

TEKTRONIX®

475

OSCILLOSCOPE

SERVICE

INSTRUCTION MANUAL

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Serial Number _____

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273



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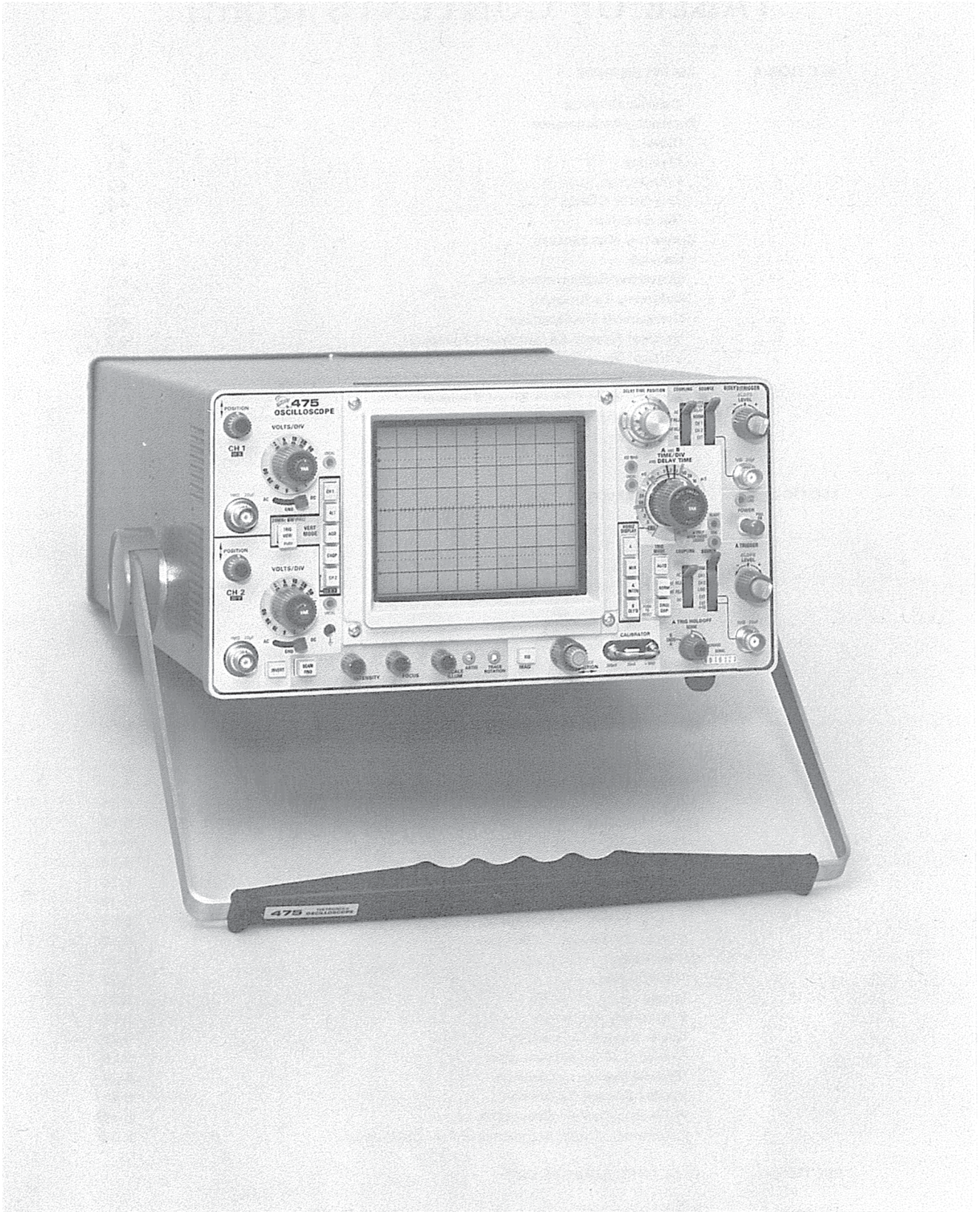
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475 Oscilloscope

SPECIFICATION

Introduction

The 475 Oscilloscope is a wide bandwidth, portable oscilloscope designed to operate in a wide range of environmental conditions. The instrument is light in weight and compact of design for ease of transportation, yet capable of performance necessary for accurate high-frequency measurements. The dual-channel, DC-to-200 megahertz vertical deflection system provides calibrated deflection factors from 2 millivolts to 5 volts/division. The bandwidth limiting switch reduces interference from signals above about 20 megahertz for viewing low-frequency, low-level signals.

The trigger circuits provide stable sweep triggering to beyond the bandwidth of the vertical deflection system. Separate controls are provided to select the desired mode of triggering for the A and B sweeps. The A sweep can be operated in one of three modes; automatic triggering, normal triggering, or single sweep. A variable trigger holdoff control provides the ability for A sweep to trigger in a stable manner on aperiodic signals or complex digital

words. The horizontal deflection system has calibrated sweep rates from .5 second to .01 microsecond/division. A X10 magnifier increases each sweep rate by a factor of 10 to provide a maximum sweep rate of one nanosecond/division in the .01 μ s position. The delayed and mixed sweep features allow the start of B sweep to be delayed a selected amount from the start of A sweep to provide accurate relative-time measurements. Calibrated X-Y measurements can be made with Channel 2 providing the vertical deflection and Channel 1 providing the horizontal deflection (TIME/DIV switch fully counterclockwise and VERT MODE switch to CH 2). The regulated DC power supplies ensure that instrument performance is not affected by variations in line voltage and frequency. Maximum power consumption of the instrument is approximately 100 watts.

The following instrument specifications apply over an ambient temperature range of -15°C to $+55^{\circ}\text{C}$ unless otherwise specified. Warm-up time for specified accuracies is 20 minutes. The calibration procedure given in section 5, if performed completely, will allow an instrument to meet the electrical characteristics listed below.

VERTICAL DEFLECTION SYSTEM

Deflection Factor

Calibrated range is from 2 millivolts to 5 volts per division in 11 steps in a 1-2-5 sequence. Accuracy is within 3%. Uncalibrated VAR control provides deflection factors continuously variable between the calibrated settings. Extends deflection factor to at least 12.5 volts per division in the 5 volts/div position.

Frequency Response

Bandwidth in both Channel 1 and Channel 2 is DC to at least 200 megahertz. Risetime is 1.75 nanoseconds or less. The AC-coupled lower -3 dB point is 10 hertz or less (1 hertz or less when using a 10X probe). Vertical system bandwidth with the BW LIMIT pushbutton pulled is approximately 20 megahertz.

Chopped Mode Repetition Rate

Approximately one megahertz.

Input Resistance And Capacitance

One megohm within 2%, paralleled by approximately 20 picofarads.

Maximum Input Voltage

DC coupled: 250 V (DC + peak AC) or 500 V P-P AC at 1 kHz or less.

AC coupled: 500 V (DC + peak AC) or 500 V P-P AC at 1 kHz or less.

Cascaded Operation (CH 2 VERTICAL SIGNAL OUT connected to CH 1 OR X)

Bandwidth is DC to at least 50 MHz with a sensitivity of approximately 400 μ V/division.

TRIGGERING

Sensitivity

DC Coupled: 0.3 division internal or 50 millivolts external from DC to 40 megahertz, increasing to 1.5 divisions internal or 250 millivolts external at 200 megahertz.

AC Coupled: 0.3 division internal or 50 millivolts external from 60 hertz to 40 megahertz, increasing to 1.5 divisions internal or 250 millivolts external at 200 megahertz. Attenuates all signals below about 60 hertz.

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LF REJ Coupled: 0.3 division internal or 100 millivolts external from 50 kilohertz to 40 megahertz, increasing to 1.5 divisions internal or 500 millivolts external at 200 megahertz. Blocks DC and attenuates all signals below about 50 kilohertz.

HF REJ Coupled: 0.3 division internal or 100 millivolts external from 60 hertz to 50 kilohertz. Blocks DC and attenuates all signals below about 60 hertz and above about 50 kilohertz.

Trigger Jitter

0.2 nanosecond or less at 200 megahertz at 1 nanosecond/division (X10 MAG on).

External Trigger Input

Maximum input voltage is 250 V DC + peak AC or 250 V P-P AC (1 kilohertz or less). Input impedance is 1 megohm within 10%, paralleled by approximately 20 picofarads.

LEVEL Control Range

EXT: At least + and -2 volts, 4 volts peak to peak.

EXT ÷10: At least + and -20 volts, 40 volts peak to peak.

Exclude the LF REJ coupling mode.

Trigger View Deflection Factor

Approximately 50 millivolts/division.

HORIZONTAL DEFLECTION SYSTEM

Calibrated Sweep Range

A Sweep or B DLYD Sweep: from 0.5 second/division to 0.01 microsecond/division in 24 steps in a 1-2-5 sequence. X10 MAG extends maximum sweep rate to 1 nanosecond/division.

A Delaying Sweep: from 0.5 second/division to 0.05 microsecond/division in 22 steps in a 1-2-5 sequence.

Calibrated Sweep Accuracy (Over full ten horizontal divisions)

| | X1 MAG | X10 MAG |
|-------------------------|--------|---------|
| +20°C to +30°C | | |
| A or B DLYD Sweep | | |
| 5 ms/div to 0.01 μs/div | ±1% | ±2% |
| .5 s/div to 10 ms/div | ±2% | ±3% |
| A INT Sweep | | |
| All rates | ±2% | ±3% |
| -15°C to +55°C | | |
| All Sweeps, All Rates | ±3% | ±4% |

X10 Magnified Sweep Accuracy

Within 5% over any two-division interval.

Mixed Sweep Accuracy

Within 3%

Variable Time/Division Control Range

Provides continuously variable (uncalibrated) sweep rates between the calibrated settings of the TIME/DIV switch. Extends the slowest A sweep rate to at least 1.25 seconds/division.

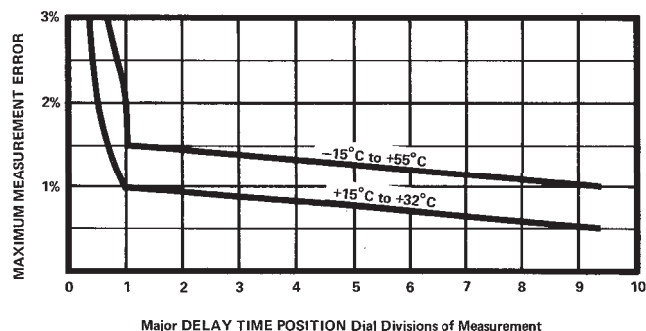
A Trigger Holdoff

Increases A sweep holdoff time to at least nine times the TIME/DIV switch setting.

Delay Time And Differential Time Measurement Accuracy (Simplified)

| | +15°C to +35°C (+60°F to +95°F) | -15°C to +55°C (+5°F to +131°F) |
|--|------------------------------------|------------------------------------|
| Over One Or More Major Dial Divisions Over Less Than One Major Dial Division | ±1% | ±1.5% |
| Than One Major Dial Division | ±0.01 Major Dial Division | ±0.02 Major Dial Division |

Delay Time And Differential Time Measurement Accuracy (Detailed)



Delay Pickoff Jitter

Within 0.002% (less than one part in 50,000) of the maximum available delay time when operating the instrument on power line frequencies other than 50 hertz.

Within 0.005% (less than one part in 20,000) of the maximum available delay time when operating the instrument on power line frequency of 50 hertz.

Maximum available delay time is ten times the setting of the A TIME/DIV switch.

Delay Range

From 0.05 microsecond or less to at least 5 seconds after the start of the delaying (A) sweep.

X-Y OPERATION

Sensitivity

Same as vertical deflection system.

Deflection Accuracy

Same as vertical deflection system.

Variable Range

Same as vertical deflection system.

X-Axis Bandwidth

DC to 3 MHz.

Input Resistance

Same as vertical deflection system.

Input Capacitance

Same as vertical deflection system.

Maximum Usable Input Voltage

Same as vertical deflection system.

CALIBRATOR

Output

An approximate 1 kilohertz repetition rate, 30 milliamperes ($\pm 2\%$), 300 millivolt ($\pm 1\%$) square-wave signal.

Z AXIS INPUT

Sensitivity

A 5-volt peak to peak signal causes noticeable modulation at normal intensity.

Usable Frequency Range

From DC to 50 megahertz.

SIGNAL OUTPUTS

CH 2 VERT SIGNAL OUT

Output voltage is approximately 20 millivolts/division into a 1 megohm load (approximately 10 millivolts/division into 50 ohm load).

Bandwidth is DC to at least 50 megahertz into a 50 ohm load.

Output DC level is approximately zero volts.

A and B +GATE Outputs

Output voltage is approximately 5 volts positive-going.

POWER SOURCE

Line Voltages

110, 115, 120, 220, 230, or 240 VAC (all $\pm 10\%$) depending on the settings of the Line Voltage Selector switch and the Regulating Range Selector assembly, with a

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line frequency of 48 to 440 hertz. Maximum power consumption is 100 watts at 115 VAC, 60 hertz.

CATHODE-RAY TUBE

Graticule Area

Eight by ten centimeters.

Phosphor

P31 is the standard phosphor with P11 offered as an option.

ENVIRONMENTAL

Temperature

Operating: -15°C to $+55^{\circ}\text{C}$; Storage: -55°C to $+75^{\circ}\text{C}$.

Altitude

Operating: to 15,000 feet. Maximum operating temperature decreased $1^{\circ}\text{C}/1,000$ feet above 5,000 feet.

Storage: to 50,000 feet.

Humidity (Operating and Storage)

5 cycles (120 hours) referenced to MIL-E-16400F.

Vibration

15 minutes along each of three major axes at a total displacement of 0.025" peak to peak (4 g's at 55 hertz) with frequency varied from 10 hertz to 55 hertz to 10 hertz in one minute sweeps. After sweep vibration in each axis, hold the frequency steady at each major resonance for 3 minutes, or if no such resonances are found, hold at 55 hertz for 3 minutes.

Shock (Operating and Nonoperating)

30 g's 1/2 sine, 11 milliseconds duration, 2 shocks per axis each direction for a total of 12 shocks.

Transportation

Tested to National Safe Transit Committee Procedure 1A, with a 30-inch drop.

SUPPLEMENTAL INFORMATION

The supplemental information listed here represents limits that, when met, ensure optimum instrument operation. They are, however, not instrument specifications but are intended to be used only as maintenance or operational aids.

VERTICAL DEFLECTION SYSTEM

Low-Frequency Linearity

There should be no more than 0.1 division of compression or expansion of a two-division signal (at center screen) positioned to the upper and lower extremes of the graticule area.

Bandwidth Limiter Bandwidth

The -3 dB point should be between 15 and 25 megahertz.

Step Response Aberrations

There should be less than +4%, -4% , or a total of 4% peak to peak aberration on a positive-going step in the 5 mV/DIV position of the VOLTS/DIV switch. Add 3% when checking a negative-going step or when checking for aberrations while operating in the added mode.

Common-Mode Rejection Ratio

At least 20:1 at 1 kilohertz for common-mode signals of 8 divisions or less.

Trace Shift As Variable Is Rotated

Adjustable to 2 divisions or less.

INVERT Trace Shift

One division or less when switching from normal to inverted.

Input Gate Current

1 nanoampere or less (0.2 division at 5 mV/division) from $+20^{\circ}\text{C}$ to $+30^{\circ}\text{C}$. Four nanoamperes or less (0.8 division at 5 mV/division) from -15°C to $+55^{\circ}\text{C}$.

Channel Isolation

At least 100:1 at 50 megahertz.

POSITION Control Range

At least +12 and –12 divisions from graticule center.

Signal Delay Between Channel 1 and Channel 2

±0.25 nanosecond at 5 mV/DIV.

Input R and C Time Constant

Aberrations should be 2% or less using a one megohm, 20 picofarad input time-constant normalizer.

TRIGGERING**External Trigger Input Capacitance**

Twenty picofarads within 30%.

TRIG VIEW Deflection Factor

50 mV/div ±20%. Exclude LF REJ and HF REJ trigger coupling modes.

TRIG VIEW Risetime

≤3.5 nanoseconds over the 10% to 90% part of the fast rise portion.

TRIG VIEW Delay Difference

≤2 nanoseconds with 5 division signal having 1 nanosecond or less risetime from 25 ohm source, centered vertically with equal cable length from signal source to vertical channel and external trigger inputs, each terminated in 50 ohms.

TRIG VIEW Centering of Trigger Point

Adjustable to within one division of center screen.

HORIZONTAL DEFLECTION SYSTEM**Sweep Accuracy**

Exclude the first 25 nanoseconds or 2 divisions (whichever is greater) and all beyond the 100th division of the sweep when checking 1 ns through 500 ns/division magnified sweep rates.

Mixed Sweep Accuracy

Exclude the first 0.5 division after the display start, and the first 0.2 division or 0.1 microsecond (whichever is greater) after the transition of A to B.

Differential Time Measurement Accuracy

Exclude DELAY TIME POSITION dial settings of 0.00 through 0.50 for 0.5 second through 1.0 microsecond/division delaying sweep rates.

Exclude DELAY TIME POSITION dial settings of 0.00 through 1.00 for 0.5 microsecond through 0.05 microsecond/division delaying sweep rates.

Sweep Length (A Only)

At least 10.1 divisions.

Magnifier Registration

Within 0.5 division from graticule center at 1 millisecond/division.

POSITION Control Range

Start of sweep must position to right of graticule center. End of sweep must position to left of graticule center. Check made at 1 millisecond/Division sweep rate.

Phase Difference between X and Y Axes Amplifiers

Within 1° from DC to 1 megahertz. Within 3° from 1 megahertz to 2 megahertz.

X Axis Low Frequency Linearity

0.2 division or less compression or expansion of a 2 division signal (at center screen) positioned to both horizontal extremes of the display area.

CALIBRATOR**Repetition Rate**

Repetition Rate accuracy is typically within 25%.

Output Resistance

Approximately 9.4 ohms.

EXTERNAL Z AXIS INPUT**Maximum Input Voltage**

Voltages applied to the EXT Z AXIS INPUT connector should be limited to less than 100 volts DC plus peak AC or 100 volts peak to peak AC at 1 kilohertz or less.

OUTPUT SIGNALS

Output Resistance

Output resistance of the CH 2 VERT SIGNAL OUT connector is approximately 50 ohms. Output resistance of +A and +B GATE outputs is approximately 500 ohms.

CATHODE-RAY TUBE

Resolution

Typically at least 15 lines per division horizontally and vertically.

Geometry

0.1 division or less of tilt or bowing.

Raster Distortion

0.1 division or less.

Nominal Accelerating Potential

Approximately 18,000 volts.

OPERATING INFORMATION

Introduction

This section of the manual is intended to allow the operator to become familiar with the instrument's power requirements, functions of controls and connectors, and how to obtain a few basic displays. For more complete operating information, refer to the 475 Operators Handbook.

Operating Voltage

CAUTION

This instrument is designed for operation from a power source with its neutral at or near earth (ground) potential 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.

This instrument can be operated from either a 115-volt or 230-volt nominal line voltage source, 48 to 440 hertz. The Line Voltage Selector switch in the instrument converts the instrument from one nominal operating voltage to the other. The Regulating Range Selector assembly on the instrument rear panel selects one of three regulating ranges for each nominal line voltage, and also contains the line fuses for overload protection for both nominal line voltages. To select the correct nominal line voltage and regulating range, proceed as follows:

1. Disconnect the instrument from the power source.
2. To convert from 115-volts nominal to 230-volts nominal line voltage, set the selector switch to the 230 volts position (toward the rear of the instrument). Change the line-cord plug to match the power source or use a 115-to-230 volt adapter.

NOTE

Color-coding of the cord conductors is as follows (in accordance with National Electrical Code):

| | |
|------------------------------|--|
| <i>Line</i> | <i>Black</i> |
| <i>Neutral</i> | <i>White</i> |
| <i>Safety earth (ground)</i> | <i>Green (or green with yellow tracer)</i> |

3. To change regulating ranges, loosen the two captive screws which hold the cover onto the regulating range selector assembly; then pull to remove the cover.

4. Pull out the range selector switch bar (see Fig. 2-1). Slide the bar to the desired position and plug it back in. Select a range which is centered about the average line voltage to which the instrument is to be connected (see Table 2-1).

TABLE 2-1
Regulating Ranges

| Range Selector Switch Position | Regulating Range | |
|--------------------------------|-------------------|-------------------|
| | 115-Volts Nominal | 230-Volts Nominal |
| LO (switch bar in upper holes) | 99 to 121 volts | 198 to 242 volts |
| M (switch bar in middle holes) | 104 to 126 volts | 208 to 252 volts |
| HI (switch bar in lower holes) | 108 to 132 volts | 216 to 264 volts |

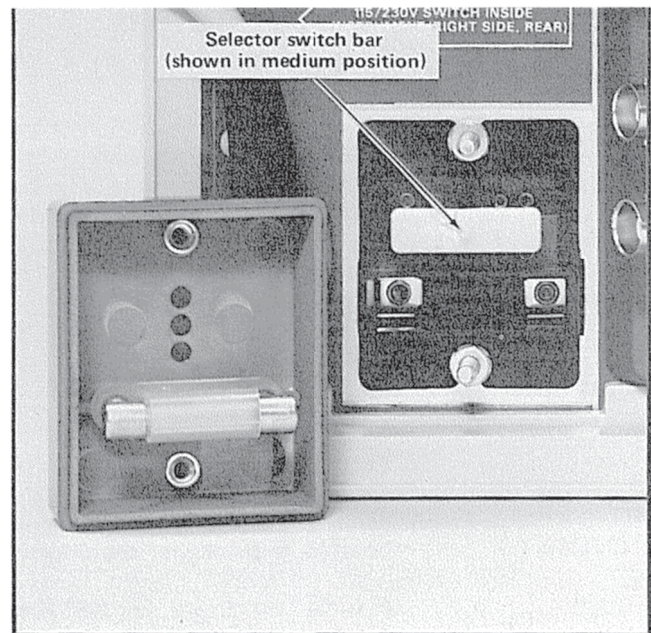


Fig. 2-1. Power supply regulating range selector.

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5. Re-install the cover and tighten the two captive screws.

6. Before applying power to the instrument, check that the line voltage selector switch and the indicating tabs on the regulating range selector assembly are in the correct positions for the desired nominal line voltage and regulating range.



This instrument may be damaged if operated with the line voltage selector switch or the regulating range selector assembly set to incorrect positions for the line voltage applied.

The 475 is designed to be used with a three-wire AC power system. If a three-to two-wire adapter is used to connect this instrument to a two-wire AC power system, be sure to connect the ground lead of the adapter to earth (ground). Failure to complete the ground system may allow the chassis of this instrument to be elevated above ground potential and pose a shock hazard.

The feet on the rear panel provide a convenient cord wrap to store the power cord when not in use.

CONTROLS AND CONNECTORS

General

The major controls and connectors for operation of the 475 are located on the front panel of the instrument. A few auxiliary functions are provided on the rear panel. Fig. 2-2 shows the front and rear panels of the 475. A brief description of each control and connector is given here. More detailed operating information is given in the 475 Oscilloscope Operators Handbook.

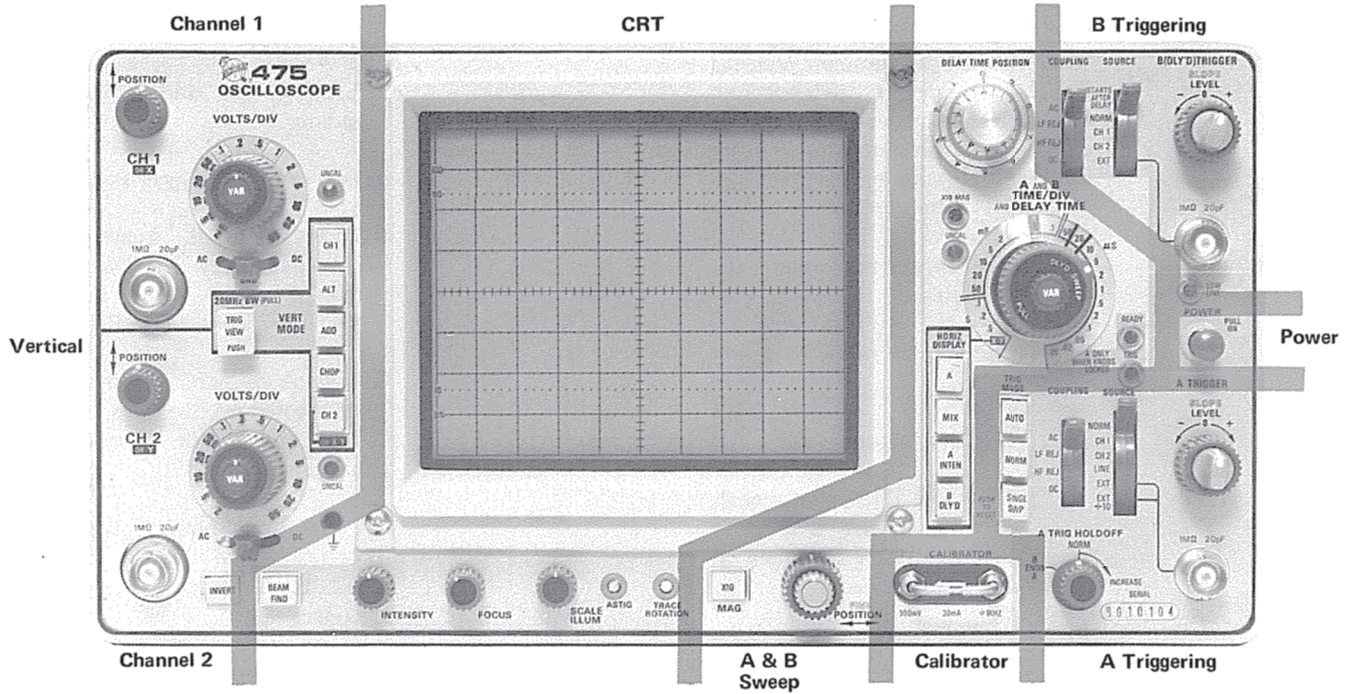
Cathode-Ray Tube (CRT) and Display

- BEAM FIND** Compresses the display to within the graticule area, independently of display position or applied signals.
- INTENSITY** Controls brightness of the display.
- FOCUS** Provides adjustment for optimum display definition.
- SCALE ILLUM** Controls graticule brightness.

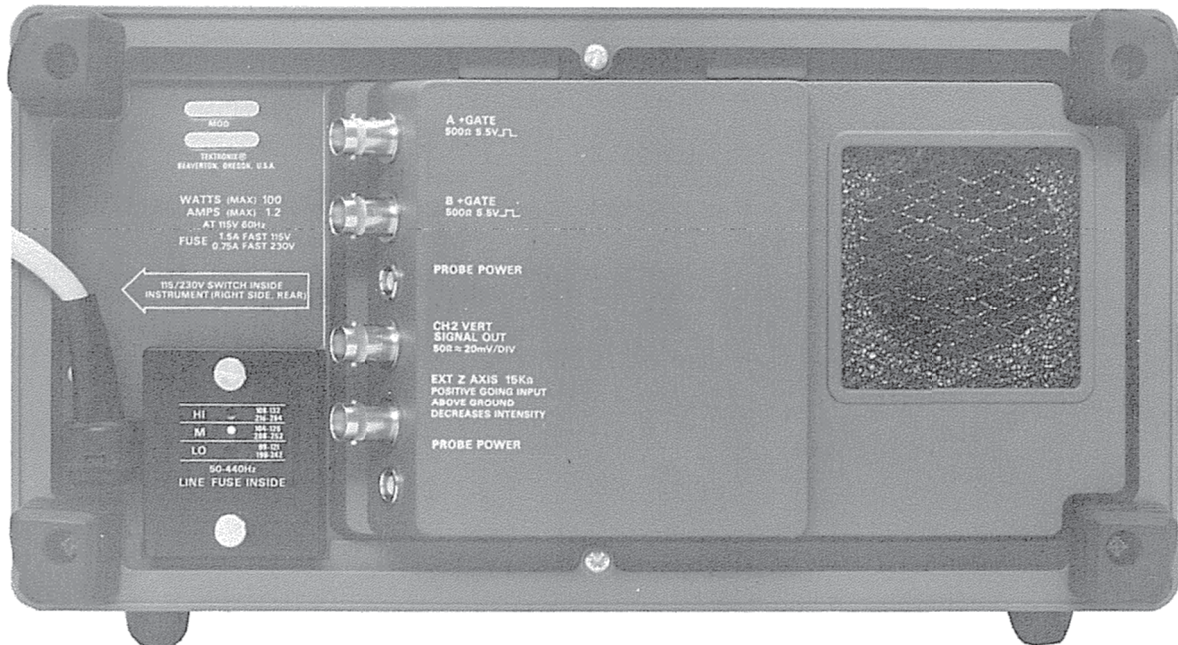
- ASTIG** Screwdriver adjustment used in conjunction with the FOCUS control to obtain a well-defined display. Does not require readjustment in normal use.
- TRACE ROTATION** Screwdriver adjustment to align the trace with the horizontal graticule lines.

Vertical Deflection System (Channel 1 & Channel 2)

- POSITION** Controls the vertical position of the trace. In the X-Y mode of operation, the CH 2 control positions on the Y-axis (vertically) and the CH 1 POSITION control positions on the X-axis (horizontally).
- CH 1 OR X** Input connector for Channel 1 deflection signals or X-axis deflection in the X-Y mode of operation.
- CH 2 OR Y** Input connector for Channel 2 deflection signals or Y-axis deflection in the X-Y mode of operation.
- GAIN (2 and 5 mV)** Screwdriver adjustments to set the gain of the Vertical Preamp.
- VOLTS/DIV** Selects vertical deflection factor in a 1-2-5 sequence (VAR control must be in the calibrated detent for the indicated deflection factor).
- VAR** Provides continuously variable uncalibrated deflection factors between the calibrated settings of the VOLTS/DIV switch.
- UNCAL** Light indicates that the VAR control is not in the calibrated position.
- Input Coupling (AC-GND-DC)** Selects the method of coupling signal to the input of the Vertical Amplifier.
 - AC:** Signal is capacitively coupled to the Vertical Amplifier. DC component of signal is blocked. Low-frequency limit (lower -3 dB point) is about 10 hertz.
 - GND:** Input signal is removed and the input circuit is grounded. Does not ground the input signal.



A. Front panel.



B. Rear panel.

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

| | | | |
|---|---|--------|---|
| | DC: All components of the input signal are passed to the Vertical Amplifier. | | HF REJ: Accepts signals between 60 Hz and 50 kHz. Rejects DC and attenuates all signals outside the above range. |
| 20 MHz BW/ TRIG VIEW | Dual-purpose switch that limits the bandwidth of the complete Vertical Deflection System to approximately 20 MHz when pulled out, or causes signal present in A Trigger Generator circuit to be displayed on the CRT when pressed. | SOURCE | DC: Accepts all trigger signals between DC and 200 MHz or greater. Selects source of trigger signal. |
| INVERT | Pushbutton switch that inverts the Channel 2 display. | | NORM: Internal trigger signal obtained from Vertical Deflection System. Actual source is signal(s) displayed on CRT. |
| VERT MODE | Selects the vertical mode of operation. CH 1: Displays Channel 1 only. ALT: Dual-trace display of signals on both channels. Display is switched between channels at the end of each sweep. ADD: Signals applied to the CH 1 OR X and the CH 2 OR Y connectors are algebraically added and the sum is displayed on the CRT. The INVERT switch in Channel 2 allows the display to be CH 1 + CH 2 or CH 1 – CH 2. CHOP: Dual-trace display of signals on both channels. Display is switched between channels at an approximate repetition rate of 1 megahertz. CH 2 OR X-Y: Displays Channel 2 only. Must be pushed when operating in X-Y mode. | | CH 1: A sample of the signal connected to the CH 1 OR X input connector is used as a trigger signal. CH 2: A sample of the signal connected to the CH 2 OR Y input connector is used as a trigger signal. EXT: Trigger signal obtained from signal connected to the External Trigger Input connector. EXT ÷10 (A trigger circuit only): External trigger signal attenuated by a factor of 10. STARTS AFTER DELAY (B trigger circuit only): B sweep starts immediately after the delay time selected by the DELAY-TIME POSITION dial and the DELAY-TIME switch. LINE (A trigger circuit only): Trigger signal obtained from a sample of the line voltage applied to the instrument. |
| A and B Triggering (both where applicable) | | SLOPE | Selects the slope of the trigger signal which starts the sweep. +: Sweep can be triggered from the positive-going portion of the trigger signal. –: Sweep can be triggered from the negative-going portion of the trigger signal. |
| COUPLING | Determines the method used to couple signal to input of trigger circuits. AC: Rejects DC and attenuates signals below about 60 Hz. Accepts signals above about 60 Hz. LF REJ: Rejects DC and attenuates signals below about 50 kHz. Accepts signals above about 50 kHz. | LEVEL | Selects the amplitude point on the trigger signal at which the sweep is triggered. |

| | | | |
|--|--|---|--|
| <p>A TRIG MODE</p> | <p>Determines the operating mode for the A Trigger Circuit.</p> <p>AUTO: With the proper trigger control settings, A Sweep can be initiated by signals that have repetition rates above about 20 hertz and are within the frequency range selected by the COUPLING switch. In the absence of an adequate trigger signal or when the trigger controls are misadjusted, the sweep free-runs to produce a reference trace.</p> <p>NORM: With the proper trigger control settings, A Sweep can be initiated by signals that are within the frequency range selected by the COUPLING switch. In the absence of an adequate trigger signal or when the trigger controls are misadjusted, there is no trace.</p> <p>SINGL SWP: After a sweep is displayed, further sweeps cannot be presented until the SINGL SWP pushbutton is pressed again. The display is triggered as for NORM operation using the A Triggering controls.</p> | <p>A AND B TIME/DIV AND DELAY TIME</p> | <p>A TIME/DIV switch (clear plastic outer flange) selects the basic delay time (to be multiplied by the DELAY-TIME POSITION dial setting) for delayed-sweep operation. The B TIME/DIV switch (inner dark knob) selects the sweep rate for A only displays or for the B portion of a delayed sweep display. VAR control must be in the calibrated detent for calibrated sweep rates.</p> |
| <p>A TRIG HOLDOFF</p> | <p>Provides control of holdoff time between sweeps to obtain stable displays when triggering on aperiodic signals (such as complex digital words). Variable can increase holdoff time up to at least 9 times the setting of the TIME/DIV switch. In the B ENDS A position (fully clockwise), the A sweep is reset at the end of the B sweep to provide the fastest possible sweep repetition rate for delayed sweep presentations.</p> | <p>VAR</p> | <p>Provides continuously variable (uncalibrated) sweep rates between the calibrated settings of the TIME/DIV switch. Varies the A Time Base sweep rate in the non-delayed mode of horizontal operation and the B Time Base sweep rate in the delayed sweep mode. Extends the slowest sweep rate to at least 1.25 seconds/division. Sweep rate is calibrated when the control is rotated fully clockwise to the calibrated detent.</p> |
| <p>External Trigger Input (not labeled)</p> | <p>Input connectors for external trigger signals.</p> | <p>UNCAL</p> | <p>Light that indicates when the VAR TIME/DIV control is out of the calibrated detent and the horizontal sweep rate is uncalibrated.</p> |
| <p>A and B Sweep</p> | <p>DELAY-TIME POSITION</p> | <p>X10 MAG Indicator</p> | <p>Light that indicates when the X10 MAG is turned on.</p> |
| <p>External Trigger Input (not labeled)</p> | <p>Input connectors for external trigger signals.</p> | <p>READY</p> | <p>Light that indicates that A Sweep has been prepared to present a single sweep upon receipt of an adequate trigger signal.</p> |
| <p>A and B Sweep</p> | <p>DELAY-TIME POSITION</p> | <p>HORIZ DISPLAY</p> | <p>Selects the horizontal mode of operation.</p> <p>A: Horizontal deflection provided by A Sweep. B Sweep inoperative.</p> <p>MIX: The first part of the horizontal sweep is displayed at a rate set by the A TIME/DIV switch and the latter part of the sweep at a rate set by the B TIME/DIV switch. Relative amounts of the display allocated to each of the two rates are determined by the setting of the DELAY-TIME POSITION dial.</p> <p>A INT: Displayed sweep rate determined by the A TIME/DIV</p> |

switch. An intensified portion appears on the display during the B sweep time. This switch position provides a check of the duration and position of the B sweep (delayed sweep) with respect to the delaying sweep (A).

B DLYD: Sweep rate determined by the B TIME/DIV switch with the delay time determined by the setting of the DELAY TIME (A TIME/DIV) switch and the DELAY-TIME POSITION dial.

Horizontal POSITION Positions the display horizontally.

X10 MAG Increases the displayed sweep rate by a factor of 10.

Calibrator and Power

CALIBRATOR A combination current loop/square-wave voltage output device. Provides a 30 mA squarewave current, 300 mV squarewave voltage signal with a repetition rate of approximately 1 kHz.

POWER Turns instrument power on and off.

LOW LINE Light that indicates the applied line voltage is below the lower limit of the regulating range selected by the Regulating Range Selector assembly.

Rear Panel

A +GATE Output connector providing a positive-going rectangular pulse coincident with the A sweep time.

B +GATE Output connector providing a positive-going rectangular pulse coincident with the B sweep time.

CH 2 VERT SIGNAL OUT Output connector providing a sample of the signal applied to the CH 2 input connector.

EXT Z AXIS INPUT Input connector for intensity modulation of the CRT display.

Regulating Range Selector Selects the regulating range of the internal power supplies (low, medium, high; determined by specific line voltage applied to instrument).

PROBE POWER Connectors that make operating power available for active device probe systems.

OBTAINING BASIC DISPLAYS

Introduction

The following instructions will allow the operator who is unfamiliar with the operation of the 475 to obtain the basic displays commonly used. Before proceeding with these instructions, preset the instrument controls as follows:

Vertical Controls

| | |
|----------------------------|--|
| VERT MODE Switch | CH 1 |
| VOLTS/DIV Switches | Proper position determined by amplitude of signal to be applied. |
| VOLTS/DIV VAR Controls | Calibrated detent. |
| Input Coupling Switches | AC |
| Vertical POSITION Controls | Midrange |
| 20 MHz BW Switch | Not limited |
| INVERT Switch | Button out |
| INTENSITY Control | Fully counterclockwise |
| FOCUS Control | Midrange |
| SCALE ILLUM Control | Midrange |

Trigger Controls (both A and B if applicable)

| | |
|------------------------|------|
| SLOPE Switch | + |
| LEVEL Control | 0 |
| SOURCE Switch | NORM |
| COUPLING Switch | AC |
| TRIG MODE Switch | AUTO |
| A TRIG HOLDOFF Control | NORM |

Horizontal Sweep Controls

| | |
|----------------------|-------------------------|
| TIME/DIV Switches | Locked together at 1 ms |
| TIME/DIV VAR | Calibrated detent |
| HORIZ DISPLAY Switch | A |
| X10 MAG Switch | Off (button out) |
| POSITION Control | Midrange |

Normal Sweep Display

1. Set the POWER switch to on (button out). Allow several minutes for instrument warmup.

2. Connect the external signal to the CH 1 input connector.

3. Advance the INTENSITY control until the display is visible. If the display is not visible with the INTENSITY control at midrange, press the BEAM FIND pushbutton and adjust the CH 1 VOLTS/DIV switch until the display is reduced in size vertically; then center the compressed display with the vertical and horizontal POSITION controls; release the BEAM FIND pushbutton. Adjust the FOCUS control for a well-defined display.

4. Set the CH 1 VOLTS/DIV switch and CH 1 POSITION control for a display which remains in the display area vertically.

5. Adjust the A Trigger LEVEL control for a stable display.

6. Set the B TIME/DIV switch and the horizontal POSITION control for a display which remains in the display area horizontally.

Magnified Sweep Display

1. Preset the instrument controls and follow steps 1 through 6 for obtaining a Normal Sweep Display.

2. Adjust the horizontal POSITION control to move the area to be magnified to within the center graticule division of the CRT. If necessary, change the TIME/DIV switch setting so the complete area to be magnified is within the center division.

3. Set the X10 MAG switch to the on position (button in) and adjust the horizontal POSITION control for precise positioning of the magnified display.

Delayed Sweep Displays

1. Preset the instrument controls and follow steps 1 through 6 for obtaining a Normal Sweep Display.

2. Set the HORIZ DISPLAY switch to A INT and the B Trigger SOURCE switch to STARTS AFTER DELAY.

3. Pull out the B TIME/DIV switch knob and turn clockwise so the intensified zone on the display is the desired length. Adjust the INTENSITY control to achieve the desired display brightness.

4. Adjust the DELAY-TIME POSITION dial to position the intensified zone to the portion of the display to be delayed.

5. Set the HORIZ DISPLAY switch to B DLYD. The intensified zone on the display noted in step 3 is now being displayed in delay form. The delayed sweep rate is indicated by the dot on the B TIME/DIV switch knob.

6. For a delayed sweep display that will exhibit less jitter, set the B Trigger SOURCE switch to the same position as the A Trigger SOURCE switch and adjust the B Trigger LEVEL control for a stable display. If the A Trigger SOURCE switch is in the LINE position, a sample of the line voltage will have to be supplied to the B Trigger circuit externally.

Mixed Sweep Display

1. Preset the instrument controls and follow steps 1 through 6 for obtaining a Normal Sweep Display.

2. Pull out the B TIME/DIV switch knob and turn clockwise to the desired sweep rate. Adjust the INTENSITY control to achieve the desired display brightness.

3. Set the HORIZ DISPLAY switch to MIX. The CRT display now contains more than one time factor on the horizontal axis. The first portion of the display is at the A Time Base sweep rate and the latter part is at the B Time Base sweep rate. The start of the B Time Base portion of the display can be changed by adjusting the DELAY-TIME POSITION control.

X-Y Display

1. Preset the instrument controls and turn the instrument power on. Allow several minutes for instrument warm-up.

2. Set the TIME/DIV switch to X-Y and the VERT MODE to CH 2. Apply the vertical signal to the CH 2 OR Y input connector and the horizontal signal to the CH 1 OR X input connector. The CH 2 POSITION control will provide vertical positioning and the CH 1 POSITION control will provide horizontal positioning.

3. Advance the INTENSITY control until the display is visible. If the display is not visible with the INTENSITY control at midrange, press the BEAM FIND pushbutton and adjust the CH 1 and CH 2 VOLTS/DIV switches until the display is reduced in size both vertically and horizontally; then center the compressed display with the POSITION controls; release the BEAM FIND pushbutton. Adjust the FOCUS control for a well-defined display.

CIRCUIT DESCRIPTION

Introduction

This section of the manual contains a description of the circuitry used in the 475 Oscilloscope. The description begins with a discussion of the instrument, using the basic block diagram shown in Fig. 3-1. Then, each circuit is described in detail, using detailed block diagrams to show the interconnections between the stages in each major circuit and the relationship of the front panel controls to the individual stages.

A complete block diagram is located in the Diagrams Section at the back of this manual. This block diagram shows the overall relationship between all of the circuits. Complete schematics of each circuit are also given in the Diagrams Section. Refer to these diagrams throughout the following circuit description for electrical values and relationships.

Digital Logic

Digital logic techniques are used to perform many functions within this instrument. The function and operation of the logic circuits are described using logic symbology and terminology. All logic functions are described using the positive logic convention. Positive logic is a system of notation where the more positive of two levels (HI) is called the true or 1 state; the more negative level (LO) is called the false or 0 state. The HI-LO method of notation is used in this logic description. The specific voltages that constitute a HI or LO state vary between individual devices. Typical HI or LO logic levels are shown on the diagrams at the rear of this manual.

It should be noted that not all of the integrated circuit devices in this instrument are digital logic devices. The function of non-digital devices are described individually, using operating waveforms or other techniques to illustrate their function.

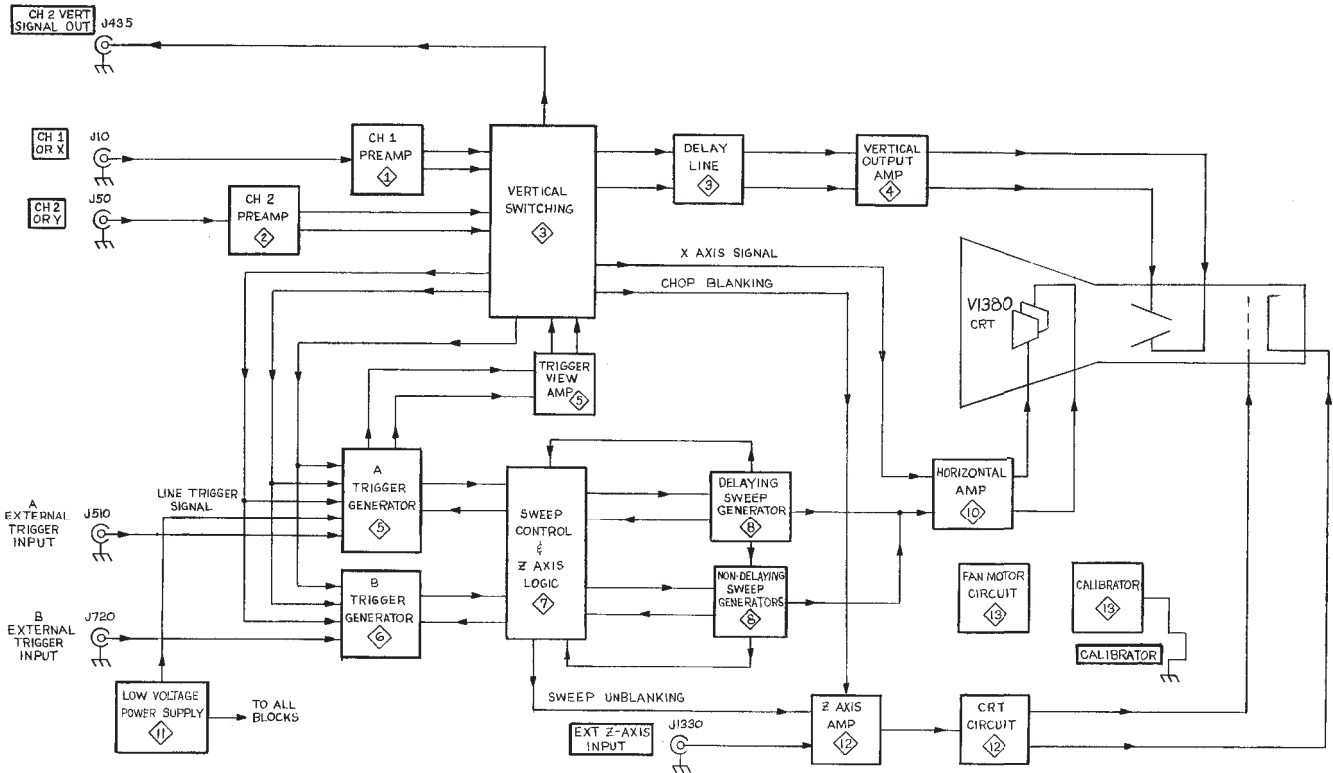


Fig. 3-1. Basic block diagram of the 475.

BLOCK DIAGRAM

General

The following discussion is provided to aid in understanding the overall concept of the 475 Oscilloscope before the individual circuits are discussed in detail. A basic block diagram of the 475 Oscilloscope is shown in Fig. 3-1. Only the basic interconnections between the individual blocks are shown on this diagram. Each block represents a major circuit within the instrument. The number on each block refers to the complete circuit diagram, which is located at the rear of this manual.

Signals to be displayed on the CRT are applied to the CH 1 OR X or CH 2 OR Y connectors. The input signals are then amplified by the Pre-amplifier circuits. Each Pre-amplifier circuit includes separate vertical deflection factor, input coupling, balance, gain, and variable attenuation controls. The Channel 2 Pre-amplifier circuit also contains an invert feature to invert the Channel 2 signal as displayed on the CRT.

The output of both Vertical Pre-amplifier circuits connects to the Vertical Channel Switching circuit. This circuit selects the channel(s) to be displayed. An output signal from this circuit connects to the Z Axis Amplifier circuit to blank out the switching transients between channels when in the chopped mode of operation. The Vertical Channel Switching circuit also provides the Channel 2 VERT SIG OUT signal (available on the instrument rear panel) as well as the signals used for sweep triggering in the NORM, CH 1, and CH 2 positions of the trigger SOURCE switches and the signal used for X-axis deflection in the X-Y mode of horizontal operation.

The output of the Vertical Channel Switching circuit connects to the Vertical Output Amplifier through the Delay Line. The Delay Line provides a fixed amount of signal delay through the vertical deflection system to allow viewing the leading edge of a triggering waveform. The Vertical Output Amplifier circuit provides the final amplification for the signal before it is connected to the vertical deflection plates of the CRT. This circuit includes the BEAM FIND switch which compresses the vertical and horizontal deflection to within the viewing area to aid in locating an off-screen display.

The A and B Trigger Generator circuits produce an output pulse that initiates generation of the sawtooth sweep signals produced by the A or B Sweep Generator circuits. The input signal to the Trigger Generator circuits can be individually selected from the Channel 1 signal, Channel 2 signal, the signal(s) displayed on the CRT (NORM), a signal connected to the external trigger input

connectors, or a sample of the line voltage applied to the instrument. Each trigger circuit contains separate level, slope, coupling, and source controls.

There are three sweep generator circuits in the 475. For purposes of explanation, they are called Delaying, Slow Non-Delaying, and Fast Non-Delaying. The Delaying Sweep generates a range of sweep rates from 0.5 seconds to 0.05 microseconds/division. The Slow Non-Delaying Sweep generates sweeps from 0.5 seconds to 1 microsecond/division and the Fast Non-Delaying Sweep from 0.5 microsecond to 0.01 microsecond/division.

The Delaying Sweep runs only when the instrument is operated in a delayed-sweep mode (MIX, A INTEN, or B DLY'D) and is displayed as the A portion of a MIX or A INTEN display. The sweep rate for this generator is selected by the A TIME/DIV switch. One of the Non-Delaying Sweeps (depending on the sweep rate selected) will run and be displayed in the A or B DLY'D modes or as the B portion of a MIX or A INTEN display. In the A mode of operation, the sweep rate is selected by the B TIME/DIV switch. In the MIX, A INTEN, and B DLY'D modes of operation, the Non-Delaying (B) sweep rate is also selected by the B TIME/DIV switch.

The TRIG MODE switch controls the mode of operation of the sweep generator deriving the A portion of a display. In the AUTO position, the absence of an adequate trigger signal causes the sweep to free run. In the NORM position, a horizontal sweep is presented only when correctly triggered by an adequate trigger signal. Pushing the SING SWP pushbutton allows one (and only one) sweep to be presented. The Z Axis Logic circuit produces an unblanking gate signal to unblank the CRT so that the display can be presented. This gate signal is coincident with the sawtooth produced by the sweep generator. The Z Axis Logic Circuit also produces, at the end of each sweep, a gate signal that is supplied to the Vertical Channel Switching circuit. This pulse switches the display between channels at the end of each sweep when the Vertical Deflection System is operating in the ALT mode.

The outputs of the sweep generators are amplified by the Horizontal Amplifier to produce horizontal deflection for the CRT except in the fully counterclockwise (X-Y) position of the TIME/DIV switch. The Horizontal Amplifier contains a 10X magnifier to increase the sweep by a factor of 10 in any A or B TIME/DIV switch position. Other horizontal deflection signals can be connected to the Horizontal Amplifier by using the X-Y mode of operation. When the TIME/DIV switch is set to X-Y, the X-axis signal is connected to the Horizontal Amplifier circuit through the Channel 1 Vertical Pre-amplifier circuit.

The Z Axis Amplifier circuit determines the CRT intensity and blanking. The Z Axis Amplifier circuit sums the current inputs from the INTENSITY control, the Vertical Channel Switching circuit (chopped blanking), the Z Axis Logic circuit (unblanking), and the external Z AXIS INPUT connector. The output level of the Z Axis Amplifier circuit controls the trace intensity through the CRT circuit. The CRT circuit provides the voltages and contains the controls necessary for operation of the cathode-ray tube.

The Power Supply circuit provides the low voltage power necessary for operation of this instrument. This voltage is distributed to all of the circuits in the instrument as shown by the Power Distribution Diagram. The Calibrator circuit provides a square-wave output with accurate voltage and current amplitudes, which can be used to check the calibration of the instrument and the compensation of probes. The CALIBRATOR current loop provides an accurate current source for calibration of current measuring probe systems.

CHANNEL 1 PREAMP

General

Input signals for vertical deflection on the CRT can be connected to the CH 1 OR X input connector. In the X-Y mode of operation, the input signal connected to the CH 1 OR X connector provides the horizontal (X-axis) deflection (TIME/DIV switch set to X-Y, VERT MODE switch set to CH 2 OR X-Y). The Channel 1 Preamp circuit provides control of input coupling, vertical deflection factor, gain, and DC balance. Fig. 3-2 shows a detailed block diagram of the Channel 1 Preamp circuit. A schematic of this circuit is shown on Diagram 1 at the rear of this manual.

Input Coupling

Signals applied to the input connector can be AC coupled, DC coupled, or internally disconnected from the input to the Vertical Input Amplifier circuit. When Input Coupling switch S20A is set for DC coupling, the input signal is coupled directly to the Input Attenuator stage. When AC coupled, the input signal passes through capacitor C10. This capacitor prevents the DC component of the signal from passing to the amplifier. In the GND position, S20A opens the signal path and connects the input of the amplifier to ground. This provides a ground reference without the need to disconnect the applied signal from the input connector. Resistor R22, connected across the input coupling switch, allows C10 to be pre-charged in the ground position, which prevents generation of large voltage transients at the input to the amplifier and allows the trace to remain on screen when switched to the AC position.

Input Attenuator

The effective overall deflection factor of each channel of the 475 is determined by the appropriate VOLTS/DIV switch setting. The basic deflection factor of the Vertical Deflection System is 5 millivolts/division of CRT deflection. To achieve the deflection factor values indicated on the front panel, precision attenuators are switched into the circuit and, in the 2 mV position, the gain of the Second Cascode Amplifier stage is changed.

For the VOLTS/DIV switch positions above 5 mV, attenuators are switched into the circuit singly or in pairs to help produce the vertical deflection factors indicated. These attenuators are frequency-compensated voltage dividers. In addition to providing constant attenuation at all frequen-

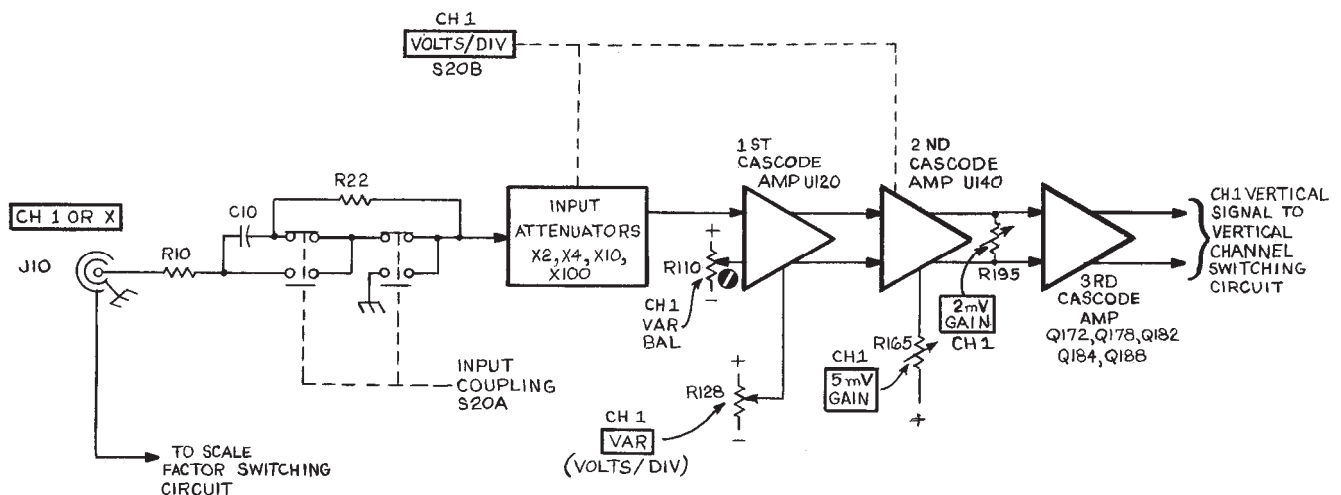


Fig. 3-2. Detailed block diagram of the Channel 1 Vertical Preamplifier circuit.

Circuit Description—475

cies within the bandwidth of the instrument, the Input Attenuators are designed to maintain the same input RC characteristics for each setting of the VOLTS/DIV switch. Each attenuator contains an adjustable series capacitor to provide correct attenuation at high frequencies and an adjustable shunt capacitor to provide correct input capacitance.

NOTE

Each attenuator is a hybrid encapsulated plug-in assembly; therefore, replacement of individual components within the attenuator is not possible. Should defects occur, the attenuator must be replaced as a unit.

First Cascode Amplifier

The first amplifier stage in the Channel 1 Preamplifier circuit is hybrid circuit U120. U120 basically consists of an integrated emitter-coupled, push-pull, cascode amplifier cell and two discrete field-effect transistors (FET) mounted on a ceramic substrate with the thick-film resistors. The stage is configured as a paraphase amplifier and converts the single-ended input signal to push-pull output signals. CR104 and CR107 provide protection for the input to U120 if large negative-going signals or DC levels are applied to the CH 1 OR X input connector.

This input amplifier stage contains the CH 1 VAR VOLTS/DIV control. This control provides the ability to obtain continuously variable (uncalibrated) vertical deflection factors between the calibrated positions of the VOLTS/DIV switch. With the VAR control in its calibrated detent (wiper at ground), the output transistors of U120, whose collectors connect to pins 5 and 9 are conducting; the output transistors whose collectors connect to pins 6 and 8 are biased off. Thus, the current available to the following amplifier stage is that flowing from pins 5 and 9.

When the VAR control is rotated out of its calibrated detent, the transistors whose collectors connect to pins 6 and 8 begin to conduct. The current they conduct is robbed from the other output transistors. This causes two things to occur:

1. The current flowing in the collectors of the transistors connected to pins 5 and 9 is less now than when the VAR control was in its calibrated detent.

2. The current available to the following amplifier stage is the algebraic sum of the currents in the collectors tied together (i.e., pins 8 and 9 and pins 5 and 6). Since the two collectors tied together have signals of opposite polarity, the signal available to the following amplifier stage is less than that available when the VAR control was in its

calibrated detent. The component values selected for the variable function provide a variable attenuation ratio of approximately 2.5 to 1. The Channel 1 Variable Balance adjustment R110 adjusts for no trace shift in the display when rotating the VAR control. The Channel 1 UNCAL light indicates when the Channel 1 VAR control is out of its calibrated detent. The components connected between pins 2 and 3 of U120 provide high-frequency compensation for the stage.

Second Cascode Amplifier

The second amplifier stage in the Channel 1 Preamplifier circuit is U140. U140 is the same integrated emitter-coupled, push-pull, cascode amplifier as the one used in U120. It is used as a push-pull amplifier and contains 2 mV and 5 mV gain adjustments that determine the overall gain of the Channel 1 Preamplifier circuit. The output signals available to the next stage for amplification are taken from pins 5 and 9 of U140.

The gain of U140 is determined by biasing the output transistors connected to pins 6 and 8 to conduct more or less current. As more current is conducted through the transistors connected to pins 6 and 8, that much less is conducted through the transistors connected to pins 5 and 9. The current conducted by the transistors connected to pins 5 and 9 in the 2 mV position of the VOLTS/DIV switch is approximately 2.5 times the current conducted by the same transistors in all of the other VOLTS/DIV switch positions. This results in increased gain and a DC level shift at the signal output terminals of U140. The VOLTS/DIV switch compensates for a shift in the DC level by shorting out part of the common-mode resistance (R157) when operating with 2 mV sensitivity. The Gain Switch Balance adjustment R135 adjusts the DC balance of the stage, so there is no baseline shift in the CRT display when switching between the 2 mV and 5 mV positions of the CH 1 VOLTS/DIV switch. The remainder of the components connected between pins 2 and 3 of U140 provide high-frequency compensation for the stage. Resistor-thermistor RT149 reduces in value with increases in temperature to compensate for losses in gain associated with increases in ambient temperature.

Third Cascode Amplifier

The third amplifier stage in the Channel 1 Preamplifier circuit is a discrete component cascode amplifier made up of Q172, Q178, Q182, Q184, and Q188. Q184 is a relatively constant current source for Q172 and Q182. Q172 and Q182 convert the input voltage signals into current signals which are in turn converted back to voltage signals by Q178 and Q188 respectively. R172 and R182 provide thermal compensation and C172 and C182 AC-couple the signal around R172 and R182 to reduce Miller effect. C175 and R175 are variable high-frequency compensation adjustments while CR170, CR174, and RT170

offset compensation changes associated with variations in ambient temperature. As temperature increases, the value of RT170 decreases. This results in a decrease in voltage across CR170 and CR174. CR170 and CR174 are voltage-variable capacitance semiconductors whose capacitance increases with a decrease in reverse voltage across them. Thus, CR170 and CR174 will provide more peaking at higher temperatures. L178 is a toroid inductor that cancels high-frequency common-mode signals generated by the previous stages. The Channel 1 Position Centering adjustment centers the range of control of the Channel 1 POSITION control.

the biasing on the output transistors of U220 so that the normally inactive transistors are now carrying the signal. Since their outputs are cross-coupled from side to side the output signal is of opposite polarity to that available in the normal (button out) position of the INVERT switch. The Channel 2 Invert Balance adjustment R215 adjusts the DC balance of the stage to eliminate baseline shift in the display when switching from a normal to an inverted display.

CHANNEL 2 PREAMP

General

The Channel 2 Preamp circuit is virtually the same as the Channel 1 Preamp circuit. Only the differences between the two circuits are described here. Portions of this circuit not described in the following description operate in the same manner as for the Channel 1 Preamp circuit. Fig. 3-3 shows a detailed block diagram of the Channel 2 Preamp circuit. A schematic of this circuit is shown on Diagram 2 at the rear of this manual.

First Cascode Amplifier

Basically, the First Cascode Amplifier stage in Channel 2 operates as described for the First Cascode Amplifier stage in Channel 1. However, the Channel 2 First Cascode Amplifier also contains the INVERT switching function. This allows the Channel 2 signal to be inverted as displayed on the CRT. The INVERT switch, when pushed, changes

VERTICAL CHANNEL SWITCHING CIRCUIT

General

The Vertical Channel Switching Circuit determines whether the Channel 1 or the Channel 2 Preamp signal or both will be connected to the Vertical Output Amplifier circuit. In the ALT and CHOP modes of operation, both channels are alternately displayed on a shared-time basis. The Vertical Channel Switching Circuit also provides several internal trigger signals to the Trigger Generator circuits, the Channel 2 VERT SIGNAL OUT signal to a connector on the rear panel, and the chopped blanking signal to the Z Axis Amplifier. Fig. 3-4 shows a detailed block diagram of the Vertical Channel Switching Circuit. A schematic of this circuit is shown on Diagram 3 at the rear of this manual.

Channel Switch IC

The Channel Switch IC, U370, determines which of the Preamp signals will be passed to the Vertical Output Amplifier. The push-pull Preamp signals connect between pins 2 and 3 (Channel 2) and between pins 10 and 11

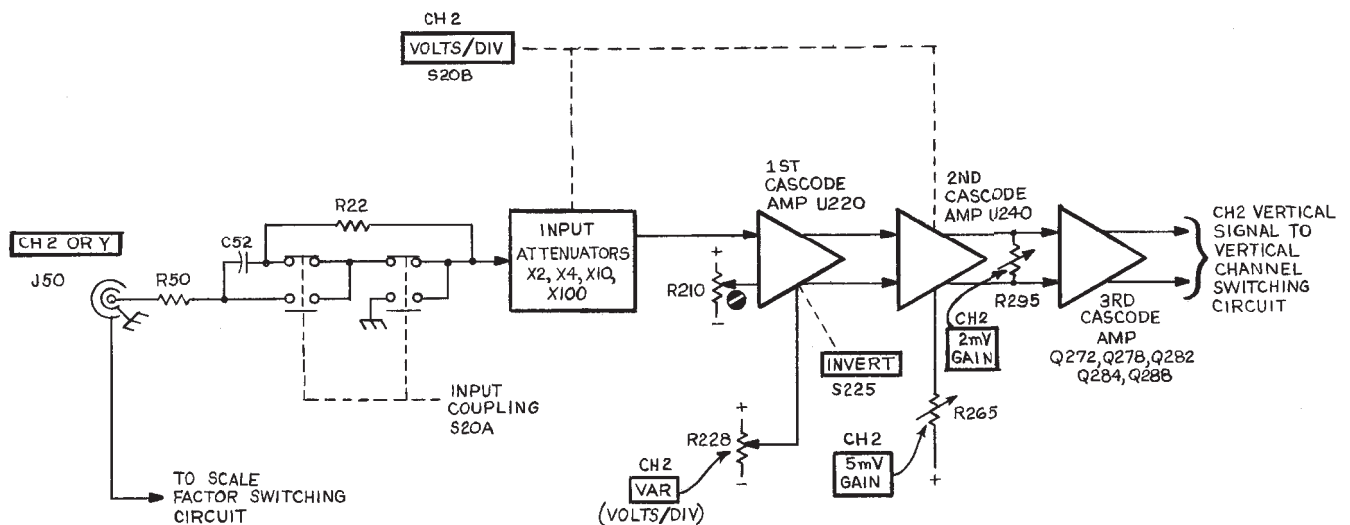


Fig. 3-3. Detailed block diagram of the Channel 2 Vertical Preamplifier circuit.

Circuit Description—475

(Channel 1) of U370. The logic levels connected to pins 1, 12, 13, and 16 determine what signals are presented at output pins 14 and 15. The following logic truth table defines the switching function of U370.

| Pin 1 | Pin 12 | Pin 13 | Pin 16 | Output Signal |
|-------|--------|--------|--------|------------------------------|
| 1 | 0 | 1 | 0 | Channel 1 |
| 0 | 1 | 0 | 1 | Channel 2 |
| 1 | 1 | 0 | 0 | Algebraic sum of CH 1 & CH 2 |

U370 also makes available samples of the Channel 1 signal at pins 8 and 9 and samples of the Channel 2 signal at pins 4 and 5. The output signals at pins 4, 5, 8, and 9 are always present when signals are applied to the channel inputs regardless of the switching logic levels applied to U370. The Channel 1 signal present at pin 9 provides drive to the Horizontal Amplifier in the X-Y mode of horizontal operation. The Channel 1 signal at pin 8 and the Channel 2 signal at pin 4 are used by the Trigger Generator circuits in the appropriate positions of the Trigger SOURCE switches. The Channel 2 signal at pin 5 connects to the Channel 2 Vertical Signal Out Amplifier.

Switching Logic Flip-Flops

U350A and U350B are edge-triggered flip-flops that derive the switching logic for the Channel Switch IC U370. In the CH 1, CH 2, and ADD positions of the VERT MODE switch the output logic from U350A and U350B is determined by the voltage levels applied to the clear (pins 1 and 13) and preset (pins 4 and 10) inputs. In the ALT mode of operation the flip-flops are switched by the alternate-trace sync pulse applied to their clock inputs through Q338 and U330B. In the CHOP mode, the clock pulse generated by U330C and U330D switch the flip-flops at a one-megahertz rate.

Two Megahertz Clock

U330C and U330D form an astable multivibrator having a repetition rate of two megahertz. The rectangular output waveform connects to the Switching Logic Flip-Flops through nand gate U330B. Only in the CHOP position of the VERT MODE switch is a LO level applied to the input to inverter U330A. This puts a logical HI on pin 13 of U330D, which permits the astable multivibrator to free-run. At the same time, Q338 is biased on, which puts a logical HI on pin 5 of U330B. Thus, the signal present at pin 6 of U330B will be the two-megahertz clock signal.

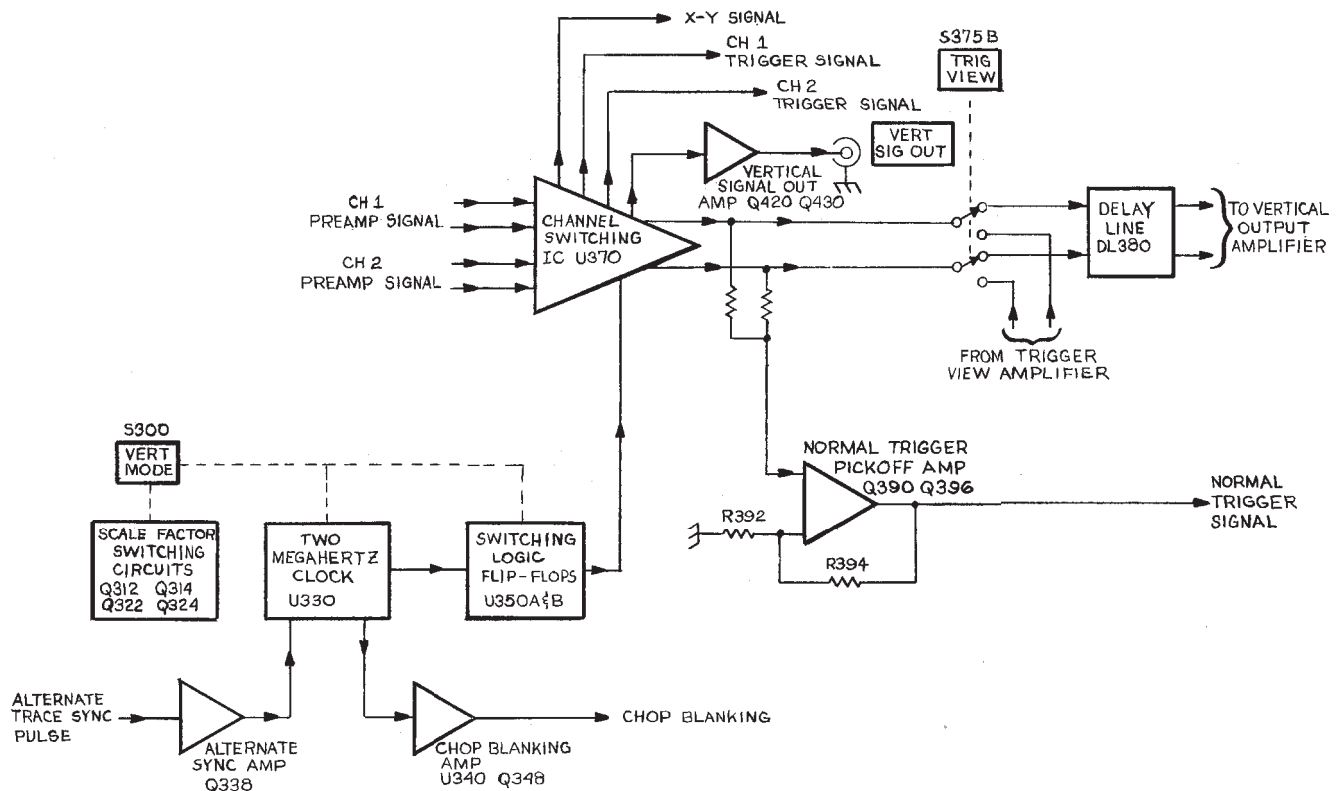


Fig. 3-4. Detailed block diagram of the Vertical Channel Switching circuit.

Chop Blanking Amplifier

The Chop Blanking Amplifier Q348 provides an output pulse to the Z Axis Amplifier circuit, which blanks out the transitions between the Channel 1 and Channel 2 traces when operating in the CHOP mode. The inherent propagation delay of inverters U340A, U340B, and U340C are used to provide some signal delay to the chop blanking signal. This allows the blanking signal and the channel switching transient to arrive in the CRT simultaneously.

Channel 2 Signal Output Amplifier

Q420 and Q430 compose the Channel 2 Vertical Signal Output Amplifier. A sample of the Channel 2 signal from pin 5 of Channel Switch IC U370 is amplified and inverted by Q420. CR422 provides thermal compensation for the base-emitter junction of Q420. Common-base amplifier Q430 provides the final amplification and isolates the output from the internal amplifier circuitry. Output impedance of the amplifier is equal to the parallel combination of R431 and R432 (approximately 50 ohms).

Normal Trigger Pickoff Amplifier

The trigger signal for NORM trigger operation is obtained from a sample of the vertical deflection signal that is available from pin 15 of U370. Normal Trigger DC Adjustment R425 sets the DC level of the normal trigger output signal so that the sweep is triggered at the 0 level of the displayed signal when the Triggering LEVEL control is set to 0. Q390 and Q396 are connected as a non-inverting feedback amplifier. Gain of the stage is approximately:

$$\frac{R392 + R394}{R392}$$

Scale-Factor Switching Circuits

The vertical deflection factor for each channel is indicated by back-lighting the appropriate figures imprinted on the flange of each VOLTS/DIV knob. For purposes of explanation, only the circuit action of the Channel 1 Scale-Factor Switching Circuit is discussed. When a X1 probe is connected to the CH 1 OR X input connector, the base level of Q312 is drawn positive by R316 toward the collector level of Q314. Q314 conducts heavily through X1 display factor bulb DS314 and Q312 is turned off. Therefore, the X1 display factor bulb is on and the X10 display factor bulb is off.

When a X10 probe with a scale factor switching connector is attached to the CH 1 OR X input connector, the base of Q312 is grounded through R311. Now, Q312 conducts very heavily through X10 display factor bulb DS312. The positive level at the collector of Q312 turns Q314 off (through the divider R313-R314); the X10 display factor bulb is on and the X1 display factor bulb is off.

VERTICAL OUTPUT AMPLIFIER

General

The Vertical Output Amplifier provides the final amplification for the vertical deflection signal. This circuit includes the BEAM FIND function. The BEAM FIND pushbutton, when pressed, compresses an overscan display to within the CRT viewing area. A schematic of the Vertical Output Amplifier is shown on Diagram 4 at the rear of this manual.

First IC Amplifier

The first amplifier stage in the Vertical Output Amplifier is integrated circuit U450. U450 is basically an emitter-coupled, push-pull, cascode amplifier cell. Biasing is arranged so that there is no phase-inversion through the stage. The signal from the delay line is applied to the amplifier through C441, L441, L442, C445, L445, and L444. These inductances and capacitances are part of the etched runs of the circuit board and provide some high-frequency peaking by forming a T-coil circuit without mutual coupling. Most of the components connected between pins 2 and 3 of U450 provide high-frequency compensation of the stage. RT452 varies in value with variations in ambient temperature to compensate for associated changes in amplifier gain. The BEAM FIND pushbutton, when pressed, removes -8 volts from the top of R459. This reduces the dynamic swing capabilities of the stage to limit the display on the CRT to within the viewing area. The gain of the Vertical Output Amplifier section is adjusted in this stage by adjusting Vertical Output Gain R449.

Second IC Amplifier

The second amplifier stage in the Vertical Output Amplifier is integrated circuit U470. U470 is a multi-stage cascode amplifier cell. The input signal is applied to pins 1 and 5 with the inverted output signal taken from pins 9 and 12. Pins 2 and 4 are emitter connections. Some of the components connected between pins 2 and 4 provide slower time constants to compensate for signal rolloff that occurs in the delay line, while the remaining components compensate for thermal considerations in the stage. The Output Bias adjust (R487) sets the DC levels within the stage to optimize the operating performance of U470. The output signal from U470 connects directly to the deflection plates of the CRT.

A TRIGGER GENERATOR

General

The A Trigger Generator circuit produces the trigger pulse used to start the Sweep Generator circuit that provides the A portion of the CRT display. The trigger pulse is derived from the internal trigger signal from the vertical deflection system, an external signal connected to

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the external trigger input connector, or a sample of the line voltage connected to the instrument. Controls are provided to select trigger level, slope, coupling, and source. Fig. 3-5 shows a detailed block diagram of the A Trigger Generator circuit. A schematic of this circuit is shown on Diagram 5 at the rear of this manual.

Trigger Source

The Trigger SOURCE switch S505 selects the source of the trigger signal. The sources available to the A Trigger Generator circuit are the signal being displayed (NORM), Channel 1 (CH 1), Channel 2 (CH 2), the instrument line voltage (LINE), and external signals (EXT and EXT $\div 10$). Emitter followers Q502, Q504, and Q506 provide isolation between the input to the A Trigger Circuit and the output of the Vertical Channel Switching Circuit.

In the LINE mode of triggering, a sample of the power line frequency is obtained from the secondary of the power transformer T1400 in the Low Voltage Power Supply circuit. The Trigger COUPLING switches should not be in the LF REJ mode when using the instrument line voltage as a trigger signal source.

Trigger Coupling

The Trigger COUPLING switches offer a means of accepting or rejecting certain components of the trigger signal. In the AC, LF REJ, and HF REJ mode of trigger coupling, the DC component of the trigger signal is blocked by coupling capacitors C515 or C516. Frequency components below about 60 Hz are attenuated when using AC or HF REJ coupling and below about 50 kHz when using LF REJ coupling. The higher frequency components of the trigger signal are passed without attenuation. In the HF REJ mode of trigger coupling, the high frequency components of the trigger signal (above about 50 kHz) are

attenuated, while the lower frequency components (between about 60 Hz and 50 kHz) are passed without attenuation. The DC mode of trigger coupling passes unattenuated all signals from DC to 200 MHz and above.

Input Source Follower

Transistor Q522 is an FET source follower. It provides a high input impedance (set primarily by R517) for the trigger signal; it also provides isolation between the Trigger Generator circuit and the trigger signal sources. CR519 provides input protection for Q522 if excessively high amplitude negative-going input signals are present. Q524 is a high-impedance, relatively constant current source for Q522 and provides a measure of temperature compensation for Q522. The output signal from the Source Follower is taken from Emitter Follower Q526.

Paraphase Amplifier

U520 is a paraphase amplifier stage that converts the single-ended input from Emitter Follower Q526 into a dual-ended push-pull output, which is applied to one of the Tunnel Diode Driver stages. Trigger Centering adjustment R534 sets the level at pin 14 of U520 (through emitter follower Q532) so that the display is correctly triggered when the LEVEL control is centered. The LEVEL control varies the level at pin 14 of U520 to select the point on a trigger signal where triggering occurs.

The slope of the input signal that triggers the Sweep Generator circuit is determined by the setting of the SLOPE switch S530. When the SLOPE switch is set to the + position, the output signal at pin 8 of U520 is inverted with respect to the input signal, and the output signal at pin 9 is

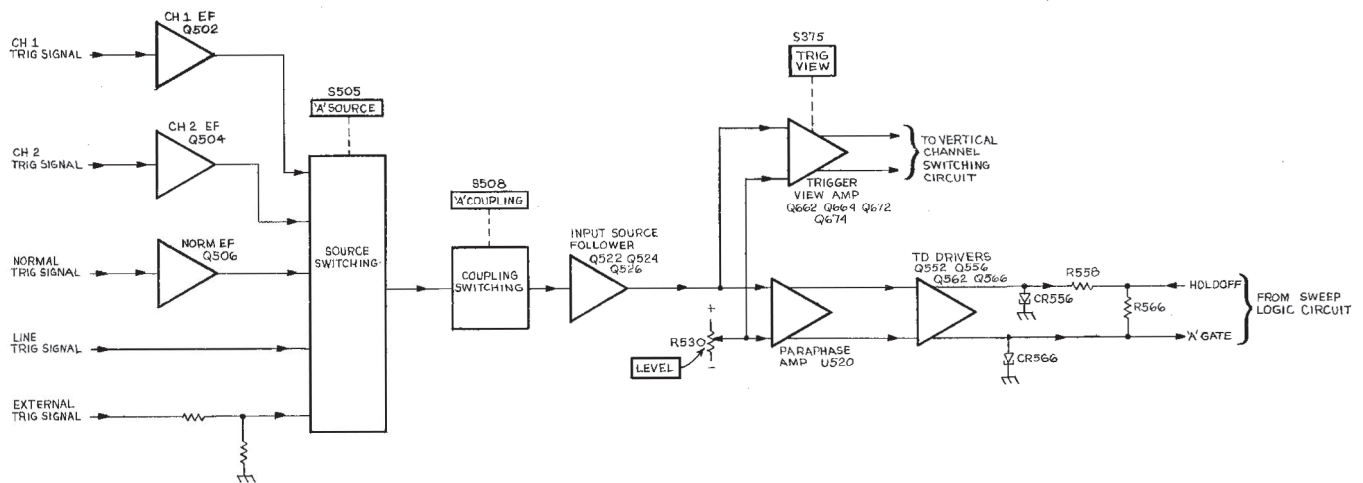


Fig. 3-5. Detailed block diagram of the A Trigger Generator.

in phase with respect to the input signal. When the SLOPE switch is set to the — position, the output signal at pin 8 is in phase with respect to the input signal, and the output signal at pin 9 is inverted with respect to the input signal.

Tunnel Diode Driver

Q552, Q556, Q562, and Q566 are common-emitter amplifier stages that provide the signal currents necessary to switch the triggering tunnel diodes. CR556 and CR566 are ten-milliamper tunnel diodes. Quiescently (i.e., after the sweep holdoff period has passed, but before triggering), CR556 and CR566 are biased into their low voltage states. When the input signal increases the current in Q556 slightly above its quiescent state, this current and the current thru R555 is sufficient to bias CR556 into its high voltage state. The anode of CR556 steps positive to an approximately +0.5 volt level. Since less current is required to maintain a tunnel diode in its high voltage state than is required to switch it to its high voltage state, approximately 6 mA of current is additionally available to switch CR566 to its high voltage state. Thus, the next time Q566 conducts signal current, CR566 steps to its high voltage state sending a positive pulse to the logic circuit to initiate sweep action. The A Trig Sensitivity adjustment, R565, adjusts the tunnel diode bias to the proper level that will not allow CR566 to be switched to its high voltage state until CR556 has been switched to its high voltage state. At the end of the sweep time and during holdoff, a negative level is applied to the junction of R558 and R566, thereby resetting both CR556 and CR566 to their low voltage states. The reset level remains during holdoff time to ensure that a sweep gating signal is not generated until the sweep circuit has returned to its quiescent state.

Trigger View Amplifier

The Trigger View Amplifier circuit amplifies a sample of the signal present in the A Trigger Generator circuit and passes it on to the Vertical Output Amplifier for display on the CRT when the TRIG VIEW pushbutton is pressed. This provides a method of making a quick and convenient check of the signal being used to trigger the oscilloscope and is intended primarily to be used to check the timing difference between the trigger signal and the vertical deflection signal.

The amplifier consists of two emitter-coupled push-pull amplifier stages. The emitter source voltage for Q662 and Q672 is switched on and off by the TRIG VIEW pushbutton. With the TRIG VIEW pushbutton not pushed, the emitters of Q662 and Q672 are returned to ground through R665. This reverse-biases the base-emitter junctions of the transistors, preventing any loading of the A Trigger Generator circuit. When the TRIG VIEW pushbutton is pushed, the emitters are now returned to +15 volts through R663. This forward biases Q662 and Q672 to allow signal amplification. R673 adjusts for correct DC balance in the circuit.

Normally, the output of the Vertical Channel Switching circuit is applied to the input of the Delay Line. When the TRIG VIEW pushbutton is pushed, the signal from the Vertical Channel Switching circuit is removed and the output from the Trigger View Amplifier is applied in its place.

B TRIGGER GENERATOR

General

The B Trigger Generator circuit produces the trigger pulse used to start the Sweep Generator circuit that provides the B portion of the CRT display. The B Trigger Generator circuit is virtually the same as the A Trigger Generator circuit and only the differences between the two are described here. A schematic of this circuit is shown on Diagram 6 at the rear of this manual.

Trigger Source

The B Trigger Generator circuit has no LINE or EXT ± 10 positions on its Trigger SOURCE switch. If the Generator is to be triggered from a line voltage signal or the external trigger signal is to be attenuated, it must be accomplished in some other manner. The B Trigger SOURCE switch does have a STARTS AFTER DELAY position, however, that the A Trigger SOURCE switch does not. This position allows the B portion of a display to start immediately after the selected delay time without waiting for a triggering signal.

SWEEP AND Z AXIS LOGIC CIRCUIT

General

The Sweep And Z Axis Logic Circuit derives the logic levels necessary to control the sequence of events associated with sweep generation and CRT unblanking. The +A and +B GATE signals are also generated in this circuit. Positive logic terminologies and symbologies are used in the following explanation of circuit operation. A schematic of this circuit is shown on Diagram 7 at the rear of this manual.

Sweep Control Integrated Circuit

U600 is the Sweep Control Integrated Circuit. Several functions are performed in this stage, depending on the mode of operation of the instrument sweep generators. The following is a brief explanation of the function associated with each pin of the IC.

Pin 1. This is the positive Auto Sense input. The signal connected here comes from the A Fire TD in the A Trigger Generator circuit.

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Pin 2. This is the negative Auto Sense Input. A fixed DC level established by R602 and R603 is connected here.

Pin 3. This is the + auto gate terminal. In the AUTO mode of operation, if no trigger signals are applied to pin 1 of U600 during the ≈ 40 ms time period following the end of holdoff, the gate level at pin 3 steps LO to turn Q574 on, which initiates a sweep.

Pin 4. This is the – auto gate terminal, not used in this application.

Pin 5. Input terminal for negative voltage supply.

Pin 6. This is the auto gate timing terminal. R609 and C609 determine the amount of time between the end of holdoff and the generation of the auto gate.

Pin 7. This terminal lights the TRIG'D light when a triggering gate has occurred.

Pin 8. This is the holdoff timing terminal. The time between the end of a sweep and when a positive pulse is conducted at pin 8 is determined by RC components (selected by the TIME/DIV Switch) in the Holdoff Timing circuit.

Pin 9. Ground terminal.

Pin 10. Not used in this application.

Pin 11. This terminal lights the READY light when operating in the single sweep mode.

Pin 12. This is the single sweep mode terminal. When +5 volts is connected to this terminal, the sweep operates in the single sweep mode; when the terminal is left open or grounded, the sweep operates in the repetitive mode.

Pin 13. Not used in this application.

Pins 14 and 15. Single sweep reset terminals. Pushing the PUSH TO RESET button prepares the single sweep circuitry to respond to the next one triggering event. Also causes the READY light to be lit.

Pin 16. This is the holdoff start input terminal. The HI sweep reset gate pulse from the Holdoff Start circuit is applied here to initiate sweep holdoff.

Pin 17. This is the holdoff output terminal. The gate level at this terminal is HI during holdoff and LO otherwise.

Pin 18. Sweep disable input. +5 volts applied to this terminal disables all sweep action.

Pin 19. Auto mode terminal. Grounding this terminal enables auto sweep operation.

Pin 20. Input terminal for positive voltage supply.

Main Gate Comparator

Q572 and Q574 form the Main Gate Comparator and are connected as a voltage comparator, where both transistors do not conduct at the same time. The input signal to the stage is the positive-going trigger signal from the A Fire Trigger TD in the A Trigger Generator circuit. The signal at the collector of Q574 is inverted by Q588, is connected to the Z Axis Logic Multivibrator to control CRT blanking, and to Q584 to generate the A + GATE output signal. The signal at the collector of Q574 connects to the base of the Main Gate Amplifier stage (Q902) in the Sweep Generators circuit to initiate sweep generation.

Delayed Gate Comparator

Q802 and Q804 form the Delayed Gate Comparator and are connected as a voltage comparator where both transistors do not conduct at the same time. The input signal to the stage is the positive-going trigger signal from the B Fire Trigger TD in the B Trigger Generator circuit. The signal at the collector of Q804 is inverted by Q826 and is connected to the Z Axis Logic Multivibrator to control CRT blanking and to Q824 to generate the B + GATE output signal. The signal at the collector of Q802 connects to the base of the Delayed Gate Amplifier stage (Q996) in the Sweep Generators circuit to initiate sweep generation.

A Trigger TD Reset Circuit

Q612 and Q628 are connected as a voltage comparator and form the A Trigger TD Reset Circuit. At the start of holdoff, pin 17 of U600 steps HI. This turns on Q612 and turns Q628 off. The collector signal of Q612 connects to the Trigger Tunnel Diodes in the A Trigger Generator circuit and resets them to their LO state. At the end of holdoff pin 17 of U600 steps LO, Q612 turns off, and Q628 turns on.

Holdoff Start Circuit

Q594 and Q596 form the Holdoff Start Circuit. The input signal to the stage is the positive-going end-of-sweep signal from the Sweep Generators circuit or from the

Delayed Latch circuit. The positive-going signal turns Q594 on which in turn turns on Q596. The positive-going signal at the collector of Q596 is connected to pin 16 of U600 to start the holdoff period and is also used in the Vertical Switching Circuit to switch between channels in the ALT mode of operation.

Z Axis Logic Multivibrator

Q688 and Q698 are basically a Schmitt Multivibrator and form the Z Axis Logic Multivibrator. Quiescently, with the CRT display blanked, Q688 is on and Q698 is off. The signal to switch states of the multivibrator (and thereby unblank the CRT) can come from the Main Gate Comparator (via Q588 and CR681) or from the Delayed Gate Comparator (via Q826 and C684). The negative going signals turn off Q688 and cause Q698 to turn on. The positive going signals that return the multivibrator to its original state (thereby blanking the CRT display) come from Q588 via CR682 and CR683, or from Q680 via CR680 and CR683. Q680 is used primarily to ensure proper early turn-off of the CRT display at faster sweep rates. In the MIX or A INTEN positions of the HORIZ DISPLAY switch, some additive unblanking is accomplished to slightly increase the intensity of the B portion of the display. In these positions of the switch, -8 volts is connected to the cathode of either CR691 or CR692. Now, when the Z Axis signal from the collector of Q826 steps negative at the beginning of the B portion of the display, CR693 is made to conduct less current, which makes a slight amount of additional unblanking current available to the Z Axis Amplifier (via CR694, R692, and either CR691 or CR692).

Delayed Sweep Latch Circuit

Q788, Q794, and Q796 form the Delayed Sweep Latch Circuit. The circuit function is used during the three delayed sweep modes of operation that the instrument is capable of (MIX, A INTEN, and B DLY'D). Q938A, in the Delay Pickoff Comparator of the Delaying Sweep Generator, is the current source for the emitters of Q794 and Q796. Prior to the end of the delay time selected by the A TIME/DIV switch and the DELAY TIME POSITION control, Q938A is off, thereby causing both Q794 and Q796 to be off also. The base level of Q794 sits at a more negative level than does the base of Q796 so that when Q938A turns on, at the delay pickoff point, C749 will turn on and Q796 will remain off. The resultant positive movement at the collector of Q794 is connected to the B Trigger TD Reset Circuit.

The end-of-sweep pulse from the Non-Delaying Sweep Generators connects to the emitter of Q788. When this pulse steps positive at the end of a delayed sweep, Q788 turns off and the current through R788 pulls the base of Q794 positive. This turns off Q794 and causes Q796 to turn on. The circuit remains in this state until the Delaying

Sweep Generator ends its sweep and resets the Delay Pickoff Comparator. In the B ENDS A position of the A TRIG HOLDOFF control +5 volts is connected to R798. This enables the diode gate composed of CR799 and CR592. Now, when the end-of-sweep pulse signals the end of a delayed sweep, the positive movement at the collector of Q796 is connected to the base of Q594. This starts the beginning of holdoff at the end of the delayed sweep instead of waiting until the end of the delaying sweep. This mode of operation gives the fastest possible sweep repetition rate when operating in the delayed sweep mode.

B Trigger TD Reset Circuit

Q790 and Q792 are connected as a voltage comparator and form the B Trigger TD Reset Circuit. At all times other than when the Non-Delaying Sweep Generators are running, Q790 is on, which holds the trigger tunnel diodes in the B Trigger Generator circuit in their LO states. At the end of the delay time selected by the A TIME/DIV switch and the DELAY TIME POSITION control, the positive movement at the collector of Q794 turns on Q792 and causes Q790 to turn off. The tunnel diodes in the B Trigger Generator are capable of being biased into their HI states. Also, if the B Triggering SOURCE switch is in the STARTS AFTER DELAY TIME position, the negative movement at the collector of Q792 reverse biases CR811, letting the -8 volt supply pull down on the base of Q804 in the Delayed Gate Comparator. This turns on Q804 and causes Q802 to turn off, which initiates a delayed sweep.

Delayed Sweep Override Amplifier

Q798 is the Delayed Sweep Override Amplifier. It is possible, with the right combination of control settings, to achieve a delayed sweep presentation where the delayed sweep would normally want to continue running after the end of the delaying sweep. For instance, if the TIME/DIV switches are set only one or two ranges apart and the DELAY TIME POSITION control is set to a 8.50 setting. Under these conditions the delaying sweep end-of-sweep pulse occurs before the delayed sweep end-of-sweep pulse. The positive movement on the collector of Q588 at the time of the delaying sweep end-of-sweep pulse turns Q798 on. The negative movement on the collector of Q798 pulls down on the collectors of Q794 and Q796, through CR793 and CR792 respectively, which in turn pulls down on the base of Q792. This turns off Q792 and causes Q790 to turn on, which resets the B Trigger Tunnel Diodes to their LO states, thereby terminating the delayed sweep.

A +GATE And B +GATE Amplifiers

Q584 and Q824 are the A +GATE and B +GATE amplifiers respectively. They provide the +GATE output signals available at the instrument rear panel. These output gate signals are positive-going rectangular waveforms, approximately 5 volts in amplitude, coincident with their respective sweep waveforms.

SWEEP GENERATORS

General

The Sweep Generators produce the sawtooth voltages that are amplified by the Horizontal Amplifier to provide horizontal deflection on the CRT. These sawtooth voltages are produced on command (trigger pulses) from the Trigger Generator circuits. The Sweep Generator circuits also produce gate waveforms that are used by the Z Axis Logic circuit to unblank the CRT during sweep time, and by the Sweep Logic circuit to terminate sweep generation. There are three Sweep Generator circuits in the instrument. Operation of all three is very similar; therefore only the operation of the Delaying Sweep Generator and the differences in operation of the three generators is discussed. Fig. 3-6 shows a detailed block diagram of the Sweep Generators. A schematic of the Sweep Generators is shown on Diagram 8 at the rear of this manual.

Delaying Sweep Generator

Basically the Delaying Sweep Generator is composed of Q904, Q920, Q922, and Q914. This generator only runs in the A INTEN, MIX, and B DLY'D positions of the HORIZ DISPLAY switch and generates the A portion of the display. The sweep rate is selected by the A TIME/DIV switch.

Main Gate Amplifier

Q902 is the Main Gate Amplifier stage. The negative-going Main Gate waveform from the Sweep Logic circuit is applied to the base of Q902. The amplified and inverted waveform at the collector of Q902 is applied to the Delaying Sweep Generator (through CR903), or to both of the Non-Delaying Sweep Generators (through Q992). This initiates sweep generation.

Sweep Disconnect Amplifier

Q904 is the Sweep Disconnect Amplifier. The biasing on the base of this stage determines whether the Delaying Sweep Generator will run. In the A position of the HORIZ DISPLAY switch, the anode of CR907 is connected to +5 volts through R908 and the HORIZ DISPLAY switch. This biases the base of Q904 far enough positive that the positive-going gates on the emitter cannot turn off Q904. Q904 therefore conducts all of the timing current through timing resistor R_t , keeping timing capacitance C_t discharged. When the HORIZ DISPLAY switch is in any position other than A, the anode of CR907 is connected to -8 volts. CR907 is now reverse-biased, which lets the base of Q904 be biased at a level that will allow the positive-going gates on the emitter of Q904 to interrupt the current flow through Q904. When Q904 turns off, the timing current starts to charge timing capacitance C_t .

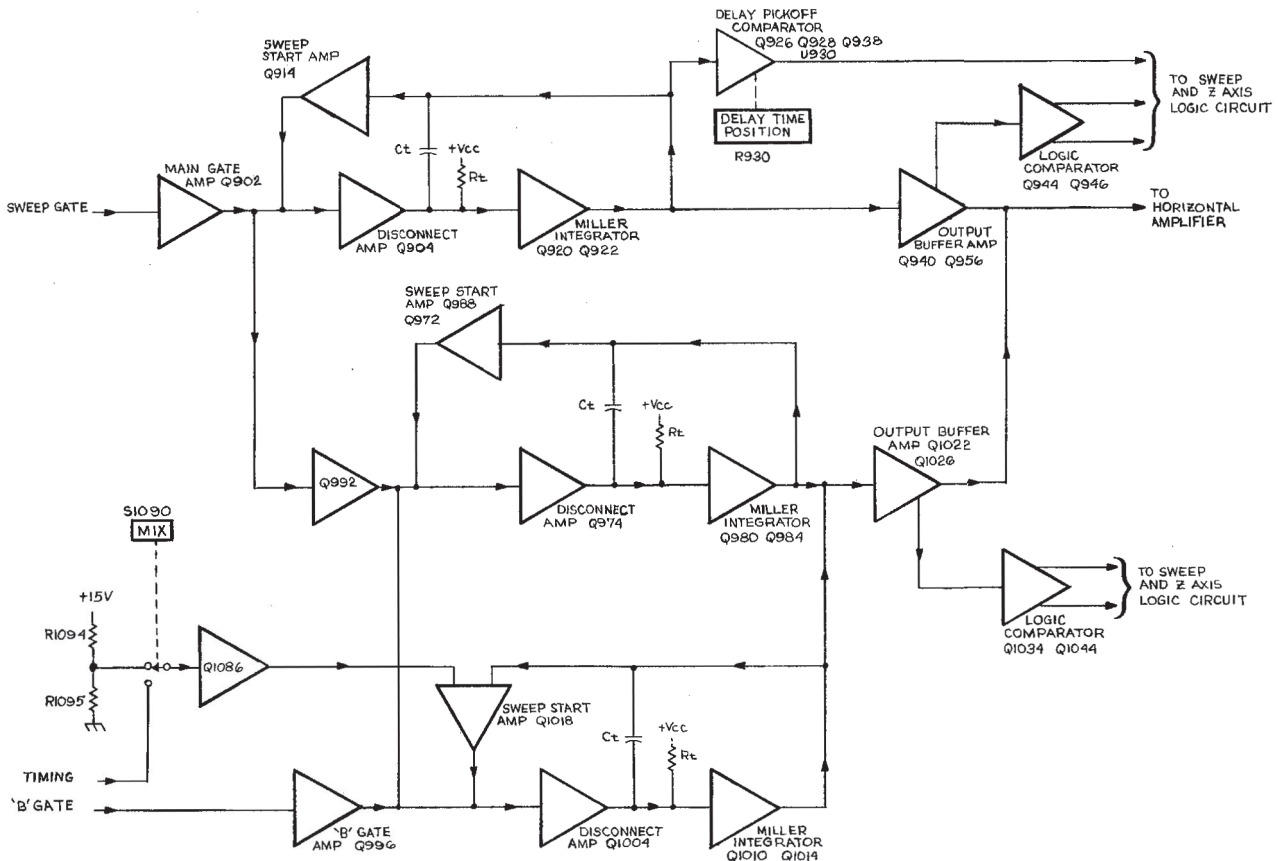


Fig. 3-6. Detailed block diagram of the Sweep Generator circuits.

Sawtooth Sweep Generator

Q920 and Q922 form a Miller Integrator circuit. When the current through the Sweep Disconnect Amplifier Q904 is interrupted, the timing capacitance begins to charge through the timing resistor. The timing resistor and capacitance are selected by the A TIME/DIV switch to provide the various sweep rates listed on the instrument front panel. The output signal at the collector of Q922 is a negative-going sawtooth voltage waveform.

Sweep Start Amplifier

Just before the sweep starts to run down, the levels at the bases of Q914 are approximately equal. When the sweep starts to run down, the base of Q914B goes negative, which increases the forward bias on CR914B. This in turn decreases the forward bias on CR914A, which very shortly after the start of the sweep, becomes reverse biased to interrupt the current through Q914A. The circuit remains in this condition until after the sweep retrace is complete. When the circuit returns to quiescence, Q914A begins to conduct through R904. This sets the current through Q904, which in turn establishes the DC level starting point for the sweep.

Output Buffer Amplifier

Q940 and Q956 form the Output Buffer Amplifier. Q940 is an emitter follower and Q956 is a common-base amplifier whose emitter is current-driven by the signal. The Output Buffer Amplifier provides the output sawtooth signal current to the Horizontal Amplifier and provides a measure of isolation between the Sawtooth Generator and the Horizontal Amplifier. Intensified Gain adjustment R950 adjusts the gain of the stage to match the output signal amplitude with that of the Non-Delaying Sweep Generators.

The Delaying Sweep Output Buffer Amplifier passes signal to the Horizontal Amplifier only when the HORIZ DISPLAY switch is in the A INTEN position and the TIME/DIV switches are not in the X-Y position. When the TIME/DIV switches are in the X-Y position the anode of CR956 is connected to +5 volts. This sets the base of Q956 at a positive enough level (about +6.3 volts in the A INTEN position; about +8.5 volts in the A, MIX, and B DLY'D positions) to reverse bias Q956 and prevent passage of the Delaying Sweep signal to the Horizontal Amplifier. With the TIME/DIV switches not in the X-Y position and the HORIZ DISPLAY switch in the A INTEN position R955 is connected to -8 volts and the anode of CR956 is not connected to any voltage. This forward biases CR955 and sets the base of Q956 at a DC level of approximately +4.3 volts. Now Q956 is forward biased and the Delaying Sweep signal is passed to the Horizontal Amplifier.

Logic Comparator

Q944 and Q946 are connected as a voltage comparator and generate the logic pulses that signal the end of sweep and blank the CRT display at the end of the sweep. Prior to the generation of a sawtooth voltage waveform by the Delaying Sweep Generator, the base of Q944 is at an approximate -1.6 volt level. The base of Q946 is held at about -3 volts by the divider made up of R948 and R949. Therefore, Q946 is reversed biased and not conducting and Q944 is forward biased and is conducting. Now, when the sweep voltage at the emitter of Q940 begins to go in a negative direction, the base of Q944 follows until the base of Q944 goes more negative than the base of Q946. Q944 turns off and Q946 turns on, generating a positive pulse at the collector of Q944 and a negative pulse at the collector of Q946. The positive pulse at the collector of Q944 signals the end of sweep and starts the holdoff period. The negative pulse at the collector of Q946 signals the Z-Axis Logic circuit to blank the CRT and prevent any further display.

Delay Pickoff Comparator

The Delay Pickoff Comparator stage allows selection of the amount of delay from the start of the Delaying Sweep Generator before one of the Non-Delaying Sweep Generators is turned on. The amount of delay available is variable from 0.00 to 10.00 times the setting of the A TIME/DIV switch. The sweep rate of the Delayed (non-delaying) Sweep Generator is determined by the setting of the B TIME/DIV switch.

Q926A and Q926B are connected as a voltage comparator. Q928 is a relatively constant current source for Q926. Q938 is also connected as a voltage comparator circuit and is used to improve the switching capabilities of the stage. The reference voltage for the Delay Pickoff Comparator stage is provided by DELAY-TIME POSITION control R930. U930 is an integrated circuit containing two high-gain amplifier cells used in a feedback amplifier configuration. They provide accurate fixed voltages to both ends of the DELAY-TIME POSITION control to allow precise delay pickoff. The instrument is calibrated so that the major dial divisions of the DELAY-TIME POSITION control correspond to major divisions of horizontal deflection on the CRT graticule. For example, if the DELAY-TIME POSITION control is set to 5.00, the Non-Delaying Sweep Generator is delayed five divisions of the Delaying Sweep time before it can produce a sweep.

The sawtooth voltage waveform from the Delaying Sweep Generator is connected to the gate of Q926B. The quiescent level of the delaying sawtooth biases Q926B on and its drain is negative enough to bias Q938B on. Q926A and Q938A are off and not conducting. As the Delaying Sweep sawtooth voltage goes down, the gate of Q926B also

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goes down. When it goes more negative than the level at the gate of Q926A (established by the DELAY-TIME POSITION control), Q926A conducts and Q926B turns off. This also switches the states of Q938A and B and produces a positive-going rectangular pulse at the collector of Q938A. When the Delaying Sweep resets, Q926B again conducts and Q926A is turned off. This switches Q938A and B back to their original states.

Non-Delaying Sweep Generators

There are two Non-Delaying Sweep Generators. In any position of the HORIZ DISPLAY switch, one of these generators will be running. They generate the displayed sweep in the A position of the HORIZ DISPLAY switch and the B portion of a display in the remaining positions. The B TIME/DIV switch selects the sweep rate for these generators. One generator provides the 0.5 second through 1 microsecond sweep rates, while the other generator provides the 1 microsecond through 0.05 microsecond sweep rates.

Either the "Main" Gate or the "B" Gate can initiate sweep generation by the Non-Delaying Sweep Generators. When the HORIZ DISPLAY switch is in the A position, +5 volts is applied to the emitter of Q992, through R922. Q992 is forward biased, and the "Main" Gate is passed on to the Non-Delaying Sweep Generators through CR922 and CR971 or CR1001. In all the other positions of the HORIZ DISPLAY switch, -8 volts is connected to the emitter of Q992 through R922. This reverse-biases Q992 and prevents the "Main" Gate from reaching the generators. Now, only the "B" Gate can initiate sweep action in the Non-Delaying Sweep Generators.

"B" Gate Amplifier

Q996 is the "B" Gate Amplifier stage. The negative-going waveform from the Sweep Logic circuit is applied to the base of Q996. The amplified and inverted waveform at the collector of Q996 is applied to the Non-Delaying Sweep Generators through CR996 and CR971 or CR1001 to initiate sweep generation.

Non-Delaying Sweep Generator Differences

Basically the Non-Delaying Sweep Generators operate in the same manner as the Delaying Sweep Generator. The "fast" generator (Q1004, Q1010, Q1014, and Q1018) has only one timing capacitance (the parallel combination of C1008 and C1009). The capacitance is variable to achieve precise timing accuracy. Timing resistors are selected by the B TIME/DIV switch to provide the fastest six sweep speeds listed on the front panel.

Q988 and Q1018 are Sweep Start Amplifiers and establish the DC level starting points for the sweeps. The "slow" generator (Q974, Q980, Q984, Q988, and Q972) has an additional emitter follower (Q972). This emitter follower increases the current-gain of the loop to speed up the retrace time of the generator (determined by the time required to discharge the timing capacitor).

Mixed Mode Operation

Normally, Q1086 is an emitter follower, with a fixed DC level at its base established by R1094 and R1095. The fixed level at the emitter of Q1086, in turn, is applied to the base of Q1018 and Q988, through CR1017 and CR987, respectively. This established the quiescent current flow through Q988 and Q1018 to establish the DC level starting points for the sweeps as previously explained. However, when the HORIZ DISPLAY switch is in the MIX position, the fixed level at the base of Q1086 is replaced by the sawtooth voltage waveform being generated by the Delaying Sweep Generator. Now, the DC level starting point of the Non-Delaying Generator, that is running is constantly being changed by the Delaying Sweep sawtooth. The output waveform from the Non-Delaying Sweep Generator that is running will be a composite sawtooth waveform with the first and last parts occurring at a rate determined by the Delaying Sweep Generator (last part blanked out of CRT display) and the middle part occurring at a rate determined by one of the Non-Delaying Sweep Generators.

Logic Comparator

Q1044 and Q1034 are connected as a voltage comparator, and generate the same sort of logic pulses as the Logic Comparator in the Delaying Sweep Generator circuit. The positive-going pulse at the collector of Q1034 signals the end of the Non-Delaying Sweep, and the negative-going pulse at the collector of Q1044 blanks the display at the end of the Non-Delaying Sweep. However, the logic pulses from this comparator are not always allowed to pass to the Sweep and Z-Axis Logic circuits.

In the A INTEN position of the HORIZ DISPLAY switch, +5 volts is connected to the anode of CR1049 through R1049. This forward biases CR1044, which sets the collector of Q1044 at approximately +0.7 volts. This keeps CR1046 reverse-biased and prevents completely blanking the CRT at the end of the B portion of the display. In the A INTEN, MIX, and B DLY'D positions of the HORIZ DISPLAY switch, -8 volts is connected to the anode of CR1036. This disables the diode gate composed of CR1034 and CR1037 and does not allow the end-of-sweep pulse from Q1034 to pass to the Sweep Logic circuit. In the A position of the HORIZ DISPLAY switch, +5 volts is connected to the anode of CR1036. This enables CR1034-CR1037 and allows the end-of-sweep pulse to pass to the Sweep Logic circuit.

HORIZONTAL AMPLIFIER

General

The Horizontal Amplifier circuit provides the output signals to the CRT horizontal deflection plates. The signal applied to the input of the Horizontal Amplifier is determined by the TIME/DIV switch. The signal can be a sawtooth waveform generated within the instrument, or some external signal applied to the CH 1 OR X input connector (X-Y mode of operation). The Horizontal Amplifier also contains the X10 magnifier, horizontal positioning controls, and some beam finder circuitry. Fig. 3-7 shows a detailed block diagram of the Horizontal Amplifier circuit. A schematic of this circuit is shown on Diagram 10 at the rear of this manual.

Input Paraphase Amplifier

Q1124 and Q1134 form the Input Paraphase Amplifier. This is an emitter-coupled amplifier stage that converts the single-ended input signal to a push-pull output signal. The X10 Magnifier circuitry is in this stage and consists of a divide-by-ten attenuator R1106-R1107-R1108. When the X10 Magnifier is on, the input signal is applied unattenuated to the Input Paraphase Amplifier. When the X10 Magnifier is off, the input signal is applied to the Input Paraphase Amplifier through the attenuator. X10 MAG indicator DS1110 lights when the X10 Magnifier is being used. CR1121 and CR1122 limit signal amplitudes at the input to the amplifier to prevent amplifier overdrive. Q1140 is a relatively constant current source for Q1124 and Q1134. CR1140 provides temperature compensation for the base-emitter junction of Q1140. RT1123 varies in value with changes in temperature to compensate for associated changes in amplifier gain. Magnifier Registration adjustment R1130 balances quiescent DC current in Q1124

and Q1134 so that a center screen display does not change position when the X10 Magnifier is turned on.

Q1114 is a current-source that is an interruptable path for the horizontal positioning currents. When the TIME/DIV switch is in any position other than X-Y, the anodes of CR1103, CR1104, and CR1111 are connected to -8 volts through R1104, which reverse-biases them. In the X-Y position of the TIME/DIV switch, $+5$ volts is connected directly to the anodes of CR1103, CR1104, and CR1111. This accomplishes three things. First, the emitter-base junction of Q1114 is reverse biased which prevents the Horizontal POSITION and FINE controls from having any affect on the display. Second, relay K1103 is energized which connects the X-axis signal from the Channel 1 Preamplifier to the input to the Horizontal Amplifier. Third, $+5$ volts is connected to the Channel 1 Scale Factor Switching circuit so that both deflection factor indicators are operating. When operating in the X-Y mode, R1102 adjusts for correct X-axis gain and L1103 adjusts to reduce the phase differences between the horizontal (X) and vertical (Y) signal paths.

Gain Setting Amplifier

Q1152 and Q1162 are an emitter-coupled push-pull amplifier stage. The gain of this stage is adjusted to match the CRT sensitivity. When the BEAM FIND pushbutton is pushed R1168 is switched into the circuit. This reduces the dynamic swing capabilities of this stage, thereby limiting horizontal deflection to within the limits of the CRT viewing area. Q1152 and Q1162 operate in an overdriven mode. This means at the extremes of signal amplitude, one side will be turned off while the other side is still conducting. This condition generates some common-mode signal differences between Q1152 and Q1162. Q1164 monitors any common-mode signal differences (through R1165 and R1167) and conducts to minimize them.

