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TEKTRONIX®

**T921/T922/T922R
15 MHz
OSCILLOSCOPES
WITH OPTIONS**

INSTRUCTION MANUAL

TEKTRONIX®

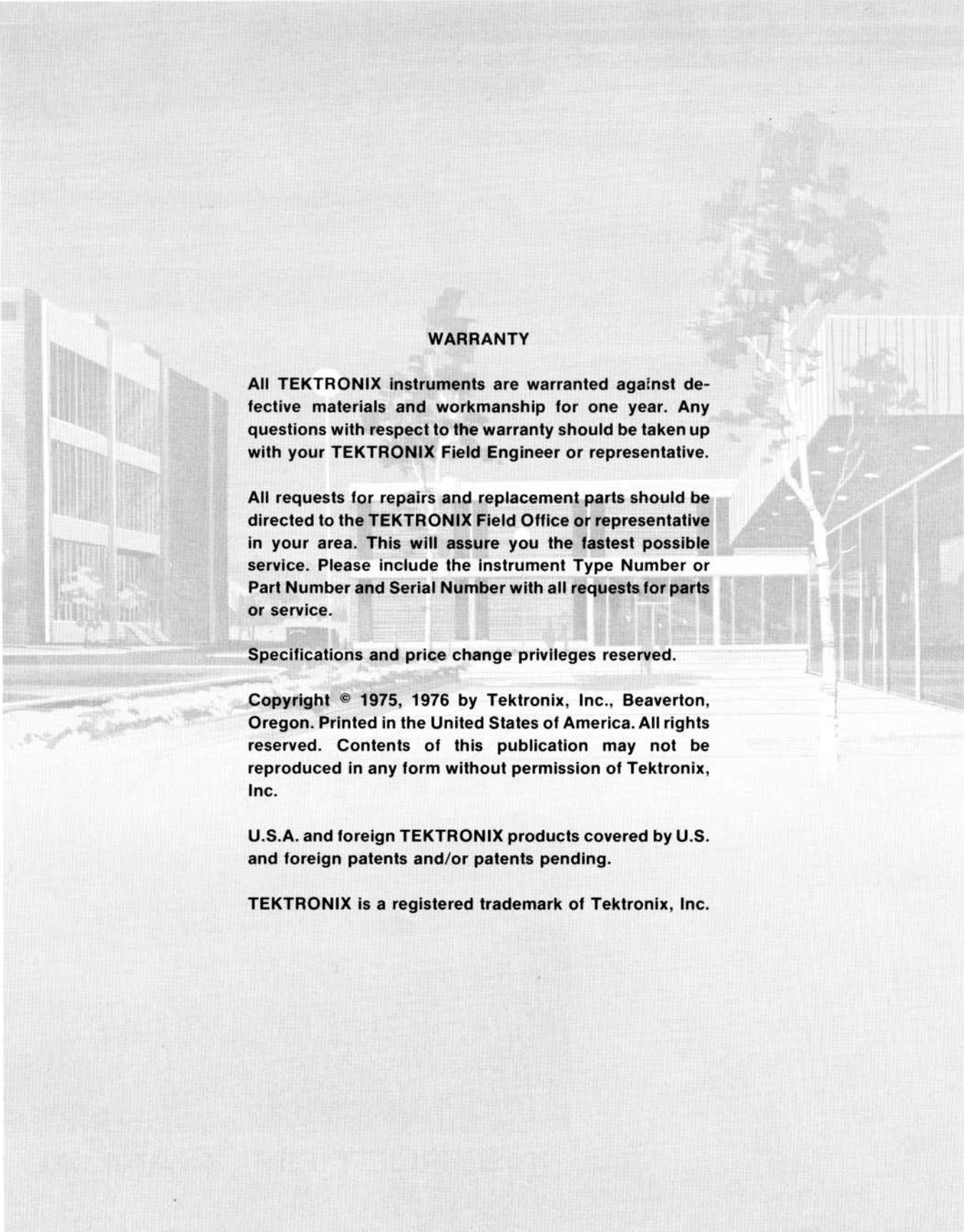
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15 MHz
OSCILLOSCOPES
WITH OPTIONS**

INSTRUCTION MANUAL

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

Serial Number

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All requests for repairs and replacement parts should be directed to the TEKTRONIX Field Office or representative in your area. This will assure you the fastest possible service. Please include the instrument Type Number or Part Number and Serial Number with all requests for parts or service.

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TABLE OF CONTENTS

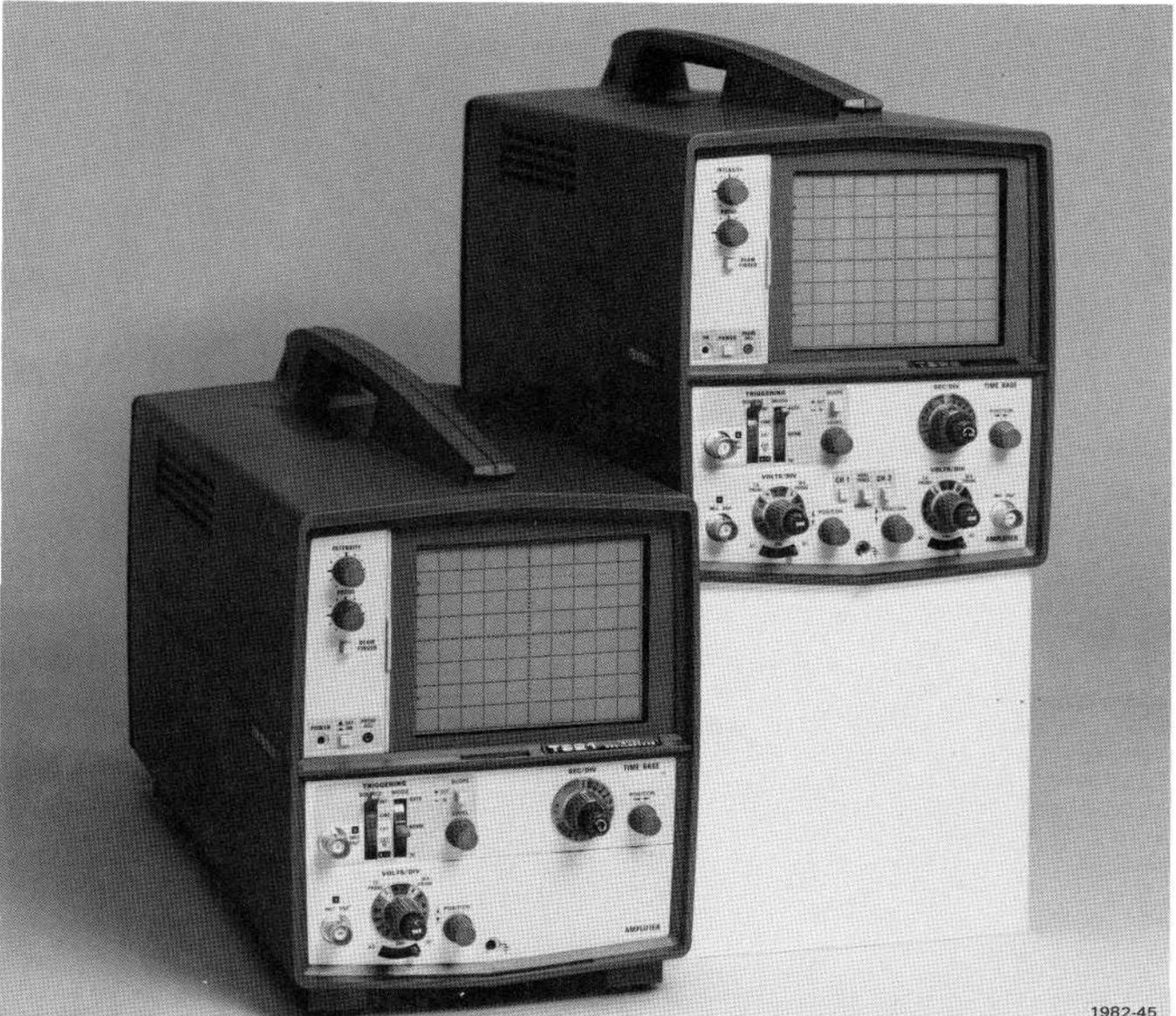
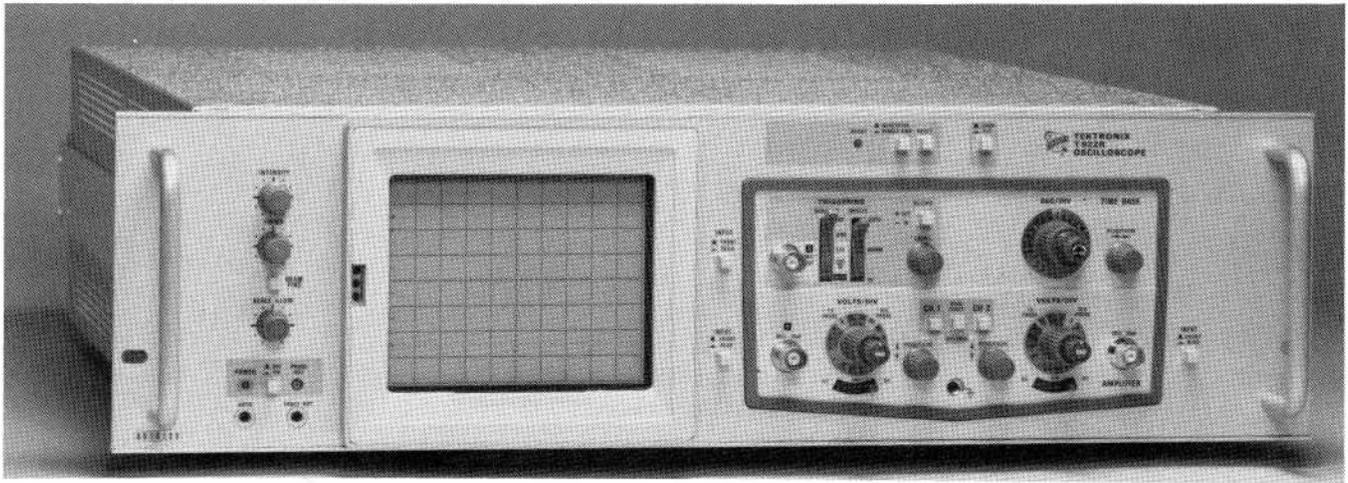
	Page	THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR QUALIFIED SERVICE PERSONNEL ONLY	
LIST OF ILLUSTRATIONS	ii	SECTION 4 ADJUSTMENTS	Page
LIST OF TABLES	iii	Limits and Tolerances	4-1
SECTION 1 SPECIFICATIONS		Adjustment Interaction	4-1
Electrical	1-1	Partial Procedures	4-1
Environmental	1-3	Test Equipment Required	4-1
Physical	1-3	Preliminary Procedure	4-2
Standard Accessories	1-5	A. Display and Power Supply	4-4
Recommended Accessories	1-6	B. Vertical Amplifier	4-6
SECTION 2 OPERATING INSTRUCTIONS		C. Time Base	4-10
Operating Voltage	2-1	SECTION 5 SERVICE INFORMATION	
Safety Information	2-1	Cabinet Removal	5-1
Function of Controls, Connectors and Indicators, T921 and T922		Preventive Maintenance	5-1
A. Display	2-1	Troubleshooting	5-2
B. Vertical Amplifier	2-3	Corrective Maintenance	5-10
C. Time Base	2-5	T922R Line Voltage and Range Selection	5-21
Function of Controls, Connectors and Indicators, T922R		Repackaging For Shipment	5-21
A. Display	2-7	SECTION 6 ELECTRICAL REPLACEABLE PARTS OPTIONS	
B. Vertical Amplifier	2-8	SECTION 7 CIRCUIT DESCRIPTION AND DIAGRAMS	
C. Time Base	2-8	Block Diagram	
First Time Operation	2-10	CRT and Vertical Amplifier	
Probe Compensation	2-13	Power Supply	
Applications	2-13	Vertical Input (T921)	
T922R Rackmounting	2-17	Vertical Input (T922)	
SECTION 3 PERFORMANCE CHECK		Vertical Switching (T922)	
Limits and Tolerances	3-1	Trigger (Late)	
Test Equipment Required	3-1	Trigger (Early)	
Preliminary Procedure	3-2	Sweep & Horizontal Amplifier	
Performance Check Procedure	3-3	T922R Single Sweep, Buffer, & Z Axis	
		T922R Scale Illum, +32 V P.S., Vert Out, F&R Sw.	
		T922R Circuit Board Interconnections	
		SECTION 8 MECHANICAL REPLACEABLE PARTS CHANGE INFORMATION	

LIST OF ILLUSTRATIONS

Fig. No.	Description	Page No.	Fig. No.	Description	Page No.
1-1	T921/T922/T922R 15 MHz oscilloscopes.	Frontis	4-1	T922R adjustment locations.	4-3
1-2	T922R dimensional drawing.	1-4	4-2	Power supply adjustment location (bottom of T921 and T922).	4-4
1-3	T921/T922 dimensional drawing.	1-5	4-3	Interface board adjustment locations.	4-5
2-1	Display front panel controls and connectors.	2-2	4-4	Vertical amplifier adjustment locations (bottom view of T921 and T922).	4-7
2-2	Rear panel controls and connectors.	2-3	4-5	Display of correct (idealized) attenuator compensation.	4-8
2-3	Left side of cabinet.	2-4	4-6	Time base adjustment locations.	4-11
2-4	Bottom of cabinet.	2-4			
2-5	Vertical amplifier front panel controls.	2-5			
2-6	Time base front panel controls and connectors.	2-6	5-1	Troubleshooting chart.	5-4
2-7	T922R display controls, connectors, and indicators.	2-7	5-2	Color code for resistors and capacitors.	5-6
2-8	T922R vertical amplifier controls, connectors and indicators.	2-9	5-3	Lead configuration for semiconductor devices.	5-7
2-9	T922R time base controls, connectors and indicators.	2-10	5-4	Multi-connector holder orientation.	5-8
2-10	Probe compensation.	2-14	5-5	Pin connector replacement.	5-12
2-11	Effects of probe compensation.	2-14	5-6	Shaft-knob removal.	5-13
2-12	Peak-to-peak voltage measurement.	2-15	5-7	T921 and T922 circuit board locations.	5-13
2-13	Instantaneous voltage measurement.	2-15	5-8	T921 and T922 circuit board locations.	5-15
2-14	Phase difference.	2-16	5-9	T922R circuit board locations.	5-17
2-15	Time duration.	2-16	5-10	T922R vertical module replacement.	5-18
2-16	Risetime.	2-17	5-11	T922R horizontal module replacement.	5-18
2-17	T922R rackmounting methods.	2-19	5-12	T922R interface board replacement.	5-19
3-1	Deflection accuracy and X gain check test setup.	3-3	5-13	T922R power module replacement.	5-19
3-2	T922R rear input test setup.	3-4	5-14	T922R scale illum assembly replacement.	5-20
3-3	Bandwidth check test setup.	3-6	5-15	T922R line-voltage and range selection.	5-21
3-4	Triggering and Z-axis input check test setup.	3-7	7-1	Foldback circuit action.	
3-5	Timing accuracy check test setup.	3-8	7-2	Timing diagram: sweep generator and gate.	
3-6	SWEEP RAMP OUT display.	3-10	7-3	Timing diagram of signals generated during a single-sweep display.	
3-7	SWEEP GATE OUT display.	3-10	7-4	Bench version T922 +33 volt power supply.	
3-8	TV trigger check test setup.	3-11	7-5	Simplified block diagram of the vertical output amplifier circuit.	

LIST OF TABLES

Table No.	Title	Page No.
1-1	Electrical Characteristics	1-1
1-2	Environmental Characteristics	1-3
1-3	Physical Characteristics	1-3
3-1	Test Equipment	3-1
3-2	Deflection Accuracy	3-3
3-3	Normal Sweep Timing Accuracy	3-9
3-4	Magnified Sweep Timing Accuracy	3-9
4-1	Test Equipment	4-1
5-1	Power Supply Tolerance	5-3
7-1	Attenuator and Gain Switching Sequence	
7-2	Attenuator and Gain Switching	



1982-45

Fig. 1-1. T921/T922/T922R 15 MHz oscilloscopes.

SPECIFICATIONS

This manual includes instructions for the T921, T922 and T922R portable oscilloscopes. The T922 is a 15 MHz, dual trace, oscilloscope and the T921 is a 15 MHz, single trace oscilloscope. The Vertical Amplifier, either single trace or dual trace, 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(s) and provides calibrated sweep rates from 0.5 s/div to 0.2 μ s/div. A variable X1 to X10 magnifier extends the maximum sweep rate to 20 ns/div.

The T992R is a rackmount version of the T922 oscilloscope which takes 5-1/4 inches of rack space.

Features added to the rackmount version include: single sweep; rear panel outputs for Sweep Gate, Sweep Ramp, and Vertical Signal; internally selectable Z Axis polarity; user selection of the CHOP or ALT dual trace modes; and switch-selectable front-panel or rear-panel inputs for CH 1, CH 2, and EXT TRIG signals.

The following instrument specifications apply over an ambient temperature range of 0°C to +45°C unless otherwise specified. The Adjustment Procedure in Section 4, when performed completely, allows the T921/T922/T922R 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.
Signal Polarity	
T921 and T922 T922R	Positive going from ground. Either polarity of signal can be applied, depending upon internal jumper connections.
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 k Ω .
Power Source	(T922R 120 V—240 V Range and HI-LO adjustments are not externally accessible).
Line Voltage Ranges (ac,rms)	
120 V Range	HI—108 to 132 V. LO—90 to 110 V.
240 V Range	HI—216 to 250 V. LO—198 to 242 V.

Characteristic	Performance Requirement
Line Frequency	50 to 60 Hz.
Maximum Power Consumption	36 W, 0.35 A at 60 Hz, 120 V line.
CRT Display	
Display Area	8 x 10 cm.
Trace Rotation Range	Adequate to align trace with horizontal center line.
Standard Phosphor	P31.
Nominal Accelerating Potential	12,400 V.

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).

Specifications—T921/T922/T922R

TABLE 1-1 (cont)

Characteristic	Performance Requirement
B. VERTICAL AMPLIFIER (cont)	
Frequency Response	
Bandwidth	Dc to at least 15 MHz (5 division reference signal centered vertically from a 25 Ω source with VOLTS/DIV VAR control in calibrated detent).
Risetime	23 ns or less.
Chopped Mode Repetition Rate (T922)	Approximately 250 kHz.
Input Resistance	Approximately 1 M Ω .
Input Capacitance (T921 and T922)	Approximately 30 pF.
Input Capacitance (T922R)	
CH 1 and CH 2, (front only)	Approximately 40 pF.
Maximum Input Voltage	
DC Coupled	400 V (dc + peak ac). 800 V (p-p ac) at 1 kHz or less.
AC Coupled	400 V (dc + peak ac). 800 V (p-p ac) at 1 kHz or less.
Vertical Output (T922R)	
Amplitude	
High Impedance Load	At least 0.5V/div of display.
50 Ω Load	Approximately 50 mV/div of display.
Bandwidth	Approximately 1 MHz.

Characteristic	Performance Requirement
C. TIME BASE	
Sweep Rate	
Calibrated Range	0.5 s/div to 0.2 μ s/div; 20 steps in a 1-2-5 sequence. Variable X1 to X10 magnifier extends maximum sweep rate to 20 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.
X-Y Operation	
Deflection Factor	
Variable Magnifier	
X10	Approximately 100 mV/div.
X1	Approximately 1 V/div.
X-Axis Bandwidth	
T921 & T922	DC to at least 1 MHz with 10 div reference signal.
T922R	DC to at least 1 MHz with 5 div reference signal.
Input Resistance	Approximately 1 M Ω .
Input Capacitance	
T921 & T922	Approximately 30 pF.
T922R	Approximately 40 pF (front input only).
Phase Difference Between X- and Y-Axis Amplifiers	5° or less from dc to 50 kHz.

TABLE 1-1 (cont)

Characteristic	Performance Requirement
C. TIME BASE (cont)	
Triggering	
Sensitivity	0.5 div internal or 100 mV external from 2 Hz to 1 MHz, increasing to 1.5 div internal or 150 mV external at 15 MHz.
TV Sync	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	400 V (dc + peak ac). 800 V (p-p ac) (1 kHz or less).
Input Resistance	Approximately 1 MΩ.
Input Capacitance (T921 and T922)	Approximately 30 pF.
Input Capacitance (T922R, front only)	Approximately 40 pF.
Level Range	
EXT	+0.5 V to -0.5 V.
<u>EXT</u> 10	+5 V to - 5 V.

**TABLE 1-2
 Environmental**

Characteristic	Performance Requirement
Temperature	
Storage	-55°C to +75°C.
Operating	
T921 & T922	0°C to +45°C.
T922R	0°C to +50°C.

TABLE 1-2 (cont)

Characteristic	Performance Requirement
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	
T921 and T922	
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).
T922R	
Without Accessories	19.0 lbs (8.6 kg).
Domestic Shipping Wt	33.0 lbs (15.0 kg).
Overall Dimensions (T921 and T922)	Refer to Fig. 1-3.
Overall Dimensions (T922R)	Refer to Fig. 1-2.

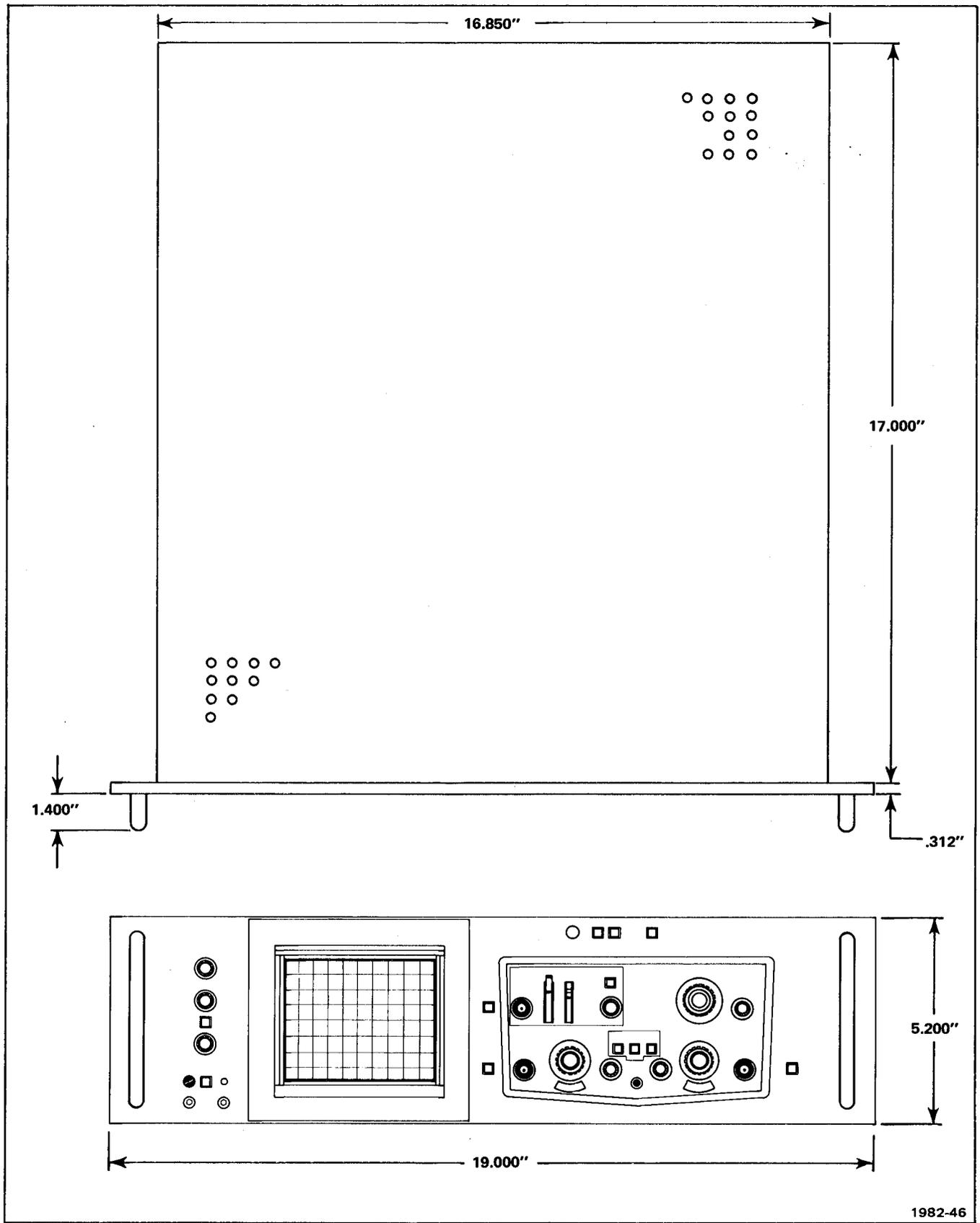
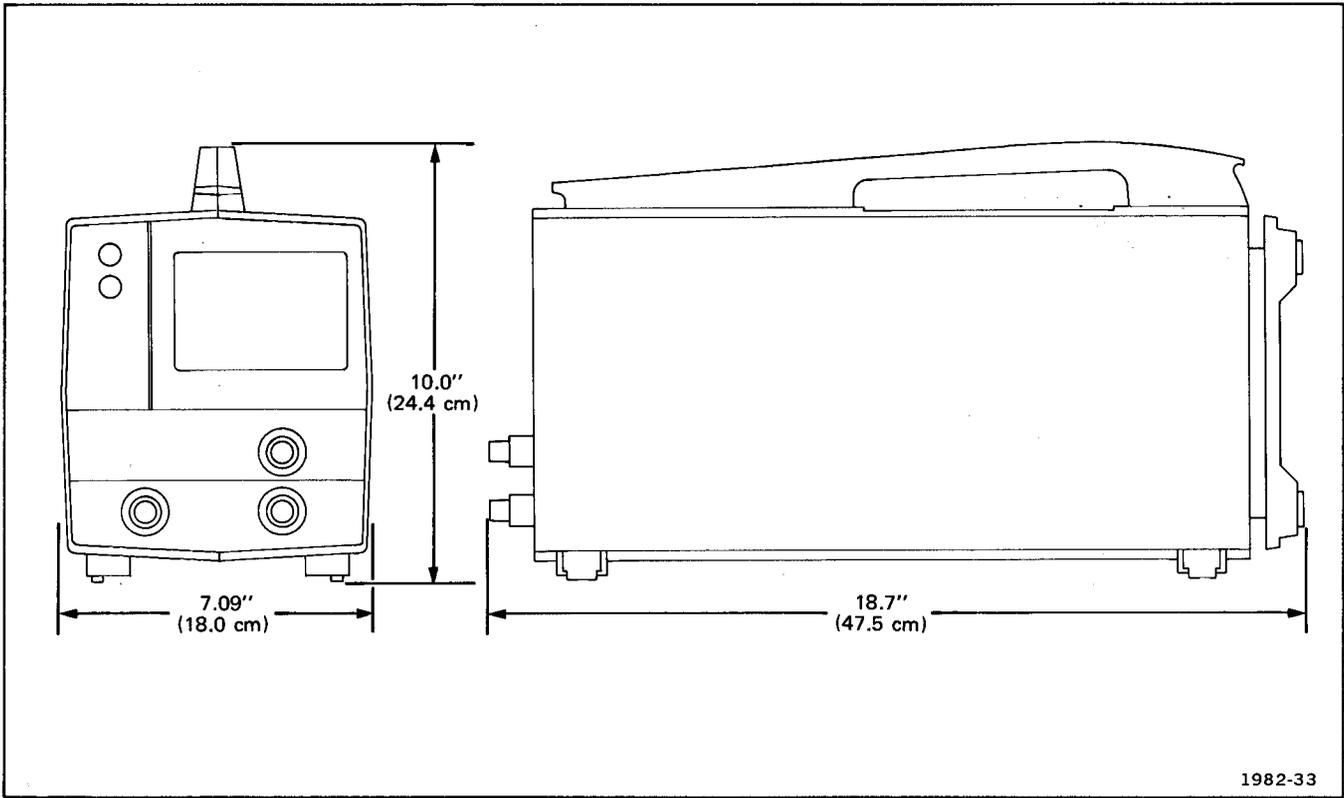


Fig. 1-2. T922R dimensional drawing.



1982-33

Fig. 1-3. T921/T922 dimensional drawing.

STANDARD ACCESSORIES

1	Instruction Manual	070-1982-01
1	Probe (T921)	010-0160-00
2	Probes (T922)	010-0160-00

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

STAND

PORTABLE STAND: The Portable Stand sits on the floor and holds the instrument at an angle to provide easy viewing and access. Also provides storage for small accessories (probe, cables, etc.).

Order 209

PROBES

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

Order010-6101-03

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

P6006 GENERAL PURPOSE 10X VOLTAGE PROBE: The P6006 is a 10X dc to 35 MHz voltage probe. The compensation range of the P6006 allows adjustment to match the front inputs of the T922R. The dc to 35 MHz bandwidth of the P6006 allows full use of the dc to 15 MHz bandwidth of the T922R.

Order 010-0160-00

CAMERAS

C-5A Option 3 Camera: Provides graticule illumination with xenon flash lamp powered by two AA penlight batteries. Recommended for, and molded to fit all bench version T900-series instruments. Fixed focus, fixed aperture f/16 lens with 0.67 or 0.85 user adjustable magnification. Mechanical shutter with speeds of 1/5 to 1/25 s, plus bulb and time.

Order C-5A Option 3

C-5A Option 1 Camera: Recommended for use with the T922R. Option 1 deletes the graticule flash unit from C5A. The T922R is equipped with scale illumination, so the graticule flash unit is not necessary.

The following cameras are also compatible with the T922R using the listed adapter.

CAMERA	ADAPTER
C12, Order	016-0299-00
C27, Order	016-0249-03
C30A, Order	016-0248-00
C59, Order	016-0249-03

RACKMOUNT HARDWARE KIT

Provides the slides and hardware needed to mount the T922R in a rack.

Order 016-0375-00

OPERATING INSTRUCTIONS

OPERATING VOLTAGE

The T921, T922, and T922R will operate from either a 120 V or 240 V ac, 50 to 60 Hz nominal power input source. To avoid equipment damage, the power input range selector switch (120 V or 240 V) and HI/LO switch on the bottom of the instrument (T921/T922 only) must be set to positions which include the value of the applied power input voltage. The POWER indicator lamp will blink when the applied power input voltage varies more than about 10% from the value for which the switches are set.

WARNING

To avoid electric shock and equipment damage, do not attempt to change the power input range selector switch, HI/LO switch, or internal fuse. This must be done by qualified service personnel only.

SAFETY INFORMATION

The T921, T922, and T922R operate from a single-phase power source with one of the current-carrying conductors (the neutral conductor) at ground (earth) potential. Operation from power sources where both current-carrying conductors are live with respect to ground (such as phase-to-phase on a 3-wire system) is not recommended, since only the line conductor has over-current (fuse) protection within the instrument.

The T921, T922, and T922R 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 T921 AND T922

NOTE

(See text preceding FIRST TIME OPERATION for features found only in T922R or those which differ from the T921/T922.)

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.

- ④ **PROBE ADJ**—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). (In some versions this switch is labeled POWER.)

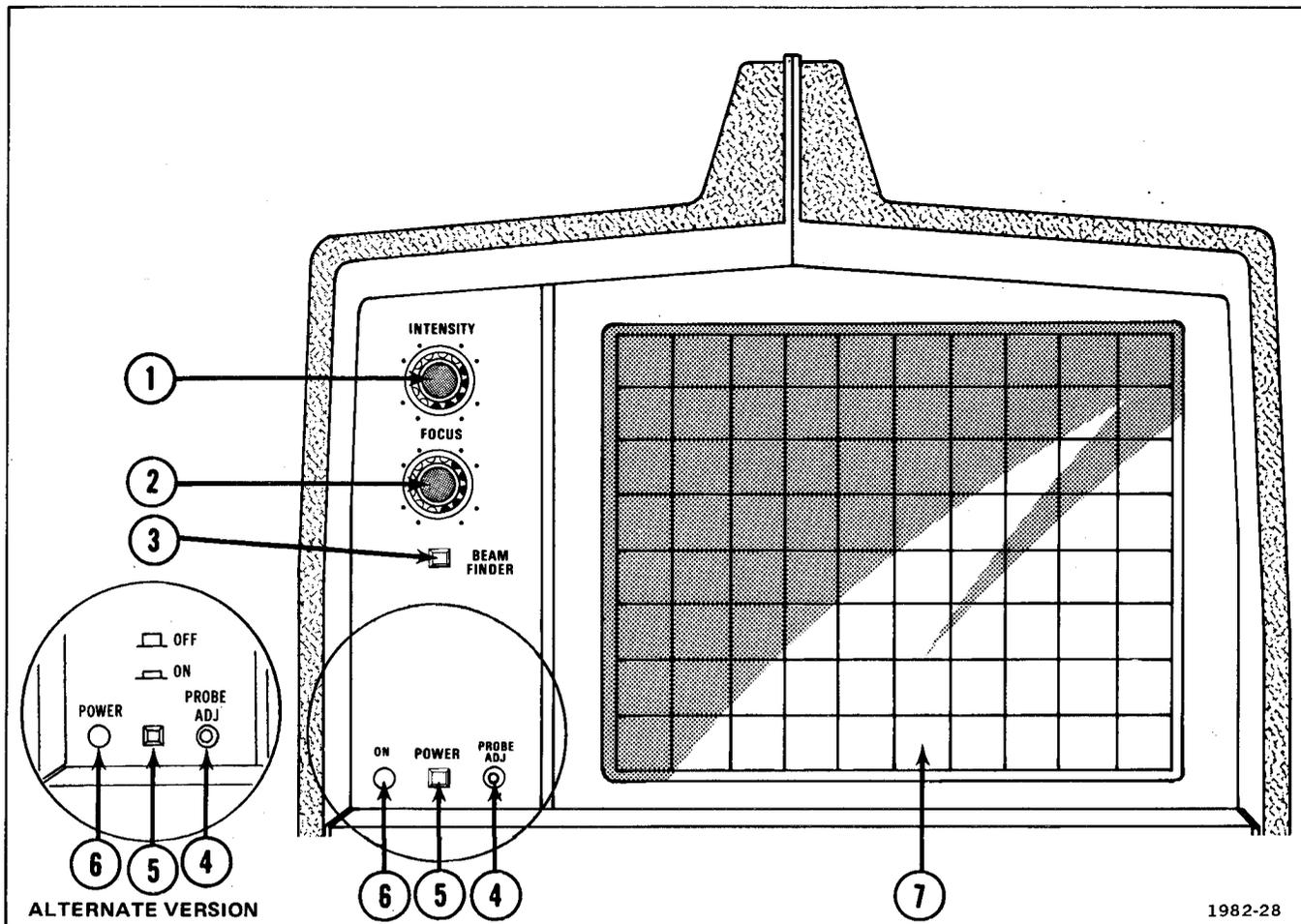


Fig. 2-1. Display front panel controls and connectors.

6 **POWER**—Indicator lamp 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 lamp will blink. (In some versions this lamp is labeled ON.)

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 INPUT**—BNC connector for applying signals to intensity modulate the crt display. Signals must be time-related to the display for a stable display.

Left Side of Cabinet—T921/T922 only (See Fig. 2-3)

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

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

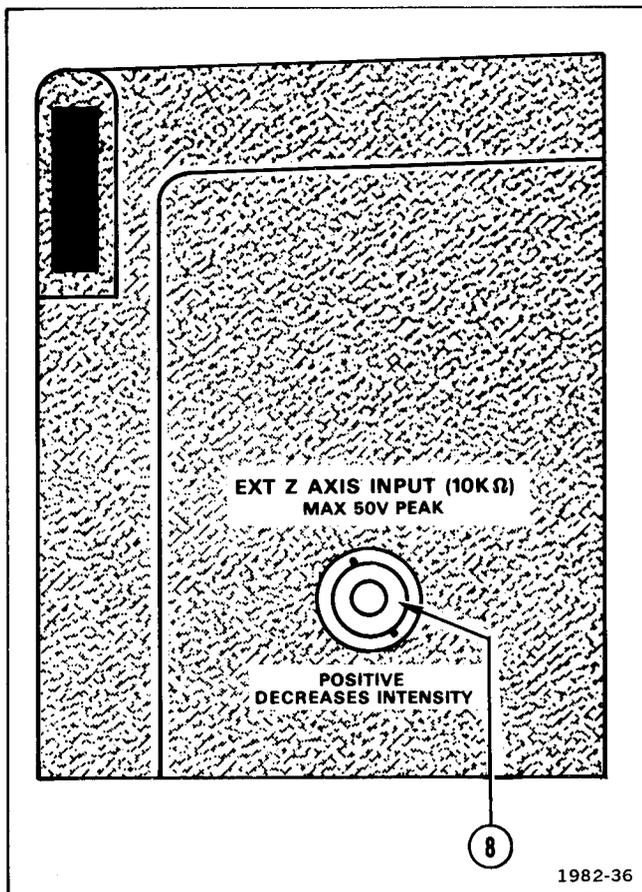


Fig. 2-2. Rear panel controls and connectors.

Bottom of Cabinet—T921/T922 only (see Fig. 2-4)

- ⑪ **120 V/240 V**—Screwdriver actuated switch selects either 120 V or 240 V nominal power input voltage.

WARNING

To avoid electric shock and equipment damage, do not attempt to replace the internal fuse or change the settings of the power input range selector switch or HI/LO switch. This must be done by qualified service personnel only.

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

- ⑬ **CH 1 DC BAL**—Screwdriver adjustment. When properly adjusted, prevents trace shift when switching between adjacent positions of the CH 1 VOLTS/DIV switch.
- ⑭ **CH 2 DC BAL**—Screwdriver adjustment. When properly adjusted, prevents trace shift when switching between adjacent positions of the CH 2 VOLTS/DIV switch.

B. VERTICAL AMPLIFIER

Front Panel (Fig. 2-5)

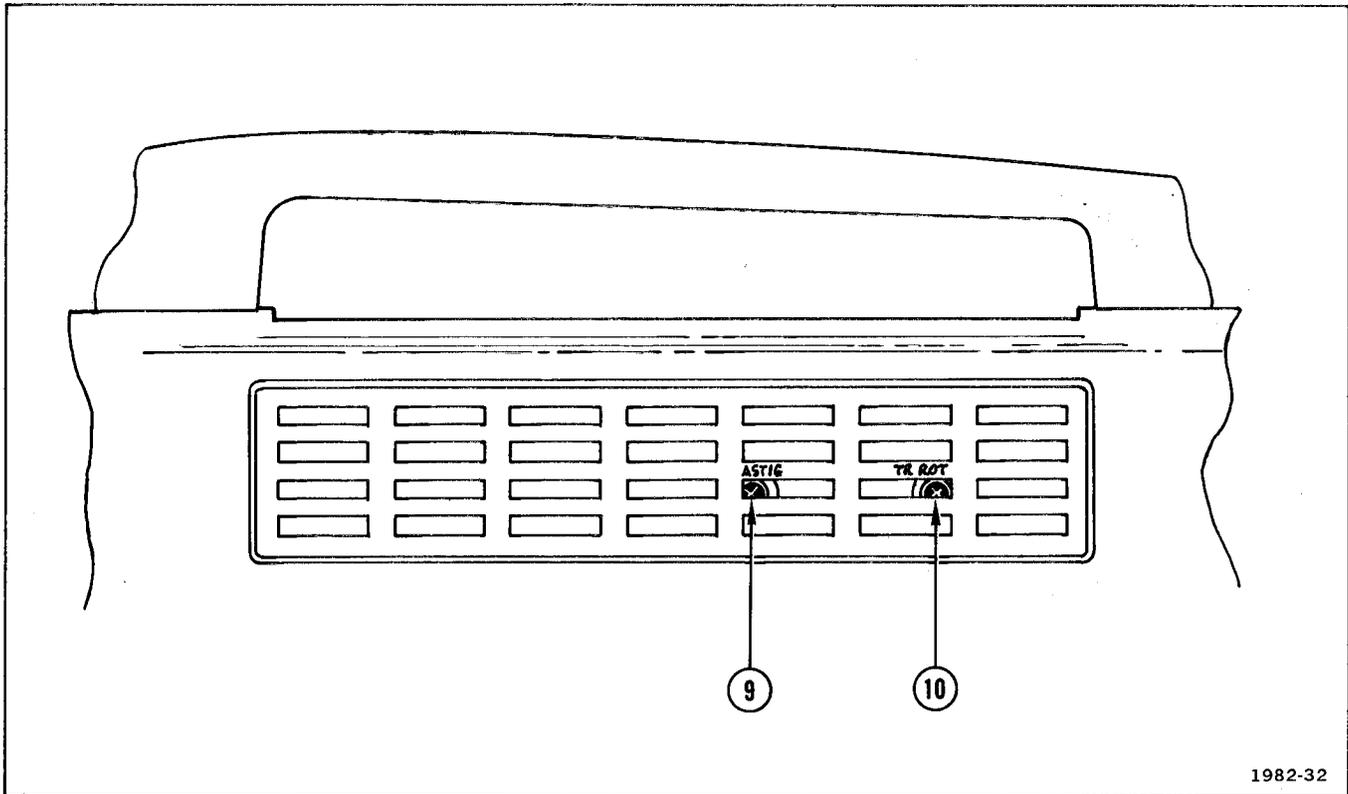
- ① **VOLTS/DIV**—Selects the vertical deflection factor in a 1-2-5 sequence (VAR control must be in detent position to obtain the indicated deflection factors). Read the correct deflection factor for a 1X probe from the 1X position and a 10X probe from the 10X position.
- ② **VAR**—Provides continuously variable uncalibrated deflection factors between the calibrated steps of the VOLTS/DIV switches. Extends the maximum deflection factor to 25 V/div in the 10 V position. Detent position provides calibrated VOLTS/DIV deflection factors.
- ③ **Input Coupling**—Selects the method of coupling the input signal to the vertical input signal amplifier.

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

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

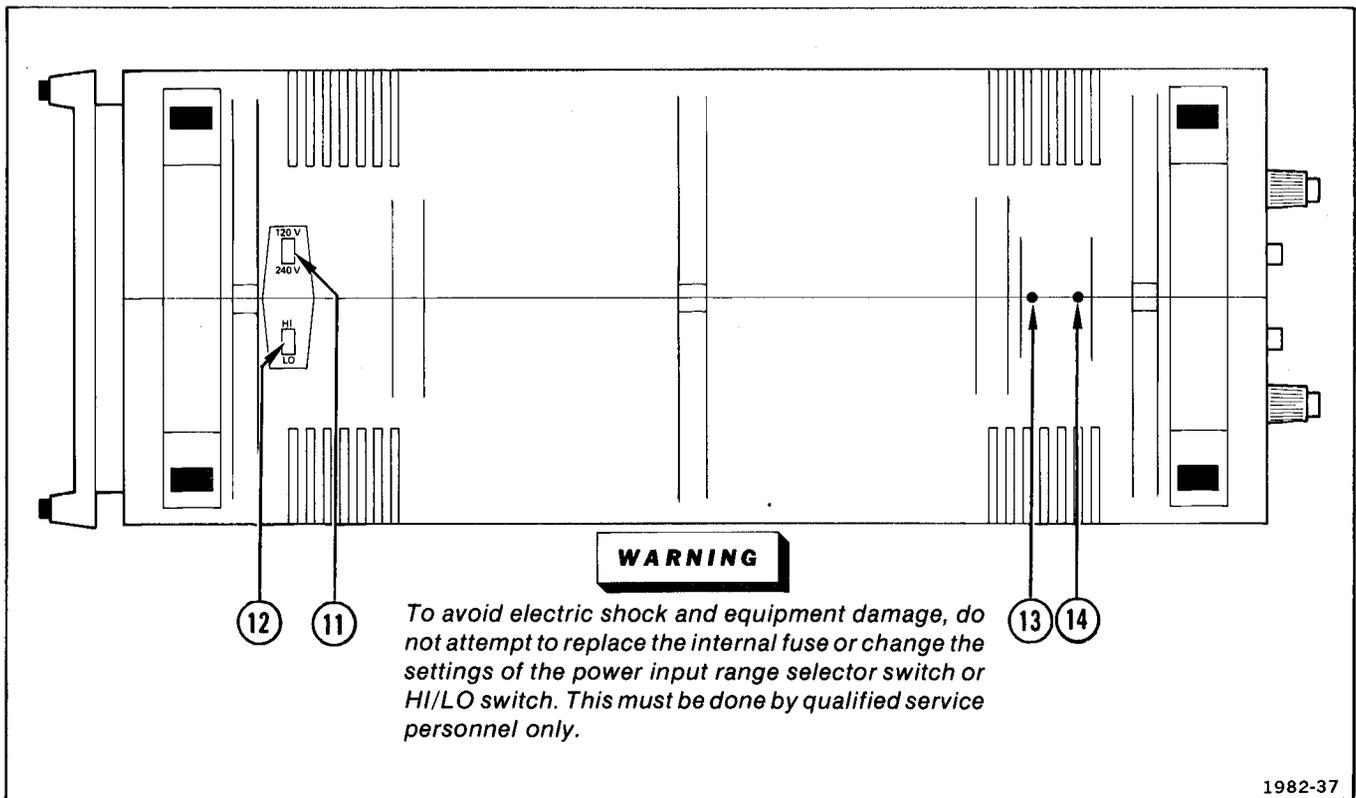
DC: All components of the input signal are passed to the vertical amplifier.

- ④ **Channel 1 or Y Input**—Connector for applying an external signal to the vertical deflection system. Provides the Y input in the X-Y mode when CH 1 vertical mode button is in.
- ⑤ **Channel 2 Input**—Connector for applying an external signal to the vertical deflection system.



1982-32

Fig. 2-3. Left side of cabinet.



1982-37

Fig. 2-4. Bottom of cabinet.

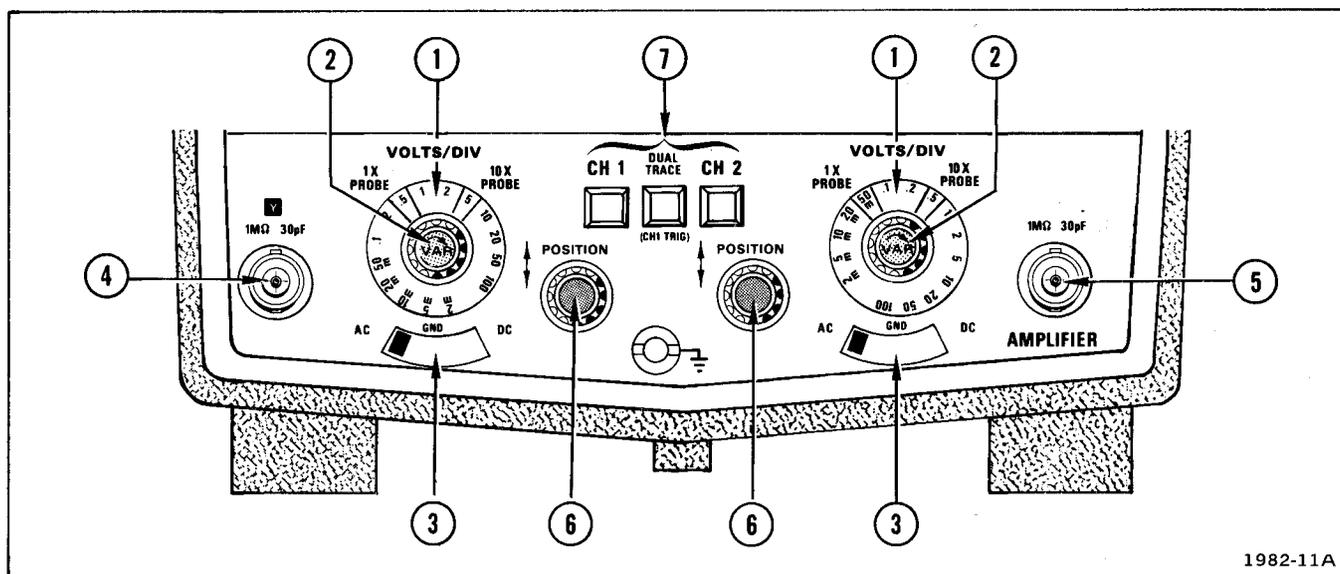


Fig. 2-5. Vertical amplifier front panel controls.

6 POSITION—Controls the vertical position of the crt display.

7 Vertical Mode—Selects the vertical amplifier operating mode.

CH 1: Displays only signal applied to the CH 1 input connector. This button must be latched in for X-Y operation.

CH 2: Displays only signal applied to the CH 2 input connector.

DUAL TRACE: Displays CH 1 and CH 2 input signals alternately. Chop or Alternate mode is selected automatically by the SEC/DIV switch. For SEC/DIV switch settings of 1 ms and slower, Chop is selected. For settings of .5 ms and faster, Alternate is selected. In DUAL TRACE mode, the trigger signal is derived from CH 1. When the DUAL TRACE and CH 2 buttons are locked in at the same time, the trigger signal comes from CH 2 (instead of CH 1) while DUAL TRACE signals are displayed.

C. TIME BASE

Front Panel (Fig. 2-6)

1 SOURCE—Selects the source of the trigger signal.

INT: Uses a sample of the signal displayed on the crt as a trigger signal in the CH 1 or CH 2 modes. In DUAL TRACE mode, the trigger signal is obtained from CH 1. If CH 2 and DUAL TRACE buttons are both latched in, channel 2 is the trigger source.

Line: Uses a sample of the power-line frequency as a trigger signal.

EXT: Permits triggering on signals applied to the X (external trigger) input connector. External trigger signals must be time-related to the displayed signal for a stable display.

EXT÷10: External trigger signal is attenuated by a factor of 10.

X-Y: Permits x-y display. X (horizontal) input is through the X input connector. Y (vertical) input is normally through the CH 1 or Y input connector (vertical mode CH 1 button must be latched in). For special applications, the Y input may be obtained from the CH 2 input connector (CH 2 button latched in), or from both CH 1 and CH 2 (DUAL TRACE button latched in).

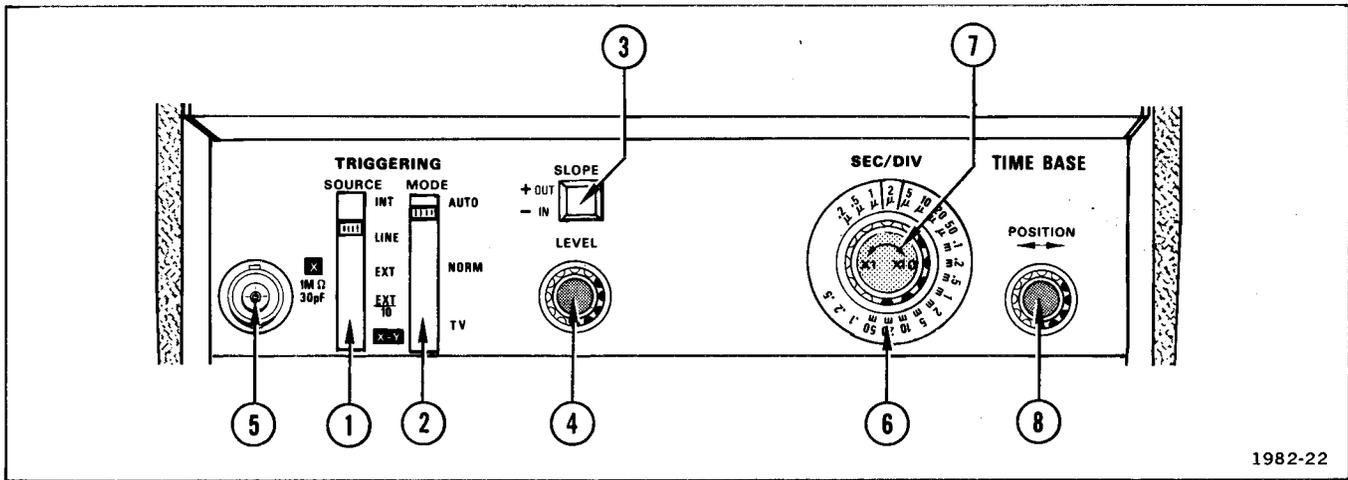


Fig. 2-6. Time base front panel controls and connectors.

1982-22

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. Setting **SOURCE** to **LINE** position provides an adequate trigger signal.

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 μ s or faster. Set the **SLOPE** switch to **+OUT** for sync-positive input signals and to **-IN** for sync-negative input signals.

3 **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.

4 **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.

5 **X (External Trigger)**—Provides input for external trigger signals or for X axis signals in the X-Y mode.

6 **SEC/DIV**—Selects calibrated sweep rates in a 1-2-5 sequence. X1-X10 variable control must be in the X1 detent position (fully ccw) to read calibrated sweep rates directly from the **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.

7 **X1-X10**—Provides calibrated sweep rates when in X1 (fully ccw) detent position. Increases the horizontal gain by a factor of 10, providing at least 20 ns/div sweep rate in the X10 detent position (fully cw) with the **SEC/DIV** knob set to .2 μ s.

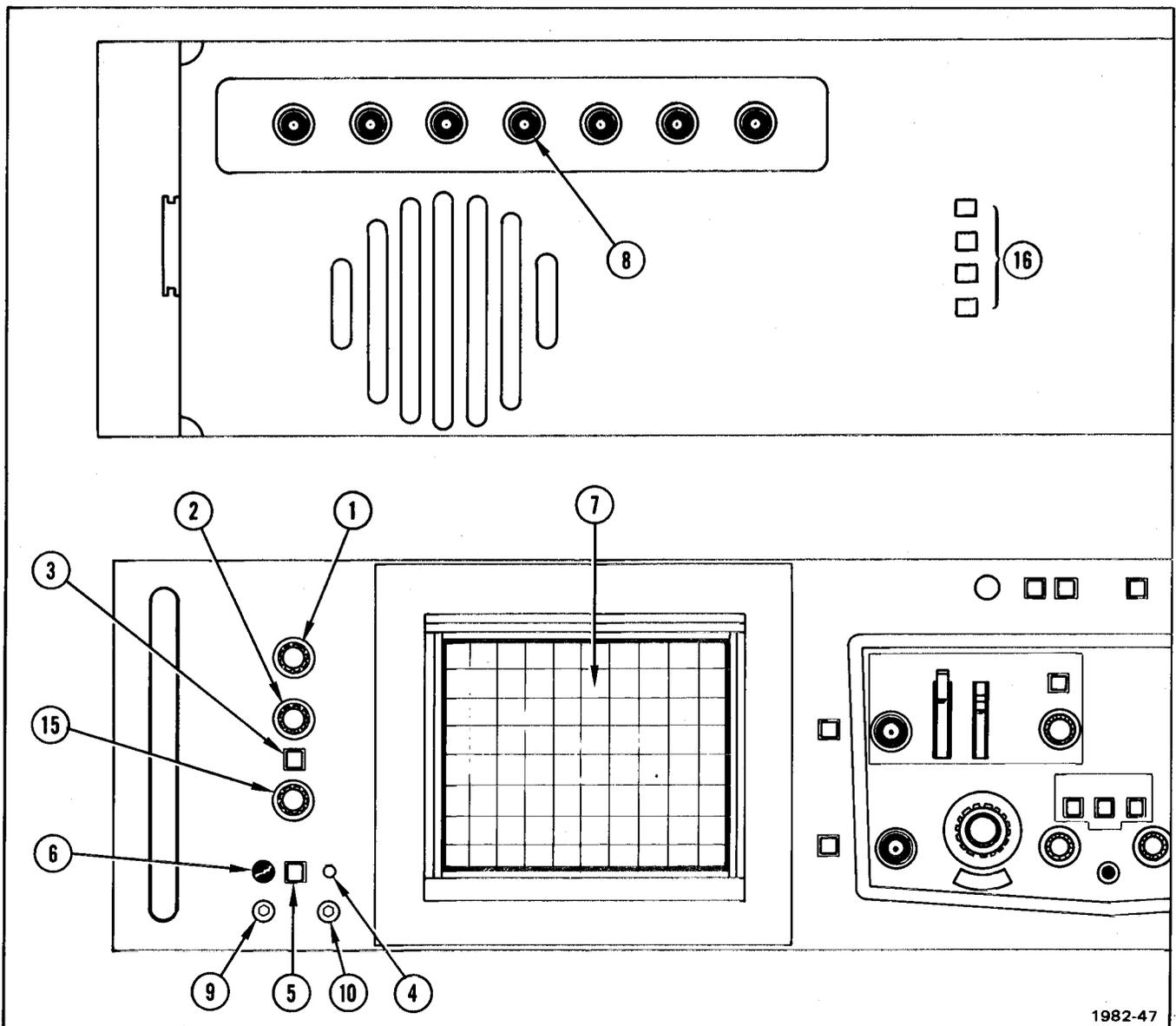
8 **POSITION**—Controls the horizontal position of the crt display.

FUNCTIONS OF CONTROLS, CONNECTORS, AND INDICATORS T922R

A. DISPLAY (FIG. 2-7)

The following information shows the different mechanical layout of the T922R and discusses features found only on the rackmount version. The location and names of all T922R controls, connectors, and indicators are given here. For the discussion of those common to T921, T922 and T922R, see the Operating Instructions section of the standard T921/T922 portion of this manual.

- ① INTENSITY
- ② FOCUS
- ③ BEAM FIND



1982-47

Fig. 2-7. T922R display controls, connectors, and indicators.

Operating Instructions—T921/T922/T922R

- ④ PROBE ADJ
- ⑤ OFF—ON
- ⑥ POWER Lamp
- ⑦ Internal Graticule
- ⑧ Z AXIS IN
- ⑨ ASTIG
- ⑩ TRACE ROT
- ⑪, ⑫, ⑬, and ⑭—In the T922R these controls are internally accessible only.

WARNING

To avoid electric shock and equipment damage, do not attempt to change the power input range selector switch, HI/LO switch, or internal fuse. This must be done by qualified service personnel only.

- ⑮ SCALE ILLUM
- ⑯ AC RMS RANGE—Indicates the voltage from which the T922R is set to operate.

B. VERTICAL AMPLIFIER (FIG. 2-8)

- ① VOLTS/DIV
- ② VAR
- ③ Input Coupling
- ④ Channel 1 or Y Inputs—Two switch-selectable inputs for applying signals to Channel 1. One is mounted on the front panel and the other on the rear panel.

- ⑤ Channel 2 Inputs—Two switch-selectable inputs for applying signals to Channel 2. One is mounted on the front panel and the other on the rear panel.
- ⑥ POSITION
- ⑦ Vertical Mode—When operating in the DUAL TRACE mode you must manually select either CHOP or ALT (see control 8).
- ⑧ CHOP-ALT—Selects either CHOP or ALT dual trace modes. Use CHOP at lower sweep speeds and ALT at higher sweep speeds.
- ⑨ COMP VERT SIG OUT—The signal available at this connector is a sample of the vertical signal being displayed plus a dc component proportional to the the vertical position of the display.
- ⑩ FRONT-REAR—Two push-button switches, one for CH 1 and one for CH 2, which select either the front or the rear vertical inputs.

C. TIME BASE (FIG. 2-9)

- ① SOURCE
- ② MODE—To use the AUTO, NORM, or TV SYNC modes the SINGLE SWEEP/REPETITIVE button must be set to REPETITIVE (out).
- ③ SLOPE
- ④ LEVEL
- ⑤ EXT TRIG or X—Two switch-selectable inputs for external trigger or X axis signals. One is mounted on the front panel and the other on the rear panel.
- ⑥ SEC/DIV
- ⑦ X1-X10
- ⑧ POSITION

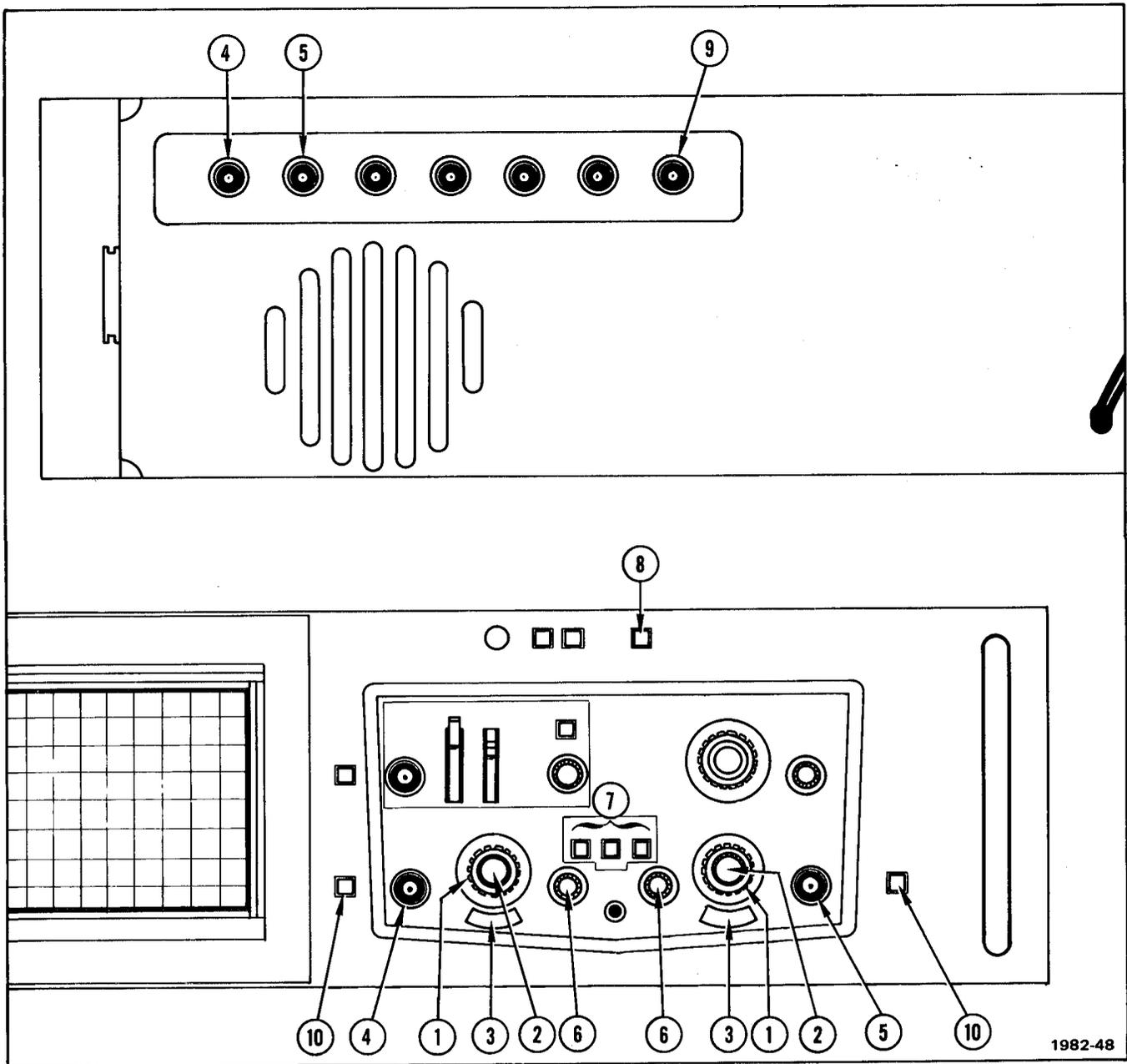


Fig. 2-8. T922R vertical amplifier controls, connectors, and indicators.

9 SWEEP RAMP OUT—Provides a ramp output corresponding to the sweep waveform applied to the crt.

10 SWEEP GATE OUT—Provides a logic level output which goes high while the crt trace is being swept and goes low during retrace and holdoff.

11 REPETITIVE/SINGLE SWEEP—Set the SINGLE SWEEP pushbutton to the in position to operate in the single sweep mode. In the single sweep mode, when an adequate trigger signal becomes available, the sweep generator runs only once. Set RESET.

12 RESET—When operating in the single sweep mode and after a single sweep display has been presented,

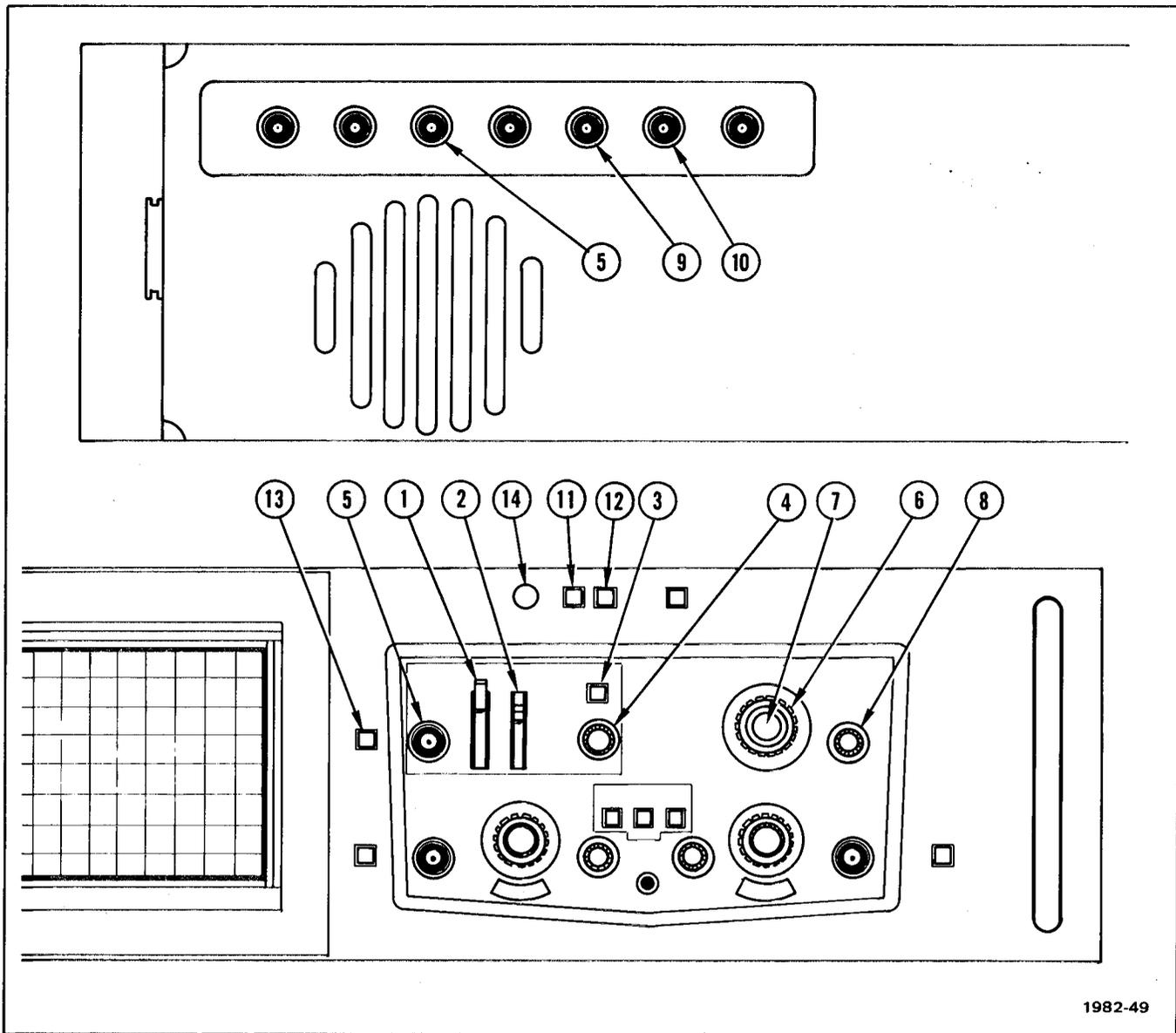


Fig. 2-9. T922R time base controls, connectors, and indicators.

another single sweep display cannot be presented until the RESET button is pushed.

13 FRONT-REAR—Pushbutton switch which selects either the front or rear EXT TRIG or X input.

14 READY—An indicator, that when lit indicates the RESET button has been pushed and that a single sweep will be presented when an adequate trigger signal is received.

FIRST TIME OPERATION

Use this procedure when you turn instrument on for the first time. It checks that most functions of the instrument are operational. The procedure requires a probe, and a 10X probe is supplied as a standard accessory with the T921 and T922. See the Accessories list in Section 1 for the recommended probe for the T922R. 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. If you have a T921, use the control settings for Channel 1 only.

First, check that the Power Input Voltage Selector switch and the HI-LO Range Selector switch on the bottom of the cabinet (T921/T922 only) are set for your power input voltage. In the United States the Power Input Voltage Selector switch is normally set for 120 V and the HI-LO Range Selector switch is normally set for HI at the factory. In Europe the Power Input Voltage Selector switch is normally set for 240 V and the HI-LO Range Selector is normally set for LO.

CAUTION

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

WARNING

To avoid electric shock, refer T922R input voltage and range changes to qualified service personnel. See the Service Information section of this manual for range change instructions.

For the T922R, the input voltage selection and range selection controls are internally accessible only. Before connecting your instrument to the power source, check AC RMS RANGE indicator on the instrument rear panel. When the instrument leaves the factory, this indicator is set to indicate the voltage range from which the instrument is set to operate.

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

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

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.

Vertical Positioning and Horizontal Operation

- | | | |
|---------|---------------|-----------------------|
| 1. Set: | LEVEL | mid-range |
| | SEC/DIV | 1 ms |
| | X1 - X10 | X1 (fully ccw detent) |
| | vertical mode | CH 1 |

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 TRACE. You should have two traces on the crt screen—one above the center line and one below.

5. Check that there are two traces at every setting of the SEC/DIV switch from .2 μ s 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 ADJ signal to the inputs.

Operating Instructions—T921/T922/T922R

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 with T921 and T922), use the 10X probe window.

The PROBE ADJ output is a square wave. An incorrectly compensated 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) |
| | CH 1 VAR | detent
(fully clockwise) |
| | 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 of T921 and T922) 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 ADJ connector. Set the CH 1 AC-GND-DC switch to DC. You should have approximately 2.5 divisions 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 ADJ 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 ADJ 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 ADJ 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 (if a 1X probe is available, use it, if a 10X probe is used, rotate the X1-X10 control fully clockwise) and hold the probe tip against the PROBE ADJ 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 X1-X10 control setting. Return X1-X10 to X1 (fully counterclockwise detent).

X-Y and Dual Trace Operation

This mode is usable with SEC/DIV settings of 1 ms or slower. Set controls and connect signals as you would for independent X-Y or Dual Trace operation.

Astigmatism Operation

- | | | |
|---------|--------|-----|
| 1. Set: | SOURCE | INT |
|---------|--------|-----|

2. Connect the probe to the CH 1 input and hold the probe tip against the PROBE ADJ connector. Rotate the LEVEL control for the most stable display. Adjust the FOCUS control for the 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 of T921/T922) for the best defined display.

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

Ext Z Axis Input Operation

For the T921 or T922 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. For the T922R, an internal plug allows a selection of either a positive-going or a negative-going signal to cause a decrease in intensity. See Service Information.

X1-X10 and Trigger Operation

1. Note a display with several cycles of the PROBE ADJ 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-hand edge) on the screen. Set the SLOPE button to +OUT 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	INT
	MODE	AUTO
	CH 1 AC-GND-DC	AC

The instrument is now ready to operate when signal is applied 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. 2-10.

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 ADJ connector. Notice a display similar to those shown in Fig. 2-11. Adjust the probe for the correct compensation. The effects of incorrect probe compensation on three types of signals are illustrated in Fig. 2-11.

APPLICATIONS

Peak-to-Peak Amplitude Measurements

To measure the amplitude of a signal, multiply 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 3 divisions (see Fig. 2-12) and the VOLTS/DIV switch is set to .5 V. Substituting the given values:

$$\text{Amplitude} = 3 \text{ divisions} \times 0.5 \text{ volt/division} = 1.5 \text{ V p-p}$$

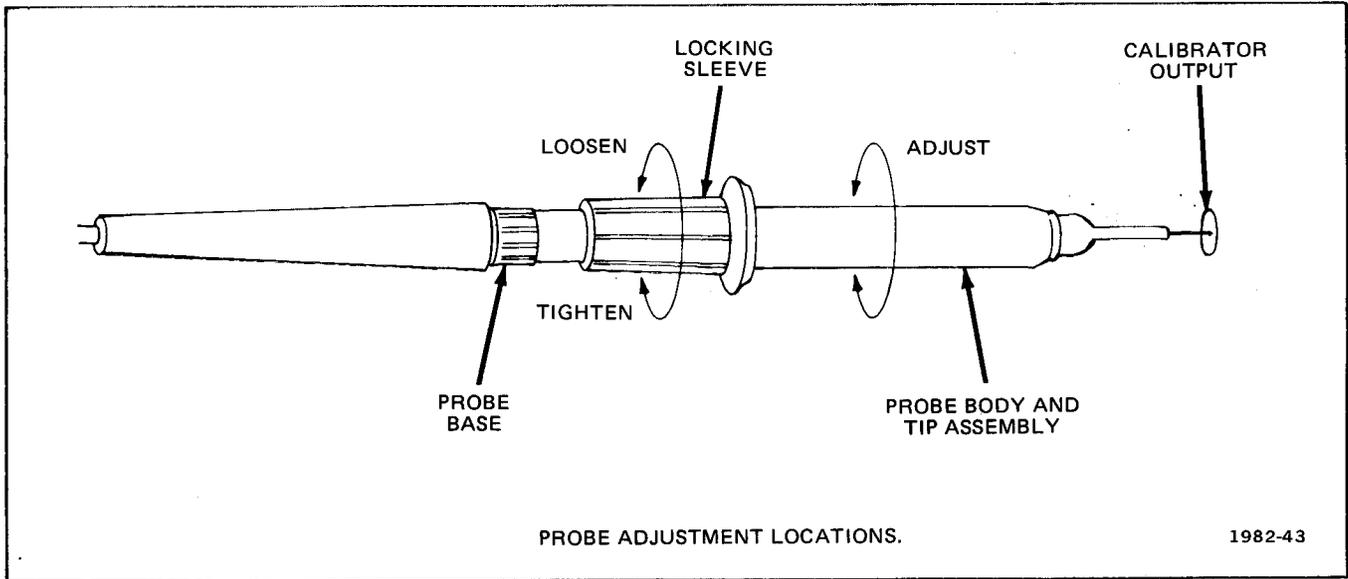


Fig. 2-10. Probe compensation.

