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
2-	070-1681-00			1		MANUAL,TECH:INSTRUCTION	80009	070-1681-00

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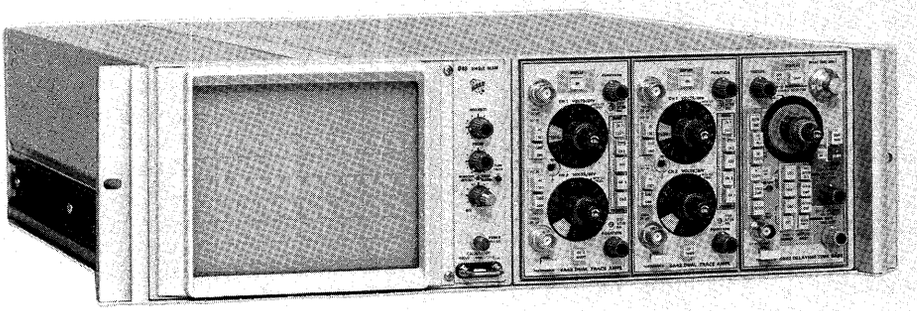

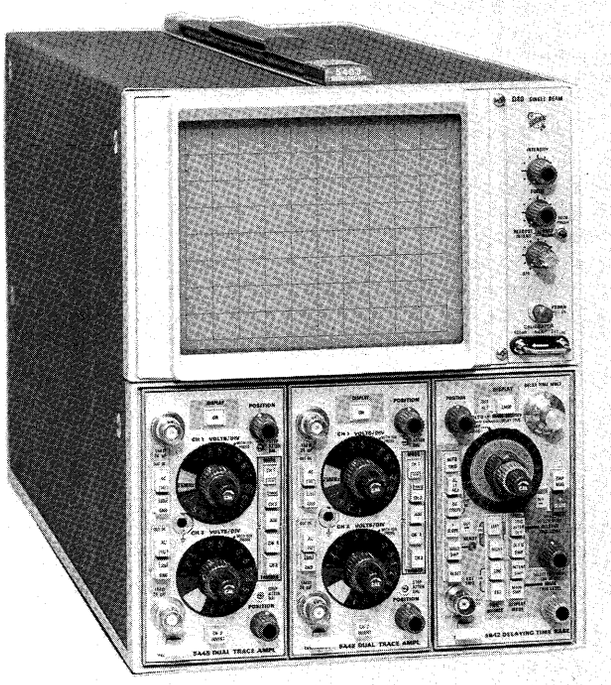

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INSTALLATION

OPERATING VOLTAGE

CAUTION

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

5400 Panel (Dust Cover) Removal

WARNING

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

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 set is marked on the rear panel of the instrument. Use the following procedure to obtain correct instrument operation from the line voltage available.

1. Disconnect the instrument from the power source.

2. Remove the bottom dust cover of the instrument to gain access to the Power Supply circuit board.

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

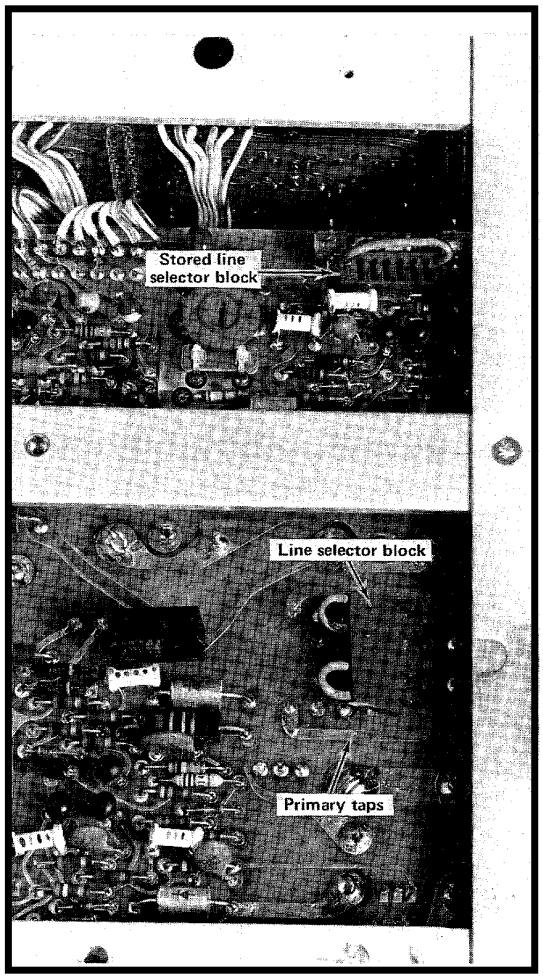

Fig. 0-1. Location of the line-selector block on the Power Supply circuit board.

NOTE

The 120-volt block is color coded brown, and 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 0-1).

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 0-1

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

INSTRUMENT CONVERSION

The 5403 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 from Tektronix, Inc. Order: 040-0583-01, Bench-to-rack conversion; 040-0584-02, Rack-to-bench conversion.

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 3.

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 R5400, 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. 0-2A. If the front rails are tapped, and the stationary section is mounted in front of the front rail as shown in Fig. 0-2B, the 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 R5400 in the fully extended position, use cables that are long enough to reach from the signal source to the instrument.

Installing The Slide-Out Tracks

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 vertical rack rails having this compatibility.

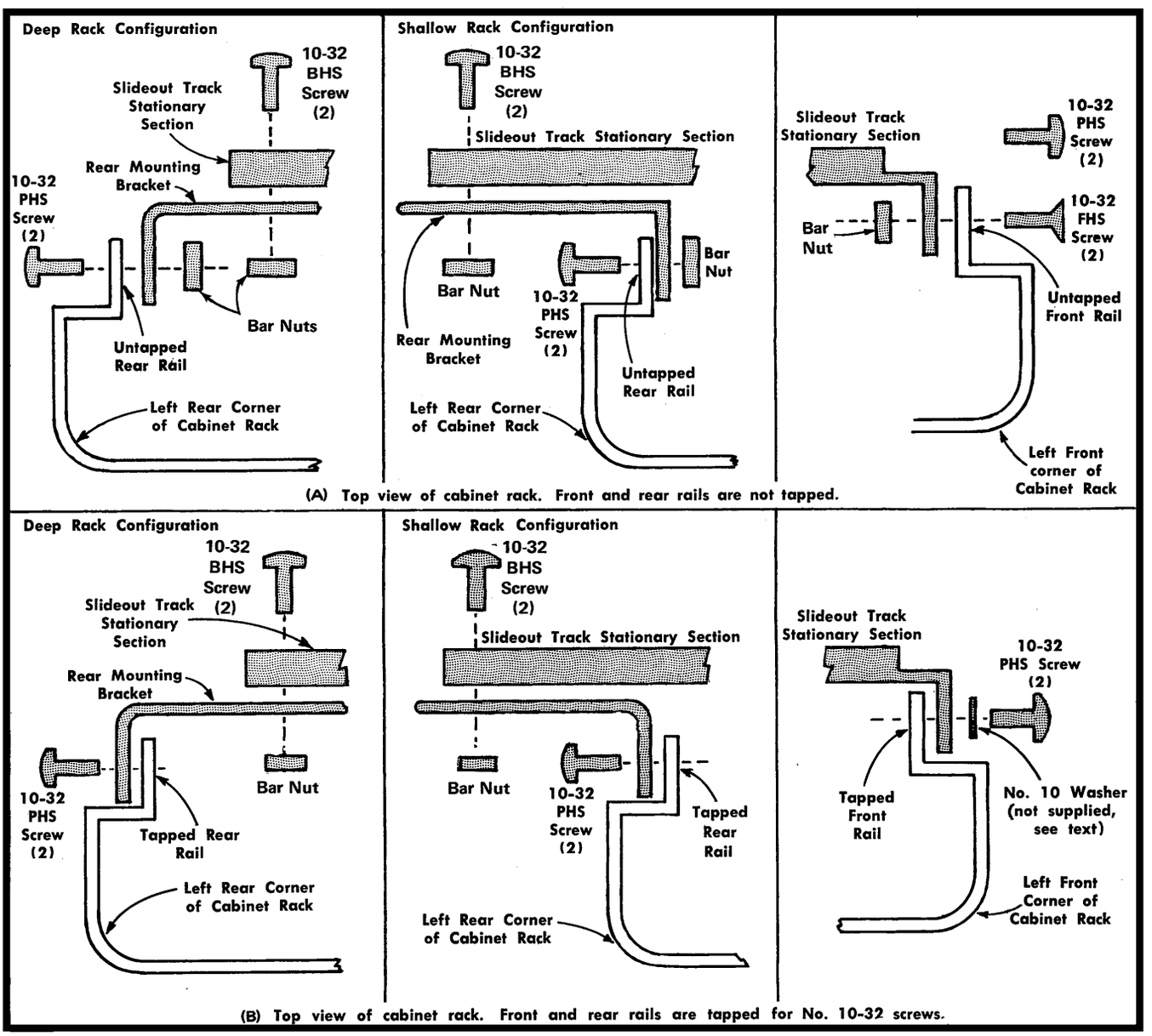

Fig. 0-2. Mounting the left stationary section (with its matched intermediate section, not shown in illustrations A and B) to the rack rails.

NOTE

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

2. Or, front and rear rail holes must be tapped to accept a 10-32 screw if Fig. 0-2B mounting method is used. Note in Fig. 0-2B right illustration that a No. 10 washer (not supplied) may be added to provide increased bearing surface for the slide-out track stationary section front flange.

Because of the above compatibility, there will be some small parts left over. The stationary and intermediate sections for both sides of the rack are shipped as a matched set and should not be separated. The matched sets 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. 0-2 for installation details.

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

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

(a) If the front flanges of the stationary sections are to be mounted behind the front rails (rails are countersunk or not tapped), mount the stationary sections as shown in Fig. 0-2A right illustration.

(b) If the front flanges of the stationary sections are to be mounted in front of the front rails (rails are tapped for 10-32 screws), mount the stationary sections as shown in Fig. 0-2B right illustration. To provide increased bearing surface for the screw head to securely fasten the front flange to the rail, a flat washer (not supplied) may be added under the screw head. However, if this mounting method is used, the front panel will not fit flush against the front rail because of the stationary section and washer thickness. If a flush fit is preferred, method 2 (a) should be used.

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

(a) If the rear rack rail holes are not tapped to accept 10-32 machine screws, mount the left stationary section with hardware provided as shown in the left or center illustration of Fig. 0-2A. Note that the rear mounting bracket can be installed either way so the slide-out tracks will fit a deep or shallow cabinet rack. Use Fig. 0-2A as a guide for mounting the right stationary section. Make sure that the stationary sections are horizontally aligned so they are level and parallel with each other.

(b) If the rear rack rail holes are tapped to accept 10-32 machine screws, mount the left stationary section with hardware provided as shown in the left or center illustration of Fig. 0-2B. Note that the rear mounting bracket can be installed either way so the slide-out tracks will fit a deep or shallow cabinet rack. Use Fig. 0-2B as a guide for mounting the right stationary section. Make sure the stationary sections are horizontally aligned so they are level and parallel with each other.

R5400 Installation And Adjustment

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

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

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

3. Press the 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. 0-3. Using the hardware (not furnished) indicated in Fig. 0-3, secure the R5403 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.

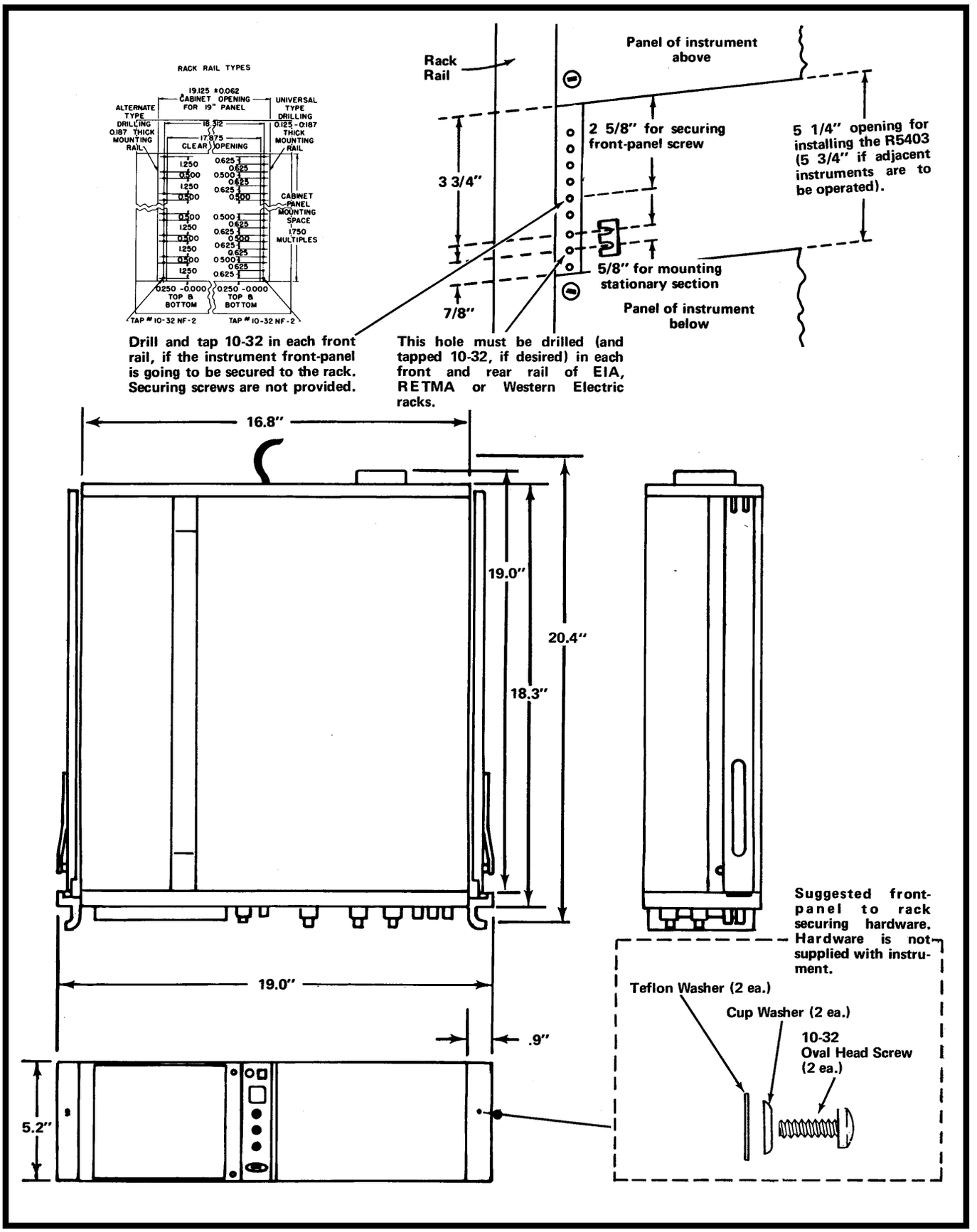

Fig. 0-3. Dimensional diagram.

OPERATING TEMPERATURE

The 5403 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 5403 is designed to accept up to three Tektronix 5-series plug-in units. (Only the plug-in units without an N suffix will provide display readout.) This plug-in feature allows a variety of display combinations and also allows selection of bandwidth, sensitivity, display mode, etc., to meet the measurement requirements. In addition, it allows the oscilloscope system to be expanded to meet future measurement requirements. The overall capabilities of the resultant system are in large part determined by the characteristics of the plug-ins selected.

Installation

To install a plug-in unit into one of the plug-in compartments, align the slots in the top and bottom of the plug-in with the associated guides in the plug-in compartment. Push the plug-in unit firmly into the plug-in compartment until it locks into place. To remove a plug-in, pull the release latch on the plug-in unit to 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.

OPERATING INSTRUCTIONS

The 5403 Power Supply/Amplifier module forms the basis of an oscilloscope system, and requires a display module and plug-ins to complete the system. This section describes general operating information, and some basic oscilloscope applications.

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

GENERAL OPERATING INFORMATION

Display Switching Logic

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

NOTE

At sweep rates faster than approximately 1 µs, the 5B10, 5B12, and 5B13 Time Base plug-in trigger circuit will not respond fast enough, when used in a 5403 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 5403. 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 multitrace display will occur (Alternate or Chopped). When no plug-in is in the active mode, the signal from the left compartment will be displayed. A time-base unit operated in one of the vertical compartments has a permanent internal connection to apply a logic level to the switching circuit; thus, a vertical trace produced by this unit will always be displayed.

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

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

Vertical Display Mode

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

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

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

Dual-Sweep Displays. When a dual-sweep time-base unit is operated in the horizontal compartment, the alternate and chopped time-shared switching for either the A or B sweep is identical to that for a single time-base unit. However, if both the A and B sweeps are operating, the 5403 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 5403 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 saw-tooth 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. Complete information on operation using the Z-axis feature is given in the operating instructions section of the display module manuals.

BASIC OSCILLOSCOPE APPLICATIONS

The 5400-series 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 Waveform Analysis", Howard W. Sams & Co. Inc., The Bobbs-Merrill Company Inc., Indianapolis, 1963.

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

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

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

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

Peak-to-Peak Voltage Measurements—AC

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

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

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

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

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

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.

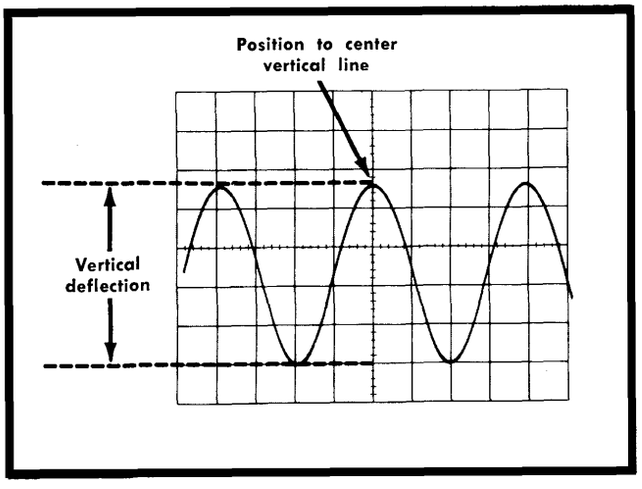

Fig. 1-1. Measuring peak-to-peak voltage of a waveform.

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

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

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

NOTE

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

Instantaneous Voltage Measurement—DC

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

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

NOTE

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

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

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

4. Measure the distance in divisions between the reference line and the point on the waveform at which the

DC level is to be measured. For example, in Fig. 1-2 the measurement is made between the reference line and point A.

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

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.

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

Comparison Measurements

In some applications, it may be necessary to establish a set of deflection factors other than those indicated by the Volts/Div or Sec/Div switches. This is useful for comparing signals to a reference voltage amplitude or period. To establish a new set of deflection factors based upon a specific reference amplitude or period, proceed as follows:

Vertical Deflection Factor

1. Apply a reference signal of known amplitude to the vertical input connector. Using the Volts/Div switch and variable Volts/Div control, adjust the display for an exact number of divisions. Do not move the variable Volts/Div control after obtaining the desired deflection.

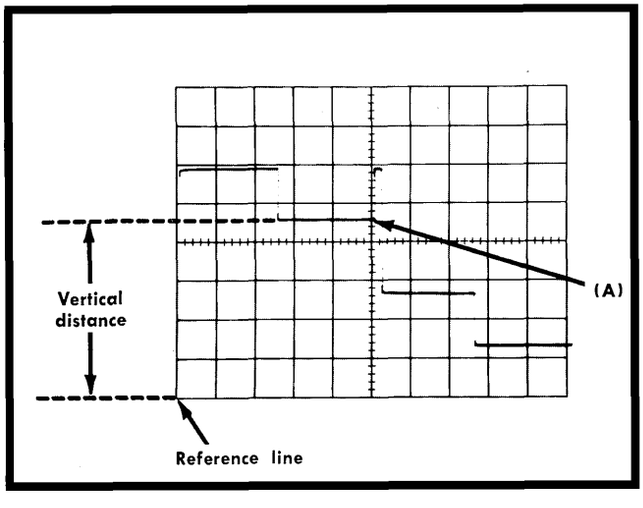

Fig. 1-2. Measuring instantaneous DC voltage with respect to a reference voltage.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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.

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

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

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

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

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

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

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

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

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

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

Time Period Measurement

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

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

2. Set the time-base triggering controls to obtain a stable display. Set the Sec/Div switch to the fastest sweep rate that will permit displaying one cycle of the waveform in less than eight divisions (some non-linearity may occur in the first and last graticule divisions of display). Refer to Fig. 1-3.

