TEKTRONIX®

T932A/T935A 35MHz

PORTABLE OSCILLOSCOPE

INSTRUCTION MANUAL

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

Serial Number ____________________

070-2492-00

First Printing DEC 1977

WARRANTY

This Tektronix instrument is warranted against defective materials and workmanship for one year. Any questions with respect to the warranty should be taken up with your Tektronix Field Engineer or representative.

All requests for repairs and replacement parts should be directed to the Tektronix Field Office or representative in your area. This will assure you the fastest possible service. Please include the instrument type number or part number and serial number with all requests for parts or service.

TABLE OF CONTENTS

WARNING

THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

LIST OF ILLUSTRATIONS

LIST OF TABLES

2492-01

Fig. 1-1. T932A/T935A 35 MHz Oscilloscopes.

SPECIFICATIONS

This manual includes instructions for both the T932A and the T935A portable oscilloscopes. The T932A is a 35 MHz, dual trace oscilloscope and the T935A is a 35 MHz, dual trace oscilloscope capable of delayed sweep operation. The Vertical Amplifier provides calibrated deflection factors from 2 mV to 10 V/div. The Time Base provides stable triggering over the full bandwidth of the Vertical Amplifier and provides calibrated sweep rates from 0.5 s/div to 0.1 μs/div. A variable X1 to X10 magnifier extends the maximum sweep rate to 10 ns/div.

The following instrument specifications apply over an ambient temperature range of 0 to +45° C unless otherwise indicated. The adjustment procedures in Section 4, when performed completely, allow the T932A and the T935A to meet the electrical specifications listed in Table 1-1.

TABLE 1-1

Electrical

Characteristic	Performance Requirement
A. DISPLAY	
Probe Adjust Output	
Voltage (0° C to +40° C)	Approximately 0.5 V.
Repetition Rate	Approximately 1 kHz.
Z-Axis Input	
Sensitivity	5 volt signal causes a noticeable decrease in intensity. Positive amplitude decreases intensity.
Usable Frequency Range	Dc to 5 MHz.
Maximum Input Voltage	30 V (dc + peak ac), 30 V p-p at 1 kHz or less.
Input Impedance	Approximately 10 kΩ.
Power Source	
Line Voltage Ranges (ac,rms)	
120 V Range	HI—108 to 132 V. LO—90 to 110 V.
240 V Range	HI—216 to 250 V. LO—198 to 242 V.
Line Frequency	50 to 60 Hz.
Maximum Power Consumption	36 W, 0.35 A at 60 Hz, 120 V line.
CRT Display	
Display Area	8 x 10 cm.
Trace Rotation Range	Adequate to align trace with horizontal center line.
Standard Phosophor	P31.
Nominal Accel-erating Potential	12,400 V.

Characteristics	Performance Requirements
B. VERTICAL AMPLIFIER	
Deflection Factor	
Range	2 mV/div to 10 V/div; 12 steps in a 1-2-5 sequence.
Accuracy	
+20° C to +30° C	Within 3%.
0° C to +45° C	Within 4%.
Uncalibrated (VAR) Range	Continuously variable between settings. Extends deflection factor to at least 25 V/div (at least 2.5:1).
Frequency Response	
Bandwidth	DC to at least 35 MHz.
Chopped Mode Repetition Rate	Approximately 250 kHz.
Input Resistance	Approximately 1 MΩ.
Input Capacitance	Approximately 30 pF.
Maximum Input Voltage	
DC Coupled	250 V (dc + peak ac). 500 V (p-p ac) at 1 kHz or less.
AC Coupled	250 V (dc + peak ac). 500 V (p-p ac) at 1 kHz or less.
CMRR (DIFF Mode)	At least 10:1 at 1 MHz in 10 mV/div position for common mode signals of 8 div or less with gain adj. for both CMRR at 50 kHz.

TABLE 1-1 (cont)

Characteristic	Performance Requirement
C. TIME BASE	
Sweep Rate	
Calibrated Range (T932A)	0.5 s/div to 0.1 μs/div; 21 steps in a 1-2-5 sequence. Variable X1 to X10 magnifier extends maximum sweep rate to 10 ns/div.
Calibrated Range (T935A) A Sweep	0.5 s to 0.1 μs/div; 21 steps in a 1-2-5 sequence. Variable X1 to X10 magnifier extends maximum sweep rate to 10 ns/div.
B Sweep	50 ms to 0.1 μs/div; 18 steps in a 1-2-5 sequence. Variable X1 to X10 magnifier extends maximum sweep rate to 10 ns/div.
Accuracy	Accuracy specification applies over center 8 divisions. Exclude first 50 ns of sweep for both magnified and unmagnified sweep rates and anything beyond the 100th magnified division.
+20°C to +30°C	
Unmagnified	Within 3%.
Magnified	Within 5%.
0°C to +45°C	
Unmagnified	Within 4%.
Magnified	Within 6%.
Variable Magnifier	10:1 (In the X10 position, the sweep speed is one tenth of the SEC/DIV switch setting.).
Delay Time Position Range (T935A)	0.5 to 10 div.
Delay Time Jitter (T935A)	One part or less in 10,000 (0.01%) of one tenth of the SEC/DIV switch setting.

Characteristic	Performance Requirement
C. TIME BASE (cont)	
X-Y Operation	
Sensitivity	Same as Ch 1 and Ch 2 with magnifier in X1 position. (Not specified with use of magnifier to X10 position.)
X-Axis Bandwidth	Dc to at least 2 MHz with 10 div reference signal.
Input Resistance	Approximately 1 MΩ.
Input Capacitance	Approximately 30 pF.
Deflection Accuracy	+20°C to 30°C ±5% (magnifier in X1 only) 0 to 45°C ±6% (magnifier in X1 only)
Triggering	
AC Sensitivity	0.5 div internal or 100 mV external from 60 Hz to 2 MHz, increasing to 1.5 div internal or 150 mV external at 35 MHz.
DC Sensitivity	.5 div int or 100 mV ext from dc to 2 MHz increasing to 1.5 div int or 150 mV ext at 35 MHz.
TV Sync Sensitivity	Composite sync 1 div internal or 100 mV external (approximately 2.3 div or 230 mV of composite video).
External Trigger Input	
Maximum Input Voltage	250 V (dc + peak ac). 500 V (p-p ac) (1 kHz or less).
Input Resistance	Approximately 1 MΩ.
Input Capacitance	Approximately 30 pF.
Level Range	
EXT	+0.5 V to −0.5 V.
$\frac{EXT}{10}$	+5 V to −5V.

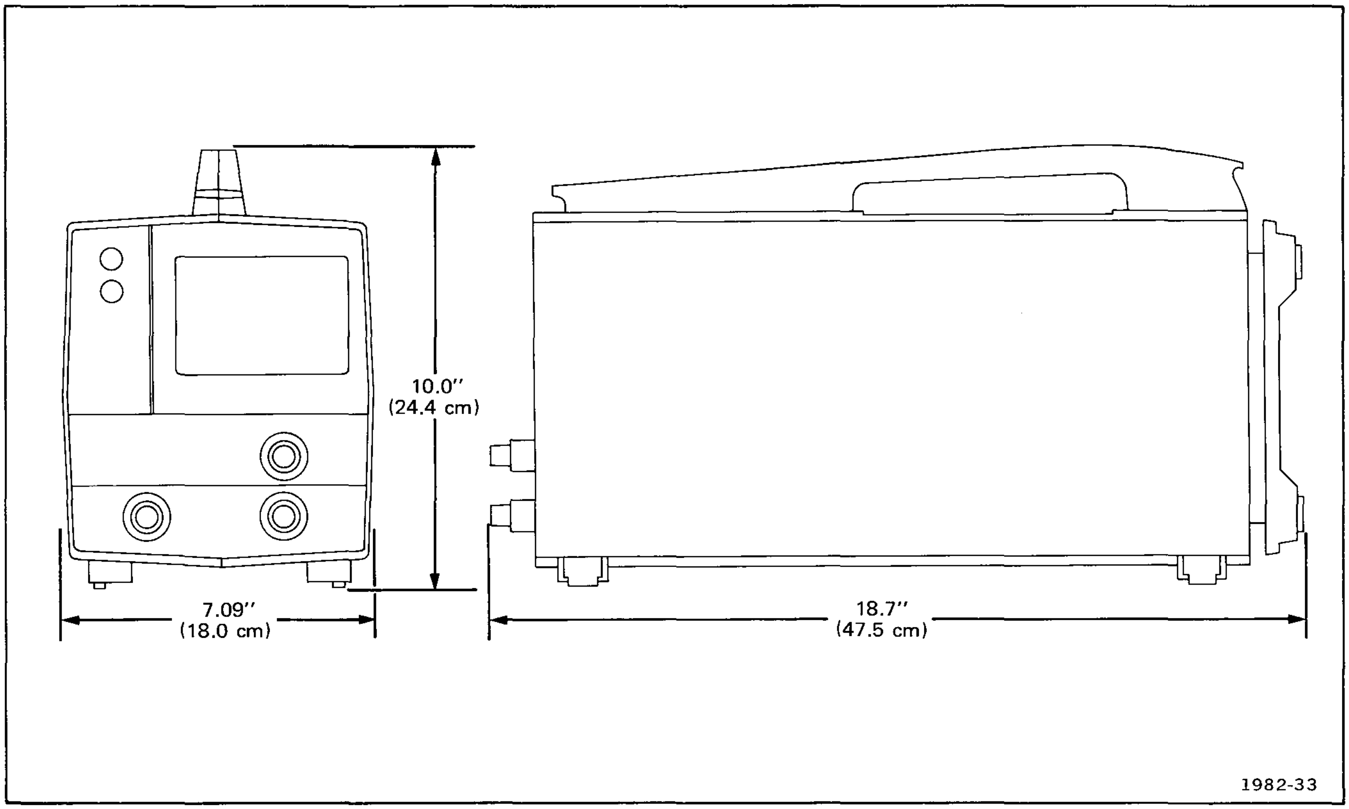


Fig. 1-2. T932A/T935A dimensional drawing.

TABLE 1-2

Environmental

Characteristic	Performance Requirement
Temperature	
Storage	−55° C to +75° C.
Operating	0° C to +45° C.
Altitude	
Storage	To 50,000 ft.
Operating	To 15,000 ft. Maximum operating temperature decreases 1° C/1,000 ft. above 5,000 ft.

TABLE 1-3

Physical

Characteristic	Performance Requirement
Weight	
With Panel Cover, Accessories and Accessory Pouch	15.5 lbs. (7.0 kg).
Without Panel Cover, Accessories and Accessory Pouch	15.0 lbs. (6.8 kg).
Overall Dimensions	Refer to Fig. 1-2.

STANDARD ACCESSORIES

1 Instruction Manual
2 Probes (P6108)

RECOMMENDED ACCESSORIES

NOTE

The following accessories have been selected from our catalog specifically for your instrument. They are listed as a convenience to help you meet your measurement needs. For detailed information and prices, refer to a Tektronix Products Catalog or contact your local Tektronix Field Representative.

COVERS

FRONT COVER: Protects the instrument front panel during transport or storage and provides storage for small accessories (probes, cables, etc.). Made of blue plastic to match the instrument case.

Order **016-0340-00**

PROTECTIVE WATERPROOF COVER: Blue vinyl cover provides protection for the entire oscilloscope during transport or storage.

Order **016-0361-00**

PROBES

P6101 GENERAL PURPOSE 1X VOLTAGE PROBE: Input capacitance is 54 picofarads (plus input capacitance of oscilloscope).

Order **010-6101-03**

P6062A SWITCHABLE 1X-10X VOLTAGE PROBE: Provides full bandwidth capabilities of T900-series instruments. Can be compensated to match the vertical input capacitance.

Order **010-6062-13**

P6009 GENERAL PURPOSE 100X VOLTAGE PROBE: Provides full bandwidth capabilities of T900-series instruments. Can be compensated to match the vertical input capacitance.

Order **010-0264-01**

P6015 GENERAL PURPOSE 1000X VOLTAGE PROBE: Provides full bandwidth capabilities of T900-series instruments. Can be compensated to match the vertical input capacitance.

Order **010-0172-00**

P6021 AC CURRENT PROBE: Provides a bandwidth from 120 Hz to the upper bandwidth of T900-series instruments. Spring-loaded slide opens (up to 0.150 inches) to allow measurement of current without breaking the circuit under test.

Order **015-0140-02**

CAMERAS

C-5A Option 3 Camera: Provides graticule illumination with xenon flash lamp powered by two AA penlight batteries. Recommended for, and molded to fit all bench version T900-series instruments. Fixed focus, fixed aperture f16 lens with 0.67 or 0.85 user adjustable magnification. Mechanical shutter with speeds of 1/5 to 1/25 s, plus bulb and time.

Order . . . . **C-5A Option 3**

OPERATING INSTRUCTIONS

CAUTION

To prevent electric shock, do not remove cover. Refer servicing to qualified personnel.

OPERATING VOLTAGE

The T932A and T935A will operate from either a 120 V or 240 V ac, 50 to 60 Hz nominal power input source. To avoid equipment damage, the power input range selector switch (120 V or 240 V) and HI/LO switch on the bottom of the instrument must be set to positions which include the value of the applied power input voltage. The POWER indicator LED will blink when the applied power input voltage varies more than about 10% from the value for which the switches are set.

Refer 120/140 voltage selection to qualified service personnel. (Setting of this switch is visible, and Hi-Low switch is operable, at bottom of instrument.)

SAFETY INFORMATION

The T932A and T935A operate from a single-phase power source with one of the current-carrying conductors (the neutral conductor) at ground (earth) potential. Operation from power sources where both current-carrying conductors are live with respect to ground (such as phase-to-phase on a 3-wire system) is not recommended, since only the line conductor has over-current (fuse) protection within the instrument.

The T932A and T935A each have a 3-wire cord with a 3-terminal polarized plug for connection to the power source and safety-earth. The ground terminal of the plug is directly connected to the metal parts of the instrument. For electric-shock protection, insert this plug in a mating outlet with a safety-earth contact.

FUNCTIONS OF CONTROLS, CONNECTORS, AND INDICATORS

Before you turn the instrument on, read this portion of the manual to familiarize yourself with the controls, connectors, and indicators.

A. DISPLAY

Front Panel (Fig. 2-1)

1 **INTENSITY**—Adjusts the brightness of the crt display. Set for the lowest visible display to prolong crt life.

2 **FOCUS**—Adjusts for optimum spot size and definition.

3 **BEAM FINDER**—Locates off-screen displays. Compresses the crt display to within the graticule area independently of the position control or applied signals.

To locate an off-screen display:

a. Set the vertical POSITION and INTENSITY controls to midrange and rotate the horizontal POSITION control clockwise.

b. If a display or dot still is not visible, press BEAM FINDER and hold in. A compressed display or dot should appear. If not, increase the INTENSITY until a display appears.

If a dot or vertical line appears, the sweep is not triggered. Set the trigger MODE switch to AUTO to obtain a display. Use the vertical and horizontal POSITION controls to move the display near the center of the graticule. Release the BEAM FINDER button and adjust the trigger level control for a stable display.

If a compressed display appears, adjust the VOLTS/DIV switch and the horizontal and vertical POSITION controls for a stable display.

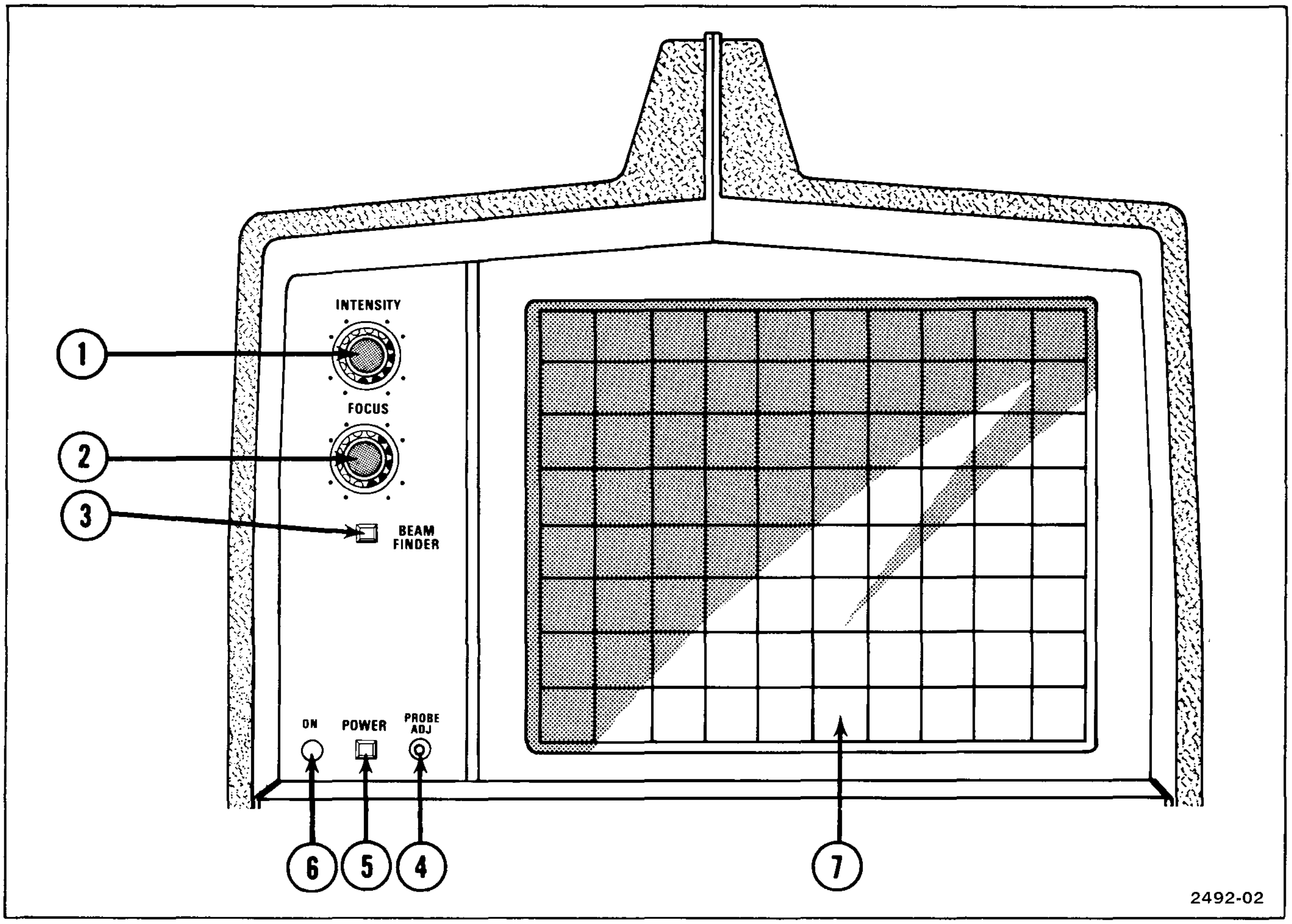


Fig. 2-1. Display front panel controls and connectors.

(4) **PROBE COMP**—Provides a square-wave output of approximately 0.5 V (negative-going with respect to ground) at approximately 1 kHz, for compensating voltage probes.

(5) **ON-OFF**—Push-push switch turns the instrument power on (button in) and off (button out).

(6) **POWER**—Indicator LED lights when ON-OFF button is depressed to ON (in) position and applied power input voltage does not vary more than about 10% from the value indicated by the 120 V/240 V and HI/LO voltage selector switch settings. When applied power input voltage varies more than about 10% (either high or low) from the selected value, the LED will blink.

(7) **Internal Graticule**—Eliminates parallax. Risetime, amplitude, and measurement points are indicated at the left edge of the graticule.

Rear Panel (Fig. 2-2)

(8) **EXT Z-AXIS IN**—BNC connector for applying signals to intensity modulate the crt display. Signals must be time-related to the display for a stable display.

Left Side of Cabinet (Fig. 2-3)

(9) **ASTIG**—Screwdriver adjustment used with FOCUS control to obtain a well-defined display. Requires little or no adjustment once set.

(10) **TR ROT**—Trace rotation screwdriver adjustment. Aligns trace with the horizontal graticule lines.

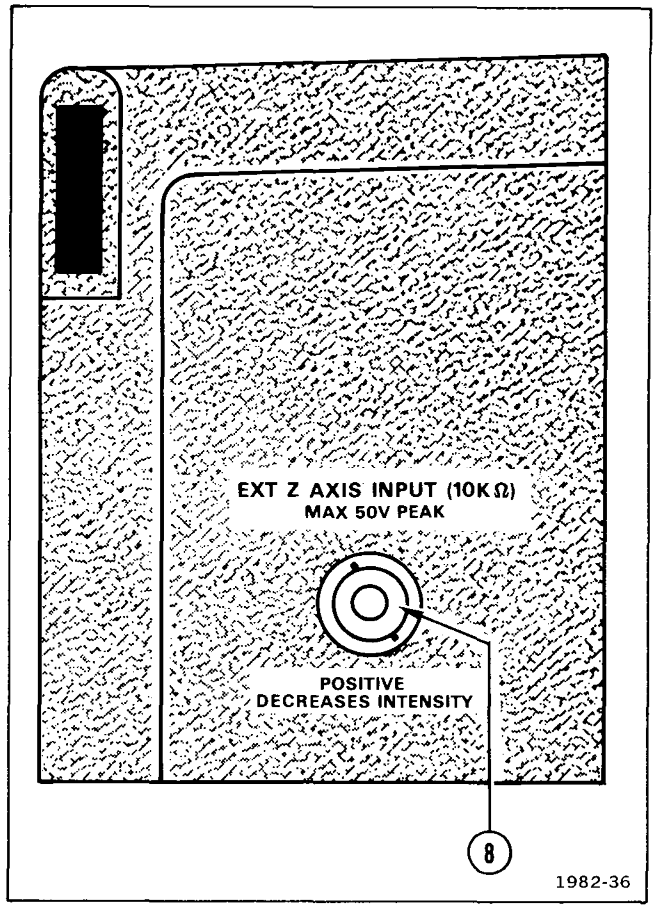


Fig. 2-2. Rear panel controls and connectors.

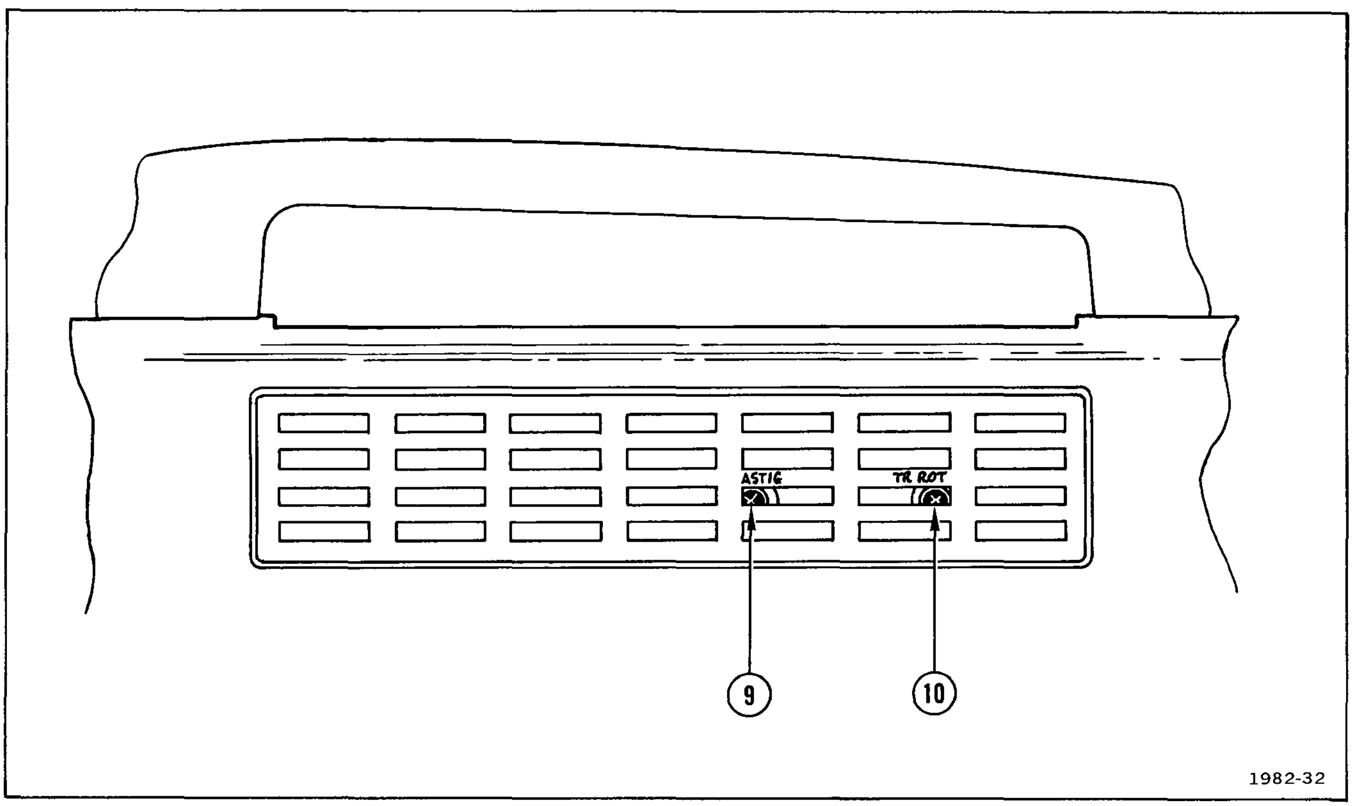


Fig. 2-3. Left side of cabinet.

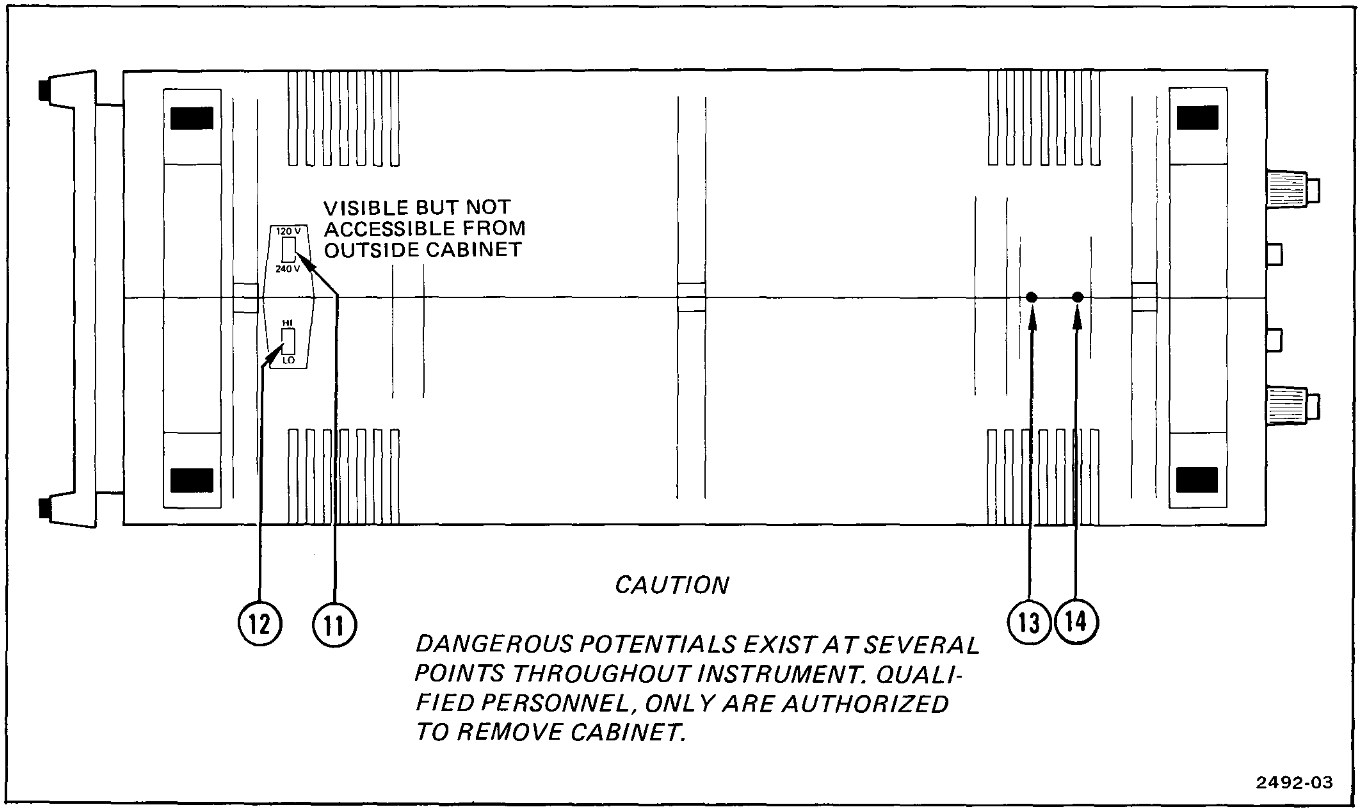


Fig. 2-4. Bottom of cabinet.

Bottom of Cabinet (Fig. 2-4)

(11) **120 V/240 V**—Switch selects either 120 V or 240 V nominal power input voltage (is visible, but not adjustable from outside cabinet).

(12) **HI/LO**—Screwdriver actuated switch selects either high or low nominal line-voltage regulating range: LO selects 100 V or 220 V and HI selects 120 V or 240 V.

(13) **CH 1 DC BAL**—Screwdriver adjustment. When properly adjusted, prevents trace shift when switching between adjacent positions of the CH 1 VOLTS/DIV switch.

(14) **CH 2 DC BAL**—Screwdriver adjustment. When properly adjusted, prevents trace shift when switching between adjacent positions of the CH 2 VOLTS/DIV switch.

B. VERTICAL AMPLIFIER

Front Panel (Fig. 2-5)

(1) **VOLTS/DIV**—Selects the vertical deflection factor in a 1-2-5 sequence (VAR control must be in detent position to obtain the indicated deflection factors). Read the correct deflection factor for a 1X probe from the 1X position and a 10X probe from the 10X position.

(2) **VAR**—Provides continuously variable uncalibrated deflection factors between the calibrated steps of the VOLTS/DIV switches. Extends the maximum deflection factor to 25 V/div in the 10 V position. Detent position provides calibrated VOLTS/DIV deflection factors.

(3) **Input Coupling**—Selects the method of coupling the input signal to the vertical input signal amplifier.

AC: Signals are coupled capacitively. Any dc signal component is blocked. Low frequencies are attenuated (3 dB down at about 1 Hz using a 10X probe). Ac coupling causes tilting of square waves below about 1 kHz.

GND: Grounds the input of the vertical amplifier to provide a ground reference display. Connects the input signal to ground through the input coupling capacitor and a 1 MΩ resistor to allow the input coupling capacitor to be precharged by the input signal.

DC: All components of the input signal are passed to the vertical amplifier.

(4) **Channel 1 or X Input**—BNC connector for applying an external signal to the vertical deflection system. In X-Y operation, CH 1 or X is horizontal input. Display mode is selected by Vertical Mode switches.

NOTE

CH 1 (X) is horizontal input and CH 2 (Y) is vertical input when instrument is used in SOURCE X-Y.

(5) **Channel 2 or Y Input**—BNC connector for applying an external signal to the vertical deflection system. In X-Y operation, CH 2 or Y is vertical input. Display mode is selected by Vertical Mode switches.

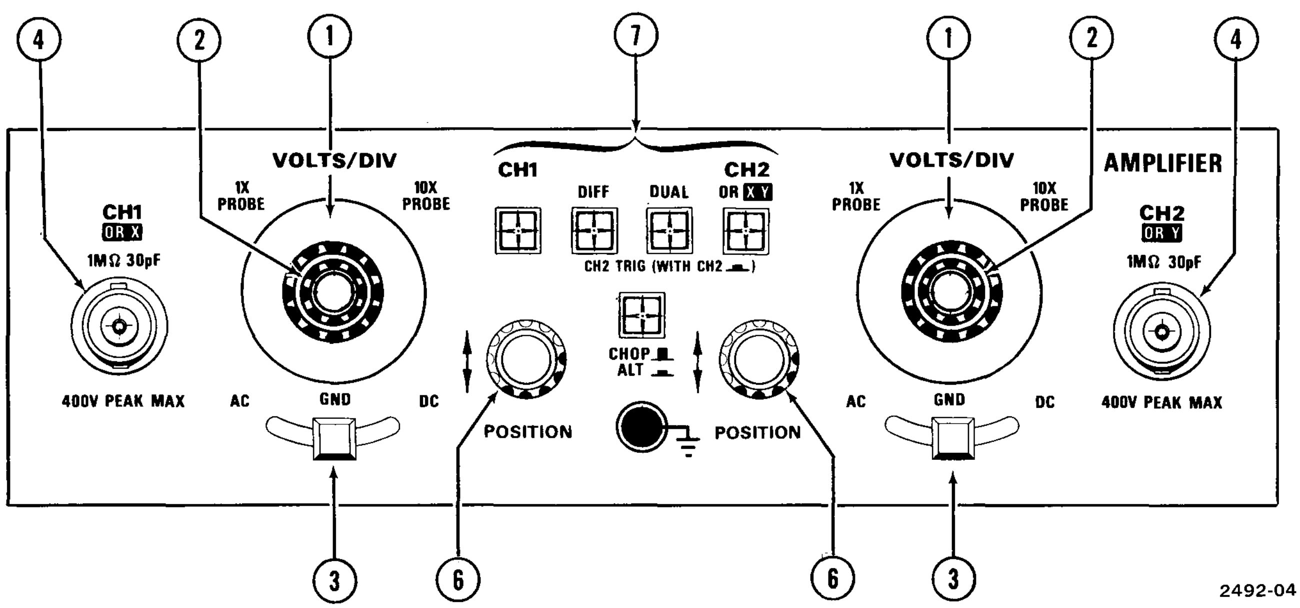


Fig. 2-5. Vertical Amplifier front panel controls and connectors.

(6) **POSITION**—Controls the vertical position of the crt display.

(7) **Vertical Mode**—Vertical amplifier operating mode is selected by a series five pushbutton switches (CHOP-ALT switch placed below four in line). Triggering signals are derived from channel 1 input except when CH 2 and one of DIFF or DUAL are engaged simultaneously.

CH 1: Displays only signals applied to CH 1 input connector.

DIFF: Provides a display of the algebraic difference between CH 1 and CH 2 input signals. Trigger signal is automatically derived from CH 1 unless CH 2 and DIFF pushbuttons are depressed simultaneously.

DUAL: with CHOP: Provides a display of signals from both channels switched from CH 1 to CH 2 at a frequency of approximately 250 kHz. Trigger signal is automatically derived from CH 1 input signal unless CH 2 and DUAL pushbuttons are depressed simultaneously.

DUAL: with ALT: Provides a display of CH 1 and CH 2 inputs alternately. Display is switched between channels at the end of each sweep. Trigger signal is automatically derived from CH 1 input signal unless CH 2 and DUAL (with ALT) pushbuttons are depressed simultaneously.

CH 2: Displays only signals applied to the CH 2 input connector. CH 2 pushbutton must be engaged for X-Y operation. Trigger signal is derived from CH 2.

C. TIME BASE

Front Panel (Fig. 2-6)

(1) **SOURCE**—The source of the signal supplied to trigger input amplifier is determined by six-position SOURCE switch and associated circuitry.

COMP (Composite Triggering): In this position the trigger signal is obtained from signal(s) displayed on crt. Does not show the time relationship of CH 1 and CH 2 in ALTernate vertical mode. Do not use composite triggering in CHOP vertical mode because display will trigger on switching transients, not on desired signal.

CH 1/CH 2 (Internal Triggering): In this position the trigger signal is a sample of channel signal displayed on crt — CH 1 or CH 2 in single trace. In DUAL, CHOP or ALT, and DIFF mode, the trigger signal is a sample of CH 1 input unless CH 2 is depressed simultaneously with DUAL or DIFF.

LINE: In this position the trigger signal is a sample of the line voltage applied to instrument.

EXT (External Triggering): This position permits triggering on signals applied to the external triggering input connector (item 5).

EXT/10: External trigger signals are attenuated by a factor of 10.

X-Y: This position permits X-Y displays. X input is through CH 1 and Y input is through CH 2.

(2) **MODE**—Selects the operating mode for the trigger circuit.

AUTO: With the proper LEVEL control setting, the sweep can be triggered by trigger signals with repetition rates above about 20 Hz. In the absence of an adequate trigger signal, or when the LEVEL control is misadjusted, the sweep free runs to provide a reference display.

NORM: Permits triggering on displayed signal. In the absence of an adequate trigger signal, or when the LEVEL control is misadjusted, the sweep does not run and no display is visible.

TV: Permits triggering on television signals. Triggers on TV field when SEC/DIV switch is set at .1 ms or slower. Triggers on TV line when SEC/DIV switch is set at 50 μs or faster. Set the SLOPE switch to +OUT for sync-positive input signals and to −IN for sync-negative input signals.

(3) **CPLG (Coupling)**—Push-button switch allows choice of capacitive or direct coupling to trigger input circuits.

(4) **SLOPE**—Selects the positive- or negative-going slope of the trigger waveform.

+(out): The sweep can be triggered from the positive-going portion of a trigger signal.

−(in): The sweep can be triggered from the negative-going portion of a trigger signal.

(5) **LEVEL**—Selects the amplitude point on the trigger signal at which the sweep is triggered. Usually adjusted for the desired display after trigger SOURCE and SLOPE have been selected.

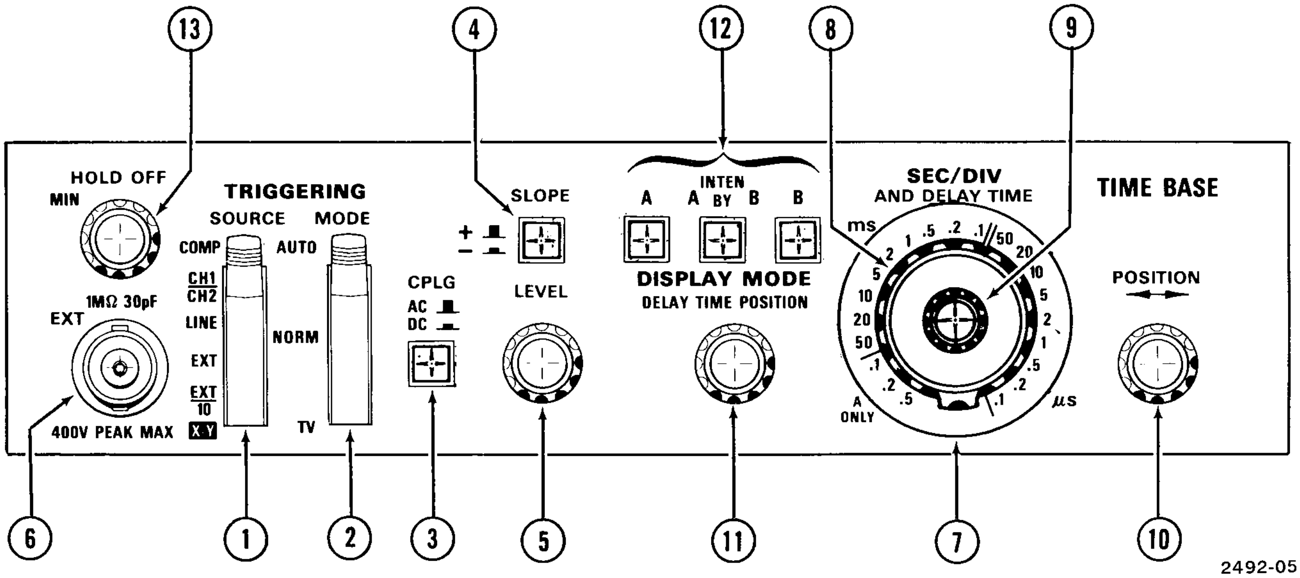


Fig. 2-6. Time Base front panel controls and connectors.

(6) **EXT (External Trigger)**—Provides input for external trigger signals.

(7) **A SEC/DIV AND DELAY TIME (clear plastic skirt)**—Selects calibrated sweep rates in a 1-2-5 sequence for the A Sweep Generator and the basic delay time for delayed sweep operation. The X1-X10 variable control must be in the X1 detent position (fully counterclockwise) to read calibrated sweep rates directly from the A SEC/DIV knob. Knob numerals with μ underneath indicates sweep rates in microseconds/division, numerals with **m** underneath indicate sweep rates in milliseconds/division, positions with no symbol under the numerals indicate sweep rates in seconds/division.

NOTE

Item 8 applies only to the T935A.

(8) **B SEC/DIV (black inner knob, pull out and turn to unlock)**—Selects calibrated sweep rates in a 1-2-5 sequence for the B Sweep (delayed sweep) Generator. (B sweep runs at 50 ms in the 0.1, 0.2, and 0.5 positions of the B SEC/DIV switch.)

(9) **X1-X10**—Provides calibrated sweep rates when in X1 (fully ccw) detent position. Increases the horizontal gain by a factor of 10, providing 10 ns/div sweep rate in the X10 detent position (fully cw) with the SEC/DIV knob set to .1 μs.

(10) **POSITION**—Controls the horizontal position of the crt display.

NOTE

Items 11 and 12 apply only to the T935A.

(11) **DELAY TIME POSITION**—Provides variable sweep delay from 0.5 to 10.0 times the setting of the A SEC/DIV switch. To find the delay time, multiply the number of divisions between the start of the sweep and the start of the intensified zone times the A SEC/DIV switch setting.

(12) **DISPLAY MODE**—Determines the mode of operation for the horizontal deflection system.

A: The A Sweep Generator provides the horizontal deflection. The A SEC/DIV switch determines the sweep rate, and the B Sweep Generator is inoperative.

A INTEN BY B: The A Sweep Generator provides the horizontal deflection and the B Sweep Generator produces an intensified zone after the delay time. The DELAY TIME POSITION control determines the location of the intensified zone. The duration of the intensified zone is determined by the B SEC/DIV switch.

B (delayed): The B Sweep Generator provides the horizontal deflection and the B SEC/DIV switch determines the sweep rate. The A Sweep Generator continues to run, and the start of the B sweep is delayed by a time determined by the A SEC/DIV switch.

(13) **HOLD-OFF**—Varies the hold-off time between sweeps. Allows triggering on aperiodic signals (such as complex digital words). Turn the control fully counterclockwise for the shortest sweep hold-off time and fully clockwise for the longest sweep hold-off time.

FIRST TIME OPERATION

Use this procedure when you turn the instrument on for the first time. It checks that most functions of the instrument are operational. This procedure requires a probe. (10X probes are supplied as standard accessories.) Read the descriptions of the controls and connectors to familiarize yourself with them before you turn your instrument on.

A complete performance check is given in Section 3.

Only the control settings that affect the check being performed are given. Do not move the control settings unless instructed to do so. Start at the beginning and follow the sequence of steps through to the end. If you skip a step or start in the middle of a check, you won't be able to tell whether a particular function is operational.

First, check that the Power Input Voltage Selector switch and the HI/LO Range Selector switch on the bottom of the cabinet are set for your power input voltage. In the United States the Power Input Voltage Selector switch is normally set for 120 V and the HI/LO Range Selector switch is normally set for HI at the factory. In Europe the Power Input Voltage Selector switch is normally set for 240 V and the HI/LO Range Selector is normally set for LO.

CAUTION

Your instrument may be damaged if it is operated from a 240 V power input voltage source with the Power Input Voltage Selector switch set for 120 V. Only qualified service personnel should change the Power Input Voltage Selector switch to a different range.

The POWER indicator LED will blink when the applied power input voltage varies more than about 10% (either high or low) from the value selected by the 120 V/240 V and HI/LO selector switches.

If the 120 V/240 V and HI/LO switches are properly set, connect the power cord plug to the power source and turn the instrument on. Set the trigger MODE to AUTO, and SOURCE to CH 1/CH 2.

You should get a trace on the crt screen. If you don't, push the BEAM FINDER button and hold it in while increasing the INTENSITY (clockwise). A trace, or one or two bright dots, indicates that the instrument is operating. You may also have to adjust the FOCUS and POSITION controls: then adjust POSITION controls until they have effect on trace or dots.

Vertical Positioning and Horizontal Operation

1. Set:

LEVEL	Mid-range
A SEC/DIV	1 ms
X1-X10	X1 (fully ccw detent)
Vertical Mode	CH 1
DISPLAY MODE	A

2. Check that the CH 1 POSITION control moves the trace off the top and bottom of the screen. Leave the trace between one and two divisions above the center line. If the trace does not extend across the screen, move the horizontal POSITION control until it does.

3. Set the vertical mode switch for CH 2. Check that the CH 2 POSITION control moves the trace off the top and bottom of the screen. Leave the trace between one and two divisions below the center line.

4. Set the vertical mode switch for DUAL. You should have two traces on the crt screen—one above the center line and one below.

NOTE

Set to CHOP for slower than 1 ms/div; set to ALT at .5 μs/div and faster.

5. Check that there are two traces at every setting of the SEC/DIV switch from .1 μs to .5 s.

6. Set the SEC/DIV switch to 1 ms and the Vertical Mode switch to CH 1.

FOCUS and INTENSITY Operation

Adjust the FOCUS and the INTENSITY controls for a fine line at a comfortable brightness level.

Trace Rotation and Vertical Input Operation

Most of the remaining checks require applying the PROBE COMP signal to the inputs.

NOTE

In the following steps, if you use a 1X probe or coaxial cable, use the 1X PROBE window for VOLTS/DIV settings. If you use a 10X probe (as supplied), use the 10X probe window.

The PROBE COMP output is a square wave. An incorrectly commpensated probe will distort the top and bottom of the signal but will not affect the checks.

If you want to compensate a probe, refer to the Probe Compensation information after this procedure.

1. Set:

CH 1 VOLTS/DIV	.2 V (10X window for X10 probe, 1X window for 1X probe)
CH 1 VAR	Detent (fully cw)
CH 1 AC-GND-DC	GND

2. Using the CH 1 POSITION control, align the trace with the center graticule line. If the trace is tilted, adjust the trace rotation (control marked TR ROT on the left-cabinet side) for the best alignment of the trace with the center graticule line.

3. Connect the probe to the CH 1 input and hold the probe tip against the PROBE COMP connector. Set the CH 1 AC-GND-DC switch to DC. You should have approximately 2.5 divisions of display. The square wave will be below the center line. This display may or may not be stable.

4. Set the CH 1 AC-GND-DC switch to AC. The display should be approximately equidistant above and below the center line.

NOTE

If you cannot obtain a display, remove the probe tip from the PROBE COMP connector. Touch the tip to your hand. Change the VOLTS/DIV setting if necessary to get a display. The display should be a thick (vertically) trace. A thickening trace indicates that the probe is picking up the power line radiation that your body normally picks up. If this occurs, the vertical is usable but the PROBE COMP output isn't. If the thickening does not occur, you have a defective probe or other instrument malfunction.

5. Rotate the CH 1 VAR control through its range. The display amplitude will decrease. Leave the VAR control fully clockwise (detent)—maximum display amplitude.

6. Set:

Vertical Mode	CH 2
CH 2 VOLTS/DIV	.2 V
CH 2 VAR	Detent (fully cw)
CH 2 AC-GND-DC	GND
CH 2 POSITION	To align trace with center graticule line

7. Connect the probe to the CH 2 input and hold the probe tip against the PROBE COMP connector.

8. Set the CH 2 AC-GND-DC switch to DC. The square wave will be below the center line.

9. Set the CH 2 AC-GND-DC switch to AC. The square wave will be approximately equidistant above and below the center line.

10. Rotate the CH 2 VAR control through its range. The display amplitude will decrease. Leave the VAR control fully clockwise (in detent).

11. Return the vertical mode switch to CH 1.

X-Axis Operation

1. Connect the probe to the X input (CH 1) and hold the probe tip against the PROBE COMP connector.

2. Set the SOURCE switch to X-Y, and reduce INTENSITY as necessary. Adjust the horizontal POSITION control as needed to locate the display. You should see 2 dots separated by a distance dependent on the CH 1 VAR control setting. Return VAR to cal (fully counterclockwise detent).

Astigmatism Operation

1. Set: SOURCE — CH 1/CH 2

2. Connect the probe to the CH 1 input and hold the probe tip against the PROBE COMP connector. Rotate the LEVEL control for the most stable display. Adjust the FOCUS control for a display with the sharpest edges both horizontally and vertically over the entire screen. Vertical trace thickness is typically more than the horizontal but the edges should be equally sharp. This is easier to observe at the "corners" of the signal.

3. Set the INTENSITY and FOCUS controls for the best defined display. If the display still appears out of focus, use a small screwdriver to adjust the ASTIG control (through left cabinet side) for the best defined display.

4. Rotate the INTENSITY control fully clockwise. The display will get brighter and defocus (get thicker). Return the INTENISTY control to the preferred brightness level.

Ext Z Axis Input Operation

A positive-going signal will cause a decrease in intensity, and a negative-going signal will increase the intensity level of a low-intensity trace.

X1-X10 and Trigger Operation

1. Note a display with about 10 cycles of the PROBE COMP waveform. Rotate the X1-X10 control fully clockwise to X10 and note that only one cycle is visible. Return control to X1.

2. Set the SEC/DIV to .1 ms. Position the start of the display (left edge) on the screen. Set the SLOPE button to the +(in) position. Rotate the LEVEL control through its range. The start of the display will move along the positive (rising) slope of the signal until the display becomes unstable.

3. Set the LEVEL control for a stable display that starts at about the middle of the slope.

Now set the SLOPE button to −(out) position. Rotate the LEVEL control through its range. The start of the display will move along the negative (falling) slope of the signal until the display becomes unstable.

4. Set the LEVEL control for a stable display that starts at about the middle of the slope.

5. Set the MODE switch to NORM. The display should start on the negative slope. In the NORM mode the display will disappear if the LEVEL control is improperly adjusted.

6. Set the SLOPE button to +(out) position. The display should start on the positive slope.

7. Disconnect the probe from the instrument. Set the CH 1 AC-GND-DC switch to GND. The trace should disappear.

8. Set the SOURCE switch to LINE. If a trace doesn't appear, adjust the LEVEL control until a trace appears.

9. Set:

SOURCE	CH 1/CH 2
MODE	AUTO
CH 1 AC-GND-DC	AC

Delay Time Position and Delayed Sweep Operation (T935A only)

1. Set:

DISPLAY MODE	A INTEN BY B
DELAY TIME POSITION	Fully ccw

2. The start of the intensified portion of the sweep should be within 0.5 div of the start of the sweep.

3. Rotate the DELAY TIME POSITION control until it is fully clockwise. The start of the intensified portion of the sweep will move until it is at least 10 divisions from the start of the sweep.

4. Set DISPLAY MODE to B. The display will consist of only the intensified portion or delayed (B Sweep) portion.

5. Return the DISPLAY MODE to A INTEN BY B and turn the DELAY TIME POSITION control fully counterclockwise.

6. Set the B SEC/DIV switch to .1 μs. The intensified portion will reduce to a dot. Rotating the DELAY TIME POSITION control will move the dot across the screen.

7. Set:

SOURCE	CH 1/CH 2
MODE	AUTO
CH 1 AC-GND-DC	AC

Your instrument is now ready to operate when you apply a signal to the CH 1 input.

PROBE COMPENSATION

An incorrectly-compensated probe is one of the greatest sources of operator error. Most attenuator probes are equipped with adjustments to ensure optimum measurement accuracy.

Some probes are compensated by using a small, insulated screwdriver through an access hole to the compensation adjustment. Other probes may have an adjustment system similar to that shown in Fig. 2-7.

Probe compensation is accomplished as follows:

Set the appropriate VOLTS/DIV switch to .1 V, the AC-GND-DC switch to DC, and the SEC/DIV switch to 2 ms.

Connect the probe to the vertical input and touch the probe tip to the PROBE COMP connector. Notice a display similar to those shown in Fig. 2-8. Adjust the probe for the correct compensation. The effects of incorrect probe compensation on three types of signals are illustrated in Fig. 2-8.

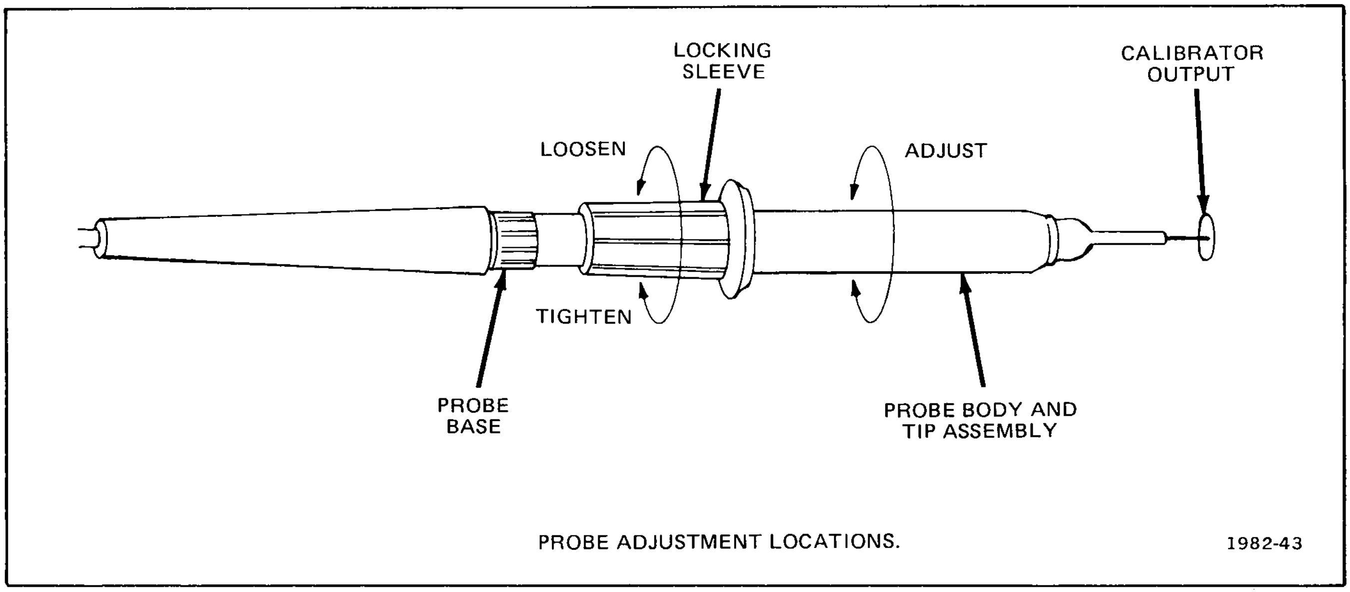


Fig. 2-7. Probe compensation.

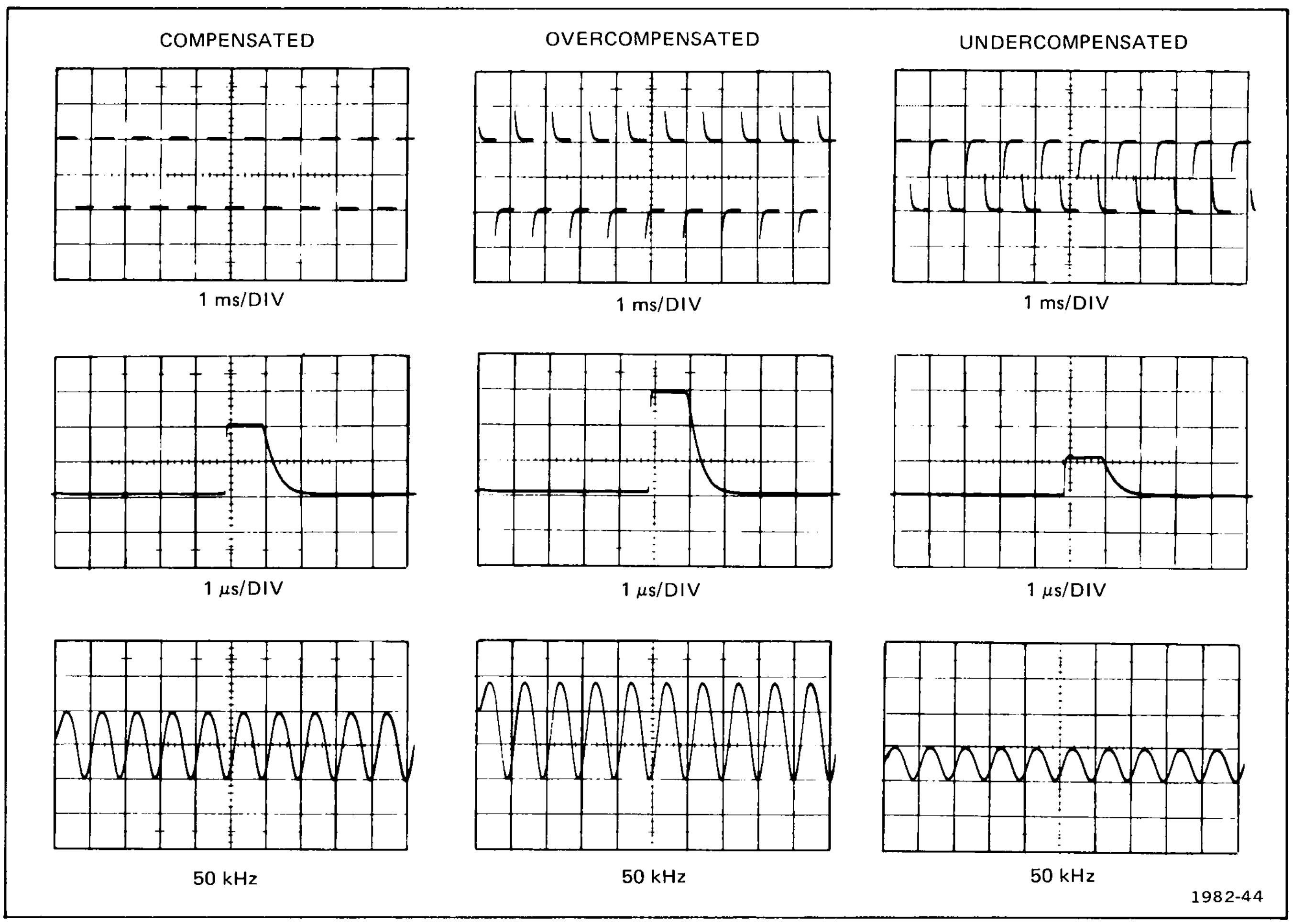


Fig. 2-8. Effects of probe compensation.

APPLICATIONS

Peak-to-Peak Amplitude Measurements

To measure the amplitude of a signal, mulitply the vertical deflection (in divisions) by the VOLTS/DIV switch setting. (Use VOLTS/DIV window to match attenuation factor of probe used.)

