Tektronix®

COMMITTED TO EXCELLENCE

T932A/T935A OSCILLOSCOPE

INSTRUCTION MANUAL

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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.

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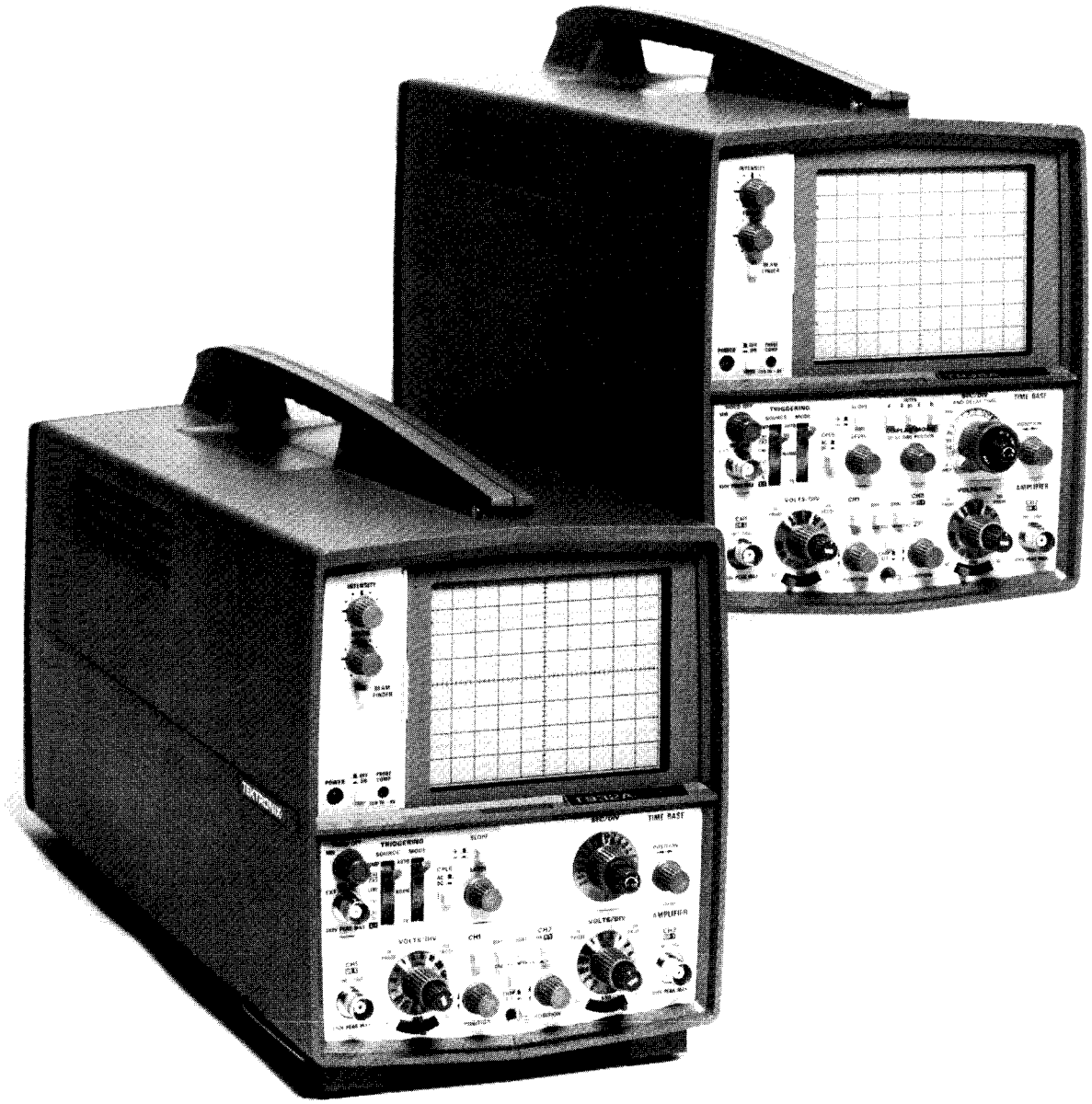

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Fig. 1-1. T932A/T935A 35 MHz Oscilloscopes.

SPECIFICATION

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—110 to 132 V. LO—92 to 110 V.
240 V Range	HI—216 to 250 V. LO—202 to 242 V.
Line Frequency	50 to 60 Hz.
Maximum Power Consumption	50 watts; 60 Volt-Amps.
CRT Display	
Display Area	8 x 10 cm.
Trace Rotation Range	Adequate to align trace with horizontal center line.
Standard Phosophor	P31.
Nominal Accelerating 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 best 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 5 div reference signal.
Input Resistance	Approximately 1 MΩ.
Input Capacitance	Approximately 30 pF.
Deflection Accuracy	With 5-division reference signal. +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.
EXT 10	+5 V to −5V.

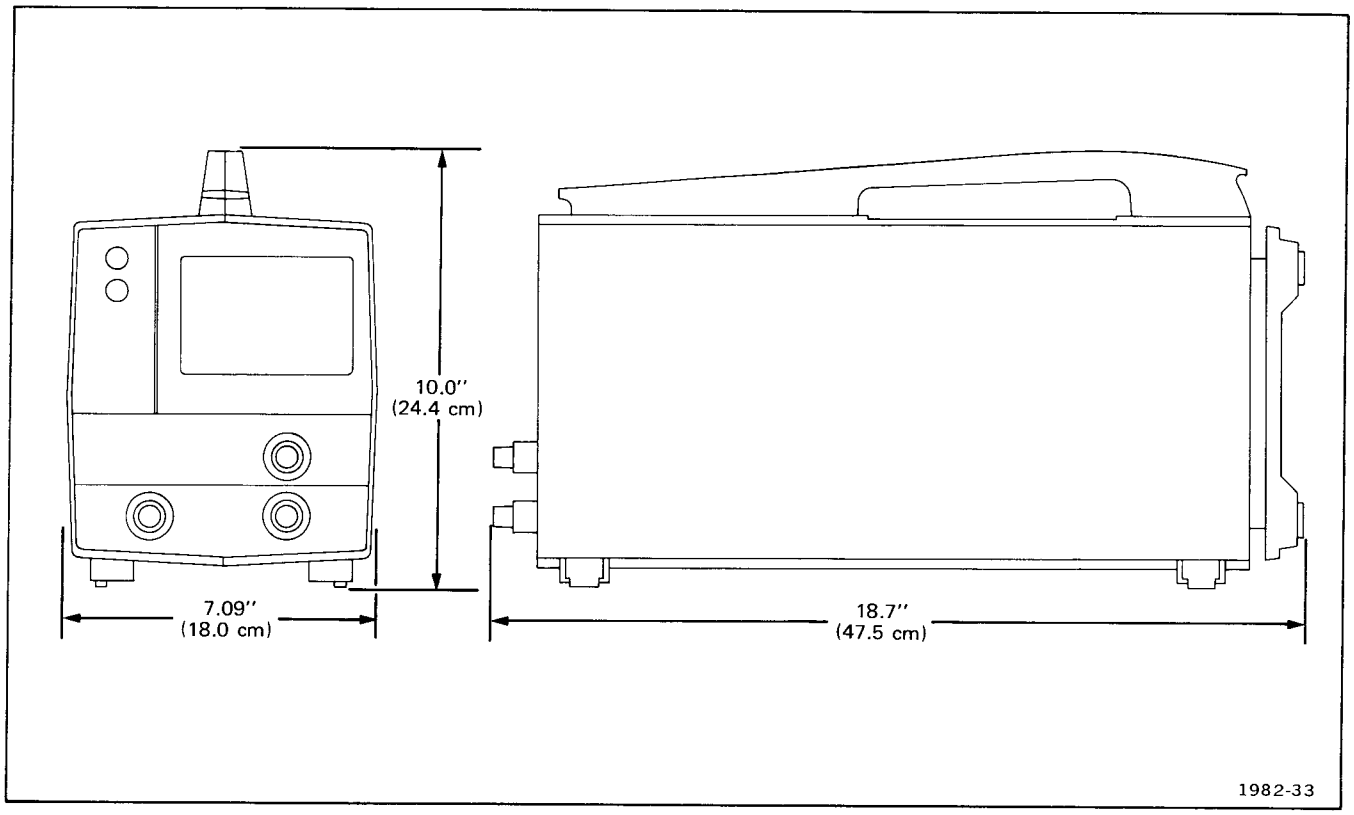


Fig. 1-2. T932A/T935A dimensional drawing.

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 10X Probes
1 Clear Light Filter

(See ACESSORIES tab page at back of this manual for further information.)

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-5C 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-5C Option 3**

OPERATING INSTRUCTIONS

WARNING

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

OPERATING VOLTAGE

Your instrument will operate from either a 120 V or 240 V ac 50 to 60 Hz nominal power input source. Check that the Power Input Voltage Selector (120 V/240 V) switch and the Regulating Range Selector (HI/LO) switch are set to positions that include the value of the applied power input voltage. In the United States, the 120 V/240 V switch is normally set for 120 V and the HI/LO switch is normally set for HI at the factory. In Europe, the 120 V/240 V switch is set for 240 V and the HI/LO switch is normally set for LO. The POWER indicator lamp will blink when the applied power input voltage varies more than about 10% (either high or low) from the value for which the switches are set.

CAUTION

Your instrument may be damaged if it is operated from a 240 V power input voltage source with the 120 V/240 V switch set for 120 V. The 120 V/240 V switch and the HI/LO switch are both visible from the bottom of the instrument in all T900-series bench version oscilloscopes, but the 120 V/240 V switch is not adjustable from outside of the cabinet. Refer 120 V/240 V power input voltage selection to qualified service personnel.

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.

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.

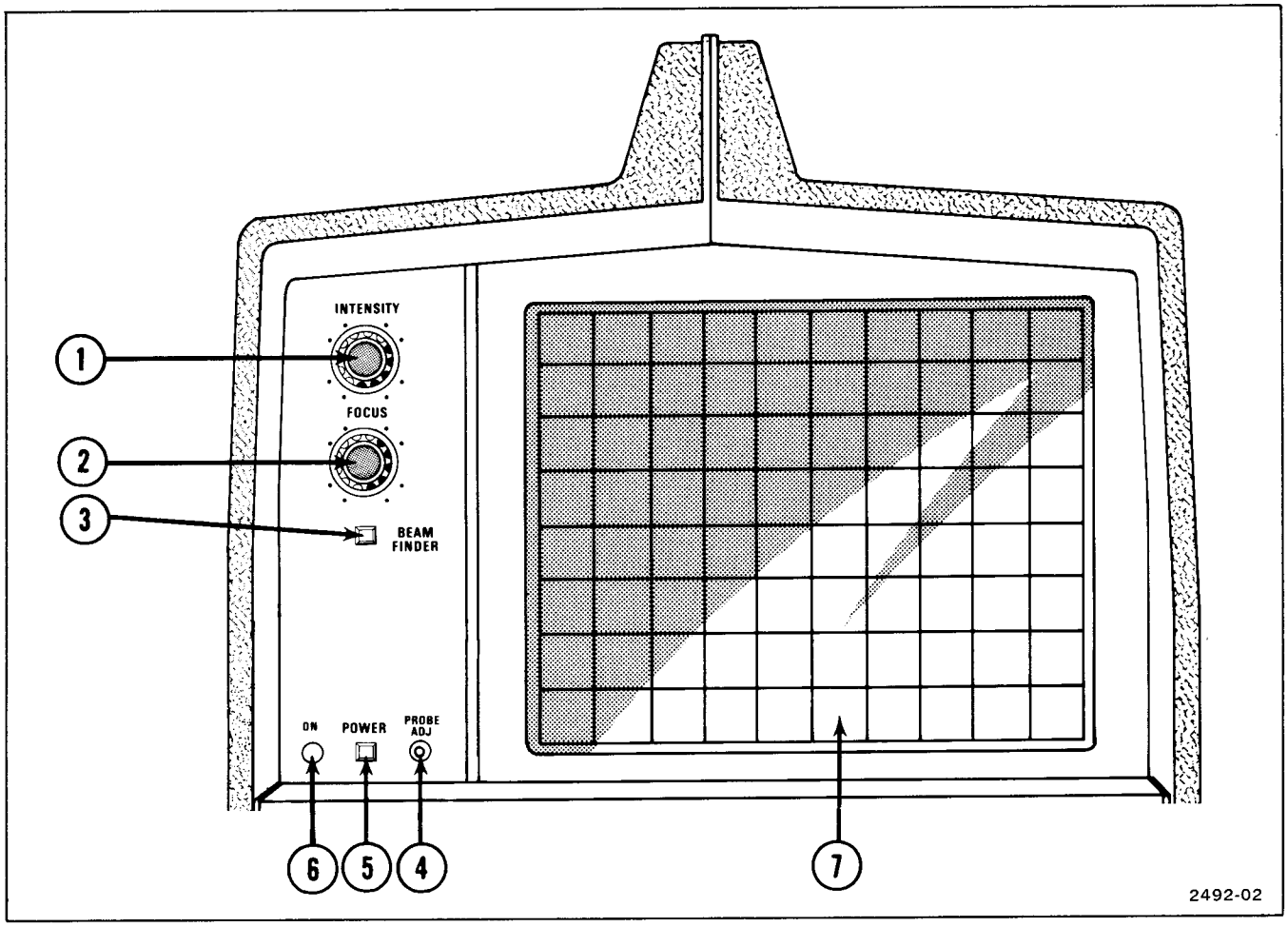


Fig. 2-1. Display front panel controls and connectors.

(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.

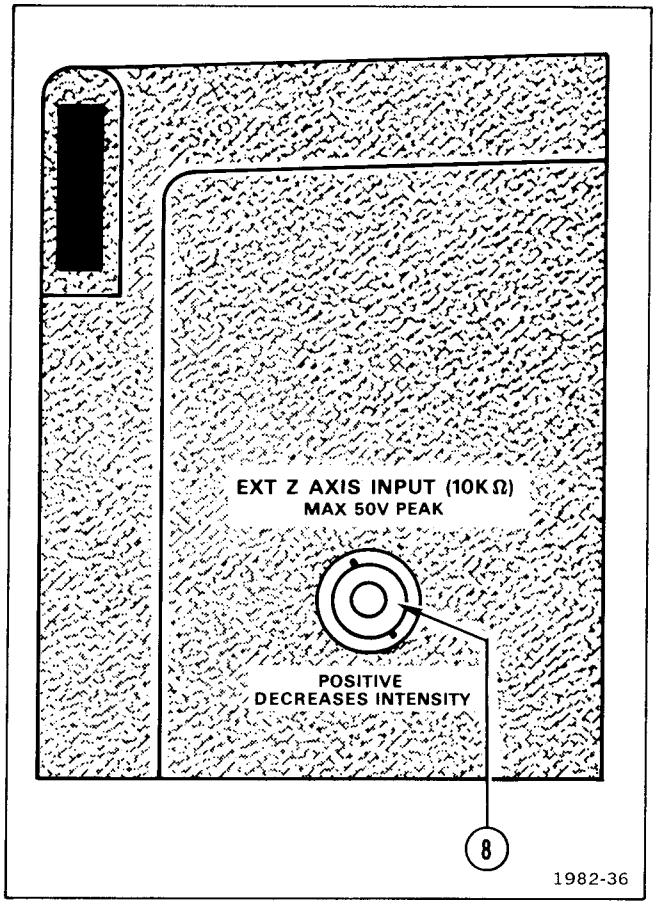


Fig. 2-2. Rear panel controls and connectors.

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.

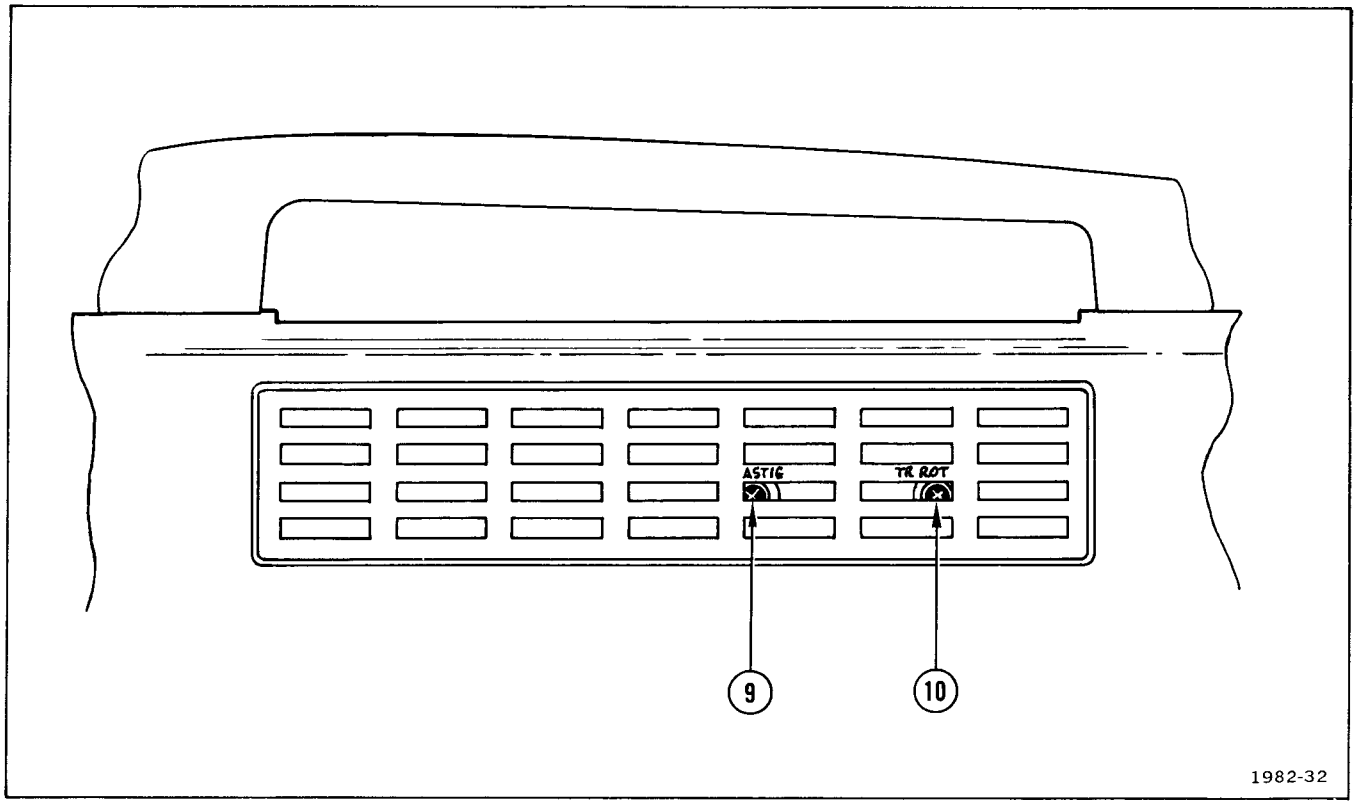


Fig. 2-3. Left side of cabinet.

