TEKTRONIX®

5440 OSCILLOSCOPE

INSTRUCTION MANUAL

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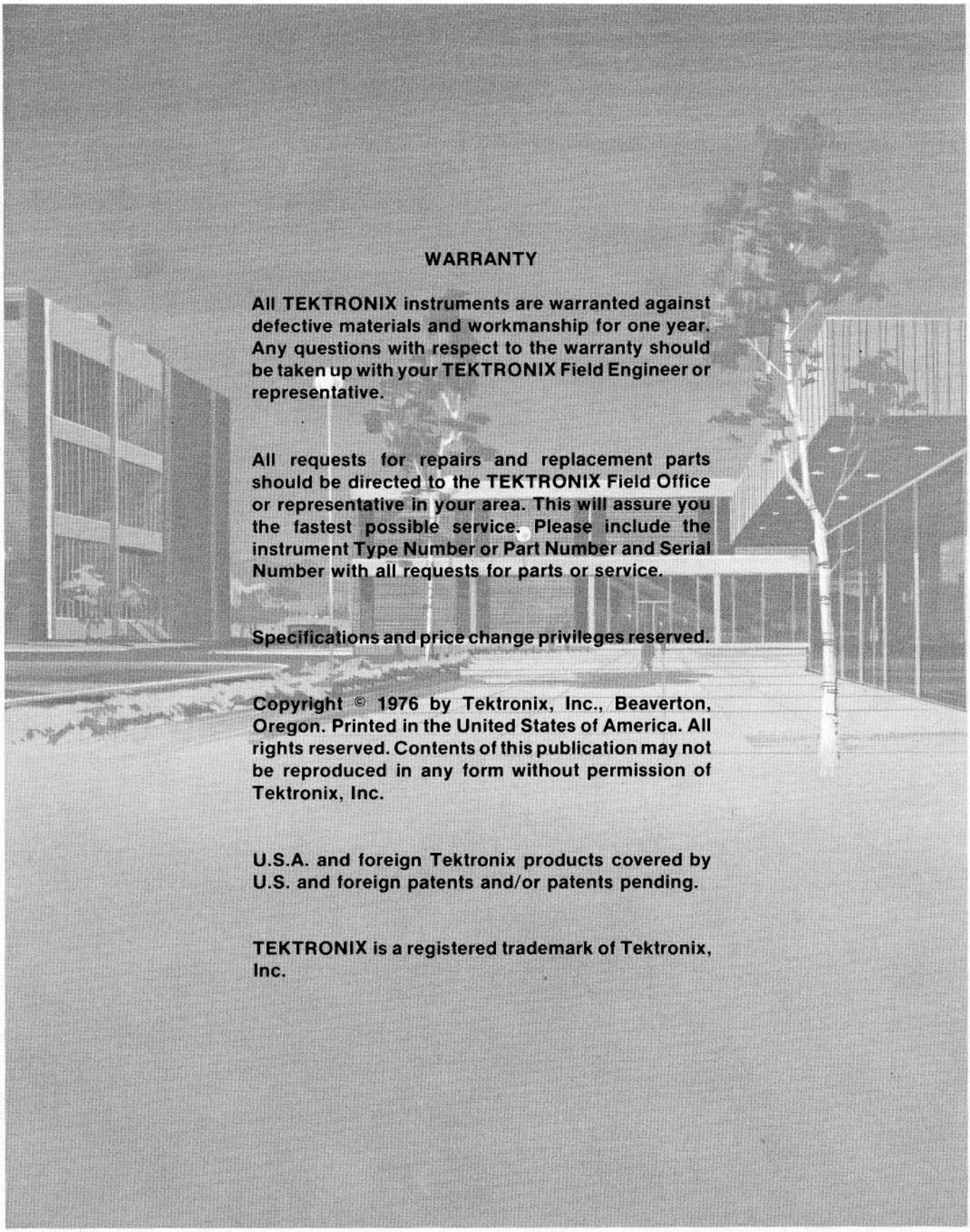

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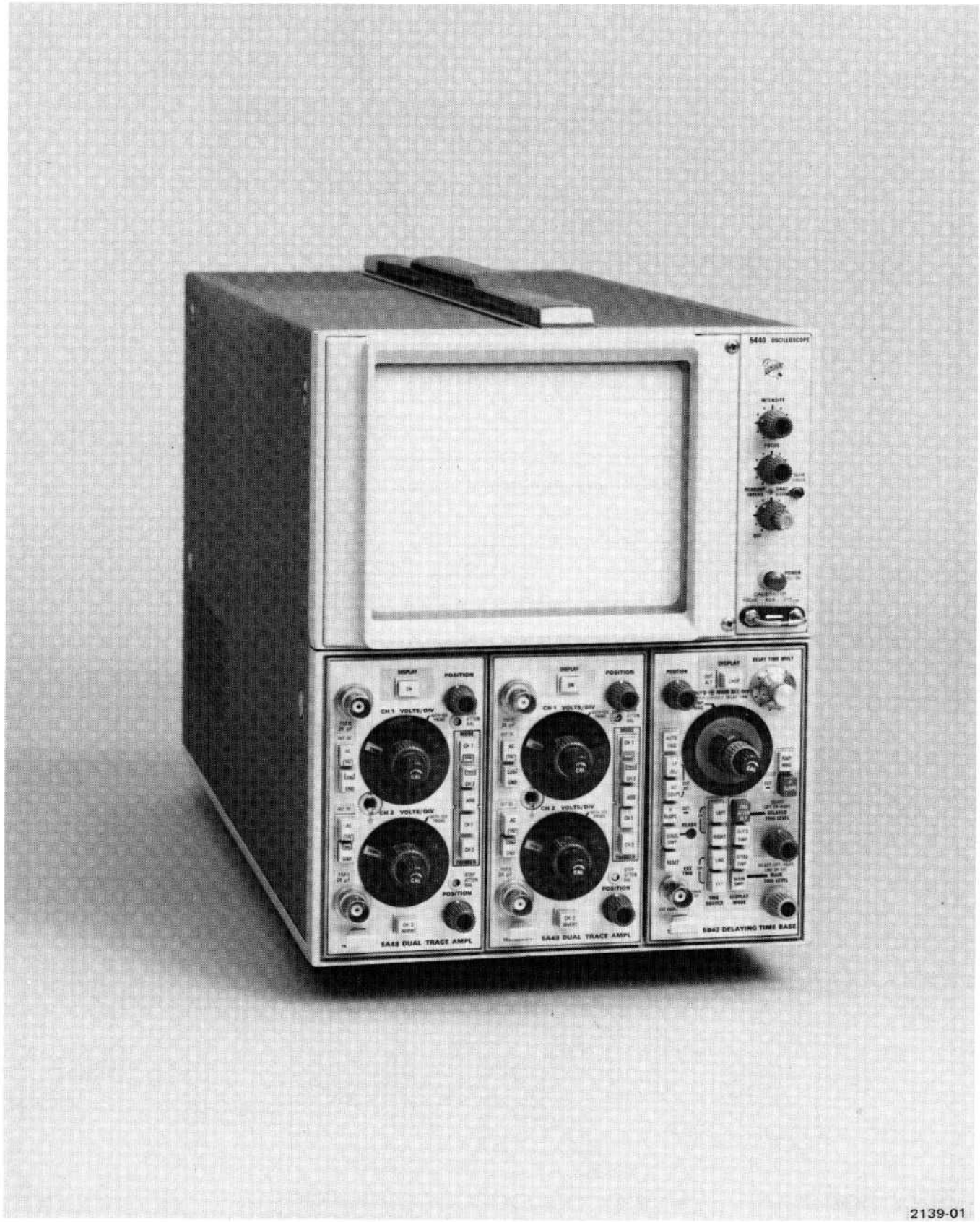


5440 Oscilloscope

OPERATING INFORMATION

The Tektronix 5440 Oscilloscope is a solid-state instrument designed for general-purpose applications. This instrument has three plug-in compartments that accept 5000-series plug-in units to form a complete measurement system. To effectively use this instrument, the operation and capabilities of the instrument must be known. This section describes front-panel control functions, giving first-time and general operating information. Information on operating voltage, instrument conversion, rackmounting, operating temperature, and plug-in installation is also included.

FIRST TIME OPERATION

Steps 1 through 19 of the following procedure provide an operational check to verify satisfactory operation of the oscilloscope and associated plug-ins. Refer to Fig. 1-1 for front-panel control and connector locations.

1. For the following procedure, a 5A-series amplifier plug-in should be in one of the vertical (left or center) plug-in compartments and a 5B-series time-base plug-in should be in the horizontal (right) compartment.

2. See Operating Voltage in this section before proceeding. Set the POWER switch to off (pushed in) and connect the 5440 to a power source that meets the voltage and frequency requirements of this instrument.

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

Amplifier Plug-In

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

Time-Base Plug-In

Display	Alternate (button out)
Position	Centered
Main Sec/Div	5 ms
Variable Seconds/Div	Cal (fully clockwise)
Mag	Off (button out)
Main Trig Level	Counterclockwise
Source	Left (or Right if the amplifier plug-in is in the center compartment)
Coupling	Auto Trig, AC Coupl, +Slope
Mode	Main Sweep

FOCUS Control

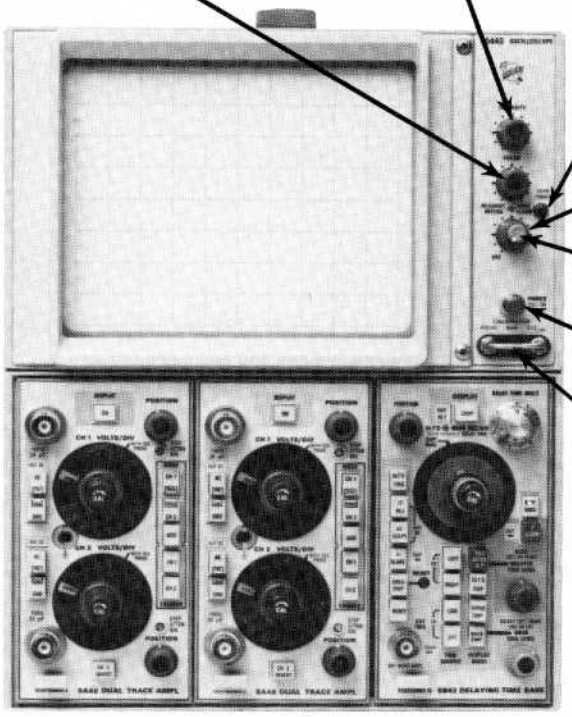
Provides adjustment to obtain a well-defined display.

INTENSITY Control

Controls display brightness.

BEAM FINDER Pushbutton

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



READOUT INTENS Control

Controls brightness of the readout portion of the CRT display. In the fully counterclockwise position, the readout system is inoperative.

GRAT ILLUM Control

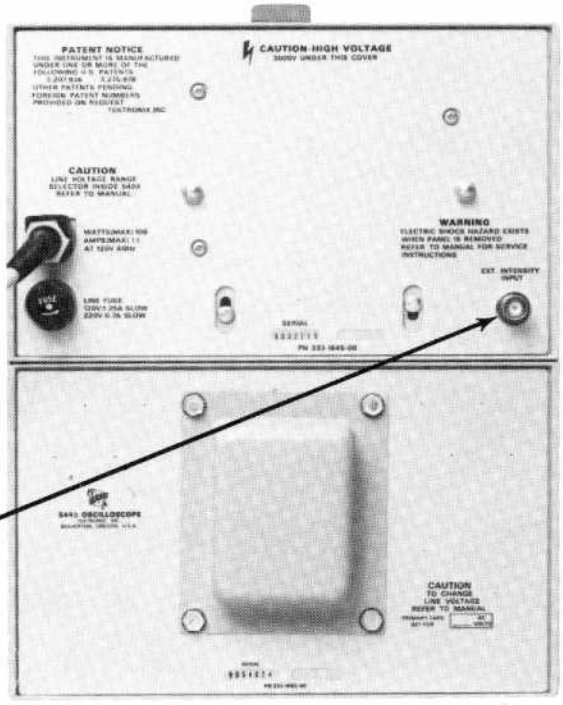
Controls Graticule illumination.

POWER Switch

Turns instrument power on or off.

CALIBRATOR Loop

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



EXT INTENSITY INPUT Connector

Permits application of Z-axis signals to the CRT (DC coupled). Positive-going signal increases intensity.

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

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4. Advance the INTENSITY control until the trace is at the desired viewing level. The trace should appear near the graticule center.

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

6. Turn the Main Trig Level control clockwise until a stable display is obtained. Adjust the vertical and horizontal Position controls so that the display is centered vertically and starts at the left edge of the graticule.

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

8. Disconnect the input signal and position the trace vertically so that it coincides with the center horizontal line of the graticule.

9. If the trace is not parallel with the center horizontal line, see Trace Alignment Adjustment 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 trace two divisions below graticule center and reconnect the calibrator signal to the amplifier plug-in input connector.

12. The display 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 oscillosocpe mainframe or plug-ins need to be recalibrated.

Readout

13. Turn the READOUT INTENS control clockwise until an alphanumeric display is visible within the top or bottom division of the crt (reset the FOCUS adjustment if necessary for best definition of the readout). Change the Volts/Div switch of the amplifier plug-in that is selected for display. Notice that the readout portion of the display changes as the deflection factor is changed. Likewise, change the Sec/Div switch of the time-base unit that is selected for display. Notice that the readout display for the time-base unit changes also as the sweep rate is changed.

14. Set the time-base unit for magnified operation. Notice that the readout display changes to indicate the correct magnified sweep rate. If a readout-coded 10X probe is available for use with the vertical unit, install it on the input connector of the vertical plug-in. Notice that the deflection factor indicated by the readout is increased by 10 times when the probe is added. Return the time-base unit to normal sweep operation and disconnect the probe.

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 appears within the lower division of the crt below the readout for Channel 1.

Beam Finder

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

17. Push the BEAM FINDER button and observe that the display compresses into the screen area. Reposition the display to screen center and release the BEAM FINDER button.

External Intensity Input

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

19. Slowly rotate the INTENSITY control counter-clockwise until the trace appears to be a series of dimmed and brightened segments. The brightened segments correspond with the tops of the calibrator squarewaves.

GENERAL OPERATING INFORMATION

Display Focus

If a well-defined display cannot be obtained with the FOCUS control, even at low intensity settings, adjustment of the internal astigmatism control may be required.

To check for proper setting of the Astig control, slowly turn the FOCUS control through the optimum setting with a signal displayed on the crt screen. If the 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 a free-running trace is not parallel with the horizontal graticule lines, set the Trace Rotation adjustment (internal adjustment) as follows: Position the trace to the center horizontal line and adjust the Trace Rotation adjustment so that the trace is parallel with the horizontal graticule lines.

Beam Finder

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

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

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

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

Readout (Works Only With 5400-Series Plug-In Units)

The readout system of the power supply/amplifier and display modules allows alphanumeric 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 beam on a time-shared basis with the signal waveforms.

The Readout System operates in a free-running mode to interrupt the waveform display to present characters. The waveform display is interrupted for only about 20 microseconds for each character that is displayed.

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. 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. 1-2 shows the area of the graticule where the readout from each plug-in unit channel is displayed (external readout 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 within 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.

The READOUT INTENS 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 position. This may be desirable when the top and bottom divisions of the graticule are to be used for waveform display, or when the trace interruptions necessary to display characters do not allow a satisfactory 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 5440 through which two ten-character readout words can be displayed on the crt, see Fig. 1-2.

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.

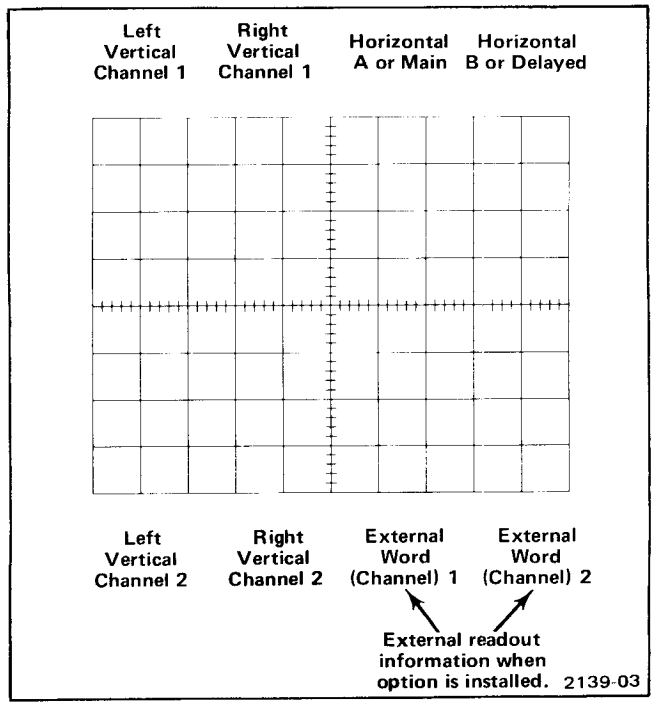


Fig. 1-2. Location of readout on the crt identifying the originating plug-in unit and channel (and external, if Option 3 is installed).

NOTE

At sweep rates faster than approximately 1 μs, the 5B10, 5B12, and 5B13 Time Base plug-in trigger circuit will not respond fast enough, when used in a 5440, 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 will not allow the use of the composite trigger mode of the 5B10, 5B12, and 5B13 Time Base plug-ins when used in the 5440. If the time base units are put in this mode, they will trigger off the left vertical plug-in only.

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

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

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

Vertical Display Mode

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

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

Chopped Mode. The Chop position of the time-base unit Display switch produces a display that is electronically switched between channels at a 100-kilohertz rate. The switching sequence is discussed earlier. In general, the Chop mode provides the best display at sweep rates slower than about one millisecond/diviision or whenever dual-trace, single-shot phenomena are to be displayed. At faster sweep rates, the chopped switching becomes apparent and may interfere with the display.

Dual-Sweep Displays. When a dual-sweep time-base unit is operated in the horizontal compartment, the alternate and chopped time-shared switching for either the A or B sweep is identical to that for a single time-base unit. However, if both the A and B sweeps are operating, the 5440 operates in the independent pairs mode. Under this condition, the left vertical unit is always displayed at the sweep rate of the A time base and the right vertical unit is displayed at the sweep rate of the B time-base (non-delayed sweep only). This results in two displays that have completely independent vertical deflection and chopped or alternate sweep switching.

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 5440 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.

Raster Display

A raster-type display can be used to effectively increase the apparent sweep length. For this type of display, the trace is deflected both vertically and horizontally by sawtooth signals, and is accomplished by installing a 5B-series time-base unit in the left vertical compartment, as well as one in the horizontal compartment. Normally, the unit in the vertical compartment should be set to a slower sweep rate than the one in the horizontal compartment; the number of horizontal traces in the raster depends upon the ratio between the two sweep rates. Information can be displayed on the raster using the Ext Intensity Input to provide intensity modulation of the display. This type of raster display can be used to provide a television-type display.

Intensity Modulation

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

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

Calibrator

The internal calibrator of the 5440 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 5440 provides integral mounting for a Tektronix oscilloscope camera. The instruction manuals for the Tektronix oscilloscope cameras include complete instructions for obtaining waveform photographs.

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 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. The instrument should be operated with the panels in place to protect the interior from dust, and to eliminate shock hazard.

TABLE 1-1

Power Cord Conductor Identification

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

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. 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. 1-3) and replace it with the other block. Remove the line fuse from the fuse holder located on the rear panel 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 receptacle or use an adapter.

NOTE

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

4. To change 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 1-2).

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

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 1-2

Regulating Ranges for Power Transformer

Line Selector Block Position	Regulating Range	
	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	1.25 A slow-blow	0.7 A slow-blow

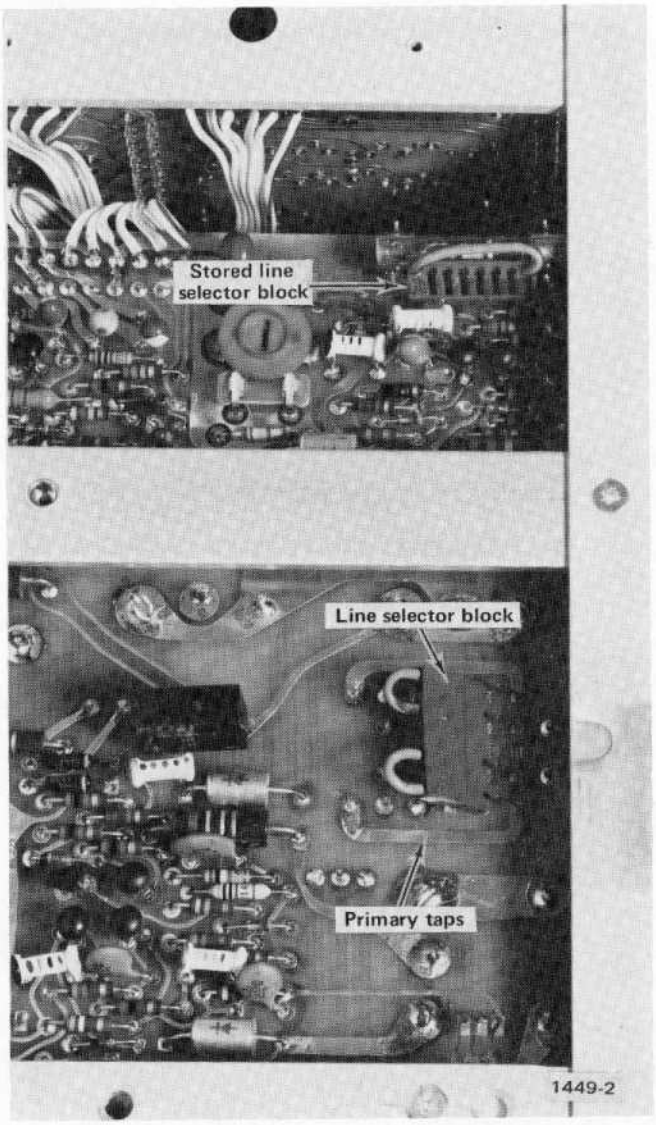


Fig. 1-3. Location of the line-selector block on the Power Supply circuit board.

INSTRUMENT CONVERSION

The 5440 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 parts, and instructions are available and can be installed at a later time. See your Tektronix Catalog or contact your Tektronix field office.

NOTE

Before attempting 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 2.

Mounting Method

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

Rack Dimensions

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

Width. A standard 19-inch wide rack may be used. The dimension of opening between the front rails must be at least 17-5/8 inches for a cabinet in which the front lip of the stationary section is mounted behind an untapped front rail as shown in Fig. 1-4A. If the front rails are tapped, and the stationary section is mounted in front of the front rail as shown in Fig. 1-4B, the dimension between the front rails should be at least 17-3/4 inches. These dimensions allow room on each side of the instrument for the slide-out tracks to operate so the instrument can move freely in and out of the rack.

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

Installing The Slide-Out Tracks

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

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

NOTE

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

2. Or, front and rear rail holes must be tapped to accept a 10-32 screw if Fig. 1-4B mounting method is used. Note in Fig. 1-4B right illustration that a No. 10 washer (not supplied) may be added to provide increased bearing surface for the slide-out track stationary section front flange.

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

Mounting Procedure. Use the following procedure to mount both sides. See Fig. 1-4 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. 1-5 as a guide.

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

(a) If the front flanges of the stationary sections are to be mounted behind the front rails (rails are countersunk or not tapped), mount the stationary sections as shown in Fig. 1-4A 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. 1-4B right illustration. To provide increased bearing surface for the screw head to securely fasten the front flange to the rail, a flat washer (not supplied) may be added under the screw head. However, if this mounting method is used, the front panel will not fit flush against the front rail because of the stationary section and washer thickness. If a flush fit is preferred, method 2 (a) should be used.

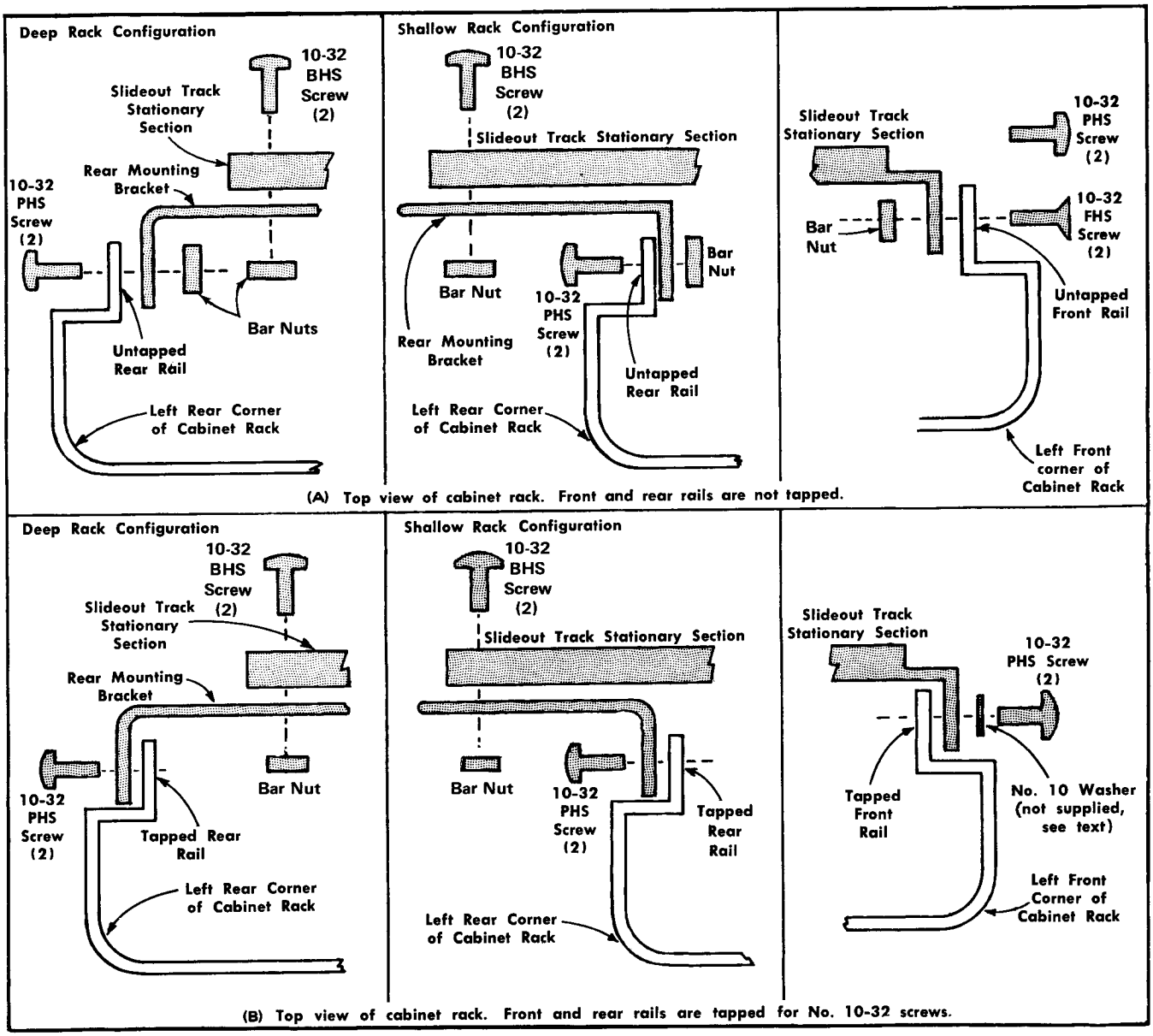


Fig. 1-4. Mounting the left stationary section (with its matched intermediate section, not shown in illustrations A and B) to the rack rails.

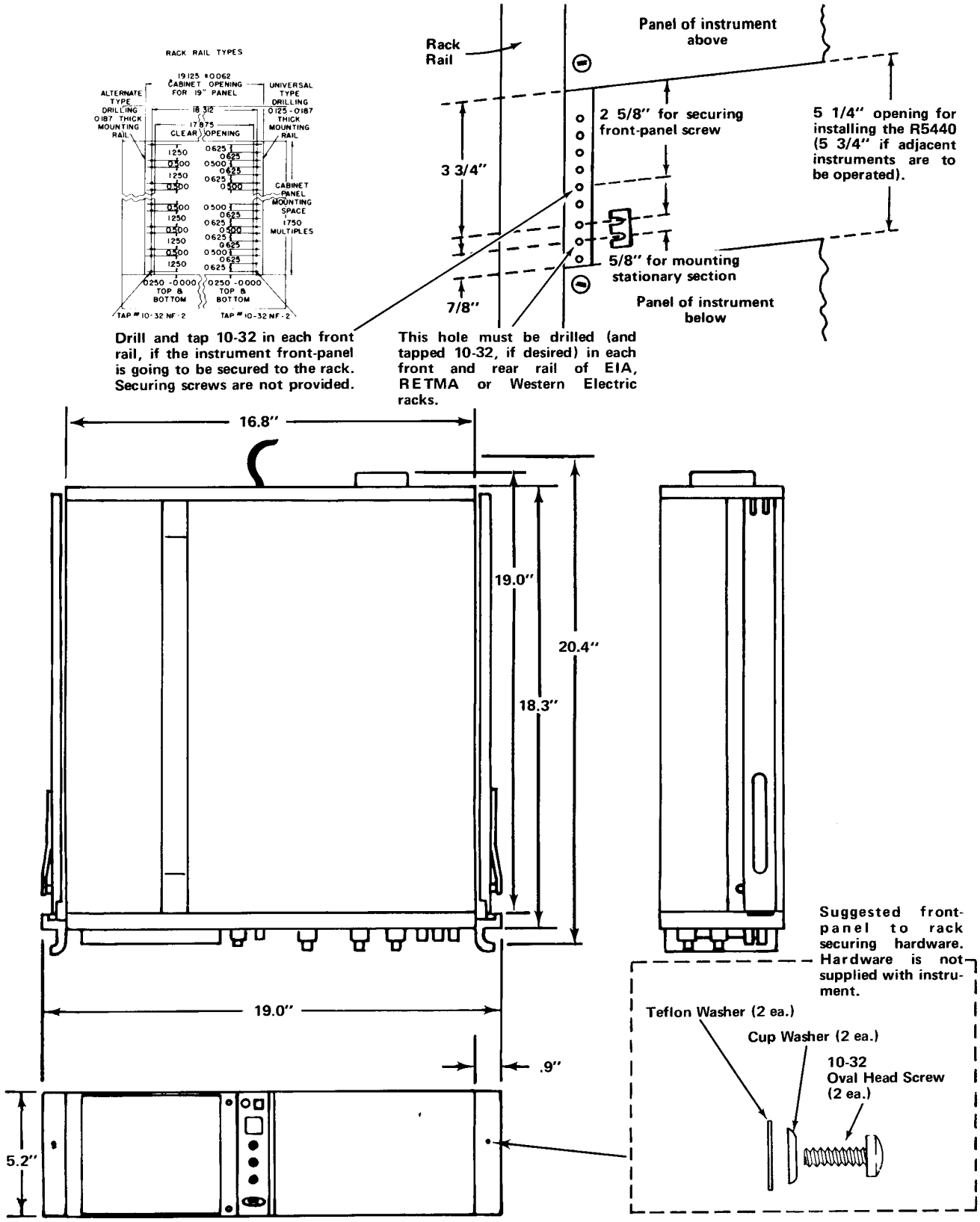


Fig. 1-5. Dimensional diagram.

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. 1-4A. 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. 1-4A 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. 1-4B. 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. 1-4B 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.

Installation And Adjustment

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

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

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

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

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

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

To secure the instrument front-panel to the rack, the rack must either have universal hole spacing, or a hole must be drilled and tapped for a 10-32 screw, see Fig. 1-5. Using the hardware (not furnished) indicated in Fig. 1-5, secure the R5440 to the front rails of the rack.

Slide-Out Track Maintenance

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

OPERATING TEMPERATURE

The 5440 can be operated where the ambient air temperature is between 0°C and +50°C. The instrument can be stored in ambient temperature between −40°C and +70°C. After storage at a temperature beyond the operating limits, allow the chassis temperature to come within the operating limits before power is applied.

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

PLUG-IN UNITS

The 5440 is designed to accept up to three Tektronix 5000-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 disengage it and pull the unit out of the plug-in compartment. 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 gain are standardized. This allows adjusted plug-in units to be changed from one plug-in compartment to another without readjustment. However, the basic adjustment of the individual plug-in units should be checked when they are installed in this system to verify their measurement accuracy. See the 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 single-channel operation) in either of the vertical (left or center) compartments and a time-base unit in the horizontal (right) compartment. For dual-trace displays, either install a dual-channel vertical unit in one of the vertical compartments or install a single-channel vertical unit in each vertical compartment. A combination of a single-channel and a dual-channel vertical unit allows a three-trace display; likewise, a combination of two dual-channel vertical units allows a four-trace display.

To obtain a vertical sweep with the input signal displayed horizontally, insert the time-base unit into one of the vertical compartments and the amplifier unit in the horizontal compartment. If a vertical sweep is used, there is no retrace blanking and the time-base unit triggering must be accomplished externally.

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

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

BASIC OSCILLOSCOPE APPLICATIONS

The 5400-series oscilloscope and its associated plug-in units provide a very flexible measurement system. The capabilities of the overall system depend mainly upon the plug-ins that are chosen. The following information describes the techniques for making basic measurements. These applications are not described in detail, since each application must be adapted to the requirements of the individual measurement. Specific applications for the individual plug-in units are described in the manuals for these units. Contact your local Tektronix Field Office or representative for additional assistance.

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

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

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

Robert G. Middleton, "Scope Wavefrom 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. 1-6).

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 settings of 5 V.

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

NOTE

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

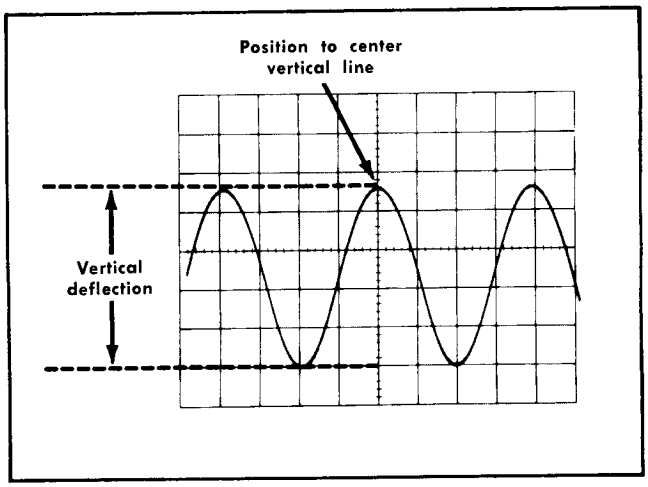


Fig. 1-6. Measuring peak-to-peak voltage of a waveform.

Instantaneous Voltage Measurement—DC

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

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

NOTE

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

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

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

4. Measure the distance in divisions between the reference line and the point on the waveform at which the dc level is to be measured. For example, in Fig. 1-7 the measurement is made between the reference line and point A.

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

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

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

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

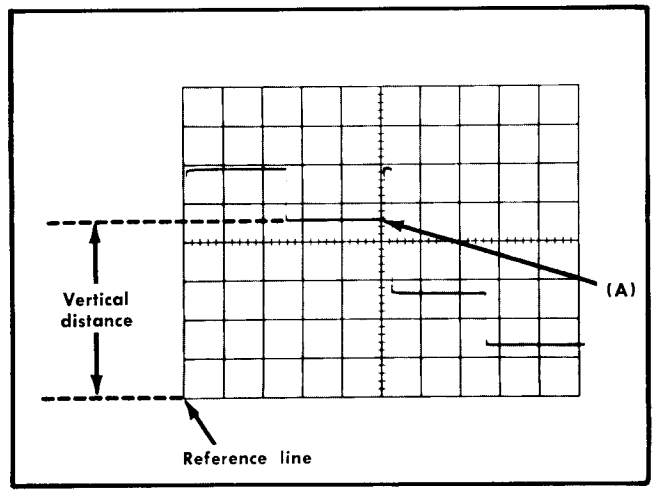


Fig. 1-7. Measuring instantaneous dc voltage with respect to a reference voltage.

Comparison Measurements

In some applications, it may be necessary to establish a set of deflection factors other than those indicated by the Volts/Div or 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.

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

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

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

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

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

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

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

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

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

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

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

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

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

Sweep Rate

1. Apply a reference signal of known 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.

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

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

4. Set the Sec/Div switch to a setting that provides 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.

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

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 μs) (1.375) = 68.75 microseconds/division

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

(68.75 μs) (7) = 481 microseconds

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

Time Period Measurement

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

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

2. Set the time-base triggering controls to obtain a stable display. Set the Sec/Div switch to the fastest sweep rate that will permit displaying one cycle of the waveform in less than eight divisions (some non-linearity may occur in the first and last graticule divisions of display). Refer to Fig. 1-8.

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:

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

The period is 0.5 millisecond.

Determining Frequency

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

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

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

EXAMPLE: The frequency of the signal shown in Fig. 1-8, which has a period of 0.5 millisecond is:

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

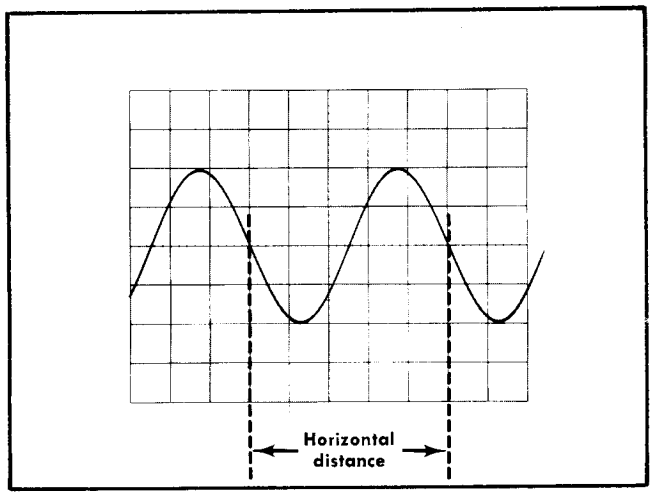


Fig. 1-8. Measuring time duration (period) between points on a waveform.

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. 1-9).

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.

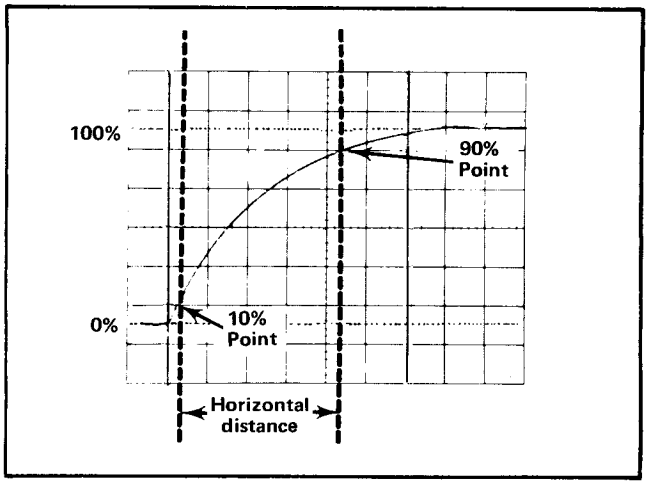


Fig. 1-9. Measuring risetime.

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

Using the period formula to find risetime:

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

The risetime is 4 microseconds.

Time Difference Measurements

When used in conjuction with a calibrated time-base plug-in unit, the multi-trace feature of the 5400-series oscilloscope permits measurement of time difference between two or more separate events. To measure time difference, use the following procedure:

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

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

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

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

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

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

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

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

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

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

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 is four divisions. Using the formula:

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

The time delay is 200 microseconds.

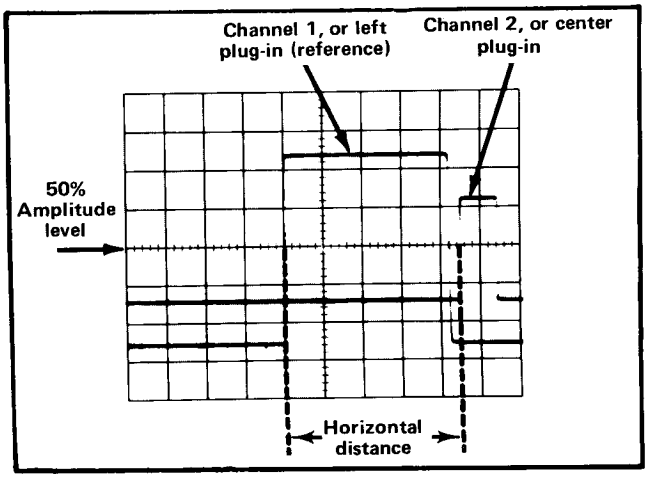


Fig. 1-10. Measuring time difference between two pulses.

Multi-trace Phase Difference Measurement

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

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

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

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

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

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

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

7. Set the time-base triggering controls to obtain a stable display. Set the 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, or left plug-in) occupies exactly eight divisions between the second and tenth vertical lines of the graticule (see Fig. 1-11). Each division of the graticule represents 45° of the cycle (360° ÷ 8 divisions =45°/division). The sweep rate can be stated in terms of degrees as 45°/division.

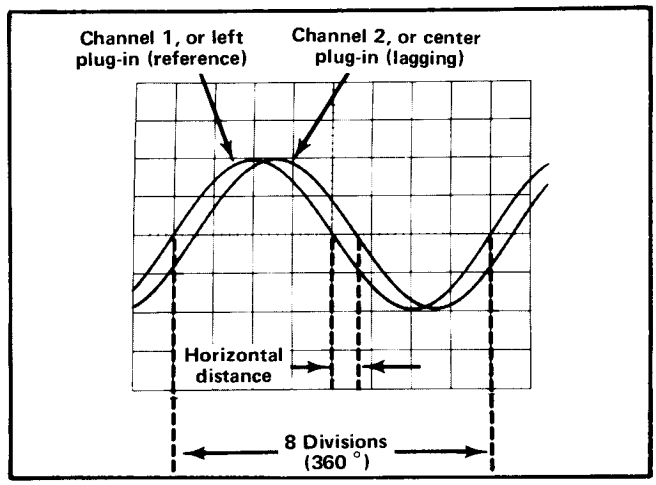


Fig. 1-11. Measuring phase difference.

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

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

EXAMPLE: Assume a horizontal difference of 0.6 division with a sweep rate of 45°/division as shown in Fig. 1-11. Use the formula:

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

The phase difference is 27°.

High Resolution Phase Measurement

More accurate dual-trace phase measurements can be made by increasing the sweep rate (without changing the variable 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. 1-12 shows the same signals as used in Fig. 1-11, but with the Swp Mag button pushed in. With a horizontal difference of six divisions the phase difference is:

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

The phase difference is 27°.

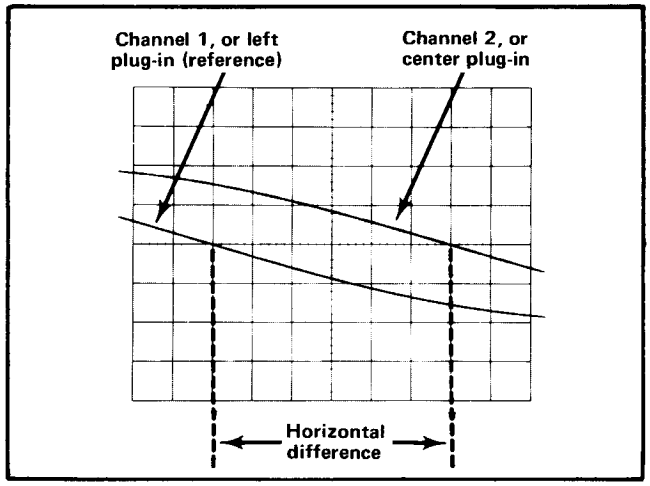


Fig. 1-12. High-resolution phase difference measurement with increased sweep rate.

SPECIFICATION AND PERFORMANCE CHECK

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.

SPECIFICATION

TABLE 2-1
Vertical Amplifier

Characteristics	Performance Requirements	Supplemental Information
Input Signal Amplitude (Differential)		50 mV/division ±2%. Less than 0.5% difference between left and right vertical plug-in compartments.
Bandwidth (6-Division Reference)	Dc to at least 90 MHz with a 067-0680-00 Calibration Fixture. Dc to at least 60 MHz with a calibrated 5A48.	
Risetime (6-Division Reference)	3.9 ns or less with a 067-0680-00 Calibration Fixture. 5.8 ns or less with a calibrated 5A48.	
Aberrations (6-Division Reference)	6% or less measured with a 067-0680-00 Calibration Fixture. 3% or less measured with a calibrated 5A48.	
Position Effect on Aberrations (6-Division Reference with a 067-0680-00 Calibration Fixture)		Front corner aberrations of +step or −step response signal should not exceed ±6% when the waveform is positioned not more than 1 division beyond graticule center.
Vertical Centering		Within ±0.5 division of graticule center.
Delay Line Length		140 ns.
Modes	Chop and Alt.	
Rate		
Chop	50 kHz +50% −30%; 3 μs on, 2 μs off.	
Alt	Once every two sweeps.	

TABLE 2-2

Horizontal Amplifier

Characteristics	Performance Requirements	Supplemental Information
Bandwidth	Dc to at least 2 MHz.	8-division signal used as a reference.
Horizontal Centering		Within 0.5 division of graticule center.
X-Y Operation	Less than 2° phase shift from dc to at least 20 kHz.	

TABLE 2-3

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 2-4

Display

Characteristics	Performance Requirements	Supplemental Information
Geometry	Bowing or tilt ≤ 0.1 division.	
Orthogonality	90° ±0.7°.	
Photographic Writing Rate	90 cm/μs, using a C-59 camera and Polaroid 3000 speed film.	
Phosphor	P31 standard; P7 and P11 optional.	
Deflection	Electrostatic, with mesh magnification.	
Acceleration Potential	15 kV.	

@

TABLE 2-5

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	100 W maximum at 120 V ac, 60 Hz.	
Fuse Data	1.25 A slow blow (120 V ac). 0.7 A slow blow (240 V ac).	
Calibrator		
Voltage	400 mV, ±1%.	
Current	4 mA, ±1%.	
Frequency	Twice the power line frequency.	

TABLE 2-6

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 2-7

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.	
Optional	Black internal graticule lines.	
Beam Finder	Limits trace within viewing area and intensifies trace.	

TABLE 2-8

Environmental

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

TABLE 2-9

Physical

Parameter	Information
Finish	Anodized aluminum panel with gray vinyl coated frame. Blue-vinyl coated cabinet.
Net Weight of Cabinet Version with Feet and Handle	25 lbs (11 kg).
Overall Dimensions	See Fig. 2-1.
Overall rack depth	19 inches.

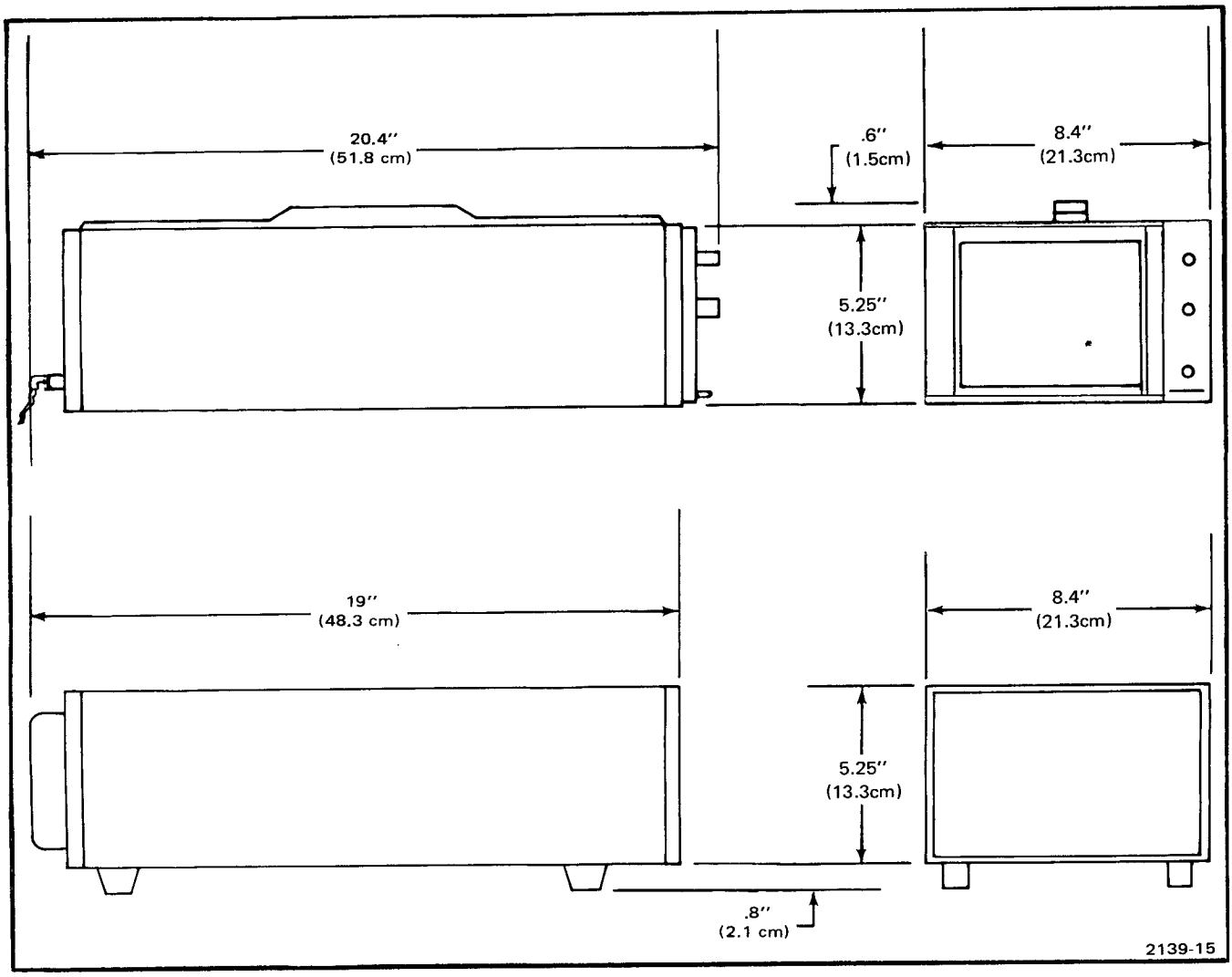


Fig. 2-1. Illustration showing dimensions of the cabinet version of the 5440.

POWER TO EXTERNAL EQUIPMENT

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

Table 2-10 lists the maximum current draw and Main Interface pin assignment for only those power supply voltages recommended for operating external electronic equipment.

TABLE 2-10
Power Available to External Equipment

Power Supply Voltage	Maximum Current	Main Interface Pin Number
+200 V	30 mA	A1
+30 V	240 mA	A5
+15 V	600 mA	A6
+5 V	1.5 A	B2
−15 V	600 mA	B6
−30 V	240 mA	B5

PERFORMANCE CHECK

Introduction

This procedure checks the 5440 electrical characteristics against the performance requirements that appear in the Specification section of this manual. If the instrument fails to meet the requirements given in this performance check, the adjustment procedure should be performed. This procedure can also be used by an incoming inspection facility to determine acceptability of performance.

Tolerances that are specified in this performance check procedure apply to the instrument under test and do not include test equipment error.

Test Equipment Required

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

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

TABLE 2-11

List of Test Equipment Requirements

Description	Performance Requirements	Application	Examples
Oscilloscope	Bandwidth dc to 1 MHz; minimum deflection factor, 1 mV/div; sweep rate, 1 ms/div.	LV power supply ripple check.	a. Tektronix 5110, 5A13N, 5B10N.
Digital voltmeter[1]	Range, zero to 200 volts; accuracy, within 0.1%.	LV power supply check and adjustment.	a. Tektronix DM 501 Digital Multimeter.[2]
DC voltmeter (vom)[1]	Range, zero to 3000 volts; accuracy, checked to within 1% at 3000 volts.	HV power supply check.	a. Triplett Model 630NA. b. Simpson Model 262
Calibration generator	Amplitude calibration, 10 mV to 1 V; accuracy, ±0.25% into 1 MΩ output, square wave at approximately 1 kHz.	Vert and Horiz gain check and adjustment.	a. Tektronix PG 506 Calibration Generator.[2]
Time-mark generator	Marker outputs, 5 ns and 10 ns; accuracy, within 1%.	Sweep timing checks and adjustment at 5 and 10 ns.	a. Tektronix TG 501 Time-Mark Generator.[2]
Pulse generator	Pulse duration, 10 ns or less; pulse amplitude, .5 V to at least 5 V into 50 Ω load.	Vert compensation check and adjustment.	a. Tektronix PG 501 Pulse Generator.[2]
Medium-frequency signal generator	Sinewave output, to at least 60 MHz, leveled; output amplitude 5 V p-p; accuracy, 2%.	Vertical bandwidth check.	a. Tektronix SG 503 Signal Generator.[2]

TABLE 2-11 (cont.)

List of Test Equipment Requirements

Description	Performance Requirements	Application	Examples
Amplifier plug-in unit[3]	Bandwidth, dc to 60 MHz; display mode, CH 1 and dual-trace; deflection factor, 5 mV to 10 V/div.	Vert and Horiz gain check and adjustment.	a. Tektronix 5A48 Amplifier plug-in unit.
Time-base unit	Sweep rate, at least 5 ns/div.	Sweep timing check and adjustment. Used to provide sweep throughout procedure.	a. Tektronix 5B44 Time-Base unit.
Calibration fixture	Produces gain-check and pulse-response waveforms.	Vert and Horiz gain check and adjustment.	a. Tektronix Calibration Fixture 067-0680-00.
Coaxial cable (2 required)	Impedance, 50 Ω; length, 42 inch; connectors, bnc.	Provides signal interconnection.	a. Tektronix part 012-0057-01.
1X passive probe	Compatible with 5A-series amplifiers used in the oscilloscope.	Calibrator signal check.	a. Tektronix P6028 Probe.
Termination	Impedance, 50 Ω; accuracy, within 2%; connectors, bnc.	Vert check and adjustment.	a. Tektronix part 011-0049-01.
T-connector	Connectors, bnc.	External Z-axis amplifier check.	a. Tektronix part 103-0030-00.
Screwdriver	3-inch shaft, 3/32 inch bit.	Adjustments.	a. Xcelite R3323.

[1]**Required only for Adjustment procedure. A high-voltage probe can be used with the DM501 in lieu of the DC voltmeter. Order 010-0277-00.**
[2]**Requires TM 500-Series Power Module.**
[3]**Additional amplifier, such as 5A24N, required to check dual amplifier operation.**

Preliminary Procedure

1. Ensure that the line voltage selector block has been installed on the correct line selector pins on the Low Voltage and Calibrator circuit board and that the regulating range includes the applied line voltage. Refer to the Operating Voltage section of this manual.

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

3. If applicable, install the TM 500-series test equipment into the test equipment Power Module.

4. Install a vertical amplifier unit into the left vertical compartment of the 5440.

5. Install a time-base unit in the horizontal compartment of the 5440.

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

Initial Control Settings

Set the following controls during warm-up time:

Oscilloscope

Intensity, Focus	Set for well-defined trace and normal brightness.

Amplifier Plug-In

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

Time Base Plug-In

Display	Alternate.
Position	Centered.
Main Sec/Div	1 ms.
Main Variable	Cal.
Swp Mag	Off.
Triggering	+ Slope, Auto Trig, AC Coupl.
Trig Source	Left.

PERFORMANCE CHECK PROCEDURE

1. Check Trace Alignment

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

b. CHECK—For alignment error of .1 division or less.

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

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

e. Position the vertical trace over the center vertical graticule line.

f. CHECK—For alignment error of .1 division or less.

2. Check Geometry

a. Set the FOCUS and INTENSITY controls for a well-defined trace, extending vertically above and below the graticule area.

b. CHECK—Vertical bowing and tilt of the trace display is less than .1 division when positioned horizontally across the entire graticule area.

c. Press the POWER switch to turn off the Oscilloscope and interchange the amplifier and time-base units.

d. Pull the POWER switch to on.

3. Check Beam Finder

a. Press the BEAM FINDER switch.

b. CHECK—The display is compressed within the graticule area and is intensified.

c. Press and hold the BEAM FINDER switch in, then rotate the position control of the vertical amplifier and the time-base unit fully clockwise and counterclockwise.

d. CHECK—The display is compressed within the graticule area and is intensified.

4. Check Trigger Amplifier

a. Connect a 60 MHz sine-wave signal from the MF (Medium Frequency) generator to the vertical amplifier input, using a 42 inch bnc cable and a 50 ohm termination.

b. Set the vertical amplifier and generator controls to obtain a signal amplitude of 1 major division.

c. Set the time-base unit for 20 ns/div (SWP MAG on) and adjust the trig level control for a stable display.

d. CHECK—That a stable display can be obtained.

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

f. Pull the POWER switch to on, select the right trigger source, and repeat parts b through d of this step.

g. Disconnect the bnc cable and termination from the vertical amplifier input connector and release the SWP MAG pushbutton.

5. Check Alternate Operation

a. Push both CH 1 and CH 2 pushbuttons in.

b. Set the time-base unit for 10 ms/div and position the traces about two divisions apart.

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

d. CHECK—Trace alternation at all sweep rates (except AMP position). At faster sweep rates, alternation is not apparent; instead, display appears as two traces on the screen.

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

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

6. Check Chop Operation

a. Push the CHOP button in on the time-base unit.

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

c. CHECK—For dual-trace display at all sweep rates, without alteration (except AMP position).

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

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

7. Check Alternate Operation Between Amplifiers

a. Install a second vertical dual-trace plug-in unit in the left plug-in compartment and set its controls for dual-trace operation.

b. Set the time-base Chop pushbutton to its out position and the Sec/Div switch to 20 ms/div.

c. CHECK—For two traces for the left amplifier (one for each channel), then two traces for the center amplifier, alternately. (If a single-channel amplifier is used instead of the second dual-trace amplifier, the single-channel trace will appear twice for each alternation.)

d. Press the POWER switch to turn off the Oscilloscope and interchange the two vertical amplifiers in their respective compartments. Remove the vertical amplifier from the center compartment. Pull the POWER switch to on.