Example:

The display amplitude is three divisions (see Fig. 2-9) and the VOLTS/DIV switch is set to .5 V. Substituting the given values:

Amplitude = 3 divisions X 0.5 volt/division = 1.5 V p-p

Instantaneous Amplitude Measurement

The following procedure explains how to measure the amplitude of any point on a waveform with respect to ground.

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

2. Apply the signal to be measured to one of the vertical input connectors. Set the Vertical Mode switch to select the channel used.

3. Obtain a stable display, centered vertically.

4. Set the AC-GND-DC switch to GND. Adjust the trace to some reference line (see Fig. 2-10).

5. Set the AC-GND-DC switch to DC. If the waveform appears above the reference line, the voltage is positive. If the waveform appears below the reference line, the voltage is negative.

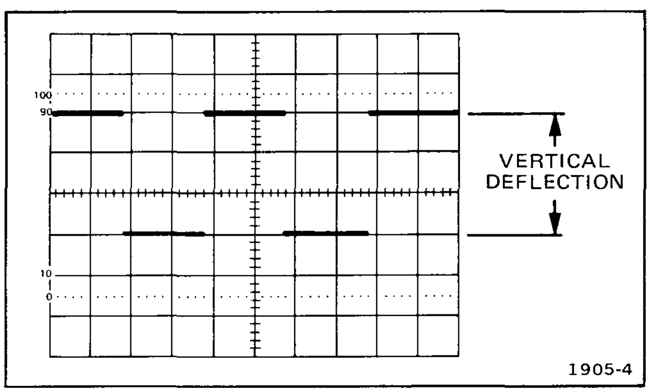


Fig. 2-9. Peak-to-peak voltage measurement.

6. Measure the vertical difference (in divisions) between the reference line and the desired point on the waveform and multiply by the VOLTS/DIV switch setting.

Example:

The vertical difference is 5 divisions (see Fig. 2-10). The VOLTS/DIV switch is set to 10 mV. The waveform appears above the reference line.

Substituting the given values:

$$\text{Instantaneous Voltage} = 5\ \text{divisions} \times \frac{10\ \text{mV}}{\text{divisions}} = 50\ \text{mV}$$

$$\text{Instantaneous Voltage} = +50\ \text{mV}$$

Dual Trace Phase Difference Measurement

Phase comparison between two signals of the same frequency can be accomplished using the dual-trace feature. This method of phase difference measurement can be used up to the frequency limit of the vertical system. To make the comparison, use the following procedure:

1. Set the AC-GND-DC switches to AC.

2. Set the Vertical Mode switch to DUAL and select ALT or CHOP. Position both traces to the graticule horizontal centerline.

3. Connect the reference signal to the Channel 1 input connector and the comparison signal to the Channel 2 input connector. Use coaxial cables or probes which have equal time delay to connect the signals to the input connectors.

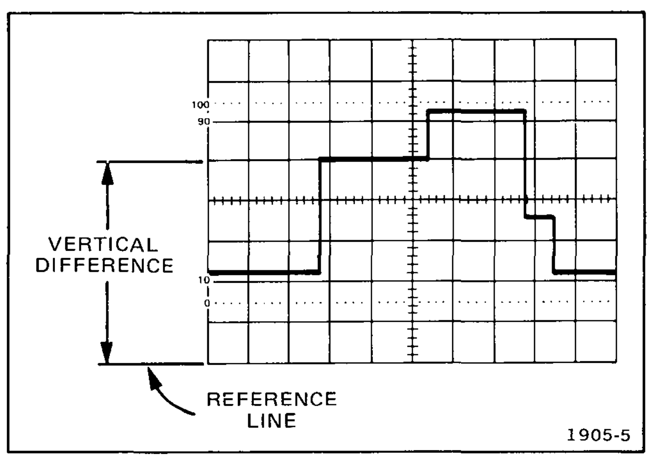


Fig. 2-10. Instantaneous voltage measurement.

4. Set the Channel 1 and Channel 2 VOLT/DIV switches and the Channel 1 and Channel 2 VAR controls so that the displays are equal and about five divisions in amplitude.

5. Set the SEC/DIV switch to a sweep rate which displays about one cycle of the reference waveform.

6. Turn the variable (X1-X10) SEC/DIV control until one cycle of the reference signal (Channel 1) occupies exactly eight divisions between the first and ninth graticule lines (see Fig. 2-11). Each division of the graticule represents 45° of the cycle (360° ÷ 8 divisions = 45°/division).

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

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

Example:

Assume a horizontal difference of 0.6 division with a sweep rate of 45°/division as shown in Fig. 2-11.

Substituting the given values:

$$\text{Phase Difference} = 0.6 \text{ division X } 45°/\text{division}$$

$$\text{Phase Difference} = 27°$$

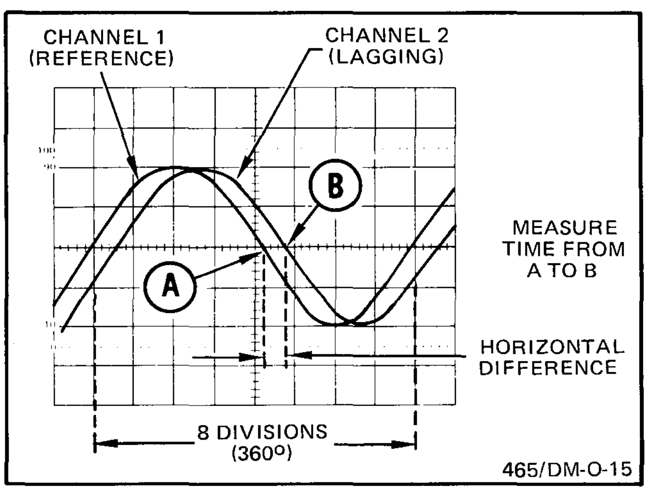


Fig. 2-11. Phase difference.

Time Duration and Frequency Measurements

To find the time duration between two points on a waveform, multiply the horizontal distance (in divisions) between the two points by the SEC/DIV switch setting. Frequency (in hertz) is the reciprocal of the time duration of one cycle (in seconds).

Example:

The horizontal distance measured is 8.3 divisions (see Fig. 2-12).

The SEC/DIV switch is set to 2 ms.

Substituting the given values:

$$\text{Time Duration} = \text{Horizontal distance (divisions)} \text{ X } \text{SEC/DIV setting}$$

$$\text{Time Duration} = 8.3 \text{ divisions X } 2 \text{ ms/division}$$

$$\text{Time Duration} = 16.6 \text{ ms (milliseconds)}$$

and

$$\text{Frequency} = \frac{1}{\text{time duration}}$$

$$\text{Frequency} = \frac{1}{16.6 \text{ ms}^{a}} = 60 \text{ Hz}$$

[a]16.6 ms = .0166 second.

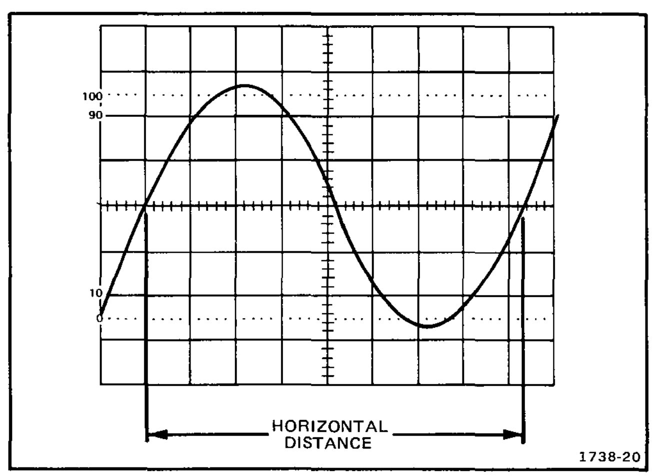


Fig. 2-12. Time duration.

Risetime Measurements

Risetime measurements are made in the same manner as time duration measurements, except the measurements are made between the 10% and 90% points of the waveform's amplitude (see percentage markings on the left edge of the graticule).

Use the following procedure to measure risetime:

1. Adjust the VOLTS/DIV and VAR controls for a display amplitude of exactly five divisions.

2. Adjust the vertical POSITION control so that the display bottom just touches the 0% graticule line and the display top just touches the 100% graticule line (see Fig. 2-13).

3. Measure the horizontal distance (divisions) between the 10% and 90% points on the waveform (point A to point B, Fig. 2-13).

4. Use the following formula to find risetime:

$$\text{Risetime} = \begin{array}{c}\text{horizontal}\\ \text{distance}\\ \text{(divisions)}\end{array} \times \begin{array}{c}\text{SEC/DIV}\\ \text{setting}\end{array}$$

Examples:

The horizontal distance between the 10% and 90% point on the waveform is five divisions with a SEC/DIV switch setting of 1 μs.

Substituting the given values:

Risetime = 5 divisions X 1 μs/division

Risetime = 5 μs

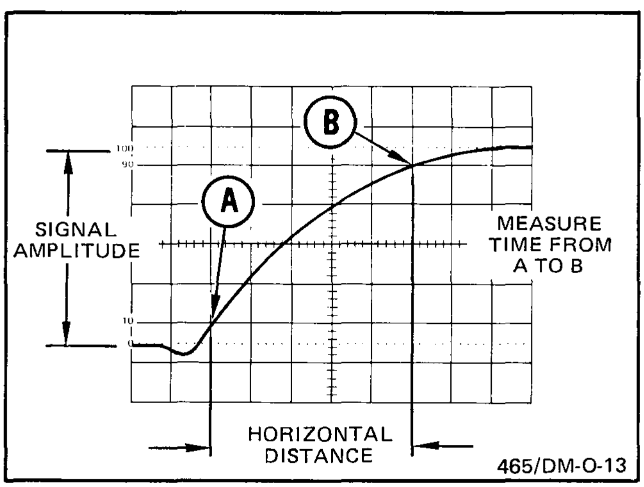


Fig. 2-13. Risetime.

A Intensified Differential Time Measurements

1. Set the A SEC/DIV switch and the horizontal POSITION control to locate both time measurement points within the graticule area (see Fig. 2-14).

2. Set the DISPLAY MODE switch to A INTEN BY B.

3. Unlock the B SEC/DIV switch and rotate clockwise to obtain the shortest usable intensified zone.

4. Use the DELAY TIME POSITION (DTP) control to move the left edge of the intensified zone to just touch the first time measurement point (see Fig. 2-14, point A). Note the number of divisions between the start of the sweep and the start of the intensified zone.

5. Use the DTP control to move the left edge of the intensified zone to just touch the second time measurement point (see Fig. 2-14, point B). Note the number of divisions between the start of the sweep and the start of the intensified zone. Also note the number of divisions between point A and point B.

6. To find the Time Difference, multiply the number of divisions between point A and point B by the A SEC/DIV switch setting.

Example:

The A SEC/DIV switch was set to 2 ms and the B SEC/DIV switch was set to 0.1 ms. Point A is 8.4 divisions from point B. So the time difference is 8.4 x 2 ms = 16.8 ms.

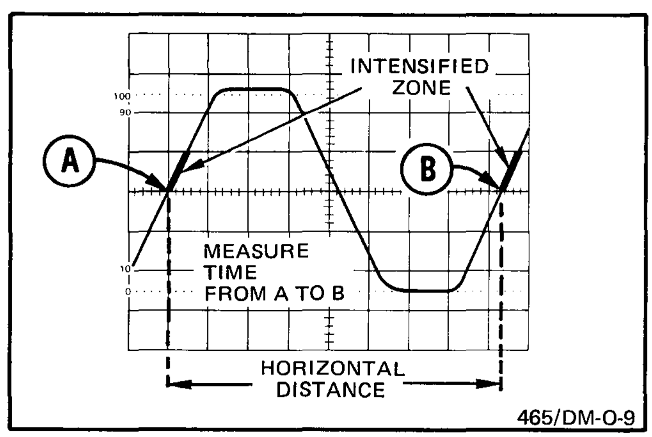


Fig. 2-14. Time duration between points on a waveform.

@

Delayed Sweep Magnification

The B Delayed mode can provide higher apparent sweep rate magnification than that provided by the X1-X10 control.

Magnified Sweep Starts After Delay. To determine the apparent magnification factor, proceed as follows:

1. Set the DISPLAY MODE switch to A INTEN BY B.

2. With the DELAY TIME POSITION control, move the left edge of the intensified zone to the left side of the portion of the A sweep display to be magnified.

3. Set the B SEC/DIV switch so just the portion of the A sweep display to be magnified is intensified (see Fig. 2-15A).

4. Set the DISPLAY MODE switch to B. The portion of the A sweep display that was intensified in step 3 is now displayed in magnified form (see Fig. 2-15B). The displayed sweep rate is determined by the B SEC/DIV switch. To calculate the apparent magnification factor, use the formula:

$$\text{Apparent Magnification} = \frac{\text{A SEC/DIV switch setting}}{\text{B SEC/DIV switch setting}}$$

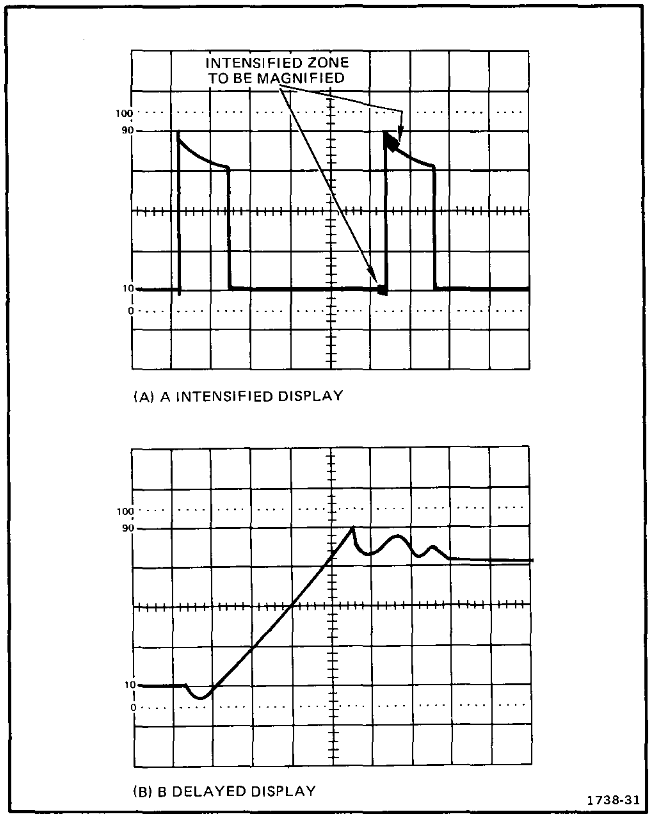


Fig. 2-15. Delayed sweep magnification.

PERFORMANCE CHECK

This procedure allows the basic performance specifications to be checked without removing the instrument covers. It is intended for use in incoming inspection to determine acceptability of newly purchased or recently calibrated instruments.

LIMITS AND TOLERANCES

Tolerances given are for the instrument under test and do not include test equipment error. Limits and tolerances in this check, are instrument specifications only if they are called out as performance requirements in the Specifications section.

TEST EQUIPMENT REQUIRED

You will need the test equipment listed in Table 3-1, or equivalent, to perform a complete Performance Check of the T932A or T935A. The Specifications given for the equipment are the minimum necessary for accurate results.

TABLE 3-1

Test Equipment

Description	Minimum Specifications	Usage	Examples of Applicable Test Equipment
1. Amplitude Calibrator	Amplitude accuracy, within 0.5%; signal amplitude, 10 mV to 10 V; output signal, 1 kHz square wave.	Vertical Gain checks, X gain check.	a. Tektronix PG 506 Calibration Generator[a]. b. Tektronix 067-0502-01 Calibration Fixture.
2. Sine-Wave Generator	Frequency, 50 kHz to above 35 MHz; output amplitude, variable from 0.5 to 5 V p-p; output impedance, 50 Ω; reference frequency, 50 kHz; amplitude accuracy, constant within 3% of reference frequency as output frequency changes.	Vertical Amplifier bandwidth checks, X bandwidth check. Triggering checks. Z axis input check.	a. Tektronix SG 503 Leveled Sine-Wave Generator[a] (with included precision cable). b. Tektronix Type 191 Constant Amplitude Signal Generator.
3. Time-Mark Generator	Marker outputs, 10 ns to 0.5 s; marker accuracy within 0.5%; trigger output, 1 ms to 0.1 μs, time coincident with markers.	Timing checks.	a. Tektronix TG 501 Time-Mark Generator.[a] b. Tektronix 2901 Time-Mark Generator.
4. Termination	Impedance, 50 Ω; bnc connectors.	Signal termination.	a. Tektronix Part 011-0049-01.
5. Cable (3)	50 Ω impedance; bnc connectors.	Signal interconnection.	a. Tektronix Part 012-0057-01.
6. Dual Input Coupler	Connectors, bnc female to 2 bnc male.	Signal interconnection.	a. Tektronix Part 067-0525-00.

[a]**Requires a TM 500 Series Power Module.**

TABLE 3-1 (cont)

Description	Minimum Specifications	Usage	Examples of Applicable Test Equipment
7. T Connector	Connectors, bnc.	Signal interconnection.	a. Tektronix Part 103-0030-00.
8. Adapter	Bnc female to bnc female.	Signal interconnection.	a. Tektronix Part 103-0028-00.
9. TV Source	Composite Sync, output at least 100 mV (or Composite video, output at least 230 mV).	TV SYNC trigger.	a. Any video source with the specified output, including a TV set.

[a]Requires a TM 500 Series Power Module.

PRELIMINARY PROCEDURE

Use the following steps to put your instrument into a basic operating mode before proceeding with the Performance Check. This procedure is the same for both the T932A and the T935A, except where noted.

1. Check that the Power Input Voltage Selector switch and the HI/LO Range Selector switch on the bottom of the cabinet are set for your power input voltage. In the United States, the Power Input Voltage Selector switch is normally set for 120 V and the HI/LO Range Selector switch is normally set for HI at the factory. In Europe, the Power Input Voltage Selector switch is normally set for 240 V and the HI/LO Range Selector switch is normally set for LO. Only qualified service personnel should change the Power Input Voltage Selector switch to a different voltage range setting.

2. If the 120 V/240 V and HI/LO switches are properly set, connect the power cord plug to the power source and turn the instrument on. Connect test equipment to an appropriate power source and turn it on. Set the trigger MODE to AUTO, and SOURCE to CH 1/CH 2.

NOTE

Allow a 20 minute warmup before starting the Performance Check Procedure. This instrument must have been adjusted at an ambient temperature of +25° C within 5° C to ensure that checks in this procedure will meet the specifications listed in Section 1.

3. Set the controls as follows:

Vertical Amplifier

Vertical Mode	CH 1
POSITION (both)	Midrange
VOLTS/DIV (both)	2 mV[1]
VAR (both)	Detent (cw)
CH 1 AC-GND-DC	DC
CH 2 AC-GND-DC	GND

Time Base

SEC/DIV	.5 ms
X1-X10 (variable)	X1 (unmagnified—fully ccw in detent)
SOURCE	CH 1/CH 2
MODE	AUTO
CPLG	AC (out)
POSITION	Midrange
SLOPE	+(out)
LEVEL	Midrange
HOLD-OFF	Fully ccw
DELAY TIME POSITION	Fully ccw
DISPLAY MODE	A

4. The POWER ON light should be on and a baseline trace should be visible on the graticule. Adjust INTENSITY, FOCUS, and ASTIG controls for low intensity, well-defined trace.

The baseline should be parallel with horizontal graticule lines. If not, adjust R472, TR ROT (trace rotation), in the left side panel until the trace aligns with the horizontal graticule lines.

This ends the preliminary procedure.

[1]Unless otherwise stated, use the 1X PROBE window for VOLTS/DIV settings throughout the Performance Check Procedure.

PERFORMANCE CHECK PROCEDURE

1. CH 1 and CH 2 Deflection Accuracy

a. Connect test equipment as shown in Fig. 3-1 (use appropriate POSITION control as needed to center the display within the graticule area).

b. CHECK—Deflection accuracy for CH 1 according to Table 3-2 within 3% (+20°C to +30°C).

c. Set: CH 1 AC-GND-DC GND
CH 2 AC-GND-DC DC
Vertical Mode CH 2
CH 2 POSITION As needed

d. CHECK—Deflection accuracy for CH 2 according to Table 3-2 within 3% (+20°C to +30°C).

e. Set amplitude calibrator to 0.1 volt.

2. CH 1 and CH 2 VAR (Variable) Volts/Div Range

a. Set CH 1 and CH 2 VOLTS/DIV to 20 mV.

TABLE 3-2
Deflection Accuracy

VOLTS/DIV (1X PROBE WINDOW)	Amplitude Calibrator Output	Vertical Deflection (divisions)	±3% Tolerance (divisions)
2 mV	10 mV	5	4.85 to 5.15
5 mV	20 mV	4	3.88 to 4.12
10 mV	50 mV	5	4.85 to 5.15
20 mV	.1 V	5	4.85 to 5.15
50 mV	.2 V	4	3.88 to 4.12
.2 V	1 V	5	4.85 to 5.15
2 V	10 V	5	4.85 to 5.15
5 V	20 V	4	3.88 to 4.12
10 V	100 V	5	4.85 to 5.I5

b. CHECK—Display amplitude reduces from five divisions to less than two divisions with CH 2 VAR control turned fully counterclockwise.

c. Set: Vertical Mode CH 1
CH 1 AC-GND-DC DC
CH 2 AC-GND-DC GND

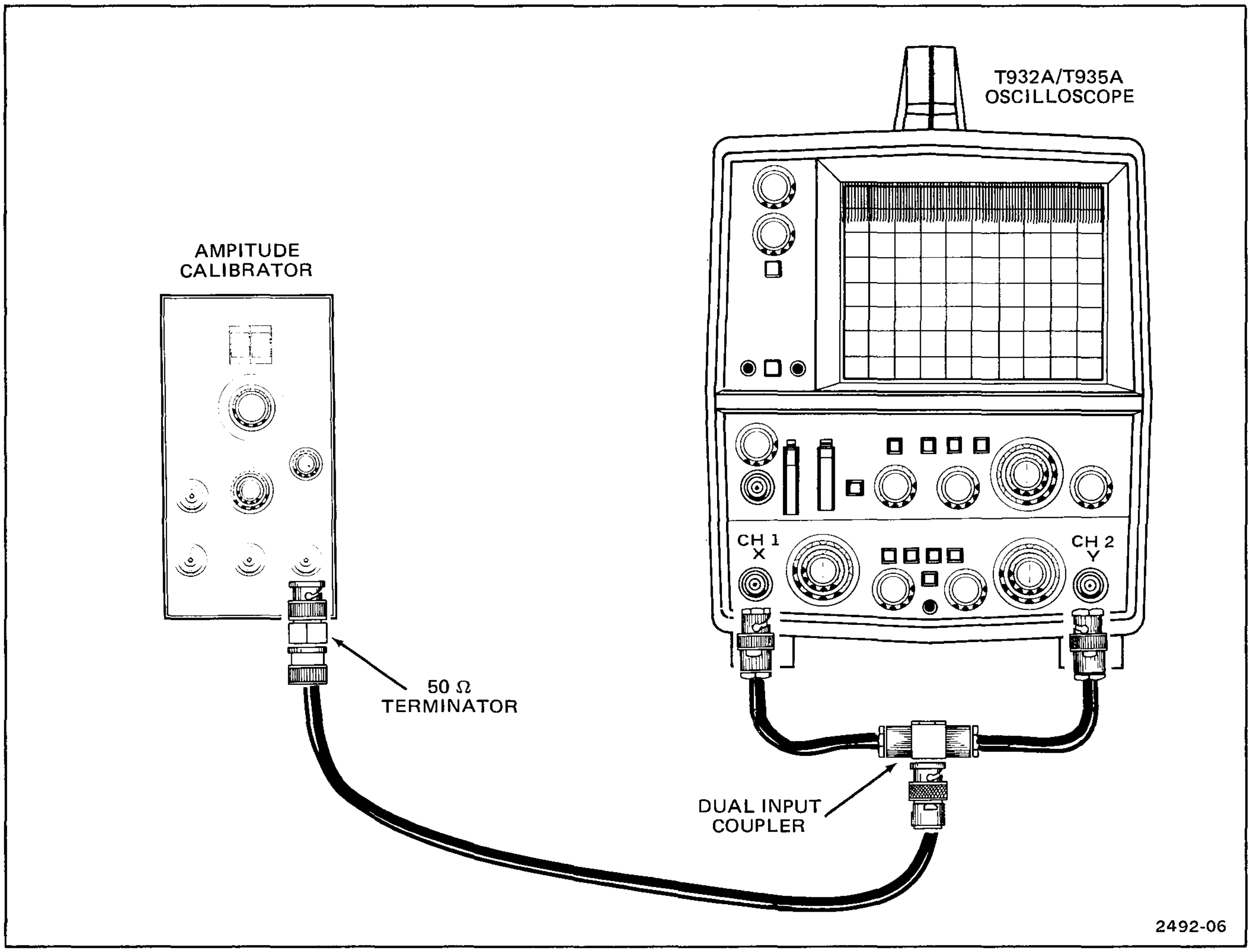


Fig. 3-1. Deflection accuracy check test setup.

d. CHECK—Display amplitude reduces from 5 divisions to less than 2 divisions with CH 1 VAR control turned fully counterclockwise.

e. Return both VAR controls to detent position.

3. X-Axis Gain

a. Set:

Vertical Mode	CH 2
VOLTS/DIV (CH 1)	.1 V
SOURCE	X-Y
X1-X10	X1
INTENSITY	For visible display
SEC/DIV	0.1 ms

b. CHECK—Horizontal deflection between 3.5 and 6.5 divisions (set horizontal POSITION as needed to view start and end of display).

c. Disconnect test equipment.

4. Channel 1 Bandwidth

a. Connect test equipment as shown in Fig. 3-2.

b. Set:

VOLTS/DIV (both)	2 mV
AC-GND-DC (both)	DC
LEVEL	Fully cw
POSITION (all)	As required

c. Set generator frequency to 50 kHz (reference) and adjust output amplitude for a 5 division display.

d. Set generator frequency to 35 MHz.

e. CHECK—Display amplitude is at least 3.5 divisions.

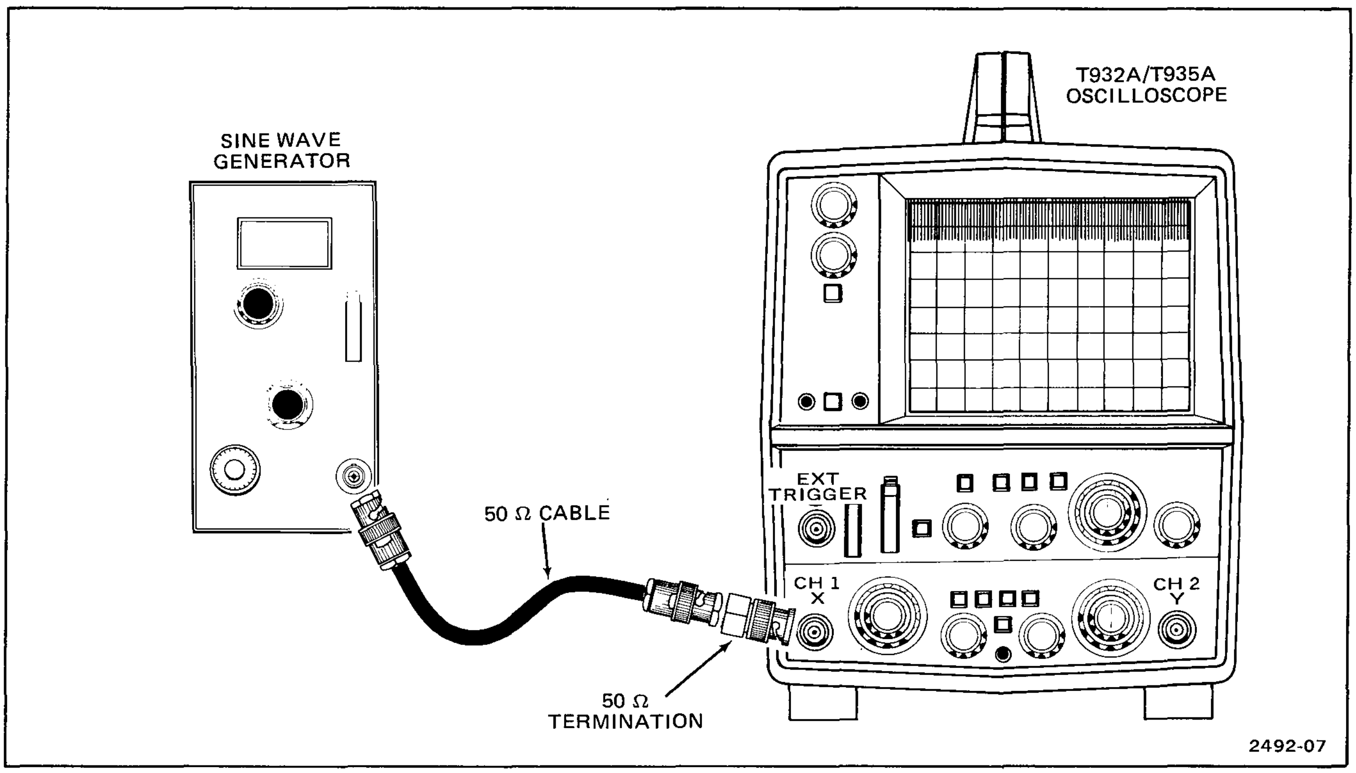


Fig. 3-2. Bandwidth check test setup.

5. Channel 2 Bandwidth

a. Set: Vertical Mode CH 2

b. Move the sine-wave generator output (through 50 Ω cable and 50 Ω termination) from CH 1 input connector to CH 2 input connector.

c. Set generator frequency to 50 kHz (reference) and adjust output amplitude for a 5 division display.

d. Set generator frequency to 35 MHz.

e. CHECK—Display amplitude is at least 3.5 divisions.

f. Disconnect test equipment.

6. X-Axis Bandwidth

a. Set:

SOURCE	X-Y
Vertical Mode	CH 2
CH 1 AC-GND-DC	AC
CH 2 AC-GND-DC	GND

b. Connect sine-wave generator though 50 Ω cable, without 50 Ω termination, to X (CH 1) input.

c. Set generator frequency to 50 kHz (reference) and adjust output amplitude for 10 divisions (about 1 volt) of horizontal deflection.

d. Set generator frequency to 2 MHz.

e. CHECK—Display amplitude is at least seven divisions.

f. Disconnect test equipment.

g. Set SOURCE to CH 1/CH 2; MODE to NORM.

NOTE

When making trigger checks, adjust the LEVEL control, POSITION controls, and INTENSITY as needed for a stable visible display, unless instructed otherwise.

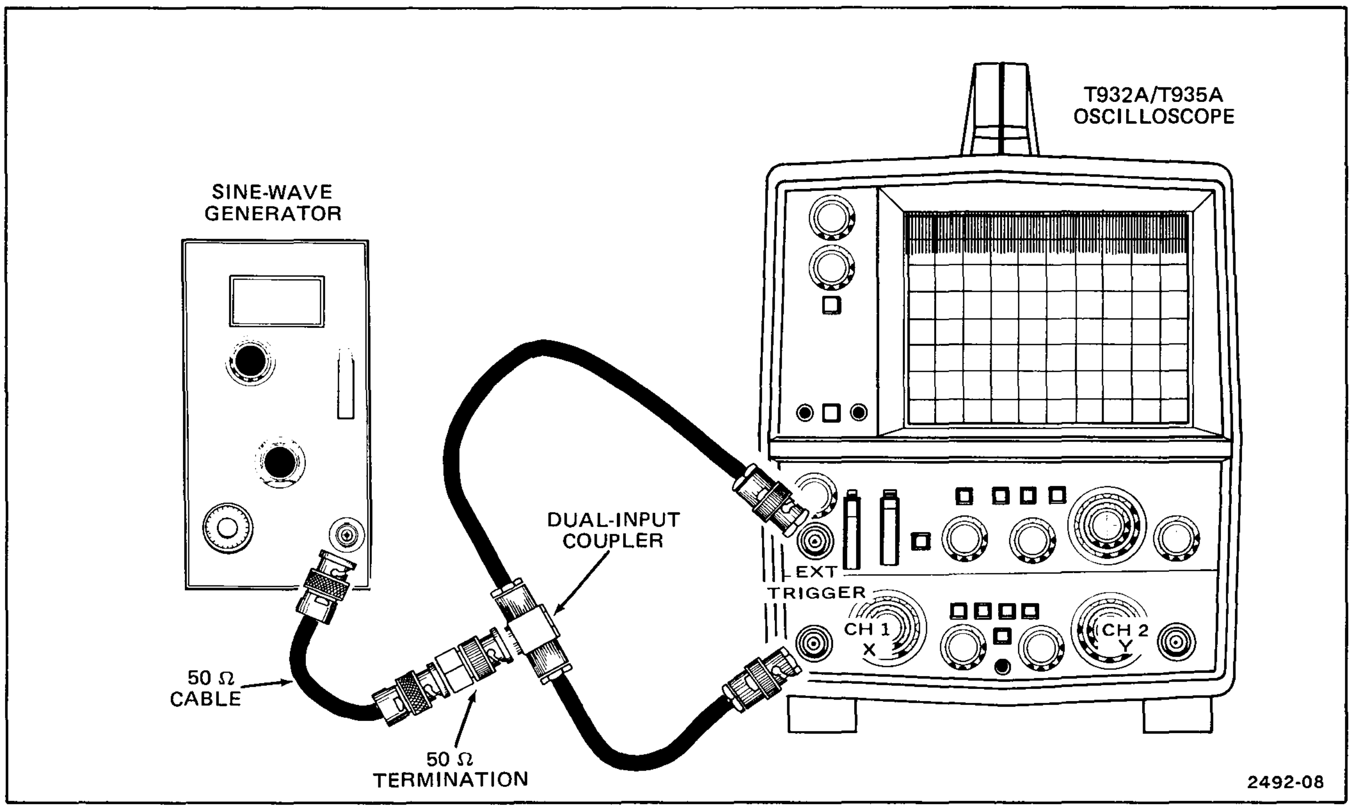


Fig. 3-3. X Gain, Triggering, and Z-axis input check test setup.

7. 2 MHz Internal Triggering

a. Connect test equipment as shown in Fig. 3-3.

b. Set:

CH 1 VOLTS/DIV	1 V
SEC/DIV	.1 μs
X1-X10	X1 (fully ccw detent)
SOURCE	CH 1/CH 2

c. Set sine-wave generator frequency for 2 MHz and adjust output amplitude for a 0.5-division display.

d. CHECK—Stable display can be obtained in both the +OUT and −IN positions of the SLOPE switch for both AUTO and NORM.

e. CHECK—Stable display can be obtained in DC as well as AC CPLG.

8. 2 MHz External Triggering

a. Set: CH 1 VOLTS/DIV .1 V

b. Adjust sine-wave generator output amplitude for 100 mV (one division on crt).

c. Set: SOURCE EXT

d. CHECK—Stable display can be obtained in both the +(out) and −(in) positions of the SLOPE switch for both AUTO and NORM.

9. 35 MHz Internal Triggering

a. Set:

SOURCE	CH 1/CH 2
CH 1 VOLTS/DIV	50 mV
X1-X10 (variable)	X10 (fully cw detent)

b. Set sine-wave generator frequency for 35 MHz and output amplitude for a 3-division display; then set CH 1 VOLTS/DIV to .1 V.

c. CHECK—Stable display can be obtained in both the +OUT and −IN positions of the SLOPE switch for both AUTO and NORM modes.

d. CHECK—Stable display can be obtained in DC as well as AC CPLG.

10. 35 MHz External Triggering

a. Set: SOURCE EXT

b. CHECK—Stable display can be obtained in both the +OUT and −IN positions of the SLOPE switch for both AUTO and NORM.

e. CHECK—Stable display can be obtained in DC as well as AC CPLG.

11. Z-Axis Input

a. Set:

CH 1 VOLTS/DIV	1 V
SEC/DIV	.1 ms
SOURCE	CH 1/CH 2
MODE	AUTO
X1-X10 (variable)	X1 (fully ccw detent)

b. Set sine-wave generator frequency to 50 kHz and adjust output amplitude for a 5-division display.

c. Disconnect 50 Ω cable from EXT (external trigger) input, and connect it to EXT Z AXIS connector at rear of instrument.

d. CHECK—Trace modulation is noticeable at normal intensity. (Adjust LEVEL control as required to obtain stable display).

e. Disconnect test setup.

12. Low Frequency Triggering

a. Set:

SEC/DIV	10 ms
VOLTS/DIV (CH 1)	2 mV
CH 1 AC-GND-DC	DC
MODE	NORM

b. Connect 10X probe to CH 1 input.

c. Lay probe near ac line voltage source and adjust CH 1 VOLTS/DIV switch and VAR control for a 0.4-division display.

d. CHECK—Stable display can be obtained in both the +(out) and −(in) positions of the SLOPE switch for AUTO and NORM modes, and LINE and CH 1/CH 2 SOURCE positions.

e. Remove probe.

f. Return VAR to detent; MODE to NORM; and SOURCE to INT.

13. A and B Sweep Rate Accuracy

NOTE

For T932A, use the procedure for the A sweep only.

a. Connect test setup as shown in Fig. 3-4.

b. Set:

CH 1 VOLTS/DIV	.2 V
SOURCE	CH 1/CH 2
MODE	NORM
X1-X10	X1 (fully ccw)
SLOPE	As needed
LEVEL	As needed
POSITION (all)	As needed

c. CHECK—A sweep SEC/DIV accuracy according to Table 3-3; one or two time marks, as indicated, within 3% (0.24 div) over center eight divisions. Accuracy specifications apply for a temperature range of +20° C to +30° C.

d. Set: DISPLAY MODE B

e. CHECK—B sweep accuracy according to Table 3-3. Display one or two time marks as indicated within 3% (within 0.24 div) over the center 8 divisions (+20° C to +30° C).

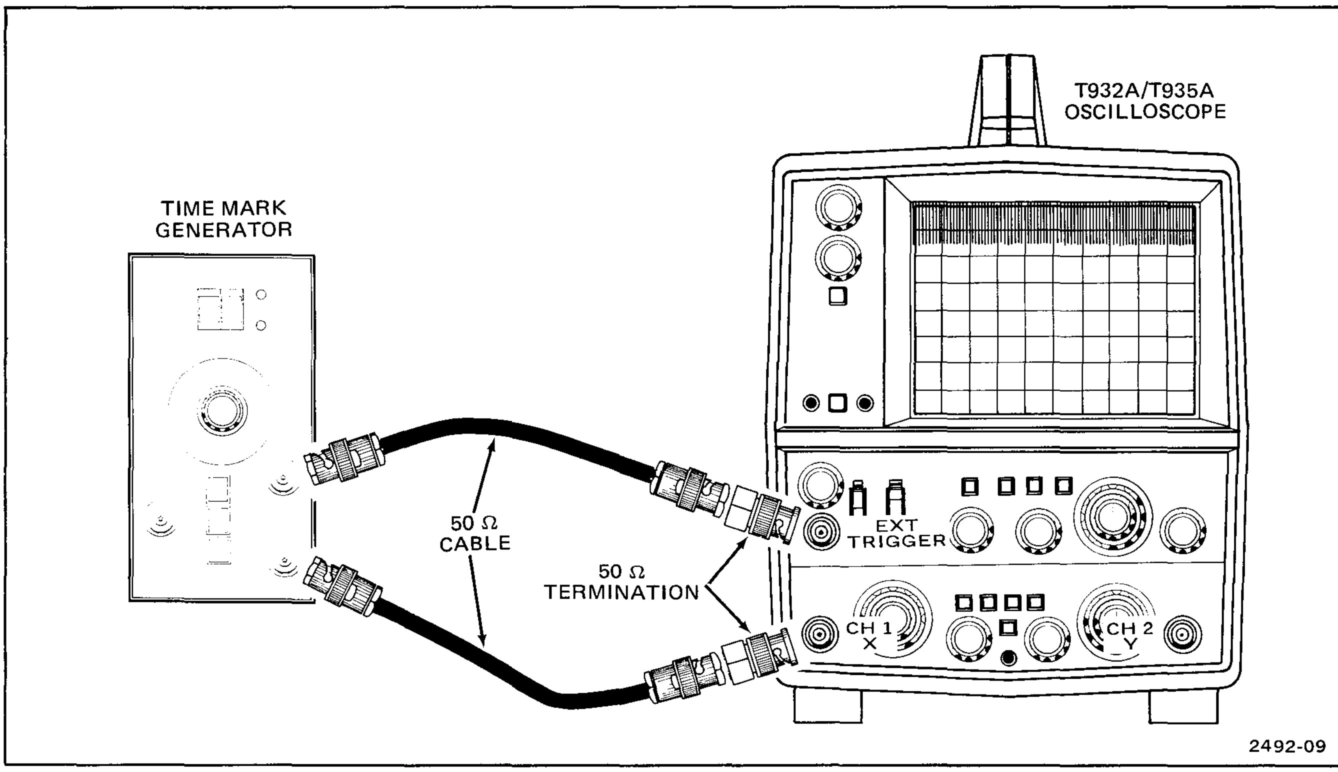


Fig. 3-4. Timing accuracy and delay time check test setup.

TABLE 3-3

A and B Sweep Timing Accuracy

SEC/DIV Setting	Time-Mark Generator Output	CRT Display (Markers/ Divisions)
.1 μs	0.1 microsecond	1[a]
.2 μs	0.1 microsecond	2
.5 μs	0.5 microsecond	1
1 μs	1 microsecond	1
2 μs	1 microsecond	2
5 μs	5 microseconds	1
10 μs	10 microseconds	1
20 μs	10 microseconds	2
50 μs	50 microseconds	1
.1 ms	0.1 millisecond	1
.2 ms	0.1 millisecond	2
.5 ms	0.5 millisecond	1
1 ms	1 millisecond	1
2 ms	1 millisecond	2
5 ms	5 milliseconds	1
10 ms	10 milliseconds	1
20 ms	10 milliseconds	2
50 ms	50 milliseconds	1
	A Sweep Only	
.1 s	0.1 s	1
.2 s	0.1 s	2
.5 s	0.5 s	1

[a]**Exclude the first .5 div (50 ns) at this sweep speed.**

14. MAGNIFIED SWEEP ACCURACY

a. Set: X1-X10 — X10 (fully cw)
SEC/DIV — 0.1 μs
DISPLAY MODE — A
SOURCE — CH 1/CH 2 (see note)

b. Set time-mark generator to 10 ns (adjust CH 1 VOLTS/DIV as necessary for a visible display).

NOTE

If you cannot obtain a stable display, connect the time-mark generator trigger output to the EXT (external trigger) connector via a 50 Ω cable and 50 Ω termination. Set MODE to EXT and adjust LEVEL control for a stable display.

c. CHECK—Magnified sweep accuracy according to Table 3-4: One or two time marks as indicated, within 5% (0.4 div) over center 8 divisions. Exclude the first 50 ns after the start of the sweep (5 divisions for the 0.1 μs setting; 2.5 divisions for the 0.2 μs setting; one division for 0.5 μs and 1 μs settings), and anything beyond the 100th magnified division. Accuracy specifications apply for a temperature range of +20° C to +30° C.

d. Set: DISPLAY MODE — B

e. Repeat part c.

f. Return X1-X10 control to X1 (fully counterclockwise).

TABLE 3-4

Magnified Sweep Timing Accuracy

SEC/DIV Setting	Time-Mark Generator Output	CRT Display (Markers/ Division)
.1 μs	10 nanosecond	1
.2 μs	10 nanosecond	2
.5 μs	50 nanosecond	1
1 μs	.1 microsecond	1
.5 ms	50 microsecond	1

15. Delay Time Position (T935A only)

a. Set: A SEC/DIV — .5 ms
B SEC/DIV (pull out to separate) — 5 μs
VOLTS/DIV — .5 V
DISPLAY MODE — A INTEN BY B
SOURCE — CH 1/CH 2
X1-X10 — X1 (fully ccw)

b. Adjust the time-mark generator for .5 ms.

c. Move the trace horizontally so you can see the start of the sweep at the left edge of the graticule.

d. CHECK—With the DELAY TIME POSITION control fully counterclockwise, the intensified portion of the sweep should be less than 0.5 div from the start of the sweep. With the DELAY TIME POSITION control fully clockwise, the dot should be at least 10 div from the start of the sweep (to the right of the graticule area).

16. Delay Time Jitter (T935A only)

a. Position the start of the intensified portion of the sweep on the tenth time marker.

b. Set: MODE AUTO
DISPLAY MODE B

c. Adjust the Horizontal POSITION control so the display is in the center of the screen.

d. Set: INTENSITY For well-defined display

e. CHECK—Horizontal jitter is 1 division or less.

f. Disconnect test equipment.

17. TV TRIGGER

NOTE

We recommend that you only check the TV Trigger if you are going to be using it. Any TV signal source will do for the check—such as a TV set.

The amplitude settings given in this procedure are to check both the CH1/CH2 and EXT trigger requirements. You can check just the CH1/CH2 trigger by using the VOLTS/DIV settings to attenuate the signal to 1 div of composite sync or 2.3 div of composite video.

a. Connect test setup as shown in Fig. 3-5.

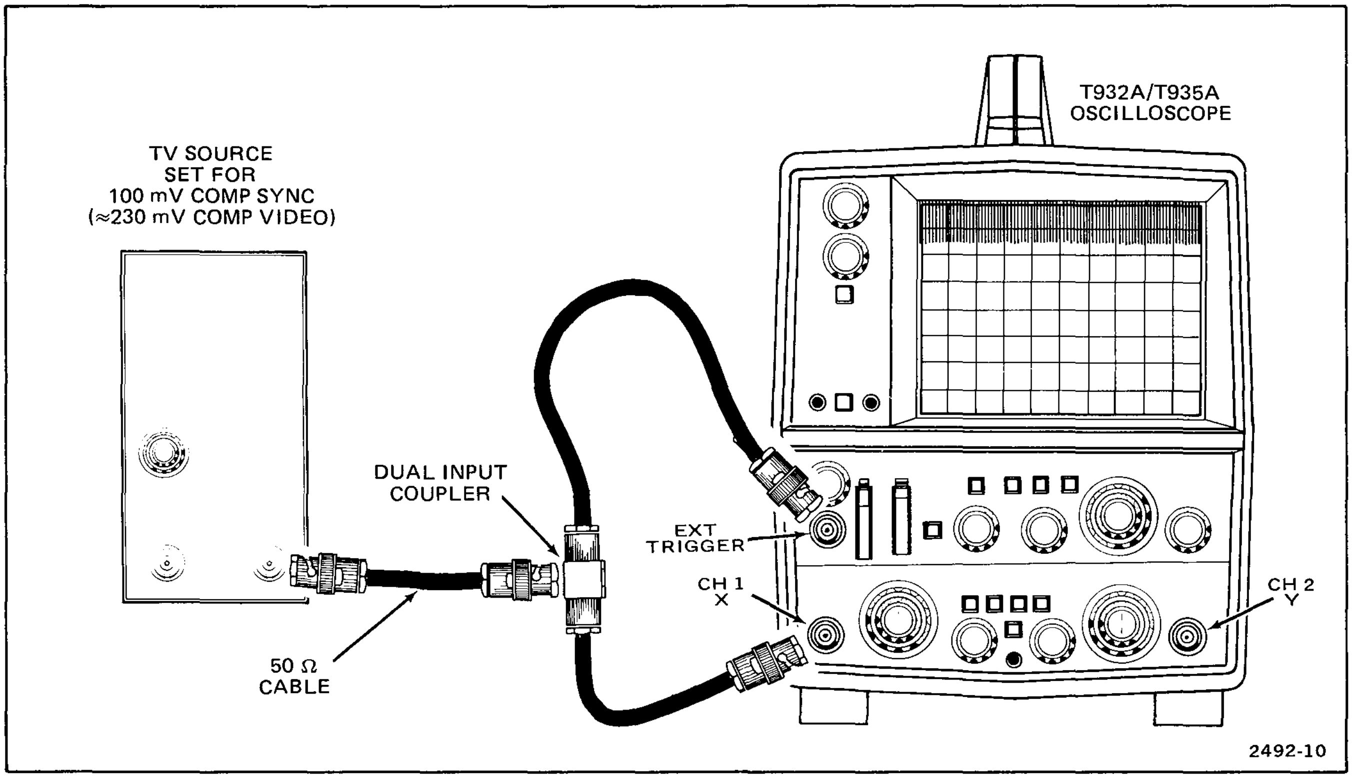


Fig. 3-5. TV trigger check test setup.

b. Set: SEC/DIV .1 ms
CH 1 VOLTS/DIV .1 V
MODE TV

c. Set signal source for 1 division of composite sync (or about 2.3 divisions of composite video).

d. Adjust LEVEL and SLOPE as needed to trigger display.

e. CHECK—Stable display is present (display triggers on TV field).

f. Set: SEC/DIV 50 μs

g. CHECK—Stable display is present (display triggers on TV line).

h. Set: SOURCE EXT

i. Adjust LEVEL and SLOPE as needed to trigger display.

j. CHECK—Stable display is present (display triggers on TV line).

k. Set: SEC/DIV .1 ms

l. CHECK—Stable display is present (display triggers on TV field).

m. Disconnect test setup.

END OF PROCEDURE

WARNING

THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

ADJUSTMENTS

WARNING

SERVICING INFORMATION IN THE FOLLOWING SECTIONS IS INTENDED FOR USE BY QUALIFIED SERVICE PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT REMOVE INSTRUMENT COVERS OR PERFORM ANY SERVICING UNLESS QUALIFIED TO DO SO.

IMPORTANT—PLEASE READ BEFORE USING THIS PROCEDURE

When done properly, this procedure allows you to adjust the instrument to its original performance specifications. The Adjustment Procedure is not intended as a troubleshooting guide. Any trouble you find during the procedure should be corrected before continuing. Refer to the Service Information section for further information.

LIMITS AND TOLERANCES

Limits and tolerances are instrument specifications only if they are called out as performance requirements in the Specification section. Tolerances given are for the oscilloscope under test and do not include test equipment error.

ADJUSTMENT INTERACTION

Some adjustments interact with others. These are identified with an INTERACTION step.

PARTIAL PROCEDURES

You can perform part of the adjustment procedure after replacing components or just to touch up the performance between major re-adjustments. Do not change the setting of the −8 V supply unless you intend to re-adjust the entire instrument.

To adjust only part of the instrument, set the controls according to the nearest preceding Control Settings and use the test setup given in the step you intend to perform or the setup in a preceding step. To prevent unnecessary re-adjustment only if the tolerance given for that step is not met. If it is necessary to reset an adjustment, also check any steps listed in the INTERACTION—part of the step.

TEST EQUIPMENT REQUIRED

The test equipment listed in Table 4-1, or equivalent is required for complete calibration of the oscilloscope. Specifications given for the equipment are the minimum necessary for accurate calibration.

TABLE 4-1

Test Equipment

Description	Minimum Specifications	Usage	Examples of Applicable Test Equipment
1. Digital Voltmeter	Range, 0 to 9 V dc; accuracy within 0.3%.	Power supply adjustment.	a. Tektronix DM 501 Digital Multimeter.[a]
2. Time-Mark Generator	Markers, 0.5 μs to 0.5 s; accuracy, within 0.3%.	Y-axis alignment, geometry adjustment, sweep and timing adjustments.	a. Tektronix TG 501 Time-Mark Generator.[a] b. Tektronix 2901 Time-Mark Generator.
3. Amplitude Calibrator	Signal Amplitude, 10 mV to 50 V square wave; frequency, 1 kHz; amplitude accuracy, within 0.3%.	Vertical gain adjustment.	a. Tektronix PG 506 Calibration Generator.[a]
4. Square-Wave Generator	Frequency, 1 kHz and 100 kHz; risetime, 2 ns or less.	High frequency compensation and vertical attenuator adjustments.	a. Tektronix PG 506 Calibration Generator.[a] b. Tektronix Type 106 Square-Wave Generator.
5. Cable	Length, 42 in.; impedance, 50 Ω; connectors, bnc.	Signal interconnection.	a. Tektronix Part 012-0057-01.
6. Termination	Impedance, 50 Ω; connectors bnc.	Signal termination.	a. Tektronix Part 011-0049-01.
7. Low-Capacitance Alignment Tool		Variable capacitor adjustments. Vertical attenuator and high-frequency compensation adjustment.	a. General Cement adjustment tool G.C. 8722.
8. Screwdriver	Length, 3 in. shaft; bit size, 3/32 in.	Variable resistor adjustments.	a. Xcelite R-3323.
9. 10X Attenuator	Ratio, 10X; impedance, 50 Ω; connectors, bnc.	Vertical attenuator adjustments.	a. Tektronix Part 011-0059-02.
10. Probe, 10X	Attenuation, 10X; Probe can be compensated for input characteristics of T932A/T935A.	Vertical attenuator compensation.	a. P6108, Tektronix Part 010-6108-03 (Standard accessory for T932A and T935A.)
11. Adapter	Probe-tip-to-bnc.	Vertical attenuator. compensation.	a. Tektronix Part 013-0084-02.

[a]Requires TM 500 Series Power Module

PRELIMINARY PROCEDURE

WARNING

Dangerous potentials exist at several points inside your instrument. To prevent electrical shock, do not touch exposed connections or components when the instrument is operated with the cover removed. Disconnect power cord plug from power input voltage source while disassembling or repairing this instrument.

1. Remove the cabinet from the instrument. To remove the cabinet, remove the six retaining screws (three on the top and three on the bottom) and slide the halves apart.

2. Check the 120 V/240 V range selector switch, S701, and the High/Low selector switch, S705, for correct settings. Both switches are located on the bottom of the instrument. If you change the setting of the range selector switch, change the line fuse. Refer to the Replaceable Electrical Parts list for correct fuse values.

3. Connect the T932A or T935A and test equipment to an appropriate power input source. Turn them on and allow at least 20 minutes warmup before starting the adjustment procedure.

For best overall accuracy, make adjustments at an ambient temperature of +20° C to +30° C.

A. DISPLAY AND POWER SUPPLY

Equipment Required

1. Digital Voltmeter	4. 50 Ω Termination
2. Time-Mark Generator	5. Screwdriver
3. 50 Ω BNC Cable	6. Low-Capacitance Alignment Tool

PRELIMINARY CONTROL SETTINGS

Preset front panel controls as follows:

NOTE

Do not preset internal controls.

INTENSITY	Midrange
Vertical Mode	CH 1
CH 1 VOLTS/DIV	1 V (1X)[1]
VOLTS/DIV VAR (both)	Detent (cw)
AC-GND-DC (both)	GND
A & B SEC/DIV	.1 ms
X1-X10	X1 (fully ccw)
SOURCE	CH 1/CH 2
MODE	AUTO
SLOPE	+(out)
LEVEL	Midrange
CH 1 POSITION	Midrange
Horizontal POSITION	Midrange
HOLD-OFF	Fully ccw
DISPLAY mode	A

Set all other controls as desired. The oscilloscope should produce a baseline trace with the controls set as above. Adjust the INTENSITY and FOCUS controls (on front panel), and ASTIG control (left side of cabinet) as needed to maintain a well-defined display.

1. −8 V Power Supply

NOTE

Do not change the setting of the −8 V adjustment unless you intend to re-adjust the entire instrument.

a. Connect digital voltmeter between the −8 V side of R775 and ground (see Fig. 4-1). If meter does not read between −7.96 V and −8.04 V, proceed to part b.

b. ADJUST—R773, −8 V Adj (see Fig. 4-1) for −8.00 V dc.

c. Disconnect digital voltmeter.

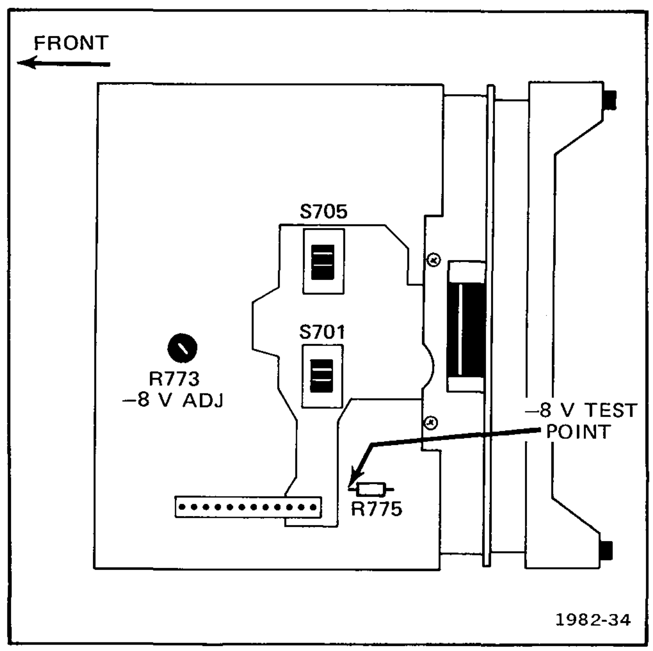


Fig. 4-1. Power supply adjustment locations (on bottom of chassis).

[1]**Refers to window on VOLTS/DIV switch knob. Use 1X probe window unless otherwise specified in individual steps of the procedure.**

2. Trace Rotation

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

b. ADJUST—Trace Rot, R472 (see Fig. 4-2), to align trace with center horizontal graticule line.

3. Y-Axis Alignment

a. Set CH 1 AC-GND-DC to DC.

b. Connect .1 ms markers from time-mark generator to CH 1 input via 50 Ω BNC termination and 50 Ω BNC cable.

c. Set CH 1 VOLTS/DIV and VAR to obtain slightly more than 8 divisions of vertical deflection and position display baseline below bottom graticule line (off screen).

d. Set SEC/DIV to obtain about one marker/division and rotate horizontal POSITION to align a marker with center graticule line.

e. ADJUST—Y-axis, R474, (see Fig. 4-2) to align center marker with center vertical graticule line.

f. INTERACTION—Position display baseline to center horizontal graticule line and check that baseline aligns with horizontal graticule line. If not, re-adjust trace rotation. Then re-check Y-Axis alignment.

4. Geometry

a. Move display baseline slightly below bottom graticule line.

b. ADJUST—Geom, R473 (see Fig. 4-2) for best alignment of markers with the vertical graticule lines, i.e.: minimum bowing of markers.

c. INTERACTION—Between Geom and Y-Axis. Repeat both adjustments for best alignment of markers with vertical graticule lines.

d. Disconnect time-mark generator.