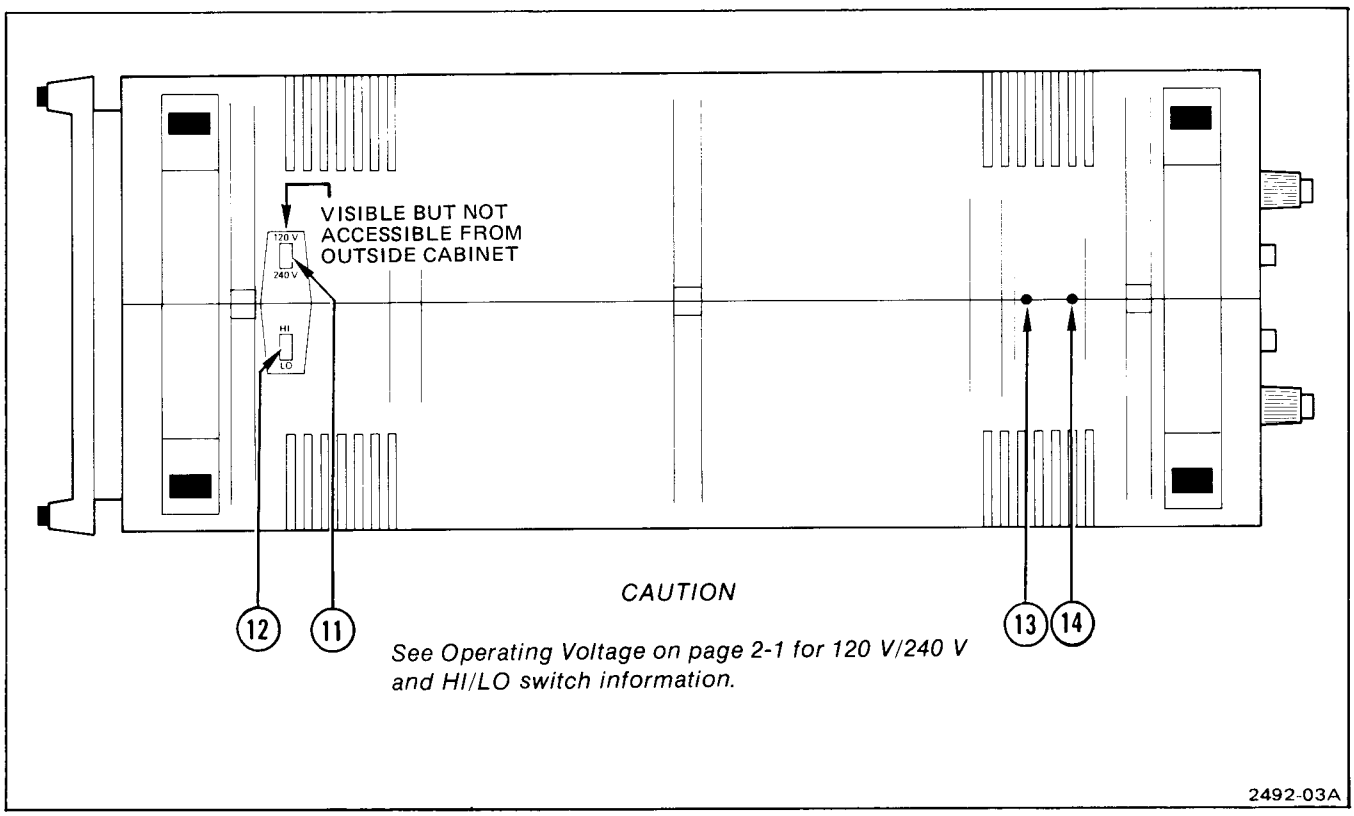


Fig. 2-4. Bottom of cabinet.

Bottom of Cabinet (Fig. 2-4)

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

(12) **HI/LO**—Externally adjustable screwdriver actuated switch selects operation from either high or low power input voltage regulating range: LO selects 92 to 110 V or 202 to 242 V, and HI selects 110 to 132 or 220 to 250 V (depending on setting of 120 V/240 V switch).

(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.

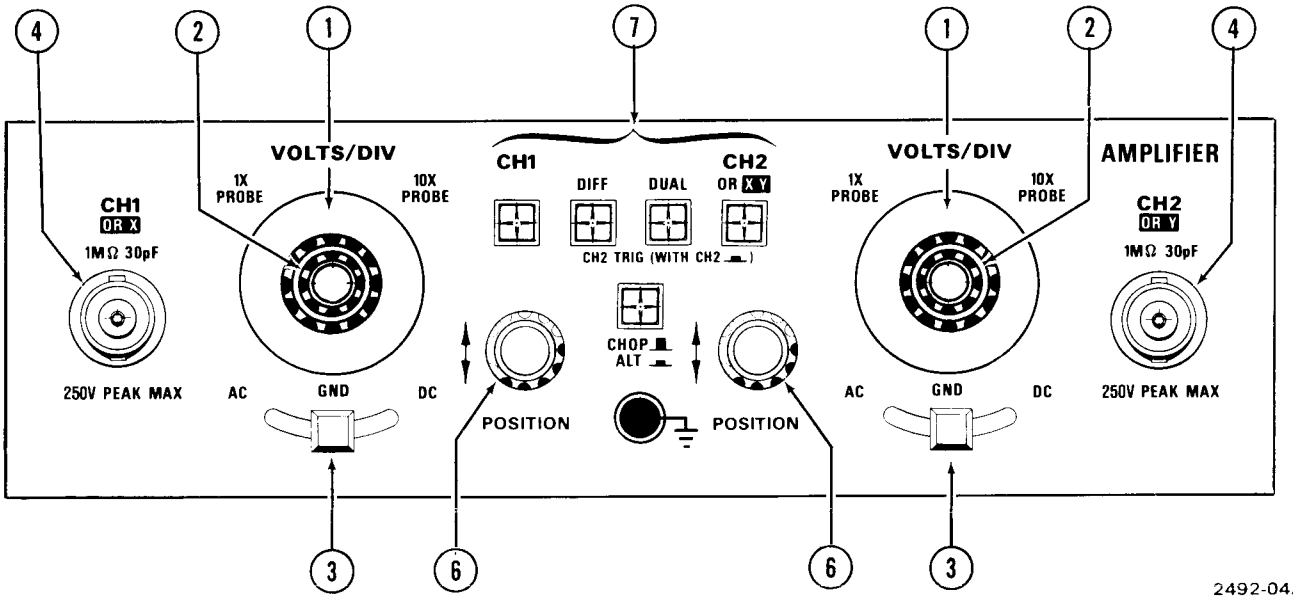


Fig. 2-5. Vertical Amplifier front panel controls and connectors.

(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.

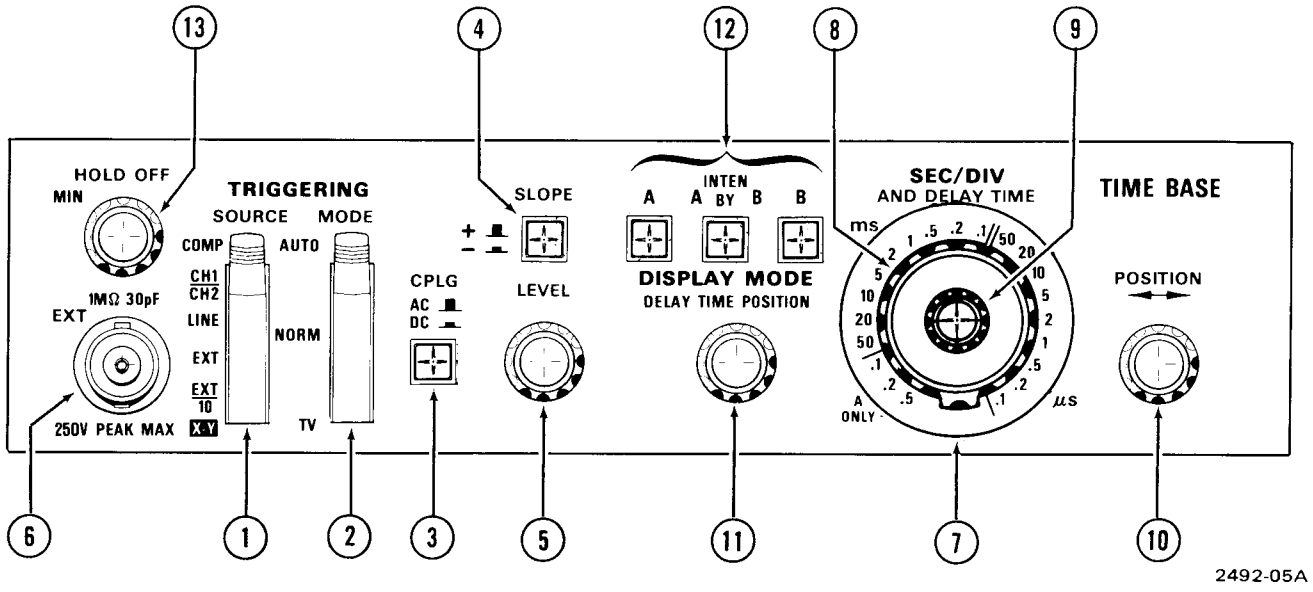


Fig. 2-6. Time Base front panel controls and connectors.

(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 are set for your power input voltage (see page 2-1).

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 − (in) 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
DISPLAY MODE (T935A)	A

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.

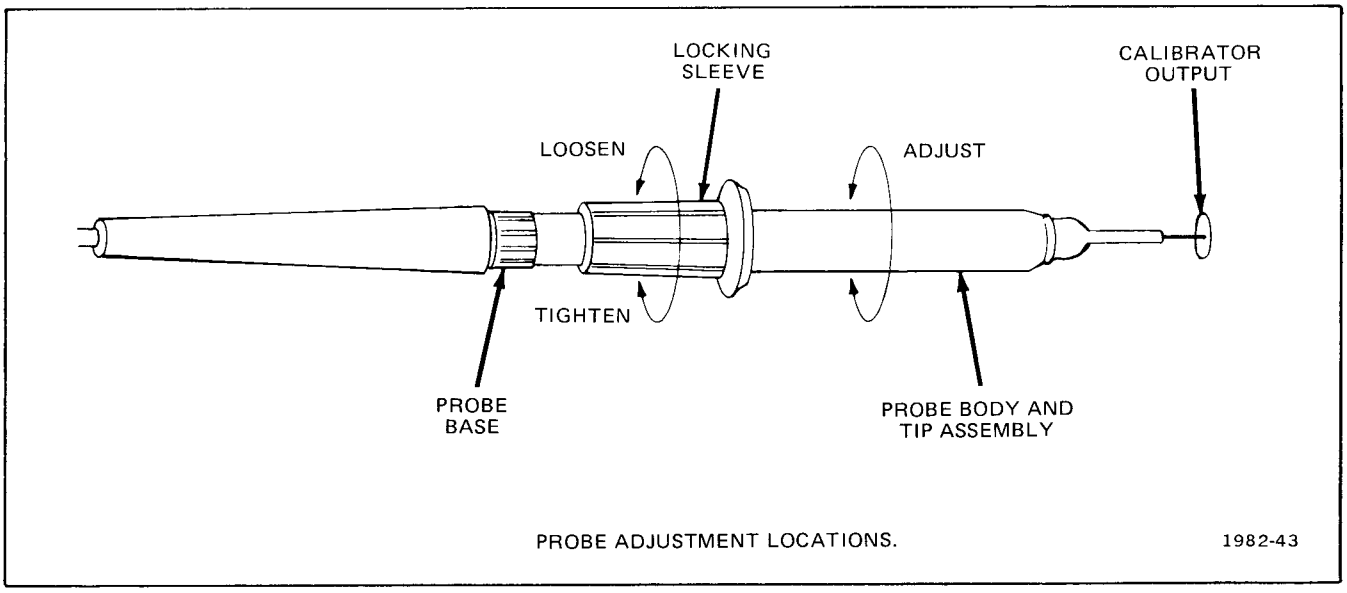


Fig. 2-7. Probe compensation.

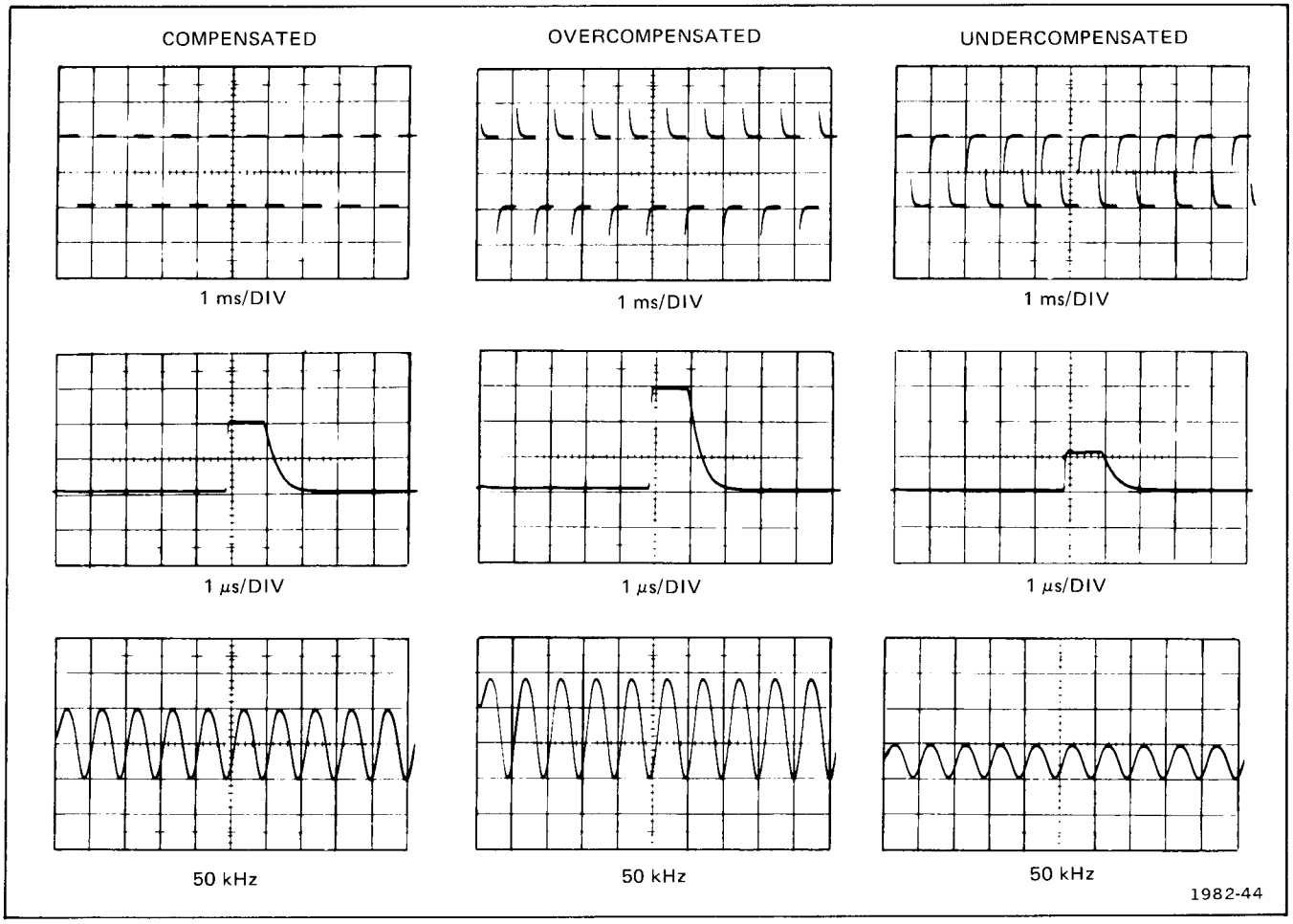


Fig. 2-8. Effects of probe compensation.

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.

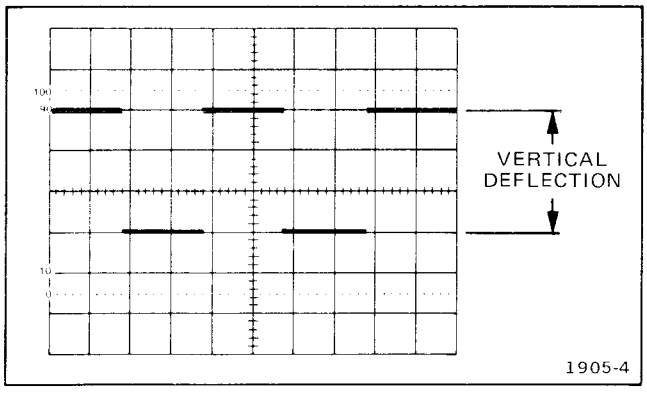


Fig. 2-9. Peak-to-peak voltage measurement.

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.

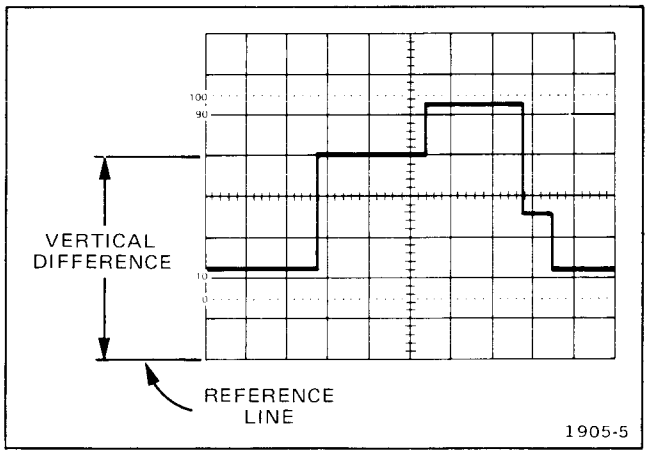


Fig. 2-10. Instantaneous voltage measurement.

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:

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

$$\text{Phase Difference} = 27°$$

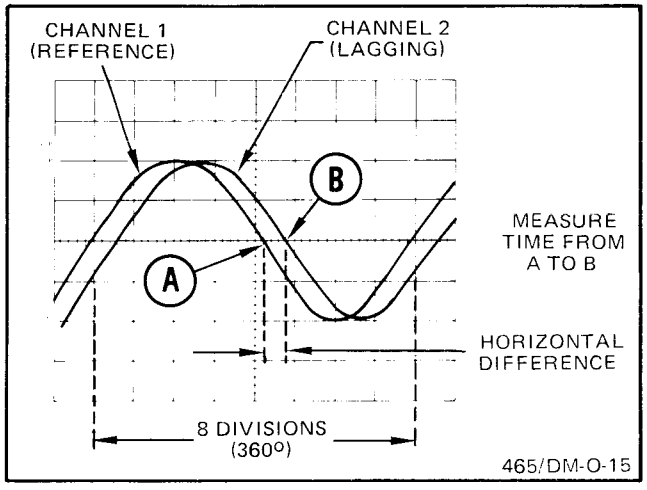


Fig. 2-11. Phase difference.

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:

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

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

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

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.**

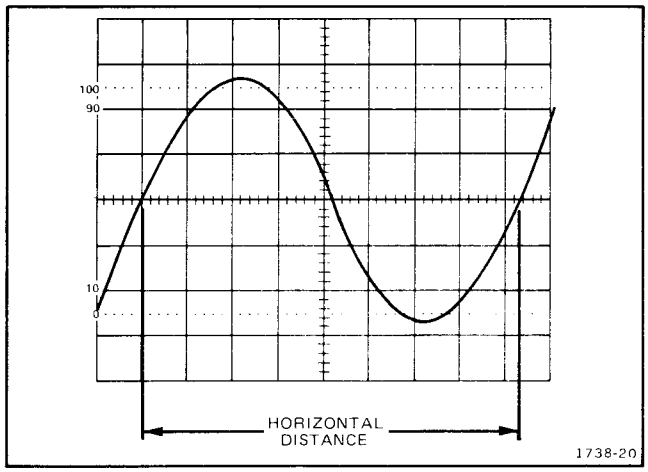


Fig. 2-12. Time duration.