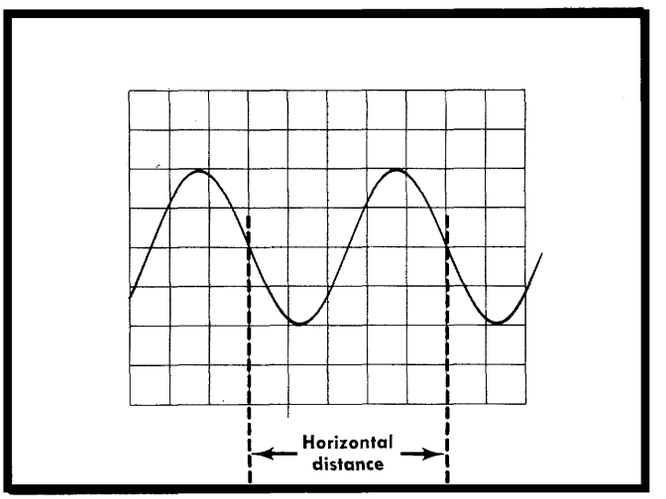

Fig. 1-3. Measuring time duration (period) between points on a waveform.

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

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

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

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

Period =

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

The period is 0.5 millisecond.

Determining Frequency

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

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

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

EXAMPLE: The frequency of the signal shown in Fig. 1-3, which has a period of 0.5 millisecond, is:

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

Risetime Measurement

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

1. Connect the signal to the input connector.

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

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

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

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

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

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

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.

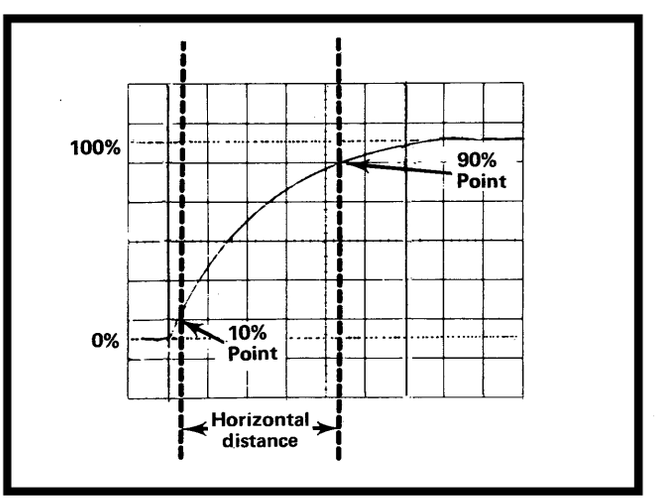

Fig. 1-4. Measuring risetime.

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 microsecond.

Time Difference Measurements

When used in conjunction 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 precede the comparison signal in time. Use coaxial cables or probes which have similar time-delay characteristics to connect the signal to the input connectors.

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

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

7. Set the time-base triggering controls for a stable display. Set the 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. 1-5).

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.

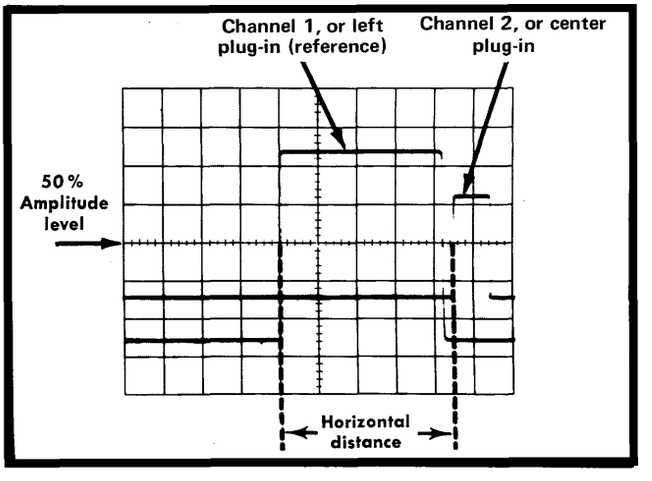

Fig. 1-5. Measuring time difference between two pulses.

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. 1-6). Each division of the graticule represents 45° of the cycle (360° ÷ 8 divisions = 45°/division). The sweep rate can be stated in terms of degrees as 45°/division.

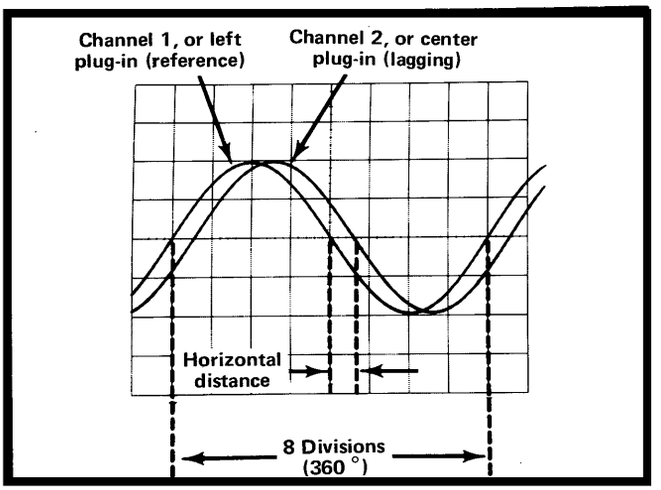

Fig. 1-6. Measuring phase difference.

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. 1-6. Use the formula:

Phase Difference =

horizontal difference (divisions) X sweep rate (degrees/ divisions) = (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. 1-7 shows the same signals as used in Fig. 1-6, but with the Swp Mag button pushed in. With a horizontal difference of six divisions the phase difference is:

Phase Difference =

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

The phase difference is 27°.

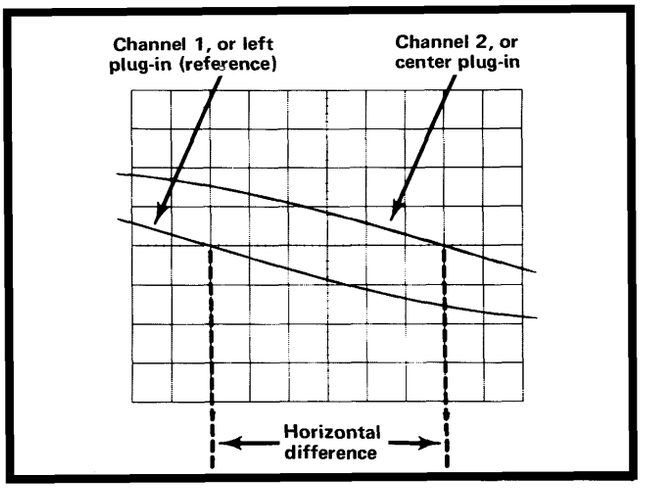

Fig. 1-7. High-resolution phase difference measurement with increased sweep rate.

THEORY OF OPERATION

LOW-VOLTAGE POWER SUPPLY AND CALIBRATOR

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

Power Input

Power is applied to the primary of transformer T800/F300/S300 through the display unit (fuse F300, thermal cutout S300, and Power switch S302, and the 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 Outputs

The full-wave bridge rectifiers and associated filter components in the secondaries of T800 provide filtered DC voltages. The unregulated outputs are +200 volts, +18 volts, +38 volts, −18 volts and −38 volts. The +200-volt 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 variation in output voltage due to ripple, change of current through the load, etc., is immediately transmitted to the base of Q940 and nullified by a change in Q940 conduction, thus maintaining a steady output. The output of the supply is set to exactly −30 volts by adjustment of R950, −30 V adj. This control sets the conduction of Q950, which controls the bias levels of Q958 and Q940. CR955 and Q958 provide short-circuit protection by limiting the current through Q940 when the voltage drop across R940 exceeds 1.1 V.

−15-Volt Supply. The regulator for the −15 volt supply consists of series-pass transistor Q880, error amplifier Q900 and error sensing transistors Q894 and Q896. This is a feedback amplifier system 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. The error sensing circuit change is applied to the base of the error amplifier, Q900. The output of the error amplifier changes the conduction of the series-pass transistor Q880 to correct for any output error. Q885 protects the supply, in the event the output is shorted, by limiting the current demanded from the series-pass transistor under excessive load. During normal operation, Q885 is biased off.

+15-Volt Supply. The regulator for the +15 volt supply consists of series-pass transistor Q850, error amplifier Q870 and error sensing transistors Q864 and Q866. Operation of this 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.

INTERFACE

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

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 fully discussed in the General 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-hand 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-hand vertical plug-in to pass. If the left-hand 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-hand 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 transition), 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.

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 available 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. 2-1 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

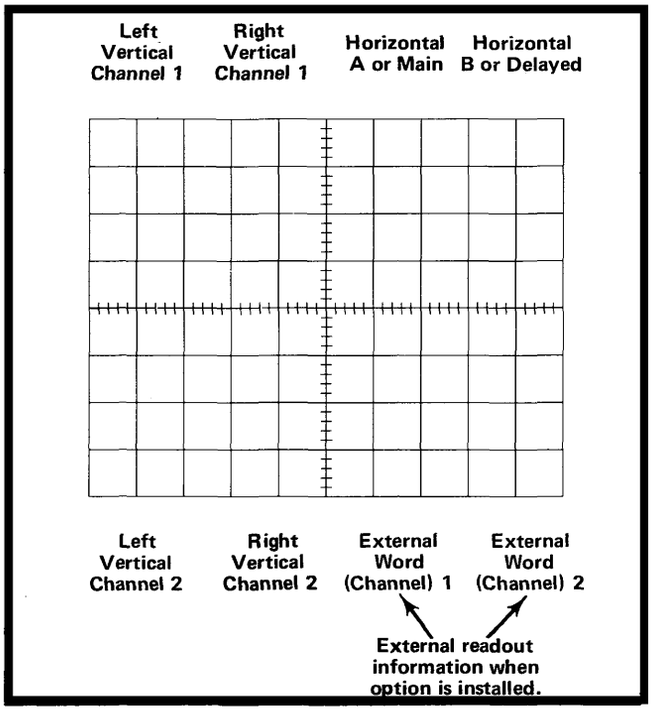

Fig. 2-1. Location of readout words on the CRT, identifying the originating plug-in and channel.

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.

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 channel switch instead of the horizontal plug-in signal.

CIRCUIT ANALYSIS OF READOUT SYSTEM

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

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

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

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

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

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

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

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

Timer

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

The signals at pin 12, 13, 14, and 16 are produced only when the triangle waveform is on its negative slope and the trapezoidal waveform has reached the lower level. The timing sequence of these waveforms is very important to the correct operation of the readout system (see expanded waveforms in Fig. 2-3). The Z-Axis 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 prevent the zeros logic and memory stage U1060 from storing incorrect data during the quiescent period of the strobe pulse. When the strobe pulse goes positive, CR1010 is reverse biased to disconnect Q1010 from U1092, and allow the row decoder to operate in the normal manner.

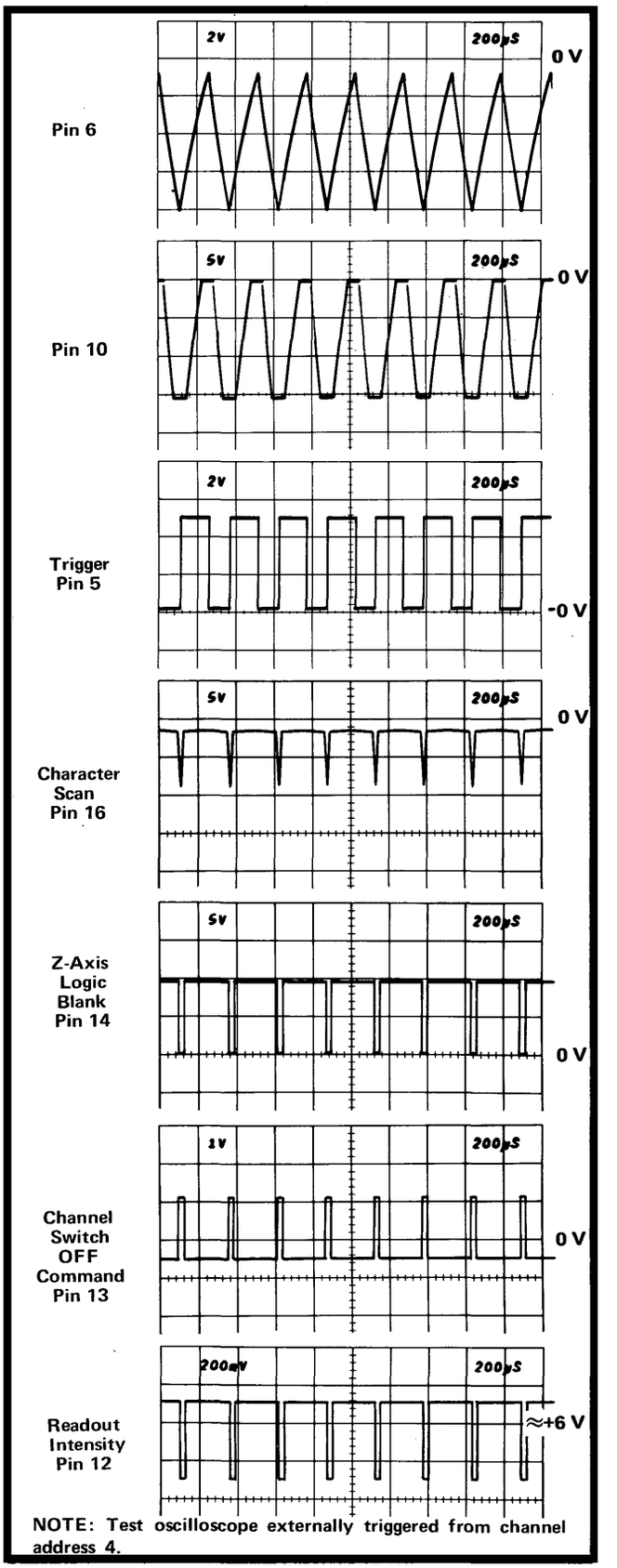

Fig. 2-2. Output waveforms of timer stage.

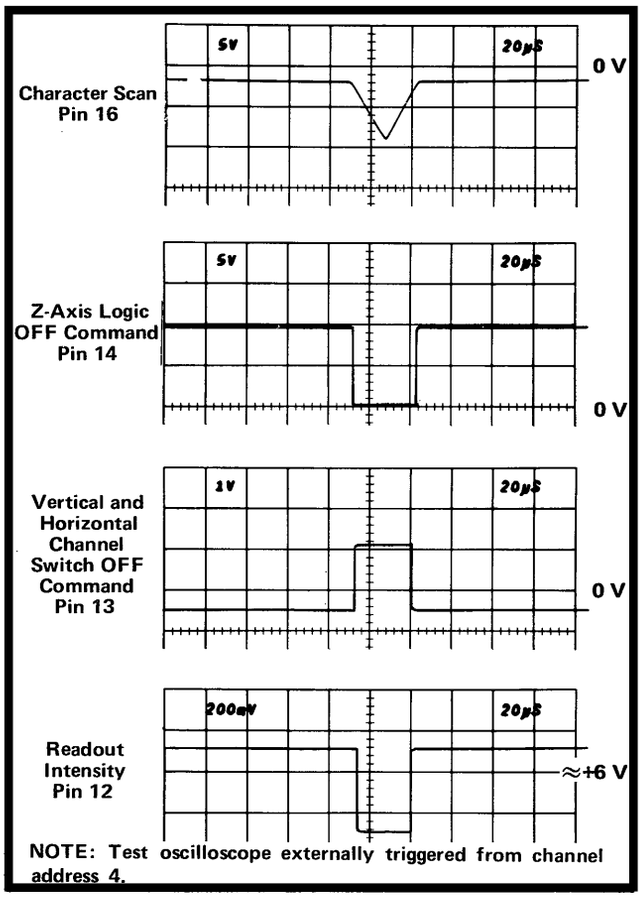

Fig. 2-3. Detail of output at pins 12, 13, 14 and 16 of U1000.

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 operates in one of two modes, as controlled by the display skip level at pin 4. The basic mode just described is a condition that does not occur unless all ten characters of each word (80 characters total) are displayed on the CRT. Under typical conditions only a few characters are displayed in each word. The display skip level at pin 4 determines the period of the timer output signal. When a character is to be generated, pin 4 is LO and the circuit operates as just described. However, when a character is not 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. 2-4 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.

Time-Slot Counter

Time-Slot counter U1025 is a sequential switch that directs the trapezoidal waveform input at pin 8 to one of its 10 output lines. These time-slot pulses are used to interrogate the plug-in units to obtain data for the readout system. The trigger pulse at pin 15 switches the time-slot counter to the next output line; the output signal is sequenced consecutively from time-slot 1 through time-slot 10. Fig. 2-5 shows the time-relationship of the time-slot pulses. Notice that only one of the lines carries a time-slot pulse at any given time. When time-slot 10 is completed a negative-going end-of-word pulse is produced at pin 2. The end-of-word pulse provides a drive pulse for the channel counter and also provides an enabling level to the display-skip generator during time-slot 1 only. The end-of-word pulse also resets the decimal point logic and zeros logic.

Word Counter

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

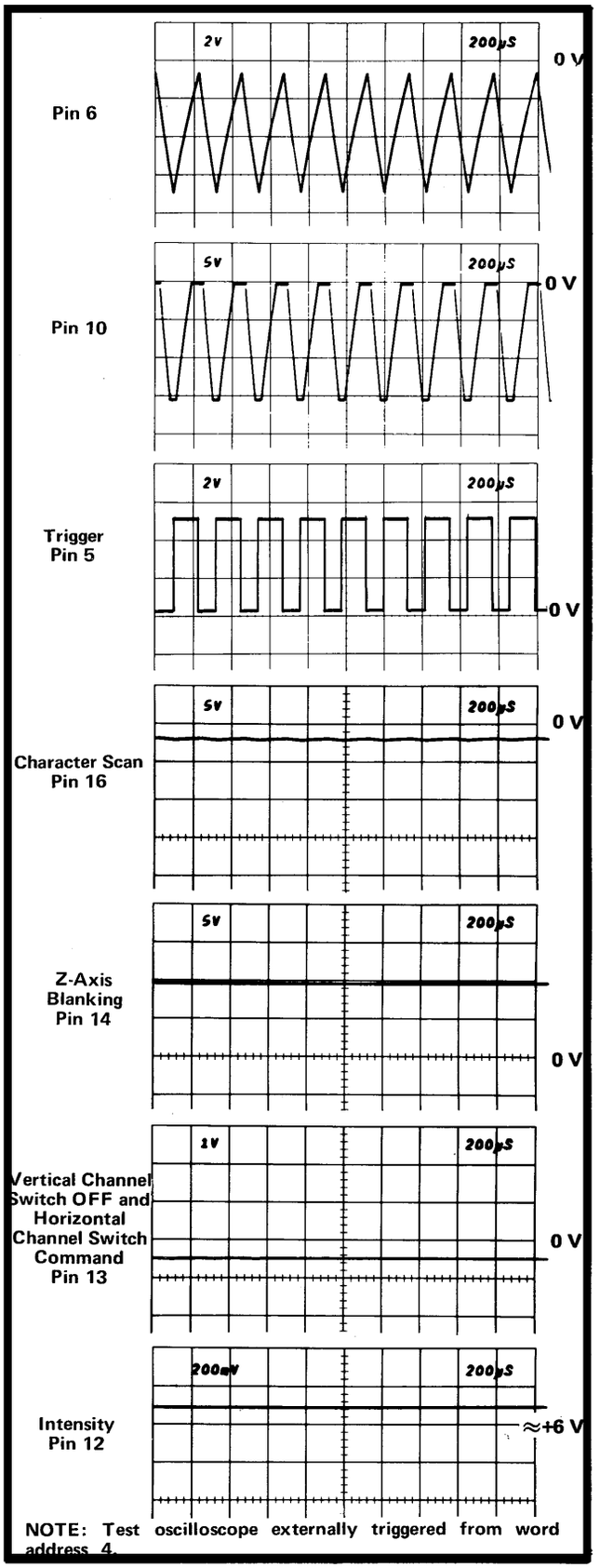

Fig. 2-4. Timer stage operation when display-skip condition occurs.

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

Encoding The Data

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

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

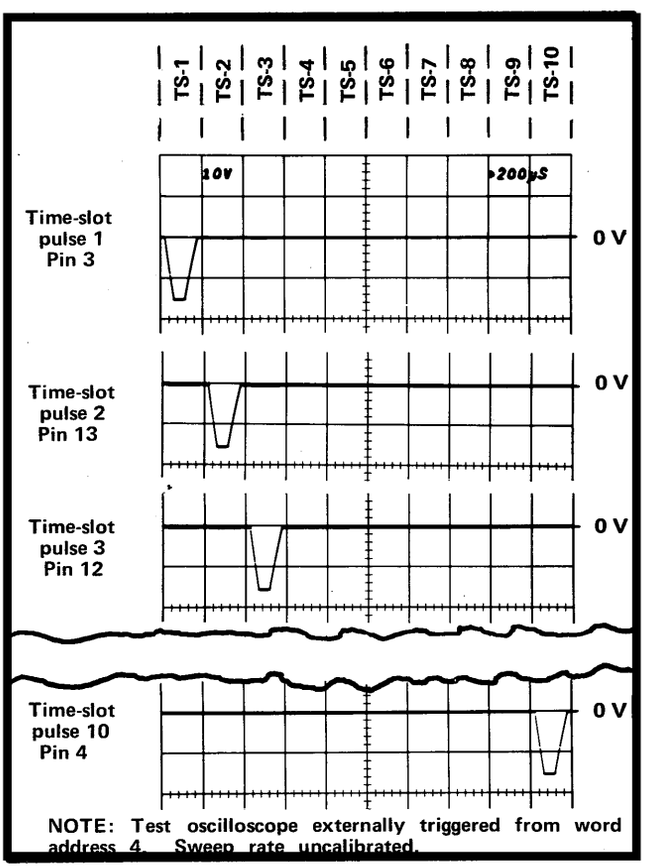

Fig. 2-5. Time relationship of the time-slot (TS) pulses produced by U1025.