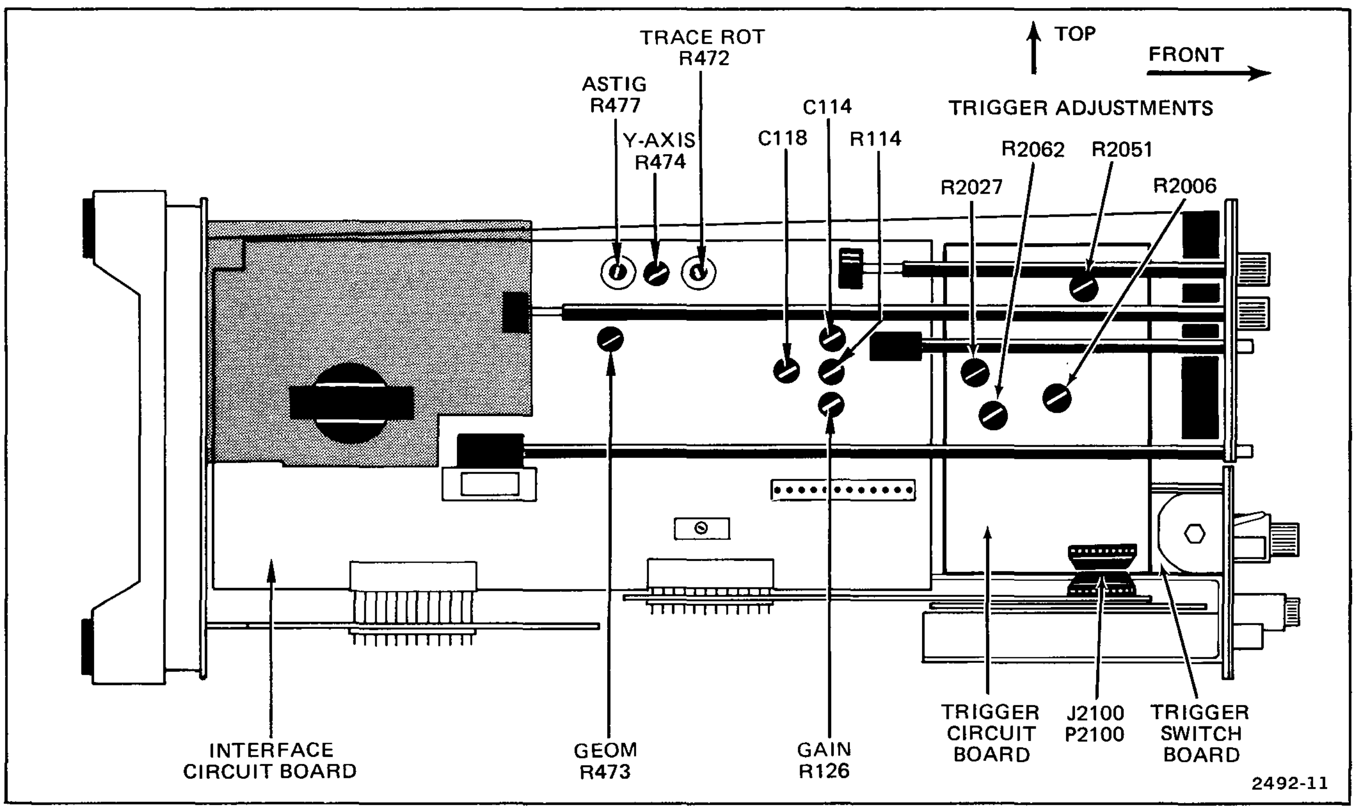


Fig. 4-2. Interface board adjustment locations (on left side of crt).

B. VERTICAL AMPLIFIER

Equipment Required

1. Digital Voltmeter
2. Amplitude Calibrator
3. Square-Wave Generator
4. 50 Ω BNC Termination
5. 50 Ω BNC Cable
6. Low Capacitance Alignment Tool
7. Screwdriver
8. 10X Probe
9. 10X Attenuator
10. Probe-tip-to-BNC Adapter
11. Dual Input Coupler (optional)

PRELIMINARY CONTROL SETTINGS

Preset front panel controls as follows:

INTENSITY	Midrange (for visible trace)
HOLD-OFF	Fully ccw
FOCUS	Midrange
Vertical Mode	CH 1
VOLTS/DIV (both)	2 mV (1X)[1]
AC-GND-DC (both)	GND
VAR (both)	Detent (cw)
A SEC/DIV	.5 ms
X1-X10	X1 (fully ccw detent)
SOURCE	CH 1/CH 2
MODE	AUTO
SLOPE	+(out)
LEVEL	Midrange
POSITION (all)	Midrange
DISPLAY MODE	A

Set all other controls as desired.

The oscilloscope should produce a baseline trace with the controls set as above. Adjust INTENSITY and FOCUS controls as needed to maintain a well-defined display while making adjustments.

PROCEDURE

1. Vertical Preamplifier Balance

a. ADJUST—CH 1 DC BAL, R4130 (see Fig. 4-3), for no trace shift while switching CH 1 VOLTS/DIV control between 2 mV and 10 mV.

b. Set: Vertical Mode CH 2

c. ADJUST—CH 2 DC BAL, R4232 (see Fig. 4-3), for no trace shift while switching CH 2 VOLTS/DIV control between 2 mV and 10 V.

2. Vertical Output Amplfier Gain

NOTE

You should not have to re-adjust the vertical output gain unless you have replaced the crt or other components, or adjustments have accidentally been altered.

a. Set VOLTS/DIV (both) to 5 mV/div and Vertical Mode to CH 1.

b. Set Gain, R126 (see Fig. 4-2), to physical midrange.

c. Connect digital voltmeter between P4-9 and P4-11 (see Fig. 4-3). Select range on meter for at least 500 mV reading.

d. Set vertical POSITION control so trace is aligned with center horizontal graticule line. Note meter reading.

e. Rotate vertical POSITION control until meter reading has changed 150 mV positive from reading in part d (trace moved toward top of screen).

f. Adjust Gain, R126 (see Fig. 4-2), so trace aligns with third graticule line above center horizontal graticule line.

g. Disconnect digital voltmeter.

[1]**Refers to window on VOLTS/DIV switch knob. Use 1X probe window unless otherwise specified in individual steps of the procedure.**

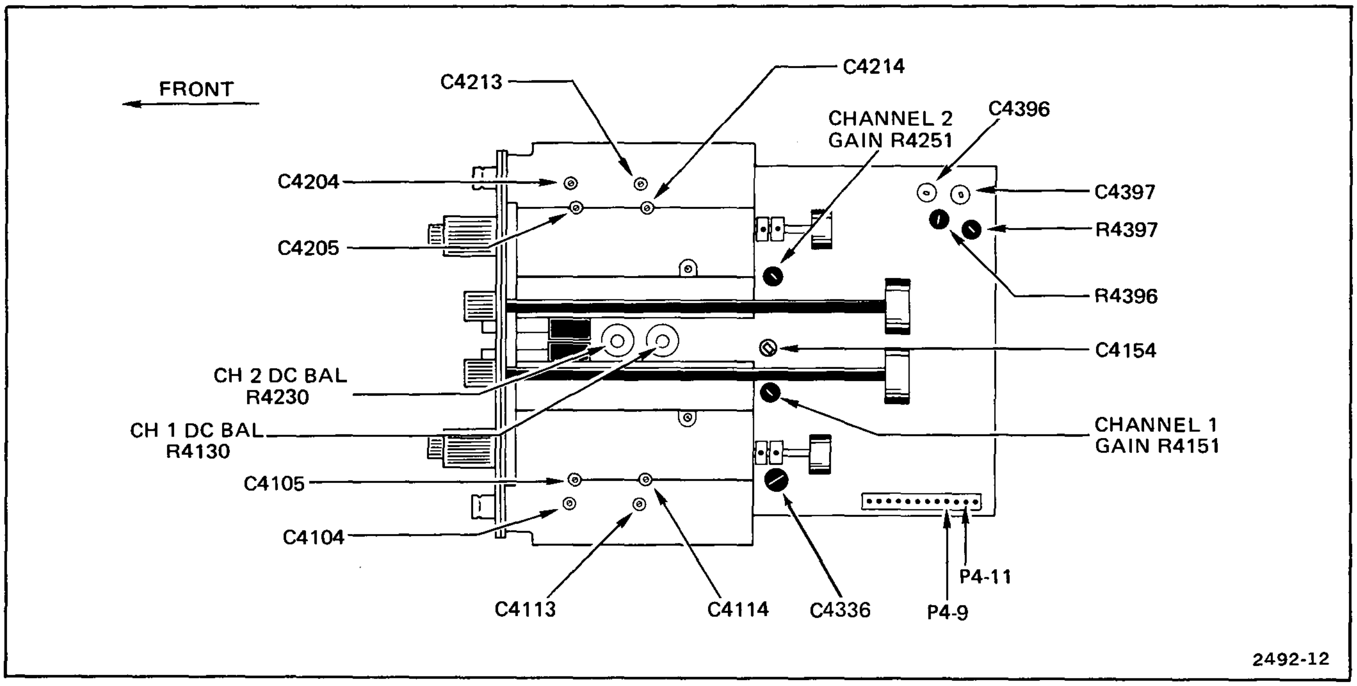


Fig. 4-3. Vertical Amplifier adjustment locations (bottom view of instrument).

3. Vertical Preamplifier Gain

a. Set:

VOLTS/DIV (both)	5 mV[1]
AC-GND-DC (both)	DC
Vertical Mode	CH 1

b. Connect a 1 kHz, 20 mV amplitude calibrator (standard output) signal to CH 1 input via a 50 Ω unterminated cable. Set CH 1 POSITION to center the display vertically.

c. ADJUST—Gain, R4151 (see Fig. 4-3), for a 4-division display.

d. Move 20 mV amplitude calibrator signal to CH 2 input and set Vertical Mode to CH 2. Set CH 2 POSITION to center the display vertically.

e. ADJUST—Gain, R4351 (see Fig. 4-3), for 4-division display.

f. INTERACTION—If you cannot adjust CH 1 and CH 2 Preamplifier Gain for 4-division display, repeat steps 2 and 3.

g. Disconnect test equipment.

NOTE

For convenience in the following steps, set the TIME BASE to 1 ms (SEC/DIV to 1 ms and X1-X10 to X1) while adjusting the generator for a 5-division display. Then set TIME BASE TO 50 μ (SEC/DIV to .5 μ and X1-X10 to X10) when observing or adjusting leading edge detail.

4. High Frequency Compensation

a. Set:

VOLTS/DIV (both)	2 mV[1]
Vertical Mode	CH 2
AC-GND-DC (both)	DC
A SEC/DIV	1 ms

b. Connect square-wave generator (fast rise, +transition) to Channel 2 input connector via 50 Ω cable, 10X attenuator, and 50 Ω termination.

c. Set square-wave generator for 100 kHz, fast rise, and amplitude for 5-division display. Set SEC/DIV to .5 μs, and INTENSITY as necessary to view the display.

d. Set POSITION and LEVEL controls to position the leading edge of the signal on screen.

e. ADJUST—C4397, R4397, C4396, R4396 (see Fig. 4-3), C114, R114, C118 (see Fig. 4-2), for best front corner of waveform using a low-capacitance alignment tool.

[1]**Refers to window on VOLTS/DIV switch knob. Use 1X probe window unless otherwise specified in individual steps of procedure.**

f. Set: Vertical Mode CH 1

g. Connect square-wave generator to Channel 1 input connector via 50 Ω cable, 10X attenuator, and 50 Ω termination.

h. ADJUST—C4154 (see Fig. 4-3), for best square front corner of waveform using low-capacitance alignment tool.

i. INTERACTION—If you cannot obtain square front corner, re-adjust C4396, R4396, C4397, R4397, C114, C118, and R114 for best square front corner in both CH 1 and CH 2.

j. Disconnect test equipment.

5. Channel 1 Attenuator Compensation

a. Set:

CH 1 VOLTS/DIV	20 mV[1]
CH 1 AC-GND-DC	DC
Vertical Mode	CH 1
A SEC/DIV	1 ms
X1-X10	X10 (fully cw)

b. Connect a 50 Ω cable from the high-amplitude output of the square-wave generator, through a 10X attenuator and a 50 Ω termination to the CH 1 input connector. Set generator to 1 kHz and adjust for a 5-division display.

c. ADJUST—C4114 (see Fig. 4-3) for best square front corner (see Fig. 4-4 for example).

d. Remove 10X attenuator and set CH 1 VOLTS/DIV to .2 V. Set generator output for a 5-division display.

e. ADJUST—C4105 (see Fig. 4-3) for best square front corner (see Fig. 4-4 for example). Disconnect test equipment.

f. Set CH 1 VOLTS/DIV to 10 mV and X1-X10 to X1 (fully ccw).

g. Connect a 10X probe to the CH 1 input. Connect the probe tip to a probe tip-to-bnc adapter, the adapter to a 50 Ω bnc termination, and the termination to a 50 Ω bnc 10X attenuator attached to the square-wave generator high-amplitude output connector. Set generator for a 5-division, 1 kHz display.

h. Compensate probe for best front corner of waveform.

i. Set CH 1 VOLTS/DIV to 20 mV and set generator for a 5-divison display (remove 10X attenuator if necessary).

j. ADJUST—C4113 for flat top on square wave.

k. Set CH 1 VOLTS/DIV to .2 V, and square-wave generator output for a 5-division display (remove 10X attenuator, and also 50 Ω termination if necessary).

l. ADJUST—C4104 for a flat top on square wave.

m. Disconnect test equipment.

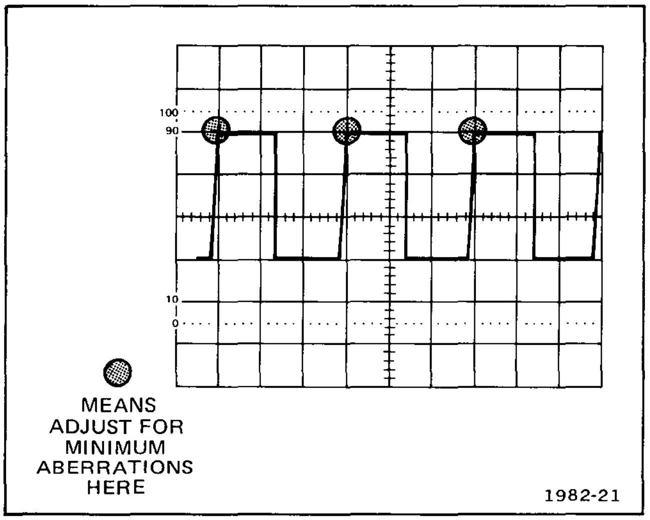


Fig. 4-4. Display of correct attenuator compensation (idealized).

[1]Refers to window on VOLTS/DIV switch knob. Use 1X probe window unless otherwise specified in individual steps of the procedure.

6. CH 2 Attenuator Compensation

a. Set:

CH 2 VOLTS/DIV	20 mV[1]
Ch 2 AC-GND-DC	DC
Vertical Mode	CH 2
A SEC/DIV	1 ms
X1-X10	X10 (fully cw)
POSITION (all)	As required

b. Connect a 50 Ω cable from the high-amplitude output of the square-wave generator, through a 10X attenuator, and a 50 Ω termination to the CH 2 input connector. Set generator to 1 kHz and adjust for 5-division display.

c. ADJUST—C4214 (see Fig. 4-3) for best square front corner (see Fig. 4-4 for example).

d. Remove 10X attenuator and set CH 2 VOLTS/DIV to .2 V. Set generator output for a 5-division display.

e. ADJUST—C4205 (see Fig. 4-3) for best square front corner (see Fig. 4-4 for example). Disconnect test equipment.

f. Set CH 2 VOLTS/DIV to 10 mV and X1-X10 to X1 (fully ccw).

g. Connect a 10X probe to the CH 1 input. Connect the probe tip to a probe tip-to-bnc adapter, the adapter to a 50 Ω bnc termination, and the termination to a 50 Ω bnc 10X attenuator attached to the square-wave generator high-amplitude output connector. Set generator for a 5-division, 1 kHz display.

h. Compensate probe for best front corner of waveform.

i. Set CH 2 VOLTS/DIV to 20 mV and set generator for a 5-division display (remove 10X attenuator if necessary).

j. ADJUST—C4213 for flat top on square wave.

k. Set CH 2 VOLTS/DIV to .2 V, and square-wave generator output for a 5-division display (remove 10X attenuator, and also 50 Ω termination if necessary).

l. ADJUST—C4204 for a flat top on square wave.

m. Disconnect test equipment.

[1]Refers to window on VOLTS/DIV switch knob. Use 1X probe window unless otherwise specified in individual steps of the procedure.

C. TIME BASE

Equipment Required	
1. Time-Mark Generator	3. 50 Ω BNC Cable
2. 50 Ω Termination	4. Low Capacitance Alignment Tool

PRELIMINARY CONTROL SETTINGS

Preset front panel controls as follows:

INTENSITY	Midrange
FOCUS	Midrange
Vertical Mode	CH 1
CH 1 VOLTS/DIV	.5 V[1]
CH 1 VAR	Detent
CH 1 AC-GND-DC	DC
CH 2 AC-GND-DC	GND
A SEC/DIV	.5 ms
X1-X10	X1 (fully ccw)
SOURCE	CH 1/CH 2
MODE	AUTO
SLOPE	+(out)
HOLD-OFF	Fully ccw
LEVEL	Midrange
DISPLAY MODE	A
POSITION (all)	Midrange
DELAY TIME POSITION	Fully ccw

Set all other controls as desired.

The oscilloscope should produce a baseline trace with the controls set as above. Adjust INTENSITY and FOCUS controls as needed to maintain a well-defined display while making adjustments.

PROCEDURE

1. Horizontal Gain

a. Connect a 50 Ω cable from the time-mark generator to a 50 Ω termination at the CH 1 input. Set generator for .5 ms markers.

b. ADJUST—Horiz Cal, R2332 (see Fig. 4-5), and horizontal POSITION control for 1 marker per division over center 8 divisions.

2. A and B Sweep Timing

NOTE

For T932A, use steps 2a and 2b only.

a. Set SEC/DIV to .5 μs and the generator for .5 μs time marks.

b. ADJUST—C2235 (see Fig. 4-5), and horizontal POSITION control for 1 marker per division over center 8 divisions.

c. Set: DISPLAY MODE B

d. ADJUST—C2535 and horizontal POSITION control for 1 marker per division over center 8 divisions.

e. Disconnect test equipment.

3. X10 Gain

a. Set: MAGNIFIER X10 (cw)
A SEC/DIV 1 ms

b. Set time mark generator for .1 m.

c. ADJUST—R2321 (see Fig. 4-5) for one marker per division over 8 divisions. Use POSITION control.

d. Move MAGNIFIER control through X10 to X1 and note there are 10 markers per division.

[1]Refers to window on VOLTS/DIV switch knob. Use 1X probe window unless otherwise specified in individual steps of the procedure.

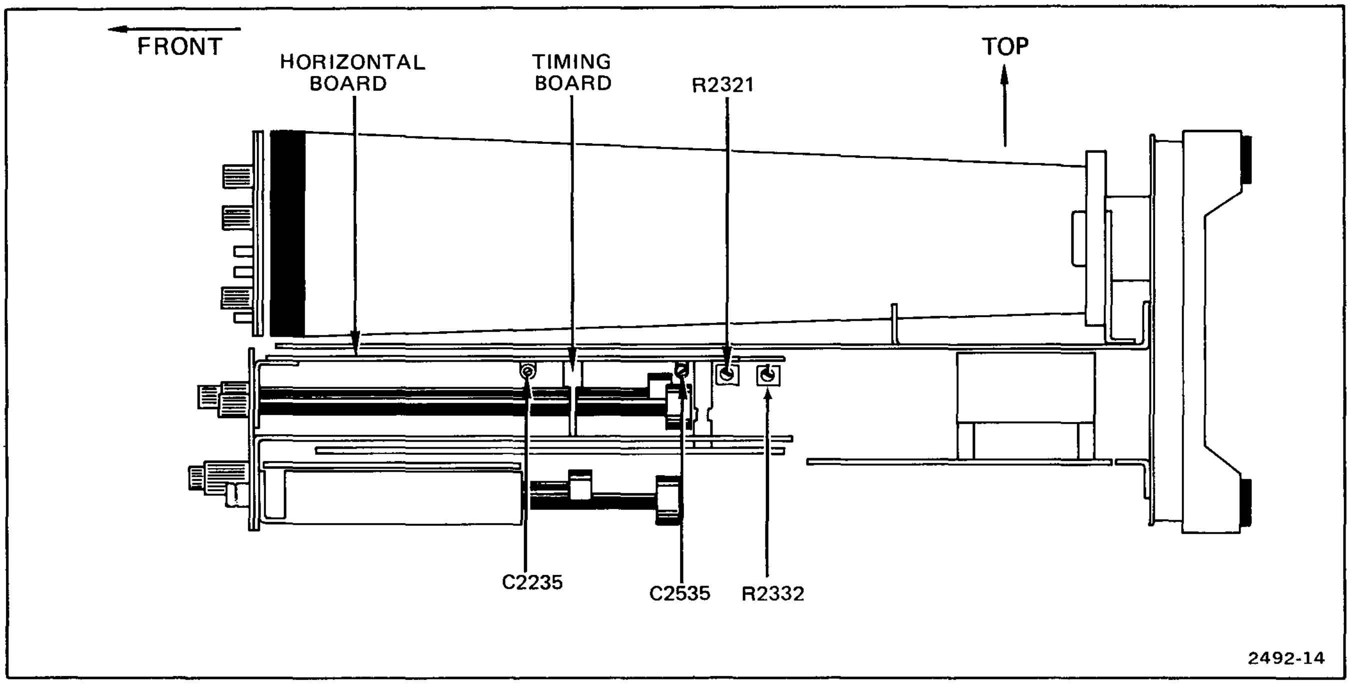


Fig. 4-5. Time Base adjustment locations (on right side of instrument).

D. TRIGGERS

Equipment Required

1. Sine-Wave Generator
2. Square-Wave Generator
3. 50 Ω Termination (2)
4. 50 Ω BNC Cable
5. Dual Input Coupler
6. Alignment Tool

1. Trigger Slope and Level Centering

NOTE

Re-check Vertical Preamplifier Balance (B. 1., this section) before making trigger adjustments. See that SOURCE is CH 1/CH 2.

a. Connect sine wave generator to both channels through 50 Ω cables, dual input coupler, and 50 Ω terminators.

b. Set: A SEC/DIV 10 μ
VOLTS/DIV (both) 10 m
AC-GND-DC (both) DC
Vertical Mode CH 1

c. Set sine wave generator to 50 kHz and adjust amplitude for 4 divisions on crt screen. Center display with Channel 1 POSITION control.

d. ADJUST—Horizontal POSITION so sweep start is visible.

e. ADJUST—LEVEL so sweep starts at center line.

f. Set: CPLG DC

g. ADJUST—Internal Trigger DC Level, R2027, (see Fig. 4-9) to bring sweep to center line.

h. Set: SOURCE COMP

i. ADJUST—Composite DC Level, R2006 (see Fig. 4-6), to bring sweep to center line.

j. INTERACTION—Between CPLG AC and DC. Then leave CPLG in AC and return SOURCE to CH 1/CH 2.

k. Set: Vertical Mode CH 2

l. ADJUST—LEVEL so sweep starts at center line.

m. Set: CPLG DC

n. ADJUST—Channel 2 DC Trigger Level adjust, R4336 (see Fig. 4-3), so sweep starts at center line.

o. INTERACTION—Between CPLG AC and DC; SOURCE CH 1/CH 2 and COMP; and VERT MODE CH 1 and CH 2. Sweep should stay as close to center line as possible while switching in all positions. Adjust related components to minimize interaction.

p. Disconnect test equipment.

2. X Centering

a. Set: SOURCE CH 1/CH 2
CPLG AC
A SEC/DIV 1 m
Vertical Mode CH 2

b. ADJUST—Horizontal POSITION so sweep starts at left graticule line.

@

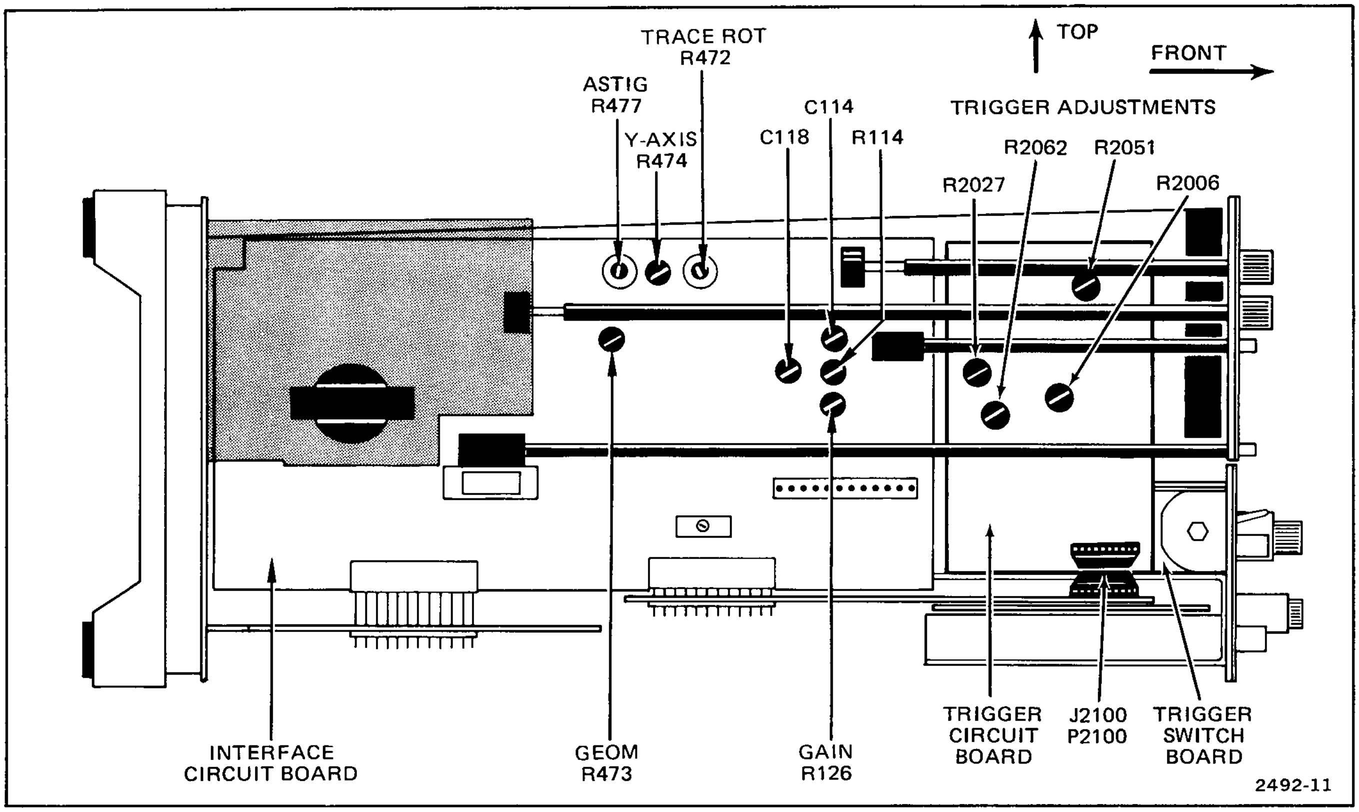


Fig. 4-6. Trigger board adjustment locations (on left side of crt).

c. Set SOURCE to X-Y.

d. ADJUST—X Centering, R2051 (see Fig. 4-6), so sweep start is at center line.

3. 6 X-Y Gain

a. Set:

Vertical Mode	CH 2
VOLTS/DIV (both)	5 m
Channel 1	
AC-GND-DC	AC
Channel 2	
AC-GND-DC	GND

b. Connect square-wave generator to Channel 1 input. Adjust generator for 1 kHz, 50 mV signal.

c. ADJUST—X Gain R2062 (see Fig. 4-6), for 10 divisions of horizontal deflection.

d. Set Channel 1 AC-GND-DC to DC.

e. Set generator for 20 mV output.

f. CHECK—4 divisions of deflection in AC CPLG.

SERVICE INFORMATION

The following information is provided to help you keep your T932A and T935A in good operating condition. We recommend that servicing be done by qualified service personnel only. You can, if you like, send your instrument to a Tektronix Service Center for re-adjustment and repair. Contact your local Tektronix representative for information about the Service Centers in your area.

CABINET REMOVAL

WARNING

Dangerous potentials exist at several points throughout the T932A and T935A. When operating the instrument with the covers off, avoid touching connections and components. Some transistors have elevated cases. Disconnect the power before cleaning the instrument or replacing parts.

To remove the cover, take out the six screws (top and bottom) holding the two halves together. Pull the two halves apart.

To replace the cover, line up the slots on the cover with the front panel and the rear subpanel and slide together. Replace screws.

PREVENTIVE MAINTENANCE

Preventive maintenance consists of cleaning the instrument regularly and inspecting it occasionally for broken or damaged parts. Regular maintenance will improve the reliability of your instrument and prevent breakdowns.

Cleaning

Accumulations of dirt and dust on components act as an insulating blanket preventing efficient heat dissipation. Dust on circuit boards and wires can cause arcing and short circuits, resulting in damage to components or even instrument failure. Your instrument should be cleaned before this happens!

The cabinet provides protection from dust and dirt and should be in place during normal operation of the instrument.

CAUTION

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

Exterior. Dust the cabinet with a soft cloth. Dust the front panel controls with a small soft paint brush. Dirt clinging to the surface of the cabinet may be removed with a soft cloth dampened with a mild detergent and water solution. Avoid using abrasive cleaners. They will scratch the cabinet and front panel.

Interior. Dust in the interior of the instruments should be removed before it builds up enough to cause arcing and short circuits during periods of high humidity. Dust is best removed from the interior by dry (approximately 9 lb/in^2), low-pressure air. Dirt clinging to surfaces may be removed with a soft paint brush or cloth dampened with a mild detergent and water solution. Use a cotton-tipped applicator for cleaning in narrow spaces and on the circuit boards.

Switch Contacts

CAUTION

Do not use acetone, MEK, MIBK, benzene, toluene, carbon tetrachloride, trichloroethylene, methyl alcohol, methylene chloride, sulphuric acid, or Freon TC, TE, TF, TA, 12, 22, to clean the switch contacts. Check the contents of spray coolants and cleaners before using.

Most of the switches are cam-actuated assemblies which do not require frequent maintenance. When maintenance is necessary due to accumulated dirt and dust on the contacts, observe the following precautions: Clean the switch contacts with isopropyl alcohol or a solution of one part Kelite to 20 parts water. If these are not available, petroleum ether, white kerosene, or a solution of 1% Joy detergent and 99% water may be used.

Recommended circuit coolants are dry ice and isopropyl alcohol.

The cam switch contacts are designed to operate without lubrication. They do require cleaning periodically to remove accumulations of dust and dirt. The use of lubricants, or cleaners that leave a residue, increase dust attraction and should be avoided.

Visual Inspection

Inspect the interior occasionally for broken connections, improperly seated semiconductors, damaged or improperly installed circuit boards, heat damaged components, etc. If heat damaged components are found, care must be taken to find the cause of the excessive heat and measures must be taken to prevent recurrence of the damage.

Lubrication

Most of the potentiometers are permanently sealed. Both the cam- and lever-type switches are installed with proper lubrication where necessary. Therefore, periodic lubrication is not recommended and only rarely should lubrication even be necessary.

Semiconductor Checks

Periodic checks of the semiconductor devices in this instrument are not recommended. The best check of semiconductor performance is actual operation in the instrument.

Re-adjustment

Re-adjust the instrument whenever the Performance Check indicates the instrument is not meeting specifications. The Performance Check should be performed on a regular basis; for example, every 1000 hours of operation or every six months.

TROUBLESHOOTING

If you perform preventive maintenance on a regular basis, you should correct most problems before your instrument breaks down. Occasionally, you may have to troubleshoot. In addition to the following information, you may find information in the Circuit Description and Diagrams section useful.

Troubleshooting Aids

Troubleshooting Chart. Use the troubleshooting chart (Fig. 5-1) to locate problem areas.

Diagrams. Complete circuit diagrams are located on the foldout pages in the Circuit Description and Diagrams section. The component number and electrical value of each component in the instrument are shown on the diagrams (see the first page of the Diagrams section for the definitions of the reference designators used to identify components). Each main circuit is assigned a series of component numbers to assist in identifying their circuit location. Important voltages and waveforms are also shown on the diagrams. Also, a heavy line encloses the portion of the circuit mounted on a circuit board.

Color Codes. The resistors used in this instrument are either brown composition or precision metal-film resistors. The resistors are color-coded with the EIA color-code. (Some metal-film resistors may have the value printed on the body.) Refer to Fig. 5-2. For the values of the thick film resistors refer to the parts list.

The capacitance values of common disc and some small electrolytic capacitors are marked on the side of the component body. The white ceramic capacitors are color-coded, using a modified EIA code. (See Fig. 5-2).

The cathode end of each glass-encased diode is indicated by a stripe, a series of stripes, or a dot.

Power Cord Conductor Identification

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

Semiconductor Lead Configuration. Fig. 5-3 shows the lead configuration of the semiconductor devices used in this instrument.

Multi-Connector Holders. The multi-connector holder is keyed with two triangles, one on the holder and one on the circuit board. When a connection is made perpendicular to a circuit board surface, the orientation of the triangle and the slot numbers on the connector holder are determined by the direction of the nomenclature marking (see Fig. 5-4).

TABLE 5-1

Power Supply Tolerance

Supply	Tolerance
−8 V	Set within 0.5%
+8 V	Within 3%
+100 V	Within 5%

Troubleshooting Equipment

The following equipment is useful for troubleshooting.

1. Semiconductor Tester

Description: Dynamic-type tester. Must be capable of measuring reverse breakdown voltages of at least 400 V.

Purpose: To test semiconductors.

Example: Tektronix Type 576 Curve Tracer or Tektronix 577 (D1 or D2) Curve Tracer with 177 Test Fixture.

2. Test Oscilloscope

Description: Frequency response, dc to at least 15 MHz. A 10X, 10 MΩ voltage probe should be used to reduce circuit loading for voltage measurements.

Purpose: To check operating waveforms.

3. Multimeter

Description: Non-loading digital multimeter. Voltmeter, 10 MΩ input impedance and 0 to 150 V range; dc voltage accuracy, within 0.15%; display, 4-1/2 digits. Ohmmeter, 0 to 20 MΩ. (2 kV rating required for high voltage supply measurement.)

Purpose: To check voltages and for general troubleshooting.

4. Variable Autotransformer

Description: Output variable from 0 to 140 V, 1.2 A minimum rating. Must have a three-wire power cord, plug and receptacle.

Purpose: To vary the input line voltage when troubleshooting in the power supply.

Example: General Radio W8MT3VM or W10MT3W Metered Variac Autotransformer.

5. Vertical Amplifier Extender Troubleshooting Fixture

Description: 18 inch ribbon cable with an interface connector at each end (Tektronix part 067-0773-00).

Purpose: To operate the vertical amplifier outside the instrument. Useful for troubleshooting the time base which is inaccessible with the vertical amplifier installed.

Troubleshooting Techniques

The following checklist is arranged so that you check the simple things before you get the instrument taken apart. Start at the beginning.

1. Check the Control Settings. See the Operating Instructions for the correct control settings.

2. Check Associated Equipment and Connectors. Check to see that the signal source is properly connected and that the interconnecting cables are not defective. Also check the power cord and plug and the power source for defects.

3. Check the Performance of the instrument. If the instrument does not meet specifications, the trouble may be corrected by readjusting the instrument. See the Adjustment Procedure, Section 4, for instructions.

4. Visual Check. A visual check may reveal broken connections, damaged components, semiconductors not firmly mounted, damaged circuit boards, etc.

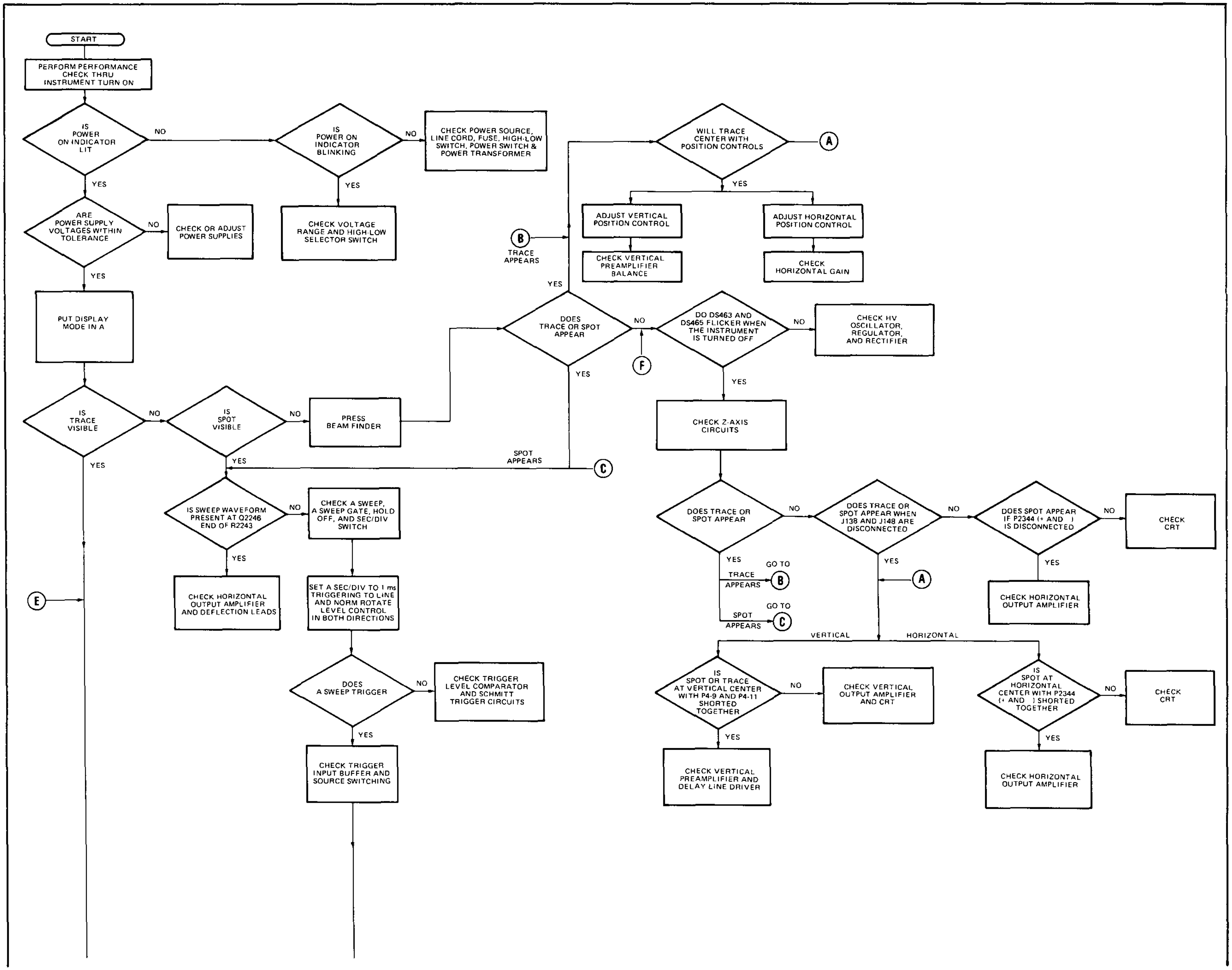


Fig. 5-1. Troubleshooting chart.

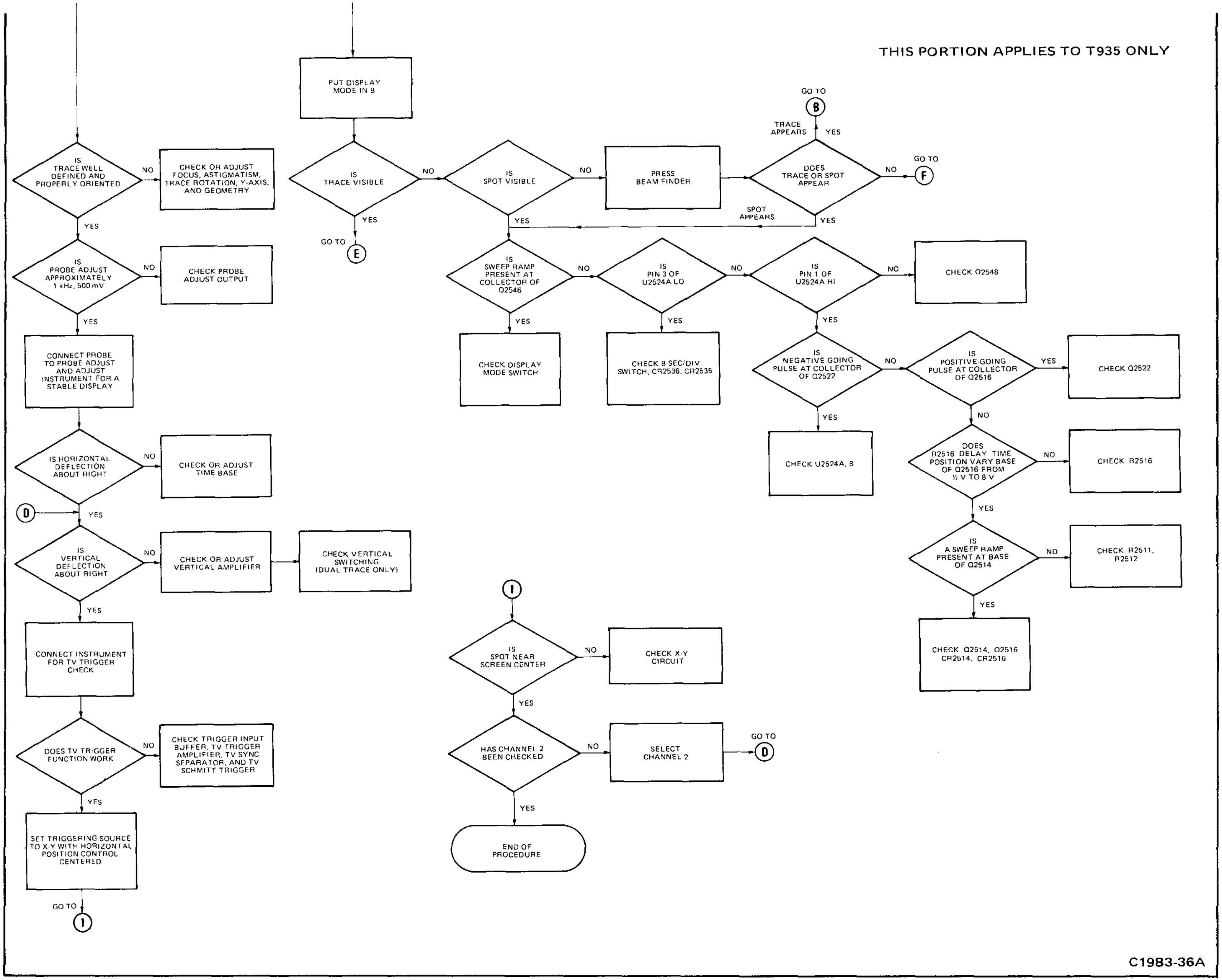
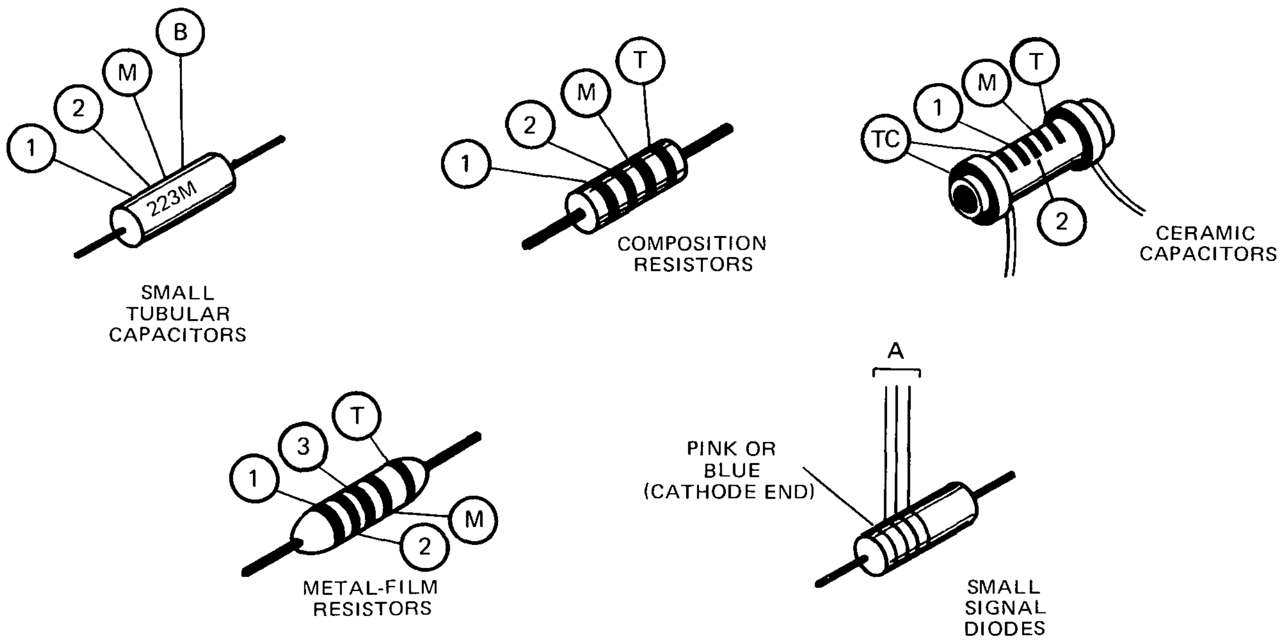


Fig. 5-1. Troubleshooting chart (cont).



(A) COLORS IDENTIFY SIGNIFICANT DIGITS IN TEKTRONIX PART NUMBER (E.G. BROWN, GRAY, GREEN STRIPES INDICATE PART NUMBER 152-0185-00)

(B) TOLERANCE; F=±1%, J=5%, K=10%, M=20%

(1) (2) and (3) 1ST, 2ND, AND 3RD SIGNIFICANT FIGS.

(T) AND/OR (TC) COLOR CODE MAY NOT BE PRESENT ON SOME CAPACITORS;

(M) MULTIPLIER (T) TOLERANCE;

(TC) TEMPERATURE COEFFICIENT.

COLOR	SIGNIFICANT FIGURES	RESISTORS (Ω)		CAPACITORS (pF)		
		MULTIPLIER	TOLERANCE	MULTIPLIER	TOLERANCE	
					over 10 pF	under 10 pF
BLACK	0	1	---	1	±20%	±2 pF
BROWN	1	10	±1%	10	±1%	±0.1 pF
RED	2	10^2 or 100	±2%	10^2 or 100	±2%	---
ORANGE	3	10^3 or 1 K	±3%	10^3 or 1000	±3%	---
YELLOW	4	10^4 or 10 K	±4%	10^4 or 10,000	+100% −9%	---
GREEN	5	10^5 or 100 K	±½%	10^5 or 100,000	±5%	±0.5 pF
BLUE	6	10^6 or 1 M	±¼%	10^6 or 1,000,000	---	---
VIOLET	7	---	±1/10%	---	---	---
GRAY	8	---	---	10^{-2} or 0.01	+80% −20%	±0.25 pF
WHITE	9	---	---	10^{-1} or 0.1	±10%	±1 pF
GOLD	–	10^{-1} or 0.1	±5%	---	---	---
SILVER	–	10^{-2} or 0.01	±10%	---	---	---
NONE	–	---	±20%	---	±10%	±1 pF

1982-31

Fig. 5-2. Color code for resistors and capacitors.

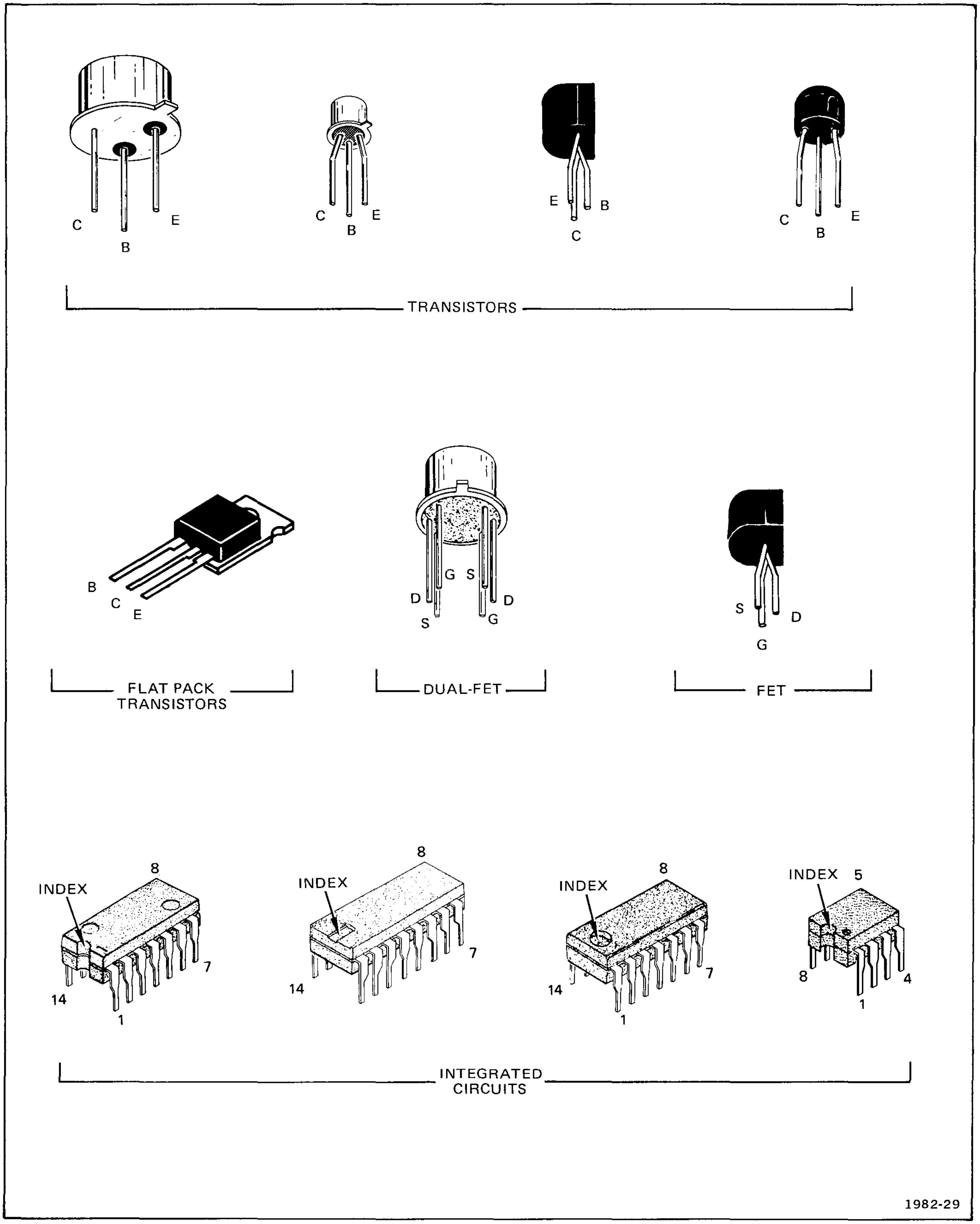


Fig. 5-3. Lead configuration for semiconductor devices.

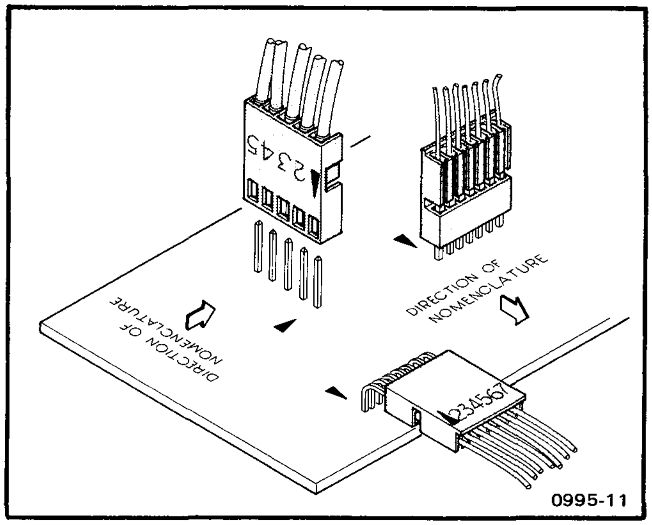


Fig. 5-4. Multi-connector holder orientation.

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

Incorrect operation of all circuits often indicates trouble in the power supply. Check first for correct voltage of the individual supplies. However, a defective component elsewhere in the instrument can appear as a power supply trouble and may also affect the operation of other circuits. Table 5-1 lists the tolerances of the power supplies. Voltages are measured between the power supply test points and ground. If a power supply voltage is within the listed tolerance, assume the supply is working correctly.

Use the troubleshooting chart to locate trouble. Not all problems appear on the chart. Continue with this checklist in those cases.

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

NOTE

Voltages and waveforms given on the diagrams are not absolute and therefore may vary slightly between instruments. To obtain operating conditions similar to those used to take these readings, see the voltage and waveform setup procedures in the Diagrams section. Individual deviations should be noted on the schematics for future reference.

7. Check the individual components. Remember that the best check of semiconductors—transistors, diodes, IC's—and thick film resistors is actual operation in a circuit. If you suspect that a semiconductor is bad, substitute a new one for it. Before you start checking IC's, read the part of the Circuit Description that covers the circuit.

WARNING

The power switch must be turned off before removing or replacing components to prevent electrical shock or circuit damage.

To check other components, resistors, capacitors, and inductors, clip one lead and lift it. You may have to add a piece of wire when you resolder the connection, however.

Resistors: Check the resistors for discoloration. Then check the resistors with an ohmmeter after disconnecting one end from the circuit. Check the Replaceable Electrical Parts list for the tolerance of the resistors used in this instrument. Resistors normally do not need to be replaced unless the measured value varies widely from the specified value.

Inductors: Check for open inductors by checking continuity with an ohmmeter. (It may be helpful to disconnect one end of the inductor when checking continuity.) Shorted or partially shorted inductors can also be found by checking the waveform response when high-frequency signals are passed through the circuit. Partial shorting often reduces high-frequency response (increases roll-off).

Capacitors: A leaky or shorted capacitor can be detected by checking resistance with an ohmmeter on the highest scale, after disconnecting one end from the circuit. Do not exceed the voltage rating of the capacitor (some ohmmeters use 30 volts as source voltage). The resistance reading should be high after inital charge of the capacitor. An open capacitor can also be detected with a capacitance meter or by checking whether the capacitor passes ac signals.

Switches: The most common cause of switch failure is dust between the contact and the pad. Check the suspected contact for continuity with an ohmmeter. If open and not obviously damaged, try cleaning (see Cam Switch Repair and Replacement).

Another frequent cause of switch failure is solder smoke residue. This can occur when replacing a component near the switch. This problem is usually indicated by reduced high-frequency response. Flushing the contact with isopropyl alcohol usually fixes this problem.

If the contact is physically damaged, replace the contact strip. Bending the contact is only a temporary repair. See Cam Switch Repair and Replacement.

8. After repairing a circuit or replacing components, check the performance of the instrument. If the Performance Check is within specifications, it is not necessary to re-adjust the instrument. If the instrument does not meet the specifications, perform the Adjustment Procedure in Section 4.

Troubleshooting Hints

Power. SYMPTOM—No visible trace and no display when the BEAM FINDER button is pushed (Power ON lamp is lit).

a. Does beam appear on screen? If not, rotate INTENSITY control clockwise while holding BEAM FINDER button in until beam appears or control is fully clockwise. If beam does not appear, the trouble may be in the power supplies (see Power Supply schematic).

b. Check all low voltage power supplies, starting with −8 V (−8 V is reference supply), the +8 V, and +100 V at appropriate test points.

(1) If no voltage is present, check F700.

(2) If −8 V is low (or zero), check Q772, Q774, Q776, or U742.

(3) If −8 V is correct but +8 V is low (or zero), check Q752, Q754, Q756, and U742 (U742 is used for both −8 and +8 V supplies).

c. Check high-voltage supplies (see CRT and Vertical Amplifier schematic).

(1) Check for −2 kV at pin 1, P465, or pin 2, crt base socket.

(2) If no −2 kV, check for 50 kHz sine wave (approximately 200 V, peak-to-peak) at pin 5 of T460 (high-voltage transformer primary).

(3) If neither −2 kV or 50 kHz sine wave is present, check Q454, Q458, and Q446.

CAUTION

Do not unload the secondary of the high-voltage transformer, T460; the transformer may be damaged.

Z-Axis. SYMPTOM—No intensity or no control over intensity (BEAM FINDER button pushed).

a. Does beam come on screen? If not, and low and high-voltage supplies are correct, trouble may be in Z-Axis circuit (see CRT and Vertical Amplifier schematic).

(1) Check for approximately 60 V swing between crt-socket pins 2 and 3. If no voltage swing, trouble may be in unblanking.

(2) Check for pulse at Q416 emitter. This pulse amplitude should vary from 20 to 80 mV with change (fully cw to fully ccw) in INTENSITY control position.

(3) Check for 0-40 V, peak-to-peak unblanking pulse (varies with INTENSITY control position) at Q426 collector.

(4) If no unblanking pulse, check Q426, Q424, Q416, or Q434.

VERTICAL: SYMPTOM 1.—No trace on crt or vertical POSITION control does not center display (see Vertical Switching and CRT and Vertical Amplifier schematics).

a. If trace is on screen, but about 2 cm above graticule center, it indicates trouble in vertical amplifier.

b. Short P4-9 to P4-11 (A8, Vertical board). If trace does not center, trouble is in output circuits. Check Q112, Q122, Q134, Q144, Q136, and Q146.

c. If trace centers with pins 9 and 11 short-circuited, trouble is ahead of P4.

d. Short Q4376 collector to Q4386 collector. If trace centers, trouble is ahead of delay-line drivers, Q4376-Q4386.

e. Check voltage at Q4344 and Q4346 emitters. Each should read approximately +5 V above ground. If emitter voltage is okay, trouble is either in Q4344 or Q4346, or in switching circuit.

SYMPTOM 2.—With 50 mV signal ac coupled to CH 1 input and VOLTS/DIV set to 10 mV, crt display position is low and does not position above graticule center.

a. If trace does not appear on screen, rotate vertical POSITION control.

b. If trace appears, but decreases in amplitude at graticule center, suspect vertical output circuit.

c. Short Q136 collector to Q146 collector. If trace centers, short Q112 collector to Q122 collector. Trace should center. If not, suspect Q112, Q134, or Q136 and associated circuitry.