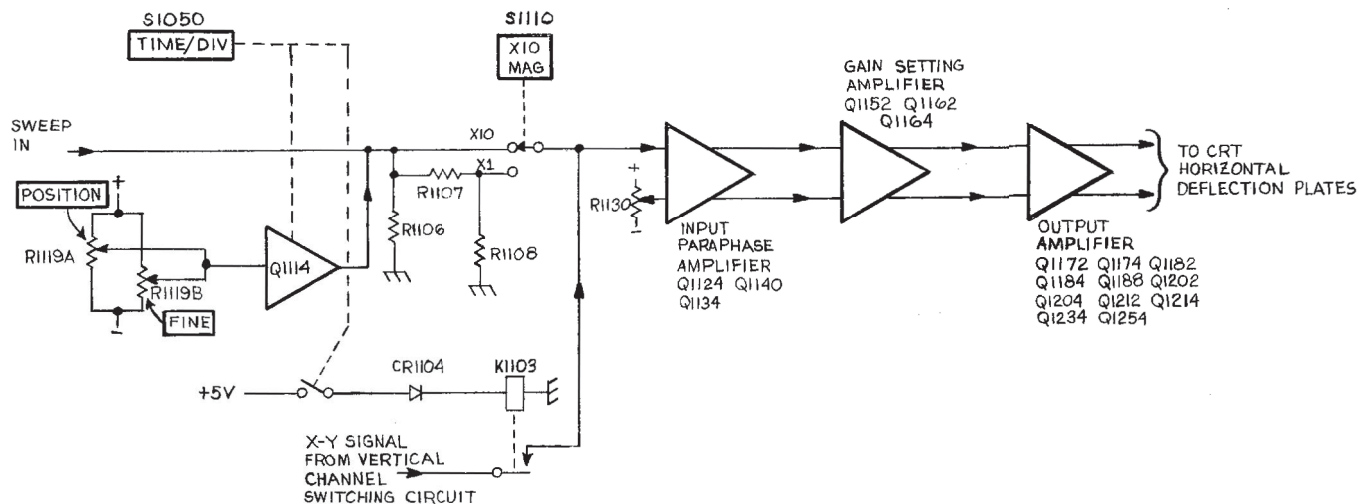


Fig. 3-7. Detailed block diagram of the Horizontal Amplifier.

Output Amplifier

The push-pull signal from the Gain Setting Amplifier is connected to the Output Amplifier. Each half of the Output Amplifier can be considered as a single-ended feedback amplifier, which amplifies the signal at its input to produce a voltage output to drive one of the horizontal deflection plates of the CRT. Both halves of the Output Amplifier are basically the same with only minor differences; therefore, only the upper amplifier (drives the + horizontal deflection plate) and the differences will be explained.

Q1172 and Q1174 are connected in a Darlington configuration. Q1234 is a feedback amplifier in the feedback path for the output amplifier. Q1234 sets DC levels and reduces the impedance of the feedback path. Q1202 and Q1204 form a complementary amplifier that provides the output signal to drive the + deflection plate of the CRT. CR1173 clips excessive signal amplitudes and also provides temperature compensation for several of the emitter-base junctions in the output amplifier. R1175, C1233, and C1179 are high-frequency compensation adjustments. R1256 centers the output signal swing within the dynamic swing capabilities of the output amplifier.

There are two signal paths through each half of the Output Amplifiers. Slow signal transitions are applied to the CRT through Q1172, Q1174, and Q1204 with feedback via R1233 and R1235. C1235, C1233, and C1178-C1179 compensate the amplifier and provide a fast AC signal path from one side of the amplifier to the other. The lower amplifier (drives the - horizontal deflection plate) is basically the same as the upper except for two things. Q1188 is a relatively constant current source for Q1182 and Q1184. VR1216 shifts the DC level of the signal from the collectors of Q1182 and Q1184 to the emitter level of Q1214.

LOW-VOLTAGE POWER SUPPLY

General

The Low-Voltage Power Supply circuit provides the operating power for this instrument from six regulated power supplies. Electronic regulation is used to provide stable, low-ripple output voltages. Fig. 3-8 shows a detailed block diagram of the Power Supply circuit. A schematic of this circuit is shown at the back of this manual.

Power Input

Power is applied to the primary of transformer T1400 through Line Fuse F1401, POWER switch S1401, Thermal Cutout S1402, Line Voltage Selector switch S1403, and the Regulating Range Selector. Line Voltage Selector switch S1403 connects the split primaries of T1400 in parallel for

115-volt nominal operation, or in series for 230-volt nominal operation. Line Fuse F1401 should be changed for each nominal line voltage (current rating of fuse for 230-volt operation is one-half the current rating of fuse for 115-volts).

The vacant windings between pins 10, 10A, 11, 12, and 12A of T1400 are intended for use with the optional Inverter Circuit Board (Option 7). This allows the instrument to be operated from an external DC power source or an 1106 Power Supply.

Secondary Circuit

The -8 volt, -15 volt, +5 volt, +15 volt, +50 volt, and +110 volt supplies are series-regulated supplies. U1418, U1454A and B, and U1464A and B are high-gain amplifier cells with differential inputs. These amplifiers monitor variations in the output voltages and generate error signals to maintain relative constant output levels. Additionally unregulated voltages are used from the +15 volt and +50 volt supplies.

Q1492, Q1498, and their associated circuitry monitor the unregulated voltage in the +50 volt supply and provide a visual indication (via the LOW LINE indicator on the front panel) when the applied line voltage falls below the lower regulating limit selected by the Regulating Range Selector assembly. Q1482 provides operating power to the CRT graticule lights that is adjustable via the SCALE ILLUM control R1480.

CRT CIRCUIT

General

The CRT Circuit provides the voltage levels and control circuits necessary for operation of the cathode-ray tube (CRT). Fig. 3-9 shows a detailed block diagram of the CRT Circuit. A schematic of this circuit is shown on Diagram 12 at the rear of this manual.

High-Voltage Oscillator

Q1318 and associated circuitry compose the high-voltage oscillator that produces the drive for high-voltage transformer T1320. When the instrument is turned on, current through Q1316 provides forward bias for Q1318. Q1318 conducts and the collector current increases, which develops a voltage across the collector winding of T1320. This produces a corresponding voltage increase in the feedback winding of T1320, which is connected to the base of Q1318, and Q1318 conducts even harder. Eventually the rate of collector current increase in Q1318 becomes less than that required to maintain the voltage across the collector winding and the output voltage drops. This turns

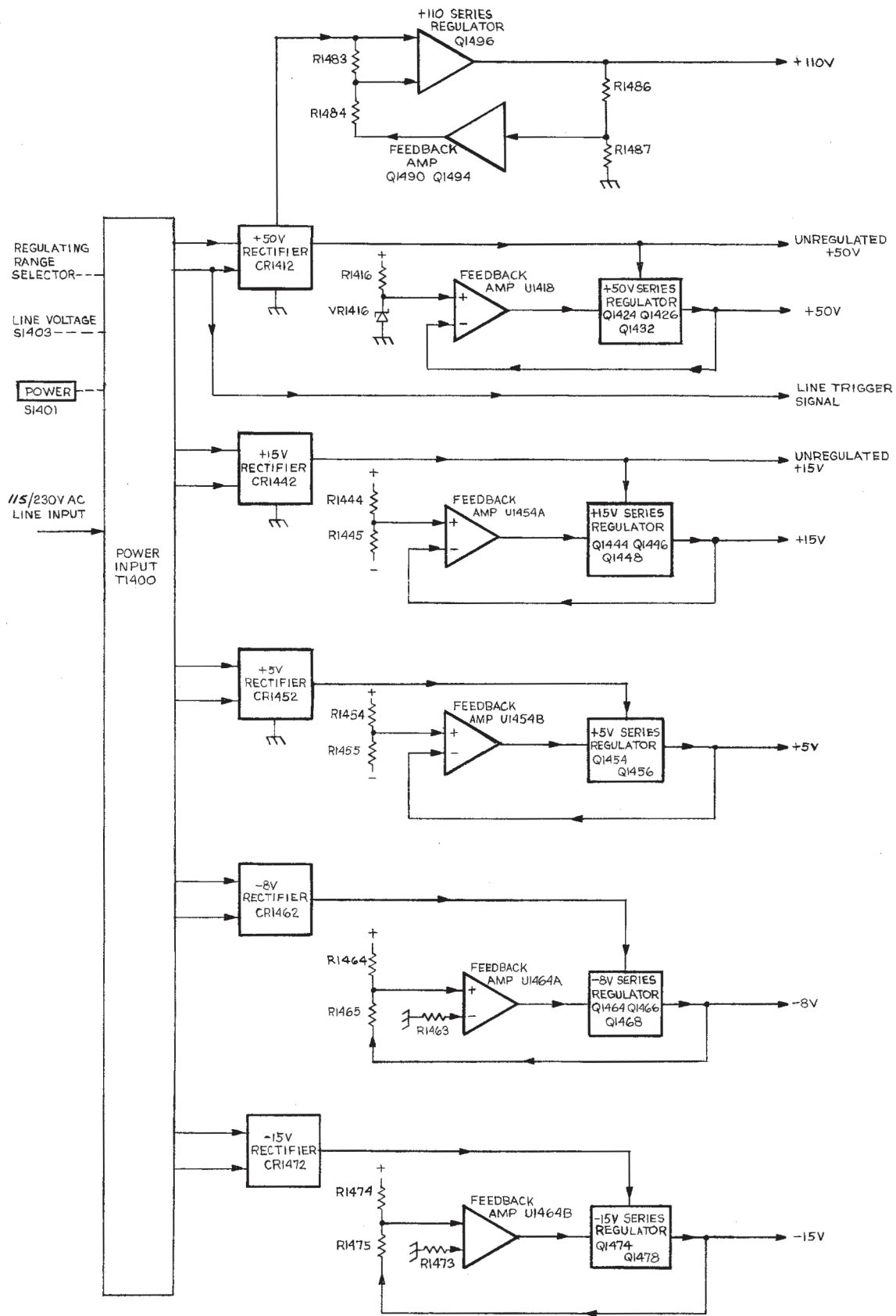


Fig. 3-8. Detailed block diagram of the Power Supply.

Circuit Description—475

Q1318 off by way of the feedback voltage to the base. The voltage waveform at the collector of Q1318 is a sine wave at the resonant frequency of T1320. Q1318 remains off during the negative half cycle while the field collapses in the primary of T1320. When the field is collapsed sufficiently, the base of Q1318 becomes forward biased into conduction again and the cycle begins anew. The amplitude of sustained oscillation depends upon the average current delivered to the base of Q1318. The frequency of oscillation is approximately 50 kilohertz. Fuse F1318 protects the +15 volts supply in the event the High-Voltage Oscillator stage becomes shorted. C1318 and L1318 decouple the +15 volt supply line and prevent the current changes present in the circuit from affecting the +15 volt regulator.

High-Voltage Regulator

Feedback from the CRT cathode -2450 volt supply is applied to the base of Q1306 through R1303A. Any change in the level at the base of Q1306 produces an error signal at the collector of Q1306, which is amplified by Q1308 and Q1316 and applied to the base of Q1318 through the feedback winding of T1320. Regulation occurs as follows.

If the output voltage at the -2450 volt test point starts to go positive (less negative), this positive-going change is applied to the base of Q1306. Q1306 conducts harder, which in turn causes Q1308 and Q1316 to conduct harder. This results in greater bias current to the base of Q1318 through the feedback winding of T1320. Now, Q1318 is biased closer to its conduction level so that it comes into conduction sooner to produce a larger induced voltage in the secondary of T1320. This increased voltage appears as a more negative voltage at the -2450 volt test point to correct the original positive-going change. By sampling the output from the CRT cathode supply in this manner, the total output of the High-Voltage Supply is held relatively constant.

Q1312 and Q1310 compose an overvoltage protection circuit. In the event the regulating action of the circuit should cause the CRT cathode supply to approach approximately -3000 volts, the voltage level at the emitter of Q1316 will be very close to -6 volts. Normally Q1312 and Q1310 are biased off and do not conduct. When the voltage level at the emitter of Q1316 reaches approximately -6 volts, Q1312 is biased into conduction, which in turn biases Q1310 on. Q1310 now starts to reduce the base drive

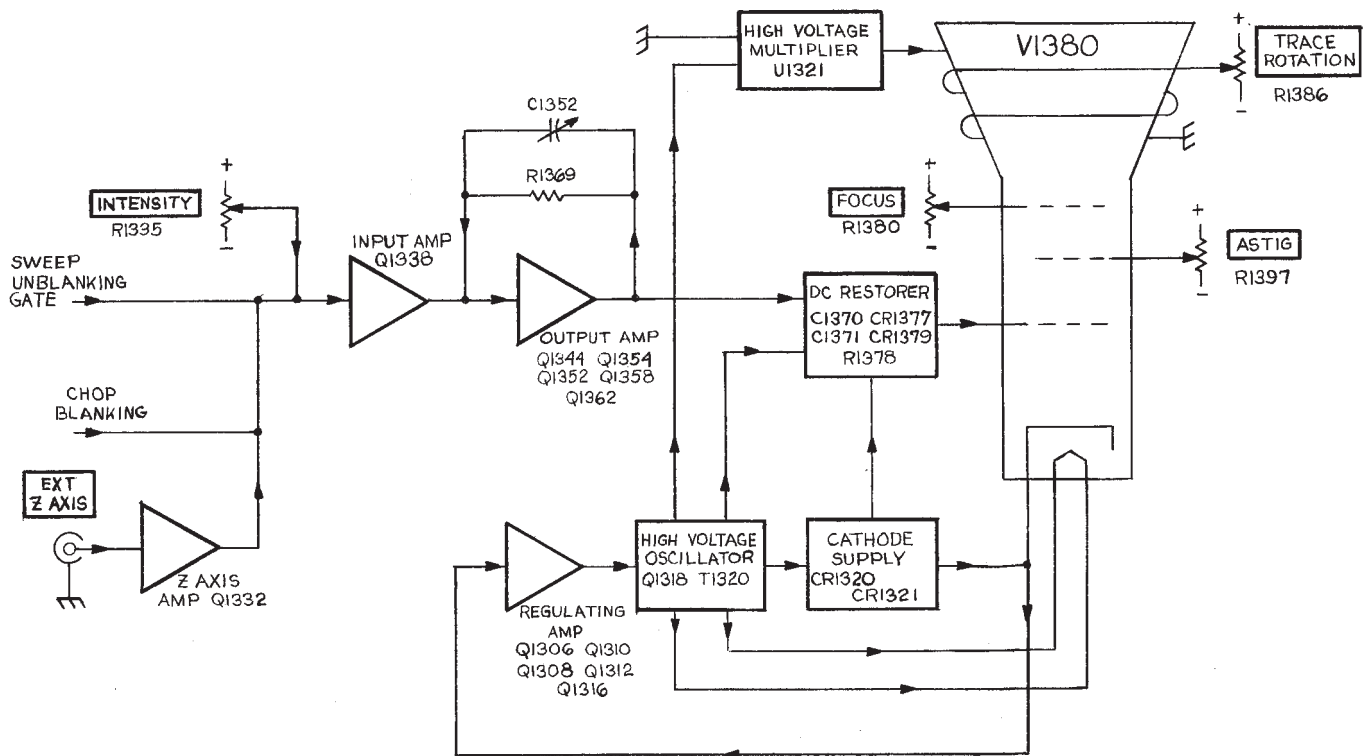


Fig. 3-9. Detailed block diagram of the CRT Circuit.

applied to Q1318 and prevents the amplitude of oscillations from increasing. This prevents the CRT cathode supply from going more negative than approximately -3300 volts.

High-Voltage Rectifiers and Output

The high-voltage transformer T1320 has two output windings. One winding provides filament voltage for the cathode-ray tube. The filament voltage can be supplied from the High-Voltage Supply, since the cathode-ray tube has a very low filament current drain. The filament of the cathode-ray tube is elevated to the cathode level to prevent cathode-to-filament arcing. The other winding of T1320 is used to derive both the negative cathode potential and the positive anode accelerating potential. The CRT grid bias voltage is derived by a DC restorer circuit that uses a sample of the signal in the high-voltage winding in conjunction with DC levels provided by the Z-Axis Amplifier and the negative CRT cathode potential.

The positive accelerating potential is supplied by High Voltage Multiplier U1321. Regulated output voltage is approximately $+15,500$ volts. The negative cathode potential is supplied by a voltage doubler circuit. Voltage output is -2450 volts. Variations in supply voltage are monitored by the High-Voltage Regulator circuit to provide a regulated high-voltage output.

In the 0.1 s, 0.2 s, 0.5 s, and X-Y positions of the TIME/DIV switch the anode of CR1337 is connected to ground. This limits how negative the operating level at the emitter of Q1338 can go to reduce the unblanking capabilities of the amplifier, thereby reducing the possibility of inadvertently burning the CRT phosphor. When the BEAM FIND pushbutton is pushed -8 volts is connected to the junction of R1342 and R1346. This biases Q1338 off which in turn causes CR1343 to be reverse biased. Now the output of the Z-Axis Amplifier is isolated from all of the circuit's normal signal inputs. The output level of the amplifier is set at a fixed level determined by the parallel value of R1343 and R1346 divided into the feedback resistance of the amplifier.

CRT Control Circuits

Focus of the CRT display is controlled by FOCUS control R1380. ASTIG adjustment R1397, which is used in conjunction with the FOCUS control to provide a well-defined display, varies the positive level on the astigmatism grid. Geometry adjustment R1390 varies the positive level on the horizontal deflection plate shields to control the overall geometry of the display.

Two adjustments control the trace alignment by varying the magnetic field around the CRT. Y Align adjustment R1385 controls the current through L1385, which affects

the CRT beam after vertical deflection but before horizontal deflection. Therefore, it affects only the vertical (Y) components of the display. TRACE ROTATION adjustment R1386 controls the current through L1386 and affects both vertical and horizontal rotation of the beam.

Z-Axis Amplifier

The Z-Axis Amplifier circuit controls the CRT intensity level from several inputs. The effect of these input signals is to either increase or decrease the trace intensity, or to completely blank portions of the display. The input transistor Q1338 is a current-driven, low input impedance amplifier. It provides termination for the input signals as well as isolation between the input signals and the following stages. The current signals from the various control sources are connected to the emitter of Q1338 and the algebraic sum of the signals determines the collector conduction level.

Q1344, Q1352, Q1354, Q1358, and Q1362 compose a feedback amplifier stage. R1369 is the feedback element, C1352 provides high-frequency compensation. Q1344 is an emitter follower that provides drive to the output complementary amplifier made up of Q1352, Q1354, and Q1358. Q1358 is a device with higher frequency characteristics than Q1354 and is used to improve the overall frequency capabilities of the Z-Axis Amplifier. On the fast positive-going output signal peaks, Q1358 depletes the charge on C1358. Then, on the negative-going signal peaks, Q1362 is pulsed on to renew the charge on C1358. CR1367 provides protection to the Z-Axis Amplifier circuitry in the event of short duration arcing in the CRT High-Voltage Power Supplies.

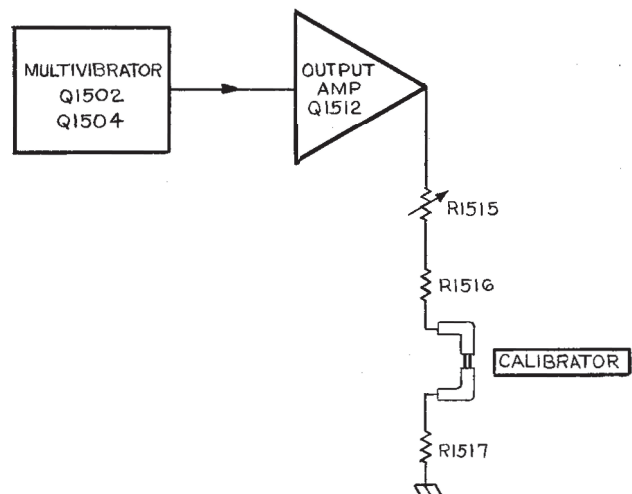


Fig. 3-10. Detailed block diagram of the Calibrator.

Circuit Description—475

DC Restorer Circuit

C1372, C1371, CR1377, CR1379, and R1378 form a DC restorer circuit. All DC levels in this circuit are referenced to the negative potential of the CRT cathode. The voltage difference across R1378 approximately equals the voltage swing present at the junction of CR1371 and CR1373. The control grid end of R1378 is more negative than the end connected to CR1379. The amplitude of the voltage swings present at the junction of CR1371 and CR1373 is determined by the voltage levels established by the Z-Axis Amplifier and the CRT Bias adjust circuit. The output level of the Z-Axis Amplifier sets the limit of the negative excursion (through CR1371) and the Grid Bias adjust circuit sets the limit of the positive excursion (through CR1373).

CALIBRATOR

General

The Calibrator circuit produces a square-wave output signal with accurate voltage and current amplitudes. This output is available as a voltage or current at the CALIBRATOR current loop on the instrument front panel. Fig. 3-10 shows a detailed block diagram of the Calibrator circuit. A schematic of this circuit is shown on Diagram 13 at the back of this manual.

Multivibrator

Q1502 and Q1504 along with their associated circuitry compose an astable multivibrator. The basic frequency of the multivibrator is approximately one kilohertz and is essentially determined by the RC combination of C1505 and R1502. The multivibrator symmetry is set by R1502

and R1504. Q1502 and Q1504 alternately conduct, producing a square-wave signal that is taken from the collector of Q1504.

Output Amplifier

The output signal from the Multivibrator overdrives Output Amplifier Q1512 to produce a square wave at the output. When the base of Q1512 goes positive, Q1512 is cut off and the collector level drops down to ground. When the base goes negative, Q1512 is biased into saturation and the collector of Q1512 rises positive to about +5 volts. Amplitude adjustment R1515 adjusts the resistance between the collector of Q1512 and ground to determine the amount of current allowed to flow, which in turn determines the voltage developed across R1517.

FAN MOTOR CIRCUIT

General

The fan motor used in the 475 is a brushless DC fan motor using Hall Effect devices. The fan motor circuitry varies the rotational speed of the fan with variations in operating temperature. When the ambient temperature increases, the value of thermistor RT1696 reduces. This biases Q1698 on harder to conduct more current through the Hall devices. Higher currents through the Hall devices causes the potential difference across them (for instance between pins 6 and 8 of the fan) to increase. This potential difference biases one of a pair of transistors on and the other off. For instance, if pin 8 is more positive than pin 6 of the fan, Q1690A will be on and Q1690B will be off. The higher the potential difference between pin 8 and pin 6 the harder the on transistor will be conducting. The harder the transistor is conducting, the faster the fan rotates.

MAINTENANCE

Cabinet Removal

WARNING

Dangerous potentials exist at several points throughout this instrument. When the instrument is operated with the cover removed, do not touch exposed connections or components. Some transistors may have elevated cases. Disconnect power before cleaning the instrument or replacing parts.

The instrument wrap-around cabinet can be removed in the following manner:

1. Unwrap the power cord from the instrument feet.
2. Remove the six screws indicated in Fig. 4-1 and remove the instrument feet and rear ring assembly from the instrument.
3. Slide the wrap-around cabinet to the rear and remove the oscilloscope.

To replace the instrument in its wrap-around cabinet, reverse the removal procedure. The portable wrap-around cabinet should be installed with the carrying handle pivot points positioned toward the bottom of the instrument.

PREVENTIVE MAINTENANCE

General

Preventive maintenance consists primarily of cleaning and visual inspection. When performed on a regular basis, preventive maintenance can prevent instrument breakdown

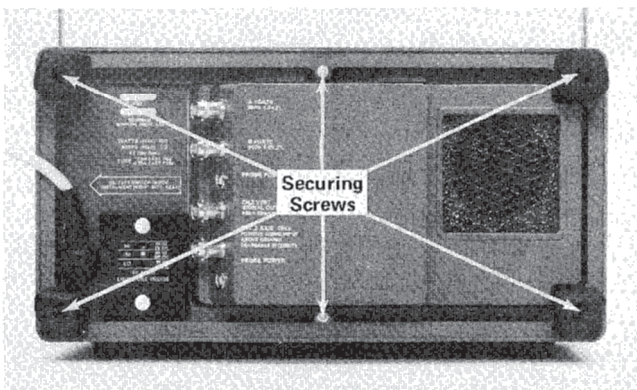


Fig. 4-1. Removing wrap-around cabinet.

and will improve the reliability of this instrument. The severity of the environment to which the 475 is subjected will determine the frequency of maintenance. A convenient time to perform preventive maintenance is just prior to recalibration of the instrument.

Cleaning

General. The 475 should be cleaned as often as operating conditions require. Accumulation of dirt in the instrument can cause overheating and component breakdown. Dirt on components acts as an insulating blanket and prevents efficient heat dissipation. It also provides an electrical conduction path which can result in instrument failure.

The cabinet provides protection against dust in the interior of the instrument. Operation without the cabinet in place necessitates more frequent cleaning. The front cover provides a measure of dust protection for the front panel and the CRT face. The front cover should be installed when storing or transporting the instrument.

CAUTION

Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Avoid chemicals which contain benzene, toluene, xylene, acetone or similar solvents. Recommended cleaning agents are isopropyl alcohol or Kelite (1 part Kelite, 20 parts water).

Switch Contacts. Most of the switching in the 475 is accomplished with circuit-board mounted, cam-actuated contacts. Care must be exercised to preserve the high-frequency characteristics of these switches. Seldom is switch maintenance necessary, but if it is required, observe the following precautions.

Cleaning the switch contacts should only be done using isopropyl alcohol or a solution of one part Kelite to 20 parts water. In the absence of these cleaners it is safe to use petroleum ether, white kerosene, or a solution of 1% Joy detergent and 99% water. Do not use acetone, MEK, MIBK, benzol, toluol, carbon tetrachloride, trichlor, trichlene, methyl alcohol, methylene chloride, sulfuric acid, or Freon TC-TE-TF-22-TA-12.

Most spray circuit coolants and contact cleaners contain Freon 12 as a propellant. Because many Freons adversely affect the contacts, check the contents before using a spray cleaner or coolant. No Noise (Electronic Chemical) is an acceptable contact cleaner-restorer. The only recommended circuit coolants are dry ice or isopropyl alcohol. There are three recommended switch lubricants. They are Silicone Versilube (General Electric Co.), Rykon R (Standard Oil), and WD-40 (Rocket Chemical Co.).

Exterior. Loose dust accumulated on the outside of the 475 can be removed with a soft cloth or small paint brush. The paint brush is particularly useful for dislodging dirt on and around the front-panel controls. Dirt which remains can be removed with a soft cloth dampened in a mild detergent and water solution. Abrasive cleaners should not be used.

CRT. Clean the blue and clear plastic light filters and the CRT face with a soft, lint-free cloth dampened with denatured alcohol or a mild detergent and water solution. The optional CRT mesh filter can be cleaned in the following manner.

1. Hold the filter in a vertical position and brush lightly with a soft No. 7 watercolor brush to remove light coatings of dust and lint.
2. Greasy residues or dried-on dirt can be removed with a solution of warm water and a neutral pH liquid detergent. Use the brush to lightly scrub the filter.
3. Rinse the filter thoroughly in clean water and allow to air dry.
4. If any lint or dirt remains, use clean low-pressure air to remove. Do not use tweezers or other hard cleaning tools on the filter as the special finish may be damaged.
5. When not in use, store the mesh filter in a lint-free dust-proof container such as a plastic bag.

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

Lubrication

The fan motor and most of the potentiometers used in the 475 are permanently sealed and generally do not require periodic lubrication. The switches used in the 475, both cam- and lever-type, are installed with proper lubrication applied where necessary and will only rarely require any additional lubrication. It is recommended that a regular periodic lubrication program not be performed on any of the components used in the 475.

Transistor Checks

Periodic checks of the transistors and other semiconductors in the 475 are not recommended. The best check of semiconductor performance is actual operation in the instrument.

Recalibration

To assure accurate measurements, check the calibration of this instrument after each 1000 hours of operation or every six months if used infrequently. In addition, replacement of components may necessitate recalibration of the affected circuits. Complete calibration instructions are given in the Calibration section.

The calibration procedure can also be helpful in localizing certain troubles in the instrument. In some cases, minor troubles may be revealed or corrected by recalibration.

CORRECTIVE MAINTENANCE

General

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

Obtaining Replacement Parts

Standard Parts. All electrical and mechanical part replacements for the 475 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 list for value, tolerance, rating, and description.

NOTE

When selecting replacement parts, it is important to remember that the physical size and shape of a component may affect its performance in the instru-

ment, particularly at high frequencies. All replacement parts should be direct replacements unless it is known that a different component will not adversely affect instrument performance.

Special Parts. In addition to the standard electronic components, some special components are used in the 475. These components are manufactured or selected by Tektronix, Inc. to meet specific performance requirements, or are manufactured for Tektronix, Inc. in accordance with our specifications. These special components are indicated in the Electrical Parts List by an asterisk preceding the part number. Most of the mechanical parts used in this instrument have been manufactured by Tektronix, Inc. Order all special parts directly from your local TEKTRONIX Field Office or representative.

Ordering Parts. When ordering replacement parts from Tektronix, Inc., it is imperative that all of the following information be included in the order to ensure receiving the proper parts.

1. Instrument type.
2. Instrument serial number.
3. A description of the part (if electrical, include the circuit number).
4. TEKTRONIX Part number.

Soldering Techniques

WARNING

Always disconnect the instrument from the power source before attempting to solder in the instrument.

Ordinary 60/40 solder and a 35- to 40-watt pencil-type soldering iron can be used to accomplish the majority of the soldering to be done in the 475. If a higher wattage-rated soldering iron is used on the etched circuit boards, excessive heat can cause the etched circuit wiring to separate from the board base material.

CAUTION

The Vertical Preamplifier Attenuator circuit boards are made of material easily damaged by excessive heat. When soldering to these boards, do not use a soldering iron with a rating of more than approxi-

mately 15 watts. Avoid prolonged applications of heat to circuit-board connections. Use only isopropyl alcohol when cleaning this circuit board.

When soldering to the ceramic strips in the instrument a slightly larger soldering iron can be used. It is recommended that a solder containing about 3% silver be used when soldering to these strips to avoid destroying the bond to the ceramic material. This bond can be broken by repeated use of ordinary tin-lead solder or by the application of too much heat; however, occasional use of ordinary solder will not break the bond if excessive heat is not applied.

If it becomes necessary to solder in the general area of any of the high-frequency contacts in the instrument, clean the contacts immediately upon completion of the soldering. Refer to the section entitled Switch Contacts under PREVENTIVE MAINTENANCE for recommended cleaners and procedures.

Component Replacement

WARNING

Always disconnect the instrument from the power source before attempting to replace components.

Circuit Board Replacement. Occasionally it may be necessary to gain access to the reverse side of a circuit board or to remove one circuit board to gain access to another. The following procedures outline the necessary steps to facilitate instrument disassembly. Most of the connections to the circuit boards in the instrument are made with pin connectors. However, some connections are soldered to the board. Observe the soldering precautions given under Soldering Techniques given in this section.

Vertical Preamp Circuit Board Removal

1. Unplug the delay line from the Vertical Preamp circuit board.
2. Unplug the six coaxial cables and one wire from the front side of the Vertical Preamp circuit board. Note wire color codes to facilitate correct reinstallation.
3. Unplug the two coaxial cables from the back side of the Vertical Preamp circuit board. Note wire color codes to facilitate correct reinstallation.
4. Unplug a 6-wire, a 7-wire, and a 10-wire ribbon cable from the Vertical Mode Switch circuit board.

5. Remove the shafts from the vertical POSITION potentiometers on the Vertical Preamp circuit board. Loosen the front setscrew in the couplers and pull the shafts out through the front panel.

6. Remove the attenuator shields.

7. Unsolder the two resistors that connect the Vertical Preamp circuit board to the Attenuator circuit boards.

8. Unsolder the two discaps that connect between the Vertical Preamp circuit board and the Interface circuit board.

9. Remove the actuator shaft from the 20 MHz BW/TRIG VIEW switch. Loosen the setscrew and remove the shaft through the front panel.

10. Remove the six securing screws from the Vertical Preamp circuit board and remove the board from the instrument.

To reinstall the Vertical Preamp circuit board, reverse the order of the removal steps.

Vertical Mode Switch Circuit Board Removal

1. Remove the Vertical Preamp circuit board as outlined previously.

2. Remove the two UNCAL light lenses. Pry them away from the front panel with a fingernail and pull them straight out.

3. Remove the knobs from both VAR controls and both VOLTS/DIV switches.

4. Remove the knobs from the Input Coupling switches. They can be removed by pulling them off by hand.

5. Unplug the ribbon cables from the Vertical Mode Switch circuit board that run to the VOLTS/DIV sensitivity lights.

6. Unplug all remaining connectors from the Vertical Mode Switch circuit board. Note wire color codes to facilitate correct reinstallation.

7. Remove the two securing screws from the rear of the Vertical Mode Switch circuit board.

8. Remove the four nuts that secure the attenuator assemblies to the front casting.

9. Remove the Vertical Mode Switch circuit board from the instrument.

To reinstall the Vertical Mode Switch circuit board, reverse the order of the removal steps. To align the VERT MODE switch pushbuttons, hold the assembly in place with a slight forward pressure and use a small tool to reach through the front panel to align the buttons. Install the remaining parts in the reverse order they were removed. Do not tighten the circuit board securing screws until the securing nuts at the front of the attenuator chassis are tight and the circuit board is aligned properly.

Trigger Generator And Sweep Logic Circuit Board Removal

1. Remove the LOW LINE, TRIG, and READY light lenses. Pry them away from the front panel with a fingernail and pull them straight out.

2. Disconnect the six coaxial cables, single wire, and two four-wire ribbon cables from the front of the Trigger Generator And Sweep Logic circuit board. Note wire color codes to facilitate correct reinstallation.

3. Disconnect the two coaxial cables and a five-wire ribbon cable from the back side of the Trigger Generator And Sweep Logic circuit board. Note wire color codes to facilitate correct reinstallation.

4. Remove the actuator shaft from the POWER switch coupler. Use a small flat-bladed screwdriver and exercise caution so as not to damage the switch coupler.

5. Remove the POWER switch mounting bracket from the Trigger Generator And Sweep Logic circuit board.

6. Unsolder the resistors from the External Trigger Input connectors.

7. Remove the five board securing screws and remove the circuit board from the instrument.

To reinstall the Trigger Generator And Sweep Logic circuit board, reverse the order of the removal steps.

Sweep Timing Circuit Board Removal

1. Remove the Trigger Generator And Sweep Logic circuit board as outlined previously.

2. Remove the X10 MAG and UNCAL light lenses. Pry them away from the front panel with a fingernail and pull them straight out.

3. Remove the knobs from the VAR TIME/DIV control and the A AND B TIME/DIV switches. Be careful not to lose the plastic bushing behind the knobs.

4. Remove the board mounting screw and the hex rod from the Sweep Timing circuit board.

5. Remove the Sweep Timing circuit board from the instrument. Use caution so as not to damage the connector pins.

To reinstall the Sweep Timing board, reverse the order of the removal steps.

Power Transformer Replacement. If the power transformer becomes defective, contact your local TEKTRONIX Field Office or representative for a warranty replacement (see warranty note in the front of this manual). Be sure to replace only with a direct replacement TEKTRONIX transformer. After the transformer is replaced check the performance of the complete instrument. The transformer is removed as follows:

1. Unsolder the power cord leads.
2. Remove the small blue panel from the rear of the instrument. It will be necessary to remove the cover from the Regulating Range Selector Assembly and the two feet from that side of the instrument.
3. Unsolder the transformer leads from the Interface Board and from the Regulating Range Selector Assembly. Note the wire color codes to facilitate correct reinstallation.
4. Remove the actuating shaft from the POWER switch coupler. Exercise caution so as not to damage the switch coupler.

5. Remove the POWER switch mounting bracket from the Trigger Board.

6. Remove the transformer leads from the Regulating Range Selector Assembly. It will be necessary to use a special pin removing tool available under TEKTRONIX Part Number 003-0707-00. It is only necessary to use this tool to remove the transformer leads from the Selector Assembly. The leads may be reinstalled by simply pushing them into place. Note wire color codes to facilitate correct reinstallation.

7. Remove the transformer bracket mounting hardware. This includes two screws on the Trigger Board, one screw on the Interface Board, two nuts on the U-channel (one on the transformer side and one on the CRT side), and two screws and nuts on the rear subpanel.

8. Thoroughly loosen the Trigger Board and remove the transformer assembly from the instrument.

9. Remove the thermal cutout and POWER switch from the old transformer and install on the new transformer. Note wire color codes to facilitate correct installation.

10. Install the new transformer assembly in the instrument, reversing the order of the removal steps.

Recalibration After Repair

After any electrical component has been replaced, the calibration of that particular circuit should be checked, as well as the calibration of other closely related circuits. Since the power supply affects all circuits, calibration of the entire instrument should be checked if work has been done in the power supply or if the transformer has been replaced.

Instrument Repackaging

If the 475 is to be shipped for long distances by commercial means of transportation, it is recommended that the instrument be repackaged in the original manner for maximum protection. The original shipping carton can be saved and used for this purpose. The Repackaging illustration in the Mechanical Parts Illustrations shows how to repackage the 475 and gives the part numbers for the repackaging components. New shipping cartons can be obtained from Tektronix, Inc. Contact your local TEKTRONIX Field Office or representative.

CALIBRATION

Calibration Interval

To assure instrument accuracy, check the calibration of the 475 every 1000 hours of operation, or every six months if used infrequently. Before complete calibration, thoroughly clean and inspect this instrument as outlined in the Maintenance section of the manual.

Tektronix Field Service

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

Using This Procedure

Outline. To aid in locating a step in the Performance Check or Calibration Procedure, an outline is given preceding Part I—Performance Check and Part III—Calibration procedure.

Performance Check. The performance of this instrument can be checked without removing the covers or making internal adjustments, by performing only Part I—Performance Check. This procedure does not check every facet of the instrument's calibration; rather it is concerned primarily with those portions of the instrument essential to measurement accuracy and correct operation.

Short-Form Calibration. A short-form calibration procedure is provided to the technician experienced with the 475 as guidelines for calibration of this instrument, in Part II—Short-Form Calibration.

Calibration Procedure. Completion of each step in Part III—Calibration procedure, ensures that this instrument meets the electrical specifications given in the front of this manual. Where possible, instrument performance is checked before an adjustment is made. For best overall instrument performance when performing a complete calibration procedure, make each adjustment to the exact setting, even if the CHECK— is within the allowable tolerance.

Partial Procedures. A partial check or adjustment is often desirable after replacing components or to touch up the adjustment of a portion of the instrument between major recalibrations. To check or adjust only part of the instrument, set the controls as given under the nearest Control Settings and use the Equipment Required list preceding the desired portion of the step. To prevent unnecessary recalibration of other parts of the instrument, readjust only if the tolerance given in the CHECK— part of the step is not met. If readjustment is necessary, also check

the calibration of any steps listed in the INTERACTION— part of the step.

TEST EQUIPMENT REQUIRED

General

The following test equipment and accessories, or its equivalent, is required for complete calibration of the 475. Specifications given for the test equipment are the minimum necessary for accurate calibration. Therefore, some of the specifications listed here may differ from the actual performance capabilities of the test equipment. All test equipment is assumed to be correctly calibrated and operating within the listed specifications. Detailed operating instructions for the test equipment are not given in this procedure. Refer to the instruction manual for the test equipment if more information is needed.

If only a Performance Check procedure or a Calibration procedure is performed, not all of the listed test equipment will be required. Items used only for the Calibration procedures are indicated by footnote 1. The remaining pieces of equipment are items common to both a Performance Check procedure and a Calibration procedure.

Special Calibration Fixtures

Special Tektronix calibration fixtures are used only where they facilitate instrument calibration. These special calibration fixtures are available from Tektronix, Inc. Order by part number through your local Tektronix Field Office or representative.

Calibration Equipment Alternatives

All of the listed test equipment is required to completely check and calibrate this instrument. However, complete checking or calibration may not always be necessary or desirable. The user may be satisfied with checking only selected characteristics, thereby reducing the amount of test equipment actually required.

The Performance Check and Calibration Procedures are based on the first item of equipment given as an example of applicable equipment. When other equipment is substituted, control settings or calibration setup may need to be altered to meet the requirements of the substitute equipment. If the exact item of test equipment given as an example in the Test Equipment list is not available, first check the Specifications column carefully to see if any other equipment is available which might suffice. Then check the Usage column to see what this item is used for. If used for a check or adjustment that is of little or no importance to your measurement requirements, the item and corresponding step(s) can be deleted.

TABLE 5-1
Test Equipment

| Description | Minimum Specifications | Usage | Examples |
|--|--|--|--|
| 1. Variable Autotransformer ¹ | Capable of supplying 1.2 amperes over a range of 103.5 to 126.5 volts. | Power supply adjustment. | a. General Radio W10MT3W Variac Autotransformer. |
| 2. Precision DC Voltmeter ¹ | Range, zero to 150 volts; accuracy, within 0.05%. | Low voltage power supply check and adjustment. | a. Fluke Model 825A Differential DC Voltmeter. |
| 3. DC Voltmeter (VOM) ¹ | Range, zero to 2500 volts; accuracy, within 3% . | High Voltage check and adjustment. | a. Triplet Model 630-NA. b. Simpson Model 262. |
| 4. Test Oscilloscope ¹ | Bandwidth, DC to 100 megahertz; minimum deflection factor, five millivolts/division; accuracy, within 3%. | Power supply checks; Z-Axis compensation; Vertical gain adjustments; A Trigger Hold-off check; High-speed timing adjustment; A and B +Gate checks. | a. Tektronix 454A Oscilloscope with two P6054 probes and one P6022 probe. |
| 5. Standard Amplitude Calibrator | Amplitude accuracy, within 0.25%; signal amplitude, five millivolts to 50 volts; output signal, one-kilohertz square wave and positive DC voltage. | Vertical deflection system checks; Trigger View deflection factor adjustment; X-Gain adjustment. | a. Tektronix calibration fixture Part Number 067-0502-01. |
| 6. High-Frequency Constant-Amplitude Signal Generator | Frequency, 65 megahertz to above 200 megahertz; reference frequency, three megahertz; output amplitude, variable from 0.5 volt to 4 volts; amplitude accuracy, within 1%. | Vertical system bandwidth checks. | a. Tektronix calibration fixture Part Number 067-0532-01. |
| 7. Medium-Frequency Constant-Amplitude Signal Generator | Frequency, 350 kilohertz to 50 megahertz; reference frequency 50 kilohertz; output amplitude, variable from five millivolts to 5 volts into 50 ohms or 10 volts unterminated; amplitude accuracy, within 3%. | Vertical system bandwidth and trigger circuits operation checks. X-Y phasing adjustment and EXT Z-AXIS operation check. | a. Tektronix Type 191 Constant-Amplitude Signal Generator. b. General Radio 1211-C with 1263-C Amplitude Regulating Power Supply. |
| 8. Fast-Rise High-Amplitude Pulse Generator ¹ | Risetime, 0.25 nanosecond or less; repetition rate, 550 to 720 pulses/second; amplitude, variable from 20 millivolts to 10 volts. | Vertical deflection system checks. | a. Tektronix Type 109 Pulse Generator. |

¹ Used for calibration procedure only.

TABLE 5-1 (cont)

| Description | Minimum Specifications | Usage | Examples |
|--|---|---|---|
| 9. Square-Wave Generator ¹ | Frequency, 10 hertz to one megahertz; risetime, one nanosecond or less from fast-rise output; output amplitude, about 120 volts un-terminated or 12 volts into 50 ohms. | Vertical deflection system compensation checks. | a. Tektronix Type 106 Square-Wave Generator. |
| 10. Low-Frequency Sine-Wave Generator ¹ | Frequency, 10 hertz to 100 kilohertz; output amplitude, variable from 0.5 volt to 40 volts peak-to-peak; amplitude accuracy, within 3%. | Low frequency triggering checks. | a. General Radio 1310-A Oscillator. |
| 11. Time-Mark Generator | Marker outputs, two nanoseconds to 0.5 second; marker accuracy, within 0.1%. | CRT geometry; Horizontal deflection system timing checks and adjustments. | a. Tektronix 2901 Time-Mark Generator. b. Tektronix 184 Time-Mark Generator. |
| 12. Signal Insertion ¹ | Connectors, GR874 input connector and output connectors to fit input jacks of the 475 delay line. | Vertical output amplifier frequency response adjustment. | a. Tektronix calibration fixture Part Number 067-0676-00. |
| 13. Signal Pickoff | Connectors, GR874 thru-signal connectors and BNC signal-pickoff connector. | Trigger system checks and adjustments. | a. Tektronix Part Number 017-0061-00. |
| 14. Cable | Impedance, 50 ohms; type RG 213; electrical length, five nanoseconds; connectors, GR874. | Used for signal inter-connection. | a. Tektronix Part Number 017-0502-00. |
| 15. Adapter | BNC female connector to GR connector. | Used for signal inter-connection. | a. Tektronix Part Number 017-0063-00. |
| 16. Cable (two required) | Impedance, 50 ohms; type RG-58/U; length, 42 inches; connectors, BNC. | Used for signal inter-connection. | a. Tektronix Part Number 012-0057-01. |
| 17. Cable (two required) | Impedance, 50 ohms; type RG-58/U; length, 18 inches; connectors, BNC. | Used for signal inter-connection. | a. Tektronix Part Number 012-0076-00. |
| 18. Attenuator | Attenuation ratio, X10; connectors, BNC; impedance, 50 ohms. <i>2cc</i> | Vertical amplifier compensation and trigger checks and adjustments. | a. Tektronix Part Number 011-0059-01. |
| 19. Attenuator | Attenuation ratio, X2; connectors, BNC; impedance, 50 ohms. | Trigger checks and adjustments. | a. Tektronix Part Number 011-0069-01. |

TABLE 5-1 (cont)

| Description | Minimum Specifications | Usage | Examples |
|--|---|---|---|
| 20. Attenuator (two required) ¹ | Attenuation ratio, X10; connectors, GR; impedance, 50 ohms. | Vertical system frequency response adjustments. | a. Tektronix Part Number 017-0078-00. |
| 21. Attenuator ¹ | Attenuation ratio, X5; connectors, GR; impedance, 50 ohms. | Vertical system frequency response adjustments. | a. Tektronix Part Number 017-0079-00. |
| 22. Termination (two required) | Impedance, 50 ohms; accuracy, within 3%; connectors, BNC. | Vertical amplifier bandwidth check; trigger circuit operation checks and adjustments. | a. Tektronix Part Number 011-0049-01. |
| 23. T-Connector ¹ | Connectors, BNC. | Used for signal interconnection. | a. Tektronix Part Number 103-0030-00. |
| 24. Input Normalizer ¹ | RC time constant, 20 picofarads times 1 megohm. | Standardize input RC time constant. | a. Tektronix Part Number 067-0538-00. |
| 25. Dual-Input Coupler (two required) | Connectors, BNC; matched signal transfer to each input. | Used for signal interconnection. | a. Tektronix calibration fixture Part Number 067-0525-00. |
| 26. Screwdriver ¹ | Three-inch shaft; 3/32-inch bit. | Used throughout procedure to adjust variable resistors. | a. Tektronix Part Number 003-0192-00. |
| 27. Low-Capacitance Screwdriver ¹ | 1 1/2-inch shaft. | Used throughout procedure to adjust variable capacitors. | a. Tektronix Part Number 003-0000-00. |

PRELIMINARY CONTROL SETTINGS

Preset the instrument controls to the settings given below when starting a Performance Check or a Calibration procedure.

VERT MODE
INVERT
20 MHz BW (PULL)

CH 1
Off (button out)
Off

Power Controls

POWER ON

CRT Controls

INTENSITY Midrange
FOCUS Midrange
SCALE ILLUM Midrange
BEAM FIND Off (button out)

Vertical Controls (both Channels if applicable)

VOLTS/DIV 5 mV
VAR Calibrated detent
POSITION Midrange
AC-GND-DC DC

Triggering Controls (both A and B if applicable)

LEVEL Fully clockwise
SLOPE +
COUPLING AC
SOURCE NORM
TRIG MODE AUTO

Sweep Controls

HORIZ DISPLAY A
DELAY TIME POSITION Fully counterclockwise
A TIME/DIV 1 ms
B TIME/DIV 1 ms
VAR Calibrated detent
X10 MAG Off (button out)
POSITION Midrange
FINE Midrange
A TRIG HOLDOFF NORM

PART I—PERFORMANCE CHECK

Introduction

The following procedure is intended to be used for incoming inspection to determine the acceptability of newly purchased or recently recalibrated instruments. This procedure does not check every facet of the instrument's calibration; rather it is concerned primarily with those portions of the instrument which are essential to measurement accuracy and correct operation. Removing the instrument dust cover is not necessary to perform this procedure. All checks are made from the front panel.

Outline for Part I—Performance Check

VERTICAL SYSTEM CHECK

| | |
|--|----------|
| 1. Check Beam Finder Operation | Page 5-6 |
| 2. Check Channel 1 and 2 Gain Switch Balance | Page 5-6 |
| 3. Check Channel 1 and 2 Variable Volts/Division Balance | Page 5-6 |
| 4. Check Channel 2 Inverted Balance | Page 5-7 |
| 5. Check Channel 1 and 2 Position Range | Page 5-7 |
| 6. Check Channel 1 and 2 Gain | Page 5-7 |
| 7. Check Add Mode Operation | Page 5-7 |
| 8. Check Channel 1 and 2 Deflection Accuracy | Page 5-7 |
| 9. Check Channel 1 and 2 Variable Volts/Division Range | Page 5-8 |
| 10. Check Alternate Mode Operation | Page 5-8 |
| 11. Check Chop Mode Operation | Page 5-8 |
| 12. Check Vertical Amplifier Bandwidth | Page 5-8 |
| 13. Check Cascaded Bandwidth | Page 5-9 |

TRIGGER SYSTEM CHECK

| | |
|-----------------------------------|-----------|
| 14. Check A Triggering | Page 5-9 |
| 15. Check B Triggering | Page 5-10 |
| 16. Check A Normal Mode Operation | Page 5-10 |
| 17. Check Single Sweep Operation | Page 5-11 |
| 18. Check Trigger View Operation | Page 5-11 |

HORIZONTAL SYSTEM CHECK

| | |
|--|-----------|
| 19. Check Variable Time/Division Range | Page 5-11 |
| 20. Check Timing Accuracy | Page 5-12 |
| 21. Check Delay Time Accuracy | Page 5-12 |
| 22. Check Delay Time Jitter | Page 5-13 |
| 23. Check Mixed Sweep Timing Accuracy | Page 5-13 |
| 24. Check X Gain | Page 5-13 |
| 25. Check X-Y Phasing and Bandwidth | Page 5-13 |

Preliminary Procedure for Performance Check

NOTE

The performance of this instrument can be checked at any temperature within the 0°C to +40°C (+32°F to +104°F) temperature range unless stated otherwise.

1. Connect the 475 to a power source that meets the voltage and frequency requirements of this instrument.
2. Set the controls as given under Preliminary Control Settings.
3. Allow at least 20 minutes warmup before proceeding.

VERTICAL SYSTEM CHECK

| Equipment Required | |
|--|---|
| 1. Standard Amplitude Calibrator (067-0502-01). | 4. GR to BNC Female Adapter. |
| 2. High-Frequency Constant-Amplitude Signal Generator (067-0532-01). | 5. 42-inch 50 Ω BNC cable (two). |
| 3. Medium-Frequency Constant-Amplitude Signal Generator (Type 191). | 6. X10 BNC Attenuator. |
| | 7. 50 Ω BNC Termination (two). |
| | 8. Dual Input Coupler. |

Control Settings

Preset instrument controls to the settings given under Preliminary Control Settings.

1. Check Beam Finder Operation

- a. Position the trace off screen with the CH 1 and horizontal POSITION controls.
- b. Push the BEAM FIND button and hold it in.
- c. CHECK—That the trace is compressed and brought into the CRT viewing area.
- d. Release the BEAM FIND button.

2. Check Channel 1 and 2 Gain Switch Balance

- a. Set both VOLTS/DIV switches to 2 mV and both AC-GND-DC switches to GND.
- b. Position the trace to the center horizontal line with the CH 1 POSITION control.
- c. CHECK—CRT display for minimum trace shift between 2 mV and 5 mV positions of the CH 1 VOLTS/DIV switch.
- d. Set the VERT MODE switch to CH 2.
- e. Position the trace to the center horizontal line with the CH 2 POSITION control.

f. CHECK—CRT display for minimum trace shift between 2 mV and 5 mV positions of the CH 2 VOLTS/DIV switch.

3. Check Channel 1 and 2 Variable Volt/Division Balance

- a. Position the trace to the center horizontal line with the CH 2 POSITION control.
- b. Rotate the CH 2 VAR control through its range.
- c. CHECK—That the CH 2 UNCAL light comes on when the VAR control is out of the detent position.
- d. CHECK—CRT display for 2 divisions or less of vertical trace shift when rotating the CH 2 VAR control through its range.
- e. Set the VERT MODE switch to CH 1.
- f. Position the trace to the center horizontal line with the CH 1 POSITION control.
- g. Rotate the CH 1 VAR control through its range.
- h. CHECK—That the CH 1 UNCAL light comes on when the VAR control is out of the detent position.
- i. CHECK—CRT display for 2 divisions or less of vertical trace shift when rotating the CH 1 VAR control through its range.
- j. Return both VAR controls to the detent position.

4. Check Channel 2 Inverted Balance

- a. Set the VERT MODE switch to CH 2 and the CH 2 AC-GND-DC switch to GND.
- b. Position the trace to the center horizontal line with the CH 2 POSITION control.
- c. Push the INVERT switch.
- d. CHECK—Trace does not vertically shift more than 1 division between the positions of the INVERT switch.

5. Check Channel 1 and 2 Position Range

- a. Connect the Standard Amplitude Calibrator output to the CH 1 and CH 2 inputs via a 42-inch 50 Ω BNC cable and a dual input coupler.
- b. Set both VOLTS/DIV switches to 2 mV and both AC-GND-DC switches to AC.
- c. Adjust the Standard Amplitude Calibrator for a 50 mV output.
- d. CHECK—That the top of the CRT display can be positioned below the center horizontal line, and the bottom of the display can be positioned above the center horizontal line.

e. Set the VERT MODE switch to CH 1.

f. CHECK—That the top of the CRT display can be positioned below the center horizontal line, and the bottom of the display can be positioned above the center horizontal line.

6. Check Channel 1 and 2 Gain

- a. Set both VOLTS/DIV switches to 5 mV.
- b. Adjust the Standard Amplitude Calibrator for a 20 mV square-wave output.
- c. CHECK—CRT display for 4 divisions of deflection, within 0.12 division.
- d. Set the VERT MODE switch to CH 2.

e. CHECK—CRT display for 4 divisions of deflection, within 0.12 division.

7. Check Add Mode Operation

- a. Set both AC-GND-DC switches to DC.
- b. Adjust the Standard Amplitude Calibrator for a 10 mV output.
- c. Set the VERT MODE switch to ADD.
- d. CHECK—CRT display for 4 divisions, within 0.12 division, of amplitude.

8. Check Channel 1 and 2 Deflection Accuracy

- a. Set the VERT MODE switch to CH 1 and the CH 2 AC-GND-DC switch to GND.
- b. CHECK—Using the CH 1 VOLTS/DIV switch and the Standard Amplitude Calibrator settings given in Table 5-2, check that the vertical deflection factor is within the given tolerance in each position of the CH 1 VOLTS/DIV switch.

TABLE 5-2
Vertical Deflection Accuracy

| VOLTS/ DIV Switch Setting | Standard Amplitude Calibrator Output | Vertical Deflection in Divisions | Maximum Error for 3% Accuracy |
|------------------------------------|---|---|--|
| 2 mV | 10 mV | 5 | Previously set |
| 5 mV | 20 mV | 4 | Previously set |
| 10 mV | 50 mV | 5 | ±0.15 div |
| 20 mV | 0.1 V | 5 | ±0.15 div |
| 50 mV | 0.2 V | 4 | ±0.12 div |
| 0.1 V | 0.5 V | 5 | ±0.15 div |
| 0.2 V | 1 V | 5 | ±0.15 div |
| 0.5 V | 2 V | 4 | ±0.12 div |
| 1 V | 5 V | 5 | ±0.15 div |
| 2 V | 10 V | 5 | ±0.15 div |
| 5 V | 20 V | 4 | ±0.12 div |

c. Set the VERT MODE switch to CH 2.

d. Set the CH 1 AC-GND-DC switch to GND and the CH 2 AC-GND-DC switch to DC.

Calibration—475

e. CHECK—Using the CH 2 VOLTS/DIV switch and the Standard Amplitude Calibrator settings given in Table 5-2, check that the vertical deflection factor is within the given tolerance in each position of the CH 2 VOLTS/DIV switch.

9. Check Channel 1 and 2 Variable Volts/Division Range

- a. Set both VOLTS/DIV switches to 20 mV.
- b. Adjust the Standard Amplitude Calibrator for a 0.1 volt output.
- c. Rotate the CH 2 VAR control fully counterclockwise.
- d. CHECK—CRT display reduces to less than 2 divisions.
- e. Set the CH 1 AC-GND-DC switch to DC and the VERT MODE switch to CH 1.
- f. Rotate the CH 1 VAR control fully counterclockwise.
- g. CHECK—CRT display reduces to less than 2 divisions.
- h. Return both VAR controls to the detent positions.
- i. Disconnect the test setup.

10. Check Alternate Mode Operation

- a. Set the VERT MODE switch to ALT and the A LEVEL control fully clockwise.
- b. Position the traces 2 divisions apart.
- c. CHECK—That the sweeps alternate in all settings of the TIME/DIV switch except X-Y.

11. Check Chop Mode Operation

- a. Set the A TIME/DIV switch to 1 μ s, the A SOURCE switch to NORM, and the VERT MODE switch to CHOP.
- b. Position the two traces about 4 divisions apart.

c. Adjust the A LEVEL control for a stable display.

d. CHECK—Duration of each cycle is about 1 division.

e. CHECK—CRT display for complete blanking of switching transients between chopped segments (see Fig. 5-1).

12. Check Vertical Amplifier Bandwidth

- a. Set the TRIG MODE switch to AUTO, the A TIME/DIV switch to 0.2 ms, and both VOLTS/DIV switches to 5 mV.
- b. Connect the output of the High-Frequency Constant-Amplitude Signal Generator (067-0532-01) to the CH 1 input via a GR-to-BNC adapter, X10 BNC attenuator, and a 50 Ω BNC termination.
- c. Adjust the High-Frequency signal generator output amplitude for a five-division display of a 3 megahertz reference signal.
- d. Without changing the output amplitude, increase the output frequency of the signal generator until the display is reduced to 3.5 divisions.
- e. CHECK—Output frequency of the High-Frequency signal generator must be at least 200 megahertz.
- f. Move the test signal to the CH 2 input and set the VERT MODE switch to CH 2.

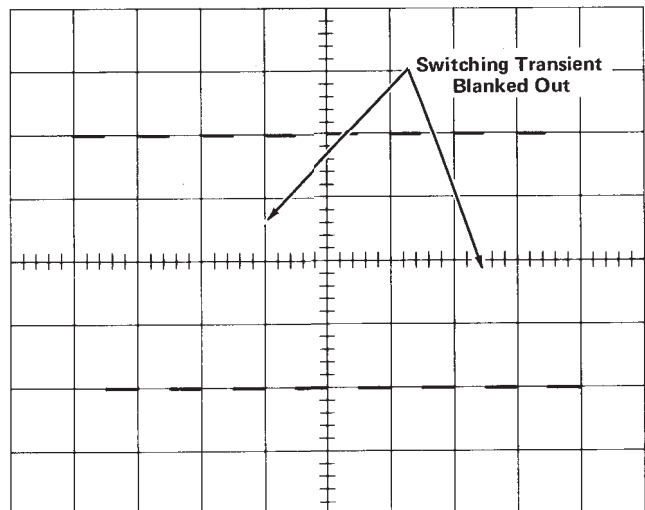


Fig. 5-1. Typical CRT display when checking chopped blanking.

- g. Repeat the bandwidth check procedure, step 12-c through 12-e.
- h. Disconnect the test setup.

13. Check Cascaded Bandwidth

- a. Set both AC-GND-DC switches to DC, the A TIME/DIV switch to 1 ms, and the VERT MODE switch to CH 1.
- b. Connect the CH 2 VERT SIGNAL OUT (on the rear panel) to the CH 1 input via a 42-inch 50 Ω BNC cable and a 50 Ω BNC termination.
- c. Connect the output of the Medium-Frequency Constant-Amplitude Signal Generator (Type 191) to the

CH 2 input via a GR-to-BNC adapter, 42-inch 50 Ω BNC cable, X10 BNC attenuator, and a 50 Ω BNC termination.

d. Adjust the Medium-Frequency signal generator for a five-division display of a 50 kilohertz signal.

e. Without changing the output amplitude of the signal generator, increase the output frequency until the display is reduced to 3.5 divisions.

f. CHECK—Output frequency of the Medium-Frequency signal generator must be at least 50 megahertz.

g. Disconnect the test setup.

TRIGGER SYSTEM CHECK

| Equipment Required | |
|---|---------------------------------|
| 1. Standard Amplitude Calibrator (067-0502-01). | 6. 42-inch 50 Ω BNC Cable. |
| 2. Medium-Frequency Constant-Amplitude Signal Generator (Type 191). | 7. 18-inch 50 Ω BNC Cable. |
| 3. 50 Ω Signal Pickoff Unit (Type CT-3). | 8. X10 BNC Attenuator. |
| 4. 50 Ω 5 nanosecond GR Cable. | 9. X2 BNC Attenuator. |
| 5. GR-to-BNC female Adapter. | 10. 50 Ω BNC Termination (two). |
| | 11. Dual Input Coupler (two). |

Control Settings

Preset instrument controls to the settings given under Preliminary Control Settings except as follows:

both TIME/DIV 0.05 μs

14. Check A Triggering

a. Connect the output of the Medium-Frequency Constant-Amplitude Signal Generator (Type 191) to the A External Trigger input via a 50 Ω 5 ns GR cable, 50 Ω Signal Pickoff Unit (Type CT-3) thru output, GR-to-BNC adapter, X10 BNC attenuator, X2 BNC attenuator, 50 Ω BNC termination, and a dual input coupler.

b. Connect the 10% BNC output connector of the 50 Ω Signal Pickoff Unit to the CH 1 and CH 2 inputs via an

18-inch 50 Ω BNC cable, a 50 Ω BNC termination, and a dual input coupler.

c. Adjust the Medium-Frequency signal generator to maintain a 0.3-division display of a 50 kilohertz signal.

d. Rotate the A SLOPE switch between + and –.

e. CHECK—A stable display can be obtained on both slopes of the displayed waveform in all positions of the A COUPLING switch by adjusting the A LEVEL control.

f. Set the A SOURCE switch to CH 1.

g. CHECK—Repeat steps 14-d and 14-e.

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h. Set the VERT MODE switch to CH 2 and the A SOURCE switch to CH 2.

i. CHECK—Repeat steps 14-d and 14-e.

j. Set the A SOURCE switch to EXT and the CH 2 VOLTS/DIV switch to 20 mV.

k. Adjust the Medium-Frequency signal generator for a five-division display of a 50 kilohertz signal.

l. CHECK—That a stable display can be obtained, by adjusting the A LEVEL control, in both slopes of the displayed waveform in the AC and DC positions of the A COUPLING switch.

m. Remove the X2 BNC attenuator from the External Trigger signal test setup.

n. CHECK—That a stable display can be obtained, by adjusting the A LEVEL control, in both slopes of the displayed waveform in the HF REJ and LF REJ positions of the A COUPLING switch.

o. Replace the X2 BNC attenuator and set the A SOURCE switch to EXT ÷ 10.

p. Remove the X10 BNC attenuator from the External Trigger test setup.

q. CHECK—Repeat step 14-l through 14-n.

r. Replace both the X10 and X2 BNC attenuators to the External Trigger test setup.

s. Set the A SOURCE switch to NORM.

15. Check B Triggering

a. Move the External Trigger test signal to the B External Trigger input. Set the HORIZ DISPLAY switch to B DLY'D.

b. Adjust the Medium-Frequency signal generator to maintain a 0.3-division display of a 50 kilohertz signal.

c. Rotate the B SLOPE switch between + and —.

d. CHECK—A stable display can be obtained on both slopes of the displayed waveform in all positions of the B COUPLING switch by adjusting the LEVEL controls.

e. Set the B SOURCE switch to CH 2.

f. CHECK—Repeat steps 15-c and 15-d.

g. Set the VERT MODE and B SOURCE switches to CH 1.

h. CHECK—Repeat steps 15-c and 15-d.

i. Set the B SOURCE switch to EXT and the CH 1 VOLTS/DIV to 20 mV.

j. Adjust the Medium-Frequency signal generator for a five-division display of a 50 kilohertz signal.

k. CHECK—That a stable display can be obtained, by adjusting the LEVEL controls, in both slopes of the displayed waveform in the AC and DC positions of the B COUPLING switch.

l. Remove the X2 BNC attenuator from the External Trigger test setup.

m. CHECK—That a stable display can be obtained, by adjusting the LEVEL controls, in both slopes of the displayed waveform in the HF REJ and LF REJ positions of the B COUPLING switch.

16. Check A Normal Mode Operation

a. Set the HORIZ DISPLAY switch to A, the A COUPLING switch to AC, both SOURCE switches to NORM, and the TRIG MODE switch to AUTO.

b. Adjust the Medium-Frequency signal generator for a 50 kilohertz signal.

c. Adjust the A LEVEL control for a triggered display.

d. Switch the TRIG MODE switch to NORM.

e. CHECK—CRT for a stable display.

- f. Remove the test signal from the CH 1 input.
- g. CHECK—For no display in the absence of an adequate trigger signal.

17. Check Single Sweep Operation

- a. Set the A COUPLING switch to AC and the TRIG MODE switch to AUTO.
- b. Reconnect the test signal from the Medium-Frequency signal generator to the CH 1 input.
- c. Adjust the A LEVEL control for a triggered display.
- d. Remove the test signal from the CH 1 input.
- e. Press the SINGL SWP button.
- f. CHECK—READY light comes on when SINGL SWP button is pressed and remains on until the test signal is re-applied.
- g. Reconnect the test signal to the CH 1 input.
- h. CHECK—READY light is extinguished.
- i. Press the SINGL SWP button.

- j. CHECK—That a single-sweep display (one sweep only) is presented.

- k. Disconnect the test setup.

18. Check Trigger View Operation

- a. Set the CH 1 AC-GND-DC switch to DC, the CH 1 VOLTS/DIV switch to 10 mV, the VERT MODE switch to CH 1, the A COUPLING switch to DC, the A SOURCE switch to EXT, the A SLOPE switch to +, the A LEVEL control to 0, and the TRIG MODE switch to AUTO.
- b. Connect the output of the Standard Amplitude Calibrator to the A External Trigger input via a 42-inch 50 Ω BNC cable.
- c. Adjust the Standard Amplitude Calibrator for a 200 mV square-wave output.
- d. Push the TRIG VIEW button and hold it in.
- e. CHECK—For 3.2 to 4.8 divisions of display.
- f. Release the TRIG VIEW button.
- g. Disconnect the test setup.

HORIZONTAL SYSTEM CHECK

| Equipment Required | |
|---|----------------------------|
| 1. Standard Amplitude Calibrator (067-0502-01). | 4. 42-inch 50 Ω BNC cable. |
| 2. Medium-Frequency Constant-Amplitude Signal Generator (Type 191). | 5. 50 Ω BNC Termination. |
| 3. Time-Mark Generator (Type 2901). | 6. Dual Input Coupler. |

Control Settings

Preset instrument controls to the settings given under Preliminary Control Settings except as follows:

- A TIME/DIV 2 ms
- B TIME/DIV 5 μs
- B SOURCE STARTS AFTER DELAY

19. Check Variable Time/Division Range

- a. Connect 5 ms time marks to the CH 1 input from the Time-Mark Generator (Type 2901) via a 42-inch 50 Ω BNC cable and a 50 Ω BNC termination.
- b. CHECK—At least 1 time marker/division can be obtained by adjusting the VAR TIME/DIV control.

c. CHECK—That the UNCAL light comes on when the VAR TIME/DIV control is out of the detent position.

d. Return the VAR TIME/DIV control to the detent position.

20. Check Timing Accuracy

a. CHECK—Using the A TIME/DIV switch and the Time-Mark Generator settings given in Table 5-3, check that A SWEEP timing is within the given tolerance over entire 10 divisions.

TABLE 5-3

A and B Timing Accuracy

| A TIME/ DIV Switch Setting | Time- Mark Generator Output | CRT Display (markers/ divisions) | Accuracy | |
|-------------------------------------|--------------------------------------|---|---------------------|---------------------|
| | | | +20° C to +20° C | -15° C to +55° C |
| 0.01 μ s | 10 ns | 1 | 1% | 3% |
| 0.02 μ s | 10 ns | 2 | 1% | 3% |
| 0.05 μ s | 50 ns | 1 | 1% | 3% |
| 0.1 μ s | 0.1 μ s | 1 | 1% | 3% |
| 0.2 μ s | 0.1 μ s | 2 | 1% | 3% |
| 0.5 μ s | 0.5 μ s | 1 | 1% | 3% |
| 1 μ s | 1 μ s | 1 | 1% | 3% |
| 2 μ s | 1 μ s | 2 | 1% | 3% |
| 5 μ s | 5 μ s | 1 | 1% | 3% |
| 10 μ s | 10 μ s | 1 | 1% | 3% |
| 20 μ s | 10 μ s | 2 | 1% | 3% |
| 50 μ s | 50 μ s | 1 | 1% | 3% |
| 0.1 ms | 0.1 ms | 1 | 1% | 3% |
| 0.2 ms | 0.1 ms | 2 | 1% | 3% |
| 0.5 ms | 0.5 ms | 1 | 1% | 3% |
| 1 ms | 1 ms | 1 | 1% | 3% |
| 2 ms | 1 ms | 2 | 1% | 3% |
| 5 ms | 5 ms | 1 | 1% | 3% |
| 10 ms | 10 ms | 1 | 2% | 3% |
| 20 ms | 10 ms | 2 | 2% | 3% |
| 50 ms | 50 ms | 1 | 2% | 3% |
| 0.1 s | 0.1 s | 1 | 2% | 3% |
| 0.2 s | 0.1 s | 2 | 2% | 3% |
| 0.5 s | 0.5 s | 1 | 2% | 3% |

21. Check Delay Time Accuracy

a. Set the B SOURCE switch to STARTS AFTER DELAY, the A TIME/DIV switch to 0.05 μ s, the B TIME/DIV switch to 0.01 μ s, and the HORIZ DISPLAY switch to B DLY'D.

b. CHECK—Using the A TIME/DIV switch, the B TIME/DIV switch and the Time-Mark Generator settings given in Table 5-4, check that delayed sweep accuracy is within the given tolerance. First set the DELAY TIME POSITION dial to 1.00 and rotate the dial until the sweep starts at the top of the second time marker. Note the control setting and then set the dial to 2.00 and rotate it slightly until the sweep starts at the top of the third time marker. The error for intervals less than 1 dial division cannot exceed 0.01 dial division. Continue to rotate the DELAY TIME POSITION dial to check between the 1.00 and 9.00 settings for all A sweep speeds from 0.05 μ s to 0.5 s. The difference between any two time markers greater than 1 dial division apart cannot exceed 1%.

NOTE

Sweep will start at the top of the third time marker at 1.00 and at the top of the nineteenth time marker at 9.00 for sweep rates that are multiples of 2 (e.g., 2 μ s, 20 μ s, 0.2 ms, etc.). If in doubt as to the correct setting of the DELAY TIME POSITION dial, set the HORIZ DISPLAY switch to A INTEN and check which time marker is intensified.

TABLE 5-4

Delayed Sweep Accuracy

| A TIME/DIV Switch Setting | B TIME/DIV Switch Setting | Time-Mark Generator Output |
|---------------------------------|---------------------------------|----------------------------------|
| 0.05 μ s | 0.01 μ s | 0.05 μ s |
| 0.1 μ s | 0.01 μ s | 0.1 μ s |
| 0.2 μ s | 0.05 μ s | 0.1 μ s |
| 0.5 μ s | 0.05 μ s | 0.5 μ s |
| 1 μ s | 0.1 μ s | 1 μ s |
| 2 μ s | 0.1 μ s | 1 μ s |
| 5 μ s | 0.1 μ s | 5 μ s |
| 10 μ s | 1 μ s | 10 μ s |
| 20 μ s | 1 μ s | 10 μ s |
| 50 μ s | 1 μ s | 50 μ s |
| 0.1 ms | 10 μ s | 0.1 ms |
| 0.2 ms | 10 μ s | 0.1 ms |
| 0.5 ms | 10 μ s | 0.5 ms |
| 1 ms | 0.1 ms | 1 ms |
| 2 ms | 0.1 ms | 1 ms |
| 5 ms | 0.1 ms | 5 ms |
| 10 ms | 1 ms | 10 ms |
| 20 ms | 1 ms | 10 ms |
| 50 ms | 1 ms | 50 ms |
| 0.1 s | 10 ms | 0.1 s |
| 0.2 s | 10 ms | 0.1 s |
| 0.5 s | 10 ms | 0.5 s |

22. Check Delay Time Jitter

- a. Set the DELAY TIME POSITION dial to 1.00, the HORIZ DISPLAY switch to B DLY'D, the A TIME/DIV switch to 1 ms, and the B TIME/DIV switch to 0.2 μ s.
- b. Position the time marker near the center of the display area with the DELAY TIME POSITION dial.
- c. CHECK—Jitter on the leading edge of the time marker does not exceed 1 division.
- d. Turn the DELAY TIME POSITION dial to 9.00 and adjust it so that the time marker is displayed near the center of the display area.
- e. CHECK—Jitter on the leading edge of the time marker does not exceed 1 division.

23. Check Mixed Sweep Timing Accuracy

- a. Set the A TIME/DIV switch to 1 ms, the B TIME/DIV switch to 0.5 ms, the HORIZ DISPLAY switch to A, the B SOURCE switch to STARTS AFTER DELAY, and the DELAY TIME POSITION dial fully clockwise.
- b. Select 1 ms time marks from the Time-Mark Generator.
- c. CHECK—Timing between the second and tenth time markers.
- d. Set the HORIZ DISPLAY switch to MIX.
- e. CHECK—The timing between second and tenth time markers is within ± 0.3 division.
- f. Disconnect the test setup.

NOTE

Exclude first 0.5 division of sweep after display start and first 0.2 division, or 0.1 μ s (whichever is greater) after the transition of A to B.

24. Check X Gain

- a. Set the A TIME/DIV switch to X-Y, the VERT MODE switch to CH 2, both VOLTS/DIV switches to 5 mV, and the CH 1 AC-GND-DC switch to DC.

- b. Apply a 20 mV square wave from the Standard Amplitude Calibrator to the CH 1 or X input through a 42-inch 50 Ω BNC cable.

- c. CHECK—CRT display for 4 divisions of deflection between the two displayed dots.

- d. Disconnect the test setup.

25. Check X-Y Phasing and Bandwidth

- a. Set both VOLTS/DIV switches to 5 mV and both AC-GND-DC switches to AC.

- b. Connect the output of the Medium-Frequency Constant-Amplitude Signal Generator (Type 191) to the CH 1 and CH 2 inputs through a 42-inch 50 Ω BNC cable, 50 Ω BNC termination, and a dual input coupler.

- c. Adjust the Medium-Frequency signal generator for an eight-division horizontal display of 50 kilohertz signal.

- d. Center the display vertically and horizontally with the CH 1 and CH 2 POSITION controls.

- e. CHECK—CRT display for an opening at the center horizontal line of 0.14 division or less.

- f. Increase the output frequency of the Medium-Frequency signal generator to 2 megahertz.

- g. CHECK—CRT display for an opening at the center horizontal line of 0.42 division or less.

- h. Remove the dual input coupler from the test setup.

- i. Reconnect the test signal to the CH 1 input.

- j. Adjust the signal generator for a four-division horizontal display of 50 kilohertz signal.

- k. Increase the output frequency of the signal generator until the display is reduced to 2.8 divisions.

- l. CHECK—Output frequency of the signal generator is at least 3 megahertz.

- m. Disconnect the test setup.

PART II—SHORT-FORM CALIBRATION

Introduction

The following procedure is intended to be used as guidelines for calibration of the 475 by experienced technicians familiar with the instrument. Only essential information is given. Test Equipment Required is the same as that given for Part III—Calibration.

Preliminary Procedure for Short-Form Calibration

NOTE

This instrument should be adjusted at an ambient temperature of +25°C (±5°C) for best overall accuracy.

1. Remove the dust cover from the 475.
2. Connect the 475 to the autotransformer and set the line voltage to 115 VAC.
3. Set the controls as given under Preliminary Control Settings (given prior to Part I—Performance Check). Allow at least 20 minutes warmup before proceeding.

NOTE

Titles for external controls of this instrument are capitalized in this procedure (e.g., INTENSITY). Internal adjustments are initial capitalized only (e.g., Grid Bias).

POWER SUPPLIES and DISPLAY CALIBRATION

1. Low Voltage Power Supplies

- a. ADJUST—+50 V supply, R1430, ±0.5%.
- b. Check—+110 V supply, ±3%.
- c. Check—+15 V supply, ±1.5%.
- d. Check—+5 V supply, ±1.5%.
- e. Check—-15 V supply, ±1.5%.
- f. Check—-8 V supply, ±1.5%.

g. Check ripple on supplies (except +110 V supply) is 2 mV P-P maximum; +110 V supply ripple is 1 V P-P maximum.

h. Check regulation between 126.5 V and 103.5 V line.

i. Check LOW LINE indicator comes on below 103 VAC.

2. High Voltage Power Supply

—2450 volts, ±49 volts.

3. Adjust CRT Grid Bias

- a. TRIG MODE to NORM.
- b. Connect DC Voltmeter to TP1364 and adjust INTENSITY for a reading of +15 volts.
- c. ADJUST—CRT Grid Bias, R1375, for dimmest dot.

4. Check Display Controls

- a. ASTIG
- b. SCALE ILLUM
- c. FOCUS
- d. INTENSITY

5. Adjust Trace Alignment

- a. Connect time markers to CH 1 input.
- b. ADJUST—TRACE ROTATION to align trace with center horizontal line.
- c. ADJUST—Y Axis Alignment, R1385, to align center time marker with the center vertical line.
- d. Check for no more than 0.1 division curvature.

e. ADJUST—Geometry, R1390, for no more than 0.1 division curvature of the time markers.

f. Remove the time markers and check the trace at top and bottom graticule lines: no more than 0.1 division bowing or tilt.

6. Z-Axis Compensation

a. Connect X10 probe from Test Oscilloscope to TP1366.

b. A TIME/DIV to 0.05 μ s.

c. Connect A +GATE to External Trigger input of Test Oscilloscope.

d. ADJUST—C1353 for optimum square corner on positive step, 1 volt display of signal.

VERTICAL SYSTEM CALIBRATION

7. Adjust Vertical Output Bias

a. Connect a 200 MHz sine wave to CH 1 from the High-Frequency Constant-Amplitude Signal Generator (067-0532-01).

b. ADJUST—Output Bias, R488, for maximum signal deflection.

8. Adjust Vertical Shield Volts

a. Vertically center the trace.

b. Using DC Voltmeter, measure voltage at each CRT vertical deflection plate. Add together and divide by two.

c. Connect DC Voltmeter between TP1395 and ground.

d. ADJUST—Vertical Shield Volts, R1395, for a reading equal to that calculated in step 8-b.

9. Adjust Delay-Line Driver Centering

a. Using DC Voltmeter, monitor the sides of the delay line until readings are equal while adjusting the CH 1 POSITION.

b. ADJUST—Delay-Line Driver Centering, R385 for reading of 0 volts on both sides of the delay line.

10. Check BEAM FIND Operation

11. Adjust CH 1 Switch Balance

a. Vertically center the trace.

b. ADJUST—CH 1 Var Bal, R110, for no more than 2 divisions trace shift when rotating the CH 1 VAR control through its range.

c. ADJUST—CH 1 Gain Switch Bal, R135, for minimum trace shift when switching between 2 mV and 5 mV.

d. Check CH 1 UNCAL light.

12. Check Probe Indicator Lights

a. Connect X10 probe to CH 1 input.

b. Check that the left light goes out and the right comes on.

c. Repeat for CH 2.

13. Check CH 1 and 2 AC-GND-DC Switches

14. Adjust CH 2 Switch Balance

a. Vertically center the trace.

b. ADJUST—CH 2 Var Bal, R210, for no more than 2 divisions trace shift when rotating the CH 2 VAR control through its range.

c. ADJUST—CH 2 Gain Switch Bal, R235, for minimum trace shift when switching between 2 mV and 5 mV.

d. Check CH 2 UNCAL light.

15. Adjust CH 1 and 2 Position Centering

a. Both VOLTS/DIV to 20 mV,
both AC-GND-DC to AC.

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b. Connect a 50 mV signal from the Standard Amplitude Calibrator to the CH 1 input.

c. ADJUST—CH 1 Position Centering, R176, so the top and bottom of the display can be positioned past the center horizontal line.

d. Repeat the above for CH 2 — adjust R276.

16. Adjust CH 2 Invert Balance (R215) and Check Operation

17. Adjust CH 1 Gain

a. CH 1 VOLTS/DIV to 5 mV.

b. Connect 20 mV signal from Standard Amplitude Calibrator to CH 1 input.

c. ADJUST—CH 1 5 mV Gain, R165, for 200 mV push-pull signal between preamp sides of the delay line.

d. CH 1 VOLTS/DIV to 2 mV.

e. ADJUST—CH 1 2 mV Gain, R125, for 100 mV push-pull signal between preamp sides of the delay line.

f. ADJUST—R449 for 5 divisions of deflection.

g. Check all attenuator ranges for proper deflection, within 3%.

h. Check Variable Range: CH 1 VAR control must reduce a 5 division signal to less than 2 divisions.

18. Adjust CH 2 Gain

a. CH 2 VOLTS/DIV to 5 mV.

b. Connect 20 mV signal from Standard Amplitude Calibrator to CH 2 input.

c. ADJUST—CH 2 5 mV Gain, R265, for 4 divisions deflection, within 3%.

d. CH 2 VOLTS/DIV to 2 mV; test signal to 10 mV.

e. ADJUST—CH 2 2 mV Gain, R225, for 5 divisions deflection, within 3%.

f. Check all attenuator ranges for proper deflection, within 3%.

g. Check Variable Range: CH 2 VAR control must reduce a 5 division signal to less than 2 divisions.

19. Check ADD Operation

a. Both VOLTS/DIV to 5 mV,

both AC-GND-DC to DC.

b. Connect a 10 mV signal from the Standard Amplitude Calibrator to both CH inputs.

c. VERT MODE to ADD.

d. Check for 4 divisions deflection, within 3%.

20. Check Compression and Expansion

a. Position a 2 division signal to top and bottom of graticule.

b. Check for no more than 0.1 division of compression or expansion.

21. Check ALT Operation

22. Check CHOP Operation

a. TIME/DIV to 0.2 μ s,

VERT MODE to CHOP.

b. Check for blanking of transients at normal INTENSITY level.

c. Check duration of each cycle is about 5 divisions.

23. Adjust Vertical Output High-Frequency Response

a. VERT MODE to CH 1.

b. Connect preamp end of delay line to Signal Insertion Unit (067-0676-00).

c. Connect +15 V and -8 V to Signal Insertion Unit.

d. Connect 5 divisions, + polarity, from Fast-Rise High-Amplitude Pulse Generator (Type 109) to Signal Insertion Unit via a GR cable, X5 GR attenuator, Signal Pickoff Unit (Type CT-3), and GR-to-BNC adapter.

e. Connect 10% output of Signal Pickoff unit to A External Trigger input via a terminated cable.

f. ADJUST—C450, R450, C466, R466, C470, and R470 for best flat-top waveform.

24. Adjust High-Frequency Compensation

a. VOLTS/DIV to 5 mV,

AC-GND-DC to DC.

b. Adjust for 5 division display of 10 kHz signal from fast-rise output of Square-Wave Generator (Type 106) to CH 1 input.

c. ADJUST—R139 and R475 for no more than 4% aberrations.

d. Adjust Square-Wave Generator for 5 divisions of 100 kHz signal.

e. ADJUST—C471 and C477 for no more than 4% aberrations.

f. Move the test signal to CH 2,

VOLTS/DIV to 5 mV,

AC-GND-DC to DC.

g. Adjust Square-Wave Generator for 5 divisions of 10 kHz signal.

h. ADJUST—R239, R475, C471, and C477 for no more than 4% aberrations.

i. Disconnect Square-Wave Generator.

j. Connect output of Fast-Rise High-Amplitude Pulse Generator (Type 109) to the CH 1 input.

k. Adjust for 5 divisions of deflection.

l. ADJUST—C175, R175, C133, R133, C112, and R112 for no more than 4% aberrations.

m. Move test signal to CH 2.

n. ADJUST—C275, R275, C233, R233, C212, and R212 for no more than 4% aberrations.

25. Adjust VOLTS/DIV Compensation

a. Adjust CH 1 VOLTS/DIV compensation for no more than 2% aberrations. Use a 20 pF normalizer and a 5 division signal.

| | |
|-------|------------|
| 5 mV | C10 or C50 |
| 2 mV | Check |
| 10 mV | C36, C37 |
| 20 mV | C34, C35 |
| 50 mV | C32, C33 |
| 0.1 V | Check |
| 0.2 V | Check |
| 0.5 V | C30, C31 |

b. Repeat for CH 2.

26. Check Vertical Amplifier Bandwidth

a. Use High-Frequency Constant-Amplitude Signal Generator (067-0532-01): 5 division display of 3 MHz reference signal.

b. At 5 mV setting of both VOLTS/DIV switches, check frequency is at least 200 MHz when display is reduced to 3.5 divisions.

27. Check Cascaded Bandwidth

a. CH 2 VERT SIGNAL OUT to CH 1 input through a terminated cable.

b. Check bandwidth is at least 50 MHz.

28. Check Vertical Channel Isolation

At least 100:1 at 50 MHz.

29. Check Bandwidth Limit Operation

- a. Connect a 6 division display of a 50 kHz signal to the CH 1 input.
- b. Check frequency is 20 MHz, within 5 MHz, when display is reduced to 4.2 divisions.

TRIGGER SYSTEM CALIBRATION

30. Adjust A and B Trigger Sensitivity

- a. VOLTS/DIV to 0.1 V,
A SOURCE to EXT,
A COUPLING to AC.
- b. Connect the Medium-Frequency Constant-Amplitude Signal Generator (Type 191) to the A and B External Trigger inputs via a 50 Ω 5 ns GR cable, 50 Ω Signal Pickoff Unit, GR-to-BNC adapter, X10 attenuator, 50 Ω termination, and a dual input coupler.
- c. Connect the 10% BNC output of the Signal Pickoff Unit to both channel inputs via a terminated dual input coupler.
- d. ADJUST—A and B Sensitivity, R565, R785, to just obtain a stable display with a 0.35 division, 350 kHz signal.

31. Adjust Trigger Centering and Symmetry

- a. VOLTS/DIV to 50 mV,
SOURCE to NORM,
TIME/DIV to 10 μ s.
- b. Position a 2 division display of 350 kHz signal to the center horizontal line.
- c. ADJUST—B Trigger Symmetry, R547, so trigger point is the same in both slopes.
- d. ADJUST—B Trigger Center, R543, for a triggering point at graticule center.
- e. ADJUST—A Trigger Symmetry, R767, so triggering point is the same in both slopes.

- f. ADJUST—A Trigger Center, R754, for triggering point at graticule center.

32. Adjust A Trigger DC Balance

- a. A COUPLING to DC,
A SOURCE to NORM,
A LEVEL to 0.
- b. Use a 0.3 division display.
- c. ADJUST—Normal Trigger DC Balance, R425, to obtain a stable display in both slopes.
- d. Change A SOURCE to CH 1.
- e. ADJUST—CH 1 Trigger DC Balance, R403, to obtain a stable display in both slopes.
- f. VERT MODE to CH 2,
A SOURCE to CH 2.
- g. Check for stable display in both slopes.

33. Check B Trigger DC Balance

- a. B COUPLING to DC,
B SOURCE to NORM,
B LEVEL to 0,
VERT MODE to CH 1.
- b. Use a 0.3 division display.
- c. Check for stable display in both slopes.
- d. Set B SOURCE to CH 1 and repeat part c.
- e. Set B SOURCE to CH 2, VERT MODE to CH 2, and repeat part c.

34. Check Triggering

- a. High-frequency triggering:

| Internal | 40 MHz | 200 MHz |
|-----------------|---------|---------|
| AC | 0.3 div | 1.5 div |
| LF REJ | 0.3 div | 1.5 div |
| DC | 0.3 div | 1.5 div |
| External | | |
| AC | 50 mV | 250 mV |
| LF REJ | 100 mV | 500 mV |
| DC | 50 mV | 250 mV |

Multiply by 10 for EXT ÷ 10 sensitivity.

b. HF REJ—Triggers on 0.3 division at 50 kHz; does not trigger at 1 MHz.

c. LF REJ—Triggers on 0.3 division at 50 kHz; does not trigger on 60 Hz.

d. Check SINGL SWP operation and READY light.

e. Check A NORM triggering.

f. Check LINE triggering.

g. Check AUTO recovery time.

35. Check External LEVEL Range

a. EXT: at least ± 2 V (4 V P-P) for both A and B.

b. EXT ÷ 10: at least ± 20 V (40 V P-P) for A only.

36. Adjust TRIG VIEW

a. ADJUST—Trigger View Centering, R673, so trace is at center horizontal line, within 1 division.

b. Connect 200 mV square-wave signal from Standard Amplitude Calibrator to A External Trigger input.

c. Check for 3.2 to 4.8 divisions of display with TRIG VIEW in.

HORIZONTAL SYSTEM CALIBRATION**37. Adjust Delay Start and Delay Stop**

a. A TIME/DIV to 1 ms,

B TIME/DIV to 5 μ s,

HORIZ DISPLAY to A INTEN,

B SOURCE to STARTS AFTER DELAY,

DELAY TIME POSITION to 1.00.

b. Use 1 ms time markers.

c. ADJUST—Delay Start, R938, to intensify the left side of the 2nd time marker.

d. DELAY TIME POSITION to 9.00.

e. ADJUST—Delay Stop, R936, to intensify the left side of the 10th time marker.

f. HORIZ DISPLAY to B DLY'D.

g. DELAY TIME POSITION to 1.00.

h. ADJUST—Delay Start, R938, so the 2nd time marker starts at the beginning of the sweep.

i. DELAY TIME POSITION to 9.00.

j. ADJUST—Delay Stop, R936, so the 10th time marker starts at the beginning of the sweep.

38. Check Differential Time Accuracy

a. Accuracy within 0.01 division from +15°C to +35°C.

b. Accuracy within 0.02 division from -15°C to +55°C.

39. Adjust Horizontal Gain

a. HORIZ DISPLAY to A,

both TIME/DIV to 1 ms.

b. Use 1 ms time markers.

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c. ADJUST—Horizontal Gain, R1155, for 1 time marker/division, within 1%, from +20°C to +30°C; for 1 time marker/division, within 3%, from -15°C to +55°C.

d. Use 0.1 ms time markers.

e. Push X10 MAG in.

f. Check that the X10 MAG light is on.

g. Check for 1 time marker/division, within 2%, from +20°C to +30°C; for 1 time marker/division, within 4%, from -15°C to +55°C.

40. Adjust Magnifier Registration

a. Use 5 ms time markers.

b. ADJUST—Magnifier Registration, R1130, to position the second time marker to the center vertical line, within 0.4 division, between positions of X10 MAG switch.

41. Check VAR TIME/DIV Range

a. A TIME/DIV to 2 ms.

b. Use 5 ms time markers.

c. Check for 1 time marker/division by rotating the VAR TIME/DIV control.

d. Check UNCAL light.

42. Check Horizontal POSITION Control Range

43. Adjust 10 μ s Timing

a. Both TIME/DIV to 10 μ s.

b. Use 10 μ s time markers.

c. ADJUST—C1064 for 1 time marker/division, within 1%, from +20°C to +30°C; 1 time marker/division, within 3%, from -15°C to +55°C.

d. HORIZ DISPLAY to A INTEN,

B TIME/DIV to 0.01 μ s.

e. ADJUST—C1023 for 1 time marker/division, within 1%, from +20°C to +30°C; 1 time marker/division, within 3%, from -15°C to +55°C.

44. Adjust 0.1 μ s Timing

a. DELAY TIME POSITION to 1.00,

HORIZ DISPLAY to A INTEN,

B TIME/DIV to 0.1 μ s.

b. Use 0.1 μ s time markers.

c. ADJUST—C1025 for 1 time marker/division, within 2%, from +20°C to +30°C; 1 time marker/division, within 3%, from -15°C to +55°C.

d. HORIZ DISPLAY to A,

both TIME/DIV to 0.1 μ s.

e. ADJUST—C1009 for 1 time marker/division, within 1%, from +20°C to +30°C; 1 time marker/division, within 3%, from -15°C to +55°C.

45. Adjust Horizontal Output Centering

a. A TIME/DIV to X-Y,

HORIZ DISPLAY to A.

b. Horizontally center the dot.

c. Adjust the CH 1 POSITION until the voltage on the collector of Q1214 equals that on the collector of Q1204.

d. ADJUST—Horizontal Output Center, R1256, for +50 V on the collectors of Q1214 and Q1204.

46. Adjust High Speed Timing—Visual Method

a. A TIME/DIV to 0.05 μ s,

X10 MAG pushed in,

A SOURCE to EXT,

A COUPLING to LF REJ.

- b. Use 5 nanosecond time markers and 0.1 μ s triggers.
- c. ADJUST—C1233 and C1253 for 1 cycle/division, within 2%, from +20°C to +30°C; 1 cycle/division, within 4%, from -15°C to +55°C.
- d. A TIME/DIV to 0.02 μ s.
- e. Use 2 nanosecond time markers.
- f. ADJUST—C1179 for 1 cycle/division, within 2%, from +20°C to +30°C; 1 cycle/division, within 4%, from -15°C to +55°C.
- g. A TIME/DIV to 0.01 μ s.
- h. ADJUST—R1075 for 1 cycle/2 divisions, within 2%, from +20°C to +30°C; 1 cycle/2 divisions, within 4%, from -15°C to +55°C.
- g. ADJUST—C1233 and C1253 for 1 time marker/division.
- h. A TIME/DIV to 0.02 μ s.
- i. Use 2 nanosecond time markers.
- j. Set Test Oscilloscope: VOLTS/DIV to 10 mV, TIME/DIV to 0.2 μ s.
- k. ADJUST—C1179 for 1 time marker/division.
- l. A TIME/DIV to 0.01 μ s.
- m. Set Test Oscilloscope: VOLTS/DIV to 20 mV, TIME/DIV to 0.1 μ s.
- n. ADJUST—R1075 for 1 time marker/2 divisions.

NOTE

If timing cannot be adjusted within 2% from +20°C to +30°C, or 4% from -15°C to +55°C, proceed to step 47. If timing is within given tolerance, proceed to step 48.

47. Adjust High Speed Timing—Current Probe Method

- a. A TIME/DIV to 0.05 μ s,
X10 MAG pushed in.
- b. Use 5 nanosecond time markers and 0.1 μ s triggers.
- c. Hook the P6022 current probe, with passive termination, around the crossed horizontal deflection leads on the 475. Connect the P6022 to the test oscilloscope.
- d. Set Test Oscilloscope: VOLTS/DIV to 5 mV, TIME/DIV to 0.5 μ s, X10 MAG engaged.
- e. ADJUST—R1175 to midrange, R1185 to midrange, C1233 and C1253 half-closed, and C1179 one turn from fully clockwise.
- f. ADJUST—R1175 and R1185 for symmetrical waveform.

- o. ADJUST—R1175 and R1185 for flat-top symmetrical waveform.

48. Check A and B Timing Accuracy

- a. From 0.01 μ s to 5 ms, at +20°C to +30°C, accuracy is 1%.
- b. From 10 ms to 0.5 s, at +20°C to +30°C, accuracy is 2%.
- c. From -15°C to +55°C, accuracy of all sweep settings is 3%.

49. Check A INTEN Timing Accuracy

- a. From +20°C to +30°C, from 0.05 μ s to 0.5 s, accuracy is within 2%.
- b. From -15°C to +55°C, from 0.05 μ s to 0.5 s, accuracy is within 3%.

50. Check A and B Magnified Timing Accuracy

- a. From +20°C to +30°C, from 0.01 μ s to 5 ms, accuracy is within 2%.
- b. From +20°C to +30°C, from 10 ms to 50 ms, accuracy is within 3%.

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c. From -15°C to $+55^{\circ}\text{C}$, from $0.01\ \mu\text{s}$ to $50\ \text{ms}$, accuracy is within 4%.

d. Exclude the following portions of the sweep, from $0.01\ \mu\text{s}$ to $1\ \mu\text{s}$:

First 25 nanoseconds and all beyond the 100th magnified division.

51. Check Delay Time Accuracy

a. Error for intervals less than 1 dial division cannot exceed 0.01 dial division.

b. Error between any two time markers greater than 1 dial division apart cannot exceed 1%.

52. Check Delay Time Jitter

a. HORIZ DISPLAY to B DLY'D,

A TIME/DIV to 1 ms,

B TIME/DIV to $0.2\ \mu\text{s}$.

b. Check for no more than 1 division jitter.

53. Check MIX Sweep Accuracy

a. Use 1 ms time markers.

b. Check for proper timing within 0.24 division.

NOTE

Exclude first 0.5 division of sweep after display start and first 0.2 division, or $0.1\ \mu\text{s}$ (whichever is greater) after the transition of A to B.

54. Adjust X Gain

a. A TIME/DIV to X-Y,

both VOLTS/DIV to 5 mV,

VERT MODE to CH 2.

b. Apply 20 mV square wave from Standard Amplitude Calibrator to CH 1 or X input.

c. ADJUST—X Gain, R1102, for 4 divisions of deflection between the dots, within 3%.

55. Check X-Y Phasing and Bandwidth

a. Connect an 8 division display of 50 kHz signal from Medium-Frequency Constant-Amplitude Signal Generator to the CH 1 and 2 inputs.

b. Check X-Y phase shift is no more than 0.14 division.

c. Increase output frequency of signal generator to 2 MHz.

d. Check X-Y phase shift is no more than 0.42 division.

e. ADJUST—L1103 for minimum phase shift.

f. Check bandwidth is at least 3 MHz.

56. Check B ENDS A Operation

57. Check A TRIG HOLDOFF

Should increase holdoff to nine times the TIME/DIV setting.

CALIBRATOR, + GATES, AND EXT Z-AXIS CALIBRATION

58. Adjust CALIBRATOR Amplitude

a. Short emitter to base of Q1504.

b. Check for +0.3 V DC, within 3 mV, from CALIBRATOR current loop to ground.

c. ADJUST—R1515 for +0.3 V DC, within 1% from 0°C to $+40^{\circ}\text{C}$; for +0.3 V DC, within 1.5% from -15°C to $+55^{\circ}\text{C}$.

d. Remove the short from emitter to base of Q1504.

59. Check A and B +GATES

a. A + GATE: +5.5 V P-P, within 0.5 V.

b. B + GATE: +5.5 V P-P, within 0.5 V.

60. Check EXT Z-AXIS Operation

a. Connect 5 V 50 kHz signal to CH 1 input and EXT Z-AXIS input.

b. Check for noticeable intensity modulation of the positive peaks.

PART III—CALIBRATION

Introduction

The following procedure returns the 475 to correct calibration. All limits and tolerances given in this procedure are calibration guides and should not be interpreted as instrument specifications except as specified in the Specifications section of this manual. Where possible, instrument performance is checked before an adjustment is made. For best overall instrument performance when performing a complete calibration procedure, make each adjustment to the exact setting even if the CHECK— is within the allowable tolerance.

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| 2. Check High Voltage Power Supply | Page 5-26 |

DISPLAY and Z-AXIS CALIBRATION

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HORIZONTAL SYSTEM CALIBRATION

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CALIBRATOR, + GATES, and EXT Z-AXIS CALIBRATION

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Preliminary Procedure for Calibration

NOTE

This instrument should be adjusted at an ambient temperature of +25°C (±5°C) for best overall accuracy.

1. Remove the dust cover from the 475 as outlined in the Disassembly Instructions in the Maintenance section of the manual.

2. Connect the autotransformer to a suitable power source.
3. Connect the 475 to the autotransformer output.
4. Set the autotransformer output voltage to the center of the voltage range selected by the Line Voltage Selector.

5. Set the controls as given under Preliminary Control Settings (given prior to Part I—Performance Check). Allow at least 20 minutes warmup before proceeding.

NOTE

Titles for external controls of this instrument are capitalized in this procedure (e.g., INTENSITY). Internal adjustments are initial capitalized only (e.g., CRT Grid Bias).

POWER SUPPLY CALIBRATION

| Equipment Required | |
|---------------------------|------------------------------|
| 1. Precision DC Voltmeter | 4. Three-inch Screwdriver |
| 2. DC Voltmeter | |
| 3. Test Oscilloscope | 5. Variable Auto-Transformer |

Control Settings

Preset instrument controls to the settings given under Preliminary Control Settings.

1. Check Power Supply DC Levels and Ripple

a. Connect the Precision DC Voltmeter between test point +50 V and GND (negative meter lead to ground) on the main interface board. See Fig. 5-2.

b. CHECK—Meter for a reading of +50 volts, within 0.5% or ± 250 mV.

c. ADJUST—+50 volt supply adjustment, R1430, (see Fig. 5-2) for a meter reading of +50 volts, within 0.1% or 50 mV.

d. Using the Precision DC Voltmeter, measure the low voltage power supplies given in Table 5-5. Observe proper meter polarity. See Fig. 5-2 for test point locations.

e. Using the Test Oscilloscope, check for correct ripple as given in Table 5-5, while varying the autotransformer between 103.5 VAC and 126.5 VAC.

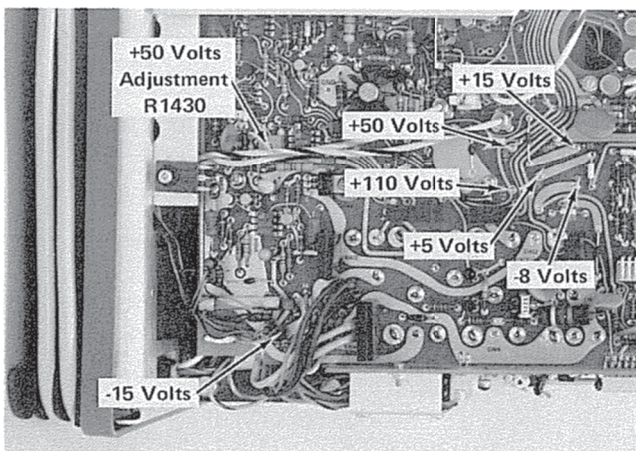


Fig. 5-2. Low voltage power supply test points and +50 V adjustment.

TABLE 5-5

Power Supply Tolerance and Ripple

| Power Supply | Tolerance | Typical Ripple (peak-to-peak) |
|--------------|---------------|-------------------------------|
| +110 V | 3% (3.3 V) | 1 V |
| +50 V | 0.5% (250 mV) | 2 mV |
| +15 V | 1.5% (225 mV) | 2 mV |
| +5 V | 1.5% (75 mV) | 2 mV |
| -15 V | 1.5% (225 mV) | 2 mV |
| -8 V | 1.5% (120 mV) | 2 mV |

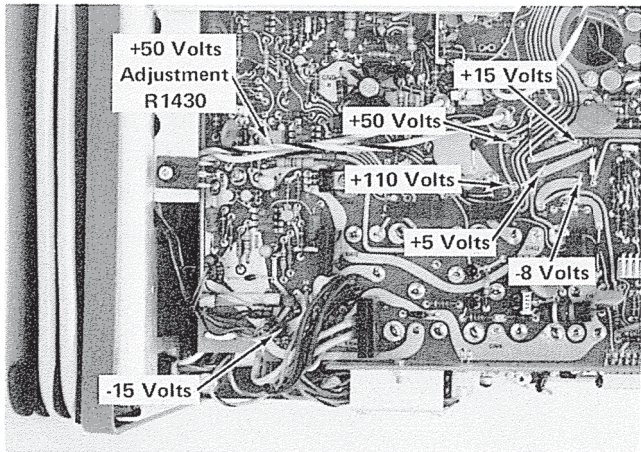


Fig. 5-2. Low voltage power supply test points and +50 V adjustment.

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f. CHECK—For LOW LINE indicator light to turn on when the autotransformer is below 103 volts.

g. Return the autotransformer for a 115 VAC output.

2. Check High Voltage Power Supply

a. Connect the DC Voltmeter between the -2450-volt test point and ground (positive meter lead to ground). See Fig. 5-3.

b. CHECK—Meter for a reading of -2450 volts, within ±49 volts.

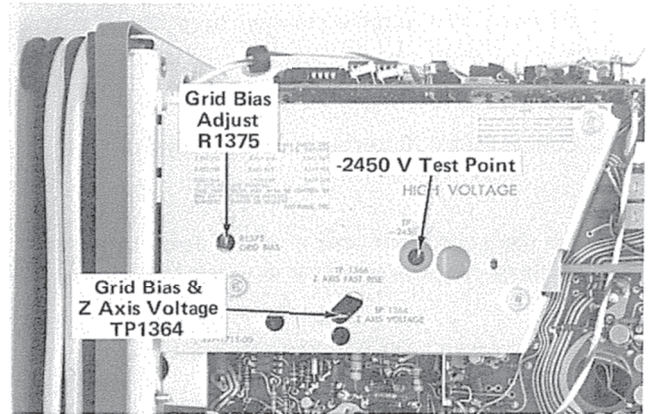


Fig. 5-3. Location of high-voltage and Grid Bias test points and adjustments.

DISPLAY and Z-AXIS CALIBRATION

| Equipment Required | |
|------------------------------------|--------------------------------|
| 1. DC Voltmeter | 5. 42-inch 50 Ω BNC Cable |
| 2. Time-Mark Generator (Type 2901) | 6. 50 Ω BNC Termination |
| 3. Test Oscilloscope | 7. Three-inch Screwdriver |
| 4. X10 Probe | 8. Low-Capacitance Screwdriver |

Control Settings

Preset instrument controls to the settings given under Preliminary Control Settings except as follows:

| | |
|-----------|------------------------|
| INTENSITY | Fully Counterclockwise |
| TRIG MODE | NORM |

3. Adjust CRT Grid Bias

a. Connect the DC Voltmeter between TP1364 and ground. (Negative meter lead to ground.) See Fig. 5-3.

b. Set the INTENSITY control for a meter reading of +15 volts.

c. CHECK—CRT display for the dimmest, well-defined dot.

d. ADJUST—CRT Grid Bias adjustment, R1375 (see Fig. 5-3) for dimmest, visible dot.

e. Turn CH 1 POSITION, FOCUS, and INTENSITY controls fully clockwise.

f. CHECK—Meter reading is between +20 volts and +30 volts.

g. Push BEAM FIND pushbutton.

h. CHECK—Meter for a reading of approximately +25 volts.

i. Release BEAM FIND button and remove DC Voltmeter connections.

j. Turn FOCUS, INTENSITY, and CH 1 POSITION controls to mid-range.

k. Adjust FOCUS and INTENSITY controls for a well-defined dot of nominal intensity.

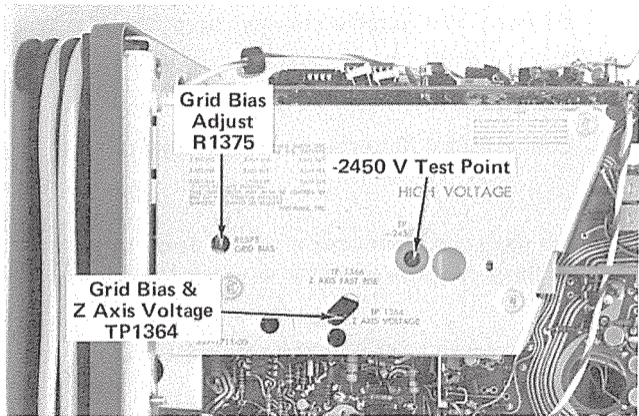


Fig. 5-3. Location of high-voltage and Grid Bias test points and adjustments.

4. Check ASTIG Control

- a. Rotate ASTIG control (front panel screwdriver adjustment) through its range.
- b. CHECK—For dot de-focus at both extremes of the ASTIG control.
- c. Reset the ASTIG control for a well-defined dot.

5. Check Display Controls

- a. Rotate SCALE ILLUM control through its range.
- b. CHECK—For a smooth increase in illumination.
- c. Set the INTENSITY control to mid-range.
- d. Rotate the FOCUS control through its range.
- e. CHECK—For trace de-focus at both extremes of the FOCUS control.
- f. Rotate the INTENSITY control from fully counter-clockwise to fully clockwise.
- g. CHECK—For trace intensity to increase smoothly from minimum to maximum intensity.
- h. Reset the INTENSITY and FOCUS controls for a well-defined trace.

6. Adjust Trace Alignment

- a. Position the trace to the center horizontal graticule line.
- b. CHECK—That the trace is parallel with the center horizontal line.
- c. ADJUST—TRACE ROTATION adjustment (front panel adjustment) to make the trace parallel to the center horizontal line.

7. Adjust Y Axis Alignment

- a. Connect 0.1 ms time marks from the Time-Mark Generator (Type 2901) to the CH 1 input via a 42-inch 50 Ω BNC cable and a 50 Ω BNC termination.

- b. Set the CH 1 AC-GND-DC switch to DC and the CH 1 VOLTS/DIV switch to 0.1 V.

- c. Adjust the A LEVEL control for a stable display, the ASTIG and FOCUS controls for a well-defined display.

- d. Adjust the VAR TIME/DIV control for 1 time marker/division.

- e. CHECK—For no more than 0.1 division of tilt of the center time marker as compared with the center vertical graticule line.

- f. ADJUST—Y Axis Alignment adjustment, R1385, (see Fig. 5-4) to align the center time marker with the center vertical line.

- g. INTERACTION—Between Y Axis Alignment and TRACE ROTATION adjustments. Adjust both for total optimum response.

8. Adjust Geometry

- a. CHECK—CRT display for no more than 0.1 division vertical curvature of the time markers across the viewing area.
- b. ADJUST—Geometry adjustment, R1390 (see Fig. 5-4) for minimum curvature of the time markers across the viewing area.
- c. Remove the test signal from CH 1 input.
- d. CHECK—For no more than 0.1 division of curvature of the trace when positioned from top to bottom of the graticule area.

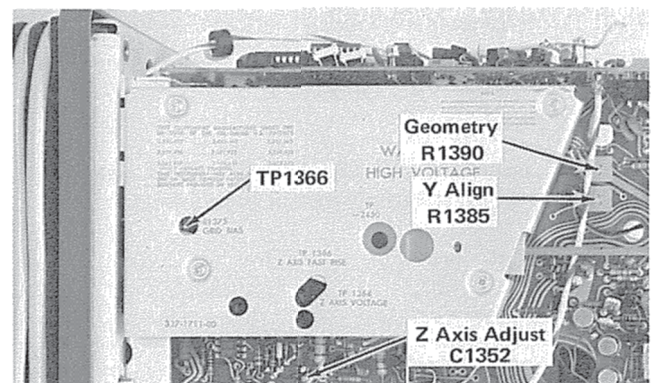


Fig. 5-4. Location of Y-Axis Align, Z-Axis, and Geometry adjustments and test point.

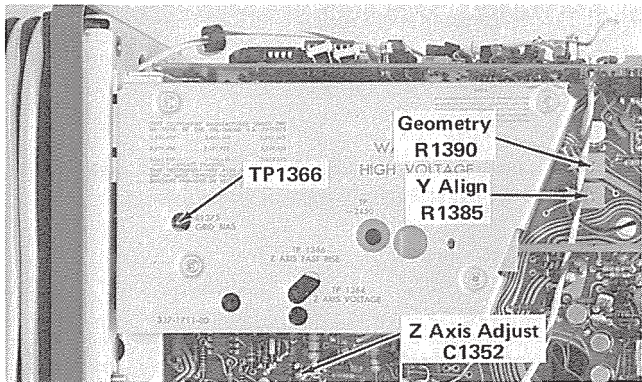


Fig. 5-4. Location of Y-Axis Align, Z-Axis, and Geometry adjustments and test point.

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e. INTERACTION—Between Geometry and Y Axis Alignment adjustments. Adjust both for optimum response.

9. Adjust Z-Axis Compensation

- a. Set A TIME/DIV switch to 0.05 μ s.
- b. Connect the X10 probe from the Test Oscilloscope to TP1366 (see Fig. 5-4).
- c. Connect the A +GATE output to the External Trigger input of the Test Oscilloscope via a 42-inch 50 Ω BNC cable.

d. Adjust the Test Oscilloscope trigger controls to view the positive step of a 1 volt display of the Z-Axis signal.

e. CHECK—Test Oscilloscope display for optimum square corner on the unblanking gate.

f. ADJUST—Z-Axis Compensation adjustment, C1352, using a low capacitance screwdriver, (see Fig. 5-4) for optimum square corner on the unblanking gate.

g. Disconnect the test setup.

