B3	R861	B6	VR950	H2

ADJUSTMENTS

Before making adjustments, thoroughly clean and inspect this instrument as outlined in the service information section of this manual.

NOTE

This procedure facilitates checking and adjusting the low-voltage power supply ONLY. For complete oscilloscope mainframe calibration (plug-in interface, deflection amplifiers, crt circuits, etc.), refer to the calibration procedure given in the manual for the display unit.

Services Available

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

Equipment Required

For power-supply calibration, proper loading must be established to ensure correct operation and regulation of the low-voltage supplies. For best results, the 5443 should be operated with a display unit and plug-in units as this provides actual operating-condition loads for the supplies.

For measurement of the supply voltages, a precision dc voltmeter is required. The voltmeter must have an accuracy of within ±0.1%, and a measurement range from about −35 volts to +250 volts. A DM 501 Digital Multimeter (operated in a TM 500-Series Power Module), or any dc voltmeter meeting the listed requirements may be used.

Preliminary Procedure

NOTE

The performance of this instrument can be checked at any temperature within the 0° C to +50° C range. Make any adjustments at a temperature of +25° C, ±5° C. Turn on all equipment and allow a 15-minute warmup period before making adjustments.

a. Remove the bottom dust cover of the 5443 to gain access to the LV power supply circuit board.

b. Check that the correct nominal line-selector block (120 V ac or 220 V ac) has been installed on the line-selector pins and that the regulating range selected includes the input line voltage, see Installation section for complete instructions.

c. Connect the 5443 to the line voltage source. Turn the INTENSITY control on the display unit counterclockwise and pull the POWER switch out to turn the instrument on.

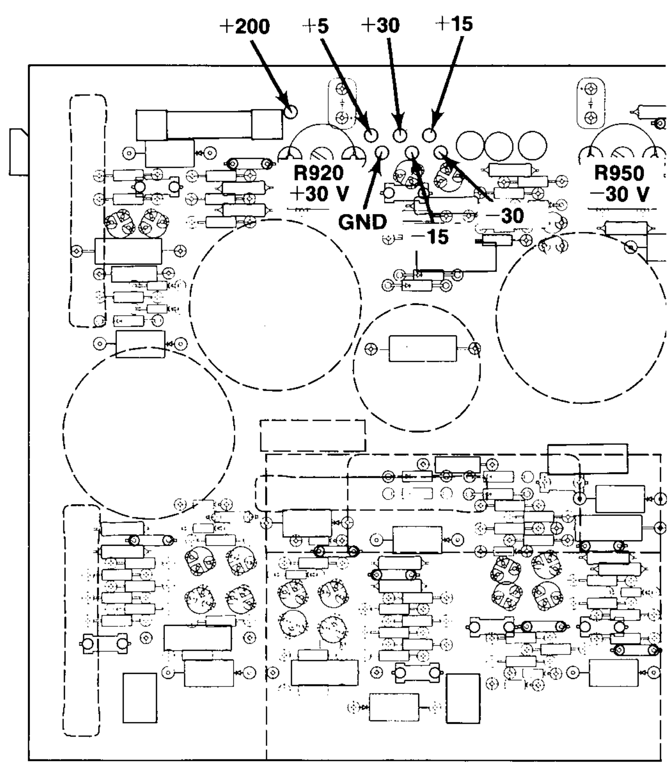
1. LV Power Supply Checks

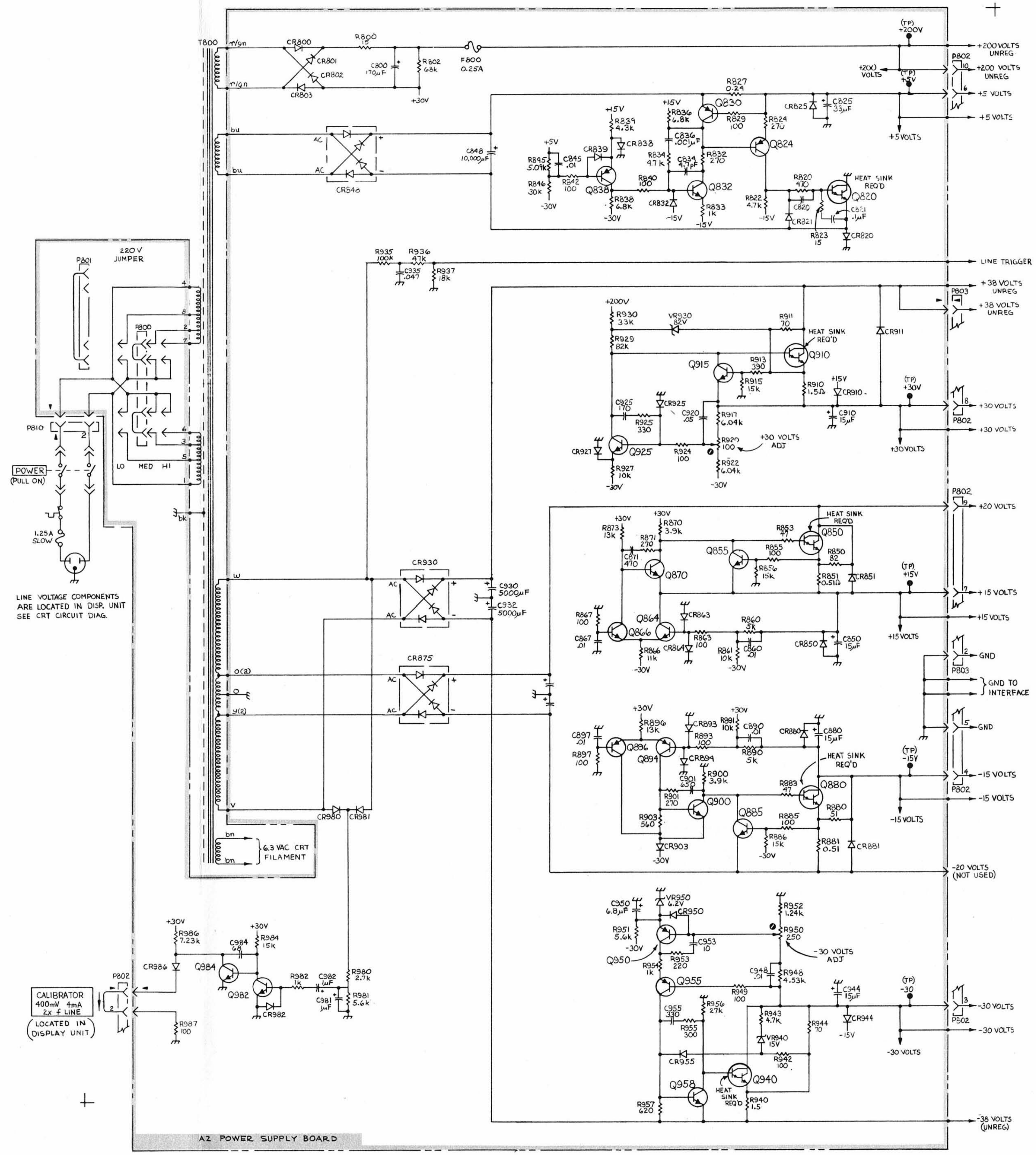
Connect the precision dc voltmeter between each low-voltage test point and ground. Check that each supply is within the tolerance listed below.

Supply	Tolerance
−30 V	−29.925 V to −30.075 V
−15 V	−14.85 V to −15.15 V
+5 V	+4.9 V to +5.1 V
+15 V	+14.85 V to +15.15 V
+30 V	+29.925 V to +30.075 V
+200 V	+180 V to +240 V

2. LV Power Supply Voltage Adjustments

Connect the precision dc voltmeter between each test point (−30 V and +30 V) and ground. First adjust R950, −30 V Adj, and then using the appropriate test point, R920, +30 V Adj, for voltmeter readings of exactly 30 volts.