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:

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

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

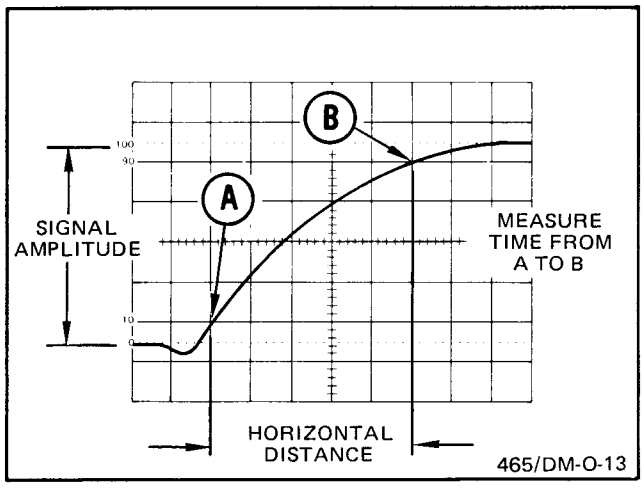


Fig. 2-13. Risetime.

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.

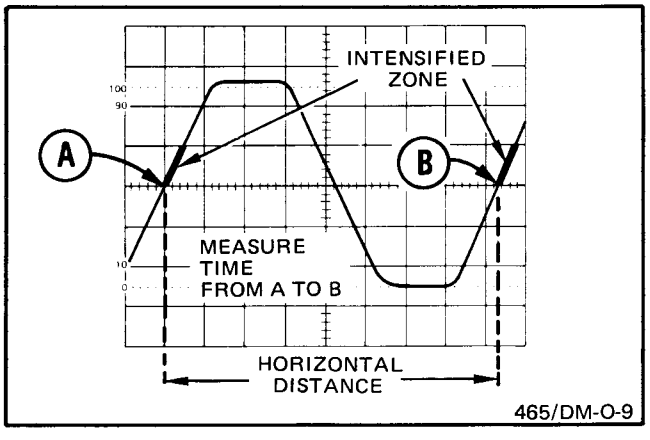


Fig. 2-14. Time duration between points on a waveform.

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).

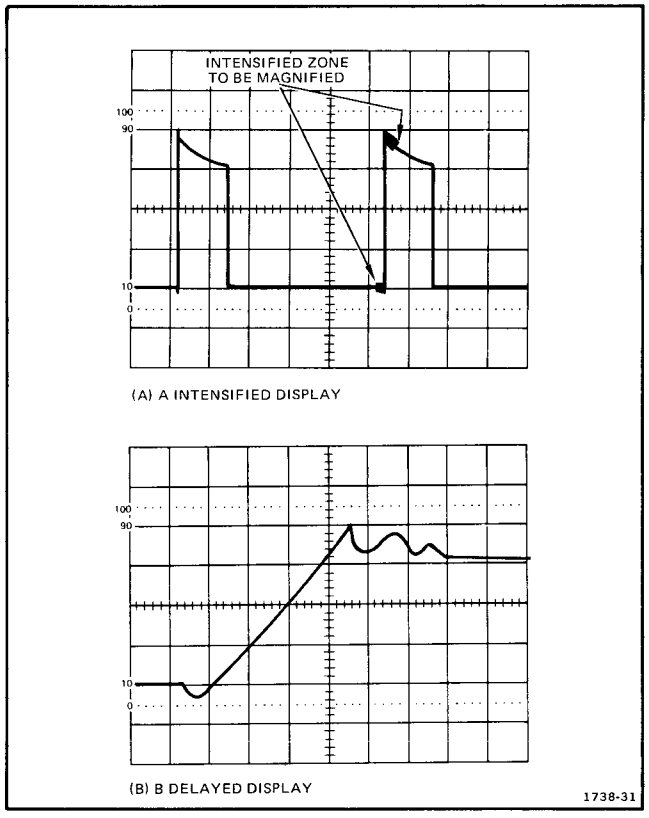


Fig. 2-15. Delayed sweep magnification.

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:

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

OSCILLOSCOPE LIGHT FILTER AND GRATICULE ILLUMINATION PHOTGRAPHY 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 C5B or C5B 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 severely 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.

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)	Impedance, 50 Ω; length, 42 inches; connectors, bnc.	Signal interconnection.	a. Tektronix Part 012-0057-01.
6. Dual Input Coupler	Connectors, bnc female to 2 bnc male.	Signal interconnection.	a. Tektronix Part 067-0525-01.

[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 are set for your power input voltage (see page 2-1).

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	50 V	5	4.85 to 5.15

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

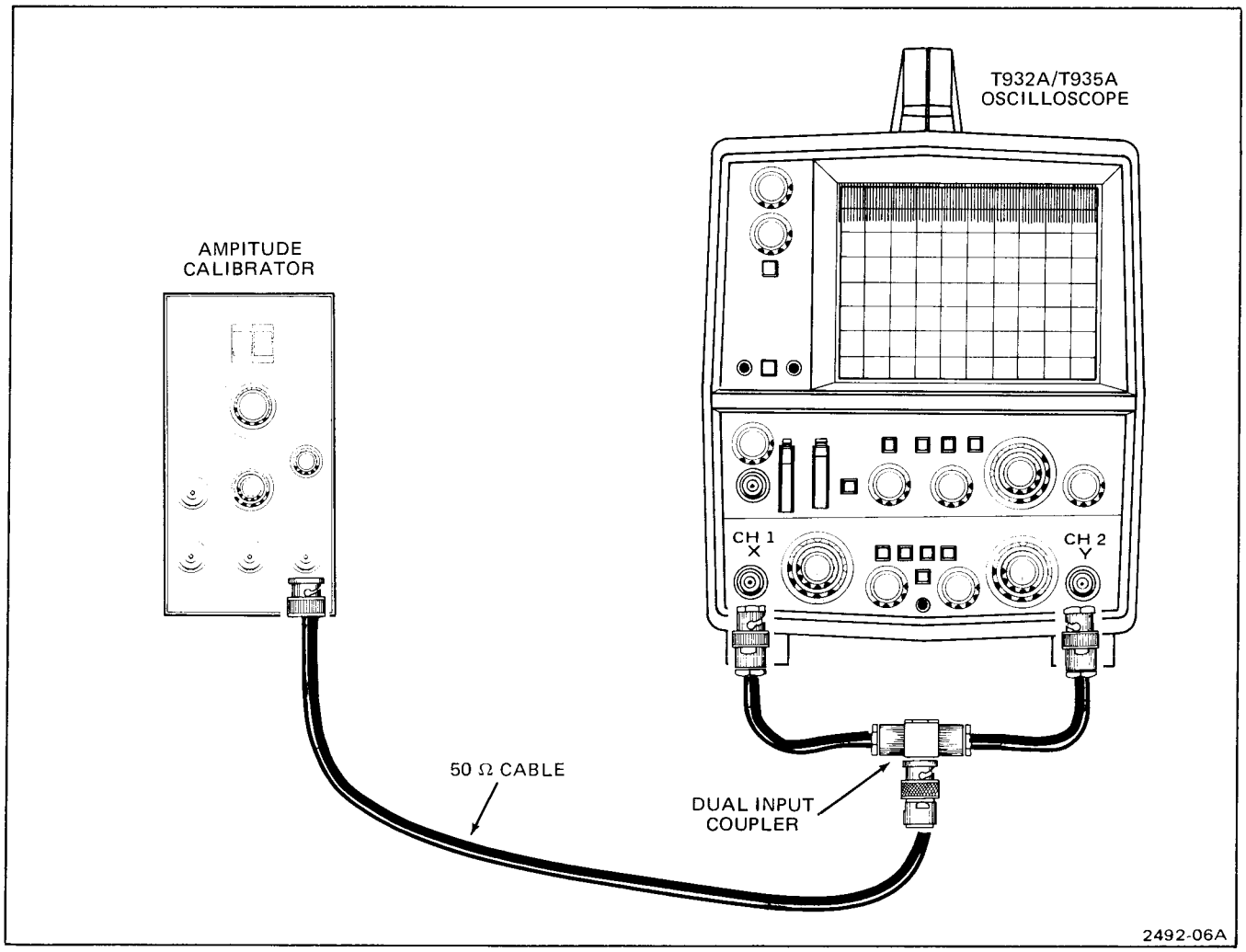


Fig. 3-1. Deflection accuracy check test setup.

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.

f. Set Amplitude Calibrator for a .5 V output.

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 5 divisions ±5% (4.75 to 5.25 div). 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.

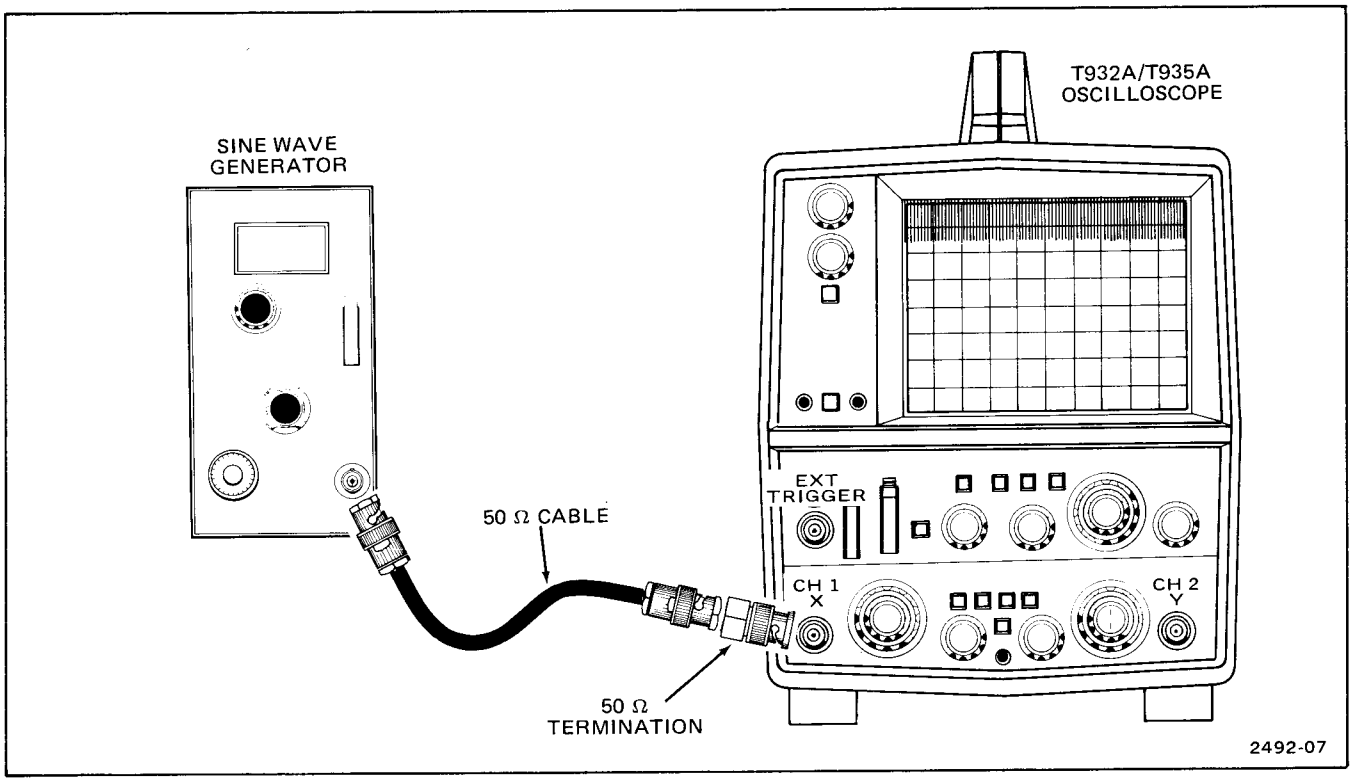


Fig. 3-2. Bandwidth check test setup.

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 (or X-Y)
CH 1 AC-GND-DC	AC
CH 2 AC-GND-DC	GND
CH 1 VOLTS/DIV	.1V

b. Connect sine-wave generator through 50 Ω cable and 50 Ω termination, to X (CH 1) input.

c. Set generator frequency to 50 kHz (reference) and adjust output amplitude for 5 divisions (about .5 volt) of horizontal deflection.

d. Set generator frequency to 2 MHz.

e. CHECK—Display amplitude is at least 3.5 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.

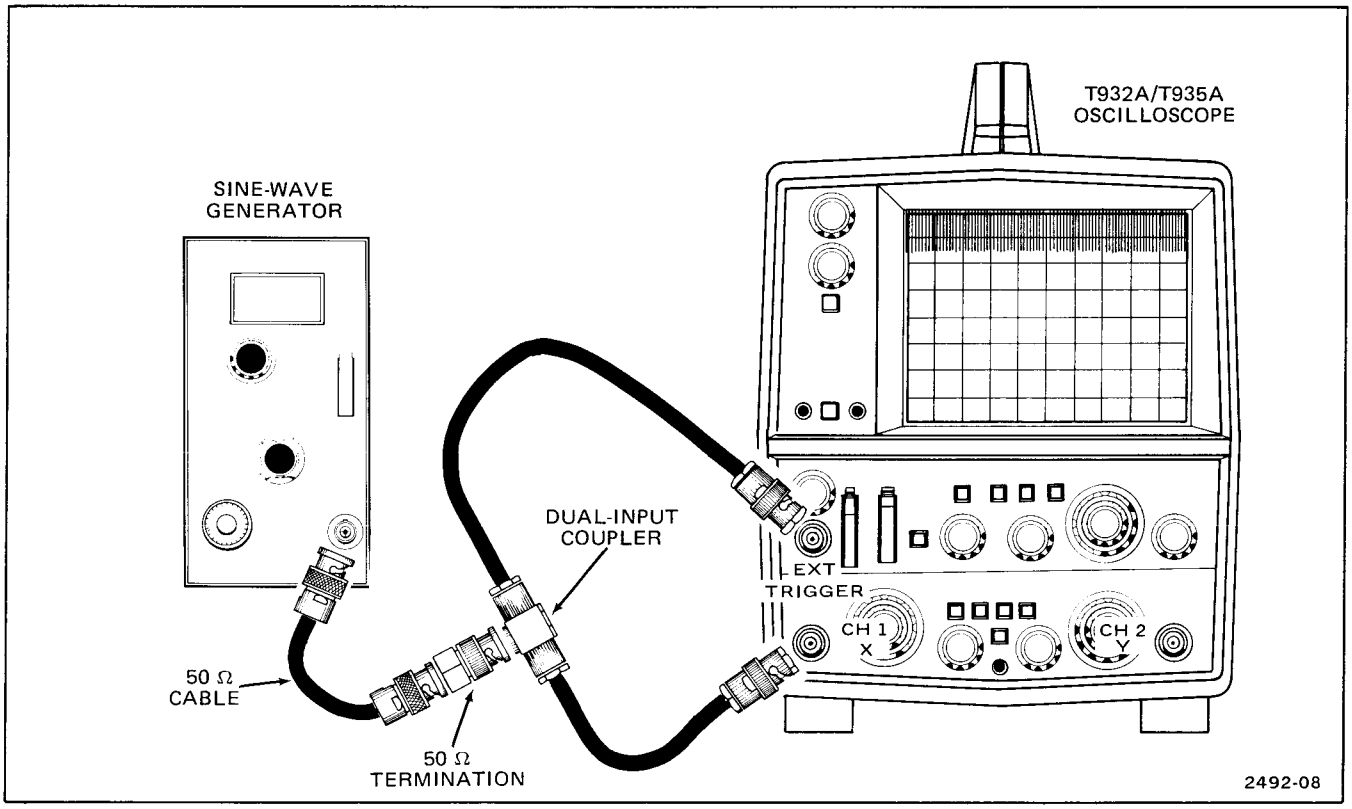


Fig. 3-3. X Gain, Triggering, and Z-axis input check test setup.

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
SOURCE LINE

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 0.5-division display.

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.

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).

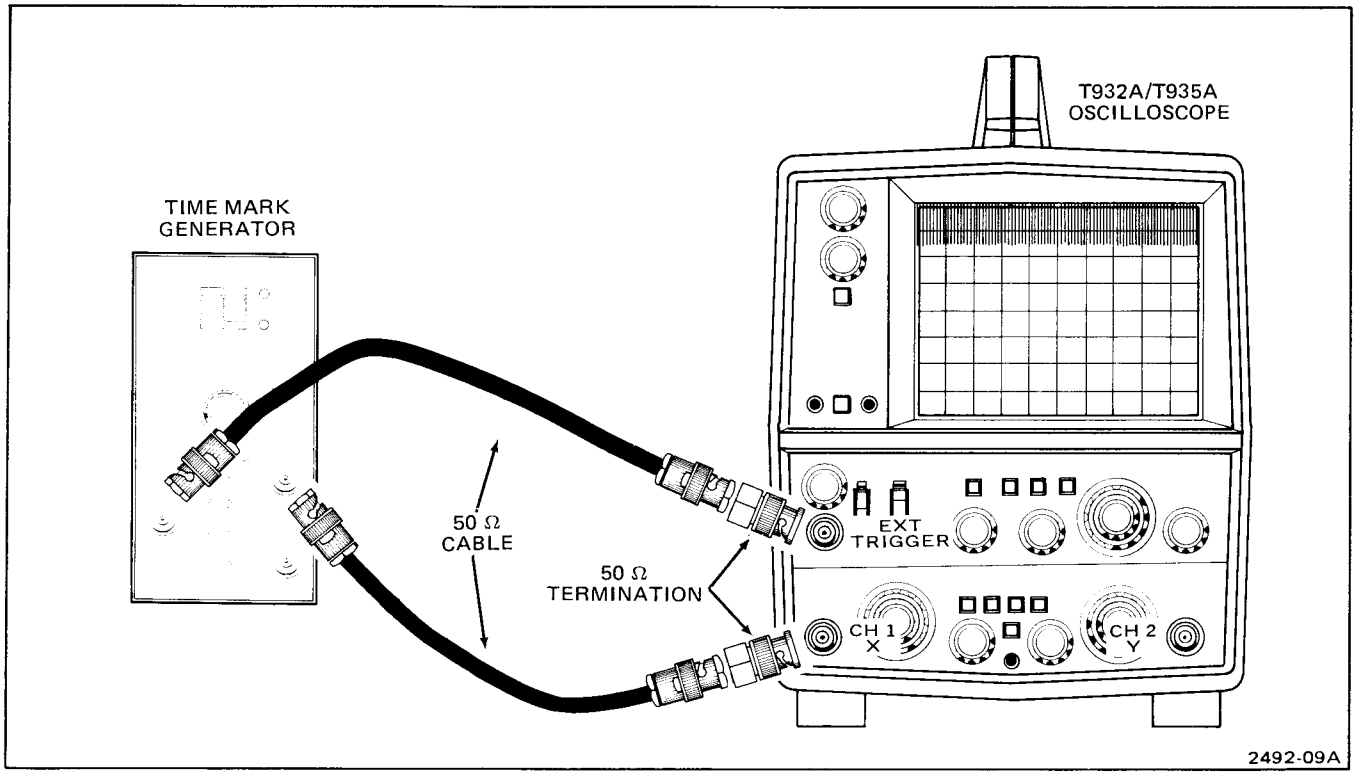


Fig. 3-4. Timing accuracy and delay time check test setup.