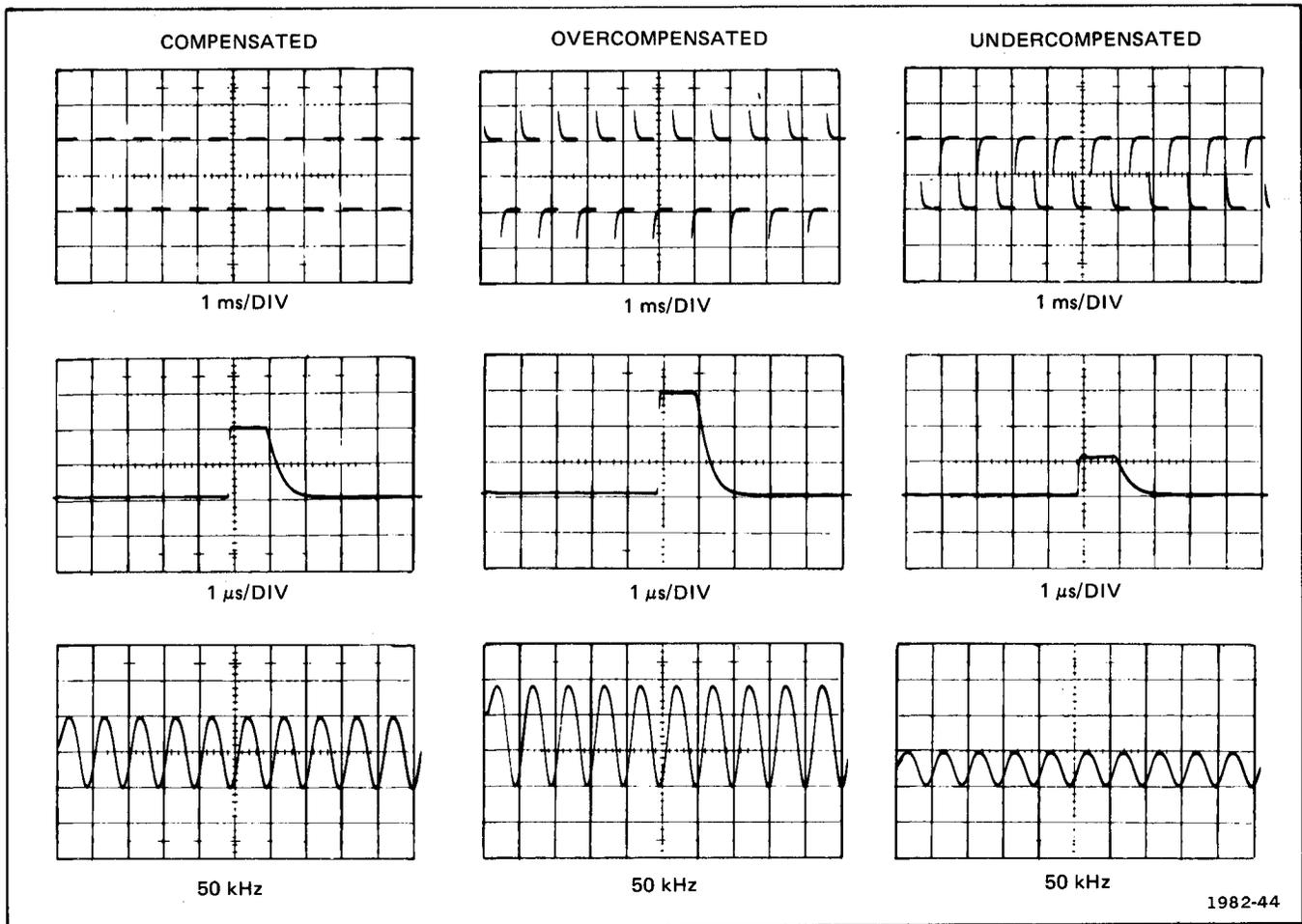


Fig. 2-11. Effects of probe compensation.

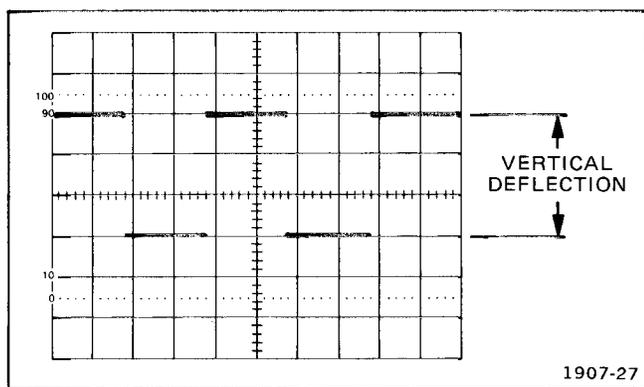


Fig. 2-12. Peak-to-peak voltage measurement.

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. 2-13).
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.

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. 2-13). The VOLTS/DIV switch is set to 10 mV. The waveform appears above the reference line.

Substituting the given values:

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

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

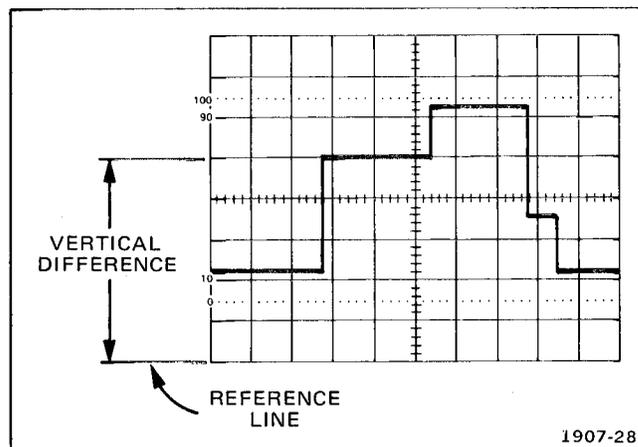


Fig. 2-13. Instantaneous voltage measurement.

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. It is also more accurate and easier to use than the X-Y method. 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 TRACE. Position both traces to the graticule horizontal centerline.
3. Connect the reference signal to the CH 1 input connector and the comparison signal to the CH 2 input connector. Use coaxial cables or probes which have equal time delay to connect the signals to the input connectors.
4. Set the CH 1 and CH 2 VOLTS/DIV switches and the CH 1 and CH 2 VAR controls to 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.

Operating Instructions—T921/T922/T922R

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. 2-14). Each division of the graticule represents 45° of the cycle ($360^\circ \div 8 \text{ divisions} = 45^\circ/\text{division}$).

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 divisions with a sweep rate of 45°/division as shown in Fig. 2-14.

Substituting the given values:

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

$$\text{Phase Difference} = 27^\circ$$

Example:

The horizontal distance measured is 8.3 divisions (see Fig. 2-15).

The SEC/DIV switch is set to 2 ms.

Substituting the given values:

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

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

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

and

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

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

$$*16.6 \text{ ms} = .0166 \text{ seconds}$$

Time Duration and Frequency Measurements

To find the time duration between 2 points on a waveform, multiply the horizontal distance (in divisions) between the 2 points by the SEC/DIV switch setting. Frequency (in hertz) is the reciprocal of the time duration of one cycle (in seconds).

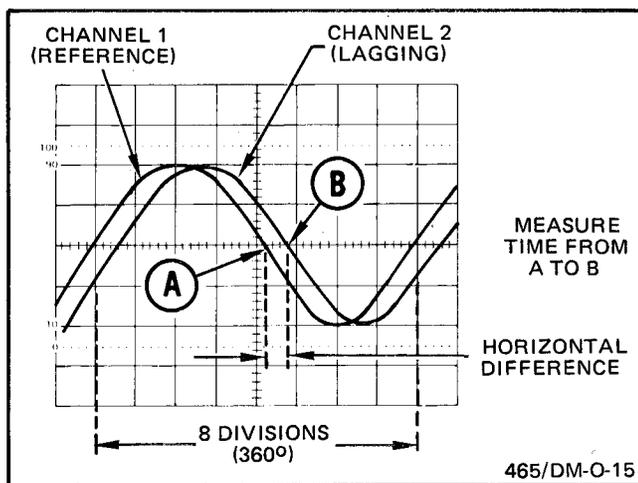


Fig. 2-14. Phase difference.

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).

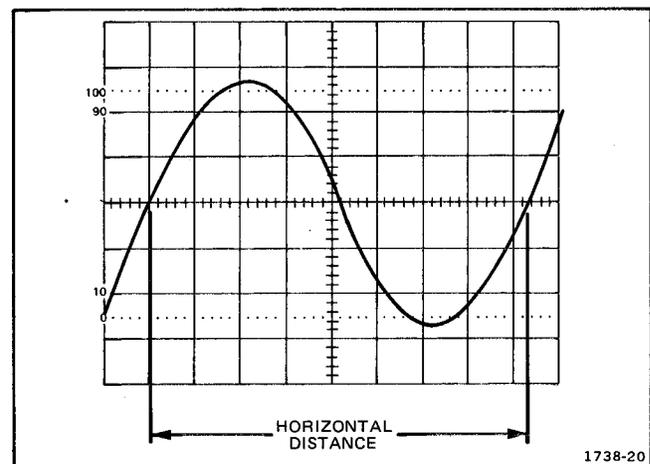


Fig. 2-15. Time duration.

T922R RACKMOUNTING

Use the following procedure to measure risetime:

1. Adjust the VOLTS/DIV and VAR controls for a display amplitude of exactly 5 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. 2-16).
3. Measure the horizontal distance (divisions) between the 10% and 90% points on the waveform (point A to point B, Fig. 2-16).
4. Use the following formula to find risetime:

$$\text{Risetime} = \frac{\text{horizontal distance (divisions)}}{\text{SEC/DIV setting}}$$

Examples:

The horizontal distance between the 10% and 90% point on the waveform is 5 divisions with a SEC/DIV switch setting of 1 μs .

Substituting the given values:

$$\text{Risetime} = 5 \text{ divisions} \times 1 \mu\text{s/division}$$

$$\text{Risetime} = 5 \mu\text{s}$$

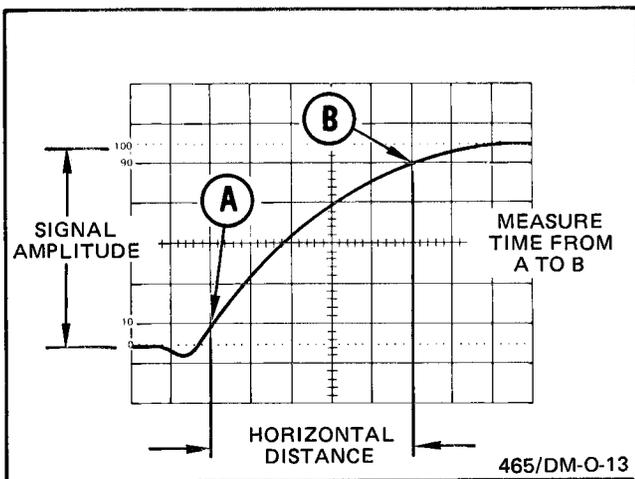


Fig. 2-16. Risetime.

Introduction

The Tektronix T922R Oscilloscope is designed to mount in a standard 19-inch rack. When mounted in accordance with the following mounting procedure, the instrument will meet all electrical and environmental characteristics given in Section 1 of this manual.

Instrument Dimensions

A dimensional drawing showing the major dimensions of the T922R is shown in Fig. 1-2 in Section 1 of this manual.

Rack Dimensions

Height. A least 5.25 inches of vertical space is required to mount this instrument in a rack.

Width. When used with the optional slide-out tracks, the minimum width of the opening between the left and right front rails of the rack must be 17 5/8 inches. This allows room on each side of the instrument for the slide-out tracks to operate freely, permitting the instrument to move smoothly in and out of the rack.

Depth. Total depth necessary to mount the T922R in a cabinet rack is 18 inches. This allows room for air circulation, power cord clearance and the necessary mounting hardware. (Additional room may be needed if access to rear panel connections is required.)

Slide-Out Tracks

The optional slide-out tracks permit the T922R to be extended out of the rack for maintenance or calibration without removing the instrument from the rack. To operate the T922R in the extended position, be sure the power cord and any interconnecting cables are long enough for this purpose.

The slide-out tracks consist of two assemblies—one for the left side of the instrument and one for the right side. Illustrations at the end of this section show the complete slide-out track assemblies. The stationary section of each assembly attaches to the front and rear rails of the rack, and the chassis section is attached to the instrument. The intermediate section slides between the stationary and chassis sections and allows the T922R to be extended out of the rack. The stationary and intermediate sections of the tracks are packaged as matched sets and should not be separated. To identify the left or right assembly, note the position of the automatic latch. When mounted in the rack, the automatic latch should be at the top of both assemblies.

Operating Instructions—T921/T922/T922R

The hardware needed to mount the slide-out tracks is shown in the illustrations at the end of this section. Since the hardware supplied is intended to make the tracks compatible with a variety of cabinet racks and installation methods, not all of it will be needed for this installation. Use only the hardware that is required for the mounting method used.

Mounting Procedure

Refer to the illustrations at the end of this section for recommended mounting procedures.

Removing or Installing the Instrument

After initial installation and adjustment of the slide-out tracks, the T922R can be removed or installed without further adjustments under normal conditions.

Slide-Out Track Lubrication

The slide-out tracks normally require no lubrication. The special finish on the sliding surfaces provides permanent lubrication. However, if the tracks do not slide smoothly even after proper adjustment, a thin coating of paraffin rubbed onto the sliding surfaces may improve operation.

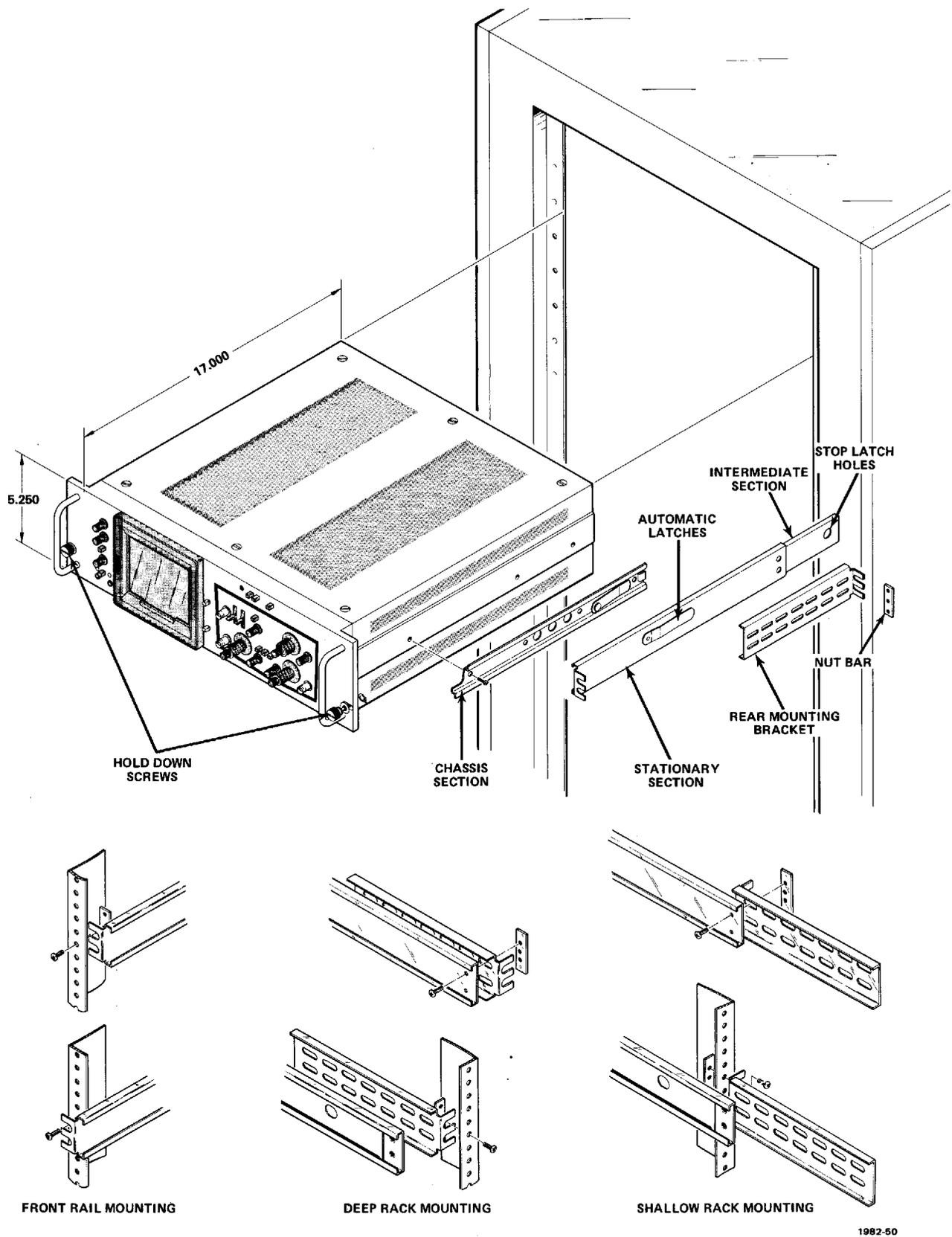


Fig. 2-17. T922R rackmounting methods.

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 T921, T922, and T922R. 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. ¹ b. Tektronix 067-0502-01 Calibration Fixture.
2. Sine-Wave Generator	Frequency 50 kHz to above 15 MHz; output amplitude variable from 0.5 to 5 V p-p; output impedance, 50 Ω ; reference frequency, 50 kHz; amplitude accuracy, constant within 0.3% 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. ¹ b. Tektronix Type 191 Constant Amplitude Signal Generator.
3. Time-Mark Generator	Marker outputs, 20 ns to 0.5 s; marker accuracy within 0.5%; trigger output 1 ms to 0.1 μ s, time coincident with markers.	Timing checks.	a. Tektronix TG 501 Time-Marker Generator. ¹ 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 ; BNC connectors.	Signal interconnection.	a. Tektronix Part 012-0057-01.

¹Requires a TM500 Series Power Module.

Performance Check—T921/T922/T922R

Table 3-1 (cont)

Description	Minimum Specifications	Usage	Examples of Applicable Test Equipment
6. Dual Input Coupler	Connectors, BNC female to 2 BNC male.	Signal interconnection.	a. Tektronix Part 067-0525-00.
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.

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 the T921, T922, and T922R except that the T921 has only one vertical channel.

NOTE

For the T921, use the channel 1 control settings and procedures.

1. Check that the Power Input Voltage Selector switch and the HI-LO Range Selector switch on the bottom of the cabinet (T921 and T922) are set for your power input voltage. In the United States, the Power Input Voltage Selector switch is normally set for 120 V and the HI-LO Range Selector switch is normally set for HI at the factory. In Europe, the Power Input Voltage Selector switch is normally set for 240 V and the HI-LO Range Selector is normally set for LO. Only qualified service personnel should change the Power Input Voltage Selector Switch to a different voltage range setting.

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

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 specifications in Section 1.

3. Set the controls as follows:

Vertical Amplifier

Vertical Mode	CH 1
POSITION (both)	Midrange
VOLTS/DIV (both) ²	2 mV
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)
SOURCE	INT
MODE	AUTO
POSITION	Midrange
SLOPE	+OUT
LEVEL	Midrange

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.

²Unless otherwise stated, use the 1X PROBE window for VOLTS/DIV settings throughout the Performance Check procedure.

Baseline should be parallel with horizontal graticule lines. If not, adjust R472, TR ROT, (trace rotation) in left side panel (T921 and T922) until trace aligns with horizontal graticule lines.

This ends the preliminary 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).

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
.2 V	1 V	5	4.85 to 5.15
2 V	10 V	5	4.85 to 5.15

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

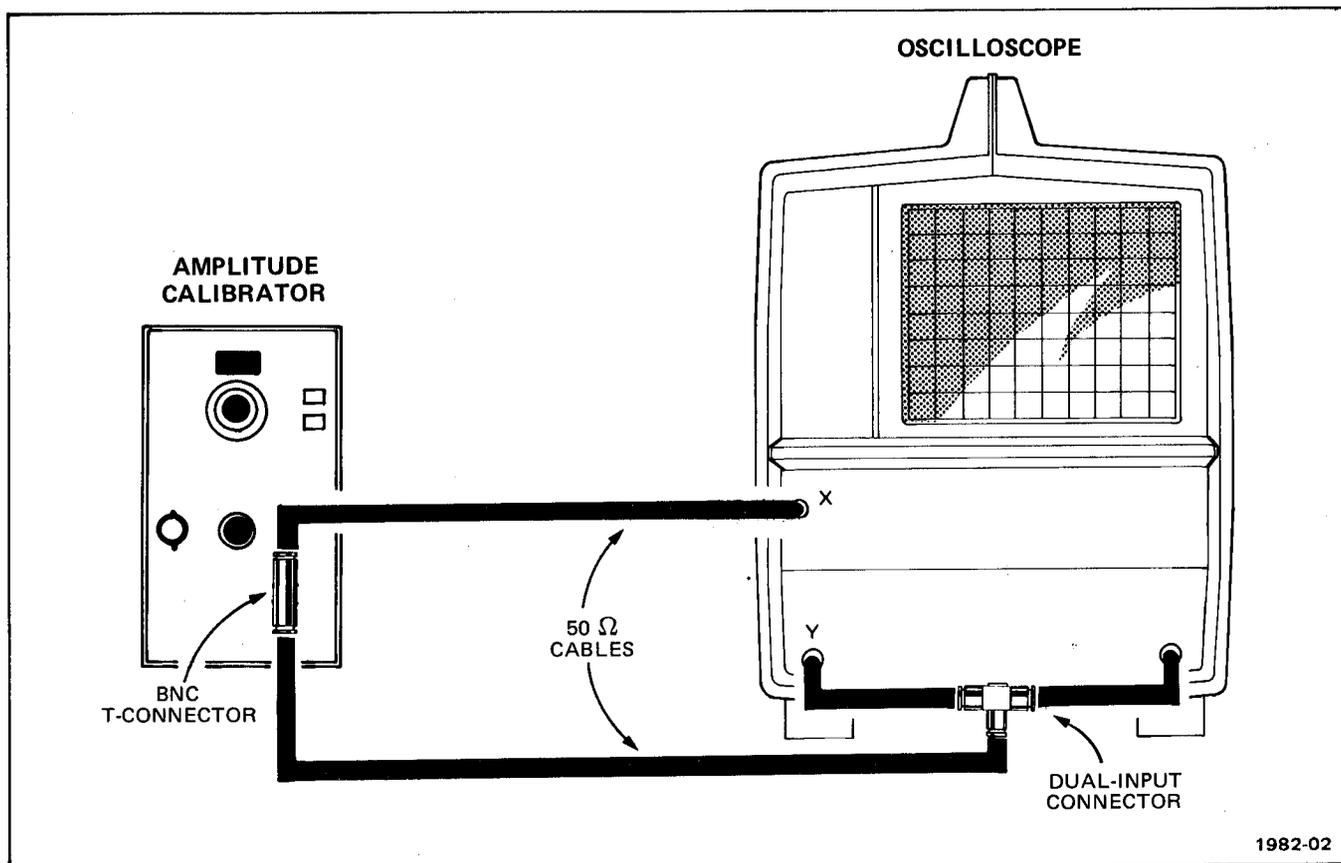


Fig. 3-1. Deflection accuracy and X gain check test setup.

Performance Check—T921/T922/T922R

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.

b. CHECK—Display amplitude reduces from 5 divisions to less than 2 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

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. Reduce INTENSITY setting for a dim display.

f. Disconnect Test equipment.

NOTE

For bench versions of the T921 and T922, skip steps 3 and 4 and proceed with step 5.

3. Rear Vertical Inputs (T922R)

a. Set:	SEC/DIV	.2 m
	VOLTS/DIV	.1
	CH 1 and CH 2 FRONT-REAR	REAR
	Vertical Mode	CH 1
	Trigger Mode	AUTO

b. Connect test equipment as shown in Figure 3-2.

c. Set amplitude calibrator for a 0.5 volt standard amplitude output.

d. CHECK—Display amplitude is 4.85 to 5.15 divisions.

e. Set CH 1 FRONT-REAR to FRONT.

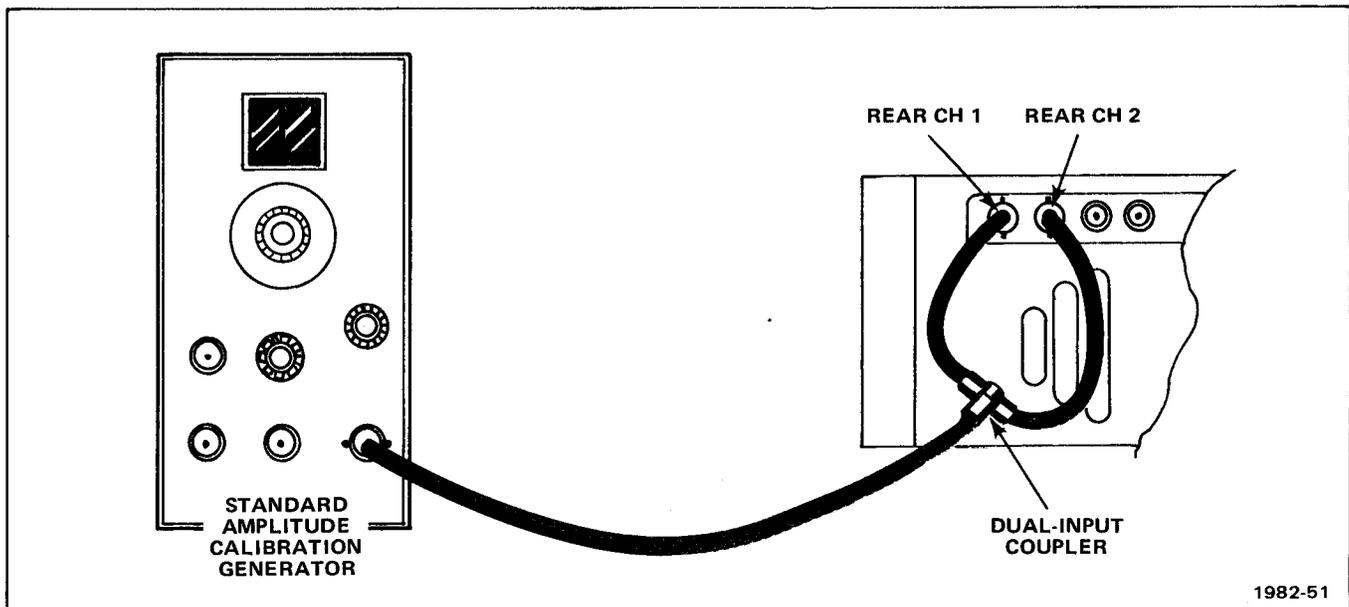


Fig. 3-2. T922R rear input test setup.

- f. CHECK—No vertical deflection.
- g. Set Vertical Mode to CH 2.
- h. CHECK—Display amplitude is 4.85 to 5.15 divisions.
- i. Set CH 2 FRONT-REAR to FRONT.
- j. CHECK—No vertical deflection.

4. Rear EXT TRIG or X Input (T922R)

- a. Disconnect BNC cable from dual input coupler and connect it to rear-panel EXT TRIG or X input (see Fig. 3-2).
- b. Set:

EXT TRIG or	
X FRONT-REAR	REAR
Trigger SOURCE	X-Y
- c. Set Amplitude calibrator Amplitude to 5 volts.
- d. CHECK—Display is two dots separated horizontally by about 5 divisions.



Do not allow a bright spot to remain stationary on the crt. This can burn the crt phosphor.

- e. Set EXT TRIG or X FRONT-REAR to FRONT.
- f. CHECK—No horizontal deflection.
- g. Disconnect test equipment.

5. X Gain

- a. Set:

CH 1 AC-GND-DC	GND
SOURCE	X-Y
INTENSITY	For a dim display
- b. Connect test equipment as shown in Fig. 3-1 and set calibration generator output amplitude to 5 V.

- c. CHECK—Horizontal deflection is between 3.5 and 6.5 divisions (set horizontal POSITION as needed to view start and end of display).
- d. Disconnect test equipment.
- e. Set SOURCE to INT.

6. CH 1 Bandwidth

- a. Connect test equipment as shown in Fig. 3-3.
- b. Set:

VOLTS/DIV (both)	2 mV
AC-GND-DC (both)	DC
LEVEL	Fully cw
- c. Set generator frequency to 50 kHz (reference) and adjust output amplitude for 5 division display.
- d. Set generator frequency to 15 MHz.
- e. CHECK—Display amplitude is at least 3.5 divisions.

7. CH 2 Bandwidth (T922 and T922R Only)

- 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 5 division display.
- d. Set generator frequency to 15 MHz.
- e. CHECK—Display amplitude is at least 3.5 divisions.
- f. Disconnect generator from CH 2 input connector and reduce INTENSITY setting for a dim display.

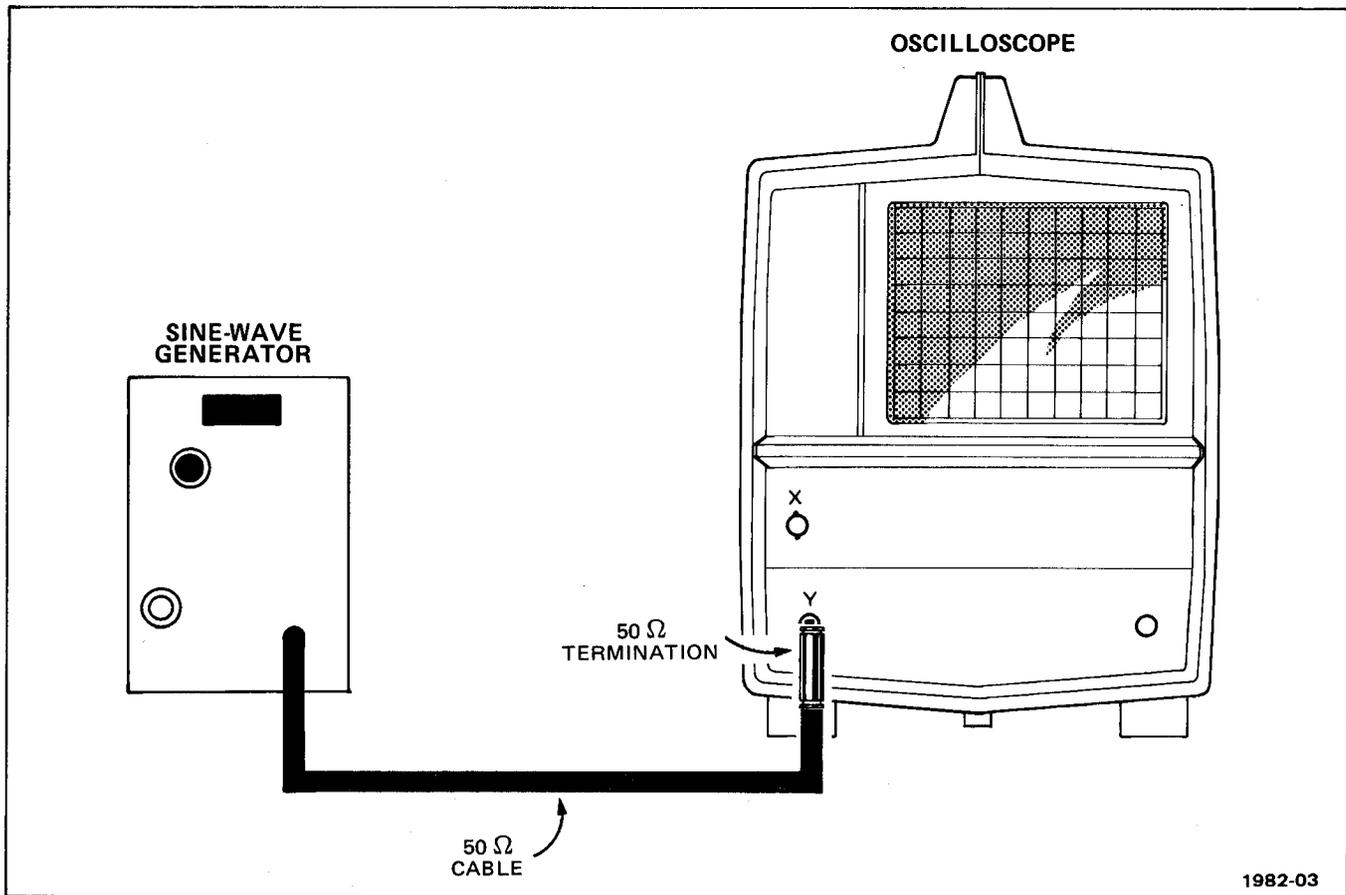


Fig. 3-3. Bandwidth check test setup.

8. X Bandwidth

a. SET:	SEC/DIV	1 ms
	SOURCE	X-Y
	INTENSITY	For visible display
	X1-X10	X10

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

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

d. Set generator frequency to 1 MHz.

e. CHECK—Display amplitude is at least 7 divisions.

f. Disconnect test equipment.

g. Set SOURCE to INT.

NOTE

When making trigger checks, adjust the LEVEL control as needed for a stable display, unless instructed otherwise.

9. Low Frequency Triggering

a. Set:	SEC/DIV	10 ms
	X1-X10 (variable)	X1 (fully ccw)
	Vertical Mode	CH 1
	MODE	NORM

b. Connect 10X probe to CH 1 input.

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

d. CHECK—Stable display can be obtained in both +OUT and -IN positions of SLOPE switch for AUTO and NORM modes in LINE and INT source positions.

e. Remove probe.

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

10. 1 MHz Internal Triggering

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

b. Set: CH 1 VOLTS/DIV 1 V
SEC/DIV .5 μ s

c. Set sine-wave generator frequency for 1 MHz and adjust output amplitude for 0.5 division display.

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

11. 1 MHz External Triggering

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

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

c. Set: SOURCE EXT

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

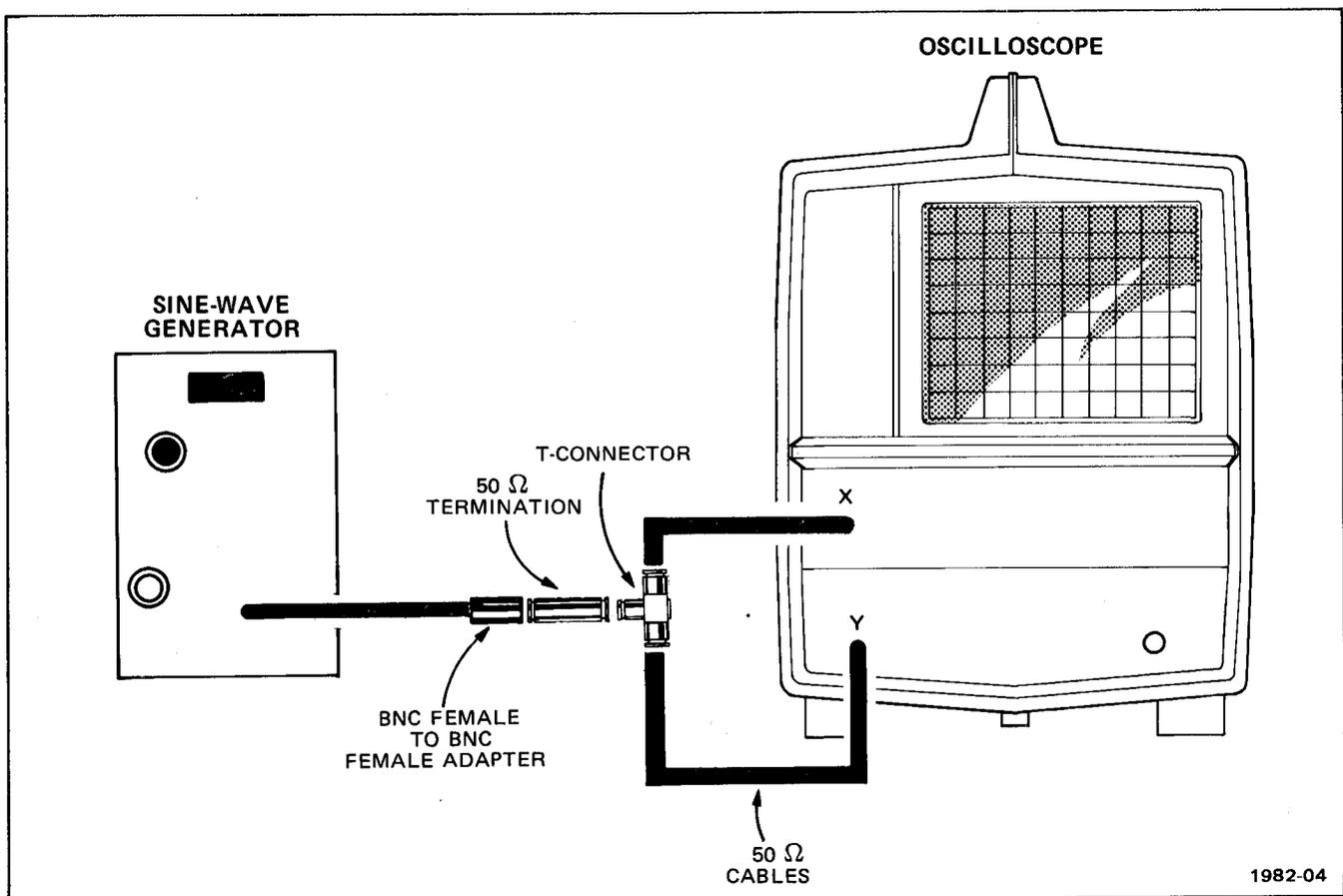


Fig. 3-4. Triggering and Z-axis input check test setup.

Performance Check—T921/T922/T922R**12. 15 MHz Internal Triggering**

- a. Set:
- | | |
|----------------|------------|
| SOURCE | INT |
| CH 1 VOLTS/DIV | 50 mV |
| SEC/DIV | .2 μ s |

b. Set sine-wave generator frequency to 15 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 +OUT and -IN positions of SLOPE switch for both AUTO and NORM modes.

13. 15 MHz External Triggering

- a. Set:
- | | |
|--------|-----|
| SOURCE | EXT |
|--------|-----|

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

14. Z-Axis Input

- a. Set:
- | | |
|----------------|-------|
| CH 1 VOLTS/DIV | 1 V |
| SEC/DIV | .1 ms |
| SOURCE | INT |
| MODE | AUTO |

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

c. Disconnect 50 Ω cable from X or 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.

15. Sweep Rate Accuracy

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

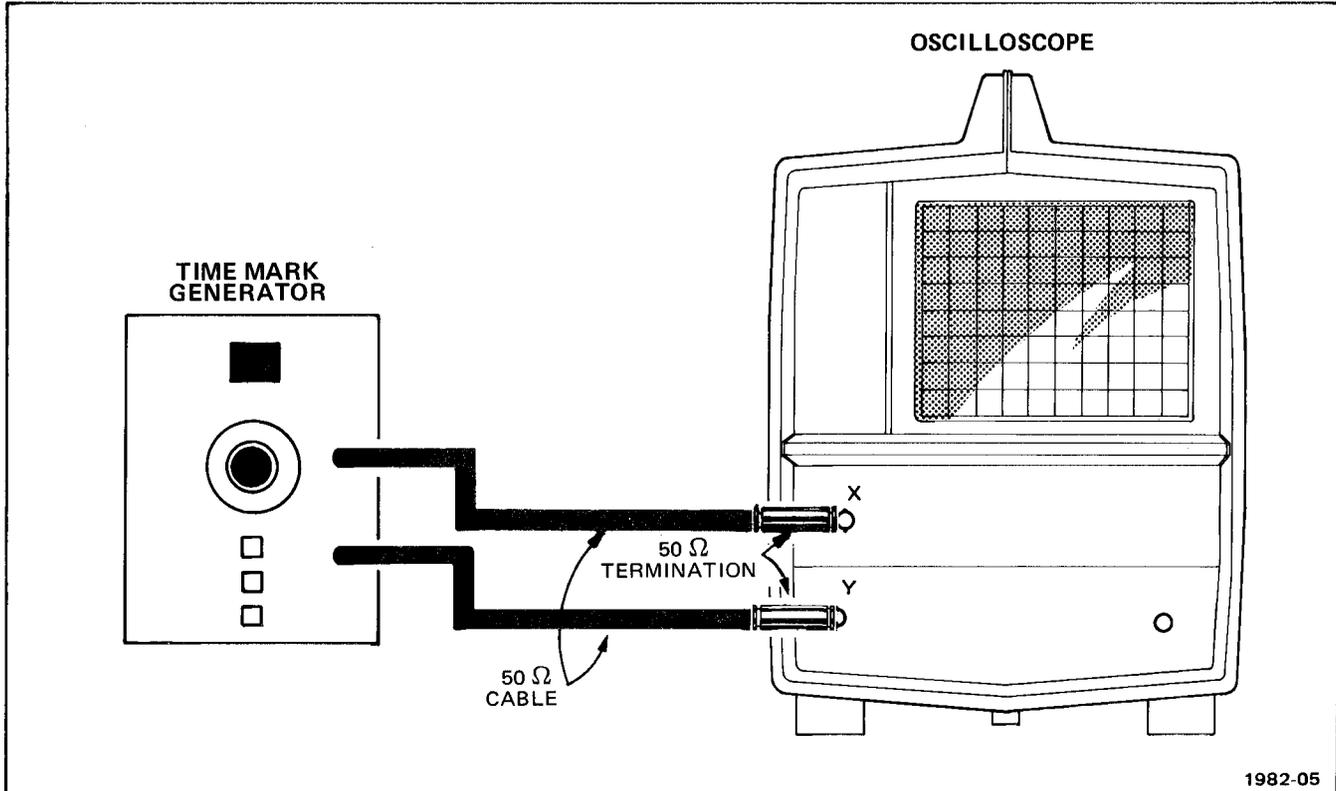


Fig. 3-5. Timing accuracy check test setup.

b. Set:

CH 1 VOLTS/DIV	.2 V
SOURCE	INT
MODE	NORM

c. CHECK—SEC/DIV accuracy according to Table 3-3: One or two time marks, as indicated, within 3% (0.24 div) over center 8 divisions. Accuracy specifications apply for a temperature range of +20°C to +30°C.

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; 2.5 divisions for the 0.2 μ s setting (one division for 0.5 μ s and 1 μ s settings) and anything beyond the 100th magnified divisions. Accuracy specifications apply for a temperature range of +20°C to +30°C.

d. Return X1-X10 to X1 and SOURCE to INT.

e. Disconnect test equipment.

TABLE 3-3

Normal Sweep Timing Accuracy

SEC/DIV switch setting	Time-mark generator output	crt display (marker/division)
.2 μ s	0.1 microsecond	2
.5 μ s	0.5 microsecond	1
1 μ s	1 microsecond	1
2 μ s	1 microsecond	2
5 μ s	5 microsecond	1
10 μ s	10 microsecond	1
20 μ s	10 microsecond	2
50 μ s	50 microsecond	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 millisecond	1
10 ms	10 millisecond	1
20 ms	10 millisecond	2
50 ms	50 millisecond	1
.1 s	0.1 second	1
.2 s	0.1 second	2
.5 s	0.5 second	1

16. Magnified Sweep Accuracy

a. Set:

X1-X10	X10 (fully cw)
SEC/DIV	0.2 μ s

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 X or 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.

TABLE 3-4

Magnified Sweep Timing Accuracy

SEC/DIV switch setting	Time-mark generator output	crt display (markers/division)
.2 μ s	10 nanosecond	2
.5 μ s	50 nanosecond	1
1 μ s	.1 microsecond	1
.5 ms	50 microsecond	1

17. Rear Panel Outputs (T922R)

a. Set:

Vertical Mode	CH 1
CH 1 VOLTS/DIV	.1
SEC/DIV	.5 μ s
Trigger MODE	AUTO
Trigger SOURCE	INT

b. Connect 50 Ω BNC cable to SWEEP RAMP OUT connector. Connect 50 Ω termination to free end of cable. Connect 50 Ω termination to CH 1 vertical input.

c. CHECK—Display is tilted line (see Fig. 3-6).

d. Disconnect cable from SWEEP RAMP OUT connector and connect it to SWEEP GATE OUT connector.

e. CHECK—Display is leading edge of squarewave (see Fig. 3-7).

f. Disconnect cable and termination.

Performance Check—T921/T922/T922R

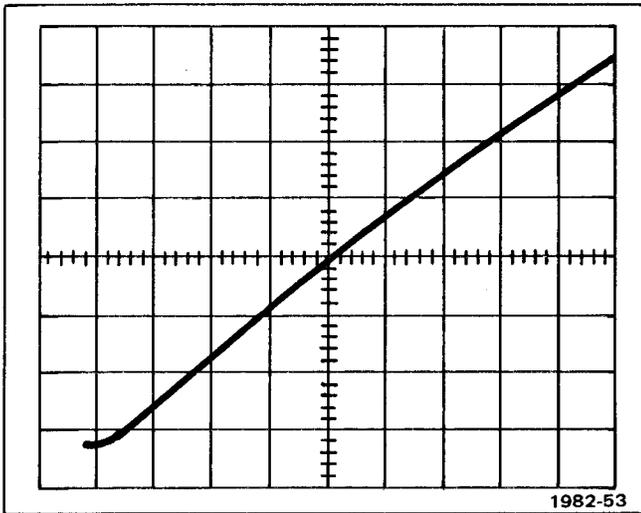


Fig. 3-6. SWEEP RAMP OUT display.

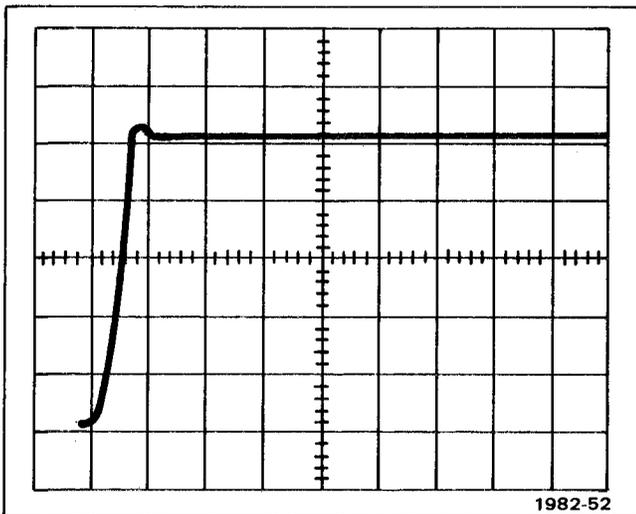


Fig. 3-7. SWEEP GATE OUT display.

18. Single Sweep (T922R)

a. Connect time-mark generator to front CH 2 input via 50 Ω BNC cable and 50 Ω BNC termination.

- b. Set: CH 1 VOLTS/DIV .1
 SINGLE SWEEP REPETITIVE (out)
 SEC/DIV 20 ms

- c. Set generator for 0.1 second time marks.
 d. Adjust LEVEL for a stable display.
 e. Set: SINGLE SWEEP SINGLE SWEEP (in)
 Input Coupling GND
 f. CHECK—No visible display.
 g. Push RESET and release.
 h. CHECK—READY lamp lights.
 i. Set CH 1 Input Coupling to DC.

j. CHECK—Crt is swept only once and READY lamp extinguishes.

k. Disconnect test equipment.

19. 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.

NOTE

The amplitude settings given in this procedure are to check both the INT and EXT trigger requirements. You can check just the INT trigger by using the VOLTS/DIV setting 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. 3-8.

- 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).

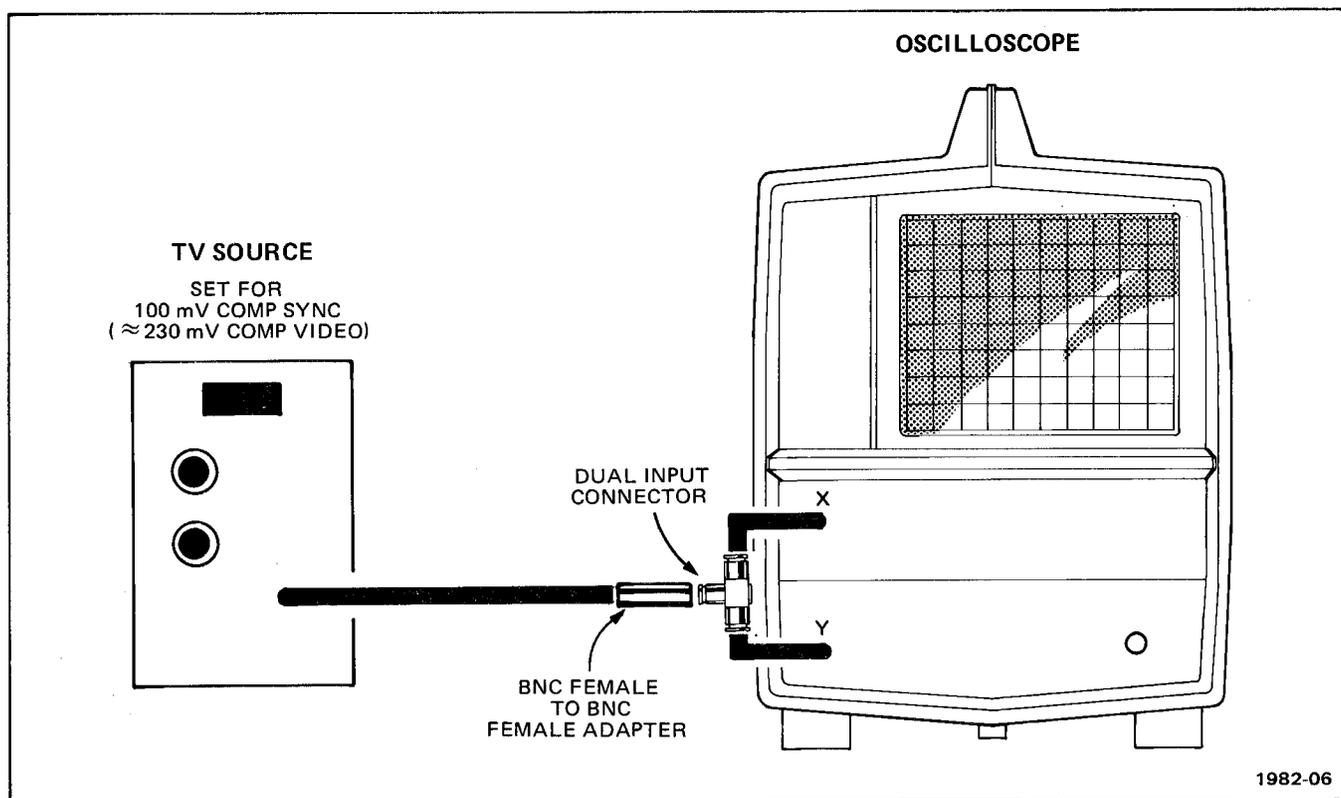


Fig. 3-8. TV trigger check test setup.

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 μ s

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.

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 of other parts of the instrument, reset an 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.

ADJUSTMENT INTERACTION

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

TEST EQUIPMENT REQUIRED

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

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

TABLE 4-1
Test Equipment

Description	Minimum Specifications	Usage	Examples of Applicable Test Equipment
1. Digital Voltmeter	Range, 0 to 9 V dc; accuracy within 0.3%.	Power supply adjustment.	a. Tektronix DM 501 Digital Multimeter. ¹
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. ¹ 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. ¹

¹Requires TM500 Series Power Module.

Adjustments—T921/T922/T922R

TABLE 4-1 (cont)

Description	Minimum Specifications	Usage	Examples of Applicable Test Equipment
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. ¹ 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 Screwdriver		Variable capacitor adjustments.	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. Alignment Tool		Vertical attenuator and high-frequency compensation adjustment.	a. General Cement Adjustment tool G.C. 8722.
10. 10X Attenuator	Ratio, 10X; impedance, 50 Ω ; connectors, BNC.	Vertical attenuator adjustments.	a. Tektronix Part 011-0059-02.
11. Probe, 10X	Attenuation, 10X; Probe can be compensated for input characteristics of T921/T922/T922R.	Vertical attenuator compensation.	a. P6006, Tektronix Part 010-0160-00. (Standard accessory for T921/T922.)
12. Adapter	Probe-tip-to-BNC.	Vertical attenuator compensation.	a. Tektronix Part 013-0054-00.

¹Requires TM500 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 T921/T922 cabinet, remove the six retaining screws (three on the top and three on the bottom) and slide the halves apart.

Because of the different mechanical layout of the T922R, use Fig. 4-1 (which shows the adjustment locations on the T922R) in place of Figs. 4-2 through 4-4

and 4-6. The T922R cabinet is made of two pieces which can be removed independently. Each half is held on by six captive screws. To remove a cabinet half, turn the six captive screws 90 degrees counterclockwise and lift the cabinet half away from the instrument. Use a large coin to loosen the captive screws.

2. Check the 120 V/240 V range selector switch S701 and the High/Low selector switch S705 for correct settings. For the T921 and T922, both switches are located on the bottom of the cabinet. For the T922R, see Fig. 4-1 for the internal locations of S701 and S705. If you change the setting of the range selector switch, change the line fuse. Refer to Electrical Parts List for correct fuse values.

3. Turn the instrument on and allow at least 20 minutes warm-up before starting the adjustment procedure.

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

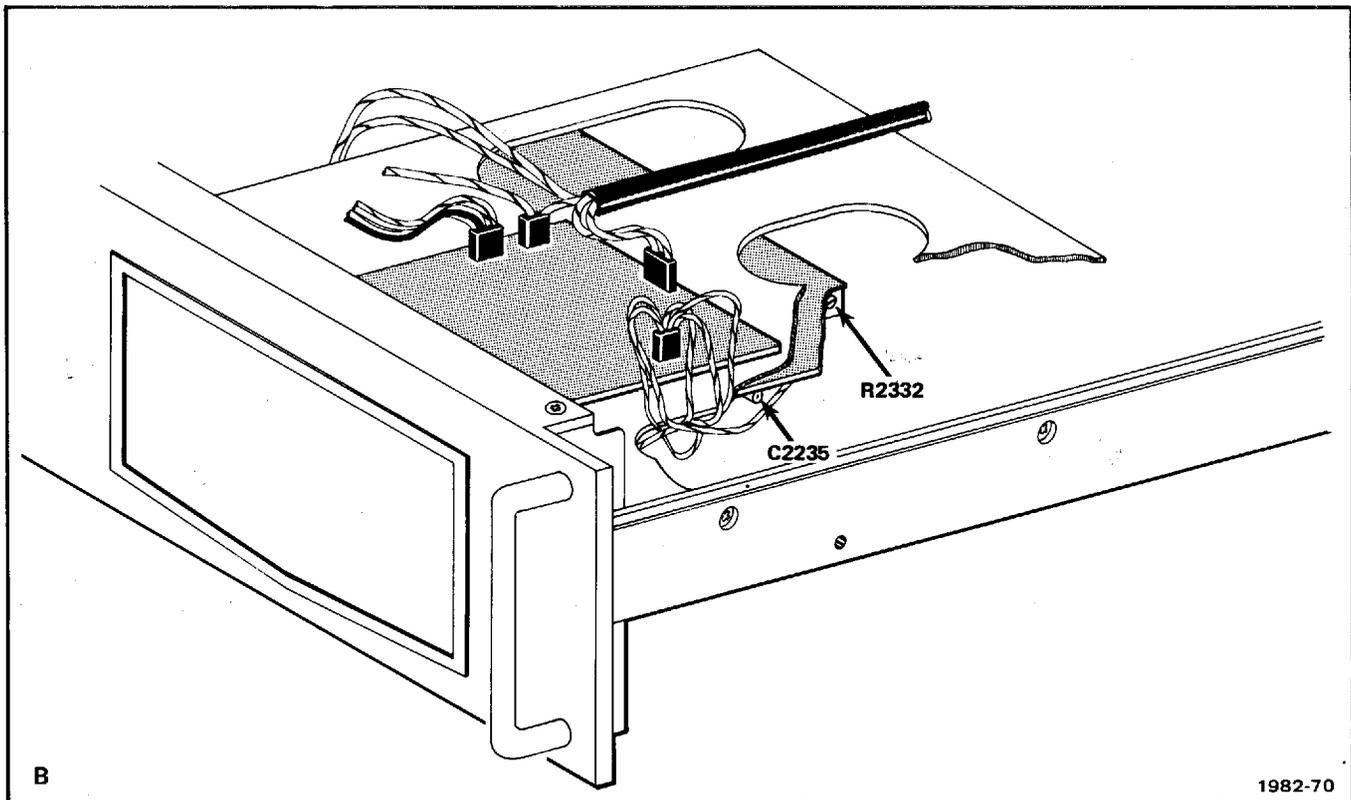
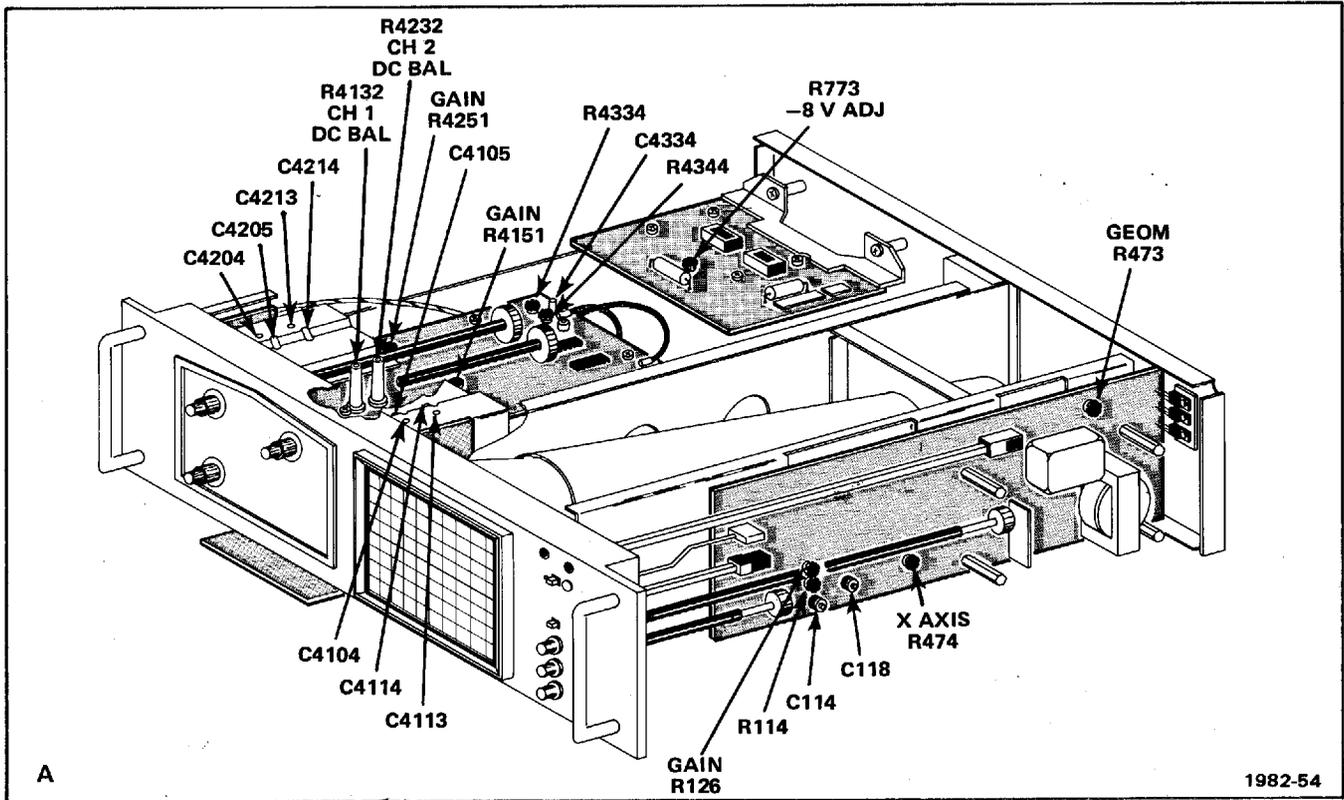


Fig. 4-1A & B. T922R adjustment locations.

Adjustments—T921/T922/T922R

A. DISPLAY AND POWER SUPPLY

Equipment Required

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

1. Set the Front Panel Controls as Follows:

NOTE

Do not preset internal controls.

NOTE

For adjustment of the T921, use the channel 1 control settings and procedures.

INTENSITY	midrange
Vertical Mode	CH 1
CH 1 VOLTS/DIV ²	1 V
VOLTS/DIV VAR (both)	detent
AC-GND-DC (both)	GND
SEC/DIV	.1 ms
X1-X10	X1 (fully ccw)
SOURCE	INT
MODE	AUTO
SLOPE	+OUT
LEVEL	midrange
CH 1 POSITION	midrange
Horizontal POSITION	midrange

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.

2. -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. 4-2). 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. 4-2) for -8.00 V dc.

c. Disconnect digital voltmeter.

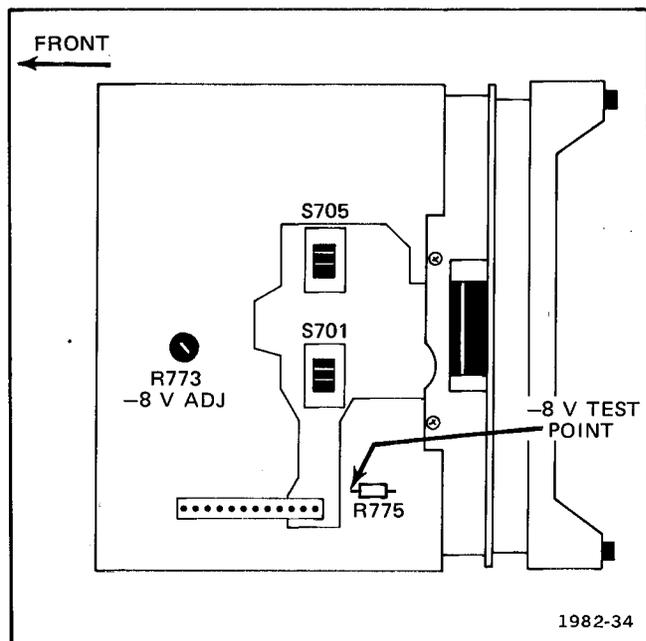


Fig. 4-2. Power supply adjustment location (bottom of T921 and T922).

²Unless otherwise stated, use the 1X probe window for VOLTS/DIV settings throughout this procedure.

3. Trace Rotation

a. Position trace vertically to center horizontal graticule line.

b. ADJUST—TRACE ROT, R472, to align trace with center horizontal graticule line.

4. 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 cable and 50 Ω BNC termination.

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. 4-3) 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.

5. Geometry

a. Move display baseline to bottom graticule line.

b. ADJUST—Geom, R473, (see Fig. 4-3) for best alignments of markers with the vertical graticule lines.

c. INTERACTION—Between Geometry and Y-axis. Repeat both adjustment for best alignment of markers with vertical graticule lines.

d. Disconnect time-mark generator.

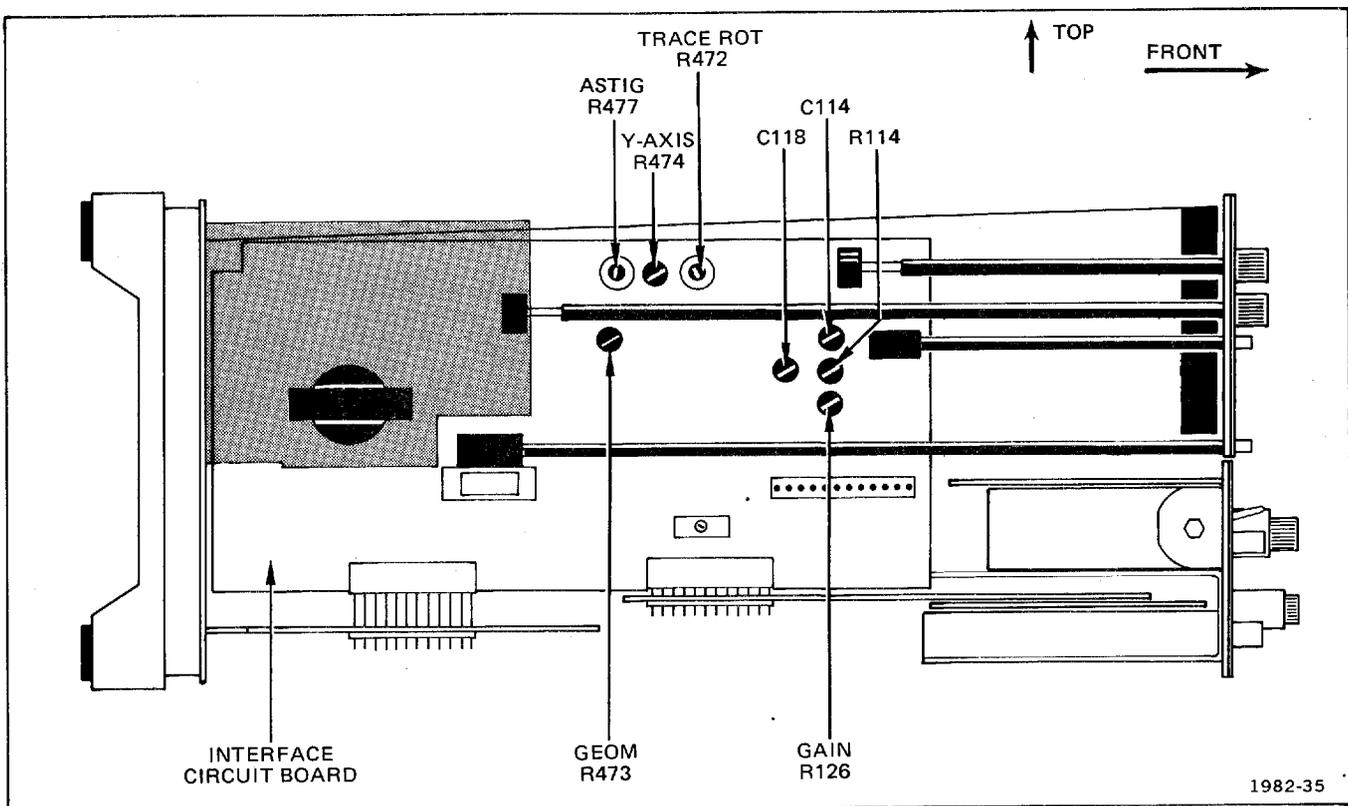


Fig. 4-3. Interface board adjustment locations.

B. VERTICAL AMPLIFIER**NOTE**

Use Channel 1 control settings and procedures for the T921.

Equipment Required

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

PRELIMINARY CONTROL SETTINGS

Preset front panel controls as follows:

INTENSITY	midrange
FOCUS	midrange
Vertical Mode	CH 1
VOLTS/DIV (both) ³	2 mV
AC-GND-DC (both)	GND
VAR (both)	detent
SEC/DIV	.5 ms
X1-X10	X1 (fully cw)
SOURCE	INT
MODE	AUTO
SLOPE	+OUT
LEVEL	midrange
POSITION (all)	midrange

Set all other controls as desired.

³Unless otherwise stated, use the 1X probe window for VOLTS/DIV settings throughout this procedure.

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.

1. Vertical Preamplifier Balance

a. ADJUST—CH 1 DC BAL, R4132 (see Fig. 4-4) for no trace shift while switching CH 1 VOLTS/DIV control between 2 mV and 10 mV.

b. SET: Vertical Mode CH 2.

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

2. Vertical Output Amplifier Gain**NOTE**

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

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

b. Set Gain, R126 (see Fig. 4-3) to physical midrange.

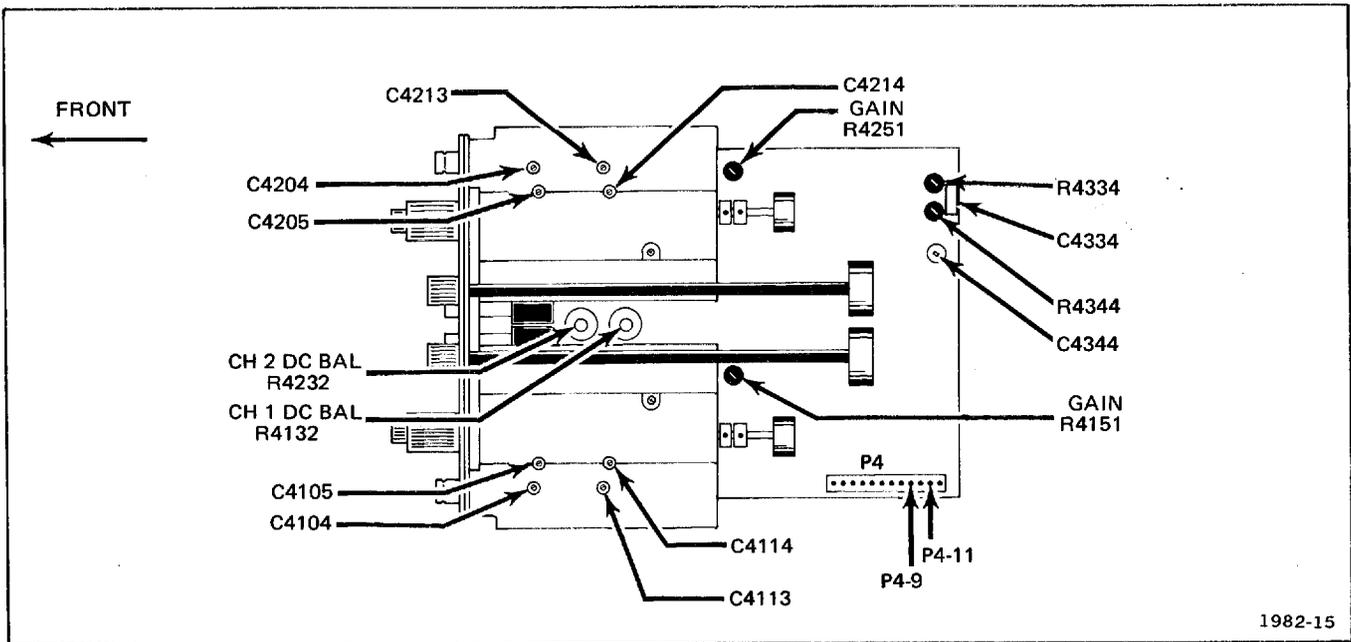


Fig. 4-4. Vertical amplifier adjustment locations (bottom view of T921 and T922).

c. Connect digital voltmeter between P4-9 and P4-11 (see Fig. 4-4). 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 increased 150 mV from reading in part d (trace moved toward top of screen).

f. Adjust Gain, R126 (see Fig. 4-3), so trace aligns with third graticule line above center horizontal graticule line.

g. Disconnect digital voltmeter.

3. Vertical Preamp Gain

- | | | |
|---------|------------------|------|
| a. Set: | VOLTS/DIV (both) | 5 mV |
| | 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.

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

d. Move 20 mV amplitude calibrator signal to CH 2 input and set Vertical Mode to CH 2.

e. ADJUST—Gain, R4251 (see Fig. 4-4), for 4 division display.

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

g. Disconnect test equipment.

4. High-Frequency Compensation

- | | | |
|---------|----------------|-------|
| a. Set: | CH 1 VOLTS/DIV | 5 mV |
| | Vertical Mode | CH 1 |
| | CH 1 AC-GND-DC | DC |
| | CH 2 AC-GND-DC | GND |
| | SEC/DIV | .1 ms |

b. Connect square-wave generator (fast-rise, + transition) to CH 1 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.

Adjustments—T921/T922/T922R

d. Set POSTION controls to position the leading edge of the signal on screen.

e. ADJUST—R4334, C4334, R4344, C4344 (see Fig. 4-4), C114, R114, C118 (see Fig. 4-3), for best front corner of waveform using low capacitance screwdriver.

f. Disconnect test equipment.

5. CH 1 Attenuator Compensation

a. Set:	CH 1 VOLTS/DIV ⁴	20 mV
	CH 1 AC-GND-DC	DC
	Vertical Mode	CH 1
	SEC/DIV	1 ms
	X1-X10	X10 (fully ccw)

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. 4-4) for best square front corner (see Fig. 4-5 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. 4-4) for best square front corner (see Fig. 4-5 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-division display (remove 10X attenuator if necessary).

⁴Use 1X probe window in all of this step.

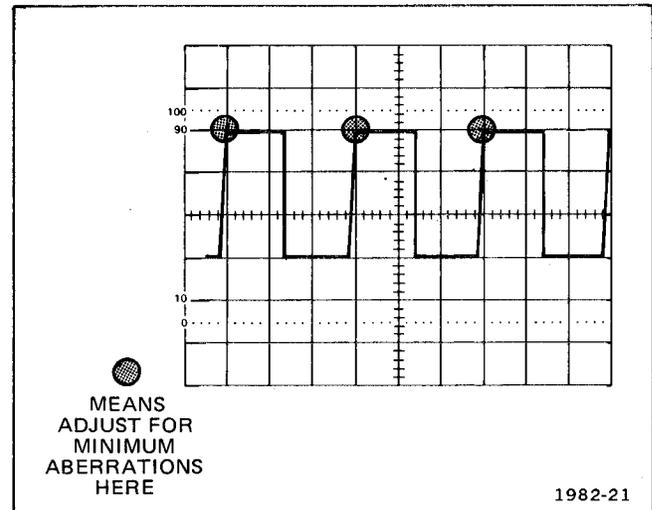


Fig. 4-5. Display of correct (idealized) attenuator compensation.

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.

6. CH 2 Attenuator Compensation

a. Set:	CH 2 VOLTS/DIV ⁴	20 mV
	CH 2 AC-GND-DC	DC
	Vertical Mode	CH 2
	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 2 input connector. Set generator to 1 kHz and adjust for 5-division display.

c. ADJUST—C4214 (see Fig. 4-4) for best square front corner (see Fig. 4-5 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. 4-4) for best square front corner (see Fig. 4-5 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.

C. TIME BASE

Equipment Required

- | | |
|----------------------------|--------------------------------|
| 1. Time-Mark Generator | 3. 50 Ω BNC Cable |
| 2. 50 Ω Termination | 4. Low-Capacitance Screwdriver |

PRELIMINARY CONTROL SETTINGS

Preset front panel controls as follows:

INTENSITY	midrange
FOCUS	midrange
Vertical Mode	CH 1
CH 1 VOLTS/DIV ⁵	.5 V
CH 1 VAR	detent
CH 1 AC-GND-DC	DC
CH 2 AC-GND-DC	GND
SEC/DIV	.5 ms
X1-X10	X1 (fully ccw)
SOURCE	INT
MODE	AUTO
SLOPE	+ OUT
LEVEL	midrange
POSITION (all)	midrange

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.

1. Horizontal Gain

a. Connect time-mark generator to channel 1 input via 50 Ω BNC cable and 50 Ω termination. Set generator for .5 ms markers.

b. ADJUST—Horiz Cal R2332 (see Fig. 4-6 or Fig. 4-1B) and horizontal POSITION control for 1 time marker per division over center 8 divisions.

2. Sweep Timing

a. Set SEC/DIV to .5 μ s and time-mark generator for .5 μ s markers.

b. ADJUST—C2235 (see Fig. 4-6 or Fig. 4-1B) and horizontal POSITION control for 1 marker per division over center 8 divisions.

c. Disconnect the test setup.

⁵Unless otherwise stated, use the 1X probe window for VOLTS/DIV settings throughout this procedure.

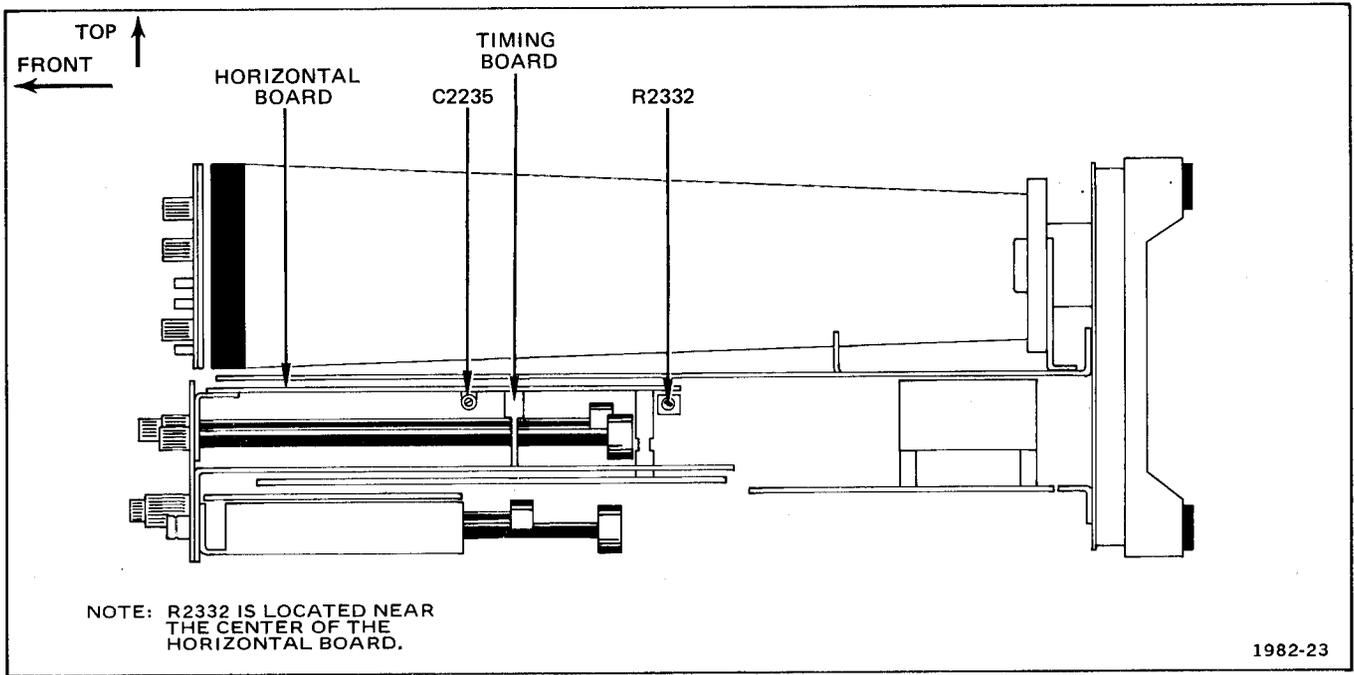


Fig. 4-6. Time base adjustment locations.