COLUMN NUMBER →		C-0	C-1	C-2	C-3	C-4	C-5	C-6	C-7	C-8	C-9	C-10
ROW NUMBER ↓	CURRENT (MILLI-AMPERES)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	⩾ 1.0
R-1	0	SKIP[1] (R-1 through R-9)	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
R-2	0.1		ƀ	<	*I*	/	+	−	+	*C*	Δ	>
R-3	0.2		ADD[1] ONE ZERO	ADD[1] TWO ZEROS	SHIFT[1] PREFIX ←	SHIFT[1] PREFIX ← AND ADD ONE ZERO						*IDENTIFY*[1]
R-4	0.3		*m*	*μ*	*n*	*p*	*X*	*K*	*M*	*G*	*T*	*R*
R-5	0.4		*S*	*V*	*A*	*W*	*H*	*d*	*B*	*c*	Ω	*E*
R-6	0.5		*U*	*N*	*L*	*Z*	*Y*	*P*	*F*	*J*	*Q*	*D*
R-7	0.6				DECIMAL[1] POINT LOCATION NO. 3	DECIMAL[1] POINT LOCATION NO. 4	DECIMAL[1] POINT LOCATION NO. 5	DECIMAL[1] POINT LOCATION NO. 6	DECIMAL[1] POINT LOCATION NO. 7			
R-8	0.7										DECIMAL[2] POINT	
R-9	0.8											
R-10	0.9	ADD SPACE IN DISPLAY[1]										

(Shaded box) UNUSED LOCATIONS. AVAILABLE FOR FUTURE EXPANSION OF READOUT SYSTEM

[1] OPERATIONAL ADDRESS.

[2] DECIMAL POINT CHARACTER. SEE DECIMAL POINT CHARACTER DESCRIPTION IN TEXT.

1195-25A

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

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

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

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 nor column analog data is encoded during time-slots 5, 6, and 7. During TS-8 two units of column current and three units of row current are encoded. This addresses the μ prefix in the character selection matrix. The final data output is provided from time slot 9: three units of column current and four units of row current cause a V (volts) to be displayed. The resultant CRT readout is 100 μV.

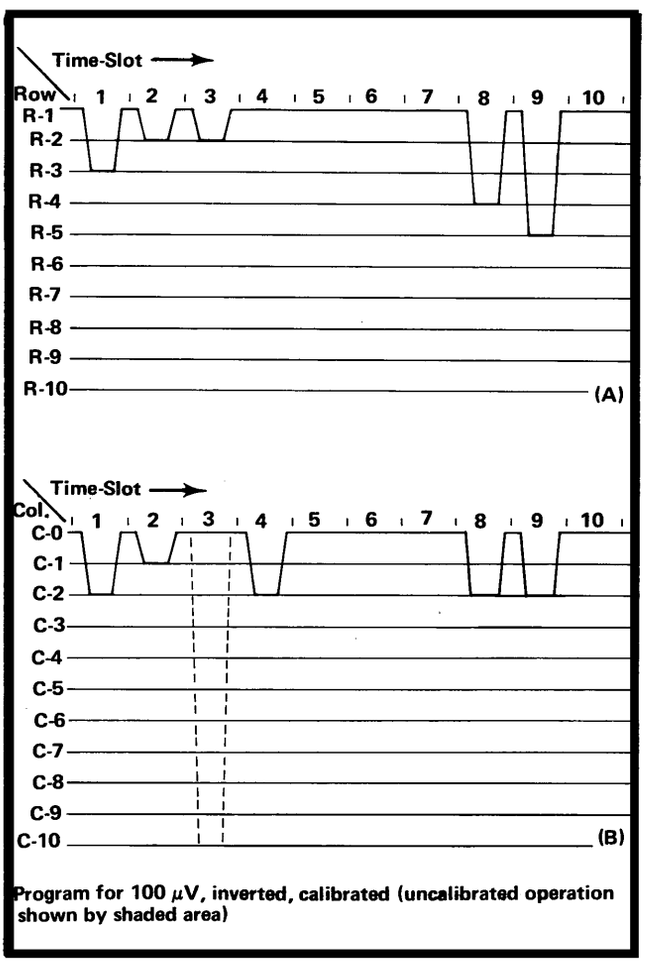

Fig. 2-7. Idealized current waveforms of: (A) Row analog data, (B) Column analog data.

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

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

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

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

Column and Row Data Switches

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

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

TABLE 2-1

Word Address Code

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

Display-Skip Generator

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

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

Column and Row Decoder

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

Zeros Logic and Memory

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

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

During time-slot 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

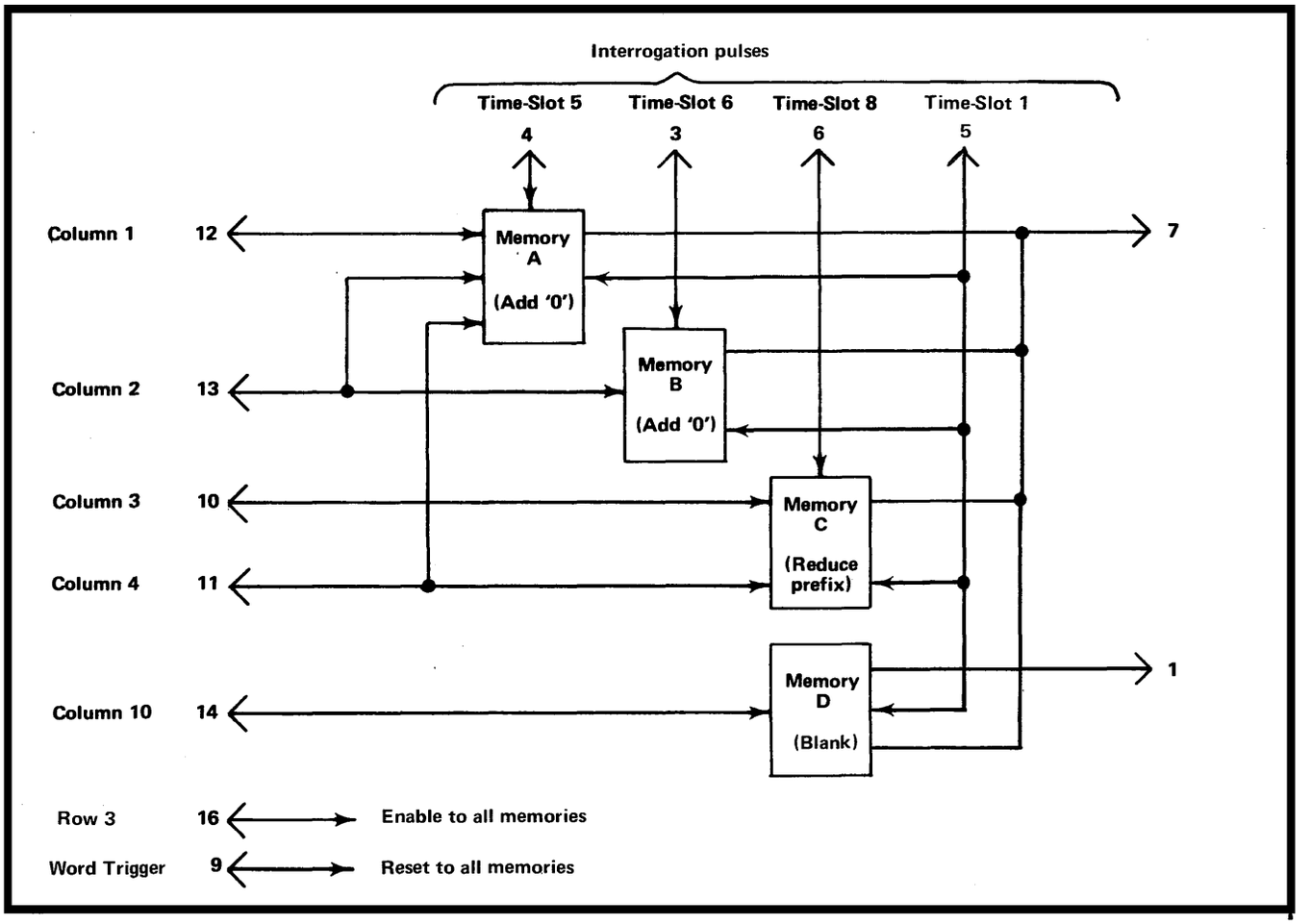

Fig. 2-8. Block representation of memory sequence in U1060.

of current at the input of the column decoder. This produces a zero after the character displayed on the CRT during time-slot 4. During time-slot 6, memory B is interrogated to see if another zero should be added. If another zero is necessary, a second positive output is produced at pin 7, which again results in a column 1 output from the column decoder and a second zero in the CRT display.

Finally, memory C is interrogated during time-slot 8 to obtain information on whether the prefix should be reduced, or left at the value 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. 2-6 that a reduction of one column when row 4 is programmed results in a one unit reduction of the prefix. For example, with the 100 μV program, if data was received from the plug-in calling for a reduction in prefix, the CRT readout would be changed to 1 mV (zeros deleted by program; see Encoding the Data).

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

A further function of the zeros logic is the blank function. If ten units of column current are encoded along with two units of row current (row 3, column 10), the zero logic produces a negative-going output pulse at pin 1 of U1060. This pulse lasts until the end of time-slot 10. Pin 1 of U1060 is connected to the base of Q1018 through R1020. When turned on, Q1018 prevents the readout intensity current from reaching the Z-Axis amplifier.

The end-of-word signal from the time-slot counter is connected to pin 9 of U1060 through C1065. At the end of each word of readout information, this pulse goes LO. This

erases the four memories in the zeros logic and memory in preparation for the data to be received from the next channel.

Character Generators

The Character Generator stage consists of five similar integrated circuits U1090-U1098, which generate the X (horizontal) and Y (vertical) outputs at pins 16 and 1 respectively, to produce the character displayed on the CRT. Each integrated circuit can produce 10 individual characters. U1090 which is designated as the "numerals" character generator can produce the numerals 0 through 9 shown in row 1 of the character selection matrix (Fig. 2-6). U1092 can produce the symbols shown in row 2 of the character selection matrix and U1094 produces the prefixes and some letters of the alphabet that are used as prefixes in row 4. U1096 and U1098 produce the remaining letters of the alphabet shown in rows 5 and 6 of the character selection matrix. All of the character-generator stages receive the column digital data from column decoder U1070 in parallel. However, only one of the character generators receives row data at a particular time and only the stage that receives both row and column data is activated. For example, if column 2 is encoded by a plug-in unit, the five character generators are enabled so that either a 1, <, μ, V, or an N can be produced. However, if at the same time row 4 has also been encoded by the plug-in unit, only the prefix character generator U1094 will produce an output to result in a μ displayed on the screen. This integrated circuit provides current outputs to the format generator, which 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 R1083. When row 10 and column 0 is encoded, the output of this stage advances one step to move the next character another space to the right. However, under this condition, no display is produced on the CRT during this time-slot, since the character generators are not activated.

Time-slot pulses 1, 2, and 3 are also connected to pin 4 of U1080 through VR1080, VR1081, and VR1082 respectively and 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 time-slot 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 time-slot 1), a decimal point is placed at one of the five locations on the CRT identified in row 7 of the character selection matrix (Fig. 2-6). This instruction refers to the decimal point location in relation to the total number of characters that can be displayed on the CRT (see Fig. 2-9). For example, if column 3 and row 7 are encoded during time-slot 1, the system is instructed to place a decimal point in location No. 3. As shown in Fig. 2-9, this displays a decimal point before the third character that can be displayed on the CRT (first three time-slots produce a space whether data is encoded or not; see previous paragraph). The simultaneous application of row 7 data to the Y-input of the format generator through R1080 raises the decimal point so it appears between the displayed characters.

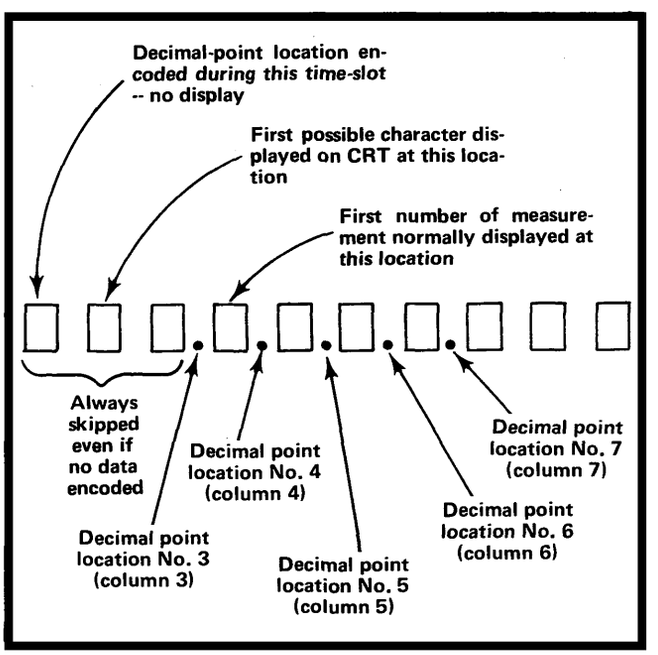

Fig. 2-9. Readout word relating 10 possible character locations to the decimal point instructions that can be encoded, and the resultant CRT display.

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. 2-1).

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

X-Output Amplifier

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

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

SERVICE INFORMATION

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

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

Cleaning

CAUTION

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

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

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

Adjustment

To ensure accurate measurements, the performance of individual units composing the 5400-series oscilloscope should be checked periodically. Complete adjustment instructions are given in the manual for each unit.

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

REPAIR

Troubleshooting Aids

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

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

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

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

WARNING

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

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

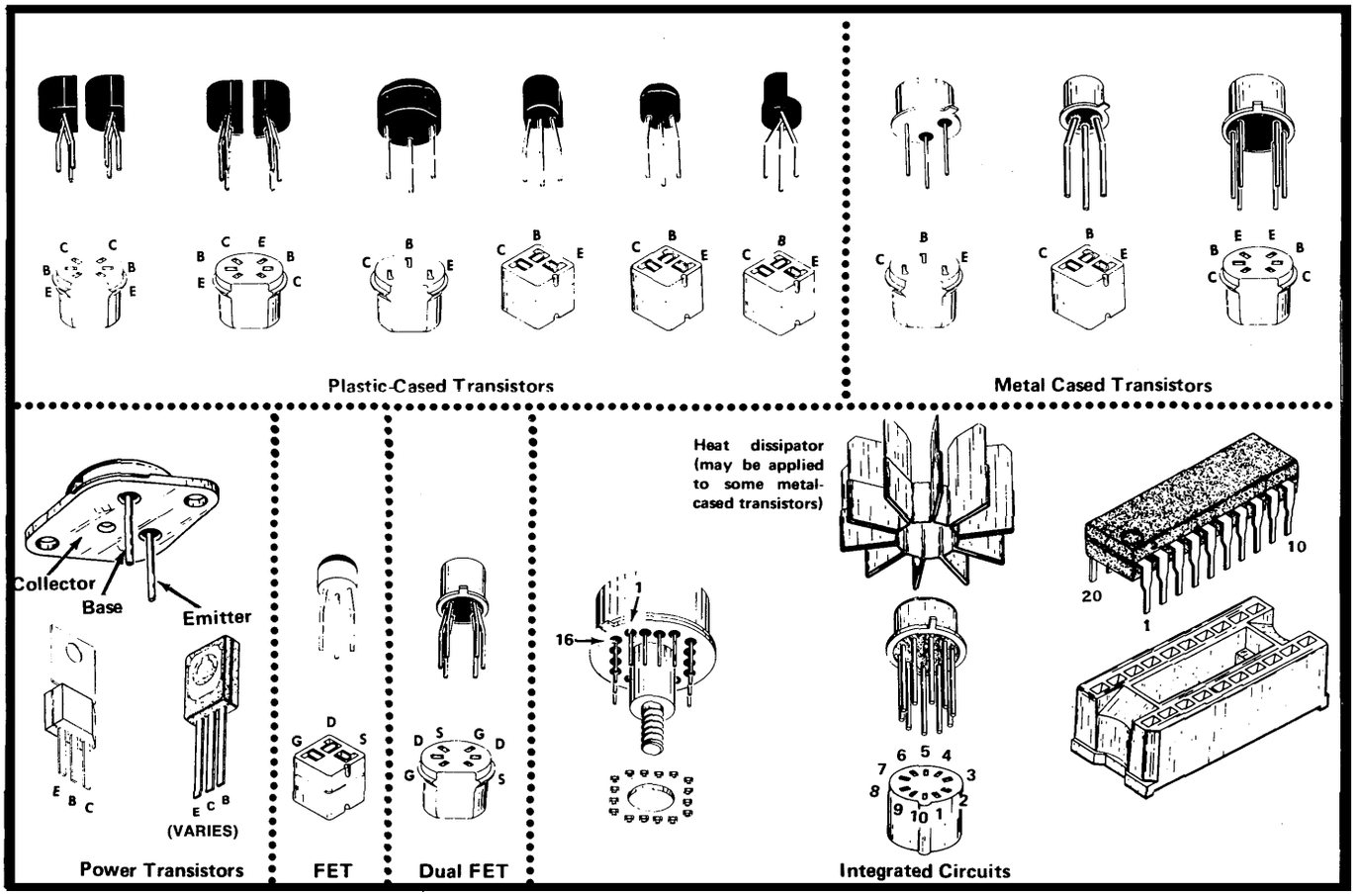

Fig. 3-1. Electrode configuration data for semiconductor devices.

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

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

Troubleshooting Equipment

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

Semiconductor Tester

Description: Dynamic-type tester.

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

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

Multimeter

Description: VTVM, 10-megohm input impedance and 0 to 300 volts range, AC and DC; ohmmeter, 0 to 50 megohms. Accuracy, within 3%. Test probes must be insulated to prevent accidental shorting.

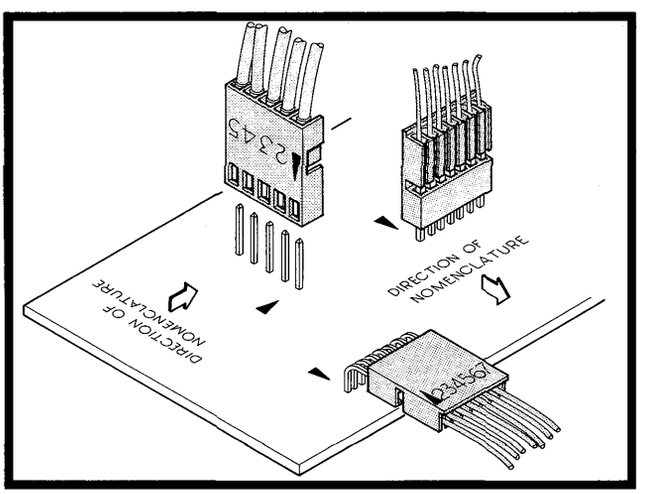

Fig. 3-2. Multi-connector holder orientation.

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

NOTE

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

Test Oscilloscope

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

Purpose: To check operating waveforms in this instrument.

Troubleshooting Techniques

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

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

2. Check System and Associated Equipment. Before proceeding with troubleshooting of the 5400 system, check that the instruments in the system are operating correctly. Check for proper interconnection between the display unit and power supply/amplifier unit. Check that the signal is properly connected and that the interconnecting cables or signal source are not defective. Also, check the power source. The associated plug-in units can be checked for proper operation by substituting other units that are known to be operating properly (preferably of the same types), or by interchanging plug-in units within the 5403. If the trouble persists after substitution, the oscilloscope mainframe is probably at fault.

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

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

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

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

TABLE 3-1

Power Supply Tolerances

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

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

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

CAUTION

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

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

Integrated circuits can be checked with a voltmeter, test oscilloscope, or by direct substitution. A good understanding of the circuit description is essential to troubleshooting circuits using IC's. Operating waveforms, logic levels, and other operating information for the IC's are given in the Theory Of Operation section of the appropriate manual. Use care when checking voltages and waveforms around the IC's so that adjacent leads are not shorted together. A convenient means of clipping a test probe to the 14- and 16- pin in-line IC's is with an integrated-circuit test clip. This device also doubles as an extraction tool.

b. Diodes. A diode can be checked for an open or for a short circuit by measuring the resistance between terminals with an ohmmeter set to the R X 1k scale. The diode resistance should be very high in one direction and very low when the meter leads are reversed. Do not check tunnel diodes or back diodes with an ohmmeter.