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 Horizonal 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.

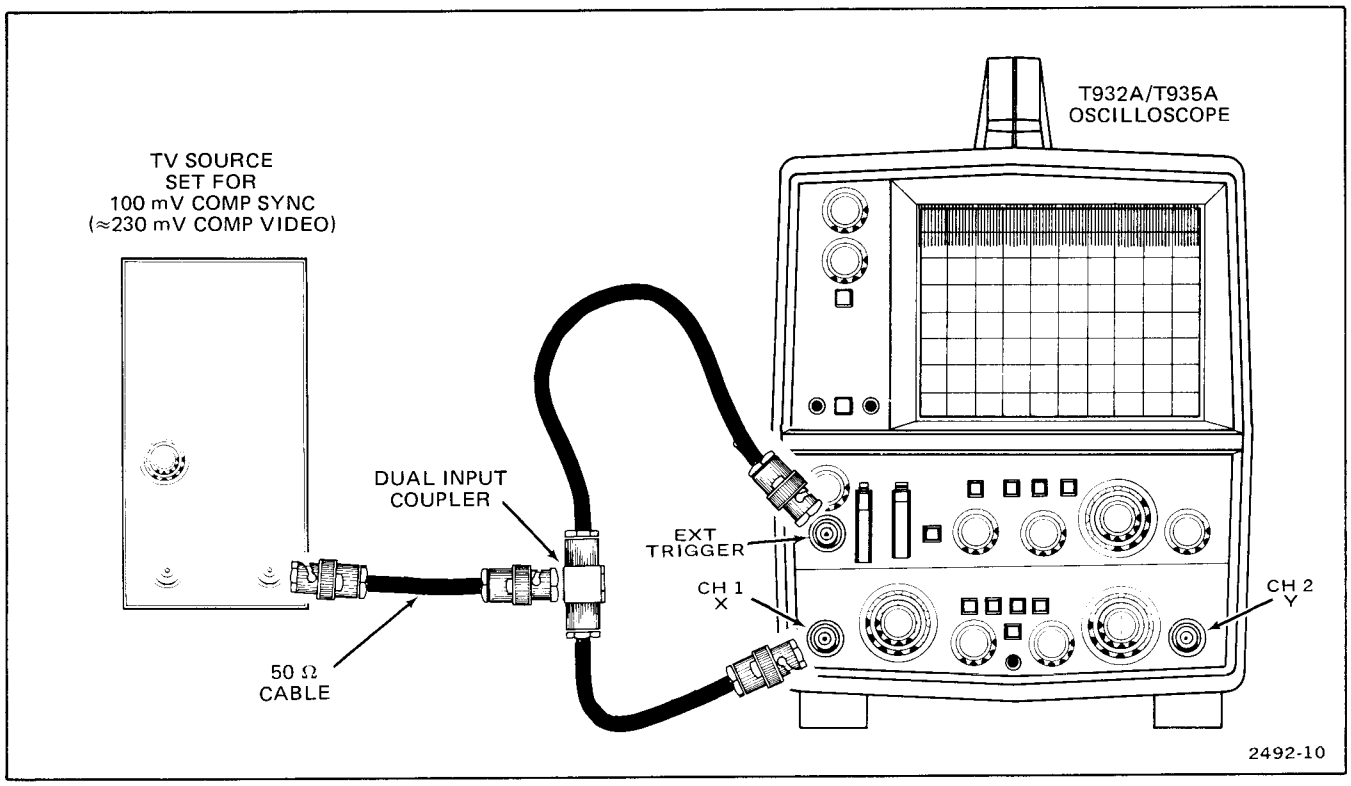


Fig. 3-5. TV trigger check test setup.

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 501A 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 that the 120 V/240 V and HI/LO switches are properly set (see Operating Voltage Selection, Page 5-1).

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
2. Time-Mark Generator
3. 50 Ω BNC Cable
4. 50 Ω Termination
5. Screwdriver
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.

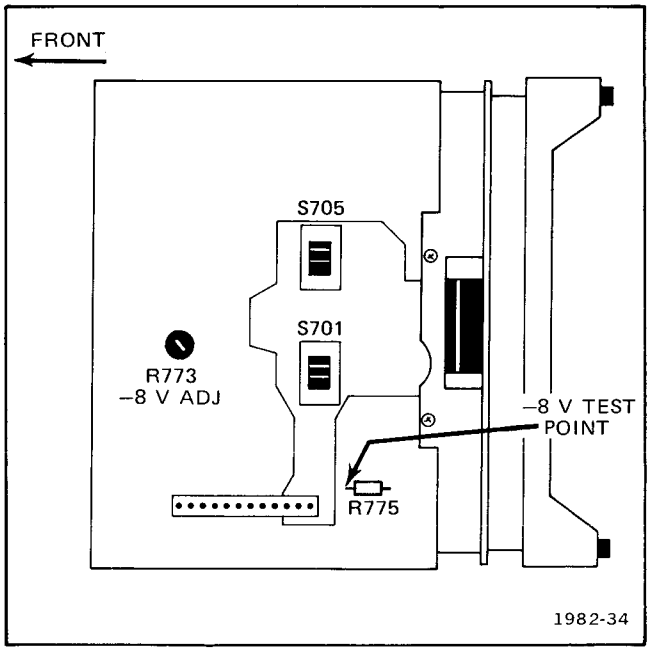


Fig. 4-1. Power supply adjustment locations (on bottom of chassis).

[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.

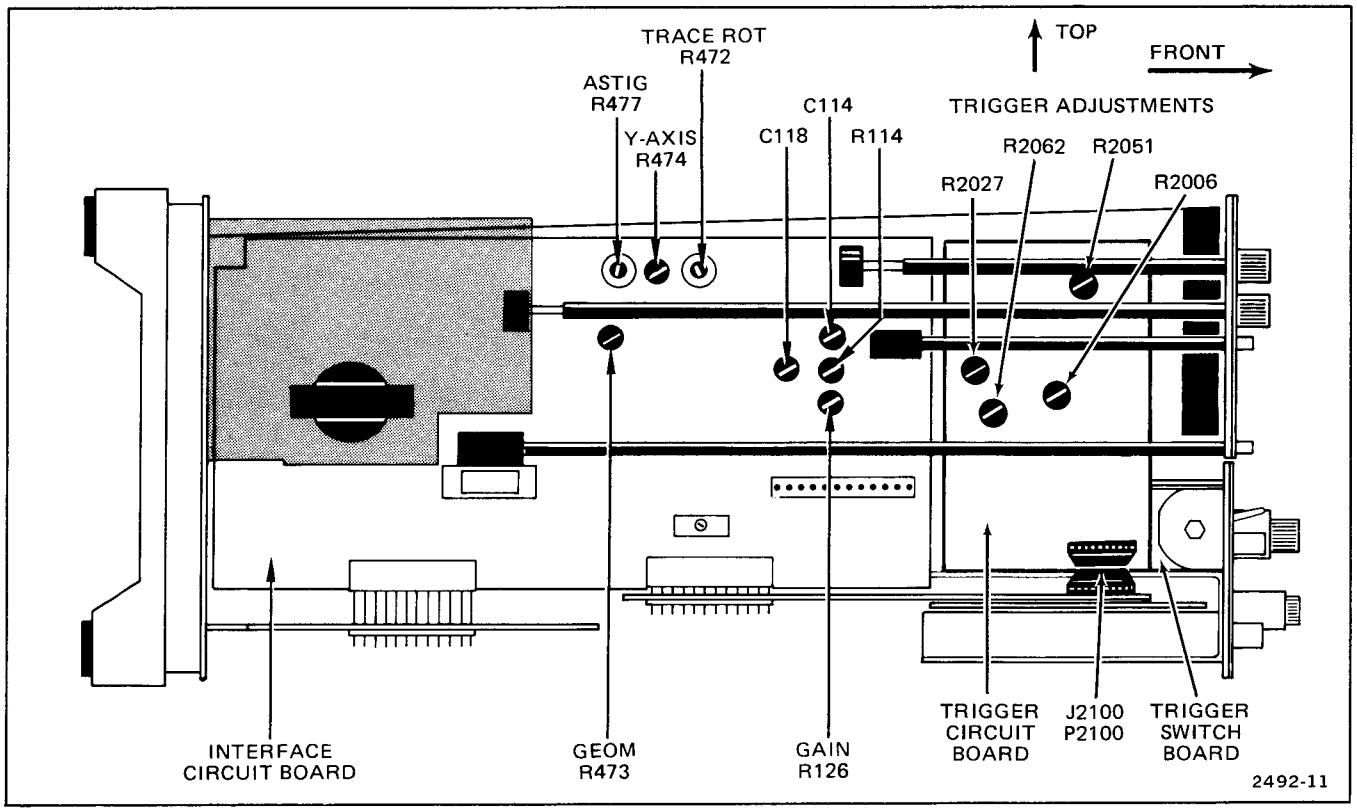


Fig. 4-2. Interface board adjustment locations (on left side of crt).

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
CPLG	AC

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 and CH 2 Invert 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, R4230 (see Fig. 4-3), for no trace shift while switching CH 2 VOLTS/DIV control between 2 mV and 10 mV.

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.

g. ADJUST CH 2 Invert Balance, R4265 (on A8 VERTICAL board near C4154) for no trace shift while alternately pressing CH 2 and DIFF Vertical Mode buttons.

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.

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

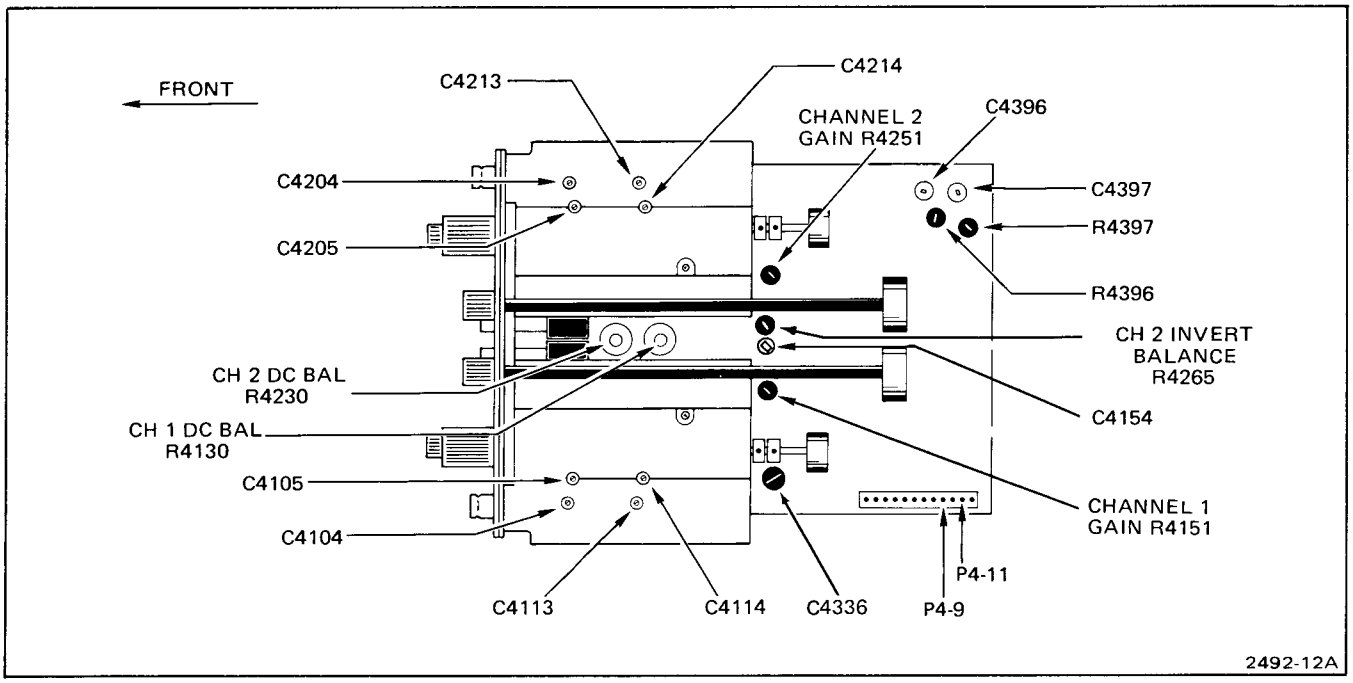


Fig. 4-3. Vertical Amplifier adjustment locations (bottom view of instrument).

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.

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—CH 1 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.

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

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, (see Fig. 4-2), for best front corner of waveform using a low-capacitance alignment tool.

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-adust C4396, R4396, C4397, R4397, C114, 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.

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

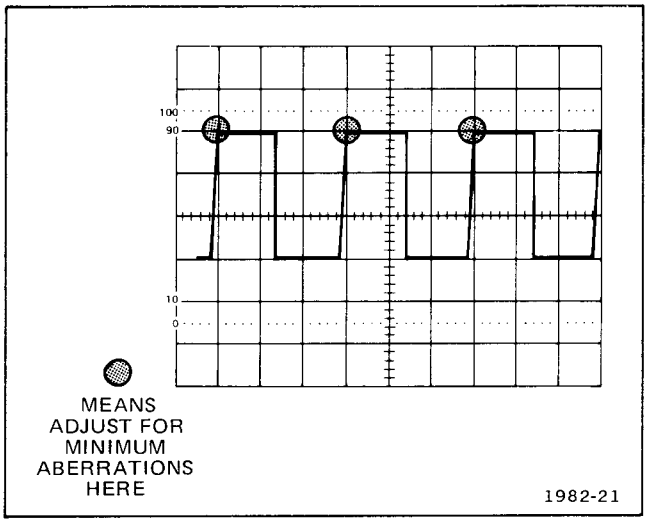


Fig. 4-4. Display of correct attenuator compensation (idealized).

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 2 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
2. 50 Ω Termination
3. 50 Ω BNC Cable
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
CPLG	AC

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
DISPLAY MODE (T935A)	A

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.**

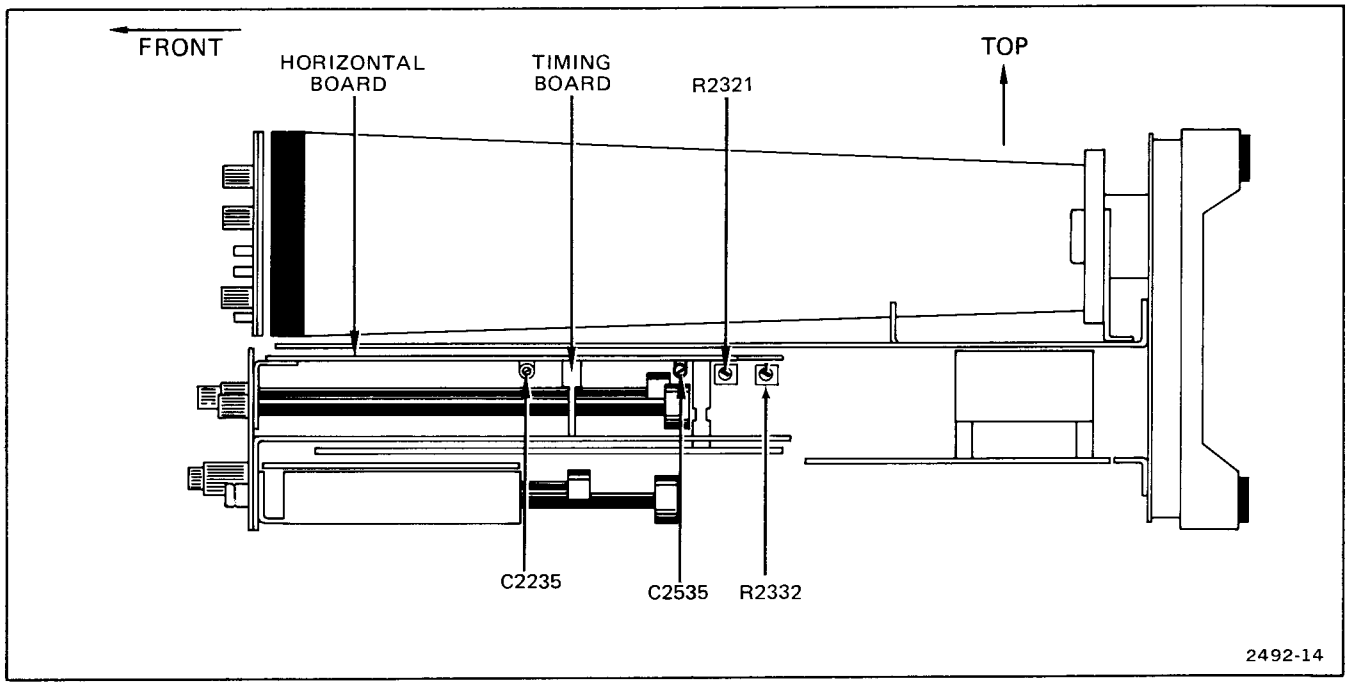


Fig. 4-5. Time Base adjustment locations (on right side of instrument).

D. TRIGGERING & X-AXIS

Equipment Required

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

PRELIMINARY CONTROL SETTINGS

Preset front panel controls as follows:

INTENSITY	Midrange
FOCUS	Midrange
Vertical Mode	CH 1
VOLTS/DIV (both)	10 m[1]
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

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 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.

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.

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

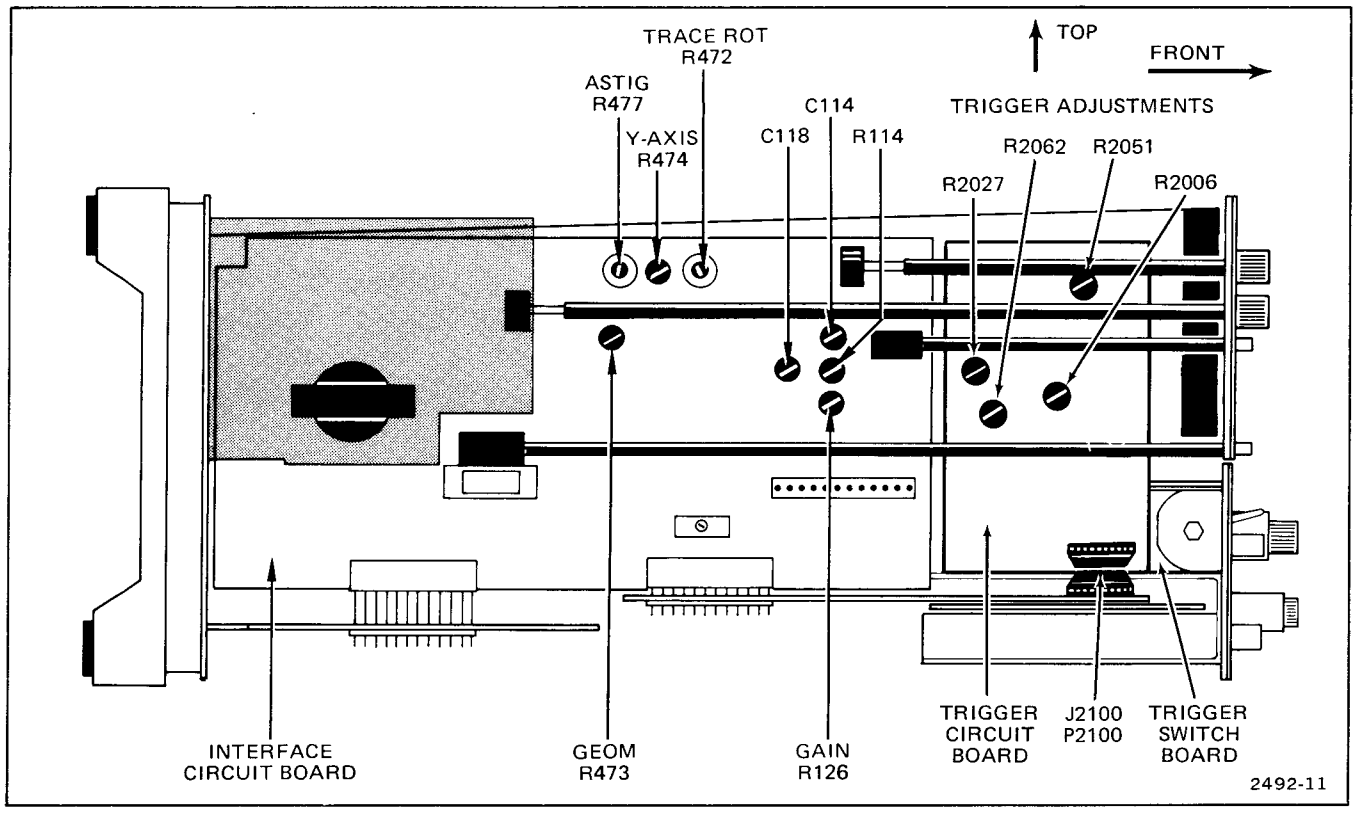


Fig. 4-6. Trigger board adjustment locations (on left side of crt).