NOTE

The 5A48 is used for the vertical system performance procedure. When a different amplifier plug-in is used to verify vertical specifications, the oscilloscope system frequency response may be degraded.

8. Check Vertical Gain

a. Connect a 1 kHz square-wave signal from the calibration Generator to the amplifier input, using a 42-inch bnc cable. Set the time-base Sec/Div to 1 ms.

b. Set the amplifier and generator controls to obtain a five-volt reference signal. Center the display.

c. CHECK—The crt display for a vertical deflection of 5 divisions ±0.15 division (±3%).

d. Press the POWER switch to turn off the Oscilloscope and remove the amplifier from the left vertical compartment and install it in the center compartment. Pull the POWER switch to on.

e. CHECK—The crt display for a vertical deflection of 5 divisions ±0.15 division (±3%).

f. Disconnect the bnc cable from the 5A48 input connector.

9. Check Vertical Compensation

a. Set the amplifier CH 1 VOLTS/DIV switch to .1. Connect the pulse generator to the CH 1 input connector with the 42 inch cable and a 50 ohm termination.

b. Set the time-base unit for a calibrated sweep rate of 20 ns/div and triggering for auto mode, ac coupled, and RIGHT trigger source. Adjust the trigger level control for a stable display, triggered on the rising portion of a 1 MHz pulse. Center the pulse horizontally on the graticule.

c. CHECK—For optimum square leading corner and flat top on a 5-division displayed pulse with aberrations not to exceed +0.15 or −0.15 division, with total peak-to-peak aberrations not to exceed 0.15 division.

d. Press the POWER switch to turn off the Oscilloscope and install the amplifier in the left compartment. Pull the POWER switch to on.

e. Push in the LEFT Trigger Source button. Adjust trigger level control for a stable display, triggered on the rising portion of the pulse. Center the pulse horizontally on the graticule.

f. CHECK—For optimum square leading corner and flat top on a 5-division displayed pulse with aberrations not to exceed +0.15 or −0.15 division, with total peak-to-peak aberrations not to exceed 0.15 division.

10. Check Vertical Bandwidth

a. Disconnect the bnc cable from the pulse generator and connect it to the output connector of the MF generator.

b. Set the amplifier VOLTS/DIV switch to .1 and adjust the MF generator controls for a 6-division display, at a frequency of 50 kHz. Center the display on the graticule.

c. Set the time-base unit for a sweep rate of 10 μs/div.

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

e. CHECK—The generator for a reading of at least 60 megahertz.

f. Press the POWER switch to turn off the Oscilloscope and install the amplifier in the center compartment. Pull the POWER switch to on.

g. Repeat parts b through e for the center vertical compartment.

h. Disconnect the bnc cable and termination from the amplifier input connector.

NOTE

The 5A48 amplifier is used for the horizontal system adjustment procedure. When a different amplifier plug-in is used to verify horizontal specifications, the amplifier frequency must be considered.

11. Check Horizontal Gain

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

b. Connect a 1 kHz square-wave signal from the Calibration Generator to the amplifier input connector, using a 42 inch bnc cable.

c. Set the amplifier and generator controls to obtain a five-volt reference signal. Center the display between the second and seventh vertical graticule lines.

d. CHECK—The crt display for a horizontal deflection of 5 divisions ±0.15 division.

e. Disconnect the bnc cable from the amplifier input donnector.

12. Check Horizontal Bandwidth

a. Connect a 50 kHz sine-wave signal from the MF generator to the amplifier input, using a 42 inch bnc cable and 50 ohm termination.

b. Set the amplifier and generator controls to obtain a 6-division display. Center the display between the second and eighth vertical graticule lines.

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

d. CHECK—The generator for a reading of at least 2 megahertz.

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

13. Check 10 ns Timing

NOTE

A 5B42 time-base or a time-base having a 10 ns sweep must be used.

a. Disconnect the bnc cable and 50 ohm termination from the amplifier input connector and connect the time-mark generator signal to the input connector.

b. Set the time-mark generator for 10 nanosecond markers. Set the deflection factor of the amplifier so the markers are at least five divisions in amplitude.

c. Set the time-base unit for a sweep rate of 10 ns/div. Adjust the time-base triggering control for a stable display.

d. CHECK—For one 10 nanosecond marker per division over the center eight graticule divisions of the display (position as necessary). Sweep accuracy is ±5% over the entire sweep, excluding the first 30 and the last 100 ns of the magnified sweep.

14. Check 5 ns Timing

NOTE

This step can be performed only with a time-base unit having a 5 ns sweep rate, such as Tektronix 5B44.

a. Press the POWER switch to turn off the Oscilloscope and install an appropriate time-base unit in the horizontal compartment. Pull the POWER switch to on.

b. Set the time-base unit for a sweep rate of 5 ns/div. Adjust the time-base triggering control for a stable display.

c. CHECK—For one 5 nanosecond marker per division over the center eight graticule divisions of the display (position as necessary). Sweep accuracy is ±6% over the entire sweep, excluding the first 30 and the last 100 ns of the magnified sweep.

d. Disconnect all cables.

NOTE

If the Readout System was deleted from the instrument (Option 1), omit step 15.

15. Check Readout Modes

a. Set the time-base unit for a free-running sweep.

b. Set the READOUT INTENSITY control for a visible readout display.

c. Select dual-trace operation on the amplifier.

d. CHECK—That the characters are displayed at the top and bottom of the crt. Characters do not touch or overlap and they correlate to the respective volts/div dial settings.

e. Rotate both CH 1 and CH 2 CAL controls counterclockwise.

f. CHECK—That a > symbol is displayed at the left of the readout character. Return the CAL controls to the calibrated position (fully clockwise).

g. Rotate the time-base MAIN SEC/DIV control throughout its range.

h. CHECK—That the characters are displayed at the top-center of the crt. Characters do not touch or overlap and they correlate to the respective s/div dial settings.

i. Rotate the MAIN VARIABLE control counterclockwise.

j. CHECK—That a > symbol is displayed at the left of the readout character. Return the control to the calibrated position (fully clockwise).

k. Push the DLY'D SWP pushbutton in on the time-base unit.

l. CHECK—That characters are displayed at the top-right of the crt and that characters do not touch or overlap and they correlate to the dly'd swp s/div dial settings.

m. Push the Display Mode button to MAIN SWP.

16. Check Calibrator Signal

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

b. Set the amplifier CH 1 Volts/Div switch to .1, and select CH 1.

c. Set the time-base sweep rate to 5 ms/div.

d. CHECK—The crt display for a vertical deflection of 4 divisions ±0.04 division.

e. Disconnect the 1X probe.

17. Check Z Axis Amplifier

a. Connect a 50 kHz sine-wave signal from the generator to the amplifier input connector (use a bnc T connector at the amplifier input), using a 42 inch bnc cable.

b. Set the amplifier and generator controls to obtain a calibrated five volt reference display.

c. Set the time-base unit for auto, internal triggering at a sweep rate of 10 μs/div.

d. Connect the signal from the output of the T connector at the amplifier input to the EXT INTENSITY INPUT connector on the rear panel.

e. CHECK—The bottom portion of the waveform is blanked out (reduce trace brightness to observe Z axis modulation).

f. Turn off all equipment and remove all plug-ins and cables.

This completes the Performance Check of the 5440 Oscilloscope.

CIRCUIT DESCRIPTION

Introduction

This section of the manual contains a description of the circuitry used in the 5440 oscilloscope. Individual descriptions are separated into the following parts: Interface, Vertical Amplifier, Horizontal Amplifier, Z-Axis Amplifier and CRT Circuit, Low-Voltage Power Supply and Calibrator, and Readout System. Refer to the appropriate diagrams in the Diagrams section of this manual while reading the circuit descriptions.

INTERFACE CIRCUIT

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

Chop Oscillator

The chop oscillator produces a 200-kilohertz square-wave signal for chopping between vertical plug-ins and amplifier channels within the plug-ins. This multivibrator circuit consists of U770A, U770B, and associated passive components. When the multivibrator receives a chop actuate level (+5 volts), it free-runs at a 100 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 chop actuate level also disables Q770, locking out alternate-drive pulses. The multivibrator has two outputs; one is sent through buffers to the divider circuit as a timing signal, and the other is sent to the U770D and U770C circuit to blank the chop-switching transients.

Divider Circuit

The divider circuit produces the display switching signal for both the Alternate and Chopped switching modes. This circuit is composed of U780 and its discrete passive components, which is connected as a pair of JK flip-flops. Each flip-flop is a divide-by-two counter, the first one driving the second. The divider circuit is activated by a negative going transition, which can come from either the chop oscillator or from the time-base plug-in unit via grounded-base amplifier Q770. The chop oscillator input results in chopped-mode vertical switching. The input from the time-base unit coincides with the end of each sweep, and results in alternate-mode vertical switching. The output from the divide-by-two portion of the divider circuit, U780A, is sent via contacts B21 of J610 and J620 to the channel-switching circuits incorporated within multi-trace vertical plug-in units. The outputs from the divide-by-four portion of the divider circuit, U780B, are used for plug-in switching; one output is sent to pin 4 of the vertical integrated switching circuit to produce plug-in switching and the other output is sent via contact B21 of J630 to produce dual-sweep switching in dual-time-base units. The vertical mode switching sequence and some of the display combination possibilities are discussed in the Operating Instructions section of this manual.

Vertical Amplifier and Vertical Integrated Switching Circuit

Emitter followers Q600, Q604, Q610 and Q614 provide a high-impedance input to the vertical amplifier and vertical integrated switching circuit, U620. The vertical amplifier input resistance for the oscilloscope main frame is determined by R601, R605, R611 and R615.

The vertical integrated switching circuit permits only one of the two vertical plug-in signals to pass to the vertical output amplifier; the level at pin 4 of U620 determines the plug-in signal that is passed to the vertical amplifier. When the Display ON pushbutton (on the right vertical plug-in) is depressed, −30 V is connected to contact B18 of J620, turning Q680 on. This increases the voltage level on pin 4 of U620, allowing the signal from the right vertical plug-in to pass. If the left vertical plug-in is to be displayed, the voltage on pin 4 of U620 is decreased by applying −30 V through contact B18 of J610 to R688. The signal from the left plug-in now passes through U620. If, however, both plug-ins have an "on" logic level, the two logic levels applied to Q680 cancel each other and the signal from the divider circuit controls the plug-in signal passed. In the chopped switching mode, the switching between pairs of amplifiers occurs at a 50 kHz rate (switching occurs on both the negative and positive-going gtransition), and in the alternate mode, switching occurs at the end of every second sweep. If neither plug-in has an "on" logic level, the level at pin 4 of U620 is such that the left plug-in signal passes to the vertical amplifier.

The gain of the vertical amplifier portion of U620 is set by resistors R620 (left plug-in amplifier) and R626 (center plug-in amplifier). The vertical output signal at pins 12 and 13 of U620 goes to a grounded-base stage consisting of Q640 and Q660. Q640 and Q660 change the dc level of the vertical signal so that it is compatible with the vertical amplifier in the Display module. Q630 and Q650 act as both a current source for the grounded base stage and an insertion point for the vertical readout and trace separation information.

Trace separation information from contact B16 of J630 is supplied to the emitter of Q650 via Q674. Trace separation information is only available when a dual time base plug-in is used.

The vertical CH switch OFF signal is supplied to Q670 where it causes Q674 to be reverse biased during readout time, thus blocking the trace separation information. The signal also goes to pin 6 of U620 where it is used to prevent any vertical signal output from U620 during readout time. During the time of the vertical CH switch OFF signal, vertical readout signal information is supplied to the emitter of Q630.

Horizontal Amplifier

The horizontal amplifier consists of an emitter follower stage (Q740, Q744) and a gain stage (Q748, Q752). The gain setting resistor is R750. Thermistor RT754 and resistor R756 provide a temperature compensation network for the amplifier.

Trigger Amplifiers

Left Vertical Plug-In. A nominal 250 mv/division, single-ended, input 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 Q700-Q708 amplifies the signal by 1/4. The second gain stage consists of Q710 and Q715; R713 sets the stage gain. The output signal amplitude of the trigger amplifier 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 5100-series oscilloscope have a high input impedance, which results in a signal amplitude of 240 mV/division. Time-base plug-ins designed for the 5400-series oscilloscope have a low impedance, which results in a signal amplitude of 50 mV/division.

Right Vertical Plug-In. The right vertical plug-in trigger Amplifier operates the same as described above.

Z-Axis Signal

The gate signal from the A and B sweeps are added on the interface circuit board. The combined A and B gate signal is also summed with the trace intensification and chopped blanking signals before being supplied, via contact 4 of P755, to the display module as the Z-Axis signal. Diode CR761 limits the combined signals on the Z-Axis signal line. C766 and R766, which are in parallel with the input to the Z-Axis amplifier, serve to increase the rise time of the Z-Axis signal.

VERTICAL AMPLIFIER

The vertical amplifier circuit 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, which reduces the final drive to compress an over-scanned display to within the viewing area of the crt.

Delay Line

Delay line DL100 provides approximately 140 ns of delay for the vertical signal.. This allows the time-base circuits time to initate 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 50 ohms, or about 100 ohms from side-to-side.

Amplifier

The vertical amplifier consists of a high bandpass three-stage paraphase amplifier having an input sensitivity of approximately 25 mV/division and a voltage gain of about 160. 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 the emitter resistor R111. The networks parallel to the emitter resistor compensates for the signal losses in the delay lline. R135 acts as a dc centering control, which 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, Q165, and Q172. Thermistor RT157, resistor R157, varicap CR146, and capacitor C160 (between the emitters of Q148 and Q165) form 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. This is accomplished by turning off Q140, when the BEAM FINDER is pushed, which reduces the standing current in the final amplifier stage. Theis 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.

HORIZONTAL AMPLIFIER CIRCUIT

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

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, control 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, within ±10%.

To compress an off-screen display so that it may be viewed on the crt, the BEAM FINDER reduces the dynamic range of the input amplifier. This is done by disconnecting CR208 in the emitter circuitry of Q200-Q215, and supplying a reduced current through current setting 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-Q250 and Q270-Q274-Q280 are connected as two separate current-driven feedback amplifiers. Input transistor Q240 (in the left output amplifier) is an NPN transistor for better response to positive-going signals, while input transistor Q270 (in the right output amplifier) is a PNP transistor for better negative-going signal response.

Negative feedback is provided from the collectors of output transistors Q244-Q250-Q274-Q280 to the base of input transisors Q240 and Q270 through feedback networks C242-R242-R238 and C272-R272-R268. Variable capacitors C242 and C272 adjust the transient response of the feedback networks to provide good linearity at fast sweep rates. The Zener diode fast-switching series diode, 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 amplifier. 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.

Z-AXIS AMPLIFIER AND CRT CIRCUIT

The crt circuit produces the high voltages 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.

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 combinations of several sources, such as INTENSITY control, plug-in interface (unblanking, 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 act 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 T410 and induced into the secondary. Current drive for the primary winding is furnished by Q410. The conduction of Q410 is controlled by the collector voltage of Q400.

High-Voltage Regulation. Regulation is accomplished by sampling the −3 kV across voltage divider R395A-R395B. If the output level of the cathode supply goes above the nominal −3 kV (goes more negative), the input base of Darlington transistor Q390 goes negative from its quiescent 0 V. The output of Q390 goes more positive, reducing the conduction of Q400 and Q410. This reduces the peak-to-peak sinusoidal signal amplitude, resulting in a reduced voltage in the secondary of T410. Conversely, if the output drops below −3 kV (goes more positive), Q410 will conduct more, i.e., have a larger sinusoidal signal amplitude. CR395 and C395 form a delay turn-on circuit to prevent the crt beam from coming on immediately at instrument turn-on. The delay time is controlled by the time it takes C395 to charge to +30.6 V through R397 from the +200 V power supply. At the moment the top of C395 reaches +30.6 V, diode CR395 will turn on and clamp the CR395-C395-R397-R395A junction at 30 V. R402 and C402 limit the bandwidth of the regulator to prevent oscillations.

High-Voltage Outputs

The secondary winding of T410 provides the negative and positive accelerating potentials for the crt and the bias voltage for the control grid.

Positive accelerating voltage for the crt anode is supplied by voltage quadrupler U410. The applied voltage to the input of U410 from the T410 secondary winding is about +3 kV peak-to-peak. The output voltage of U410 is about +12 kV at the crt anode. The negative accelerating voltage for the crt cathode is also obtained from the T410 secondary winding. CR412 half-wave rectifies the transformer output and supplies the 3 kV to the crt cathode. R418 connects the crt cathode voltage to the crt filament to prevent cathode-to-filament breakdown.

Diodes CR420 and CR422 provide the rectified negative control voltage for the crt control grid. The output level of this supply is set by the Intens Range adjustment, R435. Diodes CR428 and CR430 clip the crt grid bias voltage from the T410 secondary, to determine the operating level at the control grid. CR428 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 CR430 is set by the Intens Range adjustment. R420 connects the crt grid voltage to the crt cathode voltage to ensure that the crt grid is more negative.

CRT Control Circuits

In addition to the INTENSITY control discussed previously, front-panel FOCUS and internal astigmatism controls have been incorporated for arriving at an optimum crt display. FOCUS control R440 provides the correct voltage for the second anode in the crt. Proper voltage for the third anode is obtained by adjusting Astig control R370. In order to obtain optimum spot size and shape, both the FOCUS and Astig controls are adjusted to provide the proper electrostatic lens configuration in the crt.

The GEOM adjustment R365 varies the positive level on the horizontal deflection plate shields to control the overall geometry of the display. The trace rotation control, R375, permits adjustment of the dc current through beam-rotation coil L375 to align the display with the horizontal graticule lines.

LOW-VOLTAGE POWER SUPPLY AND CALIBRATOR CIRCUIT

The Low-Voltage Power Supply circuit provides the operating power for the oscilloscope system. Electronic regulation is used, where necesssary, 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/F300/S300 through the display unit (fuse F300, thermal cutout S300, Power switch S302, and line-selector block P800 or P801). The line-selector blocks allow changing the primary-winding taps of T800 to fit different line requirements.

Low-Voltage Rectifiers and Unregulated Output

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 outputs to the display unit are 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 which operates between ground and the unregulated −38 volts. Current to the load is delivered by the series-pass transistor, Q940. The supply voltage is established by the 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 variataion 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 which operates between +30 volts and −20 volts. Current to the load is delivered by the 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. Ther 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 trnsistor 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 feedback 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 feedback 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-Q832, and error-sensing transistor Q838. This is a feedback 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 error feedback path is through 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.

CRT Heater Winding

A separate secondary winding is provided for the crt writing-gun heaters. The writing-gun heaters are elevated to −3000 volts in the crt circuit (display unit) to maintain a potential near that of the crt cathode.

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 of twice the power-line frequency. This output is available at the probe test loop on the display unit front panel as a 4-milliampere (peak to peak) square-wave current, or as a 400-millivolt (ground to peak) square-wave voltage.

The resistive-capacitive network at the base of Q982 receives a pulsating dc voltage from full-wave rectifier CR980-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 through the transistor or through CR986, the probe test loop, and R987, producing the required test signal.

READOUT SYSTEM

The Readout System provides an alphanumeric 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 display. A schematic for the Readout System is located at the rear of this manual.

Display Format

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. 3-1 shows the word positions on the display unit crt.

Each word in the readout display can contain up to ten characters, although a typical display contains between two and seven characters per word. The characters are chosen from a set of fifty.

Developing the Display

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

The key block in the Readout System is the timer stage. This stage produces the basic signals that establish the timing sequences within the Readout System. The timer stage also produces control signals for other stages within the Readout System, and interrupt signals to the vertical amplifier and Z-Axis Amplifier to allow a readout display to be presented.

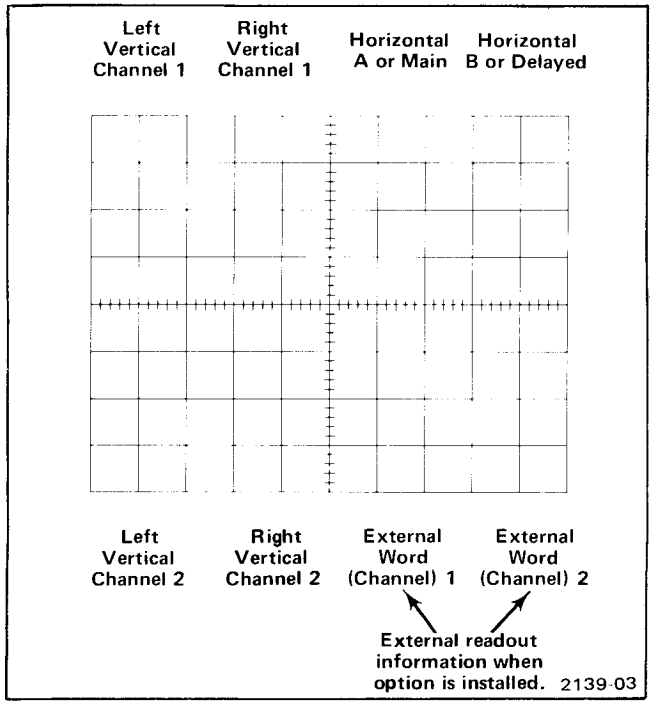


Fig. 3-1. Location of readout words on the CRT, identifying the originating plug-in and channel.

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 readout 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 readout system stages.

Within each plug-in are readout 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 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 readout display.

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

The horizontal component of the readout display is connected to the horizontal channel switch. When the readout is not displayed, signals from the horizontal plug-in pass through the channel switch without change. During the interval when readout is displayed, the horizontal readout signal appears at the output 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 character selection matrix (see Fig. 3-6). Columns C-O (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. 3-6). 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. 3-2). 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.

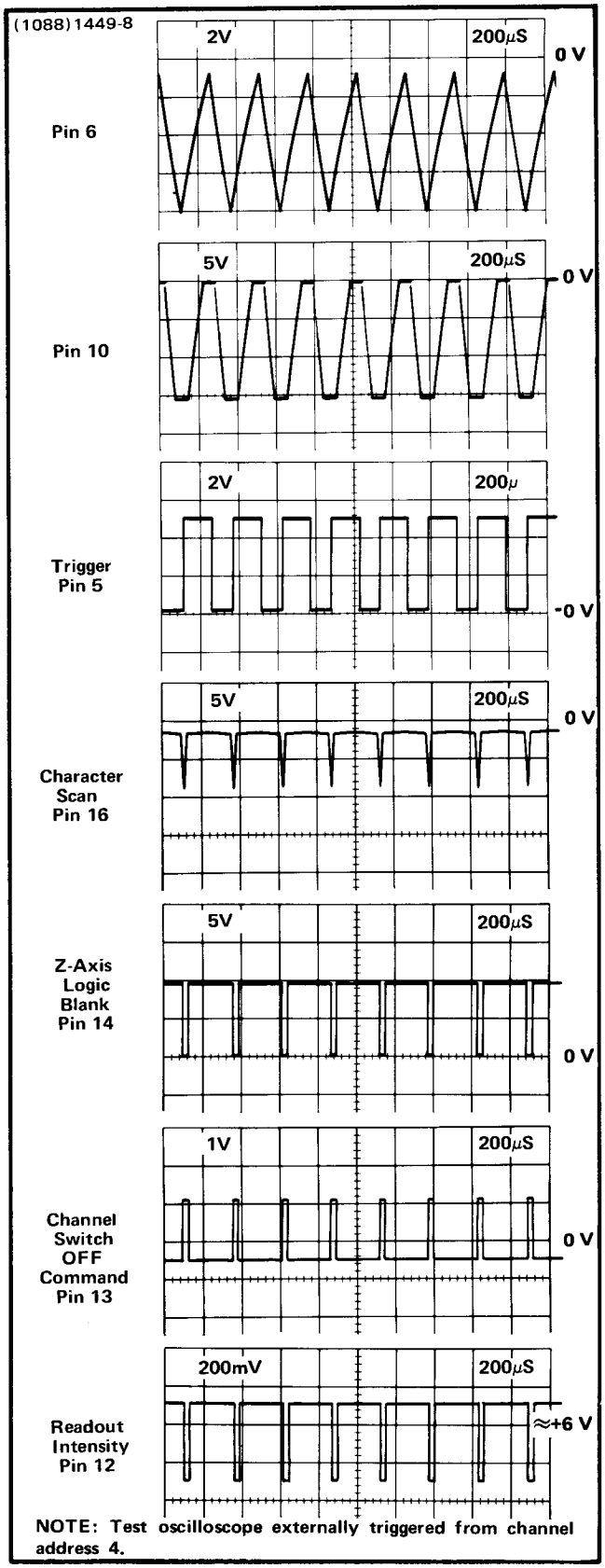


Fig. 3-2. Output waveforms of timer stage.

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. 3-3). The Z-Axis blank at pin 14 is produced first. This negative-going signal drives Q1015 which removes the current input for the interface to 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-CR1010. This activates 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 provent the zeros logic and memory stage U1060 from storing incorrect data during the quiescent period of the stobe pulse. When the strobe pulse goes positive, CR1010 is reverse biased to disconnect Q1010 from U1092, and allow the row decoder to operate in the normal manner.

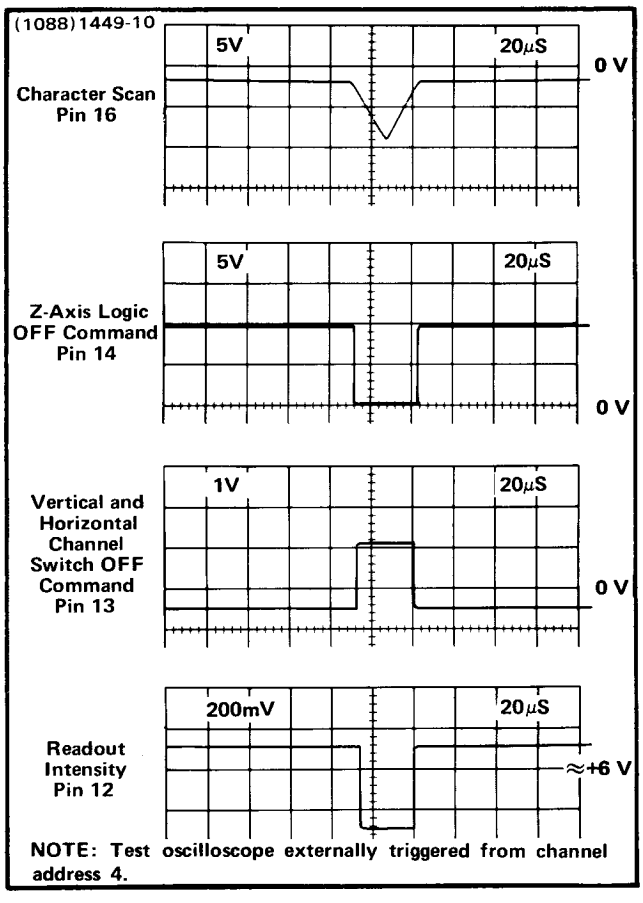


Fig. 3-3. Detail of output at pins 12, 13, 14 and 16 of U1000.

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 and 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 operations 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 to 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. 3-4 show the operation of the timer stage when the display skip condition 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 condition 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.

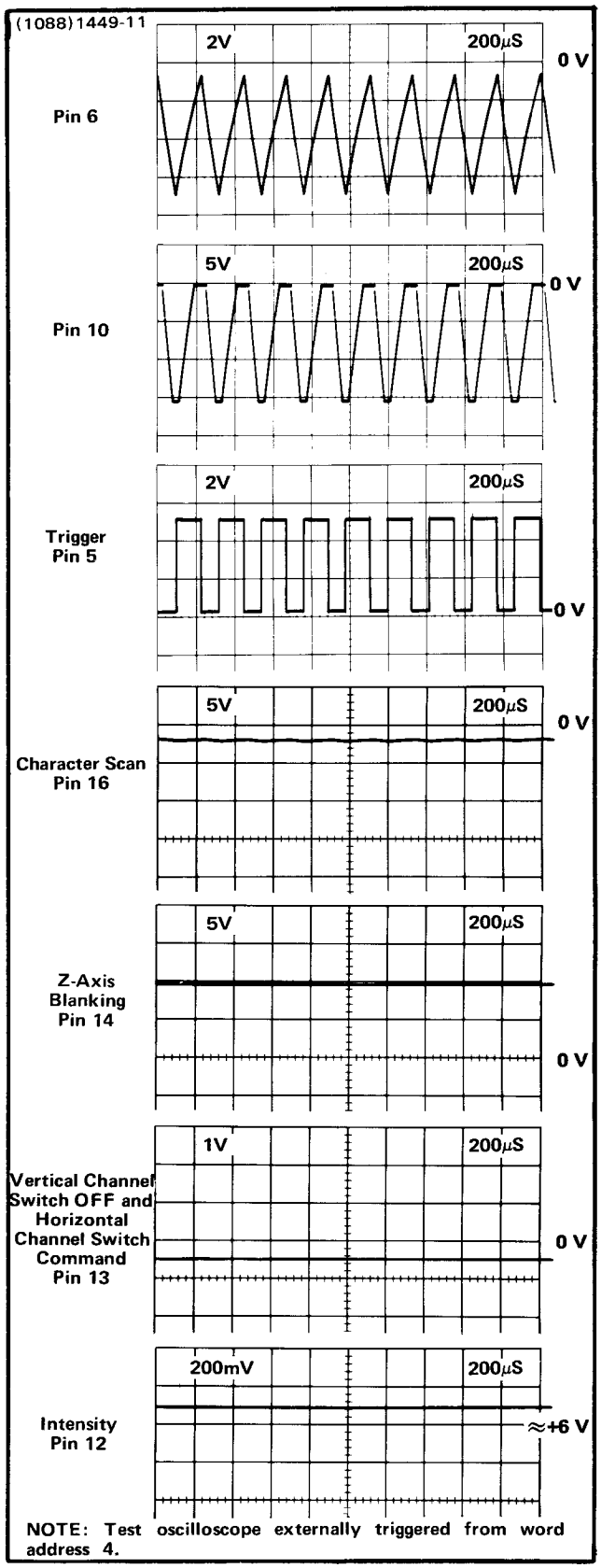


Fig. 3-4. Timer stage operation when display-skip condition occurs.

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. 3-5 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 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 U1085, 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 displyed with each combination of the word address code is given in the discussion for the applicable stages.

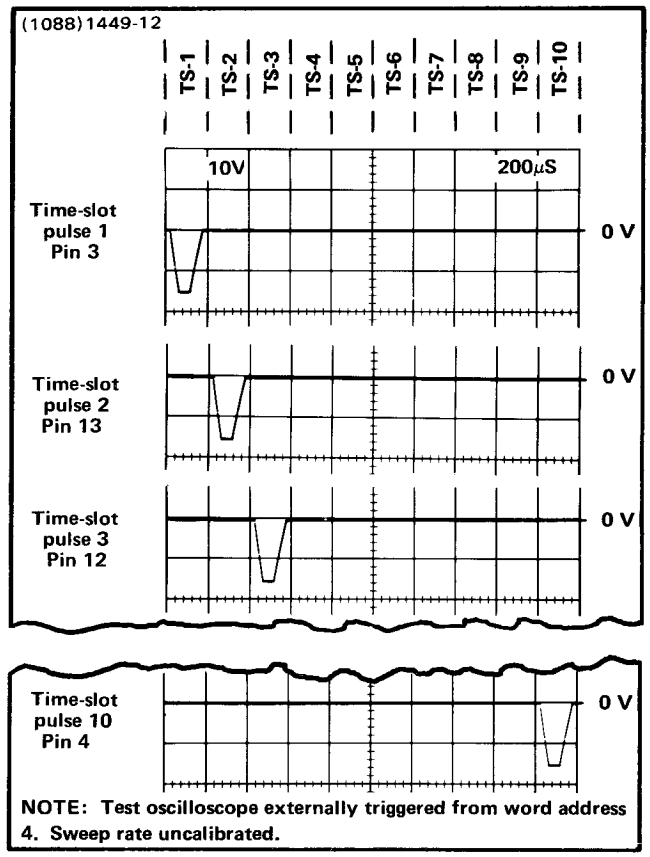


Fig. 3-5. Time relationship of the time-slot (TS) pulses produced by U1025.

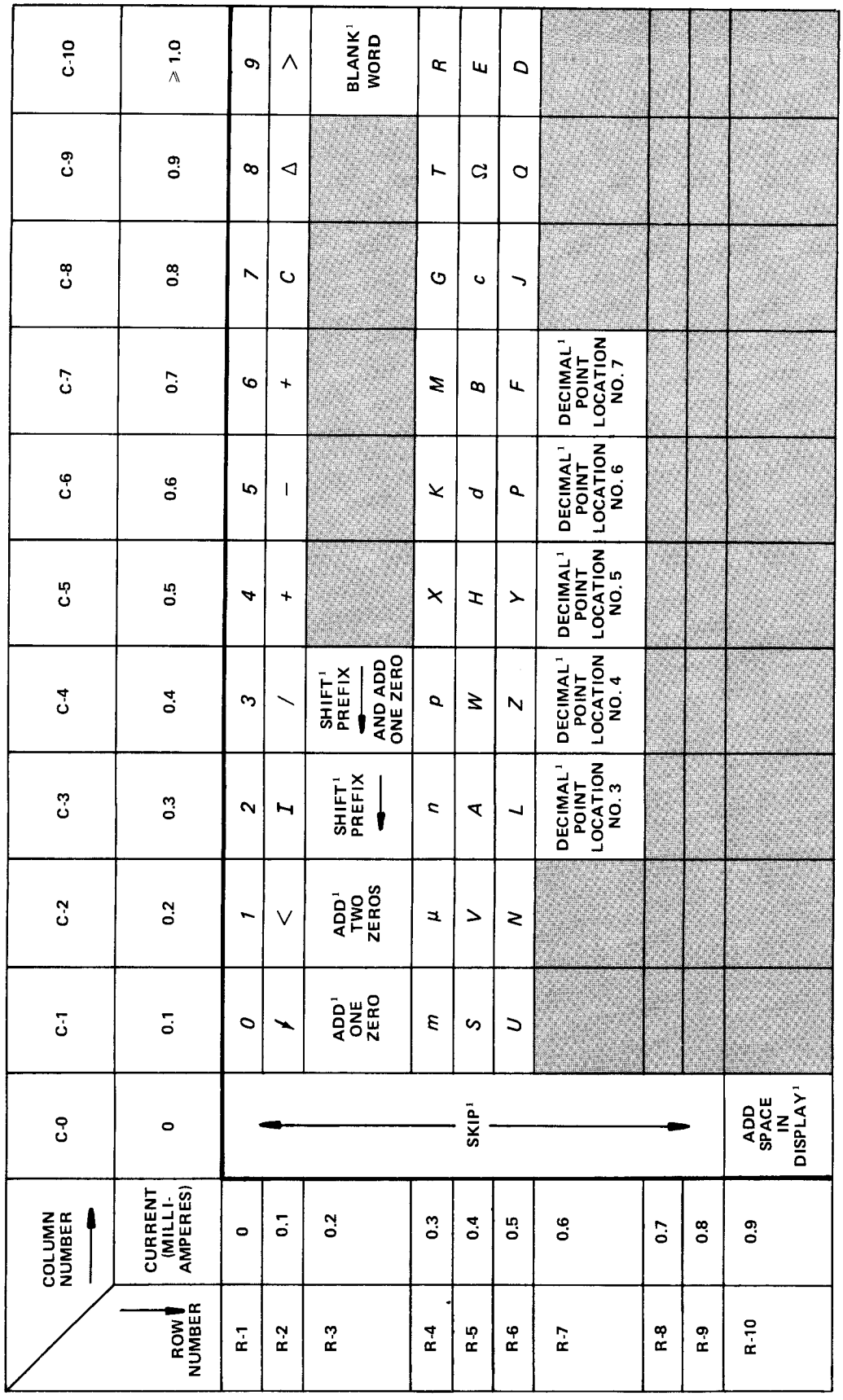


Fig. 3-6. Character selection matrix for readout system.

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. 3-6). 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. 3-7A shows an idealized current waveform of row analog data, which results from the 10 time-slot pulses. Each of the row levels of current shown in these waveforms correspond to 100 microamperes of current. The row numbers on the left side of the waveform correspond to the rows in the character selection matrix shown in Fig. 3-6. 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. 3-7B.

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

No column current output during TS-3 means 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 or 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 from TS-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 the column analog data during TS-1. Since two units of current were encoded in Fig. 3-7, 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.

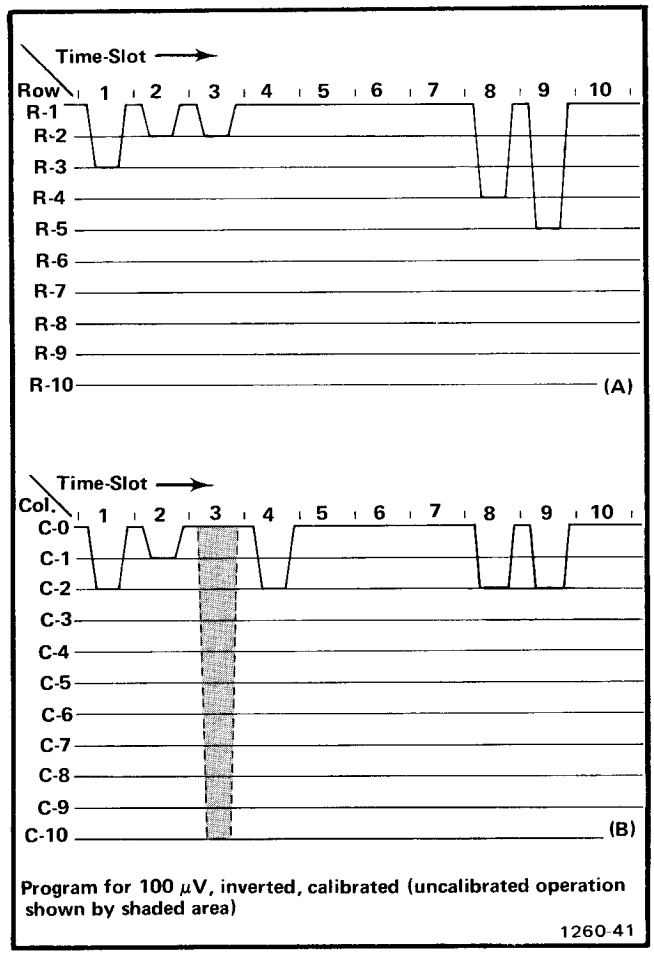


Fig. 3-7. Idealized current waveforms of: (A) Row analog data, (B) Column analog data.

Likewise, if a 100X readout-coded probe is connected to the input of the plug-in unit, the column current during TS-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 3-1 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 3-1

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 (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 and remain on unless its base is pulled more negative that 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 TS-1. This means that Q1048-Q1050 are enabled only during TS-1. These transitors allow the zero logic and memory stage to generate a display-skip signal during TS-1 when information that is not to be displayed on the crt has been stored in memory (further information is later 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. 3-8. If the plug-in unit encodes data for column 1, 2, 3, 4, or 10 of row 3, the appropriate memory (or memories) is set.

If data is encoded, a 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 in TS-1.

During TS-5, memory A is interrogated. If information is stored in this memory, a 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 TS-4. During TS-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 TS-8 to obtain information on whether the prefix should be reduced, or left at the value which was encoded. If data has been encoded which 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. 3-6 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, discussed earlier in this section).

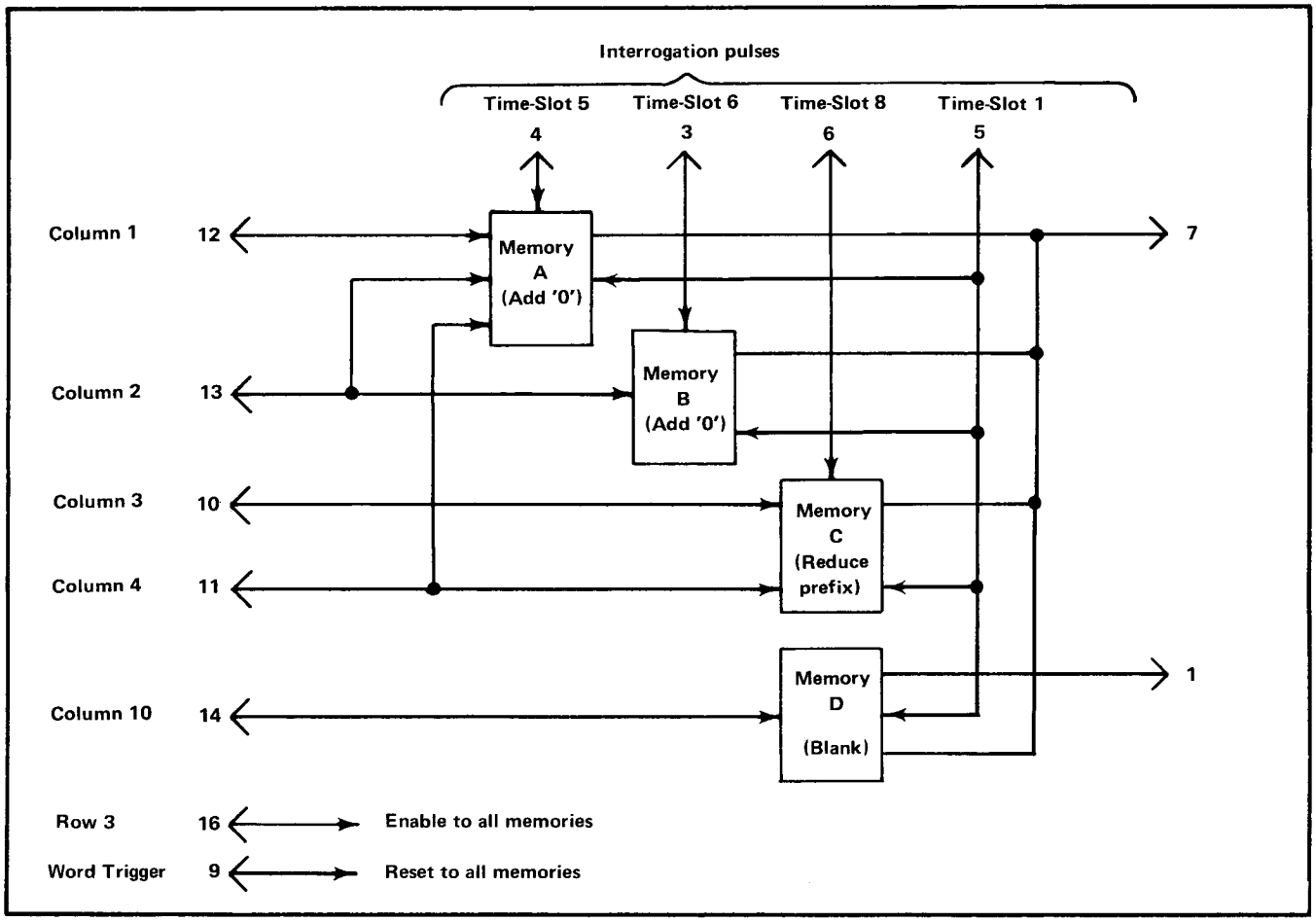


Fig. 3-8. Block representation of memory sequence in U1060.

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 micoramperes 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 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 TS-10. Pin 1 of U1060 is connected to the base of Q1018 through R1020. When turned on, Q1018 prevents the readout intensity current from reading 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-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. 3-6). 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 rrow 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 produce 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 channel 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 U1083. 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 R1088, R1082. 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 TS-4 (1-2-5 data) always starts in the fourth character position whether data has been displayed in the previous time-slots or not. 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 TS-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. 3-6). 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. 3-9). For example, if column 3 and row 7 are encoded during TS-1, the system is instructed to place a decimal point in location No. 3. As shown in Fig. 3-9, 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.

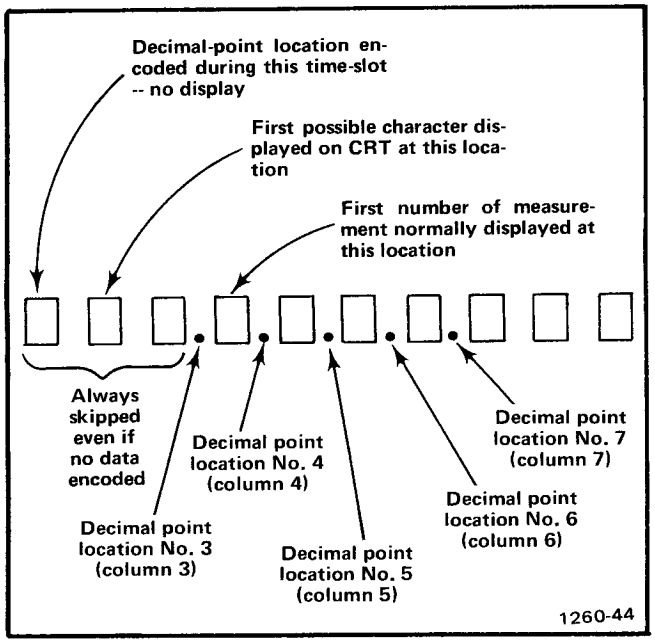


Fig. 3-9. Readout word relating 10 possible character locations to the decimal point instructions that can be encoded, and the resultant CRT display.

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.

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. 3-1).

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 channel switch OFF signal at pin 13 activates this stage when a character is to be displayed on the crt. Vertical spacing adjustment, R118, sets the separation between the upper and lower readout displays.

Y-Output Amplifier. The Y-Output Amplifier 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 channel switch OFF signal is generated by timer U1000, the channel switch substitutes the horizontal readout signal for the horizontal plug-in connector signal.

MAINTENANCE

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

PREVENTIVE MAINTENANCE

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

CABINET REMOVAL

WARNING

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

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

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

CLEANING

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

CAUTION

Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. In particular, avoid chemicals that contain benzene, toluene, xylene, acetone, or similar solvents.

Exterior

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

Interior

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

Switch Contacts

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

VISUAL INSPECTION

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

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

LUBRICATION

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

Cam Switch Lubrication

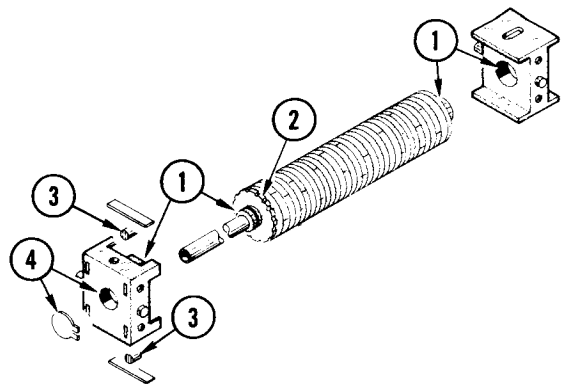
In most cases, factory lubrication should be adequate for the life of the instrument. However, if the switch has been disassembled for replacement of switch sub-parts, a lubrication kit containing the necessary lubricating materials and instructions is available through any Tektronix Field Office. Order Tektronix Part No. 003-0342-01. General Electric Versilube® silicone grease should be applied sparingly so that the lubricant does not get on the contacts. Refer to Fig. 4-1 for lubrication instructions.

SEMICONDUCTOR CHECKS

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

ADJUSTMENT AFTER REPAIR

After any electrical component has been replaced, the adjustment of that particular circuit should be checked, as well as the adjustment of other closely related circuits. The Performance Check and Adjustment procedure in this manual provides a quick and convenient means of checking instrument operation. In some cases, minor troubles may be revealed or corrected by adjustment.



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

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

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

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

(1481)1967-2

Fig. 4-1. Lubrication procedure for a typical cam switch.

TROUBLESHOOTING

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

TROUBLESHOOTING AIDS

Diagrams

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

Circuit-Board Illustrations

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

Wiring Color Code

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

Semiconductor Basing

Fig. 4-2 illustrates the basing configurations for all semiconductors used in this instrument. Some plastic-case transistors have lead configurations that do not agree with those shown here. If a replacement transistor is made by a different manufacturer than the original, check the manufacturer's basing diagram. All transistor sockets in this instrument are wired for the standard basing used for metal-case transistors.

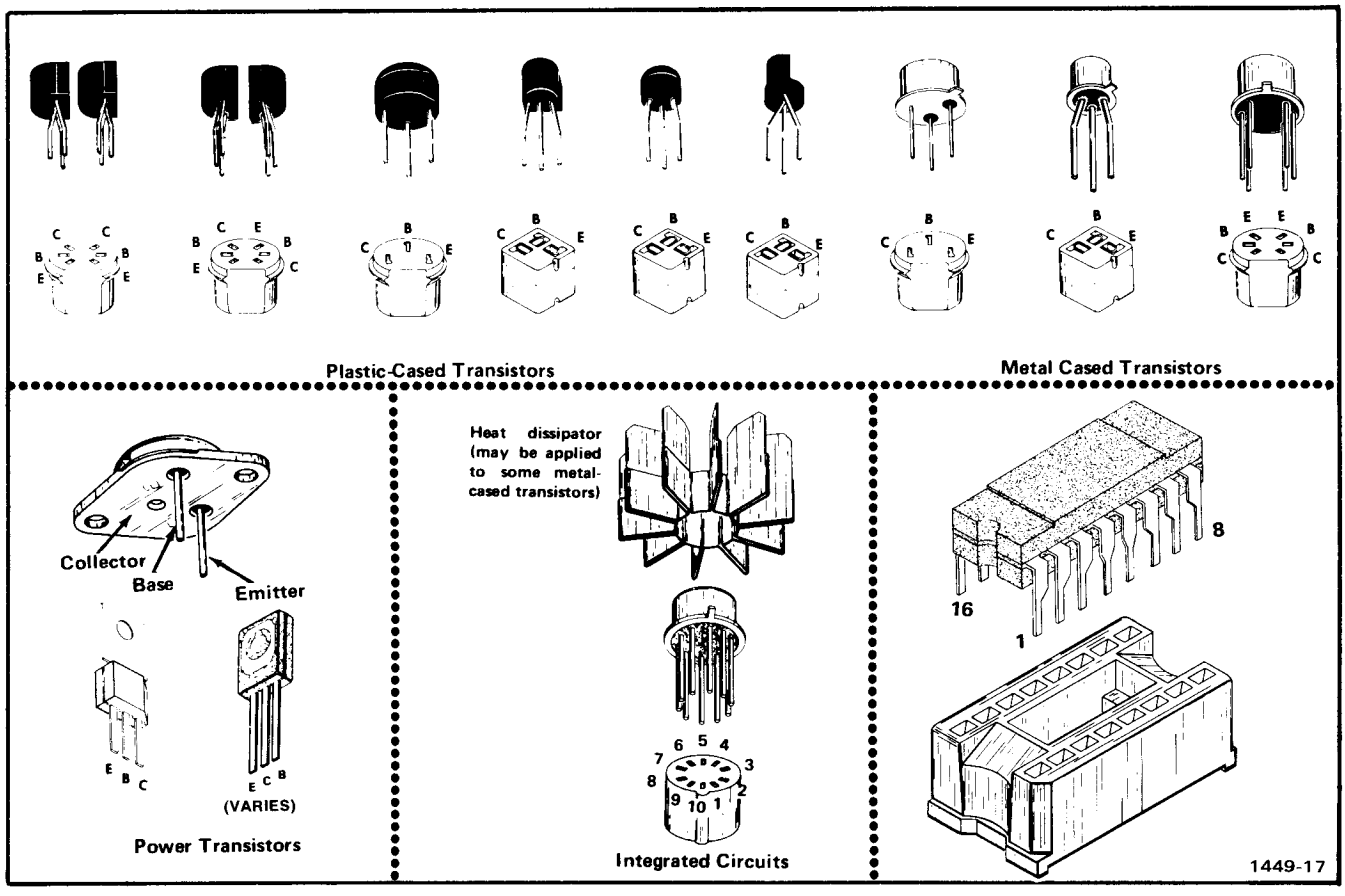


Fig. 4-2. Electrode configuration data for semiconductor devices.

Multi-Pin Connector Identification

Multi-pin connectors mate with groups of pins soldered to circuit boards. Pin number 1 is indexed with a triangular mark on the circuit board and molded on the holder of the multi-pin connector, as shown in Fig. 4-3.

Interface Connector Pin Locations

The Interface circuit board couples the plug-in unit to the associated mainframe (oscilloscope). Fig. 4-4 identifies the pins on the interface connector as shown on the main Interface diagram in the Diagrams section.

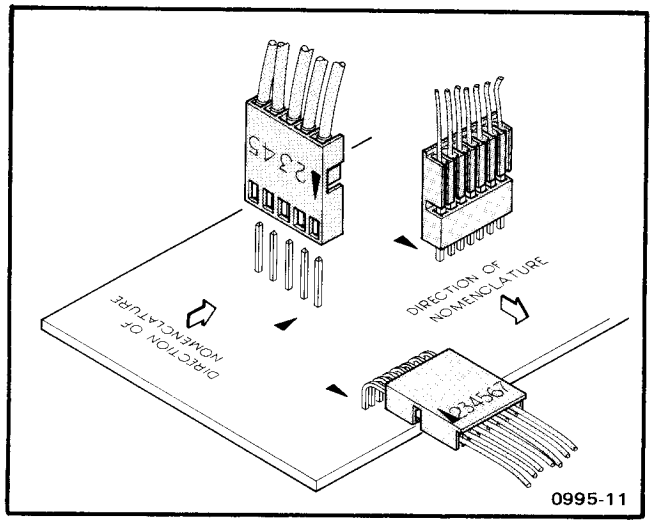


Fig. 4-3. Multi-pin connector holder orientation.

Performance Check

The Performance Check procedure, given in Section 2 of this manual, provides a quick and convenient means of checking instrument operation. In some cases, minor troubles may be revealed or corrected by adjustment.

TROUBLESHOOTING EQUIPMENT

The following equipment, in addition to that listed in the Performance Check section is useful for troubleshooting.

Transistor Tester

Description: Dynamic-type tester.

Purpose: Test semiconductors.

Recommeded Tektronix types: 576 Curve Tracer, 577/177 Curve Tracer system, 7CT1N Curve Tracer unit and a 7000-series oscilloscope system, or a 5CT1N Curve Tracer unit and a 5000-series oscilloscope.

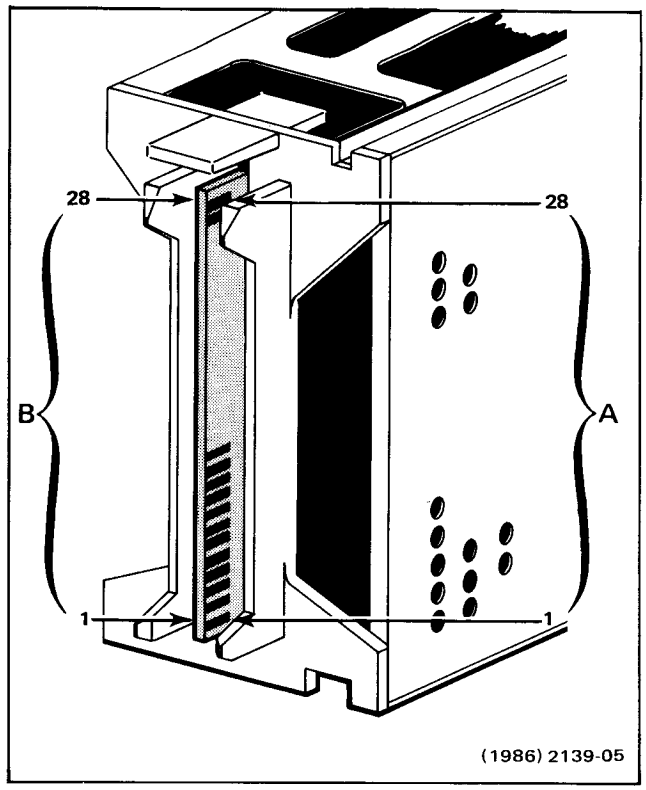


Fig. 4-4. Location of pin numbers on Interface connector.

Multimeter

Description: Voltmeter, 10 megohm input impedance and a range of 0 to at least 50 volts dc; accuracy, within 0.1%. Ohmmeter, 0 to 20 megohms. Test probes should be insulated to prevent accidental shorting.

Purpose: Check voltage and resistance.

Test Oscilloscope

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

Purpose: Check operating waveforms.

TROUBLESHOOTING TECHNIQUES

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

Troubleshooting Procedure

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

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

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

4. Isolate Trouble to a Circuit. To isolate trouble to a circuit, note the trouble symptom. The symptom often identifies the circuit in which the trouble is located. When trouble symptoms appear in more than one circuit, check the affected circuits by taking voltage and waveform readings. Incorrect operation of all circuits often indicates trouble in the power supply. Check first for correct voltages of the individual supplies. See Table 4-1. However, a defective component elsewhere in the instrument can appear as a power-supply trouble and may also affect the operation of other circuits.

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

6. Check Instrument Adjustment. Check the adjustment of this instrument, or the affected circuit if the trouble appears in one circuit. The apparent trouble may be the result of misadjustment. Complete adjustment instructions are given in Section 5.

Table 4-1

Power Supply Tolerances

Power Supply	Tolerance	Typical 120 Hz 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

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

CAUTION

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

TRANSISTORS. The best check of transistor operation is actual performance under operating conditions. A transistor can be most effectively checked by substituting a new component or one that has been checked previously. However, be sure that circuit conditions are not such that a replacement transistor might also be damaged. If substitute transistors are not available, use a dynamic tester. Static-type testers are not recommended, since they do not check operation under simulated operating conditions.

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

CAUTION

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

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

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

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

CAPACITORS. A leaky or shorted capacitor can usually be detected by checking resistance with an ohmmeter on the highest scale. Do not exceed the voltage rating of the capacitor. The resistance reading should be high after initial charge of the capacitor. An open capacitor can best be detected with a capacitance meter or by checking that the capacitor passes ac signals.

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

CORRECTIVE MAINTENANCE

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

OBTAINING REPLACEMENT PARTS

All electrical and mechanical part replacements can be obtained through your Tektronix Field Office or representative. However, many of the standard electronic components can be obtained locally in less time than is required to order them from Tektronix, Inc. Before purchasing or ordering replacement parts, check the parts list for value, tolerance, rating, and description.