CAUTION

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

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

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

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

Replacement Parts

Standard Parts. All electrical and mechanical part replacements for the 5400-series oscilloscope system can be obtained through your local 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 lists for value, tolerance, rating, and description.

NOTE

When selecting replacement parts, it is important to remember that the physical size and shape of the component may affect its performance in the instrument. All replacement parts should be direct replacements unless it is known that a different component will not adversely affect the instrument performance.

Special Parts. Some parts are manufactured or selected by Tektronix to satisy particular requirements, or are manufactured for Tektronix to our specifications. These special parts are indicated in the parts list by an asterisk preceding the part number. Most of the mechanical parts used in this system have been manufactured by Tektronix. Order all special parts directly from your local Tektronix Field Office or representative.

Ordering Parts. When ordering replacement parts from Tektronix, Inc., refer to the page immediately preceding each electrical parts list section. Include the following information:

1. Instrument Type (5403, D40, 5A48, etc.)

2. Instrument Serial Number

3. A description of the part (if electrical, include the circuit number)

4. Tektronix Part Number

Component Replacement

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

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

To remove or replace a board, proceed as follows:

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

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

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

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

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

CAUTION

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

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

An extracting 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 extracting tool is not available, use care to avoid damaging the pins. Pull slowly and evenly on both ends of the IC. Try to avoid having one end of the IC disengage from the socket before the other end.

To replace one of the power transistors mounted on the chassis adjacent to the Power Supply circuit board, first unsolder the leads. Then, loosen the nuts on the plastic bar, or the screw in the metal clamp, that clamps the transistor to the chassis. Remove the defective transistor. When replacing the transistor, use silicone grease on both sides of the insulator plate and on the metal tab, if the transistor has one, to increase heat transfer from the transistor 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.

NOTE

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

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

CAUTION

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

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

The cam switches consist of a rotating drum with lobes, whose position is controlled by the front-panel knobs, which actuates 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.

D40 Cathode-Ray Tube Replacement. The following procedure outlines the removal and replacement of the tube. Refer to Figs. 3-3- and 3-4.

WARNING

Use care when handling a CRT. Protective clothing and safety glasses should be worn. Avoid striking it on any object 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 scrathces.

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.

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.

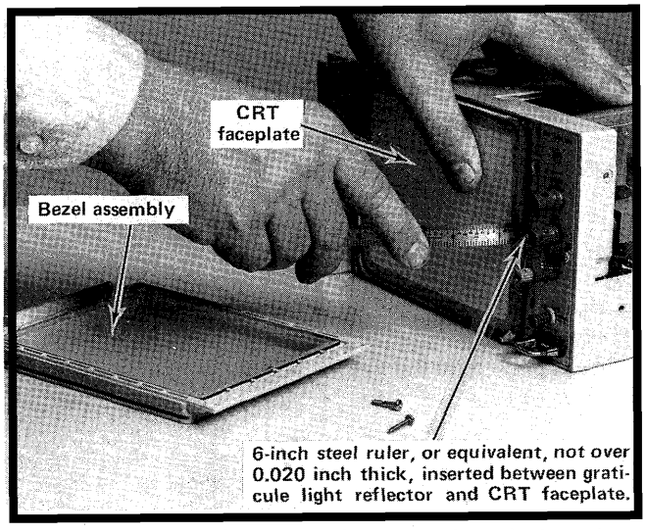

Fig. 3-3. Illustration showing equipment and method used to correctly align light reflector with CRT faceplate.

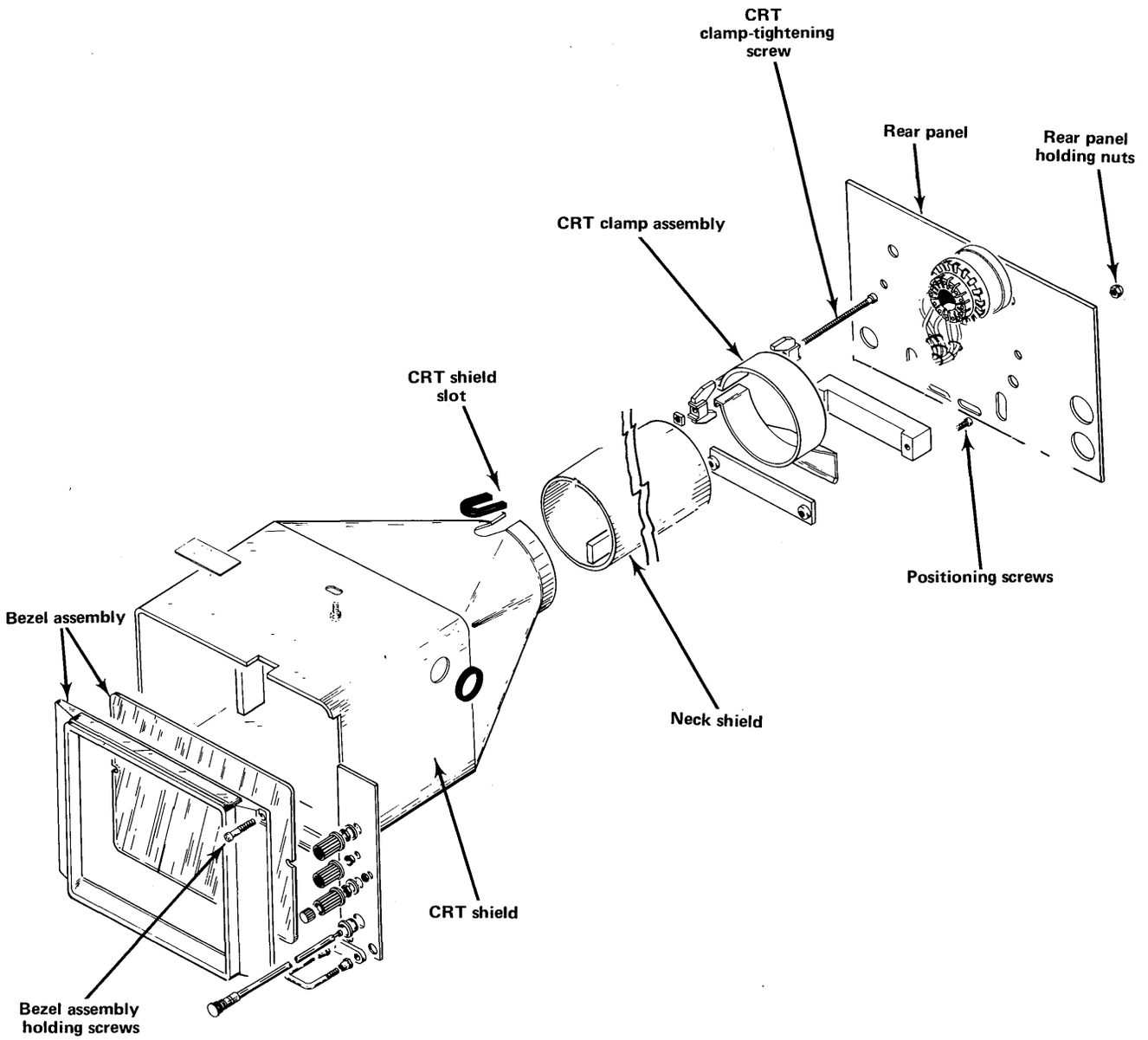

Fig. 3-4. Illustration showing location of CRT mounting hardware described in CRT replacement instructions.

(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 Service Information section of the display unit manual.

D41 Cathode-Ray Tube Replacement. The following procedure outlines the removal and replacement of the cathode-ray tube.

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 and disconnect the storage-element cable connector from the Storage circuit board.

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 CRT base cover on the rear panel of the instrument. Remove the CRT base-pin socket.

(4) Disconnect the CRT anode plug from the jack located on the panel adjacent to the left side of the CRT shield. Ground the CRT anode plug to the chassis momentarily to dissipate any stored charge.

(5) With one hand on the CRT faceplate, push on the CRT base being sure to feed the storage-element cable and the anode lead through the slot and hole in the bottom and rear of 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 and the anode lead through the slot and hole in the bottom and rear of the CRT shield.

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

NOTE

If the CRT support ring has come out of the CRT shield, place over rear of CRT and position inside CRT shield between CRT and CRT shield.

(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 CRT base cover on the rear panel. Connect the storage-element cable to the pin connectors on the Storage circuit board, and connect the deflection leads to the CRT neck pins. Reconnect the CRT anode plug to the jack from the high-voltage circuit board.

(5) Replacing the CRT will require partial instrument adjustment. Refer to the Adjustments information later in this manual.

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

NOTE

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

1. Remove the light shield.

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

3. Replace the light shield.

To replace the D40 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.

6. Install CRT into display unit using CRT Replacement instructions.

To replace the D41 graticule lights, proceed as follows:

1. Remove the CRT bezel assembly.

2. Pull out the light reflector assembly slightly.

3. Replace the burned out light(s).

4. Replace the light reflector assembly back into its original position.

5. Re-install the CRT bezel assembly.

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

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

TABLE 3-2

Circuit Number	Rating	Function	Location
F300	120 VAC –1.25 A Slow 240 VAC –0.7 A Slow	Line-Voltage Input	Display unit rear panel
F800	0.25 A Fast	+200 V Unreg supply	5403 L.V. Power Supply board
F410	0.3 A Slow	+38 V Unreg supply	Display Unit H.V. Power Supply board

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:

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

The carton test strength for your instrument is 275 pounds.

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.

			Pages
Option 1	Removes Readout Circuitry	Described in this section.	1
Option 3	External Readout Input	Described in this section.	6
Option 4	Protective Front Panel Cover	Described in this section.	1

OPTION 1

This modification removes the Readout circuitry from the 5403.

ELECTRICAL PARTS LIST

Ckt. No.	Tektronix Part No.	Description
Remove:		
A3	670-2413-00	READOUT Circuit Board Assembly
U1030	155-0015-01	Monolithic Analog Data Switch
U1040	155-0015-01	Monolithic Analog Data Switch
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 5403. 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. 1. These words are designated EXT. 1 and EXT. 2.

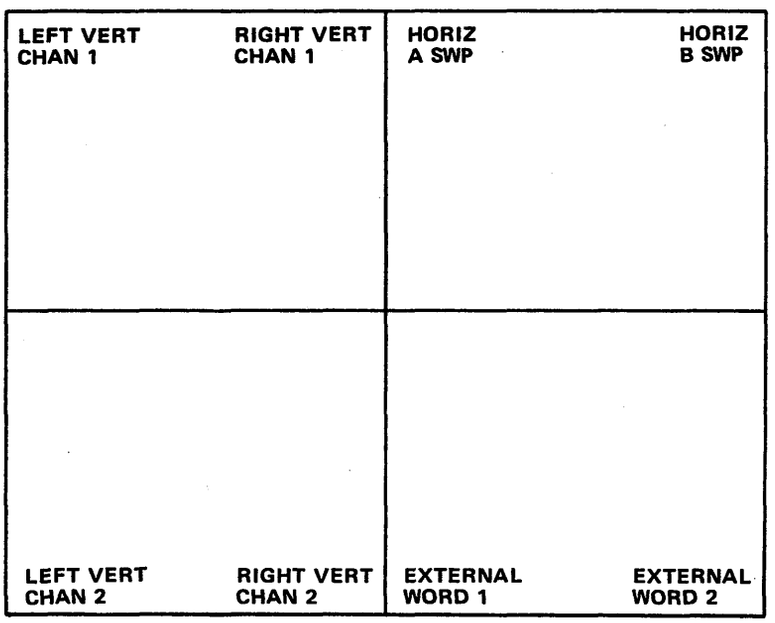

Fig. 1. Readout Word Location

CONNECTOR DESCRIPTION

The connector provided for the External Readout Input is a 25 pin female connector located on the rear panel of the 5403. The connector mates with an ITT - Cannon DB - 25P or equivalent connector (TEK PN 131-0570-00). Refer to Fig. 2 for connector pin assignments.

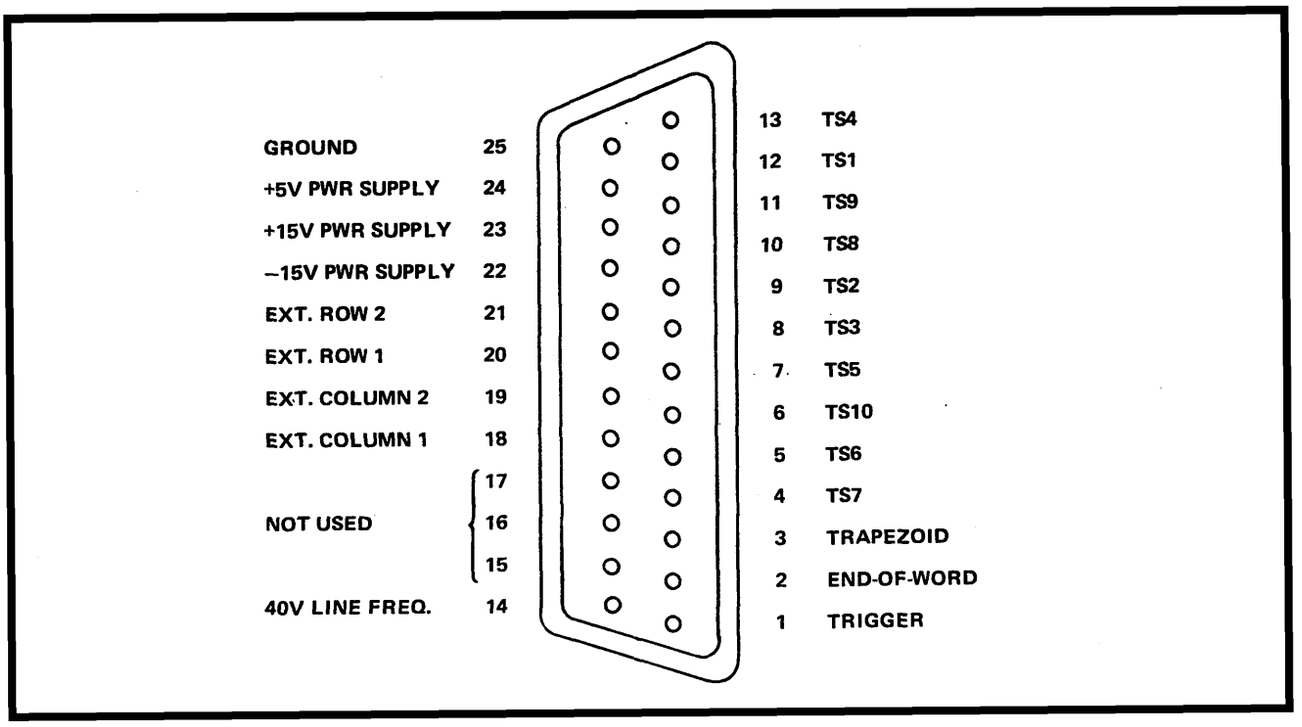

Fig. 2. Connector pin assignments (View looking at rear panel of 5403)

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 5403 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. 2-6 (the Character Selection Matrix) in the 5403 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. 3. RESISTOR PROGRAM for "TEST 1".

In Fig. 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.

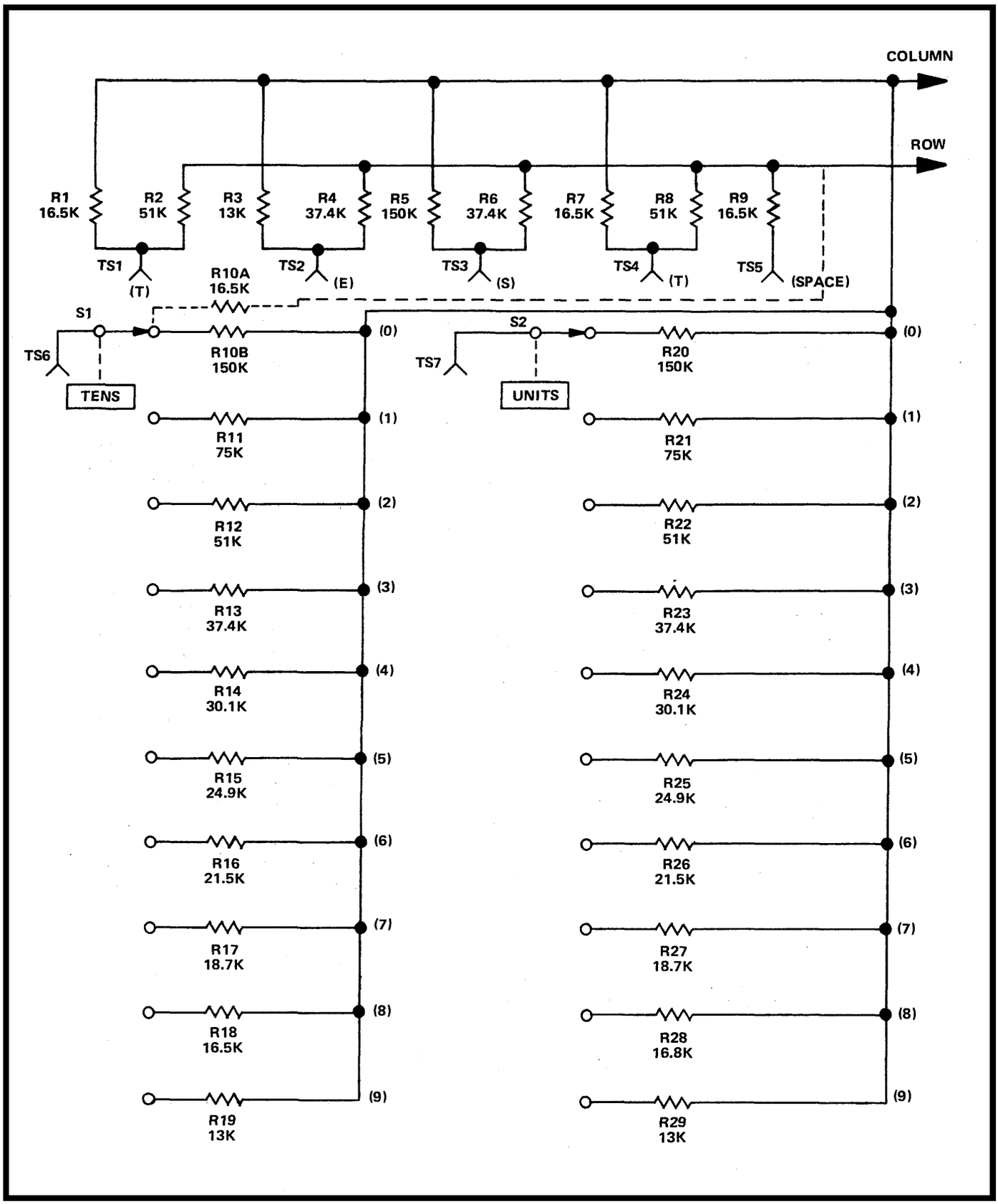

Fig. 4. PROGRAMMING "TEST n"

Ⓐ

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 × 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:			
2-7	390-0193-01	1	CABINET SIDE (left)
2-12	390-0192-01	1	CABINET SIDE (right)
Add:			
	200-1375-00	1	COVER FRONT (oscilloscope)