VERTICAL SYSTEM CALIBRATION

| Equipment Required | |
|---|---|
| 1. Standard Amplitude Calibrator (067-0502-01) | 12. GR-to-BNC Female Adapter |
| 2. Test Oscilloscope | 13. 42-inch 50 Ω BNC Cable (two) |
| 3. High-Frequency Constant-Amplitude Signal Generator (067-0532-01) | 14. 18-inch 50 Ω BNC Cable |
| 4. Medium-Frequency Constant-Amplitude Signal Generator (Type 191) | 15. X10 BNC Attenuator |
| 5. Fast-Rise High-Amplitude Pulse Generator (Type 109) | 16. X10 GR Attenuator (two) |
| 6. Square-Wave Generator (Type 106) | 17. X5 GR Attenuator |
| 7. Precision DC Voltmeter | 18. 50 Ω BNC Termination (two) |
| 8. X10 Probe (two) | 19. GR 50 Ω Termination |
| 9. Signal Insertion Unit (067-0676-00) | 20. 20 Picofarad Normalizer |
| 10. 50 Ω Signal Pickoff Unit (Type CT-3) | 21. Dual Input Coupler |
| 11. GR 5 Nanosecond Cable | 22. Three-inch Screwdriver |
| | 23. Low-Capacitance Screwdriver |

Control Settings

Preset instrument controls to the settings given under Preliminary Control Settings except as follows:

VOLTS/DIV 0.1 V

10. Adjust Vertical Output Bias

a. Connect the High Frequency Constant-Amplitude Signal Generator (067-0532-01) output to the CH 1 input

via a GR-to-BNC female adapter and a 50 Ω BNC termination.

b. Adjust the High-Frequency signal generator for a 200 MHz sine-wave output on the 0.5 V amplitude range.

c. ADJUST—Vertical Output Bias adjustment, R488 (see Fig. 5-5) for maximum deflection of the signal.

d. Disconnect the test setup.

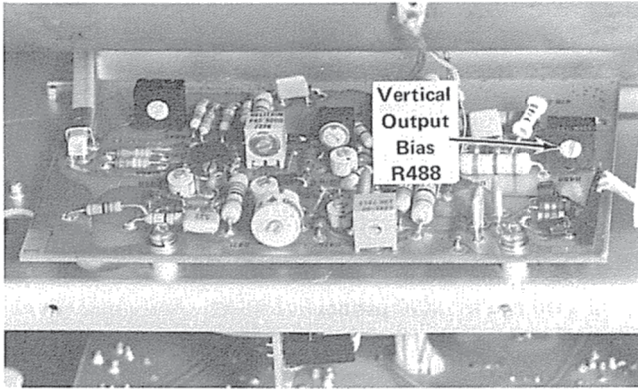


Fig. 5-5. Location of Vertical Output Bias adjustment.

11. Adjust Vertical Shield Voltage

a. Vertically position the trace to the center horizontal graticule line.

b. Using the Precision DC Voltmeter, measure the voltage on each vertical deflection plate of the CRT with respect to ground. (Negative meter lead to ground.) Note the meter reading.

c. Add both readings noted in step 11-b together and divide by two. Note the calculated voltage.

d. Connect the Precision DC Voltmeter between TP1395 and ground. (Negative meter lead to ground.)

e. CHECK—Meter reading is equal to the voltage calculated in step 11-c, within ± 0.5 volt.

f. ADJUST—Vertical Shield Volts adjustment, R1395 (see Fig. 5-6), for a meter reading equal to the voltage calculated in step 11-c.

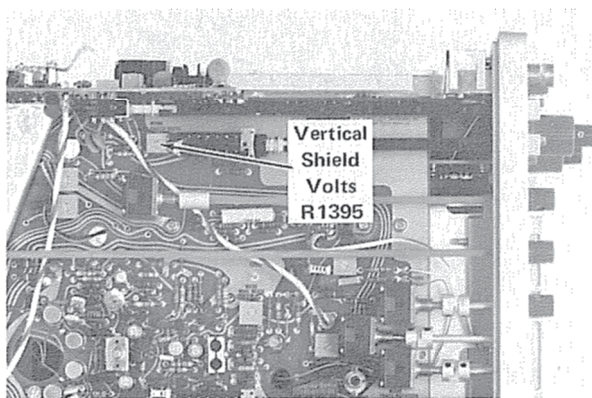


Fig. 5-6. Location of Vertical Shield Voltage adjustment.

g. Remove the Precision DC Voltmeter connections.

12. Adjust Delay-Line Driver Centering

a. Using the Precision DC Voltmeter, monitor both ends of the delay line until the readings are equal, while adjusting the CH 1 POSITION control.

b. CHECK—Precision DC Voltmeter for a reading of 0 volts.

c. ADJUST—Delay-Line Driver Centering adjustment, R385 (see Fig. 5-7), for a reading of 0 volts at both ends of the delay line.

d. Remove the Precision DC Voltmeter connections.

13. Check BEAM FIND Operation

a. Position the trace off-screen with the CH 1 POSITION and horizontal POSITION controls.

b. Push the BEAM FIND pushbutton and hold it in.

c. CHECK—That the trace is brought into the CRT viewing area.

d. Release the BEAM FIND.

14. Adjust CH 1 Variable Volts/Division Balance

a. Set the CH 1 VOLTS/DIV switch to 5 mV.

b. Position the trace to the center horizontal line.

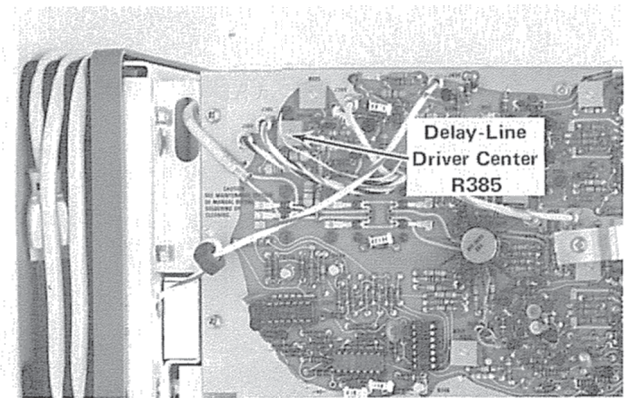


Fig. 5-7. Location of Delay-Line Driver Centering adjustment.

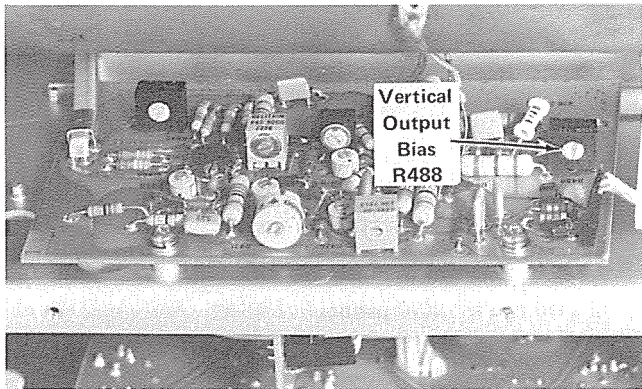


Fig. 5-5. Location of Vertical Output Bias adjustment.

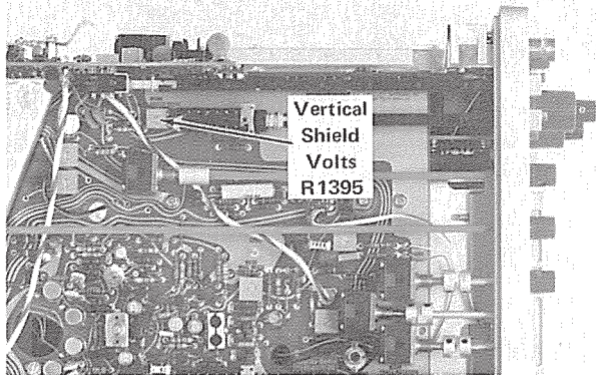
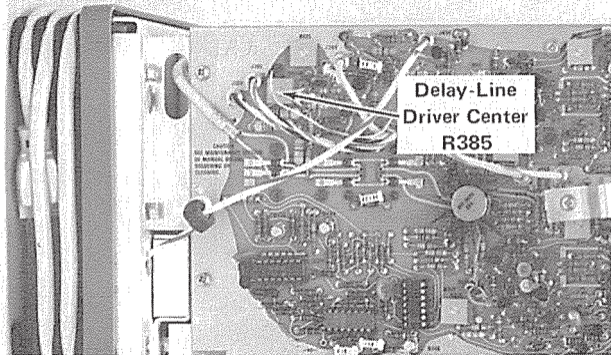


Fig. 5-6. Location of Vertical Shield Voltage adjustment.



h Fig. 5-7. Location of Delay-Line Driver Centering adjustment.

Calibration—475

c. CHECK—That the CH 1 UNCAL light turns on when the VAR control is out of the detent position.

d. CHECK—CRT display for 2 divisions or less of trace shift when rotating the CH 1 VAR control through its range.

e. ADJUST—CH 1 Variable Balance adjustment, R110 (see Fig. 5-8) for minimum trace shift when rotating the CH 1 VAR control through its range.

f. Return the CH 1 VAR control to the detent position.

15. Adjust CH 1 Gain Switch Balance

a. Set the CH 1 VOLTS/DIV switch to 2 mV.

b. Position the trace to the center horizontal line.

c. CHECK—CRT display for minimum trace shift between 2 mV and 5 mV positions of the CH 1 VOLTS/DIV switch.

d. ADJUST—CH 1 Gain Switch Bal adjustment, R135 (see Fig. 5-8), for minimum trace shift between 2 mV and 5 mV positions of the CH 1 VOLTS/DIV switch.

16. Check Probe Indicator Lights

a. Set both VOLTS/DIV switches to 5 mV.

b. Connect a X10 probe to the CH 1 input.

c. CHECK—Light under 5 mV setting is extinguished and the light under 50 mV setting turns on.

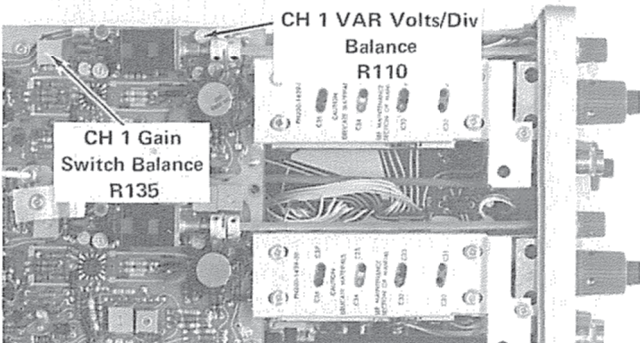


Fig. 5-8. Location of CH 1 Var Volts/Div Balance and Gain Switch Balance adjustments.

d. Set the VERT MODE switch to CH 2.

e. Move the X10 probe to the CH 2 input.

f. CHECK—Light under 5 mV setting is extinguished and the light under 50 mV setting turns on.

g. Remove the X10 probe.

17. Check AC-GND-DC Switches

a. Set both AC-GND-DC switches to DC.

b. Connect the Standard Amplitude Calibrator output to the CH 2 input via a 42-inch 50 Ω BNC cable.

c. Adjust the Standard Amplitude Calibrator for a 20 mV output.

d. Position the bottom of the display to the center horizontal line.

e. Set CH 2 AC-GND-DC switch to GND.

f. CHECK—For no vertical deflection, trace is at the center horizontal line.

g. Set the CH 2 AC-GND-DC switch to AC.

h. CHECK—That the display is centered about the center horizontal line.

i. Move the test signal to the CH 1 input.

j. Set the VERT MODE switch to CH 1.

k. Position the bottom of the display to the center horizontal line.

l. Set the CH 1 AC-GND-DC switch to GND.

m. Repeat step 17-f.

n. Set the CH 1 AC-GND-DC switch to AC.

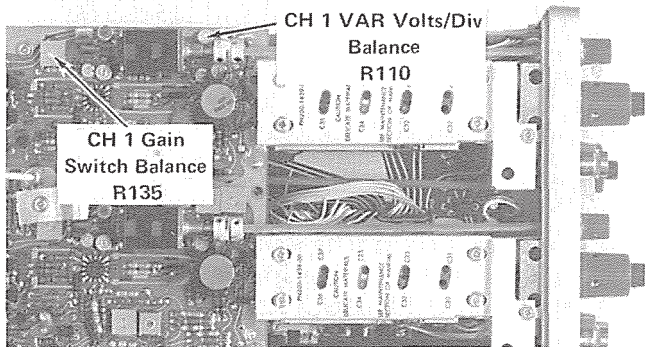


Fig. 5-8. Location of CH 1 Var Volts/Div Balance and Gain Switch Balance adjustments.

- o. Repeat step 17-h.

18. Adjust CH 1 Position Centering

- a. Set the CH 1 VOLTS/DIV switch to 2 mV.
- b. Adjust the Standard Amplitude Calibrator for a 50 mV output.
- c. CHECK—The top of the CRT display can be positioned below the center horizontal graticule line, and that the bottom of the display can be positioned above the center horizontal graticule line.
- d. ADJUST—CH 1 Position Centering adjustment, R176 (see Fig. 5-9), so the top of the CRT display can be positioned below the center horizontal graticule line, and the bottom of the display can be positioned above the center horizontal graticule line.

19. Adjust CH 2 Variable Volts/Division Balance

- a. Set the CH 2 VOLTS/DIV switch to 5 mV and the VERT MODE switch to CH 2.
- b. CHECK—That the CH 2 UNCAL light turns on when the VAR control is out of the detent position.
- c. CHECK—CRT display for 2 divisions or less of trace shift when rotating the CH 2 VAR control through its range.
- d. ADJUST—CH 2 Variable Balance adjustment, R210 (see Fig. 5-10), for minimum trace shift when rotating the CH 2 VAR control through its range.

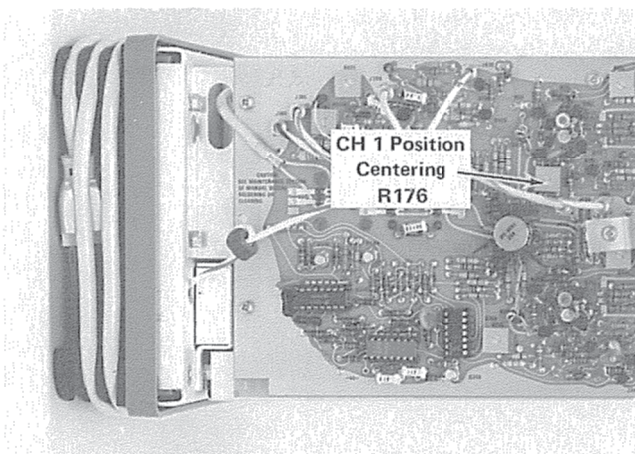


Fig. 5-9. Location of CH 1 Position Centering adjustment.

- e. Return the CH 2 VAR control to the detent position.

20. Adjust CH 2 Gain Switch Balance

- a. Set the CH 2 VOLTS/DIV switch to 2 mV.
- b. Position the trace to the center horizontal line.
- c. CHECK—CRT display for minimum trace shift between 2 mV and 5 mV positions of the CH 2 VOLTS/DIV switch.
- d. ADJUST—CH 2 Gain Switch Balance adjustment, R235 (see Fig. 5-10), for minimum trace shift between 2 mV and 5 mV positions of the CH 2 VOLTS/DIV switch.

21. Check CH 2 INVERT Balance

- a. Set the CH 2 AC-GND-DC switch to GND.
- b. Position the trace to the center horizontal graticule line.
- c. Push the INVERT pushbutton.
- d. CHECK—For less than 1 division of trace shift when switching from normal to inverted.
- e. ADJUST—Invert Balance adjustment, R215 (see Fig. 5-10), for minimum trace shift between positions of the INVERT switch.
- f. Return the INVERT to the normal (out) position.

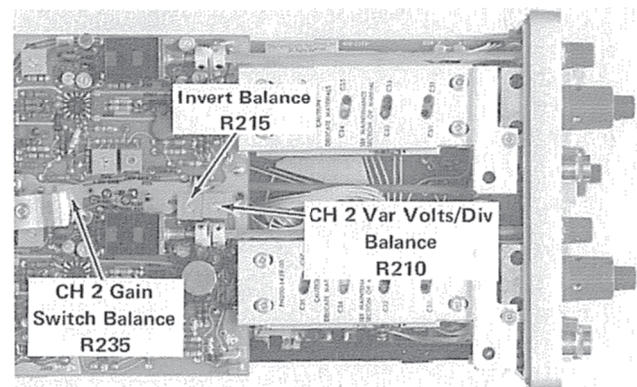


Fig. 5-10. Location of CH 2 Var Volts/Div Balance, Gain Switch Balance, and Invert Balance adjustments.

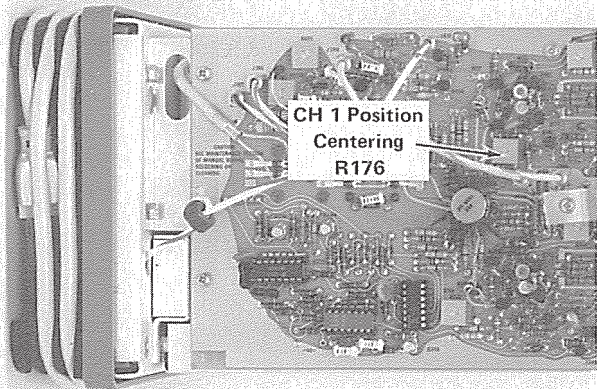


Fig. 5-9. Location of CH 1 Position Centering adjustment.

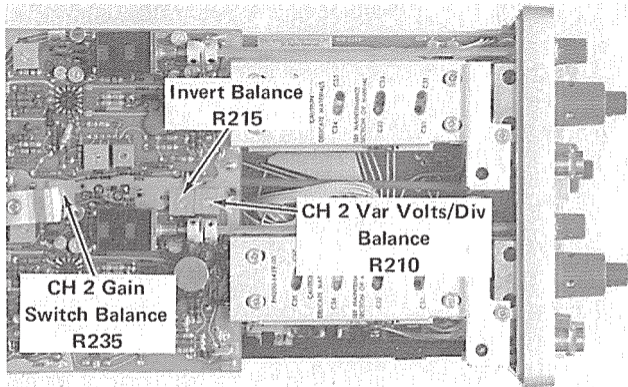


Fig. 5-10. Location of CH 2 Var Volts/Div Balance, Gain Switch Balance, and Invert Balance adjustments.

22. Adjust CH 2 Position Centering

- a. Set the CH 2 VOLTS/DIV switch to 2 mV.
- b. Move the test signal to the CH 2 input.
- c. CHECK—The top of the CRT display can be positioned below the center horizontal graticule line, and that the bottom of the display can be positioned above the center horizontal graticule line.
- d. ADJUST—CH 2 Position Centering adjustment, R276 (see Fig. 5-11), so the top of the CRT display can be positioned below the center horizontal graticule line, and the bottom of the display can be positioned above the center horizontal graticule line.

23. Adjust CH 1 Gain

- a. Set the VERT MODE switch to CH 1, the CH 1 VOLTS/DIV switch to 5 mV, and the CH 1 AC-GND-DC switch to DC.
- b. Move the test signal to the CH 1 input.
- c. Adjust the Standard Amplitude Calibrator for a 20 mV output.
- d. Set the Test Oscilloscope: Vertical Mode to ADD, Channel 2 to INVERT, and both VOLTS/DIV switches to 5 mV.
- e. Connect two X10 probes from the Test Oscilloscope to the preamp side of the delay line.

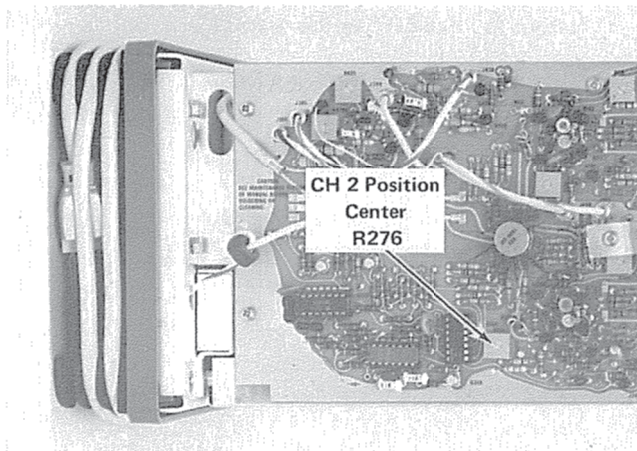


Fig. 5-11. Location of CH 2 Position Centering adjustment.

f. CHECK—The Test Oscilloscope for a 200 mV (peak-to-peak) signal.

g. ADJUST—CH 1 5 mV Gain adjustment, R165 (see Fig. 5-12) for a 200 mV (peak-to-peak) display on the Test Oscilloscope.

NOTE

200 mV value is dependent on the CRT sensitivity.

h. Set the CH 1 VOLTS/DIV to 2 mV and adjust the Standard Amplitude Calibrator for a 10 mV output.

i. CHECK—The Test Oscilloscope for a 100 mV (peak-to-peak) signal.

j. ADJUST—CH 1 2 mV Gain adjustment, R125 (see Fig. 5-12) for a 100 mV (peak-to-peak) display on the Test Oscilloscope.

k. Remove the X10 probes from the delay line.

l. CHECK—CRT display for 5 divisions of deflection.

m. ADJUST—Vertical Output Gain adjustment, R449 (see Fig. 5-13) for 5 divisions of deflection.

n. CHECK—Accuracy of the CH 1 VOLTS/DIV switch using the settings given in Table 5-6 to see if the deflection factor accuracy for each position is within 3%.

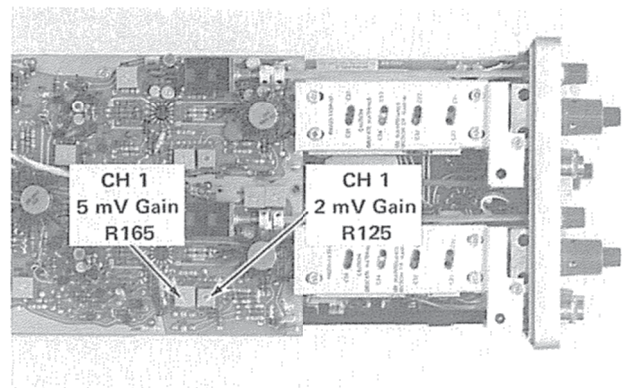
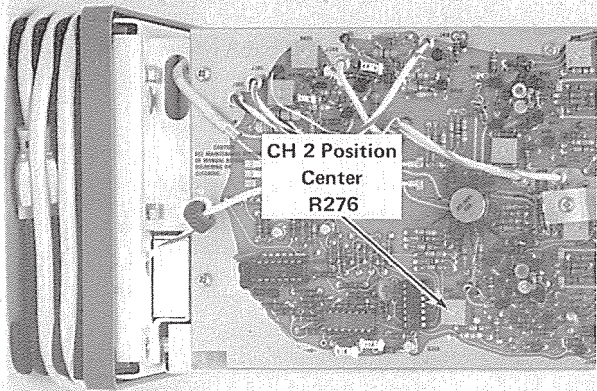
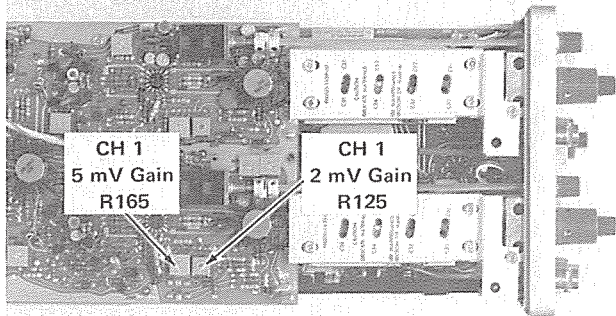


Fig. 5-12. Location of Gain adjustments for Channel 1.



<http://www.monon.schill.com>
Fig. 5-11. Location of CH 2 Position Centering adjustment.



ht Fig. 5-12. Location of Gain adjustments for Channel 1.

24. Adjust CH 2 Gain

a. Set the VERT MODE switch to CH 2, the CH 2 VOLTS/DIV switch to 5 mV, and the AC-GND-DC switch to DC.

b. Move the test signal to the CH 2 input.

c. Adjust the Standard Amplitude Calibrator for a 20 mV output.

d. CHECK—CRT display for 4 divisions of deflection, within 3%.

e. ADJUST—CH 2 5 mV Gain adjustment, R265 (see Fig. 5-14), for 4 divisions of deflection.

f. Set the CH 2 VOLTS/DIV switch to 2 mV and adjust the Standard Amplitude Calibrator for a 10 mV output.

g. CHECK—CRT display for 5 divisions of deflection, within 3%.

h. ADJUST—CH 2 2 mV Gain adjustment, R225 (see Fig. 5-14), for 5 divisions of deflection.

i. CHECK—Accuracy of the CH 2 VOLTS/DIV switch using the settings given in Table 5-6. Deflection factor accuracy to be within 3% in all switch positions.

25. Check CH 2 and CH 1 Variable Volts/Division Ranges

a. Adjust the Standard Amplitude Calibrator for 5 divisions of deflection.

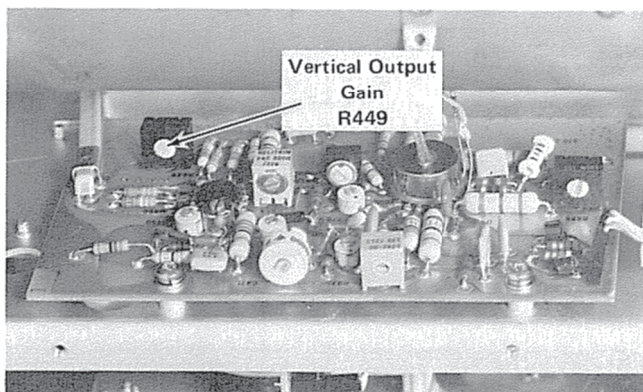


Fig. 5-13. Location of Vertical Output Gain adjustment.

TABLE 5-6

Vertical Deflection Accuracy

| VOLTS/DIV Switch Setting | Standard Amplitude Calibrator Output | Vertical Deflection in Divisions | Maximum Error for 3% Accuracy |
|--------------------------|--------------------------------------|----------------------------------|-------------------------------|
| 2 mV | 10 mV | 5 | Previously set |
| 5 mV | 20 mV | 4 | Previously set |
| 10 mV | 50 mV | 5 | ±0.15 div |
| 20 mV | 0.1 V | 5 | ±0.15 div |
| 50 mV | 0.2 V | 4 | ±0.12 div |
| 0.1 V | 0.5 V | 5 | ±0.15 div |
| 0.2 V | 1 V | 5 | ±0.15 div |
| 0.5 V | 2 V | 4 | ±0.12 div |
| 1 V | 5 V | 5 | ±0.15 div |
| 2 V | 10 V | 5 | ±0.15 div |
| 5 V | 20 V | 4 | ±0.12 div |

b. Rotate the CH 2 VAR control fully counterclockwise.

c. CHECK—CRT display reduces to less than 2 divisions.

d. Move the test signal to CH 1.

e. Set the VERT MODE switch to CH 1.

f. Adjust the Standard Amplitude Calibrator for 5 divisions of deflection.

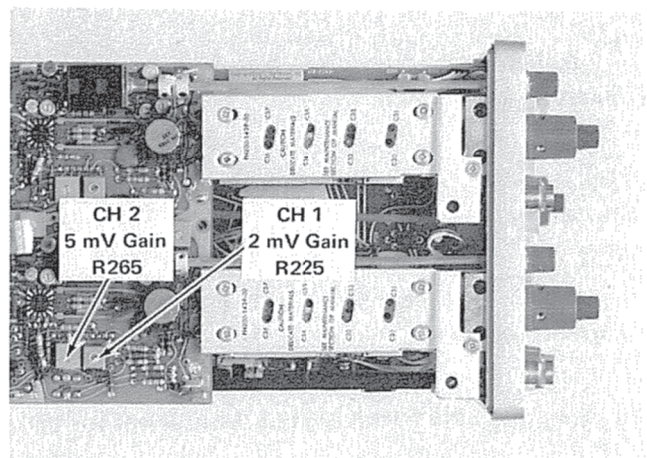


Fig. 5-14. Location of Gain adjustment for Channel 2.

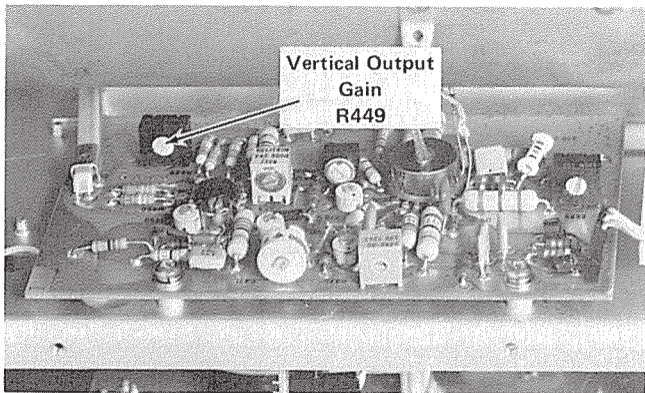


Fig. 5-13. Location of Vertical Output Gain adjustment.

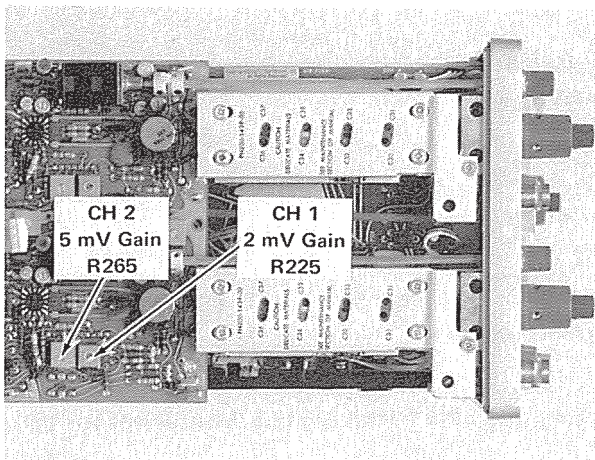


Fig. 5-14. Location of Gain adjustment for Channel 2.

Calibration—475

- g. Rotate the CH 1 VAR control fully counterclockwise.
- h. CHECK—CRT display reduces to less than 2 divisions.
- i. Return the VAR controls to the detent position.

26. Check ADD Mode Operation

- a. Set both VOLTS/DIV switches to 5 mV and both AC-GND-DC switches to DC.
- b. Connect the Standard Amplitude Calibrator output to both channel inputs via a dual input coupler.
- c. Adjust the Standard Amplitude Calibrator for a 10 mV output.
- d. Set the VERT MODE switch to ADD.
- e. CHECK—For 4 divisions of deflection, within 0.12 division.

27. Check Compression and Expansion

- a. Set the CH 2 AC-GND-DC switch to GND and the VERT MODE switch to CH 1.
- b. Adjust the CH 1 VAR control for 2 divisions of deflection centered about the center horizontal line.
- c. Position the top of the display to the top graticule line.
- d. CHECK—CRT display for 0.1 division or less of compression or expansion.
- e. Position the bottom of the display to the bottom graticule line.
- f. CHECK—CRT display for 0.1 division or less of compression or expansion.
- g. Return the CH 1 VAR control to the detent position.
- h. Disconnect the test setup.

28. Check ALT Mode Operation

- a. Set the VERT MODE switch to ALT and the A LEVEL control fully clockwise.
- b. Position the two traces 2 divisions apart.
- c. CHECK—That the sweeps alternate at all settings of the A TIME/DIV switch, except X-Y.

29. Check CHOP Mode Operation

- a. Set the A TIME/DIV switch to $0.2 \mu s$, the A SOURCE switch to NORM, the A SLOPE switch to +, the VERT MODE switch to CHOP, and both AC-GND-DC switches to GND.
- b. Position the two traces 4 divisions apart.
- c. Adjust the A LEVEL control for a stable display.
- d. CHECK—For complete blanking of switching transients between chopped segments (see Fig. 5-15).
- e. CHECK—Duration of each cycle is about 5 divisions.

30. Adjust Vertical Output Amplifier High-Frequency Response

- a. Set the VERT MODE switch to CH 1.

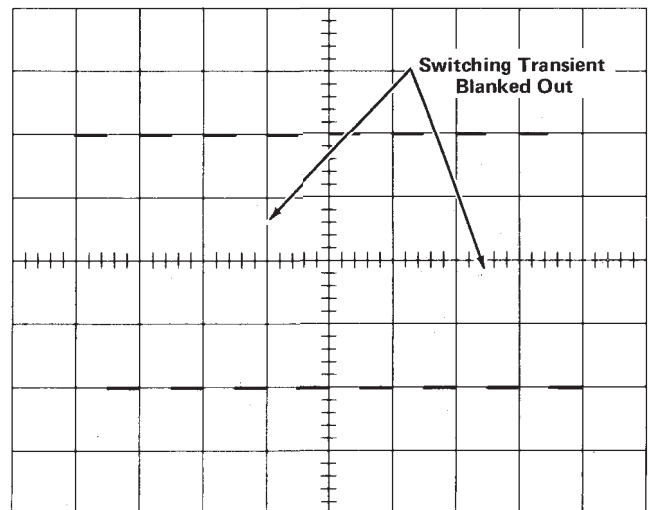


Fig 5-15. Typical CRT display when checking chopped blanking.

b. Connect the preamp end of the delay line to the output of the Signal Insertion Unit (067-0676-00).

c. Connect the Signal Insertion Unit to +15 volts and -8 volts from the 475.

d. Connect the Fast-Rise High-Amplitude Pulse Generator (Type 109) to the Signal Insertion Unit via a 50 Ω 5 ns GR cable, a X5 GR attenuator Signal Pickoff Unit (Type CT-3), and a GR-to-BNC adapter.

e. Connect the 10% output BNC connector of the Signal Pickoff Unit (Type CT-3) to the A External Trigger input via an 18-inch 50 Ω BNC cable and a 50 Ω BNC termination.

f. Adjust the Pulse Generator for 5 divisions of deflection, + Polarity.

g. CHECK—CRT display for flat-top waveform with no more than 10% overshoot on the leading edge.

h. ADJUST—C450, R450, C466, R466, C470, R470 (see Fig. 5-16), for best flat-top waveform.

i. CAL AID—Adjust C450 and R450 for minimum aberrations; C466 and R466 for flat response over the first 5 ns; C470 and R470 for flat response over the first 15 ns. R450 should be adjusted as far counterclockwise as possible.

j. INTERACTION—Between all adjustments in this step. Re-adjust for best flat-top response.

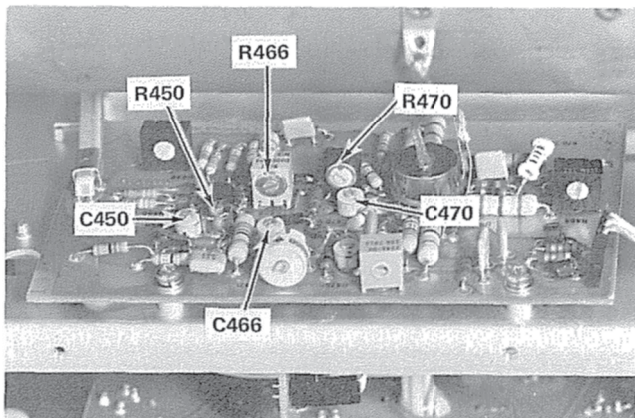


Fig. 5-16. Location of vertical output high-frequency adjustments.

k. Disconnect the test setup and reconnect the Delay Line to the Vertical preamp.

31. Adjust High-Frequency Compensation

a. Connect the fast-rise output of the Square-Wave Generator (Type 106) to the CH 1 input via a 42-inch 50 Ω BNC cable and a 50 Ω BNC termination.

b. Set the CH 1 AC-GND-DC switch to DC and the VOLTS/DIV switch to 5 mV.

c. Adjust the Square-Wave Generator for a 5 division display of a 10 kHz signal.

d. CHECK—CRT display for flat-top waveform within +4%, -4%, or a total of 4% aberrations.

e. ADJUST—R139 and R475 (see Fig. 5-17 & 5-18) for the best flat-top waveform.

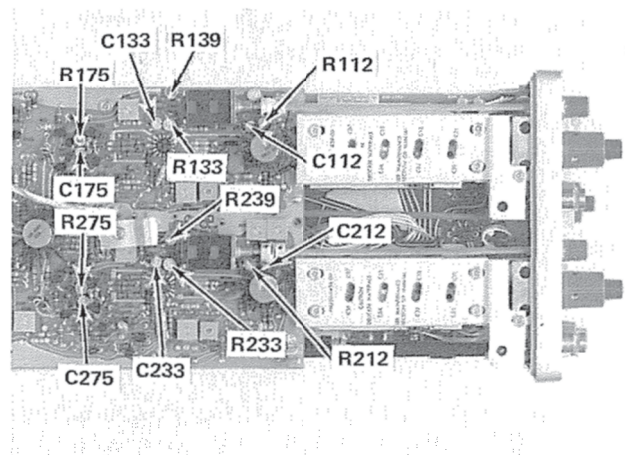


Fig. 5-17. Location of high-frequency compensation adjustments.

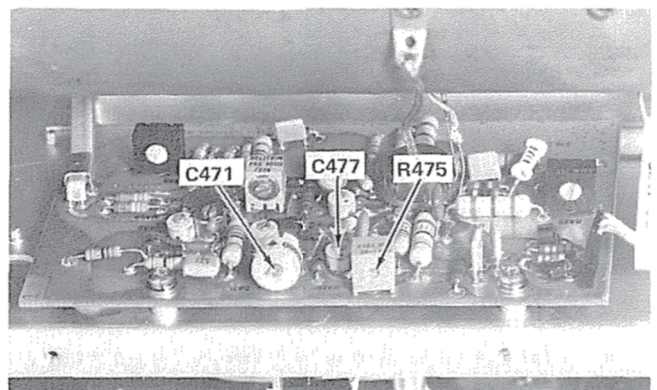


Fig. 5-18. Location of R475, C471, and C477.

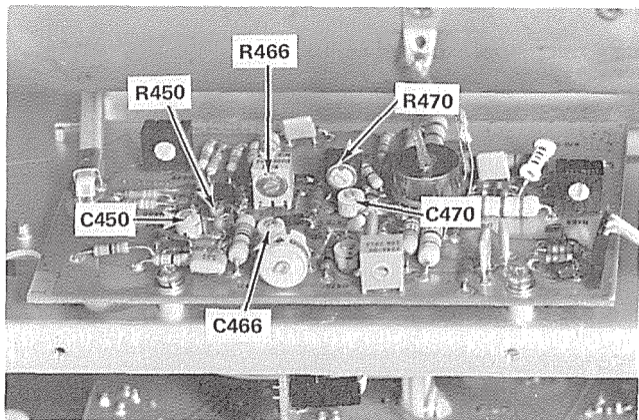


Fig. 5-16. Location of vertical output high-frequency adjustments.

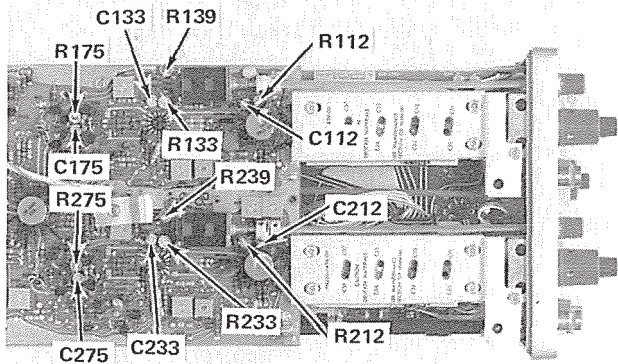


Fig. 5-17. Location of high-frequency compensation adjustments.

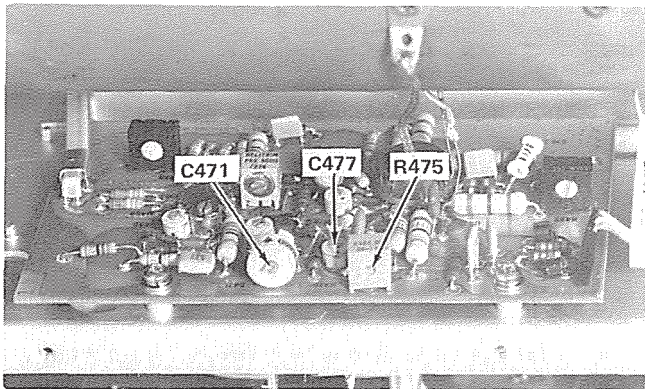


Fig. 5-18. Location of R475, C471, and C477.

Calibration—475

- f. Adjust the Square-Wave Generator for 5 divisions of a 100 kHz signal.
- g. CHECK—Repeat step 31-d.
- h. ADJUST—C471 and C477 (see Fig. 5-18) with a low-capacitance screwdriver, for the best flat-top waveform.
- i. Move the test signal to CH 2 input.
- j. Set the VERT MODE switch to CH 2, the CH 2 AC-GND-DC switch to DC, and the CH 2 VOLTS/DIV switch to 5 mV.
- k. Adjust the Square-Wave Generator for a 5 division display of a 10 kHz signal.
- l. CHECK—Repeat step 31-d.
- m. ADJUST—R239, R475, C471, and C477 (see Fig. 5-17 & 5-18), for the best flat-top waveform.
- n. CAL AID—Compromise the adjustment of R475, C471, and C477 for the best response for both CH 1 and CH 2.
- o. Disconnect the test setup from the Square-Wave Generator to the CH 2 input.
- p. Connect the output of the Fast-Rise High-Amplitude Pulse Generator (Type 109) to the CH 1 input via a 50 Ω 5 ns GR cable, (2) X10 GR attenuators, X5 GR attenuator, a 50 Ω GR termination, and a GR-to-BNC adapter.
- q. Set the Pulse Generator polarity to + and the voltage range to 50 V.
- r. Adjust the Pulse Generator for five divisions of deflection.
- s. CHECK—Repeat step 31-d.
- t. ADJUST—C175, R175, C133, R133, C112, and R112 (see Fig. 5-17), with a low-capacitance screwdriver, for the best flat-top waveform.
- u. CAL AID—C175 and R175 affect aberrations 10 ns from the leading edge; C133 and R133 affect aberrations 2 ns from the leading edge; C112 and R112 affect the front corner aberrations.
- v. Move the test signal to the CH 2 input.
- w. Set the VERT MODE switch to CH 2 and adjust the Pulse Generator for five divisions of deflection.
- x. CHECK—Repeat step 31-d.
- y. ADJUST—C275, R275, C233, R233, C212, and R212 (see Fig. 5-17), with a low-capacitance screwdriver, for the best flat-top waveform.
- z. CAL AID—C275 and R275 affect aberrations 10 ns from the leading edge; C233 and R233 affect aberrations 2 ns from the leading edge; C212 and R212 affect the front corner aberrations.
- aa. Disconnect the test setup.

32. Adjust CH 2 VOLTS/DIV Compensation

- a. Set the VERT MODE switch to CH 2, both AC-GND-DC switches to DC, both VOLTS/DIV switches to 5 mV, and the A TIME/DIV switch to 0.2 ms.
- b. Connect the high-amplitude output of the Square-Wave Generator (Type 106) to the CH 2 input via a GR-to-BNC adapter, 42-inch 50 Ω BNC cable, X10 BNC attenuator, 50 Ω BNC termination, and a 20 pF normalizer.
- c. Adjust the Square-Wave Generator for a five division display of a 1 kHz signal. Add or remove attenuators as necessary to maintain a five division display throughout this step.
- d. CHECK—CRT display for flat-top waveform with no more than 2% overshoot or roll-off on the leading edge.
- e. ADJUST—C10 (see Fig. 5-19) with a low-capacitance screwdriver for best flat-top waveform.
- f. Turn the CH 2 VOLTS/DIV switch to 2 mV.
- g. CHECK—Repeat step 32-d.

- h. Turn the CH 2 VOLTS/DIV switch to 10 mV.
- i. CHECK—Repeat step 32-d.
- j. ADJUST—Channel 2's C36 and C37 (see Fig. 5-19) with a low-capacitance screwdriver, for best corner and flat-top waveform.
- k. CAL AID—Remove the 20 pF normalizer when adjusting or checking the corner response.
- l. INTERACTION—Between Channel 2's C36 and C37. Re-adjust both for optimum response.
- m. Turn the CH 2 VOLTS/DIV switch to 20 mV.
- n. CHECK—Repeat step 32-d.
- o. ADJUST—Channel 2's C34 and C35 (see Fig. 5-19), with a low-capacitance screwdriver, for best corner and flat-top waveform.
- p. INTERACTION—Between Channel 2's C34 and C35. Re-adjust both for optimum response.
- q. Turn the CH 2 VOLTS/DIV switch to 50 mV.
- r. CHECK—Repeat step 32-d.
- s. ADJUST—Channel 2's C32 and C33 (see Fig. 5-19) with a low-capacitance screwdriver, for best corner and flat-top waveform.

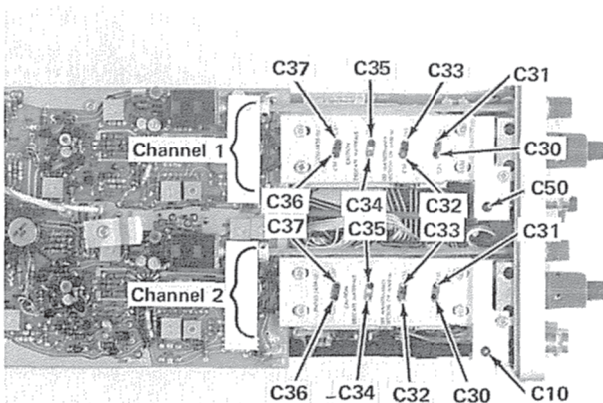


Fig. 5-19. Location of VOLTS/DIV Compensation adjustments.

- t. INTERACTION—Between Channel 2's C32 and C33. Re-adjust both for optimum response.
- u. Turn the CH 2 VOLTS/DIV switch to 0.1 V.
- v. CHECK—Repeat step 32-d.
- w. Turn the CH 2 VOLTS/DIV switch to 0.2 V.
- x. CHECK—Repeat step 32-d.
- y. Turn the CH 2 VOLTS/DIV switch to 0.5 V.
- z. CHECK—Repeat step 32-d.
- aa. ADJUST—Channel 2's C30 and C31 (see Fig. 5-19) with a low-capacitance screwdriver, for best corner and flat-top waveform.
- ab. INTERACTION—Between Channel 2's C30 and C31. Re-adjust both for optimum response.
- ac. Repeat step 32-z for 1 V, 2 V, and 5 V positions of the CH 2 VOLTS/DIV switch.

33. Adjust CH 1 VOLTS/DIV Compensation

- a. Set the VERT MODE switch to CH 1 and move the test signal to the CH 1 input.
- b. Adjust the Square-Wave Generator (Type 106) for a five division display of a 1 kHz signal. Add or remove attenuators as necessary to maintain a five division display.
- c. CHECK—CRT display for flat-top waveform with no more than 2% overshoot or roll-off on the leading edge.
- d. ADJUST—C50 (see Fig. 5-19) with a low-capacitance screwdriver for best flat-top waveform.
- e. Turn the CH 1 VOLTS/DIV switch to 2 mV.
- f. CHECK—Repeat step 33-d.
- g. Turn the CH 1 VOLTS/DIV switch to 10 mV.

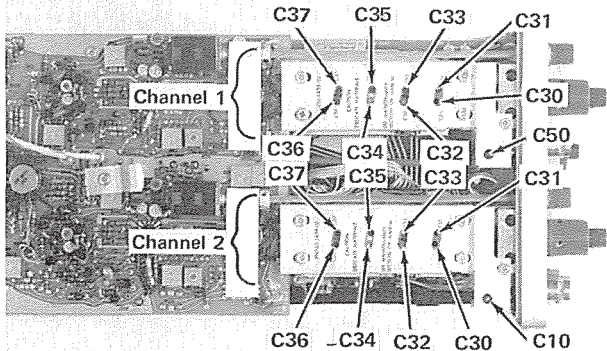


Fig. 5-19. Location of VOLTS/DIV Compensation adjustments.

Calibration—475

- h. CHECK—Repeat step 33-d.
- i. ADJUST—Channel 1's C36 and C37 (see Fig. 5-19) with a low-capacitance screwdriver, for best corner and flat-top waveform.
- j. CAL AID—Remove the 20 pF normalizer when adjusting or checking the corner response.
- k. INTERACTION—Between Channel 1's C36 and C37. Re-adjust both for optimum response.
- l. Turn the CH 1 VOLTS/DIV switch to 20 mV.
- m. CHECK—Repeat step 33-d.
- n. ADJUST—Channel 1's C34 and C35 (see Fig. 5-19) with a low-capacitance screwdriver, for best corner and flat-top waveform.
- o. INTERACTION—Between Channel 1's C34 and C35. Re-adjust both for optimum response.
- p. Turn the CH 2 VOLTS/DIV switch to 50 mV.
- q. CHECK—Repeat step 33-d.
- r. ADJUST—Channel 1's C32 and C33 (see Fig. 5-19) with a low-capacitance screwdriver, for best corner and flat-top waveform.
- s. INTERACTION—Between Channel 1's C32 and C33. Re-adjust both for optimum response.
- t. Turn the CH 1 VOLTS/DIV switch to 0.1 V.
- u. CHECK—Repeat step 33-d.
- v. Turn the CH 1 VOLTS/DIV switch to 0.2 V.
- w. CHECK—Repeat step 33-d.
- x. Turn the CH 1 VOLTS/DIV switch to 0.5 V.
- y. CHECK—Repeat step 33-d.
- z. ADJUST—Channel 1's C30 and C31 (see Fig. 5-19) with a low-capacitance screwdriver, for best corner and flat-top waveform.
- aa. INTERACTION—Between Channel 1's C30 and C31. Re-adjust both for optimum response.
- ab. Repeat step 33-d for 1 V, 2 V, and 5 V positions of the CH 1 VOLTS/DIV switch.
- ac. Disconnect the test setup.

34. Check Vertical Amplifier Bandwidth

- a. Connect the output of the High-Frequency Constant-Amplitude Signal Generator (067-0532-01) to the CH 1 input via a GR-to-BNC adapter, X10 BNC attenuator, and a 50 Ω BNC termination.
- b. Set the TRIG MODE switch to AUTO, the A TIME/DIV switch to 0.2 ms, and both VOLTS/DIV switches to 5 mV.
- c. Adjust the High-Frequency signal generator output amplitude for a five division display of a 3 megahertz reference signal.
- d. Without changing the output amplitude, increase the output frequency of the High-Frequency signal generator until the display is reduced to 3.5 divisions.
- e. CHECK—Output frequency of the High-Frequency signal generator must be at least 200 megahertz.
- f. Move the test signal to the CH 2 input and set the VERT MODE switch to CH 2.
- g. Repeat the bandwidth check procedure, step 34-c through 34-e.

- h. Disconnect the test setup.

35. Check Cascaded Bandwidth

- a. Set both AC-GND-DC switches to DC, both VOLTS/DIV switches to 5 mV, the A TIME/DIV switch to 1 ms, and the VERT MODE switch to CH 1.

b. Connect the CH 2 VERT SIGNAL OUT (on the rear panel) to the CH 1 input via a 42-inch 50 Ω BNC cable and a 50 Ω BNC termination.

c. Connect the output of the Medium-Frequency Constant-Amplitude Signal Generator (Type 191) to the CH 2 input via a GR-to-BNC adapter, 42-inch 50 Ω BNC cable, X10 BNC attenuator, and a 50 Ω BNC termination.

d. Adjust the Medium-Frequency signal generator for a five division display of a 50 kHz signal.

e. Without changing the output amplitude of the Medium-Frequency signal generator, increase the output frequency until the display is reduced to 3.5 divisions.

f. CHECK—Output frequency of the Medium-Frequency signal generator must be at least 50 megahertz.

g. Disconnect the test setup from the CH 2 VERT SIGNAL OUT to the CH 1 input connector.

36. Check Vertical Channel Isolation

a. Set the VERT MODE switch to CH 2, the CH 2 VOLTS/DIV switch to 0.2 V, and the CH 1 AC-GND-DC switch to GND.

b. Connect the output of the Medium-Frequency Constant-Amplitude Signal Generator (Type 191) to the CH 1 & 2 inputs via a GR-to-BNC adapter, 42-inch 50 Ω BNC cable, X10 BNC attenuator, 50 Ω BNC termination, and a dual input coupler.

c. Adjust the Medium-Frequency signal generator for a 4 division display of a 50 MHz signal.

d. Set both VOLTS/DIV switches to 20 mV and the VERT MODE switch to CH 1.

e. CHECK—CRT display for no more than 0.2 division of deflection.

f. Set the CH 2 AC-GND-DC switch to GND, the CH 1 AC-GND-DC switch to DC, and the CH 1 VOLTS/DIV switch to 0.2 V.

g. Adjust the Medium-Frequency signal generator for a 4 division display of a 50 MHz signal.

h. Set the VERT MODE switch to CH 2.

i. CHECK—CRT display for no more than 0.2 division of deflection.

j. Disconnect the test setup.

37. Check Bandwidth Limit Operation

a. Pull the 20 MHz BW/TRIG VIEW button to BW and set the CH 1 AC-GND-DC switch to DC.

b. Connect the Medium-Frequency Constant-Amplitude Signal Generator (Type 191) to the CH 1 input via a 42-inch 50 Ω BNC cable and a 50 Ω BNC termination.

c. Adjust the Medium-Frequency signal generator for a six division display of a 50 kilohertz signal.

d. Increase the output frequency of the signal generator until the display is reduced to 4.2 divisions.

e. CHECK—Output frequency of the signal generator is between 15 and 25 megahertz.

f. Disconnect the test setup.

TRIGGER SYSTEM CALIBRATION

| Equipment Required | |
|--|--|
| 1. Standard Amplitude Calibrator (067-0502-01). | 8. GR-to-BNC Female Adapter. |
| 2. High-Frequency Constant-Amplitude Signal Generator (067-0532-01). | 9. 42-inch 50 Ω BNC Cable. |
| 3. Medium-Frequency Constant-Amplitude Signal Generator (Type 191). | 10. 18-inch 50 Ω BNC Cable (two). |
| 4. Low-Frequency Sine-Wave Generator (General Radio 1310-A). | 11. X10 BNC Attenuator |
| 5. Time-Mark Generator (Type 2901). | 12. X2 BNC Attenuator |
| 6. 50 Ω Signal Pickoff Unit (Type CT-3). | 13. BNC-T Connector |
| 7. 50 Ω 5 nanosecond GR Cable. | 14. 50 Ω BNC Termination (two). |
| | 15. Dual Input Coupler (two). |
| | 16. Three-inch Screwdriver. |

Control Settings

Preset instrument controls to the settings given under Preliminary Control Settings except as follows:

| | |
|----------------|-------|
| CH 1 VOLTS/DIV | 10 mV |
| A SOURCE | EXT |
| A COUPLING | AC |
| A LEVEL | 0 |

38. Adjust A Trigger Sensitivity

a. Connect the output of the Medium-Frequency Constant-Amplitude Signal Generator (Type 191) to the A and B External Trigger inputs via a 50 Ω 5 ns GR cable, 50 Ω Signal Pickoff Unit (Type CT-3) thru output, GR-to-BNC adapter, X10 BNC attenuator, 50 Ω BNC termination, and a dual input coupler.

b. Connect the 10% BNC output connector of the Signal Pickoff Unit to the CH 1 and CH 2 inputs via an 18-inch 50 Ω BNC cable, a 50 Ω BNC termination, and a dual input coupler.

c. Adjust the Medium-Frequency signal generator output for a 3 division display of a 350 kHz signal.

d. Turn the CH 1 VOLTS/DIV switch to 0.1 V.

e. CHECK—That a stable display can be obtained by rotating the A LEVEL control.

f. Adjust the Medium-Frequency signal generator to increase the CRT display to 0.35 division.

g. ADJUST—A Trigger Sensitivity adjustment, R565, (see Fig. 5-20) so that a stable display can just be obtained by rotating the A LEVEL control.

39. Adjust B Trigger Sensitivity

a. Set the HORIZ DISPLAY to B DLY'D, the B COUPLING switch to AC, the B SOURCE switch to EXT, and the B SLOPE switch to +.

b. Adjust the Medium-Frequency signal generator for a 0.3 division display.

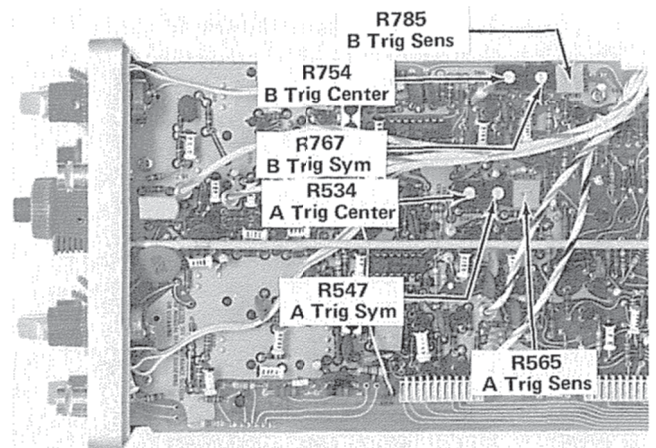


Fig. 5-20. Location of Trigger Sensitivity, Symmetry, and Centering adjustments.

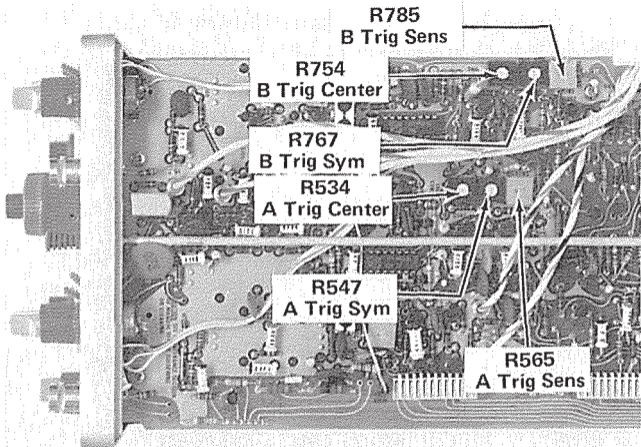


Fig. 5-20. Location of Trigger Sensitivity, Symmetry, and Centering adjustments.

c. CHECK—That a stable display can just be obtained by rotating the B LEVEL control.

d. Adjust the Medium-Frequency signal generator to increase the CRT display to 0.35 division.

e. ADJUST—B Trigger Sensitivity adjustment, R785 (see Fig. 5-20) so that a stable display can just be obtained by rotating the B LEVEL control.

40. Adjust B Trigger Centering and Symmetry

a. Set both TIME/DIV switches to $10 \mu\text{s}$, both LEVEL controls to 0, the CH 1 VOLTS/DIV switch to 50 mV, and the B SOURCE switch to NORM.

b. Adjust the Medium-Frequency signal generator for a 2 division display of a 350 kilohertz signal.

c. Vertically center the display about the center horizontal graticule line.

d. CHECK—CRT display begins at the same vertical point in both slopes of the displayed waveform.

e. ADJUST—B Trigger Symmetry adjustment, R767 (see Fig. 5-20), so that the trace begins at the same point in both slopes of the displayed waveform.

f. ADJUST—B Trigger Centering adjustment, R754 (see Fig. 5-20), for the trigger point of the display to be at the graticule center.

g. CAL AID—A gap equal to 35 mV should exist between the + and – trigger points.

41. Adjust A Trigger Centering and Symmetry

a. Set the HORIZ DISPLAY switch to A and the A SOURCE switch to NORM.

b. CHECK—CRT display begins at the same vertical point in both slopes of the displayed waveform.

c. ADJUST—A Trigger Symmetry adjustment, R547 (see Fig. 5-20), so that the trace begins at the same point in both slopes of the displayed waveform.

d. ADJUST—A Trigger Centering adjustment, R534 (see Fig. 5-20), for the trigger point of the display to be at the graticule center.

e. CAL AID—A gap equal to 35 mV should exist between the + and – trigger points.

42. Adjust Trigger DC Balance

a. Set the A COUPLING switch to DC, the A SOURCE switch to NORM, and the A LEVEL control to 0.

b. Adjust the Medium-Frequency signal generator for a 0.3 division display.

c. Position the display to the vertical center of the graticule viewing area.

d. CHECK—That a stable display can be obtained on both slopes of the displayed waveform.

e. ADJUST—Normal Trigger DC Balance adjustment, R425 (see Fig. 5-21), so that the display begins at the same DC level when switching the A COUPLING switch from DC to AC.

f. Set the A SOURCE switch to CH 1.

g. CHECK—That a stable display can be obtained on both slopes of the displayed waveform.

h. ADJUST—CH 1 Trigger DC Balance adjustment, R403 (see Fig. 5-21), so that the display begins at the same DC level when switching the A COUPLING switch from DC to AC.

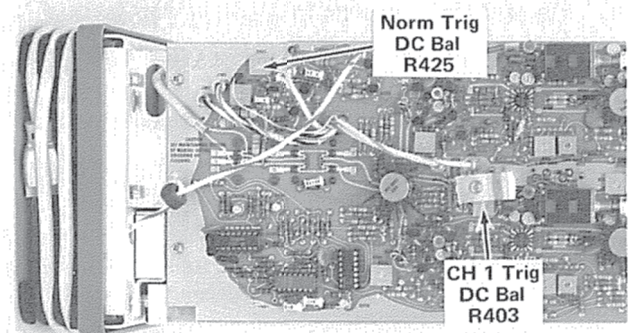


Fig. 5-21. Location of Normal Trigger DC Balance and CH 1 Trigger DC Balance adjustments.

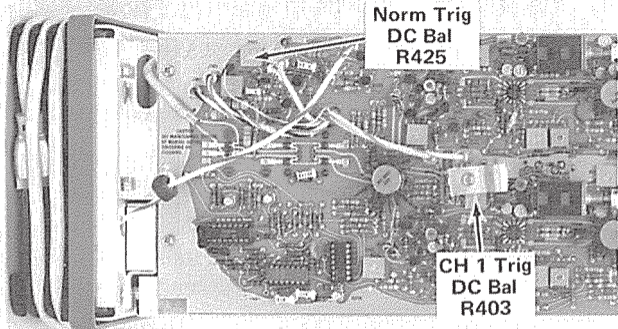


Fig. 5-21. Location of Normal Trigger DC Balance and CH 1 Trigger DC Balance adjustments.

Calibration—475

- i. Set the VERT MODE switch to CH 2.
- j. Adjust the CH 2 VOLTS/DIV switch to obtain a 0.3 division display.
- k. Position the display to the vertical center of the graticule viewing area.
- l. Set the A SOURCE switch to CH 2.
- m. CHECK—That a stable display can be obtained on both slopes of the displayed waveform.

43. Check B Trigger DC Balance

- a. Set the HORIZ DISPLAY switch to B DLY'D, the B LEVEL control to 0, the B SOURCE switch to NORM, and the B COUPLING switch to DC.
- b. CHECK—That a stable display can be obtained on both slopes of the displayed waveform in the NORM and CH 2 positions of the B SOURCE switch.
- c. Set the VERT MODE switch to CH 1.
- d. Adjust the CH 1 VOLTS/DIV switch to obtain a 0.3 division display.
- e. Position the display to the vertical center of the graticule viewing area.
- f. CHECK—That a stable display can be obtained on both slopes of the displayed waveform in the NORM and CH 1 positions of the B SOURCE switch.

44. Check B Internal 40 Megahertz Triggering

- a. Set the DELAY TIME POSITION dial fully counter-clockwise, both TIME/DIV switches to $0.5\ \mu\text{s}$, both VOLTS/DIV switches to 10 mV, and both SOURCE switches to NORM.
- b. Adjust the Medium-Frequency Constant-Amplitude Signal Generator (Type 191) to maintain a 0.3 division display of a 40 megahertz signal throughout this step.
- c. CHECK—A stable display can be obtained on both slopes of the displayed waveform in the AC, LF REJ, and

DC positions of the B COUPLING switch by adjusting the B LEVEL control.

- d. Set the B SOURCE switch to CH 1.
- e. CHECK—Repeat step 44-c.
- f. Set the VERT MODE switch to CH 2.
- g. CHECK—That a stable display cannot be obtained with the B SOURCE switch set to CH 1.
- h. Set the B SOURCE switch to CH 2.
- i. CHECK—A stable display can be obtained on both slopes of the displayed waveform in the AC, LF REJ, and DC positions of the B COUPLING switch by adjusting the B LEVEL control.
- j. Set the B SOURCE switch to NORM.
- k. CHECK—Repeat step 44-i.

45. Check A Internal 40 Megahertz Triggering

- a. Set the HORIZ DISPLAY switch to A.
- b. Adjust the Medium-Frequency signal generator to maintain a 0.3 division display of a 40 megahertz signal throughout this step.
- c. CHECK—A stable display can be obtained on both slopes of the displayed waveform in the AC, LF REJ, and DC positions of the A COUPLING switch by adjusting the A LEVEL control.
- d. Set the A SOURCE switch to CH 2.
- e. CHECK—Repeat step 45-c.
- f. Set the VERT MODE switch to CH 1.
- g. CHECK—That a stable display cannot be obtained with the A SOURCE switch set to CH 2.

h. Set the A SOURCE switch to CH 1.

i. CHECK—A stable display can be obtained on both slopes of the displayed waveform in the AC, LF REJ, and DC positions of the A COUPLING switch by adjusting the A LEVEL control.

j. Set the A SOURCE switch to NORM.

k. CHECK—Repeat step 45-i.

46. Check A External 40 Megahertz Triggering

a. Set the HORIZ DISPLAY switch to A, the A SOURCE switch to EXT, the B SOURCE switch to NORM, and the CH 1 VOLTS/DIV switch to 20 mV.

b. Adjust the Medium-Frequency signal generator for a five division display of a 40 megahertz signal.

c. Add a X2 BNC attenuator to the External Trigger signal test setup between the X10 BNC attenuator and the 50 Ω BNC termination.

d. CHECK—A stable display can be obtained, by adjusting the A LEVEL control, on both slopes of the displayed waveform in the AC and DC positions of the A COUPLING switch.

e. Remove the X2 BNC attenuator from the External Trigger signal test setup.

f. CHECK—A stable display can be obtained, by adjusting the A LEVEL control, on both slopes of the displayed waveform in the LF REJ position of the A COUPLING switch.

g. Set the A SOURCE switch to EXT \div 10.

h. Remove the X10 BNC attenuator from the test setup.

i. CHECK—Repeat step 46-f.

j. Replace the X2 BNC attenuator to the test setup.

k. CHECK—Repeat step 46-d.

l. Replace the X10 BNC attenuator to the test setup.

47. Check B External 40 Megahertz Triggering

a. Set the HORIZ DISPLAY switch to B DLY'D, the B SOURCE switch to EXT, and the A SOURCE switch to NORM.

b. Adjust the Medium-Frequency signal generator for a five division display.

c. CHECK—A stable display can be obtained, by adjusting the LEVEL controls, on both slopes of the displayed waveform in the AC and DC positions of the B COUPLING switch.

d. Remove the X2 BNC attenuator from the test setup.

e. CHECK—A stable display can be obtained, by adjusting the LEVEL controls, on both slopes of the displayed waveform in the LF REJ position of the B COUPLING switch.

f. Disconnect the test setup.

48. Check External 200 Megahertz Triggering

a. Set the TIME/DIV switch to 10 μ s, the TRIG MODE switch to AUTO, the X10 MAG button in, both VOLTS/DIV switches to 1 V, the VERT MODE switch to CH 1, and the A SOURCE switch to EXT.

b. Connect the High-Frequency Constant-Amplitude Signal Generator (067-0532-01) to the A and B External Trigger inputs via a 50 Ω Signal Pickoff Unit (Type CT-3), GR-to-BNC adapter, X10 BNC attenuator, X2 BNC attenuator, 50 Ω BNC termination, and a dual-input coupler.

c. Connect the 10% BNC output connector of the Signal Pickoff Unit to the CH 1 and CH 2 inputs via an 18-inch 50 Ω BNC cable, a 50 Ω BNC termination, and a dual input coupler.

d. Adjust the High-Frequency signal generator for a five division display of a 3 megahertz signal.

e. Set the TIME/DIV switch to 0.1 μ s.

Calibration—475

f. Adjust the High-Frequency signal generator for a 200 megahertz output frequency.

g. CHECK—That a stable display, with no more than 0.2 division of jitter, can be obtained on both slopes of the displayed waveform, by adjusting the A LEVEL control, in the AC and DC positions of the A COUPLING switch.

h. Remove the X2 BNC attenuator from the test setup.

i. CHECK—That a stable display, with no more than 0.2 division of jitter, can be obtained on both slopes of the displayed waveform, by adjusting the A LEVEL control, in the LF REJ position of the A COUPLING switch.

j. Remove the X10 BNC attenuator and replace the X2 BNC attenuator to the test setup.

k. Set the A SOURCE switch to EXT \div 10.

l. CHECK—Repeat step 48-g.

m. Replace the X10 BNC attenuator to the test setup.

n. Set the HORIZ DISPLAY switch to B DLY'D, the B SOURCE switch to EXT, and the A SOURCE switch to NORM.

o. CHECK—That a stable display, with no more than 0.2 division of jitter, can be obtained on both slopes of the displayed waveform, by adjusting both LEVEL controls, in the AC and DC positions of the B COUPLING switch.

p. Remove the X2 BNC attenuator from the test setup.

q. CHECK—That a stable display, with no more than 0.2 division of jitter, can be obtained on the slopes of the displayed waveform, by adjusting both LEVEL controls, in the LF REJ position of the B COUPLING switch.

49. Check B Internal 200 Megahertz Triggering

a. Set the B SOURCE switch to NORM and both VOLTS/DIV switches to 10 mV.

b. Adjust the High-Frequency Constant-Amplitude Signal Generator (067-0532-01) for a 1.5 division display of a 200 megahertz signal.

c. CHECK—That a stable display, with no more than 0.2 division of jitter, can be obtained on both slopes of the displayed waveform, by adjusting both LEVEL controls, in the AC, LF REJ, and DC positions of the B COUPLING switch.

d. Set the B SOURCE switch to CH 1.

e. CHECK—Repeat step 49-c.

f. Set the B SOURCE switch to CH 2.

g. CHECK—That a stable display cannot be obtained in any position of the B COUPLING switch.

h. Set the VERT MODE switch to CH 2.

i. CHECK—Repeat step 49-c.

j. Set the B SOURCE switch to NORM.

k. CHECK—Repeat step 49-c.

l. Set the B SOURCE switch to CH 1.

m. CHECK—Repeat step 49-g.

50. Check A Internal 200 Megahertz Triggering

a. Set the HORIZ DISPLAY switch to A.

b. CHECK—That a stable display, with no more than 0.2 division of jitter, can be obtained on both slopes of the displayed waveform, by adjusting the A LEVEL control, in the AC, LF REJ, and DC positions of the A COUPLING switch.

c. Set the A SOURCE switch to CH 2.

d. CHECK—Repeat step 50-b.

e. Set the A SOURCE switch to CH 1.

f. CHECK—That a stable display cannot be obtained in any position of the A COUPLING switch.

- g. Set the VERT MODE switch to CH 1.
- h. CHECK—Repeat step 50-b.
- i. Set the A SOURCE switch to NORM.
- j. CHECK—Repeat step 50-b.
- k. Set the A SOURCE switch to CH 2.
- l. CHECK—Repeat step 50-f.
- m. Disconnect the test setup.
- i. Set the A SOURCE switch to EXT.
- j. CHECK—That a stable display cannot be obtained in the HF REJ position of the A COUPLING switch.
- k. Reduce the Medium-Frequency signal generator output frequency to 50 kilohertz.
- l. CHECK—That a stable display can be obtained on both slopes of the displayed waveform, in all positions of the A COUPLING switch, by adjusting the A LEVEL control.
- m. Move the external Trigger signal to the B External Trigger input.

51. Check HF REJ Triggering

- a. Set the HORIZ DISPLAY switch to A, the TIME/DIV switches to $2\ \mu\text{s}$, the TRIG MODE switch to AUTO, both COUPLING switches to HF REJ, and both SOURCE switches to NORM.
- b. Connect the output of the Medium-Frequency Constant-Amplitude Signal Generator (Type 191) to the CH 1 input via a $50\ \Omega$ 5 ns GR cable, a $50\ \Omega$ Signal Pickoff Unit (Type CT-3), a GR-to-BNC adapter, and an 18-inch $50\ \Omega$ BNC cable.
- c. Connect the 10% output of the Signal Pickoff Unit to the A External Trigger input via an 18-inch $50\ \Omega$ BNC cable and a $50\ \Omega$ BNC termination.
- d. Adjust the Medium-Frequency signal generator for a 0.5 volt, 50 kilohertz, output signal.
- e. Adjust the CH 1 VOLTS/DIV switch for a 0.3 division display.
- f. CHECK—That a stable display can be obtained on both slopes of the displayed waveform in all positions of the A COUPLING switch, by adjusting the A LEVEL control.
- g. Increase the output of the Medium-Frequency signal generator to 1 megahertz.
- h. CHECK—That a stable display cannot be obtained in the HF REJ position of the A COUPLING switch.
- n. Set the HORIZ DISPLAY switch to B DLY'D.
- o. CHECK—That a stable display can be obtained on both slopes of the displayed waveform, in all positions of the B COUPLING switch, by adjusting the LEVEL controls.
- p. Increase the output of the Medium-Frequency signal generator to 1 megahertz.
- q. CHECK—That a stable display cannot be obtained in the HF REJ position of the B COUPLING switch.
- r. Set the B SOURCE switch to EXT.
- s. CHECK—That a stable display cannot be obtained in the HF REJ position of the B COUPLING switch.
- t. Reduce the Medium-Frequency signal generator output frequency to 50 kilohertz.
- u. CHECK—That a stable display can be obtained on both slopes of the displayed waveform, in all positions of the B COUPLING switch, by adjusting the LEVEL controls.
- v. Disconnect the test setup.

52. Check B 60 Hertz and LF REJ Triggering

a. Set the B TIME/DIV switch to 5 ms, the HORIZ DISPLAY switch to B DLY'D, both SOURCE switches to NORM, and both VOLTS/DIV switches to 0.1 V.

b. Connect the Low-Frequency Sine-Wave Generator (General Radio 1310-A) to the CH 1 input via a 42-inch 50 Ω BNC cable, a BNC-T connector, an 18-inch 50 Ω BNC cable, and a 50 Ω BNC termination.

c. Connect the other side of the BNC-T connector to the B External Trigger input via a X10 BNC attenuator and a 50 Ω BNC termination.

d. Adjust the Low-Frequency generator for a 0.3 division display of a 60 hertz signal.

e. CHECK—That a stable display can be obtained on both slopes of the displayed waveform in the AC, HF REJ, and DC positions of the B COUPLING switch, by adjusting the LEVEL controls.

f. CHECK—That a stable display cannot be obtained in the LF REJ position of the B COUPLING switch.

g. Set the B SOURCE switch to CH 1.

h. CHECK—Repeat step 52-e.

i. CHECK—Repeat step 52-f.

j. Set the B SOURCE switch to CH 2.

k. CHECK—That a stable display cannot be obtained in any position of the B COUPLING switch.

l. Move the test signal from the CH 1 input to the CH 2 input.

m. Set the VERT MODE switch to CH 2.

n. Adjust the Low-Frequency generator for a 0.3 division display of a 60 hertz signal.

o. CHECK—Repeat step 52-e.

p. CHECK—Repeat step 52-f.

q. Set the B SOURCE switch to EXT.

r. CHECK—Repeat step 52-e.

s. CHECK—Repeat step 52-f.

53. Check A 60 Hertz and LF REJ Triggering

a. Set the HORIZ DISPLAY switch to A.

b. Move the signal from the B External Trigger input to the A External Trigger input.

c. CHECK—That a stable display can be obtained on both slopes of the displayed waveform, in the AC, HF REJ, and DC positions of the A COUPLING switch, by adjusting the A LEVEL control.

d. CHECK—That a stable display cannot be obtained in the LF REJ position of the A COUPLING switch.

e. Set the A SOURCE switch to CH 2.

f. CHECK—Repeat step 53-c.

g. CHECK—Repeat step 53-d.

h. Set the A SOURCE switch to CH 1.

i. CHECK—That a stable display cannot be obtained in any position of the A COUPLING switch.

j. Move the test signal from the CH 2 input to the CH 1 input.

k. Set the VERT MODE switch to CH 1.

l. Adjust the Low-Frequency generator for a 0.3 division display of a 60 hertz signal.

m. CHECK—Repeat step 53-c.

- n. CHECK—Repeat step 53-d.
- o. Set the A SOURCE switch to EXT.
- p. CHECK—Repeat step 53-c.
- q. CHECK—Repeat step 53-d.
- r. Disconnect the test setup.

54. Check A LEVEL Control External Range

a. Set both SOURCE switches to EXT, the CH 1 VOLTS/DIV switch to 1 V, the A SLOPE switch to +, and the A COUPLING switch to AC.

b. Connect the output of the Low-Frequency Sine-Wave Generator (General Radio 1310-A) to the CH 1 input and the A External Trigger input through a BNC-T connector and two 18-inch 50 Ω BNC cables.

c. Adjust the Low-Frequency generator for a four division display of a 1 kilohertz signal.

d. CHECK—That the display can be triggered at any point along the positive slope of the waveform when rotating the A LEVEL control throughout its range.

e. CHECK—CRT display is not triggered at either extreme of the A LEVEL control.

f. Set the A SLOPE switch to —.

g. CHECK—That the display can be triggered at any point along the negative slope of the displayed waveform when rotating the A LEVEL control throughout its range.

h. CHECK—Repeat step 54-e.

i. Set the CH 1 VOLTS/DIV switch to 10 V and the A SOURCE switch to EXT \div 10.

j. Adjust the Low-Frequency generator for a four division display of a 1 kilohertz signal.

k. CHECK—That the display can be triggered at any point along the negative slope of the displayed waveform, in the AC, HF REJ, and DC positions of the A COUPLING switch, when rotating the A LEVEL control throughout its range.

l. CHECK—Repeat step 54-e.

m. Set the A SLOPE switch to +.

n. CHECK—That the display can be triggered at any point along the positive slope of the displayed waveform, in the AC, HF REJ, and DC positions of the A COUPLING switch, when rotating the A LEVEL control throughout its range.

o. CHECK—Repeat step 54-e.

55. Check B LEVEL Control External Range

a. Set the HORIZ DISPLAY switch to B DLY'D, the A SOURCE switch to NORM, the B SLOPE switch to +, and the CH 1 VOLTS/DIV switch to 1 V.

b. Move the External Trigger signal to the B External Trigger input.

c. Adjust the Low-Frequency generator for a four-division display of a 1 kilohertz signal.

d. CHECK—That the display can be triggered at any point along the positive slope of the displayed waveform when rotating the B LEVEL control throughout its range.

e. CHECK—CRT display is not triggered at either extreme of the B LEVEL control.

f. Set the B SLOPE switch to —.

g. CHECK—That the display can be triggered at any point along the negative slope of the displayed waveform when rotating the B LEVEL control throughout its range.

h. CHECK—Repeat step 55-e.

56. Check Single Sweep Operation

a. Set the HORIZ DISPLAY switch to A and the A COUPLING switch to AC.

Calibration—475

b. Adjust the Low-Frequency Sine-Wave Generator (General Radio 1310-A) for a 50 kilohertz signal output.

c. Adjust the A LEVEL control for a triggered display.

d. Disconnect the test signal from the CH 1 input.

e. Press the SINGL SWP button of the TRIG MODE switch.

f. CHECK—READY light turns on when SINGL SWP button is pressed and remains on until the test signal is re-applied.

g. Reconnect the test signal to the CH 1 input.

h. CHECK—READY light is extinguished.

i. Press the SINGL SWP button.

j. CHECK—That a single-sweep display (one sweep only) is presented.

57. Check Normal Mode Operation

a. Set the A SOURCE switch to NORM and the TRIG MODE switch to AUTO.

b. Adjust the Low-Frequency Sine-Wave Generator (General Radio 1310-A) for a 50 kilohertz signal.

c. Adjust the A LEVEL control for a triggered display.

d. Switch the TRIG MODE switch to NORM.

e. CHECK—For a stable display.

f. Remove the test signal from the CH 1 input.

g. CHECK—For no trace in the absence of an adequate trigger signal.

58. Check LINE Triggering

a. Set the HORIZ DISPLAY switch to A, the TRIG MODE switch to AUTO, the A SOURCE switch to LINE,

the A COUPLING switch to AC, and the A SLOPE switch to +.

b. Push the TRIG VIEW button and hold it in.

c. CHECK—CRT display is triggerable on the positive slope by rotating the A LEVEL control.

d. Release the TRIG VIEW button.

59. Check Automatic Recovery Time

a. Set the A TIME/DIV switch to 50 ms, the A SLOPE switch to +, and the A SOURCE switch to NORM.

b. Connect the Time-Mark Generator (Type 2901) to the CH 1 input via a 42-inch 50 Ω BNC cable and a 50 Ω BNC termination.

c. Select 50 ms time marks from the Time-Mark Generator.

d. CHECK—That a stable display can be obtained by adjusting the A LEVEL control. Time marker must be at the start of the sweep.

e. Disconnect the test setup.

60. Adjust Trigger View Centering

a. Set the CH 1 AC-GND-DC switch to DC, the CH 1 VOLTS/DIV switch to 10 mV, the A COUPLING switch to DC, the A SOURCE switch to EXT, the A SLOPE switch to +, and the A LEVEL control to 0.

b. Push the TRIG VIEW button and hold it in.

c. CHECK—That the trace is within 1 division of the center horizontal graticule line.

d. ADJUST—Trigger View Centering adjustment, R673 (see Fig. 5-22), so that the trace is at the center horizontal line.

e. Release the TRIG VIEW button.

f. Disconnect the test setup.

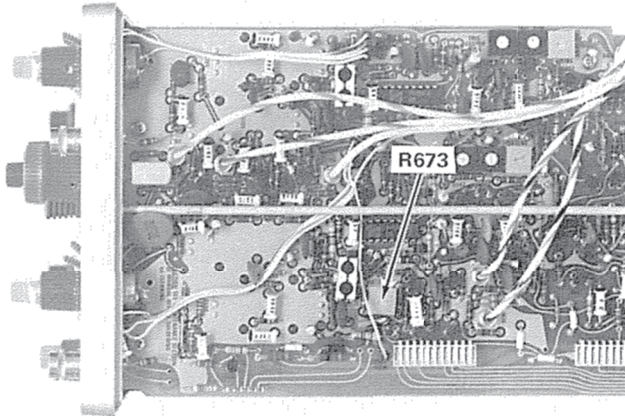


Fig. 5-22. Location of Trigger View Centering adjustment.

61. Check Trigger View Deflection Factor

- a. Connect the output of the Standard Amplitude Calibrator to the A External Trigger input via a 42-inch 50 Ω BNC cable.
- b. Adjust the Standard Amplitude Calibrator for a 200 mV output.
- c. Push the TRIG VIEW button and hold it in.
- d. CHECK—For 3.2 to 4.8 divisions of display.
- e. Release the TRIG VIEW button.
- f. Disconnect the test setup.

HORIZONTAL SYSTEM CALIBRATION

| Equipment Required | |
|--|---------------------------------|
| 1. Standard Amplitude Calibrator (067-0502-01) | 6. P6022 Current Probe |
| 2. Medium-Frequency Constant-Amplitude Signal Generator (Type 191) | 7. 42-inch 50 Ω BNC Cable (two) |
| 3. Time-Mark Generator (Type 2901) | 8. 50 Ω BNC Termination (two) |
| 4. Test Oscilloscope | 9. Dual Input Coupler |
| 5. X10 Probe | 10. Three-inch Screwdriver |
| | 11. Low-Capacitance Screwdriver |

Control Settings

Preset instrument controls to the settings given under Preliminary Control Settings except as follows:

- A TIME/DIV 1 ms
- B TIME/DIV 1 μs
- HORIZ DISPLAY A INTEN
- B SOURCE STARTS AFTER DELAY
- DELAY TIME POSITION 1.00

62. Adjust Delay Start and Delay Stop

- a. Connect 1 ms time marks to the CH 1 input from the Time-Mark Generator (Type 2901) via a 42-inch 50 Ω BNC cable and a 50 Ω BNC termination.
- b. CHECK—Intensified portion of the sweep begins at the second time marker.

c. ADJUST—Delay Start adjustment, R938 (see Fig. 5-23), so the left side of the intensified zone starts on the leading edge of the second time marker.

d. Set the DELAY TIME POSITION dial to 9.00.

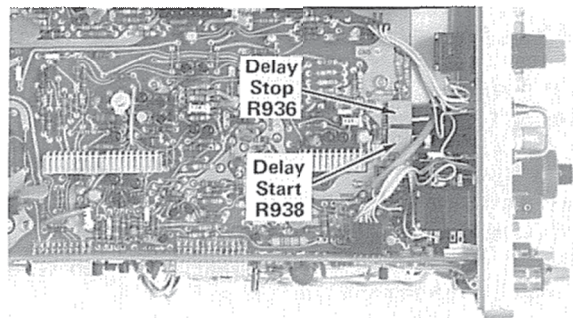


Fig. 5-23. Location of Delay Start and Delay Stop adjustments.

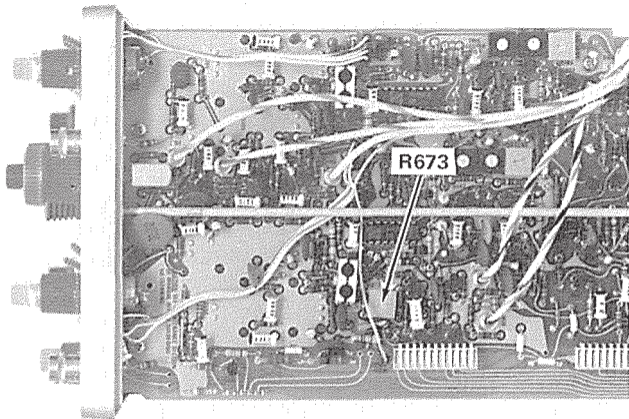
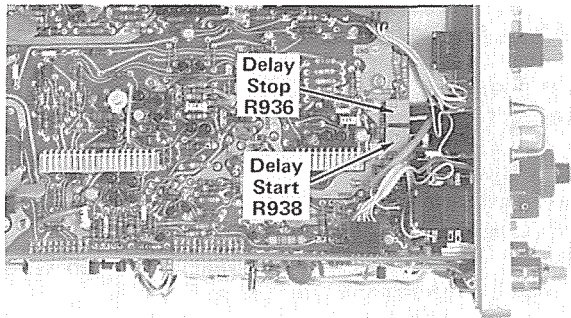


Fig. 5-22. Location of Trigger View Centering adjustment.



<http://mahomah.squmil.com> Fig. 5-23. Location of Delay Start and Delay Stop adjustments.

Calibration—475

e. CHECK—Intensified portion of the sweep begins at the tenth time marker.

f. ADJUST—Delay Stop adjustment, R936 (see Fig. 5-23), so the left side of the intensified zone starts on the leading edge of the tenth time marker.

g. Set the HORIZ DISPLAY switch to B DLY'D.

h. Set the DELAY TIME POSITION dial to 1.00.

i. CHECK—Displayed pulse starts at the beginning of the sweep.

j. ADJUST—Delay Start adjustment, R938, so the displayed pulse starts at the beginning of the sweep.

k. Set the DELAY TIME POSITION dial to 9.00.

l. CHECK—Displayed pulse starts at the beginning of the sweep.

m. ADJUST—Delay Stop adjustment, R936, so the displayed pulse starts at the beginning of the sweep.

n. INTERACTION—Between Delay Start and Delay Stop adjustments. Repeat both for no visible interaction.

63. Check Differential Time Accuracy

a. Set the DELAY TIME POSITION dial to position the tenth time marker to the beginning of the sweep.

b. Note the reading on the DELAY TIME POSITION dial.

c. Adjust the DELAY TIME POSITION dial so the ninth time marker is at the beginning of the sweep.

d. CHECK—DELAY TIME POSITION dial for a reading one division less, within 0.01 division from $+15^{\circ}\text{C}$ to $+35^{\circ}\text{C}$ (one division less, within 0.02 division from -15°C to $+55^{\circ}\text{C}$) than the reading noted in step 63-b.

e. Rotate the DELAY TIME POSITION dial to position each successive time marker to the beginning of the sweep.

f. CHECK—DELAY TIME POSITION dial for a reading of one division less, within 0.01 division from $+15^{\circ}\text{C}$ to $+35^{\circ}\text{C}$ (one division less, within 0.02 division from -15°C to $+55^{\circ}\text{C}$), than the adjacent time marker.

64. Adjust Horizontal Amplifier Gain

a. Set the HORIZ DISPLAY switch to A, both TIME/DIV switches to 1 ms, and the VERT MODE switch to CH 1.

b. Select 1 ms time marks from the Time-Mark Generator.

NOTE

Unless otherwise stated, timing checks are made over the entire 10 divisions.

c. CHECK—CRT display for 1 time marker/division, within 1% from $+20^{\circ}\text{C}$ to $+30^{\circ}\text{C}$; for 1 time marker/division, within 3% from -15°C to $+55^{\circ}\text{C}$.

d. ADJUST—Horizontal Gain adjustment, R1155 (see Fig. 5-24), for 1 time marker/division.

NOTE

Effective range of R1155 is determined by the selected value of R1154. R1154 may be 100 Ω , 124 Ω , or 150 Ω , 1/8 watt, 1% resistor.

e. Select 0.1 ms time marks from the Time-Mark Generator.

f. Push the X10 MAG button.

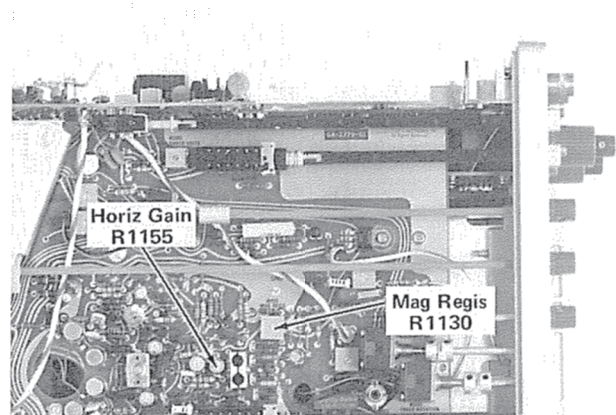


Fig. 5-24. Location of Horizontal Gain and Magnifier Registration adjustments.

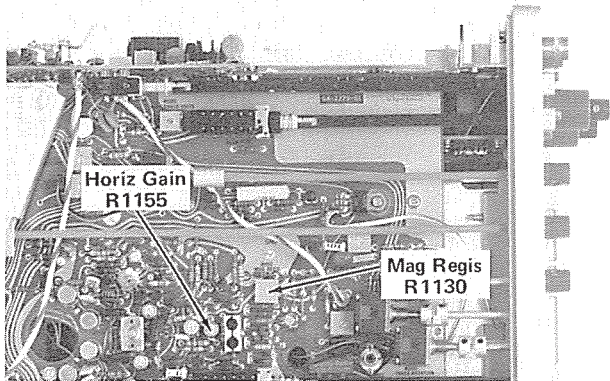


Fig. 5-24. Location of Horizontal Gain and Magnifier Registration adjustments.
<http://www.man.sqhill.com>

g. CHECK—X10 MAG light is on when the X10 MAG button is in.

h. CHECK—CRT display for 1 time marker/division, within 2% from +20°C to +30°C; for 1 time marker/division, within 4% from -15°C to +55°C.

65. Adjust Magnifier Registration

a. Select 5 ms time marks from the Time-Mark Generator.

b. Position the second time marker to the center vertical graticule line.

c. Release the X10 MAG.

d. CHECK—Second time marker is within 0.4 division of the center vertical graticule line.

e. ADJUST—Magnifier Registration adjustment, R1130 (see Fig. 5-24), to position the second time marker to the center vertical graticule line.

f. CAL AID—Repeat the above procedure until no shift occurs between the positions of the X10 MAG switch.

66. Check VAR TIME/DIV Range

a. Set the A TIME/DIV switch to 2 ms and the HORIZ DISPLAY switch to A.

b. Select 5 ms time marks from the Time-Mark Generator.

c. CHECK—At least 1 time marker/division can be obtained by rotating the VAR TIME/DIV control.

d. CHECK—That the UNCAL light comes on when the VAR TIME/DIV control is out of the detent position.

e. Return the VAR TIME/DIV control to the detent position.

67. Check Horizontal POSITION Control Range

a. Set the Horizontal FINE control to midrange and the A TIME/DIV switch to 2 ms.

b. Turn the horizontal POSITION control fully clockwise.

c. CHECK—Start of sweep is to the right of the center vertical graticule line.

d. Turn the horizontal POSITION control fully counterclockwise.

e. CHECK—End of sweep is to the left of the center vertical graticule line.

f. Rotate the horizontal FINE control.

g. CHECK—That the FINE control will position the sweep between one and two divisions.

68. Adjust 10 Microsecond Timing

a. Set the DELAY TIME POSITION dial to 0.00, the B SOURCE switch to STARTS AFTER DELAY, and both TIME/DIV switches to 10 μ s.

b. Select 10 μ s time marks from the Time-Mark Generator.

c. CHECK—CRT display for 1 time marker/division, within 1% from +20°C to +30°C; 1 time marker/division, within 3% from -15°C to +55°C.

d. ADJUST—C1064 (see Fig. 5-25) with a low-capacitance screwdriver, for 1 time marker/division.

e. Set the HORIZ DISPLAY switch to A INTEN, and the B TIME/DIV switch to 0.1 μ s.

f. CHECK—CRT display for 1 time marker/division, within 1% from +20°C to +30°C; 1 time marker/division, within 3% from -15°C to +55°C.

g. ADJUST—C1023 (see Fig. 5-25) with a low-capacitance screwdriver, for 1 time marker/division.

h. Set the HORIZ DISPLAY switch to B DLY'D and the DELAY TIME POSITION dial to 1.00.

i. Adjust the DELAY TIME POSITION dial to position the time marker to the center vertical graticule line.

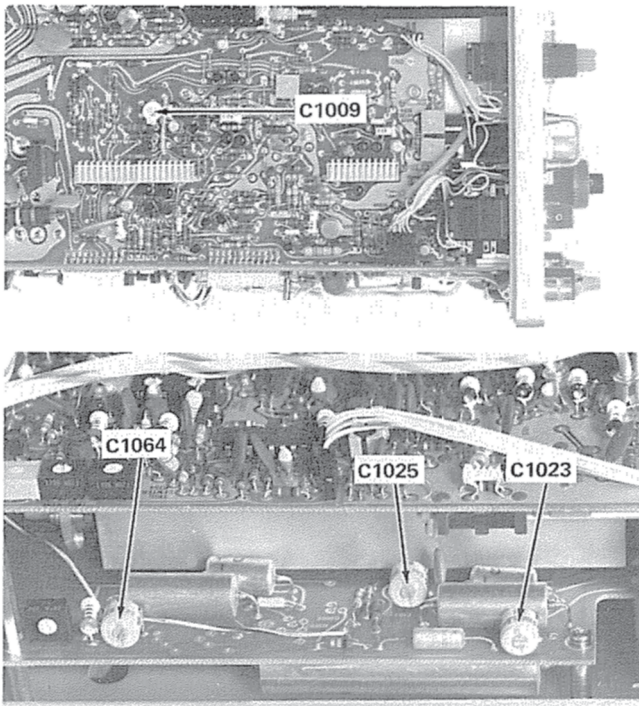


Fig. 5-25. Location of A and B Sweep timing adjustments.

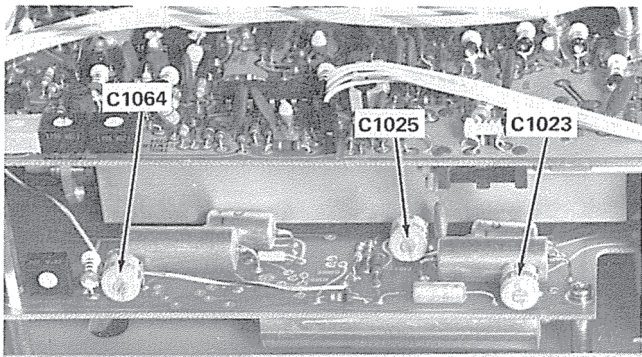
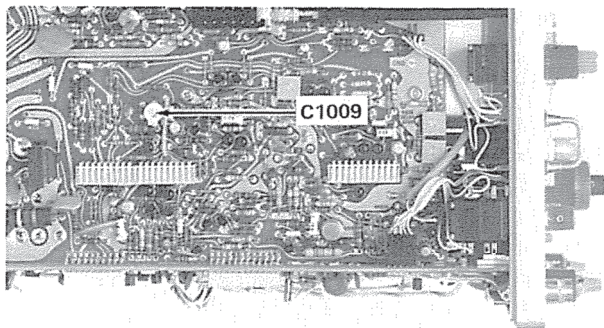
- j. Note the reading on the DELAY TIME POSITION dial for use in step 68-k.
- k. Turn the DELAY TIME POSITION dial 8 divisions higher than the reading in step 68-j.
- l. CHECK—Time marker is at center vertical graticule line.
- m. ADJUST—C1023 to position the time marker to the center vertical graticule line.
- n. CAL AID—Repeat the above procedure for optimum timing response at +1.00 and +8.00 settings of the DELAY TIME POSITION dial.
- c. CHECK—CRT display for 1 time marker/division, within 2% from +20°C to +30°C; 1 time marker/division, within 3% from -15°C to +55°C.
- d. ADJUST—C1025 (see Fig. 5-25) with a low-capacitance screwdriver, for 1 time marker/division.
- e. Set the HORIZ DISPLAY switch to B DLY'D and the B TIME/DIV switch to 0.01 μs.
- f. Adjust the DELAY TIME POSITION dial to position the time marker to the center vertical graticule line.
- g. Note the reading of the DELAY TIME POSITION dial for use in step 69-h.
- h. Turn the DELAY TIME POSITION dial 8 divisions higher than the reading in step 69-g.
- i. CHECK—Time marker is at center vertical graticule line.
- j. ADJUST—C1025 to position the time marker to the center vertical graticule line.
- k. CAL AID—Repeat the above procedure for optimum timing response at +1.00 and +8.00 settings of the DELAY TIME POSITION dial.
- l. Set the HORIZ DISPLAY switch to A and both TIME/DIV switches to 0.1 μs.
- m. CHECK—CRT display for 1 time marker/division, within 1% from +20°C to +30°C; 1 time marker/division, within 3% from -15°C to +55°C.
- n. ADJUST—C1009 (see Fig. 5-25) with a low-capacitance screwdriver for 1 time marker/division.
- o. Disconnect the test setup.

69. Adjust 0.1 Microsecond Timing

- a. Set the DELAY TIME POSITION dial to 1.00, the HORIZ DISPLAY switch to A INTEN, and the B TIME/DIV switch to 0.1 μs.
- b. Select 0.1 μs time marks from the Time-Mark Generator.

70. Adjust Horizontal Output Centering

- a. Set the A TIME/DIV switch to X-Y, the HORIZ DISPLAY switch to A, and the VERT MODE switch to CH 1.



<http://www.localdhw.com> Fig. 5-25. Location of A and B Sweep timing adjustments.

b. Adjust the CH 1 POSITION control to horizontally center the dot.

c. Set the Test Oscilloscope: TIME/DIV switch to 1 ms, VOLTS/DIV switch to 0.5 V, and AC-GND-DC switch to DC.

d. Connect a X10 probe from the Test Oscilloscope to the +50 V test point on the 475 (see Fig. 5-26).

e. Position the trace on the Test Oscilloscope to the center vertical graticule line.

f. Disconnect the probe from the +50 V test point.

g. Alternately check the voltage on the collectors of Q1214 and Q1204 (see Fig. 5-26).

h. CHECK—That the voltage at the collectors of Q1214 and Q1204 is equal.

i. Adjust the 475 CH 1 POSITION control until the voltage at the collector of Q1214 equals that on the collector of Q1204.

j. ADJUST—Horizontal Output Centering adjustment, R1256 (see Fig. 5-26), for +50 V on the collector of Q1214 and Q1204.

k. Disconnect the test setup.

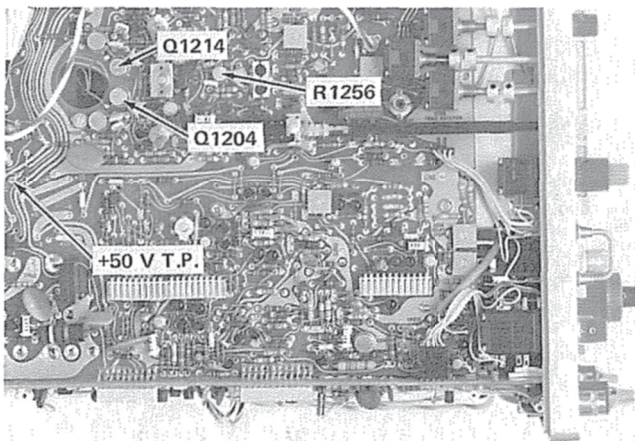


Fig. 5-26. Location of Q1204, Q1214, +50 V TP, and Horizontal Output Centering adjustment.

71. Adjust High-Speed Timing—Visual Method

NOTE

This step is intended only as a “touch up” of the timing adjustments. If the adjustments are greatly misadjusted, or major portions of the circuitry have been replaced, proceed with step 72.

a. Set the A TIME/DIV switch to 0.05 μ s, the X10 MAG button in, the A SOURCE switch to EXT, and the A COUPLING switch to LF REJ.

b. Connect the output of the Time-Mark Generator (Type 2901) to the CH 1 input via a 42-inch 50 Ω BNC cable and a 50 Ω BNC termination.

c. Connect the TRIGGER OUT of the Time-Mark Generator to the A External Trigger input via a 42-inch 50 Ω BNC cable and a 50 Ω BNC termination.

d. Select 5 ns time marks and 0.1 μ s triggers from the Time-Mark Generator.

e. CHECK—CRT display for 1 cycle/division, within 2% from +20°C to +30°C; 1 cycle/division, within 4% from -15°C to +55°C.

f. ADJUST—C1233 and C1253 (see Fig. 5-27), with a low-capacitance screwdriver, in approximately equal amounts to achieve 1 cycle/division.

g. Set the A TIME/DIV switch to 0.02 μ s.

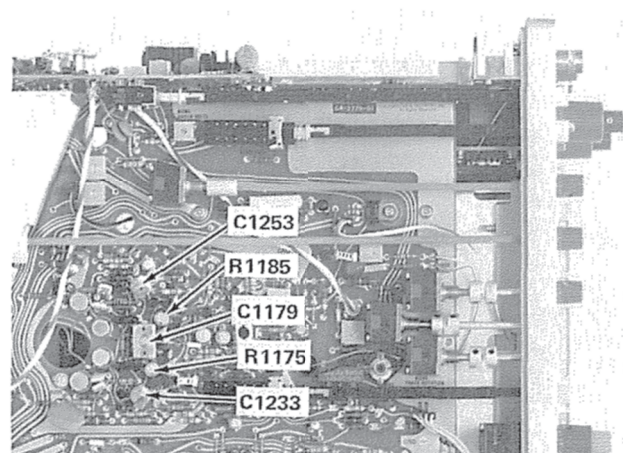


Fig. 5-27. Location of high-speed timing adjustments (except R1075).

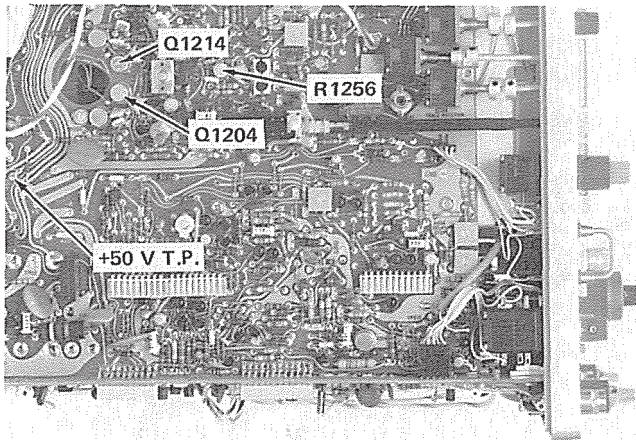


Fig. 5-26. Location of Q1204, Q1214, +50 V TP, and Horizontal Output Centering adjustment.

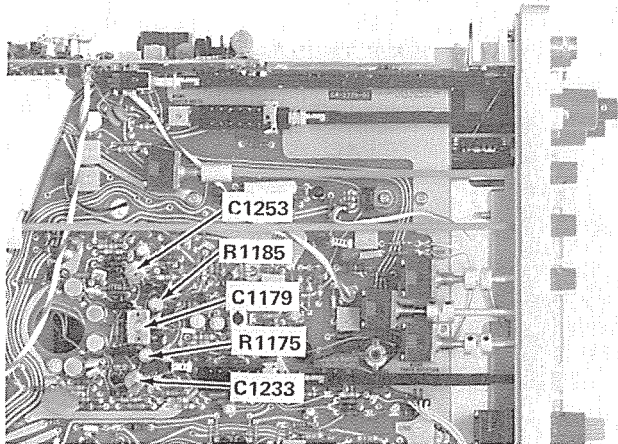


Fig. 5-27. Location of high-speed timing adjustments (except R1075).

Calibration—475

h. Select 2 ns time marks from the Time-Mark Generator.

i. CHECK—CRT display for 1 cycle/division, within 2% from +20°C to +30°C; 1 cycle/division, within 4% from -15°C to +55°C.

j. ADJUST—C1179 (see Fig. 5-27) with a low-capacitance screwdriver, for 1 cycle/division.

k. Set the A TIME/DIV switch to 0.01 μ s.

l. CHECK—CRT display for 1 cycle/2 divisions, within 2% from +20°C to +30°C; 1 cycle/2 divisions, within 4% from -15°C to +55°C.

m. ADJUST—R1075 (see Fig. 5-28) with a low-capacitance screwdriver, for 1 cycle/2 divisions.

n. CAL AID—If the 2 ns timing is long and the 5 ns timing is short, decrease C1179 and increase C1233 or C1253.

NOTE

If timing cannot be adjusted to within 2% accuracy from +20°C to +30°C, or 4% accuracy from -15°C to +55°C, proceed to step 72. If timing is within the given accuracy, proceed with step 73.

72. Adjust High-Speed Timing—Current Probe Method

NOTE

The signal amplitudes given in this step are only approximations and should only be used as guides. It is desirable to obtain as flat and wide a current waveform as possible.

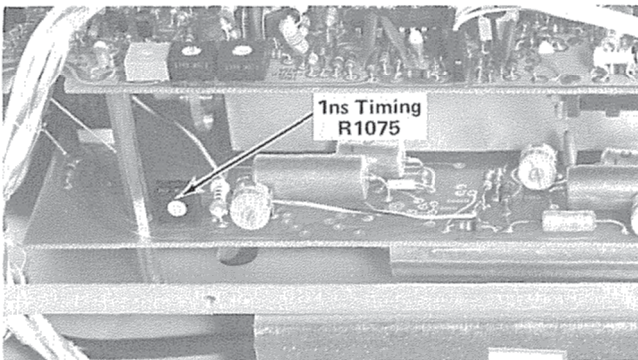


Fig. 5-28. Location of 1 nanosecond timing adjustment.

a. Set the A TIME/DIV switch to 0.05 μ s and push the X10 MAG button in.

b. Select 5 ns time marks and 0.1 μ s triggers from the Time-Mark Generator.

c. Connect a P6022 current probe with passive termination from the Test Oscilloscope.

d. Hook the current probe around the crossed horizontal deflection leads on the 475 (see Fig. 5-29).

e. Horizontally center the trace with the horizontal POSITION control.

f. Set the Test Oscilloscope: VOLTS/DIV switch to 5 mV, TIME/DIV switch to 0.5 μ s, and the X10 MAG switch engaged.

g. CHECK—Test Oscilloscope for current waveform with approximately 16 mA amplitude.

h. ADJUST—(See Fig. 5-27), R1175 to midrange, R1185 to midrange, C1233 and C1253 half-closed, and C1179 one turn from fully clockwise.

i. ADJUST—R1175 and R1185 (see Fig. 5-27) for a symmetrical waveform similar to that in Fig. 5-30.

j. CAL AID—The small ringing is from the Time-Mark Generator. The top should be as flat and wide as possible. Since R1175 and R1185 have a greater effect on the 1 ns and 2 ns ranges, they will be adjusted again later in the step.

k. ADJUST—C1233 and C1253 (see Fig. 5-27) equally for 1 time marker/division.

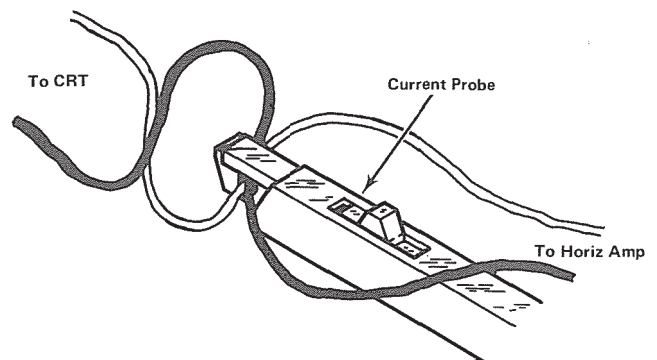


Fig. 5-29. Proper connection of current probe to horizontal deflection leads for high-speed timing calibration.

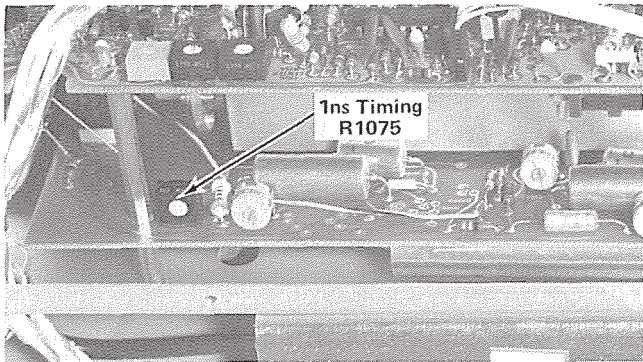


Fig. 5-28. Location of 1 nanosecond timing adjustment.

Calibration—475

h. Select 2 ns time marks from the Time-Mark Generator.

i. CHECK—CRT display for 1 cycle/division, within 2% from +20°C to +30°C; 1 cycle/division, within 4% from -15°C to +55°C.

j. ADJUST—C1179 (see Fig. 5-27) with a low-capacitance screwdriver, for 1 cycle/division.

k. Set the A TIME/DIV switch to 0.01 μ s.

l. CHECK—CRT display for 1 cycle/2 divisions, within 2% from +20°C to +30°C; 1 cycle/2 divisions, within 4% from -15°C to +55°C.

m. ADJUST—R1075 (see Fig. 5-28) with a low-capacitance screwdriver, for 1 cycle/2 divisions.

n. CAL AID—If the 2 ns timing is long and the 5 ns timing is short, decrease C1179 and increase C1233 or C1253.

NOTE

If timing cannot be adjusted to within 2% accuracy from +20°C to +30°C, or 4% accuracy from -15°C to +55°C, proceed to step 72. If timing is within the given accuracy, proceed with step 73.

72. Adjust High-Speed Timing—Current Probe Method

NOTE

The signal amplitudes given in this step are only approximations and should only be used as guides. It is desirable to obtain as flat and wide a current waveform as possible.

