



**PLEASE CHECK FOR CHANGE INFORMATION
AT THE REAR OF THIS MANUAL.**

7904
OSCILLOSCOPE
SN B260000-UP

INSTRUCTION MANUAL

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

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WARNING

THE REMAINING PORTION OF THIS TABLE OF CONTENTS LISTS THE SERVICING INSTRUCTIONS. THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED SERVICE PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK OR OTHER PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT DESCRIBED IN THE OPERATORS INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

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OPERATORS SAFETY INFORMATION

The following general safety information applies to all operators and service personnel. Specific warnings will be found throughout the manual where they apply and should be followed in each instance.

WARNING statements identify conditions or practices which could result in personal injury or loss of life.

CAUTION statements identify conditions or practices which could result in damage to the equipment or other property.

The word **DANGER** on the equipment identifies areas of immediate hazard which could result in personal injury or loss of life.

The following safety symbols may appear on the equipment.

 **CAUTION—Refer to manual**

 **DANGER—High voltage**

 **Protective ground (earth) terminal**

Other warning symbols where they apply.

WARNING

AC Power Source and Connection

This instrument operates from a single-phase power source. It has a three-wire power cord and a two-pole, three-terminal grounding-type connector. The voltage to ground (earth) from either pole of the power source must not exceed the maximum rated operating voltage, 250 volts.

Before making connection to the power source, determine that the instrument is adjusted to match the voltage of the power source, and has a suitable two-pole, three-terminal grounding-type connector. Refer any changes to qualified service personnel.

Grounding the Instrument

This instrument is safety class 1 equipment (IEC designation). All accessible conductive parts are directly connected through the grounding conductor of the power cord to the grounding contact of the power connector.

The power-input plug must be inserted only into a mating receptacle with a grounding contact. Do not defeat the grounding connection. Any interruption of the grounding connection can create an electric-shock hazard. Refer to qualified service personnel for verification of adequate protective grounding system to which this instrument is to be connected.

For electric-shock protection, the grounding connection must be made before making connection to the instrument's input or output terminals.

Do Not Remove Instrument Covers

To avoid electric-shock hazard, operating personnel must not remove the protective instrument covers. Component replacement and internal adjustments must be made by qualified service personnel only.

Do Not Remove CRT Implosion Shield

Do not remove the clear plastic implosion shield covering the crt face plate. This crt implosion shield provides protection to the operator from crt implosion.

Do Not Operate in Explosive Atmosphere

To avoid explosion, do not operate this instrument in an explosive atmosphere unless it has been certified for such operation.

CAUTION**Use the Proper Fuse**

Refer fuse replacement to qualified service personnel only. To avoid fire hazard, use only the fuse specified in the parts list for your instrument and which is identical in the following respects:

- A. Type: Slow blow, fast blow, etc.
- B. Voltage rating: 250 V, etc.
- C. Current rating.

Operating-Power Consideration

To prevent damage to the instrument always check the **LINE VOLTAGE SELECTOR** switch, located on the rear of the instrument, before connecting the instrument to the supply circuit.

Exercise Care with Intensity Level

Crt phosphor damage can occur under adverse conditions. Avoid any condition where an extremely bright, sharply focused dot exists on the crt. Also, remember that the light filter reduces the apparent light output from the crt.

Prevent Instrument Damage

Plug-in units should not be installed or removed without first turning the instrument power off, to prevent instrument damage.

SERVICE SAFETY INFORMATION

The following are safety precautions which appear in the servicing information sections of this manual. This Service Safety Information is in addition to the Operators Safety Information given previously.

WARNING

Do Not Service Alone

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

Exercise Care When Operating Instrument with Covers Removed

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

Disconnect Instrument Power

To avoid electric-shock hazard, always disconnect the 7904 from the power source before removing or replacing components.

To avoid electric-shock hazard, disconnect the instrument from the power source before soldering.

Silicone Grease Handling

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

Exercise Care When Servicing Power Unit

The power supply unit has been tested at the factory to ensure safe operation. Improper repair of this unit can result in hazardous potentials on the instrument chassis. Do not remove the plate insulator, block insulator, or transistor shield from the heat-sink. (See the exploded view drawing of the power supply unit for the location of these components.)

Disconnect the instrument from the power source and allow the line storage capacitors to discharge before removing the power-unit cover. The line storage capacitors remain charged with high-voltage dc for several minutes after the line power is disconnected unless they are manually discharged. A warning-indicator neon bulb, located on the Power-Supply Inverter board, flashes when this stored voltage exceeds about 80 volts. Do not remove the power-unit cover while this light is flashing.

Use extreme caution when troubleshooting in the power-supply unit, to avoid electric shock. Stored dc potentials on the Power-Supply Inverter circuit board remain long after the instrument is disconnected from the power source. Verify that the power-cord plug is disconnected and that the line storage capacitors (C1216 and C1217) are completely discharged before attempting any repairs or ohmic measurements. (A warning-indicator neon bulb, located on the Power-Supply Inverter board, flashes when this storage voltage exceeds about 80 volts. However, simply because the neon bulb is not flashing does not mean that the capacitors are fully discharged.)

CRT Handling

Use care when handling a crt. Breakage of the crt causes a high-velocity scattering of glass fragments (implosion). Protective clothing and safety glasses should be worn. Avoid striking the crt on any object which might cause it to crack or implode. When storing a crt, place it in a protective carton or set it face down in a protected location on a smooth surface with a soft mat under the face plate.

CAUTION

Avoid Excessive Moisture

Circuit boards and components must be dry before applying power to prevent damage from electrical arcing.

Exercise Care When Checking Diodes

When checking diodes, do not use an ohm-meter scale that has a high internal current, since high currents may damage the diodes under test.

Exercise Care When Soldering on Multi-Layer Boards

Several of the circuit boards in the 7904 are multi-layer type boards with a conductive path laminated between the top and bottom board layers. All soldering on these boards should be done with extreme care to prevent breaking the connections to this center conductor. Only experienced maintenance personnel should attempt repair of these boards: A2—Main Interface, A4—Logic, A5—Trigger Selector, A7—Vertical Interface, A12—Cap-Rectifier.

Exercise Care When Handling CRT Anode Lead

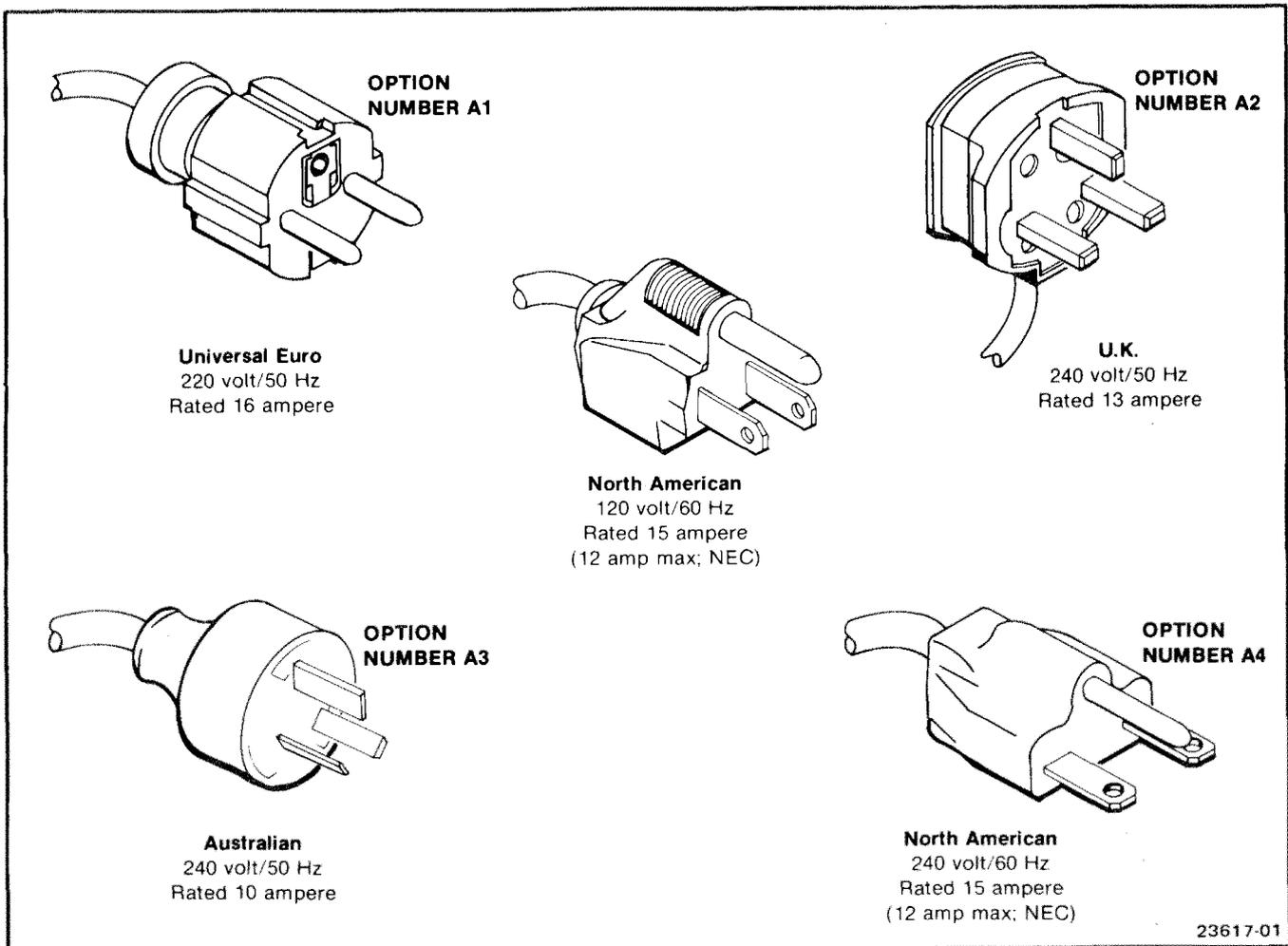
Do not touch any components with the crt anode lead until it is fully discharged.

Use Proper Cleaning Agents

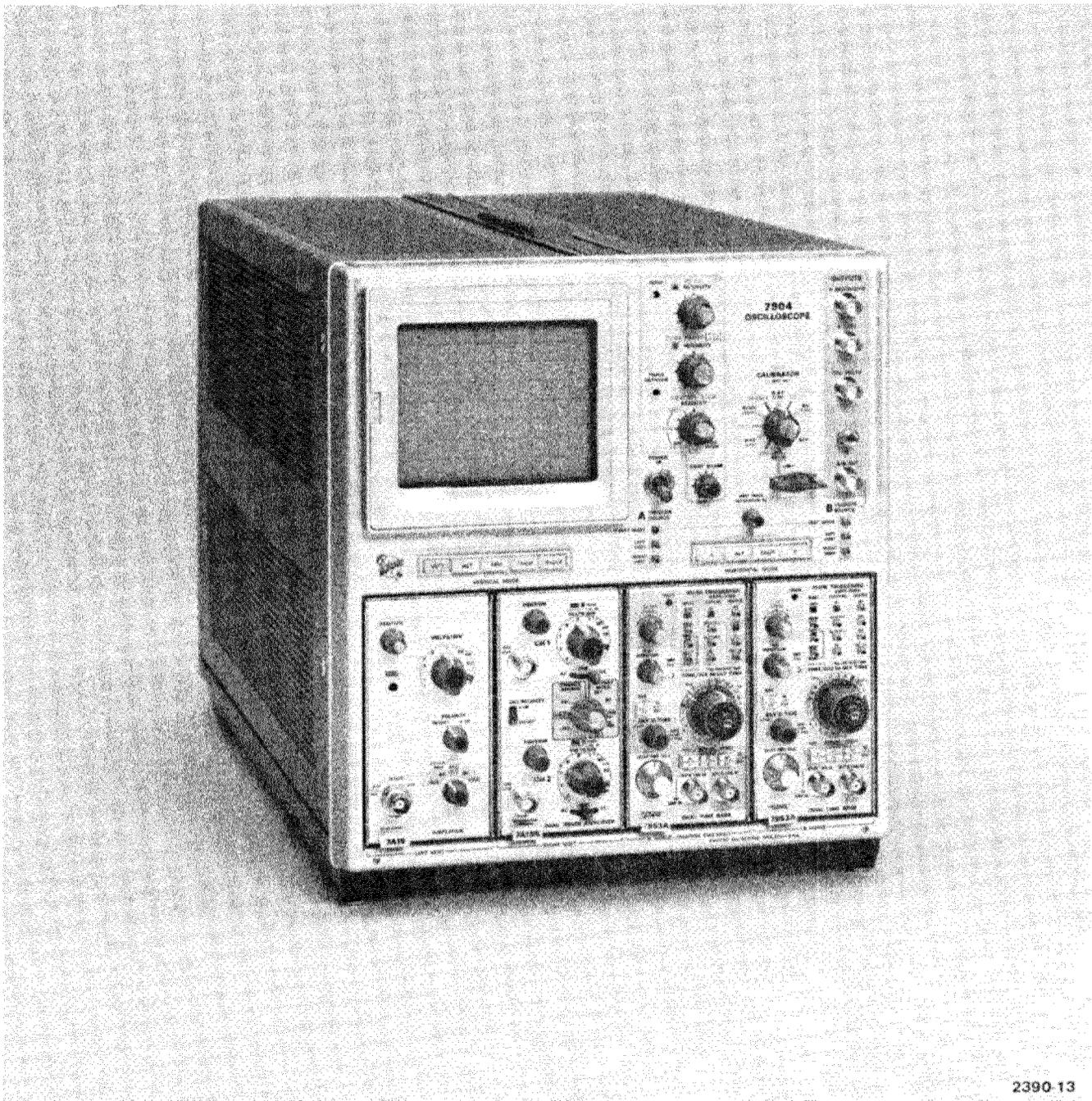
Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Use a non-residue type of cleaner, preferably isopropyl alcohol, totally denatured ethyl alcohol, or TP35. Before using any other type of cleaner consult your Tektronix Service Center or representative.

Do Not Use Pin Sockets for Connection Points

The spring tension of the pin sockets ensures a good connection between the circuit board and the pin. This spring tension can be destroyed by using the pin sockets as a connecting point for spring-loaded probe tips, alligator clips, etc.



Power plug options.



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7904 FEATURES

The TEKTRONIX 7904 Oscilloscope is a solid-state, high performance instrument designed for general purpose applications. The 7904 features a crt with small spot size and high writing rate. Graticule area is 8 X 10 cm. Additionally, the instrument includes a readout system providing crt display of alphanumeric information from the plug-ins, including deflection factor, sweep rate, and other encoded parameters.

The instrument's high vertical bandwidth (500 MHz), and four plug-in compartments which accept 7-series plug-in units, form a highly flexible measurement system.

GENERAL INFORMATION

INTRODUCTION

The Instruction Manual contains both operating and servicing information for the 7904 Oscilloscope.

Section 1—General Information; contains safety information, instrument description, electrical specifications, environmental characteristics, standard and recommended accessories, and packaging for shipment instructions.

Section 2—Operating Instructions; contains information relative to operating and checking the instrument operation.

Section 3—Circuit Description; contains basic and general circuit analysis that may be useful for servicing or operating the instrument.

Section 4—Maintenance; describes routine and corrective maintenance procedures with detailed instructions for replacing assemblies, subassemblies, and individual components.

Section 5—Performance Check and Adjustment; contains procedures to check the operational performance and electrical characteristics of the instrument. Procedures also include methods for adjustment of the instrument to meet specifications.

Section 6—Instrument Options; contains a description of available options and locations of incorporated information for those options.

Section 7—Replaceable Electrical Parts; contains information necessary to order replaceable parts and assemblies related to the electrical functions of the instrument.

Section 8—Diagrams and Circuit Board Illustrations; includes detailed circuit schematics, locations of assembled boards within the instrument, voltage and waveform information, circuit board component locators, and locations of adjustments to aid in performing the Adjustment procedure.

Section 9—Replaceable Mechanical Parts; includes information necessary to order replaceable mechanical parts and shows exploded drawings which identify assemblies.

INSTALLATION

Initial Inspection

This instrument was inspected both mechanically and electrically before shipment. It should be free of marks or scratches and should meet or exceed all electrical specifications. To confirm this, inspect the instrument for physical damage incurred in transit and test the electrical performance by following the Operating Instructions in Section 2 and Performance Check Procedure in Section 5 of the Instruction Manual. If there is damage or deficiency, contact your local Tektronix Field Office or representative.

Operating-Power Information

This instrument can be operated from either a 115-volt or 230-volt nominal supply source, 48 to 440 Hz.

CAUTION

To prevent damage to the instrument, always check the LINE VOLTAGE SELECTOR switch located on the rear of the instrument before connecting the instrument to the supply circuit.

WARNING

AC POWER SOURCE AND CONNECTION. *This instrument operates from a single-phase power source. It has a three-wire power cord and two-pole, three terminal grounding-type plug. The voltage to ground (earth) from either pole of the power source must not exceed the maximum rated operating voltage, 250 volts.*

Before making connection to the power source, determine that the instrument is adjusted to match the voltage of the power source, and has a suitable two-pole, three-terminal grounding-type plug. Refer any changes to qualified service personnel.

WARNING

GROUNDING. This instrument is safety class I equipment (IEC designation). All accessible conductive parts are directly connected through the grounding conductor of the power cord to the grounding contact of the power plug.

The power input plug must only be inserted in a mating receptacle with a grounding contact. Do not defeat the grounding connection. Any interruption of the grounding connection can create an electric shock hazard.

For electric shock protection, the grounding connection must be made before making connection to the instrument's input or output terminals.

**Table 1-1
POWER-CORD CONDUCTOR IDENTIFICATION**

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

The power-cord plug required depends upon the ac input voltage and the country in which the instrument is to be used. Should you require a power-cord plug other than that supplied with your instrument, refer to the standards listed in Table 1-2.

**Table 1-2
POWER-CORD PLUG CONFIGURATION**

Nominal Supply Voltage	Reference Standards
115 Vac	^a ANSI C73.11 ^b NEMA 5-15-P ^c IEC 83
230 Vac	^a ANSI C73.20 ^c IEC 83 ^d BS 1363 ^e CEE 7, sheets IV, VI, and VII ^f AS C112 ^b NEMA 6-15-P

^aANSI—American National Standards Institute
^bNEMA—National Electrical Manufacturer's Association
^cIEC—International Electrotechnical Commission
^dBS—British Standards Institution
^eCEE—International Commission on Rules for the Approval of Electrical Equipment
^fAS—S

Operating Voltage

The 7904 can be operated from either a 115 V or a 230 V nominal line voltage source. The Line Selector assembly on the rear panel converts this instrument from one operating voltage to the other. This assembly also includes fuses to provide protection for the line-input portion of this instrument. Use the following procedure to obtain correct instrument operation from the line voltage available. Refer to Table 1-3.

**Table 1-3
REGULATING RANGE LIMITS**

Line Selector Switch Position	Regulating Range
115 V	90 to 132 volts
230 V	180 to 264 volts

1. Disconnect the instrument from the power source.
2. Loosen the two captive screws which hold the cover onto the selector assembly; then pull to remove the cover.
3. To convert from 115 V to 230 V nominal line voltage, or vice versa, pull out the Line Selector switch bar (see Fig. 1-1) and plug it back into the remaining hole. Change the line-cord power plug to match the power source receptacle or use a 115 V to 230 V adapter.
4. Re-install the cover and tighten the captive screws.

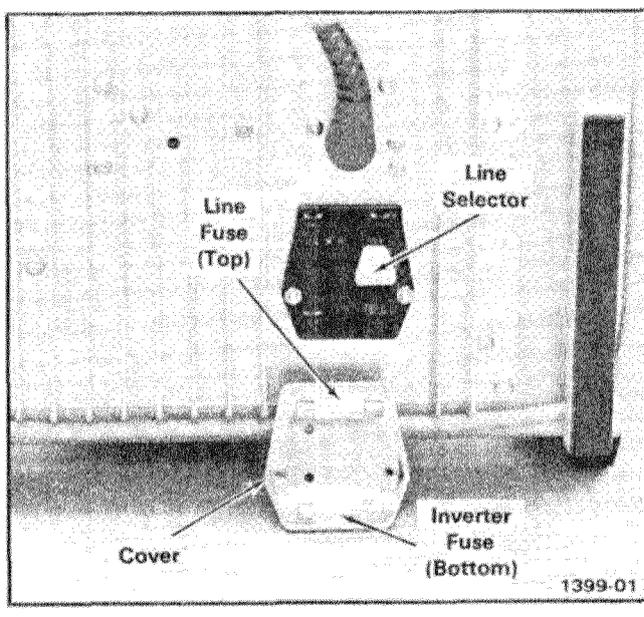


Fig. 1-1. Line Selector assembly on rear panel (shown with cover removed).

5. Before applying power to the instrument, check that the indicator tab on the switch bar is protruding through the correct hole for the desired nominal line voltage.



This instrument may be damaged if operated with the Line Selector assembly set to incorrect positions for the line voltage applied.

Operating Position

A bail-type stand is mounted on the bottom of this instrument. This stand permits the 7904 to be tilted up about 10° for more convenient viewing.

Operating Temperature

The 7904 can be operated where the ambient air temperature is between 0°C and +50°C. This instrument can be stored in ambient temperatures between -55°C and +75°C. After storage at temperatures beyond the operating limits, allow the chassis temperature to come within the operating limits before power is applied.

The 7904 is cooled by convection air flow through the instrument. Adequate clearance must be provided on all sides to allow heat to be dissipated from the instrument. Do not block or restrict the air flow through the holes in the cabinet. Maintain the clearance provided by the feet on the bottom and rear and allow about two inches clearance on the top and sides (more if possible).

A thermal cutout in this instrument provides thermal protection and disconnects the power from the instrument if the internal temperature exceeds a safe operating level. Power is automatically restored when the temperature returns to a safe level. Operation of this instrument in confined areas or in close proximity to heat-producing instruments may cause the thermal cutout to open more frequently.

REPACKAGING FOR SHIPMENT

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

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

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

The carton test strength for your instrument is 375 pounds.

SPECIFICATION

The electrical characteristics listed in Table 1-4 apply when the following conditions are met: (1) Adjustment of the instrument must have taken place at an ambient temperature between +20°C and +30°C; (2) the instrument must be allowed a 30-minute warm-up period; (3) all specifications are valid at an ambient temperature of 0° to +50°C, unless otherwise stated; (4) the instrument must be in an environment that meets the limits described in Table 1-5. Any applicable conditions not listed above are expressly stated as part of that characteristic.

Items listed in the Performance Requirements column are verified by completing the Performance Check in this manual. Items listed in the Supplemental Information column are not verified in this manual; they are either explanatory notes or performance characteristics for which no limits are specified.

Table 1-4
ELECTRICAL CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
VERTICAL SYSTEM		
Deflection Factor	Compatible with all 7-series plug-in units.	
Accuracy	Less than 1% difference between vertical compartments.	
Low-frequency linearity	0.1 div or less compression or expansion of a center-screen two-division signal when positioned anywhere vertically within the graticule area.	
Bandwidth	Varies with amplifier plug-in selected. See Table 1-7, Vertical System Specification.	
Isolation Between Vertical Compartments (eight-division reference signal)	At least 100:1 from dc to 250 MHz; decreasing to at least 40:1 from 250 MHz to 500 MHz.	
Chopped Mode		
Repetition rate		1 MHz ±20%.
Time segment from each compartment		0.4 to 0.6 μs.
Delay Line		Permits viewing of leading edge of triggering signal.
Difference in Delay Between Compartments		0.1 ns or less.
Vertical Display Modes		Selected by front-panel VERTICAL MODE switch.
LEFT:	Left vertical unit only.	
ALT:	Dual-trace, alternates between vertical units.	
ADD:	Added algebraically.	
CHOP:	Dual-trace, chopped between vertical units.	
RIGHT:	Right vertical unit only.	
Trace Separation Range for Dual-Sweep Modes		B trace can be positioned approximately +4 and -4 div from the A trace.

Table 1-4 (cont)

ELECTRICAL CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
TRIGGER SYSTEM		
Trigger Source		Selected by front-panel A TRIGGER SOURCE AND B TRIGGER SOURCE switches. VERT MODE position automatically provides optimum trigger source for each vertical display mode.
VERT MODE:	Determined by vertical mode.	
LEFT VERT:	From left vertical unit only.	
RIGHT VERT:	From right vertical unit only.	
HORIZONTAL SYSTEM		
Deflection Factor	Compatible with all 7-series plug-in units.	
Deflection Accuracy	Less than 1% difference between compartments.	
DC Linearity	0.1 div or less error at each graticule line after adjusting for no error at the second and tenth graticule lines.	
Bandwidth 10 div reference	dc to at least 1 MHz.	
Fastest Calibrated Sweep Rate	0.5 ns/div	With 7B92A time-base unit only. Other 7B-series units are uncalibrated for first 60 ns of sweep time when used with 7904.
Horizontal Display Modes		Selected by front-panel HORIZONTAL MODE switch.
A:	A horizontal unit only.	
ALT:	Dual-sweep, alternates between horizontal units.	
CHOP:	Dual-sweep, chopped between horizontal units.	
B:	B horizontal unit only.	
Phase Shift Between Vertical and Horizontal Deflection Systems		
Without phase correction	2° or less from dc to at least 35 kHz.	
With phase correction (Option 2)	Adjustable to less than 2° from dc to 1 MHz.	
Chopped Mode Repetition rate	200 kHz \pm 20%.	
Time segment from each compartment	2.0 to 3.0 μ s.	
Display Factor	At least 75%.	

Table 1-4 (cont)
ELECTRICAL CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
CALIBRATOR		
Wave Shape	Square wave and dc.	
Polarity	Positive-going with baseline voltage at zero.	
Output Voltage		Selected by front-panel CALIBRATOR switch.
Open circuit	4 mV, 40 mV, 0.4 V, 4 V, 40 V.	
Into 50 ohms	2 mV, 20 mV, 0.2 V, 0.4 V.	
Output Current	40 mA through front-panel current loop.	
Amplitude Accuracy (Voltage and Current)		
+15°C to +35°C	Within 1%.	
0°C to +50°C	Within 2%.	
Repetition Rates	1 kHz. 1/2 repetition rate of B Sweep gate. Dc.	Selected by front-panel RATE switch.
1 kHz Accuracy (Voltage and Current)		
+15°C to +35°C	Within 0.25%.	
0°C to +50°C	Within 0.5%.	
Dual Cycle	50% within 0.1%.	
Risetime and Falltime		
4 mV through 4V and 40 mA	Less than 0.25 μ s.	
40 V	Less than 2 μ s with 10 pF load.	

Table 1-4 (cont)

ELECTRICAL CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
EXTERNAL Z-AXIS INPUT		
Sensitivity	2 V p-p provides trace modulation over full intensity range.	Approximately 0 V input produces no intensity change.
Polarity of Operation	Positive-going signal decreases trace intensity; negative-going signal increases trace intensity.	
Intensity Circuit Pulse Performance (Between Rear-Panel Connector and crt) Low-frequency limit		Dc
Response to negative-going input		Approximately 10 ns.
Response to positive-going input		Approximately 20 ns.
Propagation delay		Approximately 25 ns.
Recovery time in response to positive input step		Approximately 50 ns.
Recover time in response to negative input step		Approximately 0 ns.
Input Resistance at Dc		500 Ω \pm 10%.
Maximum Safe Input Voltage		15 V (dc + peak ac)
+Sawtooth Source	A HORIZ time-base unit or B HORIZ time-base unit.	Selected by internal Sweep switch.
Polarity		Positive-going with baseline at 0 V within 1 V (into 1 M Ω).
Output voltage Rate of rise	50 mV/unit of time selected by the time base TIME/DIV switch, within 15%.	
Into 50 Ω	100 ns/div maximum.	
Into 1 M Ω (parallel with 150 pF)	1 V/unit of time selected by the time-base TIME/DIV switch, within 10%. 1 μ s/div maximum.	
Peak voltage Into 50 Ω	At least 500 mV.	
Into 1 M Ω	At least 10 V.	

Table 1-4 (cont)
ELECTRICAL CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
EXTERNAL Z-AXIS INPUT (cont)		
Output resistance		950 Ω \pm 10%.
+Gate Source	A HORIZ time-base unit.	Selected by internal Gate switch.
	B HORIZ time-base unit. Delaying time-base unit (in either horizontal compartment).	
Polarity		Positive-going with base-line at 0 V within 0.1 V (into 1 M Ω).
Output voltage Into 50 Ω	0.5 V within 10%.	
	Into 1 M Ω	10 V within 10%.
Risetime into 50 Ω		3 ns or less.
Output resistance		950 Ω \pm 10%.
Vertical Signal Output Source	Determined by B TRIGGER SOURCE switch.	
Output voltage Into 50 Ω	25 mV/div of vertical deflection \pm 25%.	
	Into 1 M Ω	0.5 V/div of vertical deflection \pm 25%.
Bandwidth	Varies with amplifier plug-in unit selected; see System Specifications.	
Output resistance		950 Ω \pm 10%.
READOUT DISPLAY		
Readout Modes	Free-run independent of sweep.	Selected by internal Readout Mode switch.
	Triggered at end of selected sweep.	
	Single-shot controlled through rear-panel Remote Control Connector J90.	
Word Location		See Fig. 2-5.
Character Height	0.25 div to 0.5 div.	

Table 1-4 (cont)
ELECTRICAL CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information	
READOUT DISPLAY (cont)			
Zero Display Total characters (Each row)	40 zeros displayed, no overlap, at least 9.5 div in width.	With Q2225 removed	
Horizontal Centering	Left side within 0.25 div of 0 graticule line. Right side within 0.25 div of 10th graticule line.		
Vertical Centering Top Row	CH 1 characters located within upper graticule line.		
Bottom Row	CH 2 characters located within lower graticule line.		
DISPLAY			
Cathode Ray Tube Graticule Type	Internal, illuminated with variable edge lighting.		
Area Standard instrument	8 div vertical by 10 div horizontal. Each division equals 1 cm.		
Option 4	8 div vertical by 10 div horizontal. Each division equals 0.5 cm.		
Phosphor	P31 standard.	Others available on special order.	
Beam Finder		Limits display within graticule area when actuated.	
Minimum Photographic Writing Speed with Polaroid® Type 410 Film (without film fogging techniques) Standard instrument Tektronix C-51R camera with <i>f</i> 1.2 lens and 1:0.5 object-to-image ratio		P31: 2.81 cm/ns	P11: 6.1 cm/ns
Option 4 Tektronix C-51R camera with <i>f</i> 1.2 lens and 1:0.5 object-to-image ratio		P31: 5.0 cm/ns	P11: 10.0 cm/ns

*Registered trademark of the Polaroid Corporation.

Table 1-4 (cont)
ELECTRICAL CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
POWER SUPPLY		
Live Voltage Range Ac, RMS		Selected by rear-panel Line Selector assembly.
115 V nominal	90 to 132 V.	
230 V nominal	180 to 264 V.	
Line Frequency		48 to 440 Hz.
Maximum Power Consumption		190 W, 2.5 A at 60 Hz, 115 V line.

Table 1-5
ENVIRONMENTAL

Characteristic	Information
----------------	-------------

NOTE

This instrument will meet the electrical characteristics given in the Performance Requirement column of Table 1-4 over the following environmental limits.

Temperature Range	
Operating	0° to +50° C.
Nonoperating	–55° C to +75° C.
Altitude	
Operating	15,000 feet.
Nonoperating	Test limit 50,000 feet.
EMC (Electro-Magnetic Compatibility) in accordance with MIL-STD-462A (when equipped with Option 3)	NOTE <i>Any unused plug-in compartments must be covered with a blank plug-in panel (EMC shielded) in order to meet EMC specifications. See Instrument Options section for additional information.</i>
Radiated Interference	Interference radiated from the instrument under test within the given limits from 150 kHz to 1000 MHz.
Conducted Interference	Interference conducted out of the instrument under test through the power cord within the given limits from 150 kHz to 25 MHz.
Transportation (packaged instrument, without plug-ins)	Qualifies under National Safe Transit Committee test procedure 1A, Category 11.

Table 1-6
PHYSICAL

Characteristic	Information
Ventilation	Convection cooling. Automatic resetting thermal cutout protects instrument from overheating.
Warm-up Time	20 minutes for rated accuracy.
Finish	Anodized front- and rear-panel with blue-vinyl painted aluminum cabinet.
Overall Dimension (measured at maximum points); See Fig. 1-2 for dimensional drawing.	
Height	13.5 in. 34.2 cm
Width	12.0 in. 30.5 cm
Length	23.8 in. 69.5 cm
Net Weight (Instrument Only)	30.0 lbs. 13.5 kg

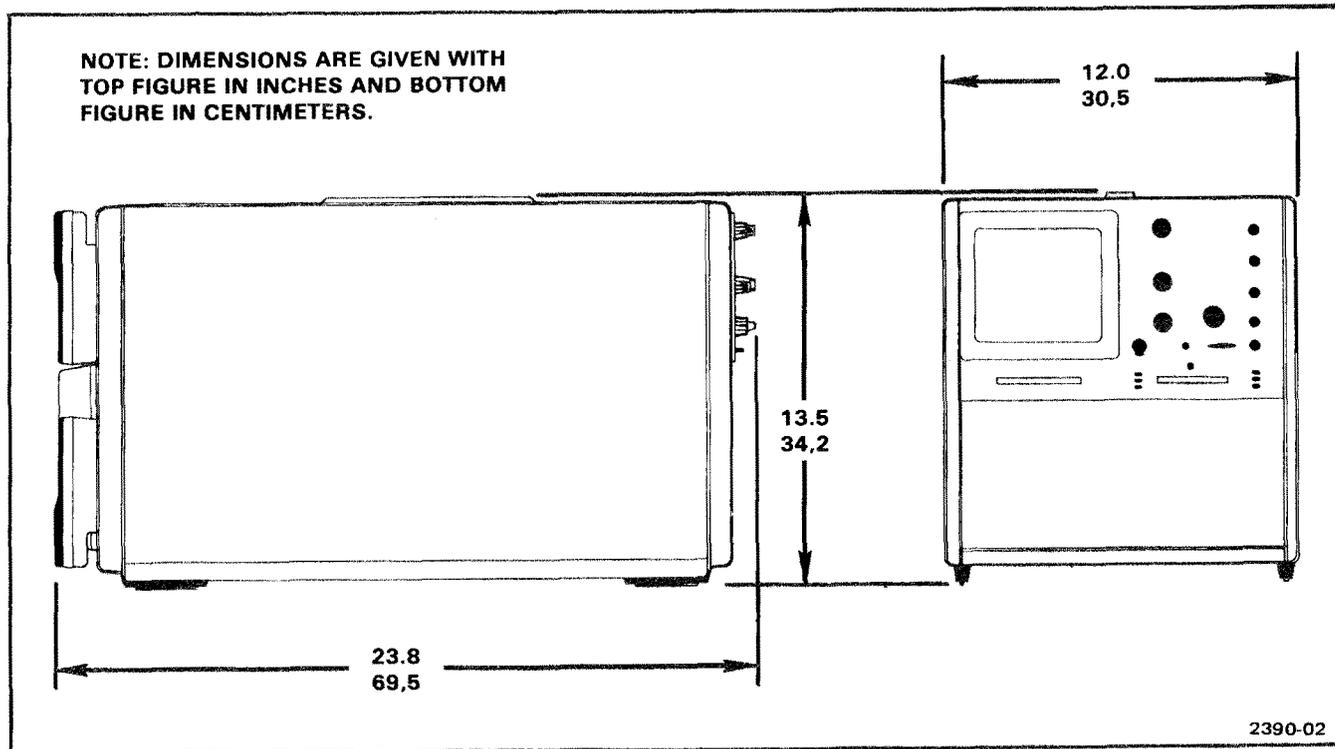


Fig. 1-2. 7904 dimensional drawing.

SYSTEM ELECTRICAL SPECIFICATION

Your TEKTRONIX 7904 Oscilloscope System provides exceptional flexibility in operation with a wide choice of general- and special-purpose plug-in units. The type number of a particular plug-in unit identifies its usage as follows:

The first digit (7) denotes the oscilloscope system for which the plug-in is designed (7000-series).

The second letter describes the purpose of the plug-in unit:

A—Amplifier	L—Spectrum Analyzer
B—Time base (real time)	M—Miscellaneous
C—Curve Tracer	S—Sampling
D—Digital	T—Time base (sampling)

The third and fourth digits of the plug-in type number do not carry any special connotation.

The "N" suffix letter added to the normal four-digit type number identifies a unit not equipped with the circuitry necessary to encode data for the 7000-series readout system.

Table 1-7 lists the vertical specifications which are system dependent. For more complete specifications on plug-in units for the 7000-Series Oscilloscope System, refer to the Tektronix Products catalog.

Table 1-8 lists the horizontal specifications which are system dependent. For more complete specifications on plug-in units for the 7000-Series Oscilloscope System, refer to Table 1-7 and the Tektronix Products catalog.

Table 1-7

7904 OSCILLOSCOPE VERTICAL SYSTEM SPECIFICATION

Amplifier Plug-In Unit	Probe	Bandwidth (MHz)	Rise Time (ns)	Accuracy			VERT SIG OUT	
				Ext Cal 0° to +50° C (%)	Int Cal +15° to +35° C (%)	Int Cal 0° to +50° C (%)	BW (MHz)	Tr (ns)
7A11	Integral	250	1.4	2	3	4	140	2.5
7A12	None	120	2.9	2	3	4	110	3.2
	P6053B			3	4	5		
7A13	None	105	3.4	1.5	2.5	3.5	100	3.5
	P6053B						100	3.5
	P6055						65	5.4
7A14	P6021	55	6.4	2	3	4	50	7.0
	P6022	120	2.9				100	3.5
7A15A/N	None	80	4.4	2	3	4	70	5.0
	P6053A			3	4	5		
7A16A	None	225	1.6	2	3	4	140	2.5
	P6053B			3	4	5		
7A17	None	150	2.4				15	24
7A18	None	80	4.4	2 ^b	3 ^b	4 ^b	70	5.0
	P6053B			3 ^b	4 ^b	5 ^b		
7A19	None	500	0.8	3		4	300	1.2
	P6056			4		5		
	P6057							
7A19 (10 mV/Div (Only))	None	500	0.8	2	3	4	300	1.2
	P6056, P6057			3	4	5		
	P6201			300	1.2	4		
7A22	None or Any	1 MHz (within 10%)	350 (within 9%)	2	3	4	1.0 ±10%	350 ±9%
7A24	None	350	1.0	2	3	4	140	2.5
	P6056, P6057			3	4	5		
	P6201			275	1.3	3		
7A26	None	200	1.8	2		3	140	2.5
	P6053B			3		4		

^aDeflection Factor accuracy is checked as follows:

EXT CAL 0° C to +50° C—Plug-in gain set at a temperature within 10° C of operating temperature, using an external calibrator whose accuracy is within 0.25%.

INT CAL +15° C to +35° C—Plug-in gain set while operating within a temperature range of +15° C to +35° C, using the oscilloscope calibrator.

INT CAL 0° C to +50° C—Plug-in gain set using the oscilloscope calibrator (within 10° C of the operating temperature) in a temperature range between 0° C and +50° C.

^b7A18 Opt. 6 (offset) version. Add 1% to accuracy figures when switched to "OFFSET".

Table 1-8

7904 OSCILLOSCOPE HORIZONTAL SYSTEM SPECIFICATION

Time-Base Unit	Performance Feature	Maximum Calibrated Sweep Rate	Triggering Frequency Range
7B50A	Delayed Sweep	5 ns/div	Dc to 150 MHz
7B70	Delayed Sweep and Ext Amplifier	2 ns/div	Dc to 200 MHz
7B71	Dual Sweep Delaying and Delayed	2 ns/div	Dc to 200 MHz
7B92A	Display Switching	1 ns/div	Dc to 500 MHz
7B80	Delayed Sweep	1 ns/div	Dc to 400 MHz
7B85	Delaying Sweep	1 ns/div	Dc to 400 MHz

Table 1-9

SPECIAL PURPOSE PLUG-IN UNITS

Plug-In Unit	Performance Feature
7CT1N	Low-Power Semiconductor Curve Tracer
7D01	Logic Analyzer
7D10	Digital Events Delay
7D11	Digital Delay
7D12	A/D Converter; plug-in modules provide flexible measurement capability
7D13	Measures Temperature, Voltage, Current and Resistance
7D14	Directly Gated Counter to 525 MHz
7K11	CATV Preamplifier
7L12	100 kHz to 1.7 GHz Spectrum Analyzer
7L13	1 kHz to 1.8 GHz Spectrum Analyzer
7M11	Dual Delay Line
7M13	Readout Access Unit
7S11	Accepts Plug-In Sampling Heads
7S12	Time Domain Reflectometer and Sampling Applications
7S14	Dual Trace Delayed Sweep Sampler
7T11	Random or Sequential; equivalent or Real-Time Sampling

STANDARD ACCESSORIES

- 1 each Instruction Manual
- 2 each Lead, Test; bnc, red 18-inch long
- 1 each Adapter, conn: female bnc post
- 1 each conn, plug, elec: 9 pin cable, with male insert

OPERATING INSTRUCTIONS

PRELIMINARY OPERATION

To operate this instrument effectively, the user must become familiar with the operation and capabilities of the instrument. This section describes how to use the front- and rear-panel controls and connectors.

WARNING

To avoid electric-shock hazard, see installation in the General Information section of this manual before operating this instrument.

PLUG-IN UNITS

The 7904 accepts up to four Tektronix 7000-Series plug-in units. This feature allows selection of bandwidth, sensitivity, display mode, etc., and provides for future expansion of the system.

The overall capabilities of the system are mainly determined by the characteristics of the selected plug-ins. Some typical combinations are given under Applications, in this section, along with simplified setup instructions. For information on other plug-in units, refer to the current Tektronix Products catalog.

Installation of Plug-In Units

CAUTION

Plug-in units should not be installed or removed without first turning the instrument power off, to prevent instrument damage.

To install a plug-in unit into a compartment, align the slots in the top and bottom of the plug-in unit with the associated guide rails in the plug-in compartment. Insert the plug-in unit into the compartment until it locks into place. To remove a plug-in unit, pull out on the release latch to disengage the plug-in. To meet the EMC (electromagnetic compatibility) specifications, cover all unused plug-in compartments with an EMC shielded blank plug-in panel, Tektronix Part 016-0155-00.

The gain of the 7904 vertical and horizontal systems has been normalized to allow plug-in units to be interchanged among plug-in compartments without adjustment of the system. The basic calibration of the plug-in units should be checked when installed to verify their accuracy (refer to the operating instructions in the plug-in manual).

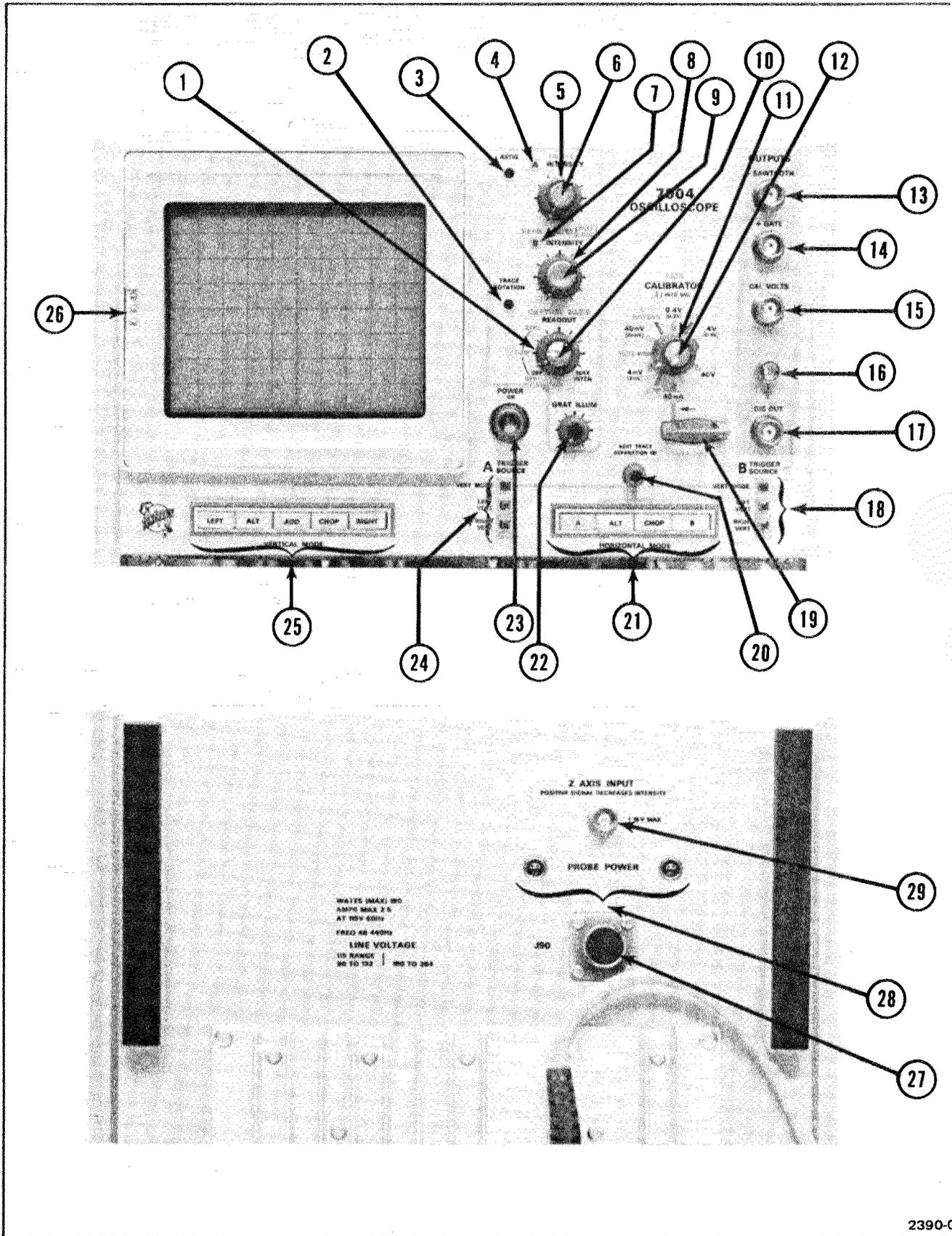
CONTROLS AND CONNECTORS

The 7904 front and rear panels are shown in Figure 2-1. A brief, functional description of each control and connector is included in the illustration. Refer to Detailed Operating Information for additional information.

Front-Panel Color Coding

The 7904 front panel has color coded areas. These colors define areas by function. Blue identifies controls that affect the display mode; green identifies triggering controls.

Other colors such as gray, orange and yellow, have no functional assignment, but indicate the relationships among controls and connectors.



2390-01

Fig. 2-1. Front and rear-panel controls, connectors and indicators.

- ① READOUT Intensity (Option 1 deletes Readout System)—Controls brightness of readout display. Disables Readout System in counterclockwise detent position.
- ② TRACE ROTATION—Screwdriver adjustment to align trace(s) with graticule lines.
- ③ ASTIG—Screwdriver adjustment used in conjunction with FOCUS control to obtain a well-defined display.
- ④ A INTENSITY (Indicator)—Illuminates when selected by HORIZONTAL MODE switch.
- ⑤ A INTENSITY—Controls brightness of trace produced by the plug-in unit installed in the A HORIZ compartment.
- ⑥ FOCUS—Control optimizes crt trace definition.
- ⑦ B INTENSITY (Indicator)—Illuminates when selected by HORIZONTAL MODE switch.
- ⑧ B INTENSITY—Controls brightness of trace produced by plug-in unit installed in B HORIZ compartment.
- ⑨ BEAM FINDER—When pressed, compresses and defocuses display within graticule area.
- ⑩ CONTROL ILLUM—Controls illumination of readout characters.
- ⑪ CALIBRATOR—Provides 1 kHz calibrated square-wave voltages.
- ⑫ RATE—Selects repetition rate of calibrator; selects B GATE ÷2 providing a variable calibrator rate.
- ⑬ +SAWTOOTH—Sawtooth output signal derived from A or B time-base unit.
- ⑭ +GATE—Output signal derived from: A Gate, B Gate, or A Div'd Gate.
- ⑮ CAL VOLTS—Square-wave output signal used for application to external equipment.
- ⑯ Ground—(not labeled) Binding post for use as chassis ground.
- ⑰ SIG OUT—Output signal derived from vertical signal as selected by A TRIGGER SOURCE switch.
- ⑱ B TRIGGER SOURCE—Selects internal trigger source for B HORIZ plug-in.
- ⑲ Current loop—(not labeled) Provides a 40-milliampere output current to check and calibrate current-measuring probe systems.
- ⑳ VERT TRACE SEPARATION (B)—Vertically positions B HORIZ trace with respect to A HORIZ trace.
- ㉑ HORIZONTAL MODE—Selects input source for horizontal deflection.
- ㉒ GRAT ILLUM—Controls illumination of graticule lines.
- ㉓ POWER—Switch controls power to instrument.
- ㉔ A TRIGGER SOURCE—Selects internal trigger source for A HORIZ plug-in.
- ㉕ VERTICAL MODE—Selects input source for vertical deflection.
- ㉖ Camera Power Connector (not labeled)—Three-pin connector provides power for camera operation and receives single-sweep-reset signal.
- ㉗ J90 Connector—Input for external operation of certain instrument functions.
- ㉘ PROBE POWER—Connectors (2) provide power to active probe system.
- ㉙ Z AXIS INPUT—Input for external intensity modulation of crt display.

Fig. 2-1. Front and rear-panel controls, connectors and indicators. (cont)

FUNCTIONAL CHECK

General

The following Functional Check procedure can be used for incoming inspection to verify proper operation and may also be used by the operator for instrument familiarization. Only instrument functions (not measurement quantities or specifications) are checked in the procedure; therefore, a minimum amount of test equipment is required. If performing the Functional Check procedure reveals improper performance or instrument malfunction, first check the operation of associated equipment; then refer to qualified service personnel for repair or adjustment of the instrument.

This procedure also demonstrates the use of the controls and connectors of the 7904. It is recommended that this procedure be followed completely for familiarization with this instrument.

Set-Up Information

1. Set the front-panel controls as follows:

A INTENSITY	Counterclockwise
FOCUS	Midrange
B INTENSITY	Counterclockwise
BEAM FINDER	Released
READOUT	OFF
CONTROL ILLUM	OFF
GRAT ILLUM	Counterclockwise
POWER	Off
CALIBRATOR	4 V
RATE	1 kHz
VERTICAL MODE	LEFT
A TRIGGER SOURCE	VERT MODE
HORIZONTAL MODE	A
VERT TRACE	Midrange
SEPARATION (B)	
B TRIGGER SOURCE	VERT MODE

2. Connect the 7904 to a power source that meets the voltage and frequency requirements of this instrument. If the available line voltage is outside the limits of the Line Selector switch setting (on rear panel,) see Operating Voltage in section 1.

3. Insert Tektronix 7A-series amplifier units into both the LEFT VERT and RIGHT VERT compartments. Insert Tektronix 7B-series time-base units into both the A HORIZ and B HORIZ compartments.

4. Set the POWER switch to ON. Allow several minutes warmup so the instrument reaches a normal operating temperature before proceeding.

5. Set both vertical units for a vertical deflection factor of two volts/division and center the vertical position controls. Set both vertical units for ac input coupling.

6. Set both time-base units for a sweep rate of one millisecond/division in the auto, internal trigger mode.

7. Advance the A INTENSITY control until the trace is at the desired viewing level (near midrange).

8. Connect the CAL VOLTS connector to the input of the left vertical unit with a bnc-to-bnc patch cord (supplied accessory).

Display Focus

9. Adjust the FOCUS control so the top and bottom of the displayed square wave are as thin as possible but not elongated. Set the ASTIG adjustment so the top and bottom of the displayed square wave are as thin as possible. Repeat the adjustments for best overall focus.

NOTE

This instrument contains circuitry to automatically protect the crt phosphor against damage due to excessive crt beam current. If the A or B INTENSITY control is set to a point where crt phosphor damage could occur, this circuit limits the beam current to a safe level. Also, this circuit action will cause the trace to de-focus (widen) to indicate that the intensity control setting should be reduced. If the FOCUS and ASTIG adjustments cannot be made as given in step nine, decrease the setting of the A INTENSITY control and repeat the step.

Trace Alignment

10. Disconnect the input signal and position the trace with the left vertical unit position control so it coincides with the center horizontal line of the graticule. If necessary, adjust the TRACE ROTATION adjustment so the trace is parallel with the center horizontal graticule line.

Graticule Illumination

11. Rotate the GRAT ILLUM control throughout its range and notice that the graticule lines are illuminated as the control is turned clockwise (most obvious with tinted filter installed). Set control so graticule lines are illuminated as desired.

Control Illumination

12. Notice that only the light associated with the A INTENSITY control is illuminated. Sequentially press all the HORIZONTAL MODE switch buttons and notice the A or B INTENSITY lights; these lights indicate which intensity control is active. The lights also provide an indication that the POWER switch is on. Set the CONTROL ILLUM switch to the LOW position. Notice that the selected pushbuttons of the 7904 and the plug-in units are illuminated.

13. Change the CONTROL ILLUM switch to the HIGH position. Notice that the selected pushbuttons of the instrument and the plug-in units are illuminated at maximum intensity. Return the HORIZONTAL MODE switch to A.

Vertical Deflection System

14. Connect the CAL VOLTS connector to the input connectors of both vertical units with the bnc-to-bnc jumper leads. The display amplitude should be two divisions within 0.12 division. Note the exact display amplitude.

15. Notice that the position control of only the left vertical unit has any effect on the vertical position of the displayed trace. Position the trace to the upper half of the graticule with the left vertical unit position control.

16. Press the RIGHT button of the VERTICAL MODE switch. The display amplitude should be two divisions within 0.12 division. Note the exact display amplitude.

17. Notice that the position control of only the right vertical unit has any effect on the vertical position of the displayed trace. Position the trace to the lower half of the graticule with the right vertical unit position control.

18. A correct display in both steps 14 and 16 indicates that the Vertical Deflection System and the vertical plug-in units are calibrated. Re-calibration is indicated when the display amplitudes noted in steps 14 and 16 are both outside the given tolerance by an equal amount in the same direction (i.e., high or low); otherwise, re-calibration of one or both vertical plug-in units is indicated.

19. Press the ALT button of the VERTICAL MODE switch. Notice that two traces are displayed on the crt. The top trace is produced by the left vertical unit and the bottom trace is produced by the right vertical unit; the sweep for both traces is produced by the A time-base unit. Reduce the sweep rate of the A time-base unit to 50 milliseconds/division. Notice that the display alternates between the left and right vertical plug-ins after each sweep. Turn the A time-base sweep rate switch throughout its range. Notice that the display alternates between vertical units at all sweep rates.

20. Press the CHOP button of the VERTICAL MODE switch. Turn the A time-base unit sweep rate switch throughout its range. Notice that a dual-trace display is presented at all sweep rates, but unlike ALT, both vertical units are displayed on each sweep on a time-sharing basis. Return the A time-base unit sweep rate switch to 0.5 millisecond/division.

21. Press the ADD button of the VERTICAL MODE switch. The display should be four divisions in amplitude. Notice that the position control of either vertical unit moves the display. Return the VERTICAL MODE switch to the LEFT position.

Horizontal Deflection System

22. Notice that the position control of only the A time-base unit has any effect on the horizontal position of the displayed trace. Position the start of the trace to the left graticule line with the A time-base unit position control.

23. The center eight complete cycles of the displayed waveform should occupy the center eight graticule divisions within 0.25 division. Note the exact number of horizontal divisions occupied by the center eight complete cycles of the waveform (see Fig. 2-2).

24. Press the B button of the HORIZONTAL MODE switch. Advance the B INTENSITY control until the display becomes de-focused. The de-focused display indicates that the B INTENSITY control is set too high and the crt beam-current limiting circuit is operating to protect the crt phosphor from damage. Reduce the setting of the B INTENSITY control to obtain a bright, well-defined display.

25. Notice that the position control of only the B time-base unit has any effect on the horizontal position of the display trace. Position the start of the trace to the left graticule line with the B time-base unit position control.

Operating Instructions—7904 (SN B260000-UP)

26. The center eight complete cycles of the displayed waveform should occupy the center eight graticule divisions within 0.25 division. Note the exact number of horizontal divisions occupied by the center eight complete cycles of the waveform (see Fig. 2-2).

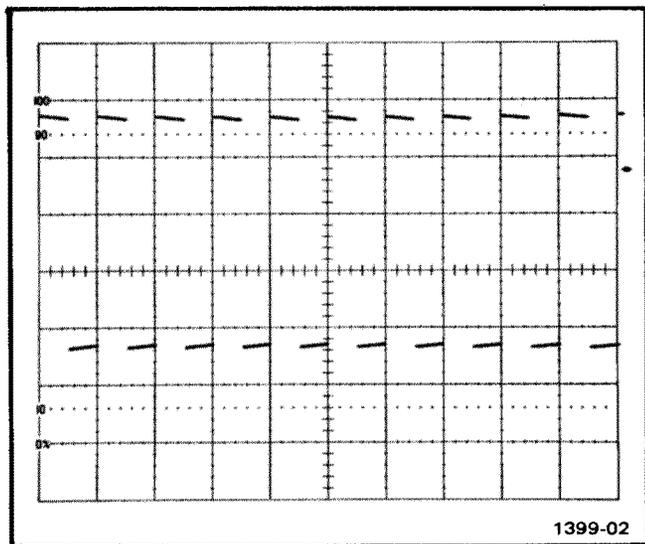


Fig. 2-2. Display showing correct calibration of the Horizontal Deflection System.

27. A correct display in both steps 23 and 26 indicates that the Horizontal Deflection System and the time-base plug-in units are calibrated. Re-calibration is required if the waveform displays noted in both steps 23 and 26 are outside the given tolerance by an equal amount in the same direction (i.e., long or short); otherwise, recalibration of one or both plug-in units is required.

28. Press the ALT button of the HORIZONTAL MODE switch. Two traces should be presented on the crt. If the display overlaps, adjust the VERT TRACE SEPARATION (B) control to position one trace to the bottom of the graticule area. Turn the sweep rate switches of both time-base units throughout their range. Notice that each time-base unit controls one of the traces independent of the other time-base unit. Also notice that when one of the time-base units is set to a slow sweep rate (below about 50 milliseconds/division), sweep alternation is evident. Only one of the traces is presented on the crt at a time. Set the sweep rates of both time-base units to 0.5 millisecond/division. Adjust the A INTENSITY control. Notice that it changes the intensity of the trace produced by the A time-base unit only. Likewise, the B INTENSITY control changes the intensity of the trace produced by the B time-base unit only. Return both intensity controls to the desired level.

29. Press the CHOP button of the HORIZONTAL MODE switch. Notice that two traces are shown on the crt in a manner similar to the ALT display. Turn the sweep rate switches of both time-base units throughout their range. Notice that two traces are displayed on the crt at all sweep rates. Also notice that when both time-base units are set to a slow sweep rate (50 milliseconds/division or slower), both traces are visible on the crt at the same time. Return the sweep rate switches of both time-base units to 0.5 millisecond/division.

30. Set the CALIBRATOR switch to 0.4 V. Press the CHOP button of the VERTICAL MODE switch. Four traces should be displayed on the crt. If not, adjust the position controls of the vertical units and the VERT TRACE SEPARATION (B) control to position the four traces onto the viewing area. Adjust the position controls of the plug-in units to identify which traces are produced from each of the plug-in units (if vertical units have the identify feature, it can be used to identify the traces). Also, set one of the time-base units to a sweep rate of one millisecond/division. Notice that the vertical deflection produced by the left vertical unit is displayed at the sweep rate of both the A and B time-base units and that the vertical deflection produced by the right vertical plug-in unit is also displayed at the sweep rate of both time-base units.

31. Press the ALT button of the HORIZONTAL MODE switch. Notice that the display is very similar to the display obtained in the previous step. The main difference in this display is that the sweeps are produced alternately by the time-base units (noticeable only at slow sweep rates).

32. Press the ALT button of the VERTICAL MODE switch. Set the CALIBRATOR switch to 4 V. Notice that only two traces are displayed on the crt. Also notice that one of the traces is produced by the left vertical unit at the sweep rate of the B time-base unit and the other trace is produced by the right vertical unit at sweep rate of the A time-base unit. This feature is called independent-pairs operation and is obtained only when the VERTICAL MODE switch is in the ALT position and the HORIZONTAL MODE switch is in either the ALT or the CHOP position.

Triggering

33. Press the LEFT button of the VERTICAL MODE switch and the A button of the HORIZONTAL MODE switch. Center the display on the crt with the left vertical unit position control. Disconnect the input signal from the right vertical unit input connector. Sequentially press all of the VERTICAL MODE switch buttons. Notice that a stable display is obtained in all positions of the VERTICAL MODE switch (straight line in RIGHT position). Also notice that in addition to the VERT MODE pushbutton of the A TRIGGER SOURCE switch, the RIGHT VERT or LEFT VERT (or both) pushbuttons are illuminated to indicate the trigger signal source for each VERTICAL MODE switch setting.

34. Press the LEFT VERT button of the A TRIGGER SOURCE switch. Again, sequentially press all of the VERTICAL MODE buttons. Notice that the display is again stable in all positions, as in the previous step.

35. Press the RIGHT VERT button of the A TRIGGER SOURCE switch. Sequentially press all the VERTICAL MODE switch buttons and notice that a stable display cannot be obtained in any position. This is because there is no input signal connected to the right vertical unit. Return the A TRIGGER SOURCE switch to VERT MODE.

36. The B TRIGGER SOURCE switch operates in a similar manner to the A TRIGGER SOURCE switch when the B time-base unit is selected for display. Return the B TRIGGER SOURCE switch to VERT MODE.

37. Press the ALT button of the VERTICAL MODE switch. Notice that all the A and B TRIGGER SOURCE pushbuttons are illuminated. This indicates that the internal trigger signals are being obtained alternately from the LEFT and RIGHT VERT compartments.

38. Press the ALT or CHOP button of the HORIZONTAL MODE switch. Notice that this is the same display obtained in step 32 (independent-pairs operation). Also, notice that the VERT MODE and RIGHT VERT pushbuttons of the A TRIGGER SOURCE switch and the VERT MODE and LEFT VERT pushbuttons of the B TRIGGER SOURCE switch are illuminated. This indicates the true trigger source for both time-base units for independent-pairs operation.

Readout

NOTE

The following three steps apply only to instruments equipped with a Readout System.

39. Turn the READOUT control clockwise until an alphanumeric display is visible within the top or bottom division of the crt. Change the deflection factor of the vertical unit that is selected for display. Notice that the readout portion of the display changes as the deflection factor is changed. Likewise, change the sweep rate of the time-base unit which is selected for display. Notice that the readout display for the time-base unit changes also as the sweep rate is changed.

40. Set the time-base unit for magnified operation. Notice that the readout display changes to indicate the correct magnified sweep rate. If a readout-coded 10X probe is available for use with the vertical unit, install it on the input connector of the right vertical plug-in unit. Notice that the deflection factor indicated by the readout is increased by 10 times when the probe is added. Return the time-base unit to normal sweep operation and disconnect the probe.

41. Sequentially press all of the VERTICAL MODE switch buttons and the HORIZONTAL MODE buttons. Notice that the readout from a particular plug-in occupies a specific location on the display area. If either of the vertical plug-in units is a dual-trace unit, notice that the readout for channel 2 appears within the lower division of the crt. Return the VERTICAL MODE switch to LEFT VERT.

Beam Finder

42. Set the deflection factor of the left vertical plug-in to 0.1 volts/division. Notice that a square-wave display is not visible since the deflection exceeds the scan area of the crt.

43. Press the BEAM FINDER button. Notice that the display is returned to the viewing area in compressed form. Release the BEAM FINDER switch and notice that the display again disappears from the viewing area. Pull the BEAM FINDER outward so it locks in the "find" position. Notice that the display is again returned to the viewing area in compressed form, but that in this position it remains on the viewing area as long as the BEAM FINDER switch is locked in the outward position.

44. With the BEAM FINDER switch locked in the outward position, increase the vertical unit deflection factor until the display is reduced to about two divisions vertically. Adjust the position control of the displayed vertical unit to position the compressed display about the center of the graticule. Press the BEAM FINDER switch in and release. Notice that the display remains within the viewing area.

Calibrator

45. Set the RATE switch to the B GATE $\div 2$ position. Press the A button of the HORIZONTAL MODE switch and set the B time-base unit for free-running operation (auto-triggering with level control set so unit is not triggered). Change the sweep rate of the B time-base unit and notice that the repetition rate of the displayed signal changes as the sweep rate is changed. The repetition rate of the displayed signal rate is one-half the repetition rate of the gate signal produced by the B time-base unit (duration of one cycle of Calibrator waveform equals approximately 20 times the setting of the B sweep rate switch). Also notice that the amplitude of the square wave is adjustable with the CALIBRATOR switch.

46. Set the RATE switch to dc. Establish a ground reference level on the crt (such as center horizontal line of graticule). Set the vertical unit for dc input coupling. Notice that the display is a straight line deflected from the ground reference line by the amount selected by the CALIBRATOR switch.

47. If a current-probe amplifier plug-in is available, the current function of the Calibrator can be demonstrated. Install the current-probe amplifier plug-in unit in the instrument and press the VERTICAL MODE button which will display this unit. Set the RATE switch to the 1 kHz position and the CALIBRATOR switch to the 40 mA position. Connect the current probe to the 40 mA current loop (observe current direction shown by arrow). Set the deflection factor of the current-probe amplifier to display several divisions of the calibrator waveform. Set the RATE switch to the B GATE $\div 2$ position. Notice that the display is the same amplitude as obtained previously, but that the repetition rate is variable with the B time-base unit sweep rate switch. Change the RATE switch to the dc position. Notice that there is no deflection on the crt. This is because the dc current function can be demonstrated only with a current-probe that is sensitive to dc current.

Z-Axis Input

48. If an external signal is available (two volts peak-to-peak minimum), the function of the Z-AXIS INPUT can be demonstrated. Remove the bnc cap from the Z-AXIS INPUT connector (on rear panel). Connect the external signal to both the input connector of the displayed vertical unit and the Z-AXIS INPUT connector. Set the sweep rate of the displayed time-base unit to display about five cycles of the waveform. Adjust the amplitude of the signal generator until intensity modulation is visible on the display (change the vertical unit deflection factor as necessary to produce an on-screen display). The positive peaks of the waveform should be blanked out and the negative peaks intensified. Notice that the setting of the intensity controls determines the amount of intensity modulation that is visible. Replace the bnc cap on the Z-AXIS INPUT connector.

49. This completes the Function Check procedure. Instrument operations not explained here, or operations which need further explanation are discussed under Detailed Operating Information.

SIMPLIFIED OPERATING INSTRUCTIONS

General

The following information is provided to aid in quickly obtaining the correct setting for the 7904 controls to present a display. The operator should be familiar with the complete function and operation of this instrument as described in this section before using this procedure. For detailed operating information for the plug-in units, see the instruction manuals for the applicable units.

Single-Trace Display

The following procedure will provide a display of a single-trace vertical unit against one time-base unit. For simplicity of explanation, the vertical unit is installed in the LEFT VERT compartment and the time-base unit is installed in the A HORIZ compartment. Other compartments can be used if the following procedure is changed accordingly.

1. Install a 7A-series amplifier unit in the LEFT VERT compartment.
2. Press the LEFT button of the VERTICAL MODE switch.
3. Install a 7B-series time-base unit in the A HORIZ compartment.
4. Press the A button of the HORIZONTAL MODE switch.
5. Press the VERT MODE button of the A TRIGGER SOURCE switch.
6. Set the POWER switch to ON. Allow several minutes warmup.
7. Connect the signal to the input connector of the vertical unit.
8. Set the vertical unit for ac input coupling and calibrated deflection factors.

9. Set the time-base unit for auto mode, internal triggering at a sweep rate of one millisecond/division.

10. Advance the A INTENSITY control until a display is visible (if display is not visible with A INTENSITY at about midrange, press BEAM FINDER switch and adjust the vertical deflection factor until the display is reduced in size vertically; then center compressed display with vertical and horizontal position controls; release BEAM FINDER). Adjust the FOCUS control for a well-defined display.

11. Set the vertical deflection factor and vertical position control for a display which remains within the graticule area vertically.

12. If necessary, set the time-base triggering controls for a stable display.

13. Adjust the time-base position control so the display begins at the farthest left vertical line of the graticule. Set the time-base sweep rate to display the desired number of cycles.

Dual-Trace Display

The following procedure will provide a display of two single-trace vertical units against one time-base unit.

1. Install 7A-series amplifier units in both vertical plug-in compartments.

2. Press the LEFT button of the VERTICAL MODE switch.

3. Install a 7B-series time-base unit in the A HORIZ compartment.

4. Press the A button of the HORIZONTAL MODE switch.

5. Press the VERT MODE button of the A TRIGGER SOURCE switch.

6. Set the POWER switch to ON. Allow several minutes warmup.

7. Connect the signals to the input connectors of the vertical units.

8. Set the vertical units for ac input coupling and calibrated deflection factors.

9. Set the time-base unit for auto mode, internal triggering at a sweep rate of one millisecond/division.

10. Advance the A INTENSITY control until a display is visible (if display is not visible with A INTENSITY at midrange, press BEAM FINDER switch and adjust vertical deflection factor until display is reduced in size vertically; then center compressed display with vertical and horizontal position controls; release BEAM FINDER). Set the FOCUS control for a well-defined display.

11. Set the left vertical unit deflection factor for a display about four divisions in amplitude. Adjust the vertical position control to move this display to the top of the graticule area.

12. Press the RIGHT button of the VERTICAL MODE switch.

13. Set the right vertical unit deflection factor for a display which is about four divisions in amplitude (if display cannot be located, use BEAM FINDER switch). Position this display to the bottom of the graticule area with the right vertical unit position control.

14. Press the ALT or CHOP button of the VERTICAL MODE switch. A dual-trace display of the signal from the left vertical and right vertical plug-ins should be presented on the crt. (For more information on choice of dual-trace mode, see Dual-Trace Displays in this section.)

15. If necessary, adjust the time-base triggering controls for a stable display.

16. Adjust the time-base position control so the display begins at the left graticule line. Set the time-base sweep rate for the desired horizontal display.

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Dual-Sweep Display

The following procedure will provide a dual-sweep display of a single-trace vertical unit against time-base units.

1. Install a 7A-series amplifier unit in the LEFT VERT compartment.
2. Press the LEFT button of the VERTICAL MODE switch.
3. Install 7B-series time-base units in both the A HORIZ and B HORIZ compartments.
4. Press the A button of the HORIZONTAL MODE switch.
5. Press the VERT MODE buttons of the A TRIGGER SOURCE and B TRIGGER SOURCE switches.
6. Set the POWER switch to ON. Allow several minutes warmup.
7. Connect the signal to the input connector of the vertical unit.
8. Set the vertical unit for ac input coupling and calibrated deflection factors.
9. Set both time-base units for auto mode, internal triggering at a sweep rate of one millisecond/division.
10. Advance the A INTENSITY control until a display is visible (if display is not visible with A INTENSITY at midrange, press BEAM FINDER switch and adjust vertical deflection factor until display is reduced in size vertically; then center compressed display with vertical position control; release BEAM FINDER). Set the FOCUS control for a well-defined display.
11. Set the vertical unit for a display about four divisions in amplitude and move the display to the top of the graticule area with the vertical position control.
12. If necessary, set the A time-base unit for stable triggering.
13. Set the A time-base sweep rate for the desired display.
14. Press the B button of the HORIZONTAL MODE switch.
15. Advance the B INTENSITY control until a display is visible (if display is not visible with B INTENSITY at midrange, press BEAM FINDER switch and adjust the vertical deflection factor until display is reduced in size vertically; then center compressed display with vertical position control; release BEAM FINDER).
16. If necessary, set the B time-base unit for stable triggering.
17. Set the B time-base unit sweep rate for the desired display.
18. Press the ALT or CHOP button of the HORIZONTAL MODE switch (see Dual-Sweep Displays in this section for further information on selecting sweep mode).
19. Adjust the VERT TRACE SEPARATION (B) control to position the trace produced by the B time-base unit with respect to the trace produced by the A time-base unit.

Dual Trace—Dual Sweep Display

The following procedure will provide a dual-trace, dual-sweep display of two single-trace vertical units against two time-base units (four traces displayed on crt).

1. Install 7A-series amplifier units in both vertical compartments.
2. Press the LEFT button of the VERTICAL MODE switch.
3. Install 7B-series time-base units in both horizontal compartments.
4. Press the B button of the HORIZONTAL MODE switch.
5. Press the VERT MODE buttons of the A TRIGGER SOURCE and B TRIGGER SOURCE switches.
6. Set the POWER switch to ON. Allow several minutes warmup.

7. Connect the signals to the input connectors of the vertical units.

8. Set the vertical units for ac input coupling and calibrated deflection factors.

9. Set both time-base units for auto mode, internal triggering at a sweep rate of one millisecond/division.

10. Advance the B INTENSITY control until a display is visible (if display is not visible with B INTENSITY at midrange, press BEAM FINDER switch and adjust the left vertical unit deflection factor until display is reduced in size vertically; then center compressed display with left vertical position control; release BEAM FINDER). Set the FOCUS control for a well-defined display.

11. Set the left vertical unit deflection factor for a display which is about two divisions in amplitude and position the display to the top of the graticule area.

12. If necessary, adjust the B time-base unit triggering controls for a stable display.

13. Position the start of the trace to the left graticule line with the B time-base unit position control. Set the B time-base unit sweep rate for the desired display.

14. Press the RIGHT button of the VERTICAL MODE switch and the A button of the HORIZONTAL MODE switch.

15. Advance the A INTENSITY control until a display is visible (if display is not visible with A INTENSITY at midrange, press BEAM FINDER switch and adjust the right vertical unit deflection factor until display is reduced in size vertically; then center compressed display with right vertical unit position control; release BEAM FINDER).

16. Set the right vertical unit deflection factor for a display about two division in amplitude and position the display just below the center horizontal line of the graticule.

17. If necessary, adjust the A time-base unit triggering controls for a stable display.

18. Position the start of the trace to the left graticule line with the A time-base unit position control. Set the A time-base sweep rate for the desired display.

19. Press the ALT or CHOP button of the HORIZONTAL MODE switch.

20. If necessary, adjust the VERT TRACE SEPARATION (B) control to separate the two traces.

21. Press the CHOP button of the VERTICAL MODE switch.

22. Adjust the vertical position controls and the VERT TRACE SEPARATION (B) control as necessary to obtain the desired display.

Independent-Pairs Display

The following procedure will provide a dual-trace, dual-sweep display where the left vertical unit is displayed only at the sweep rate of the B time-base unit and the right vertical unit is displayed only at the sweep rate of the A time-base unit.

1. Follow steps 1 through 19 of the previous procedure for Dual-Trace/Dual-Sweep displays.

2. Press the ALT button of the VERTICAL MODE switch.

3. If necessary, adjust the position controls of the vertical units to separate the two traces. The vertical deflection produced by the unit in the LEFT VERT compartment is displayed at the sweep rate of the time-base in the B HORIZ compartment, and the vertical deflection produced by the unit in the RIGHT VERT compartment is displayed at the sweep rate of the time-base in the A HORIZ compartment.

Delayed Sweep—Single Trace Display

The following procedure will provide a delayed-sweep display of a single-trace vertical unit.

1. Follow the complete procedure given under Single-Trace Displays.

2. Be sure the time-base unit installed in the A HORIZ (DELAYING TIME BASE) compartment is a delaying time-base unit.

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3. Install a 7B-series time-base unit in the B HORIZ compartment.

4. Follow the procedure given in the instruction manual for the delaying sweep time-base unit to obtain a delayed-sweep display.

5. Press the B button of the HORIZONTAL MODE switch and advance the B INTENSITY control until a display is visible. Only the delayed sweep is shown on this display.

6. Press the ALT or CHOP button of the HORIZONTAL MODE switch.

7. If necessary, adjust the VERT TRACE SEPARATION (B) control to separate the two traces. This display provides a simultaneous presentation of the delaying (A HORIZ) time-base unit and the delayed (B HORIZ) time-base unit.

Delayed Sweep—Dual Trace

The following procedure will provide a delayed-sweep display of two single-trace vertical units (four traces displayed on screen).

1. Follow the complete procedure given under Dual-Trace Displays.

2. Be sure the time-base unit installed in the A HORIZ (DELAYING TIME BASE) compartment is a delaying time-base unit.

3. Install a 7B-series time-base unit in the B HORIZ compartment.

4. Follow the procedure given in the instruction manual for the delaying sweep time-base unit to obtain a delayed-sweep display.

5. Press the B button of the HORIZONTAL MODE switch and advance the B INTENSITY control until a display is visible. Only the delayed sweep display of both vertical traces is shown on this display.

6. Press the ALT or CHOP button of the HORIZONTAL MODE switch.

7. Adjust the vertical position controls and the VERT TRACE SEPARATION (B) control as necessary to obtain the desired display.

NOTE

When operated in the delayed-sweep mode, there is no special display relationship between the vertical and horizontal plug-ins as for independent-pairs operation, regardless of the vertical mode selected.

X-Y Display

The following procedure will provide an X-Y display (one signal versus another rather than against time).

NOTE

Some 7B-series time-base units have provisions for amplifier operation in the X-Y mode; see X-Y Operation in this section for details of operation in this manner.

1. Install 7A-series amplifier units in both the LEFT VERT and the A HORIZ compartments.

2. Press the LEFT button of the VERTICAL MODE switch and the A button of the HORIZONTAL MODE switch.

3. Set the POWER switch to ON. Allow several minutes warmup.

4. Connect the X-signal to the amplifier unit in the LEFT VERT compartment.

5. Connect the Y-signal to the amplifier unit in the LEFT VERT compartment.

6. Set both amplifier units for ac input coupling and calibrated deflection factors.

7. Advance the A INTENSITY control until a display is visible (if display is not visible, press BEAM FINDER switch and adjust the deflection factors of both amplifier units until display is reduced in size both vertically and horizontally; then center compressed display with the position controls; release BEAM FINDER).

8. Set the deflection factor of both amplifier units for the desired display and center the display with the position controls. The amplifier unit in the A HORIZ compartment controls the horizontal deflection, and the unit in the LEFT VERT compartment controls the vertical deflection.

DETAILED OPERATING INFORMATION

Intensity Controls

General. The 7904 has three separate intensity controls. The A INTENSITY control determines the brightness of the display produced by the plug-in unit in the A HORIZ compartment. Likewise, the B INTENSITY control determines the brightness of the display produced by the plug-in unit in the B HORIZ compartment. The READOUT intensity control determines the brightness of only the readout portion of the crt display.

Crt Phosphor Protection. To protect the crt phosphor, this instrument contains protection circuitry which limits the display intensity by limiting the crt beam current to a safe level. If the intensity control(s) is advanced to a point where the crt beam current exceeds a potentially damaging level for more than about ten milliseconds, the circuit action automatically limits the beam current to a safe level. This circuit action also de-focuses the trace to indicate that the setting of the intensity control(s) should be reduced. The crt beam current is limited to an even lower level when operating in an X-Y mode, or if either one of the time-base units is set to a slow sweep rate (even if the time-base unit with slow sweep rate is not selected for display by the HORIZONTAL MODE switch). This reduces the danger of damaging the crt phosphor with a stationary or slowly moving spot. Since beam-current limiting does not take effect until after about ten milliseconds, the full display-intensity capability of this instrument is available for most single-shot and photography uses.

Light Filters. Light filters reduce the observed light output from the crt. When the highest intensity display is desired, remove the filters and use only the clear faceplate protector (permanently installed behind bezel). Apparent trace intensity can also be improved in such cases by reducing the ambient light or using a viewing hood.

Display Focus

This instrument contains an automatic-focusing circuit which maintains optimum focus after correct setting of the FOCUS control is established. This eliminates the need to re-adjust the FOCUS control for various intensity settings within the range of the crt phosphor-protection circuitry (see Crt Phosphor Protection). Set the FOCUS control for best definition of a low-intensity display.

Astigmatism Adjustment

If a well-defined display cannot be obtained with the FOCUS control, adjust the ASTIG adjustment as follows:

NOTE

To check for proper setting of the ASTIG adjustment, slowly turn the FOCUS control through the optimum setting. If the ASTIG adjustment is correctly set, the vertical and horizontal portions of the display will come into sharpest focus at the same position of the FOCUS control. This setting of the ASTIG adjustment should be correct for any display.

1. Connect the CAL VOLTS connector to the input of the vertical unit with a bnc-to-bnc jumper lead.
2. Set the CALIBRATOR switch to 4 V and the RATE switch to 1 kHz. Adjust the vertical deflection factor to produce a two- or three-division display.
3. Set the time-base unit for a sweep rate of 0.2 millisecond/division.
4. Set the A INTENSITY control so the display is at normal intensity (about midrange).
5. Turn the FOCUS control fully counterclockwise and set the ASTIG adjustment to midrange.
6. Adjust the FOCUS control so the top and bottom of the displayed square wave are as thin as possible, but not elongated.
7. Set the ASTIG adjustment so the top and bottom of the displayed square wave are as thin as possible.
8. Repeat steps 6 and 7 for the best overall focus.

Trace Alignment Adjustment

If a free-running trace is not parallel with the horizontal graticule lines, set the TRACE ROTATION adjustment as follows: Position the trace to the center horizontal line and adjust the TRACE ROTATION adjustment so the trace is parallel with the horizontal graticule lines.

Graticule

The graticule is internally marked on the faceplate of the crt to provide accurate, no-parallax measurements. The graticule is divided into eight vertical and ten horizontal divisions. In addition, each major division is divided into five minor divisions at the center vertical and horizontal lines. The vertical gain and horizontal timing of the plug-ins are calibrated to the graticule so accurate measurements can be made from the crt. The illumination of the graticule lines can be varied with the GRAT ILLUM control.

NOTE

Two types of crt graticules have been used in some Tektronix oscilloscopes. One graticule has 0% and 100% risetime reference points that are separated by 6 vertical graticule divisions. The other graticule has the 0% and 100% risetime reference points separated by 5 vertical divisions. In your manual, illustrations of the crt face or risetime measurement instructions may not correspond with the graticule markings on your oscilloscope.

Figure 2-3 shows the oscilloscope graticule and defines the various measurement lines. The terminology defined here will be used in all discussions involving graticule measurements. Notice the 0%, 10, 90, and 100 markings on the left side of the graticule. These markings are provided to facilitate risetime measurements.

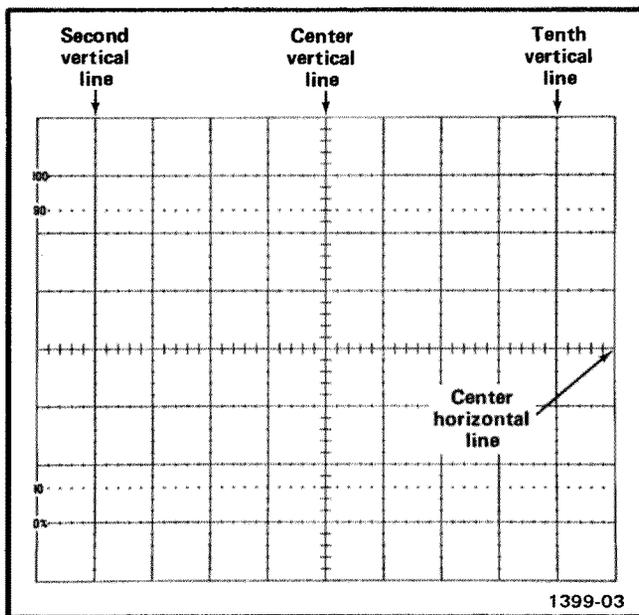


Fig. 2-3. Definition of measurement lines on the graticule.

Light Filter

The tinted filter provided with this instrument minimizes light reflections from the face of the crt to improve contrast when viewing the display under high ambient light conditions. This filter should be removed for waveform photographs or when viewing high writing rate displays. To remove the filter, pull outward on the bottom of the plastic crt mask and remove it from the crt. Remove the tinted filter (leave the metal light shield in place) and snap the plastic crt mask back into place. A clear plastic faceplate protector is mounted between the crt faceplate and the bezel. This faceplate protector should be left in place at all times to protect the crt faceplate from scratches.

An optional mesh filter is available for use with the instrument (included with Option 3). This filter provides shielding against radiated EMI (electro-magnetic interference) from the face of the crt. It also serves as a light filter to make the trace more visible under high ambient light conditions. The mesh filter fits in place of the plastic crt mask and the tinted filter.

Beam Finder

The BEAM FINDER switch provides a means of locating a display which overscans the viewing area either vertically or horizontally. When the BEAM FINDER switch is pressed, the display is compressed within the graticule area. This switch can also be pulled outward to lock it in the beam-finder position. The latter feature is convenient when attempting to locate traces from more than one of the plug-in units in this instrument. Press the BEAM FINDER switch in to release it from the locked position. To locate and reposition an overscanned display, use the following procedure:

1. Press the BEAM FINDER switch in (or if desired, pull it outward to the lock position).
2. While the display is compressed, increase the vertical and horizontal deflection factors until the vertical deflection is reduced to about two divisions and the horizontal deflection is reduced to about four divisions (the horizontal deflection needs to be reduced only when in the X-Y mode of operation).
3. Adjust the vertical and horizontal position controls to center the display about the vertical and horizontal center lines of the graticule.
4. Release the BEAM FINDER switch; the display should remain within the viewing area.

Control Illumination

The CONTROL ILLUM switch determines the illumination level of the pushbutton switches on this instrument and the associated plug-in units. This switch controls the illumination of only the pushbutton switches on the plug-in units, and does not affect the intensity of lights which are used as function indicators (for example, it does not affect the illumination of the ready light on a time-base unit which has the single-sweep feature). In the OFF position, all pushbutton lights on the instrument and the associated plug-ins are off. The A and B INTENSITY lights remain on at low intensity to provide a power-on indication. In the LOW position, the selected buttons are illuminated at low intensity. This is the recommended position for the CONTROL ILLUM switch, since it provides an adequate indication of switch position and also results in longest bulb life. The HIGH position provides maximum intensity for the pushbuttons and can be used so the selected switch is obvious even under high ambient light conditions.

NOTE

If the Readout System is not installed in this instrument (Option 1), disregard the following information. Also, the READOUT control has no effect upon instrument operation in this case.

Readout

The Readout System allows alphanumeric display of information on the crt along with the analog waveform displays. The information displayed by the Readout System is obtained from the plug-in units which are installed in the plug-in compartments. The characters of the readout display are written by the crt beam on a time-shared basis with the signal waveforms.

The Readout Mode switch, located behind the right side panel (see Fig. 2-4), determines the operating mode of the Readout System. When this switch is in the Free Run—Remote position, the Readout System operates in a free-running mode to randomly interrupt the waveform display to display characters. However, the waveform display is interrupted for only about 20 microseconds for each character that is displayed. The Readout System can also be remotely switched to the single-shot mode when in this position (see Remote Readout for further information). In the Gate Trig'd position, the Readout System is locked out so no characters are displayed during the sweep. At the end of the sweep, the Readout System is triggered and a complete frame of all applicable readout words is displayed. This mode of operation can be used when the trace interruptions necessary to display characters would not otherwise allow a satisfactory waveform display to be obtained. The trigger for the Readout System in the Gate Trig'd position is produced

from the sweep gate selected by the Gate switch (located on the Output Signals and Calibrator board; see Fig. 2-4) and is the same as the gate signal connected to the front-panel +GATE connector (time-base unit must be installed in selected horizontal compartment).

The readout information from each plug-in channel is called a word. Up to eight words of readout information can be displayed on the crt (two channels from each of the four plug-in compartments). The location at which each readout word is presented is fixed and is directly related to the plug-in unit and channel from which it originated. Fig. 2-5 shows the area of the graticule where the readout from each plug-in unit and channel is displayed. Notice that the readout from channel 1 of each plug-in unit is displayed within the top division of the graticule, and the readout from channel 2 is displayed directly below within the bottom division of the graticule. Only the readout from plug-ins or channels which are selected for display by the VERTICAL MODE or HORIZONTAL MODE switches, or by the mode switches of dual-channel plug-ins, appear in the readout display (some special purpose plug-in units may over-ride the mode switches to display readout even though the compartment is not selected for waveform display).

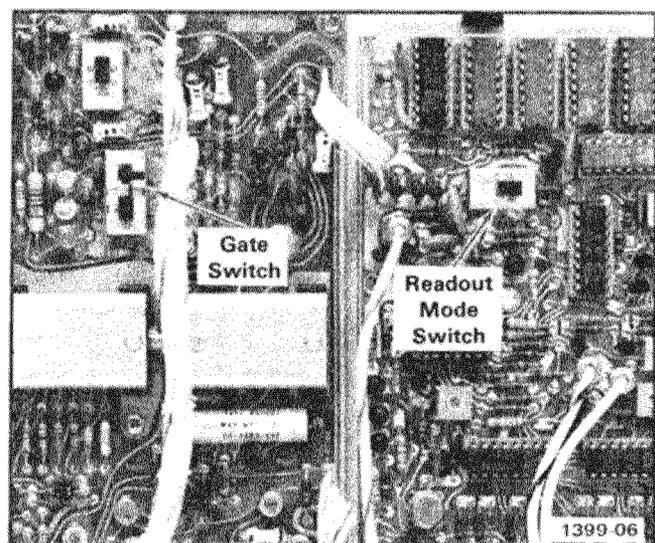


Fig. 2-4. Location of Readout Mode and Gate switches (behind right side panel).

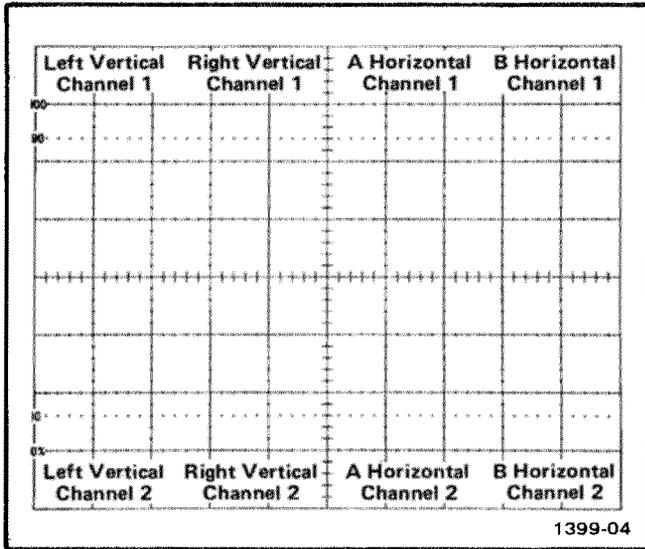


Fig. 2-5. Location of readout on the crt identifying the originating plug-in and channel.

An "identify" feature is provided by the Readout System to link the readout word with the originating plug-in unit and channel (amplifier units only). When the "Identify" button of an amplifier unit is pressed, the word IDENTIFY appears in the readout location allocated to that plug-in and channel. Other readout words in the display remain unchanged. When the "Identify" button is released, the readout display from this plug-in channel is again displayed. Circuitry may also be provided in the amplifier unit which produces a noticeable change in the analog waveform display to also identify the associated trace when the "Identify" button is pressed; see the plug-in instruction manuals for details.

The READOUT control determines the intensity of only the readout portion of the display independent of the other traces. The Readout System is inoperative in the fully counterclockwise OFF position. This may be desirable when the top and bottom divisions of the graticule are to be used for waveform display.

Remote Readout

The operating mode of the Readout System can be remotely controlled through the rear-panel Remote control connector J90. Grounding Pin E inhibits (locks out) the Readout System; grounding Pin F triggers one complete frame of applicable readout words (single-shot). This mode of operation can be used to display the readout independent of the waveforms, such as for display photography. Requirements for remote readout operation are as follows:

Remote Readout Lockout

Pin of J90	E
Signal Required	Closure to ground (within 0.1 V) from a positive level locks out Readout System
Maximum current required	2 mA
Maximum open circuit voltage	+2 V
Maximum safe input voltage	+5 V, -1 V (dc + peak ac)

Remote Single-Shot Readout

Pin of J90	F
Signal required	Closure to ground (within 0.4 V) from a positive level with pin E grounded allows Readout System to display one complete frame. Rate of change must be at least 0.1 V/ μ s.
Maximum current required	3 mA
Maximum open circuit voltage	+10 V
Maximum safe input voltage	+10 V, -5 V (dc + peak ac)

Display Photography

A permanent record of the crt display can be obtained with an oscilloscope camera system. The instruction manuals for the Tektronix Oscilloscope Cameras include complete instructions for obtaining waveform photographs.

The crt bezel of this instrument provides integral mounting for a Tektronix Oscilloscope Camera. The three pins located on the left side of the crt bezel connect power to compatible camera systems. Control signals are also received from Tektronix automatic cameras to allow camera-controlled single-shot photography (see camera manual for further information).

If the readout portion of the display is to be included on waveform photographs, the following suggestions will aid in obtaining good photographs.

1. Focus the oscilloscope display and the camera on the center of the crt display. The auto-focus feature in this instrument will maintain the traces at optimum focus.

2. Set the READOUT intensity control for a minimum setting that allows the characters to be written. This normally occurs at a slightly lower intensity level than is necessary for complete writing of the waveform display. Some experimentation may be necessary to establish the correct level. Too high a setting of the READOUT intensity control will result in a broad, poorly defined photograph of the readout display.

3. If single-shot photography is used, set the Readout Mode switch to the Gate Trig'd position (see Readout for complete operating information). Then, the readout is displayed in a single-shot manner after the trace is complete (be sure the camera shutter remains open at least 0.5 second after the sweep is completed to photograph the entire readout). Also, set the GRAT ILLUM control counterclockwise while the trace is being photographed. Then, the graticule can be photographed later to produce a double-exposure picture showing complete information.

Vertical and Horizontal Mode Switch Logic

There are 20 possible combinations of VERTICAL MODE and HORIZONTAL MODE switch settings. The total possible number of display combinations is further multiplied by the variety of plug-in units available for use with this instrument (such as voltage amplifiers, current amplifiers, sampling units, etc.), the interchangeability of plug-ins (i.e., an amplifier or time-base unit can be installed in either of the vertical or horizontal compartments), or by the capabilities of the plug-in units which are used in this instrument (e.g., a dual-trace vertical unit can be used in either of the two single-channel modes, in either dual-trace mode, or added algebraically; a delaying time base may be used either for a normal sweep or for delayed sweep). Therefore, it is difficult to list all of the display combinations which can occur using the plug-in units which are available, since the display combinations possible are dictated by the specific combination of plug-in units used. Table 2-1 lists the combination of VERTICAL MODE and HORIZONTAL MODE switch positions available and the type of display provided with each combination. For further information on operation in each position of the VERTICAL MODE and HORIZONTAL MODE switch positions, see the following sections on Vertical Mode and Horizontal Mode.

Table 2-1

DISPLAY COMBINATIONS*

VERT MODE Sw. Position	HORIZ MODE Sw. Position	Comments
LEFT	A	One trace. Vertical deflection from single unit; horizontal deflection from single unit.
	B	
	ALT	Two traces. Vertical deflection from single unit; horizontal deflection from both units.
	CHOP	
ALT	A	Two traces. Vertical deflection from both units; horizontal deflection from single unit.
	B	
	ALT	Two traces. Vertical deflection from both units; horizontal deflection from both units. Provides independent-pairs operation between the LEFT VERT and B HORIZ plug-ins and the RIGHT VERT and A HORIZ plug-ins (except for delayed-sweep operation).
	CHOP	
ADD	A	One trace. Vertical deflection is algebraic summation of both units; horizontal deflection from single unit.
	B	
	ALT	Two traces. Vertical deflection is algebraic summation of both units; horizontal deflection from both units.
	CHOP	
CHOP	A	Two traces. Vertical deflection from both units; horizontal deflection from single unit.
	B	
	ALT	Four traces. Vertical deflection from both units; horizontal deflection from both units.
	CHOP	
RIGHT	A	One trace. Vertical deflection from single unit; horizontal deflection from single unit.
	B	
	ALT	Two traces. Vertical deflection from single unit; horizontal deflection from both units.
	CHOP	

*Combinations given for single-channel vertical and horizontal units only.

Vertical Mode

Left and Right Mode. When the LEFT or RIGHT button of the VERTICAL MODE switch is pressed, only the signal from the plug-in unit in the selected compartment is displayed.

Alternate Mode. The ALT position of the VERTICAL MODE switch produces a display which alternates between the plug-in units in the LEFT VERT and RIGHT VERT compartments with each sweep on the crt. Although the ALT mode can be used at all sweep rates, the CHOP mode provides a more satisfactory display at sweep rates below about 20 milliseconds/division. At these slower sweep rates, alternate-mode switching becomes visually perceptible.

The A and B TRIGGER SOURCE switches allow selection of the triggering for an alternate display. When these switches are set to the VERT MODE positions, each sweep is triggered by the signal being displayed on the crt. This provides a stable display of two unrelated signals, but does not indicate the time relationship between the signals. In either the LEFT VERT or the RIGHT VERT positions, the two signals are displayed showing true time relationship. However, if the signals are not time-related, the display from the plug-in which is not providing a trigger signal will be unstable on the crt.

When the ALT vertical mode is selected and either the ALT or CHOP buttons of the HORIZONTAL MODE switch are pressed, the instrument operates in the independent-pairs mode. Under this condition, the left vertical unit is always displayed at the sweep rate of the time-base unit in the B HORIZ compartment and the right vertical unit is displayed at the sweep rate of the time-base unit in the A HORIZ compartment (non-delayed sweep only). This results in two displays that have completely independent vertical deflection and sweep rate. This display is equivalent to the display obtainable with a dual-beam oscilloscope for most repetitive display combinations. See Horizontal Mode for information on selection of either ALT or CHOP horizontal mode. See Trigger Source for information on obtaining correct trigger operation. If delayed-sweep operation is used under this condition, a different sequence of display occurs. First, the left vertical unit is displayed at the sweep rate of the time-base unit in the A HORIZ compartment (delaying sweep) and then at the sweep rate of the time-base unit in the B HORIZ compartment (delayed sweep). The vertical display then shifts to the right vertical unit and it is displayed consecutively at the delaying and delayed sweep rate.

Chopped Mode. The CHOP position of the vertical mode switch produces a display which is electronically switched between channels at a one-megahertz rate. In general, the CHOP mode provides the best display at sweep rates slower than about 20 milliseconds/division or whenever dual-trace, single-shot phenomena are to be displayed. At faster sweep rates, the chopped switching becomes apparent and may interfere with the display.

Correct internal triggering for the CHOP mode can be obtained in any of the three positions of the trigger source switches. When the A or B TRIGGER SOURCE switches are set to VERT MODE or LEFT VERT, the internal trigger signal is obtained from the left vertical plug-in unit. Use of the RIGHT VERT trigger source position triggers the time-base units on the internal trigger signal from the right vertical unit. This allows two time-related signals to be displayed showing true time relationship. However, if the signals are not time-related, the display from the channel which is not providing the trigger signal will appear unstable. The CHOP mode can be used to compare two single-shot, transient, or random signals which occur within the time interval determined by the time-base unit (ten times selected sweep rate). To provide correct triggering, the display which provides the trigger signal must precede the second display in time. Since the signals show true time relationship, time-difference measurements can be made from the display.

Algebraic Addition. The ADD position of the VERTICAL MODE switch can be used to display the sum or difference of two signals, for common-mode rejection to remove an undesired signal, or for dc offset (applying a dc voltage to one channel to offset the dc component of a signal on the other channel). The common-mode rejection ratio between the vertical plug-in compartments of this instrument is at least 5:1 at 500 megahertz. The rejection ratio increases to 100:1 at 100 megahertz.

The overall deflection on the crt in the ADD mode is the resultant of the algebraic addition of the signals from the two vertical plug-in units. It is difficult to determine the voltage amplitude of the resultant display unless the amplitude of the signal applied to one of the plug-ins is known. This is particularly true when the vertical units are set to different deflection factors, since it is not obvious which portion of the display is a result of the signal applied to either plug-in unit. Also, the polarity and repetition rate of the applied signals enters into the calculation.

The following general precautions should be observed to provide the best display when using the ADD mode:

1. Do not exceed the input voltage rating of the plug-in units.

2. Do not apply large signals to the plug-in inputs. A good rule to follow is not to apply a signal which exceeds an equivalent of about eight times the vertical deflection factors. For example, with a vertical deflection factor of 0.5 volt/division, the voltage applied to that plug-in should not exceed four volts. Larger voltages may result in a distorted display.

3. To ensure the greatest dynamic range in the ADD mode, set the position controls of the plug-in units to a setting which would result in a mid-screen display if viewed in the LEFT or RIGHT positions of the VERTICAL MODE switch.

4. For similar response from each channel, set the plug-in units for the same input coupling.

Horizontal Mode

A and B. When either the A or B button of the HORIZONTAL MODE switch is pressed, the display is presented at the sweep rate of only the selected time-base unit. Set the applicable intensity control and trigger source switch for the desired display.

Alternate Mode. The ALT position of the HORIZONTAL MODE switch produces a display which alternates between time-base units after each sweep on the crt. Although the ALT horizontal mode can be used at all sweep rates, the CHOP horizontal mode provides a more satisfactory display at sweep rates below about 20 milliseconds/division. At slower sweep rates, the switching between the alternate-mode traces becomes apparent and may interfere with correct analysis of the display.

NOTE

This instrument will not operate in the ALT position of the HORIZONTAL MODE switch if either horizontal plug-in compartment is left vacant.

The A and B INTENSITY controls allow individual adjustment of the traces produced by the time-base units in the A HORIZ and B HORIZ compartments. Correct triggering of both time-base units is essential to obtain the correct display in the ALT horizontal mode. If either of the time-base units does not receive a correct trigger, and therefore does not produce a sweep, the other unit cannot produce a sweep either. This means that one time-base unit cannot begin its sweep until the previous unit has completed its entire display. This can be avoided if the time-base units are set for auto-mode triggering (sweep

free runs if not correctly triggered). The A and B TRIGGER SOURCE switches allow individual selection of the trigger source for the A HORIZ and B HORIZ time-base units. See the information on Trigger Source for complete operation of the A and B TRIGGER SOURCE switches. Also, see Vertical Trace Separation for information on positioning the B HORIZ display when in the ALT dual-sweep mode.

Chopped Mode. When the CHOP button of the HORIZONTAL MODE switch is pressed, the display is electronically switched between the two time-base units at a 200-kilohertz rate. In general, the CHOP horizontal mode provides the best display when either of the time-base units is set to a sweep rate slower than about 20 milliseconds/division. It also provides the best display when the two time-base units are set to widely varying sweep rates. In the CHOP horizontal mode, equal time segments are displayed from each of the time-base units. This provides a display which does not change greatly in intensity as the sweep rate of one of the time-base units is reduced (in contrast to ALT horizontal mode operation, where the slowest trace tends to be the brightest).

The A and B INTENSITY controls allow individual adjustment of the intensity of the traces produced by the time-base units in the A HORIZ and B HORIZ compartments respectively. Triggering is not as critical in the CHOP horizontal mode as in ALT, since only the trace from the un-triggered time-base unit is missing from the display if one of the units is not triggered properly. The other trace will be presented in the normal manner. The A and B TRIGGER SOURCE switches allow individual selection of the trigger source for the A HORIZ and B HORIZ time-base units. See the information on Trigger Source. Also, see Vertical Trace Separation for information on positioning the trace produced by the B HORIZ unit in relation to the trace from the A HORIZ unit.

Vertical Trace Separation

The VERT TRACE SEPARATION (B) control allows the trace produced by the B HORIZ plug-in to be positioned about four divisions above or below the trace produced by the plug-in unit in the A HORIZ compartment when one of the dual-sweep horizontal modes is selected. This control effectively operates as a vertical position control for all dual-sweep modes except independent-pairs operation. Then, the vertical position of the B HORIZ trace is determined by the plug-in unit in the LEFT VERT compartment only.

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To use the VERT TRACE SEPARATION (B) control, first establish the desired portion of the trace produced by the unit in the A HORIZ compartment. Then adjust the VERT TRACE SEPARATION (B) control to move the trace produced by the unit in the B HORIZ compartment away from the A HORIZ display. If both of the waveforms are larger than four divisions in amplitude, the displays can only be positioned so they do not directly overlap, since each waveform cannot be positioned to a unique area of the crt.

Trigger Source

The A and B TRIGGER SOURCE switches allow selection of the internal trigger signals for the A HORIZ and B HORIZ time-base units respectively. For most applications, these switches can be set to the VERT MODE positions. This position is the most convenient, since the internal trigger signal is automatically switched as the VERTICAL MODE switch is changed. Table 2-2 shows the internal trigger source selected in the VERT MODE position of both trigger switches for each position of the VERTICAL MODE switch.

Table 2-2
VERT MODE
Trigger Source

VERTICAL MODE Switch Position	Trigger Source for A and B HORIZ units
LEFT	LEFT VERT unit only
ALT	Determined by HORIZONTAL MODE Switch (see Table 2-3)
ADD	Algebraic sum of signals from LEFT and RIGHT VERT units
CHOP	LEFT VERT unit only
RIGHT	RIGHT VERT unit only

The internal trigger signal obtained in the ADD position of the VERTICAL MODE switch is a composite of the signals from the left and right vertical plug-in units. In the ALT position of the VERTICAL MODE switch, the internal trigger source is pre-selected by the HORIZONTAL MODE switch. This automatically selects the proper trigger source for the A and B time-base units for independent-pairs operation (ALT vertical mode with ALT or CHOP horizontal mode unless time-base units are set

for delayed-sweep operation; see Independent-Pairs Operation). For the A or B positions of the HORIZONTAL MODE switch, the internal trigger signal is automatically switched as the display is electronically switched between the LEFT VERT and RIGHT VERT plug-ins. Table 2-3 shows the trigger source selected in the ALT vertical mode for the A HORIZ and B HORIZ time-base units for each position of the HORIZONTAL MODE switch. Therefore, the VERT MODE positions ensure that the time-base units receive a trigger signal regardless of the mode switch settings without the need to change the trigger source selection.

The pushbuttons of the A and B TRIGGER SOURCE switches are illuminated (CONTROL ILLUM switch set to LOW or HIGH) to indicate the selected position (VERT MODE) and the actual internal trigger source obtained as a result of the VERTICAL and HORIZONTAL MODE switch settings and operating mode of the time-base units (LEFT VERT or RIGHT VERT).

Table 2-3

A AND B VERT MODE TRIGGER SOURCE FOR ALT VERTICAL MODE

HORIZONTAL MODE Switch Position	Trigger Source	
	A	B
A	Alternates between vertical units (follows display).	
ALT	^b RIGHT VERT unit	^b LEFT VERT unit
CHOP	^b RIGHT VERT unit	^b LEFT VERT unit
B	Alternates between vertical units (follows display).	

^bAlternates between vertical units when time-base units are set for delayed-sweep operation.

If correct triggering for the desired display is not obtained in the VERT MODE position, the trigger source for either the A HORIZ or B HORIZ time-base unit can be changed to obtain the trigger signal from either the LEFT VERT or RIGHT VERT plug-in. The internal trigger signal is obtained from the selected vertical compartment, whether the plug-in in that compartment is selected for display on the crt or not. If the internal trigger signal is obtained from one of the vertical units, but the other vertical unit is selected for display, the internal trigger signal must be time-related to the displayed signal in order to obtain a triggered (stable) display.

X-Y Operation

In some applications, it is desirable to display one signal versus another (X-Y) rather than against time (internal sweep). The flexibility of the plug-in units available for use with this instrument provides a means for applying an external signal to the horizontal deflection system for this type of display. Some of the 7B-series time-base units can be operated as amplifiers in addition to their normal use as time-base generators. This feature allows an external signal to provide the horizontal deflection on the crt. For most of the time-base units with the amplifier function, the X (horizontal) signal can be connected either to an external input connector on the time-base unit or it can be routed to the time-base through the internal triggering system (see time-base instruction manual for details). If the latter method is used, the A and B TRIGGER SOURCE switches must be set so that the X (horizontal) signal is obtained from one of the vertical units and the Y (vertical) signal is obtained from the other vertical unit. The advantages of using the internal trigger system to provide the X signal are that the attenuator switch of the amplifier unit providing the horizontal signal determines the horizontal deflection factor to allow full-range operation, and the plug-in units do not have to be moved between compartments when X-Y operation is desired.

Another method of obtaining an X-Y display is to install an amplifier plug-in unit in one of the horizontal plug-in compartments (check amplifier unit gain as given in the plug-in instruction manual to obtain calibrated horizontal deflection factors). This method provides the best X-Y display, particularly if two identical amplifier units are used, since both the X and Y input systems will have the same delay time, gain characteristics, input coupling, etc. For further information on obtaining X-Y displays, see the plug-in unit manuals. Also, the reference books listed under Applications provide information on X-Y measurements and interpreting the resultant lissajous displays.

An optional X-Y delay compensation network is available for this instrument. This network provides close delay matching between the vertical and horizontal deflection systems up to one megahertz for use in X-Y applications which require precise phase measurement. The network can be added to this instrument at any time. Order the X-Y Conversion kit from your local Tektronix Field Office or representative; installation instructions are included.

While the X-Y delay compensation network provides minimum phase shift between the X and Y portions of an X-Y display, it adds negative preshoot distortion and some corner rounding to fast step functions. An internal Delay Disable switch (see Fig. 2-6) is provided for both the A and B delay compensation networks to allow selection of either minimum phase-shift characteristics or optimum step response. When the Delay Disable switch is set to In (up), minimum phase-shift operation is provided as controlled by the plug-in units in the associated horizontal compartment. When set to the Out (down) position, the X-Y delay compensation network for the applicable horizontal compartment is disabled; the horizontal signal is connected to the horizontal deflection system with minimum distortion.

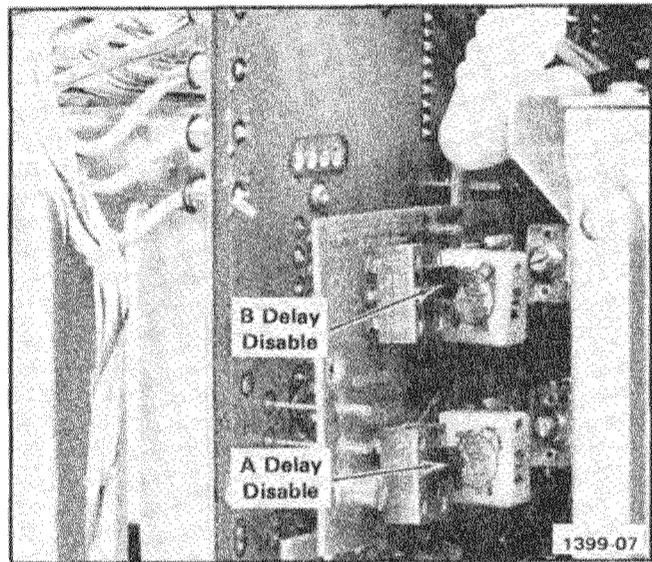


Fig. 2-6. Location of A and B Delay Disable switches (behind right side panel).

Intensity Modulation

Intensity (Z-axis) modulation can be used to relate a third item of electrical phenomena to the vertical (Y-axis) and the horizontal (X-axis) coordinates without affecting the waveshape of the displayed signal. The Z-axis modulating signal applied to the crt circuit changes the intensity of the displayed waveform to provide this type of display. "Gray scale" intensity modulation can be obtained by applying signals which do not completely blank the display. Large amplitude signals of the correct polarity will completely blank the display; the sharpest display is provided by signals with a fast rise and fall. The voltage amplitude required for visible trace modulation depends on the setting of the intensity controls.

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Time markers applied to the Z-AXIS INPUT provide a direct time reference on the display. With uncalibrated horizontal sweep or X-Y mode operation, the time markers provide a means of reading time directly from the display. However, if the markers are not time-related to the displayed waveform, a single-sweep display should be used (for internal sweep only) to provide a stable display.

The Z-AXIS INPUT (on rear panel) permits intensity modulation of the crt display through the intensity circuit. Negative-going signals increase the display intensity and positive-going signals decrease the display intensity. At dc and low frequencies, a two-volt peak-to-peak signal will completely blank the display even at maximum intensity levels. At higher frequencies, the signal characteristics necessary to obtain intensity modulation without distortion are determined by the intensity circuit pulse performance characteristics (see Section 3). The maximum input voltage should be limited to 15 volts (dc plus peak ac). When the Z-AXIS INPUT is not in use, replace the bnc cap.

Raster Display

A raster-type display can be used to effectively increase the apparent sweep length. For this type of display, the trace is deflected both vertically and horizontally by sawtooth signals. This is accomplished by installing a 7B-series time-base unit in one of the vertical plug-in compartments. Normally, the time-base unit in the vertical compartment should be set to a slower sweep rate than the time-base unit in the horizontal compartment; the number of horizontal traces in the raster depends upon the ratio between the two sweep rates. Information can be displayed on the raster using several different methods. In the ADD position of the VERTICAL MODE switch, the signal from an amplifier unit can be algebraically added to the vertical deflection. With this method, the vertical signal amplitude on the crt should not exceed the distance between the horizontal lines of the raster. Another method of displaying information on the raster is to use the Z-AXIS INPUT to provide intensity modulation for the display. This type of raster display could be used to provide a television-type display. Complete information on operation using the Z-axis feature is given under Intensity Modulation.

To provide a stable raster display, both time-base units must be correctly triggered. Internal triggering is not provided for the time-base units when they are in the vertical compartments; external triggering must be used. Also, blanking is not provided from the time-base units when they are installed in a vertical compartment. To blank out the retrace portion from the time-base unit in the vertical compartment, special connections must be made from this time-base unit to the blanking network (for further information, see the instruction manual for the applicable time-base unit).

Calibrator

General. The internal calibrator provides a convenient signal source for checking basic vertical gain and sweep timing. The calibrator output signal is also very useful for adjusting probe compensation as described in the probe instruction manual. In addition, the calibrator can be used as a convenient signal source for application to external equipment.

Voltage. The calibrator provides accurate output voltages at the CAL VOLTS connector from 4 millivolts to 40 volts in decade steps into high impedance loads. In addition, the positions from 4 mV to 4 V provide an output of two millivolts to 0.4 volts into 50 Ω (shown on front panel in brackets). The amplitude of the output voltage is selected by the CALIBRATOR switch. The output voltage is available at the front-panel CAL VOLTS connector.

Current. The current loop provides a 40 mA output current which can be used to check and calibrate current-measuring probe systems. The current output is selected by the CALIBRATOR switch when set to the 40 mA position. The current signal is obtained by clamping the probe around the current loop. The arrow above the current loop indicates conventional current flow; i.e., from plus to minus.

Repetition Rate. The calibrator circuit uses frequency-stable components to maintain accurate frequency and constant duty cycle. Thus, the calibrator can be used for checking the basic sweep timing of time-base units (one kilohertz rate only). The RATE switch selects the repetition rate of the calibrator. Two positions of the RATE switch provide a square-wave output signal both at the CAL VOLTS connector and through the current loop. In the 1 kHz position, the repetition rate of the calibrator is one kilohertz. The B GATE $\div 2$ position of the RATE switch provides a variable calibrator repetition rate. In this position, the repetition rate of the calibrator output signal is one-half the repetition rate of the gate signal produced by the time-base unit in the B HORIZ compartment (length of B gate is about ten times the setting of the B sweep rate switch). This position of the RATE switch allows selection of the repetition rate of the calibrator output signal by changing the sweep rate of the time-base unit in the B HORIZ compartment. The calibrator circuit maintains a constant 50% duty cycle on the output waveform, regardless of the repetition rate (B time-base free running).

In the dc position, positive dc voltage levels are available at the CAL VOLTS connector; the amplitude of the dc voltage is determined by the setting of the CALIBRATOR switch to one of the voltage ranges. When the CALIBRATOR switch is set to the 40 mA position, a dc current of 40 mA is provided through the current loop.

Wave Shape. The square-wave output signal of the calibrator can be used as a reference wave shape when checking or adjusting the compensation of passive, high-resistance probes. Since the square-wave output from the calibrator has a flat top, any distortion in the displayed waveform is due to the probe compensation.

Signal Outputs

+ **Sawtooth.** The + SAWTOOTH connector provides a positive-going sample of the sawtooth signal from the time-base units in the horizontal plug-in compartments. The internal Sweep switch (located behind right side panel; see Fig. 2-7) allows the output sawtooth to be selected from the time-base unit in either the A HORIZ or B HORIZ compartments. Rate of rise of the sawtooth output signal is about 50 millivolts/unit of time into a 50 Ω load, or about one volt/unit of time into a 1 M Ω load. Unit of time is determined by the time-base time/division switch (e.g., if time/division switch is set to one millisecond/division, a unit of time is one millisecond; at five milliseconds/division, a unit of time is five milliseconds). The peak output voltage is about 500 millivolts into a 50 Ω load or about 10 volts into a 1 M Ω load.

+ **Gate.** The + GATE output connector provides a positive-going rectangular output pulse from the time-base unit in the horizontal plug-in compartments. The Gate switch (located behind the right side panel; see Fig. 2-7) allows the output signal to be selected from the time-base unit in the A HORIZ compartment, B HORIZ compartment, or the delayed gate from a delaying time-base unit in either horizontal compartment. Duration of the gate output signal is the same as the duration of the respective sweep or, in the case of the delayed gate, it starts at the end of the delay period and lasts until the end of the sweep from the delaying time-base unit. Amplitude of the output signal at the + GATE connector is about 0.5 volt into 50 Ω , or about 10 volts into 1 M Ω .