SERVICE INFORMATION

The following information is provided to help you keep your T921/T922/T922R 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 T921, T922, and T922R. 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.

T921 AND T922

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.

T922R

The T922R cabinet is made of two pieces which can be removed independently. Each half is held on by six captive screws. To remove a cabinet half, turn the six captive screws 90 degrees counterclockwise and lift that half of the cabinet away from the instrument. Use a large coin to loosen the captive screws.

PREVENTIVE MAINTENANCE

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

Cleaning

Accumulations of dirt and dust on components act as an insulating blanket preventing efficient heat dissipation. Dust on circuit boards and wires can cause arcing and short circuits, resulting in damage to components or even instrument failure. Clean your instrument 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. Damage may result. 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

Service Information—T921/T922/T922R

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.

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).

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 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.

Purpose: To check voltages and for general troubleshooting.

4. Variable Autotransformer

Description: Output variable from 0 to 140 V, 1.2A 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.

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.

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.

Troubleshooting Techniques

NOTE

The troubleshooting techniques for the T922R are similar to those for the standard T922. However, the Vertical Amplifier extender troubleshooting fixture will not work with the T922R. The ribbon cable already in the T922R, which connects the interface board and the vertical module, will serve as an extender.

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

TABLE 5-1

Power Supply Tolerance

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

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

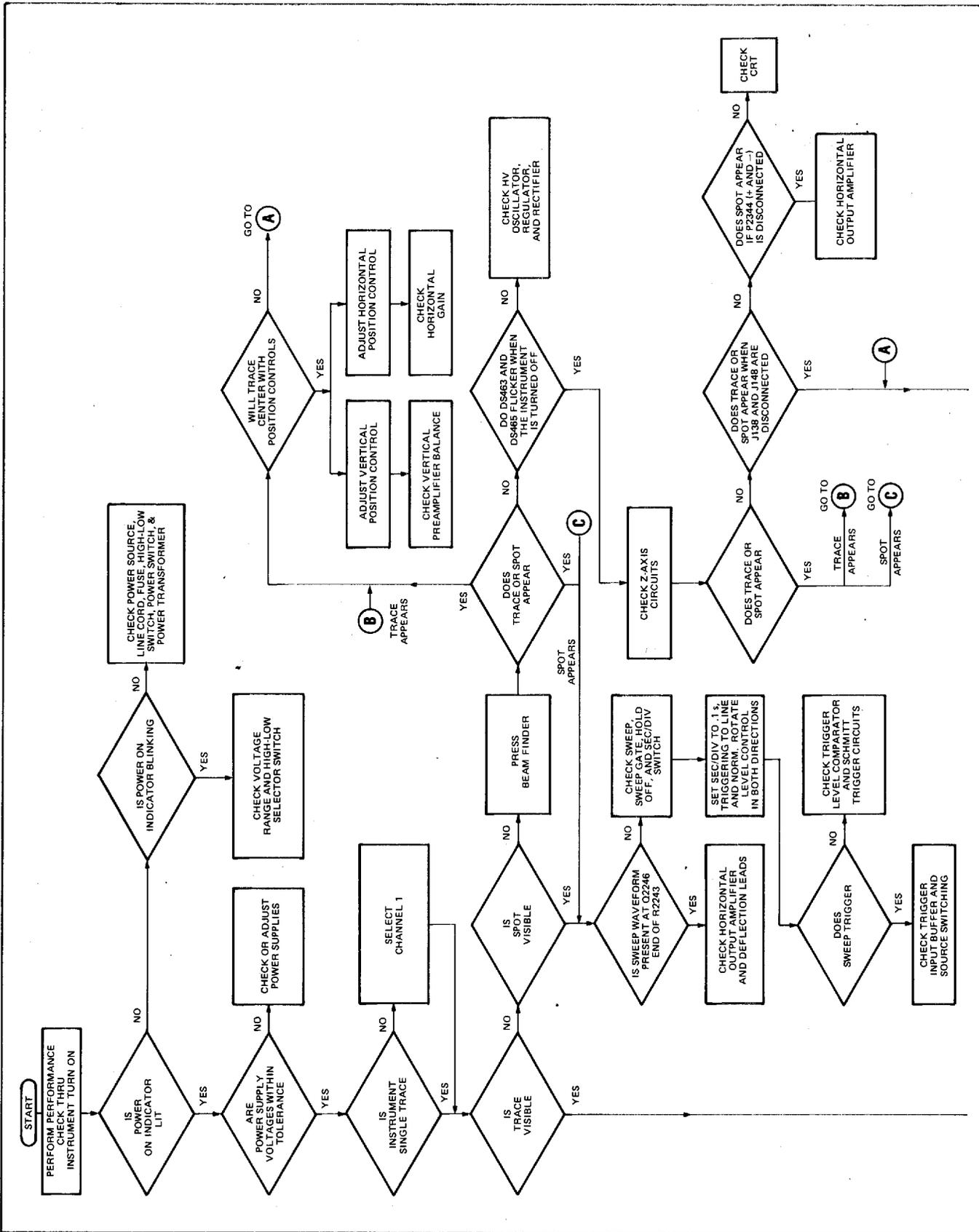
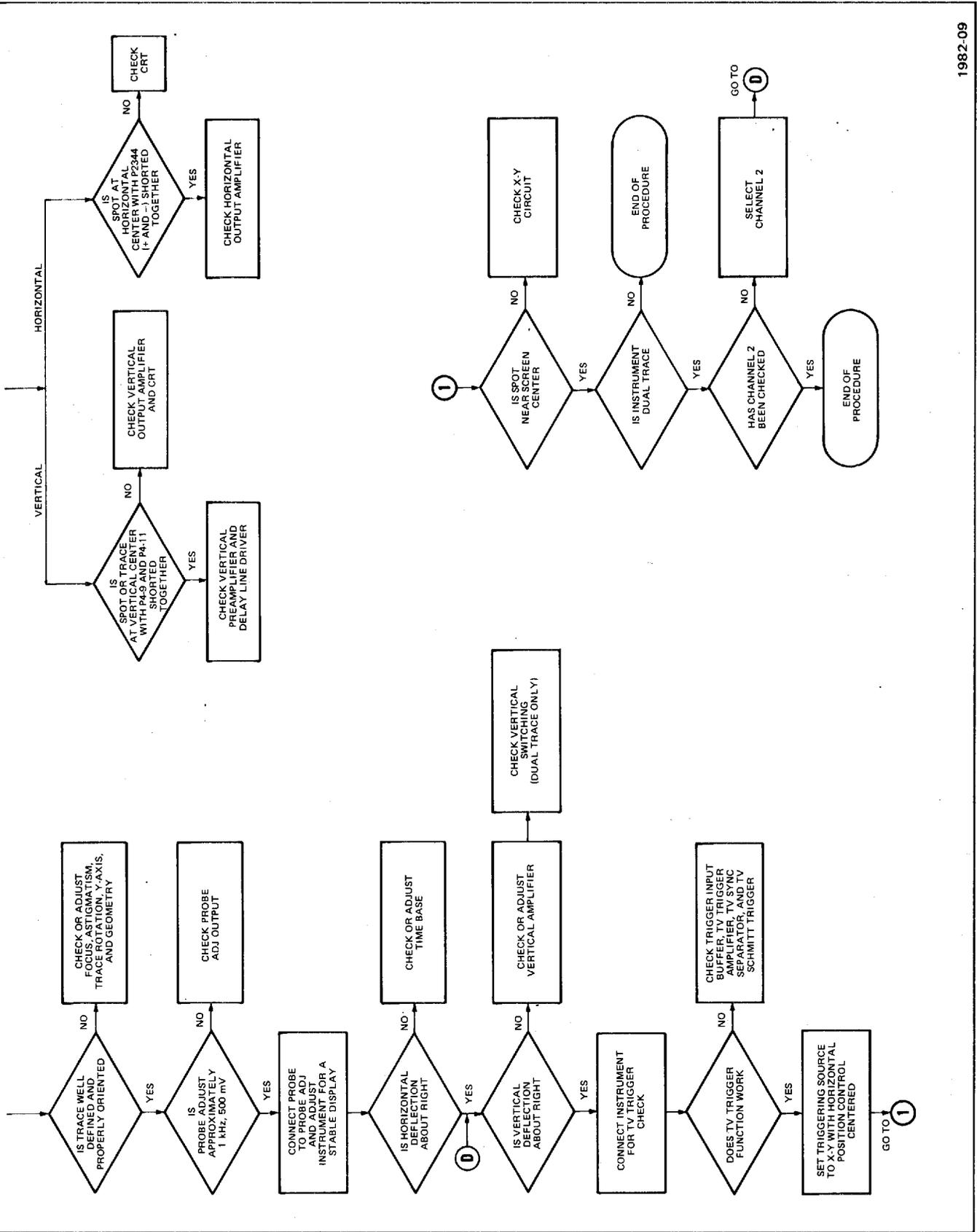


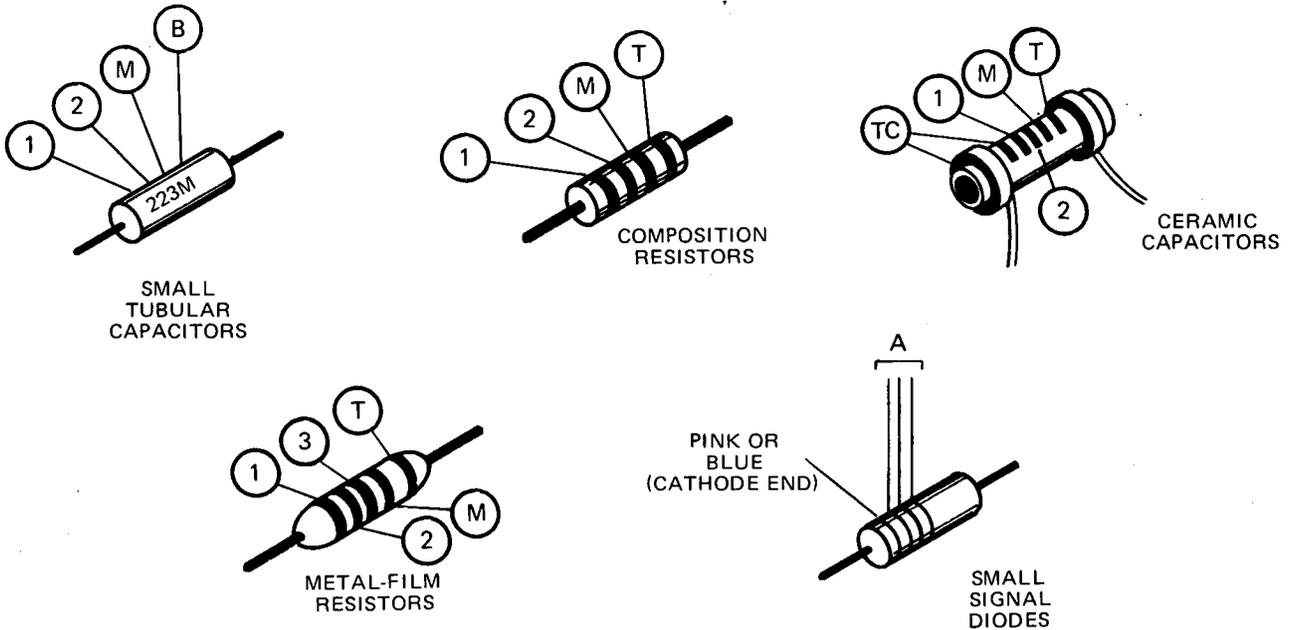
Fig. 5-1. Troubleshooting chart.



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

Service Information—T921/T922/T922R

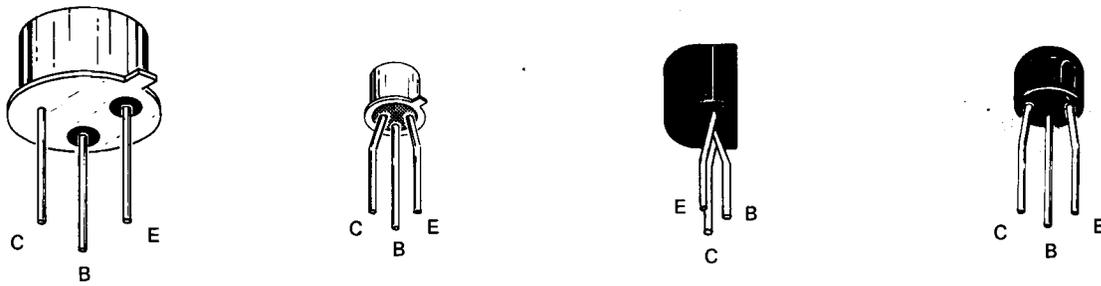


- (A) COLORS IDENTIFY SIGNIFICANT DIGITS IN TEKTRONIX PART NUMBER (E.G. BROWN, GRAY, GREEN STRIPES INDICATE PART NUMBER 152-0185-00)
- (B) TOLERANCE; F=±1%, J=5%, K=10%, M=20%
- (1) (2) and (3) 1ST, 2ND, AND 3RD SIGNIFICANT FIGS.
- (M) MULTIPLIER (T) TOLERANCE;
- (TC) TEMPERATURE COEFFICIENT.
- (T) AND/OR (TC) COLOR CODE MAY NOT BE PRESENT ON SOME CAPACITORS;

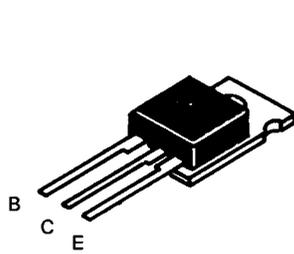
COLOR	SIGNIFICANT FIGURES	RESISTORS (Ω)		CAPACITORS (μF)		
		MULTIPLIER	TOLERANCE	MULTIPLIER	TOLERANCE	
					over 10 μF	under 10 μF
BLACK	0	1	---	1	±20%	±2 μF
BROWN	1	10	±1%	10	±1%	±0.1 μF
RED	2	10^2 or 100	±2%	10^2 or 100	±2%	----
ORANGE	3	10^3 or 1 K	±3%	10^3 or 1000	±3%	----
YELLOW	4	10^4 or 10 K	±4%	10^4 or 10,000	+100% -9%	----
GREEN	5	10^5 or 100 K	±½%	10^5 or 100,000	±5%	±0.5 μF
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 μF
WHITE	9	----	----	10^{-1} or 0.1	±10%	±1 μF
GOLD	-	10^{-1} or 0.1	±5%	----	----	----
SILVER	-	10^{-2} or 0.01	±10%	----	----	----
NONE	-	----	±20%	----	±10%	±1 μF

1982-31

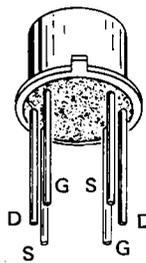
Fig. 5-2. Color code for resistors and capacitors.



TRANSISTORS



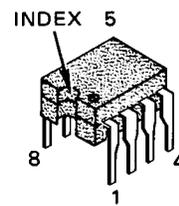
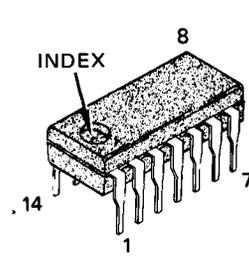
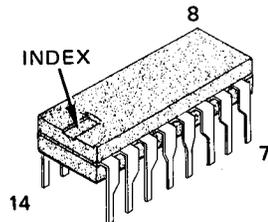
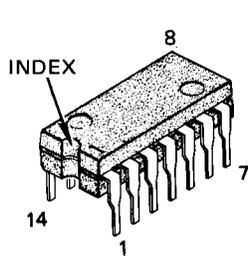
FLAT PACK
TRANSISTORS



DUAL-FET



FET



INTEGRATED
CIRCUITS

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

Service Information—T921/T922/T922R

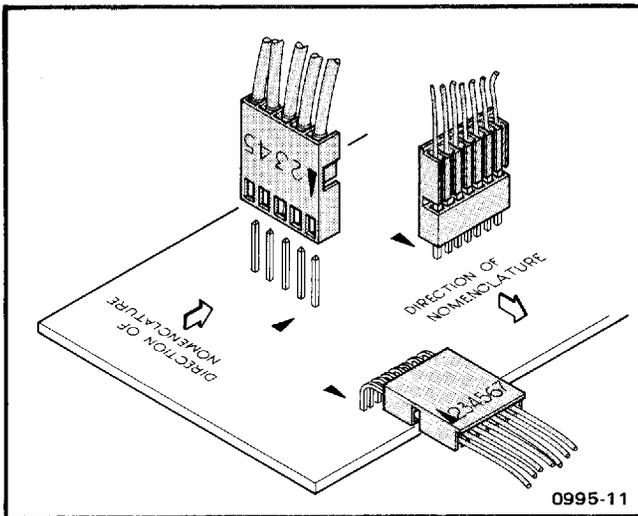


Fig. 5-4. Multi-connector holder orientation.

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 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 initial charge of the capacitor. An open capacitor can also be detected with a capacitance meter or by checking whether the capacitor passes ac signals.

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

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

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

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

Troubleshooting Hints

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

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

b. Check all low voltage power supplies, starting with -8 V (-8 V is reference supply), the $+8\text{ V}$, and $+100\text{ V}$ at appropriate test points.

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

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

(3) If -8 V is correct but $+8\text{ V}$ is low (or zero), check Q752, Q754, Q756, and U742 (U742 is used for both -8 and $+8\text{ V}$ 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. Use DVM for all voltage checks in this circuit to prevent circuit loading.

(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 positive-going 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 $0-40\text{ V}$, 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 with BEAM FINDER button pushed, or vertical POSITION control does not center display (see Vert Input, Vert switching, and Crt & Vert Ampl 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-circuit Q4322 collector to Q4324 collector. If trace centers, trouble is ahead of delay-line drivers, Q4336-Q4346.

e. Check voltage at Q4302 and Q4303 emitters. Each should read approximately $+5\text{ V}$ above ground. If emitter voltage is okay, trouble is either in Q4302 or Q4303, or in switching circuit (short-circuited CR4314, CR4303, or open CR4304).

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

a. Press BEAM FINDER button. 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-circuit Q136 collector to Q146 collector. If trace centers, short-circuit Q112 collector to Q122 collector. Trace should center. If not, suspect Q112, Q134, or Q136.

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.

Service Information—T921/T922/T922R

b. Check voltage at junction of R2147, 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.

SWEEP: SYMPTOM 1.—No sweep on crt (see Sweep & 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.

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 schematic).

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

SYMPTOM 2.—Trace is on screen but 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-R2244-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.

The T900 Series uses some single-sided circuit boards, i.e., wiring is plated on only one side. The components are located on the front of the circuit boards. The circuit designations have been silk-screened onto the component side of the circuit board next to the components. The circuit boards are mounted with the component side out to allow access to the components. If it is necessary to replace a component, the leads may be clipped and the new part soldered to the leads of the previous one. However, be careful not to loosen the connection with the etched circuit wiring on the back of the circuit board.

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.

NOTE

If the instrument does not work after replacing components by soldering to the leads of the previous one, the connection with the etched circuit wiring may be broken. To check the connections, it is necessary to remove the circuit board from the instrument. Refer to the circuit board replacement information.

Replacement Parts

All parts for the T921/T922/T922R can be ordered from your local Tektronix Field Office, but many of the components are standard items that may be more readily available locally. Check the Parts Lists for value, tolerance, ratings, and description before you replace any components.

When ordering parts from Tektronix, include the following information:

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

COMPONENT REPLACEMENT (T921 and T922)**NOTE**

Refer to the end of this section for component replacement information for the T922R.

WARNING

Disconnect the power cord plug from the power input source before replacing components.

Since the components are located on one side of the circuit boards, it may be necessary to remove the circuit boards before replacing some components. Refer to the part on circuit board replacement for instructions on 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 at the beginning of the corrective maintenance 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.

Power Cord Conductor Identification

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

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 Electrical Parts List for correct fuse values.

Thick Film Resistor Replacement

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

To replace the thick film resistor, R118, match the triangles—one on the resistor and one on the circuit board. Resolder all of the pins to the circuit board. To replace the thick film resistor, R444, match the pins on the resistor with the holes in the circuit board. Re-solder all of the pins to the circuit board.

Service Information—T921/T922/T922R**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.

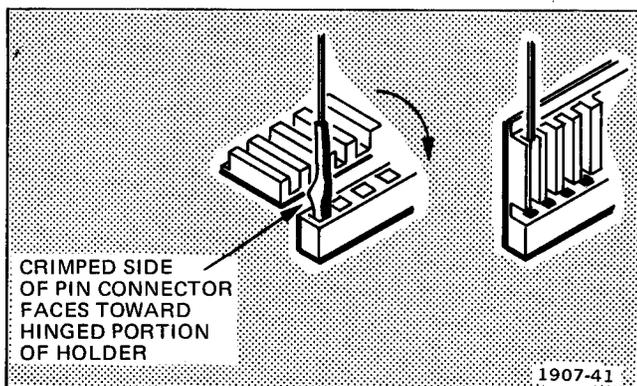


Fig. 5-5. Pin connector replacement.

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 long-nose pliers and use a gentle rocking motion to separate the shaft from the bushing.

Vertical Amplifier Replacement

To remove the Vertical Amplifier from the instrument:

1. Support the Vertical Amplifier, while removing the retaining screws. One is between the attenuators and the other two are in the lower corners.

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

To replace the Vertical Amplifier, reverse the above procedure.

NOTE

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

Attenuator Replacement

To remove the attenuator from the instrument:

1. Remove the POSITION switch 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.
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 below the BNC connector.

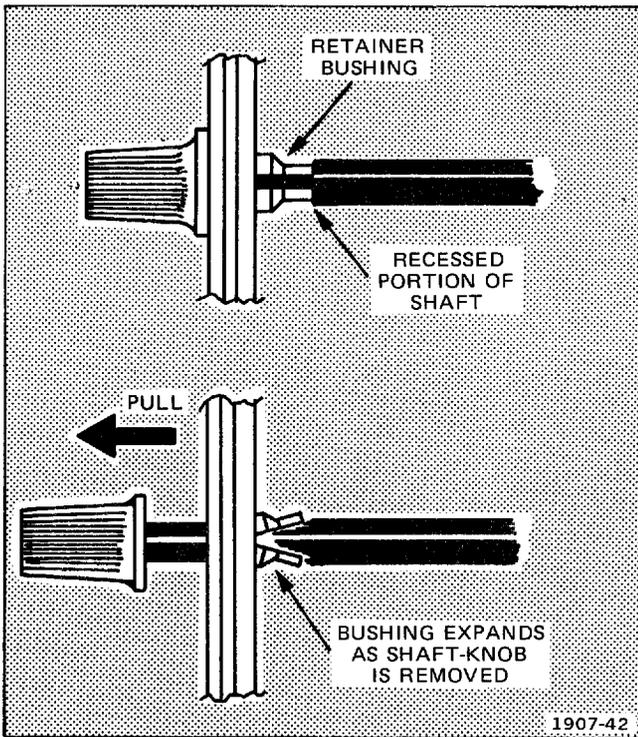


Fig. 5-6. Shaft-knob removal.

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 the retaining screws. Be careful not to remove the screws holding the cam switch against the attenuator board. Lift the shield off the attenuator.

To replace the attenuator:

1. Replace the attenuator shield 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. Set the attenuator board down on the Vertical board and secure it with the three retaining screws.

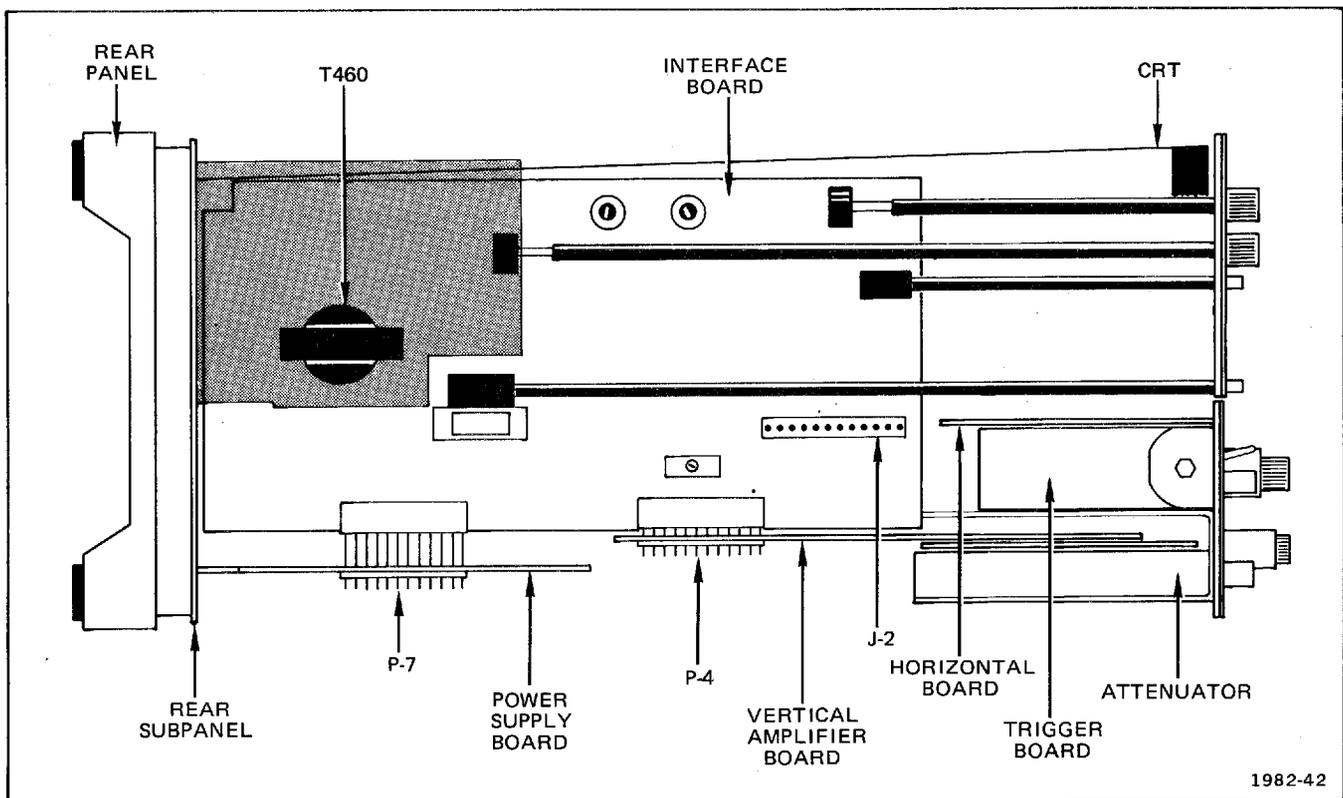


Fig. 5-7. T921 and T922 circuit board locations.

Service Information—T921/T922/T922R**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. Replace 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 repair.

Trigger Switch Board Replacement

If the early production Trigger Switch board is to be replaced, it must be replaced with the late production Trigger Switch board. In this event, C2123, R2117, R2119, and R2120 (located on the A12 Horizontal board), may be removed; they have no effect when the late production Trigger Switch board is used. Refer to Diagram 5 and Circuit Description for the late version when the late production Trigger Switch board is used.

Time Base 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 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 white-red crt lead to the - side of P2344 and a white-green crt lead to the + side of P2344).

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

To replace the Time Base, reverse the above procedure.

To remove the Trigger board, unplug it from the Time Base by pulling up and toward the back of the instrument.

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

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 top right and bottom left screws (the ones holding the Power Supply board to the crt shield). The other two screws hold the transformer to the Power Supply board.

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

To replace 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.

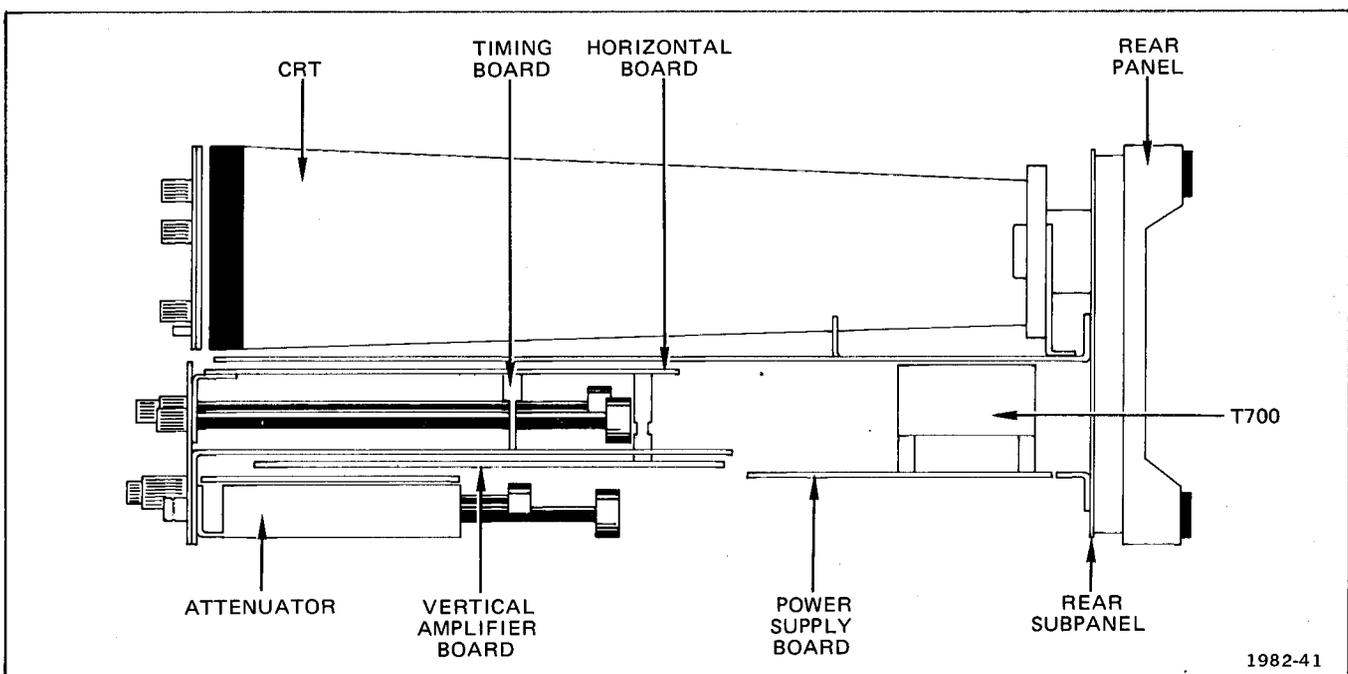


Fig. 5-8. T921 and T922 circuit board locations.

Service Information—T921/T922/T922R

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

3. Remove the front panel knobs and shafts.

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

5. Disconnect J138 (white-blue wire), J148 (white-brown wire), J470 (a brown two-lead connector and a black two-lead connector), J475, J465, J466, and the Cal Out lead (goes to PROBE ADJ on front panel). The J138 and J148 wires pass through the board to the crt.

NOTE

To disconnect J475, J466, and J465, lift the cable retainers with a screwdriver until you can remove the cable. Also remove the high-voltage lead from U460 to the crt.

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.

6. Remove the five retaining screws.

7. Disconnect J7 from the Power Supply board by lifting the Interface board out.

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 the power cord plug from the power input source and remove the 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.

Service Information—T921/T922/T922R

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.

COMPONENT REPLACEMENT (T922R)

Vertical Module Replacement

1. Remove right handle. It is held on by two screws on the back of the front panel.

2. Lift the plastic mask and light filter away from the crt to remove.

3. Remove the four screws holding the bezel. Remove the bezel.

4. Remove the front panel and the plastic module surrounding it.

5. Make note of their location to aid reassembly, then disconnect:

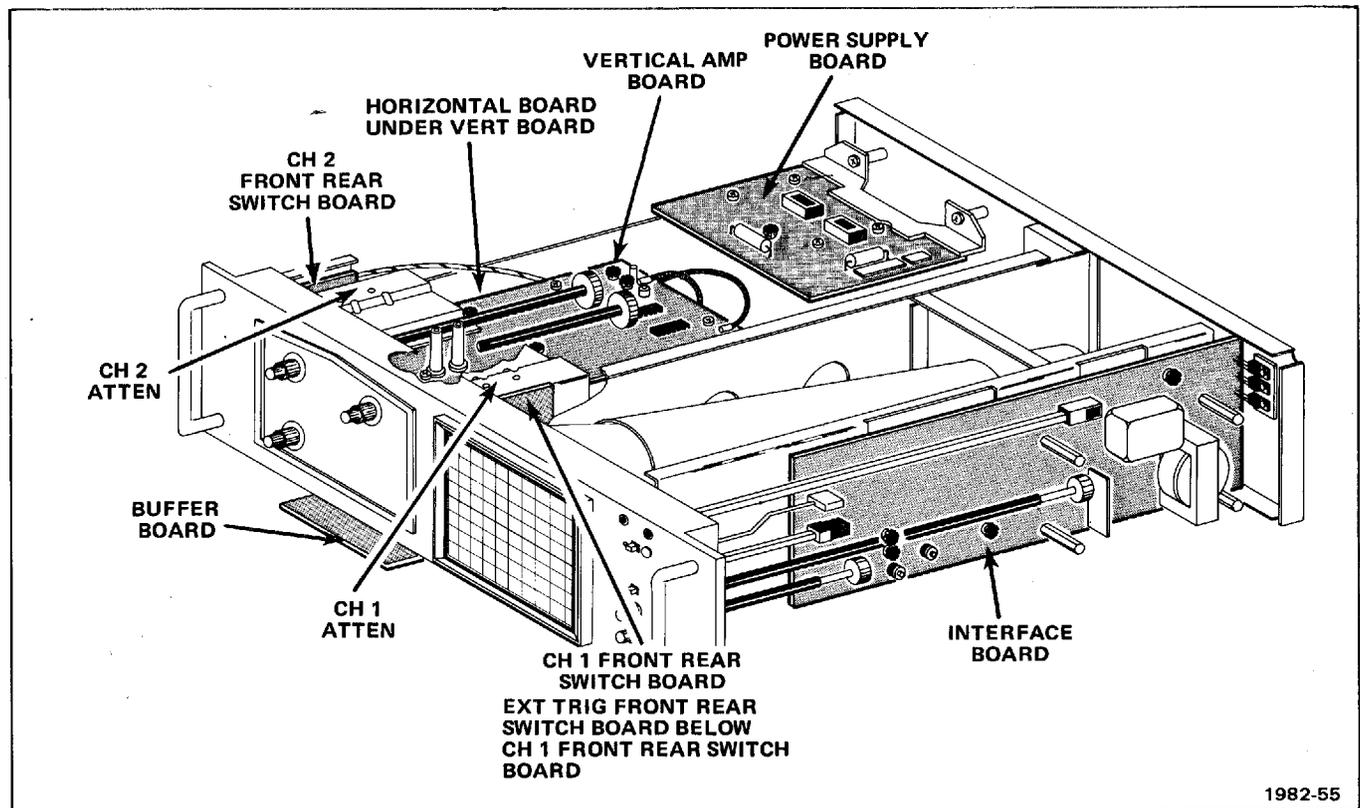
P4 connector

Three vertical input harmonica connectors (3 pin) from FRONT-REAR switch boards.

6. Remove three screws (see Fig. 5-10). Remove vertical module by sliding it forward slightly, lifting the rear to clear the power supply, then sliding it back and out of the instrument.

Horizontal Module Replacement

1. Remove the vertical module. See preceding instructions.



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Fig. 5-9. T922R circuit board locations (shown with bottom of instrument facing upward).

Service Information—T921/T922/T922R

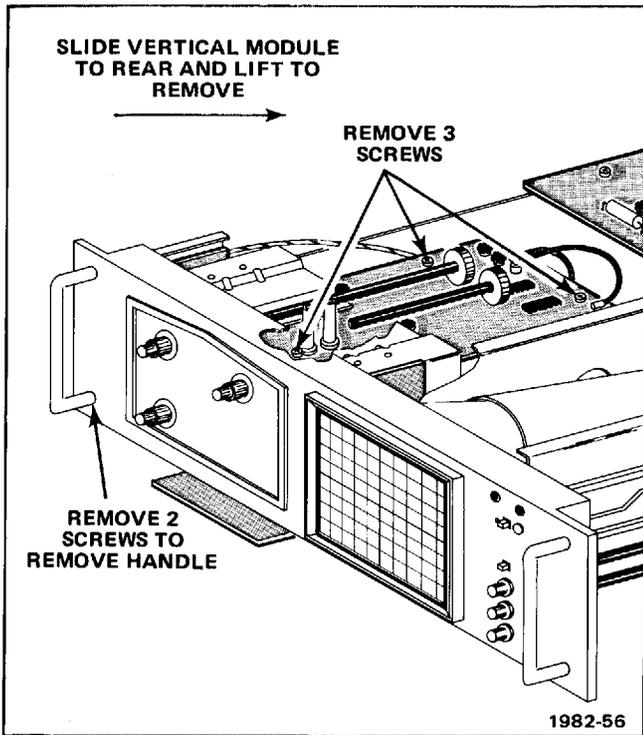


Fig. 5-10. T922R vertical module replacement.

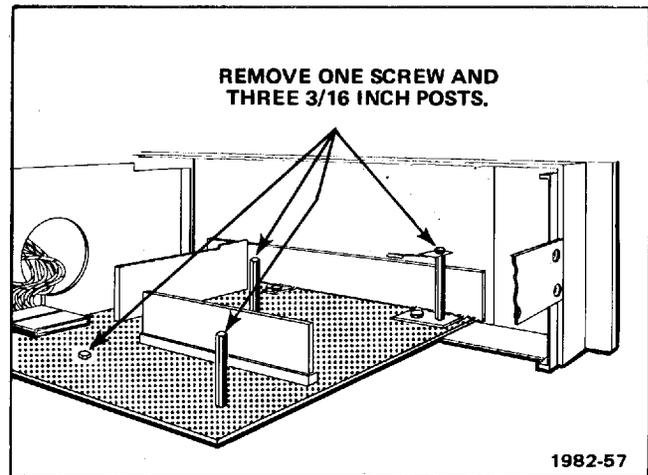


Fig. 5-11. T922R horizontal module replacement.

2. Remove the knob/shafts and shafts from the following controls:

- | | |
|-----------|-----------|
| INTENSITY | BEAM FIND |
| FOCUS | POWER |

WARNING

To avoid a shock hazard, be certain you have disconnected the power cord before continuing.

2. Make note of their location to aid in reassembly, then disconnect:

- P2 from horizontal module
- P2412 from buffer board
- P2103 from EXT TRIG switch board (3 wire connector)
- The two horizontal deflection leads

3. Remove one screw and three 3/16-inch posts (see Fig. 5-11).

4. Lift horizontal module away from instrument to remove.

Interface Board Replacement

1. Remove four screws from the left side rail and remove the side rail.

3. Remove the four screws from the high-voltage shield and lift the shield away from the instrument.

4. Make note of the line cord color code and position, to aid in reassembly. Then, unsolder the line cord conductors from the interface board.

5. Push the clear plastic POWER light-pipe out the front of the instrument to remove.

WARNING

The crt anode and the high voltage multiplier will hold a charge after you turn off the instrument. To prevent a shock hazard, use only one hand to remove the anode lead. Then, touch the anode lead to one of the posts to discharge the crt (see Fig. 5-12). Also take a short piece of insulated wire and short the output of the high-voltage multiplier to the chassis (see Fig. 5-12).

6. Pull the crt anode lead forward to remove.

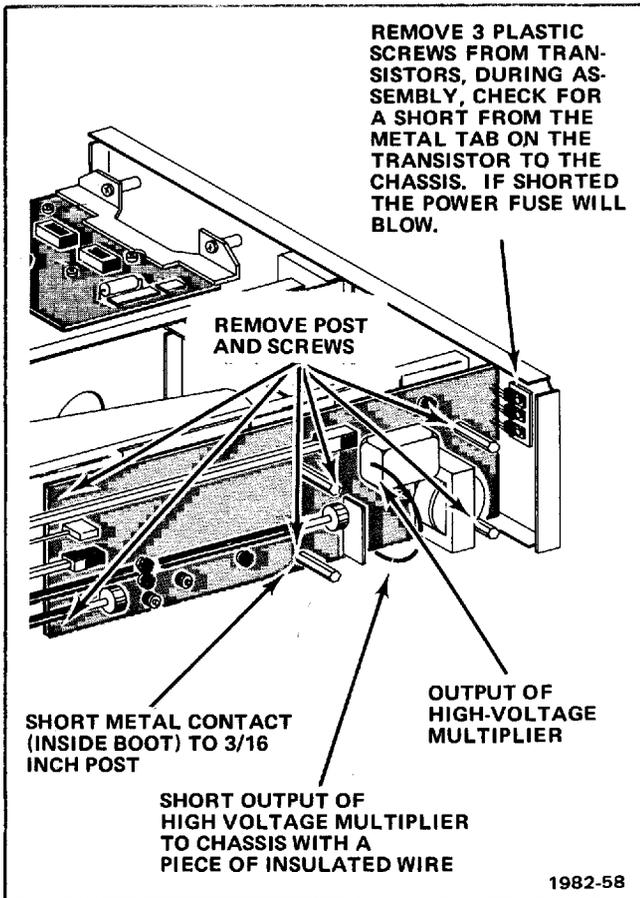


Fig. 5-12. T922R interface board replacement.

7. Remove crt socket.

8. Make note of their location to aid reassembly, then disconnect all harmonica and molex connectors from the interface board. Don't forget to disconnect the vertical crt leads and guide them through the holes in the interface board.

9. Remove the screws and posts from the interface board (see Fig. 5-12).

10. Lift the interface board out of the instrument.

11. During reassembly, use the plastic screws to hold the power transistors (see Fig. 5-12).

Power Module Replacement

1. Remove the plastic shield covering the power module.

2. Remove P7 from the power module.

3. Remove two screws and two bolts from the power module (see Fig. 5-13).

4. Lift the power module away from the instrument.

Buffer Board Replacement

1. To aid in reassembly, make note of the positions of the harmonica connectors on the buffer board. Then, disconnect the harmonica connectors from the buffer board.

2. Remove the four screws from the buffer board.

NOTE

You don't need to remove the switch extensions to remove the buffer board.

3. Slide the buffer board toward the rear of the instrument to remove.

CRT Replacement

1. Remove the four screws from the left side rail and remove the side rail.

2. Remove the four screws from the high-voltage shield and lift the shield away from the instrument.

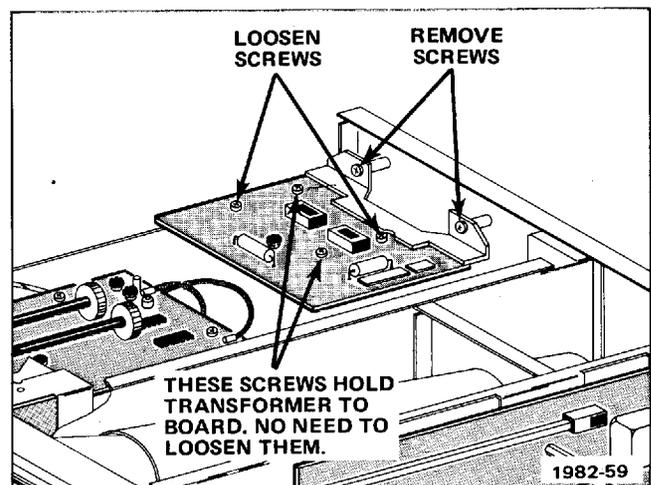


Fig. 5-13. T922R power module replacement.

Service Information—T921/T922/T922R

WARNING

The crt anode and the high-voltage multiplier will hold a charge after you turn off the instrument. To prevent a shock hazard, use only one hand to remove the anode lead. Then, touch the anode lead to one of the posts to discharge the crt (see Fig. 5-12). Also, take a short piece of insulated wire and short the output of the high-voltage multiplier to the chassis (see Fig. 5-12).

3. Slide the crt anode lead out from under the plastic clip which holds it next to the chassis near the interface board.

4. Make note of the positions of the four crt leads to aid in reassembly. Remove the four crt leads from the neck of the crt.

5. Remove crt socket from the base of the crt.

6. Lift the plastic mask and light filter away from the crt to remove.

CAUTION

After you remove the bezel, the crt can slide forward. To avoid crt damage, hold one hand over the crt face if you must turn or move the instrument.

7. Remove the four screws holding the bezel. Lift the bezel and implosion shield away from the crt.

8. Remove the graticule illumination assembly.

9. While holding one hand over the crt face, push the base of the crt forward. When you are able, firmly grasp the front of the crt and slide it out of the crt shield assembly.

SCALE ILLUM Lamp Replacement

1. Lift the plastic mask and light filter away from crt to remove.

2. Disconnect P816 from the SCALE ILLUM assembly.

3. Pull SCALE ILLUM assembly away from the crt to remove. If this is difficult, push against the two screws from behind the front panel (see Fig. 5-14).

4. Remove the two screws holding the plastic piece to the circuit board. Remove the plastic piece.

5. Unsolder the defective lamp and replace.

Fuse Replacement**WARNING**

Line voltage is present on the fuse whenever the power cord is plugged in. To prevent a shock hazard, disconnect the power cord.

The fuse is located in a holder near the rear of the interface board. To remove, grasp firmly and pull away from the interface board.

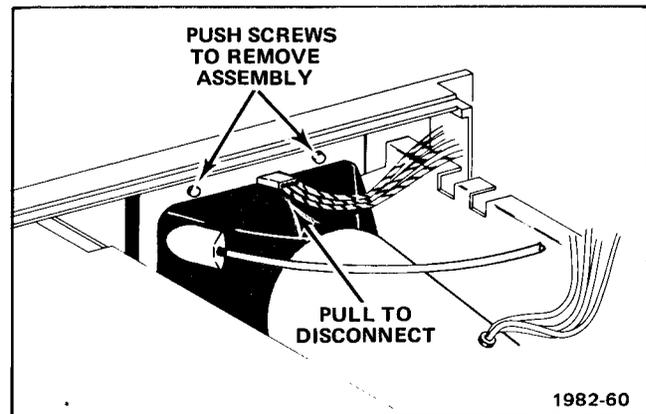


Fig. 5-14. T922R scale illum assembly replacement.

T922R LINE VOLTAGE AND RANGE SELECTION**CAUTION**

When you change the line voltage range, be sure you change the position of the screw on the AC RMS RANGE indicator on the rear panel.

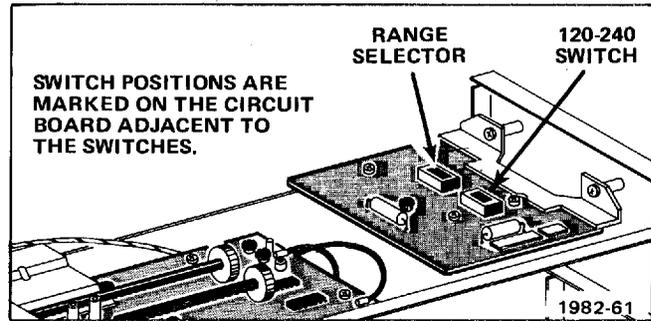


Fig. 5-15. T922R line-voltage and range selection.

In the T922R, the Line Selector (120V/240V) and Range Selector HI/LO switches are not accessible outside the instrument. To change the settings, remove the top cover and set the switches according to the available line voltage (see Fig. 5-15). See the Specifications in Section 1 of this manual for the ranges.

T922R Z-Axis Input Polarity Selection

Jumper plug P2430 may be installed on the A15 Buffer board in either of two positions. When the plug is installed with the index mark aligned with the + = DIM mark on the board, a 5-volt positive signal applied to Z AXIS IN (J2430) will cause the trace to decrease in intensity (a negative-going signal will cause the trace intensity to increase). When plug P2430 is installed with its index mark aligned with the + = BRIGHT mark on the board, a 5-volt positive signal will increase the trace intensity (a negative-going signal will cause trace intensity to decrease). Remove top cover of the T922R for access to Buffer board and P2430.

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 the T921 and T922 is 275 pounds and for the T922R is 375 pounds.

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

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

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

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

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

SPECIAL NOTES AND SYMBOLS

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

ITEM NAME

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

ABBREVIATIONS

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

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P O BOX 128	PICKENS, SC 29671
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
02735	RCA CORPORATION, SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD, PO BOX 20923	PHOENIX, AZ 85036
05091	TRI-ORDINATE CORPORATION	343 SNYDER AVENUE	BERKELEY HEIGHTS, NJ 07922
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
07910	TELEDYNE SEMICONDUCTOR	12515 CHADRON AVE.	HAWTHORNE, CA 90250
08806	GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPARTMENT	NELA PARK	CLEVELAND, OH 44112
12697	CLAROSTAT MFG. CO., INC.	LOWER WASHINGTON STREET	DOVER, NH 03820
14099	SEMTECH CORP.	652 MITCHELL RD.	NEWBURY PARK, CA 91320
15818	TELEDYNE SEMICONDUCTOR	1300 TERRA BELLA AVE.	MOUNTAIN VIEW, CA 94043
19396	ILLINOIS TOOL WORKS, INC. PAKTRON DIV.	900 FOLLIN LANE, SE	VIENNA, VA 22180
27014	NATIONAL SEMICONDUCTOR CORP.	2900 SEMICONDUCTOR DR.	SANTA CLARA, CA 95051
27264	MOLEX PRODUCTS CO.	5224 KATRINE AVE.	DOWNERS GROVE, IL 60515
53184	XCITON CORPORATION	5 HEMLOCK STREET	LATHAM, NY 12110
56289	SPRAGUE ELECTRIC CO.		NORTH ADAMS, MA 01247
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
80031	ELECTRA-MIDLAND CORP., MEPCO DIV.	22 COLUMBIA ROAD	MORRISTOWN, NJ 07960
81483	INTERNATIONAL RECTIFIER CORP.	9220 SUNSET BLVD.	LOS ANGELES, CA 90069
82389	SWITCHCRAFT, INC.	5555 N. ELSTON AVE.	CHICAGO, IL 60630
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	3029 E WASHINGTON STREET	INDIANAPOLIS, IN 46206
91637	DALE ELECTRONICS, INC.	P O BOX 372 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 ¹	670-4235-00			CKT BOARD ASSY:INTERFACE	80009	670-4235-00
A1 ²	670-3738-00	B010100	B010125	CKT BOARD ASSY:INTERFACE	80009	670-3738-00
A1 ²	670-3738-01	B010126	B010756	CKT BOARD ASSY:INTERFACE	80009	670-3738-01
A1 ²	670-3738-03	B010757		CKT BOARD ASSY:INTERFACE	80009	670-3738-03
A1 ³	670-3738-00	B010100	B010349	CKT BOARD ASSY:INTERFACE	80009	670-3738-00
A1 ³	670-3738-01	B010350	B015123	CKT BOARD ASSY:INTERFACE	80009	670-3738-01
A1 ³	670-3738-03	B015124		CKT BOARD ASSY:INTERFACE	80009	670-3738-03
A2	670-3980-00			CKT BOARD ASSY:L.V. POWER SUPPLY	80009	670-3980-00
A6 ²	670-3972-00	B010100	B010549	CKT BOARD ASSY:CH1 ATTENUATOR	80009	670-3972-00
A6 ²	670-3972-02	B010550		CKT BOARD ASSY:CH1 ATTENUATOR	80009	670-3972-02
A6 ³	670-3972-00	B010100	B013399	CKT BOARD ASSY:CH1 ATTENUATOR	80009	670-3972-00
A6 ³	670-3972-02	B013400		CKT BOARD ASSY:CH1 ATTENUATOR	80009	670-3972-02
A6 ¹	670-3972-00	B010100	B010429	CKT BOARD ASSY:CH1 ATTENUATOR	80009	670-3972-00
A6 ¹	670-3972-02	B010430		CKT BOARD ASSY:CH1 ATTENUATOR	80009	670-3972-02
A7 ³	670-3973-00	B010100	B013399	CKT BOARD ASSY:CH2 ATTENUATOR	80009	670-3973-00
A7 ³	670-3973-02	B013400		CKT BOARD ASSY:CH2 ATTENUATOR	80009	670-3973-02
A7 ¹	670-3973-00	B010100	B010409	CKT BOARD ASSY:CH2 ATTENUATOR	80009	670-3973-00
A7 ¹	670-3973-02	B010410		CKT BOARD ASSY:CH2 ATTENUATOR	80009	670-3973-02
A8 ²	670-4109-00	B010100	B010756	CKT BOARD ASSY:VERTICAL	80009	670-4109-00
A8 ²	670-4109-01	B010757		CKT BOARD ASSY:VERTICAL	80009	670-4109-01
A8 ³	670-3740-00	B010100	B014355	CKT BOARD ASSY:VERTICAL	80009	670-3740-00
A8 ³	670-3740-01	B014356		CKT BOARD ASSY:VERTICAL	80009	670-3740-01
A8 ¹	670-3740-00	B010100	B010409	CKT BOARD ASSY:VERTICAL	80009	670-3740-00
A8 ¹	670-3740-01	B010410		CKT BOARD ASSY:VERTICAL	80009	670-3740-01
A11 ²	670-3894-00	B010100	B010129	CKT BOARD ASSY:TRIGGER SWITCH	80009	670-3894-00
A11 ²	670-4230-00	B010130	B010599	CKT BOARD ASSY:TRIGGER SWITCH	80009	670-4230-00
A11 ²	670-4230-01	B010600		CKT BOARD ASSY:TRIGGER SWITCH	80009	670-4230-01
A11 ³	670-3894-00	B010100	B010169	CKT BOARD ASSY:TRIGGER SWITCH	80009	670-3894-00
A11 ³	670-4230-00	B010170	B014623	CKT BOARD ASSY:TRIGGER SWITCH	80009	670-4230-00
A11 ³	670-4230-01	B014624		CKT BOARD ASSY:TRIGGER SWITCH	80009	670-4230-01
A11 ¹	670-4230-00	B010100	B010389	CKT BOARD ASSY:TRIGGER SWITCH	80009	670-4230-00
A11 ¹	670-4230-01	B010390		CKT BOARD ASSY:TRIGGER SWITCH	80009	670-4230-01
A12 ²	670-3739-00	B010100	B010633	CKT BOARD ASSY:HORIZONTAL	80009	670-3739-00
A12 ²	670-3739-01	B010634		CKT BOARD ASSY:HORIZONTAL	80009	670-3739-01
A12 ³	670-3739-00	B010100	B014318	CKT BOARD ASSY:HORIZONTAL	80009	670-3739-00
A12 ³	670-3739-01	B014319		CKT BOARD ASSY:HORIZONTAL	80009	670-3739-01
A12 ¹	670-3739-01			CKT BOARD ASSY:HORIZONTAL	80009	670-3739-01
A13	672-0524-00			CKT BOARD ASSY:TIMING	80009	672-0524-00
A15 ¹	670-4548-00			CKT BOARD ASSY:BUFFER	80009	670-4548-00
A16 ¹	672-0588-00			CKT BOARD ASSY:SCALE ILLUMINATION	80009	672-0588-00
A17 ¹	670-4549-00			CKT BOARD ASSY:SWITCH	80009	670-4549-00
A18 ¹	670-4549-00			CKT BOARD ASSY:SWITCH	80009	670-4549-00
A19 ¹	670-4549-00			CKT BOARD ASSY:SWITCH	80009	670-4549-00
C24	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C114	281-0207-00			CAP.,VAR,PLSTC:2-18PF,100V	80031	HT10EA/218
C115	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	72982	8131N075 E224M
C118	281-0207-00			CAP.,VAR,PLSTC:2-18PF,100V	80031	HT10EA/218
C119	281-0768-00			CAP.,FXD,CER DI:470PF,20%,100V	72982	314022X5P0471M
C124	281-0762-00			CAP.,FXD,CER DI:27PF,20%,100V	72982	390-049X5P0270M
C129	281-0768-00			CAP.,FXD,CER DI:470PF,20%,100V	72982	314022X5P0471M
C167 ¹	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C169 ¹	290-0748-00			CAP.,FXD,ELCTLT:10UF,+50-10%,20V	56289	500D149
C412	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9ABZ5U104M

¹T922R only
²T921 only
³T922 only

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C423 ¹	281-0627-00	B010100	B010739	CAP.,FXD,CER DI:1PF,+/-0.25PF,500V	72982	301-000COK0109C
C423 ¹	281-0661-00	B0101740		CAP.,FXD,CER DI:0.8PF,+/-0.1PF,500V	72982	301-000COK0808B
C423 ²	281-0627-00	B010100	B011069	CAP.,FXD,CER DI:1PF,+/-0.25PF,500V	72982	301-000COK0109C
C423 ²	281-0661-00	B011070		CAP.,FXD,CER DI:0.8PF,+/-0.1PF,500V	72982	301-000COK0808B
C423 ³	281-0627-00	B010100	B015779	CAP.,FXD,CER DI:1PF,+/-0.25PF,500V	72982	301-000COK0109C
C423 ³	281-0661-00	B015780		CAP.,FXD,CER DI:0.8PF,+/-0.1PF,500V	72982	301-000COK0808B
C424	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C425	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C433	285-1099-00			CAP.,FXD,PLSTC:0.047UF,20%,200V	19396	PT605C473M
C434	285-1099-00			CAP.,FXD,PLSTC:0.047UF,20%,200V	19396	PT605C473M
C435	285-1099-00			CAP.,FXD,PLSTC:0.047UF,20%,200V	19396	PT605C473M
C443	290-0297-00			CAP.,FXD,ELCTLT:39UF,10%,10V	56289	150D396X9010B2
C445	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C455	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
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	283-0034-00			CAP.,FXD,CER DI:0.005UF,20%,4000V	56289	41C107A
C466	283-0034-00			CAP.,FXD,CER DI:0.005UF,20%,4000V	56289	41C107A
C476	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C477	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C478	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C722	290-0750-00			CAP.,FXD,ELCTLT:100UF,+50-10%,160V	56289	D76244
C738	290-0744-00			CAP.,FXD,ELCTLT:3.3UF,+50-10%,160V	90201	TT3R3U160B0L3P
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
C763	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C774	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C778	290-0107-00			CAP.,FXD,ELCTLT:25UF,+75-10%,25V	56289	30D256G025DB9
C796	290-0164-00			CAP.,FXD,ELCTLT:1UF,+50-10%,150V	56289	30D105F150BA2
C817 ¹	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C2101 ²	281-0651-00	XB010130		CAP.,FXD,CER DI:47PF,5%,200V	72982	374-001T2H0470J
C2101 ³	281-0651-00	XB010170		CAP.,FXD,CER DI:47PF,5%,200V	72982	374-001T2H0470J
C2101 ¹	281-0651-00			CAP.,FXD,CER DI:47PF,5%,200V	72982	374-001T2H0470J
C2102	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2103 ²	281-0528-00	XB010130		CAP.,FXD,CER DI:82PF,+/-8.2PF,500V	72982	301-000U2M0820K
C2103 ³	281-0528-00	XB010170		CAP.,FXD,CER DI:82PF,+/-8.2PF,500V	72982	301-000U2M0820K
C2103 ¹	281-0528-00			CAP.,FXD,CER DI:82PF,+/-8.2PF,500V	72982	301-000U2M0820K
C2106 ²	281-0775-00	XB010130		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2106 ³	281-0775-00	XB010170		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2106 ¹	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2107 ²	281-0797-00	XB010130		CAP.,FXD,CER DI:15PF,10%,100V	72982	8005-D-COG-150K
C2107 ³	281-0797-00	XB010170		CAP.,FXD,CER DI:15PF,10%,100V	72982	8005-D-COG-150K
C2107 ¹	281-0797-00			CAP.,FXD,CER DI:15PF,10%,100V	72982	8005-D-COG-150K
C2112 ²	281-0763-00	B010100	B010129X	CAP.,FXD,CER DI:47PF,10%,100V	72982	390049X5P0470K
C2112 ³	281-0763-00	B010100	B010169X	CAP.,FXD,CER DI:47PF,10%,100V	72982	390049X5P0470K
C2113 ²	281-0763-00	XB010130		CAP.,FXD,CER DI:47PF,10%,100V	72982	390049X5P0470K
C2113 ³	281-0763-00	XB010170		CAP.,FXD,CER DI:47PF,10%,100V	72982	390049X5P0470K
C2113 ¹	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	72982	390049X5P0470K

¹T922R only
²T921 only
³T922 only

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C2114 ¹	281-0764-00	B010100	B010129X	CAP.,FXD,CER DI:82PF,5%,100V	72982	314022X5P0820J
C2114 ²	281-0764-00	B010100	B010169X	CAP.,FXD,CER DI:82PF,5%,100V	72982	314022X5P0820J
C2116 ¹	281-0775-00	B010100	B010129X	CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2116 ²	281-0775-00	B010100	B010169X	CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2123 ¹	290-0114-00	B010100	B010129X	CAP.,FXD,ELCTLT:47UF,20%,6V	56289	150D476X0006B2
C2123 ²	290-0114-00	B010100	B010169X	CAP.,FXD,ELCTLT:47UF,20%,6V	56289	150D476X0006B2
C2125	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C2128	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2132	290-0201-00			CAP.,FXD,ELCTLT:100UF,+75-10%,15V	56289	30D107G015DC9
C2136	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2144	290-0183-00			CAP.,FXD,ELCTLT:1UF,10%,35V	56289	162D105X9035CD2
C2147	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2156	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2163	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	72982	390049X5P0470K
C2165	290-0183-00			CAP.,FXD,ELCTLT:1UF,10%,35V	56289	162D105X9035CD2
C2167	290-0183-00			CAP.,FXD,ELCTLT:1UF,10%,35V	56289	162D105X9035CD2
C2173	290-0183-00			CAP.,FXD,ELCTLT:1UF,10%,35V	56289	162D105X9035CD2
C2174	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C2175	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2176	281-0774-00			CAP.,FXD,CER DI:0.022UF,20%,100V	72982	8045A9ABDZ2U223M
C2182	290-0183-00			CAP.,FXD,ELCTLT:1UF,10%,35V	56289	162D105X9035CD2
C2212	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2213 ¹	281-0634-00	XB010300	B010633	CAP.,FXD,CER DI:10PF,+/-0.25PF,500V	72982	374-011C0G0100C
C2213 ¹	281-0757-00	B010634		CAP.,FXD,CER DI:10PF,20%,100V	72982	314-022C0G100M
C2213 ²	281-0634-00	XB011000	B014318	CAP.,FXD,CER DI:10PF,+/-0.25PF,500V	72982	374-011C0G0100C
C2213 ²	281-0757-00	B014319		CAP.,FXD,CER DI:10PF,20%,100V	72982	314-022C0G100M
C2213 ³	281-0757-00			CAP.,FXD,CER DI:10PF,20%,100V	72982	314-022C0G100M
C2226	290-0135-00			CAP.,FXD,ELCTLT:15UF,20%,20V	56289	150D156X0020B2
C2233	283-0706-00			CAP.,FXD,MICA D:91PF,+/-1PF,500V	00853	D15-5E910FO
C2234	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2235	281-0216-00			CAP.,VAR,CER DI:0.8-6.8PF,400V	80031	2222-801-96024
C2245	281-0759-00			CAP.,FXD,CER DI:22PF,10%,100V	72982	390-049X5P0220K
C2246	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	72982	390049X5P0470K
C2252 ⁴	295-0179-00			CAP.,SET,MTCHD:0.01UF,1.0UF,1%	80009	295-0179-00
C2253 ⁴	295-0179-00			CAP.,SET,MTCHD:0.01UF,1.0UF,1%	80009	295-0179-00
C2274	290-0183-00			CAP.,FXD,ELCTLT:1UF,10%,35V	56289	162D105X9035CD2
C2275	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C2276	281-0758-00			CAP.,FXD,CER DI:15PF,20%,100V	72982	314022C0G0150M
C2317	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2327	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2331 ¹	281-0797-00	XB010150		CAP.,FXD,CER DI:15PF,10%,100V	72982	8005-D-COG-150K
C2331 ²	281-0797-00	XB010600		CAP.,FXD,CER DI:15PF,10%,100V	72982	8005-D-COG-150K
C2331 ³	281-0797-00			CAP.,FXD,CER DI:15PF,10%,100V	72982	8005-D-COG-150K
C2345	290-0135-00			CAP.,FXD,ELCTLT:15UF,20%,20V	56289	150D156X0020B2
C2392	290-0135-00			CAP.,FXD,ELCTLT:15UF,20%,20V	56289	150D156X0020B2
C2408 ³	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C2424 ³	290-0743-00			CAP.,FXD,ELCTLT:100UF,+50-10%,16V	56289	500D146
C4101	281-0541-00			CAP.,FXD,CER DI:6.8PF,10%,500V	72982	301-000C0H0689D
C4102	285-1124-00			CAP.,FXD,PLSTC:0.022UF,20%,400V	19396	PP721E223M
C4104	281-0207-00			CAP.,VAR,PLSTC:2-18PF,100V	80031	HT10EA/218
C4105	281-0214-00			CAP.,VAR,CER DI:0.5-3PF,400V	80031	2222-801-96138
C4106	283-0213-00			CAP.,FXD,CER DI:300PF,5%,100V	72982	8121N130A301J
C4113	281-0207-00			CAP.,VAR,PLSTC:2-18PF,100V	80031	HT10EA/218

¹T921 only
²T922 only
³T922R only
⁴Matched pair

Replaceable Electrical Parts—T921/T922/T922R

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C4114 ¹	281-0214-00	B010100	B010599	CAP.,VAR,CER DI:0.5-3PF,400V	80031	2222-801-96138
C4114 ¹	281-0220-00	B010560		CAP.,VAR,CER DI:1-5.5PF,400V	80031	2222-801-96139
C4114 ²	281-0214-00	B010100	B012199	CAP.,VAR,CER DI:0.5-3PF,400V	80031	2222-801-96138
C4114 ²	281-0220-00	B012200		CAP.,VAR,CER DI:1-5.5PF,400V	80031	2222-801-96139
C4114 ³	281-0220-00			CAP.,VAR,CER DI:1-5.5PF,400V	80031	2222-801-96139
C4116	281-0759-00			CAP.,FXD,CER DI:22PF,10%,100V	72982	390-049X5P0220K
C4123 ¹	281-0773-00	B010100	B010339	CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C4123 ¹	283-0002-00	B010340		CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C4123 ²	281-0773-00	B010100	B011099	CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C4123 ²	283-0002-00	B011100		CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C4123 ³	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C4143 ¹	281-0763-00	B010100	B010229X	CAP.,FXD,CER DI:47PF,10%,100V	72982	390049X5P0470K
C4143 ²	281-0763-00	B010100	B010999X	CAP.,FXD,CER DI:47PF,10%,100V	72982	390049X5P0470K
C4153	281-0584-00			CAP.,FXD,CER DI:100PF,5%,500V	72982	301-000Y5D101J
C4155	281-0768-00			CAP.,FXD,CER DI:470PF,20%,100V	72982	314022X5P0471M
C4158	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N075W5R103M
C4165	281-0768-00			CAP.,FXD,CER DI:470PF,20%,100V	72982	314022X5P0471M
C4168	283-0065-01			CAP.,FXD,CER DI:0.001UF,5%,100V	80009	283-0065-01
C4201 ⁴	281-0541-00			CAP.,FXD,CER DI:6.8PF,10%,500V	72982	301-000COH0689D
C4202 ⁴	285-1124-00			CAP.,FXD,PLSTC:0.022UF,20%,400V	19396	PP721E223M
C4204 ⁴	281-0207-00			CAP.,VAR,PLSTC:2-18PF,100V	80031	HT10EA/218
C4205 ⁴	281-0214-00			CAP.,VAR,CER DI:0.5-3PF,400V	80031	2222-801-96138
C4206 ⁴	283-0213-00			CAP.,FXD,CER DI:300PF,5%,100V	72982	8121N130A301J
C4213 ⁴	281-0207-00			CAP.,VAR,PLSTC:2-18PF,100V	80031	HT10EA/218
C4214 ²	281-0214-00	B010100	B012199	CAP.,VAR,CER DI:0.5-3PF,400V	80031	2222-801-96138
C4214 ²	281-0220-00	B012200		CAP.,VAR,CER DI:1-5.5PF,400V	80031	2222-801-96139
C4214 ³	281-0220-00			CAP.,VAR,CER DI:1-5.5PF,400V	80031	2222-801-96139
C4216 ⁴	281-0759-00			CAP.,FXD,CER DI:22PF,10%,100V	72982	390-049X5P0220K
C4223 ²	281-0773-00	B010100	B011099	CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C4223 ²	283-0002-00	B011100		CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C4223 ³	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C4243 ²	281-0763-00	B010100	B010999X	CAP.,FXD,CER DI:47PF,10%,100V	72982	390049X5P0470K
C4253 ⁴	281-0584-00			CAP.,FXD,CER DI:100PF,5%,500V	72982	301-000Y5D101J
C4255 ⁴	281-0768-00			CAP.,FXD,CER DI:470PF,20%,100V	72982	314022X5P0471M
C4258 ⁴	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N075W5R103M
C4265 ⁴	281-0768-00			CAP.,FXD,CER DI:470PF,20%,100V	72982	314022X5P0471M
C4268 ⁴	283-0065-01			CAP.,FXD,CER DI:0.001UF,5%,100V	80009	283-0065-01
C4333	281-0759-00			CAP.,FXD,CER DI:22PF,10%,100V	72982	390-049X5P0220K
C4334	281-0214-00			CAP.,VAR,CER DI:0.5-3PF,400V	80031	2222-801-96138
C4338	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C4344	281-0207-00			CAP.,VAR,PLSTC:2-18PF,100V	80031	HT10EA/218
C4349	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C4362 ⁴	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C4363 ⁴	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C4364 ⁴	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005H9AABZ5U104M
C4365 ⁴	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C4366 ⁴	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C4368 ²	283-0103-00	XB010500		CAP.,FXD,CER DI:180PF,5%,500V	56289	40C638
C4368 ³	283-0103-00			CAP.,FXD,CER DI:180PF,5%,500V	56289	40C638
C4370 ⁴	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C4371 ⁴	283-0065-01			CAP.,FXD,CER DI:0.001UF,5%,100V	80009	283-0065-01
C4372 ⁴	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	72982	390049X5P0470K
C4375 ⁴	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K

¹T921 only²T922 only³T922R only⁴T922 and T922R only

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C4376 ¹	281-0775-00			CAP., FXD, CER DI: 0.1UF, 20%, 50V	72982	8005H9AABZ5U104M
C4377 ¹	281-0788-00			CAP., FXD, CER DI: 470PF, 10%, 100V	72982	8005H9AADW5R471K
C4385 ²	281-0797-00	XB010500		CAP., FXD, CER DI: 15PF, 10%, 100V	72982	8005-D-COG-150K
C4385 ³	281-0797-00			CAP., FXD, CER DI: 15PF, 10%, 100V	72982	8005-D-COG-150K
C4386 ¹	281-0770-00			CAP., FXD, CER DI: 0.001UF, 20%, 100V	72982	314022X5P0102M
C4392	283-0177-00			CAP., FXD, CER DI: 1UF, +80-20%, 25V	72982	8131N039 E 105Z
C4393	283-0177-00		CAP., FXD, CER DI: 1UF, +80-20%, 25V	72982	8131N039 E 105Z	
C4394	283-0111-00		CAP., FXD, CER DI: 0.1UF, 20%, 50V	72982	8121-N088Z5U104M	
C4395 ¹	283-0111-00		CAP., FXD, CER DI: 0.1UF, 20%, 50V	72982	8121-N088Z5U104M	
C4396	283-0111-00		CAP., FXD, CER DI: 0.1UF, 20%, 50V	72982	8121-N088Z5U104M	
C4397 ¹	283-0111-00		CAP., FXD, CER DI: 0.1UF, 20%, 50V	72982	8121-N088Z5U104M	
CR26	152-0141-02			SEMICON D DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR27	152-0141-02			SEMICON D DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR416	152-0075-00			SEMICON D DEVICE: GE, 25V, 40MA	80009	152-0075-00
CR418	152-0141-02			SEMICON D DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR437	152-0061-00			SEMICON D DEVICE: SILICON, 175V, 100MA	80009	152-0061-00
CR443	152-0141-02			SEMICON D DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR463	152-0639-00			SEMICON D DEVICE: RECT, SI, 10KV, 10MA	14099	SEF100
CR465	152-0639-00			SEMICON D DEVICE: RECT, SI, 10KV, 10MA	14099	SEF100
CR721	152-0066-03			SEMICON D DEVICE: RECT, SI, 400V, 1A	80009	152-0066-03
CR722	152-0066-03			SEMICON D DEVICE: RECT, SI, 400V, 1A	80009	152-0066-03
CR723	152-0066-03			SEMICON D DEVICE: RECT, SI, 400V, 1A	80009	152-0066-03
CR724	152-0066-03			SEMICON D DEVICE: RECT, SI, 400V, 1A	80009	152-0066-03
CR732	152-0066-03			SEMICON D DEVICE: RECT, SI, 400V, 1A	80009	152-0066-03
CR734	152-0066-03			SEMICON D DEVICE: RECT, SI, 400V, 1A	80009	152-0066-03
CR737	152-0141-02			SEMICON D DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR738	152-0066-03			SEMICON D DEVICE: RECT, SI, 400V, 1A	80009	152-0066-03
CR741	152-0066-03			SEMICON D DEVICE: RECT, SI, 400V, 1A	80009	152-0066-03
CR742	152-0066-03			SEMICON D DEVICE: RECT, SI, 400V, 1A	80009	152-0066-03
CR743	152-0066-03			SEMICON D DEVICE: RECT, SI, 400V, 1A	80009	152-0066-03
CR744	152-0066-03			SEMICON D DEVICE: RECT, SI, 400V, 1A	80009	152-0066-03
CR758	152-0066-03			SEMICON D DEVICE: RECT, SI, 400V, 1A	80009	152-0066-03
CR764	152-0141-02			SEMICON D DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR765	152-0141-02			SEMICON D DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR766	152-0141-02			SEMICON D DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR767	152-0141-02			SEMICON D DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR778	152-0066-03			SEMICON D DEVICE: RECT, SI, 400V, 1A	80009	152-0066-03
CR816 ³	152-0061-00			SEMICON D DEVICE: SILICON, 175V, 100MA	80009	152-0061-00
CR2103 ⁴	152-0141-02	XB010130		SEMICON D DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR2103 ²	152-0141-02		XB010170		SEMICON D DEVICE: SILICON, 30V, 150MA	07910
CR2103 ³	152-0141-02				SEMICON D DEVICE: SILICON, 30V, 150MA	07910
CR2108 ⁴	152-0141-02	XB010130		SEMICON D DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR2108 ²	152-0141-02		XB010170		SEMICON D DEVICE: SILICON, 30V, 150MA	07910
CR2108 ³	152-0141-02				SEMICON D DEVICE: SILICON, 30V, 150MA	07910
CR2112 ⁴	152-0141-02	XB010130		SEMICON D DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR2112 ²	152-0141-02		XB010170		SEMICON D DEVICE: SILICON, 30V, 150MA	07910
CR2112 ³	152-0141-02				SEMICON D DEVICE: SILICON, 30V, 150MA	07910
CR2115	152-0141-02			SEMICON D DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR2116 ⁴	152-0141-02	B010100	B010129X	SEMICON D DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR2116 ²	152-0141-02	B010100	B010169X	SEMICON D DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR2118 ⁴	152-0141-02	B010100	B010129X	SEMICON D DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR2118 ²	152-0141-02	B010100	B010169X	SEMICON D DEVICE: SILICON, 30V, 150MA	07910	1N4152