Triggering: SYMPTOM 1.—Trace free runs, does not trigger in AUTO or NORM (see Trigger schematic).

a. Set TRIGGERING MODE to AUTO. Turn LEVEL control cw and ccw to both limits. Does the trace flicker? If not, triggering signal is not reaching sweep circuit.

b. Check voltage at junction of R2151, R2152, and R2143. Does voltage vary from −2 to +3 V while turning LEVEL control throughout its range? If yes, check U2156B output. Does U2156 output level change while turning LEVEL control as above?

c. Connect a signal to CH 1. Check for trigger pulse at U2156B output. If no signal, suspect U2156A or B, or related circuits.

SYMPTOM 2.—Does not trigger in AUTO.

a. Check for trigger pulse at pin 6 of U2212B. If none, check for HI at U2212B, pin 4, while varying the LEVEL control. If pin 4 does not go HI, check for defective U2212B, U2224B, or CR2227.

A Sweep: SYMPTOM 1.—No A Sweep on crt (see A Sweep and Horizontal Amplifier schematic).

a. Push BEAM FINDER button. If trace or dot is right of center, check at R2243 (end of resistor toward board center) for a 12 V (approximately) ramp.

b. If ramp is not present, check for approximately 0.7 V at Q2274 base.

c. If voltage at Q2274 base is high (approximately 8.0 volts) check Q2274, Q2242, Q2244, or Q2246.

SYMPTOM 2.—No trace on crt.

a. Repeat sweep symptom 1, parts a and b.

b. Check for a HI at U2234C, pin 8. If not HI, check U2234C.

B Sweep SYMPTOM 1.—No B Sweep on crt (see B Sweep schematic) but A Sweep is present.

a. Check for 12 V ramp at collector of Q2546.

b. If ramp is not present, check for LO at pin 3 of U2524B. If pin 3 is HI, check DISPLAY MODE switch S2510 and for HI at pins 1 and 2 of U2524B.

c. If pin 1 is not HI, check Q2548.

d. If pin 2 is not HI, check for a LO at pin 5 of U2524A. If pin 5 is not LO, check Q2514, Q2516, and Q2522.

e. If pin 3 of U2524B is LO, check Q2542, Q2544, and Q2546.

SYMPTOM 2.—No intensified portion of sweep in the A INTEN BY B mode.

a. Check DISPLAY MODE switch S2510.

NOTE

When troubleshooting the sweep or horizontal circuits, the Vertical AMPLIFIER may be removed from the instrument.

Sweep may lock up while troubleshooting. If in doubt, switch instrument power off and back on. If there are no problems, trace should free run.

Horizontal. SYMPTOM 1.—No trace on screen (see Sweep and Horizontal Amplifier schematic).

a. Check output (Q2334-Q2344 collectors) for approximately 40 V ramp. If okay, check for possibly defective crt leads.

SYMPTOM 2.—Trace on screen, but is short.

a. Check horizontal output (Q2334-Q2344 collectors) for approximately 40 V ramp.

b. If no ramp at output, check for 12 V ramp at junction of R2243-R2311, C2246-R2245.

c. If ramp is present, check Q2314, Q2326, Q2332, Q2334, or Q2344.

CORRECTIVE MAINTENANCE

Corrective maintenance consists of repair and parts replacement. This section contains general information, troubleshooting information, and component replacement information.

NOTE

Be sure you are familiar with soldering techniques and parts replacement procedures before replacing any components.

Soldering Techniques

WARNING

To prevent electrical shock, or damage to the instrument, always disconnect the instrument from the power source before soldering.

For soldering, use ordinary 60/40 solder and a 15-watt soldering iron. Excessive heat can cause the etched circuit wiring to separate from the board base material. Use caution if using a higher wattage-rated soldering iron on the circuit boards.

Replacement Parts

All parts for the T932A and T935A can be ordered from your local Tektronix Field Office, but many of the components are standard items that may be more readily available locally. Check the parts list for value, tolerance, ratings, and description before you replace any components.

When ordering parts from Tektronix, include the following information:

(1) Instrument type.

(2) Instrument serial number.

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

(4) Tektronix part number.

Component Replacement

WARNING

Disconnect the instrument from the power source before replacing components.

Since the components are located on one side of the circuit boards, it is necessary to remove the circuit boards before replacing some components. Refer to the paragraphs on circuit board replacement for instructions in removal and installation of each circuit board. Also be sure you're familiar with soldering techniques used on single-sided circuit boards.

Semiconductors

Replacement of semiconductors may affect the adjustment of this instrument. After replacing semiconductors, especially if using parts other than those listed in the parts list, check the performance of the instrument to be sure that the performance has not been degraded.

WARNING

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

Replacement semiconductors should be of the original type or a direct replacement. Lead configuration of the semiconductors used in this instrument are shown in this section. Some plastic case transistors have lead configurations which do not agree with those shown there. If a replacement transistor is made by a different manufacturer than the original, check the manufacturer's basing diagram for correct basing. Most transistors are soldered directly onto the circuit boards. Transistors having heat radiators or those mounted on the chassis use silicone grease to increase heat transfer. Replace the silicone grease when replacing these transistors. Those transistors mounted on the chassis are held in place by a metal clip.

NOTE

After replacing a power transistor, check that the collector is not shorted to ground before applying power.

Fuse Replacement

The line-voltage fuse, F700, is located next to the POWER ON switch, S700, on the Interface board. The high voltage fuse, F722, is located on the Power Supply board. Refer to the Replaceable Electrical Parts list for correct fuse values.

Low voltage — 8 Vdc supply — is fused in two legs of transformer secondary. Fuses F742 and F743 are easily seen on Power Supply board. These fuses are soldered in circuit but should not blow unless transformer secondary is physically shorted.

Thick Film Resistor Replacement

To remove the thick film resistors, first remove the solder from the pins and then remove the resistors.

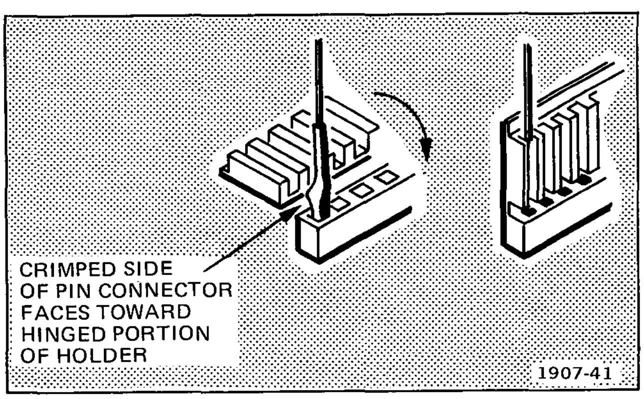


Fig. 5-5. Pin connector replacement.

To install the thick film resistors, R444 or R118, match the pins on the resistor with the holes in the circuit board. Resolder all of the pins to the circuit board.

Interconnecting Cable and Pin Connector Replacement

The interconnecting cable assemblies are factory assembled. They consist of machine installed pin connectors mounted in plastic holders. The plastic holders are easily replaced as individual items, but if the connectors are faulty, the entire cable should be replaced.

It is possible for the pin connectors to become dislodged from the plastic holders. If this happens, the connector can be re-installed as follows (see Fig. 5-5).

1. Bend grooved portion of holder away from cable as shown.

2. Re-insert connector into its hole in plug-in portion of holder.

NOTE

Holder positions are numbered (number one is identified with a triangle).

3. Bend grooved part of holder so that connector is inserted into groove.

When plugging connector holders onto board pins, be sure to match triangle mark on holder with triangle mark on circuit board.

Shaft-Knob Removal

1. Grip knob end with one hand and shaft end with other hand.

2. Pull on knob, while pushing on shaft, to free recessed portion of shaft from retainer bushing (see Fig. 5-6). Some shaft-knobs may require considerable force to remove.

CAUTION

The bushing and shaft may separate abruptly. To avoid damage to the potentiometer and circuit board, or personal injury, grip both pieces firmly during shaft-knob removal. It may be helpful to grip the shaft with the tip of a long-nose pliers and use a gentle rocking motion to separate the shaft from the bushing.

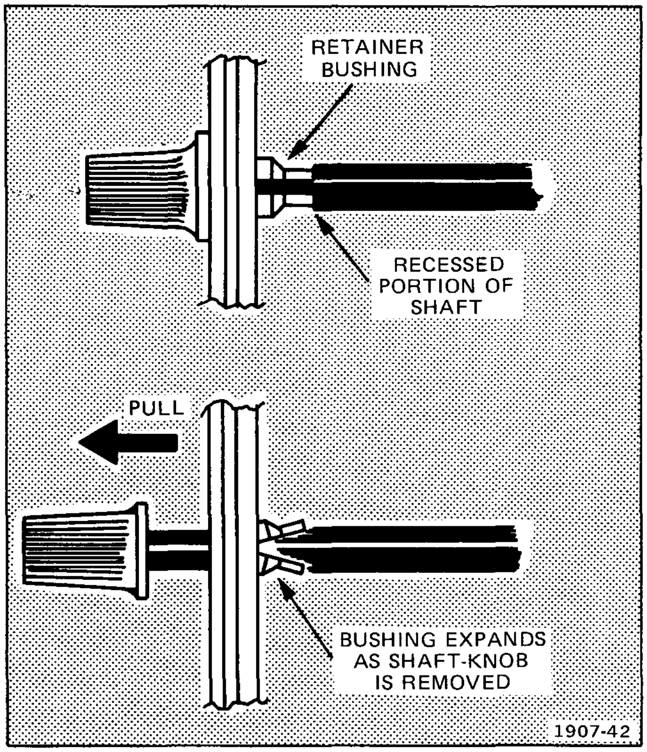


Fig. 5-6. Shaft-knob removal.

Vertical Amplifier Replacement

To remove the vertical amplifier (see Fig. 5-7) from the instrument:

1. Support the vertical amplifier, while removing the retaining screws. One is between the attenuators, one is near C4307, and one is near R4373.

2. Disconnect P4 (see Fig. 5-7) from J4 on the Interface board by lifting the entire vertical amplifier. Be careful not to bend the pins.

To reinstall the vertical amplifier, reverse the above procedure.

NOTE

The front panel, switches, delay line, and attenuators are attached to the Vertical board.

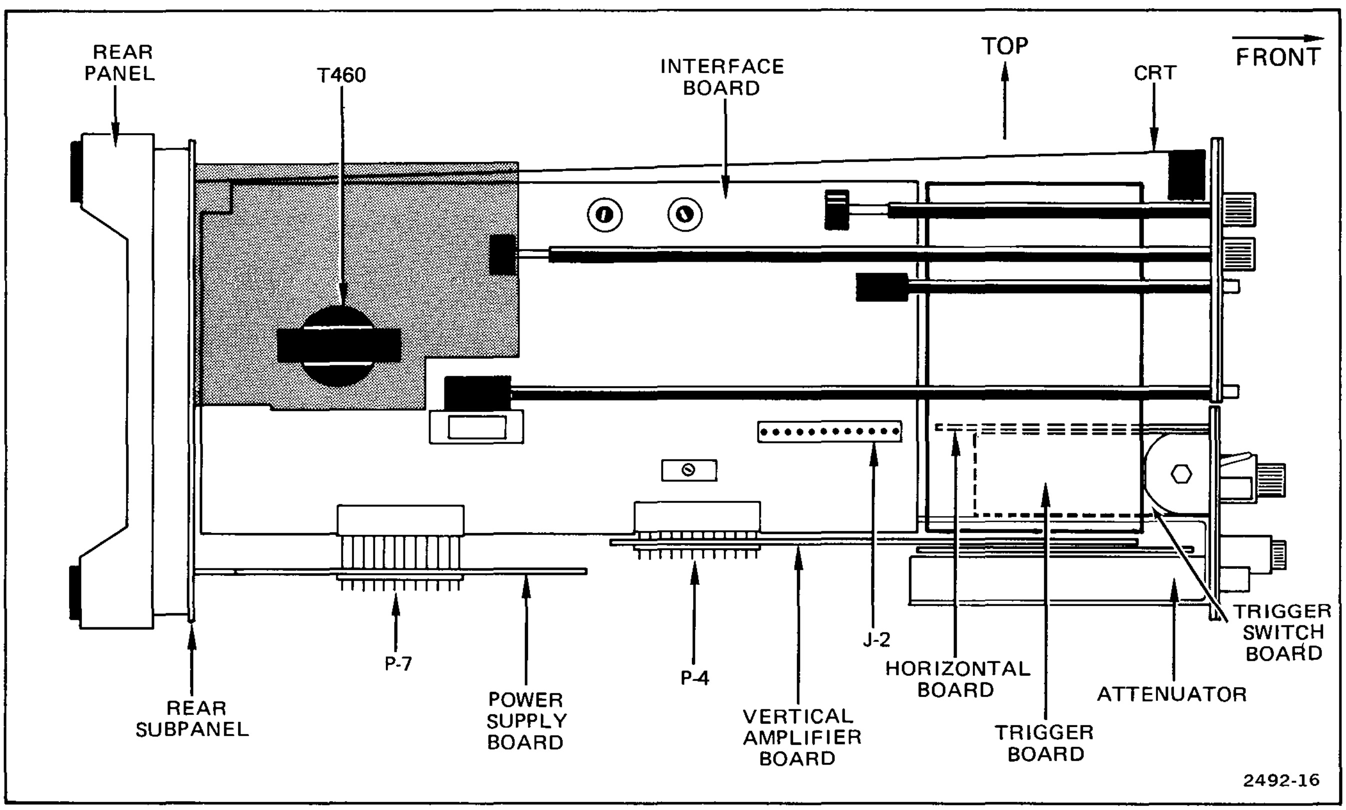


Fig. 5-7. Circuit board locations (on left side of crt).

Attenuator Replacement

To remove the attenuator from the instrument:

1. Remove the POSITION control knob and shaft.

2. Remove the VOLTS/DIV VAR knob and shaft. To remove the shaft, loosen the set screws holding the shaft to the potentiometer and pull the shaft out (observe knob orientation for re-assembly reference).

3. Pull the VOLTS/DIV knob and shaft out of the front panel.

4. Remove the three retaining screws from the attenuator shield and the hex nut behind the front panel near the bnc connector.

5. Pull the attenuator assembly off the Vertical Amplifier board. Be careful not to bend the connector pins.

6. To remove the attenuator shield, first unsolder the leads to the bnc connector. Take care not to touch the body of the capacitor with a hot soldering iron. Then remove one retaining screw from the board side. Be careful not to remove the screws holding the cam switch against the attenuator board. Lift the shield off the attenuator.

To reinstall the attenuator:

1. Attach the attenuator shield to the board with one screw, and resolder the lead to the bnc connector. Avoid touching the capacitor with a hot soldering iron.

2. Slide the bnc connector and coupling switch into the front panel.

3. Make sure the connecting pins and holders on the bottom of the attenuator board align properly.

4. Press the attenuator board down on the Vertical Amplifier board and secure it with the three retaining screws.

NOTE

The VOLTS/DIV shaft end is molded to form a key that fits into the cam. Attempting to force the shaft into the cam when it is not properly lined up, will damage the cam switch.

5. Line the VOLTS/DIV knob and shaft up with the cam and slide into place. When the shaft and cam are lined up, the shaft slides into the cam easily.

6. Reinstall the VOLTS/DIV VAR knob and shaft, and tighten the set screws.

Cam Switch Repair and Replacement

A cam switch is actually an assembly consisting of a cam rotated by a front panel control and a set of contacts on an adjacent circuit board.

CAUTION

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

Cleaning. If the contact is not obviously damaged, try cleaning it before replacing. Follow the cleaning procedures in the order given; the first ones are the easiest.

CAUTION

When cleaning cam switch contacts:

1. Don't use cleaners, detergents, or lubricants which leave a residue. The residue can interfere with the high-frequency response of the contact. Also, the residue will attract dust and cause the contact to require frequent cleaning.

2. Don't use any cleaners which contain fluorocarbons. These will damage the cam portion of the switch. Fluorocarbons also damage the circuit board material used in some instruments.

3. Don't use anything that could snag the contact, like a cotton swab.

4. Don't scrape the pad. If the gold is removed from the pad, the pad will oxidize and cause future problems.

5. Don't bend the contacts. This may temporarily fix the problem. However, bending the contact damages its self-cleaning action and causes problems in the future.

Use the following procedures to clean the contacts:

1. Operate the switch several times. The wiping action may clean the contacts.

2. Blow low pressure air in the area of the contact while operating the switch.

3. Flush the contact with isopropyl alcohol and blow dry with low-pressure air. Isopropyl alcohol is flammable; avoid its use near open flame or other potential sources of ignition.

If the above procedures don't work, replace the contact strip. If cleaning the switch restores continuity, check to ensure that the contact wipes across the pad. If the contact does not wipe, replace the contact strip.

Contact Replacement. Cam Switch contacts in this instrument are part of a contact strip assembly. Refer to the mechanical parts list for ordering information.

If you do not have a replacement contact strip assembly, bend the contact for a temporary repair. If you do bend the contact, make note of its location and the symptom it causes. This will speed repair if the contact fails before you can make permanent repairs.

Delay Line Replacement

To remove the delay line from the instrument:

1. Remove the vertical amplifier. See Vertical Amplifier Replacement for instructions.

2. Remove the three cable wrap ends from the back of the vertical chassis by unfastening the three nuts.

3. Unsolder the two wires at each end of the delay line where they connect to the board. The darker colored wires go to the solder connections nearest the index marks on the board.

4. Remove the two screws holding the cable end clamps to the board.

5. To reinstall the delay line, reverse the above procedure.

Time Base (Horizontal Board) Replacement

To remove the Time Base from the instrument:

1. Remove the Vertical Amplifier. See Vertical Amplifier Replacement for instructions.

2. Support the Time Base (horizontal board) while removing the retaining screw in the upper right corner (near the POSITION control), the post by the LEVEL potentiometer, and the post in the lower right corner.

3. Carefully remove the leads from P2344 (a red on white crt lead to the − side of P2344 and a green on white crt lead to the + side of P2344).

4. Remove P2 (see Fig. 5-7) from J2 on the Interface board by pulling the entire Time Base toward the right side of the instrument. Be careful not to bend the pins.

To reinstall the TIME BASE (HORIZONTAL BOARD), reverse the above procedure.

To remove the Trigger board, unsolder the coaxial cable from the X connector and unplug the board from the Horizontal board by pulling out and toward the back of the instrument.

To remove the Timing board, first remove the SEC/DIV knob and the POSITION control knob and shaft assembly. Then unplug the Timing board from the Horizontal board and pull the SEC/DIV shaft out of the front panel. To reinstall the timing board, reverse the procedure.

Trigger Board Replacement

To remove the trigger board from the instrument:

1. Remove INTENSITY, FOCUS, and BEAM FINDER shafts.

2. Remove P2100 (see Fig. 5-7) from trigger board.

3. Remove four screws to take board from chassis.

To replace trigger board, reverse the above procedure.

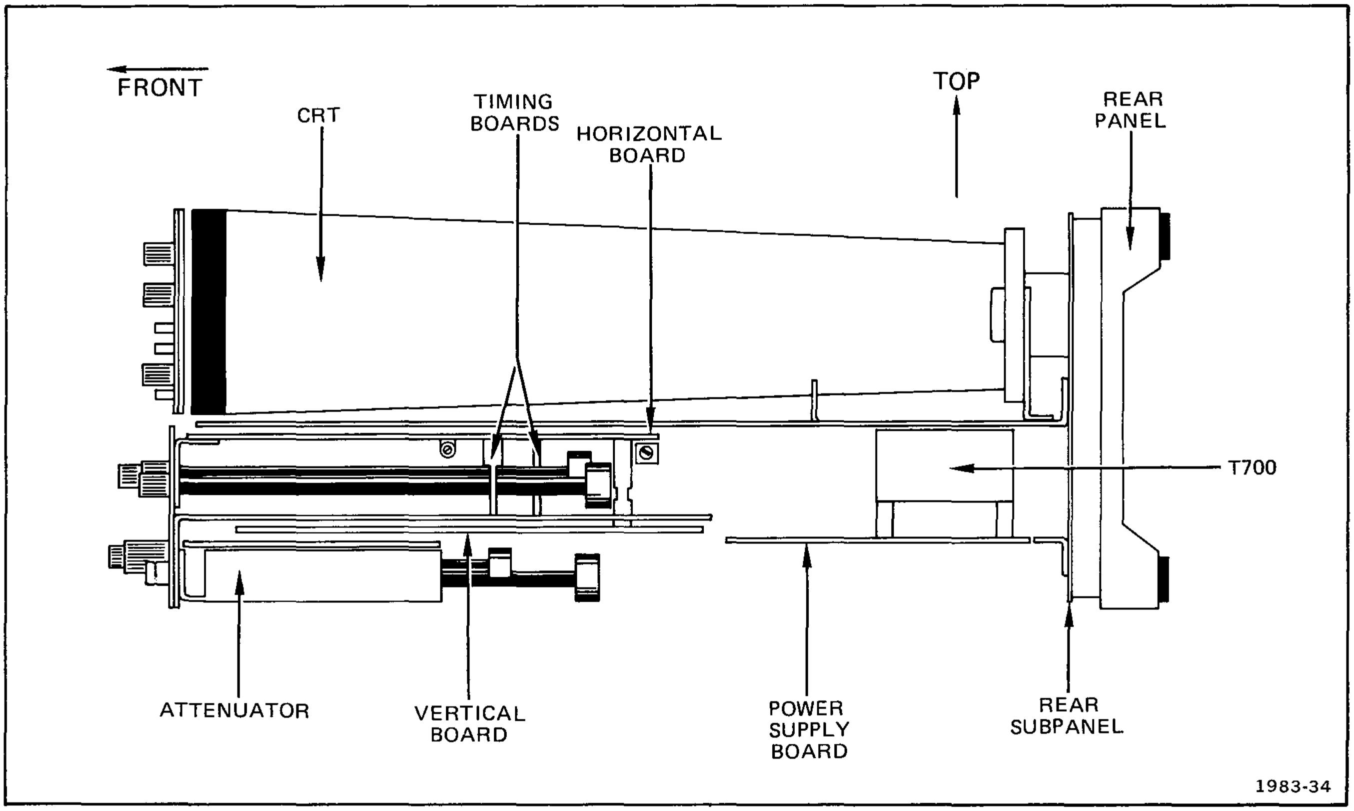


Fig. 5-8. Circuit board locations (on right side of crt).

Power Supply Board Replacement

To remove the Low Voltage Power Supply from the instrument:

1. Remove the two retaining screws holding the heat sink to the rear subpanel.

2. Remove the bolts near C743 and C722 (the ones holding the Power Supply board to the crt shield). The other two bolts hold the transformer to the Power Supply board.

3. Disconnect P7 from J7 on the Interface board by lifting the Power Supply board and transformer out. (See Fig. 5-7).

To reinstall the Power Supply board, reverse the above procedure.

Interface Board Replacement

To remove the Interface board from the instrument:

1. Remove the Vertical Amplifier and Time Base.

2. Use a small screwdriver to remove the clip holding Q458 to the rear subpanel.

3. Remove the front-panel FOCUS and INTENSITY knobs and shafts.

4. Remove the high-voltage shield (two screws) and the two posts underneath the shield.

5. Disconnect the following plugs from the Interface board:

   a. Cal Out (P24, unmarked on some boards), a brown on white wire that goes to PROBE ADJ on front panel.

   b. P419 from J419 (a red on white wire from pin marked Z Axis that goes to EXT Z AXIS INPUT connector on back panel). Push wire through hole in board.

   c. P470 from J470, (two plugs, each containing a red wire and a black wire that goes through hole in crt shield).

@

NOTE

To disconnect J475, J466, and J465, lift the cable retainers with a screwdriver until you can remove the cable.

d. Unplug P465 from J465 (a 4-pin plug); P466 from J466 (yellow on white single wire); and P475 from J475 (a 4-pin plug).

e. Unplug P138 from J138 (a blue on white wire); P148 from J148 (a brown on white wire); pull wires down through holes in board.

WARNING

The crt anode and the output terminal of high-voltage multiplier U460 may retain a 10,000 volt charge after the instrument is turned off. To avoid electrical shock, ground both the output terminal of U460 and the crt high-voltage anode lead to chassis ground.

f. Remove the high voltage lead from U460 (large white lead that goes the crt).

6. Remove the five retaining screws.

7. Disconnect J7 from P7 on Power Supply board by lifting the Interface board toward the top and back of the instrument so that the POWER (ON) light pipe disengages from DS796 housing, and the BEAM FINDER and OFF/ON (POWER) buttons slide back out of the front panel as J7 and P7 separate.

8. Unsolder the power cord conductors (a blue wire and a brown wire) from the back of the board.

To replace the Interface board, reverse the above procedure.

Cathode Ray Tube (CRT) Replacement

WARNING

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

To remove the crt from the instrument, disconnect power cord plug from power input source and remove cabinet halves. Turn the front of the instrument toward you, and perform the following steps.

1. Remove the two screws holding the high-voltage shield over the Interface board, and remove the shield.

WARNING

The crt anode and the output terminal of high-voltage multiplier U460 may retain a 10,000 volt charge after the instrument is turned off. To avoid electrical shock, ground both the output terminal of U460 and the crt high-voltage anode lead to chassis ground.

2. Grip the insulated portion of the anode lead and disconnect it from the U460 output terminal, and ground both terminals to chassis. Pull the free end of the anode lead out through the chassis holes. This lead is part of the crt and is supplied with the new crt.

3. Grip the 14-pin crt base socket, and pull it backward off the base of the crt.

4. Disconnect the four-pin plug from J470 on the Interface board. This terminates two black wires and two red wires from the trace rotation (TR ROT) and Y AXIS controls.

5. Remove the three screws holding the Vertical Amplifier to the chassis, and separate the amplifier from the Interface board by pulling downward to disconnect the P4 connector.

6. Disconnect the two connectors from the pins on the left side of the crt neck. These are the vertical deflection plate leads, the upper wire color is blue on white and the lower wire color is brown on white.

7. Disconnect the two connectors from the pins on the bottom of the crt neck. These are the Horizontal Deflection Plate leads; the left wire color is red on white and the right wire color is green on white.

8. Carefully raise the plastic crt front support ring upward and to the right to disengage the two buttons on the bottom and the two buttons on the left side from the instrument chassis.

NOTE

Although it may be convenient, it is not necessary to remove any front panel or subpanel controls or parts. The foregoing steps will allow the front of the crt to be moved to the right of its normal position while slightly bending the plastic subpanel to allow clearance for the crt to be pulled forward out of its shield.

9. Gently press forward on the crt base, supporting the front of the crt, until the front extends far enough forward to grasp. Pull the crt the rest of the way out of its shield.

10. To install a new crt, reverse the above procedure.

REPACKAGING FOR SHIPMENT

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

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

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

The carton test strength for your instrument is 275 pounds.

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

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

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

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

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

SPECIAL NOTES AND SYMBOLS

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

ITEM NAME

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

ABBREVIATIONS

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

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P O BOX 128	PICKENS, SC 29671
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
02111	SPECTROL ELECTRONICS CORPORATION	17070 EAST GALE AVENUE	CITY OF INDUSTRY, CA 91745
03614	BUSSMAN MFG. DIV. McGRAW EDISON CO.	502 EARTH CITY PLAZA	EARTH CITY, MO 63045
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867, 19TH AVE. SOUTH	MURTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
05091	TRI-ORDINATE CORPORATION	343 SNYDER AVENUE	BERKELEY HEIGHTS, NJ 07922
05574	VIKING INDUSTRIES, INC.	21001 NORDHOFF STREET	CHATSWORTH, CA 91311
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
07910	TELEDYNE SEMICONDUCTOR	12515 CHADRON AVE.	HAWTHORNE, CA 90250
08806	GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPARTMENT	NELA PARK	CLEVELAND, OH 44112
11237	CTS KEENE, INC.	3230 RIVERSIDE AVE.	PASO ROBLES, CA 93446
12697	CLAROSTAT MFG. CO., INC.	LOWER WASHINGTON STREET	DOVER, NH 03820
14099	SEMTECH CORP.	652 MITCHELL RD.	NEWBURY PARK, CA 91320
14193	CAL-R, INC.	1601 OLYMPIC BLVD.	SANTA MONICA, CA 90404
19396	IILINOIS TOOL WORKS, INC. PAKTRON DIV.	900 FOLLIN LANE, SE	VIENNA, VA 22180
27264	MOLEX PRODUCTS CO.	5224 KATRINE AVE.	DOWNERS GROVE, IL 60515
50157	N. L. INDUSTRIES, INC., ELECTRONICS DEPT.	P. O. BOX 787	MUSKEGON, MI 49445
51406	MURATA CORPORATION OF AMERICA	2 WESTCHESTER PLAZA	ELMSFORD, NY 10523
56289	SPRAGUE ELECTRIC CO.		NORTH ADAMS, MA 01247
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
80031	ELECTRA-MIDLAND CORP., MEPCO DIV.	22 COLUMBIA ROAD	MORRISTOWN, NJ 07960
81483	INTERNATIONAL RECTIFIER CORP.	9220 SUNSET BLVD.	LOS ANGELES, CA 90069
82389	SWITCHCRAFT, INC.	5555 N. ELSTON AVE.	CHICAGO, IL 60630
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	3029 E WASHINGTON STREET P O BOX 372	INDIANAPOLIS, IN 46206
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-5446-00			CIRCUIT BD ASSY:INTERFACE	80009	670-5446-00
A2	670-5473-00			CIRCUIT BD ASSY:LOW VOLTAGE POWER SUPPLY	80009	670-5473-00
A6	670-3972-04			CIRCUIT BD ASSY:ATTENUATOR,CHANNEL 1	80009	670-3972-00
A7	670-3973-04			CIRCUIT BD ASSY:ATTENUATOR,CHANNEL 2	80009	670-3973-04
A8	670-5443-00			CIRCUIT BD ASSY:VERTICAL	80009	670-5443-00
A10	670-5448-00			CIRCUIT BD ASSY:TRIGGER FUNCTION	80009	670-5448-00
A11	670-5447-00			CIRCUIT BD ASSY:TRIGGER	80009	670-5447-00
A12[1]	670-5445-00			CIRCUIT BD ASSY:HORIZONTAL	80009	670-5445-00
A12[2]	670-5444-00			CIRCUIT BD ASSY:HORIZONTAL	80009	670-5444-00
A13[1]	672-0551-00			CIRCUIT BD ASSY:TIMING W/ROTARY SWITCH	80009	672-0551-00
A13[2]	672-0533-00			CIRCUIT BD ASSY:TIMING W/ROTARY SWITCH	80009	672-0533-00
C24	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C114	281-0207-00			CAP.,VAR,PLSTC:2-18PF,100V	80031	HT10EA/218
C115	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	72982	8131N075 E224M
C118	281-0207-00			CAP.,VAR,PLSTC:2-18PF,100V	80031	HT10EA/218
C119	281-0768-00			CAP.,FXD,CER DI:470PF,20%,100V	72982	314022X5P0471M
C124	281-0762-00			CAP.,FXD,CER DI:27PF,20%,100V	72982	390-049X5P0270M
C129	281-0768-00			CAP.,FXD,CER DI:470PF,20%,100V	72982	314022X5P0471M
C412	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C423	281-0661-00			CAP.,FXD,CER DI:0.8PF,+/-0.1PF,500V	72982	301-000C0K0808B
C424	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C425	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C433	285-1099-00			CAP.,FXD,PLSTC:0.047UF,20%,200V	19396	473M02PT605
C434	285-1099-00			CAP.,FXD,PLSTC:0.047UF,20%,200V	19396	473M02PT605
C435	285-1099-00			CAP.,FXD,PLSTC:0.047UF,20%,200V	19396	473M02PT605
C443	290-0297-00			CAP.,FXD,ELCTLT:39UF,10%,10V	56289	150D396X9010B2
C445	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C455	281-0772-00			CAP.,FXD,CER DI:0.0047UF,10%,100V	72982	8005H9AADW5R472K
C458	290-0405-00			CAP.,FXD,ELCTLT:10UF,+50-10%,150V	56289	30D106F150DD4
C462	283-0034-00			CAP.,FXD,CER DI:0.005UF,20%,4000V	56289	41C107A
C463	283-0034-00			CAP.,FXD,CER DI:0.005UF,20%,4000V	56289	41C107A
C464	283-0034-00			CAP.,FXD,CER DI:0.005UF,20%,4000V	56289	41C107A
C465	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	56289	33C325
C466	283-0404-00			CAP.,FXD,CER DI:0.01UF,20%,4000V	51406	ADVISE
C469	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	56289	33C325
C476	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C477	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C478	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C722	290-0750-00			CAP.,FXD,ELCTLT:100UF,+50-10%,160V	56289	D76244
C738	290-0744-00			CAP.,FXD,ELCTLT:3.3UF,+50-10%,160V	90201	TT3R3U160B013P
C742	290-0751-00			CAP.,FXD,ELCTLT:2200UF,+50-10%,16V	56289	D76245
C743	290-0751-00			CAP.,FXD,ELCTLT:2200UF,+50-10%,16V	56289	D76245
C746	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C756	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C758	290-0107-00			CAP.,FXD,ELCTLT:25UF,+75-10%,25V	56289	30D256G025DB9
C762	290-0301-00			CAP.,FXD,ELCTLT:10UF,10%,20V	56289	150D106X9020B2
C763	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C774	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C778	290-0107-00			CAP.,FXD,ELCTLT:25UF,+75-10%,25V	56289	30D256G025DB9
C807	290-0524-00			CAP.,FXD,ELCTLT:4.7UF,20%,10V	90201	TDC475M010EL
C2001	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2005	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M

[1]T932A only
[2]T935A only

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C2010	281-0534-00			CAP.,FXD,CER DI:3.3PF,+/-0.25PF,500V	72982	301-000C0J0339C
C2011	281-0792-00			CAP.,FXD,CER DI:82PF,10%,100V	72982	390049X5P0820K
C2013	281-0760-00			CAP.,FXD,CER DI:22PF,10%,500V	72982	314-011C0G220K
C2014	281-0797-00			CAP.,FXD,CER DI:15PF,10%,100V	72982	8005A9AADC1G150K
C2023	281-0814-00			CAP.,FXD,CER DI:100PF,10%,100V	72982	8005A9AADC1G101K
C2030	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558-Z5V0203Z
C2033	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2035	281-0797-00			CAP.,FXD,CER DI:15PF,10%,100V	72982	8005A9AADC1G150K
C2040	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C2063	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	72982	390049X5P0470K
C2090	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2091	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2092	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C2102	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2124	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C2125	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2128	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C2144	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2149	290-0183-00			CAP.,FXD,ELCTLT:1UF,10%,35V	56289	162D105X9035CD2
C2156	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2162	290-0135-00			CAP.,FXD,ELCTLT:15UF,20%,20V	56289	150D156X0020B2
C2163	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	72982	390049X5P0470K
C2166	290-0183-00			CAP.,FXD,ELCTLT:1UF,10%,35V	56289	162D105X9035CD2
C2171	290-0183-00			CAP.,FXD,ELCTLT:1UF,10%,35V	56289	162D105X9035CD2
C2174	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C2175	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C2176	281-0774-00			CAP.,FXD,CER DI:0.022UF,20%,100V	72982	8045A9ABDZ2U223M
C2181	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2212	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2226	290-0135-00			CAP.,FXD,ELCTLT:15UF,20%,20V	56289	150D156X0020B2
C2233	283-0706-00			CAP.,FXD,MICA D:91PF,+/-1PF,500V	00853	D15-5E910F0
C2234	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2235	281-0216-00			CAP.,VAR,CER DI:0.8-6.8PF,400V	80031	2222-801-96024
C2236	290-0135-00			CAP.,FXD,ELCTLT:15UF,20%,20V	56289	150D156X0020B2
C2245	281-0759-00			CAP.,FXD,CER DI:22PF,10%,100V	72982	390-049X5P0220K
C2252A-D	295-0179-00			CAP.,SET,MTCHD:0.01UF,1.0UF,1%	80009	295-0179-00
C2274	281-0772-00			CAP.,FXD,CER DI:0.0047UF,10%,100V	72982	8005H9AADW5R472K
C2275	290-0167-00			CAP.,FXD,ELCTLT:10UF,20%,15V	56289	150D106X0015B2
C2276	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2278	281-0758-00			CAP.,FXD,CER DI:15PF,20%,100V	72982	314022C0G0150M
C2317	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2325	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2327	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2337	290-0480-00			CAP.,FXD,ELCTLT:0.5UF,+50-10%,200V	80009	290-0480-00
C2517[1]	290-0135-00			CAP.,FXD,ELCTLT:15UF,20%,20V	56289	150D156X0020B2
C2521[1]	281-0758-00			CAP.,FXD,CER DI:15PF,20%,100V	72982	314022C0G0150M
C2525[1]	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	72982	390049X5P0470K
C2533[1]	281-0759-00			CAP.,FXD,CER DI:22PF,10%,100V	72982	390-049X5P0220K
C2535[1]	281-0216-00			CAP.,VAR,CER DI:0.8-6.8PF,400V	80031	2222-801-96024
C2536[1]	283-0632-00			CAP.,FXD,MICA D:87PF,1%,100V	00853	D151E870F0
C2539	290-0135-00			CAP.,FXD,ELCTLT:15UF,20%,20V	56289	150D156X0020B2
C2544[1]	281-0759-00			CAP.,FXD,CER DI:22PF,10%,100V	72982	390-049X5P0220K
C2548[1]	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	72982	390049X5P0470K

[1]T935A only

@

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C4101	281-0541-00			CAP.,FXD,CER DI:6.8PF,10%,500V	72982	301-000C0H0689D
C4102	285-1124-00			CAP.,FXD,PLSTC:0.022UF,20%,400V	19396	PP721E223M
C4104	281-0207-00			CAP.,VAR,PLSTC:2-18PF,100V	80031	HT10EA/218
C4105	281-0214-00			CAP.,VAR,CER DI:0.5-3PF,400V	80031	2222-801-96138
C4106	283-0213-00			CAP.,FXD,CER DI:300PF,5%,100V	72982	8121N130A301J
C4113	281-0207-00			CAP.,VAR,PLSTC:2-18PF,100V	80031	HT10EA/218
C4114	281-0214-00			CAP.,VAR,CER DI:0.5-3PF,400V	80031	2222-801-96138
C4115	281-0610-00			CAP.,FXD,CER DI:2.2PF,+/-0.1PF,500V	72982	374-001C0J0229B
C4116	281-0759-00			CAP.,FXD,CER DI:22PF,10%,100V	72982	390-049X5P0220K
C4122	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C4131	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	72982	8131N075 E224M
C4143	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	72982	390049X5P0470K
C4154	281-0204-00			CAP.,VAR,PLSTC:2-22PF,100V	80031	C010EA-20E
C4156	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	04222	7001-1380
C4158	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C4166	283-0119-00			CAP.,FXD,CER DI:2200PF,5%,200V	72982	855-535B222J
C4168	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C4177	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C4187	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C4196	281-0762-00			CAP.,FXD,CER DI:27PF,20%,100V	72982	390-049X5P0270M
C4201	281-0541-00			CAP.,FXD,CER DI:6.8PF,10%,500V	72982	301-000C0H0689D
C4202	285-1124-00			CAP.,FXD,PLSTC:0.022UF,20%,400V	19396	PP721E223M
C4204	281-0207-00			CAP.,VAR,PLSTC:2-18PF,100V	80031	HT10EA/218
C4205	281-0214-00			CAP.,VAR,CER DI:0.5-3PF,400V	80031	2222-801-96138
C4206	283-0213-00			CAP.,FXD,CER DI:300PF,5%,100V	72982	8121N130A301J
C4213	281-0207-00			CAP.,VAR,PLSTC:2-18PF,100V	80031	HT10EA/218
C4214	281-0214-00			CAP.,VAR,CER DI:0.5-3PF,400V	80031	2222-801-96138
C4215	281-0610-00			CAP.,FXD,CER DI:2.2PF,+/-0.1PF,500V	72982	374-001C0J0229B
C4216	281-0759-00			CAP.,FXD,CER DI:22PF,10%,100V	72982	390-049X5P0220K
C4222	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C4231	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	72982	8131N075 E224M
C4243	281-0792-00			CAP.,FXD,CER DI:82PF,10%,100V	72982	390049X5P0820K
C4256	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	04222	7001-1380
C4258	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C4266	283-0119-00			CAP.,FXD,CER DI:2200PF,5%,200V	72982	855-535B222J
C4268	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C4277	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C4287	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C4296	281-0762-00			CAP.,FXD,CER DI:27PF,20%,100V	72982	390-049X5P0270M
C4302	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	72982	390049X5P0470K
C4306	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C4307	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	72982	390049X5P0470K
C4308	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	72982	390049X5P0470K
C4312	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C4315	281-0770-00			CAP.,FXD,CER DI:0.001UF,20%,100V	72982	314022X5P0102M
C4324	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C4331	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C4332	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C4334	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C4339	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	72982	8131N075 E224M
C4355	281-0786-00			CAP.,FXD,CER DI:150PF,10%,100V	72982	390049X5P0151K
C4368	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C4375	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C4378	281-0762-00			CAP.,FXD,CER DI:27PF,20%,100V	72982	390-049X5P0270M
C4385	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C4386	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C4388	281-0762-00			CAP.,FXD,CER DI:27PF,20%,100V	72982	390-049X5P0270M
C4395	281-0511-00			CAP.,FXD,CER DI:22PF,+/-2.2PF,500V	72982	301-000C0G0220K
C4396	281-0207-00			CAP.,VAR,PLSTC:2-18PF,100V	80031	HT10EA/218
C4397	281-0207-00			CAP.,VAR,PLSTC:2-18PF,100V	80031	HT10EA/218
C4398	281-0786-00			CAP.,FXD,CER DI:150PF,10%,100V	72982	390049X5P0151K
C4410	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C4411	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C4412	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	72982	8131N075 E224M
C4413	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C4416	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C4417	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
CR26	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR27	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR416	152-0075-00			SEMICOND DEVICE:GE,25V,40MA	80009	152-0075-00
CR418	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR437	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR443	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR463	152-0639-00			SEMICOND DEVICE:RECT,SI,10KV,10MA	14099	SEF100
CR465	152-0639-00			SEMICOND DEVICE:RECT,SI,10KV,10MA	14099	SEF100
CR721	152-0066-03			SEMICOND DEVICE:RECT,SI,400V,1A	80009	152-0066-03
CR722	152-0066-03			SEMICOND DEVICE:RECT,SI,400V,1A	80009	152-0066-03
CR723	152-0066-03			SEMICOND DEVICE:RECT,SI,400V,1A	80009	152-0066-03
CR724	152-0066-03			SEMICOND DEVICE:RECT,SI,400V,1A	80009	152-0066-03
CR732	152-0066-03			SEMICOND DEVICE:RECT,SI,400V,1A	80009	152-0066-03
CR734	152-0066-03			SEMICOND DEVICE:RECT,SI,400V,1A	80009	152-0066-03
CR737	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR738	152-0066-03			SEMICOND DEVICE:RECT,SI,400V,1A	80009	152-0066-03
CR741	152-0066-03			SEMICOND DEVICE:RECT,SI,400V,1A	80009	152-0066-03
CR742	152-0066-03			SEMICOND DEVICE:RECT,SI,400V,1A	80009	152-0066-03
CR743	152-0066-03			SEMICOND DEVICE:RECT,SI,400V,1A	80009	152-0066-03
CR744	152-0066-03			SEMICOND DEVICE:RECT,SI,400V,1A	80009	152-0066-03
CR758	152-0066-03			SEMICOND DEVICE:RECT,SI,400V,1A	80009	152-0066-03
CR764	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR765	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR766	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR767	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR778	152-0066-03			SEMICOND DEVICE:RECT,SI,400V,1A	80009	152-0066-03
CR2001	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2002	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2005	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2006	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2024	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2032	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2036	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2063	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2181	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2182	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2183	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2185	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2227	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR2233	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2234	152-0245-00			SEMICOND DEVICE:SILICON,10NA AT 5V	80009	152-0245-00
CR2317	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2326	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2331	152-0075-00			SEMICOND DEVICE:GE,25V,40MA	80009	152-0075-00
CR2332	152-0075-00			SEMICOND DEVICE:GE,25V,40MA	80009	152-0075-00
CR2334	152-0574-00			SEMICOND DEVICE:SILICON,120V,0.15A	80009	152-0574-00
CR2342	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2356	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2514[1]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2516[1]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2535[1]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2536[1]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR4122	152-0246-00			SEMICOND DEVICE:SILICON,400PIV,200MA	80009	152-0246-00
CR4222	152-0246-00			SEMICOND DEVICE:SILICON,400PIV,200MA	80009	152-0246-00
CR4323	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR4324	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR4326	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR4328	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR4331	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR4332	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR4335	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR4336	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR4346	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR4347	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR4348	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR4349	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR4356	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR4357	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR4358	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR4359	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
DL4380	119-0703-00			DELAY LINE,ELEC:120 NANOSEC	80009	119-0703-00
DS463	150-0002-00			LAMP,GLOW:0.5 MA 60/125V	08806	NE2T-A1AT
DS465	150-0002-00			LAMP,GLOW:0.5 MA 60/125V	08806	NE2T-A1AT
DS811	198-3853-00			WIRE SET,ELEC:	80009	198-3853-00
F700	159-0042-00			FUSE,CARTRIDGE:3AG,0.75A,250V,FAST-BLOW	71400	AGC 3/4
F722	159-0051-00			FUSE,CARTRIDGE:3AG,0.062A,250V,20 SEC	71400	MDL1-16
F742	159-0153-00			FUSE,WIRE LEAD:1.5A,125V,FAST-BLOW	03614	GSA 1 1/2
F743	159-0153-00			FUSE,WIRE LEAD:1.5A,125V,FAST-BLOW	03614	GSA 1 1/2
J4	131-1795-00			CONNECTOR,RCPT,:12 FEMALE CONTACT,RT-ANGLE	27264	09-62-3121
J7	131-1749-01			CONN,RCPT,ELEC:CKT BD,8 CONTACTS	27264	09-52-3101
J138	131-0955-00			CONN,RCPT,ELEC:BNC,FEMALE	05091	31-279
J148	131-0955-00			CONN,RCPT,ELEC:BNC,FEMALE	05091	31-279
J419	131-0955-00			CONNECTOR,RCPT,:BNC,FEMALE,W/HARDWARE	05091	31-279
J2100	131-1802-00			CONNECTOR,RCPT,:15 CONTACTS	80009	131-1802-00
J2550[1]	131-1801-00			CONN,RCPT,ELEC:CKT BD,9 CONTACTS	05574	0002,01-4832
J2250	131-1801-00			CONN,RCPT,ELEC:CKT BD,9 CONTACTS	05574	0002,01-4832
J2260	131-1802-00			CONNECTOR,RCPT,:15 CONTACTS	80009	131-1802-00
J4200	131-1792-00			CONTACT ASSY,EL:12 MALE CONTACT,FLAT WAFER	27264	09-70-2121
L470	108-0819-00			COIL,TUBE DEFLE:X-Y ALIGNMENT	80009	108-0819-00
L472	108-0818-00			COIL,TUBE DEFLE:TRACE ROTATION	80009	108-0818-00

[1]T935A only

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q112	151-0199-02			TRANSISTOR:NPN,SI (SEL FROM 151-0199-00)	80009	151-0199-02
Q122	151-0199-02			TRANSISTOR:NPN,SI (SEL FROM 151-0199-00)	80009	151-0199-02
Q134	151-0127-04			TRANSISTOR:NPN,SI (SEL FROM 2N2369)	80009	151-0127-04
Q136	151-0127-04			TRANSISTOR:NPN,SI (SEL FROM 2N2369)	80009	151-0127-04
Q144	151-0127-04			TRANSISTOR:NPN,SI (SEL FROM 2N2369)	80009	151-0127-04
Q146	151-0127-04			TRANSISTOR:NPN,SI (SEL FROM 2N2369)	80009	151-0127-04
Q416	151-0190-05			TRANSISTOR:SILICON,NPN,(SEL FROM 2N3904)	80009	151-0190-05
Q424	151-0190-05			TRANSISTOR:SILICON,NPN,(SEL FROM 2N3904)	80009	151-0190-05
Q426	151-0347-01			TRANSISTOR:SILICON,NPN,(SEL FROM 2N5551)	80009	151-0347-01
Q434	151-0350-01			TRANSISTOR:SILICON,PNP,(SEL FROM 2N5401)	80009	151-0350-01
Q446	151-0126-01			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0126-00)	80009	151-0126-01
Q454	151-0188-03			TRANSISTOR:SILICON,PNP,(SEL FROM 151-0188-00)	80009	151-0188-03
Q458	151-0358-00			TRANSISTOR:SILICON,NPN,(SEL FROM D44R4)	80009	151-0358-00
Q722	151-0347-01			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0347-01)	80009	151-0347-00
Q726	151-0347-01			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0347-01)	80009	151-0347-00
Q734	151-0347-01			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0347-01)	80009	151-0347-00
Q736	151-0497-01			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0497-00)	80009	151-0497-01
Q752	151-0302-00			TRANSISTOR:SILICON,NPN	04713	2N2222A
Q754	151-0302-00			TRANSISTOR:SILICON,NPN	04713	2N2222A
Q756	151-0478-01			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0478-00)	80009	151-0478-01
Q772	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q774	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q776	151-0478-01			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0478-00)	80009	151-0478-01
Q792	151-0224-02			TRANSISTOR:SILICON,NPN,(SEL FROM 2N3692)	80009	151-0224-02
Q796	151-0347-01			TRANSISTOR:SILICON,NPN,(SEL FROM 2N5551)	80009	151-0347-01
Q810	151-0190-05			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0190-00)	80009	151-0190-05
Q2020	151-0188-03			TRANSISTOR:SILICON,PNP,(SEL FROM 151-0188-00)	80009	151-0188-03
Q2028	151-0188-03			TRANSISTOR:SILICON,PNP,(SEL FROM 151-0188-00)	80009	151-0188-03
Q2032A,B	151-1042-02			TRANSISTOR:MATCHED PAIR FET	80009	151-1042-02
Q2038	151-0188-03			TRANSISTOR:SILICON,PNP,(SEL FROM 151-0188-00)	80009	151-0188-03
Q2050	151-0188-03			TRANSISTOR:SILICON,PNP,(SEL FROM 151-0188-00)	80009	151-0188-03
Q2054	151-0190-05			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0190-00)	80009	151-0190-05
Q2058	151-0188-03			TRANSISTOR:SILICON,PNP,(SEL FROM 151-0188-00)	80009	151-0188-03
Q2122	151-0224-02			TRANSISTOR:SILICON,NPN,(SEL FROM 2N3962)	80009	151-0224-02
Q2124	151-0224-02			TRANSISTOR:SILICON,NPN,(SEL FROM 2N3962)	80009	151-0224-02
Q2128	151-0188-03			TRANSISTOR:SILICON,PNP,(SEL FROM 151-0188-00)	80009	151-0188-03
Q2134	151-0188-03			TRANSISTOR:SILICON,PNP,(SEL FROM 151-0188-00)	80009	151-0188-03
Q2136	151-0188-03			TRANSISTOR:SILICON,PNP,(SEL FROM 151-0188-00)	80009	151-0188-03
Q2142	151-0224-02			TRANSISTOR:SILICON,NPN,(SEL FROM 2N3962)	80009	151-0224-02
Q2144	151-0224-02			TRANSISTOR:SILICON,NPN,(SEL FROM 2N3962)	80009	151-0224-02
Q2152	151-0188-03			TRANSISTOR:SILICON,PNP,(SEL FROM 151-0188-00)	80009	151-0188-03
Q2164	151-0190-05			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0190-00)	80009	151-0190-05
Q2174	151-0188-03			TRANSISTOR:SILICON,PNP,(SEL FROM 151-0188-00)	80009	151-0188-03
Q2176	151-0216-02			TRANSISTOR:SILICON,PNP,(SEL FROM MPS6523)	80009	151-0216-02
Q2242	151-1042-02			SEMICOND DVC SE:MATCHED PAIR FET,(SEL FR U252)	80009	151-1042-02
Q2244	151-1042-02			SEMICOND DVC SE:MATCHED PAIR FET,(SEL FR U252)	80009	151-1042-02
Q2246	151-0190-05			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0190-00)	80009	151-0190-05
Q2274	151-0190-05			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0190-00)	80009	151-0190-05
Q2314	151-0192-00			TRANSISTOR:SILICON,NPN,(SEL FROM MPS6521)	80009	151-0192-00
Q2326	151-0188-03			TRANSISTOR:SILICON,PNP,(SEL FROM 151-0188-00)	80009	151-0188-03
Q2332	151-0188-03			TRANSISTOR:SILICON,PNP,(SEL FROM 151-0188-00)	80009	151-0188-03
Q2334	151-0124-02			TRANSISTOR:SILICON,NPN,(SEL FROM 2N3501)	80009	151-0124-02
Q2344	151-0124-02			TRANSISTOR:SILICON,NPN,(SEL FROM 2N3501)	80009	151-0124-02

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q2354	151-0190-05			TRANSISTOR:SILICON,NPN(SEL FROM 151-0190-00)	80009	151-0190-05
Q2514[1]	151-0188-03			TRANSISTOR:SILICON,PNP,(SEL FROM 151-0188-00	80009	151-0188-03
Q2516[1]	151-0188-03			TRANSISTOR:SILICON,PNP,(SEL FROM 151-0188-00)	80009	151-0188-03
Q2522[1]	151-0190-05			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0190-00)	80009	151-0190-05
Q2542[1]	151-1042-02			SEMICOND DVC SE:MATCHED PAIR FET,(SEL FR U252)	80009	151-1042-02
Q2544[1]	151-1042-02			SEMICOND DVC SE:MATCHED PAIR FET,(SEL FR U252)	80009	151-1042-02
Q2546[1]	151-0190-05			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0190-00)	80009	151-0190-05
Q2548[1]	151-0190-05			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0190-00)	80009	151-0190-05
Q4122A-B	151-1032-02			TRANSISTOR:FE,SILICON,(SEL FROM U252)	80009	151-1032-02
Q4132	151-0198-03			TRANSISTOR:SILICON,NPN,MATCHED	80009	151-0198-03
Q4134	151-0198-03			TRANSISTOR:SILICON,NPN,MATCHED	80009	151-0198-03
Q4158	151-0198-03			TRANSISTOR:SILICON,NPN,MATCHED	80009	151-0198-03
Q4168	151-0198-03			TRANSISTOR:SILICON,NPN,MATCHED	80009	151-0198-03
Q4174	151-0199-02			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0199-00)	80009	151-0199-02
Q4176	151-0427-01			TRANSISTOR:SILICON,NPN,(SEL FROM 2N3563)	80009	151-0427-01
Q4184	151-0199-02			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0199-00)	80009	151-0199-02
Q4186	151-0427-01			TRANSISTOR:SILICON,NPN,(SEL FROM 2N3563)	80009	151-0427-01
Q4194	151-0198-02			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0198-00)	80009	151-0198-02
Q4196	151-0198-02			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0198-00)	80009	151-0198-02
Q4222A-B	151-1032-02			TRANSISTOR:FE,SILICON,(SEL FROM U252)	80009	151-1032-02
Q4232	151-0198-03			TRANSISTOR:SILICON,NPN,MATCHED	80009	151-0198-03
Q4234	151-0198-03			TRANSISTOR:SILICON,NPN,MATCHED	80009	151-0198-03
Q4258	151-0198-03			TRANSISTOR:SILICON,NPN,MATCHED	80009	151-0198-03
Q4268	151-0198-03			TRANSISTOR:SILICON,NPN,MATCHED	80009	151-0198-03
Q4274	151-0199-02			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0199-00)	80009	151-0199-02
Q4276	151-0427-01			TRANSISTOR:SILICON,NPN,(SEL FROM 2N3563)	80009	151-0427-01
Q4284	151-0199-02			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0199-00)	80009	151-0199-02
Q4286	151-0427-01			TRANSISTOR:SILICON,NPN,(SEL FROM 2N3563)	80009	151-0427-01
Q4294	151-0198-02			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0198-00)	80009	151-0198-02
Q4296	151-0198-02			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0198-00)	80009	151-0198-02
Q4302	151-0223-03			TRANSISTOR:SILICON,NPN,(SEL FROM 2N4275)	80009	151-0223-03
Q4344	151-0199-02			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0199-00)	80009	151-0199-02
Q4346	151-0199-02			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0199-00)	80009	151-0199-02
Q4350	151-0199-02			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0199-00)	80009	151-0199-02
Q4352	151-0199-02			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0199-00)	80009	151-0199-02
Q4354	151-0199-02			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0199-00)	80009	151-0199-02
Q4356	151-0199-02			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0199-00)	80009	151-0199-02
Q4376	151-0434-01			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0434-00)	80009	151-0434-01
Q4386	151-0434-01			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0434-00)	80009	151-0434-01
Q4388	151-0190-05			TRANSISTOR:SILICON,NPN,(SEL FROM 151-0190-00)	80009	151-0190-05
R22	315-0134-00			RES.,FXD,CMPSN:130K OHM,5%,0.25W	01121	CB1345
R23	315-0434-00			RES.,FXD,CMPSN:430K OHM,5%,0.25W	01121	CB4345
R24	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R25	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R26	321-0235-00			RES.,FXD,FILM:2.74K OHM,1%,0.125W	91637	MFF1816G27400F
R27	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	MFF1816G200R0F
R112	321-0085-00			RES.,FXD,FILM:75 OHM,1%,0.125W	91637	MFF1816G75R00F
R114	311-1563-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	73138	91A R1K
R115	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R116	321-0163-00			RES.,FXD,FILM:487 OHM,1%,0.125W	91637	MFF1816G487R0F
R117	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R118A-P	307-0494-00			RES,NTWK,FXD,FI:THICK FILM,VERT OUTPUT	80009	307-0494-00
R122	321-0085-00			RES.,FXD,FILM:75 OHM,1%,0.125W	91637	MFF1816G75R00F