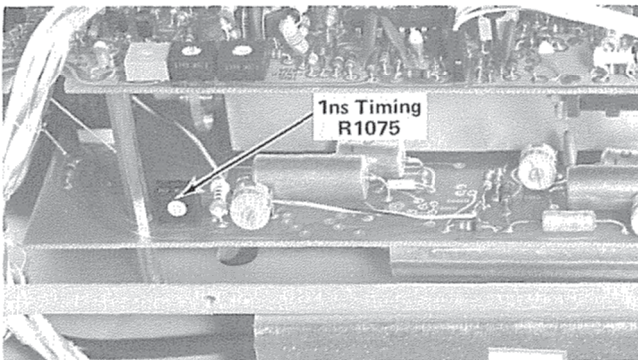


Fig. 5-28. Location of 1 nanosecond timing adjustment.

a. Set the A TIME/DIV switch to 0.05 μ s and push the X10 MAG button in.

b. Select 5 ns time marks and 0.1 μ s triggers from the Time-Mark Generator.

c. Connect a P6022 current probe with passive termination from the Test Oscilloscope.

d. Hook the current probe around the crossed horizontal deflection leads on the 475 (see Fig. 5-29).

e. Horizontally center the trace with the horizontal POSITION control.

f. Set the Test Oscilloscope: VOLTS/DIV switch to 5 mV, TIME/DIV switch to 0.5 μ s, and the X10 MAG switch engaged.

g. CHECK—Test Oscilloscope for current waveform with approximately 16 mA amplitude.

h. ADJUST—(See Fig. 5-27), R1175 to midrange, R1185 to midrange, C1233 and C1253 half-closed, and C1179 one turn from fully clockwise.

i. ADJUST—R1175 and R1185 (see Fig. 5-27) for a symmetrical waveform similar to that in Fig. 5-30.

j. CAL AID—The small ringing is from the Time-Mark Generator. The top should be as flat and wide as possible. Since R1175 and R1185 have a greater effect on the 1 ns and 2 ns ranges, they will be adjusted again later in the step.

k. ADJUST—C1233 and C1253 (see Fig. 5-27) equally for 1 time marker/division.

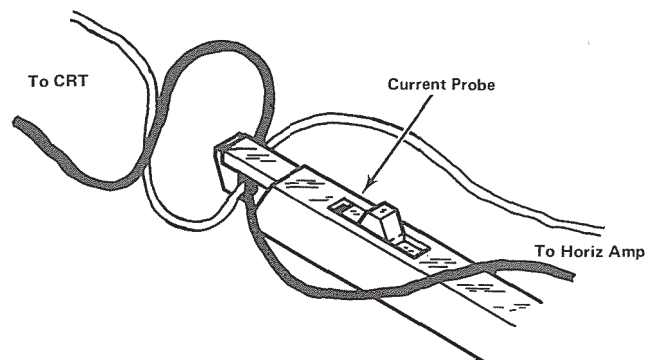
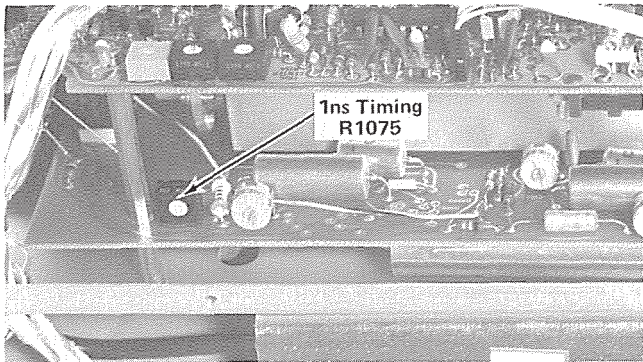


Fig. 5-29. Proper connection of current probe to horizontal deflection leads for high-speed timing calibration.



NOTE

C1253 may need to be closed more than C1233 to make the top of the waveform flatter on the 2 ns range.

l. Set the A TIME/DIV switch to 0.02 μ s and select 2 ns time marks from the Time-Mark Generator.

m. Set the Test Oscilloscope TIME/DIV switch to 0.2 μ s, and the VOLTS/DIV switch to 10 mV.

n. ADJUST—C1179 (see Fig. 5-27) for 1 time marker/division.

o. CHECK—Test Oscilloscope for a current waveform approximately 40 mA in amplitude.

p. Set the 475 A TIME/DIV switch to 0.01 μ s.

q. Set the Test Oscilloscope TIME/DIV switch to 0.1 μ s, and the VOLTS/DIV switch to 20 mV.

r. ADJUST—R1075 for 1 time marker/2 divisions.

s. CHECK—Test Oscilloscope for a current waveform approximately 80 mA in amplitude.

t. ADJUST—R1175 and R1185 for a symmetrical waveform with a flat top.

NOTE

Q1234 affects the flatness of the top of the waveform and should be changed if it is difficult to obtain a flat-top waveform.

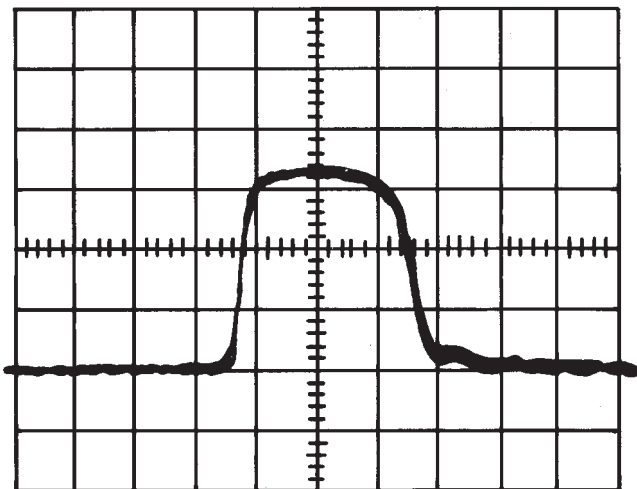


Fig. 5-30. Typical CRT display with high-speed timing adjustments preset.

v. CHECK—Timing error at 2 ns and 5 ns ranges.

NOTE

If 2 ns timing is long and 5 ns timing is short, decrease C1179 and increase C1233 and/or C1253.

w. INTERACTION—R1175 and R1185 should be readjusted for best symmetry and flatness on the 1 ns and 2 ns ranges if C1179, C1233, C1253, or R1075 is re-adjusted.

x. Remove the current probe, being sure not to spread the CRT horizontal deflection leads.

73. Check TIME/DIV Accuracy

a. CHECK—Using the A TIME/DIV switch and the Time-Mark Generator settings given in Table 5-7, check that A SWEEP timing is within the given tolerance.

TABLE 5-7

Timing Accuracy

| A TIME/ DIV Switch Setting | Time- Mark Generator Output | CRT Display (markers/ division) | Accuracy | |
|-------------------------------------|--------------------------------------|--|---------------------|---------------------|
| | | | +20° C to +30° C | -15° C to +55° C |
| 0.01 μ s | 10 ns | 1 | 1% | 3% |
| 0.02 μ s | 10 ns | 2 | 1% | 3% |
| 0.05 μ s | 50 ns | 1 | 1% | 3% |
| 0.1 μ s | 0.1 μ s | 1 | 1% | 3% |
| 0.2 μ s | 0.1 μ s | 2 | 1% | 3% |
| 0.5 μ s | 0.5 μ s | 1 | 1% | 3% |
| 1 μ s | 1 μ s | 1 | 1% | 3% |
| 2 μ s | 1 μ s | 2 | 1% | 3% |
| 5 μ s | 5 μ s | 1 | 1% | 3% |
| 10 μ s | 10 μ s | 1 | 1% | 3% |
| 20 μ s | 10 μ s | 2 | 1% | 3% |
| 50 μ s | 50 μ s | 1 | 1% | 3% |
| 0.1 ms | 0.1 ms | 1 | 1% | 3% |
| 0.2 ms | 0.1 ms | 2 | 1% | 3% |
| 0.5 ms | 0.5 ms | 1 | 1% | 3% |
| 1 ms | 1 ms | 1 | 1% | 3% |
| 2 ms | 1 ms | 2 | 1% | 3% |
| 5 ms | 5 ms | 1 | 1% | 3% |
| 10 ms | 10 ms | 1 | 2% | 3% |
| 20 ms | 10 ms | 2 | 2% | 3% |
| 50 ms | 50 ms | 1 | 2% | 3% |
| 0.1 s | 0.1 s | 1 | 2% | 3% |
| 0.2 s | 0.1 s | 2 | 2% | 3% |
| 0.5 s | 0.5 s | 1 | 2% | 3% |

74. Check A INTEN Timing Accuracy

- a. Set the HORIZ DISPLAY switch to A INTEN.
- b. CHECK—Using the A TIME/DIV switch and Time-Mark Generator settings given in Table 5-8, check that A INTEN timing is within the given tolerance.

TABLE 5-8

A Intensified Timing Accuracy

| A TIME/ DIV Switch Setting | Time- Mark Generator Output | CRT Display (markers/ division) | Accuracy | |
|-------------------------------------|--------------------------------------|--|---------------------|---------------------|
| | | | +20° C to +30° C | +15° C to +55° C |
| 0.05 μs | 50 ns | 1 | 2% | 3% |
| 0.1 μs | 0.1 μs | 1 | 2% | 3% |
| 0.2 μs | 0.1 μs | 2 | 2% | 3% |
| 0.5 μs | 0.5 μs | 1 | 2% | 3% |
| 1 μs | 1 μs | 1 | 2% | 3% |
| 2 μs | 1 μs | 2 | 2% | 3% |
| 5 μs | 5 μs | 1 | 2% | 3% |
| 10 μs | 10 μs | 1 | 2% | 3% |
| 20 μs | 10 μs | 2 | 2% | 3% |
| 50 μs | 50 μs | 1 | 2% | 3% |
| 0.1 ms | 0.1 ms | 1 | 2% | 3% |
| 0.2 ms | 0.2 ms | 2 | 2% | 3% |
| 0.5 ms | 0.5 ms | 1 | 2% | 3% |
| 1 ms | 1 ms | 1 | 2% | 3% |
| 2 ms | 1 ms | 1 | 2% | 3% |
| 5 ms | 5 ms | 1 | 2% | 3% |
| 10 ms | 10 ms | 1 | 2% | 3% |
| 20 ms | 10 ms | 2 | 2% | 3% |
| 50 ms | 50 ms | 1 | 2% | 3% |
| 0.1 s | 0.1 s | 1 | 2% | 3% |
| 0.2 s | 0.1 s | 2 | 2% | 3% |
| 0.5 s | 0.5 s | 1 | 2% | 3% |

75. Check Magnified Timing Accuracy

- a. CHECK—Using the A TIME/DIV switch and the Time-Mark Generator settings given in Table 5-10, check that A magnified sweep timing is within the given tolerance. Note the portions of the total magnified sweep length to be excluded from the measurement.

76. Check Delay Time Accuracy

- a. Set the HORIZ DISPLAY switch to B DLY'D, the A TIME/DIV switch to 0.05 μs, the B TIME/DIV switch to 0.01 μs and the B SOURCE switch to STARTS AFTER DELAY.

- b. CHECK—Using the A TIME/DIV switch, the B TIME/DIV switch and the Time-Mark Generator settings given in Table 5-9, check that delayed sweep accuracy is within the given tolerance. First set the DELAY TIME POSITION dial to 1.00 and rotate the dial until the sweep starts at the top of the second time marker. Note the control setting, then set the dial to 2.00 and rotate it slightly until the sweep starts at the top of the third time marker. The error for intervals less than 1 dial division cannot exceed 0.01 dial division. Continue to rotate the DELAY TIME POSITION dial to check between the 1.00 and 9.00 settings for all A sweep speeds from 0.05 μs to 0.5 s. The difference between any two time markers greater than 1 dial division apart cannot exceed 1%.

NOTE

Sweep will start at the top of the third time marker at 1.00 and at the top of the nineteenth time marker at 9.00 for sweep rates which are multiples of 2 (e.g., 2 μs, 20 μs, 0.2 ms, etc.). If in doubt as to the correct setting of the DELAY TIME POSITION dial, set the HORIZ DISPLAY switch to A INTEN and check which time marker is intensified.

TABLE 5-9

Delayed Sweep Accuracy

| A TIME/DIV Switch Setting | B TIME/DIV Switch Setting | Time-Mark Generator Output |
|---------------------------------|---------------------------------|----------------------------------|
| 0.05 μs | 0.01 μs | 0.05 μs |
| 0.1 μs | 0.01 μs | 0.1 μs |
| 0.2 μs | 0.05 μs | 0.1 μs |
| 0.5 μs | 0.05 μs | 0.5 μs |
| 1 μs | 0.1 μs | 1 μs |
| 2 μs | 0.1 μs | 1 μs |
| 5 μs | 0.1 μs | 5 μs |
| 10 μs | 1 μs | 10 μs |
| 20 μs | 1 μs | 10 μs |
| 50 μs | 1 μs | 50 μs |
| 0.1 ms | 10 μs | 0.1 ms |
| 0.2 ms | 10 μs | 0.1 ms |
| 0.5 ms | 10 μs | 0.5 ms |
| 1 ms | 0.1 ms | 1 ms |
| 2 ms | 0.1 ms | 1 ms |
| 5 ms | 0.1 ms | 5 ms |
| 10 ms | 1 ms | 10 ms |
| 20 ms | 1 ms | 10 ms |
| 50 ms | 1 ms | 50 ms |
| 0.1 s | 10 ms | 0.1 s |
| 0.2 s | 10 ms | 0.1 s |
| 0.5 s | 10 ms | 0.5 s |

TABLE 5-10
A and B Magnified Timing Accuracy

| A TIME/DIV Switch Setting | Time-Mark Generator Output | CRT Display (Markers/ Division) | Portions of total magnified sweep length to exclude from measurement | Accuracy | |
|---------------------------------|----------------------------------|---------------------------------------|---|----------------|----------------|
| | | | | +20°C to +30°C | -15°C to +55°C |
| 0.01 μ s | 2 ns | 2 | First 25 ns and all beyond the 100 th magnified division. | 2% | 4% |
| 0.02 μ s | 2 ns | 1 | | 2% | 4% |
| 0.05 μ s | 5 ns | 1 | | 2% | 4% |
| 0.1 μ s | 10 ns | 1 | | 2% | 4% |
| 0.2 μ s | 10 ns | 2 | | 2% | 4% |
| 0.5 μ s | 50 ns | 1 | | 2% | 4% |
| 1 μ s | 0.1 μ s | 1 | | 2% | 4% |
| 2 μ s | 0.1 μ s | 2 | | 2% | 4% |
| 5 μ s | 0.5 μ s | 1 | | 2% | 4% |
| 10 μ s | 1 μ s | 1 | | 2% | 4% |
| 20 μ s | 1 μ s | 2 | | 2% | 4% |
| 50 μ s | 5 μ s | 1 | | 2% | 4% |
| 0.1 ms | 10 μ s | 1 | | 2% | 4% |
| 0.2 ms | 10 μ s | 2 | | 2% | 4% |
| 0.5 ms | 50 μ s | 1 | | 2% | 4% |
| 1 ms | 0.1 ms | 1 | | 2% | 4% |
| 2 ms | 0.1 ms | 2 | | 2% | 4% |
| 5 ms | 0.5 ms | 1 | | 2% | 4% |
| 10 ms | 1 ms | 1 | | 3% | 4% |
| 20 ms | 1 ms | 2 | | 3% | 4% |
| 50 ms | 5 ms | 1 | 3% | 4% | |

77. Check Delay Time Jitter

a. Set the DELAY TIME POSITION dial to 1.00, the HORIZ DISPLAY switch to B DLY'D, the A TIME/DIV switch to 1 ms, and the B TIME/DIV switch to 0.2 μ s.

b. Position the time marker near the center of the display area with the DELAY TIME POSITION dial.

c. CHECK—Jitter on the leading edge of the time marker does not exceed 1 division.

d. Turn the DELAY TIME POSITION dial to 9.00 and adjust it so the time marker is displayed near the center of the display area.

e. CHECK—Jitter on the leading edge of the time marker does not exceed 1 division.

78. Check Mixed Sweep Timing Accuracy

a. Set the A TIME/DIV switch to 1 ms, the B TIME/DIV switch to 0.5 ms, the HORIZ DISPLAY switch to MIX, the

B SOURCE switch to STARTS AFTER DELAY, and the DELAY TIME POSITION dial fully clockwise.

b. Select 1 ms time marks from the Time-Mark Generator.

c. CHECK—The timing between first and eleventh time markers is within ± 0.3 division.

NOTE

Exclude the first 0.5 division of sweep after the display start and the first 0.2 division, or 0.1 μ s (whichever is greater) after the transition of A to B.

d. Disconnect the test setup.

79. Adjust X Gain

a. Set the A TIME/DIV switch to X-Y, the VERT MODE switch to CH 2, both VOLTS/DIV switches to 5 mV, and the CH 1 AC-GND-DC switch to DC.

Calibration—475

b. Apply a 20 mV square wave from the Standard Amplitude Calibrator to the CH 1 or X input through a 42-inch 50 Ω BNC cable.

c. CHECK—CRT display for 4 divisions of deflection between the two displayed dots, within 3%.

d. ADJUST—X-Gain adjustment, R1102 (see Fig. 5-31) for exactly four divisions of deflection between the two dots displayed on the CRT.

e. Disconnect the test setup.

80. Adjust X-Y Phasing and Bandwidth

a. Set both VOLTS/DIV switches to 5 mV and both AC-GND-DC switches to AC.

b. Connect the output of the Medium-Frequency Constant-Amplitude Signal Generator (Type 191) to the CH 1 and CH 2 inputs through a GR-to-BNC adapter, a 42-inch 50 Ω BNC cable, 50 Ω BNC termination, and a dual input coupler.

c. Adjust the Medium-Frequency signal generator for an eight division horizontal display of 50 kilohertz signal.

d. Center the display vertically and horizontally with the CH 1 and CH 2 POSITION controls.

e. CHECK—CRT display for an opening at the center horizontal line of 0.14 division or less.

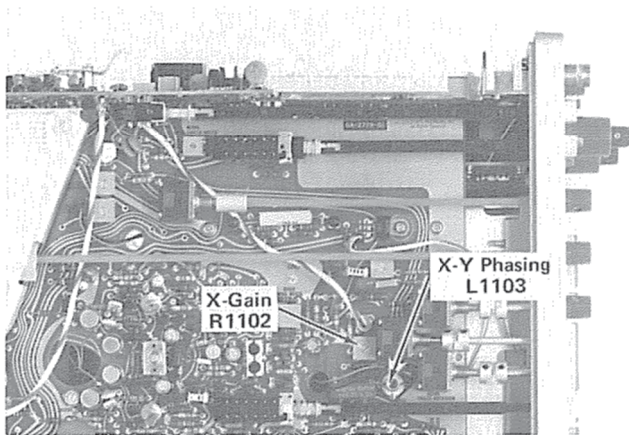


Fig. 5-31. Location of X Gain and X-Y Phasing adjustments.

f. Increase the output frequency of the Medium-Frequency signal generator to 2 megahertz.

g. CHECK—CRT display for an opening at the center horizontal line of 0.42 division or less.

h. ADJUST—L1103 (see Fig. 5-31), for maximum closing of the display.

i. Remove the dual input coupler from the test setup.

j. Reconnect the test signal to the CH 1 input.

k. Adjust the signal generator for a 4 division horizontal display of 50 kilohertz signal.

l. Increase the output frequency of the signal generator until the display is reduced to 2.8 divisions.

m. CHECK—Output frequency of the signal generator is at least 3 megahertz.

n. Disconnect the test setup.

81. Check B ENDS A Operation

a. Set the HORIZ DISPLAY switch to A INTEN, the A TIME/DIV switch to 1 ms, the B TIME/DIV switch to 0.1 ms, and the A TRIG HOLDOFF control to B ENDS A.

b. Adjust the INTENSITY control so that the A sweep is visible.

c. Rotate the DELAY TIME POSITION dial through its range.

d. CHECK—A Sweep ends after the intensified portion at all settings of the DELAY TIME POSITION dial settings.

82. Check A TRIG HOLDOFF Operation

a. Set the HORIZ DISPLAY switch to A, the A TIME/DIV switch to 50 μ s, and the A TRIG HOLDOFF control fully counterclockwise.

b. Connect the +A GATE output signal to the Test Oscilloscope via a 42-inch 50 Ω BNC cable.

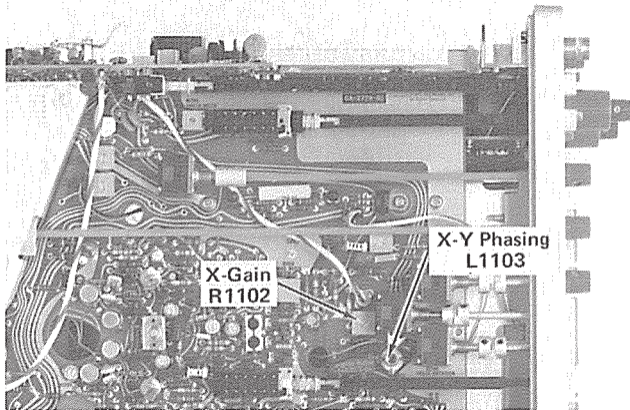


Fig. 5-31. Location of X Gain and X-Y Phasing adjustments.

c. Set the Test Oscilloscope TIME/DIV switch so that the bottom portion of the waveform (holdoff time of the +A GATE) is slightly less than one division.

e. CHECK—For at least nine times increase in the holdoff time of the +A GATE.

d. Rotate the A TRIG HOLDOFF control clockwise (not into the B ENDS A detent).

f. Set the A TRIG HOLDOFF control fully counter-clockwise.

CALIBRATOR, + GATES, AND EXT Z-AXIS CALIBRATOR

| Equipment Required | |
|--|---------------------------------|
| 1. Medium-Frequency Constant-Amplitude Signal Generator (Type 191) | 4. BNC-T Connector |
| 2. Precision DC Voltmeter | 5. 42-inch 50 Ω BNC Cable (two) |
| 3. GR-to-BNC Female Adapter | 6. Three-inch Screwdriver |

Control Settings

Preset instrument controls to the settings given under Preliminary Control Settings.

83. Adjust CALIBRATOR Amplitude

a. Connect the Precision DC Voltmeter between the CALIBRATOR current loop and ground.

b. Short the emitter and base of Q1504 together (see Fig. 5-32).

c. CHECK—For a meter reading of +0.3 volt, within 3 mV.

d. ADJUST—Calibrator Amplitude adjustment, R1515 (see Fig. 5-32) for +0.3 volt, within 1% from 0°C to +40°C; for +0.3 volt, within 1.5% from -15°C to +55°C.

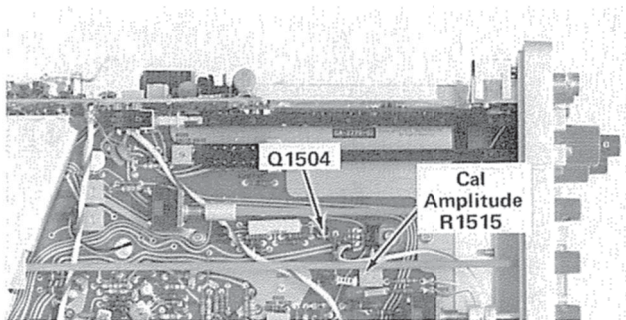


Fig. 5-32. Location of Q1504 and Calibrator amplitude adjustment.

e. Remove the Precision DC Voltmeter connections and the short between emitter and base of Q1504.

84. Check A and B + GATE Outputs

a. Set the DELAY TIME POSITION dial fully counter-clockwise, the HORIZ DISPLAY switch to B DLY'D, the B SOURCE switch to STARTS AFTER DELAY, the B TIME/DIV switch to 50 μs, and the TRIG MODE to AUTO.

b. Connect the B + GATE output signal to the Test Oscilloscope via a 42-inch 50 Ω BNC cable.

c. CHECK—Test Oscilloscope for a positive-going pulse +5.5 volts in amplitude (within 0.5 V).

d. Remove the B + GATE output signal and connect the A + GATE output signal to the Test Oscilloscope.

e. CHECK—Repeat step 84-c.

f. Disconnect the test setup.

85. Check EXT Z-AXIS Operation

a. Set the HORIZ DISPLAY switch to A, the A TIME/DIV switch to 0.2 ms, and the A SOURCE switch to NORM.

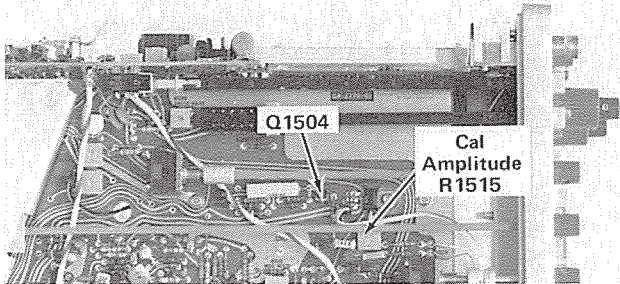


Fig. 5-32. Location of Q1504 and Calibrator amplitude adjustment.

Calibration—475

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

c. Connect the Medium-Frequency Constant-Amplitude Signal Generator (Type 191) to the CH 1 input and the EXT Z-AXIS input (on the rear panel) via a GR-to-BNC adapter, a BNC-T connector, and two 42-inch 50 Ω BNC cables.

d. Adjust the Medium-Frequency signal generator for a 5 volt (peak-to-peak) 50 kilohertz signal.

e. CHECK—CRT display for noticeable intensity modulation of the positive peaks.

f. Disconnect the test setup.

ELECTRICAL PARTS LIST

Replacement parts should be ordered from the Tektronix Field Office or Representative in your area. Changes to Tektronix products give you the benefit of improved circuits and components. Please include the instrument type number and serial number with each order for parts or service.

ABBREVIATIONS AND REFERENCE DESIGNATORS

| | | | | | |
|--------|-----------------------------------|-----|--|-----|---|
| A | Assembly, separable or repairable | FL | Filter | PTM | paper or plastic, tubular molded |
| AT | Attenuator, fixed or variable | H | Heat dissipating device (heat sink, etc.) | R | Resistor, fixed or variable |
| B | Motor | HR | Heater | RT | Thermistor |
| BT | Battery | J | Connector, stationary portion | S | Switch |
| C | Capacitor, fixed or variable | K | Relay | T | Transformer |
| Cer | Ceramic | L | Inductor, fixed or variable | TP | Test point |
| CR | Diode, signal or rectifier | LR | Inductor/resistor combination | U | Assembly, inseparable or non-repairable |
| CRT | cathode-ray tube | M | Meter | V | Electron tube |
| DL | Delay line | Q | Transistor or silicon-controlled rectifier | Var | Variable |
| DS | Indicating device (lamp) | P | Connector, movable portion | VR | Voltage regulator (zener diode, etc.) |
| Elect. | Electrolytic | PMC | Paper, metal cased | WW | wire-wound |
| EMC | electrolytic, metal cased | PT | paper, tubular | Y | Crystal |
| EMT | electrolytic, metal tubular | | | | |
| F | Fuse | | | | |

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|-------------------|--------------------|----------------------|------|---|
| ASSEMBLIES | | | | |
| A1 | 670-2100-00 | | | CH 1 ATTEN Circuit Board Assembly |
| A2 | 670-2100-00 | | | CH 2 ATTEN Circuit Board Assembly |
| A3 | 670-2240-00 | | | VERT PREAMP. Circuit Board Assembly |
| A4 | 670-2243-00 | | | GAIN SW Circuit Board Assembly |
| A5 | 670-2242-00 | | | VERT OUTPUT Circuit Board Assembly |
| A6 | 670-2245-00 | | | FAN MOTOR Circuit Board Assembly |
| A7 | 670-2244-00 | | | TIMING Circuit Board Assembly |
| A8 | 670-2241-00 | | | TRIGGER GEN & Z AXIS LOGIC Circuit Board Assembly |
| A9 | 670-2239-00 | | | MAIN Circuit Board Assembly |
| A10 | 670-2279-00 | | | GRATICULE ILLUM Circuit Board Assembly |
| MOTOR | | | | |
| B1690 | 147-0035-00 | | | Motor, 10-5VDC, 145 mA |
| CAPACITORS | | | | |
| C10 | 281-0064-00 | | | 0.25-1.5 pF, Var, Tub., 600 V |
| C11 | 283-0000-00 | | | 0.001 uF, Cer, 500 V, +100%-10% |
| C12 | 285-0816-01 | | | 0.019 uF, Plastic, 600 V, 10% |
| C13 | 283-0000-00 | | | 0.001 uF, Cer, 500 V, +100%-10% |
| C30} 2 | 307-1014-01 | | | Attenuator strip, 100X |
| C31} 2 | | | | |
| C32} 2 | 307-1013-01 | | | Attenuator strip, 10X |
| C33} 2 | | | | |
| C34} 2 | 307-1011-00 | | | Attenuator strip, 10X |
| C35} 2 | | | | |
| C36} 2 | 307-1010-01 | | | Attenuator strip, 2X |
| C37} 2 | | | | |

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|-------------------|--------------------|----------------------|---------|------------------------------------|
| CAPACITORS (cont) | | | | |
| C41 | 283-0156-00 | | | 1000 pF, Cer, 200 V, +100%-0% |
| C50 | 281-0064-00 | | | 0.25-1.5 pF, Var, Tub., 600 V |
| C51 | 283-0000-00 | | | 0.001 uF, Cer, 500 V, +100%-0% |
| C52 | 285-0816-01 | | | 0.019 uF, Plastic, 600 V, 10% |
| C53 | 283-0000-00 | | | 0.001 uF, Cer, 500 V, +100%-0% |
| C61 | 283-0156-00 | | | 1000 pF, Cer, 200 V, +100%-0% |
| C104 | 281-0619-00 | B010100 | B010309 | 1.2 pF, Cer, 200 V, ±0.1 pF |
| C104 | 281-0064-00 | B010310 | | 0.25-1.5 pF, Var, Tub., 600 V |
| C105 | 283-0080-00 | | | 0.022 uF, Cer, 25 V, +80%-20% |
| C107 | 283-0111-00 | | | 0.1 uF, Cer, 50 V |
| C109 | 283-0238-00 | B010100 | B049999 | 0.01 uF, Cer, 50 V, 10% |
| C109 | 283-0238-00 | B050000 | | 0.01 uF, (nominal value), selected |
| C112 | 281-0123-00 | | | 5-25 pF, Var, Cer |
| C113 | 283-0156-00 | | | 0.001 uF, Cer, 200 V, +100%-0% |
| C119 | 283-0191-00 | | | 0.022 uF, Cer, 50 V, 20% |
| C123 | 283-0080-00 | XB050000 | | 0.022 uF, Cer, 25 V, +80%-20% |
| C127 | 283-0080-00 | XB050000 | | 0.022 uF, Cer, 25 V, +80%-20% |
| C133 | 281-0123-00 | | | 5-25 pF, Var, Cer |
| C136 | 283-0213-00 | | | 300 pF, Cer, 100 V, 5% |
| C137 | 283-0178-00 | | | 0.1 uF, Cer, 100 V, +80%-20% |
| C138 | 283-0177-00 | | | 1 uF, Cer, 25 V, +80%-20% |
| C139 ¹ | 283-0268-00 | | | 0.015 uF, Cer, 50 V, 10% |
| C142 ¹ | | | | |
| C144 ¹ | 290-0534-00 | | | 1 uF, Elect., 35 V, 20% |
| C147 ¹ | | | | |
| C151 ¹ | | | | |
| C152 ¹ | | | | |
| C153 | 283-0186-00 | B010100 | B029999 | 27 pF, Cer, 50 V, 5% |
| C153 | 281-0504-00 | B030000 | | 10 pF, (nominal value), selected |
| C157 | 290-0534-00 | | | 1 uF, Elect., 35 V, 20% |
| C158 | 283-0156-00 | XB030000 | | 0.001 uF, Cer, 200 V, +100%-0% |
| C172 | 283-0103-00 | | | 180 pF, Cer, 500 V, 5% |
| C175 | 281-0123-00 | | | 5-25 pF, Var, Cer |
| C182 | 283-0103-00 | | | 180 pF, Cer, 500 V, 5% |
| C204 | 281-0619-00 | B010100 | B010309 | 1.2 pF, Cer, 200 V, ±0.1 pF |
| C204 | 281-0064-00 | B010310 | | 0.25-1.5 pF, Var, Tub., 600 V |
| C205 | 283-0080-00 | | | 0.022 uF, Cer, 25 V, +80%-20% |
| C207 | 283-0111-00 | | | 0.1 uF, Cer, 50 V |
| C209 | 283-0238-00 | B010100 | B049999 | 0.01 uF, Cer, 50 V, 10% |
| C209 | 283-0238-00 | B050000 | | 0.01 uF, (nominal value), selected |
| C212 | 281-0123-00 | | | 5-25 pF, Var, Cer |
| C213 | 283-0156-00 | | | 0.001 uF, Cer, 200 V, +100%-0% |
| C219 | 283-0191-00 | | | 0.022 uF, Cer, 50 V, 20% |
| C223 | 283-0080-00 | XB050000 | | 0.022 uF, Cer, 25 V, +80%-20% |
| C227 | 283-0080-00 | XB050000 | | 0.022 uF, Cer, 25 V, +80%-20% |

¹Part of Circuit Board.

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|-------------------|--------------------|----------------------|---------|----------------------------------|
| CAPACITORS (cont) | | | | |
| C233 | 281-0123-00 | | | 5-25 pF, Var, Cer |
| C236 | 283-0213-00 | | | 300 pF, Cer, 100 V, 5% |
| C237 | 283-0178-00 | | | 0.1 uF, Cer, 100 V, +80%-20% |
| C238 | 283-0177-00 | | | 1 uF, Cer, 25 V, +80%-20% |
| C239 ¹ | 283-0268-00 | | | 0.015 uF, Cer, 50 V, 10% |
| C242 ¹ | | | | |
| C244 | 290-0534-00 | | | 1 uF, Elect., 35 V, 20% |
| C247 ¹ | | | | |
| C251 ¹ | | | | |
| C252 ¹ | | | | |
| C253 | 283-0186-00 | B010100 | B029999 | 27 pF, Cer, 50 V, 5% |
| C253 | 281-0578-00 | B030000 | | 18 pF, (nominal value), selected |
| C257 | 290-0534-00 | | | 1 uF, Elect., 35 V, 20% |
| C258 | 283-0156-00 | XB050000 | | 1000 pF, Cer, 200 V, +100%-0% |
| C272 | 283-0103-00 | | | 180 pF, Cer, 500 V, 5% |
| C275 | 281-0123-00 | | | 5-25 pF, Var, Cer |
| C282 | 283-0103-00 | | | 180 pF, Cer, 500 V, 5% |
| C291 | 290-0525-00 | | | 4.7 uF, Elect., 50 V, 20% |
| C292 | 290-0523-00 | | | 2.2 uF, Elect., 20 V, 20% |
| C297 | 290-0523-00 | | | 2.2 uF, Elect., 20 V, 20% |
| C310 | 283-0000-00 | | | 0.001 uF, Cer, 500 V, +100%-0% |
| C320 | 283-0000-00 | | | 0.001 uF, Cer, 500 V, +100%-0% |
| C329 | 283-0024-00 | XB030000 | | 0.1 uF, Cer, 30 V, +80%-20% |
| C335 | 283-0632-00 | B010100 | B010274 | 87 pF, Mica, 100 V, 1% |
| C335 | 283-0677-00 | B010275 | | 82 pF, Mica, 500 V, 1% |
| C336 | 283-0632-00 | B010100 | B010274 | 87 pF, Mica, 100 V, 1% |
| C336 | 283-0677-00 | B010275 | | 82 pF, Mica, 500 V, 1% |
| C343 | 281-0549-00 | | | 68 pF, Cer, 500 V, 10% |
| C346 | 281-0543-00 | | | 270 pF, Cer, 500 V, 10% |
| C375 | 281-0544-00 | | | 5.6 pF, Cer, 500 V, 10% |
| C376 | 281-0589-00 | | | 170 pF, Cer, 500 V, 5% |
| C393 | 281-0610-00 | B010100 | B010309 | 2.2 pF, Cer, 200 V, ±0.1 pF |
| C393 | 281-0659-00 | B010310 | | 4.3 pF, Cer, 500 V, ±0.25 pF |
| C396 | 290-0534-00 | | | 1 uF, Elect., 35 V, 20% |
| C398 | 281-0518-00 | B010100 | B010309 | 47 pF, Cer, 500 V, 20% |
| C398 | 281-0511-00 | B010310 | | 22 pF, Cer, 500 V, 10% |
| C399 | 281-0508-00 | | | 12 pF, Cer, 500 V, 10% |
| C403 | 290-0534-00 | | | 1 uF, Elect., 35 V, 20% |
| C420 | 281-0544-00 | | | 5.6 pF, Cer, 500 V, 10% |
| C430 | 290-0534-00 | | | 1 uF, Elect., 35 V, 20% |
| C436 | 283-0080-00 | | | 0.022 uF, Cer, 25 V, +80%-20% |
| C437 | 283-0080-00 | | | 0.022 uF, Cer, 25 V, +80%-20% |
| C438 | 290-0534-00 | | | 1 uF, Elect., 35 V, 20% |
| C439 | 290-0534-00 | | | 1 uF, Elect., 35 V, 20% |
| C441 ¹ | | | | |

¹Part of Circuit Board.

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|-------------------|--------------------|----------------------|---------|-------------------------------|
| CAPACITORS (cont) | | | | |
| C445 ¹ | | | | |
| C450 | 281-0122-00 | | | 2.5-9 pF, Var, Cer, 100 V |
| C454 | 283-0058-00 | | | 0.027 uF, Cer, 100 V, 10% |
| C455 | 283-0180-00 | | | 5600 pF, Cer, 200 V, 20% |
| C460 | 283-0111-00 | | | 0.1 uF, Cer, 50 V |
| C466 | 281-0122-00 | | | 2.5-9 pF, Var, Cer, 100 V |
| C470 | 281-0122-00 | | | 2.5-9 pF, Var, Cer, 100 V |
| C471 | 281-0097-00 | | | 9-35 pF, Var, Cer |
| C475 | 283-0116-00 | | | 820 pF, Cer, 500 V, 5% |
| C476 | 283-0139-00 | | | 150 pF, Cer, 50 V, 20% |
| C477 | 281-0122-00 | | | 2.5-9 pF, Var, Cer, 100 V |
| C485 | 283-0111-00 | | | 0.1 uF, Cer, 50 V |
| C486 | 281-0523-00 | | | 100 pF, Cer, 350 V, 20% |
| C491 | 283-0067-00 | | | 0.001 uF, Cer, 200 V, 10% |
| C494 | 283-0198-00 | | | 0.22 uF, Cer, 50 V, 20% |
| C498 | 283-0111-00 | | | 0.1 uF, Cer, 50 V |
| C499 | 283-0111-00 | | | 0.1 uF, Cer, 50 V |
| C500 | 281-0508-00 | | | 12 pF, Cer, 500 V, 20% |
| C504 | 290-0524-00 | | | 4.7 uF, Elect., 10 V, 20% |
| C506 | 283-0081-00 | | | 0.1 uF, Cer, 25 V, +80%-20% |
| C507 | 281-0546-00 | | | 330 pF, Cer, 500 V, 10% |
| C508 | 283-0081-00 | | | 0.1 uF, Cer, 25 V, +80%-20% |
| C509 | 281-0508-00 | | | 12 pF, Cer, 500 V, 20% |
| C510 | 281-0505-00 | | | 12 pF, Cer, 500 V, 10% |
| C511 ² | 281-0572-00 | | | 6.8 pF, cer, 500 V, ±0.5 pF |
| C513 ² | | | | |
| C515 | 281-0523-00 | | | 100 pF, Cer, 350 V, 20% |
| C516 | 283-0003-00 | | | 0.01 uF, Cer, 150 V, +80%-20% |
| C517 | 281-0579-00 | | | 21 pF, Cer, 500 V, 5% |
| C519 | 290-0524-00 | | | 4.7 uF, Elect., 10 V, 20% |
| C520 | 281-0508-00 | | | 12 pF, Cer, 500 V, 20% |
| C521 | 283-0003-00 | | | 0.01 uF, Cer, 150 V, +80%-20% |
| C524 | 283-0003-00 | | | 0.01 uF, Cer, 150 V, +80%-20% |
| C525 | 283-0003-00 | | | 0.01 uF, Cer, 150 V, +80%-20% |
| C526 | 281-0601-00 | | | 7.5 pF, Cer, 500 V |
| C543 | 283-0003-00 | | | 0.01 uF, Cer, 150 V, +80%-20% |
| C546 | 283-0003-00 | | | 0.01 uF, Cer, 150 V, +80%-20% |
| C554 | 281-0508-00 | | | 12 pF, Cer, 500 V, 20% |
| C555 | 290-0524-00 | | | 4.7 uF, Elect., 10 V, 20% |
| C556 | 281-0662-00 | B010100 | B029999 | 10 pF, Cer, 500 V, ±0.5 pF |
| C556 | 281-0523-00 | B030000 | | 100 pF, Cer, 350 V, 20% |
| C557 | 283-0003-00 | | | 0.01 uF, Cer, 150 V, +80%-20% |
| C562 | 283-0003-00 | | | 0.01 uF, Cer, 150 V, +80%-20% |
| C565 | 290-0524-00 | | | 4.7 uF, Elect., 10 V, 20% |
| C571 | 290-0524-00 | | | 4.7 uF, Elect., 10 V, 20% |

¹Part of Circuit Board.

²Short adjustable wire.

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|-------------------|--------------------|----------------------|----------|---------------------------------|
| CAPACITORS (cont) | | | | |
| C572 | 281-0509-00 | XB030000 | B049999X | 15 pF, Cer, 500 V, 10% |
| C575 | 281-0509-00 | XB030000 | B049999X | 15 pF, Cer, 500 V, 10% |
| C583 | 281-0523-00 | XB050000 | | 100 pF, Cer, 350 V, 20% |
| C584 | 281-0617-00 | XB030000 | | 15 pF, Cer, 200 V, 10% |
| C593 | 281-0524-00 | | | 150 pF, Cer, 500 V, 20% |
| C596 | 290-0524-00 | | | 4.7 uF, Elect., 10 V, 20% |
| C599 | 281-0519-00 | XB030000 | | 47 pF, Cer, 500 V, 10% |
| C600 | 290-0524-00 | | | 4.7 uF, Elect., 10 V, 20% |
| C606 | 290-0526-00 | | | 6.8 uF, Elect., 20% |
| C607 | 290-0535-00 | XB010310 | | 33 uF, Elect., 10 V, 20% |
| C608 | 290-0524-00 | | | 4.7 uF, Elect., 10 V, 20% |
| C609 | 290-0534-00 | | | 1 uF, Elect., 35 V, 20% |
| C610 | 290-0535-00 | XB010310 | | 33 uF, Elect., 10 V, 20% |
| C611 | 281-0592-00 | | | 4.7 pF, Cer, 500 V, $\pm 0.5\%$ |
| C622 | 290-0524-00 | | | 4.7 uF, Elect., 10 V, 20% |
| C627 | 283-0000-00 | | | 0.001 uF, Cer, 500 V, +100%-0% |
| C644 | 283-0003-00 | XB020000 | | 0.01 uF, Cer, 150 V, +80%-20% |
| C647 | 281-0523-00 | | | 100 pF, Cer, 350 V, 20% |
| C668 | 283-0003-00 | | | 0.01 uF, Cer, 150 V, +80%-20% |
| C669 | Selected | XB030000 | | |
| C670 | 283-0000-00 | | | 0.001 uF, Cer, 500 V, +100%-0% |
| C673 | 281-0632-00 | | | 35 pF, Cer, 500 V, 1% |
| C675 | 283-0003-00 | | | 0.01 uF, Cer, 150 V, +80%-20% |
| C679 | 283-0003-00 | | | 0.01 uF, Cer, 150 V, +80%-20% |
| C683 | 281-0629-00 | | | 33 pF, Cer, 600 V, 5% |
| C684 | 281-0519-00 | | | 47 pF, Cer, 500 V, 10% |
| C693 | 281-0528-00 | | | 82 pF, Cer, 500 V, 10% |
| C695 | 281-0503-00 | | | 8 pF, Cer, 500 V, $\pm 0.5\%$ |
| C698 | 290-0523-00 | | | 2.2 uF, Elect., 20 V, 20% |
| C708 | 281-0579-00 | | | 21 pF, Cer, 500 V, 5% |
| C711 | 290-0524-00 | | | 4.7 uF, Elect., 10 V, 20% |
| C712 | 290-0524-00 | | | 4.7 uF, Elect., 10 V, 20% |
| C713 | 290-0524-00 | | | 4.7 uF, Elect., 10 V, 20% |
| C714 | 283-0003-00 | | | 0.01 uF, Cer, 150 V, +80%-20% |
| C715 | 283-0003-00 | | | 0.01 uF, Cer, 150 V, +80%-20% |
| C717 | 281-0509-00 | | | 15 pF, Cer, 500 V, 10% |
| C718 | 281-0509-00 | | | 15 pF, Cer, 500 V, 10% |
| C719 | 281-0509-00 | | | 15 pF, Cer, 500 V, 10% |
| C721 | 281-0505-00 | | | 12 pF, Cer, 500 V, 10% |
| C722 | 281-0572-00 | | | 6.8 pF, Cer, 500 V, $\pm 0.5\%$ |
| C729 | 283-0003-00 | | | 0.01 uF, Cer, 150 V, +80%-20% |
| C735 | 281-0523-00 | | | 100 pF, Cer, 350 V, 20% |
| C736 | 283-0003-00 | | | 0.01 uF, Cer, 150 V, +80%-20% |
| C739 | 290-0524-00 | | | 4.7 uF, Elect., 10 V, 20% |
| C741 | 283-0003-00 | | | 0.01 uF, Cer, 150 V, +80%-20% |

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|-------------------|--------------------|----------------------|----------|--------------------------------|
| CAPACITORS (cont) | | | | |
| C744 | 283-0003-00 | | | 0.01 uF, Cer, 150 V, +80%-20% |
| C745 | 283-0003-00 | | | 0.01 uF, Cer, 150 V, +80%-20% |
| C746 | 281-0601-00 | | | 7.5 pF, Cer, 500 V |
| C752 | 290-0524-00 | | | 4.7 uF, Elect., 10 V, 20% |
| C763 | 283-0003-00 | | | 0.01 uF, Cer, 150 V, +80%-20% |
| C764 | 290-0524-00 | | | 4.7 uF, Elect., 10 V, 20% |
| C766 | 283-0003-00 | | | 0.01 uF, Cer, 150 V, +80%-20% |
| C771 | 283-0003-00 | | | 0.01 uF, Cer, 150 V, +80%-20% |
| C774 | 281-0508-00 | | | 12 pF, Cer, 500 V, 20% |
| C775 | 290-0524-00 | | | 4.7 uF, Elect., 10 V, 20% |
| C776 | 281-0662-00 | B010100 | B029999 | 10 pF, Cer, 500 V, ±0.5 pF |
| C776 | 281-0523-00 | B030000 | | 100 pF, Cer, 350 V, 20% |
| C777 | 283-0003-00 | | | 0.01 uF, Cer, 150 V, +80%-20% |
| C783 | 283-0003-00 | | | 0.01 uF, Cer, 150 V, +80%-20% |
| C785 | 290-0524-00 | | | 4.7 uF, Elect., 10 V, 20% |
| C795 | 283-0001-00 | | | 0.005 uF, Cer, 500 V |
| C798 | 290-0523-00 | | | 2.2 uF, Elect., 20 V, 20% |
| C799 | 283-0000-00 | | | 0.001 uF, Cer, 500 V, +100%-0% |
| C803 | 290-0523-00 | | | 2.2 uF, Elect., 20 V, 20% |
| C811 | 281-0509-00 | XB050000 | | 15 pF, Cer, 500 V, 10% |
| C813 | 281-0509-00 | XB030000 | B049999X | 15 pF, Cer, 500 V, 10% |
| C819 | 290-0524-00 | | | 4.7 uF, Elect., 10 V, 20% |
| C823 | 281-0523-00 | XB050000 | | 100 pF, Cer, 350 V, 20% |
| C824 | 281-0617-00 | XB030000 | | 15 pF, Cer, 200 V, 10% |
| C825 | 290-0524-00 | | | 4.7 uF, Elect., 10 V, 20% |
| C826 | 290-0523-00 | | | 2.2 uF, Elect., 20 V, 20% |
| C905 | 290-0523-00 | | | 2.2 uF, Elect., 20 V, 20% |
| C913 | 290-0527-00 | | | 15 uF, Elect., 20 V, 20% |
| C917 | 281-0525-00 | | | 470 pF, Cer, 500 V, 20% |
| C922 | 281-0509-00 | | | 15 pF, Cer, 500 V, 10% |
| C923 | 283-0024-00 | | | 0.1 uF, Cer, 30 V, +80%-20% |
| C933 | 290-0523-00 | | | 2.2 uF, Elect., 20 V, 20% |
| C947 | 283-0000-00 | | | 0.001 uF, Cer, 500 V, +100%-0% |
| C961 | 290-0523-00 | | | 2.2 uF, Elect., 20 V, 20% |
| C963 | 290-0523-00 | | | 2.2 uF, Elect., 20 V, 20% |
| C965 | 290-0523-00 | | | 2.2 uF, Elect., 20 V, 20% |
| C967 | 290-0524-00 | | | 4.7 uF, Elect., 10 V, 20% |
| C969 | 290-0523-00 | | | 2.2 uF, Elect., 20 V, 20% |
| C976 | 281-0579-00 | | | 21 pF, Cer, 500 V, 5% |
| C984 | 281-0503-00 | | | 8 pF, Cer, 500 V, ±0.5 pF |
| C1007 | 283-0000-00 | | | 0.001 uF, Cer, 500 V, +100%-0% |
| C1008 | 283-0157-00 | | | 7 pF, Cer, 500 V, 5% |
| C1009 | 281-0168-00 | | | 1.3-5.4 pF, Var, Air |
| C1010 | 283-0003-00 | | | 0.01 uF, Cer, 150 V, +80%-20% |
| C1023 | 281-0096-00 | | | 5.5-18 pF, Var, Air |

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|-------------------|--------------------|----------------------|-----------------|----------------------------------|
| CAPACITORS (cont) | | | | |
| | C1025 | 281-0096-00 | | 5.5-18 pF, Var, Air |
| | C1033 | 281-0549-00 | | 68 pF, Cer, 500 V, 10% |
| | C1045 | 283-0000-00 | | 0.001 uF, Cer, 500 V, +100%-0% |
| | C1050 | 283-0003-00 | | 0.01 uF, Cer, 150 V, +80%-20% |
| | C1052 | 281-0589-00 | | 170 pF, Cer, 500 V, 5% |
| | C1054 | 290-0525-00 | | 4.7 uF, Cer, 50 V, 20% |
| | C1056 | 283-0187-00 | B010100 B049999 | 0.047 uF, Cer, 400 V, 10% |
| | C1056 | 283-0341-00 | B050000 | 0.047 uF, Cer, 100 V, 10% |
| | C1058 | 281-0543-00 | | 270 pF, Cer, 500 V, 10% |
| | C1059 | 290-0392-00 | | 3.6 uF, Elect., 125 V, 10% |
| | C1064 | 281-0096-00 | | 5.5-18 pF, Var, Air |
| | C1071 | 295-0163-00 | | 10 uF, |
| | C1072 | | | 0.1 uF, Matched capacitors |
| | C1073 | | | 0.001 uF, |
| | C1075 | | | 33 pF, Cer, 500 V, 1% |
| | C1081 | 281-0523-00 | | 100 pF, Cer, 350 V, 20% |
| | C1082 | 295-0163-00 | | 10 uF, |
| | C1083 | | | 0.1 uF, Matched capacitors |
| | C1085 | | | 0.001 uF, |
| | C1091 | 290-0523-00 | | 2.2 uF, Cer, 350 V, 20% |
| | C1093 | 290-0523-00 | | 2.2 uF, Cer, 350 V, 20% |
| | C1103 | 283-0670-00 | | 375 pF, Mica, 500 V, 1% |
| | C1112 | 283-0010-00 | | 0.05 uF, Cer, 50 V |
| | C1116 | 283-0000-00 | | 0.001 uF, Cer, 500 V, +100%-0% |
| | C1124 | 283-0003-00 | | 0.01 uF, Cer, 150 V, +80%-20% |
| | C1134 | 283-0003-00 | | 0.01 uF, Cer, 150 V, +80%-20% |
| | C1140 | 283-0010-00 | | 0.05 uF, Cer, 50 V |
| | C1152 | 283-0003-00 | | 0.01 uF, Cer, 150 V, +80%-20% |
| | C1162 | 283-0003-00 | | 0.01 uF, Cer, 150 V, +80%-20% |
| | C1171 | 281-0564-00 | | 24 pF, Cer, 500 V, 5% |
| | C1178 | 283-0631-00 | | 95 pF, (nominal value), selected |
| | C1179 | 281-0118-00 | | 8-90 pF, Var, Mica |
| | C1187 | 283-0010-00 | | 0.05 uF, Cer, 50 V |
| | C1201 | 283-0005-00 | | 0.01 uF, Cer, 250 v, +100%-0% |
| | C1205 | 283-0005-00 | | 0.01 uF, Cer, 250 V, +100%-0% |
| | C1211 | 283-0005-00 | | 0.01 uF, Cer, 250 V, +100%-0% |
| | C1212 | 283-0005-00 | | 0.01 uF, Cer, 250 V, +100%-0% |
| | C1216 | 283-0010-00 | | 0.05 uF, Cer, 50 V |
| | C1231 | 283-0638-00 | | 130 pF, Mica, 100 V, 1% |
| | C1233 | 281-0153-00 | | 1.7-10 pF, Var, Air, 250 V |
| | C1235 ² | | | |
| | C1251 | 283-0638-00 | | 130 pF, Mica, 100 V, 1% |
| | C1253 | 281-0153-00 | | 1.7-10 pF, Var, Air, 250 V |
| | C1255 ² | | | |
| | C1261 | 290-0523-00 | | 2.2 uF, Elect., 20 V, 20% |

¹C1071, C1072, C1073, C1082, C1083, and C1085 furnished as a unit. Individual timing capacitors in this assembly must be ordered by the 9 digit part number, letter suffix and tolerance printed on the timing capacitor to be replaced.

285-XXXX-XX F-

The letter suffix and the tolerance should be the same for all of the timing capacitors in the assembly.

²Part of the Circuit Board.

Electrical Parts List-475

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|-------------------|--------------------|----------------------|----------|----------------------------------|
| CAPACITORS (cont) | | | | |
| C1263 | 290-0524-00 | | | 4.7 uF, Elect., 10 V, 20% |
| C1265 | 290-0523-00 | | | 2.2 uF, Elect., 20 V, 20% |
| C1267 | 283-0092-00 | | | 0.03 uF, Cer, 200 V, +80%-20% |
| C1302 | 290-0534-00 | | | 1 uF, Elect., 35 V, 20% |
| C1304 | 290-0573-00 | | | 2.7 uF, Elect., 50 V, 20% |
| C1305 | 290-0572-00 | | | 0.1 uF, Elect., 50 V, 20% |
| C1316 | 290-0534-00 | | | 1 uF, Elect., 35 V, 20% |
| C1317 | 290-0536-00 | | | 10 uF, Elect., 25 V, 20% |
| C1318 | 290-0312-00 | | | 47 uF, Elect., 35 V, 10% |
| C1320 | 283-0011-00 | | | 0.01 uF, Cer, 2000 V |
| C1322 | 283-0071-00 | | | 0.0068 uF, Cer, 5000 V, +80%-30% |
| C1323 | 283-0071-00 | | | 0.0068 uF, Cer, 5000 V, +80%-30% |
| C1326 | 281-0518-00 | | | 47 pF, Cer, 500 V, 20% |
| C1328 | 283-0071-00 | | | 0.0068 uF, Cer, 5000 V, +80%-30% |
| C1330 | 290-0524-00 | | | 4.7 uF, Elect., 10 V, 20% |
| C1335 | 283-0078-00 | | | 0.001 uF, Cer, 500 V, 20% |
| C1336 | 283-0078-00 | | | 0.001 uF, Cer, 500 V, 20% |
| C1346 | 283-0002-00 | | | 0.01 uF, Cer, 500 V |
| C1348 | 283-0005-00 | | | 0.01 uF, Cer, 250 V, +100%-0% |
| C1352 | 281-0064-00 | | | 0.25-1.5 pF, Var, Cer, 600 V |
| C1354 | 283-0005-00 | | | 0.01 uF, Cer, 250 V, +100%-0% |
| C1358 | 283-0057-00 | | | 0.1 uF, Cer, 200 V, +80%-20% |
| C1363 | 283-0057-00 | | | 0.1 uF, Cer, 200 V, +80%-20% |
| C1366 | 281-0627-00 | | | 1 pF, Cer, 600 V |
| C1371 | 285-1040-00 | | | 0.0012 uF, Plastic, 4000 V, 10% |
| C1372 | 285-1040-00 | | | 0.0012 uF, Plastic, 4000 V, 10% |
| C1373 | 283-0178-00 | | | 0.1 uF, Cer, 100 V, +80%-20% |
| C1374 | 290-0164-00 | | | 1 uF, Elect., 150 V |
| C1380 | 285-1040-00 | | | 0.0012 uF, Plastic, 4000 V, 10% |
| C1381 | 283-0002-00 | | | 0.01 uF, Cer, 500 V |
| C1387 | 290-0523-00 | | | 2.2 uF, Elect., 20 V, 20% |
| C1388 | 290-0523-00 | | | 2.2 uF, Elect., 20 V, 20% |
| C1390 | 283-0001-00 | | | 0.005 uF, Cer, 500 V |
| C1394 | 283-0001-00 | B010100 | B029999X | 0.005 uF, Cer, 500 V |
| C1394 | 283-0001-00 | XB050000 | | 0.005 uF, Cer, 500 V |
| C1397 | 283-0001-00 | | | 0.005 uF, Cer, 500 V |
| C1399 | 283-0111-00 | | | 0.1 uF, Cer, 50 V |
| C1412 | 290-0585-00 | | | 350 uF, Elect., 75 V, +75%-10% |
| C1414 | 290-0586-00 | | | 1000 uF, Elect., 75 V, +75%-10% |
| C1416 | 283-0004-00 | | | 0.02 uF, Cer, 150 V |
| C1428 | 290-0525-00 | | | 4.7 uF, Elect., 50 V, 20% |
| C1431 | 281-0546-00 | | | 330 pF, Cer, 500 V, 10% |
| C1442 | 290-0584-00 | | | 5500 uF, Elect., 30 V, +100%-10% |
| C1448 | 290-0536-00 | | | 10 uF, Elect., 25 V, 20% |
| C1452 | 290-0571-00 | | | 5000 uF, Elect., 25 V, +100%-10% |

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|-------------------|--------------------|----------------------|------|--|
| CAPACITORS (cont) | | | | |
| C1458 | 290-0535-00 | | | 33 uF, Elect., 10 V, 20% |
| C1462 | 290-0584-00 | | | 5500 uF, Elect., 30 V, +100%-10% |
| C1468 | 290-0535-00 | | | 33 uF, Elect., 10 V, 20% |
| C1472 | 290-0583-00 | | | 3000 uF, Elect., 35 V, +100%-10% |
| C1478 | 290-0536-00 | | | 10 uF, Elect., 25 V, 20% |
| C1486 | 281-0523-00 | | | 100 pF, Cer, 350 V, 20% |
| C1489 | 283-0092-00 | | | 0.03 uF, Cer, 200 V, +80%-20% |
| C1492 | 290-0523-00 | | | 2.2 uF, Elect., 20 V, 20% |
| C1505 | 285-0686-00 | | | 0.068 uF, PTM, 100 V, 10% |
| C1511 | 290-0532-00 | | | 150 uF, Elect., 6 V, 20% |
| C1512 | 281-0523-00 | | | 100 pF, Cer, 350 V, 20% |
| C1698 | 290-0536-00 | | | 10 uF, Elect., 25 V, 20% |
| DIODES | | | | |
| CR104 | 152-0323-00 | | | Silicon, SE365 |
| CR105 | 152-0323-00 | | | Silicon, SE365 |
| CR107 | 152-0141-02 | | | Silicon, 1N4152 |
| CR170 | 152-0422-00 | | | Silicon, VVC, 7 pF, 4 V, PG1084 |
| CR174 | 152-0422-00 | | | Silicon, VVC, 7 pF, 4 V, PG1084 |
| CR204 | 152-0323-00 | | | Silicon, SE365 |
| CR205 | 152-0323-00 | | | Silicon, SE365 |
| CR207 | 152-0141-02 | | | Silicon, 1N4152 |
| CR270 | 152-0422-00 | | | Silicon, VVC, 7 pF, 4 V, PG1084 |
| CR274 | 152-0422-00 | | | Silicon, VVC, 7 pF, 4 V, PG1084 |
| CR290 | 152-0141-02 | | | Silicon, 1N4152 |
| CR301 | 152-0141-02 | | | Silicon, 1N4152 |
| CR306 | 152-0141-02 | | | Silicon, 1N4152 |
| CR312 | 152-0141-02 | | | Silicon, 1N4152 |
| CR322 | 152-0141-02 | | | Silicon, 1N4152 |
| CR336 | 152-0141-02 | | | Silicon, 1N4152 |
| CR351 | 152-0141-02 | | | Silicon, 1N4152 |
| CR352 | 152-0141-02 | | | Silicon, 1N4152 |
| CR359 | 152-0141-02 | | | Silicon, 1N4152 |
| CR361 | 152-0141-02 | | | Silicon, 1N4152 |
| CR368 | 152-0141-02 | | | Silicon, 1N4152 |
| CR369 | 152-0141-02 | | | Silicon, 1N4152 |
| CR422 | 152-0141-02 | | | Silicon, 1N4152 |
| CR519 | 152-0246-00 | | | Silicon, CD12676 or FD3375 |
| CR556 | 152-0386-00 | | | Tunnel, 10 mA, 25 pF, selected from 1N3718 |
| CR566 | 152-0386-00 | | | Tunnel, 10 mA, 25 pF, selected from 1N3718 |
| CR582 | 152-0141-02 | | | Silicon, 1N4152 |
| CR584 | 152-0141-02 | | | Silicon, 1N4152 |
| CR592 | 152-0141-02 | | | Silicon, 1N4152 |
| CR601 | 152-0141-02 | | | Silicon, 1N4152 |
| CR604 | 152-0141-02 | | | Silicon, 1N4152 |

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|---------------|--------------------|----------------------|------|--|
| DIODES (cont) | | | | |
| CR605 | 152-0141-02 | | | Silicon, 1N4152 |
| CR680 | 152-0141-02 | | | Silicon, 1N4152 |
| CR681 | 152-0141-02 | | | Silicon, 1N4152 |
| CR682 | 152-0141-02 | | | Silicon, 1N4152 |
| CR683 | 152-0141-02 | | | Silicon, 1N4152 |
| CR685 | 152-0141-02 | | | Silicon, 1N4152 |
| CR689 | 152-0141-02 | | | Silicon, 1N4152 |
| CR691 | 152-0141-02 | | | Silicon, 1N4152 |
| CR692 | 152-0141-02 | | | Silicon, 1N4152 |
| CR693 | 152-0141-02 | | | Silicon, 1N4152 |
| CR694 | 152-0141-02 | | | Silicon, 1N4152 |
| CR699 | 152-0141-02 | | | Silicon, 1N4152 |
| CR701 | 152-0141-02 | | | Silicon, 1N4152 |
| CR703 | 152-0141-02 | | | Silicon, 1N4152 |
| CR705 | 152-0141-02 | | | Silicon, 1N4152 |
| CR739 | 152-0246-00 | | | Silicon, CD12676 or FD3375 |
| CR776 | 152-0386-00 | | | Tunnel, 10 mA, 25 pF, selected from 1N3718 |
| CR786 | 152-0386-00 | | | Tunnel, 10 mA, 25 pF, selected from 1N3718 |
| CR787 | 152-0141-02 | | | Silicon, 1N4152 |
| CR788 | 152-0141-02 | | | Silicon, 1N4152 |
| CR792 | 152-0141-02 | | | Silicon, 1N4152 |
| CR793 | 152-0141-02 | | | Silicon, 1N4152 |
| CR794 | 152-0141-02 | | | Silicon, 1N4152 |
| CR795 | 152-0141-02 | | | Silicon, 1N4152 |
| CR796 | 152-0141-02 | | | Silicon, 1N4152 |
| CR797 | 152-0141-02 | | | Silicon, 1N4152 |
| CR799 | 152-0141-02 | | | Silicon, 1N4152 |
| CR801 | 152-0141-02 | | | Silicon, 1N4152 |
| CR802 | 152-0141-02 | | | Silicon, 1N4152 |
| CR806 | 152-0141-02 | | | Silicon, 1N4152 |
| CR811 | 152-0141-02 | | | Silicon, 1N4152 |
| CR812 | 152-0141-02 | | | Silicon, 1N4152 |
| CR814 | 152-0141-02 | | | Silicon, 1N4152 |
| CR822 | 152-0141-02 | | | Silicon, 1N4152 |
| CR824 | 152-0141-02 | | | Silicon, 1N4152 |
| CR903 | 152-0141-02 | | | Silicon, 1N41552 |
| CR907 | 152-0141-02 | | | Silicon, 1N4152 |
| CR914 | 152-0501-00 | | | Silicon, MSD6150 |
| CR922 | 152-0141-02 | | | Silicon, 1N4152 |
| CR926 | 152-0322-00 | | | Silicon, A1108 |
| CR927 | 152-0322-00 | | | Silicon, A1108 |
| CR940 | 152-0141-02 | | | Silicon, 1N4152 |
| CR943 | 152-0141-02 | | | Silicon, 1N4152 |
| CR944 | 152-0141-02 | | | Silicon, 1N4152 |
| CR945 | 152-0141-02 | | | Silicon, 1N4152 |

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|---------------|--------------------|----------------------|---------|----------------------------|
| DIODES (cont) | | | | |
| CR952 | 152-0141-02 | | | Silicon, 1N4152 |
| CR955 | 152-0141-02 | | | Silicon, 1N4152 |
| CR956 | 152-0141-02 | | | Silicon, 1N4152 |
| CR971 | 152-0141-02 | | | Silicon, 1N4152 |
| CR976 | 152-0141-02 | | | Silicon, 1N4152 |
| CR985 | 152-0141-02 | | | Silicon, 1N4152 |
| CR987 | 152-0141-02 | | | Silicon, 1N4152 |
| CR988 | 152-0141-02 | | | Silicon, 1N4152 |
| CR996 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1001 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1006 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1015 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1017 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1018 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1023 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1026 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1028 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1029 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1034 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1036 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1037 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1044 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1046 | 151-0141-02 | | | Silicon, 1N4152 |
| CR1049 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1052 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1054 | 152-0141-02 | B010100 | B049999 | Silicon, 1N4152 |
| CR1054 | 152-0061-00 | B050000 | | Silicon, CD8393 or FDH2161 |
| CR1056 | 152-0141-02 | B010100 | B049999 | Silicon, 1N4152 |
| CR1056 | 152-0061-00 | B050000 | | Silicon, CD8393 or FDH2161 |
| CR1058 | 152-0141-02 | B010100 | B049999 | Silicon, 1N4152 |
| CR1058 | 152-0061-00 | B050000 | | Silicon, CD8393 or FDH2161 |
| CR1060 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1061 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1062 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1075 | 152-0141-02 | XB010316 | | Silicon, 1N4152 |
| CR1097 | 152-0141-02 | XB010316 | | Silicon, 1N4152 |
| CR1102 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1103 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1104 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1111 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1121 | 152-0322-00 | | | Silicon, A1108 |
| CR1122 | 152-0322-00 | | | Silicon, A1108 |
| CR1140 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1164 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1173 | 152-0322-00 | | | Silicon, A1108 |

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|---------------|--------------------|----------------------|------|---|
| DIODES (cont) | | | | |
| CR1183 | 152-0322-00 | | | Silicon, All108 |
| CR1237 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1304 | 152-0333-00 | | | Silicon, FDH6012 |
| CR1310 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1312 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1314 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1316 | 152-0333-00 | | | Silicon, FDH6012 |
| CR1317 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1320 | 152-0429-00 | | | Silicon, VG-5X |
| CR1321 | 152-0429-00 | | | Silicon, VG-5X |
| CR1331 | 152-0153-00 | | | Silicon, FD7003 or CD5574 |
| CR1337 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1341 | 152-0153-00 | | | Silicon, FD7003 or CD5574 |
| CR1342 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1343 | 152-0153-00 | | | Silicon, FD7003 or CD5574 |
| CR1344 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1345 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1352 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1353 | 152-0061-00 | | | Silicon, CD8393 or FDH2161 |
| CR1354 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1358 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1360 | 152-0107-00 | | | Silicon, TI60 or 1N647 |
| CR1366 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1367 | 152-0107-00 | | | Silicon, TI60 or 1N647 |
| CR1371 | 152-0061-00 | | | Silicon, CD8393 or FDH2161 |
| CR1373 | 152-0061-00 | | | Silicon, CD8393 or FDH2161 |
| CR1377 | 152-0242-00 | | | Silicon, selected from 1N486A |
| CR1379 | 152-0242-00 | | | Silicon, selected from 1N486A |
| CR1412 | 152-0488-00 | | | Silicon, full wave bridge, 1.5A, 200 V |
| CR1415 | 152-0107-00 | | | Silicon, TI60 or 1N647 |
| CR1421 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1422 | 152-0061-00 | | | Silicon, CD8393 or FDH2161 |
| CR1424 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1426 | 152-0066-00 | | | Silicon, diffused, selected from 1N3194 |
| CR1428 | 152-0066-00 | | | Silicon, diffused, selected from 1N3194 |
| CR1432 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1442 | 152-0462-00 | | | Silicon, MDA960-3 |
| CR1448 | 152-0066-00 | | | Silicon, diffused, selected from 1N3194 |
| CR1452 | 152-0488-00 | | | Silicon, full wave bridge, 1.5A, 200 V |
| CR1456 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1458 | 152-0066-00 | | | Silicon, diffused, selected from 1N3194 |
| CR1462 | 152-0488-00 | | | Silicon, full wave bridge, 1.5A, 200 V |
| CR1466 | 152-0141-02 | | | Silicon, 1N4152 |
| CR1468 | 152-0066-00 | | | Silicon, diffused, selected from 1N3194 |
| CR1472 | 152-0488-00 | | | Silicon, full wave bridge, 1.5A, 200 V |

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|---------------|--------------------|----------------------|------|---|
| DIODES (cont) | | | | |
| | CR1478 | 152-0066-00 | | Silicon, diffused, selected from 1N3194 |
| | CR1489 | 152-0061-00 | | Silicon, CD8393 or FDH2161 |
| | CR1691 | 152-0141-02 | | Silicon, 1N4152 |
| | CR1692 | 152-0141-02 | | Silicon, 1N4152 |
| | CR1694 | 152-0141-02 | | Silicon, 1N4152 |
| | CR1696 | 152-0141-02 | | Silicon, 1N4152 |
| | CR1698 | 152-0141-02 | | Silicon, 1N4152 |
| DELAY LINE | | | | |
| | DL380 | 119-0388-00 | | Delay line assembly |
| BULBS | | | | |
| | DS128 | 150-0111-00 | | Neon, AICT, 125VAC, 1.2 mA |
| | DS228 | 150-0111-00 | | Neon, AICT, 125VAC, 1.2 mA |
| | DS312 | 150-0130-00 | | Incandescent, 5 V, 60 mA |
| | DS314 | 150-0130-00 | | Incandescent, 5 V, 60 mA |
| | DS322 | 150-0130-00 | | Incandescent, 5 V, 60 mA |
| | DS324 | 150-0130-00 | | Incandescent, 5 V, 60 mA |
| | DS608 | 150-0130-00 | | Incandescent, 5 V, 60 mA |
| | DS610 | 150-0130-00 | | Incandescent, 5 V, 60 mA |
| | DS1091 | 150-0111-00 | | Neon, AICT, 125VAC, 1.2 mA |
| | DS1110 | 150-0111-00 | | Neon, AICT, 125VAC, 1.2 mA |
| | DS1382 | 150-0002-00 | | Neon, NE2 |
| | DS1383 | 150-0002-00 | | Neon, NE2 |
| | DS1482 | 150-0129-00 | | Incandescent 2112, 6.3 V, 200 mA |
| | DS1483 | 150-0129-00 | | Incandescent 2112, 6.3 V, 200 mA |
| | DS1492 | 150-0130-00 | | Incandescent, 5 V, 60 mA |
| FUSES | | | | |
| | F1318 | 159-0016-00 | | Cartridge, 1.5A, 3AG, fast-blo |
| | F1401 | 159-0016-00 | | Cartridge, 1.5A, 3AG, fast-blo |
| CONNECTORS | | | | |
| | J10 | 131-0679-00 | | Receptacle, electrical, 3 contact, BNC |
| | J50 | 131-0679-00 | | Receptacle, electrical, 3 contact, BNC |
| | J349 | 131-1003-00 | | Receptacle, electrical, coaxial cable |
| | J379 | 131-1003-00 | | Receptacle, electrical, coaxial cable |
| | J380 | 131-1003-00 | | Receptacle, electrical, coaxial cable |
| | J385 | 131-1003-00 | | Receptacle, electrical, coaxial cable |
| | J400 | 131-1003-00 | | Receptacle, electrical, coaxial cable |
| | J405 | 131-1003-00 | | Receptacle, electrical, coaxial cable |
| | J410 | 131-1003-00 | | Receptacle, electrical, coaxial cable |
| | J430 | 131-1003-00 | | Receptacle, electrical, coaxial cable |
| | J435 | 131-0955-00 | | Receptacle, electrical, BNC |
| | J510 | 131-0955-00 | | Receptacle, electrical, BNC |
| | J584 | 131-1003-00 | | Receptacle, electrical, coaxial cable |
| | J589 | 131-0955-00 | | Receptacle, electrical, BNC |

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|-------------------|--------------------|----------------------|---------|---------------------------------------|
| CONNECTORS (cont) | | | | |
| J664 | 131-1003-00 | | | Receptacle, electrical, coaxial cable |
| J674 | 131-1003-00 | | | Receptacle, electrical, coaxial cable |
| J694 | 131-1003-00 | | | Receptacle, electrical, coaxial cable |
| J702 | 131-1003-00 | | | Receptacle, electrical, coaxial cable |
| J704 | 131-1003-00 | | | Receptacle, electrical, coaxial cable |
| J706 | 131-1003-00 | | | Receptacle, electrical, coaxial cable |
| J720 | 131-0955-00 | | | Receptacle, electrical, BNC |
| J824 | 131-1003-00 | | | Receptacle, electrical, coaxial cable |
| J829 | 131-0955-00 | | | Receptacle, electrical, BNC |
| J1101 | 131-1003-00 | | | Receptacle, electrical, coaxial cable |
| J1302 | 131-1003-00 | | | Receptacle, electrical, coaxial cable |
| J1330 | 131-0955-00 | | | Receptacle, electrical, BNC |
| J1333 | 131-1003-00 | | | Receptacle, electrical, coaxial cable |
| J1334 | 131-1003-00 | | | Receptacle, electrical, coaxial cable |
| J1478 | 131-0771-00 | | | Receptacle, electrical, 4 contact |
| J1479 | 131-0771-00 | | | Receptacle, electrical, 4 contact |
| RELAY | | | | |
| K1103 | 148-0076-00 | | | Mag reed |
| INDUCTORS | | | | |
| L141 ¹ | | | | |
| L142 ¹ | | | | |
| L147 ¹ | | | | |
| L148 ¹ | | | | |
| L151 | 108-0743-00 | | | 52 nH |
| L152 | 108-0743-00 | | | 52 nH |
| L170 | 108-0440-00 | | | 8 uH |
| L171 | 276-0528-00 | B010100 | B029999 | Core, ferramic suppressor |
| L171 | 276-0507-00 | B030000 | | Core, ferramic suppressor, selected |
| L172 | 276-0507-00 | | | Core, ferramic suppressor |
| L174 | 276-0528-00 | B010100 | B029999 | Core, ferramic suppressor |
| L174 | 276-0507-00 | B030000 | | Core, ferramic suppressor, selected |
| L180 | 108-0440-00 | | | 8 uH |
| L182 | 276-0507-00 | | | Core, ferramic suppressor |
| L241 ¹ | | | | |
| L242 ¹ | | | | |
| L247 ¹ | | | | |
| L248 ¹ | | | | |
| L251 | 108-0743-00 | | | 52 nH |
| L252 | 108-0743-00 | | | 52 nH |
| L270 | 108-0440-00 | | | 8 uH |
| L271 | 276-0528-00 | B010100 | B029999 | Core, ferramic suppressor |
| L271 | 276-0507-00 | B030000 | | Core, ferramic suppressor, selected |
| L272 | 276-0507-00 | | | Core, ferramic suppressor |

¹ Part of Circuit Board.

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|-------------------|--------------------|----------------------|----------|-------------------------------------|
| INDUCTORS (cont) | | | | |
| L274 | 276-0528-00 | B010100 | B029999 | Core, ferramic suppressor |
| L274 | 276-0507-00 | B030000 | | Core, ferramic suppressor, selected |
| L280 | 108-0440-00 | | | 8 uH |
| L282 | 276-0507-00 | | | Core, ferramic suppressor |
| L291 | 108-0440-00 | | | 8 uH |
| L292 | 108-0440-00 | | | 8 uH |
| L297 | 108-0440-00 | | | 8 uH |
| L375 | 108-0182-00 | | | 0.3 uH |
| L376 | 108-0182-00 | | | 0.3 uH |
| L435 | 276-0588-00 | | | Core, ferrite |
| L439 | 108-0440-00 | | | 8 uH |
| L441 ¹ | | | | |
| L442 ¹ | | | | |
| L444 ¹ | | | | |
| L445 ¹ | | | | |
| L498 | 108-0440-00 | | | 8 uH |
| L499 | 108-0440-00 | | | 8 uH |
| L546 | 108-0433-00 | | | 0.09 uH |
| L551 | 108-0433-00 | | | 0.09 uH |
| L552 | 276-0528-00 | | | Core, ferramic suppressor |
| L562 | 276-0528-00 | | | Core, ferramic suppressor |
| L572 | 276-0507-00 | | | Core, ferramic suppressor |
| L574 | 276-0507-00 | | | Core, ferramic suppressor |
| L584 | 276-0507-00 | B010100 | B029999X | Core, ferramic suppressor |
| L588 | 276-0507-00 | XB030000 | | Core, ferramic suppressor |
| L600 | 120-0402-00 | XB020000 | | Toroid, 3 turns, single |
| L771 | 108-0433-00 | | | 0.09 uH |
| L772 | 276-0528-00 | | | Core, ferramic suppressor |
| L781 | 108-0433-00 | | | 0.09 uH |
| L782 | 276-0528-00 | | | Core, ferramic suppressor |
| L794 | 276-0507-00 | | | Core, ferramic suppressor |
| L802 | 276-0507-00 | XB050000 | | Core, ferramic suppressor |
| L804 | 276-0507-00 | XB050000 | | Core, ferramic suppressor |
| L826 | 276-0507-00 | XB050000 | | Core, ferramic suppressor |
| L917 | 108-0750-00 | | | 9.3 uH |
| L922 | 276-0507-00 | | | Core, ferramic suppressor |
| L984 | 276-0507-00 | | | Core, ferramic suppressor |
| L1018 | 120-0407-00 | | | Toroid, 5 turns, single |
| L1091 | 276-0507-00 | | | Core, ferramic suppressor |
| L1093 | 276-0507-00 | | | Core, ferramic suppressor |
| L1102 | 108-0538-00 | | | 2.7 uH |
| L1103 | 114-0278-00 | | | 4.6-16.7 uH, Var, Core 276-0568-00 |
| L1209 | 108-0245-00 | | | 3.9 uH |
| L1231 | 276-0507-00 | | | Core, ferramic suppressor |
| L1232 | 276-0507-00 | | | Core, ferramic suppressor |

¹Part of Circuit Board.

Electrical Parts List—475

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|------------------|--------------------|----------------------|---------|--|
| INDUCTORS (cont) | | | | |
| L1251 | 276-0507-00 | | | Core, ferramic suppressor |
| L1261 | 108-0245-00 | | | 3.9 uH |
| L1263 | 108-0245-00 | | | 3.9 uH |
| L1265 | 108-0245-00 | | | 3.9 uH |
| L1318 | 108-0422-00 | | | 80 uH |
| L1330 | 108-0440-00 | | | 8 uH |
| L1385 | 108-0714-00 | | | Y axis alignment |
| L1386 | 108-0713-00 | | | Trace rotator |
| L1387 | 108-0245-00 | | | 3.9 uH |
| L1388 | 108-0245-00 | | | 3.9 uH |
| L1394 | 276-0541-00 | XB030000 | | Core, ferrite |
| L1511 | 108-0245-00 | | | 3.9 uH |
| LR496 | 108-0685-00 | | | 80 nH |
| LR497 | 108-0685-00 | | | 80 nH |
| LR1335 | 108-0537-00 | XB050000 | | 200 uH |
| LR1336 | 108-0537-00 | XB050000 | | 200 uH |
| TRANSISTORS | | | | |
| Q172 | 151-0271-00 | | | Silicon, PNP, SAB4113 |
| Q178 | 151-0271-00 | | | Silicon, PNP, SAB4113 |
| Q182 | 151-0271-00 | | | Silicon, PNP, SAB4113 |
| Q184 | 151-0188-00 | | | Silicon, PNP, 2N3906 |
| Q188 | 151-0271-00 | | | Silicon, PNP, SAB4113 |
| Q272 | 151-0271-00 | | | Silicon, PNP, SAB4113 |
| Q278 | 151-0271-00 | | | Silicon, PNP, SAB4113 |
| Q282 | 151-0271-00 | | | Silicon, PNP, SAB4113 |
| Q284 | 151-0188-00 | | | Silicon, PNP, 2N3906 |
| Q288 | 151-0271-00 | | | Silicon, PNP, SAB4113 |
| Q312 | 151-0301-00 | | | Silicon, PNP, 2N2907 |
| Q314 | 151-0301-00 | | | Silicon, PNP, 2N2907 |
| Q322 | 151-0301-00 | | | Silicon, PNP, 2N2907 |
| Q324 | 151-0301-00 | | | Silicon, PNP, 2N2907 |
| Q338 | 151-0301-00 | | | Silicon, PNP, 2N2907 |
| Q348 | 151-0301-00 | | | Silicon, PNP, 2N2907 |
| Q390 | 151-0367-00 | | | Silicon, NPN, SKA6516 |
| Q396 | 151-0271-00 | | | Silicon, PNP, SAB4113 |
| Q420 | 151-0367-00 | B010100 | B010309 | Silicon, NPN, SKA6516 |
| Q420 | 151-0223-00 | B010310 | | Silicon, NPN, 2N4275 |
| Q430 | 151-0188-00 | | | Silicon, PNP, 2N3906 |
| Q444 | 151-0301-00 | | | Silicon, PNP, 2N2907 |
| Q502 | 151-0367-00 | | | Silicon, NPN, SKA6516 |
| Q504 | 151-0367-00 | | | Silicon, NPN, SKA6516 |
| Q506 | 151-0367-00 | | | Silicon, NPN, SKA6516 |
| Q522} | 151-1042-00 | | | Silicon, FET, N channel, selected from |
| Q524} | | | | 2N5245, matched pair |
| Q526 | 151-0221-00 | | | Silicon, PNP, 2N4258 |

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|--------------------|--------------------|----------------------|---------|--|
| TRANSISTORS (cont) | | | | |
| Q532 | 151-0188-00 | | | Silicon, PNP, 2N3906 |
| Q552 | 151-0369-00 | | | Silicon, PNP, replaceable by 151-0271-00 |
| Q556 | 151-0221-00 | | | Silicon, PNP, 2N4258 |
| Q562 | 151-0369-00 | | | Silicon, PNP, replaceable by 151-0271-00 |
| Q566 | 151-0221-00 | | | Silicon, PNP, 2N4258 |
| Q572 | 151-0199-00 | | | Silicon, PNP, MPS3640 |
| Q574 | 151-0199-00 | | | Silicon, PNP, MPS3640 |
| Q584 | 151-0190-00 | | | Silicon, NPN, 2N3904 or TE3904 |
| Q588 | 151-0199-00 | | | Silicon, PNP, MPS3640 |
| Q594 | 151-0190-00 | | | Silicon, NPN, 2N3904 or TE3904 |
| Q596 | 151-0188-00 | | | Silicon, PNP, 2N3906 |
| Q612 | 151-0223-00 | | | Silicon, NPN, 2N4275 |
| Q628 | 151-0223-00 | | | Silicon, NPN, 2N4275 |
| Q644 | 151-0350-00 | | | Silicon, PNP, 2N5401 |
| Q662 | 151-0221-00 | | | Silicon, PNP, 2N4258 |
| Q664 | 151-0367-00 | | | Silicon, NPN, SKA6516 |
| Q672 | 151-0221-00 | | | Silicon, PNP, 2N4258 |
| Q674 | 151-0367-00 | | | Silicon, NPN, SKA6516 |
| Q680 | 151-0188-00 | | | Silicon, PNP, 2N3906 |
| Q688 | 151-0223-00 | B010100 | B010161 | Silicon, NPN, 2N4275 |
| Q688 | 151-0367-00 | B010162 | | Silicon, NPN, SKA6516 |
| Q698 | 151-0223-00 | B010100 | B010161 | Silicon, NPN, 2N4275 |
| Q698 | 151-0367-00 | B010162 | | Silicon, NPN, SKA6516 |
| Q712 | 151-0367-00 | | | Silicon, NPN, SKA6516 |
| Q714 | 151-0367-00 | | | Silicon, NPN, SKA6516 |
| Q716 | 151-0367-00 | | | Silicon, NPN, SKA6516 |
| Q742 } Q744 } | 151-1042-00 | | | Silicon, FET, N channel, selected from 2N5245, matched pair |
| Q746 | 151-0221-00 | | | Silicon, PNP, 2N4258 |
| Q752 | 151-0188-00 | | | Silicon, PNP, 2N3906 |
| Q772 | 151-0271-00 | | | Silicon, PNP, SAB4113 |
| Q776 | 151-0221-00 | | | Silicon, PNP, 2N4258 |
| Q782 | 151-0271-00 | | | Silicon, PNP, SAB4113 |
| Q786 | 151-0221-00 | | | Silicon, PNP, 2N4258 |
| Q788 | 151-0190-00 | | | Silicon, NPN, 2N3904 or TE3904 |
| Q790 | 151-0223-00 | | | Silicon, NPN, 2N4275 |
| Q792 | 151-0223-00 | | | Silicon, NPN, 2N4275 |
| Q794 | 151-0188-00 | | | Silicon, PNP, 2N3906 |
| Q796 | 151-0188-00 | | | Silicon, PNP, 2N3906 |
| Q798 | 151-0190-00 | | | Silicon, NPN, 2N3904 or TE3904 |
| Q802 | 151-0199-00 | | | Silicon, PNP, MPS3640 |
| Q804 | 151-0199-00 | | | Silicon, PNP, MPS3640 |
| Q824 | 151-0190-00 | | | Silicon, NPN, 2N3904 or TE3904 |
| Q826 | 151-0199-00 | | | Silicon, PNP, MPS3640 |
| Q902 | 151-0199-00 | | | Silicon, PNP, MPS3640 |

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|--------------------|--------------------|----------------------|------|---|
| TRANSISTORS (cont) | | | | |
| Q904 | 151-0190-01 | | | Silicon, NPN, 2N3904 or TE3904 |
| Q914 | 151-0261-00 | | | Silicon, PNP, NS7406 |
| Q920 | 151-1025-00 | | | Silicon, JFET, N channel, similar to KE4416 |
| Q922 | 151-0127-00 | | | Silicon, NPN, selected from 2N2369 |
| Q926A,B | 151-1036-00 | | | Silicon, JFET, N channel, 2N4393, dual |
| Q928 | 151-0190-00 | | | Silicon, NPN, 2N3904 or TE3904 |
| Q938 | 151-0261-00 | | | Silicon, PNP, NS7406 |
| Q940 | 151-0190-00 | | | Silicon, NPN, 2N3904 or TE3904 |
| Q944 | 151-0190-00 | | | Silicon, NPN, 2N3904 or TE3904 |
| Q946 | 151-0190-00 | | | Silicon, NPN, 2N3904 or TE3904 |
| Q956 | 151-0188-00 | | | Silicon, PNP, 2N3906 |
| Q972 | 151-0188-00 | | | Silicon, PNP, 2N3906 |
| Q974 | 151-0190-01 | | | Silicon, NPN, 2N3904 or TE3904 |
| Q980 | 151-1025-00 | | | Silicon, JFET, N channel, similar to KE4416 |
| Q984 | 151-0127-00 | | | Silicon, NPN, selected from 2N2369 |
| Q988 | 151-0188-00 | | | Silicon, PNP, 2N3906 |
| Q992 | 151-0188-00 | | | Silicon, PNP, 2N3906 |
| Q996 | 151-0199-00 | | | Silicon, PNP, MPS3640 |
| Q1002 | 151-0347-00 | | | Silicon, NPN, 2N5551 |
| Q1004 | 151-0367-00 | | | Silicon, NPN, SKA6516 |
| Q1008 | 151-0347-00 | | | Silicon, NPN, 2N5551 |
| Q1010 | 151-1025-00 | | | Silicon, JFET, N channel, similar to KE4416 |
| Q1014 | 151-0127-00 | | | Silicon, NPN, selected from 2N2369 |
| Q1018 | 151-0188-00 | | | Silicon, PNP, 2N3906 |
| Q1022 | 151-0190-00 | | | Silicon, NPN, 2N3904 or TE3904 |
| Q1026 | 151-0188-00 | | | Silicon, PNP, 2N3906 |
| Q1034 | 151-0190-00 | | | Silicon, NPN, 2N3904 or TE3904 |
| Q1044 | 151-0190-00 | | | Silicon, NPN, 2N3904 or TE3904 |
| Q1052 | 151-0350-00 | | | Silicon, PNP, 2N5401 |
| Q1054 | 151-0350-00 | | | Silicon, PNP, 2N5401 |
| Q1056 | 151-0350-00 | | | Silicon, PNP, 2N5401 |
| Q1058 | 151-0350-00 | | | Silicon, PNP, 2N5401 |
| Q1086 | 151-0190-00 | | | Silicon, NPN, 2N3904 or TE3904 |
| Q1114 | 151-0302-00 | | | Silicon, NPN, 2N2222A |
| Q1124 | 151-0367-00 | | | Silicon, NPN, SKA6516 |
| Q1134 | 151-0367-00 | | | Silicon, NPN, SKA6516 |
| Q1140 | 151-0302-00 | | | Silicon, NPN, 2N2222A |
| Q1152 | 151-0325-00 | | | Silicon, PNP, 2N4258 |
| Q1162 | 151-0325-00 | | | Silicon, PNP, 2N4258 |
| Q1164 | 151-0188-00 | | | Silicon, PNP, 2N3906 |
| Q1172 | 151-0325-00 | | | Silicon, PNP, 2N4258 |
| Q1174 | 151-0325-00 | | | Silicon, PNP, 2N4258 |

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|--------------------|--------------------|----------------------|---------|--------------------------------------|
| TRANSISTORS (cont) | | | | |
| Q1182 | 151-0367-00 | | | Silicon, NPN, SKA6516 |
| Q1184 | 151-0367-00 | B010100 | B010274 | Silicon, NPN, SKA6516 |
| Q1184 | 151-0127-00 | B010275 | | Silicon, NPN, selected from 2N2369 |
| Q1188 | 151-0302-00 | | | Silicon, NPN, 2N2222A |
| Q1202 | 151-0270-00 | | | Silicon, PNP, selected from 2N3495 |
| Q1204 | 151-0124-00 | | | Silicon, NPN, selected from 2N3501 |
| Q1212 | 151-0270-00 | | | Silicon, PNP, selected from 2N3495 |
| Q1214 | 151-0124-00 | | | Silicon, NPN, selected from 2N3501 |
| Q1234 | 151-0188-00 | | | Silicon, PNP, 2N3906 |
| Q1254 | 151-0188-00 | | | Silicon, PNP, 2N3906 |
| Q1306 | 151-0126-00 | | | Silicon, NPN, 2N2484 |
| Q1308 | 151-0301-00 | | | Silicon, PNP, 2N2907 |
| Q1310 | 151-0190-00 | | | Silicon, NPN, 2N3904 or TE3904 |
| Q1312 | 151-0188-00 | | | Silicon, PNP, 2N3906 |
| Q1316 | 151-0136-00 | | | Silicon, NPN, 2N3053 |
| Q1318 | 151-0140-00 | | | Silicon, NPN, selected from 2N3055 |
| Q1332 | 151-0199-00 | | | Silicon, PNP, MPS3640 |
| Q1338 | 151-0367-00 | | | Silicon, NPN, SKA6516 |
| Q1344 | 151-0188-00 | | | Silicon, PNP, 2N3906 |
| Q1352 | 151-0124-00 | | | Silicon, NPN, selected from 2N3501 |
| Q1354 | 151-0270-00 | | | Silicon, PNP, selected from 2N3495 |
| Q1358 | 151-0199-00 | | | Silicon, PNP, MPS3640 |
| Q1362 | 151-0188-00 | | | Silicon, PNP, 2N3906 |
| Q1424 | 151-0347-00 | | | Silicon, NPN, 2N5551 |
| Q1426 | 151-0349-00 | | | Silicon, NPN, SJE924 |
| Q1432 | 151-0347-00 | | | Silicon, NPN, 2N5551 |
| Q1444 | 151-0302-00 | | | Silicon, NPN, 2N2222A |
| Q1446 | 151-0302-00 | | | Silicon, NPN, 2N2222A |
| Q1448 | 151-0349-00 | | | Silicon, NPN, SJE924 |
| Q1454 | 151-0302-00 | | | Silicon, NPN, 2N2222A |
| Q1456 | 151-0390-00 | | | Silicon, NPN, MPSU45 |
| Q1464 | 151-0302-00 | | | Silicon, NPN, 2N2222A |
| Q1466 | 151-0302-00 | | | Silicon, NPN, 2N2222A |
| Q1468 | 151-0349-00 | | | Silicon, NPN, replaceable by MJE2801 |
| Q1474 | 151-0302-00 | | | Silicon, NPN, 2N2222A |
| Q1478 | 151-0260-02 | | | Silicon, NPN, 2N5189 or 2N5859 |
| Q1482 | 151-0390-00 | | | Silicon, NPN, MPSU45 |
| Q1490 | 151-0190-00 | | | Silicon, NPN, 2N3904 or TE3904 |
| Q1492 | 151-0302-00 | | | Silicon, NPN, 2N2222A |
| Q1494 | 151-0347-00 | | | Silicon, NPN, 2N5551 |
| Q1496 | 151-0350-00 | | | Silicon, PNP, 2N5401 |
| Q1498 | 151-0302-00 | | | Silicon, NPN, 2N2222A |
| Q1502 | 151-0342-00 | | | Silicon, PNP, 2N4249 |
| Q1504 | 151-0342-00 | | | Silicon, PNP, 2N4249 |
| Q1512 | 151-0164-00 | | | Silicon, PNP, 2N5447 or 2N3702 |
| Q1698 | 151-0301-00 | | | Silicon, PNP, 2N2907 |

Electrical Parts List-475

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|-------------------|--------------------|----------------------|---------|-------------------------------------|
| RESISTORS | | | | |
| R10 | 315-0430-00 | | | 43 ohm, 1/2 W, 5% |
| R13 | 316-0101-00 | | | 100 ohm, 1/2 W, 10% |
| R22 (2) | 316-0105-00 | | | 1M ohm, 1/2 W, 10% |
| R24 (2) | 315-0510-00 | | | 51 ohm, 1/2 W, 5% |
| R32 (2) | 317-0047-00 | | | 4.7 ohm, 1/8 W, 5% |
| R33 (2) | 315-0360-00 | | | 36 ohm, 1/2 W, 5% |
| R34 (2) | 317-0120-00 | B010100 | B010309 | 12 ohm, 1/8 W, 5% |
| R34 (2) | 317-0100-00 | B010310 | | 10 ohm, 1/8 W, 5% |
| R35 (2) | 317-0390-00 | XB010310 | | 39 ohm, 1/8 W, 5% |
| R36 (2) | 317-0120-00 | | | 12 ohm, 1/8 W, 5% |
| R39 (2) | 321-0481-00 | | | 1M ohm, 1/8 W, 1% |
| R41 | 317-0474-00 | | | 470K ohm, 1/8 W, 5% |
| R42 | 315-0300-00 | | | 30 ohm, 1/2 W, 5% |
| R50 | 315-0430-00 | | | 43 ohm, 1/2 W, 5% |
| R53 | 316-0101-00 | | | 100 ohm, 1/2 W, 10% |
| R61 | 317-0474-00 | | | 470K ohm, 1/8 W, 5% |
| R62 | 315-0300-00 | | | 30 ohm, 1/2 W, 5% |
| R104 | 317-0391-00 | | | 390 ohm, 1/8 W, 5% |
| R105 | 315-0470-00 | | | 47 ohm, 1/2 W, 5% |
| R109 | 317-0332-00 | B010100 | B049999 | 3.3K ohm, 1/8 W, 5% |
| R109 | 317-0332-00 | B050000 | | 3.3K ohm, (nominal value), selected |
| R110 | 311-1228-00 | | | 10K ohm, Var |
| R111 | 315-0103-00 | | | 10K ohm, 1/2 W, 5% |
| R112 | 311-1259-00 | | | 100 ohm, Var |
| R113 | 317-0102-00 | | | 1K ohm, 1/8 W, 5% |
| R114 | 315-0151-00 | | | 150 ohm, 1/2 W, 5% |
| R119 | 315-0300-00 | | | 30 ohm, 1/2 W, 5% |
| R120 | 315-0104-00 | | | 100K ohm, 1/2 W, 5% |
| R122 | 321-0239-00 | | | 3.01K ohm, 1/8 W, 1% |
| R123 | 315-0470-00 | B010100 | B049999 | 47 ohm, 1/2 W, 5% |
| R123 | 316-0101-00 | B050000 | | 100 ohm, 1/2 W, 10% |
| R124 | 321-0307-00 | | | 15.4K ohm, 1/8 W, 1% |
| R125 | 311-1226-00 | B010100 | B029999 | 2.5K ohm, Var |
| R125 | 315-0222-00 | B030000 | | 2.2K ohm, 1/2 W, 5% |
| R126 | 321-0277-00 | | | 7.5K ohm, 1/8 W, 1% |
| R127 | 315-0470-00 | B010100 | B049999 | 47 ohm, 1/2 W, 5% |
| R127 ¹ | 316-0101-00 | B050000 | | 100 ohm, 1/2 W, 10% |
| R128 ¹ | 311-1403-00 | | | 5K ohm, Var |
| R129 | 316-0105-00 | | | 1M ohm, 1/2 W, 10% |
| R130 | 321-0133-00 | | | 237 ohm, 1/8 W, 1% |
| R131 | 321-0133-00 | | | 237 ohm, 1/8 W, 1% |
| R132 | 317-0101-00 | | | 100 ohm, 1/8 W, 5% |
| R133 | 311-1259-00 | | | 100 ohm, Var |
| R134 | 317-0101-00 | | | 100 ohm, 1/8 W, 5% |

¹Furnished as a unit with S128.

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|------------------|--------------------|----------------------|---------|-------------------------------------|
| RESISTORS (cont) | | | | |
| R135 | 311-1222-00 | | | 100 ohm, Var |
| R136 | 317-0101-00 | | | 100 ohm, 1/8 W, 5% |
| R137 | 317-0152-00 | B010100 | B010309 | 1.5K ohm, 1/8 W, 1% |
| R137 | 317-0132-00 | B010310 | | 1.3K ohm, 1/8 W, 5% |
| R138 | 317-0242-00 | | | 2.4K ohm, 1/8 W, 5% |
| R139 | 311-0635-00 | | | 1K ohm, Var |
| R142 | 321-0072-00 | | | 54.9 ohm, 1/8 W, 1% |
| R143 | 321-0072-00 | | | 54.9 ohm, 1/8 W, 1% |
| R145 | 315-0470-00 | | | 47 ohm, 1/2 W, 5% |
| R149 | 321-0260-00 | | | 4.99K ohm, 1/8 W, 1% |
| RT149 | 307-0124-00 | | | 5K ohm, Thermal |
| R151 | 321-0076-00 | | | 60.4 ohm, 1/8 W, 1% |
| R152 | 321-0076-00 | | | 60.4 ohm, 1/8 W, 1% |
| R154 | 321-0076-00 | | | 60.4 ohm, 1/8 W, 1% |
| R155 | 321-0076-00 | | | 60.4 ohm, 1/8 W, 1% |
| R156 | 321-0081-00 | | | 68.1 ohm, 1/8 W, 1% |
| R157 | 321-0024-00 | | | 17.4 ohm, 1/8 W, 1% |
| R161 | 315-0511-00 | | | 510 ohm, 1/2 W, 5% |
| R162 | 321-0172-00 | | | 604 ohm, 1/8 W, 1% |
| R163 | 321-0211-00 | | | 1.54K ohm, 1/8 W, 1% |
| R164 | 321-0147-00 | | | 332 ohm, 1/8 W, 1% |
| R165 | 311-1225-00 | | | 1K ohm, Var |
| R168 | 315-0222-00 | | | 2.2K ohm, 1/2 W, 5% |
| R170 | 315-0152-00 | B010100 | B029999 | 1.5K ohm, 1/2 W, 5% |
| R170 | 315-0122-00 | B030000 | | 1.2K ohm, (nominal value), selected |
| RT170 | 307-0181-00 | | | 100K ohm, Thermal |
| R171 | 315-0100-00 | | | 100 ohm, 1/2 W, 5% |
| R172 | 315-0471-00 | B010100 | B010244 | 470 ohm, 1/2 W, 5% |
| R172 | 315-0331-00 | B010245 | | 330 ohm, 1/2 W, 5% |
| R173 | 321-0018-00 | | | 15 ohm, 1/8 W, 1% |
| R174 | 315-0154-00 | | | 150K ohm, 1/2 W, 5% |
| R175 | 311-1260-00 | | | 250 ohm, Var |
| R176 | 311-1223-00 | B010100 | B010244 | 250 ohm, Var |
| R176 | 311-1226-00 | B010245 | | 2.5K ohm, Var |
| R177 | 317-0201-00 | | | 200 ohm, 1.8 W, 5% |
| R178 | 315-0391-00 | | | 390 ohm, 1/2 W, 5% |
| R179 | 321-0152-00 | B010100 | B010244 | 374 ohm, 1/8 W, 1% |
| R179 | 321-0164-00 | B010245 | | 499 ohm, 1/8 W, 1% |
| R180 | 315-0152-00 | B010100 | B029999 | 1.5K ohm, 1/2 W, 5% |
| R180 | 315-0122-00 | B030000 | | 1.2K ohm, (nominal value), selected |
| R181 | 315-0101-00 | | | 100 ohm, 1/2 W, 5% |
| R182 | 315-0471-00 | B010100 | B010244 | 470 ohm, 1/2 W, 5% |
| R182 | 315-0331-00 | B010245 | | 330 ohm, 1/2 W, 5% |
| R183 | 321-0018-00 | | | 15 ohm, 1/8 W, 1% |
| R184 | 321-0067-00 | B010100 | B010244 | 48.7 ohm, 1/8 W, 1% |

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|-------------------|--------------------|----------------------|---------|-------------------------------------|
| RESISTORS (cont) | | | | |
| R184 | 321-0051-00 | B010245 | | 33.2 ohm, 1/8 W, 1% |
| R185 | 311-1397-00 | | | 2 x 5K ohm, Var |
| R186 | 321-0152-00 | B010100 | B010244 | 374 ohm, 1/8 W, 1% |
| R186 | 321-0148-00 | B010245 | | 340 ohm, 1/8 W, 1% |
| R187 | 321-0231-00 | | | 2.49K ohm, 1/8 W, 1% |
| R188 | 315-0391-00 | | | 390 ohm, 1/2 W, 5% |
| R189 | 321-0152-00 | B010100 | B010244 | 374 ohm, 1/8 W, 1% |
| R189 | 321-0164-00 | B010245 | | 499 ohm, 1/8 W, 1% |
| R193 | 321-0097-00 | XB030000 | | 100 ohm, 1/8 W, 1% |
| R194 | 321-0097-00 | XB030000 | | 100 ohm, 1/8 W, 1% |
| R195 | 311-1266-00 | XB030000 | | 2.5K ohm, Var |
| R196 | 315-0182-00 | XB010245 | | 1.8K ohm, 1/2 W, 5% |
| R198 | 315-0182-00 | XB010245 | | 1.8K ohm, 1/2 W, 5% |
| R204 | 317-0391-00 | | | 390 ohm, 1/8 W, 5% |
| R205 | 315-0470-00 | | | 47 ohm, 1/2 W, 5% |
| R209 | 317-0332-00 | B010100 | B049999 | 3.3K ohm, 1/8 W, 5% |
| R209 | 317-0332-00 | B050000 | | 3.3K ohm, (nominal value), selected |
| R210 | 311-1228-00 | | | 10K ohm, Var |
| R211 | 315-0103-00 | | | 10K ohm, 1/2 W, 5% |
| R212 | 311-1259-00 | | | 100 ohm, Var |
| R213 | 317-0102-00 | | | 1K ohm, 1/8 W, 5% |
| R214 | 315-0151-00 | | | 150 ohm, 1/2 W, 5% |
| R215 | 311-1268-00 | | | 10K ohm, Var |
| R216 | 315-0103-00 | | | 10K ohm, 1/2 W, 5% |
| R217 | 321-0277-00 | | | 7.5K ohm, 1/8 W, 1% |
| R218 | 321-0277-00 | | | 7.5K ohm, 1/8 W, 1% |
| R219 | 315-0300-00 | | | 30 ohm, 1/2 W, 5% |
| R220 | 315-0104-00 | | | 100K ohm, 1/2 W, 5% |
| R221 | 321-0307-00 | | | 15.4K ohm, 1/8 W, 1% |
| R222 | 321-0253-00 | | | 4.22K ohm, 1/8 W, 1% |
| R223 | 315-0470-00 | B010100 | B049999 | 47 ohm, 1/2 W, 5% |
| R223 | 316-0101-00 | B050000 | | 100 ohm, 1/2 W, 10% |
| R224 | 321-0307-00 | | | 15.4K ohm, 1/8 W, 1% |
| R225 | 311-1226-00 | B010100 | B029999 | 2.5K ohm, Var |
| R225 | 315-0222-00 | B030000 | | 2.2K ohm, 1/2 W, 5% |
| R226 | 321-0253-00 | | | 4.22K ohm, 1/8 W, 1% |
| R227 | 315-0470-00 | B010100 | B049999 | 47 ohm, 1/2 W, 5% |
| R227 ¹ | 316-0101-00 | B050000 | | 100 ohm, 1/2 W, 10% |
| R228 ¹ | 311-1403-00 | | | 5K ohm, Var |
| R229 | 316-0105-00 | | | 1M ohm, 1/2 W, 10% |
| R230 | 321-0133-00 | | | 237 ohm, 1/8 W, 1% |
| R231 | 321-0133-00 | | | 237 ohm, 1/8 W, 1% |
| R232 | 317-0101-00 | | | 100 ohm, 1/8 W, 5% |
| R233 | 311-1259-00 | | | 100 ohm, Var |
| R234 | 317-0101-00 | | | 100 ohm, 1/8 W, 5% |

¹ Furnished as a unit with S228.