NOTE

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

Some parts are manufactured or selected by Tektronix, Inc. to satisfy particular requirements, or are manufactured to specifications for Tektronix, Inc. Most of the mechanical parts used in this instrument have been manufactured by Tektronix, Inc. To determine the manufacturer of parts, refer to parts list, Cross Index Mfr. Code Number to Manufacturer.

SOLDERING TECHNIQUES

WARNING

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

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

CAUTION

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

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

The following techniques should be used to replace a component on a circuit board:

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

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

NOTE

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

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

Use only enough heat to remove the component lead without removing the solder from the board. If it is desired to remove solder from a circuit-board hole for easier installation of a new component, a solder-removing wick should be used.

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

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

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

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

COMPONENT REMOVAL AND REPLACEMENT

WARNING

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

The exploded-view drawing associated with the Replaceable Mechanical Parts list may be helpful in the removal or disassembly of individual components or subassemblies. Component locations are shown in the Diagrams section.

Circuit Boards

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

To remove or replace a board, proceed as follows:

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

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

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

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

Circuit-Board Pins

CAUTION

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

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

Semiconductors

CAUTION

To avoid component damage, power must be turned off before removing or replacing semiconductors.

Semiconductors should not be replaced unless actual defective. If semiconductors are removed during routine maintenance, return them to their original sockets. Unnecessary replacement of semiconductors may affect the adjustment of this instrument. When semiconductors are replaced, check the operation of that part of the instrument which may be affected.

WARNING

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

Replacement devices should be of the original type or a direct replacement. Fig. 4-2 shows the lead configurations of the semiconductor devices used in this instrument. Some plastic-case transistors have lead configurations that do not agree with those shown here. When replacing, check the manufacturer's basing diagram for correct basing. All transistor sockets in this instrument are wired for the standard biasing used for metal-case transistors. Semiconductors that have heat radiators use silicone grease to increase heat transfer. Replace the silicone grease when replacing these semiconductors.

An extraction tool should be used to remove the 14- and 16-pin integrated circuits to prevent damage to the pins. This tool is available from Tektronix, Inc. Order Tektronix Part No. 003-0619-00. If an extraction tool is not available when removing one of these integrated circuits, pull slowly and evenly on both ends of the device. Try to avoid having one end of the integrated circuit disengage from the socket before the other, as the pins may be damaged.

To replace one of the power transistors mounted on the chassis adjacent to the Power Supply circuit board, first unsolder the leads. Then, loosen the nuts on the plastic bar, 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 to the chassis.

Interconnecting Pin Replacement. To replace a pin which 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.

Switches

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

Switch Replacement. The following 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.

A. 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, Tektronix 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, Tektronix 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, whose position is controlled by the front-panel knobs, which actuate spring-leaf contacts.

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.

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

NOTE

Cam switch bearing blocks which 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.

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

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

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

B. 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 tube. Refer to Figs. 4-5 and 4-6.

WARNING

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

A. REMOVAL

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

2. Disconnect deflection leads from crt neck pin receptacles. For storage crt's, disconnect the storage-element cable connector from the storage circuit board.

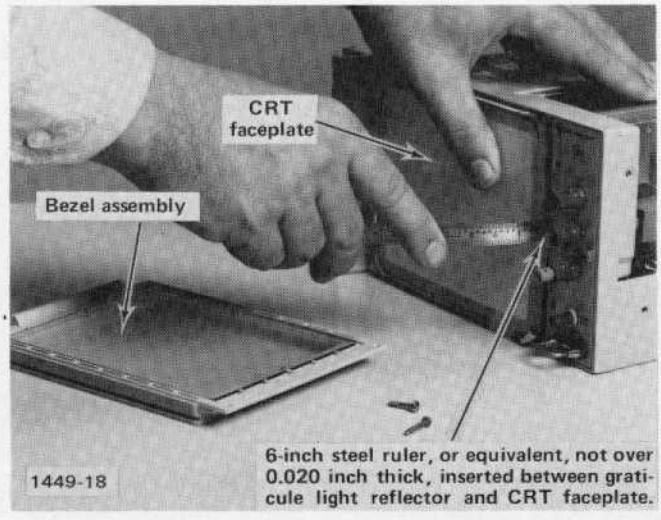


Fig. 4-5. Illustration showing equipment and method used to correctly align light reflector with crt faceplate.

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.

3. Remove the rear panel holding nuts, then move the rear panel away from the instrument by sliding it along the power cord.

4. Remove the crt base socket.

5. With one hand on the crt faceplate, push on the crt base. Slide the crt forward until the crt anode plug can be disconnected. For storage crt's, be sure to feed the storage-element cable through the slot in the main portion of the crt shield as the crt slides forward. Pull the crt out of the instrument from the front.

B. REPLACEMENT

1. Make sure the soft plastic crt faceplate supports are in place, then insert the crt into the shield while feeding the storage-element cable through the slot in the shield. Before the crt is completely inserted, reconnect the anode plug and place the steel rulers for the light reflector alignment.

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

3. 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 four deflection crt neck pin receptacles are centered in the neck shield cutout, then tighten the clamp hardware.

4. Place the crt base socket onto the crt base pins. Replace the rear panel. If applicable, connect the storage-element cable to the pin connectors on the storage circuit board, and connect the deflection leads to the crt neck pins.

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

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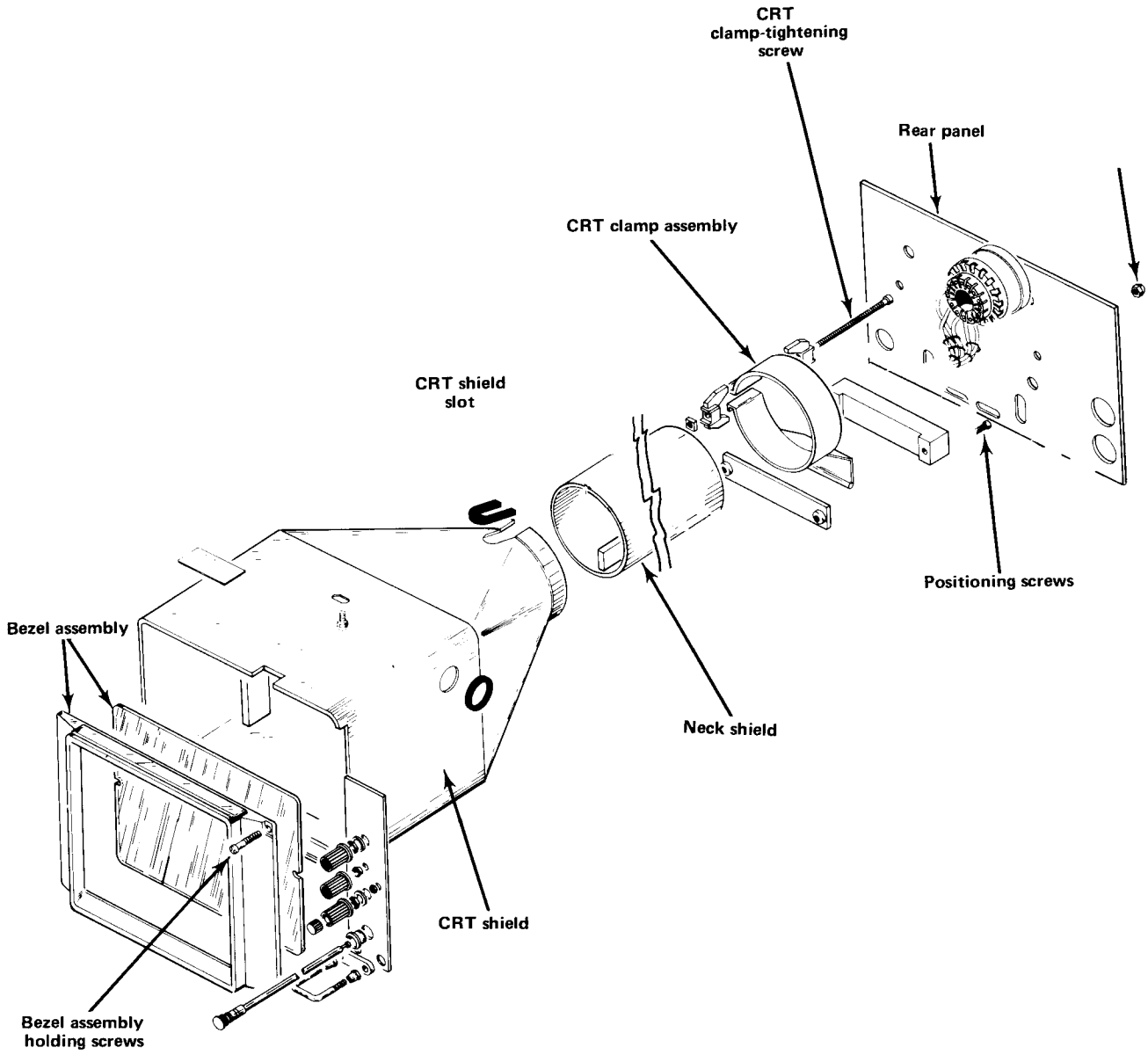

Fig. 4-6. Illustration showing location of crt mounting hardware described in crt replacement instructions.

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

NOTE

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

1. Remove the light shield.

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

3. Replace the light shield.

To replace the graticule lights, proceed as follows:

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

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

3. Replace the burned out light(s).

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

5. Install the front-panel circuit board, replacing all nuts and knobs. Replace the crt by reversing the procedure in step 4.

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 Adjustment section of this manual.

Fuse Replacement. Table 4-2 gives the rating, location, and function of the fuses used in this instrument system.

Table 4-2

Circuit Number	Rating	Function	Location
F300	120 VAC—1.25 A Slow 240 VAC—0.7 A Slow	Line-Voltage Input	Display unit rear panel
F800	0.25 A Fast	+200 V Unreg supply	L.V. Power Supply board
F410	0.3 A Slow	+38 V Unreg supply	Display Unit H.V. Power Supply board

ADJUSTMENT AFTER REPAIR

After any electrical component has been replaced, the adjustment of that particular circuit should be checked, as well as other closely related circuits. See Section 5 for a complete adjustment procedure.

REPACKAGING FOR SHIPMENT

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

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

1. Obtain a carton of corrugated cardboard having inside dimensions of no less than six inches more than the instrument dimensions; this will allow for cushioning. Refer to the following table for carton test strength requirements.

2. Surround the instrument with polyethylene sheeting to protect the finish of the instrument.

3. Cushion the instrument on all sides by tightly packing dunnage or urethane foam between carton and instrument, allowing three inches on all sides.

4. Seal carton with shipping tape or industrial stapler.

SHIPPING CARTON TEST STRENGTH

Gross Weight (lb)	Carton Test Strength (lb)
0-10	200
10-30	275
30-120	375
120-140	500
140-160	600

ADJUSTMENT

The following procedure returns the 5440 Oscilloscope to correct calibration. All limits and tolerances given in this procedure are calibration guides, and should not be interpreted as instrument specifications except as specified in the Performance Requirement column of the Specification section in this manual.

INTRODUCTION

Tektronix Field Service

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

Test Equipment Required

The test equipment listed at the beginning of the Performance Check Procedure is required to perform the Adjustment Procedure.

PRELIMINARY PROCEDURE

NOTE

The Oscilloscope must be adjusted within an ambient temperature range of +20° C to +30° C for best overall accuracy and to meet the electrical characteristic tolerances given as Performance Requirements in the Specification section of this manual.

Information given in the Supplemental Information column is provided for user information only, and should not be interpreted as Performance Requirements.

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

2. Connect the Oscilloscope to a power source which meets the voltage and frequency requirements of the instrument (refer to Operating Voltage in the Operating Instructions section of this manual).

NOTE

If the correct line voltage is not available, use a variable autotransformer to provide the correct input voltage.

3. Assemble the plug-in units and Oscilloscope together as directed under Install Plug-In Units preceding the subsection to be performed.

4. Set the controls as given under Control Settings preceding the same subsection.

5. If applicable, install the TM 500 series test equipment into the test equipment Power Module.

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

NOTE

Titles for external controls of the Oscilloscope are capitalized in this procedure (e.g., GRAT ILLUM, POWER). Internal adjustments are initial capitalized only (e.g., Crt Grid Bias, Vertical Centering).

POWER SUPPLY AND CALIBRATOR

Install Plug-In Units

Install an amplifier unit in the left vertical compartment and the time-base unit in the horizontal compartment.

Control Settings

Oscilloscope

INTENSITY	Counterclockwise (off)
FOCUS	Midrange
GRAT ILLUM	As desired
READOUT INTENS	Midrange
POWER	On

1. Adjust −30 Volt Power Supply

a. Remove the bottom dust cover of the 5440 to gain access to the LV power supply circuit board.

b. Connect the digital voltmeter between −30 V test point on the LV power supply circuit board and chassis ground. See Fig. 5-1 for voltage test point location.

c. CHECK—For a meter reading of −29.925 to −30.075 volts.

NOTE

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

d. ADJUST—−30 Adj R950 for a meter reading of −30 volts. See Fig. 5-1 for adjustment location.

2. Adjust +30 Volt Power Supply

a. Connect the digital voltmeter between +30 V test point on the LV power supply circuit board, and chassis ground. See Fig. 5-1 for voltage test point location.

b. CHECK—For a meter reading of +29.925 to +30.075 volts.

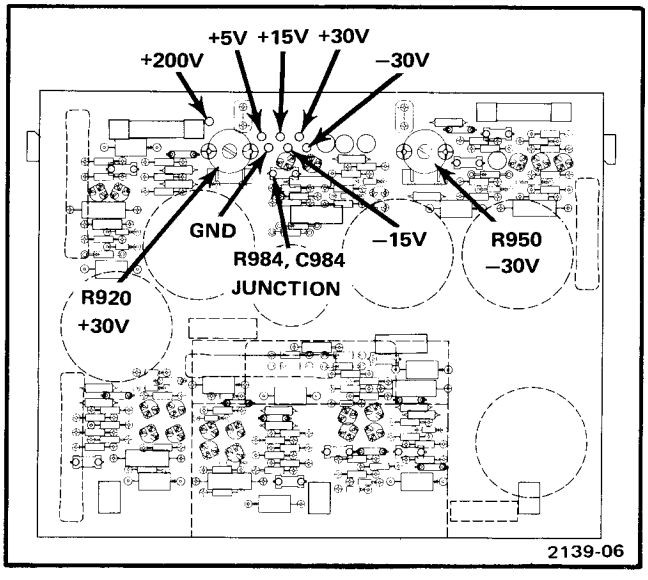

Fig. 5-1. Location of power supply test points and −30, +30-volt adjustments.

NOTE

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

c. ADJUST—+30 Adj R920 for a meter reading of exactly +30 volts. See Fig. 5-1 for adjustment location.

3. Check Remaining Power Supply Voltages

a. CHECK—Each supply with the digital voltmeter to ensure that all output voltages are within the limits given in Table 5-1. See Fig. 5-1 for voltage test point locations.

TABLE 5-1

Power Supply Voltage, Tolerance, and Ripple

Supply	Tolerance	Typical 120 Hz Ripple (P-P)
−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
+200 V	+180 V to +240 V	2 V or less

NOTE

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

b. Disconnect the digital voltmeter.

4. Check Calibrator Output Voltage

a. Connect the digital voltmeter between the CALIBRATOR current loop and a ground test point. See Fig. 5-1 for ground test point location.

b. Apply a ground connection (short circuit) between the junction of R984 and C984 and a ground test point on the low-voltage and calibrator board. See Fig. 5-1 for the junction and ground test point location.

c. CHECK—For a meter reading of +396 to +404 millivolts.

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

e. Disconnect the digital voltmeter.

5. Check High-Voltage Power Supply

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

b. Remove the time-base unit from the horizontal compartment and insert the vertical amplifier into the compartment.

c. Remove the three 4-40 screws securing the HV cover to the High Voltage circuit board assembly, and remove the cover.

d. Set the dc voltmeter (vom) to measure at least −3000 volts dc and connect it between HV Test Point and chassis ground. See Fig. 5-2 for test point location.

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

f. CHECK—For a meter reading of −3000 volts ±2%.

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

h. Disconnect the dc voltmeter and replace the HV cover, reversing the procedure given in part c of this step.

i. Pull the POWER switch to turn on the Oscilloscope.

6. Adjust Intensity Range

a. Turn the INTENSITY control slowly clockwise and check for a visible spot display. Note that the spot appears when control is between its 8 and 11 o'clock position. If the spot appears before or after the given control position, proceed with part b of this step.

b. Turn INTENSITY control fully counterclockwise.

c. ADJUST—Intensity Range R435 so spot is just extinguished. See Fig. 5-2 for adjustment location.

d. Repeat part a of this step.

e. Press the POWER switch to turn off the Oscilloscope. Install the time-base unit in the horizontal compartment and the vertical amplifier in the vertical compartment.

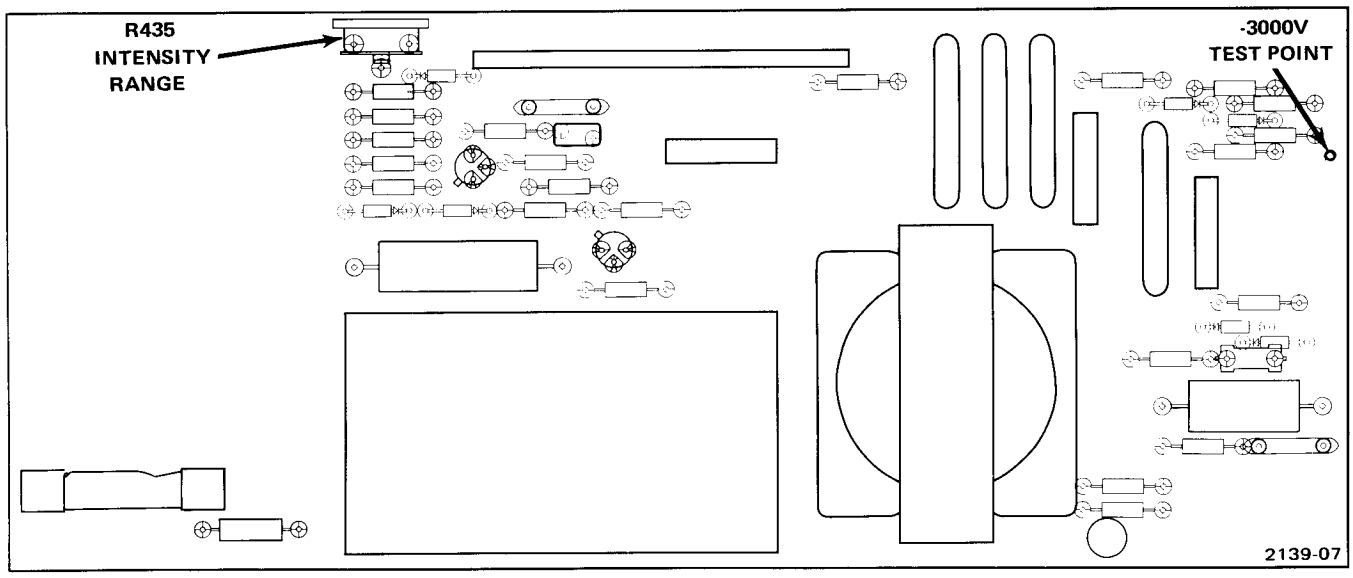

Fig. 5-2. Location of Intensity Range and HV test point on High Voltage assembly. (Board shown with cover removed.)

CRT DISPLAY

Control Settings

Oscilloscope

INTENSITY	Midrange
FOCUS	Midrange
GRAT ILLUM	Midrange
READOUT INTENS	Midrange
POWER	On

Amplifier Unit

Position	Midrange
Input coupling	Dc
Mode	CH 1
Trigger	CH 1

Time-Base Unit

Main Triggering	
Slope	+
Mode	Auto
Trigger Source	Left
Position	As desired
Mag	X1
Main Sec/Div	1 ms
Display Mode	Main Swp

1. Adjust Focus and Astigmatism

a. Set the INTENSITY control for a normal viewing level.

b. Set the time-base Main Sec/Div switch to Amp (fully counterclockwise).

c. Turn the FOCUS control fully clockwise.

d. CHECK—For a spot display that is nearly round.

e. ADJUST—Astig R370 and FOCUS control together, to obtain the best defined spot display. See Fig. 5-3 for adjustment location.

f. Set the time-base Main Sec/Div switch to 1 ms.

2. Adjust Trace Alignment

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

b. CHECK—That the trace is aligned with the center horizontal graticule line.

c. ADJUST—ROTATION (Trace) R375 to align the trace with the center horizontal graticule line. See Fig. 5-3 for adjustment location.

d. Press the POWER switch to turn off the Oscilloscope.

3. Adjust Geometry

a. Remove the time-base unit from the right horizontal compartment and install it in the center vertical compartment.

b. Remove the vertical amplifier unit from the left vertical compartment and install it in the right horizontal compartment.

c. Pull the POWER switch to turn on the Oscilloscope.

d. Set the FOCUS and INTENSITY controls for a well-defined trace, extending vertically above and below the graticule area.

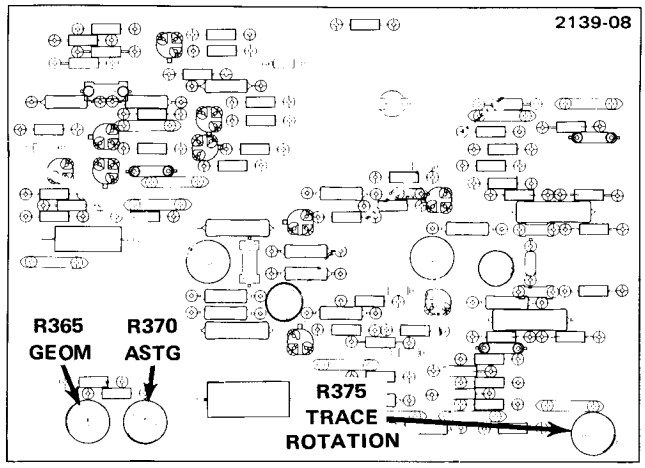

Fig. 5-3. Location of Geom, Astig, and Trace Rotation adjustments (Horizontal circuit board).

e. CHECK—Vertical bowing and tilt of the trace display is less than .1 division, when positioned horizontally across the entire graticule area.

f. ADJUST—Geom R365 for minimum bowing or tilt of the trace display at the left and right edges of the graticule. Adjustment may have to be compromised to obtain less than .1 graticule division bowing and tilt everywhere within the graticule area. See Fig. 5-3 for adjustment location.

g. Press the POWER switch to turn off the Oscilloscope.

VERTICAL SYSTEM

NOTE

The Calibration Fixture is used for the vertical system adjustment procedure. When a different amplifier plug-in is used to verify vertical specifications, the Oscilloscope system frequency must be considered. An alternate procedure is provided when the 5A48 amplifier is substituted for the vertical amplifier plug-in unit.

Install Plug-In Units

Install the Calibration Fixture in the left vertical compartment and the time-base unit in the horizontal compartment.

Control Settings

Calibration Fixture

Position	Midrange
Amplitude	Midrange
Test Switch	Common Mode
Rep Rate	100 kHz

1. Adjust Vertical Centering

a. Pull POWER switch to turn on the Oscilloscope.

b. CHECK—That the displayed trace is within 0.5 division of the center horizontal graticule line.

c. ADJUST—Vertical Centering R135 to position the trace to the center horizontal graticule line. See Fig. 5-4 for adjustment location.

d. Press POWER switch to turn off Oscilloscope, and install Calibration Fixture in center compartment. Pull POWER switch ON.

e. CHECK—That the displayed trace is within 0.5 division of the center horizontal graticule line.

2. Adjust Vertical Gain

a. Press POWER switch to turn off Oscilloscope, and install Calibration Fixture in the left vertical compartment. Pull the POWER switch ON.

b. Set the Test switch of the Calibration Fixture to Vert or Horiz Gain, and depress the 1 kHz Rep Rate switch.

c. Position the display with the Calibration Fixture position control to align the bright center trace of the display with the center horizontal graticule line.

d. CHECK—That the center 7 traces coincide with the respective horizontal graticule lines, one trace per division, ±0.1 division.

e. ADJUST—Vertical Gain R175 for 6 divisions of deflection over the center 7 horizontal graticule lines.

f. Press POWER switch and remove the Calibration Fixture from the left vertical compartment and install it in the center compartment. Pull the POWER switch ON.

g. Repeat part d of this step, and if necessary, readjust Vertical Gain R175 for the optimum gain setting compromise for both vertical compartments.

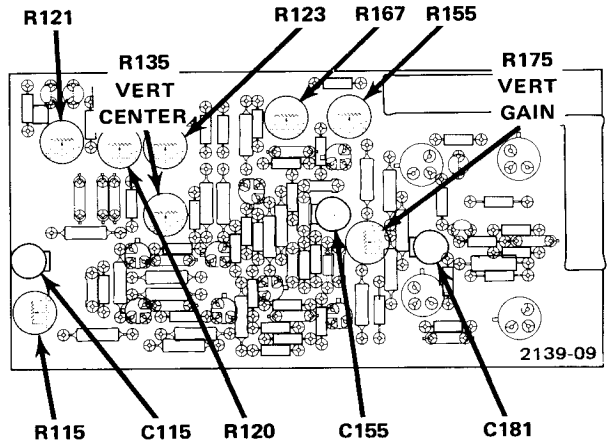

Fig. 5-4. Location of Vertical Amplifier adjustments.

3. Adjust Vertical Compensation

a. Install the Calibration Fixture in the left vertical compartment.

b. Set the Test switch of the Calibration Fixture to Vert or Horiz +Step Resp and depress the 100 kHz Rep Rate switch. Adjust Amplitude and Position controls for a 6-division display centered vertically on the graticule.

c. Set the time-base unit for a calibrated sweep rate of 2 μs/division and triggering for auto mode, ac coupled from the internal source. Adjust trigger level controls for a stable display, triggered on the rising portion of the pulse. Center the pulse horizontally on the graticule.

d. CHECK—For optimum square leading corner and flat top on the displayed pulse with aberrations not to exceed +0.36 or −0.36 division, with total peak-to-peak aberrations not to exceed 0.36 division.

NOTE

The Calibration Fixture has a high bandwidth, and aberrations can typically measure near the specification limit. The following compensation adjustments may not be necessary if aberrations and bandwidth meet specification.

e. ADJUST—Vertical compensation R121 for optimum flat top on the displayed pulse, then adjust R120 and R123, increasing the sweep rate of the time-base unit to 1 μs/div and 0.5 μs/div, respectively. Repeat as necessary to obtain optimum flat top on the waveform. See Fig. 5-4 for adjustment locations.

f. Depress the 1 MHz Rep Rate switch on the Calibration Fixture, and set the sweep rate of the time-base unit to 0.1 μs/div. Adjust trigger level controls for a stable display.

g. ADJUST—Vertical compensations C637 (this adjustment is located on the main interface board between vertical compartments, SN B063251-up), C115, R115, C155, R155, R167, and C181 in the order given, for optimum square leading corner with aberrations within the limits given in part d. There is direct interaction between C115 and R115, and between C155 and R155. Best results are usually obtained by setting R115 fully clockwise, then adjusting C115. See Fig. 5-4 for adjustment location.

h. ADJUST—R155 and R167 for minimum ringing of front corner. Adjust C637 (on the main interface board between vertical compartments, SN B063251-up), C155 and C115 for a level front corner. After front corner adjustments have been made, adjust C181 for optimum risetime and minimum front corner spike.

i. Press the POWER switch to turn off the Oscilloscope, and install the Calibration Fixture in the center compartment. Pull POWER switch ON.

j. Repeat parts c through h. If necessary, compromise the vertical compensation adjustment to obtain the best response for both left and right vertical compartments.

4. Check Vertical Position Effect

a. Set the Calibration Fixture and generator controls to obtain a centered, positive-going, 6-division display. Set the time-base unit for a triggered display on the rising portion of the pulse, at a sweep rate of 20 ns/div.

b. Position the 6-division display down so a 3-division display remains within the graticule area.

c. CHECK—For optimum square leading corner and flat top on the displayed pulse with aberrations not to exceed 0.36 division (6.0%).

d. Set the Calibration Fixture and generator controls to obtain a centered, negative-going, 6-division display. Set the time-base unit for a triggered display on the falling portion of the pulse, at a sweep rate of 20 ns/div.

e. Position the 6-division display up so a 3-division display remains within the graticule area.

f. CHECK—For optimum square leading corner and flat top on the displayed pulse with aberrations not to exceed 0.36 division (6.0%).

5. Check Bandwidth

a. Set the Test switch to Vert or Horiz Freq Resp and turn the Amplitude control fully clockwise.

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

c. Connect the sine-wave generator output to the CW In connector of the Calibration Fixture.

d. Set the sine-wave generator for a reference frequency of 3 MHz and adjust the output for an 8-division display.

e. Set the Calibration Fixture Position and Amplitude controls to obtain a centered, 6-division display.

NOTE

The Calibration Fixture CW Leveled light must be on and the sine-wave generator must be properly connected for a valid check. Refer to the Calibration Fixture and sine-wave generator manual for detailed instructions.

f. Without changing the output amplitude, increase the generator frequency until the displayed amplitude is reduced to 4.2 divisions.

g. CHECK—The generator for a reading of at least 90 MHz.

h. Press POWER switch OFF and install the Calibration Fixture in the center plug-in compartment. Pull the POWER switch ON.

i. Repeat parts a through g for the center vertical compartment.

j. Press POWER switch to turn off the Oscilloscope and disconnect the cable from the Calibration Fixture input connector.

VERTICAL SYSTEM

NOTE

The following alternative procedure is used when the 5A48 is substituted for the Calibration Fixture plug-in unit.

Install Plug-In Units

Install the 5A48 in the left vertical compartment and the time-base unit in the horizontal compartment.

Control Settings

Amplifier Unit

Position	Midrange
Input Coupling	Dc
Mode	CH 1
Trigger	CH 1
Volts/Div	1

1. Adjust Vertical Centering

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

b. Short together the vertical deflection pins 7A and 7B, at the vertical plug-in with an appropriate shorting bar.

c. CHECK—That the displayed trace is within 0.5 division of the center horizontal graticule line.

d. ADJUST—Vertical Centering R135 to position the trace to the center horizontal graticule line. See Fig. 5-4 for adjustment location.

e. Press POWER switch to turn off Oscilloscope and install vertical amplifier unit in center compartment. Pull the POWER switch ON.

f. CHECK—That the displayed trace is within 0.5 division of the center horizontal graticule line.

2. Adjust Vertical Gain

a. Press the POWER switch to turn off the Oscilloscope and install vertical amplifier in the left vertical compartment. Pull the POWER switch ON.

b. Connect a 1 kHz square-wave signal from the Calibration Generator to the vertical amplifier input, using a 42-inch BNC cable.

c. Set the vertical amplifier and generator controls to obtain a six volt reference signal. Center the display.

d. CHECK—The crt display for a vertical deflection of 6 divisions ±0.18 division.

e. ADJUST—Vertical Gain R175 for 6 divisions of deflection.

f. Press POWER switch to turn off the Oscilloscope and remove the vertical amplifier from the left vertical compartment and install it in the center compartment. Pull the POWER switch ON.

g. Repeat part d of this step, and if necessary, readjust Vertical Gain R175 for the optimum gain setting. Compromise for both vertical compartments.

3. Adjust Vertical Compensation

a. Press POWER switch to turn off the Oscilloscope and install the vertical amplifier in the left vertical compartment. Pull the POWER switch ON.

b. Set the vertical amplifier CH 1 VOLTS/DIV switch to .1. Connect the pulse generator to the CH 1 input connector with a 50 ohm termination and a 42-inch BNC cable.

c. Set the time-base unit for a calibrated sweep rate of 20 ns/division and triggering for auto mode, ac coupled from the LEFT source. Adjust trigger level control for a stable display, triggered on the rising portion of the pulse. Center the pulse horizontally on the graticule.

d. CHECK—For optimum square leading corner and flat top on a 5-division displayed pulse with aberrations not to exceed +0.15 or −0.15 division, with total peak-to-peak aberrations not to exceed 0.15 division.

e. ADJUST—Vertical compensation R121 for optimum flat top on the displayed pulse, then adjust R120 and R123, increasing the sweep rate of the time-base, when necessary. Repeat as necessary to obtain optimum flat top on the waveform. See Fig. 5-4 for adjustment location.

f. ADJUST—Vertical compensations C637 (this adjustment is located on the main interface board between vertical compartments, SN B063251-up), C115, R115, C155, R155, R167, and C181 in the order given, for optimum square leading corner with aberrations within the limits given in part d of this step. There is direct interaction between C115 and R115, and between C155 and R155. Best results are usually obtained by setting R115 fully clockwise, then adjusting C115. See Fig. 5-4 for adjustment location.

g. ADJUST—R155 and R167 for minimum ringing of front corner. Adjust C637 (on the main interface board between vertical compartments, SN B063251-up), C155 and C115 for a level front corner. After front corner adjustments have been made, adjust C181 for optimum risetime and minimum front corner spike.

h. Press the POWER switch to turn off the Oscilloscope, and install the Vertical Amplifier in the center compartment. Pull POWER switch ON.

i. Repeat parts d through g. If necessary, compromise the vertical compensation adjustment to obtain the best response for both left and right vertical compartments.

4. Check Bandwidth

a. Press the POWER switch to turn off the Oscilloscope and install the vertical amplifier in the left vertical compartment. Pull the POWER switch ON.

b. Set the time-base unit for a sweep rate of 10 μs/division.

c. Disconnect the BNC cable from the pulse generator and connect it to the output connector of the sine-wave generator.

d. Set the vertical amplifier volts/division switch to .1 and adjust the sine-wave generator controls for a 6-division display at a frequency of 3 megahertz.

e. Without changing the output amplitude, increase the generator frequency until the displayed amplitude is reduced to 4.2 divisions.

f. CHECK—The generator for a reading of at least 60 megahertz.

g. Press the POWER switch to turn off the Oscilloscope and install the vertical amplifier in the center vertical compartment. Pull the POWER switch ON.

h. Repeat parts d through f for the center vertical compartment.

i. Press the POWER switch to turn off the Oscilloscope and disconnect cable and termination from the equipment.

HORIZONTAL SYSTEM

NOTE

The Calibration Fixture is used for the horizontal system adjustment procedure. When a different amplifier plug-in is used to verify horizontal specifications, the amplifier frequency must be considered. An alternate procedure is provided when the 5A48 is substituted for the Calibration Fixture plug-in unit.

Install Plug-In Units

Install the Calibration Fixture in the horizontal plug-in compartment and the time-base unit in the left vertical compartment.

Control Settings

Calibration Fixture

Position	Midrange
Amplitude	Midrange
Test Switch	Common Mode
Rep Rate	1 MHz

Time-Base Unit

Main Triggering

Slope	+
Mode	Auto
Trigger Source	Left
Position	As desired
Mag	X1
Main Sec/Div	1 ms
Display Mode	Main Swp

1. Adjust Horizontal Centering

a. Pull POWER switch to turn on the Oscilloscope and check for a vertical trace over the entire graticule area.

b. CHECK—That the displayed trace is within 0.5 division of the center vertical graticule line.

c. ADJUST—Horizontal Centering R222 to position the trace to the center vertical graticule line. See Fig. 5-5 for adjustment location.

2. Adjust Horizontal Gain

a. Set the Test switch of the Calibration Fixture to Vert or Horiz Gain.

b. Position the display with the Calibration Fixture position control to align the bright center trace of the display with the center vertical graticule line.

c. CHECK—That the center 7 traces coincide with the respective vertical graticule lines, one trace per division, ±0.25 division.

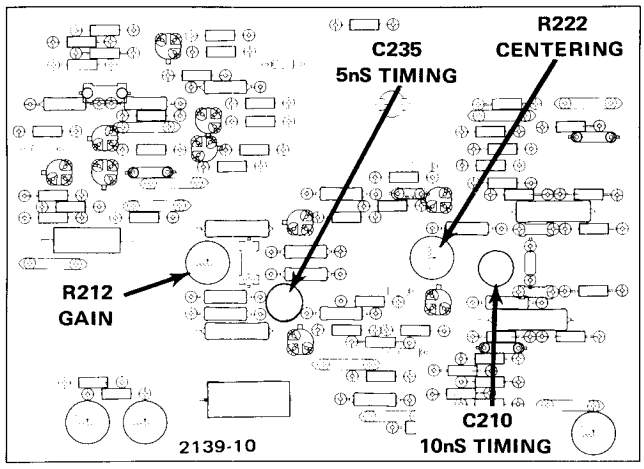

Fig. 5-5. Location of Horizontal Amplifier adjustments.

d. ADJUST—Horizontal Gain R212 for 6 divisions of deflection over the center 7 vertical graticule lines.

e. Press POWER switch to turn off the Oscilloscope and interchange the Calibration Fixture and the time-base unit in their respective compartments. Pull POWER switch ON.

3. Adjust 10 ns Timing

NOTE

A 5B42 time-base or a time-base having a 10 ns sweep must be used.

a. Set the Calibration Fixture test switch to AUX IN.

b. Connect the time-mark generator to the aux in connector of the Calibration Fixture.

c. Set the time-mark generator for 10 nanosecond markers. Set the Calibration Fixture amplitude control so the markers are at least five divisions in amplitude.

d. Set the time-base unit for auto, internal triggering, and the sweep rate to 10 ns/div. Adjust the time-base triggering controls for a stable display.

e. CHECK—For one 10 nanosecond marker per division over the center eight major graticule divisions of the display (position as necessary).

f. ADJUST—C210 for one 10 nanosecond marker per division over the center eight major graticule divisions of the display. Sweep accuracy is ±5% over the entire sweep, excluding the first 30 ns and the last 10 divisions of the magnified sweep. See Fig. 5-5 for adjustment location.

4. Adjust 5 ns Timing

NOTE

This step can be performed only with a time-base unit having a 5 ns sweep rate, such as Tektronix 5B44.

a. Press POWER switch to turn off Oscilloscope and install appropriate time-base unit in the horizontal compartment. Pull POWER switch ON.

b. Set the time-mark generator for 5 nanosecond markers. Set the Calibration Fixture amplitude control so the markers are at least five divisions in amplitude.

c. Set the time-base unit for auto, internal triggering, and the sweep rate to 5 ns/div. Adjust the time-base triggering controls for a stable display.

d. CHECK—For one 5 nanosecond marker per division over the center eight major graticule divisions of the display (position as necessary).

e. ADJUST—C235 for one 5 nanosecond marker per division over the center eight graticule divisions of the display. Sweep accuracy is ±6% over the entire sweep, excluding the first 30 ns and the last 10 divisions of the magnified sweep. See Fig. 5-5 for adjustment location.

f. Interaction will occur between adjustment of C210 and C235. Repeat step 3 and step 4 to achieve a timing compromise.

g. Press POWER switch to turn off the Oscilloscope. Disconnect all cables.

HORIZONTAL SYSTEM

NOTE

The following alternative procedure is used when the 5A48 is substituted for the Calibration Fixture plug-in unit.

Install Plug-In Units

Install the 5A48 in the horizontal plug-in compartment and the time-base unit in the left vertical compartment.

Control Settings

Amplifier Unit

Position	Midrange
Input coupling	Dc
Mode	CH 1
Trigger	CH 1
Volts/Div	1

Time-Base Unit

Main Triggering

Slope	+
Mode	Auto
Trigger Source	Left
Position	As desired
Mag	X1
Main Sec/Div	1 ms
Display Mode	Main Swp

1. Adjust Horizontal Centering

a. Pull the POWER switch to turn on the Oscilloscope and check for a vertical trace over the entire graticule area.

b. Short together pins 7A and 7B on the 5A48 vertical amplifier with an appropriate shorting bar.

c. CHECK—That the displayed trace is within 0.5 division of the center vertical graticule line.

d. ADJUST—Horizontal Centering R222 to position the trace to the center vertical graticule line. See Fig. 5-5 for adjustment location.

2. Adjust Horizontal Gain

a. Connect a 1 kHz square-wave signal from the Calibration Generator to the 5A48 input, using a 42-inch BNC cable.

b. Set the vertical amplifier and generator controls to obtain a five volt reference signal. Center the display between the third and eighth vertical graticule lines.

c. CHECK—The crt display for a horizontal deflection of 5 divisions ±0.15 division.

d. ADJUST—Horizontal Gain R212 for 5 divisions of deflection. See Fig. 5-5 for adjustment location.

e. Press the POWER switch to turn off the Oscilloscope and interchange the vertical amplifier and the time-base unit in their respective compartments. Pull POWER switch ON.

f. Disconnect the BNC cable from the vertical amplifier input connector.

3. Adjust 10 ns timing

NOTE

A 5B42 time-base or a time-base having a 10 ns sweep must be used.

a. Connect the time-mark generator signal to the input of the 5A48.

b. Set the time-mark generator for 10 nanosecond markers. Set the deflection factor of the vertical amplifier so the markers are at least five divisions in amplitude.

c. Set the time-base unit for a sweep rate of 10 ns/div. Adjust the time-base triggering control for a stable display.

d. CHECK—For one 10 nanosecond marker per division over the center eight graticule divisions of the display (position as necessary).

e. ADJUST—C210 for one 10 nanosecond marker per division over the center eight major graticule divisions of the display. Sweep accuracy is ±5% over the entire sweep, excluding the first 30 ns and the last 10 divisions of the magnified sweep. See Fig. 5-5 for adjustment location.

4. Adjust 5 ns Timing

NOTE

This step can be performed only with a time-base unit having a 5 ns sweep rate, such as Tektronix 5B44.

a. Press the POWER switch to turn off the Oscilloscope and install an appropriate time-base unit in the horizontal compartment. Pull POWER switch ON.

b. Set the time-mark generator for 5 nanosecond markers. Set the deflection factor of the vertical amplifier so the markers are at least five divisions in amplitude.

c. Set the time-base unit for a sweep rate of 5 ns/div. Adjust the time-base triggering control for a stable display.

d. CHECK—For one 5 nanosecond marker per division over the center eight graticule divisions of the display (position as necessary).

e. ADJUST—C235 for one 5 nanosecond marker per division over the center eight graticule divisions of the display. Sweep accuracy is ±6% over the entire sweep, excluding the first 30 ns and the last 10 divisions of the magnified sweep. See Fig. 5-5 for adjustment location.

f. Interaction will occur between adjustment of C210 and C235. Repeat step 3 and step 4 to achieve a timing compromise.

READOUT SYSTEM

NOTE

If the Readout System was deleted from the instrument (Option 1), omit this section of the procedure.

It is not necessary to install any plug-ins to perform this procedure. With plug-ins installed and Q1052 removed, random characters will appear; with plug-in and Q1052 removed, all zeros will appear.

1. Adjust Vertical Spacing

a. Remove Q1052 from its socket on the Readout board. See Fig. 5-6A for location.

b. Pull the POWER switch ON and set the READOUT control for visible characters.

c. CHECK—Crt display for two rows of zeros, 40 zeros to a row with no overlap. The two rows of zeros should be located vertically in the middle of the top and bottom divisions of the graticule. See Fig. 5-6B.

d. ADJUST—Vertical Spacing R1118 to position the top row of readout characters to the middle of the top graticule division. Then adjust Vertical Centering R135 (located on vertical circuit board) so the bottom row of readout characters is in the middle of the bottom graticule division. Some interaction will occur between adjustment of R1118 and R135. Repeat until correct readout character location is achieved. See Fig. 5-6A and 5-6B.

2. Adjust Horizontal Positioning

a. CHECK—That the first and last characters of both rows of zeros are within the graticule area. See Fig. 5-6B.

b. ADJUST—Horizontal Positioning R1110 to position both rows of zeros so the first and last characters are within the graticule area. See Fig. 5-6B for correct positioning of the readout display.

3. Adjust Character Scan

a. CHECK—Displayed characters for completeness without overscanning (overscanning causes a bright dot where traces overlap).

b. ADJUST—Character Scan R1006 for fully scanned characters without overscanning. See Fig. 5-6A and 5-6B.

c. Press POWER switch to turn off Oscilloscope. Replace Q1052 to its socket. This completes the adjustment procedure.

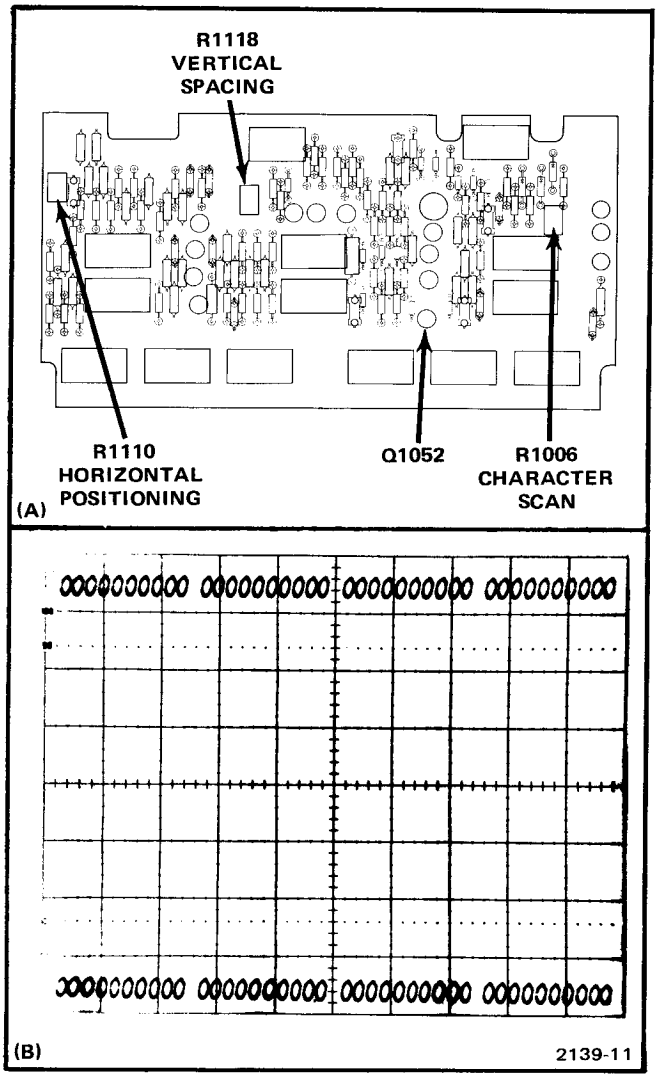

Fig. 5-6. (A) Locations of Readout Adjustment, Q1052, (B) Readout display with Q1052 removed (with plug-ins removed).

OPTION INFORMATION

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

			No. of Pages
Option 1	Removes Readout Circuitry	Described in this section.	1
Option 3	External Readout Input	Described in this section.	5
Option 4	Protective Front Panel Cover	Described in this section.	1
Option 76	P7 Phosphor	Described in this section.	1
Option 78	P11 Phosphor	Described in this section.	1

OPTION 1

This modification removes the Readout circuitry from the 5440.

ELECTRICAL PARTS LIST

Ckt. No.	Tektronix Part No.	Description
Remove:		
A7	670-2413-00	READOUT Circuit Board Assembly
A9	670-5035-00	READOUT PROTECTION Circuit Board Assembly (SN B074125 &up)
U1030	155-0015-01	Monolithic Analog Data Switch (SN B074124 & below)
U1040	155-0015-01	Monolithic Analog Data Switch (SN B074124 & below)
Add:		
	131-1398-00	Contact, Elect. 16 Pin, dip, gnd
	131-1398-00	Contact, Elect. 16 Pin, dip, gnd

(131-1398-00 are installed where the 155-0015-01 are removed)

OPTION 3
EXTERNAL READOUT INPUT

The External Readout Input option provides access to the two readout display words which cannot be programmed via plug-ins in the 5440. This option does not alter the display or 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. Option 3-1. These words are designated EXT. 1 and EXT 2.

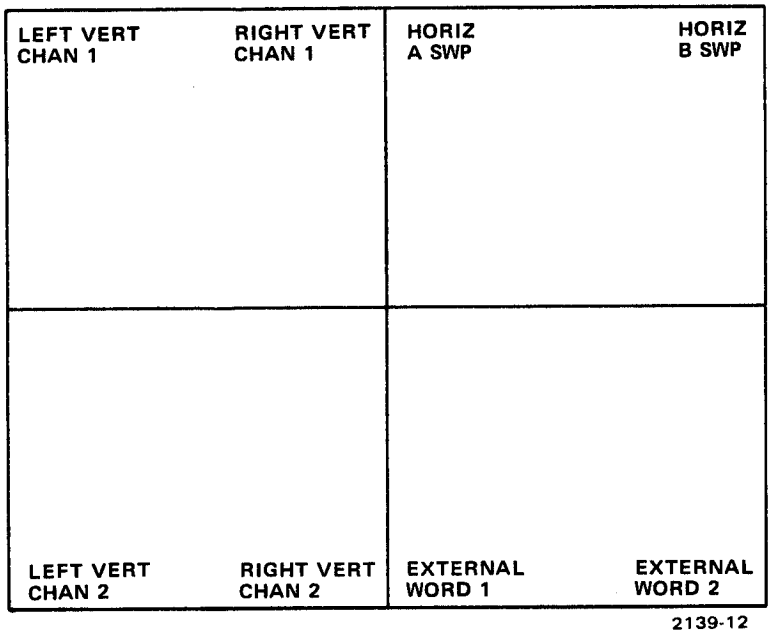

Fig. Option 3-1. Readout Word Location

CONNECTOR DESCRIPTION

The connector provided for the External Readout Input is a 25 pin female connector located on the rear panel of the 5440. The connector mates with an ITT-Cannon DB-25P or equivalent connector (TEK PN 131-0570-00). Refer to Fig. Option 3-2 for connector pin assignments.

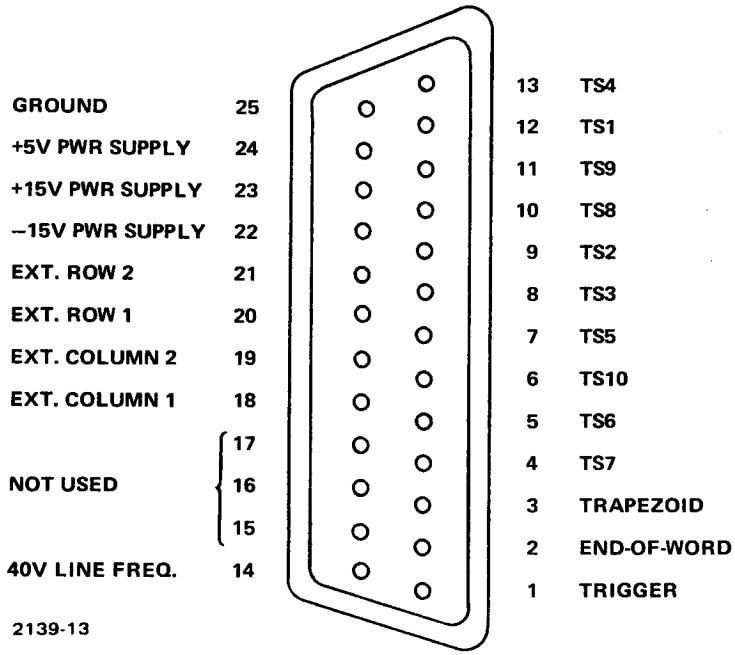

Fig. Option 3-2. Connector pin assignments (View looking at rear panel of 5440)

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 approx. 40 V P-P. 10 mA maximum.
TS1-TS10	Time Slot signals.
TRAPEZOID	Trapezoid signal from pin 10 of Timer, U1000, on Readout Board.
END-OF-WORD	End-of-word pulse from pin 2 of Time Slot counter, U1025, on Readout Board.
TRIGGER	Pulse from pin 5 of Timer, U1000, on Readout Board.

PROGRAMMING

The 5440 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, see Fig. Option 3-3 (the Character Selection Matrix) in this manual. All programming resistors smaller than 51K and larger than 13K should be 1% tolerance or better; all others can be 5% or less.

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

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

Fig. Option 3-3. RESISTOR PROGRAM FOR "TEST 1".

In Fig. Option 3-3 the Matrix indicates, for example, that the character "T" is programmed by Column 9 and Row 4. The Selection Matrix also indicates that a 16.5K resistor is required for Column 9 while 51K 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, character position is unchanged during that Time Slot. 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. 4. This circuit displays "TEST n" where "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 location of EXT 1. Likewise, connection to Row 2 and Column 2 displays in the location of EXT 2.

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.

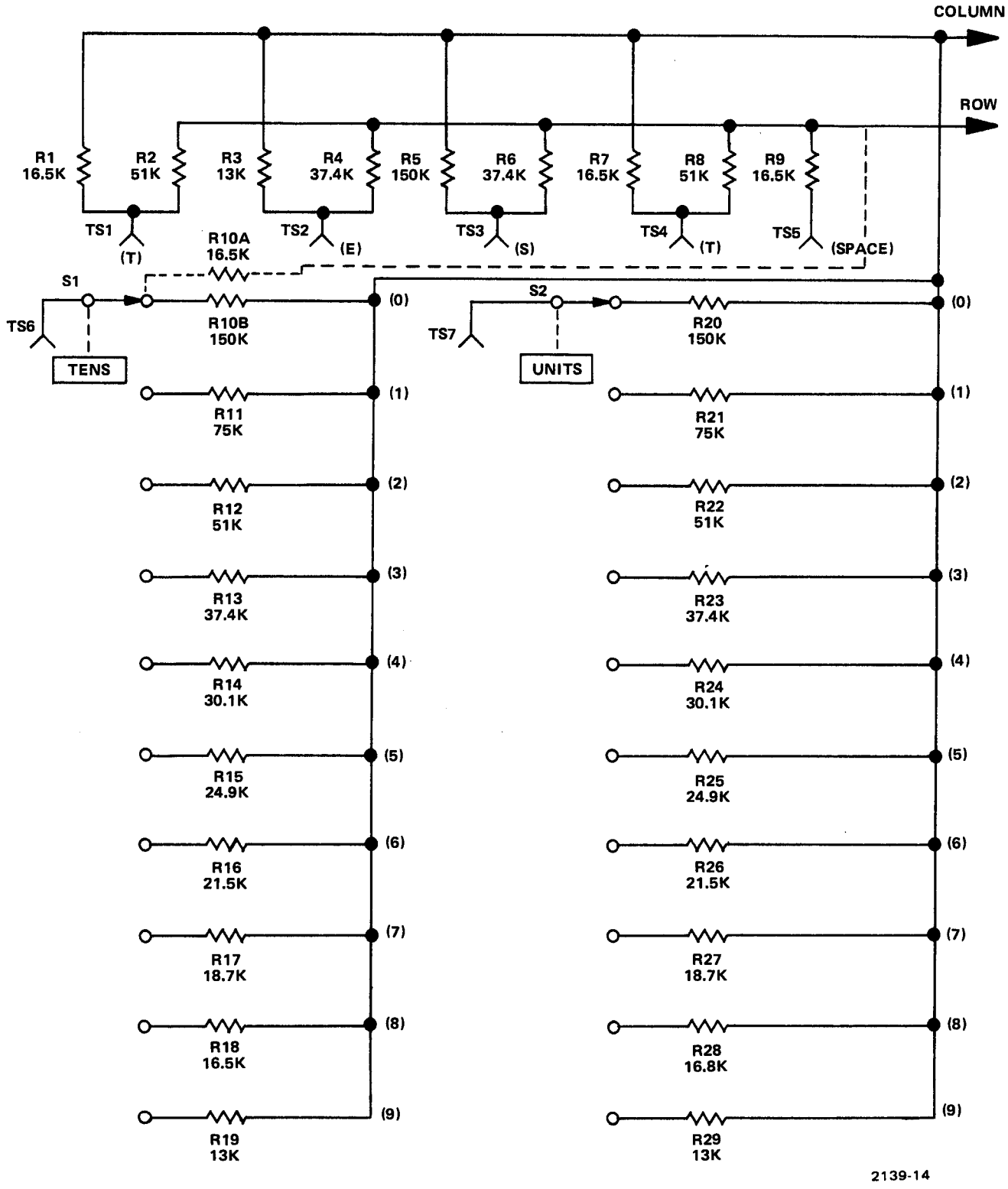

Fig. Option 3-4. Programming "Test n"

@

MECHANICAL PARTS LIST

Tektronix Part No.	Quantity	Description
Add:		
131-0569-00	1	Connector, 25 Pin Female
131-0570-00	1	Connector, 25 Pin Male
210-0004-00	2	Washer, Lock No. 4
210-0406-00	2	Nut, 4-40 x 3/16
129-0370-00	2	Post, Metallic (Stud)
200-1055-00	1	Cover, Connector
Change to:		
333-1775-00	1	Rear Panel

OPTION 4

The purpose of OPTION 4 is to provide a protective front panel cover. The cabinet sides have been modified by the addition of a retaining hook for the protective cover.

MECHANICAL PARTS LIST

Fig. & Index No.	Tektronix Part No.	Qty	Description
Change to:			
3-7	390-0193-01	1	CABINET SIDE (left)
3-12	390-0192-01	1	CABINET SIDE (right)
Add:			
	200-1375-00	1	COVER FRONT (oscilloscope)

OPTION 76

P7 PHOSPHOR

The purpose of OPTION 76 is to provide a cathode-ray tube with P7 phosphor, which is excellent for long-persistence display requirements. The Tektronix part number for the tube is listed in the Replaceable Electrical Parts (see V400).

OPTION 78

P11 PHOSPHOR

The purpose of OPTION 78 is to provide a cathode-ray tube with P11 phosphor, which is best suited for waveform photography. The Tektronix part number for the tube is listed in the Replaceable Electrical Parts (see V400).