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.

c. Set SOURCE to X-Y.

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

3. X-Axis Gain

a. Set:

Vertical Mode	CH 2 (X-Y)
VOLTS/DIV (both)	10 m
Channel 1	
AC-GND-DC	AC
Channel 2	
AC-GND-DC	GND

b. Connect a 1 kHz, 50 mV Amplitude Calibrator signal through a 50 Ω cable to the Channel 1 input.

c. ADJUST—X Gain R2062 (see Fig. 4-6), for two dots spaced for a horizontal deflection of 5-divisions (set INTENSITY for visible low-intensity dots).

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

e. CHECK—For two dots spaced for a horizontal deflection of 5 divisions ±5% (4.75 to 5.25 div).

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.

OPERATING VOLTAGE SELECTION

Your instrument will operate from either a 120 V or 240 V ac 50 to 60 Hz nominal power input source. Check that the Power Input Voltage Selector (120 V/240 V) switch and the Regulating Range Selector (HI/LO) switch are set to positions that include the value of the applied power input voltage. In the United States, the 120 V/240 V switch is normally set for 120 V and the HI/LO switch is normally set for HI at the factory. In Europe, the 120 V/240 V switch is set for 240 V and the HI/LO switch is normally set for LO. The POWER indicator lamp will blink when the applied power input voltage varies more than about 10% (either high or low) from the value for which the switches are set.

CAUTION

Your instrument may be damaged if it is operated from a 240 V power input voltage source with the 120 V/240 V switch set for 120 V. The 120 V/240 V switch and the HI/LO switch are both visible from the bottom of the instrument in all T900-series bench version oscilloscopes, but the 120 V/240 V switch is not adjustable from outside of the cabinet. Refer 120 V/240 V power input voltage selection to qualified service personnel.

The 120 V/240 V switch S701 is accessible in all T900-series instruments when the cabinet is removed. If S701 setting needs to be changed, the value of the line fuse F700 must also be changed. See Fuse Replacement in Corrective Maintenance portion of Service Information section of this manual.

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.

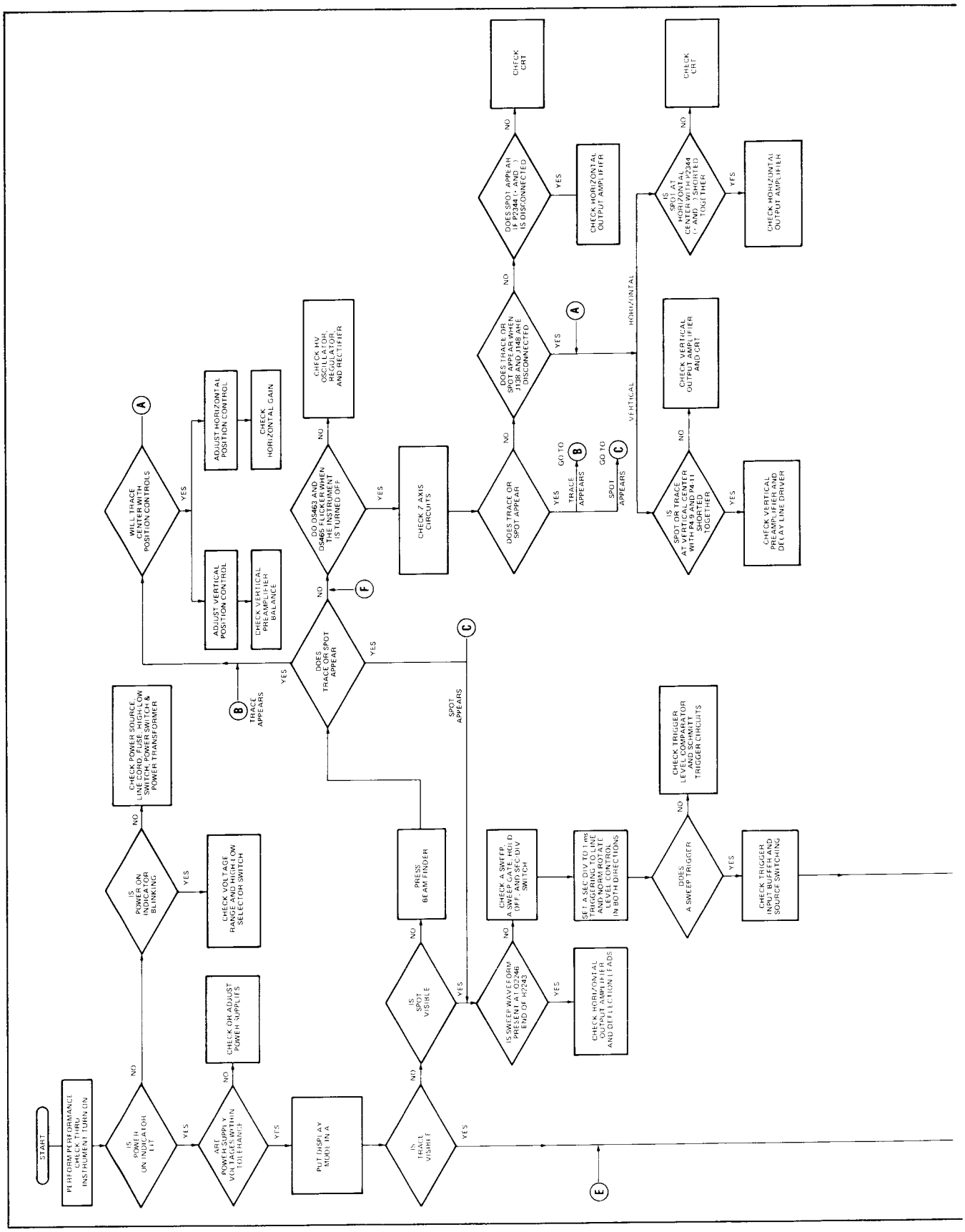


Fig. 5-1. Troubleshooting chart.

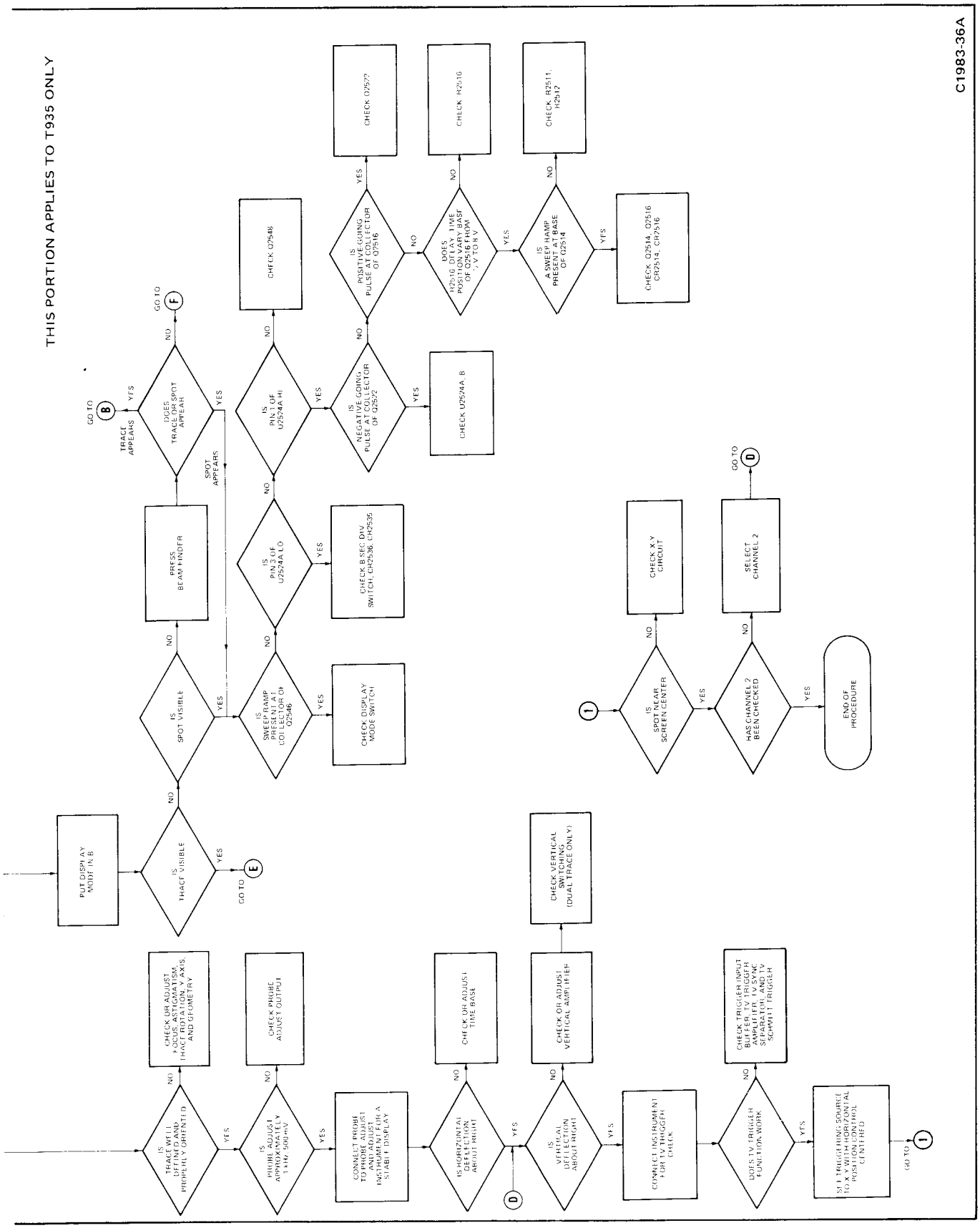
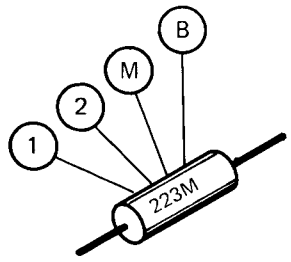
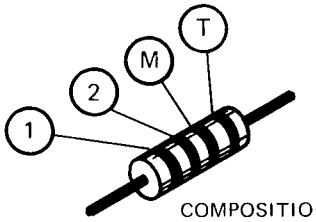


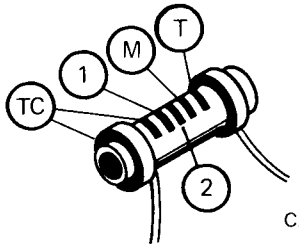
Fig. 5-1. Troubleshooting chart (cont).



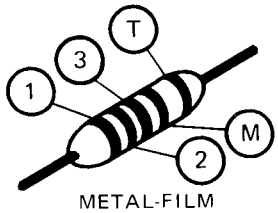
SMALL TUBULAR CAPACITORS



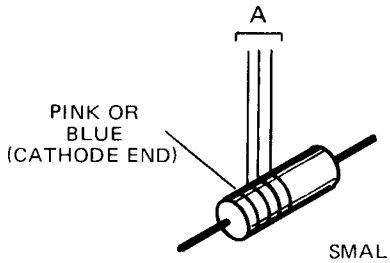
COMPOSITION RESISTORS



CERAMIC CAPACITORS



METAL-FILM RESISTORS



SMALL SIGNAL DIODES

(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

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

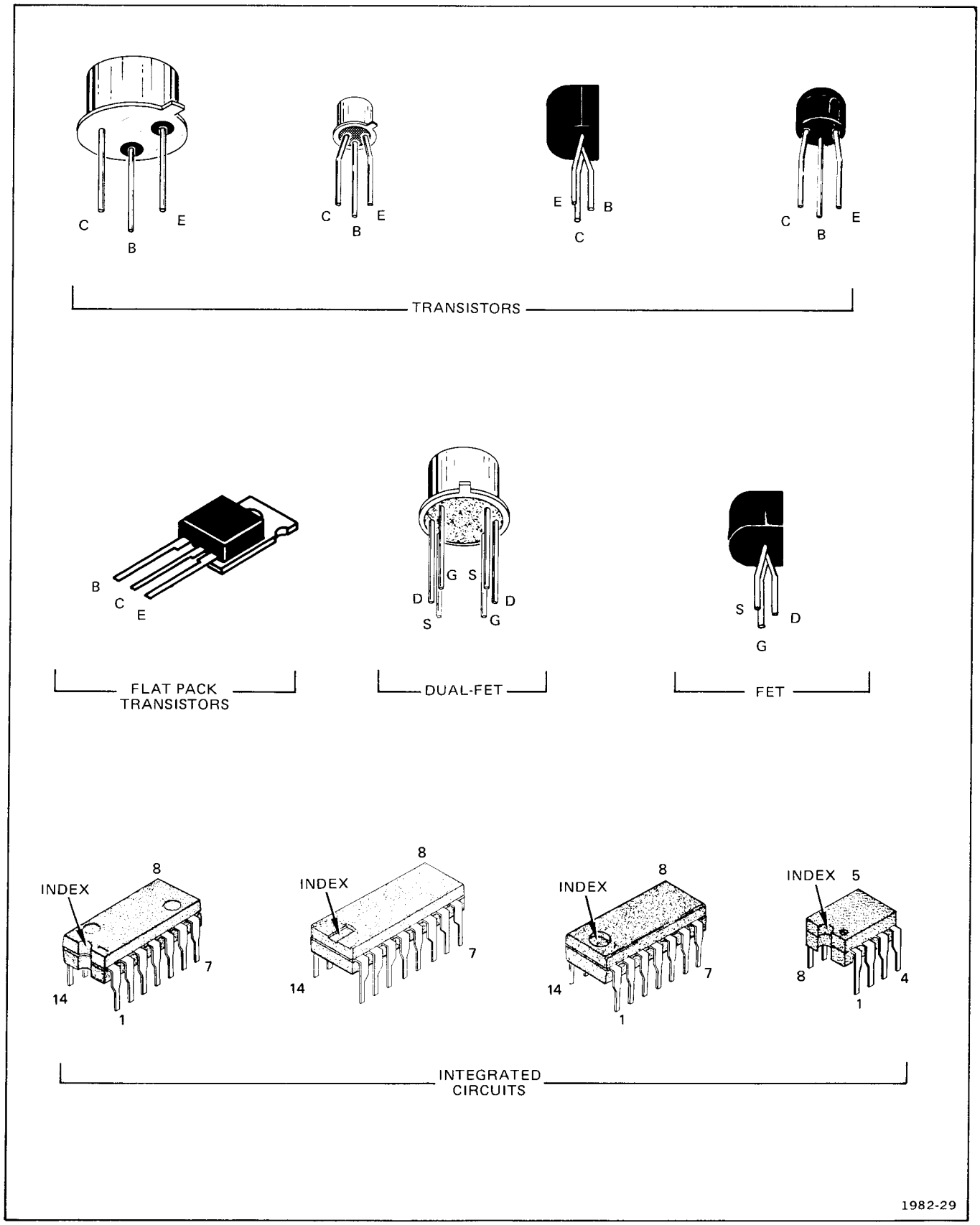

Fig. 5-3. Lead configuration for semiconductor devices.

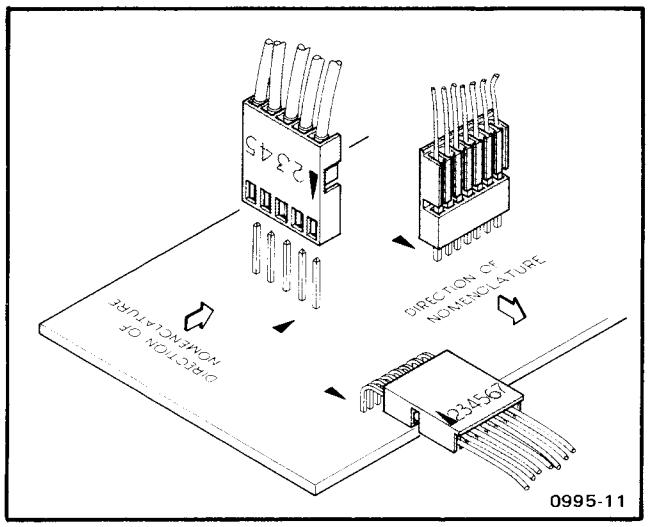

Fig. 5-4. Multi-connector holder orientation.

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, if lamp is not lit, check fuse F700).

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

(2) 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.

Obtaining Replacement Parts

Most electrical and mechanical parts can be obtained through your local Tektronix field office or representative. However, you should be able to obtain many of the standard electronic components from a local commercial source in your area. Before you purchase or order a part from a source other than Tektronix, Inc., please check the electrical parts list for the proper value, rating, tolerance and description.

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 + and −8 Vdc supplies—are fused in two legs of transformer secondary. Fuses F742 and F743 are easily seen on Power Supply board. These fuses are soldered in circuit and should not become open circuited 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.

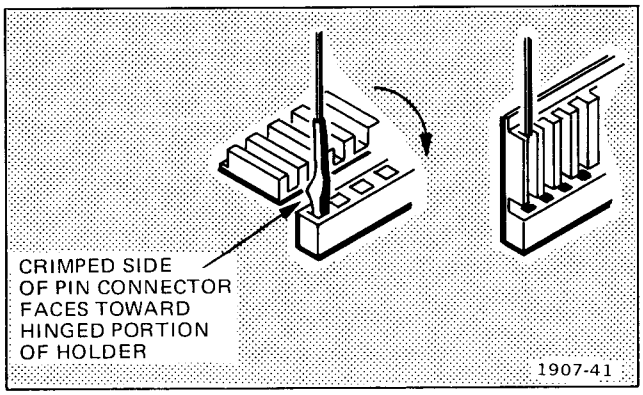

Fig. 5-5. Pin connector replacement.

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.