[1]T935A only

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R124	315-0560-00			RES.,FXD,CMPSN:56 OHM,5%,0.25W	01121	CB5605
R126	311-1559-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	73138	91A-10001M
R412	311-1786-00			RES.,VAR,NONWIR:2K OHM,20%,2W	12697	381-CM40946
R413	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R414	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R416	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R417	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R419	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R423	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R424	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R425	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R426	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R432	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R433	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R434	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315
R435	315-0360-00			RES.,FXD,CMPSN:36 OHM,5%,0.25W	01121	CB3605
R437	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R443	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
R444A-D	307-0495-01			RES,NTWK,FXD,FI:NETWORK,HV,NON STORAGE	80009	307-0495-01
R445	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R446	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R447	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
R453	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R455	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R457	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315
R458	308-0218-00			RES.,FXD,CMPSN:150 OHM,5%,3W	91637	RS2B-R150R0J
R462	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R463	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R464	315-0226-00			RES.,FXD,CMPSN:22M OHM,5%,0.25W	01121	CB2265
R465	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
R468	311-1784-00			RES.,VAR,NONWIR:5M OHM,20%,1W	12697	381-CM40944
R469	315-0205-00			RES.,FXD,CMPSN:2M OHM,5%,0.25W	01121	CB2055
R472	311-1562-00			RES.,VAR,NONWIR:2K OHM,20%,0.50W	73138	91A R2K
R473	311-1555-00			RES.,VAR,NONWIR:100K OHM,20%,0.5W	73138	91A R100K
R474	311-1562-00			RES.,VAR,NONWIR:2K OHM,20%,0.50W	73138	91A R2K
R475	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R476	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R477	311-1555-00			RES.,VAR,NONWIR:100K OHM,20%,0.5W	73138	91A R100K
R478	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R722	301-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.50W	01121	EB4735
R726	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R732	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R733	321-0368-00			RES.,FXD,FILM:66.5K OHM,1%,0.125W	91637	MFF1816G66501F
R734	308-0574-00			RES.,FXD,WW:10 OHM,5%,2W	91637	RS2B162K10R00J
R736	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
R737	321-0280-00			RES.,FXD,FILM:8.06K OHM,1%,0.125W	91637	MFF1816G80600F
R741	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R742	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
R745	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R746	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R747	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R752	321-0130-00			RES.,FXD,FILM:221 OHM,1%,0.125W	91637	MFF1816G221R0F
R753	321-0239-00			RES.,FXD,FILM:3.01K OHM,1%,0.125W	91637	MFF1816G30100F

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R754	308-0755-00			RES.,FXD,WW:0.75 OHM,5%,2W	75042	BWH-R7500J
R756	321-0671-00			RES.,FXD,FILM:8.51K OHM,0.5%,0.125W	91637	MFF1816D85100D
R757	321-0671-00			RES.,FXD,FILM:8.51K OHM,0.5%,0.125W	91637	MFF1816D85100D
R762	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R763	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R764	321-0239-00			RES.,FXD,FILM:3.01K OHM,1%,0.125W	91637	MFF1816G30100F
R765	321-0130-00			RES.,FXD,FILM:221 OHM,1%,0.125W	91637	MFF1816G221R0F
R766	301-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.50W	01121	EB3915
R772	321-0256-00			RES.,FXD,FILM:4.53K OHM,1%,0.125W	91637	MFF1816G45300F
R773	311-1563-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	73138	91A R1K
R774	321-0232-00			RES.,FXD,FILM:2.55K OHM,1%,0.125W	91637	MFF1816G25500F
R775	308-0755-00			RES.,FXD,WW:0.75 OHM,5%,2W	75042	BWH-R7500J
R784	308-0781-00			RES.,FXD,WW:1.34K OHM,2%,10W	91637	HLW10R1Z-13400G
R791	315-0435-00			RES.,FXD,CMPSN:4.3M OHM,5%,0.25W	01121	CB4355
R792	321-0402-00			RES.,FXD,FILM:150K OHM,1%,0.125W	91637	MFF1816G15002F
R793	321-0283-00			RES.,FXD,FILM:8.66K OHM,1%,0.125W	91637	MFF1816G86600F
R794	321-0394-00			RES.,FXD,FILM:124K OHM,1%,0.125W	91637	MFF1816G12402F
R795	321-0283-00			RES.,FXD,FILM:8.66K OHM,1%,0.125W	91637	MFF1816G86600F
R799	315-0305-00			RES.,FXD,CMPSN:3M OHM,5%,0.25W	01121	CB3055
R805	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
R806	315-0304-00			RES.,FXD,CMPSN:300K OHM,5%,0.25W	01121	CB3045
R807	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R808	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R810	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R811	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R2000	315-0150-00			RES.,FXD,CMPSN:15 OHM,5%,0.25W	01121	CB1505
R2001	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2005	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2006	321-0175-00			RES.,FXD,FILM:649 OHM,1%,0.125W	91637	MFF1816G649R0F
R2007	311-1564-00			RES.,VAR,NONWIR:500 OHM,20%,0.50W	73138	91A R500
R2008	315-0150-00			RES.,FXD,CMPSN:15 OHM,5%,0.25W	01121	CB1505
R2010	322-0524-01			RES.,FXD,FILM:2.8M OHM,0.5%,0.25W	91637	MFF1421G28003D
R2011	321-0389-00			RES.,FXD,FILM:110K OHM,1%,0.125W	91637	MFF1816G11002F
R2012	317-0150-00			RES.,FXD,CMPSN:15 OHM,5%,0.125W	01121	BB1505
R2013	322-0481-00			RES.,FXD,FILM:1M OHM,1%,0.25W	75042	CEBT0-1004F
R2014	321-0481-00			RES.,FXD,FILM:1M OHM,1%,0.125W	91637	MFF1816G10003F
R2021	321-0150-00			RES.,FXD,FILM:357 OHM,1%,0.125W	91637	MFF1816G357R0F
R2022	321-0201-00			RES.,FXD,FILM:1.21K OHM,1%,0.125W	91637	MFF1816G12100F
R2023	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R2024	321-0229-00			RES.,FXD,FILM:2.37K OHM,1%,0.125W	91637	MFF1816G23700F
R2026	321-0220-00			RES.,FXD,FILM:1.91K OHM,1%,0.125W	91637	MFF1816G19100F
R2027	311-1563-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	73138	91A R1K
R2028	315-0162-00			RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	01121	CB1625
R2030	321-0481-00			RES.,FXD,FILM:1M OHM,1%,0.125W	91637	MFF1816G10003F
R2032	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R2033	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R2035	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R2036	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R2037	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R2038	321-0234-00			RES.,FXD,FILM:2.67K OHM,1%,0.125W	91637	MFF1816G26700F
R2039	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R2040	315-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R2048	321-0161-00			RES.,FXD,FILM:464 OHM,1%,0.125W	91637	MFF1816G464R0F

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R2049	321-0226-00			RES.,FXD,FILM:2.21K OHM,1%,0.125W	91637	MFF1816G22100F
R2050	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R2051	311-1566-00			RES.,VAR,NONWIR:200 OHM,20%,0.50W	73138	91A R200
R2052	321-0166-00			RES.,FXD,FILM:523 OHM,1%,0.125W	91637	MFF1816G523R0F
R2053	321-0213-00			RES.,FXD,FILM:1.62K OHM,1%,0.125W	91637	MFF1816G16200F
R2055	321-0251-00			RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R2057	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2060	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R2061	311-1565-00			RES.,VAR,NONWIR:250 OHM,20%,0.50W	73138	91A R250
R2062	321-0143-00			RES.,FXD,FILM:301 OHM,1%,0.125W	91637	MFF1816G301R0F
R2063	321-0251-00			RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R2065	321-0214-00			RES.,FXD,FILM:1.65K OHM,1%,0.125W	91637	MFF1816G16500F
R2092	315-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R2102	315-0152-00			RES.,FXD,CMSPN:1.5K OHM,5%,0.25W	01121	CB1525
R2116	321-0641-00			RES.,FXD,FILM:1.8K OHM,1%,0.125W	91637	MFF1816G18000F
R2118	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2121	321-0182-00			RES.,FXD,FILM:768 OHM,1%,0.125W	91637	MFF1816G768R0F
R2122	315-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R2124	321-0249-00			RES.,FXD,FILM:3.83K OHM,1%,0.125W	91637	MFF1816G38300F
R2125	321-0181-00			RES.,FXD,FILM:750 OHM,1%,0.125W	91637	MFF1816G750R0F
R2126	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R2127	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R2128	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R2131	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R2132	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R2133	323-0346-00			RES.,FXD,FILM:39.2K OHM,1%,0.50W	75042	CECT0-3922F
R2135	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R2136	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R2137	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
R2138	311-1787-00			RES.,VAR,NONWIR:20K OHM,10%,2W	12697	470-CM40947
R2142	321-0231-00			RES.,FXD,FILM:2.49K OHM,1%,0.125W	91637	MFF1816G24900F
R2143	321-0231-00			RES.,FXD,FILM:2.49K OHM,1%,0.125W	91637	MFF1816G24900F
R2144	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R2145	321-0231-00			RES.,FXD,FILM:2.49K OHM,1%,0.125W	91637	MFF1816G24900F
R2146	321-0189-00			RES.,FXD,FILM:909 OHM,1%,0.125W	91637	MFF1816G909R0F
R2147	315-0222-00			RES.,FXD,CMPSN:2.2 OHM,5%,0.25W	01121	CB2225
R2151	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2152	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R2153	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R2154	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R2156	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2157	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R2158	315-0163-00			RES.,FXD,CMPSN:16K OHM,5%,0.25W	01121	CB1635
R2162	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R2163	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2164	315-0222-00			RES.,FXD,CMPSN:2.2 OHM,5%,0.25W	01121	CB2225
R2166	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R2167	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R2171	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R2172	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R2174	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R2175	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R2176	315-0222-00			RES.,FXD,CMPSN:2.2 OHM,5%,0.25W	01121	CB2225

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R2178	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R2182	321-0236-00			RES.,FXD,FILM:2.8K OHM,1%,0.125W	91637	MFF1816G28000F
R2185	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R2186	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R2188	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R2223	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R2224	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R2226	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R2227	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2233	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R2235	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R2236	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R2237	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R2243	308-0212-00			RES.,FXD,WW:10K OHM,5%,3W	91637	CW2B-B10001J
R2245	321-0326-00			RES.,FXD,FILM:24.3K OHM,1%,0.125W	91637	MFF1816G24301F
R2246	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R2247	321-0312-00			RES.,FXD,FILM:17.4K OHM,1%,0.125W	91637	MFF1816G17401F
R2252	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R2253	321-0444-00			RES.,FXD,FILM:412K OHM,1%,0.125W	91637	MFF1816G41202F
R2254	321-0377-01			RES.,FXD,FILM:82.5K OHM,0.5%,0.125W	91637	MFF1816G82501D
R2255	321-0377-01			RES.,FXD,FILM:82.5K OHM,0.5%,0.125W	91637	MFF1816G82501D
R2256	321-0348-00			RES.,FXD,FILM:41.2K OHM,1%,0.125W	91637	MFF1816G41201F
R2257	321-0281-00			RES.,FXD,FILM:8.25K OHM,1%,0.125W	91637	MFF1816G82500F
R2258	321-0281-00			RES.,FXD,FILM:8.25K OHM,1%,0.125W	91637	MFF1816G82500F
R2262	322-0519-01			RES.,FXD,FILM:2.49M OHM,0.5%,0.25W	91637	HFF143G24903D
R2263	321-0473-01			RES.,FXD,FILM:825K OHM,0.5%,0.125W	91637	MFF1816G82502D
R2264	321-0473-01			RES.,FXD,FILM:825K OHM,0.5%,0.125W	91637	MFF1816G82502D
R2269	311-1789-00			RES.,VAR,NONWIR:100K OHM,10%,1W	12697	381-CM40949
R2271	315-0434-00			RES.,FXD,CMPSN:430K OHM,5%,0.25W	01121	CB4345
R2272	311-0580-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	11237	300SF-41695
R2274	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R2276	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2278	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R2310	321-0184-00			RES.,FXD,FILM:806 OHM,1%,0.125W	91637	MFF1816G806R0F
R2311	321-0268-00			RES.,FXD,FILM:6.04K OHM,1%,0.125W	91637	MFF1816G60400F
R2313	321-0279-00			RES.,FXD,FILM:7.87K OHM,1%,0.125W	91637	MFF1816G78700F
R2314	321-0320-00			RES.,FXD,FILM:21K OHM,1%,0.125W	91637	MFF1816G21001F
R2315	321-0297-00			RES.,FXD,FILM:12.1K OHM,1%,0.125W	91637	MFF1816G12101F
R2316	311-1974-00			RES.,VAR,NONWIR:PNL,50K/20K OHM,10%,0.5W	12697	CM41730
R2317	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R2321	311-1918-00			RES.,VAR,NONWIR:2K OHM,10%,0.5W	73138	72-199-0
R2322	321-0293-00			RES.,FXD,FILM:11K OHM,1%,0.125W	91637	MFF1816G11001F
R2323	321-0197-00			RES.,FXD,FILM:1.1K OHM,1%,0.125W	91637	MFF1816G11000F
R2324	315-0162-00			RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	01121	CB1625
R2325	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R2326	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R2327	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R2328	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R2331	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R2332	311-1239-00			RES.,VAR,NONWIR:2.5K OHM,10%,0.50W	73138	72X-76-0252K
R2334	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R2335	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R2336	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R2337	308-0329-00			RES.,FXD,WW:4K OHM,2%,3W	91637	RS2B-B40000G
R2342	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R2344	308-0329-00			RES.,FXD,WW:4K OHM,2%,3W	91637	RS2B-B40000G
R2345	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R2347	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R2352	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2353	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
R2354	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2355	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R2355	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R2356	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R2357	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R2392	301-0240-00			RES.,FXD,CMPSN:24 OHM,5%,0.50W	01121	EB2405
R2511[1]	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2512[1]	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R2514[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2515[1]	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R2516[1]	311-1531-00			RES.,VAR,WW:PNL,2K OHM	02111	535-9304
R2517[1]	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2519[1]	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R2521[1]	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
R2523[1]	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R2525[1]	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R2527[1]	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
R2531[1]	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R2532[1]	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R2533[1]	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R2535[1]	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R2537[1]	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R2539[1]	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R2541[1]	308-0212-00			RES.,FXD,WW:10K OHM,5%,3W	91637	CW2B-B10001J
R2544[1]	321-0326-00			RES.,FXD,FILM:24.3K OHM,1%,0.125W	91637	MFF1816G24301F
R2545[1]	321-0312-00			RES.,FXD,FILM:17.4K OHM,1%,0.125W	91637	MFF1816G17401F
R2546[1]	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R2547[1]	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R2548[1]	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2552[1]	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R2553[1]	321-0444-00			RES.,FXD,FILM:412K OHM,1%,0.125W	91637	MFF1816G41202F
R2554[1]	321-0377-01			RES.,FXD,FILM:82.5K OHM,0.5%,0.125W	91637	MFF1816G82501D
R2555[1]	321-0377-01			RES.,FXD,FILM:82.5K OHM,0.5%,0.125W	91637	MFF1816G82501D
R2556[1]	321-0348-00			RES.,FXD,FILM:41.2K OHM,1%,0.125W	91637	MFF1816G41201F
R2557[1]	321-0281-00			RES.,FXD,FILM:8.25K OHM,1%,0.125W	91637	MFF1816G82500F
R2558[1]	321-0281-00			RES.,FXD,FILM:8.25K OHM,1%,0.125W	91637	MFF1816G82500F
R2590[1]	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R4101	317-0150-00			RES.,FXD,CMPSN:15 OHM,5%,0.125W	01121	BB1505
R4102	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R4104	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R4105	321-0790-01			RES.,FXD,FILM:990K OHM,0.5%,0.125W	91637	HFF1104G99002D
R4106	315-0180-00			RES.,FXD,CMPSN:18 OHM,5%,0.25W	01121	CB1805
R4107	321-1289-01			RES.,FXD,FILM:10.1K OHM,0.5%,0.125W	91637	MFF1816G10101D
R4108	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R4114	321-0807-01			RES.,FXD,FILM:900K OHM,0.5%,0.125W	91637	HFF1104G90002D
R4116	321-1389-01			RES.,FXD,FILM:111K OHM,0.5%,0.125W	91637	MFF1816G11102D

[1]T935A only

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R4117	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R4118	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R4121	321-0481-00			RES.,FXD,FILM:1M OHM,1%,0.125W	91637	MFF1816G10003F
R4122	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R4124	321-0030-00			RES.,FXD,FILM:20 OHM,1%,0.125W	91637	MFF1816G20R00F
R4125	321-0030-00			RES.,FXD,FILM:20 OHM,1%,0.125W	91637	MFF1816G20R00F
R4127	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R4130	311-1559-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	73138	91A-10001M
R4131	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R4133	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R4136	321-0077-00			RES.,FXD,FILM:61.9 OHM,1%,0.125W	91637	MFF1816G61R90F
R4137	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R4143	321-0062-00			RES.,FXD,FILM:43.2 OHM,1%,0.125W	91637	MFF1816G43R20F
R4144	321-0114-00			RES.,FXD,FILM:150 OHM,1%,0.125W	91637	MFF1816G150R0F
R4145	321-0771-01			RES.,FXD,FILM:50 OHM,0.5%,0.125W	91637	MFF1816G50R00D
R4146	321-0771-01			RES.,FXD,FILM:50 OHM,0.5%,0.125W	91637	MFF1816G50R00D
R4147	321-0030-00			RES.,FXD,FILM:20 OHM,1%,0.125W	91637	MFF1816G20R00F
R4151	311-1563-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	73138	91A R1K
R4152	311-1785-00			RES.,VAR,NONWIR:1K OHM,5%,2W	12697	381-CM40945
R4154	321-0078-00			RES.,FXD,FILM:63.4 OHM,1%,0.125W	91637	MFF1816G63R40F
R4155	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R4156	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R4157	321-0225-00			RES.,FXD,FILM:2.15K OHM,1%,0.125W	91637	MFF1816G21500F
R4158	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R4161	321-0154-00			RES.,FXD,FILM:392 OHM,1%,0.125W	91637	MFF1816G392R0F
R4162	321-0070-00			RES.,FXD,FILM:52.3 OHM,1%,0.125W	91637	MFF1816G52R30F
R4166	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R4167	321-0225-00			RES.,FXD,FILM:2.15K OHM,1%,0.125W	91637	MFF1816G21500F
R4168	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R4171	321-0185-00			RES.,FXD,FILM:825 OHM,1%,0.125W	91637	MFF1816G825R0F
R4172	321-0204-00			RES.,FXD,FILM:1.3K OHM,1%,0.125W	91637	MFF1816G13000F
R4173	321-0164-00			RES.,FXD,FILM:499 OHM,1%,0.125W	91637	MFF1816G499R0F
R4174	321-0080-00			RES.,FXD,FILM:66.5 OHM,1%,0.125W	91637	MFF1816G66R50F
R4175	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R4176	321-0167-00			RES.,FXD,FILM:536 OHM,1%,0.125W	91637	MFF1816G536R0F
R4177	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R4178	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R4179	321-0131-00			RES.,FXD,FILM:226 OHM,1%,0.125W	91637	MFF1816G226R0F
R4181	321-0185-00			RES.,FXD,FILM:825 OHM,1%,0.125W	91637	MFF1816G825R0F
R4182	321-0165-00			RES.,FXD,FILM:511 OHM,1%,0.125W	91637	MFF1816G511R0F
R4183	321-0164-00			RES.,FXD,FILM:499 OHM,1%,0.125W	91637	MFF1816G499R0F
R4184	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R4186	321-0167-00			RES.,FXD,FILM:536 OHM,1%,0.125W	91637	MFF1816G536R0F
R4187	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R4188	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R4189	321-0131-00			RES.,FXD,FILM:226 OHM,1%,0.125W	91637	MFF1816G226R0F
R4193	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R4194	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R4195	321-0117-00			RES.,FXD,FILM:162 OHM,1%,0.125W	91637	MFF1816G162R0F
R4196	315-0820-00			RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R4198	321-0177-00			RES.,FXD,FILM:681 OHM,1%,0.125W	91637	MFF1816G681R0F
R4199	321-0177-00			RES.,FXD,FILM:681 OHM,1%,0.125W	91637	MFF1816G681R0F
R4201	317-0150-00			RES.,FXD,CMPSN:15 OHM,5%,0.125W	01121	BB1505

Scan by Zenith

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R4202	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R4204	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R4205	321-0790-01			RES.,FXD,FILM:990K OHM,0.5%,0.125W	91637	HFF1104G99002D
R4206	315-0180-00			RES.,FXD,CMPSN:18 OHM,5%,0.25W	01121	CB1805
R4207	321-1289-01			RES.,FXD,FILM:10.1K OHM,0.5%,0.125W	91637	MFF1816G10101D
R4208	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R4214	321-0807-01			RES.,FXD,FILM:900K OHM,0.5%,0.125W	91637	HFF1104G90002D
R4216	321-1389-01			RES.,FXD,FILM:111K OHM,0.5%,0.125W	91637	MFF1816G11102D
R4217	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R4218	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R4221	321-0481-00			RES.,FXD,FILM:1M OHM,1%,0.125W	91637	MFF1816G10003F
R4222	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R4224	321-0030-00			RES.,FXD,FILM:20 OHM,1%,0.125W	91637	MFF1816G20R00F
R4225	321-0030-00			RES.,FXD,FILM:20 OHM,1%,0.125W	91637	MFF1816G20R00F
R4227	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R4230	311-1559-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	73138	91A-10001M
R4231	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R4233	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R4236	321-0077-00			RES.,FXD,FILM:61.9 OHM,1%,0.125W	91637	MFF1816G61R90F
R4237	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R4243	321-0062-00			RES.,FXD,FILM:43.2 OHM,1%,0.125W	91637	MFF1816G43R20F
R4244	321-0114-00			RES.,FXD,FILM:150 OHM,1%,0.125W	91637	MFF1816G150R0F
R4245	321-0771-01			RES.,FXD,FILM:50 OHM,0.5%,0.125W	91637	MFF1816G50R00D
R4246	321-0771-01			RES.,FXD,FILM:50 OHM,0.5%,0.125W	91637	MFF1816G50R00D
R4247	321-0030-00			RES.,FXD,FILM:20 OHM,1%,0.125W	91637	MFF1816G20R00F
R4251	311-1563-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	73138	91A R1K
R4252	311-1785-00			RES.,VAR,NONWIR:1K OHM,5%,2W	12697	381-CM40945
R4254	321-0078-00			RES.,FXD,FILM:63.4 OHM,1%,0.125W	91637	MFF1816G63R40F
R4256	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R4257	321-0225-00			RES.,FXD,FILM:2.15K OHM,1%,0.125W	91637	MFF1816G21500F
R4258	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R4261	321-0154-00			RES.,FXD,FILM:392 OHM,1%,0.125W	91637	MFF1816G392R0F
R4262	321-0070-00			RES.,FXD,FILM:52.3 OHM,1%,0.125W	91637	MFF1816G52R30F
R4266	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R4267	321-0225-00			RES.,FXD,FILM:2.15K OHM,1%,0.125W	91637	MFF1816G21500F
R4268	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R4271	321-0185-00			RES.,FXD,FILM:825 OHM,1%,0.125W	91637	MFF1816G825R0F
R4272	321-0204-00			RES.,FXD,FILM:1.3K OHM,1%,0.125W	91637	MFF1816G13000F
R4273	321-0164-00			RES.,FXD,FILM:499 OHM,1%,0.125W	91637	MFF1816G499R0F
R4274	321-0080-00			RES.,FXD,FILM:66.5 OHM,1%,0.125W	91637	MFF1816G66R50F
R4275	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R4276	321-0173-00			RES.,FXD,FILM:619 OHM,1%,0.125W	91637	MFF1816G619R0F
R4277	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R4278	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R4279	321-0133-00			RES.,FXD,FILM:237 OHM,1%,0.125W	91637	MFF1816G237R0F
R4280	311-1568-00			RES.,VAR,NONWIR:50 OHM,20%,0.50W	73138	91A R50
R4281	321-0185-00			RES.,FXD,FILM:825 OHM,1%,0.125W	91637	MFF1816G825R0F
R4282	321-0165-00			RES.,FXD,FILM:511 OHM,1%,0.125W	91637	MFF1816G511R0F
R4283	321-0164-00			RES.,FXD,FILM:499 OHM,1%,0.125W	91637	MFF1816G499R0F
R4284	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R4286	321-0173-00			RES.,FXD,FILM:619 OHM,1%,0.125W	91637	MFF1816G619R0F
R4287	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R4288	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R4289	321-0129-00			RES.,FXD,FILM:215 OHM,1%,0.125W	91637	MFF1816G215R0F
R4293	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R4294	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R4295	315-0161-00			RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
R4296	315-0820-00			RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R4298	321-0185-00			RES.,FXD,FILM:825 OHM,1%,0.125W	91637	MFF1816G825R0F
R4299	321-0185-00			RES.,FXD,FILM:825 OHM,1%,0.125W	91637	MFF1816G825R0F
R4301	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R4302	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R4303	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R4304	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R4307	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R4308	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R4312	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R4314	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R4315	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R4318	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R4321	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R4322	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R4324	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R4325	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R4331	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R4332	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R4334	321-0158-00			RES.,FXD,FILM:432 OHM,1%,0.125W	91637	MFF1816G432R0F
R4335	321-0262-00			RES.,FXD,FILM:5.23K OHM,1%,0.125W	91637	MFF1816G52300F
R4336	311-1559-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	73138	91A-10001M
R4339	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R4340	321-0207-00			RES.,FXD,FILM:1.4K OHM,1%,0.125W	91637	MFF1816G14000F
R4341	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R4344	321-0169-00			RES.,FXD,FILM:562 OHM,1%,0.125W	91637	MFF1816G562R0F
R4345	321-0139-00			RES.,FXD,FILM:274 OHM,1%,0.125W	91637	MFF1816G274R0F
R4346	311-1978-00			RES.,VAR,NONWW:CKT BD,5K OHM,20%,0.5W	12697	S-7-03178
R4347	321-0139-00			RES.,FXD,FILM:274 OHM,1%,0.125W	91637	MFF1816G274R0F
R4348	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R4349	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R4350	321-0207-00			RES.,FXD,FILM:1.4K OHM,1%,0.125W	91637	MFF1816G14000F
R4351	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R4352	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R4353	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R4354	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R4355	321-0139-00			RES.,FXD,FILM:274 OHM,1%,0.125W	91637	MFF1816G274R0F
R4356	311-1978-00			RES.,VAR,NONWW:CKT BD,5K OHM,20%,0.5W	12697	S-7-03178
R4357	321-0139-00			RES.,FXD,FILM:274 OHM,1%,0.125W	91637	MFF1816G274R0F
R4358	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R4359	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R4360	321-0226-00			RES.,FXD,FILM:2.21K OHM,1%,0.125W	91637	MFF1816G22100F
R4362	321-0226-00			RES.,FXD,FILM:2.21K OHM,1%,0.125W	91637	MFF1816G22100F
R4363	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R4364	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R4368	323-0131-00			RES.,FXD,FILM:226 OHM,1%,0.50W	75042	CECT0-2260F
R4373	321-0120-00			RES.,FXD,FILM:174 OHM,1%,0.125W	91637	MFF1816G174R0F
R4375	315-0430-00			RES.,FXD,CMPSN:43 OHM,5%,0.25W	01121	CB4305
R4376	323-0162-00			RES.,FXD,FILM:475 OHM,1%,0.50W	75042	CECT0-4750F

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R4377	321-0120-00			RES.,FXD,FILM:174 OHM,1%,0.125W	91637	MFF1816G174R0F
R4378	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
R4383	321-0120-00			RES.,FXD,FILM:174 OHM,1%,0.125W	91637	MFF1816G174R0F
R4384	322-0133-00			RES.,FXD,FILM:237 OHM,1%,0.25W	75042	CEBT0-2370F
R4385	315-0430-00			RES.,FXD,CMPSN:43 OHM,5%,0.25W	01121	CB4305
R4386	322-0133-00			RES.,FXD,FILM:237 OHM,1%,0.25W	75042	CEBT0-2370F
R4387	321-0120-00			RES.,FXD,FILM:174 OHM,1%,0.125W	91637	MFF1816G174R0F
R4388	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
R4389	321-0156-00			RES.,FXD,FILM:412 OHM,1%,0.125W	91637	MFF1816G412R0F
R4396	311-1563-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	73138	91A R1K
R4397	311-1561-00			RES.,VAR,NONWIR:2.5K OHM,20%,0.50W	73138	91A R2500
R4398	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R4411	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R4412	315-0150-00			RES.,FXD,CMPSN:15 OHM,5%,0.25W	01121	CB1505
R4413	315-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R4415	315-0161-00			RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
R4416	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
RT2060	307-0122-00			RES.,THERMAL:50 OHM,10%	50157	3D1515
RT2310	307-0477-00			RES.,THERMAL:1K OHM,10%,6MW/DEG C	14193	1013-10000K
RT4175	307-0127-00			RES.,THERMAL:1K OHM,10%	50157	2D1596
RT4275	307-0127-00			RES.,THERMAL:1K OHM,10%	50157	2D1596
S100	260-1421-00			SWITCH,PUSH:1 STA,MOMENTARY,NON-SHORT	80009	260-1421-00
S700	260-1768-00			SWITCH,PUSH:DPDT,3A,125VAC	82389	14S-7102C
S701	260-1776-00			SWITCH,SLIDE:DPDT,3A,125VAC	80009	260-1776-00
S705	260-1776-00			SWITCH,SLIDE:DPDT,3A,125VAC	80009	260-1776-00
S2030	260-1445-01			SWITCH,PUSH:1 BUTTON	80009	260-1445-01
S2140	260-1445-01			SWITCH,PUSH:1 BUTTON	80009	260-1445-01
S2510[1]	260-1268-00			SWITCH,PUSH:3 BUTTON,2 POLE,INTERLOCK	80009	260-1268-00
S4310	260-1666-00			SWITCH,PUSH:X-Y LOAD	71590	2KAB010000-674
S4320	260-1823-00			SWITCH,PUSH:VERTICAL MODE,2 POLE INTLK	80009	260-1823-00
T460	120-0996-00			XFMR,PWR,STU:HIGH VOLTAGE	80009	120-0996-00
T700	120-0994-02			XFMR,PWR,STPDN:	80009	120-0994-02
U24	156-0067-12			MICROCKT,LINEAR:OPTIONAL AMPLIFIER	04713	MC1741CU
U460	152-0637-00			VOLTAGE MULTR:HV MULTR,SI,6.6KV IN,10KV OUT	80009	152-0637-00
U742A,B	156-0158-00			MICROCIRCUIT,LI:DUAL OPNL AMPL,	80009	156-0158-00
U805	156-0067-12			MICROCRT,LINEAR:OPTIONAL AMPLIFIER	04713	MC1741CU
U2156A-D	156-0180-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	01295	SN74S00N
U2212A-D	156-0180-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	01295	SN74S00N
U2224A,B	156-0405-00			MICROCIRCUIT,DI:DUAL RETRIG MONOSTABLE MV	07263	9602PC
U2234A-D	156-0180-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	01295	SN74S00N
U2524[1]	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U4306	156-0113-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	80009	156-0113-02
U4324	156-0388-00			MICROCIRCUIT,DI:DUAL D FLIP-FLOP	80009	156-0338-00
V470	154-0729-00			ELECTRON TUBE:P31,INT SCALE,	80009	154-0729-00
VR412	152-0280-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	80009	152-0280-00
VR746	152-0306-00			SEMICOND DEVICE:ZENER,0.4W,9.1V,5%	81483	1N960B
VR762	152-0195-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	80009	152-0195-00
VR784	152-0293-00			SEMICOND DEVICE:ZENER,1W,33V,5%	04713	1N3032B
VR2392	152-0279-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	80009	152-0279-00
VR2590[1]	152-0195-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	80009	152-0195-00

[1]T935A only

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
VR4184	152-0195-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	80009	152-0195-00
VR4284	152-0195-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	80009	152-0195-00
VR4415	152-0195-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	80009	152-0195-00

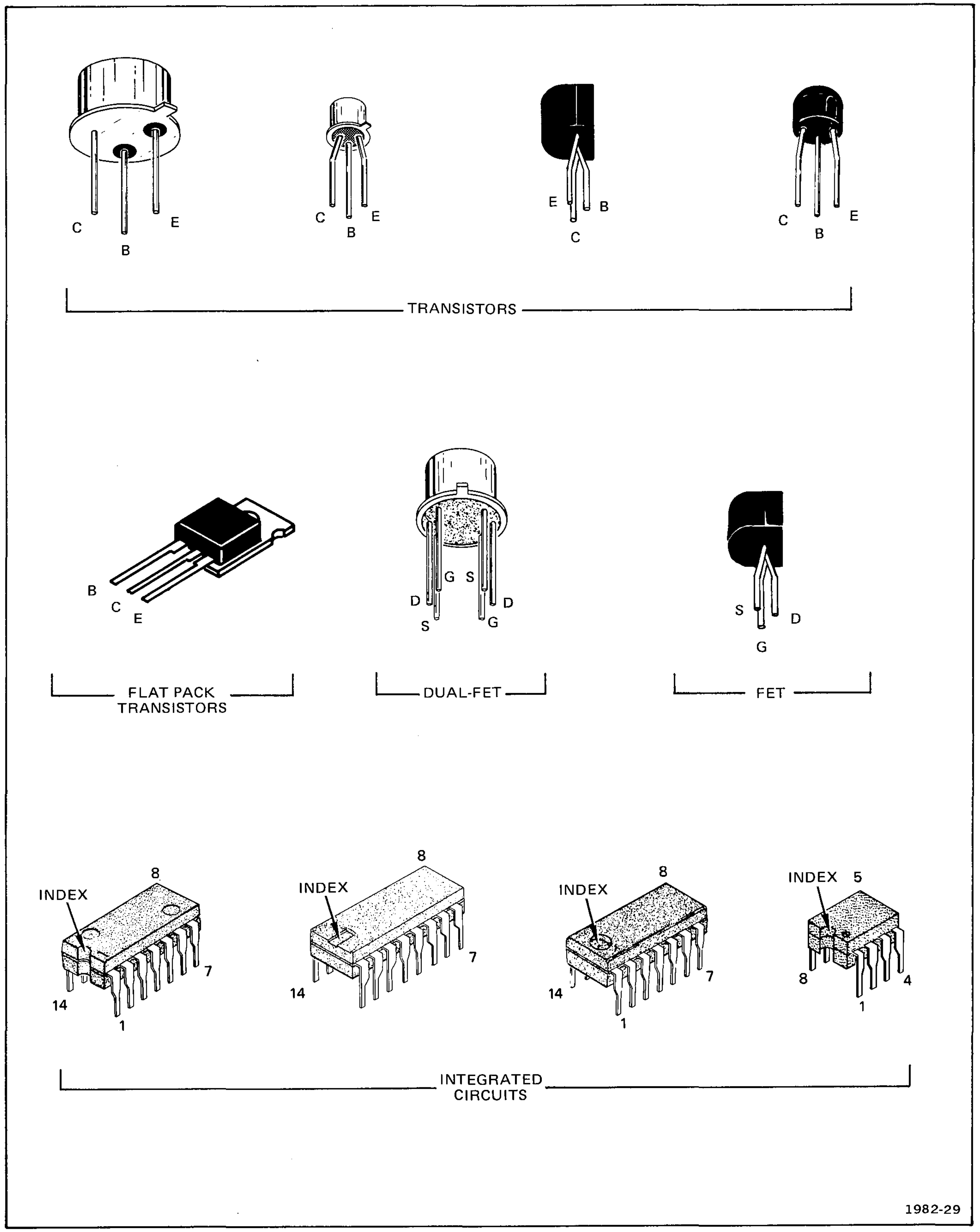


Fig. 7-1. Lead configuration for semiconductor devices.

@

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

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

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

Resistors = Ohms (Ω).

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

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

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

Abbreviations are based on ANSI Y1.1-1972.

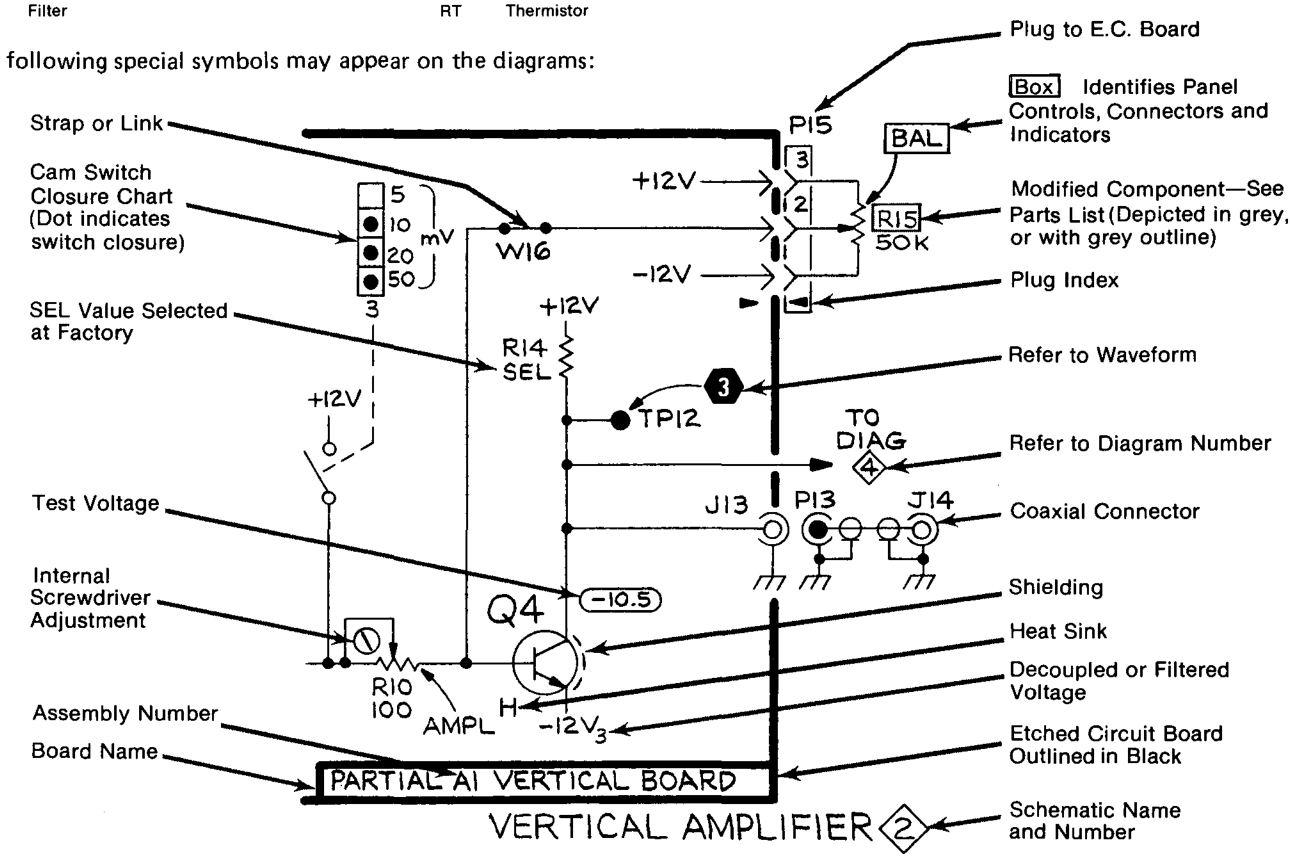
Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

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

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

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

The following special symbols may appear on the diagrams:



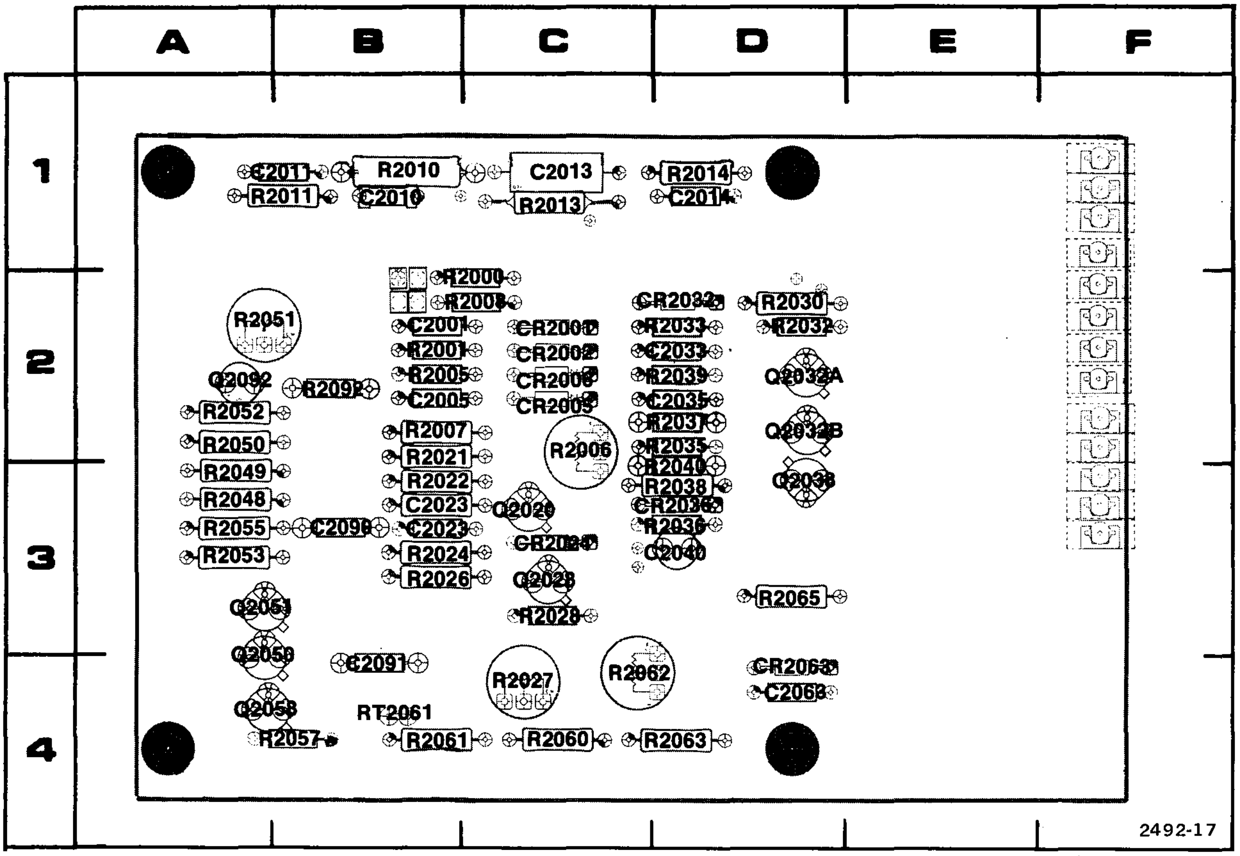


Fig. 7-2. A13—Trigger circuit board component locations.

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C2001	2B	Q2038	3D	R2036	3D
C2005	2B	Q2050	3A	R2037	2D
C2010	1B	Q2051	3A	R2038	3D
C2011	1B	Q2058	4A	R2039	2D
C2013	1C	Q2092	2A	R2040	3D
C2014	1D			R2048	3A
C2023	3B	R0010	1B	R2049	3A
C2033	2D	R2000	2C	R2050	2A
C2035	2D	R2001	2B	R2051	2A
C2040	3D	R2005	2B	R2052	2A
C2063	4D	R2006	2C	R2053	3A
C2090	3B	R2007	2B	R2055	3A
C2091	4B	R2008	2C	R2057	4B
		R2011	1B	R2060	4C
CR2001	2C	R2013	1C	R2061	4B
CR2002	2C	R2014	1D	R2062	4C
CR2005	2C	R2021	2B	R2063	4D
CR2006	2C	R2022	3B	R2065	3D
CR2024	3C	R2024	3B	R2092	2B
CR2032	2D	R2026	3B		
CR2036	3D	R2027	4C	RT2061	4B
CR2063	4D	R2028	3C		
		R2030	2D		
Q2020	3C	R2032	2D		
Q2028	3C	R2032	3B		
Q2032A	2D	R2033	2D		
Q2032B	2D	R2035	2D		

BLOCK DIAGRAM DESCRIPTION

VERTICAL INPUT

Signals to be displayed on the crt are applied to either (or both) the channel 1 (X) or channel 2 (Y) input connector. The input signals are amplified by the preamplifier circuits. Each preamplifier circuit includes separate input coupling, attenuators, gain switching, variable attenuators, balance, and gain adjustments.

A Trigger Pickoff circuit in each channel supplies a sample of the vertical input signal to the Trigger Input Amplifier via the Trigger Switching circuit and the SOURCE switch.

A trigger pickoff at the delay line driver provides a sample of the signal at the deflection plates for composite trigger.

When SOURCE switch is in X-Y position, triggering is disabled, CH1 signals are connected to Horizontal Output Amplifier through X Buffer Amplifier, and CH2 signals are connected through regular CH2 circuits. Channel 1 is X: Channel 2 is Y.

VERTICAL SWITCHING

The Vertical Mode switch selects which channel supplies the trigger signal as well as the vertical function. The vertical signal passes through the Input Buffer Amplifier circuit which isolates the preamplifier circuits from the Delay Line Driver. The output of each Input Buffer Amplifier is connected to the Delay Line Driver through a Diode Gate circuit. The Diode Gate circuits are controlled by the Vertical Switching circuit to select the channel(s) to be displayed. An output from the Vertical Switching circuit (through the Chop Blanking Pulse Generator) is connected to the Z Axis Amplifier to blank switching transients in the CHOP mode. A sync pulse from the sweep (via the Alternate Sync Pulse Amplifier) switches the display between channels at the end of each sweep in the ALT mode.

A DIFFerential function allows display of the difference between two input signals using circuitry which inverts CH2 signal and adds it algebraically to CH1 signal.

VERTICAL AMPLIFIER

The vertical input signal goes from the Delay Line Driver through the Delay Line to the Vertical Output Amplifier. The Delay Line provides approximately 120 ns delay in the vertical signal. This allows the sweep generator circuit time to initiate a sweep before the vertical signal reaches the crt vertical deflection plates. The Vertical Output Amplifier provides final amplification of the signal to drive the crt vertical deflection plates. One section of the BEAM FINDER switch, when pressed, causes the display to compress vertically to aid in locating off-screen displays. Another section affects the horizontal circuitry.

TRIGGER

The Trigger circuit produces a logic triggering signal to trigger the sweep. Trigger signals are selected by the SOURCE switch from four sources: external trigger (via the External Trigger Input Buffer circuit), vertical amplifier input signal (CH1/CH2), line voltage at the secondary of T700, or from Composite Pickoff for COMP. (No trigger signal is produced during X-Y operation.)

The selected trigger signal is amplified and inverted by the Trigger Input Amplifier. The trigger signal passes to the Trigger Level Comparator, which determines the voltage level (on the trigger waveform) at which triggering occurs. The SLOPE switch determines whether the sweep triggers on the positive-going or negative-going portion of the trigger signal. For TV signals, the SLOPE switch determines whether the sweep triggers from positive or negative sync polarity. The Trigger Level comparator also supplies a signal to the TV Sync Separator circuit.

Two Schmitt Trigger circuits produce the logic trigger signal; one is for conventional trigger signals and the other is for TV signals. The MODE switch selects which Schmitt Trigger circuit is operating.

A SWEEP AND HORIZONTAL AMPLIFIER

The A Sweep circuit, when triggered by the Trigger circuit, produces a linear sawtooth output signal to the Horizontal Amplifier. The slope of the sawtooth is controlled by the SEC/DIV switch. When the sawtooth output reaches a predetermined level, the Hold-off Circuit resets the A Sweep circuit, blanks the crt (through the Z Axis Amplifier) and prevents subsequent triggers from initiating another sweep until the sweep reset is completed.

The sawtooth output from the Sweep circuit is amplified by the Horizontal Output Amplifier circuit to produce horizontal deflection on the crt. One section of the BEAM FINDER switch, when pressed, causes the display to compress horizontally to aid in locating off-screen displays.

B SWEEP

The B Sweep circuit produces a linear sawtooth output signal to the Horizontal Amplifier after a delay. The length of the delay is determined by the DELAY TIME POSITION control. The output signal from the A sweep circuit triggers the B sweep circuit. The DISPLAY MODE switch selects A, A INTEN BY B, or B (delayed) modes. In the A INTEN BY B mode, the B sweep intensifies a portion of the A sweep.

CRT CIRCUIT

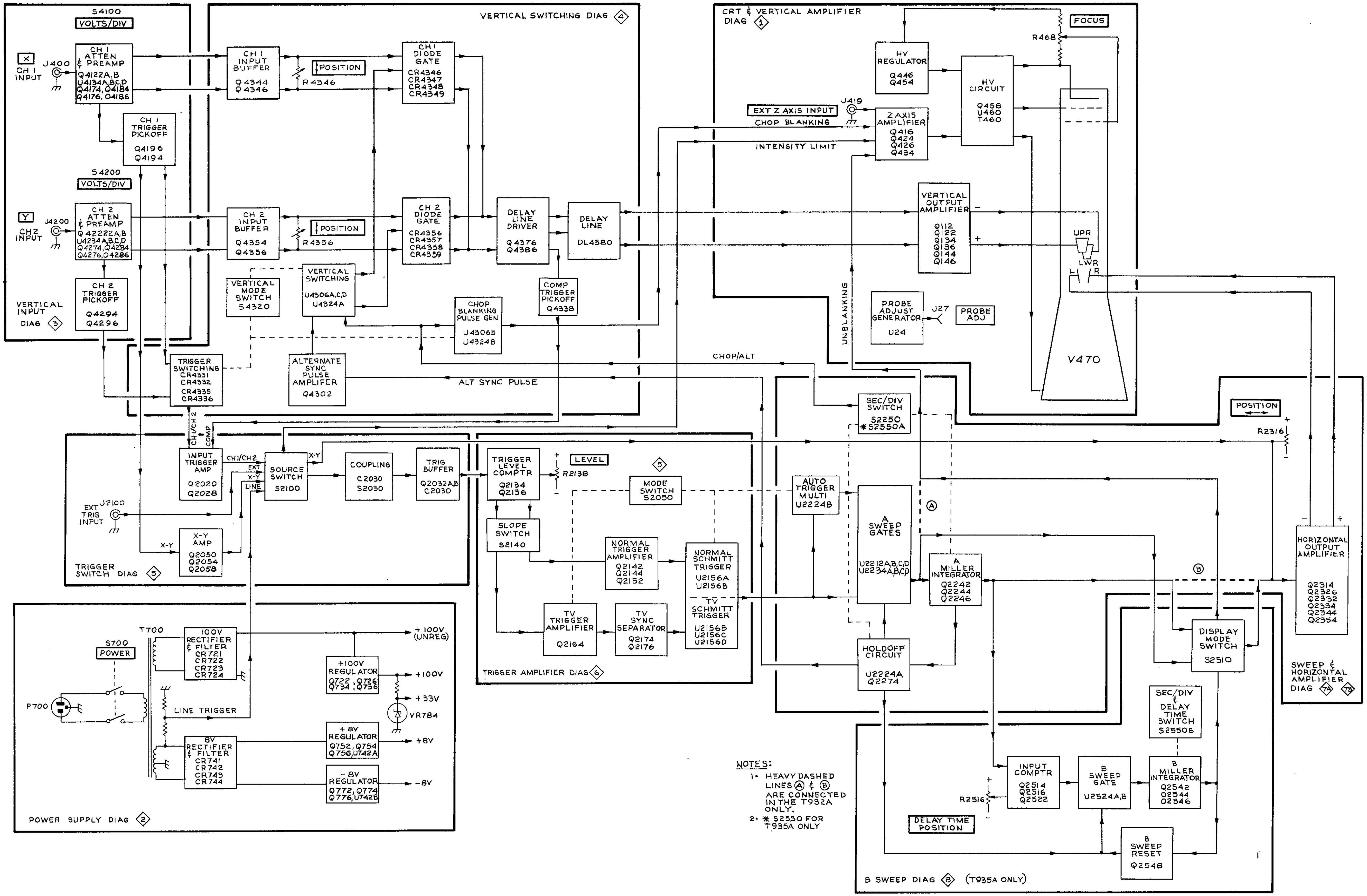
The Z Axis Amplifer determines the crt intensity and blanking. The Z Axis Amplifier sums the current inputs from several sources: INTENSTIY control, X-Y intensity limit, unblanking signal from sweep circuit, chop blanking signal from the Vertical Switching circuit, and EXT Z AXIS INPUT connector, J419.

Output of the Z Axis circuit controls the trace intensity through the HV circuit. The HV circuit provides the voltages (greater than 100 V) necessary for operation of the crt.

The Probe Comp Generator provides a square-wave voltage output for compensating voltage probes.

POWER SUPPLY

The Power Supply circuits provide the low-voltage power necessary for operation of the instrument.


S4100
VOLTS/DIV
CH 1 INPUT
J400
CH 1 ATTEN & PREAMP
Q4122A,B
U4134A,B,C,D
Q4174, Q4184
Q4176, Q4186
CH 1 TRIGGER PICKOFF
Q4196
Q4194
S4200
VOLTS/DIV
CH2 INPUT
J4200
CH 2 ATTEN & PREAMP
Q42222A,B
U4234A,B,C,D
Q4274, Q4284
Q4276, Q4286
CH 2 TRIGGER PICKOFF
Q4294
Q4296
VERTICAL INPUT DIAG 3
VERTICAL SWITCHING DIAG 4
CH 1 INPUT BUFFER
Q4344
Q4346
POSITION
R4346
CH 1 DIODE GATE
CR4346
CR4347
CR4348
CR4349
CH 2 INPUT BUFFER
Q4354
Q4356
POSITION
R4356
CH 2 DIODE GATE
CR4356
CR4357
CR4358
CR4359
DELAY LINE DRIVER
Q4376
Q4386
DELAY LINE
DL4380
VERTICAL MODE SWITCH
S4320
VERTICAL SWITCHING
U4306A,C,D
U4324A
CHOP BLANKING PULSE GEN
U4306B
U4324B
COMP TRIGGER PICKOFF
Q4338
ALTERNATE SYNC PULSE AMPLIFIER
Q4302
ALT SYNC PULSE
TRIGGER SWITCHING
CR4331
CR4332
CR4335
CR4336
CH1/CH2
COMP
CRT & VERTICAL AMPLIFIER DIAG 1
FOCUS
R468
HV REGULATOR
Q446
Q454
HV CIRCUIT
Q458
U460
T460
EXT Z AXIS INPUT
J419
CHOP BLANKING
INTENSITY LIMIT
Z AXIS AMPLIFIER
Q416
Q424
Q426
Q434
VERTICAL OUTPUT AMPLIFIER
Q112
Q122
Q134
Q136
Q144
Q146
UPR
LWR
L
R
UNBLANKING
PROBE ADJUST GENERATOR
U24
J27
PROBE ADJ
V470
CHOP/ALT
INPUT TRIGGER AMP
Q2020
Q2028
CH1/CH2
EXT
X-Y
LINE
SOURCE SWITCH
S2100
X-Y
COUPLING
C2030
S2030
TRIG BUFFER
Q2032A,B
C2030
EXT TRIG INPUT
J2100
X-Y
X-Y AMP
Q2050
Q2054
Q2058
TRIGGER SWITCH DIAG 5
TRIGGER LEVEL COMPTR
Q2134
Q2136
LEVEL
R2138
5
MODE SWITCH
S2050
SLOPE SWITCH
S2140
NORMAL TRIGGER AMPLIFIER
Q2142
Q2144
Q2152
NORMAL SCHMITT TRIGGER
U2156A
U2156B
TV SCHMITT TRIGGER
U2156B
U2156C
U2156D
TV TRIGGER AMPLIFIER
Q2164
TV SYNC SEPARATOR
Q2174
Q2176
TRIGGER AMPLIFIER DIAG 6
SEC/DIV SWITCH
S2250
*S2550A
AUTO TRIGGER MULTI
U2224B
A SWEEP GATES
U2212A,B,C,D
U2234A,B,C,D
A
A MILLER INTEGRATOR
Q2242
Q2244
Q2246
B
HOLDOFF CIRCUIT
U2224A
Q2274
POSITION
R2316
HORIZONTAL OUTPUT AMPLIFIER
Q2314
Q2326
Q2332
Q2334
Q2344
Q2354
DISPLAY MODE SWITCH
S2510
SWEEP & HORIZONTAL AMPLIFIER DIAG 7A 7B
SEC/DIV & DELAY TIME SWITCH
S2550B
INPUT COMPTR
Q2514
Q2516
Q2522
R2516
DELAY TIME POSITION
B SWEEP GATE
U2524A,B
B MILLER INTEGRATOR
Q2542
Q2544
Q2546
B SWEEP RESET
Q2548
B SWEEP DIAG 8 (T935A ONLY)
T700
S700
POWER
P700
100V RECTIFIER & FILTER
CR721
CR722
CR723
CR724
+100V (UNREG)
+100V REGULATOR
Q722, Q726
Q734, Q736
+100V
+33V
VR784
LINE TRIGGER
8V RECTIFIER & FILTER
CR741
CR742
CR743
CR744
+8V REGULATOR
Q752, Q754
Q756, U742A
+8V
-8V REGULATOR
Q772, Q774
Q776, U742B
-8V
POWER SUPPLY DIAG 2
NOTES:
1. HEAVY DASHED LINES A & B ARE CONNECTED IN THE T932A ONLY.
2. * S2550 FOR T935A ONLY

@

CRT & VERT AMPL CIRCUIT DESCRIPTION

PROBE COMPENSATION

The Probe Compensation (PROBE COMP) circuit provides an output of approximately 0.5 V peak-to-peak negative from ground at approximately 1 kHz.

When the output (pin 6) of U24 is positive, the voltage divider, R22-R23, sets pin 3 at a positive voltage. Feedback through R24 charges C24 until the pin 2 level reaches the same positive voltage as pin 3. When pin 3 and pin 2 are at the same voltage, U24 output (pin 6) switches from positive to negative. The output of U24 is about 7.2 V either positive or negative. Then C24 starts charging negative. When pin 2 and pin 3 are at the same voltage again, U24 output (pin 6) switches positive, and the cycle repeats.

During the positive half cycle, CR26 is forward biased and CR27 is reverse biased, keeping the output at ground level. During the negative half cycle, CR26 is reverse biased and CR27 is forward biased, causing current to flow from ground through R27, CR27 and R26 to −8 V. This sets the output level to approximately −0.5 V.

VERTICAL OUTPUT AMPLIFIER

The vertical output amplifier circuit provides final amplification for the signal to drive the vertical deflection plates of the crt.

Q112, Q122, Q134, Q136, Q144, and Q146 form a common-emitter shunt-feedback amplifier. Shunt-feedback transistors Q134, Q136, Q144, and Q146 are stacked. Resistors R118K, R118L, R118H, and R118J provide the feedback. The output voltage at the collectors of Q136 and Q146 is proportional to the collector current of Q112 and Q122 through feedback resistors R118K-R118L and R118H-R118J.

When BEAM FINDER button S100A is pressed, R117 is placed in series with R118B and R118C, limiting Q112 and Q122 emitter current. This limits the maximum vertical deflection to within the crt screen area. Another section of the BEAM FINDER switch limits the horizontal deflection.