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
000AX	BUEHLER PROD.	HIGHWAY 70 EAST	KINGSTON, NC 28501
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867, 19TH AVE. SOUTH	MYRTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
13511	AMPHENOL CARDRE DIV., BUNKER RAMO CORP.		LOS GATOS, CA 95030
15454	RODAN INDUSTRIES, INC.	2905 BLUE STAR ST.	ANAHEIM, CA 92806
24546	CORNING GLASS WORKS, ELECTRONIC COMPONENTS DIVISION	550 HIGH STREET	BRADFORD, PA 16701
31514	STANFORD APPLIED ENGINEERING, INC. ADVANCED PACKAGING DIV.	3080 AIRWAY DRIVE	COSTA MESA, CA 92626
50157	MIDWEST COMPONENTS INC.	P. O. BOX 787 1981 PORT CITY BLVD.	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
71450	CTS CORP.	905 N. WEST BLVD	ELKHART, IN 46514
71744	CHICAGO MINIATURE LAMP WORKS	4433 RAVENSWOOD AVE.	CHICAGO, IL 60640
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
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
80031	ELECTRA-MIDLAND CORP., MEPCO DIV.	22 COLUMBIA ROAD	MORRISTOWN, NJ 07960
81073	GRAYHILL, INC.	561 HILLGROVE AVE., PO BOX 373	LA GRANGE, IL 60525
81439	THERM-O-DISC, INC.	1320 S MAIN, P O BOX 1538	MANSFIELD, OH 44907
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	3029 E. WASHINGTON STREET P. O. BOX 372	INDIANAPOLIS, IN 46206
91418	RADIO MATERIALS COMPANY, DIV. OF P.R. MALLORY AND COMPANY, INC.	4242 W BRYN MAWR	CHICAGO, IL 60646
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601
91929	HONEYWELL, INC., MICRO SWITCH DIV.	CHICAGO & SPRING STS.	FREEPORT, IL 61032
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	670-2442-00			CKT BOARD ASSY:FRONT PANEL CONTROL	80009	670-2442-00
A1	670-2441-00			CKT BOARD ASSY:FRONT PANEL CONTROL	80009	670-2441-00
	----- -----			(OPTION 2 ONLY)		
A2	670-2335-00	B010100	B053530	CKT BOARD ASSY:INTERFACE	80009	670-2335-00
A2	670-2335-01	B053531	B053858	CKT BOARD ASSY:INTERFACE	80009	670-2335-01
A2	670-2335-02	B053859	B055252	CKT BOARD ASSY:INTERFACE	80009	670-2335-02
A2	670-2335-03	B055253	B074124	CKT BOARD ASSY:INTERFACE	80009	670-2335-03
A2	670-2335-04	B074125		CKT BOARD ASSY:INTERFACE	80009	670-2335-04
A3	670-3078-00	B010100	B029999	CKT BOARD ASSY:VERTICAL OUTPUT AMPL	80009	670-3078-00
A3	670-3078-01	B030000		CKT BOARD ASSY:VERTICAL OUTPUT AMPL	80009	670-3078-01
A4	670-2333-00	B010100	B019999	CKT BOARD ASSY:HORIZONTAL AMPL & Z AXIS	80009	670-2333-00
A4	670-2333-01	B020000		CKT BOARD ASSY:HORIZONTAL AMPL & Z AXIS	80009	670-2333-01
A5	670-2443-00	B010100	B073742	CKT BOARD ASSY:HIGH VOLTAGE	80009	670-2443-00
A5	670-2443-02	B073743		CKT BOARD ASSY:HIGH VOLTAGE	80009	670-2443-02
A6	670-2336-00			CKT BAORD ASSY:POWER SUPPLY	80009	670-2336-00
A7	670-2413-00			CKT BOARD ASSY:READOUT	80009	670-2413-00
A8	670-0702-04			CKT BOARD ASSY:GRATICULE LAMPS	80009	670-0702-04
	----- -----			(STANDARD ONLY)		
A9	670-5035-00	XB074125		CKT BOARD ASSY:READOUT PROTECTION	80009	670-5035-00
B800	119-0830-00	XB080000		FAN,TUBEAXIAL:12 VDC,2.4W,5250 RPM,47 CFM	000AX	69.11.2
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	855-558Z5U-103Z
C102	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C115	281-0204-00			CAP.,VAR,PLSTC:2-22PF,100V	80031	287C00222MJ02
C120	281-0638-00			CAP.,FXD,CER DI:240PF,5%,500V	72982	301000Z5D241J
C121	283-0032-00			CAP.,FXD,CER DI:470PF,5%,500V	72982	0831085Z5E00471J
C123	281-0524-00			CAP.,FXD,CER DI:150PF,+/-30PF,500V	04222	7001-1381
C127	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C148	281-0623-00			CAP.,FXD,CER DI:650PF,5%,500V	04222	7001-1362
C153	281-0651-00			CAP.,FXD,CER DI:47PF,5%,200V	72982	374001T2H0470J
C155	281-0204-00			CAP.,VAR,PLSTC:2-22PF,100V	80031	287C00222MJ02
C156	281-0651-00			CAP.,FXD,CER DI:47PF,5%,200V	72982	374001T2H0470J
C160	281-0651-00			CAP.,FXD,CER DI:47PF,5%,200V	72982	374001T2H0470J
C165	281-0623-00			CAP.,FXD,CER DI:650PF,5%,500V	04222	7001-1362
C167	281-0634-00			CAP.,FXD,CER DI:10PF,+/-0.25PF,500V	72982	374011C0G100C
C170	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C173	283-0000-00	XB032530		CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C180	290-0534-00	B010100	B033099	CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C180	283-0111-00	B033100		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C181	281-0203-00			CAP.,VAR,PLSTC:2-10PF,100V	80031	2807C00210MJ02F0
C184	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	04222	7001-1380
C185	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	04222	7001-1380
C188	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C192	290-0534-00	B010100	B010278	CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C192	290-0522-00	B010279	B033099	CAP.,FXD,ELCTLT:1UF,20%,50V	56289	196D105X0050HA1
C192	283-0111-00	B033100		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C197	290-0534-00	B010100	B033099	CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C197	283-0111-00	B033100		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C198	290-0523-00	B010100	B033099	CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	196D225X0020HA1
C198	283-0111-00	B033100		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C210	281-0205-00			CAP.,VAR,PLSTC:4-65PF,100V	80031	2810C5R565QJ02F0
C211	281-0634-00	B010100	B019999	CAP.,FXD,CER DI:10PF,+/-0.25PF,500V	72982	374011C0G100C
C211	281-0574-00	B020000		CAP.,FXD,CER DI:82PF,10%,500V	72982	308000S2H820K
C235	281-0204-00	B010100	B019999	CAP.,VAR,PLSTC:2-22PF,100V	80031	287C00222MJ02
C235	281-0202-00	B020000		CAP.,VAR,PLSTC:1.5-5.5PF,100V	80031	2807C1R406MM02F

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C240	283-0167-00			CAP.,FXD,CER DI:0.1UF,10%,100V	72982	8131N145X5R0104K
C242	281-0627-00	B010100	B019999	CAP.,FXD,CER DI:1PF,+/-0.25PF,500V	72982	301-000C0K0109C
C242	281-0670-00	B020000		CAP.,FXD,CER DI:1.8PF,+/-0.1PF,500V	72982	374005C0K0189B
C244	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C250	283-0092-00	B010100	B019999	CAP.,FXD,CER DI:0.03UF,+80-20%,200V	72982	845-534E303Z
C250	283-0003-00	B020000	B020715	CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C250	283-0142-00	B020716		CAP.,FXD,CER DI:0.0027UF,5%,200V	72982	875-571-Y5E0272J
C252	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C266	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C272	281-0627-00	B010100	B019999	CAP.,FXD,CER DI:1PF,+/-0.25PF,500V	72982	301-000C0K0109C
C272	281-0670-00	B020000		CAP.,FXD,CER DI:1.8PF,+/-0.1PF,500V	72982	374005C0K0189B
C280	283-0110-00			CAP.,FXD,CER DI:0.005UF,+80-20%,150V	56289	19C242B
C282	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C286	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C310	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C335	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C350	281-0627-00			CAP.,FXD,CER DI:1PF,+/-0.25PF,500V	72982	301-000C0K0109C
C352	290-0523-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	196D225X0020HA1
C353	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C354	283-0110-00			CAP.,FXD,CER DI:0.005UF,+80-20%,150V	56289	19C242B
C358	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C360	283-0057-00			CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	274C10
C395	290-0410-00			CAP.,FXD,ELCTLT:15UF,+50-10%,100V	56289	30D156F100DD4
C402	283-0010-00	B010100	B010372	CAP.,FXD,CER DI:0.05UF,+100-20%,50V	56289	273C20
C402	283-0249-00	B010373		CAP.,FXD,CER DI:0.068UF,10%,50V	72982	8131N075 C 683K
C406	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C410	290-0525-00	B010100	B031988	CAP.,FXD,ELCTLT:4.7UF,20%,50V	56289	196D475X0050KA1
C410	290-0767-00	B031989		CAP.,FXD,ELCTLT:4.7UF,+75-10%,160V	56289	502D228
C412	283-0261-00			CAP.,FXD,CER DI:0.01UF,20%,4000V	56289	575C1A1
C414	283-0261-00			CAP.,FXD,CER DI:0.01UF,20%,4000V	56289	575C1A1
C415	283-0261-00			CAP.,FXD,CER DI:0.01UF,20%,4000V	56289	575C1A1
C417	283-0021-00			CAP.,FXD,CER DI:0.001UF,20%,5000V	72982	848-556-Y5S-102M
C418	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C422	283-0261-00			CAP.,FXD,CER DI:0.01UF,20%,4000V	56289	575C1A1
C425	283-0021-00			CAP.,FXD,CER DI:0.001UF,20%,5000V	72982	848-556-Y5S-102M
C427	281-0512-00			CAP.,FXD,CER DI:27PF,+/-2.7PF,500V	72982	308-000C0G0270K
C430	290-0159-00			CAP.,FXD,ELCTLT:2UF,+50-10%,150V	56289	30D205F150BB9
C440	283-0021-00			CAP.,FXD,CER DI:0.001UF,20%,5000V	72982	848-556-Y5S-102M
C608	283-0023-00			CAP.,FXD,CER DI:0.1UF,+80-20%,12V	91418	MX0104Z1205R5
C610	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C619	283-0023-00			CAP.,FXD,CER DI:0.1UF,+80-20%,12V	91418	MX0104Z1205R5
C620	283-0023-00			CAP.,FXD,CER DI:0.1UF,+80-20%,12V	91418	MX0104Z1205R5
C621	281-0534-00			CAP.,FXD,CER DI:3.3PF,+/-0.25PF,500V	72982	301-000C0J0339C
C622	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C624	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C626	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C627	281-0547-00	B010100	B053799	CAP.,FXD,CER DI:2.7PF,10%,500V	72982	301-000C0J0279C
C627	281-0534-00	B053800		CAP.,FXD,CER DI:3.3PF,+/-0.25PF,500V	72982	301-000C0J0339C
C628	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C629	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C630	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C637	281-0503-00	B010100	B054023	CAP.,FXD,CER DI:8PF,+/-0.5PF,500V	72982	301-000C0H0809D
C637	281-0604-00	B054024	B063250	CAP.,FXD,CER DI:2.2PF,+/-0.25PF,500V	72982	301-000C0J0229C
C637	281-0182-00	B063251		CAP.,VAR,PLSTC:1.8-10PF,500V	80031	2805D1R810BH02F0
C639	283-0023-00			CAP.,FXD,CER DI:0.1UF,+80-20%,12V	91418	MX0104Z1205R5
C640	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	04222	7001-1380

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C652	283-0023-00			CAP.,FXD,CER DI:0.1UF,+80-20%,12V	91418	MX0104Z1205R5
C660	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	04222	7001-1380
C704	281-0604-00			CAP.,FXD,CER DI:2.2PF,+/-0.25PF,500V	72982	301-000C0J0229C
C724	281-0604-00			CAP.,FXD,CER DI:2.2PF,+/-0.25PF,500V	72982	301-000C0J0229C
C766	281-0509-00			CAP.,FXD,CER DI:15PF,+/-1.5PF,500V	72982	301-000C0G0150K
C770	283-0023-00			CAP.,FXD,CER DI:0.1UF,+80-20%,12V	91418	MX0104Z1205R5
C775	283-0150-00	B010100	B055252	CAP.,FXD,CER DI:650PF,5%,200V	72982	835-515B651J
C775	283-0065-01	B055253		CAP.,FXD,CER DI:0.001UF,5%,100V	72982	0835582Z5E00102J
C780	283-0150-00	B010100	B055252	CAP.,FXD,CER DI:650PF,5%,200V	72982	835-515B651J
C780	283-0065-01	B055253		CAP.,FXD,CER DI:0.001UF,5%,100V	72982	0835582Z5E00102J
C784	283-0003-00	B010100	B063389	CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C784	283-0164-00	B063390		CAP.,FXD,CER DI:2.2UF,20%,25V	72982	8141N037Z5U0225M
C790	281-0524-00	B010100	B010180	CAP.,FXD,CER DI:150PF,+/-30PF,500V	04222	7001-1381
C790	283-0054-00	B010181		CAP.,FXD,CER DI:150PF,5%,200V	72982	855-535U2J151J
C800	290-0587-00			CAP.,FXD,ELCTLT:170UF,+50-10%,250VDC	56289	68D10496
C820	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C821	283-0167-00	XB040000		CAP.,FXD,CER DI:0.1UF,10%,100V	72982	8131N145X5R0104K
C822	283-0114-00	B010100	B039999X	CAP.,FXD,CER DI:0.0015UF,5%,200V	72982	805-509B152J
C825	290-0535-00			CAP.,FXD,ELCTLT:33UF,20%,10V	56289	196D336X0010KA1
C832	283-0000-00	B010100	B039999X	CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C834	281-0550-00	B010100	B039999	CAP.,FXD,CER DI:120PF,10%,500V	04222	7001-1373
C834	281-0501-00	B040000		CAP.,FXD,CER DI:4.7PF,+/-1PF,500V	72982	301-000S2H0479F
C836	281-0546-00	B010100	B039999	CAP.,FXD,CER DI:330PF,10%,500V	04222	7001-1380
C836	283-0000-00	B040000		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	855-558Z5U-103Z
C848	290-0645-00			CAP.,FXD,ELCTLT:10,000UF,+100-10%	56289	68D10548
C850	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C860	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C867	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C871	281-0580-00			CAP.,FXD,CER DI:470PF,10%,500V	04222	7001-1374
C875	290-0636-00			CAP.,FXD,ELCTLT:7500UF,+100-10%,25V	56289	68D10501
C876	290-0636-00			CAP.,FXD,ELCTLT:7500UF,+100-10%,25V	56289	68D10501
C880	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C890	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C897	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C901	281-0623-00			CAP.,FXD,CER DI:650PF,5%,500V	04222	7001-1362
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	301000Z5D0171J
C930	290-0637-00			CAP.,FXD,ELCTLT:5000UF,+45-10%,50V	56289	68D10527
C932	290-0509-00			CAP.,FXD,ELCTLT:3000UF,+100-10%,50V	56289	68D10454
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
C948	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
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	301-055C0G0100F
C955	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	04222	7001-1380
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	XB030000		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	04222	7001-1364
C1041	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364

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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
CR146	152-0422-00			SEMICOND DEVICE:SILICON,4V,7PF	80009	152-0422-00
CR204	152-0574-00	XB020000		SEMICOND DEVICE:SILICON,120V,0.15A	80009	152-0574-00
CR206	152-0574-00	XB020000		SEMICOND DEVICE:SILICON,120V,0.15A	80009	152-0574-00
CR208	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR240	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR242	152-0574-00			SEMICOND DEVICE:SILICON,120V,0.15A	80009	152-0574-00
CR246	152-0574-00			SEMICOND DEVICE:SILICON,120V,0.15A	80009	152-0574-00
CR270	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR272	152-0574-00			SEMICOND DEVICE:SILICON,120V,0.15A	80009	152-0574-00
CR274	152-0574-00			SEMICOND DEVICE:SILICON,120V,0.15A	80009	152-0574-00
CR324	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR352	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR390	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR391	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR395	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR412	152-0409-00			SEMICOND DEVICE:SILICON,12,000V,5MA	80009	152-0409-00
CR420	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR422	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR428	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR430	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR602	152-0141-02	XB050000		SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR608	152-0141-02	XB050000		SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR686	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR687	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR740	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR741	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR742	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR761	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR770	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR772	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR800	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	80009	152-0107-00
CR801	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	80009	152-0107-00
CR802	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	80009	152-0107-00
CR803	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	80009	152-0107-00
CR820	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR821	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR825	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR832	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR838	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR839	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR848	152-0556-00	B010100	B094512	SEMICOND DEVICE:BRIDGE,50V,2.5A	04713	SDA10271K
CR848	152-0556-01	B094513		SEMICOND DEVICE:RECT BRIDGE,SI,50V,2.5A	80009	152-0556-01
CR850	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR851	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR863	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR864	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR875	152-0556-00			SEMICOND DEVICE:BRIDGE,50V,2.5A	04713	SDA10271K
CR880	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR881	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR893	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR894	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR903	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR910	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR911	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR925	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR927	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR930	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	80009	152-0488-00
CR944	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR950	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR955	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR980	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	80009	152-0107-00
CR981	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	80009	152-0107-00
CR982	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR986	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR1002	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR1003	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR1005	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR1010	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR1012	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR1013	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR1018	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR1024	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR1025	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR1040	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR1041	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR1052	152-0141-02			SEMICOND DEVICE:SILICON,30V,50NA	80009	152-0141-02
CR1060	152-0333-00	XB074125		SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR1061	152-0333-00	XB074125		SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR1062	152-0333-00	XB074125		SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR1063	152-0333-00	XB074125		SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR1064	152-0333-00	XB074125		SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR1065	152-0333-00	XB074125		SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR1066	152-0333-00	XB074125		SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR1067	152-0333-00	XB074125		SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR1068	152-0333-00	XB074125		SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR1069	152-0333-00	XB074125		SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR1070	152-0333-00	XB074125		SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR1071	152-0333-00	XB074125		SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR1072	152-0333-00	XB074125		SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR1073	152-0333-00	XB074125		SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR1074	152-0333-00	XB074125		SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR1075	152-0333-00	XB074125		SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR1076	152-0333-00	XB074125		SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR1077	152-0333-00	XB074125		SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR1078	152-0333-00	XB074125		SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR1079	152-0333-00	XB074125		SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR1080	152-0333-00	XB074125		SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR1081	152-0333-00	XB074125		SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR1082	152-0333-00	XB074125		SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR1083	152-0333-00	XB074125		SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
DL100	119-0392-00	B010100	B029999	DELAY LINE,ELEC:140NS,100 OHM	80009	119-0392-00
DL100	119-0486-00	B030000	B073788	DELAY LINE,ELEC:140NS,100 OHM	80009	119-0486-00
DL100	119-0693-00	B073789		DELAY LINE,ELEC:	80009	119-0693-00
DS310	150-0137-00			LAMP,CARTRIDGE:14V,100MA	71744	CM9818
	----- -----			(STANDARD ONLY)		
DS312	150-0137-00			LAMP,CARTRIDGE:14V,100MA	71744	CM9818
	----- -----			(STANDARD ONLY)		
DS314	150-0137-00			LAMP,CARTRIDGE:14V,100MA	71744	CM9818
	----- -----			(STANDARD ONLY)		
F300	159-0041-00			FUSE,CARTRIDGE:3AG,1.25A,250V,SLOW-BLOW	71400	MDX 1 25/100
	----- -----			(DOMESTIC (120V NOMINAL LINE)		
F300	159-0040-00			FUSE,CARTRIDGE:3AG,0.7A,SLOW-BLOW	71400	MDL 7/10
	----- -----			(EXPORT (240V NOMINAL LINE)		
F410	159-0029-00			FUSE,CARTRIDGE:3AG,0.3A,250V,SLOW-BLOW	71400	MDL3/10
F800	159-0028-00			FUSE,CARTRIDGE:3AG,0.25A,250V,FAST-BLOW	71400	AGC 1/4
J300	131-0955-00			CONNECTOR,RCPT,:BNC,FEMALE,W/HARDWARE	13511	31-279
J610	131-1078-00	B010100	B059999	CONNECTOR,RCPT,:28/56 CONTACT	95238	600-1156Y256DF30
J610	131-1078-01	B060000	B094553	CONN,RCPT,ELEC:CKT CARD,28/56 CONTACT	31514	SAM28D/2-TX
J610	131-1078-00	B094554		CONNECTOR,RCPT,:28/56 CONTACT	95238	600-1156Y256DF30
J620	131-1078-00	B010100	B059999	CONNECTOR,RCPT,:28/56 CONTACT	95238	600-1156Y256DF30
J620	131-1078-01	B060000	B094553	CONN,RCPT,ELEC:CKT CARD,28/56 CONTACT	31514	SAM28D/2-TX
J620	131-1078-00	B049554		CONNECTOR,RCPT,:28/56 CONTACT	95238	600-1156Y256DF30
J630	131-1078-00	B010100	B059999	CONNECTOR,RCPT,:28/56 CONTACT	95238	600-1156Y256DF30
J630	131-1078-01	B060000	B094553	CONN,RCPT,ELEC:CKT CARD,28/56 CONTACT	31514	SAM28D/2-TX
J630	131-1078-00	B094554		CONNECTOR,RCPT,:28/56 CONTACT	95238	600-1156Y256DF30
L167	108-0733-00			COIL,RF:113NH	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 DEFLE:TRACE ROTATOR	80009	108-0644-00
LR193	108-0328-00			COIL,RF:0.3UH	80009	108-0328-00
LR195	108-0328-00			COIL,RF:0.3UH	80009	108-0328-00
LR1100	108-0212-00			COIL,RF:0.5UH	80009	108-0212-00
Q100	151-0441-00			TRANSISTOR:SILICON,NPN	80009	151-0441-00
Q106	151-0212-00			TRANSISTOR:SILICON,NPN	80009	151-0212-00
Q125	151-0441-00			TRANSISTOR:SILICON,NPN	80009	151-0441-00
Q130	151-0212-00			TRANSISTOR:SILICON,NPN	80009	151-0212-00
Q140	151-0342-00			TRANSISTOR:SILICON,PNP	80009	151-0342-00
Q148	151-0271-00			TRANSISTOR:SILICON,PNP	80009	151-0271-00
Q165	151-0271-00			TRANSISTOR:SILICON,PNP	80009	151-0271-00
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	80009	151-0446-00
Q190	151-0446-00			TRANSISTOR:SILICON,NPN	80009	151-0446-00
Q200	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q215	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q240	151-0302-00	B010100	B019999	TRANSISTOR:SILICON,NPN	80009	151-0302-00
Q240	151-0333-00	B020000		TRANSISTOR:SILICON,NPN,SEL FROM MPS918	80009	151-0333-00
Q244	151-0407-00			TRANSISTOR:SILICON,NPN	80009	151-0407-00
Q250	151-0406-00			TRANSISTOR:SILICON,PNP	80009	151-0406-00
Q255	151-0262-00	XB020000		TRANSISTOR:SILICON,NPN	80009	151-0262-00
Q270	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q274	151-0407-00			TRANSISTOR:SILICON,NPN	80009	151-0407-00
Q280	151-0406-00			TRANSISTOR:SILICON,PNP	80009	151-0406-00

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q310	151-0352-00			TRANSISTOR:SILICON,NPN	80009	151-0352-00
Q320	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q335	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q340	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q345	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q352	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q356	151-0350-00			TRANSISTOR:SILICON,PNP	80009	151-0350-00
Q390	151-0254-00			TRANSISTOR:SILICON,NPN	80009	151-0254-00
Q400	151-0342-00			TRANSISTOR:SILICON,PNP	80009	151-0342-00
Q410	151-0262-00			TRANSISTOR:SILICON,NPN	80009	151-0262-00
Q600	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q604	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q610	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q614	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q630	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q640	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q650	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q660	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q670	151-0341-00			TRANSISTOR:SILICON,NPN	80009	151-0341-00
Q674	151-0341-00			TRANSISTOR:SILICON,NPN	80009	151-0341-00
Q680	151-0342-00			TRANSISTOR:SILICON,PNP	80009	151-0342-00
Q700	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q708	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q710	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q715	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q720	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q728	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q730	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q735	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q740	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q744	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q748	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	80009	151-0333-00
Q752	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	80009	151-0333-00
Q770	151-0341-00			TRANSISTOR:SILICON,NPN	80009	151-0341-00
Q820	151-0405-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE800	80009	151-0405-00
Q824	151-0342-00			TRANSISTOR:SILICON,PNP	80009	151-0342-00
Q830	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q832	151-0341-00			TRANSISTOR:SILICON,NPN	80009	151-0341-00
Q838	151-0342-00			TRANSISTOR:SILICON,PNP	80009	151-0342-00
Q850	151-0405-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE800	80009	151-0405-00
Q855	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q864	151-0341-00			TRANSISTOR:SILICON,NPN	80009	151-0341-00
Q866	151-0341-00			TRANSISTOR:SILICON,NPN	80009	151-0341-00
Q870	151-0341-00			TRANSISTOR:SILICON,NPN	80009	151-0341-00
Q880	151-0405-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE800	80009	151-0405-00
Q885	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q894	151-0342-00			TRANSISTOR:SILICON,PNP	80009	151-0342-00
Q896	151-0342-00			TRANSISTOR:SILICON,PNP	80009	151-0342-00
Q900	151-0341-00			TRANSISTOR:SILICON,NPN	80009	151-0341-00
Q910	151-0331-00	B010100	B049999	TRANSISTOR:SILICON,NPN	80009	151-0331-00
Q910	151-0496-00	B050000		TRANSISTOR:SILICON,NPN	80009	151-0496-00
Q915	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q925	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q940	151-0331-00	B010100	B049999	TRANSISTOR:SILICON,NPN	80009	151-0331-00
Q940	151-0496-00	B050000		TRANSISTOR:SILICON,NPN	80009	151-0496-00
Q950	151-0342-00			TRANSISTOR:SILICON,PNP	80009	151-0342-00

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Q955	151-0342-00			TRANSISTOR:SILICON,PNP	80009	151-0342-00
Q958	151-0341-00			TRANSISTOR:SILICON,NPN	80009	151-0341-00
Q982	151-0341-00			TRANSISTOR:SILICON,NPN	80009	151-0341-00
Q984	151-0341-00			TRANSISTOR:SILICON,NPN	80009	151-0341-00
Q1010	151-0410-00			TRANSISTOR:SILICON,PNP	80009	151-0410-00
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	80009	151-0232-00
Q1048	151-0341-00			TRANSISTOR:SILICON,NPN	80009	151-0341-00
Q1050	151-0341-00			TRANSISTOR:SILICON,NPN	80009	151-0341-00
Q1052	151-0410-00			TRANSISTOR:SILICON,PNP	80009	151-0410-00
Q1056	151-0341-00			TRANSISTOR:SILICON,NPN	80009	151-0341-00
Q1100	151-0410-00			TRANSISTOR:SILICON,PNP	80009	151-0410-00
Q1110	151-0410-00			TRANSISTOR:SILICON,PNP	80009	151-0410-00
Q1140 Q1150	153-0597-00			SEMICOND DVC SE:SILICON,PNP	80009	153-0597-00
R100	321-0068-00	B010100	B029999	RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R100	321-0085-00	B030000		RES.,FXD,FILM:75 OHM,1%,0.125W	91637	MFF1816G75R00F
R102	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R103	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	MFF1816G100R0F
R104	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	MFF1816G100R0F
R108	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R110	321-0217-00			RES.,FXD,FILM:1.78K OHM,1%,0.125W	91637	MFF1816G17800F
R111	321-0089-00			RES.,FXD,FILM:82.5 OHM,1%,0.125W	91637	MFF1816G82R50F
R112	321-0217-00			RES.,FXD,FILM:1.78K OHM,1%,0.125W	91637	MFF1816G17800F
R115	311-1566-00			RES.,VAR,NONWIR:200 OHM,20%,0.50W	73138	91-88-0
R117	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R118	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R120	311-1560-00			RES.,VAR,NONWIR:5K OHM,5%,0.50W	73138	91A R5K
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 R1K
R125	321-0068-00	B010100	B029999	RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R125	321-0085-00	B030000		RES.,FXD,FILM:75 OHM,1%,0.125W	91637	MFF1816G75R00F
R127	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R128	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	MFF1816G100R0F
R129	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	MFF1816G100R0F
R132	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R135	311-1563-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	73138	91A R1K
R136	321-0121-00			RES.,FXD,FILM:178 OHM,1%,0.125W	91637	MFF1816G178R0F
R138	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R139	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R141	315-0102-00	B010100	B010250	RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R141	315-0152-00	B010251		RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R142	315-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R143	315-0510-00	B010100	B095249	RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R143	315-0750-00	B095250		RES.,FXD,CMPSN:75 OHM,(NOM VALUE),SEL	01121	CB7505
R144	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315
R145	321-0148-00			RES.,FXD,FILM:340 OHM,1%,0.125W	91637	MFF1816G340R0F
R146	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R148	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R149	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R151	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R153	321-0093-00			RES.,FXD,FILM:90.9 OHM,1%,0.125W	91637	MFF1816G90R90F
R155	311-1567-00			RES.,VAR,NONWIR:TRMR,100 OHM,0.50W	73138	91-89-0
R157	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
R158	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025

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R160	321-0148-00			RES.,FXD,FILM:340 OHM,1%,0.125W	91637	MFF1816G340R0F
R163	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315
R164	315-0510-00	B010100	B095249	RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R164	315-0750-00	B095250		RES.,FXD,CMPSN:75 OHM,(NOM VALUE),SEL	01121	CB7505
R165	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R167	311-1564-00			RES.,VAR,NONWIR:500 OHM,20%,0.50W	73138	91A R500
R172	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	MFF1816G200R0F
R173	321-0093-00			RES.,FXD,FILM:90.9 OHM,1%,0.125W	91637	MFF1816G90R90F
R175	311-1561-00			RES.,VAR,NONWIR:2.5K OHM,20%,0.50W	73138	91A R2500
R176	321-0093-00			RES.,FXD,FILM:90.9 OHM,1%,0.125W	91637	MFF1816G90R90F
R178	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	MFF1816G200R0F
R180	301-0151-00	B010100	B020396	RES.,FXD,CMPSN:150 OHM,5%,0.50W	01121	EB1515
R180	315-0910-00	B020397		RES.,FXD,CMPSN:91 OHM,5%,0.25W	01121	CB9105
R181	321-0059-00	B010100	B020396	RES.,FXD,FILM:40.2 OHM,1%,0.125W	91637	MFF1816G40R20F
R181	321-0063-00	B020397	B029999	RES.,FXD,FILM:44.2 OHM,1%,0.125W	91637	MFF1816G44R20F
R181	321-0086-00	B030000		RES.,FXD,FILM:76.8 OHM,1%,0.125W	91637	MFF1816G76R80F
R182	301-0151-00	B010100	B020396	RES.,FXD,CMPSN:150 OHM,5%,0.50W	01121	EB1515
R182	315-0910-00	B020397		RES.,FXD,CMPSN:91 OHM,5%,0.25W	01121	CB9105
R183	301-0300-00	XB020397		RES.,FXD,CMPSN:30 OHM,5%,0.50W	01121	EB3005
R184	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R185	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R187	315-0820-00			RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R188	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R190	315-0820-00			RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R191	307-0435-00			RES.,FXD,FILM:510 OHM,5%,4W	24546	FP45100J
R192	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R193	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R194	307-0435-00			RES.,FXD,FILM:510 OHM,5%,4W	24546	FP45100J
R195	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R197	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R198	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R200	321-0069-00	B010100	B019999	RES.,FXD,FILM:51.1 OHM,1%,0.125W	91637	MFF1816G51R10F
R200	321-0065-00	B020000		RES.,FXD,FILM:46.4 OHM,1%,0.125W	91637	MFF1816G46R40F
R201	317-0047-00	XB020000		RES.,FXD,CMPSN:4.7 OHM,5%,0.125W	01121	BB47G5
R202	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R203	321-0200-00			RES.,FXD,FILM:1.18K OHM,1%,0.125W	91637	MFF1816G11800F
R205	322-0205-00			RES.,FXD,FILM:1.33K OHM,1%,0.25W	91637	MFF1421G13300F
R207	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R208	315-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.25W	01121	CB3615
R210	321-0158-00			RES.,FXD,FILM:432 OHM,1%,0.125W	91637	MFF1816G432R0F
R211	321-0093-00	B010100	B019999	RES.,FXD,FILM:90.9 OHM,1%,0.125W	91637	MFF1816G90R90F
R211	321-0076-00	B020000		RES.,FXD,FILM:60.4 OHM,1%,0.125W	91637	MFF1816G60R40F
R212	311-1564-00			RES.,VAR,NONWIR:500 OHM,20%,0.50W	73138	91A R500
R213	322-0205-00			RES.,FXD,FILM:1.33K OHM,1%,0.25W	91637	MFF1421G13300F
R215	321-0069-00	B010100	B019999	RES.,FXD,FILM:51.1 OHM,1%,0.125W	91637	MFF1816G51R10F
R215	321-0065-00	B020000		RES.,FXD,FILM:46.4 OHM,1%,0.125W	91637	MFF1816G46R40F
R216	317-0047-00	XB020000		RES.,FXD,CMPSN:4.7 OHM,5%,0.125W	01121	BB47G5
R217	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R218	321-0200-00			RES.,FXD,FILM:1.18K OHM,1%,0.125W	91637	MFF1816G11800F
R220	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R222	311-1558-00			RES.,VAR,NONWIR:20K OHM,20%,0.50W	73138	91-80-0
R224	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R238	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R240	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R242	323-0318-00			RES.,FXD,FILM:20K OHM,1%,0.50W	91637	MFF1226D20001F
R243	315-0332-00	B010100	B019999X	RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325

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R244	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R245	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R246	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R247	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R248	315-0104-00	XB020000		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R250	301-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.50W	01121	EB3935
R252	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R256	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R257	305-0622-00	B010100	B019999	RES.,FXD,CMPSN:6.2K OHM,5%,2W	01121	HB6225
R257	304-0392-00	B020000		RES.,FXD,CMPSN:3.9K OHM,10%,1W	01121	GB3921
R258	315-0753-00	XB020000		RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R259	316-0100-00			RES.,FXD,CMPSN:10 OHM,10%,0.25W	01121	CB1001
R265	321-0268-00			RES.,FXD,FILM:6.04K OHM,1%,0.125W	91637	MFF1816G60400F
R266	321-0389-00			RES.,FXD,FILM:110K OHM,1%,0.125W	91637	MFF1816G11002F
R268	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R270	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R272	323-0318-00			RES.,FXD,FILM:20K OHM,1%,0.50W	91637	MFF1226D20001F
R274	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R275	315-0332-00	B010100	B019999X	RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R276	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R280	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R282	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R284	301-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.50W	01121	EB3935
R286	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R289	316-0100-00			RES.,FXD,CMPSN:10 OHM,10%,0.25W	01121	CB1001
R320	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R322	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R324	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R326	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R327	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R328	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R330	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R332	311-1428-00			RES.,VAR,NONWIR:20K OHM,1W	01121	10M959
R334	315-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.25W	01121	CB2245
R335	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R336	315-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.25W	01121	CB2245
R338	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R342	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R343	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R345	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R347	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R349	321-0311-00			RES.,FXD,FILM:16.9K OHM,1%,0.125W	91637	MFF1816G16901F
R350	321-0311-00			RES.,FXD,FILM:16.9K OHM,1%,0.125W	91637	MFF1816G16901F
R352	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R356	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R358	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R359	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R360	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R362	303-0153-00	B010100	B010372	RES.,FXD,CMPSN:15K OHM,5%,1W	01121	GB1535
R362	305-0153-00	B010373		RES.,FXD,CMPSN:15K OHM,5%,2W	01121	HB1535
R365	311-1555-00			RES.,VAR,NONWIR:100K OHM,20%,0.5W	73138	91-77-0
R368	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R370	311-1555-00			RES.,VAR,NONWIR:100K OHM,20%,0.5W	73138	91-77-0
R375	311-1559-00	B010100	B020892	RES.,VAR,NONWIR:10K OHM,20%,0.50W	73138	91A-10001M
R375	311-1558-00	B020893		RES.,VAR,NONWIR:20K OHM,20%,0.50W	73138	91-80-0
R390	316-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021

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R392	316-0154-00			RES.,FXD,CMPSN:150K OHM,10%,0.25W	01121	CB1541
R394	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R395A,B R395C,D	307-0290-06			RES.,FXD,FILM:250K OHM	80009	307-0290-06
R397	316-0474-00			RES.,FXD,CMPSN:470K OHM,10%,0.25W	01121	CB4741
R400	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R402	316-0182-00	B010100	B010372	RES.,FXD,CMPSN:1.8K OHM,10%,0.25W	01121	CB1821
R402	316-0102-00	B010373		RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R404	315-0270-00	XB010373		RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R405	316-0273-00			RES.,FXD,CMPSN:27K OHM,10%,0.25W	01121	CB2731
R406	316-0391-00	B010100	B033099	RES.,FXD,CMPSN:390 OHM,10%,0.25W	01121	CB3911
R406	316-0101-00	B033100		RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R408	316-0100-00			RES.,FXD,CMPSN:10 OHM,10%,0.25W	01121	CB1001
R410	307-0053-00			RES.,FXD,CMPSN:3.3 OHM,5%,0.50W	01121	EB33G5
R412	316-0223-00			RES.,FXD,CMPSN:22K OHM,10%,0.25W	01121	CB2231
R415	316-0470-00			RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701
R417	316-0104-00			RES.,FXD,CMPSN:100K OHM,10%,0.25W	01121	CB1041
R418	316-0104-00			RES.,FXD,CMPSN:100K OHM,10%,0.25W	01121	CB1041
R420	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R422	316-0106-00			RES.,FXD,CMPSN:10M OHM,10%,0.25W	01121	CB1061
R425	316-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R427	316-0105-00			RES.,FXD,CMPSN:1M OHM,10%,0.25W	01121	CB1051
R428	316-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R430	316-0473-00			RES.,FXD,CMPSN:47K OHM,10%,0.25W	01121	CB4731
R433	316-0393-00			RES.,FXD,CMPSN:39K OHM,10%,0.25W	01121	CB3931
R435	311-1206-00			RES.,VAR,NONWIR:250K OHM,30%,0.25W	71450	201-YA5546
R440	311-1312-00			RES.,VAR,NONWIR:5M OHM,20%,1W	01121	73M4G048L505M
R600	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R601	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R602	315-0331-00	XB050000		RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R603	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R604	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R605	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R607	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R608	315-0331-00	XB050000		RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R610	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R611	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R613	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R614	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R615	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R617	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R619	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R620	321-0091-03			RES.,FXD,FILM:86.6 OHM,0.25%,0.125W	91637	MFF1816D86R60C
R621	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R622	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R626	321-0091-03			RES.,FXD,FILM:86.6 OHM,0.25%,0.125W	91637	MFF1816D86R60C
R627	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R628	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R630	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R632	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R634	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R636	315-0390-00			RES.,FXD,CMPSN:39 OHM,5%,0.25W	01121	CB3905
R637	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R638	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R640	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R641	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715

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R643	321-0097-00	B010100	B053530	RES.,FXD,FILM:100 OHM,1%,0.125W	91637	MFF1816G100R0F
R643	321-0114-00	B053531		RES.,FXD,FILM:150 OHM,1%,0.125W	91637	MFF1816G150R0F
R650	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R651	315-0101-00	B010100	B053445X	RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R652	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R654	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R656	315-0390-00			RES.,FXD,CMPSN:39 OHM,5%,0.25W	01121	CB3905
R660	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R670	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R671	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R672	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R673	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R674	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R677	315-0103-00	B010100	B053858	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R677	315-0102-00	B053859		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R680	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R681	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
R683	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R684	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R686	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R688	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R689	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R700	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R702	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R703	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R704	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R705	321-0177-00			RES.,FXD,FILM:681 OHM,1%,0.125W	91637	MFF1816G681R0F
R706	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R708	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R709	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R710	321-0146-00			RES.,FXD,FILM:324 OHM,1%,0.125W	91637	MFF1816G324R0F
R712	315-0112-00			RES.,FXD,CMPSN:1.1K OHM,5%,0.25W	01121	CB1125
R713	321-0103-00			RES.,FXD,FILM:115 OHM,1%,0.125W	91637	MFF1816G115R0F
R714	315-0112-00			RES.,FXD,CMPSN:1.1K OHM,5%,0.25W	01121	CB1125
R715	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R720	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R722	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R723	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R724	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R725	321-0177-00			RES.,FXD,FILM:681 OHM,1%,0.125W	91637	MFF1816G681R0F
R726	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R728	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R729	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R730	321-0146-00			RES.,FXD,FILM:324 OHM,1%,0.125W	91637	MFF1816G324R0F
R732	315-0112-00			RES.,FXD,CMPSN:1.1K OHM,5%,0.25W	01121	CB1125
R733	321-0103-00			RES.,FXD,FILM:115 OHM,1%,0.125W	91637	MFF1816G115R0F
R734	315-0112-00			RES.,FXD,CMPSN:1.1K OHM,5%,0.25W	01121	CB1125
R735	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R737	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R738	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R740	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R741	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R742	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R744	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R746	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R748	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315

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R750	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	91637	MFF1816G51R10F
R752	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R754	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R756	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R757	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R760	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R761	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R763	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R764	321-0291-00			RES.,FXD,FILM:10.5K OHM,1%,0.125W	91637	MFF1816G10501F
R766	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R768	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R770	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R772	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R773	315-0103-00	XB055253		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R774	315-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.25W	01121	CB2245
R775	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
R776	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R777	315-0103-00	XB055253		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R778	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R779	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R781	315-0472-00	B010100	B055252	RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R781	315-0102-00	B055253		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R782	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R784	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R786	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R787	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R789	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R790	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
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	B010100	B096709	RES.,FXD,CMPSN:470 OHM,10%,0.25W	01121	CB4711
R820	315-0471-00	B096710		RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R822	316-0822-00	B010100	B039999	RES.,FXD,CMPSN:8.2K OHM,10%,0.25W	01121	CB8221
R822	316-0472-00	B040000	B096709	RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R822	315-0472-00	B096710		RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R823	315-0150-00	XB040000		RES.,FXD,CMPSN:15 OHM,5%,0.25W	01121	CB1505
R824	316-0271-00	B010100	B096709	RES.,FXD,CMPSN:270 OHM,10%,0.25W	01121	CB2711
R824	315-0271-00	B096710		RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R827	308-0742-00			RES.,FXD,WW:0.24 OHM,5%,2W	75042	BWH-R2400J
R829	316-0101-00	B010100	B096709	RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R829	315-0101-00	B096710		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R832	316-0102-00	B010100	B039999	RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R832	315-0271-00	B040000		RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R833	315-0102-00	XB040000		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R834	315-0162-00	B010100	B039999	RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	01121	CB1625
R834	316-0472-00	B040000	B096709	RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R834	315-0472-00	B096710		RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R836	316-0682-00	B010100	B096709	RES.,FXD,CMPSN:6.8K OHM,10%,0.25W	01121	CB6821
R836	315-0682-00	B096710		RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R838	316-0682-00	B010100	B096709	RES.,FXD,CMPSN:6.8K OHM,10%,0.25W	01121	CB6821
R838	315-0682-00	B096710		RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R839	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R840	316-0101-00	B010100	B096709	RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R840	315-0101-00	B096710		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R842	316-0101-00	B010100	B096709	RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R842	315-0101-00	B096710		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015

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R845	321-0764-01	B010100	B084405	RES.,FXD,FILM:5.09K OHM,0.5%,0.125W	91637	MFF1816G50900D
R845	321-0629-00	B084406		RES.,FXD,FILM:5.11K OHM,0.5%,0.125W	91637	MFF1816G51100D
R846	321-0685-00			RES.,FXD,FILM:30K OHM,0.5%,0.125W	91637	MFF1816D30001D
R850	307-0405-00			RES.,FXD,FILM:82 OHM,5%,7W	91637	FP-34G82R00J
R851	308-0679-00			RES.,FXD,WW:0.51 OHM,5%,2W	75042	BWH-R5100J
R853	316-0470-00	B010100	B096709	RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701
R853	315-0470-00	B096710		RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R855	316-0101-00	B010100	B096709	RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R855	315-0101-00	B096710		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R856	316-0153-00	B010100	B096709	RES.,FXD,CMPSN:15K OHM,10%,0.25W	01121	CB1531
R856	315-0153-00	B096710		RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R860	321-0816-03			RES.,FXD,FILM:5K OHM,0.25%,0.125W	91637	MFF1816D50000C
R861	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R863	316-0101-00	B010100	B096709	RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R863	315-0101-00	B096710		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R866	315-0113-00			RES.,FXD,CMPSN:11K OHM,5%,0.25W	01121	CB1135
R867	316-0101-00	B010100	B096709	RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R867	315-0101-00	B096710		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R870	316-0392-00	B010100	B096709	RES.,FXD,CMPSN:3.9K OHM,10%,0.25W	01121	CB3921
R870	315-0392-00	B096710		RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R871	316-0471-00	B010100	B010250	RES.,FXD,CMPSN:470 OHM,10%,0.25W	01121	CB4711
R871	315-0271-00	B010251		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	PF-35G51R00J
R881	308-0679-00			RES.,FXD,WW:0.51 OHM,5%,2W	75042	BWH-R5100J
R883	316-0470-00	B010100	B096709	RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701
R883	315-0470-00	B096710		RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R885	316-0101-00	B010100	B096709	RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R885	315-0101-00	B096710		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R886	316-0153-00	B010100	B096709	RES.,FXD,CMPSN:15K OHM,10%,0.25W	01121	CB1531
R886	315-0153-00	B096710		RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R890	321-0816-03			RES.,FXD,FILM:5K OHM,0.25%,0.125W	91637	MFF1816D50000C
R891	321-0289-03			RES.,FXD,FILM:10K OHM,0.25%,0.125W	91637	MFF1816D10001C
R893	316-0101-00	B010100	B096709	RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R893	315-0101-00	B096710		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R896	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R897	316-0101-00	B010100	B096709	RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R897	315-0101-00	B096710		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R900	316-0392-00	B010100	B096709	RES.,FXD,CMPSN:3.9K OHM,10%,0.25W	01121	CB3921
R900	315-0392-00	B096710		RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R901	315-0561-00	B010100	B010250	RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R901	315-0271-00	B010251		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	308-0686-00			RES.,FXD,WW:2.2 OHM,5%,2W	75042	BWH-2R200J
R911	307-0301-00			RES.,FXD,FILM:120 OHM,5%,10W	24546	FP10 120 OHM 5%
R913	316-0391-00	B010100	B096709	RES.,FXD,CMPSN:390 OHM,10%,0.25W	01121	CB3911
R913	315-0391-00	B096710		RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R915	316-0153-00	B010100	B096709	RES.,FXD,CMPSN:15K OHM,10%,0.25W	01121	CB1531
R915	315-0153-00	B096710		RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R917	321-0268-00			RES.,FXD,FILM:6.04K OHM,1%,0.125W	91637	MFF1816G60400F
R920	311-1120-00			RES.,VAR,NONWIR:100 OHM,30%,0.25W	71450	201-YA5531
R922	321-0268-00			RES.,FXD,FILM:6.04K OHM,1%,0.125W	91637	MFF1816G60400F
R924	316-0101-00	B010100	B096709	RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R924	315-0101-00	B096710		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R925	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R927	316-0103-00	B010100	B096709	RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031

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R927	315-0103-00	B096710		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R929	316-0823-00	B010100	B096709	RES.,FXD,CMPSN:82K OHM,10%,0.25W	01121	CB8231
R929	315-0823-00	B096710		RES.,FXD,CMPSN:82K OHM,5%,0.25W	01121	CB8235
R930	302-0333-00			RES.,FXD,CMPSN:33K OHM,10%,0.50W	01121	EB3331
R935	316-0104-00	B010100	B096709	RES.,FXD,CMPSN:100K OHM,10%,0.25W	01121	CB1041
R935	315-0104-00	B096710		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R936	316-0473-00	B010100	B096709	RES.,FXD,CMPSN:47K OHM,10%,0.25W	01121	CB4731
R936	315-0473-00	B096710		RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R937	316-0183-00	B010100	B096709	RES.,FXD,CMPSN:18K OHM,10%,0.25W	01121	CB1831
R937	315-0183-00	B096710		RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R940	307-0007-00	B010100	B049999	RES.,FXD,CMPSN:2.7 OHM,10%,2W	01121	GB27G1
R940	308-0703-00	B050000		RES.,FXD,WW:1.8 OHM,5%,2W	75042	BWH-1R800J
R942	316-0101-00	B010100	B096709	RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R942	315-0101-00	B096710		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R943	316-0472-00	B010100	B096709	RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R943	315-0472-00	B096710		RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R944	307-0384-00	B010100	B049999	RES.,FXD,FILM:270 OHM,2%,4W	91637	FP-32G270R0G
R944	308-0110-00	B050000		RES.,FXD,WW:100 OHM,5%,8W	56289	283EX100R0JQ24
R948	321-0256-00			RES.,FXD,FILM:4.53K OHM,1%,0.125W	91637	MFF1816G45300F
R949	316-0101-00	B010100	B096709	RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R949	315-0101-00	B096710		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R950	311-1124-00			RES.,VAR,NONWIR:250 OHM,30%,0.25W	71450	201-YA5533
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	91637	MFF1816G12400F
R953	316-0221-00	B010100	B096709	RES.,FXD,CMPSN:220 OHM,10%,0.25W	01121	CB2211
R953	315-0221-00	B096710		RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R954	316-0102-00	B010100	B096709	RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R954	315-0102-00	B096710		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R955	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R956	316-0273-00	B010100	B096709	RES.,FXD,CMPSN:27K OHM,10%,0.25W	01121	CB2731
R956	315-0273-00	B096710		RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R957	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R980	316-0272-00	B010100	B096709	RES.,FXD,CMPSN:2.7K OHM,10%,0.25W	01121	CB2721
R980	315-0272-00	B096710		RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R981	316-0562-00	B010100	B096709	RES.,FXD,CMPSN:5.6K OHM,10%,0.25W	01121	CB5621
R981	315-0562-00	B096710		RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R982	316-0102-00	B010100	B096709	RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R982	315-0102-00	B096710		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R984	316-0153-00	B010100	B096709	RES.,FXD,CMPSN:15K OHM,10%,0.25W	01121	CB1531
R984	315-0153-00	B096710		RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R986	322-0686-03			RES.,FXD,FILM:7.23K OHM,0.25%,0.25W	91637	MFF1421D72300C
R987	321-0097-03			RES.,FXD,FILM:100 OHM,0.25%,0.125W	91637	MFF1816D100R0C
R1000A	311-1491-00	B010100	B063888X	RES.,VAR,NONWIR:PNL 5K OHM,1W,W/SW (FURNISHED AS A UNIT WITH S1000, OPTION 2 ONLY)	01121	11M123
R1000A,B	311-1492-00			RES.,VAR,NONWIR:PNL,5 X 5K OHM,0.5W,W/SW (FURNISHED AS A UNIT WITH S1000, STANDARD ONLY)	01121	11M136
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,CMPSN:1K OHM,10%,0.5W	73138	91W-1000M
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	B010100	B095939	RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021

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R1016	315-0102-00	B095940		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1018	316-0561-00	B010100	B095939	RES.,FXD,CMPSN:560 OHM,10%,0.25W	01121	CB5611
R1018	315-0561-00	B095940		RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R1019	316-0103-00	B010100	B095939	RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R1019	315-0103-00	B095940		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1020	316-0103-00	B010100	B095939	RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R1020	315-0103-00	B095940		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1021	316-0393-00	B010100	B095939	RES.,FXD,CMPSN:39K OHM,10%,0.25W	01121	CB3931
R1021	315-0393-00	B095940		RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R1023	316-0103-00	B010100	B095939	RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R1023	315-0103-00	B095940		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1024	316-0391-00	B010100	B095939	RES.,FXD,CMPSN:390 OHM,10%,0.25W	01121	CB3911
R1024	315-0391-00	B095940		RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
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	91637	MFF1816G10002F
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	91637	MFF1816G52300F
R1040	321-0277-00	B010100	B010199	RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R1040	321-0269-00	B010200		RES.,FXD,FILM:6.19K OHM,1%,0.125W	91637	MFF1816G61900F
R1041	321-0261-00			RES.,FXD,FILM:5.11K OHM,1%,0.125W	91637	MFF1816G51100F
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	91637	MFF1816G750R0F
R1047	321-0294-00			RES.,FXD,FILM:11.3K OHM,1%,0.125W	91637	MFF1816G11301F
R1048	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
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	91637	MFF1816G60400F
R1056	321-0329-00			RES.,FXD,FILM:26.1K OHM,1%,0.125W	91637	MFF1816G26101F
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
R1065	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R1070	316-0561-00	B010100	B095939	RES.,FXD,CMPSN:560 OHM,10%,0.25W	01121	CB5611
R1070	315-0561-00	B095940		RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R1071	316-0561-00	B010100	B095939	RES.,FXD,CMPSN:560 OHM,10%,0.25W	01121	CB5611
R1071	315-0561-00	B095940		RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R1072	316-0561-00	B010100	B095939	RES.,FXD,CMPSN:560 OHM,10%,0.25W	01121	CB5611
R1072	315-0561-00	B095940		RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R1073	316-0563-00	B010100	B095939	RES.,FXD,CMPSN:56K OHM,10%,0.25W	01121	CB5631
R1073	315-0563-00	B095940		RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
R1080	316-0823-00	B010100	B095939	RES.,FXD,CMPSN:82K OHM,10%,0.25W	01121	CB8231
R1080	315-0823-00	B095940		RES.,FXD,CMPSN:82K OHM,5%,0.25W	01121	CB8235
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	91637	MFF1816G11801F
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	91637	MFF1816G324R0F
R1093	321-0250-00			RES.,FXD,FILM:3.92K OHM,1%,0.125W	91637	MFF1816G39200F
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	91637	MFF1816G14000F
R1098	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R1101	321-0167-00			RES.,FXD,FILM:536 OHM,1%,0.125W	91637	MFF1816G536R0F
R1103	321-0255-00			RES.,FXD,FILM:4.42K OHM,1%,0.125W	91637	MFF1816G44200F

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R1105	321-0230-00			RES.,FXD,FILM:2.43K OHM,1%,0.125W	91637	MFF1816G24300F
R1106	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R1110	311-1571-00			RES.,VAR,NONWIR:500 OHM,0.50W	73138	91W R500
R1111	316-0681-00	B010100	B095939	RES.,FXD,CMPSN:680 OHM,10%,0.25W	01121	CB6811
R1111	315-0681-00	B095940		RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R1113	321-0125-00			RES.,FXD,FILM:196 OHM,1%,0.125W	91637	MFF1816G196R0F
R1115	321-0242-00			RES.,FXD,FILM:3.24K OHM,1%,0.125W	91637	MFF1816G32400F
R1117	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1118	311-1571-00			RES.,VAR,NONWIR:500 OHM,0.50W	73138	91W R500
R1120	315-0512-00	B010100	B010250	RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R1120	315-0432-00	B010251		RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R1122	321-0152-00	B010100	B054731	RES.,FXD,FILM:374 OHM,1%,0.125W	91637	MFF1816G374R0F
R1122	321-0155-00	B054732		RES.,FXD,FILM:402 OHM,1%,0.125W	91637	MFF1816G402R0F
R1124	321-0228-00			RES.,FXD,FILM:2.32K OHM,1%,0.125W	91637	MFF1816G23200F
R1125	321-0228-00			RES.,FXD,FILM:2.32K OHM,1%,0.125W	91637	MFF1816G23200F
R1127	321-0141-00			RES.,FXD,FILM:287 OHM,1%,0.125W	91637	MFF1816G287R0F
R1129	315-0220-00	XB030000		RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R1130	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	91637	MFF1816G51R10F
R1131	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	91637	MFF1816G51R10F
R1132	315-0220-00	XB030000		RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R1133	321-0143-00	B010100	B010250	RES.,FXD,FILM:301 OHM,1%,0.125W	91637	MFF1816G301R0F
R1133	321-0141-00	B010251		RES.,FXD,FILM:287 OHM,1%,0.125W	91637	MFF1816G287R0F
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	91637	MFF1816G23200F
R1137	321-0228-00			RES.,FXD,FILM:2.32K OHM,1%,0.125W	91637	MFF1816G23200F
R1140	315-0910-00	B010100	B010250	RES.,FXD,CMPSN:91 OHM,5%,0.25W	01121	CB9105
R1140	315-0121-00	B010251		RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R1141	321-0178-00			RES.,FXD,FILM:698 OHM,1%,0.125W	91637	MFF1816G698R0F
R1142	321-0187-00			RES.,FXD,FILM:866 OHM,1%,0.125W	91637	MFF1816G866R0F
R1143	321-0157-00	B010100	B054739	RES.,FXD,FILM:422 OHM,1%,0.125W	91637	MFF1816G422R0F
R1143	321-0128-00	B054740		RES.,FXD,FILM:210 OHM,1%,0.125W	91637	MFF1816G210R0F
R1144	321-0187-00			RES.,FXD,FILM:866 OHM,1%,0.125W	91637	MFF1816G866R0F
R1146	322-0159-00			RES.,FXD,FILM:442 OHM,1%,0.125W	91637	MFF1421G442R0F
R1147	321-0099-00	B010100	B010250	RES.,FXD,FILM:105 OHM,1%,0.125W	91637	MFF1816G105R0F
R1147	321-0069-00	B010251		RES.,FXD,FILM:51.1 OHM,1%,0.125W	91637	MFF1816G51R10F
R1148	322-0159-00			RES.,FXD,FILM:442 OHM,1%,0.125W	91637	MFF1421G442R0F
R1150	315-0910-00	B010100	B010250	RES.,FXD,CMPSN:91 OHM,5%,0.25W	01121	CB9105
R1150	315-0121-00	B010251		RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R1151	323-0178-00			RES.,FXD,FILM:698 OHM,1%,0.50W	91637	MFF1226G698R0F
R1155	316-0681-00	B010100	B095939	RES.,FXD,CMPSN:680 OHM,10%,0.25W	01121	CB6811
R1155	315-0681-00	B095940		RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R1156	316-0333-00	B010100	B095939	RES.,FXD,CMPSN:33K OHM,10%,0.25W	01121	CB3331
R1156	315-0333-00	B095940		RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R1157	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
RT157	307-0181-00			RES.,THERMAL:100K OHM,10%,4MW/DEG C	15454	1DE104-K-220EC
RT754	307-0125-00			RES.,THERMAL:500 OHM,10%,25 DEG C	50157	2D1595
S300	260-0618-00	B010100	B063462	SWITCH,THRMSTC:NC OPEN 60 DEG,CLOSE 48,9,10A	81439	36T21 S3781
S300	260-0071-00	B063643		SWITCH,THRMSTC:NC,OPEN 68.3,CL 48.9,10V	80009	260-0071-00
S302	260-1222-00			SWITCH,PUSH-PUL:10A,250VAC	91929	2DM301
S335	260-1238-00			SWITCH,PUSH:0.5A AT 115VAC	81073	39YY2084
S1000	----- -----			(FURNISHED AS A UNIT WITH R1000A,B OR R1000A)		
T410	120-0822-00	B010100	B021356	XFMR,PWR,STU:HV	80009	120-0822-00
T410	120-0920-00	B021357		XFMR,PWR,STU:HV	80009	120-0920-00
T800	120-0821-00			XFMR,PWR,SDN & SU:	80009	120-0821-00

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
U410	152-0495-01	B010100	B073742	SEMICOND DEVICE:V MULTR,6KV IN,12KV OUT	80009	152-0495-01
U410	152-0495-00	B073743		SEMICOND DEVICE:V MULTR,6KV IN,12KV OUT	80009	152-0495-00
U620	155-0022-01			MICROCIRCUIT,DI:A AND B LOGIC,ML,CHANNEL SW	80009	155-0022-01
U770	156-0057-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	80009	156-0057-00
U780	156-0039-00			MICROCIRCUIT,DI:DUAL J-K FLIP FLOP	80009	156-0039-00
U1000	155-0021-00	B010100	B020733	MICROCIRCUIT,DI:ML,TIMING GENERATOR	80009	155-0021-00
U1000	155-0021-01	B020734		MICROCIRCUIT,DI:ML,TIMING GENERATOR	80009	155-0021-01
U1025	155-0017-00			MICROCIRCUIT,DI:ML,ZERO LOGIC COUNTER	80009	155-0017-00
U1030	155-0015-01			MICROCIRCUIT,DI:ML,ANALOG DATA SWITCH	80009	155-0015-01
U1035	155-0014-01			MICROCIRCUIT,DI:ML,ANALOG TO DECIMAL CONV	80009	155-0014-01
U1040	155-0015-01			MICROCIRCUIT,DI:ML,ANALOG DATA SWITCH	80009	155-0015-01
U1060	155-0018-00			MICROCIRCUIT,DI:ML,ZERO LOGIC	80009	155-0018-00
U1070	155-0014-01			MICROCIRCUIT,DI:ML,ANALOG TO DECIMAL CONV	80009	155-0014-01
U1075	156-0032-00			MICROCIRCUIT,DI:4-BIT BINARY COUNTER	80009	156-0032-00
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	155-0022-01			MICROCIRCUIT,DI:A AND B LOGIC ML,CHANNEL SW	80009	155-0022-01
V400	154-0701-00 ----- -----	B010100	B073742	ELECTRON TUBE:CRT,P31,INT SCALE (STANDARD ONLY)	80009	154-0701-00
V400	154-0701-05 ----- -----	B073743		ELECTRON TUBE:CRT,P31,INT SCALE (STANDARD ONLY)	80009	154-0701-05
V400	154-0684-00 ----- -----			ELECTRON TUBE:CRT,P31,INT SCALE (OPTION 2 ONLY)	80009	154-0684-00
VR175	152-0195-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	80009	152-0195-00
VR240	152-0255-00	B010100	B019999X	SEMICOND DEVICE:ZENER,0.4W,51V,5%	80009	152-0255-00
VR242	152-0255-00	B010100	B019999X	SEMICOND DEVICE:ZENER,0.4W,51V,5%	80009	152-0255-00
VR245	152-0427-00	XB020000	B073839	SEMICOND DEVICE:ZENER,0.4W,100V,5%	80009	152-0427-00
VR245	152-0428-00	B073840		SEMICOND DEVICE:ZENER,0.4W,120V,5%	80009	152-0428-00
VR252	152-0427-00	XB020000		SEMICOND DEVICE:ZENER,0.4W,100V,5%	80009	152-0427-00
VR270	152-0255-00	B010100	B019999X	SEMICOND DEVICE:ZENER,0.4W,51V,5%	80009	152-0255-00
VR272	152-0255-00	B010100	B019999X	SEMICOND DEVICE:ZENER,0.4W,51V,5%	80009	152-0255-00
VR365	152-0285-00			SEMICOND DEVICE:ZENER,0.4W,62V,5%	80009	152-0285-00
VR435	152-0427-00			SEMICOND DEVICE:ZENER,0.4W,100V,5%	80009	152-0427-00
VR930	152-0357-00			SEMICOND DEVICE:ZENER,0.4W,82V,5%	80009	152-0357-00
VR940	152-0243-00			SEMICOND DEVICE:ZENER,0.4W,15V,5%	80009	152-0243-00
VR950	152-0227-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	80009	152-0227-00
VR1080	152-0243-00			SEMICOND DEVICE:ZENER,0.4W,15V,5%	80009	152-0243-00
VR1081	152-0243-00			SEMICOND DEVICE:ZENER,0.4W,15V,5%	80009	152-0243-00
VR1082	152-0243-00			SEMICOND DEVICE:ZENER,0.4W,15V,5%	80009	152-0243-00

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

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

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

Resistors = Ohms (Ω).