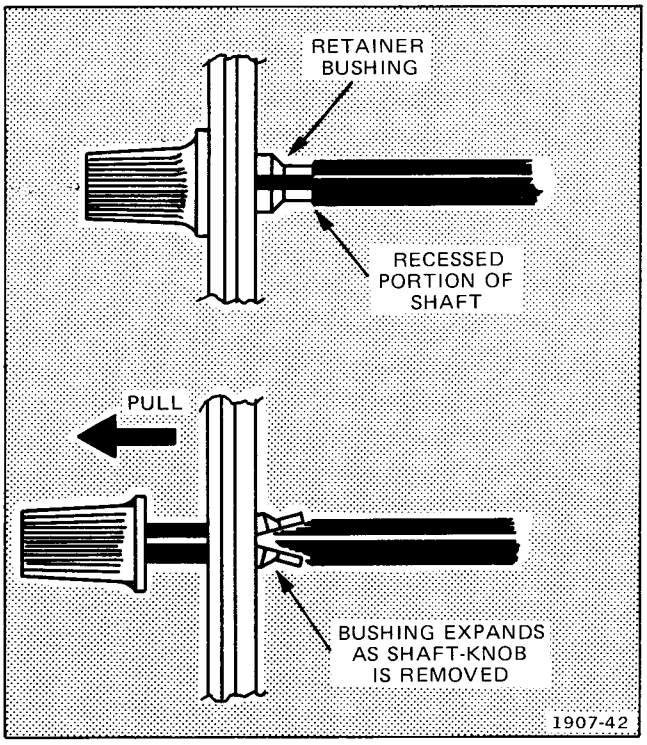

Fig. 5-6. Shaft-knob removal.

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.

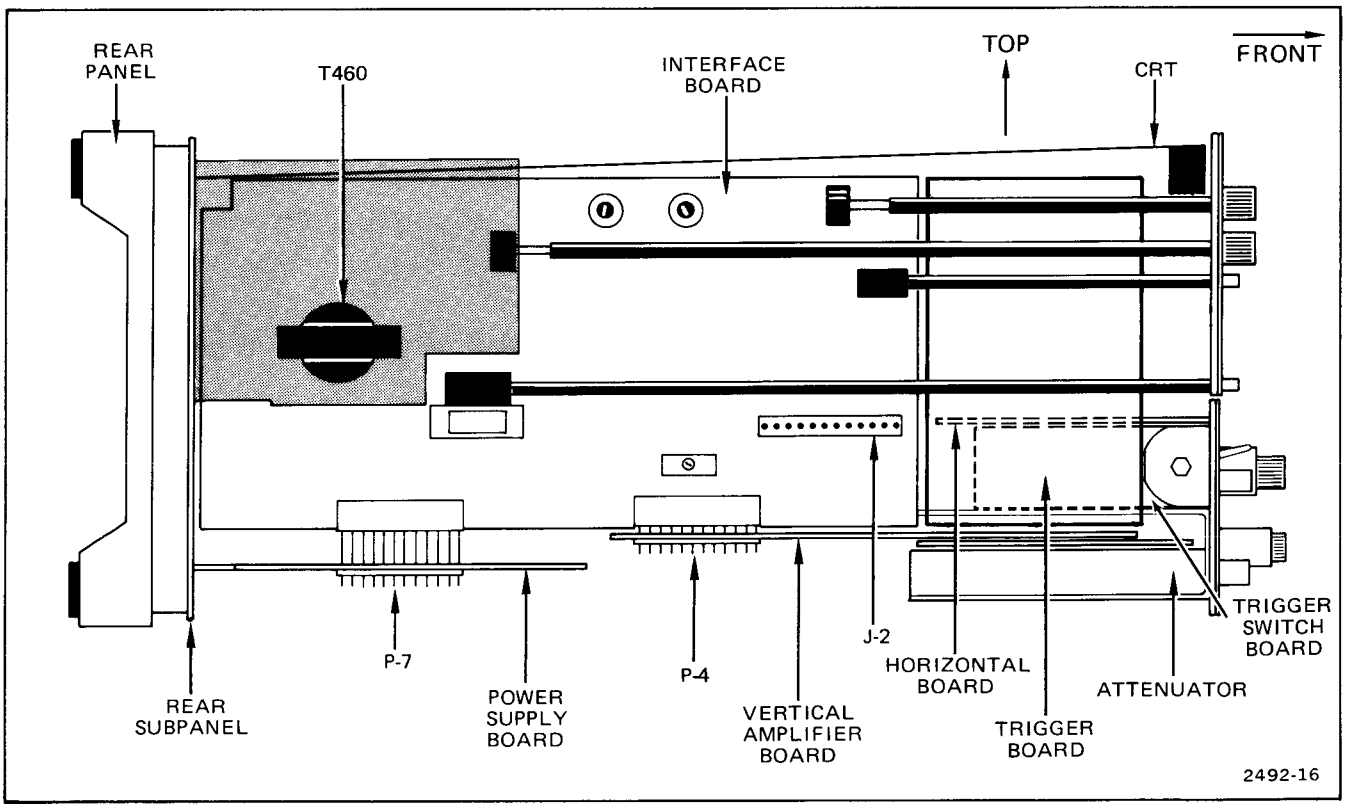

Fig. 5-7. Circuit board locations (on left side of crt).

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.

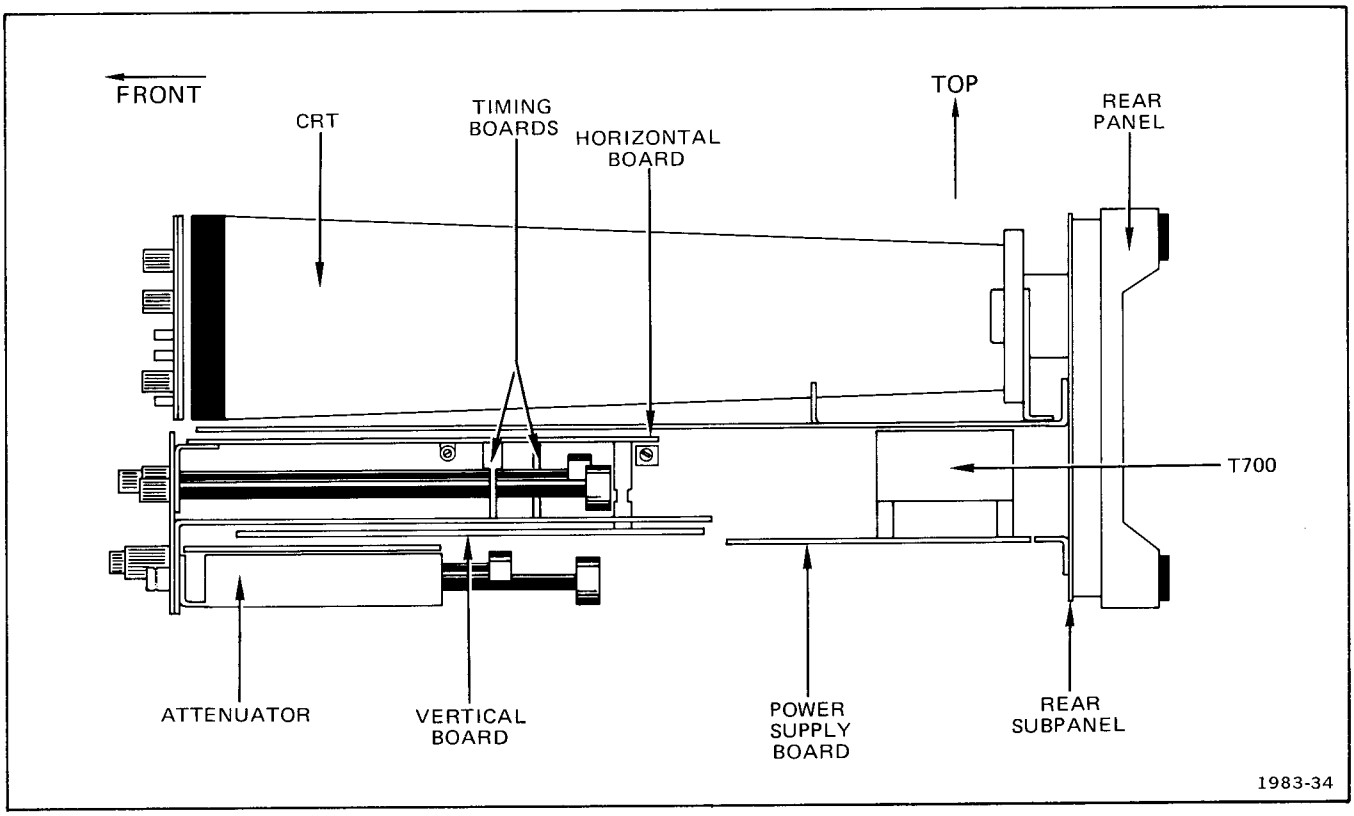

Fig. 5-8. Circuit board locations (on right side of crt).

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
000DN	FUSES UNLIMITED	9740 COZYCRAFT AVENUE	CHATSWORTH, CA 91311
00213	NYTRONICS, COMPONENTS GROUP, INC., SUBSIDIARY OF NYTRONICS, INC.	ORANGE STREET	DARLINGTON, SC 29532
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
03508	GENERAL ELECTRIC COMPANY, SEMI-CONDUCTOR PRODUCTS DEPARTMENT	ELECTRONICS PARK	SYRACUSE, NY 13201
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867, 19TH AVE. SOUTH	MYRTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
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
11237	CTS KEENE, INC.	3230 RIVERSIDE AVE.	PASO ROBLES, CA 93446
12697	CLAROSTAT MFG. CO., INC.	LOWER WASHINGTON STREET	DOVER, NH 03820
13511	AMPHENOL CARDRE DIV., BUNKER RAMO CORP.		LOS GATOS, CA 95030
14193	CAL-R, INC.	1601 OLYMPIC BLVD.	SANTA MONICA, CA 90404
14433	ITT SEMICONDUCTORS	3301 ELECTRONICS WAY P O BOX 3049	WEST PALM BEACH, FL 33402
16299	CORNING GLASS WORKS, ELECTRONIC COMPONENTS DIVISION	3900 ELECTRONICS DR.	RALEIGH, NC 27604
19396	ILLINOIS TOOL WORKS, INC. PAKTRON DIV.	900 FOLLIN LANE, SE	VIENNA, VA 22180
24546	CORNING GLASS WORKS, ELECTRONIC COMPONENTS DIVISION	550 HIGH STREET	BRADFORD, PA 16701
27014	NATIONAL SEMICONDUCTOR CORP.	2900 SEMICONDUCTOR DR.	SANTA CLARA, CA 95051
27264	MOLEX PRODUCTS CO.	5224 KATRINE AVE.	DOWNERS GROVE, IL 60515
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
50157	MIDWEST COMPONENTS INC.	P. O. BOX 787 1981 PORT CITY BLVD.	MUSKEGON, MI 49443
51406	MURATA CORPORATION OF AMERICA	2 WESTCHESTER PLAZA	ELMSFORD, NY 10523
52306	HIGH VOLTAGE DEVICES, INC.	7485 AVENUE 304	VISALIA, CA 93277
52763	STETTNER-TRUSH, INC.	67 ALBANY STREET	CAZENOVIA, NY 13035
55210	GETTIG ENG. AND MFG. COMPANY	PO BOX 85, OFF ROUTE 45	SPRING MILLS, PA 16875
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
74276	SIGNALITE DIV., GENERAL INSTRUMENT CORP.	1933 HECK AVE.	NEPTUNE, NJ 07753
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
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	B010100	B021397	CKT BOARD ASSY:INTERFACE (T932A ONLY)	80009	670-5446-00
A1	670-5446-01	B021398		CKT BOARD ASSY:INTERFACE (T932A ONLY)	80009	670-5446-01
A1	670-5446-00	B010100	B022299	CKT BOARD ASSY:INTERFACE (T935A ONLY)	80009	670-5446-00
A1	670-5446-01	B022300		CKT BOARD ASSY:INTERFACE (T935A ONLY)	80009	670-5446-01
A2	670-5473-00	B010100	B020641	CKT BOARD ASSY:LOW,VOLTAGE POWER SUPPLY (T932A ONLY)	80009	670-5473-00
A2	670-5473-01	B020642	B021759	CKT BOARD ASSY:LOW,VOLTAGE POWER SUPPLY (T932A ONLY)	80009	670-5473-01
A2	670-5473-02	B021760	B021864	CKT BOARD ASSY:LOW VOLTAGE POWER SUPPLY (T932A ONLY)	80009	670-5473-02
A2	670-5473-03	B021865		CKT BOARD ASSY:LOW VOLTAGE POWER SUPPLY (T932A ONLY)	80009	670-5473-03
A2	670-5473-00	B010100	B020968	CKT BOARD ASSY:LOW,VOLTAGE POWER SUPPLY (T935A ONLY)	80009	670-5473-00
A2	670-5473-01	B020969	B022991	CKT BOARD ASSY:LOW,VOLTAGE POWER SUPPLY (T935A ONLY)	80009	670-5473-01
A2	670-5473-03	B022992		CKT BOARD ASSY:LOW VOLTAGE POWER SUPPLY (T935A ONLY)	80009	670-5473-03
A6	670-3972-04	B010100	B010613	CKT BOARD ASSY:ATTENUATOR,CHANNEL 1 (T932A ONLY)	80009	670-3972-04
A6	670-3972-06	B010614		CKT BOARD ASSY:ATTENUATOR,CHANNEL 1 (T932A ONLY)	80009	670-3972-06
A6	670-3972-04	B010100	B010911	CKT BOARD ASSY:ATTENUATOR,CHANNEL 1 (T935A ONLY)	80009	670-3972-04
A6	670-3972-06	B010912		CKT BOARD ASSY:ATTENUATOR,CHANNEL 1 (T935A ONLY)	80009	670-3972-06
A7	670-3973-04	B010100	B020919	CKT BOARD ASSY:ATTENUATOR,CHANNEL 2 (T932A ONLY)	80009	670-3973-04
A7	670-3973-06	B020920		CKT BOARD ASSY:ATTENUATOR,CHANNEL 2 (T932A ONLY)	80009	670-3973-06
A7	670-3973-04	B010100	B021388	CKT BOARD ASSY:ATTENUATOR,CHANNEL 2 (T935A ONLY)	80009	670-3973-04
A7	670-3973-06	B021389		CKT BOARD ASSY:ATTENUATOR,CHANNEL 2 (T935A ONLY)	80009	670-3973-06
A8	670-5443-00	B010100	B020976	CKT BOARD ASSY:VERTICAL (T932A ONLY)	80009	670-5443-00
A8	670-5443-01	B020977	B022189	CKT BOARD ASSY:VERTICAL (T932A ONLY)	80009	670-5443-01
A8	670-5443-02	B022190		CKT BOARD ASSY:VERTICAL (T932A ONLY)	80009	670-5443-02
A8	670-5443-00	B010100	B021497	CKT BOARD ASSY:VERTICAL (T935A ONLY)	80009	670-5443-00
A8	670-5443-01	B021498	B023669	CKT BOARD ASSY:VERTICAL (T935A ONLY)	80009	670-5443-01
A8	670-5443-02	B023670		CKT BOARD ASSY:VERTICAL (T935A ONLY)	80009	670-5443-02
A10	670-5448-00			CKT BOARD ASSY:TRIGGER FUNCTION	80009	670-5448-00
A11	670-5447-00	B010100	B020886	CKT BOARD ASSY:TRIGGER (T932A ONLY)	80009	670-5447-00
A11	670-5447-01	B020887		CKT BOARD ASSY:TRIGGER (T932A ONLY)	80009	670-5447-01
A11	670-5447-00	B010100	B021372	CKT BOARD ASSY:TRIGGER (T935A ONLY)	80009	670-5447-00

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A11	670-5447-01	B021373		CKT BOARD ASSY:TRIGGER	80009	670-5447-01
	----- -----			(T935A ONLY)		
A12	670-5445-00	B010100	B021643	CKT BOARD ASSY:HORIZONTAL	80009	670-5445-00
	----- -----			(T932A ONLY)		
A12	670-5445-01	B021644		CKT BOARD ASSY:HORIZONTAL	80009	670-5445-01
	----- -----			(T932A ONLY)		
A12	670-5444-00	B010100	B022727	CKT BOARD ASSY:HORIZONTAL	80009	670-5444-00
	----- -----			(T935A ONLY)		
A12	670-5444-01	B022728	B023669	CKT BOARD ASSY:HORIZONTAL	80009	670-5444-01
	----- -----			(T935A ONLY)		
A12	670-5444-02	B023670		CKT BOARD ASSY:HORIZONTAL	80009	670-5444-02
	----- -----			(T935A ONLY)		
A13	263-0051-00			SWITCH,ROTARY:PANCAKE,TIME/DIVISION	80009	263-0051-00
	----- -----			(T932A ONLY)		
A13	263-0052-00			SWITCH,ROTARY:PANCAKE,TIME/DIVISION	80009	263-0052-00
	----- -----			(T935A ONLY)		
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	2807C00218MH02F0
C115	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	72982	8121N083Z5U0224M
C118	281-0627-00			CAP.,FXD,CER DI:1PF,+/-0.25PF,500V	72982	301-000C0K0109C
C119	281-0768-00			CAP.,FXD,CER DI:470PF,20%,100V	72982	8035D9AADW5R471M
C124	281-0762-00			CAP.,FXD,CER DI:27PF,20%,100V	72982	8035D9AADC0G270M
C129	281-0768-00			CAP.,FXD,CER DI:470PF,20%,100V	72982	8035D9AADW5R471M
C412	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
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	8005D9AABZ5U104M
C425	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
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	8005D9AABZ5U104M
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	B010100	B021397	CAP.,FXD,CER DI:0.001UF,20%,4000V	56289	33C325
	----- -----			(T932A ONLY)		
C465	283-0404-00	B021398		CAP.,FXD,CER DI:0.01UF,20%,4KV	51406	DHR2825U103M1KV
	----- -----			(T932A ONLY)		
C465	283-0271-00	B010100	B022299	CAP.,FXD,CER DI:0.001UF,20%,4000V	56289	33C325
	----- -----			(T935A ONLY)		
C465	283-0404-00	B022300		CAP.,FXD,CER DI:0.01UF,20%,4KV	51406	DHR2825U103M1KV
	----- -----			(T935A ONLY)		
C466	283-0404-00			CAP.,FXD,CER DI:0.01UF,20%,4KV	51406	DHR2825U103M1KV
C468	283-0271-00	XB021398		CAP.,FXD,CER DI:0.001UF,20%,4000V	56289	33C325
	----- -----			(T932A ONLY)		
C468	283-0271-00	XB022300		CAP.,FXD,CER DI:0.001UF,20%,4000V	56289	33C325
C468	----- -----			(T935A ONLY)		
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
C723	281-0551-00	XB021865		CAP.,FXD,CER DI:390PF,10%,500V	04222	7001-1363
	----- -----			(T932A ONLY)		