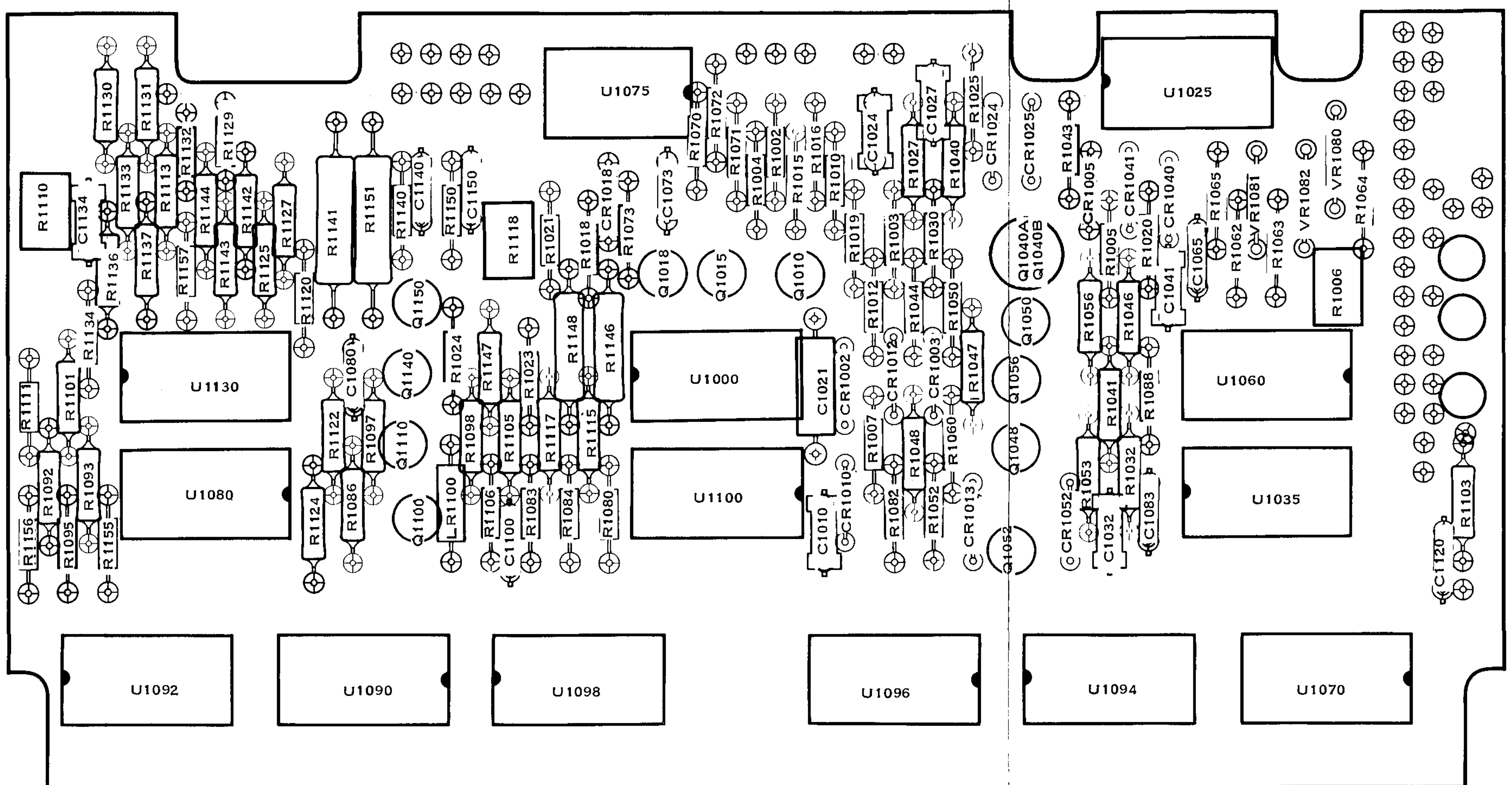




220V JUMPER
POWER (PULL ON)
1.25A SLOW
LINE VOLTAGE COMPONENTS ARE LOCATED IN DISP. UNIT SEE CRT CIRCUIT DIAG.
LO MED HI
6.3 VAC CRT FILAMENT
CALIBRATOR 400mV 4mA 2x f LINE
(LOCATED IN DISPLAY UNIT)
+200 VOLTS UNREG
+5 VOLTS
LINE TRIGGER
+38 VOLTS UNREG
+30 VOLTS
+30 VOLTS ADJ
+20 VOLTS
+15 VOLTS
GND
GND TO INTERFACE
-15 VOLTS
-20 VOLTS (NOT USED)
-30 VOLTS
-30 VOLTS ADJ
-38 VOLTS (UNREG)
HEAT SINK REQ'D
A2 POWER SUPPLY BOARD

PARTS LOCATION GRID

READOUT BOARD



CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C1010	F4	R1010	F2	R1111	A3
C1021	F3	R1012	F2	R1113	B2
C1024	F1	R1015	F2	R1115	D3
C1027	G1	R1016	F1	R1117	D3
C1032	H4	R1018	D2	R1118	D2
C1041	H2	R1019	F2	R1120	C2
C1065	H2	R1020	H2	R1122	C3
C1073	E2	R1021	D2	R1124	C4
C1080	C3	R1023	D3	R1125	B2
C1083	H4	R1024	D3	R1127	C2
C1100	D4	R1025	G1	R1129	B1
C1120	J4	R1027	F2	R1130	A1
C1134	A2	R1030	G2	R1131	B1
C1140	C2	R1032	H3	R1132	B1
C1150	D2	R1040	G2	R1133	B2
		R1041	H3	R1134	A3
CR1002	F3	R1043	G1	R1136	A2
CR1003	G3	R1044	F2	R1137	B2
CR1005	G2	R1046	H2	R1140	C2
CR1010	F4	R1047	G3	R1141	C2
CR1012	F3	R1048	F3	R1142	B2
CR1013	G4	R1050	G2	R1143	B2
CR1018	E2	R1052	G4	R1144	B2
CR1024	G1	R1053	G3	R1146	E3
CR1025	G1	R1056	G2	R1147	D3
CR1040	H2	R1060	G3	R1148	D3
CR1041	H2	R1062	H2	R1150	D2
CR1052	G4	R1063	I2	R1151	C2
		R1064	I2	R1155	B4
LR1100	D4	R1065	H2	R1156	A4
		R1070	E1	R1157	B2
Q1010	F2	R1071	E1		
Q1015	E2	R1072	E1	U1000	E3
Q1018	E2	R1073	E2	U1025	H1
Q1040	G2	R1080	E4	U1035	I4
Q1048	G3	R1082	F4	U1060	I3
Q1050	G2	R1083	D4	U1070	I5
Q1052	G4	R1084	D4	U1075	E1
Q1056	G3	R1086	C4	U1080	B4
Q1100	C4	R1088	H3	U1090	C5
Q1110	C3	R1092	A3	U1092	B5
Q1140	C3	R1093	A3	U1094	H5
Q1150	C2	R1095	A4	U1096	F5
		R1097	C3	U1098	D5
R1002	F1	R1098	D3	U1100	E4
R1003	F2	R1101	A3	U1130	B3
R1004	E2	R1103	J4		
R1005	H2	R1105	D3	VR1080	I2
R1006	I2	R1106	D4	VR1081	H2
R1007	F3	R1110	A2	VR1082	I2

ADJUSTMENTS

Equipment Required

A display unit must be connected to the 5443. It is not necessary to install any plug-in units.

Preliminary Procedure

a. Remove the cabinet panels covering the 5443 access to the readout circuit board.

b. With the power to the 5443 turned off, remove Q1052. Turn on the 5443 and display unit.