Vertical Signal. The SIG OUT connector provides a sample of the vertical deflection signal. The source of the output signal at this connector is determined by the B TRIGGER SOURCE switch (notice line connecting SIG OUT connector to B TRIGGER SOURCE switch). In the VERT MODE position of the B TRIGGER SOURCE switch, the output signal is determined by the setting of the VERTICAL MODE switch. The output signal in the LEFT and RIGHT positions of the VERTICAL MODE switch is obtained only from the selected vertical unit. The vertical output signal in the ADD position of the VERTICAL MODE switch is the algebraic sum of the left and right vertical unit signals. In the CHOP position of the VERTICAL MODE switch, the output signal is obtained from the left vertical unit. In the ALT position of the VERTICAL MODE switch, the output signal source is also determined by the setting of the HORIZONTAL MODE switch.

When the HORIZONTAL MODE switch is set to A or B, the output signal at the SIG OUT connector switches between vertical units along the crt display. However, when the HORIZONTAL MODE switch is set to ALT or CHOP, the output signal is obtained from the left vertical unit (except for delayed sweep operation; then the output signal is the same as in the A or B positions). The LEFT VERT and RIGHT VERT positions of the B TRIGGER SOURCE switch provide the vertical output signal only from the selected vertical unit even when it is not selected for display. The output voltage into a 50 Ω load is about 25 millivolts/division of crt display and about 0.5 volt/division of display into a 1 M Ω load. The bandwidth of the output signal is determined by the vertical plug-in unit which is used (see Systems Specification given in Section 1).

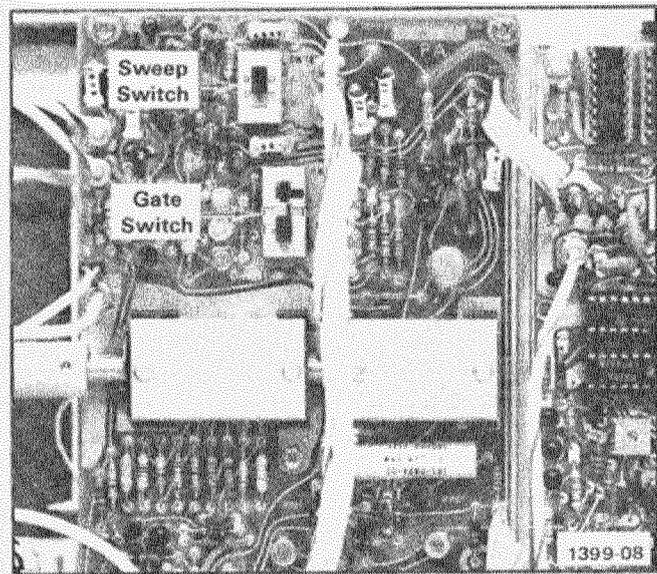


Fig. 2-7. Location of Sweep and Gate switches (behind right side panel).

Probe Power Connectors

The two PROBE POWER connectors on the rear panel of this instrument provide operating power for active probe systems. It is not recommended that these connectors be used as a power source for applications other than the compatible probes or other accessories which are specifically designed for use with this system.

Remote Connector

The nine-terminal connector (J90) on the rear panel provides input for remote operation of the instrument and the associated plug-in units. Table 2-4 lists the function of each terminal of J90. The methods of obtaining remote single-sweep reset and ready indication are given under Remote Single-Sweep Reset. See Remote Readout for information on remote operation of the Readout System. Notice that there are several blank terminals on J90. These terminals can be used for special remote applications.

Table 2-4

REMOTE CONNECTIONS

J90 Terminal	Function
A	Remote Single-sweep reset (A and B HORIZ)
B	Chassis ground
C	Remote ready indicator (A HORIZ)
D	Remote ready indicator (B HORIZ)
E	Remote readout lockout
F	Remote single-shot readout
H	No connection
J	No connection
K	No connection

Remote Single-Sweep Reset

Remote single-sweep reset operation can be provided to 7B-series time-base units with compatible features through rear-panel connector J90. The remote single-sweep reset actuation can be obtained from either an active system (pulse generator, logic circuit, etc.) or a passive system (switch or relay). Requirements for remote single-sweep reset operation are:

Remote Single-Sweep Reset (A and B HORIZ)

Pin of J90	A
Signal required	Closure to ground (within -5 to +0.5 volts) from a positive level.
Maximum current required	10 mA
Minimum pulse width	10 μ s at 50% amplitude points
Maximum input voltage	15 V (dc + peak ac).

A HORIZ Remote Ready Indicator

Pin of J90	C
Output signal	Open or ground when not ready; +5 V at 47 Ω source impedance when ready. Output sufficient to light a No. 49 bulb.

B HORIZ Ready Indicator

Pin of J90	D
Output signal	Open or ground when not ready; +5 V at 47 Ω source impedance when ready. Output sufficient to light a No. 49 bulb.

Figure 2-8 shows a typical passive system to provide remote single-sweep reset operation. The remote ready lights are optional and can be used with an active or passive system whenever it is necessary to provide an indication at the remote location that reset has occurred.

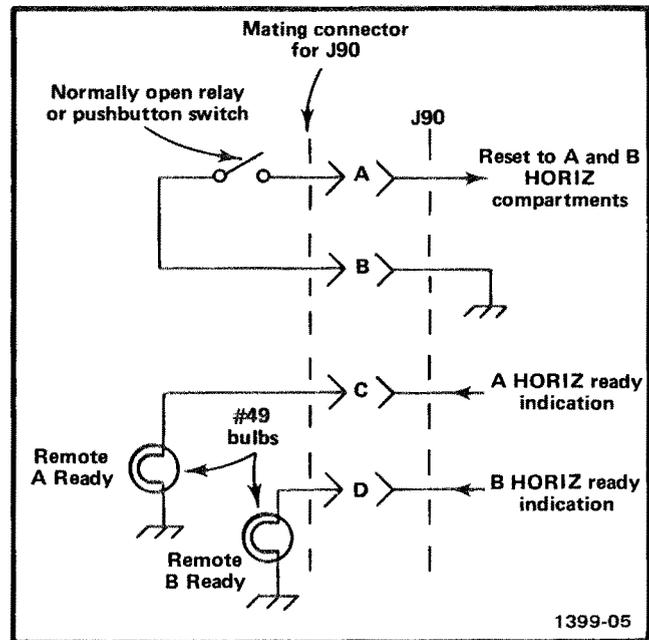


Fig. 2-8. Typical circuit for remote single-sweep reset operation.

Applications

The 7904 Oscilloscope and its associated plug-in units provide a very flexible measurement system. The capabilities of the overall system depend mainly upon the plug-ins that are chosen for use with this instrument. Specific applications for the individual plug-in units are described in the plug-in unit manuals. The overall system can also be used for many applications which are not described in detail, either in this manual or in the manuals for the individual plug-in units. Contact your local Tektronix Field Office or representative for assistance in making specific measurements with this instrument.

CIRCUIT DESCRIPTION

Introduction

This section describes the circuitry used in the 7904 Oscilloscope. The circuit description begins with a discussion of the instrument, using the basic block diagram. Next, each circuit is described in detail, using detailed block diagrams when appropriate, to show the relationship between the stages in each major circuit. Detailed schematics of each circuit are located in the Diagrams section at the back of this manual; refer to these schematics throughout the following circuit description for specific electrical values and relationships.

The theory of operation for circuits unique to this instrument is described in detail in this discussion. Circuits commonly used in the electronics industry are not discussed in detail. If more information is desired on these commonly used circuits, refer to the following textbooks (also see books under Logic Fundamentals):

Lloyd P. Hunter (Ed.), "Handbook of Semiconductor Electronics", third edition, McGraw-Hill, New York, 1970.

Jacob Millman and Herbert Taub, "Pulse, Digital, and Switching Waveforms", McGraw-Hill, New York, 1965.

The detailed circuit analysis is written around the detailed block diagrams that are given for each major circuit. These detailed block diagrams give the names of the individual stages within the major circuits and show how they are connected together to form the major circuit. The block diagrams also show the inputs and outputs for each circuit and the relationship of the front-panel controls to the individual stages. The circuit diagrams from which the detailed block diagrams are derived are shown in the Diagrams section.

NOTE

All references to direction of current in this manual are in terms of conventional current; i.e., from plus to minus.

LOGIC FUNDAMENTALS

Digital logic techniques are used to perform many functions within this instrument. The function and operation of the logic circuits are described using logic symbology and terminology. This portion of the manual is provided to aid in the understanding of these symbols and terms. The following information is a basic introduction to logic concepts, not a comprehensive discussion of the

subject. For further information on binary number systems and the associated Boolean Algebra concepts, the derivation of logic functions, a more detailed analysis of digital logic, etc., refer to the following textbooks:

Robert C. Baron and Albert T. Piccirilli, "Digital Logic and Computer Operation", McGraw-Hill, New York 1967.

Thomas C. Bartee, "Digital Computer Fundamentals", McGraw-Hill, New York, 1966.

Yaohan Chu, "Digital Computer Design Fundamentals", McGraw-Hill, New York, 1962.

Joseph Millman and Herbert Taub, "Pulse, Digital, and Switching Waveforms", McGraw-Hill, New York, Chapters 9-11, 1965.

Symbols

The operation of circuits in this instrument which use digital techniques is described using the graphic symbols set forth in military standard MIL-STD-806B. Table 3-1 provides a basic logic reference for the logic devices used within this instrument. Any deviations from the standard symbology, or devices not defined by the standard are described in the circuit description for the applicable device.

NOTE

Logic symbols used on the diagrams depict the logic function as used in this instrument and may differ from the manufacturer's data.

Logic Polarity

All logic functions are described using the positive logic convention. Positive logic is a system of notation where the more positive of two levels (HI) is called the true or 1-state; the more negative level (LO) is called the false or 0-state. The HI-LO method of notation is used in this logic description. The specific voltages which constitute a HI or LO state vary between individual devices.

NOTE

The HI-LO logic notation can be conveniently converted to 1-0 notation by disregarding the first letter of each step. Thus:

*HI = 1
LO = 0*

Circuit Description—7904 (SN B260000-UP)

Wherever possible, the input and output lines are named to indicate the function that they perform when at the HI (true) state. For example, the line labeled "Z-Axis OFF Command" means that the Z-Axis is turned off when this line is HI.

Input/Output Tables

Input/Output (truth) tables are used in conjunction with the logic diagrams to show the input combinations important to a particular function, along with the resultant output conditions. This table may be given either for an individual device or for a complete logic stage.

Non-Digital Devices

Not all of the integrated circuit devices in this instrument are digital logic devices. The function of non-digital devices is described individually, using operating waveforms or other techniques to illustrate their function.

BLOCK DIAGRAM

Introduction

The basic block diagram in Fig. 3-1 shows the primary interconnections between the individual blocks; each block represents a major circuit within the instrument. The numbered diamond in each block refers to the circuit diagram (located at the rear of the manual) that covers that specific part of the instrument.

Block Diagram Description

Vertical signals to be displayed on the crt are applied to the Vertical Channel Switch from both vertical plug-in compartments. The Vertical Channel Switch determines whether the signal from the left or right vertical unit is displayed. The selected vertical signal is then amplified by the Vertical Amplifier circuit to bring it to the level necessary to drive the vertical deflection plates of the crt. This circuit also includes an input to produce the vertical portion of an alphanumeric readout display.

Horizontal signals for display on the crt are connected to the Horizontal Channel Switch from both horizontal plug-in compartments. The Horizontal Channel Switch determines whether the signal from the A or B horizontal unit is displayed. The horizontal signal selected by the Horizontal Channel Switch is connected to the Horizontal Amplifier circuit which amplifies it to provide the horizontal deflection for the crt. This circuit also accepts the X-signal from the Readout System to produce the horizontal portion of the readout display.

The Readout System provides alphanumeric display of information encoded by the plug-in units. This display is presented on the crt, and is written by the crt beam on a time-shared basis with the analog waveform display.

The internal trigger signals from the vertical plug-in units are connected to the A and B Trigger Channel Switch circuits. These circuits, in conjunction with the Trigger Select Logic circuit, determine whether the trigger signal from the left or right vertical unit is connected to the A or B horizontal unit. The B Trigger Channel Switch also produces the drive signal for the Output Signals circuit to provide an output that is a sample of the vertical signal. In addition, the Output Signals circuit provides a sawtooth output signal and a gate output signal.

The Calibrator circuit produces an output with accurate amplitude that can be used to check the calibration of this instrument and the compensation of probes. The repetition rate of the Calibrator signal is selectable between dc, one kilohertz, or one-half the B-gate signal. This signal is available as a voltage at the CAL VOLTS connector or as a current through the 40 mA current loop.

The Logic circuit develops control signals for use in other circuits within this instrument and the plug-in units. These control signals automatically determine the correct instrument operation in relation to the plug-in units installed or selected, plug-in control settings, and 7904 control settings. The crt circuit contains the Z-Axis Amplifier which provides the drive signal to control the intensity level of the display. The crt circuit also contains the controls necessary for operation of the cathode-ray tube.

The Converter/Rectifiers and Low-Voltage Regulator circuits provide the power necessary for operation of this instrument. These voltages are connected to all circuits within the instrument. The High-Voltage Power Supply provides the positive accelerating potential for the crt. The Front-Panel Interconnect circuit contains the front-panel controls, switches, and interconnection circuitry.

MAIN INTERFACE

Diagram 1 shows the plug-in interface and the interconnections between the plug-in compartments, circuit boards, etc. of this instrument. Also, the signal and voltage connections of each interface connector are identified. The signals connected to only the vertical plug-in interface connectors (J1 and J2) are labeled (V); those connected to only the horizontal connectors (J3 and J4) are labeled (H).

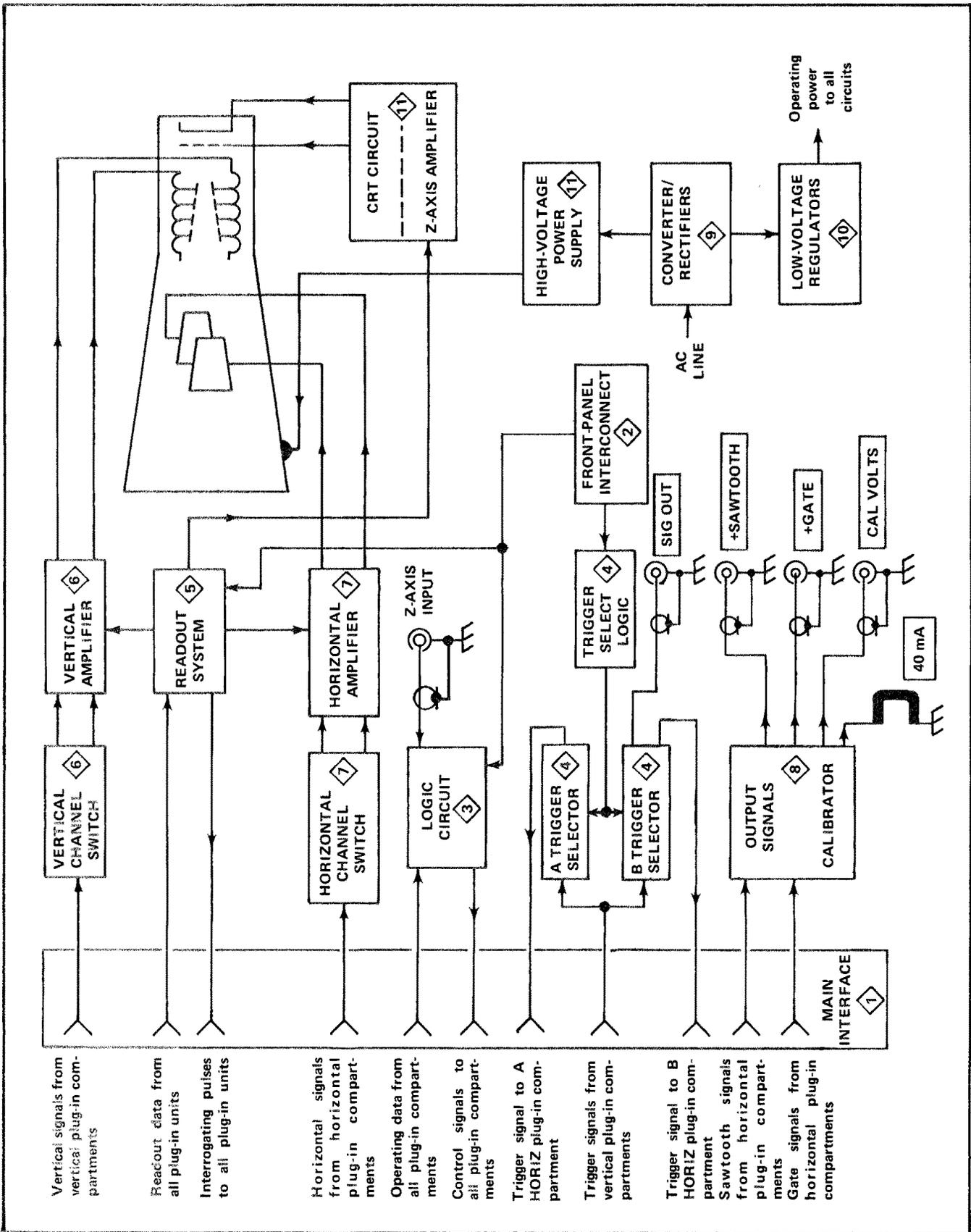


Fig. 3-1. Basic block diagram of the 7904 Oscilloscope.

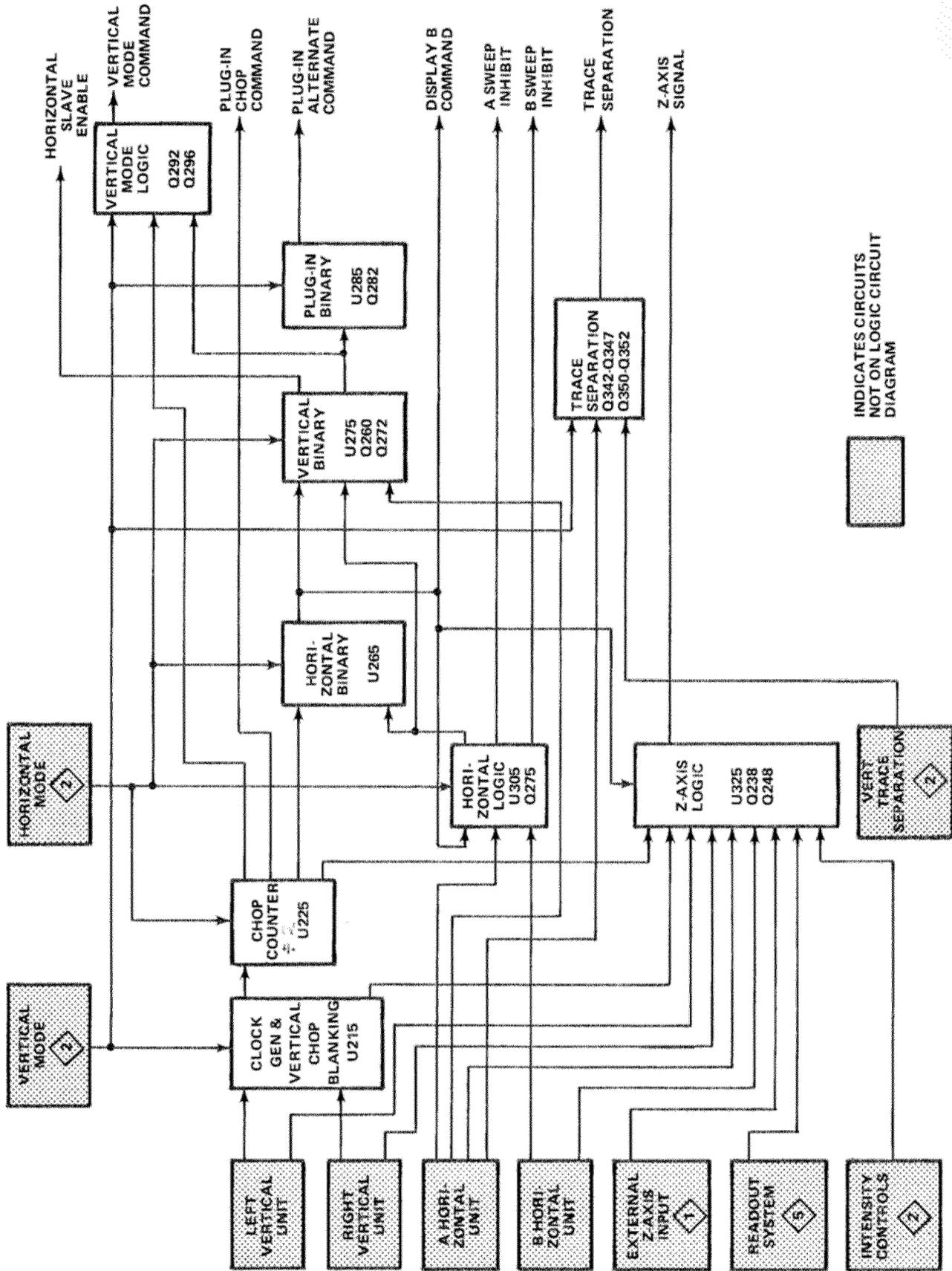


Fig. 3-2. Detailed block diagram of Logic circuit.

FRONT-PANEL INTERCONNECT 2

The Front-Panel Interconnect diagram shows the front-panel controls, switches, and interconnection circuitry.

LOGIC 3

Introduction

The Logic circuit develops control signals for use in other circuits within this instrument and any plug-in units installed. These control signals automatically determine the correct instrument operation in relation to the plug-in units installed or selected, plug-in control settings, and 7904 control settings. A block diagram of the Logic circuit is shown in Fig. 3-2.

This circuit description for the Logic circuit is written with the approach that each of the integrated circuits and its associated discrete components composes an individual stage as shown by the block diagram (Fig. 3-2).

The operation of each stage is discussed, relating the input signals or levels to the output, with consideration given to the various modes of operation that may affect the stage. A logic diagram is also provided for each stage. These diagrams are not discussed in detail, but are provided to aid in relating the function performed by a given stage to standard logic techniques. It should be noted that these logic diagrams are not an exact representation of the internal structure of the integrated circuit, but are only a logic diagram of the function performed by the stage. An input/output table is given, where applicable, for use along with the circuit description and logic diagram. These input/output tables document the combination of input conditions that are of importance to perform the described function of an individual stage.

Horizontal Logic

The Horizontal Logic stage performs three separate logic functions: A Sweep Inhibit, B Sweep Inhibit, and Alternate Pulse Generator. Figure 3-3 identifies the three individual stages and the input and output terminals associated with each. Note that some of the input levels are connected internally to more than one of the individual stages.

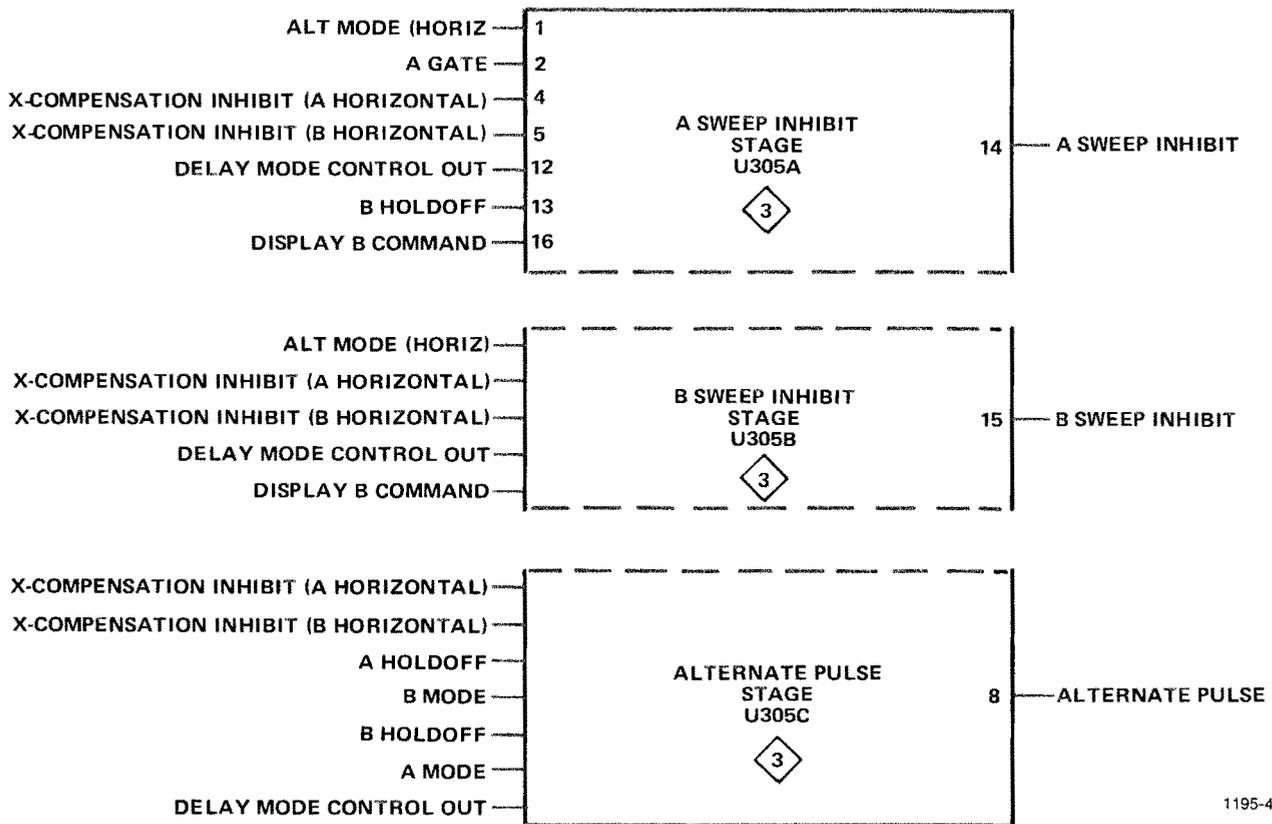


Fig. 3-3. Breakdown of separate stages within Horizontal Logic IC, U305, showing inputs and outputs for each stage.

Circuit Description—7904 (SN B260000-UP)

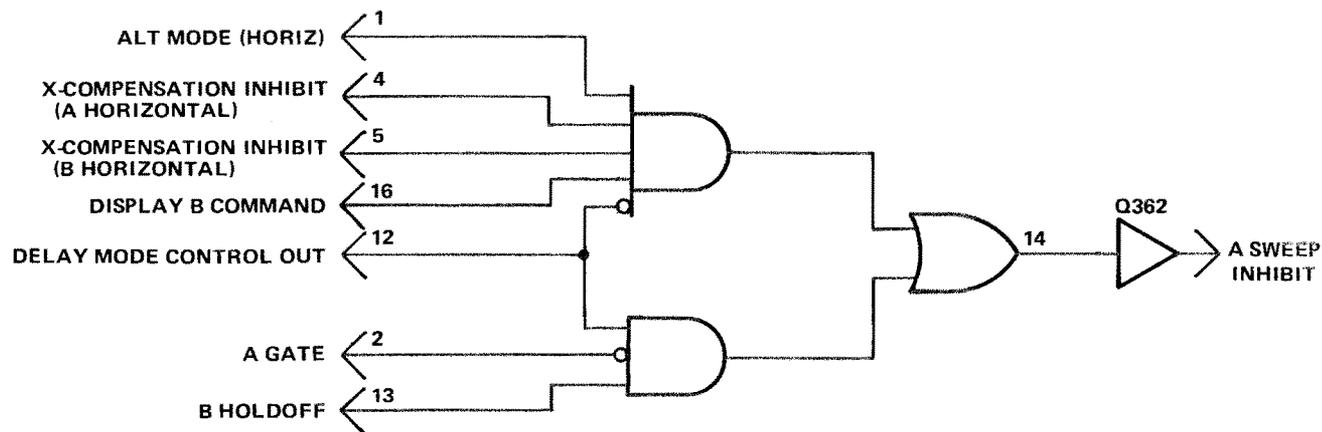
A Sweep Inhibit. The A Sweep Inhibit stage produces an output level at the collector of Q362 that determines if the A HORIZ time-base unit can produce a sweep. If this output is HI, the A HORIZ unit is locked out (disabled) so it cannot produce a sweep. If the level is LO, the A HORIZ unit is enabled and can produce a sweep when triggered.

As shown by the logic diagram and input/output table of Fig. 3-4, only two combinations of input conditions produce an A Sweep Inhibit level (HI); if any of the prescribed conditions is not met, the A Sweep Inhibit level is LO and the A HORIZ time-base unit is enabled.

The first combination disables the A sweep while the B sweep is being displayed in the ALT horizontal mode (both units must be in time-base mode), if non-delayed operation is being used. The second combination disables the A sweep during delayed-sweep operation so that the B sweep can complete its holdoff before the next A sweep begins.

B Sweep Inhibit. The B Sweep Inhibit stage produces an output level at the collector of Q367 that determines if the B HORIZ time-base unit can produce a sweep. A HI output level locks out (inhibits) the B HORIZ unit and a LO level enables the B HORIZ unit to produce a sweep.

As shown by Fig. 3-5B, the output of this stage is HI only under one set of input conditions. This set of conditions disables the B sweep while the A sweep is being displayed in the ALT horizontal mode, if both units are in a time-base mode and non-delayed sweep is used. For any other combination of input conditions, the B Sweep Inhibit level is LO. However, the output level to the B time-base unit is determined by both the Delay Gate from the A time-base unit and the B Sweep Inhibit level produced by this stage. The B Sweep is enabled only when both of these levels are LO.



(A) U305A 3

INPUT							OUTPUT
ALT MODE (HORIZ)	A GATE	X-COMPENSATION INHIBIT (A HORIZONTAL)	X-COMPENSATION INHIBIT (B HORIZONTAL)	DELAY MODE CONTROL OUT	B HOLDOFF	DISPLAY B COMMAND	A SWEEP INHIBIT
1	2	4	5	12	13	16	14
HI	Φ	HI	HI	LO	Φ	HI	HI
Φ	LO	Φ	Φ	HI	HI	Φ	HI
ALL OTHER COMBINATIONS							LO

Φ = HAS NO EFFECT IN THIS CASE

Fig. 3-4. (A) Logic diagram for A Sweep Inhibit stage; (B) Table of input/output combinations.

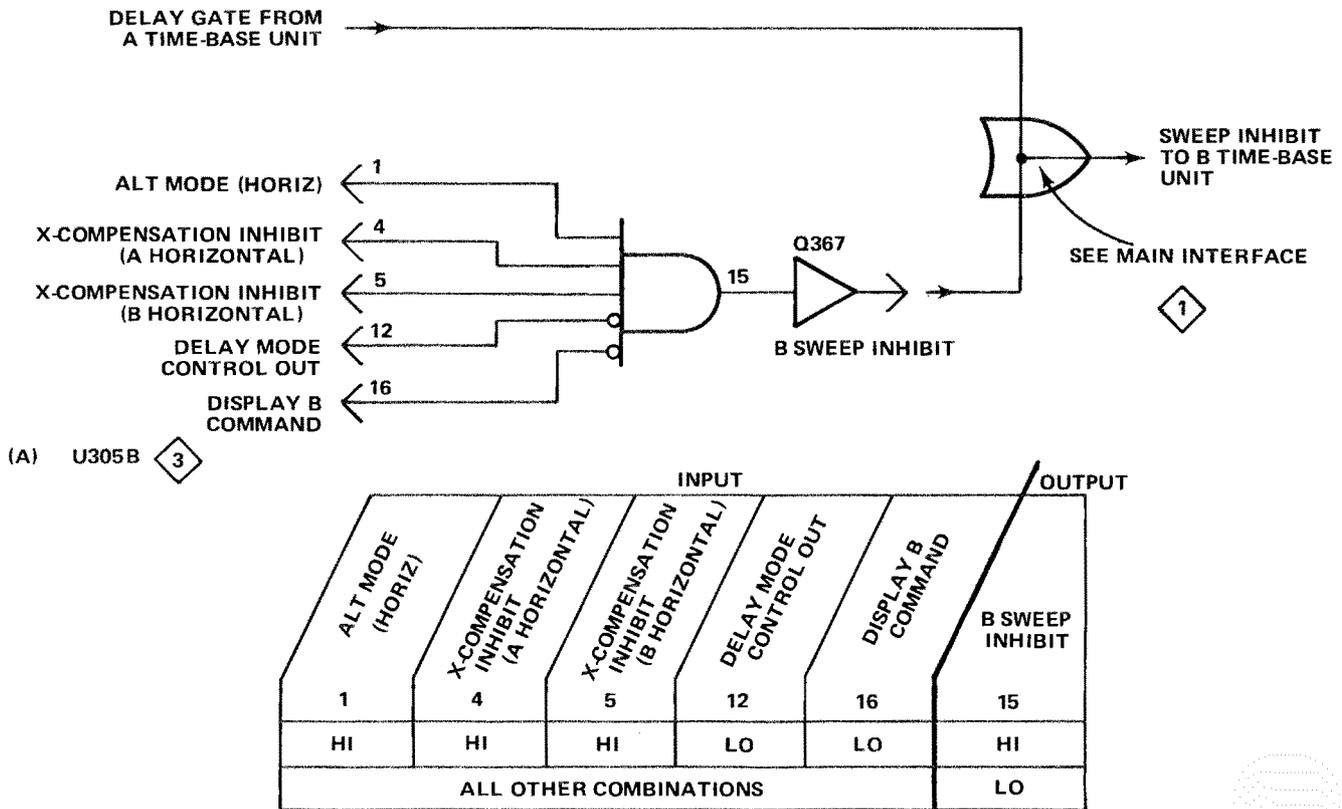


Fig. 3-5. (A) Logic diagram for B Sweep Inhibit stage; (B) Table of input/output combinations.

Figure 3-5A shows the logic diagram of the B Sweep Inhibit stage. The gate connected to the output of this stage is a phantom-OR gate shown on the Main Interface diagram. (A phantom-OR gate performs the OR-logic function merely by interconnection of the two signal lines.)

Alternate Pulse Generator. The third function performed by the Horizontal Logic stage is to produce an Alternate Pulse signal for use by the Horizontal and Vertical Binary stages. The Alternate Pulse is produced at the end of either sweep, depending upon the operating conditions as shown in Fig. 3-6B. The holdoff gate produced at the end of the sweep by the respective time-base unit is differentiated by either C311 or C309 to provide a positive-going pulse to pin 6 or 9.

In Fig. 3-6A, note the resistors shown connected to pins 6 and 9. These resistors, which are internal to the IC, hold the levels at pins 6 and 9 LO unless a HI level is applied to the corresponding input. Since the holdoff gate is capacitively-coupled to pins 6 and 9, these inputs are at the LO level except when a differentiated A or B Holdoff gate is received.

The following discussions describe the operation of the Alternate Pulse Generator stage in relation to the various combinations of input conditions shown in Fig. 3-6B.

1. A (ONLY) MODE

An Alternate Pulse is produced at the end of each A sweep when the HORIZONTAL MODE switch is set to the A position.

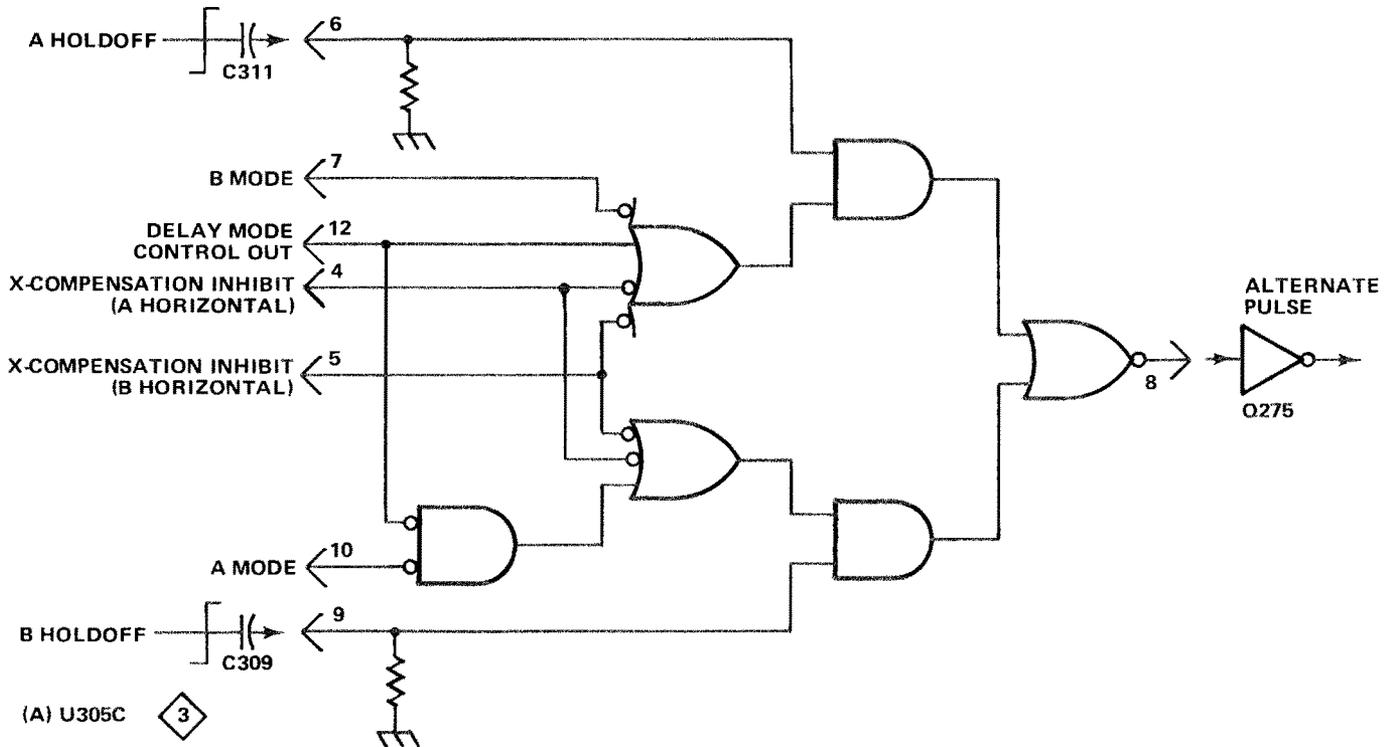
2. B (ONLY) MODE

In the B position of the HORIZONTAL MODE switch, an Alternate Pulse is produced at the end of each B sweep (A time-base must be in independent, non-delayed mode).

3. ALT OR CHOP MODE

When the HORIZONTAL MODE switch is set to ALT or CHOP (A time-base unit must be in independent, non-delayed mode), an Alternate Pulse is produced at the end of each sweep. For example, an Alternate Pulse is produced at the end of the A sweep, then at the end of the B sweep, again at the end of the A sweep, etc. Although Alternate Pulses are produced in the CHOP horizontal mode, they are not used in this instrument.

Circuit Description—7904 (SN B260000-UP)



INPUT							OUTPUT	
X-COMPENSATION INHIBIT (A HORIZONTAL)	X-COMPENSATION INHIBIT (B HORIZONTAL)	A HOLD OFF	B MODE	B HOLD OFF	A MODE	DELAY MODE CONTROL OUT	TIME-BASE WHICH IS SOURCE OF ALTERNATE PULSE	
4	5	6	7	9	10	12	8 ²	HORIZONTAL CONDITIONS
HI	Φ	HI ¹	LO	Φ	HI	Φ	A	A ONLY
Φ	HI	Φ	HI	HI ¹	LO	LO	B	B ONLY
HI	HI	HI ¹	LO	HI ¹	LO	LO	A AND B	ALT OR CHOP
HI	HI	HI ¹	Φ	Φ	Φ	HI	A	A DELAYS B
HI	LO	HI ¹	LO	LO	Φ	Φ	A	A WITH VERTICAL UNIT IN B COMPARTMENT.
LO	HI	LO	Φ	HI ¹	LO	LO	B	B WITH VERTICAL UNIT IN A COMPARTMENT.
ALL OTHER COMBINATIONS							NO OUTPUT PULSE (LO AT OUTPUT)	

Φ = HAS NO EFFECT IN THIS CASE

¹ POSITIVE-GOING PULSE. WHERE BOTH A AND B HOLD OFF ARE REQUIRED TO BE HI, A HI AT EITHER INPUT PRODUCES AN ALTERNATE PULSE.

² NEGATIVE-GOING PULSE.

(B)

Fig. 3-6. (A) Logic diagram for Alternate Pulse Generator stage; (B) Table of Input/output combinations.

4. DELAYED SWEEP (A DELAYS B)

When the A time-base unit is set for delayed operation, the operation of the Alternate Pulse Generator is changed so an Alternate Pulse is produced only at the end of the A sweep, even when the HORIZONTAL MODE switch is set to B. This is necessary since the A time-base establishes the amount of delay time for the B time-base unit whenever it is displayed.

5. AMPLIFIER UNIT IN HORIZONTAL COMPARTMENT

When an amplifier unit is installed in either of the horizontal plug-in compartments, the Alternate Pulse can be produced only from the remaining time-base unit. If amplifier units are installed in both horizontal compartments, an Alternate Pulse is not produced since there are no time-base units to produce a holdoff pulse.

Z-Axis Logic

The Z-Axis Logic stage produces an output current which sets the intensity of the display on the crt. The level of this output current is determined by the setting of the A or B INTENSITY controls, by a current added during B sweep time to provide an intensified zone on the A sweep for delayed-sweep operation, or by an external signal. The input current from the A and B INTENSITY controls is switched so the output current matches the horizontal display. The Vertical Chopped Blanking, Horizontal Chopped Blanking, and readout blanking signals are applied to this stage to block the output current and blank the crt display for vertical chopping, horizontal chopping, or during a readout display.

Figure 3-7 identifies the inputs to the Z-Axis Logic stage. This circuit is current-driven at all inputs except pins 5 and 15. The current at pins 1, 2, 9, and 16 is variable from zero to four milliamperes and is determined by the applicable current source to control the output current at pin 8.

The Vertical Chopping Blanking Inhibit connected to pin 6, and the Horizontal Chopped Blanking Inhibit connected to both pins 6 and 7 through Q238-CR240-CR241, enables or disables this stage to control all output current. Quiescently, the level at pins 6 and 7 is HI so that the intensity current from pins 1, 2, 9, and 16 can pass to the output. However, pin 6 goes LO during Vertical Chopped Blanking and both pins 6 and 7 go LO for Horizontal Chopped Blanking or during a readout display. This blocks the output current and the crt is blanked. The Vertical Chopped Blanking Inhibit signal is connected to pin 6 of U235 directly from pin 4 of U215. The Horizontal

Chopped Blanking Inhibit signal is connected to U325 from pin 4 of U225 through LR232, Q238, and CR240-CR241. Notice that this signal is connected to the collector of Q238. This transistor is normally operating in the saturated condition, and the HI Horizontal Chopped Blanking Inhibit level from U225 is the collector source voltage. When the Horizontal Chopped Blanking Inhibit level goes LO, the current through Q238 drops to produce a corresponding LO level at its emitter. This level is connected to pins 6 and 7 of U325 through CR240 and CR241 respectively.

Q238 also controls the level at pins 6 and 7 for readout displays. The Z-Axis Logic OFF Command from the Readout System is connected to the base of Q238 through VR235 and R237. This level is normally HI, so Q238 operates as controlled by the Horizontal Chopped Blanking Inhibit level at its collector. When a readout display is to be presented, the Z-Axis Logic OFF Command drops LO and this level is coupled to the base of Q238 through VR235 with very little voltage attenuation. Q238 is reverse biased to produce a LO level at its emitter. This level is coupled to pins 6 and 7 of U325 through CR240 and CR241 to block the Z-Axis Logic output current during the readout display. (The intensity of the readout display is determined by a separate READOUT intensity level connected directly to the Z-Axis Amplifier; see crt circuit description.) Diode CR239 clamps the emitter of Q238 at about -0.66 volt when this transistor is off.

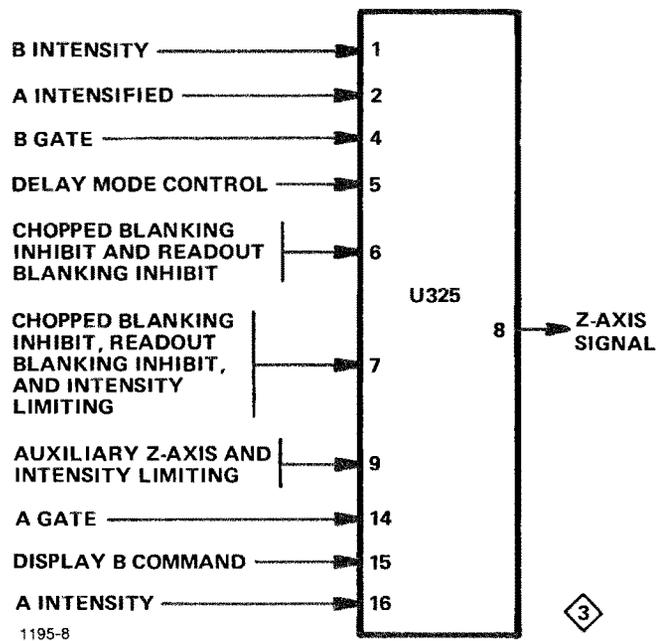


Fig. 3-7. Input and output pins for Z-Axis Logic IC, U325.

Circuit Description—7904 (SN B260000-UP)

The Beam I (current) Sense input from the crt circuit limits the output current of this stage to limit the maximum trace intensity. Further intensity limiting is provided for high crt beam currents at slow sweep rates and X-Y operation by the Intensity Limit and X-Compensation Inhibit inputs respectively. For low and medium levels of crt beam current, Q248 is reverse biased; resistors R241-R242-R243-R245-R246-R248 establish the current at pines 7 and 9 of U325. When the crt beam current exceeds a safe level, the Beam I Sense level goes positive to forward bias Q248. When forward-biased, Q248 takes current from pins 7 and 9 of U325 to limit the output current from this stage.

The Intensity Limit and X-Compensation Inhibit inputs are connected to ground in the plug-in units for slow sweep rates and amplifier operation, respectively. This connects the emitter of Q248 to ground through CR248, CR250, or CR251 to further limit the output current of U325. The Intensity Limit and X-Compensation Inhibit inputs have no effect at low or medium crt beam current levels since Q248 is reverse biased by the Beam I Sense input.

The A INTENSITY control sets the output current level when the A Gate at pin 14 is HI and the Display B Command at pin 15 is LO. Whenever the A Gate level goes LO indicating that the A sweep is complete or the Display B Command goes HI indicating that the B sweep is being displayed, the A INTENSITY current is blocked. The current from the A INTENSITY control is connected to pin 16 through R335.

In the delayed mode, current is added to the A INTENSITY current during the A-sweep time to intensify a portion of the trace. This intensified portion is coincident with the B-sweep time to provide an indication of which portion of the A sweep is displayed in the delayed mode. The A Intensified current is supplied to pin 2 of U325 from the A INTENSITY control through R331. With this configuration, the intensified current increases as the A INTENSITY control setting is advanced to provide a proportional intensity increase in the intensified zone as the overall A-sweep intensity increases. Therefore, the intensified zone is more readily visible at high intensity levels. The intensified current is added to the A INTENSITY current to produce an intensified zone on the A sweep under the following conditions: HI A Gate level at pin 14, LO Display B Command at pin 15, HI B Gate level at pin 4, and HI Delay Mode Control Out level at pin 5.

The B INTENSITY control determines the output current when the B Gate level at pin 4 and the Display B Command at pin 15 are both HI. The current from the B INTENSITY control is connected to the Z-Axis Logic stage through R337.

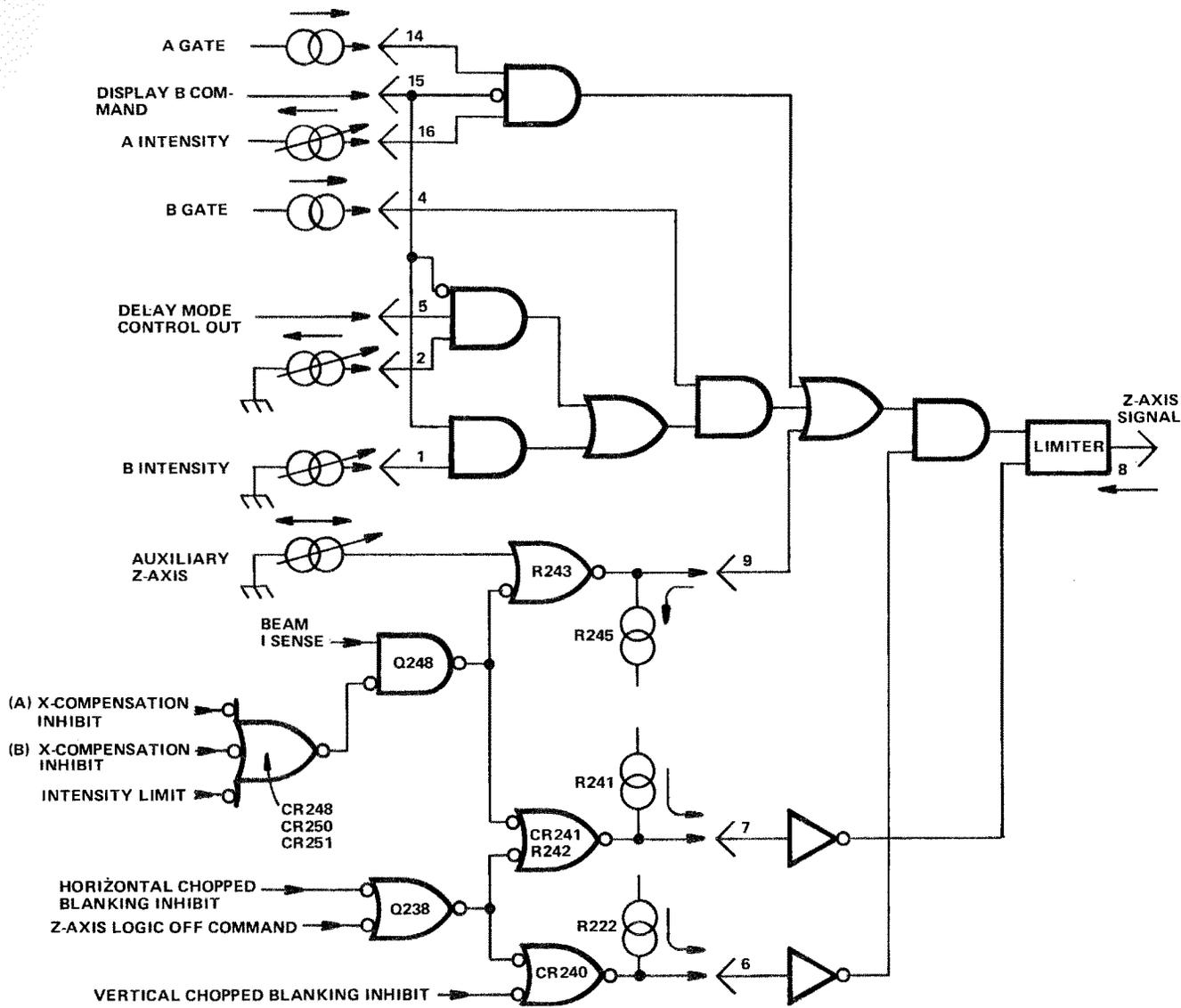
The current level established by the intensity controls can be altered by the Auxiliary Z-Axis current level at pin 9. The current at this pin can come from the Z AXIS INPUT connector on the rear panel (see diagram 1) or from any of the plug-in compartments. This current either increases or decreases (depending on polarity) the output current to modulate the intensity of the display. Input from the Z AXIS INPUT connector allows the trace to be modulated by external signals. The Auxiliary Z-Axis inputs from the plug-in compartments allow special-purpose plug-in units to modulate the display intensity. Diodes CR253 and CR254 limit the maximum voltage change at pin 9 to about + and -0.6 volt to protect the Z-Axis Logic stage if an excessive voltage is applied to the Z AXIS INPUT connector.

Figure 3-8A shows a logic diagram of the Z-Axis Logic stage. Notice the current-driven inputs as indicated by the current-generator symbols at the associated inputs. An input/output table for the Z-Axis Logic stage is given in Fig. 3-8B.

Horizontal Binary

The Horizontal Binary stage produces the Display B Command to determine which horizontal unit provides the sweep display on the crt. When this level is HI, the B HORIZ unit is displayed; when it is LO, the A HORIZ unit is displayed.

The Display B Command is used in the following stages within the Logic circuit: Horizontal Logic (A and B Sweep Inhibit), Z-Axis Logic, Vertical Binary, and Trace Separation. In addition, it is connected to the following circuits elsewhere in the instrument to indicate which horizontal unit is to be displayed: Main Interface (A and B HORIZ plug-in compartments), Horizontal Amplifier (for horizontal channel selection), and the crt circuit.



(A) 3

INPUT											OUTPUT
B INTENSITY	A INTENSIFIED	B GATE	DELAY MODE CONTROL OUT	CHOPPED BLANKING INHIBIT OR READOUT BLANKING INHIBIT	READOUT BLANKING INHIBIT OR INTENSITY LIMITING	AUXILIARY Z-AXIS AND INTENSITY LIMITING	A GATE	DISPLAY B COMMAND	A INTENSITY	Z-AXIS SIGNAL	CURRENT SOURCE CONTROLLING Z-AXIS SIGNAL
1 ¹	2 ¹	4	5	6	7	9 ¹	14	15	16 ¹	8 ¹	
Φ	Φ	Φ	LO	HI	HI	Φ ²	HI	LO	HI	HI	A INTENSITY
HI	Φ	HI	Φ	HI	HI	Φ ²	Φ	HI	Φ	HI	B INTENSITY
Φ	HI	HI	HI	HI	HI	Φ ²	HI	LO	HI	HI	A INTENSITY AND B INTENSIFIED
Φ	Φ	Φ	Φ	HI	HI	HI	Φ	Φ	Φ	LO	EXTERNAL SIGNAL
ALL OTHER COMBINATIONS											NO OUTPUT SIGNAL

LO = MINIMUM VOLTAGE OR CURRENT.
 HI = MAXIMUM VOLTAGE OR CURRENT.
 Φ = HAS NO EFFECT IN THIS CASE.

¹ CURRENT LEVEL, LO = 0 mA
 HI = VARIABLE FROM 0 TO 4 mA

² CURRENT CAN BE ADDED OR SUBTRACTED FOR INTENSITY MODULATING.

Fig. 3-8. (A) Logic diagram for Z-Axis Logic stage; (B) Table of input/output combinations.

Circuit Description—7904 (SN B260000-UP)

Figure 3-9 identifies the function of the input pins for this stage. Notice that the levels at pins 3, 4, 7, and 10 are determined by the HORIZONTAL MODE switch (see diagram 2). This switch indicates which horizontal mode has been selected by providing a HI output level on only one of four output lines; the remaining lines are LO. Therefore, at any one time, either pin 3, pins 4 and 7 (notice that pins 4 and 7 are tied together at U265), or pin 10 can be HI and the two unselected lines from the HORIZONTAL MODE switch remain LO.

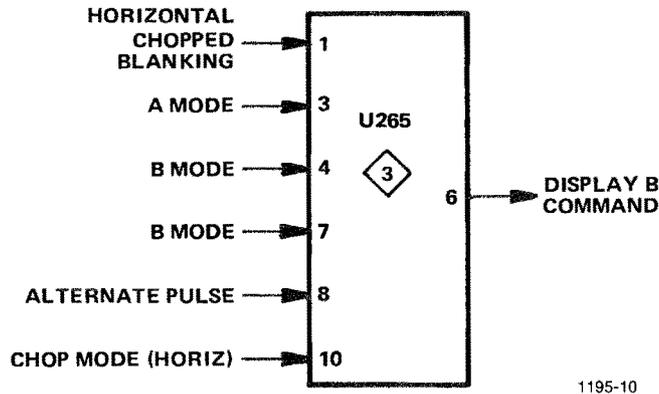


Fig. 3-9. Input and output pins for Horizontal Binary IC, U265.

The Horizontal Binary stage operates as follows for each position of the HORIZONTAL MODE switch (refer to Fig. 3-10B for input/output conditions):

1. A MODE

When the HORIZONTAL MODE switch is set to A, the Display B Command is LO to indicate to all circuits that the A HORIZ unit is to be displayed.

2. B MODE

Selecting the B horizontal mode provides a HI Display B Command to all circuits.

3. CHOP MODE

In the CHOP position of the HORIZONTAL MODE switch, the Display B Command switches between the HI and LO levels to produce a display that switches between the A and B HORIZ units at a 0.2-megahertz rate. The repetition rate of the Display B Command in this mode is determined by the Horizontal Chopped Blanking pulse. (See Chop Counter stage for further information on this pulse.) Each time the Horizontal Chopped Blanking pulse at pin 1 drops LO, the output at pin 6 switches to the opposite state.

4. ALT MODE

For ALT horizontal operation, the Display B Command switches to the opposite state each time the negative portion of the Alternate Pulse is received from the Horizontal Logic stage. Repetition rate of the Display B Command in this mode is one-half the repetition rate of the Alternate Pulse.

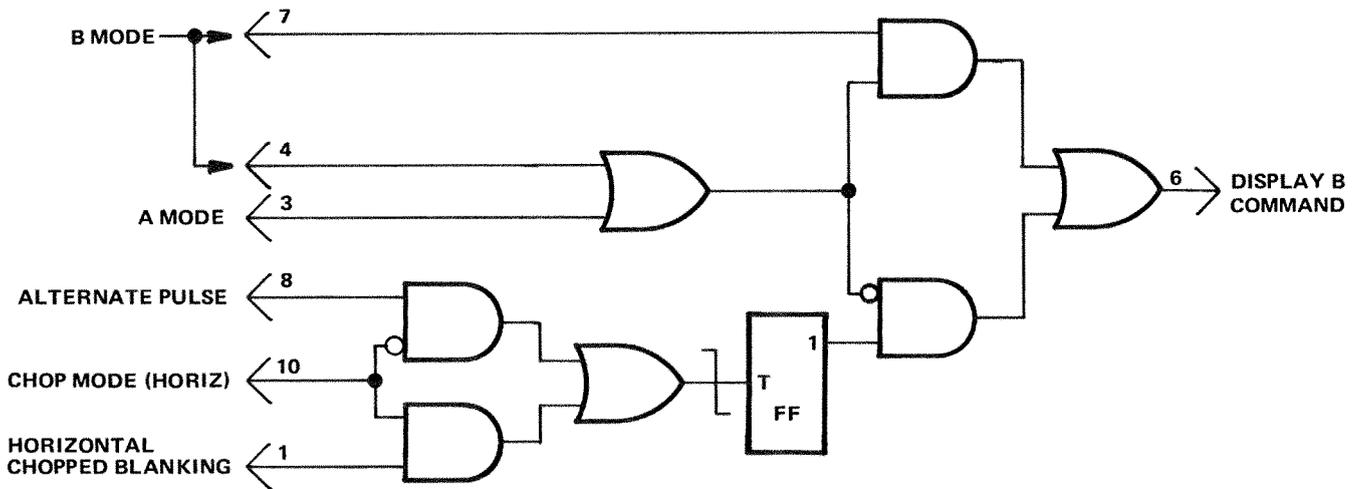
Figure 3-10A shows a logic diagram for the Horizontal Binary stage. An input/output table showing the conditions for each position of the HORIZONTAL MODE switch is shown in Fig. 3-10B.

Vertical Binary

The Vertical Binary stage produces the Display Right Command to determine which vertical unit is to be displayed on the crt. When this output level is HI, the RIGHT VERT unit is displayed; when it is LO, the LEFT VERT unit is displayed. In the ALT or CHOP positions of the HORIZONTAL MODE switch (non-delayed operation only), the output of this stage is slaved to the output of the Horizontal Binary stage so that the Display Right Command is always HI when the Display B Command is LO, and vice versa. This action allows independent-pairs operation (sweep-slaving) in the ALT position of the VERTICAL MODE switch and the ALT or CHOP positions of the HORIZONTAL MODE switch, whereby the LEFT VERT unit is always displayed at the sweep rate of the B time-base and the RIGHT VERT unit is displayed at the sweep rate of the A time-base. Thus, independent-pairs operation can simulate dual-beam operation for repetitive sweeps.

When the A time-base unit is set to the delaying mode, the repetition rate of the Display Right Command is one-half the repetition rate of the Display B Command input. This results in each vertical unit being displayed first against the A time-base unit (delaying), then the B time-base unit (delayed), before the display is switched to the other vertical unit.

The Display Right Command is used in the following stages within the Logic circuit: Plug-In Binary, Vertical Chopped Blanking, and Vertical Mode Logic. It is also connected to the following circuits elsewhere in the instrument to indicate which vertical unit is to be displayed (through Vertical Mode Logic stage; ALT vertical mode only): Main Interface (LEFT and RIGHT VERT plug-in compartments), Vertical Amplifier, and Trigger Selector.



(A) U265



INPUT						OUTPUT	
HORIZONTAL CHOPPED BLANKING	A MODE	B MODE	B MODE	ALTERNATE PULSE	CHOP MODE (HORIZ)	DISPLAY B COMMAND	
1	3	4	7	8	10	6	
Φ	HI	LO	LO	Φ	LO	LO	HORIZONTAL DISPLAY
Φ	LO	HI	HI	Φ	LO	HI	A HORIZONTAL UNIT
LO^1	LO	LO	LO	Φ	HI	$n+1^2$	B HORIZONTAL UNIT
Φ	LO	LO	LO	LO^1	LO	$n+1^3$	CHOP BETWEEN A AND B
							ALTERNATE BETWEEN A AND B

Φ = HAS NO EFFECT IN THIS CASE

$n+1$ = IF OUTPUT IS LO PRIOR TO LO^1 , IT GOES HI, AND VICE VERSA

¹ ACTUATED BY NEGATIVE-GOING EDGE.

² REPETITION RATE ONE-HALF HORIZONTAL CHOPPED BLANKING RATE.

³ REPETITION RATE ONE-HALF ALTERNATE PULSE RATE.

(B)

Fig. 3-10. (A) Logic diagram for Horizontal Binary stage; (B) Table of input/output combinations.

Circuit Description—7904 (SN B26000-UP)

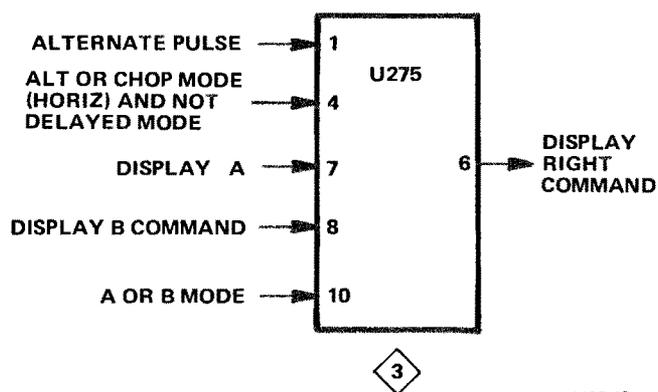
Also, the Vertical Binary stage produces the Horizontal Slave Enable output to indicate that the HORIZONTAL MODE switch is set to ALT or CHOP and that the A time-base unit is set for non-delayed operation. These are the horizontal-mode conditions necessary for independent-pairs operation. When this output level is HI, the horizontal-mode conditions are correct for independent-pairs operation. A LO output level indicates improper horizontal modes for independent-pairs operation. The Horizontal Slave Enable output is used within the Vertical Binary stage, and is also connected to the Trigger Selector circuit. This enables the trigger-selection circuitry to automatically select the correct internal trigger signal source for both time-base units when operating in the independent-pairs mode (VERT MODE trigger source; see Trigger Selector circuit).

Figure 3-11 identifies the function of the input pins for the Vertical Binary IC (U275). This stage uses the same type of IC as the Horizontal Binary stage. Notice the Display A level at pin 7. This input is the inverse of the Display B level at pin 8. Therefore, the Display A level is always HI when the Display B level is LO, and vice versa.

The following discussions describe the operations of the Vertical Binary stage in relation to the modes of operation that can occur.

NOTE

Although the output at pin 6 of U275 is always controlled by the HORIZONTAL MODE switch as described here, this level determines the Vertical Mode Control level at the collector of Q296 only in the ALT position of the VERTICAL MODE switch due to AND gate CR201-CR204. See the discussion on the Vertical Mode Logic stage in this section for further information.



1195-12

Fig. 3-11. Input and output pins for Vertical Binary IC, U275.

1. A OR B MODE

When the HORIZONTAL MODE switch is set to either A or B, the Display Right Command switches to the opposite state each time an Alternate Pulse is received from the Horizontal Logic stage. Repetition rate of the Display Right Command in this mode is one-half the repetition rate of the Alternate Pulse. The input conditions for these modes are:

Pin 1 LO—Alternate Pulse generated by Horizontal Logic stage goes negative.

Pin 4 LO—HORIZONTAL MODE switch in any position except ALT or CHOP, or the A time-base unit is set for delayed sweep.

Pin 10 HI—HORIZONTAL MODE switch set to A or B.

2. ALT OR CHOP MODE (HORIZ)—NON-DELAYED

In the ALT or CHOP positions of the HORIZONTAL MODE switch, the output level at pin 6 is the same as the Display A level at pin 7. The Display A level is produced by inverting the Display B Command from the Horizontal Binary stage. Therefore, the repetition rate of the output signal is the same as the Display B Command. The result, with the VERTICAL MODE switch set to ALT and the A time-base unit set for non-delayed operation, is that the RIGHT VERT unit is always displayed at the sweep rate of the A time-base unit, and the LEFT VERT unit at the sweep rate of the B time-base unit (independent-pairs operation or sweep slaving). The input conditions to provide a HI output level so that the RIGHT VERT unit can be displayed at the A-sweep rate are:

Pin 4 HI—HORIZONTAL MODE switch set to ALT or CHOP with non-delayed sweep.

Pin 7 HI—A sweep is to be displayed (Display B Command LO).

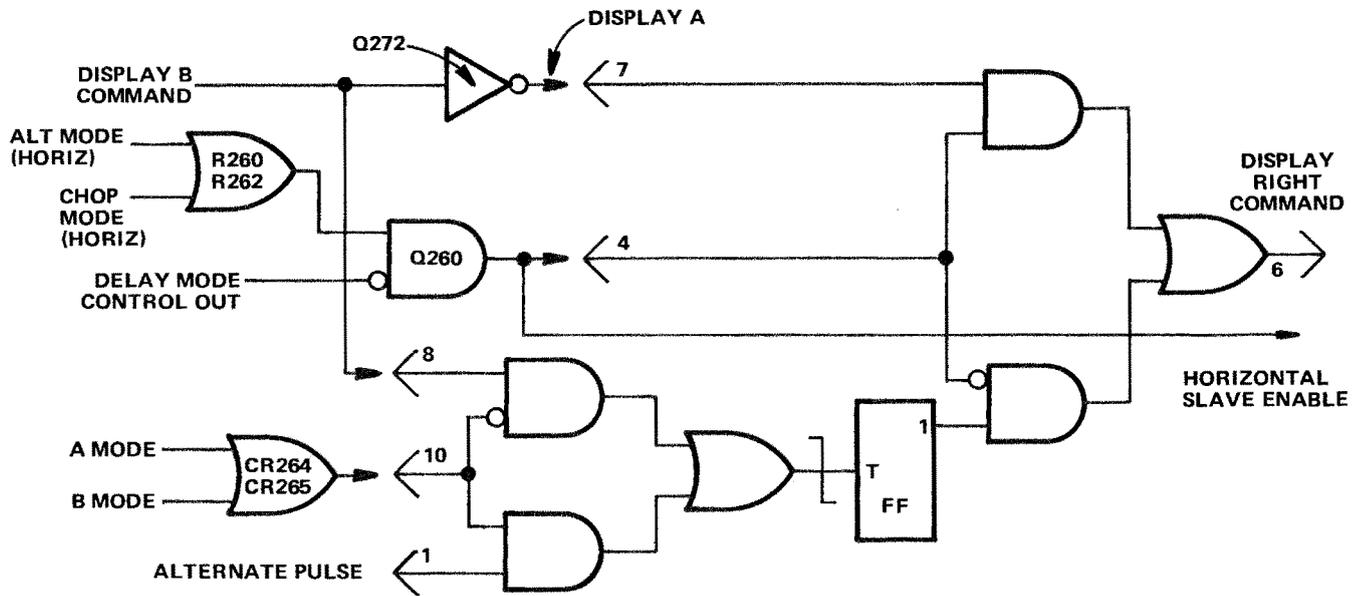
Pin 10 LO—HORIZONTAL MODE switch set to any position except A or B.

The input conditions to provide a LO output level so the LEFT VERT unit can be displayed at the B-Sweep rate are:

Pin 4 HI—HORIZONTAL MODE switch set to ALT or CHOP with non-delayed sweep.

Pin 7 LO—B sweep is to be displayed (Display B Command HI).

Pin 10 LO—HORIZONTAL MODE switch set to any position except A or B.



(A) U275 3

INPUT					OUTPUT	
1	4	7	8	10	6	
ALTERNATE PULSE	ALT OR CHOP MODE (HORIZ) AND NOT DELAYED MODE	DISPLAY A	DISPLAY B COMMAND	A OR B MODE	DISPLAY RIGHT COMMAND	HORIZONTAL MODE
LO ¹	LO	Φ	Φ	HI	n+1 ²	A OR B
Φ	HI	HI	LO	LO	HI	} ALT OR CHOP, NON-DELATED MODE (SWEEP-SLAVING)
Φ	HI	LO	HI	LO	LO	
Φ	LO	Φ	LO ¹	LO	n+1 ³	ALT OR CHOP, DELAYED MODE

Φ = HAS NO EFFECT IN THIS CASE.

n+1 = IF OUTPUT IS LO PRIOR TO LO¹ IT GOES HI, AND VICE VERSA.

¹ ACTUATED BY NEGATIVE-GOING EDGE.

² REPETITION RATE ONE-HALF ALTERNATE PULSE RATE.

³ REPETITION RATE ONE-HALF DISPLAY B RATE.

(B)

Fig. 3-12. (A) Logic diagram for Vertical Binary stage; (B) Table of input/output combinations.

Circuit Description—7904 (SN B260000-UP)

The Display Right Command switches from HI to LO along with the Display A level at pin 7 (inverse of Display B Command). However, notice that the Display Right Command changes from HI to LO as the Display B Command changes from LO to HI, and vice versa.

3. ALT OR CHOP MODE (HORIZ)—DELAYED

If the A time-base unit is set to the delayed mode when the HORIZONTAL MODE switch is set to either ALT or CHOP, the operation of the stage is changed from that discussed above. Now, the Display Right Command switches between the HI and LO states at a rate that is one-half the repetition rate of the Display B Command. The resultant crt display in the ALT position of the VERTICAL MODE switch allows the RIGHT VERT unit to be displayed first against the A sweep (delaying) and then against the B sweep (delayed). Then the display switches to the LEFT VERT unit and is displayed consecutively against the A and B sweeps in the same manner. The input conditions for this mode of operation are:

Pin 4 LO—A time-base unit set for delayed operation.

Pin 8 LO—Display B Command generated by Horizontal Binary stage goes negative.

Pin 10 LO—HORIZONTAL MODE switch set to any position except A or B.

A logic diagram of the Vertical Binary stage is shown in Fig. 3-12A. Several logic functions in this stage are performed by logic devices made up of discrete components. The components that make up these logic devices are identified on the logic diagram. An input/output table for the Vertical Binary stage is given in Fig. 3-12B.

Plug-In Binary

The Plug-In Binary stage produces the Plug-In Alternate Command to dual-trace units. Figure 3-13 identifies the function of the input pins for the Plug-In Binary IC, U285. This stage uses the same type of integrated circuit as the Horizontal Binary and Vertical Binary stages.

When the Plug-In Alternate Command level is HI and the plug-in unit is set for alternate operation, Channel 2 of the dual-trace unit is displayed. When it is LO, Channel 1 is displayed. The repetition rate of the Plug-In Alternate Command is determined by the setting of the VERTICAL MODE switch. For all positions of the VERTICAL MODE switch except ALT, the Plug-In Alternate Command level

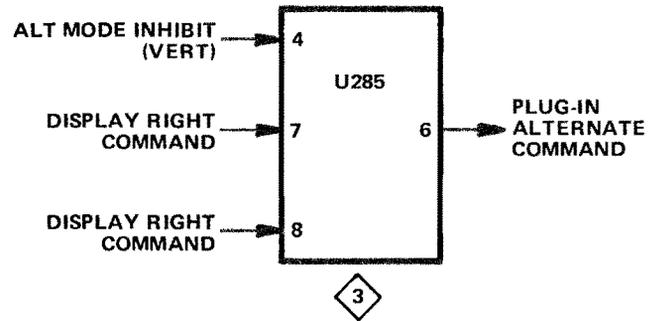


Fig. 3-13. Input and output pins for Plug-In Binary IC, U285.

is the same as the Display Right Command from the Vertical Binary stage. Since the Display Right Command is derived directly from the Display B Command, this allows the two channels of a dual-trace vertical unit to be slaved to the time-base units (non-delayed, dual-sweep horizontal modes only) in the same manner as previously described for independent-pairs operation between the vertical and time-base units. The resultant crt presentation, when the dual-trace unit is set for alternate operation, displays the Channel 1 trace at the sweep rate of the B time-base unit and the Channel 2 trace at the sweep rate of the A time-base unit. Input conditions for a LO output level so that Channel 1 of the vertical plug-in can be displayed at the B-sweep rate are:

Pin 4 HI—VERTICAL MODE switch set to any position except ALT.

Pin 7 LO—B sweep to be displayed (Display Right Command and Display B Command HI).

The input conditions to provide a HI output level so that Channel 2 of the plug-in unit can be displayed at the A-sweep rate are:

Pin 4 HI—VERTICAL MODE switch set to any position except ALT.

Pin 7 HI—A sweep to be displayed (Display Right Command and Display B Command LO).

The Plug-In Alternate Command switches from HI to LO as the Display B Command from the Horizontal Binary stage switches from LO to HI, and vice versa.

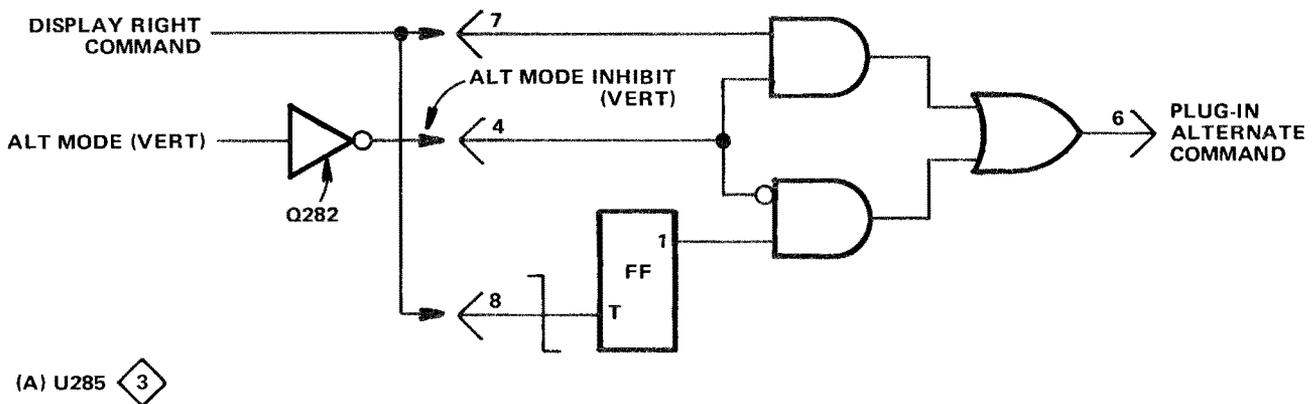
When the VERTICAL MODE switch is set to ALT, the Display Right Command from the Vertical Binary stage switches the vertical display between the two vertical units. However, if either of the vertical plug-in units are dual-trace units, they can be operated in the alternate mode also. To provide a switching command to these units, the Plug-In Binary stage produces an output signal with a repetition rate that is one-half the repetition rate of the Display Right Command. The sequence of operation, when two dual-trace vertical units are installed in the vertical plug-in compartments and they are both set for alternate operation, is as follows (VERTICAL MODE and HORIZONTAL MODE switches set to ALT): 1. Channel 1 of LEFT VERT unit at sweep rate of B time-base unit, 2. Channel 1 of RIGHT VERT unit at sweep rate of A time-base unit, 3. Channel 2 of LEFT VERT unit at sweep rate of B time-base unit, 4. Channel 2 of RIGHT VERT unit at

sweep rate of A time-base unit. Notice that under these conditions, both channels of the LEFT VERT unit are displayed at the B-sweep rate and that both channels of the RIGHT VERT unit are displayed at the A-sweep rate. The repetition rate at the output of this stage is one-half the Display Right Command rate. Input conditions when the VERTICAL MODE switch is set to ALT are:

Pin 4 LO—VERTICAL MODE switch set to ALT.

Pin 8 LO—Display Right Command generated by Vertical Binary stage goes negative.

Figure 3-14A shows a logic diagram of the Plug-In Binary stage. An input/output table for this stage is given in Fig. 3-14B.



(A) U285 3

INPUT				OUTPUT	COMMENTS
ALT MODE INHIBIT (VERT)	DISPLAY RIGHT COMMAND	DISPLAY RIGHT COMMAND	PLUG-IN ALTERNATE COMMAND		
4	7	8	6		
LO	Φ	LO ¹	n+1 ²		ALT VERTICAL MODE
HI	LO	Φ	LO		ALL VERTICAL MODES EXCEPT ALT PROVIDE SWEEP-SLAVING FOR NON-DELAYED DUAL-SWEEP OPERATION.
HI	HI	Φ	HI		

Φ = HAS NO EFFECT IN THIS CASE.

n+1 = IF OUTPUT IS LO PRIOR TO LO¹ IT GOES HI, AND VICE VERSA.

¹ ACTUATED BY NEGATIVE-GOING EDGE.

² REPETITION RATE ONE-HALF DISPLAY RIGHT COMMAND RATE.

(B)

Fig. 3-14. (A) Logic diagram for Plug-In Binary stage; (B) Table of input/output combinations.

Circuit Description—7904 (SN B260000-UP)

Clock Generator

Part of integrated circuit U215, along with the external components shown in Fig. 3-15A, make up the Clock Generator stage. R1, Q1, Q2, and Q3 represent an equivalent circuit within U215A. This circuit, along with discrete components C213-R212-R213-R214, compose a two-megahertz free-running oscillator to provide a timing (Clock) signal used to synchronize the vertical, horizontal, and plug-in chopping modes.

This stage operates as follows: Assume that Q2 is conducting and Q1 is off. The collector current of Q2 produces a voltage drop across R1 to cut off Q1. This negative level at the collector of Q2 is also connected to pin 14 through Q3 (see waveforms in Fig. 3-15B at time T_0). Since there is no current through Q1, C213 begins to charge towards -15 volts through R212-R213. The emitter of Q1 goes negative as C213 charges, until it reaches a level about 0.6 volt more negative than the level at its base. Then, Q1 is forward biased and its emitter rapidly rises positive (see time T_1 on waveforms). Since C213 cannot change its charge instantaneously, the sudden change in voltage at the emitter of Q1 pulls the emitter of Q2 positive also, to reverse-bias it. With Q2 reverse biased, its collector rises positive to produce a positive output level at pin 14.

Now, conditions are reversed. Since Q2 is reverse biased, there is no current through it. Therefore, C213 can

begin to discharge through R214. The emitter level of Q2 follows the discharge of C213 until it reaches a level about 0.6 volt more negative than its base. Then, Q2 is forward biased and its collector drops negative to reverse-bias Q1. The level at pin 14 drops negative also, to complete the cycle. Once again, C213 begins to charge through R212-R213 to start the second cycle.

Two outputs are provided from this oscillator. The Delay Ramp signal from the junction of R212-R213 is connected to the Vertical Chopped Blanking stage. This signal has the same waveshape as shown by the waveform at pin 13; its slope is determined by the divider ratio between R212-R213. A square-wave output is provided at pin 14. The frequency of this square wave is determined by the overall RC relationship between C213-R212-R213-R214, and its duty cycle is determined by the ratio of R212-R213 to R214.

The square wave at pin 14 is connected to pin 16 through C218. C218, along with the internal resistance of U215A, differentiates the square wave at pin 14 to produce a negative-going pulse coincident with the falling edge of the square wave (positive-going pulse coincident with rising edge has no effect on circuit operation). This negative-going pulse is connected to pin 15 through an inverter-shaper that is also part of U215A. The output at pin 15 is a positive-going Clock pulse with a repetition rate of about two megahertz.

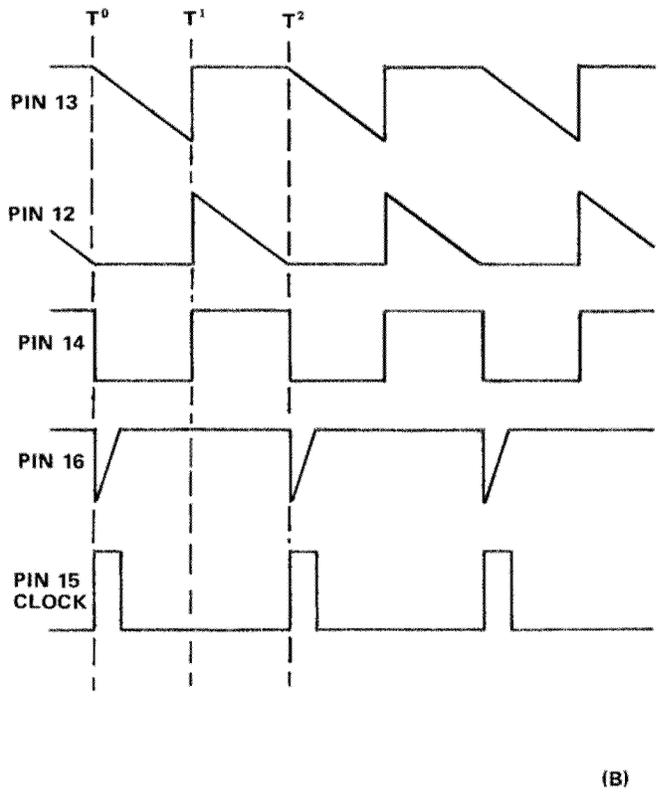
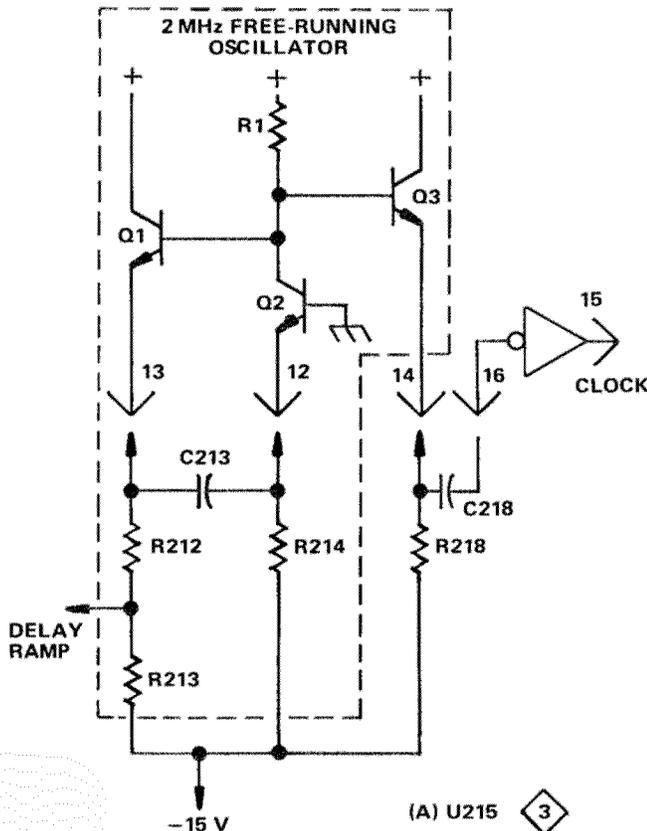
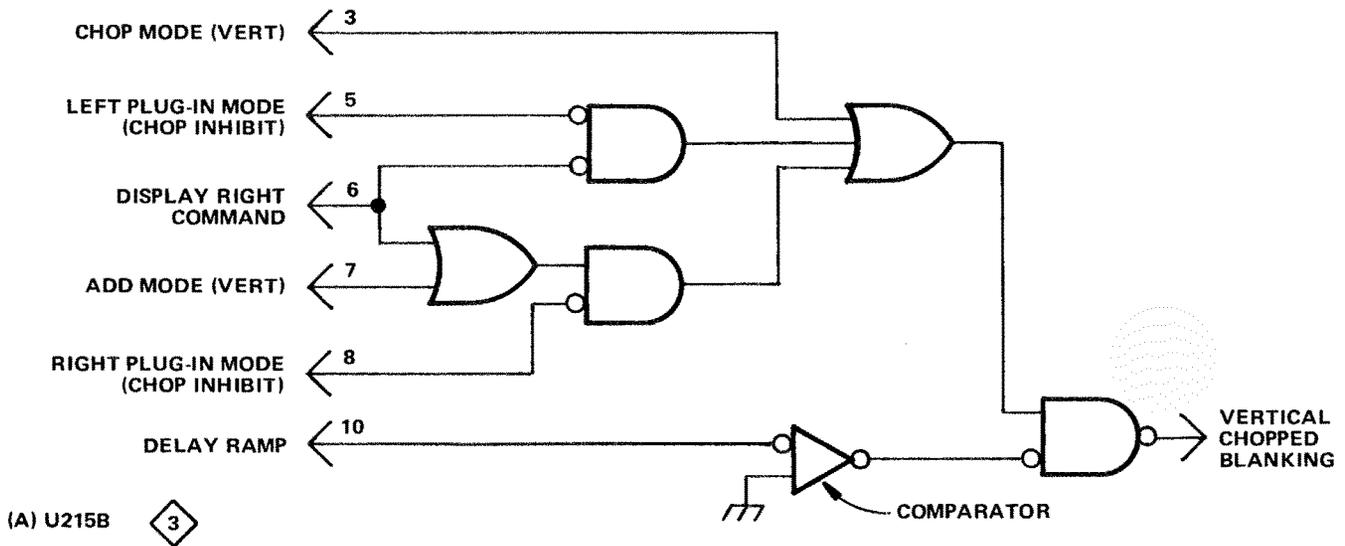


Fig. 3-15. (A) Diagram of Clock Generator stage; (B) Idealized waveforms for Clock Generator stage.



INPUT						OUTPUT	
CHOP MODE (VERT)	LEFT PLUG-IN MODE (CHOP INHIBIT)	DISPLAY RIGHT COMMAND	ADD MODE (VERT)	RIGHT PLUG-IN MODE (CHOP INHIBIT)	DELAY RAMP	VERTICAL CHOPPED BLANKING	
3	5	6	7	8	10 ¹	4 ²	CONDITIONS
HI	Φ	Φ	LO	Φ	LO	LO	CHOP MODE (VERT)
LO	LO	LO	LO	Φ	LO	LO	LEFT PLUG-IN CHOPPED
LO	Φ	HI	LO	LO	LO	LO	RIGHT PLUG-IN CHOPPED
LO	LO ³	LO	HI	LO ³	LO	LO	ADD MODE, LEFT OR RIGHT PLUG-IN CHOPPED
ALL OTHER COMBINATIONS						HI	NO VERTICAL CHOPPED BLANKING PULSES AT OUTPUT

Φ = HAS NO EFFECT IN THIS CASE

¹ RAMP SIGNAL; CONSIDERED LO WHEN MORE NEGATIVE THAN ABOUT ZERO VOLTS.

² NEGATIVE-GOING PULSE AT TWO MEGAHERTZ RATE.

(B) ³ PIN 5 CAN BE HI AND NOT AFFECT OPERATION IF PIN 8 IS LO, AND VICÉ VERSA.

Fig. 3-16. (A) Logic diagram for Vertical Chopped Blanking stage; (B) Table of input/output combinations.

Vertical Chopped Blanking

The Vertical Chopped Blanking stage is made up of the remainder of U215. This stage determines if Vertical Chopped Blanking pulses are required, based upon the operating mode of the vertical system or the plug-in units (dual-trace units only). Vertical Chopped Blanking pulses are produced if: 1. VERTICAL MODE switch is set to CHOP; 2. Dual-trace vertical unit is operating in the chopped mode and that unit is being displayed; 3. Dual-trace vertical unit operating in the chopped mode with the VERTICAL MODE switch set to ADD. The repetition rate

of the negative-going Vertical Chopped Blanking pulse output at pin 4 is two megahertz for all of the above conditions as determined by the Clock Generator stage.

Figure 3-16 shows a logic diagram and an input/output table for the Vertical Chopped Blanking stage. Notice the comparator block on the diagram. The output of this comparator is determined by the relationship between the levels of its inputs. If pin 10 is more positive (HI) than the grounded input, the output is HI also; if it is more negative, the output is LO.

Circuit Description—7904 (SN B260000-UP)

The Delay Ramp signal from the Clock Generator stage determines the repetition rate and pulse width of the Vertical Chopped Blanking pulses. The Delay Ramp applied to pin 10 starts to go negative from a level of about +1.1 volts coincident with the leading edge of the Clock pulse (see waveforms in Fig. 3-17). This results in a HI quiescent condition for the Vertical Chopped Blanking pulse. The slope of the negative-going Delay Ramp is determined by the Clock Generator stage. As it reaches a level slightly negative from ground, the Vertical Chopped Blanking pulse output level changes to the LO state and remains LO until the Delay Ramp goes HI again.

Notice the delay between the leading edge of the Clock pulse generated by U215A, and the leading edge of the Vertical Chopped Blanking pulses. The amount of delay between the leading edges of these pulses is determined by the Delay Ramp applied to pin 10. This delay is necessary due to the delay line in the vertical deflection system. Otherwise, the trace blanking resulting from the Vertical Chopped Blanking pulse would not coincide with the switching between the displayed traces. The duty cycle of the square wave produced in the Clock Generator stage determines the pulse width of the Vertical Chopped Blanking pulses (see Clock Generator description for more information).

Chop Counter

The Chop Counter stage (U255) produces the Vertical Chopping signal, the Plug-In Chop Command, and the Horizontal Chopped Blanking signal. The Clock pulse produced by the Clock Generator stage provides the timing signal for this stage. The functions of the input and output pins for the Chop Counter IC, U225, are identified in Fig. 3-18A. Idealized waveforms showing the timing relationship between the input and output signals for this stage are shown in Fig. 3-18B.

The repetition rate of the output signals from this stage is determined by the setting of the HORIZONTAL MODE switch. When the HORIZONTAL MODE switch is set to any position except CHOP, the repetition rate of the Vertical Chopping Signal output at pin 1 is one megahertz (one-half Clock rate). This determines the switching between the LEFT and RIGHT VERT units when the VERTICAL MODE switch is set to CHOP. At the same time, the repetition rate of the Plug-In Chop Command at pin 8 is 0.5 megahertz (one-fourth Clock rate). This provides a chopping signal to dual-trace vertical units to provide switching between the two channels. The relationship between these output signals and the Clock input is shown by the waveforms in Fig. 3-18B in the area between T_0 and T_1 . During this time, the level at pin 4 remains HI.

When the HORIZONTAL MODE switch is set to CHOP, the basic repetition rate of the Vertical Chopping Signal and the Plug-In Chop Command is altered. For example, if the HORIZONTAL MODE switch is changed to the CHOP position at time T_1 (see Fig. 3-18B), a HI level is applied to pin 6. This stage continues to produce outputs at pins 1 and 8 in the normal manner until both outputs are at their HI level. (See time T_2 ; this condition only occurs once every fifth Clock pulse when the HORIZONTAL MODE switch is set to CHOP.) When both of these outputs are at their HI level, the next Clock pulse switches both outputs LO, and at the same time switches the Horizontal Chopped Blanking to the LO level.

This change at time T_2 does not appear at pin 4 immediately, due to a delay network in the circuit. The delay is necessary to make the Horizontal Chopped Blanking coincide with the Vertical Chopped Blanking produced by U215A and the switching between the displayed signals. (Compare bottom two waveforms of Fig. 3-18B; also see Vertical Chopped Blanking for further information.) After the delay time, the output level at pin 4 goes LO where it remains for about 0.5 microsecond which is equal to the period of the Clock pulse (two-megahertz repetition rate).

The Horizontal Chopped Blanking time must be longer than the Vertical Chopped Blanking time, since it takes more time for the display to switch between horizontal units than between vertical units. During the time that the level at pin 4 is LO, the crt is blanked and the Vertical Chopping Signal and the Plug-In Chop Command cannot change levels. The Clock pulse at T_3 changes only the Horizontal Chopped Blanking output at pin 4. The level on this pin goes HI after the delay time to unblank the crt.

For the next three Clock pulses, the Vertical Chopping Signal output and Plug-In Chop Command operate in the normal manner. However, just prior to the fourth Clock pulse (time T_4), both outputs are again at their HI level. The fourth Clock pulse at T_4 switches the output at pin 1, pin 8, and pin 4 (after delay) to the LO level to start the next cycle. Notice that a Horizontal Chopped Blanking pulse is produced at pin 4 with every fifth Clock pulse. Also notice that with the HORIZONTAL MODE switch set to CHOP, two complete cycles of the Vertical Chopping Signal are produced with each five Clock pulses (repetition rate two-fifths Clock rate) and one complete cycle of the Plug-In Chop Command for every five Clock pulses (one-fifth Clock rate). Notice that the large shaded area produced by the Horizontal Chopped Blanking pulse (see Fig. 3-18B) is not part of the display time (crt display blanked). However, about the same time segment is displayed from the vertical signal source with or without Horizontal Chopped Blanking, due to the change in repetition rate when in the CHOP horizontal mode.

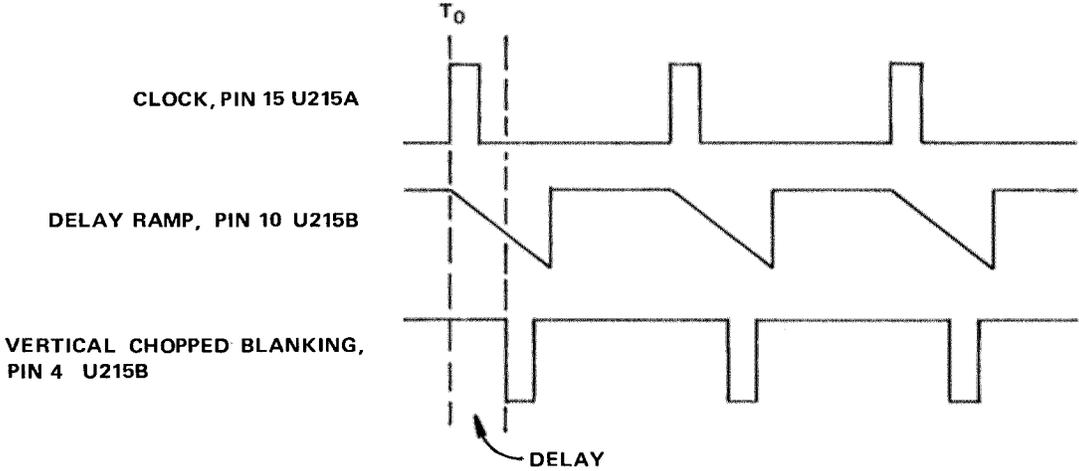


Fig. 3-17. Idealized waveforms for Vertical Chopped Blanking stage.

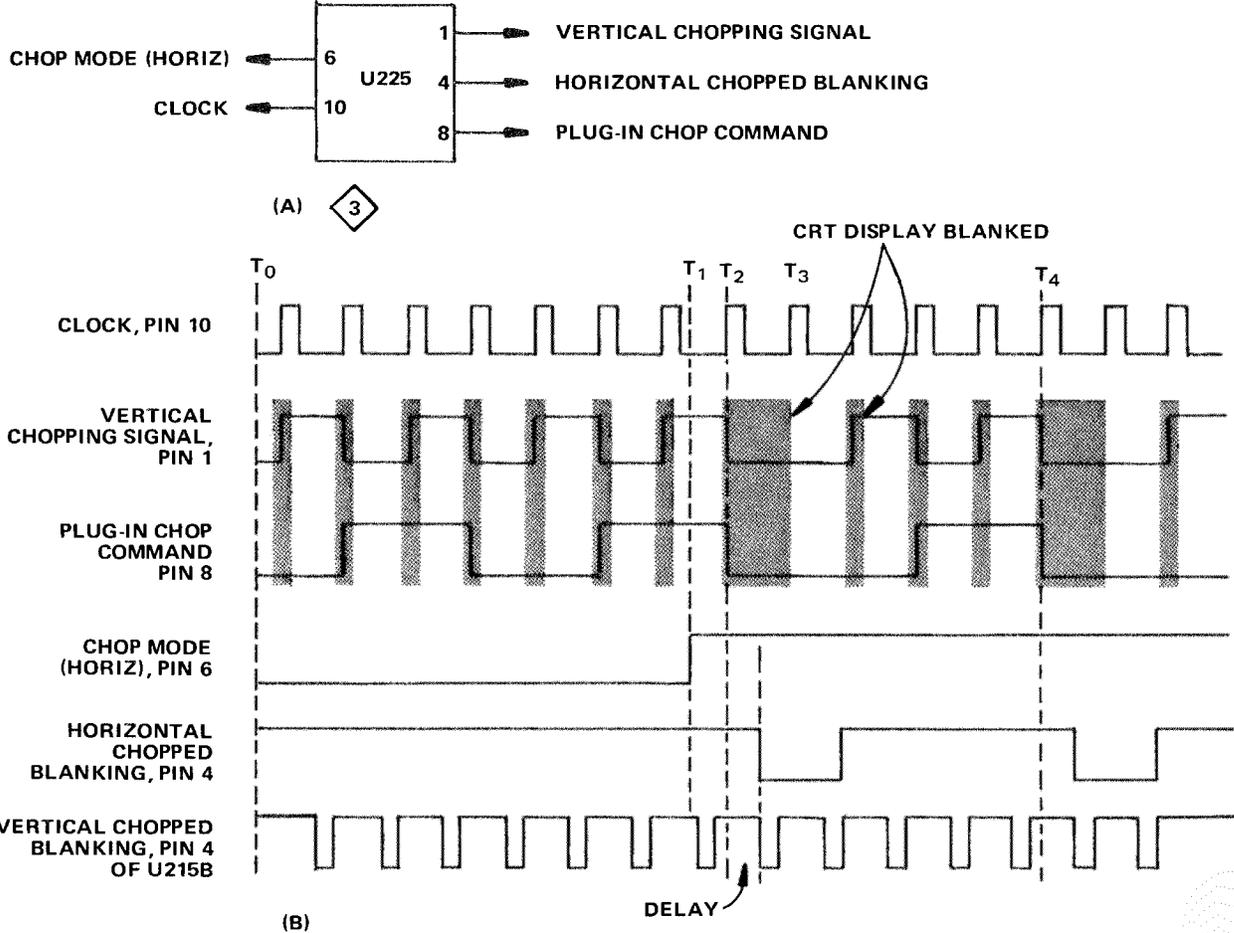


Fig. 3-18. (A) Input and output pins for Chop Counter IC, U225; (B) Idealized waveforms for Chop Counter stage.

Circuit Description—7904 (SN B260000-UP)

The Vertical Chopping at pin 1 of U255 is connected to the Vertical Mode Logic stage (see following description) through L224-R224. This signal is HI when the RIGHT VERT unit is to be displayed and it is LO when the LEFT VERT unit is to be displayed. The Plug-In Chop Command at pin 8 is connected to the plug-in units in the vertical compartments through L228-R228 via the Main Interface board. When this signal is HI, Channel 2 of the plug-in units can be displayed; when this level is LO, Channel 1 can be displayed. The Horizontal Chopped Blanking signal at pin 4 is connected through LR232 to the Horizontal Binary stage U265, and to the Z-Axis Logic stage U325 by way of Q238. When this signal is HI, the crt is unblanked to display the selected signal. When it is LO, the crt is blanked to allow switching between the horizontal units.

A logic diagram of the Chop Counter stage is shown in Fig. 3-19. Use the waveforms given in Fig. 3-18B along with this diagram for reference of time relationships with other signals.

Vertical Mode Logic

The Vertical Mode Logic stage is made up of discrete components CR202-CR203, CR201,-CR204, and buffer Q292-Q296. These components develop the Vertical Mode Command, which is connected to the Main Interface, Vertical Amplifier, and Trigger Selector circuits to indicate which vertical unit is to be displayed. When this output level is HI, the RIGHT VERT unit is displayed; when it is LO, the LEFT VERT unit is displayed.

The VERTICAL MODE switch shown on diagram 2 provides control levels to this stage. This switch provides a HI level on only one of five output lines to indicate the selected vertical mode; the remaining lines are LO. Notice that only four of the lines from the VERTICAL MODE switch are connected to the Logic circuit. Operation of this stage is as follows:

When the VERTICAL MODE switch is set to RIGHT, a HI level is connected to the base of Q292 through R204. This forward biases Q292, and the positive-going level at its emitter is connected to the emitter of Q296. The collector of Q296 goes HI to indicate that the RIGHT VERT unit is to be displayed. For the CHOP position of the VERTICAL MODE switch, a HI level is applied to the anodes of CR202-CR203 through R202. Both diodes are forward biased so that the Vertical Chopping Signal from pin 1 of U225 can pass to the base of Q292. This signal switches between the HI and LO levels at a one-megahertz rate and produces a corresponding Vertical Mode Command output at the collector of Q296. When the output is HI the RIGHT VERT unit is displayed and when it switches to LO, the LEFT VERT unit is displayed.

In the ALT position of the VERTICAL MODE switch, a HI level is applied to the anodes of CR201-CR204 through R201. These diodes are forward biased so the Display Right Command from pin 6 of the Vertical Binary stage can pass to the base of Q292 to determine the Vertical Mode Command level. The Display Right Command switches between its HI and LO levels at a rate determined by the Vertical Binary stage.

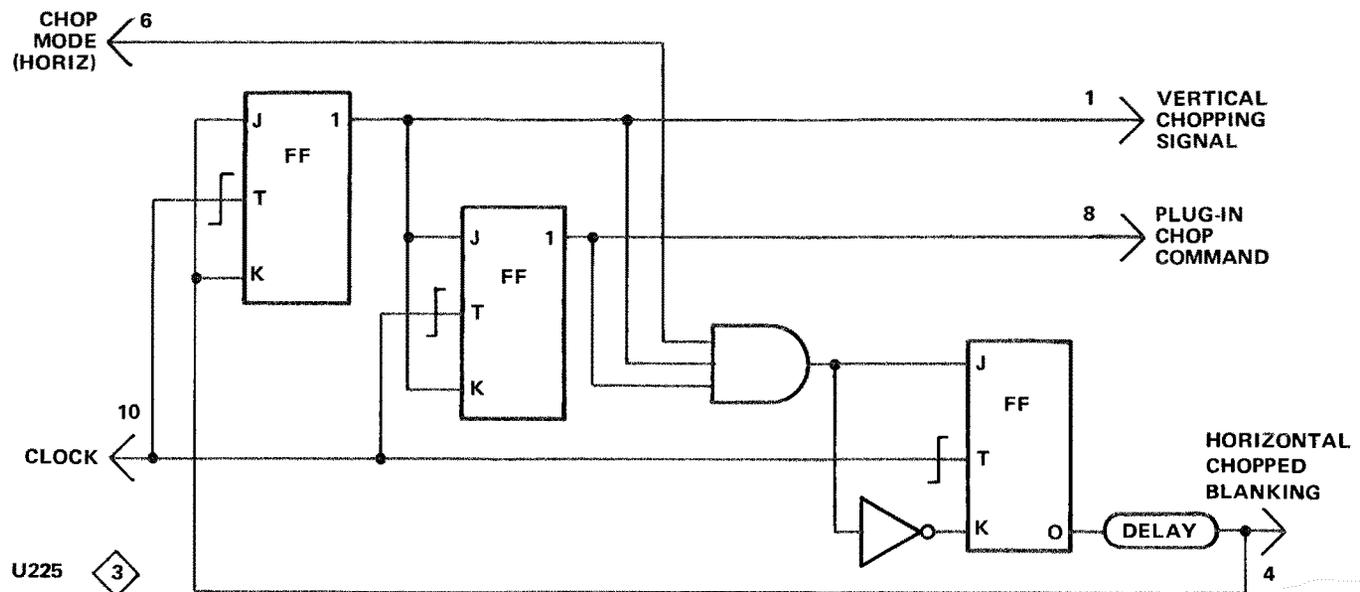


Fig. 3-19. Logic diagram of Chop Counter stage.

The control levels in the LEFT and ADD positions of the VERTICAL MODE switch are not connected to this stage. However, since only the line corresponding to the selected vertical mode can be HI, the RIGHT, CHOP, and ALT lines must remain at their LO level when either LEFT or ADD are selected. Therefore, the base of Q292 remains LO to produce a LO Vertical Mode Command output level at the collector of Q296.

A logic diagram of the Vertical Mode Logic stage is shown in Fig. 3-20. The discrete components that make up each logic function are identified.

Trace Separation

The Trace Separation stage is made up of discrete components Q342, Q347, Q350, and Q352. This stage produces the Trace Separation output to the Vertical Amplifier circuit to offset the B-sweep display when operated in a dual-sweep mode (horizontal). The level of this output current is determined by the setting of the VERT TRACE SEPARATION (B) control. The current from the VERT TRACE SEPARATION (B) control is switched so that the Trace Separation output is provided only when the B sweep is being displayed in the ALT or CHOP horizontal modes and not when B sweep only is being displayed, nor for independent-pairs operation (sweep slaving). Operation of this stage is as follows:

The VERT TRACE SEPARATION (B) control provides current to the Trace Separation output through R351 and

Q352 when Q352 is forward biased. When the B sweep is being displayed (for ALT or CHOP horizontal operation), the Display B Command at the base of Q347 is HI. This forward biases Q347 causing its collector to go negative to forward-bias Q350. This causes Q350 to saturate and its collector goes positive to forward bias Q352. During the time the A sweep is being displayed, the Display B Command is LO. This reverse biases Q347 and Q350; Q352 is reverse biased through CR349 and R349. Since Q352 is reverse biased, the VERT TRACE SEPARATION (B) control is disconnected while the A sweep is being displayed.

When the HORIZONTAL MODE switch is set to B (only), a HI level is connected to the emitter of Q347 through R344. This reverse biases Q347 even though the Display B Command at its base is HI for this mode. Therefore, the VERT TRACE SEPARATION (B) control has no effect. When the VERTICAL MODE switch is set to ALT and the Delay Mode Control Out level from the A time-base unit is LO (indicating non-delayed sweep operation), a HI level is applied to the emitter of Q347 through R342 and CR343. This HI level reverse biases Q347 even though the Display B Command is HI. This action disconnects the VERT TRACE SEPARATION (B) control for independent-pairs operation so that the vertical position of the B-sweep display is determined by the slaved LEFT VERT plug-in unit only. If delayed-sweep operation is selected, the Delay Mode Control Out level is HI to forward bias Q342 and Q347. This allows the VERT TRACE SEPARATION (B) control to position the B-sweep display, since independent-pairs operation is not possible when operating in a delayed-sweep mode.

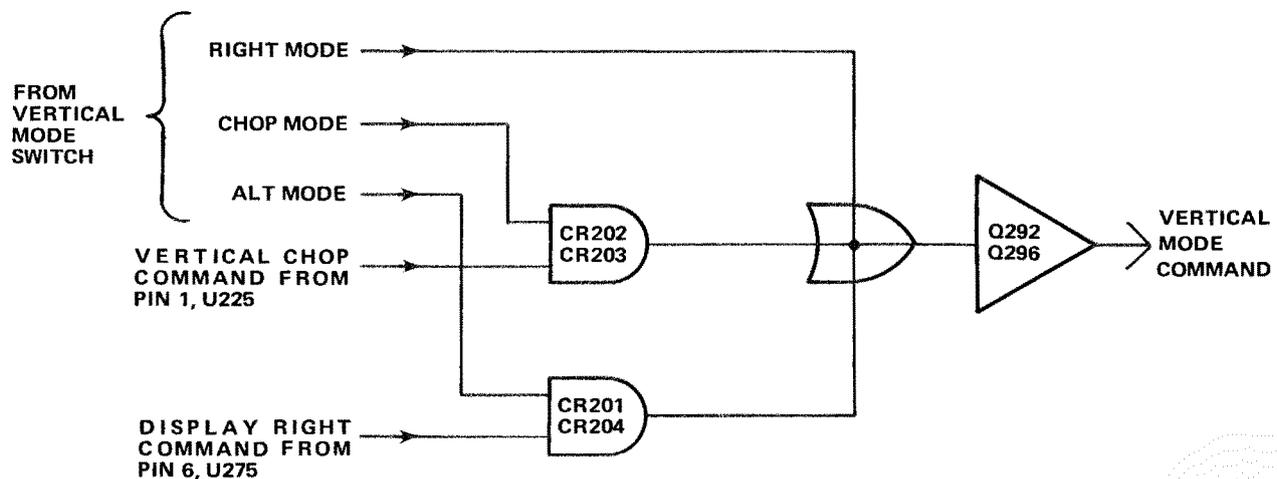


Fig. 3-20. Logic diagram of Vertical Mode Logic stage.

Circuit Description—7904 (SN B260000-UP)

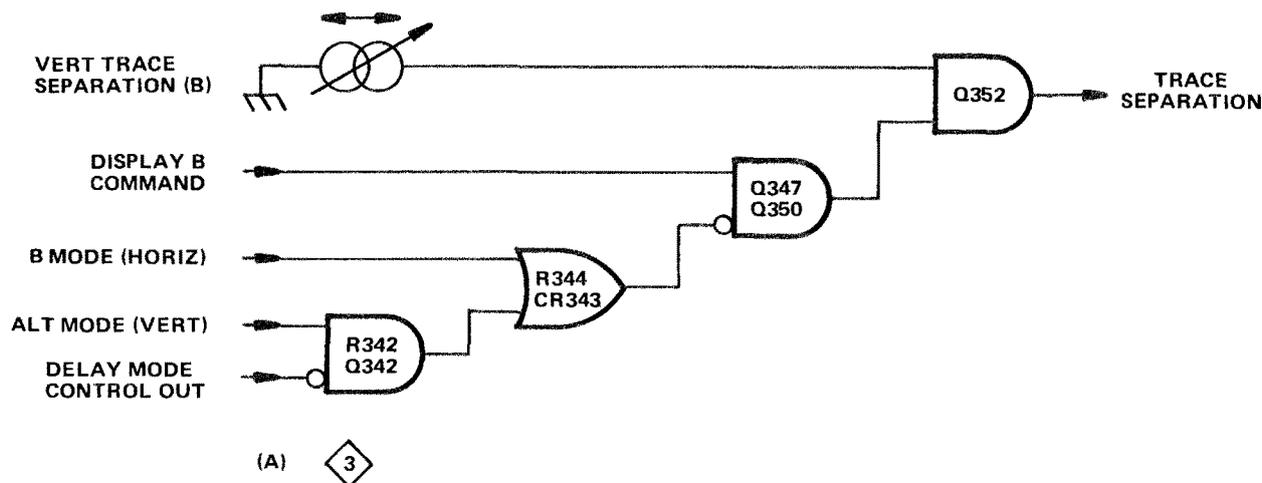
A logic diagram of the Trace Separation stage is shown in Fig. 3-21A. The discrete components which make up each logic function are identified. An input/output table for this stage is given in Fig. 3-21B.

TRIGGER SELECTOR 4

The Trigger Selector circuit determines the source of the internal triggering signals connected to the A and B HORIZ plug-in compartments. In addition, the B Trigger Channel Switch stage also includes the Vertical Signal Out Amplifier. Figure 3-22 shows a detailed block diagram of the Trigger Selector circuit.

Slave Enable

The Slave Enable stage provides an output to the A and B Trigger Select Logic stages to indicate when independent-pairs operation (sweep slaving) is selected. The output of this stage is determined by the Horizontal Slave Enable level from the Logic circuit and by the VERTICAL MODE switch. (For further information on independent-pairs operation and the Horizontal Enable level, see the description of the Vertical Binary stage in the Logic circuit.) When independent-pairs operation is selected, the output of the Slave Enable stage (at the emitter of Q438) is LO. In this condition, the Left Vertical unit provides the B Horizontal trigger signal and the Right Vertical unit provides the A Horizontal trigger signal in the VERT MODE position of the trigger source switches.



(A) 3

INPUT				OUTPUT
DISPLAY B COMMAND	B MODE (HORIZ)	ALT MODE (VERT)	DELAY MODE CONTROL OUT	TRACE SEPARATION (B)
HI	LO	HI	HI	YES
HI	LO	LO	Φ	YES
ALL OTHER COMBINATIONS				NO OUTPUT

(B)

Φ = HAS NO EFFECT IN THIS CASE

Fig. 3-21. (A) Logic diagram of Trace Separation stage; (B) Table of input/output combinations.

A and B Trigger Select Logic

The A and B Trigger Select Logic stages select the operation of the A and B Trigger Channel Switch stages as determined by the Horizontal Slave Enable level from the Logic circuit and the setting of the VERTICAL MODE, A TRIGGER SOURCE, and B TRIGGER SOURCE switches. These stages also include the circuitry to illuminate the trigger-source pushbutton lights.

Table 3-1 and Table 3-2 show the output of the A and B Trigger Select Logic stages respectively for each combination of the Horizontal Slave Enable level, the setting of the VERTICAL MODE switch, and the setting of the trigger

source switches. The trigger-source pushbutton illuminated for each combination is also shown. Notice that only the trigger source switches control the output when in the LEFT or RIGHT VERT positions; the trigger signal is obtained from the indicated plug-in compartment.

A and B Trigger Channel Switch

The A and B Trigger Channel Switch stages determine which input signal provides the internal trigger signal to the horizontal units as controlled by the trigger Right and Add signals from the trigger select logic stages.

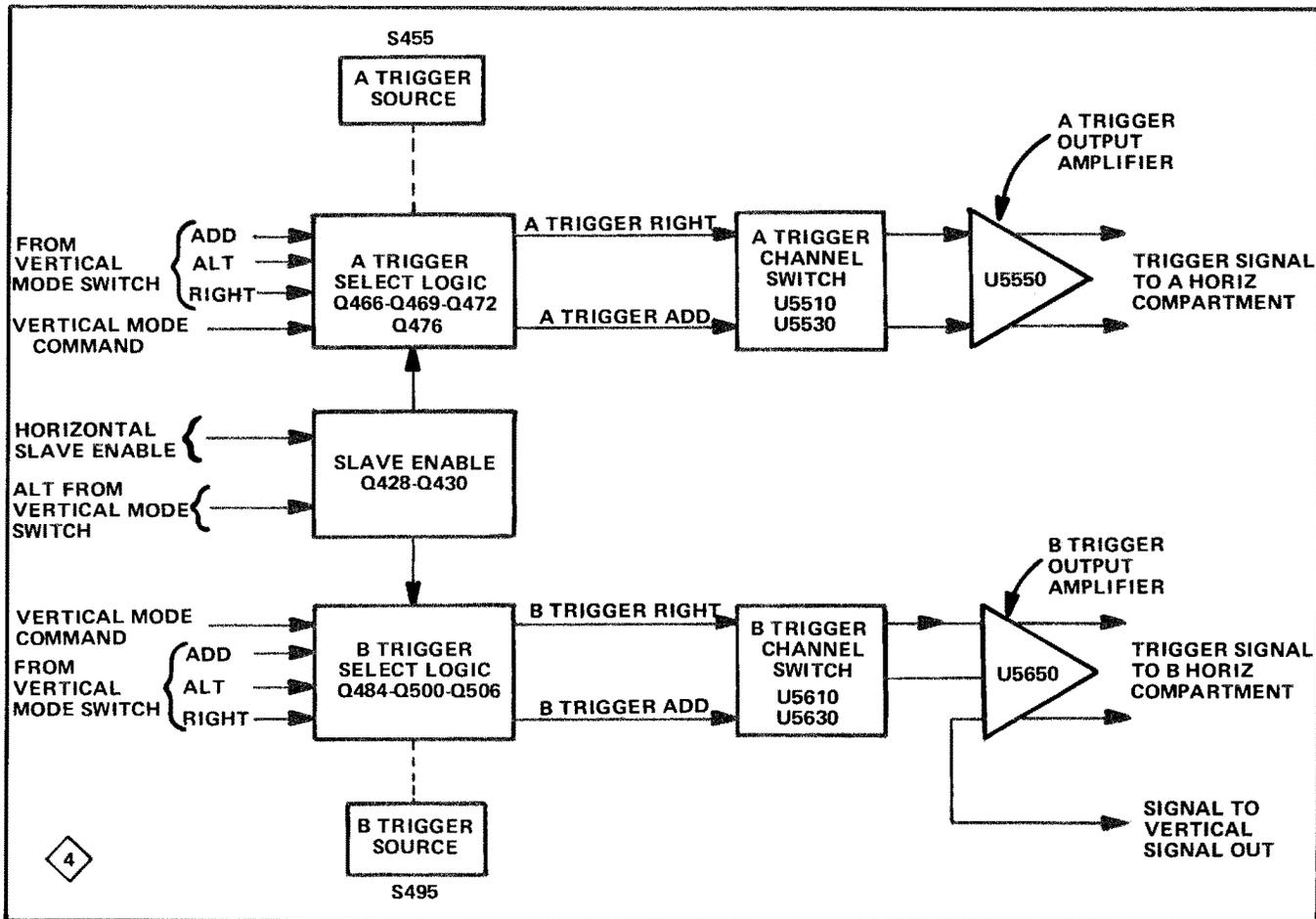


Fig. 3-22. Detailed block diagram of Trigger Selector circuit.