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|------------------|--------------------|----------------------|---------|-------------------------------------|
| RESISTORS (cont) | | | | |
| R235 | 311-1222-00 | | | 100 ohm, Var |
| R236 | 317-0101-00 | | | 100 ohm, 1/8 W, 5% |
| R237 | 317-0152-00 | B010100 | B010309 | 1.5K ohm, 1/8 W, 5% |
| R237 | 317-0132-00 | B010310 | | 1.3K ohm, 1/8 W, 5% |
| R238 | 317-0242-00 | | | 2.4K ohm, 1/8 W, 5% |
| R239 | 311-0635-00 | | | 1K ohm, Var |
| R242 | 321-0072-00 | | | 54.9 ohm, 1/8 W, 1% |
| R243 | 321-0072-00 | | | 54.9 ohm, 1/8 W, 1% |
| R245 | 315-0470-00 | | | 47 ohm, 1/4 W, 5% |
| R249 | 321-0260-00 | | | 4.99K ohm, 1/8 W, 1% |
| RT249 | 307-0124-00 | | | 5K ohm, Thermal |
| R251 | 321-0076-00 | | | 60.4 ohm, 1/8 W, 1% |
| R252 | 321-0076-00 | | | 60.4 ohm, 1/8 W, 1% |
| R254 | 321-0076-00 | | | 60.4 ohm, 1/8 W, 1% |
| R255 | 321-0076-00 | | | 60.4 ohm, 1/8 W, 1% |
| R256 | 321-0081-00 | | | 68.1 ohm, 1/8 W, 5% |
| R257 | 321-0024-00 | | | 17.4 ohm, 1/8 W, 1% |
| R261 | 315-0511-00 | | | 510 ohm, 1/4 W, 5% |
| R262 | 321-0172-00 | | | 604 ohm, 1/8 W, 1% |
| R263 | 321-0211-00 | | | 1.54K ohm, 1/8 W, 1% |
| R264 | 321-0147-00 | | | 332 ohm, 1/8 W, 1% |
| R265 | 311-1225-00 | | | 1K ohm, Var |
| R268 | 315-0222-00 | | | 2.2K ohm, 1/4 W, 5% |
| R270 | 315-0152-00 | B010100 | B029999 | 1.5K ohm, 1/4 W, 5% |
| R270 | 315-0122-00 | B030000 | | 1.2K ohm, (nominal value), selected |
| RT270 | 307-0181-00 | | | 100K ohm, Thermal |
| R271 | 315-0100-00 | | | 100 ohm, 1/4 W, 5% |
| R272 | 315-0471-00 | B010100 | B010244 | 470 ohm, 1/4 W, 5% |
| R272 | 315-0331-00 | B010245 | | 330 ohm, 1/4 W, 5% |
| R273 | 321-0018-00 | | | 15 ohm, 1/8 W, 1% |
| R274 | 315-0154-00 | | | 150K ohm, 1/4 W, 5% |
| R275 | 311-1260-00 | | | 250 ohm, Var |
| R276 | 311-1223-00 | B010100 | B010244 | 250 ohm, Var |
| R276 | 311-1226-00 | B010245 | | 2.5K ohm, Var |
| R277 | 317-0201-00 | | | 200 ohm, 1/8 W, 5% |
| R278 | 315-0391-00 | | | 390 ohm, 1/4 W, 5% |
| R279 | 321-0152-00 | B010100 | B010244 | 374 ohm, 1/8 W, 1% |
| R279 | 321-0164-00 | B010245 | | 499 ohm, 1/8 W, 1% |
| R280 | 315-0152-00 | B010100 | B029999 | 1.5K ohm, 1/4 W, 5% |
| R280 | 315-0122-00 | B030000 | | 1.2K ohm, (nominal value), selected |
| R281 | 315-0101-00 | | | 100 ohm, 1/4 W, 5% |
| R282 | 315-0471-00 | B010100 | B010244 | 470 ohm, 1/4 W, 5% |
| R282 | 315-0331-00 | B010245 | | 330 ohm, 1/4 W, 5% |
| R283 | 321-0018-00 | | | 15 ohm, 1/8 W, 1% |
| R284 | 321-0067-00 | B010100 | B010244 | 48.7 ohm, 1/8 W, 1% |

Electrical Parts List—475

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|------------------|--------------------|----------------------|---------|----------------------|
| RESISTORS (cont) | | | | |
| R284 | 321-0051-00 | B010245 | | 33.2 ohm, 1/8 W, 1% |
| R285 | 311-1397-00 | | | 2 x 5K ohm, Var |
| R286 | 321-0152-00 | B010100 | B010244 | 374 ohm, 1/8 W, 1% |
| R286 | 321-0148-00 | B010245 | | 340 ohm, 1/8 W, 1% |
| R287 | 321-0231-00 | | | 2.49K ohm, 1/8 W, 1% |
| R288 | 315-0391-00 | | | 390 ohm, 1/2 W, 5% |
| R289 | 321-0152-00 | B010100 | B010244 | 374 ohm, 1/8 W, 1% |
| R289 | 321-0164-00 | B010245 | | 499 ohm, 1/8 W, 1% |
| R291 | 307-0106-00 | | | 4.7 ohm, 1/2 W, 5% |
| R292 | 307-0106-00 | | | 4.7 ohm, 1/2 W, 5% |
| R293 | 321-0097-00 | XB030000 | | 100 ohm, 1/8 W, 1% |
| R294 | 321-0097-00 | XB030000 | | 100 ohm, 1/8 W, 1% |
| R295 | 311-1266-00 | XB030000 | | 2.5K ohm, Var |
| R296 | 315-0182-00 | XB010245 | | 1.8K ohm, 1/2 W, 5% |
| R297 | 307-0106-00 | | | 4.7 ohm, 1/2 W, 5% |
| R298 | 315-0182-00 | XB010245 | | 1.8K ohm, 1/2 W, 5% |
| R301 | 321-0164-00 | | | 499 ohm, 1/8 W, 1% |
| R302 | 321-0131-00 | | | 226 ohm, 1/8 W, 1% |
| R304 | 315-0102-00 | | | 1K ohm, 1/2 W, 5% |
| R306 | 315-0121-00 | | | 120 ohm, 1/2 W, 5% |
| R310 | 315-0101-00 | | | 100 ohm, 1/2 W, 5% |
| R311 | 315-0152-00 | | | 1.5K ohm, 1/2 W, 5% |
| R312 | 315-0120-00 | | | 12 ohm, 1/2 W, 5% |
| R313 | 315-0222-00 | | | 2.2K ohm, 1/2 W, 5% |
| R314 | 316-0822-00 | | | 8.2K ohm, 1/2 W, 10% |
| R316 | 315-0223-00 | | | 22K ohm, 1/2 W, 5% |
| R320 | 315-0101-00 | | | 100 ohm, 1/2 W, 5% |
| R321 | 315-0152-00 | | | 1.5K ohm, 1/2 W, 5% |
| R322 | 315-0120-00 | | | 12 ohm, 1/2 W, 5% |
| R323 | 315-0222-00 | | | 2.2K ohm, 1/2 W, 5% |
| R324 | 316-0822-00 | | | 8.2K ohm, 1/2 W, 10% |
| R326 | 315-0223-00 | | | 22K ohm, 1/2 W, 5% |
| R331 | 315-0102-00 | | | 1K ohm, 1/2 W, 5% |
| R332 | 315-0123-00 | | | 12K ohm, 1/2 W, 5% |
| R333 | 315-0182-00 | | | 1.8K ohm, 1/2 W, 5% |
| R335 | 315-0123-00 | | | 12K ohm, 1/2 W, 5% |
| R336 | 315-0182-00 | | | 1.8K ohm, 1/2 W, 5% |
| R338 | 315-0203-00 | | | 20K ohm, 1/2 W, 5% |
| R339 | 315-0222-00 | | | 2.2K ohm, 1/2 W, 5% |
| R341 | 315-0102-00 | | | 1K ohm, 1/2 W, 5% |
| R342 | 315-0132-00 | | | 1.3K ohm, 1/2 W, 5% |
| R343 | 315-0511-00 | | | 510 ohm, 1/2 W, 5% |
| R346 | 315-0102-00 | | | 1K ohm, 1/2 W, 5% |
| R347 | 315-0102-00 | | | 1K ohm, 1/2 W, 5% |
| R348 | 315-0391-00 | | | 390 ohm, 1/2 W, 5% |

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|------------------|--------------------|----------------------|---------|-------------------------------|
| RESISTORS (cont) | | | | |
| R351 | 315-0202-00 | | | 2K ohm, $\frac{1}{2}$ W, 5% |
| R353 | 321-0152-00 | | | 374 ohm, $\frac{1}{8}$ W, 1% |
| R354 | 321-0114-00 | | | 150 ohm, $\frac{1}{8}$ W, 1% |
| R355 | 321-0174-00 | | | 634 ohm, $\frac{1}{8}$ W, 1% |
| R356 | 321-0114-00 | | | 150 ohm, $\frac{1}{8}$ W, 1% |
| R357 | 321-0174-00 | | | 634 ohm, $\frac{1}{8}$ W, 1% |
| R358 | 321-0152-00 | | | 374 ohm, $\frac{1}{8}$ W, 1% |
| R359 | 315-0202-00 | | | 2K ohm, $\frac{1}{2}$ W, 5% |
| R361 | 315-0202-00 | | | 2K ohm, $\frac{1}{2}$ W, 5% |
| R363 | 321-0152-00 | | | 374 ohm, $\frac{1}{8}$ W, 1% |
| R364 | 321-0114-00 | | | 150 ohm, $\frac{1}{8}$ W, 1% |
| R365 | 321-0174-00 | | | 634 ohm, $\frac{1}{8}$ W, 1% |
| R366 | 321-0114-00 | | | 150 ohm, $\frac{1}{8}$ W, 1% |
| R367 | 321-0174-00 | | | 634 ohm, $\frac{1}{8}$ W, 1% |
| R368 | 321-0152-00 | | | 374 ohm, $\frac{1}{8}$ W, 1% |
| R369 | 315-0202-00 | | | 2K ohm, $\frac{1}{2}$ W, 5% |
| R371 | 315-0470-00 | | | 47 ohm, $\frac{1}{4}$ W, 5% |
| R372 | 315-0470-00 | | | 47 ohm, $\frac{1}{2}$ W, 5% |
| R373 | 315-0470-00 | | | 47 ohm, $\frac{1}{2}$ W, 5% |
| R374 | 315-0470-00 | | | 47 ohm, $\frac{1}{2}$ W, 5% |
| R380 | 321-0078-00 | | | 63.4 ohm, $\frac{1}{8}$ W, 1% |
| R381 | 321-0078-00 | | | 63.4 ohm, $\frac{1}{8}$ W, 1% |
| R382 | 323-0130-00 | | | 221 ohm, $\frac{1}{2}$ W, 1% |
| R383 | 323-0130-00 | | | 221 ohm, $\frac{1}{2}$ W, 1% |
| R384 | 322-0107-00 | | | 127 ohm, $\frac{1}{2}$ W, 1% |
| R385 | 311-1221-00 | | | 50 ohm, Var |
| R388 | 315-0270-00 | | | 27 ohm, $\frac{1}{2}$ W, 5% |
| R391 | 321-0154-00 | | | 392 ohm, $\frac{1}{8}$ W, 1% |
| R392 | 321-0124-00 | B010100 | B010309 | 191 ohm, $\frac{1}{8}$ W, 1% |
| R392 | 321-0122-00 | B010310 | | 182 ohm, $\frac{1}{8}$ W, 1% |
| R393 | 315-0200-00 | B010100 | B010309 | 20 ohm, $\frac{1}{2}$ W, 5% |
| R393 | 315-0271-00 | B010310 | | 270 ohm, $\frac{1}{2}$ W, 5% |
| R394 | 321-0143-00 | B010100 | B010309 | 301 ohm, $\frac{1}{8}$ W, 1% |
| R394 | 321-0146-00 | B010310 | | 324 ohm, $\frac{1}{8}$ W, 1% |
| R395 | 322-0156-00 | | | 412 ohm, $\frac{1}{8}$ W, 1% |
| R396 | 315-0100-00 | | | 10 ohm, $\frac{1}{2}$ W, 5% |
| R398 | 315-0620-00 | | | 62 ohm, $\frac{1}{2}$ W, 5% |
| R399 | 315-0390-00 | | | 39 ohm, $\frac{1}{2}$ W, 5% |
| R401 | 321-0132-00 | | | 232 ohm, $\frac{1}{8}$ W, 1% |
| R402 | 321-0078-00 | | | 63.4 ohm, $\frac{1}{8}$ W, 1% |
| R403 | 311-1221-00 | | | 50 ohm, Var |
| R404 | 321-0132-00 | | | 232 ohm, $\frac{1}{8}$ W, 1% |
| R405 | 321-0078-00 | | | 63.4 ohm, $\frac{1}{8}$ W, 1% |
| R411 | 321-0132-00 | | | 232 ohm, $\frac{1}{8}$ W, 1% |
| R412 | 321-0078-00 | | | 63.4 ohm, $\frac{1}{8}$ W, 1% |

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|------------------|--------------------|----------------------|---------|----------------------|
| RESISTORS (cont) | | | | |
| R414 | 321-0132-00 | | | 232 ohm, 1/8 W, 1% |
| R415 | 321-0078-00 | | | 63.4 ohm, 1/8 W, 1% |
| R419 | 321-0068-00 | | | 49.9 ohm, 1/8 W, 1% |
| R420 | 315-0200-00 | | | 20 ohm, 1/2 W, 5% |
| R421 | 321-0151-00 | | | 365 ohm, 1/8 W, 1% |
| R422 | 321-0210-00 | | | 1.5K ohm, 1/8 W, 1% |
| R423 | 321-0070-00 | | | 52.3 ohm, 1/8 W, 1% |
| R425 | 311-1223-00 | | | 250 ohm, Var |
| R426 | 322-0161-00 | | | 464 ohm, 1/2 W, 1% |
| R427 | 315-0271-00 | | | 270 ohm, 1/2 W, 5% |
| R430 | 315-0471-00 | | | 470 ohm, 1/2 W, 5% |
| R431 | 321-0071-00 | | | 53.6 ohm, 1/8 W, 1% |
| R432 | 321-0184-00 | | | 806 ohm, 1/8 W, 1% |
| R436 | 315-0100-00 | | | 10 ohm, 1/2 W, 5% |
| R437 | 315-0100-00 | | | 10 ohm, 1/2 W, 5% |
| R438 | 307-0106-00 | | | 4.7 ohm, 1/2 W, 5% |
| R441 | 321-0068-00 | | | 49.9 ohm, 1/8 W, 1% |
| R445 | 321-0068-00 | | | 49.9 ohm, 1/8 W, 1% |
| R446 | 321-0136-00 | | | 255 ohm, 1/8 W, 1% |
| R447 | 321-0249-00 | B010100 | B049999 | 3.83K ohm, 1/8 W, 1% |
| R447 | 321-0239-00 | B050000 | | 3.01K ohm, 1/8 W, 1% |
| R448 | 321-0193-00 | | | 1K ohm, 1/8 W, 1% |
| R449 | 311-1238-00 | | | 5K ohm, Var |
| R450 | 311-1260-00 | | | 250 ohm, Var |
| R451 | 317-0101-00 | | | 100 ohm, 1/8 W, 1% |
| R452 | 317-0200-00 | | | 20 ohm, 1/8 W, 5% |
| RT452 | 307-0127-00 | | | 1K ohm, Thermal |
| R453 | 317-0200-00 | | | 20 ohm, 1/8 W, 5% |
| R454 | 317-0681-00 | | | 680 ohm, 1/8 W, 5% |
| R455 | 317-0102-00 | | | 1K ohm, 1/8 W, 5% |
| R457 | 321-0163-00 | | | 487 ohm, 1/8 W, 1% |
| R458 | 321-0163-00 | | | 487 ohm, 1/8 W, 1% |
| R459 | 315-0751-00 | | | 750 ohm, 1/2 W, 5% |
| R460 | 315-0270-00 | | | 27 ohm, 1/2 W, 5% |
| R461 | 321-0198-00 | | | 1.13K ohm, 1/8 W, 1% |
| R462 | 323-0147-00 | | | 332 ohm, 1/2 W, 1% |
| R463 | 315-0561-00 | | | 560 ohm, 1/2 W, 5% |
| R464 | 323-0147-00 | | | 332 ohm, 1/2 W, 1% |
| R465 | 315-0561-00 | | | 560 ohm, 1/2 W, 5% |
| R466 | 311-1279-00 | | | 500 ohm, Var |
| R467 | 317-0150-00 | | | 15 ohm, 1/8 W, 5% |
| R468 | 321-0055-00 | | | 36.5 ohm, 1/8 W, 1% |
| R469 | 321-0055-00 | | | 36.5 ohm, 1/8 W, 1% |
| R470 | 311-1278-00 | | | 250 ohm, Var |
| R471 | 315-0102-00 | | | 1K ohm, 1/2 W, 5% |

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|------------------|--------------------|----------------------|------|--------------------------------|
| RESISTORS (cont) | | | | |
| R472 | 315-0200-00 | | | 20 ohm, $\frac{1}{2}$ W, 5% |
| R473 | 315-0200-00 | | | 20 ohm, $\frac{1}{2}$ W, 5% |
| R474 | 317-0150-00 | | | 15 ohm, $\frac{1}{8}$ W, 5% |
| R475 | 311-1245-00 | | | 10K ohm, Var |
| R476 | 317-0182-00 | | | 1.8K ohm, $\frac{1}{8}$ W, 5% |
| R477 | 315-0102-00 | | | 1K ohm, $\frac{1}{2}$ W, 5% |
| R478 | 321-0164-00 | | | 499 ohm, $\frac{1}{8}$ W, 1% |
| R479 | 321-0164-00 | | | 499 ohm, $\frac{1}{8}$ W, 1% |
| R480 | 315-0330-00 | | | 33 ohm, $\frac{1}{2}$ W, 5% |
| R481 | 321-0039-00 | | | 24.9 ohm, $\frac{1}{8}$ W, 1% |
| R482 | 321-0039-00 | | | 24.9 ohm, $\frac{1}{8}$ W, 1% |
| R483 | 322-0157-00 | | | 422 ohm, $\frac{1}{2}$ W, 1% |
| R484 | 322-0157-00 | | | 422 ohm, $\frac{1}{2}$ W, 1% |
| R485 | 315-0560-00 | | | 56 ohm, $\frac{1}{2}$ W, 5% |
| R486 | 315-0100-00 | | | 10 ohm, $\frac{1}{2}$ W, 5% |
| R487 | 315-0301-00 | | | 300 ohm, $\frac{1}{2}$ W, 5% |
| R488 | 311-1236-00 | | | 250 ohm, Var |
| R489 | 315-0911-00 | | | 910 ohm, $\frac{1}{2}$ W, 5% |
| R491 | 301-0100-00 | | | 10 ohm, $\frac{1}{2}$ W, 5% |
| R492 | 323-0134-00 | | | 243 ohm, $\frac{1}{2}$ W, 1% |
| R493 | 323-0134-00 | | | 243 ohm, $\frac{1}{2}$ W, 1% |
| R494 | 317-0621-00 | | | 620 ohm, $\frac{1}{8}$ W, 5% |
| R495 | 323-0134-00 | | | 243 ohm, $\frac{1}{2}$ W, 1% |
| R496 | 323-0134-00 | | | 243 ohm, $\frac{1}{2}$ W, 1% |
| R497 | 307-0292-00 | | | Thick film |
| R498 | 307-0106-00 | | | 4.7 ohm, $\frac{1}{2}$ W, 5% |
| R499 | 307-0106-00 | | | 4.7 ohm, $\frac{1}{2}$ W, 5% |
| R500 | 315-0560-00 | | | 56 ohm, $\frac{1}{2}$ W, 5% |
| R501 | 316-0221-00 | | | 220 ohm, $\frac{1}{2}$ W, 10% |
| R502 | 316-0152-00 | | | 1.5K ohm, $\frac{1}{2}$ W, 10% |
| R503 | 316-0221-00 | | | 220 ohm, $\frac{1}{2}$ W, 10% |
| R504 | 316-0152-00 | | | 1.5K ohm, $\frac{1}{2}$ W, 10% |
| R505 | 316-0470-00 | | | 47 ohm, $\frac{1}{2}$ W, 10% |
| R506 | 316-0152-00 | | | 1.5K ohm, $\frac{1}{2}$ W, 10% |
| R507 | 316-0103-00 | | | 10K ohm, $\frac{1}{2}$ W, 10% |
| R508 | 316-0274-00 | | | 270K ohm, $\frac{1}{2}$ W, 10% |
| R509 | 315-0560-00 | | | 56 ohm, $\frac{1}{2}$ W, 5% |
| R510 | 316-0330-00 | | | 33 ohm, $\frac{1}{2}$ W, 10% |
| R511 | 315-0914-00 | | | 910 ohm, $\frac{1}{2}$ W, 5% |
| R512 | 315-0434-00 | | | 430K ohm, $\frac{1}{2}$ W, 5% |
| R513 | 315-0475-00 | | | 4.7M ohm, $\frac{1}{2}$ W, 5% |
| R514 | 315-0154-00 | | | 150K ohm, $\frac{1}{2}$ W, 5% |
| R515 | 316-0104-00 | | | 100K ohm, $\frac{1}{2}$ W, 10% |
| R516 | 316-0563-00 | | | 56K ohm, $\frac{1}{2}$ W, 10% |
| R517 | 315-0105-00 | | | 1M ohm, $\frac{1}{2}$ W, 5% |

Electrical Parts List-475

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|-------------------|--------------------|----------------------|---------|----------------------|
| RESISTORS (cont) | | | | |
| R518 | 316-0100-00 | | | 10 ohm, 1/2 W, 10% |
| R519 | 316-0101-00 | | | 100 ohm, 1/2 W, 10% |
| R520 | 315-0560-00 | | | 56 ohm, 1/2 W, 5% |
| R521 | 316-0101-00 | | | 100 ohm, 1/2 W, 10% |
| R522 | 316-0150-00 | | | 15 ohm, 1/2 W, 10% |
| R523 | 316-0150-00 | | | 15 ohm, 1/2 W, 10% |
| R524 | 316-0101-00 | | | 100 ohm, 1/2 W, 10% |
| R525 | 316-0821-00 | | | 820 ohm, 1/2 W, 10% |
| R526 | 315-0220-00 | | | 22 ohm, 1/2 W, 5% |
| R527 | 322-0178-00 | | | 698 ohm, 1/2 W, 1% |
| R528 | 315-0220-00 | | | 22 ohm, 1/2 W, 5% |
| R529 | 316-0103-00 | | | 10K ohm, 1/2 W, 10% |
| R530 ¹ | 311-1192-00 | | | 10K ohm, Var |
| R532 | 315-0122-00 | | | 1.2K ohm, 1/2 W, 5% |
| R533 | 316-0821-00 | | | 820 ohm, 1/2 W, 10% |
| R534 | 311-1230-00 | | | 20K ohm, Var |
| R535 | 315-0302-00 | | | 3K ohm, 1/2 W, 5% |
| R536 | 316-0101-00 | | | 100 ohm, 1/2 W, 10% |
| R537 | 316-0152-00 | | | 1.5K ohm, 1/2 W, 10% |
| R538 | 316-0332-00 | | | 3.3K ohm, 1/2 W, 10% |
| R541 | 316-0682-00 | | | 6.8K ohm, 1/2 W, 10% |
| R542 | 316-0392-00 | | | 3.9K ohm, 1/2 W, 10% |
| R543 | 316-0221-00 | | | 220 ohm, 1/2 W, 10% |
| R544 | 315-0302-00 | | | 3K ohm, 1/2 W, 5% |
| R545 | 315-0242-00 | | | 2.4K ohm, 1/2 W, 5% |
| R546 | 316-0470-00 | | | 47 ohm, 1/2 W, 10% |
| R547 | 311-1230-00 | | | 20K ohm, Var |
| R551 | 321-0082-00 | | | 69.8 ohm, 1/8 W, 1% |
| R552 | 322-0283-00 | | | 8.66K ohm, 1/2 W, 1% |
| R553 | 321-0082-00 | | | 69.8 ohm, 1/8 W, 1% |
| R554 | 321-0059-00 | | | 40.2 ohm, 1/8 W, 1% |
| R555 | 321-0185-00 | | | 825 ohm, 1/8 W, 1% |
| R556 | 321-0047-00 | | | 30.1 ohm, 1/8 W, 1% |
| R557 | 321-0224-00 | | | 2.1K ohm, 1/8 W, 1% |
| R558 | 321-0044-00 | | | 28 ohm, 1/8 W, 1% |
| R559 | 321-0259-00 | | | 4.87K ohm, 1/8 W, 1% |
| RT559 | 307-0124-00 | | | 5K ohm, Thermal |
| R561 | 321-0082-00 | | | 69.8 ohm, 1/8 W, 1% |
| R562 | 322-0283-00 | | | 8.66K ohm, 1/2 W, 1% |
| R563 | 321-0082-00 | | | 69.8 ohm, 1/8 W, 1% |
| R564 | 315-0242-00 | | | 2.4K ohm, 1/2 W, 5% |
| R565 | 311-1228-00 | | | 10K ohm, Var |
| R566 | 321-0044-00 | | | 28 ohm, 1/8 W, 1% |
| R567 | 321-0224-00 | | | 2.1K ohm, 1/8 W, 1% |
| R568 | 316-0470-00 | B010100 | B029999 | 47 ohm, 1/2 W, 10% |

¹Furnished as a unit with S530.

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | No. Disc | Description |
|-------------------|--------------------|----------------------|----------|-------------------------------|
| RESISTORS (cont) | | | | |
| R568 | 316-0101-00 | B030000 | | 100 ohm, $\frac{1}{2}$ W, 10% |
| R569 | 321-0279-00 | | | 7.87K ohm, 1/8 W, 1% |
| R570 | 301-0181-00 | | | 180 ohm, $\frac{1}{2}$ W, 5% |
| R571 | 315-0100-00 | | | 10 ohm, $\frac{1}{2}$ W, 5% |
| R572 | 321-0187-00 | | | 866 ohm, 1/8 W, 1% |
| R574 | 315-0432-00 | | | 4.3K ohm, $\frac{1}{2}$ W, 5% |
| R575 | 315-0151-00 | | | 150 ohm, $\frac{1}{2}$ W, 5% |
| R577 | 321-0246-00 | | | 3.57K ohm, 1/8 W, 1% |
| R578 | 321-0164-00 | | | 499 ohm, 1/8 W, 1% |
| R579 | 301-0201-00 | | | 200 ohm, $\frac{1}{2}$ W, 5% |
| R580 | 316-0220-00 | XB030000 | | 22 ohm, $\frac{1}{4}$ W, 10% |
| R581 | 315-0101-00 | | | 100 ohm, $\frac{1}{2}$ W, 5% |
| R582 | 315-0471-00 | | | 470 ohm, $\frac{1}{2}$ W, 5% |
| R583 | 315-0331-00 | | | 330 ohm, $\frac{1}{2}$ W, 5% |
| R588 | 301-0121-00 | | | 120 ohm, $\frac{1}{2}$ W, 5% |
| R590 | 315-0102-00 | | | 1K ohm, $\frac{1}{2}$ W, 5% |
| R591 | 321-0242-00 | | | 3.24K ohm, 1/8 W, 1% |
| R592 | 321-0222-00 | | | 2K ohm, 1/8 W, 1% |
| R593 | 316-0103-00 | | | 10K ohm, $\frac{1}{2}$ W, 10% |
| R594 | 315-0162-00 | | | 1.6K ohm, $\frac{1}{2}$ W, 5% |
| R595 | 315-0102-00 | | | 1K ohm, $\frac{1}{2}$ W, 5% |
| R596 | 307-0106-00 | | | 4.7 ohm, $\frac{1}{2}$ W, 5% |
| R597 | 315-0221-00 | | | 220 ohm, $\frac{1}{2}$ W, 5% |
| R598 | 315-0221-00 | | | 220 ohm, $\frac{1}{2}$ W, 5% |
| R599 | 321-0318-00 | | | 20K ohm, 1/8 W, 1% |
| R600 | 307-0106-00 | | | 4.7 ohm, $\frac{1}{2}$ W, 5% |
| R601 | 315-0472-00 | | | 4.7K ohm, $\frac{1}{2}$ W, 5% |
| R602 | 315-0472-00 | | | 4.7K ohm, $\frac{1}{2}$ W, 5% |
| R603 | 315-0241-00 | | | 240 ohm, $\frac{1}{2}$ W, 5% |
| R604 | 316-0393-00 | | | 39K ohm, $\frac{1}{2}$ W, 10% |
| R607 | 315-0101-00 | | | 100 ohm, $\frac{1}{2}$ W, 5% |
| R608 | 307-0103-00 | XB010310 | | 2.7 ohm, $\frac{1}{2}$ W, 5% |
| R609 | 315-0104-00 | | | 100K ohm, $\frac{1}{2}$ W, 5% |
| R610 | 307-0103-00 | XB010310 | | 2.7 ohm, $\frac{1}{2}$ W, 5% |
| R611 | 321-0174-00 | | | 634 ohm, 1/8 W, 1% |
| R612 | 321-0190-00 | | | 931 ohm, 1/8 W, 1% |
| R613 | 315-0101-00 | | | 100 ohm, $\frac{1}{2}$ W, 5% |
| R622 | 307-0103-00 | | | 2.7 ohm, $\frac{1}{2}$ W, 5% |
| R626 | 315-0201-00 | | | 200 ohm, $\frac{1}{2}$ W, 5% |
| R627 | 315-0101-00 | | | 100 ohm, $\frac{1}{2}$ W, 5% |
| R628 | 321-0184-00 | | | 806 ohm, 1/8 W, 1% |
| R629 | 321-0205-00 | | | 1.33K ohm, 1/8 W, 1% |
| R641 | 321-0222-00 | | | 2K ohm, 1/8 W, 1% |
| R642 ¹ | 321-0275-00 | | | 7.15K ohm, 1/8 W, 1% |
| R644 ¹ | 311-1401-00 | | | 100K ohm, Var |

¹Furnished as a unit with S644.

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|------------------|--------------------|----------------------|---------|----------------------|
| RESISTORS (cont) | | | | |
| R647 | 315-0473-00 | | | 47K ohm, ½ W, 5% |
| R661 | 315-0430-00 | | | 43 ohm, ½ W, 5% |
| R662 | 315-0150-00 | | | 15 ohm, ½ W, 5% |
| R663 | 322-0207-00 | | | 1.4K ohm, ½ W, 1% |
| R664 | 315-0510-00 | | | 51 ohm, ½ W, 5% |
| R665 | 316-0103-00 | | | 10K ohm, ½ W, 10% |
| R666 | 315-0102-00 | | | 1K ohm, ½ W, 5% |
| R667 | 315-0510-00 | | | 51 ohm, ½ W, 5% |
| R668 | 321-0178-00 | | | 698 ohm, 1/8 W, 1% |
| R669 | 315-0150-00 | | | 15 ohm, ½ W, 5% |
| R670 | 316-0470-00 | | | 47 ohm, ½ W, 10% |
| R671 | 315-0430-00 | | | 43 ohm, ½ W, 5% |
| R672 | 315-0150-00 | | | 15 ohm, ½ W, 5% |
| R673 | 311-1223-00 | | | 250 ohm, Var |
| R674 | 315-0510-00 | | | 51 ohm, ½ W, 5% |
| R675 | 321-0155-00 | | | 402 ohm, 1/8 W, 1% |
| R676 | 315-0102-00 | | | 1K ohm, ½ W, 5% |
| R677 | 315-0510-00 | | | 51 ohm, ½ W, 5% |
| R678 | 321-0178-00 | | | 698 ohm, 1/8 W, 1% |
| R679 | 316-0220-00 | | | 22 ohm, ½ W, 10% |
| R680 | 321-0225-00 | | | 2.15K ohm, 1/8 W, 1% |
| R681 | 321-0209-00 | | | 1.47K ohm, 1/8 W, 1% |
| R682 | 315-0102-00 | | | 1K ohm, ½ W, 5% |
| R683 | 315-0202-00 | | | 2K ohm, ½ W, 5% |
| R684 | 321-0248-00 | | | 3.74K ohm, 1/8 W, 1% |
| R685 | 321-0248-00 | | | 3.74K ohm, 1/8 W, 1% |
| R686 | 321-0210-00 | | | 1.5K ohm, 1/8 W, 1% |
| R687 | 321-0209-00 | | | 1.47K ohm, 1/8 W, 1% |
| R688 | 321-0141-00 | | | 287 ohm, 1/8 W, 1% |
| R689 | 315-0432-00 | | | 4.3K ohm, ½ W, 5% |
| R692 | 315-0472-00 | | | 4.7K ohm, ½ W, 5% |
| R693 | 315-0181-00 | B010100 | B039999 | 180 ohm, ½ W, 5% |
| R693 | 315-0471-00 | B040000 | | 470 ohm, ½ W, 5% |
| R694 | 315-0470-00 | | | 47 ohm, ½ W, 5% |
| R695 | 321-0204-00 | | | 1.3K ohm, 1/8 W, 1% |
| R696 | 321-0222-00 | | | 2K ohm, 1/8 W, 1% |
| R697 | 321-0178-00 | | | 698 ohm, 1/8 W, 1% |
| R698 | 315-0100-00 | | | 10 ohm, ½ W, 5% |
| R699 | 315-0472-00 | | | 4.7K ohm, ½ W, 5% |
| R701 | 315-0152-00 | | | 1.5K ohm, ½ W, 5% |
| R702 | 315-0162-00 | | | 1.6K ohm, ½ W, 5% |
| R703 | 315-0152-00 | | | 1.5K ohm, ½ W, 5% |
| R704 | 315-0162-00 | | | 1.6K ohm, ½ W, 5% |
| R705 | 315-0152-00 | | | 1.5K ohm, ½ W, 5% |
| R706 | 315-0162-00 | | | 1.6K ohm, ½ W, 5% |

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|-------------------|--------------------|----------------------|------|--------------------------------|
| RESISTORS (cont) | | | | |
| R711 | 316-0152-00 | | | 1.5K ohm, $\frac{1}{2}$ W, 10% |
| R712 | 316-0221-00 | | | 220 ohm, $\frac{1}{2}$ W, 10% |
| R713 | 316-0152-00 | | | 1.5K ohm, $\frac{1}{2}$ W, 10% |
| R714 | 316-0221-00 | | | 220 ohm, $\frac{1}{2}$ W, 10% |
| R715 | 316-0151-00 | | | 150 ohm, $\frac{1}{2}$ W, 10% |
| R716 | 316-0152-00 | | | 1.5K ohm, $\frac{1}{2}$ W, 10% |
| R717 | 315-0620-00 | | | 62 ohm, $\frac{1}{2}$ W, 5% |
| R718 | 315-0620-00 | | | 62 ohm, $\frac{1}{2}$ W, 5% |
| R719 | 315-0620-00 | | | 62 ohm, $\frac{1}{2}$ W, 5% |
| R721 | 316-0330-00 | | | 33 ohm, $\frac{1}{2}$ W, 10% |
| R722 | 315-0754-00 | | | 750K ohm, $\frac{1}{2}$ W, 5% |
| R723 | 315-0334-00 | | | 330K ohm, $\frac{1}{2}$ W, 5% |
| R729 | 316-0101-00 | | | 100 ohm, $\frac{1}{2}$ W, 10% |
| R731 | 316-0332-00 | | | 3.3K ohm, $\frac{1}{2}$ W, 10% |
| R735 | 316-0104-00 | | | 100K ohm, $\frac{1}{2}$ W, 10% |
| R736 | 316-0563-00 | | | 56K ohm, $\frac{1}{2}$ W, 10% |
| R737 | 315-0105-00 | | | 1M ohm, $\frac{1}{2}$ W, 5% |
| R738 | 316-0100-00 | | | 10 ohm, $\frac{1}{2}$ W, 10% |
| R739 | 316-0101-00 | | | 100 ohm, $\frac{1}{2}$ W, 10% |
| R741 | 316-0101-00 | | | 100 ohm, $\frac{1}{2}$ W, 10% |
| R742 | 316-0150-00 | | | 15 ohm, $\frac{1}{2}$ W, 10% |
| R743 | 316-0150-00 | | | 15 ohm, $\frac{1}{2}$ W, 10% |
| R744 | 316-0101-00 | | | 100 ohm, $\frac{1}{2}$ W, 10% |
| R745 | 316-0821-00 | | | 820 ohm, $\frac{1}{2}$ W, 10% |
| R746 | 315-0220-00 | | | 22 ohm, $\frac{1}{2}$ W, 5% |
| R747 | 322-0178-00 | | | 698 ohm, $\frac{1}{2}$ W, 1% |
| R748 | 315-0220-00 | | | 22 ohm, $\frac{1}{2}$ W, 5% |
| R750 ¹ | 311-1192-00 | | | 10K ohm, Var |
| R752 | 315-0122-00 | | | 1.2K ohm, $\frac{1}{2}$ W, 5% |
| R753 | 316-0821-00 | | | 820 ohm, $\frac{1}{2}$ W, 10% |
| R754 | 311-1230-00 | | | 20K ohm, Var |
| R755 | 315-0302-00 | | | 3K ohm, $\frac{1}{2}$ W, 5% |
| R756 | 315-0101-00 | | | 100 ohm, $\frac{1}{2}$ W, 5% |
| R758 | 316-0152-00 | | | 1.5K ohm, $\frac{1}{2}$ W, 10% |
| R759 | 321-0259-00 | | | 4.87K ohm, 1/8 W, 1% |
| RT759 | 307-0124-00 | | | 5K ohm, Thermal |
| R761 | 316-0682-00 | | | 6.8K ohm, $\frac{1}{2}$ W, 10% |
| R762 | 316-0392-00 | | | 3.9K ohm, $\frac{1}{2}$ W, 10% |
| R763 | 316-0221-00 | | | 220 ohm, $\frac{1}{2}$ W, 10% |
| R764 | 315-0302-00 | | | 3K ohm, $\frac{1}{2}$ W, 5% |
| R765 | 315-0242-00 | | | 2.4K ohm, $\frac{1}{2}$ W, 5% |
| R766 | 316-0470-00 | | | 47 ohm, $\frac{1}{2}$ W, 10% |
| R767 | 311-1230-00 | | | 20K ohm, Var |
| R769 | 321-0279-00 | | | 7.87K ohm, 1/8 W, 1% |
| R771 | 321-0082-00 | | | 69.8 ohm, 1/8 W, 1% |

¹Furnished as a unit with S750.

Electrical Parts List-475

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|------------------|--------------------|----------------------|---------|----------------------|
| RESISTORS (cont) | | | | |
| R772 | 322-0283-00 | | | 8.66K ohm, 1/8 W, 1% |
| R773 | 321-0082-00 | | | 69.8 ohm, 1/8 W, 1% |
| R774 | 321-0059-00 | | | 40.2 ohm, 1/8 W, 1% |
| R775 | 321-0185-00 | | | 825 ohm, 1/8 W, 1% |
| R776 | 321-0047-00 | | | 30.1 ohm, 1/8 W, 1% |
| R777 | 321-0224-00 | | | 2.1K ohm, 1/8 W, 1% |
| R778 | 321-0044-00 | | | 28 ohm, 1/8 W, 1% |
| R781 | 321-0082-00 | | | 69.8 ohm, 1/8 W, 1% |
| R782 | 322-0283-00 | | | 8.66K ohm, 1/8 W, 1% |
| R783 | 321-0082-00 | | | 69.8 ohm, 1/8 W, 1% |
| R784 | 315-0242-00 | | | 2.4K ohm, 1/8 W, 5% |
| R785 | 311-1228-00 | | | 10K ohm, Var |
| R786 | 321-0044-00 | | | 28 ohm, 1/8 W, 1% |
| R787 | 321-0224-00 | | | 2.1K ohm, 1/8 W, 1% |
| R788 | 315-0472-00 | | | 4.7K ohm, 1/8 W, 5% |
| R789 | 316-0221-00 | | | 220 ohm, 1/8 W, 10% |
| R793 | 321-0289-00 | | | 10K ohm, 1/8 W, 1% |
| R794 | 321-0260-00 | | | 4.99K ohm, 1/8 W, 1% |
| R795 | 321-0225-00 | | | 2.15K ohm, 1/8 W, 1% |
| R796 | 321-0227-00 | | | 2.26K ohm, 1/8 W, 1% |
| R797 | 315-0101-00 | | | 100 ohm, 1/8 W, 5% |
| R798 | 321-0249-00 | | | 3.83K ohm, 1/8 W, 1% |
| R799 | 316-0102-00 | XB010205 | | 1K ohm, 1/8 W, 10% |
| R801 | 315-0332-00 | | | 3.3K ohm, 1/8 W, 5% |
| R802 | 315-0471-00 | B010100 | B010204 | 470 ohm, 1/8 W, 5% |
| R802 | 315-0221-00 | B010205 | | 220 ohm, 1/8 W, 5% |
| R803 | 307-0103-00 | | | 2.7 ohm, 1/8 W, 5% |
| R804 | 321-0166-00 | | | 523 ohm, 1/8 W, 1% |
| R805 | 321-0193-00 | | | 1K ohm, 1/8 W, 1% |
| R806 | 321-0177-00 | | | 681 ohm, 1/8 W, 1% |
| R807 | 321-0254-00 | | | 4.32K ohm, 1/8 W, 1% |
| R808 | 321-0250-00 | | | 3.92K ohm, 1/8 W, 1% |
| R809 | 315-0101-00 | | | 100 ohm, 1/8 W, 5% |
| R810 | 315-0201-00 | | | 200 ohm, 1/8 W, 5% |
| R811 | 315-0202-00 | | | 2K ohm, 1/8 W, 5% |
| R812 | 315-0332-00 | | | 3.3K ohm, 1/8 W, 5% |
| R813 | 315-0151-00 | | | 150 ohm, 1/8 W, 5% |
| R814 | 315-0102-00 | | | 1K ohm, 1/8 W, 5% |
| R815 | 321-0232-00 | | | 2.55K ohm, 1/8 W, 1% |
| R816 | 321-0155-00 | | | 402 ohm, 1/8 W, 1% |
| R817 | 315-0221-00 | | | 200 ohm, 1/8 W, 5% |
| R818 | 321-0187-00 | | | 866 ohm, 1/8 W, 1% |
| R819 | 316-0100-00 | | | 10 ohm, 1/8 W, 10% |
| R821 | 315-0101-00 | | | 100 ohm, 1/8 W, 5% |
| R822 | 315-0471-00 | | | 470 ohm, 1/8 W, 5% |

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|------------------|--------------------|----------------------|------|--------------------------------|
| RESISTORS (cont) | | | | |
| R823 | 315-0331-00 | | | 330 ohm, $\frac{1}{4}$ W, 5% |
| R825 | 307-0106-00 | | | 4.7 ohm, $\frac{1}{4}$ W, 5% |
| R826 | 307-0106-00 | | | 4.7 ohm, $\frac{1}{4}$ W, 5% |
| R900 | 321-0225-00 | | | 2.15K ohm, 1/8 W, 1% |
| R902 | 321-0155-00 | | | 402 ohm, 1/8 W, 1% |
| R903 | 315-0221-00 | | | 220 ohm, $\frac{1}{4}$ W, 5% |
| R904 | 321-0168-00 | | | 549 ohm, 1/8 W, 1% |
| R905 | 307-0106-00 | | | 4.7 ohm, $\frac{1}{4}$ W, 5% |
| R906 | 321-0268-00 | | | 6.04K ohm, 1/8 W, 1% |
| R907 | 321-0289-00 | | | 10K ohm, 1/8 W, 1% |
| R908 | 321-0294-00 | | | 11.3K ohm, 1/8 W, 1% |
| R911 | 321-0164-00 | | | 499 ohm, 1/8 W, 1% |
| R912 | 321-0274-00 | | | 6.98K ohm, 1/8 W, 1% |
| R913 | 316-0100-00 | | | 10 ohm, $\frac{1}{4}$ W, 10% |
| R916 | 323-0227-00 | | | 2.26K ohm, $\frac{1}{4}$ W, 1% |
| R917 | 315-0471-00 | | | 470 ohm, $\frac{1}{4}$ W, 5% |
| R918 | 316-0220-00 | | | 22 ohm, $\frac{1}{4}$ W, 10% |
| R921 | 315-0182-00 | | | 1.8K ohm, $\frac{1}{4}$ W, 5% |
| R922 | 315-0821-00 | | | 820 ohm, $\frac{1}{4}$ W, 5% |
| R923 | 316-0100-00 | | | 10 ohm, $\frac{1}{4}$ W, 10% |
| R924 | 301-0682-00 | | | 6.8K ohm, $\frac{1}{4}$ W, 5% |
| R925 | 321-0218-00 | | | 1.82K ohm, 1/8 W, 1% |
| R926 | 321-0193-00 | | | 1K ohm, 1/8 W, 1% |
| R927 | 321-0238-00 | | | 2.94K ohm, 1/8 W, 1% |
| R928 | 321-0193-00 | | | 1K ohm, 1/8 W, 1% |
| R929 | 316-0123-00 | | | 12K ohm, $\frac{1}{4}$ W, 10% |
| R930 | 311-1458-00 | | | 50K ohm, Var |
| R931 | 316-0392-00 | | | 3.9K ohm, $\frac{1}{4}$ W, 10% |
| R932 | 316-0102-00 | | | 1K ohm, $\frac{1}{4}$ W, 10% |
| R933 | 321-0338-00 | | | 32.4K ohm, 1/8 W, 1% |
| R934 | 321-0193-00 | | | 1K ohm, 1/8 W, 1% |
| R935 | 321-0274-00 | | | 6.98K ohm, 1/8 W, 1% |
| R936 | 311-1226-00 | | | 2.5K ohm, Var |
| R937 | 321-0196-00 | | | 1.07K ohm, 1/8 W, 1% |
| R938 | 311-1225-00 | | | 1K ohm, Var |
| R939 | 321-0258-00 | | | 4.75K ohm, 1/8 W, 1% |
| R940 | 315-0153-00 | | | 15K ohm, $\frac{1}{4}$ W, 5% |
| R941 | 321-0193-00 | | | 1K ohm, 1/8 W, 1% |
| R942 | 321-0145-00 | | | 316 ohm, 1/8 W, 1% |
| R943 | 321-0152-00 | | | 374 ohm, 1/8 W, 1% |
| R944 | 321-0231-00 | | | 2.49K ohm, 1/8 W, 1% |
| R946 | 321-0216-00 | | | 1.74K ohm, 1/8 W, 1% |
| R947 | 315-0220-00 | | | 22 ohm, $\frac{1}{4}$ W, 5% |
| R948 | 321-0239-00 | | | 3.01K ohm, 1/8 W, 1% |
| R949 | 321-0260-00 | | | 4.99K ohm, 1/8 W, 1% |

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|------------------|--------------------|----------------------|------|----------------------|
| RESISTORS (cont) | | | | |
| R950 | 311-1222-00 | | | 100 ohm, Var |
| R951 | 321-0183-00 | | | 787 ohm, 1/8 W, 1% |
| R952 | 321-0199-00 | | | 1.15K ohm, 1/8 W, 1% |
| R955 | 315-0272-00 | | | 2.7K ohm, 1/2 W, 5% |
| R956 | 315-0103-00 | | | 10K ohm, 1/4 W, 5% |
| R961 | 315-0100-00 | | | 10 ohm, 1/4 W, 5% |
| R963 | 315-0100-00 | | | 10 ohm, 1/4 W, 5% |
| R965 | 315-0100-00 | | | 10 ohm, 1/2 W, 5% |
| R967 | 307-0106-00 | | | 4.7 ohm, 1/2 W, 5% |
| R969 | 307-0106-00 | | | 4.7 ohm, 1/4 W, 5% |
| R971 | 315-0472-00 | | | 4.7K ohm, 1/2 W, 5% |
| R972 | 321-0287-00 | | | 9.53K ohm, 1/8 W, 1% |
| R973 | 315-0391-00 | | | 390 ohm, 1/2 W, 5% |
| R974 | 321-0268-00 | | | 6.04K ohm, 1/8 W, 1% |
| R975 | 321-0354-00 | | | 47.5K ohm, 1/8 W, 1% |
| R976 | 315-0562-00 | | | 5.6K ohm, 1/2 W, 5% |
| R981 | 315-0182-00 | | | 1.8K ohm, 1/2 W, 5% |
| R982 | 316-0101-00 | | | 100 ohm, 1/2 W, 10% |
| R985 | 301-0682-00 | | | 6.8K ohm, 1/2 W, 5% |
| R986 | 316-0103-00 | | | 10K ohm, 1/4 W, 10% |
| R987 | 316-0332-00 | | | 3.3K ohm, 1/2 W, 10% |
| R988 | 315-0680-00 | | | 68 ohm, 1/2 W, 5% |
| R994 | 321-0225-00 | | | 2.15K ohm, 1/8 W, 1% |
| R995 | 321-0155-00 | | | 402 ohm, 1/8 W, 1% |
| R996 | 315-0221-00 | | | 220 ohm, 1/2 W, 5% |
| R1001 | 315-0392-00 | | | 3.9K ohm, 1/2 W, 5% |
| R1002 | 315-0332-00 | | | 3.3K ohm, 1/4 W, 5% |
| R1004 | 321-0268-00 | | | 6.04K ohm, 1/8 W, 1% |
| R1005 | 321-0354-00 | | | 47.5K ohm, 1/8 W, 1% |
| R1006 | 321-0287-00 | | | 9.53K ohm, 1/8 W, 1% |
| R1007 | 315-0220-00 | | | 22 ohm, 1/2 W, 5% |
| R1010 | 321-0414-00 | | | 200K ohm, 1/8 W, 1% |
| R1011 | 315-0182-00 | | | 1.8K ohm, 1/2 W, 5% |
| R1012 | Selected | | | |
| R1015 | 301-0682-00 | | | 6.8K ohm, 1/2 W, 5% |
| R1016 | 316-0103-00 | | | 10K ohm, 1/4 W, 10% |
| R1017 | 316-0332-00 | | | 3.3K ohm, 1/2 W, 10% |
| R1018 | 315-0330-00 | | | 33 ohm, 1/4 W, 5% |
| R1022 | 315-0153-00 | | | 15K ohm, 1/2 W, 5% |
| R1023 | 321-0185-00 | | | 825 ohm, 1/8 W, 1% |
| R1024 | 321-0197-00 | | | 1.1K ohm, 1/8 W, 1% |
| R1028 | 315-0103-00 | | | 10K ohm, 1/2 W, 5% |
| R1029 | 315-0272-00 | | | 2.7K ohm, 1/2 W, 5% |
| R1031 | 321-0193-00 | | | 1K ohm, 1/8 W, 1% |
| R1032 | 321-0145-00 | | | 316 ohm, 1/8 W, 1% |

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|--------------------|--------------------|----------------------|---------|--------------------------|
| RESISTORS (cont) | | | | |
| R1033 | 321-0149-00 | | | 348 ohm, 1/8 W, 1% |
| R1036 | 321-0222-00 | | | 2K ohm, 1/8 W, 1% |
| R1042 | 321-0208-00 | | | 1.43K ohm, 1/8 W, 1% |
| R1045 | 315-0220-00 | | | 22 ohm, 1/2 W, 5% |
| R1046 | 321-0239-00 | | | 3.01K ohm, 1/8 W, 1% |
| R1047 | 321-0260-00 | | | 4.99K ohm, 1/8 W, 1% |
| R1049 | 315-0102-00 | | | 1K ohm, 1/2 W, 5% |
| R1050 | 316-0220-00 | | | 22 ohm, 1/2 W, 10% |
| R1051 | 315-0101-00 | | | 100 ohm, 1/2 W, 5% |
| R1052 | 315-0563-00 | | | 56K ohm, 1/2 W, 5% |
| R1053 | 315-0202-00 | B010100 | B010179 | 2K ohm, 1/2 W, 5% |
| R1053 | 315-0432-00 | B010180 | | 4.3K ohm, 1/2 W, 5% |
| R1056 | 321-0352-00 | | | 45.3K ohm, 1/8 W, 1% |
| R1057 | 315-0204-00 | | | 200K ohm, 1/2 W, 5% |
| R1058 | 315-0105-00 | | | 1M ohm, 1/2 W, 5% |
| R1059 | 316-0103-00 | | | 10K ohm, 1/2 W, 10% |
| R1060 ¹ | 315-0331-00 | | | 330 ohm, 1/2 W, 5% |
| R1070 ¹ | 311-1402-00 | | | 20K ohm, Var |
| R1071 | 321-0472-04 | | | 806K ohm, 1/8 W, 1/10% |
| R1072 | 321-0481-04 | | | 1M ohm, 1/8 W, 1/10% |
| R1073 | 321-0976-04 | | | 602K ohm, 1/8 W, 1/10% |
| R1074 | 321-0431-04 | | | 301K ohm, 1/8 W, 1/10% |
| R1075 | 311-1246-00 | | | 50K ohm, Var |
| R1076 | 321-0973-04 | | | 60.2K ohm, 1/8 W, 1/10% |
| R1077 | 321-0977-04 | | | 120.4K ohm, 1/8 W, 1/10% |
| R1078 | 321-0973-04 | | | 60.2K ohm, 1/8 W, 1/10% |
| R1079 | 321-0973-04 | | | 60.2K ohm, 1/8 W, 1/10% |
| R1080 | 311-1246-00 | XB010316 | | 1M ohm, Var |
| R1081 | 316-0101-00 | | | 100 ohm, 1/2 W, 10% |
| R1082 | 321-0973-04 | | | 60.2K ohm, 1/8 W, 1/10% |
| R1083 | 321-0472-04 | | | 806K ohm, 1/8 W, 1/10% |
| R1084 | 321-0481-04 | | | 1M ohm, 1/8 W, 1/10% |
| R1085 | 321-0976-04 | | | 602K ohm, 1/8 W, 1/10% |
| R1086 | 321-0431-04 | | | 301K ohm, 1/8 W, 1/10% |
| R1087 | 321-0975-04 | | | 180.6K ohm, 1/8 W, 1/10% |
| R1088 | 321-0973-04 | | | 60.2K ohm, 1/8 W, 1/10% |
| R1089 | 321-0973-04 | | | 60.2K ohm, 1/8 W, 1/10% |
| R1091 | 316-0105-00 | | | 1M ohm, 1/2 W, 10% |
| R1092 | 316-0104-00 | | | 100K ohm, 1/2 W, 10% |
| R1093 | 316-0101-00 | | | 100 ohm, 1/2 W, 10% |
| R1094 | 321-0164-00 | | | 499 ohm, 1/8 W, 1% |
| R1095 | 321-0274-00 | | | 6.98K ohm, 1/8 W, 1% |
| R1096 | 316-0220-00 | | | 22 ohm, 1/2 W, 10% |
| R1097 | 316-0105-00 | XB010316 | | 1M ohm, 1/2 W, 10% |
| R1101 | 321-0068-00 | | | 49.9 ohm, 1/8 W, 1% |

¹
Furnished as a unit with S1070A,B.

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|------------------|--------------------|----------------------|------|------------------------------------|
| RESISTORS (cont) | | | | |
| | R1102 | 311-1223-00 | | 250 ohm, Var |
| | R1104 | 315-0103-00 | | 10K ohm, $\frac{1}{2}$ W, 5% |
| | R1106 | 321-0118-04 | | 165 ohm, $\frac{1}{8}$ W, 1/10% |
| | R1107 | 321-0738-04 | | 1.485K ohm, $\frac{1}{8}$ W, 1/10% |
| | R1108 | 321-0118-04 | | 165 ohm, $\frac{1}{8}$ W, 1/10% |
| | R1109 | 316-0104-00 | | 100K ohm, $\frac{1}{2}$ W, 10% |
| | R1110 | 316-0105-00 | | 1M ohm, $\frac{1}{2}$ W, 10% |
| | R1111 | 315-0201-00 | | 200 ohm, $\frac{1}{2}$ W, 5% |
| | R1112 | 321-0258-00 | | 4.75K ohm, $\frac{1}{8}$ W, 1% |
| | R1113 | 321-0243-00 | | 3.32K ohm, $\frac{1}{8}$ W, 1% |
| | R1114 | 321-0141-00 | | 287 ohm, $\frac{1}{8}$ W, 1% |
| | R1115 | 315-0470-00 | | 47 ohm, $\frac{1}{2}$ W, 5% |
| | R1116 | 315-0561-00 | | 560 ohm, $\frac{1}{2}$ W, 5% |
| | R1117 | 315-0622-00 | | 6.2K ohm, $\frac{1}{2}$ W, 5% |
| | R1119A,B | 311-1411-00 | | 1K ohm x 10K ohm, Var |
| | R1121 | 315-0560-00 | | 56 ohm, $\frac{1}{2}$ W, 5% |
| | R1122 | 315-0201-00 | | 200 ohm, $\frac{1}{2}$ W, 5% |
| | RT1123 | 307-0124-00 | | 5K ohm, Thermal |
| | R1124 | 315-0201-00 | | 200 ohm, $\frac{1}{2}$ W, 5% |
| | R1125 | 321-0134-00 | | 243 ohm, $\frac{1}{8}$ W, 1% |
| | R1126 | 321-0108-00 | | 130 ohm, $\frac{1}{8}$ W, 1% |
| | R1128 | 321-0056-00 | | 37.4 ohm, $\frac{1}{8}$ W, 1% |
| | R1130 | 311-1230-00 | | 20K ohm, Var |
| | R1131 | 315-0273-00 | | 27K ohm, $\frac{1}{2}$ W, 5% |
| | R1132 | 315-0151-00 | | 150 ohm, $\frac{1}{2}$ W, 5% |
| | R1134 | 315-0271-00 | | 270 ohm, $\frac{1}{2}$ W, 5% |
| | R1135 | 321-0134-00 | | 243 ohm, $\frac{1}{8}$ W, 1% |
| | R1138 | 321-0056-00 | | 37.4 ohm, $\frac{1}{8}$ W, 1% |
| | R1140 | 321-0097-00 | | 100 ohm, $\frac{1}{8}$ W, 1% |
| | R1141 | 321-0195-00 | | 1.05K ohm, $\frac{1}{8}$ W, 1% |
| | R1142 | 321-0164-00 | | 499 ohm, $\frac{1}{8}$ W, 1% |
| | R1152 | 315-0121-00 | | 120 ohm, $\frac{1}{2}$ W, 5% |
| | R1153 | 321-0147-00 | | 332 ohm, $\frac{1}{8}$ W, 1% |
| | R1154 | 321-0106-00 | | 124 ohm, $\frac{1}{8}$ W, 1% |
| | R1155 | 311-1258-00 | | 50 ohm, Var |
| | R1156 | 321-0159-00 | | 442 ohm, $\frac{1}{8}$ W, 1% |
| | R1159 | 321-0159-00 | | 442 ohm, $\frac{1}{8}$ W, 1% |
| | R1162 | 315-0121-00 | | 120 ohm, $\frac{1}{2}$ W, 5% |
| | R1163 | 321-0147-00 | | 332 ohm, $\frac{1}{8}$ W, 1% |
| | R1164 | 315-0223-00 | | 22K ohm, $\frac{1}{2}$ W, 5% |
| | R1165 | 321-0193-00 | | 1K ohm, $\frac{1}{8}$ W, 1% |
| | R1166 | 315-0513-00 | | 51K ohm, $\frac{1}{2}$ W, 5% |
| | R1167 | 321-0193-00 | | 1K ohm, $\frac{1}{8}$ W, 1% |
| | R1168 | 315-0821-00 | | 820 ohm, $\frac{1}{2}$ W, 5% |
| | R1169 | 315-0161-00 | | 160 ohm, $\frac{1}{2}$ W, 5% |

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|------------------|--------------------|----------------------|----------|---------------------------|
| RESISTORS (cont) | | | | |
| R1171 | 131-0566-00 | | | Link, terminal connecting |
| R1172 | 321-0157-00 | | | 422 ohm, 1/8 W, 1% |
| R1173 | 321-0157-00 | | | 422 ohm, 1/8 W, 1% |
| R1174 | 315-0751-00 | | | 750 ohm, 1/2 W, 5% |
| R1175 | 311-1258-00 | | | 50 ohm, Var |
| R1182 | 321-0145-00 | | | 316 ohm, 1/8 W, 1% |
| R1183 | 321-0131-00 | | | 226 ohm, 1/8 W, 1% |
| R1184 | 315-0751-00 | | | 750 ohm, 1/2 W, 5% |
| R1185 | 311-1258-00 | | | 50 ohm, Var |
| R1186 | 321-0182-00 | | | 768 ohm, 1/8 W, 1% |
| R1187 | 321-0162-00 | | | 475 ohm, 1/8 W, 1% |
| R1188 | 321-0114-00 | | | 150 ohm, 1/8 W, 1% |
| R1189 | 315-0102-00 | | | 1K ohm, 1/2 W, 5% |
| R1201 | 315-0102-00 | | | 1K ohm, 1/2 W, 5% |
| R1202 | 321-0218-00 | | | 1.82K ohm, 1/8 W, 1% |
| R1203 | 321-0234-00 | | | 2.67K ohm, 1/8 W, 1% |
| R1204 | 321-0213-00 | | | 1.62K ohm, 1/8 W, 1% |
| R1205 | 311-1007-00 | B010100 | B010274X | 20 ohm, Var |
| R1209 | 321-0121-00 | | | 178 ohm, 1/8 W, 1% |
| R1211 | 315-0102-00 | | | 1K ohm, 1/2 W, 5% |
| R1212 | 321-0218-00 | | | 1.82K ohm, 1/8 W, 1% |
| R1216 | 321-0153-00 | | | 383 ohm, 1/8 W, 1% |
| R1233 | 321-0260-00 | | | 4.99K ohm, 1/8 W, 1% |
| R1234 | 315-0101-00 | | | 100 ohm, 1/2 W, 5% |
| R1235 | 321-0385-00 | | | 100K ohm, 1/8 W, 1% |
| R1237 | 321-0193-00 | | | 1K ohm, 1/8 W, 1% |
| R1239 | 321-0365-00 | | | 61.9K ohm, 1/8 W, 1% |
| R1253 | 321-0260-00 | | | 4.99K ohm, 1/8 W, 1% |
| R1254 | 315-0100-00 | | | 10 ohm, 1/2 W, 5% |
| R1255 | 321-0385-00 | | | 100K ohm, 1/8 W, 1% |
| R1256 | 311-1230-00 | | | 20K ohm, Var |
| R1257 | 321-0385-00 | | | 100K ohm, 1/8 W, 1% |
| R1258 | 321-0202-00 | | | 1.24K ohm, 1/8 W, 1% |
| R1259 | 321-0291-00 | | | 10.5K ohm, 1/8 W, 1% |
| R1267 | 315-0101-00 | | | 100 ohm, 1/2 W, 5% |
| R1268 | 315-0473-00 | | | 47K ohm, 1/2 W, 5% |
| R1302 | 315-0203-00 | | | 20K ohm, 1/2 W, 5% |
| R1303A | 307-0290-03 | | | 24.5M ohm, |
| R1303B | | | | 500K ohm, |
| R1303C | | | | 23.4M ohm, Thick film |
| R1303D | | | | 6.57M ohm, |
| R1304 | 315-0244-00 | | | 240K ohm, 1/2 W, 5% |
| R1305 | 315-0822-00 | | | 8.2K ohm, 1/2 W, 5% |
| R1306 | 315-0123-00 | | | 12K ohm, 1/2 W, 5% |
| R1307 | 315-0683-00 | | | 68K ohm, 1/2 W, 5% |

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|------------------|--------------------|----------------------|---------|----------------------|
| RESISTORS (cont) | | | | |
| R1308 | 315-0102-00 | | | 1K ohm, 1/4 W, 5% |
| R1310 | 316-0392-00 | | | 3.9K ohm, 1/4 W, 10% |
| R1312 | 315-0242-00 | | | 2.4K ohm, 1/4 W, 5% |
| R1313 | 321-0327-00 | | | 24.9K ohm, 1/8 W, 1% |
| R1314 | 316-0103-00 | | | 10K ohm, 1/4 W, 10% |
| R1315 | 316-0473-00 | | | 47K ohm, 1/4 W, 10% |
| R1316 | 316-0472-00 | | | 4.7K ohm, 1/4 W, 10% |
| R1317 | 321-0329-00 | | | 26.1K ohm, 1/8 W, 1% |
| R1322 | 316-0103-00 | | | 10K ohm, 1/4 W, 10% |
| R1326 | 315-0394-00 | | | 390K ohm, 1/4 W, 5% |
| R1328 | 321-0157-00 | | | 422 ohm, 1/8 W, 1% |
| R1331 | 301-0153-00 | | | 15K ohm, 1/2 W, 5% |
| R1332 | 315-0220-00 | B010100 | B010161 | 22 ohm, 1/4 W, 5% |
| R1332 | 331-0566-00 | B010162 | | Zero ohm strap |
| R1333 | 315-0221-00 | | | 220 ohm, 1/4 W, 5% |
| R1335 | 311-1373-00 | | | 5K ohm, Var |
| R1336 | 321-0206-00 | | | 1.37K ohm, 1/8 W, 1% |
| R1337 | 321-0206-00 | | | 1.37K ohm, 1/8 W, 1% |
| R1339 | 321-0174-00 | | | 634 ohm, 1/8 W, 1% |
| R1340 | 321-0120-00 | | | 174 ohm, 1/8 W, 1% |
| R1341 | 322-0197-00 | | | 1.1K ohm, 1/4 W, 1% |
| R1342 | 315-0331-00 | | | 330 ohm, 1/4 W, 5% |
| R1343 | 321-0322-00 | | | 22.1K ohm, 1/8 W, 1% |
| R1344 | 316-0102-00 | | | 1K ohm, 1/4 W, 10% |
| R1345 | 315-0390-00 | B010100 | B039999 | 39 ohm, 1/4 W, 5% |
| R1345 | 315-0201-00 | B040000 | | 200 ohm, 1/4 W, 5% |
| R1346 | 315-0682-00 | | | 6.8K ohm, 1/4 W, 5% |
| R1349 | 315-0682-00 | | | 6.8K ohm, 1/4 W, 5% |
| R1352 | 315-0911-00 | XB040000 | | 910 ohm, 1/4 W, 5% |
| R1354 | 301-0752-00 | | | 7.5K ohm, 1/2 W, 5% |
| R1355 | 302-0273-00 | | | 27K ohm, 1/2 W, 10% |
| R1356 | 301-0752-00 | | | 7.5K ohm, 1/2 W, 5% |
| R1358 | 315-0241-00 | | | 240 ohm, 1/4 W, 5% |
| R1362 | 315-0332-00 | | | 3.3K ohm, 1/4 W, 5% |
| R1363 | 315-0332-00 | | | 3.3K ohm, 1/4 W, 5% |
| R1364 | 315-0470-00 | | | 47 ohm, 1/4 W, 5% |
| R1368 | 315-0201-00 | B010100 | B039999 | 200 ohm, 1/4 W, 5% |
| R1368 | 315-0271-00 | B040000 | | 270 ohm, 1/4 W, 5% |
| R1369 | 323-0307-00 | | | 15.4K ohm, 1/2 W, 1% |
| R1371 | 316-0471-00 | | | 470 ohm, 1/4 W, 10% |
| R1372 | 316-0471-00 | | | 470 ohm, 1/4 W, 10% |
| R1373 | 316-0471-00 | | | 470 ohm, 1/4 W, 10% |
| R1375 | 311-1231-00 | | | 25K ohm, Var |
| R1376 | 316-0103-00 | | | 10K ohm, 1/4 W, 10% |
| R1378 | 315-0226-00 | | | 22M ohm, 1/4 W, 5% |

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|------------------|--------------------|----------------------|------|---------------------------------|
| RESISTORS (cont) | | | | |
| R1379 | 316-0103-00 | | | 10K ohm, $\frac{1}{2}$ W, 10% |
| R1380 | 311-0075-00 | | | 5M ohm, Var |
| R1384 | 302-0121-00 | | | 120 ohm, $\frac{1}{2}$ W, 10% |
| R1385 | 311-1227-00 | | | 5K ohm, Var |
| R1386 | 311-1373-00 | | | 5K ohm, Var |
| R1390 | 311-1235-00 | | | 100K ohm, Var |
| R1391 | 316-0470-00 | | | 47 ohm, $\frac{1}{2}$ W, 10% |
| R1393 | 321-0231-00 | | | 2.49K ohm, 1/8 W, 1% |
| R1394 | 321-0248-00 | | | 3.74K ohm, 1/8 W, 1% |
| R1395 | 311-1226-00 | | | 2.5K ohm, Var |
| R1396 | 316-0100-00 | | | 10 ohm, $\frac{1}{2}$ W, 10% |
| R1397 | 311-1372-00 | | | 100K ohm, Var |
| R1398 | 316-0100-00 | | | 10 ohm, $\frac{1}{2}$ W, 10% |
| R1399 | 316-0470-00 | | | 47 ohm, $\frac{1}{2}$ W, 10% |
| R1416 | 323-0265-00 | | | 5.62K ohm, $\frac{1}{2}$ W, 1% |
| R1417 | 321-0282-00 | | | 8.45K ohm, 1/8 W, 1% |
| R1422 | 315-0682-00 | | | 6.8K ohm, $\frac{1}{2}$ W, 5% |
| R1423 | 303-0822-00 | | | 8.2K ohm, 1 W, 5% |
| R1424 | 315-0122-00 | | | 1.2K ohm, $\frac{1}{2}$ W, 5% |
| R1425 | 315-0563-00 | | | 56K ohm, $\frac{1}{2}$ W, 5% |
| R1426 | 307-0052-00 | | | 3 ohm, $\frac{1}{2}$ W, 5% |
| R1430 | 311-1226-00 | | | 2.5K ohm, Var |
| R1431 | 321-0351-00 | | | 44.2K ohm, 1/8 W, 1% |
| R1432 | 321-0284-00 | | | 8.87K ohm, 1/8 W, 1% |
| R1444 | 321-0761-03 | | | 35K ohm, 1/8 W, $\frac{1}{2}$ % |
| R1445 | 321-0684-00 | | | 15K ohm, 1/8 W, $\frac{1}{2}$ % |
| R1446 | 315-0471-00 | | | 470 ohm, $\frac{1}{2}$ W, 5% |
| R1447 | 315-0622-00 | | | 6.2K ohm, $\frac{1}{2}$ W, 5% |
| R1448 | 308-0245-00 | | | 0.6 ohm, 2 W, WW, 5% |
| R1454 | 321-0775-03 | | | 45K ohm, 1/8 W, $\frac{1}{2}$ % |
| R1455 | 321-0816-03 | | | 5K ohm, 1/8 W, $\frac{1}{2}$ % |
| R1456 | 315-0331-00 | | | 330 ohm, $\frac{1}{2}$ W, 5% |
| R1457 | 315-0302-00 | | | 3K ohm, $\frac{1}{2}$ W, 5% |
| R1458 | 308-0245-00 | | | 0.6 ohm, 2 W, WW, 5% |
| R1463 | 321-0273-00 | | | 6.81K ohm, 1/8 W, 1% |
| R1464 | 321-0756-03 | | | 50K ohm, 1/8 W, $\frac{1}{2}$ % |
| R1465 | 321-0962-03 | | | 8K ohm, 1/8 W, $\frac{1}{2}$ % |
| R1466 | 315-0561-00 | | | 560 ohm, $\frac{1}{2}$ W, 5% |
| R1467 | 315-0432-00 | | | 4.3K ohm, $\frac{1}{2}$ W, 5% |
| R1468 | 308-0245-00 | | | 0.6 ohm, 2 W, WW, 5% |
| R1473 | 321-0287-00 | | | 9.53K ohm, 1/8 W, 1% |
| R1474 | 321-0756-03 | | | 50K ohm, 1/8 W, $\frac{1}{2}$ % |
| R1475 | 321-0684-00 | | | 15K ohm, 1/8 W, $\frac{1}{2}$ % |
| R1476 | 315-0331-00 | | | 330 ohm, $\frac{1}{2}$ W, 5% |
| R1477 | 315-0472-00 | | | 4.7K ohm, $\frac{1}{2}$ W, 5% |

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|-------------------|--------------------|----------------------|------|--|
| RESISTORS (cont) | | | | |
| R1478 | 307-0052-00 | | | 3 ohm, ½ W, 5% |
| R1480 | 311-1373-00 | | | 5K ohm, Var |
| R1481 | 315-0392-00 | | | 3.9K ohm, ½ W, 5% |
| R1483 | 315-0202-00 | | | 2K ohm, ½ W, 5% |
| R1484 | 315-0433-00 | | | 43K ohm, ½ W, 5% |
| R1485 | 315-0473-00 | | | 47K ohm, ½ W, 5% |
| R1486 | 321-0364-00 | | | 60.4K ohm, 1/8 W, 1% |
| R1487 | 321-0356-00 | | | 49.9K ohm, 1/8 W, 1% |
| R1488 | 305-0242-00 | | | 2.4K ohm, 2 W, 5% |
| R1493 | 315-0104-00 | | | 100K ohm, ½ W, 5% |
| R1494 | 315-0104-00 | | | 100K ohm, ½ W, 5% |
| R1496 | 321-0356-00 | | | 49.9K ohm, 1/8 W, 1% |
| R1497 | 321-0280-00 | | | 8.06K ohm, 1/8 W, 1% |
| R1498 | 315-0153-00 | | | 15K ohm, ½ W, 5% |
| R1499 | 315-0102-00 | | | 1K ohm, ½ W, 5% |
| R1501 | 315-0912-00 | | | 9.1K ohm, ½ W, 5% |
| R1502 | 315-0433-00 | | | 43K ohm, ½ W, 5% |
| R1503 | 315-0822-00 | | | 8.2K ohm, ½ W, 5% |
| R1504 | 315-0473-00 | | | 47K ohm, ½ W, 5% |
| R1506 | 315-0512-00 | | | 5.1K ohm, ½ W, 5% |
| R1515 | 311-1221-00 | | | 50 ohm, Var |
| R1516 | 321-0107-00 | | | 127 ohm, 1/8 W, 1% |
| R1517 | 321-0001-00 | | | 10 ohm, 1/8 W, 1% |
| R1691 | 303-0150-00 | | | 15 ohm, 1 W, 5% |
| R1692 | 321-0062-00 | | | 43.2 ohm, 1/8 W, 1% |
| R1693 | 323-0140-00 | | | 280 ohm, ½ W, 1% |
| R1694 | 323-0140-00 | | | 280 ohm, ½ W, 1% |
| R1695 | 321-0228-00 | | | 2.32K ohm, 1/8 W, 1% |
| RT1696 | 307-0124-00 | | | 5K ohm, Thermal |
| R1697 | 321-0201-00 | | | 1.21K ohm, 1/8 W, 1% |
| R1698 | 315-0363-00 | | | 36K ohm, ½ W, 5% |
| SWITCHES | | | | |
| S20A (2) | 105-0282-00 | | | Actuator assembly, Cam, AC/GND/DC |
| S20B (2) | 105-0343-00 | | | Actuator assembly, Cam, VOLTS/DIV |
| S128 ¹ | | | | |
| S225 ² | 260-1208-00 | | | Push, INVERT |
| S228 ² | | | | |
| S300 | 260-1424-00 | | | Pushbutton, VERT MODE |
| S375A | 105-0423-00 | | | Actuator assembly, slide, 20 MHz BW |
| S375B,C | 105-0421-00 | | | Actuator assembly, slide, TRIG VIEW |
| S450 | 260-1310-01 | | | Push, BEAM FIND |
| S505 | 105-0400-00 | | | Actuator assembly, slide, A TRIGGER SOURCE |
| S508 ³ | 105-0399-00 | | | Actuator assembly, slide, A TRIGGER COUPLING |
| S530 ³ | | | | A TRIGGER SLOPE |

¹Furnished as a unit with R128.

²Furnished as a unit with R228.

³Furnished as a unit with R530.

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|-----------------------|--------------------|----------------------|------|---|
| SWITCHES (cont) | | | | |
| S600 ₁ | 260-1422-00 | | | Pushbutton, TRIG MODE |
| S644 ₁ | | | | B ENDS A |
| S705 | 105-0401-00 | | | Actuator assembly, slide, B (DLY'D) TRIGGER SOURCE |
| S708 ₂ | 105-0399-00 | | | Actuator assembly, slide, B (DLY'D) COUPLING |
| S750 ₂ | | | | B DLY'D TRIGGER SLOPE |
| S1050A,B | 105-0363-00 | | | Actuator assembly, A & B TIME/DIV & DELAY TIME |
| | | | | |
| S1070A,B ₃ | | | | |
| S1090 | 260-1423-00 | | | Pushbutton, HORIZ DISPLAY |
| S1110 | 260-1209-00 | | | Push, X10 MAG |
| S1401 | 260-0834-00 | | | Toggle, POWER |
| S1402 | 260-0638-00 | | | Thermostatic, open 75 deg. C, close 55 deg. C |
| S1403 | 260-1300-01 | | | Slide |
| TRANSFORMERS | | | | |
| T178 | 120-0469-00 | | | Toroid, 3 turns, bifilar |
| T278 | 120-0469-00 | | | Toroid, 3 turns, bifilar |
| T1320 ₄ | 120-0815-00 | | | HV Power (varnished) |
| T1320 ₄ | 120-0815-01 | | | HV Power (molded) |
| T1400 | 120-0799-00 | | | LV Power |
| INTEGRATED CIRCUITS | | | | |
| U120 | 155-0085-00 | | | Hybrid, dual FET input & amplifier |
| U140 | 155-0078-00 | | | Monolithic, vertical amplifier |
| U220 | 155-0085-00 | | | Hybrid, dual FET input & amplifier |
| U240 | 155-0078-00 | | | Monolithic, vertical amplifier |
| U330 | 156-0030-00 | | | Quad 2-input positive nand gate, SN7400N |
| U340 | 156-0030-00 | | | Quad 2-input positive nand gate, SN7400N |
| U350 | 156-0041-00 | | | Dual 15 MHz D-type pos.-edge-trig, flip-flop, SN7474N |
| U370 | 155-0091-00 | | | Monolithic, channel switch |
| U450 | 155-0078-01 | | | Monolithic, vert amp., selected |
| U470 | 155-0082-00 | | | Hybrid, vert output amp. |
| U520 | 155-0032-01 | | | Monolithic, input pre-amplifier, selected |
| U600 | 155-0049-00 | | | Monolithic, sweep control |
| U720 | 155-0032-01 | | | Monolithic, input pre-amplifier, selected |
| U930 | 156-0158-00 | | | Dual operational amplifier, N5558V |
| U1418 | 156-0158-00 | | | Dual operational amplifier, N5558V |
| U1454 | 156-0158-00 | | | Dual operational amplifier, N5558V |
| U1464 | 156-0158-00 | | | Dual operational amplifier, N5558V |
| U1690 | 156-0281-00 | | | 4 transistor array, Motorola MPQ2221 |
| VOLTAGE MULTIPLIER | | | | |
| U1321 | 152-0552-00 | | | Voltage multiplier |

¹Furnished as a unit with R644.

²Furnished as a unit with R750.

³Furnished as a unit with R1070.

⁴Either of these transformers may be used.

Electrical Parts List-475

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|---------------|--------------------|----------------------|------|--|
| ELECTRON TUBE | | | | |
| V1380 | 154-0677-00 | | | CRT |
| DIODES, ZENER | | | | |
| VR144 | 152-0195-00 | | | Selected from 1N751A, 0.4 W, 5.1 V, 5% |
| VR161 | 152-0166-00 | | | Selected from 1N753A, 0.4 W, 6.2 V, 5% |
| VR244 | 152-0195-00 | | | Selected from 1N751A, 0.4 W, 5.1 V, 5% |
| VR261 | 152-0166-00 | | | Selected from 1N753A, 0.4 W, 6.2 V, 5% |
| VR290 | 152-0280-00 | | | 1N753A, 0.4 W, 6.2 V, 5% |
| VR396 | 152-0280-00 | | | 1N753A, 0.4 W, 6.2 V, 5% |
| VR462 | 152-0195-00 | | | Selected from 1N751A, 0.4 W, 5.1 V, 5% |
| VR464 | 152-0195-00 | | | Selected from 1N751A, 0.4 W, 5.1 V, 5% |
| VR482 | 152-0195-00 | | | Selected from 1N751A, 0.4 W, 5.1 V, 5% |
| VR570 | 152-0217-00 | | | Selected from 1N756A, 0.4 W, 8.2 V, 5% |
| VR608 | 152-0278-00 | | | 1N4372A, 0.4 W, 3 V, 5% |
| VR647 | 152-0195-00 | | | Selected from 1N751A, 0.4 W, 5.1 V, 5% |
| VR796 | 152-0226-00 | | | Selected from 1N751A, 0.4 W, 5.1 V, 5% |
| VR798 | 152-0278-00 | | | 1N4372A, 0.4 W, 3 V, 5% |
| VR930 | 152-0265-00 | | | 1N970B, 0.4 W, 24 V, 5% |
| VR938 | 152-0304-00 | | | 1N968B, 0.4 W, 20 V, 5% |
| VR956 | 152-0278-00 | | | 1N4372A, 0.4 W, 3 V, 5% |
| VR1026 | 152-0278-00 | | | 1N4372A, 0.4 W, 3 V, 5% |
| VR1216 | 152-0055-00 | | | 1N962B, 0.4 W, 11 V, 5% |
| VR1267 | 152-0166-00 | | | Selected from 1N753A, 0.4 W, 6.2 V, 5% |
| VR1362 | 152-0166-00 | | | Selected from 1N753A, 0.4 W, 6.2 V, 5% |
| VR1374 | 152-0357-00 | | | 1N983B, 0.4 W, 82 V, 5% |
| VR1381 | 152-0247-00 | | | 1N989B, 0.4 W, 150 V, 5% |
| VR1416 | 152-0411-00 | | | 1N937, 0.25 W, 9 V, 5% |
| VR1418 | 152-0022-00 | | | Selected from 1N3029, 1 W, 25 V, 5% |
| VR1422 | 152-0283-00 | | | 1N976B, 0.4 W, 43 V, 5% |
| VR1423 | 152-0304-00 | | | 1N968B, 0.4 W, 20 V, 5% |

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

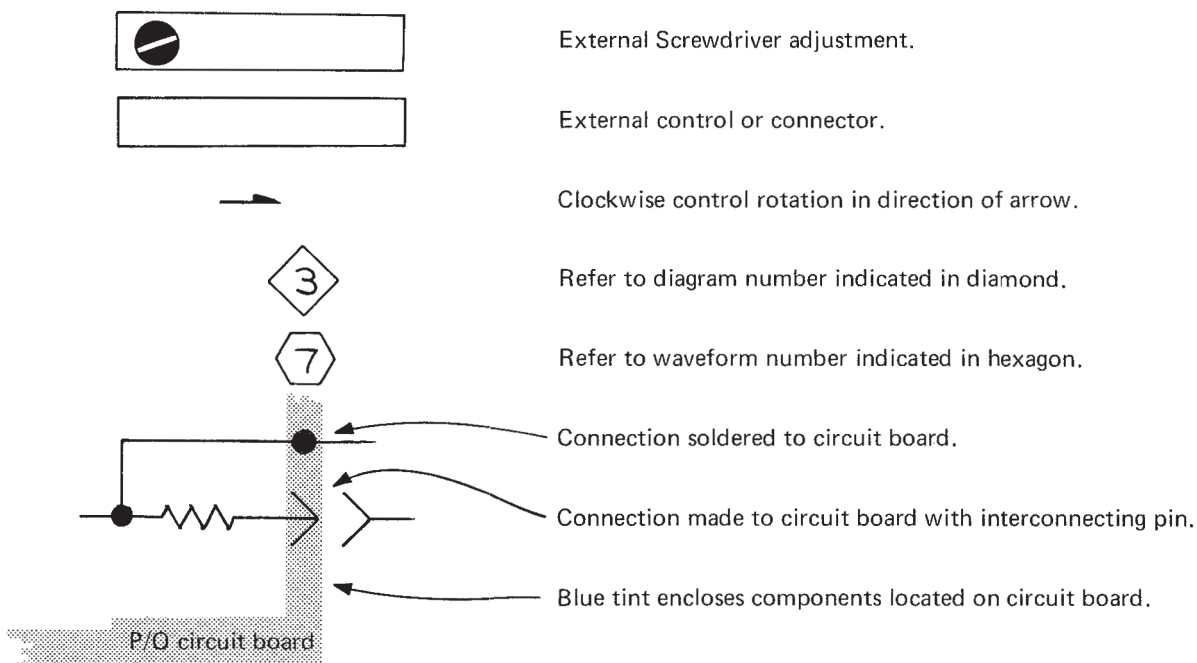
Electrical components shown on the diagrams are in the following units unless noted otherwise:

| | |
|--------------|--|
| Capacitors = | Values one or greater are in picofarads (pF). Values less than one are in microfarads (μ F). |
| Resistors = | Ohms (Ω) |

Symbols used on the diagrams are based on USA Standard Y32.2-1967.

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

The following special symbols are used on the diagrams:



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

| | | | |
|----|--|----|--|
| A | Assembly, separable or repairable (circuit board, etc.) | LR | Inductor/resistor combination |
| AT | Attenuator, fixed or variable | M | Meter |
| B | Motor | Q | Transistor or silicon-controlled rectifier |
| BT | Battery | P | Connector, movable portion |
| C | Capacitor, fixed or variable | R | Resistor, fixed or variable |
| CR | Diode, signal or rectifier | RT | Thermistor |
| DL | Delay line | S | Switch |
| DS | Indicating device (lamp) | T | Transformer |
| F | Fuse | TP | Test point |
| FL | Filter | U | Assembly, inseparable or non-repairable (integrated circuit, etc.) |
| H | Heat dissipating device (heat sink, heat radiator, etc.) | V | Electron tube |
| HR | Heater | VR | Voltage regulator (zener diode, etc.) |
| J | Connector, stationary portion | Y | Crystal |
| K | Relay | | |
| L | Inductor, fixed or variable | | |

Diagrams—475

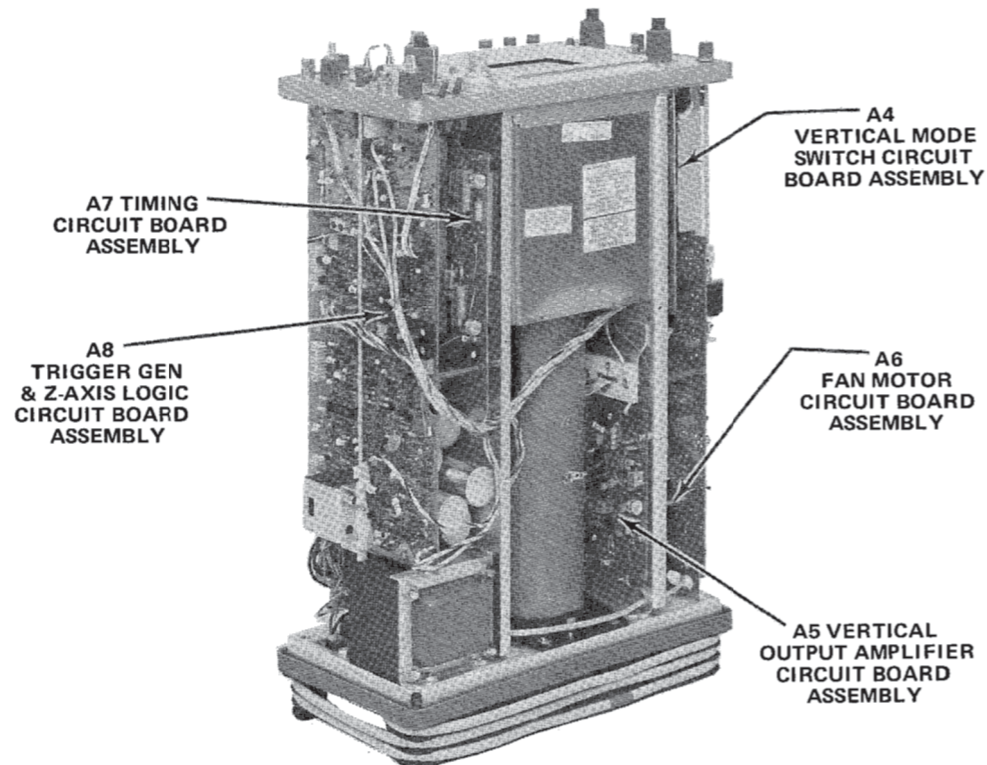
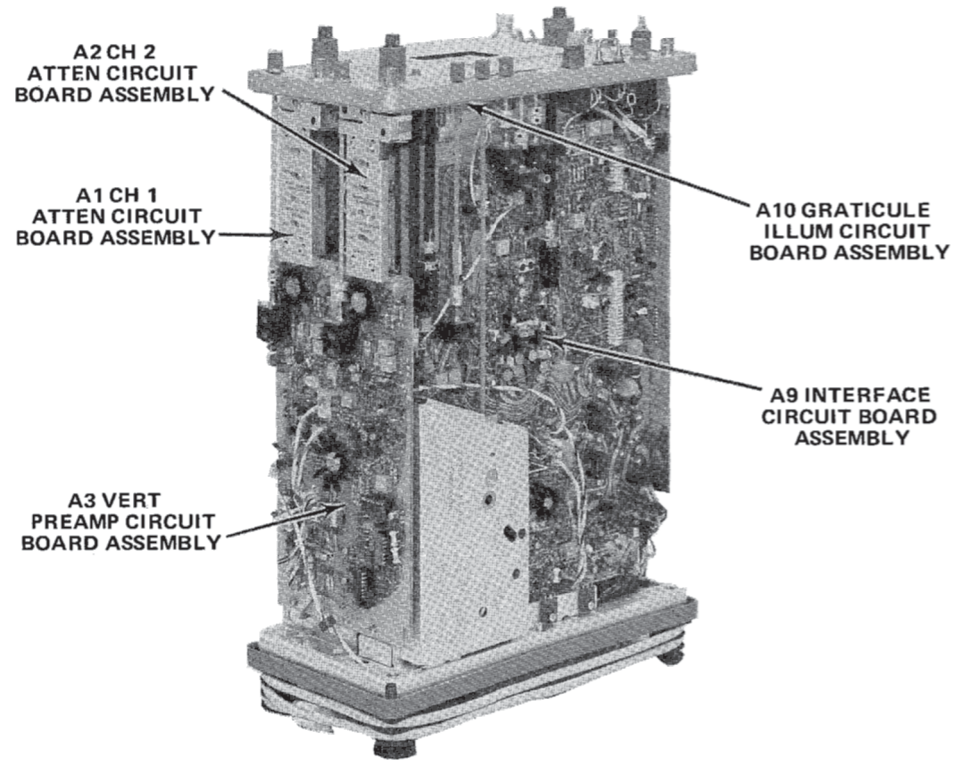
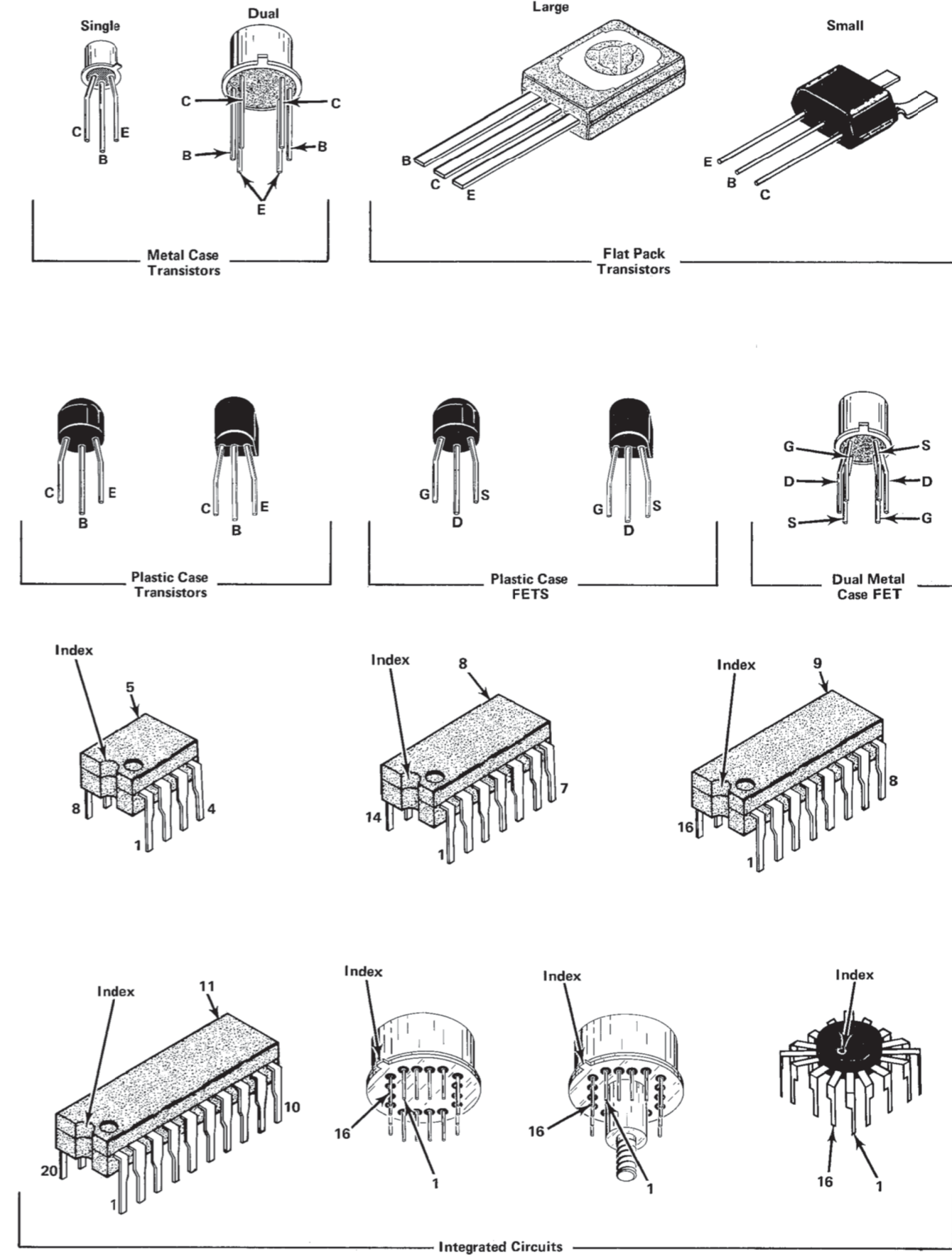


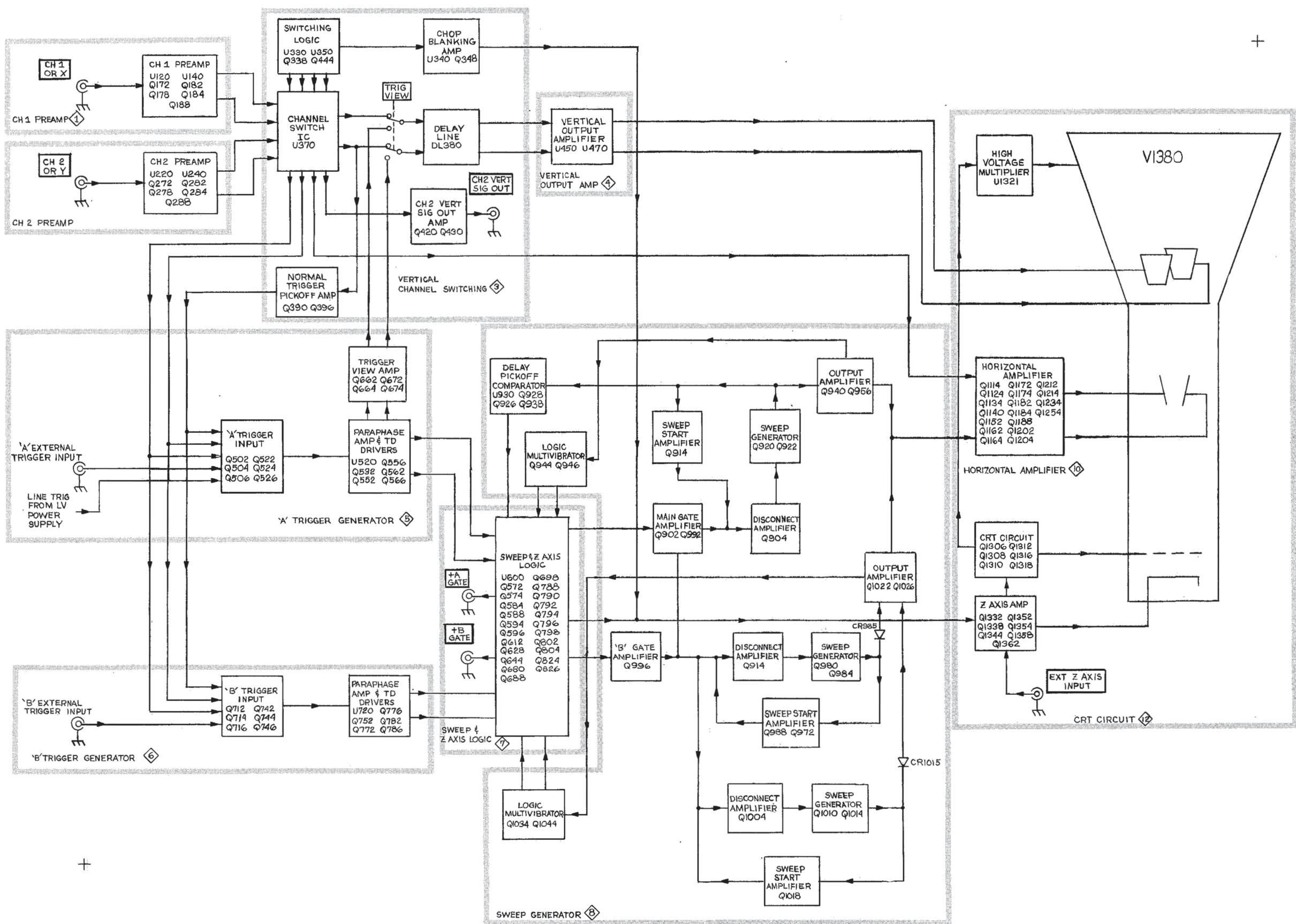
Fig. 7-1. Location of circuit boards in the 475 Oscilloscope.

Diagrams—475



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Fig. 7-2. Lead configurations for semiconductors used in this instrument.



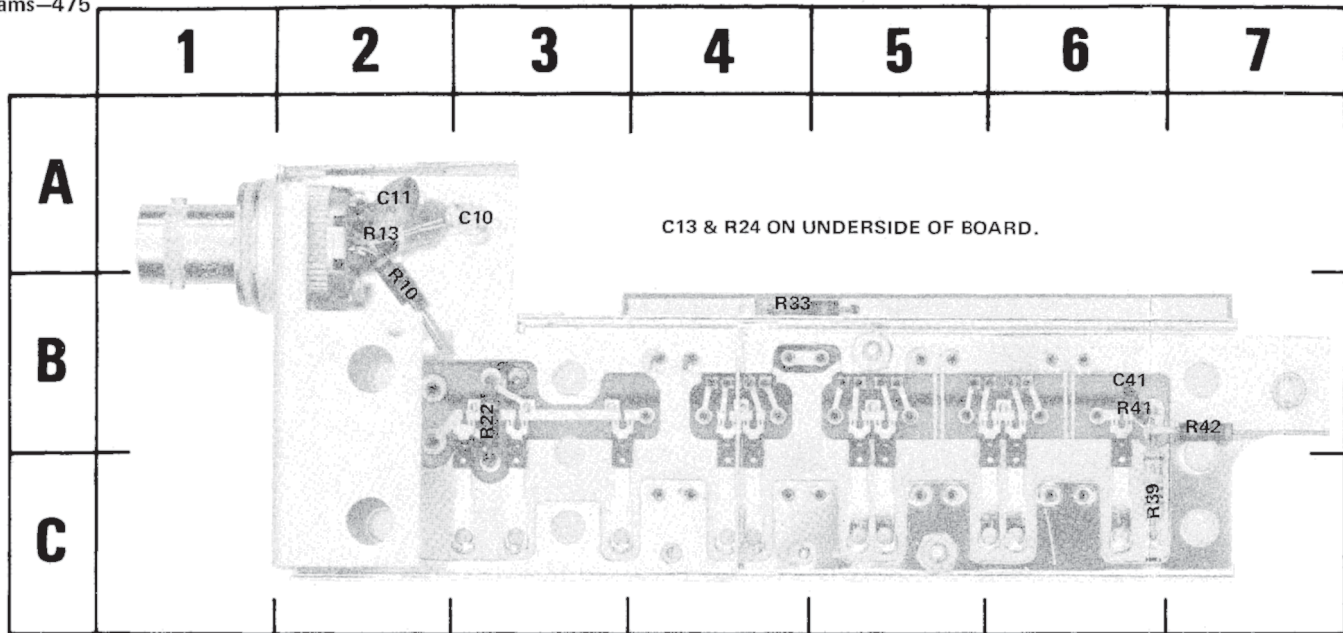


Fig. 7-3. A1 Channel 1 Attenuator circuit board.

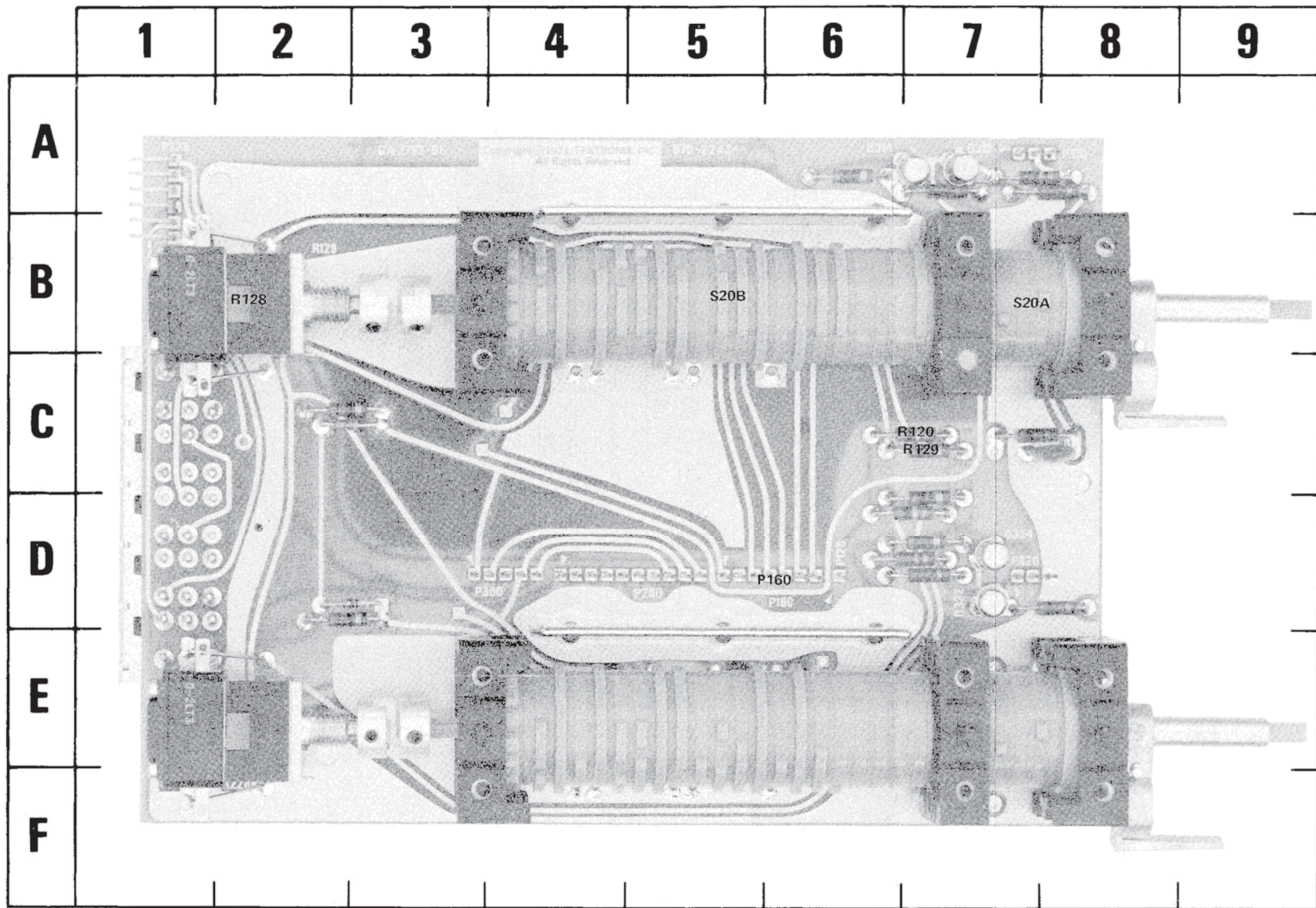


Fig. 7-4. P/O A4 Vertical Mode Switch circuit board.

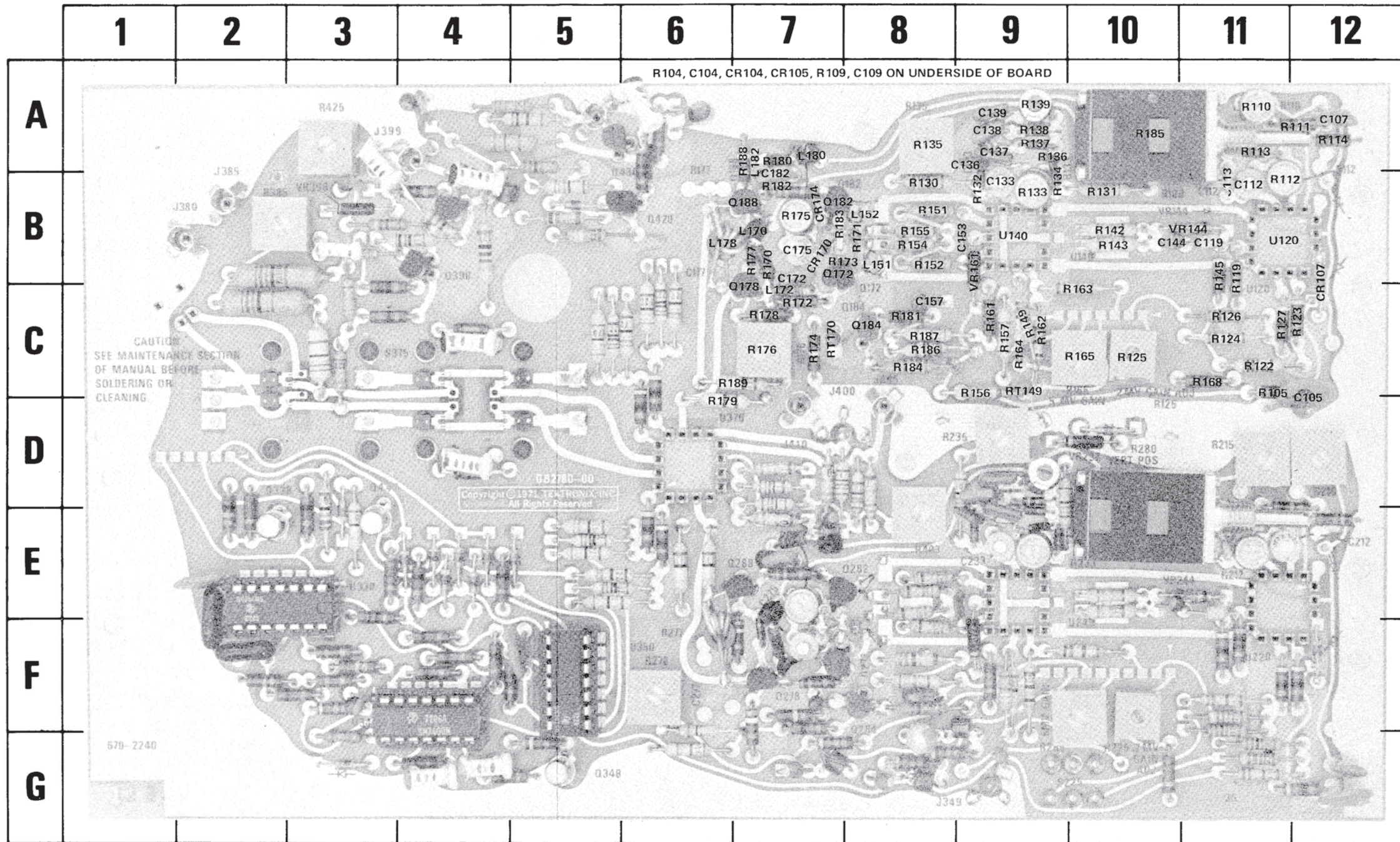


Fig. 7-5. P/O A3 Vertical Preamp circuit board.

Fig. 7-3. A1 Channel 1 Attenuator circuit board.

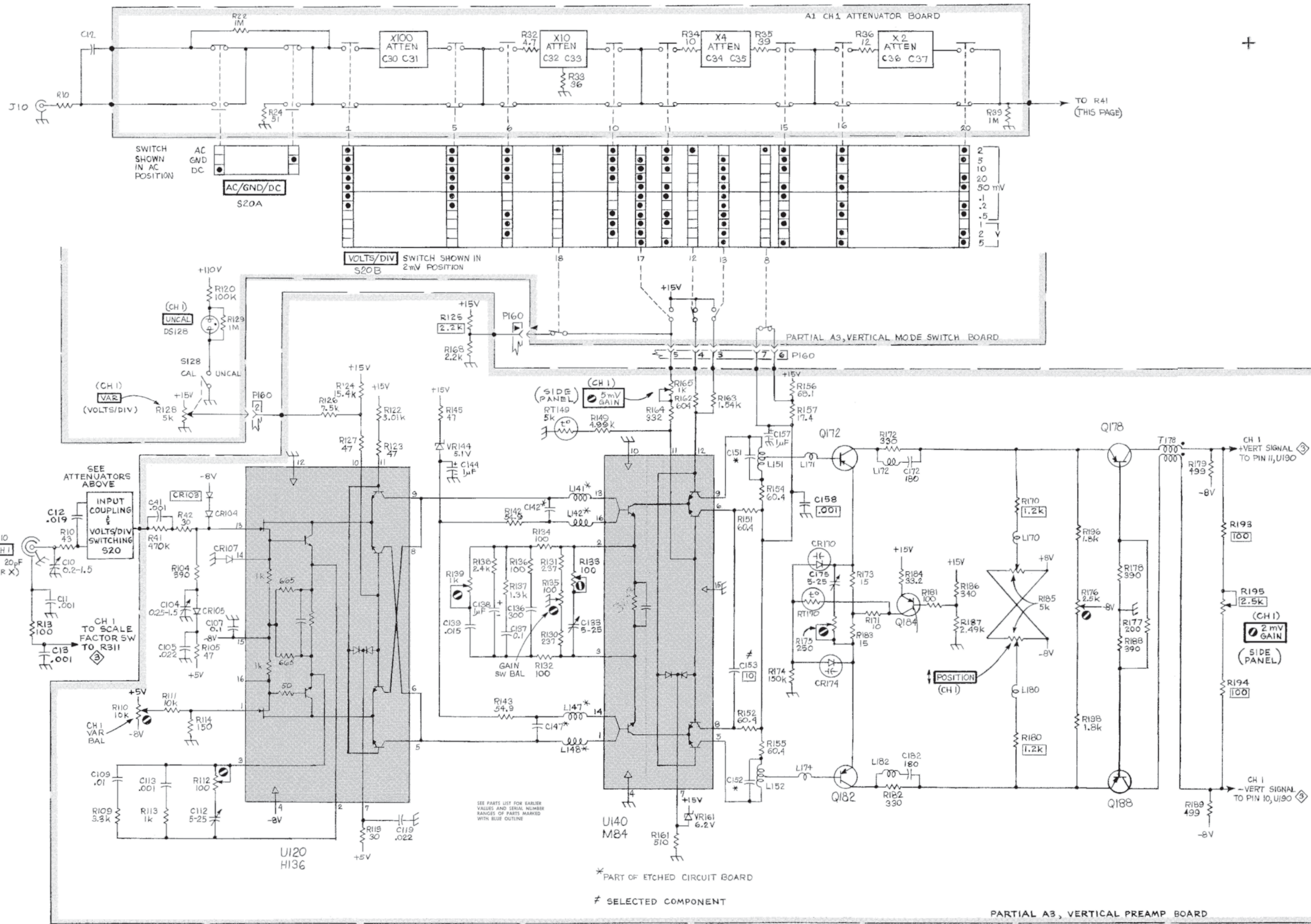
| CKT NO | GRID LOC | CKT NO | GRID LOC |
|-----------|-------------|-----------|-------------|
| C10 | 3A | R22 | 3B |
| C11 | 2A | R33 | 4B |
| C41 | 6B | R39 | 6C |
| R10 | 2B | R41 | 6B |
| R13 | 2A | R42 | 7B |

Fig. 7-4. A4 Vertical Mode Switch circuit board.

| CKT NO | GRID LOC | CKT NO | GRID LOC |
|-----------|-------------|-----------|-------------|
| P160 | 5D | R129 | 7C |
| R120 | 7C | S20A | 7B |
| R128 | 2B | S20B | 5B |

Fig. 7-5. A3 Vertical Preamp circuit board.

| CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC |
|-----------|-------------|-----------|-------------|-----------|-------------|-----------|-------------|-----------|-------------|-----------|-------------|-----------|-------------|-----------|-------------|
| C105 | 12C | C172 | 7B | L180 | 7A | R113 | 11A | R134 | 9B | R155 | 8B | R174 | 7C | R187 | 8C |
| C107 | 12A | C175 | 7B | L182 | 7B | R114 | 12A | R135 | 8A | R156 | 9C | R175 | 7B | R188 | 7B |
| C112 | 11B | C182 | 7B | | | R119 | 11C | R136 | 9A | R157 | 9C | R176 | 7C | R189 | 6C |
| C113 | 11B | | | Q172 | 7B | R122 | 11C | R137 | 9A | R161 | 9C | R177 | 7B | | |
| C119 | 11B | CR107 | 12C | Q178 | 7C | R123 | 12C | R138 | 9A | R162 | 9C | R178 | 7C | RT170 | 7C |
| C133 | 9B | CR170 | 7B | Q182 | 7B | R124 | 11C | R139 | 9A | R163 | 9C | R179 | 6D | | |
| C136 | 9A | CR174 | 7B | Q184 | 8C | R125 | 10C | R142 | 10B | R164 | 9C | R180 | 7A | U120 | 11B |
| C137 | 9A | | | Q188 | 7B | R126 | 11C | R143 | 10B | R165 | 10C | R181 | 8C | U140 | 9B |
| C138 | 9A | L151 | 8B | | | R127 | 11C | R145 | 11C | R168 | 11C | R182 | 7B | | |
| C139 | 9A | L152 | 8B | R105 | 11C | R130 | 8B | R149 | 9C | R170 | 7B | R183 | 7B | VR144 | 10B |
| C144 | 10B | L172 | 7C | R110 | 11A | R131 | 10B | R151 | 8B | R171 | 8B | R184 | 8C | VR161 | 9C |
| C153 | 9B | L170 | 7B | R111 | 11A | R132 | 9B | R152 | 8B | R172 | 7C | R185 | 10A | | |
| C157 | 8C | L178 | 6B | R112 | 11B | R133 | 9B | R154 | 8B | R173 | 7B | R186 | 8C | | |



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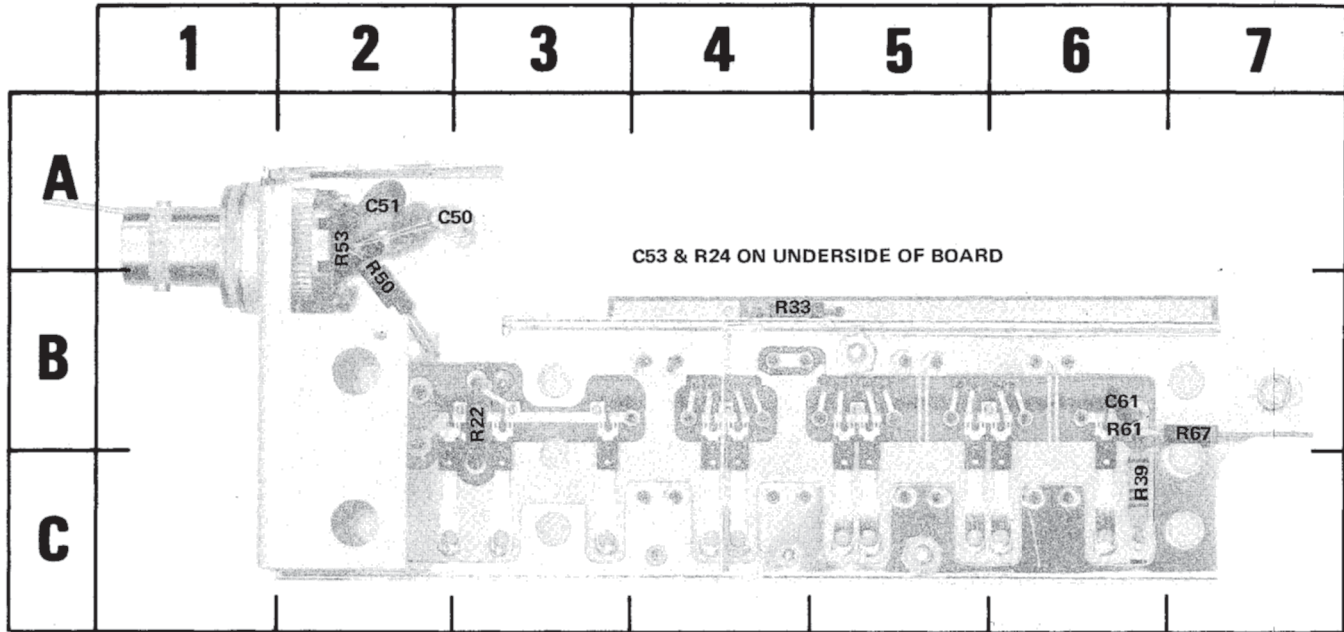


Fig. 7-6. A2 Channel 2 Attenuator circuit board.