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

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

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

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

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

SPECIAL NOTES AND SYMBOLS

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

ITEM NAME

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

ABBREVIATIONS

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

CROSS INDEX MFR. CODE NUMBER TO MANUFACTURER

MFR.CODE	MANUFACTURER	ADDRESS	CITY,STATE,ZIP
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
03508	GENERAL ELECTRIC COMPANY, SEMI-CONDUCTOR PRODUCTS DEPARTMENT	ELECTRONICS PARK	SYRACUSE, NY 13201
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867, 19TH AVE. SOUTH	MURTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
07910	TELEDYNE SEMICONDUCTOR	12515 CHADRON AVE.	HAWTHORNE, CA 90250
34553	AMPEREX ELECTRONIC CORP., COMPONENT DIV.	35 HOFFMAN AVE.	HAPPAUGE, NY 11787
50157	N. L. INDUSTRIES, INC., ELECTRONICS DEPT.	P. O. BOX 787	MUSKEGON, MI 49445
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.	1142 W. BEARDSLEY AVE.	ELKHART, IN 46514
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
81483	INTERNATIONAL RECTIFIER CORP.	9220 SUNSET BLVD.	LOS ANGELES, CA 90069
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY 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
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	670-2335-00	B010100	B053530	CKT BOARD ASSY:INTERFACE	80009	670-2335-00
A1	670-2335-01	B053531	B053858	CKT BOARD ASSY:INTERFACE	80009	670-2335-01
A1	670-2335-02	B053859	B055101	CKT BOARD ASSY:INTERFACE	80009	670-2335-02
A1	670-2335-03	B055102		CKT BOARD ASSY:INTERFACE	80009	670-2335-03
A2	670-2336-00			CKT BOARD ASSY:POWER SUPPLY	80009	670-2336-00
A3	670-2413-00			CKT BOARD ASSY:READOUT	80009	670-2413-00
C608	283-0023-00			CAP.,FXD,CER DI:0.1UF,+80-20%,10V	91418	MX104Z1201R0
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%,10V	91418	MX104Z1201R0
C620	283-0023-00			CAP.,FXD,CER DI:0.1UF,+80-20%,10V	91418	MX104Z1201R0
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,(NOM VALUE),SEL	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	B061532	CAP.,FXD,CER DI:2.2PF,(NOM VALUE),SEL	72982	301-000C0J0229C
C637	281-0182-00	B061533		CAP.,VAR,PLSTC:1.8-10PF,500V	34553	2222-809-05002
C639	283-0023-00			CAP.,FXD,CER DI:0.1UF,+80-20%,10V	91418	MX104Z1201R0
C640	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	04222	7001-1380
C652	283-0023-00			CAP.,FXD,CER DI:0.1UF,+80-20%,10V	91418	MX104Z1201R0
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%,10V	91418	MX104Z1201R0
C775	283-0150-00	B010100	B055101	CAP.,FXD,CER DI:650PF,5%,200V	72982	835-515B651J
C775	283-0065-01	B055102		CAP.,FXD,CER DI:0.001UF,5%,100V	80009	283-0065-01
C780	283-0150-00	B010100	B055101	CAP.,FXD,CER DI:650PF,5%,200V	72982	835-515B651J
C780	283-0065-01	B055102		CAP.,FXD,CER DI:0.001UF,5%,100V	80009	283-0065-01
C784	283-0003-00	B010100	B061699	CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C784	283-0164-00	B061700		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%,275V	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	81314147 C 104K
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

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
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	301000Z5D171J
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
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
CR602	152-0141-02	XB050000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR608	152-0141-02	XB050000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR686	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR687	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR740	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR741	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR742	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR761	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR770	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR772	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
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

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
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,150MA	07910	1N4152
CR825	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR832	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR838	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR839	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR848	152-0556-00			SEMICOND DEVICE:BRIDGE,50V,2.5A	04713	SDA10271K
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
CR863	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR864	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR875	152-0556-00			SEMICOND DEVICE:BRIDGE,50V,2.5A	04713	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,150MA	07910	1N4152
CR894	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR903	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR910	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	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,150MA	07910	1N4152
CR927	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR930	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	80009	152-0488-00
CR944	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR950	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR955	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR980	152-0107-00			SEMICOND DEVICE:SILICON,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,150MA	07910	1N4152
CR986	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1002	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1003	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1005	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1010	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1012	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1013	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1018	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1024	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1025	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1040	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1041	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1052	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
F800	159-0028-00			FUSE,CARTRIDGE:3AG,0.25A,250V,FAST-BLOW	71400	AGC 1/4
J610	131-1078-00			CONNECTOR,RCPT,:28/56 CONTACT	95238	K600-11-56Y25
J620	131-1078-00			CONNECTOR,RCPT,:28/56 CONTACT	95238	K600-11-56Y25
J630	131-1078-00			CONNECTOR,RCPT,:28/56 CONTACT	95238	K600-11-56Y25
LR1100	108-0212-00			COIL,RF:0.5UH	80009	108-0212-00
Q600	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
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

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
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	07263	S040065
Q674	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
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	07263	S040065
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	01295	2N3906
Q832	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
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	07263	S040065
Q866	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q870	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
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	07263	S040065
Q910	151-0331-00	B010100	B049999	TRANSISTOR:SILICON,NPN	80009	151-0331-00
Q910	151-0496-00	B050000		TRANSISTOR:SILCION,NPN	03508	D40K2
Q915	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q925	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q940	151-0331-00	B010100	B049999	TRANSISTOR:SILICON,NPN	80009	151-0331-00
Q940	151-0496-00	B050000		TRANSISTOR:SILCION,NPN	03508	D40K2
Q950	151-0342-00			TRANSISTOR:SILICON,PNP	80009	151-0342-00
Q955	151-0342-00			TRANSISTOR:SILICON,PNP	80009	151-0342-00
Q958	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q982	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q984	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q1010	151-0410-00			TRANSISTOR:SILICON,PNP	01295	SKA6991
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	07263	S040065
Q1050	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q1052	151-0410-00			TRANSISTOR:SILICON,PNP	01295	SKA6991

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Q1056	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q1100	151-0410-00			TRANSISTOR:SILICON,PNP	01295	SKA6991
Q1110	151-0410-00			TRANSISTOR:SILICON,PNP	01295	SKA6991
Q1140	153-0597-00			SEMICOND DVC SE:SILICON,PNP	80009	153-0597-00
Q1150						
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
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

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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	315-030-00			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
R750	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	91637	MFF1816G51R1OF
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
RT754	307-0125-00			RES.,THERMAL:500 OHM,10%,25 DEG C	50157	2D1595
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	XB055102		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R774	315-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.25W	01121	CB2245

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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	XB055102		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	B055101	RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R781	315-0102-00	B055102		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	301-0150-00			RES.,FXD,CMPSN:15 OHM,5%,0.50W	01121	EB1505
R802	304-0683-00			RES.,FXD,CMPSN:68K OHM,10%,1W	01121	GB6831
R820	316-0471-00			RES.,FXD,CMPSN:470 OHM,10%,0.25W	01121	CB4711
R822	316-0822-00	B010100	B039999	RES.,FXD,CMPSN:8.2K OHM,10%,0.25W	01121	CB8221
R822	316-0472-00	B040000		RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R823	315-0150-00	XB040000		RES.,FXD,CMPSN:15 OHM,5%,0.25W	01121	CB1505
R824	316-0271-00			RES.,FXD,CMPSN:270 OHM,10%,0.25W	01121	CB2711
R827	308-0742-00			RES.,FXD,WW:0.24 OHM,5%,2W	75042	BWH-R2400J
R829	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R832	316-0102-00	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		RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R836	316-0682-00			RES.,FXD,CMPSN:6.8K OHM,10%,0.25W	01121	CB6821
R838	316-0682-00			RES.,FXD,CMPSN:6.8K OHM,10%,0.25W	01121	CB6821
R839	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R840	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R842	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R845	321-0764-01			RES.,FXD,FILM:5.09K OHM,0.5%,0.125W	91637	MFF1816G50900D
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			RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701
R855	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R856	316-0153-00			RES.,FXD,CMPSN:15K OHM,10%,0.25W	01121	CB1531
R860	321-0816-03			RES.,FXD,FILM:5K OHM,0.25%,0.125W	91637	MFF1816D50000C
R861	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R863	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R866	315-0113-00			RES.,FXD,CMPSN:11K OHM,5%,0.25W	01121	CB1135
R867	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R870	316-0392-00			RES.,FXD,CMPSN:3.9K OHM,10%,025W	01121	CB3921
R871	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	FP-35G51R00J
R881	308-0679-00			RES.,FXD,WW:0.51 OHM,5%,2W	75042	BWH-R5100J
R883	316-0470-00			RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701
R885	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R886	316-0153-00			RES.,FXD,CMPSN:15K OHM,10%,0.25W	01121	CB1531

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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			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R896	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R897	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R900	316-0392-00			RES.,FXD,CMPSN:3.9K OHM,10%,025W	01121	CB3921
R901	315-0561-00	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	91637	FP-35G120R0J
R913	316-0391-00			RES.,FXD,CMPSN:390 OHM,10%,0.25W	01121	CB3911
R915	316-0153-00			RES.,FXD,CMPSN:15K OHM,10%,0.25W	01121	CB1531
R917	321-0268-00			RES.,FXD,FILM:6.04K OHM,1%,0.125W	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			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R925	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R927	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R929	316-0823-00			RES.,FXD,CMPSN:82K OHM,10%,0.25W	01121	CB8231
R930	302-0333-00			RES.,FXD,CMPSN:33K OHM,10%,0.50W	01121	EB3331
R935	316-0104-00			RES.,FXD,CMPSN:100K OHM,10%,0.25W	01121	CB1041
R936	316-0473-00			RES.,FXD,CMPSN:47K OHM,10%,0.25W	01121	CB4731
R937	316-0183-00			RES.,FXD,CMPSN:18K OHM,10%,0.25W	01121	CB1831
R940	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			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R943	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R944	307-0384-00	B010100	B049999	RES.,FXD,FILM:270 OHM,2%,4W	91637	FP-33G270R0G
R944	308-0110-00	B050000		RES.,FXD,WW:100 OHM,5%,8W	91637	RS1088K100R0J
R948	321-0256-00			RES.,FXD,FILM:4.53K OHM,1%,0.125W	91637	MFF1816G45300F
R949	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R950	311-1124-00			RES.,VAR,CMPSN: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			RES.,FXD,CMPSN:220 OHM,10%,0.25W	01121	CB2211
R954	316-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R955	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R956	316-0273-00			RES.,FXD,CMPSN:27K OHM,10%,0.25W	01121	CB2731
R957	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R980	316-0272-00			RES.,FXD,CMPSN:2.7K OHM,10%,0.25W	01121	CB2721
R981	316-0562-00			RES.,FXD,CMPSN:5.6K OHM,10%,0.25W	01121	CB5621
R982	316-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R984	316-0153-00			RES.,FXD,CMPSN:15K OHM,10%,0.25W	01121	CB1531
R986	322-0686-03			RES,FXD,FILM:7.23K OHM,0.25%,0.25W	91637	MFF1421D72300C
R987	321-0097-03			RES.,FXD,FILM:100 OHM,0.25%,0.125W	91637	MFF1816D100R0C
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-10000M
R1007	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R1010	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R1012	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R1015	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R1016	316-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R1018	316-0561-00			RES.,FXD,CMPSN:560 OHM,10%,0.25W	01121	CB5611
R1019	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R1020	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R1021	316-0393-00			RES.,FXD,CMPSN:39K OHM,10%,0.25W	01121	CB3931
R1023	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R1024	316-0391-00			RES.,FXD,CMPSN:390 OHM,10%,0.25W	01121	CB3911
R1025	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R1027	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	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			RES.,FXD,CMPSN:560 OHM,10%,0.25W	01121	CB5611
R1071	316-0561-00			RES.,FXD,CMPSN:560 OHM,10%,0.25W	01121	CB5611
R1072	316-0561-00			RES.,FXD,CMPSN:560 OHM,10%,0.25W	01121	CB5611
R1073	316-0563-00			RES.,FXD,CMPSN:56K OHM,10%,0.25W	01121	CB5631
R1080	316-0823-00			RES.,FXD,CMPSN:82K OHM,10%,0.25W	01121	CB8231
R1082	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R1083	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R1084	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R1086	321-0296-00			RES.,FXD,FILM:11.8K OHM,1%,0.125W	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
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-500R0M
R1111	316-0681-00			RES.,FXD,CMPSN:680 OHM,10%,0.25W	01121	CB6811
R1113	321-0125-00			RES.,FXD,FILM:196 OHM,1%,0.125W	91637	MFF1816G196R0F
R1115	321-0242-00			RES.,FXD,FILM:3.24K OHM,1%,0.125W	91637	MFF1816G32400F

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
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-500R0M
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	B010250	RES.,FXD,FILM:422 OHM,1%,0.125W	91637	MFF1816G422R0F
R1143	321-0126-00	B010251	B054739	RES.,FXD,FILM:200 OHM,1%,0.125W	91637	MFF1816G200R0F
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	75042	CECT0-6980F
R1155	316-0681-00			RES.,FXD,CMPSN:680 OHM,10%,0.25W	01121	CB6811
R1156	316-0333-00			RES.,FXD,CMPSN:33K OHM,10%,0.25W	01121	CB3331
R1157	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
T800	120-0821-00			XFMR,PWR:	80009	120-0821-00
U620	155-0022-00			MICROCIRCUIT,DI:A AND B LOGIC ML CHAN SW	80009	155-0022-00
U770	156-0057-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	07263	7401PC
U780	156-0039-00			MICROCIRCUIT,DI:DUAL J-K FLIP FLOP	01295	SN7473N
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: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	01295	SN7493AN
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

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
U1094	155-0025-00			MICROCIRCUIT,DI:ML,CHAR GEN PREFIXES	80009	155-0025-00
U1096	155-0026-00			MICROCIRCUIT,DI:ML,CHAR GEN LETTERS	80009	155-0026-00
U1098	155-0027-00			MICROCIRCUIT,DI:ML,CHAR GEN SPCL ALPHA	80009	155-0027-00
U1100	155-0020-00			MICROCIRCUIT,DI:ML,CHANNEL SW OUTPUT ASSY	80009	155-0020-00
U1130	155-0022-00			MICROCIRCUIT,DI:A AND B LOGIC ML CHAN SW	80009	155-0022-00
VR930	152-0357-00			SEMICOND DEVICE:ZENER,0.4W,82V,5%	04713	1N983B
VR940	152-0243-00			SEMICOND DEVICE:ZENER,0.4W,15V,5%	81483	1N965B
VR950	152-0227-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	81483	69-6585
VR1080	152-0243-00			SEMICOND DEVICE:ZENER,0.4W,15V,5%	81483	1N965B
VR1081	152-0243-00			SEMICOND DEVICE:ZENER,0.4W,15V,5%	81483	1N965B
VR1082	152-0243-00			SEMICOND DEVICE:ZENER,0.4W,15V,5%	81483	1N965B

ADJUSTMENTS, DIAGRAMS AND ILLUSTRATIONS

Symbols and Reference Designators

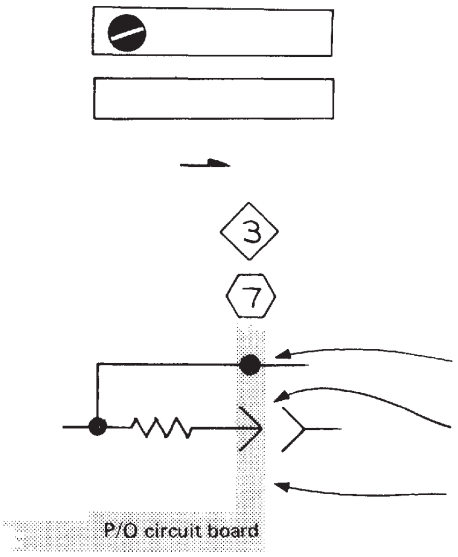
Electrical components shown on the diagrams are in the following units unless noted otherwise:

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

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

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

The following special symbols are used on the diagrams:



External Screwdriver adjustment.

External control or connector.

Clockwise control rotation in direction of arrow.

Refer to diagram number indicated in diamond.

Refer to waveform number indicated in hexagon.

Connection soldered to circuit board.

Connection made to circuit board with interconnecting pin.

Blue tint encloses components located on circuit board.

ADJUSTMENTS

Equipment Required

A display unit must be connected to the 5403. It is not necessary to install any plug-in units.

Preliminary Procedure

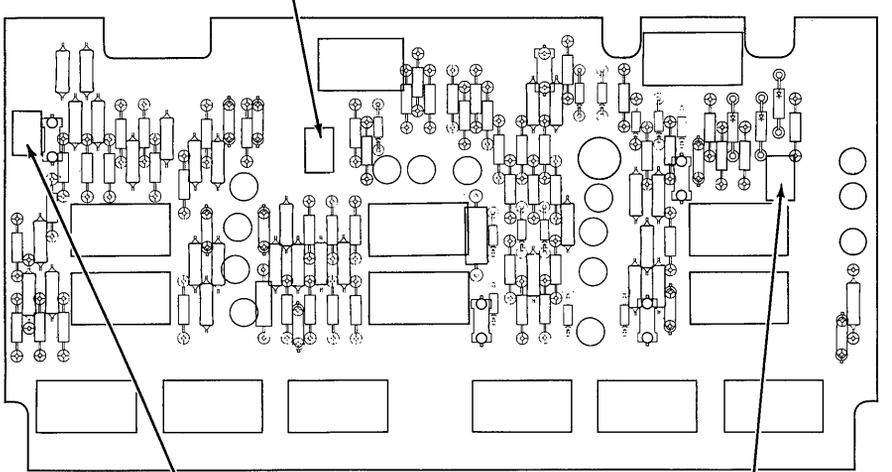
a. Remove the cabinet panels covering the 5403 access to the readout circuit board.

b. With the power to the 5403 turned off, remove Q1052. Turn on the 5403 and display unit.

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

1. Top Row Vertical Spacing, R1118

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

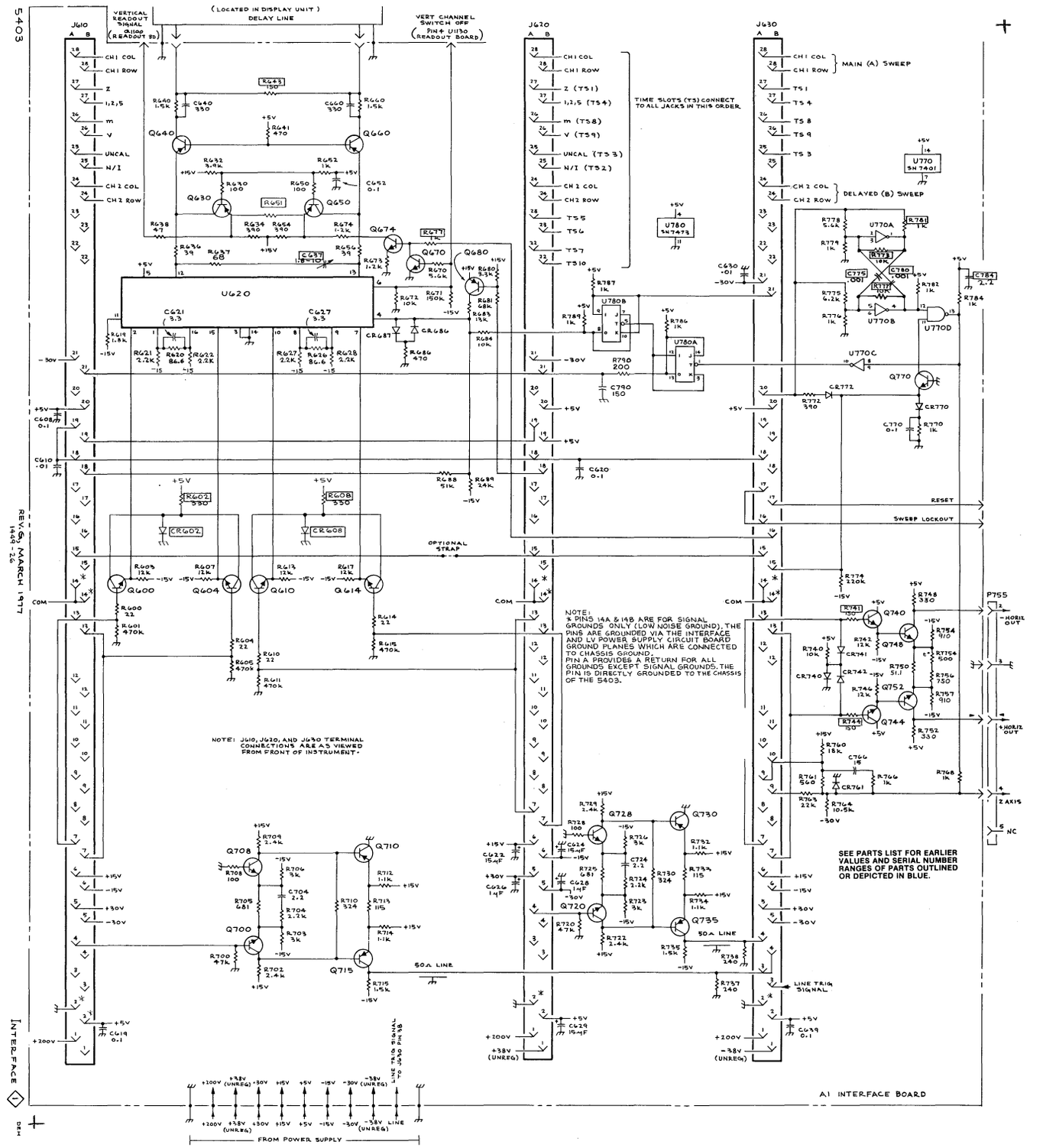


2. Horizontal Positioning, R1110

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

3. Character Scan, R1006

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


5403
REV. G, MARCH 1977
1449-26
INTERFACE
A1 INTERFACE BOARD
J610
J620
J630
VERTICAL READOUT SIGNAL (A1100 READOUT BD.)
(LOCATED IN DISPLAY UNIT) DELAY LINE
VERT CHANNEL SWITCH OFF PIN 4 U1130 (READOUT BOARD)
CH1 COL
CH1 ROW
Z
1,2,5
m
V
UNCAL
N/1
CH2 COL
CH2 ROW
TIME SLOTS (TS) CONNECT TO ALL JACKS IN THIS ORDER
Z (TS1)
1,2,5 (TS4)
m (TS8)
V (TS9)
UNCAL (TS3)
N/1 (TS2)
TS5
TS6
TS7
TS10
MAIN (A) SWEEP
TS1
TS4
TS8
TS9
TS3
DELAYED (B) SWEEP
U620
U770 SN7401
U780 SN7473
U780B
U780A
U770A
U770B
U770C
U770D
U620
RESET
SWEEP LOCKOUT
OPTIONAL STRAP
COM
NOTE: J610, J620, AND J630 TERMINAL CONNECTIONS ARE AS VIEWED FROM FRONT OF INSTRUMENT.
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 A PROVIDES A RETURN FOR ALL GROUNDS EXCEPT SIGNAL GROUNDS. THE PIN IS DIRECTLY GROUNDED TO THE CHASSIS OF THE 5403.
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN BLUE.
50Ω LINE
LINE TRIG SIGNAL
P755
- HORIZ OUT
+ HORIZ OUT
Z AXIS
NC
+200V
+38V (UNREG)
+30V
+15V
+5V
-15V
-30V
-38V (UNREG)
LINE TRIG SIGNAL TO J430 PIN 9B
FROM POWER SUPPLY

ADJUSTMENTS

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

NOTE

This procedure facilitates checking and adjusting the Low-Voltage Power Supply ONLY. For complete oscilloscope mainframe calibration (plug-in interface, deflection amplifiers, CRT circuits, etc.), refer to the calibration procedure given in the manual for the display unit.