Z AXIS CIRCUIT

The Z Axis Amplifier controls the crt intensity level from several inputs: the INTENSITY control, unblanking signal from the sweep circuit, chop blanking signal from the vertical amplifier, and external signals from the EXT Z AXIS INPUT connector (also intensity limit signal during X-Y operation). The INTENSITY control, R412, varies the trace intensity from off to maximum brightness, overriding all other inputs to the Z Axis Amplifier. The unblanking signal from the sweep circuit blanks the signal during retrace and holdoff. The chop blanking signal (with the vertical in the DUAL TRACE chop mode) blanks the crt during the channel switching interval to eliminate vertical chopping noise from appearing on the display. The EXT Z AXIS INPUT connector, through J419, allows control of the trace intensity from an external source.

The current signals from the various inputs are connected to the emitter of Q416. The algebraic sum of the signals determines the collector conduction level. In case of overdrive from any input, Q416 cuts off and CR416 conducts the excess current to ground and thereby prevents the output stage from saturating.

Transistors Q424, Q426, Q434, and assoicated circuitry form an inverting operational amplifier. Components R423 and C423 are the feedback elements. Any current into the input summing point, the base of Q424, results in an output voltage at the collectors of Q426 and Q434. This output voltage controls the display intensity level by changing the dc voltage level at the junction of R462, C463, and C464.

HIGH VOLTAGE OSCILLATOR

Transistor Q458 and associated circuitry make up the high-voltage oscillator that produces the drive for high-voltage transformer T460. When the instrument is turned on, current through Q454 provides forward bias for Q458. Transistor Q458 conducts and the collector current increases, which develops a voltage across the primary (Q458 collector) winding of T460. This produces a corresponding voltage increase in the feedback winding of T460, which is connected to the base of Q458, and Q458 conducts even harder. Eventually the rate of collector current increase in Q458 becomes less than that required to maintain the voltage across the collector winding, and the output voltage drops. This turns off Q458 by way of the feedback voltage to the base. The voltage waveform at the collector of Q458 is a sine wave at the resonant frequency of T460. During the negative half cycle, Q458 remains off and the field collapses in the primary of T460. When the field is collapsed sufficiently, the base of Q458 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 Q458 by the regulator circuitry. The frequency of oscillation is approximately 50 kHz. Components C458 and R458 decouple the unregulated +100 V supply line.

HIGH-VOLTAGE REGULATOR

Transistors Q446-Q454 and associated circuitry control the output voltage of the High Voltage supply. Components R443 and C443 provide a slow start up for the high-voltage oscillator. When the instrument is turned on, the +100 V supply charges C443 through R443. The voltage increases until it is sufficient to forward bias CR443, holding the voltage at slightly above +8 volts. This forms the reference for the high-voltage regulator.

The resulting current in R444A (100 μA) turns on Q446 and Q454, providing base current for Q458. This starts the high voltage oscillator, causing a negative voltage to develop at the crt cathode.

Resistors R444B, C, D, and R468 sample the cathode voltage. The high voltage increases until the cathode voltage is −2000 V, At this point the current in R444B is approximately the same as the current in R444A with Q446 barely conducting.

Any change in the level at the base of Q446 produces an error signal at the collector of Q446, which is amplified by Q454 and applied to the base of Q458 through the feedback winding of T460. Regulation occurs as follows:

If the cathode voltage at the −2000 V point starts to go positive (less negative), this positive-going change is applied to the base of Q446. Q446 conducts harder, which in turn causes Q454 to conduct harder. This results in greater bias current to the base of Q458 through the feedback winding of T460. Now Q458 is biased closer to its conduction level so that it comes into conduction sooner to produce a larger induced voltage in the secondary of T460. This increased voltage appears as a more negative voltage at the crt cathode 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.

Components, R445 and C445, damp the response of the regulator against fast changes in the load such as when the crt is unblanked at the beginning of the sweep.

Resistors, R446, R453, and R457, help prevent instabilities in the high-voltage oscillator.

HIGH-VOLTAGE RECTIFIERS AND OUTPUT

The high-voltage transformer, T460, has 3 output windings. One winding provides about 6.3 V for the crt filament. The crt filament is referenced to the cathode voltage (≈−2 kV), preventing cathode-to-filament breakdown. A second winding provides high ac voltage to the multiplier, U460, to produce a 10 kV crt anode accelerating voltage. The same winding is tapped and rectified by CR465 to produce the dc voltage for the crt cathode. Components C465, R465, and C466 filter the dc voltage.

The third winding is used to control the crt intensity. Components CR463, C462, C463, C464, R462, and R463 rectify and filter the secondary voltage to provide approximately −2100 V which is applied to the crt grid. The entire winding is referenced to the output of the Z axis amplifier whose output voltage variations are used to control the crt intensity by varying the grid to cathode voltage. The dc path for the Z axis signal to the grid is through R462, CR463, R463 and the transformer winding. Resistor R462 isolates the transformer capacitance from the Z axis Amplifier. Capacitors C463 and C464 provide a path for fast changes in the Z axis output to the crt grid. Resistor R464 provides a discharge path for C462, C463, and C464. Glow lamps DS463 and DS465 prevent the grid-to-cathode voltage from rising high enough to cause breakdown within the crt during turn-on or when the cathode or grid is shorted to ground.

CRT CONTROL CIRCUITS

Crt display focus is controlled by FOCUS control R468. ASTIG adjustment R477, which is used in conjunction with the FOCUS control to provide a well-defined display, varies the voltage on the astigmatism grid. Geometry adjustment, R473, varies the voltage 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 axis adjustment, R474, controls the current through L470, 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 (TR ROT) adjustment, R472, controls the current through L472 and affects both vertical and horizontal rotation of the beam.

R475 and R476 provide the proper voltage for the vertical plate shield and R478 and C478 decouple the first accelerator electrode from the +33 V supply.

VOLTAGE AND WAVEFORM CONDITIONS

VOLTAGE CONDITIONS

Voltages shown on this diagram were measured with a Tektronix DM 501 Digital Multimeter. Voltage measurements can vary as much as ±20%. No signals were applied to the vertical inputs or to the X (external trigger) input. Refer to Waveform Conditions for T932A or T935A control settings. In the crt circuit, set the INTENSITY control for a voltage measurement of +22 volts at the collector of Q426 and of Q434 before attempting to measure voltages in the rest of the circuit.

WAVEFORM CONDITIONS

Waveforms below were monitored with a Tektronix 7704A Oscilloscope, 7B71 Time Base, 7A15A Amplifier, and 10X probe. The oscilloscope input coupling was set to ac. Waveforms vary as much as ±20%.

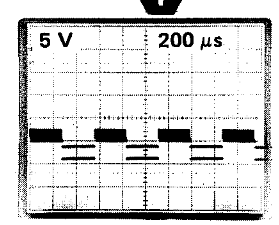
A 50 kHz, 100 mV sine wave was applied to the CH 1 input and a 50 kHz, 2 V square wave was applied to the CH 2 input. A Tektronix FG 501 Function Generator provides either of the input waveforms.

The T932A or T935A controls were set as follows:

SOURCE	CH1/CH2
MODE	AUTO
Vertical Mode	DUAL ALT
CH 1 VOLTS/DIV	50 mV
CH 2 VOLTS/DIV	1 V
VAR (both)	Detent
AC-GND-DC (both)	DC
DISPLAY MODE	A
A & B SEC/DIV	10 μs
1X-10X	1X
HOLD-OFF	Fully ccw
LEVEL	For triggered display

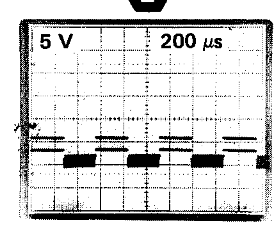
The other controls were set as necessary to obtain the desired display.

1



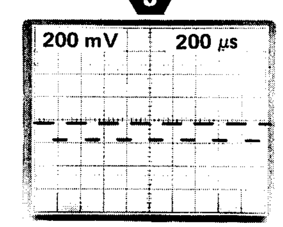
WAVEFORM POSITIONS VARY WITH POSITION CONTROL SETTINGS

2

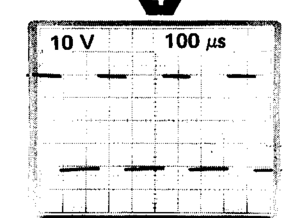


WAVEFORM POSITIONS VARY WITH POSITION CONTROL SETTINGS

3

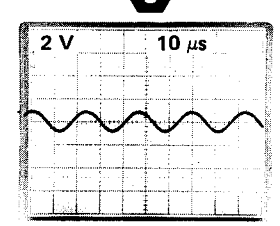


4



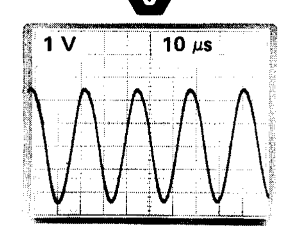
PULSE AMPLITUDE VARIES WITH INTENSTIY CONTROL SETTING

5

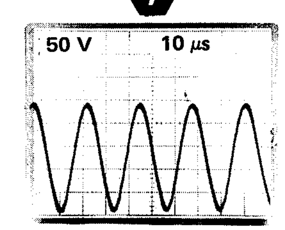


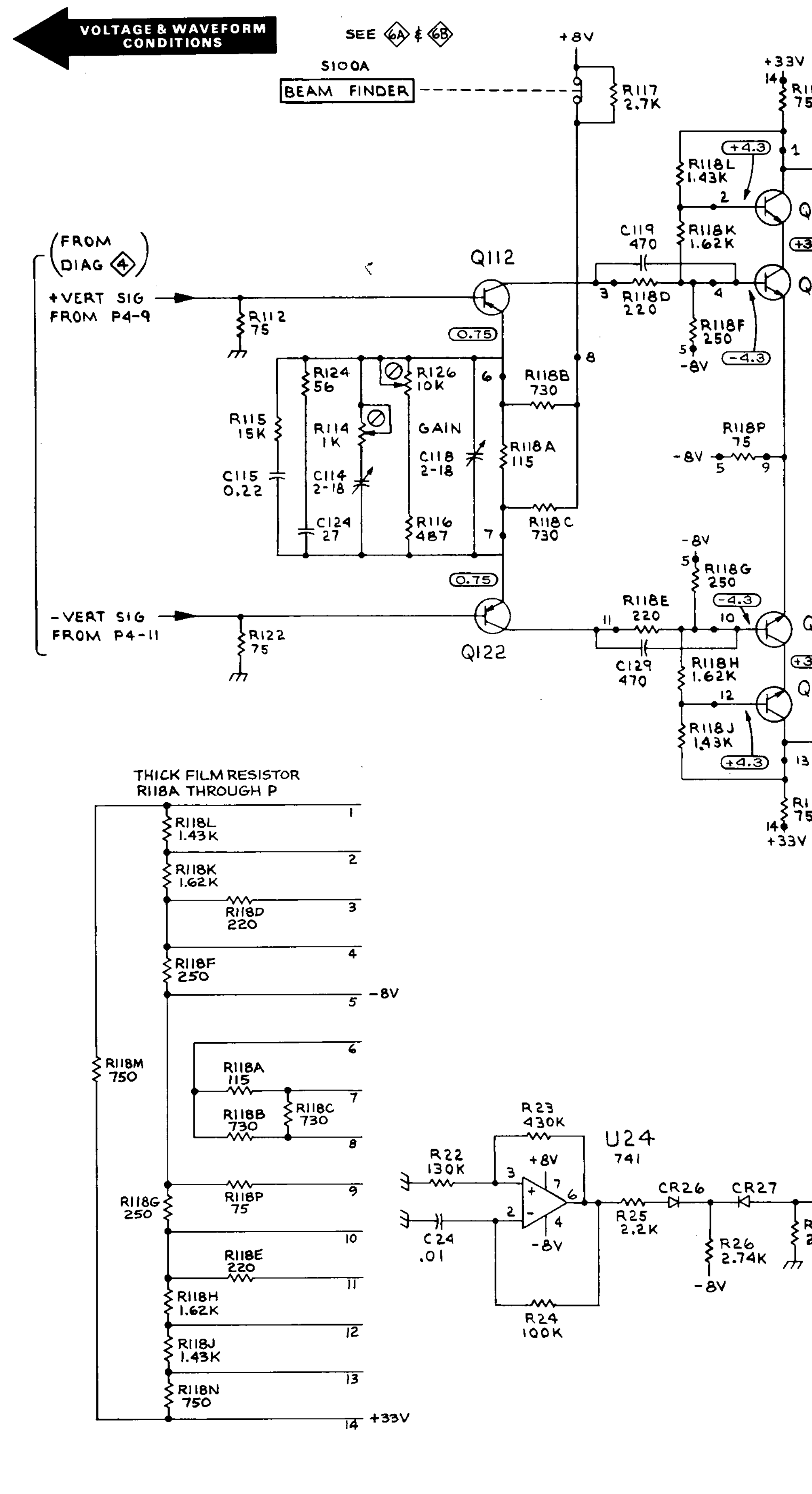
SET INTENSITY FULL CCW

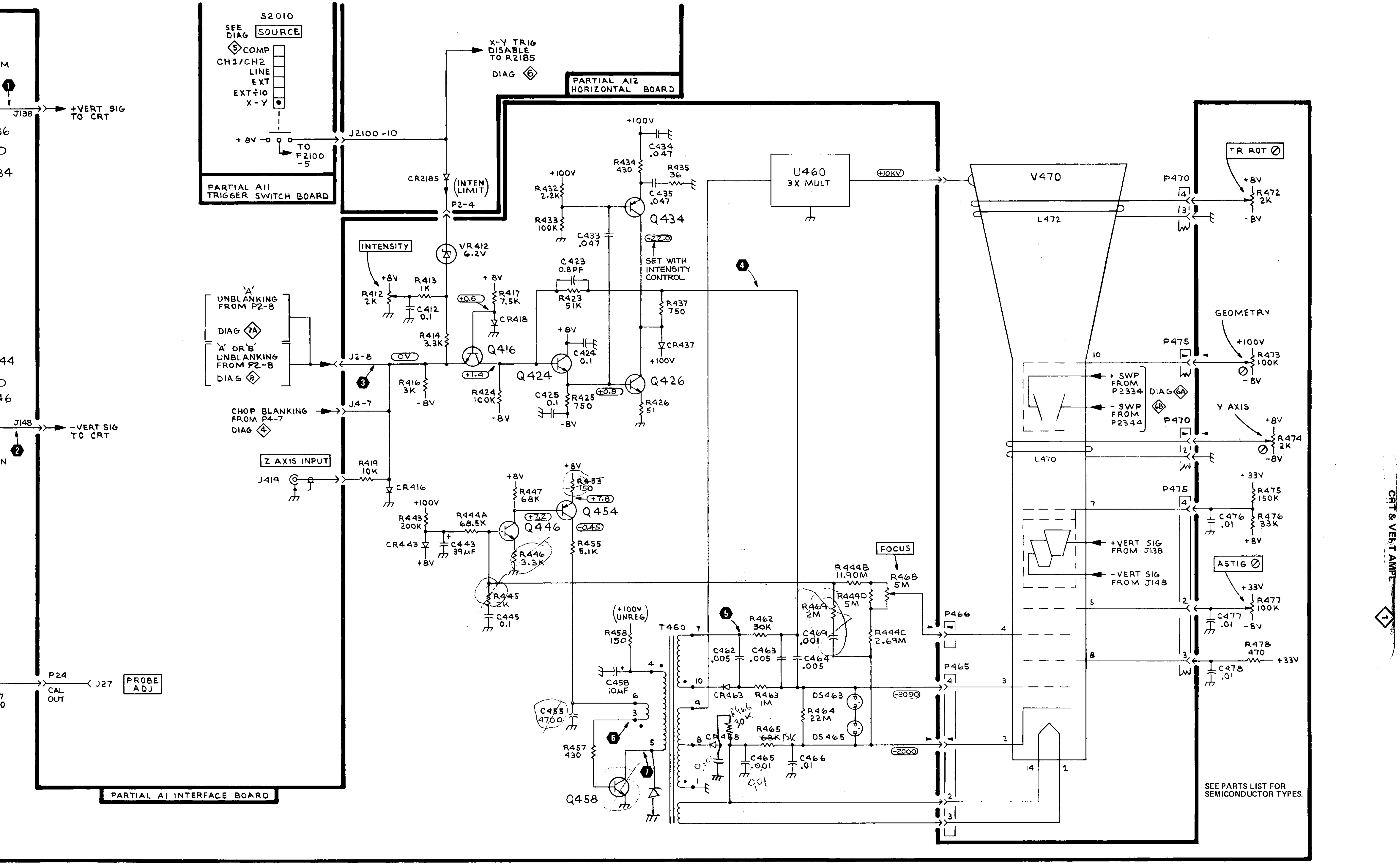
6



7




VOLTAGE & WAVEFORM CONDITIONS
SEE 6A & 6B
S100A
BEAM FINDER
+8V
R117 2.7K
+33V
(FROM DIAG 4)
+VERT SIG FROM P4-9
-VERT SIG FROM P4-11
R112 75
R122 75
Q112
Q122
0.75
R124 56
R126 10K
R115 15K
R114 1K
GAIN
C115 0.22
C114 2-18
C118 2-18
C124 27
R116 487
R118B 730
R118A 115
R118C 730
C119 470
R118D 220
R118L 1.43K
R118K 1.62K
R118F 250
+4.3
-4.3
-8V
R118P 75
R118G 250
R118E 220
C129 470
R118H 1.62K
R118J 1.43K
THICK FILM RESISTOR
R118A THROUGH P
R118M 750
R118N 750
U24
741
R22 130K
R23 430K
R24 100K
C24 .01
R25 2.2K
R26 2.74K
CR26
CR27



CRT & VERTICAL AMPLIFIER 1

@

POWER SUPPLY CIRCUIT DESCRIPTION

POWER INPUT

AC power is applied to the primary of T700 though line fuse F700, POWER switch S700, Line Selector switch S701, and Range Selector switch S705.

The Line Selection switch, S701, connects the split primary windings of T700 in parallel for 120 V operation or in series for 240 V. When changing the nominal line voltage, also change the line fuse. See parts list for correct fuse values.

The Range Selector switch, S705, selects either LO (100 or 220 V) or HI (120 or 240 V) nominal line-voltage range.

SECONDARY CIRCUITS

The secondary circuit supplies four regulated voltages: −8 V, +8 V, +33 V, and +100 V.

Operational amplifiers U742A (+8 V supply) and U742B (−8 V supply) have differential inputs that monitor output voltage variations and provide correction signals to the series-regulating transistors. For example, suppose the +8 volt supply drops. This negative change is coupled to the inverting input of U742A through sense resistor R756, causing pin 7 to go positive. Since the voltage across VR746 remains essentially constant, Q754 and Q756 follow this change and raise the output voltage back to +8 volts. In the +100 volt supply, Q726 acts as the feedback amplifier with its base being the inverting input. The regulating action is the same as in the +8 and −8 volt supplies. Zener diode, VR762, provides a 5 volt reference for the −8 V supply, which in turn provides the reference for the +8 and +100 volt supplies. The series regulating elements in the +100 V and +8 V supplies are transistors Q734-Q736 and Q754-Q756. The series regulating element in the −8 V supply is a modified Darlington configuration consisting of Q774 and Q776. Current limiting circuits provide short-circuit protection for each regulated supply. The following describes the +8 V current-limiting circuit. The other current-limiting circuits operate similarly.

In the +8 V supply, Q752 is normally biased off. Under normal conditions, the base of Q752 is set at about +8 V. As the supply current increases, the voltage drop across R754 increases. Since the Q756 emitter-base diode voltage difference remains constant, the increasing voltage on Q756 emitter due to the R754 voltage drop causes a corresponding increase at the base of Q756. This voltage is applied to voltage divider R752 and R753, causing the base of Q752 to go more positive. When the supply current increases sufficiently beyond the normal operating current, Q752 turns on. The collector of Q752 moves in the negative direction, which begins turning off Q754-Q756 and creates a foldback condition, (see Fig. 7-3). Transistor, Q756, continues to conduct some current when the supply is limited, dropping enough voltage across R754 to keep Q752 biased on.

Regulated +33 V is provided by Zener diode VR784 from the +100 V supply. Current divider, R741, R742, R2102 (see diagram 5) provides a sample of the line voltage for line triggering.

POWER-ON LED CIRCUIT

The POWER (On) LED, DS811, remains on, steady, as long as the line voltage does not vary more than approximately 10% from the nominal selected line voltage (100, 120, 220, 0r 240V). When the line voltage is not within the 10% limit, the POWER LED blinks.

As long as Q796 is conducting (with nominal selected line voltage), the oscillator is off—output of the oscillator is at +8 V—and Q810 is conducting to provide steady current to DS811. The LED stays steadily lit. When Q796 is biased off, because of low or high input voltage, U805 begins oscillating and output level of the oscillator goes from approximately −8 to approximately +8 volts at a low frequency repetition rate. Q810 acts as a buffer for oscillator, output resulting in an on, off LED display at the oscillators repetition rate.

For detailed description of theory of operation for U805 as an oscillator, refer to Probe Comp Circuit Description (U24), II.1.

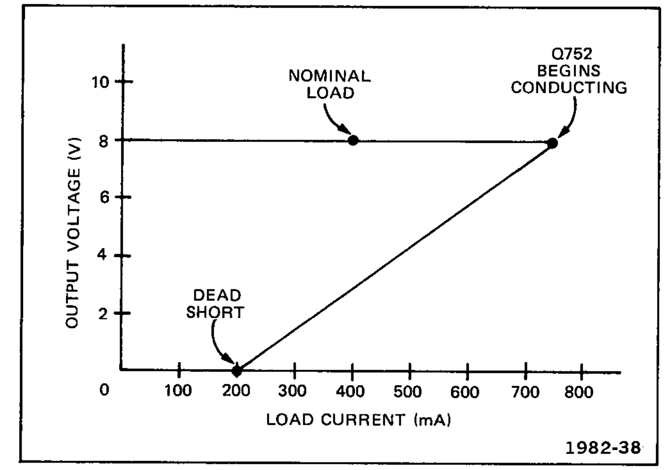
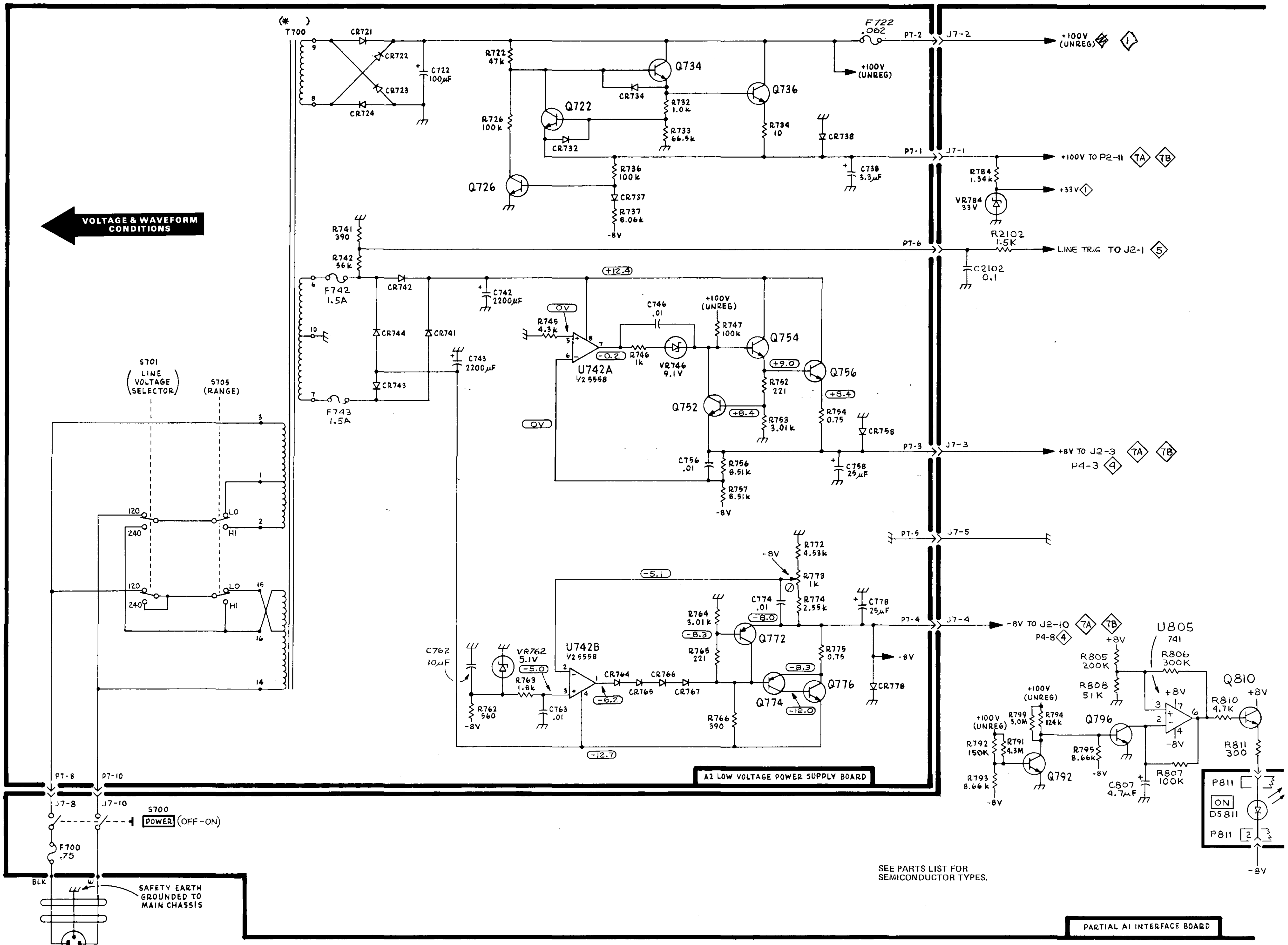


Fig. 7-3. Foldback circuit action.



SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

T932A/T935A

VERT INPUT CIRCUIT DESCRIPTION

Since Channel 1 and Channel 2 vertical input circuits are identical, only Channel 1 is discussed in detail. The 4100 series circuit numbers identify the Channel 1 components and 4200 series numbers identify the Channel 2 components.

INPUT COUPLING SWITCH

Vertical input signal is ac-coupled, dc-coupled, or grounded by S4100. In the DC position, the input signal is coupled directly to the VOLTS/DIV switch attenuator. In the AC position, the input signal passes through C4102 to the attenuator. In the GND position, the signal path from the input connector to the attenuator is grounded though C4102-R4102. This provides a ground reference without disconnecting the signal from the input connector. In the GND position, C4102 is charged to the average signal level through R4102 so that the trace remains on screen when S4100 is changed to the AC position.

VOLTS/DIV SWITCH

The VOLTS/DIV switch selects attenuator ratio and preamplifier gain to determine the deflection factor. The basic 1X deflection factor of the vertical deflection system is 2 mV/division. At this setting, no attenuators are switched in and the gain switching circuit sets the preamplifier gain to maximum. To provide the complete range of deflection factors indicated on the front panel, precision attenuators are switched in and out of the attenuator and gain switching circuit.

The attenuators are frequency compensated voltage dividers that provide constant attenuation at all frequencies within the bandwidth of the instrument. The input RC characteristics (approximately 1 MΩ shunted by approximately 30 pF) are maintained for each setting of the VOLTS/DIV switch. The attenuator circuit consists of a 10X and a 100X attenuator. 1000X is obtained when the 10X and 100X attenuators are cascaded.

The gain switching circuit consists of R4143 through R4147 and three VOLTS/DIV switch contacts. Three preamplifier gains are selected: 1X (maximum), 2.5X reduction, and 5X reduction. Refer to Table 7-1 for the attenuator and gain switching sequence.

PREAMPLIFIER

The signal from the input attenuator is connected to source follower Q4122A via C4122 and R4122. Resistor R4121 determines the 1 MΩ input resistance, and R4122 limits current drive to the gate of Q4122A. Diode CR4122 protects the circuit from high negative-going input signals by limiting the voltage at the gate of Q4122A to about −8 volts. The Q4122A gate-drain junction provides protection from high positive-going signals by limiting the gate voltage to about +8 volts. FET Q4122B provides a constant-current source for Q4122A.

Circuits including Q4132 and Q4134 are emitter followers. The signal at the emitter of Q4132 follows the signal at the gate of Q4122A. Divider network R4143 through R4147 attenuates the signal from Q4132 which drives the base of Q4132. DC BAL, R4130 adjusts for minimum trace shift when switching between adjacent positions of the VOLTS/DIV switch.

First Cascode Amplifier

Paraphase amplifier stage, Q4168, Q4158, and associated circuitry, converts the single-ended signal at the base of Q4158 to a push-pull current signal. Capacitors C4158 and C4168 minimize the Miller effect through Q4158 and Q4168. Components C4154, C4156, R4156, R4166 and C4166, connected between Q4168 and Q4158 emitters, compensate for high-frequency losses in the preamplifier. Gain adjustment R4151 determines the gain of the preamplifier. The VAR control, R4152, provides uncalibrated deflection factors between VOLTS/DIV switch settings by attenuating the signal to the base of Q4158. When R4152 is rotated clockwise, its full resistance is in series with R4162, and the deflection factors are calibrated.

Transistors Q4174 and Q4184 and associated circuitry make up a common base amplifier stage.

TABLE 7-1

Attenuator and Gain Switching Sequence

VOLTS/DIV Setting	Attenuator (signal attenuation)	Gain Switch (preamp gain reduction)
2 mV	1X	1X
5 mV	1X	2.5X
10 mV	1X	5X
20 mV	10X	1X
50 mV	10X	2.5X
.1 V	10X	5X
.2 V	100X	1X
.5 V	100X	2.5X
1 V	100X	5X
2 V	1000X	1X
5 V	1000X	2.5X
10 V	1000X	5X

Second Cascode Amplifier

Transistors Q4176-Q4186 and Q4344-Q4346 (on diagram 4) comprise the second cascode amplifier. Capacitors C4177 and C4187 minimize the Miller effect through Q4176 and Q4186. The value of thermal resistor RT4175 (connected between emitters of Q4176 and Q4186) changes with temperature to counteract any gain change in the amplifier due to thermal variations. This holds the gain of the entire vertical amplifier constant over the operating temperature range of the instrument.

A sample of the vertical voltage signal from the emitters of Q4176 and Q4186 is applied to Q4194 and Q4196 where it is converted to a current signal. This current signal is applied to the trigger input amplifier (see diagram 5) via diode switching circuitry (see diagram 4). See circuit descriptions for diagrams 4 and 5 for further details.

VOLTAGE AND WAVEFORM CONDITIONS

VOLTAGE CONDITIONS

Voltages shown on this diagram were measured with a Tektronix DM 501 Digital Multimeter. Voltage measurements can vary as much as ±20%. No signals were applied to the vertical inputs or to the X (external trigger) input. Refer to Waveform Conditions for T932A or T935A control settings.

WAVEFORM CONDITIONS

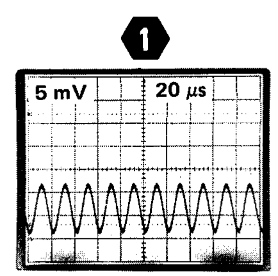
Waveforms below were monitored with a Tektronix 7704A Oscilloscope, 7B71 Time Base, 7A15A Amplifier, and 10X probe (unless otherwise stated). The oscilloscope input coupling was set to ac. Waveforms vary as much as ±20%.

A 50 kHz, 100 mV sine wave was applied to the CH 1 input and a 50 kHz, 2 V square wave was applied to the CH 2 input. A Tektronix FG 501 Function Generator provides either of the input waveforms.

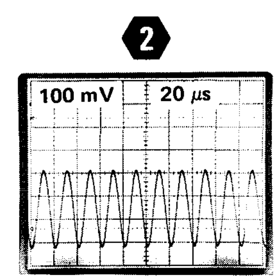
The T932A or T935A controls were set as follows:

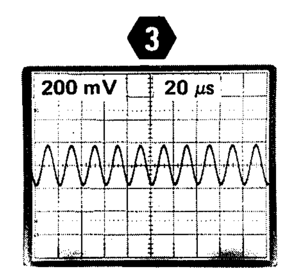
SOURCE	CH1/CH2
MODE	AUTO
Vertical Mode	CH 1
CH 1 VOLTS/DIV	50 mV
CH 2 VOLTS/DIV	1 V
VAR (both)	Detent
AC-GND-DC (both)	DC
DISPLAY MODE	A
A & B SEC/DIV	10 μs
1X-10X	1X
HOLD-OFF	Fully ccw
LEVEL	For triggered display

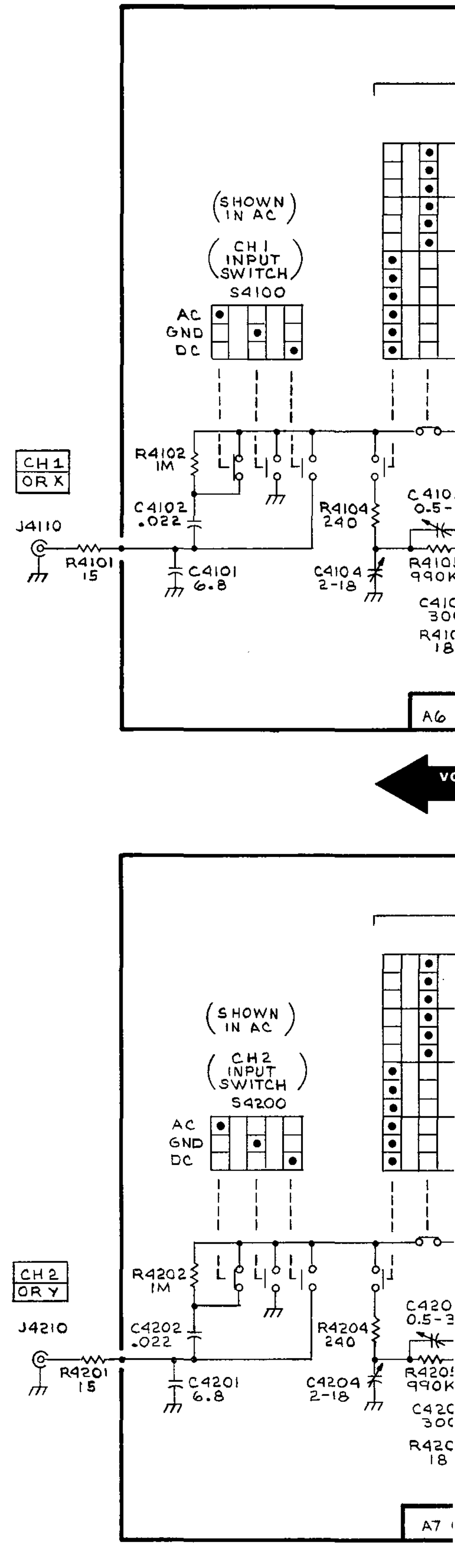
The other controls were set as necessary to obtain the desired display.



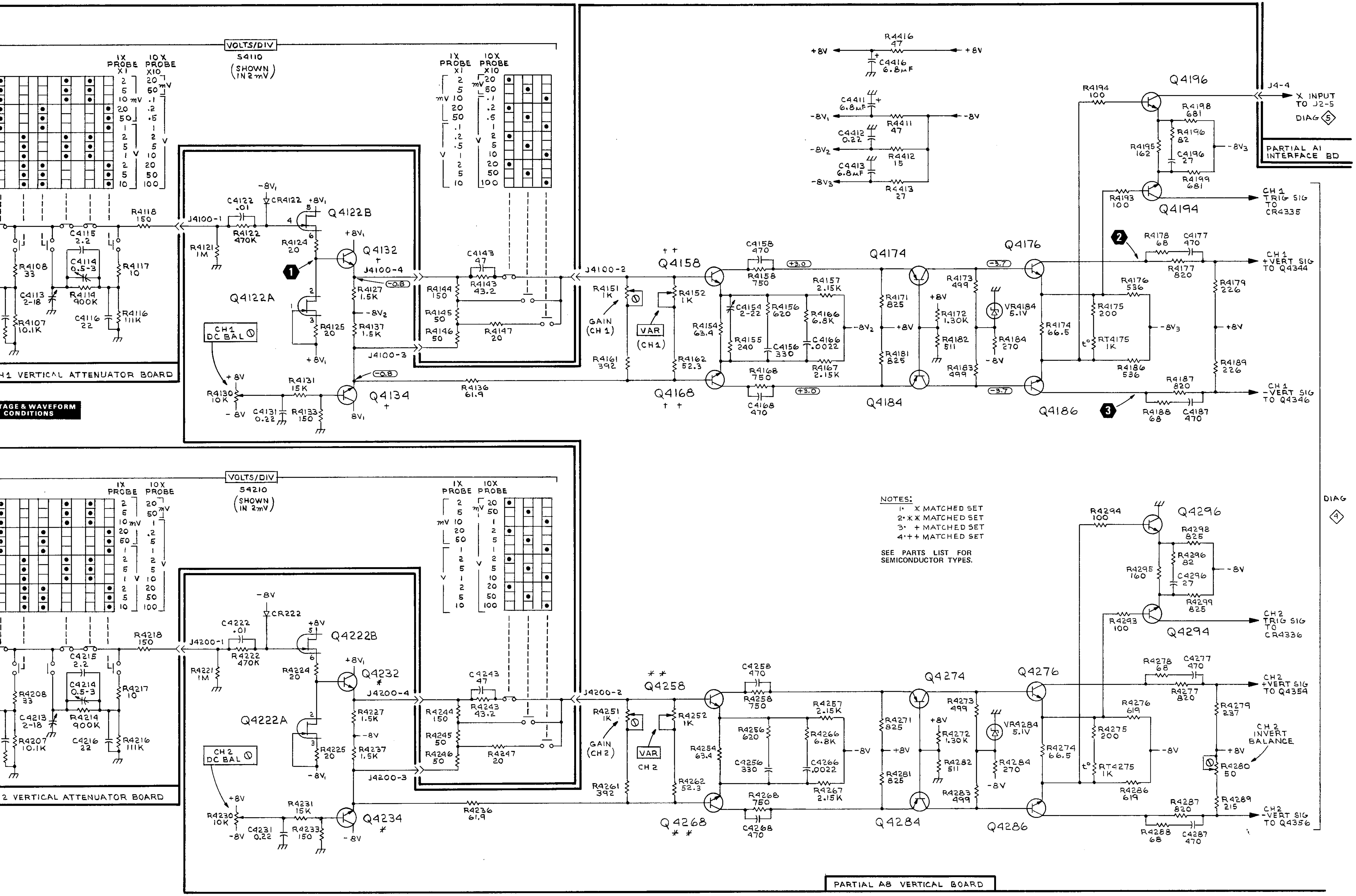
USE 1X PROBE







(SHOWN IN AC)
(CH1 INPUT SWITCH)
S4100
AC
GND
DC
CH1 OR X
J4110
R4101 15
R4102 1M
C4102 .022
C4101 6.8
R4104 240
C4104 2-18
A6
(SHOWN IN AC)
(CH2 INPUT SWITCH)
S4200
AC
GND
DC
CH 2 OR Y
J4210
R4201 15
R4202 1M
C4202 .022
C4201 6.8
R4204 240
C4204 2-18
A7


VOLTS/DIV
S4110
(SHOWN IN 2mV)
1X PROBE X1
10X PROBE X10
CH1 VERTICAL ATTENUATOR BOARD
VOLTAGE & WAVEFORM CONDITIONS
CH1 DC BAL
GAIN (CH 1)
VAR (CH1)
R4416 47
C4416 6.8µF
C4411 6.8µF
R4411 47
C4412 0.22
R4412 15
C4413 6.8µF
R4413 27
Q4122B
Q4122A
Q4132
Q4134
Q4158
Q4168
Q4174
Q4184
Q4176
Q4186
Q4194
Q4196
J4-4
X INPUT TO J2-5
DIAG 5
PARTIAL A1 INTERFACE BD
CH 1 TRIG SIG TO CR4335
CH 1 +VERT SIG TO Q4344
CH 1 -VERT SIG TO Q4346
DIAG 4
VOLTS/DIV
S4210
(SHOWN IN 2mV)
CH2 VERTICAL ATTENUATOR BOARD
CH 2 DC BAL
GAIN (CH 2)
VAR CH 2
Q4222B
Q4222A
Q4232
Q4234
Q4258
Q4268
Q4274
Q4284
Q4276
Q4286
Q4294
Q4296
CH2 TRIG SIG TO CR4336
CH2 +VERT SIG TO Q4354
CH 2 INVERT BALANCE
CH2 -VERT SIG TO Q4356
NOTES:
1· X MATCHED SET
2· X X MATCHED SET
3· + MATCHED SET
4· + + MATCHED SET
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
PARTIAL A8 VERTICAL BOARD

VERT SWITCHING CIRCUIT DESCRIPTION

Since Channel 1 and Channel 2 vertical circuits are identical, only Channel 1 is discussed in detail.

Digital logic devices are used to perform some of the functions in this instrument. LO and HI designations are used in this circuit description to indicate the state of the digital circuit. HI indicates the more positive of the two levels. The specific voltages that constitute a LO and HI logic state, may vary between individual devices.

POSITION CONTROL

POSITION control R4346 varies the dc voltage at the bases of Q4386 and Q4376 to vertically position the trace on the crt.

DELAY LINE DRIVER

The delay line driver is a push-pull feedback amplifier stage composed of Q4386, Q4376, and associated circuitry. A sample of the output of Q4386 and Q4376 is fed back through R4383 and R4373 to the bases of Q4386 and Q4376. Due to this feedback, this stage forms an inverting operational amplifier with a virtual ground at the bases of Q4386 and Q4376. Any current into these virtual ground null points causes an output voltage that is proportional to the feedback resistance.

Components C4396, R4396, C4397, C4395, R4397, C4398, R4398 provide compensation (peaking) to correct for delay line losses.

DELAY LINE

The vertical switching circuit determines whether CH 1 or CH 2 is connected to the vertical output amplifier. In the DUAL alternate (ALT) or chopped (CHOP) modes, both channels are alternately displayed on a time shared basis.

VERTICAL SWITCHING

The vertical switching circuit determines whether CH 1 or CH 2 is connected to the vertical output amplifier in the DUAL alternate (ALT) or chopped (CHOP) modes. Both channels are alternately displayed on a time shared basis.

The diode gates, consisting of four diodes each, act as switches that allow either of the vertical preamplifier signals to be coupled to the delay line driver. Diodes CR4346, CR4347, CR4348, and CR4349 control the CH 1 output; CR4356, CR4357, CR4358, and CR4359 control the CH 2 output. These diodes are controlled by flip-flop U4324A, which in turn is controlled by Vertical Mode switch, S4320.

@

When the Vertical Mode switch is in the CH 1 position, pin 4 of U4324A is held LO, causing pin 5 to go HI. A HI at pin 5 (a voltage higher than at the bases of Q4386 and Q4376) reverse biases CR4347 and CR4348 and forward biases CR4346 and CR4349. This allows the CH 1 signal to pass to the delay line driver. When pin 5 is HI, pin 6 is LO, causing the cathodes of CR4357 and CR4358 to be connected to a voltage much lower than on the bases of Q4386 and Q4376. Diodes CR4357 and CR4358 are now forward biased and diodes CR4356 and CR4359 are reverse biased, preventing the CH 2 signal from passing to the delay line driver.

In the CH 2 mode, the above conditions are reversed. Diodes CR4357 and CR4358 are reverse biased, passing the CH 2 signal and blocking the CH 1 signal.

In the DUAL Vertical Mode, CH 1 and CH 2 are alternately connected to the delay line driver. There are two dual trace modes: chopped (CHOP) and alternate (ALT). These modes are determined by the ALT or CHOP push-button switch setting. Chopped mode should be selected for sweep speeds of about 1 ms and slower; alternate should be selected for sweep speeds of about 0.5 ms and faster.

In the chopped mode, pin 2 of U4306A is ungrounded by Vertical Mode push-button switching, allowing the multivibrator, U4306A and U4306D, to free run at about 500 kHz. The output at pin 8 of U4306C serves as a clock pulse for U4324A, which in turn switches the diode gates at the 250 kHz rate. The clock pulse is also fed to U4324B, which provides an output pulse to the Z Axis amplifier to blank out the transition between CH 1 and CH 2 traces. If pin 13 of U4324B goes LO, the output pin 9 is set LO, causing pin 6 of U4306B to go HI. This causes pin 13 of U4324A to go HI after being delayed by C4315 charging through R4315.

The clock pulse applied to pin 11 of U4324B causes pin 9 to go HI, which in turn, after passing through the inverter and after some delay, sets pin 13 LO again. This causes pin 9 to go LO again. The positive-going voltage pulse (whose width is determined by R4315 and C4315) is converted to current by R4318 and sent to the Z Axis Amplifier to blank switching transients.

In the alternate mode, pin 2 of U4306A is grounded (via Vertical Mode switching), preventing multivibrator operation, thus keeping pin 10 of U4306C HI. At the end of each sweep, the base of Q4302 receives a current pulse driving it into saturation. The resulting negative-going pulse at the collector is fed through C4302 to pin 9 of U4306C causing pin 8 to go HI. This in turn, switches U4324A to pass either CH 1 or CH 2 to the delay line driver at the end of each sweep. Pin 12 of U4324B is grounded through Vertical Mode switching and prevents an output at pin 9.

With Vertical Mode in DIFFerential, the inputs from both channels are added at the delay line driver. The DIFF push-button switch inverts CH 2 by removing forward bias voltage from the bases of Q4354 and Q4356 and applying it to bases of Q4350 and Q4352. The DIFF mode switch also takes pins 1 and 4 of U4324A low, causing pins 5 and 6 to go high, turning on both CH 1 and CH 2. CH 1 and the inverted CH 2 signal currents are then added at the input to the delay line driver.

The Vertical Mode switch also selects the appropriate internal triggering source for CH 1 and CH 2. With the Vertical Mode switch set to CH 1 and DUAL TRACE, CR4335 is forward biased and the signal from the CH 1 trigger pickoff goes to the sweep circuit. In these modes, CR4331 is connected to the +8 volts, thus reverse biasing CR4336, preventing the CH 2 trigger signal from entering the trigger input amplifier. With the Vertical Mode switch set to CH 2, CR4336 becomes forward biased while CR4335 is reverse biased because CR4332 is now connected to +8 volts.

TRIGGER PICKOFF

Transistors Q4196 and Q4194 (diagram 3) convert a sample of the vertical signal to a single-ended current signal to drive the trigger input amplifier. When the TRIGGERING SOURCE switch is set to CH 1/CH 2 or COMP diode switching network, CR2002, CR2005, CR2006, CR2001 is used to select either trigger signal from CH 1 or 2, or composite trigger pickoff. When in EXT, EXT ÷10, LINE, X-Y these circuits are disabled.

VOLTAGE AND WAVEFORM CONDITIONS

VOLTAGE CONDITIONS

Voltages shown on this diagram were measured with a Tektronix DM 501 Digital Multimeter. Voltage measurements can vary as much as ±20%. No signals were applied to the vertical inputs or to the X (external trigger) input. Refer to Waveform Conditions for T932A or T935A control settings.

WAVEFORM CONDITIONS

Waveforms below were monitored with a Tektronix 7704A Oscilloscope, 7B71 Time Base, 7A15A Amplifier, and 10X probe. The oscilloscope input coupling was set to ac. Waveforms vary as much as ±20%.

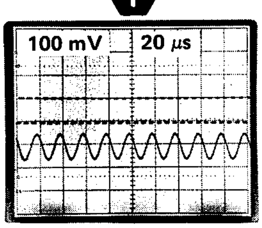
A 50 kHz, 100 mV sine wave was applied to the CH 1 input and a 50 kHz, 2 V square wave was applied to the CH 2 input. A Tektronix FG 501 Function Generator provides either of the input waveforms.

The 442 or T935A controls were set as follows:

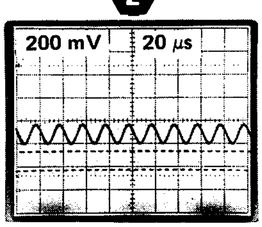
SOURCE	CH 1/CH 2
MODE	AUTO
Vertical Mode	DUAL ALT
CH 1 VOLTS/DIV	50 mV
CH 2 VOLTS/DIV	1 V
VAR (both)	Detent
AC-GND-DC (both)	DC
DISPLAY MODE	A
A & B SEC/DIV	10 μs*
1X-10X	1X
HOLD-OFF	Fully ccw
LEVEL	For triggered display

The other controls were set as necessary to obtain the desired display. For waveforms 1, 2, 5, and 6, adjust CH 1 and CH 2 POSITION controls as necessary for the desired display.

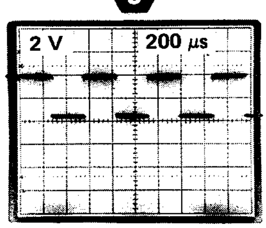
1



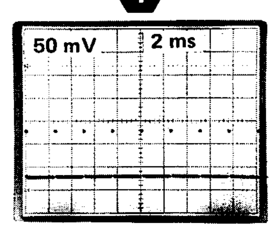
2



3

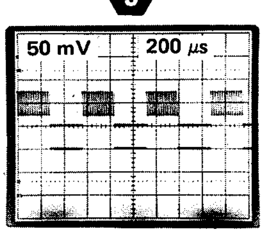


4

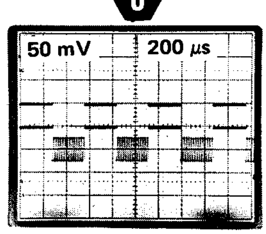


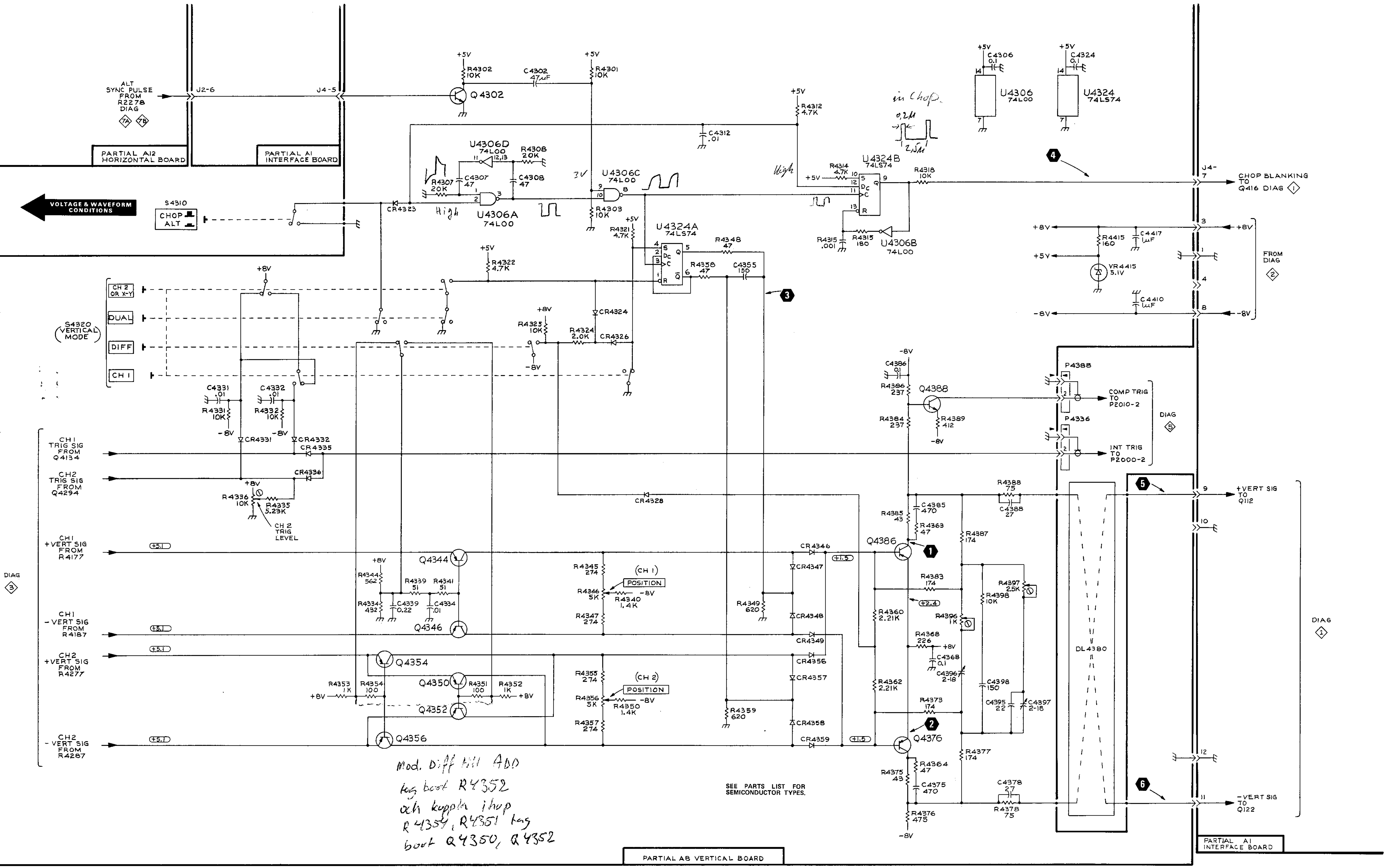
*SET T932A OR T935A SEC/DIV TO 0.2 ms

5



6




ALT SYNC PULSE FROM R2278 DIAG
PARTIAL A12 HORIZONTAL BOARD
PARTIAL A1 INTERFACE BOARD
VOLTAGE & WAVEFORM CONDITIONS
S4310
CHOP
ALT
S4320 VERTICAL MODE
CH 2 OR X-Y
DUAL
DIFF
CH 1
CH1 TRIG SIG FROM Q4134
CH2 TRIG SIG FROM Q4294
CH 2 TRIG LEVEL
CH1 +VERT SIG FROM R4177
CH1 -VERT SIG FROM R4187
CH2 +VERT SIG FROM R4277
CH2 -VERT SIG FROM R4287
U4306D 74L00
U4306A 74L00
U4306C 74L00
U4324A 74LS74
U4324B 74LS74
U4306B 74L00
U4306 74L00
U4324 74LS74
in chop
CHOP BLANKING TO Q416 DIAG
FROM DIAG
COMP TRIG TO P2010-2
INT TRIG TO P2000-2
+VERT SIG TO Q112
-VERT SIG TO Q122
DL4380
(CH 1) POSITION
(CH 2) POSITION
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
PARTIAL A8 VERTICAL BOARD
PARTIAL A1 INTERFACE BOARD
Mod. Diff till ADD
tag bort R4352
och koppla ihop
R4354, R4351 tag
bort Q4350, Q4352

TRIGGER CIRCUIT DESCRIPTION

Digital logic devices are used to perform some of the functions in this instrument. LO and HI designations are used in this circuit decription to indicate the state of the digital circuit. HI indicates the more positive of the two levels. The specific voltages that constitute a LO and HI logic state may vary between individual devices.

TRIG SWITCH CKT
DESC VOLTS & W.F. COND

Digital logic devices are used to perform some of the functions in this instrument. LO and HI designations are used in this circuit decription to indicate the state of the digital circuit. HI indicates the more positive of the two levels. The specific voltages that constitute a LO and HI logic state may vary between individual devices.

INPUT AND SWITCHING

SOURCE Switch

The SOURCE switch, S2010, selects trigger signals from COMP, CH 1/CH 2, LINE, EXT, EXT ÷ 10, and X-Y sources.

COMP. Signal at P2000-1, from collector of Q4388 (Vertical Switching Diagram), is portion of output of the delay line driver. It is a current which represents actual crt display—signal at vertical output amplifier input. This current signal is switched on through CR2006 to emitter of common base stage amplifier, Q2020, when SOURCE switch is in COMP. Follower Q2028 provides voltage signal and R2006 maintains dc level for coupling at S2030.

CH 1/CH2. Internal trigger input for SOURCE switching is a current signal from Q4194, or Q4294 (Vertical Switching diagram) which is fed through CR2002 to the common base stage amplifier, Q2020. Current output at Q2020 collector is fed to base of follower, Q2028, and is a voltage signal at its emitter. Coupling switch, S2030, inputs voltage change to source followers, Q2032A and B, which is common to all trigger signals (see description in Trigger Amplifier Circuit Description).

The Follower stage, a buffer amplifier using Q2032A and B, provides high impedance for all trigger inputs and C2035 provides peaking for high frequency signals to ensure stable triggers. Q2038 is a common base stage amplifier which provides current output for Trigger Input Amplifier.

LINE. A sample of line voltage, obtained from power transformer, is switched directly to S2030 and to follower stage at gate of Q2032A.

EXT. Externally applied trigger signals are connected to the gate of source follower, Q2032A, after passing through the appropriate attenuator. Voltages are then converted to current signals, as with all trigger signals, and fed to trigger input amplifier.

EXT
10. R2010, R2011, C2010, and C2011 provide attenuator network to divide EXT signal by a factor of ten (10).

X-Y current signals from X input are fed to common base stage amplifier Q2050; then followed by Q2054 and converted to voltage output for X-Y gain adjustment. Q2058 acts as an emitter follower and R2060, R2062, R2061, RT2061 convert this signal to a current for input to the horizontal amplifier. Y signals proceed through regular CH 2 circuits.

MODE Switch

The MODE switch (S2150) selects three triggering modes: AUTO, NORM, and TV.

AUTO. Allows the sweep to free run in the absence of a triggering signal. See sweep circuit description for details.

NORM. Connects +8 volts to R2223 in the sweep generator circuit. Allows the sweep to run only when a suitable triggering signal is present.

TV. The trigger signal is applied to the TV sync separator circuit (Q2164, Q2174, Q2176 on Trigger Amplifier diagram) and the normal trigger generator circuit is disabled. In this mode, the SLOPE switch is used to supply the sync separator with a signal of the proper polarity. For SEC/DIV settings of .1 ms/div or slower, the sweep is triggered by vertical sync pulses which occur at a field rate. For SEC/DIV settings of 50 μs and faster, the sweep is triggered by the TV horizontal line signals.

CPLG Switch

Coupling Switch, S2030, provides direct circuit from trigger switching to follower output in DC position; and provides capacitive circuit, C2030, in AC position.

Scan by Zenith

VI.3

VOLTAGE AND WAVEFORM CONDITIONS

VOLTAGE CONDITIONS

Voltages shown on this diagram were measured with a Tektronix DM 501 Digital Multimeter. Voltage measurements can vary as much as ±20%. No signals were applied to the vertical inputs or to the EXT (external trigger) input. Refer to Waveform Conditions for T932A or T935A control settings.