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C723	281-0551-00	XB022922		CAP.,FXD,CER DI:390PF,10%,500V	04222	7001-1363
	----- -----			(T935A ONLY)		
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
C764	281-0773-00	XB021760		CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
	----- -----			(T932A ONLY)		
C764	281-0773-00	XB023030		CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
	----- -----			(T935A ONLY)		
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	8005D9AABZ5U104M
C2005	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
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	8035D2AADC0G820K
C2013	281-0760-00	B010100	B020861	CAP.,FXD,CER DI:22PF,10%,500V	72982	0314021 C0G0220K
	----- -----			(T932A ONLY)		
C2013	281-0515-00	B020862		CAP.,FXD,CER DI:27PF,+/-1.35PF,500V	72982	302-005C0G0270J
	----- -----			(T932A ONLY)		
C2013	281-0760-00	B010100	B021344	CAP.,FXD,CER DI:22PF,10%,500V	72982	0314021 C0G0220K
	----- -----			(T935A ONLY)		
C2013	281-0515-00	B021345		CAP.,FXD,CER DI:27PF,+/-1.35PF,500V	72982	302-005C0G0270J
	----- -----			(T935A ONLY)		
C2014	281-0797-00	B010100	B020861	CAP.,FXD,CER DI:15PF,10%,100V	72982	8035D9AADC0G150K
	----- -----			(T932A ONLY)		
C2014	281-0727-00	B020862		CAP.,FXD,CER DI:12.8PF,1%,500V	72982	374005C0G01289F
	----- -----			(T932A ONLY)		
C2014	281-0797-00	B010100	B021344	CAP.,FXD,CER DI:15PF,10%,100V	72982	8035D9AADC0G150K
	----- -----			(T935A ONLY)		
C2014	281-0727-00	B021345		CAP.,FXD,CER DI:12.8PF,1%,500V	72982	374005C0G01289F
	----- -----			(T935A ONLY)		
C2023	281-0814-00			CAP.,FXD,CER DI:100PF,10%,100V	04222	GC70-1-A101K
C2030	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558Z5V0203Z
C2033	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C2035	281-0797-00			CAP.,FXD,CER DI:15PF,10%,100V	72982	8035D9AADC0G150K
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	8035D9AADC1G470K
C2090	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C2091	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
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	8005D9AABZ5U104M
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	8005D9AABZ5U104M
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	8005D9AABZ5U104M
C2149	290-0183-00			CAP.,FXD,ELCTLT:1UF,10%,35V	90201	TAE105K035P1A
C2156	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C2162	290-0135-00			CAP.,FXD,ELCTLT:15UF,20%,20V	56289	150D156X0020B2
C2163	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	72982	8035D9AADC1G470K
C2166	290-0183-00			CAP.,FXD,ELCTLT:1UF,10%,35V	90201	TAE105K035P1A
C2171	290-0183-00			CAP.,FXD,ELCTLT:1UF,10%,35V	90201	TAE105K035P1A

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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	8045A9ABDZ5U223M
C2181	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C2212	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
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	8005D9AABZ5U104M
C2235	281-0216-00			CAP.,VAR,CER DI:0.8-6.8PF,400V	52763	R-TRIKO-122-09SD
C2236	290-0135-00			CAP.,FXD,ELCTLT:15UF,20%,20V	56289	150D156X0020B2
C2245	281-0759-00			CAP.,FXD,CER DI:22PF,10%,100V	72982	8035D9AADC1G220K
C2246	281-0759-00	XB021644		CAP.,FXD,CER DI:22PF,10%,100V	72982	8035D9AADC1G220K
	----- -----			(T932A ONLY)		
C2246	281-0759-00	XB022728		CAP.,FXD,CER DI:22PF,10%,100V	72982	8035D9AADC1G220K
	----- -----			(T935A ONLY)		
C2252A-D	295-0179-00	B010100	B023669	CAP.,SET,MTCHD:0.01UF,1.0UF,1%	80009	295-0179-00
	----- -----			(T935A ONLY)		
C2252A-D	295-0183-00	B023670		CAP.,SET,MTCHD:(2) 1UF,0.01UF	80009	295-0183-00
	----- -----			(T935A ONLY)		
C2274	281-0772-00			CAP.,FXD,CER DI:0.0047UF,10%,100V	72982	8005H9AADW5R472K
C2275	290-0167-00	B010100	B010582	CAP.,FXD,ELCTLT:10UF,20%,15V	56289	150D106X0015B2
	----- -----			(T932A ONLY)		
C2275	290-0415-00	B010583		CAP.,FXD,ELCTLT:5.6UF,10%,35V	56289	150D565X9035B2
	----- -----			(T932A ONLY)		
C2275	290-0167-00	B010100	B010914	CAP.,FXD,ELCTLT:10UF,20%,15V	56289	150D106X0015B2
	----- -----			(T935A ONLY)		
C2275	290-0415-00	B010915		CAP.,FXD,ELCTLT:5.6UF,10%,35V	56289	150D565X9035B2
	----- -----			(T935A ONLY)		
C2276	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
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	8005D9AABZ5U104M
C2325	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C2327	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C2337	290-0480-00			CAP.,FXD,ELCTLT:0.5UF,+50-10%,200V	80009	290-0480-00
C2517	290-0135-00			CAP.,FXD,ELCTLT:15UF,20%,20V	56289	150D156X0020B2
	----- -----			(T935A ONLY)		
C2521	281-0758-00			CAP.,FXD,CER DI:15PF,20%,100V	72982	314022C0G0150M
	----- -----			(T935A ONLY)		
C2525	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	72982	8035D9AADC1G470K
	----- -----			(T935A ONLY)		
C2533	281-0759-00			CAP.,FXD,CER DI:22PF,10%,100V	72982	8035D9AADC1G220K
	----- -----			(T935A ONLY)		
C2535	281-0216-00			CAP.,VAR,CER DI:0.8-6.8PF,400V	52763	R-TRIKO-122-09SD
	----- -----			(T935A ONLY)		
C2536	283-0632-00			CAP.,FXD,MICA D:87PF,1%,100V	00853	D151E870F0
	----- -----			(T935A ONLY)		
C2539	290-0135-00			CAP.,FXD,ELCTLT:15UF,20%,20V	56289	150D156X0020B2
	----- -----			(T935A ONLY)		
C2544	281-0759-00			CAP.,FXD,CER DI:22PF,10%,100V	72982	8035D9AADC1G220K
	----- -----			(T935A ONLY)		
C2546	281-0759-00	XB022728		CAP.,FXD,CER DI:22PF,10%,100V	72982	8035D9AADC1G220K
	----- -----			(T935A ONLY)		
C2548	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	72982	8035D9AADC1G470K
	----- -----			(T935A ONLY)		
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	2807C00218MH02F0

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C4105	281-0214-00			CAP.,VAR,CER DI:0.5-3PF,400V	80031	2502A0R503VP02F0
C4106	283-0213-00			CAP.,FXD,CER DI:300PF,5%,100V	72982	8121N130C0G0301J
C4113	281-0207-00			CAP.,VAR,PLSTC:2-18PF,100V	80031	2807C00218MH02F0
C4114	281-0214-00			CAP.,VAR,CER DI:0.5-3PF,400V	80031	2502A0R503VP02F0
C4115	281-0610-00			CAP.,FXD,CER DI:2.2PF,+/-0.1PF,500V	72982	374001C0J0229B
C4116	281-0759-00			CAP.,FXD,CER DI:22PF,10%,100V	72982	8035D9AADC1G220K
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	8121N083Z5U0224M
C4143	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	72982	8035D9AADC1G470K
C4154	281-0204-00			CAP.,VAR,PLSTC:2-22PF,100V	80031	287C00222MJ02
C4156	281-0543-00			CAP.,FXD,CER DI:270PF,10%,500V	72982	301055X5P271K
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	8035D9AADC0G270M
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	2807C00218MH02F0
C4205	281-0214-00			CAP.,VAR,CER DI:0.5-3PF,400V	80031	2502A0R503VP02F0
C4206	283-0213-00			CAP.,FXD,CER DI:300PF,5%,100V	72982	8121N130C0G0301J
C4213	281-0207-00			CAP.,VAR,PLSTC:2-18PF,100V	80031	2807C00218MH02F0
C4214	281-0214-00			CAP.,VAR,CER DI:0.5-3PF,400V	80031	2502A0R503VP02F0
C4215	281-0610-00			CAP.,FXD,CER DI:2.2PF,+/-0.1PF,500V	72982	374001C0J0229B
C4216	281-0759-00			CAP.,FXD,CER DI:22PF,10%,100V	72982	8035D9AADC1G220K
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	8121N083Z5U0224M
C4243	281-0792-00			CAP.,FXD,CER DI:82PF,10%,100V	72982	8035D2AADC0G820K
C4256	281-0543-00			CAP.,FXD,CER DI:270PF,10%,500V	72982	301055X5P271K
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	8035D9AADC0G270M
C4302	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	72982	8035D9AADC1G470K
C4306	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C4307	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	72982	8035D9AADC1G470K
C4308	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	72982	8035D9AADC1G470K
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	8035D9AADX5R102M
C4324	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
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	8121N083Z5U0224M
C4355	281-0786-00			CAP.,FXD,CER DI:150PF,10%,100V	72982	8035D2AADX5P151K
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
C4378	281-0762-00			CAP.,FXD,CER DI:27PF,20%,100V	72982	8035D9AADC0G270M
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	8035D9AADC0G270M
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	2807C00218MH02F0
C4397	281-0207-00			CAP.,VAR,PLSTC:2-18PF,100V	80031	2807C00218MH02F0
C4398	281-0786-00			CAP.,FXD,CER DI:150PF,10%,100V	72982	8035D2AADX5P151K

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C4410	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	273C5
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	8121N083Z5U0224M
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	56289	273C5
CR26	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR27	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR416	152-0075-00			SEMICOND DEVICE:GE,25V,40MA	14433	G866
CR418	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR437	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR443	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR463	152-0639-00			SEMICOND DEVICE:RECT,SI,10KV,10MA	52306	CX345
CR465	152-0639-00			SEMICOND DEVICE:RECT,SI,10KV,10MA	52306	CX345
CR466	152-0066-03 ----- -----	XB010531		SEMICOND DEVICE:RECT,SI,400V,1A (T932A ONLY)	80009	152-0066-03
CR466	152-0066-03 ----- -----	XB010739		SEMICOND DEVICE:RECT,SI,400V,1A (T935A ONLY)	80009	152-0066-03
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	01295	1N4152R
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 ----- -----	B010100	B021760X	SEMICOND DEVICE:SILICON,30V,150MA (T932A ONLY)	01295	1N4152R
CR764	152-0141-02 ----- -----	B010100	B023030X	SEMICOND DEVICE:SILICON,30V,150MA (T935A ONLY)	01295	1N4152R
CR765	152-0141-02 ----- -----	B010100	B021760X	SEMICOND DEVICE:SILICON,30V,150MA (T932A ONLY)	01295	1N4152R
CR765	152-0141-02 ----- -----	B010100	B023030X	SEMICOND DEVICE:SILICON,30V,150MA (T935A ONLY)	01295	1N4152R
CR766	152-0141-02 ----- -----	B010100	B021760X	SEMICOND DEVICE:SILICON,30V,150MA (T932A ONLY)	01295	1N4152R
CR766	152-0141-02 ----- -----	B010100	B023030X	SEMICOND DEVICE:SILICON,30V,150MA (T935A ONLY)	01295	1N4152R
CR767	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR778	152-0066-03			SEMICOND DEVICE:RECT,SI,400V,1A	80009	152-0066-03
CR2001	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2002	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2005	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2006	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2024	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2032	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2036	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2063	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2181	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2182	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2183	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2185	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR2227	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2233	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2234	152-0245-00			SEMICOND DEVICE:SILICON,10NA AT 5V	80009	SN74L192
CR2317	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2326	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2331	152-0075-00			SEMICOND DEVICE:GE,25V,40MA	14433	G866
CR2332	152-0075-00			SEMICOND DEVICE:GE,25V,40MA	14433	G866
CR2334	152-0574-00			SEMICOND DEVICE:SILICON,120V,0.15A	80009	152-0574-00
CR2342	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2356	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2514	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
	----- -----			(T935A ONLY)		
CR2516	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
	----- -----			(T935A ONLY)		
CR2535	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
	----- -----			(T935A ONLY		
CR2536	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
	----- -----			(T935A ONLY)		
CR4122	152-0246-00	B010100	B010199	SEMICOND DEVICE:SW,SI,40V,200MA	03508	DE140
	----- -----			(T935A ONLY)		
CR4122	152-0324-00	B010200		SEMICOND DEVICE:SILICON,35V,100MA	03508	DE103
	----- -----			(T935A ONLY)		
CR4122	152-0246-00	B010100	B010154	SEMICOND DEVICE:SW,SI,40V,200MA	03508	DE140
	----- -----			(T932A ONLY)		
CR4122	152-0324-00	B010155		SEMICOND DEVICE:SILICON,35V,100MA	03508	DE103
	----- -----			(T932A ONLY)		
CR4222	152-0246-00	B010100	B010199	SEMICOND DEVICE:SW,SI,40V,200MA	03508	DE140
	----- -----			(T935A ONLY)		
CR4222	152-0324-00	B010200		SEMICOND DEVICE:SILICON,35V,100MA	03508	DE103
	----- -----			(T935A ONLY)		
CR4222	152-0246-00	B010100	B010154	SEMICOND DEVICE:SW,SI,40V,200MA	03508	DE140
	----- -----			(T932A ONLY)		
CR4222	152-0324-00	B010155		SEMICOND DEVICE:SILICON,35V,100MA	03508	DE103
	----- -----			(T932A ONLY)		
CR4323	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR4324	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR4326	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR4328	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR4331	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR4332	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR4335	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR4336	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR4346	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR4347	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR4348	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR4349	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR4356	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR4357	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR4358	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR4359	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
DL4380	119-0703-00			DELAY LINE,ELEC:120 NANOSEC	80009	119-0703-00
DS463	150-0002-00			LAMP,GLOW:0.5 MA 60/125V	74276	NE-2T(T2)
DS465	150-0002-00			LAMP,GLOW:0.5 MA 60/125V	74276	NE-2T(T2)
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
	----- -----			(FOR 92-132V OPERATION)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
F700	159-0029-00			FUSE,CARTRIDGE:3AG,0.3A,250V,SLOW-BLOW	71400	MDL3/10
	----- -----			(FOR 202-250V OPERATION)		
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	000DN	BUSSGFA 11/2
F743	159-0153-00			FUSE,WIRE LEAD:1.5A,125V,FAST BLOW	000DN	BUSSGFA 11/2
J4	131-1795-00			CONNECTOR,RCPT,:12 FEMALE CONTACT,RT-ANGLE	27264	09-62-3121
J7	131-1749-01			CONN,RCPT,ELEC:CKT CARD,8 CONTACTS	80009	131-1749-01
J138	131-0955-00			CONNECTOR,RCPT,:CKT BD,28/56 CONTACT	13511	31-279
J148	131-0955-00			CONNECTOR,RCPT,:CKT BD,28/56 CONTACT	13511	31-279
J419	131-0955-00			CONNECTOR,RCPT,:CKT BD,28/56 CONTACT	13511	31-279
J2100	131-1802-00			CONNECTOR,RCPT,:15 CONTACTS	05574	000201-4831
J2250	131-1801-00			CONNECTOR,RCPT,:9 CONTACTS	05574	000201-4832
J2260	131-1802-00			CONNECTOR,RCPT,:15 CONTACTS	05574	000201-4831
J2550	131-1801-00			CONNECTOR,RCPT,:9 CONTACTS	05574	000201-4832
	----- -----			(T935A ONLY)		
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
Q112	151-0199-00			TRANSISTOR:SILICON,PNP	04713	SPS6866K
Q122	151-0199-00			TRANSISTOR:SILICON,PNP	04713	SPS6866K
Q134	151-0127-00			TRANSISTOR:SILICON,NPN	07263	S006075
Q136	151-0127-00			TRANSISTOR:SILICON,NPN	07263	S006075
Q144	151-0127-00			TRANSISTOR:SILICON,NPN	07263	S006075
Q146	151-0127-00			TRANSISTOR:SILICON,NPN	07263	S006075
Q416	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q424	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q426	151-0347-00			TRANSISTOR:SILICON,NPN	56289	2N5551
Q434	151-0350-00			TRANSISTOR:SILICON,PNP	04713	SPS6700
Q446	151-0126-00			TRANSISTOR:SILICON,NPN	04713	ST1046
Q454	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q458	151-0358-00	B010100	B010560	TRANSISTOR:SILICON,NPN,SEL FROM D44R4	80009	151-0358-00
	----- -----			(T932A ONLY)		
Q458	151-0423-01	B010561		TRANSISTOR:SILICON,NPN,PRESTRESSED	80009	151-0423-01
	----- -----			(T932A ONLY)		
Q458	151-0358-00	B010100	B010825	TRANSISTOR:SILICON,NPN,SEL FROM D44R4	80009	151-0358-00
	----- -----			(T935A ONLY)		
Q458	151-0423-01	B010826		TRANSISTOR:SILICON,NPN,PRESTRESSED	80009	151-0423-01
	----- -----			(T935A ONLY)		
Q722	151-0347-00			TRANSISTOR:SILICON,NPN	56289	2N5551
Q726	151-0347-00			TRANSISTOR:SILICON,NPN	56289	2N5551
Q734	151-0347-00			TRANSISTOR:SILICON,NPN	56289	2N5551
Q736	151-0497-00			TRANSISTOR:SILICON,NPN	01295	TIP47
Q752	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q754	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q756	151-0478-00			TRANSISTOR:SILICON,NPN	80009	151-0478-00
Q772	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
Q774	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
Q776	151-0478-00			TRANSISTOR:SILICON,NPN	80009	151-0478-00
Q792	151-0224-00			TRANSISTOR:SILICON,NPN	07263	S24850
Q796	151-0347-00			TRANSISTOR:SILICON,NPN	56289	2N5551
Q810	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q2020	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q2028	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q2032A,B	151-1042-00			SEMICOND DVC SE:MATCHED PAIR FET	27014	SF50031
Q2038	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K

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Q2050	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q2054	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q2058	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q2122	151-0224-00			TRANSISTOR:SILICON,NPN	07263	S24850
Q2124	151-0224-00			TRANSISTOR:SILICON,NPN	07263	S24850
Q2128	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q2134	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q2136	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q2142	151-0224-00			TRANSISTOR:SILICON,NPN	07263	S24850
Q2144	151-0224-00			TRANSISTOR:SILICON,NPN	07263	S24850
Q2152	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q2164	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q2174	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q2176	151-0216-00			TRANSISTOR:SILICON,PNP	04713	SPS8803
Q2242	151-1042-00			SEMICOND DVC SE:MATCHED PAIR FET	27014	SF50031
Q2244						
Q2246	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q2274	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q2314	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	04713	SPS8801
Q2326	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q2332	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q2334	151-0124-00			TRANSISTOR:SILICON,NPN,SEL FROM 2N3501	04713	SM8138
Q2344	151-0124-00			TRANSISTOR:SILICON,NPN,SEL FROM 2N3501	04713	SM8138
Q2354	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q2514	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
	----- -----			(T935A ONLY)		
Q2516	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
	----- -----			(T935A ONLY)		
Q2522	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
	----- -----			(T935A ONLY)		
Q2542	151-1042-00			SEMICOND DVC SE:MATCHED PAIR FET	27014	SF50031
	----- -----			(T935A ONLY)		
Q2544	151-1042-00			SEMICOND DVC SE:MATCHED PAIR FET	27014	SF50031
	----- -----			(T935A ONLY)		
Q2546	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
	----- -----			(T935A ONLY)		
Q2548	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
	----- -----			(T935A ONLY)		
Q4122A-B	151-1032-00			TRANSISTOR:SILICON,FET,DUAL	80009	151-1032-00
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	151-0199-00			TRANSISTOR:SILICON,PNP	04713	SPS6866K
Q4176	151-0427-00			TRANSISTOR:SILICON,NPN	80009	151-0427-00
Q4184	151-0199-00			TRANSISTOR:SILICON,PNP	04713	SPS6866K
Q4186	151-0427-00			TRANSISTOR:SILICON,NPN	80009	151-0427-00
Q4194	151-0198-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS8802-1
Q4196	151-0198-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS8802-1
Q4222A-B	151-1032-00			TRANSISTOR:SILICON,FET,DUAL	80009	151-1032-00
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	151-0199-00			TRANSISTOR:SILICON,PNP	04713	SPS6866K
Q4276	151-0427-00			TRANSISTOR:SILICON,NPN	80009	151-0427-00
Q4284	151-0199-00			TRANSISTOR:SILICON,PNP	04713	SPS6866K