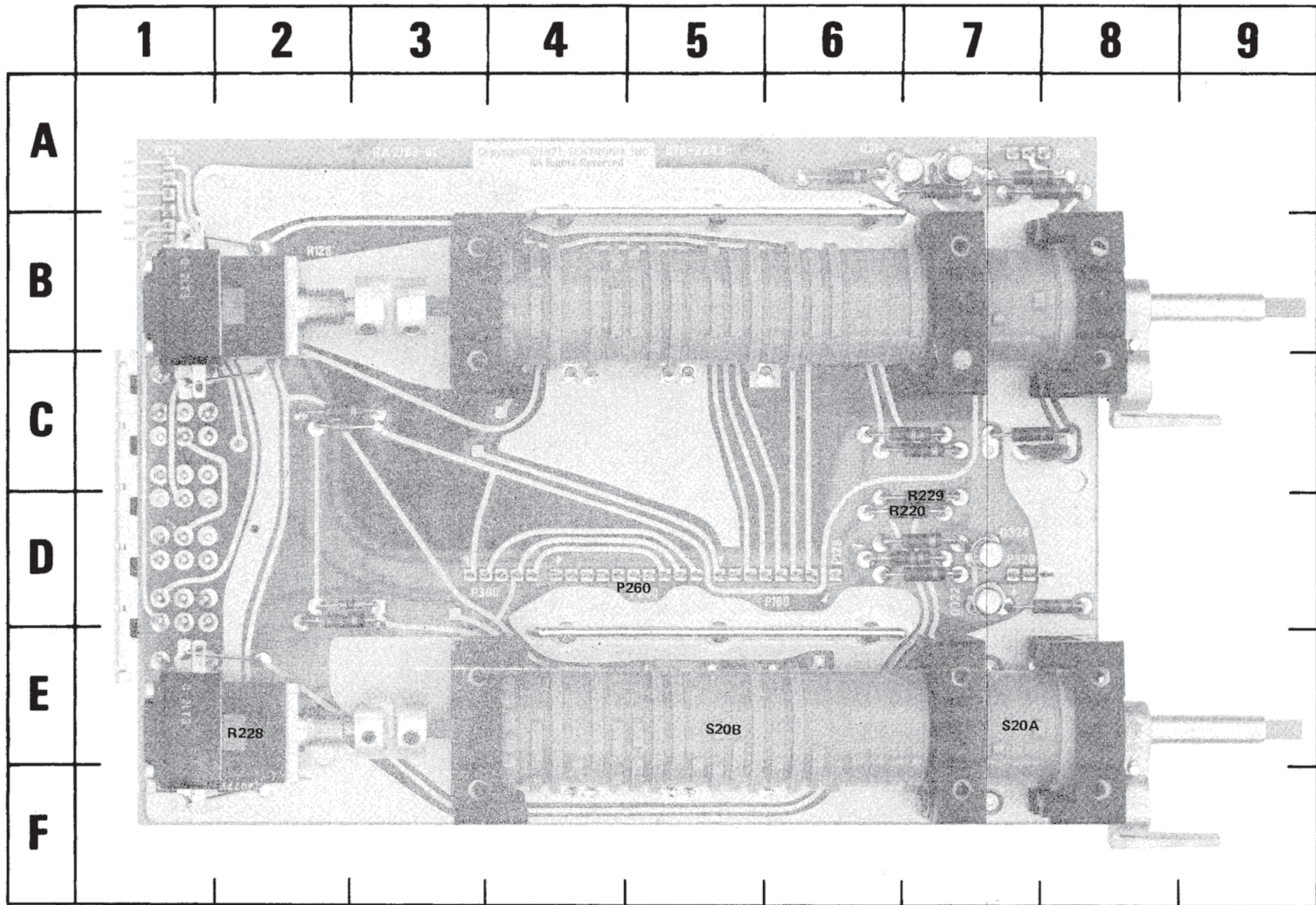


Fig. 7-7. P/O A4 Vertical Mode Switch circuit board.

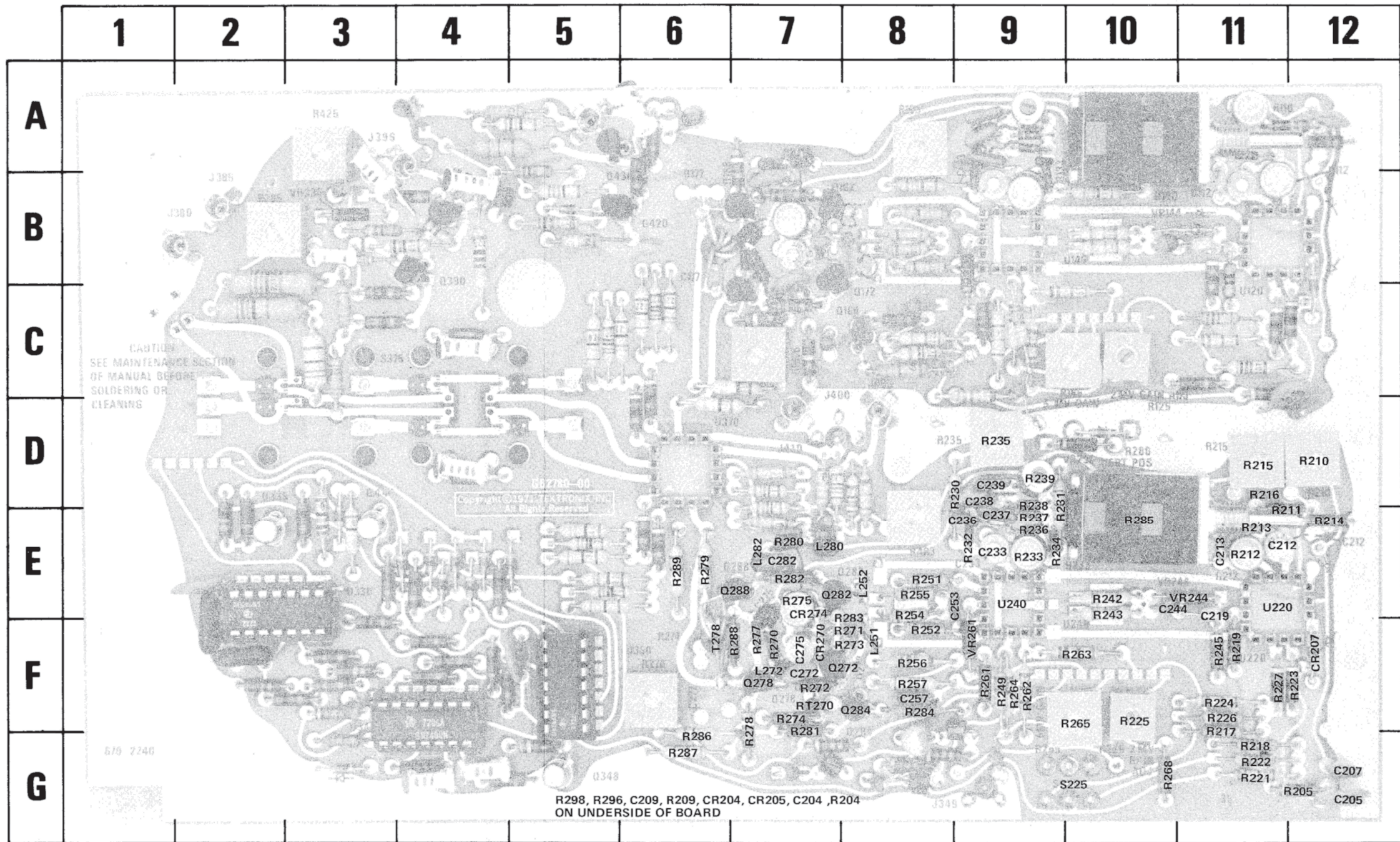


Fig. 7-8. P/O A3 Vertical Preamp circuit board.

Fig. 7-6. A2 Channel 2 Attenuator circuit board.

| CKT NO | GRID LOC | CKT NO | GRID LOC |
|-----------|-------------|-----------|-------------|
| C50 | 2A | R39 | 6C |
| C51 | 2A | R50 | 2A |
| C61 | 6B | R53 | 2A |
| | | R61 | 6B |
| R22 | 3B | R67 | 7B |
| R33 | 4B | | |

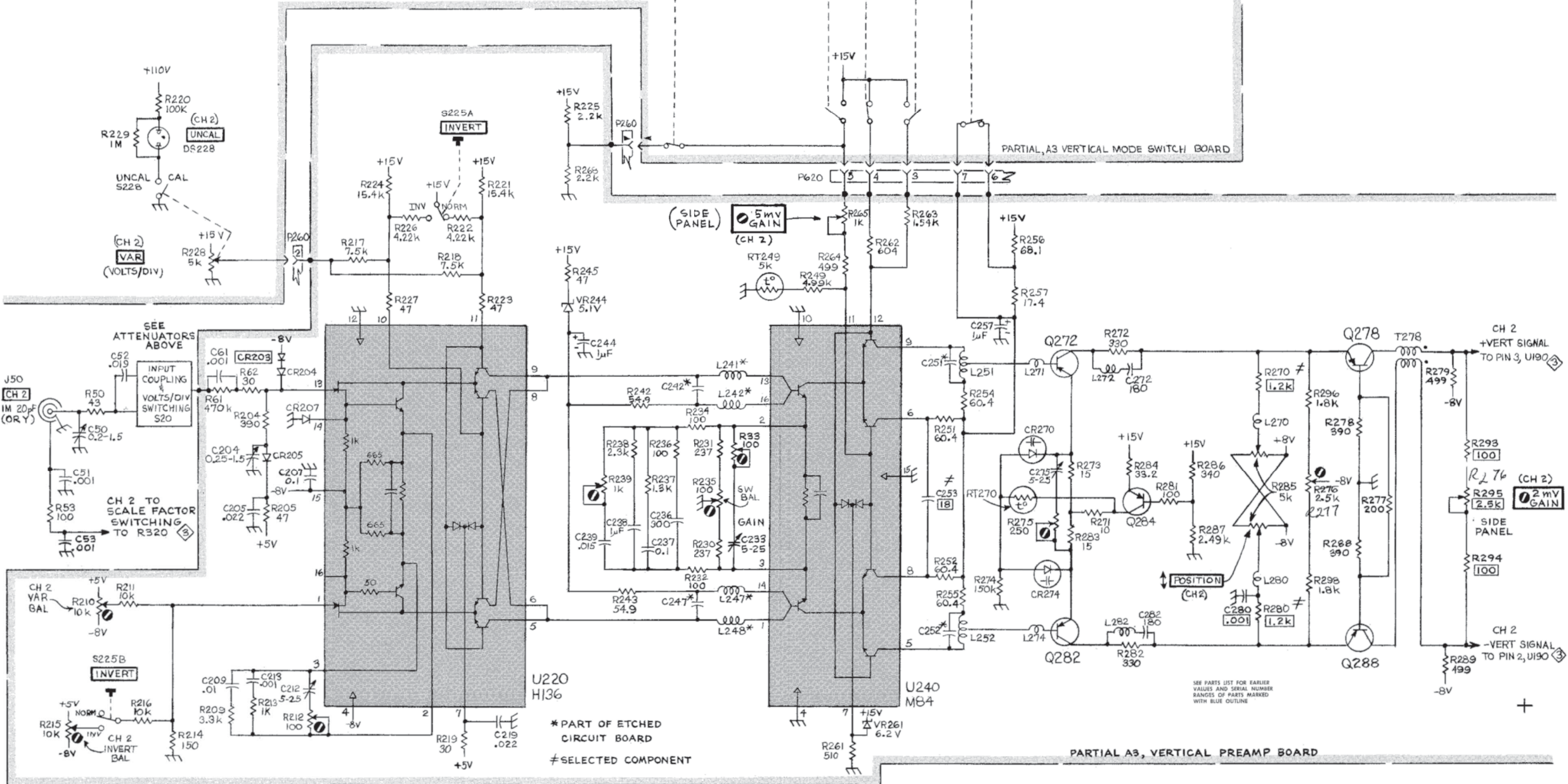
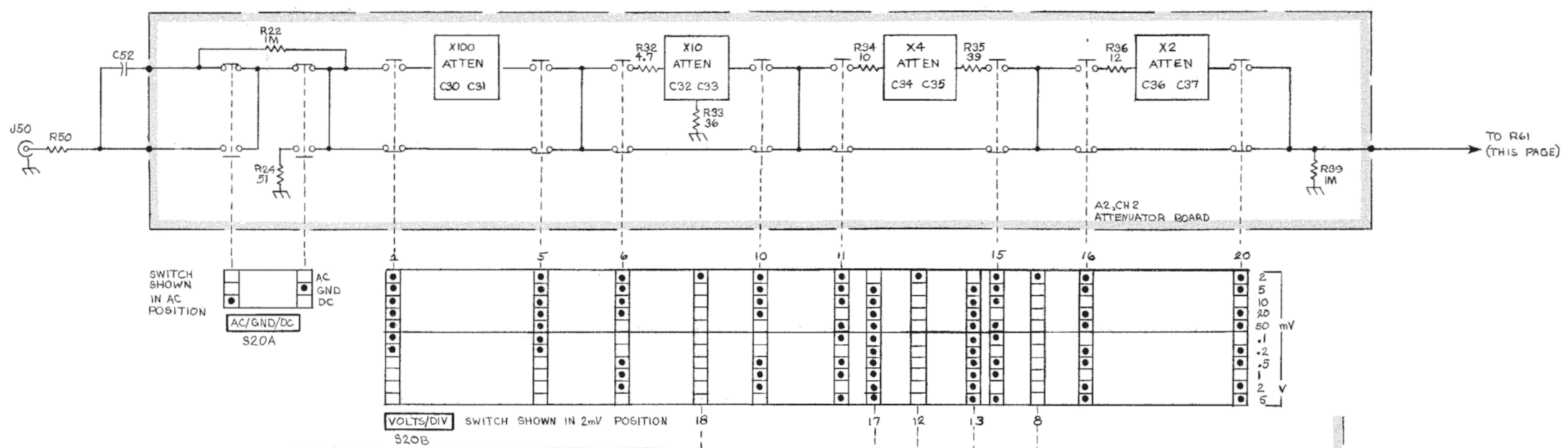
Fig. 7-7. A4 Vertical Mode Switch circuit board.

| CKT NO | GRID LOC | CKT NO | GRID LOC |
|-----------|-------------|-----------|-------------|
| P260 | 4D | R229 | 7D |
| R220 | 7D | S20A | 7E |
| R228 | 2E | S20B | 5E |

Fig. 7-8. A3 Vertical Preamp circuit board.

| CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC |
|-----------|-------------|-----------|-------------|-----------|-------------|-----------|-------------|-----------|-------------|-----------|-------------|-----------|-------------|-----------|-------------|
| C205 | 12G | C275 | 7F | Q282 | 7E | R219 | 11F | R236 | 9E | R261 | 9F | R279 | 6E | S225 | 10G |
| C207 | 12G | C282 | 7E | Q284 | 8F | R221 | 11G | R237 | 9E | R262 | 9F | R280 | 7E | | |
| C212 | 11E | CR207 | 12F | Q288 | 6E | R222 | 11G | R238 | 9D | R263 | 10F | R281 | 7F | T278 | 6F |
| C213 | 11E | CR270 | 7F | | | R223 | 12F | R239 | 9D | R264 | 9F | R282 | 7E | | |
| C219 | 11E | CR274 | 7E | R205 | 11G | R224 | 11F | R242 | 10E | R265 | 10F | R283 | 8E | U220 | 11E |
| C233 | 9E | | | R210 | 12D | R225 | 10F | R243 | 10E | R268 | 10G | R284 | 8F | U240 | 9E |
| C236 | 8E | L251 | 8F | R211 | 11E | R226 | 11F | R245 | 11F | R270 | 7F | R285 | 10E | | |
| C237 | 9E | L252 | 8E | R212 | 11E | R227 | 11F | R249 | 9F | R271 | 7F | R286 | 6G | VR244 | 10E |
| C238 | 9D | L272 | 7F | R213 | 11E | R230 | 9D | R251 | 8E | R272 | 7F | R287 | 6G | VR261 | 9F |
| C239 | 9D | L280 | 7E | R214 | 12E | R231 | 9E | R252 | 8F | R273 | 7F | R288 | 7F | | |
| C244 | 10E | L282 | 7E | R215 | 11D | R232 | 9E | R254 | 8E | R274 | 7F | R289 | 6E | | |
| C253 | 9E | | | R216 | 11D | R233 | 9E | R255 | 8E | R275 | 7E | | | | |
| C257 | 8F | Q272 | 7F | R217 | 11F | R234 | 9E | R256 | 8F | R277 | 7F | RT270 | 7F | | |
| C272 | 7F | Q278 | 7F | R218 | 11G | R235 | 9D | R257 | 8F | R278 | 7G | | | | |

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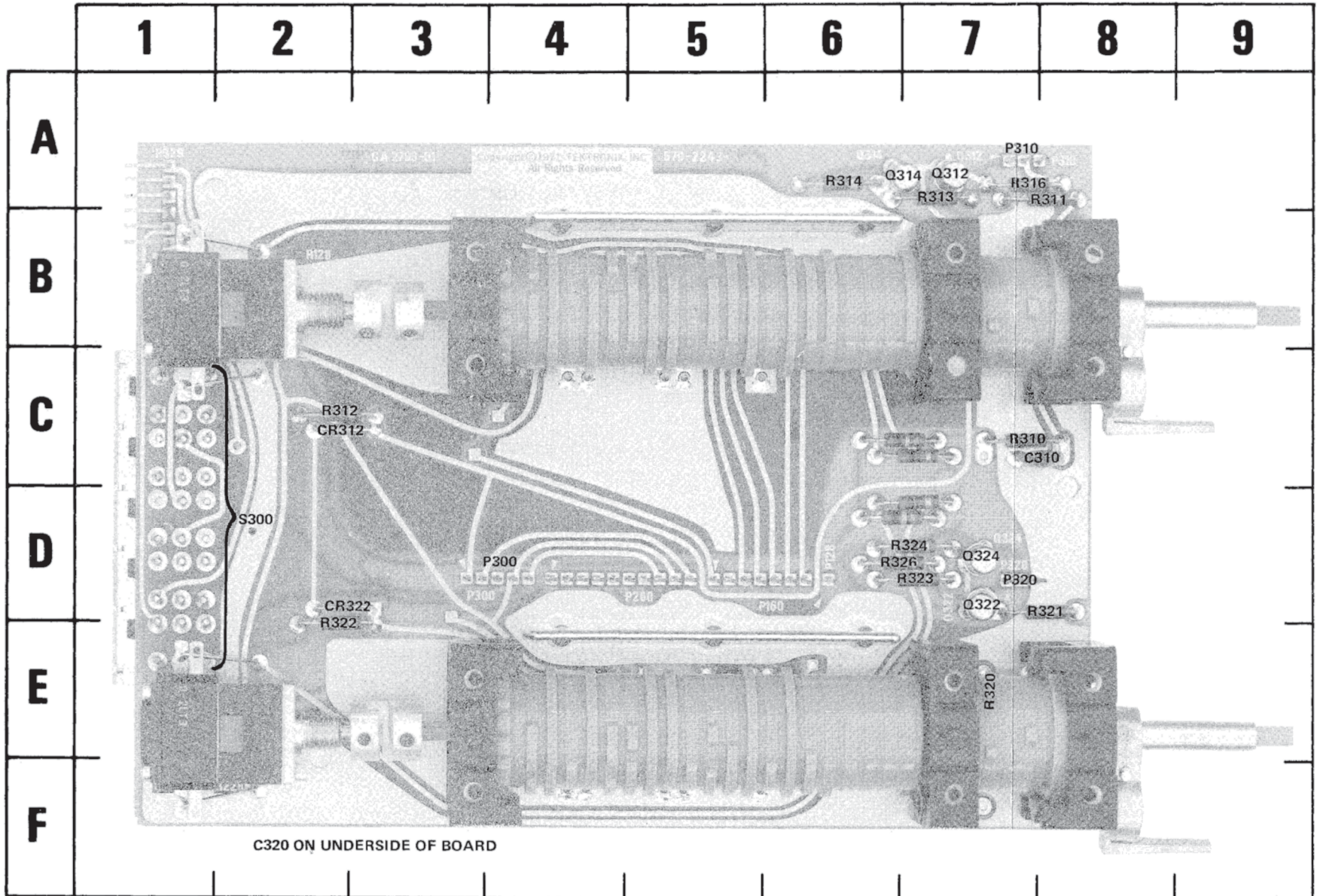


Fig. 7-9. P/O A4 Vertical Mode Switch circuit board.

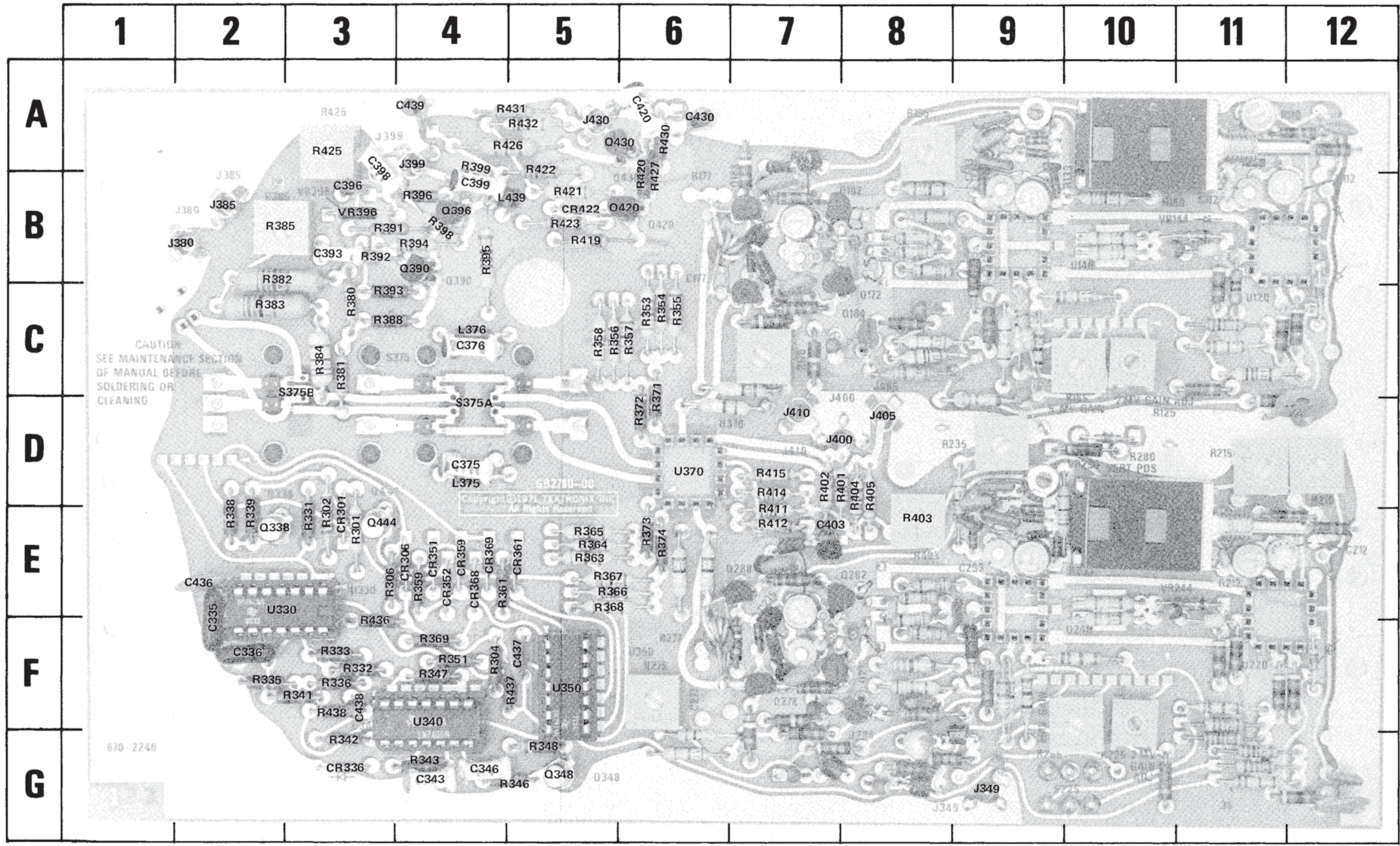


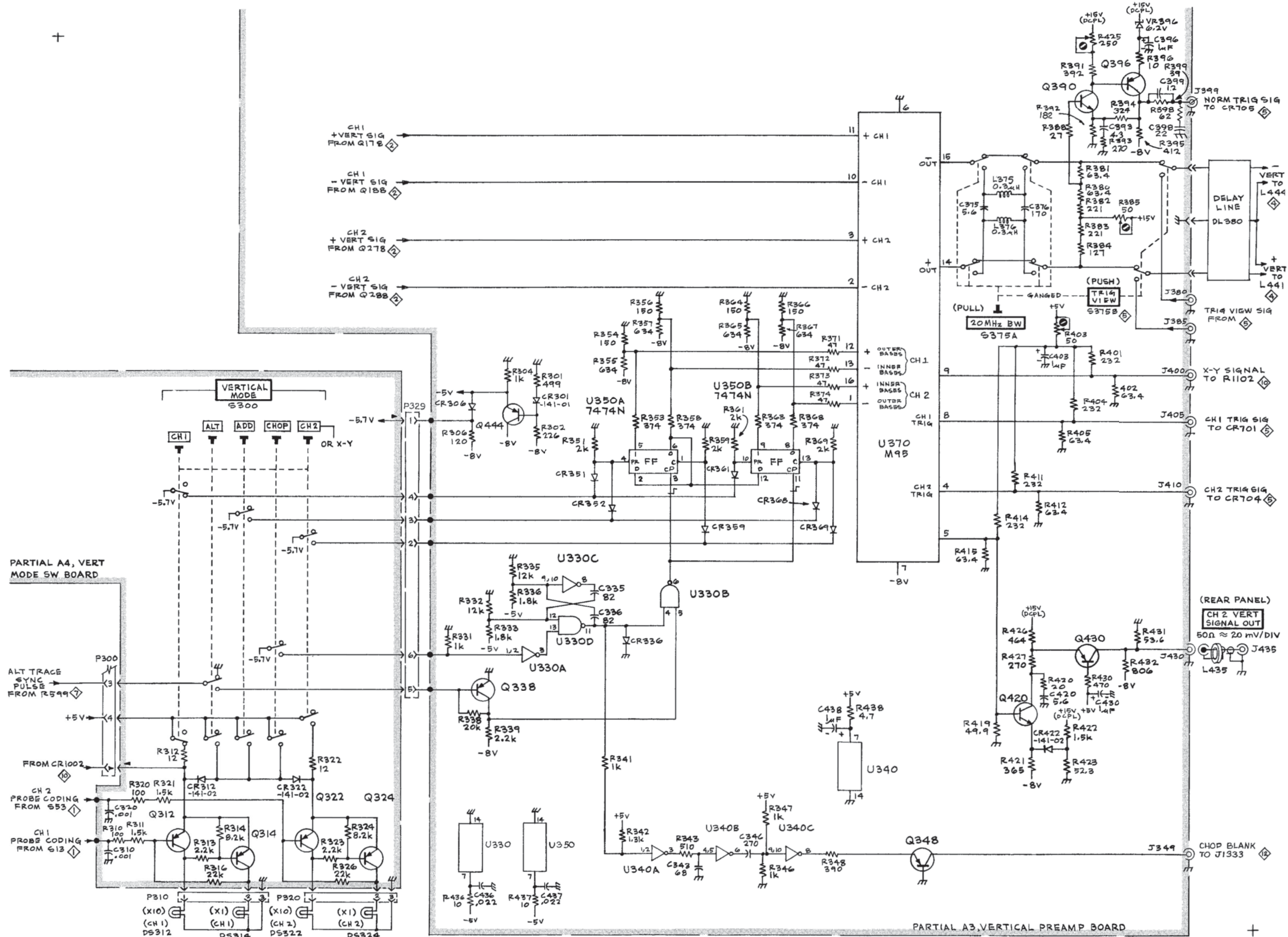
Fig. 7-10. P/O A3 Vertical Preamp circuit board.

Fig. 7-9. A4 Vertical Mode Switch circuit board.

| CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC |
|--------|----------|--------|----------|--------|----------|--------|----------|
| C310 | 7C | Q312 | 7A | R312 | 2C | R324 | 6D |
| | | Q314 | 6A | R313 | 7A | R326 | 6D |
| CR312 | 2C | Q322 | 7D | R314 | 6A | | |
| CR322 | 2D | Q324 | 7D | R316 | 7A | S300 | 2D |
| | | Q348 | 5G | R320 | 7E | | |
| P300 | 4D | | | R321 | 7D | | |
| P310 | 7A | R310 | 7C | R322 | 2D | | |
| P320 | 7D | R311 | 7A | R323 | 6D | | |

Fig. 7-10. A3 Vertical Preamp circuit board.

| CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC |
|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|
| C335 | 2F | CR301 | 3E | J410 | 7D | R332 | 3F | R357 | 6C | R382 | 2B | R405 | 8D | R437 | 5F |
| C336 | 2F | CR306 | 4E | J430 | 5A | R333 | 3F | R358 | 6C | R383 | 2C | R411 | 7D | | |
| C343 | 4G | CR336 | 3G | | | R335 | 2F | R359 | 4E | R384 | 3C | R412 | 7E | S375A | 4D |
| C346 | 4G | CR351 | 4E | L375 | 4D | R336 | 2F | R361 | 5E | R385 | 2B | R414 | 7D | S375B | 3C |
| C347 | 5F | CR352 | 4E | L376 | 4C | R338 | 2E | R363 | 5E | R388 | 3C | R415 | 7D | | |
| C375 | 4D | CR359 | 4E | L439 | 4B | R339 | 2E | R364 | 5E | R391 | 3B | R419 | 5B | U330 | 2E |
| C376 | 4C | CR361 | 5E | | | R341 | 2F | R365 | 5E | R392 | 3B | R420 | 6B | U340 | 4F |
| C393 | 3B | CR368 | 4E | Q338 | 2E | R342 | 2G | R366 | 5E | R393 | 3C | R421 | 5B | U350 | 5F |
| C396 | 3B | CR369 | 4E | Q390 | 4B | R343 | 4G | R367 | 5E | R394 | 4B | R422 | 5A | U370 | 6D |
| C398 | 3A | CR422 | 5B | Q396 | 4B | R346 | 5G | R368 | 5E | R395 | 4B | R423 | 5B | | |
| C399 | 4B | | | Q430 | 5A | R347 | 4F | R369 | 4F | R396 | 4B | R425 | 3A | VR396 | 3B |
| C403 | 7E | J349 | 9G | Q444 | 3E | R348 | 5G | R371 | 6D | R398 | 4B | R426 | 4A | | |
| C420 | 6A | J380 | 2B | | | R351 | 4F | R372 | 6D | R399 | 4A | R427 | 6B | | |
| C430 | 6A | J385 | 2B | R302 | 3E | R353 | 6C | R373 | 6E | R401 | 8D | R430 | 6A | | |
| C436 | 2E | J399 | 4A | R304 | 4F | R354 | 6C | R374 | 6E | R402 | 7D | R431 | 4A | | |
| C438 | 3F | J400 | 7D | R306 | 3E | R355 | 6C | R380 | 3C | R403 | 8E | R432 | 5A | | |
| C439 | 4A | J405 | 8D | R331 | 3E | R356 | 6C | R381 | 3C | R404 | 8D | R436 | 3F | | |



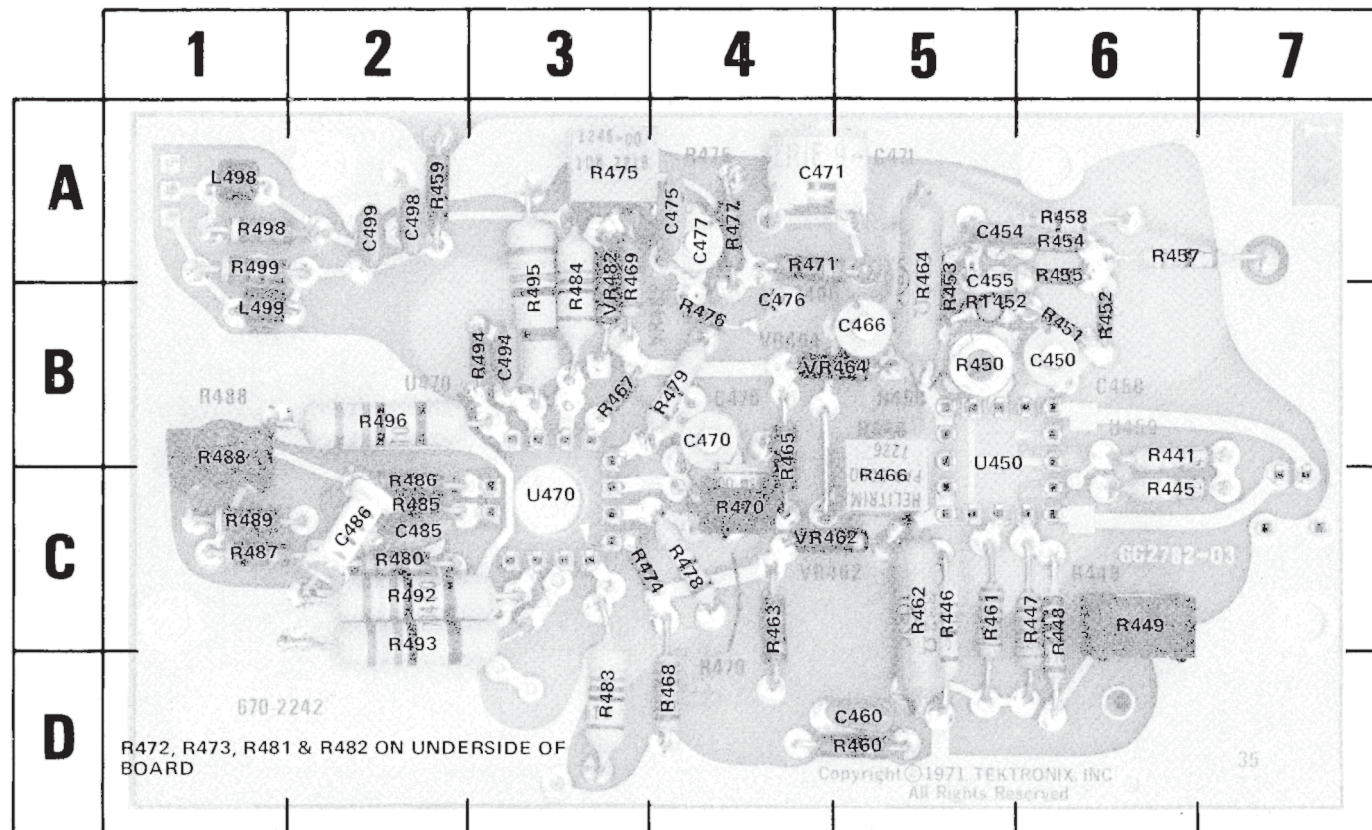
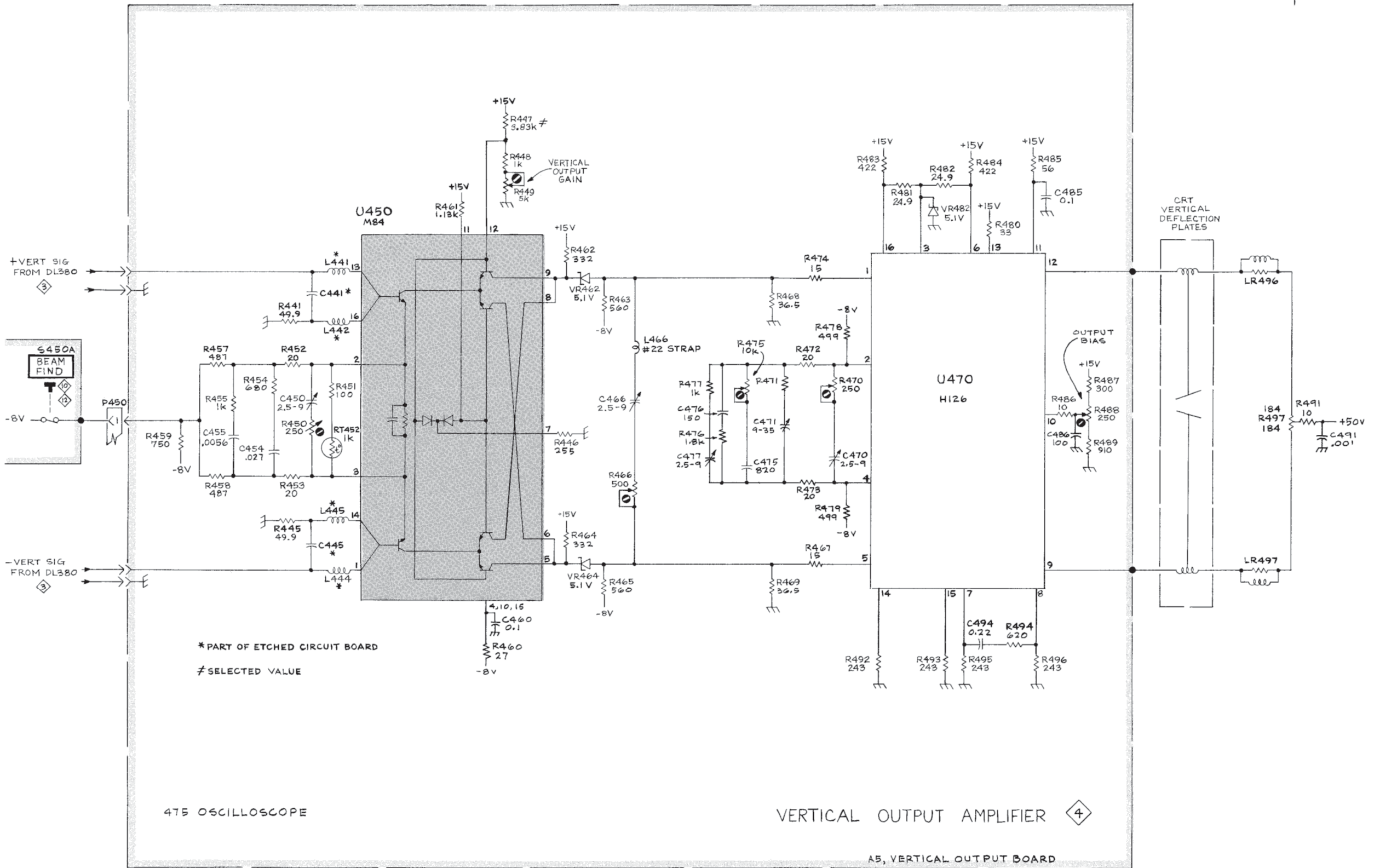


Fig. 7-11. A5 Vertical Output circuit board.

Fig. 7-11. A5 Vertical Output circuit board.

| CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC |
|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|
| C450 | 6B | C485 | 2C | R445 | 6C | R455 | 6A | R466 | 5C | R478 | 4C | R492 | 2C | U450 | 5B |
| C454 | 5A | C486 | 2C | R446 | 5C | R457 | 6A | R467 | 3B | R479 | 4B | R493 | 2C | U470 | 3C |
| C455 | 5A | C494 | 3B | R447 | 6C | R458 | 6A | R468 | 4D | R480 | 2C | R494 | 3B | | |
| C460 | 5D | C498 | 2A | R448 | 6C | R459 | 2A | R469 | 3B | R483 | 3D | R495 | 3B | VR462 | 4C |
| C466 | 5B | C499 | 2A | R449 | 6C | R460 | 5D | R470 | 4C | R484 | 3B | R496 | 2B | VR464 | 4B |
| C470 | 4B | | | R450 | 5B | R461 | 5C | R471 | 4A | R485 | 2C | R498 | 1A | VR482 | 3B |
| C471 | 4A | L498 | 1A | R451 | 6B | R462 | 5C | R474 | 3C | R486 | 2C | R499 | 1A | | |
| C475 | 4A | L499 | 1B | R452 | 6B | R463 | 4C | R475 | 3A | R487 | 1C | | | | |
| C476 | 4B | | | R453 | 5B | R464 | 5B | R476 | 4B | R488 | 1B | RT452 | 5B | | |
| C477 | 4A | R441 | 6B | R454 | 6A | R465 | 4C | R477 | 4A | R489 | 1C | | | | |



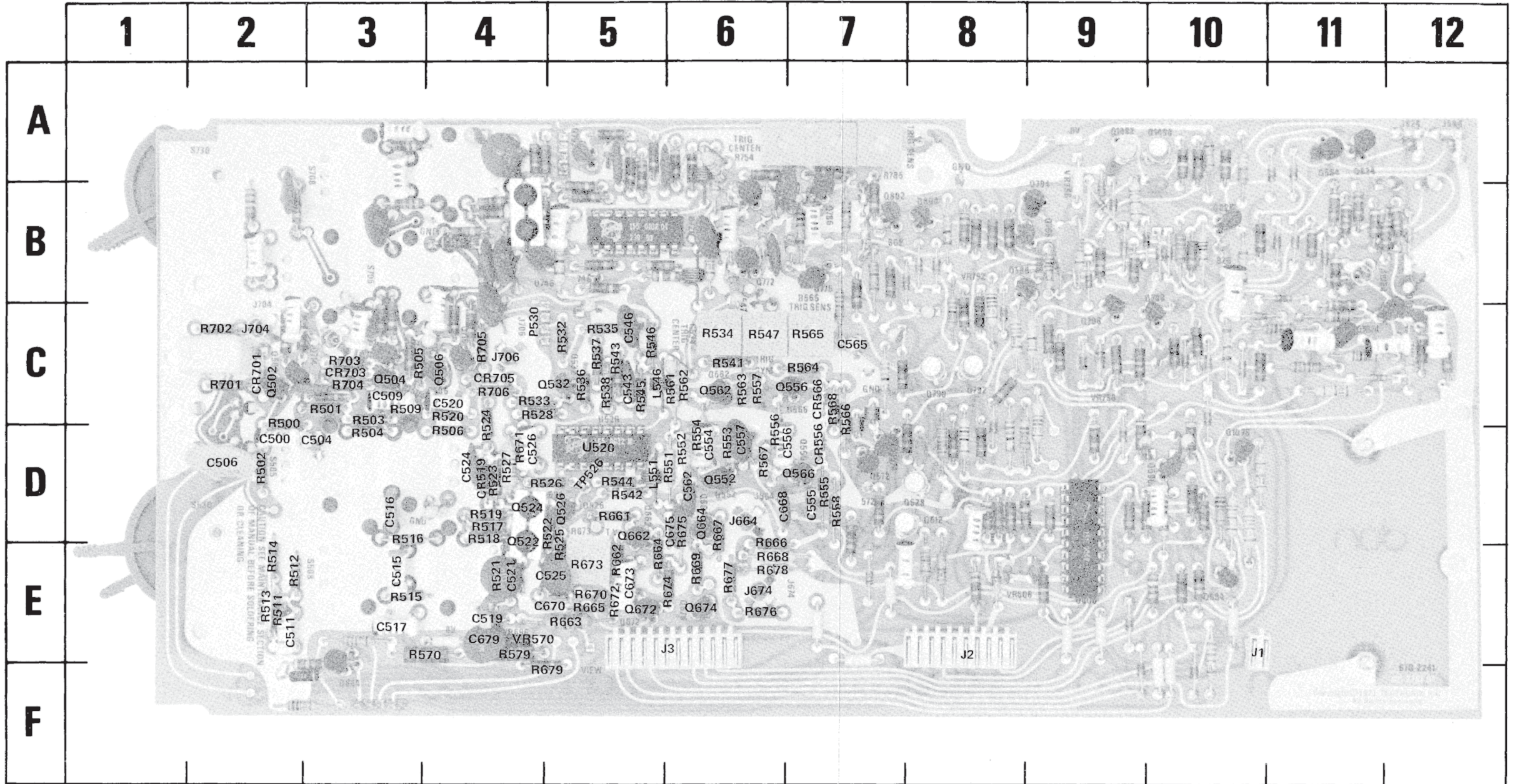
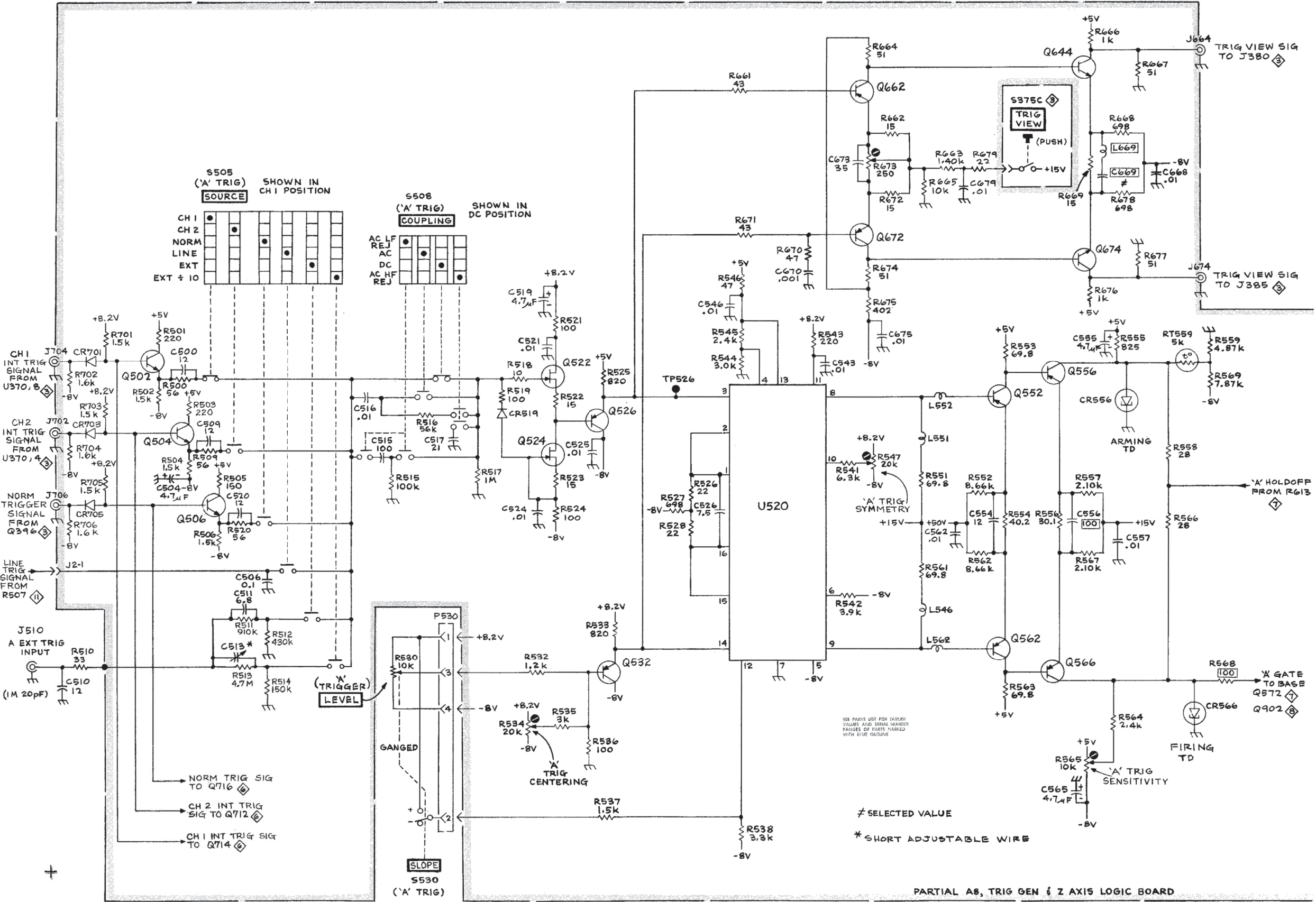


Fig. 7-12. P/O A8 Trigger Generator And Sweep Logic circuit board.

Fig. 7-12. A8 Trigger Generator and Sweep Logic circuit board.

| CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC |
|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|
| C500 | 2D | C557 | 6D | J674 | 6E | Q566 | 7D | R516 | 3D | R538 | 5C | R564 | 7C | R673 | 5E |
| C504 | 3D | C562 | 6D | J704 | 2C | Q662 | 5D | R517 | 4D | R541 | 6C | R565 | 7C | R674 | 6E |
| C506 | 2D | C565 | 7C | J706 | 2C | Q664 | 6D | R518 | 4D | R542 | 5D | R566 | 7D | R675 | 6E |
| C509 | 3C | C668 | 6D | | | Q672 | 5E | R519 | 4D | R543 | 5C | R567 | 6D | R676 | 6E |
| C511 | 2E | C673 | 5E | L546 | 5C | Q674 | 6E | R520 | 4C | R544 | 5D | R568 | 7C | R677 | 6E |
| C515 | 3E | C675 | 6E | L551 | 5D | | | R521 | 4E | R545 | 5C | R570 | 3E | R678 | 6E |
| C516 | 3D | C679 | 4E | | | R500 | 2C | R522 | 5E | R546 | 5C | R579 | 4E | R679 | 4F |
| C517 | 3E | | | P530 | 4C | R501 | 3C | R523 | 4D | R547 | 6C | R661 | 5D | R701 | 2C |
| C519 | 4E | CR519 | 4D | | | R502 | 2D | R524 | 4D | R551 | 6D | R662 | 5E | R702 | 2C |
| C520 | 4C | CR556 | 7D | Q502 | 2C | R503 | 3C | R525 | 5E | R552 | 6D | R663 | 5E | R703 | 3C |
| C521 | 4E | CR566 | 7C | Q504 | 3C | R504 | 3D | R526 | 4D | R553 | 6D | R664 | 5E | R704 | 3C |
| C524 | 4D | CR701 | 2C | Q506 | 4C | R505 | 3C | R527 | 4D | R554 | 6D | R665 | 5E | R705 | 4C |
| C525 | 4E | CR703 | 3C | Q522 | 4D | R506 | 4D | R528 | 4C | R555 | 7D | R666 | 6D | R706 | 4C |
| C526 | 4D | CR705 | 4C | Q524 | 4D | R509 | 3C | R532 | 5C | R556 | 6D | R667 | 6E | | |
| C543 | 5C | | | Q526 | 5D | R511 | 2E | R533 | 4C | R557 | 6C | R668 | 6E | TP526 | 5D |
| C546 | 5C | J1 | 10E | Q532 | 4C | R512 | 2E | R534 | 6C | R558 | 7D | R669 | 6E | | |
| C554 | 6D | J2 | 8E | Q552 | 6D | R513 | 2E | R535 | 5C | R561 | 6C | R670 | 5E | U520 | 5D |
| C555 | 7D | J3 | 6E | Q556 | 6C | R514 | 2E | R536 | 5C | R562 | 6C | R671 | 4D | | |
| C556 | 7D | J664 | 6D | Q562 | 6C | R515 | 3E | R537 | 5C | R563 | 6C | R672 | 5E | VR570 | 4E |



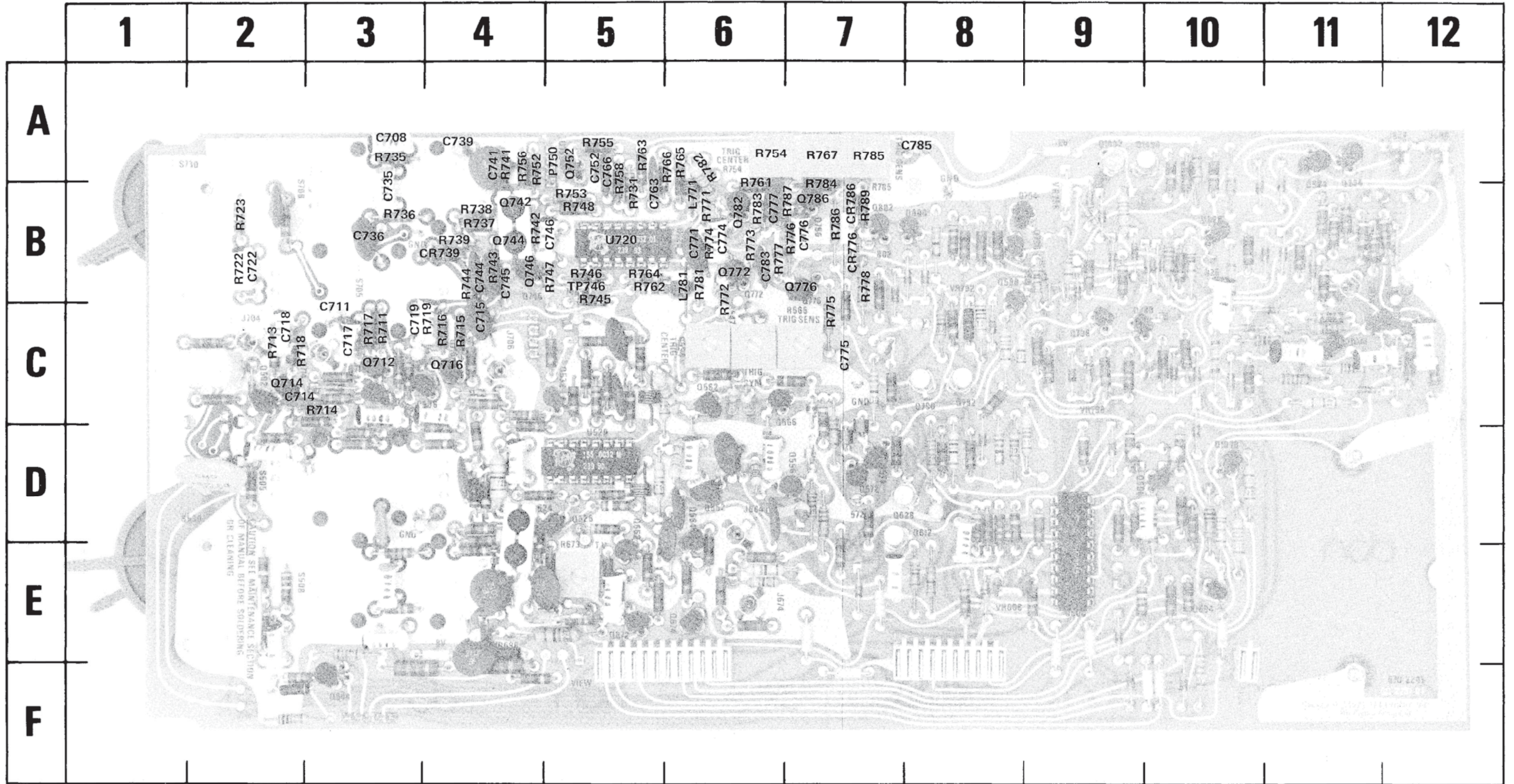
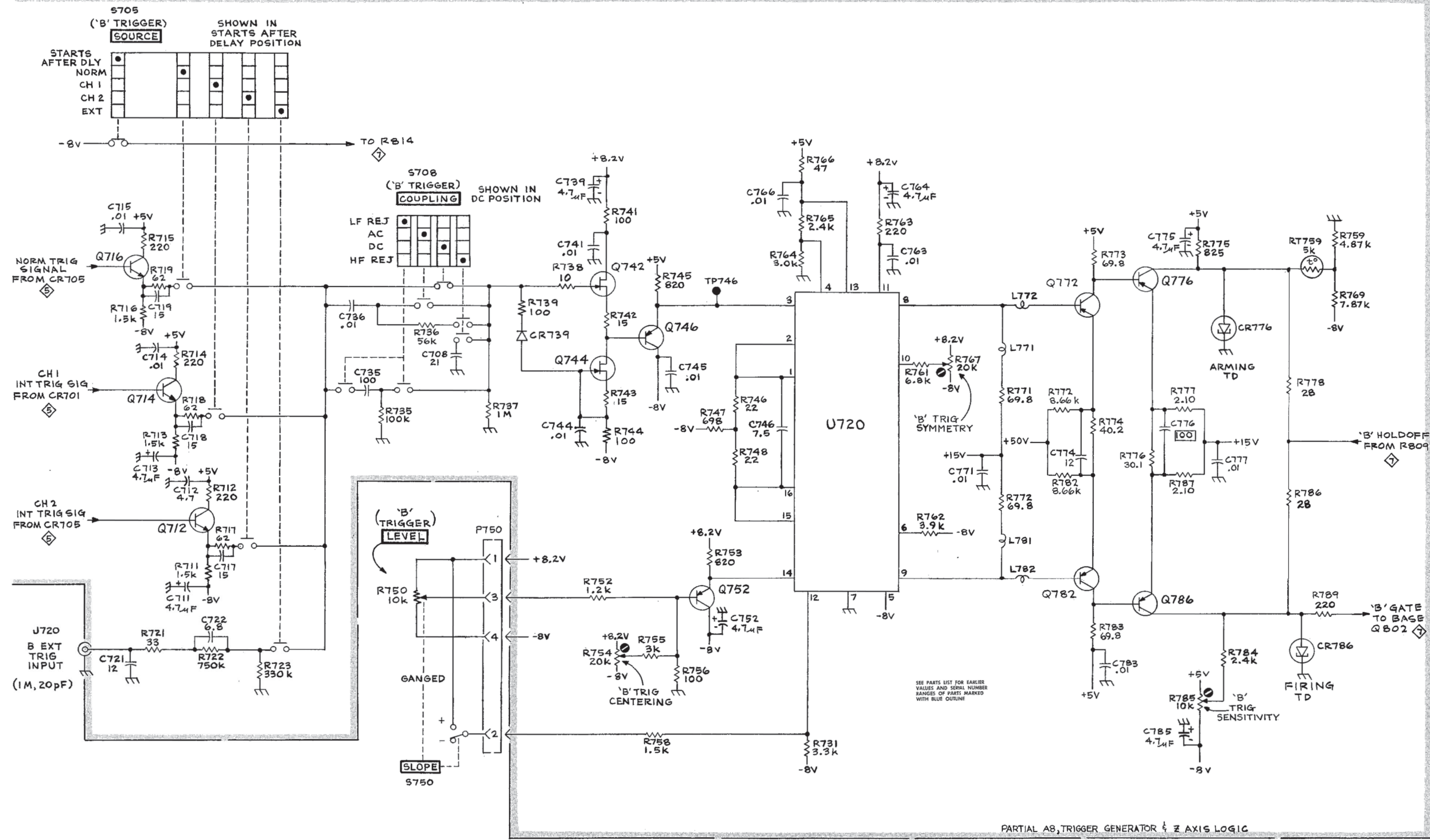


Fig. 7-13. P/O A8 Trigger Generator And Sweep Logic circuit board.

Fig. 7-13. A8 Trigger Generator and Sweep Logic circuit board.

| CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC |
|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|
| C708 | 3A | C745 | 4B | CR739 | 4B | Q744 | 4B | R717 | 3C | R743 | 4B | R763 | 5A | R781 | 6B |
| C711 | 3C | C746 | 5B | CR776 | 7B | Q746 | 4B | R718 | 2C | R744 | 4B | R764 | 5B | R782 | 6A |
| C714 | 2C | C752 | 5A | CR786 | 7B | Q752 | 5A | R719 | 4C | R745 | 5B | R765 | 6A | R783 | 6B |
| C715 | 4C | C763 | 5B | | | Q772 | 6B | R722 | 2B | R746 | 5B | R766 | 6A | R784 | 7B |
| C717 | 3C | C766 | 5A | L771 | 6B | Q776 | 7B | R723 | 2B | R748 | 5B | R767 | 7A | R785 | 7A |
| C718 | 2C | C771 | 6B | L781 | 6B | Q782 | 6B | R731 | 5B | R752 | 4A | R771 | 6B | R786 | 7B |
| C719 | 3C | C774 | 6B | | | Q786 | 7B | R735 | 3A | R753 | 5B | R772 | 6C | R787 | 7B |
| C722 | 2B | C775 | 7C | P750 | 5A | | | R736 | 3B | R754 | 6A | R773 | 6B | R789 | 7B |
| C735 | 3B | C776 | 7B | | | R711 | 3C | R737 | 4B | R755 | 5A | R774 | 6B | | |
| C736 | 3B | C777 | 6B | Q712 | 3C | R713 | 2C | R738 | 4B | R756 | 4A | R775 | 7C | TP746 | 5B |
| C739 | 4A | C783 | 6B | Q714 | 2C | R714 | 3C | R739 | 4B | R758 | 5B | R776 | 7B | | |
| C741 | 4A | C785 | 7A | Q716 | 4C | R715 | 4C | R741 | 4A | R761 | 5B | R777 | 6B | U720 | 5B |
| C744 | 4B | | | Q742 | 4B | R716 | 4C | R742 | 4B | R762 | 5B | R778 | 7B | | |

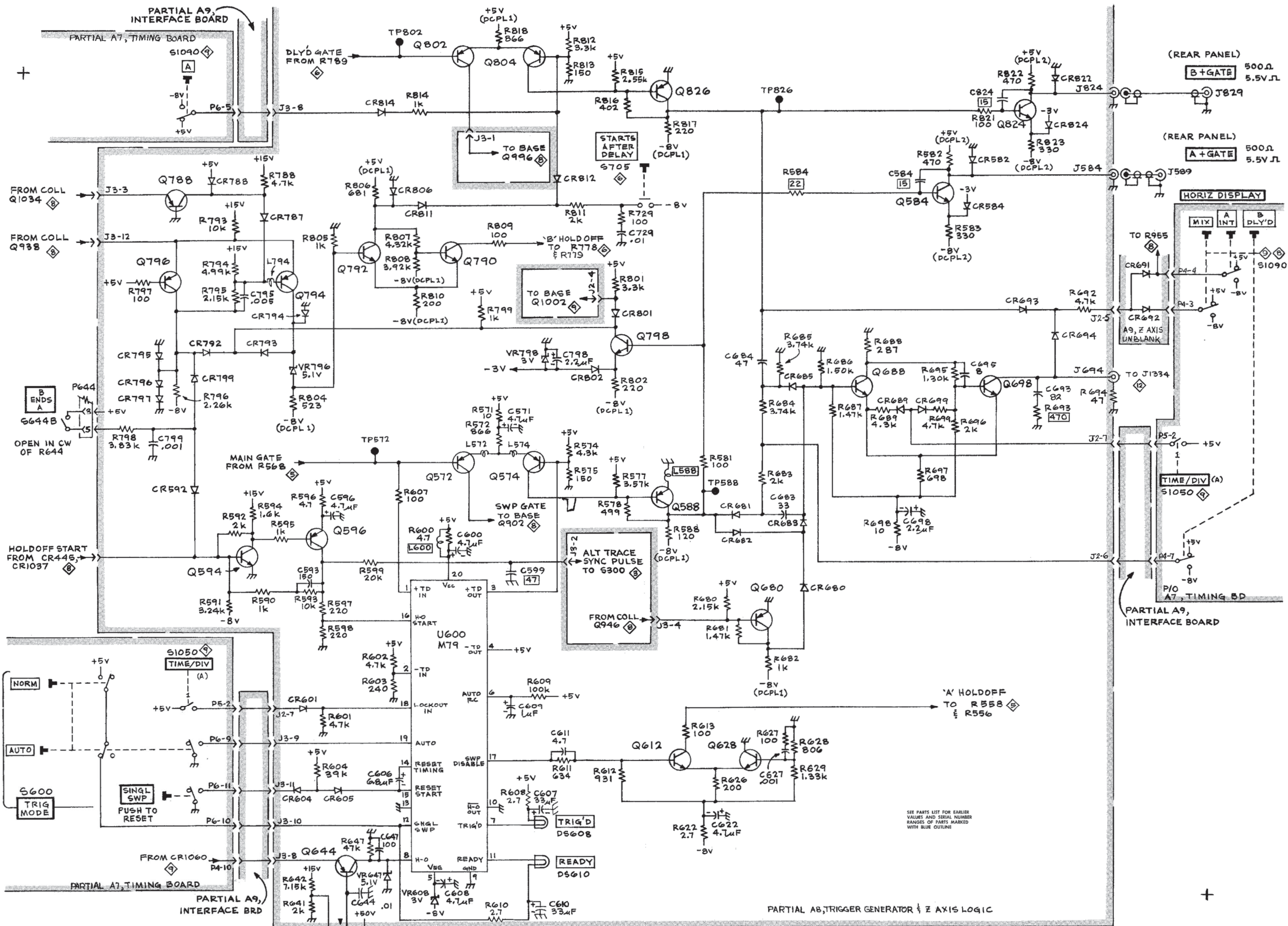


PARTIAL A8, TRIGGER GENERATOR & Z AXIS LOGIC

'B' TRIGGER GENERATOR

Fig. 7-14. A8 Trigger Generator and Sweep Logic circuit board.

| CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC |
|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|
| C571 | 7C | CR592 | 10F | CR811 | 8B | Q584 | 11A | R577 | 8C | R613 | 7E | R698 | 10C | R815 | 10B |
| C593 | 9D | CR601 | 9D | CR812 | 8B | Q588 | 8B | R578 | 8C | R622 | 8D | R699 | 12C | R816 | 10B |
| C600 | 9D | CR604 | 9F | CR814 | 7E | Q594 | 10E | R581 | 9C | R626 | 8D | R729 | 2B | R817 | 10B |
| C606 | 9E | CR605 | 9E | CR822 | 12B | Q596 | 9D | R582 | 11B | R627 | 8D | R788 | 9B | R818 | 8B |
| C608 | 8E | CR680 | 10D | CR824 | 10B | Q612 | 7D | R583 | 11B | R628 | 8D | R793 | 9B | R819 | 8C |
| C609 | 8E | CR681 | 10C | | | Q628 | 7D | R588 | 9C | R629 | 8D | R794 | 9C | R821 | 10B |
| C611 | 7E | CR682 | 10C | DS608 | 2C | Q644 | 3F | R590 | 10E | R641 | 2F | R795 | 9B | R822 | 11B |
| C622 | 8D | CR683 | 10C | DS610 | 2C | Q680 | 10D | R591 | 10D | R642 | 3E | R796 | 9B | R823 | 11B |
| C627 | 8D | CR685 | 10C | | | Q688 | 11C | R592 | 10D | R647 | 2F | R797 | 8B | R825 | 11B |
| C647 | 8D | CR689 | 10B | J1 | 10E | Q698 | 11C | R593 | 10E | R680 | 10D | R798 | 10F | R826 | 12B |
| C683 | 11C | CR693 | 10B | J2 | 8E | Q788 | 9C | R594 | 10D | R681 | 10D | R799 | 8C | | |
| C684 | 10C | CR694 | 11B | J3 | 5E | Q790 | 8C | R595 | 10D | R682 | 10C | R801 | 8E | TP572 | 7D |
| C693 | 12C | CR699 | 11C | J584 | 12A | Q792 | 8C | R596 | 10D | R683 | 11C | R802 | 9C | TP588 | 8B |
| C695 | 11C | CR787 | 10B | J694 | 11B | Q794 | 8A | R597 | 9D | R684 | 10C | R803 | 9C | TP802 | 7B |
| C698 | 12B | CR788 | 10B | J824 | 12A | Q796 | 8A | R598 | 9D | R685 | 10B | R804 | 8D | TP826 | 10B |
| C729 | 2B | CR792 | 9B | | | Q798 | 9C | R599 | 10D | R686 | 10C | R805 | 8C | | |
| C795 | 9B | CR793 | 9B | L572 | 7D | Q802 | 7A | R600 | 9D | R687 | 11C | R806 | 8C | U600 | 9D |
| C798 | 9C | CR794 | 8C | L574 | 7D | Q804 | 8A | R601 | 9D | R688 | 11C | R807 | 8D | | |
| C803 | 10B | CR795 | 9B | L584 | 11A | Q824 | 11A | R602 | 9D | R689 | 11C | R808 | 8D | VR647 | 2F |
| C819 | 7C | CR796 | 9B | L794 | 8B | Q826 | 10B | R603 | 8D | R692 | 11B | R809 | 7C | VR608 | 8E |
| C825 | 12B | CR797 | 9B | | | | | R604 | 9E | R693 | 12C | R810 | 8D | VR796 | 8C |
| C826 | 11B | CR799 | 9C | P644 | 3F | R571 | 7C | R607 | 7D | R694 | 11B | R811 | 7B | VR798 | 9C |
| | | CR801 | 8B | | | R572 | 7C | R609 | 9E | R695 | 11C | R812 | 8B | | |
| CR582 | 11B | CR802 | 9C | Q572 | 7D | R574 | 8D | R611 | 8E | R696 | 12C | R813 | 8B | | |
| CR584 | 11B | CR806 | 7B | Q574 | 7D | R575 | 8D | R612 | 8E | R697 | 11C | R814 | 2B | | |



475 OSCILLOSCOPE

A TRIG HOLDOFF
 B ENDS A
 OPEN IN CW POS OF R644

(A)

SWEEP & Z AXIS LOGIC

GAB
 8-22-72

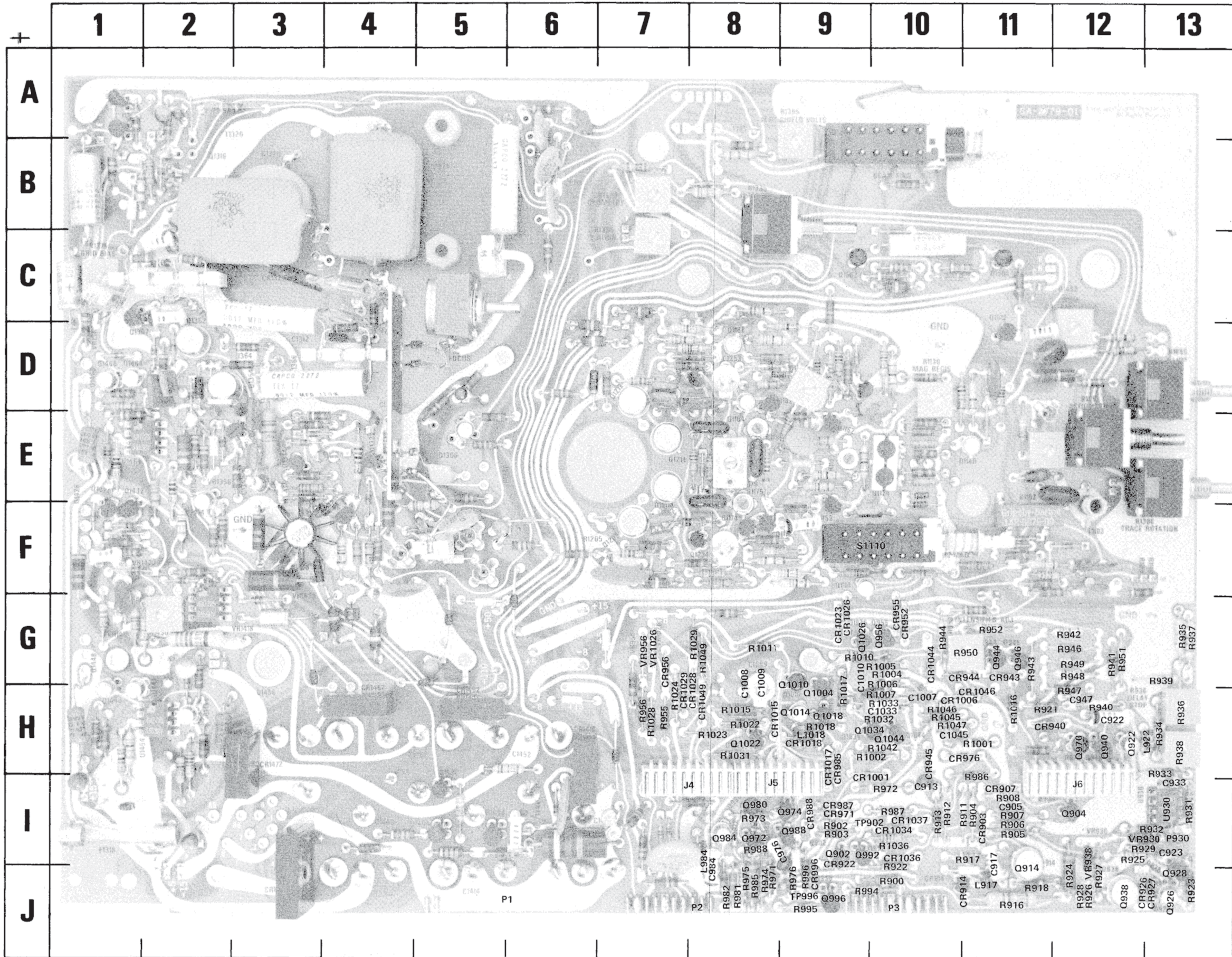
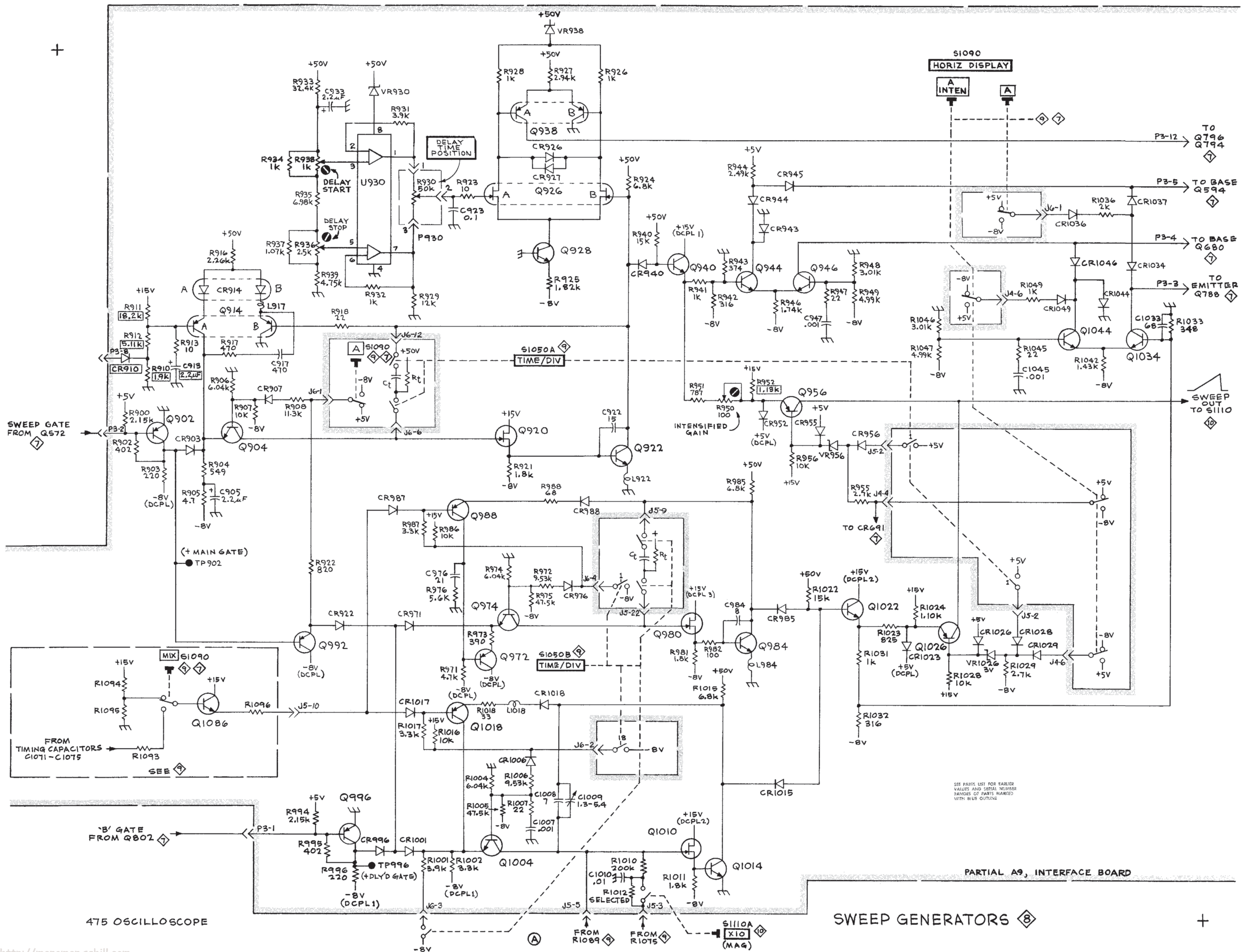


Fig. 7-15. P/O A9 Interface circuit board assembly.

Fig. 7-15. A9 Interface circuit board.

| CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC |
|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|
| C905 | 11I | CR945 | 10H | J4 | 7I | Q970 | 12H | R911 | 11I | R941 | 12G | R994 | 9J | R1046 | 10H |
| C913 | 10I | CR952 | 10G | J5 | 8I | Q972 | 8I | R912 | 10I | R942 | 12G | R995 | 9J | R1047 | 10H |
| C917 | 11J | CR955 | 10G | J6 | 12I | Q974 | 9I | R913 | 10I | R943 | 11G | R996 | 9J | R1049 | 10H |
| C922 | 12H | CR956 | 7G | | | Q980 | 8I | R916 | 11J | R944 | 10G | R1001 | 11H | | |
| C923 | 13I | CR971 | 9I | L917 | 11J | Q984 | 8I | R917 | 10I | R946 | 12G | R1002 | 9H | S1110 | 9F |
| C933 | 13I | CR976 | 10H | L922 | 13H | Q988 | 9I | R918 | 11J | R947 | 12H | R1004 | 9G | | |
| C947 | 12H | CR985 | 9I | L984 | 8J | Q992 | 9I | R921 | 11H | R948 | 12G | R1005 | 10G | TP902 | 9I |
| C976 | 9I | CR987 | 9I | L1018 | 9H | Q996 | 9J | R922 | 10I | R949 | 12G | R1006 | 10G | TP996 | 9J |
| C1007 | 10H | CR988 | 9I | | | Q1004 | 9H | R923 | 13J | R950 | 10G | R1007 | 10H | | |
| C1008 | 8H | CR996 | 9J | P1 | 5J | Q1010 | 9G | R924 | 12J | R951 | 12G | R1010 | 9G | U930 | 13I |
| C1009 | 8H | CR1001 | 9I | P2 | 8J | Q1014 | 9H | R925 | 12I | R953 | 11G | R1011 | 8G | | |
| C1010 | 9H | CR1006 | 10H | P3 | 10J | Q1018 | 9H | R926 | 12J | R955 | 7H | R1015 | 8H | VR930 | 12I |
| C1033 | 10H | CR1015 | 8H | P930 | 13I | Q1022 | 8H | R927 | 12J | R956 | 7H | R1016 | 11H | VR938 | 12J |
| C1045 | 10H | CR1017 | 9I | | | Q1026 | 9G | R928 | 12J | R971 | 8J | R1017 | 9H | VR956 | 7G |
| | | CR1018 | 9H | Q902 | 9I | Q1034 | 9H | R929 | 12I | R972 | 10I | R1018 | 9H | VR1026 | 7G |
| CR903 | 11I | CR1023 | 9G | Q904 | 12I | Q1044 | 10H | R931 | 13I | R973 | 8I | R1022 | 8H | | |
| CR907 | 11I | CR1026 | 9G | Q914 | 11I | | | R932 | 12I | R974 | 8J | R1023 | 8H | | |
| CR914 | 11I | CR1028 | 8H | Q922 | 12H | R900 | 10J | R933 | 13H | R975 | 8J | R1024 | 7H | | |
| CR922 | 9I | CR1029 | 7H | Q926 | 13J | R902 | 9I | R934 | 13H | R976 | 9J | R1028 | 7H | | |
| CR926 | 12J | CR1034 | 10I | Q928 | 13J | R903 | 9I | R935 | 13G | R981 | 8J | R1029 | 8G | | |
| CR927 | 13J | CR1036 | 10I | Q938 | 12J | R904 | 11I | R936 | 13H | R982 | 8J | R1031 | 8H | | |
| CR940 | 11H | CR1037 | 10I | Q940 | 12H | R905 | 11I | R937 | 13G | R985 | 8J | R1032 | 10H | | |
| CR943 | 11G | CR1044 | 10G | Q944 | 11G | R906 | 11I | R938 | 13H | R986 | 11H | R1033 | 10H | | |
| CR944 | 10G | CR1046 | 11H | Q946 | 11G | R907 | 11I | R939 | 13G | R987 | 10I | R1042 | 10H | | |
| | | CR1049 | 8H | Q956 | 10G | R908 | 11I | R940 | 12H | R988 | 8I | R1045 | 10H | | |



475 OSCILLOSCOPE

SEE PARTS LIST FOR EARLIER
VALUES AND SERIAL NUMBERS.
RANGES OF PARTS MARKED
WITH BLUE OUTLINE.

PARTIAL A9, INTERFACE BOARD

SWEEP GENERATORS

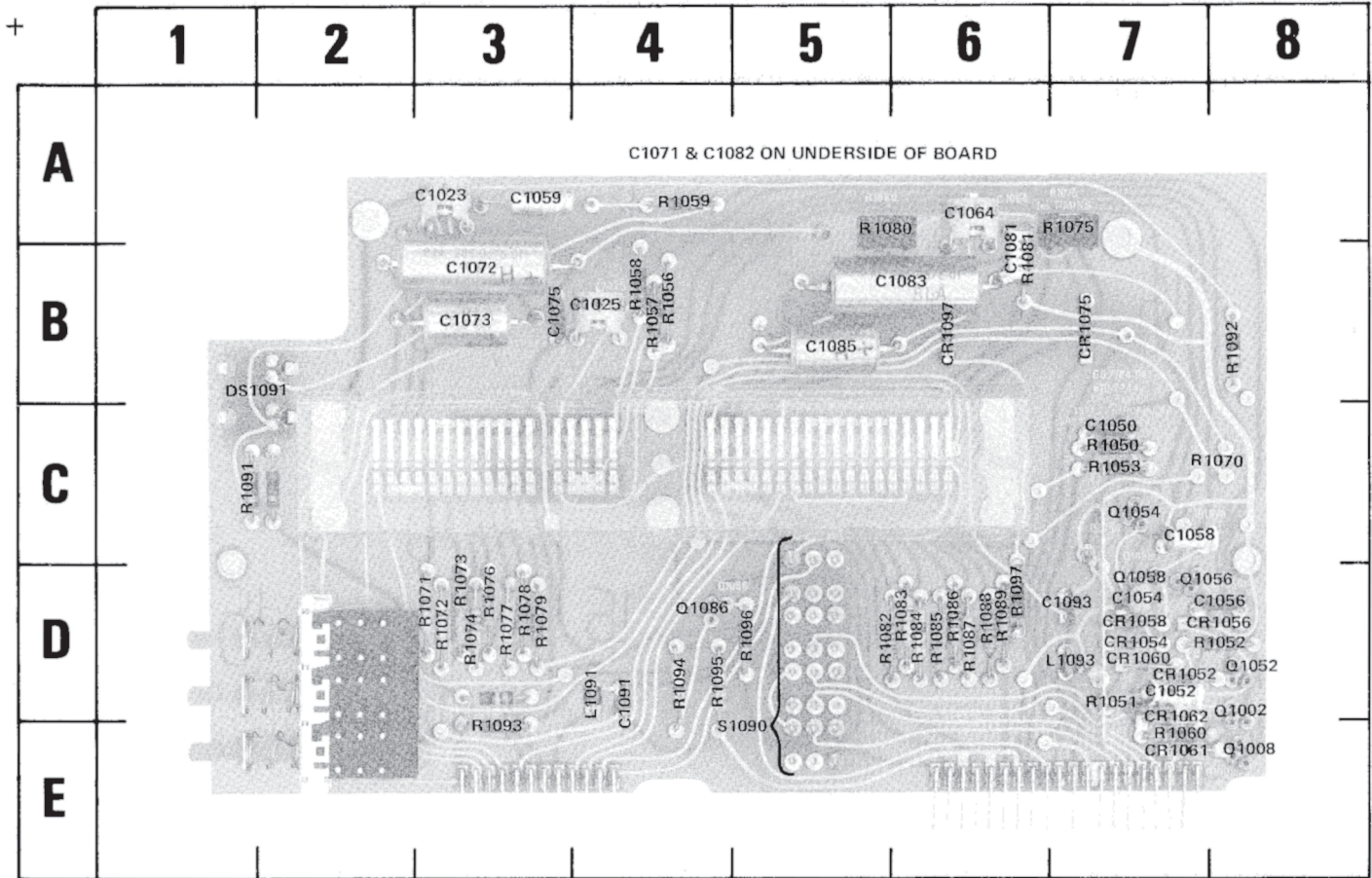


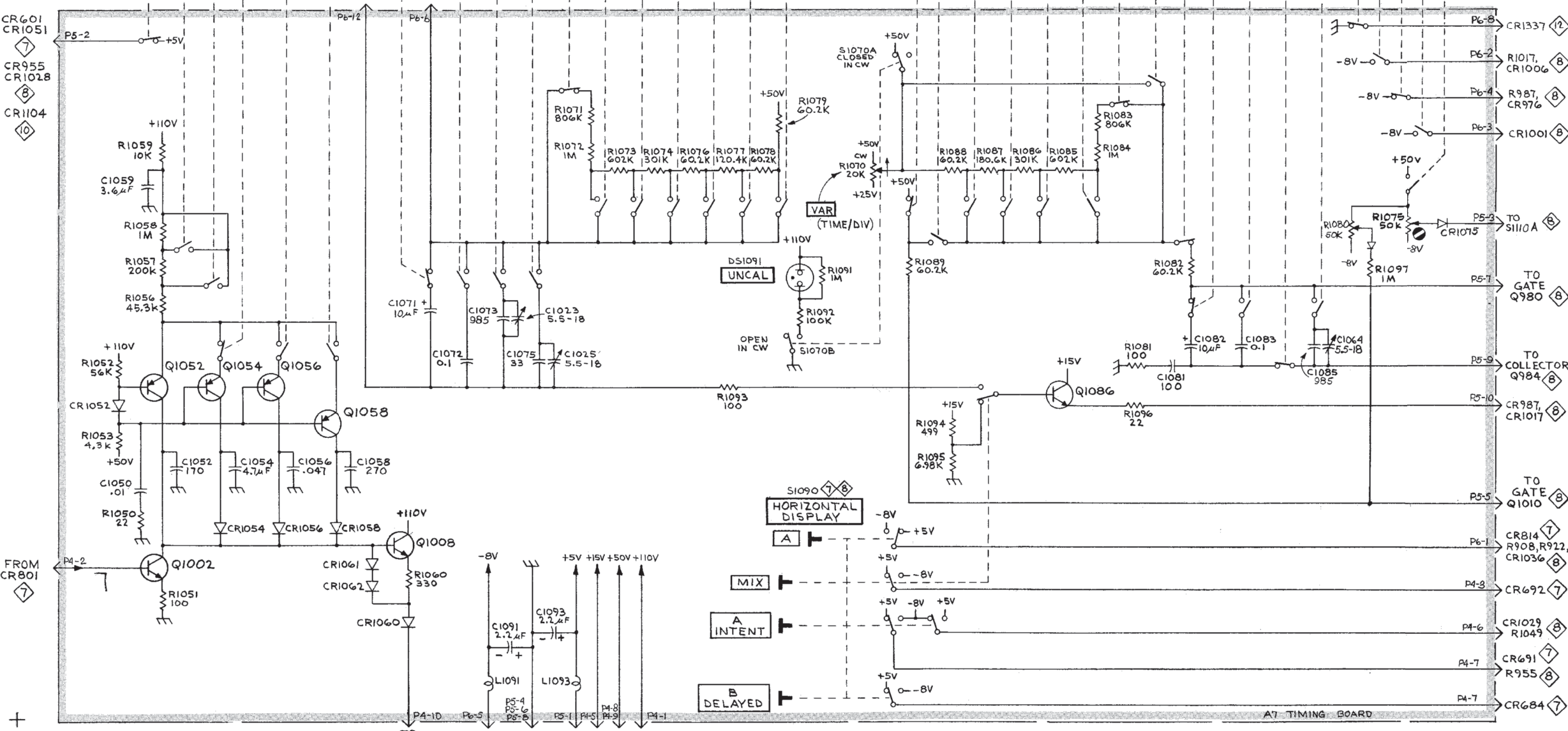
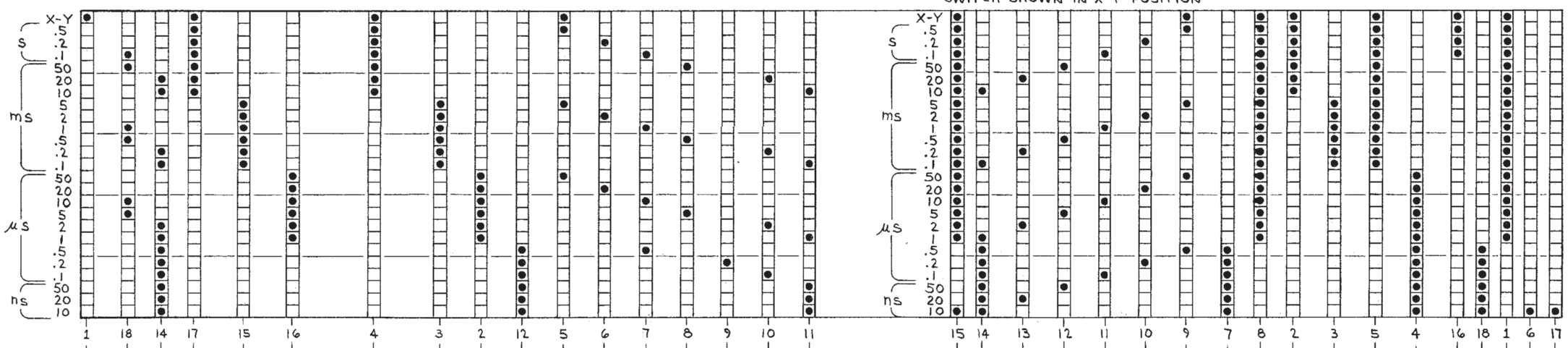
Fig. 7-16. P/O A7 Timing circuit board.

Fig. 7-16. A7 Timing circuit board.

| CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC |
|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|
| C1023 | 3A | C1073 | 3B | CR1056 | 7D | L1091 | 4D | R1050 | 7C | R1071 | 3D | R1081 | 6B | R1092 | 8B |
| C1025 | 4B | C1075 | 3B | CR1058 | 7D | L1093 | 7E | R1051 | 7D | R1072 | 3D | R1082 | 5D | R1093 | 4D |
| C1050 | 7C | C1081 | 6B | CR1060 | 7D | | | R1052 | 7D | R1073 | 3D | R1083 | 6D | R1094 | 4D |
| C1052 | 7D | C1083 | 5B | CR1061 | 7E | Q1002 | 8D | R1053 | 7C | R1074 | 3D | R1084 | 6D | R1095 | 4D |
| C1054 | 7D | C1085 | 5B | CR1062 | 7D | Q1008 | 8E | R1056 | 4B | R1075 | 7A | R1085 | 6D | R1096 | 5D |
| C1056 | 7D | C1091 | 4D | CR1075 | 7B | Q1052 | 8D | R1057 | 4B | R1076 | 3D | R1086 | 6D | R1097 | 6D |
| C1058 | 7C | C1093 | 7D | CR1097 | 6B | Q1054 | 7C | R1058 | 4B | R1077 | 3D | R1087 | 6D | | |
| C1059 | 3A | | | | | Q1056 | 7D | R1059 | 4A | R1078 | 3D | R1088 | 6D | S1090 | 5E |
| C1064 | 6A | CR1052 | 7D | DS1091 | 1B | Q1058 | 7D | R1060 | 7D | R1079 | 3D | R1089 | 6D | | |
| C1072 | 3B | CR1054 | 7D | | | Q1086 | 4D | R1070 | 7C | R1080 | 5A | R1091 | 1C | | |

S1050
TIME/DIV
DELAY TIME

SWITCH SHOWN IN X-Y POSITION



TO EMITTER Q644

(A)

TIMING AND HORIZONTAL DISPLAY SWITCHING

mgf 972

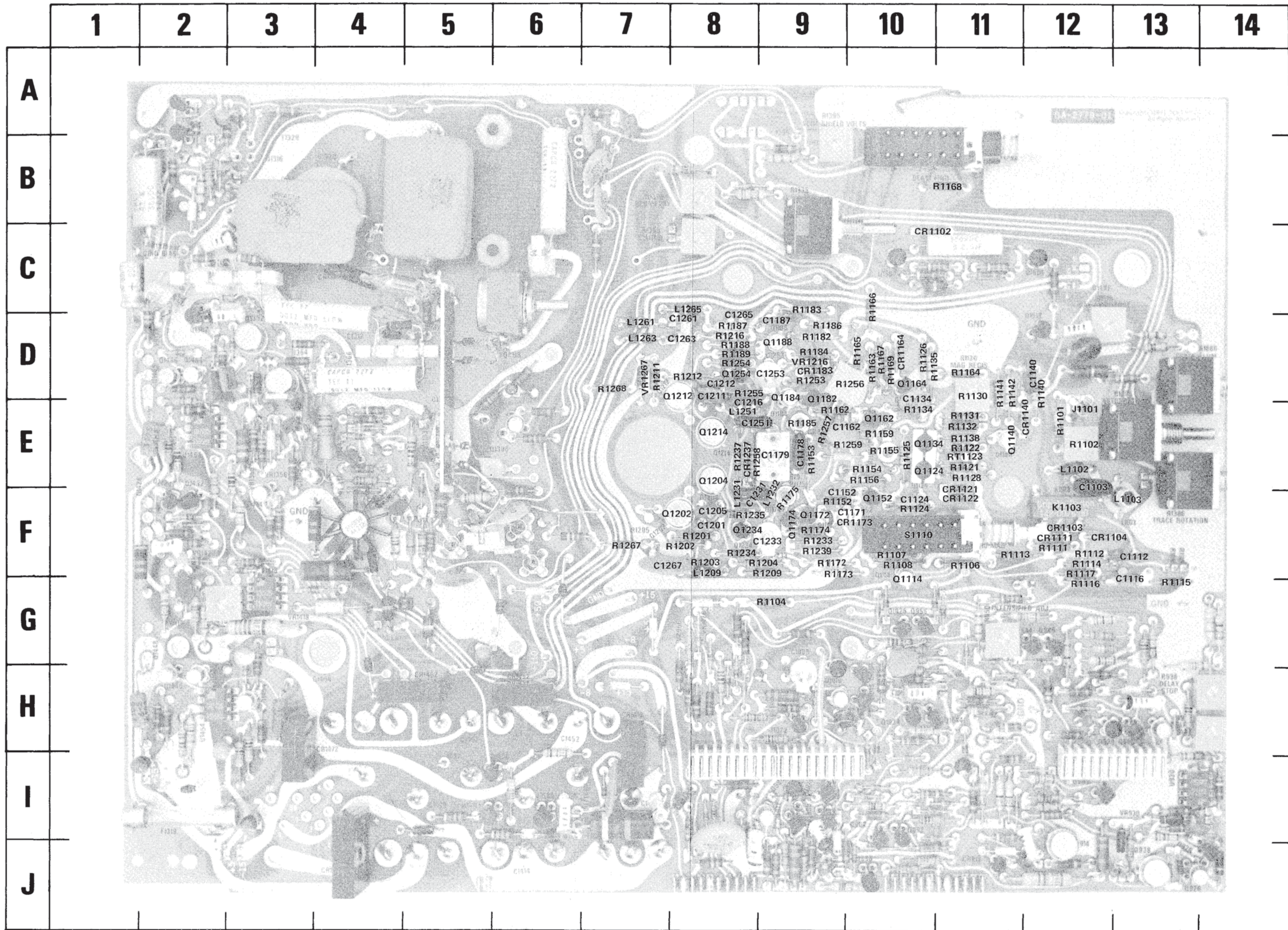
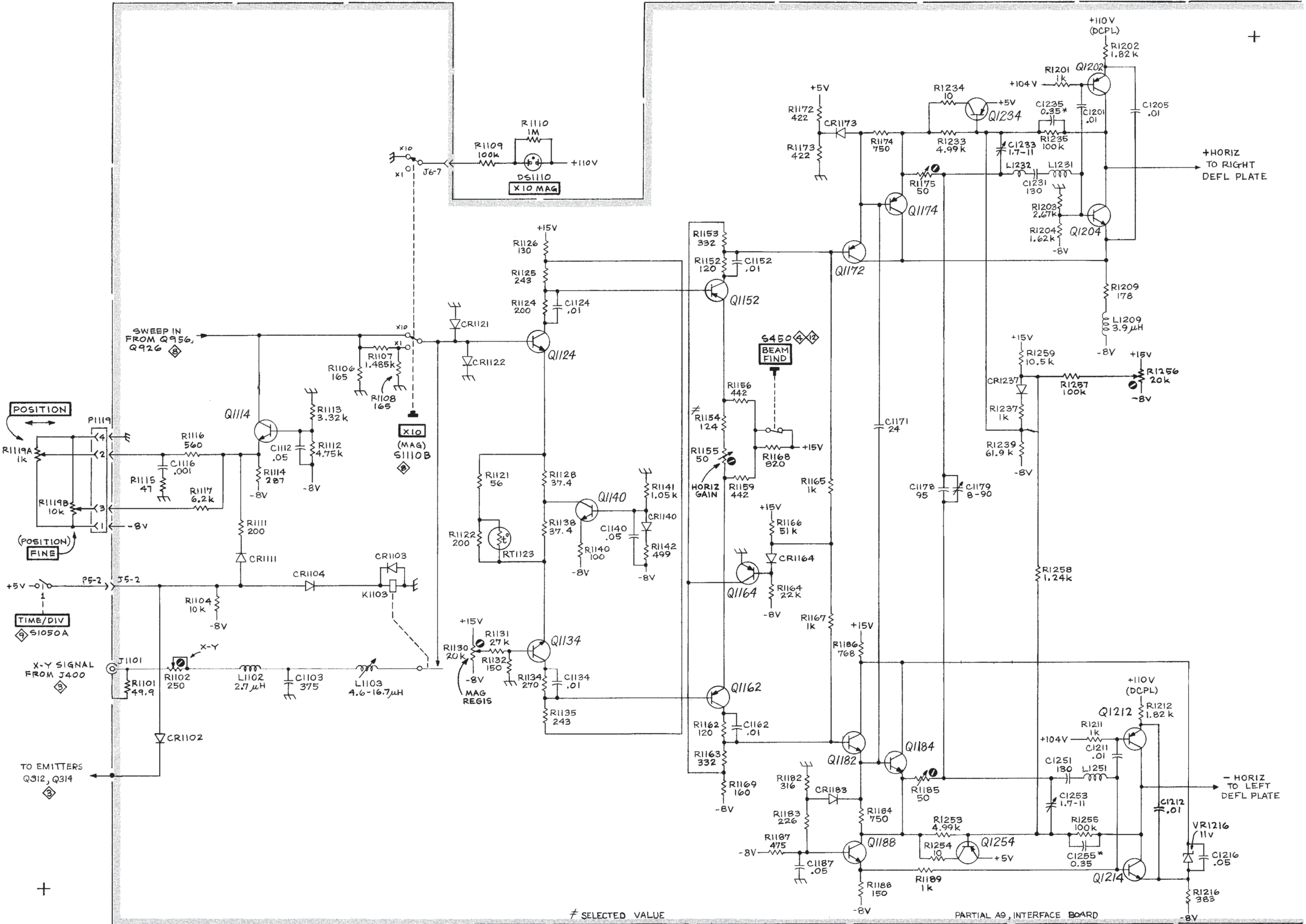


Fig. 7-17. A9 Interface circuit board.

| CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC |
|-----------|-------------|-----------|-------------|-----------|-------------|-----------|-------------|-----------|-------------|-----------|-------------|-----------|-------------|-----------|-------------|
| C1103 | 12E | C1253 | 9D | K1103 | 12F | Q1172 | 9F | R1111 | 12F | R1138 | 11E | R1173 | 9F | R1234 | 8F |
| C1112 | 13F | C1261 | 8D | | | Q1174 | 9F | R1112 | 12F | R1140 | 12E | R1174 | 9F | R1235 | 8F |
| C1116 | 13F | C1263 | 8D | L1102 | 12E | Q1182 | 9D | R1113 | 11F | R1141 | 11E | R1182 | 9D | R1239 | 9F |
| C1124 | 10F | C1265 | 8D | L1103 | 13F | Q1184 | 9D | R1114 | 12F | R1142 | 11E | R1183 | 9C | R1253 | 9D |
| C1134 | 10D | C1267 | 7F | L1209 | 8F | Q1188 | 9D | R1115 | 13G | R1152 | 9F | R1184 | 9D | R1254 | 8D |
| C1140 | 12D | | | L1231 | 8F | Q1202 | 7F | R1116 | 12G | R1153 | 9E | R1185 | 9E | R1255 | 8D |
| C1152 | 9F | CR1102 | 10C | L1232 | 9F | Q1204 | 8E | R1117 | 12F | R1154 | 10E | R1186 | 9D | R1256 | 9D |
| C1162 | 9E | CR1103 | 12F | L1251 | 8E | Q1212 | 8D | R1121 | 11E | R1155 | 10E | R1187 | 8D | R1257 | 9E |
| C1171 | 9F | CR1104 | 12F | L1261 | 7D | Q1214 | 8E | R1122 | 11E | R1156 | 10E | R1188 | 8D | R1258 | 8E |
| C1178 | 9E | CR1111 | 12F | L1263 | 7D | Q1233 | 8F | R1124 | 10F | R1159 | 10E | R1189 | 8D | R1259 | 9E |
| C1179 | 9E | CR1121 | 11E | L1265 | 8C | Q1234 | 8F | R1125 | 10E | R1162 | 9E | R1201 | 8F | R1267 | 7F |
| C1187 | 9D | CR1122 | 11F | | | Q1254 | 8D | R1126 | 10D | R1163 | 10D | R1202 | 7F | R1268 | 7D |
| C1201 | 8F | CR1140 | 12E | Q1114 | 10F | | | R1128 | 11E | R1164 | 11D | R1203 | 8F | | |
| C1205 | 8F | CR1164 | 10D | Q1124 | 10E | R1101 | 12E | R1130 | 11D | R1165 | 10D | R1204 | 8F | RT1123 | 11E |
| C1211 | 8D | CR1164 | 10D | Q1134 | 10E | R1102 | 12E | R1131 | 11E | R1166 | 10D | R1209 | 8F | | |
| C1212 | 8D | CR1183 | 9D | Q1140 | 11E | R1104 | 9G | R1132 | 11E | R1167 | 10D | R1211 | 7D | S1110 | 10F |
| C1216 | 8E | CR1237 | 8E | Q1152 | 10F | R1106 | 11F | R1134 | 10E | R1168 | 11B | R1212 | 8D | | |
| C1231 | 8F | | | Q1162 | 10E | R1107 | 10F | R1135 | 10D | R1169 | 10D | R1216 | 8D | VR1216 | 9D |
| C1251 | 8E | J1101 | 12E | Q1164 | 10D | R1108 | 10F | R1137 | 8E | R1172 | 9F | R1233 | 9F | VR1267 | 7D |



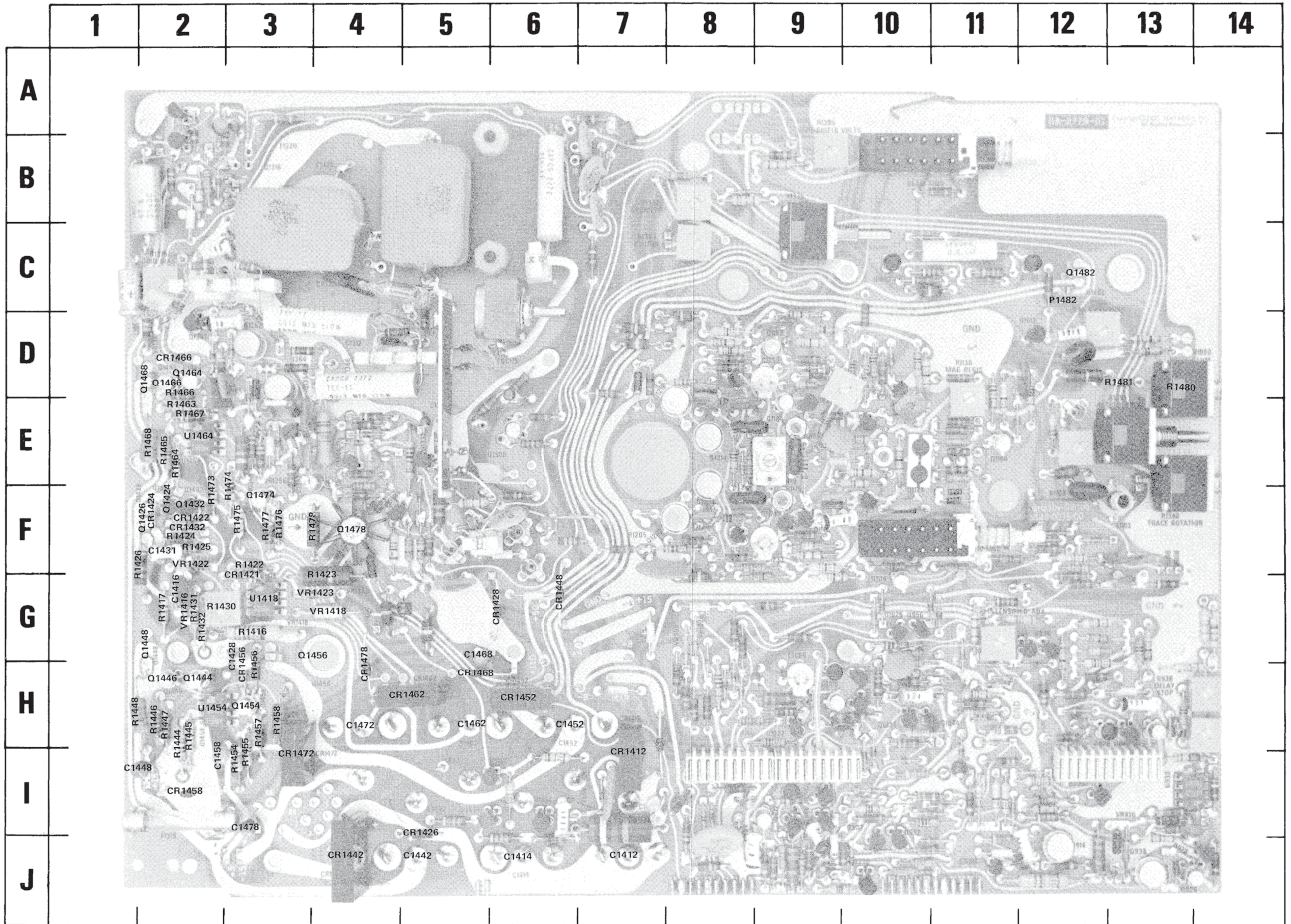
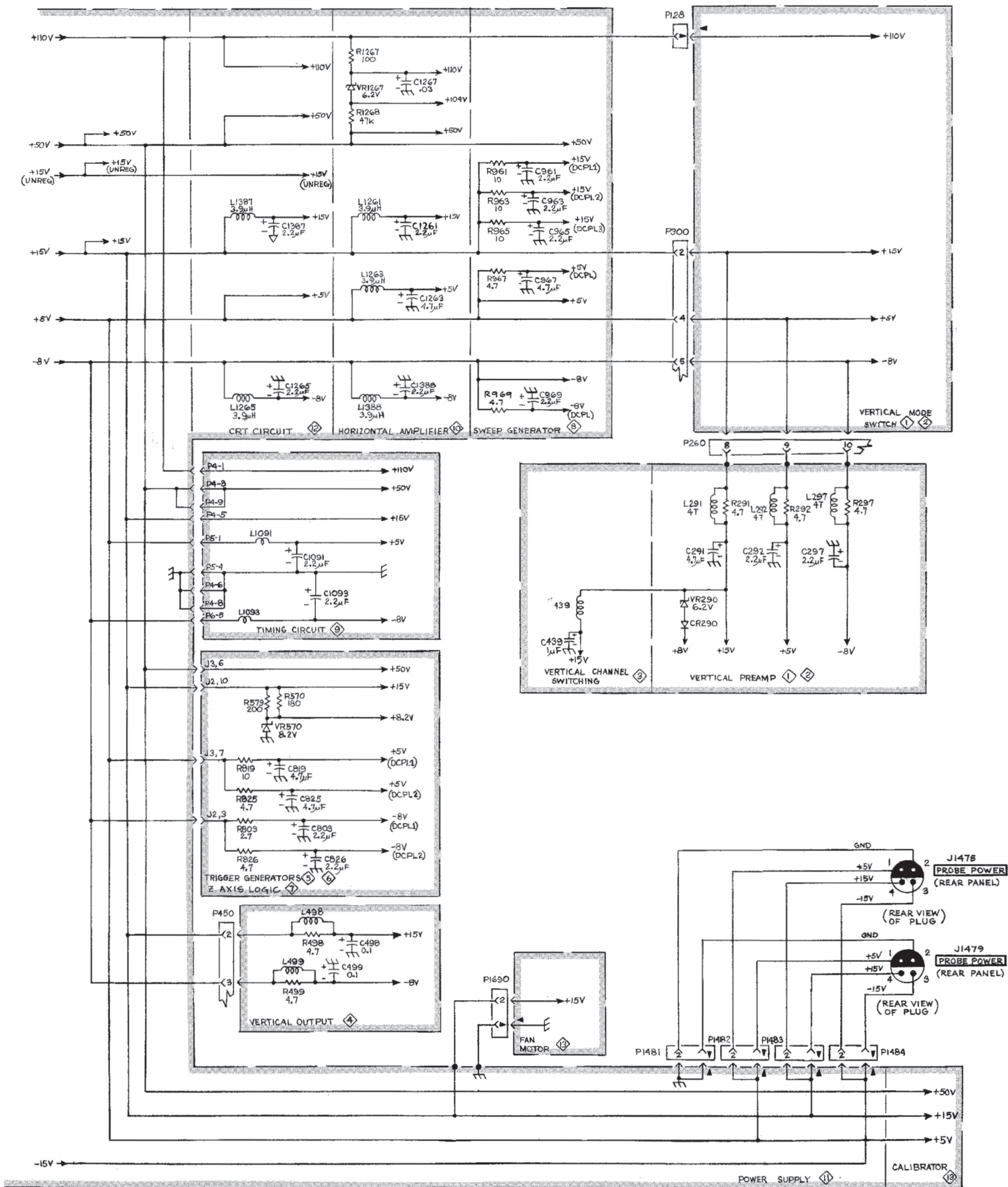


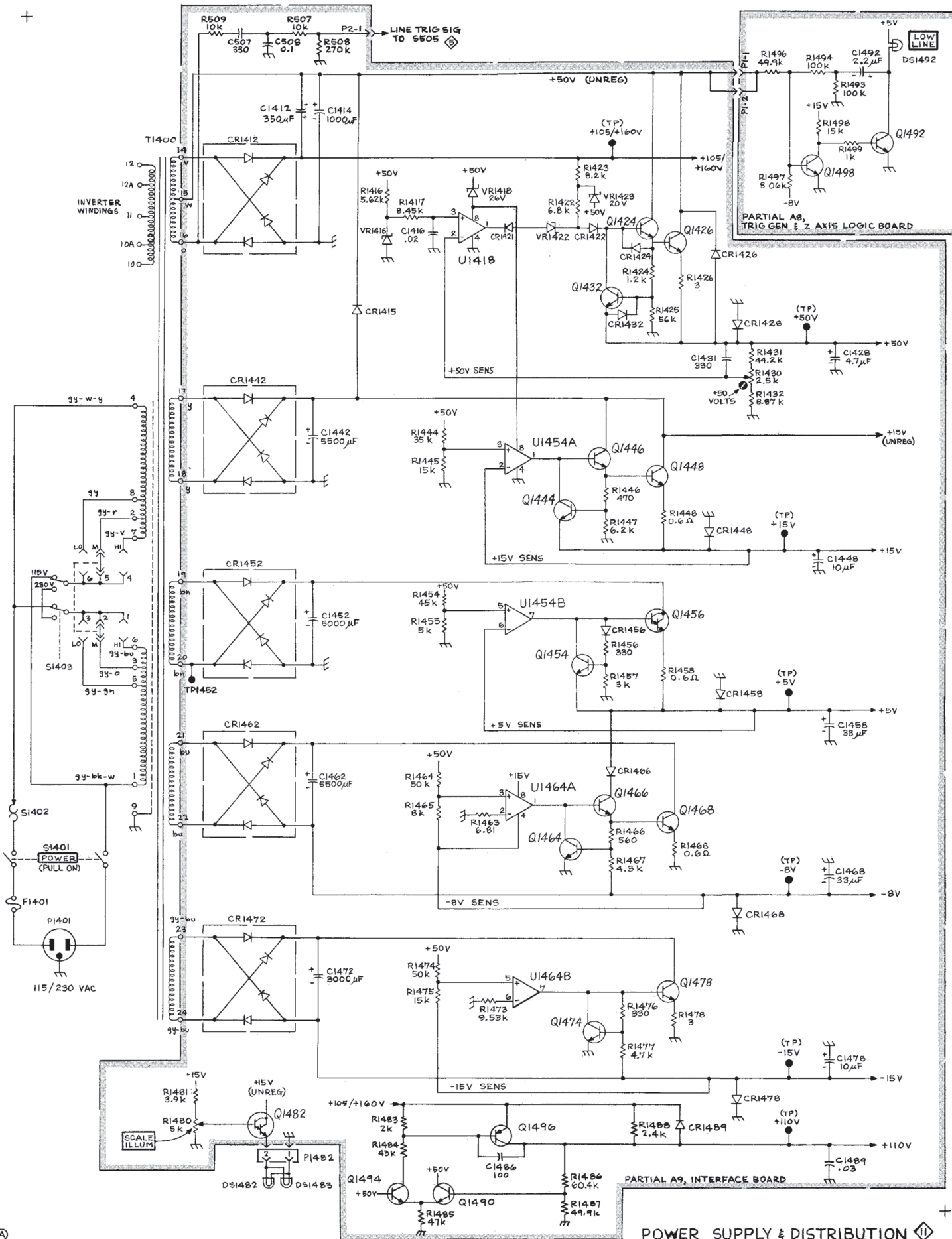
Fig. 7-18. P/O A9 Interface circuit board.