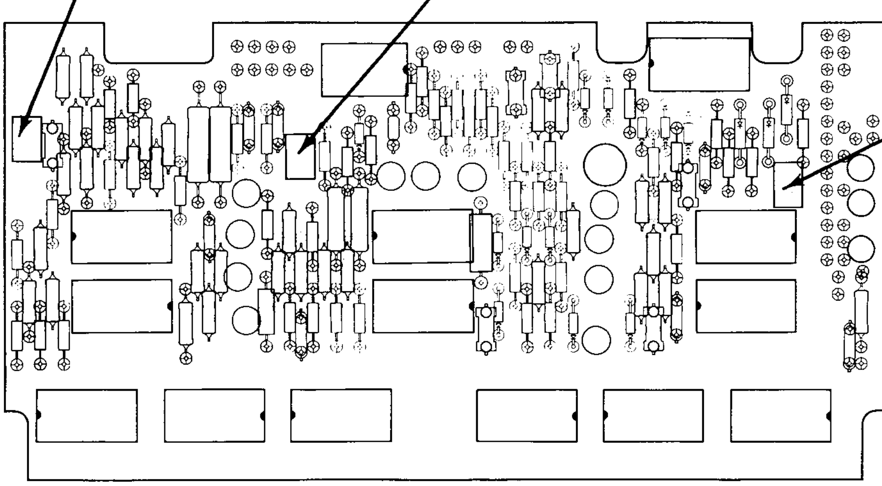
c. Observe an eight word (four words on bottom graticule and four words on top), ten-characters/word readout.

1. Top Row Vertical Spacing, R1118

Adjust R1118 so all of top row of readout is within the top division of graticule. Now adjust vertical centering R135 (located on display unit vertical circuit board) so all of the bottom row of readout is within the bottom division of the graticule.

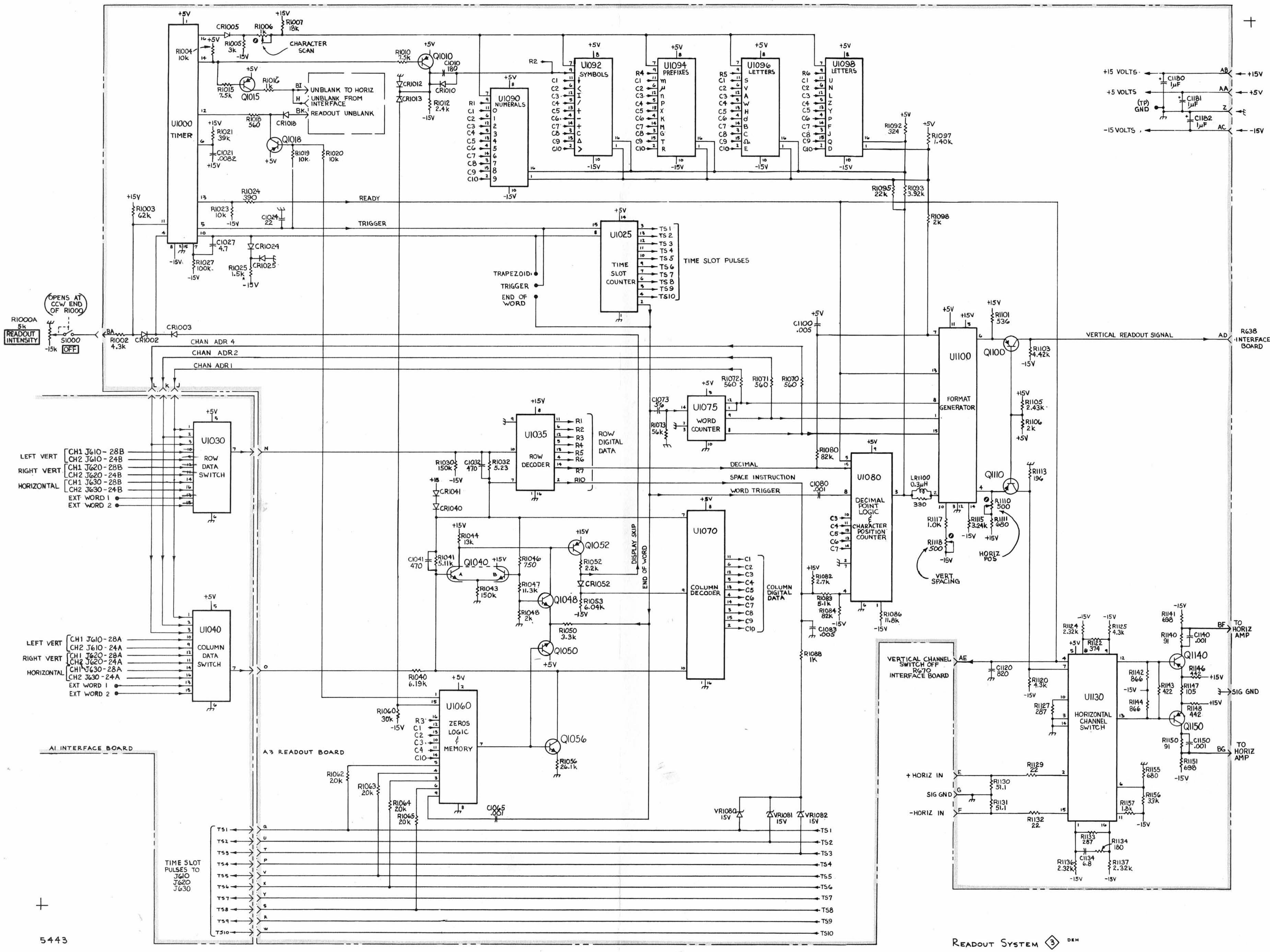
2. Horizontal Positioning, R1110

Adjust until the first character of the first and second words, and the last character of the seventh and eighth words are just inside the graticule area.