Graphic symbols and class designation letters are based on ANSI Standard Y32.2-1975.

Logic symbology is based on ANSI Y32.14-1973 in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The overline on a signal name indicates that the signal performs its intended function when it goes to the low state.

Abbreviations are based on ANSI Y1.1-1972.

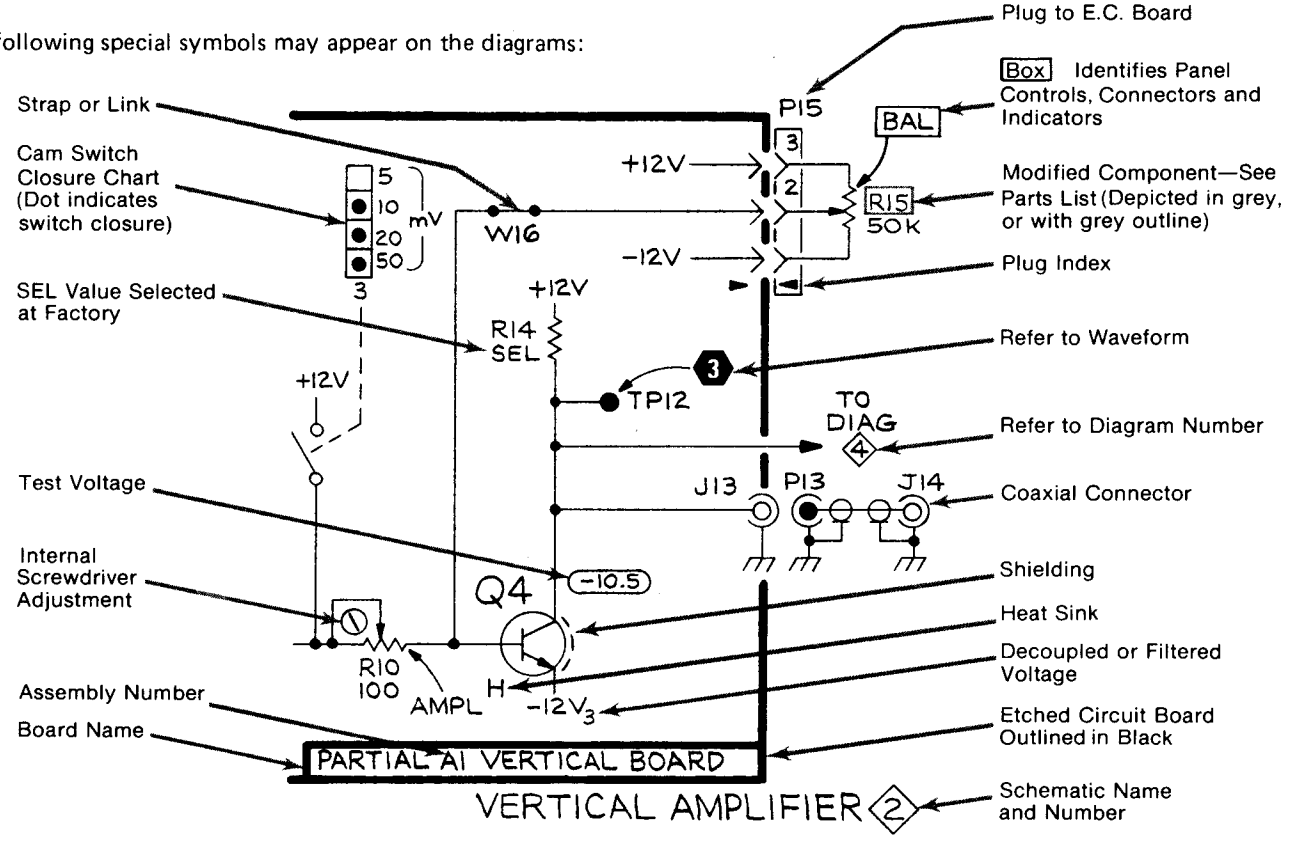
Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

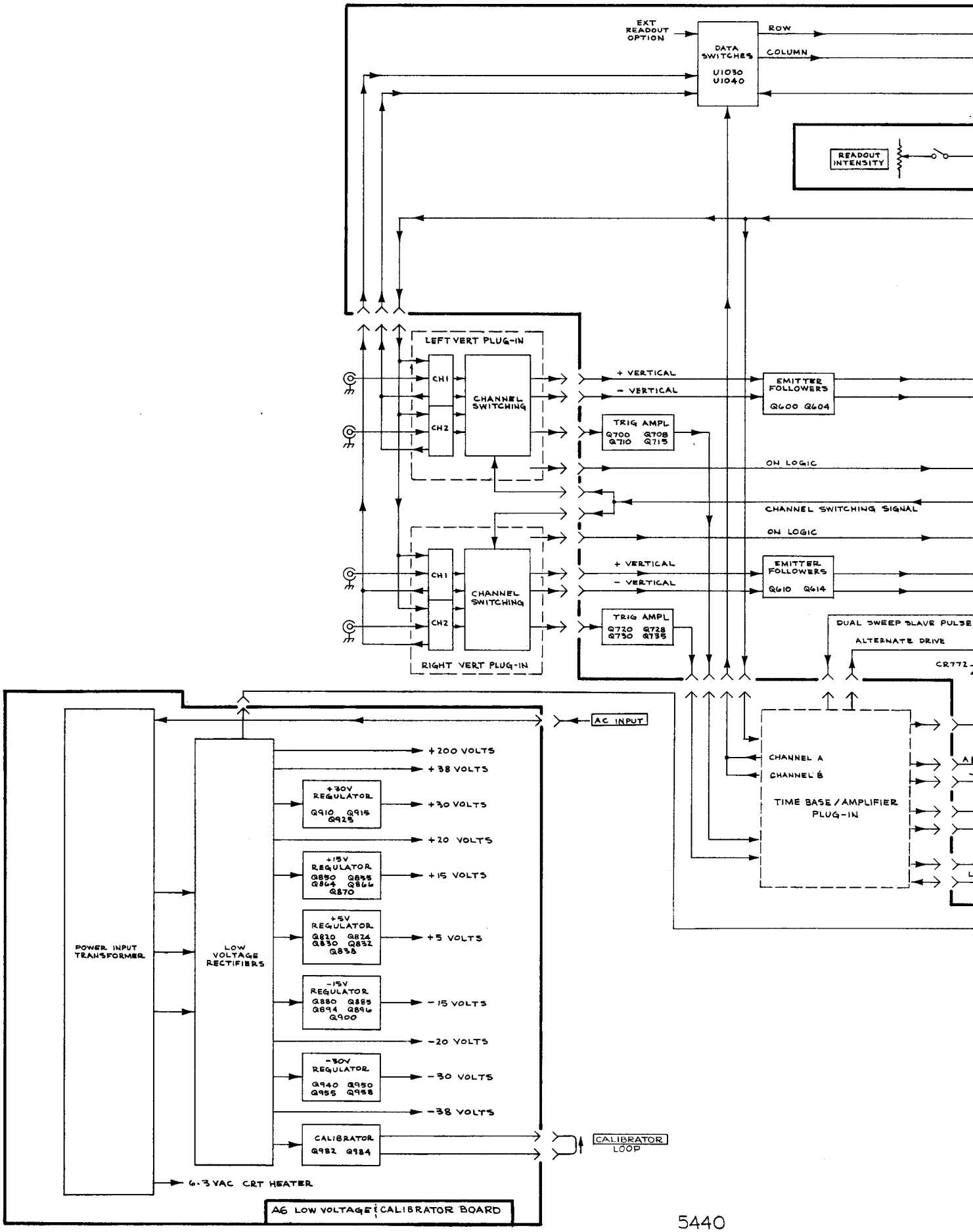
Y14.15, 1966	Drafting Practices.
Y14.2, 1973	Line Conventions and Lettering.
Y10.5, 1968	Letter Symbols for Quantities Used in Electrical Science and Electrical Engineering.

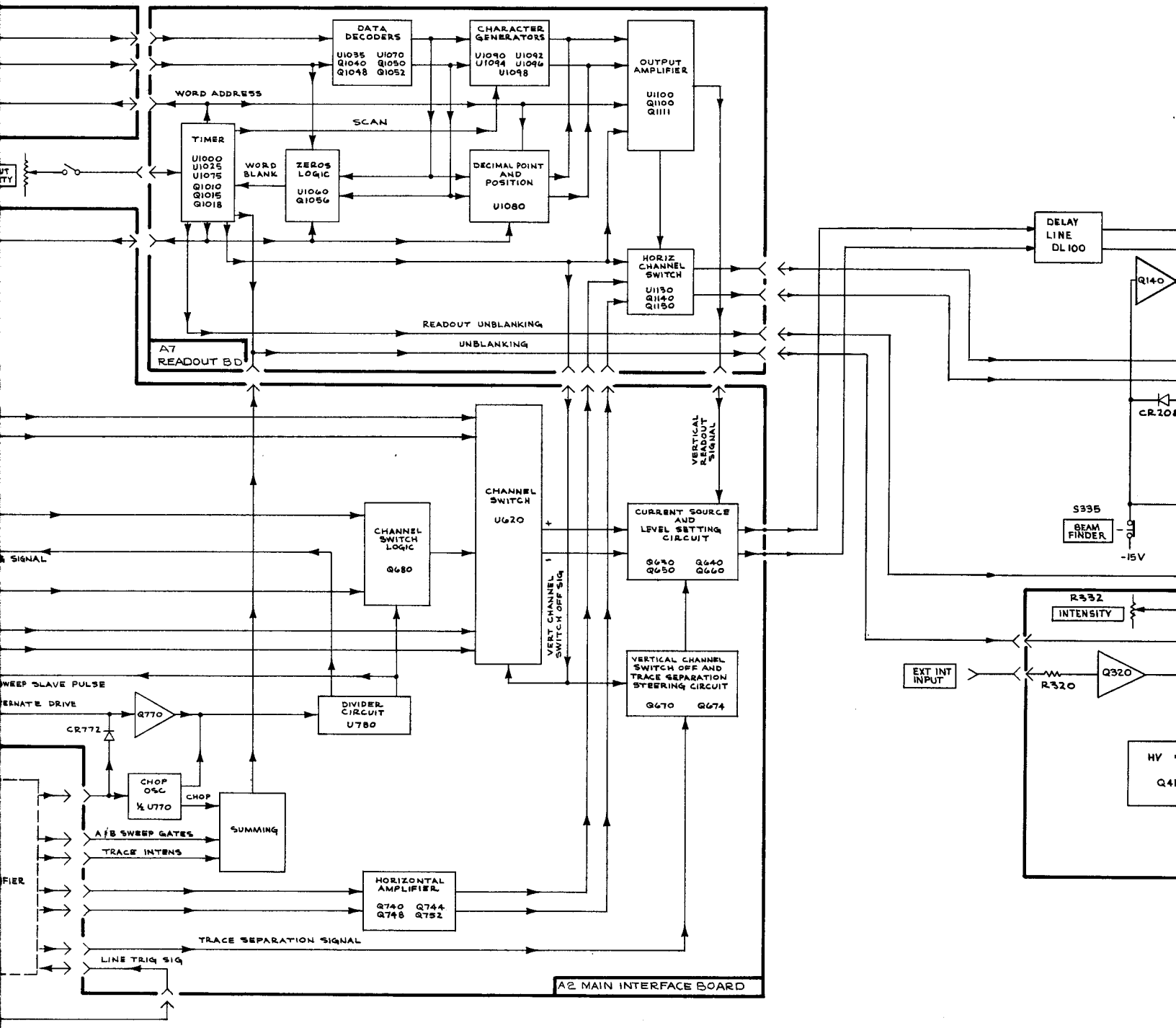
The following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

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

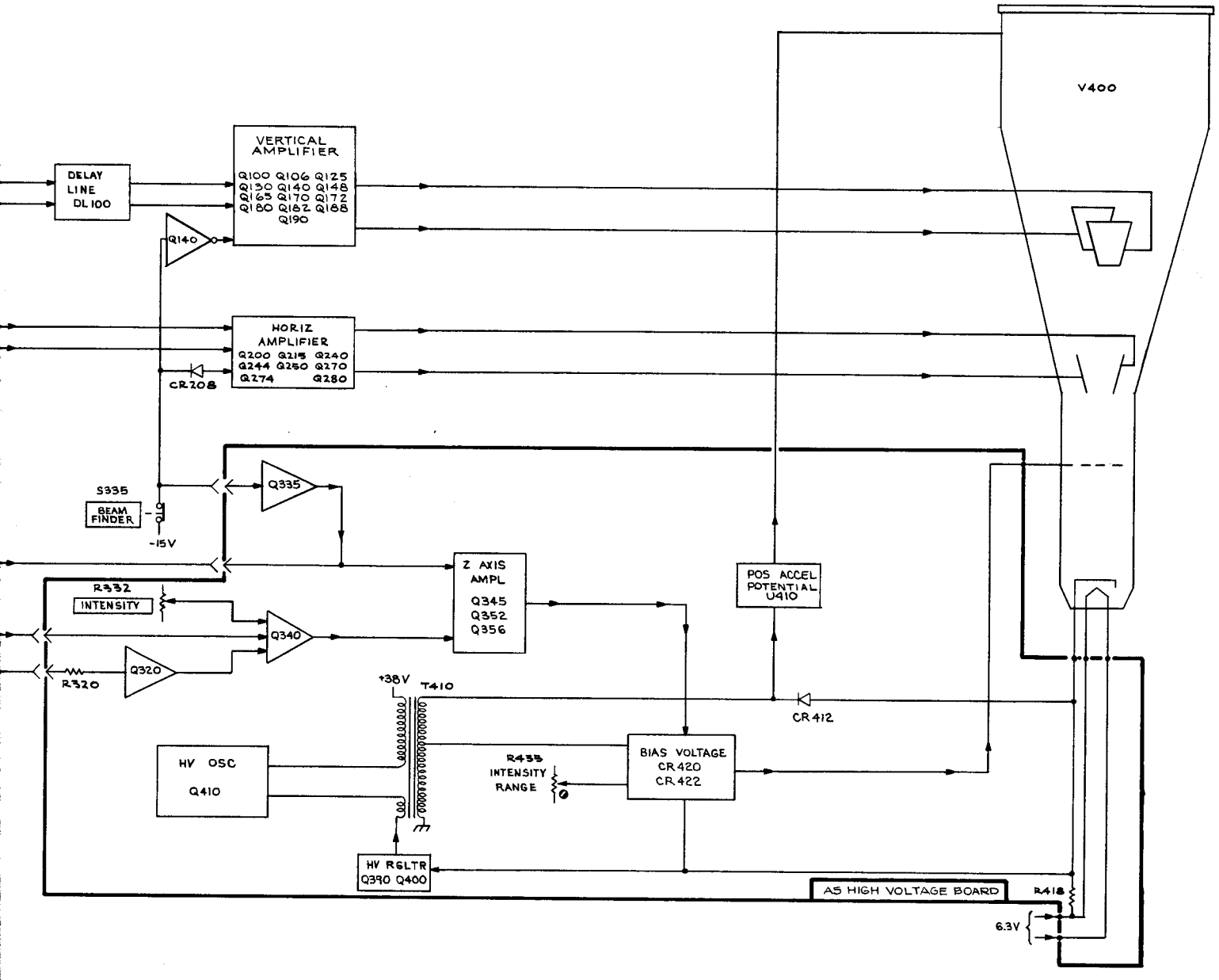
The following special symbols may appear on the diagrams:



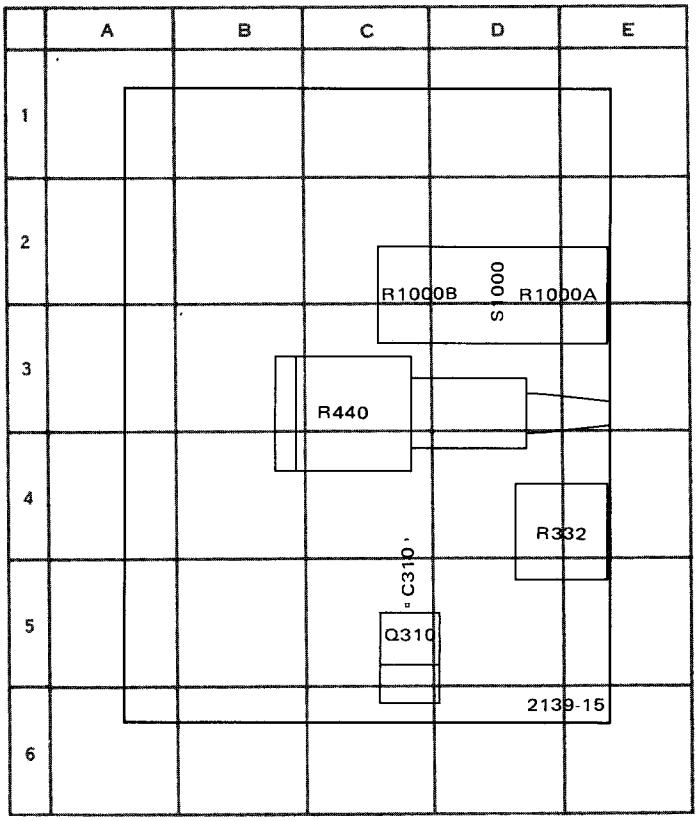

EXT READOUT OPTION
DATA SWITCHES U1030 U1040
ROW
COLUMN
READOUT INTENSITY
LEFT VERT PLUG-IN
CH1
CH2
CHANNEL SWITCHING
+ VERTICAL
- VERTICAL
EMITTER FOLLOWERS Q600 Q604
TRIG AMPL Q700 Q708 Q710 Q715
ON LOGIC
CHANNEL SWITCHING SIGNAL
ON LOGIC
EMITTER FOLLOWERS Q610 Q614
TRIG AMPL Q720 Q728 Q730 Q735
RIGHT VERT PLUG-IN
DUAL SWEEP SLAVE PULSE
ALTERNATE DRIVE
CR772
CHANNEL A
CHANNEL B
TIME BASE / AMPLIFIER PLUG-IN
AC INPUT
POWER INPUT TRANSFORMER
LOW VOLTAGE RECTIFIERS
+200 VOLTS
+38 VOLTS
+30V REGULATOR Q910 Q915 Q925
+30 VOLTS
+20 VOLTS
+15V REGULATOR Q850 Q858 Q864 Q866 Q870
+15 VOLTS
+5V REGULATOR Q810 Q824 Q830 Q832 Q838
+5 VOLTS
-15V REGULATOR Q880 Q885 Q894 Q896 Q900
-15 VOLTS
-20 VOLTS
-30V REGULATOR Q940 Q950 Q955 Q958
-30 VOLTS
-38 VOLTS
CALIBRATOR Q982 Q984
CALIBRATOR LOOP
6.3 VAC CRT HEATER
A6 LOW VOLTAGE/CALIBRATOR BOARD


DATA DECODERS
U1035 U1070
Q1040 Q1050
Q1048 Q1052
CHARACTER GENERATORS
U1090 U1092
U1094 U1096
U1098
OUTPUT AMPLIFIER
U1100
Q1100
Q1111
WORD ADDRESS
SCAN
TIMER
U1000
U1025
U1075
Q1010
Q1015
Q1018
WORD BLANK
ZEROS LOGIC
U1060
Q1056
DECIMAL POINT AND POSITION
U1080
HORIZ CHANNEL SWITCH
U1130
Q1140
Q1150
READOUT UNBLANKING
UNBLANKING
A7
READOUT BD
DELAY LINE
DL100
Q140
CR20
S335
BEAM FINDER
-15V
VERTICAL READOUT SIGNAL
CHANNEL SWITCH
U620
CHANNEL SWITCH LOGIC
Q680
CURRENT SOURCE AND LEVEL SETTING CIRCUIT
Q630 Q640
Q650 Q660
VERT CHANNEL SWITCH OFF SIG
R332
INTENSITY
EXT INT INPUT
R320
Q320
SWEEP SLAVE PULSE
ERNATE DRIVE
Q770
CR772
DIVIDER CIRCUIT
U780
VERTICAL CHANNEL SWITCH OFF AND TRACE SEPARATION STEERING CIRCUIT
Q670 Q674
CHOP OSC
½ U770
CHOP
SUMMING
A/B SWEEP GATES
TRACE INTENS
HORIZONTAL AMPLIFIER
Q740 Q744
Q748 Q752
TRACE SEPARATION SIGNAL
LINE TRIG SIG
A2 MAIN INTERFACE BOARD

2139-21
@

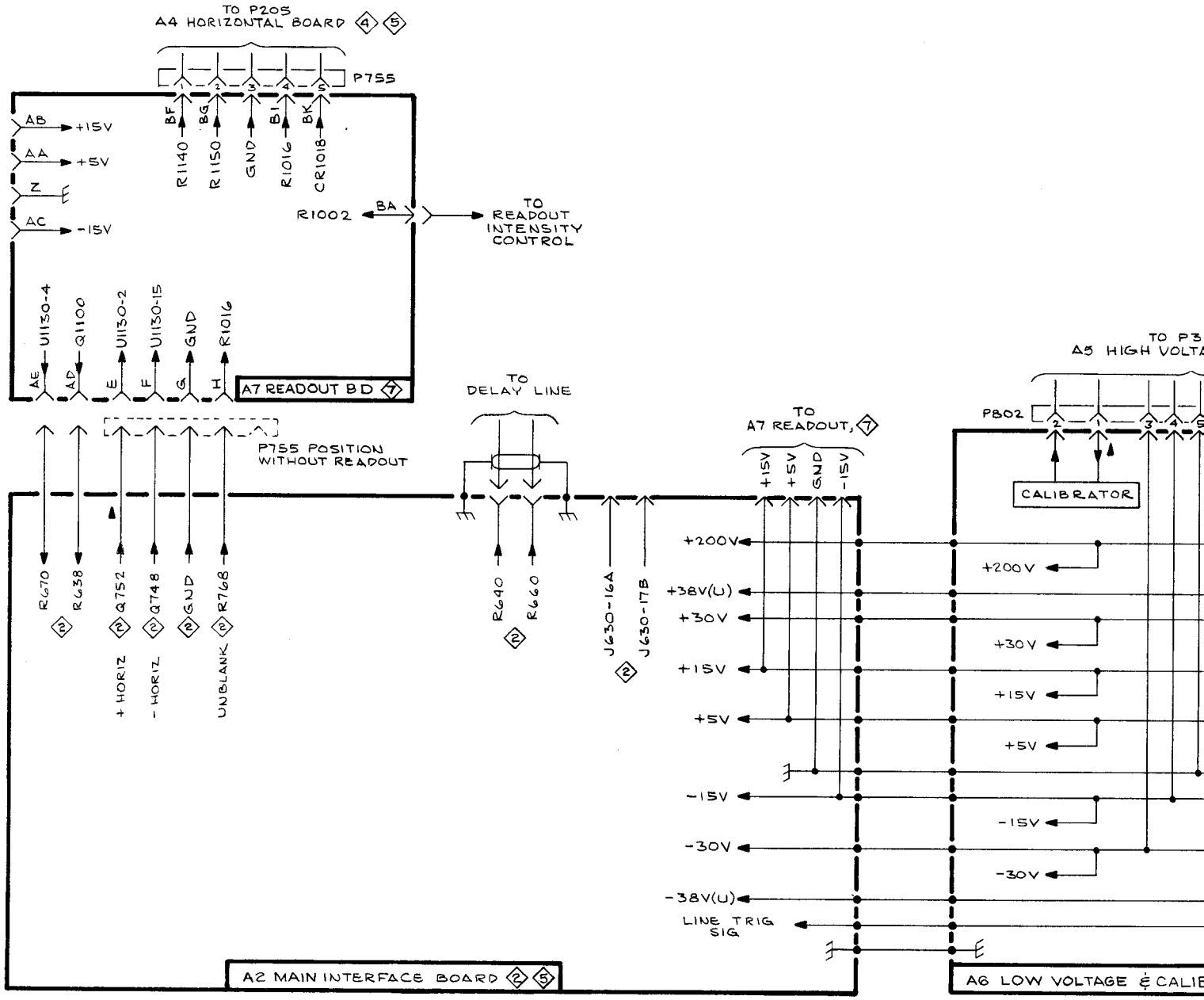


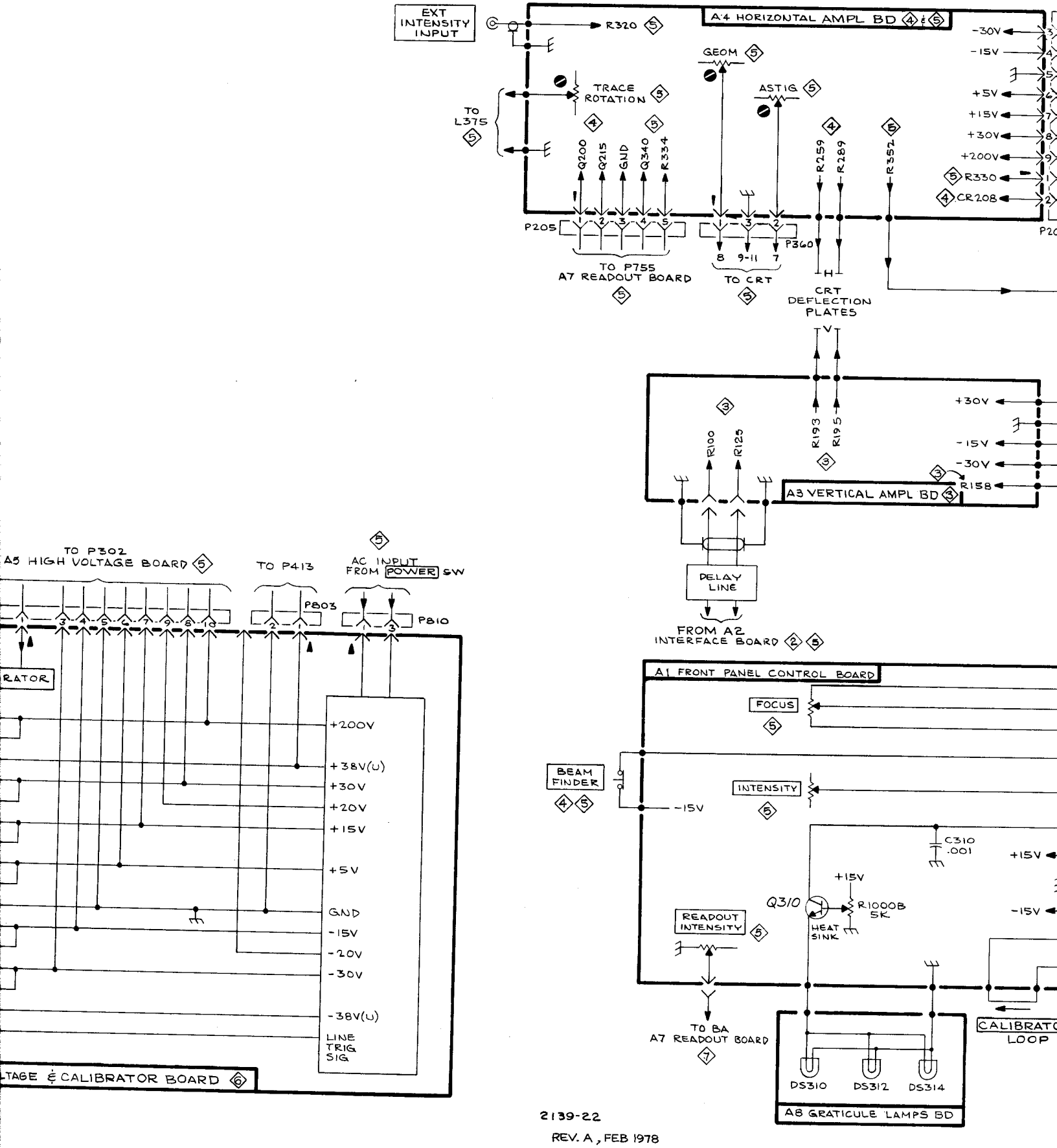
BLOCK DIAGRAM



A1—Front Panel Control circuit board.

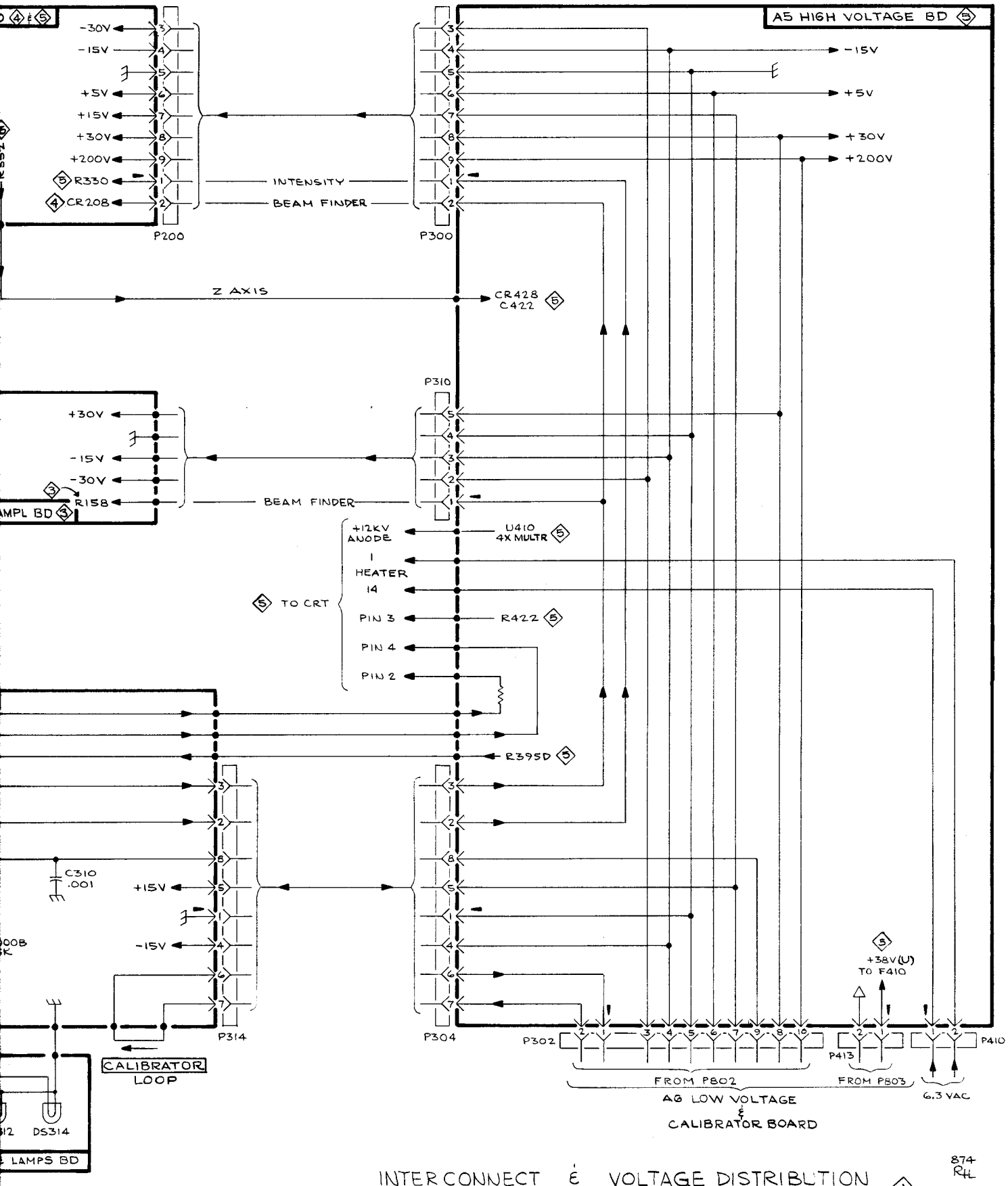
CKT NO	GRID LOC
C310	C-5
Q310	C-5
R332	D-4
R440	C-3
R1000A	E-2
R1000B	C-2
S1000	D-2


TO P205
A4 HORIZONTAL BOARD 4 5
P755
AB +15V
AA +5V
Z
AC -15V
BF R1140
BG R1150
GND
BJ R1016
BK CR1018
R1002
BA
TO READOUT INTENSITY CONTROL
AE U1130-4
AD Q1100
E U1130-2
F U1130-15
G GND
H R1016
A7 READOUT B D 7
P755 POSITION WITHOUT READOUT
TO DELAY LINE
TO A7 READOUT, 7
+15V
+5V
GND
-15V
TO P3
A5 HIGH VOLTA
P802
CALIBRATOR
R670
R638
Q752
Q748
GND
R768
+ HORIZ
- HORIZ
UNBLANK
R640
R660
J630-16A
J630-17B
+200V
+38V(U)
+30V
+15V
+5V
-15V
-30V
-38V(U)
LINE TRIG SIG
A2 MAIN INTERFACE BOARD 2 5
A6 LOW VOLTAGE & CALIB



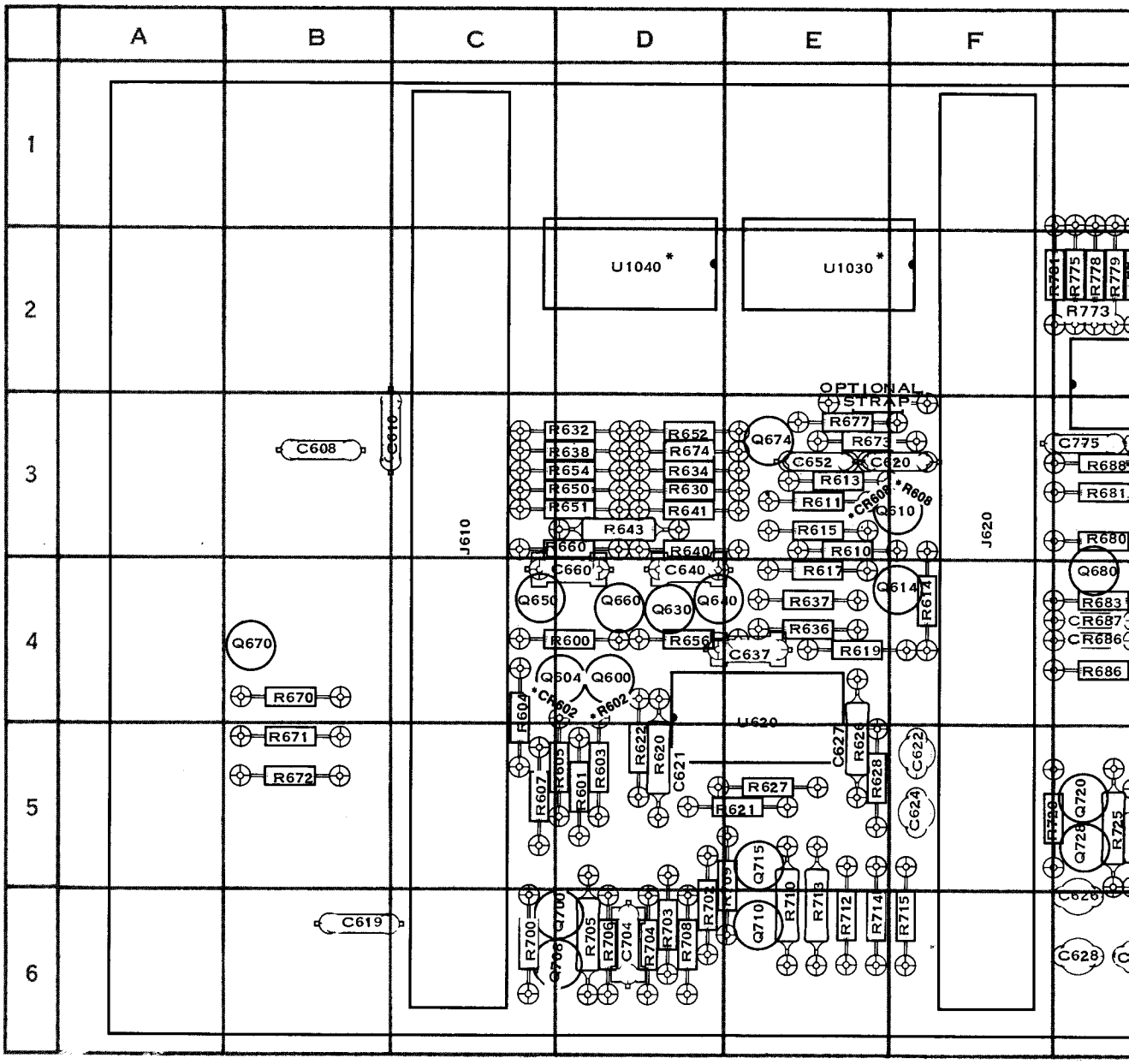
2139-22

REV. A, FEB 1978



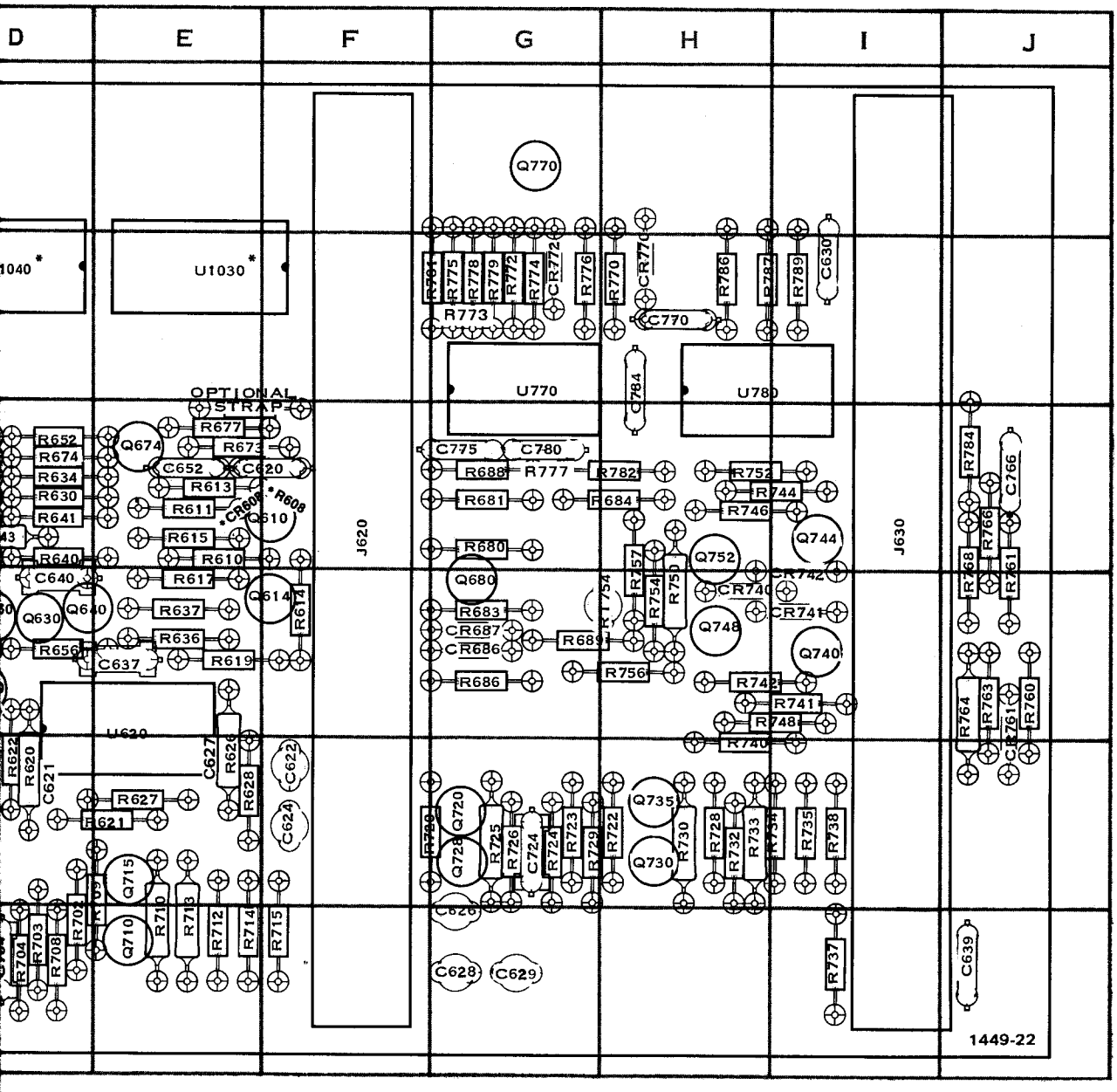
INTERCONNECT & VOLTAGE DISTRIBUTION 1

874
RHL



A2—Main Interface circuit board.

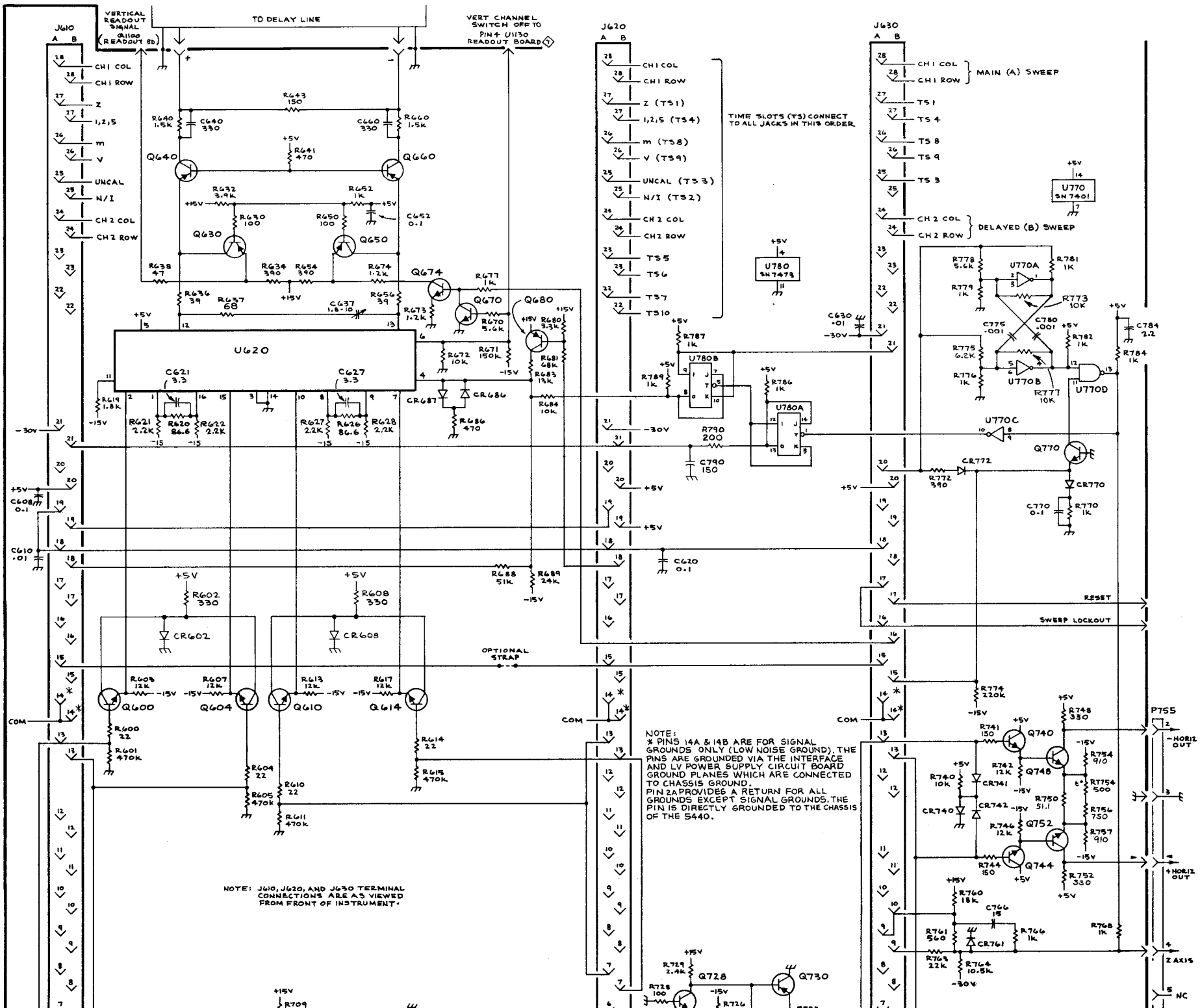
CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CK NO
C608	B-3	C704	D-6	J610	C-3	Q710	E-6	R607	C-5	R634	D-3	R674	D-3	R7
C610	B-3	C724	G-5	J620	F-3	Q715	E-5	R608	F-3	R636	E-4	R677	E-3	R7
C619	B-6	C766	J-3	J630	I-3	Q728	G-5	R610	E-3	R637	E-4	R680	G-3	R7
C620	E-3	C770	H-2			Q730	H-5	R611	E-3	R638	D-3	R681	G-3	R7
C621	D-5	C775	G-3	Q600	D-4	Q735	H-5	R613	E-3	R640	D-3	R683	G-4	R7
C622	F-5	C780	G-3	Q604	D-4	Q740	I-4	R614	F-4	R641	D-3	R684	H-3	R7
C624	F-5	C784	H-2	Q610	F-3	Q744	I-3	R615	E-3	R643	D-3	R686	G-4	R7
C626	G-5			Q614	F-4	Q748	H-4	R617	E-4	R650	D-3	R688	G-3	R7
C627	E-5	CR602	C-4	Q630	D-4	Q752	H-3	R619	E-4	R651	D-3	R689	G-4	R7
C628	G-6	CR608	F-3	Q640	D-4	Q770	G-1	R620	D-5	R652	D-3	R700	C-6	R7
C629	G-6	CR686	G-4	Q650	C-4			R621	E-5	R654	D-3	R702	D-6	R7
C630	I-2	CR687	G-4	Q660	D-4	R600	D-4	R622	D-5	R656	D-4	R703	D-6	R7
C637	E-4	CR740	H-4	Q670	B-4	R601	D-5	R626	E-4	R660	D-3	R704	D-6	R7
C639	J-6	CR741	I-4	Q674	E-3	R602	C-4	R627	E-5	R670	B-4	R705	D-6	R7
C640	D-4	CR742	I-3	Q680	G-3	R603	D-5	R628	E-5	R671	B-5	R706	D-6	R7
C652	E-3	CR770	H-2	Q700	D-6	R604	C-4	R630	D-3	R672	B-5	R708	D-6	R7
C660	D-4	CR772	G-2	Q708	D-6	R605	D-5	R632	D-3	R673	E-3	R709	E-5	R7
												R710	E-6	R7



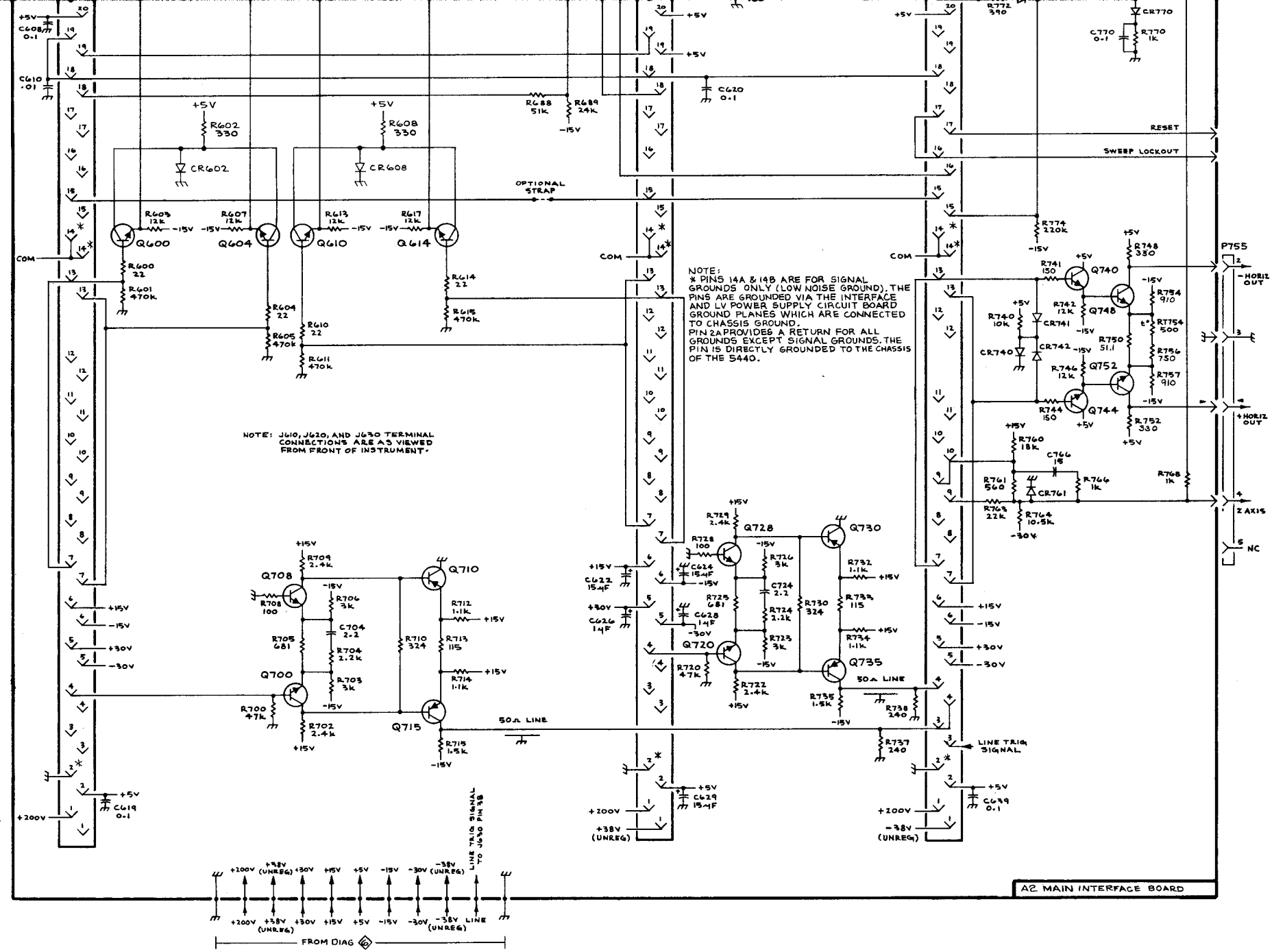
A2—Main Interface circuit board.

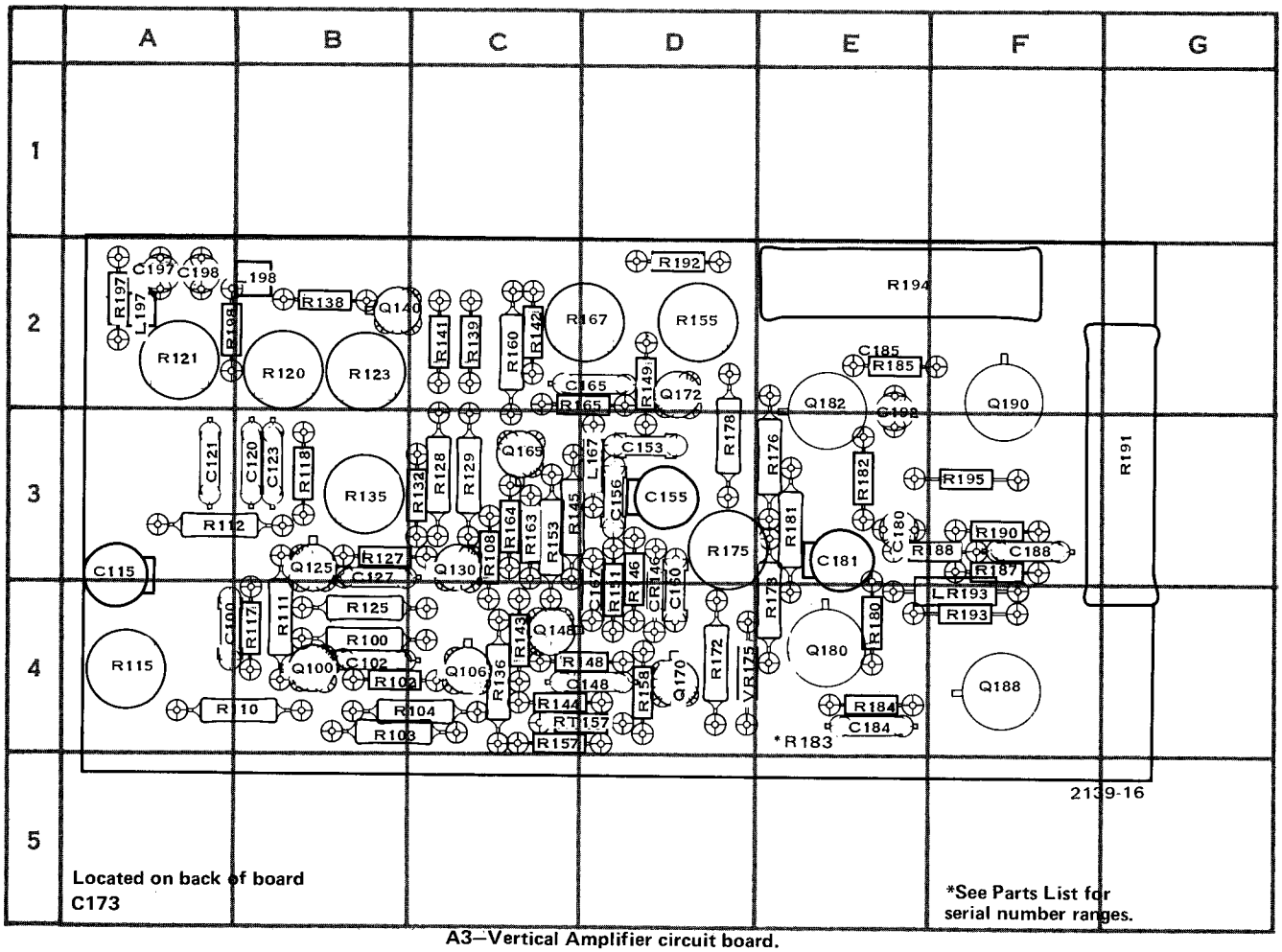
*See Parts List for serial number ranges.