¹T922 and T922R only

²T922 only

³T922R only

⁴T921 only

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR2124	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR2135	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR2182	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR2186	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR2227	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR2233	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR2234 ¹	152-0141-02	B010100	B010179	SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR2234 ¹	152-0245-00	B010180		SEMICONV DEVICE:SILICON,10NA AT 5V	80009	152-0245-00
CR2234 ²	152-0141-02	B010100	B010289	SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR2234 ²	152-0245-00	B010290		SEMICONV DEVICE:SILICON,10NA AT 5V	80009	152-0245-00
CR2234 ³	152-0245-00			SEMICONV DEVICE:SILICON,10NA AT 5V	80009	152-0245-00
CR2317	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR2326	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR2331	152-0075-00			SEMICONV DEVICE:GE,25V,40MA	80009	152-0075-00
CR2332	152-0075-00			SEMICONV DEVICE:GE,25V,40MA	80009	152-0075-00
CR2334	152-0061-00			SEMICONV DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR2342	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR2356	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR2400 ³	150-1029-00			LAMP,LED:2.0V,GREEN	53184	XC209G
CR2404 ³	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR2406 ³	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR2407 ³	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR2409 ³	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR2431 ³	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR4123	152-0246-00			SEMICONV DEVICE:SILICON,400PIV,200MA	07910	CD12676
CR4223 ⁴	152-0246-00			SEMICONV DEVICE:SILICON,400PIV,200MA	07910	CD12676
CR4302 ⁴	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR4303 ⁴	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR4304 ⁴	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR4305 ⁴	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR4312 ⁴	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR4313 ⁴	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR4314 ⁴	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR4315 ⁴	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR4362 ⁴	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR4363 ⁴	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR4364 ⁴	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR4366 ⁴	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR4367	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
DL4339 ¹	119-0733-00	B010100	B011052	DELAY LINE,ELEC:200 NSEC,150 OHM,COIL	80009	119-0733-00
DL4339 ¹	119-0733-01	B011053		DELAY LINE,ELEC:200 NSEC,150 OHM,COIL	80009	119-0733-01
DL4339 ²	119-0733-00	B010100	B015972	DELAY LINE,ELEC:200 NSEC,150 OHM,COIL	80009	119-0733-00
DL4339 ²	119-0733-01	B015973		DELAY LINE,ELEC:200 NSEC,150 OHM,COIL	80009	119-0733-01
DL4339 ³	119-0733-00	B010100	B010659	DELAY LINE,ELEC:200 NSEC,150 OHM,COIL	80009	119-0733-00
DL4339 ³	119-0733-01	B010660		DELAY LINE,ELEC:200 NSEC,150 OHM,COIL	80009	119-0733-01
DS463	150-0002-00			LAMP,GLOW:0.5 MA 60/125V	08806	NE2T-ALAT
DS465	150-0002-00			LAMP,GLOW:0.5 MA 60/125V	08806	NE2T-ALAT
DS796	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS816 ³	150-0088-00			LAMP,INCAND:0.04A,28V	08806	2187D
DS818 ³	150-0088-00			LAMP,INCAND:0.04A,28V	08806	2187D
F700 ⁵	159-0042-00			FUSE,CARTRIDGE:3AG,0.75A,250V,FAST-BLOW	71400	AGC 3/4
F700 ⁶	159-0029-00			FUSE,CARTRIDGE:3AG,0.3A,250V,SLOW-BLOW	71400	MDL3/10

¹T921 only
²T922 only
³T922R only
⁴T922 and T922R only
⁵100V to 120V operation
⁶220V to 240V operation

Ckt No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Name & Description	Mfr Code	Mfr Part Number
F722	159-0051-00	919 Resistor inside	FUSE, CARTRIDGE: 3AG, 0.062A, 250V, 20 SEC	71400	MDL1-16
J2	131-1792-00		CONTACT ASSY, EL: 12 MALE CONTACT, FLAT WAFER	27264	09-70-2121
J4	131-1795-00		CONNECTOR, RCPT, : 12 FEMALE CONTACT, RT-ANGLE	27264	09-62-3121
J7	131-1749-00		CONNECTOR, RCPT, : 10 FEMALE CONTACT	27264	09-52-3101
J419	131-0955-00		CONNECTOR, RCPT, : BNC, FEMALE, W/HARDWARE	05091	31-279
J2100	131-1802-00		CONNECTOR, RCPT, : 15 CONTACTS	80009	131-1802-00
J2110	131-0106-02		CONNECTOR, RCPT, : BNC	80009	131-0106-02
J2250	131-1801-00		CONNECTOR, RCPT, : 9 CONTACTS	80009	131-1801-00
J2260	131-1802-00		CONNECTOR, RCPT, : 15 CONTACTS	80009	131-1802-00
J4110	131-0955-00		CONNECTOR, RCPT, : BNC, FEMALE, W/HARDWARE	05091	31-279
J4210	131-0955-00		CONNECTOR, RCPT, : BNC, FEMALE, W/HARDWARE	05091	31-279
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	} 2N3640	TRANSISTOR: SILICON, PNP	27014	ST65038
Q122	151-0199-00		TRANSISTOR: SILICON, PNP	27014	ST65038
Q134	151-0127-00	} 2N2369	TRANSISTOR: SILICON, NPN	80009	151-0127-00
Q136	151-0127-00		TRANSISTOR: SILICON, NPN	80009	151-0127-00
Q144	151-0127-00		TRANSISTOR: SILICON, NPN	80009	151-0127-00
Q146	151-0127-00	} 2N3904	TRANSISTOR: SILICON, NPN	80009	151-0127-00
Q160 ¹	151-0190-06		TRANSISTOR: SILICON, NPN	80009	151-0190-06
Q162 ¹	151-0190-06		TRANSISTOR: SILICON, NPN	80009	151-0190-06
Q166 ¹	151-0188-00		TRANSISTOR: SILICON, PNP	01295	2N3906
Q416	151-0190-06		TRANSISTOR: SILICON, NPN	80009	151-0190-06
Q424	151-0190-06	} 2N5551 } 2N5401 } 2N2484 } 2N3906	TRANSISTOR: SILICON, NPN	80009	151-0190-06
Q426	151-0347-00		TRANSISTOR: SILICON, NPN	80009	151-0347-00
Q434	151-0350-00		TRANSISTOR: SILICON, PNP	80009	151-0350-00
Q446	151-0126-00		TRANSISTOR: SILICON, NPN	15818	2N2484
Q454	151-0188-00		TRANSISTOR: SILICON, PNP	01295	2N3906
Q458	151-0423-00	TIP50	TRANSISTOR: SILICON, NPN	01295	TIP50
Q722	151-0347-00	} 2N5551	TRANSISTOR: SILICON, NPN	80009	151-0347-00
Q726	151-0347-00		TRANSISTOR: SILICON, NPN	80009	151-0347-00
Q734	151-0347-00		TRANSISTOR: SILICON, NPN	80009	151-0347-00
Q736	151-0497-00		TIP47	TRANSISTOR: SILICON, NPN	02735
Q752	151-0302-00	2N2222A	TRANSISTOR: SILICON, NPN	04713	2N2222A
Q754	151-0302-00	2N2222A	TRANSISTOR: SILICON, NPN	04713	2N2222A
Q756	151-0478-00	TIP31A	TRANSISTOR: SILICON, NPN	01295	TIP31A
Q772	151-0301-00	} 2N2907A	TRANSISTOR: SILICON, PNP	04713	2N2907A
Q774	151-0301-00		TRANSISTOR: SILICON, PNP	04713	2N2907A
Q776	151-0478-00	TIP31A	TRANSISTOR: SILICON, NPN	01295	TIP31A
Q792	151-0224-00	2N3904	TRANSISTOR: SILICON, NPN	07263	2N3904
Q796	151-0347-00	2N5551	TRANSISTOR: SILICON, NPN	80009	151-0347-00
Q812 ¹	151-0497-01	TEK SPEC (try TIP47?)	TRANSISTOR: SILICON, NPN	80009	151-0497-01
Q816 ¹	151-0497-01	TIP47-TEK SPEC.	TRANSISTOR: SILICON, NPN	80009	151-0497-01
Q818 ¹	151-0347-00	2N5551	TRANSISTOR: SILICON, NPN	80009	151-0347-00
Q2104 ²	151-1042-00	XB010130	SEMICON DVC SE: MATCHED PAIR FET	80009	151-1042-00
Q2106 ¹	151-1042-00	} 2N5454 Nch. FET			
Q2104 ¹	151-1042-00		SEMICON DVC SE: MATCHED PAIR FET	80009	151-1042-00
Q1026 ¹	151-1042-00				
Q2104 ³	151-1042-00	2N5454 XB010170	SEMICON DVC SE: MATCHED PAIR FET	80009	151-1042-00
Q2106 ¹	151-1042-00				
Q2108 ²	151-0188-00	XB010130	TRANSISTOR: SILICON, PNP	01295	2N3906
Q2108 ³	151-0188-00	XB010170 } 2N3906	TRANSISTOR: SILICON, PNP	01295	2N3906

¹T922R only
²T921 only
³T922 only

Replaceable Electrical Parts—T921/T922/T922R

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number	
Q2108 ¹	151-0188-00	2N3906		TRANSISTOR:SILICON,PNP	01295	2N3906	
Q2114 ²	151-1042-00	B010100	B010129X	SEMICON DVC SE:MATCHED PAIR FET	80009	151-1042-00	
Q2116 ¹	151-1042-00	2N5454					
Q2114 ³	151-1042-00	B010100	B010169X	SEMICON DVC SE:MATCHED PAIR FET	80009	151-1042-00	
Q2116 ¹	151-1042-00	2N5454					
Q2124	151-0188-00	2N3906		TRANSISTOR:SILICON,PNP	01295	2N3906	
Q2134	151-0188-00		TRANSISTOR:SILICON,PNP	01295	2N3906		
Q2136	151-0188-00		TRANSISTOR:SILICON,PNP	01295	2N3906		
Q2174	151-0188-00		TRANSISTOR:SILICON,PNP	01295	2N3906		
Q2176 ²	151-0188-00		B010100	B010524	TRANSISTOR:SILICON,PNP	01295	2N3906
Q2176 ²	151-0216-02	B010525		TRANSISTOR:SILICON,PNP,SELECTED	80009	151-0216-02	
Q2176 ³	151-0188-00	B010100	B012649	TRANSISTOR:SILICON,PNP	01295	2N3906	
Q2176 ³	151-0216-02	B012650		TRANSISTOR:SILICON,PNP,SELECTED	80009	151-0216-02	
Q2176 ¹	151-0216-02	MPS6523(NTE159)		TRANSISTOR:SILICON,PNP,SELECTED	80009	151-0216-02	
Q2242 ¹	151-1042-00	2N5454		SEMICON DVC SE:MATCHED PAIR FET	80009	151-1042-00	
Q2244 ¹	151-1042-00	2N5454		SEMICON DVC SE:MATCHED PAIR FET	80009	151-1042-00	
Q2246	151-0190-06	2N3904		TRANSISTOR:SILICON,NPN	80009	151-0190-06	
Q2274	151-0190-06		TRANSISTOR:SILICON,NPN	80009	151-0190-06		
Q2314 ²	151-0190-06		B010100	B010633	TRANSISTOR:SILICON,NPN	80009	151-0190-06
Q2314 ²	151-0192-03		B0106634		TRANSISTOR:SILICON,NPN	80009	151-0192-03
Q2314 ³	151-0190-06	B010100	B014318	TRANSISTOR:SILICON,NPN	80009	151-0190-06	
Q2314 ³	151-0192-03	B014319		TRANSISTOR:SILICON,NPN	80009	151-0192-03	
Q2314 ¹	151-0192-03	TPS6521(NTE123AP)		TRANSISTOR:SILICON,NPN	80009	151-0192-03	
Q2326	151-0188-00	2N3906		TRANSISTOR:SILICON,PNP	01295	2N3906	
Q2332	151-0188-00	2N3906		TRANSISTOR:SILICON,PNP	01295	2N3906	
Q2334	151-0347-00	2N5551		TRANSISTOR:SILICON,NPN	80009	151-0347-00	
Q2344	151-0347-00	2N3904		TRANSISTOR:SILICON,NPN	80009	151-0347-00	
Q2354	151-0190-06	2N5769		TRANSISTOR:SILICON,NPN	80009	151-0190-06	
Q2412 ¹	151-0223-03	2N5769		TRANSISTOR:SILICON,NPN	80009	151-0223-03	
Q2422 ¹	151-0190-06	2N3904		TRANSISTOR:SILICON,NPN	80009	151-0190-06	
Q2432 ¹	151-0190-06	2N3904		TRANSISTOR:SILICON,NPN	80009	151-0190-06	
Q4122A,B	151-1090-01	NTE461		TRANSISTOR:SILICON,DUAL,N CHANNEL,FET	80009	151-1090-01	
Q4174	151-0199-00	2N3640		TRANSISTOR:SILICON,PNP	27014	ST65038	
Q4176	151-0199-00	2N3640		TRANSISTOR:SILICON,PNP	27014	ST65038	
Q4222A,B ⁴	151-1090-01	FET,N Channel,Dual NTE461		TRANSISTOR:SILICON,DUAL,N CHANNEL,FET	80009	151-1090-01	
Q4274 ⁴	151-0199-00	2N3640		TRANSISTOR:SILICON,PNP	27014	ST65038	
Q4276 ⁴	151-0199-00		TRANSISTOR:SILICON,PNP	27014	ST65038		
Q4302	151-0199-00		TRANSISTOR:SILICON,PNP	27014	ST65038		
Q4303	151-0199-00		TRANSISTOR:SILICON,PNP	27014	ST65038		
Q4312 ⁴	151-0199-00		TRANSISTOR:SILICON,PNP	27014	ST65038		
Q4313 ⁴	151-0199-00	2N4261		TRANSISTOR:SILICON,PNP	27014	ST65038	
Q4322 ²	151-0199-00		B010100	B010209	TRANSISTOR:SILICON,PNP	27014	ST65038
Q4322 ²	151-0434-01		B010210	TEK SPEC.	TRANSISTOR:SILICON,PNP	80009	151-0434-01
Q4322 ³	151-0199-00		B010100	B010359	TRANSISTOR:SILICON,PNP	27014	ST65038
Q4322 ³	151-0434-01		B010360	TEK SPEC	TRANSISTOR:SILICON,PNP	80009	151-0434-01
Q4322 ¹	151-0434-01	2N4261	TEK SPEC	TRANSISTOR:SILICON,PNP	80009	151-0434-01	
Q4324 ²	151-0199-00	B010100	B010209	TRANSISTOR:SILICON,PNP	27014	ST65038	
Q4324 ²	151-0434-01	B010210	TEK SPEC	TRANSISTOR:SILICON,PNP	80009	151-0434-01	
Q4324 ³	151-0199-00	B010100	B010359	TRANSISTOR:SILICON,PNP	27014	ST65038	
Q4324 ³	151-0434-01	B010360	TEK SPEC	TRANSISTOR:SILICON,PNP	80009	151-0434-01	
Q4324 ¹	151-0434-01	2N4261	TEK SPEC	TRANSISTOR:SILICON,PNP	80009	151-0434-01	
Q4336	151-0199-00	2N3640		TRANSISTOR:SILICON,PNP	27014	ST65038	
Q4346	151-0199-00	2N3640		TRANSISTOR:SILICON,PNP	27014	ST65038	

¹T922R only
²T921 only
³T922 only
⁴T922 and T922R only

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q4372 ¹	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
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	MFF1816G200ROF
R112	321-0085-00			RES.,FXD,FILM:75 OHM,1%,0.125W	91637	MFF1816G75R00F
R114	311-1563-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	73138	91A R1K
R115	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R116	321-0163-00			RES.,FXD,FILM:487 OHM,1%,0.125W	91637	MFF1816G487ROF
R117	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R118A-P	307-0494-00			RES.,FXD,FILM:NETWORK,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	91A-10001M
R158 ²	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R159 ²	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R160 ²	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R162 ²	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R163 ²	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R165 ²	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R166 ²	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R167 ²	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R168 ²	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R169 ²	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
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 ³	315-0510-00	B010100	B011069	RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R435 ³	315-0360-00	B011070		RES.,FXD,CMPSN:36 OHM,5%,0.25W	01121	CB3605
R435 ⁴	315-0510-00	B010100	B015779	RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R435 ⁴	315-0360-00	B015780		RES.,FXD,CMPSN:36 OHM,5%,0.25W	01121	CB3605
R435 ²	315-0510-00	B010100	B010739	RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R435 ²	315-0360-00	B010740		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	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R446	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R447	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
R453	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025

¹T922 and T922R only
²T922R only
³T921 only
⁴T922 only

Replaceable Electrical Parts—T921/T922/T922R

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
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	301-0510-00			RES., FXD, CMPSN: 51 OHM, 5%, 0.50W	01121	EB5105
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	315-0303-00			RES., FXD, CMPSN: 30K OHM, 5%, 0.25W	01121	CB3035
R468	311-1784-00			RES., VAR, NONWIR: 5M OHM, 20%, 1W	12697	381-CM40944
R472 ¹	311-0086-00			RES., VAR, NONWIR: 2.5K OHM, 20%, 0.50W	01121	W-7699
R472	311-1562-00			RES., VAR, NONWIR: 2K OHM, 20%, 0.50W	73138	91A R2K
R473	311-1555-00			RES., VAR, NONWIR: 100K OHM, 20%, 0.5W	73138	91A R100K
R474	311-1562-00			RES., VAR, NONWIR: 2K OHM, 20%, 0.50W	73138	91A R2K
R475	315-0154-00			RES., FXD, CMPSN: 150K OHM, 5%, 0.25W	01121	CB1545
R476 ¹	315-0333-00			RES., FXD, CMPSN: 33K OHM, 5%, 0.25W	01121	CB3335
R477 ¹	311-1200-00			RES., VAR, NONWIR: 100K OHM, 20%, 0.50W	01121	W-7861
R477	311-1555-00			RES., VAR, NONWIR: 100K OHM, 20%, 0.5W	73138	91A R100K
R478	315-0471-00			RES., FXD, CMPSN: 470 OHM, 5%, 0.25W	01121	CB4715
R722	301-0473-00			RES., FXD, CMPSN: 47K OHM, 5%, 0.50W	01121	EB4735
R726	315-0104-00			RES., FXD, CMPSN: 100K OHM, 5%, 0.25W	01121	CB1045
R732	321-0193-00			RES., FXD, FILM: 1K OHM, 1%, 0.125W	91637	MFF1816G10000F
R733	321-0368-00			RES., FXD, FILM: 66.5K OHM, 1%, 0.125W	91637	MFF1816G66501F
R734	308-0574-00			RES., FXD, WW: 10 OHM, 5%, 2W	91637	RS2B162K10R00J
R736	321-0385-00			RES., FXD, FILM: 100K OHM, 1%, 0.125W	91637	MFF1816G10002F
R737	321-0280-00			RES., FXD, FILM: 8.06K OHM, 1%, 0.125W	91637	MFF1816G80600F
R741	315-0391-00			RES., FXD, CMPSN: 390 OHM, 5%, 0.25W	01121	CB3915
R742	315-0563-00			RES., FXD, CMPSN: 56K OHM, 5%, 0.25W	01121	CB5635
R745	315-0432-00			RES., FXD, CMPSN: 4.3K OHM, 5%, 0.25W	01121	CB4325
R746	315-0102-00			RES., FXD, CMPSN: 1K OHM, 5%, 0.25W	01121	CB1025
R747	315-0104-00			RES., FXD, CMPSN: 100K OHM, 5%, 0.25W	01121	CB1045
R752	321-0130-00			RES., FXD, FILM: 221 OHM, 1%, 0.125W	91637	MFF1816G221ROF
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	91637	MFF1816D85100D
R757	321-0671-00			RES., FXD, FILM: 8.51K OHM, 0.5%, 0.125W	91637	MFF1816D85100D
R762	315-0561-00			RES., FXD, CMPSN: 560 OHM, 5%, 0.25W	01121	CB5615
R763	315-0182-00			RES., FXD, CMPSN: 1.8K OHM, 5%, 0.25W	01121	CB1825
R764	321-0239-00			RES., FXD, FILM: 3.01K OHM, 1%, 0.125W	91637	MFF1816G30100F
R765	321-0130-00			RES., FXD, FILM: 221 OHM, 1%, 0.125W	91637	MFF1816G221ROF
R766	301-0391-00			RES., FXD, CMPSN: 390 OHM, 5%, 0.50W	01121	EB3915
R772	321-0256-00			RES., FXD, FILM: 4.53K OHM, 1%, 0.125W	91637	MFF1816G45300F
R773	311-1563-00			RES., VAR, NONWIR: 1K OHM, 20%, 0.50W	73138	91A R1K
R774	321-0232-00			RES., FXD, FILM: 2.55K OHM, 1%, 0.125W	91637	MFF1816G25500F
R775	308-0755-00			RES., FXD, WW: 0.75 OHM, 5%, 2W	75042	BWH-R7500J
R784	308-0781-00			RES., FXD, WW: 1.34K OHM, 2%, 10W	91637	HLW10R1Z-13400G
R792	321-0400-00			RES., FXD, FILM: 143K OHM, 1%, 0.125W	91637	MFF1816G14302F
R792	321-0402-00			RES., FXD, FILM: 150K OHM, 1%, 0.125W	91637	MFF1816G15002F
R793	321-0283-00			RES., FXD, FILM: 8.66K OHM, 1%, 0.125W	91637	MFF1816G86600F
R794 ¹	321-0393-00			RES., FXD, FILM: 121K OHM, 1%, 0.125W	91637	MFF1816G12102F
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
R796	315-0104-00			RES., FXD, CMPSN: 100K OHM, 5%, 0.25W	01121	CB1045
R797	315-0205-00			RES., FXD, CMPSN: 2M OHM, 5%, 0.25W	01121	CB2055
R812 ¹	311-0881-00			RES., VAR, NONWIR: 20K OHM, 10%, 0.50W	01121	W7674

¹T922R only

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R813 ¹	321-0407-00			RES.,FXD,FILM:169K OHM,1%,0.125W	91637	MFF1816G16902F
R814 ¹	321-0372-00			RES.,FXD,FILM:73.2K OHM,1%,0.125W	91637	MFF1816G73201F
R815 ¹	321-0403-00			RES.,FXD,FILM:154K OHM,1%,0.125W	91637	MFF1816G15402F
R817 ¹	315-0470-00	B010100	B010385	RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R817 ¹	308-0298-00	B010386		RES.,FXD,WW:560 OHM,5%,3W	91637	CW2B-B560ROJ
R818	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R1998 ¹	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R2101 ²	321-0463-00	XB010130		RES.,FXD,FILM:649K OHM,1%,0.125W	91637	MFF1816G64902F
R2101 ³	321-0463-00	XB010170		RES.,FXD,FILM:649K OHM,1%,0.125W	91637	MFF1816G64902F
R2101 ¹	321-0463-00			RES.,FXD,FILM:649K OHM,1%,0.125W	91637	MFF1816G64902F
R2102	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R2103 ²	321-0439-00	XB010130		RES.,FXD,FILM:365K OHM,1%,0.125W	91637	MFF1816G36502F
R2103 ³	321-0439-00	XB010170		RES.,FXD,FILM:365K OHM,1%,0.125W	91637	MFF1816G36502F
R2103 ¹	321-0439-00			RES.,FXD,FILM:365K OHM,1%,0.125W	91637	MFF1816G36502F
R2104 ²	315-0510-00	XB010130		RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R2104 ³	315-0510-00	XB010170		RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R2104 ¹	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R2106 ²	315-0510-00	XB010130		RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R2106 ³	315-0510-00	XB010170		RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R2106 ¹	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R2107 ²	315-0102-00	XB010130	B010149	RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2107 ²	315-0202-00	B010150		RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R2107 ³	315-0102-00	XB010170	B010799	RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2107 ³	315-0202-00	BC10800		RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R2107 ¹	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R2108 ²	315-0272-00	XB010130		RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R2108 ³	315-0272-00	XB010170		RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R2108 ¹	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R2109 ²	315-0201-00	XB010130		RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R2109 ³	315-0201-00	XB010170		RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R2109 ¹	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R2110 ²	321-0251-00	B010100	B010129X	RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R2110 ³	321-0251-00	B010100	B010169X	RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R2111 ²	315-0162-00	B010100	B010129	RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	01121	CB1625
R2111 ²	315-0103-00	B010130	B010149	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2111 ²	315-0203-00	B010150		RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R2111 ³	315-0162-00	B010100	B010169	RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	01121	CB1625
R2111 ³	315-0103-00	B010170	B010799	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2111 ³	315-0203-00	B010800		RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R2111 ¹	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R2112 ²	321-0463-00	B010100	B010129	RES.,FXD,FILM:649K OHM,1%,0.125W	91637	MFF1816G64902F
R2112 ²	315-0622-00	B010130		RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
R2112 ³	321-0463-00	B010100	B010169	RES.,FXD,FILM:649K OHM,1%,0.125W	91637	MFF1816G64902F
R2112 ³	315-0622-00	B010170		RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
R2112 ¹	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
R2113 ²	315-0510-00	B010100	B010129	RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R2113 ²	315-0122-00	B010130		RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R2113 ³	315-0510-00	B010100	B010169	RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R2113 ³	315-0122-00	B010170		RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R2113 ¹	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R2114 ²	321-0439-00	B010100	B010129	RES.,FXD,FILM:365K OHM,1%,0.125W	91637	MFF1816G36502F
R2114 ²	321-0251-00	B010130		RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R2114 ³	321-0439-00	B010100	B010169	RES.,FXD,FILM:365K OHM,1%,0.125W	91637	MFF1816G36502F

¹T922R only
²T921 only
³T922 only

Replaceable Electrical Parts—T921/T922/T922R

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R2114 ¹	321-0251-00	B010170		RES., FXD, FILM: 4.02K OHM, 1%, 0.125W	91637	MFF1816G40200F
R2114 ²	321-0251-00			RES., FXD, FILM: 4.02K OHM, 1%, 0.125W	91637	MFF1816G40200F
R2115 ³	321-0218-00	B010100	B010129	RES., FXD, FILM: 1.82K OHM, 1%, 0.125W	91637	MFF1816G18200F
R2115 ³	321-0214-00	B010130		RES., FXD, FILM: 1.65K OHM, 1%, 0.125W	91637	MFF1816G16500F
R2115 ¹	321-0218-00	B010100	B010169	RES., FXD, FILM: 1.82K OHM, 1%, 0.125W	91637	MFF1816G18200F
R2115 ¹	321-0214-00	B010170		RES., FXD, FILM: 1.65K OHM, 1%, 0.125W	91637	MFF1816G16500F
R2115 ²	321-0214-00			RES., FXD, FILM: 1.65K OHM, 1%, 0.125W	91637	MFF1816G16500F
R2116 ³	315-0510-00	B010100	B010129X	RES., FXD, CMPSN: 51 OHM, 5%, 0.25W	01121	CB5105
R2116 ¹	315-0510-00	B010100	B010169X	RES., FXD, CMPSN: 51 OHM, 5%, 0.25W	01121	CB5105
R2117 ³	315-0562-00	B010100	B010129X	RES., FXD, CMPSN: 5.6K OHM, 5%, 0.25W	01121	CB5625
R2117 ¹	315-0562-00	B010100	B010169X	RES., FXD, CMPSN: 5.6K OHM, 5%, 0.25W	01121	CB5625
R2118	321-0251-00			RES., FXD, FILM: 4.02K OHM, 1%, 0.125W	91637	MFF1816G40200F
R2119 ³	315-0431-00	B010100	B010129X	RES., FXD, CMPSN: 430 OHM, 5%, 0.25W	01121	CB4315
R2119 ¹	315-0431-00	B010100	B010169X	RES., FXD, CMPSN: 430 OHM, 5%, 0.25W	01121	CB4315
R2120 ³	315-0510-00	B010100	B010129X	RES., FXD, CMPSN: 51 OHM, 5%, 0.25W	01121	CB5105
R2120 ¹	315-0510-00	B010100	B010169X	RES., FXD, CMPSN: 51 OHM, 5%, 0.25W	01121	CB5105
R2121 ³	315-0101-00	XB010634		RES., FXD, CMPSN: 100 OHM, 5%, 0.25W	01121	CB1015
R2121 ¹	315-0101-00	XB014319		RES., FXD, CMPSN: 100 OHM, 5%, 0.25W	01121	CB1015
R2121 ²	315-0101-00			RES., FXD, CMPSN: 100 OHM, 5%, 0.25W	01121	CB1015
R2122	315-0132-00			RES., FXD, CMPSN: 1.3K OHM, 5%, 0.25W	01121	CB1325
R2123	315-0182-00			RES., FXD, CMPSN: 1.8K OHM, 5%, 0.25W	01121	CB1825
R2124	315-0242-00			RES., FXD, CMPSN: 2.4K OHM, 5%, 0.25W	01121	CB2425
R2125	315-0561-00			RES., FXD, CMPSN: 560 OHM, 5%, 0.25W	01121	CB5615
R2126	315-0102-00			RES., FXD, CMPSN: 1K OHM, 5%, 0.25W	01121	CB1025
R2127	315-0122-00			RES., FXD, CMPSN: 1.2K OHM, 5%, 0.25W	01121	CB1225
R2128	315-0122-00			RES., FXD, CMPSN: 1.2K OHM, 5%, 0.25W	01121	CB1225
R2132	315-0222-00			RES., FXD, CMPSN: 2.2K OHM, 5%, 0.25W	01121	CB2225
R2133	303-0393-00			RES., FXD, COMP: 39K OHM, 5%, 1W	01121	GB3935
R2134	315-0512-00			RES., FXD, CMPSN: 5.1K OHM, 5%, 0.25W	01121	CB5125
R2135 ³	315-0393-00	B010100	B010129	RES., FXD, CMPSN: 39K OHM, 5%, 0.25W	01121	CB3935
R2135 ³	315-0303-00	B010130		RES., FXD, CMPSN: 30K OHM, 5%, 0.25W	01121	CB3035
R2135 ¹	315-0393-00	B010100	B010169	RES., FXD, CMPSN: 39K OHM, 5%, 0.25W	01121	CB3935
R2135 ¹	315-0303-00	B010170		RES., FXD, CMPSN: 30K OHM, 5%, 0.25W	01121	CB3035
R2135 ²	315-0303-00			RES., FXD, CMPSN: 30K OHM, 5%, 0.25W	01121	CB3035
R2136	315-0751-00			RES., FXD, CMPSN: 750 OHM, 5%, 0.25W	01121	CB7515
R2137	315-0101-00			RES., FXD, CMPSN: 100 OHM, 5%, 0.25W	01121	CB1015
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	321-0255-00			RES., FXD, FILM: 4.42K OHM, 1%, 0.125W	91637	MFF1816G44200F
R2147	315-0222-00			RES., FXD, CMPSN: 2.2K OHM, 5%, 0.25W	01121	CB2225
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 ³	315-0152-00	B010100	B010349	RES., FXD, CMPSN: 1.5K OHM, 5%, 0.25W	01121	CB1525
R2156 ³	315-0102-00	B010350		RES., FXD, CMPSN: 1K OHM, 5%, 0.25W	01121	CB1025
R2156 ¹	315-0152-00	B010100	B010998	RES., FXD, CMPSN: 1.5K OHM, 5%, 0.25W	01121	CB1525
R2156 ¹	315-0102-00	B010999		RES., FXD, CMPSN: 1K OHM, 5%, 0.25W	01121	CB1025
R2156 ²	315-0102-00			RES., FXD, CMPSN: 1K OHM, 5%, 0.25W	01121	CB1025
R2157 ³	315-0272-00	B010100	B010349	RES., FXD, CMPSN: 2.7K OHM, 5%, 0.25W	01121	CB2725
R2157 ³	315-0222-00	B010350		RES., FXD, CMPSN: 2.2K OHM, 5%, 0.25W	01121	CB2225

¹T922 only
²T922R only
³T921 only

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R2157 ¹	315-0272-00	B010100	B010998	RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R2157 ¹	315-0222-00	B010999		RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R2157 ²	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R2161	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
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
R2172	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R2173	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R2174	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R2175 ³	315-0512-00	B010100	B010524	RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R2175 ³	315-0222-00	B010525		RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R2175 ¹	315-0512-00	B010100	B012649	RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R2175 ¹	315-0222-00	B012650		RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R2175 ²	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R2176	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R2184	321-0236-00			RES.,FXD,FILM:2.8K OHM,1%,0.125W	91637	MFF1816G28000F
R2188	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R2223 ³	315-0152-00	B010100	B010349	RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R2223 ³	315-0911-00	B010350		RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R2223 ¹	315-0152-00	B010100	B010998	RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R2223 ¹	315-0911-00	B010999		RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R2223 ²	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R2224 ³	315-0272-00	B010100	B010349	RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R2224 ³	315-0242-00	B010350		RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R2224 ¹	315-0272-00	B010100	B010998	RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R2224 ¹	315-0242-00	B010999		RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R2224 ²	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 ³	315-0132-00	B010100	B010349	RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	01121	CB1325
R2227 ³	315-0102-00	B010350		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2227 ¹	315-0132-00	B010100	B010998	RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	01121	CB1325
R2227 ¹	315-0102-00	B010999		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2227 ²	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
R2244	321-0271-00			RES.,FXD,FILM:6.49K OHM,1%,0.125W	91637	MFF1816G64900F
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 ³	321-0377-00	B010100	B010399	RES.,FXD,FILM:82.5K OHM,1%,0.125W	91637	MFF1816G82501F
R2254 ³	321-0377-01	B010400		RES.,FXD,FILM:82.5K OHM,0.5%,0.125W	91637	MFF1816G82501D
R2254 ¹	321-0377-00	B010100	B011699	RES.,FXD,FILM:82.5K OHM,1%,0.125W	91637	MFF1816G82501F
R2254 ¹	321-0377-01	B011700		RES.,FXD,FILM:82.5K OHM,0.5%,0.125W	91637	MFF1816G82501D
R2254 ²	321-0377-01			RES.,FXD,FILM:82.5K OHM,0.5%,0.125W	91637	MFF1816G82501D
R2255 ³	321-0377-00	B010100	B010399	RES.,FXD,FILM:82.5K OHM,1%,0.125W	91637	MFF1816G82501F

¹T922 only
²T922R only
³T921 only

Replaceable Electrical Parts—T921/T922/T922R

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R2255 ¹	321-0377-01	B010400		RES., FXD, FILM:82.5K OHM, 0.5%, 0.125W	91637	MFF1816G82501D
R2255 ²	321-0377-00	B010100	B011699	RES., FXD, FILM:82.5K OHM, 1%, 0.125W	91637	MFF1816G82501F
R2255 ²	321-0377-01	B011700		RES., FXD, FILM:82.5K OHM, 0.5%, 0.125W	91637	MFF1816G82501D
R2255 ³	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 ¹	321-0281-00	B010100	B010399	RES., FXD, FILM:8.25K OHM, 1%, 0.125W	91637	MFF1816G82500F
R2257 ¹	321-0281-01	B010400		RES., FXD, FILM:8.25K OHM, 0.5%, 0.125W	91637	MFF1816G82500D
R2257 ²	321-0281-00	B010100	B011699	RES., FXD, FILM:8.25K OHM, 1%, 0.125W	91637	MFF1816G82500F
R2257 ²	321-0281-01	B011700		RES., FXD, FILM:8.25K OHM, 0.5%, 0.125W	91637	MFF1816G82500D
R2257 ³	321-0281-01			RES., FXD, FILM:8.25K OHM, 0.5%, 0.125W	91637	MFF1816G82500D
R2258 ¹	321-0281-00	B010100	B010399	RES., FXD, FILM:8.25K OHM, 1%, 0.125W	91637	MFF1816G82500F
R2258 ¹	321-0281-01	B010400		RES., FXD, FILM:8.25K OHM, 0.5%, 0.125W	91637	MFF1816G82500D
R2258 ²	321-0281-00	B010100	B011699	RES., FXD, FILM:8.25K OHM, 1%, 0.125W	91637	MFF1816G82500F
R2258 ²	321-0281-01	B011700		RES., FXD, FILM:8.25K OHM, 0.5%, 0.125W	91637	MFF1816G82500D
R2258 ³	321-0281-01			RES., FXD, FILM:8.25K OHM, 0.5%, 0.125W	91637	MFF1816G82500D
R2259	315-0622-00			RES., FXD, CMPSN:6.2K OHM, 5%, 0.25W	01121	CB6225
R2262	322-0519-01			RES., FXD, FILM:2.49M OHM, 0.5%, 0.25W	91637	HFF143G24903D
R2263 ¹	321-0473-00	B010100	B010399	RES., FXD, FILM:825K OHM, 1%, 0.125W	91637	MFF1816G82502F
R2263 ¹	321-0473-01	B010400		RES., FXD, FILM:825K OHM, 0.5%, 0.125W	91637	MFF1816G82502D
R2263 ²	321-0473-00	B010100	B011699	RES., FXD, FILM:825K OHM, 1%, 0.125W	91637	MFF1816G82502F
R2263 ²	321-0473-01	B011700		RES., FXD, FILM:825K OHM, 0.5%, 0.125W	91637	MFF1816G82502D
R2263 ³	321-0473-01			RES., FXD, FILM:825K OHM, 0.5%, 0.125W	91637	MFF1816G82502D
R2264 ¹	321-0473-00	B010100	B010399	RES., FXD, FILM:825K OHM, 1%, 0.125W	91637	MFF1816G82502F
R2264 ¹	321-0473-01	B010400		RES., FXD, FILM:825K OHM, 0.5%, 0.125W	91637	MFF1816G82502D
R2264 ²	321-0473-00	B010100	B011699	RES., FXD, FILM:825K OHM, 1%, 0.125W	91637	MFF1816G82502F
R2264 ²	321-0473-01	B011700		RES., FXD, FILM:825K OHM, 0.5%, 0.125W	91637	MFF1816G82502D
R2264 ³	321-0473-01			RES., FXD, FILM:825K OHM, 0.5%, 0.125W	91637	MFF1816G82502D
R2273	315-0103-00			RES., FXD, CMPSN:10K OHM, 5%, 0.25W	01121	CB1035
R2275	315-0473-00			RES., FXD, CMPSN:47K OHM, 5%, 0.25W	01121	CB4735
R2276	315-0512-00			RES., FXD, CMPSN:5.1K OHM, 5%, 0.25W	01121	CB5125
R2312 ¹	321-0299-00	B010100	B010129	RES., FXD, FILM:12.7K OHM, 1%, 0.125W	91637	MFF1816G12701F
R2312 ¹	321-0298-00	B010130	B010633	RES., FXD, FILM:12.4K OHM, 1%, 0.125W	91637	MFF1816G12401F
R2312 ¹	321-0297-00	B010634		RES., FXD, FILM:12.1K OHM, 1%, 0.125W	91637	MFF1816G12101F
R2312 ²	321-0299-00	B010100	B010169	RES., FXD, FILM:12.7K OHM, 1%, 0.125W	91637	MFF1816G12701F
R2312 ²	321-0298-00	B010170	B014318	RES., FXD, FILM:12.4K OHM, 1%, 0.125W	91637	MFF1816G12401F
R2312 ²	321-0297-00	B014319		RES., FXD, FILM:12.1K OHM, 1%, 0.125W	91637	MFF1816G12101F
R2312 ³	321-0297-00			RES., FXD, FILM:12.1K OHM, 1%, 0.125W	91637	MFF1816G12101F
R2313	321-0279-00			RES., FXD, FILM:7.87K OHM, 1%, 0.125W	91637	MFF1816G78700F
R2315	315-0752-00			RES., FXD, CMPSN:7.5K OHM, 5%, 0.25W	01121	CB7525
R2316	311-1788-00			RES., VAR, NONWIR:20K OHM, 20%, 2W	12697	470-CM40948
R2317	315-0751-00			RES., FXD, CMPSN:750 OHM, 5%, 0.25W	01121	CB7515
R2322	311-1789-00			RES., VAR, NONWIR:100K OHM, 10%, 1W	12697	381-CM40949
R2323	321-0197-00			RES., FXD, FILM:1.1K OHM, 1%, 0.125W	91637	MFF1816G11000F
R2324	315-0162-00			RES., FXD, CMPSN:1.6K OHM, 5%, 0.25W	01121	CB1625
R2325	315-0392-00			RES., FXD, CMPSN:3.9K OHM, 5%, 0.25W	01121	CB3925
R2326	315-0332-00			RES., FXD, CMPSN:3.3K OHM, 5%, 0.25W	01121	CB3325
R2327	315-0331-00			RES., FXD, CMPSN:330 OHM, 5%, 0.25W	01121	CB3315
R2331 ¹	315-0912-00	XB010150		RES., FXD, CMPSN:9.1K OHM, 5%, 0.25W	01121	CB9125
R2331 ²	315-0912-00	XB010600		RES., FXD, CMPSN:9.1K OHM, 5%, 0.25W	01121	CB9125
R2331 ³	315-0912-00			RES., FXD, CMPSN:9.1K OHM, 5%, 0.25W	01121	CB9125
R2332 ¹	311-1814-00	B010100	B010249	RES., VAR, NONWIR:2K OHM, 20%, 0.50W	73138	91XR2K
R2332 ¹	311-1239-00	B010250		RES., VAR, NONWIR:2.5K OHM, 10%, 0.50W	73138	72X-76-0252K
R2332 ²	311-1814-00	B010100	B010899	RES., VAR, NONWIR:2K OHM, 20%, 0.50W	73138	91XR2K

¹T921 only
²T922 only
³T922R only

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R2332 ¹	311-1239-00	B010900		RES.,VAR, NONWIR:2.5K OHM,10%,0.50W	73138	72X-76-0252K
R2332 ²	311-1239-00			RES.,VAR, NONWIR:2.5K OHM,10%,0.50W	73138	72X-76-0252K
R2333	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
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	308-0334-00			RES.,FXD,WW:7K OHM,1%,3W	91637	RS2B-B70000H
R2342	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R2344	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R2345	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R2347	308-0334-00			RES.,FXD,WW:7K OHM,1%,3W	91637	RS2B-B70000H
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
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 ³	301-0240-00	B010100	B010149	RES.,FXD,CMPSN:24 OHM,5%,0.50W	01121	EB2405
R2392 ³	301-0270-00	B010150		RES.,FXD,CMPSN:27 OHM,5%,0.50W	01121	EB2705
R2392 ¹	301-0240-00	B010100	B010499	RES.,FXD,CMPSN:24 OHM,5%,0.50W	01121	EB2405
R2392 ¹	301-0270-00	B010500		RES.,FXD,CMPSN:27 OHM,5%,0.50W	01121	EB2705
R2392 ²	301-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.50W	01121	EB2705
R2401 ²	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R2402 ²	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R2404 ²	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R2405 ²	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2412 ²	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R2413 ²	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R2414 ²	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R2415 ²	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R2417 ²	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R2421 ²	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R2422 ²	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R2423 ²	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R2424 ²	307-0106-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
R2426 ²	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R2427 ²	315-0430-00			RES.,FXD,CMPSN:43 OHM,5%,0.25W	01121	CB4305
R2428 ²	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R2431 ²	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R2432 ²	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R2433 ²	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
R2434 ²	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R2437 ²	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R4099 ²	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
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	HFF110F90002D
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

1T922 only
2T922R only
3T921 only

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R4118	315-0151-00			RES., FXD, CMPSN:150 OHM, 5%, 0.25W	01121	CB1515
R4122	321-0481-00			RES., FXD, FILM:1M OHM, 1%, 0.125W	91637	MFF1816G10003F
R4123	315-0474-00			RES., FXD, CMPSN:470K OHM, 5%, 0.25W	01121	CB4745
R4126	321-0030-00			RES., FXD, FILM:20 OHM, 1%, 0.125W	91637	MFF1816G20R00F
R4127	321-0030-00			RES., FXD, FILM:20 OHM, 1%, 0.125W	91637	MFF1816G20R00F
R4128 ¹	315-0823-00	XB010340		RES., FXD, CMPSN:82K OHM, 5%, 0.25W	01121	CB8235
R4128 ²	315-0823-00	XB011100		RES., FXD, CMPSN:82K OHM, 5%, 0.25W	01121	CB8235
R4128 ³	315-0823-00			RES., FXD, CMPSN:82K OHM, 5%, 0.25W	01121	CB8235
R4129 ¹	315-0122-00	XB010340		RES., FXD, CMPSN:1.2K OHM, 5%, 0.25W	01121	CB1225
R4129 ²	315-0122-00	XB011100		RES., FXD, CMPSN:1.2K OHM, 5%, 0.25W	01121	CB1225
R4129 ³	315-0122-00			RES., FXD, CMPSN:1.2K OHM, 5%, 0.25W	01121	CB1225
R4132	311-1557-00			RES., VAR, NONWIR:25K OHM, 20%, 0.50W	73138	91A R25K
R4133	315-0153-00			RES., FXD, CMPSN:15K OHM, 5%, 0.25W	01121	CB1535
R4134	315-0151-00			RES., FXD, CMPSN:150 OHM, 5%, 0.25W	01121	CB1515
R4136	315-0152-00			RES., FXD, CMPSN:1.5K OHM, 5%, 0.25W	01121	CB1525
R4137	315-0152-00			RES., FXD, CMPSN:1.5K OHM, 5%, 0.25W	01121	CB1525
R4138	321-0077-00			RES., FXD, FILM:61.9 OHM, 1%, 0.125W	91637	MFF1816G61R90F
R4143	321-0062-00			RES., FXD, FILM:43.2 OHM, 1%, 0.125W	91637	MFF1816G43R20F
R4144	321-0114-00			RES., FXD, FILM:150 OHM, 1%, 0.125W	91637	MFF1816G150R0F
R4145	321-0771-01			RES., FXD, FILM:50 OHM, 0.5%, 0.125W	91637	MFF1816G50R00D
R4146	321-0771-01			RES., FXD, FILM:50 OHM, 0.5%, 0.125W	91637	MFF1816G50R00D
R4147	321-0030-00			RES., FXD, FILM:20 OHM, 1%, 0.125W	91637	MFF1816G20R00F
R4151	311-1563-00			RES., VAR, NONWIR:1K OHM, 20%, 0.50W	73138	91A R1K
R4152	311-1785-00			RES., VAR, NONWIR:1K OHM, 5%, 2W	12697	381-CM40945
R4154	321-0225-00			RES., FXD, FILM:2.15K OHM, 1%, 0.125W	91637	MFF1816G21500F
R4155	315-0152-00			RES., FXD, CMPSN:1.5K OHM, 5%, 0.25W	01121	CB1525
R4156	321-0172-00			RES., FXD, FILM:604 OHM, 1%, 0.125W	91637	MFF1816G604R0F
R4158	315-0113-00			RES., FXD, CMPSN:11K OHM, 5%, 0.25W	01121	CB1135
R4161	321-0154-00			RES., FXD, FILM:392 OHM, 1%, 0.125W	91637	MFF1816G392R0F
R4162	321-0070-00			RES., FXD, FILM:52.3 OHM, 1%, 0.125W	91637	MFF1816G52R30F
R4163	321-0072-00			RES., FXD, FILM:54.9 OHM, 1%, 0.125W	91637	MFF1816G54R90F
R4164	321-0225-00			RES., FXD, FILM:2.15K OHM, 1%, 0.125W	91637	MFF1816G21500F
R4165	315-0152-00			RES., FXD, CMPSN:1.5K OHM, 5%, 0.25W	01121	CB1525
R4166	321-0172-00			RES., FXD, FILM:604 OHM, 1%, 0.125W	91637	MFF1816G604R0F
R4168	315-0912-00			RES., FXD, CMPSN:9.1K OHM, 5%, 0.25W	01121	CB9125
R4173	321-0039-00			RES., FXD, FILM:24.9 OHM, 1%, 0.125W	91637	MFF1816G24R90F
R4174	315-0392-00			RES., FXD, CMPSN:3.9K OHM, 5%, 0.25W	01121	CB3925
R4175	315-0392-00			RES., FXD, CMPSN:3.9K OHM, 5%, 0.25W	01121	CB3925
R4199 ³	315-0470-00			RES., FXD, CMPSN:47 OHM, 5%, 0.25W	01121	CB4705
R4202 ⁴	315-0105-00			RES., FXD, CMPSN:1M OHM, 5%, 0.25W	01121	CB1055
R4204 ⁴	315-0241-00			RES., FXD, CMPSN:240 OHM, 5%, 0.25W	01121	CB2415
R4205 ⁴	321-0790-01			RES., FXD, FILM:990K OHM, 0.5%, 0.125W	91637	HFF1104G99002D
R4206 ⁴	315-0180-00			RES., FXD, CMPSN:18 OHM, 5%, 0.25W	01121	CB1805
R4207 ⁴	321-1289-01			RES., FXD, FILM:10.1K OHM, 0.5%, 0.125W	91637	MFF1816G10101D
R4208 ⁴	315-0330-00			RES., FXD, CMPSN:33 OHM, 5%, 0.25W	01121	CB3305
R4214 ⁴	321-0807-01			RES., FXD, FILM:900K OHM, 0.5%, 0.125W	91637	HFF110F90002D
R4216 ⁴	321-1389-01			RES., FXD, FILM:111K OHM, 0.5%, 0.125W	91637	MFF1816G11102D
R4217 ⁴	315-0100-00			RES., FXD, CMPSN:10 OHM, 5%, 0.25W	01121	CB1005
R4218 ⁴	315-0151-00			RES., FXD, CMPSN:150 OHM, 5%, 0.25W	01121	CB1515
R4222 ⁴	321-0481-00			RES., FXD, FILM:1M OHM, 1%, 0.125W	91637	MFF1816G10003F
R4223 ⁴	315-0474-00			RES., FXD, CMPSN:470K OHM, 5%, 0.25W	01121	CB4745
R4226 ⁴	321-0030-00			RES., FXD, FILM:20 OHM, 1%, 0.125W	91637	MFF1816G20R00F
R4227 ⁴	321-0030-00			RES., FXD, FILM:20 OHM, 1%, 0.125W	91637	MFF1816G20R00F

¹T921 only
²T922 only
³T922R only
⁴T922 and T922R only

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R4228 ¹	315-0823-00	XB011100		RES., FXD, CMPSN:82K OHM, 5%, 0.25W	01121	CB8235
R4228 ²	315-0823-00			RES., FXD, CMPSN:82K OHM, 5%, 0.25W	01121	CB8235
R4229 ¹	315-0122-00	XB011100		RES., FXD, CMPSN:1.2K OHM, 5%, 0.25W	01121	CB1225
R4229 ²	315-0122-00			RES., FXD, CMPSN:1.2K OHM, 5%, 0.25W	01121	CB1225
R4232 ³	311-1557-00			RES., VAR, NONWIR:25K OHM, 20%, 0.50W	73138	91A R25K
R4233 ³	315-0153-00			RES., FXD, CMPSN:15K OHM, 5%, 0.25W	01121	CB1535
R4234 ³	315-0151-00			RES., FXD, CMPSN:150 OHM, 5%, 0.25W	01121	CB1515
R4236 ³	315-0152-00			RES., FXD, CMPSN:1.5K OHM, 5%, 0.25W	01121	CB1525
R4237 ³	315-0152-00			RES., FXD, CMPSN:1.5K OHM, 5%, 0.25W	01121	CB1525
R4238 ³	321-0077-00			RES., FXD, FILM:61.9 OHM, 1%, 0.125W	91637	MFF1816G61R90F
R4243 ³	321-0062-00			RES., FXD, FILM:43.2 OHM, 1%, 0.125W	91637	MFF1816G43R20F
R4244 ³	321-0114-00			RES., FXD, FILM:150 OHM, 1%, 0.125W	91637	MFF1816G150R0F
R4245 ³	321-0771-01			RES., FXD, FILM:50 OHM, 0.5%, 0.125W	91637	MFF1816G50R00F
R4246 ³	321-0771-01			RES., FXD, FILM:50 OHM, 0.5%, 0.125W	91637	MFF1816G50R00F
R4247 ³	321-0030-00			RES., FXD, FILM:20 OHM, 1%, 0.125W	91637	MFF1816G20R00F
R4251 ³	311-1563-00			RES., VAR, NONWIR:1K OHM, 20%, 0.50W	73138	91A R1K
R4252 ³	311-1785-00			RES., VAR, NONWIR:1K OHM, 5%, 2W	12697	381-CM40945
R4254 ³	321-0225-00			RES., FXD, FILM:2.15K OHM, 1%, 0.125W	91637	MFF1816G21500F
R4255 ³	315-0152-00			RES., FXD, CMPSN:1.5K OHM, 5%, 0.25W	01121	CB1525
R4256 ³	321-0172-00			RES., FXD, FILM:604 OHM, 1%, 0.125W	91637	MFF1816G604R0F
R4258 ³	315-0113-00			RES., FXD, CMPSN:11K OHM, 5%, 0.25W	01121	CB1135
R4261 ³	321-0154-00			RES., FXD, FILM:392 OHM, 1%, 0.125W	91637	MFF1816G392R0F
R4262 ³	321-0070-00			RES., FXD, FILM:52.3 OHM, 1%, 0.125W	91637	MFF1816G52R30F
R4263 ³	321-0072-00			RES., FXD, FILM:54.9 OHM, 1%, 0.125W	91637	MFF1816G54R90F
R4264 ³	321-0225-00			RES., FXD, FILM:2.15K OHM, 1%, 0.125W	91637	MFF1816G21500F
R4265 ³	315-0152-00			RES., FXD, CMPSN:1.5K OHM, 5%, 0.25W	01121	CB1525
R4266 ³	321-0172-00			RES., FXD, FILM:604 OHM, 1%, 0.125W	91637	MFF1816G604R0F
R4268 ³	315-0912-00			RES., FXD, CMPSN:9.1K OHM, 5%, 0.25W	01121	CB9125
R4273 ³	321-0039-00			RES., FXD, FILM:24.9 OHM, 1%, 0.125W	91637	MFF1816G24R90F
R4274 ³	315-0392-00			RES., FXD, CMPSN:3.9K OHM, 5%, 0.25W	01121	CB3925
R4275 ³	315-0392-00			RES., FXD, CMPSN:3.9K OHM, 5%, 0.25W	01121	CB3925
R4302 ¹	315-0361-00	B010100	B010499	RES., FXD, CMPSN:360 OHM, 5%, 0.25W	01121	CB3615
R4302 ¹	321-0150-00	B010500		RES., FXD, FILM:357 OHM, 1%, 0.125W	91637	MFF1816G357R0F
R4302 ²	321-0150-00			RES., FXD, FILM:357 OHM, 1%, 0.125W	91637	MFF1816G357R0F
R4303 ¹	315-0431-00	B010100	B010499	RES., FXD, CMPSN:430 OHM, 5%, 0.25W	01121	CB4315
R4303 ¹	321-0158-00	B010500		RES., FXD, FILM:432 OHM, 1%, 0.125W	91637	MFF1816G432R0F
R4303 ²	321-0158-00			RES., FXD, FILM:432 OHM, 1%, 0.125W	91637	MFF1816G432R0F
R4306	311-1787-00			RES., VAR, NONWIR:20K OHM, 10%, 2W	12697	470-CM40947
R4307	315-0203-00			RES., FXD, CMPSN:20K OHM, 5%, 0.25W	01121	CB2035
R4316 ³	311-1787-00			RES., VAR, NONWIR:20K OHM, 10%, 2W	12697	470-CM40947
R4317 ³	315-0203-00			RES., FXD, CMPSN:20K OHM, 5%, 0.25W	01121	CB2035
R4322	321-0276-00			RES., FXD, FILM:7.32K OHM, 1%, 0.125W	91637	MFF1816G73200F
R4323	321-0276-00			RES., FXD, FILM:7.32K OHM, 1%, 0.125W	91637	MFF1816G73200F
R4324	321-0170-00			RES., FXD, FILM:576 OHM, 1%, 0.125W	91637	MFF1816G576R0F
R4325	321-0172-00			RES., FXD, FILM:604 OHM, 1%, 0.125W	91637	MFF1816G604R0F
R4326	321-0172-00			RES., FXD, FILM:604 OHM, 1%, 0.125W	91637	MFF1816G604R0F
R4327	321-0157-00			RES., FXD, FILM:422 OHM, 1%, 0.125W	91637	MFF1816G422R0F
R4328	321-0222-00			RES., FXD, FILM:2K OHM, 1%, 0.125W	91637	MFF1816G20000F
R4333	315-0473-00			RES., FXD, CMPSN:47K OHM, 5%, 0.25W	01121	CB4735
R4334	311-1557-00			RES., VAR, NONWIR:25K OHM, 20%, 0.50W	73138	91A R25K
R4336	321-0222-00			RES., FXD, FILM:2K OHM, 1%, 0.125W	91637	MFF1816G20000F
R4337	315-0750-00			RES., FXD, CMPSN:75 OHM, 5%, 0.25W	01121	CB7505
R4338	315-0102-00			RES., FXD, CMPSN:1K OHM, 5%, 0.25W	01121	CB1025

¹T922 only
²T922R only
³T922 and T922R only

Replaceable Electrical Parts—T921/T922/T922R

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R4342	321-0222-00			RES., FXD, FILM: 2K OHM, 1%, 0.125W	91637	MFF1816G20000F
R4344	311-1557-00			RES., VAR, NONWIR: 25K OHM, 20%, 0.50W	73138	91A R25K
R4346	321-0222-00			RES., FXD, FILM: 2K OHM, 1%, 0.125W	91637	MFF1816G20000F
R4347	315-0750-00			RES., FXD, CMPSN: 75 OHM, 5%, 0.25W	01121	CB7505
R4348	315-0102-00			RES., FXD, CMPSN: 1K OHM, 5%, 0.25W	01121	CB1025
R4349	315-0101-00			RES., FXD, CMPSN: 100 OHM, 5%, 0.25W	01121	CB1015
R4364 ¹	315-0472-00			RES., FXD, CMPSN: 4.7K OHM, 5%, 0.25W	01121	CB4725
R4365 ¹	315-0472-00			RES., FXD, CMPSN: 4.7K OHM, 5%, 0.25W	01121	CB4725
R4366 ²	315-0471-00	XB010500		RES., FXD, CMPSN: 470 OHM, 5%, 0.25W	01121	CB4715
R4366 ³	315-0471-00			RES., FXD, CMPSN: 470 OHM, 5%, 0.25W	01121	CB4715
R4367 ²	315-0621-00			RES., FXD, CMPSN: 620 OHM, 5%, 0.25W	01121	CB6215
R4368 ²	315-0101-00	B010100	B010499	RES., FXD, CMPSN: 100 OHM, 5%, 0.25W	01121	CB1015
R4368 ³	315-0241-00	B010500		RES., FXD, CMPSN: 240 OHM, 5%, 0.25W	01121	CB2415
R4368 ³	315-0241-00			RES., FXD, CMPSN: 240 OHM, 5%, 0.25W	01121	CB2415
R4369 ²	315-0101-00	B010100	B010499	RES., FXD, CMPSN: 100 OHM, 5%, 0.25W	01121	CB1015
R4369 ²	315-0241-00	B010500		RES., FXD, CMPSN: 240 OHM, 5%, 0.25W	01121	CB2415
R4369 ³	315-0241-00			RES., FXD, CMPSN: 240 OHM, 5%, 0.25W	01121	CB2415
R4370 ²	315-0471-00	XB010500		RES., FXD, CMPSN: 470 OHM, 5%, 0.25W	01121	CB4715
R4370 ³	315-0471-00			RES., FXD, CMPSN: 470 OHM, 5%, 0.25W	01121	CB4715
R4371 ¹	315-0102-00			RES., FXD, CMPSN: 1K OHM, 5%, 0.25W	01121	CB1025
R4372 ¹	315-0272-00			RES., FXD, CMPSN: 2.7K OHM, 5%, 0.25W	01121	CB2725
R4373 ¹	315-0103-00			RES., FXD, CMPSN: 10K OHM, 5%, 0.25W	01121	CB1035
R4374 ¹	315-0103-00			RES., FXD, CMPSN: 10K OHM, 5%, 0.25W	01121	CB1035
R4375 ²	315-0202-00	B010100	B010499	RES., FXD, CMPSN: 2K OHM, 5%, 0.25W	01121	CB2025
R4375 ²	315-0272-00	B010500		RES., FXD, CMPSN: 2.7K OHM, 5%, 0.25W	01121	CB2725
R4375 ³	315-0272-00			RES., FXD, CMPSN: 2.7K OHM, 5%, 0.25W	01121	CB2725
R4377 ²	315-0202-00	B010100	B010499	RES., FXD, CMPSN: 2K OHM, 5%, 0.25W	01121	CB2025
R4377 ³	315-0272-00	B010500		RES., FXD, CMPSN: 2.7K OHM, 5%, 0.25W	01121	CB2725
R4377 ³	315-0272-00			RES., FXD, CMPSN: 2.7K OHM, 5%, 0.25W	01121	CB2725
R4382 ¹	315-0472-00			RES., FXD, CMPSN: 4.7K OHM, 5%, 0.25W	01121	CB4725
R4384 ²	315-0102-00	XB010500		RES., FXD, CMPSN: 1K OHM, 5%, 0.25W	01121	CB1025
R4384 ³	315-0102-00			RES., FXD, CMPSN: 1K OHM, 5%, 0.25W	01121	CB1025
R4385 ²	315-0153-00	B010100	B010499	RES., FXD, CMPSN: 15K OHM, 5%, 0.25W	01121	CB1535
R4385 ²	315-0622-00	B010500		RES., FXD, CMPSN: 6.2K OHM, 5%, 0.25W	01121	CB6225
R4385 ³	315-0622-00			RES., FXD, CMPSN: 6.2K OHM, 5%, 0.25W	01121	CB6225
R4386 ¹	315-0301-00			RES., FXD, CMPSN: 300 OHM, 5%, 0.25W	01121	CB3015
R4392 ¹	315-0510-00			RES., FXD, CMPSN: 51 OHM, 5%, 0.25W	01121	CB5105
R4394	315-0470-00			RES., FXD, CMPSN: 47 OHM, 5%, 0.25W	01121	CB4705
R4395	315-0470-00			RES., FXD, CMPSN: 47 OHM, 5%, 0.25W	01121	CB4705
R4396	315-0470-00			RES., FXD, CMPSN: 47 OHM, 5%, 0.25W	01121	CB4705
R4397 ¹	315-0470-00			RES., FXD, CMPSN: 47 OHM, 5%, 0.25W	01121	CB4705
S100	260-1421-00			SWITCH, PUSH: 1 STA, MOMENTARY, NON-SHORT	80009	260-1421-00
S700	260-1768-00			SWITCH, PUSH: DPDT, 3A, 125VAC	82389	14S-7102C
S701	260-1776-00			SWITCH, SLIDE: DPDT, 3A, 125VAC	80009	260-1776-00
S705	260-1776-00			SWITCH, SLIDE: DPDT, 3A, 125VAC	80009	260-1776-00
S1998 ³	260-1363-00			SWITCH, PUSH: 6 PDT, PUSH-PUSH	80009	260-1363-00
S2100 ⁴	214-2288-01	B010100	B010129	LEVER SWITCH: STYLE A, 17.5 DEG W/CONTACTS	80009	214-2288-01
S2100 ⁴	214-2288-02	B010130		LEVER, SWITCH: STYLE A, 17.5 DEG, W/CONTACTS	80009	214-2288-02
S2100 ²	214-2288-01	B010100	B010169	LEVER SWITCH: STYLE A, 17.5 DEG W/CONTACTS	80009	214-2288-01
S2100 ²	214-2288-02	B010170		LEVER, SWITCH: STYLE A, 17.5 DEG, W/CONTACTS	80009	214-2288-02
S2100 ³	214-2288-02			LEVER, SWITCH: STYLE A, 17.5 DEG, W/CONTACTS	80009	214-2288-02
S2140	260-1445-01			SWITCH, PUSH: 1 BUTTON	80009	260-1445-01

¹T922 and T922R only²T922 only³T922R only⁴T921 only

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
S2150 ¹	214-2289-01	B010100	B010129	LEVER SWITCH:STYLE B,W/CONTACTS	80009	214-2289-01
S2150 ¹	214-2289-02	B010130		LEVER,SWITCH:STYLE B,W/CONTACTS	80009	214-2289-02
S2150 ²	214-2289-01	B010100	B010169	LEVER SWITCH:STYLE B,W/CONTACTS	80009	214-2289-01
S2150 ²	214-2289-02	B010170		LEVER,SWITCH:STYLE B,W/CONTACTS	80009	214-2289-02
S2150 ³	214-2289-02			LEVER,SWITCH:STYLE B,W/CONTACTS	80009	214-2289-02
S2250 ⁴						
S2400A,B ³	260-1465-00			SWITCH,PUSH:2 STA, NON-SHORT	80009	260-1465-00
S2408 ³	260-1208-00			SWITCH,PUSH:DPDT	80009	260-1208-00
S4099 ³	260-1363-00			SWITCH,PUSH:6 PDT,PUSH-PUSH	80009	260-1363-00
S4100 ¹	105-0678-00	B010100	B010549	DRUM,CAM SWITCH:W/LEVER	80009	105-0678-00
S4100 ¹	105-0678-01	B010550		DRUM,CAM SWITCH:AC-DC GND,CHANNEL 1	80009	105-0678-01
S4100 ²	105-0678-00	B010100	B013440	DRUM,CAM SWITCH:W/LEVER	80009	105-0678-00
S4100 ²	105-0678-01	B013441		DRUM,CAM SWITCH:AC-DC GND,CHANNEL 1	80009	105-0678-01
S4100 ³	105-0678-00	B010100	B010229	DRUM,CAM SWITCH:W/LEVER	80009	105-0678-00
S4100 ³	105-0678-01	B010230		DRUM,CAM SWITCH:AC-DC GND,CHANNEL 1	80009	105-0678-01
S4110	105-0679-00			DRUM,CAM SWITCH:	80009	105-0679-00
S4199 ³	260-1363-00			SWITCH,PUSH:6 PDT,PUSH-PUSH	80009	260-1363-00
S4200 ²	105-0678-00	B010100	B013440	DRUM,CAM SWITCH:W/LEVER	80009	105-0678-00
S4200 ²	105-0678-02	B013441		DRUM,CAM SWITCH:W/LEVER	80009	015-0678-02
S4200 ³	105-0678-00	B010100	B010229	DRUM,CAM SWITCH:W/LEVER	80009	105-0678-00
S4200 ³	105-0678-02	B010230		DRUM,CAM SWITCH:W/LEVER	80009	105-0678-02
S4210 ⁵	105-0679-00			DRUM,CAM SWITCH:	80009	105-0679-00
S4370 ⁵	260-1782-00			SWITCH,PUSH:3 BUTTON,DPDT,10MM	80009	260-1782-00
T460	120-0996-00			XFMR,PWR,STU:HIGH VOLTAGE	80009	120-0996-00
T700	120-0994-00			XFMR,PWR,STPDN:	80009	120-0994-00
U24	156-0067-10			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-10
U460	152-0637-02			SEMICONV DEVICE:SI,HV MULTR,6.6KV-10KV	80009	152-0637-02
U742A,B	156-0158-02			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	80009	156-0158-02
U2126A-E	156-0197-03			MICROCIRCUIT,LI:5-XSTR ARRAY	80009	156-0197-03
U2156A-D	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT AND GATE	80009	156-0030-00
U2212A-D	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT AND GATE	80009	156-0030-00
U2224A,B	156-0405-01			MICROCIRCUIT,DI:DUAL RETRIG ONE-SHOT	80009	156-0405-01
U2234A-D ²	156-0030-00	B010100	B010499	MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U2234A-D ²	156-0113-00	B010500	B010999	MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	80009	156-0113-00
U2234A-D ²	156-0030-00	B011000		MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U2234A-D ³	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U2234A-D ¹	156-0030-00	B010100	B010149	MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U2234A-D ¹	156-0113-00	B010150	B010299	MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	80009	156-0113-00
U2234A-D ¹	156-0030-00	B010300		MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U2402A,B ³	156-0041-03			MICROCIRCUIT,DI:DUAL D-TYPE,FLIP-FLOP	80009	156-0041-03
U4134A-D	156-0197-03			MICROCIRCUIT,LI:5-XSTR ARRAY	80009	156-0197-03
U4234A-D	156-0197-03			MICROCIRCUIT,LI:5-XSTR ARRAY	80009	156-0197-03
U4364A,B ⁵	156-0041-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	27014	DM7474N
U4376A-D ⁵	156-0030-01			MICROCIRCUIT,DI:QUAD 2-INPUT AND GATE	80009	156-0030-01
V470	154-0729-00			ELECTRON TUBE:P31,INT SCALE,	80009	154-0729-00
VR412	152-0280-00			SEMICONV DEVICE:ZENER,0.4W,6.2V,5%	80009	152-0280-00
VR746	152-0306-00			SEMICONV DEVICE:ZENER,0.4W,9.1V,5%	81483	1N960B
VR762	152-0195-00			SEMICONV DEVICE:ZENER,0.4W,5.1V,5%	80009	152-0195-00
VR784	152-0293-00			SEMICONV DEVICE:ZENER,1W,33V,5%	04713	1N3032B
VR818 ³	152-0241-00			SEMICONV DEVICE:ZENER,0.4W,33V,5%	04713	1N973B
VR2123 ¹	152-0279-00	B010100	B010149	SEMICONV DEVICE:ZENER,0.4W,5.1V,5%	80009	152-0279-00

¹T921 only
²T922 only
³T922R only
⁴Replaceable only under A13, 672-0524-00.
⁵T922 and T922R only

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
VR2123 ¹	152-0226-00	B010150		SEMICON D DEVICE: ZENER, 0.4W, 5.1V, 5%	81483	69-6584
VR2123 ²	152-0279-00	B010100	B010499	SEMICON D DEVICE: ZENER, 0.4W, 5.1V, 5%	80009	152-0279-00
VR2123 ²	152-0226-00	B010500		SEMICON D DEVICE: ZENER, 0.4W, 5.1V, 5%	81483	69-6584
VR2123 ³	152-0226-00			SEMICON D DEVICE: ZENER, 0.4W, 5.1V, 5%	81483	69-6584
VR2392	152-0279-00			SEMICON D DEVICE: ZENER, 0.4W, 5.1V, 5%	80009	152-0279-00
VR2401 ³	152-0278-00			SEMICON D DEVICE: ZENER, 0.4W, 3V, 5%	07910	1N4372A
VR4367	152-0395-00			SEMICON D DEVICE: ZENER, 0.4W, 4.3V, 5%	04713	1N749A
VR4392 ⁴	152-0279-00			SEMICON D DEVICE: ZENER, 0.4W, 5.1V, 5%	80009	152-0279-00

¹T921 only
²T922 only
³T922R only
⁴T922 and T922R only

OPTIONS

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

Option 1	Differential Mode	Described in this Section
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(Schematic diagrams for Option 1 are included at the end of the Diagrams section in this manual.)

CIRCUIT DESCRIPTION

Introduction

The following paragraphs describe circuitry unique to Option 1. Refer to the Circuit Description section of this manual for a description of those portions of the circuitry that are unchanged by Option 1. Note that numbering of the terminals and sections of several integrated circuits in Option 1 differs from their counterparts in the standard instrument.

Refer to the Option 1 schematic diagrams at the back of the Diagrams section of this manual for circuitry discussed in this circuit description.

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

Preamplifier

The buffer stages Q4302 and Q4303 isolate the channel 1 preamplifier from the switching diodes and from the delay line driver.

The channel 2 preamplifier is isolated from the switching diodes and the delay line driver by transistors Q4310 and Q4311 or transistors Q4312 and Q4313.

For a normal display (DIFF button not depressed), the channel 2 signal is passed through Q4312 and Q4313 to the switching diodes. Vertical Mode switch S4370 connects approximately +4.4 V from R4302, R4303, and R4313 through R4312 to the bases of Q4312 and Q4313. At the same time, +8 V is connected to Q4310 and Q4311 through R4311 and R4310. This biases off Q4310 and Q4311.

For a DIFF display (DIFF button depressed), the channel 2 signal passes through Q4310 and Q4311 to the switching diodes. S4370 connects +4.4 V from R4302, R4303, R4311, and R4310 to the bases of Q4310 and Q4311. This biases on Q4310 and Q4311. At the same time, +8 V is connected to the bases of Q4312 and Q4313 through R4313 and R4312. This biases off Q4312 and Q4313. The signal that was normally supplied to CR4314, through Q4312, is now supplied to CR4315 through Q4310. The signal normally supplied to CR4315, through Q4313, is now supplied to CR4314 through Q4311. The resulting display is the difference between the signals applied to the CH 1 and CH 2 inputs (CH 1 minus CH 2).

Vertical Switching

The vertical switching circuit determines whether CH 1, CH 2, or both CH 1 and CH 2 are connected to the delay line driver stage. This circuit is controlled by the Vertical Mode switch. In the DUAL TRACE alternate or chopped modes, both channels are alternately displayed on a time shared basis. In the DIFF mode, the channel 2 signal is inverted and both channels are connected to the delay line driver stage at the same time.

The diode gates, consisting of four diodes each, act as switches that allow either or both of the vertical preamplifier signals to be coupled to the delay line driver. Diodes CR4302, CR4303, CR4304, and CR4305 control the channel 1 output and CR4312, CR4313, CR4314, and CR4315 control the channel 2 output. These diodes are controlled by U4364B, U4360 respectively, and by the Vertical Mode switch, S4370.

CH 1 Mode: When the Vertical Mode switch is in the CH 1 position, pin 11 of U4360D is held LO causing pin 13 of U4364B to go HI. At the same time pins 2 and 3 of U4360A are HI causing pin 10 of U4364B to go LO. A LO on pin 10 and a HI on pin 13 of U4364B causes pin 9 to go HI and pin 8 to go LO. A HI at pin 9 (a voltage higher than at the bases of Q4322 and Q4324) reverse biases CR4302 and CR4303 and forward biases CR4304 and CR4305. This allows the channel 1 signal to pass to the delay line driver. When pin 9 is HI, pin 8 is LO, causing the cathodes of CR4312 and CR4313 to be connected to a voltage much lower than on the bases of Q4322 and Q4324. Diodes CR4312 and CR4313 are now forward biased and CR4314 and CR4315 are reverse biased. This prevents the channel 2 signal from passing to the delay line driver.

CH 2 Mode: In the channel 2 mode, the above conditions are reversed, passing the channel 2 signal and blocking the channel 1 signal.

DIFF Mode: In the DIFF mode, pin 11 of U4360D and pins 2 and 3 of U4360A are HI, causing pins 10 and 13 of U4364B to go low. This in turn makes pins 8 and 9 of U4364B go HI. Diodes CR4302, CR4303, CR4312, and CR4313 are no longer reverse biased, and CR4304, CR4305, CR4314, and CR4315 are also forward biased. This allows both channel 1 and channel 2 signals to pass on to the delay line driver stage. The -8 V supplied via S4370 to R4320 and R4321 provides sufficient current to keep both diode gates turned on without altering the dc levels of the delay line driver.

DUAL TRACE Mode: In the DUAL TRACE mode, channel 1 and channel 2 are alternately connected to the delay line driver. There are two dual trace modes: chopped and alternate. These modes are determined by the

SEC/DIV switch setting. Chopped mode is obtained for sweep speeds of 1 ms and slower; alternate mode is obtained for sweep speeds of 0.5 ms and faster.

In the DUAL TRACE mode CR4360 and CR4361 are forward biased so that pins 10 and 13 of U4364B are HI. This allows U4364B to change state upon arrival of a clock pulse.