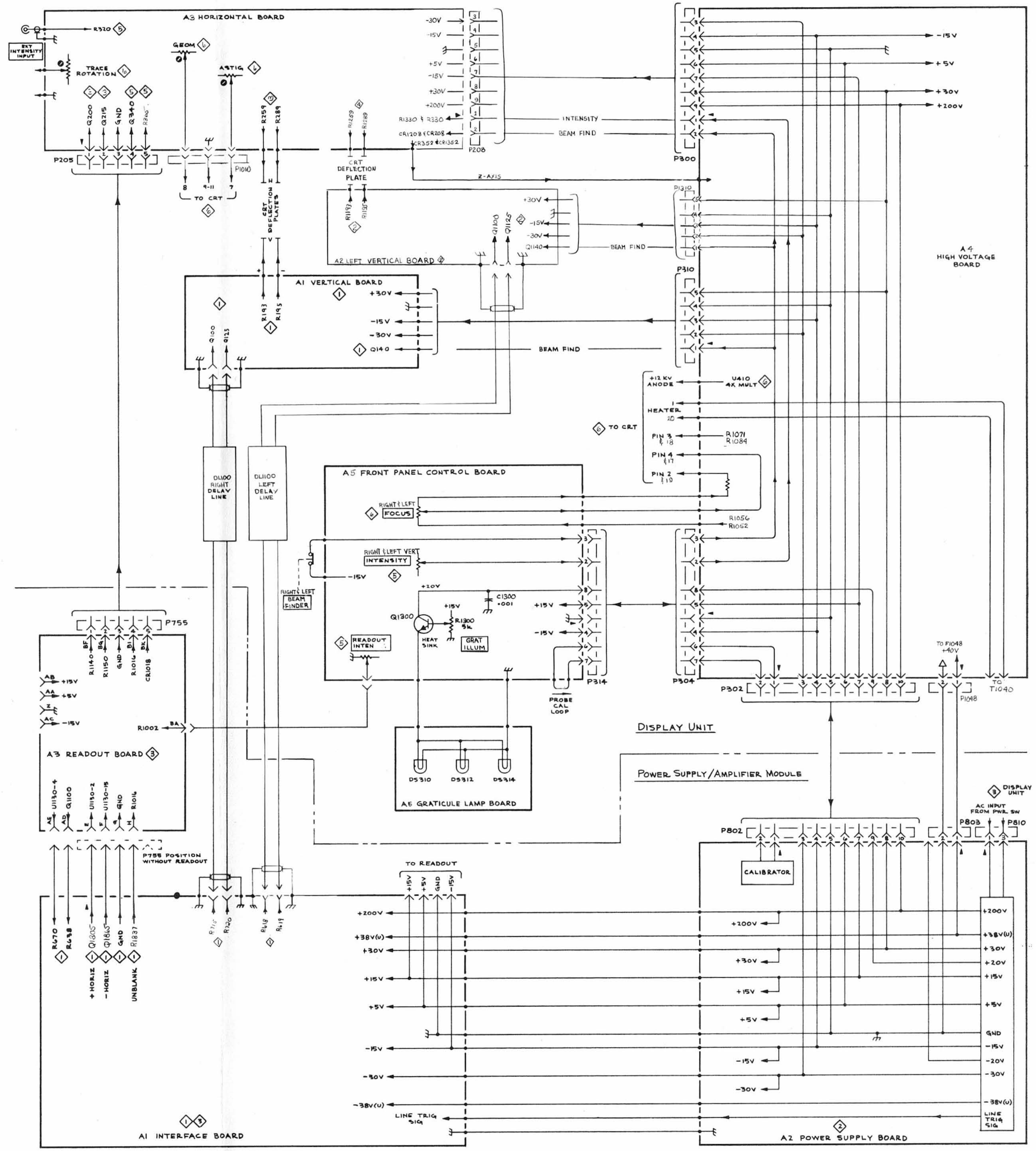
3. Character Scan, R1006

While observing the readout words, adjust R1006 for no blank areas in the characters.



READOUT SYSTEM

Scan by Zenith



INTERCONNECT AND VOLTAGE DISTRIBUTION 4

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

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

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

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

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

SPECIAL NOTES AND SYMBOLS

X000 Part first added at this serial number

00X Part removed after this serial number

FIGURE AND INDEX NUMBERS

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

INDENTATION SYSTEM

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

1 2 3 4 5 Name & Description

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

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

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

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

ABBREVIATIONS

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

CROSS INDEX MFR. CODE NUMBER TO MANUFACTURER

MFR.CODE	MANUFACTURER	ADDRESS	CITY,STATE,ZIP
00779	AMP, INC.	P. O. BOX 3608	HARRISBURG, PA 17105
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P. O. BOX 5012	DALLAS, TX 75222
05820	WAKEFIELD ENGINEERING, INC.	AUDUBON ROAD	WAKEFIELD, MA 01880
06666	GENERAL DEVICES CO., INC.	525 S. WEBSTER AVE.	INDIANAPOLIS, IN 46219
06982	MOORE, HOWARD J., CO.	105 E. 16TH ST.	NEW YORK, NY 10003
08261	SPECTRA-STRIP CORP.	7100 LAMPSON AVE.	GARDEN GROVE, CA 92642
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
23499	GAVITT WIRE AND CABLE, DIVISION OF RSC INDUSTRIES, INC.	455 N. QUINCE ST.	ESCONDIDO, CA 92025
45722	USM CORP., PARKER-KALON FASTENER DIV.	1 PEEKAY DRIVE	CLIFTON, NJ 07014
57771	STIMPSON, EDWIN B., CO., INC.	900 SYLVAN AVE.	BAYPORT, NY 11705
71468	ITT CANNON ELECTRIC	666 E. DYER RD.	SANTA ANA, CA 92702
71785	TRW ELECTRONIC COMPONENTS, CINCH CONNECTOR OPERATIONS	1501 MORSE AVE.	ELK GROVE VILLAGE, IL 60007
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
77250	PHEOLL MANUFACTURING CO., DIVISION OF ALLIED PRODUCTS CORP.	5700 W. ROOSEVELT RD.	CHICAGO, IL 60650
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
80009	TEKTRONIX, INC.	P. O. BOX 500	BEAVERTON, OR 97077
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
95238	CONTINENTAL CONNECTOR CORP.	34-63 56TH ST.	WOODSIDE, NY 11377

FIGURE 1 EXPLODED VIEW

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-1	351-0286-04			3	GUIDE,PL-IN UNIT:BLACK	80009	351-0286-04
					(ATTACHING PARTS FOR EACH)		
-2	211-0038-00			1	SCREW,MACHINE:4-40 X 0.312"100 DEG,FLH STL	83385	OBD
					- - - * - - -		
-3	351-0293-00			3	GUIDE,PL-IN UNI:BLUE	80009	351-0293-00
-4	----- -----			1	CKT BOARD ASSY:READOUT(SEE A3 EPL)		
					(ATTACHING PARTS)		
-5	211-0007-00			1	SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
					- - - * - - -		
-6	129-0285-00			1	. SPACER,POST:0.281 L X 0.188 HEX	80009	129-0285-00
					(ATTACHING PARTS)		
-7	211-0007-00			1	. SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
					- - - * - - -		
-8	131-0589-00			5	. CONTACT,ELEC:0.46 INCH LONG	01295	C931402
-9	136-0269-02			1	. SOCKET,PLUG-IN:14 PIN CONTACT,LOW CLEARANCE	71785	133-59-02-073
-10	136-0260-02			13	. SOCKET,PLUG-IN:16 PIN CONTACT,LOW CLEARANCE	01295	C931602
-11	136-0220-00			1	. SOCKET,PLUG-IN:3 PIN	71785	133-23-11-034
-12	136-0235-00			1	. SOCKET,PLUG-IN:6 CONTACT,ROUND	71785	133-96-12-062
-13	214-0579-00			1	. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-14	136-0263-03			25	. CONTACT,ELEC:FOR 0.025 INCH SQUARE PIN	00779	86250-2
-15	211-0155-00			2	. SCREW,EXT,RLV B:4-40 X 0.375 INCH,SST	80009	211-0155-00
-16	361-0238-00			2	. SPACER,SLEEVE:0.25 OD X 0.34 INCH LONG	80009	361-0238-00
-17	----- -----			1	CKT BOARD ASSY:INTERFACE(SEE A1 EPL)		
					(ATTACHING PARTS)		
-18	213-0146-00			4	SCR,TPG,THD FOR:6-20 X 0.313 INCH,PNH STL	83385	OBD
					- - - * - - -		
	----- -----			-	. CKT BOARD ASSY INCLUDES:		
-19	386-1938-00			1	. BRACKET,REINF:	80009	386-1938-00
					(ATTACHING PARTS)		
-20	210-0777-00			4	. RIVET,BLIND:0.125 DIA GRIP,AL	45722	AD42AB5
					- - - * - - -		
-21	351-0188-00			2	. GUIDE-POST,LOCK:0.65 INCH LONG	80009	351-0188-00
-22	131-0590-00			29	. CONTACT,ELEC:0.71 INCH LONG	22526	47351
-23	214-1593-02			3	. KEY,PLZN CONN:	80009	214-1593-02
-24	131-1078-00			3	. CONNECTOR,RCPT:28/56 CONTACT	95238	K600-11-56VA MOD
-25	136-0260-02			4	. SOCKET,PLUG-IN:16 CONTACT,LOW CLEARANCE	01295	C931602
-26	136-0269-02			1	. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	01295	C931402
	386-1557-00			3	. SPACER,CKT BD:PLASTIC	80009	386-1557-00
	214-1916-00			4	. HEAT SINK,XSTR:TEMPERATURE,STABILIZING	05820	256-D
	131-1398-00[1]			2	CONTACT,ELEC:	80009	131-1398-00
-27	200-0772-02			1	COVER,XFMR:	80009	200-0772-02
					(ATTACHING PARTS)		
-28	212-0515-00			4	SCREW,MACHINE:10-32 X 2.250" HEX.HD STL	83385	OBD
-29	220-0410-00			4	NUT,EXTENDED WA:10-32 X 0.375 INCH,STL	83385	OBD
-30	210-0812-00			4	WASHER,NONMETAL:#10,FIBER	06982	OBD
-31	166-0227-00			4	INS SLV,ELEC:0.187 ID X 1.50 INCH LONG	80009	166-0227-00
					- - - * - - -		
-32	----- -----			1	TRANSFORMER:(SEE T800 EPL)		
-33	333-1833-00			1	PANEL,REAR:	80009	333-1833-00
-34	343-0315-00			2	CLAMP,XSTR:	80009	343-0315-00
					(ATTACHING PARTS FOR EACH)		
-35	210-0407-00			3	NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
					- - - * - - -		
-36	342-0082-00			2	INSULATOR,PLATE:0.52 SQ X 0.015 INCH THK,AL	80009	342-0082-00
-37	343-0403-00			3	CLAMP,RIM,CLENC:TRANSISTOR	80009	343-0403-00
					(ATTACHING PARTS FOR EACH)		
-38	211-0025-00			1	SCREW,MACHINE:4-40 X 0.375 100 DEG,FLH STL	83385	OBD
					- - - * - - -		
-39	342-0082-00			3	INSULATOR,PLATE:0.52 SQ X 0.015 INCH THK,AL	80009	342-0082-00
-40	----- -----			1	CKT BOARD ASSY:POWER(SEE A2 EPL)		
					(ATTACHING PARTS)		
-41	210-0457-00			1	NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
-42	211-0504-00			6	SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
-43	211-0008-00			1	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		