Table 3-1

INPUT/OUTPUT COMBINATIONS FOR A TRIGGER SELECT LOGIC

A TRIGGER SOURCE Switch	VERTICAL MODE Switch	Horizontal Slave Enable	Vertical Mode Command	A Trigger Select Logic Output		A TRIGGER SOURCE Pushbutton Lights		
				A Trigger		LEFT VERT	RIGHT VERT	VERT MODE
				Right	Add			
LEFT VERT	φ ^a	φ	φ	LO	LO	on	off	off
RIGHT VERT	φ	φ	φ	HI	LO	off	on	off
VERT MODE	LEFT	φ	LO	LO	LO	on	off	on
	ALT	LO	Alt ^b	Alt ^b	LO	on	on	on
	ALT	HI	Alt ^b	HI	LO	off	on	on
	ADD	φ	LO	LO	HI	on	on	on
	CHOP	φ	Chop ^b	LO	LO	on	off	on
	RIGHT	φ	HI	HI	LO	off	on	on

^aφ = Has no effect in this case.

^bSwitches between HI and LO at a rate determined by Logic circuit.

Table 3-2

INPUT/OUTPUT COMBINATIONS FOR B TRIGGER SELECT LOGIC

B TRIGGER SOURCE Switch	VERTICAL MODE Switch	Horizontal Slave Enable	Vertical Mode Command	B Trigger Select Logic Output		B TRIGGER SOURCE Pushbutton Lights		
				B Trigger		LEFT VERT	RIGHT VERT	VERT MODE
				Right	Add			
LEFT VERT	φ ^a	φ	φ	LO	LO	on	off	off
RIGHT VERT	φ	φ	φ	HI	LO	off	on	off
VERT MODE	LEFT	φ	LO	LO	LO	on	off	on
	ALT	LO	Alt ^b	Alt ^b	LO	on	on	on
	ALT	HI	Alt ^b	LO	LO	on	off	on
	ADD	φ	LO	LO	HI	on	on	on
	CHOP	φ	Chop ^b	LO	LO	on	off	on
	RIGHT	φ	HI	HI	LO	off	on	on

^aφ = Has no effect in this case.

^bSwitches between HI and LO at a rate determined by Logic circuit.

Resistor networks R401 through R407, R409, R410, R411, and R413, R414, R415 are connected as 50 Ω power dividers. These power dividers, along with R5508, R5516, R5530, R5534, and R5608, R5616, R5630, R5634, provide a 100 Ω differential load for the trigger outputs of the vertical plug-in units and establish the input resistance of the trigger channel switch stages.

The A and B Trigger Channel Switch stages are made up primarily of integrated circuits U5502, U5510, and U5530 for the A Trigger, and U5602, U5610, and U5630 for the B Trigger. The operation of the A and B Trigger Channel Switch is similar. Therefore, only a discussion of the A Trigger Channel Switch is given.

Bias current for the respective switches is provided by R5510, R5512, R5597, R5530, R5532, R5598, and resistors R5516, R5536. Transistor array U5502A, B, C, and D provide a logic drive for channel switches U5510 and U5530, when the proper trigger signal selection is provided by A and B Trigger Selector Logic circuit. When the L/R signal is present, its low level turns off U5502C and turns on U5502D, causing a low at pin 12 and a high at pin 11 of U5510. This condition routes the left trigger signal at J5512 and J5516, through U5510, to pins 13-16, and 1-14 of U5550. At the same time, U5530 pin 12 is high and pin 11 is low, causing the right trigger signal current to pass through pins 5 and 9, and cancel itself. The right trigger signal is routed through U5530 in a similar manner. When the Add signal is present, the left and right trigger signals are added algebraically at pins 6 and 8 of U5510 and U5530.

A Trigger Output Amplifier

The A Trigger Output Amplifier stage (U5550) amplifies the output signals from channel switches U5510 and U5530 and drives the level shifters. Resistors R5541 and R5542, together with the channel switch bias current, set the input dc bias of U5550. Resistors R5561 and R5559 set the dc bias for common-base output stage, U5550.

B Trigger Output Amplifier

The B Trigger Output Amplifier stage (U5650) operates in a similar manner to the A Trigger Output Amplifier, except the output circuit provides the signal current for the Signal Output Amplifier. Resistors R5668, R5659, and R5661 set the correct signal current for the output amplifier circuit.

A and B Trigger Level Shifters

The level shifters remove the trigger signal from the dc bias signal at the output of U5550 and U5660. The A Trigger Level Shifter circuit is composed of a network of components connected between pin 5 of U5550 and pin CC, and between pin 9 of U5550 and pin CB. Resistors R5565 and R5566, along with VR5565 and VR5566, supply bias current to U5550; they also serve as a reverse termination for the signal. R5570 sets the output common-mode level by setting the amount of current to zeners VR5565, VR5566, and resistors R5574, and R5576. The B Trigger Level Shifter circuit operates in a similar manner.

Signal Out Amplifier

The signal out amplifier stage (Q5679) receives trigger signals by the selection of the B TRIGGER SOURCE switch, and provides a sample of the trigger signal to a front-panel connector. Resistor R5678 biases Q5679 and U5650. Resistors R5682, R5683, and R5684 set the base bias voltage of Q5679. Signal Out centering adjustment R5683 is set for zero-volt quiescent output level. Resistor R5687 sets the Q5679 bias current and R5686 sets the output impedance (950 Ω).

Word—A word is made up of a related group of characters. In the 7904 Readout System, a word can consist of up to ten characters.

Frame—A frame is a display of all words for a given operating mode and plug-in combination. Up to eight words can be displayed in one frame. Figure 3-23 shows the position of each word in a complete frame.

Column—One of the vertical lines in the Character Selection Matrix (see Fig. 3-24). Columns C-0 (column zero) to C-10 (column 10) can be addressed in the 7904 system.

Row—One of the horizontal lines in the Character Selection matrix. Rows R-1 (row 1) through R-10 (row 10) and R-14 (row 14) can be addressed in the 7904 system.

Time-Slot—A location in a pulse train. In the 7904 Readout System, the pulse train consists of 10 negative-going pulses. Each time-slot pulse is assigned a number between one and ten. For example, the first time-slot is TS-1.

Time-multiplexing—Transmission of data from two or more sources over a common path by using different time intervals for different signals.

Display Format

Up to eight words of readout information can be displayed on the crt. The position of each word is fixed and is directly related to the plug-in unit from which it originated. Figure 3-23 shows the area of the graticule where the readout from each plug-in unit is displayed. Notice that Channel 1 of each plug-in unit is displayed within the top division of the crt and Channel 2 is displayed directly below within the bottom division. Figure 3-25 shows a typical display where only Channel 2 of the Right Vertical and B Horizontal units is selected for display.

READOUT SYSTEM 8

Introduction

The Readout System provides alphanumeric display of information encoded by the plug-in units. This display is presented on the crt and is written by the crt beam on a time-shared basis with the analog waveform display.

The definition of several terms follows:

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

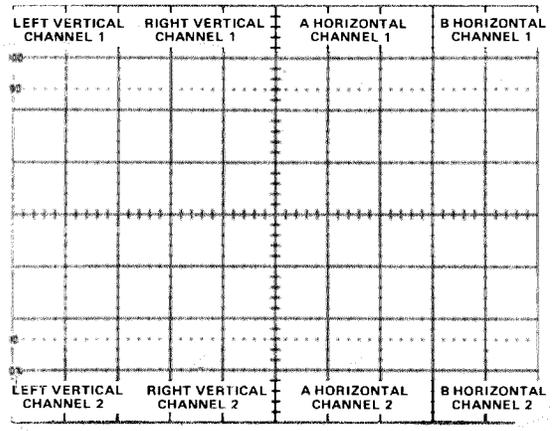


Fig. 3-23. Location of readout display on the crt identifying the originating plug-in and channel.

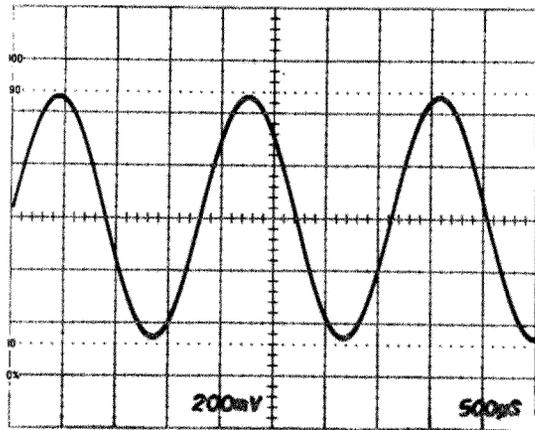


Fig. 3-25. Typical readout display where only Channel 2 of the Right Vertical and B Horizontal units is displayed.

Each word in the readout display can contain up to 10 characters, although the typical display will contain between two and seven characters per word. The characters are selected from the Character Selection Matrix shown in Fig. 3-24. In addition, 12 operational addresses are provided for special instructions to the Readout System. The unused locations in the Matrix (shaded area) are available for future expansion of the Readout System. The method of addressing the locations in the Character Selection Matrix is described in the following discussion.

Developing the Display

The following basic description of the Readout System uses the block diagram shown in Fig. 3-26. This description is intended to relate the basic function of each stage to the operation of the overall Readout System. Detailed information on circuit operation is given later.

The key block in the Readout System is the Timer stage. This stage produces the basic signals that establish the timing sequences within the Readout System. Period of the timing signal is about 250 microseconds (drops to about 210 microseconds when Display-Skip is received; see detailed description of Timer stage for further information.) This stage also produces control signals for other stages within this circuit and interrupt signals to the Vertical Amplifier, Horizontal Amplifier, and Logic circuits, which allow a readout display to be presented. The Time-Slot Counter stage receives a trapezoidal voltage signal from the Timer stage and directs it to one of ten output lines. These output lines are labeled TS-1 through TS-10 (time-slots one through ten) and are connected to the vertical and horizontal plug-in compartments as well as to various stages within the Readout System. The output lines are energized sequentially, so there is a pulse on only one of the 10 lines during any 250-microsecond timing period. After the Time-Slot Counter stage has counted time-slot 10, it produces an End-of-Word pulse which advances the system to the next channel.

Two output lines, row and column, are connected from each channel of the plug-in unit back to the Readout System. Data is typically encoded on these output lines by connecting resistors between them and the time-slot input lines. The resultant output is a sequence of ten analog current levels that range from zero to one milliamperere (100 microamperes/step) on the row and column output lines. This row and column correspond to the row and column of the Character Selection Matrix in Fig. 3-24. The standard format for encoding information onto the output lines is given in Table 3-3. (Special-purpose plug-in units may have their own format for readout; these special formats will be defined in the manuals for these units.)

The encoded column and row data from the plug-in units is selected by the Column Data Switch and Row Data Switch stages respectively. These stages take the analog currents from the eight data lines (two channels from each of the four plug-in compartments) and produce a time-multiplexed analog voltage output containing all of the column or row information from the plug-ins. The Column Data Switch and Row Data Switch are sequenced by the binary Channel Address Code from the Channel Counter

The time-multiplexed output of the Column Data Switch is monitored by the Display-Skip Generator to determine if it represents valid information that should be displayed. Whenever information is not encoded in a time-slot, the Display-Skip Generator produces an output level to prevent the Timer stage from producing the control signals that normally interrupt the crt display and present a character.

The analog outputs of the Column Data Switch and Row Data Switch are connected to the Column Decoder and Row Decoder stages respectively. These stages sense the magnitude of the analog voltage input and produce an output current on one of ten lines. The outputs of the Column Decoder stage are identified as C-1 through C-10 (column 1 through 10) corresponding to the encoded column information. Likewise, the outputs of the Row Decoder stage are identified as R-1 through R-10 (row 1 through 10) corresponding to the encoded row information. The primary function of the row and column outputs is to select a character from the Character Selection Matrix to be produced by the Character Generator stage. These outputs are also used at other points within the system to indicate when certain information has been encoded. One such stage is the Zeros Logic and Memory. During time-slot 1 (TS-1), this stage checks if zero-adding or prefix-shifting information has been encoded by the plug-in unit, and stores it in memory until time-slots 5, 6, or 8. After storing this information, it triggers the Display-Skip Generator stage so that there is no display during time-slot 1 (as defined by Standard Readout Format; see Table 3-3). When time-slots 5, 6, and 8 occur, the memory is addressed and any information stored there during time-slot 1 is transferred to the input of the Column Decoder stage to modify the analog data during the applicable time-slot.

NOTE: INDICATES NUMBER OF LINES.

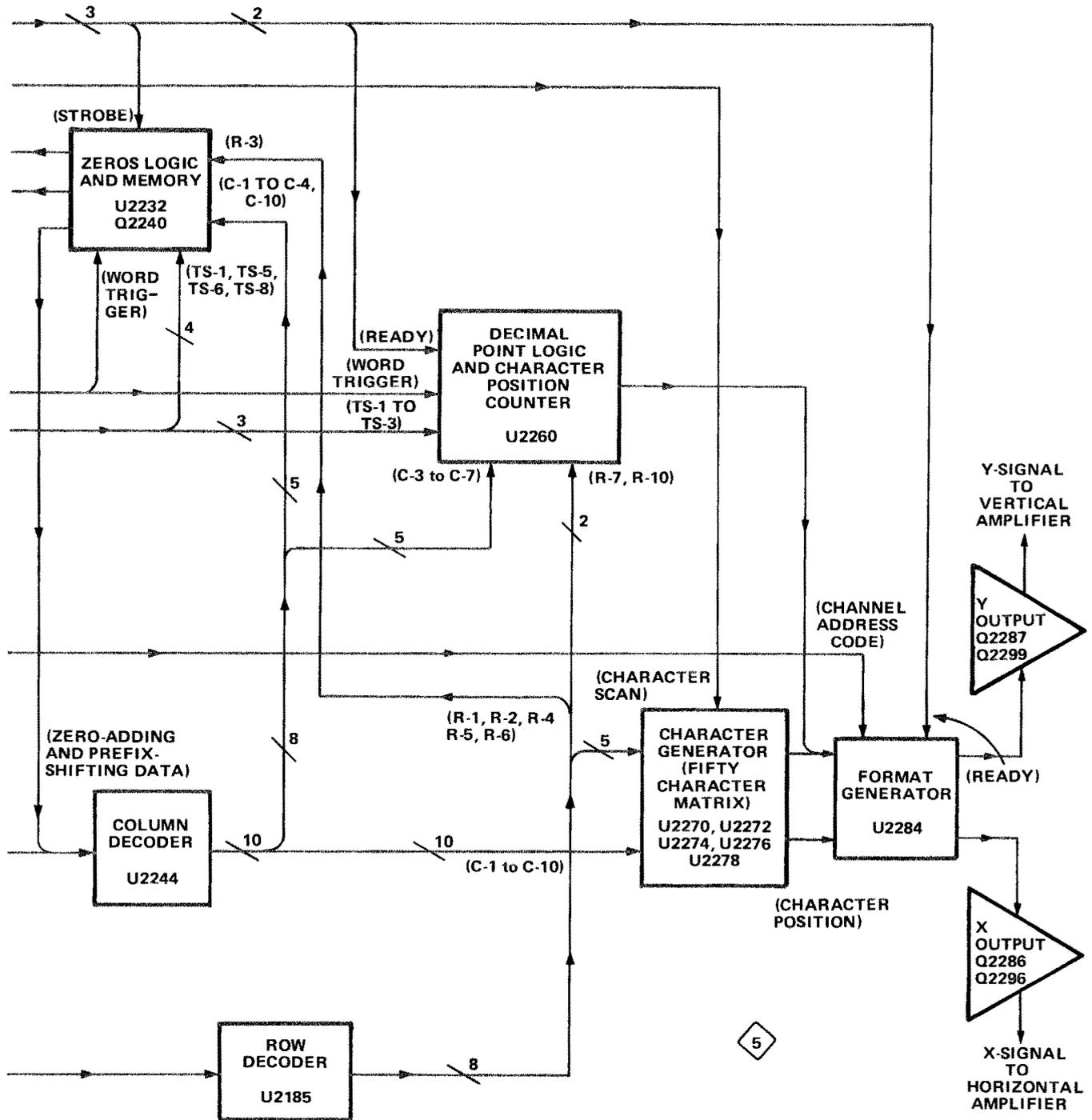


Fig. 3-26. (cont).

Table 3-3
STANDARD READOUT FORMAT

Time-Slot Number	Description
TS-1	Determines decimal magnitude (number of zeros displayed or prefix change information) or the IDENTIFY function (no display during this time-slot).
TS-2	Indicates normal or inverted input (no display for normal).
TS-3	Indicates calibrated or uncalibrated condition of plug-in variable control (no display for calibrated condition).
TS-4	Scaling.
TS-5 TS-6 TS-7	Not encoded by plug-in unit. Left blank to allow addition of zeros by Readout System.
TS-8	Defines the prefix which modifies the units of measurement.
TS-9 TS-10	Define the units of measurement of the plug-in unit. May be standard units of measurements (V, A, S, etc.) or special units selected from the Character Selection Matrix.

Also, the Zeros Logic and Memory stage produces the IDENTIFY function. When time-slot 1 is encoded for IDENTIFY (column 10, row 3), this stage produces an output level, which connects the Column Data Switch and Row Data Switch to a coding network within the Readout System. Then, during time-slots 2 through 9, an analog current output is produced from the Column Data Switch and Row Data Switch, which addresses the correct points in the Character Selection Matrix to display the word "IDENTIFY" on the crt. The Zeros Logic and Memory stage is reset after each word by the Word Trigger pulse.

The Character Generator stages produce the characters which are displayed on the crt. Any of the 50 characters shown on the Character Selection Matrix of Fig. 3-24 can be addressed by proper selection of the column and row currents. Only one character is addressable in any one time-slot; a space can be added into the displayed word by the Decimal Point Logic and Character Position Counter stage when encoded by the plug-in. The latter stage counts the number of characters generated and produces an output current to step the display one character position to the right for each character. In addition, the character position is advanced once during each of time-slots 1, 2, and 3, whether a

character is generated during these time-slots or not. This action fixes the starting point of the standard-format display such that the first digit of the scaling factor always starts at the same point within each word regardless of the information encoded in time-slot 1, 2, or 3 preceding this digit. Also, by encoding row 10 and column 0 during any time-slot, a blank space can be added to the display. Decimal points can be added to the display at any time by addressing the appropriate row and column. (See Character Selection Matrix for location of decimal points.) The Decimal Point Logic and Character Position Counter stage is reset after each word by the Word Trigger pulse.

The Format Generator stage provides the output signals to the vertical and horizontal deflection systems of the instrument to produce the character display. The binary Channel Address Code from the Channel Counter stage is connected to this stage, so that the display from each channel is positioned to the area of the crt associated with the plug-in and channel originating the word (see Fig. 3-23). The positioning current or decimal point location current generated by the Decimal Point Logic and Character Position Counter stage is added to the Horizontal (X) signal at the input to the Format Generator stage to provide horizontal positioning of the characters within each word. The X- and Y-Readout signals are connected to the Horizontal Amplifier and Vertical Amplifier through the X- and Y-Buffer stages.

The Word Trigger stage produces a trigger from the End-of-Word pulse generated by the Time-Slot Counter stage after the tenth time-slot. This Word Trigger pulse advances the Channel Counter to display the information from the next channel or plug-in. It also provides a reset pulse the Zeros Logic and Memory stage and the Decimal Point Logic and Character Position Counter stage. The Word Trigger stage can also be advanced to jump a complete word or a portion of a word when a Jump command is received from the Row Data Switch stage.

The Single-Shot Lockout stage allows the display sequence of the Readout System to be changed. Normally, the Readout System operates in a free-running mode, so the waveform display is interrupted randomly to display characters. However, under certain conditions (such as single-shot photography), it is desirable that the Readout System operate in a triggered mode where the readout portion of the display is normally blanked out, but can be presented on command. The Readout Mode switch, S2110, determines the operating mode of the Readout System.

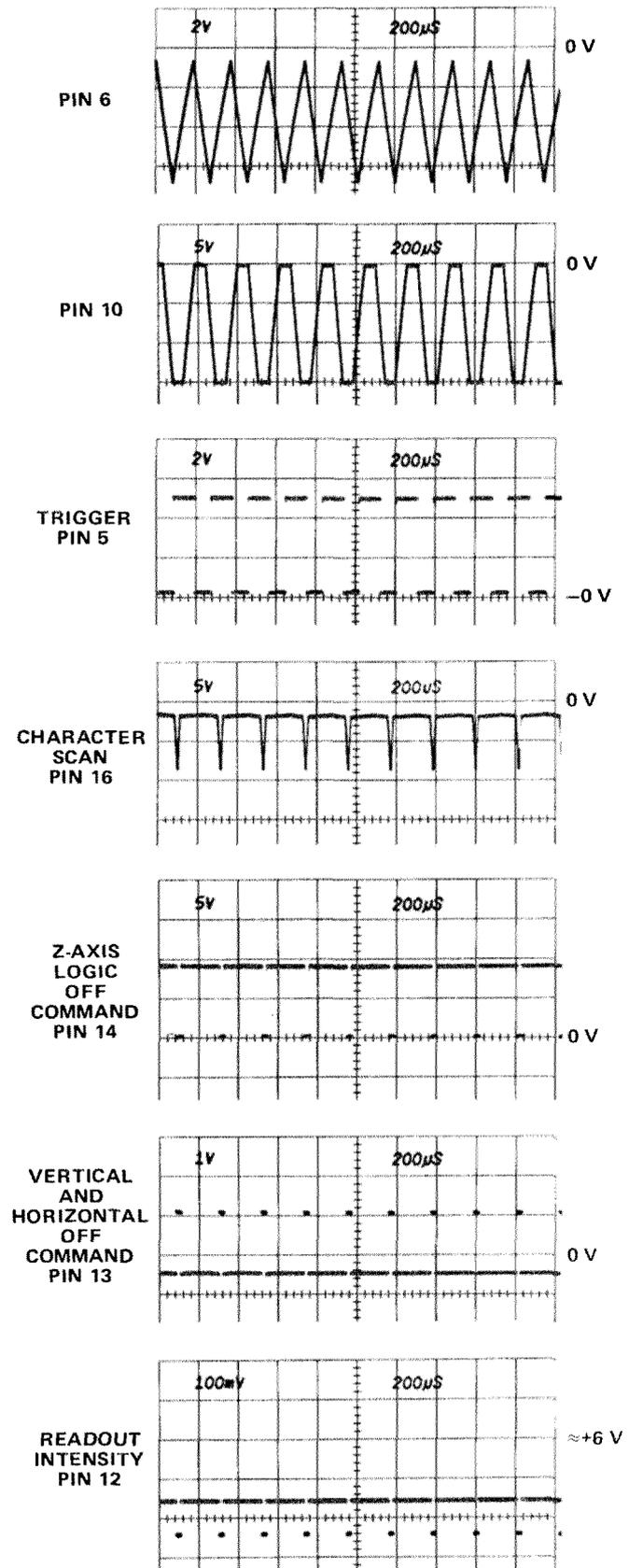
Timer

Timer U2126 establishes the timing sequence for all circuits within the Readout System. This stage produces seven time-related output waveforms (see Fig. 3-27). The triangle waveform produced at pin 6 forms the basis for the remaining signals. The basic period of this triangle waveform is about 250 microseconds as controlled by RC network R2135-C2135. The triangle waveform is clipped and amplified by U2126 to form the trapezoidal output signal at pin 10. The amplitude of this output signal is exactly 15 volts as determined by U2126 (exact amplitude necessary to accurately encode data in plug-in units; see Encoding the Data). The Trigger output at pin 5 provides the switching signal for the Time-Slot Counter and Word Trigger stages.

The signals at pins 12, 13, 14, and 16 are produced only when the triangle waveform is on its negative slope and the trapezoidal waveform has reached the lower level. The timing sequence of these waveforms is important to the operation of the Readout System (see expanded waveforms in Fig. 3-28). The Z-Axis Logic OFF Command at pin 14 is produced first. This negative-going signal provides a blanking pulse to the Z-Axis Logic stage (see diagram 3) to blank the crt before the display is switched to the Readout System. It also produces the Strobe pulse through Q2138 and CR2142 to signal other stages within the Readout System to begin the sequence necessary to produce a character. The collector level of Q2138 is also connected to Character Generator No. 2, U2272, through CR2140. This activates U2272 during the quiescent period of the Strobe pulse (collector of Q2138 negative) and diverts the output current of Row Decoder U2185 to row 2. The purpose of this configuration is to prevent the Zeros Logic and Memory stage U2232 from storing incorrect data during the quiescent period of the Strobe pulse. When the Strobe pulse goes positive, CR2140 is reverse-biased to disconnect Q2138 from U2272 and allow the Row Decoder to operate in the normal manner.

The next signal to be produced is the Vertical and Horizontal OFF Command at pin 13. This positive-going signal disconnects the plug-in signals from the vertical and horizontal deflection systems, so the plug-in units do not control the position of the crt beam during the readout display. The Ready signal derived from this output is connected to the Decimal Point Logic and Character Position Counter stage and the Format Generator stage.

The Readout Intensity output at pin 12 is produced next. This current is connected to the crt circuit to unblank the crt to the intensity level determined by the READOUT intensity control. The Character Scan ramp at pin 16 started to go negative as this timing sequence began. However, character generation does not start until the readout intensity level has been established. The triangular Character Scan ramp runs from about -2 volts to about -8.5 volts, then returns back to the original level. This waveform provides scanning signal for the Character Generator stages. Full Character Scan adjustment R2128 sets the dc level of the Character Scan ramp for complete characters on the display.



NOTE: TEST OSCILLOSCOPE EXTERNALLY TRIGGERED FROM TP2251.

Fig. 3-27. Output waveforms of Timer stage.

Circuit Description—7904 (SN B260000-UP)

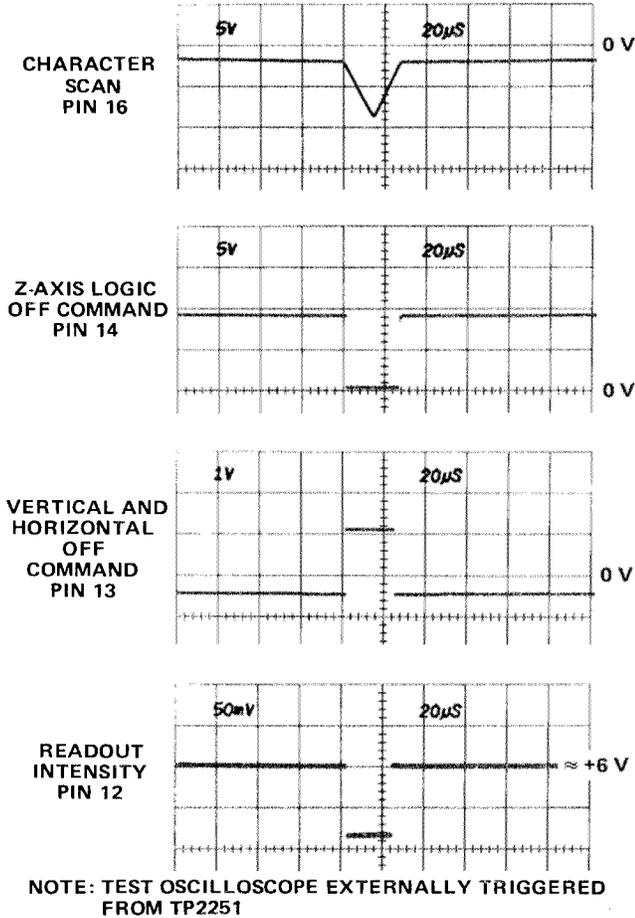


Fig. 3-28. Detail of output at pins 12, 13, 14, and 16 of U2126.

The Timer stage operates in one of two modes as controlled by the Display-Skip level at pin 4. The basic mode just described is a condition that does not occur unless all ten characters of each word (80 characters total) are displayed on the crt. Under typical conditions only a few characters are displayed in each word. The Display-Skip level at pin 4 determines the period of the Timer output signal. When a character is to be generated, pin 4 is LO and the circuit operates as just described. However, when a character is not to be displayed, a HI level is applied to pin 4 of U2126 through CR2125 from the Display-Skip Generator stage. This signal causes the Timer to shorten its period of operation to about 210 microseconds. The waveforms in Fig. 3-29 show the operation of the Timer stage when the Display-Skip conditions occurs for all positions in a word. Notice that there is no output at pins 12, 13, 14, and 16 under this condition. This means that the crt display is not interrupted to display characters. Also notice that the triangle waveform at pin 6 does not go as far negative, and that the negative portion of the trapezoidal waveform at pin 10 is shorter. Complete details on operation of the Display-Skip Generator are given later.

The Timer operation is also controlled by the Single-Shot Lockout level at pin 2. If this level is LO, the Timer operates as just described. However, if the Single-Shot Lockout stage sets a HI level at this pin, the Timer stage is locked out and can not produce any output signals (see Single-Shot Lockout description for further information).

READOUT intensity control R2124 (see diagram 2) sets the intensity of the readout display independently of the A or B INTENSITY controls. The READOUT intensity control also provides a means of turning the Readout System off when a readout display is not desired. When R2124 is turned fully counterclockwise, the switch in series with the Readout Intensity line opens. The current to pin 11 of U2126 is interrupted, and at the same time, a positive voltage is applied to pin 4 through CR2124. The positive voltage switches the stage to the same conditions as were present under the Display-Skip condition. Therefore, the crt display is not interrupted to present characters. However, time-slot pulses continue to be generated.

Time-Slot Counter

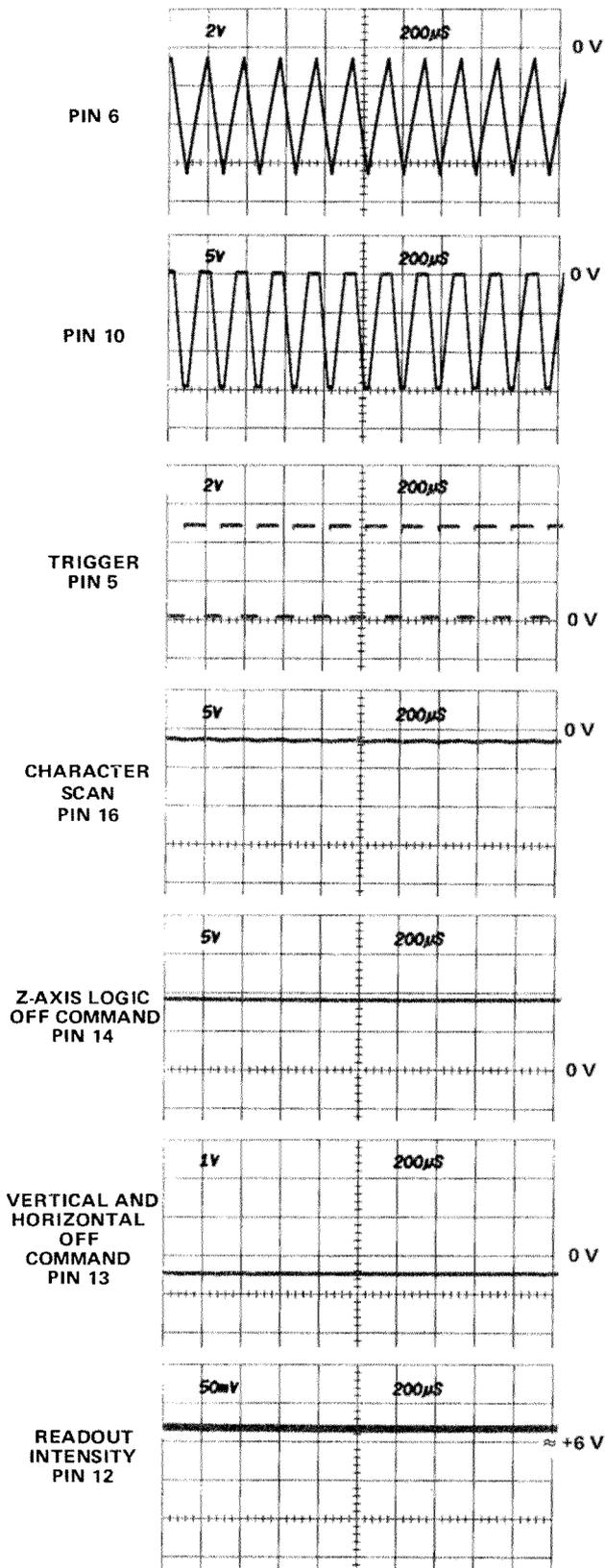
Time-Slot Counter U2159 is a sequential switch which directs the trapezoidal waveform input at pin 8 to one of its 10 output lines. These time-slot pulses are used to interrogate the plug-in units to obtain data for the Readout System. The Trigger pulse at pin 15 switches the Time-Slot Counter to the next output line; the output signal is sequenced consecutively from time-slot 1 through time-slot 10. Figure 3-30 shows the time relationship of the time-slot pulses. Notice that only one line carries a time-slot pulse at any given time. When time-slot 10 is completed, a negative-going End-of-Word pulse is produced at pin 2. The End-of-Word pulse provides a drive pulse for the Word Trigger stage and also provides an enabling level to the Display-Skip Generator during time-slot 1 only.

Pin 16 is a reset input for the Time-Slot Counter. When this pin is held LO, the Time-Slot Counter resets to time-slot 1. The Time-Slot Counter can be reset to this manner only when a Jump Command is received by U2155C and D (see following discussion).

Word Trigger

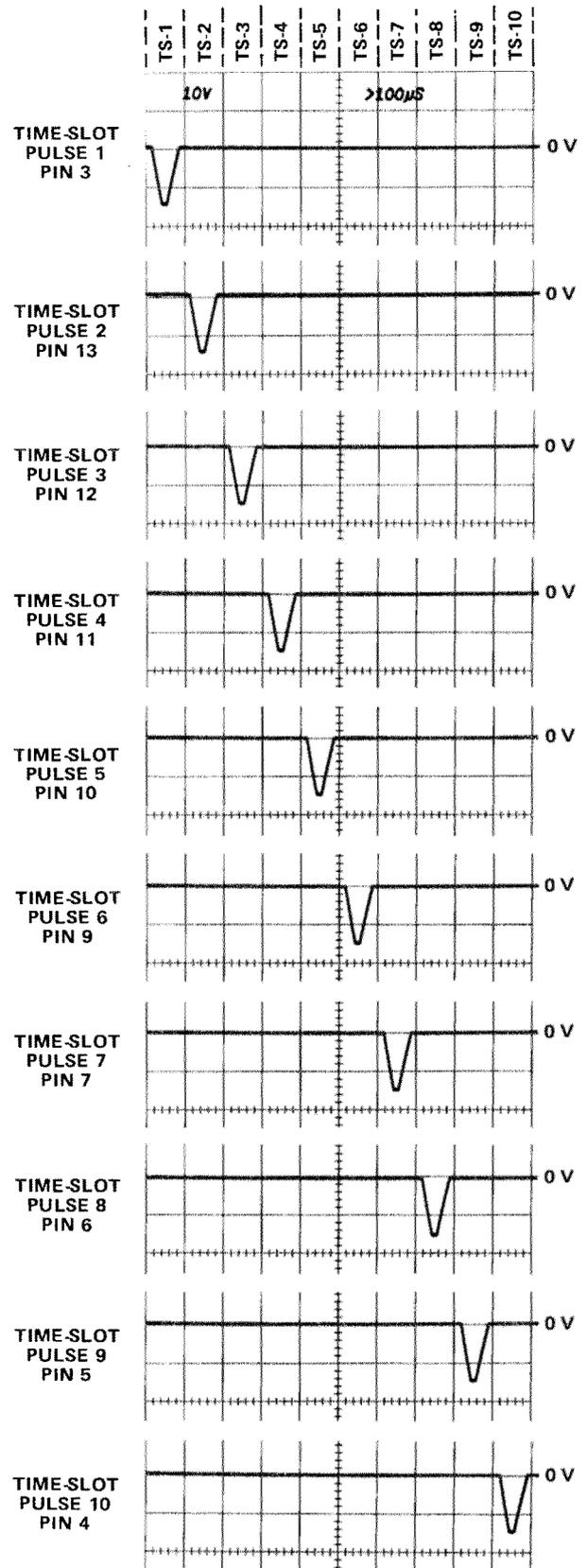
The Word Trigger stage is made up of U2155A and B. Quiescently, pin 3 of U2155A is LO as established by the operating conditions of U2155C and D. Therefore, the LO End-of-Word pulse produced by the Time-Slot Counter results in a HI level at pin 1 of U2155A. This level is inverted by U2155B to provide a negative-going Word Trigger pulse to the Channel Counter.

Also, a Word Trigger pulse is produced by U2155B when a Jump Command is received at pin 8 of U2155C. This condition can occur during any time-slot (see Row Decoder for further information on origin of the Jump



NOTE: TEST OSCILLOSCOPE EXTERNALLY TRIGGERED FROM TP2251.

Fig. 3-29. Timer stage operation when Display-Skip condition occurs.



NOTE: TEST OSCILLOSCOPE EXTERNALLY TRIGGERED FROM TP2251. SWEEP RATE UNCALIBRATED.

Fig. 3-30. Time relationship of the time-slot (TS) pulses produced by U2159.

Circuit Description—7904 (SN B260000-UP)

Command). U2155C and D are connected as a bistable flip-flop. The positive-going Jump Command at pin 8 of U2155C produces a LO at pin 10. This LO is inverted by U2155D to produce a HI at pin 13, which allows pin 9 to be pulled HI through CR2156. The flip-flop has now been set and remains in this condition until reset, even though the Jump Command at pin 8 returns to its LO level. The HI output level at pin 13 turns on Q2159 to pull pin 16 of the Time-Slot Counter LO. This resets the Time-Slot Counter to time-slot 1 and holds it there until the Word Trigger is reset. At the same time, a HI level is applied to pin 4 of the Timer through CR2157 and CR2125. This HI level causes the Timer to operate in the Display-Skip mode, so a character is not generated.

The next Trigger pulse is not recognized by the Time-Slot Counter, since U2159 is locked in time-slot 1 by U2155. However, this Trigger pulse resets the Word Trigger stage through C2155. Pin 13 of U2155D goes LO to enable the Time-Slot Counter and Timer stages for the next time-slot pulse. Simultaneously, when U2155D switches output states, the resulting negative-going edge is connected to pin 3 of U2155A. This results in a negative-going Word Trigger output at pin 4 to advance the Channel Counter to the next word. When the next Trigger pulse is received at pin 15, the Time-Slot Counter returns to the normal sequence of operation and produces an output on the time-slot 1 line.

Channel Counter

Channel Counter U2250 is a binary counter that produces the Channel Address Code for the Column and Row Decoder stages and the Format Generator stage. This code instructs these stages to sequentially select and display the eight channels of data from the plug-ins. Table 3-4 gives the eight combinations of the Channel Address Code and the resultant channel selected with each combination.

Readout Control

Q2108 and Q2112, along with S2110, control the operating mode of the Readout System through the Single-Shot Lockout stage. When Readout Mode switch S2110 is in the Free-Run position, the Readout System runs continuously in a free-running manner. The emitter of Q2108 has no ground return in this position, so it can not conduct. The collector of Q2108 rises positive through R2108 to enable the Readout System.

In the Gate Trig'd position, the emitter of Q2108 is connected to ground through R2109 and S2110 to produce a LO lockout level to the Single-Shot Lockout stage. At the end of the selected gate, a negative level is applied to the base of emitter-follower Q2112. The negative level at the emitter of Q2112 is differentiated by C2112-R2112. The resulting negative-going pulse reverse biases Q2108 to momentarily allow its collector to go HI.

Table 3-4

CHANNEL ADDRESS CODE

Pin 11 U2250	Pin 8 U2250	Pin 9 U2250	Channel Displayed
LO	LO	LO	Channel 2 Left Vertical
LO	LO	HI	Channel 1 Left Vertical
LO	HI	LO	Channel 2 Right Vertical
LO	HI	HI	Channel 1 Right Vertical
HI	LO	LO	Channel 2 A Horizontal
HI	LO	HI	Channel 1 A Horizontal
HI	HI	LO	Channel 2 B Horizontal
HI	HI	HI	Channel 1 B Horizontal

This enables the Single-Shot Lockout stage for a single-shot readout display. (For further information, see the following discussion.)

Single-Shot Lockout

U2120 makes up the Single-Shot Lockout stage. This stage allows a single readout frame (eight complete words) to be displayed on the crt, after which the Readout System is locked out, so further readout displays are not presented until the circuit is reset. U2120B and U2120C are connected to form a bistable flip-flop. For normal operation, pin 8 of U2120C is pulled HI through R2108. This activates U2120C to result in a LO output level at pin 10, enabling the Timer stage to operate in the free-running manner described previously.

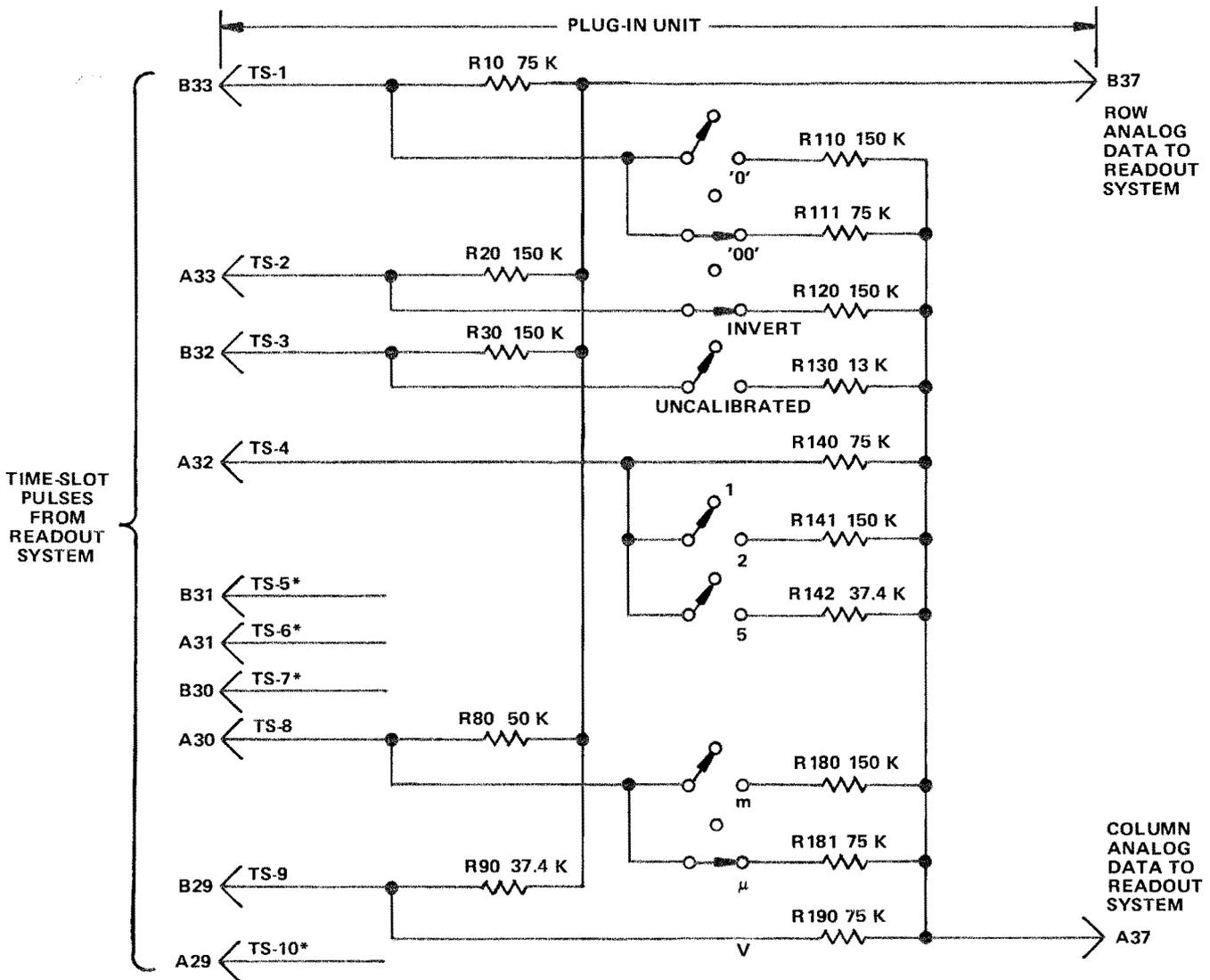
The output of the Single-Shot Lockout stage remains LO to allow U2126 to operate in the free-running mode until a LO is received at pin 8 of U2120C. When this occurs, the output level at pin 10 of U2120C does not change immediately. However, the Readout System is now enabled as far as the single-shot lockout function is concerned. If the Channel Counter has not completed word eight (Channel 1 of B HORIZ unit), the Readout System continues to operate in the normal manner. However, when word eight is completed, the negative-going End-of Frame pulse is produced at pin 11 of U2250 as the Channel Counter shifts to the code necessary to display word one. This pulse is coupled to pin 6 of U2120B. The momentary HI at pin 6 activates U2120B and its output stage goes LO to disable U2120C (pin 8 already LO). The output of U2120C goes HI to disable the Timer, so it operates in the Display-Skip mode. The HI at pin 10 of U2120C also holds U2120B enabled, so it maintains control of the flip-flop.

The Single-Shot Lockout stage remains in this condition until a positive-going trigger pulse is applied to pin 8 of U2120C. This trigger pulse produces a LO at pin 10 of U2120C to enable U2126 and disable U2120B. Now, the Timer can operate in the normal manner for another complete frame. When word eight is completed, the Channel Counter produces another End-of-Frame pulse to again lock out the Timer stage. (For further information on the Readout Mode, see the Readout Control description.)

Encoding the Data

Data is conveyed from the plug-in units to the Readout System in the form of an analog (current level) code. The characters that can be selected by the encoded data are shown on the Character Selection Matrix (see Fig. 3-24).

Each character requires two currents to define it; these currents are identified as the column current and the row current, corresponding to the column and row of the matrix. The column and row data is encoded by programming the plug-in units. Figure 3-31 shows a typical encoding scheme using resistors for a voltage-sensing amplifier plug-in unit. Notice that the 10 time-slots (TS) pulses produced by the Time-Slot Counter stage are connected to the plug-in unit. However, time-slots 5, 6, 7, and 10 are not used by the plug-in unit to encode data when using the Standard Readout Format. (See Table 3-3 for Standard Readout Format.) The amplitude of the time-slot pulse is exactly -15 volts as determined by the Timer stage. Therefore, the resultant output current from the plug-in units can be accurately controlled by the programming resistors in the plug-in units.



* NOT USED IN STANDARD FORMAT.

Fig. 3-31. Typical encoding scheme for voltage-sensing plug-in unit. Coding shown for deflection factor of 100 microvolts.

Circuit Description—7904 (SN B260000-UP)

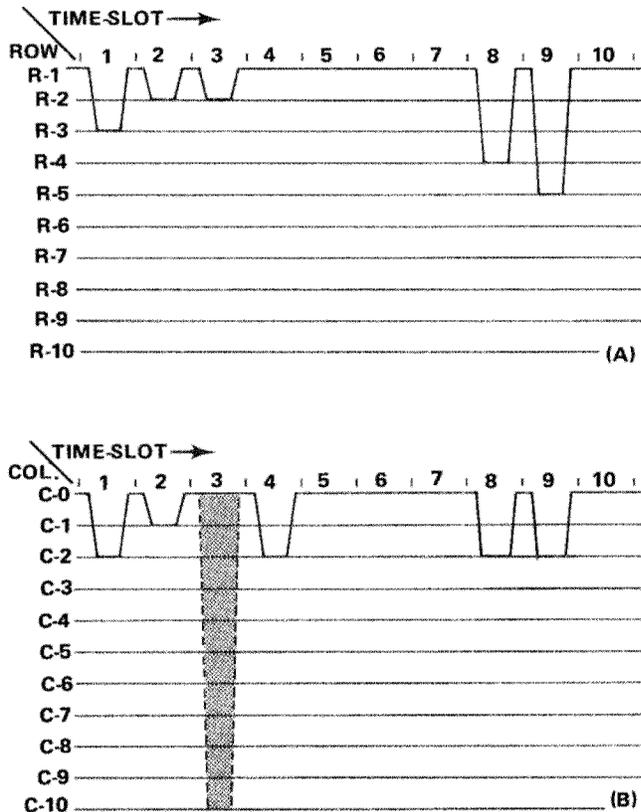
For example, in Fig. 3-31 resistors R10 through R90 control the row analog data, which is connected back to the Readout System. Figure 3-32A shows an idealized output current waveform of row analog data, which results from the time-slot pulses. Each of the row levels of current shown in these waveforms corresponds to 100 microamperes of current. The row numbers on the left-hand side of the waveform correspond to the rows in the Character Selection Matrix (see Fig. 3-24). The row analog data is connected back to the Readout System via terminal B37 of the plug-in interface.

The Column analog data is defined by resistors R110 through R190. The program resistors are connected to the time-slot lines by switch closures to encode the desired data. The data as encoded by the circuit shown in Fig. 3-31 indicates a 100-microvolt sensitivity with the crt display inverted and calibrated deflection factors. This results in the idealized output current waveforms shown in Fig. 3-32B at the column analog data output, terminal A37 of the plug-in interface.

Resistor R111, connected between time-slot 1 and the column analog data output, encodes two units of current during time-slot 1. Referring to the Character Selection Matrix, two units of column current, along with the two units of row current encoded by resistor R10 (row 3), indicates that two zeros should be added to the display. Resistor R120 adds one unit of column current during time-slot 2 and, along with the one unit of current from the row output, the Readout System is instructed to add an invert arrow to the display. Resistor R130 is not connected to the time-slot 3 line, since the deflection factor is calibrated, therefore, there is no column current output during this time-slot and no display on the crt. (See Display-Skip Generator for further information).

During time slot 4, two units of column current are encoded by R140. There is no row current encoded during this time-slot; this results in the numeral 1 being displayed on the crt. Neither row nor column analog data is encoded during time-slots 5, 6, and 7 as defined by the Standard Readout Format. During time-slot 8, two units of column current and three units of row current are encoded by resistors R181 and R80, respectively. This addresses the μ prefix in the Character Selection Matrix.

The final data output is provided from time-slot 9 by R190 connected to the column output and R90 to the row output. These resistors encode two units of column current and four units of row current to cause a V (volts) to



PROGRAM FOR 100 μ V, INVERTED, CALIBRATED (UNCALIBRATED OPERATION SHOWN BY SHADED AREA)

Fig. 3-32. Idealized current waveforms of: (A) Row analog data, (B) Column analog data.

be displayed. Time-slot 10 is not encoded, in accordance with the Standard Readout Format. The resultant crt readout will be $\downarrow 100 \mu$ V.

In the above example, the row analog data was programmed to define which row of the Character Selection Matrix was addressed to obtain information in each time-slot. The column data changes to encode the applicable readout data as the operating conditions change. For example, if the variable control of the plug-in unit was activated, R130 would be connected between time-slot 3 and the column analog data output line. This encodes 10 units of column current (see shaded area in time-slot 3 of the waveform shown in Fig. 3-23B). Since one unit of row current is also encoded during this time-slot by R30, A > symbol is added to the display. The crt readout will now show $\downarrow > 100 \mu$ V. In a similar manner, the other switches can change the encoded data for the column output and thereby change the readout display. See the descriptions which follow for decoding this information.

The column analog data encoded by most plug-in units can be modified by attenuator probes connected to the input connectors of amplifier plug-in units. A special coding ring around the input connector of the plug-in unit senses the attenuation ratio of the probe (with readout-coded probes only). The probe contains a circuit that provides additional column current. For example, if a 10X attenuator probe is connected to a plug-in unit encoded for 100 microvolts as shown in Fig. 3-31, an additional unit of current is added to the column analog data during time-slot 1. Since two units of current were encoded by R111 (see Fig. 3-31), this additional current results in a total of three units of column analog current during this time-slot. Referring to the Character Selection Matrix, three units of column current, along with the two units of row current encoded by R10, indicates that the prefix should be shifted one column to the left. Since this instruction occurs in the same time-slot that previously indicated that two zeros should be added to the display and only one instruction can be encoded during a time-slot, the zeros do not appear in the display. The crt readout will now be changed to 1 mV (readout program produced by plug-in same as for previous example).

Three other lines of information are connected from the plug-in compartments to the Readout System. The column and row analog data from Channel 2 of a dual-channel plug-in are connected to the Readout System through terminals A38 and B38 of the plug-in interface, respectively. Force readout information is encoded on terminal A35; the function of this input is described under Column and Row Data Switches.

The preceding information gave a typical example of encoding data from an amplifier plug-in unit. Specific encoding data and circuitry is shown in the individual plug-in unit manuals.

Column and Row Data Switches

The encoding data from the plug-in units is connected to the Column and Row Data Switch stages. A column-data line and a row-data line convey analog data from each of the eight data sources (two channels from each of the four plug-in compartments).

The Column Data Switch U2190 and the Row Data Switch U2180 receive the Channel Address Code from the Channel Counter. This binary code directs the Column Data Switch and the Row Data Switch as to which channel should be the source of the encoding data. Table 3-4 gives the eight combinations of the Channel Address Code and the resultant channel selected with each combination.

These stages have nine inputs and provide a time-multiplexed output at pin 7, which includes the information from all of the input channels. Eight of the nine inputs to each stage originate in the plug-in units; the ninth input comes from a special data-encoding network composed of resistors R2192 through R2199 and R2201 through R2209. (See Zeros Logic and Memory description for further information on ninth channel.)

In addition to the encoding data inputs from the plug-in units, inputs are provided to the Column Data Switch from the VERTICAL MODE and HORIZONTAL MODE switches to inhibit the readout for any plug-in unit(s) not selected for display (see Diagram 2). When a plug-in unit is selected, a HI level is applied to the inhibit input for the opposite channel. The channel inhibit lines are LO only when the associated plug-in unit has been selected for display. When a unit is not selected, the respective line is HI to forward bias the associated diodes: CR2162-CR2163, CR2166-CR2167, CR2170-CR2171, or CR2174-CR2175. The forward-biased diodes cause the channel switches to bypass the encoded data from the inhibited channel. However, since it may be desired to display information from special-purpose plug-in units (even though they do not produce a normal waveform display on the crt), a feature is provided to over-ride the channel inhibit. This is done by applying a LO to the associated Force Readout input. The LO level diverts the HI channel-inhibit current and allows the data from this plug-in unit to reach the Column Data Switch, even though it has not been selected for display by the mode switch.

Row Match adjustment R2182 sets the gain of the Row Data Switch to match the gain of the Row Decoder for correct output. Column Match adjustment R2213 performs the same function for the Column Data Switch stage.

Display-Skip Generator

The Display-Skip Generator is made up of Q2215, Q2233, Q2225, and Q2229. This stage monitors the time-multiplexed column data at the output of the Column Data Switch during each time-slot to determine if the information at this point is valid data that should result in a crt display. Quiescently, there is about 100 microamperes of current flowing through R2213 from Q2240 and the Zero Logic and Memory stage. (The purpose of this quiescent current will be discussed in connection with the Zeros Logic and Memory stage.) This current biases Q2215A so that its base is about 0.2 volt more positive than the base of Q2215B in the absence of column data. Therefore, since Q2215A and Q2215B are connected as comparator, Q2215A will remain on unless its base is pulled more negative than the base of Q2215B.

Circuit Description—7904 (SN B260000-UP)

The analog data output from the Column Data Switch produces a 0.5 volt (approximately) change for each unit of column current that has been encoded by the plug-in unit. Whenever any information appears at the output of the Column Data Switch, the base of Q2215A is pulled more negative than the base of Q2215B, resulting in a negative (LO) Display-Skip output to the Timer stage through Q2225. Recall that a LO was necessary at the skip input of the Timer so it could perform the complete sequence necessary to display a character.

Q2223-Q2229 also provide Display-Skip action. The End-of-Word level connected to their emitters is LO only during time-slot 1. This means they are enabled only during this time-slot. These transistors allow the Zeros Logic and Memory stage to generate a Display-Skip signal during time-slot 1 when information that is not to be displayed on the crt has been stored in memory (further information is given under Zeros Logic and Memory).

Column and Row Decoders

The Column Decoder U2244 and Row Decoder U2185 sense the magnitude of the analog voltages at their inputs (pin 10) and produce a binary output on one of ten lines corresponding to the column or row data encoded by the plug-in unit. These outputs provide the Column Digital Data and Row Digital Data, which is used by the Character Generator stages to select the desired character for display on the crt. The column and row data is also used throughout the Readout System to perform other functions.

The input current at pin 9 of the Column Decoder stage is steered to only one of the ten Column Digital Data outputs. When a Display-Skip signal is present (collector of Q2225 HI), pin 9 is pulled HI through CR2226. This ensures that no current is connected to the Character Generator stage under this condition. Notice the corresponding input on the Row Decoder. This input is connected to ground and causes only one of the ten row outputs to saturate to ground.

The network at the input of the Row Decoder, made up of Q2153 and its associated components, is a Row-14 detector that produces the Jump Command. This row current is encoded by special-purpose plug-ins to cause all or part of a word to be jumped. Whenever row 14 (thirteen units of row current, or 1.3 milliamperes) is

encoded, the base of Q2153 is pulled negative enough so that this transistor is reverse biased to produce a HI Jump Command output at its collector. The Jump Command is connected to the Word Trigger stage to advance the Channel Counter to the next word and to reset the Time-Slot Counter to time-slot 1.

Zeros Logic and Memory

The Zeros Logic and Memory stage U2232 stores data encoded by the plug-in units to provide zeros-adding and prefix-shifting logic for the Readout System. The Strobe pulse at pin 15 goes positive when the data has stabilized and can be inspected. This activates the Zeros Logic and Memory stage so that it can store the encoded data. A block representation of the memory sequence is shown in Fig. 3-33.

Typical output waveforms for the five possible input conditions that can occur are shown in Fig. 3-34. When time-slot 1 occurs, a store command is given to all of the memories. If the plug-in units encoded data for column 1, 2, 3, 4, or 10 during time-slot 1, the appropriate memory (or memories) is set. Notice that row 3 information from the Row Decoder must also be present at pin 16 for data to be stored in the memory of U2232.

If data was encoded during time-slot 1, a negative-going output is produced at pin 7 while the memories are being set. This negative-going pulse is connected to the base of Q2229 in the Display-Skip Generator to produce a Display-Skip output. Since the information encoded during time-slot 1 was only provided to set the memories and not intended to be displayed on the crt at this time, the Display-Skip output prevents a readout display during this time-slot.

During time-slot 5, memory A is interrogated. If information was stored in this memory, a positive-going output is produced at pin 7. This pulse is connected to pin 10 of the Column Decoder through Q2240 to add one unit of current at the input of the Column Decoder. This produces a zero after the character displayed during time-slot 4. During time-slot 6, memory B is interrogated to see if another zero should be added. If another zero is necessary, a second positive output is produced at pin 7, which again results in a column 1 output from the Column Decoder and a second zero in the crt display.

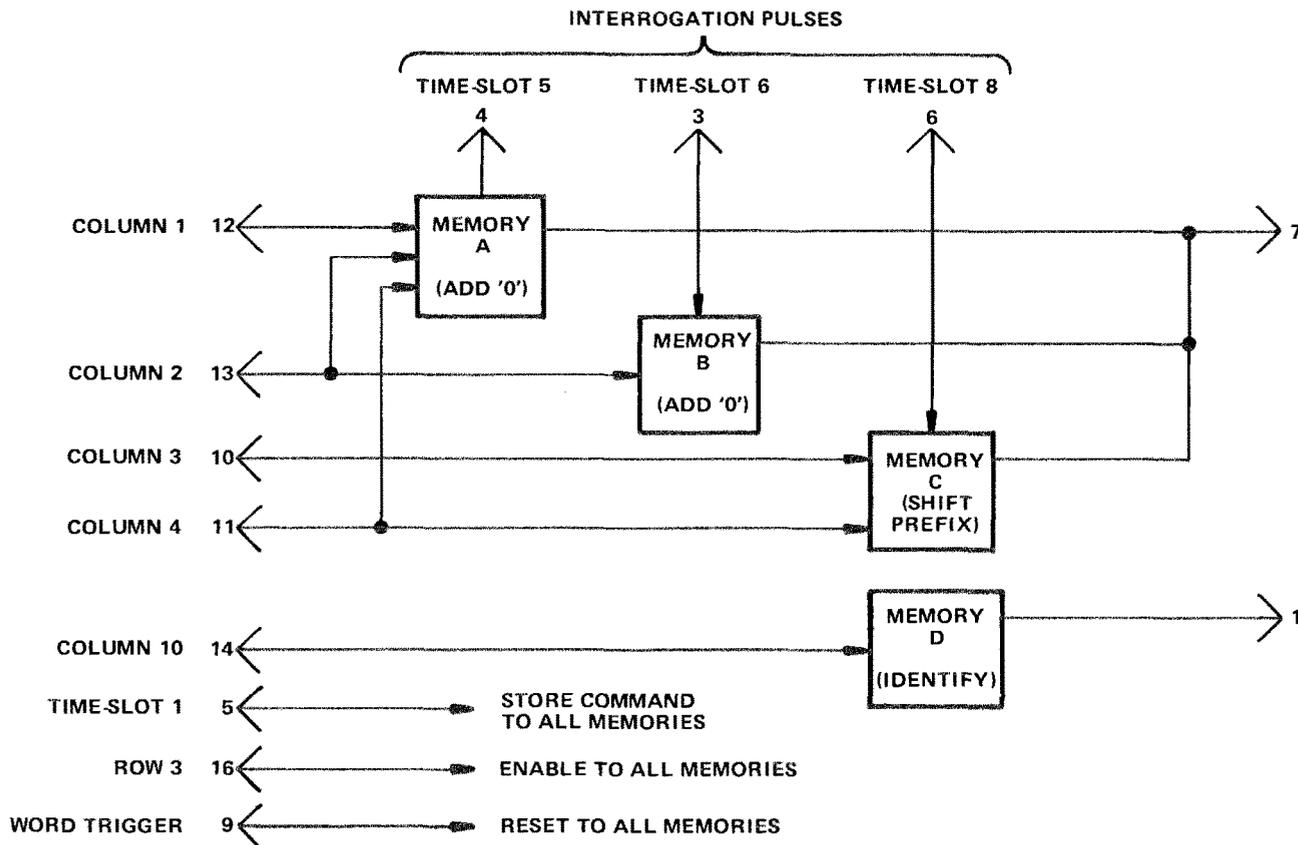


Fig. 3-33. Block representation of memory sequence in U2232.

Finally, memory C is interrogated during time-slot 8 to obtain information on whether the prefix should be changed, or left at the value that was encoded. If data has been encoded that calls for a shift in prefix, a negative-going output level is produced at pin 7. This negative level subtracts one unit of column current from the data at the input to the Column Decoder. Notice on the Character Selection Matrix of Fig. 3-24 that when row 4 is programmed, a reduction of one column results in a one-column shift of the prefix. For example, with the 100 μ V program shown in Fig. 3-31, if the data received from the plug-in called for a shift in prefix, the crt readout would be changed to 1 mV (zeros deleted by program; see Encoding the Data).

The 100 microamperes of quiescent current through R2213 provided by Q2240 (see Display-Skip Generator) allows the prefix to be shifted from m (100 microamperes column current, column 1) to no prefix (zero column current, column zero) so only the unit of measurement encoded during time-slot 9 is displayed. Notice that reducing the prefix program from column 1 to column 0 programs the Readout System to not display a character at this readout location.

A further feature of the Zeros Logic and Memory is the Identify function. If 10 units of column current are encoded by the plug-in unit along with row 3 during time-slot 1, the Zeros Logic and Memory produces a negative-going output pulse at pin 1 to switch the Column Data Switch and Row Data Switch to the ninth channel. Then, time-slot pulses 2 through 9 encode an output current through resistors R2191-R2199 for column data and R2201-R2209 for row data. This provides the currents necessary to display the word IDENTIFY in the word position allotted to the channel that originated the Identify command. After completion of this word, the Column Data Switch and Row Data Switch continue with the next word in the sequence.

The Word Trigger signal from the Word Trigger stage is connected to pin 9 of U2232 through C2242. At the end of each word of readout information, this pulse goes LO. This erases the four memories in the Zeros Logic and Memory in preparation for the data to be received from the next channel.

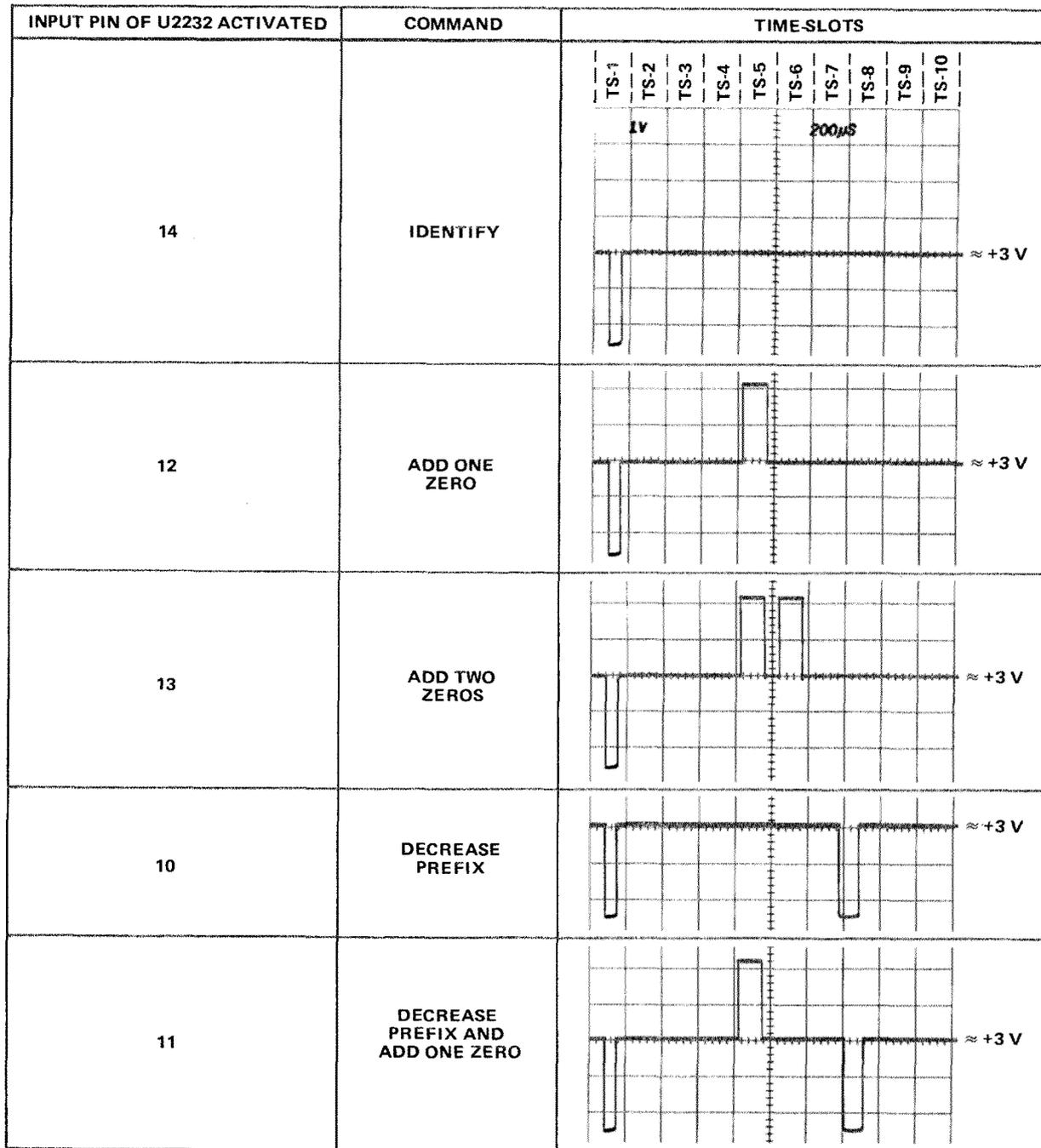


Fig. 3-34. Typical output waveforms for Zeros Logic and Memory stage operation (at pin 7 of U2232).

Character Generators

The Character Generator stage consists of five similar integrated circuits (U2270 through U2278), which generate the X (horizontal) and Y (vertical) outputs at pins 16 and 1, respectively, to produce the character display on the crt. Each integrated circuit can produce 10 individual characters. U2270 (designated "Numerals") can produce

the numerals 0 through 9 shown in row 1 of the Character Selection Matrix (Fig. 3-24). U2272 can produce the symbols shown in row 2 of the Character Selection Matrix and U2274 produces the prefixes and some letters, used as prefixes, shown in row 4. U2276 and U2278 produce the remaining letters shown in rows 5 and 6 of the Character Selection Matrix.

All of the Character Generator stages receive the Column Digital Data from the Column Decoder U2244 in parallel. However, only one of the Character Generators receives row data at a particular time and only the stage receiving this row data is activated. For example, if column 2 is encoded, the five Character Generators are enabled so that either a 1, <, μ, V, or an N can be produced. If row 4 has been encoded at the same time, only the Prefix Character Generator U2274 will produce an output to result in a "μ" being displayed. The activated Character Generator provides current output for the Format Generator to produce the selected character on the crt. In a similar manner, any of the characters shown in the Character Selection Matrix can be displayed by correct addressing of the row and column.

character another space to the right. However, under this condition, no display is produced on the crt during this time-slot, since the Character Generators are not activated.

Time-slot pulses 1, 2, and 3 are also connected to pin 4 of U2260 through VR2262, VR2263, and VR2264 respectively and R2262-R2265. This configuration adds a space to the displayed word during time-slots 1, 2, and 3 even if information is not encoded for display during these time-slots. With this feature, the information displayed during time-slot 4 (scaling data) always starts in the fourth character position whether data has been displayed in the previous time-slots or not. Therefore, the resultant crt display does not shift position as normal-invert or caluncal information is encoded. The Word Trigger pulse connected to pin 8 resets the Character Position Counter to the first character position at the end of each word.

Decimal Point Logic and Character Position Counter

Decimal Point Logic and Character Position Counter U2260 performs two functions. The first function is to add a staircase current to the X (horizontal) signal to space the characters horizontally on the crt. After each character is generated, the negative-going edge of the Ready signal at pin 5 advances the Character Position Counter. This produces a current step output at pin 3 which, when added to the X signal, causes the next character to be displayed one character space to the right. This stage can also be advanced when a Space instruction is encoded so a space is left between the displayed characters on the crt. Row 10 information from the Row Decoder is connected to pin 4 of U2260. When row 10 and column 0 are encoded, the output of this stage advances one step to move the next

The Decimal Point Logic portion of this stage allows decimal points to be added to the crt display. With the Standard Readout Format, row 7, encoded coincident with columns 3 through 7, addresses a decimal at one of the five locations, identified in row 7 of the Character Selection Matrix (Fig. 3-24). This instruction refers to the decimal point location in relation to the total number of characters possible in one word (see Fig. 3-35). For example, column 3 encoded with row 7 during time-slot 1 places a decimal point in location No. 3. As shown in Fig. 3-35, this displays a decimal point after the third character that can be displayed on the crt. (The first three time-slots produce a space whether data is encoded or not; see previous paragraph.)

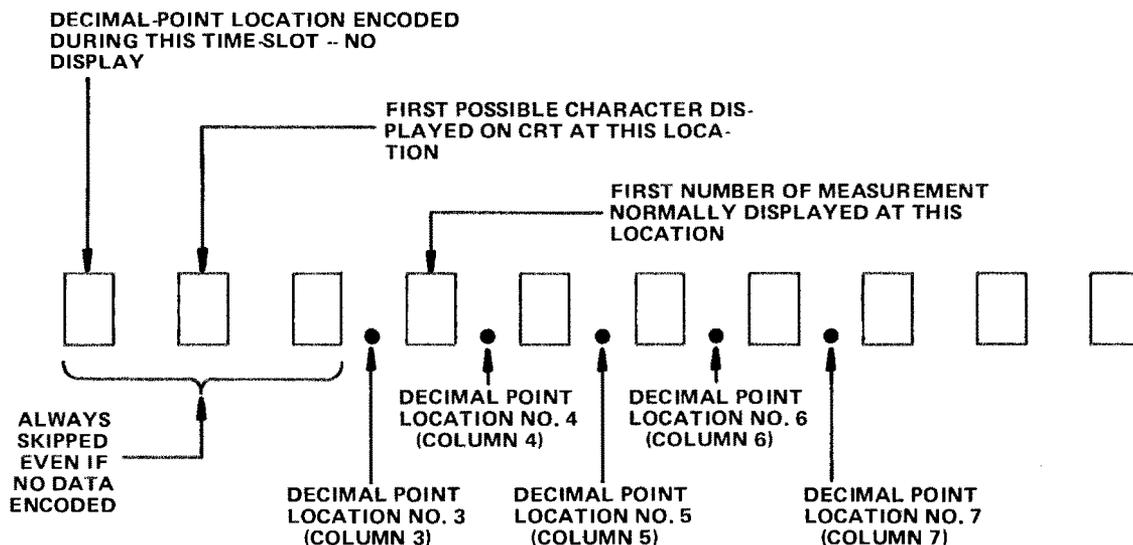


Fig. 3-35. Readout word relating 10 possible character locations to the decimal point instructions that can be encoded, and the resultant crt display.

Circuit Description—7904 (SN B260000-UP)

When decimal-point data is encoded, the crt is unblanked so a readout display is presented. Since row 7 does not activate any of the five Character Generators, the crt beam is deflected vertically by the application of row-7 data to the Y input of the Format Generator through R2280. This placed the decimal point between the characters along the bottom line of the readout word. After the decimal point is produced in the addressed location, the crt beam returns to the location indicated by the Character Position Counter to produce the remainder of the display.

Format Generator

The X- and Y- deflection signals produced by the Character Generator stage are connected to pins 2 and 7, respectively, of Format Generator U2284. The Channel Address Code from the Channel Counter is also connected to pins 1, 8, and 15 of this stage. The Channel Address Code directs the Format Generator to add current to the X and Y signals to deflect the crt beam to the area of the crt associated with the plug-in channel that originated the information (see Fig. 3-23). The Channel Address Code and the resultant word positions are shown in Table 3-4. The Ready signal at pin 13 (coincident with the Vertical and Horizontal OFF Command output) activates this stage when a character is to be displayed on the crt. R2274 and R2275 determine the horizontal and vertical size, respectively, of the displayed characters. R2273 provides an adjustment to set the vertical size of the characters (Character Height) as desired. The character

position current from the Decimal Point Logic and Character Position Counter stage is added to the X (horizontal) input signal to space the characters horizontally on the crt (see previous discussion).

Y-Output Amplifier

The Y-output signal at pin 6 of Format Generator U2284 is connected to the Y-Output Amplifier Q2287-Q2299. This stage provides a low-impedance load for the Format Generator while providing isolation between the Readout System and the driven circuits. Vertical Separation adjustment R2291 changes the gain of this stage to control the vertical separation between the readout words displayed at the top and bottom of the graticule area.

X-Output Amplifier

The X-Output Amplifier Q2286-Q2296 operates like the Y-Output Amplifier, to provide the horizontal deflection from the readout signal available at pin 4 of U2284. The gain of this stage is fixed by the values of the resistors in the circuit.

Display Sequence

Figure 3-36 shows a flow chart for the Readout System. This chart illustrates the sequence of events that occurs in the Readout System each time a character is generated and displayed on the crt.

VERTICAL AMPLIFIER

General

The Vertical Amplifier circuit includes the Vertical Channel Switch and Main Vertical Amplifier circuits. The Vertical Channel Switch circuit selects the vertical deflection signal from the output of the LEFT or RIGHT VERT plug-in unit. This circuit also accepts an input from the Readout System to block the vertical signal while readout information is displayed on the crt. The Main Vertical Amplifier circuit provides the final amplification for the vertical signal before it is applied to the vertical deflection plates of the crt. This circuit includes the delay line and an input to produce the vertical portion of a readout display. The BEAM FINDER switch limits the dynamic range of this circuit to compress an over-scanned display within the viewing area of the crt. An input from the Readout System is provided to over-ride the beam-finder function, so the BEAM FINDER switch has no effect on the readout portion of the crt display. In addition, this circuit accepts the Auxiliary Y-Axis input from the Main Interface circuit.

Figure 3-37 shows a detailed block diagram of the Vertical Amplifier circuit. A schematic of this circuit is shown on diagram 5 at the rear of this manual.

Vertical Channel Switch

The Vertical Channel Switch determines which input signal provides the vertical signal to the Main Vertical Amplifier, as controlled by the Vertical Mode Command from the Logic circuit. This stage is made up primarily of integrated circuit U4625 and U4685. An input/output table for these switches is shown in Fig. 3-38. The positive and negative-signal channels from the vertical plug-in compartments are connected to the inputs of U4625 and U4685, through 50 Ω coaxial cables. Each coaxial cable is terminated in its characteristic impedance by U4625 and external components. For example, R4602-R4603-C4603 and U4625 (at pins 12 and 13) terminate the Left Vertical positive-signal channel. R4603 is selected for a termination impedance of 50 Ω . Bias inputs to U4625 and U4685 permit the characteristics of each channel to be set by external components. For example, the Left Vertical positive-signal channel operating level is set by R4605, R4607, and R4608. Frequency compensation is provided by R4610-C4610 and R4611-C4611. Likewise, other components in the same configuration perform these functions for the remaining signal channels.

Transistor array U4641A, B, C, and D provide a logic drive for U4625 and U4685, and serve as emitter-coupled switches for routing left and right vertical signals through the respective channel switches.

The output signal at J4688 and J4689 is a push-pull signal, which is connected to the Main Vertical Amplifier through Delay Line DL650. R4689 is selected to set the Channel Switch gain to 115 mV/division. The sum of the dc current at J4688 and J4689 is always equal to the sum of the dc currents at the bias inputs in all modes. This provides a constant dc bias to the respective stage as the VERTICAL MODE switch is changed. When one integrated circuit is in the off state, the signal currents are canceled within it, but the dc bias current must still pass through the output connectors to maintain dc bias voltage at the next stage. This current comes from pin 6 of the off-state integrated circuit, and passes through R4625, R4627, R4685, and R4687, which also decouples pin 6 from the signal path.

Auxiliary Input Amplifier

The Auxiliary Input Amplifier controls the bias current to the High-Frequency Amplifier stage to provide centering for the Main Vertical Amplifier circuit. This stage also provides readout and auxiliary inputs to the Main Vertical Amplifier circuit.

Auxiliary Y-axis signals are connected to the base of Q694. Q694-Q698 are connected as a paraphase amplifier to convert the single-ended input to a push-pull output to drive Q710-Q716. The Vertical OFF Command from the Readout System goes HI when readout information is to be displayed. This HI level turns on Q705; the emitter of Q705 goes HI to turn off Q694-Q698, thus blocking any auxiliary Y-axis signals. During the readout time, bias current to Q710-Q716 is supplied through R707-R708-R709. Readout Vertical Centering adjustment, R707, balances this bias current to adjust the vertical position of the readout portion of the crt display. The Vertical Centering adjustment R712 balances the quiescent dc levels in this stage so the trace is displayed at the center of the crt when the inputs to the Main Vertical Amplifier circuit are at the same potential.

The signal at the collectors of Q710-Q716 is applied to the bases of Q723-Q728 through R718-R721. For readout displays, the Y-signal from the Readout System is connected to the base of Q723 through R719. Since the signal from the vertical units is blocked in the Vertical Channel Switch, the readout signal provides the only vertical deflection. Although this signal is connected to the base of Q723 as a single-ended signal, this transistor pair acts as a paraphase amplifier to convert the signal to push-pull. The output of this stage at the collectors of Q723-Q728 is connected to the bias inputs of U685 in the High-Frequency Amplifier stage.

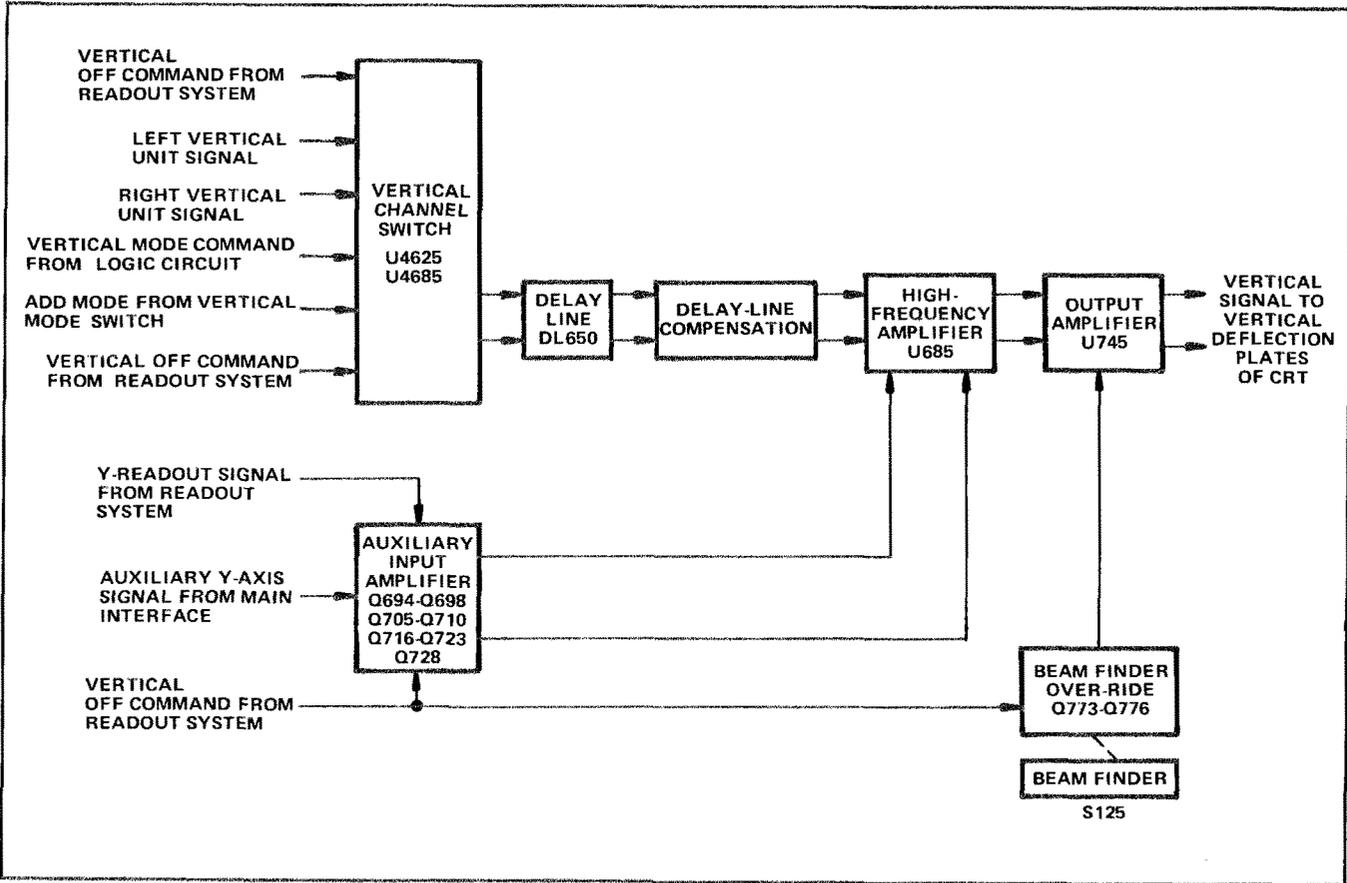


Fig. 3-37. Vertical Amplifier detailed block diagram.

INPUT			OUTPUT
VERTICAL MODE COMMAND	ADD MODE	VERTICAL/HORIZONTAL OFF COMMAND	OUTPUT SIGNAL
LO	LO	LO	LEFT VERTICAL SIGNAL
HI	LO	LO	RIGHT VERTICAL SIGNAL
LO	HI	LO	BOTH (ADDED ALGEBRAICALLY)
Φ	Φ	HI	NEITHER (BLOCKED BY READOUT SYSTEM)

Φ = HAS NO EFFECT IN THIS CASE

Fig. 3-38. Input/output table for Vertical Channel Switch IC, U4625, U4685.

Delay Line

Delay Line DL650 provides approximately 60 nanoseconds of delay for the vertical signal to allow the horizontal circuits time to initiate a sweep before the vertical signal reaches the vertical deflection plates of the crt. This allows the instrument to display the leading edge of the signal originating the trigger pulse when using internal triggering. The delay line used in this instrument has a characteristic impedance of 100 Ω differentially. It is of the coaxial type that does not produce preshoot or phase distortion in the crt display.

High-Frequency Amplifier

The High-Frequency Amplifier stage, consisting primarily of integrated circuit U685, provides a 50 Ω input impedance (100 Ω differentially) for the Main Vertical Amplifier circuit to permit accurate delay-line termination. The components connecting the input signal to U685 provide forward termination and compensation for the delay line. R658-C658 provide adjustable high-frequency compensation. The internal circuitry of U685 is represented in Fig. 3-39. Terminals to the emitters of the input transistors of U685 at pins 5-6 and 11-12 permit the quiescent operating conditions of the stage to be set by discrete components. R682 and R689 set the quiescent operating level; R684 and R688 are selected to accurately set the gain of the differential channels. These emitter inputs also provide a means of injecting the output of the Auxiliary Y-Axis Amplifier. The Vertical Gain adjustment R730 and sensistor R731 set the resistance between the output terminals of U685 to control the current gain of this stage. This adjustment sets the overall gain of the Main Vertical Amplifier circuit; the sensistor provides thermal compensation.

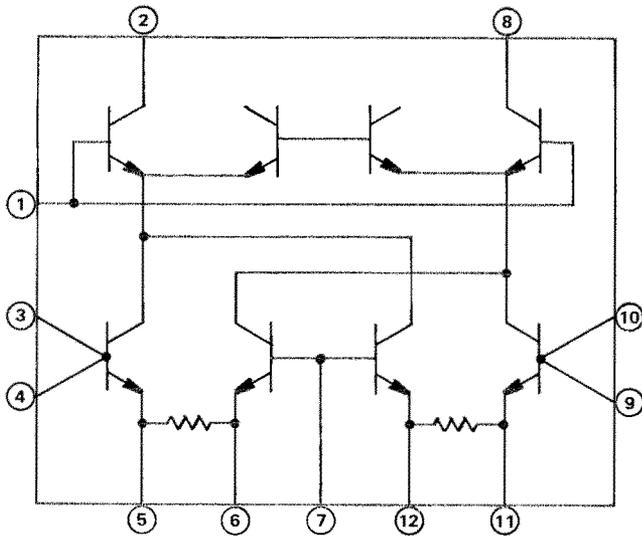


Fig. 3-39. U685 internal circuitry representation.

Output Amplifier

The Output Amplifier stage, consisting primarily of integrated circuit U745, provides final amplification for the vertical signal to drive the crt vertical deflection plates. A representation of the internal circuitry of U745 is shown in Fig. 3-40. Terminals to the emitters of the input transistors at pins 1-12 and 6-7 allow the use of discrete components to establish the quiescent operating characteristics of this stage. R741 and R756 are selected to accurately set the gain of the differential channels. R753-R754-R767-R768-R770 set the operating level of this stage. The series RC networks in parallel with R741 and R756 provide frequency compensation for uniform gain at all frequencies within the bandpass of this instrument.

The BEAM FINDER switch, S125, switches the emitter current source for U745 to provide the beam finder function. Normally, the emitter current for U745 is supplied from ground through S125. However, when S125 is actuated, the only emitter current source for U745 is through R771. This limits the dynamic range of this stage by limiting its current, so the display is compressed vertically within the graticule area.

The signal at the output collectors of U745 is connected directly to the vertical deflection plates of the crt. A distributed deflection plate system is used in this instrument for maximum frequency response and sensitivity. The signal at the output of U745 is connected to the deflection-plate structure in the crt and then to termination network LR780-R782A-LR784-R782B. As the signal passes through the deflection-plate structure in the crt, its velocity is essentially the same as the velocity of the electron beam passing between the vertical deflection plates. This synchronism of the deflection signal and the electron beam reduces the loss in high-frequency sensitivity due to electron-transit time through the deflection-plate structure.

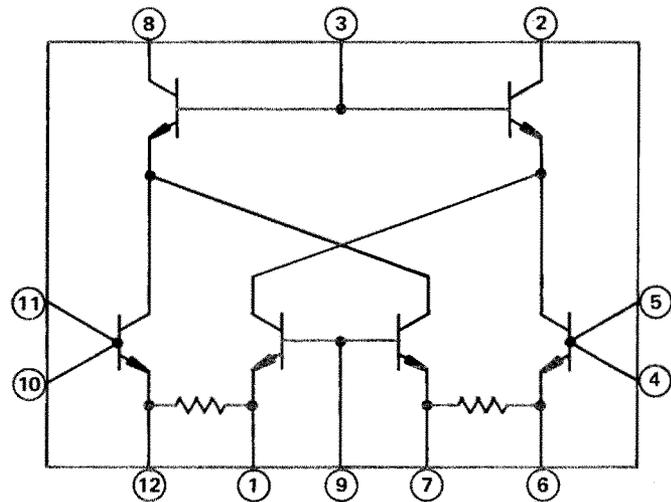


Fig. 3-40. U745 internal circuitry representation.

Transistors Q785 and Q786 make up a protection circuit for U745, in case the +15 volt supply is shorted to ground. If this occurs Q786 turns on causing the base of Q785 to drop below +35 volts. Thus, the emitter voltage of Q785 is kept at a safe level for U745.

Beam Finder Over-Ride

The Beam Finder Over-Ride stage switches the current source for the Output Amplifier stage to over-ride the beam-finder function as determined by the Vertical OFF Command from the Readout System. Quiescently, the Vertical OFF Command is LO with Q776 conducting to cut off Q773. When the BEAM FINDER switch is actuated, R771 limits the current for the Output Amplifier. When readout information is to be displayed, the Vertical OFF Command goes HI to cut off Q776. The resultant HI on the emitter of Q776 causes Q773 to saturate. The current necessary for full-range operation of U745 is supplied from ground through Q773 during this time.

HORIZONTAL AMPLIFIER

General

The Horizontal Amplifier circuit includes the X-Y Delay Compensation Network (Option 2 only), Horizontal Channel Switch, and Main Horizontal Amplifier circuits. The X-Y Delay Compensation Network provides a delay for the horizontal (X) signal portion of an X-Y display to match the delay of the vertical (Y) signal due to the Delay Line. The Horizontal Channel Switch portion of the circuit selects the horizontal deflection signal from the output of the A HORIZ and B HORIZ plug-in unit. The Main Horizontal Amplifier circuit amplifies the push-pull horizontal deflection signal from the Horizontal Channel Switch for application to the horizontal deflection plates of the crt. This circuit also accepts the X-signal from the Readout System to produce the horizontal portion of a readout display. Figure 3-41 shows a detailed block diagram of the Horizontal Amplifier circuit. A schematic of this circuit is shown on diagram 6 at the rear of this manual.

X-Y Delay Compensation (Option 2 Only)

Time-Base Operation. When the plug-in unit installed in the A or B HORIZ compartment is operated as a standard time-base unit to produce a horizontal sweep for deflection of the crt beam, the A or B Delay Compensation Networks are effectively disabled. The delay disable command is HI and relays K802-K805 or K812-K815 are not actuated. Therefore, the relay contacts remain in the normally-closed position so the horizontal signal passes directly through this network to the Horizontal Channel Switch without delay.

X-Y Operation. If the time-base unit installed in the A or B HORIZ compartment is operated as an amplifier, or if an amplifier unit is installed in a horizontal compartment, the delay disable command to the applicable Delay Compensation Network drops to the LO level (zero volts). This provides an actuating level to relays K802-K805 or K812-K815 to connect the Delay Compensation Network into the circuit. For example, if the A Delay Disable command from the A HORIZ unit goes LO, K802 and K805 close to route the A HORIZ signal through the A Delay Compensation Network. Diode CR801 shunts the voltage produced across the relays when the actuating level is removed.

The Delay Compensation Network provides flat time delay with frequency. LC network L806-C806, L807-C807, L808-C808, L809-C809 is an all-pass lattice network with a 100 Ω input impedance when terminated in 100 Ω (50 Ω each side). Low-pass network L802-R802, C803-C804, L805-R805 also has a 100 Ω input impedance when terminated in 100 Ω . Only the low-pass network determines the bandwidth of the Delay Compensation Network. The total time delay is the sum of the low-pass and lattice-network time delays. C804, in the low-pass network, is adjusted to match the horizontal-system time delay to the vertical-system time delay up to at least one megahertz.

The Delay Compensation Network normally produces negative preshoot distortion along with some corner rounding of fast step functions. The A Delay Disable switch S801 allows selection of a display with either minimum phase-shift characteristics or optimum step response. When this switch is set to Out, the A Delay Disable command is disconnected from relays K802-K805. Now, the signal from the A HORIZ unit passes directly to the Horizontal Channel Switch without delay to provide a horizontal display with optimum step response.

The B Delay Compensation Network operates in the same manner as described above. The X-Y Delay Compensation Network is an optional feature. For instruments which are not equipped with this feature, the horizontal signals from the plug-in units are connected directly to the Horizontal Channel Switch through the Horizontal Interconnect board.

Horizontal Channel Switch

The Horizontal Channel Switch determines which input signal provides the horizontal signal to the Main Horizontal Amplifier as controlled by the Display B Command from the Logic circuit. Resistors R821-R823 and R825-R827 establish the 50 Ω input resistance of this stage and provide a load for the A and B HORIZ units or terminate the actuated Delay Compensation Network (Option 2 only). Resistors R835-R836-R837 and R845-R846-R847 establish the operating levels for this stage. R835-R836 and R845-R846 set the current gain for each channel.

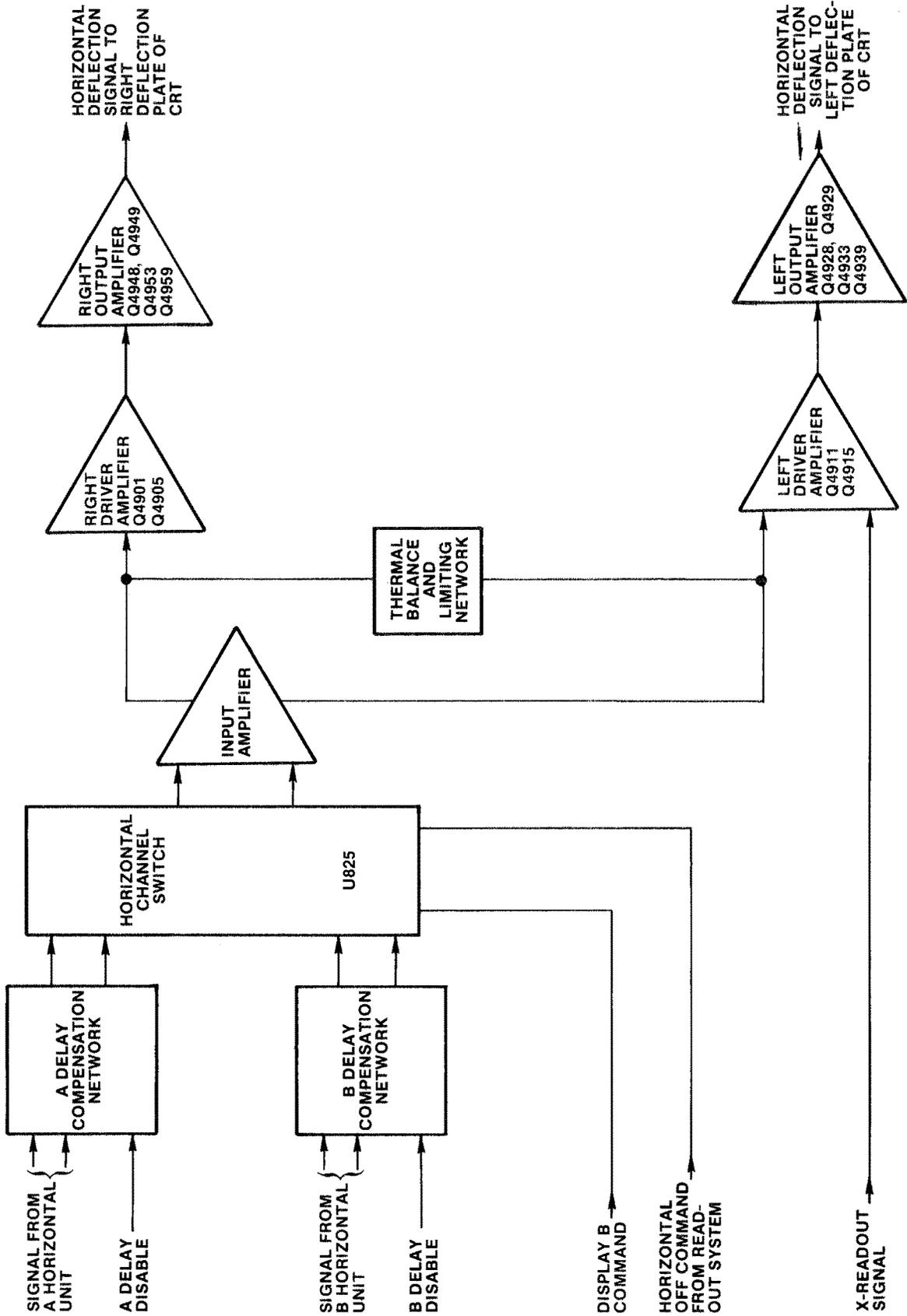


Fig. 3-41. Horizontal Amplifier detailed block diagram.

This stage is made up primarily of integrated circuit U825. An input/output table for U825 is shown in Fig. 3-42. U825 provides a differential input for the signal from the A HORIZ unit at pins 2 and 15 and the signal from the B HORIZ unit at pins 7 and 10. The output signal at pins 12 and 13 is a differential signal which is connected to the Main Horizontal Amplifier circuit. The sum of the dc current at pins 12 and 13 is always equal to the sum of the dc currents at pins 1, 8, 9, and 16 in all modes. This provides a constant dc output current level to the following stage as the HORIZONTAL MODE switch is changed.

The Horizontal OFF Command from the Readout System, which is applied to pin 6, has final control over the output signal from this stage. Quiescently, this signal is LO and the signal from the selected horizontal unit can pass to output pins 12 and 13. However, when the Readout System is ready to display readout information, the level at pin 6 goes HI. This level blocks the signal from both horizontal units so there is no signal output from this stage under this condition.

Input Amplifier

The Input Amplifier stage is a paraphase amplifier consisting of Q4885 and Q4895. Overall gain for the Horizontal Amplifier is determined by Gain adjustment R4873. Thermal compensation for the horizontal system is provided by the thermistor network, RT4877 and R4877. The Display Center adjustment, R4867, compensates for centering error in the channel switch and input amplifier circuit. Capacitor C4874 increases the gain of the input stage at high frequency, and provides adjustment for the 0.5 ns/div timing.

INPUT		OUTPUT
4	6	12, 13
LO	LO	A HORIZONTAL SIGNAL
HI	LO	B HORIZONTAL SIGNAL
Φ	HI	NEITHER (BLOCKED BY READOUT SYSTEM)

Φ = HAS NO EFFECT IN THIS CASE

Fig. 3-42. Input/output table for Horizontal Channel Switch IC, U825.

The Input Amplifier emitter current source is normally supplied from the +15 Volt Supply through R4882 and R4881, with Q4883 off. When the BEAMFINDER switch is activated the emitter current to Q4885 and Q4895 is supplied only through R4881. This reduces the dynamic range of the input stage by limiting its current source. Transistor Q4883 is forward biased and supplies the required current to the Driver and Output Amplifiers. This action reduces the dynamic range of the horizontal system to keep the display within the horizontal limits of the graticule, regardless of the setting of the positioning controls or signal amplitude.

Left and Right Driver Amplifiers

The Left and Right Driver Amplifiers are current driven shunt-feedback amplifiers, consisting of Q4901 and Q4911, and feedback resistors R4889 and R4899. Transistors Q4905 and Q4915 are emitter followers that drive the capacitive load that is presented by the output stage.

Left Output Amplifier

The Left Output Amplifier is an operational amplifier consisting of common-emitter transistors Q4948 and Q4949, and common-base transistor Q4953. R4912 is the input resistor and R4955 is the feedback resistor. To provide higher speed, the input resistor is paralleled by input capacitors C4918 and C4919, and the feedback resistor is paralleled by C4955. C4919 also provides the 2 ns/div timing adjustment. Q4959 acts as a current source for the output stage.

Right Output Amplifier

Basic operation of the Right Output Amplifier is similar to that described for the Left Output Amplifier. However, Q4939 in addition to serving as a collector current source for the output amplifier Q4933 is also the high-frequency signal path from the collectors of Q4928 and Q4929 to the crt deflection plates.

OUTPUT SIGNALS AND CALIBRATOR 7

General

The Output Signals and Calibrator circuit provides output signals to the connectors located in the OUTPUT section of the front panel. These output signals are either generated within this instrument or are samples of signals from the associated plug-in units. Figure 3-43 shows a detailed block diagram of the Output Signals and Calibrator circuit. A schematic of this circuit is shown on diagram 7 at the rear of this manual.

Sawtooth Amplifier

The sweep signals (sawtooth waveforms) from the A time-base unit or the B time-base unit are connected to the emitter of Q1042 through series resistor R1033 and R1038 respectively. The Sweep switch S1035 determines which sawtooth signal provides the output. The other sawtooth signal is terminated by S1035 grounding the previously mentioned series resistor to provide a similar load to the signal source. The signal at the collector of Q1042 is connected to transistors Q1046-Q1052, which compose an inverting feedback amplifier. The signal at the collector of Q1052 feedback amplifier. The signal at the collector of

Q1052 is connected to the front-panel +SAWTOOTH connector J1059 through R1057.

Gate Amplifier

The output signal at the front-panel + GATE connector J1089 is selected from three input gate signals by Gate switch S1065. In the A position, the A Gate signal from the A time-base unit is connected to the base of emitter-follower Q1069 through R1067. The base of Q1073 is connected to ground by S1065 in this position so it operates as a common-base stage. Q1069 provides a high input impedance for the stage, while the emitter coupling between Q1069-Q1073 provides temperature compensation. Operation is the same in the B position of S1065 except that the B Gate signal from the B time-base unit provides the input signal. In the Dly'd position, S1064 connects the base of Q1069 to ground through R1067 and disconnects both the A and B Gate signals. Now, the Delayed Gate signal from a delaying time-base unit (in either A or B HORIZ compartments) can pass to the base of Q1073 through R1077. Q1073 inverts this negative-going input signal so the gate output signals at the + GATE connector are all positive-going. C1070 provides high-frequency compensation for this stage.

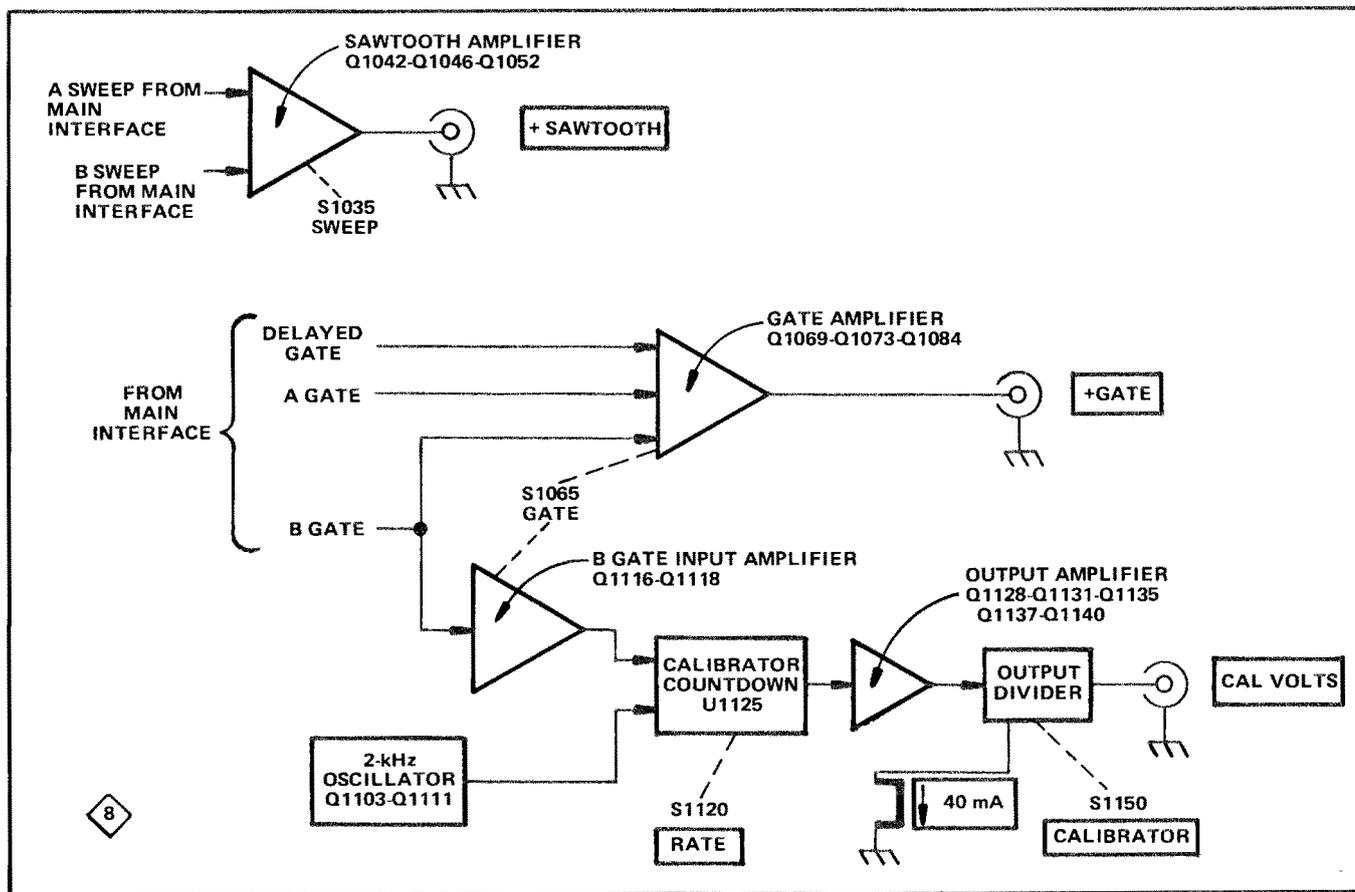


Fig. 3-43. Output Signals and Calibrator circuit detailed block diagram.

The input gate signal selected by S1065 is connected to the emitter of Q1084. Diode CR1081 provides temperature compensation for Q1084. The signal at the collector of Q1084 is connected to the + GATE connector through CR1086. CR1086 protects Q1084 if a high-level positive voltage is applied to the +GATE connector, and CR1087 clamps the output at about -0.6 volt if a negative voltage is applied to this connector.

B Gate Amplifier

The B Gate signal from the B time-base unit is connected to the base of Q1118. Q1118 amplifies and inverts the B Gate signal to provide a negative-going gate signal to the Calibrator circuit for B GATE $\div 2$ operation of the Calibrator. Q1116 provides temperature compensation for this stage.

Calibrator

General. The Calibrator circuit provides a 40-milliampere current output at the front-panel 40 mA current loop and voltage output in calibrated steps from four millivolts to 40 volts at the front-panel CAL VOLTS connector. The repetition rate of the output signal is selected by the calibrator RATE switch; voltage or current output and the output voltage amplitude are selected by the CALIBRATOR switch.

2 kHz Oscillator. Q1103 and Q1111 are connected as a two-kilohertz, square-wave oscillator to provide the drive signal for the Calibrator Countdown stage (one-kilohertz output rate only). Oscillation occurs as follows: Assume that Q1103 is conducting and Q1111 is off. The collector current of Q1103 through R1101-R1102 produces a voltage level which hold the base of Q1111 low. This keeps Q1111 turned off and since there is no current through it, its collector is positive to produce the positive portion of the square wave. At the same time, C1108 begins to charge toward -50 volts through R1109. The emitter of Q1111 goes negative also, as C1108 charges, until it reaches a level about 0.6 volt more negative than the level at its base. Then, Q1111 is forward biased and its emitter rapidly rises positive. Since C1108 cannot change its charge instantaneously, the sudden change in voltage at the emitter of Q1111 pulls the emitter of Q1103 positive also, to reverse bias it. The current through Q1111 produces a voltage drop at its collector to produce the negative portion of the square wave.

Now, conditions are reversed. Since Q1103 is reverse biased, there is no current through it. Therefore, C1108 can begin to discharge through R1106. The emitter level of

Q1103 follows the discharge of C1108 until it reaches about -0.6 volt. Then, Q1103 is forward biased and its collector drops negative to reverse bias Q1111. This interrupts the current through Q1111 and its collector goes positive again to complete the square wave. Once again, C1108 begins to charge through R1109 to start the second cycle. The signal produced at the collector of Q1111 is a two-kilohertz square wave. C1114 differentiates this signal to produce positive- and negative-going output pulses, coincident with the rise and fall of the square wave, which provides negative-going trigger pulses for the Calibrator Countdown stage (positive-going pulses have no effect on circuit operation). The 1 kHz adjustment, R1101, sets this stage so an accurate one-kilohertz square wave is produced at the output of the Calibrator circuit.

Calibrator Countdown. Integrated circuit U1125 is a triggered set-clear (J-K) flip-flop. The calibrator RATE switch S1120 selects the source of the trigger signal for U1125. S1120 is a cam-type switch; a contact-closure chart showing its operation is given on diagram 8. The dots on this chart indicate when the associated contact is closed. For the dc position (contacts on diagram shown in this position), a LO level is applied to the J input (pin 1) and a HI level is applied to the K input (pin 3). The next negative-going trigger from the 2 kHz Oscillator stage switches the output at pin 7 to its LO level. The output at pin 7 remains at the LO level as long as the RATE switch remains in this position.

For the 1 kHz position, all contacts except 1 are closed. This places a LO level at both the J and K inputs so that pin 7 changes output levels with each negative-going trigger from the 2 kHz Oscillator stage. This results in a one kilohertz square-wave output signal at pin 7. The J and K inputs are also held LO in the B GATE $\div 2$ position of S1120 so that U1125 changes output levels with each negative-going pulse at its trigger input. However, the signal from the 2 kHz Oscillator is disconnected and the B Gate signal provides the trigger to pin 2, resulting in an output square wave with a repetition rate that is one-half the B Gate repetition rate.

Output Amplifier. Transistors Q1135 and Q1137 are connected as a comparator; the reference level at the base of Q1137 is determined by network R1144-R1145-R1146-R1148-Q1140. This network establishes a voltage level at the base of Q1137 that results in a 40 volt level at its collector when it is on. The 0.4 V adjustment R1148 is set in the 0.4 V position of the CALIBRATOR switch to provide accurate calibrator output voltages at the CAL VOLTS connector J1169. With R1148 accurately set, Output Voltage Divider resistors R1150 through R1162 form a current divider such that eight milliamperes flow through R1152 and the current loop when the CALIBRATOR switch is in the 40 mA position. The current loop is a five-turn current transformer, so the effective current applied to a current probe is 40 milliamperes.

Circuit Description—7904 (SN B260000-UP)

The output of the Calibrator Countdown stage is connected to the base of Q1128 through R1126. Q1128 acts as a switch to control the current through Q1131, and the output of Q1131 controls the conduction of comparator Q1135-Q1137. When dc operation is selected by the calibrator RATE switch, a LO level is applied to the base of Q1128 to cut it off. Therefore, there is no current through Q1131 and the base of Q1135 rises positive to cut it off also. Now, the collector current of Q1137 produces a voltage drop across the output voltage divider to provide a dc voltage output or current output as determined by the CALIBRATOR switch.

For the 1 kHz and B GATE $\div 2$ positions of the RATE switch, the base of Q1128 varies between the LO and HI levels at the rate selected by the RATE switch. When the base of Q1128 is LO, Q1125 is off and Q1137 is conducting. This produces an output as for dc operation. When the level at the base of Q1128 is switched to HI, Q1135 conducts and Q1137 is reverse biased. Now, the output drops to zero. The level at the base of Q1128 is HI in the OFF position of the RATE switch to provide zero output.

Output Divider. The collector current of Q1137 in the Output Amplifier stage is applied across the voltage divider made up of R1150-R1153-R1155-R1156-R1158-R1159-R1161-R1162. This divider is designed to provide a low output resistance in all positions except 40 V while allowing selection of output voltages between 4 mV and 40 V. CALIBRATOR switch S1150 selects the output from the divider to provide the output voltages listed on the front panel (into high-impedance load). The values shown in brackets indicate the output voltage into a 50 Ω load (notice that the 40 V position lists no output into 50 Ω and should not be used in this manner). S1150 is a cam-type switch and the dots on the contact-closure chart (see diagram 7) indicate when the associated contact is closed.

CONVERTER/RECTIFIERS

Block Diagram

The Converter/Rectifiers circuit provides the operating power for this instrument from an ac line-voltage source. This circuit includes a Line Selector assembly to permit selection of the nominal operating voltage for the instrument. Figure 3-44 shows a detailed block diagram of the Converter/Rectifiers circuit.

Line Input

Power is applied through the Line Filter, line fuse F1200, POWER switch S1200, and Line Selector switch S1212. The Line Filter is designed to keep power-line interference from entering the instrument and to keep the 25 kilohertz (approximately) Inverter signal from entering

the power line. L1201-L1203, with C1201-C1203, provide EMI (electromagnetic interference) filtering. R1201-R1203 provide common-mode resonance damping. R1205-C1205-C1206 suppress reverse-recovery transients of CR1215.

Line Selector switch S1212 allows the instrument to operate from either a 115 V nominal or a 230 V nominal line-voltage source. In the 115 V position, rectifier CR1215 operates as a full-wave doubler with energy-storage capacitors C1216-C1217, so the voltage across the two capacitors in series will be the peak-to-peak value (approximately) of the line voltage. For 230 V operation, CR1215 is connected as a bridge rectifier and the voltage across C1216-C1217 will be the peak value (approximately) of the line voltage. As a result, the output voltage applied to the Inverter stage is about the same for either 115 V or 230 V operation.

Thermistor R1209 limits the surge current demanded by the power supply when it is first turned on. After the instrument is in operation, the resistance of the thermistor drops so it has little effect on the operation of this stage. When the instrument is turned off, the Inverter is turned off by the Inverter Control Line Stop stage to prevent the sudden discharge of C1216 and C1217; C1216 and C1217 discharge slowly through R1221. The discharge time-constant of C1216-C1217-R1221 is about equal to the thermistor thermal-recovery time. This ensures sufficient thermistor resistance to limit the turn-on surge current to a safe level. Since C1216 and C1217 discharge slowly, dangerous potentials exist within the power supply for several minutes after the POWER switch is turned off. The presence of voltage in the circuit is indicated by the relaxation oscillator R1219-C1219-DS1219. Neon bulb DS1219 will blink until the potential across C1216-C1217 drops to about 80 V.

DS1208-DS1213 are surge-voltage protectors. When the Line Selector switch is in the 115 V position, only DS1208 is connected across the line input. If a peak voltage greater than 230 V is present on the line, DS1208 will break down and demand high current. This excess current will quickly open line fuse F1200 to interrupt the input power before the instrument can be damaged. In the 230 V position, DS1208 and DS1213 are connected in series across the line input to provide protection for peak voltages greater than 460 V.

Transformer T1208 provides a sample of the line voltage to the plug-in connectors in the Main Interface circuit for internal triggering at line frequencies. This line-frequency signal is also connected to the Inverter Control Line Stop stage to indicate when line voltage is applied and the POWER switch is on. F1223 protects the Inverter stage if excessive current is demanded due to a malfunction.