In the chopped mode, pin 1 of U4376A is ungrounded, allowing the multivibrator, U4376A and U4376B, to free run at about 500 kHz. The output at pin 11 of U4376D serves as a clock pulse for U4364B. The state of U4364B changes on each negative transition of U4376D pin 11. Pins 8 and 9 of U4364B switch the diode gates at a 250 kHz rate.

The clock pulse is also fed to U4364A which provides an output pulse to the Z-axis amplifier to blank out the transitions between channel 1 and channel 2 traces. U4364A, U4376C and associated components form a one-shot. If pin 1 of U4364A goes LO, the output pin 5 is set LO, causing pin 8 of U4376C to go HI. This in turn causes pin 1 of U4364A to go HI after being delayed by C4386 charging through R4386.

The clock pulse applied to pin 3 of U4364A causes pin 5 to go HI, which, after inversion and some delay, moves pin 1 LO again. This causes pin 5 to go LO again. The positive-going voltage pulse (whose width is determined by R4386 and C4386) is converted to current by R4385 and sent to the Z-axis amplifier to blank switching transients.

In the alternate mode, pin 1 of U4376A is grounded, preventing multivibrator operation, thus keeping pin 12 of U4376D HI. At the end of each sweep, the base of Q4372 receives a current pulse driving it into saturation. The resulting negative-going pulse at the collector is fed through C4372 to pin 13 of U4376D, causing pin 11 to go HI. This in turn switches U4364B to pass either channel 1 or channel 2 to the delay line driver at the end of each sweep. Pin 2 of U4364A is grounded through the SEC/DIV switch and prevents an output at pin 5.

For a discussion of the Delay Line and the Delay Line Driver circuits, refer to the Circuit Description section of this manual.

Trigger Pickoff: The Vertical Mode switch also selects the appropriate internal triggering source for channel 1 and channel 2. With the Vertical Mode switch set to CH 1, DUAL TRACE, or DIFF, CR4364 is forward biased and the signal from the channel 1 trigger pickoff goes to the sweep circuit. In these modes, CR4362 is connected to -8 volts, thus reverse biasing CR4366, preventing the channel 2

trigger signal from entering the trigger input amplifier. With the Vertical Mode switch set to CH 2, CR4366 becomes forward biased while CR4364 is reverse biased, because CR4363 is now connected to -8 volts. Refer to the Circuit Description section of this manual for a discussion of the rest of the Trigger Pickoff circuitry, which is common to all versions of the T922 or T922R.

CMRR PERFORMANCE CHECK (Perform after Step 7 of Section 3, PERFORMANCE CHECK)

Equipment Required

(See Table 3-1 in Section 3 of this manual for equipment specifications and recommended types.)

1. Sine-Wave Generator
2. 50 Ω BNC Cable
3. 50 Ω BNC Termination
4. 50 Ω BNC Dual-Input Coupler

Equipment Setup

Connect the sine-wave generator to the CH 1 and CH 2 inputs via a 50 Ω bnc cable, 50 Ω bnc termination, and dual-input coupler.

Procedure

1. Set: Vertical Mode	CH 1
CH 1 and CH 2	
VOLTS/DIV	5 mV
CH 1 and CH 2	
AC-GND-DC	AC
SOURCE	INT
MODE	AUTO

2. Set generator to 50 kHz. Adjust generator for a six-division display.
3. Set Vertical Mode to DIFF.
4. Adjust one of the VAR VOLTS/DIV controls for minimum vertical deflection (best CMRR).
5. Without readjusting generator amplitude, set generator frequency to 5 MHz.
6. CHECK—Vertical deflection is 0.6 division or less.

DIFFERENTIAL BALANCE ADJUSTMENT
(Perform after Step 6 of VERTICAL
AMPLIFIER ADJUSTMENTS)

3. Set: Vertical Mode CH 2
 CH 2 POSITION Midrange

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

2. Adjust CH 1 POSITION to move the trace to the center horizontal graticule line.

4. ADJUST—Differential Balance, R4259. Alternately push the CH 2 and DIFF buttons. The adjustment is correct when there is no vertical trace shift while alternately pushing the CH 2 and DIFF buttons. You may need to readjust the CH 2 POSITION control to keep the trace on the screen.

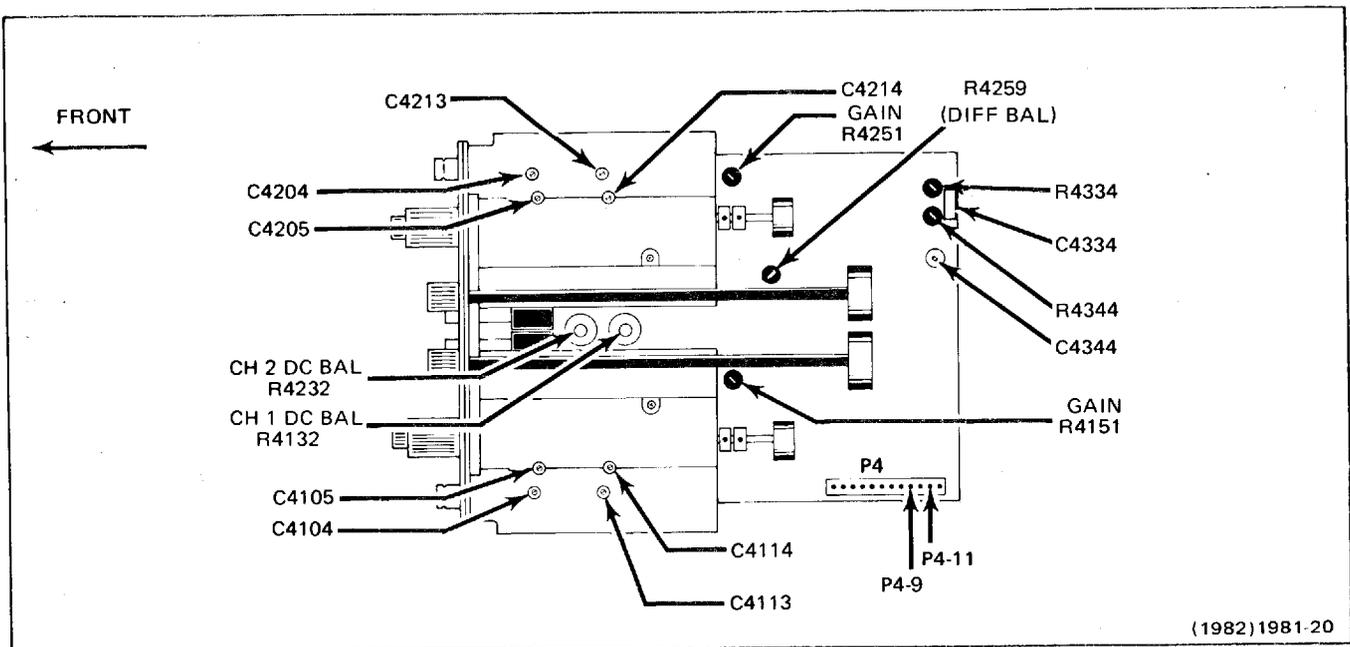


Fig. Option 1-1. Adjustment locations.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CHANGE TO:						
A8	670-4389-00			CKT BOARD ASSY:VERTICAL	80009	670-4389-00
C4155	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C4165	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C4255	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C4265	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
Q4322	151-0434-00			TRANSISTOR:SILICON,PNP	80009	151-0434-00
Q4324	151-0434-00			TRANSISTOR:SILICON,PNP	80009	151-0434-00
R4174	321-0251-00			RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R4175	321-0251-00			RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R4256	321-0170-00			RES.,FXD,FILM:576 OHM,1%,0.125W	91637	MFF1816G576R0F
R4302	321-0169-00			RES.,FXD,FILM:562 OHM,1%,0.125W	91637	MFF1816G562R0F
R4303	321-0158-00			RES.,FXD,FILM:432 OHM,1%,0.125W	91637	MFF1816G432R0F
R4392	315-0390-00			RES.,FXD,CMPSN:39 OHM,5%,0.25W	01121	CB3905
S4370	260-1823-00			SWITCH,PUSH:VERTICLE MODE,2 POLE INTLK	80009	260-1823-00
ADD:						
C4303	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C4368	283-0103-00			CAP.,FXD,CER DI:180PF,5%,500V	56289	40C638
CR4360	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR4361	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
Q4310	151-0199-00			TRANSISTOR:SILICON,PNP	27014	ST65038
Q4311	151-0199-00			TRANSISTOR:SILICON,PNP	27014	ST65038
R4128	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	01121	CB8235
R4129	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R4228	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	01121	CB8235
R4229	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R4259	311-1568-00			RES.,VAR,NONWIR:50 OHM,20%,0.50W	73138	91A R50
R4301	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R4310	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R4311	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R4312	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R4313	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R4320	321-0263-00			RES.,FXD,FILM:5.36K OHM,1%,0.125W	91637	MFF1816G53600F
R4321	321-0263-00			RES.,FXD,FILM:5.36K OHM,1%,0.125W	91637	MFF1816G53600F
R4358	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R4366	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R4370	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R4380	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
U4360	156-0043-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NOR GATE	80009	156-0043-00

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
REMOVE:						
C4143	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	72982	390049X5P0470K
C4243	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	72982	390049X5P0470K
C4362	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C4363	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C4365	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C4366	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C4397	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
R4395	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R4397	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705

¹Changes to Standard T922 or T922R when instrument is equipped with Option 1. Applies to all serial numbers of Option 1 unless otherwise stated.

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
ADD:												
-57	366-1559-00			1						PUSH BUTTON:GRAY	80009	366-1559-00
-61	426-1072-00			1						FRAME,PUSH BTN:PLASTIC	80009	426-1072-00
DELETE:												
-63	333-2040-00			1						PANEL,FRONT:VERTICAL	80009	333-2040-00
ADD:												
-63	333-2150-00			1						PANEL,FRONT:VERTICAL	80009	333-2150-00
-91	384-1136-00			1						EXTENSION SHAFT:0.95 INCH LONG	80009	384-1136-00
DELETE:												
-95	131-1817-00			1						LINK,TERM CONNE:22 AWG,2.25" LONG	80009	131-1817-00
-95	131-0566-00			1						LINK,TERM.CONNE:0.086 DIA X 2.375 INCH L	55210	ERD-18T0

DIAGRAMS AND CIRCUIT DESCRIPTION

Symbols and Reference Designators

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

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

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

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

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

Abbreviations are based on ANSI Y1.1-1972.

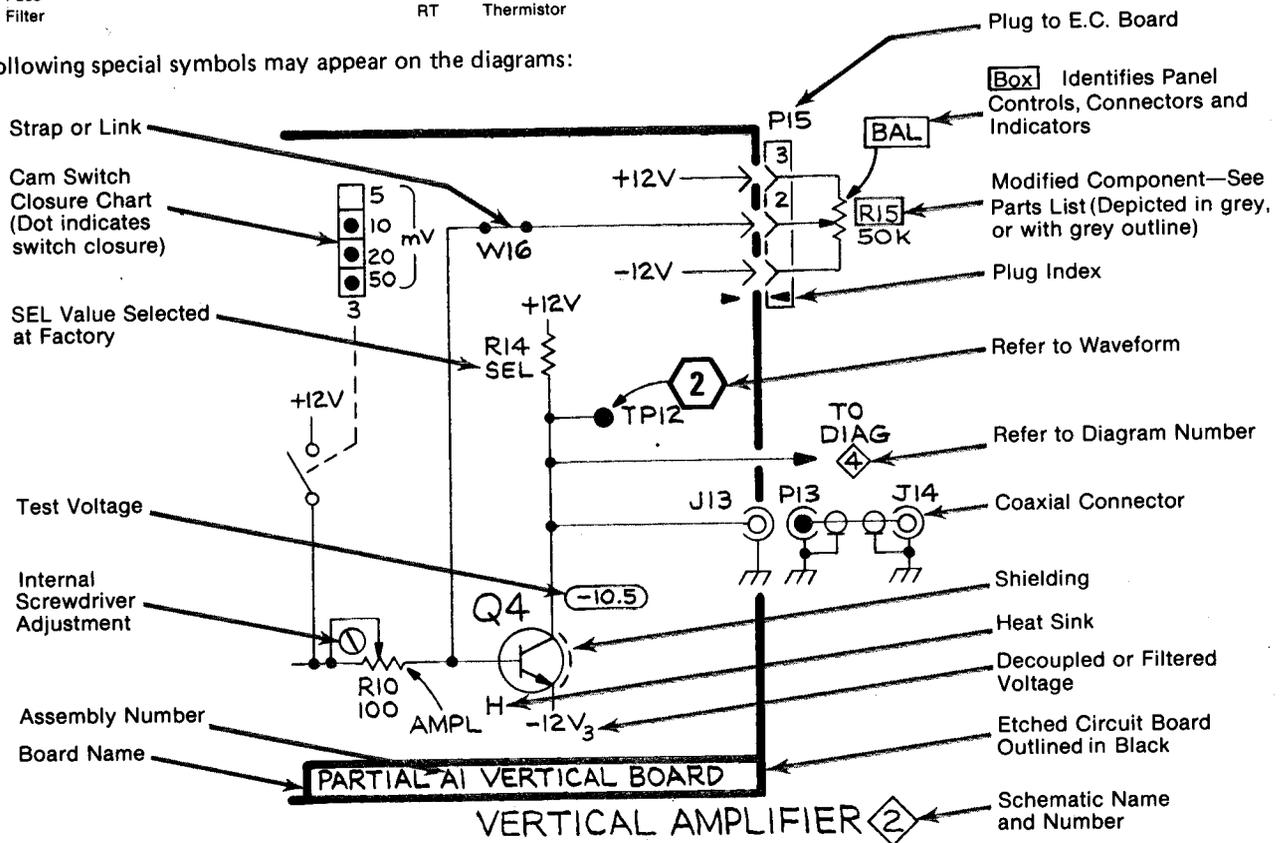
Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

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

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

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

The following special symbols may appear on the diagrams:



BLOCK DIAGRAM DESCRIPTION

Most of the circuitry described in this section is common to the T921, T922, and T922R. References to channel 2, dual trace, chop mode, and vertical switching do not pertain to T921. The T922R circuitry that differs from the bench version T922 is described with the three diagrams at the end of this section.

VERTICAL INPUT

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

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

VERTICAL SWITCHING

The Vertical Mode switch selects which channel supplies the trigger signal. The vertical signal passes through the Input Buffer Amplifier circuit which isolates the preamplifier circuits from the Delay Line Driver. In the T922, the output of each Input Buffer Amplifier is connected to the Delay Line Driver through a Diode Gate circuit. The Diode Gate circuits are controlled by the Vertical Switching circuit to select the channel(s) to be displayed. An output from the Vertical Switching circuit (through the Chop Blanking Pulse Generator) is connected to the Z Axis Amplifier to blank switching transients in the chop mode (SEC/DIV at 1 ms or slower). A sync pulse from the sweep (via the Alternate Sync Pulse Amplifier) switches the display between channels at the end of each sweep in the alternate mode (SEC/DIV at .5 ms or faster).

VERTICAL AMPLIFIER

The vertical input signal goes from the Delay Line Driver through the Delay Line to the Vertical Output Amplifier. The Delay Line provides approximately 200 ns delay in the vertical signal. This allows the sweep generator circuit time to initiate a sweep before the vertical signal reaches the crt vertical deflection plates. The Vertical Output Amplifier provides final amplification of the signal to drive the crt vertical deflection plates. One section of the BEAM FINDER switch, when pressed, causes the display to compress vertically to aid in locating off-screen displays. Another section affects the horizontal circuitry.

TRIGGER

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

The selected trigger signal is amplified and inverted by the Trigger Input Amplifier. The trigger signal passes through coupling capacitor C2132 to the Trigger Level Comparator, which determines the voltage level (on the trigger waveform) at which triggering occurs. The SLOPE switch selects the slope or sync (TV) polarity. The Trigger Level comparator also supplies a signal to the TV Sync Separator circuit.

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

SWEEP AND HORIZONTAL AMPLIFIER

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

The sawtooth output from the Sweep circuit is amplified by the Horizontal Output Amplifier circuit to produce horizontal deflection on the crt. When the SOURCE switch is in the X-Y position, the X signal, from the External Trigger Input Buffer, is applied to the Horizontal Amplifier. One section of the BEAM FINDER switch, when pressed, causes the display to compress horizontally to aid in locating off-screen displays.

CRT CIRCUIT

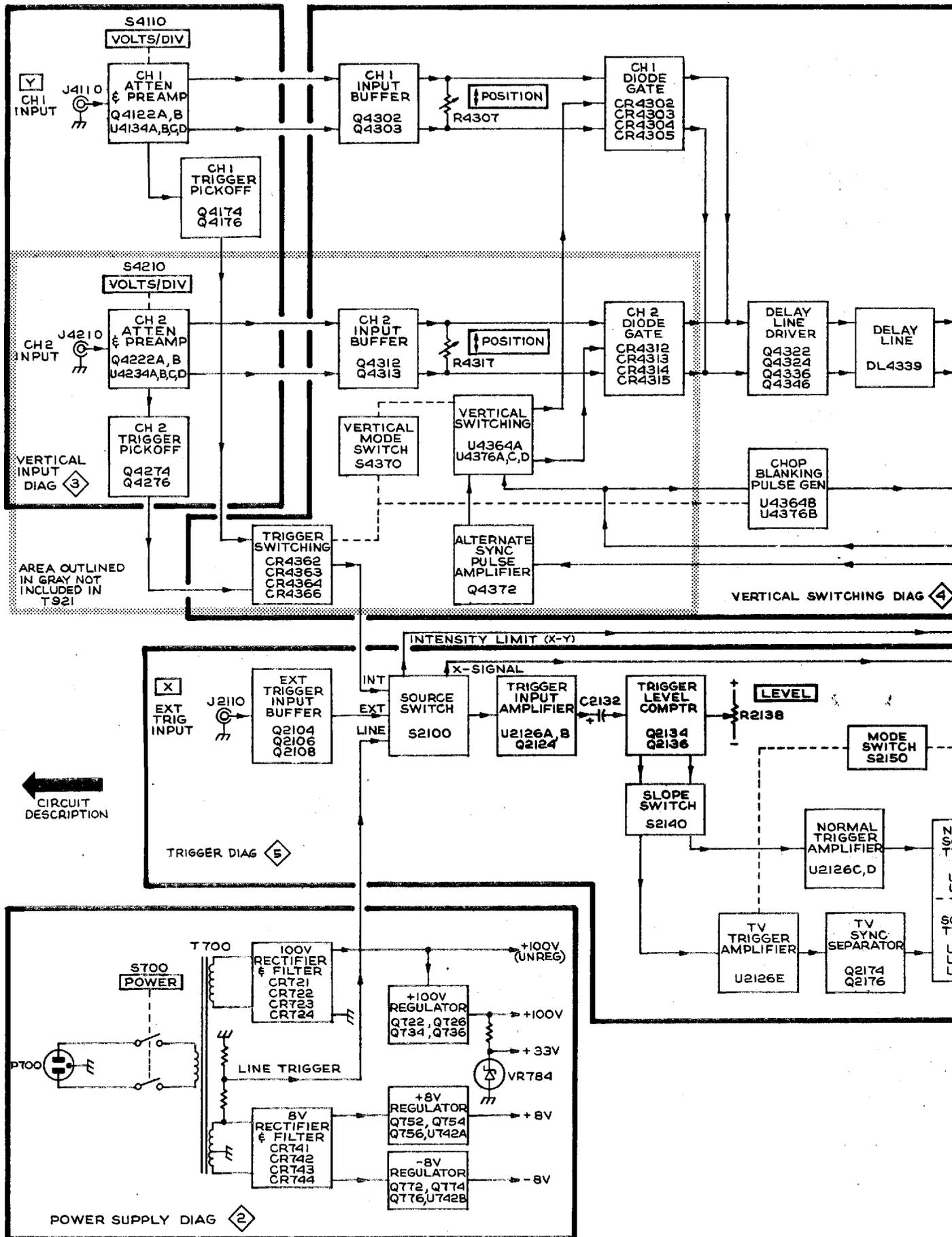
The Z Axis Amplifier determines the crt intensity and blanking. The Z Axis Amplifier sums the current inputs from several sources: INTENSITY control, X-Y intensity limit, unblanking signal from sweep circuit, chop blanking signal from the Vertical Switching circuit and EXT Z AXIS INPUT connector, J419.

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

The Probe Adjust Generator provides a square-wave voltage output for checking voltage probes.

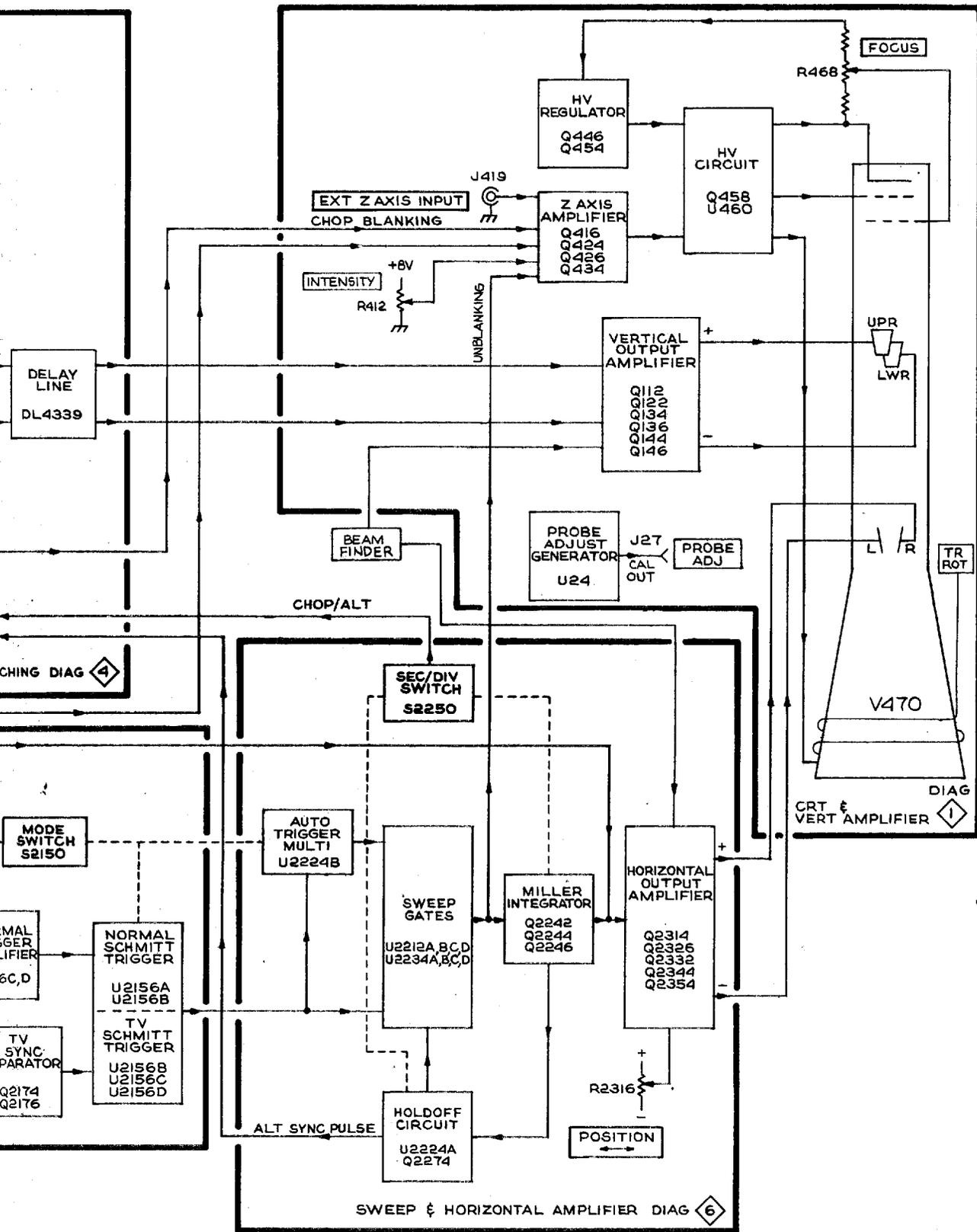
POWER SUPPLY

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



AREA OUTLINED IN GRAY NOT INCLUDED IN T921

CIRCUIT DESCRIPTION



BLOCK DIAGRAM

CRT & VERT AMPL CIRCUIT DESCRIPTION

PROBE ADJUST

The Probe Adjust circuit provides an output of approximately 0.5 V peak-to-peak negative from ground at approximately 1 kHz.

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

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

VERTICAL OUTPUT AMPLIFIER

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

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

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

Z AXIS CIRCUIT

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

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

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

HIGH VOLTAGE OSCILLATOR

Transistor Q458 and associated circuitry make up the high-voltage oscillator that produces the drive for high-voltage transformer T460. When the instrument is turned on, current through Q454 provides forward bias for Q458. Transistor Q458 conducts and the collector current increases, which develops a voltage across the primary (Q458 collector) winding of T460. This produces a corresponding voltage increase in the feedback winding of T460, which is connected via R457 to the base of Q458, and Q458 conducts even harder. Eventually the rate of collector current increase in Q458 becomes less than that required to maintain the voltage across the collector winding, and the output voltage drops. This turns off Q458 by way of the feedback voltage to the base. The voltage waveform at the collector of Q458 is a sine wave at the resonant frequency of T460. During the negative half cycle, Q458 remains off and the field collapses in the primary of T460. When the field is collapsed sufficiently, the base of Q458 becomes forward biased into conduction again and the cycle begins anew. The amplitude of sustained oscillation depends upon the average current delivered to the base of Q458 by the regulator circuitry. The frequency of oscillation is approximately 50 kHz. Components C458 and R458 decouple the unregulated +100 V supply line.

HIGH-VOLTAGE REGULATOR

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

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

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

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

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

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

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

HIGH VOLTAGE RECTIFIERS AND OUTPUT

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

The third winding is used to control the crt intensity. Components CR463, C462, C463, C464, R462, and R463 rectify and filter the secondary voltage to provide approximately -2100 V which is applied to the crt grid. The entire winding is referenced to the output of the Z axis amplifier whose output voltage variations are used to control the crt intensity by varying the grid to cathode voltage. The dc path for the Z axis signal to the grid is through R462, CR463, R463 and the transformer winding. Resistor R462 isolates the transformer capacitance from the Z axis Amplifier. Capacitors C463 and C464 provide a path for fast changes in the Z axis output to the crt grid. Resistor R464 provides a discharge path for C462, C463, and C464. Glow lamps DS463 and DS 465 prevent the grid-to-cathode voltage from rising high enough to cause breakdown within the crt during turn-on or when the cathode or grid is shorted to ground.

CRT CONTROL CIRCUITS

Crt display focus is controlled by FOCUS control R468. ASTIG adjustment R477, which is used in conjunction with the FOCUS control to provide a well-defined display, varies the voltage on the astigmatism grid. Geometry adjustment, R473, varies the voltage on the horizontal deflection plate shields to control the overall geometry of the display.

Two adjustments control the trace alignment by varying the magnetic field around the crt. Y axis adjustment, R474, controls the current through L470, which affects the crt beam after vertical deflection but before horizontal deflection. Therefore, it affects only the vertical (Y) components of the display. Trace Rotation (TR ROT) adjustment, R472, controls the current through L472 and affects both vertical and horizontal rotation of the beam.

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



II.3

VOLTAGE CONDITIONS

Voltages shown on this schematic diagram were measured with a Tektronix DM 501 Digital Multimeter. Voltage measurements can vary as much as $\pm 20\%$. No signals were applied to the vertical input or the X (external trigger) input. Refer to Waveform Conditions for T921, T922, or T922R control settings. In the crt circuit, set the INTENSITY control for a voltage measurement of +22 volts at the collector of Q426 and of Q434 before attempting to measure voltages in the rest of the circuit.

WAVEFORM CONDITIONS

NOTE

Waveforms are for T922, unless otherwise noted.

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

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

The T922 controls were set as follows:

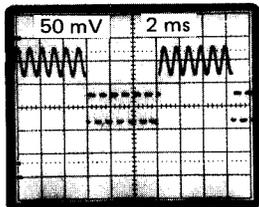
VOLTS/DIV (both)	20 mV	MODE	AUTO
AC-GND-DC (both)	DC	SLOPE	+OUT
Vertical Mode	DUAL TRACE	SEC/DIV	.5 ms
SOURCE	INT		

The other controls were set as needed to obtain a display.

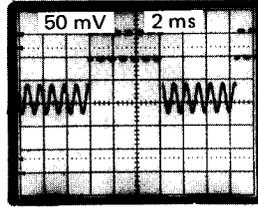
The CH 1 POSITION control was adjusted so that the bottom of the sine wave was on the first horizontal graticule line above the center and the CH 2 POSITION control was adjusted so that the top of the square wave was on the first horizontal graticule line below the center.

For waveforms 6 and 7, the AC-GND-DC switches were set to GND and SOURCE to LINE. Also for waveforms 6, and 7, the LEVEL and INTENSITY controls were set to approximately midrange.

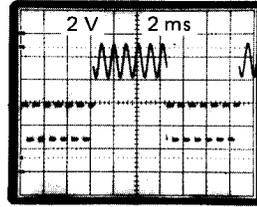
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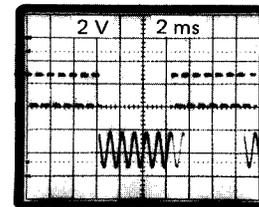
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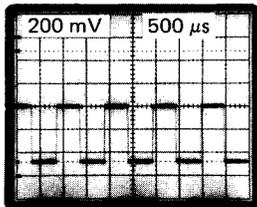
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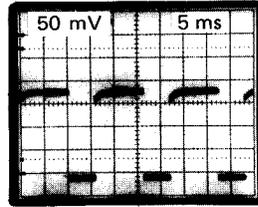
4



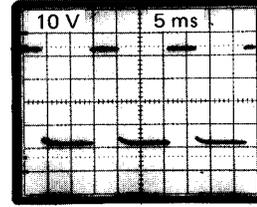
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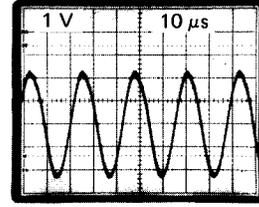
6



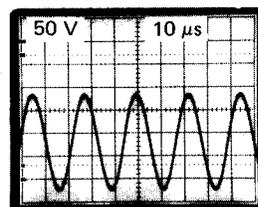
7*



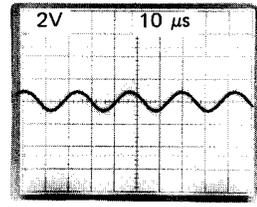
8



9

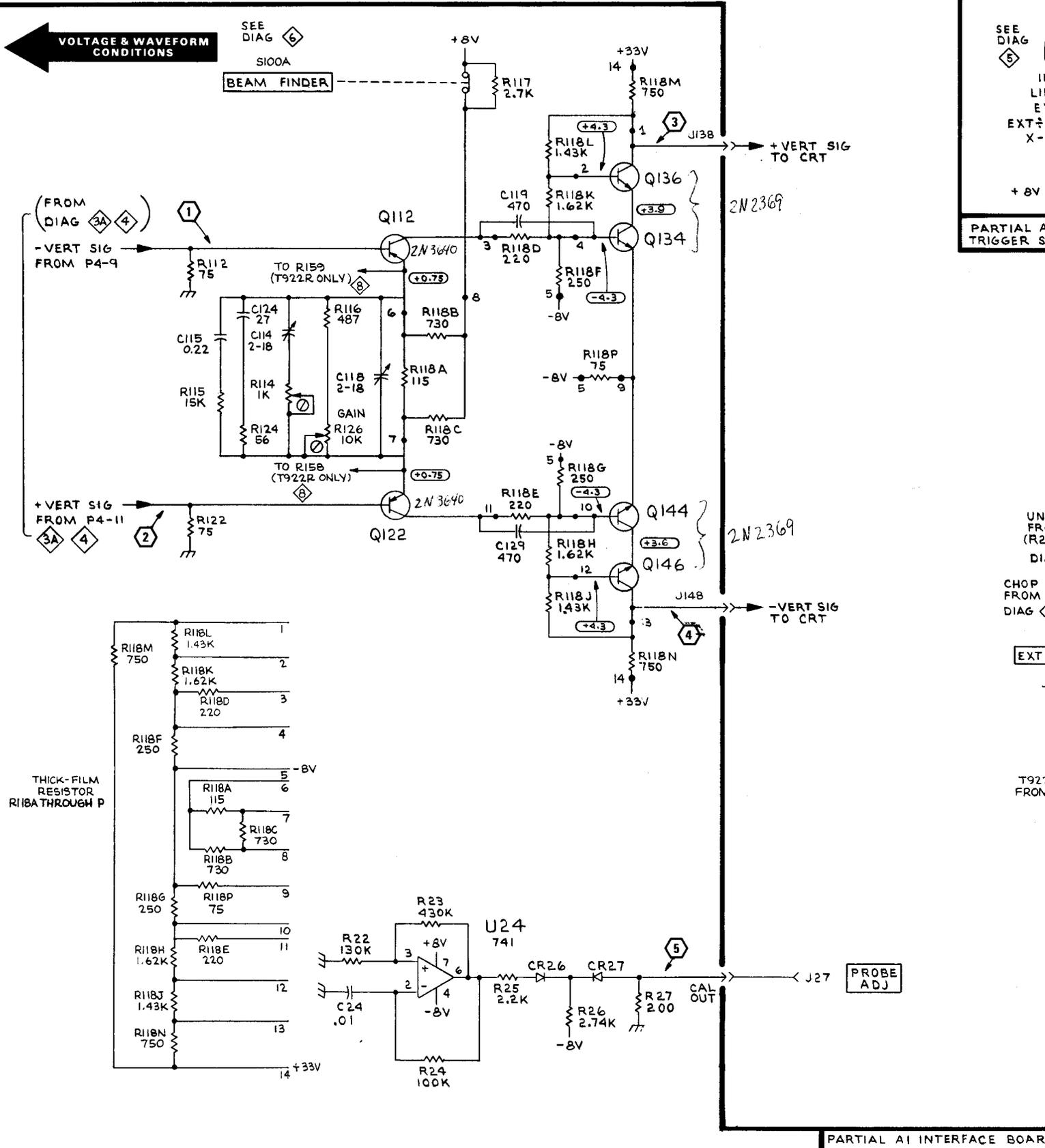


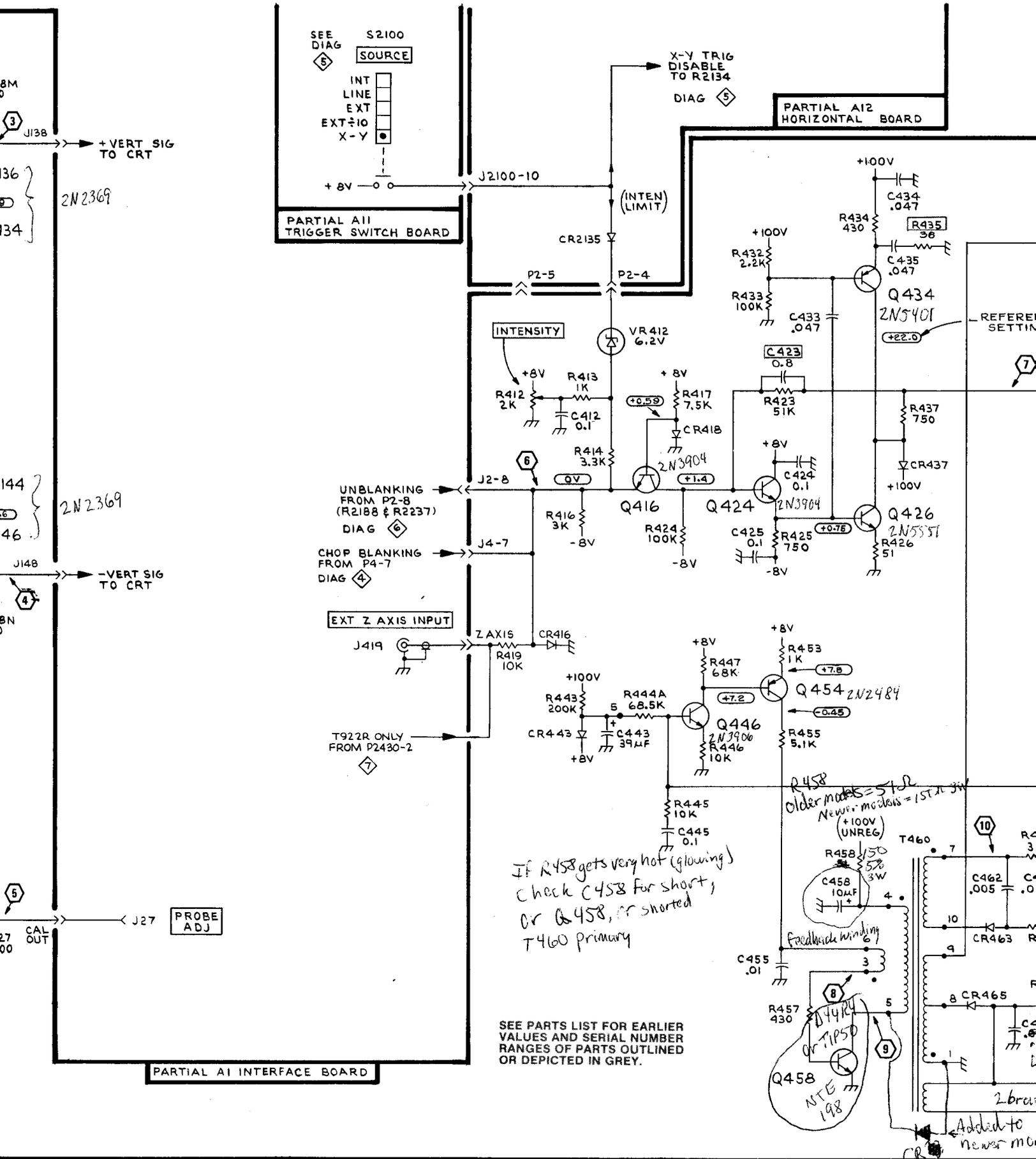
10



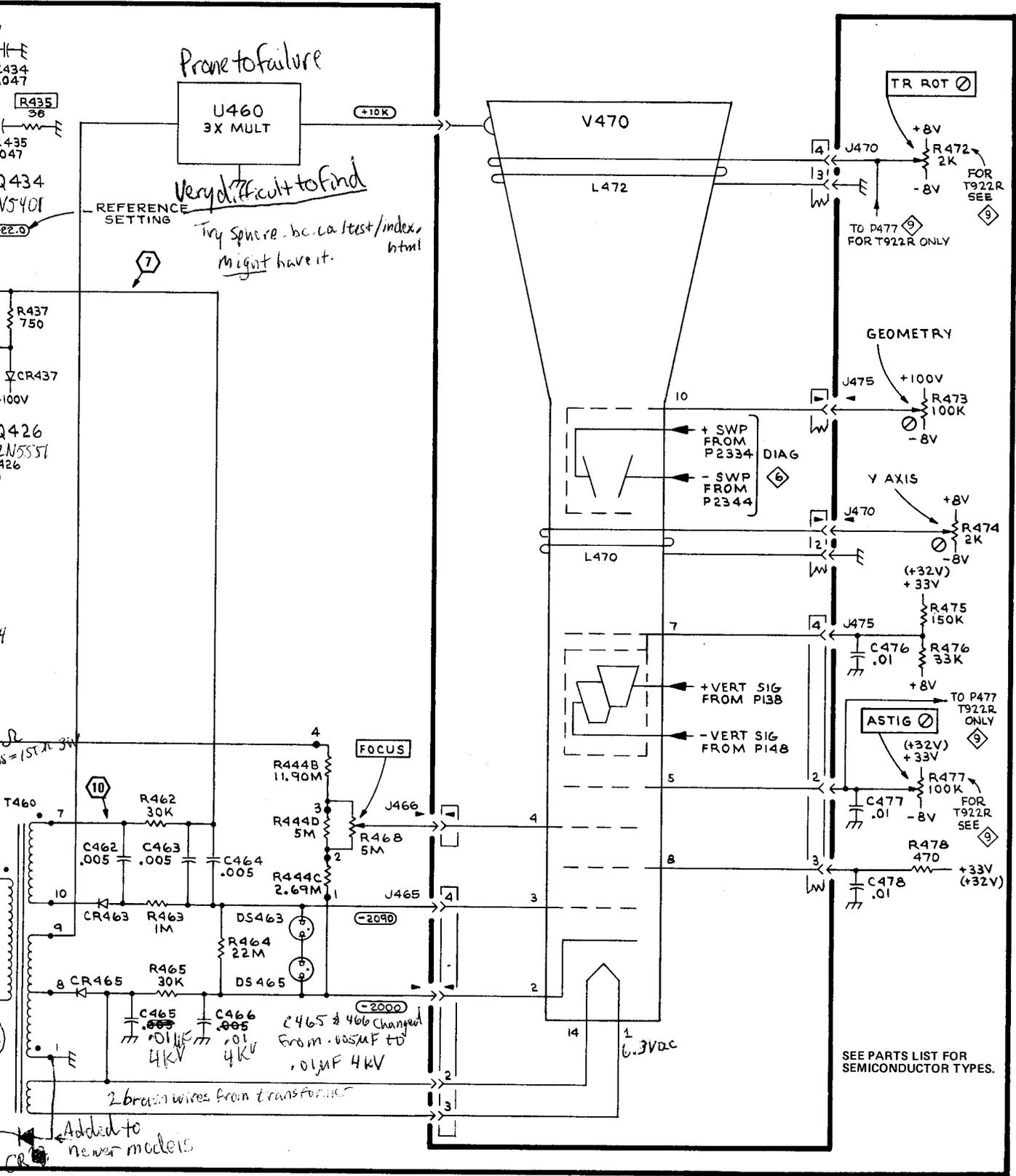
* PULSE AMPLITUDE VARIES WITH INTENSITY CONTROL SETTING.

SET INTENSITY FULLY CCW.





BOARD



CRT & VERT AMPL 1

CRT & VERTICAL AMPLIFIER 1

POWER SUPPLY CIRCUIT DESCRIPTION

POWER INPUT

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

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

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

SECONDARY CIRCUITS

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

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

In the $+8$ V supply, Q752 is normally biased off. Under normal conditions, the base of Q752 is set at about $+8$ V. As the supply current increases, the voltage drop across R754 increases. Since the Q756 emitter-base diode voltage difference remains constant, the increasing voltage on Q756 emitter due to the R754 voltage drop causes a corresponding increase at the base of Q756. This voltage is applied to voltage divider R752 and R753, causing the base of Q752 to go more positive. When the supply current increases sufficiently beyond the normal operating current, Q752 turns on. The collector of Q752 moves in the negative direction, which begins turning off Q754-Q756 and creates a foldback condition (see Fig. 7-1). Transistor Q756 continues to conduct some current when the supply is limited, dropping enough voltage across R754 to keep Q752 biased on.

Regulated $+33$ V is provided by Zener diode VR784 from the $+100$ V supply. A different circuit provides a similar voltage for the T922R (see T922R circuit description at the end of this section). Current divider, R741, R742, R2102 (see diagram 5) provides a sample of the line voltage for line triggering.

POWER-ON LAMP CIRCUIT

The ON lamp, DS796, remains on as long as the line voltage does not vary more than approximately 10% from the nominal selected line voltage (100, 120, 220, or 240 V). When the line voltage is not within the 10% limit, the ON lamp blinks.

As long as Q796 is conducting, DS796 remains on. If Q796 is biased off, DS796 goes out, allowing C796 to charge through R796 and R797. When C796 reaches about 80 V, it discharges through DS796 causing it to turn on momentarily. Capacitor C796 again is charged through R796-R797 and discharged through DS796. This cycle repeats, causing the ON lamp to blink until the line voltage is within the 10% limit and Q796 conducts.

When the 100 V unregulated supply at voltage divider R792 and R793 increases to more than about 10% above the nominal value, Q792 turns on and Q796 turns off, causing DS796 to blink. When the 100 V unregulated supply at voltage divider R794 and R795 decreases to less than about 10% below the nominal value, Q796 turns off, causing DS796 to blink.

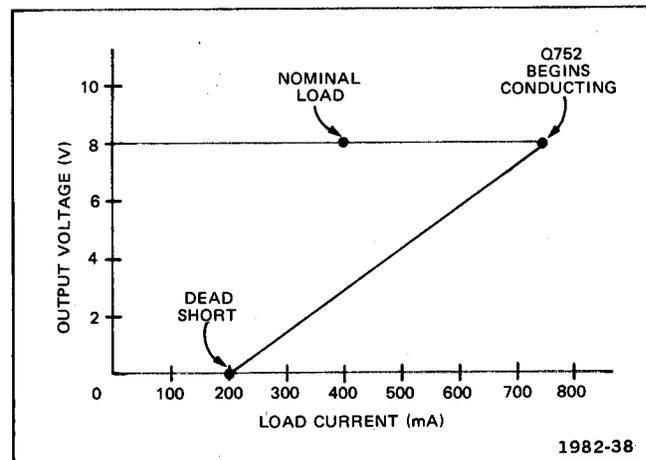
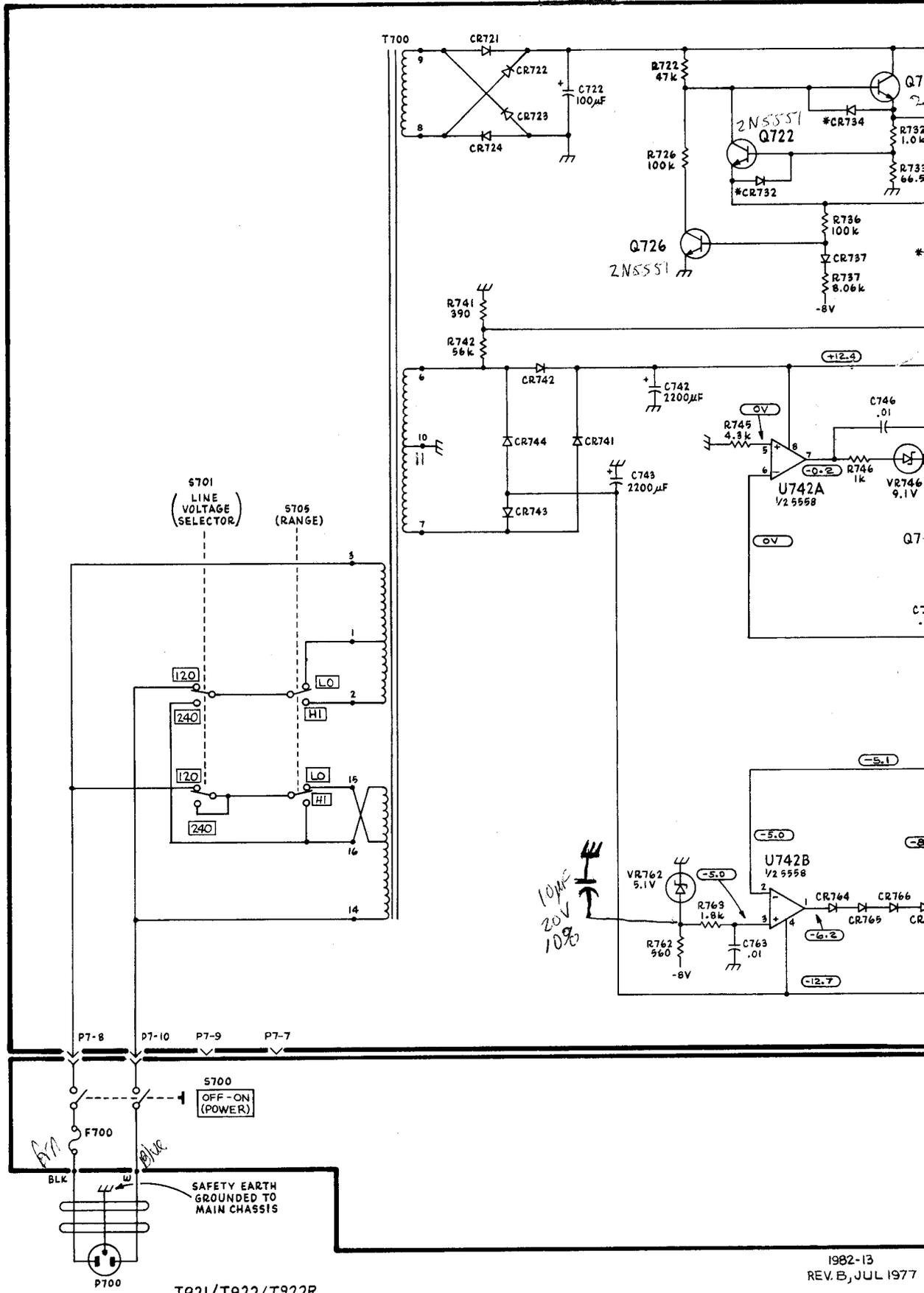


Fig. 7-1. Foldback circuit action.

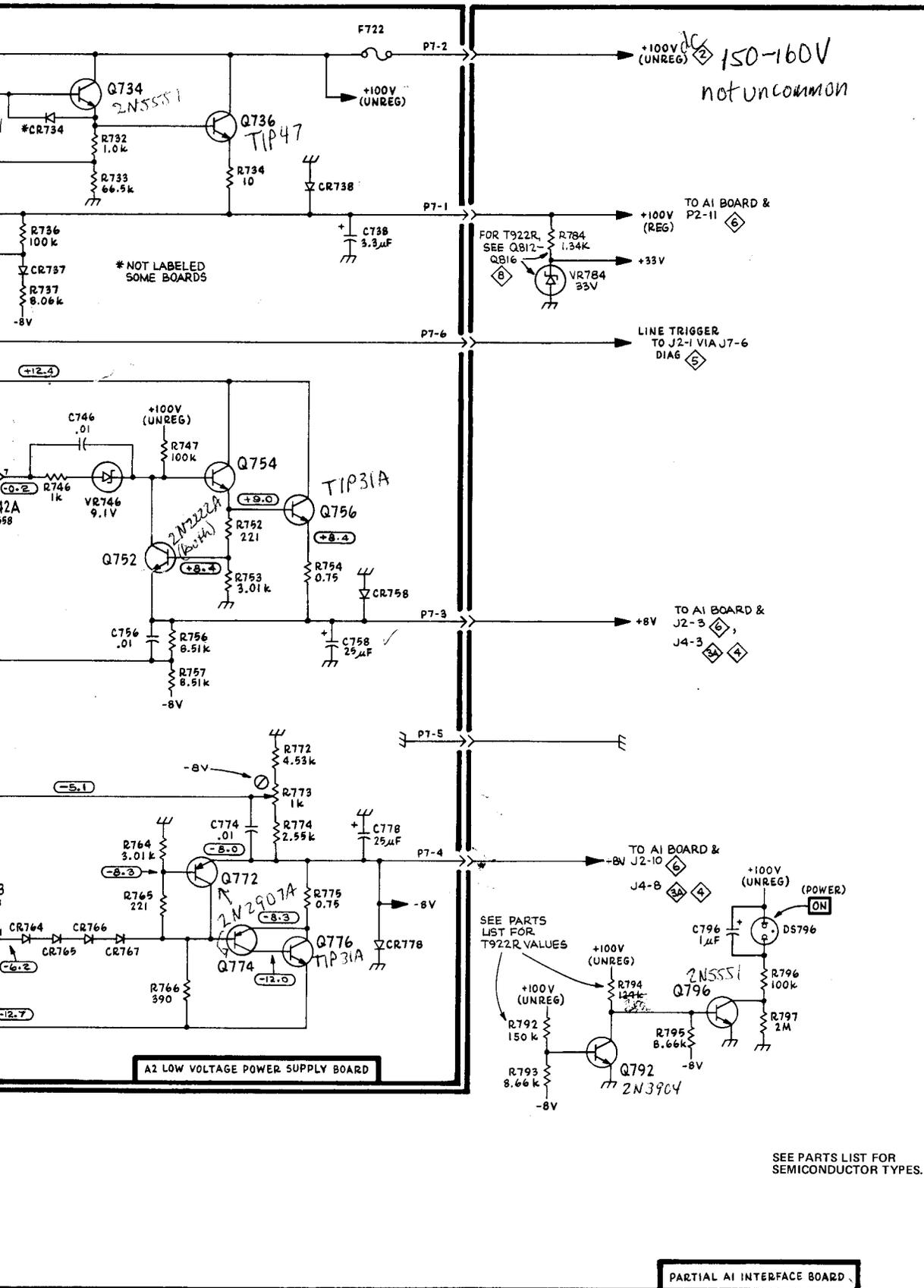
VOLTAGE CONDITIONS

Voltages shown on this schematic diagram were measured with a Tektronix DM 501 Digital Multimeter. Voltage measurements can vary as much as $\pm 20\%$. No signals were applied to the vertical input or the X (external trigger) input.

Components prone to fail with age:
 C472-2200µF filter cap
 C473 - " " " "
 C722 100µF 160V



T921/T922/T922R



SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

PARTIAL AI INTERFACE BOARD

VERT INPUT (T921) CIRCUIT DESCRIPTION

INPUT COUPLING SWITCH

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

VOLTS/DIV SWITCH

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

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

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

PREAMPLIFIER

The signal from the input attenuator is connected to source follower Q4122A via C4123 and R4123. Resistor R4122 determines the 1 M Ω input resistance and R4123 limits current drive to the gate of Q4122A. Diode CR4123 protects the circuit from high negative-going input signals by limiting the voltage at the gate of Q4122A to about -8 volts. The Q4122A gate-drain junction provides protection from high positive-going signals by limiting the gate voltage to about +8 volts. FET Q4122B provides a constant-current source for Q4122A. For some serial numbers, Q4122 substrate (pin 8) is provided with a bias to compensate for possible substrate leakage. This bias is derived by the voltage divider action of R4128 and R4129 between +8 volts and ground.

Transistors U4134B and U4134C are emitter followers. The signal at the emitter of U4134B follows the signal at the gate of Q4122A. Divider network R4143 through R4147 attenuates the signal from U4134B which drives the base of U4134A. DC BAL, R4132, adjusts for minimum trace shift when switching between adjacent positions of the VOLTS/DIV switch.

Paraphase amplifier stage, U4134A and U4134D, converts the single-ended signal at the base of U4134A to a push-pull current signal. These current signals are fed to the delay line driver stage via buffer stages Q4302 and Q4303. The buffer stages isolate the preamplifier from the delay line driver. POSITION control R4306 varies the dc voltage at the bases of Q4322 and Q4324 to vertically position the trace on the crt. Resistors R4155 and R4165 provide compensation to maintain average power during voltage excursions. Capacitors C4155 and C4165 reduce Miller effect through U4134A and U4134D.

The components connected between U4134A and U4134D emitters compensate for high-frequency losses in the preamplifier. Gain adjustment R4151 determines the gain of the preamplifier. The VAR control, R4152, provides uncalibrated deflection factors between VOLTS/DIV switch settings by attenuating the signal to the base of U4134A. When R4152 is rotated clockwise, its full resistance is in series with R4162, and the deflection factors are calibrated.

TABLE 7-1

Attenuator and Gain Switching Sequence

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

DELAY LINE DRIVER

The delay line driver is a push-pull feedback amplifier stage composed of Q4322, Q4324, Q4336, Q4346, and associated circuitry. A sample of the output of Q4346 and Q4336 is fed back through R4336-R4328 and R4346-R4342 to the bases of Q4322 and Q4324. Due to this feedback, this stage forms an inverting operational amplifier with a virtual ground at the bases of Q4322 and Q4324. Any current into these virtual grounds (null points) causes an output voltage at the emitters of Q4336 and Q4346 that is proportional to the feedback resistance.

Components C4333, C4334, C4344, R4333, R4334, and R4344 provide compensation (peaking) to correct for delay line losses.

DELAY LINE

The delay line, DL4339, provides approximately 200 ns delay in the vertical signal. This allows the sweep generator circuit time to initiate a sweep before the vertical signal reaches the crt vertical deflection plates.

TRIGGER PICKOFF

A sample of the vertical voltage signal from the emitters of U4134A and U4134D is applied to Q4176 and Q4174, where it is

converted to a current signal. This current signal is applied to the trigger input amplifier (see diagram 5). When the SOURCE switch is set to INT, approximately -4 volts from the trigger input amplifier appears at the Q4176 collector circuit, reverse biasing CR4267. When the source switch is set to LINE, EXT, EXT ÷ 10, or X-Y, the internal trigger signal is disconnected from the trigger input amplifier, permitting CR4367 to conduct and set the collector of Q4176 at about -3 volts. This maintains conduction of Q4176, providing a constant load to prevent distortion of the main vertical signal.

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.5X
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and R4344
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IV.3

VOLTAGE CONDITIONS

Voltages shown on this schematic diagram were measured with a Tektronix DM 501 Digital Multimeter. Voltage measurements can vary as much as $\pm 20\%$. No signals were applied to the vertical input or the X (external trigger) input. See Waveform Conditions for T921 control settings.

WAVEFORM CONDITIONS

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

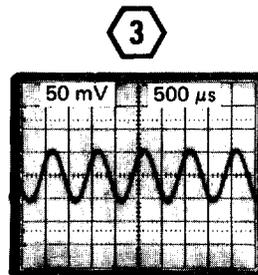
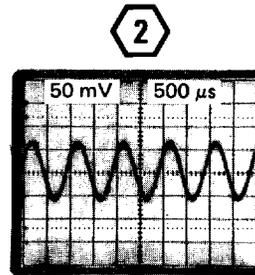
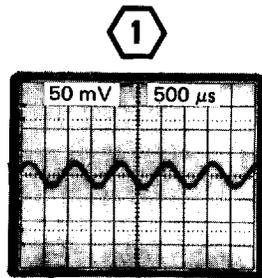
A 1 kHz, 50 mV sine wave was applied to the Y input. A Tektronix FG 501 Function Generator provided the input waveform.

The T921 controls were set as follows:

VOLTS/DIV	10 mV
AC-GND-DC	DC
SOURCE	INT
MODE	AUTO
SLOPE	+OUT
SEC/DIV	.5 ms

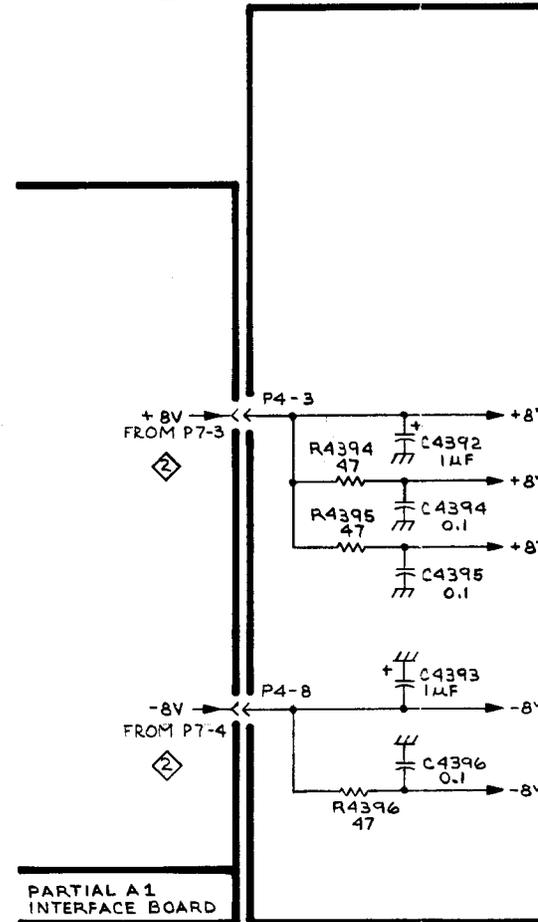
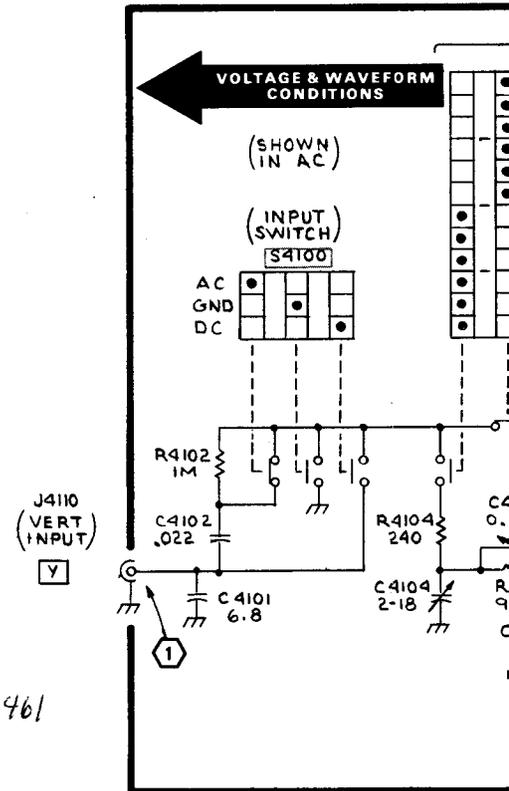
The other controls were set as needed to obtain a display.

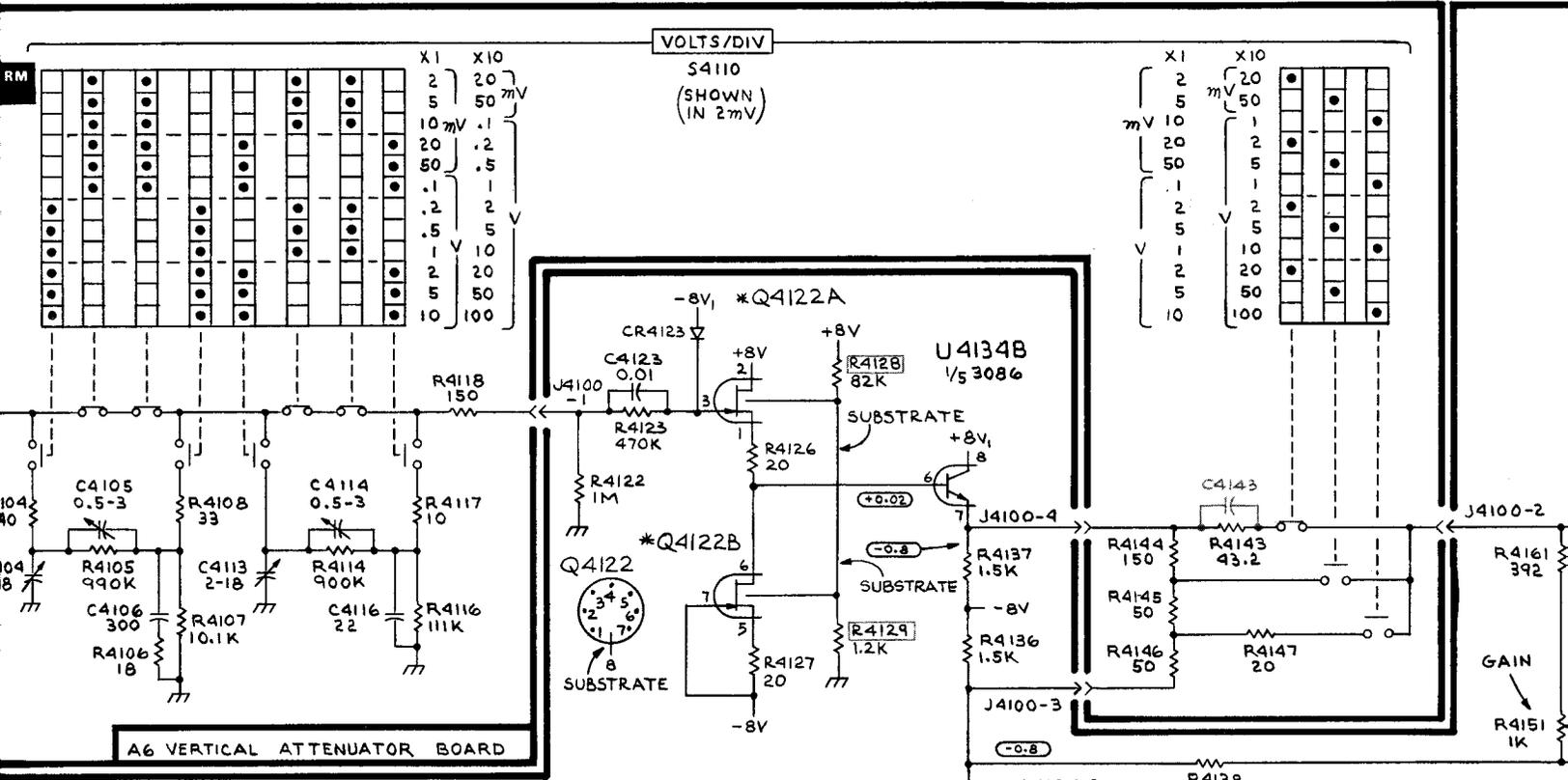
For waveform 3, the test oscilloscope was triggered externally from pin 1 of U4134.



If input signal is erratic,
 Check C4102 & C4202 0.022MF 400V
 for open or short.

Dual JFET transistors Q4122 & Q4222
 fail occasionally - can be replaced with NTE 461



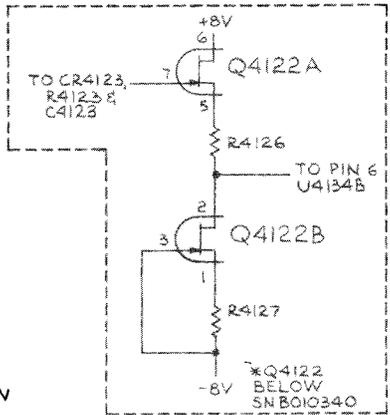


VOLTS/DIV
S4110
(SHOWN
IN 2mV)

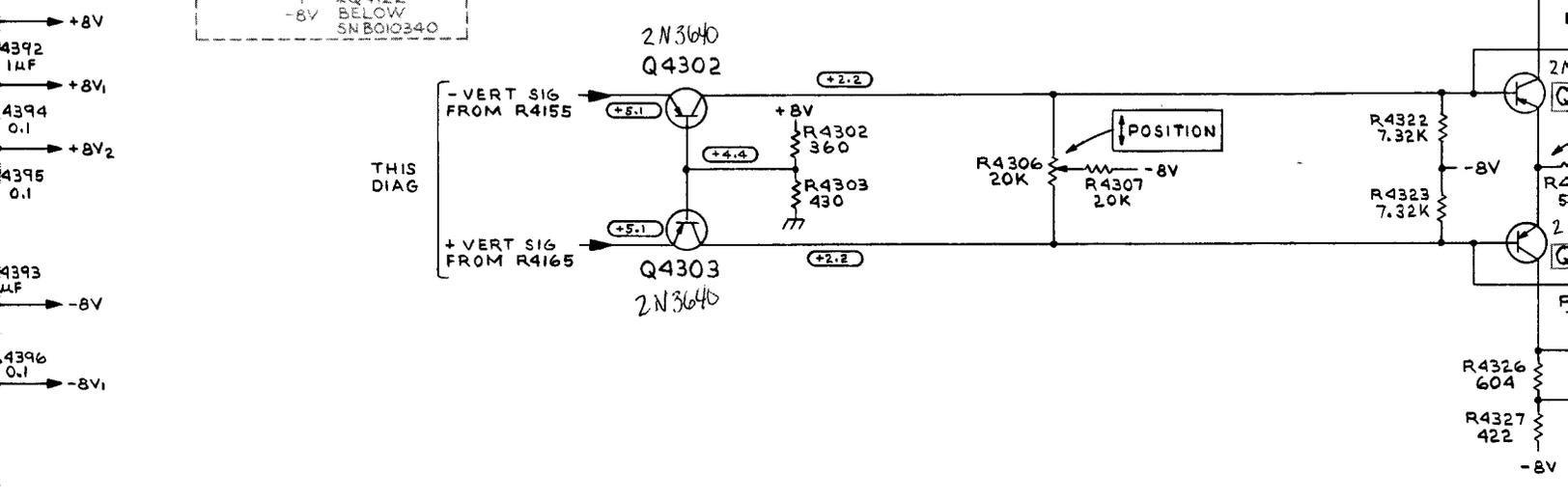
X1
2 20
5 50
10 100
mV

X10
1 10
2 20
5 50
10 100
V

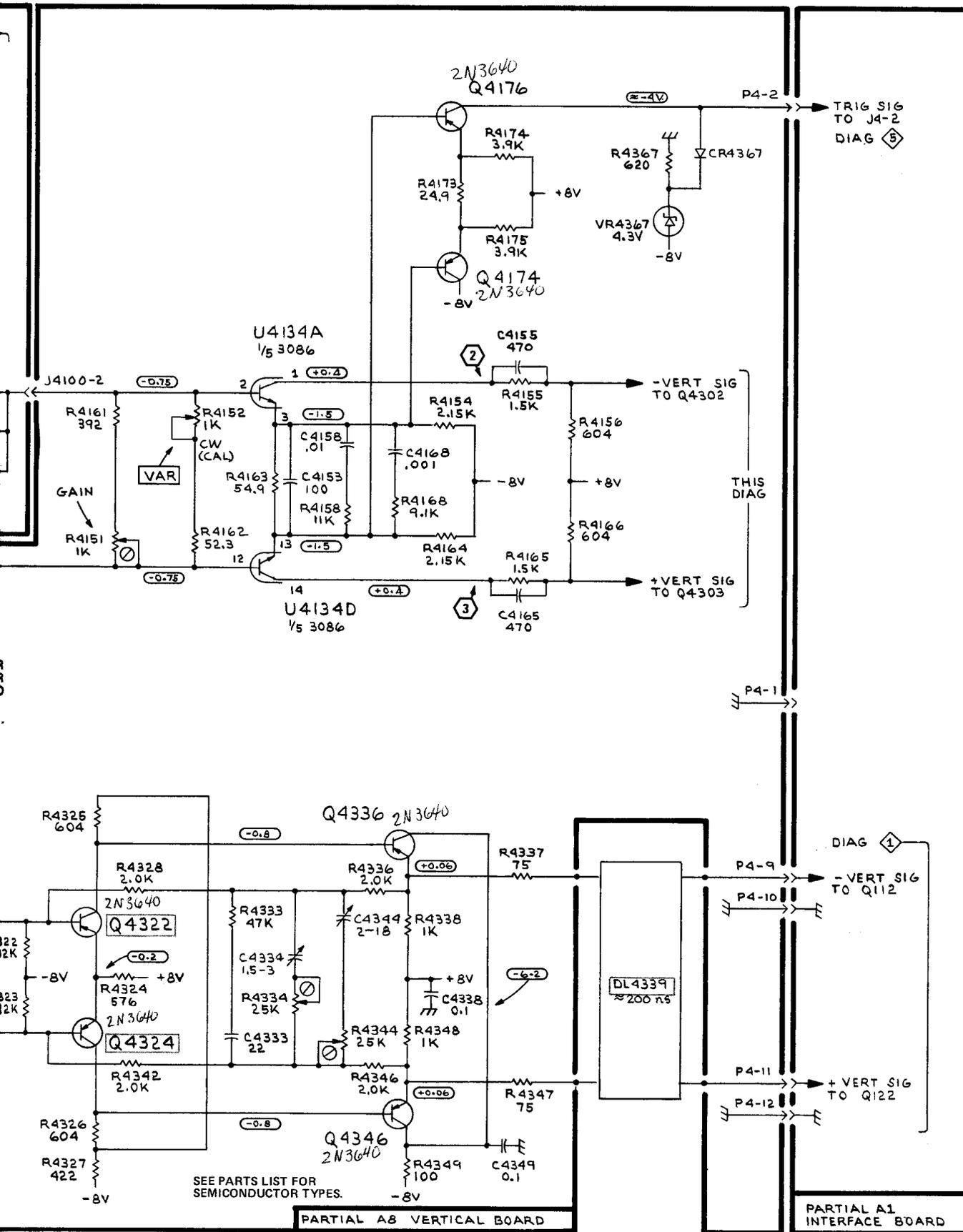
A6 VERTICAL ATTENUATOR BOARD



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



THIS DIAG



VERT INPUT (T922/T922R) CIRCUIT DESCRIPTION

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

INPUT COUPLING SWITCH

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

VOLTS/DIV SWITCH

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

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

The gain switching circuit consists of R4143 through R4147 and three VOLTS/DIV switch contacts. Three preamplifier gains are selected: 1X (maximum), 2.5X reduction, and 5X reduction. Refer to Table 7-2 for the attenuator and gain switching sequence.

PREAMPLIFIER

The signal from the input attenuator is connected to source follower Q4122A via C4123 and R4123. Resistor R4122 determines the 1 M Ω input resistance and R4123 limits current drive to the gate of Q4122A. Diode CR4123 protects the circuit from high negative-going input signals by limiting the voltage at the gate of Q4122A to about -8 volts. The Q4122A gate-drain junction provides protection from high positive-going signals by limiting the gate voltage to about +8 volts. FET Q4122B provides a constant-current source for Q4122A. For some serial numbers, Q4122 substrate (pin 8) is provided with a bias to compensate for possible substrate leakage. This bias is derived by the voltage divider action of R4128 and R4129 between +8 volts and ground.

Transistors U4134B and U4134C are emitter followers. The signal at the emitter of U4134B follows the signal at the gate of Q4122A. Divider network R4143 through R4147 attenuates the signal from U4134B which drives the base of U4134A. DC BAL, R4132, adjusts for minimum trace shift when switching between adjacent positions of the VOLTS/DIV switch.

Paraphase amplifier stage, U4134A and U4134D, converts the single-ended signal at the base of U4134A to a push-pull current signal. These current signals are fed to the delay line driver stage via buffer stages Q4302 and Q4303. The buffer stages isolate the preamplifier from the delay line driver. POSITION control R4306 varies the dc voltage at the bases of Q4322 and Q4324 to vertically position the trace on the crt. Resistors R4155 and R4165 provide compensation to maintain average power during voltage excursions. Capacitors C4155 and C4165 reduce Miller effect through U4134A and U4134D.

The components connected between U4134A and U4134D emitters compensate for high-frequency losses in the preamplifier. Gain adjustment R4151 determines the gain of the preamplifier. The VAR control, R4152, provides uncalibrated deflection factors between VOLTS/DIV switch settings by attenuating the signal to the base of U4134A. When R4152 is rotated clockwise, its full resistance is in series with R4162, and the deflection factors are calibrated.

TABLE 7-2

Attenuator and Gain Switching Sequence

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

TRIGGER PICKOFF

A sample of the vertical voltage signal from the emitters of U4134A and U4134D is applied to Q4176 and Q4174 where it is converted to a current signal. This current signal is applied to the trigger input amplifier (see diagram 5) via trigger source switching circuitry (see diagram 4). When the SOURCE switch is

set to INT, approximately -4 volts from the trigger input amplifier appears at the Q4176 collector circuit, reverse biasing CR4367. When the source switch is set to LINE, EXT, EXT ÷ 10, or X-Y, the internal trigger signal is disconnected from the trigger input amplifier, permitting CR4367 to conduct and set the collector of Q4176 at about -3 volts. This maintains conduction of Q4176, providing a constant load to prevent distortion of the main vertical signal.

V.3

VOLTAGE CONDITIONS

Voltages shown on this schematic digram were measured with a Tektronix DM 501 Digital Multimeter. Voltage measurements can vary as much as $\pm 20\%$. No signals were applied to the vertical or the X (external trigger) input. See Waveform Conditions for T922 or T922R control settings.