Services Available

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

Equipment Required

For power-supply calibration, proper loading must be established to ensure correct operation and regulation of the low-voltage supplies. For best results, the 5403 should be operated with a display unit and plug-in units as this provides actual operating-condition loads for the supplies.

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

Preliminary Procedure

NOTE

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

a. Remove the bottom dust cover of the 5403 to gain access to the LV power supply circuit board.

b. Check that the correct nominal line-selector block (120 VAC or 240 VAC) has been installed on the line-selector pins and that the regulating range selected includes the input line voltage, see Installation section for complete instructions.

c. Connect the 5403 to the line voltage source. Turn the Intensity control on the display unit counterclockwise and pull the Power switch out to turn the instrument on.

d. Allow a 20 minute warm up time before performing the calibration procedure.

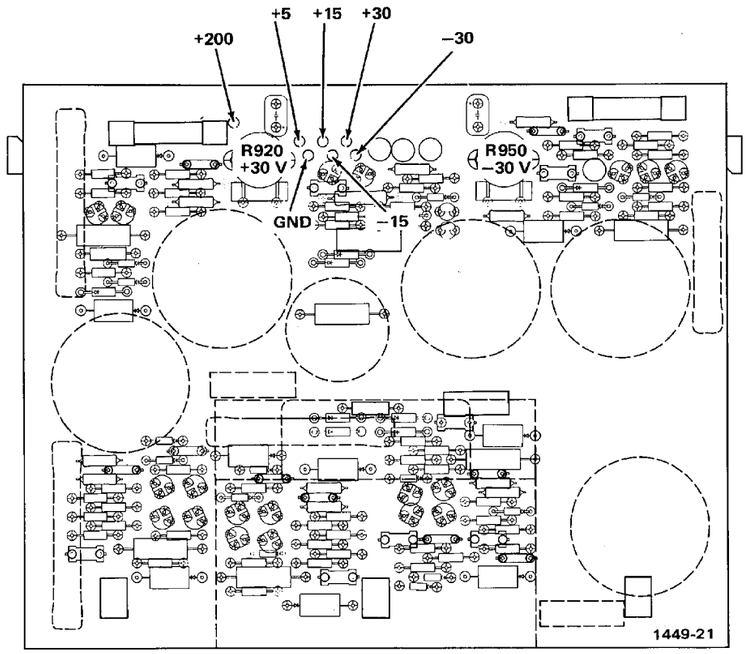
1. LV Power Supply Checks

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

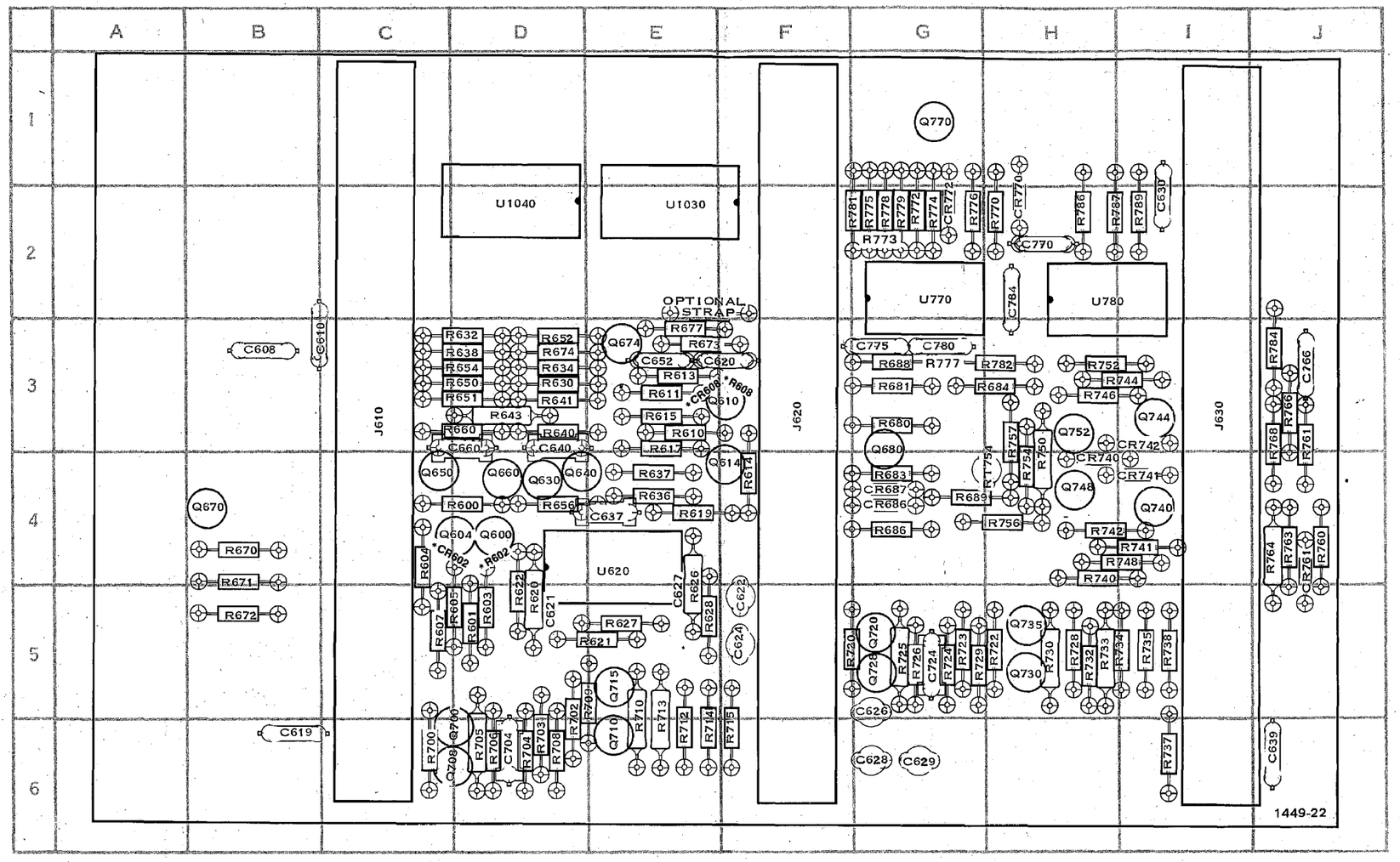
Supply	Tolerance
−30 V	−29.925 V to −30.075 V
−15 V	−14.85 V to −15.15 V
+5 V	+4.9 V to +5.1 V
+15 V	+14.85 V to +15.15 V
+30 V	+29.95 V to +30.075 V
+200 V	+180 V to +240 V

2. LV Power Supply Voltage Adjustments

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



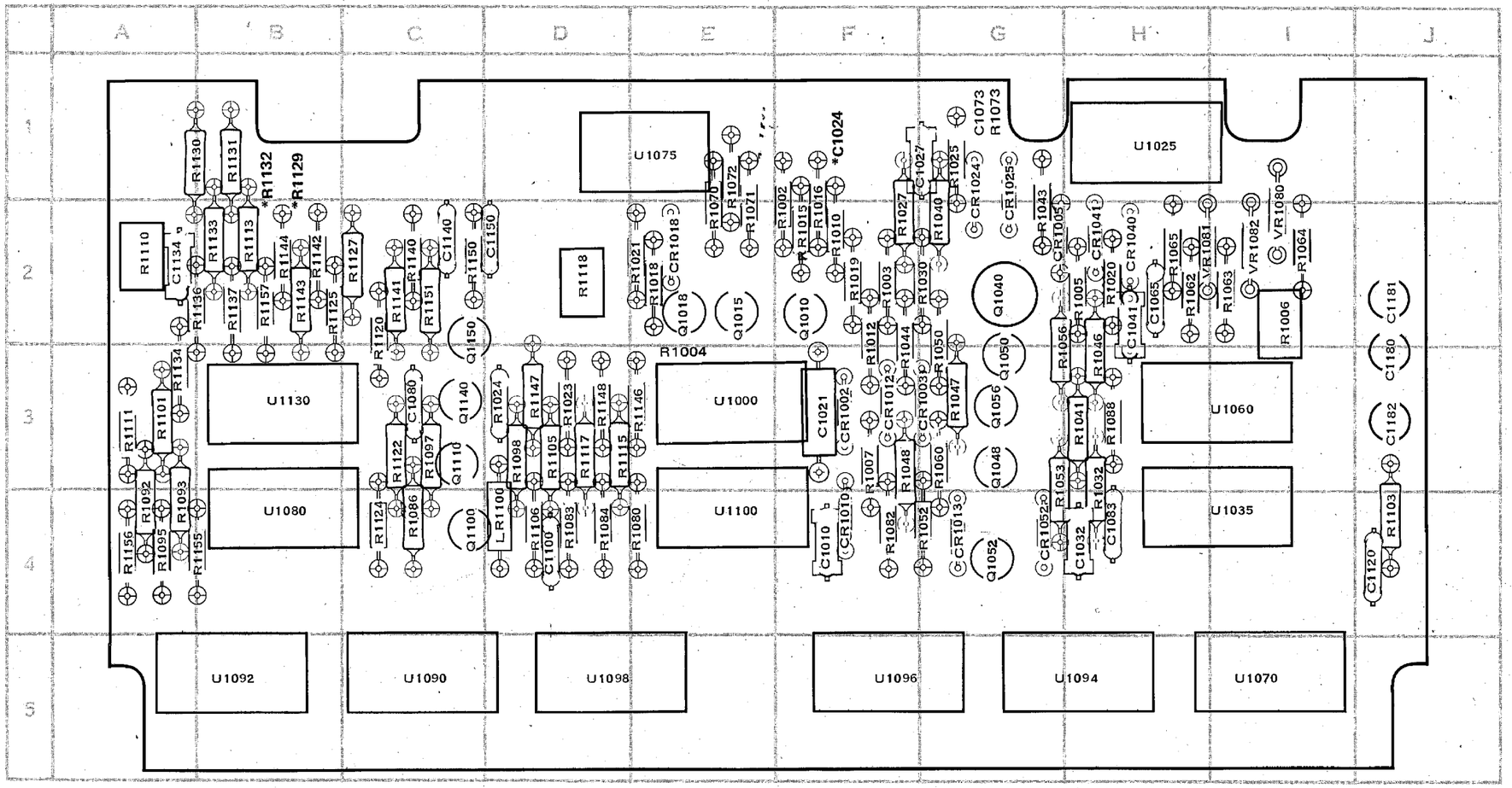
PARTS LOCATION GRID



*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	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C608	B-3	C704	D-6	J610	C-3	Q710	E-6	R607	C-5	R634	D-3	R674	D-3	R712	E-6	R738	I-5	R770	H-2	RT754	G-4
C610	B-3	C724	G-5	J620	F-3	Q715	E-5	R608	F-3	R636	E-4	R677	E-3	R713	E-6	R740	H-4	R772	G-2		
C619	B-6	C766	J-3	J630	I-3	Q728	G-5	R610	E-3	R637	E-4	R680	G-3	R714	E-6	R741	H-4	R773	G-2		
C620	E-3	C770	H-2			Q730	H-5	R611	E-3	R638	D-3	R681	G-3	R715	F-6	R742	H-4	R774	G-2	U620	E-4
C621	D-5	C775	G-3	Q600	D-4	Q735	H-5	R613	E-3	R640	D-3	R683	G-4	R720	F-5	R744	H-3	R775	G-2	U770	G-2
C622	F-5	C780	G-3	Q604	D-4	Q740	I-4	R614	F-4	R641	D-3	R684	H-3	R722	G-5	R746	H-3	R776	G-2	U780	H-2
C624	F-5	C784	H-2	Q610	F-3	Q744	I-3	R615	E-3	R643	D-3	R686	G-4	R723	G-5	R748	H-4	R777	G-3	U1030	E-2
C626	G-5			Q614	F-4	Q748	H-4	R617	E-4	R650	D-3	R688	G-3	R724	G-5	R750	H-3	R778	G-2	U1040	D-2
C627	E-5	CR602	C-4	Q630	D-4	Q752	H-3	R619	E-4	R651	D-3	R689	G-4	R725	G-5	R752	H-3	R779	G-2		
C628	G-6	CR608	F-3	Q640	D-4	Q770	G-1	R620	D-5	R652	D-3	R700	C-6	R726	G-5	R754	H-3	R781	G-2		
C629	G-6	CR686	G-4	Q650	C-4			R621	E-5	R654	D-3	R702	D-6	R728	H-5	R756	H-4	R782	H-3		
C630	I-2	CR687	G-4	Q660	D-4	R600	D-4	R622	D-5	R656	D-4	R703	D-6	R729	G-5	R757	H-3	R784	J-3		
C637	E-4	CR740	H-4	Q670	B-4	R601	D-5	R626	E-4	R660	D-3	R704	D-6	R730	H-5	R760	J-4	R786	H-2		
C639	J-6	CR741	I-4	Q674	E-3	R602	C-4	R627	E-5	R670	B-4	R705	D-6	R732	H-5	R761	J-4	R787	H-2		
C640	D-4	CR742	I-3	Q680	G-3	R603	D-5	R628	E-5	R671	B-5	R706	D-6	R733	H-5	R763	J-4	R789	I-2		
C652	E-3	CR770	H-2	Q700	D-6	R604	C-4	R630	D-3	R672	B-5	R708	D-6	R734	H-5	R764	J-4				
C660	D-4	CR772	G-2	Q708	D-6	R605	D-5	R632	D-3	R673	E-3	R709	E-5	R735	I-5	R766	J-3				
												R710	E-6	R737	I-6	R768	J-3				

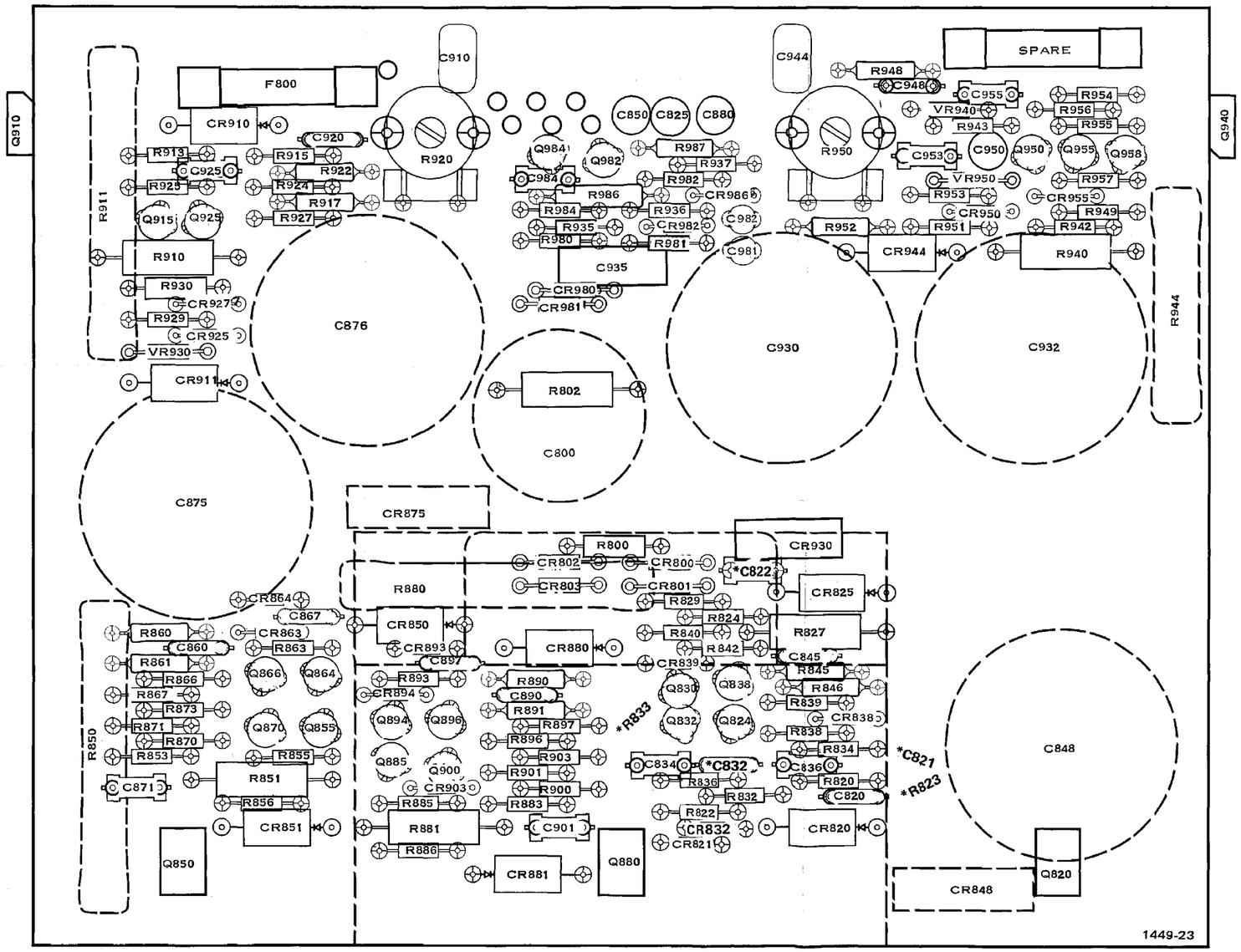
PARTS LOCATION GRID



*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	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
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	R1151	C-2	U1000	E-3	U1130	B-3
C1021	F-3	C1181	J-2			R1003	F-2	R1024	D-3	R1053	G-3	R1084	D-4	R1111	A-3	R1134	A-3	R1155	B-4	U1025	H-1		
C1024	F-1	C1182	J-3	Q1015	E-2	R1004	E-3	R1025	G-1	R1056	G-2	R1086	C-4	R1113	B-2	R1136	A-2	R1156	A-4	U1035	I-4		
C1027	G-1			Q1018	E-2	R1005	H-2	R1027	F-2	R1060	G-3	R1088	H-3	R1115	D-3	R1137	B-2	R1157	B-2	U1060	I-3	VR1080	I-2
C1032	H-4	CR1002	F-3	Q1040	G-2	R1006	I-2	R1030	G-2	R1062	H-2	R1092	A-3	R1117	D-3	R1140	C-2			U1070	I-5	VR1081	H-2
C1041	H-2	CR1003	G-3	Q1048	G-3	R1007	F-3	R1032	H-3	R1063	I-2	R1093	A-3	R1118	D-2	R1141	C-2			U1075	E-1	VR1082	I-2
C1065	H-2	CR1005	G-2	Q1050	G-2	R1010	F-2	R1041	H-3	R1064	I-2	R1095	A-4	R1120	C-2	R1142	B-2			U1080	B-4		
C1073	G-1	CR1010	F-4	Q1052	G-4	R1012	F-2	R1043	G-1	R1065	H-2	R1097	C-3	R1122	C-3	R1143	B-2			U1090	C-5		
C1080	C-3	CR1012	F-3	Q1056	G-3	R1015	F-2	R1044	F-2	R1070	E-1	R1098	D-3	R1124	C-4	R1144	B-2			U1092	B-5		
C1083	H-4	CR1013	G-4	Q1100	C-4	R1016	F-1	R1046	H-2	R1071	E-1	R1101	A-3	R1125	B-2	R1146	E-3			U1094	H-5		
C1100	D-4	CR1018	E-2	Q1110	C-3	R1018	E-2	R1047	G-3	R1072	E-1	R1103	J-4	R1127	C-2	R1147	D-3			U1096	F-5		
C1120	J-4	CR1024	G-1	Q1140	C-3	R1019	F-2	R1048	F-3	R1073	G-1	R1105	D-3	R1129	B-1	R1148	D-3			U1098	D-5		
C1134	A-2	CR1040	H-2	Q1150	C-2	R1020	H-2	R1050	G-2	R1080	E-4	R1106	D-4	R1130	A-1	R1150	C-2			U1100	E-4		
C1140	C-2	CR1041	H-2			R1021	E-2			R1082	F-4			R1131	B-1								
C1150	D-2	CR1052	G-4											R1132	B-1								