[1]Option 1 only.

FIGURE 1 EXPLODED VIEW (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-	----- -----			-	. CKT BOARD INCLUDES:		
-44	----- -----			1	. SEMICOND DEVICE:(SEE CR848 EPL)		
					(ATTACHING PARTS)		
-45	211-0578-00			1	. SCREW,MACHINE:6-32 X 0.438 1NCH,PNH STL	83385	OBD
-46	210-0457-00			1	. NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
					- - - * - - -		
-47	214-1804-00			1	. HEAT SINK,ELEC:	80009	214-1804-00
-48	131-1200-00			1	. LINK,TERM CONN:	80009	131-1200-00
	352-0166-01			1	. . HOLDER,TERM.CON:8 WIRE BROWN	80009	352-0166-01
	131-0707-00			4	. . CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	47439
-49	131-1199-00			1	. LINK,TERM CONN:	80009	131-1199-00
	352-0166-02			1	. . HOLDER,TERM.CON:8 WIRE RED	80009	352-0166-02
	131-0707-00			2	. . CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	47439
-50	131-0608-00			14	. CONTACT,ELEC:0.365 INCH LONG	22526	47357
	131-0589-00			15	. CONTACT,ELEC:0.46 INCH LONG	22526	47350
-51	344-0154-00			4	. CLIP,ELECTRICAL:FOR 0.25 INCH DIA FUSE	80009	344-0154-00
-52	175-0859-00			FT	. CABLE,SP,ELEC:0.025 FT	23499	TEK-175-0859-00
-53	175-0860-00			FT	. CABLE,SP,ELEC:0.025 FT	23499	TEK-175-0860-00
-54	214-0579-00			7	. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
	334-2359-00			1	MARKER,IDENT:WARNING	80009	334-2359-00
-55	426-0934-00			1	FRAME ASSY,CAB:	80009	426-0934-00
-56	129-0266-00			1	. SPACER,POST.MECH:	80009	129-0266-00
-57	131-1254-01			3	. CONTACT,ELEC:	80009	131-1254-01
					(ATTACHING PARTS FOR EACH)		
-58	210-0617-00			1	. EYELET,METALLIC:	57771	GS3-4
					- - - * - - -		
					OPTION 3		
-59	131-0569-00			1	CONN,RCPT,ELEC:25 PIN,FEMALE	71468	DB25S
					(ATTACHING PARTS)		
-60	129-0370-00			2	SPACER,POST:0.16 L X 0.25 HEX	80009	129-0370-00
-61	210-0406-00			2	NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-62	210-0004-00			2	WASHER,LOCK:INTL,0.12 ID X 0.26"OD,STL	78189	1204-00-00-0541C
					- - - * - - -		
-63	333-1889-00			1	PANEL,REAR:OPTION 3	80009	333-1889-00
-64	200-1641-00			1	COVER,CKT BOARD:	80009	200-1641-00
-65	388-3605-00			1	CIRCUIT BOARD:	80009	388-3605-00
-66	131-0570-00			1	CONNECTOR,RCPT,:25 PIN,MALE	71468	DB25P
-67	175-0833-00			FT	WIRE,ELECTRICAL:10 WIRE RIBBON,0.833 FT L	23499	TEK-175-0833-00
-68	175-0827-00			FT	WIRE,ELECTRICAL:4 WIRE RIBBON,0.833 FT L	08261	TEK-175-0827-00
-69	175-0826-00			FT	WIRE,ELECTRICAL:3 WIRE RIBBON,0.833 FT L	08261	TEK-175-0826-00
					ACCESSORIES		
	070-1772-00			1	MANUAL,TECH:INSTRUCTION(NOT SHOWN)	80009	070-1772-00
					REPACKAGING		
	065-0150-00			1	SHPNG CTN KIT:FOR DISL AND PWR MOL	80009	065-0150-00
	065-0152-00			1	SHPNG CTN KIT:FOR BENCH SYSTEM	80009	065-0152-00
	065-0161-00			1	SHPNG CTN KIT:FOR RACKMOUNT SYSTEM	80009	065-0161-00