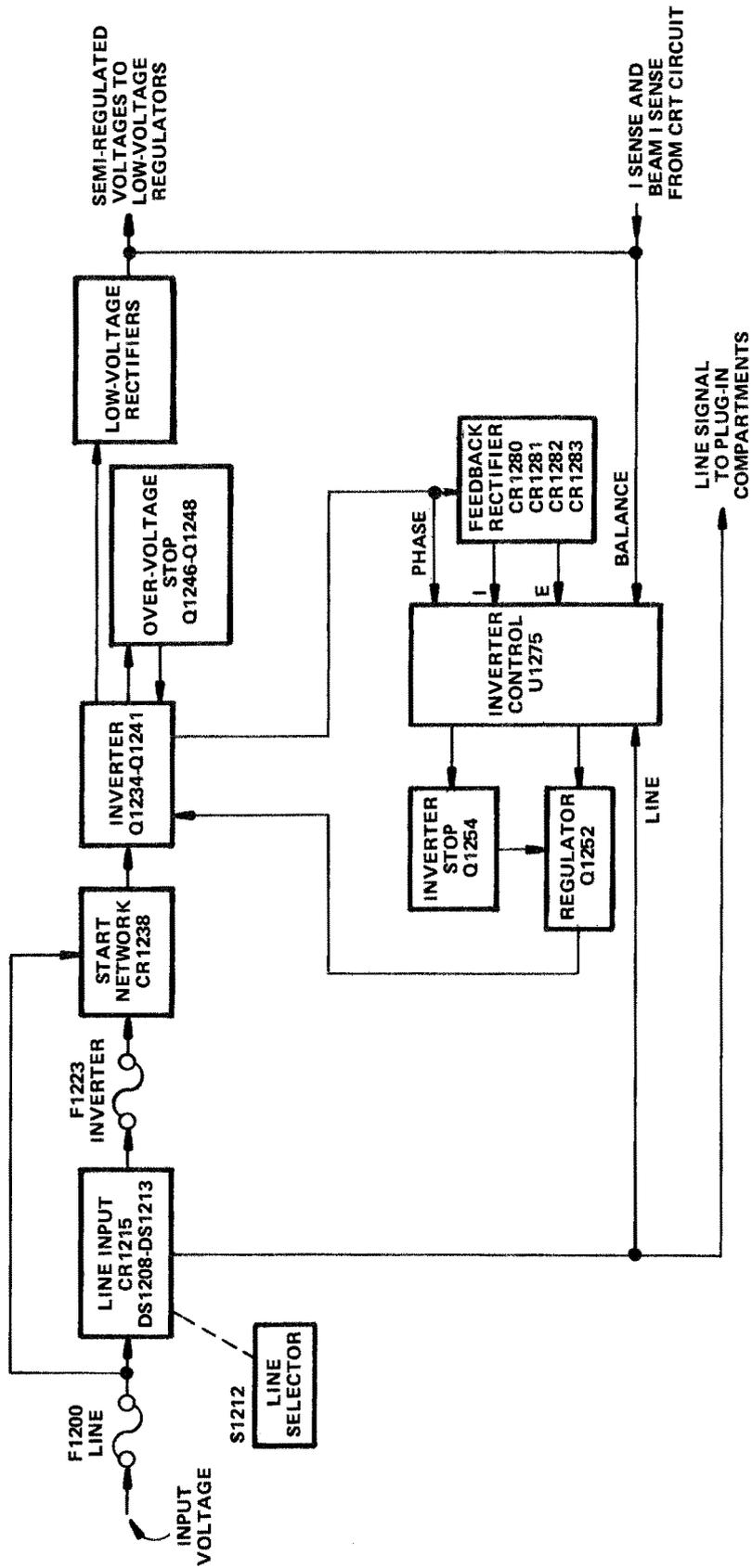


Fig. 3-44. Detailed block diagram of Converter/Rectifier circuit.

Start Network

Voltage divider R1210-R1242 is connected between the input line (ac) and the negative side of C1217 (through T1225). The voltage across R1242 charges C1242 on each half cycle of the input line voltage. When the charge on C1242 reaches about 32 V, trigger diode CR1238 conducts and C1242 is discharged through CR1238 to provide base drive to turn on Q1241 through C1239. When Q1241 is turned on, it shock-excites series-resonant network L1237-C1237 to generate a damped oscillation. This damped oscillation provides the drive necessary to start the Inverter switching action. After the Inverter is operating, the recurrent waveform at the collector of Q1241 keeps C1242 discharged through CR1242. This disables the Start Network while the instrument is on.

Inverter

The Inverter stage converts the dc output of the Line Input stage to a sine-wave current to drive Power Transformer T1310. Once the Inverter has been started by the Start Network, transformer T1230 provides feedback to the bases of Q1234 and Q1241 to sustain oscillation. The polarity of the windings causes Q1234 and Q1241 to switch alternately (i.e., only one transistor on at a time). These transistors operate at a forced beta of four due to the turns ratio of T1230. Also, T1230 provides an input from the Inverter Control and Regulator stages for pre-regulation and fault protection. This is accomplished by effectively short-circuiting one-half of the 60-turn, center-tapped winding to either delay the turn-on of Q1234-Q1241 or to completely stop their switching action.

The switching action of Q1234-Q1241 generates a square-wave voltage at the emitter of Q1234 with an amplitude approximately equal to the dc voltage at the input to this stage. The square-wave voltage at the emitter of Q1234 supplies the drive necessary to maintain a sine-wave current in the series-resonant network of L1237-C1237. Diodes CR1234 and CR1241 provide reverse-conduction paths across Q1234 and Q1241 respectively when these transistors are held off for pre-regulation.

To aid in understanding circuit operation, Fig. 3-45A shows a representation of the Inverter stage with a dc input voltage equal to E. The three possible states of the Inverter are depicted by the three possible positions of switch S1: Q1234 is on in position (a); Q1241 is on in position (c); or, both transistors are held off for pre-regulation in position (b). In the composite current waveform of Fig. 3-45B, the relative phase and amplitude of each component of I_1 is shown for periods T_a , T_b , and T_c corresponding to the three positions of S1 or the three states of the Inverter. The idealized voltage waveforms in Fig. 3-45C and Fig. 3-45D show the relationship of their amplitude to the dc input voltage and their phase with respect to the current waveform of Fig. 3-45B.

The normal sequence of operation is as follows: Assume that I_1 is passing through zero and is increasing in the direction to cause CR1234 to conduct. At zero crossing, the Regulator stage (Q1252) is turned on to hold off Q1234 and Q1241; CR1234 is forward biased to conduct I_1 as shown in Fig. 3-45B. After zero crossing, at a time determined by the Inverter Control stage, the Regulator allows Q1241 to conduct and reverse bias CR1234. Q1241 conducts as I_2 goes through its peak and back to zero. At zero crossing, with current increasing in the opposite direction, the Regulator is turned on to hold off Q1234 and Q1241. During this pre-regulation hold-off time, CR1241 conducts I_3 . When the Regulator is turned off, Q1234 is turned on to conduct I_4 and reverse bias CR1241. Q1234 conducts as I_4 goes through its peak and back to zero. The cycle then repeats itself.

The Inverter operates on the low side of the resonant frequency of L1237-C1237, which is about 29 kilohertz. Pre-regulation is achieved by varying the hold-off time of the Inverter transistors (T_b in Fig. 3-45B) and thereby varying the Inverter frequency. The power delivered to T1310 varies with the Inverter frequency because the impedance of the series-resonant network varies with frequency. At the lowest line voltage and highest load, the Inverter will operate at a frequency close to the resonant frequency. If either the line voltage is increased or the load is reduced, the Inverter frequency will decrease.

Over-Voltage Stop

The Over-Voltage Stop stage stops the Inverter whenever the voltage across the primary of T1310 exceeds a safe level to protect Inverter components from damage. This stage is activated whenever the normal voltage regulating path through Q1252 and T1230 is inoperative.

C1243 is charged through CR1244 to the peak of the voltage across the primary of T1310. If this voltage exceeds a safe level, VR1246 conducts to trigger SCR Q1248 into its forward-conduction state. C1243 then discharges through R1248, Q1248, and the base-emitter junction of Q1246. This discharge current turns on Q1246 to effectively short-circuit the base-drive winding of T1230 and stop the Inverter switching action. Since CR1249 becomes forward biased when Q1248 is triggered on, R1245-C1243 is effectively paralleled with C1242 in the Start Network. The relatively large capacitance of C1243 prevents C1242 from charging to the breakdown voltage of CR1238, thus preventing the Start Network from turning the Inverter on. Q1248 and Q1246 continue to conduct until the discharge current of C1243 drops below the holding current of Q1248. After Q1248 returns to its forward-blocking state, CR1249 remains forward biased to inhibit the Inverter Start Network while C1243 is charged through R1247. When the charge on C1243 is sufficient to reverse bias CR1249, the Start Network can start the Inverter.

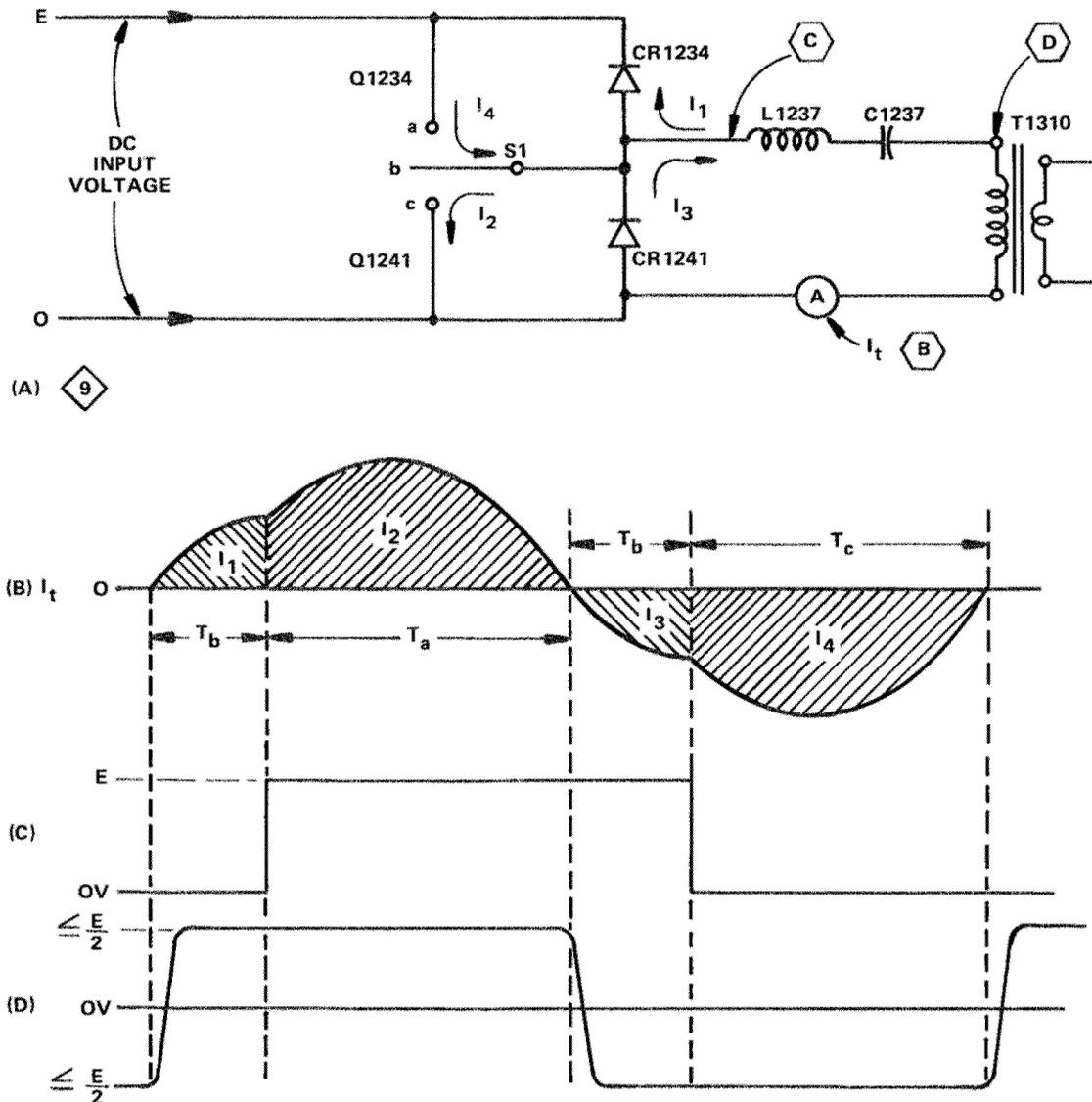


Fig. 3-45. (A) Representation of Inverter stage. Idealized waveforms of: (B) total Inverter current, I_t ; (C) voltage at junction of CR1234-CR1241; and (D) voltage across primary of T1310.

Inverter Control

The Inverter Control stage, made up primarily of U1275, provides pre-regulation and fault protection for the low- and high-voltage power supplies. For pre-regulation purposes, U1275 provides the Regulator output of the Regulator stage to vary energy delivered by the Inverter by varying the frequency. Fault protection is achieved through the Regulator output (as for pre-regulation) or by providing the Stop Trigger output to the Inverter Stop stage to turn the Inverter off.

U1275 includes a variable pulse-width monostable multivibrator which is initially triggered by current-phase

information fed back from the Inverter. The charge ramp for the multivibrator is available at pin 12 of U1275. R1300-C1300 determine the rate-of-rise of the charge ramp. The sensing inputs to U1275 determine the pulse width of the charge ramp (i.e., the multivibrator on time). The pulse width of the charge ramp corresponds to the Inverter hold-off time (T_b , in Fig. 3-45B). The multivibrator Regulator output drives the Regulator stage through pin 9-U1275. Under normal operating conditions, only the E Sense input at pin 15 has control over the output pulse width for pre-regulation. However, an error detected by any of the sensing inputs will affect the output pulse width and will also produce a Stop Trigger to the Inverter Stop stage. The operation of each individual function of the Inverter Control stage is described in the following discussion.

Circuit Description—7904 (SN B260000-UP)

Pre-Regulator. The Pre-Regulator portion of U1275, in conjunction with the Regulator stage, maintains constant voltages at the outputs of the Low- and High-Voltage Rectifiers.

Transformer T1235 provides Inverter power and phase information to U1275. The phase information is connected to the trigger input of the Inverter Control Multivibrator via pins 10 and 11 through C1275 and C1276. Bridge rectifier CR1280-CR1281-CR1282-CR1283 provides positive and negative operating voltages to U1275. A shunt regulator in U1275 regulates the +7.5 V output of the bridge rectifier connected to pin 6. The -2 V (nominal) output connected to pin 7 is unregulated. VR1297 provides a stable reference voltage for the sensing-divider resistors R1291-R1293-R1294-R1296-R1297. R1293 in this divider adjusts the voltage level at the E Sense input to the Pre-Regulator (pin 15-U1275) to set the output voltage of the rectifiers by controlling the +130 V supply. The output of the other supplies is set by the turns ratio of T1310.

In the stable state of the Inverter Control multivibrator, the Regulator output at pin 9 is near ground to turn off the Regulator stage. After the Inverter current passes through zero, either pin 10 or 11 will go positive to trigger the Inverter Control multivibrator on. While the multivibrator is on, the Regulator output voltage level is positive to turn on the Regulator stage. The duration of the on state is determined by the voltage level at the E Sense input at pin 15. If this voltage level is low, the duration is short. As this voltage level increases, the duration increases.

Fault Protection. The fault-protection portions of U1275 provide protection for the power-supply components from damage due to short circuits, turn-on surge currents, and other malfunctions. When a fault is detected at the Balance or I (current) Sense inputs (pins 2 and 13 respectively), a current output from the Sample Period Timer output (pin 1) charges C1264. If the detected fault lasts longer than about 15 milliseconds, C1264 will charge positive enough to produce a positive Stop Trigger output at pin 8 to turn the Inverter off. When the Inverter is shut off, the current charging C1264 is interrupted and C1264 will discharge. Once pin 8 goes positive, C1259 discharges through R1261 and the base-emitter junctions of Q1254 and Q1252. The discharge of C1259 keeps Q1254 and Q1252 turned on, and the Inverter turned off, for about 250 milliseconds. After this period, pin 8 returns to a near zero-volt level, turning off Q1254 and Q1252 to allow the Inverter to run. This cycle repeats until the fault is corrected, with the Inverter on for about 15 milliseconds then off for about 250 milliseconds.

Inverter Current Limiter. The Inverter Current Limiter provides protection for the Inverter components from damage due to excessive current. Operation of this stage is similar to the Pre-Regulator (voltage regulation). The Inverter Current Limiter takes control of the Inverter Control Regulator output pulse width during turn-on or whenever an overload causes the Inverter current to reach the limit value.

R1287 is the current-sensing resistor. The voltage at the junction of R1287-R1286-CR1288 is the negative rectified Inverter current. The I Sense input at pin 13 is normally held positive through R1285. If the Inverter current increases, the voltage at the I Sense input will become more negative. The Inverter Control Regulator output pulse width (i.e., Inverter hold-off time) increases until the Inverter current reaches a level that will hold pin 13 near the zero-volt level. If the voltage at pin 13 remains near zero for more than approximately 15 milliseconds, the Stop Trigger output at pin 8 will go positive to trigger the Inverter Stop stage. The Inverter Current Limiter will limit the peak Inverter current to about five amperes under fault conditions.

Balance. The Balance portion of U1275 provides overload protection for the Low- and High-Voltage Rectifiers by sensing a malfunction in these circuits. Beam I (current) Sense and I (current) sense inputs from the crt circuit and outputs from the Low-Voltage Rectifiers are applied to the Balance Sense input at pin 2-U1275 through divider R1302-R1304-R1305. During normal operation, this divider biases the Balance Sense input near a zero-volt level. If one of the inputs changes sufficiently to cause the voltage level at pin 2 to vary about 200 milliseconds, a positive Stop Trigger output is produced at pin 8-U1275.

Line Stop. The Line Stop portion of U1275 protects the Line-input components from damage due to turn-on surge current. This is achieved by triggering the Inverter Stop stage to stop the Inverter when the POWER switch is turned off. The Line Stop stage will also stop the Inverter if the ac line voltage falls below a minimum value.

The line-frequency signal from transformer T1208 is connected to the Line Stop Sense input of U1275 at pin 4. During normal operation, the line-frequency signal causes the Line Stop Timer terminal (pin 3) to be near a zero-volt level (ground). This zero-volt level keeps C1267 from being charged toward +7.5 V through R1267. When the line-frequency signal is interrupted or falls below a minimum value, C1267 will begin to charge to +7.5 V. When the voltage at pin 3 reaches approximately +0.7 V, the Line Stop stage will produce a positive Stop Trigger output at pin 8-U1275 to trigger the Inverter Stop stage.

Regulator

The Regulator stage operates in conjunction with the Inverter Control and Inverter Stop stages to regulate the Inverter switching. Q1252 acts as a switch controlled by the Regulator output of U1275 (pin 9) or by the Inverter Stop stage. When Q1252 is turned on, CR1251 or CR1252 is forward biased. This effectively short circuits one-half of the 60-turn, center-tapped winding of T1230 to shut off the Inverter. For further information, see the discussion of the Inverter stage.

Inverter Stop

The Inverter Stop stage, Q1254, is controlled by the Stop Trigger output of U1275 (pin 8) to shut off the Inverter through the Regulator stage (Q1252). During the start period, T1230 supplies current to charge C1256-C1259 through CR1256-CR1259. Also during this time, Q1254 is reverse biased by U1275. Once triggered on by a positive Stop Trigger, Q1254 will stay on while C1256-C1259 discharge through the base of Q1254. If U1275 is removed from its socket or is otherwise non-functional, the Inverter Stop stage will stop the Inverter after about two or three Inverter cycles.

Low-Voltage Rectifiers

The rectifiers and filter components in the secondaries of T1310 provide rectified, pre-regulated voltages for re-regulation by the Low-Voltage Regulators circuit.

LOW-VOLTAGE REGULATORS

General

The Low-Voltage Regulators convert semi-regulated voltages from the Converter/Rectifiers circuit to stabilized, low-ripple output voltages. The regulators are series type, using the -50 V Supply as a reference for the remaining voltage supplies. Figure 3-46 shows a detailed block diagram of the Low-Voltage Regulators circuit. A schematic is given on diagram 10.

-50 -Volt Supply

Semi-regulated -54 V from the Converter/Rectifiers circuit provides the unregulated voltage source for this supply. Transistors Q1508-Q1522-Q1534 operate as a feedback-stabilized amplifier to maintain a constant -50 V output level. Q1508 is connected as a differential amplifier to compare the feedback voltage at the base of Q1508B against the reference voltage at the base of Q1508A. The error output at the collector of Q1508B reflects the difference, if any, between these two inputs. The change in error output level at the collector of Q1508B is always in the opposite direction to the change in the feedback input at the base of Q1508B.

Zener diode VR1505 sets a reference level of about -9 V at the base of Q1508A. A sample of the output voltage from the -50 V Supply is connected to the base of Q1508B through divider network R1512-R1513-R1514. R1513 in this divider is adjustable to set the output level of this supply. Notice that the feedback voltage to this divider is obtained from a line labeled -50 V Sense. If the feedback voltage were obtained at the supply, the voltage at the load would not stay constant, due to the inherent resistance of the interconnecting cable between the supply and its load (as the load current varies, the voltage drop along the cable also varies). The Sense configuration overcomes this problem by sensing the voltage at the load. Since the current in the Sense line is small and constant, the load voltage is held constant regardless of the load current.

Regulation of the supply occurs as follows: If the output level of this supply decreases (becomes less negative) due to an increase in load or a decrease in input voltage (as a result of line-voltage changes or ripple), the voltage across divider R1512-R1513-R1514 decreases also. This results in a more positive level at the base of Q1508B than that established by the -50 V Reference stage at the base of Q1508A. Since the transistor with the more positive base controls the conduction of the differential amplifier, the output current at the collector of Q1508B increases. This increase in output from Q1508B causes an increase in current through Q1522. This allows more current to flow through Q1534, resulting in increased conduction of Q1538, the -50 V Series Regulator. The load current increases and the output voltage of this supply also increases (becomes more negative). As a result, the feedback voltage from the -50 V Sense line increases and the base of Q1508B returns to the same level as the base of Q1508A. Similarly, if the output level of this supply increases (more negative), the output current of Q1508B decreases. The feedback through Q1522 and Q1534 reduces the conduction of the -50 V Series Regulator to decrease the output voltage of this supply. The -50 V adjustment, R1513, sets the output level of this supply.

The -50 V Current Limiting stage (Q1256) protects the -50 V Supply if excess current is demanded from this supply. Since the load is connected to this supply through R1537, all current from the -50 V Supply must flow through this resistor. Transistor Q1526 senses the voltage drop across R1537. Under normal operation there is insufficient voltage drop across R1537 to forward bias Q1526. However, when excess current is demanded from the -50 V Series Regulator due to a short circuit or similar malfunction at the output of this supply, the voltage drop across R1537 increases until it is sufficient to forward bias Q1526. The collector current of Q1526 results in a reduction of current through Q1522 and Q1534 to limit the conduction of Q1538. This current limiting protects Q1538 from damage due to excess power dissipation.

Circuit Description—7904 (SN B260000-UP)

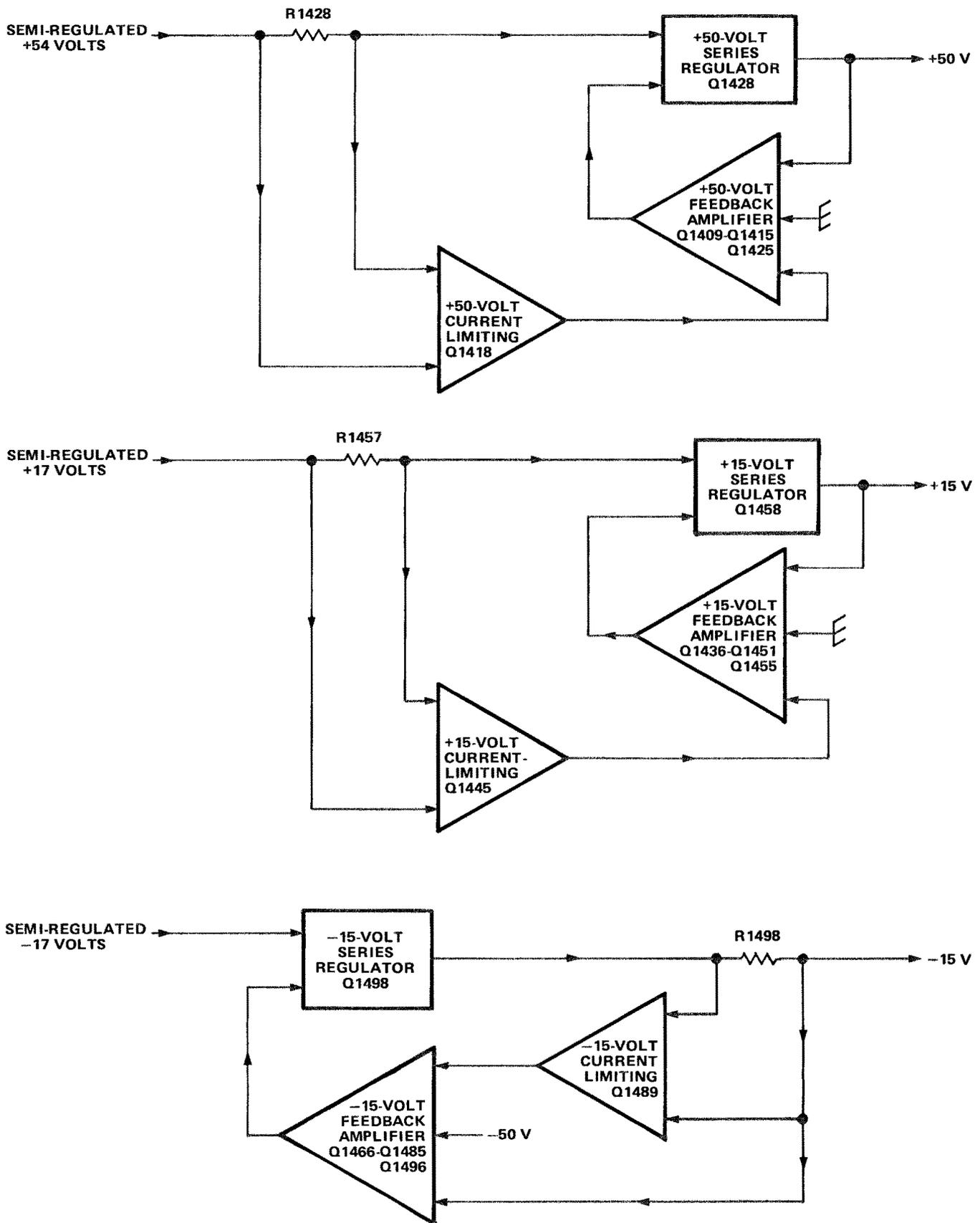


Fig. 3-46. Detailed block diagram of Low-Voltage Regulators circuit.

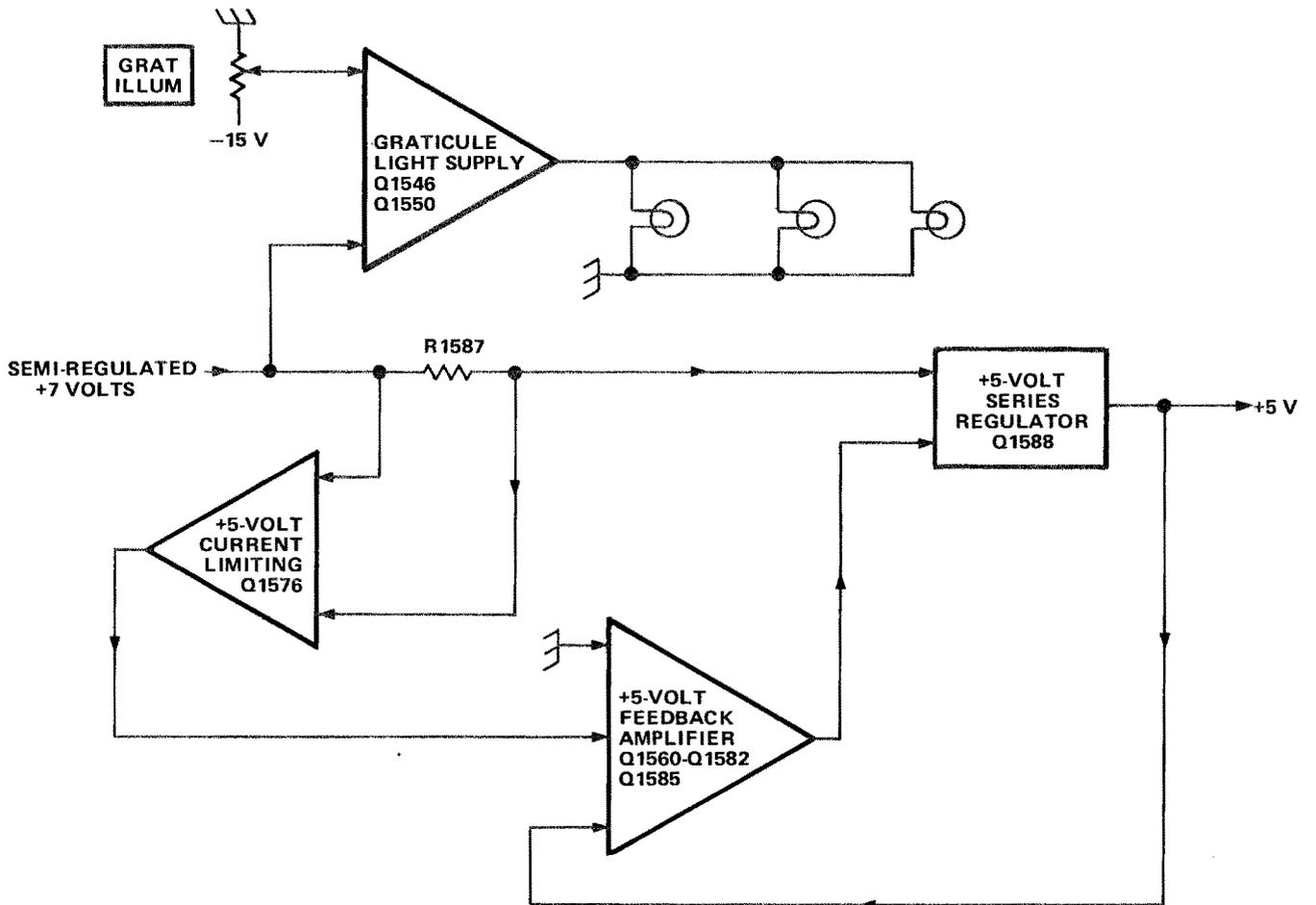
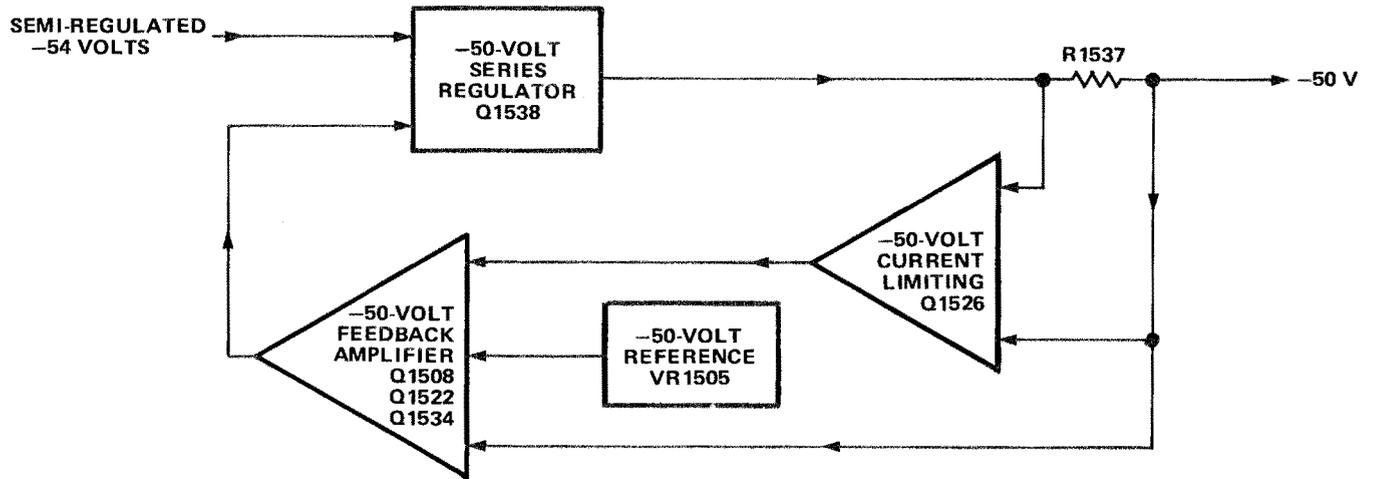


Fig. 3-46. (cont).

Circuit Description—7904 (SN B260000-UP)

Several protection diodes are also included in this circuit. CR1539 prevents the output of this supply from going more positive than about +0.6 V if it is shorted to a positive supply. VR1501 and CR1502 supply a turn-on voltage for Q1508 to start the -50 V Supply when the instrument is first turned on. As soon as the -50 V Supply turns on, VR1501 and CR1502 turn off to disconnect the turn-on voltage from Q1508.

-15-Volt Supply

Basic operation of all stages in the -15 V Supply is the same as for the -50 V Supply. Reference level for this supply is established by divider R1463-R1464 between ground and the -50 V Sense voltage. The divider ratio of R1463-R1464 sets a level of -15 V at the base of Q1466A. The level on the -50 V Sense line is held stable by the -50 V Supply. Any change at the output of the -15 V Supply appears at the base of Q1466B as an error signal. The output voltage is regulated in the same manner as described for the -50 V Supply. CR1499 limits the output of this supply from going more positive than about +0.6 V if it is shorted to one of the positive supplies. Diodes CR1468 and CR1469 provide reverse voltage protection for transistors Q1466B and Q1466A, respectively.

+5-Volt Supply

The operation of the +5 V Supply is basically the same as described for previous supplies. The reference level for this supply is established by the ground connection at the base of Q1560A. Feedback voltage to the base of Q1560B is provided by divider R1564-R1589 between the -50 V Sense line and the +5 V Sense line. The divider ratio of R1564-R1589 is 10:1, so the base of Q1560B is at zero volt when the supply is operating normally. The level on the -50 V Sense line is held stable by the -50 V Supply. Therefore, any change at the output of the -5 V Supply appears at the base of Q1560B as an error signal. The output voltage is regulated in the manner described previously for the -50 V Supply. Diode CR1589 limits the output of this supply to about -0.6 V if it is shorted to one of the negative supplies.

The +5 V Current Limiting stage (Q1576A and B) protects this supply from damage due to a demand for excessive output current. Q1576A and Q1576B are connected as a comparator to detect excessive current through R1587. With normal supply current through R1587, the voltage drop across R1587 is such that the base of Q1567B is more positive than the base of Q1576A. Therefore, Q1576A is cut off and CR1576 is reverse biased. If the current through R1587 increases above a safe level, the base of Q1576B becomes more negative than the base of Q1576A. Now, Q1576B is cut off and Q1576A conducts. The collector current of Q1576A forward biases CR1576 and decreases the voltage on the base of Q1582. This limits the conduction of Q1588 to a safe current level.

+15-Volt Supply

The +15 V Supply regulates in the same manner as the -50 V Supply; current limiting operates in the manner described for the +5 V Supply. The ground connection at the base of Q1436A provides the reference for this supply. Feedback voltage to the base of Q1436B is provided through divider R1440-R1459 between the -50 V Sense line and the +5 V Sense line. The divider ratio of R1440-R1459 sets the base of Q1436B at zero volts. Any change in the output level of the +15 V Supply appears at the base of Q1436B as an error signal. This results in an opposite change at the collector of Q1436B and at the base of Q1451. This change is connected to the +15 V Series Regulator stage through Q1455 to correct the error in the output voltage of the supply.

Diode CR1439 protects Q1436B against negative voltages if the +15 V Supply is shorted to ground. Diode CR1459 limits the output of this supply to about +0.6 V if it is shorted to one of the negative supplies.

+50-Volt Supply

Operation of the +50 V Supply is basically the same as described for the -50 V Supply; current limiting operates in a similar manner as described for the +5 V Supply. Reference voltage for this supply is established by the ground connection through R1406 at the base of Q1409A. Feedback voltage to the base of Q1409B is provided by divider R1412-R1429 between the -50 V Sense line and -15 V Sense line. The divider ratio of R1412-R1429 sets the base level of Q1409B at zero volts when the output of this supply is correct. The protection diodes in this circuit operate similarly to those in the other supplies.

Graticule-Light Supply

The Graticule-Light Supply provides voltage to the graticule lights, DS1552-DS1553-DS1554. The front-panel GRAT ILLUM control, R1541, sets the output of this supply to set the brightness of the graticule lights. Q1546-Q1550-CR1549 form a pseudo differential amplifier. The output voltage at the collector of Q1550 follows the voltage set at the base of Q1546 by the divider made up of R1544, R1545, R1543, and the GRAT ILLUM control R1541. R1551 limits the output current from this supply to protect Q1550 from damage due to a short circuit.

CRT CIRCUIT

General

The crt circuit provides the high voltage and control circuits necessary for operation of the cathode-ray tube (crt). This circuit also includes the Z-Axis Amplifier and the Auto-Focus Amplifier. Figure 3-47 shows a detailed block diagram of the crt circuit. A schematic of this circuit is shown on diagram 11 in the rear of this manual.

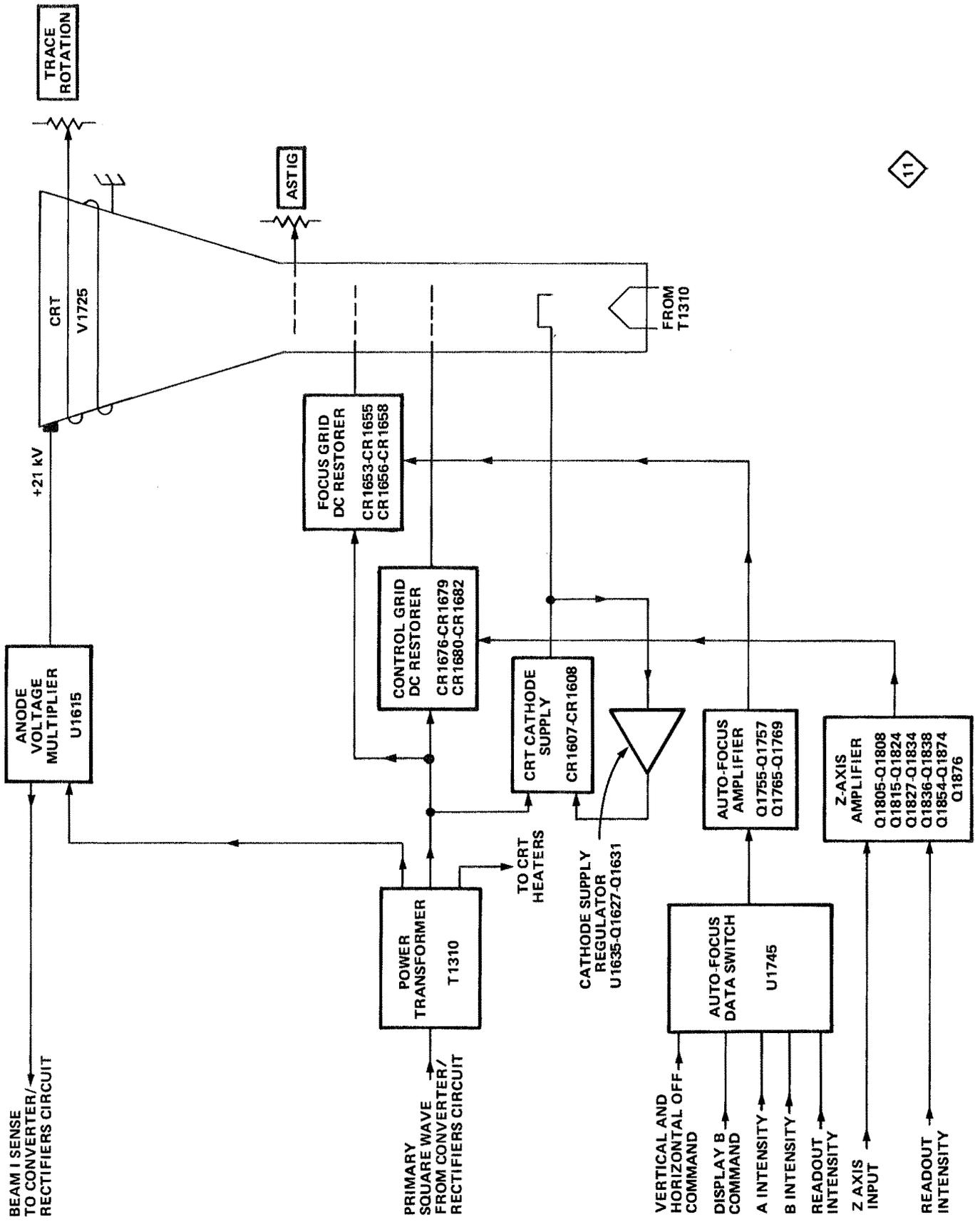


Fig. 3-47. Detailed block diagram of the CRT Circuit.

Circuit Description—7904 (SN B260000-UP)

Power Transformer

Power Transformer T1310 provides semi-regulated voltages for the crt heater and high-voltage supplies. One secondary winding of T1310 provides 6.3 V for the crt heater. The crt heater is elevated to the cathode potential through R1690. The high-voltage winding of T1310 provides a three-kilovolt peak-to-peak square-wave voltage to the Anode Voltage Multiplier, crt Cathode Supply, Control-Grid DC Restorer, and Focus-Grid DC Restorer stages. One end of the high-voltage winding is connected to ground through current-sensing resistor R1604.

Anode Voltage Multiplier

Positive accelerating potential for the crt anode is supplied by the seven times voltage multiplier contained within U1615. The applied voltage to the input of U1615 from the high-voltage secondary of T1310 is about three kilovolts peak-to-peak. This results in an output voltage of about +21 kilovolts at the crt anode. The Beam I Sense output of U1615 is fed back to the Converter/Rectifiers and Logic circuits to limit the crt beam current if it exceeds a safe level.

CRT Cathode Supply

The negative three-kilovolt accelerating potential for the crt cathode is generated by a voltage doubler consisting of CR1607-CR1608-C1607-C1608. High-frequency filtering is accomplished by R1609-C1609-R1612-C1612. R1612 and C1612 also provide an ac-coupling path for error correction from the Cathode-Supply Regulator.

Cathode-Supply Regulator

The Cathode-Supply Regulator maintains the potential on the crt cathode and reduces the ac ripple from the crt Cathode Supply. A sample of the output of the crt Cathode Supply is connected to the Cathode-Supply Regulator stage through divider resistors R1640B-R1640A. High-frequency changes from the crt Cathode Supply are coupled to the Cathode-Supply Regulator through C1642-R1642.

The Cathode-Supply Regulator consists of a non-inverting preamplifier U1635 and an inverting output amplifier Q1627-Q1631. The +50 V Supply, connected to R1640A, and the ground connected to pin 2 of U1635 through R1637, provide the reference for error amplifier U1635. Q1627 and Q1631 are connected as a collector-coupled, complementary amplifier driven by U1635 to provide error correction to the crt Cathode Supply.

Regulation occurs as follows: If the crt cathode voltage becomes less negative, a positive-going change is coupled to the input of U1635 at pin 3 and results in a positive-going output at pin 6. This positive-going change is inverted by Q1627-Q1631 into a negative-going change at their collectors. This results in a voltage increase across C1606 during the positive half cycle of the high-voltage winding of T1310. (Note that the voltage across C1606 is the difference between the positive voltage on T1310 and the voltage at TP1625.) During the negative half cycle, the increased voltage across C1606 increases the output voltage of the crt Cathode Supply to correct the original error. High-frequency correction signals from the Cathode-Supply Regulator are ac coupled to the crt cathode through C1612. Short-circuit protection for the Cathode-Supply Regulator is provided by CR1625-CR1632-CR1638-CR1639.

Z-Axis Amplifier

The Z-Axis Amplifier provides the drive signal to the crt control grid to control the crt intensity. The Z-Axis signal from the Logic circuit and the Readout Intensity signal from the Readout System are connected to the emitter of Q1805 through R1801-R1802, and form the input signals to the Z-Axis Amplifier. The output of the Z-Axis Amplifier provides the drive signal to control the crt intensity level through the Control-Grid DC Restorer.

Transistor Q1805 is a common-base amplifier to establish a low input impedance for the Z-Axis Amplifier. Q1808-Q1824-Q1815-Q1827 form a non-inverting, current-driven, operational amplifier. The Z-Axis Amplifier Gain and Output Level are set in this stage through R1810 and R1817 respectively. The output stage of the Z-Axis Amplifier circuit consists of Q1834-Q1836-Q1854-Q1874-Q1876 in a high-speed operational amplifier configuration. Transistor Q1838 is a constant-current source for Q1834-Q1836. The signal at the emitter of Q1827 is dc coupled to the bases of Q1834-Q1836 through R1833 to provide a fast rising pulse at the output of Q1854. Transistors Q1874-Q1876 maintain the output level of the Z-Axis Amplifier. The Z-Axis Amplifier is compensated to provide a fast rising pulse with optimum square corner by C1871-C1842-R1842-C1846.

Control-Grid DC Restorer

The Control-Grid DC Restorer circuit couples dc and low-frequency components of the Z-Axis Amplifier signal to the crt control grid. This allows the Z-Axis Amplifier to control the crt beam current (intensity). The potential difference between the Z-Axis Amplifier output and the control grid (about 3000 volts) prohibits direct coupling.

The dc restorer is actually a cathode-referenced bias supply for the crt control grid. Quiescently, its output voltage is more negative than the cathode by an amount set by crt Grid Bias adjustment R1674.

The Control-Grid DC Restorer stage is current drive from the high-voltage winding of T1310 through R1618-R1619-R1671-R1672. This drive signal is an approximately 25 kilohertz signal connected to the junction of CR1676-CR1680-C1678. CR1676 and CR1680 limit the peak-to-peak amplitude of the drive at their junction to the difference between their forward-bias levels. Crt Grid Bias adjustment R1674 and the output level of the Z-Axis Amplifier set the forward-bias levels of CR1676 and CR1680 respectively. C1678 couples the limited-amplitude drive to the junction of CR1679-CR1682. During positive half cycles of the drive, CR1682 clamps the cathode of CR1679 to the level of the crt cathode (-3000 V). This provides the reference level for the Control-Grid DC Restorer stage. During negative half cycles of the drive, CR1679 charges the control-grid side of C1680 to a level more equal to the difference between the crt Grid Bias adjustment setting and the Z-Axis Amplifier output level.

Auto-Focus Stages

The Auto-Focus Amplifier stages provide control voltages to maintain optimum focus of the crt display. When the FOCUS control is set for best definition of the crt display at low to medium settings of the intensity controls, these stages maintain optimum focus for all portions of the display as it is switched between readout, A Horizontal, and B Horizontal displays.

Transistors Q1740, Q1744, and Q1746 select current from the A INTENSITY control, B INTENSITY control, or READOUT INTENSITY control inputs as determined by the Vertical and Horizontal OFF Command at the base of Q1740 and the Display B Command at the base of Q1748. The input/output table shown in Fig. 3-48 shows the input of Q1755.

Q1755-Q1757-Q1765-Q1769 are connected as a non-inverting operational amplifier to amplify the output of U1745 and drive the focus-grid electrode of the crt. Resistors R1751-R1752-R1753-R1754, in conjunction with diodes CR1753 and CR1754, shape the output of U1745. Auto-Focus Gain adjustment R1751 determines the amount of signal to the base of Q1755 to set the overall gain of the Auto-Focus Amplifier. Output Level adjustment R1757 determines the output level of this stage.

Focus-Grid DC Restorer

The Focus-Grid Restorer circuit couples dc and low-frequency components of the Auto-Focus Amplifier signal to the crt focus grid. This allows the Auto Focus Amplifier to control the focus-grid potential. The potential difference between the Auto-Focus Amplifier output and the focus grid (about 2000 volts) prohibits direct coupling.

The dc restorer is actually a bias supply for the crt focus grid. The output of this stage is referenced to the level set by Focus Preset adjustment R1711. Quiescently, the focus-grid voltage is more negative than the reference level by 10 volts.

INPUT		OUTPUT
VERTICAL AND HORIZONTAL OFF COMMAND	DISPLAY B COMMAND	DATA OUT
2	1	7
LO	LO	A INTENSITY
LO	HI	B INTENSITY
HI	φ	READOUT INTENSITY

φ = HAS NO EFFECT IN THIS CASE.

Fig. 3-48. Input/output table for Auto-Focus Data Switch IC, U1745.

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The Focus-Grid DC Restorer stage is current drive from the high-voltage winding of T1310 through R1618-R1619-R1651-R1652. This drive signal is an approximately 25 kilohertz signal connected to the junction of CR1653-CR1656-CR1654. CR1653 and CR1656 limit the peak-to-peak amplitude of the drive at their junction to the difference between their forward-bias levels. The +130 V Supply and the output level of the Auto-Focus Amplifier set the forward-bias levels of CR1653 and CR1656 respectively. C1654 couples the limited-amplitude drive to the junction of CR1655-CR1658. During positive half cycles of the drive, CR1658 clamps the cathode of CR1658 to the level set by Focus Preset adjustment R1711. This provides the reference level for the Focus-Grid DC Restorer stage. During negative half cycles of the drive, CR1655 charges the focus-grid side of C1656 to a level more negative than the reference level. The resulting focus-grid voltage is more negative than the reference level by an amount equal to the difference between the +130 V Supply and the Auto-Focus Amplifier output level.

CRT Control Circuits

The ASTIG adjustment, R1733, used in conjunction with the FOCUS control to obtain a well-defined display, varies the potential on the astigmatism grid of the crt. The Geometry adjustment, R1727, varies the potential on the crt mesh to control the overall geometry of the display.

Two adjustments control the trace alignment by varying the magnetic field around the crt. The Y-Axis Align adjustment, R1730, controls the current through L1730, which affects the crt beam after vertical deflection but before horizontal deflection. Therefore, R1730 affects only the vertical (Y) components of the display. TRACE ROTATION adjustment R1725 controls the current through L1725, which affects both the vertical and horizontal rotation of the crt beam.

MAINTENANCE

This section of the manual contains maintenance information for use in preventive maintenance, corrective maintenance, or troubleshooting of the 7904.

PREVENTIVE MAINTENANCE

Preventive maintenance, when performed on a regular basis, can prevent instrument breakdown and may improve the reliability of the instrument. The severity of the environment to which the instrument is subjected will determine the frequency of maintenance. A convenient time to perform preventive maintenance is preceding electrical adjustment of the procedure.

CABINET PANEL REMOVAL

WARNING

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

The side, top, and bottom cabinet panels provide protection to personnel from operating potentials present within the instrument. In addition, they reduce radiation of electro-magnetic interference from the instrument. The cabinet panels are held in place by slotted fasteners. To remove the panels, turn each fastener counterclockwise a quarter turn with a large screwdriver. Lift the panels away. Operate the instrument with the panels in place to protect the interior from dust.

CLEANING

The 7904 should be cleaned as often as operating conditions require. Accumulation of dirt in the instrument can cause overheating and component breakdown. Dirt on components acts as an insulating blanket and prevents efficient heat dissipation. It also provides an electrical conduction path which may result in instrument failure. The side panels reduce the amount of dust reaching the interior of the instrument. Operation without the panels in place necessitates more frequent cleaning.

CAUTION

Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Use a non-residue type of cleaner, preferably isopropyl alcohol, totally denatured ethyl alcohol, or TP35. Before using any other type of cleaner, consult your Tektronix Service Center or representative.

Exterior

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

CRT

Clean the plastic light filter, implosion shield, and the crt faceplate with a soft, lint-free cloth dampened with denatured alcohol.

The crt mesh filter (furnished with Option 3 only) can be cleaned as follows:

1. Hold the mesh filter in a vertical position and brush lightly with a soft, No. 7 water color brush to remove light coatings of dust or lint.
2. Greasy residues, or dried-on dirt, can be removed with a solution of warm water and a neutral-pH liquid detergent. Use the brush to lightly scrub the filter.
3. Rinse the filter thoroughly in clean water and allow to air dry.

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4. If any lint or dirt remains, use clean low-pressure air to remove it. Do not use tweezers or other hard cleaning tools on the filter, as the special finish may be damaged.

5. When not in use, store the mesh filter in a lint-free dust-proof container, such as a plastic bag.

Interior

Cleaning the interior of the instrument should only be occasionally necessary. The best way to clean the interior is to blow off the accumulated dust with dry, low-velocity air (approximately 5 lb/in²). Remove any dirt which remains with a soft brush or a cloth dampened with a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces, or for cleaning more delicate circuit components.



CAUTION

Circuit boards and components must be dry before applying power to prevent damage from electrical arcing.

The high-voltage circuits, particularly parts located in the high-voltage compartment and the area surrounding the post-deflection anode leads, should receive special attention. Excessive dirt in these areas may cause high-voltage arcing and result in improper instrument operation.

VISUAL INSPECTION

The 7904 should be inspected occasionally for such defects as broken connections, broken or damaged ceramic strips, improperly seated semiconductors, damaged or improperly installed circuit boards, and heat-damaged parts. The corrective procedure for most visible defects is obvious; however, particular care must be taken if heat-damaged components are found. Overheating usually indicates other trouble in the instrument; therefore, it is important that the cause of overheating be corrected to prevent recurrence of the damage.

SEMICONDUCTOR CHECKS

Periodic checks of the semiconductors are not recommended. The best check of semiconductor performance is actual operation in the instrument. More details on checking semiconductor operation are given under troubleshooting.

PERIODIC ELECTRICAL ADJUSTMENT

To ensure accurate measurements, check the electrical adjustment of this instrument after each 1000 hours of operation, or every six months if used infrequently. In addition, replacement of components may necessitate adjustment of the affected circuits. Complete adjustment instructions are given in Section 5, Performance Check and Adjustment. This procedure can be helpful in localizing certain troubles in the instrument, and in some cases, may correct them.

TROUBLESHOOTING

The following information is provided to facilitate troubleshooting of the 7904 Oscilloscope. Information contained in other sections of this manual should be used in conjunction with the following data to aid in locating a defective component. An understanding of the circuit operation is helpful in locating troubles. See Section 3, Circuit Description, for this information.

TROUBLESHOOTING AIDS

Diagrams

Complete schematic diagrams are given on the pullout pages in Section 8, Diagrams and Circuit Board Illustrations. The component number and electrical value of each component in this instrument are shown on these diagrams. (See the first page of the Diagrams and Circuit Board Illustrations section for definitions of the reference designators and symbols used to identify components in this instrument.) Voltages and numbered waveform test points are also shown on the diagrams. Waveforms, and the numbered test points where they were obtained, are located adjacent to each diagram. The portions of circuits mounted on circuit boards are enclosed with heavy, solid-black lines.

Circuit Board Illustrations

To aid in locating circuit boards, a circuit board location illustration appears on the back of the pullout page facing the schematic diagram. In addition, an illustration of the circuit board(s) is included here, with the physical location of the components that appear on the schematic diagram. Each circuit board illustration is arranged in a grid locator with an index to facilitate rapid location of components contained in the schematic diagrams.

Troubleshooting Chart

A troubleshooting chart is given in Section 8, Diagrams and Circuit Board Illustrations to aid in locating a defective circuit. The shaded blocks on the Troubleshooting Chart indicate circuit(s) that may cause the indicated malfunction. The circuits listed are discussed in detail in Section 3, Circuit Description.

Adjustment and Test Point Locations

To aid in locating test points and adjustable components called out in the various sections of the Perfor-

mance Check and Adjustment procedure, the Adjustment and Test Point Locations pullout pages are provided in Section 8, Diagrams and Circuit Board Illustrations.

Component Color Coding

The instrument contains brown composition resistors, some metal-film resistors, and some wire-wound resistors. The resistance values of wire-wound resistors are usually printed on the component body. The resistance values of composition resistors and metal-film resistors are color coded on the components using the EIA color code (some metal-film resistors may have the value printed on the body). The color code is read starting with the stripe nearest the end of the resistor. Composition resistors have four stripes, which consist of two significant figures, a multiplier, and a tolerance value (see Fig. 4-1). Metal-film resistors have five stripes consisting of three significant figures, a multiplier, and a tolerance value.

The values of common disc capacitors and small electrolytics are marked on the side of the component body. The white ceramic and epoxy-coated tantalum capacitors used in the instrument are color coded using a modified EIA code (see Fig. 4-1).

The cathode end of glass-encased diodes is indicated by a stripe, a series of stripes, or a dot. The cathode and anode ends of metal-encased diodes can be identified by the diode symbol marked on the body.

Cam-Switch Contact Identification

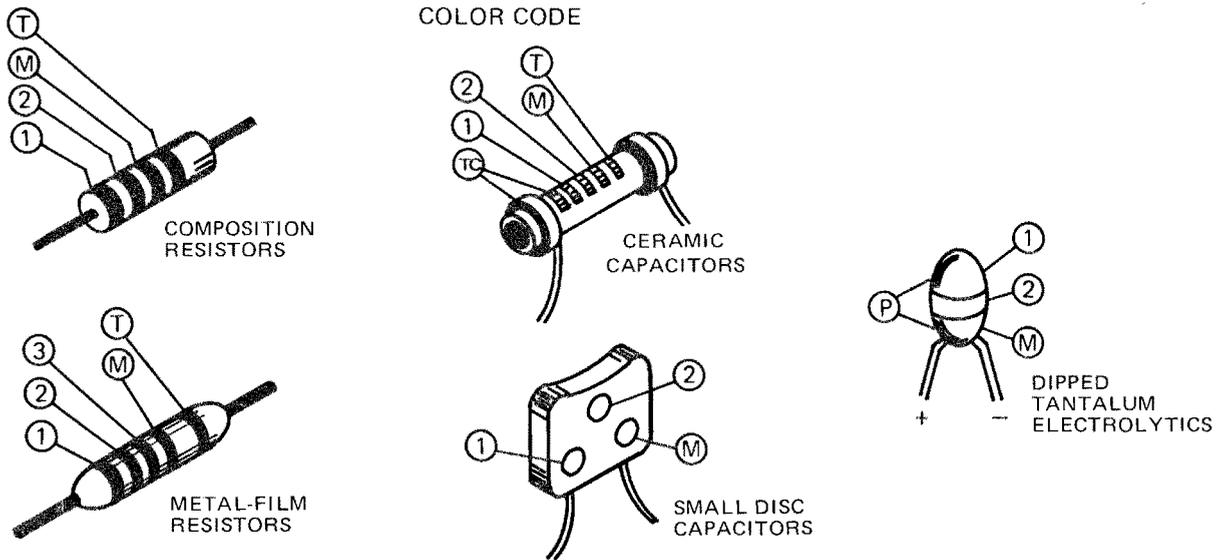
Cam switches shown on the diagrams are coded to indicate the position of the contact in the complete switch assembly counting from the front, or knob end of the switch, toward the rear. The contact closure chart on the diagrams indicates when each contact is closed.

Semiconductor Lead Configurations

Figure 4-10 in this section shows the lead configurations of the semiconductor devices used in the 7904 Oscilloscope.

Multi-Connector Holders

The multi-connector holders are keyed with two triangles, one on the holder and one on the circuit board. When a connection is made perpendicular to a circuit



① ② and ③ - 1ST, 2ND, AND 3RD SIGNIFICANT FIGS. T AND/OR TC COLOR CODE MAY NOT BE PRESENT ON SOME CAPACITORS;
 M - MULTIPLIER T - TOLERANCE;
 TC - TEMPERATURE COEFFICIENT. P - POLARITY AND VOLTAGE RATING

COLOR	SIGNIFICANT FIGURES	RESISTORS		CAPACITORS			DIPPED TANTALUM VOLTAGE RATING
		MULTIPLIER (OHMS)	TOLERANCE	MULTIPLIER (pF)	TOLERANCE		
					OVER 10pF	UNDER 10pF	
BLACK	0	1	----	1	±20%	± 2pF	4VDC
BROWN	1	10	±1%	10	±1%	±0.1pF	6VDC
RED	2	10 ² or 100	±2%	10 ² or 100	±2%	----	10VDC
ORANGE	3	10 ³ or 1 K	±3%	10 ³ or 1000	±3%	----	15VDC
YELLOW	4	10 ⁴ or 10K	±4%	10 ⁴ or 10,000	+100% -0%	----	20VDC
GREEN	5	10 ⁵ or 100 K	±1/2%	10 ⁵ or 100,000	±5%	±0.5pF	25VDC
BLUE	6	10 ⁶ or 1 M	±1/4%	10 ⁶ or 1,000,000	----	----	35VDC
VIOLET	7	----	±1/10%	10 ⁷ or 10,000,000	----	----	50VDC
GRAY	8	----	----	10 ⁻² or 0.01	+80% -20%	±0.25pF	----
WHITE	9	----	----	10 ⁻¹ or 0.1	±10%	±1pF	3VDC
GOLD	----	10 ⁻¹ or 0.1	±5%	----	----	----	----
SILVER	----	10 ⁻² or 0.01	±10%	----	----	----	----
NONE	----	----	±20%	----	±10%	±1pF	----

Fig. 4-1. Color code for resistors and capacitors.

board surface, the orientation of the triangle on the end-lead multi-pin connector holder is determined by the placement of the multi-pin connector index (see Fig. 4-2).

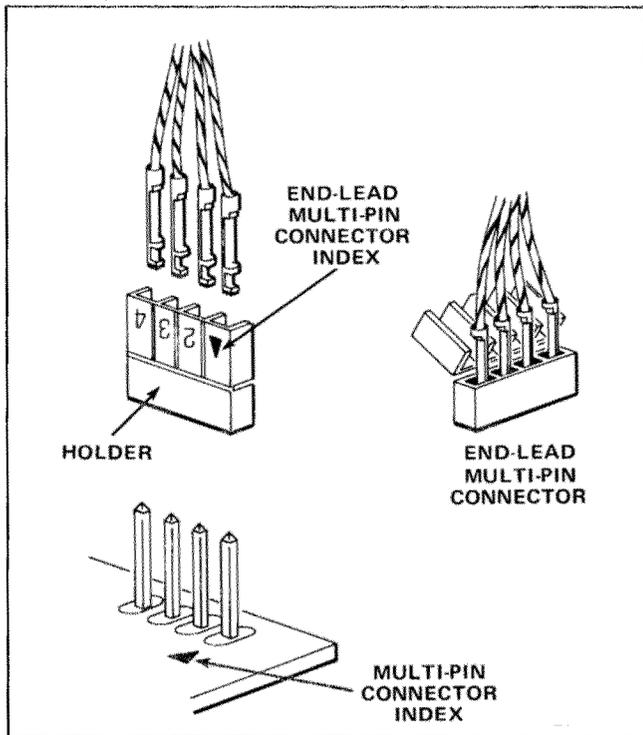


Fig. 4-2. Orientation of multi-connector holders.

TROUBLESHOOTING EQUIPMENT

The following equipment is useful for troubleshooting the 7904 Oscilloscope:

1. Transistor Tester

Description: Dynamic-type tester

Purpose: Test semiconductors.

Recommended type: Tektronix 577/177 Curve Tracer, TEKTRONIX 576 Curve Tracer, 7CT1N Curve Tracer plug-in unit and a 7000-series oscilloscope system, or a 5CT1N Curve Tracer plug-in unit and a 5000-series oscilloscope system.

2. Multimeter

Description: 10 M Ω input impedance and 0 to 500 volts range, ac and dc; ohmmeter, 0 to 50 M Ω ; accuracy, within 0.1%. Test probes must be insulated to prevent accidental shorting.

Purpose: Check voltages and resistances.

3. Test Oscilloscope

Description: Frequency response, dc to 100 megahertz minimum; deflection factor, 5 millivolts to 5 volts/division and 1 milliampere to 1 ampere/division.

A 10X, 10-megohm voltage probe should be used to reduce circuit loading for voltage measurements. For current waveforms, use a TEKTRONIX P6021 current Probe with passive termination, or the equivalent.

Purpose: Check operating waveforms.

4. Variable Autotransformer

Description: Output variable from 0 to 140 volts, 10 amperes minimum rating. Must have three-wire power cord, plug, and receptacle.

Purpose: Vary input line voltage when troubleshooting in the power-supply unit.

Recommended type: General Radio W10MT3W Variac Autotransformer.

5. Isolation Transformer

Description: 1:1 turns ratio, 500 volt-amperes minimum rating, 50-60 cycle. Must have three-wire power cord, plug, and receptacle with ground connection carried through from input to output.

Purpose: To isolate 7904 from line potential when troubleshooting power supply.

Recommended type: Stancor #P6298 (for 115-volt line only) modified to include three-wire power cord, plug, and receptacle.

TROUBLESHOOTING TECHNIQUES

This troubleshooting procedure is arranged to check the simple trouble possibilities before proceeding with extensive troubleshooting. The first few checks ensure proper connection, operation, and adjustment. If the trouble is not located by these checks, the remaining steps aid in locating the defective component. When the defective component is located, replaced it following the replacement procedures given under Corrective Maintenance.

1. Check Control Settings.

Incorrect control settings can indicate a trouble that does not exist. If there is any question about the correct function or operation of any control, refer to Section 2, Operating Instructions.

2. Check Associated Equipment.

Before proceeding with troubleshooting, check that the equipment used with this instrument is operating correctly. Also, check that the input signals are properly connected and that the interconnecting cables are not defective. Check the line-voltage source.

3. Visual Check.

Visually check the portion of the instrument in which the trouble is located. Many troubles can be found by visual indications such as unsoldered connections, broken wires, damaged circuit boards, and damaged components.

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broken wires, damaged circuit boards, and damaged components.

4. Check Instrument Adjustment

Check the electrical adjustment of this instrument, or of the affected circuit if the trouble appears in one circuit. The apparent trouble may only be a result of misadjustment. Complete adjustment instructions are given in Section 5, Performance Check and Adjustment.

5. Isolate Trouble to a Circuit

To isolate trouble to a particular circuit, note the trouble symptom. The symptom often identifies the circuit in which the trouble is located. When trouble symptoms appear in more than one circuit, check the affected circuits by taking voltage and waveform measurements. Also check for the correct output signals at the rear-panel output connectors with a test oscilloscope. If the signal is correct, the circuit is working correctly up to that point. For example, correct sawtooth output indicates that the time-base unit and sawtooth output portion of the Output Signals circuit is operating correctly. If a malfunction in the Readout System is suspected of causing trouble to appear in the Z-Axis Amplifier, Vertical Amplifier, or Horizontal Amplifier circuits, the trouble can be localized by removing the Readout System circuit board. This board can be removed without significantly affecting the operation of other circuits in the instrument.

Incorrect operation of all circuits often indicates trouble in the power supply. Check first for correct voltage of

the individual 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. If incorrect operation of the power supplies is suspected, refer to Troubleshooting the High-Efficiency Power-Supply Unit given later in this section. After the defective circuit has been located, proceed with steps 6 and 7 to locate the defective component(s).

If incorrect operation of the power supplies is suspected, connect the 7904 to a variable autotransformer. Then, check each power supply for correct regulation with a dc voltmeter (0.1% accuracy), and correct ripple with a test oscilloscope, while varying the autotransformer throughout the regulating range of this instrument (see rear-panel Line Selector for regulating range of this instrument).

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 4-1 lists the tolerance of the power supplies in this instrument. These voltages are measured between the power-supply test points (on Regulator board) and the GND SENS test point on this board. See Fig. 4-3 for power-supply test point location. If a power-supply voltage is within the listed tolerance, the supply can be assumed to be working correctly. If outside the tolerance, the supply may be misadjusted or operating incorrectly. Use the procedure given in the Performance Check and Adjustment section to adjust the power supplies.

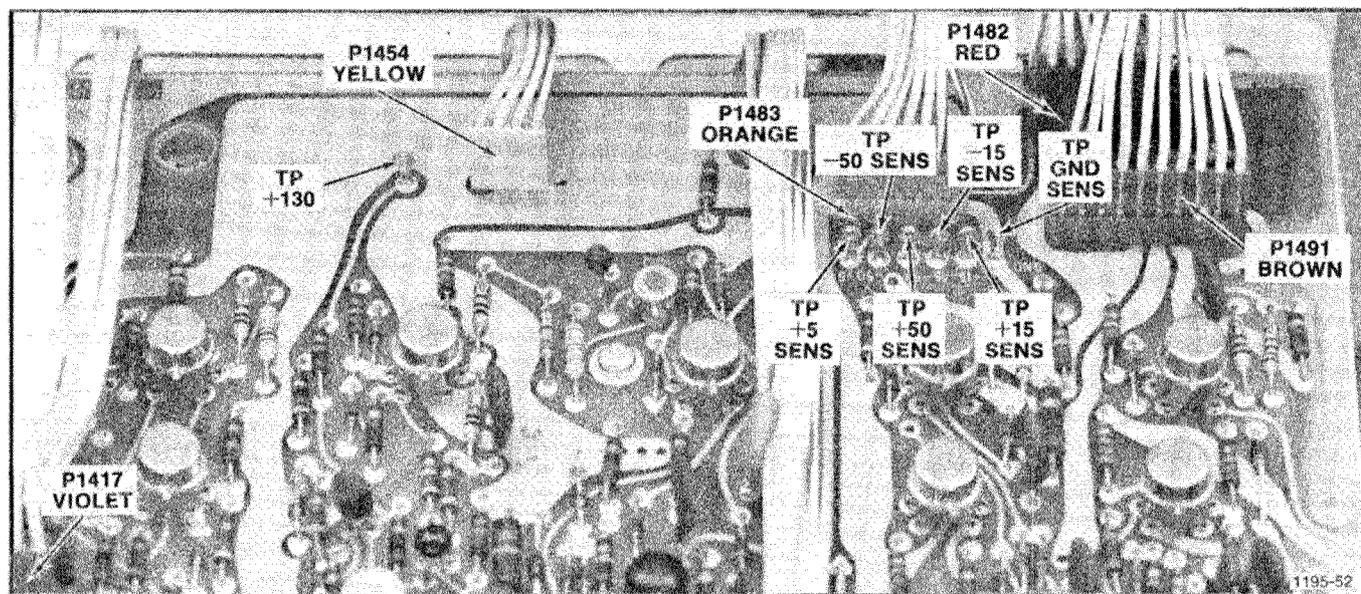


Fig. 4-3. Location of power-supply test points on Regulator board.

Table 4-1
POWER SUPPLY TOLERANCE AND RIPPLE
(REFERENCED TO TP GND SENS)

Power Supply	Test Point (see Fig. 4-3)	Tolerance	Typical ripple (peak-to-peak)
-50 V	TP -50 Sense	±0.20 V	2 mV
-15 V	TP -15 Sense	±0.15 V	1 mV
+5 V	TP +5 Sense	±0.10 V	1 mV
+15 V	TP +15 Sense	±0.15 V	1 mV
+50 V	TP +50 Sense	±0.50 V	3 mV
+130 V	TP +130	±5.2 V	500 mV

6. Check Voltages and Waveforms

Often the defective component can be located by checking for the correct voltages or waveforms in the circuit. Typical voltages and waveforms are given in Section 8, Diagrams and Circuit Board Illustrations.

NOTE

Voltages and waveforms given in Section 8, Diagrams and Circuit Board Illustrations, are not absolute and may vary slightly between 7904 Oscilloscopes. To obtain operating conditions similar to those used to take these readings, see the appropriate schematic.

7. Check Individual Components

The following procedures describe methods of checking individual components in the 7904. Components which are soldered in place are best checked by first disconnecting one end. This isolates the measurement from the effects of surrounding circuitry.

WARNING

To avoid electric-shock hazard, always disconnect the 7904 from the power source before removing or replacing components.

Fuses. Check for open fuses by checking continuity with an ohmmeter.

Transistors. A good check of transistor operation is actual performance under operating conditions. A transistor can most effectively be checked by substituting a new component for it (or one which has been previously checked). However, be sure that circuit conditions are not such that a replacement transistor might also be damaged.

If substitute transistors are not available, use a dynamic tester. Static-type testers are not recommended, since they do not check operation under simulated operating conditions.

Integrated Circuits. Integrated circuits can be checked with a voltmeter, test oscilloscope, or by direct substitution. A good understanding of the circuit operation is essential to troubleshooting circuits using integrated circuits. In addition, operating waveforms, logic levels, and other operating information for the integrated circuits are given in Section 3, Circuit Description and Section 8, Diagrams and Circuit Board Illustrations. Use care when checking voltages and waveforms around the integrated circuits so that adjacent leads are not shorted together. A convenient means of clipping a test probe to the in-line, multi-pin integrated circuits is with an integrated-circuit test clip. This device also doubles as an integrated-circuit extraction tool.

Diodes. A diode can be checked for an open or shorted condition by measuring the resistance between terminals with an ohmmeter scale having a low internal source current, such as the RX 1K scale. The resistance should be very high in one direction and very low when the meter leads are reversed.

CAUTION

When checking diodes, do not use an ohmmeter scale that has a high internal current, since high currents may damage the diodes under test.

Resistors. Check the resistors with an ohmmeter. Resistor tolerances are given in Section 7, Replaceable Electrical Parts. Normally, resistors do not need to be replaced unless the measured value varies widely from the specified value.

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

8. Repair and Adjust the Circuit

If any defective parts are located, follow the replacement procedures given under Component Replacement in this section. Check the performance of any circuit that has been repaired or that has had any electrical components replaced. Adjustment of the circuit may be necessary.

TROUBLESHOOTING THE HIGH-EFFICIENCY POWER-SUPPLY UNIT

General

The following information is provided to facilitate troubleshooting the high-efficiency power-supply unit. Information contained in other sections of this manual should be used in conjunction with this procedure to aid in locating a defective component. An understanding of the circuit operation is valuable in locating troubles. See Section 3, Circuit Description, for this information. Specifications for the troubleshooting equipment referred to in this procedure are given earlier in this section under Troubleshooting Equipment.

WARNING

Extreme caution must be used when troubleshooting in the power-supply unit due to the line voltage and the high-voltage/high-current potentials present in the unit.

When a fault condition occurs which is not of sufficient magnitude to open the line fuse, power-supply protection circuitry will cause the inverter to operate in a pulse mode. In this mode the inverter will turn on for a short period of time, and then turn off for a longer period of time. This cycle repeats until the malfunction is corrected. This pulse mode causes either a "ticking" or a "chirping" sound. Whenever either of these sounds is heard, turn off the 7904 and proceed with the Preliminary Procedure.

Preliminary Procedure

WARNING

To avoid electric shock, always disconnect the instrument from the power source before removing or replacing components or plug-in units.

1. Remove all plug-on units from the mainframe.
2. Set the CONTROL ILLUM control to the OFF position, and the GRAT ILLUM control to the fully clockwise position.

3. Remove the power-supply unit from the mainframe following the procedure given later in this section under Component Removal and Replacement.

4. Connect the power-cord plug of the 7904 to the output of a variable autotransformer that is set for 115 volts.

5. Set the POWER switch to ON and note the trouble symptoms.

6. Turn the 7904 off and proceed to the appropriate step in the Troubleshooting Procedure as indicated by the Trouble Symptom column in Table 4-2.

Table 4-2

RECOMMENDED POWER SUPPLY TROUBLESHOOTING SEQUENCE

Trouble Symptom	Procedure	Proceed to Troubleshooting Step:
7904 inoperative; no pulse mode.	1. Check line fuse.	A
7904 inoperative; no pulse mode; line fuse open.	1. Isolate malfunction from the mainframe circuitry.	B
	2. Check line input circuit.	D
	3. Check inverter circuit.	G
7904 inoperative; no pulse mode; line fuse normal.	1. Check inverter circuit.	G
7904 operating in the pulse mode.	1. Isolate malfunction from the mainframe circuitry.	B
	2. Check pre-regulated power supplies.	C
	3. Check crt and high-voltage circuits.	E
	4. Check inverter control circuit.	F
	5. Check inverter circuit.	G

Troubleshooting Procedure

Step A: Check Line Fuse. To check the line fuse, perform the following procedure:

1. Check the line fuse (F1200), located on the rear panel of the power-supply unit, for continuity and proper rating as given in Section 7, Replaceable Electrical Parts.
2. If the line fuse is open, replace with a new one of proper rating.

Step B: Isolate Malfunction from the Mainframe Circuitry. To isolate the malfunction, perform the following procedure:



Use extreme caution when troubleshooting in the Power-Supply Unit, to avoid electric shock. Stored dc potentials on the Power-Supply Inverter circuit board remain long after the instrument is disconnected from the power source. Verify that the power-cord plug is disconnected and that the line storage capacitors (C1216 and C1217) are completely discharged before attempting any repairs or ohmic measurements. (A warning-indicator neon bulb, located on the Power-Supply Inverter board, flashes when this stored voltage exceeds about 80 volts. However, simply because the neon bulb is not flashing does not mean that the capacitors are fully discharged.)

1. Remove the 7904 power-cord plug from the power source.
2. Remove the protective cover from the power-supply unit following the procedure under Access to Components in the Power-Supply Unit.
3. Manually discharge the line storage capacitors using the procedure given later in this section under Access to Components in the Power-Supply Unit.
4. Check the resistance of the power supplies at the test points given in Table 4-3 (see Fig. 4-3 for the location of these test points).

NOTE

Place the Common lead of the ohmmeter to ground when measuring power-supply resistance.

Table 4-3

TYPICAL POWER-SUPPLY RESISTANCE

Power Supply	Test Point	Ohmmeter Scale	Typical Resistance Reading
+130 V	TP +130 V	X 1k	6.6 kΩ
+50 V	TP +50 V	X 1k	3.4 kΩ
+15 V	TP +15 V	X 100	70 Ω
+5 V	TP +5 V	X 100	50 Ω
-15 V	TP -15 V	X 100	180 Ω
-50 V	TP -50 V	X 100	270 Ω

5. If any of the resistance readings are significantly lower than that listed, remove the electrical connections between the mainframe and the power-supply unit. Disconnect P1417, P1482, P1483 on the LV Regulator board (see Fig. 4-3). This isolates the circuitry in the mainframe from the power-supply unit. Recheck the resistance. If the readings remain low, the malfunction is located within the mainframe circuits. If the readings increase to normal or above, the malfunction is in the power supplies.

6. Replace all electrical connections which were disconnected in part 5.

Step C: Check the Pre-Regulated Power Supplies. To check the pre-regulated power supplies, perform the following procedures:

1. Connect a 10X voltage probe from the test oscilloscope to resistor R1287 on the Cap-Rectifier board. Set the test oscilloscope vertical deflection factor as necessary for an on-screen display; set the horizontal sweep rate for 2 milliseconds/division.
2. Set the variable autotransformer for 115 V. Connect the 7904 power-cord plug to the variable autotransformer; turn on the 7904.

3. Compare the waveform on the test oscilloscope to those shown in Figure 4-4. If the waveform resembles that of Figure 4-4A, proceed to Step E of this procedure. If it resembles that of Figure 4-4B, proceed with part 4 of this step.

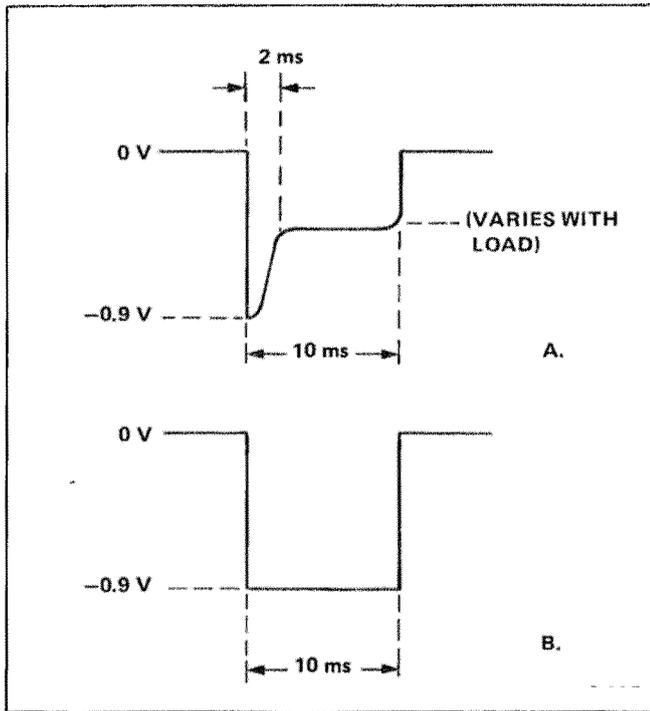


Fig. 4-4. Current sensing waveform at R1287 showing: (A) Power supplies not in current limit operation. (B) Power supplies in current limit operation.

4. Remove the 10X voltage probe from R1287. Set the test oscilloscope vertical coupling to dc and the horizontal sweep rate to 10 milliseconds/division.

5. Connect the 10X probe to each power supply at the test points given in Table 4-4. Note the polarity, amplitude, and shape of the waveform present at each test point. (Adjust the vertical deflection factor of the test oscilloscope as necessary to maintain an on-screen display.)

NOTE

Look for a power supply where the burst voltage is very low in relation to the specified supply voltage.

6. When a low supply voltage is found, disconnect the 7904 from the power source and discharge the line storage capacitors following the procedure given under Access to

Table 4-4

BURST VOLTAGE TEST POINTS

Pre-Regulated Power Supply	Test Point Located on Cap Rectifier Board
+130 V	Pin 4 of P1354
+54 V	Pin 3 of P1352
+17 V	Pin 4 of P1352
-17 V	Pin 2 of P1352
+7 V	Pin 1 of P1315
-54 V	Pin 6 of P1352
+5 V Lights	Pin 4 of P1315

Components in the Power-Supply Unit. Check for shorted components in the suspected power supply; also check the filter capacitors for leakage.

Step D. Check Line Input Circuit. To check the input circuit, perform the following procedure:

1. Disconnect the 7904 from the variable autotransformer and discharge the line storage capacitors following the procedure given under Access to Components in the Power-Supply Unit.

2. Replace the line fuse.

3. Check diode bridge CR1215 on the Power-Supply Inverter board (see A11 circuit board) and the associated line input circuit for a shorted component. If the circuit appears normal, connect the power-cord plug to the variable autotransformer.

4. Attach a 10X voltage probe from the test oscilloscope to one of the screws used to discharge C1216 and C1217 (see A11 circuit board). Set the variable autotransformer for 20 volts and turn the 7904 on. Set the test oscilloscope for line triggering.

5. Check for an ac waveform on the test oscilloscope (see Fig. 4-5). Note the amount of dc the waveform is offset. Move the probe tip to the other capacitor screw. Check for an ac waveform which is both offset an equal amount of dc, and is opposite in polarity, from the previous waveform. (This checks the condition of the line storage capacitors.)

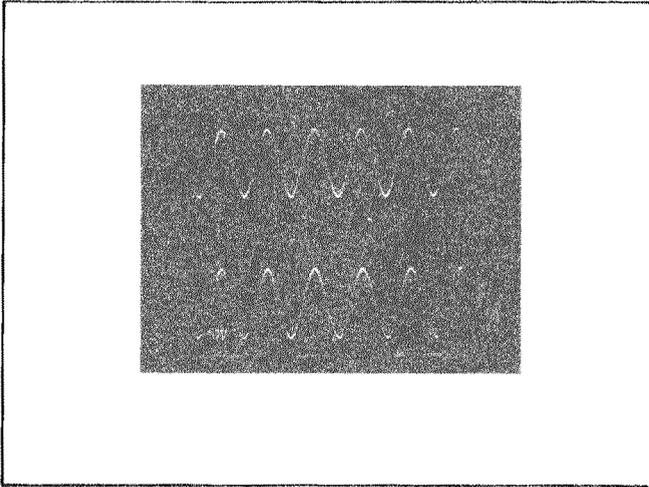


Fig. 4-5. Typical waveforms on C1216 and C1217 with the line voltage set to approximately 20 volts.

Step E. Check CRT and High-Voltage Circuits. To check the crt circuitry, perform the following procedure:

1. Disconnect the 7904 from the power source and discharge the line storage capacitors following the procedure given under Access to Components in the Power-Supply Unit.
2. Remove one end of R1304 and R1305 on the Cap-Rectifier circuit board (see A12 circuit board).
3. Set the variable autotransformer for 115 volts. Connect the 7904 power-cord plug to the variable autotransformer; turn the 7904 on.
4. Check for stable operation (no pulse mode) of the power supplies. If the power supply is still in the pulse mode, a crt failure or malfunction in the high-voltage circuitry is indicated.
5. Resolder R1304 and R1305 on the Cap-Rectifier circuit board.

Step F: Check the Inverter Control Circuit. To check the inverter control circuit, perform the following procedure:

1. Disconnect the 7904 from the power source and discharge the line storage capacitors following the procedure given under Access to Components in the Power-Supply Unit.
2. Remove Q1254 (see A12 circuit board) from the Cap-Rectifier board.

3. Connect the 7904 power-cord plug to the variable autotransformer. Turn the 7904 on and apply 115 volts from the variable autotransformer. If the power supplies stabilize, check the inverter control circuit for a malfunction. If the 7904 continues in pulse mode, proceed to part 4 of this step.

4. Repeat part 1 of this step. Then remove Q1252 from the Cap-Rectifier board.

5. Set the variable autotransformer to 0 volt. Connect the 7904 power-cord plug to the variable autotransformer. Turn the 7904 on. While monitoring the +130 V test point on the LV Regulator board (see Fig. 4-3) with a voltmeter, slowly increase the output of the variable autotransformer until the voltmeter just reads +130 volts.

NOTE

If the variable autotransformer's output is increased past the point where the voltmeter just reaches a reading of +130 volts, the 7904 will switch to pulse mode.

6. If the power supplies stabilize, check U1275 and the inverter control circuit for a malfunction. If the 7904 continues in the pulse mode, proceed to Step G of this procedure.

Step G: Check Inverter Circuit. To check the inverter circuit, perform the following procedure:

1. Disconnect the 7904 power-cord plug from the power source and discharge the line storage capacitors following the procedure given under Access to Components in the Power-Supply Unit.
2. Remove Q1234, Q1241, CR1234, and CR1241 on the Power-Supply Inverter board (see A11 circuit board) and check the characteristics of each with a curve tracer. Install the checked or replaced components in the Power-Supply Inverter board. Replace the line fuse, if it is open.
3. If the faulty component was not found, check Q1248 and VR1246 with a curve tracer.

NOTE

A shift in the zener voltage of VR1246 can cause erratic operation of the inverter circuit.

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4. If the 7904 continues in the pulse mode or to open the line fuse, check the current waveform through T1230. To do this, first repeat part 1 of this step. Then connect a current probe from the test oscilloscope to the gray lead that passes through toroid transformer T1230. Set the test oscilloscope for a vertical deflection factor of about 1 volt/division and a horizontal sweep rate of 12 milliseconds/division. Connect the 7904 power-cord plug to the variable autotransformer which is set for a voltage of 0. Turn the 7904 on and slowly increase the variable autotransformer's output to about 60 volts. Check for a burst waveform on the test oscilloscope (similar to that shown in Fig. 4-6).

NOTE

The burst waveform indicates that the inverter circuit is attempting to start. If no burst waveform occurs, proceed to part 6; if a burst waveform is obtained, proceed to part 5.

5. If a burst waveform was obtained in part 4 above, check for stable inverter operation when the line input voltage is increase to about 85 volts. Figure 4-7 shows the current waveform at T1230 for normal inverter operation at a line source of 115 volts.

NOTE

The test oscilloscope horizontal sweep rate has been changed to about 50 microseconds/division for Fig. 4-7.

6. If no burst waveform occurred in part 4, repeat part 1 of this step. Then remove the current probe from the 7904 and the test oscilloscope. Connect a 10X voltage probe from the test oscilloscope to TP1234 on the Power-Supply Inverter board (see A11 circuit board). Set the variable autotransformer for 20 volts and check for a line ripple waveform which is about dc centered (see Fig. 4-8). If the waveform is not centered, check Q1246, CR1232, CR1240, CR1242, CR1249, and CR1244 for shorts or leakage.

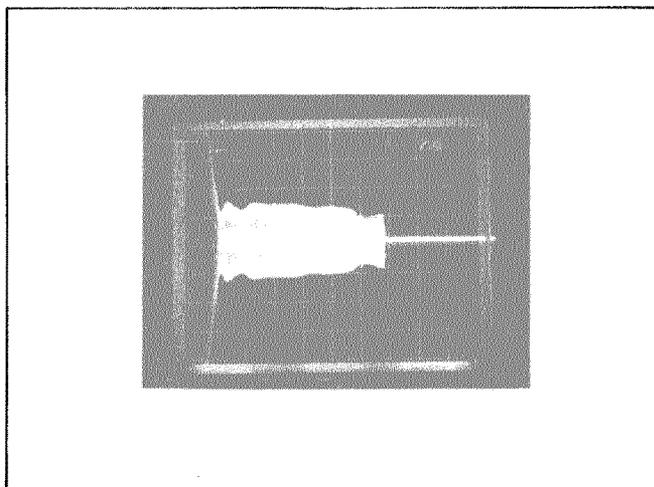


Fig. 4-6. Current waveform at T1230 showing burst operation at line voltage of approximately 60 volts.

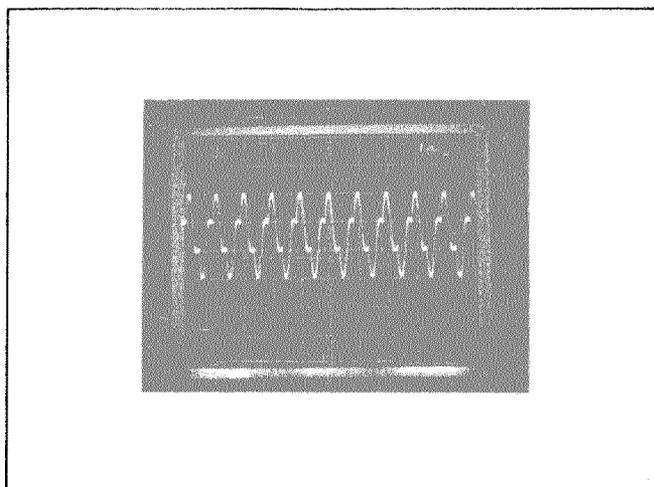


Fig. 4-7. Current waveform at T1230 for normal inverter operation at line voltage of 115 volts.

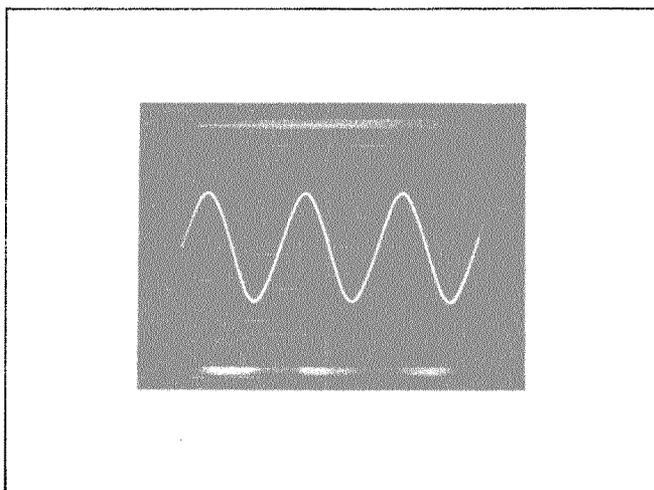


Fig. 4-8. Waveform at TP1234 on the Power Supply Inverter board with the line voltage at approximately 20 volts.

CORRECTIVE MAINTENANCE

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

OBTAINING REPLACEMENT PARTS

All electrical and mechanical part replacements for the 7904 can be obtained through your Tektronix Field Office or representative. However, many of the standard electronic components can be obtained locally in less time than is required to order them from Tektronix, Inc. Before purchasing or ordering replacement parts, check the parts list for value, tolerance, rating, and description.

NOTE

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

Some parts are manufactured or selected by Tektronix, Inc. to satisfy particular requirements, or are manufactured for Tektronix, Inc. to our specifications. Most of the mechanical parts used in this instrument have been manufactured by Tektronix, Inc. To determine manufacturer of parts, refer to Parts List, Cross Index Mfr. Code Number to Manufacturer.

When ordering replacement parts from Tektronix, Inc., include the following information:

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

SOLDERING TECHNIQUES

WARNING

To avoid electric-shock hazard, disconnect the instrument from the power source before soldering.

The reliability and accuracy of this instrument can be maintained only if proper soldering techniques are used when repairing or replacing parts. General soldering techniques which apply to maintenance of any precision electronic equipment should be used when working on this instrument. Use only 60/40 rosin-core, electronic-grade solder. The choice of soldering iron is determined by the repair to be made.

CAUTION

Several of the circuit boards in the 7904 are multi-layer type boards with a conductive path laminated between the top and bottom board layers. All soldering on these boards should be done with extreme care to prevent breaking the connections to this center conductor. Only experienced maintenance personnel should attempt repair of these boards: A2—Main Interface, A4—Logic, A5, A6—Trigger Selector, A7—Vertical Interface and A12—Cap-Rectifier circuit board.

When soldering on circuit boards or small wiring, use only a 15-watt, pencil-type soldering iron. A higher wattage soldering iron can cause the etched circuit wiring to separate from the board base material and melt the insulation from small wiring. Always keep the soldering-iron tip properly tinned to ensure the best heat transfer to the solder joint. Apply only enough heat to remove the component or to make a good solder joint. To protect heat-sensitive components, hold the component lead with a pair of long-nose pliers between the component body and the solder joint. Use a solder-removing wick to remove excess solder from connections or to clean circuit board pads.

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The following technique should be used to replace a component on any of the circuit boards not mentioned in the preceding Caution. Most components can be replaced without removing the board(s) from the instrument.

1. Touch the soldering iron to the lead at the solder connection. Never place the iron directly on the board, as this may damage the board.

2. Melt a small amount of solder onto the component lead connection. This replaces the flux, which may have been removed during instrument cleaning, and facilitates removal of the component.

3. Grip the component lead with a pair of long-nose pliers. When the solder begins to flow, gently pull the component lead from the board. If unable to separate the lead from the board, try removing the other end of the component.

NOTE

Some components are difficult to remove from the circuit boards due to a bend placed in each lead during machine insertion of the component. The purpose of the bent leads is to hold the component in position during a flow-solder manufacturing process which solders all components at once. To make removal of machine inserted components easier, straighten the leads of the component on the back of the circuit board, using a small screwdriver or pliers, while heating the soldered connection.

4. Bend the leads of the replacement component to fit the holes in the circuit board. If the component is replaced while the board is mounted in the instrument, cut the leads so they will just protrude through the board. Insert the leads into the holes in the board so that the component is firmly seated against the board, or as originally positioned.

5. Touch the iron to the connection and apply enough solder to make a firm solder joint.

6. Cut off any excess lead protruding through the board (if not clipped in step 4).

7. Clean the area around the solder connection with a flux-removing solvent. Be careful not to remove information printed on the circuit board.

COMPONENT REMOVAL AND REPLACEMENT

WARNING

To avoid electric-shock hazard, always disconnect the instrument from the power source before removing or replacing components or plug-in units.

The exploded-view drawings associated with the Replaceable Mechanical Parts list (located at the rear of this manual) may be helpful in the removal or disassembly of individual components or sub-assemblies.

Power-Supply Unit Removal

The power-supply unit can be slid out of the rear of the 7904 to gain better access to the Logic board, Main Interface board, LV Regulator board, or for power-supply maintenance and troubleshooting. To remove the power-supply unit from the mainframe, first remove the four screws which hold the power-supply unit to the rear frame of the instrument. Slide the power-supply unit out of the mainframe until it can be set down on the work surface (be sure to guide the interconnecting cables so they do not catch on other parts of the instrument). The power-supply unit remains electrically connected to the rest of the instrument in this position, allowing for troubleshooting. If it is necessary to operate this instrument with the power-supply unit removed for a period of time, we recommend that the power-supply unit be secured to the instrument with spacers between the rear frame and the power-supply unit.

Reverse the above procedure when placing the power-supply unit into the mainframe of the instrument; be careful not to pinch the interconnecting cable when replacing the unit. Be sure that all the securing screws are tight enough to hold the power-supply unit properly in place.

Access to Components in the Power-Supply Unit

To reach the components located inside the power-supply unit for maintenance or repair, use the following procedure:

WARNING

Disconnect the instrument from the power source and allow the line storage capacitors to discharge before removing the power-unit cover. The line storage capacitors remain charged with high voltage dc for several minutes after the line power is disconnected unless they are manually discharged. A warning-indicator neon bulb, located on the Power Supply Inverter board, flashes when this stored voltage exceeds about 80 volts. Do not remove the power-unit cover while this light is flashing.

1. Slide out the power unit as described previously.
2. Disconnect the crt anode plug from the jack located at the front of the power unit. Ground this lead to the chassis to dissipate any stored charge.
3. Disconnect all the multi-pin connectors which connect the power unit to the rest of the instrument.
4. Disconnect the power-unit ground lead (green-with-yellow stripe wire terminated with spade lug) by loosening the securing screw at the rear of the Z-Axis chassis (near A16, Z-Axis circuit board).
5. Remove the nut holding the POWER switch to the front panel. Remove this switch and the interconnecting cable through the rear of the instrument.
6. Remove the screws which secure the protective cover to the front and bottom of the power unit and pull the cover off of the power unit.
7. The power unit is now open for maintenance or repair. For information on circuit board removal and replacement, see the instructions given under Circuit Board Replacement for the applicable board. To replace the transformer, see Power Transformer Replacement.
8. Reverse the order of removal to replace the power-unit cover.

Before performing maintenance or taking ohmic measurements in the power-supply unit, manually discharge the line storage capacitors (C1216 and C1217) as follows:

1. Remove the protective cover from the power-supply unit following the preceding procedure.
2. Apply a 1.5 kilohm, 2-watt, insulated resistor across the capacitor screws.

Cathode-Ray Tube Removal

Remove the cathode-ray tube (crt) as follows:

WARNING

The crt may retain a dangerous electrical charge. Before removing the crt, the anode must be fully discharged by shorting the anode lead from the crt to the chassis. Wait approximately ten minutes and again firmly short this lead to the chassis. Then remove the crt. After removal, short the anode lead to the silvered patch on the funnel portion of the crt just prior to further handling.

Use care when handling a crt. Breakage of the crt causes a high-velocity scattering of glass fragments (implosion). Protective clothing and safety glasses should be worn. Avoid striking the crt on any object which might cause it to crack or implode. When storing a crt, place it in a protective carton or set it face down in a protected location on a smooth surface with a soft mat under the faceplate.

1. Remove the plastic crt mask, light filter, and metal light shield.
2. Remove the four screws securing the crt bezel to the front panel. Disconnect the multi-pin connector from the left rear of the crt bezel.
3. Release the crt anode lead from the plastic fasteners near the top of the instrument. Disconnect the anode plug from the jack on the power unit. Ground this lead to the chassis to dissipate any stored charge.
4. Disconnect the deflection-plate connectors. Be careful not to bend these pins.
5. Loosen the two screws located on each side of the crt socket until the tension of the springs on these screws is released. Then, press in on the screws to be sure that the crt clamp is loose.
7. Hold one hand on the crt faceplate and push forward on the crt base with the other. As the crt starts out of the shield, grasp it firmly. Guide the anode lead through the cutout in the crt shield as the crt is removed.

Cathode-Ray Tube Replacement

Replace the cathode-ray tube (crt) as follows:

1. Insert the crt into the shield. Guide the anode lead through the hole in the crt shield. Set the crt firmly against the cushions mounted on each corner of the frame panel.
2. Clean the crt faceplate, plastic faceplate protector, and the light filter with denatured alcohol.
3. Place the black plastic crt mask over the crt faceplate.
4. Reconnect the multi-pin connector to the crt bezel (align arrow on connector with arrow on bezel). Hold the clear faceplate protector in position and install the crt bezel. Firmly tighten the four screws.
5. Push forward on the crt base to be certain that the crt is as far forward as possible. Then tighten the two screws beside the crt base socket until the springs on the screws are fully compressed.
6. Replace the crt base socket.
7. Fasten the crt anode lead into the plastic fasteners. Reconnect the crt anode plug.
8. Carefully reconnect the deflection-plate connectors. After each connector is installed, lightly pull on its lead to be sure that it will remain in place.
9. Replace the metal light shield and the tinted filter. Then snap the plastic crt mask into the crt bezel.

NOTE

The replacement of the crt will require that the instrument be re-adjusted. Refer to Section 5, Performance Check and Adjustment.

Circuit Boards

If a circuit board is damaged beyond repair, replace the entire board assembly. Part numbers are given in section 7, Replaceable Electrical Parts, for the completely wired board.

The pin connectors, except for coaxial-type connectors, used for interconnection between circuit boards are color-coded to aid in identification and circuit tracing. The color of the connector body matches the resistor color-code for the last digit of the connector circuit number; e.g., P601 is brown, P603 is orange, etc.

Most of the circuit boards in this instrument are mounted on the chassis; pin connectors are used for electrical interconnection with chassis mounted components and other circuit boards. Several boards plug onto the front and rear or the Main Interface board; feed-thru connectors connect the plug-on board to the Main Interface board.

Chassis-Mounted Boards. Remove and replace all chassis-mounted circuit boards as follows:

1. Disconnect all pin connectors attached to the board, or which connect the board to other parts of the instrument.
2. Remove the securing screws.
3. Remove the chassis-mounted board.
4. Replace chassis-mounted boards in the reverse order of removal. Match the index arrow on the multi-pin connectors to the corresponding arrow on the board. Correct location of the pin connectors is shown on the circuit board illustration in section 8, Diagrams and Circuit Board Illustrations.

Plug-On Boards. Remove and replace the plug-on boards as follows:

1. Remove the plug-in units or the power-supply unit (see Power-Supply Unit Removal) as necessary to gain access to the boards mounted on the front or rear of the Main Interface board.
2. Disconnect any end-lead coaxial connectors located on the front of the board, or those which pass across a portion of the board.
3. Loosen all of the board's securing screws.
4. Keeping the board parallel to the Main Interface board, gently pull out on the edge of the board until the feed-thru terminals are cleared.

5. To replace a plug-on circuit board, position the board parallel to the Main Interface board so that all feed-thru pins are properly aligned with their sockets.

6. Gently press the circuit board against the mounting surface. Be sure that all feed-thru pins and sockets mate properly.

7. Uniformly tighten the securing screws (recommended torque: four to six inch-pounds).

A1—Probe Power Circuit Board. Remove and replace the Probe Power circuit board as follows:

1. Disconnect the multi-pin connector and coaxial cables from the board.

2. Remove the two screws securing the circuit board to the chassis.

3. Using a vacuum-type desoldering tool, remove the solder attaching the board to the probe power connector (J90).

4. Replace the circuit board in the reverse order of removal. Match the index arrow on the multi-pin connector to the corresponding arrow on the circuit board. Correct location of the multi-pin connector is shown on the circuit board illustration in Section 8, Diagrams and Circuit Board Illustrations.

A2—Main Interface Circuit Board. Remove and replace the Main Interface circuit board as follows:

1. Slide out the power-unit as described previously.

2. Remove all of the plug-on circuit boards from the Main Interface circuit board as given previously (remove plug-in units to gain access to plug-on boards on front of Main Interface board).

3. Disconnect the pin connectors from the Main Interface board. Note the order of these connectors so they can be correctly replaced.

4. Remove the screws from inside each plug-in compartment which hold the plug-in interface connectors to the chassis of this instrument. Also remove the screws which hold the ground straps to the chassis.

5. Slide the Main Interface board assembly to the rear and remove it from the instrument.

6. To replace the Main Interface board, reverse the order of removal. Match the arrows on the pin connectors to the arrows on the board. Correct location of the pin connectors is shown in the circuit board illustrations in the Diagrams section. Also see Pin Connectors Color-Code under Troubleshooting in this section.

A3—Front Panel Interconnect Board. Remove or replace the Front Panel Interconnect circuit board as follows:

1. Disconnect all pin connectors and cables from the board, and remove the two screws holding the board to the chassis.

NOTE

When removing wires from a circuit board, always tag the wire and the corresponding connection point on the circuit board.

2. Slide the board toward the rear of the instrument until the board clears the pushbutton switch pins.

3. Remove the board from the instrument.

4. Replace the board by reversing the order of removal. Match the index arrow on the multi-pin connectors to the corresponding arrow on the board. Correct locations of the multi-pin connectors is shown on the circuit board illustration in Section 8, Diagrams and Circuit Board Illustrations.

A8—Vertical Amplifier Circuit Board. Remove and replace the Vertical Amplifier circuit board as follows:

1. Disconnect all multi-pin connectors and coaxial cables from the board. Also, remove the vertical output IC leads from the crt neck pins.

2. Remove the seven securing screws holding the circuit board to the chassis.

3. Remove the circuit board from the instrument.

4. To replace the circuit board, place the board in the instrument, but do not tighten the securing screws at this time.

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5. Align the output IC leads to the crt neck pins, located behind the circuit board. Then tighten the securing screw.

6. Reconnect the coaxial cables and multi-pin connectors. Match the index arrow on the connectors to the corresponding arrow on the circuit board.

7. Correct location of the multi-pin connectors is shown on the circuit board illustration in Section 8, Diagrams and Circuit Board Illustrations.

A9—Horizontal Amplifier Circuit Board. Remove or replace the Horizontal Amplifier circuit board as follows:

1. Disconnect all multi-pin connectors and coaxial cables from the board. Also, disconnect the two output leads from the crt neck pins.

2. Remove the four securing screws holding the circuit board to the chassis.

3. Remove the circuit board from the instrument.

4. To replace the circuit board, reverse the removal procedure. Match the arrows on the multi-pin connectors to the arrows on the circuit board. Correct location of the pin connectors and coaxial cables is shown on the circuit board illustration in Section 8, Diagrams and Circuit Board Illustrations.

A10—Calibrator-Signal Board. To replace the Calibrator-Signals circuit board, proceed as follows:

1. Disconnect all pin connectors and cables from the board.

2. Set the CALIBRATOR and RATE switches as necessary to gain access to the shaft-coupling set screws (one in front of both switch sections). Note the knob positions so they can be correctly replaced.

3. Loosen the set screw in the rear shaft coupling with a 0.050-inch hex-key wrench. Remove the RATE knob and shaft through the front of the instrument.

4. Loosen the front set screw in the front shaft coupling with a 5/64-inch hex-key wrench. Remove the CALIBRATOR knob and shaft through the front of the instrument.

5. Remove the screws which hold the switch/board assembly to the chassis and remove the assembly from the instrument.

6. To replace the Calibrator-Signals switch/board assembly, reverse the removal procedure. Match the arrows on the multi-pin connectors to the arrows on the board. Correct location of the pin connectors and coaxial cables is shown on the circuit board illustration in Section 8. Be sure the front-panel knobs are installed so they indicate the correct switch positions.

A11—Power Supply Inverter Board. To remove and replace the Power Supply Inverter board, use the following procedures. An exploded-view drawing of the power unit is shown in the Replaceable Mechanical Parts list. All references to direction or location (e.g., left side) assume that the power unit is placed as shown in this drawing. Several critical parts are identified in Fig. 4-4, an exploded-view drawing of a portion of the power unit.

WARNING

The power-unit assembly has been tested at the factory to assure safe operation. Improper repair of this unit can result in hazardous voltages on the chassis of this instrument. Do not remove the plate insulator, block insulator, or transistor shield from the rear heat-sink (see Fig. 4-9).

REMOVAL:

1. Disconnect the instrument from the power source.

2. Remove the power unit from the instrument as described under Power-Unit Removal.

3. Remove the protective cover from the power unit as described under Access to Components in Power Unit.

4. Disconnect the multi-pin connectors from **A12** Cap-Rectifier board.

5. Remove the mounting hardware securing the plastic-cased power transistors to the rear heatsink. Note the orientation of the lockwashers so they can be correctly replaced.

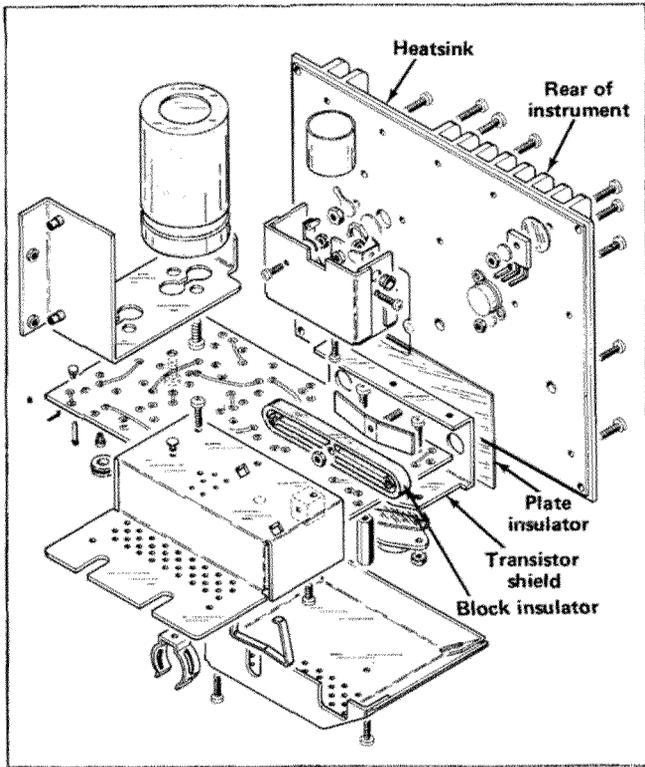


Fig. 4-9. Exploded-view drawing of a portion of the power unit identifying several critical parts.

6. Remove the Regulator chassis. This chassis is secured to the rear heatsink by two screws; access to the remaining four screws is provided by holes in **A13**, LV Regulator board. Remove this chassis along with the LV Regulator board and plastic-cased transistors.

7. Remove the right side cover. This cover is secured to the rear heatsink by two screws and to the side by one screw.

8. Remove the left side cover. This cover is secured to the rear heatsink by two screws and to the side by four screws.

9. Remove transistor shield from **A11**, Power Supply Inverter board, by removing two plastic screws and split lockwashers.

10. Unsolder the three power-transformer leads from **A11**, Power Supply Inverter board. These leads, which pass through holes in the board, are identified on the circuit-board illustration in the Diagrams section. Remove the excess solder from the board with a vacuum-type desoldering tool.

11. The left side of **A12**, Cap-Rectifier board is secured to the capacitor bracket by two screws. Remove these screws.

12. The top right corner of **A12**, Cap-Rectifier board, is secured to the nut block by a screw. Remove this screw.

13. The left side of **A11**, Power Supply Inverter board, is secured to two capacitors by four screws. Remove these screws to remove the capacitors and capacitor bracket.

14. Move the bottom edge of **A12**, Cap-Rectifier board, away from **A11**, Power Supply Inverter board, until the interconnecting pins are cleared. Remove **A12**, Cap-Rectifier board, and the high-voltage supply box as a unit.

15. Unsolder the eight line-input leads from **A11**, Power Supply Inverter board. These leads are identified on the circuit board illustration, **A11** in the Diagrams section. Remove all excess solder from the board with a vacuum-type desoldering tool.

16. The line-filter shield is held to the rear heatsink by two screws. Remove these screws; it is not necessary to disconnect the line-filter leads.

17. Remove the two transistors by removing the nuts and pulling the transistors from their sockets.

18. Shield is held to the insulator block by three screws. Remove these screws.

19. Move **A11**, Power Supply Inverter board, away from the heatsink-shield until the transistor mounting studs clear the heatsink-shield. Remove **A11**, Power Supply Inverter board, and shield as a unit.

REPLACEMENT:

1. Set the back of the rear heatsink on the work surface. Replace **A11**, Power Supply Inverter board, with shield, by guiding the transistor mounting studs through the holes in the heatsink-shield.

2. Secure the shield to the insulator block with three screws.

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3. Apply a thin coat of silicone grease to both sides of the transistor insulating washers and place these washers over the transistor mounting studs.

4. Replace transistors and secure with nuts.

5. Secure the line-filter shield to the rear heatsink with the two screws. Be sure no wires get caught between the shield and heatsink.

6. To mount **A12**, Cap-Rectifier board, and high-voltage supply box, guide the power-transformer leads through the appropriate holes in **A11**, Power Supply Inverter board. Then, align **A12**, Cap-Rectifier board, to properly mate the interconnecting pins and sockets.

7. Replace the screw which secures **A12**, Cap-Rectifier board, to the nut block.

8. Place the power-unit ground lead and power-switch cable in the slot in the top of **A12**, Cap-Rectifier board.

9. Mount the capacitors with capacitor bracket to **A11**, Power Supply Inverter board, with four screws.

10. Replace the two screws which secure **A12**, Cap-Rectifier board to the capacitor bracket.

11. Solder the three power-transformer leads and eight line-input leads to **A11**, Power Supply Inverter board. Correct connection of these leads is shown on the circuit board illustration, **A11**, in the Diagrams section.

12. Replace the transistor shield; secure with two plastic screws.

13. Replace the left side cover; secure with screws.

14. Replace the right side cover; secure with screws.

15. Before replacing the Regulator board chassis along with **A13**, LV Regulator board and plastic power transistors, apply a thin coat of silicone grease to the back (mounting surface) of each transistor case. Check that the transistor insulating washers are in place on the rear heatsink. If any of these insulating washers are replaced, apply a thin coat of silicone grease to each side.

16. Place the Regulator board chassis on the power unit. Check that the plastic transistors are aligned with their mounting holes and that the insulating washers are still in place between the transistor cases and the rear heatsink.

17. Replace the screws that secure the Regulator board chassis; do not yet tighten these screws.

18. Secure the plastic transistors to the rear heatsink, with the mounting hardware. Do not over-tighten these nuts; recommended torque, 4 to 6 inch-pounds. Tighten the screws replaced in the previous step.

19. Connect the multi-pin to **A12**, Cap-Rectifier board; match the arrows on the connectors to the arrows on the board.

A12—Cap-Rectifier Board. To remove and replace the Cap-Rectifier circuit board, use the following procedure:

1. Follow the first 12 steps of the removal procedure for the Power Supply Inverter board, as given previously.

2. Unsolder the power-transformer leads connected to the rear side of the board. Remove the excess solder with a vacuum-type desoldering tool.

3. Remove the screws which hold the circuit board to the high-voltage supply box.

4. To replace the board, reverse the order of removal. Place all of the power-transformer leads in the circuit board holes; then re-solder them to the board. To replace the Regulator board chassis along with the LV Regulator board and plastic power transistors, see the instructions given in the replacement procedure for the Power Supply Inverter board.

A13—LV Regulator Board. To remove and replace the LV Regulator circuit board, use the following procedure:

REMOVAL:

1. Slide the power unit out of the rear of the instrument as described previously.
2. Disconnect the multi-pin connectors from the board.
3. Remove the mounting hardware securing the plastic-cased power transistors to the rear heatsink. Note the orientation of the lockwashers so they can be correctly replaced.
4. Remove the screws which hold the LV Regulator board to the top chassis. Remove the board along with the plastic-cased transistors.

REPLACEMENT:

1. Apply a thin coat of silicone grease on the back (mounting surface) of each plastic transistor case.
2. Place the LV Regulator board on the chassis. Replace the screws which hold the board to the chassis; do not yet tighten these screws.
3. Check that the plastic transistors are aligned with their mounting holes and that the insulating washers are in place between the transistor cases and the rear heatsink.
4. Secure the transistors to the heatsink with the mounting hardware. Do not over-tighten the nuts; recommended torque, 4 to 6 inch-pounds.
5. Tighten the screws holding the LV Regulator board to the chassis.
6. Connect the multi-pin connectors to the board. Match the arrows on the connectors to the arrows on the board.
7. Replace the power unit in the instrument.

A14, A15—High-Voltage and Auto Focus Boards. The High-Voltage and Auto Focus circuit boards are located in

the high-voltage supply box and are removed as a unit. To replace either of these boards, proceed as follows:

1. Follow the first six steps given under Access to Components in Power Unit.
 2. Disconnect the remaining multi-pin connectors from the LV Regulator board.
 3. Remove the hardware which secures the plastic power transistors to the rear heatsink.
 4. Remove the four screws which hold the Regulator chassis to the power unit (accessible through holes in the LV Regulator board).
 5. Remove the two screws securing the lip of the Regulator chassis to the rear heatsink.
 6. Remove the Regulator chassis along with the LV Regulator board and plastic transistors.
 7. Remove the screw securing the High-Voltage board to the high-voltage supply box.
 8. Unsolder the five power-transformer leads connected to the High-Voltage board. Note the location of these leads so they can be correctly re-connected. Remove the excess solder from the board with a vacuum-type desoldering tool.
 9. Remove the High-Voltage and Auto Focus boards from the high-voltage supply box.
 10. To replace the two boards, reverse the removal procedure. To replace the Regulator chassis along with the LV Regulator board and plastic transistors, see the instructions given in the replacement procedure for the Power Supply Inverter board.
- A18—Readout Circuit Board.** Remove and replace the Readout circuit board as follows:
1. Disconnect the multi-pin connectors and coaxial cables from the board. Note the location of the connectors so they may be correctly replaced.

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2. Remove the single screw securing the circuit board to the chassis.
3. Gently, push back the plastic fasteners holding the circuit board, and remove the board from the instrument.
4. Replace the Readout circuit board by reversing the order of removal. Match the index arrow on the multi-pin connectors to the corresponding arrow on the circuit board. Correct location of the multi-pin connectors is shown on the illustration in Section 8, Diagrams and Circuit Board Illustrations.

Plug-In Interface Connectors.

The individual contacts of the plug-in interface connectors can be replaced. However, we recommend replacing the entire Main Interface board if a large number of the contacts are damaged. An alternative solution is to refer the maintenance of the damaged Main Interface board to your local Tektronix Field Office. Use the following procedure to remove and replace an individual contact of the plug-in interface connectors:

NOTE

The plug-in interface contacts which are mounted on the Follower circuit boards cannot be replaced. A Follower board with contacts and interconnecting cables is replaced as a unit. See Circuit Boards earlier in this section.

1. Remove the Main Interface circuit board from the instrument as previously described.
2. Snap the white plastic connector cover off the side of the damaged plug-in interface connector.
3. Unsolder and remove the damaged contact.
4. Install the replacement contact. Carefully position it to fit against the connector body.
5. Snap the white plastic connector cover back onto the plug-in interface connector. Check that the replaced contact is aligned with the other contacts.
6. Replace the Main Interface board.

Semiconductors

Semiconductors should not be replaced unless actually defective. If removed from their sockets during routine maintenance, return them to their original sockets. Unnecessary replacement of semiconductors may affect the adjustment of the instrument. When semiconductors are replaced, check the operation of circuits which may be affected.

WARNING

To avoid electric shock hazard, always disconnect the 7904 from the power source before removing or replacing components.