PARTS LOCATION GRID



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				

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

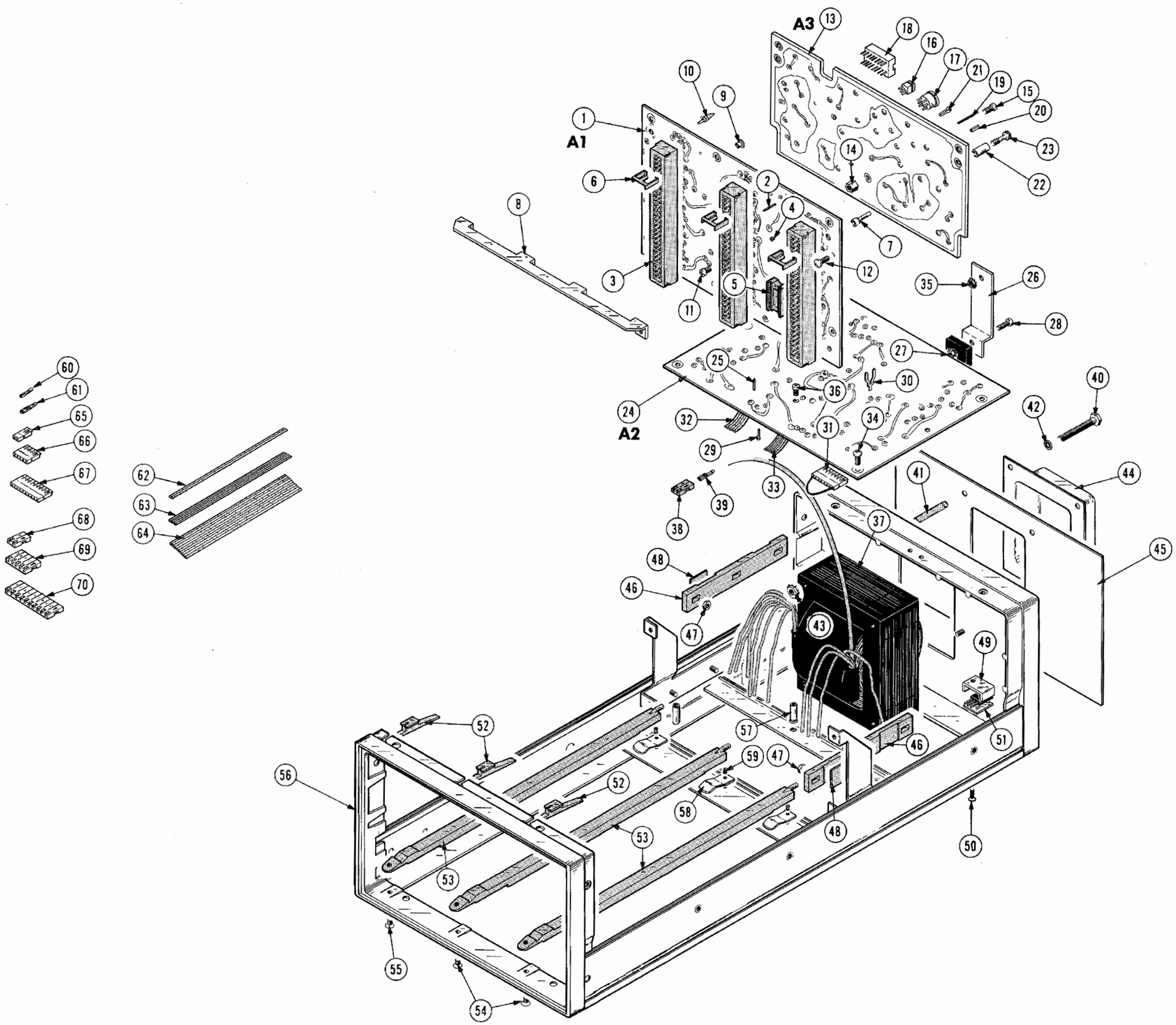
MFR.CODE	MANUFACTURER	ADDRESS	CITY,STATE,ZIP
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
06666	GENERAL DEVICES CO., INC.	525 S. WEBSTER AVE.	INDIANAPOLIS, IN 46219
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
23499	GAVITT WIRE AND CABLE, DIVISION OF RSC INDUSTRIES, INC.	455 N. QUINCE ST.	ESCONDIDO, CA 92025
45722	USM CORP., PARKER-KALON FASTENER DIV.		CAMPBELLSVILLE, KY 42718
57771	STIMPSON, EDWIN B., CO., INC.	900 SYLVAN AVENUE	BAYPORT, NY 11705
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71785	TRW, CINCH CONNECTORS	1501 MORSE AVENUE	ELK GROVE VILLAGE, IL 60007
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
77250	PHEOLL MANUFACTURING CO., DIVISION OF ALLIED PRODUCTS CORP.	5700 W. ROOSEVELT RD.	CHICAGO, IL 60650
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
86445	PENN FIBRE AND SPECIALTY CO., INC.	2032 E. WESTMORELAND ST.	PHILADELPHIA, PA 19134
95238	CONTINENTAL CONNECTOR CORP.	34-63 56TH ST.	WOODSIDE, NY 11377

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-1	----- -----			1	CKT BOARD ASSY:INTERFACE(SEE A1 EPL)		
-2	131-0590-00			29	. CONTACT,ELEC:0.71 INCH LONG	22526	47351
-3	131-1078-00			3	. CONNECTOR,RCPT,:28/56 CONTACT	95238	K600-11-56Y25
-4	136-0252-04			2	. CONTACT,ELEC:0.188 INCH LONG	22526	75060
-5	136-0260-02			3	. SOCKET,PLUG-IN:16 CONTACT,LOW CLEARANCE	01295	C931602
	136-0269-00			2	. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	71785	133-59-02-073
-6	214-1593-02			3	. KEY,CONN PLZN:	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	. BRACKET,REINF:	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:PLASTIC	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 A3 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	01295	C931602
	136-0269-00			1	. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	71785	133-59-02-073
-19	131-0589-00			9	. CONTACT,ELEC:0.46 INCH LONG	22526	47350
-20	136-0263-03			25	. CONTACT,ELEC:FOR 0.025 INCH SQUARE PIN	00779	86250-2
-21	214-0579-00			2	. TERM.,TEST PT:0.40 INCH LONG	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 A2 EPL)		
-25	131-0608-00			23	. CONTACT,ELEC:0.365 INCH LONG	22526	47357
	131-0589-00			16	. CONTACT,ELEC:0.46 INCH LONG	22526	47350
-26	214-1804-00			1	. HEAT SINK,ELEC:	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:0.40 INCH LONG	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:3A6,0.7A,250V,SLOW-BLOW	71400	MDL7/10
-31	131-1895-00			1	. LINK,TERM.CONNE:	80009	131-1895-00
	352-0166-02			1	. . CONN BODY,PL,EL:8 WIRE RED	80009	352-0166-02
	131-0707-00			2	. . CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	47439
	131-1896-00			1	. LINK,TERM.CONNE:	80009	131-1896-00
	352-0166-01			1	. . CONN BODY,PL,EL:8 WIRE BROWN	80009	352-0166-01
	131-0707-00			2	. . CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	47439
-32	175-0860-00			IN	. WIRE,ELECTRICAL:5 WIRE RIBBON,3 IN L	23499	TEK-175-0860-00
-33	175-0859-00			IN	. WIRE,ELECTRICAL:6 WIRE RIBBON,3 IN L	23499	TEK-175-0859-00
					(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
					- - - * - - -		
-37	----- -----			1	TRANSFORMER:(SEE T800 EPL)		
-38	352-0198-00			1	. CONN BODY,PL,EL: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

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-42	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
					- - - * - - -		
-44	200-0772-02			1	COVER,ELEC XFMR:	80009	200-0772-02
-45	333-1682-00			1	PANEL,REAR:	80009	333-1682-00
-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	351-0293-00			3	GUIDE,SLIDE:BLUE	80009	351-0293-00
-53	351-0286-01	B010100	B010443	3	GUIDE,SLIDE:BLACK,LOWER	80009	351-0286-01
	352-0286-02	B010444	B041135	3	GUIDE,SLIDE:BLACK,LOWER	80009	352-0286-02
	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			1	FRAME ASSY,CAB:	80009	426-0934-00
-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" LONG	57771	G53-4
					- - - * - - -		
-60	131-0707-00			17	CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	47439
-61	131-0621-00			17	CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46231
-62	175-0863-00			FT	WIRE,ELECTRICAL:2 WIRE RIBBON	80009	175-0863-00
-63	175-0860-00			FT	WIRE,ELECTRICAL:5 WIRE RIBBON	23499	TEK-175-0860-00
-64	175-0855-00			FT	WIRE,ELECTRICAL:10 WIRE RIBBON	23499	TEK-175-0855-00
-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	CONN BODY,PL,EL: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

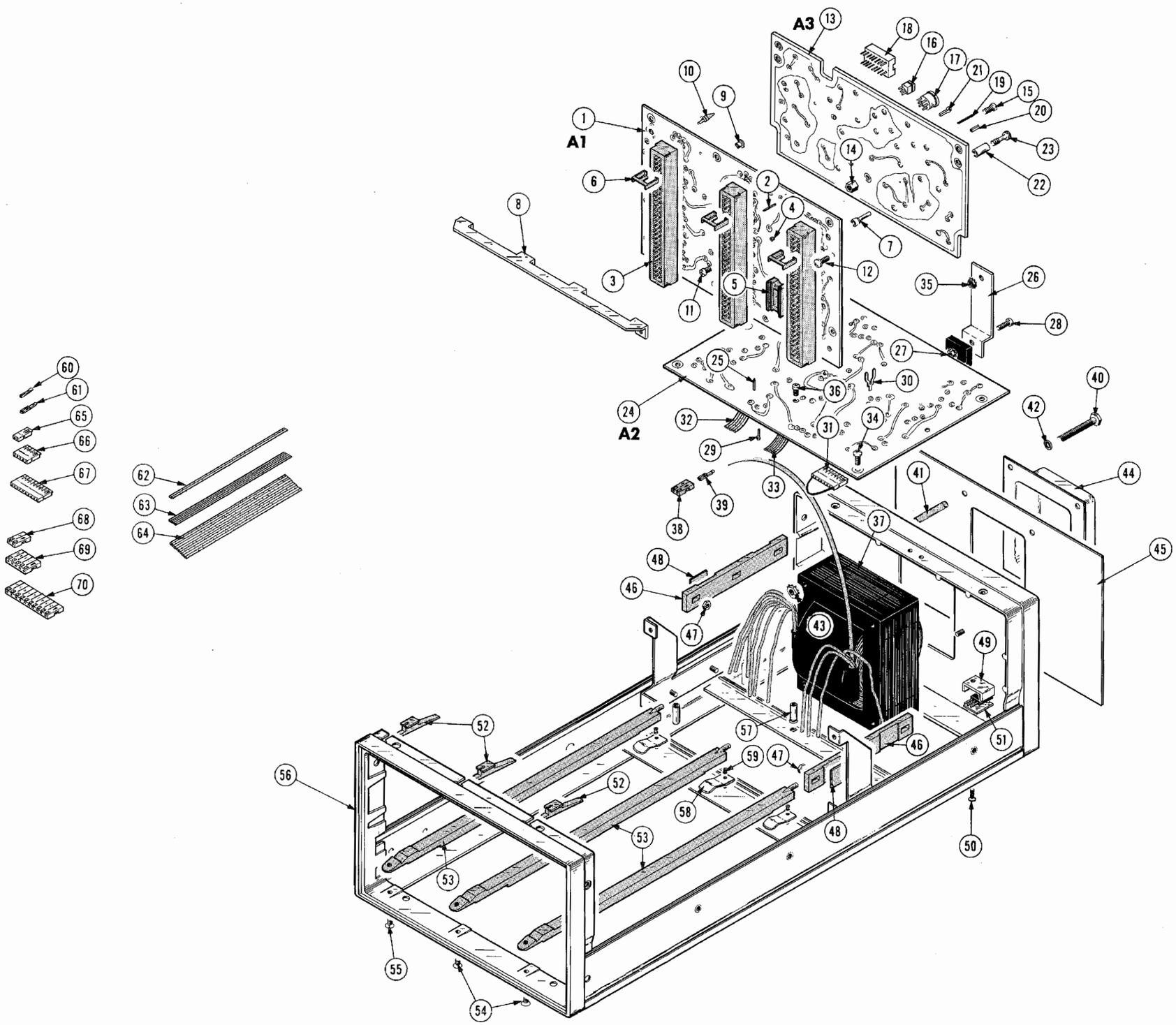
Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-1	200-0728-04			1		COV,HANDLE END:FRONT	80009	200-0728-04
-2	200-0728-00			1		COV,HANDLE END:REAR	80009	200-0728-00
-3	367-0116-00			1		HANDLE,CARRYING:	80009	367-0116-00
						(ATTACHING PARTS)		
-4	212-0597-00			4		SCREW,MACHINE:10-32 X 0.50 INCH,STL	83385	OBD
-5	386-1624-00			2		PL,RET.,HANDLE:	80009	386-1624-00
-6	386-1283-00			2		PLATE,HDL MTG:PLASTIC	80009	386-1283-00
						- - - * - - -		
-7	390-0193-00			1		COVER,SCOPE:LEFT	80009	390-0193-00
	214-0812-00			4		. FASTENER,PAWL:	80009	214-0812-00
	----- -----			-		. . EACH FASTENER INCLUDES:		
-8	386-0226-00			1		. . PL,LATCH LKG:FOR 0.080 INCH THICKNESS	80009	386-0226-00
-9	386-0227-00			1		. . PL,LATCH INDEX:	80009	386-0227-00
-10	214-0604-00			1		. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-11	214-0603-01			1		. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-12	390-0192-00			1		COVER,SCOPE:RIGHT	80009	390-0192-00
	214-0812-00			2		. FASTENER,PAWL:	80009	214-0812-00
						(EACH FASTENER INCLUDES)		
-13	386-0226-00			1		. . PL,LATCH LKG:FOR 0.080 INCH THICKNESS	80009	386-0226-00
-14	386-0227-00			1		. . PL,LATCH INDEX:	80009	386-0227-00
-15	214-0604-00			1		. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-16	214-0603-01			1		. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-17	390-0190-00			1		COVER,SCOPE:BOTTOM	80009	390-0190-00
	214-0812-00			4		. FASTENER,PAWL:	80009	214-0812-00
						(EACH FASTENER INCLUDES)		
-18	386-0226-00			1		. . PL,LATCH LKG:FOR 0.080 INCH THICKNESS	80009	386-0226-00
-19	386-0227-00			1		. . PL,LATCH INDEX:	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
						(ATTACHING PARTS FOR EACH SPACER)		
-31	212-0105-00			2		SCREW,MACHINE:8-32 X 0.312 INCH,HH,STL	80009	212-0105-00
-32	212-0008-00			2		SCREW,MACHINE:8-32 X 0.312 INCH,PNH STL	83385	OBD
-33	210-0008-00			2		WASHER,LOCK:INTL,0.172 ID X 0.331"OD,STL	78189	1208-00-00-0541C
						- - - * - - -		
-34	361-0388-00			2		SPACER,PLATE:	80009	361-0388-00
-35	343-0256-00			2		RTNR BLK,SCOPE:	80009	343-0256-00
						(ATTACHING PARTS FOR EACH)		
-36	211-0531-00			2		SCREW,MACHINE:6-32 X 0.375,FIL,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
3-1	351-0195-00			1	SLIDE,DWR,EXT:PAIR	06666	C719
-2	351-0104-00			1	SLIDE SECT,DWR:PAIR	06666	C-720-2 0
					(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			1	BRACKET,RACK MT:RIGHT	80009	407-0899-03
					(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:LEFT	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			1	COVER,SCOPE:RIGHT	80009	390-0191-00
	214-0812-00			2	. FASTENER,PAWL:	80009	214-0812-00
					(EACH FASTENER INCLUDES)		
-9	386-0226-00			1	. . PL,LATCH LKG:FOR 0.080 INCH THICKNESS	80009	386-0226-00
-10	386-0227-00			1	. . PL,LATCH INDEX:	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			1	COVER,SCOPE:LEFT	80009	390-0194-00
	214-0812-00			2	. FASTENER,PAWL:	80009	214-0812-00
					(EACH FASTENER INCLUDES)		
-14	386-0226-00			1	. . PL,LATCH LKG:FOR 0.080 INCH THICKNESS	80009	386-0226-00
-15	386-0227-00			1	. . PL,LATCH INDEX:	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			2	COVER,SCOPE:BOTTOM	80009	390-0222-00
	214-0812-00			4	. FASTENER,PAWL:	80009	214-0812-00
					(EACH FASTENER INCLUDES)		
-19	386-0226-00			1	. . PL,LATCH LKG:FOR 0.080 INCH THICKNESS	80009	386-0226-00
-20	386-0227-00			1	. . PL,LATCH INDEX:	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
					(ATTACHING PARTS FOR SPACER)		
-23	212-0103-00			6	SCREW,MACHINE:8-32 X 0.375 HEX HD,STL	77250	OBD
-24	210-0008-00			10	WASHER,LOCK:INTL,0.172 ID X 0.331"OD,STL	78189	1208-00-00-0541C
					- - - * - - -		
-25	361-0389-00			1	SPACER,PLATE:	80009	361-0389-00