FIG. 1 EXPLODED VIEW

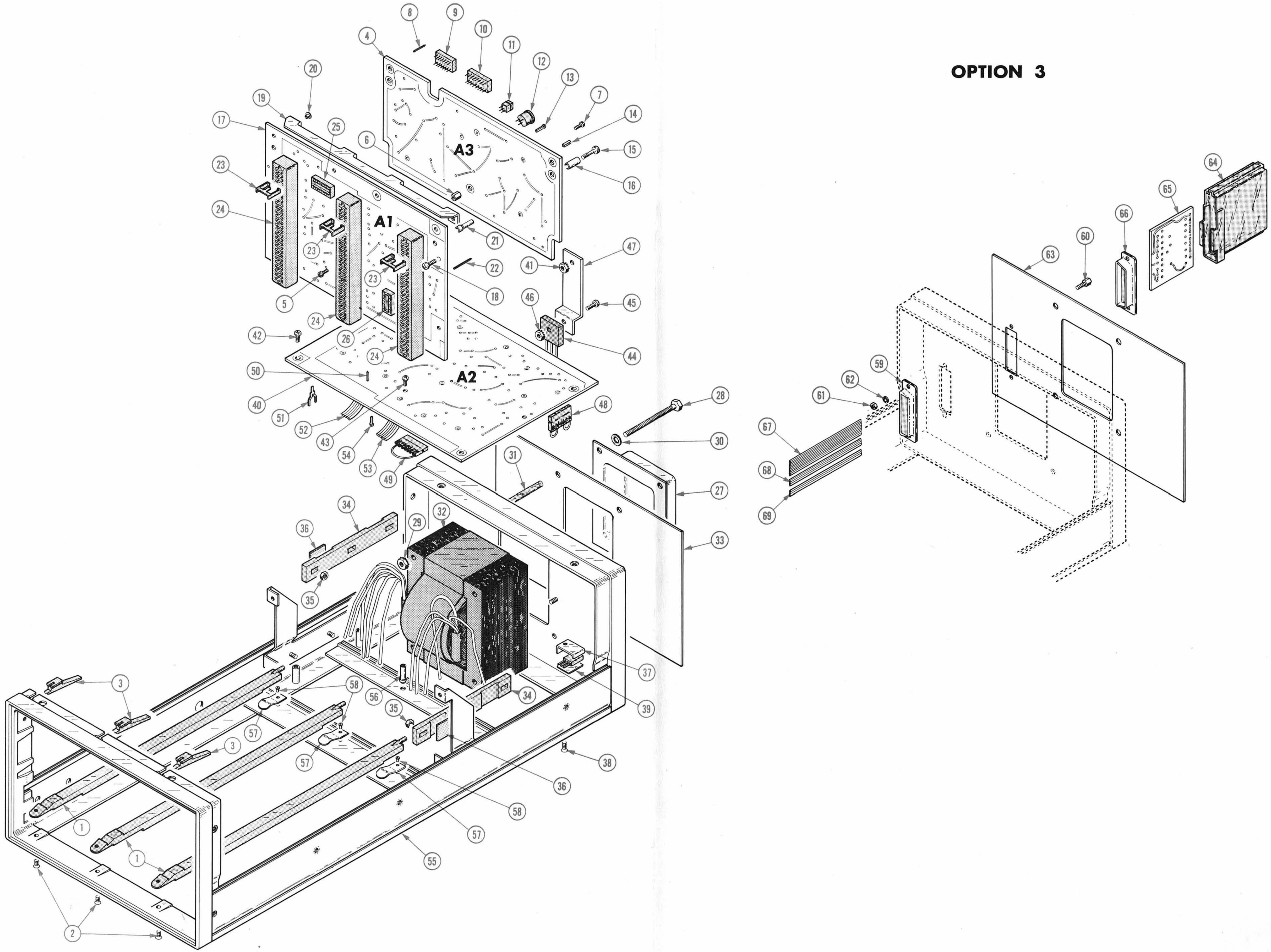


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FIG.2 STANDARD CABINET

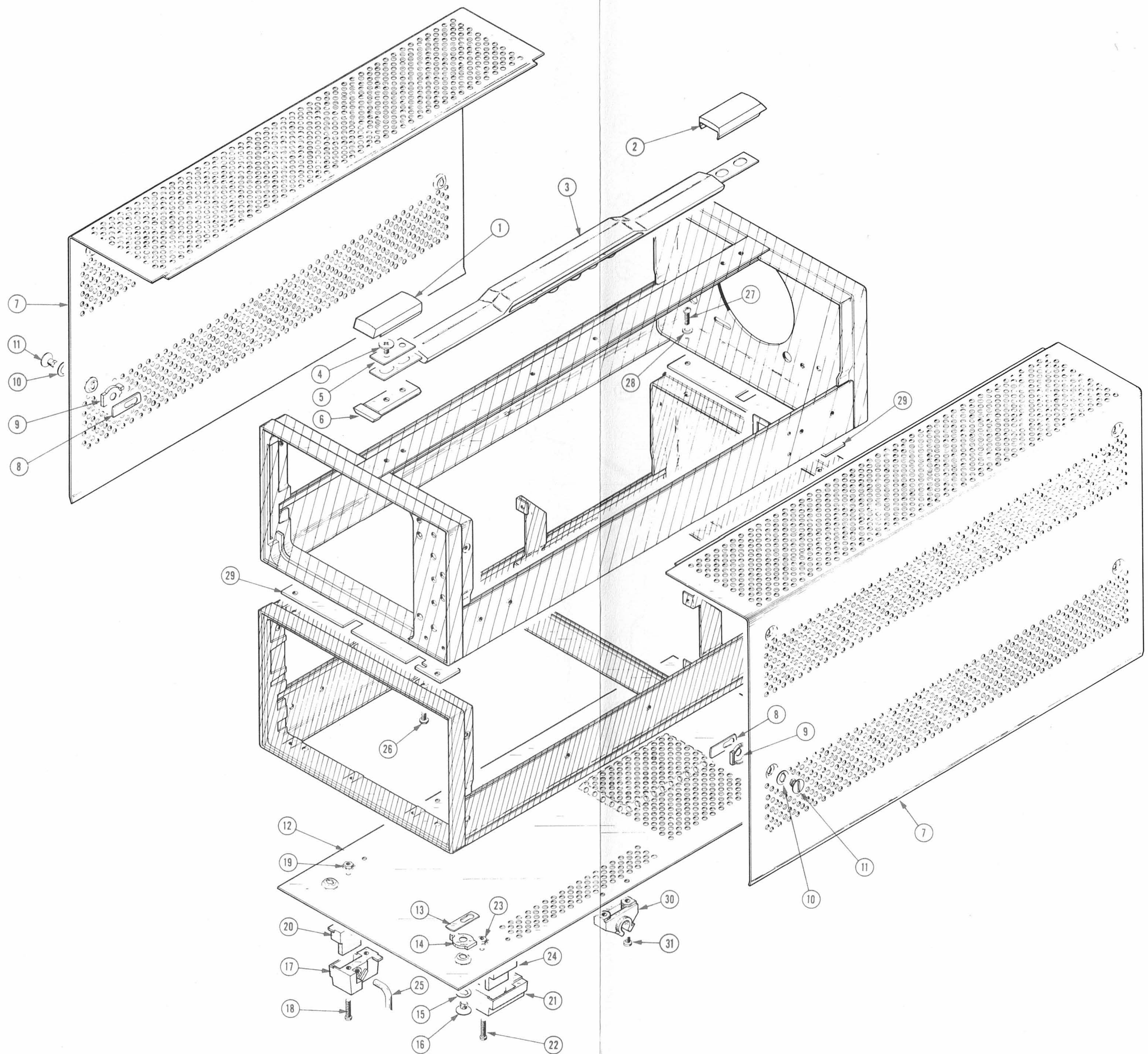

FIGURE 2 BENCH CABINET

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-1	200-0728-05			1	COVER,HDL END:	80009	200-0728-05
-2	200-0728-00			1	COV,HANDLE END:	80009	200-0728-00
-3	367-0116-00			1	HANDLE,CARRYING:	80009	367-0116-00
					(ATTACHING PARTS)		
-4	212-0597-00			4	SCREW,MACHINE:10-32 X 0.50 INCH,STL	80009	212-0597-00
-5	386-1624-00			2	PL,RET.,HANDLE:	80009	386-1624-00
-6	386-1283-00			2	PLATE,HDL MTG:	80009	386-1283-00
					- - - * - - -		
-7	390-0469-00			2	CAB.SIDE,DSPL:	80009	390-0469-00
	214-0812-00			4	. FASTENER,PAWL:	80009	214-0812-00
-8	386-0226-00			1	. . CLAMP,RIM CLENC:	80009	386-0226-00
-9	386-0227-00			1	. . PL,LATCH INDEX:	80009	386-0227-00
-10	214-0604-00			1	. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-11	214-0603-01			1	. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-12	390-0470-00			1	CAB,BOT,DSPL:	80009	390-0470-00
	214-0812-00			4	. FASTENER,PAWL:	80009	214-0812-00
-13	386-0226-00			1	. . CLAMP,RIM CLENC:	80009	386-0226-00
-14	386-0227-00			1	. . PL,LATCH INDEX:	80009	386-0227-00
-15	214-0604-00			1	. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-16	214-0603-01			1	. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-17	348-0073-00			2	. SPT PIVOT,FLIP:LEFT FRONT AND RIGHT REAR	80009	348-0073-00
					(ATTACHING APRTS FOR EACH)		
-18	211-0532-00			2	. SCREW,MACHINE:6-32 X 0.75 INCH,FILH STL	83385	OBD
-19	210-0457-00			2	. NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
					- - - * - - -		
-20	348-0208-00			2	. FOOT,CABINET:LEFT FRONT AND RIGHT REAR	80009	348-0208-00
-21	348-0074-00			2	. SPT PIVOT,FLIP:RIGHT FRONT AND LEFT REAR	80009	348-0074-00
					(ATTACHING PARTS FOR EACH)		
-22	211-0532-00			2	. SCREW,MACHINE:6-32 X 0.75 INCH,FILH STL	83385	OBD
-23	210-0457-00			2	. NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
					- - - * - - -		
-24	348-0207-00			2	. FOOT,CABINET:RIGHT FRONT AND LEFT REAR	80009	348-0207-00
-25	348-0275-00			1	STAN,ELEC EQPT:	80009	348-0275-00
-26	212-0105-00			2	SCREW,MACHINE:8-32 X 0.312 X 0.312 HEX,HD STL	80009	212-0105-00
-27	212-0008-00			2	SCREW,MACHINE:8-32 X 0.312 INCH,PNH STL	83385	OBD
-28	210-0008-00			2	WASHER,LOCK:INTL,0.172 ID X 0.331"OD,STL	78189	1208-00-00-0541C
-29	361-0388-00			2	SPACER,PLATE:	80009	361-0388-00