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Q4286	151-0427-00			TRANSISTOR:SILICON,NPN	80009	151-0427-00
Q4294	151-0198-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS8802-1
Q4296	151-0198-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS8802-1
Q4302	151-0223-00			TRANSISTOR:SILICON,NPN	04713	SPS8026
Q4344	151-0199-00			TRANSISTOR:SILICON,PNP	04713	SPS6866K
Q4346	151-0199-00			TRANSISTOR:SILICON,PNP	04713	SPS6866K
Q4350	151-0199-00			TRANSISTOR:SILICON,PNP	04713	SPS6866K
Q4352	151-0199-00			TRANSISTOR:SILICON,PNP	04713	SPS6866K
Q4354	151-0199-00			TRANSISTOR:SILICON,PNP	04713	SPS6866K
Q4356	151-0199-00			TRANSISTOR:SILICON,PNP	04713	SPS6866K
Q4376	151-0434-00			TRANSISTOR:SILICON,PNP	04713	SS7144
Q4386	151-0434-00			TRANSISTOR:SILICON,PNP	04713	SS7144
Q4388	151-0190-00	B010100	B020919	TRANSISTOR:SILICON,NPN (T932A ONLY)	07263	S032677
Q4388	151-0224-00	B020920		TRANSISTOR:SILICON,NPN (T932A ONLY)	07263	S24850
Q4388	151-0190-00	B010100	B021388	TRANSISTOR:SILICON,NPN (T935A ONLY)	07263	S032677
Q4388	151-0224-00	B021389		TRANSISTOR:SILICON,NPN (T935A ONLY)	07263	S24850
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	91-85-0
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
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	91-81-0
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

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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,WW:150 OHM,5%,3W	00213	1240S-150-5
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	B010100	B022299	RES.,FXD,CMPSN:68K OHM,5%,0.25W (T932A ONLY)	01121	CB6835
R465	315-0153-00	B022300		RES.,FXD,CMPSN:15K OHM,5%,0.25W (T932A ONLY)	01121	CB1535
R465	315-0683-00	B010100	B021397	RES.,FXD,CMPSN:68K OHM,5%,0.25W (T935A ONLY)	01121	CB6835
R465	315-0153-00	B021398		RES.,FXD,CMPSN:15K OHM,5%,0.25W (T935A ONLY)	01121	CB1535
R466	315-0303-00	XB021398		RES.,FXD,CMPSN:30K OHM,5%,0.25W (T932A ONLY)	01121	CB3035
R466	315-0303-00	XB022300		RES.,FXD,CMPSN:30K OHM,5%,0.25W (T935A ONLY)	01121	CB3035
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	91-84-0
R473	311-1555-00			RES.,VAR,NONWIR:100K OHM,20%,0.5W	73138	91-77-0
R474	311-1562-00			RES.,VAR,NONWIR:2K OHM,20%,0.50W	73138	91-84-0
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	91-77-0
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
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	24546	NC55C8511D
R757	321-0671-00			RES.,FXD,FILM:8.51K OHM,0.5%,0.125W	24546	NC55C8511D
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	B010100	B010286	RES.,FXD,FILM:3.01K OHM,1%,0.125W (T932A ONLY)	91637	MFF1816G30100F
R764	321-0285-00	B010287		RES.,FXD,FILM:9.09K OHM,1%,0.125W (T932A ONLY)	91637	MFF1816G90900F
R764	321-0239-00	B010100	B010388	RES.,FXD,FILM:3.01K OHM,1%,0.125W (T935A ONLY)	91637	MFF1816G30100F
R764	321-0285-00	B010389		RES.,FXD,FILM:9.09K OHM,1%,0.125W (T935A ONLY)	91637	MFF1816G90900F
R765	321-0130-00	B010100	B010286	RES.,FXD,FILM:221 OHM,1%,0.125W (T932A ONLY)	91637	MFF1816G221R0F
R765	321-0176-00	B010287		RES.,FXD,FILM:665 OHM,1%,0.125W (T932A ONLY)	91637	MFF1816G665R0F

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R765	321-0130-00	B010100	B010388	RES.,FXD,FILM:221 OHM,1%,0.125W (T935A ONLY)	91637	MFF1816G221ROF
R765	321-0176-00	B010389		RES.,FXD,FILM:665 OHM,1%,0.125W (T935A ONLY)	91637	MFF1816G665ROF
R766	301-0391-00	B010100	B010286	RES.,FXD,CMPSN:390 OHM,5%,0.50W (T932A ONLY)	01121	EB3915
R766	301-0561-00	B010287		RES.,FXD,CMPSN:560 OHM,5%,0.50W (T932A ONLY)	01121	EB5615
R766	301-0391-00	B010100	B010388	RES.,FXD,CMPSN:390 OHM,5%,0.50W (T935A ONLY)	01121	EB3915
R766	301-0561-00	B010389		RES.,FXD,CMPSN:560 OHM,5%,0.50W (T935A ONLY)	01121	EB5615
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	91-85-0
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-R750OJ
R784	308-0781-00			RES.,FXD,WW:1.34K OHM,2%,10W	91637	HLW10R1Z2013400G
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	24546	NA55D1503F
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	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315
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	311-1564-00			RES.,VAR,NONWIR:TRMR,500 OHM,0.5W	73138	91-86-0
R2007	321-0175-00			RES.,FXD,FILM:649 OHM,1%,0.125W	91637	MFF1816G649ROF
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	HFF143G28003D
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	24546	NA4D1004F
R2021	321-0150-00			RES.,FXD,FILM:357 OHM,1%,0.125W	91637	MFF1816G357ROF
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	B010100	B020687	RES.,FXD,FILM:1.91K OHM,1%,0.125W (T932A ONLY)	91637	MFF1816G19100F
R2026	321-0213-00	B020688		RES.,FXD,FILM:1.62K OHM,1%,0.125W (T932A ONLY)	91637	MFF1816G16200F
R2026	321-0220-00	B010100	B021026	RES.,FXD,FILM:1.91K OHM,1%,0.125W (T935A ONLY)	91637	MFF1816G19100F
R2026	321-0213-00	B021027		RES.,FXD,FILM:1.62K OHM,1%,0.125W (T935A ONLY)	91637	MFF1816G16200F
R2027	311-1563-00	B010100	B020687	RES.,VAR,NONWIR:1K OHM,20%,0.50W (T932A ONLY)	73138	91-85-0
R2027	311-1749-00	B020688		RES.,VAR,NONWIR:TRMR,1.5K OHM,0.75W (T932A ONLY)	73138	91-97-0

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R2027	311-1563-00	B010100	B021026	RES.,VAR,NONWIR:1K OHM,20%,0.50W (T935A ONLY)	73138	91-85-0
R2027	311-1749-00	B021027		RES.,VAR,NONWIR:TRMR,1.5K OHM,0.75W (T935A ONLY)	73138	91-97-0
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	24546	NA4D1004F
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
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	91-88-0
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	91-87-0
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,CMPSN: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:2.2K 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

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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:2.2K 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:2.2K OHM,5%,0.25W	01121	CB2225
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%,0.50W	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%,0.50W	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

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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-76-0-252K
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
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	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
	----- -----			(T935A ONLY)		
R2512	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
	----- -----			(T935A ONLY)		
R2514	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
	----- -----			(T935A ONLY)		
R2515	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
	----- -----			(T935A ONLY)		
R2516	311-1531-00			RES.,VAR,WW:2K OHM,5%,1.5W	01121	535-9504
	----- -----			(T935A ONLY)		
R2517	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
	----- -----			(T935A ONLY)		
R2519	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
	----- -----			(T935A ONLY)		
R2521	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
	----- -----			(T935A ONLY)		
R2523	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
	----- -----			(T935A ONLY)		
R2525	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
	----- -----			(T935A ONLY)		
R2527	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
	----- -----			(T935A ONLY)		
R2531	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
	----- -----			(T935A ONLY)		
R2532	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
	----- -----			(T935A ONLY)		
R2533	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
	----- -----			(T935A ONLY)		
R2535	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
	----- -----			(T935A ONLY)		
R2537	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
	----- -----			(T935A ONLY)		
R2539	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
	----- -----			(T935A ONLY)		
R2541	308-0212-00			RES.,FXD,WW:10K OHM,5%,3W	91637	CW2B-B10001J
	----- -----			(T935A ONLY)		
R2544	321-0326-00			RES.,FXD,FILM:24.3K OHM,1%,0.125W	91637	MFF1816G24301F
	----- -----			(T935A ONLY)		

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R2545	321-0312-00			RES.,FXD,FILM:17.4K OHM,1%,0.125W	91637	MFF1816G17401F
	----- -----			(T935A ONLY)		
R2546	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
	----- -----			(T935A ONLY)		
R2547	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
	----- -----			(T935A ONLY)		
R2548	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
	----- -----			(T935A ONLY)		
R2552	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
	----- -----			(T935A ONLY)		
R2553	321-0444-00			RES.,FXD,FILM:412K OHM,1%,0.125W	91637	MFF1816G41202F
	----- -----			(T935A ONLY)		
R2554	321-0377-01			RES.,FXD,FILM:82.5K OHM,0.5%,0.125W	91637	MFF1816G82501D
	----- -----			(T935A ONLY)		
R2555	321-0377-01			RES.,FXD,FILM:82.5K OHM,0.5%,0.125W	91637	MFF1816G82501D
	----- -----			(T935A ONLY)		
R2556	321-0348-00			RES.,FXD,FILM:41.2K OHM,1%,0.125W	91637	MFF1816G41201F
	----- -----			(T935A ONLY)		
R2557	321-0281-00			RES.,FXD,FILM:8.25K OHM,1%,0.125W	91637	MFF1816G82500F
	----- -----			(T935A ONLY)		
R2558	321-0281-00			RES.,FXD,FILM:8.25K OHM,1%,0.125W	91637	MFF1816G82500F
	----- -----			(T935A ONLY)		
R2590	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
	----- -----			(T935A ONLY)		
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	MFF1816G90002D
R4116	321-1389-01			RES.,FXD,FILM:111K OHM,0.5%,0.125W	91637	MFF1816G11102D
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	24546	NA4D1004F
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	91-81-0
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	91-85-0
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	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R4157	321-0225-00			RES.,FXD,FILM:2.15K OHM,1%,0.125W	91637	MFF1816G21500F

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R4158	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R4159	315-0220-00	B010100	B022189X	RES.,FXD,CMPSN:22 OHM,5%,0.25W (T932A ONLY)	01121	CB2205
R4159	315-0220-00	B010100	B023669X	RES.,FXD,CMPSN:22 OHM,5%,0.25W (T935A ONLY)	01121	CB2205
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	16299	NA55D52R3F
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
R4169	315-0220-00	B010100	B022189X	RES.,FXD,CMPSN:22 OHM,5%,0.25W (T932A ONLY)	01121	CB2205
R4169	315-0220-00	B010100	B023669X	RES.,FXD,CMPSN:22 OHM,5%,0.25W (T935A ONLY)	01121	CB2205
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	B010100	B010154	RES.,FXD,FILM:66.5 OHM,1%,0.125W (T932A ONLY)	91637	MFF1816G66R50F
R4174	321-0077-00	B010155	B022189	RES.,FXD,FILM:61.9 OHM,1%,0.125W (T932A ONLY)	91637	MFF1816G61R90F
R4174	321-0081-00	B022190		RES.,FXD,FILM:68.1 OHM,1%,0.125W (T932A ONLY)	91637	MFF1816G68R10F
R4174	321-0080-00	B010100	B010199	RES.,FXD,FILM:66.5 OHM,1%,0.125W (T935A ONLY)	91637	MFF1816G66R50F
R4174	321-0077-00	B010200	B023669	RES.,FXD,FILM:61.9 OHM,1%,0.125W (T935A ONLY)	91637	MFF1816G61R90F
R4174	321-0081-00	B023670		RES.,FXD,FILM:68.1 OHM,1%,0.125W (T935A ONLY)	91637	MFF1816G68R10F
R4175	315-0201-00	B010100	B010154X	RES.,FXD,CMPSN:200 OHM,5%,0.25W (T932A ONLY)	01121	CB2015
R4175	315-0201-00	B010100	B010199X	RES.,FXD,CMPSN:200 OHM,5%,0.25W (T935A ONLY)	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	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
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	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
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
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

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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	MFF1816G90002D
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	24546	NA4D1004F
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	91-81-0
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	91-85-0
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	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
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
R4259	315-0220-00 ----- -----	B010100	B022189X	RES.,FXD,CMPSN:22 OHM,5%,0.25W (T932A ONLY)	01121	CB2205
R4259	315-0220-00 ----- -----	B010100	B023669X	RES.,FXD,CMPSN:22 OHM,5%,0.25W (T935A ONLY)	01121	CB2205
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	16299	NA55D52R3F
R4265	311-0634-00 ----- -----	B010100	B020976	RES.,VAR,NONWIR:TRMR,500 OHM,0.5W (T932A ONLY)	32997	3326H-G48-501
R4265	311-1563-00 ----- -----	B020977		RES.,VAR,NONWIR:1K OHM,20%,0.50W (T932A ONLY)	73138	91-85-0
R4265	311-0634-00 ----- -----	B010100	B021497	RES.,VAR,NONWIR:TRMR,500 OHM,0.5W (T935A ONLY)	32997	3326H-G48-501
R4265	311-1563-00 ----- -----	B021498		RES.,VAR,NONWIR:1K OHM,20%,0.50W (T935A ONLY)	73138	91-85-0
R4266	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R4267	321-0221-00			RES.,FXD,FILM:1.96K OHM,1%,0.125W	91637	MFF1816G19600F
R4268	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R4269	315-0220-00 ----- -----	B010100	B022189X	RES.,FXD,CMPSN:22 OHM,5%,0.25W (T932A ONLY)	01121	CB2205
R4269	315-0220-00 ----- -----	B010100	B023669X	RES.,FXD,CMPSN:22 OHM,5%,0.25W (T935A ONLY)	01121	CB2205
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 ----- -----	B010100	B010154	RES.,FXD,FILM:66.5 OHM,1%,0.125W (T932A ONLY)	91637	MFF1816G66R50F
R4274	321-0077-00 ----- -----	B010155	B022189	RES.,FXD,FILM:61.9 OHM,1%,0.125W (T932A ONLY)	91637	MFF1816G61R90F
R4274	321-0081-00 ----- -----	B022190		RES.,FXD,FILM:68.1 OHM,1%,0.125W (T932A ONLY)	91637	MFF1816G68R106
R4274	321-0080-00 ----- -----	B010100	B010199	RES.,FXD,FILM:66.5 OHM,1%,0.125W (T935A ONLY)	91637	MFF1816G66R50F

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R4274	321-0077-00	B010200		RES.,FXD,FILM:61.9 OHM,1%,0.125W	91637	MFF1816G61R90F
	----- -----			(T935A ONLY)		
R4275	315-0201-00	B010100	B010154X	RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
	----- -----			(T932A ONLY)		
R4275	315-0201-00	B010100	B010199X	RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
	----- -----			(T935A ONLY)		
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	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R4279	321-0133-00			RES.,FXD,FILM:237 OHM,1%,0.125W	91637	MFF1816G237R0F
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	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R4289	321-0133-00			RES.,FXD,FILM:237 OHM,1%,0.125W	91637	MFF1816G237R0F
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	91-81-0
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,NONWIR:CKT BD,5K OHM,20%,0.50W	12697	CM41734
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

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
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,NONWIR:CKT BD,5K OHM,20%,0.50W	12697	CM41734
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
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
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	91-85-0
R4397	311-1561-00			RES.,VAR,NONWIR:2.5K OHM,20%,0.50W	73138	91-83-0
R4398	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
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 ----- -----	B010100	B010199X	RES.,THERMAL:1K OHM,10% (T935A ONLY)	50157	2D1596
RT4175	307-0127-00 ----- -----	B010100	B010154X	RES.,THERMAL:1K OHM,10% (T932A ONLY)	50157	2D1596
RT4275	307-0127-00 ----- -----	B010100	B010199X	RES.,THERMAL:1K OHM,10% (T935A ONLY)	50157	2D1596
RT4275	307-0127-00 ----- -----	B010100	B010154X	RES.,THERMAL:1K OHM,10% (T932A ONLY)	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-7102D
S701	260-1776-00			SWITCH,SLIDE:DPDT,3A,125VAC	82389	11A-1497A
S705	260-1776-00			SWITCH,SLIDE:DPDT,3A,125VAC	82389	11A-1497A
S2030	260-1445-01			SWITCH,PUSH:1 STA,2 POLE,W/O MTG EARS	80009	260-1445-01
S2140	260-1445-01			SWITCH,PUSH:1 STA,2 POLE,W/O MTG EARS	80009	260-1445-01
S2510	260-1268-00 ----- -----			SWITCH,PUSH:3 BUTTON,2 POLE,INTERLOCK (T935A ONLY)	80009	260-1268-00
S4310	260-1666-00			SWITCH,PUSH:1 STA,2 POLE,PUSH-PUSH	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			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1741CU
U460	152-0637-02			SEMICOND DVC,DI:HV MULTR,CHECKED	52306	CMX522
U742A,B	156-0158-04			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	01295	MC1458JG
U805	156-0067-12			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1741CU
U2156A-D	156-0180-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	01295	SN74S00N

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
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	9602 (PC OR DC)
U2234A-D	156-0180-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	01295	SN74S00N
U2524	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	01295	SN7400(N OR J)
	----- -----			(T935A ONLY)		
U4306	156-0113-00			MICROCIRCUIT,DI:QUAD 2-INP NAND GATE	80009	156-0113-00
U4324	156-0388-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	80009	156-0388-00
V470	154-0729-00			ELECTRON TUBE:CRT,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%	14433	1N960B
VR762	152-0195-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	04713	SZ11755
VR764	152-0217-00	XB021760		SEMICOND DEVICE:ZENER,0.4W,8.2V,5%	04713	SZG20
	----- -----			(T932A ONLY)		
VR764	152-0217-00	XB023030		SEMICOND DEVICE:ZENER,0.4W,8.2V,5%	04713	SZG20
	----- -----			(T935A ONLY)		
VR784	152-0293-00			SEMICOND DEVICE:ZENER,1W,33V,5%	04713	SZM25000K5
VR2392	152-0279-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	80009	152-0279-00
VR2590	152-0195-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	04713	SZ11755
	----- -----			(T935A ONLY)		
VR4184	152-0195-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	04713	SZ11755
VR4284	152-0195-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	04713	SZ11755
VR4415	152-0195-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	04713	SZ11755
W4280	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1