WAVEFORM CONDITIONS

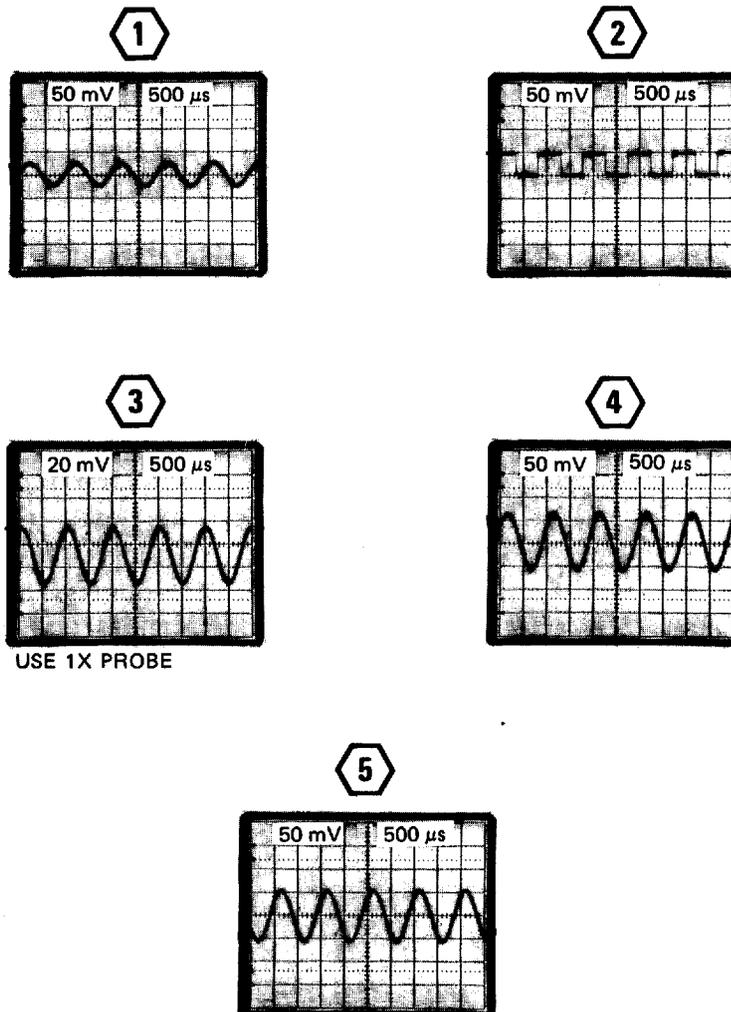
Waveforms below were monitored with a Tektronix 7704A Oscilloscope, 7B71 Time Base, 7A15A Amplifier and 10X probe (unless otherwise noted). The oscilloscope input coupling was set to ac. Waveforms may vary as much as $\pm 20\%$.

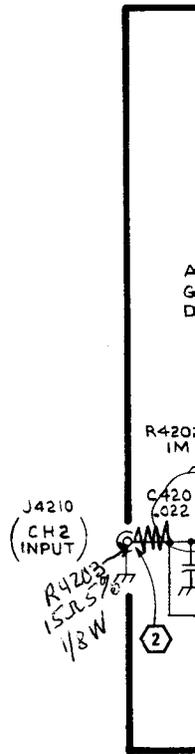
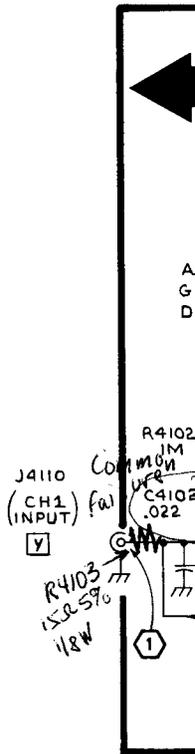
A 1 kHz, 50 mV sine wave was applied to CH 1 input and a 1 kHz, 50 mV square wave was applied to CH 2 input. A Tektronix FG 501 Function Generator provides either of the input waveforms.

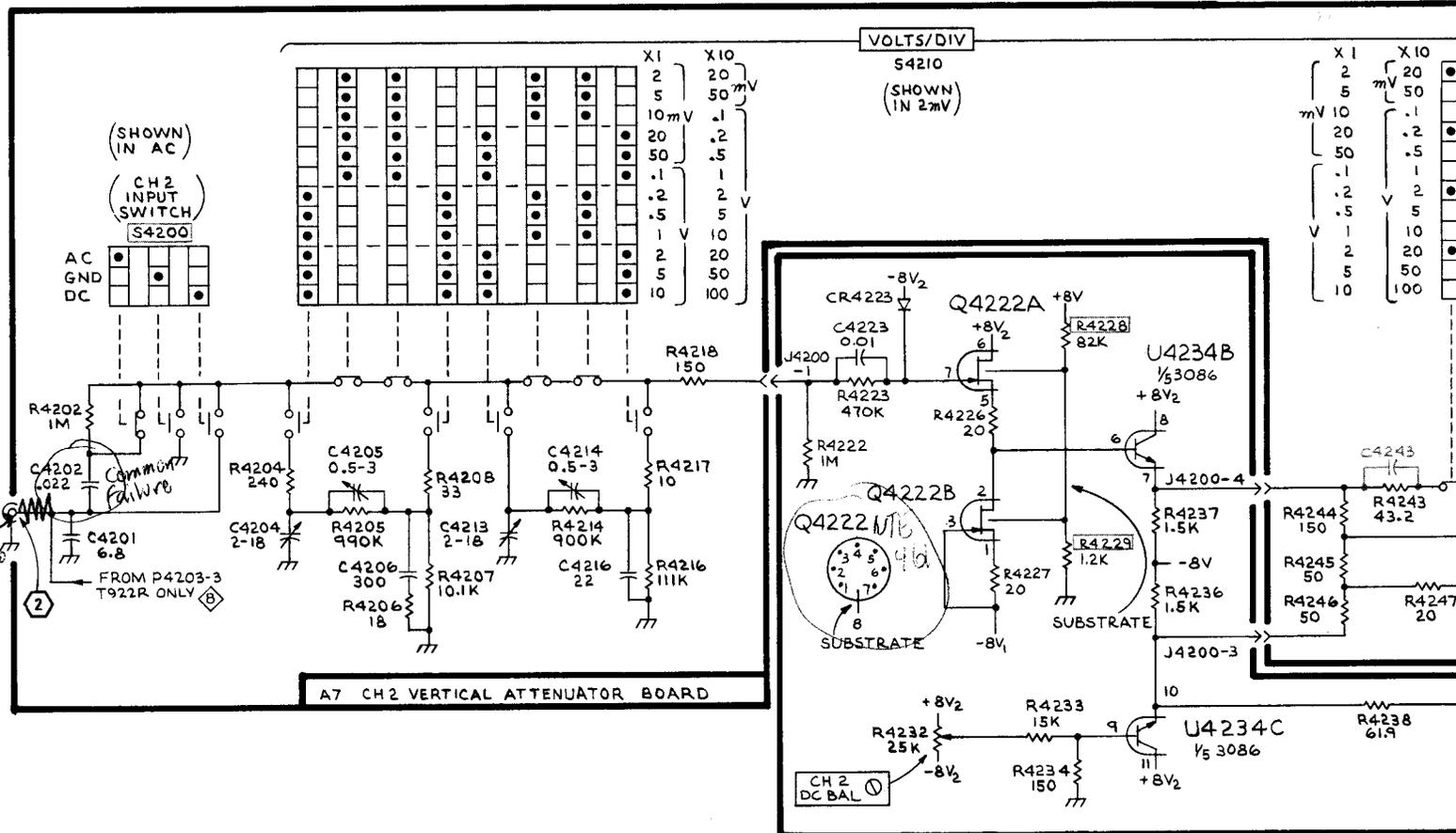
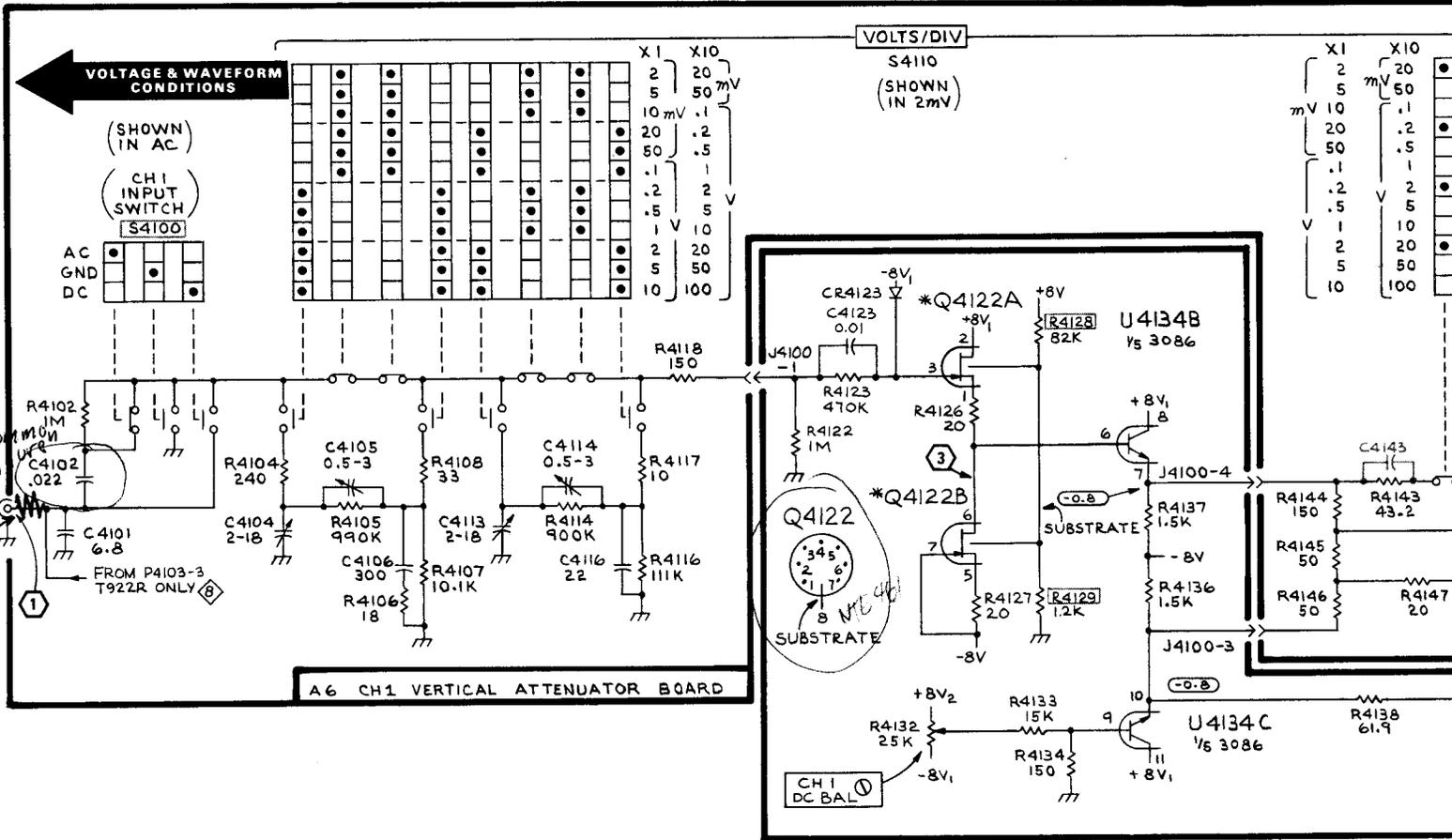
The T922 or T922R controls were set as follows:

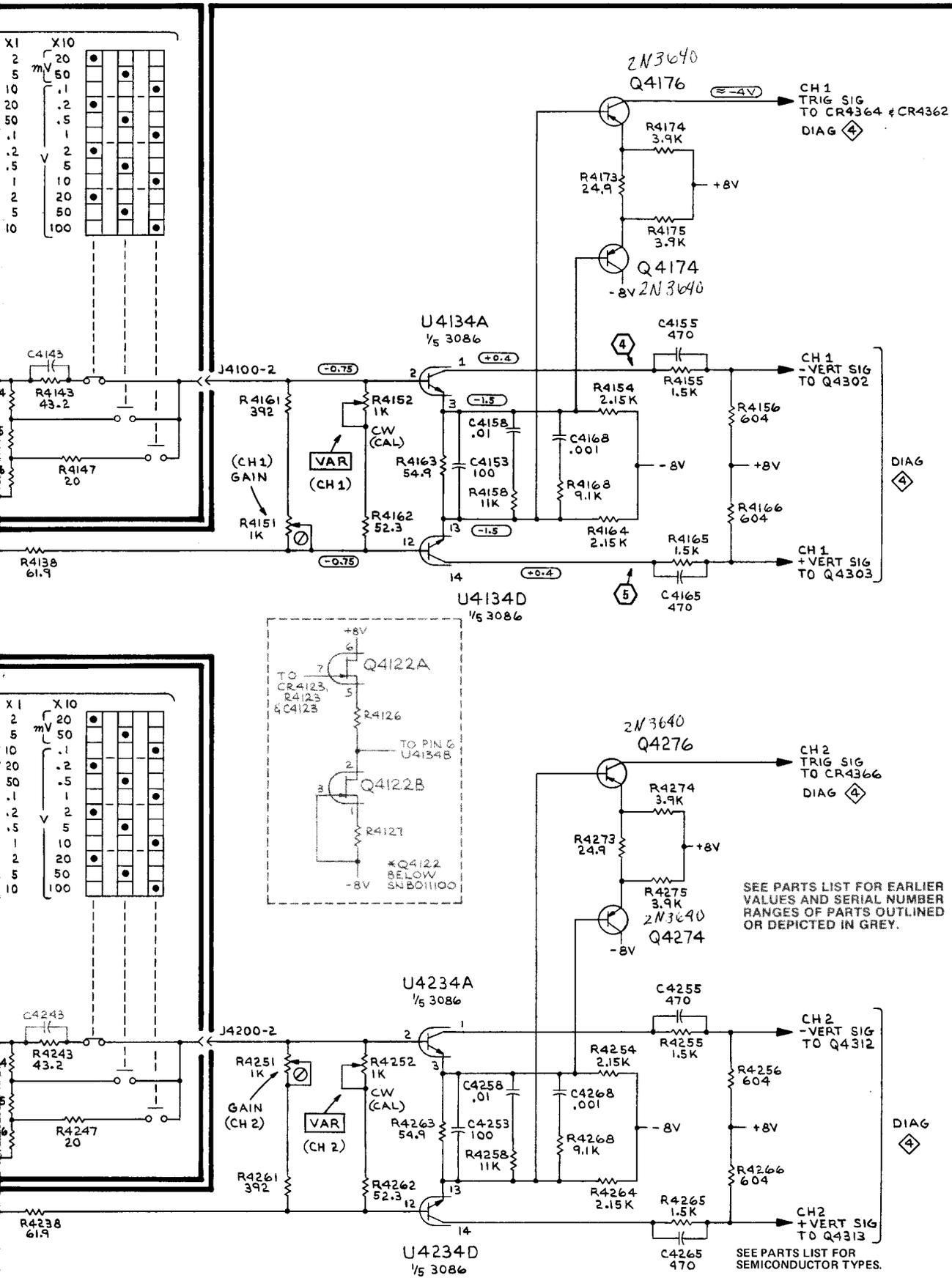
VOLTS/DIV (both)	10 mV
AC-GND-DC (both)	DC
Vertical Mode	CH 1
SOURCE	INT
MODE	AUTO
SLOPE	+OUT
SEC/DIV	.5 ms

The other controls were set as needed to obtain a display.









VERT INPUT (T922/T922R)

PARTIAL A8 VERTICAL BOARD

VERT SWITCHING (T922/T922R) CIRCUIT DESCRIPTION

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

PREAMP BUFFER

The buffer stages Q4302 and Q4303 isolate the preamplifier from the delay line driver.

DELAY LINE DRIVER

The delay line driver is a push-pull feedback amplifier stage composed of Q4322, Q4324, Q4336, Q4346, and associated circuitry. A sample of the output of Q4346 and Q4336 is fed back through R4336-R4328 and R4346-R4342 to the bases of Q4322 and Q4324. Due to this feedback, this stage forms an inverting operational amplifier with a virtual ground at the bases of Q4322 and Q4324. Any current into these virtual grounds (null points) causes an output voltage at the emitters of Q4336 and Q4346 that is proportional to the feedback resistance.

Components C4333, C4334, C4344, R4333, R4334, and R4344 provide compensation (peaking) to correct for delay line losses.

DELAY LINE

The delay line, DL4339, provides approximately 200 ns delay in the vertical signal. This allows the sweep generator circuit time to initiate a sweep before the vertical signal reaches the crt vertical deflection plates.

VERTICAL SWITCHING

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

The diode gates, consisting of four diodes each, act as switches that allow either of the vertical preamplifier signals to be coupled to the delay line driver. Diodes CR4302, CR4303, CR4304, and CR4305 control the CH 1 output; CR4312, CR4313, CR4314, and CR4315 control the CH 2 output. These diodes are controlled by flip-flop U4364A, which in turn is controlled by Vertical Mode switch, S4370.

When the Vertical Mode switch is in the CH 1 position, pin 4 of U4364A is held LO, causing pin 5 to go HI. A HI at pin 5 (a voltage higher than at the bases of Q4322 and Q4324) reverse biases CR4302 and CR4303 and forward biases CR4304 and CR4305. This allows the CH 1 signal to pass to the delay line driver. When pin 5 is HI, pin 6 is LO, causing the cathodes of CR4312 and CR4313 to be connected to a voltage much lower than on the bases of Q4322 and Q4324. Diodes CR4312 and CR4313 are now forward biased and diodes CR4314 and CR4315 are reverse biased, preventing the CH 2 signal from passing to the delay line driver.

In the CH 2 mode, the above conditions are reversed. Diodes CR4312 and CR4313 are reverse biased, passing the CH 2 signal and blocking the CH 1 signal.

In the DUAL TRACE Vertical Mode, CH 1 and CH 2 are alternately connected to the delay line driver. There are two dual trace modes: chopped and alternate. These modes are determined by the SEC/DIV switch setting. Chopped mode is obtained for sweep speeds of 1 ms and slower and alternate for sweep speeds of 0.5 ms and faster.

In the chopped mode pin 2 of U4376A is ungrounded, allowing the multivibrator, U4376A and U4376D, to free run at about 250 kHz. The output at pin 8 of U4376C serves as a clock pulse for U4364A, which in turn switches the diode gates at the 250 kHz rate. The clock pulse is also fed to U4364B, which provides an output pulse to the Z Axis amplifier to blank out the transition between CH 1 and CH 2 traces. If pin 13 of U4364B goes LO, the output pin 9 is set LO, causing pin 6 of U4376B to go HI. This causes pin 13 of U4364A to go HI after being delayed by C4386 charging through R4386.

The clock pulse applied to pin 11 of U4364B causes pin 9 to go HI, which in turn, after passing through the inverter and after some delay, sets pin 13 LO again. This causes pin 9 to go LO again. The positive-going voltage pulse (whose width is determined by R4386 and C4386) is converted to current by R4385-R4384 and sent to the Z Axis Amplifier to blank switching transients.

In the alternate mode, pin 2 of U4376A is grounded, preventing multivibrator operation, thus keeping pin 10 of U4376C HI. At the end of each sweep, the base of Q4372 receives a current pulse, driving it into saturation. The resulting negative-going pulse at the collector is fed through C4372 to pin 9 of U4376C causing pin 8 to go HI. This in turn switches U4364A to pass either CH 1 or CH 2 to the delay line driver at the end of each sweep. Pin 12 of U4364B is grounded through the SEC/DIV switch and prevents an output at pin 9.

The Vertical Mode switch also selects the appropriate internal triggering source for CH 1 and CH 2. With the Vertical Mode switch set to CH 1 and DUAL TRACE, CR4364 is forward biased and the signal from the CH 1 trigger pickoff goes to the sweep circuit. In these modes, CR4363 is connected to the -8 volts, thus reverse biasing CR4366, preventing the CH 2 trigger signal from entering the trigger input amplifier. With the Vertical Mode switch set to CH 2, CR4366 becomes forward biased while CR4364 is reverse biased because CR4362 is now connected to -8 volts.

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VI.2

VOLTAGE CONDITIONS

Voltages shown on this schematic diagram were measured with a Tektronix DM 501 Digital Multimeter. Voltage measurements can vary as much as $\pm 20\%$. No signals were applied to the vertical or the X (external trigger) input. See Waveform Conditions for T922 or T922R control settings.

WAVEFORM CONDITIONS

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

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

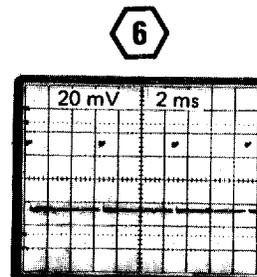
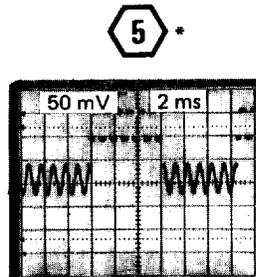
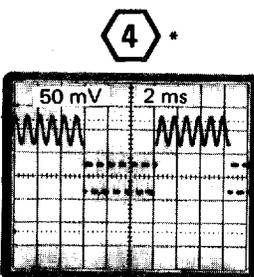
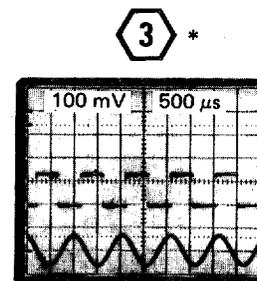
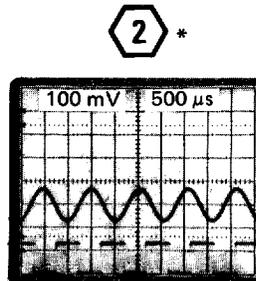
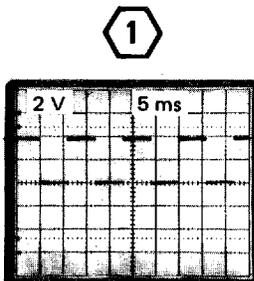
The T922 or T922R controls were set as follows:

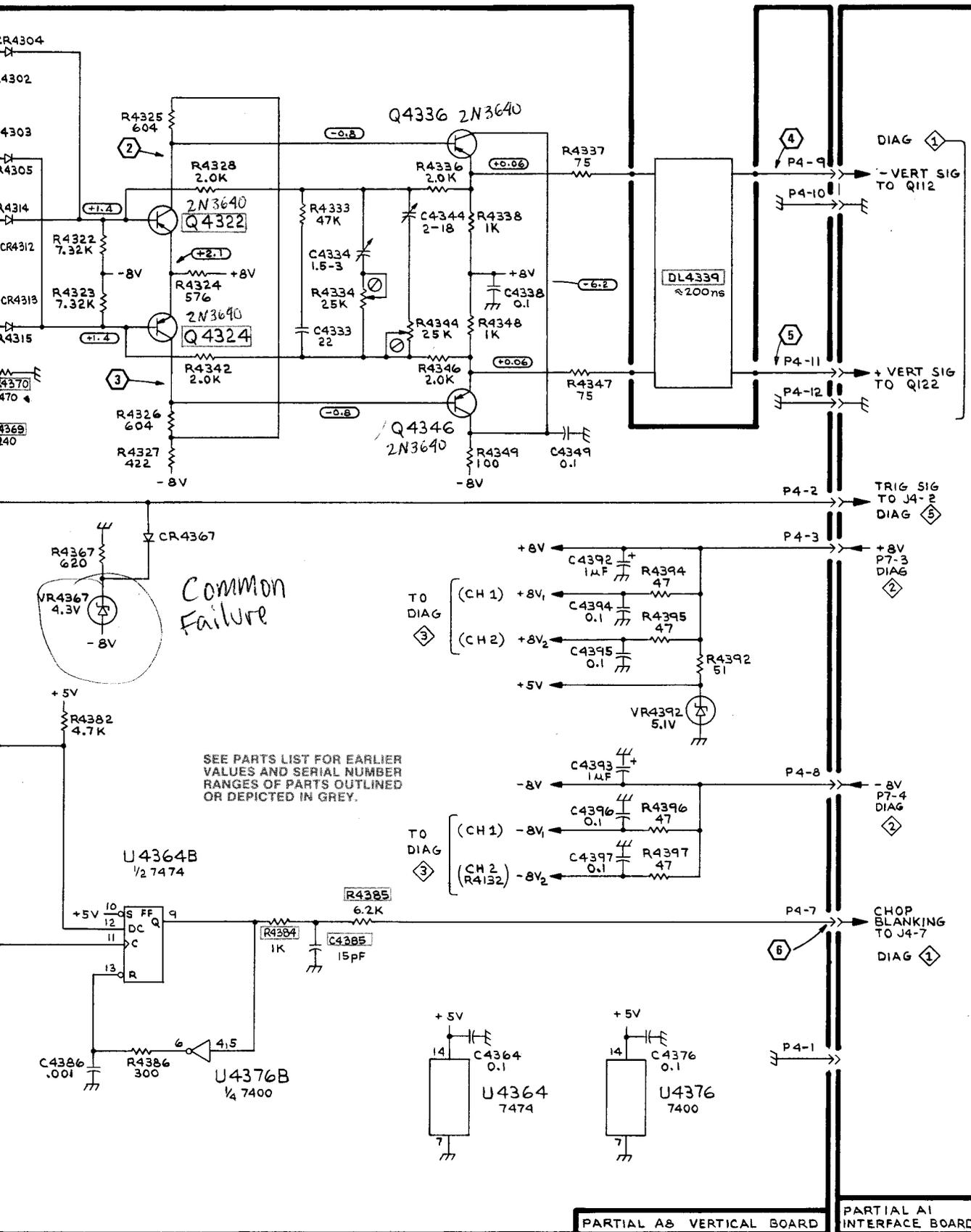
VOLTS/DIV (both)	20 mV
AC-GND-DC (both)	DC
Vertical Mode	DUAL TRACE
SOURCE	INT
MODE	AUTO
SLOPE	+OUT
SEC/DIV	.5 ms
LEVEL	As required

The other controls were set as needed to obtain a display.

The CH 1 POSITION control was adjusted so that the bottom of the sine wave was on the first horizontal graticule line above the center and the CH 2 POSITION control was adjusted so that the top of the square wave was on the first horizontal graticule line below the center.

*Screen positions for waveforms 2, 3, 4, and 5 are affected by settings of the T922 or T922R POSITION controls.





VERT SWITCHING (T922/T922R) 4

TRIGGER CIRCUIT DESCRIPTION

(For T921 SN B010130-up, T922 B010170-up & T922R all SN)

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

INPUT AND SWITCHING

SOURCE Switch

The SOURCE switch, S2100, selects trigger signals from INT, LINE, X-Y, EXT, and EXT.
10

INT. Signal from the trigger pickoff circuit in the vertical amplifier is connected to the trigger input amplifier, U2126B.

LINE. A sample of the line voltage, obtained from the power transformer, is connected to the trigger input amplifier U2126B.

EXT. Externally applied signals pass through buffer amplifier Q2104-Q2106. FET Q2104 is a source follower and Q2106 is a current source. Transistor Q2108 and R2107 convert the voltage signal at the buffer output to a current for application to the trigger input amplifier. When EXT is selected, the collector of Q2108 is connected to the trigger input amplifier (U2126B) by SOURCE switch S2100.

EXT

10. The output of buffer amplifier Q2104-Q2106 is connected to R2111. Resistor R2111 converts the buffer output voltage to a current that is connected to the trigger input amplifier via S2100.

X-Y. Signals from the X (EXT) input are routed to the horizontal amplifier via Q2104, S2100, and CR2186. The SOURCE switch connects +8 volts to R2184, forward biasing CR2186 and providing current to the horizontal amplifier to center the crt display. Also, +8 volts is applied to CR2182 and R2134 to switch the sweep into the NORM mode and to disable the trigger circuit.

MODE Switch

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

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

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

TV. The trigger signal is applied to the TV sync separator circuit (U2126E, Q2174, Q2176) and the normal trigger generator circuit is disabled. In this mode, the SLOPE switch is used to supply the sync separator with a signal of the proper polarity. For SEC/DIV settings of .1 ms/div or slower, the sweep is triggered by vertical sync pulses which occur at a field rate. For SEC/DIV settings of 50 μ s and faster, the sweep is triggered by the TV horizontal line signals.

TRIGGER INPUT AMPLIFIER

The trigger input amplifier consists of U2126A, U2126B, Q2124, and associated circuitry. Resistors R2127 and R2128 set the amplifier input at -4 volts. The inverting configuration and feedback from the emitter of Q2124 form an inverting operational amplifier with a null point at the base of U2126B. Any current into the null point produces a voltage at the output proportional to the feedback resistor, R2123. Diode CR2124 prevents the emitter of Q2124 from going below ground and reversing the voltage across C2132.

TRIGGER LEVEL COMPARATOR

Differential amplifier Q2134-Q2136 functions as a comparator. The LEVEL control R2138 selects the point on the waveform that starts a sweep. Capacitor C2132 couples the trigger signal to the comparator. As the trigger signal at the base of Q2134 passes through the same voltage level as the base of Q2136 (set by LEVEL control), the signal at the collector of U2126D passes through the threshold (about 1 volt) of Schmitt trigger U2156A-U2156B, producing a logic trigger signal. The trigger signals at the collectors of Q2134 and Q2136 are of opposite polarity. This allows the SLOPE switch S2140 to invert the signals applied to TV trigger input amplifier U2126E and normal trigger input amplifier U2126D, C. When the SLOPE switch is in the +OUT position, the output at the collector of U2126D is in phase with the trigger source signal. Transistors U2126D and U2126C convert the current signal from the collector of Q2134 or Q2136 to a voltage signal for triggering the Schmitt trigger.

TV TRIGGER CIRCUIT

The TV trigger circuit comprises U2126E, Q2174, Q2176, U2156B, C, D, and associated circuitry. When the MODE switch is in TV, R2161 is disconnected from +8 volts, which allows trigger signals from the collectors of Q2134 and Q2136 to pass through the TV trigger circuit. (In AUTO & NORM, the +8 volts applied to R2161 biases U2126E to saturation.)

Transistor U2126E is a high gain feedback amplifier. To achieve stable triggering on TV signals, the LEVEL control must be set at a point that will allow the sync pulses to appear within the dynamic range of the amplifier.

The sync separator circuit consists of Q2174 and associated circuitry. It processes sync-positive pulses when the SLOPE switch is in the +OUT position and sync-negative pulses in the -IN position. Transistor Q2174 produces large positive-going pulses from negative-going sync signals at the collector of U2126E.

In the TV field mode (SEC/DIV switch set for .1 ms or slower), Q2176 is saturated (since base is grounded), and the integrator (composed of C2174, C2176, R2174, and R2176) is switched into the circuit (effectively connected to +8 volts through saturated Q2176). The integrator filters out the horizontal sync pulses, leaving only the integrated vertical sync pulses, which trigger the TV Schmitt trigger U2156B and U2156C.

In the TV line mode (SEC/DIV switch set for 50 μ s or faster), Q2176 is turned off (base open), disconnecting C2174 and C2176 from +8 volts. Capacitors C2174 and C2176 no longer integrate the pulses, thus allowing both the horizontal and vertical sync pulses to pass through to the TV Schmitt trigger.

SCHMITT TRIGGERS

The Schmitt trigger for the NORM and AUTO triggering modes consists of U2156A, U2156B, and associated circuitry. Hysteresis of this trigger circuit is determined by R2152, R2153, and R2147.

The Schmitt trigger for the TV triggering mode is U2156B, U2156C, U2156D, and associated circuitry. Resistors R2154 and R2178 determine the sensitivity.

When the MODE switch S2150 is in AUTO or NORM, +8 volts is applied to R2156 which causes pin 1 of U2156A to go HI, enabling Schmitt trigger U2156A-U2156B. At the same time, pins 12 and 13 of U2156D are also HI disabling Schmitt trigger U2156C-U2156B. A trigger signal from U2126D triggers Schmitt trigger U2156A-U2156B to produce a logic trigger signal at pin 6 of U2156B.

When the MODE switch S2150 is in TV, +8 volts is removed from R2156 and pin 1 of U2156A is LO, disabling Schmitt trigger U2156A-U2156B. Pins 12 and 13 of U2156D are LO, enabling Schmitt trigger U2156C-U2156B. The trigger signal from the TV sync separator triggers Schmitt trigger U2156C-U2156B to produce a logic trigger signal at pin 6 of U2156B.

VII.3

VOLTAGE CONDITIONS

Voltages shown on this schematic diagram were measured with a Tektronix DM 501 Digital Multimeter. Voltage measurements can vary as much as $\pm 20\%$. No signals were applied to the vertical input or the X (external trigger) input. Refer to Waveform Conditions for T922 or T922R control settings.

WAVEFORM CONDITIONS

NOTE

Waveforms are for T922 unless otherwise noted.

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

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

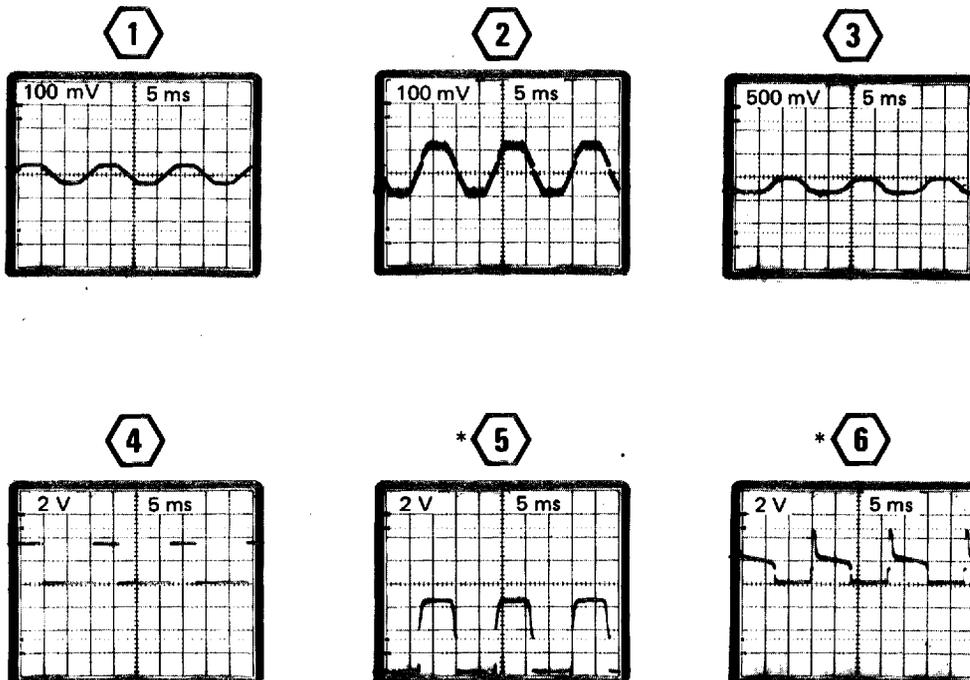
The T921, T922, or T922R controls were set as follows:	VOLTS/DIV (both)	20 mV
	AC-GND-DC (both)	DC
	Vertical Mode	DUAL TRACE
	SOURCE	LINE
	MODE	AUTO*
	SLOPE	+OUT
	SEC/DIV	.5 ms

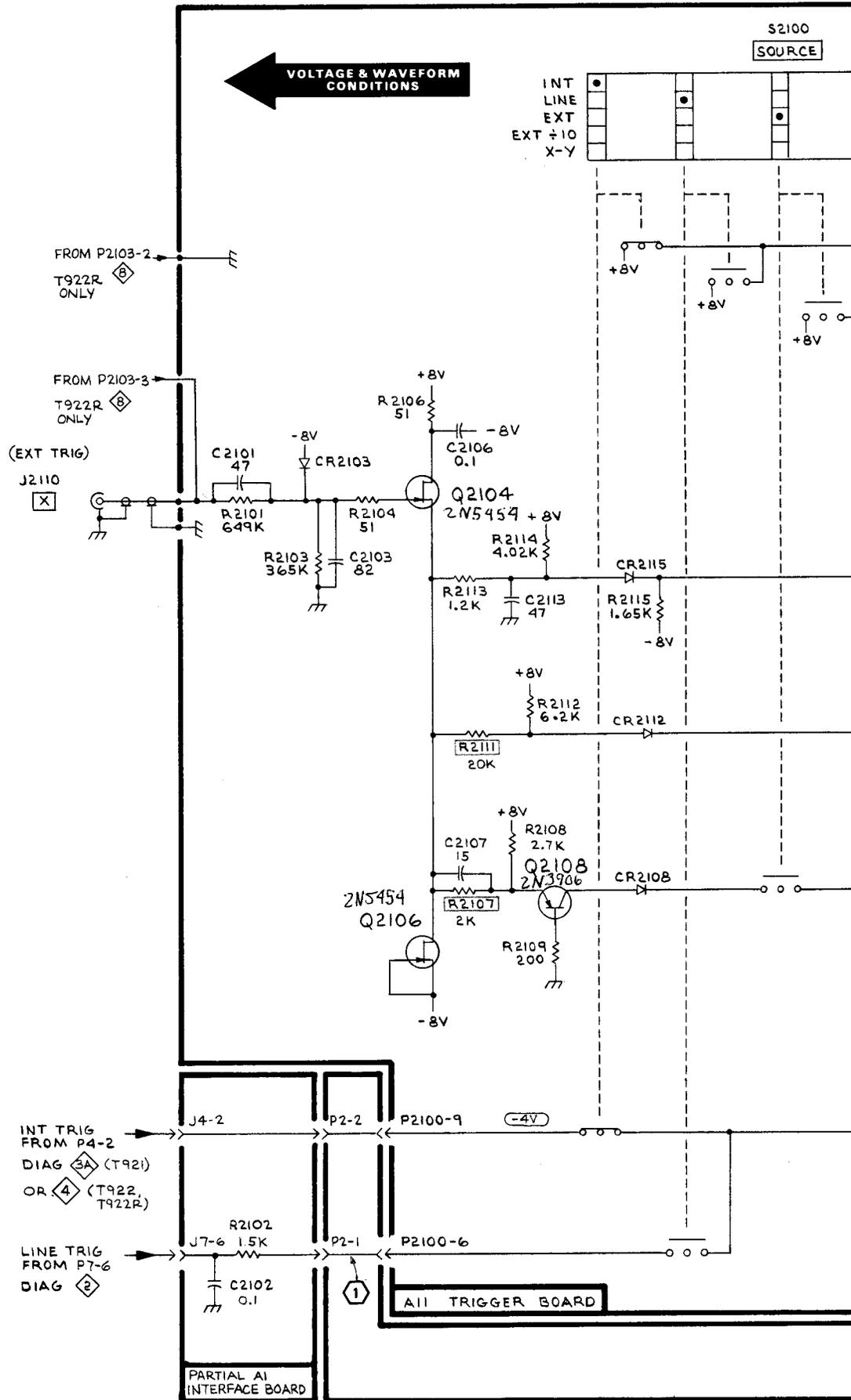
The other controls were set as needed to obtain a display.

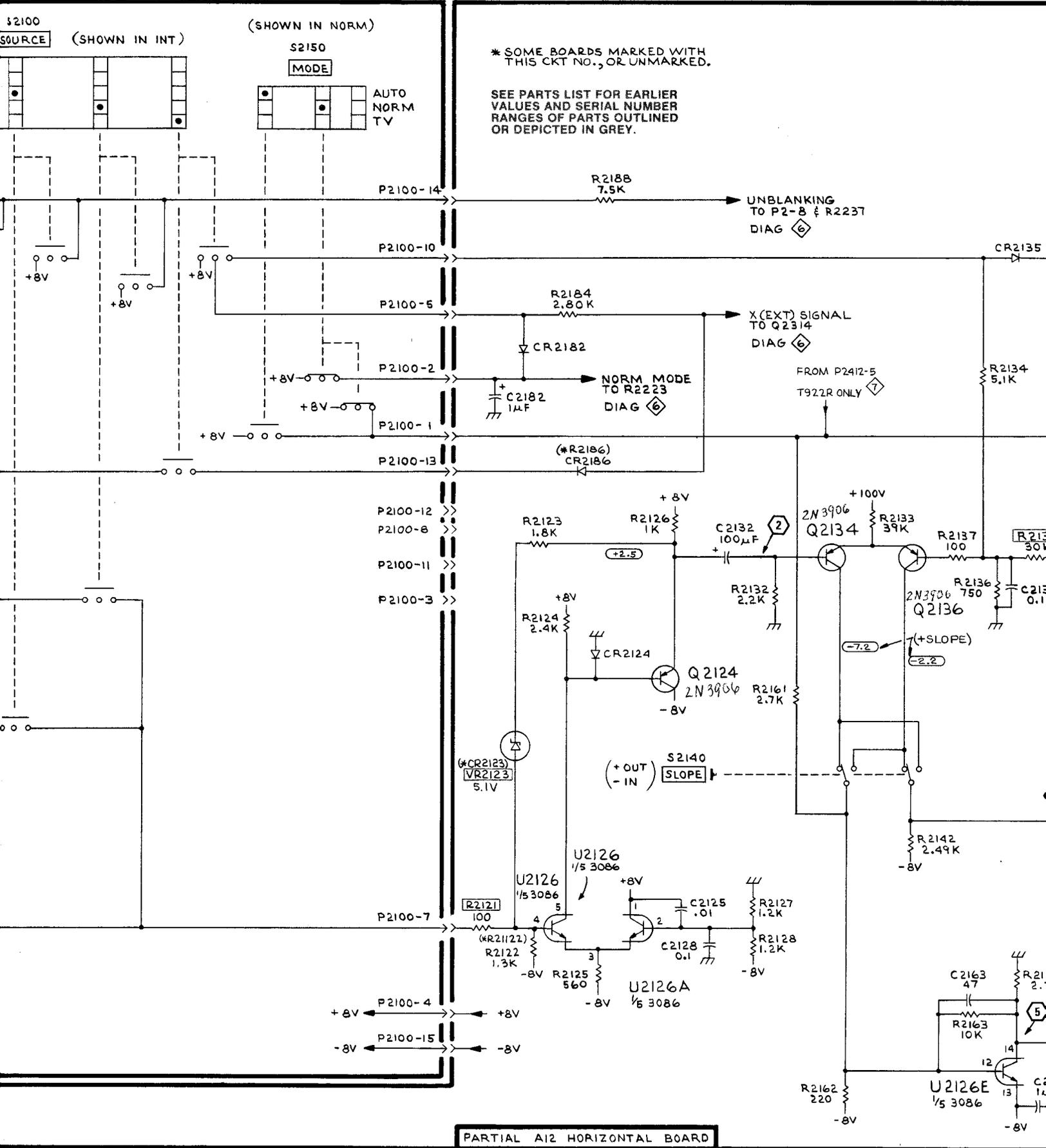
*For waveforms 5 and 6, the MODE switch was set to TV.

NOTE

To obtain voltages and waveforms on the Horizontal board, the Vertical Amplifier must be operated separately from the instrument, using a Vertical Amplifier Extender Troubleshooting Fixture. See Troubleshooting Equipment and Vertical Amplifier Replacement in the Service Information section of this manual.



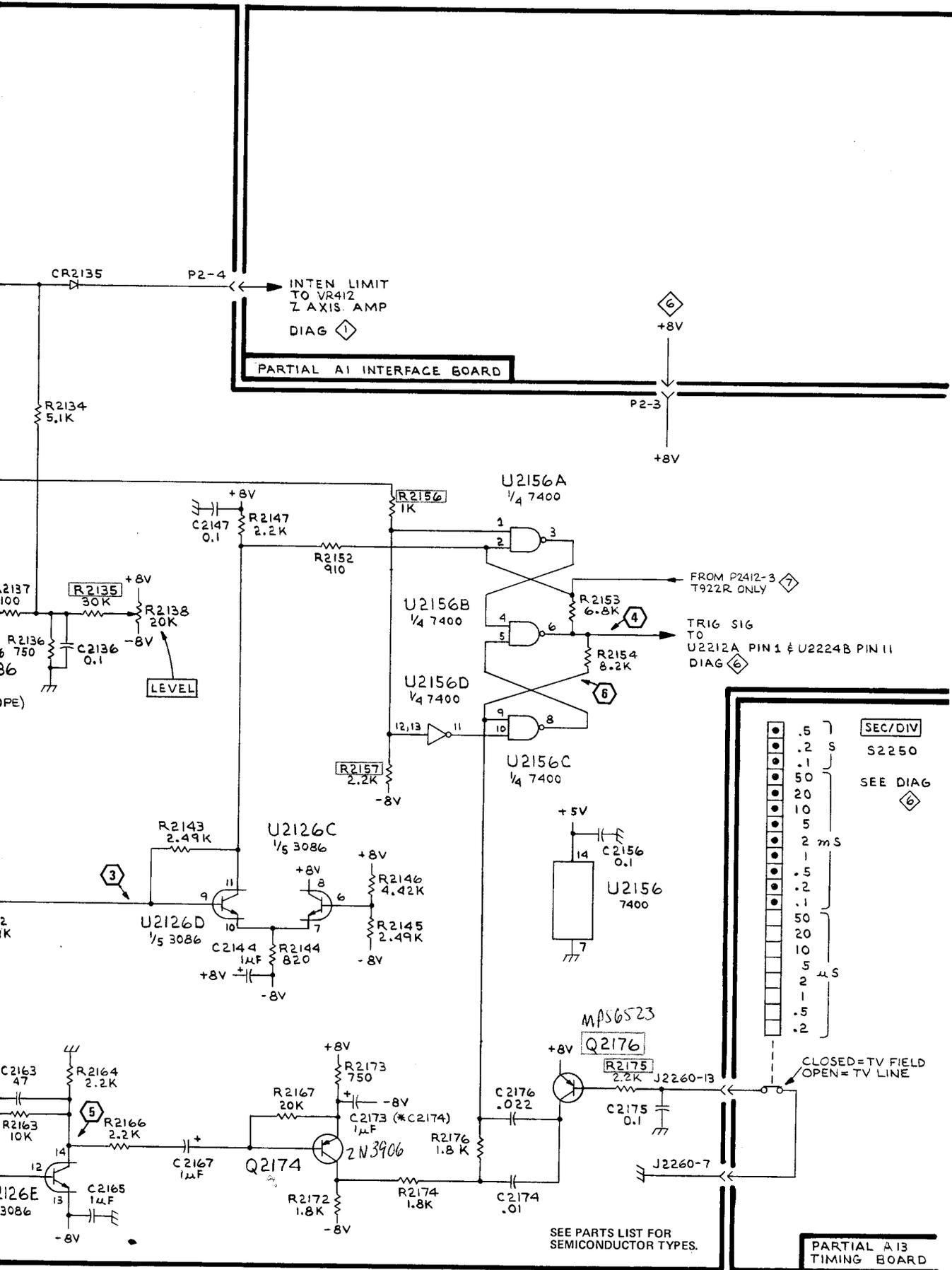




* SOME BOARDS MARKED WITH THIS CKT NO., OR UNMARKED.

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

PARTIAL A12 HORIZONTAL BOARD



TRIGGER CIRCUIT DESCRIPTION

(For T921 Below SN B010130 and T922 Below SN B010170)

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

INPUT AND SWITCHING

SOURCE Switch

The SOURCE switch, S2100, selects trigger signals from INT, LINE, X-Y, EXT, and EXT.
10

INT. Signal from the trigger pickoff circuit in the vertical amplifier is connected to the trigger input amplifier U2126B.

LINE. A sample of the line voltage, obtained from the power transformer, is connected to the trigger input amplifier U2126B.

EXT. External trigger signals applied to J2110 external trigger (X) input are connected to the trigger input amplifier, U2126B, via input buffer amplifier Q2114-Q2116 and coupling capacitor C2123. Diode CR2116 protects Q2114 from large negative-going trigger signals. (The Q2114 gate-drain junction provides protection from large positive-going signals by limiting the Q2114 gate voltage to about +8 volts.) Transistor Q2116 provides a relatively constant current source for Q2114. Resistor R2111 sets the external trigger sensitivity and converts the voltage signal to a current signal.

EXT
10 . Resistors R2119 and R2120, with R2111, form a current divider to attenuate the external trigger signal by a factor of 10. Diodes CR2115 and CR2186 form a current switch that prevents external trigger signals from coupling into the horizontal amplifier in EXT and EXT.
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X-Y. Signals from the X (EXT) input are routed to the horizontal amplifier via Q2114, S2110, and CR2186. The SOURCE switch connects +8 volts to R2184, forward biasing CR2186 and providing current to the horizontal amplifier to center the crt display. Also, +8 volts is applied to CR2182 and R2134 to switch the sweep into the NORM mode and to disable the trigger circuit.

MODE Switch

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

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

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

TV. The trigger signal is applied to the TV sync separator circuit (U2126E, Q2174, Q2176) and the normal trigger generator circuit is disabled. In this mode, the SLOPE switch is used to supply the sync separator with a signal of the proper polarity. For SEC/DIV settings of .1 ms/div or slower, the sweep is triggered by vertical sync pulses which occur at a field rate. For SEC/DIV settings of 50 μ s and faster, the sweep is triggered by the TV horizontal line signals.

TRIGGER INPUT AMPLIFIER

The trigger input amplifier consists of U2126A, U2126B, Q2124, and associated circuitry. Resistors R2127 and R2128 set the amplifier input at -4 volts. The inverting configuration and feedback from the emitter of Q2124 form an inverting operational amplifier with a null point at the base of U2126B. Any current into the null point produces a voltage at the output proportional to the feedback resistor R2123. Diode CR2124 prevents the emitter of Q2124 from going below ground and reversing the voltage across C2132.

TRIGGER LEVEL COMPARATOR

Differential amplifier Q2134-Q2136 functions as a comparator. The LEVEL control R2138 selects the point on the waveform that starts a sweep. Capacitor C2132 couples the trigger signal to the comparator. As the trigger signal at the base of Q2134 passes through the same voltage level as the base of Q2136 (set by LEVEL control), the signal at the collector of U2126D passes through the threshold (about 1 volt) of Schmitt trigger U2156A-U2156B producing a logic trigger signal. The trigger signals at the collectors of Q2134 and Q2136 are of opposite polarity. This allows the SLOPE switch S2140 to invert the signals applied to the TV trigger input amplifier U2126E and the normal trigger input amplifier U2126D, C. When the SLOPE switch is in the +OUT position, the output at the collector of U2126D is in phase with the trigger source signal. Transistors U2126D and U2126C convert the current signal from the collector of Q2134 or Q2136 to a voltage signal for triggering the Schmitt trigger.

TV TRIGGER CIRCUIT

The TV trigger circuit comprises U2126E, Q2174, Q2176, U2156B, C, D, and associated circuitry. When the MODE switch is in TV, R2161 is disconnected from +8 volts which allows trigger signals from the collectors of Q2134 and Q2136 to pass through the TV trigger circuit. (In AUTO and NORM, the +8 volts applied to R2161 biases U2126E to saturation.)

Transistor U2126E is a high gain feedback amplifier. To achieve stable triggering on TV signals, the LEVEL control must be set at a point that will allow the sync pulses to appear within the dynamic range of the amplifier.

The sync separator circuit consists of Q2174 and associated circuitry. It processes sync-positive pulses when the SLOPE switch is in the +OUT position and sync-negative pulses in the -IN position. Transistor Q2174 produces large positive-going pulses from negative-going sync signals at the collector of U2126E.

In the TV field mode (SEC/DIV switch set for .1 ms or slower), Q2176 is saturated (since base is grounded), and the integrator (composed of C2174, C2176, R2174, and R2176) is switched into the circuit (effectively connected to +8 volts through saturated Q2176). The integrator filters out the horizontal sync pulses, leaving only the integrated vertical sync pulses, which trigger the TV Schmitt trigger U2156B and U2156C.

In the TV line mode (SEC/DIV switch set for 50 μ s or faster), Q2176 is turned off (base open), disconnecting C2174 and C2176 from +8 volts. Capacitors C2174 and C2176 no longer integrate the pulses, thus allowing both the horizontal and vertical sync pulses to pass through to the TV Schmitt trigger.

SCHMITT TRIGGERS

The Schmitt trigger for the NORM and AUTO triggering modes consists of U2156A, U2156B, and associated circuitry. Hysteresis of this trigger circuit is determined by R2152, R2153, and R2147.

The Schmitt trigger for the TV triggering mode is U2156B, U2156C, U2156D, and associated circuitry. Resistors R2154 and R2178 determine the sensitivity.

When the MODE switch S2150 is in AUTO or NORM, +8 volts is applied to R2156 which causes pin 1 of U2156A to go HI, enabling Schmitt trigger U2156A-U2156B. At the same time, pins 12 and 13 of U2156D are also HI disabling Schmitt trigger U2156C-U2156B. A trigger signal from U2126D triggers Schmitt trigger U2156A-U2156B to produce a logic trigger signal at pin 6 of U2156B.

When the MODE switch S2150 is in TV, +8 volts is removed from R2156 and pin 1 of U2156A is LO, disabling Schmitt trigger U2156A-U2156B. Pins 12 and 13 of U2156D are LO, enabling Schmitt trigger U2156C and U2156B. The trigger signal from the TV sync separator triggers Schmitt trigger U2156C-U2156B to produce a logic trigger signal at pin 6 of U2156B.

VIII.3

VOLTAGE CONDITIONS

Voltages shown on this schematic diagram were measured with a Tektronix DM 501 Digital Multimeter. Voltage measurements can vary as much as $\pm 20\%$. No signals were applied to the vertical input or the X (external trigger) input. Refer to Waveform Conditions for T921, T922, or T922R control settings.

WAVEFORM CONDITIONS

NOTE

Waveforms are for T922 unless otherwise noted.

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

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

The T921, T922, or T922R controls were set as follows:

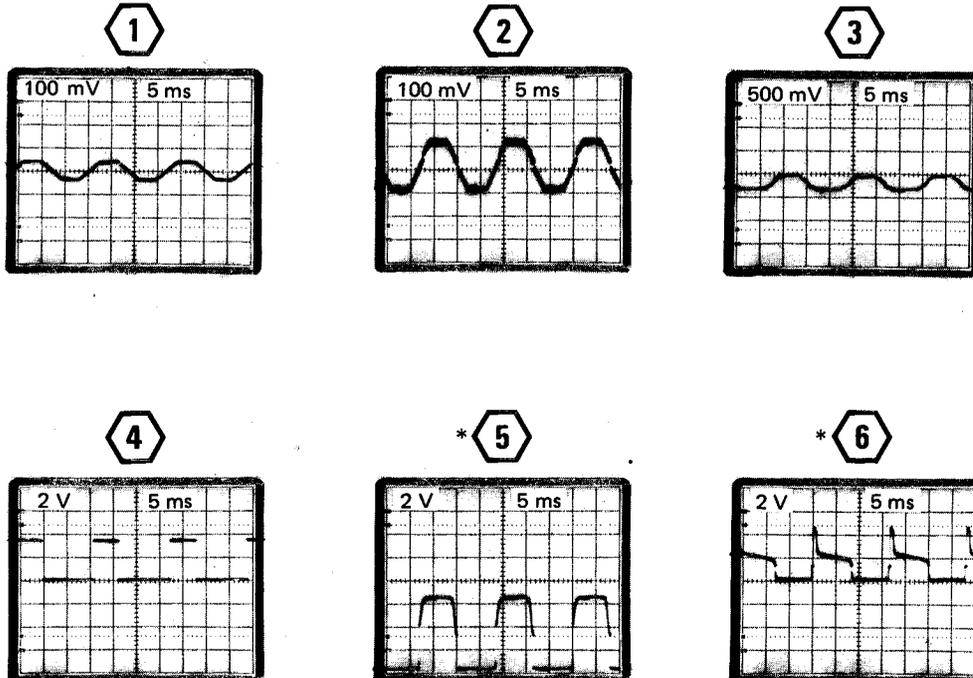
VOLTS/DIV (both)	20 mV
AC-GND-DC (both)	DC
Vertical Mode	DUAL TRACE
SOURCE	LINE
MODE	AUTO*
SLOPE	+OUT
SEC/DIV	.5 ms

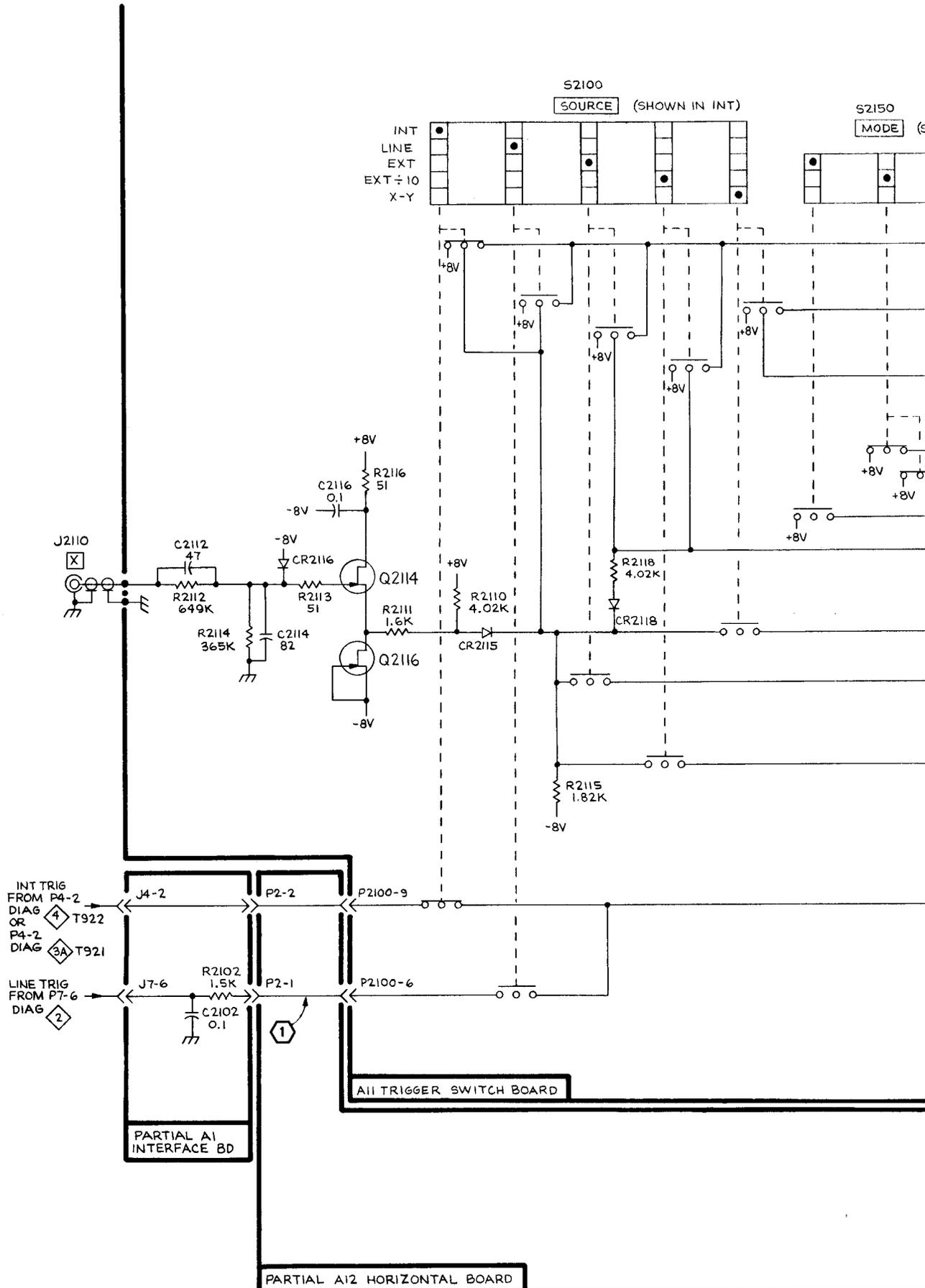
The other controls were set as needed to obtain a display.

*For waveforms 5 and 6, the MODE switch was set to TV.

NOTE

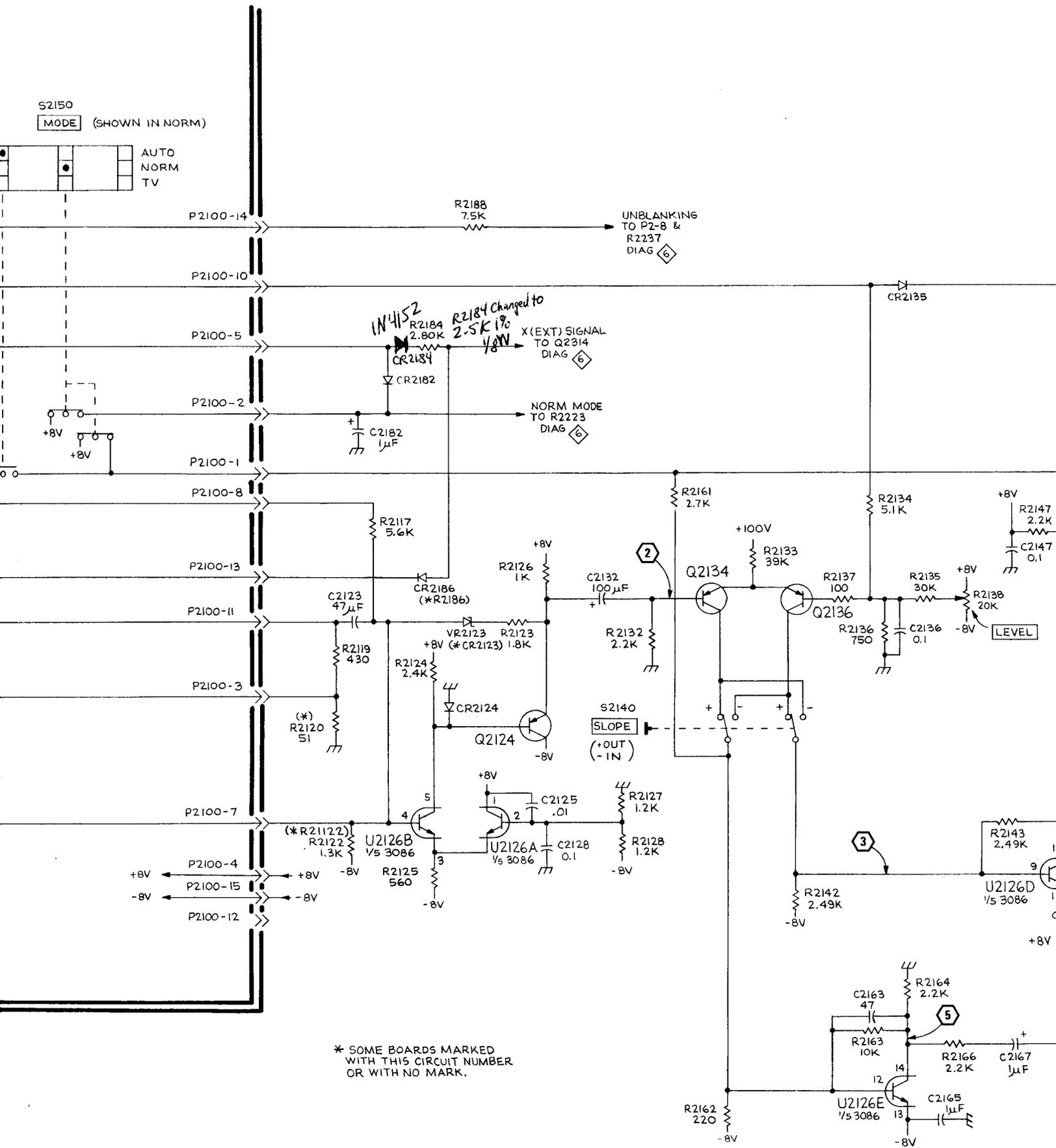
To obtain voltages and waveforms on the Horizontal board, the Vertical Amplifier must be operated separately from the instrument, using a Vertical Amplifier Extender Troubleshooting Fixture. See Troubleshooting Equipment and Vertical Amplifier Replacement in the Service Information section of this manual.





T921/T922/T922R

TRIGGER FOR T921 BELOW SN B010130 & T



* SOME BOARDS MARKED WITH THIS CIRCUIT NUMBER OR WITH NO MARK.

SWEEP AND HORIZ AMPL CIRCUIT DESCRIPTION

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

SWEEP

The sweep is produced by a Miller Integrator circuit consisting of Q2242, Q2244, and Q2246. A sweep ramp is initiated at the collector of Q2246 when pin 3 of U2234A goes LO and is terminated when pin 3 goes HI (see Timing diagram, Fig. 7-2).

In the NORM triggering mode, pin 2 of U2212A is HI, allowing a positive-going trigger signal at pin 1 of U2212A through U2212D and U2234C to cause pin 3 of U2234A to go LO. This reverse biases CR2233 and CR2234 and allows the timing capacitor (selected by the SEC/DIV switch, S2250) to charge, producing a sweep ramp at the collector of Q2246. When the sweep ramp reaches about 12 volts, Q2274 turns on. This causes pin 7 of U2224A to go LO, pin 8 of U2234C to go LO and pin 3 of U2234A to go HI. When pin 3 of U2234A goes HI, CR2233 and CR2234 are forward biased, terminating the sweep. Pin 7 of U2224A remains LO for a length of time (holdoff time) determined by C2275, C2274, R2275, and R2279. Three holdoff times are selected by the SEC/DIV switch S2250. After the selected holdoff time, pin 7 goes HI. This allows the next trigger signal to switch pin 3 of U2234A LO and again start the sweep.

In the AUTO triggering mode, when no trigger signal occurs at pin 11 of U2224B for about 50 ms, pin 10 of U2224B goes LO, causing the sweep to start after the holdoff time ends. This allows the sweep to free run and provide a reference display. When a trigger signal is present, pin 11 of U2224B goes HI, then LO (when trigger signal ends), and the time constant of C2226-R2226 prevents pin 10 from going LO as long as the repetition rate of the trigger signal is higher than about 20 Hz.

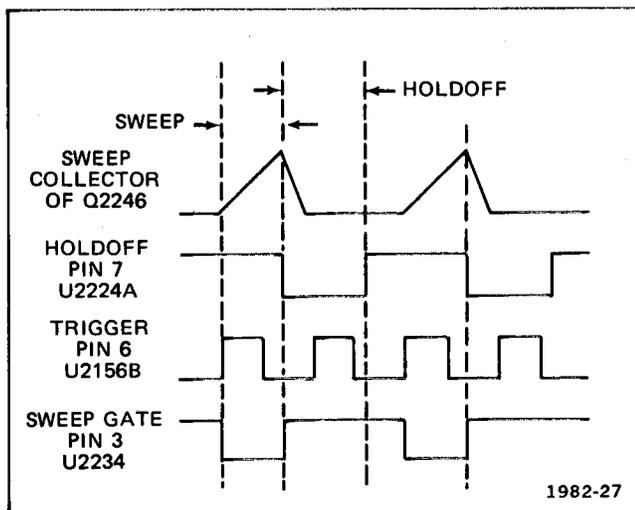


Fig. 7-2. Timing diagram: sweep generator and gate.

When pin 3 of U2234A goes HI, the current set by R2236, R2235, and R2237 is sent to the Z Axis Amplifier to blank the crt during hold-off.

HORIZONTAL AMPLIFIER

The horizontal amplifier converts the single-ended signal to a push-pull signal, which drives the crt horizontal deflection plates. The input to the horizontal amplifier comes from either the sweep generator or the X (external trigger) input connector. In the X-Y mode, the trace is shifted to the center of the screen by the current through R2184. In the AUTO and NORM modes, the input to the horizontal amplifier is a linear ramp from the sweep generator.

Transistors Q2314, Q2326, and associated circuitry, form an operational amplifier with a variable gain range of over 10 to 1. The gain is set by feedback elements R2312, R2323, and X1-X10 control, R2322. The horizontal POSITION control, R2316, positions the crt display horizontally by varying the current into the base of Q2314.

When the BEAM FINDER switch, S100B, is pressed, the dynamic range of Q2326 is decreased. This limits the horizontal deflection to the crt screen area. The BEAM FINDER switch also limits the vertical deflection to the crt screen area.

Transistors Q2332, Q2334, Q2344, and associated circuitry, compose a paraphase amplifier. Transistor Q2332 is a low-impedance input for Q2334. HORIZ CAL adjustment R2332 sets the gain of the paraphase amplifier. When the current through the collector of Q2334 increases, the current through the collector of Q2344 decreases and is 180° out of phase with the current at the collector of Q2334. The resulting signal to the crt deflection plates is a push-pull signal. Diode, CR2334, prevents Q2334 from saturating when R2322 is in the X10 position.

Since Q2334 is a shunt feedback amplifier and Q2344 is a common base amplifier, any noise in the 100 V power supply will appear as a part of the output. To prevent the noise from appearing on the crt screen, an operational amplifier, consisting of Q2354 and associated circuitry, supplies an inverted sample of the power supply noise to the output. Now, any noise in the 100 volt power supply appears common mode to the horizontal deflection plates, preventing horizontal deflection of the noise signal. Resistor R2354 provides feedback for the operational amplifier.

IX.2

VOLTAGE CONDITIONS

Voltages shown on this schematic diagram were measured with a Tektronix DM 501 Digital Multimeter. Voltage measurements can vary as much as $\pm 20\%$. No signals were applied to the vertical input or the X (external trigger) input. See Waveform Conditions for T921, T922, or T922R control settings.

WAVEFORM CONDITIONS

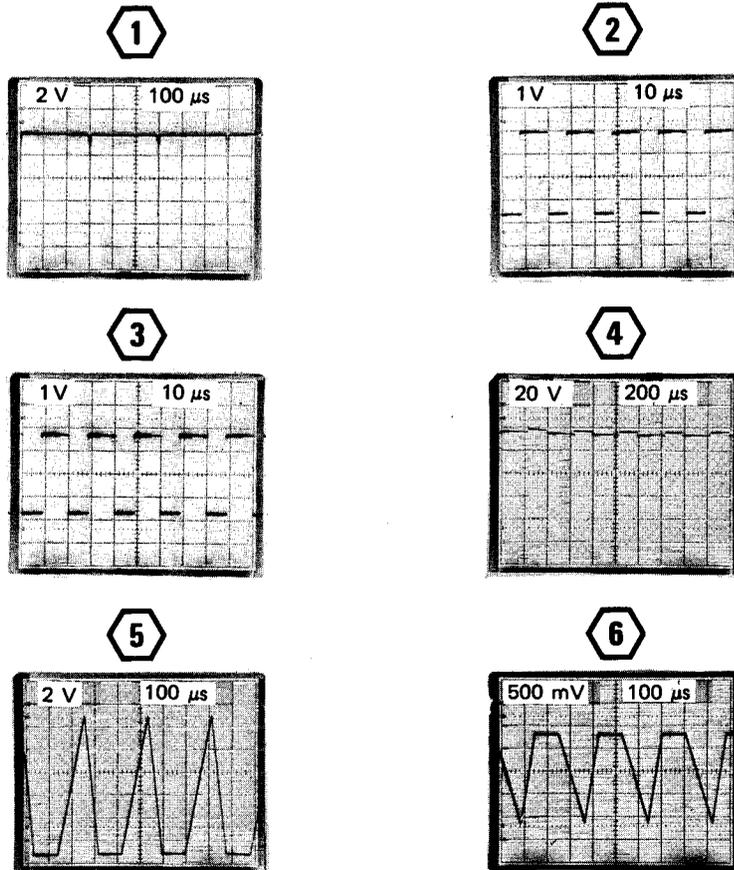
Waveforms below were monitored with a Tektronix 7704A Oscilloscope, 7B71 Time Base, 7A15A Amplifier and a 10X probe. The oscilloscope input coupling was set to ac. Waveforms may vary as much as $\pm 20\%$.

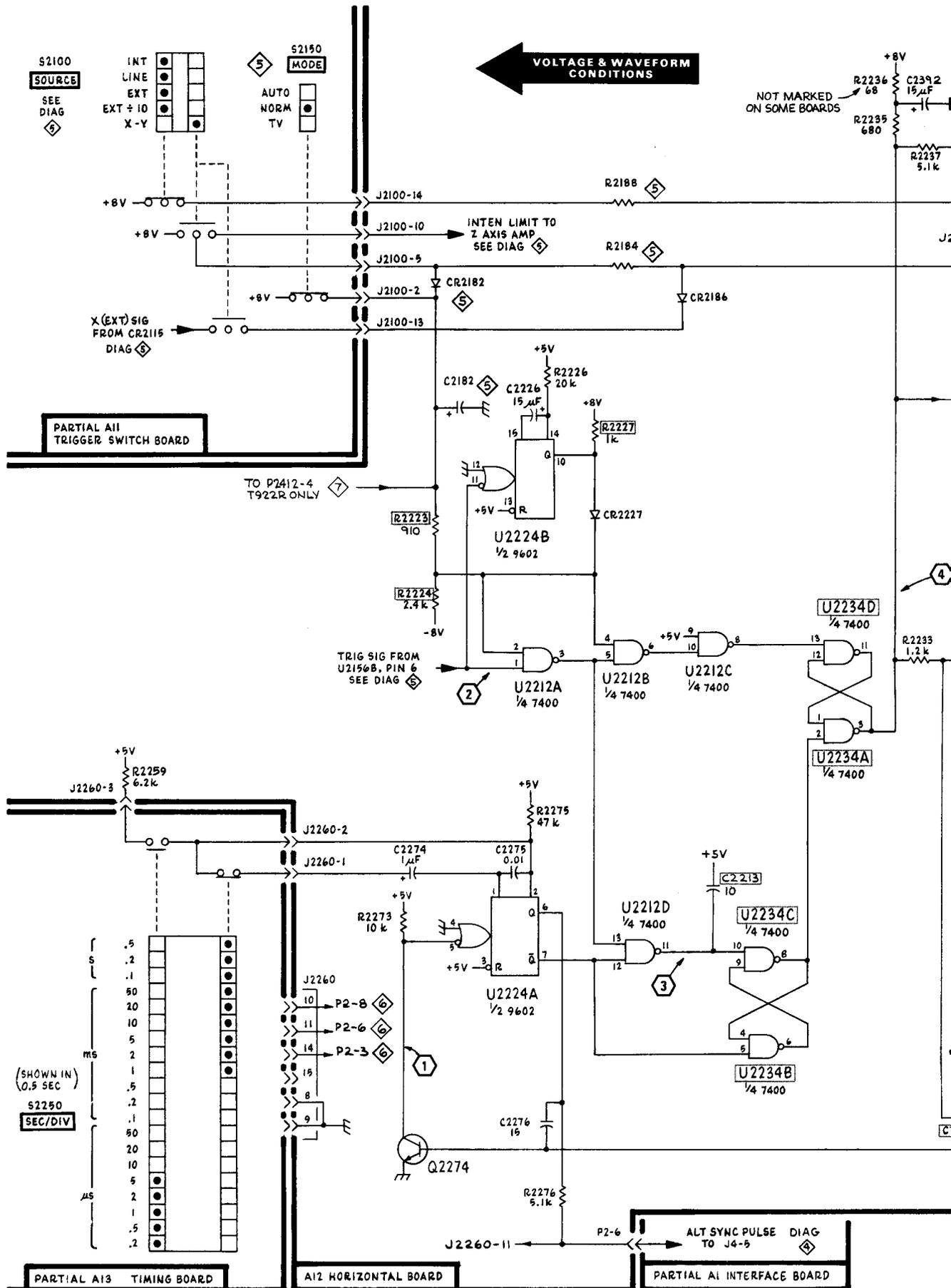
A 1 kHz, 50 mV sine wave was applied to CH 1 input and a 1 kHz, 50 mV square wave was applied to CH 2 input. A Tektronix FG 501 Function Generator provides either of the input waveforms.