WAVEFORM CONDITIONS

Waveforms below were monitored with a Tektronix 7704A Oscilloscope, 7B71 Time Base, 7A15A Amplifier, and 10X probe. The oscilloscope input coupling was set to ac. Waveforms vary as much as ±20%.

A 50 kHz, 100 mV sine wave was applied to the CH 1 input and a 50 kHz, 2 V square wave was applied to the CH 2 input. A Tektronix FG 501 Function Generator provides either of the input waveforms.

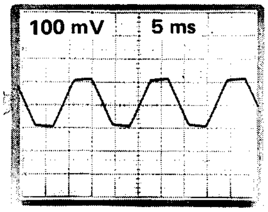
The T932A or T935A controls were set as follows:

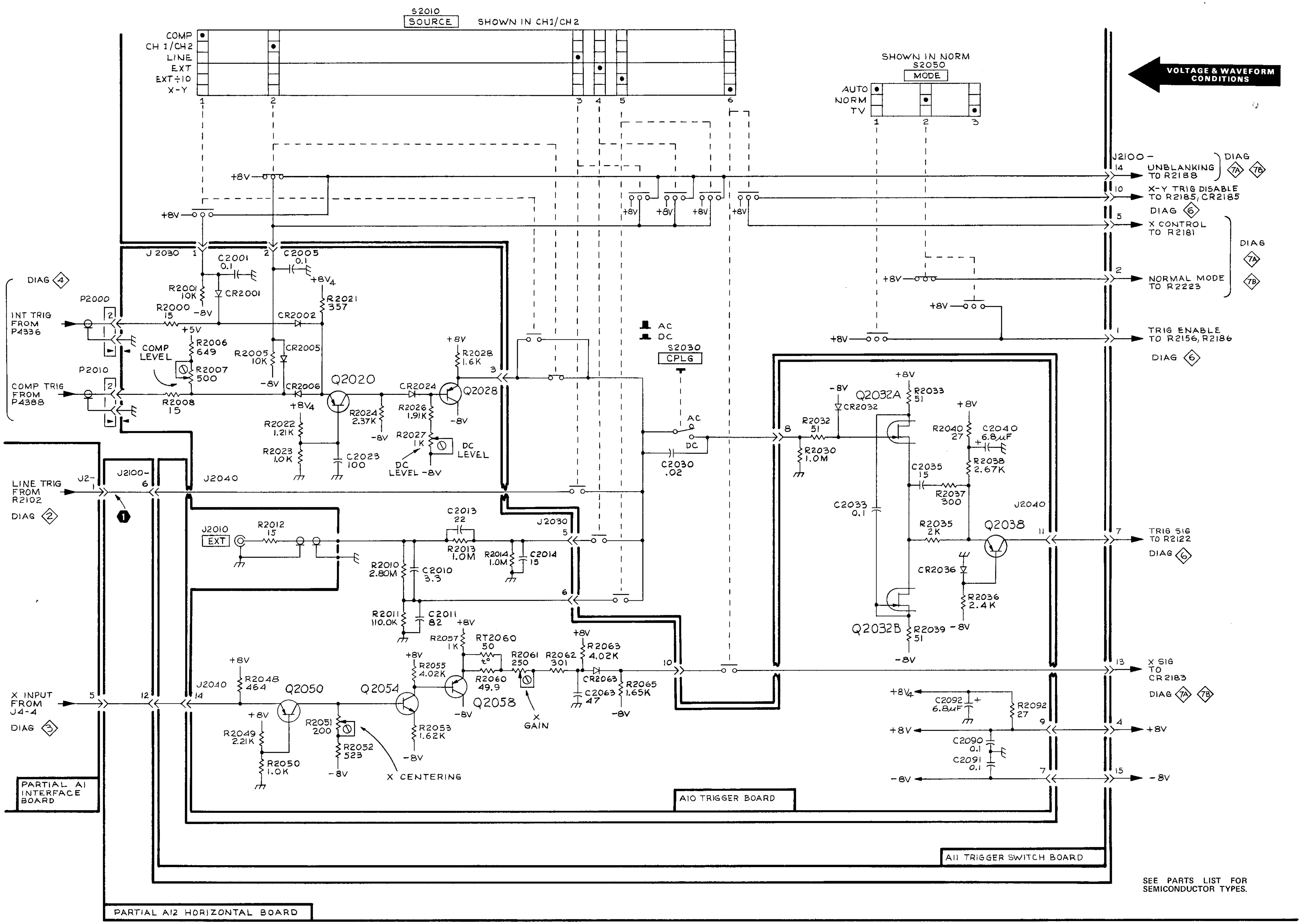
SOURCE	CH 1/CH 2
MODE	AUTO*
Vertical Mode	CH 1
CH 1 VOLTS/DIV	50 mV
CH 2 VOLTS/DIV	1 V
VAR (both)	Detent
AC-GND-DC (both)	DC
DISPLAY MODE	A
A & B SEC/DIV	10 μs
1X-10X	1X
HOLD-OFF	Fully ccw
LEVEL	For triggered display

The other controls were set as necessary to obtain the desired display.

***For waveforms 5 and 6, the MODE switch was set to TV.**

1




S2010
SOURCE
SHOWN IN CH1/CH2
COMP
CH 1/CH2
LINE
EXT
EXT÷10
X-Y
SHOWN IN NORM
S2050
MODE
AUTO
NORM
TV
VOLTAGE & WAVEFORM CONDITIONS
J2100
UNBLANKING TO R2188
DIAG 7A 7B
X-Y TRIG DISABLE TO R2185, CR2185
DIAG 6
X CONTROL TO R2181
NORMAL MODE TO R2223
DIAG 6 7A 7B
TRIG ENABLE TO R2156, R2186
DIAG 6
TRIG SIG TO R2122
DIAG 6
X SIG TO CR2183
DIAG 7A 7B
DIAG 4
INT TRIG FROM P4336
P2000
COMP TRIG FROM P4388
P2010
COMP LEVEL
J2030
J2040
AC
DC
S2030
CPLG
DC LEVEL
LINE TRIG FROM R2102
DIAG 2
J2010
EXT
X INPUT FROM J4-4
DIAG 3
X CENTERING
X GAIN
Q2020
Q2028
Q2032A
Q2032B
Q2038
Q2050
Q2054
Q2058
PARTIAL A1 INTERFACE BOARD
A10 TRIGGER BOARD
A11 TRIGGER SWITCH BOARD
PARTIAL A12 HORIZONTAL BOARD
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

TRIGGER

5

TRIGGER AMPLIFIER CIRCUIT DESCRIPTION

Digital logic devices are used to perform some of the functions in this instrument. LO and HI designations are used in this circuit description to indicate the state of the digital circuit. HI indicates the more positive of the two levels. The specific voltages that constitute a LO and HI logic state may vary between individual devices.

TRIGGER INPUT AMPLIFIER

The trigger input amplifier consists of Q2122, Q2124, Q2128, and associated circuitry. Resistors R2127 and R2128 set the amplifier input at −4 volts. The inverting configuration and feedback from the emitter of Q2128 form an inverting operational amplifier with a null point at the base of Q2122. Any current into the null point produces a voltage at the output proportional to the feedback resistor R2116.

TRIGGER LEVEL COMPARATOR

Differential amplifier Q2134-Q2136 functions as a comparator. The LEVEL control R2138 selects the point on the waveform that starts a sweep. As the trigger signal at the base of Q2134 passes through the same voltage level as the base of Q2136 (set by LEVEL control), the signal at the emitter of Q2152 passes through the threshold (about 1 volt) of Schmitt trigger U2156A-U2156B producing a logic trigger signal. The trigger signals at the collectors of Q2134 and Q2136 are of opposite polarity. This allows the SLOPE switch S2140 to invert the signals applied to the TV trigger input amplifier Q2164 and the normal trigger input amplifier Q2142, Q2144, and Q2152. When the SLOPE switch is in the +OUT position, the output at the collector of Q2142 is in phase with the trigger source signal. Transistors Q2142, Q2144 and Q2152 convert the current signal from the collectors of Q2134 or Q2136 to a voltage signal for triggering the Schmitt trigger.

TV TRIGGER CIRCUIT

Active devices Q2164, Q2174, Q2176, U2156B, C, D, and associated circuitry comprise the TV trigger circuit. When the MODE switch is in TV, R2186 is disconnected from +8 volts which allows trigger signals from the collectors of Q2134 and Q2136 to pass through the TV trigger circuit. (In AUTO and NORM, the +8 volts applied to R2186 biases Q2164 to saturation.)

Transistor Q2164 is a high gain feedback amplifier. To achieve stable triggering on TV signals, the LEVEL control must be set at a point that will allow the sync pulses to appear within the dynamic range of the amplifier.

The sync separator circuit consists of Q2174 and associated circuitry. It processes sync-positive pulses when the SLOPE switch is in the +OUT position and sync-negative pulses in the −IN position. Transistor Q2174 produces large positive-going pulses from negative-going sync signals at the collector of Q2164.

In the TV field mode (SEC/DIV switch set for .1 ms or slower), Q2176 is saturated (since base is grounded), and the integrator (composed of C2174, C2176, R2174, and R2176) is switched into the circuit (effectively connected to +8 volts through saturated Q2176). The integrator filters out the horizontal sync pulses, leaving only the integrated vertical sync pulses, which trigger the TV Schmitt trigger U2156B and U2156C.

In the TV line mode (SEC/DIV switch set for 50 μs or faster), Q2176 is turned off (base open), disconnecting C2174 and C2176 from +8 volts. Capacitors C2174 and C2176 no longer integrate the pulses, thus allowing both the horizontal and vertical sync pulses to pass through to the TV Schmitt trigger.

SCHMITT TRIGGERS

The Schmitt trigger for the NORM and AUTO triggering modes consists of U2156A, U2156B, and associated circuitry. Hysteresis of this trigger circuit is determined by R2152, R2153, and R2151.

The Schmitt trigger for the TV triggering mode is U2156B, U2156C, U2156D, and associated circuitry. Resistors R2154 and R2178 determine the sensitivity.

When the MODE switch S2150 is in AUTO or NORM, +8 volts is applied to R2156 which causes pin 1 of U2156A to go HI enabling Schmitt trigger U2156A-U2156B. At the same time, pins 12 and 13 of U2156D are also HI disabling Schmitt trigger U2156C-U2156B. A trigger signal from Q2152 triggers Schmitt trigger U2156A-U2156B to produce a logic trigger signal at pin 6 of U2156B.

When the MODE switch S2150 is in TV, +8 volts is removed from R2156 and pin 1 of U2156A is LO, disabling Schmitt trigger U2156A-U2156B. Pins 12 and 13 of U2156D are LO, enabling Schmitt trigger U2156B-U2156C. The trigger signal from the TV sync separator triggers Schmitt trigger U2156B-U2156C to produce a logic trigger signal at pin 6 of U2156B.

VII.3

VOLTAGE AND WAVEFORM CONDITIONS

VOLTAGE CONDITIONS

Voltages shown on this diagram were measured with a Tektronix DM 501 Digital Multimeter. Voltage measurements can vary as much as ±20%. No signals were applied to the vertical inputs or to the EXT (external trigger) input. Refer to Waveform Conditions for T932A or T935A control settings.

WAVEFORM CONDITIONS

Waveforms below were monitored with a Tektronix 7704A Oscilloscope, 7B71 Time Base, 7A15A Amplifier, and 10X probe. The oscilloscope input coupling was set to ac. Waveforms vary as much as ±20%.

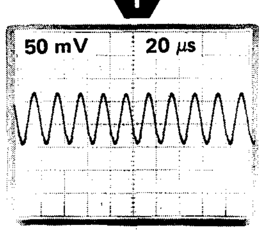
A 50 kHz, 100 mV sine wave was applied to the CH 1 input and a 50 kHz, 2 V square wave was applied to the CH 2 input. A Tektronix FG 501 Function Generator provides either of the input waveforms.

The T932A or T935A controls were set as follows:

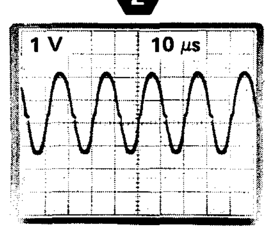
SOURCE	CH 1/CH 2
MODE	AUTO*
Vertical Mode	CH 1
CH 1 VOLTS/DIV	50 mV
CH 2 VOLTS/DIV	1 V
VAR (both)	Detent
AC-GND-DC (both)	DC
DISPLAY MODE	A
A & B SEC/DIV	10 μs
1X-10X	1X
HOLD-OFF	Fully ccw
LEVEL	For triggered display

The other controls were set as necessary to obtain the desired display.

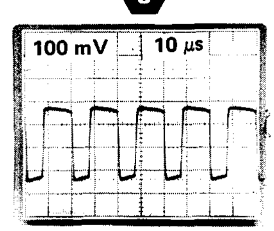
1



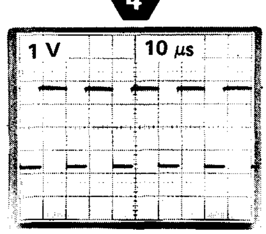
2



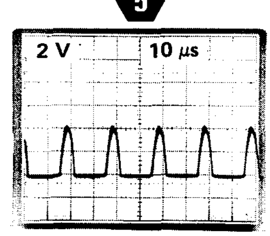
3

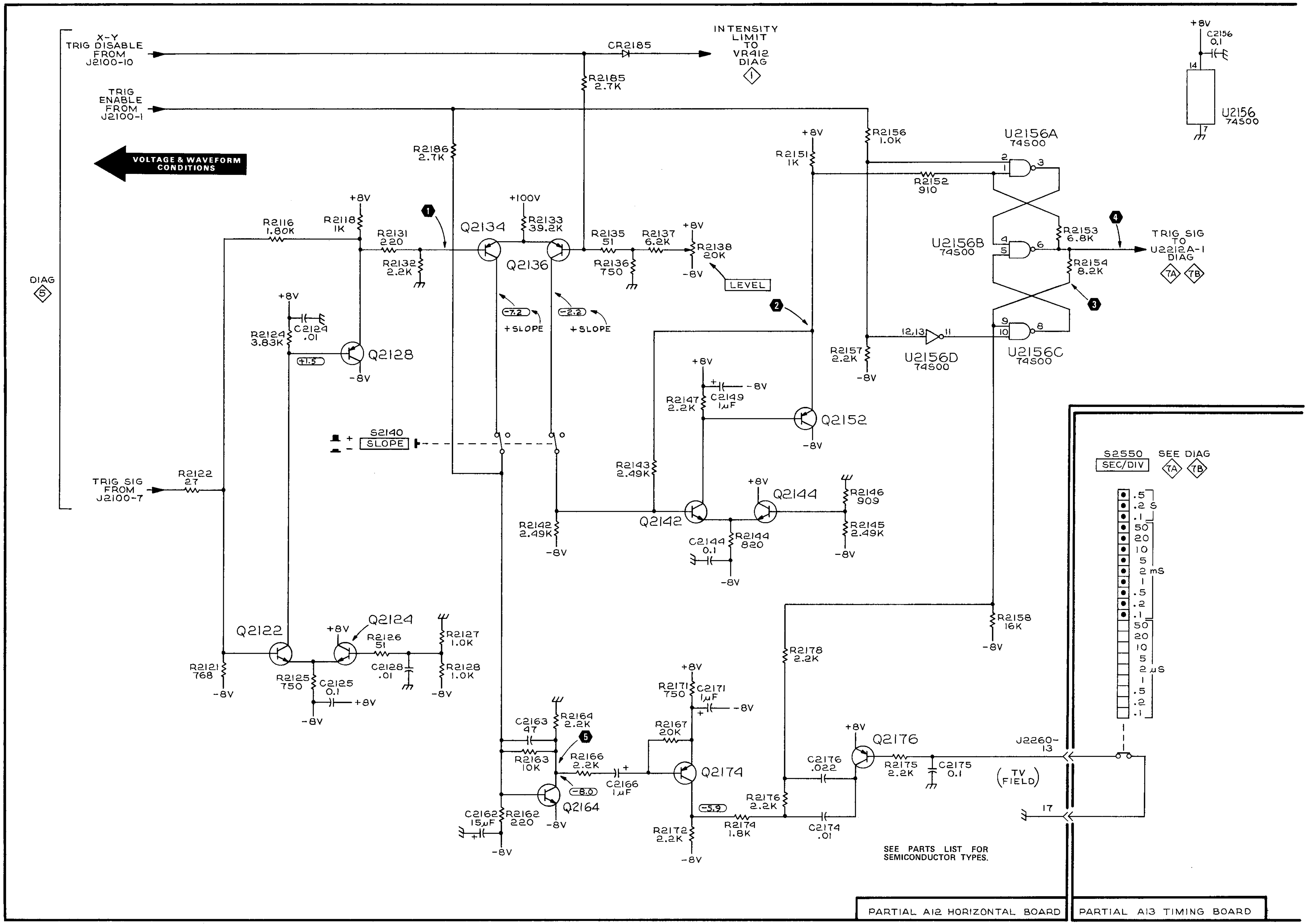


4



5





X-Y TRIG DISABLE FROM J2100-10
TRIG ENABLE FROM J2100-1
VOLTAGE & WAVEFORM CONDITIONS
INTENSITY LIMIT TO VR412 DIAG 1
TRIG SIG FROM J2100-7
DIAG 5
TRIG SIG TO U2212A-1 DIAG 7A 7B
LEVEL
S2140 SLOPE
+SLOPE
S2550 SEC/DIV
SEE DIAG 7A 7B
TV FIELD
J2260-13
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
PARTIAL A12 HORIZONTAL BOARD
PARTIAL A13 TIMING BOARD
U2156A 74S00
U2156B 74S00
U2156C 74S00
U2156D 74S00
U2156 74S00
Q2122
Q2124
Q2128
Q2134
Q2136
Q2142
Q2144
Q2152
Q2164
Q2174
Q2176

T932A SWEEP AND HORIZ AMPL CIRCUIT DESCRIPTION

Digital logic devices are used to perform some of the functions in this instrument. LO and HI designations are used in this circuit description to indicate the state of the digital circuit. HI indicates the more positive of the two levels. The specific voltages which constitute a LO and HI logic state may vary between individual devices.

Digital logic devices are used to perform some of the functions in this instrument. LO and HI designations are used in this circuit description to indicate the state of the digital circuit. HI indicates the more positive of the two levels. The specific voltages which constitute a LO and HI logic state may vary between individual devices.

SWEEP

The sweep is produced by a Miller Integrator circuit consisting of Q2242, Q2244, and Q2246. A sweep ramp is initiated at the collector of Q2246 when pin 3 of U2234A goes LO, and is terminated when pin 3 goes HI (see Timing diagram, Fig. 7-4).

In the NORM triggering mode, pin 2 of U2212A is HI allowing a positive-going trigger signal at pin 1 of U2212A to cause pin 3 of U2234A to go LO (via U2212D and U2234C). This reverse biases CR2233 and CR2234, and allows the timing capacitor (selected by the SEC/DIV switch, S2250) to charge, producing a sweep ramp at the collector of Q2246. When the sweep ramp reaches about 12 volts, Q2274 turns on. This causes pin 7 of U2224A to go LO, pin 8 of U2234C to go LO, and pin 3 of U2234A to go HI. When pin 3 of U2234A goes HI, CR2233 and CR2234 are forward biased, terminating the sweep. Pin 7 of U2224A remains LO for a length of time (hold-off time) determined by C2275, C2274, R2271, R2274, and the HOLD-OFF control, R2272. Three hold-off times are selected by the SEC/DIV switch S2250 and varied by R2272. After the selected hold-off time, U2224A pin 7 goes HI. This allows the next trigger signal to switch pin 3 of U2234A LO and again start the sweep.

In the AUTO triggering mode, when no trigger signal occurs at pin 11 of U2224B for about 50 ms, pin 10 of U2224B goes LO, causing the sweep to start after the hold-off time ends. This allows the sweep to free run and provide a reference display. When a trigger signal is present, pin 11 of U2224B goes HI, then LO (when trigger signal ends), and the time constant of C2226 and R2226 prevents pin 10 from going LO as long as the repetition rate of the trigger signal is higher than about 20 Hz.

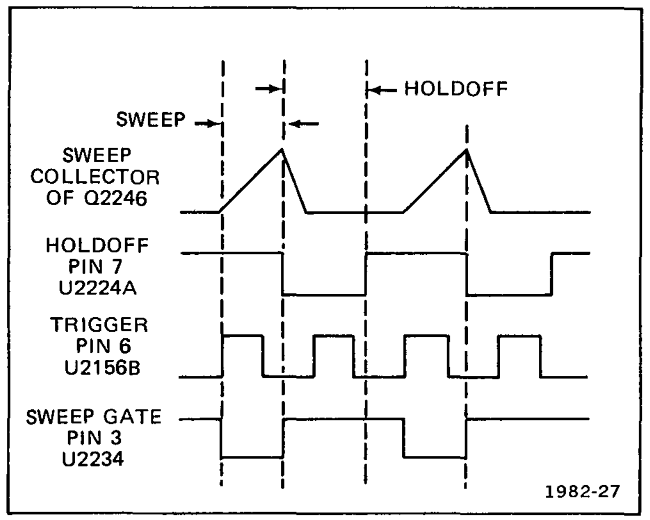


Fig. 7-4. Timing diagram: sweep generator and gate.

When pin 3 of U2234A goes HI, the current set by R2236, R2235, and R2237 is sent to the Z Axis Amplifier Q416 (see diagram 1) to blank the crt during hold-off.

HORIZONTAL AMPLIFIER

The horizontal amplifier converts the single-ended signal to a push-pull signal, which drives the crt horizontal deflection plates. The input of the horizontal amplifier comes from either the sweep generator or the CH 1 vertical "X" pickoff. In the X-Y mode, the trace is shifted to the center of the screen by the current through R2182. In the AUTO and NORM modes, the input to the horizontal amplifier is a linear ramp from the sweep generator.

Transistors, Q2314, Q2326, and associated circuitry, form an operational amplifier with a variable gain range of over 10 to 1. The gain is set by feedback elements R2312, R2323, and X1-X10 control, R2322. The horizontal POSITION control, R2316, positions the crt display horizontally by varying the current into the base of Q2314. The cascode configuration of Q2314 and Q2326 improves the high frequency response.

When the BEAM FINDER switch, section S100B, is pressed, the dynamic range of Q2326 is decreased. This limits the horizontal deflection to the crt screen area. The BEAM FINDER switch (section S100A) also limits the vertical deflection to the crt screen area.

Transistors Q2332, Q2334. Q2344, and associated circuitry form a paraphase amplifier. Transistor Q2332 is a low-impedance input for Q2334. Horiz Cal adjustment R2332, sets the gain of the paraphase amplifier. When the current through the collector of Q2334 increases, the current through the collector of Q2344 decreases and is 180° out of phase with the current at the collector of Q2334. The resulting signal to the crt deflection plates is a push-pull signal. Diode CR2334 prevents Q2334 from saturating when R2322 is in the X10 position.

Since Q2334 is a shunt feedback amplifier and Q2344 is a common base amplifier, any noise in the 100 V power supply will appear as a part of the output. To prevent the noise from appearing on the crt screen, an operational amplifier, consisting of Q2354 and associated circuitry, supplies an inverted sample of the power supply noise to the output. Now, any noise in the 100 volt power supply appears common mode to the horizontal deflection plates, preventing horizontal deflection of the noise signal. Resistor R2354 provides feedback for the operational amplifier.

VIII.3

VOLTAGE AND WAVEFORM CONDITIONS

VOLTAGE CONDITIONS

Voltages shown on this diagram were measured with a Tektronix DM 501 Digital Multimeter. Voltage measurements can vary as much as ±20%. No signals were applied to the vertical inputs or to the EXT (external trigger) input. Refer to Waveform Conditions for T932A or T935A control settings.

WAVEFORM CONDITIONS

Waveforms below were monitored with a Tektronix 7704A Oscilloscope, 7B71 Time Base, 7A15A Amplifier, and 10X probe. The oscilloscope input coupling was set to ac. Waveforms vary as much as ±20%.

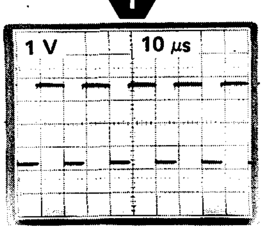
A 50 kHz, 100 mV sine wave was applied to the CH 1 input and a 50 kHz, 2 V square wave was applied to the CH 2 input. A Tektronix FG 501 Function Generator provides either of the input waveforms.

The T932A controls were set as follows:

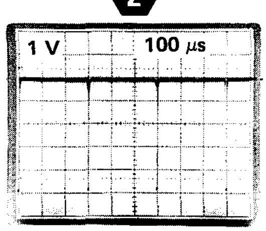
SOURCE	CH 1/CH 2
MODE	AUTO
Vertical Mode	CH 1
CH 1 VOLTS/DIV	50 mV
CH 2 VOLTS/DIV	1 V
VAR (both)	Detent
AC-GND-DC (both)	DC
DISPLAY MODE	A
A & B SEC/DIV	10 µs
1X-10X	1X
HOLD-OFF	Fully ccw
LEVEL	For triggered display

The other controls were set as necessary to obtain the desired display.

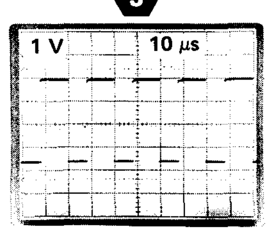
1



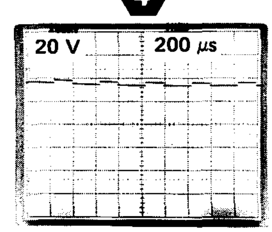
2



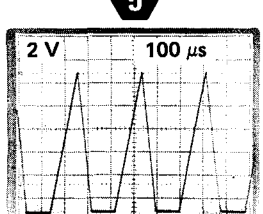
3



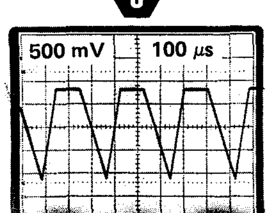
4



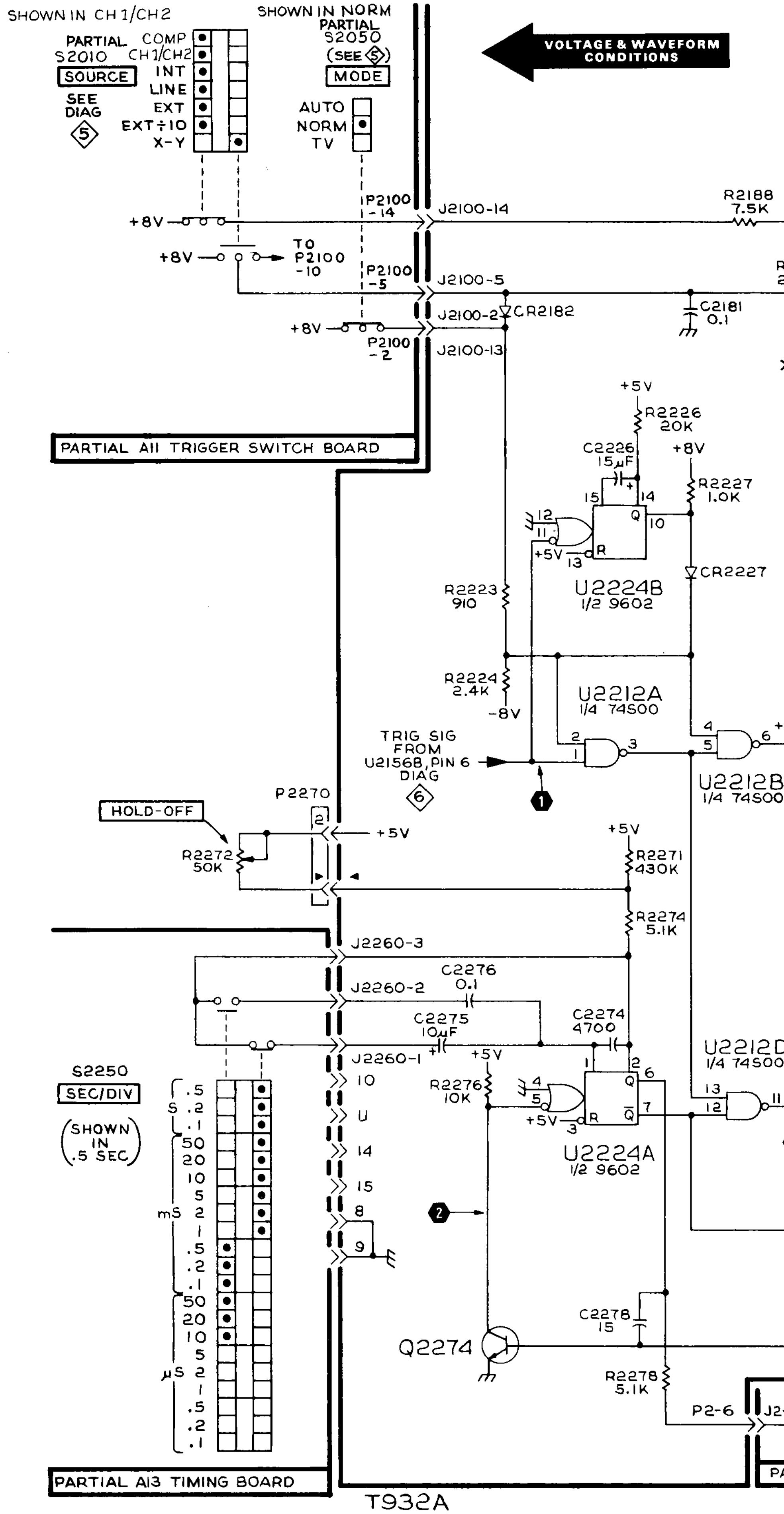
5

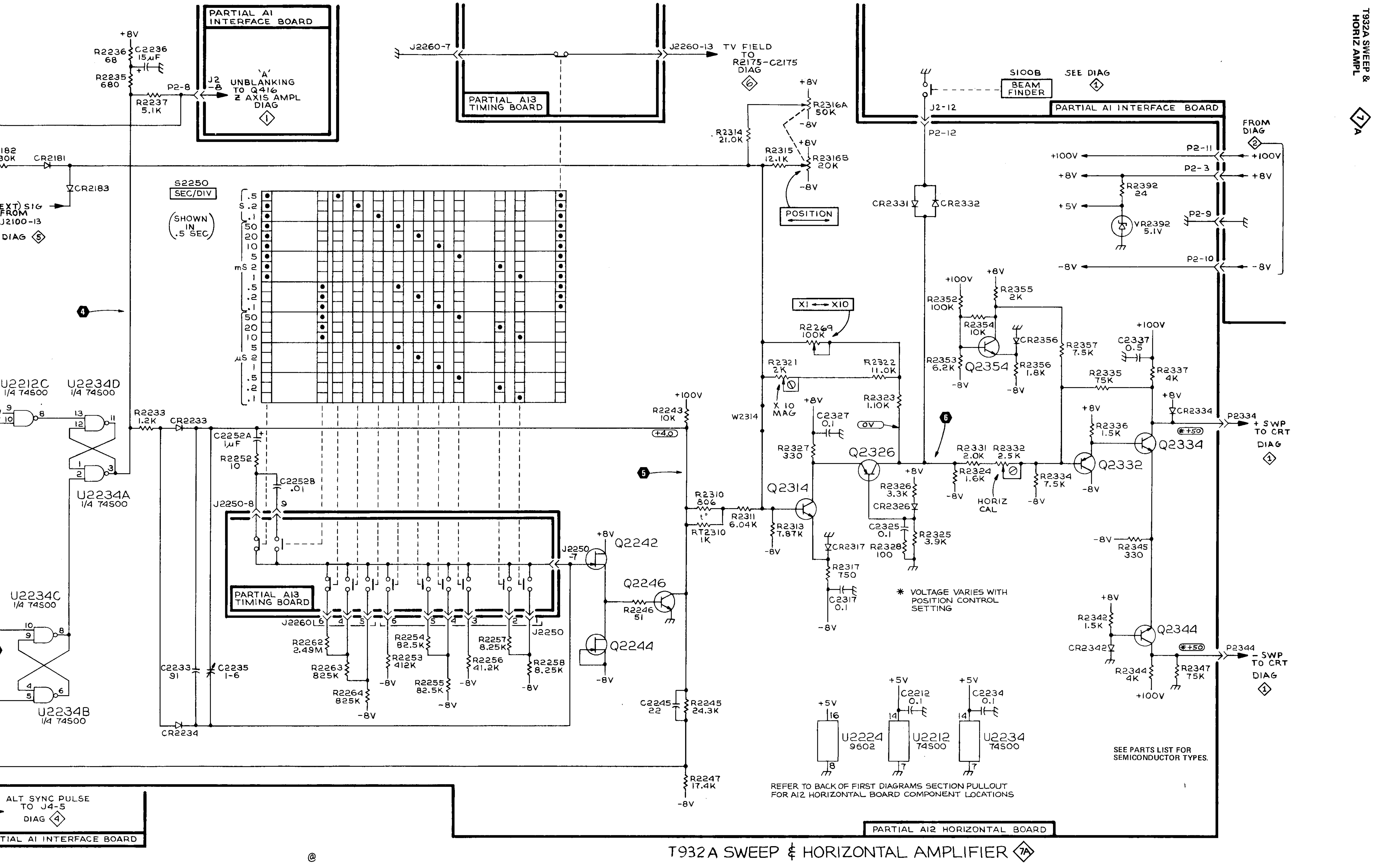


6



Scan by Zenith





T932A SWEEP & HORIZONTAL AMPLIFIER 7A

T935A A SWEEP AND HORIZ AMPL CIRCUIT DESCRIPTION

A SWEEP GENERATOR

Digital logic devices are used to perform some of t functions in this instrument. LO and HI designations a used in this circuit description to indicate the state of t digital circuit. HI indicates the more positive of the t levels. The specific voltages which constitute a LO and logic state may vary between individual devices.

The A sweep is produced by a Miller Integrator circuit consisting of Q2242, Q2244, and Q2246. A sweep ramp is initiated at the collector of Q2246 when pin 3 of U2234A goes LO, and is terminated when pin 3 goes HI (see Timing diagram, Fig. 7-5).

In the NORM triggering mode, pin 2 of U2212A is HI allowing a positive-going trigger signal at pin 1 of U2212A to cause pin 3 of U2234A to go LO (via U2212D and U2234C). This reverse biases CR2233 and CR2234, and allows the timing capacitor (selected by the A SEC/DIV switch, S2250A) to charge, producing a sweep ramp at the collector of Q2246. When the sweep ramp reaches about 12 volts, Q2274 turns on. This causes pin 7 of U2224A to go LO, pin 8 of U2234C to go LO, and pin 3 of U2234A to go HI. When pin 3 of U2234A goes HI, CR2233 and CR2234 are forward biased, terminating the sweep. Pin 7 of U2224A remains LO for a length of time (hold-off time) determined by C2275, C2274, R2271, R2274, and the HOLD-OFF control, R2272. Three hold-off times are selected by the SEC/DIV switch S2250A and varied by R2272. After the selected hold-off time, U2224A pin 7 goes HI. This allows the next trigger signal to switch pin 3 of U2234A LO and again start the sweep.

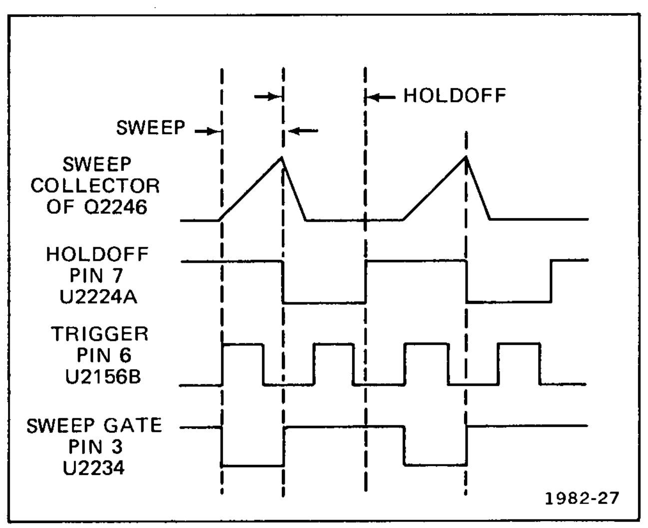


Fig. 7-5. Timing diagram: sweep generator and gate.

In the AUTO triggering mode, when no trigger signal occurs at pin 11 of U2224B for about 50 ms, pin 10 of U2224B goes LO, causing the sweep to start after the hold-off time ends. This allows the sweep to free run and provide a reference display. When a trigger signal is present, pin 11 of U2224B goes HI, then LO (when trigger signal ends), and the time constant of C2226 and R2226 prevents pin 10 from going LO as long as the repetition rate of the trigger signal is higher than about 20 Hz.

When the DISPLAY MODE switch S2510 (see diagram 7) is in the A or B modes, a signal is applied to Q416 in the Z Axis amplifier (see diagram 1) to blank the crt during hold-off time and unblank the crt during sweep time. In the A mode, when pin 3 of U2234A goes HI, R2236, R2235, and R2237 convert the voltage to a current for blanking and unblanking. Refer to T935A B Sweep circuit description for blanking and unblanking operation when S2510 is in B or A INTEN BY B modes.

HORIZONTAL AMPLIFIER

The horizontal amplifier converts the single-ended signal to a push-pull signal, which drives the crt horizontal deflection plates. The input of the horizontal amplifier comes from either the sweep generator or the CH 1 vertical "X" pickoff. In the X-Y mode, the trace is shifted to the center of the screen by the current through R2182. In the AUTO and NORM modes, the input to the horizontal amplifier is a linear ramp from the sweep generator.

Transistors, Q2314, Q2326, and associated circuitry, form an operational amplifier with a variable gain range of over 10 to 1. The gain is set by feedback elements R2312, R2323, and X1-X10 control, R2322. The horizontal POSITION control, R2316, positions the crt display horizontally by varying the current into the base of Q2314. The cascode configuration of Q2314 and Q2326 improves the high frequency response.

When the BEAM FINDER switch, section S100B, is pressed, the dynamic range of Q2326 is decreased. This limits the horizontal deflection to the crt screen area. The BEAM FINDER switch (section S100A) also limits the vertical deflection to the crt screen area.

Transistors Q2332, Q2334, Q2344, and associated circuitry form a paraphase amplifier. Transistor Q2332 is a low-impedance input for Q2334. Horiz Cal adjustment R2332, sets the gain of the paraphase amplifier. When the current through the collector of Q2334 increases, the current through the collector of Q2344 decreases and is 180° out of phase with the current at the collector of Q2334. The resulting signal to the crt deflection plates is a push-pull signal. Diode CR2334 prevents Q2334 from saturating when R2322 is in the X10 position.

Since Q2334 is a shunt feedback amplifier and Q2344 is a common base amplifier, any noise in the 100 V power supply will appear as a part of the output. To prevent the noise from appearing on the crt screen, an operational amplifier, consisting of Q2354 and associated circuitry, supplies an inverted sample of the power supply noise to the output. Now, any noise in the 100 volt power supply appears common mode to the horizontal deflection plates, preventing horizontal deflection of the noise signal. Resistor R2354 provides feedback for the operational amplifier.

IX.3

VOLTAGE AND WAVEFORM CONDITIONS

VOLTAGE CONDITIONS

Voltages shown on this diagram were measured with a Tektronix DM 501 Digital Multimeter. Voltage measurements can vary as much as ±20%. No signals were applied to the vertical inputs or to the EXT (external trigger) input. Refer to Waveform Conditions for T935A control settings.

WAVEFORM CONDITIONS

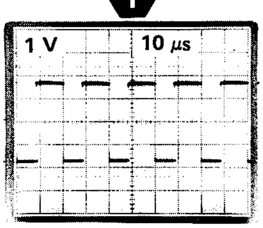
Waveforms below were monitored with a Tektronix 7704A Oscilloscope, 7B71 Time Base, 7A15A Amplifier, and 10X probe. The oscilloscope input coupling was set to ac. Waveforms vary as much as ±20%.

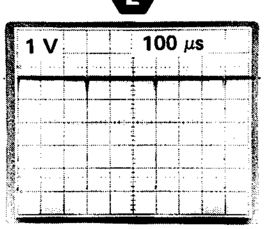
A 50 kHz, 100 mV sine wave was applied to the CH 1 input and a 50 kHz, 2 V square wave was applied to the CH 2 input. A Tektronix FG 501 Function Generator provides either of the input waveforms.

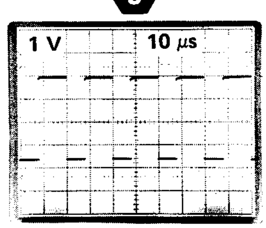
The T932A or T935A controls were set as follows:

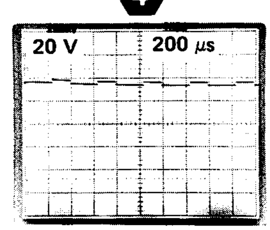
SOURCE	CH 1/CH 2
MODE	AUTO
Vertical Mode	CH 1
CH 1 VOLTS/DIV	50 mV
CH 2 VOLTS/DIV	1 V
VAR (both)	Detent
AC-GND-DC (both)	DC
DISPLAY MODE	B
A & B SEC/DIV	10 µs
1X-10X	1X
HOLD-OFF	Fully ccw
DELAY TIME POSITION	Midrange
LEVEL	For triggered display

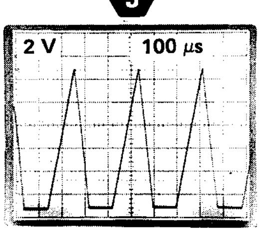
The other controls were set as necessary to obtain the desired display.

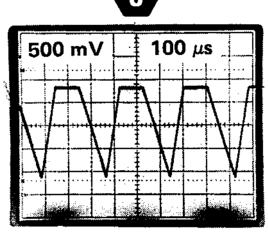
1


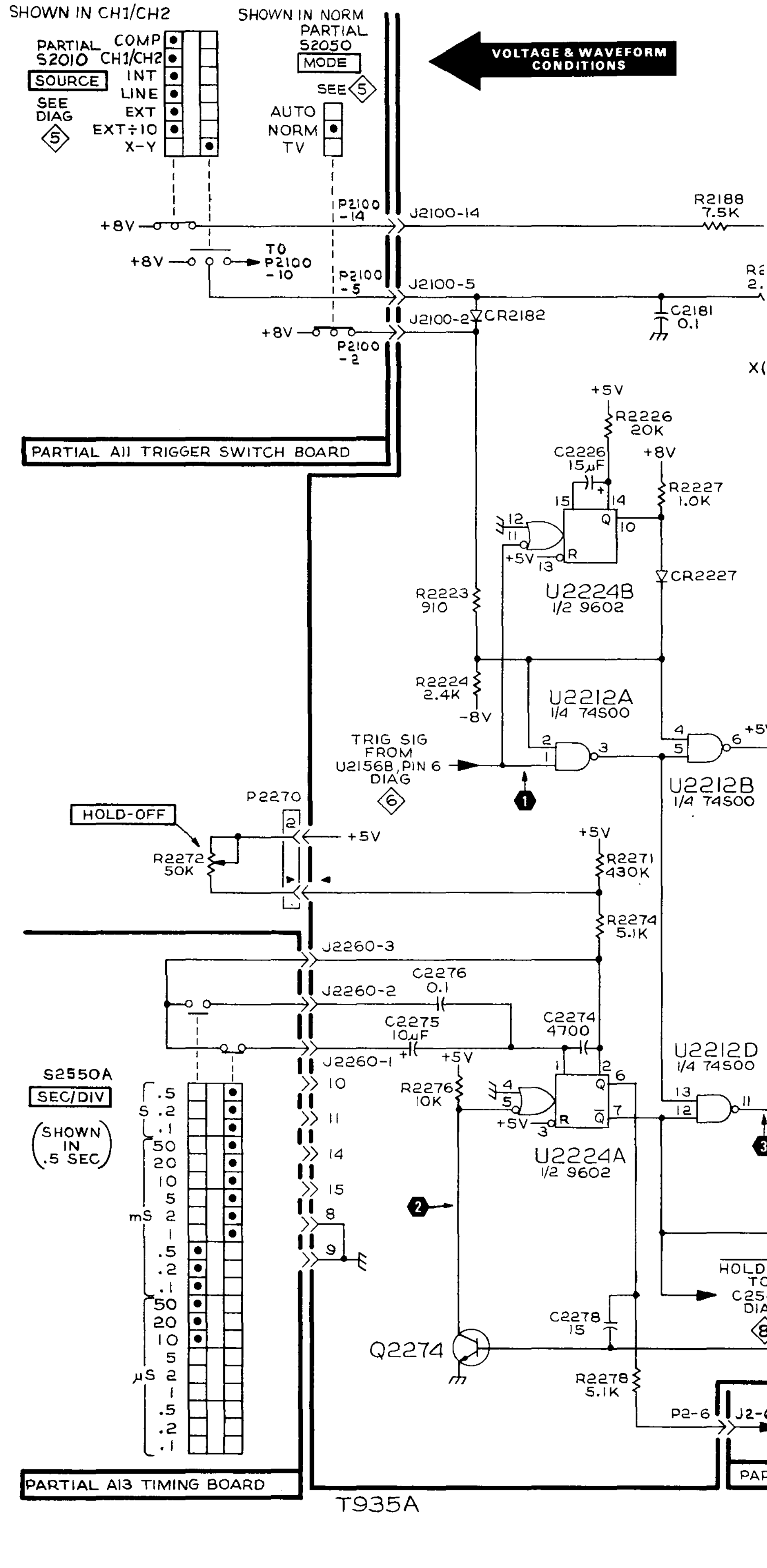
2


3


4


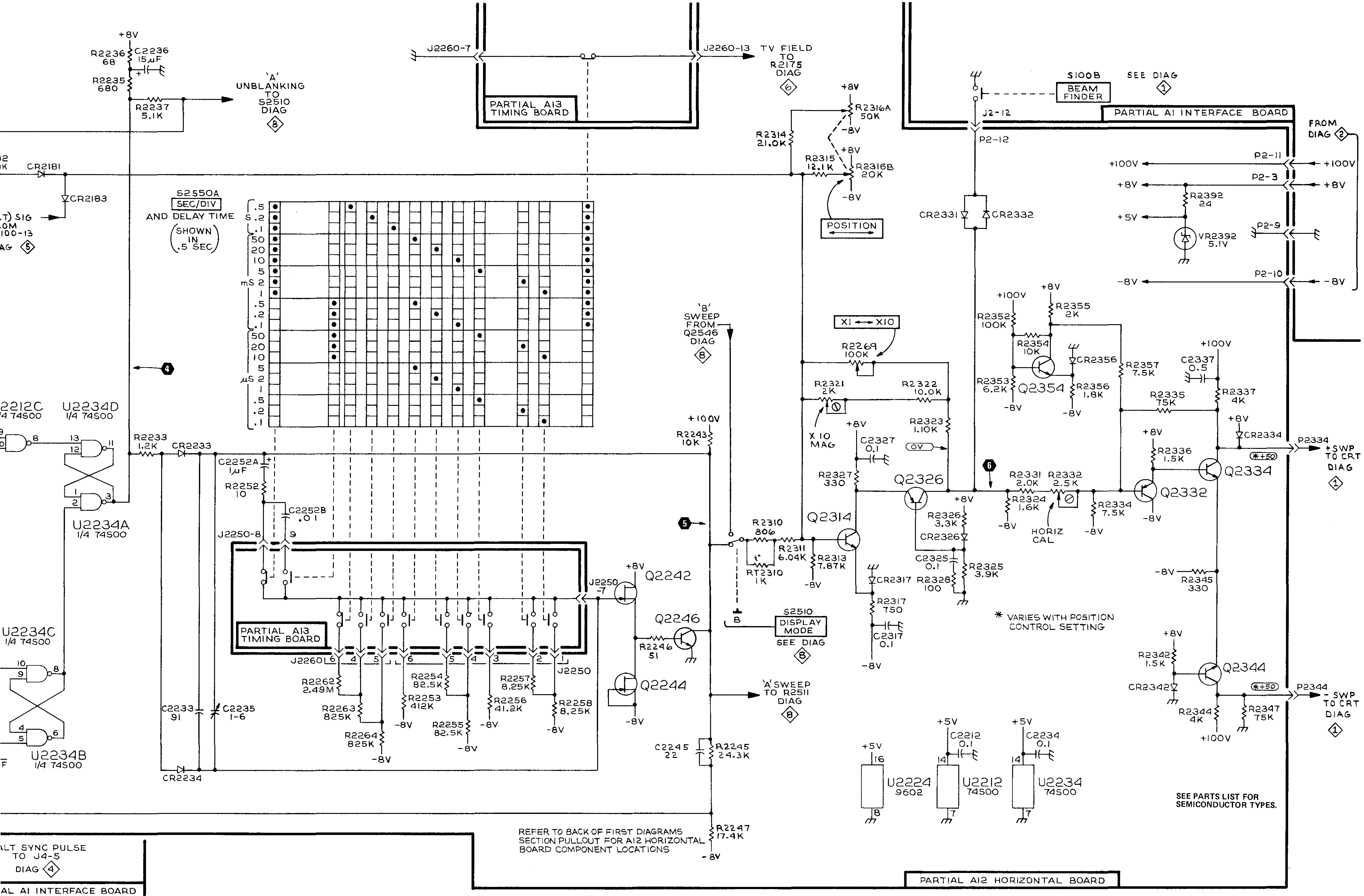
5


6




SHOWN IN CH1/CH2
PARTIAL S2010
SOURCE
SEE DIAG 5
COMP
CH1/CH2
INT
LINE
EXT
EXT÷10
X-Y
SHOWN IN NORM
PARTIAL S2050
MODE
SEE 5
AUTO
NORM
TV
VOLTAGE & WAVEFORM CONDITIONS
+8V
P2100 -14
J2100-14
R2188 7.5K
TO P2100 -10
P2100 -5
J2100-5
J2100-2
CR2182
C2181 0.1
P2100 -2
PARTIAL A11 TRIGGER SWITCH BOARD
+5V
R2226 20K
C2226 15µF
R2227 1.0K
CR2227
U2224B 1/2 9602
R2223 910
R2224 2.4K
-8V
U2212A 1/4 74S00
TRIG SIG FROM U2156B, PIN 6 DIAG 6
U2212B 1/4 74S00
HOLD-OFF
P2270
R2272 50K
R2271 430K
R2274 5.1K
J2260-3
J2260-2
C2276 0.1
C2275 10µF
C2274 4700
J2260-1
R2276 10K
U2212D 1/4 74S00
U2224A 1/2 9602
S2550A
SEC/DIV
(SHOWN IN .5 SEC)
S
mS
µS
HOLD
C2278 15
Q2274
R2278 5.1K
P2-6
PARTIAL A13 TIMING BOARD

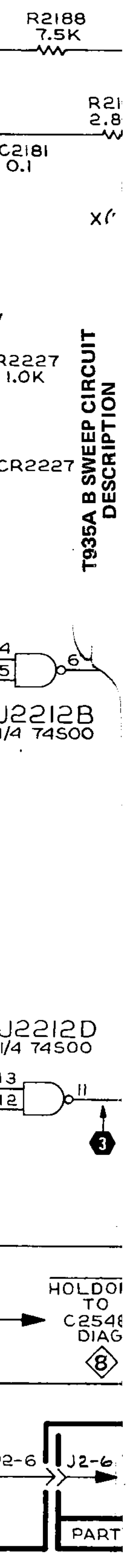
T935A



@

T935A A SWEEP & HORIZONTAL AMPLIFIER 7B

T935A A SWEEP & HORIZ AMPL 7B



T935A B SWEEP CIRCUIT DESCRIPTION

T935A B SWEEP CIRCUIT DESCRIPTION

Digital logic devices are used to perform some of the functions in this instrument. LO and HI designations are used in this circuit description to indicate the state of the digital circuit. HI indicates the more positive of the two levels. The specific voltages which constitute a LO and HI logic state may vary between individual devices.

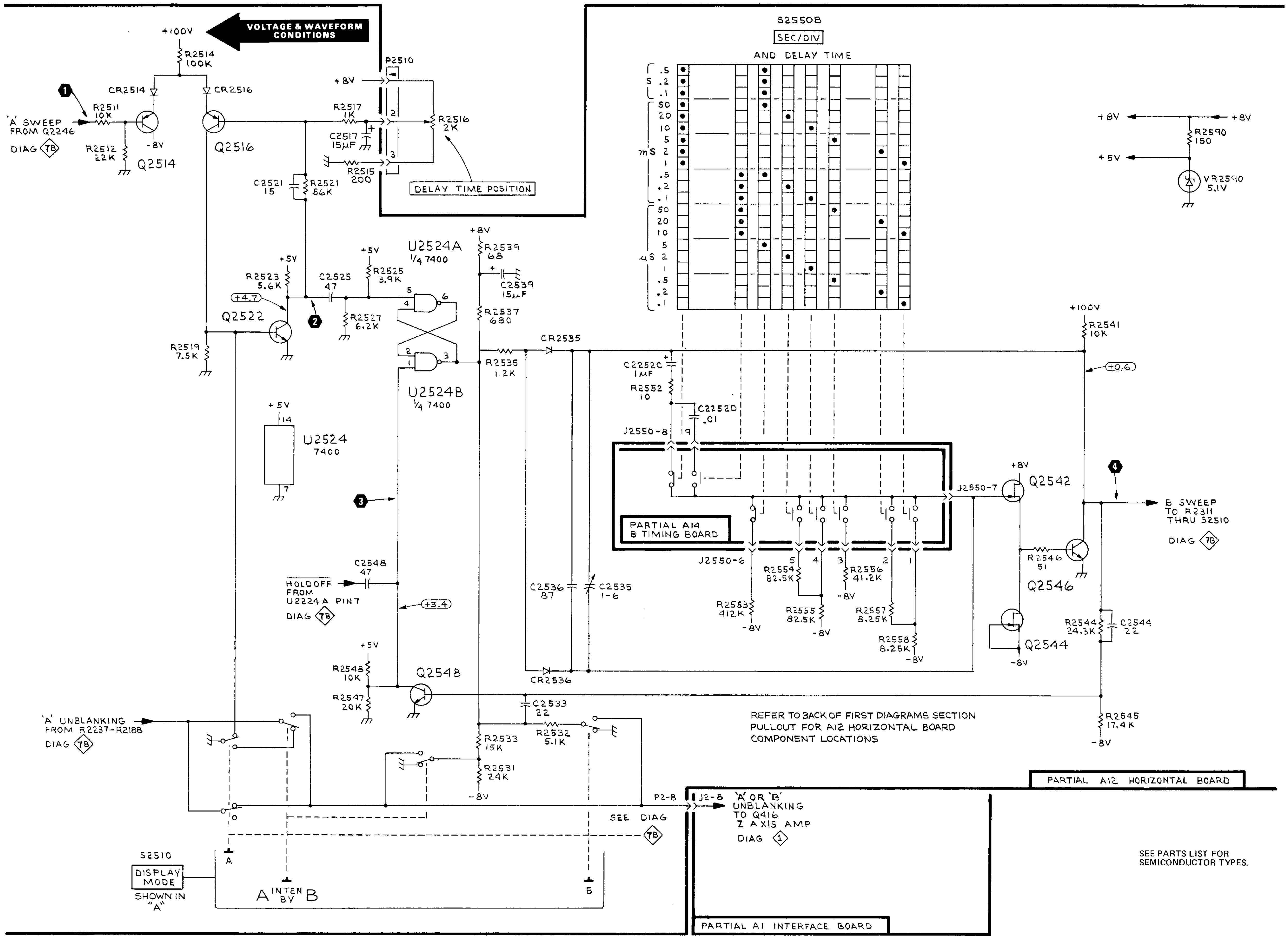
The DISPLAY MODE switch S2510 selects A, B, or A INTEN BY B. In the A position, the B sweep is disconnected from the Horizontal Output Amplifier. In the B position, the A sweep is disconnected from the Horizontal Output Amplifier and the B sweep starts after the delay. In the A INTEN BY B position, the A sweep is connected to the Horizontal Output Amplifier. In this mode, the A sweep starts and then after the delay, the B sweep runs and intensifies a portion of the A sweep.

With the B mode selected, when pin 3 of U2524B goes HI, R2539, R2537, and R2532 convert the voltage at pin 3 to a current signal. This signal is applied to Q416 in the Z-Axis amplifier (see diagram 1) to blank the crt during hold-off and unblank the crt during B sweep time. With S2510 in the A INTEN BY B mode, R2539, R2537, R2533 and R2531 provide the B sweep current source for Q416. This current signal is combined with the A sweep blanking and unblanking current signal from R2237 (see diagram 6B), allowing the A sweep to be intensified by the B sweep.

A Miller Integrator circuit consisting of Q2542, Q2544, Q2546, and associated circuitry, produces B sweep. The sweep ramp is initiated at the collector of Q2546 when pin 3 of U2524B goes LO, and is terminated when pin 3 of U2524B goes HI.

When pin 3 of U2524B goes LO, CR2535 and CR2536 are reverse biased. This allows the timing capacitor (selected by the B SEC/DIV switch S2550B) to charge, producing a sweep ramp at the collector of Q2546. When the sweep ramp reaches about 12 V, Q2548 turns on, causing pin 3 of U2524B to go HI. The HI at pin 3 of U2524B forward biases CR2535 and CR2536, ending the B sweep. If the A sweep ends before Q2548 turns on (before the B sweep ends), the Hold-off signal from pin 7 of U2224A causes pin 1 of U2524B to go LO. This in turn, causes pin 3 of U2524B to go HI, ending the B sweep. Pin 3 of U2524B will remain HI until pin 5 of U2524A goes LO again.

Transistors Q2514 and Q2516 make up a voltage comparator. The DELAY TIME POSITION control, R2516, sets the voltage at the base of Q2516. Initially, Q2514 is turned on, and Q2516 and Q2522 are turned off. The A sweep ramp from the collector of Q2246 increases the voltage at the base of Q2514. When the base of Q2514 is at the same voltage as the base of Q2516, Q2514 turns off, and Q2516 and Q2522 turn on. Components C2521 and R2521 provide feedback for a fast switch of Q2522, causing a sharp negative pulse through C2525. This pulse produces a LO at pin 5 of U2524A. The LO at pin 5 of U2524A produces a LO at pin 3 of U2524B which starts the B sweep. CR2514 and CR2516 are protection diodes. When S2510 is in the A position, the base of Q2522 is grounded, preventing the B sweep from starting.