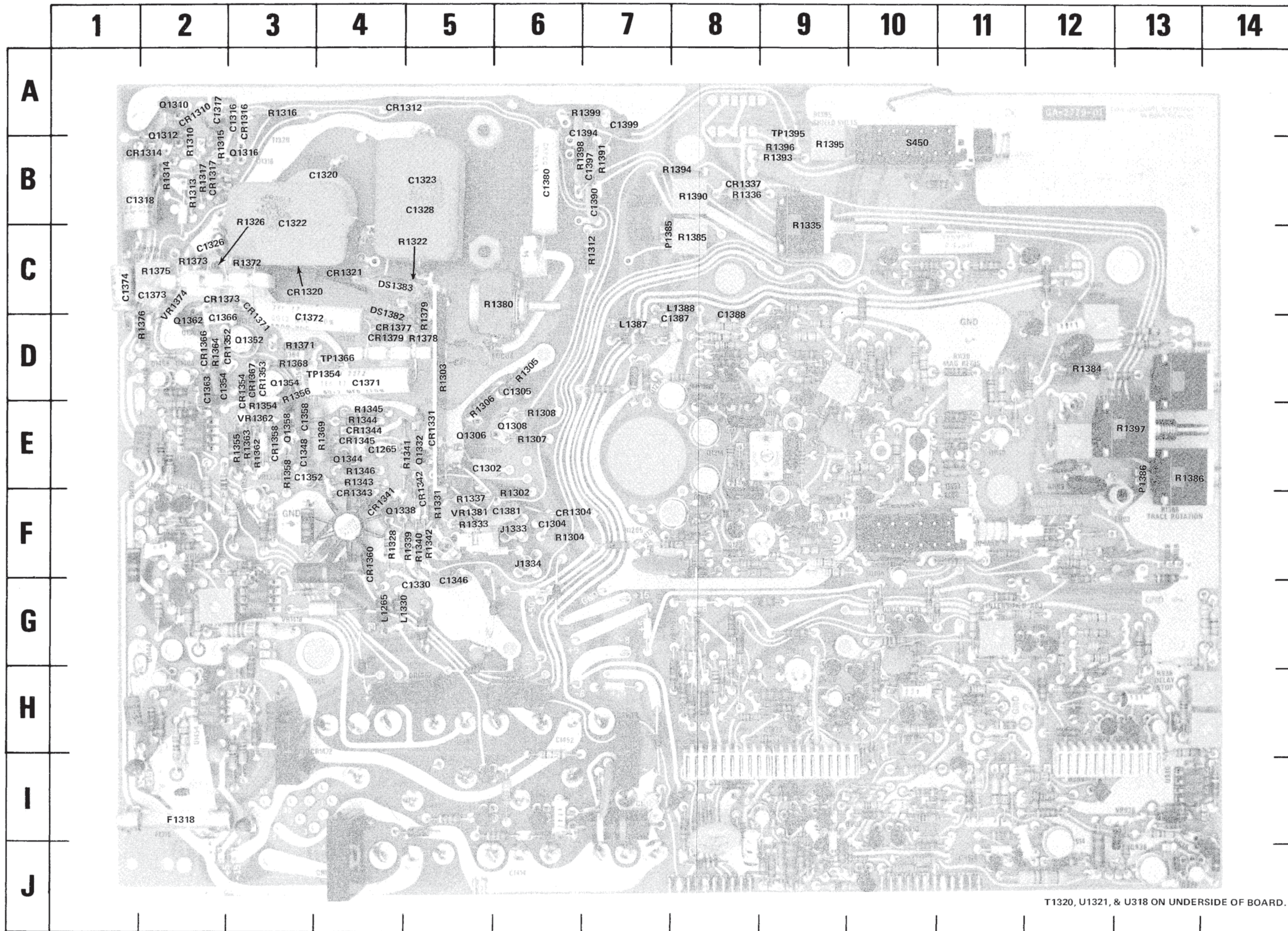
Fig. 7-18. A9 Interface circuit board.

| CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC |
|-----------|-------------|-----------|-------------|-----------|-------------|-----------|-------------|-----------|-------------|-----------|-------------|-----------|-------------|
| C1412 | 7J | CR1412 | 7I | CR1466 | 2D | Q1454 | 3H | R1424 | 2F | R1458 | 3H | R1480 | 13D |
| C1414 | 6J | CR1421 | 3G | CR1468 | 5H | Q1456 | 3G | R1425 | 2F | R1463 | 2E | R1481 | 12D |
| C1416 | 2G | CR1422 | 2F | CR1472 | 3I | Q1464 | 2D | R1426 | 2G | R1464 | 2E | | |
| C1428 | 3H | CR1424 | 2F | CR1478 | 4H | Q1466 | 2D | R1430 | 2G | R1465 | 2E | U1418 | 3G |
| C1431 | 2F | CR1426 | 5I | | | Q1468 | 2D | R1431 | 2G | R1466 | 2D | U1454 | 2H |
| C1442 | 5J | CR1428 | 6G | P1482 | 12C | Q1474 | 3F | R1432 | 2G | R1467 | 2E | U1464 | 2E |
| C1448 | 1I | CR1432 | 2F | | | Q1478 | 4F | R1445 | 2H | R1468 | 2E | | |
| C1452 | 6H | CR1442 | 4J | Q1424 | 2F | Q1482 | 12C | R1446 | 2H | R1473 | 2F | VR1416 | 2G |
| C1458 | 2I | CR1448 | 6G | Q1426 | 2F | | | R1447 | 2H | R1474 | 3F | VR1418 | 4G |
| C1462 | 5H | CR1452 | 6H | Q1432 | 2F | R1416 | 3G | R1448 | 1H | R1475 | 3F | VR1422 | 2F |
| C1468 | 5G | CR1456 | 3H | Q1444 | 2H | R1417 | 2G | R1454 | 3I | R1476 | 3F | VR1423 | 3G |
| C1472 | 5H | CR1458 | 2I | Q1446 | 2H | R1422 | 3F | R1455 | 3I | R1477 | 3F | | |
| C1478 | 3I | CR1462 | 4H | Q1448 | 2G | R1423 | 3G | R1456 | 3H | R1478 | 3F | | |
| | | | | | | | | R1457 | 3H | | | | |



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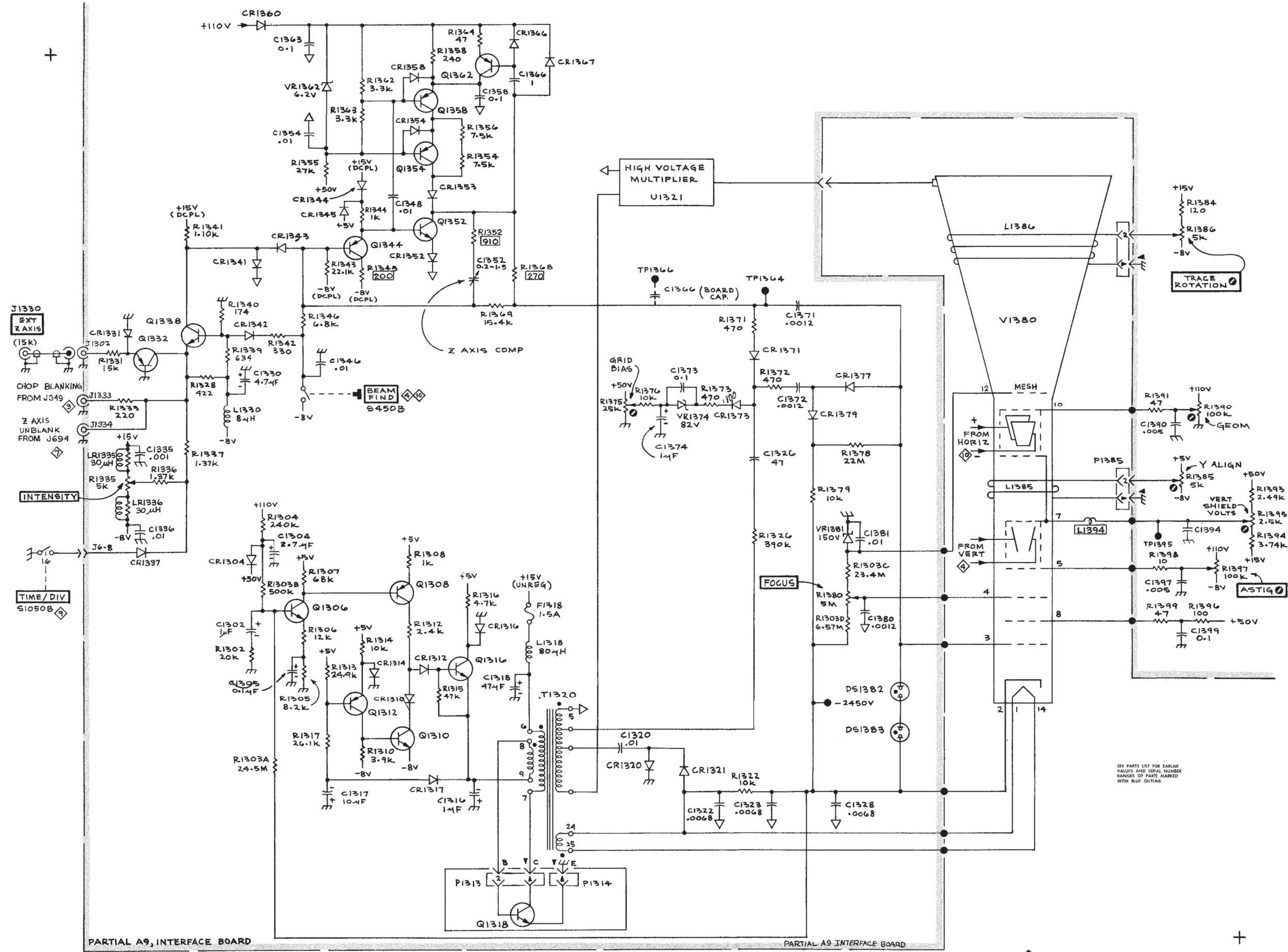


T1320, U1321, & U318 ON UNDERSIDE OF BOARD.

Fig. 7-19. P/O A9 Interface circuit board.

Fig. 7-19. Interface circuit board.

| CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC |
|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|
| C1265 | 4E | C1371 | 4D | CR1321 | 4C | DS1382 | 4C | Q1316 | 3B | R1315 | 2B | R1355 | 3E | R1391 | 7B |
| C1302 | 5E | C1372 | 3D | CR1331 | 5E | DS1383 | 4C | Q1322 | 5E | R1316 | 3A | R1356 | 3D | R1393 | 9B |
| C1304 | 6F | C1373 | 2C | CR1337 | 8B | | | Q1338 | 4F | R1317 | 2B | R1358 | 3E | R1394 | 7B |
| C1305 | 6D | C1374 | 1C | CR1341 | 4F | F1318 | 1I | Q1344 | 4E | R1322 | 4C | R1362 | 3E | R1395 | 9B |
| C1316 | 3A | C1380 | 6B | CR1342 | 5F | | | Q1352 | 3D | R1326 | 3B | R1363 | 3E | R1396 | 9B |
| C1317 | 2A | C1381 | 6F | CR1343 | 4F | J1333 | 6F | Q1354 | 3D | R1328 | 4F | R1364 | 2D | R1397 | 13E |
| C1318 | 1B | C1387 | 7D | CR1344 | 4E | J1334 | 6F | Q1358 | 3E | R1331 | 5F | R1368 | 3D | R1398 | 6B |
| C1320 | 3B | C1388 | 8C | CR1345 | 4E | | | Q1362 | 2D | R1332 | 5F | R1369 | 4E | R1399 | 6A |
| C1322 | 3B | C1390 | 7B | CR1352 | 2D | L1265 | 4G | | | R1335 | 9C | R1371 | 3D | | |
| C1323 | 5B | C1394 | 6A | CR1353 | 3D | L1330 | 4G | R1302 | 6F | R1336 | 8B | R1372 | 3C | S450 | 10B |
| C1326 | 2C | C1397 | 7B | CR1354 | 3E | L1387 | 7D | R1303 | 5D | R1337 | 5F | R1373 | 2C | | |
| C1328 | 5B | C1399 | 7A | CR1358 | 3E | L1388 | 7C | R1304 | 6F | R1339 | 5F | R1375 | 2C | TP1354 | 4D |
| C1330 | 5G | | | CR1360 | 4F | | | R1305 | 6D | R1340 | 5F | R1376 | 2D | TP1366 | 4D |
| C1346 | 5G | CR1304 | 6F | CR1366 | 2D | P1385 | 7C | R1306 | 5E | R1341 | 5E | R1378 | 5D | TP1395 | 9A |
| C1348 | 3E | CR1310 | 2A | CR1367 | 3D | P1386 | 13C | R1307 | 6E | R1342 | 5F | R1379 | 5D | | |
| C1352 | 3E | CR1312 | 4A | CR1371 | 3C | | | R1308 | 6E | R1343 | 4E | R1380 | 5C | VR1362 | 3E |
| C1354 | 2D | CR1314 | 1B | CR1377 | 4D | Q1306 | 5E | R1310 | 2B | R1344 | 4E | R1384 | 12D | VR1374 | 2C |
| C1358 | 3E | CR1316 | 3A | CR1379 | 4D | Q1308 | 6E | R1312 | 7C | R1345 | 4E | R1385 | 8C | VR1381 | 5F |
| C1363 | 2D | CR1317 | 2B | | | Q1310 | 2A | R1313 | 2B | R1346 | 4E | R1386 | 13E | | |
| C1366 | 2D | CR1320 | 3C | | | Q1312 | 2A | R1314 | 2B | R1354 | 3E | R1390 | 8B | | |



SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE

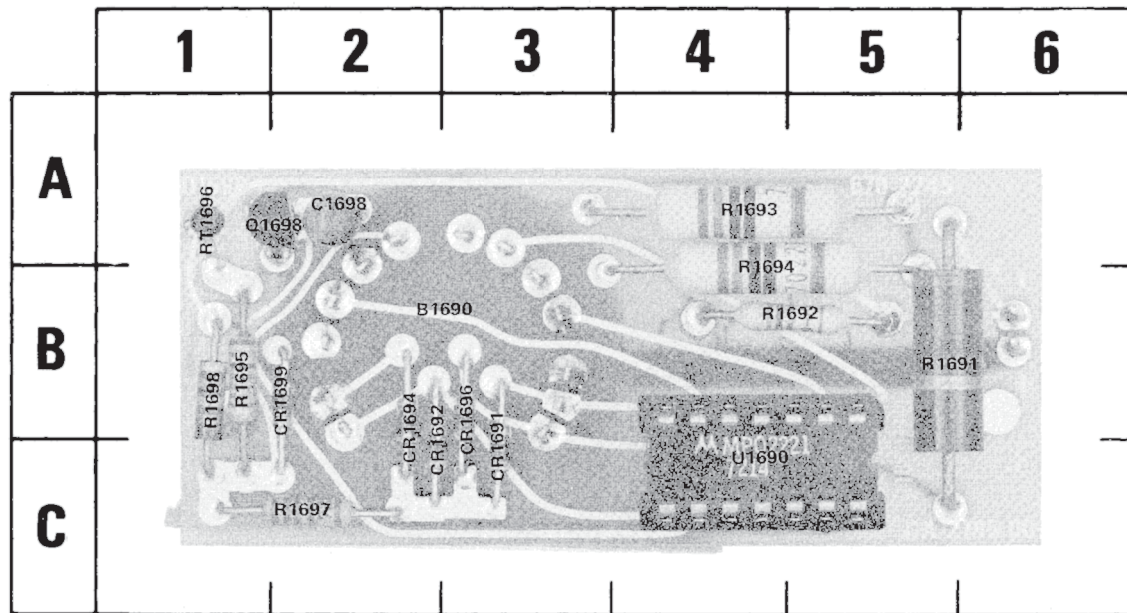


Fig. 7-20. A6 Fan Motor circuit board.

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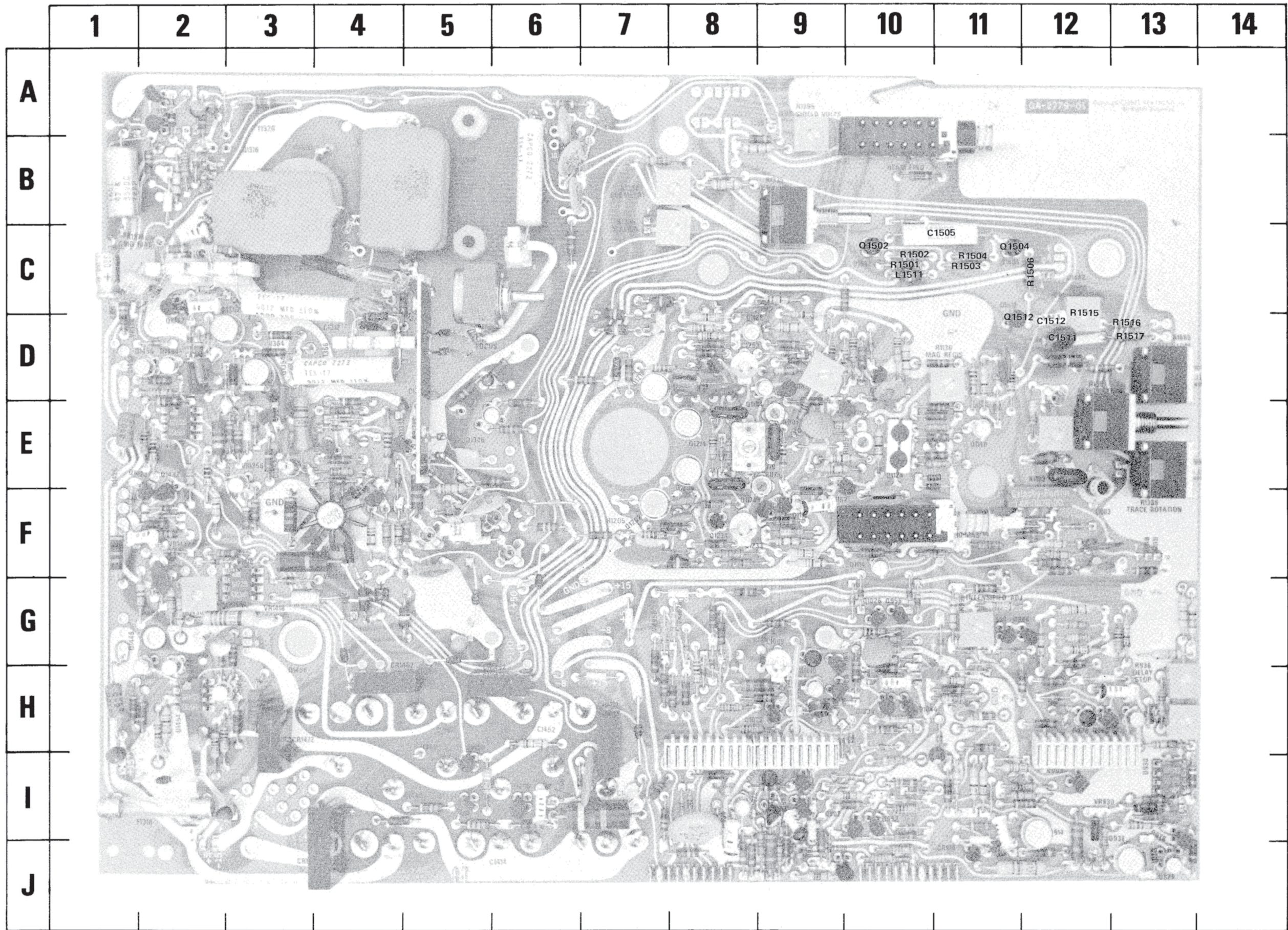


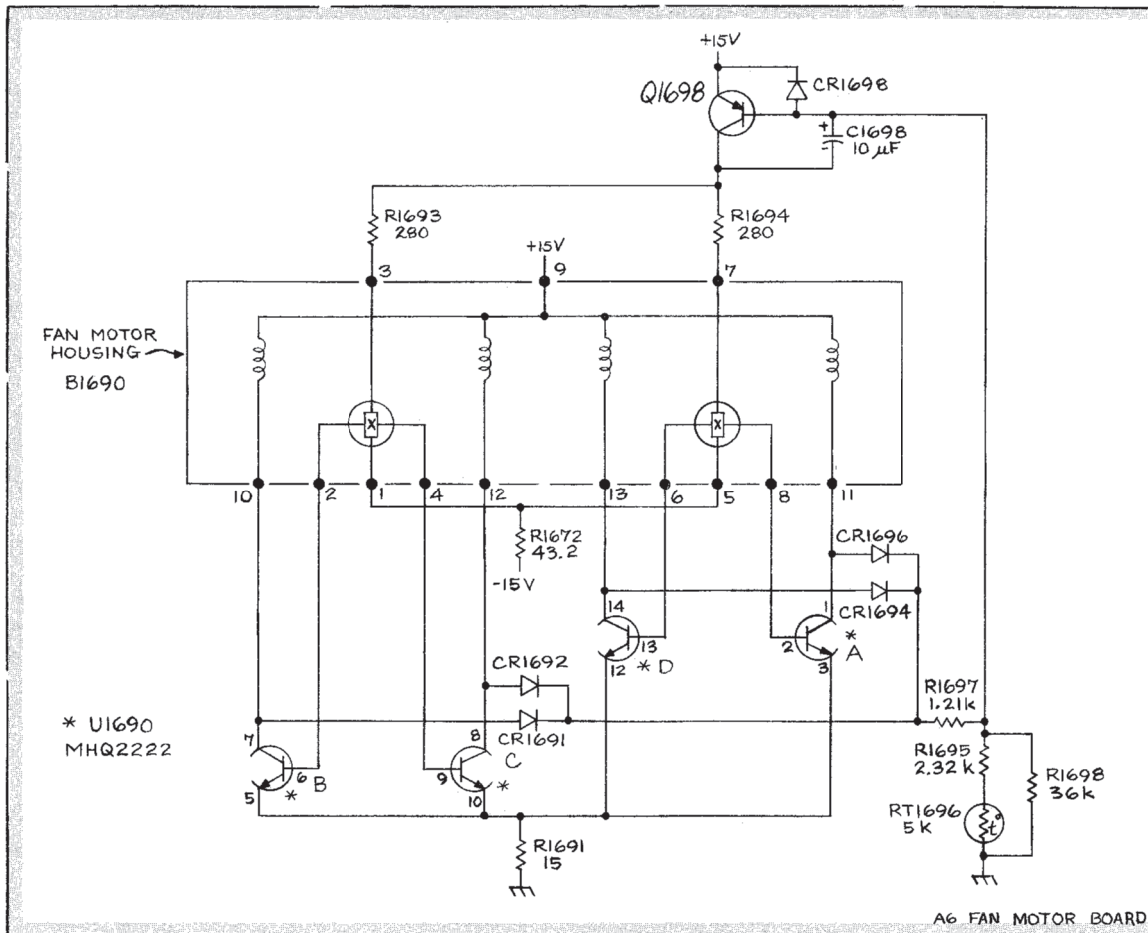
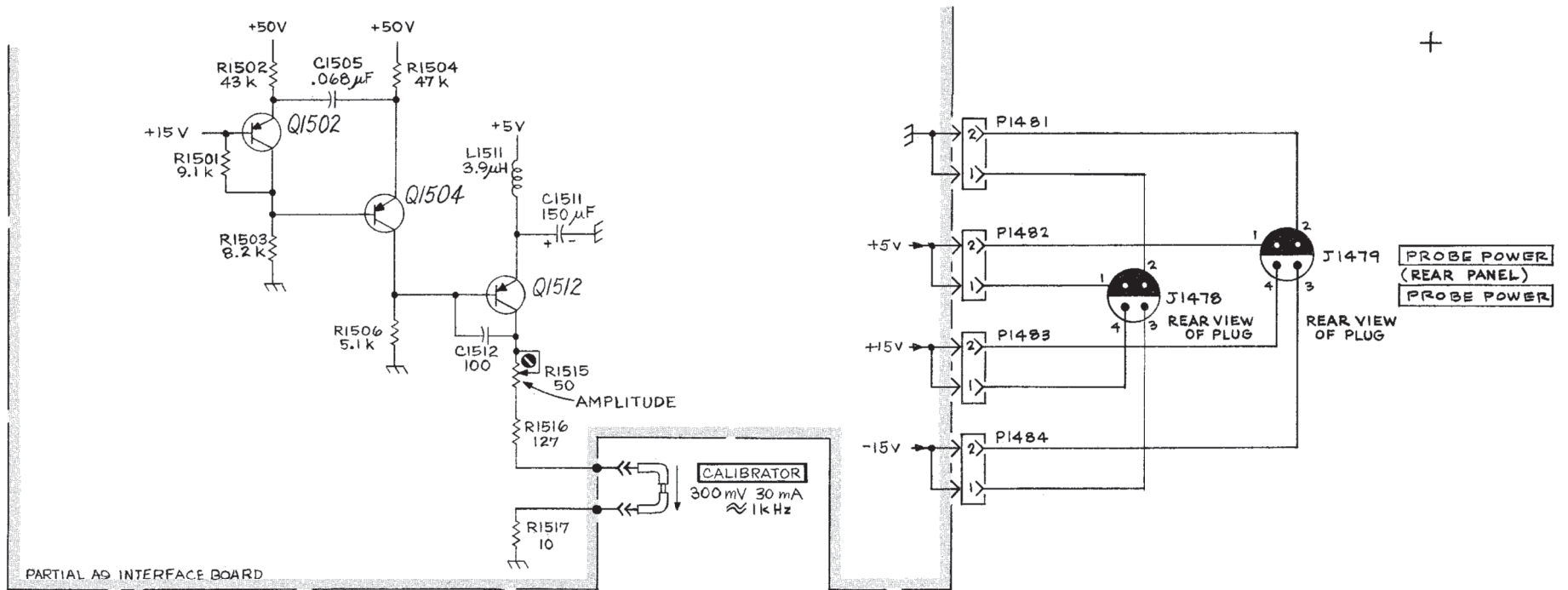
Fig. 7-21. P/O A9 Interface circuit board.

Fig. 7-20. A6 Fan Motor circuit board.

| CKT NO | GRID LOC | CKT NO | GRID LOC | CKT NO | GRID LOC |
|-----------|-------------|-----------|-------------|-----------|-------------|
| B1690 | 2B | Q1698 | 1A | RT1696 | 1A |
| C1698 | 2A | R1691 | 5B | U1690 | 4C |
| | | R1692 | 4B | | |
| CR1691 | 3C | R1693 | 4A | | |
| CR1692 | 2C | R1694 | 4B | | |
| CR1694 | 2C | R1695 | 1B | | |
| CR1696 | 3C | R1697 | 2C | | |
| CR1699 | 2B | R1698 | 1B | | |

Fig. 7-21. Interface circuit board.

| CKT NO | GRID LOC | CKT NO | GRID LOC |
|-----------|-------------|-----------|-------------|
| C1505 | 10C | Q1512 | 11C |
| C1511 | 12D | | |
| C1512 | 12D | R1501 | 10C |
| | | R1502 | 10C |
| | | R1503 | 11C |
| L1511 | 10C | R1504 | 11C |
| | | R1506 | 12C |
| | | R1515 | 12C |
| Q1502 | 10C | R1516 | 13D |
| Q1504 | 11C | R1517 | 13D |



MECHANICAL PARTS LIST

Replacement parts should be ordered from the Tektronix Field Office or Representative in your area. Changes to Tektronix products give you the benefit of improved circuits and components. Please include the instrument type number and serial number with each order for parts or service.

ABBREVIATIONS

| | | | | | |
|--------|----------------------|------|------------------|-----|------------------|
| BHB | binding head brass | h | height or high | OHB | oval head brass |
| BHS | binding head steel | hex. | hexagonal | OHS | oval head steel |
| CRT | cathode-ray tube | HHB | hex head brass | PHB | pan head brass |
| csk | countersunk | HHS | hex head steel | PHS | pan head steel |
| DE | double end | HSB | hex socket brass | RHS | round head steel |
| FHB | flat head brass | HSS | hex socket steel | SE | single end |
| FHS | flat head steel | ID | inside diameter | THB | truss head brass |
| Fil HB | fillister head brass | lg | length or long | THS | truss head steel |
| Fil HS | fillister head steel | OD | outside diameter | w | wide or width |

FRONT PANEL

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. | | Q † y | Description |
|------------------------|-----------------------|------------------|------|-------------|---|
| | | Eff | Disc | | |
| 1-1 | 200-1411-00 | | | 1 | BEZEL |
| -2 | 213-0313-00 | | | - | bezel includes: |
| -3 | 337-1674-00 | | | 4 | THUMBSCREW, 4-40 x 0.45 inch, knurled |
| -4 | 366-0494-00 | | | 1 | SHIELD, implosion, blue |
| | | | | 3 | KNOB, gray--POSITION, A TRIG HOLDOFF |
| | | | | - | each knob includes: |
| | 213-0153-00 | | | 1 | SETSCREW, 5-40 x 0.125 inch, HSS |
| -5 | 358-0378-01 | | | 14 | BUSHING, sleeve |
| -6 | 358-0216-00 | | | 3 | GROMMET, gray, plastic |
| -7 | 366-1031-02 | | | 2 | KNOB, red--VAR |
| | | | | - | each knob includes: |
| | 213-0153-00 | | | 1 | SETSCREW, 5-40 x 0.125 inch, HSS |
| -8 | 366-1425-00 | | | 2 | KNOB, gray--VOLTS/DIV |
| | | | | - | each knob includes: |
| | 213-0153-00 | | | 2 | SETSCREW, 5-40 x 0.125 inch, HSS |
| -9 | 366-0215-02 | | | 2 | KNOB, lever switch |
| -10 | 366-1402-31 | | | 1 | PUSHBUTTON--INVERT |
| -11 | 366-1402-32 | | | 1 | PUSHBUTTON--BEAM FIND |
| -12 | 378-0803-01 | | | 2 | LENS, indicator light |
| -13 | 366-1257-20 | | | 1 | PUSHBUTTON--CH 2 |
| -14 | 366-1402-37 | | | 1 | PUSHBUTTON--CHOP |
| -15 | 366-1257-16 | | | 1 | PUSHBUTTON--ADD |
| -16 | 366-1402-36 | | | 1 | PUSHBUTTON--ALT |
| -17 | 366-1257-19 | | | 1 | PUSHBUTTON--CH 1 |
| -18 | 426-0681-00 | | | 16 | FRAME, pushbutton |
| -19 | 366-1023-01 | | | 3 | KNOB, gray--INTENSITY-FOCUS-SCALE ILLUM |
| | | | | - | each knob includes: |
| | 213-0153-00 | | | 1 | SETSCREW, 5-40 x 0.125 inch, HSS |
| -20 | 366-1346-02 | | | 1 | KNOB, red--VAR |
| | | | | - | knob includes: |
| | 213-0153-00 | | | 1 | SETSCREW, 5-40 x 0.125 inch, HSS |
| -21 | 366-1219-00 | | | 1 | KNOB, interlocking--TIME/DIV |
| | | | | - | knob includes: |
| | 213-0153-00 | | | 2 | SETSCREW, 5-40 x 0.125 inch, HSS |

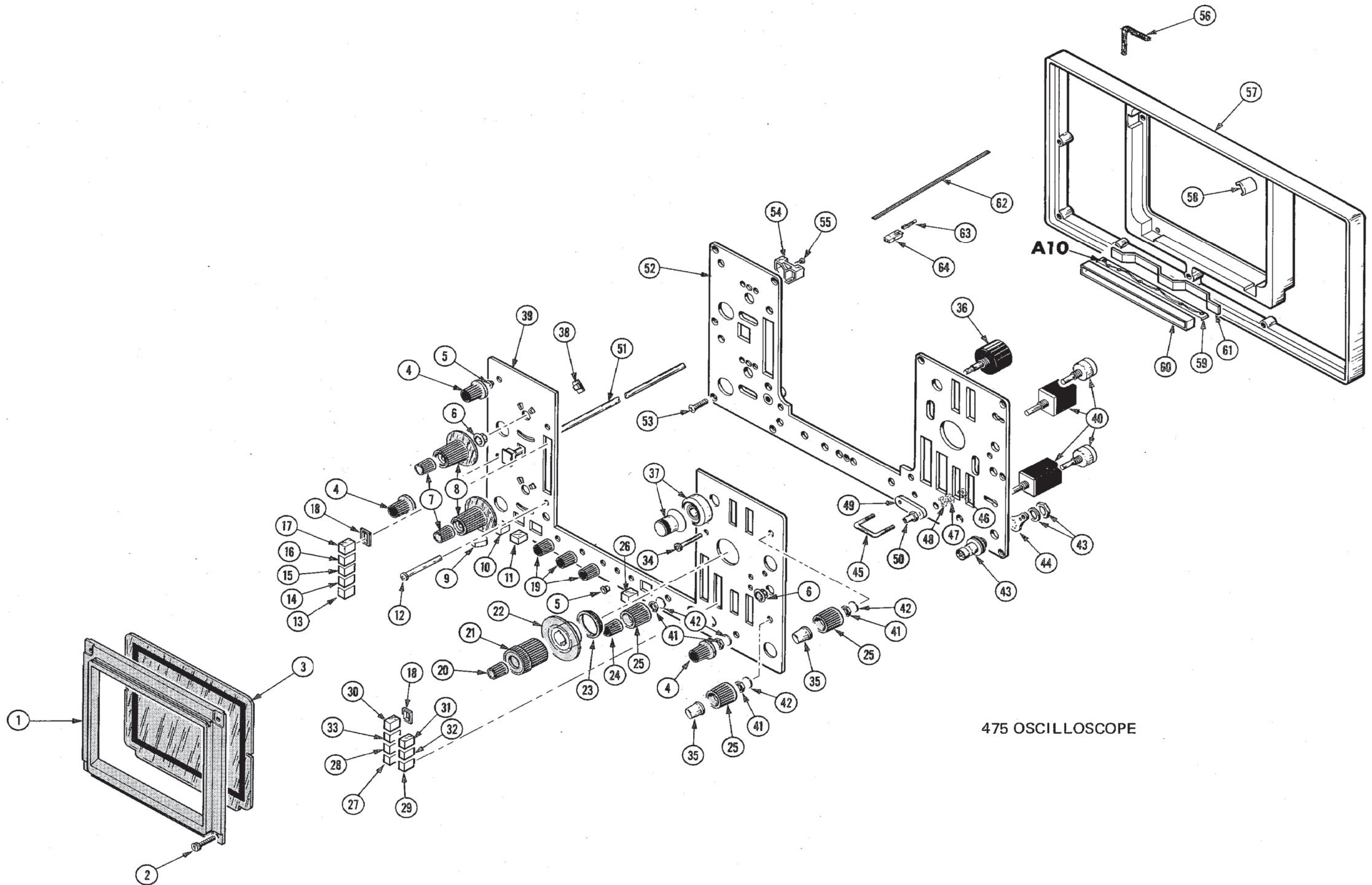
FRONT PANEL (cont)

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. | | Q † y | Description |
|------------------------|------------------------|------------------|------|-------------|--|
| | | Eff | Disc | | |
| 1-22 | 354-0442-00 | | | 1 | RING, knob skirt |
| | - - - - - | | | - | ring includes: |
| | 213-0153-00 | | | 1 | SETSCREW, 5-40 x 0.125 inch, HSS |
| -23 | 401-0080-00 | | | 1 | BEARING, knob skirt |
| -24 | 366-1327-00 | | | 1 | KNOB, gray--FINE |
| | - - - - - | | | - | knob includes: |
| | 213-0153-00 | | | 1 | SETSCREW, 5-40 x 0.125 inch, HSS |
| -25 | 366-1280-00 | | | 3 | KNOB, gray--HORIZ POSITION, LEVEL |
| | - - - - - | | | - | each knob includes: |
| | 213-0153-00 | | | 1 | SETSCREW, 5-40 x 0.125 inch, HSS |
| -26 | 366-1402-33 | | | 1 | PUSHBUTTON--X10 MAG |
| -27 | 366-1402-35 | | | 1 | PUSHBUTTON--B DLY'D |
| -28 | 366-1402-44 | | | 1 | PUSHBUTTON--A INTEN |
| -29 | 366-1257-29 | | | 1 | PUSHBUTTON--SINGLE SWP |
| -30 | 366-1402-34 | | | 1 | PUSHBUTTON--A |
| -31 | 366-1402-38 | | | 1 | PUSHBUTTON--AUTO |
| -32 | 366-1402-39 | | | 1 | PUSHBUTTON--NORM |
| -33 | 366-1402-29 | | | 1 | PUSHBUTTON--MIX |
| -34 | 378-0803-00 | | | 5 | LENS, indicator light |
| -35 | 366-1278-00 | | | 2 | KNOB, gray--SLOPE |
| | - - - - - | | | - | each knob includes: |
| | 213-0153-00 | | | 1 | SETSCREW, 5-40 x 0.125 inch, HSS |
| -36 | - - - - - ¹ | | | 1 | RESISTOR, variable, w/hardware |
| | - - - - - | | | - | mounting hardware: (not included w/resistor) |
| -37 | 331-0328-00 | | | 1 | DIAL, control--DELAY TIME POSITION |
| | - - - - - | | | - | dial includes: |
| | 213-0048-00 | | | 1 | SETSCREW, 4-40 x 0.125 inch, HSS |
| -38 | 378-0635-00 | | | 4 | LENS, indicator light |
| -39 | 333-1636-00 | | | 1 | PANEL, front |
| -40 | - - - - - ¹ | | | 4 | RESISTOR, variable |
| | - - - - - | | | - | mounting hardware for each: (not included |
| | - - - - - | | | - | w/resistor) |
| -41 | 210-0583-00 | | | 1 | NUT, hex., 0.25-32 x 0.312 inch |
| -42 | 210-0940-00 | | | 1 | WASHER, flat, 0.25 ID x 0.375 inch OD |
| | - - - - * | | | | |
| -43 | 131-0955-00 | | | 2 | CONNECTOR, electrical, female, BNC, w/hardware |
| | - - - - - | | | - | mounting hardware for each: (not included |
| | - - - - - | | | - | w/connector) |
| -44 | 210-0255-00 | | | 1 | TERMINAL, lug, solder |
| | - - - - * | | | | |
| -45 | 119-0373-00 | | | 1 | CURRENT LOOP |
| | - - - - - | | | - | mounting hardware: (not included w/current |
| | - - - - - | | | - | loop) |
| -46 | 210-0586-00 | | | 2 | NUT, keps, 4-40 x 0.25 inch |
| -47 | 210-0994-00 | | | 2 | WASHER, flat, 0.125 ID x 0.25 inch OD |
| -48 | 210-0849-00 | | | 2 | WASHER, fiber, shouldered, 0.11 ID x 0.187 inch OD |
| -49 | 361-0059-01 | | | 1 | SPACER, current loop |
| -50 | 210-0593-00 | | | 2 | NUT, current loop |

¹Refer to Electrical Parts List for part number.

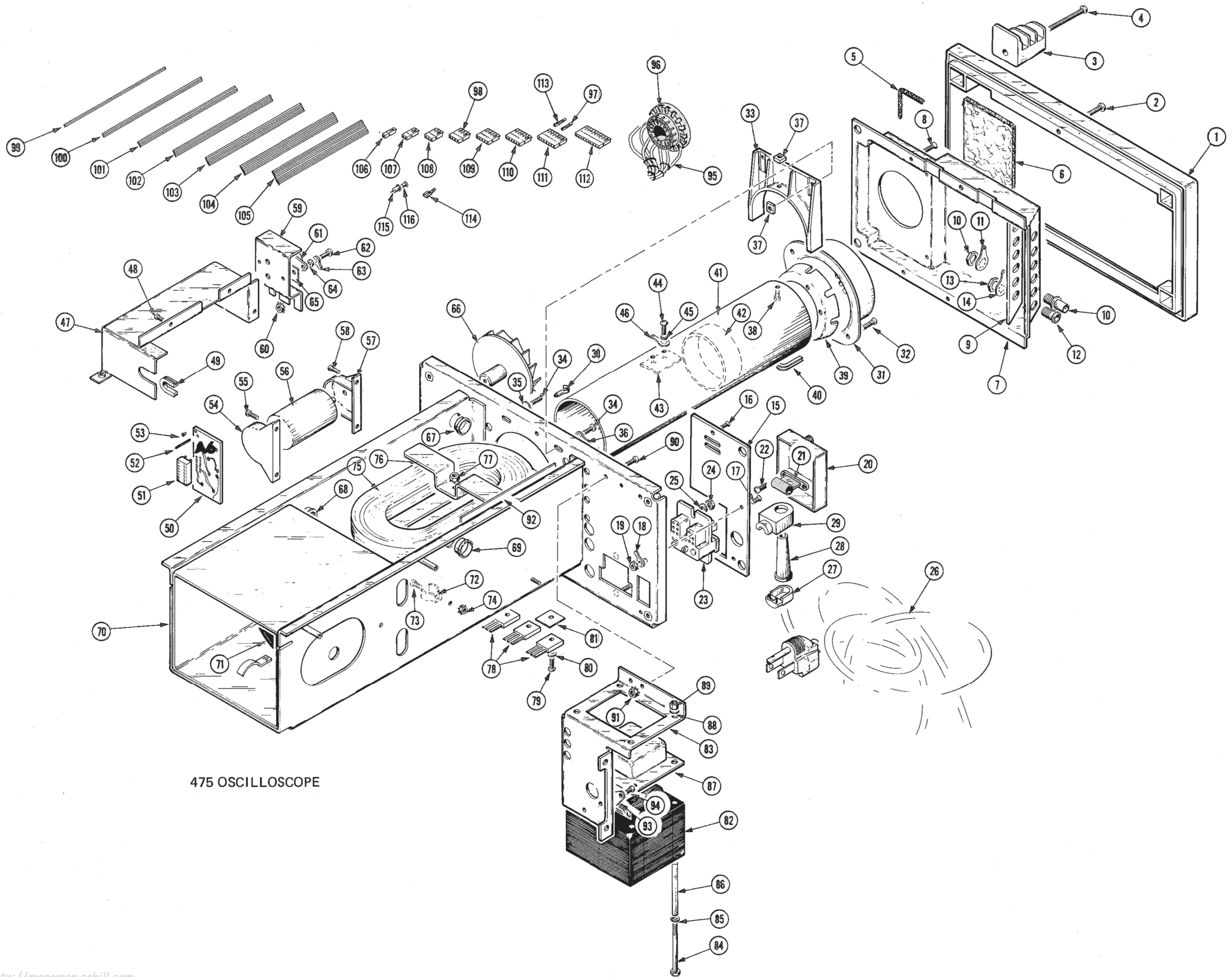
| Fig. & Index No. | Tektronix Part No. | Serial/Model No. | | FRONT PANEL (cont) | | | | | Description | |
|------------------------|------------------------|------------------|------|--------------------|---|---|---|---|-------------|--|
| | | Eff | Disc | Q † y | 1 | 2 | 3 | 4 | | 5 |
| 1-51 | 384-1162-00 | | | 1 | | | | | | SHAFT, extension, w/knob, 11.42 inches long |
| -52 | 386-2330-00 | | | 1 | | | | | | SUBPANEL, front |
| | - - - - - | | | - | | | | | | mounting hardware: (not included w/subpanel) |
| -53 | 213-0107-00 | | | 11 | | | | | | SCREW, thread forming, 4-40 x 0.25 inch, |
| | - - - - - | | | - | | | | | | 100 deg. csk, FHS |
| | | | | | | | | | | - - - * - - - |
| -54 | 352-0340-00 | | | 2 | | | | | | HOLDER, lamps |
| | - - - - - | | | - | | | | | | mounting hardware for each: (not included |
| | - - - - - | | | - | | | | | | w/holder) |
| -55 | 211-0001-00 | | | 1 | | | | | | SCREW, 2-56 x 0.25 inch, PHS |
| | | | | | | | | | | - - - * - - - |
| -56 | 348-0276-00 | | | ft | | | | | | SHIELDING GASKET, electrical, 2.75 feet |
| -57 | 426-0926-01 | | | 1 | | | | | | FRAME, cabinet, front |
| | - - - - - | | | - | | | | | | mounting hardware: (not included w/frame) |
| | 213-0183-00 | | | 4 | | | | | | SCREW, thread forming, 6-32 x 0.50 inch, PHS |
| | - - - - - | | | - | | | | | | (not shown) |
| | | | | | | | | | | - - - * - - - |
| -58 | 386-2340-00 | | | 4 | | | | | | SUPPORT, CRT, front |
| -59 | - - - - - ¹ | | | 1 | | | | | | CIRCUIT BOARD ASSEMBLY--GRATICULE ILLUM A10 |
| | - - - - - | | | - | | | | | | circuit board assembly includes: |
| -60 | 378-0728-00 | | | 1 | | | | | | REFLECTOR, light |
| -61 | 352-0329-00 | | | 1 | | | | | | HOLDER, lamps |
| -62 | 175-0825-00 | | | ft | | | | | | WIRE, electrical, 2 wire ribbon, 0.478 ft. |
| -63 | 131-0707-00 | | | 2 | | | | | | CONNECTOR, terminal |
| -64 | 352-0169-02 | | | 1 | | | | | | HOLDER, terminal connector, 2 wire (red) |

¹ Refer to Electrical Parts List for part number.



A10

475 OSCILLOSCOPE



475 OSCILLOSCOPE

MAIN FRAME

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. Eff Disc | Q | | | | | Description | |
|------------------------|-----------------------|------------------------------|----|---|---|---|---|-------------|--|
| | | | t | y | 1 | 2 | 3 | | 4 |
| 2-1 | 426-0970-00 | | 1 | | | | | | FRAME SECTION, cabinet rear |
| | - - - - - | | - | | | | | | mounting hardware: (not included w/frame section) |
| -2 | 211-0544-00 | | 2 | | | | | | SCREW, 6-32 x 0.75 inch, THS |
| | - - - - - | | | | | * | | | |
| -3 | 348-0039-00 | | 4 | | | | | | FOOT, cabinet, w/cord wrap |
| | - - - - - | | - | | | | | | mounting hardware for each: (not included w/foot) |
| -4 | 212-0020-00 | | 1 | | | | | | SCREW, 8-32 x 1 inch, PHS |
| | - - - - - | | | | | * | | | |
| -5 | 348-0349-00 | | ft | | | | | | SHIELDING GASKET, electrical, 2.75 feet |
| -6 | 378-0044-01 | | 1 | | | | | | FILTER, air |
| -7 | 200-1414-02 | | 1 | | | | | | COVER, rear |
| | - - - - - | | - | | | | | | mounting hardware: (not included w/cover) |
| -8 | 211-0101-00 | | 2 | | | | | | SCREW, 4-40 x 0.25 inch, 100 deg. csk, FHS |
| | - - - - - | | | | | * | | | |
| -9 | 386-2408-00 | | 1 | | | | | | PLATE, connector mounting |
| -10 | 131-0955-00 | | 4 | | | | | | CONNECTOR, electrical, female, BNC, w/hardware |
| | - - - - - | | - | | | | | | mounting hardware for each: (not included w/connector) |
| -11 | 210-0255-00 | | 1 | | | | | | TERMINAL, lug, solder, 0.391 inch ID |
| | - - - - - | | | | | * | | | |
| -12 | 131-0771-00 | | 2 | | | | | | CONNECTOR, receptacle, electrical |
| | - - - - - | | - | | | | | | mounting hardware for each: (not included w/connector) |
| -13 | 220-0551-00 | | 1 | | | | | | NUT, hex., 0.437 OD |
| -14 | 210-0012-00 | | 1 | | | | | | WASHER, lock, internal, 0.375 ID x 0.50 inch OD |
| | - - - - - | | | | | * | | | |
| -15 | 386-2332-01 | | 1 | | | | | | PANEL, rear |
| | - - - - - | | - | | | | | | mounting hardware: (not included w/panel) |
| -16 | 211-0105-00 | | 1 | | | | | | SCREW, 4-40 x 0.188 inch, 100 deg. csk, FHS |
| -17 | 211-0038-00 | | 1 | | | | | | SCREW, 4-40 x 0.312 inch, 100 deg. csk, FHS |
| -18 | 210-0201-00 | | 1 | | | | | | LUG, solder, SE #4 |
| -19 | 210-0586-00 | | 1 | | | | | | NUT, keps, 4-40 x 0.25 inch |
| | - - - - - | | | | | * | | | |
| -20 | 200-1445-01 | | 1 | | | | | | COVER, line voltage selector |
| | - - - - - | | - | | | | | | cover includes: |
| -21 | 352-0102-00 | | 1 | | | | | | HOLDER, fuse, plastic |
| | - - - - - | | - | | | | | | mounting hardware: (not included w/holder) |
| -22 | 213-0034-00 | | 1 | | | | | | SCREW, thread cutting, 4-40 x 0.312 inch, PHS |
| -23 | 204-0549-01 | | 1 | | | | | | BODY, line voltage selector |
| | - - - - - | | - | | | | | | mounting hardware: (not included w/body) |
| -24 | 210-0407-00 | | 2 | | | | | | NUT, hex., 6-32 x 0.25 inch |
| -25 | 210-0006-00 | | 2 | | | | | | WASHER, lock, split, 0.145 ID x 0.253 inch OD |
| | - - - - - | | | | | * | | | |
| -26 | 161-0033-07 | | 1 | | | | | | CABLE ASSEMBLY, power |
| -27 | 358-0372-00 | | 1 | | | | | | BUSHING, strain relief, bottom |
| -28 | 200-1004-00 | | 1 | | | | | | CABLE NIPPLE |
| -29 | 358-0371-00 | | 1 | | | | | | BUSHING, strain relief, top |

MAIN FRAME (cont)

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Q | | | | | Description | |
|------------------|------------------------|----------------------|------|---|---|---|---|---|-------------|--|
| | | | | t | y | 1 | 2 | 3 | | 4 |
| 2-30 | 343-0088-00 | | | 1 | | | | | | CLAMP, retaining, plastic |
| -31 | 200-1459-00 | | | 1 | | | | | | COVER, CRT, rear |
| | - - - - - | | | - | | | | | | mounting hardware: (not included w/cover) |
| -32 | 211-0008-00 | | | 2 | | | | | | SCREW, 4-40 x 0.25 inch, PHS |
| | - - - - - | | | | | | | | | * - - - - |
| -33 | 407-1128-00 | | | 1 | | | | | | BRACKET, CRT shield, rear |
| | - - - - - | | | - | | | | | | mounting hardware: (not included w/bracket) |
| -34 | 211-0507-00 | | | 2 | | | | | | SCREW, 6-32 x 0.312 inch, PHS |
| -35 | 210-0803-00 | | | 1 | | | | | | WASHER, flat, 0.15 ID x 0.375 inch OD |
| -36 | 210-0202-00 | | | 1 | | | | | | LUG, solder, SE #6 |
| -37 | 220-0419-00 | | | 3 | | | | | | NUT, square, 6-32 x 0.312 inch |
| -38 | 211-0590-00 | | | 1 | | | | | | SCREW, 6-32 x 0.25 inch, PHS |
| | - - - - - | | | | | | | | | * - - - - |
| -39 | 386-2246-00 | | | 1 | | | | | | SUPPORT, CRT, rear |
| -40 | 348-0145-00 | | | 1 | | | | | | GROMMET, u-shape |
| -41 | 337-1645-00 | | | 1 | | | | | | SHIELD SECTION, CRT, neck |
| -42 | - - - - - | | | 1 | | | | | | COIL, y axis |
| -43 | 343-0217-00 | | | 1 | | | | | | CLAMP, coil, plastic |
| | - - - - - | | | - | | | | | | mounting hardware: (not included w/clamp) |
| -44 | 211-0147-00 | | | 2 | | | | | | SCREW, 4-40 x 0.25 inch, PHS |
| -45 | 210-0994-00 | | | 2 | | | | | | WASHER, flat, 0.125 ID x 0.25 inch, OD |
| -46 | 210-0201-00 | | | 1 | | | | | | LUG, solder, SE #4 |
| | - - - - - | | | | | | | | | * - - - - |
| -47 | 337-1688-00 | | | 1 | | | | | | SHIELD, electrical, high voltage |
| | - - - - - | | | - | | | | | | mounting hardware: (not included w/shield) |
| -48 | 211-0065-00 | | | 3 | | | | | | SCREW, 4-40 x 0.188 inch, PHS |
| | - - - - - | | | | | | | | | * - - - - |
| -49 | 348-0115-00 | | | 1 | | | | | | GROMMET, plastic, u-shape |
| -50 | - - - - - ¹ | | | 1 | | | | | | CIRCUIT BOARD ASSEMBLY--FAN MOTOR A6 |
| | - - - - - | | | - | | | | | | circuit board assembly includes: |
| -51 | 136-0269-00 | | | 1 | | | | | | SOCKET, integrated circuit, 14 pin |
| -52 | 131-0608-00 | | | 2 | | | | | | TERMINAL, pin, 0.365 inch long |
| -53 | 136-0252-04 | | | 3 | | | | | | SOCKET, pin connector |
| -54 | 426-0781-00 | | | 1 | | | | | | MOUNT, motor |
| | - - - - - | | | - | | | | | | mounting hardware: (not included w/circuit board assembly) |
| -55 | 213-0088-00 | | | 2 | | | | | | SCREW, thread forming, 4-40 x 0.25 inch, PHS |
| | - - - - - | | | | | | | | | * - - - - |
| -56 | 337-1762-00 | | | 1 | | | | | | SHIELD, electrical, fan motor |
| -57 | 426-0781-00 | | | 1 | | | | | | MOUNT, motor |
| | - - - - - | | | - | | | | | | mounting hardware: (not included w/mount) |
| -58 | 213-0088-00 | | | 2 | | | | | | SCREW, thread forming, 4-40 x 0.25 inch, PHS |
| | - - - - - | | | | | | | | | * - - - - |
| -59 | 407-1153-00 | | | 1 | | | | | | BRACKET, transistor |
| | - - - - - | | | - | | | | | | mounting hardware: (not included w/bracket) |
| -60 | 210-0586-00 | | | 2 | | | | | | NUT, keps, 4-40 x 0.25 inch |

¹Refer to Electrical Parts List for part number.

MAIN FRAME (cont)

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. | | Q † y | Description |
|------------------------|-----------------------|------------------|------|-------------|---|
| | | Eff | Disc | | |
| 2-61 | - - - - - | - | - | 1 | TRANSISTOR |
| | - - - - - | - | - | - | mounting hardware: (not included w/transistor) |
| -62 | 211-0012-00 | - | - | 2 | SCREW, 4-40 x 0.375 inch, PHS |
| -63 | 210-0205-00 | - | - | 1 | LUG, solder, SE #8 |
| -64 | 358-0214-00 | - | - | 2 | BUSHING, insulator |
| -65 | 214-1610-00 | - | - | 1 | HEATSINK, transistor |
| | | | | | - - - * - - - |
| -66 | 369-0031-00 | - | - | 1 | IMPELLER, fan, w/setscrew |
| -67 | 348-0056-00 | - | - | 3 | GROMMET, plastic, 0.375 inch |
| -68 | 348-0253-00 | - | - | 1 | GROMMET, plastic, 1.145 inches |
| -69 | 348-0063-00 | - | - | 4 | GROMMET, plastic, 0.50 inch |
| -70 | 441-1084-00 | - | - | 1 | CHASSIS, main |
| -71 | - - - - - | - | - | - | COIL, trace rotation |
| -72 | 344-0250-00 | - | - | 1 | CLIP, electrical |
| | - - - - - | - | - | - | mounting hardware: (not included w/clip) |
| -73 | 211-0008-00 | - | - | 1 | SCREW, 4-40 x 0.25 inch, PHS |
| -74 | 210-0586-00 | - | - | 1 | NUT, keps, 4-40 x 0.25 inch |
| | | | | | - - - * - - - |
| -75 | - - - - - | - | - | 1 | DELAY LINE |
| -76 | 407-1138-00 | - | - | 1 | BRACKET, delay line |
| | - - - - - | - | - | - | mounting hardware: (not included w/bracket) |
| -77 | 210-0457-00 | - | - | 1 | NUT, keps, 6-32 x 0.312 inch |
| | | | | | - - - * - - - |
| -78 | - - - - - | - | - | 3 | TRANSISTOR |
| | - - - - - | - | - | - | mounting hardware for each: (not included w/transistor) |
| -79 | 211-0012-00 | - | - | 1 | SCREW, 4-40 x 0.375 inch, PHS |
| -80 | 210-0071-00 | - | - | 1 | WASHER, spring tension |
| -81 | 342-0163-00 | - | - | 1 | INSULATOR, transistor |
| | | | | | - - - * - - - |
| -82 | - - - - - | - | - | 1 | TRANSFORMER |
| | - - - - - | - | - | - | transformer includes: |
| -83 | 407-1066-00 | - | - | 1 | BRACKET, transformer |
| -84 | 212-0522-00 | - | - | 4 | SCREW, 10-32 x 2.50 inches, HHS |
| -85 | 210-0812-00 | - | - | 4 | WASHER, fiber, # 10 |
| -86 | 166-0457-00 | - | - | 4 | TUBE, insulating, 1.875 inches long |
| -87 | 200-1544-01 | - | - | 1 | COVER, transformer |
| -88 | 210-0056-00 | - | - | 4 | WASHER, lock, split, # 10 |
| -89 | 220-0561-00 | - | - | 4 | NUT, hex., 10-32 x 0.25 inch |
| | - - - - - | - | - | - | mounting hardware: (not included w/transformer) |
| -90 | 211-0538-00 | - | - | 2 | SCREW, 6-32 x 0.312 inch, 100 deg. csk, PHS |
| -91 | 210-0457-00 | - | - | 4 | NUT, keps, 6-32 x 0.312 inch |
| | | | | | - - - * - - - |
| -92 | 337-1763-00 | - | - | 1 | SHIELD, electrical, transformer |
| -93 | 260-0638-00 | - | - | 1 | SWITCH, thermostatic |
| | - - - - - | - | - | - | mounting hardware: (not included w/switch) |
| -94 | 213-0044-00 | - | - | 2 | SCREW, thread forming, 5-32 x 0.188 inch, PHS |

¹Refer to Electrical Parts List for part number.

MAIN FRAME (cont)

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. | | Q † y | Description |
|------------------------|-----------------------|------------------|------|-------------|---|
| | | Eff | Disc | | |
| 2-95 | 136-0513-00 | | | 1 | SOCKET ASSEMBLY, CRT |
| | - - - - - | | | - | socket assembly includes: |
| -96 | 136-0202-01 | | | 1 | SOCKET, CRT, 14 pin |
| -97 | 131-0707-00 | | | 4 | CONNECTOR, terminal |
| -98 | 352-0162-00 | | | 1 | HOLDER, terminal connector, 4 wire |
| -99 | 175-0825-00 | | | ft | WIRE, electrical, 2 wire ribbon, 7.375 inches |
| -100 | 175-0826-00 | | | ft | WIRE, electrical, 3 wire ribbon, 14 inches |
| -101 | 175-0827-00 | | | ft | WIRE, electrical, 4 wire ribbon, 13.50 inches |
| -102 | 175-0828-00 | | | ft | WIRE, electrical, 5 wire ribbon, 9 inches |
| -103 | 175-0829-00 | | | ft | WIRE, electrical, 6 wire ribbon, 8 inches |
| -104 | 175-0830-00 | | | ft | WIRE, electrical, 7 wire ribbon, 6.50 inches |
| -105 | 175-0833-00 | | | ft | WIRE, electrical, 10 wire ribbon, 5.50 inches |
| -106 | 352-0171-00 | | | 2 | HOLDER, terminal connector, 1 wire |
| -107 | 352-0169-00 | | | 2 | HOLDER, terminal connector, 2 wire |
| -108 | 352-0161-00 | | | 4 | HOLDER, terminal connector, 3 wire |
| | 352-0162-00 | | | 2 | HOLDER, terminal connector, 4 wire |
| -109 | 352-0163-00 | | | 2 | HOLDER, terminal connector, 5 wire |
| -110 | 352-0164-00 | | | 1 | HOLDER, terminal connector, 6 wire |
| -111 | 352-0165-00 | | | 1 | HOLDER, terminal connector, 7 wire |
| -112 | 352-0168-00 | | | 1 | HOLDER, terminal connector, 10 wire |
| | 131-0707-00 | | | 63 | CONNECTOR, terminal (small) |
| -113 | 131-0371-00 | | | 2 | CONNECTOR, terminal (large) |
| -114 | 131-1119-00 | | | 4 | CONNECTOR, terminal (deflection leads) |
| -115 | 210-0774-00 | | | 5 | EYELET, metallic, 0.152 inch OD |
| -116 | 210-0775-00 | | | 5 | EYELET, metallic, 0.126 inch OD |

RIGHT SIDE

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Q | | | | | Description |
|------------------|--------------------------|----------------------|------|-----|---|---|---|---|---|
| | | | | y | 1 | 2 | 3 | 4 | |
| 3-1 | 407-1133-00 | | | 1 | | | | | BRACKET, power switch |
| | - - - - - | | | - | | | | | mounting hardware: (not included w/bracket) |
| -2 | 210-0406-00 | | | 2 | | | | | NUT, hex., 4-40 x 0.188 inch |
| -3 | 210-0994-00 | | | 2 | | | | | WASHER, flat, 0.125 ID x 0.25 inch OD |
| | | | | | | | | | - - - * - - - |
| | 200-1536-00 | XB050000 | | 1 | | | | | COVER, switch hole |
| -4 | 260-1300-01 | | | 1 | | | | | SWITCH, slide--LINE |
| | - - - - - | | | - | | | | | mounting hardware: (not included w/switch) |
| -5 | 211-0007-00 | | | 2 | | | | | SCREW, 4-40 x 0.188 inch, PHS |
| | | | | | | | | | - - - * - - - |
| -6 | 260-0834-00 | | | 1 | | | | | SWITCH, toggle--POWER |
| | - - - - - | | | - | | | | | mounting hardware: (not included w/switch) |
| -7 | 210-0562-00 | | | 1 | | | | | NUT, hex., 0.25-40 x 0.312 inch |
| -8 | 210-0046-00 | | | 1 | | | | | WASHER, lock, internal, 0.261 ID x 0.40 inch OD |
| | | | | | | | | | - - - * - - - |
| -9 | 214-1756-00 | | | 1 | | | | | ACTUATOR, power switch |
| -10 | 384-1159-00 | | | 1 | | | | | SHAFT, extension |
| -11 | - - - - - ¹ | | | 1 | | | | | CIRCUIT BOARD ASSEMBLY--TRIG GEN & SWP LOGIC A8 |
| | - - - - - | | | - | | | | | circuit board assembly includes: |
| -12 | 214-0579-00 | | | 10 | | | | | TERMINAL, test point |
| -13 | 131-0566-00 | | | 11 | | | | | LINK, terminal connecting |
| -14 | 131-1003-00 | | | 8 | | | | | RECEPTACLE, coaxial cable |
| -15 | 136-0252-04 | | | 210 | | | | | SOCKET, connector pin, 0.181 inch long |
| -16 | 131-0608-00 | | | 14 | | | | | TERMINAL, pin, 0.365 inch long |
| -17 | 136-0499-02 | | | 1 | | | | | SOCKET, circuit board, 2 contact |
| -18 | 136-0499-10 | | | 1 | | | | | SOCKET, circuit board, 10 contact |
| -19 | 136-0499-12 | | | 1 | | | | | SOCKET, circuit board, 12 contact |
| -20 | 355-0175-00 | | | 2 | | | | | STUD, press mount, 4-40 x 0.35 inch |
| -21 | 200-0945-01 | | | 2 | | | | | COVER HALF, transistor |
| -22 | 200-0945-00 | | | 2 | | | | | COVER HALF, transistor |
| | - - - - - | | | - | | | | | mounting hardware for each: (not included |
| | - - - - - | | | - | | | | | w/cover half) |
| -23 | 211-0062-00 | | | 1 | | | | | SCREW, 2-56 x 0.312 inch, PHS |
| | | | | | | | | | - - - * - - - |
| -24 | 352-0331-00 | | | 3 | | | | | HOLDER, lamp |
| -25 | 131-1031-00 | | | 23 | | | | | CONTACT ASSEMBLY, top |
| -26 | 210-0779-00 | | | 17 | | | | | RIVET, tubular |
| -27 | 386-2376-00 | | | 1 | | | | | PLATE, lever mounting |
| -28 | 210-0657-01 | | | 2 | | | | | EYELET |
| | 105-0399-00 | | | 2 | | | | | ACTUATOR ASSEMBLY, slide switch--COUPLING |
| | - - - - - | | | - | | | | | each actuator assembly includes: |
| -29 | 105-0419-00 | | | 1 | | | | | ACTUATOR, switch, slide |
| -30 | 351-0355-00 | | | 1 | | | | | GUIDE, switch, slide |
| -31 | 214-1126-00 ² | | | - | | | | | SPRING, flat, gold |
| | 214-1126-01 ² | | | - | | | | | SPRING, flat, green |
| | 214-1126-02 ² | | | - | | | | | SPRING, flat, red |
| -32 | 214-1127-00 | | | 2 | | | | | ROLLER, detent |
| -33 | 376-0142-00 | | | 1 | | | | | COUPLER, slide to shaft |
| | 213-0048-00 | | | 1 | | | | | SETSCREW, 4-40 x 0.125 inch, HSS (not shown) |

1 Refer to Electrical Parts List for part number.
 2 Replace only with part bearing the same color code as the original part in your instrument.

RIGHT SIDE (cont)

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. | | Q † y | Description |
|------------------------|--------------------------|------------------|------|-------------|--|
| | | Eff | Disc | | |
| 3- | 105-0400-00 | | | 1 | ACTUATOR ASSEMBLY, slide switch--A SOURCE |
| | - - - - - | | | - | actuator assembly includes: |
| -34 | 105-0418-00 | | | 1 | ACTUATOR, switch, slide |
| -35 | 351-0355-00 | | | 1 | GUIDE, switch, slide |
| -36 | 214-1126-00 ¹ | | | - | SPRING, flat, gold |
| | 214-1126-01 ¹ | | | - | SPRING, flat, green |
| | 214-1126-02 ¹ | | | - | SPRING, flat, red |
| -37 | 214-1127-00 | | | 2 | ROLLER, detent |
| -38 | 376-0142-00 | | | 1 | COUPLER, slide to shaft |
| | 213-0048-00 | | | 1 | SETSCREW, 4-40 x 0.125 inch, HSS (not shown) |
| | 105-0401-00 | | | 1 | ACTUATOR ASSEMBLY, slide switch--B SOURCE |
| | - - - - - | | | - | actuator assembly includes: |
| -39 | 105-0417-00 | | | 1 | ACTUATOR, switch, slide |
| -40 | 351-0355-00 | | | 1 | GUIDE, switch, slide |
| -41 | 214-1126-00 ¹ | | | - | SPRING, flat, gold |
| | 214-1126-01 ¹ | | | - | SPRING, flat, green |
| | 214-1126-02 ¹ | | | - | SPRING, flat, red |
| -42 | 214-1127-00 | | | 2 | ROLLER, detent |
| -43 | 376-0142-00 | | | 1 | COUPLER, slide to shaft |
| | 213-0048-00 | | | 1 | SETSCREW, 4-40 x 0.125 inch, HSS (not shown) |
| -44 | 384-1160-00 | | | 4 | SHAFT, extension, lever switch |
| -45 | 214-1770-00 | | | 4 | LEVER, slide switch |
| -46 | 354-0165-00 | | | 2 | RING, retaining |
| | - - - - - | | | - | mounting hardware: (not included w/circuit |
| | - - - - - | | | - | board assembly) |
| -47 | 211-0116-00 | | | 5 | SCREW, sems, 4-40 x 0.312 inch, PHB |
| -48 | 129-0386-00 | | | 1 | POST, hex., 1.613 inches long |
| | - - - * - - - | | | | |
| -49 | - - - - - ² | | | 1 | CIRCUIT BOARD ASSEMBLY--TIMING A7 |
| | - - - - - | | | - | circuit board assembly includes: |
| | 105-0363-00 | | | 1 | ACTUATOR ASSEMBLY, cam switch--TIME/CM |
| | - - - - - | | | - | actuator assembly includes: |
| -50 | 200-1420-00 | | | 1 | COVER, cam switch |
| | - - - - - | | | - | mounting hardware: (not included w/cover) |
| -51 | 211-0008-00 | | | 6 | SCREW, 4-40 x 0.25 inch, PHS |
| -52 | 210-0004-00 | | | 6 | WASHER, lock, internal, 0.12 ID x 0.26 |
| | - - - - - | | | - | inch OD |
| | 210-0406-00 | | | 5 | NUT, hex., 4-40 x 0.188 inch (not shown) |
| | - - - * - - - | | | | |
| -53 | 131-0963-00 | | | 2 | CONTACT, electrical, grounding |
| -54 | 354-0391-00 | | | 2 | RING, retaining |
| -55 | 401-0081-00 | | | 1 | BEARING, cam switch, front |
| -56 | 214-1139-00 ¹ | | | - | SPRING, flat, gold |
| | 214-1139-02 ¹ | | | - | SPRING, flat, green |
| | 214-1139-03 ¹ | | | - | SPRING, flat, red |
| -57 | 214-1127-00 | | | 4 | ROLLER, detent |
| -58 | 105-0361-00 | | | 1 | ACTUATOR, cam switch, front |
| -59 | 401-0115-00 | | | 1 | BEARING, cam switch, center |
| -60 | 105-0362-00 | | | 1 | ACTUATOR, cam switch, rear |
| -61 | 401-0081-04 | | | 1 | BEARING, cam switch, front, w/insert |

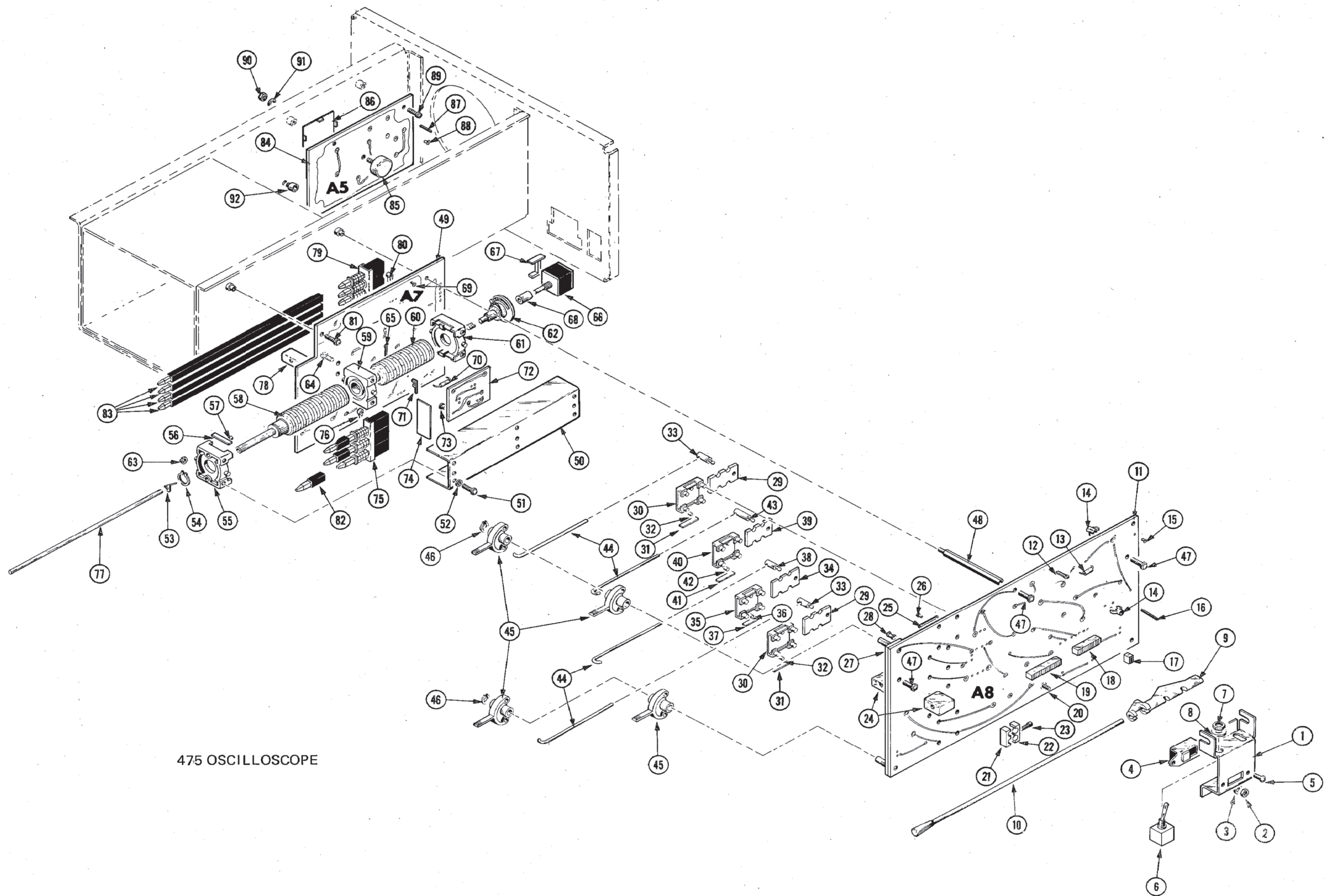
¹Replace only with part bearing the same color code as the original part in your instrument.

²Refer to Electrical Parts List for part number.

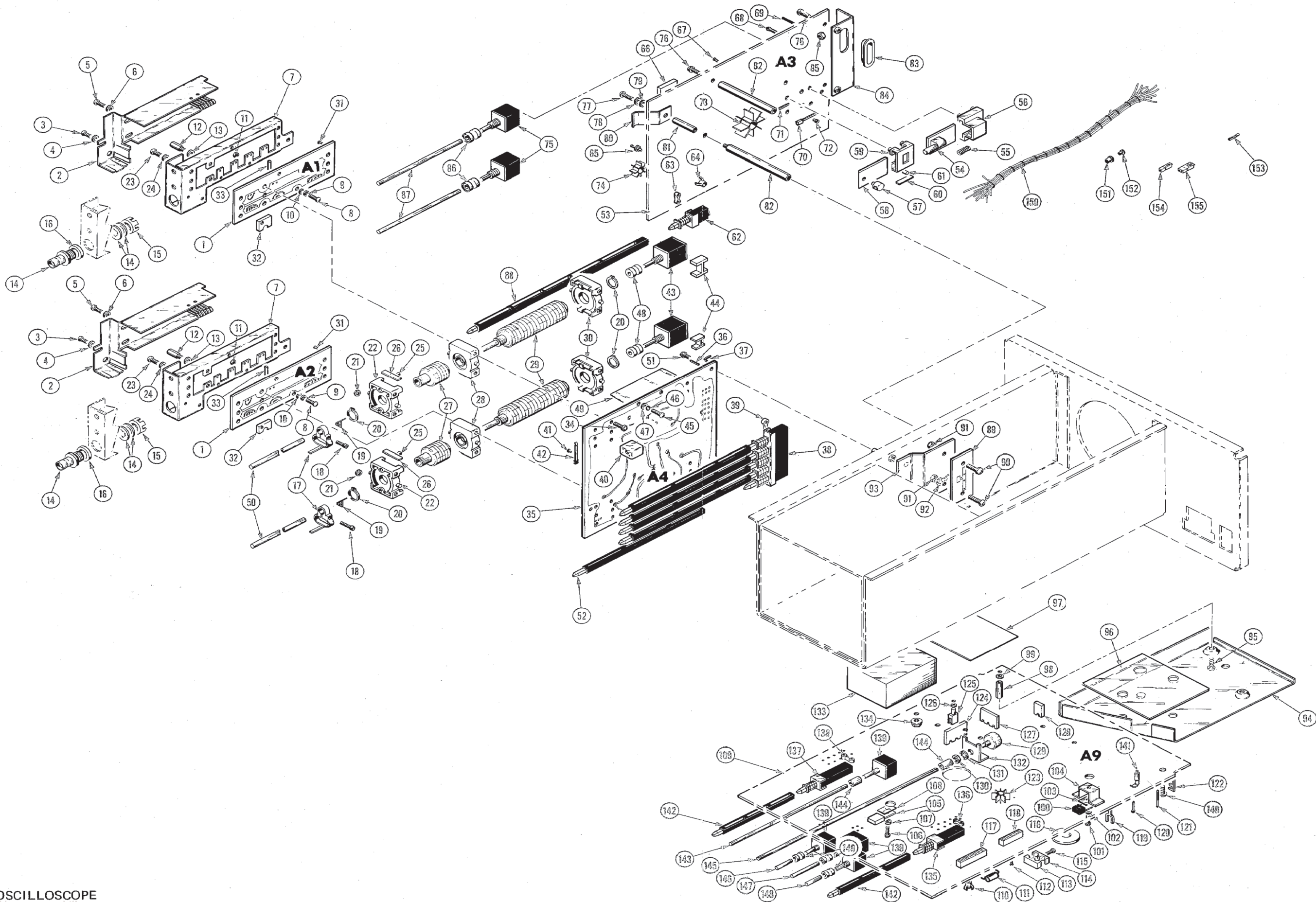
RIGHT SIDE (cont)

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. | | Q † y | Description |
|------------------|------------------------|------------------|----------|-------------|--|
| | | Eff | Disc | | |
| 3-62 | 105-0410-00 | | | 1 | STOP ASSEMBLY, cam switch |
| -63 | 210-0406-00 | | | 5 | NUT, hex., 4-40 x 0.188 inch |
| | - - - - - | | | - | mounting hardware: (not included w/actuator assembly) |
| -64 | 211-0116-00 | | | 6 | SCREW, sems, 4-40 x 0.312 inch, PHB - - - * - - - |
| -65 | 131-0604-00 | | | 36 | CONTACT, electrical, spring |
| -66 | - - - - - ¹ | | | 1 | RESISTOR, variable |
| | - - - - - | | | - | mounting hardware: (not included w/resistor) |
| -67 | 361-0515-00 | | | 1 | SPACER, switch, plastic - - - * - - - |
| -68 | 376-0039-00 | | | 1 | COUPLING, shaft |
| | - - - - - | | | - | coupling includes: |
| | 213-0075-00 | | | 2 | SETSCREW, 4-40 x 0.094 inch, HSS |
| -69 | 131-0252-04 | | | 21 | SOCKET, pin connector, 0.181 inch long |
| -70 | 131-0566-00 | B010100 | B010315X | 1 | LINK, terminal connecting |
| -71 | 131-1261-00 | | | 30 | CONTACT, electrical, F-shape |
| -72 | 388-3283-00 | B010100 | B010315X | 1 | CIRCUIT BOARD |
| -73 | 131-0158-00 | B010100 | B010315X | 4 | SPACER, stand-off |
| -74 | 337-1799-00 | B010100 | B010315 | 1 | SHIELD |
| | 337-0896-00 | B010316 | | 2 | SHIELD |
| -75 | 260-1422-00 | | | 1 | SWITCH, pushbutton--TRIG MODE |
| -76 | 361-0411-00 | | | 4 | SPACER, pushbutton switch |
| -77 | 384-1068-00 | | | 1 | SHAFT, extension, 8 inches long |
| -78 | 352-0331-00 | | | 2 | HOLDER, lamp |
| -79 | 260-1423-00 | | | 1 | SWITCH, pushbutton--HORIZ MODE |
| -80 | 361-0385-00 | | | 4 | SPACER, pushbutton switch |
| | - - - - - | | | - | mounting hardware: (not included w/circuit board assembly) |
| -81 | 211-0116-00 | | | 1 | SCREW, sems, 4-40 x 0.312 inch, PHB - - - * - - - |
| -82 | 384-1136-00 | | | 3 | SHAFT, extension, 0.95 inch long |
| -83 | 384-1101-00 | | | 4 | SHAFT, extension, 4.13 inches long |
| -84 | - - - - - ¹ | | | 1 | CIRCUIT BOARD ASSEMBLY--VERT OUTPUT A5 |
| | - - - - - | | | - | circuit board assembly includes: |
| -85 | - - - - - | | | 1 | INTEGRATED CIRCUIT |
| -86 | 407-1201-00 | | | 1 | BRACKET, integrated circuit, grounding |
| -87 | 131-0608-00 | | | 3 | TERMINAL, pin |
| -88 | 136-0252-04 | | | 34 | SOCKET, pin connector |
| | - - - - - | | | - | mounting hardware: (not included w/circuit board assembly) |
| -89 | 211-0116-00 | | | 2 | SCREW, sems, 4-40 x 0.312 inch, PHB |
| -90 | 220-0456-00 | | | 1 | NUT, hex., 6-32 x 0.25 inch |
| -91 | 210-1092-00 | | | 1 | WASHER, flat, 0.147 ID x 0.312 inch OD |
| -92 | 361-0008-00 | | | 3 | SPACER, plastic |

¹Refer to Electrical Parts List for part number.



475 OSCILLOSCOPE



LEFT SIDE & BOTTOM

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. | | Q † y | Description |
|------------------|--------------------------|------------------|---------|-------------|--|
| | | Eff | Disc | | |
| 4- | 672-0045-00 | | | 1 | CIRCUIT BOARD ASSEMBLY--ATTENUATOR |
| -1 | - - - - - | -1 | | 2 | circuit board assembly includes: CIRCUIT BOARD ASSEMBLY--CH-1 & CH-2 ATTEN A1 & A2 |
| -2 | 200-1439-00 | | | 1 | each circuit board assembly includes: COVER, chassis, attenuator |
| -3 | 213-0055-00 | | | 1 | mounting hardware: (not included w/cover) |
| -4 | 210-0845-00 | | | 1 | SCREW, thread forming, 2-32 x 0.188 inch, PHS |
| -5 | 211-0008-00 | | | 4 | WASHER, flat, 0.109 ID x 0.25 inch OD |
| -6 | 210-0994-00 | | | 4 | SCREW, 4-40 x 0.25 inch, PHS |
| | | | | | WASHER, flat, 0.125 ID x 0.25 inch OD |
| | | | | | - - - * - - - |
| -7 | 441-1058-00 | | | 1 | CHASSIS, attenuator |
| -8 | 211-0001-00 | | | 2 | mounting hardware: (not included w/chassis) |
| -9 | 210-0053-00 | | | 2 | SCREW, 2-56 x 0.25 inch, PHS |
| | | | | | WASHER, lock, split, 0.092 ID x 0.175 |
| | | | | | inch OD |
| -10 | 210-0938-00 | | | 2 | WASHER, flat, 0.109 ID x 0.25 inch OD |
| -11 | 210-0405-00 | | | 2 | NUT, hex., 2-56 x 0.188 inch |
| -12 | 129-0299-00 | | | 4 | POST, hex., 0.333 inch long |
| -13 | 210-0004-00 | | | 4 | WASHER, lock, internal, 0.12 ID x 0.26 |
| | | | | | inch OD |
| | | | | | - - - * - - - |
| -14 | 131-0679-00 | | | 1 | CONNECTOR, electrical, BNC, w/hardware |
| -15 | 220-0569-00 | | | 1 | NUT, knurled, 0.50-28 x 0.235 inch |
| -16 | 361-0424-00 | | | 1 | SPACER, ring |
| | | | | | - - - * - - - |
| -17 | 105-0243-00 | B010100 | B029999 | 1 | LEVER, switch--AC DC |
| | 105-0243-01 | B030000 | | 1 | LEVER, switch--AC DC |
| | | | | | mounting hardware: (not included w/lever) |
| -18 | 213-0214-00 | | | 1 | SCREW, 2-56 x 0.375 inch, CAP SOC |
| | | | | | - - - * - - - |
| | 131-1314-00 | XB030000 | | 1 | CONTACT, electrical, grounding (not shown) |
| -19 | 131-0963-00 | | | 2 | CONTACT, electrical, grounding |
| -20 | 354-0391-00 | | | 2 | RING, retaining |
| -21 | 210-0406-00 | | | 10 | NUT, hex., 4-40 x 0.188 inch |
| -22 | 401-0081-02 | | | 1 | BEARING, cam switch, front |
| | | | | | mounting hardware: (not included w/bearing) |
| -23 | 211-0097-00 | | | 2 | SCREW, 4-40 x 0.312 inch, PHS |
| -24 | 210-0004-00 | | | 2 | WASHER, lock, internal, 0.12 ID x 0.26 inch OD |
| | | | | | - - - * - - - |
| -25 | 214-1127-00 | | | 4 | ROLLER, detent |
| -26 | 214-1139-00 ² | | | - | SPRING, flat, gold |
| | 214-1139-02 ² | | | - | SPRING, flat, green |
| | 214-1139-03 ² | | | - | SPRING, flat, red |
| -27 | 105-0282-00 | | | 1 | DRUM, cam switch |
| -28 | 401-0115-00 | | | 1 | BEARING, cam switch, center |
| -29 | 105-0343-00 | | | 1 | ACTUATOR, cam switch |
| -30 | 401-0081-00 | | | 1 | BEARING, cam switch, front |
| -31 | 136-0252-01 | | | 36 | SOCKET, pin connector, 0.178 inch long |

¹Refer to Electrical Parts List for part number.

²Replace only with part bearing the same color code as the original part in your instrument.

LEFT SIDE & BOTTOM (cont)

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. Eff | No. Disc | Q | | | | | Description | |
|------------------------|-----------------------|-------------------------|-------------|----|---|---|---|---|-------------|---|
| | | | | t | y | 1 | 2 | 3 | | 4 |
| 4- | 136-0333-00 | | | 2 | | | | | | SOCKET, pin connector |
| -32 | 337-1406-00 | | | 1 | | | | | | SHIELD, electrical, cam switch |
| -33 | 131-1030-00 | | | 10 | | | | | | CONTACT ASSEMBLY, cam switch, bottom |
| | 131-1031-00 | | | 10 | | | | | | CONTACT ASSEMBLY, cam switch, top |
| | - - - - - | | | - | | | | | | mounting hardware for each: (not included |
| | - - - - - | | | - | | | | | | w/circuit board assembly) |
| -34 | 211-0116-00 | | | 6 | | | | | | SCREW, sems, 4-40 x 0.312 inch, PHB |
| | - - - - - | | | - | | | | | | * - - - - |
| -35 | - - - - - | 1 | | 1 | | | | | | CIRCUIT BOARD ASSEMBLY--GAIN SWITCH A4 |
| | - - - - - | | | - | | | | | | circuit board assembly includes: |
| -36 | 131-0608-00 | | | 29 | | | | | | TERMINAL, pin, 0.365 inch long |
| -37 | 131-0589-00 | | | 6 | | | | | | TERMINAL, pin, 0.46 inch long |
| -38 | 260-1424-00 | | | 1 | | | | | | SWITCH, pushbutton--VERT MODE |
| -39 | 361-0411-00 | | | 4 | | | | | | SPACER, pushbutton switch |
| -40 | 352-0331-00 | | | 2 | | | | | | HOLDER, lamp |
| -41 | 131-1031-00 | | | 10 | | | | | | CONTACT ASSEMBLY, cam switch, top |
| -42 | 136-0252-04 | | | 12 | | | | | | SOCKET, pin connector |
| -43 | - - - - - | | | 2 | | | | | | RESISTOR, variable |
| -44 | 361-0515-00 | | | 2 | | | | | | SPACER, switch, plastic |
| | - - - - - | | | - | | | | | | mounting hardware: (not included w/circuit |
| | - - - - - | | | - | | | | | | board assembly) |
| -45 | 213-0277-00 | | | 6 | | | | | | SCREW, thread forming, 2-56 x 0.312 inch, PHS |
| -46 | 210-0053-00 | | | 6 | | | | | | WASHER, lock, split, 0.092 ID x 0.175 inch OD |
| -47 | 210-1134-00 | | | 6 | | | | | | WASHER, flat, 0.09 ID x 0.25 inch OD |
| | - - - - - | | | - | | | | | | * - - - - |
| -48 | 376-0051-00 | | | 2 | | | | | | COUPLING, flexible |
| | - - - - - | | | - | | | | | | each coupling includes: |
| | 213-0022-00 | | | 4 | | | | | | SETSCREW, 4-40 x 0.188 inch, HSS |
| -49 | 337-1418-01 | | | 2 | | | | | | SHIELD, electrical |
| -50 | 384-1178-00 | | | 2 | | | | | | SHAFT, extension, 6.1 inches long |
| | - - - - - | | | - | | | | | | mounting hardware: (not included w/circuit |
| | - - - - - | | | - | | | | | | board assembly) |
| -51 | 211-0116-00 | | | 2 | | | | | | SCREW, sems, 4-40 x 0.312 inch, PHB |
| | - - - - - | | | - | | | | | | * - - - - |
| -52 | 384-1129-00 | 1 | | 5 | | | | | | SHAFT, extension |
| -53 | - - - - - | | | 1 | | | | | | CIRCUIT BOARD ASSEMBLY--VERTICAL PREAMP A3 |
| | - - - - - | | | - | | | | | | circuit board assembly includes: |
| | 105-0421-00 | | | 1 | | | | | | ACTUATOR ASSEMBLY, slide switch--MOMENTARY |
| | - - - - - | | | 1 | | | | | | actuator assembly includes: |
| -54 | 105-0420-00 | | | 1 | | | | | | ACTUATOR, slide switch |
| -55 | 214-1779-00 | | | 1 | | | | | | SPRING, helical |
| -56 | 351-0359-00 | | | 1 | | | | | | GUIDE, slide switch |

¹Refer to Electrical Parts List for part number.



LEFT SIDE & BOTTOM (cont)

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Q | | | | | Description | |
|------------------|--------------------------|----------------------|------|-----|---|---|---|---|-------------|--|
| | | | | t | y | 1 | 2 | 3 | | 4 |
| 4- | 105-0423-00 | | | 1 | | | | | | ACTUATOR ASSEMBLY, slide switch--BANDWIDTH LIMIT |
| | - - - - - | | | - | | | | | | actuator assembly includes: |
| | 213-0048-00 | | | 1 | | | | | | SETSCREW, 4-40 x 0.125 inch, HSS (not shown) |
| -57 | 376-0146-00 | | | - | | | | | | COUPLER, shaft |
| -58 | 105-0422-00 | | | 1 | | | | | | ACTUATOR, slide switch |
| -59 | 351-0355-00 | | | 1 | | | | | | GUIDE, slide switch |
| -60 | 214-1126-00 ¹ | | | 1 | | | | | | SPRING, flat, gold |
| | 214-1126-01 ¹ | | | 1 | | | | | | SPRING, flat, green |
| | 214-1126-02 ¹ | | | 1 | | | | | | SPRING, flat, red |
| -61 | 214-1127-00 | | | 2 | | | | | | ROLLER, detent |
| -62 | 260-1208-00 | | | 1 | | | | | | SWITCH, pushbutton--INVERT |
| -63 | 361-0411-00 | | | 2 | | | | | | SPACER, pushbutton switch |
| -64 | 131-1003-00 | | | 8 | | | | | | RECEPTACLE, coaxial cable |
| -65 | 131-0158-00 | | | 2 | | | | | | TERMINAL, feedthru |
| -66 | 136-0269-00 | | | 3 | | | | | | SOCKET, integrated circuit, 14 pin |
| -67 | 136-0252-04 | | | 139 | | | | | | SOCKET, pin connector, 0.178 inch long |
| -68 | 214-0579-00 | | | 2 | | | | | | TERMINAL, test point |
| -69 | 131-0608-00 | | | 1 | | | | | | TERMINAL, pin, 0.365 inch long |
| -70 | 131-1031-00 | | | 7 | | | | | | CONTACT ASSEMBLY, cam switch, top |
| -71 | 131-1030-00 | | | 6 | | | | | | CONTACT ASSEMBLY, cam switch, bottom |
| -72 | 210-0779-00 | | | 7 | | | | | | RIVET, tublar, 0.115 inch long |
| -73 | 214-1799-00 | | | 1 | | | | | | HEATSINK, transistor |
| -74 | 214-1813-00 | | | 2 | | | | | | HEATSINK, transistor |
| -75 | - - - - - ² | | | 2 | | | | | | RESISTOR, variable |
| | - - - - - | | | - | | | | | | mounting hardware: (not included w/circuit board assembly) |
| -76 | 211-0116-00 | | | 4 | | | | | | SCREW, sems, 4-40 x 0.312 inch, PHB |
| -77 | 211-0008-00 | | | 1 | | | | | | SCREW, 4-40 x 0.25 inch, PHS |
| -78 | 210-0054-00 | | | 1 | | | | | | WASHER, lock, split, 0.118 ID x 0.212 inch OD |
| -79 | 210-0994-00 | | | 1 | | | | | | WASHER, flat, 0.125 ID x 0.25 inch OD |
| -80 | 214-0276-00 | | | 1 | | | | | | SPRING, ground |
| -81 | 129-0413-00 | | | 1 | | | | | | POST, metallic, stud, hex., 0.62 inch long |
| -82 | 129-0385-00 | | | 2 | | | | | | POST, metallic, hex., 1.77 inches long |
| | - - - * - - - | | | - | | | | | | |
| | 337-1810-00 | | | 1 | | | | | | SHIELD, electrical, vertical preamp (not shown) |
| | - - - - - | | | - | | | | | | mounting hardware: (not included w/shield) |
| | 213-0088-00 | | | 4 | | | | | | SCREW, thread forming, 4-40 x 0.25 inch, PHS |
| | - - - - - | | | - | | | | | | (not shown) |
| -83 | 348-0253-00 | | | 1 | | | | | | GROMMET, plastic, 1.145 inches |
| -84 | 407-1127-00 | | | 1 | | | | | | BRACKET, preamp, rear |
| | - - - - - | | | - | | | | | | mounting hardware: (not included w/bracket) |
| -85 | 210-0586-00 | | | 2 | | | | | | NUT, keps, 4-40 x 0.25 inch |
| | - - - * - - - | | | - | | | | | | |
| -86 | 376-0051-00 | | | 2 | | | | | | COUPLING, flexible |
| | - - - - - | | | - | | | | | | each coupling includes: |
| | 213-0022-00 | | | 4 | | | | | | SETSCREW, 4-40 x 0.188 inch, HSS |
| -87 | 384-1175-00 | | | 2 | | | | | | SHAFT, extension, 5.7 inches long |
| -88 | 384-1100-00 ² | | | 1 | | | | | | SHAFT, pushbutton switch |
| -89 | - - - - - | | | 1 | | | | | | RESISTOR, thick film |
| | - - - - - | | | - | | | | | | mounting hardware: (not included w/resistor) |
| -90 | 211-0507-00 | | | 2 | | | | | | SCREW, 6-32 x 0.312 inch, PHS |
| -91 | 210-0457-00 | | | 2 | | | | | | NUT, keps, 6-32 x 0.312 inch |
| -92 | 210-0202-00 | | | 1 | | | | | | LUG, solder, SE #6 |

¹Replace only with part bearing the same color code as the original part in your instrument.

²Refer to Electrical Parts List for part number.

LEFT SIDE & BOTTOM (cont)

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. Eff Disc | Q | | | | | Description |
|------------------------|------------------------|------------------------------|--------|---|---|---|---|--|
| | | | t y | 1 | 2 | 3 | 4 | |
| 4-93 | 407-1236-00 | | 1 | | | | | BRACKET, resistor |
| | - - - - - | | - | | | | | mounting hardware: (not included w/bracket) |
| | 210-0586-00 | | 2 | | | | | NUT, keps, 4-40 x 0.25 inch (not shown) |
| | | | | | | | | - - - * - - - |
| -94 | 337-1711-00 | | 1 | | | | | SHIELD, electrical, high voltage |
| | - - - - - | | - | | | | | mounting hardware: (not included w/shield) |
| -95 | 211-0008-00 | | 4 | | | | | SCREW, 4-40 x 0.25 inch, PHS |
| | | | | | | | | - - - * - - - |
| -96 | 342-0164-00 | | 1 | | | | | INSULATOR, film, HV, 3.65 x 4.7 inches |
| -97 | 342-0159-00 | | 1 | | | | | INSULATOR, film |
| -98 | 129-0413-00 | | 4 | | | | | POST, hex., 0.62 inch long |
| | - - - - - | | - | | | | | mounting hardware for each: (not included |
| | - - - - - | | - | | | | | w/post) |
| -99 | 210-0994-00 | | 1 | | | | | WASHER, flat, 0.125 ID x 0.25 inch OD |
| | | | | | | | | - - - * - - - |
| -100 | - - - - - ¹ | | 1 | | | | | TRANSISTOR |
| | - - - - - | | - | | | | | mounting hardware: (not included w/transistor) |
| -101 | 211-0062-00 | | 1 | | | | | SCREW, 2-56 x 0.312 inch, PHS |
| -102 | 210-1156-00 | | 1 | | | | | WASHER, shouldered, plastic, 0.091 ID x 0.121 |
| | - - - - - | | - | | | | | inch OD |
| -103 | 342-0166-00 | | 1 | | | | | INSULATOR, transistor |
| -104 | 214-1845-00 | | 1 | | | | | HEATSINK |
| | | | | | | | | - - - * - - - |
| -105 | - - - - - ¹ | | 1 | | | | | TRANSISTOR |
| | - - - - - | | - | | | | | mounting hardware: (not included w/transistor) |
| -106 | 211-0180-00 | | 1 | | | | | SCREW, sems, 2-56 x 0.25 inch, PHB |
| -107 | 210-1156-00 | | 1 | | | | | WASHER, shouldered, plastic, 0.091 ID x 0.121 |
| | - - - - - | | - | | | | | inch OD |
| -108 | 342-0166-00 | | 1 | | | | | INSULATOR, transistor |
| | | | | | | | | - - - * - - - |
| -109 | - - - - - ¹ | | 1 | | | | | CIRCUIT BOARD ASSEMBLY--INTERFACE A9 |
| | - - - - - | | - | | | | | circuit board assembly includes: |
| -110 | 131-1003-00 | | | | | | | RECEPTACLE, coaxial cable |
| -111 | 131-0566-00 | | 12 | | | | | LINK, terminal connecting |
| -112 | 136-0252-04 | | 267 | | | | | SOCKET, pin connector |
| -113 | 200-0945-01 | | 1 | | | | | COVER HALF, transistor, 2-56 thread |
| -114 | 200-0945-00 | | 1 | | | | | COVER HALF, transistor |
| | - - - - - | | - | | | | | mounting hardware: (not included w/cover half) |
| -115 | 211-0062-00 | | 1 | | | | | SCREW, 2-56 x 0.312 inch, PHS |
| | | | | | | | | - - - * - - - |
| -116 | 210-0966-00 | | 2 | | | | | WASHER, insulating, rubber, 0.875 inch ID |
| -117 | 136-0499-12 | | 1 | | | | | SOCKET, circuit board, 12 contact |
| -118 | 136-0499-10 | | 2 | | | | | SOCKET, circuit board, 10 contact |
| -119 | 344-0154-00 | | 2 | | | | | HOLDER, fuse |
| -120 | 214-0579-00 | | 19 | | | | | TERMINAL, test point |
| -121 | 131-0608-00 | | 24 | | | | | TERMINAL, pin, 0.365 inch long |
| -122 | 131-1261-00 | | 24 | | | | | CONTACT, electrical, F-shape |
| -123 | 214-1291-00 | | 1 | | | | | HEATSINK, transistor |

¹Refer to Electrical Parts List for part number.

LEFT SIDE & BOTTOM (cont)

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. | | Q t y | Description |
|------------------------|-----------------------|------------------|----------|-------------|--|
| | | Eff | Disc | | |
| 4-124 | 124-0120-00 | | | 1 | STRIP, ceramic, 4 notch |
| | - - - - - | | | - | strip includes: |
| -125 | 355-0046-00 | | | 2 | STUD, plastic |
| -126 | 124-0092-00 | | | 1 | STRIP, ceramic, 3 notch |
| | - - - - - | | | - | strip includes: |
| | 355-0046-00 | | | 1 | STUD, plastic |
| -127 | 124-0118-00 | | | 3 | STRIP, ceramic, 3 notch |
| | - - - - - | | | - | each strip includes: |
| | 355-0046-00 | | | 1 | STUD, plastic |
| -128 | 358-0214-00 | 1 | | 12 | BUSHING |
| -129 | - - - - - | - | | 1 | RESISTOR, variable |
| | - - - - - | | | - | mounting hardware: (not included w/resistor) |
| -130 | 210-0583-00 | | | 1 | NUT, hex., 0.25-32 x 0.312 inch |
| | 210-0940-00 | | | 1 | WASHER, flat, 0.25 ID x 0.375 inch OD (not shown) |
| | - - - - - | | | - | |
| -131 | 210-0046-00 | | | 1 | WASHER, lock, 0.261 ID x 0.40 inch OD |
| | - - - - - | | | - | * - - - - |
| -132 | 386-2433-00 | 1 | | 1 | SUPPORT, resistor |
| -133 | - - - - - | - | | 1 | MULTIPLIER |
| | - - - - - | | | - | mounting hardware: (not included w/multiplier) |
| -134 | 220-0661-00 | | | 2 | NUT, self-locking, hex., 8-32 x 0.344 inch |
| | - - - - - | | | - | * - - - - |
| -135 | 260-1209-00 | | | 1 | SWITCH, push--X10 MAG |
| -136 | 361-0384-00 | | | 2 | SPACER, pushbutton switch, 0.133 inch long |
| -137 | 260-1310-01 | | | 1 | SWITCH, push--BEAM FINDER |
| -138 | 361-0385-00 | | | 2 | SPACER, pushbutton switch, 0.164 inch long |
| -139 | - - - - - | 1 | | 4 | RESISTOR, variable |
| | - - - - - | | | - | mounting hardware: (not included w/circuit board assembly) |
| | - - - - - | | | - | |
| -140 | 211-0116-00 | | | 7 | SCREW, sems, 4-40 x 0.312 inch, PHB |
| | 210-0261-00 | | XB030000 | 1 | LUG, solder (not shown) |
| | - - - - - | | | - | * - - - - |
| -141 | 343-0088-00 | | | 1 | CLAMP, retaining |
| -142 | 384-1101-00 | | | 2 | SHAFT, extension, 4.14 inches long |
| -143 | 384-1175-00 | | | 1 | SHAFT, extension, 5.7 inches long |
| -144 | 376-0029-00 | | | 2 | COUPLING, shaft, rigid |
| | - - - - - | | | - | each coupling includes: |
| | 213-0022-00 | | | 2 | SETSCREW, 4-40 x 0.188 inch, HSS |
| -145 | 384-1179-00 | | | 1 | SHAFT, extension, 9.312 inches long |
| -146 | 384-1176-00 | | | 1 | SHAFT, extension, 1.45 inches long |
| -147 | 384-1172-00 | | | 1 | SHAFT, extension, 1.7 inches long |
| -148 | 384-1171-00 | | | 1 | SHAFT, extension, 1.05 inches long |
| -149 | 376-0051-00 | | | 3 | COUPLING, flexible |
| | - - - - - | | | - | each coupling includes: |
| | 213-0022-00 | | | 4 | SETSCREW, 4-40 x 0.188 inch, HSS |
| -150 | 179-1934-00 | | | 1 | WIRING HARNESS, trigger |
| | - - - - - | | | - | wiring harness includes: |
| -151 | 210-0774-00 | | | 5 | EYELET, metallic, 0.152 inch OD |
| -152 | 210-0775-00 | | | 5 | EYELET, metallic, 0.126 inch OD |

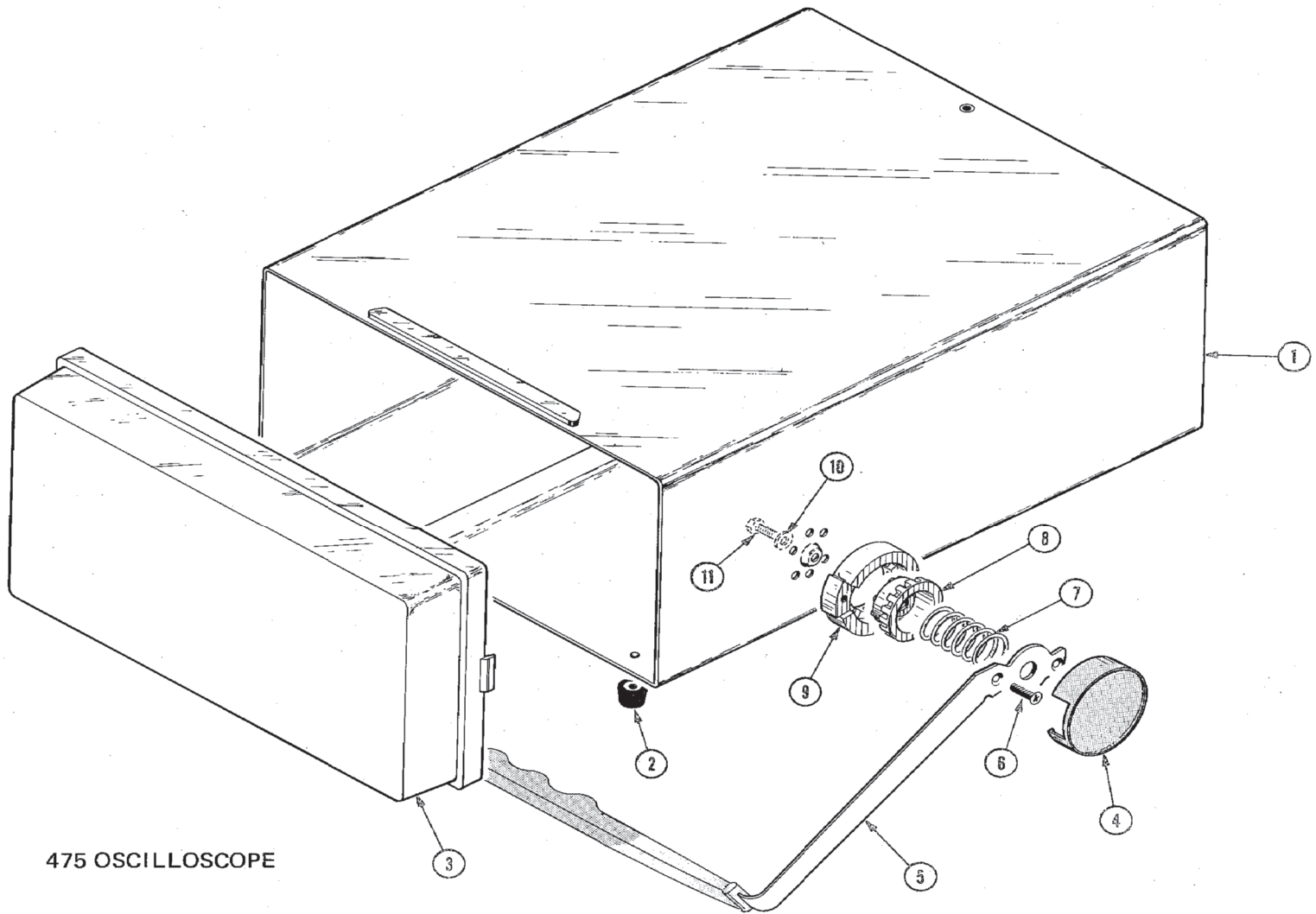
¹ Refer to Electrical Parts List for part number.