Replacement semiconductors should be of the original type or a direct replacement. Lead configurations of the semiconductors used in this instrument are shown in Fig. 4-10. Some plastic case transistors have lead configurations which do not agree with those shown. If a replacement transistor is made by a different manufacturer than the original, check the manufacturer's basing diagram for correct basing. All transistor sockets in this instrument are wired for standard basing as used for metal-cased transistors. When removing soldered-on transistors, use a solder-removing wick to remove the solder from the circuit board pads. Transistors which have heat radiators or are mounted on the chassis use silicone grease to increase heat transfer. Replace the silicone grease on both sides of the insulating washer when replacing these transistors.

WARNING

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

To replace one of the power transistors mounted on the heatsink at the rear of the power-supply unit, first remove the mounting hardware. Then, unsolder and remove the defective transistor. When replacing the transistor, be sure to install the insulating washer between the transistor and the heatsink (use silicone grease as previously described). Tighten the mounting nut just tight enough to hold the transistor in place. Then solder the replacement transistor to the LV Regulator board.

An extracting tool should be used to remove the in-line integrated circuits to prevent damaging the pins. This tool is available from Tektonix, Inc. If an extracting tool is not available, use care to avoid damaging the pins. Pull slowly and evenly on both ends of the integrated circuit. Try to avoid one end disengaging from the socket before the other end.

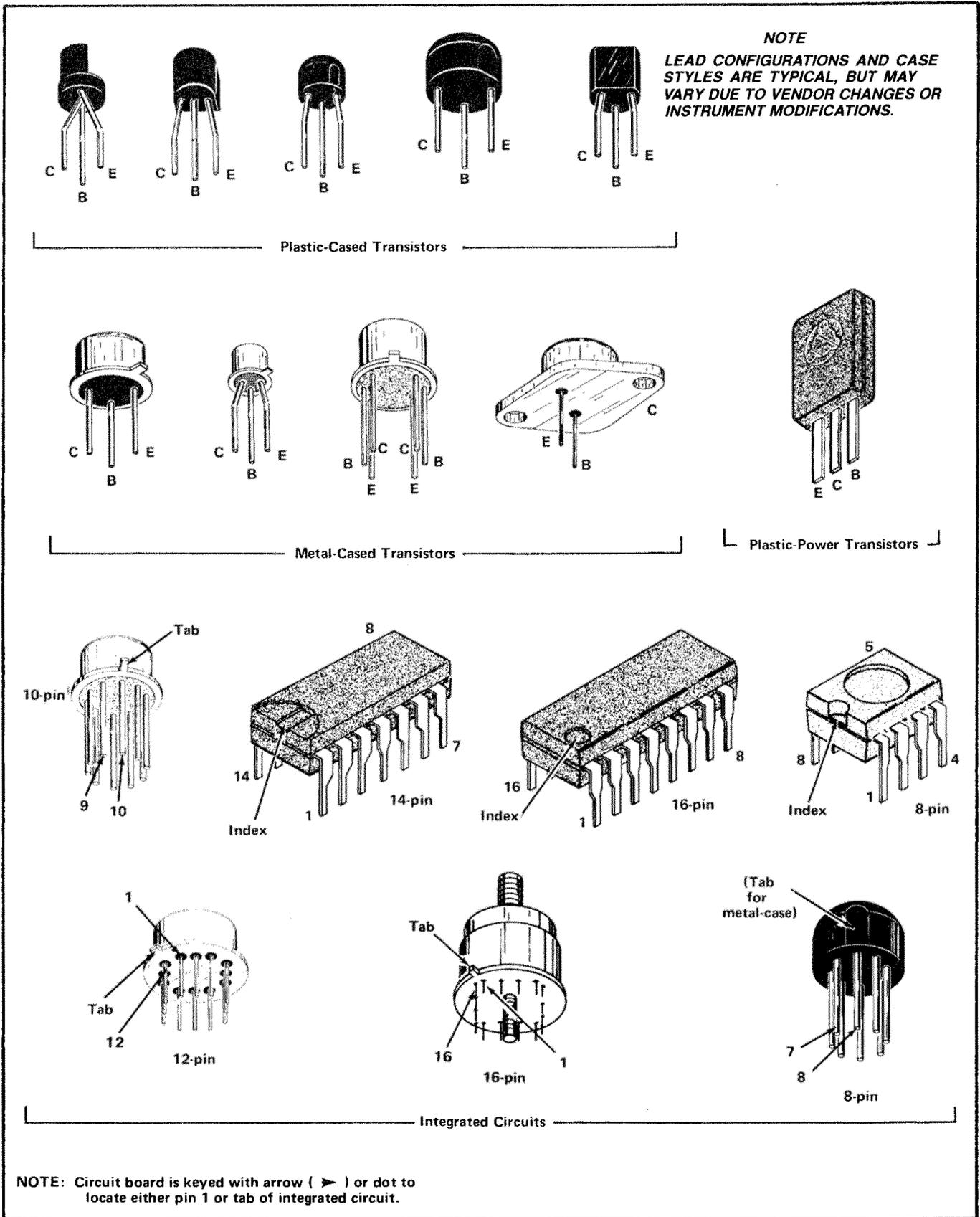


Fig. 4-10. Electrode configuration for semiconductors in this instrument.

Interconnecting Pins

Two methods of interconnection are used in this instrument to electrically connect the circuit boards with other boards and components. When the interconnection is made with a coaxial cable, a special end-lead connector plugs into socket on the board. Other interconnections are made with a pin soldered into the board. Two types of mating connectors are used for these interconnecting pins. If the mating connector is mounted on a plug-on circuit board, a special socket is soldered into the board. If the mating connector is on the end of a lead, an end-lead pin connector is used which mates with the interconnecting pin. The following information provides the removal and replacement procedure for the various types of interconnecting methods.

Coaxial-Type End-Lead Connectors. Replacement of the coaxial-type end-lead connectors requires special tools and techniques; only experienced maintenance personnel should attempt to remove or replace these connectors. We recommend that the damaged cable or wiring harness be replaced as a unit. An alternative solution is to refer the replacement of the defective connector to your local Tektronix Field Office or representative. Figure 4-11 gives an exploded view of a coaxial end-lead connector assembly.

Circuit-Board Pins. A circuit-board pin replacement kit (including necessary tools, instructions, and replacement pins with attached ferrules) is available from Tektronix, Inc. Replacing circuit-board pins on multi-layer boards is not recommended. (The multi-layer boards in this instrument are listed under Soldering Techniques in this section.)

To replace a damaged pin, first disconnect any pin connectors. Then unsolder the damaged pin and pull it from the board with a pair of pliers, leaving the ferrule (see Figure 4-12) in the circuit board if possible. If the ferrule remains in the circuit board, remove the spare ferrule from the replacement pin and press the new pin into the hole in the circuit board. If the ferrule is removed with the damaged pin, clean out the hole using a solder-removing wick and a scribe. Then press the replacement pin, with attached spare ferrule, into the circuit board. Position the replacement pin in the same manner as the original pin had been. Solder the pin to the circuit board on each side of the board. If the original pin was bent at an angle to mate with a connector, carefully bend the new pin to the same angle. Replace the pin connector.

Circuit-Board Pin Sockets. The pin sockets on the circuit boards are soldered to the back of the board. To remove or replace one of these sockets, first unsolder the pin (use a vacuum-type desoldering tool to remove excess solder). Then straighten the tabs on the socket and

remove the socket from the board. Place the new socket in the circuit board hole and press the tabs down against the board. Solder the tabs of the socket to the circuit board; be careful not to get solder inside the socket.



The spring tension of the pin sockets ensures a good connection between the circuit board and the pin. This spring tension can be destroyed by using the pin sockets as a connecting point for spring-loaded probe tips, alligator clips, etc.

End-Lead Pin Connectors. The pin connectors used to connect the wires to the interconnecting pins are clamped to the ends of the associated leads. To remove or replace damaged end-lead pin connectors, remove the old pin connector from the end of the lead and clamp the replacement connector to the lead.

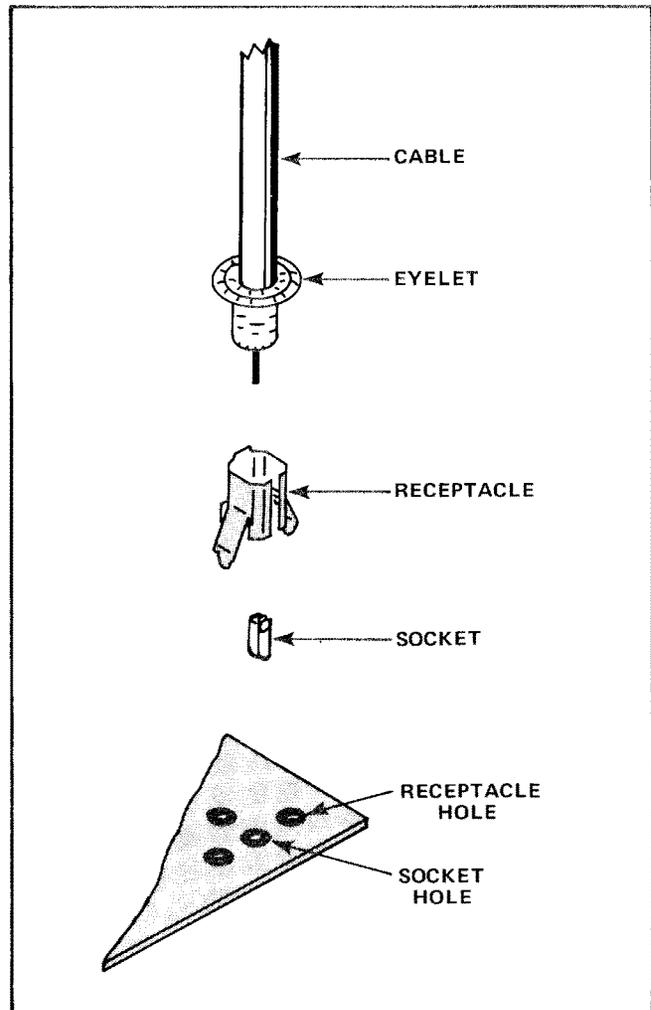


Fig. 4-11. Coaxial end-lead connector assembly.

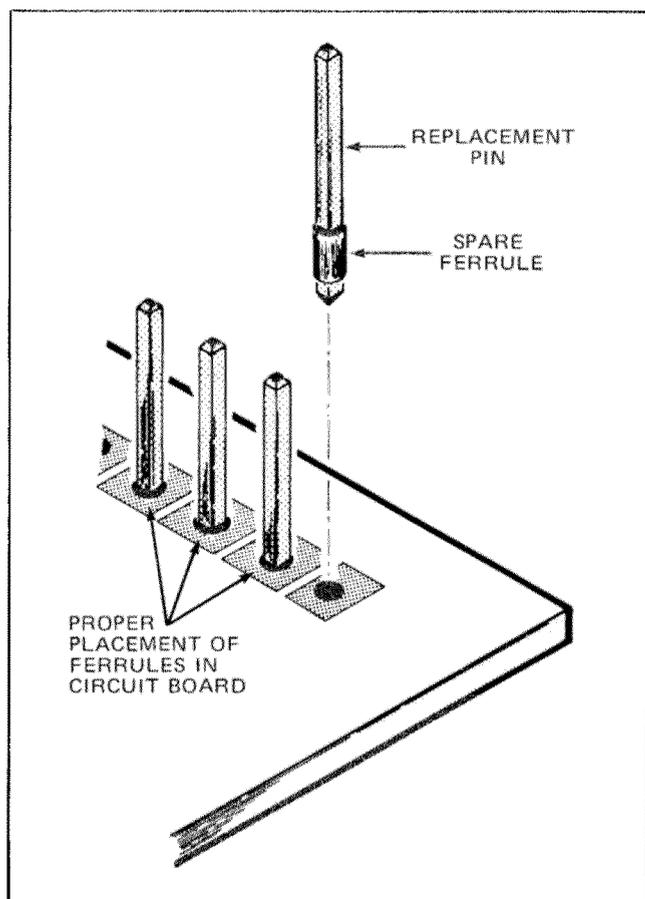


Fig. 4-12. Exploded view of circuit-board pin and ferrule.

Some of the pin connectors are grouped together and mounted in a plastic holder; the overall result is that these connectors are removed and installed as a multi-pin connector (see Troubleshooting Aids). If the individual end-lead pin connectors are removed from the plastic holder, note the order of the individual wires for correct replacement in the holder.

Pushbutton Switches

The pushbutton switches are not repairable and should be replaced as a unit if defective. Components which are mounted on the circuit board associated with the pushbutton switch can be replaced using the normal replacement procedures. See the information under Light-Bulb Replacement for instructions on replacing the light bulbs.

Mode Switches. Use the following procedure to replace the VERTICAL MODE or HORIZONTAL MODE pushbutton switches:

1. Disconnect the multi-pin connectors from the rear of the Front-Panel Interconnect board.

2. Remove the plastic screws securing the Front-Panel Interconnect board and remove this board.

3. Remove the two Phillips-head screws holding the upper plug-in guide bar to the top of the plug-in compartments associated with the mode switch which is being removed (vertical compartments for VERTICAL MODE switch, horizontal compartments for HORIZONTAL MODE switch).

4. Remove the switch from the instrument. It will be necessary to carefully guide the switch around the cabling and structural members of the instrument as it is removed.

5. To replace the switch, reverse the above procedure. Be sure the EMI gasketing is in place between the switch and the front panel when the switch is replaced. Match the arrows on the multi-pin connectors to the arrows on the Front-Panel Interconnect board.

Trigger Source Switches. To replace the A TRIGGER SOURCE or B TRIGGER SOURCE pushbutton switches, proceed as follows:

1. Disconnect the multi-pin connectors from the Front-Panel Interconnect board.

2. Remove the plastic screws securing the Front-Panel Interconnect board and remove this board.

3. Press the center of the release bar on the switch holder, then press on the front-panel pushbuttons to remove the switch from the holder.

4. To replace the switch, reverse the above procedure. Press the center of the release bar as the switch is pressed into place. Match the arrows on the multi-pin connectors to the arrows on the Front-Panel Interconnect board.

Light-Bulb Replacement. The following procedures describe replacement of the light bulbs in this instrument.

A. MODE SWITCHES.

Use the following procedure to replace light bulbs in the VERTICAL MODE or HORIZONTAL MODE switches:

1. Remove the applicable mode switch as given previously.

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2. Unsolder the leads of the bulb and the plastic holder from the circuit board; remove these items from the switch assembly as a unit.

3. Remove the defective bulb from the plastic holder.

4. Install the new bulb in the plastic holder; install this unit in the switch assembly.

5. Solder the bulb and holder to the circuit board.

6. Replace the mode switch as described previously.

B. TRIGGER SOURCE SWITCHES

To replace light bulbs in the A TRIGGER SOURCE or B TRIGGER SOURCE switches, proceed as follows:

1. Remove the applicable trigger source switch, using the procedure described previously.

2. Remove the light-bulb cover by prying between the cover and the circuit board.

3. Unsolder the defective bulb from the circuit board.

4. Install the new bulb so it is positioned in the same manner as the original bulb.

5. Solder the bulb to the circuit board. If possible, use a heat sink to protect the bulb during soldering.

6. Replace the bulb cover.

7. Install the switch using the procedure described previously.

C. INTENSITY INDICATORS.

The light bulbs which provide an indication of which intensity control is active are mounted in a cap which snaps into a holder mounted behind the front panel of the instrument. To replace either of these bulbs, pull the bulb/cap assembly off the holder. Then unsolder and remove the defective bulb. Replace the new bulb so it is positioned in the same manner as the original. Snap the bulb/cap assembly back into the holder.

D. GRATICULE BULB REPLACEMENT (FOR SN B282092 & BELOW)

To replace the graticule bulbs, first remove the plastic crt mask, light filter, and metal light shield. Pull on the white tabs to remove the graticule lamp assembly. Now, slide the lamp retaining strips to the side, off the bulb base. Pull the bulb out of the circuit board. Reverse the order of removal for replacement.

GRATICULE BULB REPLACEMENT (FOR SN B282093 & UP)

To remove or replace the graticule light bulbs, first remove the plastic crt mask, light filter, and metal shield. Pull on the white tabs to remove the graticule lamp assembly. Next unsolder the leads of the damaged bulb and pull the bulb out of the circuit board. Pre-form the leads of the replacement bulb and insert it into the circuit board and re-solder. Now reverse the order of removal for replacement of the entire crt graticule lamp assembly.

Relay Replacement. The relays on the X-Y Delay Compensation board (optional feature) are mounted in sockets. The basing (as well as the internal connections) of these relays is symmetrical so that these relays may be plugged into their socket facing in either direction.

Power Transformer Replacement. Replace the power transformer only with a direct replacement Tektronix transformer. To replace the power transformer, proceed as follows:

1. Remove the Line Inverter board assembly, Cap-Rectifier, and High-Voltage/Auto Focus boards as given under Circuit Board Replacement.

2. Remove the brass spring retainers which hold the transformer windings and core in place and remove these items.

3. To replace the power transformer, reverse the order of removal.

Vertical Amplifier Replacement. Vertical Amplifiers U685 and U745 can be replaced without removing the Vertical Amplifier board from the chassis. To remove U745, the crt connectors must be unsoldered from the integrated circuit leads. Touch a low-wattage iron tip to the leads near the solder connection and push the leads away from the connectors. See Fig. 4-14.

The code number on the respective integrated circuit must match the replacement integrated circuit code. See Fig. 4-13 for location of code number.

If the code number on the replacement integrated circuit does not match the number on the original integrated circuit, the emitter shunt resistors must also be replaced. Table 4-5 lists the resistor value to be used with each code. The shunt resistors are located on the bottom of the board near the integrated circuits. Replacement resistors must be 1/8 watt rating.

Table 4-5

SHUNT RESISTOR REPLACEMENT VALUES

U685		U745	
Code	R684, R688	Code	R741, R756
1	91 Ω	1	110 Ω
2	100 Ω	2	130 Ω
3	110 Ω	3	160 Ω
4	130 Ω	4	220 Ω
5	160 Ω	5	300 Ω
6	220 Ω	6	510 Ω
7	300 Ω	7	1000 Ω
8	510 Ω		

ADJUSTMENT AFTER REPAIR

After any electrical component has been replaced, the adjustment of that particular circuit should be checked, as well as the adjustment of any closely related circuits. Since the low-voltage supplies affect all circuits, adjustment of the entire instrument should be checked if component replacements have been made in these supplies or if the power transformer has been replaced. See Section 5 for a complete adjustment procedure.

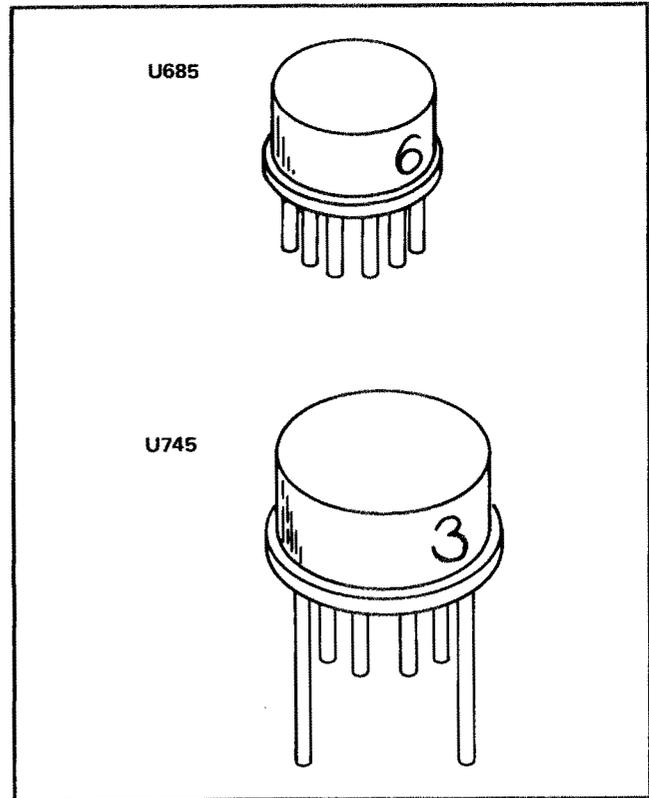


Fig. 4-13. Integrated circuit code location for U685 and U745.

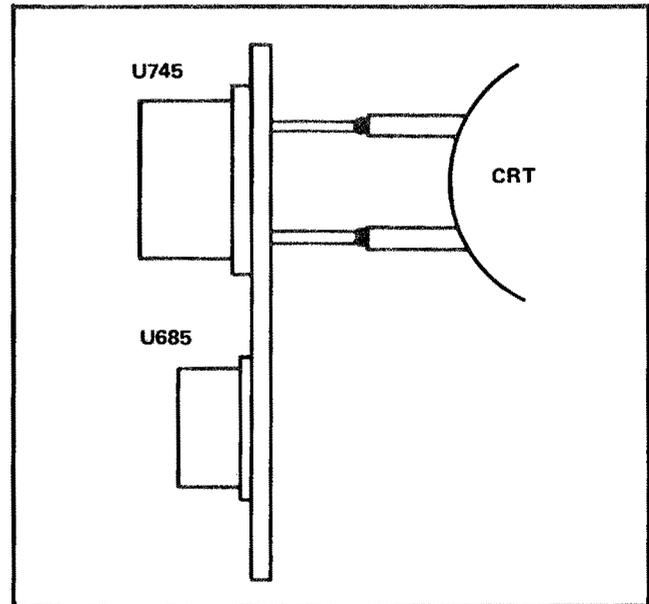


Fig. 4-14. U745 and the crt connector lead location.

PERFORMANCE CHECK AND ADJUSTMENT

Introduction

This section contains information necessary to perform a complete instrument performance check and adjustment. Limits given in the procedure are adjustment guides and should be interpreted as performance requirements unless preceded by a check mark (✓). Where possible, instrument performance is checked before an adjustment is made.

PRELIMINARY INFORMATION

Adjustment Interval

To maintain instrument accuracy, check the performance of the 7904 every 1000 hours of operation, or every six months if used infrequently. Before complete adjustment, thoroughly clean and inspect this instrument as outlined in Section 4, Maintenance.

Tektronix Field Service

Tektronix Field Service Centers and the Factory Service Centers provide instrument repair and adjustment services. Contact your Tektronix Field Office or representative for further information.

Using This Procedure

This Performance Check and Adjustment procedure can be used for a complete adjustment procedure or as a check of the instrument's performance. Completion of each step in the procedure ensures that the instrument is correctly adjusted and operating within specified limits. Refer to the following discussion for instructions on a complete or partial check and adjustment.

INDEX. An index precedes the procedure to aid in locating Performance Check and Adjustment steps.

PERFORMANCE CHECK. Instrument performance can be checked by performing the complete Performance Check and Adjustment procedure and omitting only the ADJUST part of the steps. A check mark (✓) preceding a CHECK indicates that the limit given is a performance requirement specified in Section 1, Specification.

ADJUSTMENT. Completion of each step in the Performance Check and Adjustment procedure ensures that the instrument is correctly adjusted and performing within specified limits. For best overall performance when performing the complete adjustment procedure, make each adjustment to the exact setting indicated.

PARTIAL PROCEDURES. The following procedure is written to completely check and adjust the instrument to the Performance Requirements listed in Section 1, Specification. If the applications for which the instrument is used do not require the full available performance, the procedures and the required equipment list can be shortened accordingly.

A partial performance check and adjustment may be desirable after replacing components, or to touch up the adjustment of a portion of the instrument. To check or adjust only part of the instrument, refer to the Equipment Required list which precedes that portion of the procedure to be performed. To avoid unnecessary adjustment of other parts, adjust only if the tolerance given in each CHECK is not met.

TEST EQUIPMENT REQUIRED

The test equipment listed in Table 5-1 is required for a complete performance check and adjustment of this instrument. The specifications given in Table 5-1 for test equipment are the minimum required to meet the Performance Requirements listed in Section 1, Specification. Detailed operating instructions for test equipment are omitted in this procedure. Refer to the test equipment instruction manual if more information is needed.

Special Fixtures

Special fixtures are used only where they facilitate instrument adjustment. These fixtures are available from Tektronix, Inc. Order by part number from Tektronix Field Offices or representatives.

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Test Equipment Alternatives

The test equipment listed in the Examples of Applicable Test Equipment column, Table 5-1, is required to check and adjust this instrument. The Performance Check and Adjustment procedure is based on the first item of equipment given as an example. If other equipment is substituted, control settings or setups may need to be altered. If the exact item or equipment given as an example is not available, refer to the Minimum Specifications column to determine if other equipment may be substituted. Then check the Purpose column. If you determine that your measurement requirements will not be

affected, the item and corresponding step(s) can be deleted.

Signal Connections

Detailed signal-connection information is not provided except when critical for a particular test. Rear-panel output connectors should be connected to other equipment with 50-ohm bnc cables. When simultaneously connecting a signal to two inputs, use a bnc Tee connector. For test equipment signal-connection and termination information, refer to the test equipment instruction manuals.

**Table 5-1
TEST EQUIPMENT**

Description	Minimum Specification	Purpose	Examples of Applicable Test Example
1. Digital voltmeter ^b	Range, 0 to 150 V; accuracy, within 0.1%.	Check and adjustment of calibrator output accuracy, and power supply voltages.	a. TEKTRONIX DM 501 Digital Multimeter. ^a b. Fluke Model 825A differential DC Voltmeter.
2. DC voltmeter (vom) ^b with Test Leads	Range, to 3000 V; accuracy checked to within 1% at -2965 V.	High-voltage power supply adjustment.	Valhalla Model 4500 H.V. Digital Multimeter. Tektronix Part Number 003-0120-00 test leads.
3. Time-mark generator	Marker outputs, 2 ns. to 0.1 s; marker accuracy, within 0.1%; trigger output, 1 ms.	Check horizontal timing, and calibration frequency.	a. TEKTRONIX TG 501 Time-Mark Generator. ^a
4. Low-frequency sine-wave generator	Frequency, 35 kHz to 1 MHz; output amplitude, variable from 50 mV to 100 mV into 50 Ω.	Check and adjust X-Y phasing (Option 2 only).	a. TEKTRONIX FG 503 Function Generator. b. General Radio 1310-B oscillator.

^aRequires TM 500-Series Power Module.

^bUsed for adjustment only; NOT used for performance check.

Table 5-1 (cont)
TEST EQUIPMENT

Description	Minimum Specification	Purpose	Examples of Applicable Test Equipment
5. High-frequency sine-wave generator	Frequency, 245 MHz to 500 MHz; reference frequency, 10 MHz or lower; output amplitude, variable from 0.5 to 4 V into 50 Ω ; amplitude accuracy, constant within 1% of reference as output frequency changes.	Check and adjustment of vertical bandwidth, vertical channel isolation and trigger system.	<p>a. TEKTRONIX SG504, Variable-Leveled Output.^a</p> <p>b. General Radio 1362 UHF Oscillator with 1263-C Amplitude-Regulating Power Supply.</p> <p>c. Wiltron Model 610C Swept Frequency Generator with Model 61083C, 10 to 1220 MHz plug-in.</p>
6. Test oscilloscope	Bandwidth, dc to 75 MHz; minimum deflection factor 10 mV/div; accuracy, within 3%. Dual channel with an inverting input and both added and alternate vertical modes.	Used for performance check and adjustment.	<p>a. TEKTRONIX 7603 Oscilloscope System with 7A18 Amplifier, 7B53A Time Base, and P6063B Probe.</p> <p>b. TEKTRONIX 465 Oscilloscope with P6063B Probe.</p> <p>c. Refer to the Tektronix Products catalog for compatible oscilloscope system.</p>
7. Amplifier plug-in unit	Tektronix 7A-series plug-in unit.	Used throughout procedure to provide vertical input to the instrument under adjustment.	a. TEKTRONIX 7A19 Amplifier unit.
8. Amplifier plug-in unit (Dual Trace)	Any 7A-series dual display amplifier unit.	Used to check position and operation of READOUT display.	a. Any 7A-series dual amplifier unit (may be shared with a 7000-series test oscilloscope).
9. Time-base plug-in unit (two required)	Tektronix 7B80 series; delaying unit needed for checking DLY'D gate out (7B85).	Used throughout procedure to provide sweep (delaying time base).	<p>a. TEKTRONIX 7B85 Time Base.</p> <p>b. TEKTRONIX 7B80 Time Base.</p>

^aRequires TM 500-Series Power Module.

Table 5-1 (cont)
TEST EQUIPMENT

Description	Minimum Specification	Purpose	Examples of Applicable Test Equipment
10. Calibration Fixture (signal standardizer)	Produces gain-check and pulse-response waveforms.	Used throughout procedure to standardize instrument so plug-in units can be interchanged without complete readjustment.	a. TEKTRONIX Calibration Fixture 067-0587-02. b. 7000-series plug-in units with suitable signal sources may be substituted if lower performance is acceptable.
11. 1X, 10X Passive Probe ^b	Compatible with test oscilloscope to be used.	Used to check power supply ripple, signals out, calibrator and Z-axis adjustment.	a. TEKTRONIX P6063B.
12. Tee Connector	bnc-to-bnc.	External Z-axis operation check.	a. Tektronix Part No. 103-0030-00.
13. Termination (two required)	Impedance, 50 Ω; accuracy, within 2%; connectors, bnc.	Output termination for signal generators, if amplifier unit is not 50 Ω input impedance.	a. Tektronix Part No. 011-0049-01.
14. Cable (Two of each Length Required)	Impedance, 50 Ω; type, RG-58/U; length, 18 and 42 inches; connectors, bnc.	Signal interconnection.	a. Tektronix Part No. 012-0076-00 (18 inches) Tektronix Part No. 012-0057-01 (42 inches).
15. Screwdriver ^b	Three-inch shaft, 3/32-inch bit.	Used throughout adjustment procedure to adjust variable resistors.	a. Xcelite R-3323.
16. Low-Capacitance Screwdriver ^b	1-1/2 inch shaft.	Used throughout procedure to adjust variable capacitors.	a. Tektronix Part No. 003-0000-00.
17. Nylon Tuning Tool ^b	Fits 5/64-inch (ID) hex cores.	Vertical high-frequency compensation.	a. Handle and insert, Tektronix Part Nos. 003-0307-00 and 003-0310-00.
18. Plug-in Extender ^b (Rigid Calibration Fixture).	Provides access to power supply voltages.	Power Supply Voltage, Trigger System check and adjustment.	a. Tektronix Part No. 067-0589-00.

^bUsed for adjustment only; NOT used for performance check.

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Page

7904 Serial No. _____

Calibration Date _____

Performance Check Date _____

Tested By _____

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Introduction

The following procedure checks and adjusts the 7904 to meet the performance requirements given in the Specification section.

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1. Remove the side and bottom covers from the 7904 (Refer to the Maintenance section in this manual for panel removal information.)

2. Connect the instrument to a power source which meets the voltage and frequency requirements marked on the instrument rear panel. (Refer to the General Information section in this manual for operating voltage information.)

3. Ensure that all test equipment is suitably adapted to the applied line voltage.

4. If applicable, install the TM 500-series test equipment into the test equipment power module.

5. Connect the equipment under test and the test equipment to a suitable line voltage source. Turn all equipment on and allow at least 20 minutes for the equipment to stabilize.

NOTE

Titles for external controls of this instrument are capitalized in this procedure (e.g., B TRIGGER SOURCE). Internal adjustments are initial capitalized (e.g., Horiz Gain).

Setup Procedure

NOTE

The performance of this instrument can be checked at any ambient temperature from 0° to 50° C unless otherwise stated. Adjustments must be performed at an ambient temperature from +20° to +30° C for specified accuracies.



To prevent instrument damage, plug-in units should not be installed or removed without first turning the instrument power off.

A. POWER SUPPLY

Equipment Required

- | | |
|----------------------|-----------------------------|
| 1. Digital voltmeter | 2. Screwdriver (three-inch) |
|----------------------|-----------------------------|

Control Setting

Set the 7904 controls as follows:

POWER switch	Off
A INTENSITY	Counterclockwise
B INTENSITY	Counterclockwise
CONTROL ILLUM	OFF
GRAT ILLUM	Counterclockwise
RATE	OFF

1. Adjust -50 Volt Power Supply (R1513)

WARNING

Extreme caution must be used when operating the 7904 with the power unit cover removed due to the high voltage, high current, and line voltage potentials present. Refer to the Maintenance section for information on how to remove the protective cover and shield from the power unit.

a. Disconnect the line cord from the power source. Remove any plug-in units from the plug-in compartments. Using the instructions given in the Maintenance section, slide the power unit from the rear of the 7904 and remove the power unit cover (interconnecting cables remain connected).

b. Connect the line cord to the power source and switch the POWER switch to ON.

c. Connect the digital voltmeter between TP -50 Volt Sense and TP Gnd Sense on the Low-Voltage Regulator circuit board. See Fig. 5-1 for test point location.

d. Check the meter reading for -50 volts, within the limits of -49.8 to -50.2 volts.

e. Adjust— -50 V Adj, R1513, for a meter reading of -50 volts within 0.2 volt. See Fig. 5-1 for adjustment location.

f. Interaction—any change in the setting of R1513 may affect the operation of all circuits in the instrument.

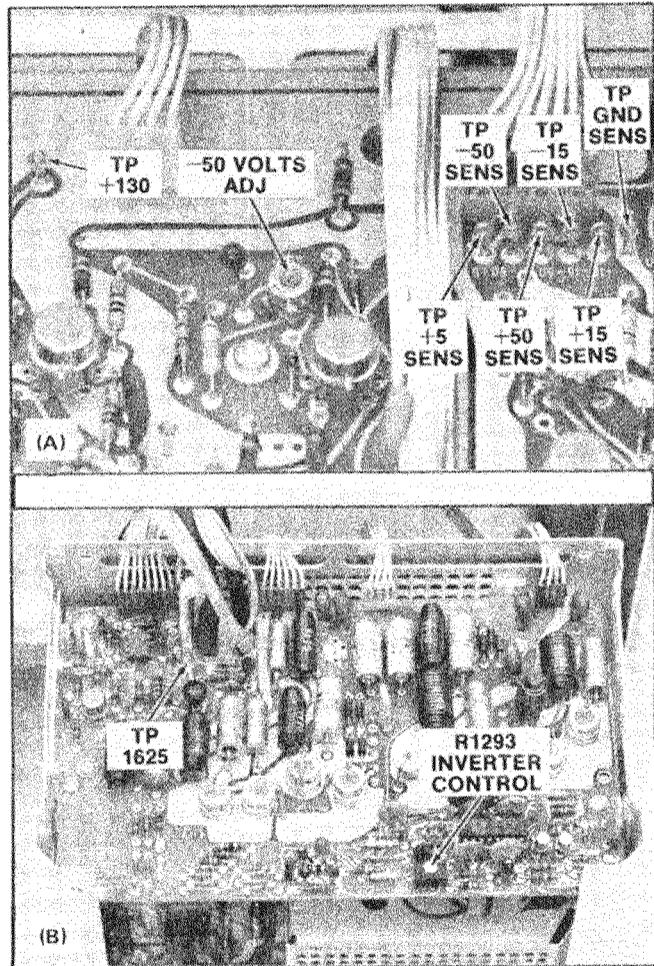


Fig. 5-1. (A) Location of low-voltage power supply test points and -50 volts adjustment on Regulator board, (B) Location of Inverter Control adjustment and TP1625 on Cap-Rectifier board.

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2. Adjust Inverter Control (R1293)

a. Connect the digital voltmeter between TP1625 and chassis ground. See Fig. 5-1 for location.

b. Check—meter reading for +40 volts within the limits of +35 to +45 volts. If the meter reading is within the given tolerance, proceed to Step 3.

c. Adjust—Inverter Control, R1293, for a meter reading of +40 volts with ± 5 volts. See Fig. 5-1 for adjustment location.

d. Interaction—any change in the setting of R1293 may affect the adjustment of the -50 Volts Power Supply (R1513).

3. Check Power-Supply Voltage

a. Table 5-2 lists the low voltage power supplies in this instrument. Check each supply with the digital voltmeter for output voltage within the given tolerance. Connect the meter common lead to TP Gnd Sense. See Fig. 5-1 for adjustment location.

b. Interaction—if the power supplies are not within the tolerances given in Table 5-2, repeat Steps 1 and 2.

Table 5-2
POWER SUPPLY TOLERANCE

Power Supply	Output Voltage Limits
TP -50 V Sense	-49.8 to -50.2 Volts
TP -15 V Sense	-14.85 to -15.15 Volts
TP +5 V Sense	+4.9 to +5.1 Volts
TP +15 V Sense	+14.85 to +15.15 Volts
TP +50 V Sense	+49.5 to +50.5 Volts
TP +130 V	+124.8 to +135.2 Volts
+5 V Lights Control Illum	+4.5 to +5.2 Volts

c. Disconnect the digital voltmeter.

NOTE

Regulation of the individual power supplies can be checked using the procedure given under Troubleshooting Techniques in the Maintenance section.

d. Disconnect the line cord from the power source.

e. Replace the power-unit cover.

f. Install the power unit in the instrument.

4. Check Protection Circuit

a. Connect the digital voltmeter between the emitter of Q785 (pin 2, P780) (vertical amplifier) and TP GND

b. Check—the meter reading for approximately +49 volts.

c. With the voltmeter probe still attached to pin 2 of P780, momentarily short across TP786 and TP GND (vertical amplifier) while reading the voltage. The meter reading should be approximately +31 volts. (If meter reading is correct, the protection circuit will operate correctly.)

d. Disconnect the digital voltmeter.

B. Z-AXIS AND DISPLAY

Equipment Required

- | | |
|--|---|
| 1. Digital Voltmeter | 6. Test oscilloscope with 10X passive probe |
| 2. Dc voltmeter (VOM) | 7. Tee connector (bnc) |
| 3. Calibration Fixture (Signal Standardizer) | 8. Screwdriver (three-inch) |
| 4. Time-base unit | 9. Low-capacitance screwdriver |
| 5. Amplifier unit | |

Control Settings

Preset the 7904 controls as follows:

POWER switch	Off
VERTICAL MODE	LEFT
VERT TRACE	
SEPARATION (B)	Midrange
A TRIGGER SOURCE	VERT MODE
A INTENSITY	Fully counterclockwise
HORIZONTAL MODE	A
B INTENSITY	Fully counterclockwise
B TRIGGER SOURCE	VERT MODE
FOCUS	Midrange
READOUT Intensity	OFF (in detent)
GRAT ILLUM	Midrange
CONTROL ILLUM	LOW
CALIBRATOR	0.4 V
RATE	1 kHz

1. Check the —2960 Volt Supply

- Set the dc voltmeter (vom) to measure at least —3000 volts and connect it between the HV Test Point, and chassis ground. See Fig. 5-2 for test point location.
- Set the POWER switch to ON.
- Check meter reading for —2960 volts within $\pm 1\%$.
- Set the POWER switch to off and disconnect the voltmeter. Set the POWER switch to ON.

2. Adjust Z-Axis DC Levels (R1757, R1810, R1817)

- Install an amplifier unit in the LEFT VERT compartment and the time-base unit in the A HORIZ compartment.
- Set the time-base unit for a free-running sweep at a sweep rate of 0.2 s/div.

c. Connect the 10X passive probe to the input of the test oscilloscope (check the probe compensation).

d. Set the test oscilloscope for dc input coupling with a vertical deflection factor of 0.2 V/div (2 V/div at probe tip) and a sweep rate of 1 ms/div.

e. Establish a ground reference for the test oscilloscope by either grounding the probe tip or setting the input coupling to ground. Then, position the test oscilloscope trace to the bottom horizontal line of the graticule. Do not change the test oscilloscope position control after setting this ground reference.

f. Connect the probe tip to TP1876; connect the probe ground to chassis ground with a short grounding strap. See Fig. 5-2 for location.

g. Check—test oscilloscope trace for dc level of +9 volts ± 1 volt (4.5 divisions within 0.5 division above ground reference level).

h. Adjust—Z-axis Amplifier Level, R1817, for a dc level of +9 volts (4.5 divisions above ground level). See Fig. 5-2 for adjustment location.

i. Connect the dc voltmeter (vom) between TP 1778 and chassis ground. See Fig. 5-2 for location.

j. Check—meter reading for +123 volts ± 3 volts.

k. Adjust—Focus Amplifier Level, R1757, for a meter reading of +123 volts. See Fig. 5-2 for adjustment location.

l. Set the A INTENSITY control for a dc level of +14 volts (test oscilloscope trace seven divisions above ground reference level). Disregard the momentary dc level shift to the +9 volts level during sweep retrace.

m. Adjust—Crt Grid Bias, R1674, so that the trace on the crt screen is just extinguished. See Fig. 5-2 for adjustment location.

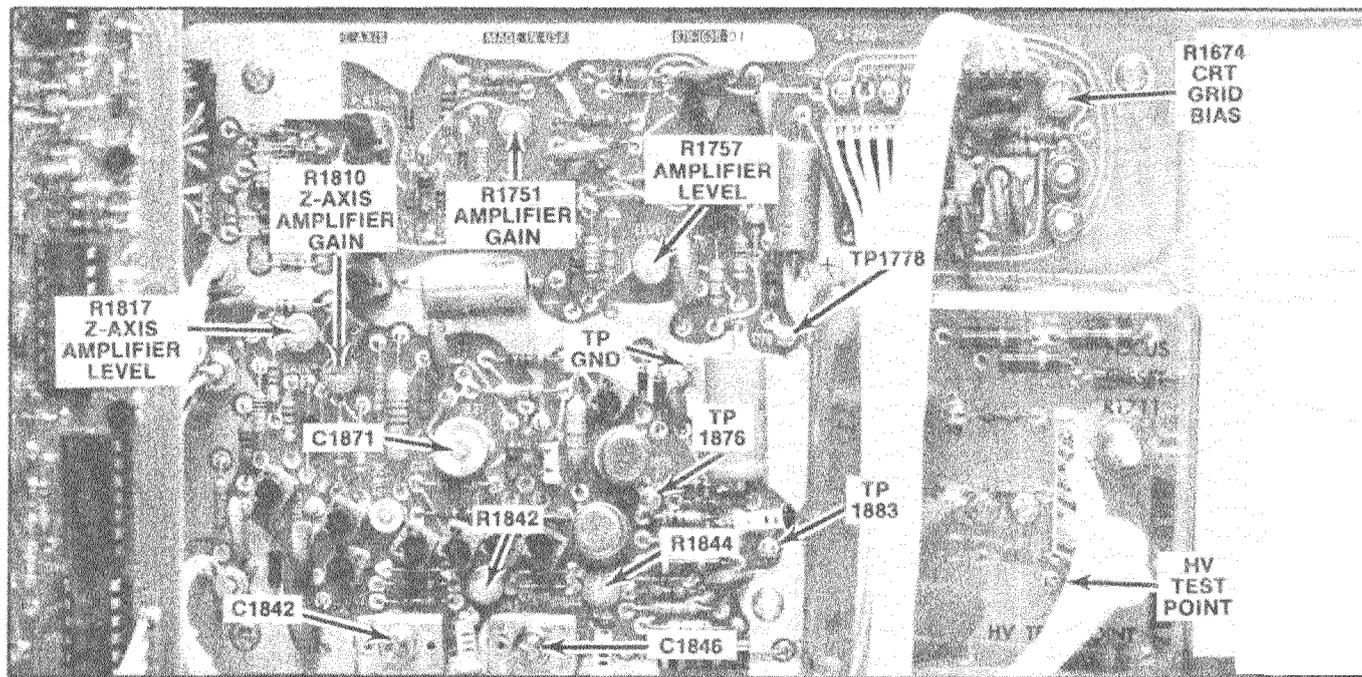


Fig. 5-2. Location of Z-Axis dc level and transient response adjustments and test points.

n. Adjust the amplifier unit position control fully clockwise.

o. Set the test oscilloscope for a vertical deflection factor of 1 V/div (10 V/div at the probe tip).

p. Adjust the A INTENSITY control fully clockwise.

q. Check—test oscilloscope display for a pulse waveform with a peak amplitude of 74 volts \pm 3 volts above the ground reference level.

r. Adjust—Z-Axis Amplifier Gain, R1810, for a pulse waveform peak amplitude of 74 volts above the ground reference level. See Fig. 5-2 for adjustment location.

s. Interaction—repeat parts d through r until no interaction is noted.

t. Adjust the A INTENSITY control fully counterclockwise.

u. Remove the time-base unit from the A HORIZ compartment and install it in the B HORIZ compartment.

v. Repeat parts g through r for the B HORIZ (B INTENSITY control for part p).

w. Disconnect the voltmeter and oscilloscope probes.

3. Adjust Z-Axis Transient Response (C1842, C1846, C1871, R1842, R1844)

a. Set the time-base unit for a sweep rate of 0.1 μ s/div.

b. Connect the test oscilloscope 10X probe tip to TP 1883; connect the probe ground to chassis ground TP located in the middle of the Z-Axis circuit board. See Fig. 5-2 for test point location.

c. Set the test oscilloscope for a vertical deflection factor of 0.1 V/div (1 V/div at probe tip) at a sweep rate of .05 μ s/div.

d. Adjust the B INTENSITY control for five divisions of vertical deflection on the test oscilloscope. Position the display so the leading edge of the waveform is displayed.

e. Check—test oscilloscope display for optimum square corner and flat top on the displayed pulse. Aberrations must be less than 7% (0.35 division).

f. Adjust—C1871 for flat top and R1842, C1842, R1844, and C1846 for optimum square corner on the displayed pulse (use low-capacitance screwdriver to adjust variable capacitors). See Fig. 5-2 for adjustment location.

g. Using the B INTENSITY control, reduce the pulse signal amplitude to 1.5 divisions of display on the test oscilloscope. Note any radical changes in the front corner. If a severe overshoot or undershoot of the front corner occurs, repeat part f of this step.

h. Adjust—R1842 and C1842 for optimum square corner at 1.5 divisions of displayed pulse. See Fig. 5-2 for adjustment location.

i. Using the B INTENSITY control, adjust the pulse signal amplitude to five divisions of display on the test oscilloscope.

j. Adjust—R1844 and C1846 for optimum square corner at five divisions of displayed pulse. See Fig. 5-2 for adjustment location.

k. Set the test oscilloscope sweep rate to 10 ns/div.

l. Check—the pulse risetime of approximately 12 ns (measured between the 10% and 90% point of the pulse).

m. Set the B INTENSITY control for a normal viewing level and disconnect the 10X probe.

4. Adjust Shield Volts Preset (R1733)

a. Set the VERTICAL MODE switch to RIGHT.

b. Connect the dc voltmeter (vom) between the lower lead of C1733, on the Z-Axis circuit board, and chassis ground. See Fig. 5-3 for test point location.

c. Check—for a meter reading of approximately +35.0 volts.

d. Adjust—Shield Volts, R1733, for a meter reading of +34.5 volts. See Fig. 5-3 for adjustment location.

e. Disconnect all test equipment.

✓ 5. Check/Adjust Trace Alignment (R1730)

a. Install a time-base unit in the RIGHT VERT compartment and a Calibration Fixture in the A HORIZ compartment.

b. Set the time-base unit for auto, internal triggering at a sweep rate of 1 μ s/div.

c. Set the Calibration Fixture Test switch to Vert or Horiz Freq Response and the Rep Rate switch to 100 kHz.

d. Set the VERTICAL MODE switch to ALT, the HORIZONTAL MODE switch to CHOP, and both A and B INTENSITY controls to midrange.

e. Position the traces to the vertical and horizontal center lines of the graticule. Use the Calibration Fixture Position control to position the vertical trace and the amplifier unit Position control to position the horizontal trace.

f. Adjust the FOCUS, ASTIG, and INTENSITY controls for well-defined traces.

✓g. Check—the vertical trace aligns with the center vertical line within 0.1 division and the horizontal trace aligns with the center horizontal line within 0.1 division.

h. Adjust—front-panel TRACE ROTATION adjustment (horizontal alignment) and Y-Axis Align, R1730, (vertical alignment), so the traces align with the vertical and horizontal center lines. See Fig. 5-3 for adjustment location.

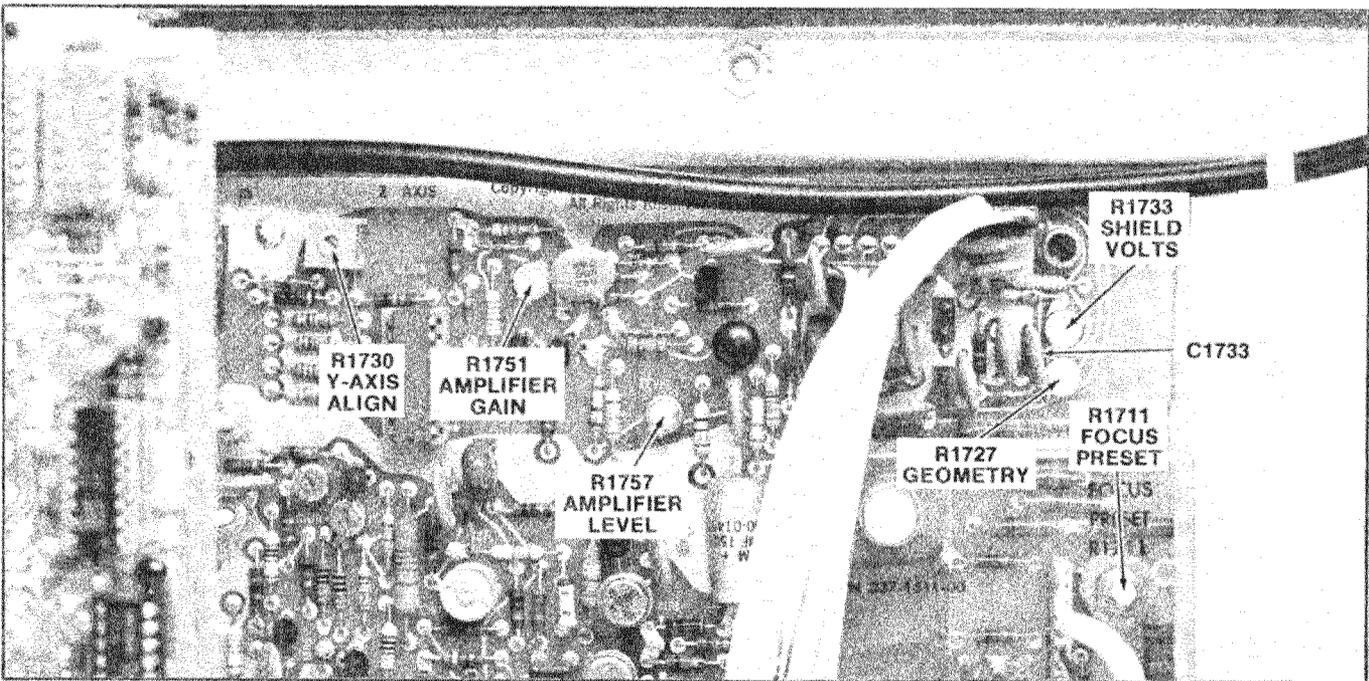


Fig. 5-3. Location of crt display adjustments and test points.

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6. Check/Adjust Geometry (R1711, R1727)

a. Set the Calibration Fixture Test switch to Vert or Horiz Gain, and superimpose the vertical traces over the graticule lines, using the vertical and horizontal position controls.

b. Position the horizontal trace slowly to the top graticule line and then to the bottom graticule line with the Calibration Fixture Position control.

✓c. Check—vertical and horizontal trace bowing and tilt is less than 0.1 division.

d. Adjust—Geometry, R1727, for minimum bowing of vertical and horizontal traces when positioned to top and bottom graticule lines. See Fig. 5-3 for adjustment location.

e. Set the front-panel FOCUS control to midrange.

f. Adjust—Focus Preset, R1711, and front-panel ASTIG adjustment for the best overall resolution of the traces. See Fig. 5-3 for adjustment location.

g. Poor focus at one edge of the crt may be compromised by adjusting the Shield Volts control, R1733. If R1733 is re-adjusted, repeat part f of this step.

7. Adjust Auto-Focus Operation

a. Transpose the time-base unit (Right Vert compartment) and the Calibration Fixture.

b. Set the VERTICAL MODE switch to RIGHT and the HORIZONTAL MODE switch to A.

c. Set the Calibration Fixture Test switch to Vert or Horiz +Step Resp, and the Rep Rate switch to 100 kHz.

d. Set the time-base unit for auto, internal triggering at a 0.1 μ s/div sweep rate.

e. Adjust the Calibration Fixture Position and Amplitude controls for a centered 4-division pulse display. Center the leading edge of the pulse to the middle of the crt with the time-base unit position control.

f. Adjust the INTENSITY control for a low-intensity display. Adjust the FOCUS control for a well-defined display.

g. Adjust the A INTENSITY control fully clockwise.

h. Adjust—Focus Amplifier Gain, R1751, for a well-defined, high intensity display. See Fig. 5-3 for adjustment location.

i. Adjust the INTENSITY control for a normal viewing level.

✓ 8. Check External Z-Axis Operation

a. Set the VERTICAL MODE switch to LEFT and the amplifier unit deflection factor to 0.1 V/div.

b. Connect a 0.4 volt calibrator signal from the CAL VOLTS output connector to the amplifier-unit input (use a bnc Tee connector at the amplifier input).

c. Set the amplifier unit for a calibrated deflection factor of 0.1 V/div.

d. Set the time-base unit for auto, internal triggering at a calibrated sweep rate of 0.5 ms/div.

e. Connect the signal from the output of the Tee connector at the amplifier input to the Z-Axis INPUT connector on the rear panel.

✓f. Check—top portion of display waveform is just blanked out. (An increase in A INTENSITY should unblank the top of the waveform.)

g. Disconnect all test equipment and remove the plug-in units.

C. TRIGGER SYSTEM

Equipment Required

- | | |
|---|---|
| 1. Calibration Fixture (Signal Standardizer) | 6. Digital voltmeter |
| 2. Time-base unit (two required) | 7. Test oscilloscope (dual trace) |
| 3. Amplifier Unit | 8. Cable (42-inch, 50 Ω bnc, two required) |
| 4. Plug-in extender (rigid calibration fixture) | 9. Cable (18-inch, 50 Ω bnc) |
| 5. High-frequency sinewave generator constant amplitude | 10. Termination (50 Ω bnc, two required) |
| | 11. Screwdriver (three-inch) |

Control Settings

Preset the 7904 controls as follows:

POWER switch	Off
VERTICAL MODE	RIGHT
VERTICAL TRACE	
SEPARATION (B)	Midrange
A TRIGGER SOURCE	VERT MODE
A INTENSITY	Midrange
HORIZONTAL MODE	A
B INTENSITY	Midrange
B TRIGGER SOURCE	VERT MODE
READOUT Intensity	OFF (in detent)
GRAT ILLUM	As desired
CONTROL ILLUM	LOW
CALIBRATOR	0.4 V
RATE	1 kHz

1. Check/Adjust A Trigger Selector DC Centering and Gain (R5547, R5570, R5575)

a. Within the plug-in extender (rigid calibration fixture), disconnect the top connector on the left and right sides (labeled A20 and B20). Connect each female connector to one of the test oscilloscope channels with the 42-inch 50 Ω bnc cable and 50 Ω bnc termination (omit 50 Ω bnc termination if the test oscilloscope has 50 Ω input impedance).

b. Install the plug-in extender (rigid Calibration Fixture) in the A HORIZ compartment and set the POWER switch to ON.

c. Set the test oscilloscope for differential operation between the two channels (added display mode with one channel inverted) at a sweep rate of 2 ms/div, with both vertical channel inputs set to dc and a vertical deflection of 50 mV.

d. Establish a ground reference level for the test oscilloscope by disconnecting the plug-in extender from the 7904 and positioning the trace to the center horizontal line of the graticule. Do not change the test oscilloscope position controls after setting this ground reference.

e. Return the plug-in extender to the 7904 A HORIZ compartment.

f. Check—the test oscilloscope display for a dc level within 0.5 division (25 mV) of the ground reference level in the LEFT, RIGHT, and ADD positions of the VERTICAL MODE switch.

g. Adjust—A DC Centering, R5575, for a display dc level within 0.5 division (25 mV) of ground reference level in the LEFT, RIGHT, and ADD positions of the VERTICAL MODE switch. See Fig. 5-4 for adjustment location.

h. Set the digital voltmeter to the 2 V scale.

i. Connect the negative lead of the digital voltmeter to chassis ground.

j. Connect the positive lead of the digital voltmeter to the plus (+) output connector on the A trigger board. See Fig. 5-4 for location.

k. Check—meter reading for less than ± 0.05 volts.

l. Adjust—Common Mode, R5570, for a voltage of approximately zero, ± 0.05 volt.

m. Move the positive digital voltmeter lead from the plus output connector (+) to the minus (–) output connector on the A Trigger board. See Fig. 5-4 for location.

n. Check—for a meter reading of less than ± 0.05 volt. If these voltage conditions cannot be met, repeat parts f and g of this step.

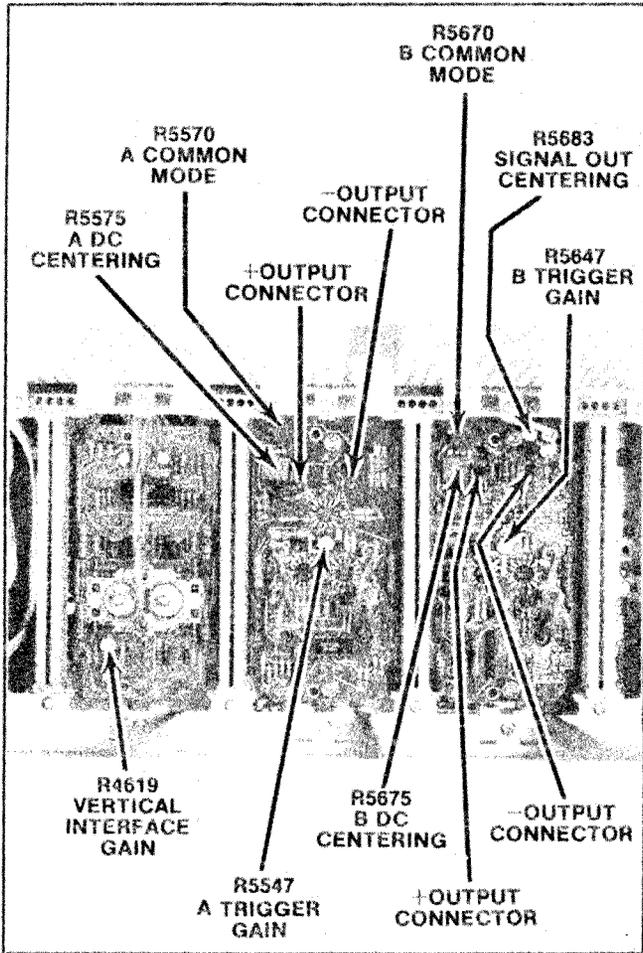


Fig. 5-4. Location of interface and trigger system adjustments (A and B Trigger Selector circuit boards.)

o. Install the Calibration Fixture in the LEFT VERT compartment.

p. Set the VERTICAL MODE switch to LEFT.

q. Set the Calibration Fixture Test switch to Triggering Gain and the Rep Rate switch to 100 kHz.

r. Check—test oscilloscope display for six divisions of vertical deflection between the center seven traces, within 0.3 division (300 mV within 15 mV).

s. Adjust—A Trigger Gain, R5547, for a test oscilloscope display of six divisions of deflection between the center seven traces, within 0.3 division (300 mV within 15 mV). See Fig. 5-4 for adjustment location.

t. Remove the Calibration Fixture from the LEFT VERT compartment and install it in the RIGHT VERT compartment.

u. Set the VERTICAL MODE switch to RIGHT.

v. Check that the display is within tolerances given in part r of this step.

w. Adjust—if necessary, compromise the setting of R5547 for optimum gain for both vertical compartments. If readjustment is necessary, recheck parts o through v of this step.

x. Remove the Calibration Fixture and plug-in extender from the compartments (leave cables connected for the next step).

2. Check/Adjust B Trigger Selector DC Centering and Gain (R5647, R5670, R5675)

a. Install the plug-in extender in the B HORIZ compartment (test oscilloscope connections are same as in Step 1a).

b. Set both channels of the test oscilloscope for a deflection factor of 50 mV/div with the inputs grounded.

c. Set the test oscilloscope for differential operation between the two channels (added display mode with one channel inverted) at a sweep rate of 2 ms/div.

d. Establish a ground reference level for the test oscilloscope by positioning the trace to the center horizontal line of the graticule. Do not change the test oscilloscope position controls after setting this ground reference.

e. Set both channels of the test oscilloscope for dc input coupling.

f. Check—test oscilloscope display for a dc level within 0.5 division (25 mV) of the ground reference level in the LEFT, RIGHT, and ADD positions of the VERTICAL MODE switch.

g. Adjust—B DC Centering, R5675, for a dc level within 0.5 division (25 mV) of ground reference level in the LEFT, RIGHT, and ADD positions of the VERTICAL MODE switch. See Fig. 5-4 for adjustment location.

h. Set the digital voltmeter to the 2 V scale.

i. Connect the negative lead of the digital voltmeter to chassis ground.

j. Connect the positive lead of the digital voltmeter to the plus (+) output connector on the B Trigger board. See Fig. 5-4 for location.

k. Check—meter reading for less than ± 0.05 volt.

l. Adjust—Common Mode, R5670, for a voltage of approximately zero, ± 0.05 volt.

m. Move the positive digital voltmeter lead from the plus output connector (+) to the minus (-) output connector on the B Trigger board. (see Fig. 5-4 for location).

n. Check—for a meter reading less than ± 0.05 volt. If these voltage conditions cannot be met, repeat parts f and g of this step.

o. Install the Calibration Fixture in the LEFT VERT compartment.

p. Set the VERTICAL MODE switch to LEFT.

q. Set the Calibration Fixture Test switch to Triggering Gain and Rep Rate switch to 100 kHz.

r. Check—test oscilloscope display for six divisions of vertical deflection between the center seven traces, within 0.3 division (300 mV within 15 mV).

s. Adjust—B Trigger Gain, R5647, for a test oscilloscope display of six divisions of deflection between the center seven traces, within 0.3 division (300 mV within 15 mV).

t. Remove the Calibration Fixture from the LEFT VERT compartment and install it in the RIGHT VERT compartment.

u. Set the VERTICAL MODE switch to RIGHT.

v. Check that the display is within tolerances given in part r of this step.

w. Adjust—if necessary, compromise the setting of R5647 for optimum gain for both vertical compartments. If readjustment is necessary, recheck parts o through v of this step.

x. Remove the plug-in extender and disconnect all test equipment.

3. Check/Adjust Vertical Signal Out DC Centering (R5683)

a. Set the test oscilloscope vertical deflection factor to 1 V/div and establish a ground reference at the graticule center line.

b. Connect the SIG OUT connector to the vertical input of the test oscilloscope with the 42-inch, 50 Ω bnc cable.

c. Set the Calibration Fixture Test switch to COM MODE.

d. Check—test oscilloscope display for a dc level within one division of the ground reference established in part a.

e. Adjust—Signal Out Centering, R5683, for a dc level within one division of the ground reference level.

f. Set the Calibration Fixture Test switch to Triggering Gain.

g. Check—test oscilloscope display for 11 gain display traces in five divisions of display within 0.5 division (5 V within 0.5 V).

h. Disconnect all cables.

✓ 4. Check Trigger Selector Operation

a. Install the Calibration Fixture in the RIGHT VERT compartment, an amplifier unit in the LEFT VERT compartment, and time-base units in both horizontal compartments.

b. Set both time-base units for auto, internal triggering at a 0.2 ms/div sweep rate.

c. Connect the CALIBRATOR 0.4 V output to the amplifier unit, using the 18-inch bnc cable. Set the amplifier for a two division display in the upper half of the graticule area.

d. Set the VERTICAL MODE switch to RIGHT.

e. Set the Calibration Fixture Test switch to Vert or Horiz +Step Resp, the Rep Rate switch to 10 kHz, and the Amplitude control for a two division display in the lower half of the graticule area.

f. Set the VERTICAL MODE switch to ALT.

✓g. Check—the crt display for 1 kHz and 10 kHz triggered waveforms (adjust the time-base unit trigger level control as necessary).

h. Set the A TRIGGER SOURCE switch to LEFT VERT.

✓i. Check—sequentially select all positions of the VERTICAL MODE switch and check for a stable display of only the 1 kHz waveform.

j. Set the A TRIGGER SOURCE switch to RIGHT VERT.

✓k. Check—sequentially select all positions of the VERTICAL MODE switch and check for a stable display of only the 10 kHz waveform.

l. Set the VERTICAL MODE switch to ALT and the HORIZONTAL MODE switch to B.

✓m. Check—crt display for 1 kHz and 10 kHz triggered waveform.

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n. Set the B TRIGGER SOURCE switch to LEFT VERT and the A TRIGGER SOURCE switch to VERT MODE.

✓o. Check—sequentially select all positions of the VERTICAL MODE switch and check for a stable display of only the 1 kHz waveform.

p. Set the B TRIGGER SOURCE switch to RIGHT VERT.

✓q. Check—sequentially select all positions of the VERTICAL MODE switch and check for a stable display of only the 10 kHz waveform.

r. Set the VERTICAL MODE switch to ALT, the HORIZONTAL MODE switch to ALT, and the B TRIGGER SOURCE switch to VERT MODE.

✓s. Check—the crt display for the B HORIZ time-base unit should be triggered on the 1 kHz waveform; the A HORIZ time-base unit should be triggered on the 10 kHz waveform.

t. Remove the bnc cable, the amplifier unit, and the time-base unit in the B HORIZ compartment.

5. Check High-Frequency Triggering

a. Set the VERTICAL MODE switch to RIGHT and the HORIZONTAL MODE switch to A.

b. Set the Calibration Fixture Test switch to Aux In and adjust the Amplitude control fully clockwise.

c. Set the time-base unit triggering for auto mode with ac coupling from the internal source at a sweep rate of 1 ns/div.

d. Connect the high-frequency sine-wave generator to the Calibration Fixture Aux In CW In (Freq Resp) input connector.

e. Set the high-frequency sine-wave generator for a one-division display at 500 MHz frequency, centered on the graticule.

f. Check—crt display for a triggered sweep.

g. Move the time-base unit into the B HORIZ compartment.

h. Set the HORIZONTAL MODE switch to B.

i. Check—crt display for a triggered sweep.

j. Disconnect all test equipment and remove the plug-in units.

D. VERTICAL SYSTEM

Equipment Required

- | | |
|---|--------------------------------|
| 1. Calibration Fixture (Signal Standardizer) | 4. Screwdriver (three-inch) |
| 2. Time-base unit (two required) | 5. Low-capacitance screwdriver |
| 3. High-frequency sinewave generator (constant amplitude) | 6. Nylon tuning tool |

Control Setting

Preset the 7904 controls as follows:

POWER switch	Off
VERTICAL MODE	CHOP
VERTICAL TRACE SEPARATION (B)	Midrange
A TRIGGER SOURCE	VERT MODE
A INTENSITY	Midrange
HORIZONTAL MODE	A
B INTENSITY	Midrange
B TRIGGER SOURCE	VERT MODE
READOUT Intensity	OFF (in detent)
GRAT ILLUM	As desired
CONTROL ILLUM	LOW
CALIBRATOR	0.4 V
RATE	1 kHz

✓ 1. Check/Adjust Vertical Amplifier Centering (R712)

- Install the time-base unit in the A HORIZ compartment.
- Set the time-base unit for auto triggering at a sweep rate of 2 ms/div.
- Install the Calibration Fixture in the RIGHT VERT compartment.
- Set the Calibration Fixture Test switch to Com Mode, the Rep Rate switch to 100 kHz, and set the POWER switch to ON.
- Check—that the vertical position of the two traces (might appear as a single trace) is within 0.4 division of the graticule center line with less than 0.5 division separation between traces.
- Adjust—Vert Cent, R712, for equal spacing of the traces from the graticule center line. (If the traces appear as a single trace, adjust R712 to position the trace to the graticule center line. See Fig. 5-5 for adjustment location.)

✓ 2. Check/Adjust Vertical Amplifier Gain (R730, R4619)

- Set the VERTICAL MODE switch to RIGHT.
- Set the Calibration Fixture Test switch to Vert or Horiz Gain. Position the display to align the bright center trace with the graticule center line.
- Check—for one trace per graticule division within 0.06 division over the center six graticule divisions; note the exact error for comparison in part g of this step.
- Adjust—Vertical Gain, R730, for one division between each of the center seven displayed traces within 0.01 division. See Fig. 5-5 for adjustment location.
- Remove the Calibration Fixture from the RIGHT VERT compartment and install it in the LEFT VERT compartment.
- Set the VERTICAL MODE switch to LEFT.
- Check—for one trace per graticule division within 0.06 division of the error noted in part c, over the center six graticule divisions.
- Adjust—Vertical Interface Gain, R4619, for one division between each of the center seven displayed traces within 0.01 division. (Remove the right side cover from the Calibration Fixture for access to R4619.) See Fig. 5-4 for adjustment location.

✓ 3. Check Low-Frequency Linearity

- Set the Calibration Fixture Test switch to Vert or Horiz +Step Resp.
- Set the Calibration Fixture Amplitude control so the display is two divisions in amplitude in the center of the graticule area.
- Check—position the two-division display vertically and check for not more than 0.1 division of compression or expansion anywhere within the graticule area.

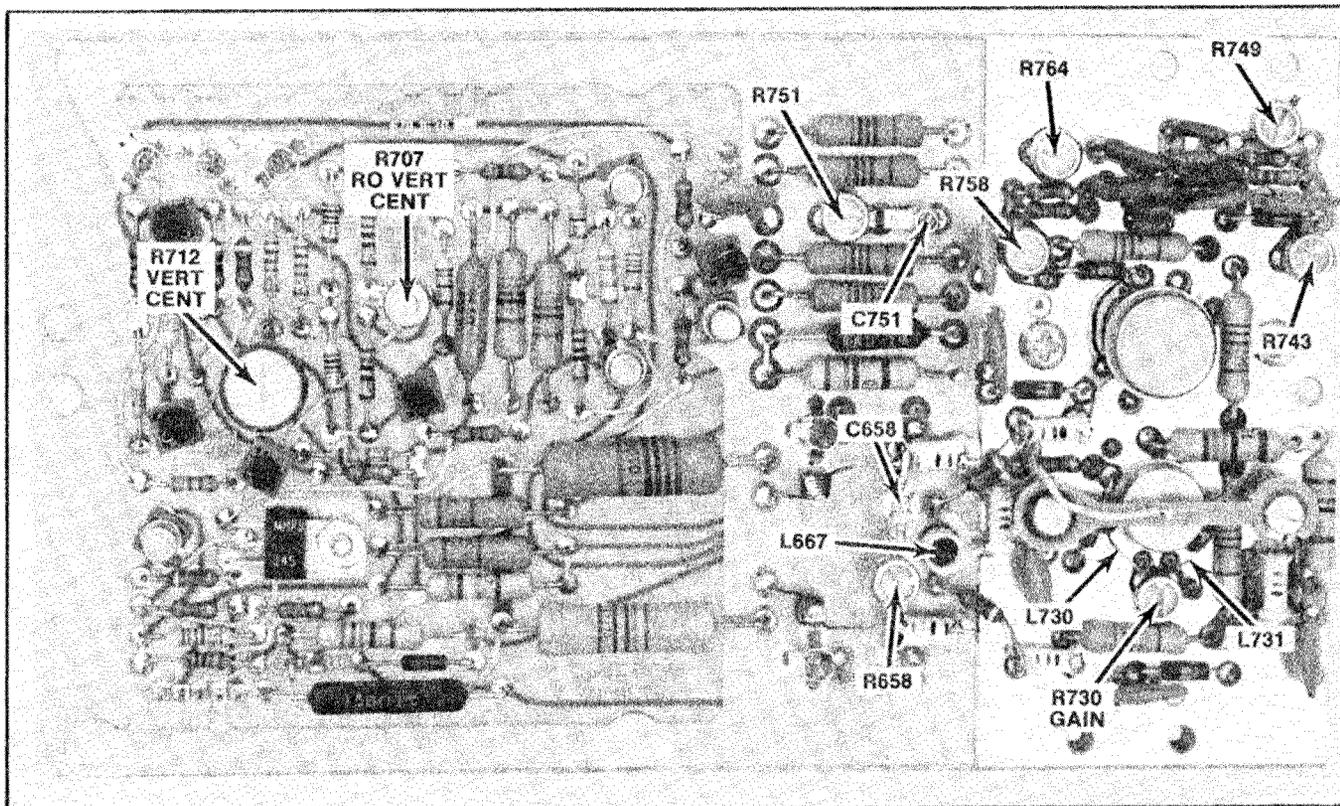


Fig. 5-5. Location of vertical system adjustments.

4. Check/Adjust Vertical Low, High-Frequency Compensation (R743, R749, R758, R764, L667, R658, C658, L4661, L4681)

a. Set the Calibration Fixture Test switch to Vert or Horiz +Step Resp with the Rep Rate switch set to 100 Hz, and adjust the amplitude control for a six-division display.

b. Set the time-base unit sweep rate for 2 ms/div and triggering for auto mode with ac coupling from the internal source; set triggering and position controls for a stable centered display.

c. Adjust—R764 and R749 for flat top within 0.06 division. See Fig. 5-5 for adjustment location.

d. Adjust READOUT control for visible characters. Note how R749 affects readout characters. R749 must be adjusted for minimum vertical flutter of readout characters. (Adjust at 100 kHz Rep Rate only).

e. Check—displayed pulse for optimum flat top within 0.06 division as given in Table 5-3.

f. Set the Calibration Fixture Rep Rate switch to 1 MHz. Set the Amplitude and Position controls for a six-division display, centered on the graticule area.

g. Set the time-base unit for a sweep rate of 100 ns/div. Set the triggering controls for a stable display triggered on the rising portion of the pulse.

Table 5-3

LOW-FREQUENCY COMPENSATION (Signal Rep Rate vs Sweep Speed)

Calibration Fixture Rep Rate	Sweep Speed
100 Hz	2.0 ms
1 kHz	0.2 ms
10 kHz	20 μs
100 kHz	2 μs

h. Check—for optimum square corner and flat top on the displayed pulse. Aberrations starting 50 ns after the initial step should be less than 0.03 divisions peak-to-peak, except allow 0.12 division of aberrations for delay-line termination at about 125 ns from step.

NOTE

Typically aberrations of 7% or less, peak-to-peak within 50 ns of step.

i. Adjust—High-frequency compensation as given in Table 5-4 for optimum square leading corner and flat top with minimum aberrations within limits given in part h.

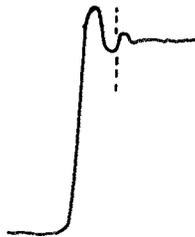
Location of the adjustments is shown in Fig. 5-4 and Fig. 5-5. Use the low-capacitance screwdriver to adjust variable capacitors. Repeat the complete adjustment procedure as necessary to obtain optimum response.

Table 5-4
HIGH-FREQUENCY COMPENSATION

Adjustment	Primary area of Pulse Affected	Best Time-Base Sweep Rate
R743, R758	First 50 ns	100 ns/div
Position crt termination leads to reduce aberrations. (The termination leads connect to crt pins directly in front of the Vertical Amplifier board.)	Single aberration 5 ns from leading edge of step.	5 ns/div
L667, R658, C658	First 5 ns	5 ns/div
R751, C751	First 5 ns	5 ns/div

j. If the displayed pulse now has a large overshoot easily exceeding 5%, remove the vertical circuit board and check for presence of R736 and C736. Selectable components R736 and C736 may be added in series between pin 5 and 11 of U745 (bottom of board). Nominal 1.5 pF and 100 Ω. This should bring the overshoot to within adjustable range.

1.5 pF — 283-0160-00
100 Ω — 317-0101-00



l. Other possible displayed pulse errors may be corrected by:

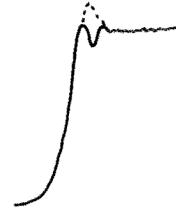
Rolloff or rise of first 3 ns may be corrected by changing length of L657 and L659 (bottom of circuit board)

1. Short to raise corner.
2. Long to lower corner.



First nanosecond of waveform too positive or negative may be corrected by changing length of L730 and L731. (See Fig. 5-4 for location.)

1. Long to raise corner.
2. Short to lower corner.



m. Adjust—Repeat adjustment R658 and C658 to obtain the least aberration in the region immediately following the initial overshoot or undershoot.

n. Check—for optimum square corner and flat top on the displayed pulse with aberrations within limits given in part h of this step.

o. Move the Calibration Fixture to the RIGHT VERT compartment and set the VERTICAL MODE switch to RIGHT.

p. Check—for optimum square corner and flat top on the displayed pulse with aberrations within limits given in part h of this step.

NOTE

If U4625 and U4685 were replaced (matched pair), high-frequency mismatching may exist between the LEFT and RIGHT VERT compartment; adjust the length of wire loop inductors L4661, L4681, and L4601, L4621, (located on the rear of the interface board) to provide matching.

q. Adjust—if necessary, compromise the high-frequency compensation adjustments for optimum pulse response for both vertical compartments. If readjustment is necessary, recheck parts a through h of this step.

✓ **5. Check Vertical Amplifier Bandwidth**

a. Install the Calibration Fixture in the RIGHT VERT compartment and set the Test switch to Vert or Horiz Freq Resp with the Amplitude control fully clockwise.

b. Set the VERTICAL MODE switch to RIGHT.

c. Connect the high-frequency sine-wave generator to the Calibration Fixture Aux In CW In (Freq Resp) input.

d. Set the time-base unit sweep rate for 50 μs/div and the triggering for a free-running sweep.

e. Set the high-frequency sine-wave generator for a eight-division display at a reference frequency (between 3 and 20 MHz), centered on the graticule.

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f. Set the Calibration Fixture Amplitude control for a six-division display, centered on the graticule. (The CW Leveled indicator should be lit.)

g. Without changing the output amplitude, increase the generator frequency until the displayed amplitude is reduced to 4.5 divisions. If the CW Leveled indicator goes off, increase the amplitude of the sine-wave generator until the light just turns on.

NOTE

The Calibration Fixture CW Leveled light must be on and the sine-wave generator must be properly connected for a valid check. Refer to the Calibration Fixture and high-frequency sine-wave generator manuals.

✓h. Check—generator frequency is 500 MHz or higher (400 MHz if check outside +20°C to +30°C temperature range).

i. Move the Calibration Fixture to the LEFT VERT compartment (leave signal connected) and set the VERTICAL MODE switch to LEFT.

✓j. Check—repeat parts e through h for the left vertical compartment.

✓ 6. Check Vertical Channel Isolation

a. Set the high-frequency sine-wave generator and the Calibration Fixture for eight divisions of deflection at 500 MHz.

✓b. Set the VERTICAL MODE switch to RIGHT.

c. Check—crt display amplitude for 0.20 division or less of signal (verifies isolation at least 40:1 at 500 MHz) at 500 MHz.

d. Set the VERTICAL MODE switch to LEFT.

e. Set the high-frequency sine-wave generator and the Calibration Fixture for eight divisions of deflection at 250 MHz.

f. Set the VERTICAL MODE switch to RIGHT.

✓g. Check—crt display amplitude for 0.08 division or less of signal (verifies isolation at least 100:1 at 250 MHz) at 250 MHz.

h. Remove the Calibration Fixture from the LEFT VERT compartment and install it in the RIGHT VERT compartment without disturbing set-up.

i. Set the VERTICAL MODE switch to LEFT.

✓j. Check—crt display amplitude for 0.08 division or less of signal (verifies isolation at least 100:1 at 250 MHz) at 250 MHz.

k. Set the VERTICAL MODE switch to RIGHT.

l. Set the high-frequency sine-wave generator and the Calibration Fixture for eight divisions of deflection at 500 MHz.

m. Set the VERTICAL MODE switch to LEFT.

✓n. Check—crt display amplitude for 0.20 division or less of signal (verifies isolation at least 40:1 at 500 MHz) at 500 MHz.

o. Disconnect the signal connection.

✓ 7. Check Vertical Display Modes

a. Install an amplifier or a Calibration Fixture in the LEFT VERT compartment.

b. Position the trace to the upper half of the graticule area with the left-vertical unit position control.

c. Set the VERTICAL MODE switch to RIGHT and position the trace to the lower half of the graticule area with the right-vertical unit position control.

✓d. Check—crt display for two traces in the ALT and CHOP positions of the VERTICAL MODE switch.

e. Set the VERTICAL MODE switch to ADD.

✓f. Check—crt display for a single trace that can be positioned vertically with either vertical-unit position control.

✓ 8. Check Vertical Trace Separation Operation

a. Set the VERTICAL MODE switch to LEFT.

b. Center the trace vertically with the left-vertical unit position control.

c. Install a time-base unit in the B HORIZ compartment.

d. Set both time-base units for a free-running sweep at a rate of 0.2 ms/div.

e. Set the HORIZONTAL MODE switch to CHOP.

✓f. Check—Adjust the VERT TRACE SEPARATION (B) control throughout its range and check that the trace produced by the B time-base unit can be positioned above and below the trace produced by the A time-base unit, approximately four divisions. Also, check this operation with the HORIZONTAL MODE switch set to ALT.

g. Remove all plug-in units.

E. HORIZONTAL SYSTEM

Equipment Required

- | | |
|--|--|
| 1. Calibration Fixture (Signal Standardizer) | 7. Cable (18-inch, 50 Ω bnc) |
| 2. Time-base unit | 8. Cable (12-inch, jumper, with alligator clips) |
| 3. Amplifier unit (two required) | 9. Termination (50 Ω bnc) |
| 4. Time-mark generator | 10. Tee connector (bnc) |
| 5. Low-frequency sinewave generator | 11. Screwdriver (three-inch) |
| 6. Cable (42-inch, 50 Ω bnc) | 12. Screwdriver, low capacitance |

Control Settings

Preset the 7904 controls as follows:

POWER switch	Off
VERTICAL MODE	RIGHT
VERTICAL TRACE SEPARATION (B)	Midrange
A TRIGGER SOURCE	VERT MODE
A INTENSITY	MIDRANGE
HORIZONTAL MODE	A
B INTENSITY	Midrange
B TRIGGER SOURCE	VERT MODE
READOUT Intensity	OFF (in detent)
GRAT ILLUM	As desired
CONTROL ILLUM	LOW
CALIBRATOR	0.4 V
RATE	1 kHz

1. Check/Adjust Horizontal Amplifier Limit Centering (R4925)

a. Install a time-base unit in the RIGHT VERT compartment and the Calibration Fixture in the A HORIZ compartment.

b. Set the Calibration Fixture Test switch to Triggering Gain and the time-base unit for auto, internal triggering at a sweep rate of 5 μ s/div. Set the POWER switch to ON.

c. Short TP 4901 to TP 4911 with a 12-inch jumper cable.

d. Check—that the vertical trace is within 0.5 division of the center vertical graticule line.

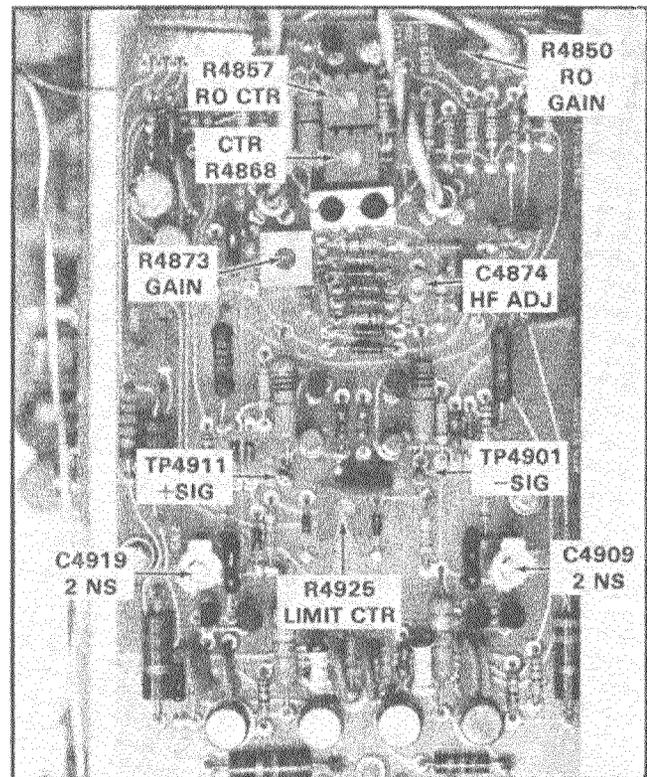


Fig. 5-6. Location of horizontal system adjustments on Main Horizontal Amplifier board.

e. Adjust—Limit Ctr, R4925, to align the displayed trace with the center vertical graticule line. See Fig. 5-6 for adjustment location.

f. Remove the 12-inch jumper cable.

2. Check/Adjust Horizontal Amplifier Centering (R4868)

- a. Check—that the vertical trace is within 0.5 division of the center vertical graticule line.
- b. Adjust—Ctr, R4868, to align the displayed trace with the center vertical graticule line, See Fig. 5-6 for adjustment location.
- c. Move the Calibration Fixture to the B HORIZ compartment and change the HORIZONTAL MODE switch to B.
- d. Check—that the vertical trace is within 0.5 division of the center vertical graticule line.
- e. Adjust—if necessary, compromise the setting of R4868 for optimum centering for both horizontal compartments. If readjustment is necessary, recheck parts a, b, c, and d of this step.

✓ 3. Check/Adjust Horizontal Gain and Low-Frequency Linearity (R4873)

- a. Set the Calibration Fixture Test switch to Vert or Horiz Gain with the Rep Rate switch set to 100 kHz. Align the bright vertical trace with the center vertical graticule line using the Calibration Fixture Position control.
- ✓ b. Check—that the second and tenth vertical traces align with the second and tenth graticule lines within 0.05 division.
- c. Adjust—Gain, R4873, for eight divisions of deflection between the second and tenth graticule lines.
- d. Check—for 0.05 division or less error at each graticule line after adjusting for no error at the second and tenth graticule lines.
- e. Move the Calibration Fixture to the A HORIZ compartment and change the HORIZONTAL MODE switch to A.
- ✓ f. Check—that the deflection between the second and tenth graticule lines is the same as in part d of this step, within 0.08 division.
- g. Adjust—if necessary, compromise the setting of R4873 for optimum gain for both horizontal compartments. If readjustment is necessary, recheck parts a, b, c, and d of this step.

4. Check/Adjust Readout Centering and Gain (R4857, R4850) (Omit this step for instruments with Option 1)

- a. Set the POWER switch to off and remove all plug-in units.
- b. Remove Q2225 from its socket on the Readout circuit board. See Fig. 5-10 for location.
- c. Set the POWER switch to ON and adjust the READOUT control for visible characters (all zeros).
- d. Check—the crt display for two rows of zeros centered horizontally within the graticule area. See Fig. 5-10A.
- e. Adjust—RO Ctr, R4857, to horizontally center the readout display within the limits of the graticule area. See Fig. 5-6 for adjustment location.
- f. Adjust—RO Gain, R4850, so all the characters are displayed within the limits of the graticule area. See Fig. 5-6 for adjustment location.
- g. Set the POWER switch to off and replace Q2225 in its socket.

✓ 5. Check/Adjust High Frequency Timing (C4874, C4909, C4919)

- a. Install the time-base unit in the B HORIZ compartment and the amplifier unit in the LEFT VERT compartment.

NOTE

For optimum performance at fast sweep rates, install the time-base unit normally used with the R7904 being calibrated.

- b. Set the VERTICAL MODE switch to LEFT and the HORIZONTAL MODE switch to B. Turn the POWER switch to ON.
- c. Set the time-base unit for auto mode with ac coupling from the internal source at a sweep rate of 1 ms/div.
- d. Connect one millisecond markers from the time-mark generator to the amplifier unit input and adjust the amplifier unit deflection factor for about two divisions of display.

e. Position the first marker to the extreme left line on the graticule.

f. Set the time-base unit sweep-calibration adjustment for one marker at each major graticule division between the second and tenth graticule lines (center eight divisions).

g. Set the time-mark generator for 2 ns time markers and the time-base unit sweep rate for 2 ns/div. If necessary, change the deflection factor of the amplifier unit to maintain a vertical deflection of at least two divisions.

✓h. Check—the crt display for one cycle each division and timing over the center eight divisions within 4% (0.32 divisions).

i. Adjust—2 NS, C4904 and C4919, equally for one cycle each division over the center eight divisions. See Fig. 5-6 for adjustment location.

j. Set the time-base unit sweep rate to 0.5 ns/div.

✓k. Check—the crt display for timing over the center eight divisions within 5% (0.40 divisions). (One cycle every four divisions).

l. Adjust—HF Adj, C4874, for one cycle every four divisions over the center eight divisions.

✓m. Check—using the procedure outlined in parts g through j, the timing accuracy at sweep rates of both 2 ns/div and 1 ns/div within 4% (0.32 division).

n. Adjust—if necessary, compromise the settings of C4909 and C4919 (2 NS) for optimum timing accuracy of both 2 ns/div and 1 ns/div sweep rates.

✓o. Check—repeat parts j through l to recheck 0.5 ns/div timing.

p. Disconnect all test equipment and remove the plug-in units.

✓ **6. Check/Adjust X-Y Delay Compensation (C804, C814)**

a. Install amplifier units in the LEFT VERT and A HORIZ compartments.

b. Set the HORIZONTAL MODE switch to A and the VERTICAL MODE switch to LEFT.

c. Set both amplifier units for a deflection factor of 10 mV/div with dc coupling.

d. Connect the low-frequency sine-wave generator to the input of either amplifier with the 42-inch 50 Ω bnc cable, and a Tee connector (bnc). Connect the output of the Tee connector to the input of the other amplifier with the 18-inch 50 Ω cable.

e. Set the low-frequency sine-wave generator output for eight divisions of vertical and horizontal deflection at a frequency of 35 kHz.

✓f. Check—the crt lissajous display for a separation of 0.28 division or less (indicates 2° or less phase shift; see Fig. 5-7A).

g. Remove the amplifier unit from the A HORIZ compartment and install it in the B HORIZ compartment (leave signal connected). Set the HORIZONTAL MODE switch to B.

h. Repeat parts e and f of this step.

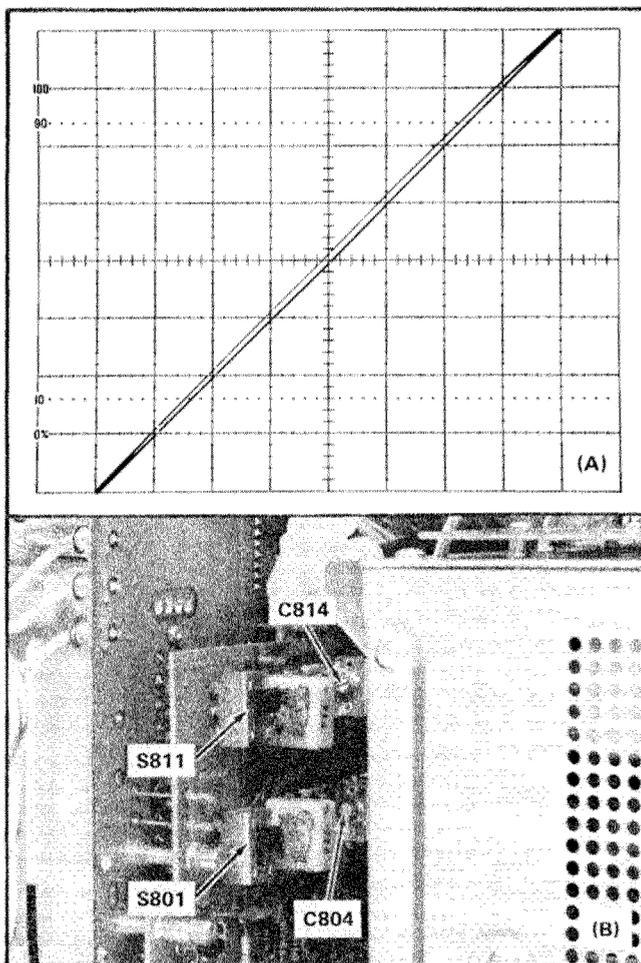


Fig. 5-7. (A) Typical display when checking X-Y delay compensation, (B) Location of phasing adjustments (X-Y Delay Compensation board).

Performance Check and Adjustment—7904 (SN B260000-UP)

NOTE

Option 2 adds a X-Y Delay Compensation network to equalize the signal delay between the vertical and horizontal deflection systems. If the instrument under test does not contain Option 2, omit the remainder of this step.

i. Set both internal delay disable switches to the In (up) position. See Fig. 5-7B for location.

j. Set the low-frequency sine-wave generator for eight divisions of vertical and horizontal deflection at 1 MHz.

✓ k. Check—the crt lissajous display for a separation of 0.28 division or less (indicates 2° or less phase shift; see Fig. 5-7A).

l. Adjust—X-Y Comp, C814, for minimum separation of the display (see Fig. 5-7A). See Fig. 5-7B for adjustment location.

m. Remove the amplifier unit from the B HORIZ compartment and install it in the A HORIZ compartment (leave signal connected).

n. Set the HORIZONTAL MODE switch to A.

✓ o. Check—the crt lissajous display for a separation of 0.28 division or less (indicates 2° or less phase shift; see Fig. 5-7A).

p. Adjust—X-Y Comp, C804, for minimum separation of the display (see Fig. 5-7A). See Fig. 5-7B for adjustment location.

q. Disconnect all cables and remove plug-in units.

F. CALIBRATOR AND OUTPUT SIGNALS

Equipment Required

- | | |
|--|-------------------------------------|
| 1. Digital voltmeter | 6. Time-mark generator |
| 2. Amplifier unit | 7. Cable (18-inch, 50 Ω bnc) |
| 3. Time-base unit (with delaying mode) | 8. Cable (42-inch, 50 Ω bnc) |
| 4. Time-base unit | 9. Tee connector (bnc) |
| 5. Test oscilloscope (dual trace) | 10. Screwdriver (three-inch) |

Control Settings

Preset the 7904 controls as follows:

POWER switch	Off
VERTICAL MODE	RIGHT
VERTICAL TRACE SEPARATION (B)	Midrange
A TRIGGER SOURCE	VERT MODE
A INTENSITY	Midrange
HORIZONTAL MODE	A
B INTENSITY	Midrange
B TRIGGER SOURCE	VERT MODE
READOUT Intensity	OFF (in detent)
GRAT ILLUM	LOW
CALIBRATOR RATE	0.4 V DC

1. Check/Adjust Calibrator Output Voltage (R1148)

a. Connect the digital voltmeter between the center contact of the CAL VOLTS connector and chassis ground. Set the POWER switch to ON.

b. Check—meter reading for 0.4000 volt \pm 0.0004 volt (within 0.0008 volt if measurement is made outside the +15°C to +35°C range).

c. Adjust—0.4 V, R1148, for a meter reading of 0.4000 volt. See Fig. 5-8 for adjustment location.

d. Check—remaining calibrator output voltage supply as listed in Table 5-5.

e. Disconnect the digital voltmeter.

Table 5-5

CALIBRATOR SUPPLY AND TOLERANCE

Supply (volts)	Tolerance
0.004	\pm 0.00004 V
0.040	\pm 0.0004 V
4.00	\pm 0.04 V
40.0	\pm 0.4 V

✓ 2. Check/Adjust Calibrator 1 kHz Repetition Rate (R1101)

NOTE

A frequency counter with an accuracy of at least 0.1% may be used to adjust the calibrator repetition rate.

a. Connect 1 ms time-markers to the vertical amplifier of the test oscilloscope and adjust the deflection for four divisions of display.

b. Set the test oscilloscope triggering to auto mode with ac coupling from the internal source, and adjust the triggering level control for a stable display. Set the sweep rate for 1 ms/div.

c. Set the other test oscilloscope vertical channel deflection factor to 0.1 V/div and connect the 0.4 V, 1 kHz signal from the CAL VOLTS connector to the vertical input connector.

d. Set the test oscilloscope to observe only the calibrator signal display and set the triggering level control to trigger only on the 1 ms markers.

Performance Check and Adjustment—7904 (SN B260000-UP)

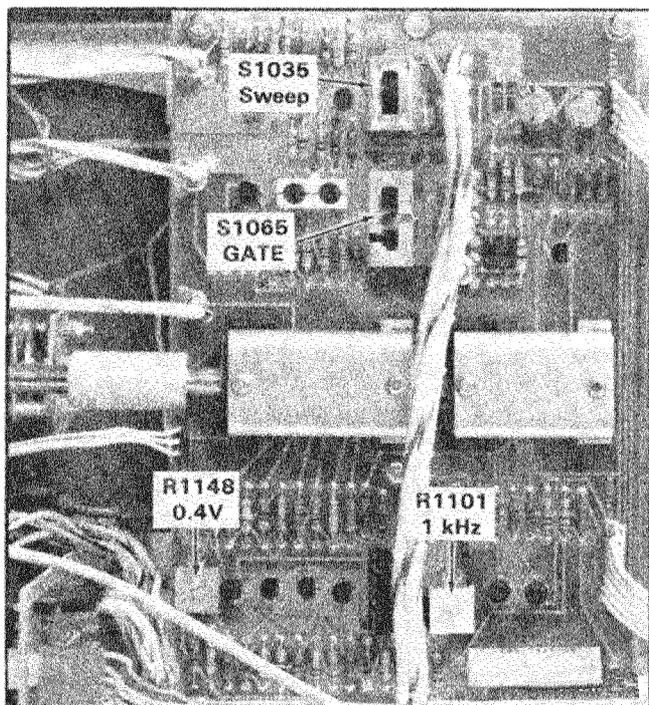


Fig. 5-8. Location of calibrator adjustments and switch locations.

e. Observe the drift of the 1 kHz signal across the test oscilloscope crt.

✓ f. Check—the time required for one cycle of the square wave signal to drift from one side of the display area to the other, is more than 10 seconds.

g. Adjust—1 kHz, R1101, for minimum drift. See Fig. 5-8 for adjustment location.

h. Disconnect all test equipment.

✓ 3. Check Calibrator Rise Time, Fall Time, and Duty Cycle

a. Set the CALIBRATOR switch to the 4 V position.

b. Connect the CAL VOLTS output to the inverting vertical input of the test oscilloscope and set the vertical mode to display the inverting channel.

c. Set the test oscilloscope vertical deflection to display four divisions of CALIBRATOR signal.

d. Set the test oscilloscope for a stable display, internally triggered on the rising portion of the calibrator signal, at a sweep rate of 100 ns/div.

✓ e. Check—displayed waveform for not more than 2.5 divisions between the 10% to 90% points of the waveform (risetime, 250 ns or less).

f. Set the test oscilloscope for a stable display triggered on the falling portion of the waveform.

✓ g. Check—displayed waveform for not more than 2.5 divisions between the 90% to 10% points of the waveform (falltime, 250 ns or less).

h. Set the test oscilloscope triggering to auto with ac coupling from the internal source, at a sweep rate of 0.1 ms/div. Center the display on the crt. Trigger the test oscilloscope on the + slope and position the negative-going slope of the waveform to the center graticule line.

i. Set the test oscilloscope sweep magnifier to X10. Then, position the display horizontally so the falling edge of the waveform aligns with the center graticule line.

j. Set the test oscilloscope vertical to invert the display. (NOTE: The display is triggered on the opposite slope, even though the display appears the same.)

✓ k. Check—the 50% point on the falling edge of the waveform now displayed is within 0.4 division horizontally of the centerline (indicates duty cycle of 50% within $\pm 0.1\%$).

l. Disconnect all cables.

✓ 4. Check Calibrator B Gate $\div 2$ Repetition Rate

a. Install an amplifier unit in the RIGHT VERT compartment. Set the VERTICAL MODE switch to RIGHT.

b. Install a time-base unit in the A HORIZ compartment and another time-base unit in the B HORIZ compartment.

c. Set the HORIZONTAL MODE switch to A; set the time-base unit to auto mode with ac coupling from the internal source at a sweep rate of 1 ms/div.

d. Connect the CAL VOLTS output to the vertical amplifier input. Set the CALIBRATOR to the 0.4 V position.

e. Set the vertical amplifier deflection to display two divisions of CALIBRATOR signal.

f. Set the time-base in the B HORIZ compartment to auto mode, external triggering at a sweep rate of 0.1 ms/div.

g. Set the CALIBRATOR switch to B GATE $\div 2$.

√h. Check—the crt display for approximately five cycles of signal in ten horizontal divisions.

i. Disconnect the cable from the equipment.

√ **5. Check A and B Sawtooth Output Signals**

a. Connect the +SAWTOOTH output connector to the test oscilloscope vertical input (1 megohm input).

b. Set the vertical amplifier unit for a deflection factor of 2 V/div with dc coupling, and the sweep rate to 2 ms/div.

c. Set the Sweep selector switch, S1035, to A. See Fig. 5-8 for location.

√d. Check—that the slope of the test oscilloscope display is 2 V/div within 10% (ten volt sawtooth display for five-division sweep).

e. Set the Sweep selector switch, S1035, to B, and the time-base in B HORIZ compartment to 1 ms/div. See Fig. 5-8 for location.

√f. Check—that the slope of the test oscilloscope display is 2 V/div within 10% (ten volt sawtooth display for five division sweep).

√ **6. Check A and B Gate, and Delayed Gate Output Signals**

a. Disconnect the cable from the +SAWTOOTH output connector and connect it to the +GATE output connector.

b. Set the Gate selector switch, S1065, to A. See Fig. 5-8 for location.

√c. Check—that the test oscilloscope display for a gate waveform is five divisions in amplitude within 10%.

d. Set the Gate selector switch, S1065, to B. See Fig. 5-8 for location.

√e. Check—that the test oscilloscope display for a gate waveform is five divisions in amplitude within 10%.

f. Set the Gate selector switch, S1065, to Dly'd. See Fig. 5-8 for location.

g. Set the delaying time-base for delaying sweep operation.

√h. Check—that the test oscilloscope display for a gate waveform is five divisions in amplitude within 10%.

i. Disconnect cables and remove plug-in units.

G. READOUT SYSTEM

NOTE

Option 1 deletes the Readout System from the instrument. If the instrument under test is an Option 1 instrument, omit this section of the procedure.

Equipment Required

- | | |
|--------------------------------|------------------------------|
| 1. Amplifier unit (dual trace) | 3. Screwdriver (three- inch) |
| 2. Time-base unit | |

Control Settings

Preset the 7904 controls as follows:

POWER switch	Off
VERTICAL MODE	RIGHT
VERTICAL TRACE SEPARATION (B)	Midrange
A TRIGGER SOURCE	VERT MODE
A INTENSITY	Midrange
HORIZONTAL MODE	A
B INTENSITY	Midrange
B TRIGGER SOURCE	VERT MODE
READOUT Intensity	OFF (in detent)
GRAT ILLUM	As desired
CONTROL ILLUM	LOW
CALIBRATOR RATE	0.4 V 1 kHz

NOTE

The Vertical Amplifier and Horizontal Amplifier Centering adjustment must be correct before making the next adjustment. Refer to D. Vertical, and E. Horizontal System adjustment.

1. Check/Adjust Readout Character Height, Vertical Separation, and Vertical Centering (R2273, R2291, R707)

- Remove Q2225 from its socket on the Readout circuit board. See Fig. 5-9B for location.
- Set the POWER switch to ON.
- Set the READOUT control for visible characters (all zeros).
- Check—the crt display for two rows of zeros, 40 zeros to a row with no overlap. The baseline of the upper characters should be located vertically between the 7.2 and 7.5 division graticule lines. The top of the lower characters should be located vertically between the 0.5 and 0.8 division graticule lines. See Fig. 5-9A for location.
- Adjust—Character Height, R2273, for desired readout character size within 0.25 div and 0.5 div. See Fig. 5-9B for adjustment location.

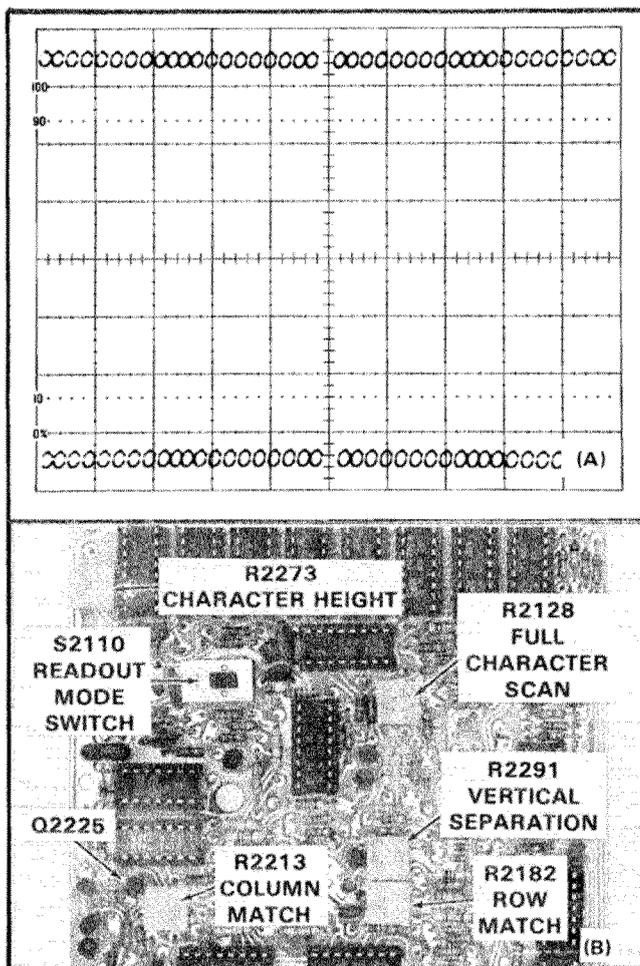


Fig. 5-9. (A) Readout display with Q2225 removed, (B) Location of Q2225 and readout adjustments.

f. Adjust—Vertical Separation, R2291, and Vertical Centering, R707, to desired location within limits given in part d of this step. See Fig. 5-9B for R2291 location and Fig. 5-5 for R707 location.

g. Set the POWER switch to off and replace Q2225 in its socket; return the POWER switch to ON.

✓ **2. Check/Adjust Full Character Scan (R2128)**

a. Install the dual-trace amplifier unit in the RIGHT VERT compartment.

b. Set the amplifier unit for a deflection factor of 50 mV/div.

✓c. Check—the displayed characters for completeness without overscanning (overscanning causes a bright dot where traces overlap).

d. Adjust—Full Character Scan, R2128, for fully scanned characters without overscanning. The m and the 5 will show the most changes. See Fig. 5-9B for adjustment location.

3. Check/Adjust Column and Row Match (R2182, R2213)

a. Set the amplifier unit for a dual-trace display mode.

b. Press and hold the amplifier unit trace-identify buttons.

c. Check—the readout display for correct indications of "IDENTIFY". If the readout display blinks or is incorrect, adjustment is required.

d. Adjust—Column Match, R2213, and Row Match, R2182, for correct readout of "IDENTIFY". Set these adjustments to the center of the adjustment range which provides correct readout indication. Release the amplifier unit trace-identify buttons. See Fig. 5-9B for adjustment location.

✓ **4. Check Readout Modes**

a. Install a time-base unit in the A HORIZ compartment.

b. Set the time-base unit for a free-running sweep.

c. Set the Readout switch (S2110), to F.R. (Free Run) and the Gate switch (S1065), to A. See Fig. 5-9B for Readout switch location and Fig. 5-8 for Gate switch location.

d. Set the time-base unit on several sweep rates throughout the time/division switch range. Check that the readout characters are presented on a free-run basis and are displayed independently of the sweep rate.

e. Set the Readout Mode switch (S2110), to Gate Trig'd position. See Fig. 5-9B for location.

f. Set the time-base unit for a free-running sweep at a rate of 0.1 s/div.

✓g. Check that the readout characters are blanked out while the sweep is running, and are displayed immediately after the end of the sweep; each character encoded by the plug-in units is displayed only once for each sweep.

h. This completes the Performance Check and Adjustment procedure. Disconnect all test equipment and replace the side panels.

SECTION 6

OPTIONS

Your instrument may be equipped with one or more instrument options. A brief description of each available option is given in the following discussion. Option information is also incorporated into the appropriate sections of the manual. This page and the Table of Contents directs the reader to where the option is documented.

Conversion kits for most options are available and can be installed at a later time. For further information on instrument options, see your Tektronix Catalog or contact your Tektronix Field Office.

Option 1

This option deletes the Readout System. Operation of the instrument is unchanged except there is not alphanumeric display on the crt and the front-panel READOUT control is non-functional. The Readout board A18 has been replaced with Dummy Readout A26 to maintain continuity of the remaining circuitry.

Option 2

This option adds a X-Y Delay Compensation network to equalize the signal delay between the vertical and horizontal deflection system. When this network is installed and activated, the phase shift between the vertical and horizontal channels is less than 2° from dc to 1 mHz. Option 2 adjustment procedure is outlined in Section 5E, Step 6 of this manual.

Option 3

This option adds special shielding and equipment to the instrument for EMI protection when operated in most severe EMI environments. Also, in order to meet EMI specifications, any unused plug-in compartment must be covered with an EMI shielded blank plug-in panel. One is required for each unused compartment.

Option 3 parts illustrations are located in Fig. 6 Options section of this manual. EMI Specifications may be found in the Specification section of this manual, Table 1-5.

**Option 4
Maximum Brightness CRT**

This option changes the standard CRT to a 4 X 5-cm type that provides maximum trace brightness and optimum photographic writing speed.

Parts List Changes

DELETE:

V1725	154-0644-05	Standard 8 X 10-cm CRT, P31 phosphor.
	331-0245-00	Mask, CRT

ADD:

V1725	154-0661-05	4 X 5-cm CRT, P31 phosphor.
	154-0661-09	4 X 5-cm CRT, P11 phosphor
	331-0318-00	Mask, CRT (4 X 5)

After installation of the 4 X 5-cm CRT, perform adjustment steps in 5B, 5D, and 5E in this manual.

Option 78

This option adds a Type P11 phosphor CRT to the instrument.

Parts List Changes

DELETE:

V1725	154-0644-00	Standard 8 X 10-cm CRT, P31 phosphor.
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ADD:

V1725	154-0644-09	8 X 10-cm CRT, P11 phosphor.
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After installation of the CRT, perform adjustment steps in Section 5B, 5D, and 5E in this manual.