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
R607	C-5	R634	D-3	R674	D-3	R712	E-6	R738	I-5	R770	H-2	RT754	G-4
R608	F-3	R636	E-4	R677	E-3	R713	E-6	R740	H-4	R772	G-2		
R610	E-3	R637	E-4	R680	G-3	R714	E-6	R741	H-4	R773	G-2		
R611	E-3	R638	D-3	R681	G-3	R715	F-6	R742	H-4	R774	G-2	U620	E-4
R613	E-3	R640	D-3	R683	G-4	R720	F-5	R744	H-3	R775	G-2	U770	G-2
R614	F-4	R641	D-3	R684	H-3	R722	G-5	R746	H-3	R776	G-2	U780	H-2
R615	E-3	R643	D-3	R686	G-4	R723	G-5	R748	H-4	R777	G-3	U1030	E-2
R617	E-4	R650	D-3	R688	G-3	R724	G-5	R750	H-3	R778	G-2	U1040	D-2
R619	E-4	R651	D-3	R689	G-4	R725	G-5	R752	H-3	R779	G-2		
R620	D-5	R652	D-3	R700	C-6	R726	G-5	R754	H-3	R781	G-2		
R621	E-5	R654	D-3	R702	D-6	R728	H-5	R756	H-4	R782	H-3		
R622	D-5	R656	D-4	R703	D-6	R729	G-5	R757	H-3	R784	J-3		
R626	E-4	R660	D-3	R704	D-6	R730	H-5	R760	J-4	R786	H-2		
R627	E-5	R670	B-4	R705	D-6	R732	H-5	R761	J-4	R787	H-2		
R628	E-5	R671	B-5	R706	D-6	R733	H-5	R763	J-4	R789	I-2		
R630	D-3	R672	B-5	R708	D-6	R734	H-5	R764	J-4				
R632	D-3	R673	E-3	R709	E-5	R735	I-5	R766	J-3				
				R710	E-6	R737	I-6	R768	J-3				



REV. A, JAN. 1977
14AB-26

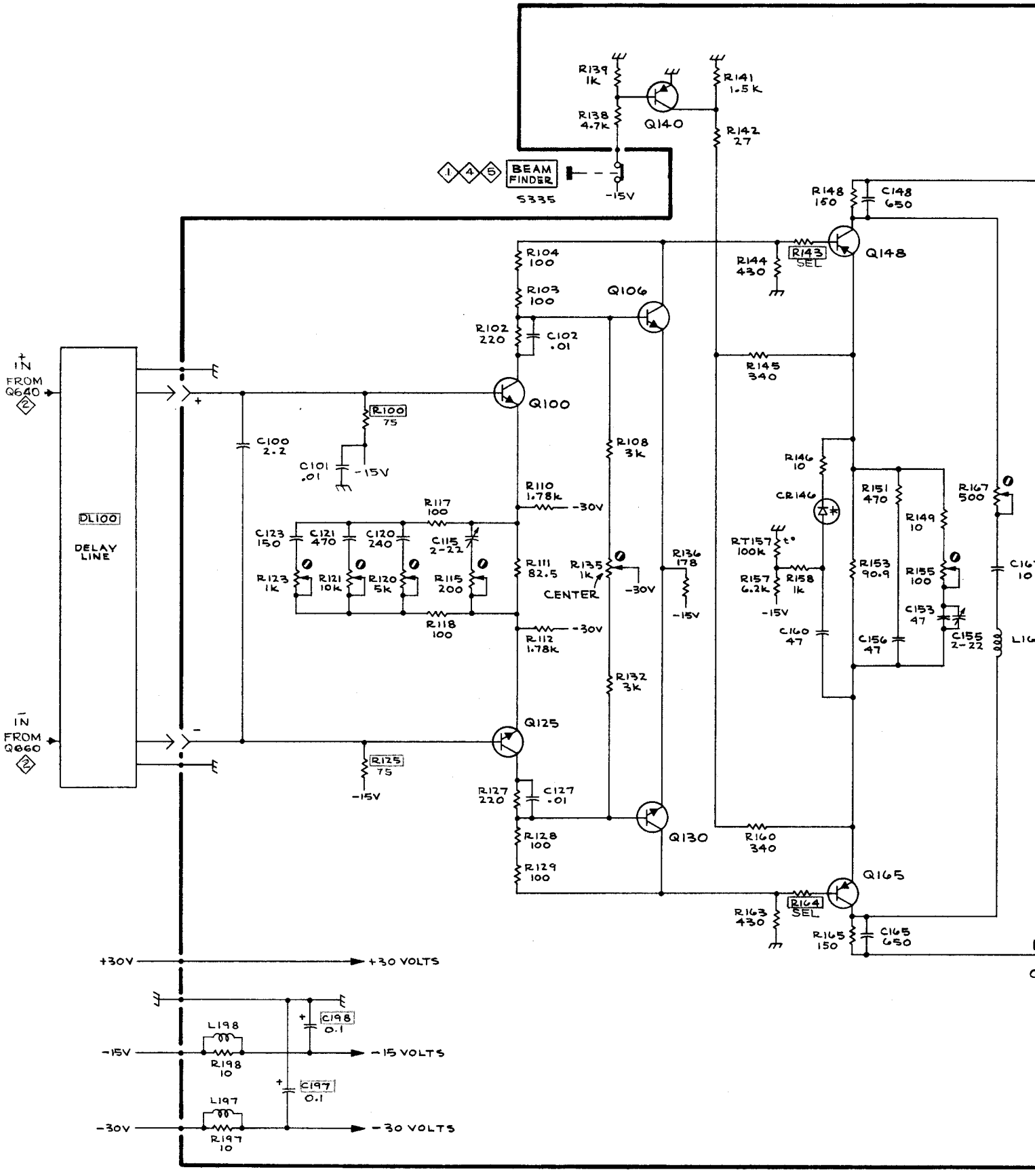

REV: A JAN. 1977
14-49-26
MAIN INTERFACE 2
DEH
NOTE:
* PINS 14A & 14B ARE FOR SIGNAL GROUNDS ONLY (LOW NOISE GROUND). THE PINS ARE GROUNDED VIA THE INTERFACE AND LV POWER SUPPLY CIRCUIT BOARD GROUND PLANES WHICH ARE CONNECTED TO CHASSIS GROUND.
PIN 2A PROVIDES A RETURN FOR ALL GROUNDS EXCEPT SIGNAL GROUNDS. THE PIN IS DIRECTLY GROUNDED TO THE CHASSIS OF THE 5440.
NOTE: J610, J620, AND J630 TERMINAL CONNECTIONS ARE AS VIEWED FROM FRONT OF INSTRUMENT.
OPTIONAL STRAP
COM
RESET
SWEEP LOCKOUT
50Ω LINE
LINE TRIG SIGNAL
+HORIZ OUT
-HORIZ OUT
Z AXIS
NC
P755
Q600
Q604
Q610
Q614
Q700
Q708
Q710
Q715
Q720
Q728
Q730
Q735
Q740
Q744
Q748
Q752
CR602
CR608
CR740
CR741
CR742
CR761
CR770
+200V
+38V (UNREG)
+30V
+15V
+5V
-15V
-30V
-38V (UNREG)
LINE TRIG SIGNAL FROM J630 88 PIN
FROM DIAG 6
A2 MAIN INTERFACE BOARD



A3—Vertical Amplifier circuit board.

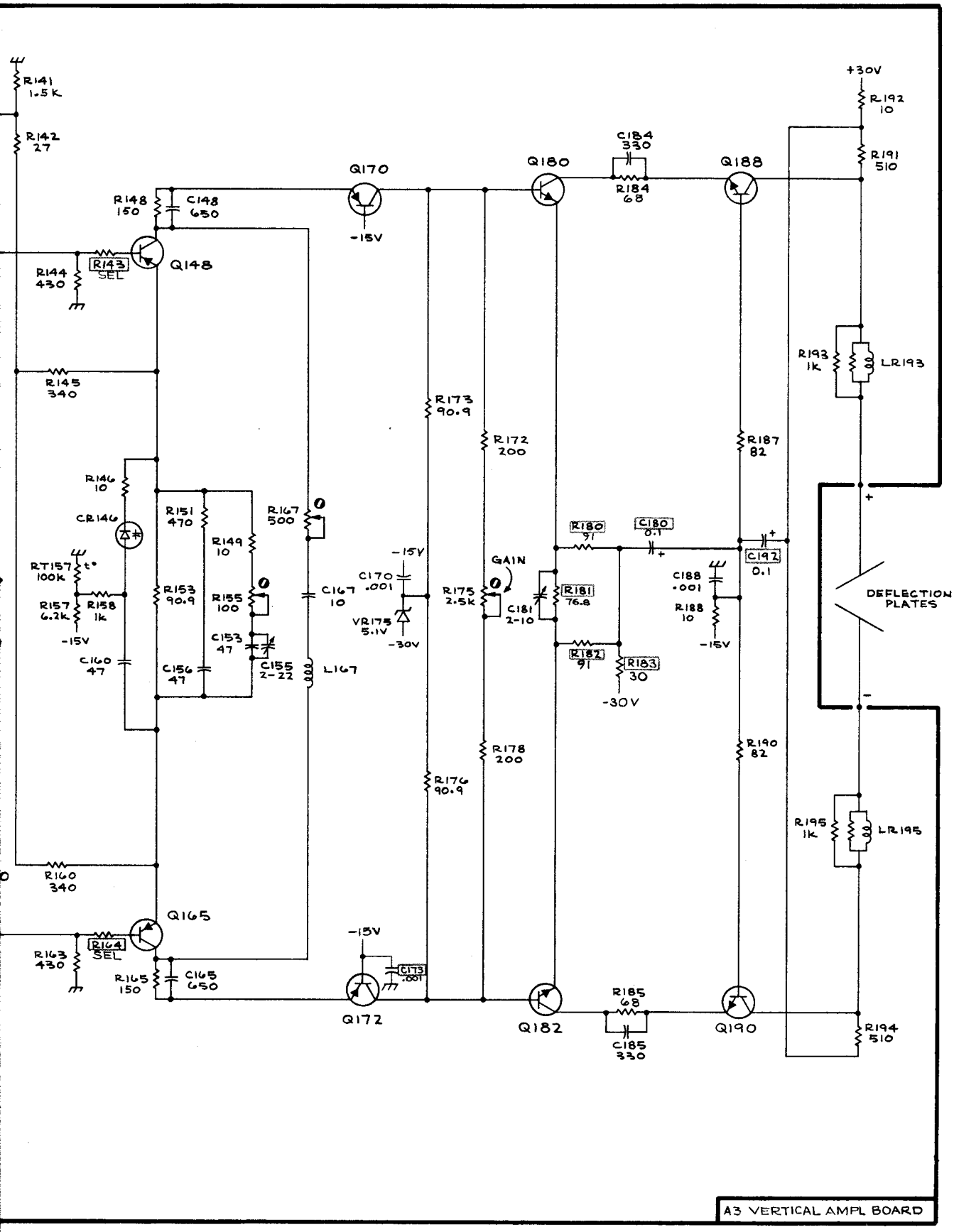
CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C100	B-4	C184	E-4	CR146	D-4	Q100	B-4	R100	B-4	R129	C-3	R155	D-2	R187	F-3
C102	B-4	C185	E-2			Q106	C-4	R102	B-4	R132	C-3	R157	C-4	R188	F-3
C115	A-3	C188	F-3			Q125	B-3	R103	B-4	R135	B-3	R158	D-4	R190	F-3
C120	B-3	C192	E-3			Q130	C-3	R104	B-4	R136	C-4	R160	C-2	R191	G-3
C121	A-3	C197	A-2	L167	D-3	Q140	B-2	R108	C-3	R137	E-4	R163	C-3	R192	D-2
C123	B-3	C198	A-2	L197	A-2	Q148	C-4	R110	B-4	R138	B-2	R164	C-3	R193	F-4
C127	B-4			L198	B-2	Q165	C-3	R111	B-4	R139	C-2	R165	D-2	R194	E-2
C148	D-4					Q170	D-4	R112	A-3	R141	C-2	R167	D-2	R195	F-3
C153	D-3					Q172	D-2	R115	A-4	R142	C-2	R172	D-4	R197	A-2
C155	D-3			LR193	F-4	Q180	E-4	R117	B-4	R143	C-4	R175	D-3	R198	B-2
C156	D-3					Q182	E-3	R118	B-3	R144	C-4	R176	E-3		
C160	D-4					Q188	F-4	R120	B-2	R145	D-3	R178	D-3	RT157	D-4
C165	D-2					Q190	F-2	R121	A-2	R146	D-4	R180	E-4		
C167	D-4							R123	B-2	R148	D-4	R181	E-3	VR175	E-4
C180	E-3							R125	B-4	R149	D-2	R182	E-3		
C181	E-3							R127	B-3	R151	D-4	R183	E-4		
								R128	C-3	R153	C-3	R184	E-4		
												R185	E-2		

@



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

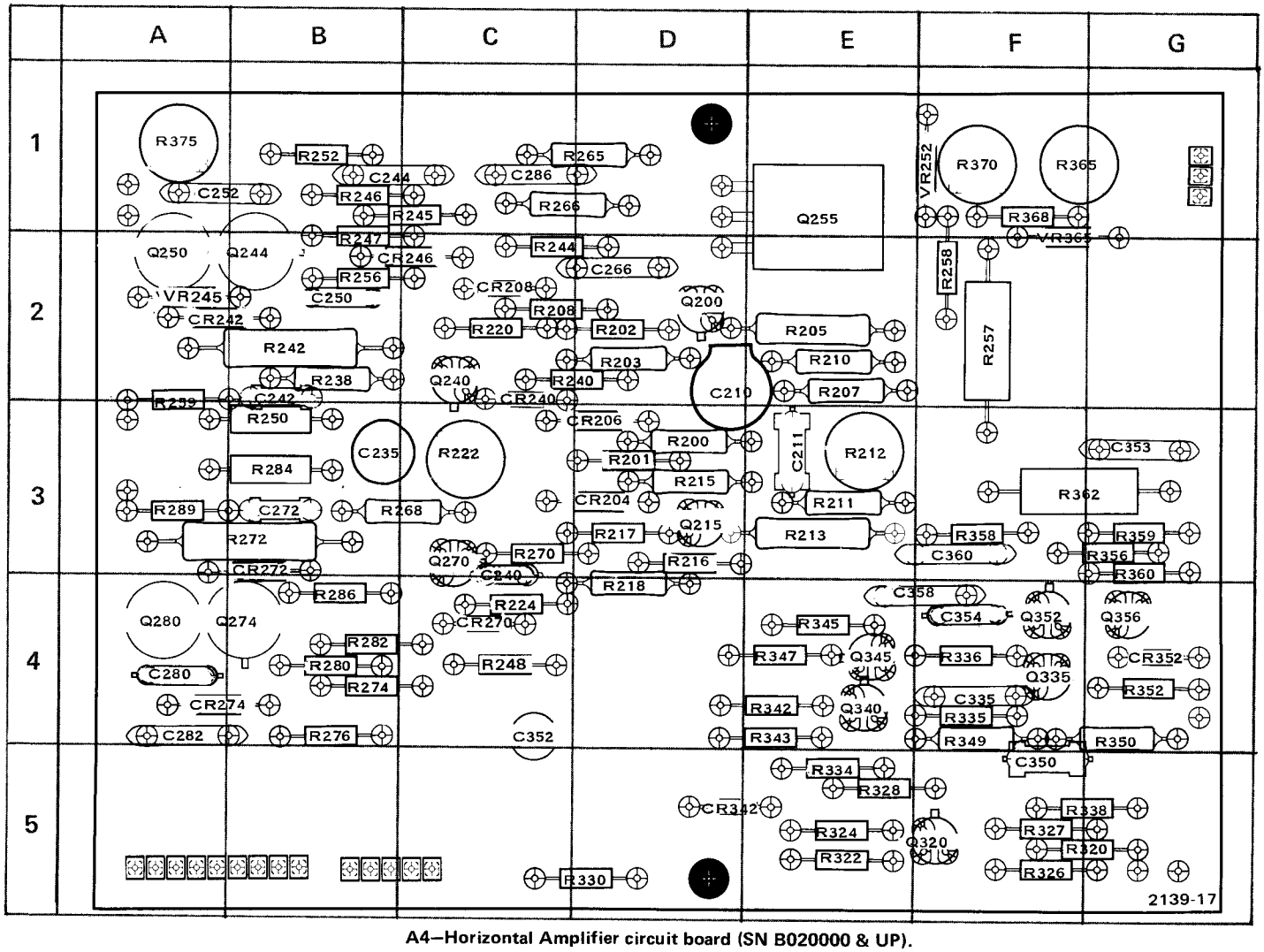
2139-23
REV B, MAR 1979



2139-23
REV B, MAR 1979

VERTICAL AMPLIFIER ③

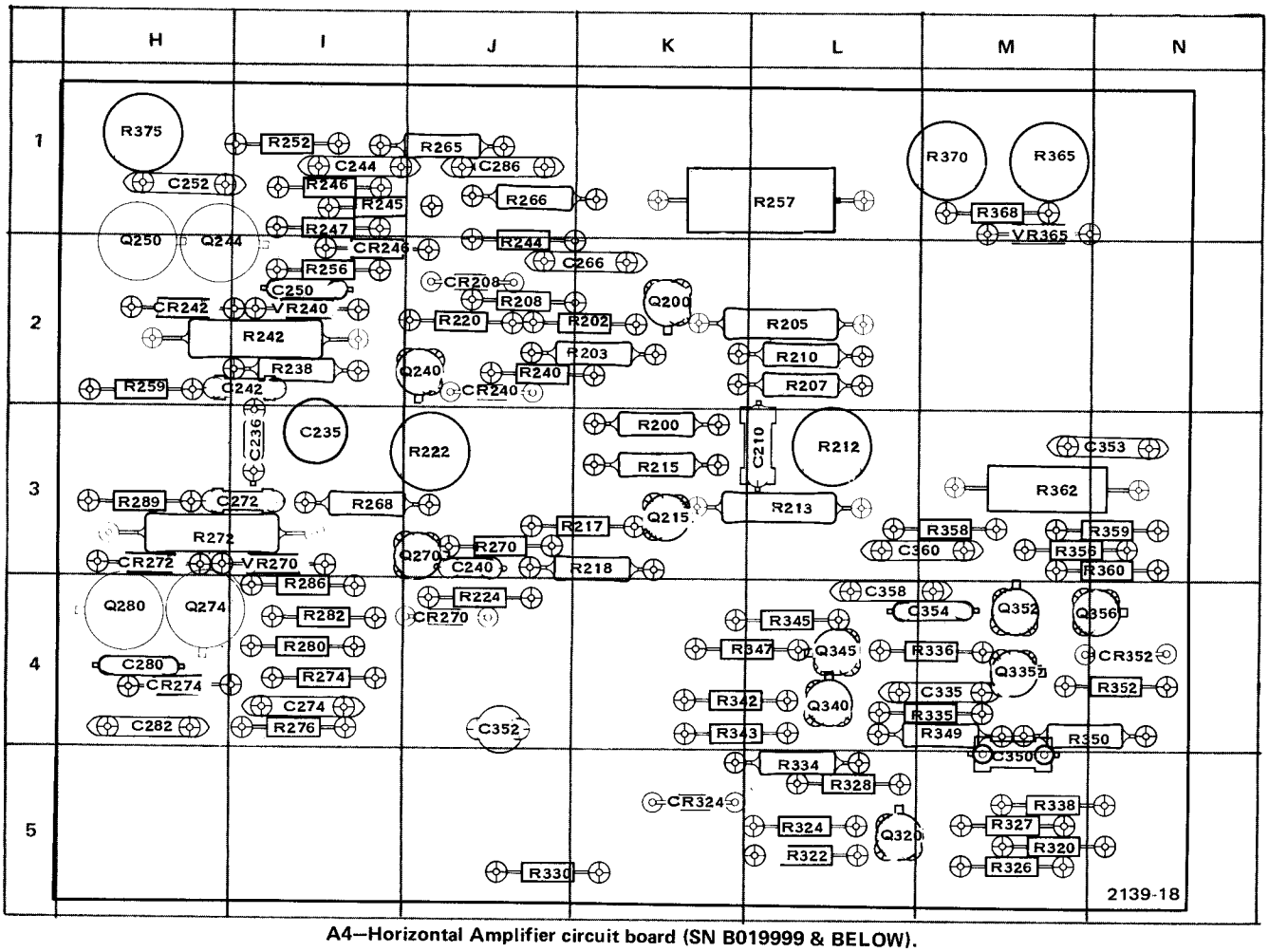
DEH



A4—Horizontal Amplifier circuit board (SN B020000 & UP).

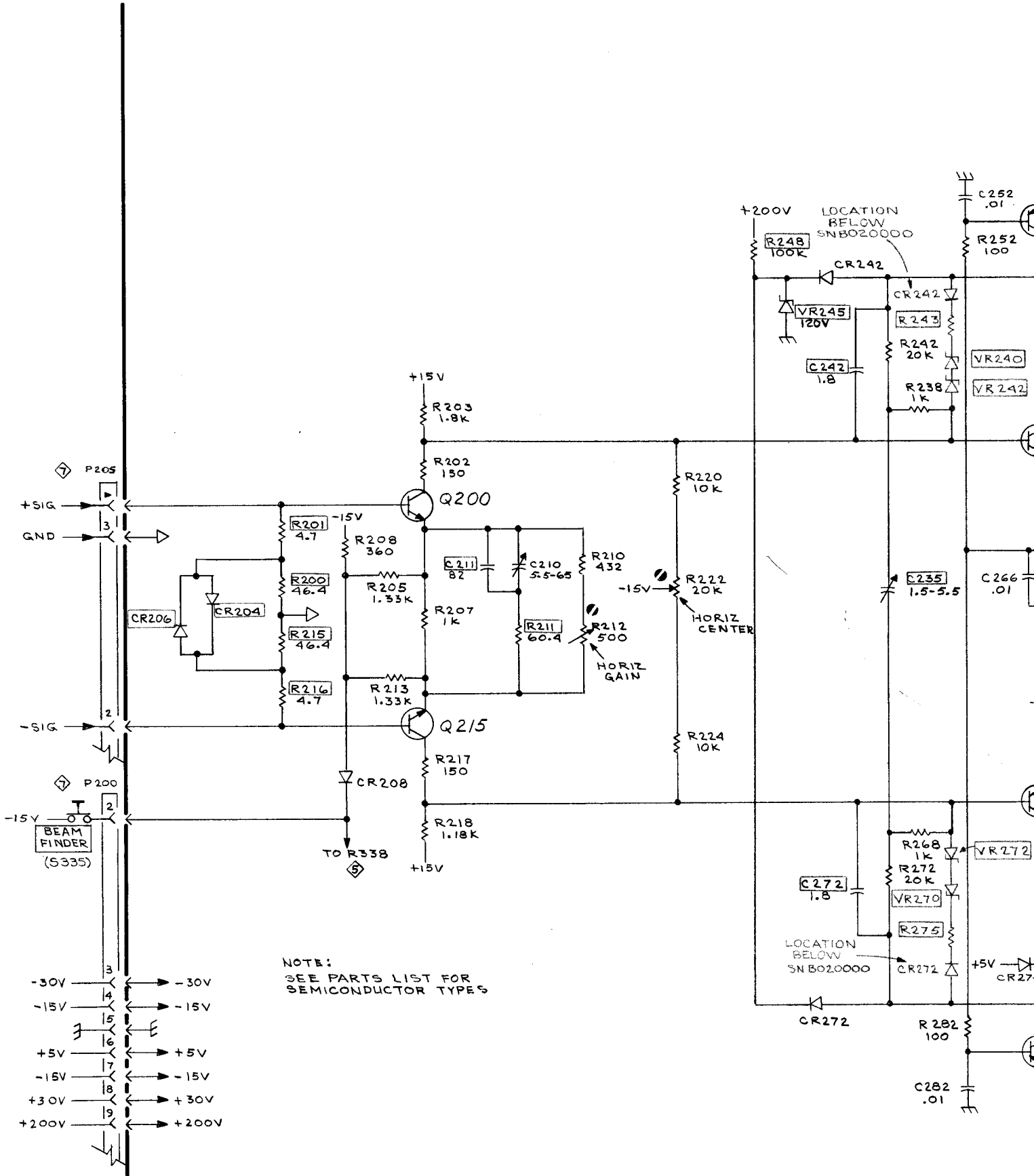
CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C210	E-2	C353	G-3	CR204	D-3	Q200	D-2	R200	D-3	R242	B-2	R289	A-3	R352	G-4
C211	E-3	C358	E-4	CR206	D-3	Q215	D-3	R201	D-3	R248	C-4	R320	F-5	R356	G-3
C235	B-3	C360	F-3	CR208	C-2	Q240	C-2	R202	D-2	R250	B-3	R322	E-5	R358	F-3
C240	C-3			CR240	C-2	Q244	B-2	R203	D-2	R252	B-1	R324	E-5	R359	G-3
C242	B-2			CR242	A-2	Q250	A-2	R205	E-2	R256	B-2	R326	F-5	R360	G-3
C244	B-1			CR246	C-2	Q255	E-1	R207	E-2	R257	F-2	R327	F-5	R362	F-3
C250	B-2			CR270	A-4	Q270	C-3	R208	C-2	R258	F-2	R328	E-5	R365	F-1
C252	A-1			CR272	B-3	Q274	B-4	R210	E-2	R259	A-2	R330	D-5	R368	F-1
C266	D-2			CR274	B-4	Q280	A-4	R211	E-3	R265	C-1	R334	E-5	R370	F-1
C272	B-3			CR342	D-5	Q320	E-5	R212	E-3	R266	C-1	R335	F-4	R375	A-1
C280	A-4			CR352	G-4	Q335	F-4	R213	E-3	R268	C-3	R336	F-4		
C282	A-4					Q340	E-4	R215	D-3	R270	C-3	R338	F-5		
C286	C-1					Q345	E-4	R216	D-3	R272	B-3	R342	E-4		
C335	F-4					Q352	F-4	R217	D-3	R274	B-4	R343	E-4	VR245	A-2
C350	F-5					Q356	G-4	R218	D-4	R276	B-4	R345	E-4	VR252	F-1
C352	C-4							R220	C-2	R280	B-4	R347	E-4	VR365	F-1
C354	F-4							R222	C-3	R282	B-4	R349	F-4		
								R224	C-4	R284	B-3	R350	G-4		
								R238	B-2	R286	B-4				
								R240	C-2						

@



A4—Horizontal Amplifier circuit board (SN B019999 & BELOW).

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C210	L-3	C353	N-3	CR208	J-2	Q200	K-2	R200	K-3	R244	J-2	R289	H-3	R352	N-4
C235	I-3	C358	L-4	CR240	J-2	Q215	K-3	R202	K-2	R245	I-1	R320	M-5	R356	M-3
C236	I-3	C360	M-3	CR242	H-2	Q240	J-2	R203	K-2	R246	I-1	R322	L-5	R358	M-3
C240	J-3			CR246	I-2	Q244	H-2	R205	L-2	R247	I-1	R324	L-5	R359	N-3
C242	I-2			CR270	J-4	Q250	H-2	R207	L-2	R252	I-1	R326	M-5	R360	N-3
C244	I-1			CR272	H-3	Q270	J-3	R208	J-2	R256	I-2	R327	M-5	R362	M-3
C250	I-2			CR274	H-4	Q274	H-4	R210	L-2	R257	L-1	R328	L-5	R365	M-1
C252	H-1			CR324	K-5	Q280	H-4	R212	L-3	R259	H-2	R330	J-5	R368	M-1
C266	K-2			CR352	N-4	Q320	L-5	R213	L-3	R265	J-1	R334	L-5	R370	M-1
C272	I-3					Q335	M-4	R215	K-3	R266	J-1	R335	M-4	R375	H-1
C274	I-4					Q340	L-4	R217	K-3	R268	I-3	R336	M-4		
C280	H-4					Q345	L-4	R218	K-3	R270	J-3	R338	M-5	VR240	I-2
C282	H-4					Q352	M-4	R220	J-2	R272	H-3	R342	K-4	VR270	I-3
C286	J-1					Q356	N-4	R222	J-3	R274	I-4	R343	K-4	VR365	M-1
C335	M-4							R224	J-4	R276	I-4	R345	L-4		
C350	M-5							R238	I-2	R280	I-4	R347	K-4		
C352	J-4							R240	J-2	R282	I-4	R349	M-4		
C354	M-4							R242	I-2	R286	I-4	R350	N-4		

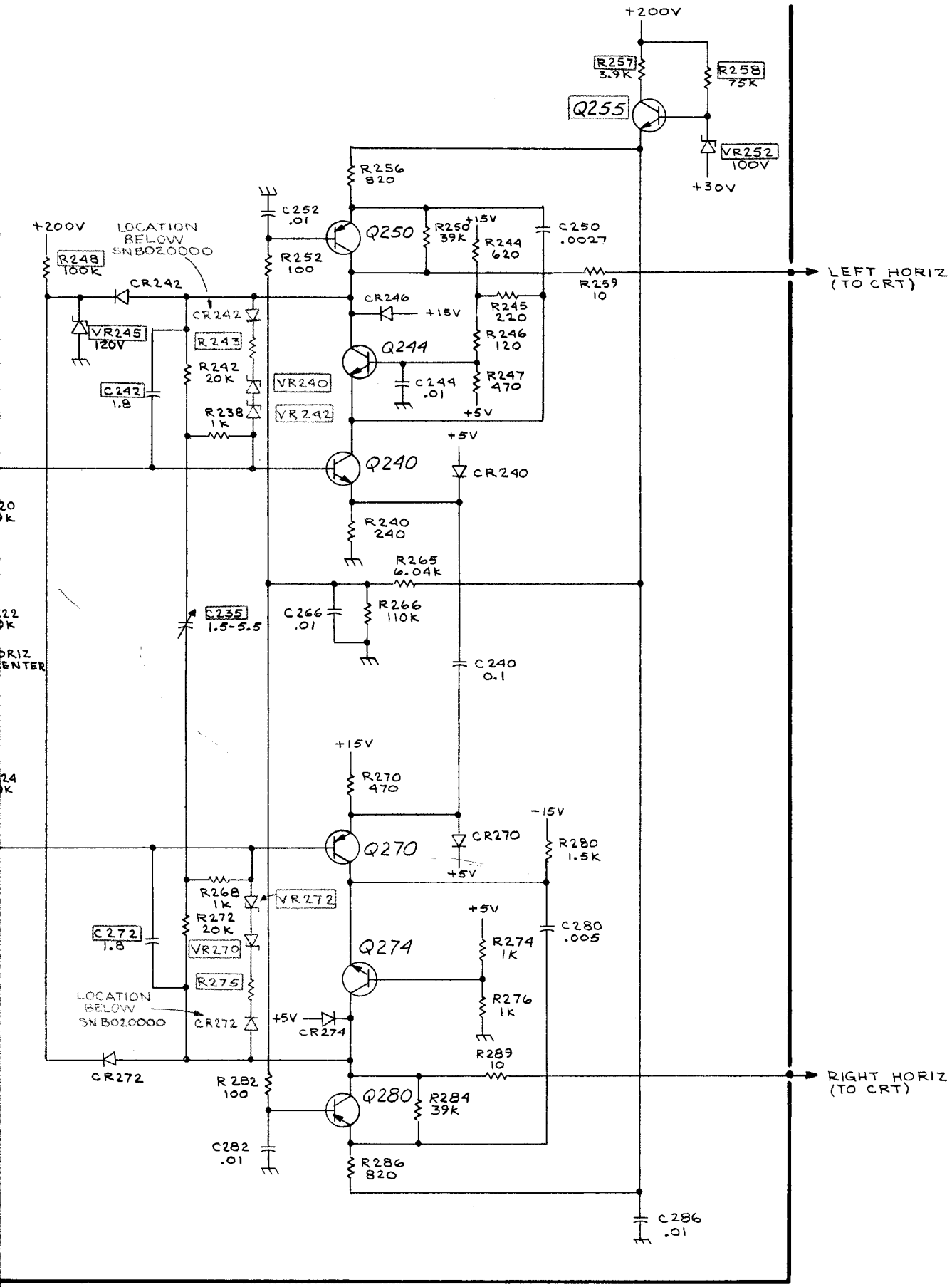


NOTE:
SEE PARTS LIST FOR SEMICONDUCTOR TYPES

A4 HORIZONTAL AMPL BD

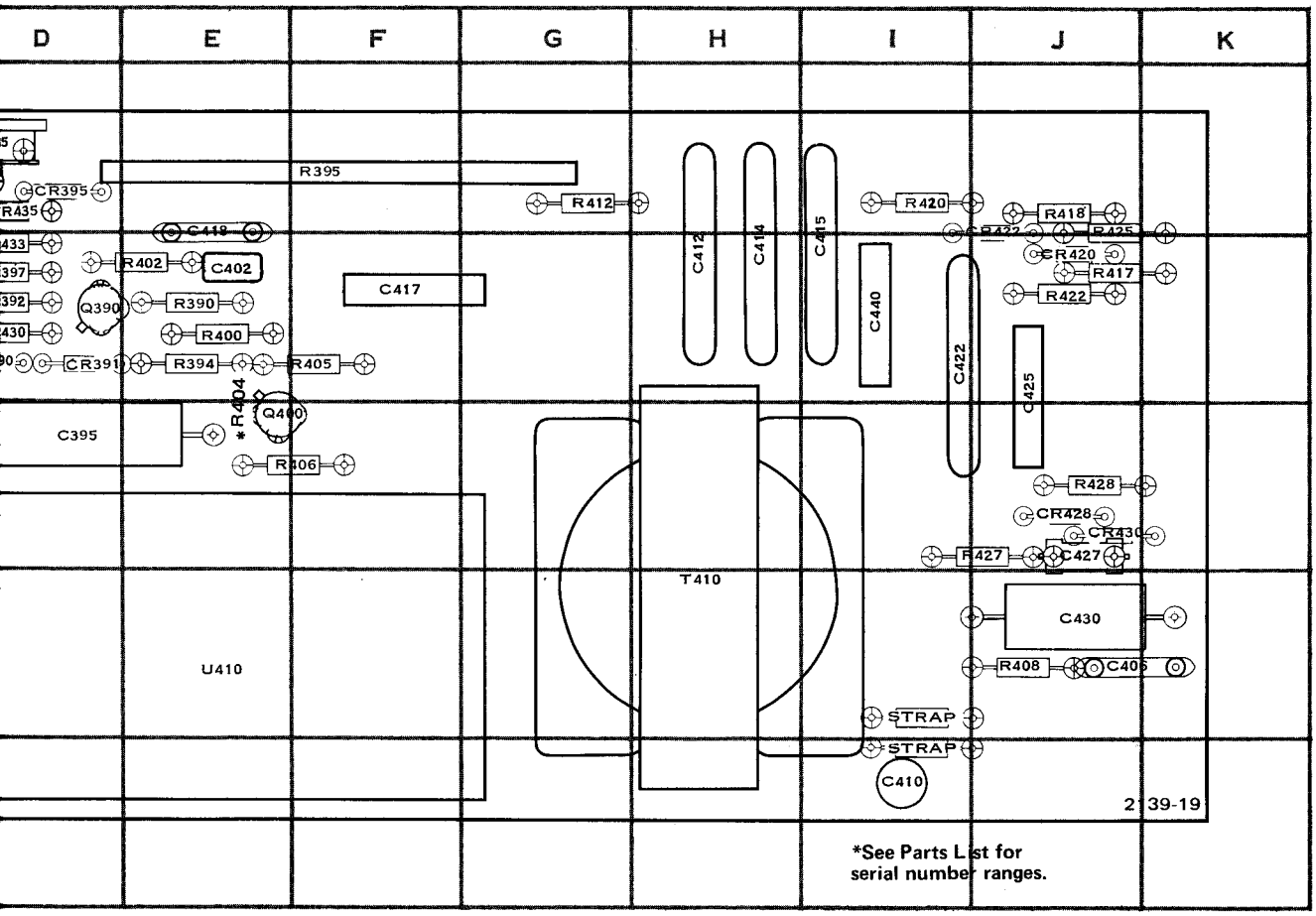
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.

2139-24
REV. A JUN 1977



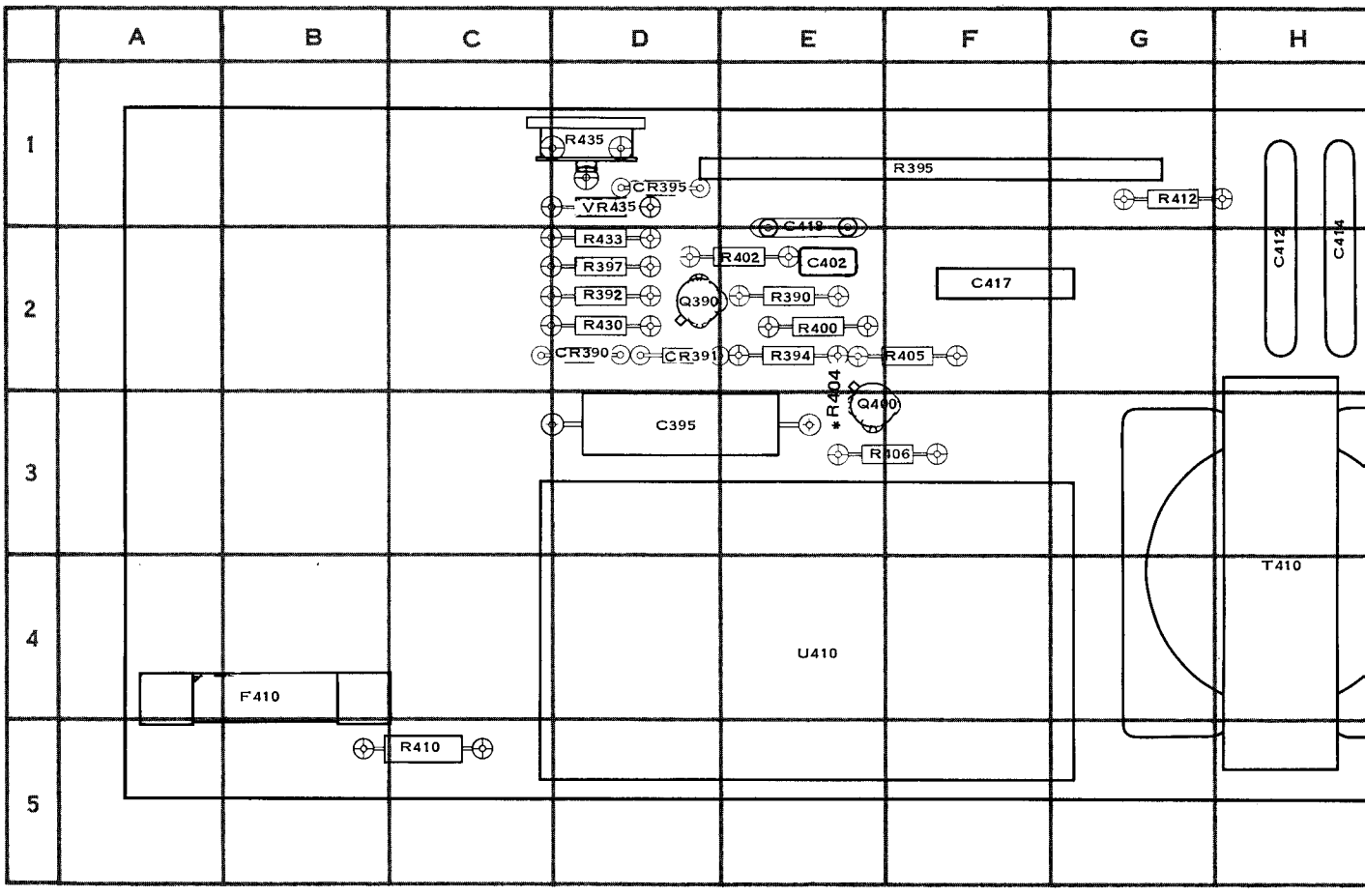
2139-24
REV. A JUN 1977

HORIZONTAL AMPLIFIER ④ hq



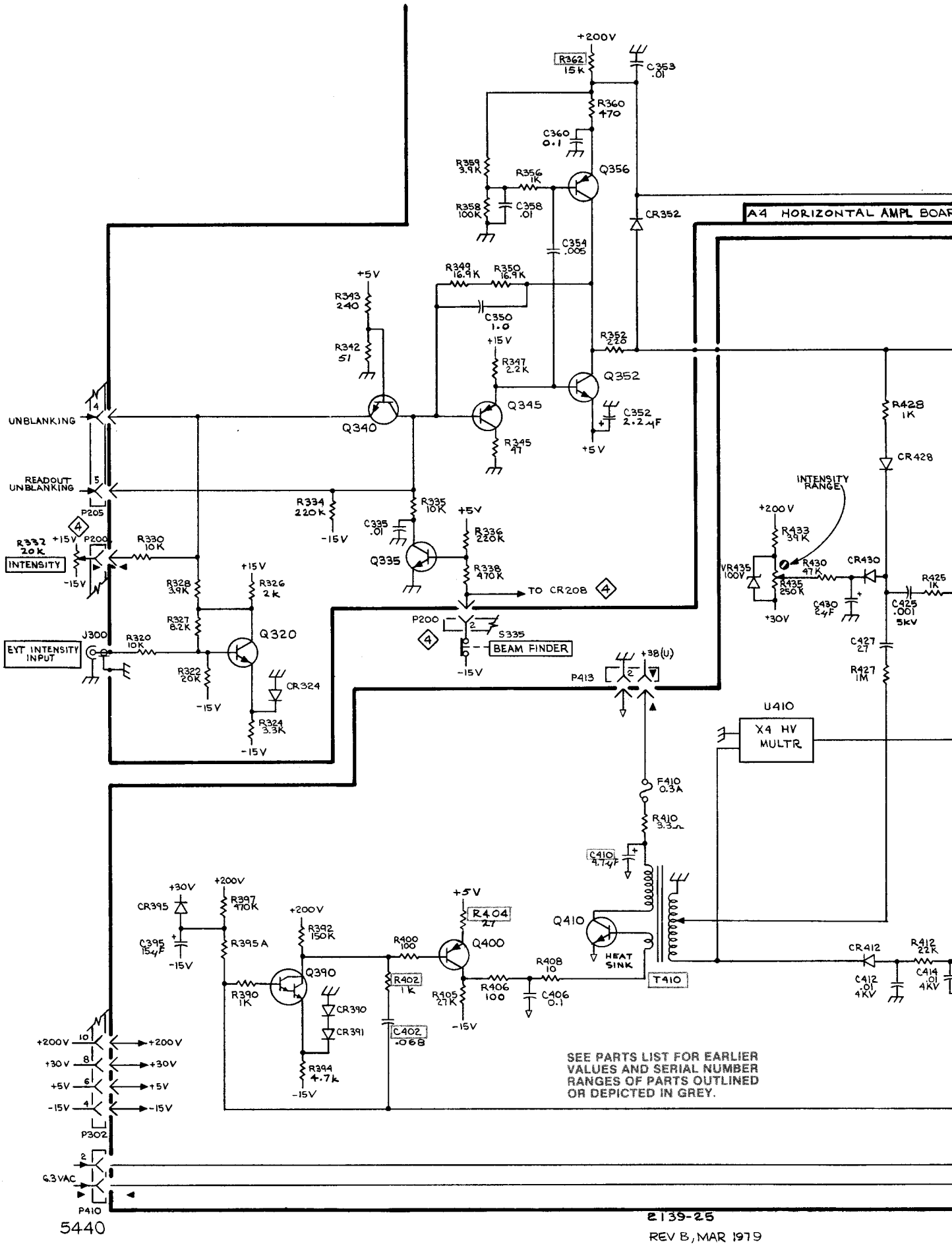
A5—High Voltage circuit board.

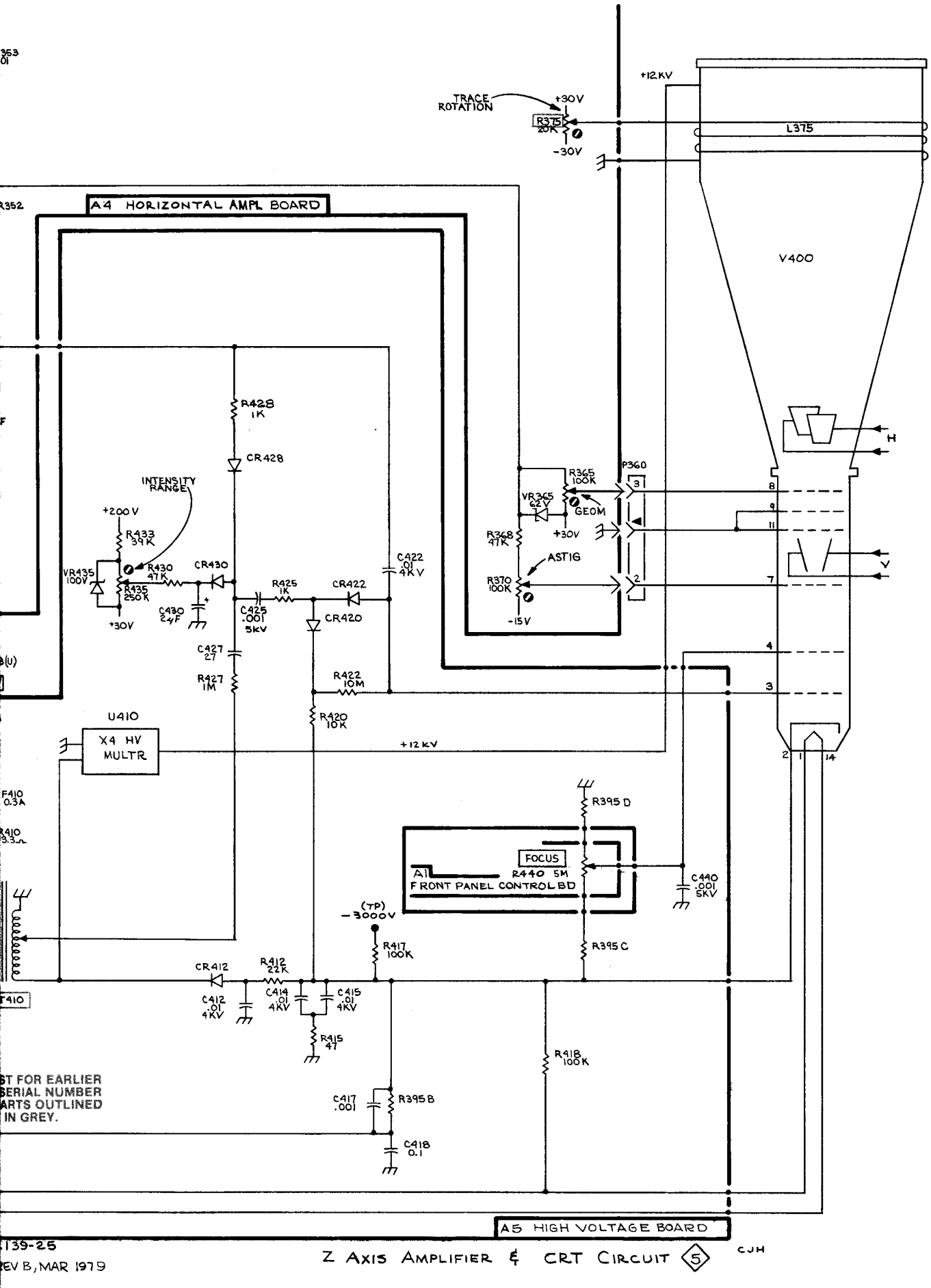
CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
F410	B-4	Q390	D-2	R390	E-2	R420	I-1	T410	H-4	U410	E-4	VR435	D-1
		Q400	E-3	R392	D-2	R422	J-2						
				R394	E-2	R425	J-1						
				R395	F-1	R427	J-3						
				R397	D-2	R428	J-3						
				R400	E-2	R430	D-2						
				R402	E-2	R433	D-2						
				R404	E-2	R435	D-1						
				R405	F-2								
				R406	E-3								
				R408	J-4								
				R410	C-5								
				R412	G-1								
				R417	J-2								
				R418	J-1								



A5—High Voltage circuit board.

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C395	D-3	CR390	D-2	F410	B-4	Q390	D-2	R390	E-2	R420	I-1	T410	H-4
C402	E-2	CR395	D-1			Q400	E-3	R392	D-2	R422	J-2		
C406	J-4	CR420	J-2					R394	E-2	R425	J-1		
C410	I-5	CR422	J-1					R395	F-1	R427	J-3		
C412	H-2	CR428	J-3					R397	D-2	R428	J-3		
C414	H-2	CR430	J-3					R400	E-2	R430	D-2		
C415	I-2							R402	E-2	R433	D-2		
C417	F-2							R404	E-2	R435	D-1		
C418	E-1							R405	F-2				
C422	I-2							R406	E-3				
C425	J-2							R408	J-4				
C427	J-3							R410	C-5				
C430	J-4							R412	G-1				
C440	I-2							R417	J-2				
								R418	J-1				


A4 HORIZONTAL AMPL BOAR
+200V
R362 15K
C353 .01
R360 470
C360 0.1
R359 3.9K
R356 1K
Q356
R358 100K
C358 .01
CR352
C354 .005
+5V
R349 16.9K
R350 16.9K
C350 1.0
R343 240
R342 51
+15V
R347 2.2K
Q352
R352 2.2K
Q345
Q340
C352 2.2μF
R345 47
+5V
UNBLANKING
READOUT UNBLANKING
P205
P200
R332 20K
INTENSITY
+15V
-15V
R330 10K
R334 220K
-15V
C335 .01
R335 10K
+5V
Q335
R336 220K
R338 470K
TO CR208
R328 3.9K
+15V
R326 2K
R327 8.2K
Q320
J300
EXT INTENSITY INPUT
R320 10K
R322 20K
-15V
CR324
R324 3.3K
-15V
P200
S335
BEAM FINDER
-15V
P413
+38(U)
INTENSITY RANGE
+200V
R433 39K
VR435 100V
R430 47K
CR430
R435 250K
C430 2μF
+30V
R425 1K
C425 .001 5kV
C427 27
R427 1M
R428 1K
CR428
U410
X4 HV MULTR
F410 0.3A
R410 3.3Ω
C410 4.7μF
Q410
HEAT SINK
T410
CR412
R412 22K
C412 .01 4KV
C414 .01 4KV
+30V
CR395
+200V
R397 470K
C395 15μF
-15V
R395A
+200V
R392 150K
R390 1K
Q390
CR390
CR391
R394 4.7k
-15V
R400 100
R402 1K
C402 .068
+5V
R404 27
Q400
R405 27K
-15V
R408 10
R406 100
C406 0.1
+200V
+30V
+5V
-15V
P302
+200V
+30V
+5V
-15V
6.3VAC
P410
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.



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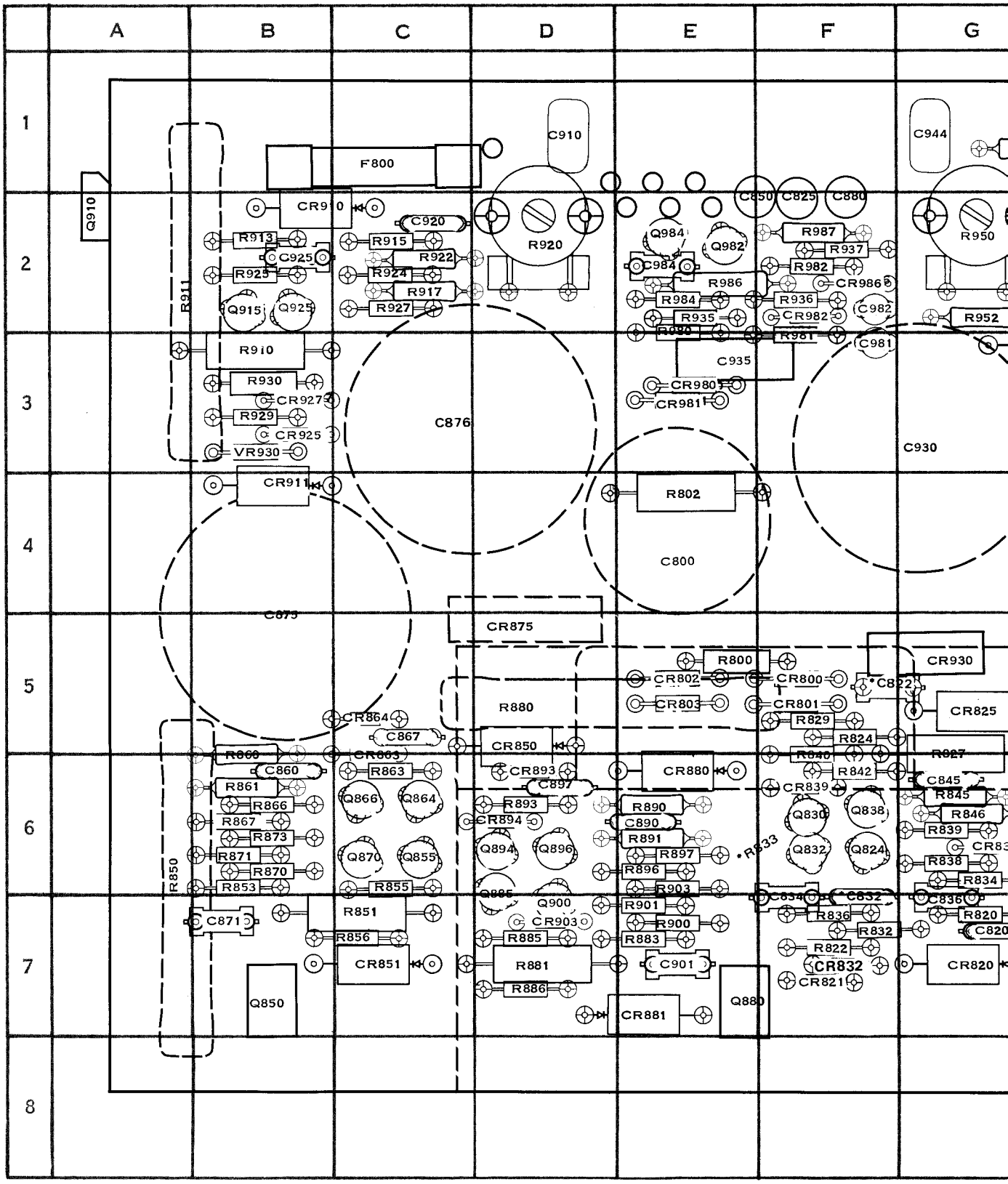
REV B, MAR 1979

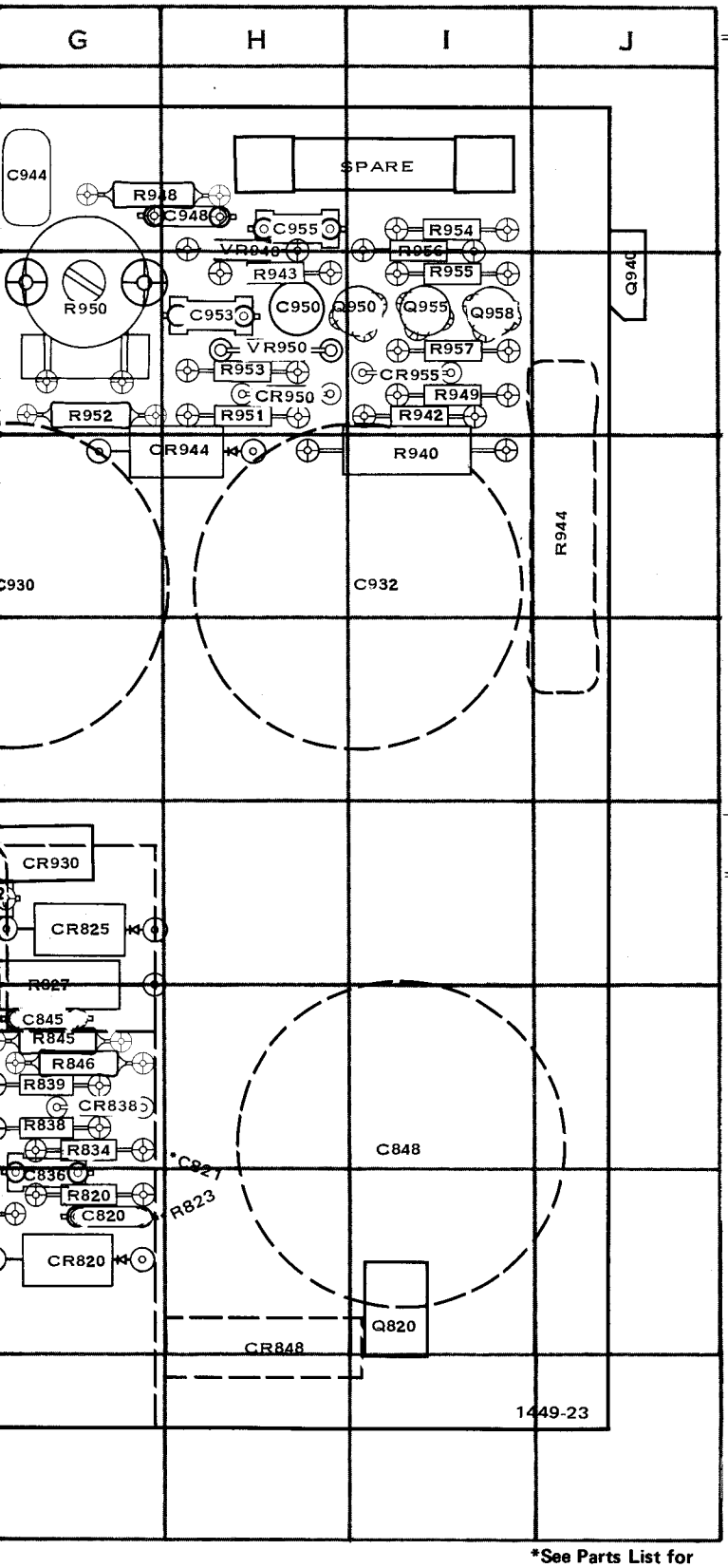
Z AXIS AMPLIFIER & CRT CIRCUIT 5

CJH



A6—Low Voltage & Calibrator circuit board.