LEFT SIDE & BOTTOM (cont)

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. Eff | No. Disc | Q | | | | | Description | |
|------------------------|-----------------------|-------------------------|-------------|----|---|---|---|---|-------------|------------------------------------|
| | | | | t | y | 1 | 2 | 3 | | 4 |
| 4- | 179-1907-00 | | | 1 | | | | | | WIRING HARNESS, main |
| | - - - - - | | | - | | | | | | wiring harness includes: |
| -153 | 131-0707-00 | | | 2 | | | | | | CONNECTOR, terminal |
| -154 | 352-0171-00 | | | 2 | | | | | | HOLDER, terminal connector, 1 wire |
| | 210-0774-00 | | | 10 | | | | | | EYELET, metallic, 0.152 inch OD |
| | 210-0775-00 | | | 10 | | | | | | EYELET, metallic, 0.126 inch OD |
| | 179-1906-00 | | | 1 | | | | | | WIRING HARNESS, probe power |
| | - - - - - | | | - | | | | | | wiring harness includes: |
| | 131-0707-00 | | | 8 | | | | | | CONNECTOR, terminal |
| -155 | 352-0169-00 | | | 4 | | | | | | HOLDER, terminal connector, 2 wire |

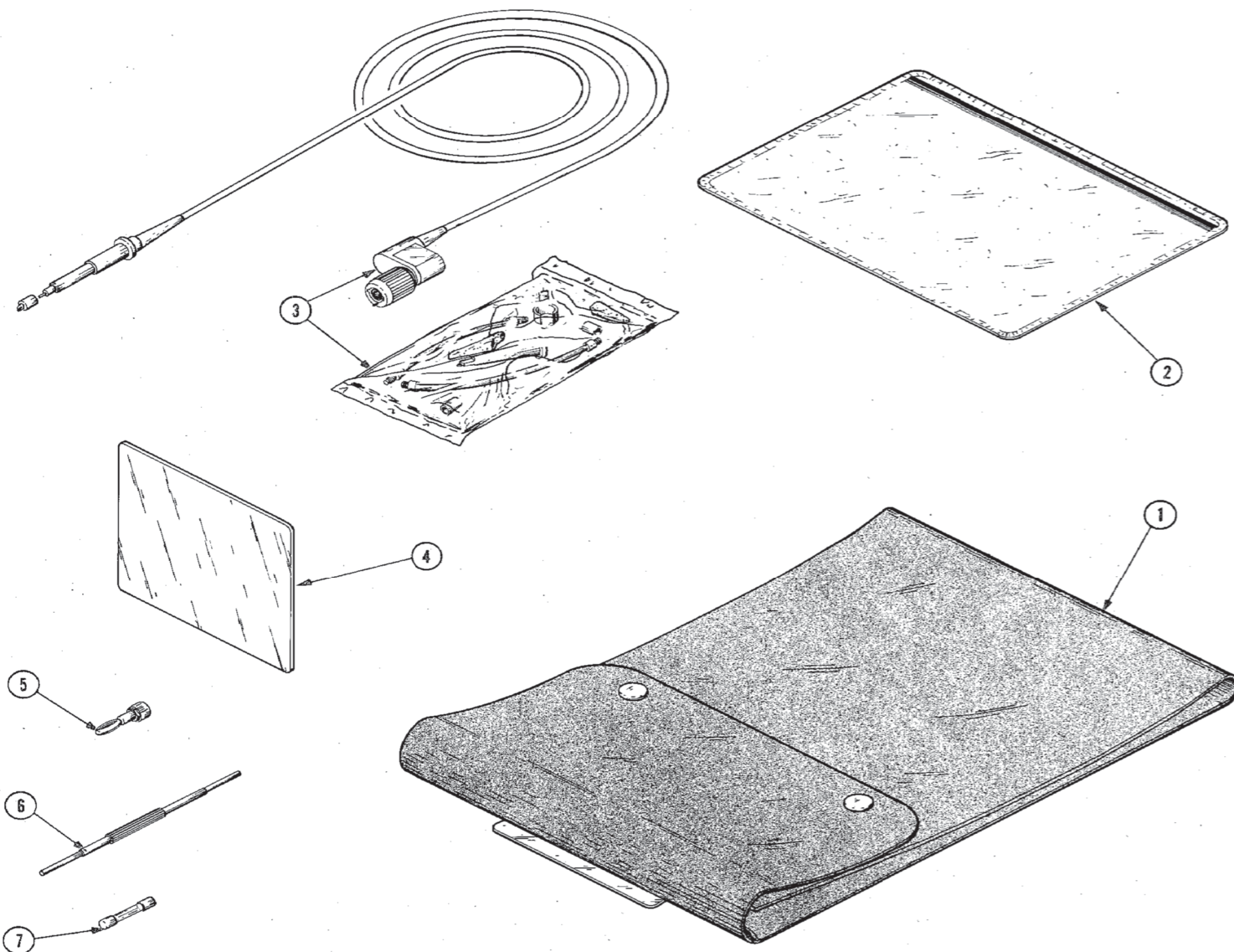
CABINET

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. | | Q t y | Description |
|------------------------|-----------------------|------------------|------|-------------|--|
| | | Eff | Disc | | |
| 5-1 | 437-0141-01 | | | 1 | CABINET, oscilloscope |
| | - - - - - | | | - | cabinet includes: |
| -2 | 348-0080-01 | | | 4 | FOOT, cabinet |
| -3 | 200-1412-00 | | | 1 | COVER, front |
| -4 | 200-0602-00 | | | 2 | COVER, handle, latch |
| -5 | 367-0140-03 | | | 1 | HANDLE, carrying |
| | - - - - - | | | - | mounting hardware: (not included w/handle) |
| -6 | 211-0512-00 | | | 4 | SCREW, 6-32 x 0.50 inch, 100 deg. csk, FHS |
| | | | | | - - - * - - - |
| | 334-1999-00 | | | 1 | PLATE, identification (not shown) |
| -7 | 214-0516-00 | | | 2 | SPRING, handle index |
| -8 | 214-0513-00 | | | 2 | INDEX, handle ring |
| -9 | 214-0515-00 | | | 2 | INDEX, handle hub |
| | - - - - - | | | - | mounting hardware for each: (not included |
| | - - - - - | | | - | w/index) |
| -10 | 213-0182-00 | | | 1 | SCREW, 0.25-20 x 0.75 inch, Cap HS |
| -11 | 210-0805-00 | | | 1 | WASHER, flat, 0.204 ID x 0.438 inch OD |



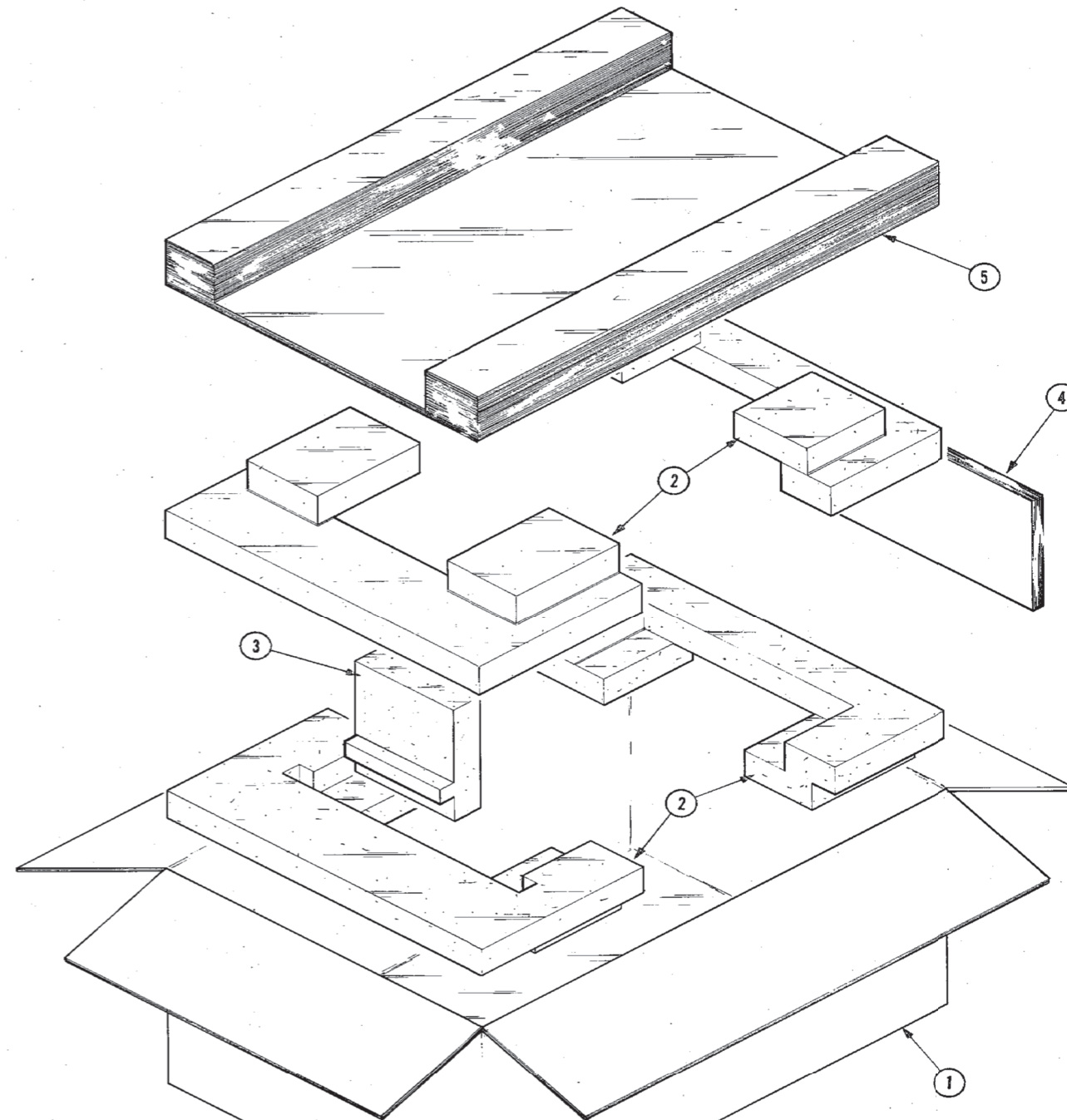
475 OSCILLOSCOPE

ACCESSORIES



| Fig. & Index No. | Tektronix Part No. | Serial/Model No. Eff | Serial/Model No. Disc | Qty | | | | | | Description |
|------------------|--------------------|----------------------|-----------------------|-----|---|---|---|---|---|---------------------------------|
| | | | | | 1 | 2 | 3 | 4 | 5 | |
| 6-1 | 016-0535-02 | | | 1 | | | | | | POUCH, accessory, w/hardware |
| -2 | 016-0537-00 | | | 1 | | | | | | POUCH, accessory, w/zipper |
| -3 | 010-6075-03 | | | 2 | | | | | | PROBE PACKAGE |
| -4 | 337-1674-01 | | | 1 | | | | | | SHIELD, implosion, clear |
| -5 | 134-0016-01 | | | 1 | | | | | | PLUG, tip, w/binding post |
| -6 | 003-0301-00 | | | 1 | | | | | | TOOL, alignment |
| -7 | 159-0016-00 | | | 2 | | | | | | FUSE, 1.5 A, fast-blo |
| | 159-0042-00 | | | 1 | | | | | | FUSE, 0.75 A, fast-blo |
| | 070-1332-00 | | | 1 | | | | | | MANUAL, instruction (not shown) |
| | 070-1333-00 | | | 1 | | | | | | MANUAL, operators (not shown) |

REPACKAGING



| Fig. & Index No. | Tektronix Part No. | Serial/Model No. Eff | Serial/Model No. Disc | Qty | | | | | | Description |
|------------------|--------------------|----------------------|-----------------------|-----|---|---|---|---|---|---------------------------|
| | | | | | 1 | 2 | 3 | 4 | 5 | |
| 7- | 065-0185-00 | | | 1 | | | | | | CARTON ASSEMBLY |
| | ----- | | | - | | | | | | carton assembly includes: |
| -1 | 004-0850-00 | | | 1 | | | | | | BOX |
| -2 | 004-1208-00 | | | 2 | | | | | | FRAME |
| -3 | 004-1209-00 | | | 1 | | | | | | FRAME, front pad |
| -4 | 004-1149-00 | | | 1 | | | | | | PAD |
| -5 | 004-1158-00 | | | 1 | | | | | | PAD |

MANUAL CHANGE INFORMATION

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

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

A single change may affect several sections. Sections of the manual are often printed at different times, so some of the information on the change pages may already be in your manual. Since the change information sheets are carried in the manual until ALL changes are permanently entered, some duplication may occur. If no such change pages appear in this section, your manual is correct as printed.

Includes corrections and changes with starting S/N as follows:

B020000 M19,949
 B030000 M20,017
 B040000 M19,283 M19,915
 B050000 M20,104 M19,994
 B060000 M19,883 M20,310 M19,855 M19,935 M20,205
 B070000 M19,947

ELECTRICAL PARTS LIST CORRECTIONS

(Changed portions are underlined, ADD's are all new)

| ACTION | CKT NO. | PART NUMBER | S/N | DESCRIPTION |
|--------|----------------------------------|----------------------------|----------|--|
| Chg | A4 | 670-2243-00 | ALL | <u>VERT MODE</u> -GAIN SW. Ckt. Brd. Assy. |
| Chg | A9 | 670-2239-00 | ALL | <u>INTERFACE</u> Ckt. Brd. Assy. |
| Chg | C420 | 281- <u>0547</u> -00 | B060000 | <u>2.7</u> pF, Cer, 500 V |
| Chg | C494 <u>A</u> | 283-0198-00 | B050000 | 0.22 μ F, Cer, 50 V, 20% |
| Add | C494 <u>B</u> | 283-0341-00 | B050000 | 0.047 μ F (added when required) |
| Chg | C515 | 281- <u>0605</u> -00 | B060000 | <u>200</u> pF, Cer, <u>500</u> V |
| Remove | C517 | 281- <u>0579</u> -00 | B059999X | 21 pF, Cer, 500 V, 5% |
| Remove | C708 | 281- <u>0579</u> -00 | B059999X | 21 pF, Cer, 500 V, 5% |
| Chg | C735 | 281- <u>0605</u> -00 | B060000 | <u>200</u> pF, Cer, <u>500</u> V |
| Chg | C913 | 290- <u>0523</u> -00 | B060000 | <u>2.2</u> μ F, Elect., 20 V, 20% |
| Add | CR910 | 152-0141-02 | B060000 | Silicon, 1N4152 |
| Remove | L552 | 276-0528-00 | B059999X | Core, ferramic suppressor |
| Remove | L562 | 276-0528-00 | B059999X | Core, ferramic suppressor |
| Add | L669 | 276-0507-00 | B030000 | Core, ferramic suppressor |
| Remove | L794 | 276-0507-00 | B059999X | Core, ferramic suppressor |
| Chg | Q552 | 151- <u>0434</u> -00 | B060000 | Silicon, PNP, <u>2N4261</u> |
| Chg | Q562 | 151- <u>0434</u> -00 | B060000 | Silicon, PNP, <u>2N4261</u> |
| Chg | Q772 | 151- <u>0434</u> -00 | B060000 | Silicon, PNP, <u>2N4261</u> |
| Chg | Q782 | 151- <u>0434</u> -00 | B060000 | Silicon, PNP, <u>2N4261</u> |
| Chg | R32, R34, R35, R36, R447, & R454 | are <u>selected</u> parts, | | nominal installed value is listed. |

| ACTION | CKT NO. | PART NUMBER | S/N | DESCRIPTION |
|--------|---------|-------------|---------|---|
| Chg | R494A | 317-0621-00 | B050000 | 620 Ω , 1/8 W, 5% |
| Add | R494B | 311-0633-00 | B050000 | 5 k Ω , Var, (added when required) |
| Add | R550 | 317-0560-00 | B060000 | 56 Ω , 1/8 W, 5% |
| Add | R560 | 317-0560-00 | B060000 | 56 Ω , 1/8 W, 5% |
| Add | R584 | 316-0220-00 | B060000 | 22 Ω , 1/4 W, 10% |
| Add | R792 | 316-0220-00 | B060000 | 22 Ω , 1/4 W, 10% |
| Chg | R806 | 315-0681-00 | B060000 | <u>680</u> Ω , <u>1/4</u> W, <u>5%</u> |
| Add | R824 | 316-0220-00 | B060000 | 22 Ω , 1/4 W, 10% |
| Add | R910 | 321-0220-00 | B060000 | 1.91 k Ω , 1/8 W, 1% |
| Chg | R911 | 321-0314-00 | B060000 | <u>18.2</u> k Ω , 1/8 W, 1% |
| Chg | R912 | 321-0261-00 | B060000 | <u>5.11</u> k Ω , 1/8 W, 1% |
| Chg | R952 | 321-0198-00 | B060000 | <u>1.13</u> k Ω , 1/8 W, 1% |
| Add | R1103 | 315-0272-00 | B060000 | 2.7 k Ω , 1/4 W, 5% |
| Chg | T1400 | 120-0799-01 | B070000 | LV Power |

SCHEMATIC DIAGRAM and BOARD PHOTO CHANGES

Schematic

1

R125 was a variable resistor in early production. Second board outline down from top of page should be titled: PARTIAL A4 VERTICAL MODE-GAIN SWITCH BOARD.

Output at right of T178 should read:

CH 1 + VERT SIGNAL 3 to Pin 11 U370 3.

Output at right of R189 should read:

CH 1 - VERT SIGNAL To Pin 10 U370 3.

Refer to accompanying partial schematic for other changes.

Fig. 7-7 Title for board in photo and grid location chart should read:

A4 Vertical Mode-Gain Switch Circuit Board.

C1/373

Schematic Diagram and Board Photo Changes

Fig. 7-8 C213, R213 and C219 are moved to the back of the board in later production. R293, R294, R296 and R298 are located on back of board.

Schematic 2

R225 was a variable resistor in early production. Second board outline down from top of page should be titled: PARTIAL A4 VERTICAL MODE-GAIN SWITCH BOARD

Output at right of T278 should read:

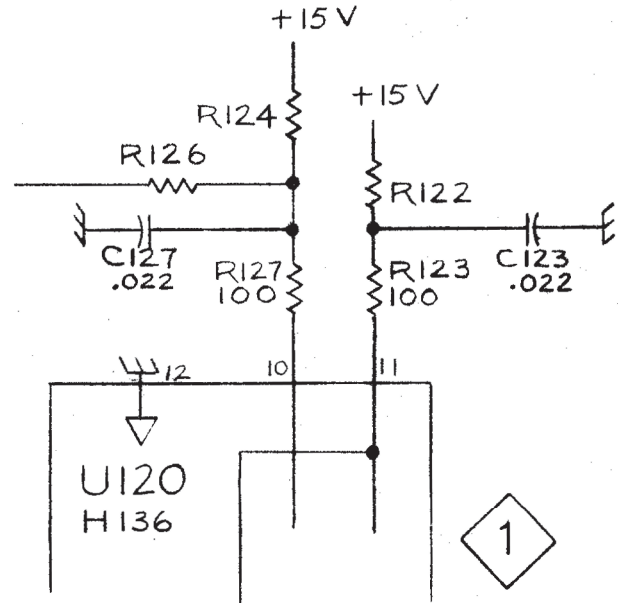
CH 2 + VERT SIGNAL To Pin 3, U370 3.

The line between R293 and R295 should be connected.

Output at right of R289 should read:

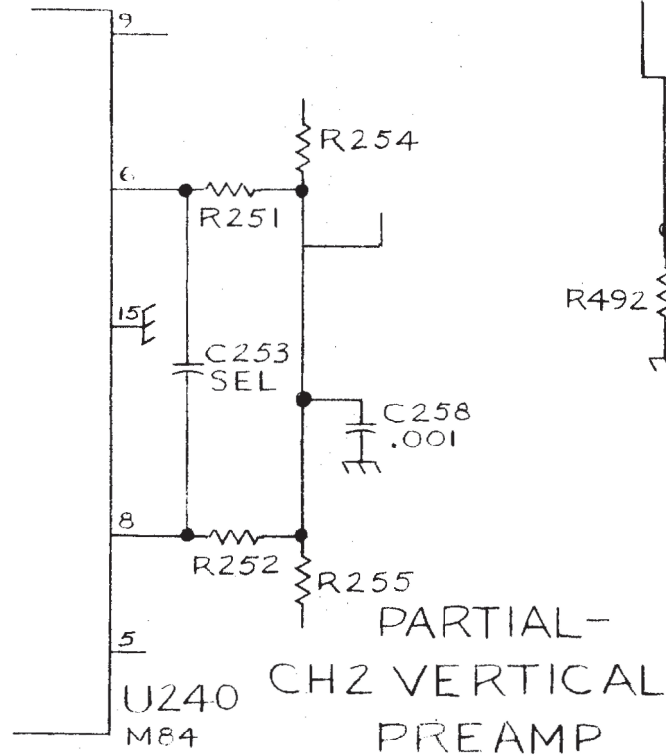
CH 2 - VERT SIGNAL To Pin 2 U370 3.

Refer to accompanying partial schematics for other changes.



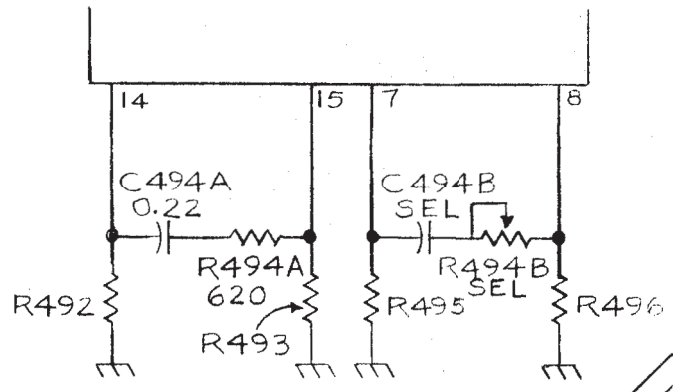
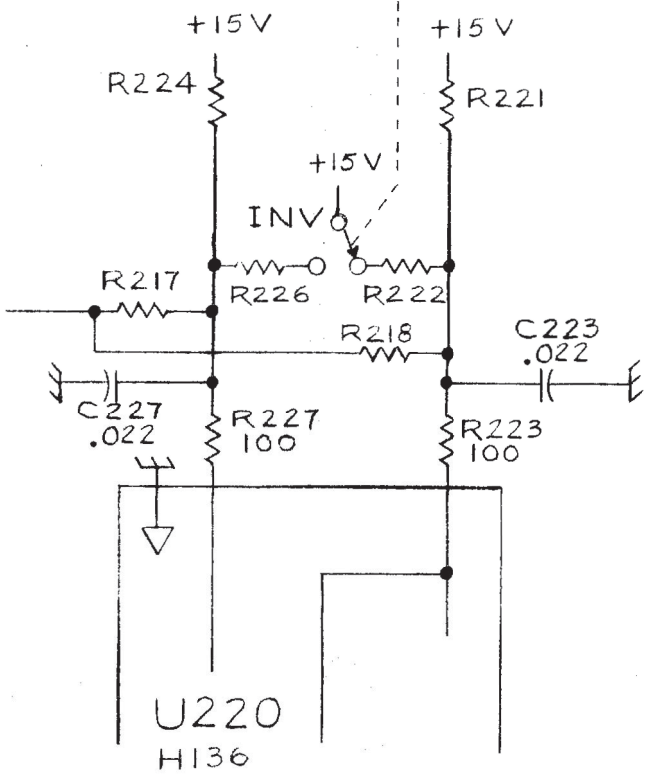
PARTIAL-
CH1 VERTICAL PREAMP

SCHEMATIC CORRECTIONS



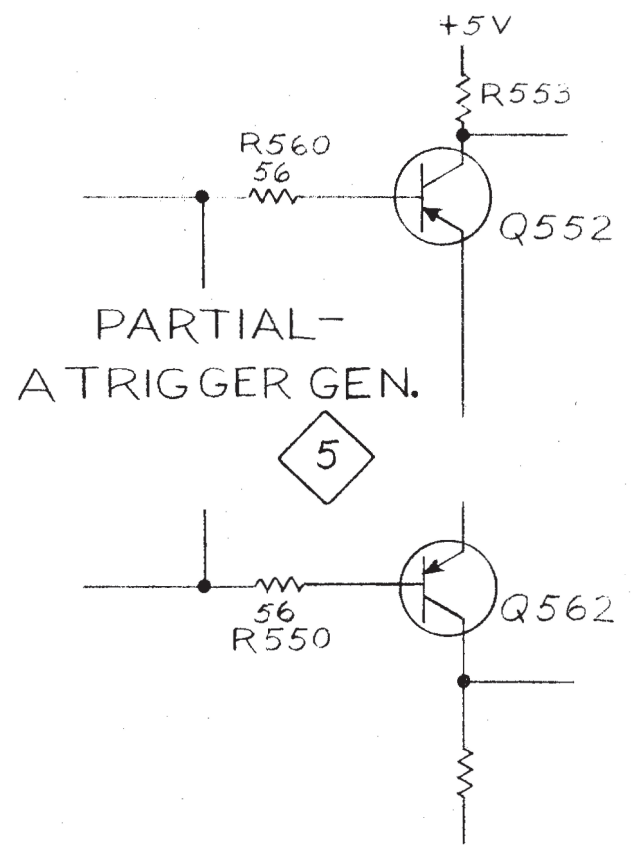
2

INVERT



4

PARTIAL-VERTICAL OUTPUT AMP



5

Schematic Diagram and Board Photo Changes

Fig. 7-9 Board title should read: A4 Vertical Mode-Gain Switch
Circuit Board.

C329 is added to board above P300.

Schematic 3

Board title at left should read PARTIAL A4, VERT MODE-GAIN SW BOARD

P300 Pin 1 (Index) input should read: From CR1102 10

The input to R320 should read: CH 2 SCALE FACTOR From S53 1

The input to R310 should read CH 1 SCALE FACTOR From S13 1

U370 Pin 11 input should read: CH 1 + VERT SIG From Q178 2 1

J410 output should read: CH 2 TRIG SIG TO CR703

C420 value is changed to 2.7 pF

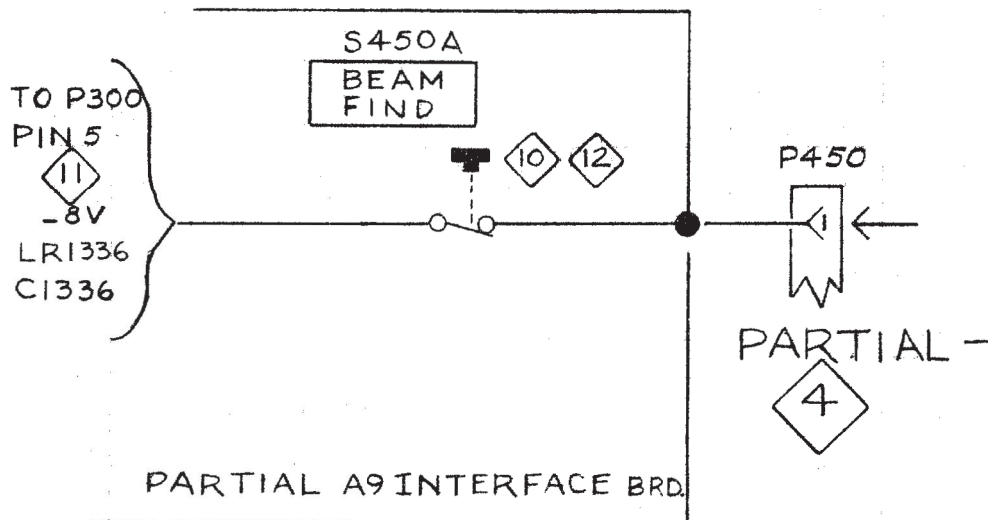
Fig. 7-11

C494A and C494B are added at the right of R492 and R493

Preexisting R494 and C494 are changed to R494B & C494B

Schematic 4

Change the details for S450A and U470 as indicated in the attached partial schematics.



R447 nominal value is 3.01 K.

Schematic Diagram and Board Photo Changes

Fig. 7-12

L562 or R550 location is directly below Q562

L552 or R560 location is directly below Q552

Schematic

5

C517 is removed in later production.

See Electrical Parts List changes for C515, L669 & C669.

L552 is replaced with R560 (56 Ω)

L562 is replaced with R550 (56 Ω)

Output at right of R568 should read: "A" GATE TO BASE OF Q572

7

Schematic

6

C708 is removed in later production

C735 value is changed to 200 pF

Input to Base of Q712 should read:

CH 2 INT TRIG SIG FROM CR703.

R721, C721 and J720 are located outside of the A8 Board outline.

The output for the lead shown connected to the right contact of

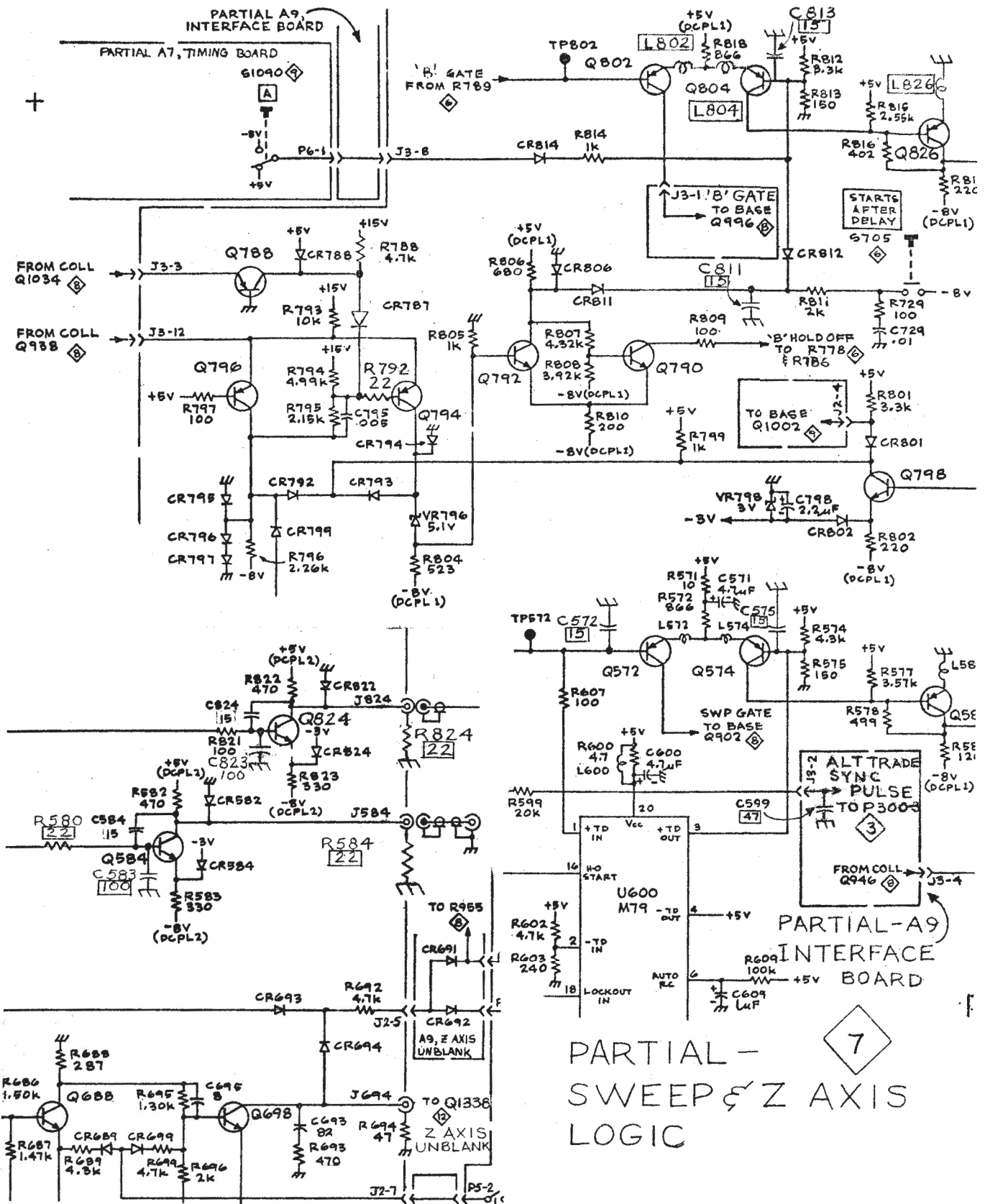
the left section of S705 should read: TO CR814

7

Fig. 7-14 These parts are located as follows for some S/N:

| | |
|--------------------|-----------------------|
| C644 below VR647 | L826 below Q826 |
| C572 left of Q572 | C798 below CR824 |
| C575 right of R574 | C583 below L584 |
| L600 right of R600 | C584 left of L584 |
| C811 below CR811 | R580 in place of L584 |
| L802 left of Q802 | C823 right of Q824 |
| L804 right of Q802 | C824 above Q824 |
| C813 right of R814 | R824 below J824 |
| R792 right of R797 | R584 below J584 |
| L588 left of Q588 | |

SCHEMATIC CORRECTIONS



7
 PARTIAL - SWEEP & Z AXIS LOGIC

Schematic Diagram and Board Photo Changes

Schematic 7

Refer to attached partial 7 schematic.

Fig. 7-15

R910 is added at left of R986 for some S/N.

CR910 is added at right of CR1036 for some S/N.

R911 is moved to left of R917 for some S/N.

Schematic 8

Input to anode of CR910 should read to J3-8 7 & J6-1 9.

Voltage source for R911 should be +50 V.

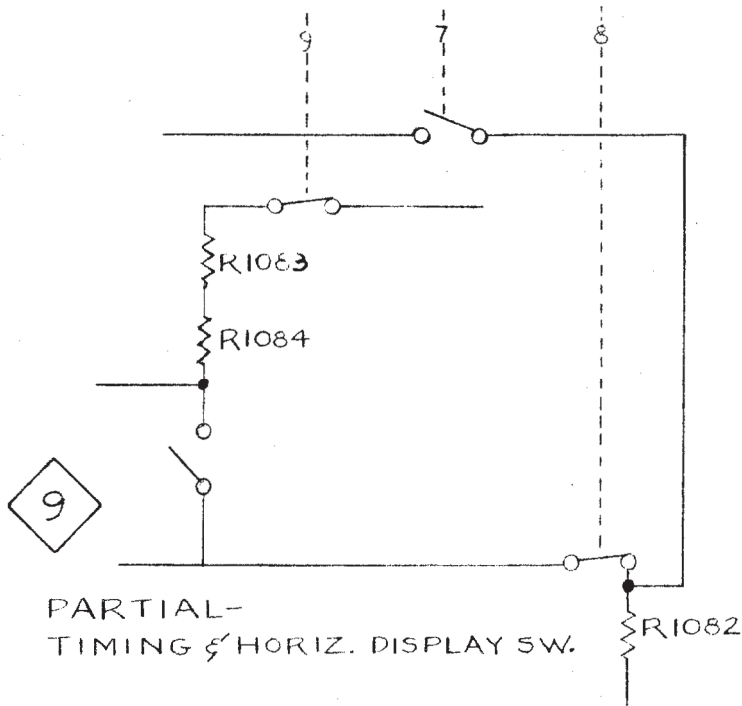
Components at left of J5-10 are located on A7 Timing Board.

Input to J5-3 should read: FROM CR1075 9.

Schematic 9

Connectors P6-5 right to P4-1 should read: FROM 11

For S1050 row 7 and 8 detail, refer to attached partial schematic 9.



SCHEMATIC CORRECTIONS

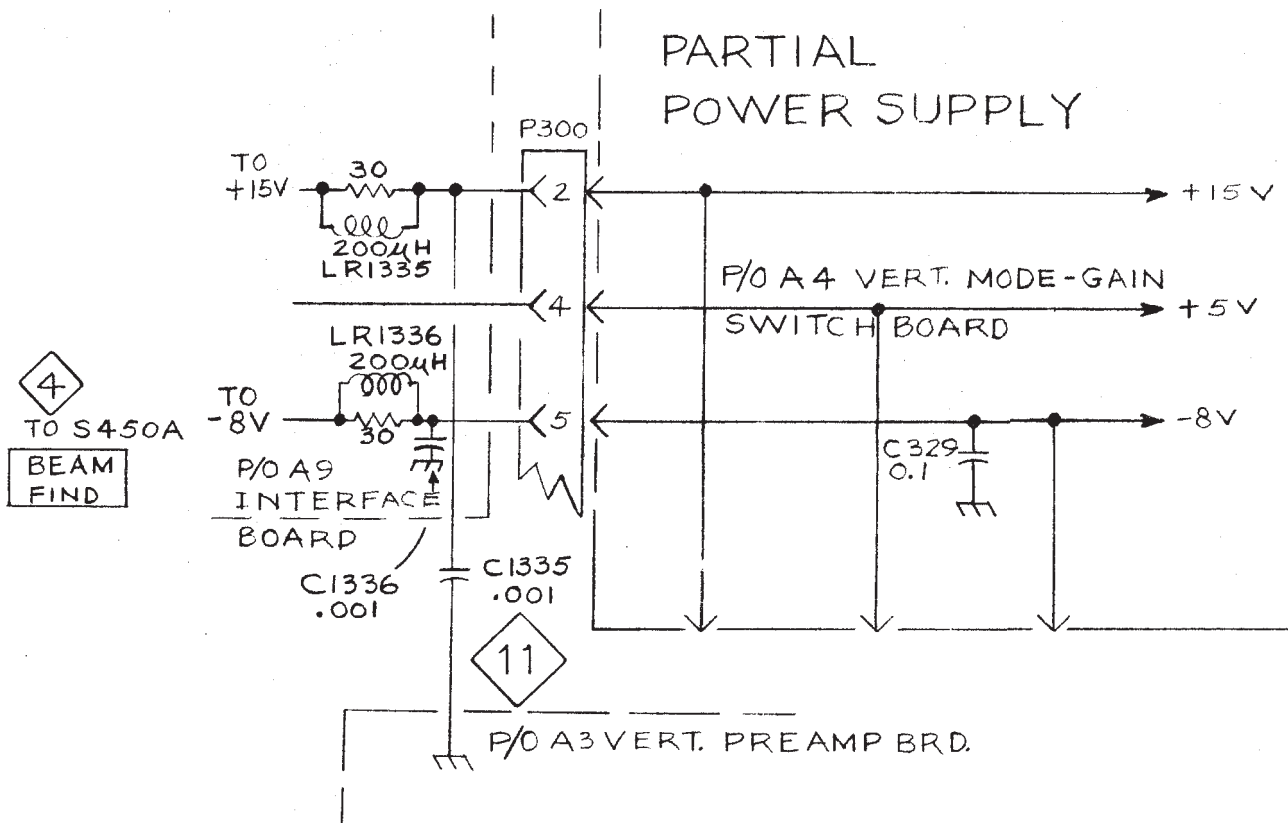
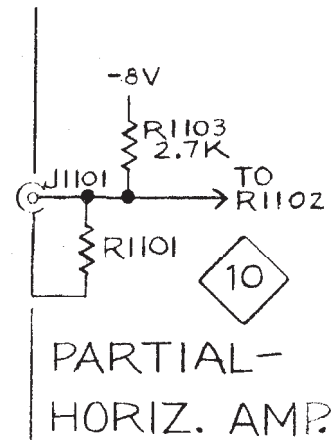
P6-1 output should read:

To CR814 7, R908, R922, CR910, & CR1036 8.

P4-7 output should read to R683, R684 7.

Fig. 7-17

R1103 is added below R1140 for some S/N.



Schematic Diagram and Board Photo Changes

Schematic 10

Refer to attached partial schematic 10 for R1103 details.

Input to Q1114 collector, R1106, and S1110B X10 terminal should read:

SWEEP IN FROM Q956, Q1026 8.

Schematic 11

Refer to attached partial schematic 11 for changes near P300.

Change voltage for Q1482 collectors to +5V (UNREG.)

Fig. 7-19

R1352 is located above C1352 for some S/N.

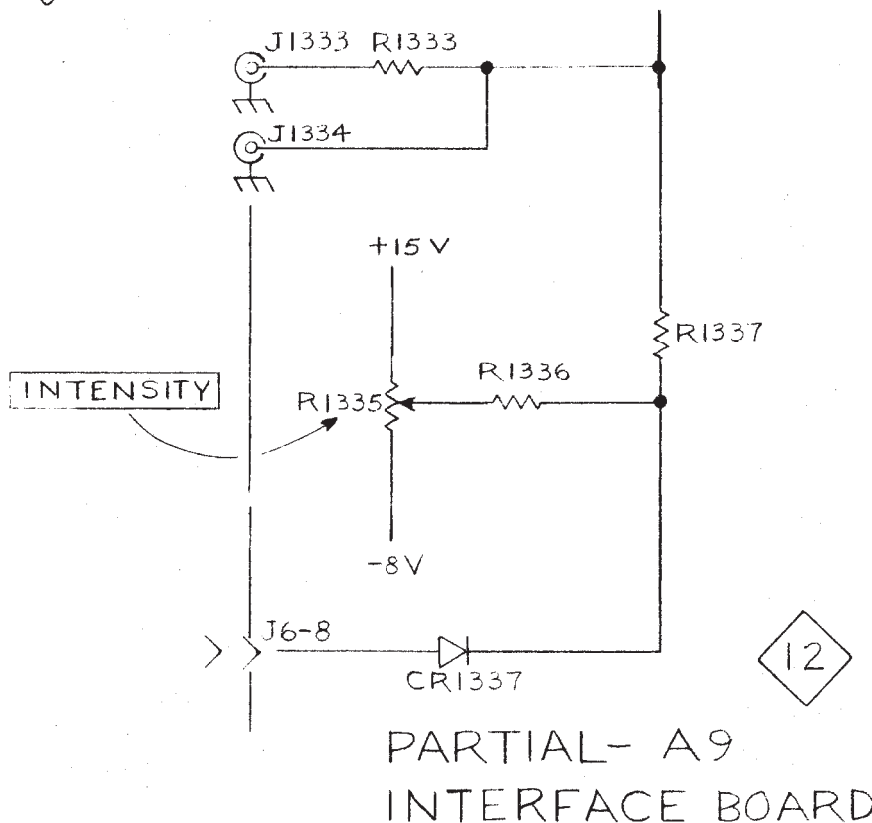
C599 is located below R1335 for some S/N.

C1335, C1336, LR1335, LR1336 are located or connect above and left of R1396 for some S/N.

Schematic 12

Change R1335 INTENSITY control details per the attached partial

12 schematic.



Calibration Procedure
Corrections for all Serial Numbers, and changes
for SN B030000 and up

Page 5-2 Table 5-1

CHANGE: Tolerance of item 3 (DC VOLTMETER) to read: "calibrated to 1% accuracy at -2450 Volts."
Description and Example of item 8 to read: "With charge line, example Tektronix Type 113 Delay Line."
Item 18; quantity of two are required.

Page 5-4 Preliminary Control Settings

CHANGE: Under "Triggering Controls (both A and B if applicable)"
B SOURCE setting should read: STARTS AFTER DELAY

Page 5-7 Step 6a

ADD: pull 20 MHz (20 or 100 MHz for SN B100000-up) BW switch fully out and set A and B TIME/DIV switches to 10 μ s.

Page 5-8 Step 12a & 12b

ADD: at the end of 12a; push 20 MHz (20 or 100 MHz for later SN) BW switch fully in (FULL BW). Set VERT MODE switch to CH-1.
For step 12b, two X10 BNC attenuators in series may be required.

Page 5-14 Step 1a

CHANGE to read:

1a. CHECK +50 V supply, $\pm 0.5\%$. ADJUST R1430 ONLY if supply is outside of this tolerance. (see accompanying note to follow step 1c on page 5-25)

Page 5-15 Step 15

CHANGE to read:

15a. Both VOLTS/DIV to 2 mV,-----

Page 5-16 For Serial Numbers B030000 and up:

REPLACE: Existing steps 17 and 18 with the attached new text for Steps 23 and 24 on pages 5-32 and 5-33.

GENERAL For all SN, in steps such as 23d & 24j on page 5-17, 30d on page 5-35, & 31p on page 5-36, where a Fast-Rise High Amplitude Pulse Generator (type 109) is used, a charge line such as the Tektronix Type 113 Delay Line should be connected to the Chg Line 2 of the 109 to provide adequate pulse width to perform the adjustments.

Page 5-25 Following Step 1c

ADD:

NOTE

If +50 V supply is readjusted the entire calibration procedure will have to be performed.

Page 5-26 Step 3c and 3j

CHANGE to read:

3c. CHECK-CRT display for a well-defined dot.

3j. -----controls to mid-range, and TRIGGER MODE to AUTO.

Page 5-27 Step 7a, Fig. 5-4, and Step 7d

CHANGE to read:

7a. Connect 1.0 ms and 0.1 ms time marks -----

Fig. 5-4: See accompanying photo for correct TP1366 location.

7d. -----for one bright (1.0 ms) marker per division

Page 5-28 Step 9d

CHANGE to read:

9d. Adjust the Test Oscilloscope trigger and Time/Div controls to view the positive step of a 1 volt display of the Z axis signal. Adjust the 475 INTENSITY control to set the 1 Volt level.

Page 5-29 Fig. 5-6 and 5-7 replace with accompanying new photos.

Step 11d

CHANGE a portion to read --- between TP1395 (see new Fig. 5-6)----

Step 12a

CHANGE a portion to read --- of the delay line (see new Fig. 5-7)---

Page 5-30 Fig. 5-8 replace with accompanying new photo.

Page 5-31 Fig. 5-9 replace with accompanying new photo.

Page 5-32 Fig. 5-11 and 5-12 replace with accompanying new photos.

Step 22a add to existing text:

Set CH-2 AC-GND-DC Switch to AC.

For SN Below B030000 in steps 23i and 23j change 100 mV to read 250 mV.

Page 5-32 and 5-33

For SN B030000 and up, replace the existing steps 23 and 24 with the following steps. Refer to the accompanying revised Figures for correct location of adjustments.

Page 5-32

23. Adjust CH 1 and Vertical Output Gain (SN B030000-up)
- a) Set the Vertical Mode Switch to CH 1, the CH 1 VOLTS/DIV switch to 2 mV and the CH 1 AC-GND-DC switch to DC.
 - b) Adjust the STANDARD AMPLITUDE CALIBRATOR for a 10 mV output.
 - c) Connect the STANDARD AMPL. CALIBRATOR to the CH 1 input.

- d) Set the Test Oscilloscope: Vertical Mode to ADD, CH 2 to invert, both Volts/Div switches to 5 mV.
 - e) Connect two X10 probes from the Test Oscilloscope to the preamp side of the delay line.
 - f) Adjust CH 1 2 mV Gain Adjustment, R195 (see new Fig. 5-12) for a 250 mV (Peak-to-Peak) display on the Test Oscilloscope.
 - g) Remove the X10 probes from delay line.
 - h) Adjust Vertical Output Gain Adjustment, R449 (see Fig. 5-13) for 5 divisions of deflection.
 - i) Set the CH 1 VOLTS/DIV to 5 mV and adjust the STANDARD AMPL. CALIBRATOR for a 20 mV output.
 - j) Adjust-CH 1 5 mV Gain Adjustment, R165 (see new Fig. 5-12) for 4 divisions of deflection.
 - k) CHECK-Accuracy of the CH 1 Volts/Div switch using the settings given in Table 5-6. The deflection factor accuracy for each position must be within 3%.
24. Adjust CH 2 Gain (SN B030000-up)
- a) Set the Vert Mode switch to CH 2, the CH 2 Volts/Div switch to 2 mV, and AC-GND-DC switch to DC.
 - b) Move the test signal to the CH 2 input.
 - c) Adjust the STANDARD AMPL. CALIBRATOR for 10 mV output.
 - d) Adjust-CH 2 2 mV Gain, R295 for 5 divisions of deflection.
 - e) Set the CH 2 Volts/Div switch to 5 mV and adjust the STANDARD AMPL. CALIBRATOR for 20 mV output.
 - f) Adjust-CH 2 5 mV Gain Adjustment, R265 (see new Fig. 5-14), for 4 divisions of deflection.
 - g) CHECK-Accuracy of the CH 2 Volts/Div switch using the settings given in Table 5-6. Deflection factor accuracy must be within 3% in all positions.

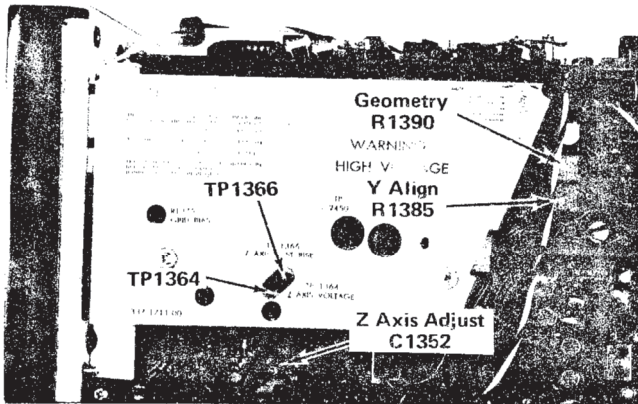


Fig. 5-4. Location of Y-Axis Align, Z-Axis, and Geometry adjustments and test point.

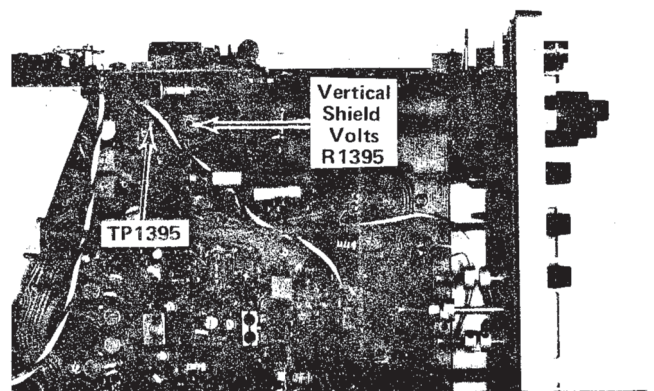


Fig. 5-6. Location of Vertical Shield Voltage adjustment and TP1395.

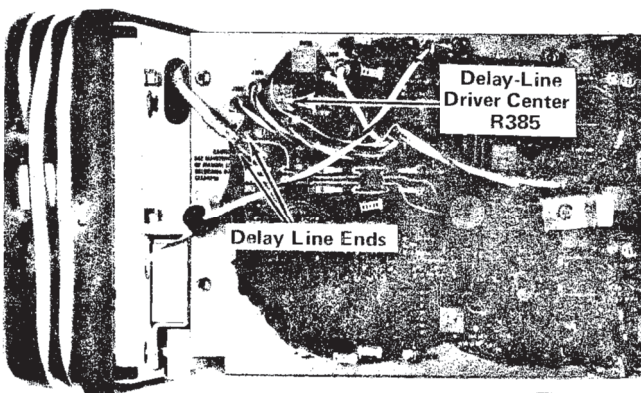


Fig. 5-7. Location of Delay-Line Driver Centering adjustment R385 and delay line ends.

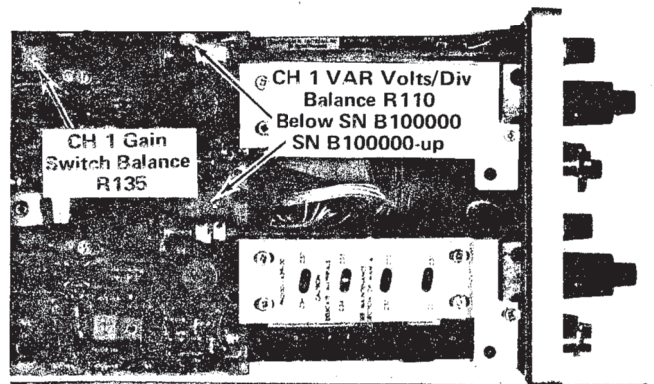


Fig. 5-8. Location of CH 1 Var Volts/Div Balance and Gain Switch Balance adjustments.

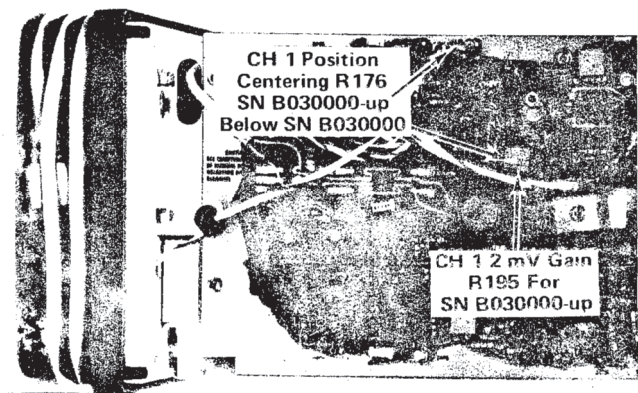


Fig. 5-9. Locations of CH 1 position centering adjustment R176 and CH 1 2 mV Gain R195 (SN B030000-up).

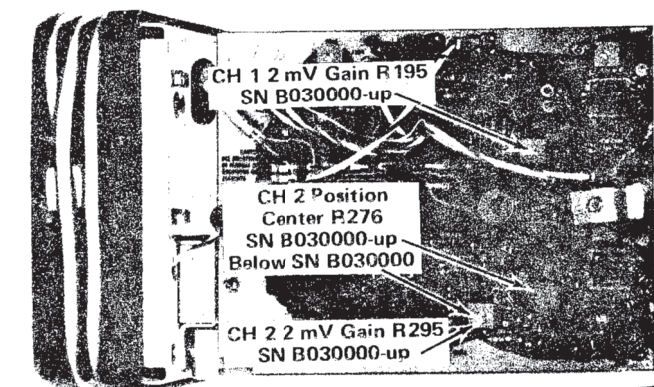


Fig. 5-11. Locations of CH 2 position center R276, CH 2 2 mV Gain R295, and CH 1 2 mV Gain R195 for SN B030000-up.

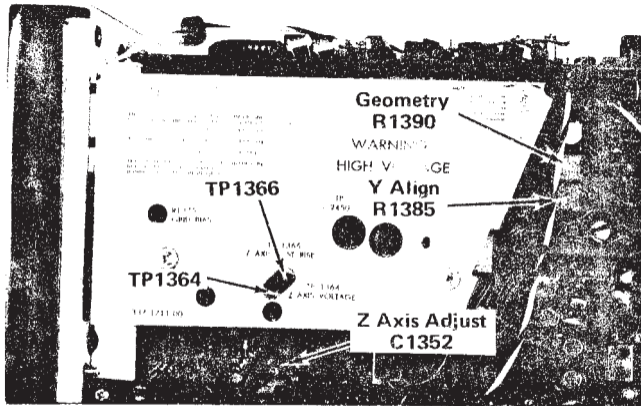


Fig. 5-4. Location of Y-Axis Align, Z-Axis, and Geometry adjustments and test point.

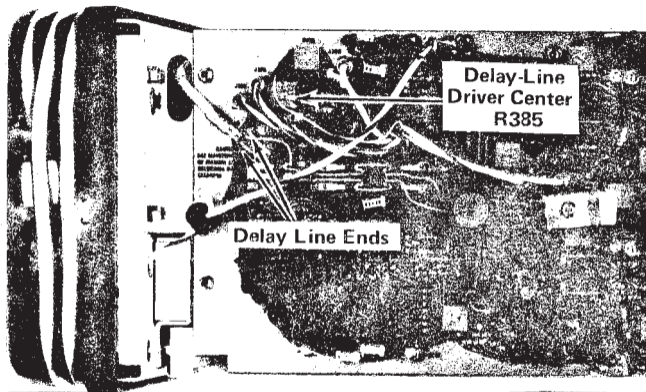


Fig. 5-7. Location of Delay-Line Driver Centering adjustment R385 and delay line ends.

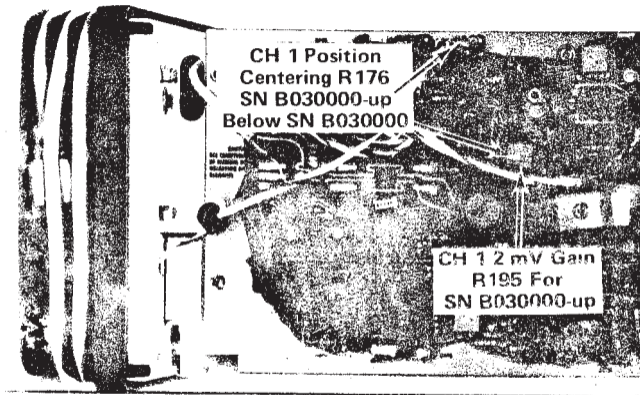


Fig. 5-9. Locations of CH 1 position centering adjustment R176 and CH 1 2 mV Gain R195 (SN B030000-up).

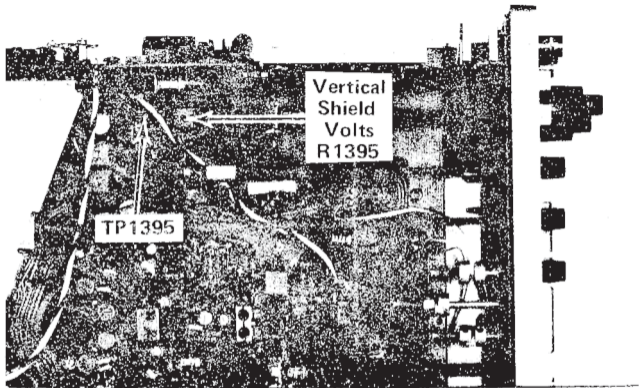


Fig. 5-6. Location of Vertical Shield Voltage adjustment and TP1395.

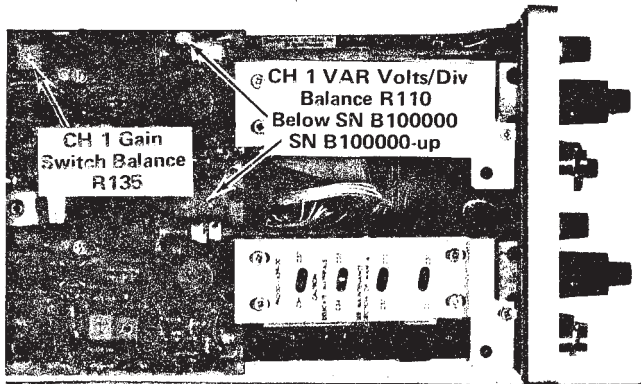


Fig. 5-8. Location of CH 1 Var Volts/Div Balance and Gain Switch Balance adjustments.

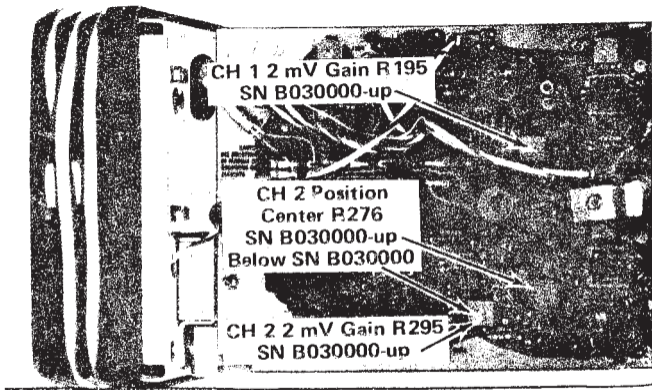


Fig. 5-11. Locations of CH 2 position center R276, CH 2 2 mV Gain R295, and CH 1 2 mV Gain R195 for SN B030000-up.

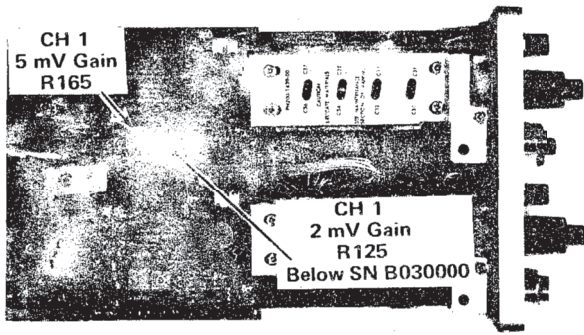


Fig. 5-12. Location of CH 1 5 mV Gain R165 (all SN) and CH 1 2 mV Gain R125 (Below SN B030000).

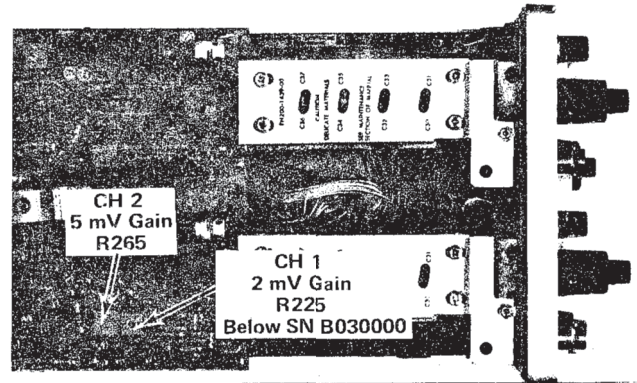


Fig. 5-14. Location of CH 2 5 mV Gain R265 (all SN) and CH 1 2 mV Gain R225 (Below SN B030000).

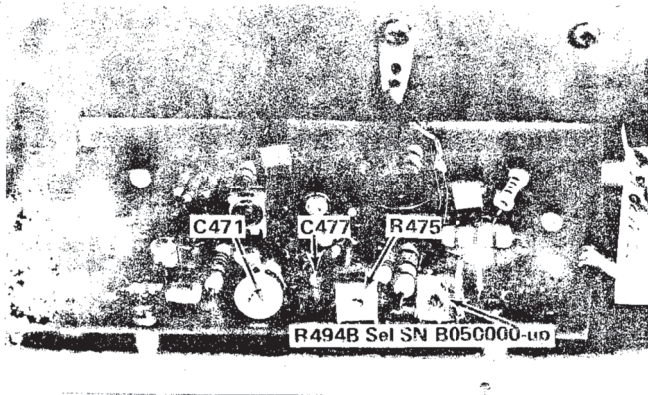


Fig. 5-18. Location of R475, C471, C477 and R494B (Selected SN B050000-up).

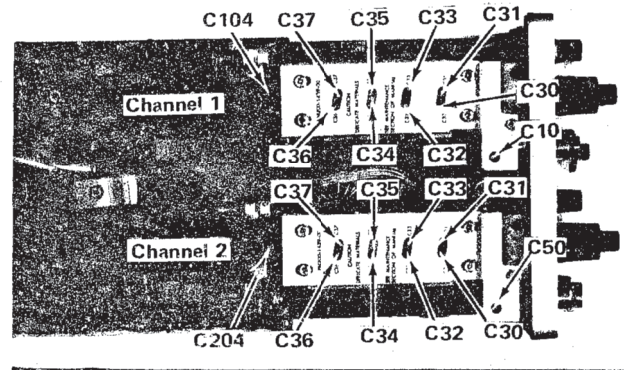


Fig. 5-19. Location of VOLTS/DIV Compensation adjustments.

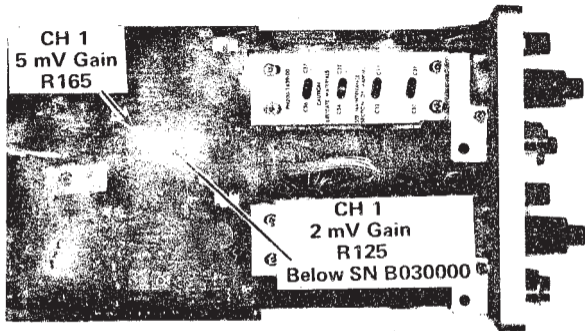


Fig. 5-12. Location of CH 1 5 mV Gain R165 (all SN) and CH 1 2 mV Gain R125 (Below SN B030000).

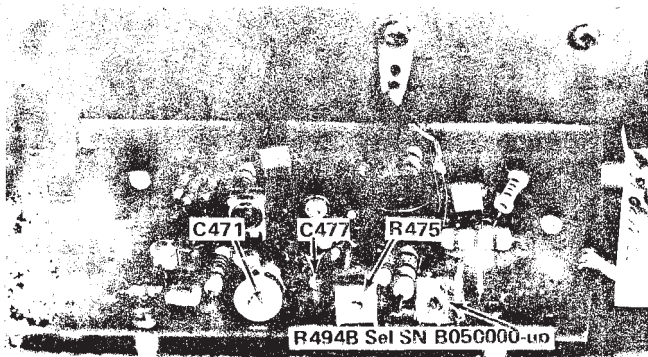


Fig. 5-18. Location of R475, C471, C477 and R494B (Selected SN B050000-up)

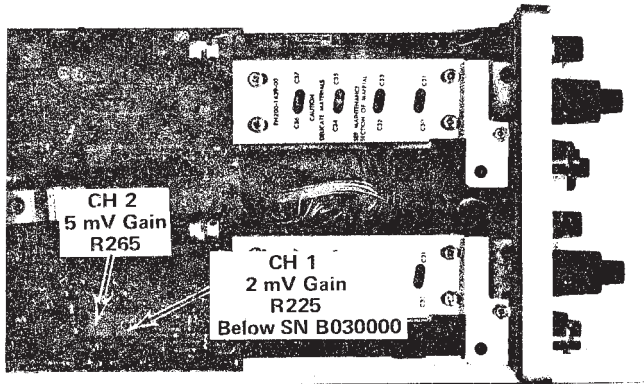


Fig. 5-14. Location of CH 2 5 mV Gain R265 (all SN) and CH 1 2 mV Gain R225 (Below SN B030000).

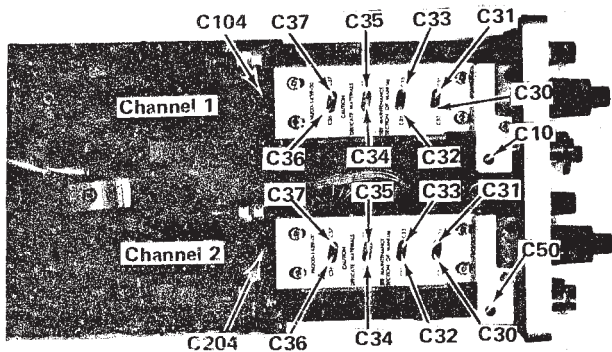


Fig. 5-19. Location of VOLTS/DIV Compensation adjustments.

ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTION

CHANGE TO:

| | | |
|-------|-------------|---|
| A3 | 670-2240-01 | VERT PREAMP Circuit Board Assembly |
| C109 | 283-0191-00 | 0.022 μ F, Cer, 50 V |
| C112 | 281-0122-00 | 2.5-9 pF, Var |
| C139 | 283-0238-00 | 0.01 μ F, Cer, 50 V |
| C209 | 283-0191-00 | 0.022 μ F, Cer, 50 V |
| C212 | 281-0122-00 | 2.5 -9 PF, Var |
| C239 | 283-0238-00 | 0.01 μ F, Cer, 50 V |
| C398 | 281-0628-00 | 15 pF, Cer, 600 V |
| L171 | 276-0528-00 | Core, ferramic suppressor, selected |
| L174 | 276-0528-00 | Core, ferramic suppressor, selected |
| L271 | 276-0528-00 | Core, ferramic suppressor, selected |
| L274 | 276-0528-00 | Core, ferramic suppressor, selected |
| Q178 | 151-0434-00 | Silicon, PNP, 2N4261 |
| Q188 | 151-0434-00 | Silicon, PNP, 2N4261 |
| Q278 | 151-0434-00 | Silicon, PNP, 2N4261 |
| Q288 | 151-0434-00 | Silicon, PNP, 2N4261 |
| R109 | 311-1268-00 | 10 k Ω , Var |
| *R110 | 311-1228-00 | 10 k Ω , Var |
| R113 | 317-0681-00 | 680 Ω (nominal value) selected |
| R137 | 317-0242-00 | 2.4 k Ω (nominal value) selected |
| R138 | 317-0202-00 | 2 k Ω (nominal value) selected |
| R145 | 315-0620-00 | 62 Ω , 1/4 W, 5% |
| R176 | 311-1226-00 | 2.5 k Ω , Var |
| R209 | 311-1268-00 | 10 k Ω , Var |
| R213 | 317-0681-00 | 680 Ω (nominal value) selected |

M19,911/573

*Note: SN B010100-B099999 R110 was 311-1268-00.

CHANGE TO:

| | | |
|-------|-------------|---|
| R237 | 317-0242-00 | 2.4 k Ω (nominal value) selected |
| R238 | 317-0202-00 | 2 k Ω (nominal value) selected |
| R245 | 315-0620-00 | 62 Ω , 1/4 W, 5% |
| R276 | 311-1226-00 | 2.5 k Ω , Var |
| R348 | 315-0331-00 | 330 Ω , 1/4 W, 5% |
| R398 | 317-0430-00 | 43 Ω , 1/8 W, 5% |
| R399 | 315-0330-00 | 33 Ω , 1/4 W, 5% |
| R425 | 311-1227-00 | 5 k Ω , Var |
| RT452 | 307-0125-00 | 500 Ω , Thermal |
| S375A | 263-1019-00 | Actuator assembly, slide, 100 or 20 MHz, BW |
| U120 | 155-0085-01 | Hybrid, dual FET input & amplifier |
| U220 | 155-0085-01 | Hybrid, dual FET input & amplifier |
| VR144 | 152-0166-00 | Selected from 1N753A, 0.4 W, 6.2 V, 5% |
| VR244 | 152-0166-00 | Selected from 1N753A, 0.4 W, 6.2 V, 5% |
| VR290 | 152-0166-00 | Selected from 1N753A, 0.4 W, 6.2 V, 5% |
| VR396 | 152-0166-00 | Selected from 1N753A, 0.4 W, 6.2 V, 5% |

REMOVE:

| | | |
|-------|-------------|-----------------------------|
| C375 | 281-0544-00 | 5.6 pF, Cer, 500 V, 10% |
| C376 | 281-0589-00 | 170 pF, Cer, 500 V, 5% |
| R149 | 321-0260-00 | 4.99 k Ω , 1/8 W, 1% |
| RT149 | 307-0124-00 | 5 k Ω , Thermal |
| R249 | 321-0260-00 | 4.99 k Ω , 1/8 W, 1% |
| RT249 | 307-0124-00 | 5 k Ω , Thermal |
| R391 | 321-0154-00 | 392 Ω , 1/8 W, 1% |

ADD:

| | | |
|------|-------------|-------------------|
| C377 | 281-0564-00 | 24 pF, Cer, 5% |
| C378 | 283-0640-00 | 160 pF, 100 V, 1% |

ADD:

| | | |
|-------|-------------|----------------------------|
| LR377 | 108-0760-00 | 67 nH |
| LR378 | 108-0760-00 | 67 nH |
| R107 | 317-0101-00 | 100 Ω , 1/8 W, 5% |
| R108 | 317-0101-00 | 100 Ω , 1/8 W, 5% |
| R207 | 317-0101-00 | 100 Ω , 1/8 W, 5% |
| R208 | 317-0101-00 | 100 Ω , 1/8 W, 5% |
| R391A | 321-0163-00 | 487 Ω , 1/8 W, 1% |
| R391B | 315-0182-00 | 1.8 k Ω , 1/4 W, 5% |

MECHANICAL PARTS LIST CORRECTION

Page 8-2

CHANGE TO:

| | | | |
|-----------|-------------|---|--|
| Fig. 1-39 | 333-1636-02 | 1 | PANEL, front |
| Fig. 1-51 | 384-1162-01 | 1 | SHAFT, extension w/Knob, TRIG VIEW, BW |

ADD: (Page 8-12)

| | | | |
|-----------|-------------|---|------------------------------------|
| Fig. 4-53 | 129-0385-00 | 1 | POST, standoff |
| Fig. 4-53 | 211-0116-00 | 1 | SCREW, 4-40 x .312 w/2 lockwashers |

Page 8-12

CHANGE TO:

| | | | |
|-----------|-------------|---|---|
| Fig. 4-53 | 105-0421-00 | 1 | ACTUATOR ASSEMBLY, slide switch-TRIG VIEW |
|-----------|-------------|---|---|

Page 8-13

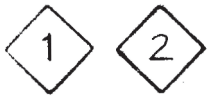
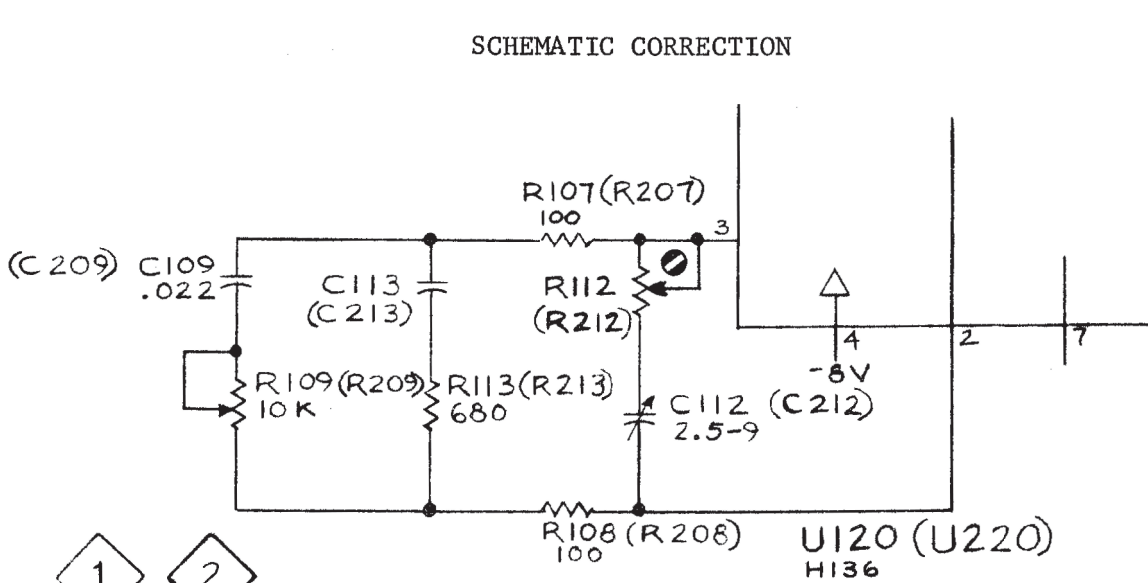
CHANGE TO:

| | | | |
|-----------|-------------|---|-------------------------------------|
| Fig. 4- | 263-1019-00 | 1 | ACTUATOR ASSEMBLY, 100 or 20 MHz BW |
| - - - - - | | | actuator assembly includes: |
| Fig. 4-57 | 376-0146-00 | 1 | COUPLER, shaft |
| -58 | 105-0517-00 | 1 | ACTUATOR, slide switch |
| -59 | 351-0355-00 | 1 | GUIDE, slide switch |
| -60 | 214-1126-00 | 2 | SPRING, detent |

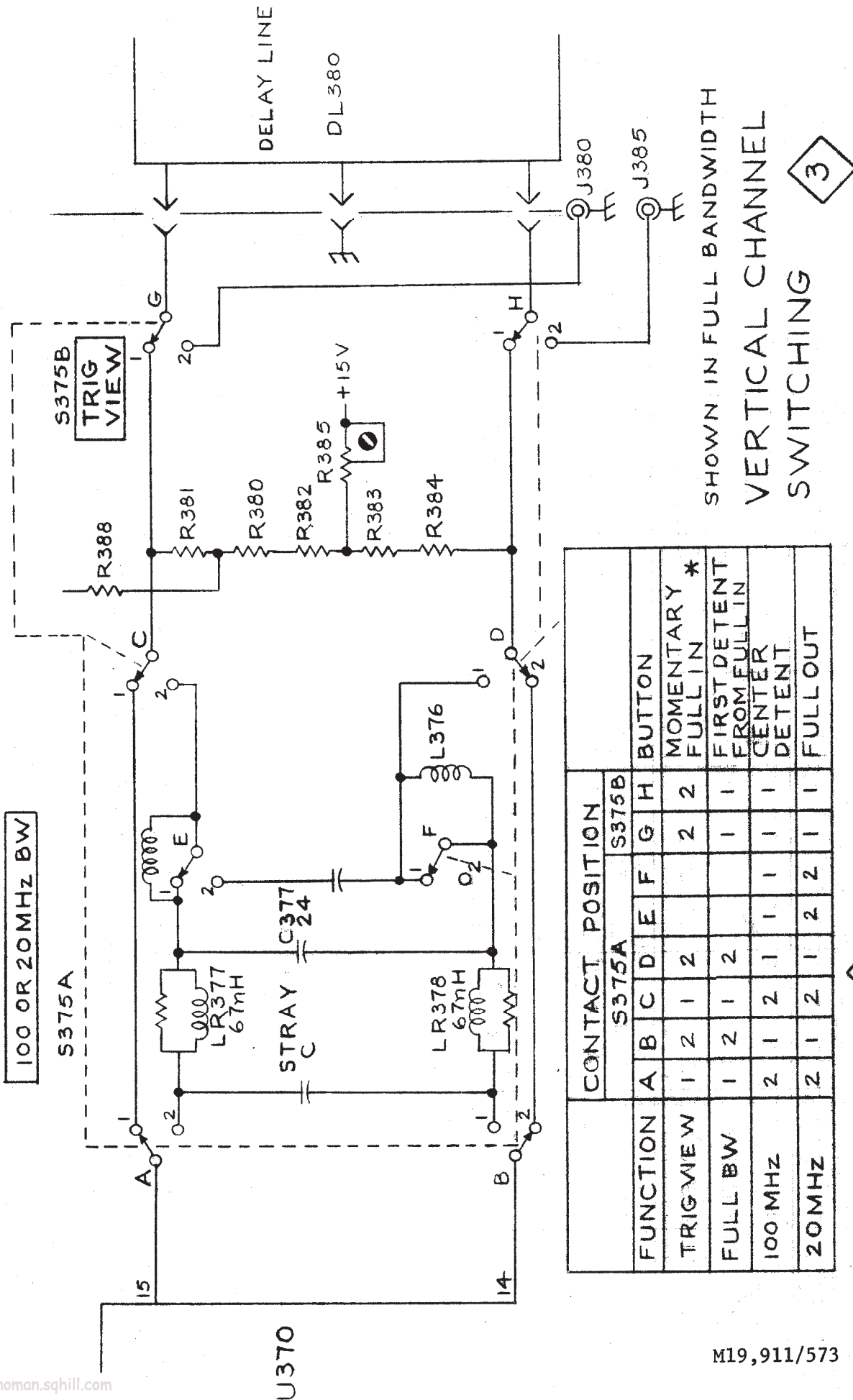
CHANGE TO:

- Fig. 4-60 214-1127-00 2 SPRING, detent
- 366-1471-01 1 KNOB (not shown)
- 255-0345-00 1 ROD, glass epoxy

SCHEMATIC CORRECTION



PARTIAL-
CHI 2 VERTICAL PREAMP



SHOWN IN FULL BANDWIDTH
VERTICAL CHANNEL
SWITCHING

3

| FUNCTION | CONTACT POSITION | | | | | | | |
|-----------|------------------|---|---|---|-------|---|---|---|
| | S375A | | | | S375B | | | |
| | A | B | C | D | E | F | G | H |
| TRIG VIEW | 1 | 2 | 1 | 2 | | | 2 | 2 |
| FULL BW | 1 | 2 | 1 | 2 | | | 1 | 1 |
| 100 MHz | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 1 |
| 20MHz | 2 | 1 | 2 | 1 | 2 | 2 | 1 | 1 |

* NOTE: S375C ON 5 IS INCLOSED POSITION FOR TRIG VIEW

U370

ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTION

CHANGE TO:

| | | |
|--------|-------------|--------------------------------------|
| A9 | 670-2239-01 | Interface Circuit Board Assembly |
| C1124 | 283-0116-00 | 820 pF, 500 V, 5% |
| C1134 | 283-0116-00 | 820 pF, 500 V, 5% |
| C1178 | 283-0644-00 | 150 pF |
| C1326 | 281-0519-00 | 47 pF, 500 V |
| C1512 | 281-0512-00 | 27 pF, 500 V |
| CR1489 | 152-0107-00 | Silicon, TI60 or 1N647 |
| L1232 | 276-0507-00 | Core, ferramic suppressor (selected) |
| Q1114 | 151-0127-00 | Silicon, NPN, selected from 2N2369 |
| Q1140 | 151-0223-00 | Silicon, NPN, 2N4275 |
| Q1496 | 151-0280-00 | Silicon, PNP, MM4003 |
| R1114 | 321-0126-00 | 200 Ω , 1/8 W, 1% |
| R1116 | 315-0182-00 | 1.8 k Ω , 1/4 W, 5% |
| R1117 | 315-0303-00 | 30 k Ω , 1/4 W, 5% |
| R1124 | 315-0361-00 | 360 Ω , 1/4 W, 5% |
| R1128 | 321-0045-00 | 28.7 Ω , 1/8 W, 1% |
| R1134 | 315-0431-00 | 430 Ω , 1/4 W, 5% |
| R1138 | 321-0045-00 | 28.7 Ω , 1/8 W, 1% |
| R1141 | 321-0190-00 | 931 Ω , 1/8 W, 1% |
| R1259 | 321-0287-00 | 9.53 k Ω 1/8 W, 1% |
| R1483 | 315-0472-00 | 4.7 k Ω , 1/4 W, 5% |
| R1484 | 315-0203-00 | 20 k Ω , 1/4 W, 5% |
| R1485 | 315-0273-00 | 27 k Ω , 1/4 W, 5% |
| R1488 | 308-0127-00 | 2.5 k Ω , 5 W |

REMOVE:

| | | |
|-------|-------------|-------------------------------------|
| C1112 | 283-0010-00 | 0.05 μ F, Cer, 50 V |
| C1116 | 283-0000-00 | 0.001 μ F, Cer, 500 V, +100%-0% |

REMOVE:

| | | |
|--------|-------------|-----------------------------|
| C1171 | 281-0564-00 | 24 pF, Cer, 500 V, 5% |
| C1381 | 283-0002-00 | 0.01 μ F, Cer, 500 V |
| C1486 | 281-0523-00 | 100 pF, Cer, 350 V, 20% |
| L1209 | 108-0245-00 | 3.9 μ H |
| R1112 | 321-0258-00 | 4.75 k Ω , 1/8 W, 1% |
| R1113 | 321-0243-00 | 3.32 k Ω , 1/8 W, 1% |
| R1115 | 315-0470-00 | 47 Ω , 1/4 W, 5% |
| R1121 | 315-0560-00 | 56 Ω , 1/4 W, 5% |
| R1122 | 315-0201-00 | 200 Ω , 1/4 W, 5% |
| R1335 | 311-1373-00 | 5 k Ω , Var |
| VR1381 | 152-0247-00 | 1N989B, 0.4 W, 150 V, 5% |

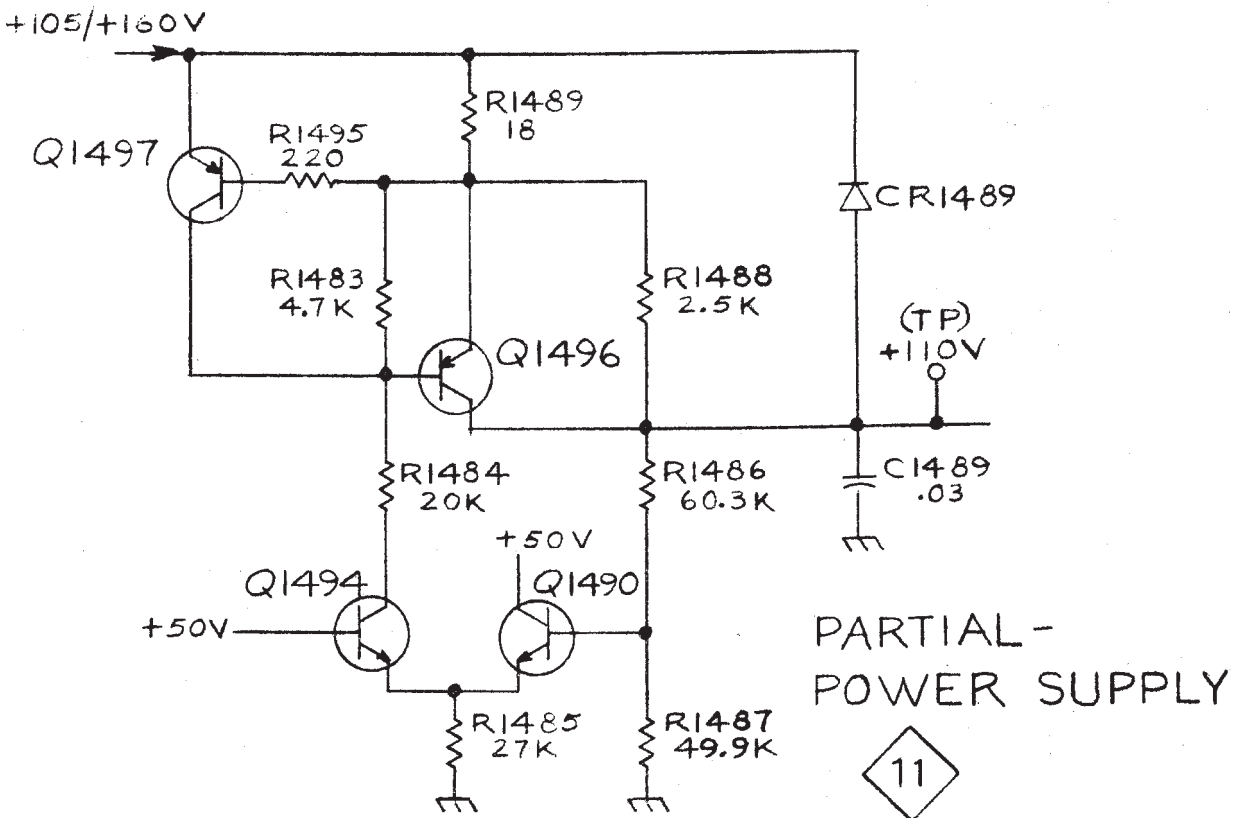
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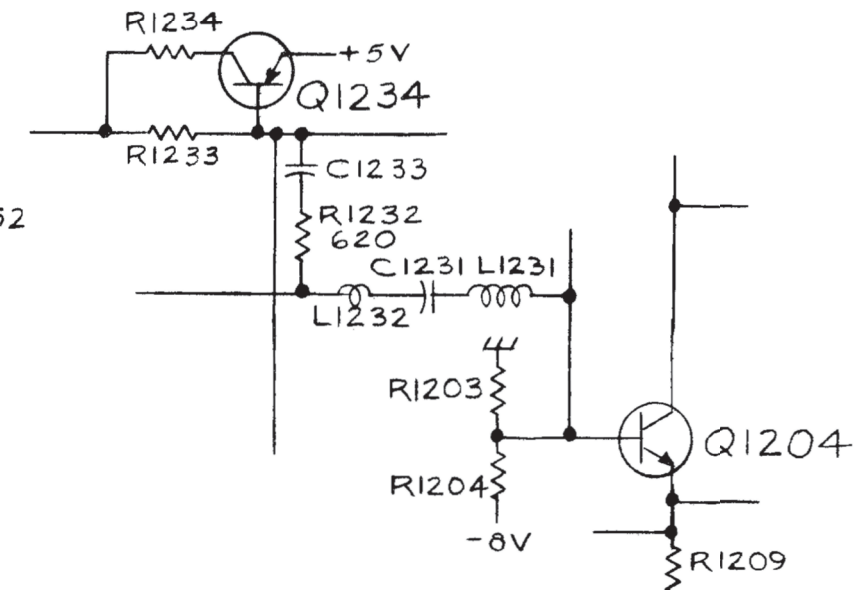
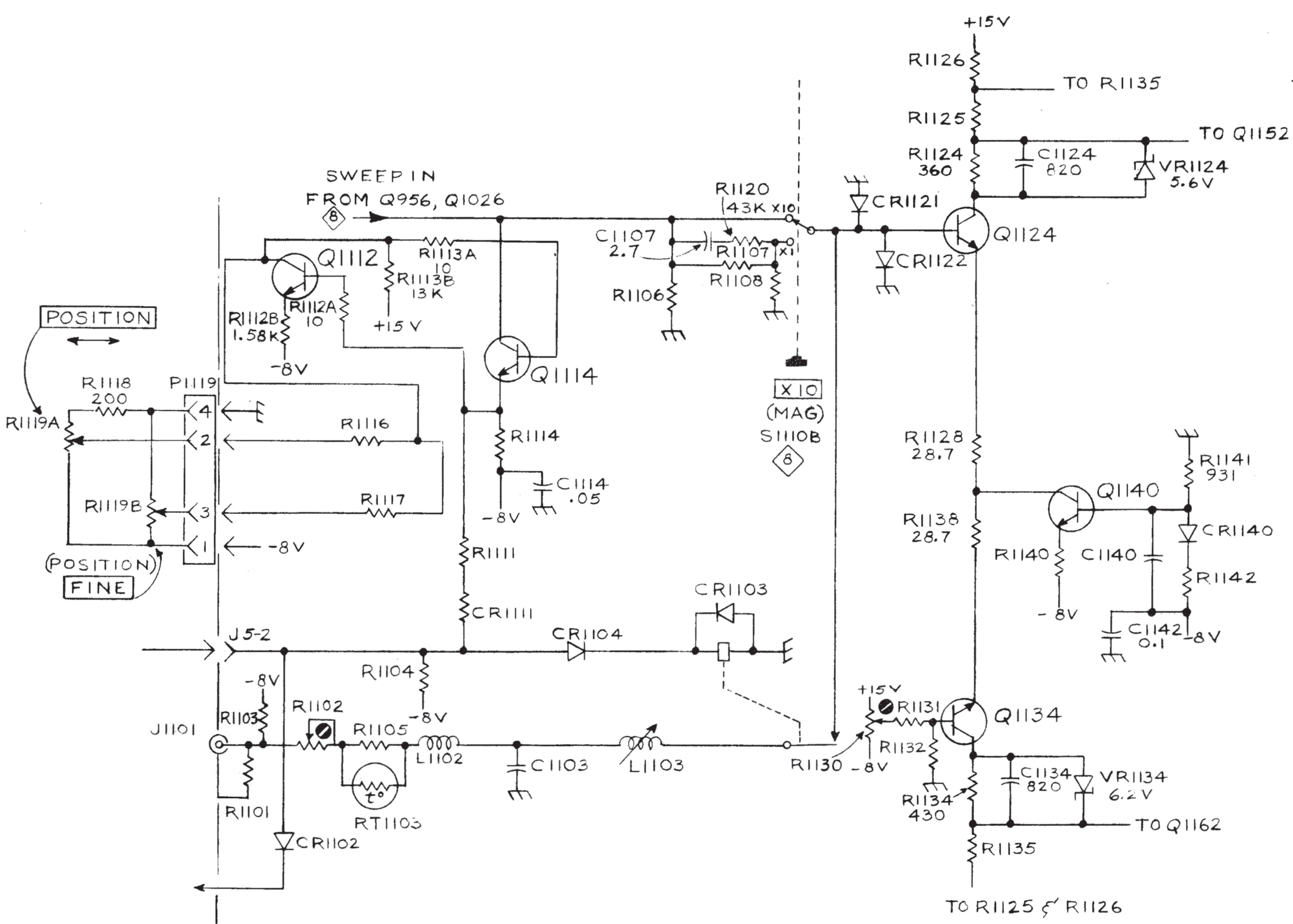
| | | |
|--------|-------------|-----------------------------|
| C1107 | 281-0547-00 | 2.7 pF, 500 V, 10% |
| C1114 | 283-0010-00 | 0.05 μ F, Cer, 50 V |
| C1142 | 283-0111-00 | 0.1 μ F, Cer, 50 V |
| C1329 | 283-0002-00 | 0.01 μ F, Cer, 500 V |
| C1455 | 283-0004-00 | 0.02 μ F, Cer, 150 V |
| C1504 | 281-0551-00 | 390 pF, 500 V |
| CR1329 | 152-0107-00 | Silicon, TI60 ro 1N647 |
| CR1512 | 152-0141-02 | Silicon, 1N4152 |
| L1252 | 276-0507-00 | Core, ferramic suppressor |
| Q1112 | 151-0302-00 | Silicon, NPN, 2N2222A |
| Q1497 | 151-0301-00 | Silicon, PNP, 2N2907 |
| R1112A | 316-0100-00 | 10 Ω , 1/4 W, 10% |
| R1112B | 321-0212-00 | 1.58 k Ω , 1/8 W, 1% |
| R1113A | 316-0100-00 | 10 Ω , 1/4 W, 10% |
| R1113B | 321-0300-00 | 13 k Ω , 1/8 W, 1% |

ADD:

| | | |
|--------|-------------|--|
| R1118 | 315-0201-00 | 200 Ω, 1/4 W, 5% |
| R1120 | 315-0433-00 | 43 kΩ, 1/4 W, 5% |
| R1232 | 317-0621-00 | 620 Ω, 1/8 W, 5% |
| R1252 | 317-0621-00 | 620 Ω, 1/8 W, 5% |
| R1329 | 316-0106-00 | 10 MΩ, 1/4 W, 10% |
| R1335A | 311-1533-00 | 5 kΩ |
| R1335B | | Dual 2.5 MΩ |
| R1489 | 315-0180-00 | 18 Ω, 1/4 W, 5% |
| R1495 | 316-0221-00 | 220 Ω, 1/4 W, 10% |
| VR1124 | 152-0175-00 | 5.6 V, Zener Diode |
| VR1134 | 152-0166-00 | Selected from 1N753A, 0.4 W, 6.2 V, 5% |

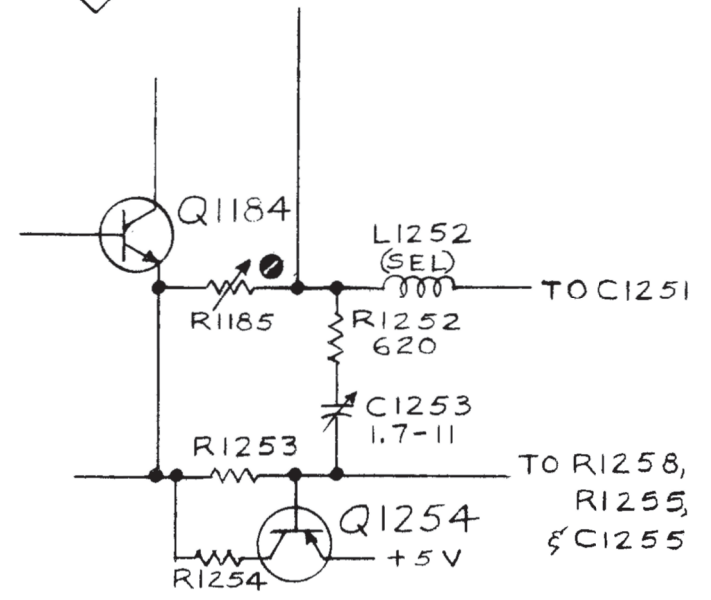
NOTE: C1455 is added in parallel with R1444.





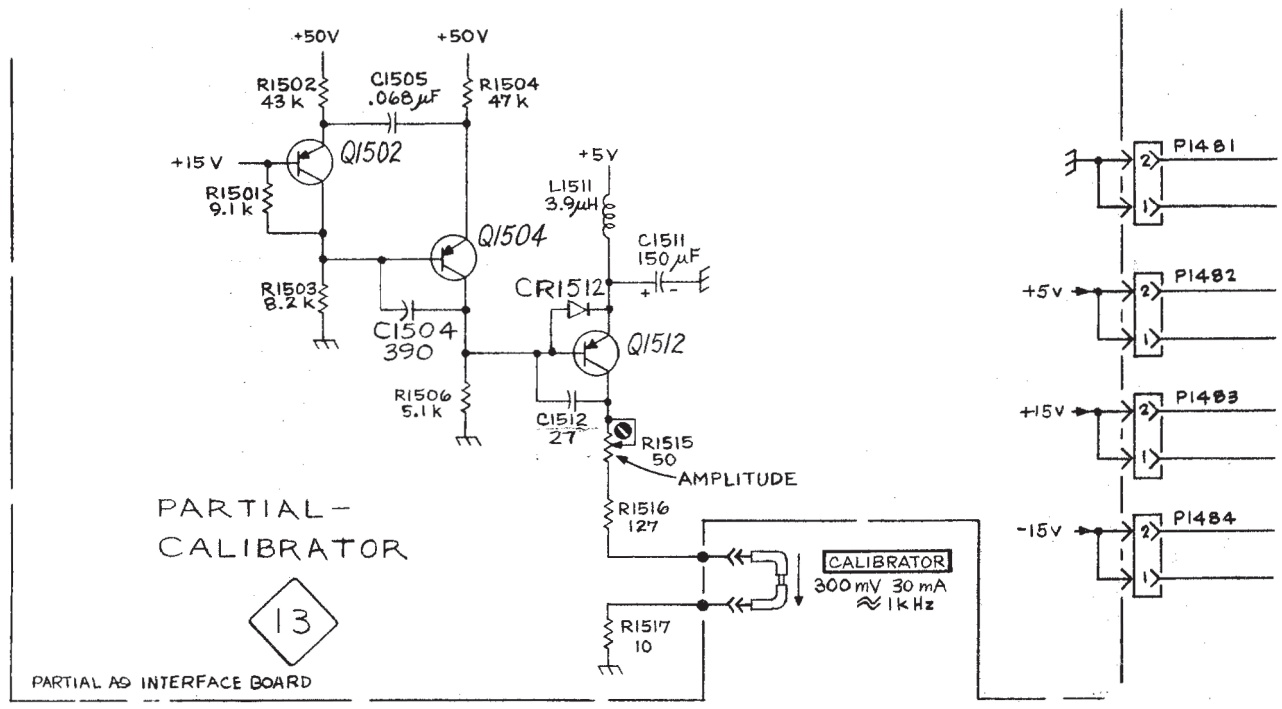
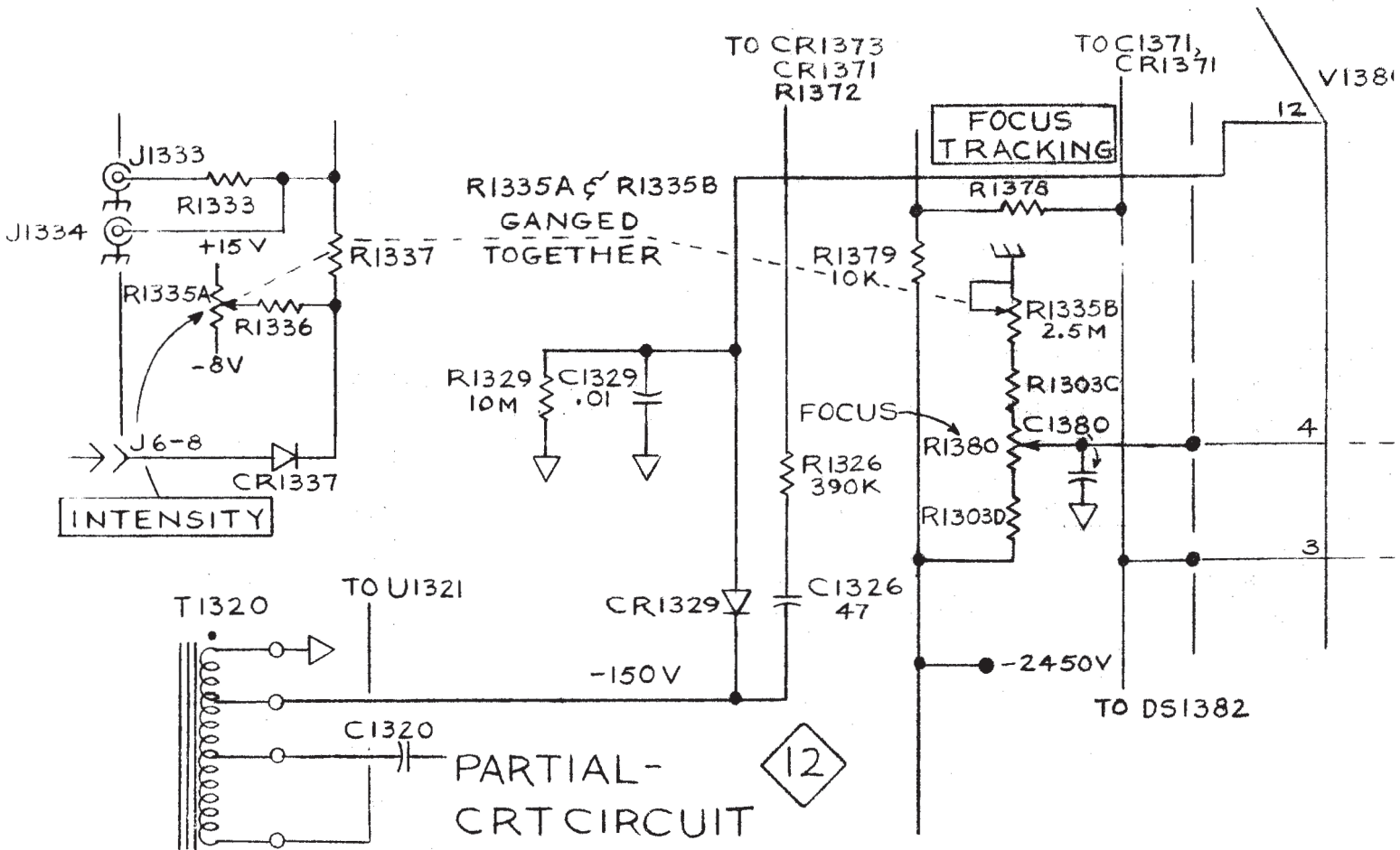
PARTIAL-HORIZONTAL AMP.

10



http://manoman.sqhill.com

SCHEMATIC CORRECTIONS



ELECTRICAL PARTS LIST CORRECTION

CHANGE TO:

| | | |
|-------|-------------|----------------|
| CR104 | 152-0323-01 | Silicon, SE365 |
| CR105 | 152-0323-01 | Silicon, SE365 |
| CR204 | 152-0323-01 | Silicon, SE365 |
| CR205 | 152-0323-01 | Silicon, SE365 |

ADD:

| | | |
|-------|-------------|----------------|
| CR103 | 152-0323-01 | Silicon, SE365 |
| CR203 | 152-0323-01 | Silicon, SE365 |

(Add CR103 and CR203 in series with CR104 and CR204 respectively.)

MECHANICAL PARTS LIST CORRECTION

CHANGE TO:

Page 8-6

| | | | | | |
|-----------|-------------|----------|---------|---|--------------------------|
| Fig. 2-66 | 369-0031-00 | B010100 | B109999 | 1 | IMPELLER, fan w/setscrew |
| | 369-0031-01 | B110000 | | 1 | IMPELLER, fan w/setscrew |
| | 105-0507-00 | XB110000 | | 1 | STOP, end play |

ELECTRICAL PARTS LIST CORRECTION

CHANGE TO:

| | | |
|------|-------------|--|
| U140 | 155-0078-07 | Monolithic, vertical amplifier, selected |
| U240 | 155-0078-07 | Monolithic, vertical amplifier, selected |
| U450 | 155-0078-05 | Monolithic, vertical amplifier, selected |

ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTION

CHANGE TO:

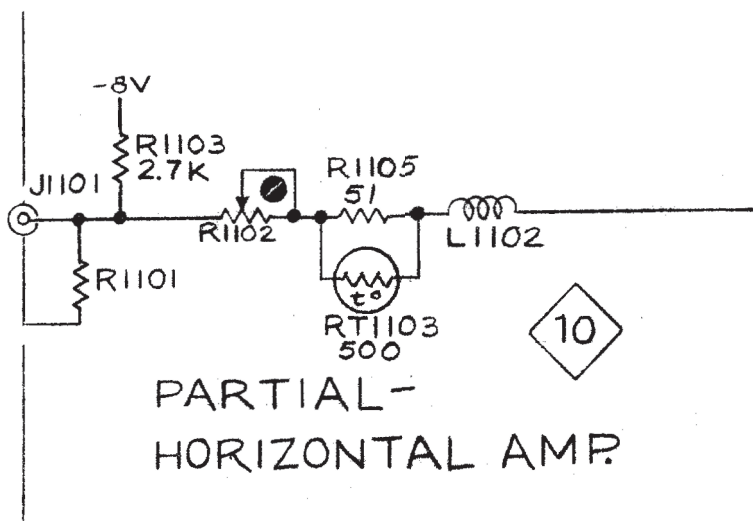
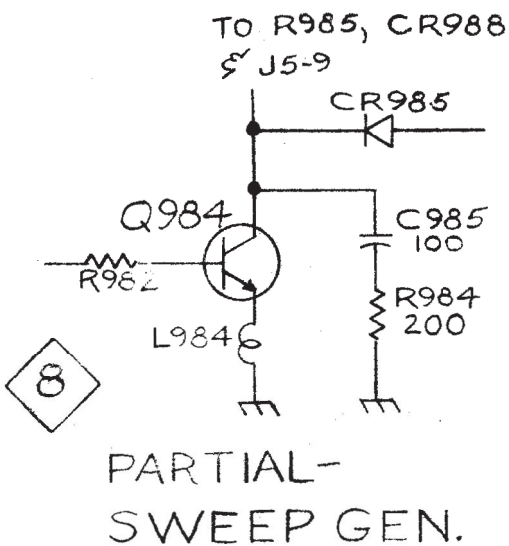
| | | |
|-------|-------------|--------------------------|
| Q1124 | 151-0212-00 | Silicon, NPN, 2N3572 |
| Q1134 | 151-0212-00 | Silicon, NPN, 2N3572 |
| R922 | 315-0471-00 | 470 Ω , 1/4 W, 5% |

REMOVE:

| | | |
|--------|-------------|------------------------|
| C984 | 281-0503-00 | 8 pF, 500 V |
| RT1123 | 307-0124-00 | 5 k Ω , Thermal |

ADD:

| | | |
|--------|-------------|--------------------------|
| C985 | 281-0523-00 | 100 pF, 350 V |
| R984 | 315-0201-00 | 200 Ω , 1/4 W, 5% |
| R1105 | 315-0510-00 | 51 Ω , 1/4 W, 5% |
| RT1103 | 307-0125-00 | 500 Ω , Thermal |



ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTION

CHANGE TO:

| | | |
|------|-------------|--|
| C477 | 281-0123-00 | 5-25 pF, Cer, 100 V |
| R447 | 321-0227-00 | 2.26 k Ω , 1/8 W, 1% |
| R448 | 321-0164-00 | 499 Ω , 1/8 W, 1% |
| R454 | 317-0681-00 | 680 Ω (nominal value) selected (per M20,104 also) |
| R455 | 317-0102-00 | 1 k Ω (nominal value) selected |
| R466 | 311-1278-00 | 250 Ω , Var |
| R467 | 317-0240-00 | 24 Ω (nominal value) selected |
| R468 | 321-0061-00 | 42.2 Ω , 1/8 W, 1% |
| R469 | 321-0061-00 | 42.2 Ω , 1/8 W, 1% |
| R470 | 311-1279-00 | 500 Ω , Var |
| R474 | 317-0240-00 | 24 Ω (nominal value) selected |
| R477 | 315-0821-00 | 820 Ω , 1/4 W, 5% |

REMOVE:

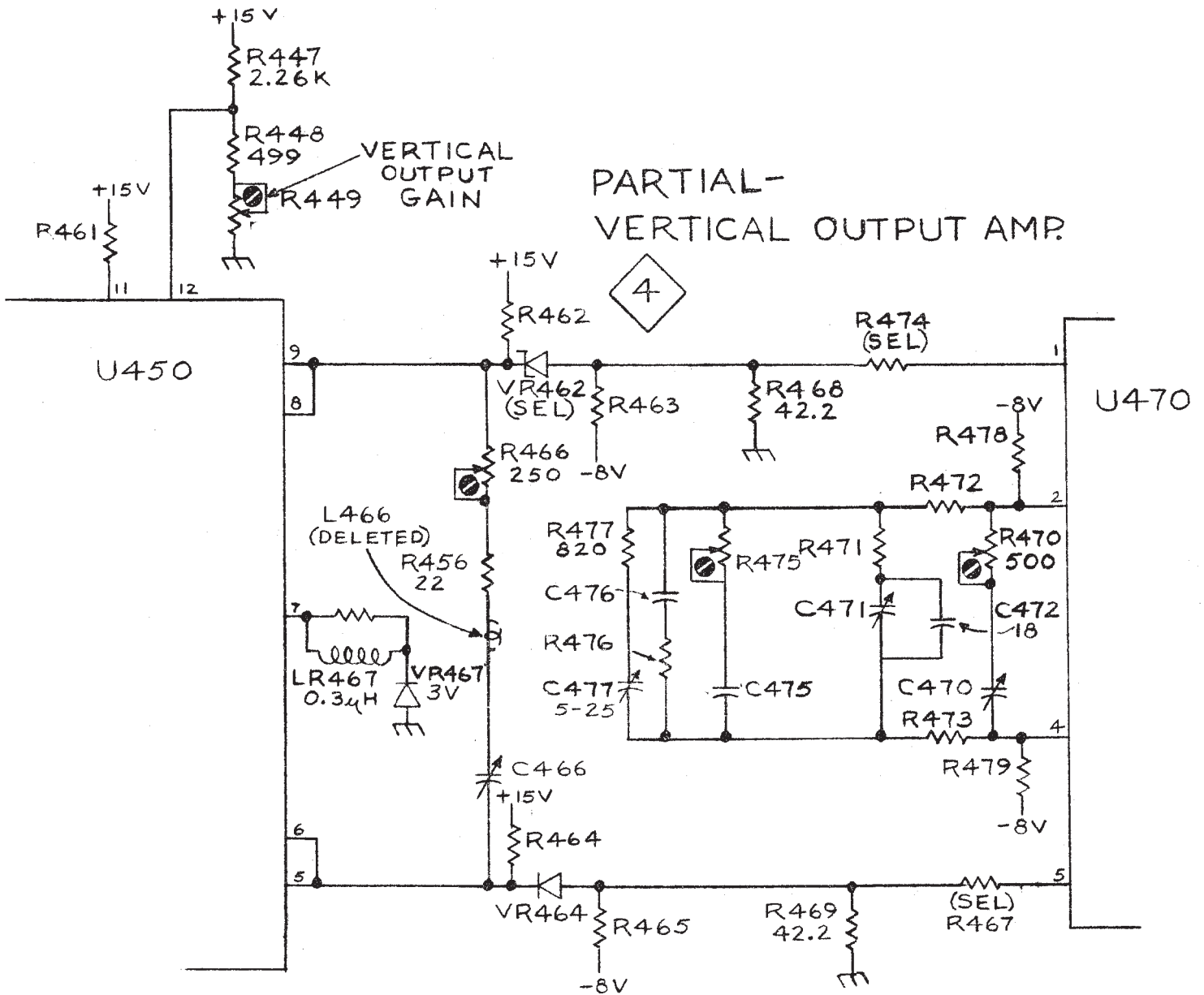
| | | |
|------|-------------|--------------------------|
| L466 | | #22 Bare Strap |
| R446 | 321-0136-00 | 255 Ω , 1/8 W, 1% |

ADD:

| | | |
|-------|-------------|-------------------------|
| C472 | 281-0558-00 | 18 pF, Cer, 500 V |
| LR467 | 108-0328-00 | 0.3 μ H |
| R456 | 315-0220-00 | 22 Ω , 1/4 W, 5% |
| VR467 | 152-0278-00 | 1N4372A, 0.4 W, 3V, 5% |

M20,525/473

SCHEMATIC CORRECTION



Note: Original schematic was in error, R466 always connected to U450 pins 8 and 9, and C466 always connected to pins 5 and 6 with L466 located between R466 and C466. (This mod removes L466)

ELECTRICAL PARTS LIST CORRECTION

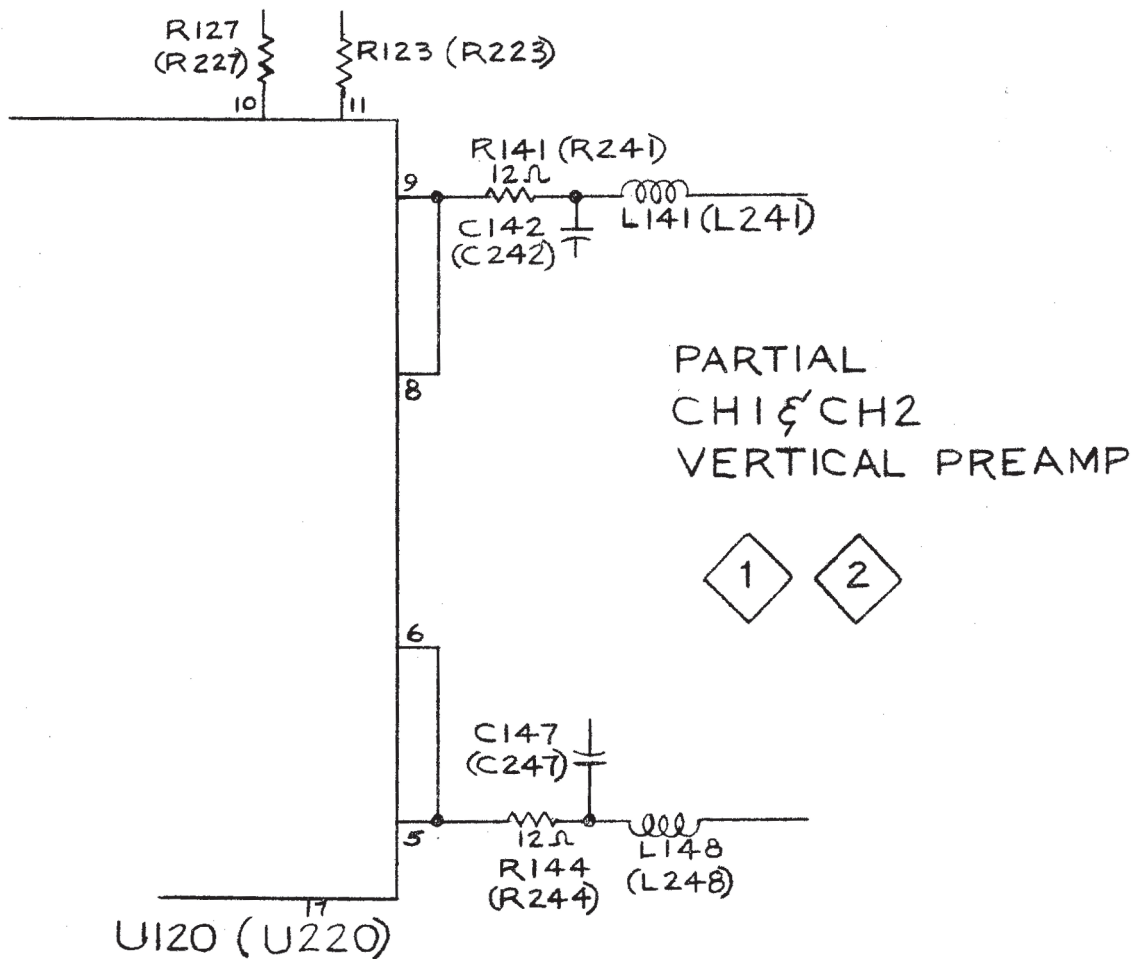
CHANGE TO:

| | | |
|------|-------------|-----------------------------------|
| R142 | 321-0072-00 | 54.9 ohm (nominal value) selected |
| R143 | 321-0072-00 | 54.9 ohm (nominal value) selected |
| R242 | 321-0072-00 | 54.9 ohm (nominal value) selected |
| R243 | 321-0072-00 | 54.9 ohm (nominal value) selected |

ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTION

ADD:

| | | |
|------|-------------|---|
| R141 | 317-0120-00 | 12 Ω , 1/8 W, 5% (Added when required) |
| R144 | 317-0120-00 | 12 Ω , 1/8 W, 5% (Added when required) |
| R241 | 317-0120-00 | 12 Ω , 1/8 W, 5% (Added when required) |
| R244 | 317-0120-00 | 12 Ω , 1/8 W, 5% (Added when required) |



ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTION

CHANGE TO:

Q390 151-0441-00 Silicon, NPN, 2N2857

REMOVE:

R396 315-0100-00 10 Ω , 1/4 W, 5%
 (replaced by a bare strap)

ADD:

C394 281-0547-00 2.7 pF, Cer, 500 V
 R103 317-0120-00 12 Ω (nominal value) selected
 R203 317-0120-00 12 Ω (nominal value) selected
 R397 315-0471-00 470 Ω , 1/4 W, 5%