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

Replaceable Electrical Parts—7904 (SN B260000 & UP)

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000JO	DILECTRON INC.	2669 S MYRTLE AVE	MONROVIA, CA 91016
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P O BOX 128	PICKENS, SC 29671
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
02111	SPECTROL ELECTRONICS CORPORATION	17070 EAST GALE AVENUE	CITY OF INDUSTRY, CA 91745
02114	FERROXCUBE CORPORATION	PO BOX 359, MARION ROAD	SAUGERTIES, NY 12477
02735	RCA CORPORATION, SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
02777	HOPKINS ENGINEERING COMPANY	12900 FOOTHILL BLVD.	SAN FERNANDO, CA 91342
03508	GENERAL ELECTRIC COMPANY, SEMI-CONDUCTOR PRODUCTS DEPARTMENT	ELECTRONICS PARK	SYRACUSE, NY 13201
03888	KDI PYROFILM CORPORATION	60 S JEFFERSON ROAD	WHIPPANY, NJ 07981
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867, 19TH AVE. SOUTH	MYRTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
05397	UNION CARBIDE CORPORATION, MATERIALS SYSTEMS DIVISION	11901 MADISON AVENUE	CLEVELAND, OH 44101
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
08806	GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPARTMENT	NELA PARK	CLEVELAND, OH 44112
11237	CTS KEENE, INC.	3230 RIVERSIDE AVE.	PASO ROBLES, CA 93446
12969	UNITRODE CORPORATION	580 PLEASANT STREET	WATERTOWN, MA 02172
14298	AMERICAN COMPONENTS, INC., AN INSILCO COMPANY	8TH AVE. AT HARRY STREET	CONSHOHOCKEN, PA 19428
14433	ITT SEMICONDUCTORS	3301 ELECTRONICS WAY P O BOX 3049	WEST PALM BEACH, FL 33402
14552	MICRO SEMICONDUCTOR CORP.	2830 E FAIRVIEW ST.	SANTA ANA, CA 92704
14752	ELECTRO CUBE INC.	1710 S. DEL MAR AVE.	SAN GABRIEL, CA 91776
15238	ITT SEMICONDUCTORS, A DIVISION OF INTER NATIONAL TELEPHONE AND TELEGRAPH CORP.	P.O. BOX 168, 500 BROADWAY	LAWRENCE, MA 01841
15454	RODAN INDUSTRIES, INC.	2905 BLUE STAR ST.	ANAHEIM, CA 92806
17856	SILICONIX, INC.	2201 LAURELWOOD DRIVE	SANTA CLARA, CA 95054
27193	CUTLER-HAMMER, INC. SPECIALTY PRODUCTS DIVISION	4201 N. 27TH ST.	MILWAUKEE, WI 53216
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
50157	MIDWEST COMPONENTS INC.	P. O. BOX 787	
50434	HEWLETT-PACKARD COMPANY	1981 PORT CITY BLVD.	MUSKEGON, MI 49443
51642	CENTRE ENGINEERING INC.	640 PAGE MILL ROAD	PALO ALTO, CA 94304
52306	HIGH VOLTAGE DEVICES, INC.	2820 E COLLEGE AVENUE	STATE COLLEGE, PA 16801
52769	SPRAGUE GOODMAN ELEC., INC.	7485 AVENUE 304	VISALIA, CA 93277
53944	ELT INC., GLOW LITE DIVISION	134 FULTON AVENUE	GARDEN CITY PARK, NY 11040
55680	NICHICON/AMERICA/CORP.	BOX 698	PAULS VALLEY, OK 73075
56289	SPRAGUE ELECTRIC CO.	6435 N PROESEL AVENUE	CHICAGO, IL 60645
57668	R-OHM CORP.	87 MARSHALL ST.	NORTH ADAMS, MA 01247
58756	CTS OF ELKHART INC	16931 MILLIKEN AVE.	IRVINE, CA 92713
		1142 W. BEARDSLEY AVE.	ELKHART, IN 46514
58756	CTS OF ELKHART INC.	1142 W. BEARDSLEY AVE.	ELKHART, IN 46514
59660	TUSONIX INC.	2155 N FORBES BLVD	TUCSON, AZ 85705
59821	CENTRALAB INC	7158 MERCHANT AVE	EL PASO, TX 79915
60705	SUB NORTH AMERICAN PHILIPS CORP		
71400	CERA-MITE CORP.	1327 6TH AVE.	GRAFTON, WI 53024
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
73899	JFD ELECTRONICS COMPONENTS CORP.	PINETREE ROAD	OXFORD, NC 27565
74276	SIGNALITE DIV., GENERAL INSTRUMENT CORP.	1933 HECK AVE.	NEPTUNE, NJ 07753
74970	JOHNSON, E. F., CO.	299 10TH AVE. S. W.	WASECA, MN 56093
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
76493	BELL INDUSTRIES, INC., MILLER, J. W., DIV.	19070 REYES AVE., P O BOX 5825	COMPTON, CA 90224
76854	OAK INDUSTRIES, INC., SWITCH DIV.	S. MAIN ST.	CRYSTAL LAKE, IL 60014
78488	STACKPOLE CARBON CO.		ST. MARYS, PA 15857
79727	C-W INDUSTRIES	550 DAVISVILLE RD.,P O BOX 96	WARMINISTER, PA 18974

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
80031	ELECTRA-MIDLAND CORP., MEPCO DIV.	22 COLUMBIA ROAD	MORRISTOWN, NJ 07960
80294	BOURNS, INC., INSTRUMENT DIV.	6135 MAGNOLIA AVE.	RIVERSIDE, CA 92506
83003	VARO, INC.	P O BOX 411, 2203 WALNUT STREET	GARLAND, TX 75040
84411	TRW ELECTRONIC COMPONENTS, TRW CAPACITORS	112 W. FIRST ST.	OGALLALA, NE 69153
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	3029 E. WASHINGTON STREET P. O. BOX 372	INDIANAPOLIS, IN 46206
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601
92966	SYLVANIA MINIATURE LIGHTING PRODUCTS, INC., SUB OF GTE SYLVANIA, LIGHT. PROD.	526 ELM STREET	KEARNY, NJ 07032
93410	ESSEX INTERNATIONAL, INC., CONTROLS DIV. LEXINGTON PLANT	P. O. BOX 1007	MANSFIELD, OH 44903

Replaceable Electrical Parts—7904 (SN B260000 & UP)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-1642-00			CKT BOARD ASSY:PROBE POWER	80009	670-1642-00
A2	670-1623-03	B260000	B269967	CKT BOARD ASSY:MAIN INTERFACE	80009	670-1623-03
A2	670-1623-04	B269968	B282859	CKT BOARD ASSY:MAIN INTERFACE	80009	670-1623-04
A2	670-1623-05	B282860		CKT BOARD ASSY:MAIN INTERFACE	80009	670-1623-05
A3	670-1637-00			CKT BOARD ASSY:FRONT PANEL INTERCONNECT	80009	670-1637-00
A4	670-1624-02	B260000	B270184	CKT BOARD ASSY:LOGIC	80009	670-1624-02
A4	670-1624-03	B270185	B282859	CKT BOARD ASSY:LOGIC	80009	670-1624-03
A4	670-1624-04	B282860		CKT BOARD ASSY:LOGIC	80009	670-1624-04
A5	670-1626-05	B260000	B268233	CKT BOARD ASSY:A TRIGGER SELECTOR	80009	670-1626-05
A5	670-1626-06	B268234	B268529	CKT BOARD ASSY:A TRIGGER SELECTOR	80009	670-1626-06
A5	670-1626-07	B268530		CKT BOARD ASSY:A TRIGGER SELECTOR	80009	670-1626-07
A6	670-1627-05	B260000	B268233	CKT BOARD ASSY:B TRIGGER SELECTOR	80009	670-1627-05
A6	670-1627-06	B268234	B268529	CKT BOARD ASSY:B TRIGGER SELECTOR	80009	670-1627-06
A6	670-1627-07	B268530		CKT BOARD ASSY:B TRIGGER SELECTOR	80009	670-1627-07
A7	670-1625-06			CKT BOARD ASSY:VERTICAL INTERFACE	80009	670-1625-06
A8	670-1630-04			CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-1630-04
A9	670-1632-02	B260000	B280908	CKT BOARD ASSY:MAIN HORIZONTAL AMPL	80009	670-1632-02
A9	670-1632-03	B280909		CKT BOARD ASSY:MAIN HORIZONTAL AMPL	80009	670-1632-03
A10	670-1635-02	B260000	B268064	CKT BOARD ASSY:CALIBRATOR SIGNAL	80009	670-1635-02
A10	670-1635-03	B268065		CKT BOARD ASSY:CALIBRATOR SIGNAL	80009	670-1635-03
A11	670-1610-05	B260000	B268784	CKT BOARD ASSY:POWER SUPPLY INVERT	80009	670-1610-05
A11	670-1610-08	B268785	B281650	CKT BOARD ASSY:POWER SUPPLY INVERT	80009	670-1610-08
A11	670-1610-12	B281651	B282859	CKT BOARD ASSY:POWER SUPPLY INVERT	80009	670-1610-12
A11	670-1610-14	B282860		CKT BOARD ASSY:POWER SUPPLY INVERT	80009	670-1610-14
A12	670-1612-06	B260000	B268904	CKT BOARD ASSY:CAPACITOR RECTIFIER	80009	670-1612-06
A12	670-1612-09	B268905	B268949	CKT BOARD ASSY:CAPACITOR RECTIFIER	80009	670-1612-09
A12	670-1612-11	B268950	B269287	CKT BOARD ASSY:CAPACITOR RECTIFIER	80009	670-1612-11
A12	670-1612-14	B269288	B270149	CKT BOARD ASSY:CAPACITOR RECTIFIER	80009	670-1612-14
A12	670-1612-18	B270150	B270204	CKT BOARD ASSY:CAPACITOR RECTIFIER	80009	670-1612-18
A12	670-1612-20	B270205	B281169	CKT BOARD ASSY:CAPACITOR RECTIFIER	80009	670-1612-20
A12	670-1612-21	B281170	B282859	CKT BOARD ASSY:CAPACITOR RECTIFIER	80009	670-1612-21
A12	670-1612-23	B282860		CKT BOARD ASSY:CAPACITOR RECTIFIER	80009	670-1612-23
A13	670-1611-00	B260000	B281329	CKT BOARD ASSY:POST REGULATOR	80009	670-1611-00
A13	670-1611-02	B281330		CKT BOARD ASSY:LV REGULATOR	80009	670-1611-02
A14	670-1613-00			CKT BOARD ASSY:HIGH VOLTAGE	80009	670-1613-00
A15	670-1622-00			CKT BOARD ASSY:AUTO FOCUS	80009	670-1622-00
A16	670-1636-02	B260000	282859	CKT BOARD ASSY:Z AXIS	80009	670-1636-02
A16	670-1636-03	B282860		CKT BOARD ASSY:Z AXIS	80009	670-1636-03
A17	670-1633-00			CKT BOARD ASSY:X&Y DELAY COMPENSATION (A17, OPTION 2 ONLY)	80009	670-1633-00
A18	670-1900-03	B260000	B269701	CKT BOARD ASSY:READOUT	80009	670-1900-03
A18	670-1900-04	B269702	B281839	CKT BOARD ASSY:READOUT	80009	670-1900-04
A18	670-1900-05	B281840	B282694	CKT BOARD ASSY:READOUT	80009	670-1900-05
A18	670-1900-06	B282695		CKT BOARD ASSY:READOUT	80009	670-1900-06
A19	670-1634-00			CKT BOARD ASSY:HORIZONTAL INTERCONNECT	80009	670-1634-00
A20	670-1638-00			CKT BOARD ASSY:VERTICAL MODE SW	80009	670-1638-00
A21	670-1639-00			CKT BOARD ASSY:HORIZONTAL MODE SW	80009	670-1639-00
A22	670-1640-00			CKT BOARD ASSY:A TRIGGER SW	80009	670-1640-00
A23	670-1698-02			CKT BOARD ASSY:50 OHM FOLLOWER	80009	670-1698-02
A24	670-1641-00			CKT BOARD ASSY:B TRIGGER SW	80009	670-1641-00
A25	670-0702-03	B260000	B282092	CKT BOARD ASSY:GRATICULE LAMPS	80009	670-0702-03
A25	670-0702-06	B282093		CKT BOARD ASSY:GRATICULE LAMPS	80009	670-0702-06
A26	670-2018-00			CKT BOARD ASSY:READOUT DUMMY	80009	670-2018-00
A27	670-4346-00			CKT BOARD ASSY:READOUT PROTECTION #1	80009	670-4346-00

Replaceable Electrical Parts—7904 (SN B260000 & UP)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C21	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C24	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	72982	8121N083Z5U0104Z
C26	283-0067-00			CAP.,FXD,CER DI:0.001UF,10%,200V	59660	835-515-Z5D0102K
C36	283-0067-00			CAP.,FXD,CER DI:0.001UF,10%,200V	59660	835-515-Z5D0102K
C60	290-0519-00	B260000	B282859	CAP.,FXD,ELCTLT:100UF,20%,20V	90201	TDC107M020WLD
C60	290-0973-00	B282860		CAP.,FXD,ELCTLT:100UF,20%,20V	90201	TDC10M020WLD
C62	290-0716-00	B260000	B299967	CAP.,FXD,ELCTLT:8.2UF,20%,75V	05397	T11C825M075AS
C62	290-0769-00	B299968	B282859	CAP.,FXD,ELCTLT:10UF,+50-10%,100V	56289	500D152
C62	290-0969-00	B282860		CAP.,FXD,ELCTLT:22UF,+50-10%,100V	55680	TLB2A220TCAANA
C64	290-0716-00	B260000	B299967	CAP.,FXD,ELCTLT:8.2UF,20%,75V	05397	T11C825M075AS
C64	290-0769-00	B299968	B282859	CAP.,FXD,ELCTLT:10UF,+50-10%,100V	56289	500D152
C64	290-0969-00	B282860		CAP.,FXD,ELCTLT:22UF,+50-10%,100V	55680	TLB2A220TCAANA
C66	290-0519-00	B260000	B282859	CAP.,FXD,ELCTLT:100UF,20%,20V	90201	TDC107M020WLD
C66	290-0973-00	B282860		CAP.,FXD,ELCTLT:100UF,20%,20V	90201	TDC107M020WLD
C68	290-0519-00	B260000	B282859	CAP.,FXD,ELCTLT:100UF,20%,20V	90201	TDC107M020WLD
C68	290-0963-00	B282860		CAP.,FXD,ELCTLT:220UF,+50-10%,25V	54473	ECEA1EV221S
C94	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	56289	273C11
C95	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	56289	273C11
C96	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	56289	273C11
C213	283-0672-00			CAP.,FXD,MICA D:200PF,1%,500V	00853	D155F2010F0
C216	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C218	281-0603-00			CAP.,FXD,CER DI:39PF,5%,500V	59660	0301080C0G0390
C224	281-0629-00			CAP.,FXD,CER DI:33PF,5%,600V	04222	7027-C0G-330J
C227	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C228	281-0629-00			CAP.,FXD,CER DI:33PF,5%,600V	04222	7027-C0G-330J
C231	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C233	281-0602-00			CAP.,FXD,CER DI:68PF,5%,500V	59660	308-000P2G0680J
C234	283-0638-00			CAP.,FXD,MICA D:130PF,1%,100V	00853	D151F131F0
C246	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	2C20Z5U105Z025B
C309	281-0603-00			CAP.,FXD,CER DI:39PF,5%,500V	59660	0301080C0G0390
C311	281-0603-00			CAP.,FXD,CER DI:39PF,5%,500V	59660	0301080C0G0390
C320	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C322	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C324	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	2C20Z5U105Z025B
C346	281-0603-00			CAP.,FXD,CER DI:39PF,5%,500V	59660	0301080C0G0390
C349	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C360	283-0604-00			CAP.,FXD,MICA D:304PF,2%,300V	00853	D155F3040G0
C365	283-0604-00			CAP.,FXD,MICA D:304PF,2%,300V	00853	D155F3040G0
C390	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	2C20Z5U105Z025B
C393	290-0529-00	B260000	B282859	CAP.,FXD,ELCTLT:47UF,20%,20V	05397	T362C476M020AS
C393	290-0963-00	B282860		CAP.,FXD,ELCTLT:220UF,+50-10%,25V	54473	ECEA1EV221S
C394	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	2C20Z5U105Z025B
C396	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	2C20Z5U105Z025B
C657	283-0185-00			CAP.,FXD,CER DI:2.5PF,5%,50V	72982	8101B057C0K0295B
C658	281-0218-00			CAP.,VAR,CER DI:1.5PF,+2-2.5%,100V	59660	513-013A1-5
C659	283-0185-00			CAP.,FXD,CER DI:2.5PF,5%,50V	72982	8101B057C0K0295B
C662	281-0603-00			CAP.,FXD,CER DI:39PF,5%,500V	59660	0301080C0G0390
C663	281-0603-00			CAP.,FXD,CER DI:39PF,5%,500V	59660	0301080C0G0390
C670	281-0543-00			CAP.,FXD,CER DI:270PF,10%,500V	72982	301055X5P271K
C672	281-0543-00			CAP.,FXD,CER DI:270PF,10%,500V	72982	301055X5P271K
C675	283-0160-00			CAP.,FXD,CER DI:1.5PF,10%,50V	93958	1C15RB
C676	283-0181-00			CAP.,FXD,CER DI:1.8PF,10%,100V	59660	8101B121COK0189B
C680	283-0181-00			CAP.,FXD,CER DI:1.8PF,10%,100V	59660	8101B121COK0189B

Replaceable Electrical Parts—7904 (SN B260000 & UP)

Ckt No.	Tektronix	Serial/Model No.		Name & Description	Mfr	Mfr Part Number
	Part No.	Eff	Dscont		Code	
C681	283-0160-00			CAP.,FXD,CER DI:1.5PF,10%,50V	93958	1C15RB
C685	281-0543-00			CAP.,FXD,CER DI:270PF,10%,500V	72982	301055X5P271K
C689	281-0543-00			CAP.,FXD,CER DI:270PF,10%,500V	72982	301055X5P271K
C733	283-0160-00			CAP.,FXD,CER DI:1.5PF,10%,50V	93958	1C15RB
C734	283-0181-00			CAP.,FXD,CER DI:1.8PF,10%,100V	59660	8101B121COKO189B
C736	283-0160-00			CAP.,FXD,CER DI:1.5PF,10%,50V	93958	1C15RB
C738	283-0181-00			CAP.,FXD,CER DI:1.8PF,10%,100V	59660	8101B121COKO189B
C739	283-0160-00			CAP.,FXD,CER DI:1.5PF,10%,50V	93958	1C15RB
C743	283-0128-00			CAP.,FXD,CER DI:100PF,5%,500V	59660	871-536T2H101J
C745	283-0114-00			CAP.,FXD,CER DI:0.0015UF,5%,200V	59660	805534Y5DO152J
C747	283-0239-00			CAP.,FXD,CER DI:0.022UF,10%,50V	72982	8121N083X7R0223K
C749	283-0203-00			CAP.,FXD,CER DI:0.47UF,20%,50V	72982	8131M058Z5U0474M
C751	281-0214-00			CAP.,VAR,CER DI:0.5-3PF,400V	80031	2502A0R503VP02F0
C758	283-0108-00			CAP.,FXD,CER DI:220PF,10%,200V	56289	1C10C0G221K200B
C760	283-0180-00			CAP.,FXD,CER DI:5600PF,20%,200V	72982	8121N204 E 562M
C762	283-0211-00			CAP.,FXD,CER DI:0.1UF,10%,200V	04222	SR06C104KAA
C764	283-0212-00			CAP.,FXD,CER DI:2UF,20%,50V	51642	400-050-Z5U205M
C770	283-0001-00			CAP.,FXD,CER DI:0.005UF, +100-0%,500V	59821	2DDH61L502P
C783	283-0001-00			CAP.,FXD,CER DI:0.005UF, +100-0%,500V	59821	2DDH61L502P
C787	283-0001-00			CAP.,FXD,CER DI:0.005UF, +100-0%,500V	59821	2DDH61L502P
C789	283-0001-00			CAP.,FXD,CER DI:0.005UF, +100-0%,500V	59821	2DDH61L502P
C791	283-0001-00			CAP.,FXD,CER DI:0.005UF, +100-0%,500V	59821	2DDH61L502P
C794	283-0001-00			CAP.,FXD,CER DI:0.005UF, +100-0%,500V	59821	2DDH61L502P
C796	283-0001-00			CAP.,FXD,CER DI:0.005UF, +100-0%,500V	59821	2DDH61L502P
C798	283-0001-00			CAP.,FXD,CER DI:0.005UF, +100-0%,500V	59821	2DDH61L502P
C803	283-0603-00			CAP.,FXD,MICA D:113PF,2%,300V	00853	D155F1130G0
C803	-----			(C803 OPTION 2 ONLY)		
C804	281-0118-00			CAP.,VAR,MICA D:8-90PF,175V	52769	GSM231
C804	-----			(C804 OPTION 2 ONLY)		
C806	283-0677-00			CAP.,FXD,MICA D:82PF,1%,500V	00853	D155E820F0
C806	-----			(C806 OPTION 2 ONLY)		
C807	283-0668-00			CAP.,FXD,MICA D:184PF,1%,500V	00853	D155F1840F0
C807	-----			(C807 OPTION 2 ONLY)		
C808	283-0668-00			CAP.,FXD,MICA D:184PF,1%,500V	00853	D155F1840F0
C808	-----			(C808 OPTION 2 ONLY)		
C809	283-0677-00			CAP.,FXD,MICA D:82PF,1%,500V	00853	D155E820F0
C809	-----			(C809 OPTION 2 ONLY)		
C813	283-0603-00			CAP.,FXD,MICA D:113PF,2%,300V	00853	D155F1130G0
C813	-----			(C813 OPTION 2 ONLY)		
C814	281-0118-00			CAP.,VAR,MICA D:8-90PF,175V	52769	GSM231
C814	-----			(C814 OPTION 2 ONLY)		
C816	283-0677-00			CAP.,FXD,MICA D:82PF,1%,500V	00853	D155E820F0
C816	-----			(C816 OPTION 2 ONLY)		
C817	283-0668-00			CAP.,FXD,MICA D:184PF,1%,500V	00853	D155F1840F0
C817	-----			(C817 OPTION 2 ONLY)		
C818	283-0668-00			CAP.,FXD,MICA D:184PF,1%,500V	00853	D155F1840F0
C818	-----			(C818 OPTION 2 ONLY)		
C819	283-0677-00			CAP.,FXD,MICA D:82PF,1%,500V	00853	D155E820F0
C819	-----			(C819 OPTION 2 ONLY)		
C837	281-0505-00			CAP.,FXD,CER DI:12PF, +/-1.2PF,500V	59660	301-012C0G0120K
C847	281-0505-00			CAP.,FXD,CER DI:12PF, +/-1.2PF,500V	59660	301-012C0G0120K
C1048	281-0772-00			CAP.,FXD,CER DI:0.0047UF,10%,100V	04222	GC701C472K
C1049	281-0772-00			CAP.,FXD,CER DI:0.0047UF,10%,100V	04222	GC701C472K
C1070	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	04222	GA101A470KAA

Replaceable Electrical Parts—7904 (SN B260000 & UP)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C1104	281-0785-00			CAP.,FXD,CER DI:68PF,10%,100V	72982	8035D2AADC0G680K
C1108	285-0824-00			CAP.,FXD,PLSTC:0.047UF,2%,100V	14752	410B1B473G
C1114	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
C1124	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	SA201C103KAA
C1140	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	SA201C103KAA
C1146	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	SA201C103KAA
C1162	283-0192-00			CAP.,FXD,CER DI:0.47UF,+80-20%,3V	000JO	RT3474Z-H
C1193	290-0745-00			CAP.,FXD,ELCTL:22UF,+50-10%,25V	54473	ECE-A25V22L
C1197	290-0745-00			CAP.,FXD,ELCTL:22UF,+50-10%,25V	54473	ECE-A25V22L
C1201	283-0279-00	B260000	B279999	CAP.,FXD,CER DI:0.001UF,20%,3000V	59660	878-530 Y5S0102M
C1203	283-0279-00	B260000	B279999	CAP.,FXD,CER DI:0.001UF,20%,3000V	59660	878-530 Y5S0102M
C1205	283-0022-00			CAP.,FXD,CER DI:0.02UF,1400VDCAC	59660	3888017Z500203Z
C1206	283-0022-00			CAP.,FXD,CER DI:0.02UF,1400VDCAC	59660	3888017Z500203Z
C1216	290-0628-00			CAP.,FXD,ELCTL:950UF,+50-10%,200V	56289	36D7560
C1217	290-0628-00			CAP.,FXD,ELCTL:950UF,+50-10%,200V	56289	36D7560
C1219	283-0057-00			CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	2C20Z5U104Z200B
C1227	283-0280-00			CAP.,FXD,CER DI:2200PF,10%,2000V	59660	0818590Y5500222K
C1228	283-0280-00			CAP.,FXD,CER DI:2200PF,10%,2000V	59660	0818590Y5500222K
C1229	285-0939-00			CAP.,FXD,PLSTC:3UF,5%,400V	84411	TEK111-30594
C1231	290-0395-00	B260000	B282859	CAP.,FXD,ELCTL:4.7UF,20%,50V	56289	150D475X0050B2
C1231	290-0748-00	B282860		CAP.,FXD,ELCTL:10UF,+50-10%,20V	56289	500D149
C1235	283-0078-00	B260000	B268784	CAP.,FXD,CER DI:0.001UF,20%,500V	59660	0801 547X5F0102M
C1235	283-0060-00	B268785	B281650	CAP.,FXD,CER DI:100PF,5%,200V	59660	855-535U2J101J
C1235	283-0078-00	B281651		CAP.,FXD,CER DI:0.001UF,20%,500V	59660	0801 547X5F0102M
C1236	283-0280-00			CAP.,FXD,CER DI:2200PF,10%,2000V	59660	0818590Y5500222K
C1237	285-0938-00			CAP.,FXD,PLSTC:0.03UF,5%,600V	56289	P192211
C1238	283-0279-00			CAP.,FXD,CER DI:0.001UF,20%,3000V	59660	878-530 Y5S0102M
C1239	290-0395-00	B260000	B282859	CAP.,FXD,ELCTL:4.7UF,20%,50V	56289	150D475X0050B2
C1239	290-0748-00	B282860		CAP.,FXD,ELCTL:10UF,+50-10%,20V	56289	500D149
C1242	283-0001-00			CAP.,FXD,CER DI:0.005UF,+100-0%,500V	59821	2DDH61L502P
C1243	290-0159-00			CAP.,FXD,ELCTL:2UF,+50-10%,150V	56289	30D205F150BB9
C1245	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C1249	290-0164-00			CAP.,FXD,ELCTL:1UF,+50-10%,150V	56289	500D105F150BA7
C1253	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C1254	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C1256	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C1259	290-0523-00	B260000	B282859	CAP.,FXD,ELCTL:2.2UF,20%,20V	56289	196D225X0020HA1
C1259	290-0782-00	B282860		CAP.,FXD,ELCTL:4.7UF,+75-10%,35V	55680	ULA1V4R7TEA
C1264	290-0573-00			CAP.,FXD,ELCTL:2.7UF,20%,50V	56289	196D275X0050JA1
C1267	290-0523-00			CAP.,FXD,ELCTL:2.2UF,20%,20V	56289	196D225X0020HA1
C1275	283-0060-00	B260000	B269133	CAP.,FXD,CER DI:100PF,5%,200V	59660	855-535U2J101J
C1275	283-0076-00	B269134	B269287	CAP.,FXD,CER DI:27PF,10%,500V	59660	831-500S2L27OK
C1275	283-0060-00	B269288		CAP.,FXD,CER DI:100PF,5%,200V	59660	855-535U2J101J
C1276	283-0060-00	B260000	B269133	CAP.,FXD,CER DI:100PF,5%,200V	59660	855-535U2J101J
C1276	283-0076-00	B269134	B269287	CAP.,FXD,CER DI:27PF,10%,500V	59660	831-500S2L27OK
C1276	283-0060-00	B269288		CAP.,FXD,CER DI:100PF,5%,200V	59660	855-535U2J101J
C1277	290-0572-00	B260000	B268904	CAP.,FXD,ELCTL:0.1UF,20%,50V	56289	196D104X0050HA1
C1277	290-0523-00	B268905	B270149	CAP.,FXD,ELCTL:2.2UF,20%,20V	56289	196D225X0020HA1
C1277	290-0522-00	B270150	B282859	CAP.,FXD,ELCTL:1UF,20%,50V	56289	196D105X0050HA1
C1277	290-0891-00	B282860		CAP.,FXD,ELCTL:1UF,+75-10%,50V	55680	ULA1H010TEA
C1278	290-0572-00	B260000	B268904	CAP.,FXD,ELCTL:0.1UF,20%,50V	56289	196D104X0050HA1
C1278	290-0523-00	B268905	B270149	CAP.,FXD,ELCTL:2.2UF,20%,20V	56289	196D225X0020HA1
C1278	290-0522-00	B270150	B282859	CAP.,FXD,ELCTL:1UF,20%,50V	56289	196D105X0050HA1
C1278	290-0891-00	B282860		CAP.,FXD,ELCTL:1UF,+75-10%,50V	55680	ULA1H010TEA

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Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C1285	283-0092-00			CAP.,FXD,CER DI:0.03UF,+80-20%,200V	59660	845-534Z5U0303Z
C1298	283-0023-00			CAP.,FXD,CER DI:0.1UF,+80-20%,12V	71590	2DDU66B104Z
C1300	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	59660	0801 547X5F0102M
C1301	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	59660	0801 547X5F0102M
C1302	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C1313	290-0425-00	B260000	B282859	CAP.,FXD,ELCTLT:100UF,20%,20V	90201	THF107M020P1G
C1313	290-0966-00	B282860		CAP.,FXD,ELCTLT:220UF,+30-10%,25V	55680	TLB1E221TAAANA
C1314	290-0529-00	B260000	B282859	CAP.,FXD,ELCTLT:47UF,20%,20V	05397	T362C476M020AS
C1314	290-0973-00	B282860		CAP.,FXD,ELCTLT:47UF,20%,20V	05397	T368C476M020AZ
C1316	290-0425-00	B260000	B282859	CAP.,FXD,ELCTLT:100UF,20%,20V	90201	THF107M020P1G
C1316	290-0966-00	B282860		CAP.,FXD,ELCTLT:220UF,+30-10%,25V	55680	TLB1E221TAAANA
C1317	290-0519-00	B260000	B282859	CAP.,FXD,ELCTLT:100UF,20%,20V	90201	TDC107M020WLD
C1317	290-0973-00	B282860		CAP.,FXD,ELCTLT:100UF,20%,20V	90201	TDC107M020WLD
C1318	290-0519-00	B260000	B282859	CAP.,FXD,ELCTLT:100UF,20%,20V	90201	TDC107M020WLD
C1318	290-0973-00	B282860		CAP.,FXD,ELCTLT:100UF,20%,20V	90201	TDC107M020WLD
C1326	283-0211-00	B260000	B270204	CAP.,FXD,CER DI:0.1UF,10%,200V	04222	SR06C104KAA
C1326	283-0208-00	B270205		CAP.,FXD,CER DI:0.22UF,10%,200V	72982	8151N230 C 224K
C1328	290-0582-00			CAP.,FXD,ELCTLT:5UF,+75-10%,150V	90201	TT5RON150C0P3P
C1330	290-0582-00			CAP.,FXD,ELCTLT:5UF,+75-10%,150V	90201	TT5RON150C0P3P
C1331	283-0057-00			CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	2C20Z5U104Z200B
C1350	290-0425-00	B260000	B282859	CAP.,FXD,ELCTLT:100UF,20%,20V	90201	THF107M020P1G
C1350	290-0966-00	B282860		CAP.,FXD,ELCTLT:220UF,+30-10%,25V	55680	TLB1E221TAAANA
C1351	290-0425-00	B260000	B282859	CAP.,FXD,ELCTLT:100UF,20%,20V	90201	THF107M020P1G
C1351	290-0966-00	B282860		CAP.,FXD,ELCTLT:220UF,+30-10%,25V	55680	TLB1E221TAAANA
C1353	290-0529-00	B260000	B282859	CAP.,FXD,ELCTLT:47UF,20%,20V	05397	T362C476M020AS
C1353	290-0973-00	B282860		CAP.,FXD,ELCTLT:47UF,20%,20V	05397	T368C476M020AZ
C1354	290-0529-00	B260000	B282859	CAP.,FXD,ELCTLT:47UF,20%,20V	05397	T362C476M020AS
C1354	290-0973-00	B282860		CAP.,FXD,ELCTLT:47UF,20%,20V	05397	T368C476M020AZ
C1358	290-0194-00	B260000	B282859	CAP.,FXD,ELCTLT:10UF,+50-10%,100V	56289	30D106F100C9
C1358	290-0975-00	B282860		CAP.,FXD,ELCTLT:10UF,+50-10%,100V	56289	30D106F100C9
C1360	290-0716-00	B260000	B282859	CAP.,FXD,ELCTLT:8.2UF,20%,75V	05397	T11C825M075AS
C1360	290-0975-00	B282860		CAP.,FXD,ELCTLT:8.2UF,20%,75V	05397	T11C825M075AS
C1362	290-0194-00	B260000	B282859	CAP.,FXD,ELCTLT:10UF,+50-10%,100V	56289	30D106F100C9
C1362	290-0975-00	B282860		CAP.,FXD,ELCTLT:10UF,+50-10%,100V	56289	30D106F100C9
C1364	290-0716-00	B260000	B282859	CAP.,FXD,ELCTLT:8.2UF,20%,75V	05397	T11C825M075AS
C1364	290-0975-00	B282860		CAP.,FXD,ELCTLT:8.2UF,20%,75V	05397	T11C825M075AS
C1371	290-0580-00			CAP.,FXD,ELCTLT:0.27UF,20%,50V	56289	196D274X0050HA1
C1392	283-0057-00			CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	2C20Z5U104Z200B
C1395	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C1397	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C1413	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	59660	0801 547X5F0102M
C1416	283-0084-00			CAP.,FXD,CER DI:270PF,5%,1000V	59660	838 533X5F0 2715
C1436	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	59660	0801 547X5F0102M
C1441	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	59660	0801 547X5F0102M
C1451	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	59660	0801 547X5F0102M
C1463	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	59660	0801 547X5F0102M
C1481	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	59660	0801 547X5F0102M
C1495	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	59660	0801 547X5F0102M
C1506	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	59660	0801 547X5F0102M
C1511	290-0572-00			CAP.,FXD,ELCTLT:0.1UF,20%,50V	56289	196D104X0050HA1
C1518	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	59660	0801 547X5F0102M
C1524	283-0068-00	B281330		CAP.,FXD,CER DI:0.01UF,+100-0%,500V	59660	871-533E103P
C1533	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	59660	0801 547X5F0102M
C1571	283-0128-00			CAP.,FXD,CER DI:100PF,5%,500V	59660	871-536T2H101J

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Ckt No.	Tektronix Part No.	Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont			
C1605	283-0006-00			CAP.,FXD,CER DI:0.02UF,+80-20%,500V	59660	0841545Z5V00203Z
C1606	283-0105-00			CAP.,FXD,CER DI:0.01UF,+80-20%,2000V	60705	564CBA202IP203ZA
C1607	283-0105-00			CAP.,FXD,CER DI:0.01UF,+80-20%,2000V	60705	564CBA202IP203ZA
C1608	283-0272-00			CAP.,FXD,CER DI:0.0068UF,30%,4000V	59660	3888 510 Y5S0682
C1609	283-0272-00			CAP.,FXD,CER DI:0.0068UF,30%,4000V	59660	3888 510 Y5S0682
C1612	283-0272-00			CAP.,FXD,CER DI:0.0068UF,30%,4000V	59660	3888 510 Y5S0682
C1629	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C1634	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C1635	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C1637	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C1642	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5S0102M
C1653	283-0079-00			CAP.,FXD,CER DI:0.01UF,20%,250V	59660	8151B202Y5S0103M
C1654	283-0279-00			CAP.,FXD,CER DI:0.001UF,20%,3000V	59660	878-530 Y5S0102M
C1656	283-0279-00			CAP.,FXD,CER DI:0.001UF,20%,3000V	59660	878-530 Y5S0102M
C1657	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	59660	0801 547X5F0102M
C1659	283-0279-00			CAP.,FXD,CER DI:0.001UF,20%,3000V	59660	878-530 Y5S0102M
C1676	283-0092-00			CAP.,FXD,CER DI:0.03UF,+80-20%,200V	59660	845-534Z5U0303Z
C1678	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5S0102M
C1680	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5S0102M
C1681	283-0104-00			CAP.,FXD,CER DI:2000PF,5%,500V	59660	811-565B202J
C1716	283-0272-00			CAP.,FXD,CER DI:0.0068UF,30%,4000V	59660	3888 510 Y5S0682
C1727	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C1729	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C1733	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C1736	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C1762	283-0001-00			CAP.,FXD,CER DI:0.005UF,+100-0%,500V	59821	2DDH61L502P
C1765	283-0001-00			CAP.,FXD,CER DI:0.005UF,+100-0%,500V	59821	2DDH61L502P
C1770	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C1778	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5S0102M
C1805	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C1820	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C1829	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C1841	281-0550-00			CAP.,FXD,CER DI:120PF,10%,500V	04222	7001-1373
C1842	281-0118-00			CAP.,VAR,MICA D:8-90PF,175V	52769	GSM231
C1844	281-0637-00			CAP.,FXD,CER DI:91PF,5%,500V	72982	301000Z5D910J
C1846	281-0118-00			CAP.,VAR,MICA D:8-90PF,175V	52769	GSM231
C1850	283-0211-00			CAP.,FXD,CER DI:0.1UF,10%,200V	04222	SR06C104KAA
C1856	290-0149-00			CAP.,FXD,ELCTLT:5UF,+75-10%,150V	56289	30D505G150CCAS
C1857	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C1871	281-0092-00			CAP.,VAR,CER DI:9-35PF,200V	59660	538-011 D9-35
C1873	281-0619-00			CAP.,FXD,CER DI:1.2PF,+/-0.1PF,200V	59660	374 018 C0K0129B
C1877	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C1883	281-0627-00			CAP.,FXD,CER DI:1PF,+/-0.25PF,500V	04222	77001-C0K-1R0C
C1884	283-0271-00			CAP.,FXD,CER DI:0.001UF,20%,4000V	59660	0828552Y5S0102M
C1890	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C1892	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C1893	290-0539-00	B260000	B282859	CAP.,FXD,ELCTLT:47UF,20%,20V	90201	THF476M020P1F
C1893	290-0966-00	B282860		CAP.,FXD,ELCTLT:220UF,+30-10%,25V	55680	TLB1E221TAAANA
C1894	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C1895	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C1896	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C1897	290-0539-00	B260000	B282859	CAP.,FXD,ELCTLT:47UF,20%,20V	90201	THF476M020P1F
C1897	290-0966-00	B282860		CAP.,FXD,ELCTLT:220UF,+30-10%,25V	55680	TLB1E221TAAANA
C1898	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z

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C1899	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C2101	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C2109	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C2112	283-0077-00			CAP.,FXD,CER DI:330PF,5%,500V	59660	831-500B331J
C2115	290-0534-00	B260000	B281839	CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C2115	290-0782-00	B281840		CAP.,FXD,ELCTLT:4.7UF,+75-10%,35V	55680	ULA1V4R7TEA
C2117	290-0534-00	B260000	B281839	CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C2117	290-0782-00	B281840		CAP.,FXD,ELCTLT:4.7UF,+75-10%,35V	55680	ULA1V4R7TEA
C2119	290-0534-00	B260000	B281839	CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C2119	290-0782-00	B281840		CAP.,FXD,ELCTLT:4.7UF,+75-10%,35V	55680	ULA1V4R7TEA
C2121	283-0594-00			CAP.,FXD,MICA D:0.001UF,1%,100V	00853	D151F102F0
C2135	285-0698-00			CAP.,FXD,PLSTC:0.0082UF,5%,100V	84411	TEK44-82251
C2140	283-0103-00			CAP.,FXD,CER DI:180PF,5%,500V	59660	831-518-Z5D0181J
C2144	281-0544-00	B260000	B281839	CAP.,FXD,CER DI:5.6PF,10%,500V	04222	7001-COH-5R6D
C2144	281-0810-00	B281840		CAP.,FXD,CER DI:5.6PF,0.5%,100V	04222	GC10-1A5R6D
C2145	290-0534-00	B260000	B281839	CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C2145	290-0782-00	B281840		CAP.,FXD,ELCTLT:4.7UF,+75-10%,35V	55680	ULA1V4R7TEA
C2155	283-0103-00			CAP.,FXD,CER DI:180PF,5%,500V	59660	831-518-Z5D0181J
C2183	283-0032-00			CAP.,FXD,CER DI:470PF,5%,500V	59660	0831085Z5E00471J
C2185	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C2214	283-0032-00			CAP.,FXD,CER DI:470PF,5%,500V	59660	0831085Z5E00471J
C2242	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C2244	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C2255	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C2281	283-0054-00			CAP.,FXD,CER DI:150PF,5%,200V	59660	855-535U2J0 151J
C2284	283-0251-00	B282695		CAP.,FXD,CER DI:87 PF,5%,100V	72982	8121B145C0G0870J
C4605	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C4610	283-0114-00			CAP.,FXD,CER DI:0.0015UF,5%,200V	59660	805534Y5DO152J
C4611	283-0268-00			CAP.,FXD,CER DI:0.015UF,10%,50V	56289	1C20X7R153K050B
C4613	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C4615	281-0615-00			CAP.,FXD,CER DI:3.9PF,+/-0.5PF,200V	59660	374018C0J0399D
C4665	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C4673	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C4677	283-0114-00			CAP.,FXD,CER DI:0.0015UF,5%,200V	59660	805534Y5DO152J
C4678	283-0268-00			CAP.,FXD,CER DI:0.015UF,10%,50V	56289	1C20X7R153K050B
C4874	281-0219-00	B260000	B280908	CAP.,VAR,CER DI:5-35PF,+2-2.5%,100V	59660	0513-501 A 5.035
C4874	281-0158-00	B280909		CAP.,VAR,CER DI:7-45PF,50V	73899	DVJ-5006
C4876	283-0080-00			CAP.,FXD,CER DI:0.022UF,+80-20%,25V	59821	2DDU60E223Z
C4882	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C4886	283-0604-00			CAP.,FXD,MICA D:304PF,2%,300V	00853	D155F3040G0
C4896	283-0604-00			CAP.,FXD,MICA D:304PF,2%,300V	00853	D155F3040G0
C4908	283-0647-00			CAP.,FXD,MICA D:70PF,1%,100V	00853	D155E700F0
C4909	281-0166-00			CAP.,VAR,AIR DI:1.9-15.7PF,250V	74970	187-0109-055
C4918	283-0647-00			CAP.,FXD,MICA D:70PF,1%,100V	00853	D155E700F0
C4919	281-0166-00			CAP.,VAR,AIR DI:1.9-15.7PF,250V	74970	187-0109-055
C4920	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C4933	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C4935	281-0659-00			CAP.,FXD,CER DI:4.3PF,+/-0.25PF,500V	59660	301-000C0H0439C
C4937	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C4941	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C4950	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C4953	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C4955	281-0659-00			CAP.,FXD,CER DI:4.3PF,+/-0.25PF,500V	59660	301-000C0H0439C
C4957	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z

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C4990	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C4992	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C4994	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L
C4996	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L
C5508	-----			(PART OF CIRCUIT BOARD)		
C5511	283-0158-00	B268530		CAP.,FXD,CER DI:1PF,10%,50V	51642	100-050-NP0-109B
C5514	-----			(PART OF CIRCUIT BOARD)		
C5516	281-0772-00			CAP.,FXD,CER DI:0.0047UF,10%,100V	04222	GC701C472K
C5528	-----			(PART OF CIRCUIT BOARD)		
C5531	283-0158-00	B268530		CAP.,FXD,CER DI:1PF,10%,50V	51642	100-050-NP0-109B
C5534	-----			(PART OF CIRCUIT BOARD)		
C5536	281-0772-00			CAP.,FXD,CER DI:0.0047UF,10%,100V	04222	GC701C472K
C5540	283-0158-00	B268530		CAP.,FXD,CER DI:1PF,10%,50V	51642	100-050-NP0-109B
C5553	281-0617-00	B260000	B268529	CAP.,FXD,CER DI:15PF,10%,200V	59660	374-018-C0G0150K
C5553	281-0797-00	B268530		CAP.,FXD,CER DI:15PF,10%,100V	72982	8035D9AADC0G150K
C5553	-----			(NOMINAL VALUE,SELECTED)		
C5567	281-0772-00			CAP.,FXD,CER DI:0.0047UF,10%,100V	04222	GC701C472K
C5567	-----			(NOMINAL VALUE,SELECTED)		
C5569	281-0772-00	B268530		CAP.,FXD,CER DI:0.0047UF,10%,100V	04222	GC701C472K
C5594	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C5596	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C5608	-----			(PART OF CIRCUIT BOARD)		
C5611	283-0158-00	B268530		CAP.,FXD,CER DI:1PF,10%,50V	51642	100-050-NP0-109B
C5614	-----			(PART OF CIRCUIT BOARD)		
C5615	281-0772-00			CAP.,FXD,CER DI:0.0047UF,10%,100V	04222	GC701C472K
C5616	281-0772-00			CAP.,FXD,CER DI:0.0047UF,10%,100V	04222	GC701C472K
C5628	-----			(PART OF CIRCUIT BOARD)		
C5631	283-0158-00	B268530		CAP.,FXD,CER DI:1PF,10%,50V	51642	100-050-NP0-109B
C5634	-----			(PART OF CIRCUIT BOARD)		
C5636	281-0772-00			CAP.,FXD,CER DI:0.0047UF,10%,100V	04222	GC701C472K
C5640	283-0158-00	B268530		CAP.,FXD,CER DI:1PF,10%,50V	51642	100-050-NP0-109B
C5653	281-0650-00	B260000	B268529	CAP.,FXD,CER DI:18PF,10%,200V	59660	374-018-C0G0180K
C5653	281-0797-00	B268530		CAP.,FXD,CER DI:15PF,10%,100V	72982	8035D9AADC0G150K
C5663	281-0772-00			CAP.,FXD,CER DI:0.0047UF,10%,100V	04222	GC701C472K
C5667	281-0772-00			CAP.,FXD,CER DI:0.0047UF,10%,100V	04222	GC701C472K
C5669	281-0772-00	B268530		CAP.,FXD,CER DI:0.0047UF,10%,100V	04222	GC701C472K
C5680	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C5688	281-0772-00			CAP.,FXD,CER DI:0.0047UF,10%,100V	04222	GC701C472K
C5690	281-0621-00	B260000	B268529	CAP.,FXD,CER DI:12PF,1%,500V	59660	301-000C0G0120F
C5690	281-0547-00	B268530		CAP.,FXD,CER DI:2.7PF,10%,500V	04222	7001-COJ-2R7C
C5694	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C5696	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
CR20	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR23	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR27	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR28	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR29	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR34	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR40	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR121	152-0423-00			SEMICONV DEVICE:SILICON,400V,3A	04713	1N5000
CR122	152-0423-00			SEMICONV DEVICE:SILICON,400V,3A	04713	1N5000
CR201	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR202	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R

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Ckt No.	Tektronix	Serial/Model No.		Name & Description	Mfr	Mfr Part Number
	Part No.	Eff	Dscont		Code	
CR203	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR204	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR239	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR240	152-0153-00			SEMICONV DEVICE:SILICON,15V,50MA	07263	FD7003
CR241	152-0153-00			SEMICONV DEVICE:SILICON,15V,50MA	07263	FD7003
CR248	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR250	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR251	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR253	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR254	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR264	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR265	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR304	152-0141-02	B268105		SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR314	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR343	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR346	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR349	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR350	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR360	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR365	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR420	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR421	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR422	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR426	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR440	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR442	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR447	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR454	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR456	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR457	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR458	152-0075-00			SEMICONV DEVICE:GE,25V,40MA	14433	G866
CR460	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR461	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR465	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR474	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR479	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR486	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR489	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR491	152-0075-00			SEMICONV DEVICE:GE,25V,40MA	14433	G866
CR493	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR494	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR495	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR503	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR801	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR801	-----			(CR801 OPTION 2 ONLY)		
CR811	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR811	-----			(CR811 OPTION 2 ONLY)		
CR1056	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1057	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1081	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1086	152-0153-00	B260000	B268064	SEMICONV DEVICE:SILICON,15V,50MA	07263	FD7003
CR1086	152-0322-00	B268065		SEMICONV DEVICE:SILICON,15V,HOT CARRIER	50434	5082-2672
CR1087	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1116	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R

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		Eff	Dscont			
CR1129	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1215	152-0396-01			SEMICONV DEVICE:SILICON,400V,3A	12969	652-821
CR1232	152-0107-00			SEMICONV DEVICE:SILICON,400V,400MA	12969	G727
CR1234	152-0400-00			SEMICONV DEVICE:SILICON,400V,1A	80009	152-0400-00
CR1238	152-0401-00	B260000	B268784	SEMICONV DEVICE:SILICON,3-LAYER,TRIGGER	04713	SPT32K
CR1240	152-0107-00			SEMICONV DEVICE:SILICON,400V,400MA	12969	G727
CR1241	152-0400-00			SEMICONV DEVICE:SILICON,400V,1A	80009	152-0400-00
CR1242	152-0107-00			SEMICONV DEVICE:SILICON,400V,400MA	12969	G727
CR1243	152-0400-00	B281651		SEMICONV DEVICE:SILICON,400V,1A	80009	152-0400-00
CR1244	152-0107-00			SEMICONV DEVICE:SILICON,400V,400MA	12969	G727
CR1245	152-0400-00	B281651		SEMICONV DEVICE:SILICON,400V,1A	80009	152-0400-00
CR1249	152-0061-00			SEMICONV DEVICE:SILICON,175V,100MA	07263	FDH2161
CR1251	152-0061-00	B260000	B281169	SEMICONV DEVICE:SILICON,175V,100MA	07263	FDH2161
CR1252	152-0061-00	B260000	B281169	SEMICONV DEVICE:SILICON,175V,100MA	07263	FDH2161
CR1253	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1256	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1259	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1280	152-0333-00	B260000	B281169	SEMICONV DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR1281	152-0333-00	B260000	B281169	SEMICONV DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR1282	152-0333-00	B260000	B281169	SEMICONV DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR1283	152-0333-00	B260000	B281169	SEMICONV DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR1288	152-0333-00	B260000	B281169	SEMICONV DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR1289	152-0333-00	B260000	B281169	SEMICONV DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR1290	152-0333-00	B260000	B281169	SEMICONV DEVICE:SILICON,55V,200MA	07263	FDH-6012
CR1294	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1306	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1310	152-0397-00			SEMICONV DEVICE:SILICON,50V,12A	80009	152-0397-00
CR1311	152-0502-00	B260000	B268949	SEMICONV DEVICE:SILICON,20V,5A	04713	1N5823
CR1311	152-0686-00	B268950		SEMICONV DEVICE:RECT,Si,100V,5A	04713	SR3273
CR1312	152-0502-00	B260000	B268949	SEMICONV DEVICE:SILICON,20V,5A	04713	1N5823
CR1312	152-0686-00	B268950		SEMICONV DEVICE:RECT,Si,100V,5A	04713	SR3273
CR1313	152-0397-00			SEMICONV DEVICE:SILICON,50V,12A	80009	152-0397-00
CR1320	152-0400-00	B260000	B281169	SEMICONV DEVICE:SILICON,400V,1A	80009	152-0400-00
CR1321	152-0400-00	B260000	B281169	SEMICONV DEVICE:SILICON,400V,1A	80009	152-0400-00
CR1322	152-0400-00			SEMICONV DEVICE:SILICON,400V,1A	80009	152-0400-00
CR1323	152-0400-00			SEMICONV DEVICE:SILICON,400V,1A	80009	152-0400-00
CR1325	152-0061-00	B260000	B281169	SEMICONV DEVICE:SILICON,175V,100MA	07263	FDH2161
CR1326	152-0061-00	B260000	B281169	SEMICONV DEVICE:SILICON,175V,100MA	07263	FDH2161
CR1340	152-0413-00			SEMICONV DEVICE:SILICON,400V,750MA	12969	UTR307
CR1341	152-0413-00			SEMICONV DEVICE:SILICON,400V,750MA	12969	UTR307
CR1342	152-0413-00			SEMICONV DEVICE:SILICON,400V,750MA	12969	UTR307
CR1343	152-0413-00			SEMICONV DEVICE:SILICON,400V,750MA	12969	UTR307
CR1345	152-0397-00			SEMICONV DEVICE:SILICON,50V,12A	80009	152-0397-00
CR1346	152-0397-00			SEMICONV DEVICE:SILICON,50V,12A	80009	152-0397-00
CR1347	152-0397-00			SEMICONV DEVICE:SILICON,50V,12A	80009	152-0397-00
CR1348	152-0397-00			SEMICONV DEVICE:SILICON,50V,12A	80009	152-0397-00
CR1376	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1378	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1402	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1410	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1429	152-0066-01			SEMICONV DEVICE:SILICON,400V,1A	15238	LG4012
CR1431	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1439	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1445	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R

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Ckt No.	Tektronix	Serial/Model No.		Name & Description	Mfr	Mfr Part Number
	Part No.	Eff	Dscont		Code	
CR1459	152-0066-01			SEMICONV DEVICE:SILICON,400V,1A	15238	LG4012
CR1468	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1469	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1482	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1483	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1489	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1499	152-0066-01			SEMICONV DEVICE:SILICON,400V,1A	15238	LG4012
CR1502	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1503	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1506	152-0233-00			SEMICONV DEVICE:SILICON,85V,100MA	07263	FDH1986
CR1510	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1520	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1521	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1523	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1539	152-0066-01			SEMICONV DEVICE:SILICON,400V,1A	15238	LG4012
CR1543	152-0075-00			SEMICONV DEVICE:GE,25V,40MA	14433	G866
CR1549	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1576	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1589	152-0066-01			SEMICONV DEVICE:SILICON,400V,1A	15238	LG4012
CR1607	152-0409-00			SEMICONV DEVICE:SILICON,12,000V,5MA	83003	VG12X-1
CR1608	152-0409-00			SEMICONV DEVICE:SILICON,12,000V,5MA	83003	VG12X-1
CR1625	152-0066-01	B260000	B281169	SEMICONV DEVICE:SILICON,400V,1A	15238	LG4012
CR1632	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1635	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1638	152-0242-00			SEMICONV DEVICE:SILICON,225V,200MA	07263	FDH5004
CR1639	152-0242-00			SEMICONV DEVICE:SILICON,225V,200MA	07263	FDH5004
CR1653	152-0242-00			SEMICONV DEVICE:SILICON,225V,200MA	07263	FDH5004
CR1655	152-0242-00			SEMICONV DEVICE:SILICON,225V,200MA	07263	FDH5004
CR1656	152-0242-00			SEMICONV DEVICE:SILICON,225V,200MA	07263	FDH5004
CR1658	152-0242-00			SEMICONV DEVICE:SILICON,225V,200MA	07263	FDH5004
CR1676	152-0242-00			SEMICONV DEVICE:SILICON,225V,200MA	07263	FDH5004
CR1679	152-0242-00			SEMICONV DEVICE:SILICON,225V,200MA	07263	FDH5004
CR1680	152-0242-00			SEMICONV DEVICE:SILICON,225V,200MA	07263	FDH5004
CR1682	152-0242-00			SEMICONV DEVICE:SILICON,225V,200MA	07263	FDH5004
CR1701	152-0242-00			SEMICONV DEVICE:SILICON,225V,200MA	07263	FDH5004
CR1741	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1742	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1744	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1745	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1747	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1748	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1753	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1754	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1764	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1768	152-0066-01			SEMICONV DEVICE:SILICON,400V,1A	15238	LG4012
CR1771	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1822	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1828	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1844	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1845	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1855	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1858	152-0233-00			SEMICONV DEVICE:SILICON,85V,100MA	07263	FDH1986
CR1872	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2124	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R

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	Part No.	Eff	Dscont		Code	
CR2125	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2127	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2140	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2141	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2142	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2145	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2146	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2156	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2157	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2162	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2163	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2166	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2167	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2170	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2171	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2174	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2175	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2192	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2193	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2196	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2198	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2226	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2235	152-0333-00			SEMICONV DEVICE:SILICON,55V,200MA	07263	FDH-6012
THRU						
CR2266						
CR4653	152-0075-00			SEMICONV DEVICE:GE,25V,40MA	14433	G866
CR4654	152-0075-00			SEMICONV DEVICE:GE,25V,40MA	14433	G866
CR4905	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR4915	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR4921	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR4922	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR4923	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR4924	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR5569	152-0321-00	B268530		SEMICONV DEVICE:SILICON,30V,0.1A	07263	FSA1480
CR5572	152-0107-00			SEMICONV DEVICE:SILICON,400V,400MA	12969	G727
CR5574	152-0107-00			SEMICONV DEVICE:SILICON,400V,400MA	12969	G727
CR5669	152-0321-00	B268530		SEMICONV DEVICE:SILICON,30V,0.1A	07263	FSA1480
CR5672	152-0107-00			SEMICONV DEVICE:SILICON,400V,400MA	12969	G727
CR5674	152-0107-00			SEMICONV DEVICE:SILICON,400V,400MA	12969	G727
CR5682	152-0141-02	B268530		SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
CR5684	152-0141-02	B260000	B268529	SEMICONV DEVICE:SILICON,30V,150MA	01295	1N4152R
DL650	119-0318-00			DELAY LINE,ELEC:60NS,100 OHM	80009	119-0318-00
DS100	150-0057-00			LAMP,INCAND:5V,0.115A	92966	7153AS15
DS102	150-0057-00			LAMP,INCAND:5V,0.115A	92966	7153AS15
DS104	150-0057-00			LAMP,INCAND:5V,0.115A	92966	7153AS15
DS106	150-0057-00			LAMP,INCAND:5V,0.115A	92966	7153AS15
DS108	150-0057-00			LAMP,INCAND:5V,0.115A	92966	7153AS15
DS110	150-0057-01			LAMP,INCAND:5V,0.115A,WIRE LD,SEL	76854	17AS15
DS112	150-0057-01			LAMP,INCAND:5V,0.115A,WIRE LD,SEL	76854	17AS15
DS114	150-0057-01			LAMP,INCAND:5V,0.115A,WIRE LD,SEL	76854	17AS15
DS116	150-0057-01			LAMP,INCAND:5V,0.115A,WIRE LD,SEL	76854	17AS15
DS120	150-0048-01			LAMP,INCAND:5V,0.06A,SEL	58854	683AS15

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		Eff	Dscont			
DS122	150-0048-01			LAMP,INCAND:5V,0.06A,SEL	58854	683AS15
DS452	150-0048-01			LAMP,INCAND:5V,0.06A,SEL	58854	683AS15
DS466	150-0048-01			LAMP,INCAND:5V,0.06A,SEL	58854	683AS15
DS469	150-0048-01			LAMP,INCAND:5V,0.06A,SEL	58854	683AS15
DS497	150-0048-01			LAMP,INCAND:5V,0.06A,SEL	58854	683AS15
DS505	150-0048-01			LAMP,INCAND:5V,0.06A,SEL	58854	683AS15
DS507	150-0048-01			LAMP,INCAND:5V,0.06A,SEL	58854	683AS15
DS1208	119-0181-00			ARSR,ELEC SURGE:230V,GAS FILLED	74276	CG230L
DS1213	119-0181-00			ARSR,ELEC SURGE:230V,GAS FILLED	74276	CG230L
DS1219	150-0035-00			LAMP,GLOW:90V,0.3MA,AID-T,WIRE LD	000LI	JH005/3011JA
DS1552	150-0029-00	B260000	B282092	LAMP,INCAND:6.3V,0.20A	08806	349
DS1552	150-0097-00	B282093		LAMP,INCAND:6.3V,0.2A	08806	7381
DS1553	150-0029-00	B260000	B282092	LAMP,INCAND:6.3V,0.20A	08806	349
DS1553	150-0097-00	B282093		LAMP,INCAND:6.3V,0.2A	08806	7381
DS1554	150-0029-00	B260000	B282092	LAMP,INCAND:6.3V,0.20A	08806	349
DS1554	150-0097-00	B282093		LAMP,INCAND:6.3V,0.2A	08806	7381
DS1687	150-0035-00			LAMP,GLOW:90V,0.3MA,AID-T,WIRE LD	000LI	JH005/3011JA
DS1688	150-0035-00			LAMP,GLOW:90V,0.3MA,AID-T,WIRE LD	000LI	JH005/3011JA
DS1718	150-0030-00			LAMP,GLOW:NEON,T-2.60 TO 90 VOLTS	74276	NE2V-T
DS1719	150-0030-00			LAMP,GLOW:NEON,T-2.60 TO 90 VOLTS	74276	NE2V-T
E5679	276-0507-00	B268530		SHIELDING BEAD,:FERRITE	78488	57-3443
F1200	159-0017-00			FUSE,CARTRIDGE:3AG,4A,250V,FAST BLOW	71400	MTH4
F1201	159-0082-00	B260000	B279999	FUSE,CARTRIDGE:1AG,15A,32V,FAST BLOW	71400	GKN15
F1223	159-0021-00			FUSE,CARTRIDGE:3AG,2A,250V,FAST-BLOW	71400	AGC 2
FL1200	119-0420-01	B280000		FILTER,RFI:6A,250VAC,48-440 HZ	02777	F12034-6
K802	148-0034-00			RELAY,ARMATURE:DPDT,15VDC,600 OHM	80009	148-0034-00
K802	-----			(K802 OPTION 2 ONLY)		
K805	148-0034-00			RELAY,ARMATURE:DPDT,15VDC,600 OHM	80009	148-0034-00
K805	-----			(K805 OPTION 2 ONLY)		
K812	148-0034-00			RELAY,ARMATURE:DPDT,15VDC,600 OHM	80009	148-0034-00
K812	-----			(K812 OPTION 2 ONLY)		
K815	148-0034-00			RELAY,ARMATURE:DPDT,15VDC,600 OHM	80009	148-0034-00
K815	-----			(K815 OPTION 2 ONLY)		
L216	108-0245-00			COIL,RF:3.9UH	76493	B6310-1
L224	108-0245-00			COIL,RF:3.9UH	76493	B6310-1
L228	108-0245-00			COIL,RF:3.9UH	76493	B6310-1
L390	108-0245-00			COIL,RF:3.9UH	76493	B6310-1
L393	108-0245-00			COIL,RF:3.9UH	76493	B6310-1
L394	108-0245-00			COIL,RF:3.9UH	76493	B6310-1
L396	108-0245-00			COIL,RF:3.9UH	76493	B6310-1
L657	195-8673-00	B282478		LEAD,ELECTRICAL:0.0203 DIA,1.625 L,BARE	80009	195-8673-00
L659	195-8673-00	B282478		LEAD,ELECTRICAL:0.0203 DIA,1.625 L,BARE	80009	195-8673-00
L660	108-0369-00			COIL,RF:0.12UH	80009	108-0369-00
L661	108-0369-00			COIL,RF:0.12UH	80009	108-0369-00
L667	114-0222-00			COIL,RF:2-6UH,CORE 276-0568-00	80009	114-0222-00
L730	195-8673-00	B282478		LEAD,ELECTRICAL:0.0203 DIA,1.625 L,BARE	80009	195-8673-00
L731	195-8673-00	B282478		LEAD,ELECTRICAL:0.0203 DIA,1.625 L,BARE	80009	195-8673-00
L802	108-0719-00			COIL,RF:805NH	80009	108-0719-00
L802	-----			(L802 OPTION 2 ONLY)		
L805	108-0719-00			COIL,RF:805NH	80009	108-0719-00
L805	-----			(L805 OPTION 2 ONLY)		

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Ckt No.	Tektronix	Serial/Model No.		Name & Description	Mfr	Mfr Part Number
	Part No.	Eff	Dscont		Code	
L806	108-0718-00			COIL,RF:1.75UH	80009	108-0718-00
L806	-----			(L806 OPTION 2 ONLY)		
L807	108-0719-00			COIL,RF:805NH	80009	108-0719-00
L807	-----			(L807 OPTION 2 ONLY)		
L808	108-0719-00			COIL,RF:805NH	80009	108-0719-00
L808	-----			(L808 OPTION 2 ONLY)		
L809	108-0718-00			COIL,RF:1.75UH	80009	108-0718-00
L809	-----			(L809 OPTION 2 ONLY)		
L812	108-0719-00			COIL,RF:805NH	80009	108-0719-00
L812	-----			(L812 OPTION 2 ONLY)		
L815	108-0719-00			COIL,RF:805NH	80009	108-0719-00
L815	-----			(L815 OPTION 2 ONLY)		
L816	108-0718-00			COIL,RF:1.75UH	80009	108-0718-00
L816	-----			(L816 OPTION 2 ONLY)		
L817	108-0719-00			COIL,RF:805NH	80009	108-0719-00
L817	-----			(L817 OPTION 2 ONLY)		
L818	108-0719-00			COIL,RF:805NH	80009	108-0719-00
L818	-----			(L818 OPTION 2 ONLY)		
L819	108-0718-00			COIL,RF:1.75UH	80009	108-0718-00
L819	-----			(L819 OPTION 2 ONLY)		
L1201	108-0686-00	B260000	B279999	COIL,RF:116UH	80009	108-0686-00
L1203	108-0686-00	B260000	B279999	COIL,RF:116UH	80009	108-0686-00
L1229	108-0681-00			COIL,RF:140UH	80009	108-0681-00
L1237	108-0678-00			COIL,RF:1MH	80009	108-0678-00
L1313	108-0679-00			COIL,RF:12UH	80009	108-0679-00
L1316	108-0679-00			COIL,RF:12UH	80009	108-0679-00
L1318	108-0554-00			COIL,RF:5UH	80009	108-0554-00
L1329	108-0646-00			COIL,RF:80UH	80009	108-0646-00
L1352	108-0680-00			COIL,RF:27UH	80009	108-0680-00
L1355	108-0680-00			COIL,RF:27UH	80009	108-0680-00
L1359	108-0646-00			COIL,RF:80UH	80009	108-0646-00
L1363	108-0646-00			COIL,RF:80UH	80009	108-0646-00
L1725	108-0544-00			COIL,TUBE DEFLE:TRACE ROTATOR	80009	108-0544-00
L1730	108-0605-00			COIL,TUBE DEFLE:Y AXIS ALIGNMENT	80009	108-0605-00
L2283	108-0331-00			COIL,RF:0.75UH	80009	108-0331-00
L4915	276-0507-00			SHIELDING BEAD,:FERRITE	78488	57-3443
L4994	108-0245-00			COIL,RF:3.9UH	76493	B6310-1
L4996	108-0245-00			COIL,RF:3.9UH	76493	B6310-1
L5565	108-0474-00	B260000	B268529	COIL,RF:2UH	80009	108-0474-00
L5565	108-0409-00	B268530		COIL,RF:17.5UH	80009	108-0409-00
L5567	108-0474-00	B260000	B268529	COIL,RF:2UH	80009	108-0474-00
L5567	108-0409-00	B268530		COIL,RF:17.5UH	80009	108-0409-00
L5665	108-0474-00	B260000	B268529	COIL,RF:2UH	80009	108-0474-00
L5665	108-0409-00	B268530		COIL,RF:17.5UH	80009	108-0409-00
L5667	108-0474-00	B260000	B268529	COIL,RF:2UH	80009	108-0474-00
L5667	108-0409-00	B268530		COIL,RF:17.5UH	80009	108-0409-00
L5679	276-0528-00	B260000	B268529	SHIELDING BEAD,:0.1UH	02114	56-0590-65C/3B
LR232	108-0543-00			COIL,RF:FIXED,1.1UH	80009	108-0543-00
LR268	108-0543-00			COIL,RF:FIXED,1.1UH	80009	108-0543-00
LR278	108-0543-00			COIL,RF:FIXED,1.1UH	80009	108-0543-00
LR288	108-0543-00			COIL,RF:FIXED,1.1UH	80009	108-0543-00
LR780	108-0685-00			COIL,RF:62NH	80009	108-0685-00
LR784	108-0685-00			COIL,RF:62NH	80009	108-0685-00

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Ckt No.	Tektronix	Serial/Model No.		Name & Description	Mfr	Mfr Part Number
	Part No.	Eff	Dscont		Code	
LR787	108-0330-00			COIL,RF:0.4UH	80009	108-0330-00
LR789	108-0325-00			COIL,RF:0.5UH	80009	108-0325-00
LR791	108-0325-00			COIL,RF:0.5UH	80009	108-0325-00
LR794	108-0325-00			COIL,RF:0.5UH	80009	108-0325-00
LR796	108-0325-00			COIL,RF:0.5UH	80009	108-0325-00
LR798	108-0325-00			COIL,RF:0.5UH	80009	108-0325-00
LR5502	108-0729-00			COIL,RF:195NH	80009	108-0729-00
LR5505	108-0729-00			COIL,RF:195NH	80009	108-0729-00
LR5522	108-0729-00			COIL,RF:195NH	80009	108-0729-00
LR5525	108-0729-00			COIL,RF:195NH	80009	108-0729-00
LR5602	108-0729-00			COIL,RF:195NH	80009	108-0729-00
LR5605	108-0729-00			COIL,RF:195NH	80009	108-0729-00
LR5622	108-0729-00			COIL,RF:195NH	80009	108-0729-00
LR5625	108-0729-00			COIL,RF:195NH	80009	108-0729-00
Q238	151-0198-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS8802-1
Q248	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS652	04713	SPS8801
Q260	151-0198-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS8802-1
Q272	151-0198-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS8802-1
Q275	151-0223-00			TRANSISTOR:SILICON,NPN	04713	SPS8026
Q282	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q292	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS652	04713	SPS8801
Q296	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS652	04713	SPS8801
Q312	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q342	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS652	04713	SPS8801
Q347	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS652	04713	SPS8801
Q350	151-0216-00			TRANSISTOR:SILICON,PNP	04713	SPS8803
Q352	151-1022-00			TRANSISTOR:FET,N-CHAN,SI,F1782,T0-18	17856	FN1234
Q362	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS652	04713	SPS8801
Q367	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS652	04713	SPS8801
Q428	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS652	04713	SPS8801
Q430	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS652	04713	SPS8801
Q466	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS652	04713	SPS8801
Q469	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS652	04713	SPS8801
Q472	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS652	04713	SPS8801
Q476	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS652	04713	SPS8801
Q484	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS652	04713	SPS8801
Q500	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS652	04713	SPS8801
Q506	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS652	04713	SPS8801
Q694	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q698	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q705	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q710	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q716	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q723	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q728	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q773	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q776	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q785	151-0390-00			TRANSISTOR:SILICON,NPN	04713	SPS3414
Q786	151-0126-00			TRANSISTOR:SILICON,NPN	04713	ST1046
Q1042	151-0223-00			TRANSISTOR:SILICON,NPN	04713	SPS8026
Q1046	151-0223-00			TRANSISTOR:SILICON,NPN	04713	SPS8026
Q1047	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q1069	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677

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Ckt No.	Tektronix	Serial/Model No.		Name & Description	Mfr	Mfr Part Number
	Part No.	Eff	Dscont		Code	
Q1073	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q1084	151-0271-00			TRANSISTOR:SILICON,PNP	04713	SPS8236
Q1111	151-0273-00			TRANSISTOR:SILICON,NPN	80009	151-0273-00
Q1118	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q1128	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q1135	151-0276-00			TRANSISTOR:SILICON,PNP	04713	2N5087
Q1137	151-0276-00			TRANSISTOR:SILICON,PNP	04713	2N5087
Q1140	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q1234	151-0368-00			TRANSISTOR:SILICON,NPN	80009	151-0368-00
Q1238	151-0508-00	B268785		TRANSISTOR:UJT,SI,2N6027,TO-98	03508	X13T520
Q1241	151-0368-00			TRANSISTOR:SILICON,NPN	80009	151-0368-00
Q1246	151-0260-00			TRANSISTOR:SILICON,NPN	80009	151-0260-00
Q1248	151-0529-00			SCR:200V,0.5A	04713	MCR206
Q1252	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q1254	151-0302-00	B260000	B268784	TRANSISTOR:SILICON,NPN	07263	S038487
Q1254	151-0273-00	B268785		TRANSISTOR:SILICON,NPN	80009	151-0273-00
Q1373	151-0216-00			TRANSISTOR:SILICON,PNP	04713	SPS8803
Q1409	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	07263	SP12141
Q1415	151-0292-00			TRANSISTOR:SILICON,NPN	01295	A5T5058
Q1418	151-0228-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4888	80009	151-0228-00
Q1425	151-0136-00	B260000	B267489	TRANSISTOR:SILICON,NPN	02735	35495
Q1425	151-0136-03	B267490		TRANSISTOR:SILICON,NPN,SEL	80009	151-0136-03
Q1428	151-0349-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE280	04713	SJE924
Q1436	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	07263	SP12141
Q1445	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	07263	SP12141
Q1451	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q1455	151-0260-02			TRANSISTOR:SILICON,NPN	04713	ST1149
Q1458	151-0349-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE280	04713	SJE924
Q1466	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	07263	SP12141
Q1485	151-0216-00			TRANSISTOR:SILICON,PNP	04713	SPS8803
Q1489	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	07263	SP12141
Q1496	151-0260-02			TRANSISTOR:SILICON,NPN	04713	ST1149
Q1498	151-0349-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE280	04713	SJE924
Q1508	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	07263	SP12141
Q1522	151-0228-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4888	80009	151-0228-00
Q1526	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q1534	151-0136-00	B260000	B267489	TRANSISTOR:SILICON,NPN	02735	35495
Q1534	151-0136-03	B267490		TRANSISTOR:SILICON,NPN,SEL	80009	151-0136-03
Q1538	151-0349-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE280	04713	SJE924
Q1546	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS652	04713	SPS8801
Q1550	151-0324-01			TRANSISTOR:SILICON,PNP	04713	SJE865
Q1560	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	07263	SP12141
Q1576	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	07263	SP12141
Q1582	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS652	04713	SPS8801
Q1585	151-0260-00			TRANSISTOR:SILICON,NPN	80009	151-0260-00
Q1588	151-0349-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE280	04713	SJE924
Q1627	151-0228-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4888	80009	151-0228-00
Q1631	151-0279-00			TRANSISTOR:SILICON,NPN	01295	SGC2622
Q1740	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q1744	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q1746	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q1748	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q1755	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q1757	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228

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Ckt No.	Tektronix	Serial/Model No.		Name & Description	Mfr	Mfr Part Number
	Part No.	Eff	Dscont		Code	
Q1765	151-0228-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4888	80009	151-0228-00
Q1769	151-0292-00			TRANSISTOR:SILICON,NPN	01295	A5T5058
Q1805	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q1808	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q1815	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q1824	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS652	04713	SPS8801
Q1827	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q1834	151-0271-00			TRANSISTOR:SILICON,PNP	04713	SPS8236
Q1836	151-0271-00			TRANSISTOR:SILICON,PNP	04713	SPS8236
Q1838	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q1854	151-0270-00			TRANSISTOR:SILICON,PNP	04713	OBD
Q1874	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS652	04713	SPS8801
Q1876	151-0274-00			TRANSISTOR:SILICON,NPN	80009	151-0274-00
Q2108	151-0223-00			TRANSISTOR:SILICON,NPN	04713	SPS8026
Q2112	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
Q2138	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q2153	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS652	04713	SPS8801
Q2159	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q2215	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	07263	SP12141
Q2223	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q2225	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q2229	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q2240	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q2287	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q2296	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q2299	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q4633	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q4652	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q4859	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q4883	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q4885	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q4895	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q4901	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q4905	151-0434-00			TRANSISTOR:SILICON,PNP	04713	SS7144
Q4911	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q4915	151-0442-00			TRANSISTOR:SILICON,NPN	80009	151-0442-00
Q4928	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q4929	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q4933	151-0274-00			TRANSISTOR:SILICON,NPN	80009	151-0274-00
Q4939	151-0270-00			TRANSISTOR:SILICON,PNP	04713	OBD
Q4948	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q4949	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q4953	151-0274-00			TRANSISTOR:SILICON,NPN	80009	151-0274-00
Q4959	151-0270-00			TRANSISTOR:SILICON,PNP	04713	OBD
Q5569	151-0254-00			TRANSISTOR:SILICON,NPN	03508	X38L3118
Q5669	151-0254-00			TRANSISTOR:SILICON,NPN	03508	X38L3118
Q5679	151-0434-00			TRANSISTOR:SILICON,PNP	04713	SS7144
R1	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R2	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R4	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R6	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R8	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R10	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F

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Ckt No.	Tektronix Part No.	Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont			
R12	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R14	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R16	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R19	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R20	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R22	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R23	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R27	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R31	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R32	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R34	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R36	321-0239-00			RES.,FXD,FILM:3.01K OHM,1%,0.125W	91637	MFF1816G30100F
R37	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R40	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R42	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R44	321-0204-00			RES.,FXD,FILM:1.3K OHM,1%,0.125W	91637	MFF1816G13000F
R46	321-0204-00			RES.,FXD,FILM:1.3K OHM,1%,0.125W	91637	MFF1816G13000F
R48	321-0231-00			RES.,FXD,FILM:2.49K OHM,1%,0.125W	91637	MFF1816G24900F
R50	321-0231-00			RES.,FXD,FILM:2.49K OHM,1%,0.125W	91637	MFF1816G24900F
R52	321-0204-00			RES.,FXD,FILM:1.3K OHM,1%,0.125W	91637	MFF1816G13000F
R54	321-0204-00			RES.,FXD,FILM:1.3K OHM,1%,0.125W	91637	MFF1816G13000F
R56	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R58	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R98	323-0160-00			RES.,FXD,FILM:453 OHM,1%,0.50W	75042	CECT0-4530F
R201	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R202	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R204	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R206	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R207	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R209	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R210	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R212	321-0147-00			RES.,FXD,FILM:332 OHM,1%,0.125W	91637	MFF1816G332R0F
R213	321-0239-00			RES.,FXD,FILM:3.01K OHM,1%,0.125W	91637	MFF1816G30100F
R214	315-0912-00			RES.,FXD,CMPSN:9.1K OHM,5%,0.25W	01121	CB9125
R216	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R218	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R219	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R220	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R222	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
R224	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R225	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R228	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R229	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R233	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R235	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R236	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R237	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R239	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R241	321-0328-00			RES.,FXD,FILM:25.5K OHM,1%,0.125W	91637	MFF1816G25501F
R242	321-0224-00			RES.,FXD,FILM:2.1K OHM,1%,0.125W	91637	MFF1816G21000F
R243	321-0226-00			RES.,FXD,FILM:2.21K OHM,1%,0.125W	91637	MFF1816G22100F
R245	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R246	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R248	321-0210-00			RES.,FXD,FILM:1.5K OHM,1%,0.125W	91637	MFF1816G15000F

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Ckt No.	Tektronix Part No.	Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont			
R249	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R250	315-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.25W	01121	CB3615
R260	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R261	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R263	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R265	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R266	315-0152-00	B260000	B270184	RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R266	315-0101-00	B270185		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R269	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R271	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R275	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R279	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R280	315-0751-00	B260000	B270184	RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R280	315-0101-00	B270185		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R281	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R289	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R290	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R291	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R294	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R296	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R298	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R299	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R303	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R304	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R306	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R308	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R309	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R312	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R313	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R315	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
R320	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R325	321-0205-00			RES.,FXD,FILM:1.33K OHM,1%,0.125W	91637	MFF1816G13300F
R328	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
R329	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
R331	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R331				(NOMINAL VALUE,SELECTED)		
R333	311-1195-00			RES.,VAR,NONWIR:PNL,5K X1M OHM,0.5W	01121	16M968
R335	321-0239-00			RES.,FXD,FILM:3.01K OHM,1%,0.125W	91637	MFF1816G30100F
R337	321-0239-00			RES.,FXD,FILM:3.01K OHM,1%,0.125W	91637	MFF1816G30100F
R339	311-1839-00			RES.,VAR,NONWIR:5K OHM,20%,0.50W,W/4PST SW	01121	14M083
R340	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R342	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R344	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R346	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R347	315-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	01121	CB1325
R349	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R350	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R351	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R353	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R354	311-0310-00			RES.,VAR,NONWIR:5K OHM,20%,0.50W	01121	W-7350A
R355	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R361	321-0288-00			RES.,FXD,FILM:9.76K OHM,1%,0.125W	91637	MFF1816G97600F
R364	321-0246-00			RES.,FXD,FILM:3.57K OHM,1%,0.125W	91637	MFF1816G35700F
R366	321-0288-00			RES.,FXD,FILM:9.76K OHM,1%,0.125W	91637	MFF1816G97600F

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Ckt No.	Tektronix Part No.	Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont			
R369	321-0246-00			RES.,FXD,FILM:3.57K OHM,1%,0.125W	91637	MFF1816G35700F
R372	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R396	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R401	321-0022-01			RES.,FXD,FILM:16.5 OHM,0.5%,0.125W	91637	MFF1816G16R50D
R402	321-0022-01			RES.,FXD,FILM:16.5 OHM,0.5%,0.125W	91637	MFF1816G16R50D
R403	321-0022-01			RES.,FXD,FILM:16.5 OHM,0.5%,0.125W	91637	MFF1816G16R50D
R405	321-0022-01			RES.,FXD,FILM:16.5 OHM,0.5%,0.125W	91637	MFF1816G16R50D
R406	321-0022-01			RES.,FXD,FILM:16.5 OHM,0.5%,0.125W	91637	MFF1816G16R50D
R407	321-0022-01			RES.,FXD,FILM:16.5 OHM,0.5%,0.125W	91637	MFF1816G16R50D
R409	321-0022-01			RES.,FXD,FILM:16.5 OHM,0.5%,0.125W	91637	MFF1816G16R50D
R410	321-0022-01			RES.,FXD,FILM:16.5 OHM,0.5%,0.125W	91637	MFF1816G16R50D
R411	321-0022-01			RES.,FXD,FILM:16.5 OHM,0.5%,0.125W	91637	MFF1816G16R50D
R413	321-0022-01			RES.,FXD,FILM:16.5 OHM,0.5%,0.125W	91637	MFF1816G16R50D
R414	321-0022-01			RES.,FXD,FILM:16.5 OHM,0.5%,0.125W	91637	MFF1816G16R50D
R415	321-0022-01			RES.,FXD,FILM:16.5 OHM,0.5%,0.125W	91637	MFF1816G16R50D
R424	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R426	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R428	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R430	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R432	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R434	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R436	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R438	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R439	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R445	315-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	01121	CB1325
R447	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R449	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R450	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R461	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R463	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R465	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R467	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R471	315-0433-00			RES.,FXD,CMPSN:43K OHM,5%,0.25W	01121	CB4335
R474	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R477	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R479	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R481	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R482	315-0433-00			RES.,FXD,CMPSN:43K OHM,5%,0.25W	01121	CB4335
R486	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R488	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R494	315-0112-00			RES.,FXD,CMPSN:1.1K OHM,5%,0.25W	01121	CB1125
R499	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R501	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R504	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R657	317-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.125W	01121	BB2705
R658	311-0605-00			RES.,VAR,NONWIR:TRMR,200 OHM,0.5W	73138	82-23-2
R659	317-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.125W	01121	BB2705
R660	324-0114-00			RES.,FXD,FILM:150 OHM,1%,1W	91637	MFF1226G1500F
R661	324-0114-00			RES.,FXD,FILM:150 OHM,1%,1W	91637	MFF1226G1500F
R662	321-0039-00			RES.,FXD,FILM:24.9 OHM,1%,0.125W	91637	MFF1816G24R90F
R663	321-0039-00			RES.,FXD,FILM:24.9 OHM,1%,0.125W	91637	MFF1816G24R90F
R667	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R668	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R670	317-0047-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.125W	01121	BB47G5

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Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R672	317-0047-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.125W	01121	BB47G5
R676	317-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.125W	01121	BB1015
R677	323-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.50W	91637	MFF1226G51R10F
R679	323-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.50W	91637	MFF1226G51R10F
R680	317-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.125W	01121	BB1015
R682	323-0121-00			RES.,FXD,FILM:178 OHM,1%,0.50W	75042	CECT0-1780F
R684	-----			SELECTED		
R685	315-0820-00			RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R686	315-0820-00			RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R688	-----			SELECTED		
R689	323-0121-00			RES.,FXD,FILM:178 OHM,1%,0.50W	75042	CECT0-1780F
R691	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R693	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	MFF1816G200R0F
R694	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R695	321-0058-00			RES.,FXD,FILM:39.2 OHM,1%,0.125W	91637	MFF1816G39R20F
R697	321-0058-00			RES.,FXD,FILM:39.2 OHM,1%,0.125W	91637	MFF1816G39R20F
R698	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R700	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R701	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	MFF1816G200R0F
R703	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R704	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R706	321-0237-00			RES.,FXD,FILM:2.87K OHM,1%,0.125W	91637	MFF1816G28700F
R707	311-1259-00			RES.,VAR, NONWIR:100 OHM,10%,0.50W	32997	3329P-L58-101
R708	321-0114-00			RES.,FXD,FILM:150 OHM,1%,0.125W	91637	MFF1816G150R0F
R709	321-0114-00			RES.,FXD,FILM:150 OHM,1%,0.125W	91637	MFF1816G150R0F
R711	321-0201-00			RES.,FXD,FILM:1.21K OHM,1%,0.125W	91637	MFF1816G12100F
R712	311-0532-00			RES.,VAR, WW:TRMR,1.5K OHM,1W	80294	3345P-1-152
R713	321-0201-00			RES.,FXD,FILM:1.21K OHM,1%,0.125W	91637	MFF1816G12100F
R715	321-0123-00			RES.,FXD,FILM:187 OHM,1%,0.125W	91637	MFF1816G187R0F
R717	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R718	321-0216-00			RES.,FXD,FILM:1.74K OHM,1%,0.125W	91637	MFF1816G17400F
R719	321-0191-00			RES.,FXD,FILM:953 OHM,1%,0.125W	91637	MFF1816G953R0F
R721	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R722	321-0117-00			RES.,FXD,FILM:162 OHM,1%,0.125W	91637	MFF1816G162R0F
R724	323-0147-00			RES.,FXD,FILM:332 OHM,1%,0.50W	75042	CECT0-3320F
R725	323-0147-00			RES.,FXD,FILM:332 OHM,1%,0.50W	75042	CECT0-3320F
R726	323-0090-00			RES.,FXD,FILM:84.5 OHM,1%,0.50W	75042	CECT0-84R5F
R727	321-0056-00			RES.,FXD,FILM:37.4 OHM,1%,0.125W	91637	MFF1816G37R40F
R730	311-0622-01			RES.,VAR, NONWIR:100 OHM,10%,0.50W	32997	3329H-K28-101
R731	307-0364-00			RES.,THERMAL:50 OHM,5%,0.125W	15454	DG125500J
R732	317-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.125W	01121	BB4705
R733	317-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.125W	01121	BB4705
R734	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R735	323-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.50W	91637	MFF1226G51R10F
R736	317-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.125W	01121	BB1015
R736	-----			(NOMINAL VALUE,SELECTED)		
R737	323-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.50W	91637	MFF1226G51R10F
R738	317-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.125W	01121	BB1015
R741	-----			SELECTED		
R743	311-1261-00			RES.,VAR, NONWIR:500 OHM,10%,0.50W	32997	3329P-L58-501
R745	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R747	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R749	311-0635-00			RES.,VAR, NONWIR:1K OHM,10%,0.5%,0.5W	73138	82P-6-2-102K
R751	311-1265-00			RES.,VAR, NONWIR:2K OHM,10%,0.50W	32997	3329P-L58-202

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Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R1048	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R1049	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R1057	321-0190-00			RES.,FXD,FILM:931 OHM,1%,0.125W	91637	MFF1816G931R0F
R1061	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R1062	321-0157-00			RES.,FXD,FILM:422 OHM,1%,0.125W	91637	MFF1816G422R0F
R1064	321-0157-00			RES.,FXD,FILM:422 OHM,1%,0.125W	91637	MFF1816G422R0F
R1065	321-0293-00			RES.,FXD,FILM:11K OHM,1%,0.125W	91637	MFF1816G11001F
R1067	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1069	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R1070	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R1071	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R1073	323-0143-00			RES.,FXD,FILM:301 OHM,1%,0.50W	75042	CECT0-3010F
R1075	321-0147-00			RES.,FXD,FILM:332 OHM,1%,0.125W	91637	MFF1816G332R0F
R1076	321-0302-00			RES.,FXD,FILM:13.7K OHM,1%,0.125W	91637	MFF1816G13701F
R1077	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1079	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R1081	321-0180-00			RES.,FXD,FILM:732 OHM,1%,0.125W	91637	MFF1816G732R0F
R1082	321-0226-00	B260000	B268064	RES.,FXD,FILM:2.21K OHM,1%,0.125W	91637	MFF1816G22100F
R1082	321-0228-00	B268065		RES.,FXD,FILM:2.32K OHM,1%,0.125W	91637	MFF1816G23200F
R1084	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1087	321-0190-00	B260000	B268064	RES.,FXD,FILM:931 OHM,1%,0.125W	91637	MFF1816G931R0F
R1087	321-0193-00	B268065		RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R1100	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	MFF1816G100R0F
R1101	311-1223-00			RES.,VAR, NONWIR:TRMR,250 OHM,0.5W	02111	63M251T602
R1102	308-0647-00			RES.,FXD,WW:2.7K OHM,1%,3W	91637	NS2B-66-27000F
R1104	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R1106	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R1109	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
R1112	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R1113	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R1114	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R1116	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R1117	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1120	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1121	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1122	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R1124	315-0200-00			RES.,FXD,CMPSN:20 OHM,5%,0.25W	01121	CB2005
R1125	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R1126	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R1127	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R1129	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R1132	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R1134	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R1136	321-1188-06			RES.,FXD,FILM:898 OHM,0.25%,0.125W	91637	MFF1816C898R0C
R1138	315-0112-00			RES.,FXD,CMPSN:1.1K OHM,5%,0.25W	01121	CB1125
R1140	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1142	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1144	321-0281-00			RES.,FXD,FILM:8.25K OHM,1%,0.125W	91637	MFF1816G82500F
R1145	321-0820-06			RES.,FXD,FILM:42K OHM,0.25%,0.125W	91637	MFF1816C42001C
R1146	315-0913-00			RES.,FXD,CMPSN:91K OHM,5%,0.25W	01121	CB9135
R1148	311-1214-00			RES.,VAR, NONWIR:200K OHM,20%,0.50W	73138	72-16-0
R1150	321-0766-06			RES.,FXD,FILM:4.053K OHM,0.25%,0.125W	91637	MFF1816C40530C
R1152	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R1153	321-0815-07			RES.,FXD,FILM:4.1K OHM,0.1%,0.125W	91637	MFF1816C41000B

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Ckt No.	Tektronix	Serial/Model No.		Name & Description	Mfr	Mfr Part Number
	Part No.	Eff	Dscont		Code	
R1155	321-0812-07			RES.,FXD,FILM:455 OHM,0.1%,0.125W	91637	MFF1816C455R0B
R1156	321-0811-07			RES.,FXD,FILM:56.3 OHM,0.1%,0.125W	91637	MFF1816C56R30B
R1158	321-0813-07			RES.,FXD,FILM:495 OHM,0.1%,0.125W	91637	MFF1816C495R0B
R1159	321-0810-07			RES.,FXD,FILM:55 OHM,0.1%,0.125W	91637	MFF1816C55R00B
R1161	321-0816-07			RES.,FXD,FILM:5K OHM,0.1%,0.125W	91637	MFF1816C50000B
R1162	321-1068-01			RES.,FXD,FILM:50.5 OHM,0.5%,0.125W	91637	MFF1816G50R50D
R1201	302-0271-00	B260000	B279999	RES.,FXD,CMPSN:270 OHM,10%,0.50W	01121	EB2711
R1203	302-0271-00	B260000	B279999	RES.,FXD,CMPSN:270 OHM,10%,0.50W	01121	EB2711
R1205	304-0270-00			RES.,FXD,CMPSN:27 OHM,10%,1W	01121	GB2701
R1208	304-0473-00			RES.,FXD,CMPSN:47K OHM,10%,1W	01121	GB4731
R1209	307-0350-00			RES.,THERMAL:7.5 OHM,10%,3.9%/DEG C	15454	75DJ7R5R0220SS
R1210	303-0304-00			RES.,FXD,CMPSN:300K OHM,5%,1W	01121	GB3045
R1213	304-0473-00			RES.,FXD,CMPSN:47K OHM,10%,1W	01121	GB4731
R1219	302-0565-00			RES.,FXD,CMPSN:5.6M OHM,10%,0.50W	01121	EB5651
R1221	304-0154-00			RES.,FXD,CMPSN:150K OHM,10%,1W	01121	GB1541
R1225	316-0471-00			RES.,FXD,CMPSN:27 OHM,10%,0.25W	01121	CB4711
R1231	307-0057-00			RES.,FXD,CMPSN:5.1 OHM,5%,0.50W	01121	EB51G5
R1232	316-0220-00			RES.,FXD,CMPSN:22 OHM,10%,0.25W	01121	CB2201
R1236	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R1238	315-0333-00	B268785	B269299	RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R1238	315-0332-00	B269300		RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R1239	307-0057-00			RES.,FXD,CMPSN:5.1 OHM,5%,0.50W	01121	EB51G5
R1240	316-0220-00			RES.,FXD,CMPSN:22 OHM,10%,0.25W	01121	CB2201
R1242	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R1243	316-0274-00			RES.,FXD,CMPSN:270K OHM,10%,0.25W	01121	CB2741
R1244	316-0270-00			RES.,FXD,CMPSN:27 OHM,10%,0.25W	01121	CB2701
R1245	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R1246	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R1247	316-0684-00			RES.,FXD,CMPSN:680K OHM,10%,0.25W	01121	CB6841
R1248	302-0332-00			RES.,FXD,CMPSN:3.3K OHM,10%,0.50W	01121	EB3321
R1249	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R1253	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R1256	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R1257	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R1259	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R1261	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1267	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R1269	315-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.25W	01121	CB2245
R1270	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R1271	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R1272	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R1277	315-0560-00			RES.,FXD,CMPSN:56 OHM,5%,0.25W	01121	CB5605
R1279	315-0181-00	B260000	B268904	RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R1279	315-0560-00	B268905		RES.,FXD,CMPSN:56 OHM,5%,0.25W	01121	CB5605
R1284	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R1285	321-0313-00			RES.,FXD,FILM:17.8K OHM,1%,0.125W	91637	MFF1816G17801F
R1286	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1287	321-0005-00			RES.,FXD,FILM:11 OHM,1%,0.125W	75042	CEAT0-11R0F
R1292	321-0425-00	B260000	B281169	RES.,FXD,FILM:261K OHM,1%,0.125W	91637	MFF1816G26102F
R1293	311-1226-00			RES.,VAR,NONWIR:2.5K OHM,20%,0.50W	32997	3386F-T04-252
R1294	321-0283-00			RES.,FXD,FILM:8.66K OHM,1%,0.125W	91637	MFF1816G86600F
R1296	321-0282-00			RES.,FXD,FILM:8.45K OHM,1%,0.125W	91637	MFF1816G84500F
R1297	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1300	321-0366-00			RES.,FXD,FILM:63.4K OHM,1%,0.125W	91637	MFF1816G63401F

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Ckt No.	Tektronix Part No.	Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont			
R1301	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R1302	315-0103-00	B260000	B181294	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1302	315-0512-00	B181295		RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R1304	321-0286-00	B260000	B268949	RES.,FXD,FILM:9.31K OHM,1%,0.125W	91637	MFF1816G93100F
R1304	321-0282-00	B268950		RES.,FXD,FILM:8.45K OHM,1%,0.125W	91637	MFF1816G84500F
R1305	321-0339-00			RES.,FXD,FILM:33.2K OHM,1%,0.125W	91637	MFF1816G33201F
R1326	302-0563-00	B260000	B281169	RES.,FXD,CMPSN:56K OHM,10%,0.50W	01121	EB5631
R1371	315-0304-00			RES.,FXD,CMPSN:300K OHM,5%,0.25W	01121	CB3045
R1373	315-0113-00			RES.,FXD,CMPSN:11K OHM,5%,0.25W	01121	CB1135
R1375	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R1376	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R1378	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R1392	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R1395	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R1397	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R1401	316-0471-00			RES.,FXD,CMPSN:470 OHM,10%,0.25W	01121	CB4711
R1402	316-0221-00			RES.,FXD,CMPSN:220 OHM,10%,0.25W	01121	CB2211
R1404	316-0474-00			RES.,FXD,CMPSN:470K OHM,10%,0.25W	01121	CB4741
R1406	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R1408	316-0274-00			RES.,FXD,CMPSN:270K OHM,10%,0.25W	01121	CB2741
R1412	321-0924-07			RES.,FXD,FILM:40K OHM,0.1%,0.125W	91637	MFF1816C40001B
R1413	321-0924-07			RES.,FXD,FILM:40K OHM,0.1%,0.125W	91637	MFF1816C40001B
R1415	316-0823-00			RES.,FXD,CMPSN:82K OHM,10%,0.25W	01121	CB8231
R1416	315-0272-00	B260000	B268787	RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R1416	315-0472-00	B268785		RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1418	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R1420	315-0433-00			RES.,FXD,CMPSN:43K OHM,5%,0.25W	01121	CB4335
R1421	316-0823-00			RES.,FXD,CMPSN:82K OHM,10%,0.25W	01121	CB8231
R1422	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R1424	316-0331-00			RES.,FXD,CMPSN:330 OHM,10%,0.25W	01121	CB3311
R1428	308-0679-00			RES.,FXD,WW:0.51 OHM,5%,2W	75042	BWH-R5100J
R1429	316-0471-00			RES.,FXD,CMPSN:470 OHM,10%,0.25W	01121	CB4711
R1431	316-0683-00			RES.,FXD,CMPSN:68K OHM,10%,0.25W	01121	CB6831
R1432	316-0104-00			RES.,FXD,CMPSN:100K OHM,10%,0.25W	01121	CB1041
R1434	316-0334-00			RES.,FXD,CMPSN:330K OHM,10%,0.25W	01121	CB3341
R1436	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R1437	316-0274-00			RES.,FXD,CMPSN:270K OHM,10%,0.25W	01121	CB2741
R1440	321-0924-07			RES.,FXD,FILM:40K OHM,0.1%,0.125W	91637	MFF1816C40001B
R1441	321-1296-07			RES.,FXD,FILM:12K OHM,0.1%,0.125W	91637	MFF1816C12001B
R1443	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R1444	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R1446	316-0333-00			RES.,FXD,CMPSN:33K OHM,10%,0.25W	01121	CB3331
R1448	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R1449	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1451	302-0392-00			RES.,FXD,CMPSN:3.9K OHM,10%,0.50W	01121	EB3921
R1453	316-0153-00			RES.,FXD,CMPSN:15K OHM,10%,0.25W	01121	CB1531
R1456	316-0681-00			RES.,FXD,CMPSN:680 OHM,10%,0.25W	01121	CB6811
R1457	308-0701-00			RES.,FXD,WW:0.12 OHM,5%,2W	75042	BWH-R1200J
R1459	316-0151-00			RES.,FXD,CMPSN:150 OHM,10%,0.25W	01121	CB1511
R1461	316-0182-00			RES.,FXD,CMPSN:1.8K OHM,10%,0.25W	01121	CB1821
R1463	321-1296-07			RES.,FXD,FILM:12K OHM,0.1%,0.125W	91637	MFF1816C12001B
R1464	321-0332-07			RES.,FXD,FILM:28K OHM,0.1%,0.125W	91637	MFF1816C28001B
R1467	316-0184-00			RES.,FXD,CMPSN:180K OHM,10%,0.25W	01121	CB1841
R1480	316-0124-00			RES.,FXD,CMPSN:120K OHM,10%,0.25W	01121	CB1241

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Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R1481	316-0471-00			RES.,FXD,CMPSN:470 OHM,10%,0.25W	01121	CB4711
R1485	316-0272-00			RES.,FXD,CMPSN:2.7K OHM,10%,0.25W	01121	CB2721
R1487	316-0222-00			RES.,FXD,CMPSN:2.2K OHM,10%,0.25W	01121	CB2221
R1490	302-0822-00			RES.,FXD,CMPSN:8.2K OHM,10%,0.50W	01121	EB8221
R1492	316-0273-00			RES.,FXD,CMPSN:27K OHM,10%,0.25W	01121	CB2731
R1493	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R1495	316-0222-00			RES.,FXD,CMPSN:2.2K OHM,10%,0.25W	01121	CB2221
R1497	316-0681-00			RES.,FXD,CMPSN:680 OHM,10%,0.25W	01121	CB6811
R1498	308-0701-00			RES.,FXD,WW:0.12 OHM,5%,2W	75042	BWH-R1200J
R1499	316-0471-00			RES.,FXD,CMPSN:470 OHM,10%,0.25W	01121	CB4711
R1502	316-0393-00			RES.,FXD,CMPSN:39K OHM,10%,0.25W	01121	CB3931
R1504	323-0264-00			RES.,FXD,FILM:5.49K OHM,1%,0.50W	91637	MFF1226G54900F
R1506	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R1509	316-0224-00			RES.,FXD,CMPSN:220K OHM,10%,0.25W	01121	CB2241
R1512	321-0272-00			RES.,FXD,FILM:6.65K OHM,1%,0.125W	91637	MFF1816G66500F
R1513	311-0635-00			RES.,VAR,NONWIR:1K OHM,10%,0.5%,0.5W	73138	82P-6-2-102K
R1514	321-0338-00			RES.,FXD,FILM:32.4K OHM,1%,0.125W	91637	MFF1816G32401F
R1517	316-0125-00			RES.,FXD,CMPSN:1.2M OHM,10%,0.25W	01121	CB1251
R1518	315-0471-00	B260000	B268784	RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R1518	315-0202-00	B268785		RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R1522	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R1524	316-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R1528	316-0123-00			RES.,FXD,CMPSN:12K OHM,10%,0.25W	01121	CB1231
R1529	301-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.50W	01121	EB1235
R1531	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1533	316-0222-00			RES.,FXD,CMPSN:2.2K OHM,10%,0.25W	01121	CB2221
R1535	316-0331-00			RES.,FXD,CMPSN:330 OHM,10%,0.25W	01121	CB3311
R1537	308-0703-00			RES.,FXD,WW:1.8 OHM,5%,2W	75042	BWH-1R800J
R1539	316-0471-00			RES.,FXD,CMPSN:470 OHM,10%,0.25W	01121	CB4711
R1541	311-0736-00			RES.,VAR,NONWIR:10K OHM,10%,0.25W	58756	200-YA5522
R1543	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R1544	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R1545	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R1548	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R1549	316-0221-00			RES.,FXD,CMPSN:220 OHM,10%,0.25W	01121	CB2211
R1551	308-0702-00			RES.,FXD,WW:0.33 OHM,5%,2W	75042	BWH-R3300J
R1562	316-0274-00			RES.,FXD,CMPSN:270K OHM,10%,0.25W	01121	CB2741
R1564	321-0924-07			RES.,FXD,FILM:40K OHM,0.1%,0.125W	91637	MFF1816C40001B
R1565	321-0926-07			RES.,FXD,FILM:4K OHM,0.1%,0.125W	91637	MFF1816C40000B
R1566	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
R1567	316-0273-00			RES.,FXD,CMPSN:27K OHM,10%,0.25W	01121	CB2731
R1568	316-0473-00			RES.,FXD,CMPSN:47K OHM,10%,0.25W	01121	CB4731
R1570	316-0334-00			RES.,FXD,CMPSN:330K OHM,10%,0.25W	01121	CB3341
R1571	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R1573	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R1574	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R1577	316-0223-00			RES.,FXD,CMPSN:22K OHM,10%,0.25W	01121	CB2231
R1579	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R1580	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
R1583	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R1586	316-0681-00			RES.,FXD,CMPSN:680 OHM,10%,0.25W	01121	CB6811
R1587	308-0701-00			RES.,FXD,WW:0.12 OHM,5%,2W	75042	BWH-R1200J
R1589	316-0470-00			RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701
R1591	316-0470-00			RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701

Replaceable Electrical Parts—7904 (SN B260000 & UP)

Ckt No.	Tektronix	Serial/Model No.		Name & Description	Mfr	Mfr Part Number
	Part No.	Eff	Dscont		Code	
R1603	302-0152-00	B260000	B267689	RES.,FXD,CMPSN:1.5K OHM,10%,0.50W	01121	EB1521
R1603	301-0222-00	B267690		RES.,FXD,CMPSN:2.2K OHM,5%,0.50W	01121	EB2225
R1603	-----			(NOMINAL VALUE,SELECTED)		
R1604	315-0130-00			RES.,FXD,CMPSN:13 OHM,5%,0.25W	01121	CB1305
R1605	315-0560-00			RES.,FXD,CMPSN:56 OHM,5%,0.25W	01121	CB5605
R1609	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R1611	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R1612	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R1614	302-0331-00			RES.,FXD,CMPSN:330 OHM,10%,0.50W	01121	EB3311
R1616	316-0471-00			RES.,FXD,CMPSN:470 OHM,10%,0.25W	01121	CB4711
R1618	301-0135-00			RES.,FXD,CMPSN:1.3M OHM,5%,0.50W	01121	EB1355
R1619	301-0135-00			RES.,FXD,CMPSN:1.3M OHM,5%,0.50W	01121	EB1355
R1625	302-0563-00	B260000	B281169	RES.,FXD,CMPSN:56K OHM,10%,0.50W	01121	EB5631
R1627	316-0821-00			RES.,FXD,CMPSN:820 OHM,10%,0.25W	01121	CB8211
R1629	315-0332-00	B260000	B268784	RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R1629	315-0112-00	B268785		RES.,FXD,CMPSN:1.1K OHM,5%,0.25W	01121	CB1125
R1631	316-0150-00			RES.,FXD,CMPSN:15 OHM,10%,0.25W	01121	CB1501
R1632	316-0681-00			RES.,FXD,CMPSN:680 OHM,10%,0.25W	01121	CB6811
R1633	316-0331-00			RES.,FXD,CMPSN:330 OHM,10%,0.25W	01121	CB3311
R1634	316-0392-00			RES.,FXD,CMPSN:3.9K OHM,10%,0.25W	01121	CB3921
R1635	315-0244-00			RES.,FXD,CMPSN:240K OHM,5%,0.25W	01121	CB2445
R1637	316-0474-00			RES.,FXD,CMPSN:470K OHM,10%,0.25W	01121	CB4741
R1640A,B	307-0290-01			RES.,FXD,FILM:500K OHM/29.65M OHM	80009	307-0290-01
R1642	302-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.50W	01121	EB1021
R1651	301-0225-00			RES.,FXD,CMPSN:2.2M OHM,5%,0.50W	01121	EB2255
R1652	301-0225-00			RES.,FXD,CMPSN:2.2M OHM,5%,0.50W	01121	EB2255
R1658	302-0183-00			RES.,FXD,CMPSN:18K OHM,10%,0.50W	01121	EB1831
R1659	316-0226-00			RES.,FXD,CMPSN:22M OHM,10%,0.25W	01121	CB2261
R1661	302-0104-00			RES.,FXD,CMPSN:100K OHM,10%,0.50W	01121	EB1041
R1671	301-0305-00			RES.,FXD,CMPSN:3M OHM,5%,0.50W	01121	EB3055
R1672	301-0305-00			RES.,FXD,CMPSN:3M OHM,5%,0.50W	01121	EB3055
R1674	311-0644-01			RES.,VAR,NONWIR:20K OHM,10%,0.5W	73138	82P-60-0-203
R1675	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R1682	316-0183-00			RES.,FXD,CMPSN:18K OHM,10%,0.25W	01121	CB1831
R1684	316-0226-00			RES.,FXD,CMPSN:22M OHM,10%,0.25W	01121	CB2261
R1686	316-0104-00			RES.,FXD,CMPSN:100K OHM,10%,0.25W	01121	CB1041
R1690	316-0104-00			RES.,FXD,CMPSN:100K OHM,10%,0.25W	01121	CB1041
R1700	-----			(PART OF R333)		
R1704	301-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.50W	01121	EB1055
R1705	301-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.50W	01121	EB1055
R1706	301-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.50W	01121	EB1055
R1707	301-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.50W	01121	EB1055
R1708	301-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.50W	01121	EB1055
R1709	301-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.50W	01121	EB1055
R1711	311-1720-00			RES.,VAR,NONWIR:2M OHM,20%,0.75W	11237	MODEL382(ADVISE)
R1712	301-0205-00			RES.,FXD,CMPSN:2M OHM,5%,0.50W	01121	EB2055
R1713	301-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.50W	01121	EB1055
R1714	301-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.50W	01121	EB1055
R1716	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1717	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1719	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1725	311-0443-00			RES.,VAR,NONWIR:2.5K OHM,20%,0.75W	11237	300SF-41330
R1727	311-0613-00			RES.,VAR,NONWIR:100K OHM,10%,0.50W	73138	82-27-2
R1730	311-1227-00			RES.,VAR,NONWIR:5K OHM,20%,0.50W	32997	3386F-T04-502

Replaceable Electrical Parts—7904 (SN B260000 & UP)

Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
	Part No.	Eff	Discont				
R1732	321-0271-00				RES.,FXD,FILM:6.49K OHM,1%,0.125W	91637	MFF1816G64900F
R1733	311-1862-00				RES.,VAR, NONWIR:5K OHM,10%,0.50W	73138	82-102-1
R1734	321-0310-00				RES.,FXD,FILM:16.5K OHM,1%,0.125W	91637	MFF1816G16501F
R1736	311-1099-00				RES.,VAR, NONWIR:100K OHM,0.5W	01121	WAIG04S104AZ
R1741	321-0304-00				RES.,FXD,FILM:14.3K OHM,1%,0.125W	91637	MFF1816G14301F
R1742	315-0102-00				RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1743	321-0304-00				RES.,FXD,FILM:14.3K OHM,1%,0.125W	91637	MFF1816G14301F
R1744	315-0102-00				RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1745	321-0322-00				RES.,FXD,FILM:22.1K OHM,1%,0.125W	91637	MFF1816G22101F
R1749	321-0316-00				RES.,FXD,FILM:19.1K OHM,1%,0.125W	91637	MFF1816G19101F
R1751	311-0609-00				RES.,VAR, NONWIR:2K OHM,10%,0.50W	73138	82-26-1
R1752	321-0227-00				RES.,FXD,FILM:2.26K OHM,1%,0.125W	91637	MFF1816G22600F
R1753	315-0101-00				RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1754	321-0254-00				RES.,FXD,FILM:4.32K OHM,1%,0.125W	91637	MFF1816G43200F
R1756	315-0102-00				RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1757	311-1267-00				RES.,VAR, NONWIR:5K OHM,10%,0.50W	32997	3329P-L58-502
R1758	321-0334-00				RES.,FXD,FILM:29.4K OHM,1%,0.125W	91637	MFF1816G29401F
R1759	321-0231-00				RES.,FXD,FILM:2.49K OHM,1%,0.125W	91637	MFF1816G24900F
R1760	321-0410-00				RES.,FXD,FILM:182K OHM,1%,0.125W	91637	MFF1816G18202F
R1762	321-0373-00				RES.,FXD,FILM:75K OHM,1%,0.125W	91637	MFF1816G75001F
R1763	321-0260-00				RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R1765	315-0132-00				RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	01121	CB1325
R1767	315-0473-00				RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R1770	315-0101-00				RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1772	315-0391-00				RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R1774	315-0103-00				RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1777	315-0104-00				RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1778	315-0202-00				RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R1801	321-0066-00				RES.,FXD,FILM:47.5 OHM,1%,0.125W	91637	MFF1816G47R50F
R1802	315-0201-00				RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R1803	321-0193-00				RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R1805	315-0101-00				RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1806	321-0126-00				RES.,FXD,FILM:200 OHM,1%,0.125W	91637	MFF1816G200R0F
R1808	321-0206-00				RES.,FXD,FILM:1.37K OHM,1%,0.125W	91637	MFF1816G13700F
R1809	321-0126-00				RES.,FXD,FILM:200 OHM,1%,0.125W	91637	MFF1816G200R0F
R1810	311-0635-00				RES.,VAR, NONWIR:1K OHM,10%,0.5%,0.5W	73138	82P-6-2-102K
R1812	321-0206-00				RES.,FXD,FILM:1.37K OHM,1%,0.125W	91637	MFF1816G13700F
R1814	321-0126-00				RES.,FXD,FILM:200 OHM,1%,0.125W	91637	MFF1816G200R0F
R1815	315-0101-00				RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1816	315-0561-00				RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R1817	311-0978-00				RES.,VAR, NONWIR:250 OHM,10%,0.50W	73138	82-4-2
R1818	315-0271-00				RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R1820	315-0272-00				RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R1822	323-0275-00				RES.,FXD,FILM:7.15K OHM,1%,0.50W	75042	CECT0-7151F
R1824	321-0193-00				RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R1825	315-0200-00				RES.,FXD,CMPSN:20 OHM,5%,0.25W	01121	CB2005
R1827	315-0152-00				RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R1829	315-0100-00				RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R1831	315-0681-00				RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R1832	315-0302-00				RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R1833	315-0391-00				RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R1838	315-0202-00				RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R1839	315-0101-00				RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1842	311-0643-00				RES.,VAR, NONWIR:50 OHM,10%,0.50W	73138	82-33-2

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Ckt No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Name & Description	Mfr Code	Mfr Part Number
R1844	311-0622-00		RES.,VAR, NONWIR:100 OHM,10%,0.50W	32997	3329H-G48-101
R1846	315-0105-00		RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1851	301-0472-00		RES.,FXD,CMPSN:4.7K OHM,5%,0.50W	01121	EB4725
R1852	301-0472-00		RES.,FXD,CMPSN:4.7K OHM,5%,0.50W	01121	EB4725
R1854	303-0432-00		RES.,FXD,CMPSN:4.3K OHM,5%,1W	01121	GB4325
R1856	315-0510-00		RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R1860	321-0347-00		RES.,FXD,FILM:40.2K OHM,1%,0.125W	91637	MFF1816G40201F
R1861	321-0367-00		RES.,FXD,FILM:64.9K OHM,1%,0.125W	91637	MFF1816G64901F
R1871	321-0266-00		RES.,FXD,FILM:5.76K OHM,1%,0.125W	91637	MFF1816G57600F
R1873	322-0356-00		RES.,FXD,FILM:49.9K OHM,1%,0.25W	75042	CEBT0-4992F
R1877	321-0253-00		RES.,FXD,FILM:4.22K OHM,1%,0.125W	91637	MFF1816G42200F
R1880	315-0103-00		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1883	315-0101-00		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R1887	315-0100-00		RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R1894	307-0106-00		RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
R1897	307-0106-00		RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
R2101	315-0682-00		RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R2102	315-0103-00		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2104	315-0333-00		RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R2105	315-0153-00		RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R2107	315-0510-00		RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R2108	315-0512-00		RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R2109	315-0221-00		RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R2112	315-0102-00		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2113	315-0301-00		RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R2122	315-0432-00		RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R2123	315-0683-00		RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
R2124	-----		(PART OF S122)		
R2127	315-0302-00		RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R2128	311-1263-00		RES.,VAR, NONWIR:1K OHM,10%,0.50W	32997	3329P-L58-102
R2129	315-0183-00		RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R2135	315-0393-00		RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R2137	315-0752-00		RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R2139	315-0242-00		RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R2144	315-0104-00		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2146	315-0152-00		RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R2148	315-0103-00		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2150	321-0403-00		RES.,FXD,FILM:154K OHM,1%,0.125W	91637	MFF1816G15402F
R2151	321-0372-00		RES.,FXD,FILM:73.2K OHM,1%,0.125W	91637	MFF1816G73201F
R2153	315-0103-00		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2155	315-0512-00		RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R2158	315-0152-00		RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R2161	315-0102-00		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2162	315-0751-00		RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R2163	315-0751-00		RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R2165	315-0102-00		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2166	315-0751-00		RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R2167	315-0751-00		RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R2169	315-0102-00		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2170	315-0751-00		RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R2171	315-0751-00		RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R2173	315-0102-00		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2174	315-0751-00		RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R2175	315-0751-00		RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515

Replaceable Electrical Parts—7904 (SN B260000 & UP)

Ckt No.	Tektronix Part No.	Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont			
R2177	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R2178	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R2179	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R2182	321-0262-00			RES.,FXD,FILM:5.23K OHM,1%,0.125W	91637	MFF1816G52300F
R2183	311-1224-00			RES.,VAR,NONWIR:500 OHM,20%,0.50W	32997	3386F-T04-501
R2191	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R2192	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R2193	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R2194	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R2196	321-0308-00			RES.,FXD,FILM:15.8K OHM,1%,0.125W	91637	MFF1816G15801F
R2197	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R2198	321-0319-00			RES.,FXD,FILM:20.5K OHM,1%,0.125W	91637	MFF1816G20501F
R2199	321-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	CMF55116G30101F
R2201	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R2202	321-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	CMF55116G30101F
R2203	321-0344-00			RES.,FXD,FILM:37.4K OHM,1%,0.125W	91637	MFF1816G37401F
R2204	321-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	CMF55116G30101F
R2206	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R2207	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R2208	321-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	CMF55116G30101F
R2209	321-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	CMF55116G30101F
R2211	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R2213	321-0259-00			RES.,FXD,FILM:4.87K OHM,1%,0.125W	91637	MFF1816G48700F
R2214	311-1224-00			RES.,VAR,NONWIR:500 OHM,20%,0.50W	32997	3386F-T04-501
R2215	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R2217	315-0124-00			RES.,FXD,CMPSN:120K OHM,5%,0.25W	01121	CB1245
R2219	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R2220	321-0299-00			RES.,FXD,FILM:12.7K OHM,1%,0.125W	91637	MFF1816G12701F
R2221	321-0212-00			RES.,FXD,FILM:1.58K OHM,1%,0.125W	91637	MFF1816G15800F
R2226	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R2227	321-0266-00			RES.,FXD,FILM:5.76K OHM,1%,0.125W	91637	MFF1816G57600F
R2229	321-0210-00			RES.,FXD,FILM:1.5K OHM,1%,0.125W	91637	MFF1816G15000F
R2231	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R2235	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R2236	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R2237	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R2238	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R2241	321-0326-00			RES.,FXD,FILM:24.3K OHM,1%,0.125W	91637	MFF1816G24301F
R2251	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2252	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2253	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2254	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R2261	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R2262	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2265	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R2266	315-0912-00			RES.,FXD,CMPSN:9.1K OHM,5%,0.25W	01121	CB9125
R2268	321-0269-00	B260000	B269701	RES.,FXD,FILM:6.19K OHM,1%,0.125W	91637	MFF1816G61900F
R2268	321-0297-00	B269702		RES.,FXD,FILM:12.1K OHM,1%,0.125W	91637	MFF1816G12101F
R2273	311-1226-00			RES.,VAR,NONWIR:2.5K OHM,20%,0.50W	32997	3386F-T04-252
R2274	321-0153-00			RES.,FXD,FILM:383 OHM,1%,0.125W	91637	MFF1816G383R0F
R2275	321-0170-00			RES.,FXD,FILM:576 OHM,1%,0.125W	91637	MFF1816G576R0F
R2276	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R2277	321-0250-00			RES.,FXD,FILM:3.92K OHM,1%,0.125W	91637	MFF1816G39200F
R2278	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	01121	CB8235

Replaceable Electrical Parts—7904 (SN B260000 & UP)

Ckt No.	Tektronix Part No.	Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont			
R2279	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R2280	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	01121	CB8235
R2281	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R2282	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R2283	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R2284	321-0216-00			RES.,FXD,FILM:1.74K OHM,1%,0.125W	91637	MFF1816G17400F
R2285	321-0245-00			RES.,FXD,FILM:3.48K OHM,1%,0.125W	91637	MFF1816G34800F
R2286	321-0210-00			RES.,FXD,FILM:1.5K OHM,1%,0.125W	91637	MFF1816G15000F
R2287	321-0199-00			RES.,FXD,FILM:1.15K OHM,1%,0.125W	91637	MFF1816G11500F
R2288	321-0273-00			RES.,FXD,FILM:6.81K OHM,1%,0.125W	91637	MFF1816G68100F
R2289	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R2291	311-1225-00			RES.,VAR, NONWIR:1K OHM,20%,0.50W	32997	3386F-T04-102
R2292	315-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	01121	CB1325
R2293	321-0245-00			RES.,FXD,FILM:3.48K OHM,1%,0.125W	91637	MFF1816G34800F
R2294	321-0255-00			RES.,FXD,FILM:4.42K OHM,1%,0.125W	91637	MFF1816G44200F
R2295	321-0241-00			RES.,FXD,FILM:3.16K OHM,1%,0.125W	91637	MFF1816G31600F
R2297	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R2298	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2299	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315
R4602	325-0044-00			RES.,FXD,FILM:100 OHM,0.5%,0.05W	03888	PME50 100 OHM
R4603	325-0114-00			RES.,FXD,FILM:105 OHM,0.5%,0.05W	14298	EE 1/20 +/-5%
R4605	323-0134-00			RES.,FXD,FILM:243 OHM,1%,0.50W	91637	MFF1226G243R0F
R4607	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	MFF1816G200R0F
R4608	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	MFF1816G200R0F
R4610	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R4611	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R4613	323-0134-00			RES.,FXD,FILM:243 OHM,1%,0.50W	91637	MFF1226G243R0F
R4615	321-0119-00			RES.,FXD,FILM:169 OHM,1%,0.125W	91637	MFF1816G169R0F
R4616	321-0119-00			RES.,FXD,FILM:169 OHM,1%,0.125W	91637	MFF1816G169R0F
R4617	321-0048-00			RES.,FXD,FILM:30.9 OHM,1%,0.125W	91637	MFF1816G30R90F
R4618	321-0048-00			RES.,FXD,FILM:30.9 OHM,1%,0.125W	91637	MFF1816G30R90F
R4619	311-1259-00			RES.,VAR, NONWIR:100 OHM,10%,0.50W	32997	3329P-L58-101
R4620	325-0114-00			RES.,FXD,FILM:105 OHM,0.5%,0.05W	14298	EE 1/20 +/-5%
R4621	325-0044-00			RES.,FXD,FILM:100 OHM,0.5%,0.05W	03888	PME50 100 OHM
R4622	317-0560-00			RES.,FXD,CMPSN:56 OHM,5%,0.125W	01121	BB5605
R4623	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R4625	325-0044-00			RES.,FXD,FILM:100 OHM,0.5%,0.05W	03888	PME50 100 OHM
R4627	325-0044-00			RES.,FXD,FILM:100 OHM,0.5%,0.05W	03888	PME50 100 OHM
R4630	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	MFF1816G100R0F
R4632	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R4634	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R4636	315-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	01121	CB1325
R4638	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R4640	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R4642	315-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	01121	CB1325
R4643	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R4645	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R4647	315-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	01121	CB1325
R4649	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R4650	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R4652	315-0161-00			RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
R4656	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R4657	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R4662	325-0044-00			RES.,FXD,FILM:100 OHM,0.5%,0.05W	03888	PME50 100 OHM