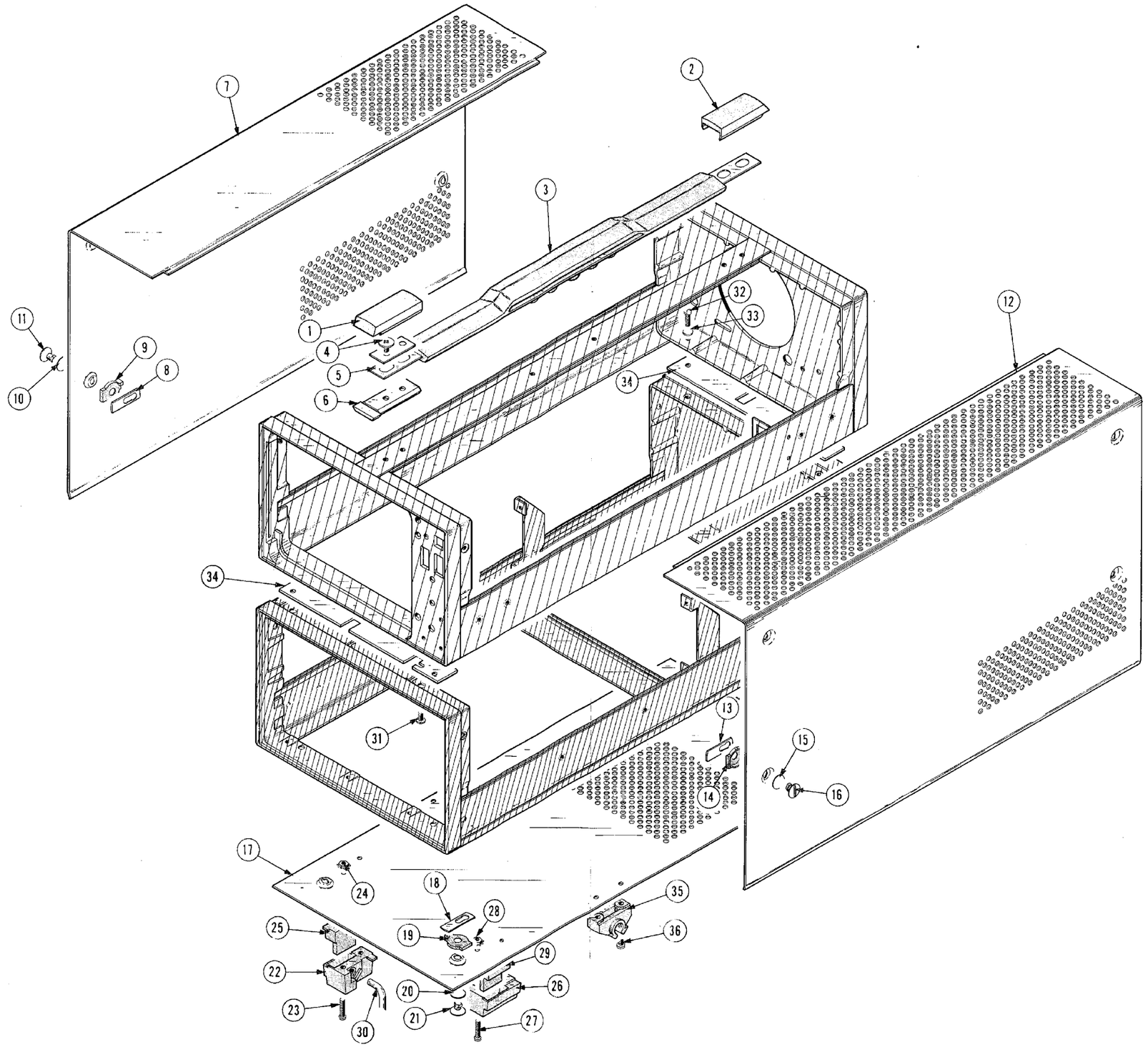
‡REV. B JAN 1976

5403 POWER SUPPLY/AMPLIFIER MODULE

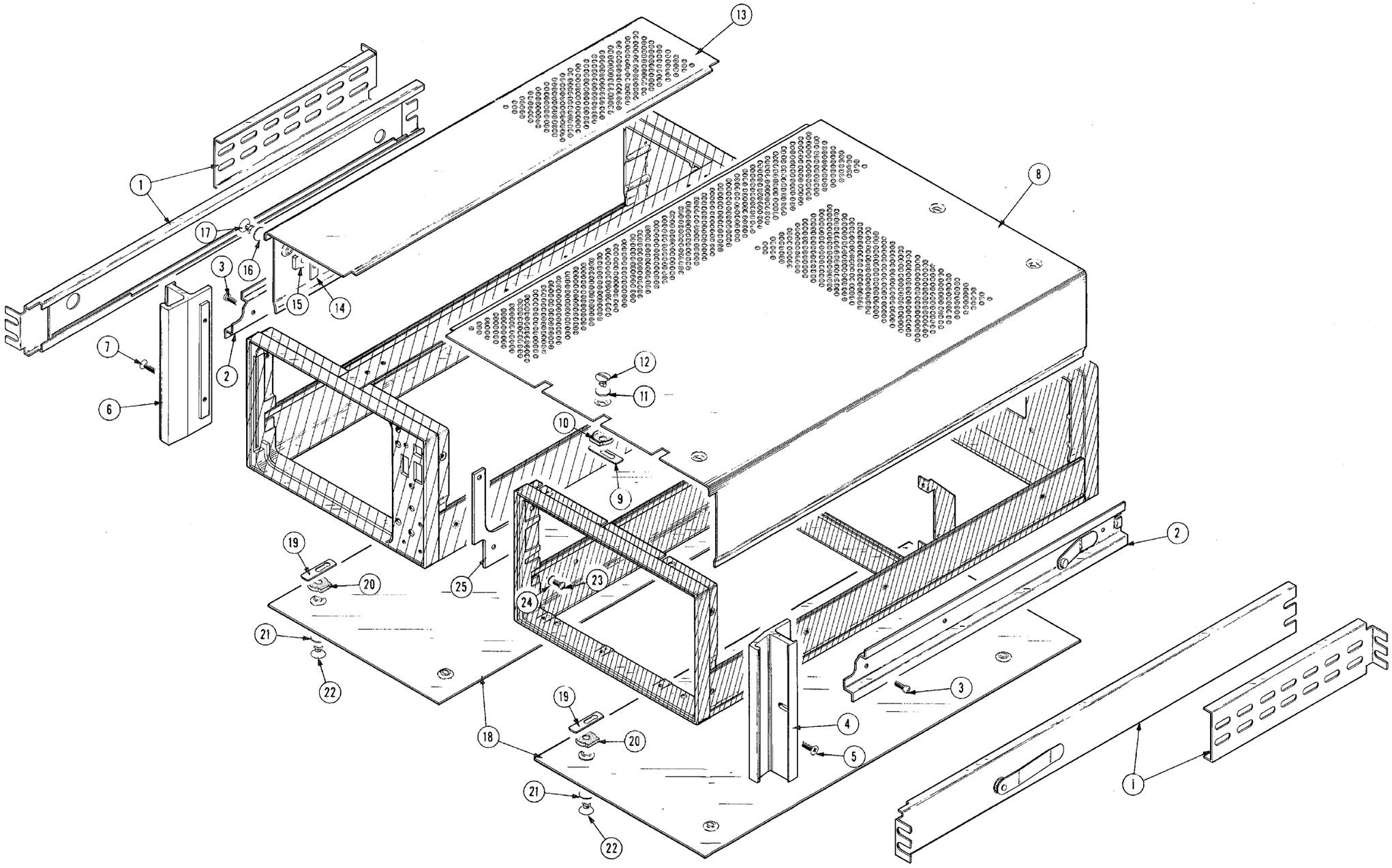


‡REV. B JAN 1976

5403 POWER SUPPLY/AMPLIFIER MODULE



5403 POWER SUPPLY/AMPLIFIER MODULE



5403 POWER SUPPLY/AMPLIFIER MODULE

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
	070-1449-00			1		MANUAL,TECH:INSTRUCTION (NOT SHOWN)	80009	070-1449-00

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.
111	PG 501 - Risetime less than 3.5 ns; 8 ns Pretrigger pulse delay.	111 - Risetime 0.5 ns; 30 to 250 ns Pretrigger Pulse delay.
114	PG 501 - ±5 V output.	114 - ±10 V output. Short proof output.
115	PG 501 - Does not have Paired, Burst, Gated, or Delayed pulse mode; ±5 V dc Offset. Has ±5 V output.	115 - Paired, Burst, Gated, and Delayed pulse mode; ±10 V output. Short-proof output.
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.
114	PG 502 - ±5 V output	114 - ±10 V output. Short proof output.
115	PG 502 - Does not have Paired, Burst, Gated, Delayed & Undelayed pulse mode; Has ±5 V output.	115 - Paired, Burst, Gated, Delayed & Undelayed pulse mode; ±10 V output. Short-proof output.
2101	PG 502 - Does not have Paired or Delayed pulse. Has ±5 V output.	2101 - Paired and Delayed pulse; 10 V output.
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	SG 503 - Frequency range 250 kHz to 250 MHz.	191 - Frequency range 350 kHz to 100 MHz.
067-0532-01	SG 503 - Frequency range 250 kHz to 250 MHz.	0532-01 - Frequency range 65 MHz to 500 MHz.
TG 501 replaces 180, 180A	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	180A - Marker outputs, 5 sec to 1 μs. Sinewave available at 20, 10, and 2 ns. Trigger pulses 1, 10, 100 Hz; 1, 10, and 100 kHz. Multiple time-marks can be generated simultaneously.
181	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns.	181 - Marker outputs, 1, 10, 100, 1000, and 10,000 μs, plus 10 ns sinewave.
184	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	184 - Marker outputs, 5 sec to 2 ns. Sinewave available at 50, 20, 10, 5, and 2 ns. Separate trigger pulses of 1 and .1 sec; 10, 1, and .1 ms; 10 and 1 μs. Marker amplifier provides positive or negative time marks of 25 V min. Marker intervals of 1 and .1 sec; 10, 1, and .1 ms; 10 and 1 μs.
2901	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	2901 - Marker outputs, 5 sec to 0.1 μs. Sinewave available to 50, 10, and 5 ns. 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

PRODUCT 5440/R & 5441/R
070-2139-01 & 070-2140-00

CHANGE REFERENCE M30734

DATE 11-8-77

CHANGE:	DESCRIPTION

EFF SN B074125 (5440/R) EFF SN B062200 (5441/R)

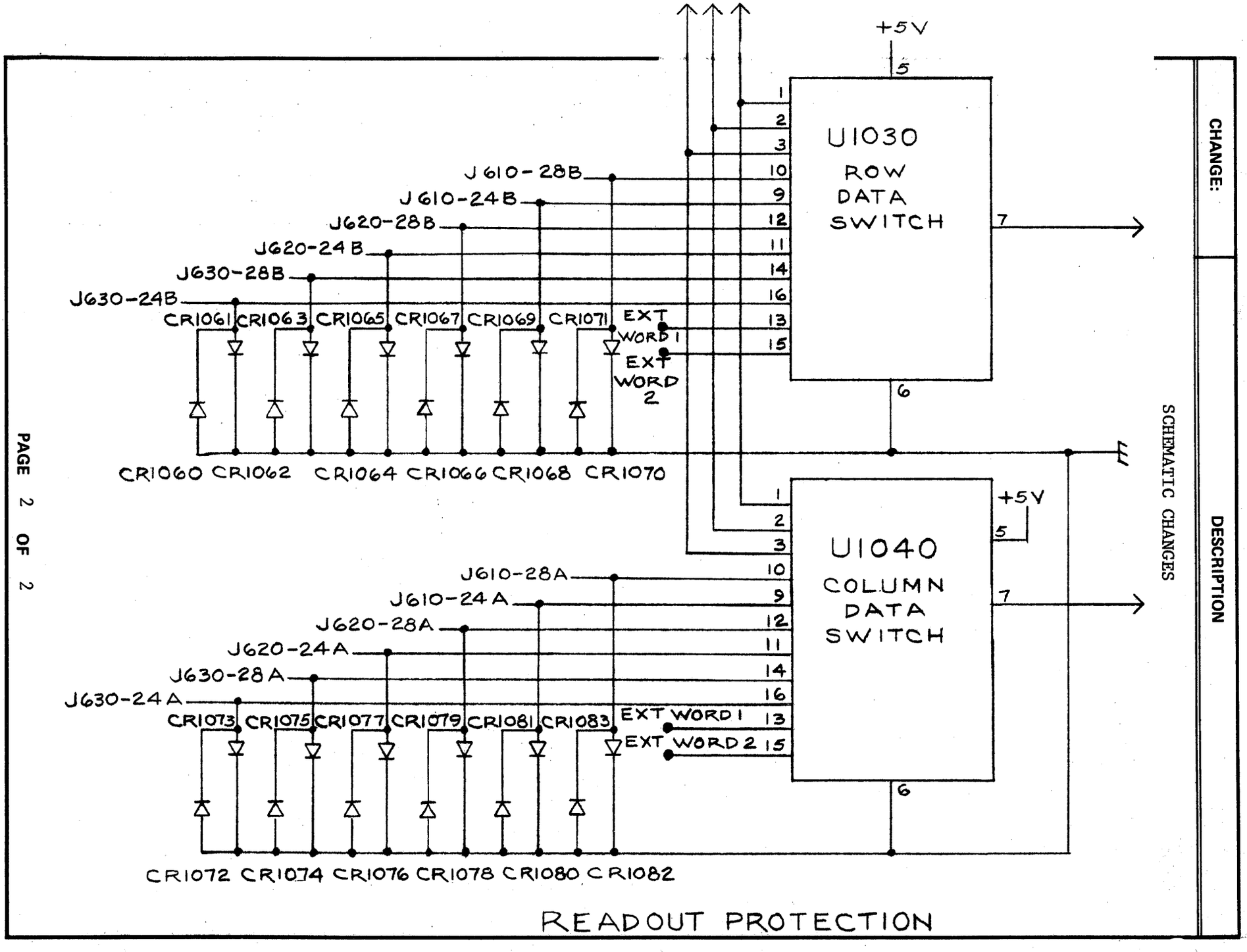
ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

CHANGE TO:

A2	670-2335-04	CKT BOARD ASSY:INTERFACE

ADD:

	670-5035-00	CKT BOARD ASSY:READOUT PROTECTION
CR1060 thru CR1083	152-0333-00	SEMICOND DEVICE:SILICON,55V,200MA,1N461D



PRODUCT 5440/R, 5441/R CHANGE REFERENCE M30734 DATE 11-8-77

CHANGE: DESCRIPTION

SCHEMATIC CHANGES

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MANUAL CHANGE INFORMATION

PRODUCT 5440 & 5441

CHANGE REFERENCE M30792

DATE 3-17-77

CHANGE:	DESCRIPTION

EFF SN B073789 (5440) 070-2139-01

EFF SN B061967 (5441) 070-2140-00

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

CHANGE TO:

DL100	119-0693-00	DELAY LINE,ELEC:

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MANUAL CHANGE INFORMATION

PRODUCT 5440/R & 5441/R

CHANGE REFERENCE M24,547

DATE 10-8-76

CHANGE:	DESCRIPTION

EFF SN B033100-up (5440) 070-2139-01

EFF SN B021497-up (5441) 070-2140-00

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

CHANGE TO:

C180	283-0111-00	CAP.,FXD,CER DI:0.1UF,20%,50V
C192	283-0111-00	CAP.,FXD,CER DI:0.1UF,20%,50V
C197	283-0111-00	CAP.,FXD,CER DI:0.1UF,20%,50V
C198	283-0111-00	CAP.,FXD,CER DI:0.1UF,20%,50V

The parts listed above are located on the VERTICAL circuit board assembly and shown on diagram 1 VERTICAL AMPLIFIER.

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MANUAL CHANGE INFORMATION

PRODUCT 5441
070-2140-00

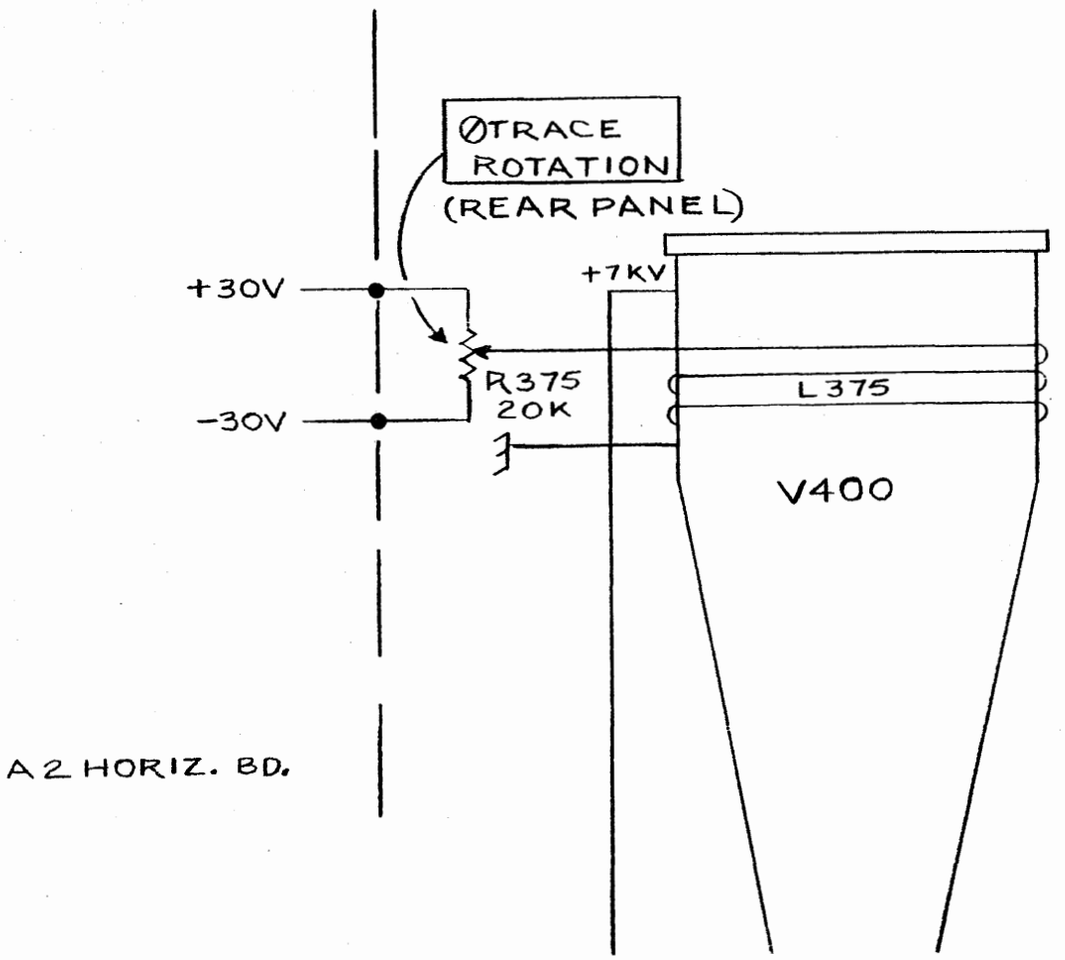
CHANGE REFERENCE M22400
DATE 8-3-77 REV.

CHANGE:	DESCRIPTION

EFF SN B020000

The Trace Rotation pot R375 is moved from the HORIZONTAL AMPLIFIER circuit board to the top right corner of rear panel. See schematic sketch below.

DIAGRAM ◇2◇ Z-AXIS AMPLIFIER & CRT CIRCUIT



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MANUAL CHANGE INFORMATION

PRODUCT 5440/R & 5441/R
070-2139-01 & 070-2140-00

CHANGE REFERENCE M24973
DATE 5-24-77 REV. 8-15-77

CHANGE:	DESCRIPTION

EFF SN B080000-up MECHANICAL PARTS LIST CHANGES

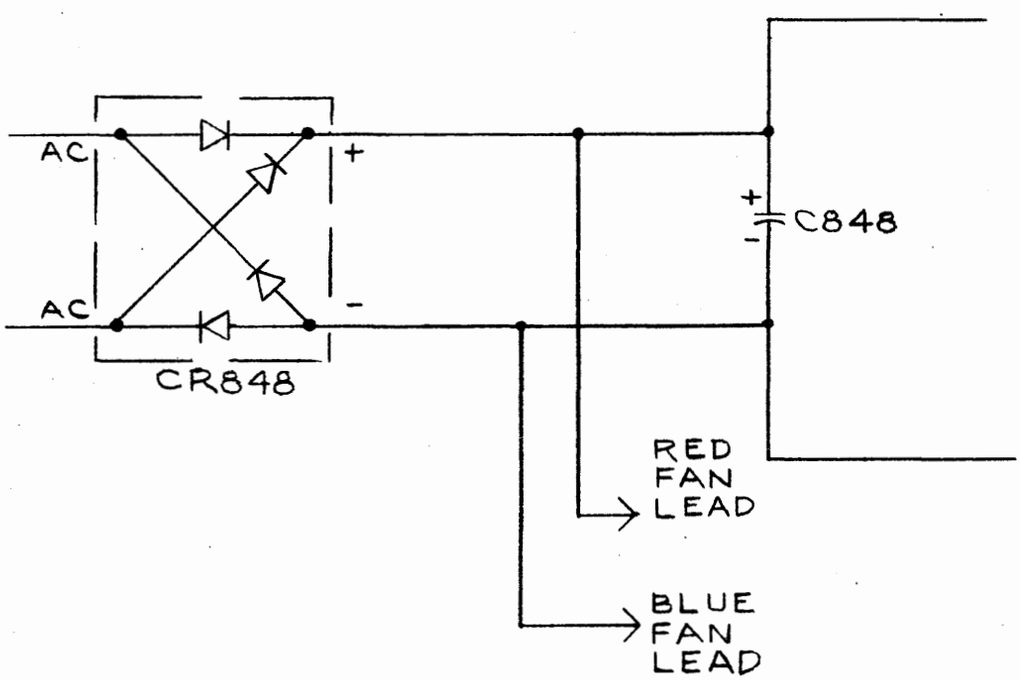
CHANGE TO:

Fig. 2-45	333-1833-02	1	PANEL,REAR
Fig. 2-56	426-0934-01	1	FRAME ASSY,CABINET
	426-0719-24	1	FRAME SECTION
	390-0469-01	2	CABINET SIDE
	390-0470-01	1	CABINET BOTTOM
	390-0502-01	1	CABINET SIDE
	390-0503-01	1	CABINET SIDE
	390-0505-01	2	CABINET BOTTOM

ADD:

333-1889-01	1	PANEL,REAR
119-0830-00	1	FAN
378-2027-01	1	FAN,GRILL
211-0018-00	2	SCREW,MACHINE:4-40 X 0.875",PNH
211-0144-00	4	SCREW,MACHINE:4-40 X 1.312.PNH
380-0490-00	1	HOUSING,FAN
407-1889-00	1	BRACKET,FAN
210-0994-00	4	WASHER,FLAT

DIAGRAM <2> LOW-VOLTAGE SUPPLY AND CALIBRATOR - Partial



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MANUAL CHANGE INFORMATION

PRODUCT 5440/R & 5441/R
070-2139-01 & 070-2140-00

CHANGE REFERENCE M31308

DATE 4-5-77

CHANGE:	DESCRIPTION

EFF SN B073840 (5440/R)

EFF SN B062000 (5441/R)

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

CHANGE TO:

VR245	152-0428-00	SEMICOND DEVICE:ZENER,0.4W,120V,5%

VR245 is located on the HORIZONTAL AMPLIFIER board and shown on diagram 4 in the 5440 manual and diagram 2 in the 5441 manual.