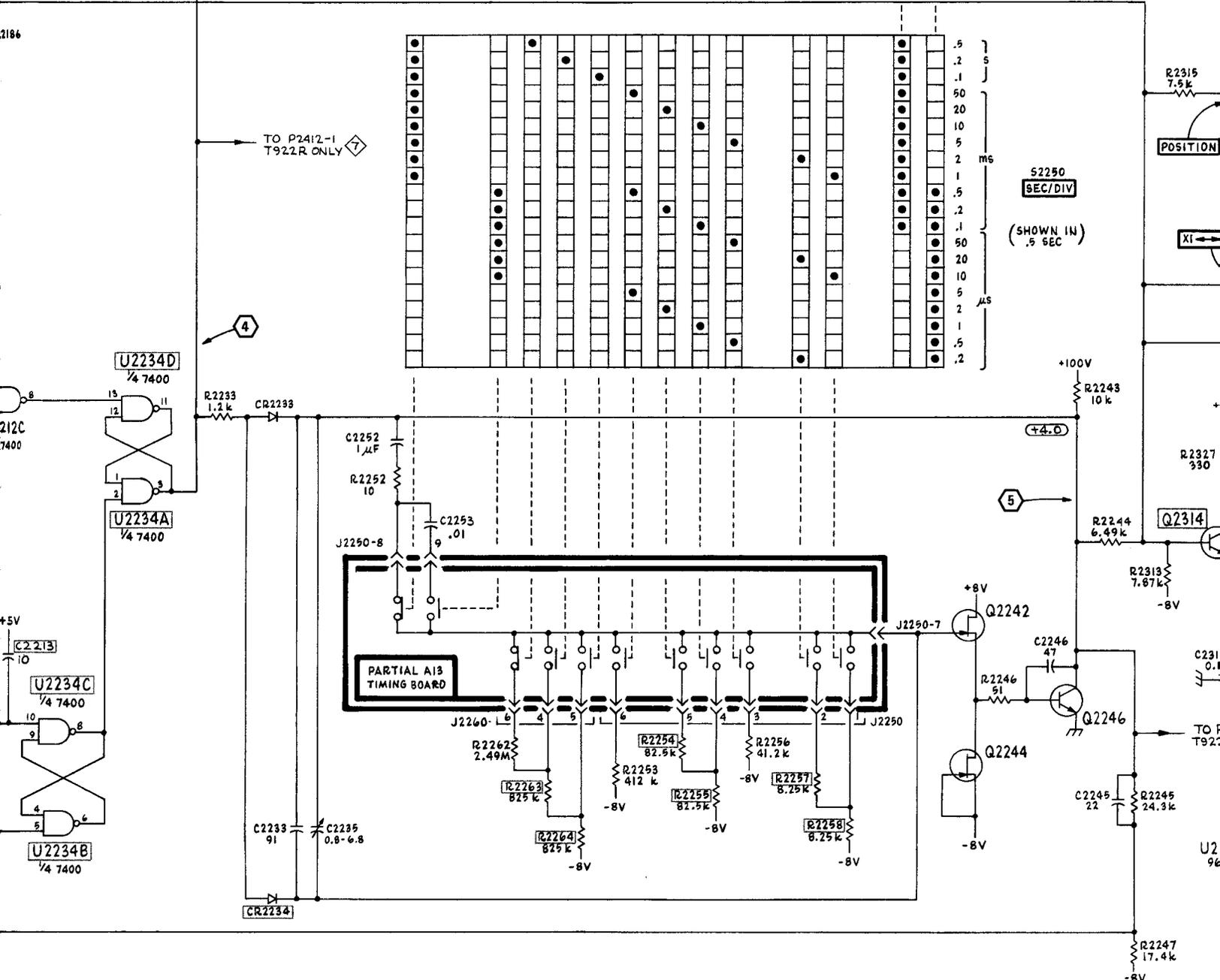
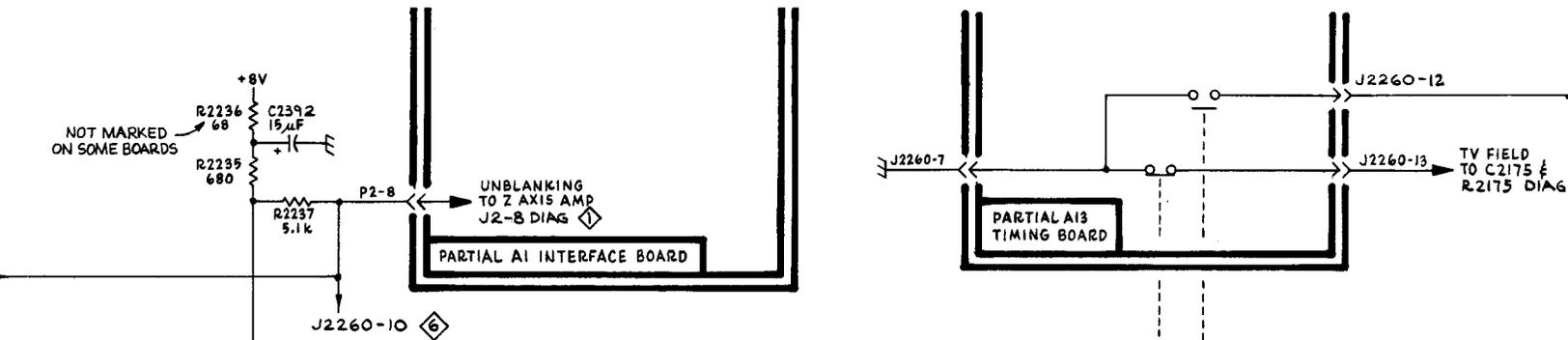
The T921, T922, or T922R controls were set as follows:

VOLTS/DIV (both	20 mV
AC-GND-DC (both)	DC
Vertical Mode	DUAL TRACE
SOURCE	INT*
MODE	AUTO
SLOPE	+OUT
SEC/DIV	.5 ms
LEVEL	For triggered display

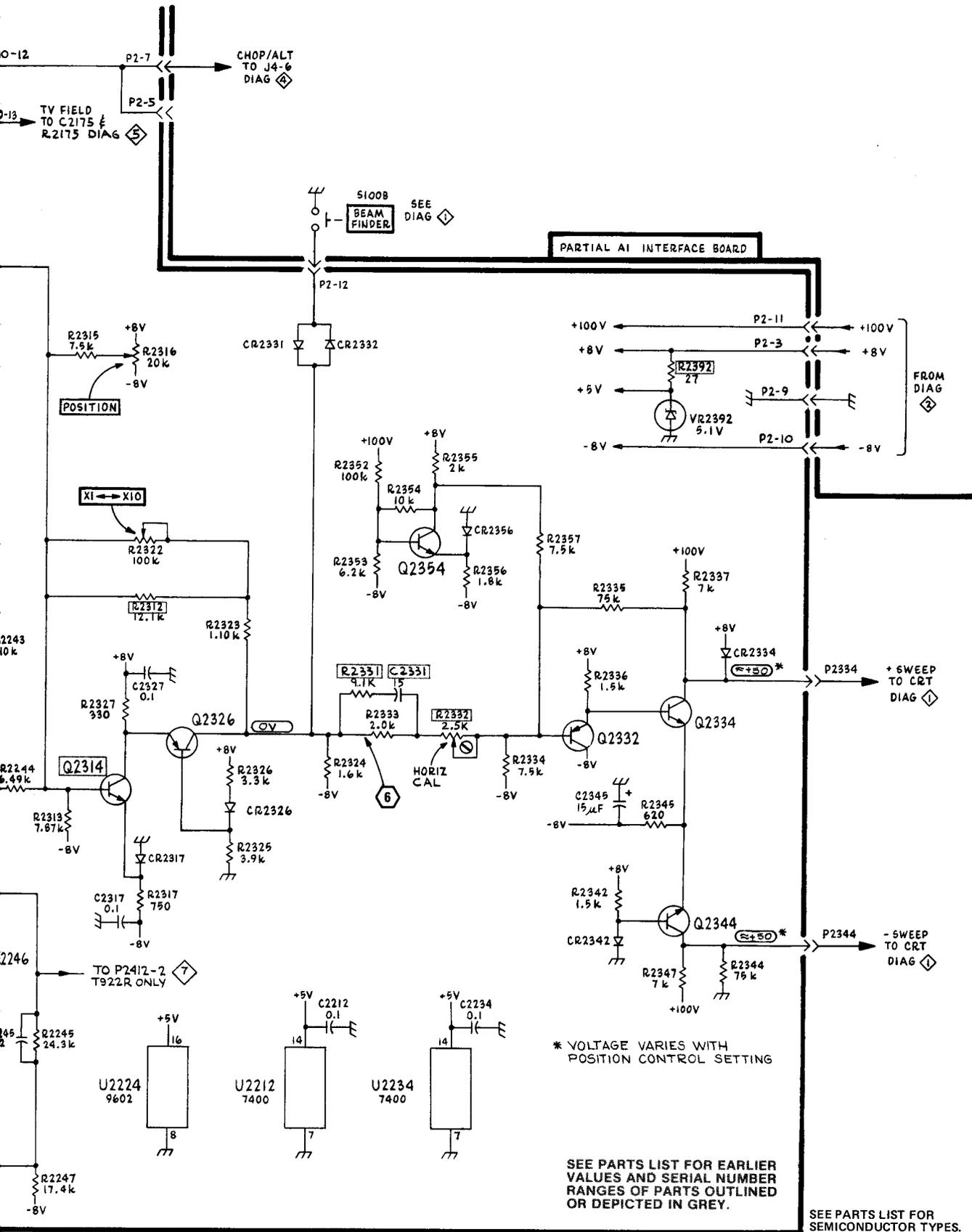
The other controls were set as needed to obtain a display.







TO SYNC PULSE DIAG TO J4-5
 AI INTERFACE BOARD



SWEEP & HORIZ AMPL



T922R

SINGLE SWEEP, OUTPUT BUFFER, & Z AXIS

Diagrams 7, 8, and 9, and associated circuit descriptions, pertain to circuitry that is used only in the T922R and is not present in the T921 and T922 bench versions. For circuit descriptions and diagrams of circuitry common to the T921, T922, and T922R, refer to diagrams 1 through 6.

SINGLE SWEEP

To operate in the Single Sweep mode, S2400B is set to SINGLE SWEEP. This applies the signal from U2402B to pin 2 of U2156A (see diagram 5) via P2412 pin 3. Pin 8 of U2402B now controls the ability of the Trigger Generator to supply a trigger signal to the Sweep Generator. Fig. 7-3 shows a timing diagram of the signals generated during a single sweep display.

The sequence of events during a single-sweep display is as follows:

1. S2400B is in the SINGLE SWEEP position. Before time A (see Fig. 7-3) pin 8 of U2402B is HI clamping pin 2 of U2156A HI.

2. At time A the RESET button (S2400A) is pushed and released. Pin 4 of U2402A is momentarily grounded and pin 1 of U2402A is momentarily ungrounded. This sets, then resets U2402A, which provides a bounce-free pulse at pin 5 of U2402A.

3. The pulse from pin 5 of U2402A is connected to the clock input of U2402B, pin 11. This causes pin 9 of U2402B to go HI, lighting the READY indicator, CR2400. At the same time, pin 8 of U2402B goes LO, reverse biasing CR2406. With CR2406 reverse biased, pin 2 of U2456A is released.

4. At time B the Trigger Generator produces a trigger signal causing the sweep gate, at pin 3 of U2234A (see diagram 6), to step LO. This causes the Sweep Generator to begin the sweep ramp.

5. The sweep gate signal from pin 3 of U2234 is applied to pin 13 of U2402B via P2412-1. At time B, the sweep gate steps LO. This resets U2402B. Pin 9 of U2402B steps LO, which extinguishes the READY indicator CR2400. At the same time, pin 8 of U2402B steps HI, which forward biases CR2406, forcing pin 2 of U2156A HI. While pin 2 of U2156A is held HI, the Trigger Generator is locked out and cannot supply another trigger signal to the Sweep Generator. No further sweeps can be displayed until the RESET button is again pushed to repeat the cycle.

Z AXIS INVERTER

Q2432 is a unity-gain common-emitter amplifier. P2430 may be installed on J2430 in either of two positions. In one position (index at + = BRIGHT), Q2432 is inserted in the external Z axis signal path from the rear-panel Z AXIS IN connector J2430, and inverts the signal, allowing a negative-going applied signal to decrease the crt intensity (and positive-going signal to increase

intensity). In the other position of P2430 (index at + = DIM), Q2432 is bypassed, allowing a positive-going applied signal to decrease the crt intensity (and negative-going signal to increase intensity).

SWEEP GATE OUT AMPLIFIER

The Sweep Gate signal is picked off pin 3 of U2234 (see diagram 6) and is applied via P2412-1 to the inverting amplifier, Q2422. This circuit inverts the Sweep Gate signal and provides isolation between the output connector and the Sweep Generator.

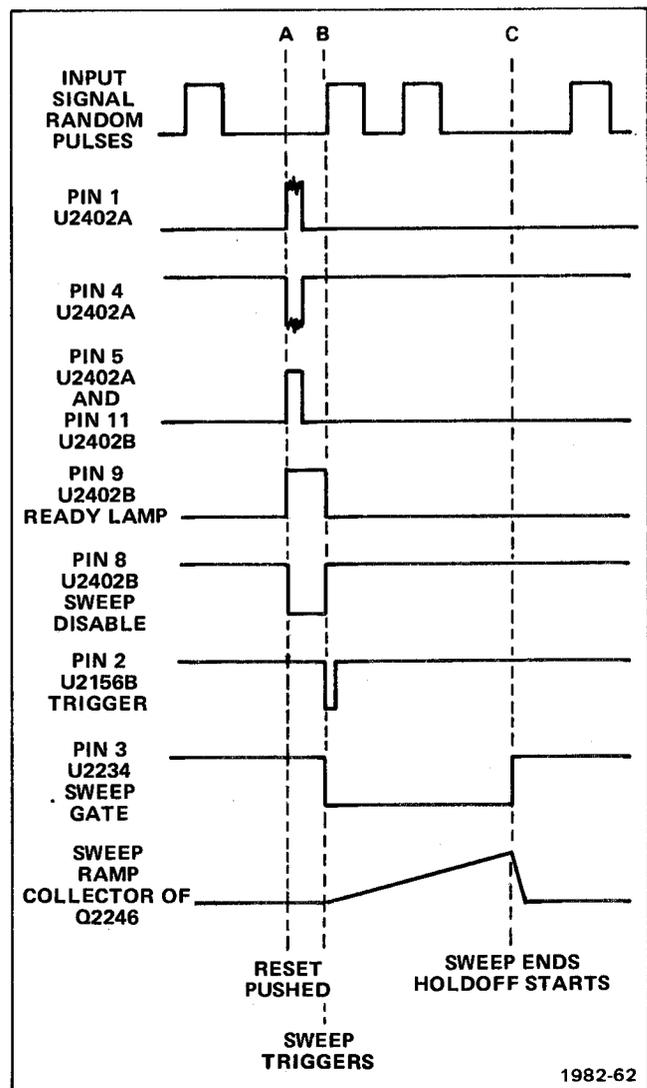


Fig. 7-3. Timing diagram of signals generated during a single-sweep display.

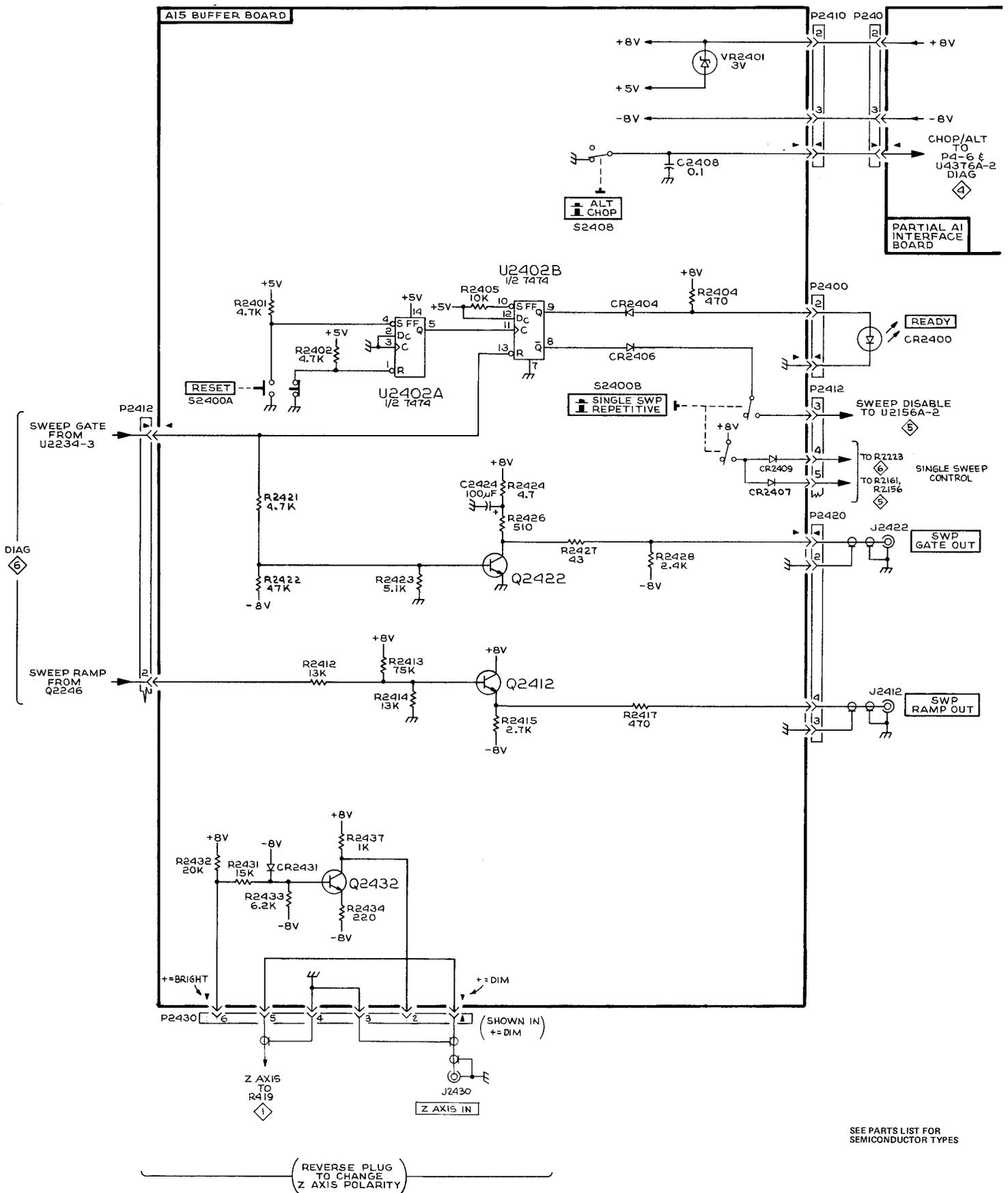
1982-62

SWEEP RAMP OUT AMPLIFIER

The Sweep Ramp signal is picked off the collector of Q2246 (see diagram 6) and applied via P2412-2 to emitter follower Q2412. Transistor Q2412 provides isolation between the output connector and the Sweep Generator.

CHOP-ALTERNATE SELECTION

In the T922 bench version, a contact on the SEC/DIV switch selects either the CHOP or ALT dual-trace modes. In the T922R, this function is performed by a front-panel mounted pushbutton switch (S2408). This allows manual selection of either CHOP or ALT when operating in the DUAL TRACE mode.



SEE PARTS LIST FOR SEMICONDUCTOR TYPES

T922R

Diagrams 7, 8, 9, and associated circuit descriptions pertain to circuitry that is used only in the T922R and is not present in the T921 and T922 bench versions. For circuit descriptions and diagrams of circuitry common to the T921, T922, and T992R, refer to diagrams 1 through 6.

SCALE ILLUMINATION AND +32 VOLT POWER SUPPLY

The T921 and T922 bench versions use a dropping resistor R784 and Zener diode VR784 to drop the +100 volt supply to +33 volts for use in the Vertical Output Amplifier and crt circuits (see Fig. 7-4). In the T922R, the Scale Illumination circuit provides a +32 volt supply in place of the +33 volt supply.

VR818 holds the base of Q812 at +33 volts. This holds the output voltage at about +32 volts. When the SCALE ILLUM control (R812) is set fully counterclockwise, Q816 and Q818 are biased off and transistor Q812 supplies all the current drawn by the +32 volt supply. To increase Scale Illumination, R812 is adjusted to forward bias Q816 and Q818. As this forward bias increases, the current through them increases. This causes a corresponding decrease in the current through Q812. The increased current through Q816 increases the current through DS816 and DS818, which increases scale illumination.

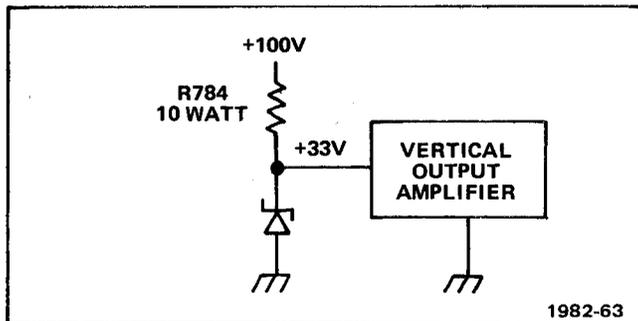


Fig. 7-4. Bench version T922 +33 volt power supply.

VERTICAL SIGNAL OUT (COMP VERT SIG OUT)

Fig. 7-5 shows a simplified block diagram of the Vertical Signal Out circuit. The Vertical Signal Out circuit supplies a sample of the signal present in the Vertical Output Amplifier to J169 (COMP VERT SIG OUT) on the rear panel.

Q160 and Q162 are connected as a differential amplifier. The paraphase signal from the emitters of Q112 and Q122 (see diagram 1) is applied to the inputs of the differential amplifier (the bases of Q160 and Q162 respectively). The output of the differential amplifier is taken from the collector of Q162 and applied to the base of Q166. Transistor Q166 amplifies the output signal and shifts its dc level. The signal from the collector of Q166 is connected (through P168) to the COMP VERT SIG OUT connector, J169.

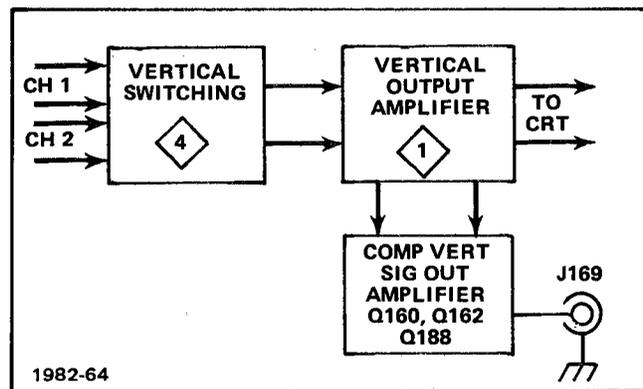
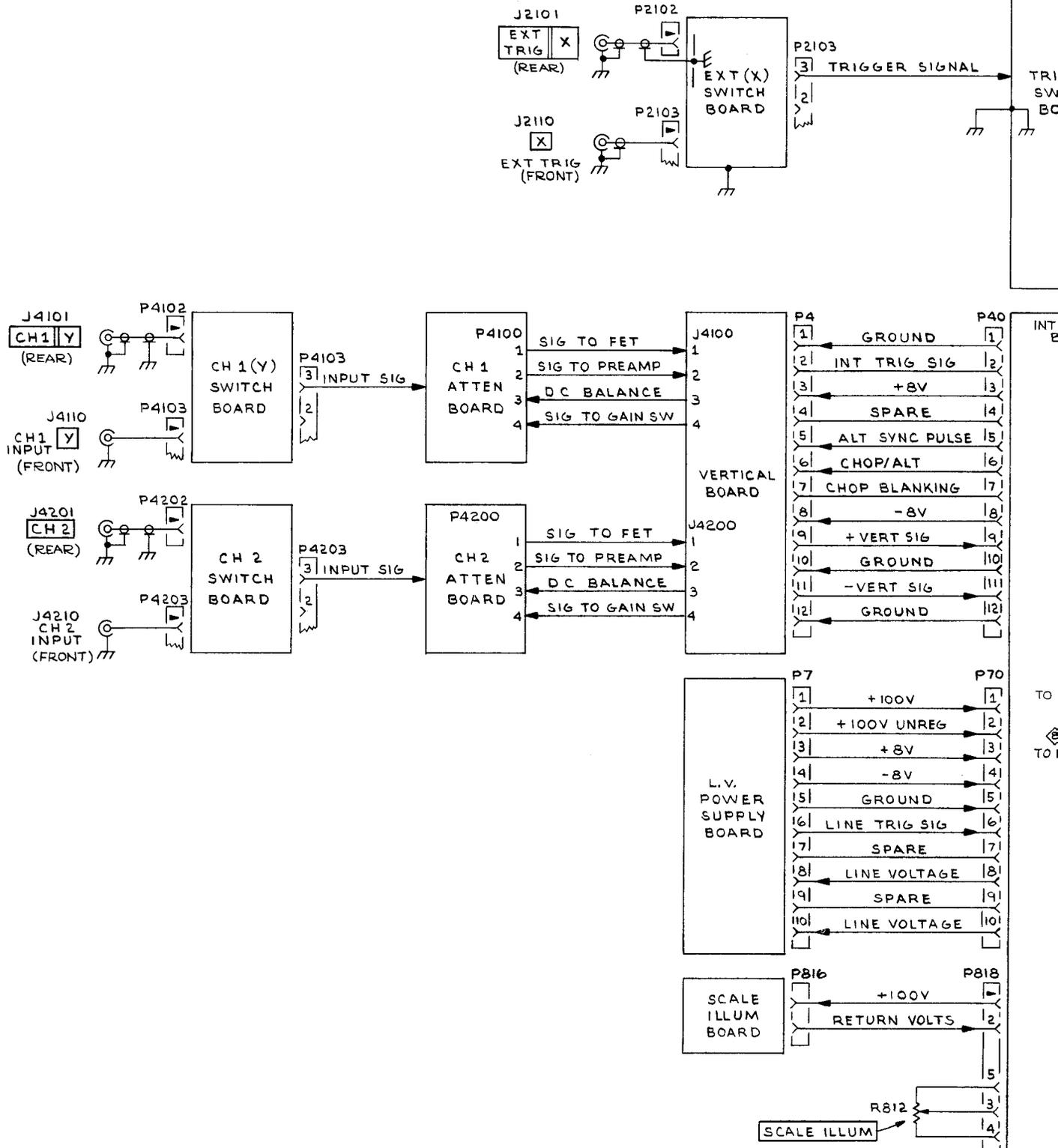
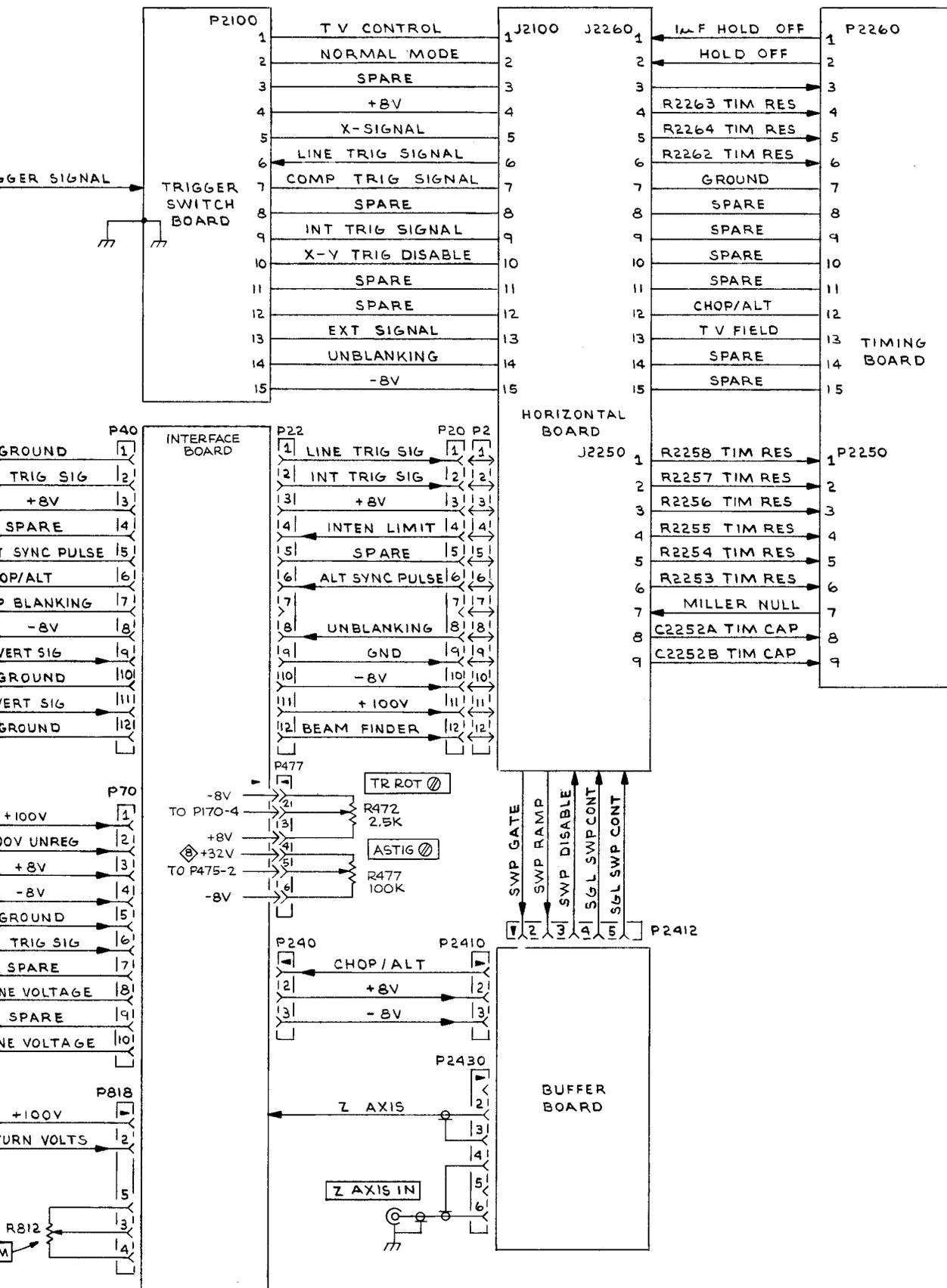
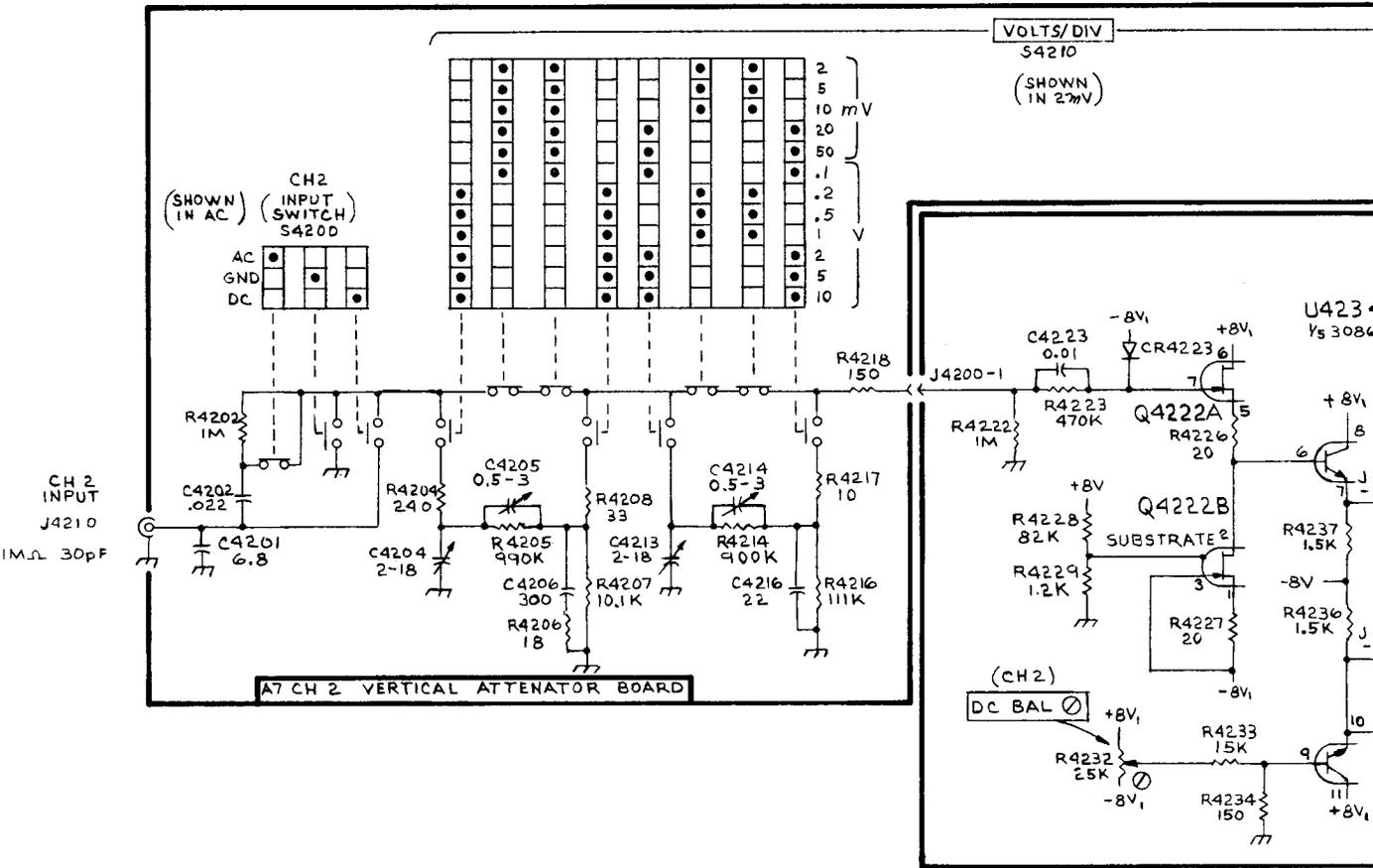
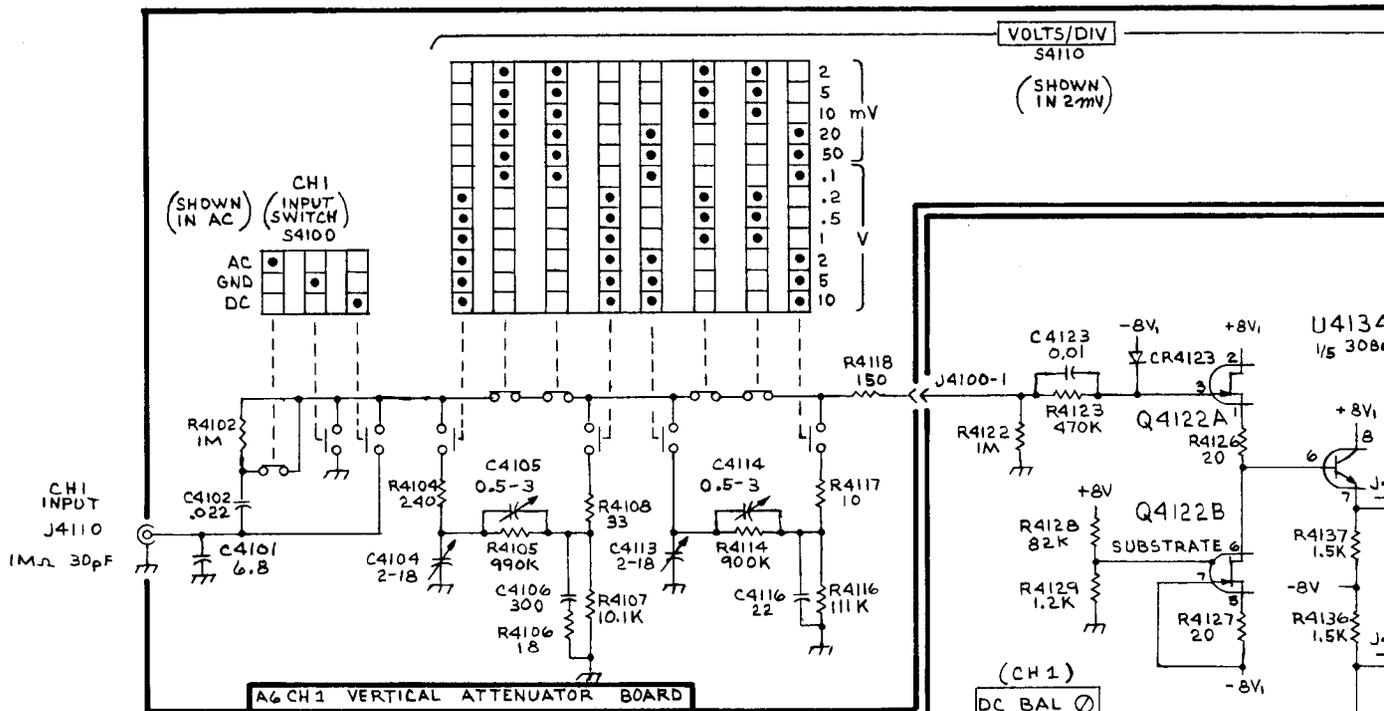


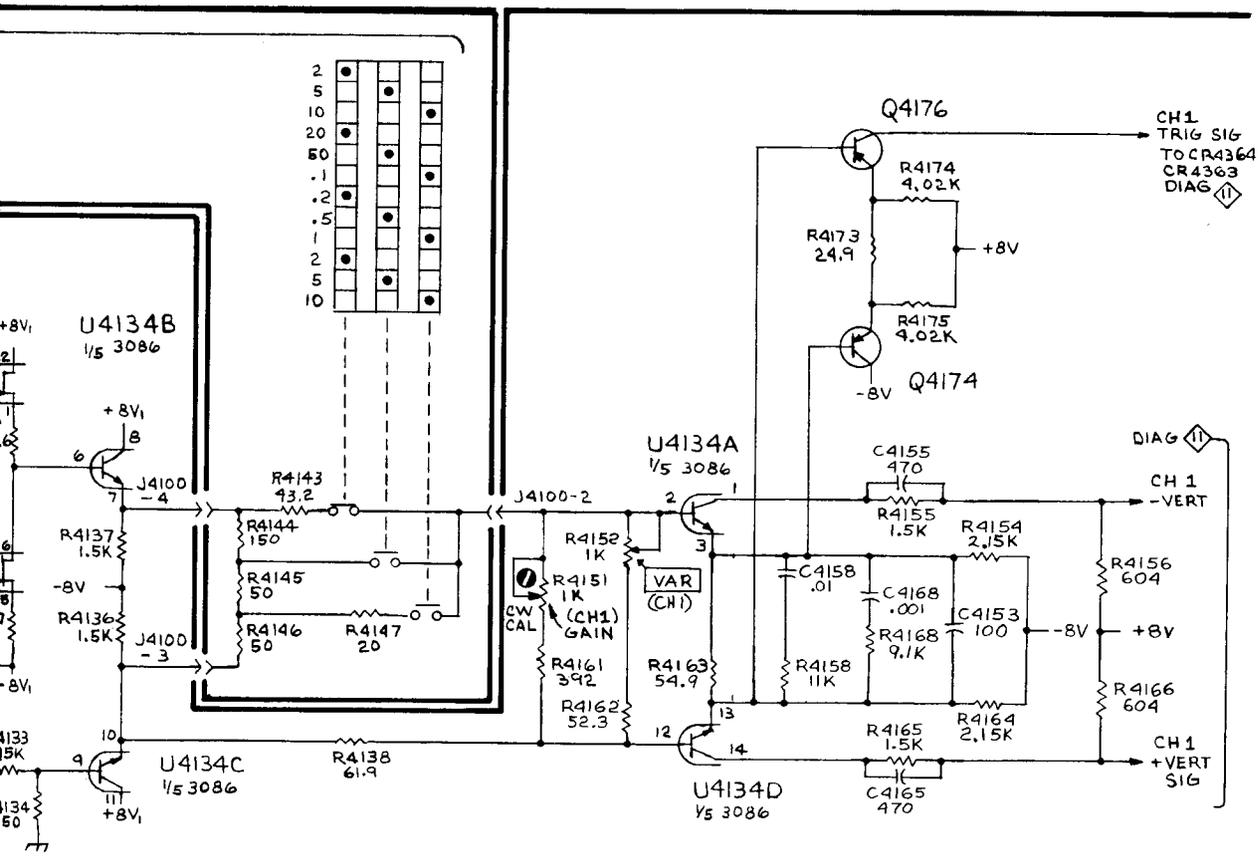
Fig. 7-5. Simplified block diagram of the vertical output amplifier circuit.



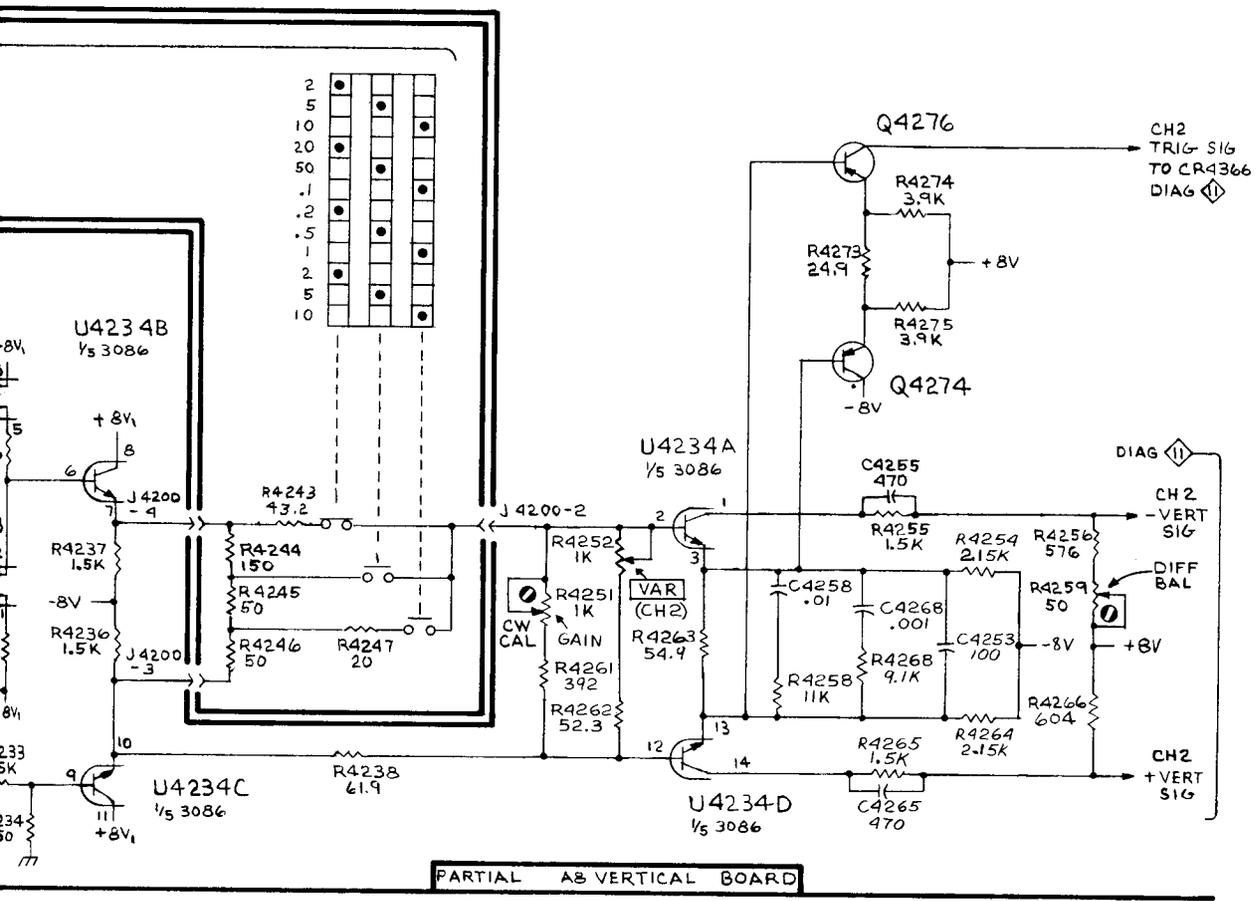


T922R CIRCUIT BOARD INTERCONNECTIONS





OPTION 1 VERT INPUT



PARTIAL AB VERTICAL BOARD



XII.1

VOLTAGE CONDITIONS

Voltages shown on this schematic digaram were measured with a Tektronix DM 501 Digital Multimeter. Voltage measurements can vary as much as $\pm 20\%$. No signals were applied to the vertical or the X (external trigger) input. See Waveform Conditions for T922 or T922R control settings.

WAVEFORM CONDITIONS

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

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

The T922 or T922R controls were set as follows:

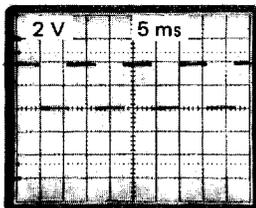
VOLTS/DIV (both)	20 mV
AC-GND-DC (both)	DC
Vertical Mode	DUAL TRACE
SOURCE	INT
MODE	AUTO
SLOPE	+OUT
SEC/DIV	.5 ms
LEVEL	As required

The other controls were set as needed to obtain a display.

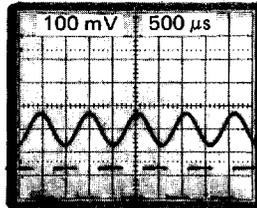
The CH 1 POSITION control was adjusted so that the bottom of the sine wave was on the first horizontal graticule line above the center and the CH 2 POSITION control was adjusted so that the top of the square wave was on the first horizontal graticule line below the center.

*Screen positions for waveforms 2, 3, 4, and 5 are affected by settings of the T922 or T922R POSITION controls.

1

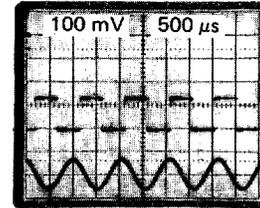


2 *



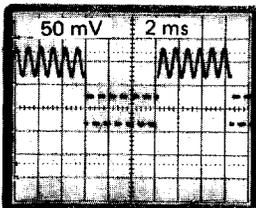
ADJUST TRIGGERING AS NECESSARY

3 *

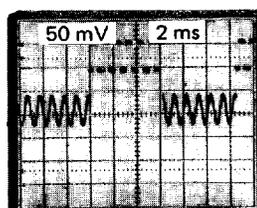


ADJUST TRIGGERING AS NECESSARY

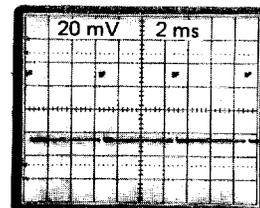
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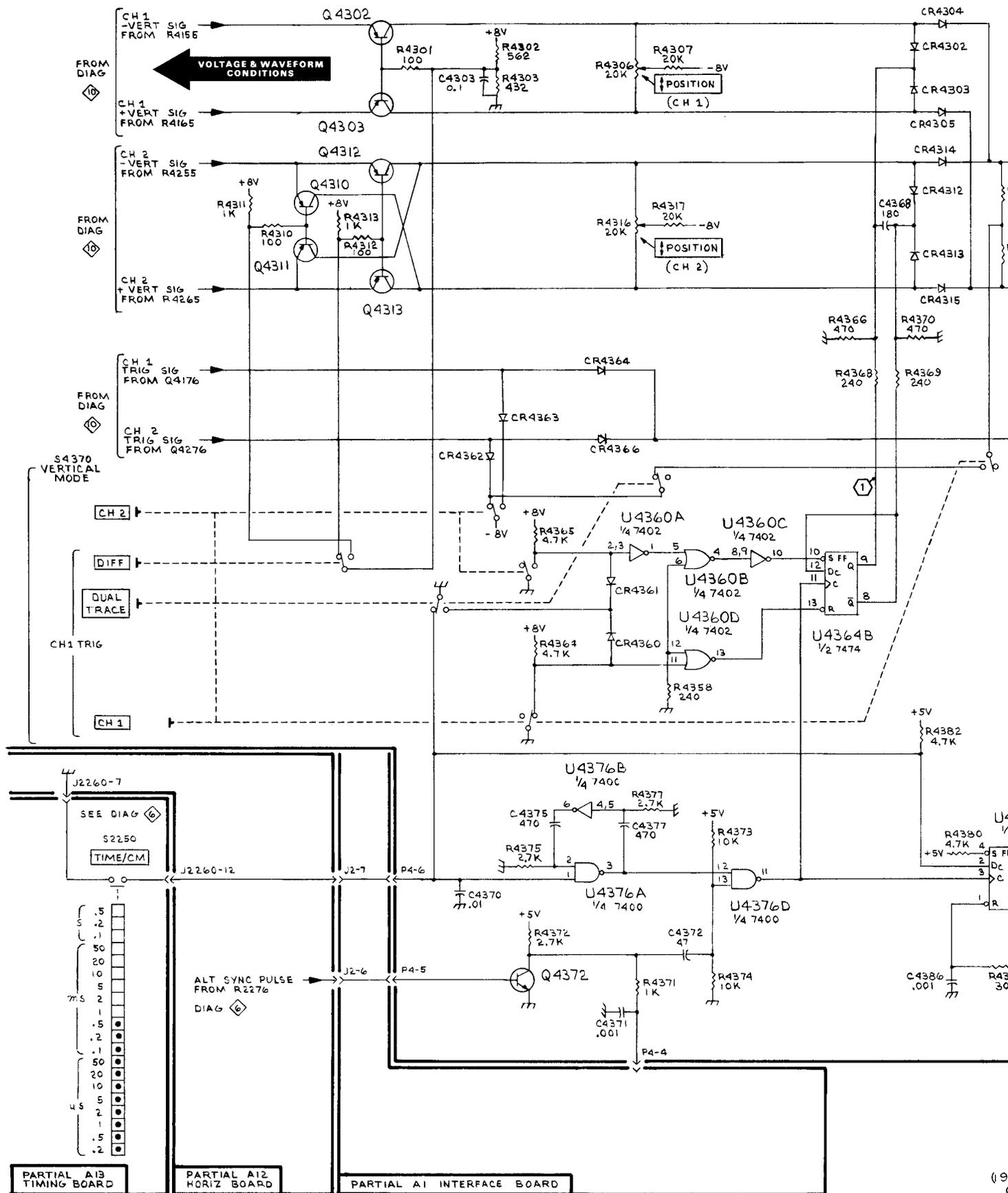
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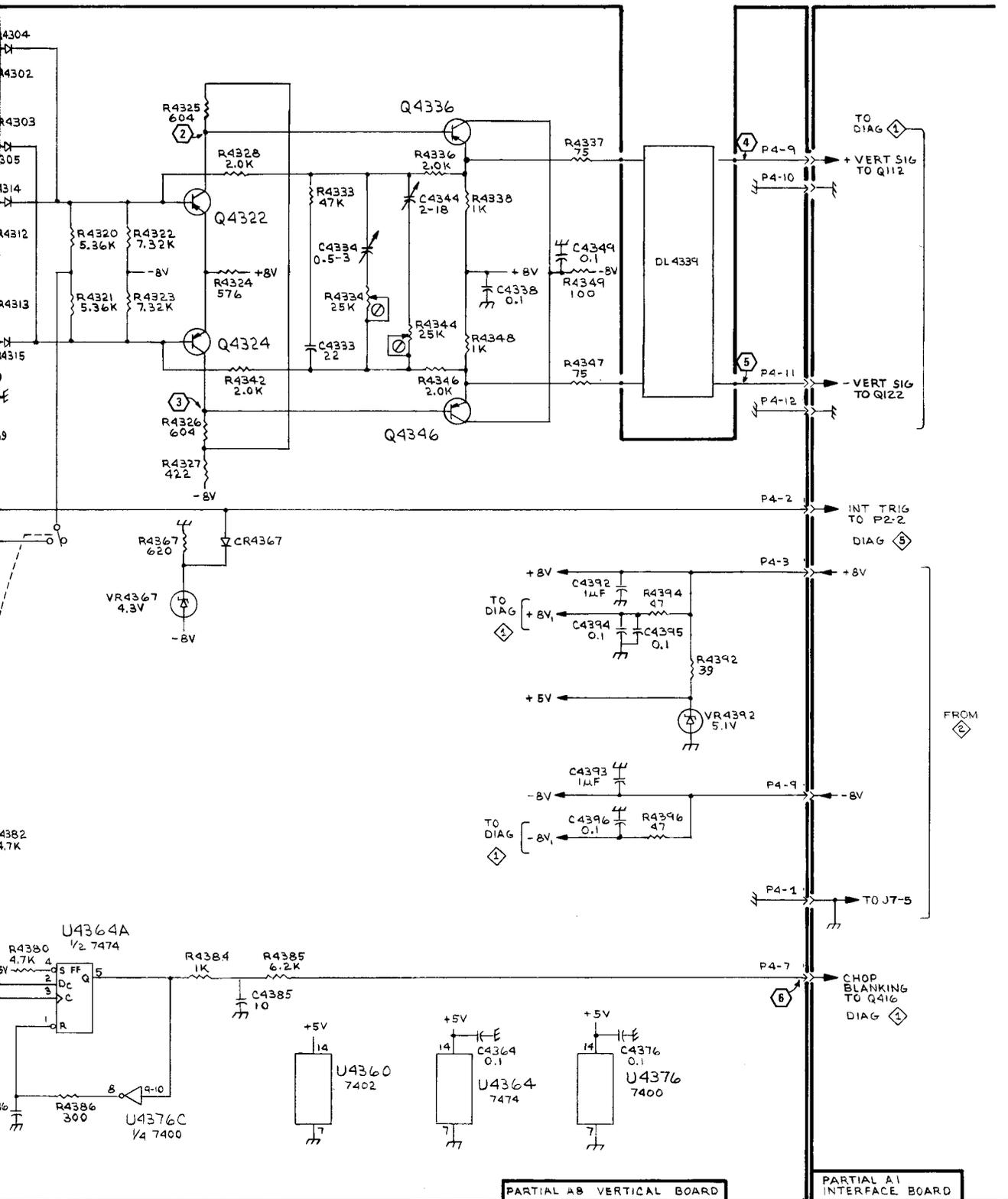


6



VOLTAGES & WAVEFORMS





OPTION 1 VERT SWITCHING



REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

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

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

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

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

SPECIAL NOTES AND SYMBOLS

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

FIGURE AND INDEX NUMBERS

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

INDENTATION SYSTEM

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

```

1 2 3 4 5           Name & Description
Assembly and/or Component
Attaching parts for Assembly and/or Component
-----
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
-----
Parts of Detail Part
Attaching parts for Parts of Detail Part
-----
    
```

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

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

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

ABBREVIATIONS

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

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000BE	EDAC, INC.	36 MOBILE DRIVE	TORONTO, ONTARIO M4AHP
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
05091	TRI-ORDINATE CORPORATION	343 SNYDER AVENUE	BERKELEY HEIGHTS, NJ 07922
11897	PLASTIGLIDE MFG. CORPORATION	P O BOX 867, 1757 STANFORD ST.	SANTA MONICA, CA 90406
12327	FREEWAY CORPORATION	9301 ALLEN DRIVE	CLEVELAND, OH 44125
12360	ALBANY PRODUCTS CO., DIV. OF PNEUMO DYNAMICS CORPORATION	145 WOODWARD AVENUE	SOUTH NORWALK, CT 06586
12697	CLAROSTAT MFG. CO., INC.	LOWER WASHINGTON STREET	DOVER, NH 03820
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
23499	GAVITT WIRE AND CABLE, DIVISION OF RSC INDUSTRIES, INC.	455 N. QUINCE ST.	ESCONDIDO, CA 92025
26365	GRIES REPRODUCER CO., DIV. OF COATS AND CLARK, INC.	125 BEECHWOOD AVE.	NEW ROCHELLE, NY 10802
27264	MOLEX PRODUCTS CO.	5224 KATRINE AVE.	DOWNERS GROVE, IL 60515
28520	HEYMAN MFG. CO.	147 N. MICHIGAN AVE.	KENILWORTH, NJ 07033
55210	GETTIG ENG. AND MFG. COMPANY	PO BOX 85, OFF ROUTE 45	SPRING MILLS, PA 16875
59730	THOMAS AND BETTS COMPANY	36 BUTLER ST.	ELIZABETH, NJ 07207
70485	ATLANTIC INDIA RUBBER WORKS, INC.	571 W. POLK ST.	CHICAGO, IL 60607
71279	CAMBRIDGE THERMIONIC CORP.	445 CONCORD AVE.	CAMBRIDGE, MA 02138
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501
72228	CONTINENTAL SCREW CO., DIV. OF AMTEL, INC.	459 MT. PLEASANT	NEW BEDFORD, MA 02742
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
74445	HOLO-KROME CO.	31 BROOK ST. WEST	HARTFORD, CT 06110
77250	PHEOLL MANUFACTURING CO., DIVISION OF ALLIED PRODUCTS CORP.	5700 W. ROOSEVELT RD.	CHICAGO, IL 60650
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
78471	TILLEY MFG. CO.	900 INDUSTRIAL RD.	SAN CARLOS, CA 94070
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
95987	WECKESSER CO., INC.	4444 WEST IRVING PARK RD.	CHICAGO, IL 60641
98159	RUBBER TECK, INC.	19115 HAMILTON AVE., P O BOX 389	GARDENA, CA 90247
99742	PERMACEL DIV. OF JOHNSON AND JOHNSON	U. S. HIGHWAY 1	NEW BRUNSWICK, NJ 08901

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
1-1	348-0443-00		1						STAND,ELEC EQPT:0.156" DIA,SST,PASSIVATE	80009	348-0443-00
-2	437-0200-00		1						CABINET,SCOPE:ASSEMBLY(T921 & T922) (ATTACHING PARTS)	80009	437-0200-00
-3	211-0648-00		6						SCR,ASSEM WSHR:6-32 X 0.625 INCH,PNH STL	83385	OBD
-4	210-0408-00		6						NUT,PLAIN,HEX.:6-32 X 0.312 INCH,BRS	73743	3040-402
	-----								* - - - -		
-5	348-0441-00		4						. CABINET ASSY INCLUDES: . FOOT,CABINET:POLYURETHANE,BLACK	80009	348-0441-00
-6	348-0447-00		2						. FOOT,CABINET:LEFT FRONT,RIGHT REAR	80009	348-0447-00
	348-0447-01		2						. FOOT,CABINET:RIGHT FRONT,LEFT REAR (ATTACHING PARTS FOR EACH)	80009	348-0447-01
-7	213-0731-00		1						. SCR,TPG,THD FOR:6-19 X 0.5 INCH,PNH STL	72228	OBD
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-8	334-2682-00		2						. PLATE,IDENT:2.50" LONG-TEKTRONIX	80009	334-2682-00
-9	334-2624-00		1						. PLATE,IDENT:MARKED--DC BAL,CH1 AND CH2	80009	334-2624-00
	351-0458-00		1						. GUIDE,LINE ADJ:HI-LO	80009	351-0458-00
	351-0458-01		1						. GUIDE,LINE ADJ:115V-230V	80009	351-0458-01
-10	384-1371-01		1						EXTENSION SHAFT:5.2" LONG W/KNOB	80009	384-1371-01
-11	384-1371-03		1						EXTENSION SHAFT:10.7" LONG W/KNOB	80009	384-1371-03
-12	366-1559-00		2						PUSH BUTTON:GRAY	80009	366-1559-00
-13	214-2309-00		1						CONDUCTOR,LIGHT:5.265" LONG	80009	214-2309-00
-14	358-0550-00		2						BUSHING,SHAFT:0.15 ID X 0.3 INCH OD,PLSTC	80009	358-0550-00
-15	426-1072-00		1						FRAME,PUSH BTN:PLASTIC	80009	426-1072-00
	334-2755-00		1						LABEL,IDENT:--PRESS TO RELEASE	80009	334-2755-00
-16	333-2078-00		1						PANEL,FRONT:	80009	333-2078-00
-17	337-2185-00		1						SHLD,IMPLOSION:BLUE	80009	337-2185-00
-18	136-0387-01		1						JACK,TIP:BLACK	71279	450-4352-01-0310
-19	386-3287-00		1						SUBPANEL,FRONT:CRT,PLASTIC (ATTACHING PARTS)	80009	386-3287-00
-20	213-0146-00		1						SCR,TPG,THD FOR:6-20 X 0.313 INCH,PNH STL	83385	OBD
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-21	384-1370-00		1						EXTENSION SHAFT:4.68" L,MOLDED PLSTC	80009	384-1370-00
-22	384-1364-00		1						EXTENSION SHAFT:10.818" L,NYLON,BLK	80009	384-1364-00
-23	351-0456-00		2						GUIDE,RES ADJ:PLASTIC	80009	351-0456-00
-24	352-0425-00		1						FUSEHOLDER:PLASTIC	80009	352-0425-00
-25	352-0331-00		1						LAMPHOLDER:	80009	352-0331-00
-26	337-2227-00		1						SHIELD,ELEC:HIGH VOLTAGE POWER SUPPLY (ATTACHING PARTS)	80009	337-2227-00
-27	211-0007-00		2						SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
	-----								* - - - -		
-28	342-0293-00		1						INSULATOR,SHLD:HIGH VOLTAGE	80009	342-0293-00
-29	343-0213-00		2						CLAMP,LOOP:PRESS MT,PLASTIC	80009	343-0213-00
-30	-----		1						TRANSISTOR:CHASSIS MTG(SEE Q458 EPL) (ATTACHING PARTS)		
-31	344-0236-01		1						CLIP,SPR TNSN:TRANSISTOR MOUNTING	80009	344-0236-01
	-----								* - - - -		
-32	342-0202-00		1						INSULATOR,PLATE:TRANSISTOR	01295	10-21-023-106
-33	253-0202-00		FT						INSUL TAPE,ELEC:POLYIMIDE,0.875" W X 1.0" LONG	99742	221
-33	-----		1						CKT BOARD ASSY:INTERFACE(SEE A1 EPL) (ATTACHING PARTS)		
-34	211-0008-00		6						SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-35	361-0750-00		2						SPACER,POST:0.188" HEX. X 0.970"L,STL,W/STUD	80009	361-0750-00
	-----								* - - - -		
	131-0566-00 ¹	B010100 B010633X	1						. CKT BOARD ASSY INCLUDES: . LINK,TERM.CONNE:0.086 DIA X 2.375 INCH LONG	55210	ERD-18T0
	131-0566-00 ²	B010100 B014318X	1						. LINK,TERM.CONNE:0.086 DIA X 2.375 INCH LONG	55210	ERD-18T0
-36	131-1817-00 ¹	B010100 B010633	34						. LINK,TERM CONNE:22 AWG,2.25" LONG	80009	131-1817-00
	131-1817-00 ¹	B010634	35						. LINK,TERM CONNE:22 AWG,2.25" LONG	80009	131-1817-00
	131-1817-00 ²	B010100 B014318	34						. LINK,TERM CONNE:22 AWG,2.25" LONG	80009	131-1817-00
	131-1817-00 ²	B014319	35						. LINK,TERM CONNE:22 AWG,2.25" LONG	80009	131-1817-00
-37	131-0608-00		17						. CONTACT,ELEC:0.365 INCH LONG	22526	47357
-38	131-1749-00		1						. CONNECTOR,RCPT,:10 FEMALE CONTACT	27264	09-52-3101
	131-1795-00		1						. CONNECTOR,RCPT,:12 FEMALE CONTACT,RT-ANGLE	27264	09-62-3121

¹T921
²T922

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-39	131-1792-00			1	.	CONTACT ASSY,EL:12 MALE CONTACT,FLAT WAFER	27264	09-70-2121
-40	-----			1	.	TRANSFORMER:H.V.(SEE T460 EPL)		
	361-0007-00			3	.	SPACER,SLEEVE:0.250 INCH DIA,PLASTIC	80009	361-0007-00
-41	-----			2	.	RES.,VAR:INTEN AND FOCUS(SEE R412,R468 EPL)		
-42	-----			1	.	SWITCH,PUSH:BEAMFINDER(SEE S100 EPL)		
-43	361-0608-00			2	.	SPACER,PUSH SW:PLASTIC	80009	361-0608-00
-44	-----			1	.	SWITCH,PUSH:POWER ON(SEE S700 EPL)		
-45	344-0154-00			2	.	CLIP,ELECTRICAL:FOR 0.25 INCH DIA FUSE	80009	344-0154-00
-46	342-0294-00			1	.	INSULATOR,FILM:MAIN CHASSIS	80009	342-0294-00
-47	386-3291-00			1	.	SUPPORT,CRT:FRONT	80009	386-3291-00
-48	-----			1	.	ELECTRON TUBE:CRT,W/ANODE(SEE V470 EPL)		
	334-1379-00			1	.	LABEL:CRT,ADHESIVE BACK	80009	334-1379-00
	334-1951-00			1	.	MARKER,IDENT:CRT WARNING	80009	334-1951-00
-49	214-2300-00			1	.	CLIP,GROUNDING:0.3W X 2.0"LONG,BRS (ATTACHING PARTS)	80009	214-2300-00
-50	211-0008-00			1	.	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-51	210-0586-00			1	.	NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
-52	-----			1	.	COIL,TUBE DEFL:TRACE ROTATION(SEE L472 EPL)		
-53	131-0707-00			2	.	CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	75691-005
-54	352-0169-01			1	.	CONN BODY,PL,EL:2 WIRE BROWN	80009	352-0169-01
-55	-----			1	.	COIL,TUBE DEFL:X-Y ALIGNMENT(SEE L470 EPL)		
	131-0707-00			2	.	CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	75691-005
-56	352-0169-00			1	.	CONN BODY,PL,EL:2 WIRE BLACK	80009	352-0169-00
-57	386-3288-00			1	.	SPRT,CRT SHIELD:REAR (ATTACHING PARTS)	80009	386-3288-00
-58	211-0507-00			2	.	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
-59	220-0419-00			2	.	NUT,PLAIN,SO:6-32 X 0.312 INCH,STL	83385	OBD
-60	386-3305-00			1	.	SUPPORT,CRT:REAR	80009	386-3305-00
-61	348-0004-00			1	.	GROMMET,RUBBER:0.281 ID X 0.563 INCH OD	70485	763
-62	337-2223-00			1	.	SHIELD,ELEC:CRT	80009	337-2223-00
	136-0645-00			1	.	SOCKET,CRT:ASSEMBLY	80009	136-0645-00
-63	136-0202-01			1	.	SOCKET,PLUG-IN:14 PIN	80009	136-0202-01
-64	131-0707-00			9	.	CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	75691-005
-65	352-0171-00			1	.	CONN BODY,PL,EL:1 WIRE BLACK	80009	352-0171-00
-66	352-0162-00			2	.	CONN BODY,PL,EL:4 WIRE BLACK	80009	352-0162-00
-67	386-3289-00			1	.	PANEL,REAR: (ATTACHING PARTS)	80009	386-3289-00
-68	211-0529-00			2	.	SCREW,MACHINE:6-32 X 1.25 INCHES,PNH STL	83385	OBD
-69	211-0578-00			2	.	SCREW,MACHINE:6-32 X 0.438 INCH,PNH STL	83385	OBD
-70	131-0955-00			1	.	CONNECTOR,RCPT,:BNC,FEMALE,W/HARDWARE (ATTACHING PARTS)	05091	31-279
-71	210-0255-00			1	.	TERMINAL,LUG:0.391" ID INT TOOTH (ATTACHING PARTS)	80009	210-0255-00
-72	200-1811-00			1	.	COVER,REAR:ASSEMBLY (ATTACHING PARTS)	80009	200-1811-00
-73	211-0517-00			2	.	SCREW,MACHINE:6-32 X 1 INCH,PNH,STL	83385	OBD
-74	348-0441-00			4	.	FOOT,CABINET:POLYURETHANE,BLACK	80009	348-0441-00
-75	161-0107-01			1	.	CABLE ASSY,PWR:3,18AWG,115V,7.5'LG,W/LUG (ATTACHING PARTS)	80009	161-0107-01
-76	358-0323-00			1	.	BSHG,STRAIN RLF:90 DEG,0.515 DIA HOLE	28520	SR15-1
-77	211-0504-00			1	.	SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
-78	210-0287-00			1	.	TERMINAL,LUG:	00779	34142
-79	348-0063-00			1	.	GROMMET,PLASTIC:0.50 INCH DIA	80009	348-0063-00
-80	255-0334-00			FT	.	PLASTIC CHANNEL:12.75 INCHES LONG	11897	122-37-2500
-81	-----			3	.	TRANSISTORS:CHAS MTG(SEE Q736,Q756,Q776 EPL) (ATTACHING PARTS FOR EACH)		
-82	344-0236-01			1	.	CLIP,SPR TNSN:TRANSISTOR MOUNTING	80009	344-0236-01

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-	342-0202-00			3		INSULATOR, PLATE: TRANSISTOR	01295	10-21-023-106
-83	253-0202-00			FT		INSUL TAPE, ELEC: POLYIMIDE, 0.875" W X 3.5" L	99742	221
-84	214-2265-00			1		HEAT SINK, XSTR: 6.0" L X 0.72" H, AL (ATTACHING PARTS)	80009	214-2265-00
-85	211-0507-00			2		SCREW, MACHINE: 6-32 X 0.312 INCH, PNH STL	83385	OBD
-86	211-0008-00			2		SCREW, MACHINE: 4-40 X 0.25 INCH, PNH STL	83385	OBD
-87	210-0586-00			2		NUT, PLAIN, EXT W: 4-40 X 0.25 INCH, STL	78189	OBD
-88	352-0425-00			1		FUSEHOLDER: PLASTIC	80009	352-0425-00
	337-2302-00	¹ XB010125		1		SHIELD, ELEC: LV POWER CARD	80009	337-2302-00
	337-2302-00	¹ XB010450		1		SHIELD, ELEC: LV POWER CARD	80009	337-2302-00
-89	-----			1		CKT BOARD ASSY: L.V. POWER SUPPLY (SEE A2 EPL) (ATTACHING PARTS)		
-90	212-0516-00			4		SCREW, MACHINE: 10-32 X 2 INCH, HEX HD STL	77250	OBD
-91	166-0432-00	B010100	B010499	4		INSUL SLVG, ELEC: BOLT INSULATING	80009	166-0432-00
	166-0227-00	B010500		4		INS SLV, ELEC: 0.187 ID X 1.50 INCH LONG	80009	166-0227-00
-92	361-0741-00			4		SPACER, SLEEVE: 0.245" ID X 0.75" L, AL	80009	361-0741-00
-93	220-0572-00			2		NUT, PLAIN, HEX.: 10-32 X 0.25 INCH, PL BRS	73743	OBD
-94	131-1817-00			9		. LINK, TERM CONNE: 22 AWG, 2.25" LONG	80009	131-1817-00
-95	131-1750-00			1		. TERM., FEED THRU: 10 PIN INSULATED	27264	09-64-1103
-96	344-0154-00			2		. CLIP, ELECTRICAL: FOR 0.25 INCH DIA FUSE	80009	344-0154-00
-97	346-0032-00			3		. STRAP, RETAINING:	98159	2829-75-4
-98	-----			2		. SW, SLIDE: LINE VOLT/SELECT (SEE S701, S705 EPL)		
-99	-----			1		TRANSFORMER: POWER (SEE T700 EPL)		
-100	343-0213-00			1		CLAMP, LOOP: PRESS MT, PLASTIC	80009	343-0213-00
-101	366-1031-02			1		KNOB: RED-VAR	80009	366-1031-02
	213-0153-00			1		. SETSCREW: 5-40 X 0.125 INCH, HEX SOC STL	74445	OBD
-102	366-1646-00			1		KNOB: GRAY, W/SHAFT	80009	366-1646-00
-103	384-1371-02			1		EXTENSION SHAFT: 6.8" LONG, W/KNOB	80009	384-1371-02
-104	358-0550-00			1		BUSHING, SHAFT: 0.15 ID X 0.3 INCH OD, PLSTC	80009	358-0550-00
-105	366-1559-00			3		PUSH BUTTON: GRAY	80009	366-1559-00
-106	384-1371-02			1		EXTENSION SHAFT: 6.8" LONG, W/KNOB	80009	384-1371-02
-107	366-1031-02			1		KNOB: RED-VAR	80009	366-1031-02
	213-0153-00			1		. SETSCREW: 5-40 X 0.125 INCH, HEX SOC STL	74445	OBD
-108	366-1646-00			1		KNOB: GRAY, W/SHAFT	80009	366-1646-00
-109	426-1072-00			3		FRAME, PUSH BTN: PLASTIC	80009	426-1072-00
-110	358-0550-00			1		BUSHING, SHAFT: 0.15 ID X 0.3 INCH OD, PLSTC	80009	358-0550-00
-111	333-2040-00			1		PANEL, FRONT: VERTICAL	80009	333-2040-00
	333-2086-00			1		PANEL, FRONT: VERTICAL	80009	333-2086-00
-112	384-1393-00			2		EXTENSION SHAFT: 0.123 DIA X 6.3" L, PLSTC	80009	384-1393-00
	384-1393-00			1		EXTENSION SHAFT: 0.123 DIA X 6.3" L, PLSTC	80009	384-1393-00
-113	376-0051-00			2		CPLG, SHAFT, FLEX: FOR 0.125 INCH DIA SHAFTS	80009	376-0051-00
	376-0051-00			1		CPLG, SHAFT, FLEX: FOR 0.125 INCH DIA SHAFTS	80009	376-0051-00
	-----			-		. EACH COUPLER INCLUDES:		
	213-0022-00			4		. SETSCREW: 4-40 X 0.188 INCH, HEX SOC STL	74445	OBD
-114	351-0456-00			2		GUIDE, RES ADJ: PLASTIC	80009	351-0456-00
	351-0456-00			1		GUIDE, RES ADJ: PLASTIC	80009	351-0456-00
	672-0518-00			1		CKT BOARD ASSY: ATTN, CH1 W/CAM SW	80009	672-0518-00
	672-0519-00			1		CKT BOARD ASSY: ATTN, CH2 W/CAM SW (ATTACHING PARTS FOR EACH)	80009	672-0519-00
-115	211-0144-00			2		SCREW, MACHINE: 4-40 X 1.312 INCH, PNH STL	83385	OBD
-116	211-0018-00			1		SCREW, MACHINE: 4-40 X 0.875 PNH, STL	83385	OBD
-117	210-0586-00			1		NUT, PLAIN, EXT W: 4-40 X 0.25 INCH, STL	78189	OBD
-118	337-2214-00			1		. SHIELD, ELEC: ATTENUATOR LEFT, CH1	80009	337-2214-00
	337-2215-00			1		. SHIELD, ELEC: ATTENUATOR, RIGHT, CH2 (ATTACHING PARTS)	80009	337-2215-00
-119	211-0116-00	¹ B010100	B010339	1		. SCR, ASSEM WSHR: 4-40 X 0.312 INCH, PNH BRS	83385	OBD
	211-0244-00	¹ B010340		1		. SCR, ASSEM WSHR: 4-40 X 0.312 INCH, PNH STL	78189	OBD
	211-0116-00	² B010100	B011674	1		. SCR, ASSEM WSHR: 4-40 X 0.312 INCH, PNH BRS	83385	OBD
	211-0244-00	² B011675		1		. SCR, ASSEM WSHR: 4-40 X 0.312 INCH, PNH STL	78189	OBD