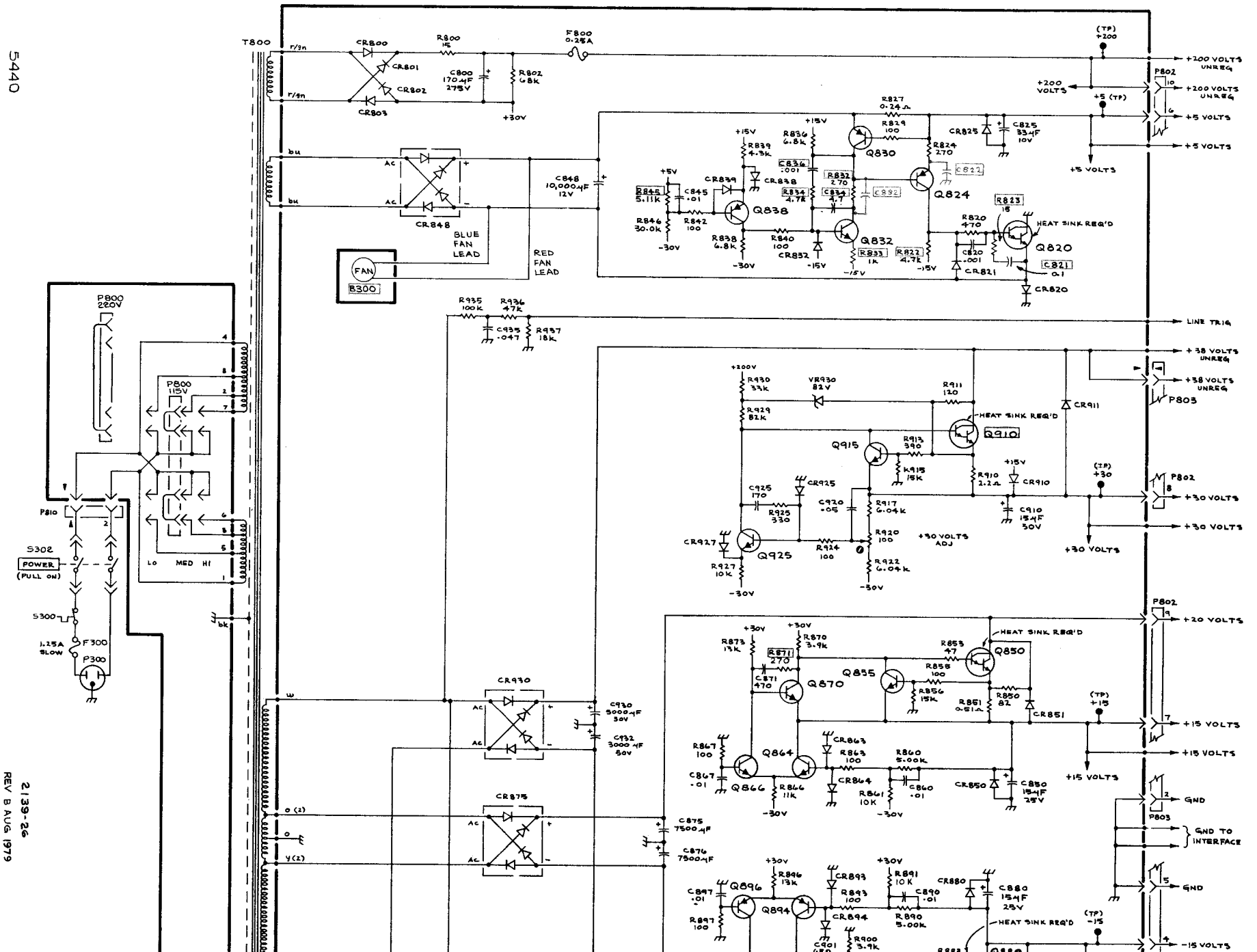
@ COMPONENTS SHOWN WITH DASHED LINES ARE LOCATED ON BACK SIDE OF BOARD.

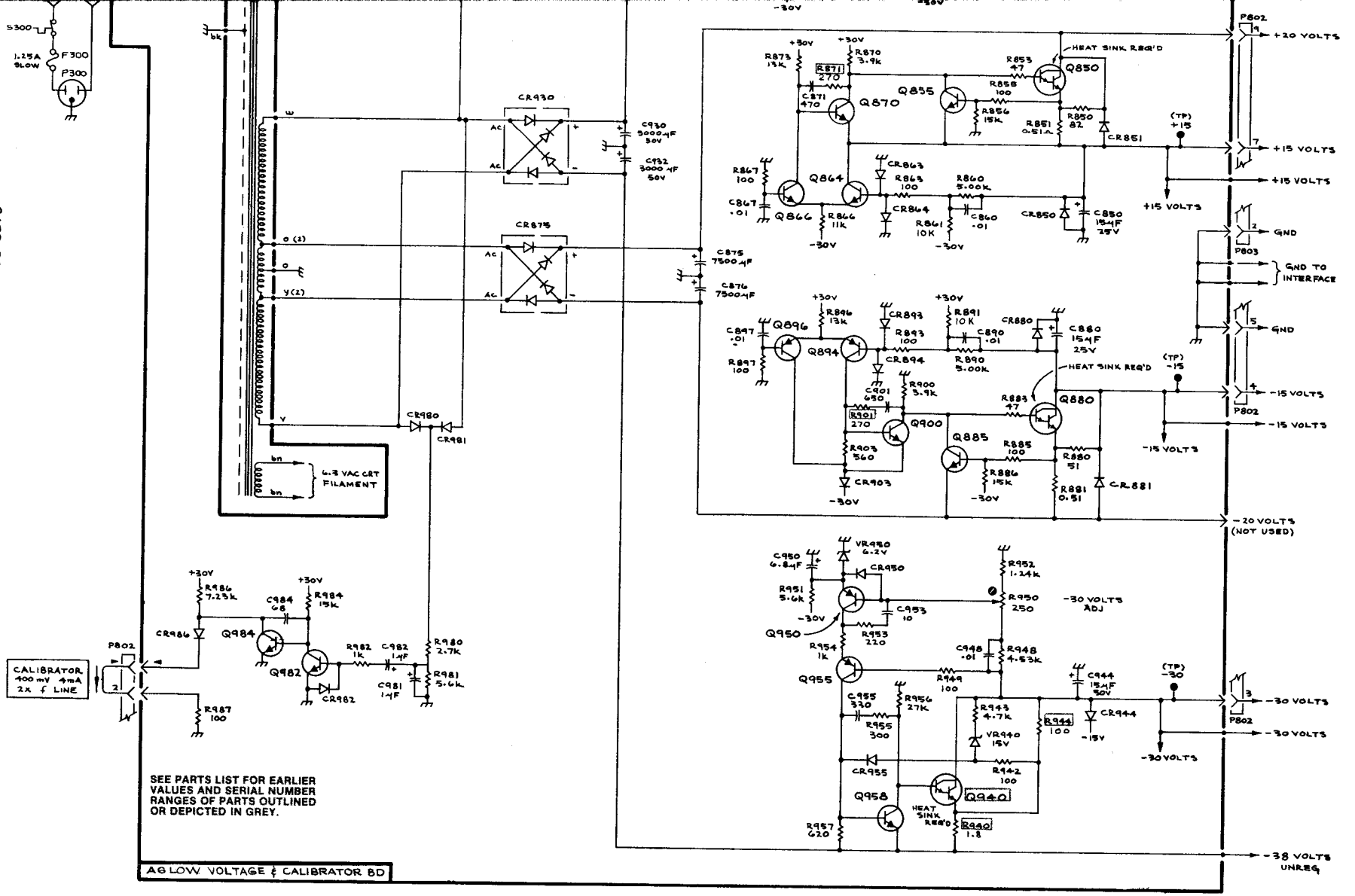


*See Parts List for serial number ranges.

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C800	E-4	C982	F-2	CR800	F-5	CR982	F-2
C820	G-7	C984	E-2	CR801	F-5	CR986	F-2
C821	H-7			CR802	E-5		
C822	F-5			CR803	E-5	F800	C-1
C825	F-2			CR820	G-7		
C834	F-6			CR821	F-7		
C836	F-6			CR825	G-5		
C845	G-6			CR832	F-7		
C848	I-6			CR838	G-6		
C850	F-2			CR839	F-6		
C860	B-6			CR848	H-7		
C867	C-5			CR850	D-5		
C871	B-7			CR851	C-7		
C875	B-4			CR863	C-5		
C876	C-3			CR864	C-5		
C880	F-2			CR875	D-4		
C890	E-6			CR880	E-6		
C897	D-6			CR881	E-7		
C901	E-7			CR893	D-6		
C910	D-1			CR903	D-7		
C920	C-2			CR910	B-2		
C925	B-2			CR911	B-4		
C930	G-3			CR925	B-3		
C932	I-3			CR927	C-2		
C935	E-3			CR930	G-5		
C944	G-1			CR944	H-3		
C948	H-1			CR950	H-2		
C950	H-2			CR955	I-2		
C953	H-2			CR980	E-3		
C955	H-1			CR981	E-3		
C981	F-3						

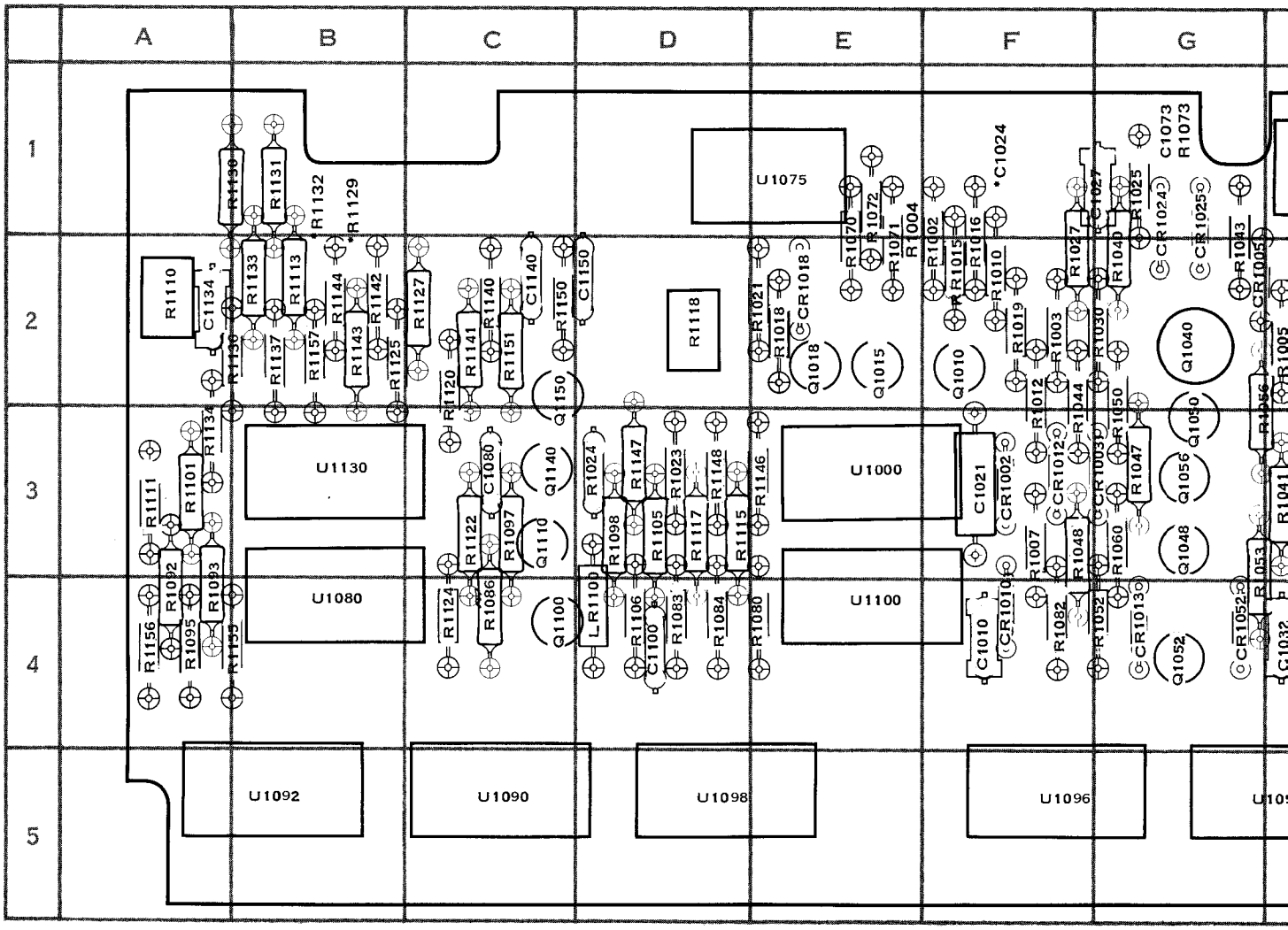
CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
Q820	I-7	R800	E-5	R883	E-7	R944	I-3
Q824	F-6	R802	E-4	R885	D-7	R948	G-1
Q830	F-6	R820	G-7	R886	D-7	R949	I-2
Q832	F-6	R822	F-7	R890	E-6	R950	G-2
Q838	F-6	R823	H-7	R891	E-6	R951	H-2
Q850	B-7	R824	F-5	R893	D-6	R952	G-2
Q855	C-6	R827	G-5	R894	D-6	R953	H-2
Q864	C-6	R829	F-5	R896	E-6	R954	I-1
Q866	C-6	R832	F-7	R897	E-6	R955	I-2
Q870	C-6	R833	F-6	R900	E-7	R956	I-1
Q880	E-7	R834	G-6	R901	E-7	R957	I-2
Q885	D-6	R836	F-7	R903	E-6	R980	E-2
Q894	D-6	R838	G-6	R910	B-3	R981	F-2
Q896	D-6	R839	G-6	R911	B-2	R982	F-2
Q900	D-6	R840	F-5	R913	B-2	R984	E-2
Q910	A-2	R842	F-6	R915	C-2	R986	E-2
Q915	B-2	R845	G-6	R917	C-2	R987	F-2
Q925	B-2	R846	G-6	R920	D-2		
Q940	J-2	R850	A-6	R922	C-2		
Q950	I-2	R851	C-7	R924	C-2	VR930	B-3
Q955	I-2	R853	B-6	R925	B-2	VR940	H-1
Q958	I-2	R855	C-6	R927	C-2	VR950	H-2
Q982	E-2	R856	C-7	R929	B-3		
Q984	E-2	R861	B-6	R930	B-3		
		R863	C-6	R935	E-2		
		R866	B-6	R936	F-2		
		R867	B-6	R937	F-2		
		R870	B-6	R940	I-3		
		R871	B-6	R942	I-2		
		R873	B-6	R943	H-2		
		R880	D-5				
		R881	D-7				


T800
CR800
CR801
CR802
CR803
R800 15
C800 170μF 275V
R802 6.8k
F800 0.25A
+30V
+200 VOLTS UNREG
+200 VOLTS
+5 VOLTS
+5 VOLTS
BLUE FAN LEAD
RED FAN LEAD
FAN
B300
C848 10,000μF 12V
CR848
Q830
Q824
Q838
Q832
Q820
HEAT SINK REQ'D
CR820
CR821
CR825
CR827
R827 0.24Ω
R819 100
R836 6.8k
R824 270
R839 4.5k
R834 4.7k
R832 270
R823 18
R820 470
R838 6.8k
R840 100
R822 4.7k
R833 1k
R845 5.11k
R846 30.0k
R842 100
C845 .01
C836 .001
C834 4.7
C832
C820 .001
C821 0.1
CR838
CR839
CR832
P800 220V
P800 115V
P810
S302
POWER (PULL ON)
S300
1.25A SLOW
F300
P300
LO MED HI
P802
P803
LINE TRIG
+38 VOLTS UNREG
+38 VOLTS UNREG
R935 100k
R936 47k
C935 .047
R937 18k
R930 33k
VR930 82V
R929 82k
R911 120
CR911
Q910
HEAT SINK REQ'D
Q915
R913 390
R915 15k
R910 2.2Ω
CR910
C910 154F 50V
C925 170
R925 330
CR925
C920 .05
R917 6.04k
R920 100
R924 100
R922 6.04k
Q925
CR927
R927 10K
+30 VOLTS ADJ
+30 VOLTS
+30 VOLTS
+30 VOLTS
+30 VOLTS
CR930
C930 5000μF 50V
C932 3000μF 50V
CR875
C875 7500μF
C876 7500μF
R873 15k
R870 3.9k
R871 270
C871 470
Q870
Q855
Q850
HEAT SINK REQ'D
R853 47
R858 100
R856 15k
R850 82
R851 0.51Ω
CR851
C850 154F 25V
+20 VOLTS
+15 VOLTS
+15 VOLTS
+15 VOLTS
R867 100
C867 .01
Q866
Q864
R866 11k
R863 100
CR863
CR864
R860 5.00k
C860 .01
R861 10K
CR850
GND
GND TO INTERFACE
GND
R896 13k
R897 100
C897 .01
Q896
Q894
R891 10 K
R893 100
CR893
CR894
R890 5.00k
C890 .01
CR880
C880 154F 25V
R900 3.9k
C901
HEAT SINK REQ'D
-15 VOLTS
(TP) +200
(TP) +5
(TP) +30
(TP) +15
(TP) -15
+200 VOLTS
+5 VOLTS
+30 VOLTS
+15 VOLTS
-15 VOLTS
bu
bk
w
o (z)
o
y (z)
r/gn
AC



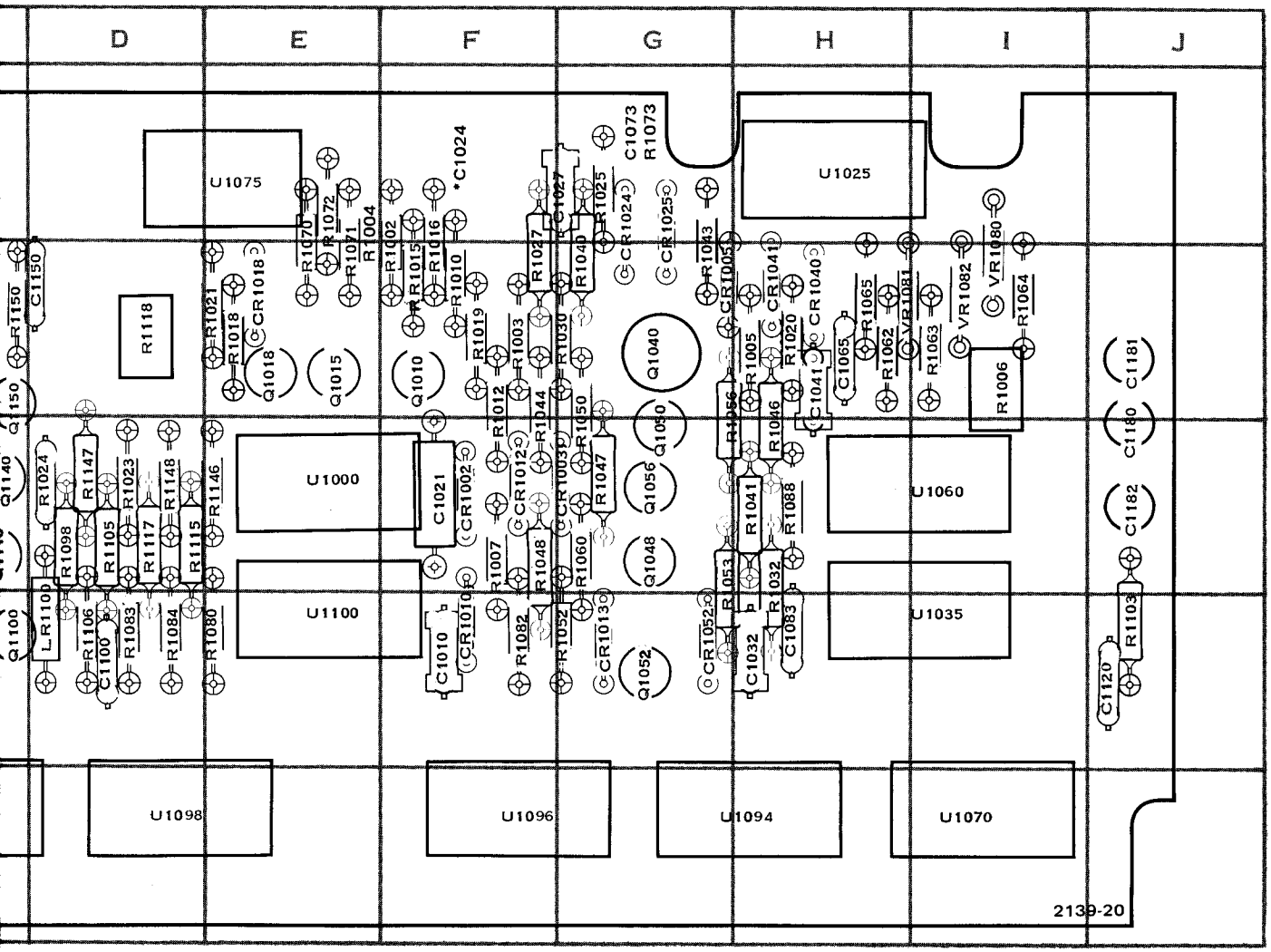
2139-26
REV B AUG 1979

LOW VOLTAGE SUPPLY + CALIBRATOR



A7—Readout circuit board.

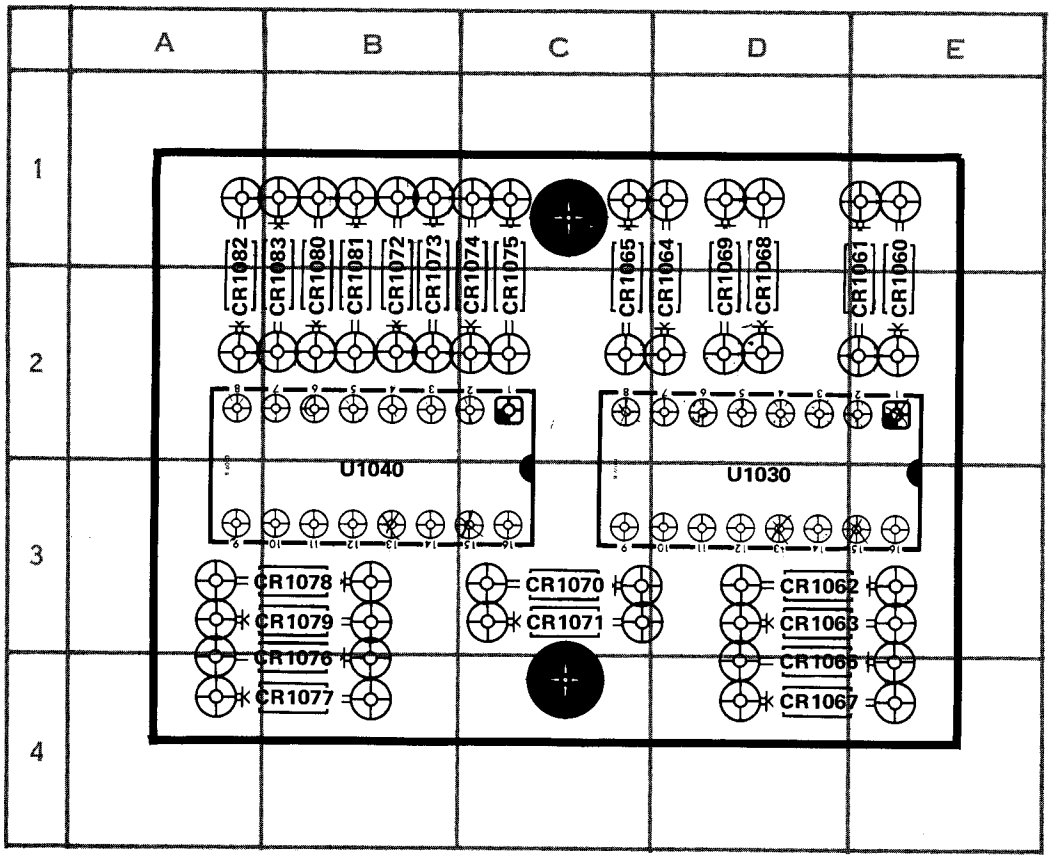
CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO
C1010	F-4	C1180	J-2	LR110	D-4	R1002	F-1	R1023	D-3	R1052	G-4	R1083	D-4	R1110	A-2	R1133	B-2	R115
C1021	F-3	C1181	J-2			R1003	F-2	R1024	D-3	R1053	G-3	R1084	D-4	R1111	A-3	R1134	A-3	R115
C1024	F-1	C1182	J-3	Q1015	E-2	R1004	E-1	R1025	G-1	R1056	G-2	R1086	C-4	R1113	B-2	R1136	A-2	R115
C1027	G-1			Q1018	E-2	R1005	H-2	R1027	F-2	R1060	G-3	R1088	H-3	R1115	D-3	R1137	B-2	R115
C1032	H-4			Q1040	G-2	R1006	I-2	R1030	G-2	R1062	H-2	R1092	A-3	R1117	D-3	R1140	C-2	
C1041	H-2	CR1002	F-3	Q1048	G-3	R1007	F-3	R1032	H-3	R1063	I-2	R1093	A-3	R1118	D-2	R1141	C-2	
C1065	H-2	CR1003	G-3	Q1050	G-2	R1010	F-2	R1041	H-3	R1064	I-2	R1095	A-4	R1120	C-2	R1142	B-2	
C1073	G-1	CR1005	G-2	Q1052	G-4	R1012	F-2	R1043	G-1	R1065	H-2	R1097	C-3	R1122	C-3	R1143	B-2	
C1080	C-3	CR1010	F-4	Q1056	G-3	R1015	F-2	R1044	F-2	R1070	E-1	R1098	D-3	R1124	C-4	R1144	B-2	
C1083	H-4	CR1012	F-3	Q1100	C-4	R1016	F-1	R1046	H-2	R1071	E-1	R1101	A-3	R1125	B-2	R1146	E-3	
C1100	D-4	CR1013	G-4	Q1110	C-3	R1018	E-2	R1047	G-3	R1072	E-1	R1103	J-4	R1127	C-2	R1147	D-3	
C1120	J-4	CR1018	E-2	Q1140	C-3	R1019	F-2	R1048	F-3	R1073	G-1	R1105	D-3	R1129	B-1	R1148	D-3	
C1134	A-2	CR1024	G-1	Q1150	C-2	R1020	H-2	R1050	G-2	R1080	E-4	R1106	D-4	R1130	A-1	R1150	C-2	
C1140	C-2	CR1040	H-2			R1021	E-2			R1082	F-4			R1131	B-1			
C1150	D-2	CR1041	H-2											R1132	B-1			
		CR1052	G-4															



A7—Readout circuit board.

*See Parts List for serial number ranges.

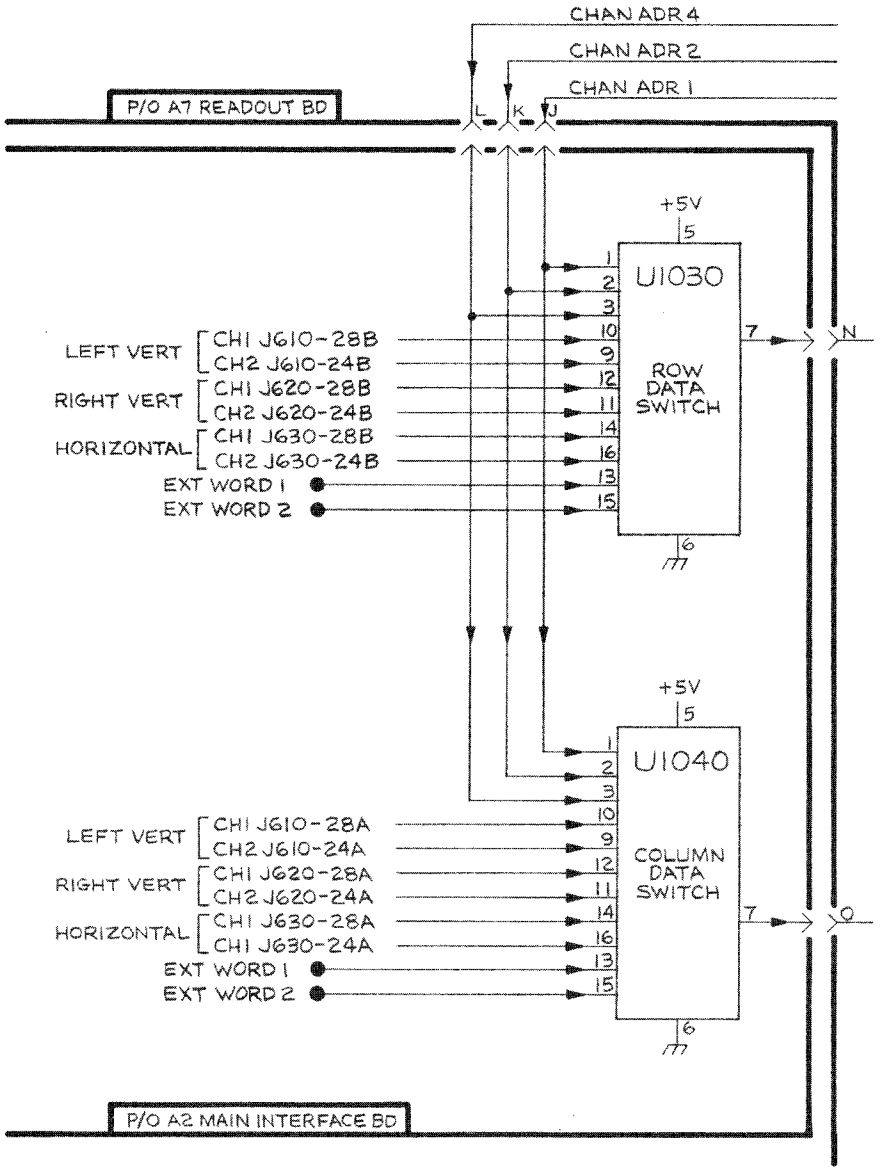
CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
1023	D-3	R1052	G-4	R1083	D-4	R1110	A-2	R1133	B-2	R1151	C-2	U1000	E-3	U1130	B-3
1024	D-3	R1053	G-3	R1084	D-4	R1111	A-3	R1134	A-3	R1155	B-4	U1025	H-1		
1025	G-1	R1056	G-2	R1086	C-4	R1113	B-2	R1136	A-2	R1156	A-4	U1035	I-4		
1027	F-2	R1060	G-3	R1088	H-3	R1115	D-3	R1137	B-2	R1157	B-2	U1060	I-3	VR1080	I-2
1030	G-2	R1062	H-2	R1092	A-3	R1117	D-3	R1140	C-2			U1070	I-5	VR1081	H-2
1032	H-3	R1063	I-2	R1093	A-3	R1118	D-2	R1141	C-2			U1075	E-1	VR1082	I-2
1041	H-3	R1064	I-2	R1095	A-4	R1120	C-2	R1142	B-2			U1080	B-4		
1043	G-1	R1065	H-2	R1097	C-3	R1122	C-3	R1143	B-2			U1090	C-5		
1044	F-2	R1070	E-1	R1098	D-3	R1124	C-4	R1144	B-2			U1092	B-5		
1046	H-2	R1071	E-1	R1101	A-3	R1125	B-2	R1146	E-3			U1094	H-5		
1047	G-3	R1072	E-1	R1103	J-4	R1127	C-2	R1147	D-3			U1096	F-5		
1048	F-3	R1073	G-1	R1105	D-3	R1129	B-1	R1148	D-3			U1098	D-5		
1050	G-2	R1080	E-4	R1106	D-4	R1130	A-1	R1150	C-2			U1100	E-4		
		R1082	F-4			R1131	B-1								
						R1132	B-1								



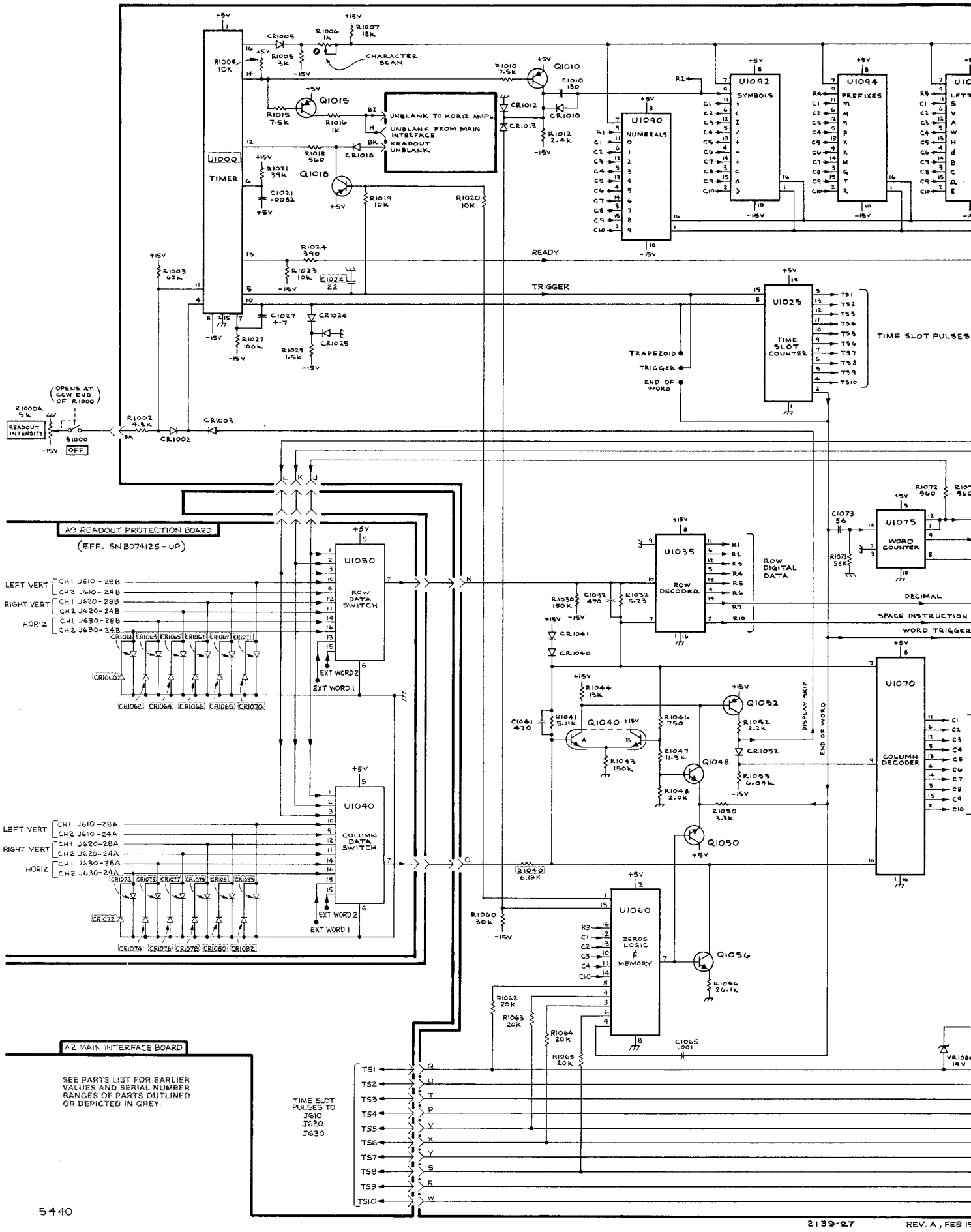
A9—Readout protection board.

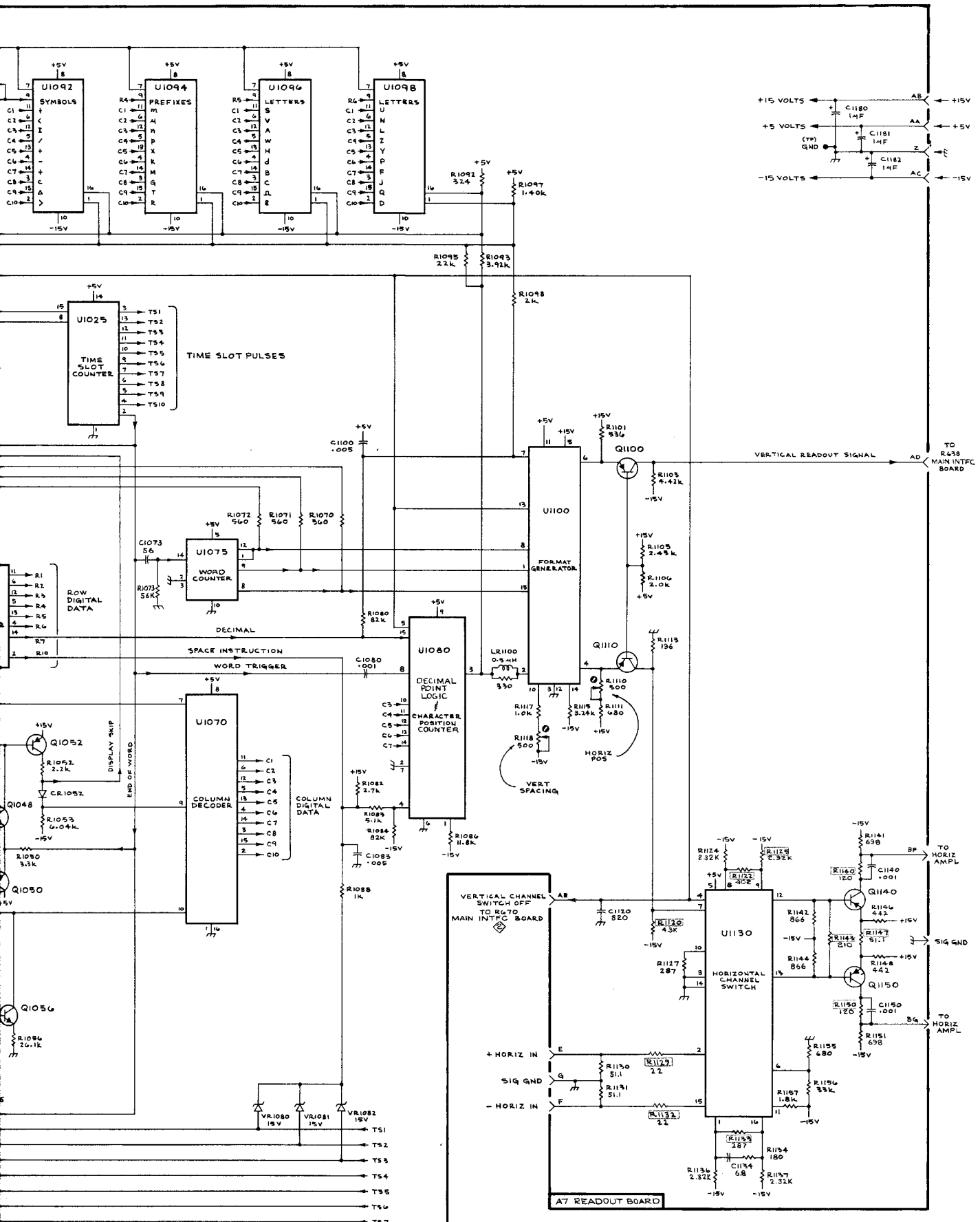
Added to Main Interface circuit board and connected through U1030 - U1040 sockets, SN B074125 & up.

CKT NO	GRID LOC	CKT NO	GRID LOC
CR1060	E2	CR1074	C2
CR1061	E2	CR1075	C2
CR1062	D3	CR1076	B4
CR1063	D3	CR1077	B4
CR1064	D2	CR1078	B3
CR1065	C2	CR1079	B3
CR1066	D4	CR1080	B2
CR1067	D4	CR1081	B2
CR1068	D2	CR1082	A2
CR1069	D2	CR1083	B2
CR1070	C3		
CR1071	C3	U1030	D3
CR1072	B2	U1040	B3
CR1073	B2		



EFF SN B074124 – BELOW


A9 READOUT PROTECTION BOARD
(EFF. SN B074125 - UP)
A2 MAIN INTERFACE BOARD
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.
U1000 TIMER
U1010 NUMERALS
U1090 SYMBOLS
U1092 PREFIXES
U1094
U1025 TIME SLOT COUNTER
U1030 ROW DATA SWITCH
U1035 ROW DECODER
U1040 COLUMN DATA SWITCH
U1060 ZEROS LOGIC & MEMORY
U1070 COLUMN DECODER
U1075 WORD COUNTER
Q1040
Q1050
Q1052
Q1056
Q1010
Q1015
Q1018
Q1048
CHARACTER SCAN
UNBLANK TO HORIZ AMPL
UNBLANK FROM MAIN INTERFACE
READOUT UNBLANK
READY
TRIGGER
TRAPEZOID
END OF WORD
TIME SLOT PULSES
TS1
TS2
TS3
TS4
TS5
TS6
TS7
TS8
TS9
TS10
ROW DIGITAL DATA
DECIMAL
SPACE INSTRUCTION
WORD TRIGGER
DISPLAY SKIP
END OF WORD
EXT WORD 1
EXT WORD 2
LEFT VERT
RIGHT VERT
HORIZ
CH1 J610-28B
CH2 J610-24B
CH1 J620-28B
CH2 J620-24B
CH1 J630-28B
CH2 J630-24B
CH1 J610-28A
CH2 J610-24A
CH1 J620-28A
CH2 J620-24A
CH1 J630-28A
CH2 J630-24A
TIME SLOT PULSES TO J610 J620 J630
READOUT INTENSITY
OPENS AT CCW END OF R1000
S1000
OFF