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Ckt No.	Tektronix Part No.	Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont			
R4663	325-0114-00			RES.,FXD,FILM:105 OHM,0.5%,0.05W	14298	EE 1/20 +/-5%
R4665	323-0134-00			RES.,FXD,FILM:243 OHM,1%,0.50W	91637	MFF1226G243R0F
R4667	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	MFF1816G200R0F
R4668	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	MFF1816G200R0F
R4669	317-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.125W	01121	BB1015
R4673	323-0134-00			RES.,FXD,FILM:243 OHM,1%,0.50W	91637	MFF1226G243R0F
R4675	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	MFF1816G200R0F
R4676	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	MFF1816G200R0F
R4677	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R4678	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R4680	325-0114-00			RES.,FXD,FILM:105 OHM,0.5%,0.05W	14298	EE 1/20 +/-5%
R4681	325-0044-00			RES.,FXD,FILM:100 OHM,0.5%,0.05W	03888	PME50 100 OHM
R4683	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R4685	325-0044-00			RES.,FXD,FILM:100 OHM,0.5%,0.05W	03888	PME50 100 OHM
R4687	325-0044-00			RES.,FXD,FILM:100 OHM,0.5%,0.05W	03888	PME50 100 OHM
R4689	SELECTED					
R4850	311-1566-00			RES.,VAR,NONWIR:200 OHM,20%,0.50W	73138	91-88-0
R4851	321-0251-00			RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R4852	321-0205-00			RES.,FXD,FILM:1.33K OHM,1%,0.125W	91637	MFF1816G13300F
R4853	321-0078-00			RES.,FXD,FILM:63.4 OHM,1%,0.125W	91637	MFF1816G63R40F
R4854	323-0167-00			RES.,FXD,FILM:536 OHM,1%,0.50W	91637	MFF1226G536R0F
R4856	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R4857	311-1228-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	32997	3386F-T04-103
R4858	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R4860	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R4862	323-0167-00			RES.,FXD,FILM:536 OHM,1%,0.50W	91637	MFF1226G536R0F
R4863	321-0078-00			RES.,FXD,FILM:63.4 OHM,1%,0.125W	91637	MFF1816G63R40F
R4865	321-0205-00			RES.,FXD,FILM:1.33K OHM,1%,0.125W	91637	MFF1816G13300F
R4867	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R4868	311-1466-00			RES.,VAR,NONWIR:2K OHM,20%,0.50W	73138	72-39-0
R4870	321-0131-00			RES.,FXD,FILM:226 OHM,1%,0.125W	91637	MFF1816G226R0F
R4872	321-0114-00			RES.,FXD,FILM:150 OHM,1%,0.125W	91637	MFF1816G150R0F
R4873	311-1222-00			RES.,VAR,NONWIR:100 OHM,20%,0.50W	32997	3386F-T04-101
R4874	315-0620-00	B260000	B280908	RES.,FXD,CMPSN:62 OHM,5%,0.25W	01121	CB6205
R4874	311-0978-00	B280909		RES.,VAR,NONWIR:250 OHM,10%,0.50W	73138	82-4-2
R4876	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R4877	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R4878	321-0199-06			RES.,FXD,FILM:1.15K OHM,0.25%,0.125W	91637	MFF1816C11500C
R4879	321-0199-06			RES.,FXD,FILM:1.15K OHM,0.25%,0.125W	91637	MFF1816C11500C
R4881	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R4882	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R4883	321-0167-00			RES.,FXD,FILM:536 OHM,1%,0.125W	91637	MFF1816G536R0F
R4885	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R4886	315-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R4888	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R4889	323-0706-01			RES.,FXD,FILM:800 OHM,0.5%,0.50W	91637	MFF1226G800R0D
R4895	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R4896	315-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R4898	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	91637	MFF1816G10000F
R4899	323-0706-01			RES.,FXD,FILM:800 OHM,0.5%,0.50W	91637	MFF1226G800R0D
R4902	321-0205-00			RES.,FXD,FILM:1.33K OHM,1%,0.125W	91637	MFF1816G13300F
R4904	308-0304-00			RES.,FXD,WW:1.5K OHM,1%,3W	91637	RS2B-B15000F
R4905	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R4906	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205

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Ckt No.	Tektronix	Serial/Model No.		Name & Description	Mfr	Mfr Part Number
	Part No.	Eff	Dscont		Code	
R4908	321-0066-00			RES.,FXD,FILM:47.5 OHM,1%,0.125W	91637	MFF1816G47R50F
R4912	321-0205-00			RES.,FXD,FILM:1.33K OHM,1%,0.125W	91637	MFF1816G13300F
R4914	308-0304-00			RES.,FXD,WW:1.5K OHM,1%,3W	91637	RS2B-B15000F
R4915	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R4916	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R4918	321-0066-00			RES.,FXD,FILM:47.5 OHM,1%,0.125W	91637	MFF1816G47R50F
R4921	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R4923	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R4925	311-1225-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	32997	3386F-T04-102
R4926	321-0258-00			RES.,FXD,FILM:4.75K OHM,1%,0.125W	91637	MFF1816G47500F
R4930	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R4931	303-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,1W	01121	GB3325
R4933	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R4935	323-0327-00			RES.,FXD,FILM:24.9K OHM,1%,0.50W	91637	MFF1226G24901F
R4936	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R4937	315-0150-00			RES.,FXD,CMPSN:15 OHM,5%,0.25W	01121	CB1505
R4938	321-0218-00			RES.,FXD,FILM:1.82K OHM,1%,0.125W	91637	MFF1816G18200F
R4939	301-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.50W	01121	EB5635
R4943	301-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.50W	01121	EB3335
R4949	303-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,1W	01121	GB2225
R4951	303-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,1W	01121	GB2725
R4953	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R4955	323-0327-00			RES.,FXD,FILM:24.9K OHM,1%,0.50W	91637	MFF1226G24901F
R4956	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R4957	315-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R4958	321-0205-00			RES.,FXD,FILM:1.33K OHM,1%,0.125W	91637	MFF1816G13300F
R4959	303-0273-00			RES.,FXD,CMPSN:27K OHM,5%,1W	01121	GB2735
R4990	307-0106-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
R4992	307-0106-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
R5501	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R5502	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R5504	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R5505	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R5508	325-0117-00			RES.,FXD,FILM:52.1 OHM,0.5%,0.05W	03888	PME50 52.1 OHM
R5510	321-0135-00			RES.,FXD,FILM:249 OHM,1%,0.125W	91637	MFF1816G249R0F
R5511	317-0101-03	B268530		RES.,FXD,FILM:100 OHM,5%,0.125W	01121	BB1015
R5511	-----			(NOMINAL VALUE,SELECTED)		
R5512	321-0135-00			RES.,FXD,FILM:249 OHM,1%,0.125W	91637	MFF1816G249R0F
R5514	325-0117-00			RES.,FXD,FILM:52.1 OHM,0.5%,0.05W	03888	PME50 52.1 OHM
R5516	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R5520	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R5521	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R5522	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R5524	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R5525	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R5528	325-0117-00			RES.,FXD,FILM:52.1 OHM,0.5%,0.05W	03888	PME50 52.1 OHM
R5530	321-0135-00			RES.,FXD,FILM:249 OHM,1%,0.125W	91637	MFF1816G249R0F
R5531	317-0101-03	B268530		RES.,FXD,FILM:100 OHM,5%,0.125W	01121	BB1015
R5531	-----			(NOMINAL VALUE,SELECTED)		
R5532	321-0135-00			RES.,FXD,FILM:249 OHM,1%,0.125W	91637	MFF1816G249R0F
R5534	325-0117-00			RES.,FXD,FILM:52.1 OHM,0.5%,0.05W	03888	PME50 52.1 OHM
R5536	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R5538	321-0073-00			RES.,FXD,FILM:56.2 OHM,1%,0.125W	91637	MFF1816G56R20F
R5539	321-0073-00			RES.,FXD,FILM:56.2 OHM,1%,0.125W	91637	MFF1816G56R20F

Replaceable Electrical Parts—7904 (SN B260000 & UP)

Ckt No.	Tektronix Part No.	Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont			
R5540	317-0101-03	B268530		RES.,FXD,FILM:100 OHM,5%,0.125W	01121	BB1015
R5541	323-0071-00			RES.,FXD,FILM:53.6 OHM,1%,0.50W	75042	CECT0-53R60F
R5542	323-0626-00			RES.,FXD,FILM:50 OHM,1%,0.50W	91637	MFF1226G50R00F
R5544	315-0750-02	B260000	B268529	RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
R5544	322-0085-00	B268530		RES.,FXD,FILM:75 OHM,1%,0.25W	75042	CEBT0-75R00F
R5545	315-0750-02	B260000	B268529	RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
R5545	322-0085-00	B268530		RES.,FXD,FILM:75 OHM,1%,0.25W	75042	CEBT0-75R00F
R5547	311-1262-00			RES.,VAR,NONWIR:750 OHM,10%,0.50W	32997	3329P-L58-751
R5552	321-0135-00			RES.,FXD,FILM:249 OHM,1%,0.125W	91637	MFF1816G249R0F
R5553	317-0750-00	B260000	B268529	RES.,FXD,CMPSN:75 OHM,5%,0.125W	01121	BB7505
R5553	317-0131-00	B268530		RES.,FXD,CMPSN:130 OHM,5%,0.125W	01121	BB1315
R5553	-----			(NOMINAL VALUE,SELECTED)		
R5554	321-0135-00			RES.,FXD,FILM:249 OHM,1%,0.125W	91637	MFF1816G249R0F
R5559	321-0221-00			RES.,FXD,FILM:1.96K OHM,1%,0.125W	91637	MFF1816G19600F
R5561	321-0189-00			RES.,FXD,FILM:909 OHM,1%,0.125W	91637	MFF1816G909R0F
R5565	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	91637	MFF1816G51R10F
R5566	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	91637	MFF1816G51R10F
R5567	315-0430-00			RES.,FXD,CMPSN:43 OHM,5%,0.25W	01121	CB4305
R5568	315-0682-00	B260000	B268529	RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R5568	317-0912-00	B268530		RES.,FXD,CMPSN:9.1K OHM,5%,0.125W	01121	BB9125
R5569	315-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R5570	311-1227-00	B260000	B268529	RES.,VAR,NONWIR:5K OHM,20%,0.50W	32997	3386F-T04-502
R5570	311-1226-00	B268530		RES.,VAR,NONWIR:2.5K OHM,20%,0.50W	32997	3386F-T04-252
R5573	315-0152-00	B260000	B268529	RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R5573	315-0332-00	B268530		RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R5574	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R5575	311-1223-00			RES.,VAR,NONWIR:TRMR,250 OHM,0.5W	02111	63M251T602
R5576	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R5595	321-0122-00			RES.,FXD,FILM:182 OHM,1%,0.125W	91637	MFF1816G182R0F
R5597	323-0132-00			RES.,FXD,FILM:232 OHM,1%,0.50W	91637	MFF1226G232R0F
R5598	323-0132-00			RES.,FXD,FILM:232 OHM,1%,0.50W	91637	MFF1226G232R0F
R5601	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R5602	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R5604	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R5605	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R5608	325-0117-00			RES.,FXD,FILM:52.1 OHM,0.5%,0.05W	03888	PME50 52.1 OHM
R5610	321-0135-00			RES.,FXD,FILM:249 OHM,1%,0.125W	91637	MFF1816G249R0F
R5611	317-0101-03	B268530		RES.,FXD,FILM:100 OHM,5%,0.125W	01121	BB1015
R5612	321-0135-00			RES.,FXD,FILM:249 OHM,1%,0.125W	91637	MFF1816G249R0F
R5614	325-0117-00			RES.,FXD,FILM:52.1 OHM,0.5%,0.05W	03888	PME50 52.1 OHM
R5616	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R5620	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R5621	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R5622	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R5624	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R5625	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R5628	325-0117-00			RES.,FXD,FILM:52.1 OHM,0.5%,0.05W	03888	PME50 52.1 OHM
R5630	321-0135-00			RES.,FXD,FILM:249 OHM,1%,0.125W	91637	MFF1816G249R0F
R5631	317-0101-03	B268530		RES.,FXD,FILM:100 OHM,5%,0.125W	01121	BB1015
R5632	321-0135-00			RES.,FXD,FILM:249 OHM,1%,0.125W	91637	MFF1816G249R0F
R5634	325-0117-00			RES.,FXD,FILM:52.1 OHM,0.5%,0.05W	03888	PME50 52.1 OHM
R5636	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R5638	321-0114-00			RES.,FXD,FILM:150 OHM,1%,0.125W	91637	MFF1816G150R0F
R5639	321-0114-00			RES.,FXD,FILM:150 OHM,1%,0.125W	91637	MFF1816G150R0F

Replaceable Electrical Parts-----7904 (SN B260000 & UP)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R5640	317-0101-03	B268530		RES.,FXD,FILM:100 OHM,5%,0.125W	01121	BB1015
R5641	323-0071-00			RES.,FXD,FILM:53.6 OHM,1%,0.50W	75042	CECT0-53R60F
R5642	323-0626-00			RES.,FXD,FILM:50 OHM,1%,0.50W	91637	MFF1226G50R00F
R5644	315-0750-02	B260000	B268529	RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
R5644	322-0085-00	B268530		RES.,FXD,FILM:75 OHM,1%,0.25W	75042	CEBT0-75R00F
R5645	315-0750-02	B260000	B268529	RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
R5645	322-0085-00	B268530		RES.,FXD,FILM:75 OHM,1%,0.25W	75042	CEBT0-75R00F
R5647	311-1262-00			RES.,VAR,NONWIR:750 OHM,10%,0.50W	32997	3329P-L58-751
R5652	321-0109-00			RES.,FXD,FILM:133 OHM,1%,0.125W	91637	MFF1816G133R0F
R5653	317-0430-00	B260000	B268529	RES.,FXD,CMPSN:43 OHM,5%,0.125W	01121	BB4305
R5653	317-0750-00	B268530		RES.,FXD,CMPSN:75 OHM,5%,0.125W	01121	BB7505
R5654	321-0109-00			RES.,FXD,FILM:133 OHM,1%,0.125W	91637	MFF1816G133R0F
R5658	321-0278-00	B260000	B268529	RES.,FXD,FILM:7.68K OHM,1%,0.125W	91637	MFF1816G76800F
R5658	321-0274-00	B268530		RES.,FXD,FILM:6.98K OHM,1%,0.125W	91637	MFF1816G69800F
R5659	321-0232-00	B260000	B268529	RES.,FXD,FILM:2.55K OHM,1%,0.125W	91637	MFF1816G25500F
R5659	321-0239-00	B268530		RES.,FXD,FILM:3.01K OHM,1%,0.125W	91637	MFF1816G30100F
R5661	321-0189-00			RES.,FXD,FILM:909 OHM,1%,0.125W	91637	MFF1816G909R0F
R5663	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R5665	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	91637	MFF1816G51R10F
R5666	321-0069-00			RES.,FXD,FILM:51.1 OHM,1%,0.125W	91637	MFF1816G51R10F
R5667	315-0430-00			RES.,FXD,CMPSN:43 OHM,5%,0.25W	01121	CB4305
R5668	315-0682-00	B260000	B268529	RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R5668	317-0912-00	B268530		RES.,FXD,CMPSN:9.1K OHM,5%,0.125W	01121	BB9125
R5669	315-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R5670	311-1227-00	B260000	B268529	RES.,VAR,NONWIR:5K OHM,20%,0.50W	32997	3386F-T04-502
R5670	311-1226-00	B268530		RES.,VAR,NONWIR:2.5K OHM,20%,0.50W	32997	3386F-T04-252
R5673	315-0152-00	B260000	B268529	RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R5673	315-0242-00	B268530		RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R5674	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R5675	311-1223-00			RES.,VAR,NONWIR:TRMR,250 OHM,0.5W	02111	63M251T602
R5676	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R5678	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R5680	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R5682	315-0511-00	B260000	B268529	RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R5682	315-0471-00	B268530		RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R5683	311-1261-00			RES.,VAR,NONWIR:500 OHM,10%,0.50W	32997	3329P-L58-501
R5684	315-0511-00	B260000	B268529	RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R5684	315-0621-00	B268530		RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R5686	321-0220-00			RES.,FXD,FILM:1.91K OHM,1%,0.125W	91637	MFF1816G19100F
R5687	321-0220-00			RES.,FXD,FILM:1.91K OHM,1%,0.125W	91637	MFF1816G19100F
R5688	315-0200-00			RES.,FXD,CMPSN:20 OHM,5%,0.25W	01121	CB2005
R5690	317-0750-00	B260000	B268529	RES.,FXD,CMPSN:75 OHM,5%,0.125W	01121	BB7505
R5690	317-0750-00	B268530		RES.,FXD,CMPSN:75 OHM,5%,0.125W (NOMINAL VALUE,SELECTED. ADDED AS NECESSARY)	01121	BB7505
R5695	321-0122-00			RES.,FXD,FILM:182 OHM,1%,0.125W	91637	MFF1816G182R0F
R5697	323-0132-00			RES.,FXD,FILM:232 OHM,1%,0.50W	91637	MFF1226G232R0F
R5698	323-0132-00			RES.,FXD,FILM:232 OHM,1%,0.50W	91637	MFF1226G232R0F
RT4877	307-0124-00			RES.,THERMAL:5K OHM,10%	50157	1D1618
S100	670-1638-00			CKT BOARD ASSY:VERTICAL MODE SW	80009	670-1638-00
S110	670-1639-00			CKT BOARD ASSY:HORIZONTAL MODE SW	80009	670-1639-00
S122	260-1138-00			SWITCH,ROTARY:	80009	260-1138-00
S125	-----			(PART OF R339)		

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Ckt No.	Tektronix Part No.	Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont			
S455	670-1640-00			CKT BOARD ASSY:A TRIGGER SW	80009	670-1640-00
S495	670-1641-00			CKT BOARD ASSY:B TRIGGER SW	80009	670-1641-00
S801	260-0723-00			SWITCH,SLIDE:DPDT,0.5A,125VAC	79727	GF126-0028
S801	-----			(S801 OPTION 2 ONLY)		
S811	260-0723-00			SWITCH,SLIDE:DPDT,0.5A,125VAC	79727	GF126-0028
S811	-----			(S811 OPTION 2 ONLY)		
S1035	260-0723-00			SWITCH,SLIDE:DPDT,0.5A,125VAC	79727	GF126-0028
S1065	260-0984-00			SWITCH,SLIDE:DP3T,0.5A,125V	79727	G-128-S-0012
S1120	105-0293-00			ACTR ASSY,CAM S:CALIBRATE RATE	80009	105-0293-00
S1150	105-0294-00			ACTR ASSY,CAM S:CALIBRATE VOLTAGE	80009	105-0294-00
S1200	260-1060-01			SWITCH,TOGGLE:DPST,15A,125VAC	27193	8906K-2507
S1201	260-0638-00			SW,THERMOSTATIC:10A,240V,OPEN 75 DEG C	93410	430-364
S1212	204-0278-00			BODY,LINE V SEL:	80009	204-0278-00
S2110	260-0723-00			SWITCH,SLIDE:DPDT,0.5A,125VAC	79727	GF126-0028
T1208	120-0636-00			XFMR,PWR,STPDN:LINE TRIGGER	80009	120-0636-00
T1225	120-0743-00			XFMR,TOROID:13 TURNS,BIFILAR	80009	120-0743-00
T1230	120-0744-00			XFMR,TOROID:5 WINDINGS	80009	120-0744-00
T1235	120-0747-00			XFMR,TOROID:55 TURNS,SINGLE	80009	120-0747-00
T1310	120-0742-00	B260000	B269359	XFMR,PWR,SDN&SU:HV	80009	120-0742-00
T1310	120-1250-00	B269360		XFMR,PWR,SDN&SU:	80009	120-1250-00
U215	155-0011-00			MICROCIRCUIT,DI:ML,CLOCK AND CHOP BLANKING	80009	155-0011-00
U225	155-0010-00			MICROCIRCUIT,DI:ML,CHOP DIVIDER/BLANKING	80009	155-0010-00
U265	155-0013-00			MICROCIRCUIT,DI:ML,DC BINARY	80009	155-0013-00
U275	155-0013-00			MICROCIRCUIT,DI:ML,DC BINARY	80009	155-0013-00
U285	155-0013-01	B260000	B267794	MICROCIRCUIT,DI:ML,DC BINARY	80009	155-0013-01
U285	155-0013-00	B267795		MICROCIRCUIT,DI:ML,DC BINARY	80009	155-0013-00
U305	155-0009-00			MICROCIRCUIT,DI:ML,HORIZ LOCKOUT LOGIC	80009	155-0009-00
U325	155-0012-00			MICROCIRCUIT,LI:ML,Z-AXIS AND AMPLIFIER	80009	155-0012-00
U685	155-0059-00			MICROCIRCUIT,LI:ML,HIGH FREQUENCY AMPL	80009	155-0059-00
U745	155-0064-00			MICROCIRCUIT,LI:OUTPUT AMPLIFIER	80009	155-0064-00
U825	155-0022-00			MICROCIRCUIT,DI:ML,CHANNEL SWITCH	80009	155-0022-00
U1125	156-0038-02			MICROCIRCUIT,DI:J-K MASTER SLAVE FF,SCRN	01295	SN7472(NP3 OR JP
U1275	155-0067-02			MICROCIRCUIT,DI:ML,POWER SUPPLY REGULATOR	80009	155-0067-02
U1615	152-0493-00			SEMICONV DEVICE:3KV P-P IN,+12KV OUT	52306	CMX114
U1635	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	01295	MICROA741CP
U2120	156-0043-03			MICROCIRCUIT,DI:QUAD 2-INP NOR GATE,SCRN	01295	SN7402
U2126	155-0021-01			MICROCIRCUIT,DI:ML,TIMING GENERATOR	80009	155-0021-01
U2155	156-0043-03			MICROCIRCUIT,DI:QUAD 2-INP NOR GATE,SCRN	01295	SN7402
U2159	155-0017-00			MICROCIRCUIT,DI:ML,ZERO LOGIC COUNTER	80009	155-0017-00
U2180	155-0015-01			MICROCIRCUIT,DI:ML,ANALOG DATA SWITCH	80009	155-0015-01
U2185	155-0014-01			MICROCIRCUIT,DI:ML,ANALOG TO DECIMAL CONV	80009	155-0014-01
U2190	155-0015-01			MICROCIRCUIT,DI:ML,ANALOG DATA SWITCH	80009	155-0015-01
U2232	155-0018-00			MICROCIRCUIT,DI:ML,ZERO LOGIC	80009	155-0018-00
U2244	155-0014-01			MICROCIRCUIT,DI:ML,ANALOG TO DECIMAL CONV	80009	155-0014-01
U2250	156-0032-03			MICROCIRCUIT,DI:4 BIT BINARY COUNTER,SCRN	07263	7493(PCQR)
U2260	155-0019-00			MICROCIRCUIT,DI:ML,DECIMAL POINT AND SPACE	80009	155-0019-00
U2270	155-0023-00			MICROCIRCUIT,DI:ML,CHAR GEN NUMERALS	80009	155-0023-00
U2272	155-0024-00			MICROCIRCUIT,DI:ML,CHAR GEN SPCL SYMBOLS	80009	155-0024-00
U2274	155-0025-00			MICROCIRCUIT,DI:ML,CHAR GEN PREFIXES	80009	155-0025-00
U2276	155-0026-00			MICROCIRCUIT,DI:ML,CHAR GEN LETTERS	80009	155-0026-00
U2278	155-0027-00			MICROCIRCUIT,DI:ML,CHAR GEN SPCL ALPHA	80009	155-0027-00
U2284	155-0020-00			MICROCIRCUIT,DI:ML,CHANNEL SW OUTPUT ASSY	80009	155-0020-00

Replaceable Electrical Parts—7904 (SN B260000 & UP)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
U4625	155-0095-01	B260000	B267819	MICROCIRCUIT,LI:HF DIFFERENTIAL AMPLIFIER (U4625/U4685 ARE A MATCHED PAIR)	80009	155-0095-01
U4625	-----					
U4625	155-0095-03	B267820		MICROCIRCUIT,LI:HF DIFF AMPLIFIER,TESTED (U4625/U4685 ARE A MATCHED PAIR)	80009	155-0095-03
U4625	-----					
U4641	156-0048-00			MICROCIRCUIT,LI:FIVE NPN TRANSISTOR ARRAY	02735	CA3046
U4685	155-0095-01	B260000	B267819	MICROCIRCUIT,LI:HF DIFFERENTIAL AMPLIFIER	80009	155-0095-01
U4685	-----			(U4685/U4625 ARE A MATCHED PAIR)		
U4685	155-0095-03	B267820		MICROCIRCUIT,LI:HF DIFF AMPLIFIER,TESTED (U4685/U4625 ARE A MATCHED PAIR)	80009	155-0095-03
U4685	-----					
U5502	156-0048-00			MICROCIRCUIT,LI:FIVE NPN TRANSISTOR ARRAY	02735	CA3046
U5510	155-0078-03	B260000	B268233	MICROCIRCUIT,LI:ML,VERTICAL AMPL,SEL	80009	155-0078-03
U5510	155-0078-10	B268234		MICROCIRCUIT,LI:ML,VERTICAL AMPLIFIER	80009	155-0078-10
U5530	155-0078-03	B260000	B268233	MICROCIRCUIT,LI:ML,VERTICAL AMPL,SEL	80009	155-0078-03
U5530	155-0078-10	B268234		MICROCIRCUIT,LI:ML,VERTICAL AMPLIFIER	80009	155-0078-10
U5550	155-0078-03	B260000	B268233	MICROCIRCUIT,LI:ML,VERTICAL AMPL,SEL	80009	155-0078-03
U5550	155-0078-10	B268234		MICROCIRCUIT,LI:ML,VERTICAL AMPLIFIER	80009	155-0078-10
U5602	156-0048-00			MICROCIRCUIT,LI:FIVE NPN TRANSISTOR ARRAY	02735	CA3046
U5610	155-0078-03	B260000	B268233	MICROCIRCUIT,LI:ML,VERTICAL AMPL,SEL	80009	155-0078-03
U5610	155-0078-10	B268234		MICROCIRCUIT,LI:ML,VERTICAL AMPLIFIER	80009	155-0078-10
U5630	155-0078-03	B260000	B268233	MICROCIRCUIT,LI:ML,VERTICAL AMPL,SEL	80009	155-0078-03
U5630	155-0078-10	B268234		MICROCIRCUIT,LI:ML,VERTICAL AMPLIFIER	80009	155-0078-10
U5650	155-0078-03	B260000	B268233	MICROCIRCUIT,LI:ML,VERTICAL AMPL,SEL	80009	155-0078-03
U5650	155-0078-10	B268234		MICROCIRCUIT,LI:ML,VERTICAL AMPLIFIER	80009	155-0078-10
V1725	154-0644-05			ELECTRON TUBE:CRT,P31 PHOSPHOR	80009	154-0644-05
V1725	154-0661-05			ELECTRON TUBE:CRT,P31,INT SCALE	80009	154-0661-05
V1725	-----			(OPTION 4 ONLY)		
V1725	154-0661-09			ELECTRON TUBE:CRT,P11,INT SCALE	80009	154-0661-09
V1725	-----			(OPTION 4 ONLY)		
V1725	154-0644-09			ELECTRON TUBE:CRT,P11,INT SCALE	80009	154-0644-09
V1725	-----			(OPTION 78 ONLY)		
VR235	152-0166-00			SEMICONV DEVICE:ZENER,0.4W,6.2V,5%	04713	SZ11738RL
VR1239	152-0241-00	B268785		SEMICONV DEVICE:ZENER,0.4W,33V,5%	04713	SZG35009K5
VR1246	152-0428-00			SEMICONV DEVICE:ZENER,0.4W,120V,5%	80009	152-0428-00
VR1253	152-0149-00			SEMICONV DEVICE:ZENER,0.4W,10V,5%	04713	SZG35009K3
VR1279	152-0304-00			SEMICONV DEVICE:ZENER,0.4W,20V,5%	15238	Z5411
VR1297	152-0212-00			SEMICONV DEVICE:ZENER,0.5W,9V,5%	04713	SZ50646RL
VR1401	152-0226-00			SEMICONV DEVICE:ZENER,0.4W,5.1V,5%	14552	TD3810980
VR1461	152-0226-00			SEMICONV DEVICE:ZENER,0.4W,5.1V,5%	14552	TD3810980
VR1501	152-0127-00			SEMICONV DEVICE:ZENER,0.4W,7.5V,5%	04713	SZG35009K2
VR1505	152-0212-00			SEMICONV DEVICE:ZENER,0.5W,9V,5%	04713	SZ50646RL
VR1635	152-0255-00			SEMICONV DEVICE:ZENER,0.4W,51V,5%	80009	152-0255-00
VR1701	152-0247-00			SEMICONV DEVICE:ZENER,0.4W,150V,5%	04713	SZG275K1RL
VR2262	152-0405-00			SEMICONV DEVICE:ZENER,1W,15V,5%	80009	152-0405-00
VR2263	152-0405-00			SEMICONV DEVICE:ZENER,1W,15V,5%	80009	152-0405-00
VR2264	152-0405-00			SEMICONV DEVICE:ZENER,1W,15V,5%	80009	152-0405-00
VR4943	152-0149-00			SEMICONV DEVICE:ZENER,0.4W,10V,5%	04713	SZG35009K3
VR4950	152-0282-00			SEMICONV DEVICE:ZENER,0.4W,30V,5%	14552	1N972B
VR5565	153-0030-00			SEMICONV DVC SE:MTCHD WITHIN 0.1V AT 0.4W (NONREPLACEABLE SUBPART OF VR5565)	80009	153-0030-00
VR5566	-----					
VR5663	152-0217-00			SEMICONV DEVICE:ZENER,0.4W,8.2V,5%	04713	SZG20
VR5665	153-0030-00			SEMICONV DVC SE:MTCHD WITHIN 0.1V AT 0.4W (NONREPLACEABLE SUBPART OF VR5665)	80009	153-0030-00
VR5666	-----					
W5684	131-0566-00	B268530		BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

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

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

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

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

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

Abbreviations are based on ANSI Y1.1-1972.

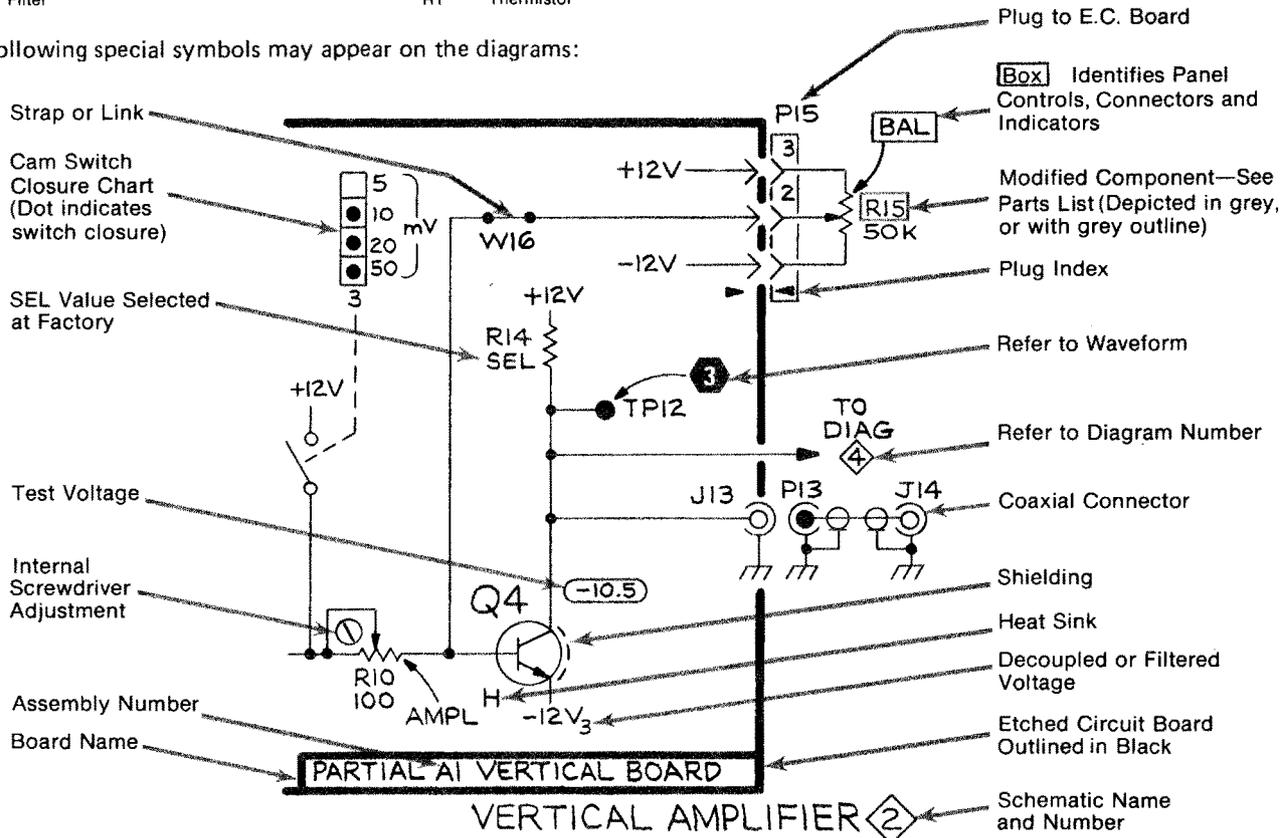
Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

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

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

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

The following special symbols may appear on the diagrams:



VOLTAGE AND WAVEFORM CONDITIONS

WARNING

Dangerous potentials exist at several points throughout this instrument. When the instrument is operated with covers removed, do not touch exposed connections or components. Some transistors have voltage present on their cases. Disconnect the power source before replacing parts.

RECOMMENDED TEST EQUIPMENT

Item	Performance Requirements	Recommended Type
Oscilloscope system	Frequency response dc to 75 MHz; deflection factor, 10 mV to 20 V/div; input impedance, 1 M Ω . Probe: 10X attenuation probe compatible with vertical input.	TEKTRONIX 7603, 7A18, 7B53A Oscilloscope System. Use a TEKTRONIX P6053B Probe.
Voltmeter (Non-loading digital multimeter)	Range, 0 to 150 V; input impedance, 10 M Ω .	TEKTRONIX DM 501 Digital Multimeter with power module.

Voltage Measurements

Voltage measurements shown on this diagram were obtained under the following conditions:

- Front-panel controls (knob type) at midrange, except the A INTENSITY control is set at minimum.
- Set VERT MODE switch to LEFT.
- Set HORIZONTAL MODE switch to A.
- Set A & B TRIG SOURCE switches to VERT MODE.
- Voltmeter common is connected to chassis ground.

Waveform Conditions

Oscilloscope Under Test. Front-panel controls are set the same as for voltage measurements, except Intensity and Readout controls are adjusted as desired. Install an amplifier unit in the left vertical compartment and a time-base unit in the A horizontal compartment. Connect the CAL VOLTS output signal to the amplifier unit (set vertical input coupling to dc and volts/div for a 2-division display). Set the time-base unit for internal triggering; auto, at 1 ms/div sweep rate.

The waveforms shown are actual waveform photographs taken with a Tektronix Oscilloscope Camera System and Projected Graticule. Vertical deflection factor shown on the waveform is the actual deflection factor from the probe tip. Voltages and waveforms on the diagrams are not absolute and may vary between instruments because of component tolerances, internal calibration, or front-panel settings. Readouts are simulated in larger-than-normal type. Waveform ground reference is the center horizontal graticule line.

The Readout control is Off (detent) for all waveform conditions, except for the Readout System diagram; in which case the Readout control is set to normal viewing and test oscilloscope is externally triggered from TP2251.

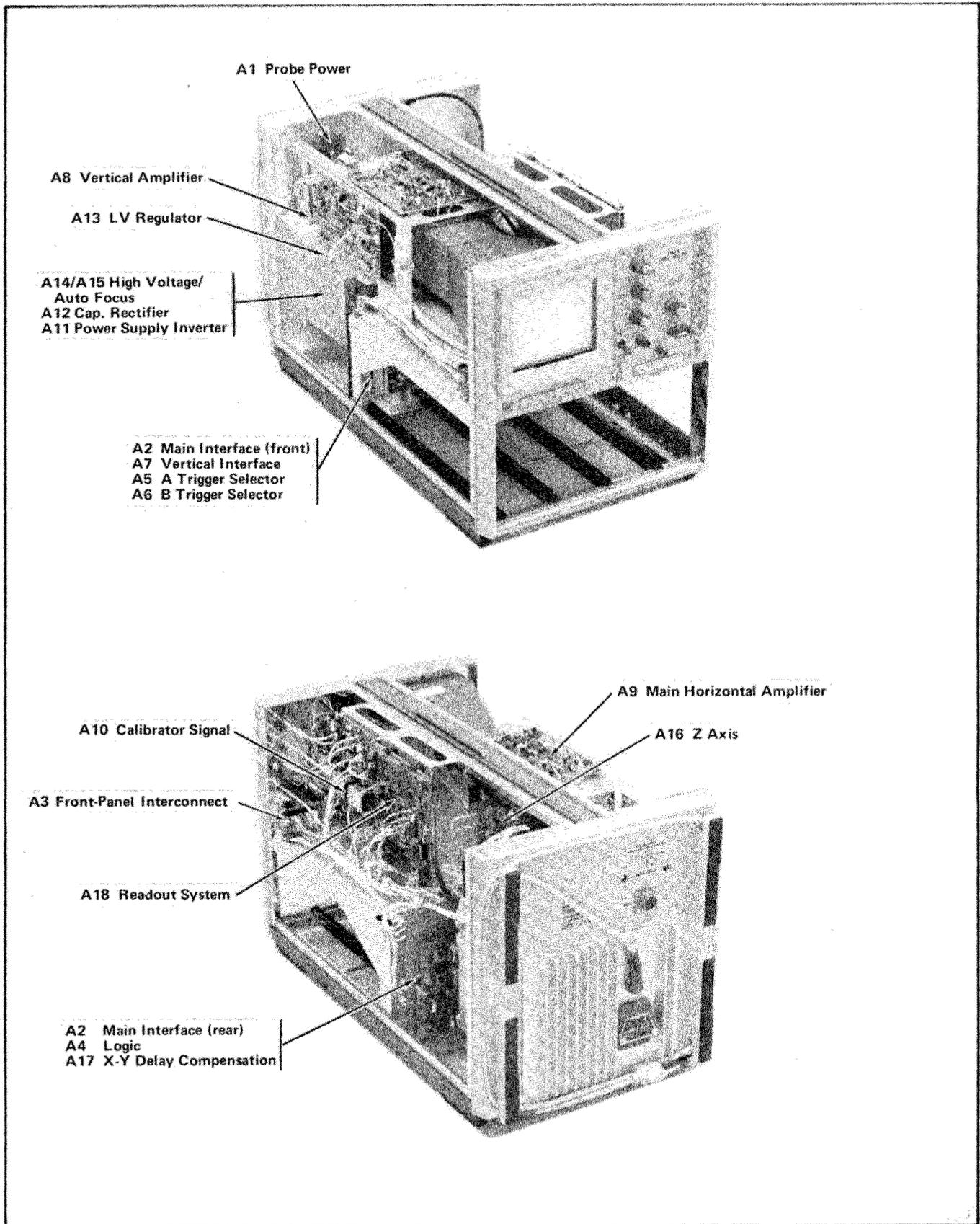
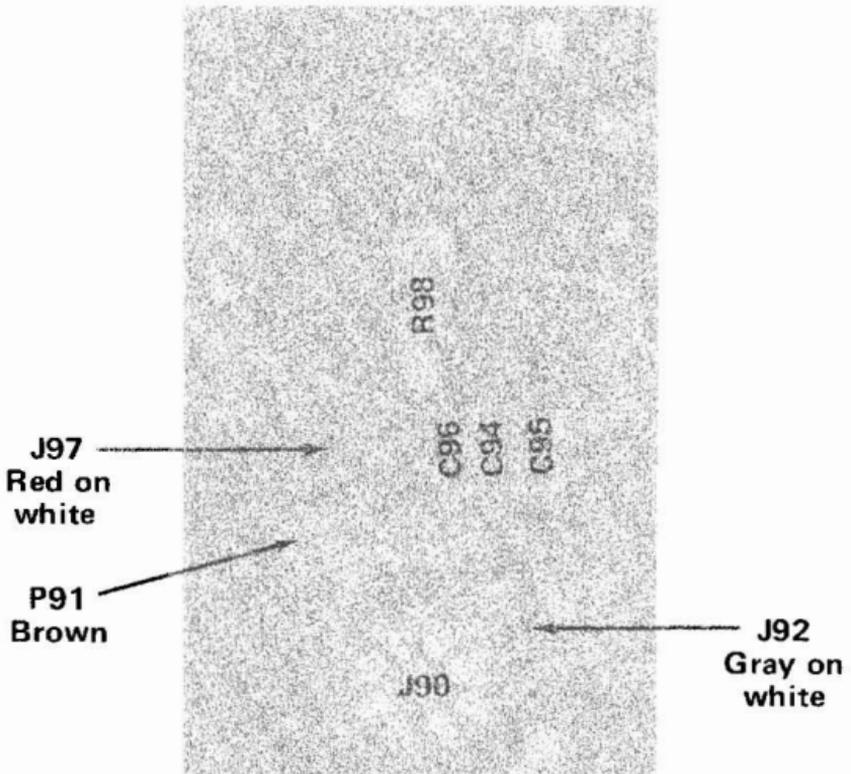
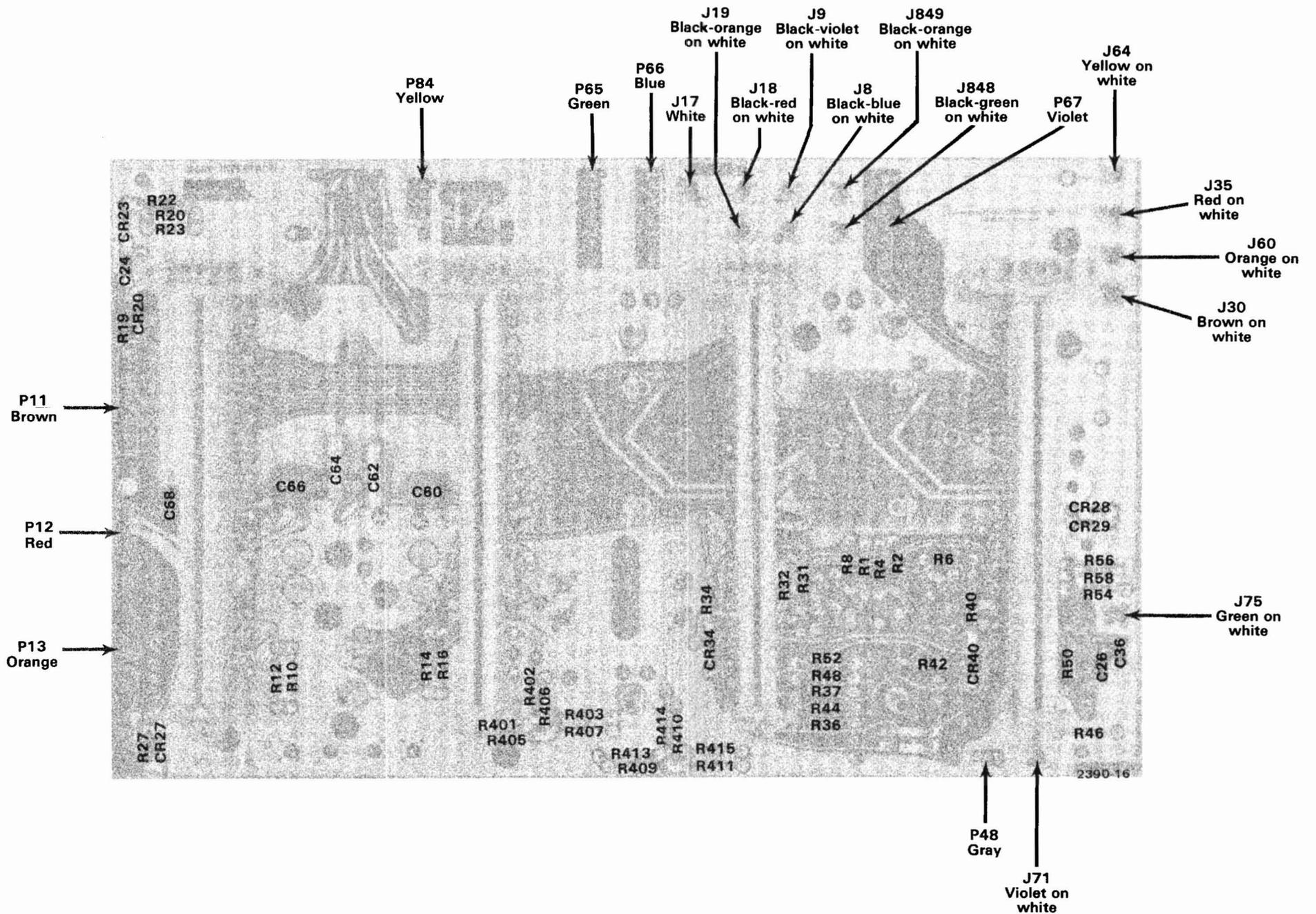


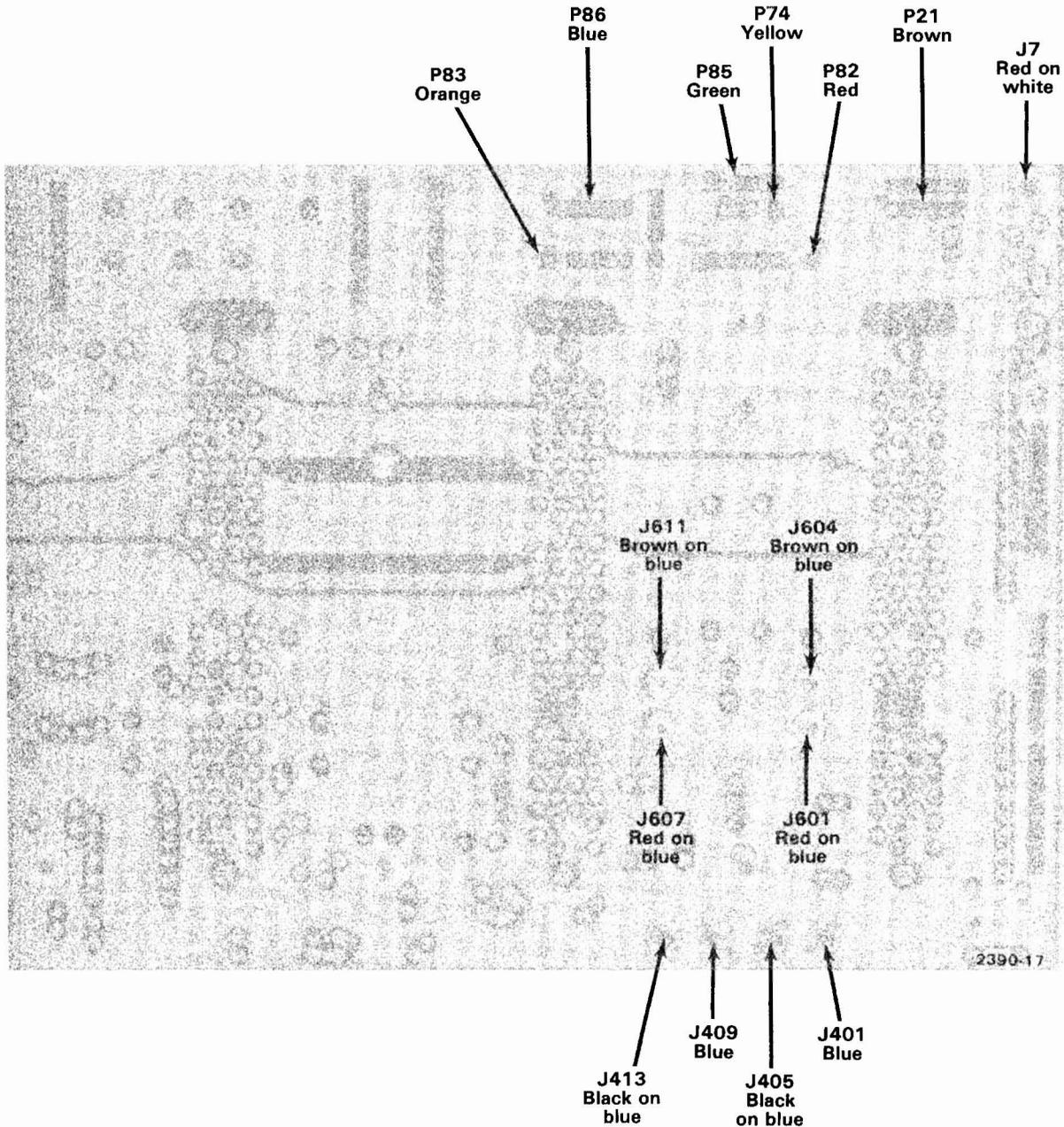
Fig. 8-1. Location of circuit boards in the 7904.



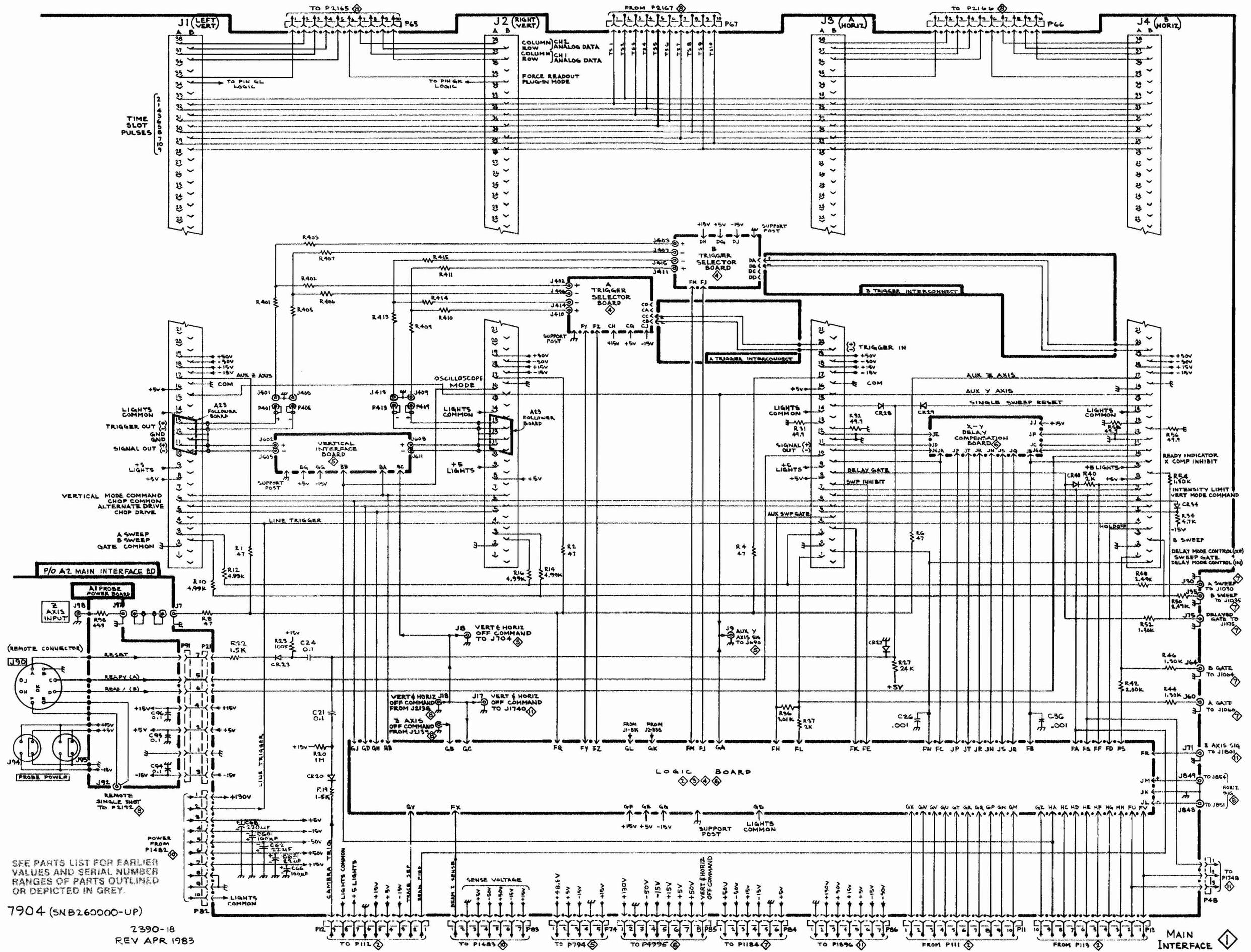
A1—Probe Power circuit board.



A2—Main Interface circuit board (front view).



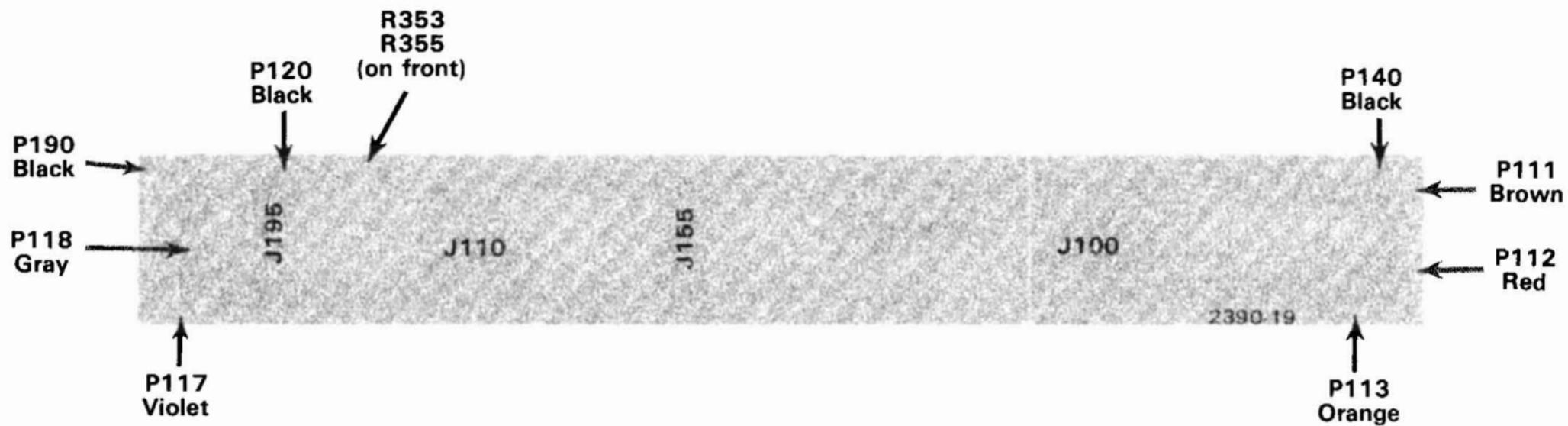
A2—Main Interface circuit board (rear view).



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

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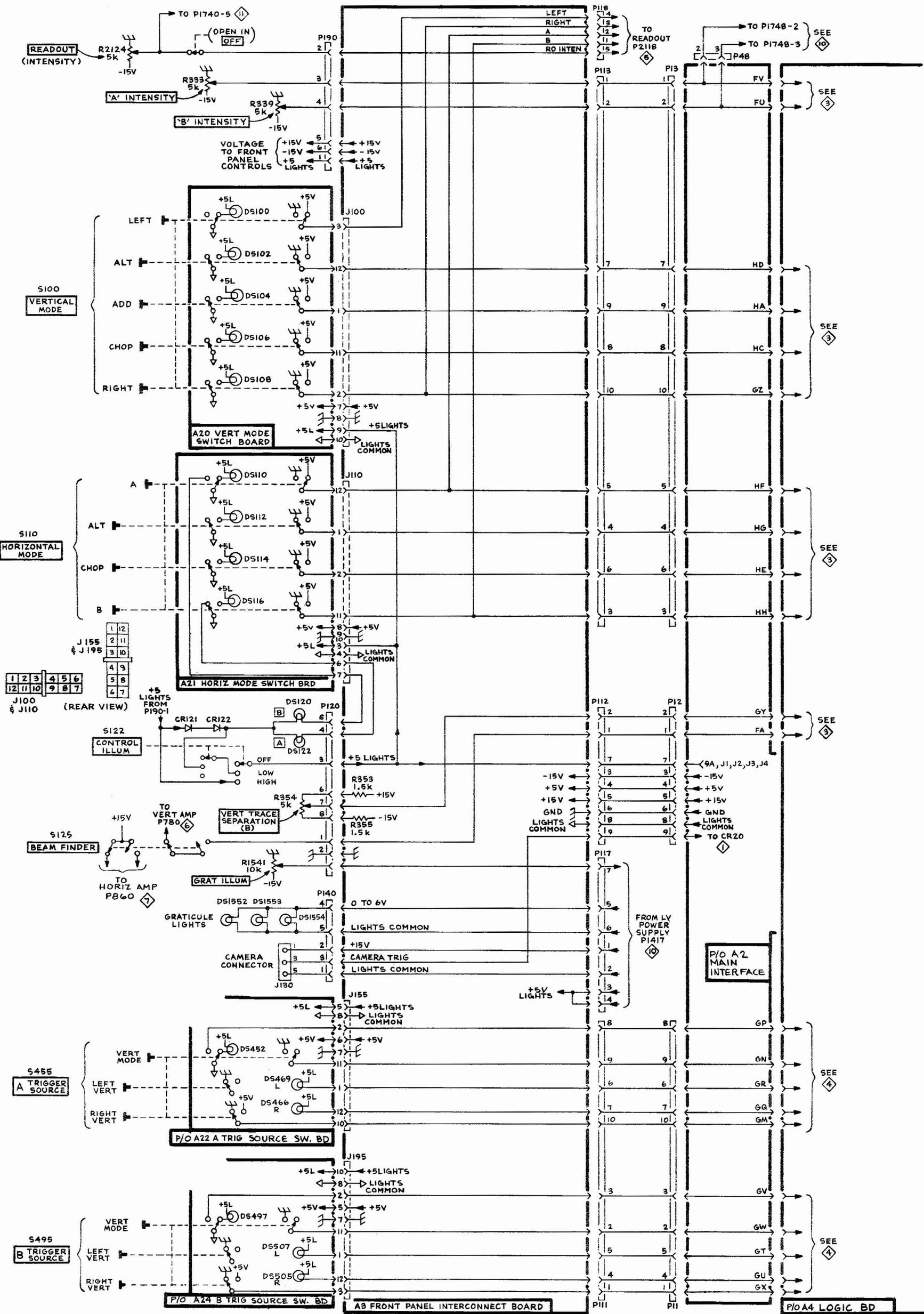
A3—Front Panel Interconnect circuit board (rear view).

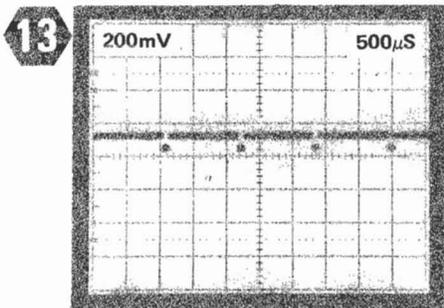
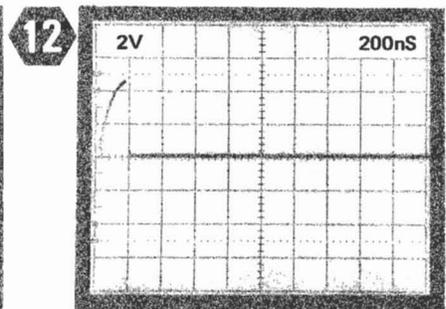
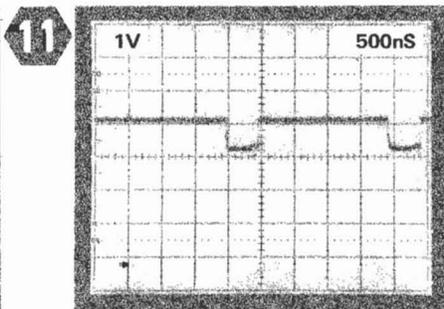
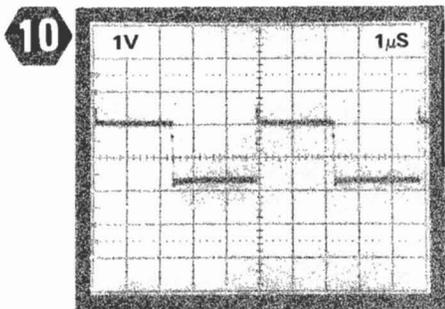
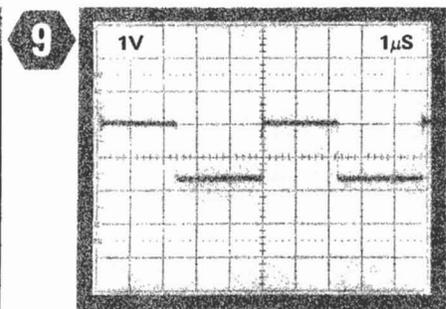
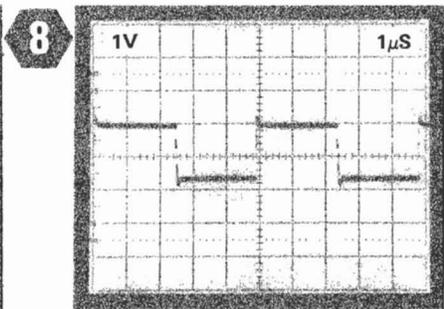
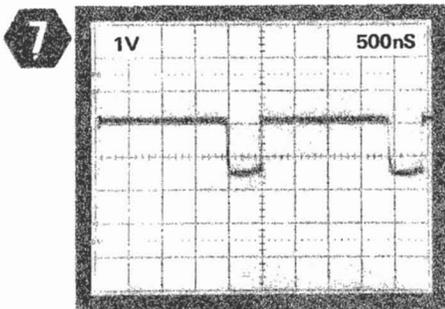
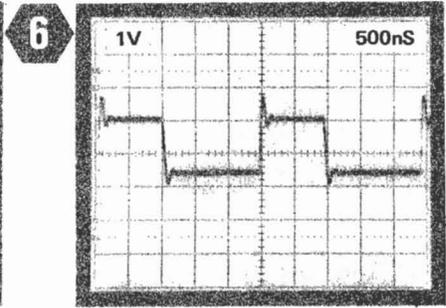
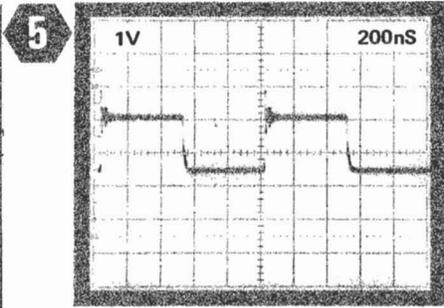
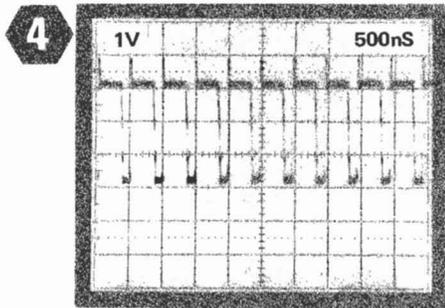
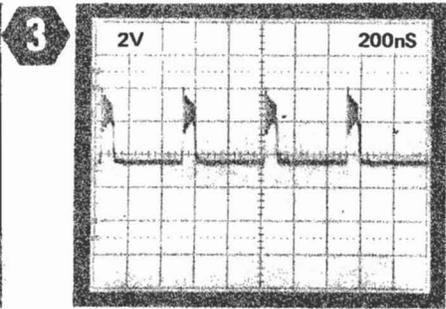
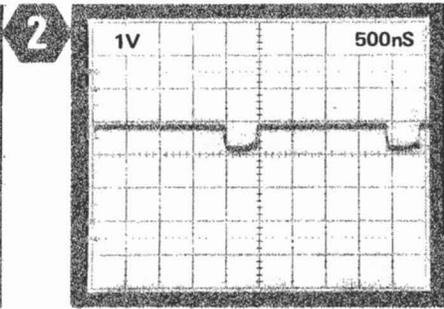
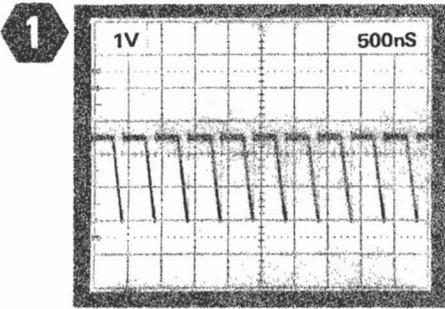
7904 (SN B260000-UP)

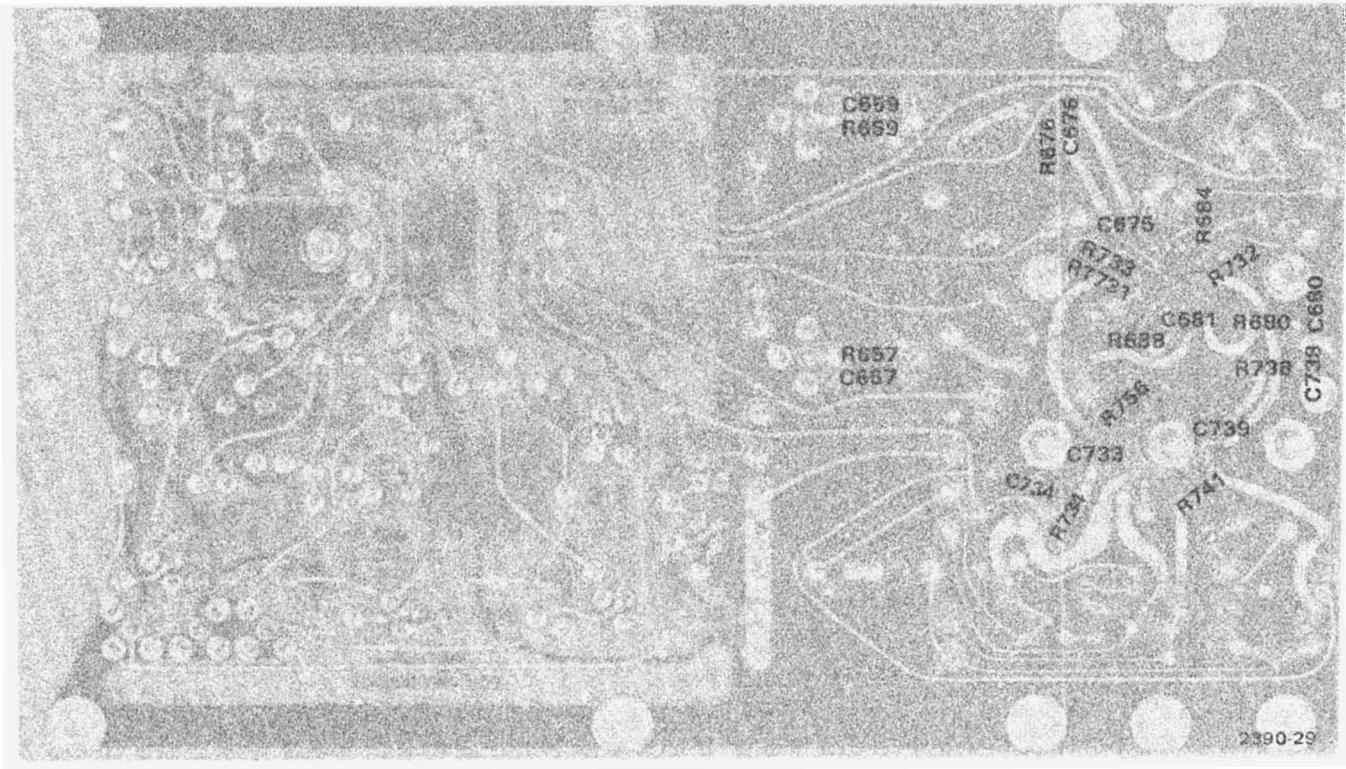
2390-20

FRONT PANEL INTERCONNECT

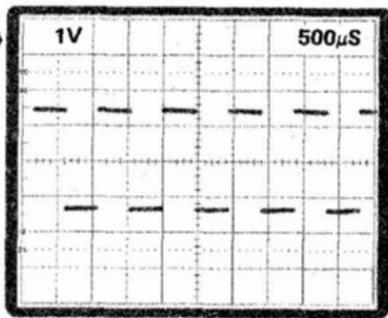
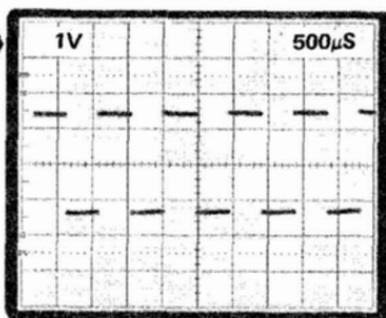
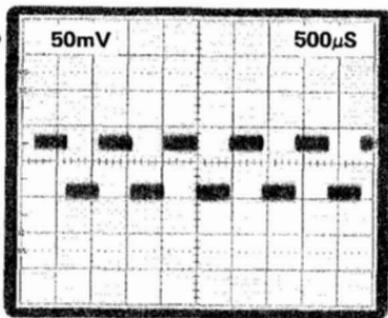
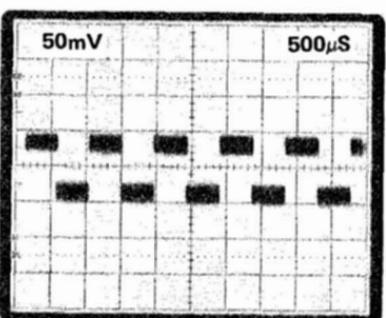
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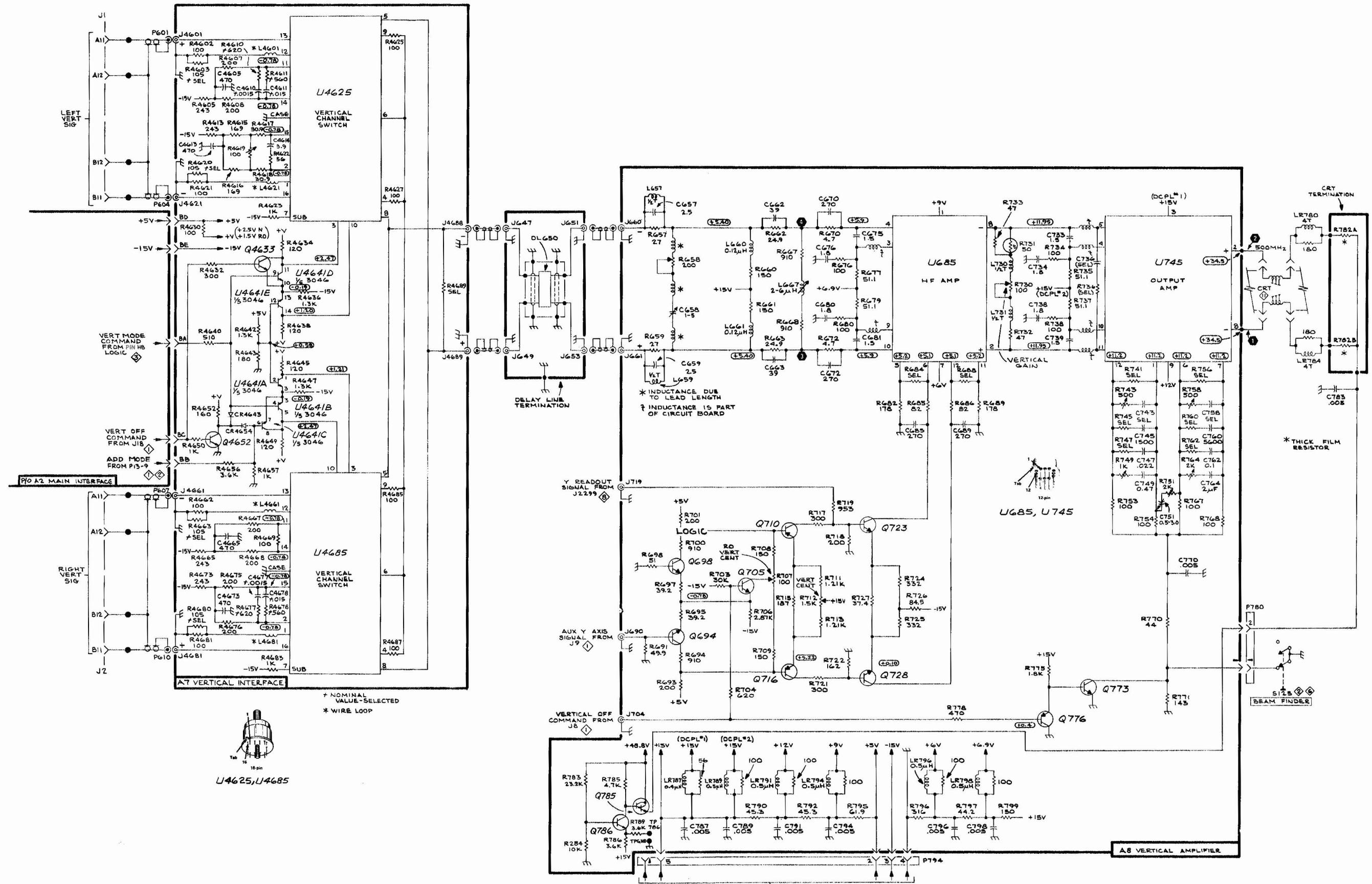






A8—Vertical Amplifier circuit board (rear view).

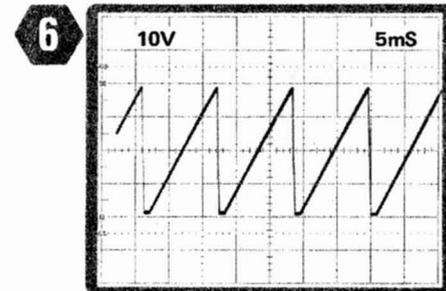
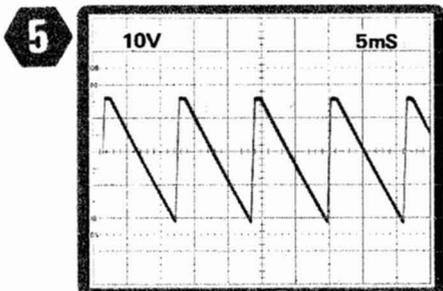
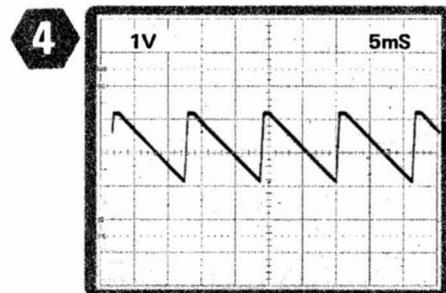
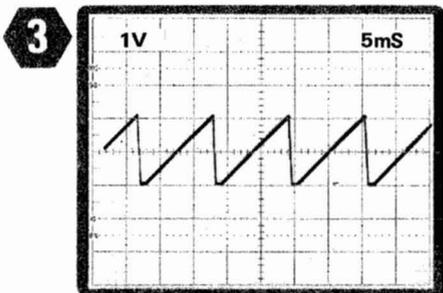
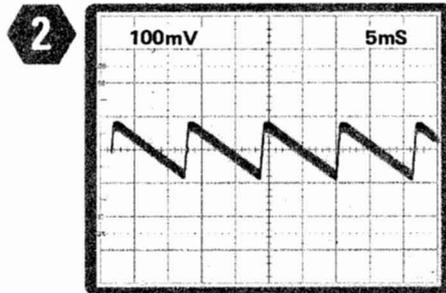
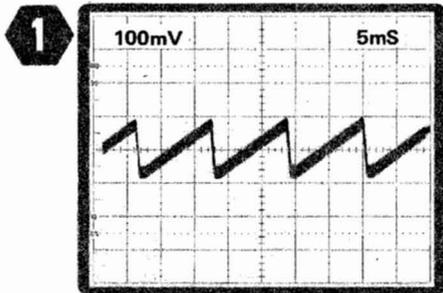
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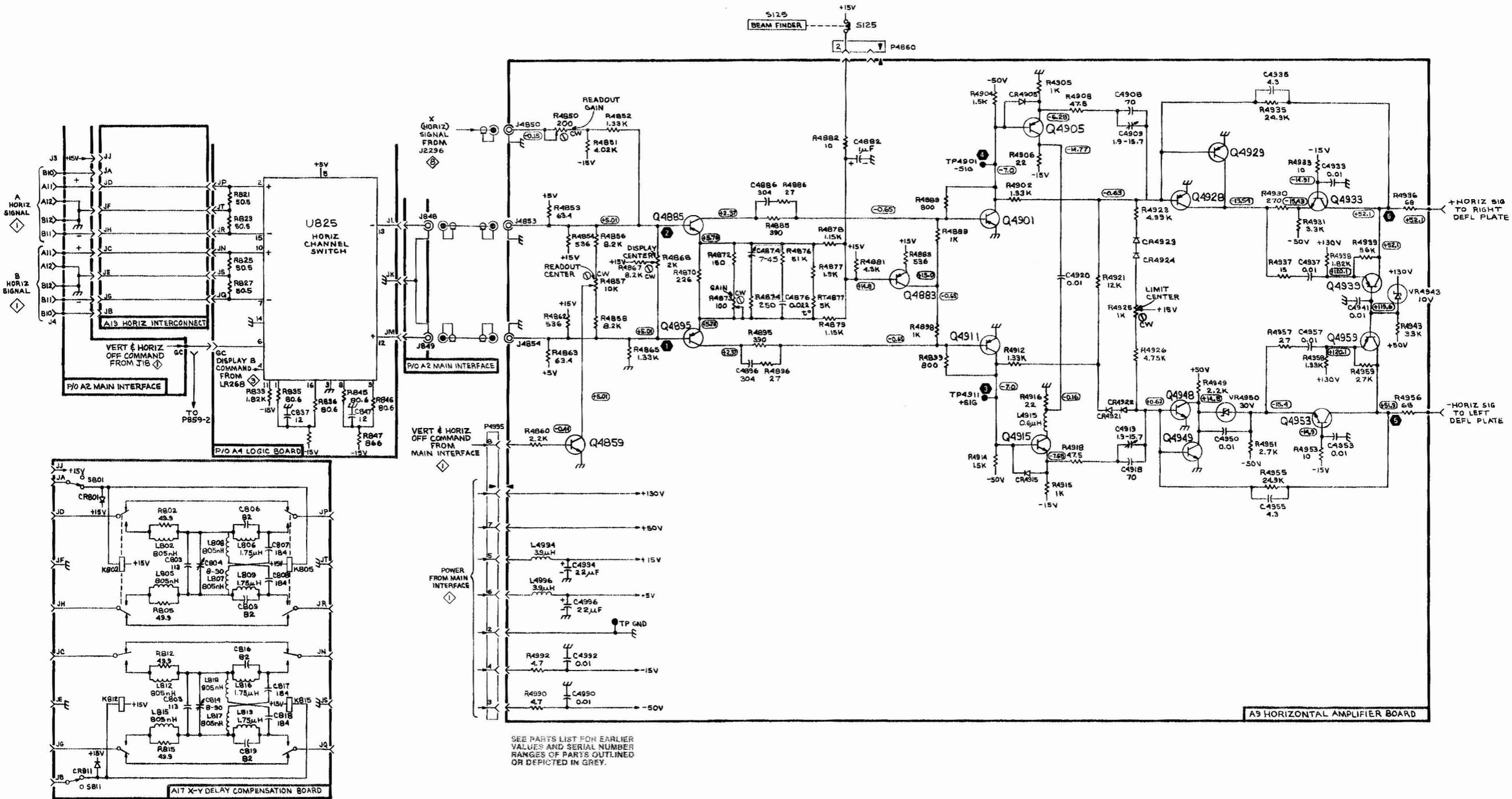


7904 (SN B260000-UP)

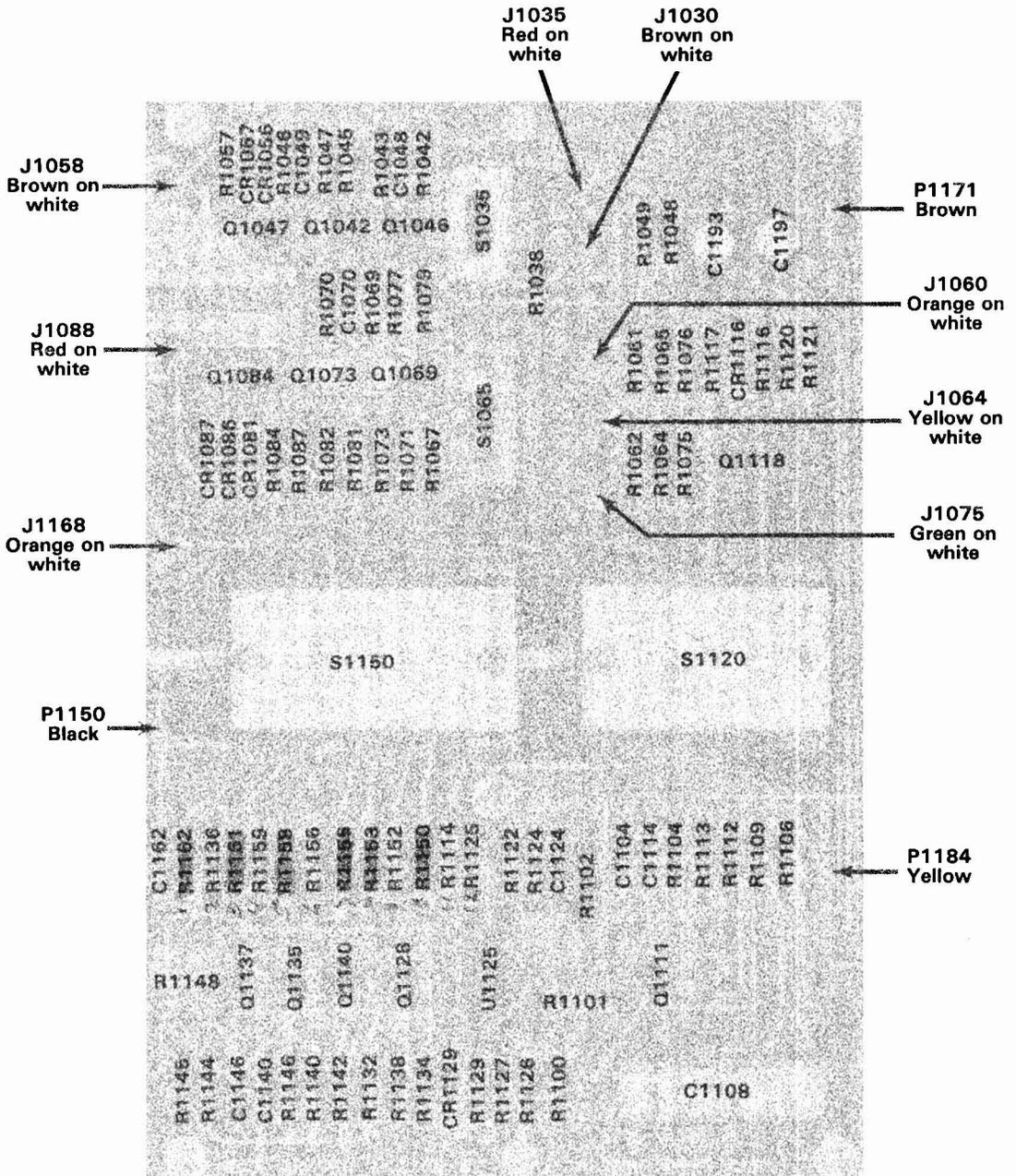
2390-31
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VERTICAL AMPLIFIER (S) RL

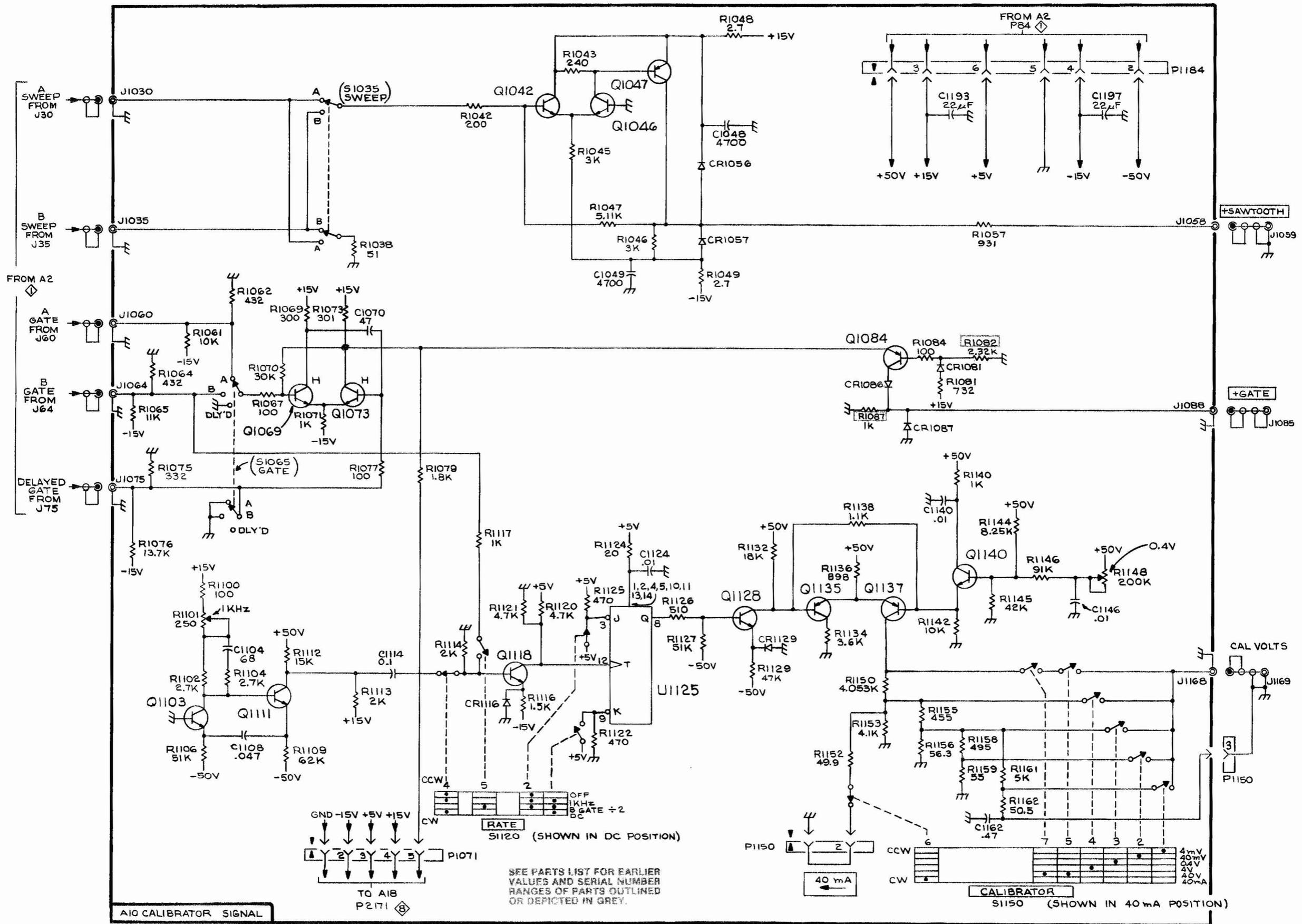




SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.



A10—Calibrator-Signal circuit board.



CR2249	CR2248	CR2257	CR2256	CR2238
CR2250	CR2247	CR2258	CR2255	CR2237
CR2263	CR2262	CR2243	CR2242	CR2252
CR2264	CR2261	CR2244	CR2241	CR2251
CR2265	CR2260	CR2245	CR2240	CR2254
CR2266	CR2259	CR2246	CR2239	CR2253

CR2236

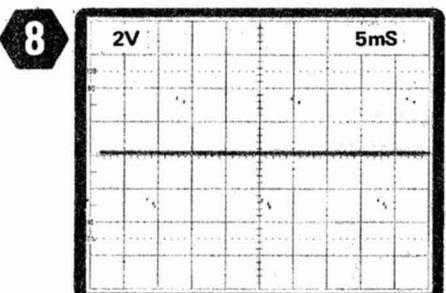
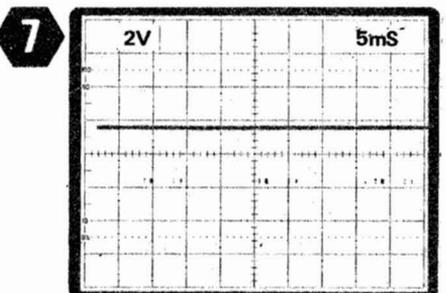
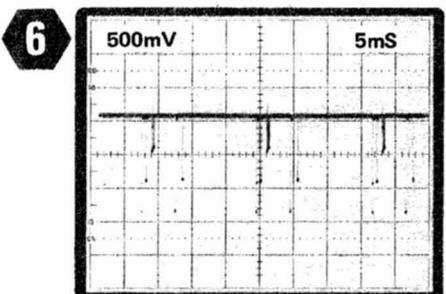
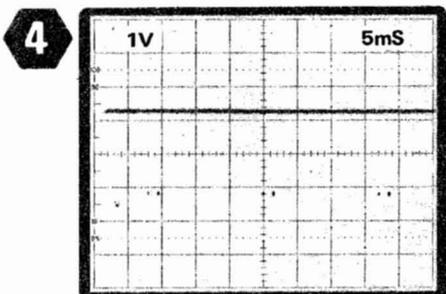
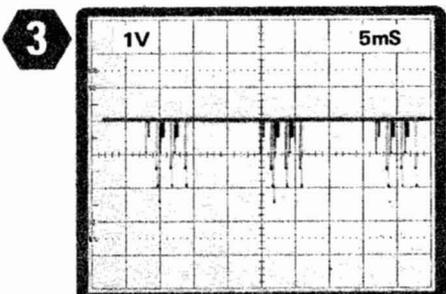
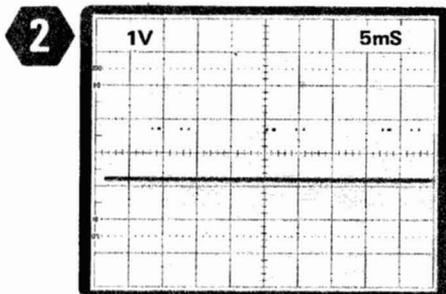
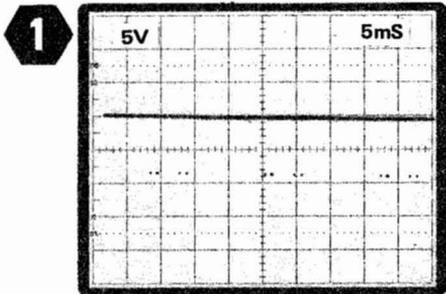
CR2235

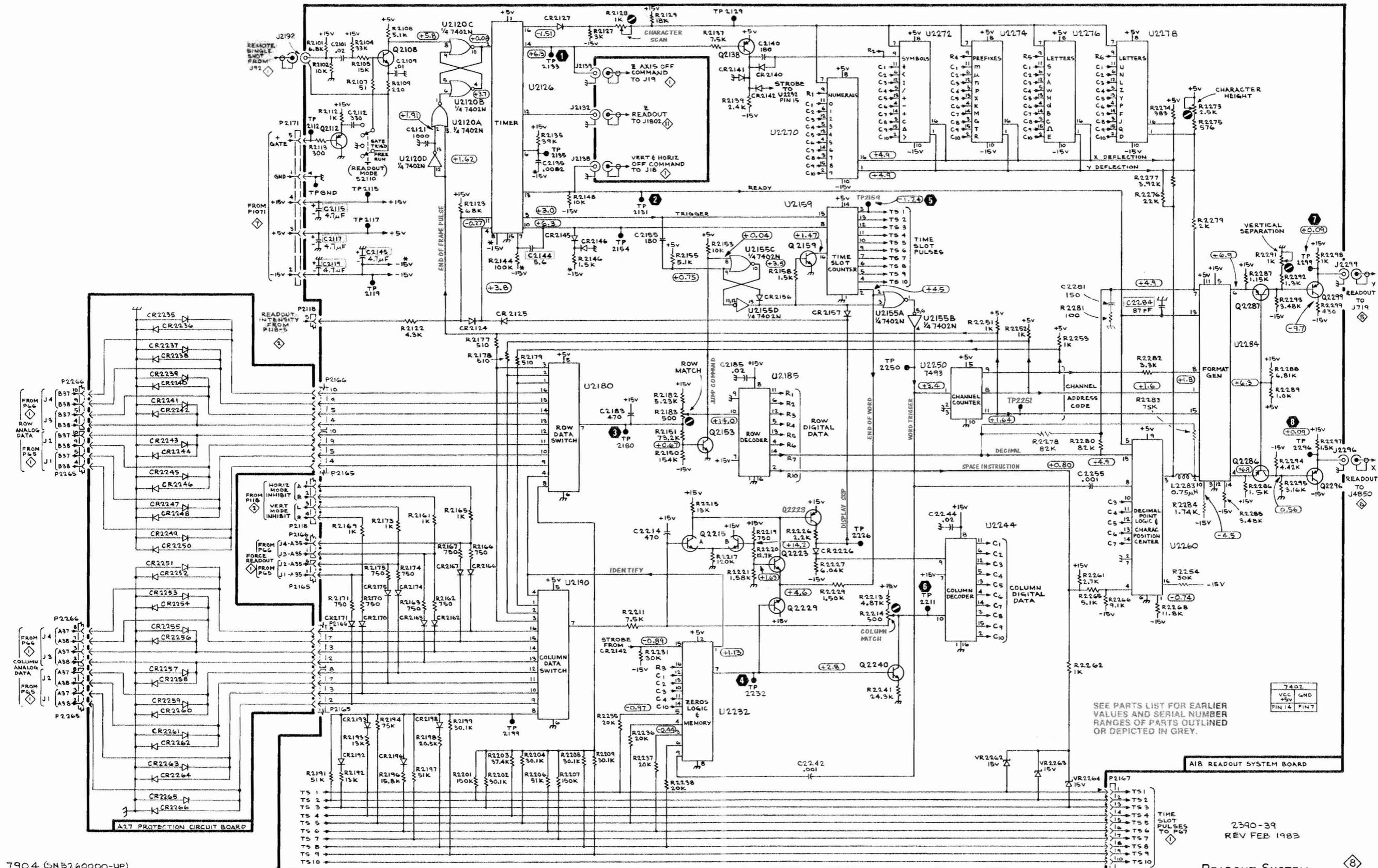
2390-37

P2265

P2266

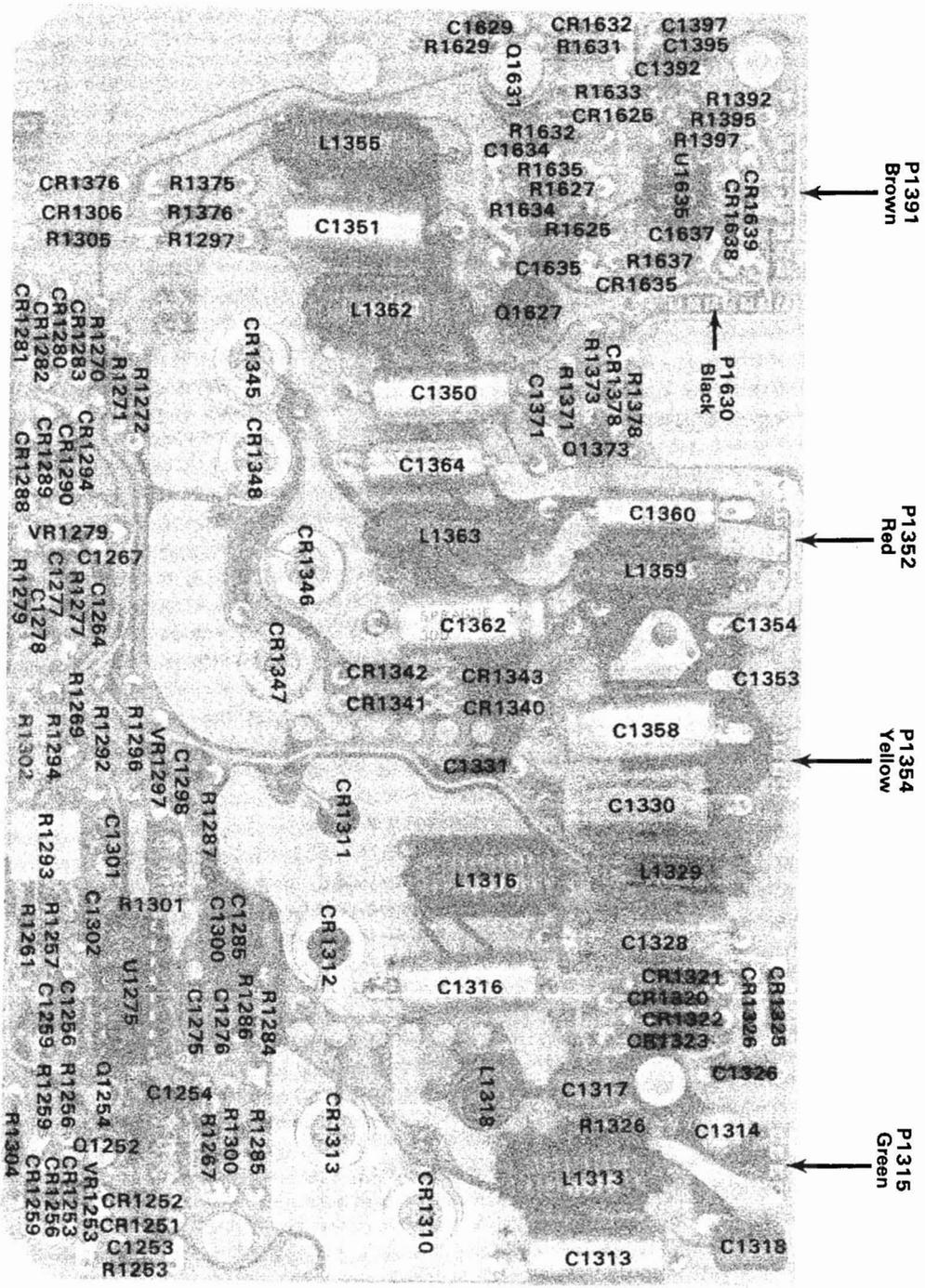
A27—Protection circuit board.





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READOUT SYSTEM



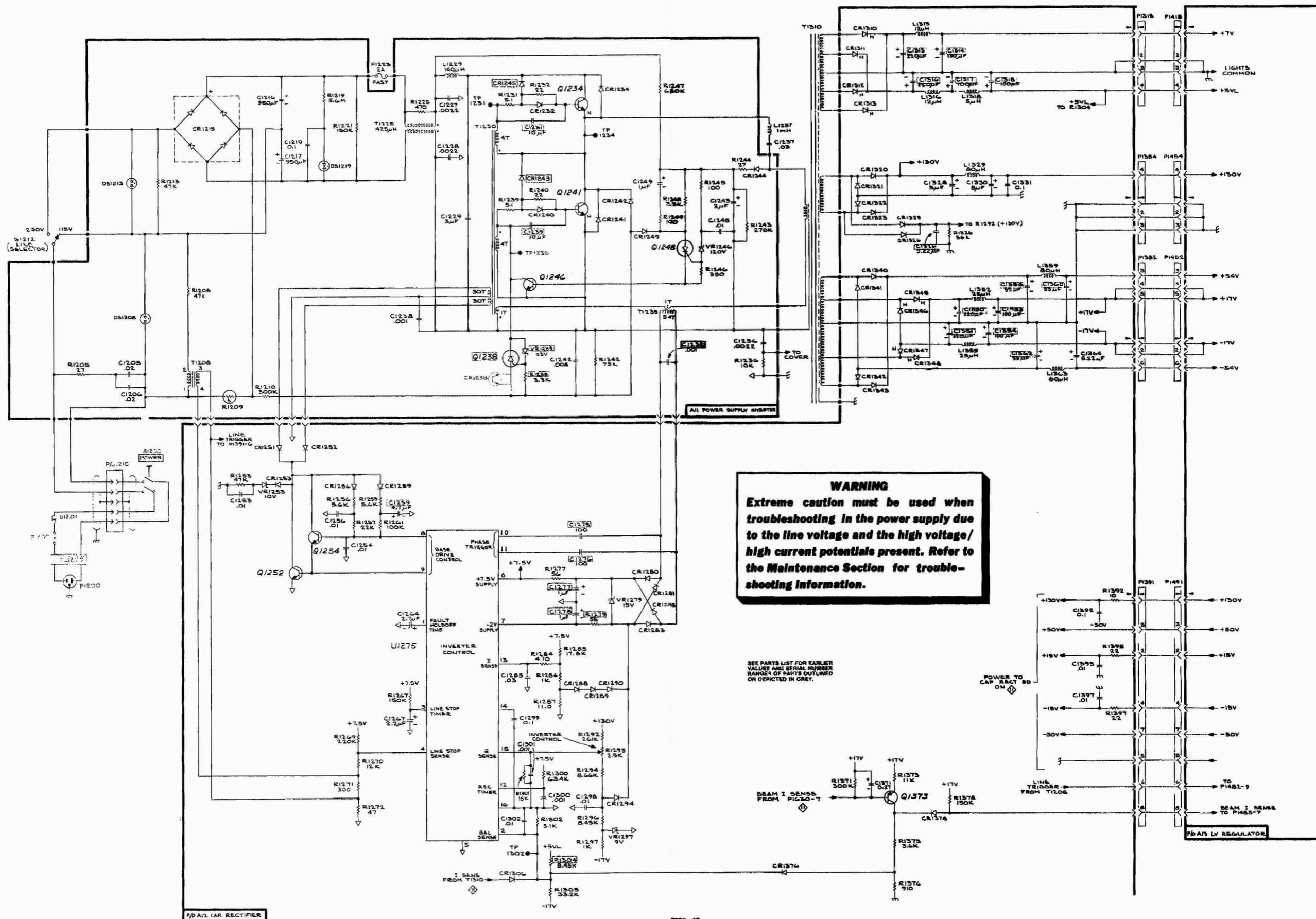
P1391
Brown

P1352
Red

P1354
Yellow

P1315
Green

A12—Cap. Rectifier circuit board.



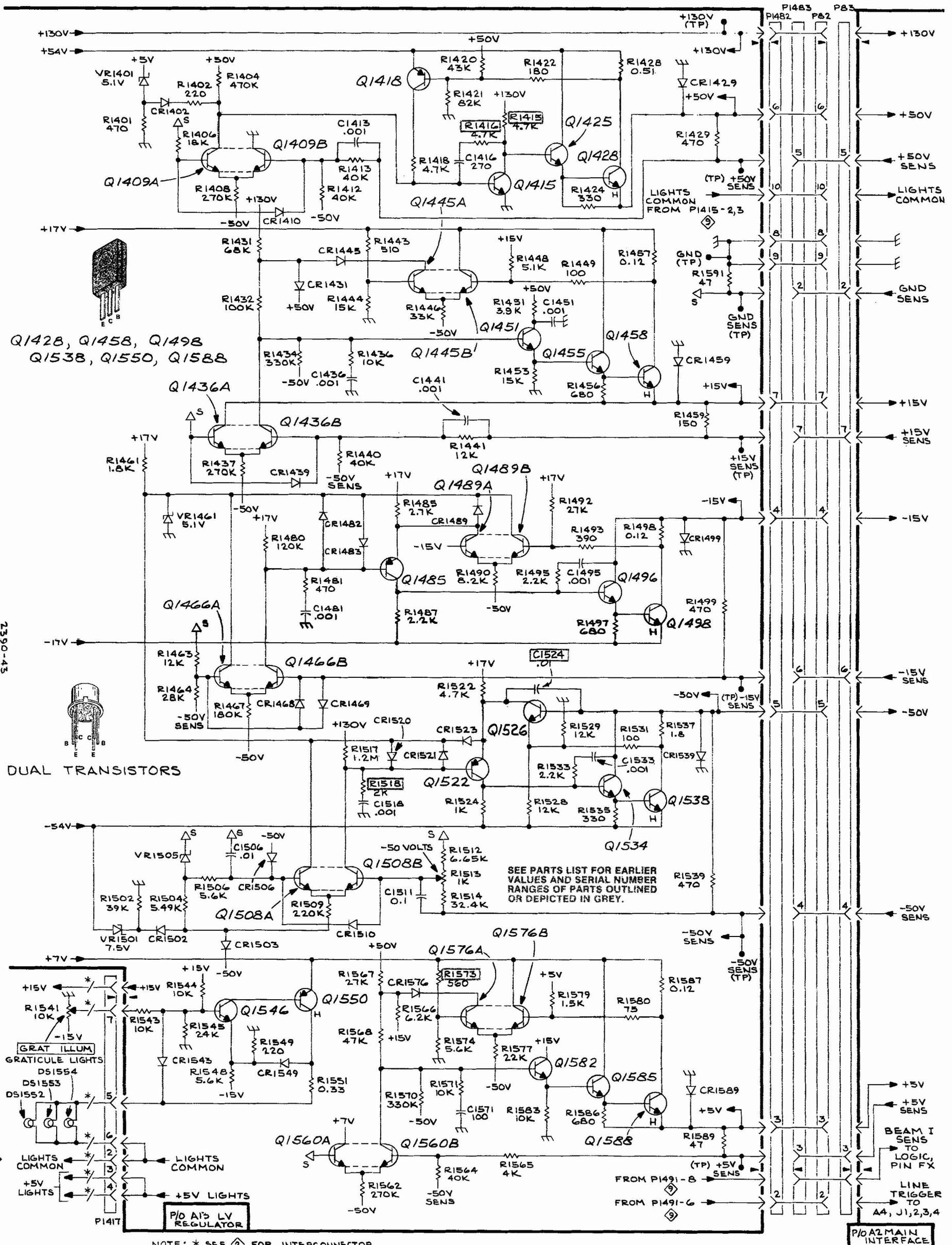
WARNING
 Extreme caution must be used when troubleshooting in the power supply due to the line voltage and the high voltage/high current potentials present. Refer to the Maintenance Section for troubleshooting information.

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBERS RANGE 9 OF PARTS OUTLINED OR DEPICTED IN GREY.

7904 (SNR26000-U)

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REV JUL 1981

LOW-VOLTAGE REGULATORS

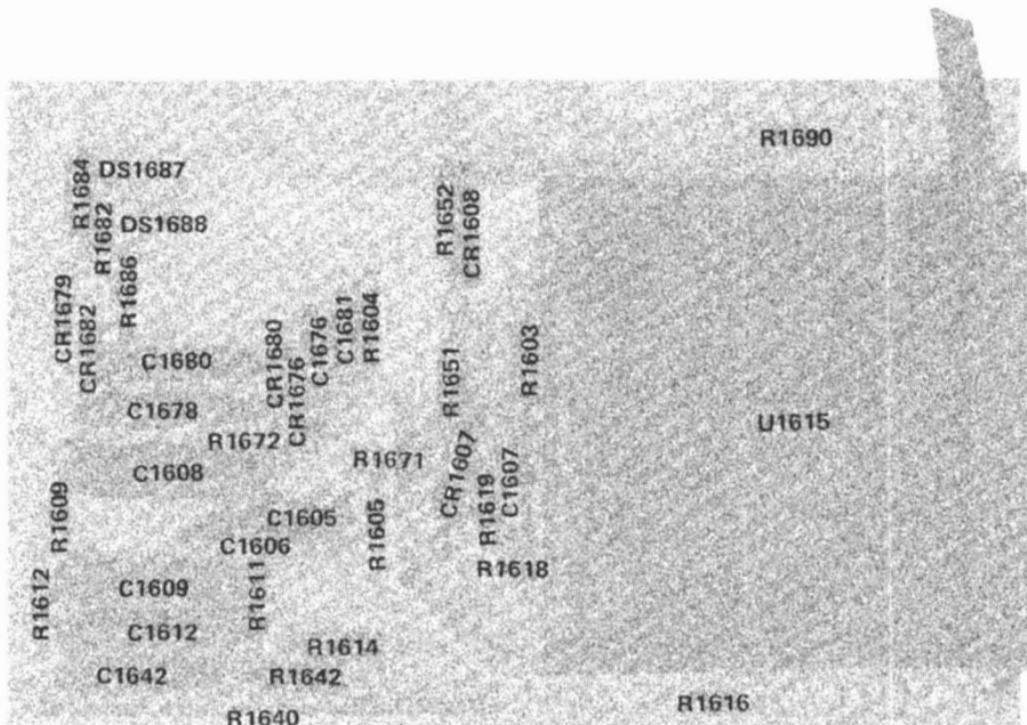


Q142B, Q1458, Q149B
Q1538, Q1550, Q1588

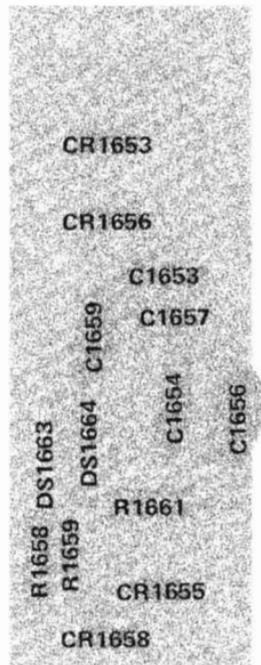
DUAL TRANSISTORS

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

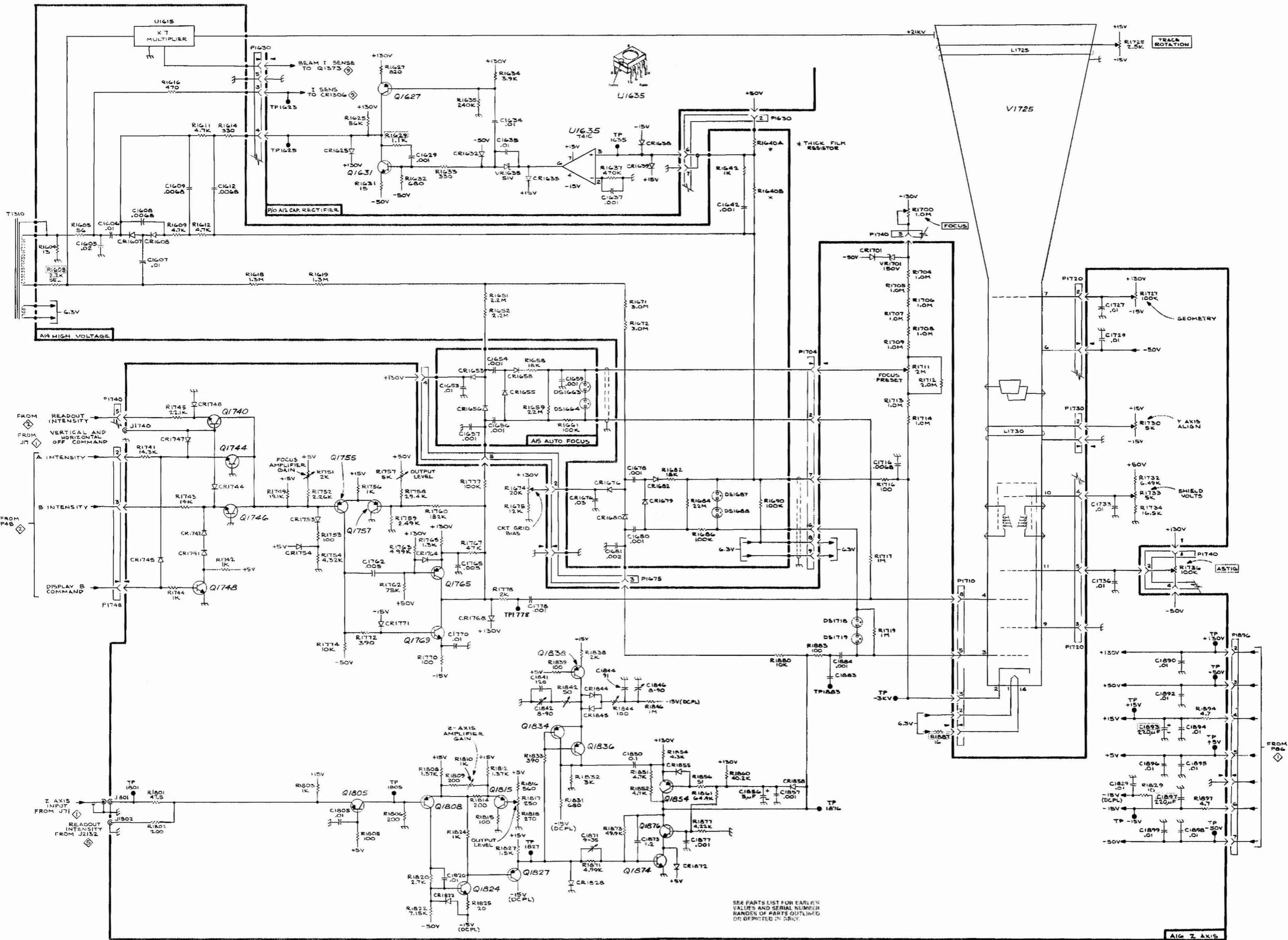
NOTE: * SEE (2) FOR INTERCONNECTOR
DETAILS.



A14—High Voltage circuit board.



A15—Auto Focus circuit board.



SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DELETED IN CRY.