-30	343-0256-00			2	RTNR BLK,SCOPE:	80009	343-0256-00
					(ATTACHING PARTS FOR EACH)		
-31	211-0531-00			2	SCREW,MACHINE:6-32 X 0.375,FIL,STL	83385	OBD
					- - - * - - -		

OPTION 4

	200-1375-00			1	COVER,SCOPE FR:	80009	200-1375-00
	390-0471-00			1	CAB.SIDE,DSPL:LEFT,BENCH W/LATCH	80009	390-0471-00
	390-0471-01			1	CAB.SIDE,DSPL:RIGHT,BENCH W/LATCH	80009	390-0471-01

FIGURE 3 RACKMOUNT CABINET

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
3-1	351-0195-00			1	SLIDE,DWR,EXT:	06666	C719
-2	351-0104-00			1	SLIDE SECT.,DWR:PAIR	80009	351-0104-00
					(ATTACHING PARTS)		
-3	212-0004-00			6	SCREW,MACHINE:8-32 X 0.312 INCH,PNH STL	83385	OBD
-4	210-0858-00			6	WASHER,FLAT:0.500 OD X 0.171 ID X 0.063 THK	80009	210-0858-00
					- - - * - - -		
-5	407-0899-04			1	BRACKET,RACK MT:RIGHT	80009	407-0899-04
					(ATTACHING PARTS)		
-6	212-0040-00			2	SCREW,MACHINE:8-32 X 0.375 100 DEG,FLH STL	83385	OBD
					- - - * - - -		
-7	407-0899-00			1	BRACKET,RACK MT:LEFT	80009	407-0899-00
					(ATTACHING PARTS)		
-8	212-0040-00			2	SCREW,MACHINE:8-32 X 0.375 100 DEG,FLH STL	83385	OBD
					- - - * - - -		
-9	390-0191-00			1	COVER,SCOPE:RIGHT	80009	390-0191-00
	214-0812-00			4	. FASTENER,PAWL:	80009	214-0812-00
-10	386-0226-00			1	. . CLAMP,RIM CLENC:	80009	386-0226-00
-11	386-0227-00			1	. . PL,LATCH INDEX:	80009	386-0227-00
-12	214-0604-00			1	. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-13	214-0603-01			1	. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-14	390-0194-00			1	COVER,SCOPE:LEFT	80009	390-0194-00
	214-0812-00			2	. FASTENER,PAWL:	80009	214-0812-00
-15	386-0226-00			1	. . CLAMP,RIM CLENC:	80009	386-0226-00
-16	386-0227-00			1	. . PL,LATCH INDEX:	80009	386-0227-00
-17	214-0604-00			1	. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-18	214-0603-01			1	. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-19	390-0222-00			2	COVER,SCOPE:BOTTOM	80009	390-0222-00
	214-0812-00			4	. FASTENER,PAWL:	80009	214-0812-00
-20	386-0226-00			1	. . CLAMP,RIM CLENC:	80009	386-0226-00
-21	386-0227-00			1	. . PL,LATCH INDEX:	80009	386-0227-00
-22	214-0604-00			1	. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-23	214-0603-01			1	. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-24	212-0103-00			3	SCREW,MACHINE:8-32 X 0.375,HEX HD,STL	77250	OBD
	212-0104-00			3	SCREW,MACHINE:8-32 X 0.75,HEX HD,STL	77250	OBD
	210-0008-00			3	WASHER,LOCK:INTL,0.172 ID X 0.331"OD,STL	78189	1208-00-00-0541C
-25	361-0389-00			2	SPACER,PLATE:	80009	361-0389-00