VOLTAGE & WAVEFORM CONDITIONS
+100V
R2514 100K
CR2514
CR2516
R2511 10K
'A' SWEEP FROM Q2246
DIAG 7B
R2512 22K
-8V
Q2514
Q2516
P2510
+8V
R2517 1K
C2517 15µF
R2515 200
R2516 2K
DELAY TIME POSITION
C2521 15
R2521 56K
S2550B
SEC/DIV
AND DELAY TIME
S
mS
µS
+8V
R2590 150
+5V
VR2590 5.1V
+5V
R2523 5.6K
+4.7
C2525 47
R2525 3.9K
U2524A 1/4 7400
R2527 6.2K
Q2522
R2519 7.5K
R2539 68
C2539 15µF
R2537 680
U2524B 1/4 7400
R2535 1.2K
CR2535
C2252C 1µF
R2552 10
C2252D .01
J2550-8
+100V
R2541 10K
+0.6
U2524 7400
PARTIAL A14 B TIMING BOARD
J2550-7
Q2542
B SWEEP TO R2311 THRU S2510
DIAG 7B
J2550-6
R2554 82.5K
R2556 41.2K
R2546 51
Q2546
C2548 47
HOLDOFF FROM U2224A PIN7
DIAG 7B
+3.4
C2536 87
C2535 1-6
R2553 412K
R2555 82.5K
R2557 8.25K
R2558 8.25K
R2544 24.3K
C2544 22
Q2544
CR2536
R2548 10K
R2547 20K
Q2548
C2533 22
R2532 5.1K
R2533 15K
R2531 24K
'A' UNBLANKING FROM R2237-R2188
DIAG 7B
REFER TO BACK OF FIRST DIAGRAMS SECTION PULLOUT FOR A12 HORIZONTAL BOARD COMPONENT LOCATIONS
R2545 17.4K
PARTIAL A12 HORIZONTAL BOARD
P2-8
J2-8
'A' OR 'B' UNBLANKING TO Q416 Z AXIS AMP
DIAG 1
SEE DIAG 7B
S2510
DISPLAY MODE
SHOWN IN "A"
A
INTEN BY
B
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
PARTIAL A1 INTERFACE BOARD

VOLTAGE AND WAVEFORM CONDITIONS

VOLTAGE CONDITIONS

Voltages shown on this diagram were measured with a Tektronix DM 501 Digital Multimeter. Voltage measurements can vary as much as ±20%. No signals were applied to the vertical inputs or to the EXT (external trigger) input. Refer to Waveform Conditions for T935A control settings.

WAVEFORM CONDITIONS

Waveforms below were monitored with a Tektronix 7704A Oscilloscope, 7B71 Time Base, 7A15A Amplifier, and 10X probe. The oscilloscope input coupling was set to ac. Waveforms vary as much as ±20%.

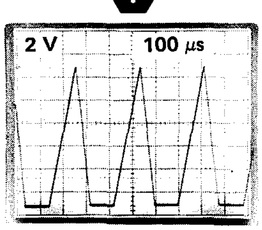
A 50 kHz, 100 mV sine wave was applied to the CH 1 input and a 50 kHz, 2 V square wave was applied to the CH 2 input. A Tektronix FG 501 Function Generator provides either of the input waveforms.

The T935A controls were set as follows:

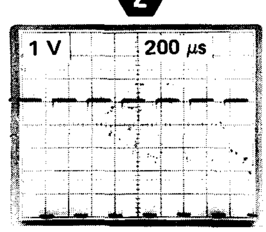
SOURCE	CH 1/CH 2
MODE	AUTO
Vertical Mode	CH 1
CH 1 VOLTS/DIV	50 mV
CH 2 VOLTS/DIV	1 V
VAR (both)	Detent
AC-GND-DC (both)	DC
DISPLAY MODE	A
A & B SEC/DIV	10 'µs
1X-10X	1X
HOLD-OFF	Fully ccw
LEVEL	For triggered display

The other controls were set as necessary to obtain the desired display.

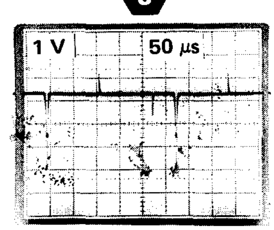
1



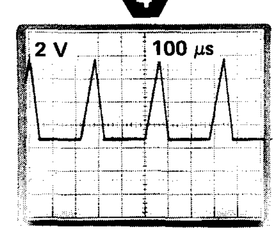
2



3



4



REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

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

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

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

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

SPECIAL NOTES AND SYMBOLS

X000 Part first added at this serial number

00X Part removed after this serial number

FIGURE AND INDEX NUMBERS

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

INDENTATION SYSTEM

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

1 2 3 4 5 Name & Description

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

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

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

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

ABBREVIATIONS

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

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
05091	TRI-ORDINATE CORPORATION	343 SNYDER AVENUE	BERKELEY HEIGHTS, NJ 07922
11897	PLASTIGLIDE MFG. CORPORATION	P O BOX 867, 1757 STANFORD ST.	SANTA MONICA, CA 90406
12327	FREEWAY CORPORATION	9301 ALLEN DRIVE	CLEVELAND, OH 44125
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
27264	MOLEX PRODUCTS CO.	5224 KATRINE AVE.	DOWNERS GROVE, IL 60515
28520	HEYMAN MFG. CO.	147 N. MICHIGAN AVE.	KENILWORTH, NJ 07033
55210	GETTIG ENG. AND MFG. COMPANY	PO BOX 85, OFF ROUTE 45	SPRING MILLS, PA 16875
59730	THOMAS AND BETTS COMPANY	36 BUTLER ST.	ELIZABETH, NJ 07207
70485	ATLANTIC INDIA RUBBER WORKS, INC.	571 W. POLK ST.	CHICAGO, IL 60607
71279	CAMBRIDGE THERMIONIC CORP.	445 CONCORD AVE.	CAMBRIDGE, MA 02138
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501
72228	CONTINENTAL SCREW CO., DIV. OF AMTEL, INC.	459 MT. PLEASANT	NEW BEDFORD, MA 02742
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
74445	HOLO-KROME CO.	31 BROOK ST. WEST	HARTFORD, CT 06110
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
88245	LITTON SYSTEMS, INC., USECO DIV.	13536 SATICOY ST.	VAN NUYS, CA 91409
95987	WECKESSER CO., INC.	4444 WEST IRVING PARK RD.	CHICAGO, IL 60641
98978	INTERNATIONAL ELECTRONIC RESEARCH CORP.	135 W. MAGNOLIA BLVD.	BURBANK, CA 91502
99742	PERMACEL DIV. OF JOHNSON AND JOHNSON	U. S. HIGHWAY 1	NEW BRUNSWICK, NJ 08901

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-1	348-0443-00			1	STAND,ELEC EQPT:0.156 DIA,SST,PSVT,0.5 HARD	80009	348-0443-00
-2	437-0200-01			1	CABINET,SCOPE:LEFT & RIGHT	80009	437-0200-01
					(ATTACHING PARTS)		
-3	211-0648-00			6	SCR ASSEM WSHR:6-32 X 0.625 INCH,PNH,STL	80009	211-0648-00
-4	210-0408-00			6	NUT,PLAIN,HEX.:6-32 X 0.312 INCH,BRS	73743	3040-402
					- - - * - - -		
	----- -----			-	. CABINET ASSY INCLUDES:		
-5	348-0441-00			4	. FOOT,CABINET:POLYURETHANE,BLACK	80009	348-0441-00
-6	348-0447-01			2	. FOOT,CABINET:LEFT FRONT,RIGHT REAR	80009	348-0447-01
	348-0447-00			2	. FOOT,CABINET:RIGHT FRONT,LEFT REAR	80009	348-0447-00
					(ATTACHING PARTS FOR EACH)		
-7	213-0731-00			1	. SCR,TPG,THD FOR:6-19 X 0.5 INCCH,PNH STL	72228	OBD
					- - - * - - -		
-8	334-2682-00			2	. PLATE,IDENT:MARKED TEKTRONIX	80009	334-2682-00
-9	334-2624-00			1	. PLATE,IDENT:MARKED DC BALANCE CH1,CH2	80009	334-2624-00
-10	337-2185-00			1	SHLD,IMPLOSION:	80009	337-2185-00
-11	384-1371-01			1	EXTENSION SHAFT:5.2" LONG W/KNOB	80009	384-1371-01
-12	384-1371-03			1	EXTENSION SHAFT:10.7" LONG W/KNOB	80009	384-1371-03
-13	366-1559-00			1	PUSH BUTTON:GRAY	80009	366-1559-00
-14	366-1559-03			1	PUSH BUTTON:SILVER GRAY,OFF	80009	366-1559-03
-15	426-1072-00			2	FRAME,PUSH BTN:PLASTIC	80009	426-1072-00
-16	358-0550-00			2	BUSHING,SHAFT:0.15 ID X 0.3INCH OD,PLSTC	80009	358-0550-00
-17	333-2421-00			1	PANEL,FRONT:	80009	333-2421-00
-18	352-0477-00			1	HOLDER,LED:	80009	352-0477-00
-19	136-0387-01			1	JACK,TIP:BLACK	71279	450-4352-01-0310
-21	386-3900-00			1	SUBPANEL,FRONT:CRT	80009	386-3900-00
					(ATTACHING PARTS)		
-21	213-0146-00			1	SCR,TPG,THD FOR:6-20 X 0.313 INCH,PNH STL	83385	OBD
					- - - * - - -		
-22	384-1370-00			1	EXTENSION SHAFT:4.68" L,MOLDED PLSTC	80009	384-1370-00
-23	384-1364-00			1	EXTENSION SHAFT:10.818" L,NYLON,BLK	80009	384-1364-00
-24	351-0456-00			2	GUIDE,RES ADJ:PLASTIC	80009	351-0456-00
-25	352-0425-00			1	FUSEHOLDER:PLASTIC	80009	352-0425-00
-26	337-2227-00			1	SHIELD,ELEC:HIGH VOLTAGE POWER SUPPLY	80009	337-2227-00
					(ATTACHING PARTS)		
-27	211-0008-00			2	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-28	342-0293-00			1	INSULATOR,SHLD:HV	80009	342-0293-00
-29	343-0213-00			2	CLAMP,LOOP:PRESS MT,PLASTIC	80009	343-0213-00
-30	----- -----			1	TRANSISTOR:CHASSIS MTG(SEE Q458 EPL)		
					(ATTACHING PARTS)		
-31	344-0236-01			1	CLIP,SPR TNSN:TRANSISTOR MOUNTING	80009	344-0236-01
					- - - * - - -		
	342-0202-00			1	INSULATOR,PLATE:TRANSISTOR	01295	10-21-023-106
-32	253-0202-00			FT	INSUL TAPE,ELEC:POLYMIDE,0.875" W X 1.0" L	99742	221
-33	----- -----			1	CKT BOARD ASSY:TRIGGER FUNCTION(SEE A10 EPL)		
					(ATTACHING PARTS)		
-34	211-0008-00			4	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
	----- -----			-	. CKT BOARD ASSY INCLUDES:		
-35	131-0608-00			4	. CONTACT,ELEC:0.365 L X 0.25 PH BRZ GOLD PL	22526	47357
-36	136-0263-04			13	. SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	22526	75377-001
-37	----- -----			1	CKT BOARD ASSY:INTERFACE(SEE A1 EPL)		
					(ATTACHING PARTS)		
-38	211-0008-00			5	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-39	361-0750-00			2	SPACER,POST:4-40 X 0.25 INT/EXT THD	80009	361-0750-00
					- - - * - - -		
	----- -----			-	. CKT BOARD ASSY INCLUDES:		
-40	131-0566-00			1	. LINK,TERM.CONNE:0.086 DIA X 2.375 INCH L	55210	L-2007-1
-41	131-0608-00			19	. CONTACT,ELEC:0.365 L X 0.25 PH BRZ GOLD PL	22526	47357
-42	131-1749-01			1	. CONN,RCPT,ELEC:CKT BD,8 CONTACT	80009	131-1749-01
	131-1795-00			1	. CONNECTOR,RCPT,:12 FEMALE CONTACT,RT-ANGLE	27264	09-62-3121
-43	131-1792-00			1	. CONTACT ASSY,EL:12 MALE CONTACT,FLAT WAFER	27264	09-70-2121

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-44	214-0693-00			4	. HEAT SINK, ELEC:0.25 ID X 0.75 INCH LONG	98978	TXD017-075
-45	----- -----			1	. TRANSFORMER:(SEE T460 EPL)		
-46	361-0007-01			3	. SPACER,SLEEVE:0.188 L X 0.111 ID,PLASTIC	80009	361-0007-01
-47	----- -----			1	. RES.,VAR:INTENSITY(SEE R412 EPL)		
-48	----- -----			1	. RES.,VAR:FOCUS(SEE R468 EPL)		
-49	----- -----			1	. SWITCH,PUSH:BEAMFINDER(SEE S100 EPL)		
-50	361-0608-00			2	. SPACER,PUSH SW:PLASTIC	80009	361-0608-00
-51	----- -----			1	. SWITCH,PUSH:POWER ON(SEE S700 EPL)		
-52	344-0154-00			2	. CLIP,ELECTRICAL:FOR 0.25 INCH DIA FUSE	80009	344-0154-00
-53	342-0294-00			1	INSULATOR,FILM:2.125 X 4.875,0.01 POLYEST	80009	342-0294-00
-54	386-3291-00			1	SUPPORT,CRT:FRONT	80009	386-3291-00
-55	----- -----			1	ELECTRON TUBE:CRT,W/ANODE(SEE V470 EPL)		
	334-1379-00			1	LABEL:CRT,ADHESIVE BACK	80009	334-1379-00
	334-2614-00			1	MARKER,IDENT:MARKED PROPERTY OF	80009	334-2614-00
-56	214-2300-00			1	SPRING,GROUND:2.0 L X 0.3 W,0.0063 THK BRS	80009	214-2300-00
					(ATTACHING PARTS)		
-57	211-0008-00			1	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-58	210-0586-00			1	NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
					- - - * - - -		
	626-0458-00			1	CRT SHIELD ASSY:	80009	626-0458-00
-59	----- -----			1	. COIL,TUBE DEFL:TRACE ROTATION(SEE L472 EPL)		
-60	131-0707-00			2	. . CONNECTOR,TERM.:0.48" L,22-26AWG WIRE	22526	75691-005
-61	352-0169-01			1	. . CONN BODY,PL,EL:2 WIRE BROWN	80009	352-0169-01
-62	----- -----			1	. COIL,TUBE DEFL:X-Y ALIGNMENT(SEE L470 EPL)		
	131-0707-00			2	. . CONNECTOR,TERM.:0.48" L,22-26AWG WIRE	22526	75691-005
-63	352-0169-00			2	. . CONN BODY,PL,EL:2 WIRE BLACK	80009	352-0169-00
-64	407-2107-00			1	. BRACKET,SUPPORT:CRT SHIELD	80009	407-2107-00
					(ATTACHING PARTS)		
-65	210-0457-00			3	. NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
-66	211-0510-00			2	. SCREW,MACHINE:6-32 X 0.375 INCH,PNH STL	83385	OBD
	210-0803-00			2	. WASHER,FLAT:0.15 ID X 0.375 INCH OD,STL	12327	OBD
	210-0006-00			2	. WASHER,LOCK:INTL,0.146 IDX 0.288 OD,STL	78189	1206-00-00-0541C
					- - - * - - -		
-67	386-3288-00			1	. SPRT,CRT SHIELD:REAR	80009	386-3288-00
					(ATTACHING PARTS)		
-68	211-0510-00			2	. SCREW,MACHINE:6-32 X 0.375 INCH,PNH STL	83385	OBD
-69	220-0419-00			2	. NUT,PLAIN,SQ:6-32 X 0.312 INCH,STL	83385	OBD
					- - - * - - -		
-70	386-3305-00			1	. SUPPORT,CRT:REAR	80009	386-3305-00
-71	348-0004-00			1	. GROMMET,RUBBER:0.281 ID X 0.563 INCH OD	70485	763
-72	337-2223-02			1	. SHIELD,CRT:	80009	337-2223-02
	129-0701-00			1	. SPACER,POST:0.665 L,W/6-32 THD ONE END AL	80009	129-0701-00
	255-0648-00			1	. RUBBER EXTR:U SHAPE,11.437 L	80009	255-0648-00
	136-0698-00			1	SKT,PL-IN ELEK:ELCTRN TUBE,9 CONT W/LEADS	80009	136-0698-00
	198-3838-00			1	. WIRE SET,ELEC:	80009	198-3838-00
-73	136-0202-01			1	. . SOCKET,PLUG-IN:14 PIN	80009	136-0202-01
-74	131-0707-00			9	. CONNECTOR,TERM.:0.48" L,22-26AWG WIRE	22526	75691-005
-75	352-0162-00			2	. CONN BODY,PL,EL:4 WIRE BLACK	80009	352-0162-00
-76	352-0171-00			1	. CONN BODY,PL,EL:1 WIRE BLACK	80009	352-0171-00
-77	386-3289-02			1	PANEL,REAR:	80009	386-3289-02
					(ATTACHING PARTS)		
-78	211-0529-00			2	SCREW,MACHINE:6-32 X 1.25 INCHES,PNH STL	83385	OBD
-79	211-0578-00			2	SCREW,MACHINE:6-32 X 0.438 INCH,PNH STL	83385	OBD
					- - - * - - -		
-80	131-0955-00			1	CONNECTOR,RCPT,:BNC,FEMALE,W/HARDWARE	05091	31-279
					(ATTACHING PARTS)		
-81	210-0255-00			1	TERMINAL,LUG:0.391" ID INT TOOTH	80009	210-0255-00
					- - - * - - -		
-82	200-1811-00			1	COVER,SCOPE:REAR PLASTIC	80009	200-1811-00
					(ATTACHING PARTS)		
-83	211-0517-00			2	SCREW,MACHINE:6-32 X 1 INCH,PNH,STL	83385	OBD
					- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-	----- -----			-	. REAR COVER ASSY INCLUDES:		
-84	348-0441-00			4	. FOOT,CABINET:POLYURETHANE,BLACK	80009	348-0441-00
-85	161-0107-01			1	CABLE ASSY,PWR:3,18 AWG,115V,7.5 FT,W/LUG	80009	161-0107-01
					(ATTACHING PARTS)		
-86	358-0323-00			1	BSHG,STRAIN RLF:90 DEG,0.515 DIA HOLE	28520	SR15-1
-87	211-0504-00			1	SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
	----- -----			-	. POWER CORD INCLUDES:		
-88	210-0287-00			1	. TERMINAL,LUG:	00779	34142
-89	348-0063-00			2	GROMMET,PLASTIC:0.50 INCH DIA	80009	348-0063-00
-90	255-0334-00			FT	PLASTIC CHANNEL:	11897	122-37-2500
	672-0711-00			1	CKT BOARD ASSY:POWER SUPPLY	80009	672-0711-00
-91	----- -----			2	. TRANSISTOR:CHAS MTG(SEE Q756 & Q776 EPL)		
	----- -----			1	. TRANSISTOR:CHAS MTG(SEE Q736 EPL)		
					(ATTACHING PARTS FOR EACH)		
-92	344-0236-01			1	. CLIP,SPR TNSN:TRANSISTOR MOUNTING	80009	344-0236-01
					- - - * - - -		
	342-0202-00			3	. INSULATOR,PLATE:TRANSISTOR	01295	10-21-023-106
-93	253-0202-00			FT	. INSUL TAPE,ELEC:POLYMIDE,0.875 ID X 3.5" L	99742	221
-94	214-2265-00			1	. HEAT SINK,XSTR:6.0" L X 0.72" H,AL	80009	214-2265-00
					(ATTACHING PARTS)		
-95	211-0507-00			2	. SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
-96	211-0008-00			2	. SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-97	210-0586-00			2	. NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
					- - - * - - -		
-98	352-0425-00			1	. FUSEHOLDER:PLASTIC	80009	352-0425-00
-99	337-2302-00			1	SHIELD,ELEC:LV POWER BOARD	80009	337-2302-00
-100	----- -----			1	. CKT BOARD ASSY:.L.V. POWER SUPPLY(SEE A2 EPL)		
					(ATTACHING PARTS)		
-101	212-0515-00			4	. SCREW,MACHINE:10-32 X 2.250" HEX.HD STL	83385	OBD
-102	166-0457-00			4	. INSUL SLVG,ELEC:0.19 ID X 1.875"LONG MYLAR	80009	166-0457-00
-103	361-0877-00			4	. SPACER,SLEEVE:0.625 L X 0.31 ID,ALUMINUM	80009	361-0877-00
-104	220-0572-00			1	. NUT,PLAIN,HEX.:10-32 X 0.25 INCH,PL BRS	73743	OBD
					- - - * - - -		
	----- -----			-	. . CKT BOARD ASSY INCLUDES:		
-105	131-1750-01			1	. . TERM,FEEDTHRU:8 PIN,INSULATED	80009	131-1750-01
-106	344-0154-00			2	. . CLIP,ELECTRICAL:FOR 0.25 INCH DIA FUSE	80009	344-0154-00
-107	260-1776-00			2	. . SW,SLIDE:LINE VOLT/SELECT(SEE S701,S705 EPL)		
-108	----- -----			1	. . TRANSFORMER:POWER(SEE T700 EPL)		
-109	343-0213-00			3	CLAMP,LOOP:PRESS MT,PLASTIC	80009	343-0213-00
	343-0002-00			1	. CLAMP,LOOP:0.188 INCH DIA	95987	3-16-6B
	343-0088-00			2	. CLAMP,LOOP:0.062 INCH DIA	80009	343-0088-00
-110	366-1031-00			2	KNOB:RED	80009	366-1031-00
	213-0153-00			2	. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-111	384-1371-02			2	EXTENSION SHAFT:6.8" LONG,W/KNOB	80009	384-1371-02
-112	366-1746-00			2	KNOB:GY,VOLTS/DIV,0.135 ID,W/SKIRT	80009	366-1746-00
-113	366-1559-00			5	PUSH BUTTON:GRAY	80009	366-1559-00
-114	426-1072-00			5	FRAME,PUSH BTN:PLASTIC	80009	426-1072-00
-115	358-0550-00			2	BUSHING,SHAFT:0.15 ID X 0.3INCH OD,PLSTC	80009	358-0550-00
-116	333-2419-00			1	PANEL,FRONT:VERTICAL	80009	333-2419-00
-117	384-1393-00			2	EXTENSION SHAFT:0.123 DIA X 6.3" L,PLSTC	80009	384-1393-00
-118	376-0051-00			2	CPLG,SHAFT,FLEX:FOR 0.125 INCH DIA SHAFTS	80009	376-0051-00
	213-0022-00			4	. SETSCREW:4-40 X 0.188 INCH,HEX SOC STL	74445	OBD
-119	351-0456-00			2	GUIDE,RES ADJ:PLASTIC	80009	351-0456-00
	672-0708-00			1	CKT BOARD ASSY:ATTENUATOR,CH1	80009	672-0708-00
	672-0709-00			1	CKT BOARD ASSY:ATTENUATOR,CH2	80009	672-0709-00
					(ATTACHING PARTS FOR EACH)		
-120	211-0144-00			2	SCREW,MACHINE:4-40 X 1.312 INCH,PNH STL	83385	OBD
-121	211-0018-00			1	SCREW,MACHINE:4-40 X 0.875 PNH,STL	83385	OBD
-122	210-0586-00			1	NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
					- - - * - - -		
	----- -----			-	. EACH ATTEN ASSY INCLUDES:		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-123	337-2214-00			1	. SHIELD,ELEC:ATTENUATOR LEFT,CH1	80009	337-2214-00
	337-2215-00			1	. SHIELD,ELEC:ATTENUATOR,RIGHT,CH2	80009	337-2215-00
					(ATTACHING PARTS)		
-124	211-0244-00			1	. SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	OBD
					- - - * - - -		
-125	131-0955-00			1	. CONNECTOR,RCPT,:BNC,FEMALE,W/HARDWARE	05091	31-279
					(ATTACHING PARTS)		
-126	210-1000-00			1	. WASHER,FLAT:0.384 ID X 0.50" OD,AL	80009	210-1000-00
					- - - * - - -		
-127	105-0678-01			1	. DRUM,CAM SWITCH:AC-DC GND,CHANNEL 1	80009	105-0678-01
	105-0678-02			1	. DRUM,CAM SWITCH:AC-DC GND,CHANNEL 2	80009	105-0678-02
-128	214-1126-01			4	. SPRING,FLAT:GREEN COLORED	80009	214-1126-01
-129	214-1752-00			1	. ROLLER,DETENT:	80009	214-1752-00
-130	401-0338-00			1	. BEARING,CAM SW:FRONT	80009	401-0338-00
					(ATTACHING PARTS)		
-131	211-0244-00			2	. SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	OBD
-132	210-0406-00			2	. NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
					- - - * - - -		
-133	376-0174-00			1	. CPLG,SHAFT,RGD:0.19 ID X 0.325 OD X 0.2" H	80009	376-0174-00
-134	105-0679-00			1	. ACTUATOR,CAM SW:ATTENUATOR	80009	105-0679-00
-135	343-0564-00			1	. RTNR BAR,CONT:ATTENUATOR,LEFT CH1	80009	343-0564-00
	343-0565-00			1	. RTNR BAR,CONT:ATTENUATOR,RIGHT CH2	80009	343-0565-00
					(ATTACHING PARTS)		
-136	211-0244-00			1	SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	OBD
-137	211-0246-00			1	. SCR,ASSEM WSHR:4-40 X 0.625 INCH,PNH,STL	78189	OBD
-138	210-0406-00			1	. NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
					- - - * - - -		
-139	131-1779-03			1	. CONT ASSY,ELEC:CAM SW,1 CONTACT,LEFT,CH1	80009	131-1779-03
	131-1779-04			1	. CONT ASSY,ELEC:CAM SW,1 CONTACT,RIGHT,CH2	80009	131-1779-04
-140	131-1779-01			1	. CONT ASSY,ELEC:CAM SW,13 CONTACT,LEFT,CH1	80009	131-1779-01
	131-1779-02			1	. CONT ASSY,ELEC:CAM SW,13 CONTACT,RIGHT,CH2	80009	131-1779-02
-141	----- -----			1	. CKT BOARD ASSY:CH1 OR CH2(SEE A6,A7 EPL)		
-142	136-0263-04			5	. . SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	22526	75377-001
-143	361-0735-00			2	SPACER,CKT BD:0.25"OD X 0.093" H,PLSTC	80009	361-0735-00
-144	384-1136-00			4	EXTENSION SHAFT:0.95 INCH LONG	80009	384-1136-00
-145	----- -----			1	CKT BOARD ASSY:VERTICAL(SEE A8 EPL)		
					(ATTACHING PARTS)		
-146	211-0008-00			3	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
	----- -----			-	. CKT BOARD ASSY INCLUDES:		
-147	131-0589-00			10	. CONTACT,ELEC:0.46 INCH LONG	22526	47350
	131-0608-00			4	. CONTACT,ELEC:0.365 L X 0.25 PH BRZ GOLD PL	22526	47357
-148	131-1792-00			1	. CONTACT ASSY,EL:12 MALE CONTACT,FLAT WAFER	27264	09-70-2121
-149	----- -----			1	. SWITCH,PUSH:CH1,CH2(SEE S4320 EPL)		
-150	361-0542-00			8	. SPACER,SWITCH:PLASTIC	71590	J-64281
-151	----- -----			2	. RES.,VAR:CH1,CH2 VAR GAIN(SEE R4152,R4252 EPL)		
-152	----- -----			-	. RES.,VAR:CH1,CH2 POSITION(SEE R4346,R4356 EPL)		
	361-0542-00			8	. SPACER,SWITCH:PLASTIC	71590	J-64281
	131-0433-00			2	. TERMINAL,FEEDTH:0.057 ID X 0.42" LONG,BRS	88245	421572-9
-153	----- -----			1	DELAY LINE:W/HDWR(SEE DS4380 EPL)		
					(ATTACHING PARTS)		
-154	211-0008-00			2	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-155	210-0586-00			2	NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
-156	210-0458-00			3	NUT,PLAIN,EXT W:8-32 X 0.344 INCH,STL	83385	OBD
					- - - * - - -		
	----- -----			-	. DELAY LINE INCLUDES:		
-157	131-1768-00			1	. CONTACT,ELEC:BRS CU-SN-ZN PL	80009	131-1768-00
-158	346-0121-00			1	. STRAP,ELEC COMP:TIE DOWN,5.0 LONG	59730	T4-34M
-159	----- -----			1	SWITCH,PUSH:(SEE S4310 EPL)		
					(ATTACHING PARTS)		
-160	211-0008-00			2	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-161	129-0230-00			2	SPACER,POST:1.375 L,W/4-40 THD EA END	80009	129-0230-00
					- - - * - - -		

Scan by Zenith

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-162	103-0186-01			1	ADAPTER,EXT SET:PUSH SW,.45 OFFSET	80009	103-0186-01
-163	386-3899-00			1	SUBPANEL,FRONT:VERTICAL	80009	386-3899-00
-164	334-3306-00[1]			1	PLATE,IDENT:MARKED T932A	80009	334-3306-00
	334-3308-00[2]			1	PLATE,IDENT:MARKED T935A	80009	334-3308-00
-165	124-0315-00			1	STRIP,TRIM:FRONT	80009	124-0315-00
-166	366-1660-00			1	KNOB:GRAY	80009	366-1660-00
	213-0153-00			1	. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-167	131-0106-02			1	CONNECTOR,RCPT,:BNC	80009	131-0106-02
					(ATTACHING PARTS)		
-168	210-0255-00			1	TERMINAL,LUG:0.391" ID INT TOOTH	80009	210-0255-00
-169	366-1559-00[1]			2	PUSH BUTTON:GRAY	80009	366-1559-00
	366-1559-00[2]			5	PUSH BUTTON:GRAY	80009	366-1559-00
-170	384-1371-00			1	EXTENSION SHAFT:2.0" LONG,W/KNOB,PLASTIC	80009	384-1371-00
-171	366-1660-00[1]			1	KNOB:GRAY	80009	366-1660-00
	366-1660-00[2]			2	KNOB:GRAY	80009	366-1660-00
	213-0153-00			1	. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-172	366-1667-00[2]			1	KNOB:RED	80009	366-1667-00
	213-0153-00			1	. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-173	366-1661-00[2]			1	KNOB:GRAY	80009	366-1661-00
	213-0153-00			2	. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-174	366-1662-00[2]			1	KNOB:CLEAR,FCTN TIMING	80009	366-1662-00
	213-0153-00			2	. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-175	366-1647-00[1]			1	KNOB:0.127" ID X 0.5" OD X 0.531"	80009	366-1647-00
	213-0153-00			1	. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-176	366-1281-00[1]			1	KNOB:GRAY	80009	366-1281-00
	213-0153-00			2	. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-177	358-0216-00			1	BUSHING,PLASTIC:0.257 ID X 0.412 INCH OD	80009	358-0216-00
-178	384-1371-02			1	EXTENSION SHAFT:6.8" LONG,W/KNOB	80009	384-1371-02
-179	358-0550-00			2	BUSHING,SHAFT:0.15 ID X 0.3INCH OD,PLSTC	80009	358-0550-00
-180	426-1072-00[1]			1	FRAME,PUSH BTN:PLASTIC	80009	426-1072-00
	426-1072-00[2]			5	FRAME,PUSH BTN:PLASTIC	80009	426-1072-00
-181	333-2420-00[1]			1	PANEL,FRONT:HORIZONTAL	80009	333-2420-00
	333-2418-00[2]			1	PANEL,FRONT:HORIZONTAL	80009	333-2418-00
-182	----- -----			1	RES.,VAR:HOLD-OFF,POSTION(SEE R2272 EPL)		
					(ATTACHING PARTS)		
-183	210-0583-00			1	NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20224-402
-184	210-0465-00			1	NUT,PLAIN,HEX.:0.25-32 X 0.375 INCH BRS	73743	3095-402
					- - - * - - -		
	672-0707-00			1	CKT BOARD ASSY:TRIGGER,W/LEVER SWITCH	80009	672-0707-00
-185	263-0030-00			1	. SW LEVER ASSY:	80009	263-0030-00
-186	214-2289-02			1	. LEVER,SWITCH:STYLE B,W/CONTACTS	80009	214-2289-02
					(ATTACHING PARTS FOR EACH)		
-187	211-0240-00			1	. SCR,ASSEM WSHR:4-40 X 0.688"PNH,STL	78189	OBD
-188	210-0551-00			1	. NUT,PLAIN,HEX.:4-40 X 0.25 INCH,STL	83385	OBD
-189	351-0448-01			2	. GUIDE ,SWITCH:W/SPRING AND ROLLER	80009	351-0448-01
					- - - * - - -		
-190	----- -----			1	. CKT BOARD ASSY:TRIGGER SWITCH(SEE A11 EPL)		
-191	131-0787-00			13	. . CONTACT,ELEC:0.64 INCH LONG	22526	47359
-192	----- -----			1	. . SWITCH,PUSH:(SEE S2030 EPL)		
-193	361-0542-00			2	. . SPACER,SWITCH:PLASTIC	71590	J-64281
	103-0186-00			1	ADAPTER,EXT SFT:PUSH SW,.30 OFFSET	80009	103-0186-00
-194	----- -----			1	RES.,VAR:DELAY TIME(SEE R2516 EPL)		
					(ATTACHING PARTS)		
-195	210-0583-00			1	NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20224-402
-196	210-0465-00			1	NUT,PLAIN,HEX.:0.25-32 X 0.375 INCH BRS	73743	3095-402
					- - - * - - -		
-197	384-1422-00[1]			1	EXTENSION SHAFT:8.06 L X 0.123 OD,PLASTIC	80009	384-1422-00
	384-1410-00[2]			1	EXTENSION SHAFT:8.296 L X 0.081 OD,SST,PSVT	80009	384-1410-00
-198	376-0051-00[1]			1	CPLG,SHAFT,FLEX:FOR 0.125 INCH DIA SHAFTS	80009	376-0051-00
	376-0050-00[2]			1	CPLG,SHAFT,FLEX:FOR 0.081/0.125 INCH SHAFTS	80009	376-0050-00
	213-0022-00			1	. SETSCREW:4-40 X 0.188 INCH,HEX SOC STL	74445	OBD
-199	672-0551-01			1	CKT BOARD ASSY:TIMING W/ROTARY SWITCH	80009	672-0551-01
	672-0533-01			1	CKT BOARD ASSY:TIMING W/ROTARY SWITCH	80009	672-0533-01

[1]T932A only
[2]T935A only

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-200	386-3901-00			1	SUBPANEL,FRONT:HORIZONTAL	80009	386-3901-00
					(ATTACHING PARTS)		
-201	211-0008-00			4	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-202	386-1136-00			2	PLATE,CONN MTG:	80009	386-1136-00
-203	384-1408-00[1]			3	EXTENSION SHAFT:3.8 L,MOLDED PLASTIC	80009	384-1408-00
-204	----- -----			1	CKT BOARD ASSY:HORIZONTAL(SEE A12 EPL)		
					(ATTACHING PARTS)		
-205	129-0573-00			3	SPACER,POST:0.188" HEX 1.627" L,AL	80009	129-0573-00
					- - - * - - -		
	----- -----			-	. CKT BOARD ASSY INCLUDES:		
-206	131-0566-00[2]			8	. LINK,TERM.CONNE:0.086 DIA X 2.375 INCH L	55210	L-2007-1
	131-0566-00[1]			11	. LINK,TERM.CONNE:0.086 DIA X 2.375 INCH L	55210	L-2007-1
-207	131-0608-00[2]			4	. CONTACT,ELEC:0.365 L X 0.25 PH BRZ GOLD PL	22526	47357
	131-0608-00[1]			7	. CONTACT,ELEC:0.365 L X 0.25 PH BRZ GOLD PL	22526	47357
-208	131-1795-00			1	. CONNECTOR,RCPT,:12 FEMALE CONTACT,RT-ANGLE	27264	09-62-3121
-209	131-1801-00[2]			1	. CONNECTOR,RCPT,:9 CONTACTS	80009	131-1801-00
	131-1801-00[1]			2	. CONNECTOR,RCPT,:9 CONTACTS	80009	131-1801-00
-210	131-1802-00			2	. CONNECTOR,RCPT,:15 CONTACTS	80009	131-1802-00
-211	----- -----			-	. SWITCH,PUSH:SLOPE(SEE S2140 EPL)		
-212	361-0541-00			2	. SPACER,SLEEVE:0.50 OD X 0.976 INCH LONG	80009	361-0541-00
-213	----- -----[1]			-	. SWITCH,PUSH:MODE(SEE S2510 EPL)		
-214	361-0542-00[1]			4	. SPACER,SWITCH:PLASTIC	71590	J-64281
-215	----- -----			1	. RES.,VAR:LEVEL(SEE R2138 EPL)		
-216	----- -----			-	. RES.,VAR:HORIZONTAL POSITION(SEE R2316 EPL)		
-217	----- -----			1	. RES.,VAR:(SEE R2332 EPL)		
-218	441-1278-01			1	CHASSIS,SCOPE:MAIN	80009	441-1278-01
	198-3071-00			1	WIRE SET,ELEC:	80009	198-3071-00
-219	131-1538-00			4	. CONTACT,ELEC:CRIMP-ON,22-26 AWG WIRE	22526	75369-002
-220	352-0197-00			1	. CONN BODY,PL,EL:1 WIRE BLACK	80009	352-0197-00
-221	131-0621-00			5	. CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	75694-006
	198-3853-00			1	WIRE SET,ELEC:	80009	198-3853-00
	131-0707-00			2	. CONNECTOR,TERM.:0.48" L,22-26AWG WIRE	22526	75691-005
	352-0169-00			1	. CONN BODY,PL,EL:2 WIRE BLACK	80009	352-0169-00
	198-3882-00			1	WIRE.SET,ELEC:	80009	198-3882-00
	131-0707-00			8	. CONNECTOR,TERM.:0.48" L,22-26AWG WIRE	22526	75691-005
	352-0169-00			2	. CONN BODY,PL,EL:2 WIRE BLACK	80009	352-0169-00
	352-0169-01			2	. CONN BODY,PL,EL:2 WIRE BROWN	80009	352-0169-01

[1] T935A only
[2] T932A only

Scan by Zenith

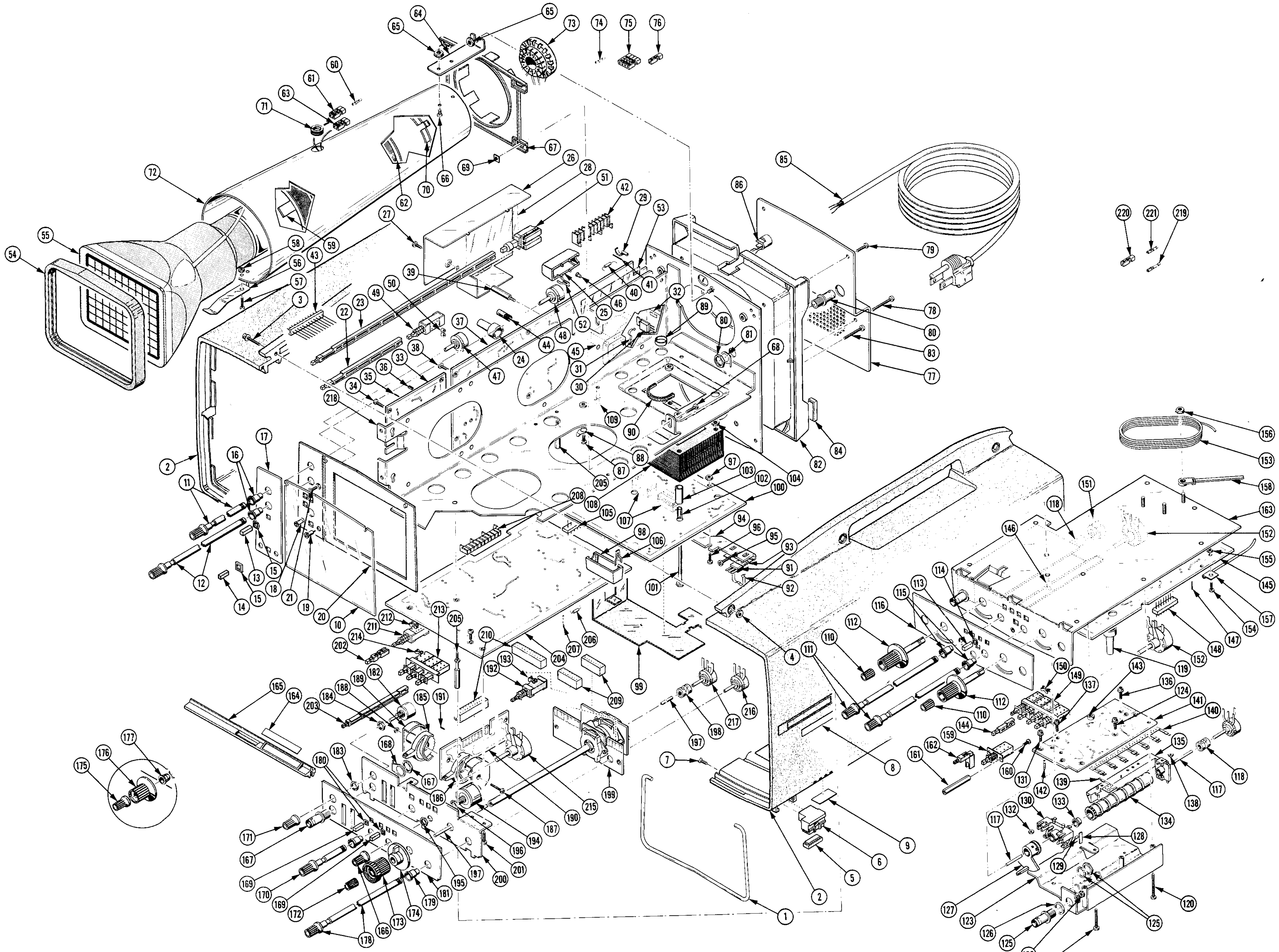


FIG. 1 EXPLODED

T932A/T935A

ACCESSORIES

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
	070-2492-00			1	MANUAL,TECH:INSTRUCTION	80009	070-2492-00
	010-6108-03			2	PROBE,VOLTAGE:10X,2 METERS,W/ACCESSORIES	80009	010-6108-03

MANUAL CHANGE INFORMATION

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

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

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

SERVICE NOTE

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

Scan by Zenith

CALIBRATION TEST EQUIPMENT REPLACEMENT

Calibration Test Equipment Chart

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

Comparison of Main Characteristics

DM 501 replaces 7D13		
PG 501 replaces 107	PG 501 - Risetime less than 3.5 ns into 50 Ω.	107 - Risetime less than 3.0 ns into 50 Ω.
108	PG 501 - 5 V output pulse; 3.5 ns Risetime.	108 - 10 V output pulse; 1 ns Risetime.
111	PG 501 - Risetime less than 3.5 ns; 8 ns Pretrigger pulse delay.	111 - Risetime 0.5 ns; 30 to 250 ns Pretrigger Pulse delay.
114	PG 501 - ±5 V output.	114 - ±10 V output. Short proof output.
115	PG 501 - Does not have Paired, Burst, Gated, or Delayed pulse mode; ±5 V dc Offset. Has ±5 V output.	115 - Paired, Burst, Gated, and Delayed pulse mode; ±10 V output. Short-proof output.
PG 502 replaces 107		
108	PG 502 - 5 V output	108 - 10 V output.
111	PG 502 - Risetime less than 1 ns; 10 ns Pretrigger pulse delay.	111 - Risetime 0.5 ns; 30 to 250 ns Pretrigger pulse delay.
114	PG 502 - ±5 V output	114 - ±10 V output. Short proof output.
115	PG 502 - Does not have Paired, Burst, Gated, Delayed & Undelayed pulse mode; Has ±5 V output.	115 - Paired, Burst, Gated, Delayed & Undelayed pulse mode; ±10 V output. Short-proof output.
2101	PG 502 - Does not have Paired or Delayed pulse. Has ±5 V output.	2101 - Paired and Delayed pulse; 10 V output.
PG 506 replaces 106	PG 506 - Positive-going trigger output signal at least 1 V; High Amplitude output, 60 V.	106 - Positive and Negative-going trigger output signal, 50 ns and 1 V; High Amplitude output, 100 V.
067-0502-01	PG 506 - Does not have chopped feature.	0502-01 - Comparator output can be alternately chopped to a reference voltage.
SG 503 replaces 190, 190A, 190B	SG 503 - Amplitude range 5 mV to 5.5 V p-p.	190B - Amplitude range 40 mV to 10 V p-p.
191	SG 503 - Frequency range 250 kHz to 250 MHz.	191 - Frequency range 350 kHz to 100 MHz.
067-0532-01	SG 503 - Frequency range 250 kHz to 250 MHz.	0532-01 - Frequency range 65 MHz to 500 MHz.
TG 501 replaces 180, 180A	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	180A - Marker outputs, 5 sec to 1 μs. Sinewave available at 20, 10, and 2 ns. Trigger pulses 1, 10, 100 Hz; 1, 10, and 100 kHz. Multiple time-marks can be generated simultaneously.
181	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns.	181 - Marker outputs, 1, 10, 100, 1000, and 10,000 μs, plus 10 ns sinewave.
184	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	184 - Marker outputs, 5 sec to 2 ns. Sinewave available at 50, 20, 10, 5, and 2 ns. Separate trigger pulses of 1 and .1 sec; 10, 1, and .1 ms; 10 and 1 μs. Marker amplifier provides positive or negative time marks of 25 V min. Marker intervals of 1 and .1 sec; 10, 1, and .1 ms; 10 and 1 μs.
2901	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	2901 - Marker outputs, 5 sec to 0.1 μs. Sinewave available to 50, 10, and 5 ns. Separate trigger pulses, from 5 sec to 0.1 μs. Multiple time-marks can be generated simultaneously.

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

TEKTRONIX®
committed to technical excellence

MANUAL CHANGE INFORMATION

PRODUCT T932A/T935A 070-2492-00	CHANGE REFERENCE C1/1277 DATE 12-22-77

CHANGE:	DESCRIPTION

EFF ALL SN

SCHEMATIC DIAGRAM CHANGES

CHANGE TO:

		REF
C4243	Value changes to 82 PF	PC 2
R4204	Value changes to 270 OHM.	PC 2

Above parts are located on the A7 CHANNEL 2 VERTICAL ATTENUATOR board and shown on VERTICAL INPUT diagram 3.

TEKTRONIX®
committed to technical excellence

MANUAL CHANGE INFORMATION

PRODUCT ALL T900 SERIES
EFF ALL SN

CHANGE REFERENCE M32883
DATE 12-21-77

CHANGE:	DESCRIPTION

Affects Manuals: 070-1981-01
070-1982-01
070-1983-01
070-2492-00

Oscilloscope Light Filter and Graticule Illumination Photography Effects

Some oscilloscopes contain a factory installed colored (usually blue or green) plastic light filter in front of the crt faceplate to improve general purpose viewing contrast in ambient lighting conditions (in some applications this device also functions as an implosion safety shield).

In order for the oscilloscope graticule to be photographed along with a crt display, oscilloscopes that do not provide internal graticule (scale) illumination must be used with a camera such as the C5A or C5A Option 3, which provide external flash illumination of the graticule. An exception to this is some storage oscilloscopes operated in the store mode, where the target illumination may also illuminate the graticule lines.

Effectiveness of the graticule illumination flash is severly degraded when used with most colored crt light filters. If a clear light filter was provided as an accessory with your oscilloscope, the colored filter should be removed and the clear filter installed in its place when taking oscilloscope display photographs. The clear filter may also provide improved photograph definition and contrast with reduced oscilloscope display intensity settings (some colored filters reduce effective display intensity as much as 75%). Under no circumstances should the oscilloscope be operated without either a clear or colored light filter when no other implosion shield is provided (optional accessory mesh filters are not intended for implosion protection and must be removed when using an oscilloscope camera).

If your oscilloscope was not provided with a clear light filter accessory, contact your local Tektronix Field Office for ordering information.

For all T900-series, bench-version oscilloscopes, the instrument cabinet must be removed in order to replace the crt light filter. Only qualified service personnel should remove the instrument cabinet. Cabinet removal instructions are provided in the Service portion of T900-series manuals. The part number for the clear light filter to fit T900-series, bench-version oscilloscopes is 337-2185-03.

TEKTRONIX®
committed to technical excellence

MANUAL CHANGE INFORMATION

PRODUCT T932A/T935A 070-2492-00

CHANGE REFERENCE C3/278

DATE 2-13-78

CHANGE:	DESCRIPTION

TEXT CORRECTIONS

Page 1-1 Table 1-1, right column, Performance Requirement for CMRR (DIFF Mode), 4th line:

CHANGE TO: ......with gain adj. for best CMRR

Page 1-2 Table 1-1, right column, Performance Requirement for X-AXIS Bandwidth:

CHANGE TO: DC to at least 2 MHz with 5 div reference signal.

Page 2-10 Left column, X1-X10 Trigger Operation, Step 3, Second paragraph, first line:

CHANGE TO:.......Now set the SLOPE button to -(IN) position. Rotate......

Page 2-10 Right column, Delay Time Position and Delayed Sweep Operation (T935A only), Step 7:

ADD: DISPLAY MODE A

Page 3-3 Fig. 3-1. Deflection accuracy check test setup:

NOTE: Do not use the 50 ohm Termination at the Amplitude Calibrator output as shown in Fig. 3-1. Connect the cable directly to the "AMPL OUTPUT HIGH or STD" (PG 506) output connector.

Page 3-3 TABLE 3-2, bottom line.

CHANGE TO: 10 V 50 V 5 4.85 to 5.15

Page 3-4 Step 2, following part e.

ADD: f. Set Amplitude Calibrator for a .5 V output.

Page 3-4 Step 3, part b, first line:

CHANGE TO: b. CHECK--Horizontal deflection 5 divisions ±5% (4.75 to 5.25 div).

Page 3-5 Step 6, part a:

ADD: CH 1 VOLTS/DIV .1V

Page 3-5 Step 6, part c, second line:

CHANGE TO: .....adjust output amplitude for 5 divisions (about .5 V) of......

Page 3-5 Step 6, part e:

CHANGE TO: e. CHECK--Display amplitude is at least 3.5 divisions.

Page 3-6 Step 12, part a:

ADD: SOURCE LINE

CHANGE:	DESCRIPTION
Page 3-7 ADD:	Before Step 12, part c:

NOTE

If the frequency of the ac-line-voltage source is lower than 60 Hz, connect the probe tip to the 60 Hz output of a sine-wave generator (instead of laying it near the line voltage source) in step 12, parts c and d.

Page 3-7 Step 12, part c, second and third lines:
CHANGE TO: CH1 VOLTS/DIV switch and CH 1 VAR control for a 0.5-division display (LEVEL adjustment may be necessary to stabilize display).

Page 3-7 Fig. 3-4 and Step 13, part a:
NOTE: Cable connections to Time Mark Generator are shown incorrectly in Fig. 3-4 if a TG 501 is being used. Connect one end of the first 50 ohm cable to the "Marker Out (5S to 2 nS)"Time Mark Generator connector and connect the other end to a 50 ohm termination at the CH 1 (X) oscilloscope input. Connect one end of the second cable to the "+ Trigger Out" Time Mark Generator connector and connect the other end to a 50 ohm termination at the EXT connector on the oscilloscope.

Page 4-6 Step 1 title:
CHANGE TO: 1. Vertical preamplifier Balance and CH 2 Invert Balance

Page 4-6 Step 1, part c:
CHANGE TO:

c. ADJUST -- CH 2 DC BAL, R4230 (see Fig. 4-3), for no trace shift while switching CH 2 VOLTS/DIV control between 2 mV and 10 mV.

Page 4-6 Step 1 following part c:
ADD:

d. Set Vertical Mode to CH 1 and adjust CH 1 POSITION to align trace with center horizontal graticule line.

e. Set Vertical Mode to CH 2 and adjust CH 2 POSITION to align trace with center horizontal graticule line.

f. Press Vertical Mode DIFF button in.

CHANGE:	DESCRIPTION
	g. ADJUST CH 2 Invert Balance, R4280 (on A8 VERTICAL board near C4396) for no trace shift while alternately pressing CH 2 and DIFF Vertical Mode buttons. Note: In some instruments R4280 may not be present and CH 2 Invert Balance will be an unmarked control R4265 located near C4154. Adjustment procedure is the same for R4280 and R4265.
Page 4-9	Step 6, part g. first line:
CHANGE TO:	g. Connect a 10X probe to the CH 2 input. Connect the.....
Page 4-10	PRELIMINARY CONTROL SETTINGS
ADD:	CPLG AC
Page 4-10	Step 3, part a:
ADD:	DISPLAY MODE (T935A) A
Page 4-12	Subsection title
CHANGE TO:	D. TRIGGERING AND X-AXIS
Page 4-12	Before Step 1
ADD:	PRELIMINARY CONTROL SETTINGS
	Preset front panel controls as follows:

INTENSITY	Midrange
FOCUS	Midrange
Vertical Mode	CH 1
VOLTS/DIV (both)	10 m[1] (See footnote page 4-10)
VAR (both)	Detent
AC-GND-DC (both)	DC
A SEC/DIV	10 μ
X1-X10	X1 (fully ccw)
SOURCE	CH 1/CH 2
MODE	AUTO
SLOPE	+ (out)
HOLD-OFF	Fully ccw
LEVEL	Midrange
DISPLAY MODE (T935A)	A
POSITION (all)	Midrange
DELAY TIME POSITION	Fully ccw
CPLG	AC

CHANGE:	DESCRIPTION

Page 4-12 Step 1, part a:

CHANGE TO:

a. Connect a 50 ohm bnc cable from the sine wave generator output to a 50 ohm termination attached to the center connector of a dual-input-coupler. Connect the end connectors of the dual-input-coupler to CH 1 and CH 2 inputs.

Page 4-13 Step 2, part d:

CHANGE TO:

d. ADJUST --X Centering, R2051 (see Fig. 4-6), so dot is at center line.

Page 4-13 Step 3 title:

CHANGE TO: 3. X-Axis Gain

Page 4-13 Step 3, part f.

CHANGE TO:

f. CHECK- Horizontal deflection 4 divisions ±5% (3.8 to 4.2 div).

Scan by Zenith

TEKTRONIX®
committed to technical excellence

MANUAL CHANGE INFORMATION

PRODUCT T932A/T935A 070-2492-00

CHANGE REFERENCE C2/278

DATE 2-17-78

CHANGE:	DESCRIPTION

EFF ALL SN   Pilot Changes 5, 7, 8, & 9

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

CHANGE TO:

			REF
A13[1]	263-0051-00	CIRCUIT BD ASSY:TIMING W/ROTARY SWITCH	PC 5
A13[2]	263-0052-00	CIRCUIT BD ASSY:TIMING W/ROTARY SWITCH	PC 5
C118	281-0627-00	CAP.,FXD,CER DI:1PF,+/-0.25PF,500V	PC 9
(Delete reference to C118 in Step 4, Part e on Page 4-7 of text)			
C4156	281-0543-00	CAP.,FXD,CER DI:270PF,10%,500V	PC 9
C4256	281-0543-00	CAP.,FXD,CER DI:270PF,10%,500V	PC 9
R766	301-0301-00	RES.,FXD,CMPSN:300 OHM,5%,0.50W	PC 8
R811	315-0431-00	RES.,FXD,CMPSN:430 OHM,5%,0.25W	PC 8
R4156	315-0681-00	RES.,FXD,CMPSN:680 OHM,5%,0.25W	PC 9
R4178	315-0220-00	RES.,FXD,CMPSN:22 OHM,5%,0.25W	PC 9
R4188	315-0220-00	RES.,FXD,CMPSN:22 OHM,5%,0.25W	PC 9
R4256	315-0681-00	RES.,FXD,CMPSN:680 OHM,5%,0.25W	PC 9
R4267	321-0221-00	RES.,FXD,FILM:1.96K OHM,1%,0.125W	PC 7
R4278	315-0220-00	RES.,FXD,CMPSN:22 OHM,5%,0.25W	PC 9
R4288	315-0220-00	RES.,FXD,CMPSN:22 OHM,5%,0.25W	PC 9
R4289	321-0133-00	RES.,FXD,FILM:237 OHM,1%,0.125W	PC 7
R4398	315-0203-00	RES.,FXD,CMPSN:20K OHM,5%,0.25W	PC 9

REMOVE:

C4375	281-0788-00	CAP.,FXD,CER DI:470PF,10%,100V	PC 9
C4385	281-0788-00	CAP.,FXD,CER DI:470PF,10%,100V	PC 9
R4280	311-1568-00	RES.,VAR,NONWIR:50 OHM,20%,0.50W	PC 7
	(R4280 is replaced with W4280)		
R4363	315-0471-00	RES.,FXD,CMPSN:470 OHM,5%,0.25W	PC 9
R4364	315-0471-00	RES.,FXD,CMPSN:470 OHM,5%,0.25W	PC 9

ADD:

R4159	315-0220-00	RES.,FXD,CMPSN:22 OHM,5%,0.25W	PC 9
	(Added in series with left end of C4158-diagram 3)		
R4169	315-0220-00	RES.,FXD,CMPSN:22 OHM,5%,0.25W	PC 9
	(Added in series with left end of C4168-diagram 3)		

PRODUCT T932A/T935A CHANGE REFERENCE C2/278 DATE 2-17-78

CHANGE:	DESCRIPTION

ADD:

			REF
R4259	315-0220-00	RES.,FXD,CMPSN:22 OHM,5%,0.25W	PC 9
	(Added in series with left end of C4258-diagram 3)		
R4265	311-0334-00	RES.,VAR,WW:500 OHM	PC 7
	(Added in series between R4267 and -8V supply; diagram 3)		
R4269	315-0220-00	RES.,FXD,CMPSN:22 OHM,5%,0.25W	PC 9
	(Added in series with left end of C4268-diagram 3)		
W4280	131-0566-00	BUS CONDUCTOR,DUMMY RES	PC 7
	(Added in place of R4280)		

Afore listed components affect circuit board and schematics as follows:

C118: A1 INTERFACE board; CRT & VERT AMPL diagram 1.

C4156, C4256, R4156, R4178, R4188, R4256, R4267, R4278, R4288, R4289, R4280, R4159, R4169, R4259, R4265, R4269 and W4280: A8 VERTICAL board; VERTICAL INPUT diagram 3.

R766: A2 LOW VOLTAGE POWER SUPPLY board; POWER SUPPLY diagram 2.

R811: A1 INTERFACE board; POWER SUPPLY diagram 2.

R4398, C4375, C4385, R4363, R4364: A8 VERTICAL board; VERTICAL SWITCHING diagram 4.

DIAGRAM 3

NOTE: Voltage at bottom of R4125 is $-8V_1$ (not $+8V_1$).

Voltage at emitter of Q4134 is $+8V_1$.

Voltage at emitter of Q4234 is $+8V_1$ (not -8V).