2350-44
REV APR 1983

7904 (SNB160000-UP)

CRT CIRCUIT (27)
RL

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

Replaceable Mechanical Parts—7904 (SN B260000 & UP)

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000BK	STAUFFER SUPPLY	105 SE TAYLOR	PORTLAND, OR 97214
000CY	NORTHWEST FASTENER SALES, INC.	7923 SW CIRRUS DRIVE	BEAVERTON, OR 97005
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
00866	GOE ENGINEERING COMPANY, INC.	P O BOX 3485, 250 S 9TH AVE.	CITY OF INDUSTRY, CA 91746
02660	BUNKER RAMO CORP., CONNECTOR DIVISION	2801 S 25TH AVENUE	BROADVIEW, IL 60153
02768	ILLINOIS TOOL WORKS, INC., FASTEX DIV.	195 ALGONQUIN ROAD	DES PLAINES, IL 60016
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
04963	MINNESOTA MINING AND MFG. CO., ADHESIVES COATINGS AND SEALERS DIVISION	3M CENTER	ST. PAUL, MN 55101
06229	ELECTROVERT, INC.	86 HARTFORD AVENUE	MT. VERNON, NY 10553
07700	TECHNICAL WIRE AND PRODUCTS, INC.	129 DERMODY ST.	CRANFORD, NJ 07016
07707	USM CORP., USM FASTENER DIV.	510 RIVER RD.	SHELTON, CT 06484
08261	SPECTRA-STRIP CORP.	7100 LAMPSON AVE.	GARDEN GROVE, CA 92642
08530	RELIANCE MICA CORP.	342-39TH ST.	BROOKLYN, NY 11232
09422	PLASTIC STAMPING CORPORATION	2216 W. ARMITAGE AVE.	CHICAGO, IL 60647
09922	BURNDY CORPORATION	RICHARDS AVENUE	NORWALK, CT 06852
11897	PLASTIGLIDE MFG. CORPORATION	P O BOX 867, 1757 STANFORD ST.	SANTA MONICA, CA 90406
12014	CHICAGO RIVET AND MACHINE CO.	950 S. 25TH AVENUE	BELLWOOD, IL 60104
12327	FREEWAY CORPORATION	9301 ALLEN DRIVE	CLEVELAND, OH 44125
13511	AMPHENOL CARDRE DIV., BUNKER RAMO CORP.		LOS GATOS, CA 95030
16428	BELDEN CORP.	P. O. BOX 1331	RICHMOND, IN 47374
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
23050	PRODUCT COMPONENTS CORP	30 LORRAINE AVE.	MT VERNON, NY 10553
26365	GRIES REPRODUCER CO., DIV. OF COATS AND CLARK, INC.	125 BEECHWOOD AVE.	NEW ROCHELLE, NY 10802
57668	R-OHM CORP.	16931 MILLIKEN AVE.	IRVINE, CA 92713
70276	ALLEN MFG. CO.	P. O. DRAWER 570	HARTFORD, CT 06101
70485	ATLANTIC INDIA RUBBER WORKS, INC.	571 W. POLK ST.	CHICAGO, IL 60607
70903	BELDEN CORP.	2000 S BATAVIA AVENUE	GENEVA, IL 60134
71159	BRISTOL SOCKET SCREW, DIV. OF AMERICAN CHAIN AND CABLE CO., INC.	P O BOX 2244, 40 BRISTOL ST.	WATERBURY, CT 06720
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
71785	TRW, CINCH CONNECTORS	1501 MORSE AVENUE	ELK GROVE VILLAGE, IL 60007
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
73803	TEXAS INSTRUMENTS, INC., METALLURGICAL MATERIALS DIV.	34 FOREST STREET	ATTLEBORO, MA 02703
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
79136	WALDES, KOHINOOR, INC.	47-16 AUSTEL PLACE	LONG ISLAND CITY, NY 11101
79727	C-W INDUSTRIES	550 DAVISVILLE RD.,P O BOX 96	WARMINISTER, PA 18974
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
80033	PRESTOLE EVERLOCK, INC.	P. O. BOX 278,1345 MIAMI ST.	TOLEDO, OH 43605
80126	PACIFIC ELECTRICORD CO.	747 W. REDONDO BEACH,P O BOX 10	GARDENA, CA 90247
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
83903	ACCURATE DIE AND STAMPING DIV., ALLIED PRODUCTS CORP.	1947 N. MAUD AVE.	CHICAGO, IL 60614
86577	PRECISION METAL PRODUCTS OF MALDEN, INC.	41 ELM ST.	STONEHAM, MA 02180
86928	SEASTROM MFG. COMPANY, INC.	701 SONORA AVENUE	GLENDALE, CA 91201
87308	N. L. INDUSTRIES, INC., SOUTHERN SCREW DIV.	P. O. BOX 1360	STATESVILLE, NC 28677
91836	KINGS ELECTRONICS CO., INC.	40 MARBLEDALE ROAD	TUCKAHOE, NY 10707
93907	TEXTRON INC. CAMCAR DIV	600 18TH AVE	ROCKFORD, IL 61101
95987	WECKESSER CO., INC.	4444 WEST IRVING PARK RD.	CHICAGO, IL 60641
98291	SEAELECTRO CORP.	225 HOYT	MAMARONECK, NY 10544
98410	ETC, DIVISION OF ITT	990 E. 67TH STREET	CLEVELAND, OH 44103
K0099	JACKSON BROS (LONDON) LTD.	258 BROADWAY	NEW YORK, NEW YORK 10007
S3109	C/O PANEL COMPONENTS CORP.	P.O. BOX 6626	SANTA ROSA, CA 95406

Replaceable Mechanical Parts—7904 (SN B260000 & UP)

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont									
1-1	390-0086-00			2						CAB,SIDE,SCOPE:LEFT & RIGHT SIDE	80009	390-0086-00
	214-0812-00			4						.FASTENER,PAWL:	80009	214-0812-00
-2	386-0226-00			1						..CLAMP,RIM CLENC:SPG STL CD PL	80009	386-0226-00
-3	386-0227-00			1						..STOP,CLP,RIM CL:ACETAL	80009	386-0227-00
-4	214-0604-00			1						..WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-5	214-0603-01			1						..PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-6	390-0085-00			1						CAB,BOT,SCOPE:BOTTOM	80009	390-0085-00
	214-0812-00			8						.FASTENER,PAWL:	80009	214-0812-00
-7	386-0226-00			1						..CLAMP,RIM CLENC:SPG STL CD PL	80009	386-0226-00
-8	386-0227-00			1						..STOP,CLP,RIM CL:ACETAL	80009	386-0227-00
-9	214-0604-00			1						..WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-10	214-0603-01			1						..PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-11	200-0973-00			2						COVER,HANDLE:1.738 X 0.888 X 0.22,PLSTC	80009	200-0973-00
-12	367-0108-00			1						HANDLE,CARRYING:19.19 L,BLUE VINYL *****ATTACHING PARTS*****	80009	367-0108-00
-13	213-0211-00			4						SCREW,SHOULDER:10-32 X 0.447,0.65 OD HD	80009	213-0211-00
-14	386-1624-00			2						PLATE,HDL RTNG:STAINLESS STEEL *****END ATTACHING PARTS*****	80009	386-1624-00
-15	386-1623-00			2						SPACER,PLATE:0.062 X 1.4 X 0.6,SST	80009	386-1623-00
-16	426-0848-00			1						FRAME SECT,CAB.:TOP CENTER *****ATTACHING PARTS*****	80009	426-0848-00
-17	212-0040-00			4						SCREW,MACHINE:8-32 X 0.375 100 DEG,FLH ST	83385	OBD
-18	210-0458-00			4						NUT,PL,ASSEM WA:8-32 X 0.344 INCH,STL *****END ATTACHING PARTS*****	83385	OBD
-19	426-0797-00			1						FRAME SECT,CAB:LOWER LEFT SIDE *****ATTACHING PARTS*****	80009	426-0797-00
-20	212-0040-00			2						SCREW,MACHINE:8-32 X 0.375 100 DEG,FLH ST	83385	OBD
-21	210-0458-00			2						NUT,PL,ASSEM WA:8-32 X 0.344 INCH,STL	83385	OBD
-22	212-0070-00			2						SCREW,MACHINE:8-32 X 0.312"100 DEG,FLH ST *****END ATTACHING PARTS*****	83385	OBD
-23	426-0810-00			1						FRAME SECT,CAB:LOWER RIGHT *****ATTACHING PARTS*****	80009	426-0810-00
-24	212-0040-00			2						SCREW,MACHINE:8-32 X 0.375 100 DEG,FLH ST	83385	OBD
-25	210-0458-00			2						NUT,PL,ASSEM WA:8-32 X 0.344 INCH,STL	83385	OBD
-26	212-0070-00			2						SCREW,MACHINE:8-32 X 0.312"100 DEG,FLH ST *****END ATTACHING PARTS*****	83385	OBD
-27	348-0180-00			2						FOOT,CABINET:L FRONT,R REAR,BLK NYL *****ATTACHING PARTS*****	80009	348-0180-00
-28	211-0513-00			4						SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL *****END ATTACHING PARTS*****	83385	OBD
-29	348-0181-00			2						FOOT,CABINET:R FRONT,L REAR,BLK NYL *****ATTACHING PARTS*****	80009	348-0181-00
-30	211-0513-00			4						SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL *****END ATTACHING PARTS*****	83385	OBD
-31	348-0182-00			4						PAD,CAB.FOOT:BLACK POLYURETHANE	80009	348-0182-00
-32	348-0193-00			1						FLIP-STAND,CAB.:	80009	348-0193-00
-33	343-0256-00			2						RTNR BLK,SCOPE: *****ATTACHING PARTS*****	80009	343-0256-00
-34	212-0091-00			4						SCREW,MACHINE:8-32 X 0.625",FILH STL,CD P	93907	OBD
-35	210-0458-00			4						NUT,PL,ASSEM WA:8-32 X 0.344 INCH,STL *****END ATTACHING PARTS*****	83385	OBD

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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									
2-1	426-0514-00			1						FRAME,MASK:PLASTIC	80009	426-0514-00
-2	378-0625-00			1						FILTER,LT,CRT:BLUE,5.15 X 4.4 X 0.03	80009	378-0625-00
-3	331-0258-03			1						MASK,CRT SCALE:	80009	331-0258-03
-4	204-0380-00			1						BODY,TERMINAL:	80009	204-0380-00
-5	131-0765-01			3						TERM,FEED THRU:0.584 L X 0.625 OD BRS GOLD	80009	131-0765-01
-6	200-0939-01			1						RTNR,CRT SCALE:5.55 X 5.068 X 0.475,AL ***** (ATTACHING PARTS) *****	80009	200-0939-01
-7	212-0023-00			4						SCREW,MACHINE:8-32 X 0.375,PNH,STL CD PL	83385	OBD
-8	131-1022-00			2						CONTACT,ELEC:CRT MASK ***** (END ATTACHING PARTS) *****	80009	131-1022-00
-9	337-1159-00	B260000	B268754	1						SHLD,IMPLOSION:4.78 X 3.95 X 0.07 PLSTC	80009	337-1159-00
	337-1159-03	B268755		1						SHLD,IMPLOSION:4.75 X 3.93 X 0.7 THK,PLSTC	80009	337-1159-03
-10	366-1146-00			1						KNOB:GRAY,IF GAIN	80009	366-1146-00
	213-0153-00			1						.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-11	366-1164-00			2						KNOB:GRAY	80009	366-1164-00
	213-0153-00			4						.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-12	366-1163-00			2						KNOB:LIGHT GRAY	80009	366-1163-00
	213-0153-00			2						.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-13	366-1165-00			1						KNOB:GRAY	80009	366-1165-00
	213-0153-00			2						.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-14	366-1122-00			1						KNOB:GRAY	80009	366-1122-00
	213-0246-00			1						.SETSCREW:5-40 X 0.093 ITL BK OXD,HEX	71159	OBD
-15	366-1120-00			1						KNOB:GRAY,0.600 INCH HIGH	80009	366-1120-00
	213-0246-00			1						.SETSCREW:5-40 X 0.093 ITL BK OXD,HEX	71159	OBD
-16	366-1189-00			1						KNOB:GRAY	80009	366-1189-00
	213-0153-00			1						.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-17	366-0392-02			1						KNOB:GY,0.125 ID X 0.375 H X 0.8	80009	366-0392-02
	129-0053-00			1						POST,BDG,ELEC:UNINSULATED	80009	129-0053-00
-18	200-0103-00			1						NUT,PLAIN,KNURL:0.25-28 X 0.375" OD,BRASS	80009	200-0103-00
-19	355-0507-00			1						.STUD,SHOULDERED:BINDING POST ***** (ATTACHING PARTS FOR BINDING POST) ****	80009	355-0507-00
-20	210-0455-00			1						NUT,PLAIN,HEX.:0.25-28 X 0.375 INCH,BRASS	73743	3089-402
-21	210-0046-00			1						WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS ***** (END ATTACHING PARTS) *****	78189	1214-05-00-0541C
-22	333-1482-01			1						PANEL,FRONT: ***** (ATTACHING PARTS) *****	80009	333-1482-01
-23	211-0091-00			2						SCREW,MACHINE:2-56 X 0.875,0VH,SST ***** (END ATTACHING PARTS) *****	83385	OBD
-24	358-0301-02			2						BUSHING,SLEEVE:GRAY PLASTIC	80009	358-0301-02
-25	378-0635-01			1						LENS,LIGHT:WHITE,MARKED A,PLASTIC	80009	378-0635-01
-26	378-0635-02			1						LENS,LIGHT:WHITE,MARKED B,PLASTIC	80009	378-0635-02
-27	----			1						RESISTOR,VAR:(SEE R333,R1700 REPL) ***** (ATTACHING PARTS) *****		
-28	210-0590-00			1						NUT,PLAIN,HEX.:0.375 X 0.438 INCH,STL ***** (END ATTACHING PARTS) *****	73743	2X28269-402
-29	----			1						RESISTOR,VAR:(SEE R339,S125 REPL) ***** (ATTACHING PARTS) *****		
-30	210-0590-00			1						NUT,PLAIN,HEX.:0.375 X 0.438 INCH,STL ***** (END ATTACHING PARTS) *****	73743	2X28269-402
-31	----			1						SWITCH,ROTARY:(SEE S122 REPL) ***** (ATTACHING PARTS) *****		
-32	210-0590-00			1						NUT,PLAIN,HEX.:0.375 X 0.438 INCH,STL ***** (END ATTACHING PARTS) *****	73743	2X28269-402
-33	----			1						SWITCH,TOGGLE:(SEE S1200 REPL) ***** (ATTACHING PARTS) *****		
-34	210-0473-00			1						NUT,PLAIN,DODEC:0.469-32 X 0.638 INCH,BRS	80009	210-0473-00
-35	210-0902-00			1						WASHER,FLAT:0.470 ID X 0.656 INCH OD,ST	12327	OBD
-36	354-0055-00			1						WASHER,KEY:0.469 ID X 0.688 INCH OD,ST	80009	354-0055-00
-37	210-0414-00			1						NUT,PLAIN,HEX.:0.468-32 X 0.562 INCH,BRS ***** (END ATTACHING PARTS) *****	73743	3167-402

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Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-38	-----		1		RESISTOR,VAR:(SEE R1541 REPL) ***** (ATTACHING PARTS)*****		
-39	210-0583-00		1		NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-40	361-0143-00		1		WASHER,KEY:0.281 ID X 0.562 INCH OD ***** (END ATTACHING PARTS)*****	80009	361-0143-00
-41	200-0984-00		1		BEZEL:PLASTIC,5 BUTTON SWITCH	80009	200-0984-00
-42	200-0983-00		1		BEZEL:PLASTIC,4 BUTTON SWITCH	80009	200-0983-00
-43	358-0029-00		1		BSHG,MACH.THD:HEX,0.375-32 X 0.438" LONG ***** (ATTACHING PARTS)*****	80009	358-0029-00
-44	210-0590-00		1		NUT,PLAIN,HEX.:0.375 X 0.438 INCH,STL	73743	2X28269-402
-45	210-0046-00		1		WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS ***** (END ATTACHING PARTS)*****	78189	1214-05-00-0541C
-46	119-0199-00		1		COIL,CAL:1.3UH,0.203 OHM ***** (ATTACHING PARTS)*****	80009	119-0199-00
-47	210-0457-00		1		NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL ***** (END ATTACHING PARTS)*****	83385	OBD
-48	134-0119-00		1		PLUG,PLASTIC:0.17 OD X 0.144 INCH LONG	80009	134-0119-00
-49	348-0204-00		2		SHLD GSKT,ELEK:FINGER TYPE,10.65 INCH LONG	80009	348-0204-00
-50	351-0202-00		4		GUIDE,SLIDE:UPPER ***** (ATTACHING PARTS)*****	80009	351-0202-00
-51	211-0038-00		8		SCREW,MACHINE:4-40 X 0.312,FLH,100 DEG ***** (END ATTACHING PARTS)*****	83385	OBD
-52	175-1931-00		1		CABLE ASSY,RF:50 OHM COAX,6.0 L	80009	175-1931-00
-53	131-0818-00		1		.CONNECTOR,RCPT,;BNC,FEMALE	91836	KC-19-153
	175-1932-00		1		CABLE ASSY,RF:50 OHM COAX,6.0 L	80009	175-1932-00
	131-0818-00		1		.CONNECTOR,RCPT,;BNC,FEMALE	91836	KC-19-153
	175-1933-00		1		CABLE ASSY,RF:50 OHM COAX,6.0 L	80009	175-1933-00
	131-0818-00		1		.CONNECTOR,RCPT,;BNC,FEMALE	91836	KC-19-153
-54	210-0255-00		1		TERMINAL,LUG:0.391 ID,LOCKING,BRS CD PL	80009	210-0255-00
-55	-----		1		RESISTOR,VAR:(SEE R359 REPL) ***** (ATTACHING PARTS)*****		
	213-0020-00		1		SETSCREW:6-32 X 0.125 INCH,HEX.SOC S ***** (END ATTACHING PARTS)*****	70276	OBD
-56	-----		1		RESISTOR,VAR:(SEE R1736 REPL)		
-57	-----		1		RESISTOR,VAR:(SEE R1725 REPL)		
-58	358-0409-00		2		BSHG,MACH.THD:0.25-32 X 0.159 ID X 0.24 ***** (ATTACHING PARTS)*****	80009	358-0409-00
-59	210-0471-00		2		NUT,SLEEVE:HEX.,0.312 X 0.594 INCH LON ***** (END ATTACHING PARTS)*****	80009	210-0471-00
-60	200-0935-00		2		BASE,LAMPHOLDER:0.29 OD X 0.19 CASE	80009	200-0935-00
-61	331-0262-00		2		DIFFUSER,LIGHT:INDICATOR LIGHTS	80009	331-0262-00
-62	352-0157-00		2		LAMPHOLDER:WHITE PLASTIC	80009	352-0157-00
-63	129-0318-00		2		INSULATOR,STDF:0.312 OD X 2.17 INCH LONG ***** (ATTACHING PARTS)*****	80009	129-0318-00
-64	211-0538-00		2		SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH ST ***** (END ATTACHING PARTS)*****	83385	OBD
-65	-----		1		CKT BOARD ASSY:FRONT PANEL INTCON(SEE A3 R		
-66	131-0608-00		61		.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-67	136-0454-00		4		.SKT,PL-IN ELEK:CKT BOARD,6/12 CONTACT ***** (ATTACHING PARTS FOR CKT BD)	00779	583407-7
-68	211-0558-00		2		SCREW,MACHINE:6-32 X 0.250 BDGH,NYL,SLOT ***** (END ATTACHING PARTS)*****	26365	921-1150-0014
-69	-----		1		CKT BOARD ASSY:A TRIG SOURCE SW(SEE A22 RE ***** (ATTACHING PARTS)*****		
-70	211-0022-00		2		SCREW,MACHINE:2-56 X 0.188 INCH,PNH STL	83385	OBD
-71	352-0195-00		1		HOLDER,PUSH SW: ***** (END ATTACHING PARTS)*****	80009	352-0195-00
-72	-----		1		CKT BOARD ASSY:B TRIG SOURCE SW(SEE A24 RE ***** (ATTACHING PARTS)*****		
-73	211-0022-00		2		SCREW,MACHINE:2-56 X 0.188 INCH,PNH STL	83385	OBD
-74	352-0195-00		1		HOLDER,PUSH SW: ***** (END ATTACHING PARTS)*****	80009	352-0195-00
-75	348-0216-00		1		SHLD GSKT ELEK: MESH TYPE,RING,5.25 ID	07700	30-90042

Replaceable Mechanical Parts—7904 (SN B260000 & UP)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
2-76	-----			1						CKT BOARD ASSY:GRATICULE LAMPS(SEE A25 REP		
-77	378-0614-00	B260000	B269434	1						.REFLECTOR,LIGHT:MOLDED PLASTIC	80009	378-0614-00
	378-0614-01	B269435		1						.REFLECTOR,LIGHT:INT SCALE ILLUMINATION	80009	378-0614-01
										*****ATTACHING PARTS*****		
-78	211-0062-00			2						.SCREW,MACHINE:2-56 X 0.312,PNH,STL	83385	OBD
-79	344-0179-00			2						.CLIP,REFL RTNG:PLASTIC	80009	344-0179-00
										*****END ATTACHING PARTS*****		
-80	210-0759-00	B260000	B282092	3						.EYELET,METALLIC:0.61 OD X 0.192 INCH L,BR	71590	30818-11
-81	210-0957-00	B260000	B282092	3						.WASHER,FLAT:0.0625 ID X 0.125" OD,STL	83903	OBD
-82	131-0704-00	B260000	B282092	3						.CONTACT,ELEC:SCALE LIGHTS,CU BE	80009	131-0704-00
-83	-----			1						CKT BOARD ASSY:HORIZ MODE SW(SEE A21 REPL)		
-84	352-0174-00			4						.LAMPHOLDER:(1)WIRE LEAD INCANDESCENT	80009	352-0174-00
-85	337-1156-00			1						.SHIELD,ELEC:SHIELDING GASKET 5 BUT SW	80009	337-1156-00
-86	366-1109-06			1						.PUSH BUTTON:A	80009	366-1109-06
-87	366-1109-02			1						.PUSH BUTTON:ALT	80009	366-1109-02
-88	366-1109-04			1						.PUSH BUTTON:CHOP	80009	366-1109-04
-89	366-1109-07			1						.PUSH BUTTON:B	80009	366-1109-07
-90	380-0168-00			1						.HOUSING,PB:FRONT,ABS CU NKL PL	80009	380-0168-00
										*****ATTACHING PARTS*****		
-91	211-0125-00			2						.SCREW,MACHINE:1-72 X 0.25 INCH,PNH STL	83385	OBD
										*****END ATTACHING PARTS*****		
										*****ATTACHING PARTS FOR CKT BD*****		
-92	211-0511-00			2						SCREW,MACHINE:6-32 X 0.500,PNH,STL,CD PL	83385	OBD
-93	407-0700-00			1						BRACKET,ELEC SW:ALUMINUM	80009	407-0700-00
										*****END ATTACHING PARTS*****		
-94	-----			1						CKT BOARD ASSY:VERT MODE SW(SEE A20 REPL)		
-95	352-0174-00			5						.LAMPHOLDER:(1)WIRE LEAD INCANDESCENT	80009	352-0174-00
-96	337-1157-00			1						.SHIELD,ELEC:SHIELDING GASKET 5 BUT SW	80009	337-1157-00
-97	366-1109-01			1						.PUSH BUTTON:LEFT	80009	366-1109-01
-98	366-1109-02			1						.PUSH BUTTON:ALT	80009	366-1109-02
-99	366-1109-03			1						.PUSH BUTTON:ADD	80009	366-1109-03
-100	366-1109-04			1						.PUSH BUTTON:CHOP	80009	366-1109-04
-101	366-1109-05			1						.PUSH BUTTON:RIGHT	80009	366-1109-05
-102	380-0147-00			1						.HOUSING,PB:FRONT,ABS	80009	380-0147-00
										*****ATTACHING PARTS*****		
-103	211-0125-00			3						.SCREW,MACHINE:1-72 X 0.25 INCH,PNH STL	83385	OBD
										*****END ATTACHING PARTS*****		
										*****ATTACHING PARTS FOR CKD BD*****		
-104	211-0511-00			2						SCREW,MACHINE:6-32 X 0.500,PNH,STL,CD PL	83385	OBD
-105	407-0701-00			1						BRACKET,ELEC SW:ALUMINUM	80009	407-0701-00
										*****END ATTACHING PARTS*****		
-106	331-0245-00			1						MASK,CRT SCALE:	80009	331-0245-00
-107	-----			1						COIL:(SEE L1725 REPL)		
-108	214-0291-00			1						CONTACT,SPRING:1.188 X 0.375 X 0.25 INCH	80009	214-0291-00
										*****ATTACHING PARTS*****		
-109	211-0007-00			1						SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
-110	210-0586-00			1						NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	OBD
										*****END ATTACHING PARTS*****		
-111	348-0055-00			2						GROMMET,PLASTIC:0.25 INCH DIA	80009	348-0055-00
-112	195-0093-00			1						LEAD SET,ELEC:CRT DEFLECTION	80009	195-0093-00
-113	131-0049-00			2						.CONTACT,ELEC:0.535 L,22-24 AWG WIRE	00779	42765-1
	131-1119-00			4						.CONTACT,ELEC:FOR NO. 22-26 AWG WIRE	22526	75374-001
-114	-----			1						COIL:(SEE L1730 REPL)		
										*****ATTACHING PARTS*****		
-115	213-0138-00			2						SCR,TPG,TF:4-24 X 0.188 INCH,PNH STL	83385	OBD
-116	343-0217-00			1						CLAMP,COIL:Y-AXIS	80009	343-0217-00
										*****END ATTACHING PARTS*****		
-117	210-0201-00			1						TERMINAL,LUG:0.12 ID,LOCKING,BRZ TIN PL	86928	OBD
										*****ATTACHING PARTS*****		
-118	211-0007-00			1						SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
-119	210-0586-00			1						NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	OBD
										*****END ATTACHING PARTS*****		
-120	337-1460-00			1						SHLD,ELECTRON T:CRT	80009	337-1460-00
-121	179-1689-00			1						WIRING HARNESS:	80009	179-1689-00

Replaceable Mechanical Parts—7904 (SN B260000 & UP)

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty						Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont		1	2	3	4	5			
2-122	131-0707-00			23						.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
-123	352-0171-00			1						.HLDR,TERM CONN:1 WIRE BLACK	80009	352-0171-00
-124	352-0169-00			1						.HLDR,TERM CONN:2 WIRE BLACK	80009	352-0169-00
-125	352-0163-00			1						.CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0163-00
-126	352-0164-00			1						.CONN BODY,PL,EL:6 WIRE BLACK	80009	352-0164-00
-127	352-0167-00			1						.HLDR,TERM CONN:9 WIRE BLACK	80009	352-0167-00
-128	426-0442-10			1						FRAME PNL,CAB:	80009	426-0442-10
-129	386-1517-00			4						.SUPPORT,CRT:FRONT	80009	386-1517-00
-130	354-0345-00			1						.RING,ORNAMENTAL:12.22 X 11.79,SST	80009	354-0345-00

Replaceable Mechanical Parts—7904 (SN B260000 & UP)

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty	Name & Description					Mfr Code	Mfr Part Number
		Eff	Dscont		1	2	3	4	5		
3-	119-0318-00			1						80009	119-0318-00
-1	388-2194-00			1						80009	388-2194-00
-2	210-0586-00			1						83385	OBD
-3	200-1265-00			1						80009	200-1265-00
-4	213-0041-00			2						83385	OBD
-5	131-1003-00			4						80009	131-1003-00
-6	210-0775-00			8						80009	210-0775-00
-7	210-0774-00			8						80009	210-0774-00
-8	200-1264-00			1						80009	200-1264-00
-9	213-0041-00			2						83385	OBD
-10	129-0325-00			2						80009	129-0325-00
-11	211-0538-00			2						83385	OBD
-12	211-0541-00			2						83385	OBD
-13	210-0457-00			1						83385	OBD
-14	441-1021-00			1						80009	441-1021-00
-15	211-0507-00			1						83385	OBD
-16	211-0510-00			2						83385	OBD
-17	211-0538-00			5						83385	OBD
-18	210-0202-00			1						78189	2104-06-00-2520N
-19	210-0457-00			7						83385	OBD
-20	343-0213-00			2						80009	343-0213-00
-21	255-0334-00			IN						11897	122-37-2500
-22	-----			1							
-23	131-0589-00			10						22526	48283-029
	131-0608-00			28						22526	47357
-24	214-0579-00			14						80009	214-0579-00
-25	136-0252-04			3						22526	75060-007
-26	136-0220-00	B260000	B268669	16						71785	133-23-11-034
-27	136-0183-00	B260000	B268669	3						80009	136-0183-00
	136-0252-04	B268670		57						22526	75060-007
-28	131-1003-00			3						80009	131-1003-00
-29	136-0260-02			1						71785	133-51-92-008
-30	385-0017-00			2						80009	385-0017-00
-31	211-0558-00			2						26365	921-1150-0014
-32	211-0008-00			4						83385	OBD
-33	337-1511-00			1						80009	337-1511-00
-34	211-0558-00			2						26365	921-1150-0014
-35	441-1029-00			1						80009	441-1029-00
-36	211-0538-00			4						83385	OBD
-37	210-0457-00			4						83385	OBD
-38	344-0133-00			4						80009	344-0133-00
-39	213-0138-00			4						83385	OBD
	672-0572-00			1						80009	672-0572-00
-40	-----			1							

Replaceable Mechanical Parts—7904 (SN B260000 & UP)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
3-41	253-0162-00			FT		..TAPE,PRESS SENS:POLYURETHANE SPONGE	04963	4116 TYPE A
-42	131-0589-00			20		..TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-43	210-0702-00			2		..EYELET,METALLIC:0.047 OD X 0.125 INCH LO	07707	S6127
-44	-----			1		..CKT BOARD ASSY:READOUT(SEE A18 REPL)		
-45	136-0260-02	B260000	B282050	14		..SKT,PL-IN ELEK:MICROCIRCUIT,16 DIP,LOW C	71785	133-51-92-008
	136-0729-00	B282051		14		..SKT,PL-IN ELEK:MICROCKT,16 CONTACT	09922	DILB16P-108T
-46	-----			1		..SWITCH,SLIDE:(SEE S2110 REPL)		
-47	214-0579-00			20		..TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-48	136-0269-02	B260000	B282050	1		..SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW C	73803	CS9002-14
	136-0728-00	B282051		1		..SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
-49	131-0608-00			39		..TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-50	136-0252-04			39		..SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
-51	136-0235-00			1		..SOCKET,PLUG-IN:6 CONTACT,ROUND	71785	133-96-12-062
-52	131-1003-00			6		..CONN,RCPT,ELEC:CKT BD MT,3 PRONG *****(ATTACHING PARTS FOR CKT BD)*****	80009	131-1003-00
-53	211-0008-00			1		..SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL ***** (END ATTACHING PARTS)*****	83385	OBD
-54	-----			1		..CKT BOARD ASSY:CALIBRATOR-SIGNAL(SEE A10 R		
-55	-----			1		..SWITCH,SLIDE:(SEE S1065 REPL)		
-56	-----			1		..SWITCH,SLIDE:(SEE S1035 REPL)		
-57	136-0252-07			33		..SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
	136-0269-00	B260000	B282414	1		..SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	73803	CS9002-14
	136-0728-00	B282415		1		..SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
-58	131-0590-00			46		..CONTACT,ELEC:0.71 INCH LONG	22526	47351
	131-0608-00			14		..TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-59	131-1003-00			8		..CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
-60	131-0566-00			3		..BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
	175-2023-00			1		..CA ASSY,SP,ELEC:3.26 AWG,6.0 L	80009	175-2023-00
-61	175-0826-00			FT		..WIRE,ELECTRICAL:3 WIRE RIBBON	80009	175-0826-00
-62	352-0161-00			1		..HLDR,TERM CONN:3 WIRE,BLACK	80009	352-0161-00
-63	131-0707-00			5		..CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOL	22526	47439
-64	200-0945-01			1		..COVER,HALF XSTR:DUAL TO-18,W/2-56 THD ***** (ATTACHING PARTS)*****	80009	200-0945-01
-65	211-0001-00			1		..SCREW,MACHINE:2-56 X 0.25 INCH,PNH STL ***** (END ATTACHING PARTS)*****	87308	OBD
-66	200-0945-00			1		..COVER,HALF XSTR:DUAL TO-18,ALUMINUM	80009	200-0945-00
	105-0293-00			1		..ACTR ASSY,CAM S:CALIBRATE RATE	80009	105-0293-00
-67	200-1032-00			1		..COVER,CAM SW:5 ELEMENTS ***** (ATTACHING PARTS)*****	80009	200-1032-00
-68	211-0022-00			2		..SCREW,MACHINE:2-56 X 0.188 INCH,PNH STL	83385	OBD
-69	210-0001-00			2		..WASHER,LOCK:INTL,0.092 ID X 0.18"OD,ST	78189	1202-00-00-0541C
-70	210-0405-00			1		..NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS ***** (END ATTACHING PARTS)*****	73743	12157-50
-71	354-0219-00			1		..RING,RETAINING:FOR 0.25 INCH SHAFT	79136	5103-25-MD-R
-72	407-0714-00			1		..BRACKET,CAM SW:GROUNDING,BRS ALBALOY PL	80009	407-0714-00
-73	401-0058-00			1		..BEARING,CAM SW:FRONT	80009	401-0058-00
-74	105-0190-00			1		..ACTUATOR,CAM SW:MODE	80009	105-0190-00
-75	401-0061-00			1		..BEARING,CAM SW:REAR	80009	401-0061-00
-76	214-1126-00			-		..SPRING,FLAT:GOLD COLORED	80009	214-1126-00
	214-1126-01			-		..SPRING,FLAT:0.7 X 0.125,CU BE GRN CLR	80009	214-1126-01
	214-1126-02			-		..SPRING,FLAT:RED COLORED	80009	214-1126-02
-77	214-1127-00			1		..ROLLER,DETENT:0.125 DIA X 0.125,SST	80009	214-1127-00
-78	210-0406-00			2		..NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS *****(ATTACHING PARTS FOR ACTR ASSY)***** ***** (END ATTACHING PARTS)*****	73743	12161-50
-79	211-0116-00	B260000	B281284	4		..SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
	211-0292-00	B281285		4		..SCR,ASSEM WSHR:4-40 X 0.29,BRS NI PL ***** (END ATTACHING PARTS)*****	78189	OBD
	105-0294-00			1		..ACTR ASSY,CAM S:CALIBRATE VOLTAGE	80009	105-0294-00
-80	200-1033-00			1		..COVER,CAM SW:7 ELEMENTS ***** (ATTACHING PARTS)*****	80009	200-1033-00
-81	211-0022-00			2		..SCREW,MACHINE:2-56 X 0.188 INCH,PNH STL	83385	OBD
-82	210-0001-00			2		..WASHER,LOCK:INTL,0.092 ID X 0.18"OD,ST	78189	1202-00-00-0541C
-83	210-0405-00			1		..NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS ***** (END ATTACHING PARTS)*****	73743	12157-50

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Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
3-84	354-0219-00			1						.RING,RETAINING:FOR 0.25 INCH SHAFT	79136	5103-25-MD-R
-85	407-0714-00			1						.BRACKET,CAM SW:GROUNDING,BRS ALBALOY PL	80009	407-0714-00
-86	401-0058-00			1						.BEARING,CAM SW:FRONT	80009	401-0058-00
-87	105-0191-00			1						.ACTUATOR,CAM SW:CAL	80009	105-0191-00
-88	401-0061-00			1						.BEARING,CAM SW:REAR	80009	401-0061-00
-89	214-1126-00			-						.SPRING,FLAT:GOLD COLORED	80009	214-1126-00
	214-1126-01			-						.SPRING,FLAT:0.7 X 0.125,CU BE GRN CLR	80009	214-1126-01
	214-1126-02			-						.SPRING,FLAT:RED COLORED	80009	214-1126-02
-90	214-1127-00			1						.ROLLER,DETENT:0.125 DIA X 0.125,SST	80009	214-1127-00
-91	210-0406-00			2						.NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
										***** (ATTACHING PARTS FOR ACTR ASSY) *****		
-92	211-0116-00	B260000	B281284	4						.SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
	211-0292-00	B281285		4						.SCR,ASSEM WSHR:4-40 X 0.29,BRS NI PL	78189	OBD
										***** (END ATTACHING PARTS) *****		
-93	131-0840-00			2						.CONTACT,ELEC:GROUNDING	80009	131-0840-00
-94	131-0604-00			12						.CONTACT,ELEC:CKT BD SW,SPR,CU BE	80009	131-0604-00
										***** (ATTACHING PARTS FOR CKT BD) *****		
-95	211-0008-00			5						SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
										***** (END ATTACHING PARTS) *****		
-96	384-0173-00			1						EXTENSION SHAFT:0.125 DIA X 6.438 INCH L	80009	384-0173-00
										***** (ATTACHING PARTS) *****		
-97	213-0075-00			1						SETSCREW:4-40 X 0.094,STL BK OXD,HEX	000BK	OBD
										***** (END ATTACHING PARTS) *****		
-98	384-1123-00			1						EXTENSION SHAFT:3.625 L X 0.248 OD BRS	80009	384-1123-00
-99	376-0007-00	B260000	B268415	1						CPLG,SHAFT,RGD:0.252 ID X 0.5 OD,AL	80009	376-0007-00
	376-0172-00	B268416		1						CPLG,SHAFT,RGD:0.25 ID X 0.750D,DELRIIN	K0099	5610/4-40
-100	351-0181-03	B260000	B269894	4						GUIDE,SLIDE:LWR,PLUG-IN UNIT	80009	351-0181-03
	351-0181-06	B269895		4						GUIDE,SLIDE:PLUG-IN UNIT,LWR,BLK NYLON	80009	351-0181-06
										***** (ATTACHING PARTS) *****		
-101	213-0104-00			4						SCR,TPG,THD FOR:6-20 X 0.375 INCH,TRH STL	83385	OBD
-102	213-0229-00			4						SCR,TPG,THD FOR:6-20 X0.375*100 DEG,FLH ST	93907	OBD
										***** (END ATTACHING PARTS) *****		
-103	380-0253-00			1						HOUSING,PLUG-IN:ALUMINUM	80009	380-0253-00
										***** (ATTACHING PARTS) *****		
-104	212-0023-00			2						SCREW,MACHINE:8-32 X 0.375,PNH,STL CD PL	83385	OBD
-105	212-0040-00			2						SCREW,MACHINE:8-32 X 0.375 100 DEG,FLH ST	83385	OBD
-106	210-0458-00			2						NUT,PL,ASSEM WA:8-32 X 0.344 INCH,STL	83385	OBD
										***** (END ATTACHING PARTS) *****		
-107	131-0800-00	B010100	B282402	2						CONTACT,ELEC:PLUG-IN GROUND	80009	131-0800-00
	131-0800-03	B282403		2						CONTACT,ELEC:PLUG-IN GROUND	80009	131-0800-03
										***** (ATTACHING PARTS) *****		
-108	211-0008-00			2						SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
-109	210-0586-00			2						NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	OBD
										***** (END ATTACHING PARTS) *****		
-110	131-0799-00			3						CONTACT,ELEC:PLUG-IN GROUND	80009	131-0799-00
										***** (ATTACHING PARTS) *****		
-111	211-0008-00			3						SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
-112	210-0586-00			3						NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	OBD
										***** (END ATTACHING PARTS) *****		
	672-0031-03			1						CKT BOARD ASSY:MAIN INTERFACE	80009	672-0031-03
-113	-----			2						.CKT BOARD ASSY:50 OHM FOLLOWER(SEE A23 RE		
-114	-----			1						.CKT BOARD ASSY:MAIN INTERFACE(SEE A2 REPL		
-115	388-2192-05			1						.CKT BOARD ASSY:TRIGGER INTERCONNECT	80009	388-2192-05
-116	131-0787-00			2						.CONTACT,ELEC:0.64 INCH LONG	22526	47359
-117	351-0213-00			2						.POST,CKT BD MTG:0.285 L X 0.219 OD,BRS	80009	351-0213-00
										***** (ATTACHING PARTS FOR CKT BD) *****		
-118	211-0213-00			2						.SCREW,MACHINE:4-40 X 0.312 INCH,PNH NYLON	23050	OBD
										***** (END ATTACHING PARTS) *****		
-119	388-2192-05			1						.CKT BOARD ASSY:TRIGGER INTERCONNECT	80009	388-2192-05
-120	131-0787-00			2						.CONTACT,ELEC:0.64 INCH LONG	22526	47359
-121	351-0213-00			2						.POST,CKT BD MTG:0.285 L X 0.219 OD,BRS	80009	351-0213-00
										***** (ATTACHING PARTS FOR CKT BD) *****		
	211-0097-00			2						.SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
-122	211-0213-00			2						.SCREW,MACHINE:4-40 X 0.312 INCH,PNH NYLON	23050	OBD
										***** (END ATTACHING PARTS) *****		

Replaceable Mechanical Parts—7904 (SN B260000 & UP)

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont					
3-123	131-0566-00			2		..BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
-124	131-0595-00			3		..CONTACT,ELEC:1.37 INCH LONG	22526	47355
-125	131-0252-04			5		..ADAPTER,CONN:		
-126	131-1003-00			21		..CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
-127	103-0146-00			4		..ADAPTER,CONN:50 OHM JACK TO JACK	98291	052-075-0000-220
-128	131-0590-00			53		..CONTACT,ELEC:0.71 INCH LONG	22526	47351
	131-0592-00			21		..CONTACT,ELEC:0.885 INCH LONG	22526	47353
	131-0608-00			128		..TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-129	131-0391-00			3		..CONNECTOR,RCPT,:50 OHM,COAX,SNAP-ON MALE	98291	51-051-0049
-130	351-0227-00			6		..GUIDE-POST,LOCK:0.84 INCH LONG	80009	351-0227-00
-131	351-0185-00			3		..GUIDE-POST,LOCK:0.65 INCH LONG	80009	351-0185-00
	351-0188-00			2		..GUIDE-POST,LOCK:0.65 INCH LONG	80009	351-0188-00
-132	386-1557-00			5		..SPACER,CKT BD:0.29 H,ACETAL	80009	386-1557-00
	131-0767-05			2		..CONNECTOR,RCPT,:PLUG-IN CKT BD,35/70 CON	80009	131-0767-05
	-----			-		...EACH CONNECTOR INCLUDES:		
-133	200-0950-00			2		...COVER,ELEC CONN:PLASTIC	80009	200-0950-00
-134	204-0365-02			1		...BODY,CONNECTOR:PLUG-IN CIRCUIT CARD	80009	204-0365-02
-135	131-0726-00			32		...CONTACT,ELEC:STRAIGHT	80009	131-0726-00
-136	131-0727-00			32		...CONTACT,ELEC:OFFSET	80009	131-0727-00
-137	214-1665-00			1		...SPRING,FLAT:2.35 X 0.041 MUSIC WIRE	80009	214-1665-00
						...*** (ATTACHING PARTS FOR CONNECTOR)*****		
-138	213-0232-00			2		..SCR,TPG,THD FOR:2-32 X 0.312 INCH,PNH ST	83385	OBD
						...***** (END ATTACHING PARTS)*****		
	131-0767-09			2		..CONN,RCPT,ELEC:CKT BD,38/76 CONTACT	80009	131-0767-09
	-----			-		...EACH CONNECTOR INCLUDES:		
-139	200-0950-00			2		...COVER,ELEC CONN:PLASTIC	80009	200-0950-00
-140	204-0365-00			1		...BODY,CONNECTOR:PLUG-IN CIRCUIT CARD	80009	204-0365-00
-141	136-0726-00			38		...CONTACT,ELEC:STRAIGHT	80009	136-0726-00
-142	131-0727-00			38		...CONTACT,ELEC:OFFSET	80009	131-0727-00
						...***** (ATTACHING PARTS)*****		
-143	213-0232-00			2		..SCR,TPG,THD FOR:2-32 X 0.312 INCH,PNH ST	83385	OBD
						...***** (END ATTACHING PARTS)*****		
						...***** (ATTACHING PARTS FOR CKT BD)		
-144	213-0263-00	B260000	B268719	12		SCREW,TPG,TF:4-24 X 0.375 INCH,PNH STL	83385	OBD
	213-0119-00	B268720		12		SCR,TPG,THD FOR:4-24 X 0.375 INCH,PNH STL	83385	OBD
						...***** (END ATTACHING PARTS)*****		
-145	-----			1		CKT BOARD ASSY:VERTICAL INTERFACE(SEE A7 R		
-146	131-1003-00			6		..CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
-147	136-0263-04			5		..SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	22526	75377-001
-148	136-0269-02	B260000	B282414	1		..SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW CL	73803	CS9002-14
	136-0728-00	B282415		1		..SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
-149	-----			1		..MICROCIRCUIT:(SEE U4625 & U4685 REPL)		
						...***** (ATTACHING PARTS)*****		
-150	210-0406-00			2		..NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
-151	210-0906-00			2		..WASHER,NONMETAL:FIBER,0.125 ID X 0.203"OD	86928	OBD
						...***** (END ATTACHING PARTS)*****		
-152	131-1429-00			1		..CONTACT,ELEC:IC GND,DUAL	80009	131-1429-00
-153	136-0252-00			32		..SOCKET,PIN TERM:0.145 INCH LONG	00779	2-330808-7
	136-0252-04			12		..SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
-154	211-0155-00			2		..SCREW,EXT,RLV B:4-40 X 0.375 INCH,SST	80009	211-0155-00
-155	361-0238-00			2		..SPACER,SLEEVE:0.25 OD X 0.34 INCH LONG	80009	361-0238-00
-156	-----			1		CKT BOARD ASSY:A TRIGGER SELECTOR(SEE A5 R		
-157	136-0252-04			52		..SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
-158	136-0263-04			7		..SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	22526	75377-001
-159	211-0155-00			2		..SCREW,EXT,RLV B:4-40 X 0.375 INCH,SST	80009	211-0155-00
-160	361-0238-00			2		..SPACER,SLEEVE:0.25 OD X 0.34 INCH LONG	80009	361-0238-00
-161	131-1003-00			4		..CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
-162	136-0269-02	B260000	B282414	1		..SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW CL	73803	CS9002-14
	136-0728-00	B282415		1		..SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
-163	-----			1		CKT BOARD ASSY:B TRIGGER SELECTOR(SEE A6 R		
-164	136-0263-04			7		..SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	22526	75377-001
-165	131-1003-00			5		..CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
-166	136-0252-04			57		..SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
	136-0252-01			2		..CONTACT,ELEC:0.178 INCH LONG	00779	1-332095-2

Replaceable Mechanical Parts—7904 (SN B260000 & UP)

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty	Name & Description					Mfr Code	Mfr Part Number
		Eff	Dscont		1	2	3	4	5		
3-167	211-0155-00			2						80009	211-0155-00
-168	361-0238-00			2						80009	361-0238-00
-169	136-0269-02	B260000	B282414	1						73803	CS9002-14
	136-0728-00	B282415		1						09922	DILB14P-108
-170	131-0805-00			3						80009	131-0805-00
-171	220-0561-00			1						80009	220-0561-00
-172	-----			1							
-173	136-0241-00			4						71785	133-99-12-064
-174	136-0263-04			50						22526	75377-001
-175	136-0260-02	B260000	B282859	4						71785	133-51-92-008
	136-0729-00	B282860		4						09922	DILB16P-108T
-176	136-0220-00	B260000	B268669	24						71785	133-23-11-034
	136-0252-04	B268670		72						22526	75060-007
-177	386-1556-00			1						80009	386-1556-00
-178	131-0787-00			6						22526	47359
-179	211-0155-00			3						80009	211-0155-00
-180	361-0238-00			3						80009	361-0238-00
	198-3313-00			1						80009	198-3313-00
-181	-----			1							
-182	136-0263-04			12						22526	75377-001
-183	211-0155-00			2						80009	211-0155-00
-184	361-0301-00			2						80009	361-0301-00
-185	179-1690-02			1						80009	179-1690-02
-186	352-0161-08			2						80009	352-0161-08
-187	131-0707-00			6						22526	47439
-188	175-1934-00			1						80009	175-1934-00
-189	131-0818-00			1						91836	KC-19-153
	198-2046-00			1						80009	198-2046-00
-190	175-0825-00			IN						80009	175-0825-00
-191	175-0828-00			IN						08261	SS-0526-710610C
	175-0860-00			IN						08261	SS-0522-7(1061)
-192	175-0859-00			IN						08261	SS-0622-7(1061)
-193	175-0858-00			IN						08261	SS-0722-7(1061)
-194	175-0857-00			IN						08261	SS-0822-7(1061)
-195	175-0832-00			IN						08261	SS-0926(1061)0C
-196	175-0833-00			IN						08261	SS-1026-7
	175-0855-00			IN						08261	SS-1022(1061)0C
-197	131-0707-00			264						22526	47439
-198	352-0163-00			1						80009	352-0163-00
	352-0163-01			2						80009	352-0163-01
	352-0163-04			2						80009	352-0163-04
	352-0163-08			2						80009	352-0163-08
-199	352-0164-04			2						80009	352-0164-04
-200	352-0165-01			2						80009	352-0165-01
	352-0165-03			2						80009	352-0165-03
	352-0165-06			2						80009	352-0165-06
	352-0165-07			2						80009	352-0165-07
-201	352-0166-05			2						80009	352-0166-05
-202	352-0167-02			2						80009	352-0167-02
-203	352-0168-01			2						80009	352-0168-01
	352-0168-02			2						80009	352-0168-02
	352-0168-03			2						80009	352-0168-03
	352-0168-05			2						80009	352-0168-05
	352-0168-06			2						80009	352-0168-06
	352-0168-07			2						80009	352-0168-07

Replaceable Mechanical Parts—7904 (SN B260000 & UP)

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont					
4-	620-0461-00			1		POWER SUPPLY:	80009	620-0461-00
-1	214-1623-00	B260000	B279999	1		.HEAT SINK,ELEC:POWER SUPPLY,AL	80009	214-1623-00
	214-1623-01	B280000		1		.HEAT SINK,ELEC:POWER SUPPLY,AL(ATTACHING PARTS).....	80009	214-1623-01
-2	211-0504-00			4		.SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL(END ATTACHING PARTS).....	83385	OBD
-3	-----			5		.TRANSISTOR:(SEE Q1458,1498,1428,1538, Q1588 REPL)(ATTACHING PARTS).....		
	-----			-				
-4	210-0071-00			5		.WASHER,SPR TNSN:0.146 ID X 0.323" OD,STL	78189	4706-05-01-0531
-5	342-0136-00			5		.INSULATOR,WSHR:0.812 OD X 0.0025 INCH THK	04713	OBD
-6	211-0578-00			5		.SCREW,MACHINE:6-32 X 0.438 1NCH,PNH STL	83385	OBD
-7	210-0407-00			5		.NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS(END ATTACHING PARTS).....	73743	3038-0228-402
-8	161-0033-06	B260000	B279999	1		.CABLE ASSY,PWR:3,18 AWG,125V,72.0 L	80009	161-0033-06
	161-0066-00	B280000		1		.CABLE ASSY,PWR.:3,18 AWG,115V,98.0 L(ATTACHING PARTS).....	S3109	1100
-9	210-0590-00			1		.NUT,PLAIN,HEX.:0.375 X 0.438 INCH,STL	73743	2X28269-402
-10	210-0012-00			1		.WASHER,LOCK:INTL,0.375 ID X 0.50" OD S(END ATTACHING PARTS).....	78189	1220-02-00-0541C
-11	210-0202-00	B260000	B279999	2		.TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED	78189	2104-06-00-2520N
	210-0204-00	B280000		1		.TERMINAL,LUG:0.146 INCH DIA DE,45 DEG BE(ATTACHING PARTS).....	78189	2157-06-01-2520N
-12	211-0507-00	B260000	B279999	2		.SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
	211-0513-00	B280000		1		.SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL	83385	OBD
-13	210-0407-00	B260000	B279999	2		.NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
	210-0407-00	B280000		3		.NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS(END ATTACHING PARTS).....	73743	3038-0228-402
-14	-----			-		.THERMO CUTOUT:(SEE S1201 REPL)(ATTACHING PARTS).....		
-15	211-0507-00			2		.SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
-16	210-0407-00			2		.NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
-17	210-0006-00			2		.WASHER,LOCK:#6 INTL,0.018 THK,STL CD PL(END ATTACHING PARTS).....	78189	1206-00-00-0541C
-18	200-0763-04			1		.COV,LINE V SEL:W/FUSEHOLDER & INSTR PL	80009	200-0763-04
	-----			-		.COVER INCLUDES:		
-19	352-0102-00			2		.FUSEHOLDER:0.262"ID TUBE FOR CRTG FUS(ATTACHING PARTS).....	80009	352-0102-00
-20	213-0088-00			2		.SCR,TPG,THD CTG:4-24 X 0.25 INCH,PNH STL(END ATTACHING PARTS).....	83385	OBD
-21	204-0278-01			1		.BODY ASSY,LINE:W/CLIPS AND CONTACTS(ATTACHING PARTS).....	80009	204-0278-01
-22	210-0407-00			2		.NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS(END ATTACHING PARTS).....	73743	3038-0228-402
-23	-----			2		.TRANSISTOR:(SEE Q1234,Q1241 REPL)(ATTACHING PARTS).....		
-24	386-0978-00			1		.INSULATOR,PLATE:TRANSISTOR,MICA	80009	386-0978-00
-25	210-0586-00			2		.NUT,PL,ASSEM WA:4-40 X 0.25,STL(END ATTACHING PARTS).....	83385	OBD
-26	342-0104-00			1		.INSULATOR,PLATE:2 X 4.40 INCHES	08530	OBD
-27	342-0103-00			1		.INSULATOR,BLOCK:HEAT-SINK SHIELD,NYLON(ATTACHING PARTS).....	80009	342-0103-00
-28	213-0041-00			2		.SCR,TPG,THD CTG:6-32 X 0.375 INCH,TRH STL	83385	OBD
-29	210-0407-00			1		.NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
-30	214-1625-00			1		.SPRING,FLAT:2.0 INCH LONG,BOWED(END ATTACHING PARTS).....	80009	214-1625-00
-31	337-1551-00	B260000	B279999	1		.SHIELD,ELEC:LINE FILTER(ATTACHING PARTS).....	80009	337-1551-00
-32	211-0507-00	B260000	B279999	2		.SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL(END ATTACHING PARTS).....	83385	OBD
-33	348-0055-00	B260000	B279999	1		.GROMMET,PLASTIC:0.25 INCH DIA	80009	348-0055-00

Replaceable Mechanical Parts—7904 (SN B260000 & UP)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
4-34	-----			1		.COIL:(SEE L1201,L1203 REPL)(ATTACHING PARTS).....		
-35	213-0138-00	B260000	B279999	1		.SCR,TPG,TF:4-24 X 0.188 INCH,PNH STL	83385	OBD
	211-0614-00	B280000		2		.SCR,ASSEM WSHR:6-32 X 0.250 PNH,STL CD PL	83385	OBD
	210-0004-00	B280000		2		.WASHER,LOCK:#4 INTL,0.015 THK,STL CD PL(END ATTACHING PARTS).....	000BK	OBD
-36	210-0201-00	B260000	B279999	1		.TERMINAL,LUG:0.12 ID,LOCKING,BRZ TIN PL(ATTACHING PARTS).....	86928	OBD
-37	211-0007-00	B260000	B279999	1		.SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
-38	210-0586-00	B260000	B279999	1		.NUT,PL,ASSEM WA:4-40 X 0.25,STL(END ATTACHING PARTS).....	83385	OBD
	361-1022-00	B280000		2		.SPCR,LINE FLTR:ALUMINUM(ATTACHING PARTS).....	80009	361-1022-00
	210-0551-00	B280000		3		.NUT,PLAIN,HEX.:4-40 X 0.25 INCH,STL	000BK	OBD
	210-0586-00	B280000		1		.NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	OBD
	210-0202-00	B280000		1		.TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED	78189	2104-06-00-2520N
	211-0014-00	B280000		2		.SCREW,MACHINE:4-40 X 0.50 INCH,PNH STL(END ATTACHING PARTS).....	83385	OBD
-39	131-0022-00	B260000	B279999	1		.TERMINAL CARD:SOLDER LUG/1 MTG LUG(ATTACHING PARTS).....	71785	332-11-02-001
-40	211-0007-00	B260000	B279999	1		.SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
-41	210-0586-00	B260000	B279999	1		.NUT,PL,ASSEM WA:4-40 X 0.25,STL(END ATTACHING PARTS).....	83385	OBD
-42	441-1019-00			1		.CHASSIS,SCOPE:POST REG CKT BD(ATTACHING PARTS).....	80009	441-1019-00
-43	211-0504-00			4		.SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
-44	211-0007-00			2		.SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
-45	211-0008-00			2		.SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
-46	-----			1		.CKT BRD ASSY:LOW VLTG RGLTR(SEE A13 REPL)(END ATTACHING PARTS).....		
-47	131-0608-00			63		..TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-48	136-0183-00	B260000	B268669	7		..SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00
-49	136-0220-00	B260000	B268669	4		..SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB	71785	133-23-11-034
	136-0252-04	B268670		27		..SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
-50	136-0235-00			8		..SOCKET,PLUG-IN:6 CONTACT,ROUND	71785	133-96-12-062
-51	214-0579-00			8		..TERM,TEST POINT:BRZ CD PL	80009	214-0579-00
-52	-----			1		..TRANSISTOR:(SEE Q1550 REPL)(ATTACHING PARTS).....		
-53	211-0097-00			1		..SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
	210-1122-00			1		..WASHER,LOCK:0.12 ID,DISHED,0.025 THK	86928	OBD
-54	210-0551-00			1		..NUT,PLAIN,HEX.:4-40 X 0.25 INCH,STL(END ATTACHING PARTS).....(ATTACHING PARTS FOR CKT BD ASSY).....	000BK	OBD
-55	211-0007-00			5		.SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL(END ATTACHING PARTS).....	83385	OBD
-56	407-0964-01	B010100	B282757	1		.BRACKET,CAP.:ALUMINUM	80009	407-0964-01
	407-2111-00	B282758		1		.BRACKET,CAP.:ALUMINUM(ATTACHING PARTS).....	80009	407-2111-00
-57	211-0504-00			4		.SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL(END ATTACHING PARTS).....	83385	OBD
-58	-----			2		.CAPACITOR:(SEE C1216,C1217 REPL)(ATTACHING PARTS).....		
-59	212-0518-00	B260000	B281239	8		.SCREW,MACHINE:10-32 X 0.312,PNH,STL,CD PL	83385	OBD
	212-0518-00	B281240		4		.SCREW,MACHINE:10-32 X 0.312,PNH,STL,CD PL	83385	OBD
	212-0651-00	B281240		4		.SCREW,MACHINE:10-32 X 0.312 INCH,PNH,NYLO	26365	OBD
	210-3057-00	B281240		4		.WASHER,FLAT:0.170 ID X 0.375 OD(END ATTACHING PARTS).....	95987	NW8-3753
-60	337-1491-00			1		.SHLD,ELECTRICAL:CIRCUIT CARD	80009	337-1491-00
-61	344-0118-00			2		..CLIP,SPG TENS:CAPACITOR MTG	80033	E50008-044
-62	210-0623-00			2		..RIVET,TUBULAR:(ATTACHING PARTS).....	12014	R-3682
-63	211-0008-00			3		.SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL(END ATTACHING PARTS).....	83385	OBD
-64	344-0230-00			1		.CLIP,SPG,TNSN:CHOKE COIL,CU BE	80009	344-0230-00
-65	220-0623-00			1		.NUT,BLOCK:0.375 X 0.5 X 0.448,(3)6-32(ATTACHING PARTS).....	80009	220-0623-00

Replaceable Mechanical Parts—7904 (SN B260000 & UP)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
4-66	211-0504-00			3		.SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL ***** (END ATTACHING PARTS)*****	83385	OBD
-67	337-1490-00	B260000	B268784	1		.SHLD,ELECTRICAL:CIRCUIT CARD	80009	337-1490-00
	337-1490-01	B268785	B269691	1		.SHIELD,ELEC:LINE INVERTER,CKT CD BOTTOM	80009	337-1490-01
	337-1490-02	B269692		1		.SHIELD,ELEC:LINE INVERTER,CKT BD BOTTOM ***** (ATTACHING PARTS)*****	80009	337-1490-02
-68	211-0040-00			2		.SCREW,MACHINE:4-40 X 0.25",BDGH PLSTC ***** (END ATTACHING PARTS)*****	26365	OBD
-69	-----			1		.CKT BOARD ASSY:PWR SPLY INVERTER(SEE A11)		
-70	348-0023-00			6		..PLUG,HOLE:	02768	207090201000101
-71	131-0591-00			7		..CONTACT,ELEC:0.835 INCH LONG	22526	47352
-72	136-0254-01			4		..SOCKET,PIN TERM:U/W 0.031 TO 0.04 DIA PI	00779	1-331892-8
-73	214-0579-00			3		..TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-74	348-0005-00			1		..GROMMET,RUBBER:0.50 INCH DIA	70485	230
-75	355-0518-02			4		..STUD,PRESSMOUNT:4-40 X 0.625 INCH,BRASS	80009	355-0518-02
-76	129-0323-00			2		..POST,ELEC-MECH:HEX,0.25 X 1 INCH LONG ***** (ATTACHING PARTS)*****	80009	129-0323-00
-77	211-0097-00			2		..SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL ***** (END ATTACHING PARTS)***** *****(ATTACHING PARTS FOR CKT BD ASSY)****	83385	OBD
-78	211-0008-00			2		.SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL ***** (END ATTACHING PARTS)*****	83385	OBD
-79	214-1624-00			1		.HEAT SINK,XSTR:(2)TO-3,AL	80009	214-1624-00
-80	348-0291-00			1		.PAD,CUSHIONING:0.925 SQ X 0.312,SIL SPONG	80009	348-0291-00
	672-0030-00			1		.CKT BOARD ASSY:HIGH VOLTAGE & AUTO FOCUS		
-81	-----			1		..SEMICONV DEVICE:(SEE U1615 REPL) ***** (ATTACHING PARTS)*****		
-82	210-0409-00			2		..NUT,PLAIN,HEX.:8-32 X 0.312 INCH,BRS ***** (END ATTACHING PARTS)*****	73743	3046-402
-83	-----			1		..CKT BOARD ASSY:HIGH VOLTAGE(SEE A14 REPL)		
-84	131-0809-00			1		..TERMINAL,STUD:PNL MT,4-40 TAP 1 END ***** (ATTACHING PARTS)*****	71279	570-1510-01-0519
-85	211-0007-00			1		..SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL ***** (END ATTACHING PARTS)*****	83385	OBD
-86	337-1492-00			1		..SHIELD,ELEC:HV CKT BD ***** (ATTACHING PARTS FOR CKT BD ASSY)*****	80009	337-1492-00
-87	211-0008-00			1		..SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL ***** (END ATTACHING PARTS)*****	83385	OBD
-88	-----			1		..CKT BOARD ASSY:AUTO FOCUS(SEE A15 REPL) ***** (ATTACHING PARTS FOR CKT BD ASSY)*****		
-89	343-0088-00			2		..CLAMP,LOOP:0.062 INCH DIA ***** (END ATTACHING PARTS)*****	80009	343-0088-00
-90	348-0023-00			2		..PLUG,HOLE:	02768	207090201000101
-91	343-0088-00			1		..CLAMP,LOOP:0.062 INCH DIA	80009	343-0088-00
-92	131-0707-00			17		..CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOL	22526	47439
-93	175-0860-00			IN		..WIRE,ELECTRICAL:5 WIRE RIBBON	08261	SS-0522-7(1061)
-94	175-1278-00			IN		..CABLE,SP,ELEC:4.26 AWG,STRD,POLYETHYLENE	80009	175-1278-00
-95	175-1279-00			IN		..CABLE,SP,ELEC:2.26 AWG,STRD,POLYETHYLENE	80009	175-1279-00
-96	352-0163-05			1		..CONN BODY,PL,EL:5 WIRE GREEN	80009	352-0163-05
-97	352-0165-04			1		..CONN BODY,PL,EL:7 WIRE YELLOW	80009	352-0165-04
-98	352-0167-04			1		..CONN BODY,PL,EL:9 WIRE YELLOW	80009	352-0167-04
-99	337-1487-00			1		.SHLD,ELECTRICAL:HV SUPPLY ***** (ATTACHING PARTS)*****	80009	337-1487-00
-100	211-0008-00			4		.SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL ***** (END ATTACHING PARTS)*****	83385	OBD
-101	386-1556-00			4		.SUPPORT,CKT BD:0.215 H,ACETAL	80009	386-1556-00
-102	348-0055-00			2		.GROMMET,PLASTIC:0.25 INCH DIA	80009	348-0055-00
-103	342-0105-00			1		.INSUL,HV SPLY:HV POWER,POLYIMIDE	80009	342-0105-00
-104	252-0562-00			IN		.PLASTIC CHANNEL:0.100 X 0.120,POLYETHYLEN	06229	GS2
-105	386-2041-00			2		.SUPPORT,XFMR:	80009	386-2041-00
-106	344-0231-00			2		.CLIP,XFMR:	80009	344-0231-00

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Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
4-107	200-1263-01			1						.COVER,PWR SPLY:RIGHT SIDE ***** (ATTACHING PARTS)*****	80009	200-1263-01
-108	211-0504-00			1						.SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL ***** (END ATTACHING PARTS)*****	83385	OBD
-109	200-1262-02			1						.COVER,PWR SPLY:LEFT SIDE ***** (ATTACHING PARTS)*****	80009	200-1262-02
-110	211-0504-00			1						.SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL ***** (END ATTACHING PARTS)*****	83385	OBD
-111	351-0279-00			2						.GUIDE,SHOE:5.18 X 0.375,NYLON	80009	351-0279-00
-112	200-1261-00			1						.CONER,PWR SPLY:BOTTOM AND FRONT ***** (ATTACHING PARTS)*****	80009	200-1261-00
-113	211-0504-00			6						.SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL ***** (END ATTACHING PARTS)*****	83385	OBD
-114	-----			1						.CKT BOARD ASSY:CAP RECTIFIER(SEE A12 REPL		
-115	136-0263-04			7						.SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PI	22526	75377-001
-116	136-0220-00	B260000	B268669	3						.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB	71785	133-23-11-034
-117	136-0183-00	B260000	B268669	2						.SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00
	136-0252-04	B268670		15						.SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
-118	131-0608-00			29						.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-119	214-0579-00			4						.TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-120	-----			6						.SEMICONV DEVICE:(SEE CR1310,1313,1347, .CR1346,1348,1345 REPL) ***** (ATTACHING PARTS)*****		
-121	210-0410-00			6						.NUT,PLAIN,HEX.:10-32 X 0.312 INCH,BRS	73743	2X20003-402
-122	210-0056-00			6						.WASHER,LOCK:SPLIT,0.195 ID X 0.32" OD,P	83385	OBD
-123	210-1003-00			6						.WASHER,FLAT:# 10 X 0.036 THICK,BRS ***** (END ATTACHING PARTS)*****	12327	OBD
-124	136-0260-02			1						.SKT,PL-IN ELEK:MICROCIRCUIT,16 DIP,LOW C ***** (ATTACHING PARTS FOR CKT BD ASSY)*****	71785	133-51-92-008
-125	211-0008-00			4						.SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL ***** (END ATTACHING PARTS)*****	83385	OBD
	198-2503-00	B260000	B280644	1						.WIRE SET,ELEC:	80009	198-2503-00
	198-2503-01	B280645		1						.WIRE SET,ELEC:	80009	198-2503-01
-126	131-0707-00			64						.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOL	22526	47439
-127	210-0230-00			1						.TERMINAL,LUG:# 6 STUD,SOLDERLESS	98410	A-134-06
-128	175-1091-00			FT						.CABLE,SP,ELEC:(4) #18 STRANDED WIRE	80009	175-1091-00
-129	175-0857-00			IN						.WIRE,ELECTRICAL:8 WIRE RIBBON	08261	SS-0822-7(1061)
-130	175-0859-00			IN						.WIRE,ELECTRICAL:6 WIRE RIBBON	08261	SS-0622-7(1061)
-131	175-0861-00			IN						.WIRE,ELECTRICAL:4 WIRE RIBBON	08261	SS-0422-7(1061)
-132	352-0162-05			2						.CONN BODY,PL,EL:4 WIRE GREEN	80009	352-0162-05
	352-0162-04			2						.CONN BODY,PL,EL:4 WIRE YELLOW	80009	352-0162-04
-133	352-0164-02			2						.CONN BODY,PL,EL:6 WIRE RED	80009	352-0164-02
-134	352-0166-01			2						.CONN BODY,PL,EL:8 WIRE BROWN ***** (ATTACHING PARTS FOR POWER SUPPLY)***	80009	352-0166-01
-135	212-0023-00			4						SCREW,MACHINE:8-32 X 0.375,PNH,STL CD PL ***** (END ATTACHING PARTS)*****	83385	OBD
-136	333-1484-00			1						PANEL,REAR:	80009	333-1484-00
-137	348-0225-00			2						PAD,CAB.FOOT:GRAY POLYURETHANE	80009	348-0225-00
-138	348-0224-00			2						FOOT,CABINET:SIL GRAY,POLYCARBONATE ***** (ATTACHING PARTS)*****	80009	348-0224-00
-139	212-0020-00			2						SCREW,MACHINE:8-32 X 1.0 INCH,PNH STL	93907	OBD
-140	211-0538-00			2						SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH ST ***** (END ATTACHING PARTS)*****	83385	OBD
-141	386-2060-00			1						SUBPANEL,REAR:	80009	386-2060-00
-142	346-0045-00			1						STRAP,CONN COV:BNC ONE END,POLYPROPYLENE	80009	346-0045-00
-143	200-0678-00			1						COVER,ELEC CONN:BNC,SHORTING	91836	KC89-58TR5
-144	131-0955-00			1						CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
-145	131-0771-00			2						CONN,RCPT,ELEC:4 CONT,QUICK DISCONNECT ***** (ATTACHING PARTS)*****	91836	1904-2M58
-146	210-0012-00			2						WASHER,LOCK:INTL,0.375 ID X 0.50" OD S	78189	1220-02-00-0541C
-147	220-0551-00			2						NUT,PLAIN,HEX.:9 MM X 0.437 INCH ***** (END ATTACHING PARTS)*****	73743	OBD

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Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
4-148	136-0089-00			1						CONNECTOR,RCPT.:9 PIN CHASSIS MOUNT *****ATTACHING PARTS)*****	02660	165-16
-149	211-0097-00			4						SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
-150	210-0586-00			4						NUT,PL,ASSEM WA:4-40 X 0.25,STL *****END ATTACHING PARTS)*****	83385	OBD
-151	-----			1						CKT BOARD ASSY:PROBE POWER(SEE A1 REPL)		
-152	136-0252-04			2						.SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
-153	131-1003-00			2						.CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
-154	131-0608-00			9						.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-155	386-1557-00			4						.SPACER,CKT BD:0.29 H,ACETAL	80009	386-1557-00
-156	210-0201-00			1						TERMINAL,LUG:0.12 ID,LOCKING,BRZ TIN PL *****ATTACHING PARTS)*****	86928	OBD
-157	211-0007-00			1						SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL *****END ATTACHING PARTS)*****	83385	OBD
-158	441-1020-01			1						CHASSIS,SCOPE:VERT AND HORIZONTAL AMPL *****ATTACHING PARTS)*****	80009	441-1020-01
-159	211-0538-00			2						SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH ST	83385	OBD
-160	211-0101-00			2						SCREW,MACHINE:4-40 X 0.25,100 DEG,FLH STL	83385	OBD
-161	211-0504-00			2						SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
-162	210-0457-00			4						NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	OBD
-163	210-0586-00			2						NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	OBD
-164	210-0803-00			4						WASHER,FLAT:0.15 ID X 0.032 THK,STL CD *****END ATTACHING PARTS)*****	12327	OBD
-165	343-0089-00			1						CLAMP,LOOP:LARGE	80009	343-0089-00
-166	348-0063-00			1						GROMMET,PLASTIC:0.50 INCH DIA	80009	348-0063-00
-167	129-0006-00			1						TERMINAL,STUD:INSULATED *****ATTACHING PARTS)*****	00866	1700P
-168	210-0202-00			1						TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED	78189	2104-06-00-2520N
-169	210-0457-00			1						NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL *****END ATTACHING PARTS)*****	83385	OBD
-170	-----			1						RESISTOR,VAR:(SEE R782A,B REPL) *****ATTACHING PARTS)*****		
-171	211-0511-00			2						SCREW,MACHINE:6-32 X 0.500,PNH,STL,CD PL	83385	OBD
-172	166-0107-00			2						SPACER,SLEEVE:0.18 ID X 0.219 L	80009	166-0107-00
-173	210-0894-00			2						WASHER,NONMETAL:0.19 ID X 0.438" OD,PLSTC *****END ATTACHING PARTS)*****	09422	OBD
-174	-----			1						CKT BOARD ASSY:VERTICAL AMPLIFIER(SEE A8 R		
-175	348-0031-00			2						.GROMMET,PLASTIC:0.156 INCH DIA	80009	348-0031-00
-176	-----			1						.MICROCIRCUIT:(SEE U745 REPL) *****ATTACHING PARTS)*****		
-177	210-0407-00			1						.NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
-178	210-0055-00			1						.WASHER,LOCK:SPLIT,0.145 ID X 0.253 OD,S *****END ATTACHING PARTS)*****	83385	OBD
-179	214-2416-00			1						.HT SK MICROCKT:VERTICAL AMPLIFIER,BACK *****ATTACHING PARTS)*****	80009	214-2416-00
-180	210-0407-00			2						.NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS *****END ATTACHING PARTS)*****	73743	3038-0228-402
-181	129-0303-00			2						.POST,ELEC-MECH:0.25 OD X 0.237 INCH LONG *****ATTACHING PARTS)*****	80009	129-0303-00
-182	211-0511-00			2						.SCREW,MACHINE:6-32 X 0.500,PNH,STL,CD PL *****END ATTACHING PARTS)*****	83385	OBD
-183	210-0627-00			1						.RIVET,SOLID:0.042 DIA X 0.25 INCH,RDH	80009	210-0627-00
-184	343-0097-00			1						.RTNR,TRANSISTOR:HEAT SINK *****ATTACHING PARTS)*****	80009	343-0097-00
-185	210-0599-00			2						.NUT,SLEEVE:4-40 X 0.391 INCH LONG	80009	210-0599-00
-186	214-0368-00			2						.SPRING,HLCPS:0.24 DIA X 0.438 INCH LONG	80009	214-0368-00
-187	210-0551-00			2						.NUT,PLAIN,HEX.:4-40 X 0.25 INCH,STL	000BK	OBD
-188	211-0097-00			2						.SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL *****END ATTACHING PARTS)*****	83385	OBD
-189	214-0579-00			2						.TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-190	-----			1						.TRANSISTOR:(SEE Q785 REPL) *****ATTACHING PARTS)*****		
-191	210-0551-00			2						.NUT,PLAIN,HEX.:4-40 X 0.25 INCH,STL	000BK	OBD
-192	211-0097-00			1						.SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL *****END ATTACHING PARTS)*****	83385	OBD

Replaceable Mechanical Parts—7904 (SN B260000 & UP)

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont									
4-193	131-0608-00			7						.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-194	136-0252-01			26						.CONTACT,ELEC:0.178 INCH LONG	00779	1-332095-2
	136-0252-06			10						.SOCKET,PIN TERM:0.178 INCH LONG	00779	2-332095-6
-195	136-0220-00			9						.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB M	71785	133-23-11-034
-196	131-1003-00			5						.CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
-197	214-1683-03			1						.HT SK,MICROCKT:VERTICAL AMPLIFIER,RIGHT	80009	214-1683-03
	198-2995-00			4						WIRE SET,ELEC:	80009	198-2995-00
	131-1963-00			1						.TERM.,QIK DISC.:FOR 0.038 DIA CRT PIN ***** (ATTACHING PARTS FOR CKT BD) *****	00779	42428-9
-198	211-0008-00			8						SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL ***** (END ATTACHING PARTS) *****	83385	OBD
-199	176-0045-00			FT						BRAID,WIRE:# 24	70903	5112R424/36
-200	210-0201-00			1						TERMINAL,LUG:0.12 ID,LOCKING,BRZ TIN PL	86928	OBD
-201				1						CKT BOARD ASSY:MAIN HORIZ AMPL(SEE A9 REPL		
-202	131-1003-00			3						.CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
-203	214-0579-00			3						.TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-204	136-0252-04			58						.SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
-205	131-0589-00			10						.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-206	200-0945-01			1						.COVER,HALF XSTR:DUAL TO-18,W/2-56 THD ***** (ATTACHING PARTS) *****	80009	200-0945-01
-207	211-0001-00			1						.SCREW,MACHINE:2-56 X 0.25 INCH,PNH STL ***** (END ATTACHING PARTS) *****	87308	OBD
-208	200-0945-00			1						.COVER,HALF XSTR:DUAL TO-18,ALUMINUM ***** (ATTACHING PARTS FOR CKT BD ASSY) *****	80009	200-0945-00
-209	211-0008-00			3						SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL ***** (END ATTACHING PARTS) *****	83385	OBD
-210	354-0347-00			1						RING,CRT CLAMP: ***** (ATTACHING PARTS) *****	80009	354-0347-00
-211	211-0170-00			2						SCREW,MACHINE:4-40 X 2.75 INCH,PNH STL ***** (END ATTACHING PARTS) *****	83385	OBD
-212	407-0975-00			1						BRACKET,CRT:REAR,ALUMINUM ***** (ATTACHING PARTS) *****	80009	407-0975-00
-213	211-0504-00			2						SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL ***** (END ATTACHING PARTS) *****	83385	OBD
-214	343-0205-01			1						RTNR,ELCTR TU:3.0 DIA X 1.5 L,DEL RIN ***** (ATTACHING PARTS) *****	80009	343-0205-01
-215	211-0507-00			4						SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
-216	210-0949-00			4						WASHER,FLAT:0.141 ID X 0.50 INCH OD,BRS ***** (END ATTACHING PARTS) *****	12327	OBD
-217	136-0477-00			1						SKT,PL-IN ELEK:ELCTR TU,10 CON W/LEADS	80009	136-0477-00
-218	136-0304-02	B260000	B270380	1						.SOCKET,PLUG-IN:CR,14 PIN SOCKET,W/PINS	80009	136-0304-02
	136-0304-03	B270381		1						.SKT,PL-IN ELEK:ELECTRON TUBE,14 CONTACT	80009	136-0304-03
-219	200-0917-01			1						.COV,ELECTRON TU:2.052 OD X 0.291" THK,PLS	80009	200-0917-01
-220	343-0254-00			1						.CLP,ELCTR TU:	80009	343-0254-00
-221	367-0117-00			1						.PULL,SOCKET:	80009	367-0117-00
-222	131-0621-00			10						.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	46231
-223	175-0860-00			FT						WIRE,ELECTRICAL:5 WIRE RIBBON	08261	SS-0522-7(1061)
-224	352-0201-00			1						.CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0201-00
-225	352-0204-00			1						.CONN BODY,PL,EL:8 WIRE BLACK	80009	352-0204-00

Replaceable Mechanical Parts—7904 (SN B260000 & UP)

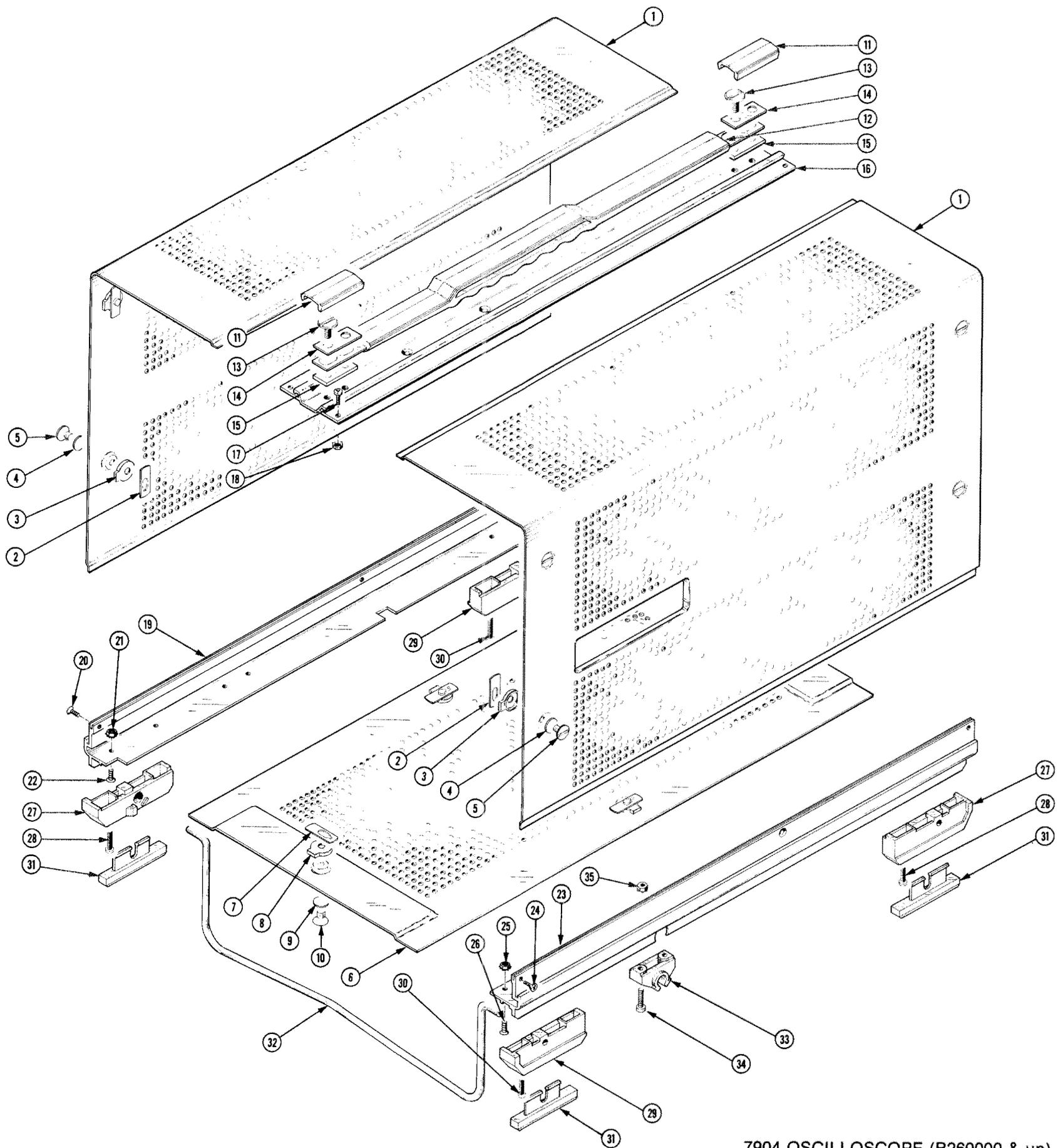
Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont									
5-	-----			1						CKT BOARD ASSY:DUMMY READOUT(SEE A26 REPL)		
-2	131-0608-00			18						.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-3	131-1003-00			6						.CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
-4	136-0252-04			6						.SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
-5	-----			1						CKT BOARD ASSY:X-Y DELAY COMP(SEE A17 REPL)		
-6	131-0285-00			4						.TERMINAL,STUD:0.324 INCH LONG	86577	5S4-86B
-7	136-0252-04			32						.SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
-8	131-0566-00			1						.BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
-9	136-0263-03			15						.SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	00779	85864-2
-10	211-0155-00			2						.SCREW,EXT,RLV B:4-40 X 0.375 INCH,SST	80009	211-0155-00
-13	361-0301-00			2						.SPACER,SLEEVE:4-40 X 0.105 INCH LONG	80009	361-0301-00
-12	260-0723-00			2						.SWITCH,SLIDE:DPDT,0.5A,125VAC	79727	GF126-0028

Replaceable Mechanical Parts—7904 (SN B260000 & UP)

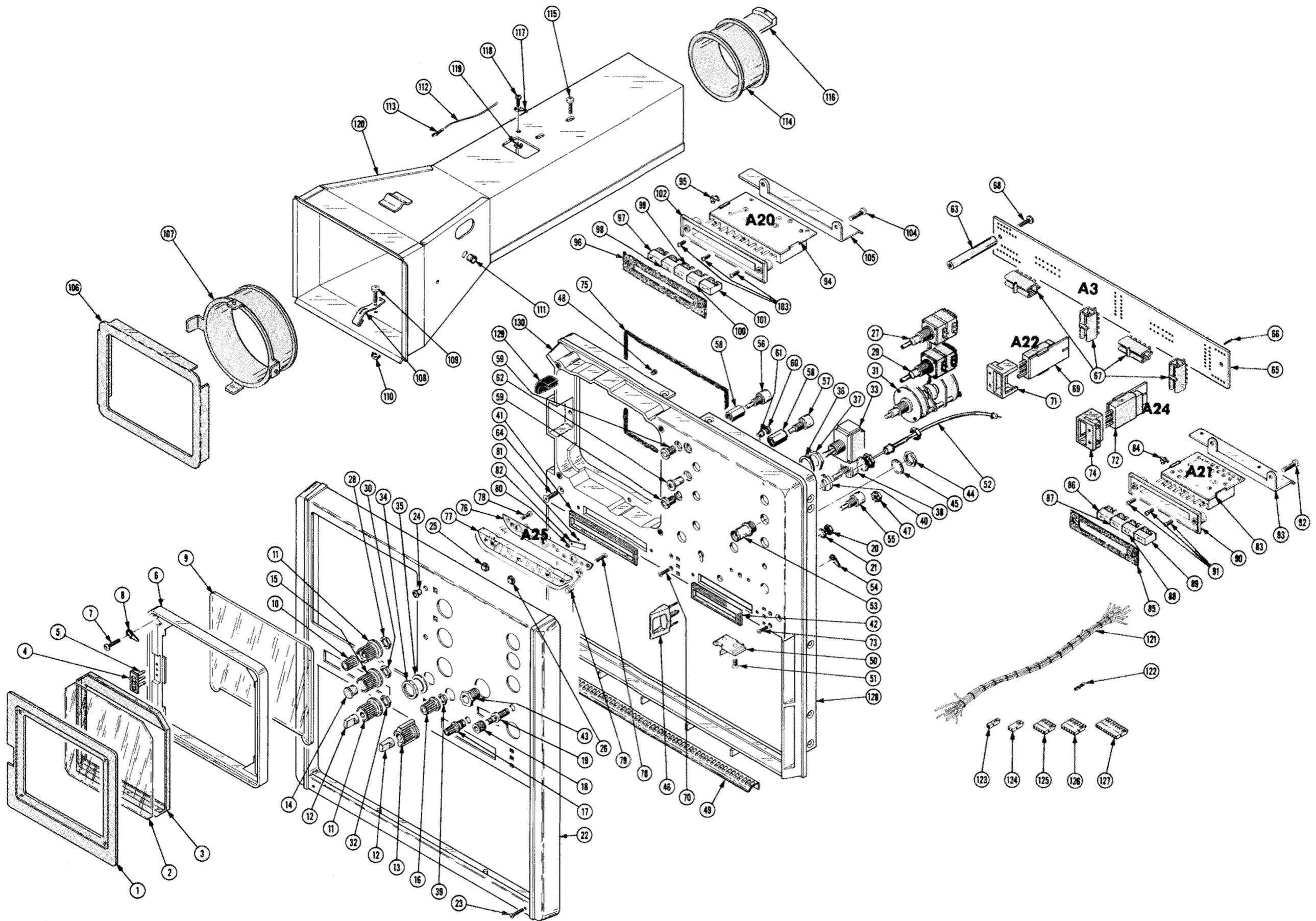
Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont					
6-1	390-0123-00			2		COVER,SCOPE:LEFT & RIGHT SIDE	80009	390-0123-00
	-----			-		.EACH CABINET SIDE INCLUDES:		
-2	214-0603-02			6		.PIN ASSY,SECRG:	80009	214-0603-02
-3	386-1634-00			6		.PLATE,LCH INDEX:ACETAL	80009	386-1634-00
-4	386-1633-00			6		.PLATE,LCH LKG:STEEL,CD PL	80009	386-1633-00
-5	348-0210-00			2		.SHLD GSKT,ELEK:SOLID TYPE,10.887 L	80009	348-0210-00
-6	348-0209-00			2		.SHLD GSKT,ELEK:SOLID TYPE,4.359 L	80009	348-0209-00
-7	348-0211-00			4		.SHLD,GSKT,ELEK:SOLID TYPE,9.322 L	80009	348-0211-00
-8	390-0122-00			1		COVER,SCOPE:BOTTOM	80009	390-0122-00
-9	214-0603-02			8		.PIN ASSY,SECRG:	80009	214-0603-02
-10	386-1634-00			8		.PLATE,LCH INDEX:ACETAL	80009	386-1634-00
-11	386-1633-00			8		.PLATE,LCH LKG:STEEL,CD PL	80009	386-1633-00
-12	348-0212-00			6		.SHLD,GSKT,ELEK:SOLID TYPE,9.1 L	80009	348-0212-00
-13	378-0603-00			1		FILTER,MESH:EMI	80009	378-0603-00
-14	378-0625-00			1		FILTER,LT,CRT:BLUE,5.15 X 4.4 X 0.03	80009	378-0625-00
-15	426-0514-00			1		FRAME,MASK:PLASTIC	80009	426-0514-00

Replaceable Mechanical Parts—7904 (SN B260000 & UP)

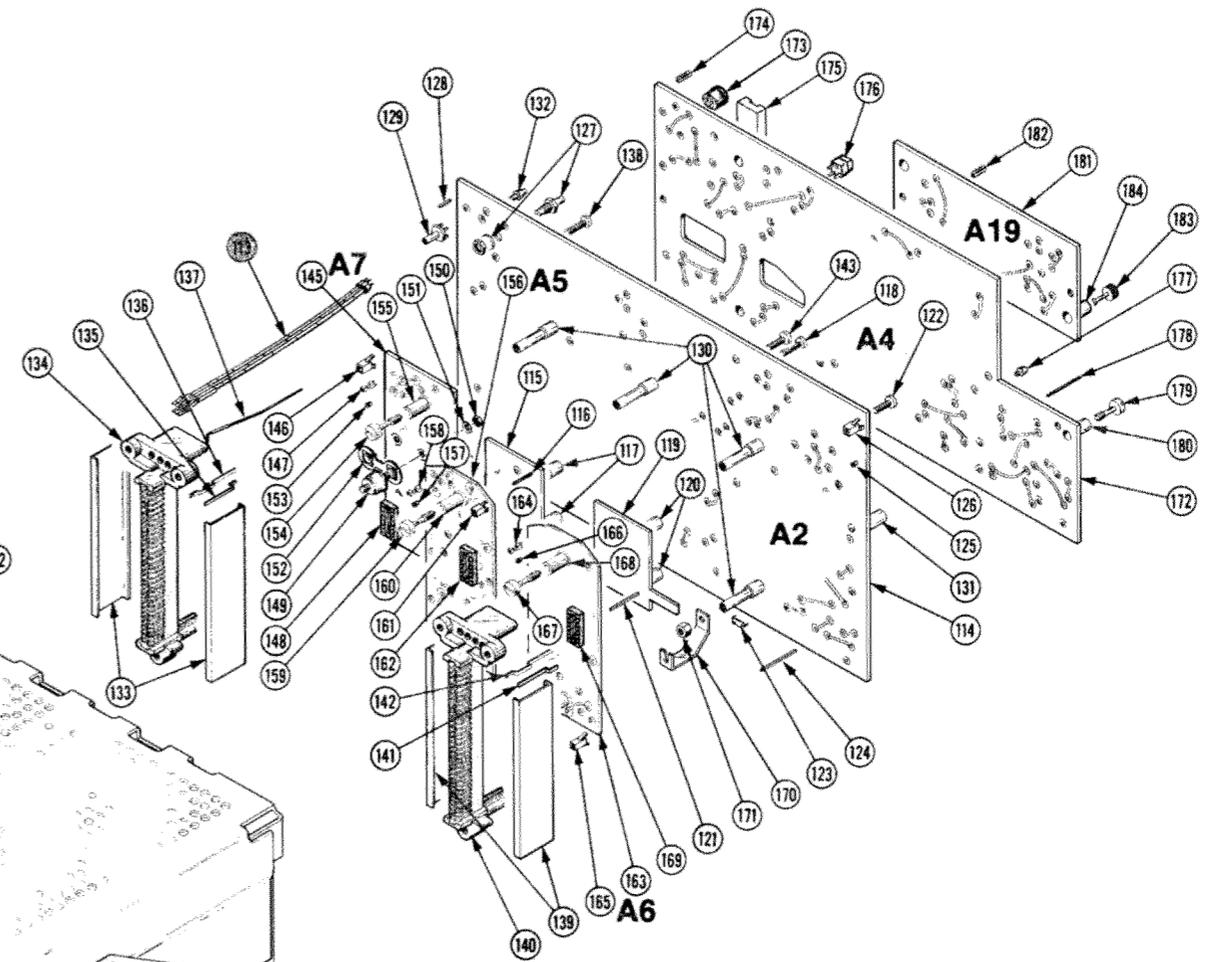
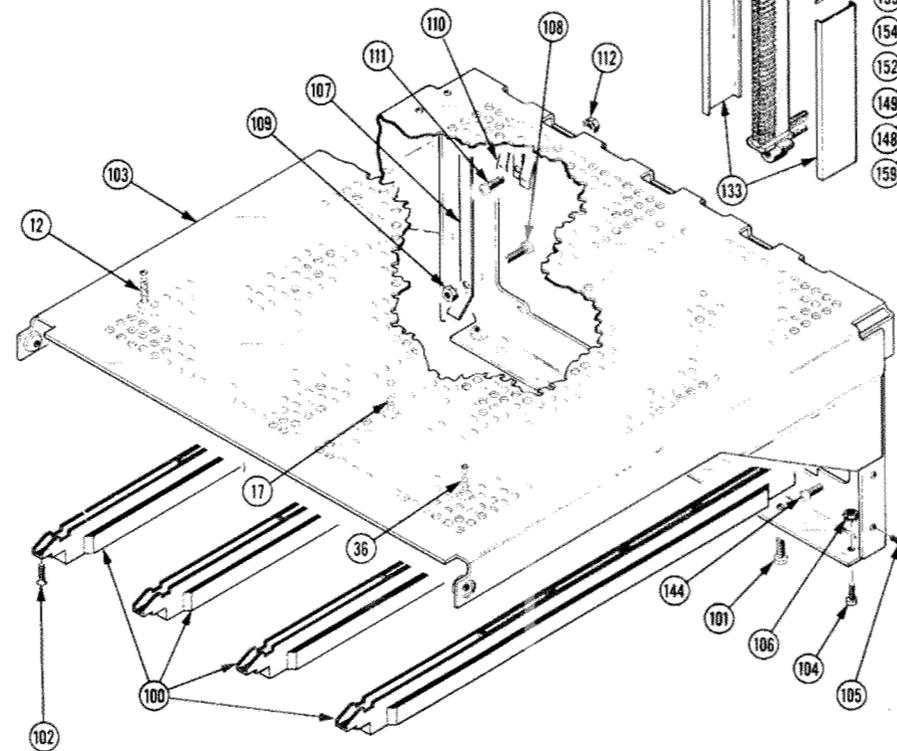
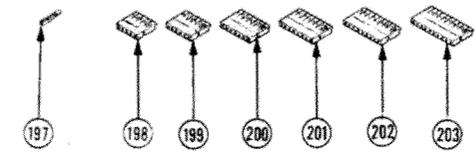
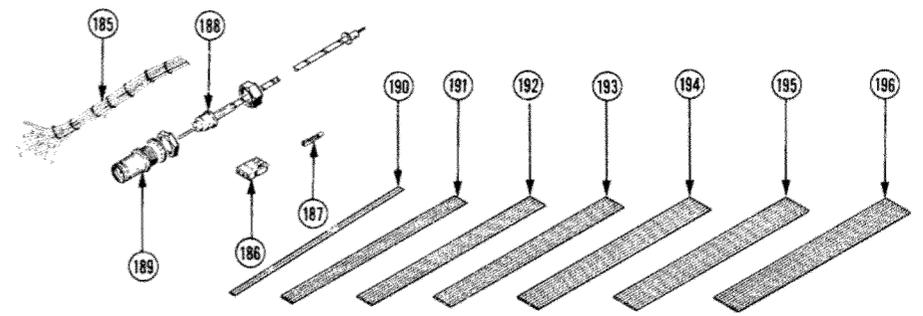
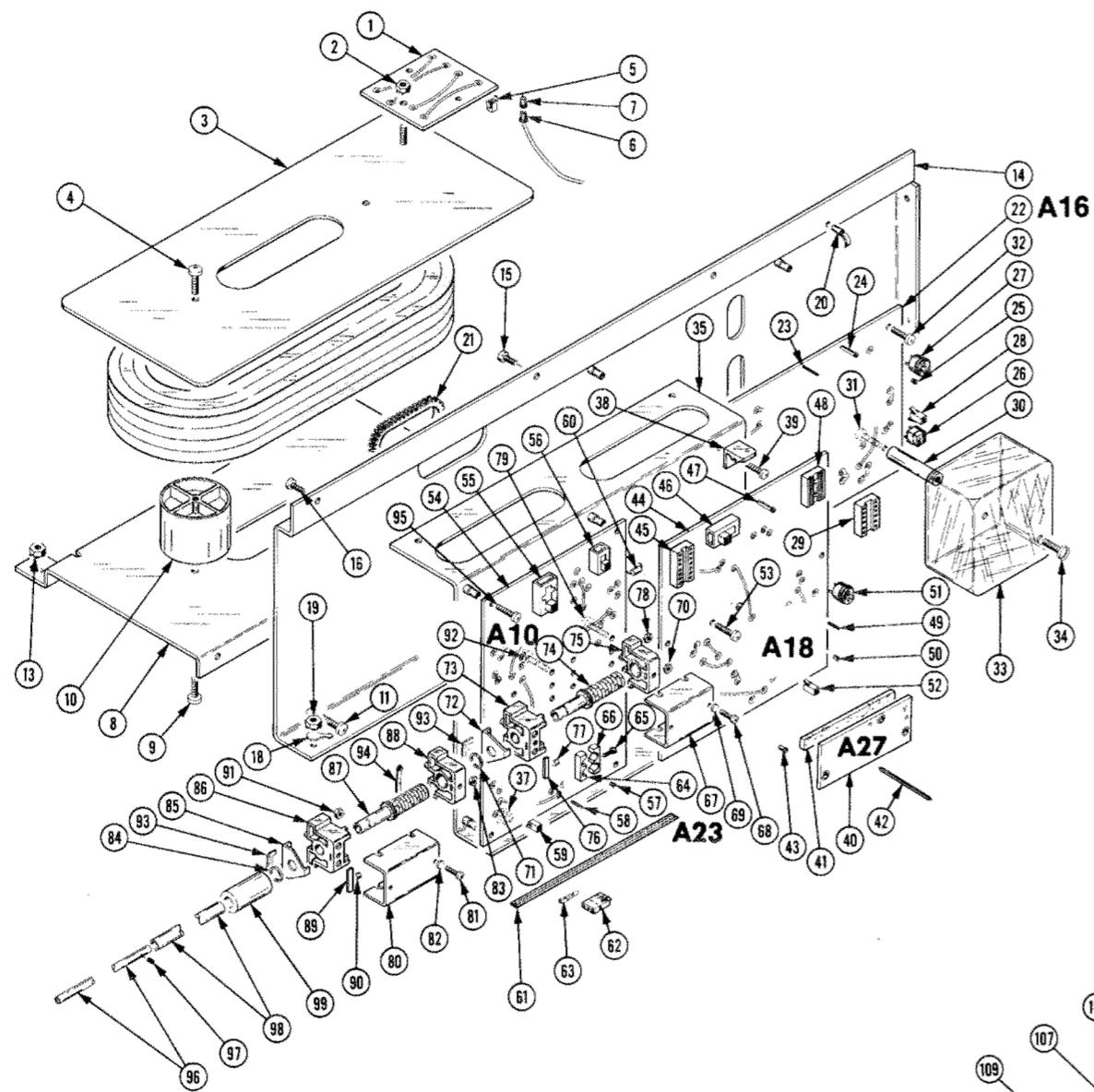
Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty						Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont		1	2	3	4	5			
STANDARD ACCESSORIES												
7-1	161-0066-09			1						CABLE ASSY,PWR:3,0.75MM SQ,220V,96.0 L (EUROPEAN ONLY)	80009	161-0066-09
-2	161-0066-10			1						CABLE ASSY,PWR:3,0.75MM SQ,240V,96.0 L (UNITED KINGDOM ONLY)	80009	161-0066-10
-3	161-0066-11			1						CABLE ASSY,PWR:3,0.75MM,240V,96.0L (AUSTRALIAN ONLY)	80009	161-0066-11
-4	161-0066-12			1						CABLE ASSY,PWR:3,18 AWG,240V,96.0 L (NORTH AMERICAN ONLY)	70903	OBD
-5	012-0087-00			2						LEAD ELECTRICAL:18.0 L RED,BNC TO BNC	80009	012-0087-00
-6	012-0092-00			1						ADAPTER,CONN:FEMALE BNC TO EXP STUD	80009	012-0092-00
-7	134-0049-00			1						CONN,PLUG,ELEC:MS TYPE,20 MALE	02660	165-13
	070-2390-00			1						MANUAL,TECH:INSTRUCTION	80009	070-2390-00



7904 OSCILLOSCOPE (B260000 & up)

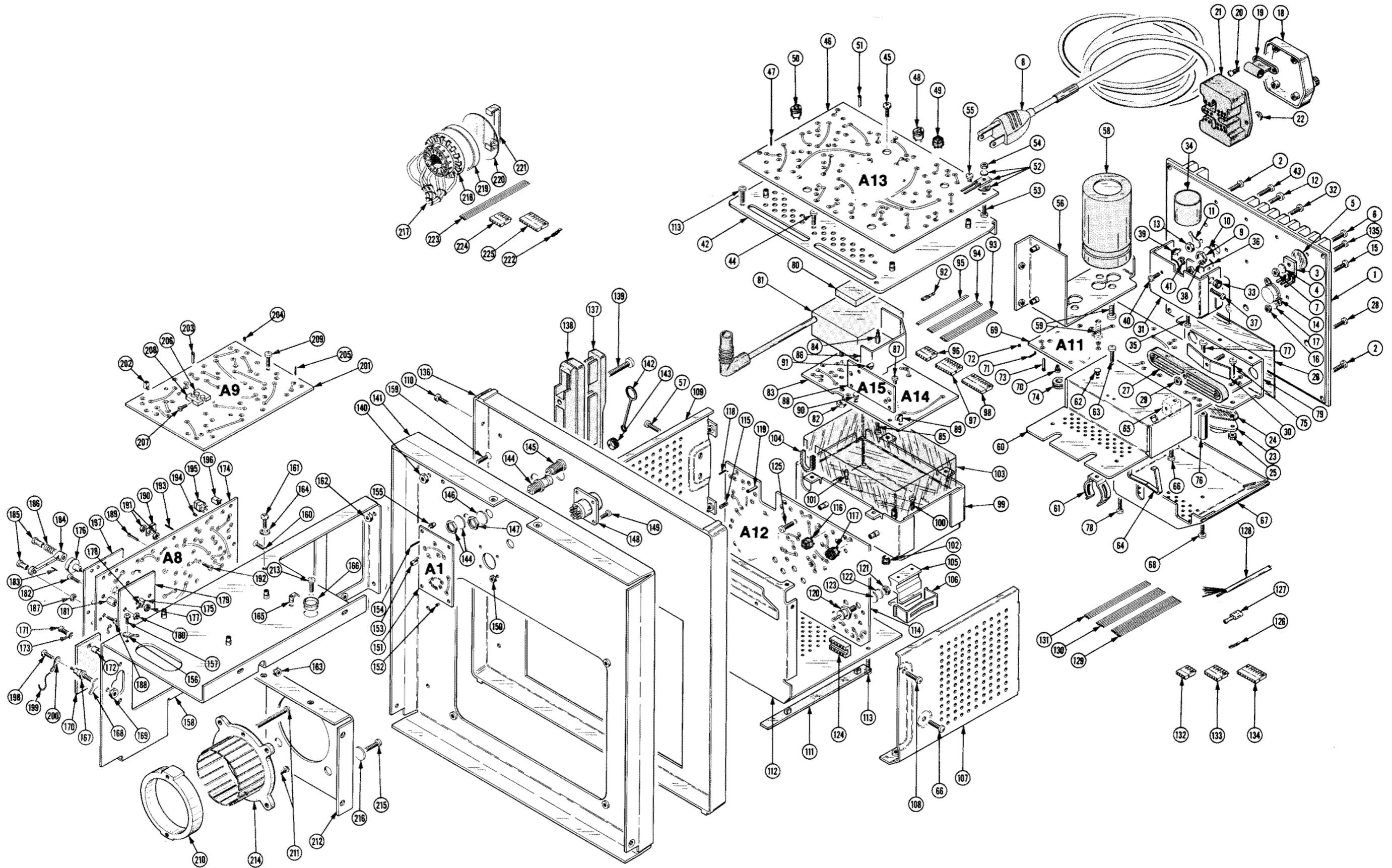


7904 OSCILLOSCOPE (B260000 & up)



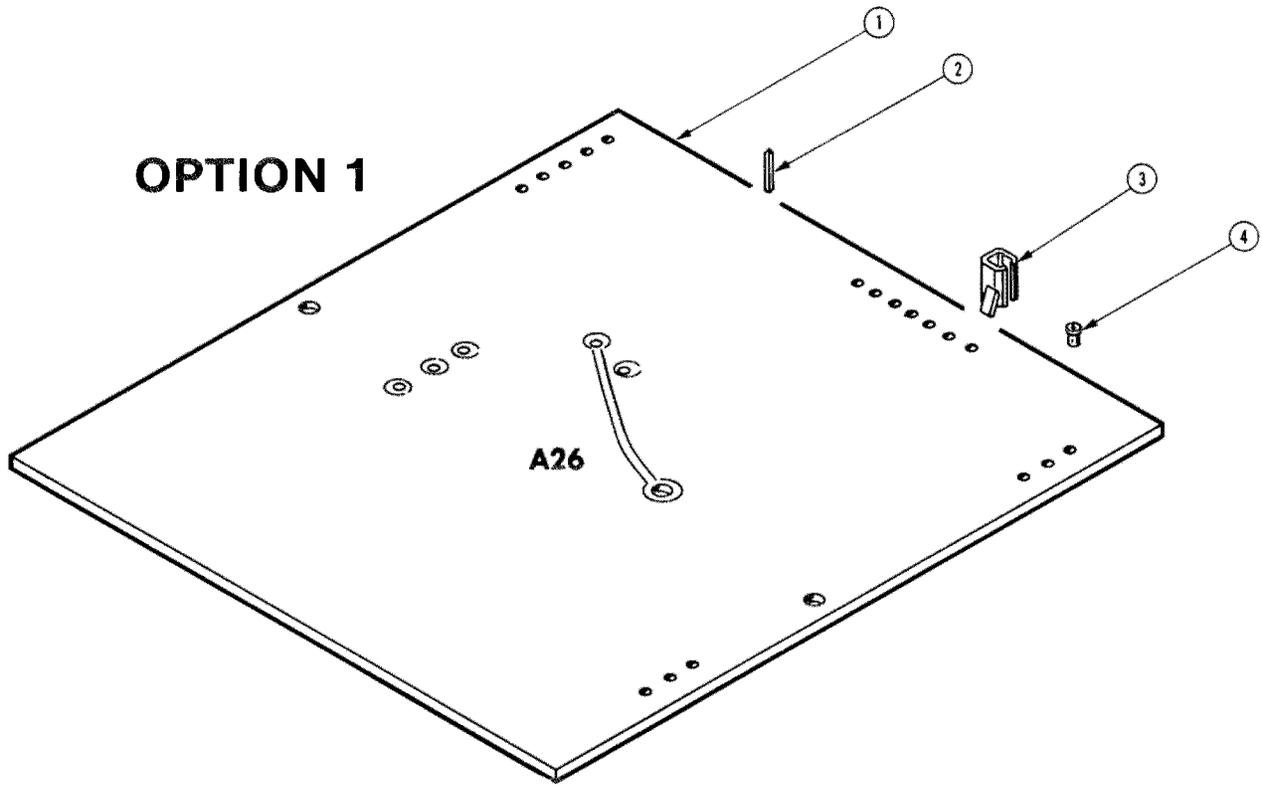
REV JAN 1982

7904 OSCILLOSCOPE (B260000 & up)

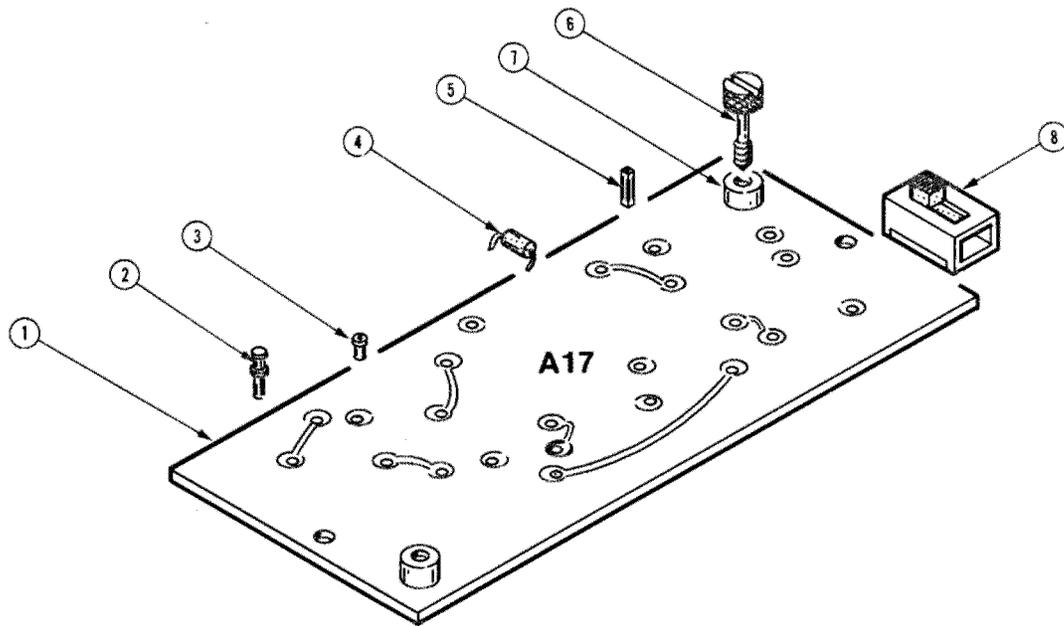


7904 OSCILLOSCOPE (B260000 & up)

OPTION 1

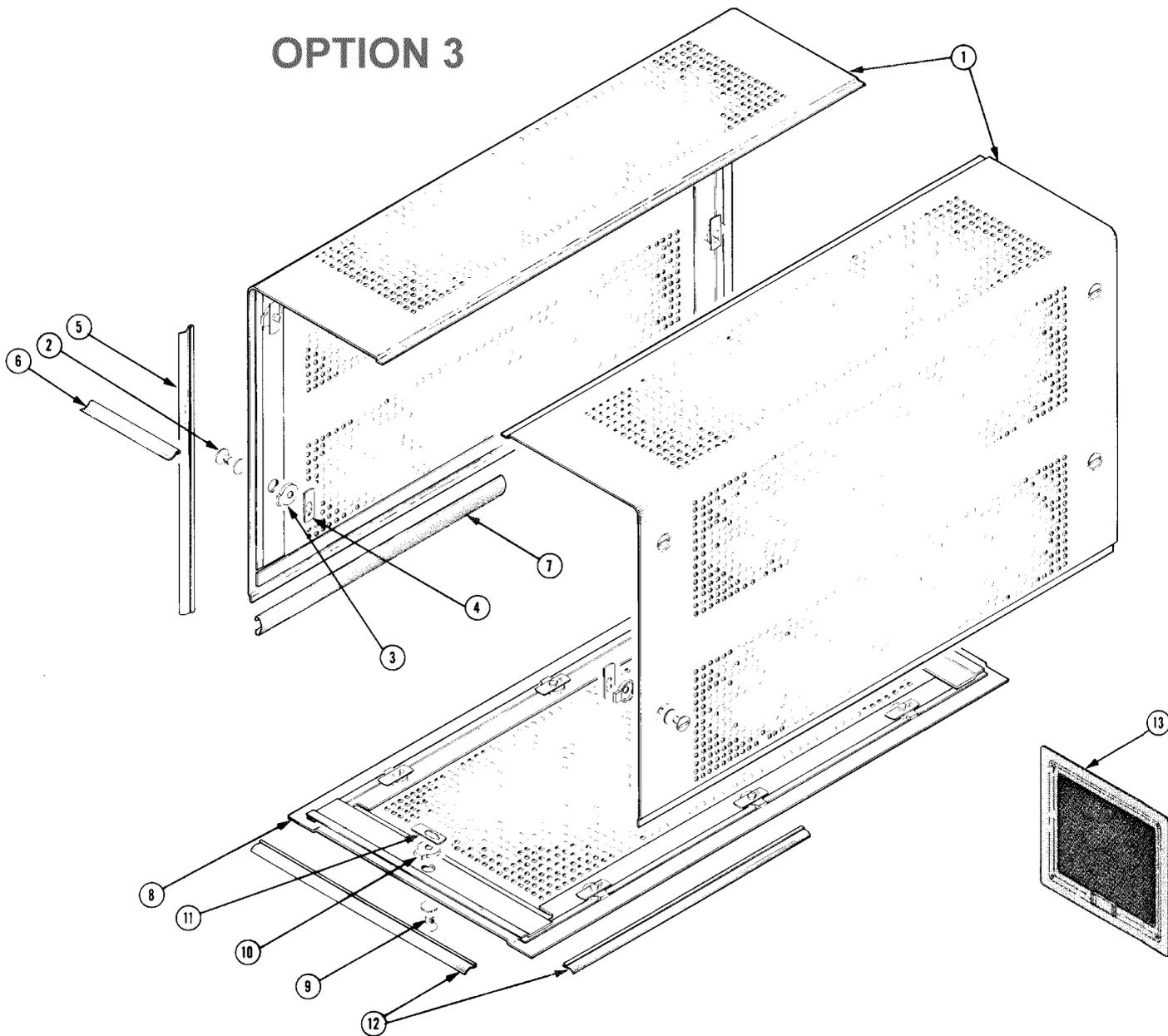


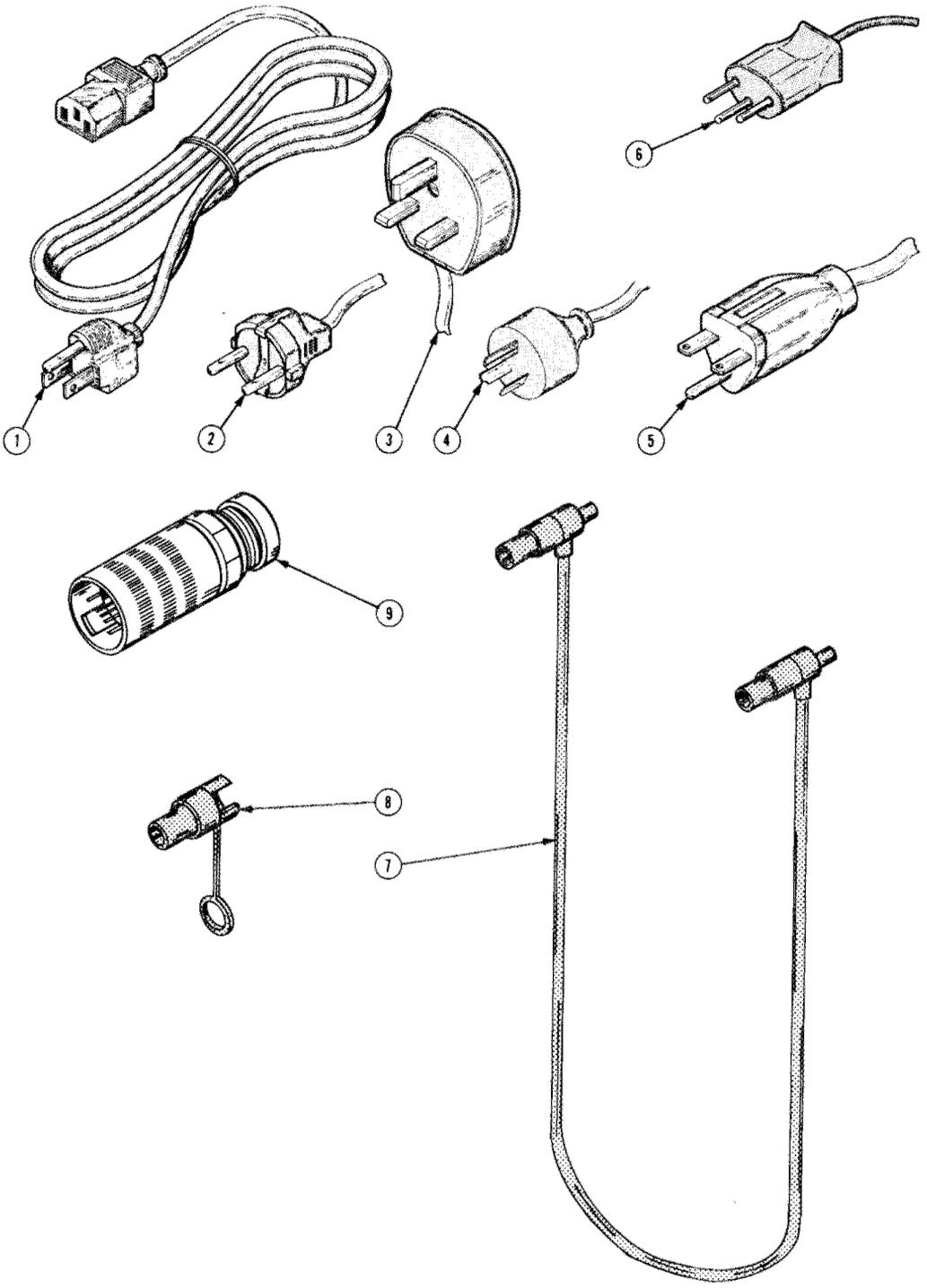
OPTION 2



REV MAR 1983

OPTION 3





REV MAR 1983

7904 OSCILLOSCOPE (B260000 & up)

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.

DESCRIPTION

EFF SN: B192116 (R7903) 070-1464-00
B282860 (7904) 070-2390-00

REPLACEABLE ELECTRICAL PARTS & SCHEMATIC CHANGES

CHANGE TO:

	670-1610-14	CKT BOARD ASSY:POWER SUPPLY INVERT
	670-1612-23	CKT BOARD ASSY:CAPACITOR RECTIFIER
A2	670-1623-05	CKT BOARD ASSY:MAIN INTERFACE(7904 ONLY)
A4	670-1624-04	CKT BOARD ASSY:LOGIC(7904 ONLY)
A16	670-1636-03	CKT BOARD ASSY:Z AXIS(7904 ONLY)
C60	290-0973-00	CAP,FXD,ELCTLT:100 UF,20%,25V(7904 ONLY)
C62	290-0969-00	CAP,FXD,ELCTLT:22 UF,+50-10%,100V(7904 ONLY)
C64	290-0969-00	CAP,FXD,ELCTLT:22 UF,+50-10%,100V(7904 ONLY)
C66	290-0973-00	CAP,FXD,ELCTLT:100 UF,20%,25V(7904 ONLY)
C68	290-0963-00	CAP,FXD,ELCTLT:220 UF,+50-10%,25V(7904 ONLY)
C393	290-0963-00	CAP,FXD,ELCTLT:220 UF,+50-10%,25V(7904 ONLY)
C1231	290-0748-00	CAP,FXD,ELCTLT:10 UF,+50-10%,25V
C1239	290-0748-00	CAP,FXD,ELCTLT:10 UF,+50-10%,25V
C1259	290-0782-00	CAP,FXD,ELCTLT:4.7 UF,+75-10%,35V
C1277	290-0891-00	CAP,FXD,ELCTLT:1 UF,+75-10%,50V
C1278	290-0891-00	CAP,FXD,ELCTLT:1 UF,+75-10%,50V
C1313	290-0966-00	CAP,FXD,ELCTLT:220 UF,+50-10%,25V
C1314	290-0973-00	CAP,FXD,ELCTLT:100 UF,20%,25V
C1316	290-0966-00	CAP,FXD,ELCTLT:220 UF,+50-10%,25V
C1317	290-0973-00	CAP,FXD,ELCTLT:100 UF,20%,25V
C1318	290-0973-00	CAP,FXD,ELCTLT:100 UF,20%,25V
C1350	290-0966-00	CAP,FXD,ELCTLT:220 UF,+50-10%,25V
C1351	290-0966-00	CAP,FXD,ELCTLT:220 UF,+50-10%,25V
C1353	290-0973-00	CAP,FXD,ELCTLT:100 UF,20%,25V
C1354	290-0973-00	CAP,FXD,ELCTLT:100 UF,20%,25V
C1358	290-0975-00	CAP,FXD,ELCTLT:33 UF,20%,100V
C1360	290-0975-00	CAP,FXD,ELCTLT:33 UF,20%,100V
C1362	290-0975-00	CAP,FXD,ELCTLT:33 UF,20%,100V
C1893	290-0966-00	CAP,FXD,ELCTLT:220 UF,+50-10%,25V(7904 ONLY)
C1897	290-0966-00	CAP,FXD,ELCTLT:220 UF,+50-10%,25V(7904 ONLY)

C60, through C68 are located on the A2-MAIN INTERFACE board(7904), and are shown on Diagram 1.

(Cont. next page)

DESCRIPTION

C393 is located on the A4-LOGIC board(7904), and is shown on Diagram 3.

C1231, and C1239 are located on the A14(R7903), or A11(7904)- Inverter circuit board, and are shown on Diagram 9.

C1259, through C1362 are located on the A15(R7903), or A12(7904)- Capacitor Rectifier circuit board, and are shown on Diagram 9.

C1893, and C1897 are located on the A16-Z AXIS board(7904), and are shown on Diagram 11.

Date: March 15, 1983 Change Reference: M49839

Product: 7844, R7844, R7903, & 7904

Manual Part No.: See Below

DESCRIPTION

EFF SN: B142890 (7844) 070-1676-01
B141400 (R7844) 070-1676-01
B192159 (R7903) 070-1464-00
B282979 (7904) 070-2390-00

REPLACEABLE ELECTRICAL PARTS & SCHEMATIC CHANGES

CHANGE TO:

A16	670-1636-04	CKT BOARD ASSY:Z-AXIS (7904)
A20	670-2536-01	CKT BOARD ASSY:Z-AXIS (R7903)
A24	670-2723-01	CKT BOARD ASSY:HIGH VOLTAGE (7844/R7844)
R1887	315-0160-00	RES,FXD,CMPSN:16 OHM,5%,0.25W (R7903,7904)
R2316	307-0109-00	RES,FXD,CMPSN:8.2 OHM,5%,0.25W (7844/R7844)

R1887 is located on the Z-AXIS board, and is shown on Diagram 11 (R7903,7904).
R2316 is located on the HIGH VOLTAGE board, and is shown on Diagram
15 (7844/R7844).