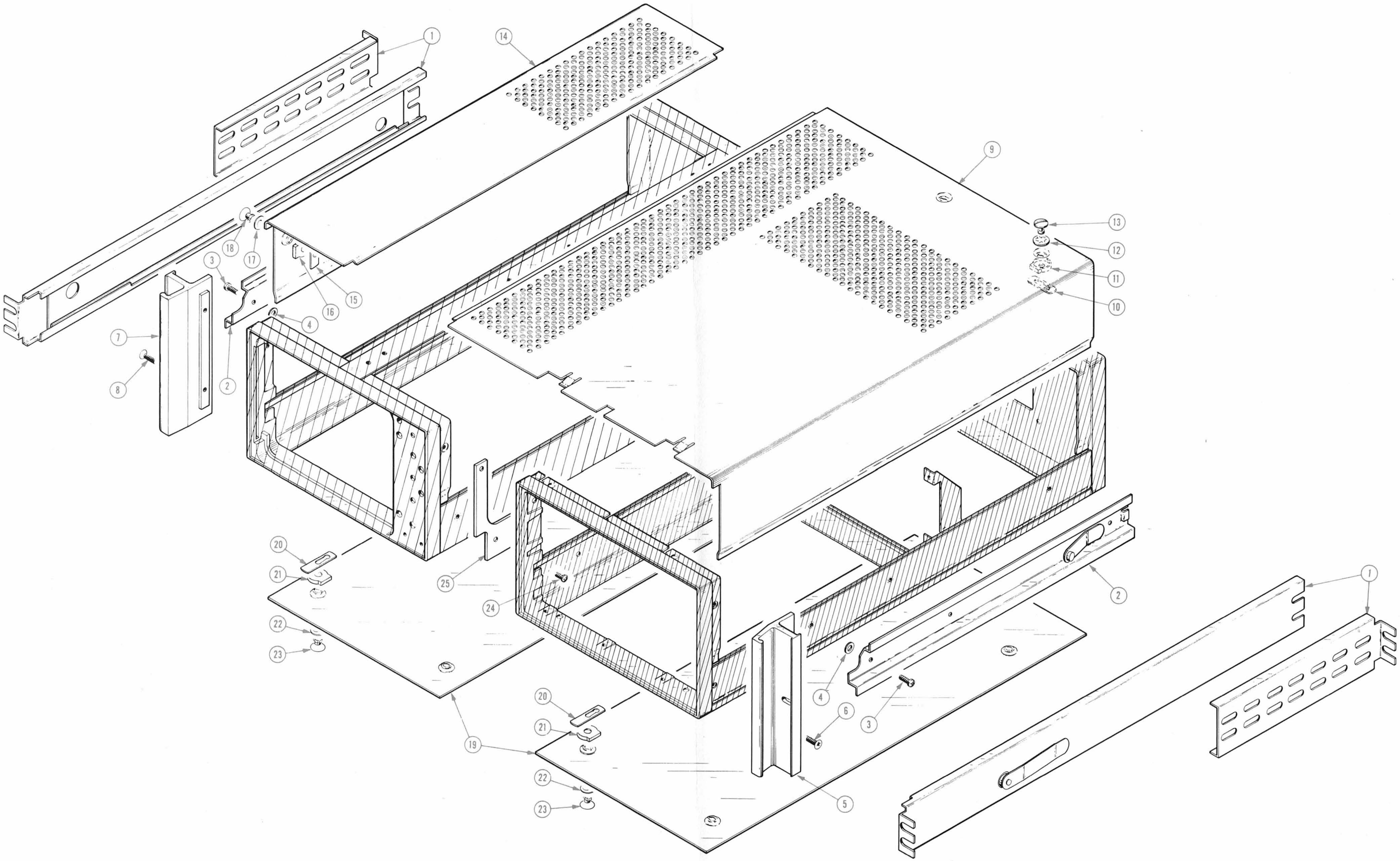

FIG.3 RACKMOUNT CABINET

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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. Sections of the manual are often printed at different times, so some of the information on the change pages may already be in your manual. 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 in this section, your manual is correct as printed.

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MANUAL CHANGE INFORMATION

PRODUCT GENERAL

CHANGE REFERENCE S23351

DATE 4-10-75

CHANGE:	DESCRIPTION

POWER CORD CHANGES

The 1974 National Electrical Code permits the use of IEC (International Electrotechnical Commission) power cord color codes. As production permits, we are changing the entire Tektronix product line to comply with IEC power cord color code requirements. As a result, the power cord on Tektronix instruments may conform to either IEC or the older NEC requirements. The change consists of the following:

Conductor	NEC	IEC
Line	Black	Brown
Neutral	White	Light Blue*
Safety Earth	Green w/Yellow Stripe	Green w/Yellow Stripe

*Tinned copper conductor.

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MANUAL CHANGE INFORMATION

PRODUCT 5443
EFF SN B020170-up

CHANGE REFERENCE M23,766
DATE 8-19-75

CHANGE:	DESCRIPTION

070-1772-00

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

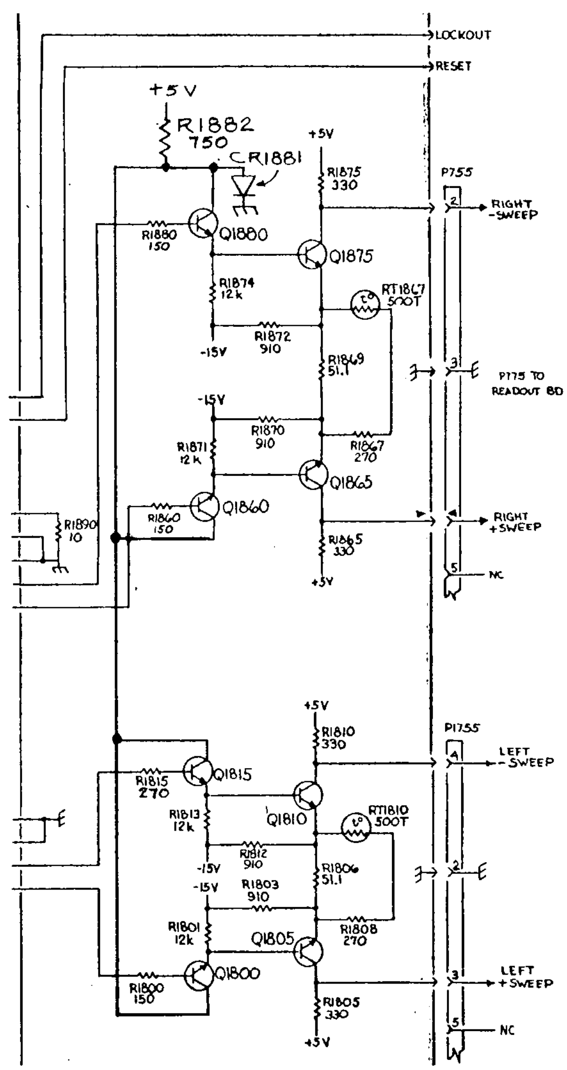
CHANGE TO:

A1	670-3165-01	CKT BOARD ASSY:INTERFACE
R1815	315-0271-00	RES.,FXD,CMPSN:270 OHM,5%,0.25W

ADD:

CR1881	152-0061-00	SEMICOND DEVICE:SILICON, 200V,100MA FDH21G1
R1882	315-0751-00	RES.,FXD,CMPSN:750 OHM,5%,0.25W

DIAGRAM 1 INTERFACE - Partial



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MANUAL CHANGE INFORMATION

PRODUCT 5443
EFF SN B020208-up

CHANGE REFERENCE M24,098
DATE 10-15-75

CHANGE:	DESCRIPTION

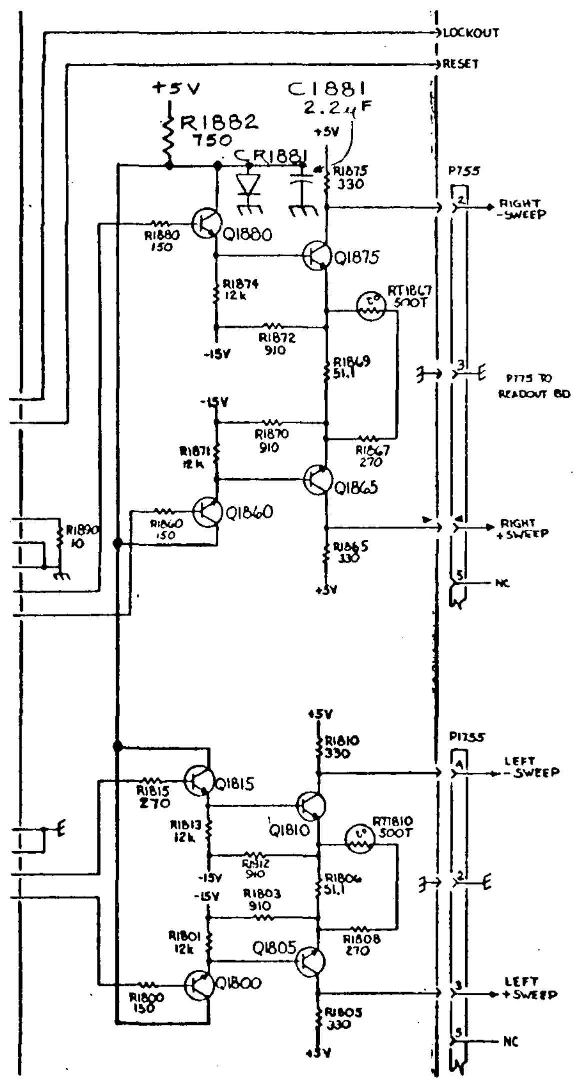
070-1772-00

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGE

ADD:

C1881 283-0164-00 CAP.,FXD,CER DI:2.2UF,20%,25V

DIAGRAM 1 INTERFACE - Partial



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MANUAL CHANGE INFORMATION

PRODUCT 5403 and 5443

CHANGE REFERENCE M24,885

DATE 4-13-76

CHANGE:	DESCRIPTION

EFF SN B054740-up (070-1449-00) 5403

EFF SN B030322-up (070-1772-00) 5443

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

CHANGE TO:

R1143	321-0128-00	RES.,FXD,FILM:210 OHM,1%,0.125W

This component is located on the Readout circuit board 670-2413-00 and shown on diagram 3 READOUT.