¹T921
²T922

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
1-120	131-0955-00			1	.					CONNECTOR, RCPT, :BNC, FEMALE, W/HARDWARE (ATTACHING PARTS)	05091	31-279
-121	210-1000-00			1	.					WASHER, FLAT: 0.384 ID X 0.50" OD, AL	80009	210-1000-00
	210-0978-00 ¹			1	.					WASHER, FLAT: 0.375 ID X 0.50 INCH OD, STL	78471	OBD
	210-0978-00 ²	XB010400		1	.					WASHER, FLAT: 0.375 ID X 0.50 INCH OD, STL	78471	OBD
										- - - * - - -		
-122	105-0678-00 ¹	B010100	B010549	1	.					DRUM, CAM SWITCH: W/LEVER	80009	105-0678-00
	105-0678-01 ¹	B010550		1	.					DRUM, CAM SWITCH: AC-DC GND, CHANNEL 1	80009	105-0678-01
	105-0678-00 ²	B010100	B013440	1	.					DRUM, CAM SWITCH: W/LEVER	80009	105-0678-00
	105-0678-02 ²	B013441		1	.					DRUM, CAM SWITCH: AC-DC GND, CHANNEL 2	80009	105-0678-02
-123	214-1126-01			4	.					SPRING, FLAT: GREEN COLORED	80009	214-1126-01
-124	214-1752-00			4	.					ROLLER, DETENT:	80009	214-1752-00
-125	401-0338-00			1	.					BEARING, CAM SW: FRONT (ATTACHING PARTS)	80009	401-0338-00
-126	211-0116-00 ¹	B010100	B010339	2	.					SCR, ASSEM WSHR: 4-40 X 0.312 INCH, PNH BRS	83385	OBD
	211-0244-00 ¹	B010340		2	.					SCR, ASSEM WSHR: 4-40 X 0.312 INCH, PNH STL	78189	OBD
	211-0116-00 ²	B010100	B011674	2	.					SCR, ASSEM WSHR: 4-40 X 0.312 INCH, PNH BRS	83385	OBD
	211-0244-00 ²	B010675		2	.					SCR, ASSEM WSHR: 4-40 X 0.312 INCH, PNH STL	78189	OBD
-127	210-0406-00			2	.					NUT, PLAIN, HEX. : 4-40 X 0.188 INCH, BRS (ATTACHING PARTS)	73743	2X12161-402
										- - - * - - -		
-128	376-0174-00			1	.					CPLG, SHAFT, RGD: 0.19 ID X 0.325 OD X 0.2" H	80009	376-0174-00
-129	105-0679-00			1	.					DRUM, CAM SWITCH:	80009	105-0679-00
-130	343-0564-00			1	.					RTNR BAR, CONT: ATTENUATOR, LEFT CH1	80009	343-0564-00
	343-0565-00			1	.					RTNR BAR, CONT: ATTENUATOR, RIGHT CH2 (ATTACHING PARTS)	80009	343-0565-00
-131	211-0116-00 ¹	B010100	B010339	1	.					SCR, ASSEM WSHR: 4-40 X 0.312 INCH, PNH BRS	83385	OBD
	211-0244-00 ¹	B010340		1	.					SCR, ASSEM WSHR: 4-40 X 0.312 INCH, PNH STL	78189	OBD
	211-0116-00 ²	B010100	B011674	1	.					SCR, ASSEM WSHR: 4-40 X 0.312 INCH, PNH BRS	83385	OBD
	211-0244-00 ²	B011675		1	.					SCR, ASSEM WSHR: 4-40 X 0.312 INCH, PNH STL	78189	OBD
-132	211-0152-00 ¹	B010100	B010339	1	.					SCR, ASSEM WSHR: 4-40 X 0.625 INCH, PNH BRS	83385	OBD
	211-0246-00 ¹	B010340		1	.					SCR, ASSEM WSHR: 4-40 X 0.625 INCH, PNH, STL	78189	OBD
	211-0152-00 ²	B010100	B011674	1	.					SCR, ASSEM WSHR: 4-40 X 0.625 INCH, PNH BRS	83385	OBD
	211-0246-00 ²	B011675		1	.					SCR, ASSEM WSHR: 4-40 X 0.625 INCH, PNH, STL	78189	OBD
-133	210-0406-00			1	.					NUT, PLAIN, HEX. : 4-40 X 0.188 INCH, BRS (ATTACHING PARTS)	73743	2X12161-402
										- - - * - - -		
-134	131-1779-03			1	.					CONT ASSY, ELEC: CAM SW, 1 CONTACT, LEFT, CH1	80009	131-1779-03
	131-1779-04			1	.					CONT ASSY, ELEC: CAM SW, 1 CONTACT, RIGHT, CH2	80009	131-1779-04
-135	131-1779-01			1	.					CONT ASSY, ELEC: CAM SW, 13 CONTACT, LEFT, CH1	80009	131-1779-01
	131-1779-02			1	.					CONT ASSY, ELEC: CAM SW, 13 CONTACT, RIGHT, CH2	80009	131-1779-02
-136	-----			1	.					CKT BOARD ASSY: CH1 OR CH2 (SEE A6, A7 EPL)		
-137	136-0263-04			5	.					SOCKET, PIN TERM: FOR 0.025 INCH SQUARE PIN	22526	75377-001
-138	361-0735-00			2	.					SPACER, CKT BD: 0.25" OD X 0.093" H, PLSTC	80009	361-0735-00
	361-0735-00			1	.					SPACER, CKT BD: 0.25" OD X 0.093" H, PLSTC	80009	361-0735-00
-139	384-1136-00			3	.					EXTENSION SHAFT: 0.95 INCH LONG	80009	384-1136-00
-140	-----			1	.					CKT BOARD ASSY: VERTICAL (SEE A8 EPL) (ATTACHING PARTS)		
-141	211-0014-00			3	.					SCREW, MACHINE: 4-40 X 0.50 INCH, PNH STL	83385	OBD
	211-0008-00			1	.					SCREW, MACHINE: 4-40 X 0.25 INCH, PNH STL (ATTACHING PARTS)	83385	OBD
										- - - * - - -		
					.					CKT BOARD ASSY INCLUDES:		
-142	131-1817-00 ¹	B010100	B010633	72	.					LINK, TERM CONNE: 22 AWG, 2.25" LONG	80009	131-1817-00
	131-1817-00 ¹	B010634		77	.					LINK, TERM CONNE: 22 AWG, 2.25" LONG	80009	131-1817-00
	131-1817-00 ²			72	.					LINK, TERM. CONN: 22 AWG, 2.25 INCH LONG	80009	131-1817-00
	131-0566-00 ¹	B010100	B010107	4	.					LINK, TERM. CONNE: 0.086 DIA X 2.375 INCH L	55210	ERD-18T0
	131-0566-00 ¹	B010108	B010633X	4	.					LINK, TERM. CONNE: 0.086 DIA X 2.375 INCH L	55210	ERD-18T0
	131-0566-00 ²			5	.					LINK, TERM. CONN: 0.086 DIA X 2.375 INCH L	55210	ERD-18T0
-143	131-0589-00			10	.					CONTACT, ELEC: 0.46 INCH LONG	22526	47350
	131-0589-00			5	.					CONTACT, ELEC: 0.46 INCH LONG	22526	47350
-144	131-1792-00			1	.					CONTACT ASSY, EL: 12 MALE CONTACT, FLAT WAFER	27264	09-70-2121
-145	-----			1	.					SWITCH, PUSH: CH1, CH2 (SEE S4370 EPL)		
-146	361-0542-00			4	.					SPACER, SWITCH: PLASTIC	71590	J-64281
-147	-----			2	.					RES., VAR: CH1, CH2 VAR GAIN (SEE R4152, R4252 EPL)		
	-----			1	.					RES., VAR: CH1 VAR GAIN (SEE R4152 EPL)		

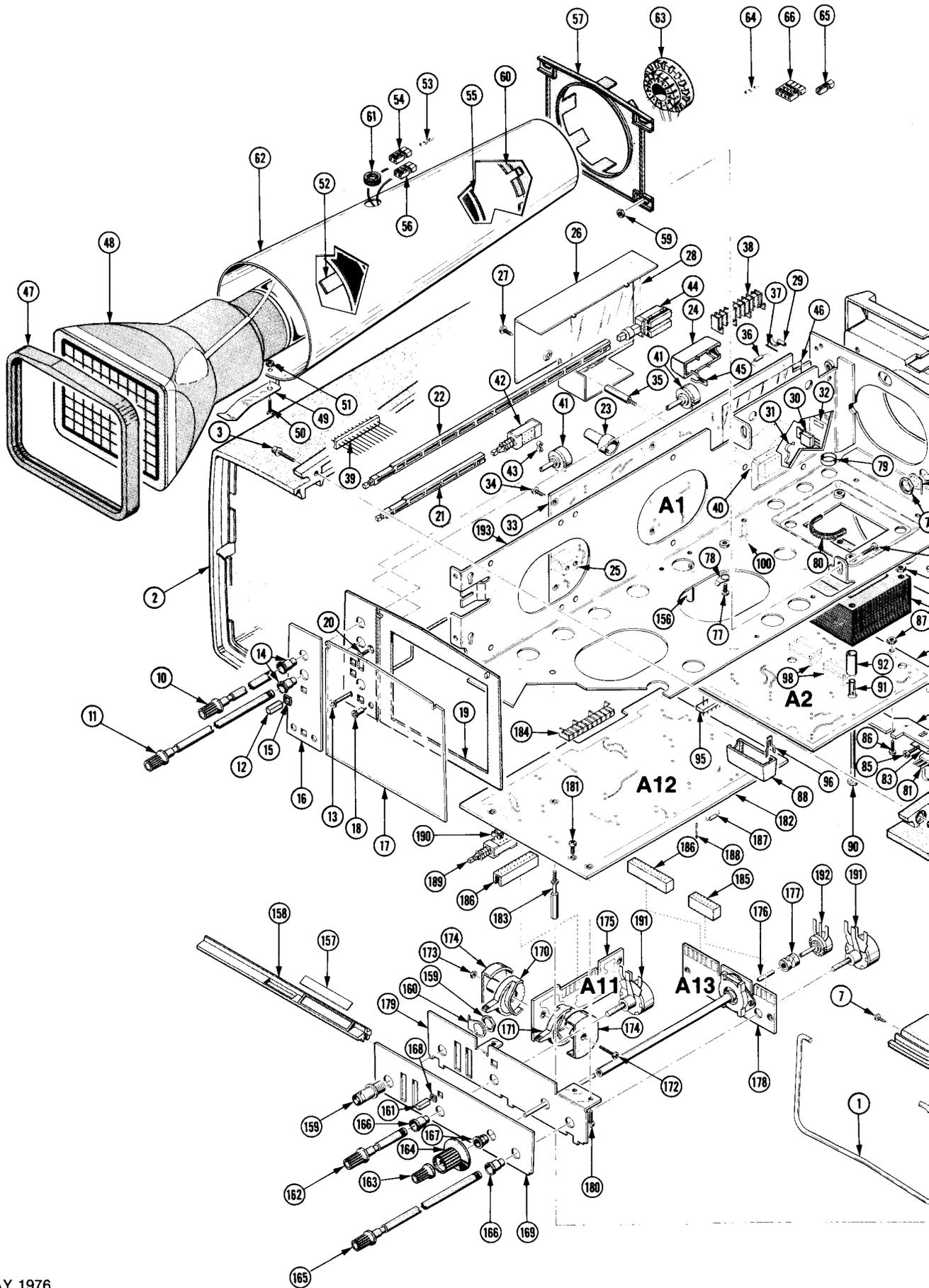
¹T921
²T922

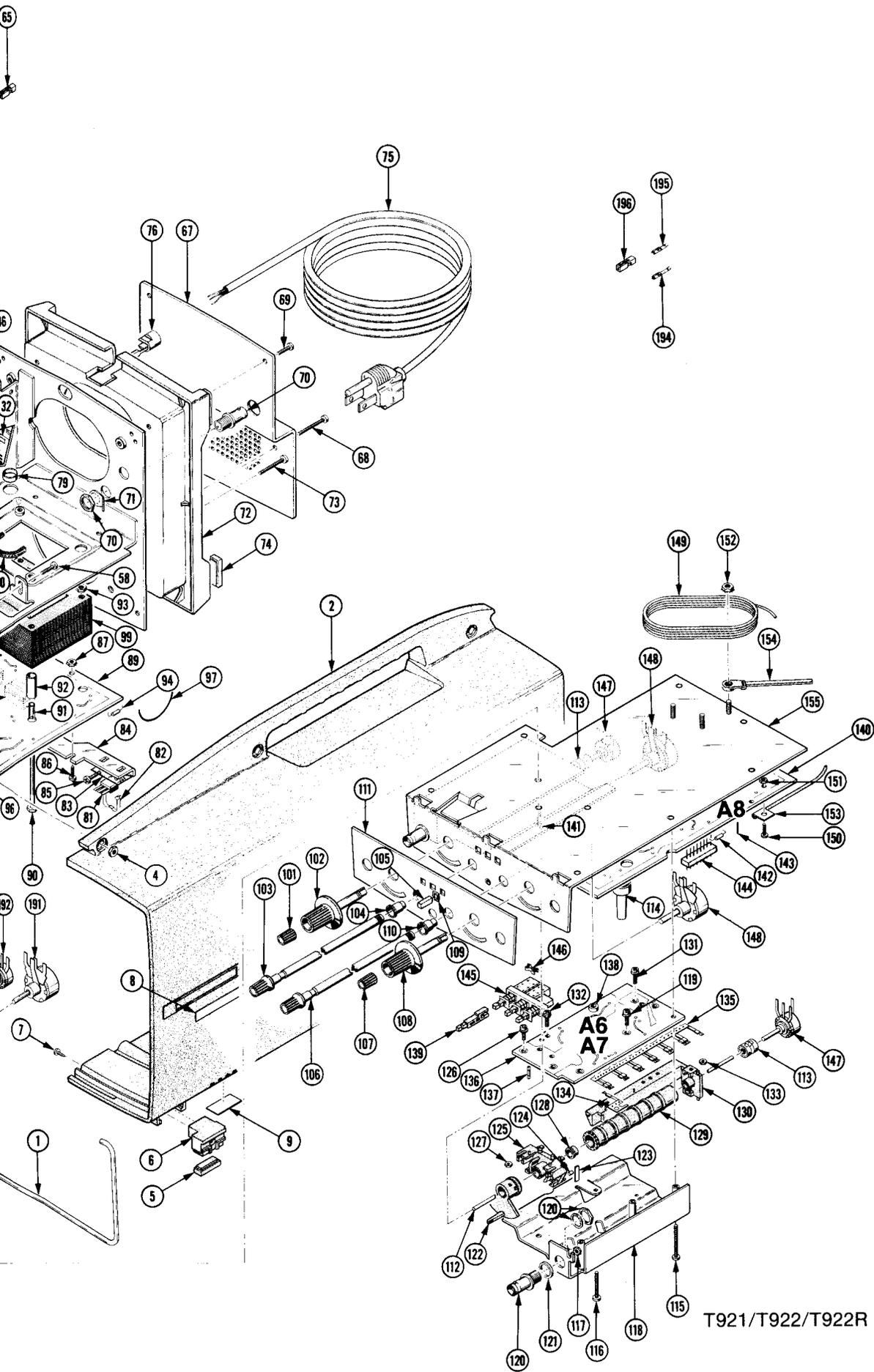
Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
1-148	-----	-----		2	.	RES.,VAR:CH1,CH2 POSITION(SEE R4306,R4316 EPL)						
	-----	-----		1	.	RES.,VAR:CH1 POSITION(SEE R4306 EPL)						
-149	-----	-----		1	DELAY LINE:W/HDWR(SEE DL4339 EPL)							
						(ATTACHING PARTS)						
-150	211-0007-00			2	SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL						83385	OBD
-151	210-0586-00			2	NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL						78189	OBD
-152	210-0458-00			3	NUT,PLAIN,EXT W:8-32 X 0.344 INCH,STL						83385	OBD
						-----*						
					.	DELAY LINE ASSY INCLUDES:						
-153	131-1798-00			2	. CONTACT,ELEC:DELAY LINE						80009	131-1798-00
-154	346-0121-00			3	. STRAP,ELEC COMP:TIE DOWN,5.0 LONG						59730	T4-34M
-155	386-3292-00			1	SUBPANEL,FRONT:VERTICAL						80009	386-3292-00
-156	129-0577-00			1	SPACER,POST:0.188 HEX X 1.442"L,BRS						80009	129-0577-00
-157	334-2536-00			1	PLATE,IDENT:MARKED T922						80009	334-2536-00
	334-2607-00			1	PLATE,IDENT:MARKED T921						80009	334-2607-00
-158	124-0315-00			1	STRIP,TRIM:FRONT,PLASTIC						80009	124-0315-00
-159	131-0106-02			1	CONNECTOR,RCPT,:BNC						80009	131-0106-02
						(ATTACHING PARTS)						
-160	210-0255-00			1	TERMINAL,LUG:0.391" ID INT TOOTH						80009	210-0255-00
						-----*						
-161	366-1559-00			1	PUSH BUTTON:GRAY						80009	366-1559-00
-162	384-1371-00			1	EXTENSION SHAFT:2.0" LONG,W/KNOB,PLASTIC						80009	384-1371-00
-163	366-1647-00			1	KNOB:0.127" ID X 0.5" OD X 0.531"						80009	366-1647-00
	213-0153-00			1	. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL						74445	OBD
-164	366-1281-02			1	KNOB:GRAY,FCNTN TIME/DIV						80009	366-1281-02
	213-0153-00			2	. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL						74445	OBD
-165	384-1371-02			1	EXTENSION SHAFT:6.8" LONG,W/KNOB						80009	384-1371-02
-166	358-0550-00			2	BUSHING,SHAFT:0.15 ID X 0.3 INCH OD,PLSTC						80009	358-0550-00
-167	358-0216-00			1	BUSHING,PLASTIC:0.257 ID X 0.412 INCH OD						80009	358-0216-00
-168	426-1072-00			1	FRAME,PUSH BTN:PLASTIC						80009	426-1072-00
-169	333-2039-00			1	PANEL,FRONT:HORIZONTAL						80009	333-2039-00
	672-0517-00 ¹	B010100	B010129	1	CKT BOARD ASSY:TRIGGER,W/LEVER SWITCH						80009	672-0517-00
	672-0549-00 ¹	B010130		1	CKT BOARD ASSY:TRIGGER,W/LEVER SWITCH						80009	672-0549-00
	672-0517-00 ²	B010100	B010169	1	CKT BOARD ASSY:TRIGGER,W/LEVER SWITCH						80009	672-0517-00
	672-0549-00 ²	B010170		1	CKT BOARD ASSY:TRIGGER,W/LEVER SWITCH						80009	672-0549-00
					.	CKT BOARD ASSY INCLUDES:						
-170	-----			1	. LEVER,SWITCH:MODE(SEE S2150 EPL)							
-171	-----			1	. LEVER,SWITCH:SOURCE(SEE S2100 EPL)							
						(ATTACHING PARTS FOR BOTH)						
-172	211-0152-00 ¹	B010100	B010339	1	. SCR,ASSEM WSHR:4-40 X 0.625 INCH,PNH BRS						83385	OBD
	211-0240-00 ¹	B010340		1	. SCR,ASSEM WSHR:4-40 X 0.688"PNH,STL						78189	OBD
	211-0152-00 ²	B010100	B011674	1	. SCR,ASSEM WSHR:4-40 X 0.625 INCH,PNH BRS						83385	OBD
	211-0240-00 ²	B011675		1	. SCR,ASSEM WSHR:4-40 X 0.688"PNH,STL						78189	OBD
-173	210-0551-00			1	NUT,PLAIN,HEX.:4-40 X 0.25 INCH,STL						83385	OBD
-174	351-0448-01			2	. GUIDE ,SWITCH:W/SPRING AND ROLLER						80009	351-0448-01
						-----*						
-175	-----			1	. CKT BOARD ASSY:TRIGGER(SEE A11 EPL)							
-176	384-1399-00			1	EXTENSION SHAFT:0.123" ID X 7.65" L,PLSTC						80009	384-1399-00
-177	376-0051-00			1	CPLG,SHAFT,FLEX:FOR 0.125 INCH DIA SHAFTS						80009	376-0051-00
	213-0022-00			4	. SETSCREW:4-40 X 0.188 INCH,HEX SOC STL						74445	OBD
-178	-----			1	CKT BOARD ASSY:A TIMING(SEE A13 EPL)							
-179	386-3293-00			1	SUBPANEL,FRONT:HORIZONTAL						80009	386-3293-00
						(ATTACHING PARTS)						
-180	211-0008-00			1	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL						83385	OBD
-181	211-0007-00			2	SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL						83385	OBD
						-----*						
-182	-----			1	CKT BOARD ASSY:HORIZONTAL(SEE A12 EPL)							
						(ATTACHING PARTS)						
-183	129-0573-00			2	SPACER,POST:0.188" HEX 1.627" L,AL						80009	129-0573-00
						-----*						
					.	CKT BOARD ASSY INCLUDES:						
	131-0566-00 ¹	B010100	B010633X	3	. LINK,TERM CONN:0.086 DIA X 2.375 INCH L						55210	ERD-18T0
	131-0566-00 ²	B010100	B014318X	3	. LINK,TERM CONN:0.086 DIA X 2.375 INCH L						55210	ERD-18T0

¹T921
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Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont									
1-184	131-1795-00			1						. CONNECTOR,RCPT,:12 FEMALE CONTACT,RT-ANGLE	27264	09-62-3121
-185	131-1801-00			1						. CONNECTOR,RCPT,:9 CONTACTS	80009	131-1801-00
-186	131-1802-00			2						. CONNECTOR,RCPT,:15 CONTACTS	80009	131-1802-00
-187	131-1817-00 ¹	B010100	B010633	33						. LINK,TERM CONNE:22 AWG,2.25" LONG	80009	131-1817-00
	131-1817-00 ¹	B010634		36						. LINK,TERM CONN:22 AWG,2.25 INCH LONG	80009	131-1817-00
	131-1817-00 ²	B010100	B014318	33						. LINK,TERM CONN:22 AWG,2.25 INCH LONG	80009	131-1817-00
	131-1817-00 ²	B014319		36						. LINK,TERM CONN:22 AWG,2.25 INCH LONG	80009	131-1817-00
-188	131-0608-00			2						. CONTACT,ELEC:0.365 INCH LONG	22526	47357
-189	-----			1						. SWITCH,PUSH:SLOPE(SEE S2140 EPL)		
-190	361-0542-00			2						. SPACER,SWITCH:PLASTIC	71590	J-64281
-191	-----			2						. RES.,VAR:LEVEL,POSITION(SEE R2138,R2316 EPL)		
-192	-----			1						. RES.,VAR:POS(SEE R2322 EPL)		
-193	441-1278-00			1						CHASSIS,SCOPE:MAIN	80009	441-1278-00
-194	131-1538-00			4						CONTACT,ELEC:CRIMP-ON,22-26 AWG WIRE	22526	75369-002
-195	131-0707-00			4						CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	47439
-196	352-0171-00			1						CONN BODY,PL,EL:1 WIRE BLACK	80009	352-0171-00

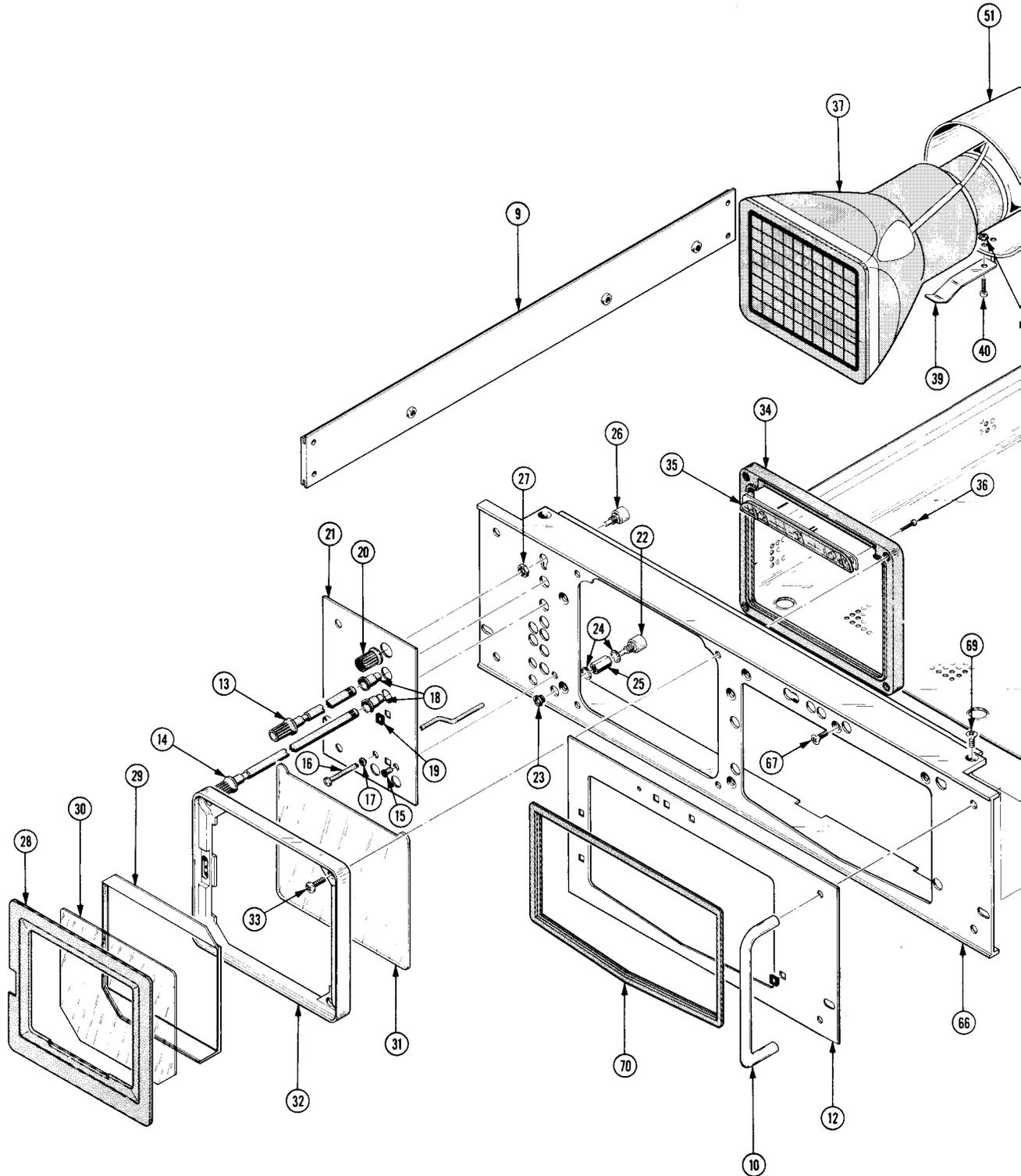
¹T921
²T922





T921/T922/T922R 15 MHz SCOPE

FIG. 2 T922R FRAME



T921/T922/T922R 15 MHz OSCILLOSCOPE

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-1	390-0530-00			2		CABINET,SCOPE:TOP AND BOTTOM(T922R)	80009	390-0530-00
-2	386-1151-00			6		. PLATE,LATCH LKG:	80009	386-1151-00
-3	386-0227-04			6		. PLATE,LCH INDEX:MOLD SI GY PLSTC	80009	386-0227-04
-4	214-0603-01			6		. PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-5	214-0604-00			6		. WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-6	426-1325-00			1		FRAME SECT,CAB.:RIGHT (ATTACHING PARTS)	80009	426-1325-00
-7	212-0004-00			4		SCREW,MACHINE:8-32 X 0.312 INCH,PNH STL	83385	OBD
-8	211-0504-00			3		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL - - - * - - -	83385	OBD
-9	426-1326-00			1		FRAME SECT,CAB.:LEFT (ATTACHING PARTS)	80009	426-1326-00
	212-0004-00			4		SCREW,MACHINE:8-32 X 0.312 INCH,PNH STL - - - * - - -	83385	OBD
-10	367-0228-00			2		HANDLE,BOW:4.0 INCH LONG,ALUM (ATTACHING PARTS FOR EACH)	80009	367-0228-00
-11	212-0574-00			2		SCREW,MACHINE:10-32 X 0.438"100 DEG FLH STL - - - * - - -	83385	OBD
-12	333-2188-00			1		PANEL,FRONT:	80009	333-2188-00
-13	384-1371-01			1		EXTENSION SHAFT:5.2" LONG W/KNOB	80009	384-1371-01
-14	384-1371-03			1		EXTENSION SHAFT:10.7" LONG W/KNOB	80009	384-1371-03
-15	136-0387-01			1		JACK,TIP:BLACK	71279	450-4352-01-0310
-16	214-2309-00			1		CONDUCTOR,LIGHT:5.265" LONG	80009	214-2309-00
-17	358-0378-01			1		BUSHING,SLEEVE:0.250 OD X 0.131 ID,PRESS MT	80009	358-0378-01
-18	358-0550-00			2		BUSHING,SHAFT:0.15 ID X 0.3 INCH OD,PLSTC	80009	358-0550-00
-19	426-1072-00			2		FRAME,PUSH BTN:PLASTIC	80009	426-1072-00
-20	366-1660-00			1		KNOB:GRAY	80009	366-1660-00
	213-0153-00			2		. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-21	333-2190-00			1		PANEL,FRONT:CRT	80009	333-2190-00
-22	-----			2		RES.,VAR:ASTIG/TRACE ROTATE(SEE R472,R477 EPL) (ATTACHING PARTS FOR EACH)		
-23	358-0342-00			1		BSHG,MACH.THD:0.25 X 32 X 0.352 INCH LONG	80009	358-0342-00
-24	210-0046-00			2		WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL	78189	1214-05-00-0541C
-25	210-0471-00			1		NUT,SLEEVE:HEX.,0.312 X 0.594 INCH LONG - - - * - - -	80009	210-0471-00
-26	-----			1		RES.,VAR:SCALE ILLUM(SEE R812 EPL) (ATTACHING PARTS)		
-27	210-0586-00			1		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL - - - * - - -	78189	OBD
-28	426-0514-00			1		FRAME,MASK:PLASTIC	80009	426-0514-00
-29	331-0258-03			1		MASK,CRT SCALE:	80009	331-0258-03
-30	378-0625-00			1		FILTER,LT,CRT:	80009	378-0625-00
-31	337-1159-03			1		SHLD,IMPLOSION:4.75 X 3.93 X0.7 THK,PLSTC	80009	337-1159-03
-32	200-0939-01			1		BEZEL,CRT: (ATTACHING PARTS)	80009	200-0939-01
-33	212-0010-00			4		SCREW,MACHINE:8-32 X 0.625 INCH,PNH STL - - - * - - -	83385	OBD
-34	386-3578-00			1		SUPPORT,CRT:FRONT	80009	386-3578-00
-35	672-0588-00			1		CKT BOARD ASSY:SCALE ILLUMINATION(SEE A EPL) (ATTACHING PARTS)	80009	672-0588-00
-36	211-0182-00			2		SCR,ASSEM WSHR:2-56 X 0.312 INCH,PNH,STL - - - * - - -	12360	OBD
-37	-----			1		ELECTRON TUBE:CRT W/ANODE(SEE V470 EPL)		
	334-1379-00			1		LABEL:CRT,ADHESIVE BACK	80009	334-1379-00
	334-1951-00			1		MARKER,IDENT:CRT WARNING	80009	334-1951-00
-38	214-2371-00			1		SPRING,GROUND:CRT SHIELD	80009	214-2371-00
-39	214-2270-00			1		SPRING,GROUND:CRT TO SHIELD (ATTACHING PARTS)	80009	214-2270-00
-40	211-0008-00			1		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
	210-0804-00			1		WASHER,FLAT:0.17 ID X 0.375 INCH OD,STL	12327	OBD
	343-0042-00			1		CLAMP,LOOP:0.287 INCH DIA	95987	5-16-6BH
	361-0158-00			1		SPACER,SLEEVE:0.116 ID X 0.156 OD X 0.093" L	80009	361-0158-00
-41	210-0586-00			1		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL - - - * - - -	78189	OBD

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont					
2-42	-----			1		COIL,TUBE DEFL:(SEE L472 EPL)		
-43	131-0707-00			2		. CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	75691-005
-44	352-0169-01			1		. CONN BODY,PL,EL:2 WIRE BROWN	80009	352-0169-01
-45	-----			1		COIL,TUBE DEFL:(SEE L470 EPL)		
	131-0707-00			2		. CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	75691-005
	352-0169-00			1		. CONN BODY,PL,EL:2 WIRE BLACK	80009	352-0169-00
-46	386-3288-00			1		SPRT,CRT SHIELD:REAR (ATTACHING PARTS)	80009	386-3288-00
-47	211-0507-00			4		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
-48	220-0419-00			4		NUT,PLAIN,SQ:6-32 X 0.312 INCH,STL -----*	83385	OBD
-49	386-3305-00			1		SUPPORT,CRT:REAR	80009	386-3305-00
-50	348-0004-00			1		GROMMET,RUBBER:0.281 ID X 0.563 INCH OD	70485	763
-51	337-2223-00			1		SHIELD,ELEC:CRT	80009	337-2223-00
	136-0652-00			1		SOCKET ASSY:CRT	80009	136-0652-00
-52	136-0202-01			1		. SOCKET,PLUG-IN:14 PIN	80009	136-0202-01
-53	131-0707-00			9		. CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	75691-005
-54	352-0171-00			1		. CONN BODY,PL,EL:1 WIRE BLACK	80009	352-0171-00
-55	352-0162-00			2		. CONN BODY,PL,EL:4 WIRE BLACK	80009	352-0162-00
-56	407-1828-00			1		BRKT,ELEC CONN:ALUMINUM (ATTACHING PARTS)	80009	407-1828-00
-57	211-0504-00			3		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
-58	211-0504-00			3		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL -----*	83385	OBD
-59	131-0955-00			7		CONNECTOR,RCPT,:BNC,FEMALE,W/HARDWARE (ATTACHING PARTS FOR EACH)	05091	31-279
-60	210-0255-00			1		TERMINAL,LUG:0.391" ID INT TOOTH -----*	80009	210-0255-00
-61	333-2189-00			1		PANEL,REAR: (ATTACHING PARTS)	80009	333-2189-00
-62	211-0504-00			6		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL -----*	83385	OBD
-63	161-0107-02			1		CABLE ASSY,PWR,:3,18 AWG,115V,93.0" L (ATTACHING PARTS)	80009	161-0107-02
-64	358-0506-00			1		BUSHING,HANDLE:0.500 INCH DIAMETER -----*	80009	358-0506-00
-65	-----			-		. POWER CORD ASSEMBLY INCLUDES:		
	210-0287-00			1		. TERMINAL,LUG: (ATTACHING PARTS)	00779	34142
	210-0586-00			1		. NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL -----*	78189	OBD
-66	386-3580-00			1		SUBPANEL,FRONT: (ATTACHING PARTS)	80009	386-3580-00
-67	211-0541-00	B010100	B010145	4		SCREW,MACHINE:6-32 X 0.25"100 DEG,FLH STL	83385	OBD
	211-0504-00	B010146		4		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL -----*	83385	OBD
-68	407-1848-00			2		BRACKET CAB.COR:ALUMINUM (ATTACHING PARTS FOR EACH)	80009	407-1848-00
-69	211-0541-00	B010100	B010145	2		SCREW,MACHINE:6-32 X 0.25"100 DEG,FLH STL	83385	OBD
	211-0504-00	B010146		2		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL -----*	83385	OBD
-70	101-0036-00			1		TRIM,FRONT PNL:	80009	101-0036-00

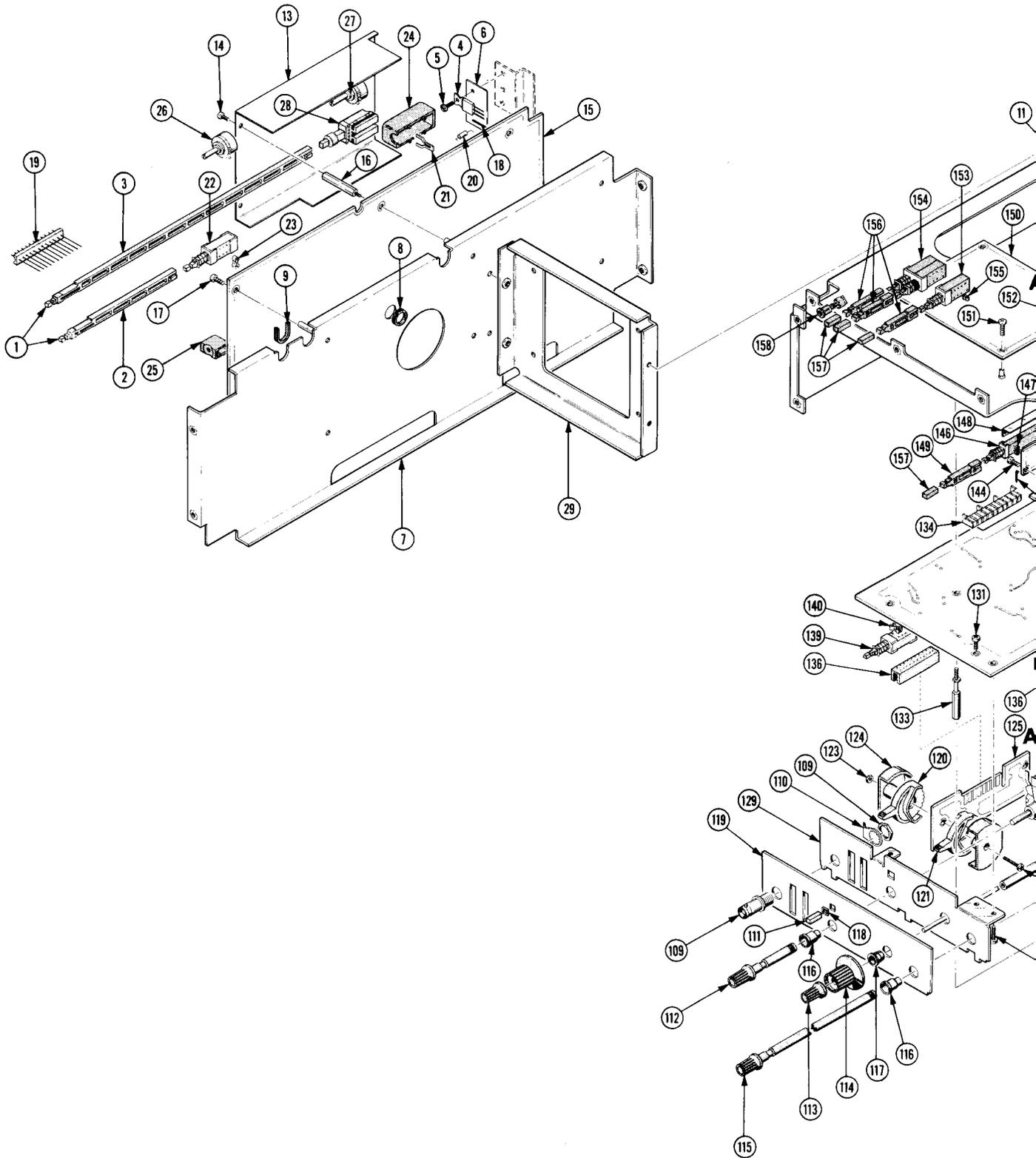
Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont					
3-1	366-1559-00			2		PUSH BUTTON:GRAY	80009	366-1559-00
-2	384-1370-00			1		EXTENSION SHAFT:4.68" L,MOLDED PLSTC	80009	384-1370-00
-3	384-1364-00			1		EXTENSION SHAFT:10.818" L,NYLON,BLK	80009	384-1364-00
-4	-----			3		TRANSISTOR:(SEE Q458,Q816,Q818 EPL) (ATTACHING PARTS FOR EACH)		
-5	211-0040-00			1		SCREW,MACHINE:4-40 X 0.25",BDGH PLSTC	26365	OBD
-6	342-0202-00			1		INSULATOR,PLATE:TRANSISTOR -----*	01295	10-21-023-106
-7	441-1341-00			1		CHASSIS,SCOPE:INTERFACE (ATTACHING PARTS)	80009	441-1341-00
	211-0541-00	B010100	B010145	4		SCREW,MACHINE:6-32 X 0.25"100 DEG,FLH STL	83385	OBD
	211-0504-00	B010146		4		SCREW.MACHINE:6-32 X 0.25 INCH,PNH STL -----*	83385	OBD
-8	348-0003-00			1		GROMMET,RUBBER:0.312 INCH DIAMETER	70485	1411B6040
-9	348-0171-00			2		GROMMET,PLASTIC:U-SHAPED	80009	348-0171-00
-10	255-0334-00			FT		PLASTIC CHANNEL:0.667 FT LONG	11897	122-37-2500
-11	343-0089-00			3		CLAMP,LOOP:LARGE	80009	343-0089-00
-12	343-0213-00			4		CLAMP,LOOP:PRESS MT,PLASTIC	80009	343-0213-00
	342-0293-00			1		INSULATOR,SHLD:HIGH VOLTAGE	80009	342-0293-00
-13	337-2351-00			1		SHIELD,ELEC:HIGH VOLTAGE (ATTACHING PARTS)	80009	337-2351-00
-14	211-0007-00			4		SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL -----*	83385	OBD
-15	-----			1		CKT BOARD ASSY:INTERFACE(SEE A1 EPL) (ATTACHING PARTS)		
-16	129-0551-00			4		POST,ELEC-MECH:0.25 HEX X 1.58 INCH LONG	80009	129-0551-00
-17	211-0008-00			2		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL -----*	83385	OBD
-18	-----			-		. CKT BOARD ASSY INCLUDES:		
-18	131-0608-00			33		. CONTACT,ELEC:0.365 INCH LONG	22526	47357
-19	131-1795-00			1		. CONNECTOR,RCPT,:12 FEMALE CONTACT,RT-ANGLE	27264	09-62-3121
	131-1792-00			2		. CONTACT ASSY,EL:12 MALE CONTACT,FLAT WAFER	27264	09-70-2121
-20	131-1817-00			1		. LINK,TERM CONNE:22 AWG,2.25" LONG	80009	131-1817-00
-21	344-0154-00			2		. CLIP,ELECTRICAL:FOR 0.25 INCH DIA FUSE	80009	344-0154-00
-22	-----			1		. SWITCH:BEAM FIND(SEE S410 EPL)		
-23	361-0608-00			2		. SPACER,PUSH SW:PLASTIC	80009	361-0608-00
-24	352-0425-00			1		. FUSEHOLDER:PLASTIC	80009	352-0425-00
-25	352-0331-00			1		. LAMPHOLDER:	80009	352-0331-00
-26	-----			1		. RES.,VAR:INTENSITY(SEE R412 EPL)		
-27	-----			1		. RES.,VAR: FOCUS(SEE R468 EPL)		
-28	-----			1		. SWITCH:POWER(SEE S700 EPL)		
-29	386-3569-00			1		SPRT,CRT SHIELD:REAR (ATTACHING PARTS)	80009	386-3569-00
-30	211-0504-00			4		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL -----*	83385	OBD
-31	385-0168-00			2		SPACER,POST:1.168 INCHES LONG (ATTACHING PARTS FOR EACH)	80009	385-0168-00
-32	211-0504-00			1		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL -----*	83385	OBD
-33	-----			3		TRANSISTOR:(SEE Q736,Q756,Q776 EPL) (ATTACHING PARTS FOR EACH)		
-34	344-0236-01			1		CLIP,SPR TNSN:TRANSISTOR MOUNTING	80009	344-0236-01
	342-0202-00			1		INSULATOR,PLATE:TRANSISTOR -----*	01295	10-21-023-106
-35	253-0202-00			FT		INSUL TAPE,ELEC:POLYIMIDE	99742	221
-36	214-2265-00			1		HEAT SINK,XSTR:6.0" L X 0.72" H,AL (ATTACHING PARTS)	80009	214-2265-00
-37	211-0504-00			2		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
-38	211-0008-00			2		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-39	210-0586-00			2		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL -----*	78189	OBD
-40	352-0425-00			1		FUSEHOLDER:PLASTIC	80009	352-0425-00
-41	337-2302-00			1		SHIELD,ELEC:LV POWER CARD	80009	337-2302-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
3-42	-----	-----		1		CKT BOARD ASSY:L.V. POWER(SEE A2 EPL) (ATTACHING PARTS)		
-43	212-0516-00			4		SCREW,MACHINE:10-32 X 2 INCH,HEX HD STL	77250	QBD
-44	166-0227-00			4		INS SLV,ELEC:0.187 ID X 1.50 INCH LONG	80009	166-0227-00
-45	361-0741-00			4		SPACER,SLEEVE:0.245" ID X 0.75" L,AL	80009	361-0741-00
-46	220-0572-00			2		NUT,PLAIN,HEX.:10-32 X 0.25 INCH,PL BRS	73743	QBD
	-----			-		. CKT BOARD ASSY INCLUDES:		
-47	131-1817-00			9		. LINK,TERM CONNE:22 AWG,2.25" LONG	80009	131-1817-00
-48	131-1750-00			1		. TERM.,FEED THRU:10 PIN INSULATED	27264	09-64-1103
-49	-----			2		. SWITCH:(SEE S701,S705 EPL)		
-50	344-0154-00			2		. CLIP,ELECTRICAL:FOR 0.25 INCH DIA FUSE	80009	344-0154-00
-51	346-0032-00			3		. STRAP,RETAINING:	98159	2829-75-4
-52	-----			1		TRANSFORMER:(SEE T700 EPL)		
	343-0213-00			4		CLAMP,LOOP:PRESS MT,PLASTIC	80009	343-0213-00
	343-0089-00			2		CLAMP,LOOP:LARGE	80009	343-0089-00
-53	366-1031-02			1		KNOB:RED-VAR	80009	366-1031-02
	213-0153-00			1		. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	QBD
-54	366-1646-00			1		KNOB:GRAY,W/SHAFT	80009	366-1646-00
-55	384-1371-02			1		EXTENSION SHAFT:6.8" LONG,W/KNOB	80009	384-1371-02
-56	358-0550-00			1		BUSHING,SHAFT:0.15 ID X 0.3INCH OD,PLSTC	80009	358-0550-00
-57	366-1559-00			3		PUSH BUTTON:GRAY	80009	366-1559-00
-58	384-1371-02			1		EXTENSION SHAFT:6.8" LONG,W/KNOB	80009	384-1371-02
-59	366-1031-02			1		KNOB:RED-VAR	80009	366-1031-02
	213-0153-00			1		. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	QBD
-60	366-1646-00			1		KNOB:GRAY,W/SHAFT	80009	366-1646-00
-61	426-1072-00			3		FRAME,PUSH BTN:PLASTIC	80009	426-1072-00
-62	358-0550-00			1		BUSHING,SHAFT:0.15 ID X 0.3INCH OD,PLSTC	80009	358-0550-00
-63	333-2040-00			1		PANEL,FRONT:VERTICAL	80009	333-2040-00
-64	384-1393-00			2		EXTENSION SHAFT:0.123 DIA X 6.3" L,PLSTC	80009	384-1393-00
-65	376-0051-00			2		CPLG,SHAFT,FLEX:FOR 0.125 INCH DIA SHAFTS	80009	376-0051-00
	213-0022-00			4		. SETSCREW:4-40 X 0.188 INCH,HEX SOC STL	74445	QBD
-66	351-0456-00			2		. GUIDE,RES ADJ:PLASTIC	80009	351-0456-00
	672-0518-00			1		CKT BOARD ASSY:ATTEN CH1 W/CAM SW	80009	672-0518-00
	672-0519-00			1		CKT BOARD ASSY:ATTEN CH2 W/CAM SW (ATTACHING PARTS FOR EACH)	80009	672-0519-00
-67	211-0144-00			2		SCREW,MACHINE:4-40 X 1.312 INCH,PNH STL	83385	QBD
-68	211-0018-00			2		SCREW,MACHINE:4-40 X 0.875 PNH,STL	83385	QBD
-69	210-0586-00			2		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	QBD
	-----			-		. EACH ATTENUATOR INCLUDES:		
-70	337-2214-00			1		. SHIELD,ELEC:ATTENUATOR LEFT,CH1	80009	337-2214-00
	337-2215-00			1		. SHIELD,ELEC:ATTENUATOR,RIGHT,CH2 (ATTACHING PARTS)	80009	337-2215-00
-71	211-0244-00			2		. SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	QBD
-72	131-0955-00			1		. CONNECTOR,RCPT,:BNC,FEMALE,W/HARDWARE (ATTACHING PARTS)	05091	31-279
-73	210-1000-00			1		. WASHER,FLAT:0.384 ID X 0.50" OD,AL	80009	210-1000-00
	210-0978-00			1		. WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	78471	QBD
-74	105-0678-00	B010100	B010229	1		. DRUM,CAM SWITCH:W/LEVER	80009	105-0678-00
	105-0678-01	B010230		1		. DRUM,CAM SWITCH:AC-DC GND,CHANNEL 1	80009	105-0678-01
	105-0678-02	B010230		1		. ACTUATOR,CAM SW:CHANNEL 2	80009	015-0678-02
-75	214-1126-01			4		. SPRING,FLAT:GREEN COLORED	80009	214-1126-01
-76	214-1752-00			4		. ROLLER,DETENT:	80009	214-1752-00
-77	401-0338-00			1		. BEARING,CAM SW:FRONT (ATTACHING PARTS)	80009	401-0338-00
-78	211-0244-00			2		. SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	QBD
-79	210-0406-00			2		. NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-80	376-0174-00			1		. CPLG,SHAFT,RGD:0.19 ID X 0.325 OD X 0.2" H	80009	376-0174-00
-81	105-0679-00			1		. DRUM,CAM SWITCH:	80009	105-0679-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty	1 2 3 4 5	Name & Description	Mfr Code	Mir Part Number
		Eff	Dscont					
3-82	343-0564-00			1		. RTNR BAR,CONT:ATTENUATOR,LEFT CH1	80009	343-0564-00
	343-0565-00			1		. RTNR BAR,CONT:ATTENUATOR,RIGHT CH2	80009	343-0565-00
						(ATTACHING PARTS)		
-83	211-0244-00			1		. SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	OBD
-84	211-0246-00			1		. SCR,ASSEM WSHR:4-40 X 0.625 INCH,PNH,STL	78189	OBD
-85	210-0406-00			1		. NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
						- - - * - - -		
-86	131-1779-03			1		. CONT ASSY,ELEC:CAM SW,1 CONTACT,LEFT,CH1	80009	131-1779-03
	131-1779-04			1		. CONT ASSY,ELEC:CAM SW,1 CONTACT,RIGHT,CH2	80009	131-1779-04
-87	131-1779-01			1		. CONT ASSY,ELEC:CAM SW,13 CONTACT,LEFT,CH1	80009	131-1779-01
	131-1779-02			1		. CONT ASSY,ELEC:CAM SW,13 CONTACT,RIGHT,CH2	80009	131-1779-02
-88	-----			1		. CKT BOARD ASSY:(SEE A6,A7 EPL)		
-89	136-0263-04			5		. SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	22526	75377-001
-90	361-0735-00			2		SPACER,CKT BD:0.25"OD X 0.093" H,PLSTC	80009	361-0735-00
-91	384-1136-00			3		EXTENSION SHAFT:0.95 INCH LONG	80009	384-1136-00
-92	-----			1		CKT BOARD ASSY:(SEE A8 EPL)		
						(ATTACHING PARTS)		
-93	211-0014-00			3		SCREW,MACHINE:4-40 X 0.50 INCH,PNH STL	83385	OBD
	211-0008-00			1		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
	-----					. CKT BOARD ASSY INCLUDES:		
	131-0566-00			3		. LINK,TERM.CONNE:0.086 DIA X 2.375 INCH L	0000L	ERD-18T0
-94	131-0589-00			10		. CONTACT,ELEC:0.46 INCH LONG	22526	47350
-95	131-1817-00			51		. LINK,TERM CONNE:22 AWG,2.25" LONG	80009	131-1817-00
-96	131-1792-00			1		. CONTACT ASSY,EL:12 MALE CONTACT,FLAT WAFER	27264	09-70-2121
-97	-----			1		. SWITCH:(SEE S4370 EPL)		
-98	361-0542-00			4		. SPACER,SWITCH:PLASTIC	71590	J-64281
-99	-----			2		. RES.,VAR:CH1,CH2 VAR.GAIN(SEE R4152,4252 EPL)		
-100	-----			2		. RES.,VAR:CH1,CH2 POSITION(SEE R4306,4316 EPL)		
-101	-----			1		DELAY LINE:(SEE DL4339 EPL)		
						(ATTACHING PARTS)		
-102	211-0007-00			2		SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
-103	210-0586-00			2		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
-104	210-0458-00			3		NUT,PLAIN,EXT W:8-32 X 0.344 INCH,STL	83385	OBD
						- - - * - - -		
	-----					. DELAY LINE ASSEMBLY INCLUDES:		
-105	131-1798-00			2		. CONTACT,ELEC:DELAY LINE	80009	131-1798-00
-106	346-0121-00			3		. STRAP,ELEC COMP:TIE DOWN,5.0 LONG	59730	T4-34M
-107	386-3292-00			1		SUBPANEL,FRONT:VERTICAL	80009	386-3292-00
-108	129-0577-00			1		SPACER,POST:0.188 HEX X 1.442"L,BRS	80009	129-0577-00
-109	131-0106-02			1		CONNECTOR,RCPT,:BNC	80009	131-0106-02
						(ATTACHING PARTS)		
-110	210-0207-00			1		TERMINAL,LUG:0.375 INCH DIAMETER	12697	01136902
						- - - * - - -		
-111	366-1559-00			1		PUSH BUTTON:GRAY	80009	366-1559-00
-112	384-1371-00			1		EXTENSION SHAFT:2.0" LONG,W/KNOB,PLASTIC	80009	384-1371-00
-113	366-1647-00			1		KNOB:0.127" ID X 0.5" OD X 0.531"	80009	366-1647-00
	213-0153-00			1		. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-114	366-1281-02			1		KNOB:GRAY,FCTN TIME/DIV	80009	366-1281-02
	213-0153-00			2		. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-115	384-1371-02			1		EXTENSION SHAFT:6.8" LONG,W/KNOB	80009	384-1371-02
-116	358-0550-00			2		BUSHING,SHAFT:0.15 ID X 0.3 INCH OD.PLSTC	80009	358-0550-00
-117	358-0216-00			1		BUSHING,PLASTIC:0.257 ID X 0.412 INCH OD	80009	358-0216-00
-118	426-1072-00			1		FRAME,PUSH BTN:PLASTIC	80009	426-1072-00
-119	333-2039-00			1		PANEL,FRONT:HORIZONTAL	80009	333-2039-00
	672-0549-00			1		CKT BOARD ASSY:TRIGGER W/LEVER SWITCH	80009	672-0549-00
-120	-----			1		. LEVER,SWITCH:MODE(SEE S2150 EPL)		
-121	-----			1		. LEVER,SWITCH:SOURCE(SEE S2100 EPL)		
						(ATTACHING PARTS FOR EACH)		
-122	211-0240-00			1		. SCR,ASSEM WSHR:4-40 X 0.688"PNH,STL	78189	OBD
-123	210-0551-00			1		. NUT,PLAIN,HEX.:4-40 X 0.25 INCH,STL	83385	OBD
-124	351-0448-01			2		. GUIDE ,SWITCH:W/SPRING AND ROLLER	80009	351-0448-01
						- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
3-125	-----	-----	1		. CKT BOARD ASSY:TRIGGER(SEE A11 EPL)		
-126	384-1399-00		1		EXTENSION SHAFT:0.123" ID X 7.65" L,PLSTC	80009	384-1399-00
-127	376-0051-00		1		CPLG,SHAFT,FLEX:FOR 0.125 INCH DIA SHAFTS	80009	376-0051-00
	213-0022-00		4		. SETSCREW:4-40 X 0.188 INCH,HEX SOC STL	74445	OBD
-128	-----	-----	1		CKT BOARD ASSY:TIMING(SEE A13 EPL)		
-129	386-3293-00		1		SUBPANEL,FRONT:HORIZONTAL (ATTACHING PARTS)	80009	386-3293-00
-130	211-0008-00		1		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-131	211-0007-00		2		SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
	214-0614-00		1		THUMBSCREW:	80009	214-0614-00
	214-0276-00		1		CONTACT,ELEC:	80009	214-0276-00
	129-0457-00		1		SPACER,POST: -----*-----	80009	129-0457-00
-132	-----	-----	1		CKT BOARD ASSY:HORIZONTAL(SEE A12 EPL) (ATTACHING PARTS)		
-133	129-0573-00		2		SPACER,POST:0.188" HEX 1.627" L,AL -----*-----	80009	129-0573-00
-134	131-1795-00		1		. CKT BOARD ASSY INCLUDES: . CONNECTOR,RCPT,:12 FEMALE CONTACT,RT-ANGLE	27264	09-62-3121
-135	131-1801-00		1		. CONNECTOR,RCPT,:9 CONTACTS	80009	131-1801-00
-136	131-1802-00		2		. CONNECTOR,RCPT,:15 CONTACTS	80009	131-1802-00
-137	131-1817-00		33		. LINK,TERM CONNE:22 AWG,2.25" LONG	80009	131-1817-00
-138	131-0608-00		2		. CONTACT,ELEC:0.365 INCH LONG	22526	47357
-139	-----	-----	1		. SWITCH:SLOPE(SEE S2140 EPL)		
-140	361-0542-00		2		. SPACER,SWITCH:PLASTIC	71590	J-64281
-141	-----	-----	2		. RES.,VAR:LEVEL,POSITION(SEE R2138,R2316 EPL)		
-142	-----	-----	1		. RES.,VAR:POS(SEE R2322 EPL)		
-143	-----	-----	3		CKT BOARD ASSY:SWITCH(SEE A17,A18,A19 EPL) (ATTACHING PARTS FOR EACH)		
-144	211-0008-00		2		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
	210-0283-00		1		TERMINAL,LUG:#6,SPADE,SOLDERLESS,CU TIN -----*-----	000BI	A-234-06X
-145	131-0787-00		4		. EACH CKT BOARD ASSY INCLUDES: . CONTACT,ELEC:0.64 INCH LONG	22526	47359
-146	-----	-----	1		. SWITCH:(SEE S4099,S4199,S1998 EPL)		
-147	361-0542-00		2		. SPACER,SWITCH:PLASTIC	71590	J-64281
-148	337-2372-00		1		. SHLD,PB SWITCH:	80009	337-2372-00
-149	384-1099-00		3		EXTENSION SHAFT:PUSH BUTTON,1.54 INCH LONG	80009	384-1099-00
	366-1559-00		1		PUSH BUTTON:GRAY	80009	366-1559-00
-150	-----	-----	1		CKT BOARD ASSY:BUFFER(SEE A15 EPL) (ATTACHING PARTS)		
-151	211-0008-00		4		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL -----*-----	83385	OBD
-152	131-0608-00		19		. CKT BOARD ASSY INCLUDES: . CONTACT,ELEC:0.365 INCH LONG	22526	47357
-153	-----	-----	1		. SWITCH:(SEE S2408 EPL)		
-154	-----	-----	1		. SWITCH:(SEE S2400A,B EPL)		
-155	361-0382-00		6		. SPACER,PB SW:BROWN,0.275 INCH LONG	80009	361-0382-00
-156	384-1099-00		3		EXTENSION SHAFT:PUSH BUTTON,1.54 INCH LONG	80009	384-1099-00
-157	366-1559-00		3		PUSH BUTTON:GRAY	80009	366-1559-00
-158	-----	-----	1		BULB ASSY:(SEE CR2400 EPL)		
	200-0935-00		1		. BASE,LAMPHOLDER:0.29 OD X 0.19 CASE	80009	200-0935-00
	352-0157-00		1		. LAMPHOLDER:WHITE PLASTIC	80009	352-0157-00
-159	441-1347-00		1		CHASSIS,SCOPE:MAIN	80009	441-1347-00
	179-2466-00		1		WIRING HARNESS,:INTERFACE	80009	179-2466-00
	131-0707-00		13		. CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	75691-005
	352-0169-00		1		. CONN BODY,PL,EL:2 WIRE BLACK	80009	352-0169-00
	352-0163-00		1		. CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0163-00
	352-0164-00		1		. CONN BODY,PL,EL:6 WIRE BLACK	80009	352-0164-00
	195-0166-00		1		LEAD SET,ELEC:DEFLECTION	80009	195-0166-00
	131-0707-00		8		. CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	75691-005
	198-3150-00		1		WIRE SET,ELEC:	80009	198-3150-00
	175-0826-00		FT		. WIRE,ELECTRICAL:3 WIRE RIBBON	80009	175-0826-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont									
3-	131-0707-00			6						. CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	75691-005
	352-0161-00			2						. CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0161-00
	175-0859-00			FT						. WIRE,ELECTRICAL:6 WIRE RIBBON	23499	TEK-175-0859-00
	131-1790-00			12						. CONTACT,ELEC:18-24 AWG,FEMALE,BRASS	27264	08-56-0105
	352-0462-00			2						. HLD,TERM. CONN:10 FEMALE,NYLON	27264	09-50-7101
	175-0860-00			FT						. WIRE,ELECTRICAL:5 WIRE RIBBON	23499	TEK-175-0860-00
	175-0859-00			FT						. WIRE,ELECTRICAL:6 WIRE RIBBON	23499	TEK-175-0859-00
	131-1790-00			22						. CONTACT,ELEC:18-24 AWG,FEMALE,BRASS	27264	08-56-0105
	352-0461-00			2						. HLD,TERM. CONN:12 FEMALE,NYLON	27264	09-50-7121
	175-0859-00			FT						. WIRE,ELECTRICAL:6 WIRE RIBBON	23499	TEK-175-0859-00
	131-1790-00			24						. CONTACT,ELEC:18-24 AWG,FEMALE,BRASS	27264	08-56-0105
	352-0461-00			2						. HLD,TERM. CONN:12 FEMALE,NYLON	27264	09-50-7121
	352-0197-00			2						. CONN BODY,PL,EL:1 WIRE BLACK	80009	352-0197-00
	352-0164-02			1						. CONN BODY,PL,EL:6 WIRE RED	80009	352-0164-02
	352-0169-00			2						. CONN BODY,PL,EL:2 WIRE BLACK	80009	352-0169-00
	352-0162-02			1						. CONN BODY,PL,EL:4 WIRE RED	80009	352-0162-02
	352-0161-00			4						. CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0161-00
	198-3071-00			1						. WIRE SET,ELEC:	80009	198-3071-00
	198-3213-00			1						. WIRE SET,ELEC:	80009	198-3213-00



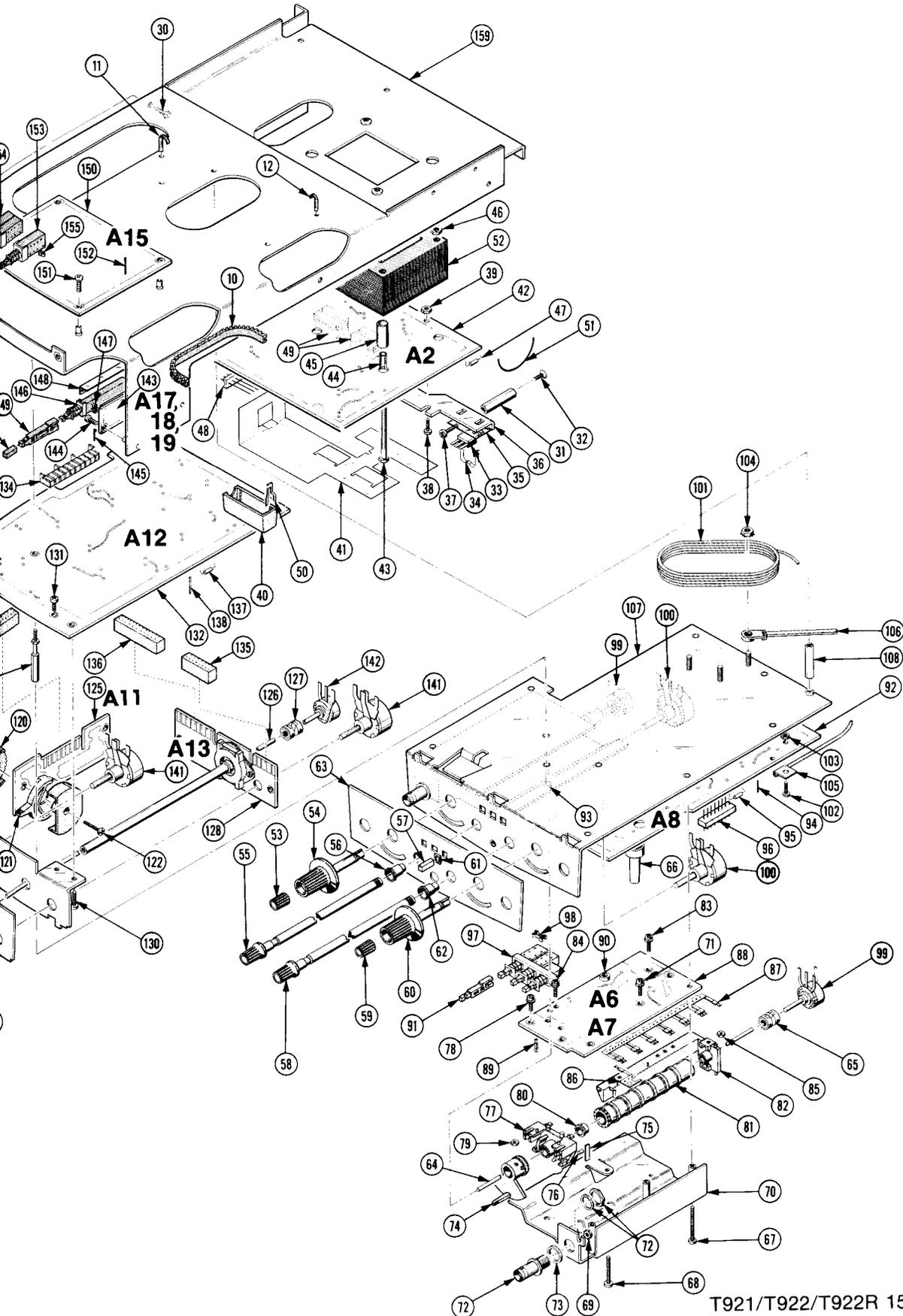


FIG. 3 T922R CH.

MANUAL CHANGE INFORMATION

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

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

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

SERVICE NOTE

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

CALIBRATION TEST EQUIPMENT REPLACEMENT

Calibration Test Equipment Chart

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

Comparison of Main Characteristics

DM 501 replaces 7D13		
PG 501 replaces 107	PG 501 - Risetime less than 3.5 ns into 50 Ω .	107 - Risetime less than 3.0 ns into 50 Ω .
108	PG 501 - 5 V output pulse; 3.5 ns Risetime.	108 - 10 V output pulse; 1 ns Risetime.
111	PG 501 - Risetime less than 3.5 ns; 8 ns Pretrigger pulse delay.	111 - Risetime 0.5 ns; 30 to 250 ns Pretrigger Pulse delay.
114	PG 501 - ± 5 V output.	114 - ± 10 V output. Short proof output.
115	PG 501 - Does not have Paired, Burst, Gated, or Delayed pulse mode; ± 5 V dc Offset. Has ± 5 V output.	115 - Paired, Burst, Gated, and Delayed pulse mode; ± 10 V output. Short-proof output.
PG 502 replaces 107		
108	PG 502 - 5 V output	108 - 10 V output.
111	PG 502 - Risetime less than 1 ns; 10 ns Pretrigger pulse delay.	111 - Risetime 0.5 ns; 30 to 250 ns Pretrigger pulse delay.
114	PG 502 - ± 5 V output	114 - ± 10 V output. Short proof output.
115	PG 502 - Does not have Paired, Burst, Gated, Delayed & Undelayed pulse mode; Has ± 5 V output.	115 - Paired, Burst, Gated, Delayed & Undelayed pulse mode; ± 10 V output. Short-proof output.
2101	PG 502 - Does not have Paired or Delayed pulse. Has ± 5 V output.	2101 - Paired and Delayed pulse; 10 V output.
PG 506 replaces 106	PG 506 - Positive-going trigger output signal at least 1 V; High Amplitude output, 60 V.	106 - Positive and Negative-going trigger output signal, 50 ns and 1 V; High Amplitude output, 100 V.
067-0502-01	PG 506 - Does not have chopped feature.	0502-01 - Comparator output can be alternately chopped to a reference voltage.
SG 503 replaces 190, 190A, 190B, 191, 067-0532-01	SG 503 - Amplitude range 5 mV to 5.5 V p-p. SG 503 - Frequency range 250 kHz to 250 MHz. SG 503 - Frequency range 250 kHz to 250 MHz.	190B - Amplitude range 40 mV to 10 V p-p. 191 - Frequency range 350 kHz to 100 MHz. 0532-01 - Frequency range 65 MHz to 500 MHz.
TG 501 replaces 180, 180A	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	180A - Marker outputs, 5 sec to 1 μ s. Sinewave available at 20, 10, and 2 ns. Trigger pulses 1, 10, 100 Hz; 1, 10, and 100 kHz. Multiple time-marks can be generated simultaneously.
181	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns.	181 - Marker outputs, 1, 10, 100, 1000, and 10,000 μ s, plus 10 ns sinewave.
184	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	184 - Marker outputs, 5 sec to 2 ns. Sinewave available at 50, 20, 10, 5, and 2 ns. Separate trigger pulses of 1 and .1 sec; 10, 1, and .1 ms; 10 and 1 μ s. Marker amplifier provides positive or negative time marks of 25 V min. Marker intervals of 1 and .1 sec; 10, 1, and .1 ms; 10 and 1 μ s.
2901	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	2901 - Marker outputs, 5 sec to 0.1 μ s. Sinewave available to 50, 10, and 5 ns. Separate trigger pulses, from 5 sec to 0.1 μ s. Multiple time-marks can be generated simultaneously.

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


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MANUAL CHANGE INFORMATION

 PRODUCT T921/T922/T922R
070-1982-01

 CHANGE REFERENCE M30436
 DATE 9-21-77
CHANGE:
DESCRIPTION

EFF SN B011555 (T921)

EFF SN B018319 (T922)

EFF SN B010670 (T922R)

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

CHANGE TO:

C465	283-0404-00	CAP.,FXD,CER DI:0.01UF,20%,4000V
C466	283-0404-00	CAP.,FXD,CER DI:0.01UF,20%,4000V
R458	308-0218-00	RES.,FXD,CMPSN:150 OHM,5%,3W

The above parts are located on the INTERFACE circuit board and shown on diagram 1 CRT & VERT AMPL.

Diagram ①



MANUAL CHANGE INFORMATION

PRODUCT T921/T922/T922R
070-1982-01

CHANGE REFERENCE M31736
DATE 9-21-77

CHANGE:	DESCRIPTION
---------	-------------

EFF SN: T921 B011589
T922 B018388

(Does not apply to T922R)

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

CHANGE TO:

A6 ²	670-3972-05	CKT BOARD ASSY:CH 1 ATTENUATOR
A6 ³	670-3972-05	CKT BOARD ASSY:CH 1 ATTENUATOR
A7 ³	670-3973-05	CKT BOARD ASSY:CH 2 ATTENUATOR

ADD:

R4103	317-0150-00	RES.,FXD,CMPSN:15 OHM,5%,0.125W
R4203	317-0150-00	RES.,FXD,CMPSN:15 OHM,5%,0.125W

R4103 is added to the A6 CH 1 ATTENUATOR board in series between J4110 CH 1 INPUT connector and the junction of C4101-C4102-S4100. In the T922, R4203 is added to the A7 CH 2 ATTENUATOR board in series between J4210 CH 2 INPUT connector and the junction of C4201-C4202-S4200. Affected parts are shown on VERT INPUT diagram 3.

Diagram 3



MANUAL CHANGE INFORMATION

PRODUCT T921/T922/T922R
070-1982-01

CHANGE REFERENCE M32553
 DATE 1-24-78

CHANGE:

DESCRIPTION

EFF SN B011626 (T921)

EFF SN B019271 (T922)

EFF SN B010873 (T922R)

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

CHANGE TO:

A12 670-3729-02 CKT BOARD ASSY:HORIZONTAL
 R2184 321-0932-00 RES.,FXD,FILM:2.5K OHM,1%,0.125W

ADD:

CR2184 152-0141-02 SEMICOND DEVICE:SILICON,30V,150MA,1N4152

CR2184 and R2184 are located on the A12 HORIZONTAL board and apply to diagram 5 TRIGGER (LATE). See partial diagram 5 below for details.

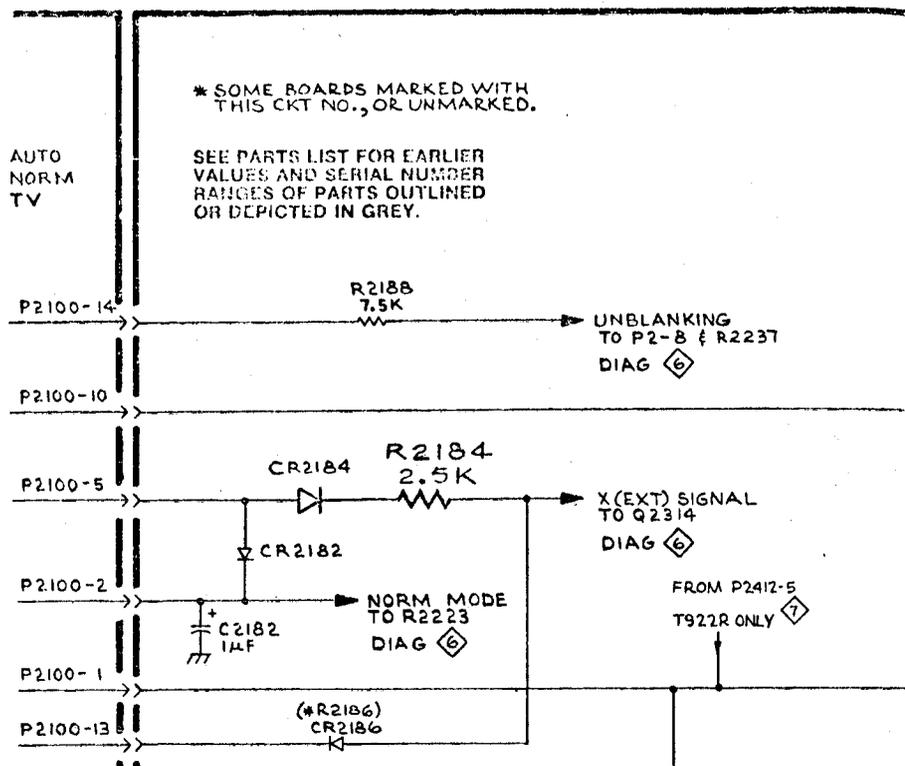


Diagram 5



MANUAL CHANGE INFORMATION

PRODUCT T912 and
T921/T922/T922R

CHANGE REFERENCE M32755
DATE 1-23-78

CHANGE:

DESCRIPTION

- EFF SN B012999 (T912) 070-1981-01
- EFF SN B011634 (T921) 070-1982-01
- EFF SN B019319 (T922) 070-1982-01
- EFF SN B010749 (T922R) 070-1982-01

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

ADD:

C762 290-0301-00 CAP., FXD, ELCTLT:10UF,10%,20V

DIAGRAM  POWER SUPPLY

Add C762 from the junction of R762 and VR762 to ground. The (+) end of capacitor goes to ground. C762 is located on the LOW VOLTAGE POWER SUPPLY board and shown on diagram 2.

*C762 10UF 10%, 20V
Diagram 2*



MANUAL CHANGE INFORMATION

PRODUCT <u>ALL T900 SERIES</u>	CHANGE REFERENCE <u>M32883</u>
<u>EFF ALL SN</u>	DATE <u>12-21-77</u>

CHANGE:	DESCRIPTION
---------	-------------

Affects Manuals: 070-1981-01
 070-1982-01
 070-1983-01
 070-2492-00

Oscilloscope Light Filter and Graticule Illumination Photography Effects
 Some oscilloscopes contain a factory installed colored (usually blue or green) plastic light filter in front of the crt faceplate to improve general purpose viewing contrast in ambient lighting conditions (in some applications this device also functions as an implosion safety shield).

In order for the oscilloscope graticule to be photographed along with a crt display, oscilloscopes that do not provide internal graticule (scale) illumination must be used with a camera such as the C5A or C5A Option 3, which provide external flash illumination of the graticule. An exception to this is some storage oscilloscopes operated in the store mode, where the target illumination may also illuminate the graticule lines.

Effectiveness of the graticule illumination flash is 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. Cabinet removal instructions are provided in the Service portion of T900-series manuals. The part number for the clear light filter to fit T900-series, bench-version oscilloscopes is

337-2185-03.