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READOUT SYSTEM 7 DEM

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

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

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

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

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

SPECIAL NOTES AND SYMBOLS

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

FIGURE AND INDEX NUMBERS

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

INDENTATION SYSTEM

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

1 2 3 4 5 Name & Description

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

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

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

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

ABBREVIATIONS

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

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

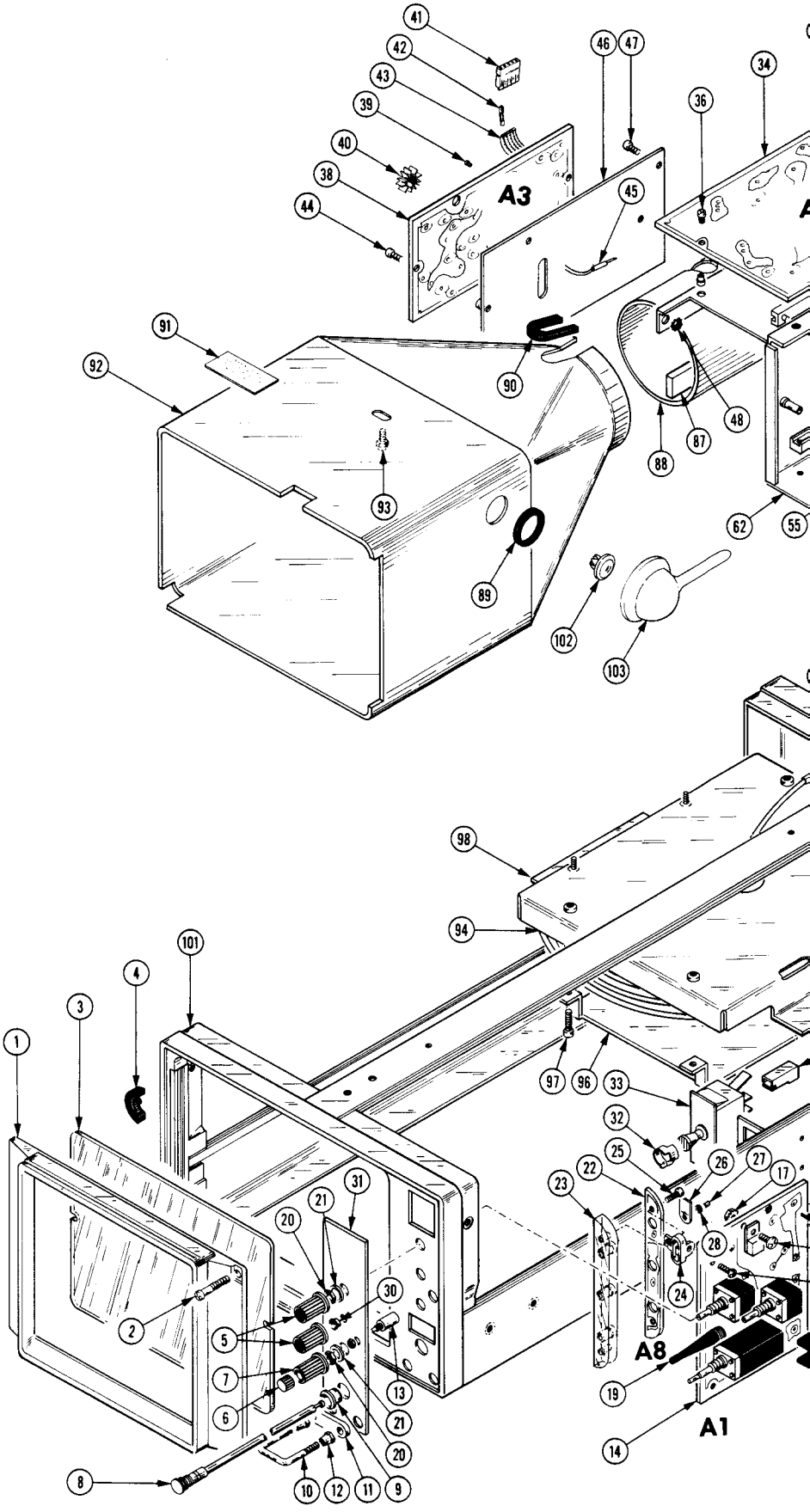
Mfr. Code	Manufacturer	Address	City, State, Zip
000AX	BUEHLER PROD.	HIGHWAY 70 EAST	KINGSTON, NC 28501
000CY	NORTHWEST FASTENER SALES, INC.	7923 SW CIRRUS DRIVE	BEAVERTON, OREGON 97005
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
05820	WAKEFIELD ENGINEERING, INC.	AUDUBON ROAD	WAKEFIELD, MA 01880
06666	GENERAL DEVICES CO., INC.	525 S. WEBSTER AVE.	INDIANAPOLIS, IN 46219
08261	SPECTRA-STRIP CORP.	7100 LAMPSON AVE.	GARDEN GROVE, CA 92642
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
23880	STANFORD APPLIED ENGINEERING, INC.	340 MARTIN AVE.	SANTA CLARA, CA 95050
24618	TRANSCON MFG. CO.	2655 PERTH ST.	DALLAS, TX 75220
24931	SPECIALTY CONNECTOR CO., INC.	3560 MADISON AVE.	INDIANAPOLIS, IN 46227
31514	STANFORD APPLIED ENGINEERING, INC. ADVANCED PACKAGING DIV.	3080 AIRWAY DRIVE	COSTA MESA, CA 92626
45722	USM CORP., PARKER-KALON FASTENER DIV.		CAMPBELLSVILLE, KY 42718
55210	GETTIG ENG. AND MFG. COMPANY	PO BOX 85, OFF ROUTE 45	SPRING MILLS, PA 16875
57771	STIMPSON, EDWIN B., CO., INC.	900 SYLVAN AVENUE	BAYPORT, NY 11705
70318	ALLMETAL SCREW PRODUCTS CO., INC.	821 STEWART AVE.	GARDEN CITY, NY 11530
70485	ATLANTIC INDIA RUBBER WORKS, INC.	571 W. POLK ST.	CHICAGO, IL 60607
71159	BRISTOL SOCKET SCREW, DIV. OF AMERICAN CHAIN AND CABLE CO., INC.	P O BOX 2244, 40 BRISTOL ST.	WATERBURY, CT 06720
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501
71785	TRW, CINCH CONNECTORS	1501 MORSE AVENUE	ELK GROVE VILLAGE, IL 60007
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
74921	ITEN FIBRE CO., THE	4001 BENEFIT AVE., P O BOX 9	ASHTABULA, OH 44004
75915	LITTELFUSE, INC.	800 E. NORTHWEST HWY	DES PLAINES, IL 60016
77250	PHEOLL MANUFACTURING CO., DIVISION OF ALLIED PRODUCTS CORP.	5700 W. ROOSEVELT RD.	CHICAGO, IL 60650
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
79807	WROUGHT WASHER MFG. CO.	2100 S. O BAY ST.	MILWAUKEE, WI 53207
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
81073	GRAYHILL, INC.	561 HILLGROVE AVE., PO BOX 373	LA GRANGE, IL 60525
82647	TEXAS INSTRUMENTS, INC., CONTROL PRODUCTS DIV.	34 FOREST ST.	ATTLEBORO, MA 02703
83058	CARR COMPANY, THE UNITED-CARR DIV. OF TRW, INC	31 AMES ST.	CAMBRIDGE, MA 02142
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
83903	ACCURATE DIE AND STAMPING DIV., ALLIED PRODUCTS CORP.	1947 N. MAUD AVE.	CHICAGO, IL 60614
86445	PENN FIBRE AND SPECIALTY CO., INC.	2032 E. WESTMORELAND ST.	PHILADELPHIA, PA 19134
86928	SEASTROM MFG. COMPANY, INC.	701 SONORA AVENUE	GLENDALE, CA 91201
93907	CAMCAR SCREW AND MFG. CO.	600 18TH AVE.	ROCKFORD, IL 61101
95987	WECKESSER CO., INC.	4444 WEST IRVING PARK RD.	CHICAGO, IL 60641
98278	MALCO A MICRODOT COMPANY, 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:6.814 X 5.125,NYLON	80009	200-1218-00
						(ATTACHING PARTS)		
-2	211-0188-00			2		SCREW,MACHINE:4-40 X 0.30 INCH,SST	83385	OBD
						- - - * - - -		
-3	337-1440-00	B010100	B074084	1		SHLD,IMPLOSION:	80009	337-1440-00
	337-1440-02	B074085		1		SHLD, IMPLOSION:AMBER	80009	337-1440-02
-4	386-2544-00			4		SUPPORT,CRT:FRONT	80009	386-2544-00
-5	366-0494-00			2		KNOBGRAY,W/SETSCREW	80009	366-0494-00
	213-0153-00			1		. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-6	366-1391-00			1		KNOB:GRAY	80009	366-1391-00
	213-0239-00			1		. SETSCREW:3-48 X 0.062 INCH,HEX SOC STL	71159	OBD
-7	366-1077-00			1		KNOB:GRAY	80009	366-1077-00
	213-0153-00			1		. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-8	384-1161-00			1		KNOB:8.767 L X 0.125 OD	80009	384-1161-00
-9	358-0216-00			1		BUSHING,PLASTIC:0.257 ID X 0.412 INCH OD	80009	358-0216-00
-10	119-0238-00	B010100	B021826	1		COIL,CAL:	80009	119-0238-00
	119-0373-00	B021827		1		COIL,CAL:	80009	119-0373-00
						(ATTACHING PARTS)		
	210-0442-00			2		NUT,PLAIN,HEX.:3-48 X 0.187 INCH,CD PL BRS	73743	3014-402
	210-0004-00			2		WASHER,LOCK:#4 INTL,0.015THK,STL CD PL	78189	1204-00-00-0541C
	210-0994-00			2		WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5714-147-20N
	210-0935-00			2		WASHER,NONMETAL:FIBER,0.14 IDX 0.375"OD	74921	OBD
-11	361-0059-01			1		SPACER,CUR LOOP:1.094 X 0.344 X 0.125 INCH	80009	361-0059-01
-12	210-0593-00			2		NUT,FINISHING:0.25 HEX X 0.312" LONG,BRS	80009	210-0593-00
						- - - * - - -		
-13	260-1238-00			1		SWITCH,PUSH:0.5A AT 115VAC	81073	39YY2084
	343-0081-00	XB021800		1		STRAP,RETAINING:	95987	3/16-H
						(ATTACHING PARTS)		
	211-0507-00	XB021800		1		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
	210-0457-00	XB021800		1		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-14	----- -----			1		CKT BOARD ASSY:FRONT PANEL CONTROL(SEE A1 EPL)		
-15	131-0608-00	B010100	B010199	9		. TERMINAL,PIN:0.365 L X 0.25 PH,BRZ,GOLD PL	22526	47357
	131-0608-00	B010200		1		. TERMINAL,PIN:0.365 L X 0.25 PH,BRZ,GOLD PL	22526	47357
-16	200-1327-00			1		. SHIELD,RESISTOR:	80009	200-1327-00
-17	210-0457-00			1		. NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
-18	211-0504-00			1		. SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
-19	384-1121-00			1		. EXTENSION SHAFT:1.41 INCH LONG	80009	384-1121-00
	175-0831-00	XB010200		FT		. WIRE,ELECTRICAL:8 WIRE RIBBON	08261	OBD
	131-0707-00	XB010200		8		. CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
	352-0166-04	XB010200		1		. CONN BODY,PL,EL:8 WIRE YELLOW	80009	352-0166-04
						(ATTACHING PARTS FOR CKT BD)		
-20	210-0583-00			2		NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20224-402
-21	210-0940-00			2		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
						- - - * - - -		
-22	----- -----			1		CKT BOARD ASSY:GRAT LAMP(SEE A8 EPL)		
-23	378-0732-00			1		. REFLECTOR,LIGHT:SCALE ILLUMINATION	80009	378-0732-00
-24	426-1017-00			2		. MOUNT,REFLECTOR:SCALE ILLUMINATION	80009	426-1017-00
-25	211-0062-00			2		. SCREW,MACHINE:2-56 X 0.312 INCH,RDH STL	83385	OBD
-26	131-0704-00			3		. CONTACT,ELEC:SCALE LIGHTS,CU BE	80009	131-0704-00
						(ATTACHING PARTS)		
-27	210-0759-00			3		. EYELET,METALLIC:0.61 OD X 0.192 INCH L,BRS	71590	30818-11
-28	210-0957-00			3		. WASHER,FLAT:0.0625 ID X 0.125" OD,STL	83903	OBD
						- - - * - - -		
						(ATTACHING PARTS FOR CKT BD)		
-29	213-0088-00			2		SCR,TPG,THD CTG:4-24 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-30	358-0378-00			1		BUSHING,SLEEVE:PRESS MOUNT	80009	358-0378-00
-31	333-1722-00	B010100	B059999	1		PANEL,FRONT:	80009	333-1722-00
	----- -----			-		* STANDARD ONLY		
	333-1722-01	B060000		1		PANEL,FRONT:	80009	333-1722-01
	----- -----			-		* STANDARD ONLY		
	333-1623-00			1		PANEL,FRONT:	80009	333-1623-00
	----- -----			-		* OPTION 2 ONLY		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-32	376-0127-00			1		COUPLER,SHAFT:PLASTIC	80009	376-0127-00
-33	----- -----			1		SWITCH,PUSH-PP:(SEE S302 EPL)		
	407-0895-00	B010100	B063567	1		BRACKET,ELEC SW:ALUMINUM	80009	407-0895-00
	407-0895-01	B063568		1		BRACKET,ELEC SW:ALUMINUM	80009	407-0895-01
-34	----- -----			1		CKT BOARD ASSY:HORIZONTAL(SEE A4 EPL)		
-35	131-0608-00			17		. TERMINAL,PIN:0.365 L X 0.25 PH,BRZ,GOLD PL	22526	47357
						(ATTACHING PARTS FOR CKT BD)		
-36	211-0008-00			2		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-37	351-0087-00			2		GUIDE,CKT CARD:4.75 INCH LONG,PLASTIC	80009	351-0087-00
-38	----- -----			1		CKT BOARD ASSY:VERTICAL(SEE A3 EPL)		
-39	136-0252-04	B010100	B029999	14		. SOCKET,PIN TERM:0.188 INCH LONG	22526	75060
	136-0252-04	B030000		12		. SOCKET,PIN TERM:0.188 INCH LONG	22526	75060
-40	214-1291-00			2		. HEAT SINK,ELEC:XSTR,0.72 OD X 0.375"H	05820	207-AB
-41	352-0163-00			1		. CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0163-00
-42	131-0707-00			5		. CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-43	175-0828-00			FT		. WIRE,ELECTRICAL:5 WIRE RIBBON	08261	OBD
	136-0260-03	B010100	B074350	13		. SOCKET,PLUG-IN ELEK:MICROCIRCUIT,16 DIP	80009	136-0260-03
	136-0260-02	B074351		13		. SOCKET,PLUG-IN:16 CONTACT,LOW CLEARANCE	82647	C9316-18
						(ATTACHING PARTS FOR CKT BD)		
-44	211-0008-00			2		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-45	195-0119-00			1		LEAD SET,ELEC:CRT DEFLECTION	80009	195-0119-00
-46	441-1090-00			1		CHASSIS,SCOPE:VERTICAL	80009	441-1090-00
						(ATTACHING PARTS)		
-47	211-0008-00			2		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-48	210-0586-00			3		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	211-041800-00
						- - - * - - -		
-49	348-0239-00			2		GROMMET,PLASTIC:U SHAPED	80009	348-0239-00
-50	337-1714-00			1		SHIELD,ELEC:HIGH VOLTAGE	80009	337-1714-00
						(ATTACHING PARTS)		
-51	211-0008-00			2		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-52	----- -----			1		CKT BOARD ASSY:HV(SEE A5 EPL)		
-53	131-0566-00			1		. LINK,TERM.CONNE:0.086 DIA X 2.375 INCH L	55210	L-2007-1
-54	131-0608-00			34		. TERMINAL,PIN:0.365 L X 0.25 PH,BRZ,GOLD PL	22526	47357
	131-0589-00			2		. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
-55	211-0008-00			3		. SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-56	214-0579-00			1		. TERM.,TEST PT:BRS CD PL	80009	214-0579-00
-57	344-0154-00			2		. CLIP,ELECTRICAL:FOR 0.25 INCH DIA FUSE	80009	344-0154-00
						(ATTACHING PARTS FOR CKT BD)		
-58	211-0008-00			2		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-59	----- -----			1		TRANSISTOR:(SEE Q410 EPL)		
						(ATTACHING PARTS)		
-60	344-0236-00			1		CLIP,SPR TNSN:	80009	344-0236-00
-61	342-0082-00			1		INSULATOR,PLATE:0.52 SQ X 0.015 INCH THK,AL	80009	342-0082-00
						- - - * - - -		
-62	441-1102-00			1		CHASSIS,SCOPE:HIGH VOLTAGE & HORIZONTAL	80009	441-1102-00
						(ATTACHING PARTS)		
-63	211-0008-00			4		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
	343-0149-00	B010100	B095114	2		CLAMP,LOOP:NYLON	80009	343-0149-00
	006-0531-00	B095115		1		STRAP,TIE DN,EL:5 INCH LONG	24618	700-3688
-64	161-0033-12			1		CABLE ASSY,PWR:3,18 AWG,125V,92.0 L	80009	161-0033-12
-65	200-1075-00			1		COVER,ELEC CONN:PLASTIC	00779	1-480435-0
-66	358-0366-00	B010100	B020141	1		BSHG,STRAIN RLF:	80009	358-0366-00
	358-0516-00	B020142		1		BSHG,STRAIN RLF:BOTTOM	80009	358-0516-00
-67	358-0365-00	B010100	B020141	1		BSHG,STRAIN RLF:	80009	358-0365-00
	358-0515-00	B020142		1		BSHG,STRAIN RLF:TOP	80009	358-0515-00
-68	200-1004-00	B010100	B020141	1		CABLE,NIP.,ELEC:0.265 ID X 0.38"OD W/FLG	80009	200-1004-00
	200-1646-00	B020142		1		CABLE NIP,PWR:1.500 X 0.625 ID W/FLANGE	80009	200-1646-00
	214-2038-00	XB020142		1		IND,LINE V:	80009	214-2038-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-69	333-1645-00	B010100	B029999	1		PANEL,REAR:	80009	333-1645-00
	333-1645-01	B060000	B095644	1		PANEL,REAR:	80009	333-1645-01
	333-1645-02	B095645		1		PANEL,REAR:	80009	333-1645-02
						(ATTACHING PARTS)		
-70	210-0401-00			2		NUT,PLAIN,HEX.:6-32 X 0.312 INCH,CD PLATED	73743	3262-402
						- - - * - - -		
	200-1388-01			1		COVER,FUSE:	80009	200-1388-01
-71	352-0362-00	B010100	B010564	1		FUSEHOLDER: W/MOUNTING HARDWARE	75915	345001
	352-0076-00	B010565	B074316	1		FUSEHOLDER:W/HARDWARE	75915	342012-L
	352-0362-00	B074317		1		FUSEHOLDER: W/MOUNTING HARDWARE	75915	345001
						(ATTACHING PARTS)		
-72	210-0873-00			1		WASHER,NONMETAL:0.5 ID X 0.688 INCH OD,NPRN	70485	OBD
						- - - * - - -		
-73	----- -----			1		CONNECTOR,RCPT,:(SEE J300 EPL)	24931	28JR200-1
-74	210-0201-00	B010100	B074275	1		TERMINAL,LUG:SE #4	86928	A373-157-2
	210-0202-00	B074276		1		TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED	78189	2104-06-00-2520N
						(ATTACHING PARTS)		
-75	210-0586-00	B010100	B074275	1		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	211-041800-00
	210-0457-00	B074276		1		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-76	----- -----			1		SW,THERMOSTATIC:(SEE S300 EPL)		
						(ATTACHING PARTS)		
-77	210-0586-00			2		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	211-041800-00
						- - - * - - -		
-78	200-0616-01			1		COV,ELECTRON TU:	80009	200-0616-01
-79	136-0301-01			1		SKT,PL-IN ELEK:ELCTN TUBE,14CONTACT	80009	136-0301-01
-80	343-0397-00			1		HOLD-DOWN,CLAMP:CRT	80009	343-0397-00
						(ATTACHING PARTS)		
-81	361-0496-00			1		SPACER,BLOCK:0.6 X 3.45 X 0.52,BLK	80009	361-0496-00
-82	211-0516-00			2		SCREW,MACHINE:6-32 X 0.875 INCH,PNH STL	83385	OBD
						- - - * - - -		
-83	354-0409-00			1		R,CLP,CRT SHLD:U/O 2.375 OD SHIELD	80009	354-0409-00
						(ATTACHING PARTS)		
-84	211-0632-00			1		SCREW,MACHINE:6-32X2.250 INCH,FILH,STL	83385	OBD
-85	343-0123-01			2		CLAMP,RET.,ELEC:CRT,REAR	80009	343-0123-01
-86	220-0444-00			1		NUT,PLAIN,SQ:6-32 X 0.250 INCH,STL	70318	OBD
						- - - * - - -		
-87	348-0070-01			3		PAD,CUSHIONING:0.69 INCH,RUBBER	80009	348-0070-01
-88	337-1712-02			1		SHIELD,CRT:	80009	337-1712-02
-89	348-0006-00			1		GROMMET,RUBBER:0.562 ID X 0.875 INCH OD	70485	1720
-90	348-0145-00			1		GROMMET,PLASTIC:U-SHP,1.0 X 0.42 INCH	80009	348-0145-00
-91	334-1379-00			1		LABEL:CRT,ADHESIVE BACK	80009	334-1379-00
-92	337-1712-00			1		SHIELD,CRT:	80009	337-1712-00
						(ATTACHING PARTS)		
-93	211-0587-00			1		SCREW,MACHINE:6-32 X 0.188 INCH,HSB	80009	211-0587-00
						- - - * - - -		
-94	----- -----			1		DELAY LINE,ELEC:(SEE DL100 EPL)		
-95	131-1090-00	B010100	B029999X	2		. CONTACT,ELEC:DL TERMN,BRS CU-SN-ZN PL	80009	131-1090-00
-96	407-1185-00	B010100	B029999X	1		. BRKT,DELAY LINE:LOWER	80009	407-1185-00
						(ATTACHING PARTS)		
-97	211-0007-00	B010100	B029999X	4		. SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
-98	380-0304-00	B010100	B029999	1		. HSG,DELAY LINE:	80009	380-0304-00
	380-0304-01	B030000		1		. HSG,DELAY LINE:ALUMINUM	80009	380-0304-01
						(ATTACHING PARTS FOR DELAY LINE)		
-99	210-0457-00			4		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
-100	343-0081-00			1		STRAP,RETAINING:	95987	3/16-H
						- - - * - - -		
-101	426-0950-00	B010100	B074275	1		FR ASSY,DSPL UN:	80009	426-0950-00
	426-0950-01	B074276		1		FR ASSY,DSPL UN:	80009	426-0950-01
-102	131-0026-00			1		BUTTON,PLUG:0.578 OD X 0.125 THK	83058	118738
-103	200-0544-00			1		SHLD,ELEC CONN:ANODE,SIL RUBBER	80009	200-0544-00
-104	179-1969-00			1		WIRING HARNESS:MAIN	80009	179-1969-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-105	131-0621-00			19		. CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	46231
-106	131-0861-00			3		. TERM,QIK DISC:16-20 AWG,0.22 W X 0.02 THK	00779	42617-2
-107	200-1075-00			3		. COVER,ELEC CONN:PLASTIC	00779	1-480435-0
-108	352-0199-03			1		. CONN BODY,PL,EL:3 WIRE ORANGE	80009	352-0199-03
	198-2134-00			1		WIRE SET,ELEC:	80009	198-2134-00
-109	175-0825-00			FT		. WIRE,ELECTRICAL:2 WIRE RIBBON	80009	175-0825-00
-110	175-0826-00			FT		. WIRE,ELECTRICAL:3 WIRE RIBBON	80009	175-0826-00
-111	175-0831-00			FT		. WIRE,ELECTRICAL:8 WIRE RIBBON	08261	OBD
-112	175-0832-00			FT		. WIRE,ELECTRICAL:9 WIRE RIBBON	08261	SS-0926(1061)0C
-113	131-0707-00	B010100	B010199	37		. CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
	131-0707-00	B010200		24		. CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-114	131-0371-00			2		. CONTACT,ELEC:FOR NO.26 AWG WIRE	98278	122-0182-019
-115	352-0161-00			1		. HLDR,TERM CONN:3 WIRE BLACK	80009	352-0161-00
-116	352-0166-04	B010100	B010199X	2		. CONN BODY,PL,EL:8 WIRE YELLOW	80009	352-0166-04
-117	352-0167-00			2		. HLDR,TERM CONN:9 WIRE BLACK	80009	352-0167-00
	175-0855-00			FT		. WIRE,ELECTRICAL:10 WIRE RIBBON	08261	SS-1022(1061)0C
	175-0860-00			FT		. WIRE,ELECTRICAL:5 WIRE RIBBON	08261	SS-0522-1910610C
	175-0863-00			FT		. WIRE,ELECTRICAL:2 WIRE RIBBON	08261	SS-0222-1910610C
	352-0163-05			1		. CONN BODY,PL,EL:5 WIRE GREEN	80009	352-0163-05
	352-0168-02			1		. CONN BODY,PL,EL:10 WIRE RED	80009	352-0168-02
	352-0169-03			1		. CONN BODY,PL,EL:2 WIRE ORANGE	80009	352-0169-03
	352-0199-03			1		. CONN BODY,PL,EL:3 WIRE ORANGE	80009	352-0199-03
	352-0201-05			1		. CONN BODY,PL,EL:5 WIRE GREEN	80009	352-0201-05
	352-0206-02			1		. CONN BODY,PL,EL:10 WIRE RED	80009	352-0206-02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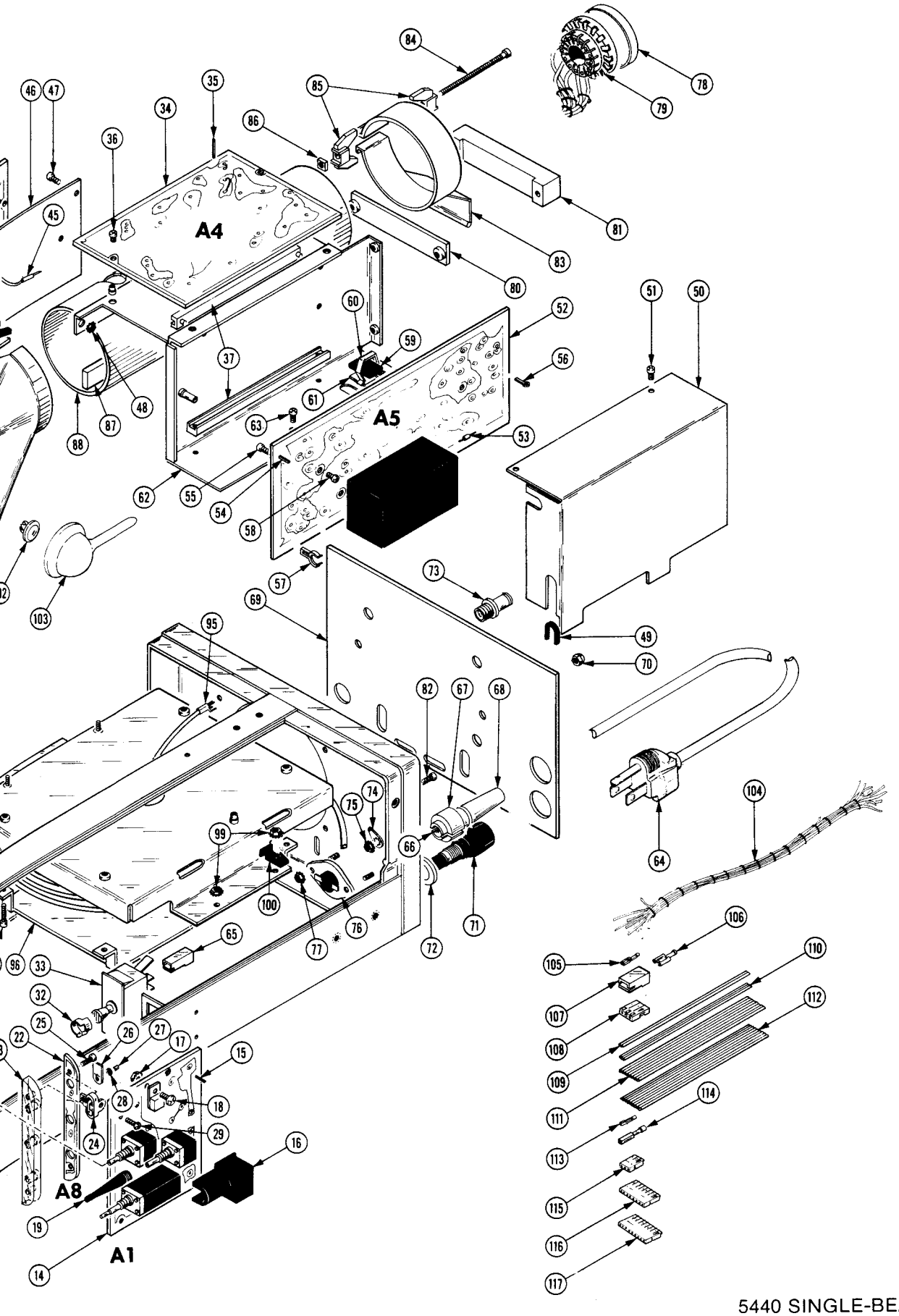
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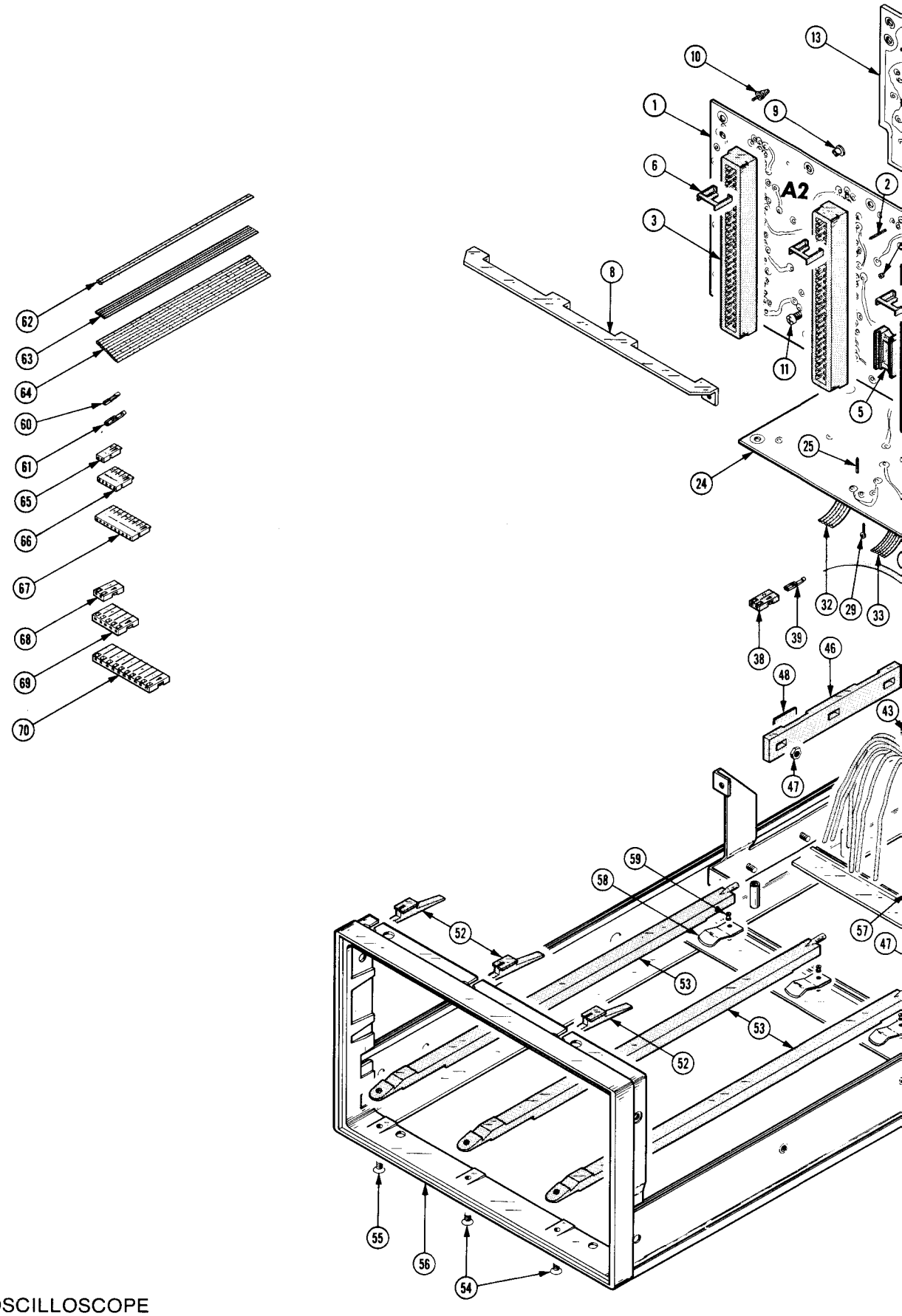
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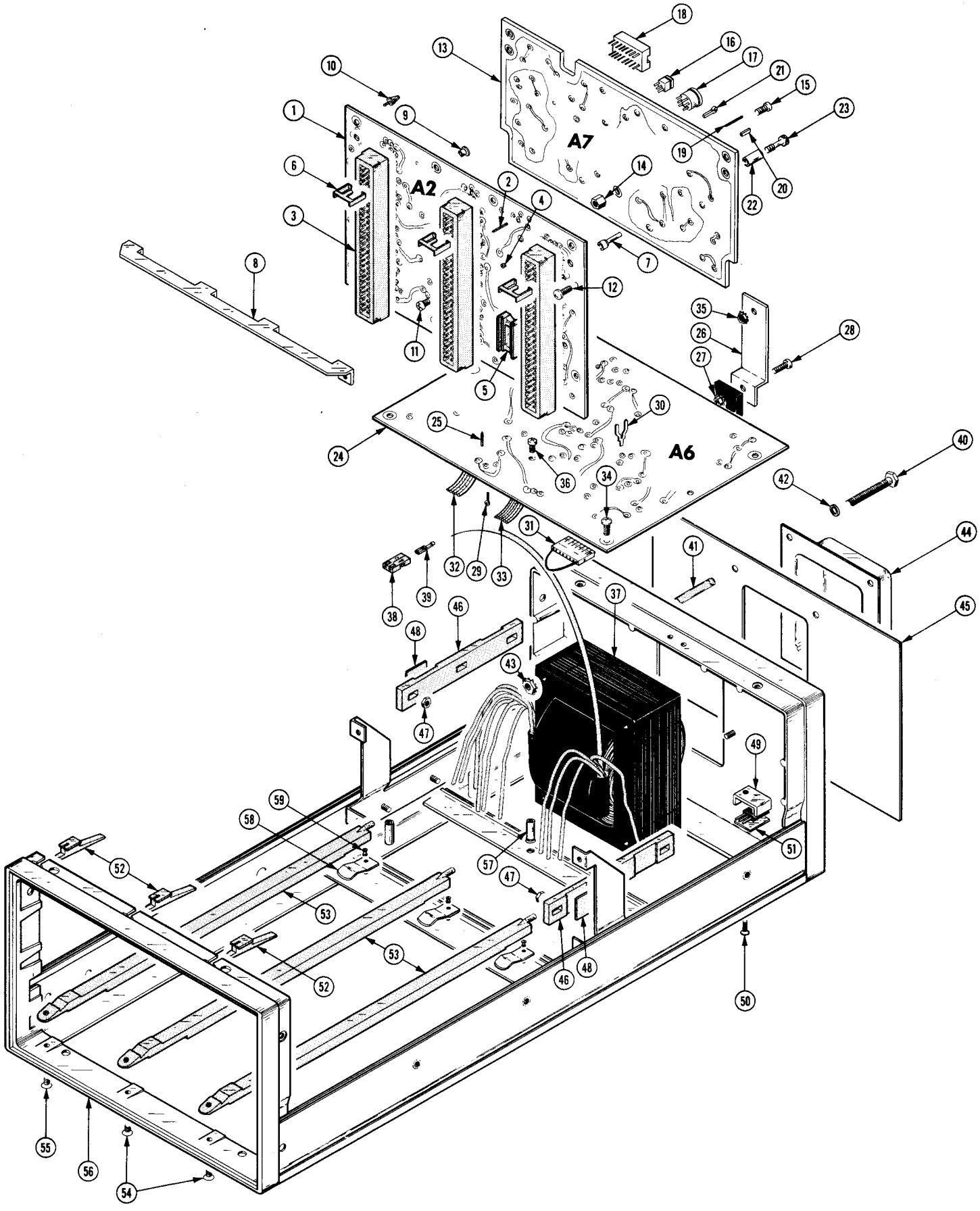
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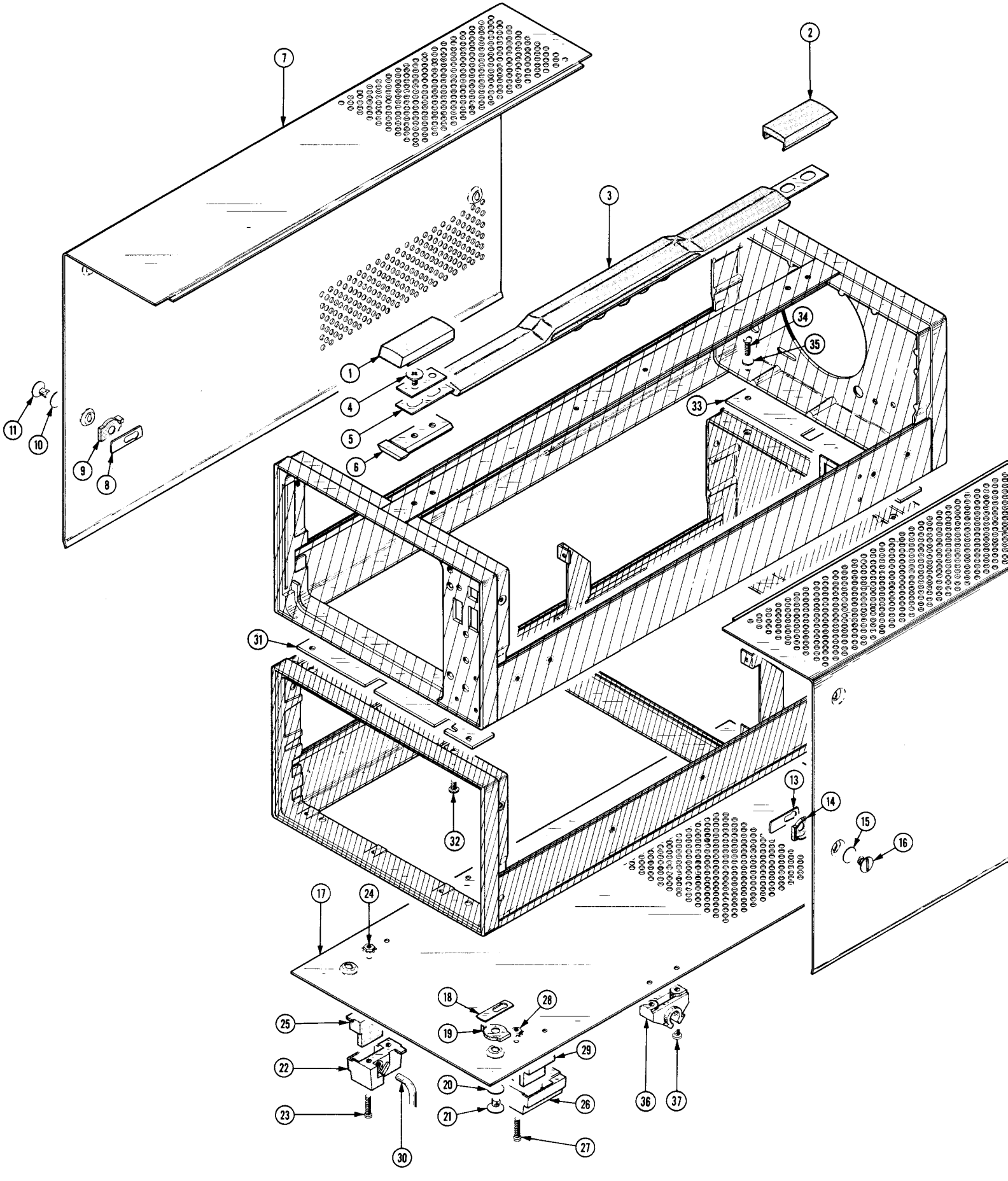
Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-	672-0642-00	XB074125		1		CKT BOARD ASSY:	80009	672-0642-00
	----- -----	XB074125		1		. CKT BOARD ASSY:(SEE A9 EPL)		
	136-0682-00	XB074125		2		. . SKT,PL-IN ELEK:MICROCIRCUIT,16 CONTACTS	23880	CWH4000-16-2L
-1	----- -----			1		. CKT BOARD ASSY:INTERFACE(SEE A2 EPL)		
-2	131-0590-00			29		. . CONTACT,ELEC:0.71 INCH LONG	22526	47351
-3	----- -----			3		. . CONNECTOR,RCPT,:(SEE J610,J620 & J630 EPL)		
-4	136-0252-04			2		. . SOCKET,PIN TERM:0.188 INCH LONG	22526	75060
-5	136-0260-03	B010100	B074350	3		. . SOCKET,PLUG-IN ELEK:MICROCIRCUIT,16 DIP	80009	136-0260-03
	136-0260-02	B074351		3		. . SOCKET,PLUG-IN:16 CONTACT,LOW CLEARANCE	82647	C9316-18
	136-0269-00			2		. . SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	71785	133-59-02-073
-6	214-1593-02	B010100	B069999	3		. . KEY,CONN PLZN:CKT BD CONN	80009	214-1593-02
	214-2627-00	B070000	B094553	3		. . KEY,CONN PLZN:CIRCUIT CARD CONNECTOR	31514	Q07900
	214-1593-02	B094554		3		. . KEY,CONN PLZN:CKT BD CONN	80009	214-1593-02
-7	351-0188-00			2		. . GUIDE-POST,LOCK:0.65 INCH LONG	80009	351-0188-00
-8	386-1938-00			1		. . REINF,CKT BD:INTERFACE	80009	386-1938-00
						(ATTACHING PARTS)		
-9	210-0777-00			4		. . RIVET,BLIND:0.125 DIA GRIP,AL	45722	AD42AB5
						- - - * - - -		
-10	386-1557-00			3		. . SPACER,CKT BD:0.29 H,ACETAL	80009	386-1557-00
						(ATTACHING PARTS FOR CKT BD)		
-11	211-0008-00			1		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-12	213-0146-00			4		SCR,TPG,THD FOR:6-20 X 0.313 INCH,PNH STL	83385	OBD
						- - - * - - -		
-13	----- -----			1		CKT BOARD ASSY:READOUT(SEE A7 EPL)		
-14	129-0285-00			1		. POST,ELEC-MECH:0.281 L X 0.188 HEX BRS	80009	129-0285-00
						(ATTACHING PARTS)		
-15	211-0007-00			1		. SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
-16	136-0220-00			1		. SOCKET,PLUG-IN:3 PIN,SQUARE	71785	133-23-11-034
-17	136-0235-00			1		. SOCKET,PLUG-IN:6 CONTACT,ROUND	71785	133-96-12-062
-18	136-0260-02			13		. SOCKET,PLUG-IN:16 CONTACT,LOW CLEARANCE	82647	C9316-18
	136-0269-00			1		. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	71785	133-59-02-073
-19	131-0589-00			9		. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
-20	136-0263-03			25		. SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	00779	86250-2
-21	214-0579-00			2		. TERM.,TEST PT:BRS CD PL	80009	214-0579-00
-22	361-0238-00			2		. SPACER,SLEEVE:0.25 OD X 0.34 INCH LONG	80009	361-0238-00
						(ATTACHING PARTS FOR CKT BD)		
-23	211-0155-00			2		SCREW,EXT,RLV B:4-40 X 0.375 INCH,SST	80009	211-0155-00
						- - - * - - -		
-24	----- -----			1		CKT BOARD ASSY:POWER SUPPLY(SEE A6 EPL)		
-25	131-0608-00			23		. TERMINAL,PIN:0.365 L X 0.25 PH,BRZ,GOLD PL	22526	47357
	131-0589-00			16		. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
-26	214-1804-00			1		. HEAT SINK,ELEC:RECTIFIER	80009	214-1804-00
						(ATTACHING PARTS)		
-27	210-0457-00			1		. NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
-28	211-0578-00			1		. SCREW,MACHINE:6-32 X 0.438 INCH,PNH STL	83385	OBD
-29	214-0579-00			7		. TERM.,TEST PT:BRS CD PL	80009	214-0579-00
-30	344-0154-00			4		. CLIP,ELECTRICAL:FOR 0.25 INCH DIA FUSE	80009	344-0154-00
	159-0040-00			1		. FUSE,CARTRIDGE:3AG,0.7A,SLOW-BLOW	71400	MDL 7/10
-31	131-1895-00			1		. LINK,TERM. CONN:8,22 AWG,1.5 L	80009	131-1895-00
	352-0166-02			1		. . CONN BODY,PL,EL:8 WIRE RED	80009	352-0166-02
	131-0707-00			2		. . CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
	131-1896-00			1		. LINK,TERM. CONN:8,22 AWG,1.5 L	80009	131-1896-00
	352-0166-01			1		. . CONN BODY,PL,EL:8 WIRE BROWN	80009	352-0166-01
	131-0707-00			2		. . CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-32	175-0860-00			FT		. WIRE,ELECTRICAL:5 WIRE RIBBON	08261	SS-0522-1910610C
-33	175-0859-00			FT		. WIRE,ELECTRICAL:6 WIRE RIBBON	08261	SS-0622-1910610C
						(ATTACHING PARTS FOR CKT BD)		
-34	211-0504-00			6		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
-35	210-0457-00			1		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
-36	211-0008-00			1		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-37	----- -----			1		TRANSFORMER:(SEE T800 EPL)		
-38	352-0198-00			1		. HLDR,TERM CONN:2 WIRE BLACK	80009	352-0198-00
-39	131-0622-00			2		. CONTACT,ELEC:0.577"L,28-32 AWG WIRE	22526	46241
						(ATTACHING PARTS FOR XFMR)		
-40	212-0515-00			4		SCREW,MACHINE:10-32 X 2.250" HEX.HD STL	83385	OBD
-41	166-0227-00			4		INS SLV,ELEC:0.187 ID X 1.50 INCH LONG	80009	166-0227-00
-42	210-0812-00			4		WASHER,NONMETAL:#10,FIBER	86445	OBD
-43	220-0410-00			4		NUT,EXTENDED WA:10-32 X 0.375 INCH,STL	83385	OBD
						- - - * - - -		
	380-0490-00	XB080000	B095136	1		HOUSING,FAN:	80009	380-0490-00
	380-0545-00	B095137		1		HOUSING,FAN:ALUMINUM	80009	380-0545-00
						(ATTACHING PARTS)		
	211-0144-00	XB080000	B095136	4		SCREW,MACHINE:4-40 X 1.312 INCH,PNH STL	83385	OBD
	211-0027-00	B095137		4		SCREW,MACHINE:4-40 X 1.50 INCH,PNH STL	83385	OBD
	210-0994-00	XB080000	B095136X	4		WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5714-147-20N
						- - - * - - -		
	378-2027-01	XB080000	B095136X	1		GRILL,FAN:	80009	378-2027-01
						(ATTACHING PARTS)		
	211-0018-00	XB080000	B095136X	2		SCREW,MACHINE:4-40 X 0.875 PNH,STL	83385	OBD
						- - - * - - -		
	407-1889-00	XB080000		1		BRACKET,FAN:ALUMINUM	80009	407-1889-00
	----- -----	XB080000		1		FAN,TUBEAXIAL:(SEE B800 EPL)		
-44	200-0772-02			1		COVER,ELEC XFMR:3.125 X 3.75 X 0.875	80009	200-0772-02
-45	333-1682-00	B010100	B059999	1		PANEL,REAR:	80009	333-1682-00
	333-1682-05	B060000	B079999	1		PANEL,REAR:	80009	333-1682-05
	333-1833-02	B080000	B096709	1		PANEL,REAR:	80009	333-1833-02
	333-1833-04	B096710		1		PANEL,REAR:	80009	333-1833-04
-46	343-0315-00			2		CLAMP,XSTR:	80009	343-0315-00
						(ATTACHING PARTS FOR EACH)		
-47	210-0407-00			3		NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
-48	342-0082-00			1		INSULATOR,PLATE:0.52 SQ X 0.015 INCH THK,AL	80009	342-0082-00
						- - - * - - -		
-49	343-0403-00			3		CLAMP,RIM,CLENC:TRANSISTOR	80009	343-0403-00
						(ATTACHING PARTS FOR EACH)		
-50	211-0025-00			1		SCREW,MACHINE:4-40 X 0.375 100 DEG,FLH STL	83385	OBD
-51	342-0082-00			1		INSULATOR,PLATE:0.52 SQ X 0.015 INCH THK,AL	80009	342-0082-00
						- - - * - - -		
-52	352-0293-00			3		HLDR-LENS ASSY:	80009	352-0293-00
-53	351-0286-01	B010100	B010443	3		GUIDE,PL-IN UNI:	80009	351-0286-01
	351-0286-02	B010444	B041135	3		GUIDE,PL-IN UNI:	80009	351-0286-02
	351-0286-04	B041136		3		GUIDE,SLIDE:BLACK	80009	351-0286-04
						(ATTACHING PARTS)		
-54	211-0038-00			2		SCREW,MACHINE:4-40 X 0.312"100 DEG,FLH STL	83385	OBD
-55	211-0101-00			1		SCREW,MACHINE:4-40 X 0.25" 100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-56	426-0934-00	B010100	B079999	1		FRAME ASSY,CAB:	80009	426-0934-00
	426-0934-01	B080000		1		FRAME ASSY,CAB.:	80009	426-0934-01
-57	129-0266-00			1		. POST,ELEC-MECH:0.515 L X 0.219 OD,0.219 BRS	80009	129-0266-00
-58	131-1254-01			3		. CONTACT,ELEC:GROUNDING	80009	131-1254-01
						(ATTACHING PARTS FOR EACH)		
-59	210-0617-00			1		. EYELET,METALLIC:0.089 OD X 0.125" L,BRASS	57771	G53-4
						- - - * - - -		
-60	131-0707-00			17		CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-61	131-0621-00			17		CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	46231
-62	175-0863-00			FT		WIRE,ELECTRICAL:2 WIRE RIBBON	08261	SS-0222-1910610C
-63	175-0860-00			FT		WIRE,ELECTRICAL:5 WIRE RIBBON	08261	SS-0522-1910610C
-64	175-0855-00			FT		WIRE,ELECTRICAL:10 WIRE RIBBON	08261	SS-1022(1061)0C
-65	352-0169-03			1		CONN BODY,PL,EL:2 WIRE ORANGE	80009	352-0169-03
-66	352-0163-05			1		CONN BODY,PL,EL:5 WIRE GREEN	80009	352-0163-05
-67	352-0168-02			1		CONN BODY,PL,EL:10 WIRE RED	80009	352-0168-02
-68	352-0198-03			1		HLDR,TERM CONN:2 WIRE ORANGE	80009	352-0198-03
-69	352-0201-05			1		CONN BODY,PL,EL:5 WIRE GREEN	80009	352-0201-05
-70	352-0206-02			1		CONN BODY,PL,EL:10 WIRE RED	80009	352-0206-02

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
3-1	200-0728-04	B010100	B059999	1		COVER,HDL END:	80009	200-0728-04
	200-0728-06	B060000	B094799	1		COVER,HDL END:	80009	200-0728-06
-2	200-0728-00	B094800		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	93907	OBD
						- - - * - - -		
-5	386-1624-00			2		PLATE,HDL RTNG:STAINLESS STEEL	80009	386-1624-00
-6	386-1283-00			2		PLATE,HDL MTG:FRONT	80009	386-1283-00
-7	390-0193-00	B010100	B073971	1		COVER,SCOPE:LEFT SIDE	80009	390-0193-00
	390-0469-00	B073972	B079999	1		CAB.SIDE,DSPL:SIDE	80009	390-0469-00
	390-0469-01	B080000		1		CAB.SIDE,DSPL:	80009	390-0469-01
	214-0812-00			4		. FASTENER,PAWL:	80009	214-0812-00
	----- -----			-		. . EACH FASTENER INCLUDES:		
-8	386-0226-00			1		. . CLAMP,RIM CLENC:SPG STL CD PL	80009	386-0226-00
-9	386-0227-00			1		. . STOP,CLP,RIM CL:ACETAL	80009	386-0227-00
-10	214-0604-00			1		. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-11	214-0603-01			1		. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-12	390-0192-00	B010100	B073971	1		COVER,SCOPE:RIGHT SIDE	80009	390-0192-00
	390-0469-00	B073972	B079999	1		CAB.SIDE,DSPL:SIDE	80009	390-0469-00
	390-0469-01	B080000		1		CAB.SIDE,DSPL:	80009	390-0469-01
	214-0812-00			2		. FASTENER,PAWL:	80009	214-0812-00
						(EACH FASTENER INCLUDES)		
-13	386-0226-00			1		. . CLAMP,RIM CLENC:SPG STL CD PL	80009	386-0226-00
-14	386-0227-00			1		. . STOP,CLP,RIM CL:ACETAL	80009	386-0227-00
-15	214-0604-00			1		. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-16	214-0603-01			1		. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-17	390-0190-00	B010100	B073971	1		COVER,SCOPE:BOTTOM	80009	390-0190-00
	390-0470-00	B073972	B079999	1		CAB.BOT,DSPL:BOTTOM	80009	390-0470-00
	390-0470-01	B080000		1		CAB.BOT,DISPLAY:	80009	390-0470-01
	214-0812-00			4		. FASTENER,PAWL:	80009	214-0812-00
						(EACH FASTENER INCLUDES)		
-18	386-0226-00			1		. . CLAMP,RIM CLENC:SPG STL CD PL	80009	386-0226-00
-19	386-0227-00			1		. . STOP,CLP,RIM CL:ACETAL	80009	386-0227-00
-20	214-0604-00			1		. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-21	214-0603-01			1		. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-22	348-0073-00			2		. SPT PIVOT,FLIP:LEFT FRONT AND RIGHT REAR	80009	348-0073-00
						(ATTACHING PARTS FOR EACH)		
-23	211-0532-00			2		. SCREW,MACHINE:6-32 X 0.75 INCH,FILH STL	83385	OBD
-24	210-0457-00			2		. NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
-25	348-0208-00			2		. FOOT,CABINET:LEFT FRONT AND RIGHT REAR	80009	348-0208-00
-26	348-0074-00			2		. SPT PIVOT,FLIP:RIGHT FRONT AND LEFT REAR	80009	348-0074-00
						(ATTACHING PARTS FOR EACH)		
-27	211-0532-00			2		SCREW,MACHINE:6-32 X 0.75 INCH,FILH STL	83385	OBD
-28	210-0457-00			2		. NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-29	348-0207-00			2		. FOOT,CABINET:RIGHT FRONT AND LEFT REAR	80009	348-0207-00
-30	348-0275-00			1		FLIPSTAND,CAB.:	80009	348-0275-00
-31	361-0388-00			1		SPACER,PLATE:	80009	361-0388-00
						(ATTACHING PARTS)		
-32	212-0008-00			2		SCREW,MACHINE:8-32 X 0.500 INCH,PNH STL	83385	OBD
						- - - * - - -		
-33	361-0388-00			1		SPACER,PLATE:	80009	361-0388-00
						(ATTACHING PARTS)		
-34	212-0105-00			2		SCREW,EXT RLV:8-32 X 0.312 INCH,HEX HD STL	80009	212-0105-00
-35	210-0008-00			2		WASHER,LOCK:INTL,0.172 ID X 0.331"OD,STL	78189	1208-00-00-0541C
						- - - * - - -		
-36	343-0256-00			2		RTNR BLK,SCOPE:	80009	343-0256-00
						(ATTACHING PARTS FOR EACH)		
-37	211-0531-00			2		SCREW,MACHINE:6-32 X 0.375,FIL,STL	83385	OBD
						- - - * - - -		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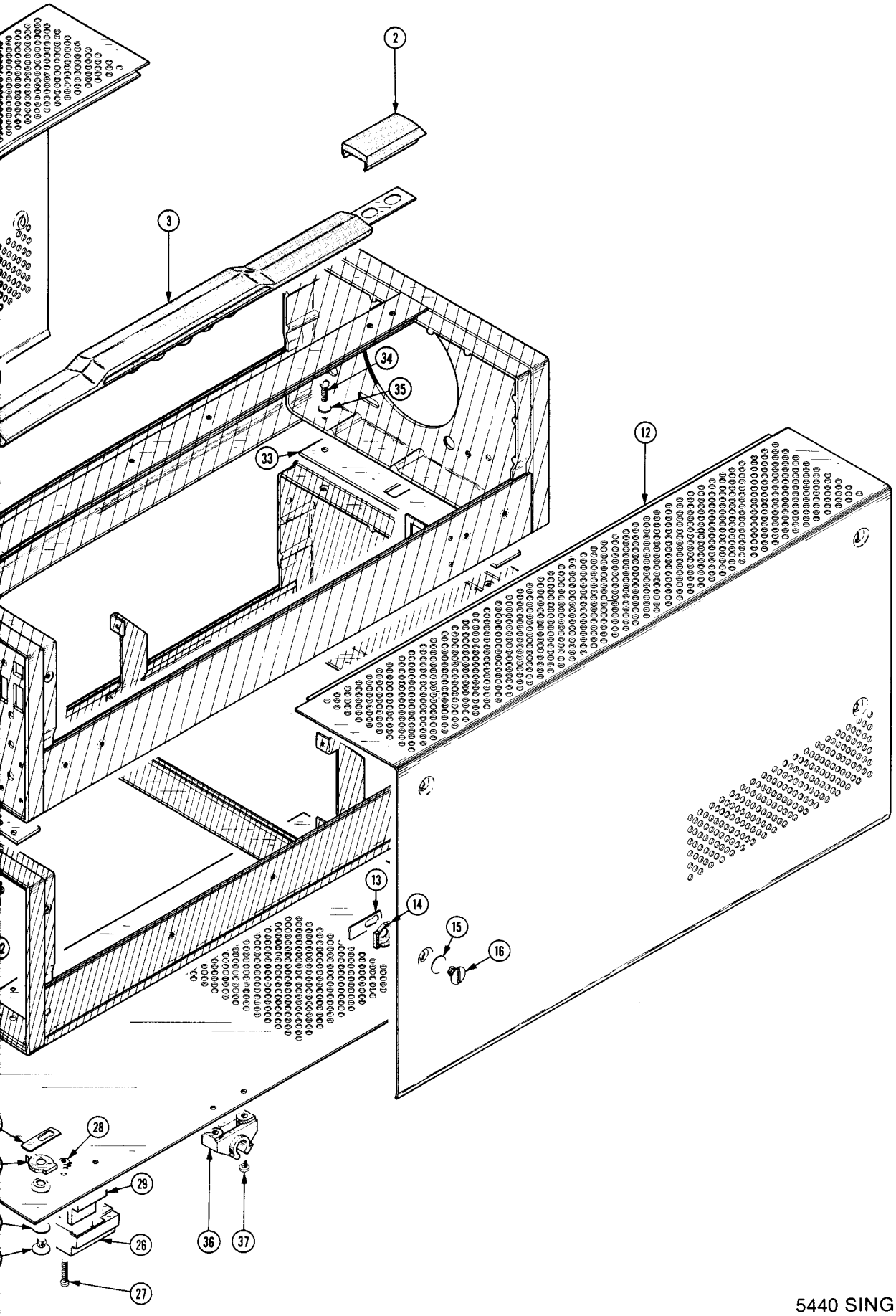
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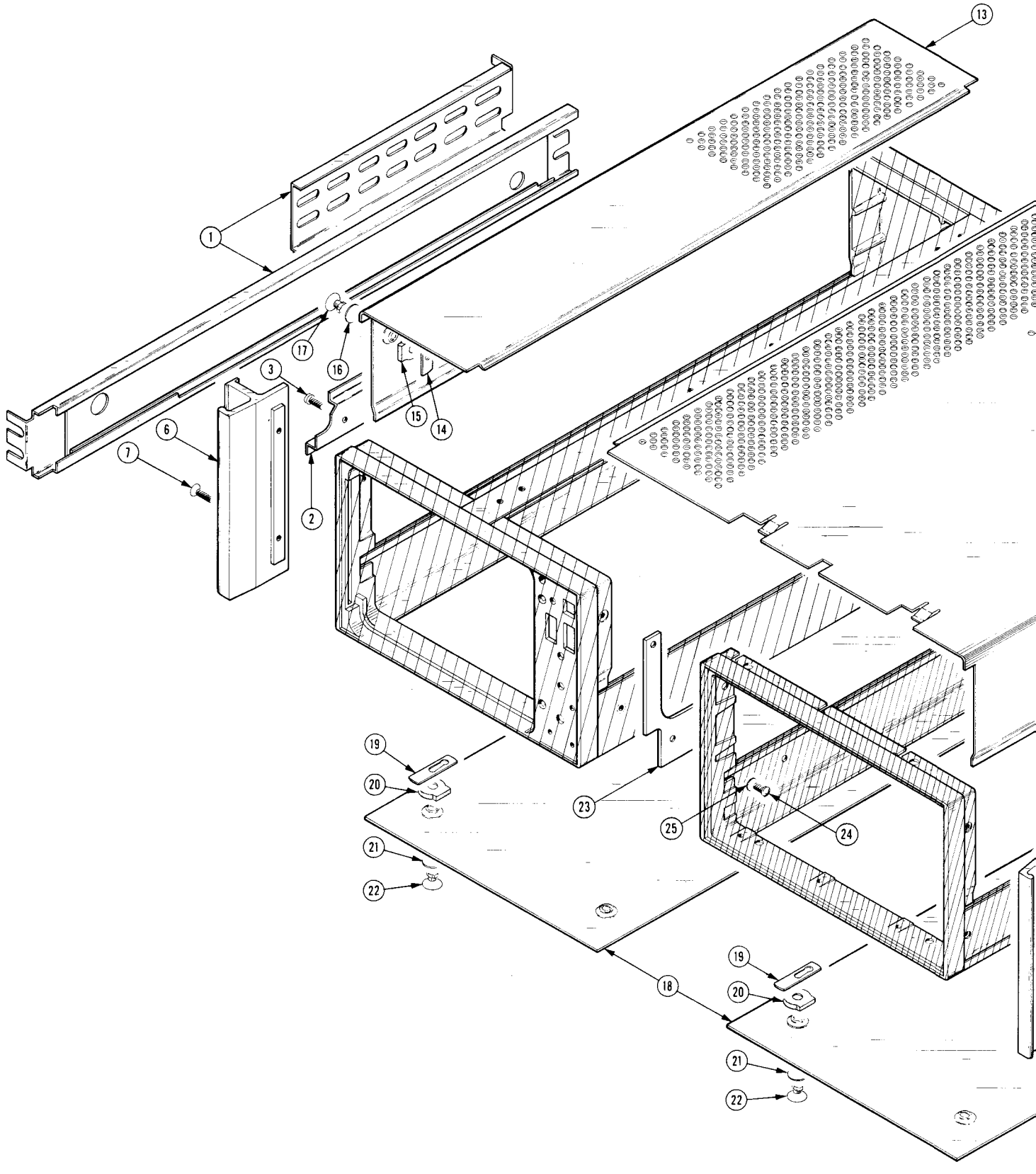
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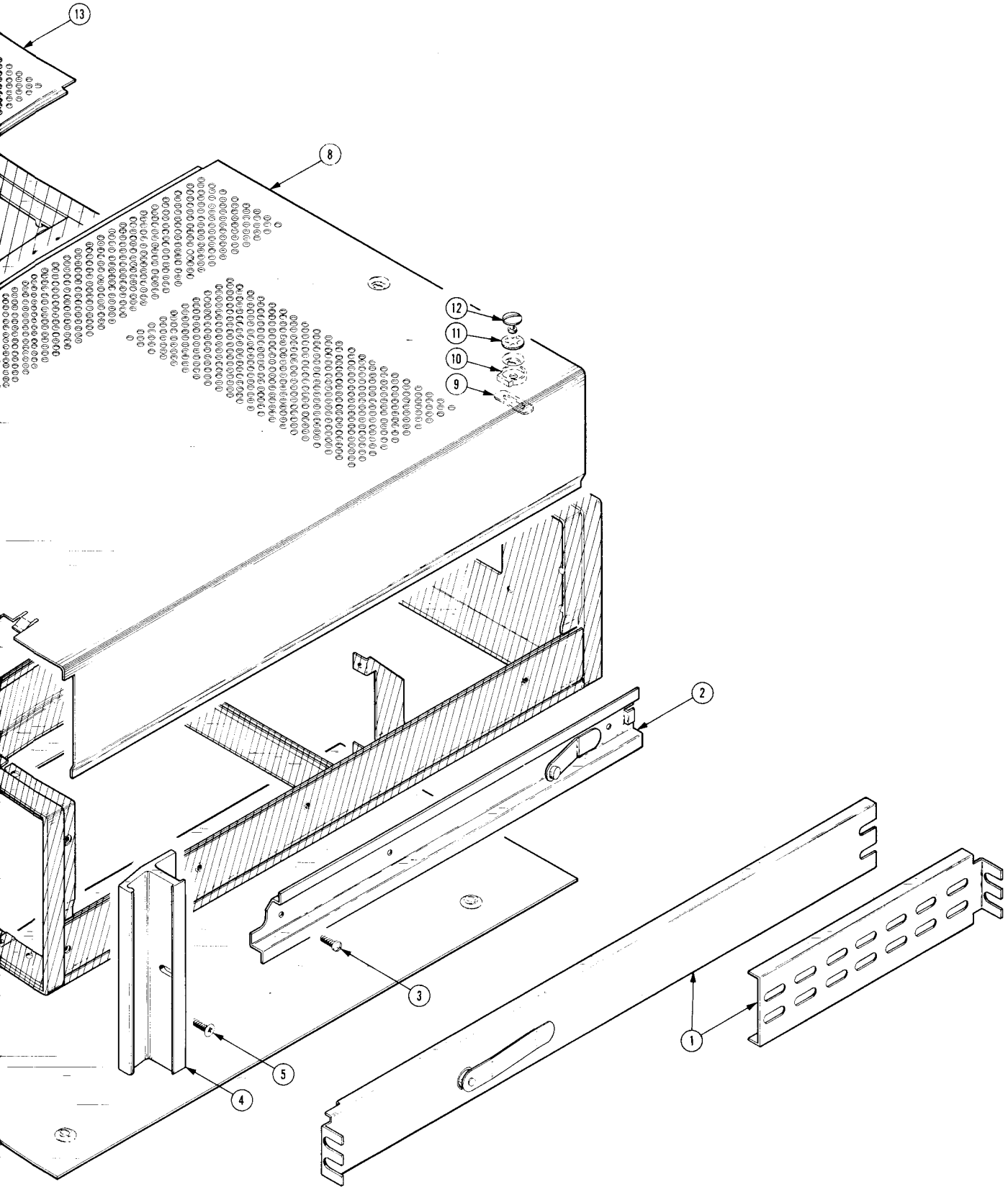
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Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
4-1	351-0195-00			1		SLIDE,DWR,EXT:SLIDE,PAIR(RACKMOUNT ONLY)	06666	C719
-2	351-0104-00			1		SLIDE SECT.,DWR:PAIR	06666	C-720-2
						(ATTACHING PARTS)		
-3	212-0004-00			6		SCREW,MACHINE:8-32 X 0.312 INCH,PNH STL	83385	OBD
	210-0858-00			6		WASHER,FLAT:0.500 OD X 0.171 ID X 0.063 THK	80009	210-0858-00
						- - - * - - -		
-4	407-0899-03	B010100	B059999	1		BRACKET,RACK MT:RIGHT	80009	407-0899-03
	407-0899-00	B060000		1		BRACKET,RACK MT:ALUMINUM	80009	407-0899-00
						(ATTACHING PARTS)		
-5	212-0040-00			2		SCREW,MACHINE:8-32 X 0.375 100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-6	407-0899-00			1		BRACKET,RACK MT:ALUMINUM	80009	407-0899-00
						(ATTACHING PARTS)		
-7	212-0040-00			2		SCREW,MACHINE:8-32 X 0.375 100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-8	390-0191-00	B010100	B073971	1		COVER,SCOPE:RIGHT SIDE	80009	390-0191-00
	390-0502-00	B073972	B079999	1		CAB.SIDE,DSPL:RIGHT,RACK	80009	390-0502-00
	390-0502-01	B080000		1		CAB.SIDE,DSPL:RIGHT	80009	390-0502-01
	390-0192-01	B010100	B073831	1		COVER,SCOPE:RIGHT SIDE	80009	390-0192-01
	390-0471-01	B073832		1		COVER,DISPLAY:RIGHT SIDE BENCH W/LATCH	80009	390-0471-01
	214-0812-00			2		. FASTENER,PAWL:	80009	214-0812-00
						(EACH FASTENER INCLUDES)		
-9	386-0226-00			1		. . CLAMP,RIM CLENC:SPG STL CD PL	80009	386-0226-00
-10	386-0227-00			1		. . STOP,CLP,RIM CL:ACETAL	80009	386-0227-00
-11	214-0604-00			1		. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-12	214-0603-01			1		. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-13	390-0194-00	B010100	B073971	1		COVER,SCOPE:LEFT SIDE	80009	390-0194-00
	390-0503-00	B073972	B079999	1		CAB.SIDE,DSPL:LEFT,RACK	80009	390-0503-00
	390-0503-01	B080000		1		CAB.SIDE,DSPL:LEFT,RACK	80009	390-0503-01
	390-0193-01	B010100	B073831	1		COVER,SCOPE:LEFT SIDE	80009	390-0193-01
	390-0471-00	B073832		1		COVER,DISPLAY:LEFT SIDE BENCH W/LATCH	80009	390-0471-00
	214-0812-00			2		. FASTENER,PAWL:	80009	214-0812-00
						(EACH FASTENER INCLUDES)		
-14	386-0226-00			1		. . CLAMP,RIM CLENC:SPG STL CD PL	80009	386-0226-00
-15	386-0227-00			1		. . STOP,CLP,RIM CL:ACETAL	80009	386-0227-00
-16	214-0604-00			1		. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-17	214-0603-01			1		. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-18	390-0222-00	B010100	B073971	2		COVER,SCOPE:BOTTOM	80009	390-0222-00
	390-0505-00	B073972	B079999	2		CAB.BOT,SCOPE:	80009	390-0505-00
	390-0505-01	B080000		2		CAB.BOT,SCOPE:	80009	390-0505-01
	214-0812-00			4		. FASTENER,PAWL:	80009	214-0812-00
						(EACH FASTENER INCLUDES)		
-19	386-0226-00			1		. . CLAMP,RIM CLENC:SPG STL CD PL	80009	386-0226-00
-20	386-0227-00			1		. . STOP,CLP,RIM CL:ACETAL	80009	386-0227-00
-21	214-0604-00			1		. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-22	214-0603-01			1		. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-23	361-0389-00			2		SPACER,PLATE:	80009	361-0389-00
						(ATTACHING PARTS FOR EACH)		
-24	212-0103-00			3		SCREW,MACHINE:8-32 X 0.375 HEX HD,STL	77250	OBD
-25	210-0008-00			5		WASHER,LOCK:INTL,0.172 ID X 0.331"OD,STL	78189	1208-00-00-0541C
						- - - * - - -		

STANDARD ACCESSORIES

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
	070-2139-01			1		MANUAL,TECH:INSTRUCTION	80009	070-2139-01
	020-0422-00			1		ACCESSORY PKG:SCOPE ACCESSORY KIT	80009	020-0422-00

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages.

A single change may affect several sections. Since the change information sheets are carried in the manual until all changes are permanently entered, some duplication may occur. If no such change pages appear following this page, your manual is correct as printed.

SERVICE NOTE

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

CALIBRATION TEST EQUIPMENT REPLACEMENT

Calibration Test Equipment Chart

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

Comparison of Main Characteristics

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

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

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MANUAL CHANGE INFORMATION

Date: 2-29-80 Change Reference: M39493

Product: 5440 and 5441 Manual Part No.: SEE BELOW

DESCRIPTION

EFF SN B097410 (5440) 070-2139-01

EFF SN B093646 (5441) 070-2140-00

REPLACEABLE ELECTRICAL PARTS CHANGES

CHANGE TO:

Q148	151-0434-00	TRANSISTOR:SILICON,PNP
Q165	151-0434-00	TRANSISTOR:SILICON,PNP

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MANUAL CHANGE INFORMATION

Date: 3-13-80 Change Reference: C4/380

Product: 5440 and 5441 Oscilloscopes Manual Part No.: see below

DESCRIPTION

EFF ALL SN

TEXT AND ILLUSTRATION CHANGES

5440 (070-2139-01) See page 5-12

5441 (070-2140-00) See Adjustment Readout Circuit Board tab page

All references to Q1052

CHANGE TO: Q1040

This illustration shows the location of Q1040: